

**TECHNICAL MANUAL  
FOR**

**TM-11**

**TAPE TRANSPORT**

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## **LIST OF EFFECTIVE PAGES**

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# SECTION I

## GENERAL DESCRIPTION

### 1-1. SCOPE.

This technical manual describes the installation, operation, theory of operation, and maintenance of the Ampex TM-11 Tape Transport. (See Figure 1-1.) Section I includes a general description of the equipment and lists performance characteristics.

### 1-2. GENERAL DESCRIPTION.

The tape transport moves computer grade magnetic tape across a dual-stack magnetic read/write head assembly, in response to commands from either an operator control panel or from remote equipment. Tape is moved in either the forward or reverse direction, or held at a standstill by a servo-controlled direct-drive capstan.

The capstan draws tape from the storage loops in the vacuum chambers. The reel motors are servo-controlled to maintain the correct supply of tape within the chambers.

The tape is held in contact with the capstan by uniform tension derived from the vacuum columns. The vacuum columns remain active during the rewind operation to provide the tension required to ensure proper tape packing. Precision air-lubricated tape guides ensure accurate tape tracking; a positive pressure system provides the lubricating air-flow to the tape guides.

The read/write head assembly reads information from the tape (to external equipment or the optional data electronics) and writes information on the tape (from external equipment or the optional data electronics).

A two-channel photosense head detects reflective markers fixed to the tape. The photosense signals are amplified and are provided to the transport control electronics, the data electronics (option), and the external equipment.

Electro-mechanical interlocks protect the operator, the tape, and the equipment in the event of failure. Programming is inhibited while the equipment stabilizes and the vacuum and positive pressures build up.

The optional data electronics is described in the Data Electronics Technical Manual.

### 1-3. PERFORMANCE CHARACTERISTICS.

Performance characteristics for the tape transport are listed in Table 1-1. Performance characteristics for the optional data electronics are listed in the Data Electronics Technical Manual.

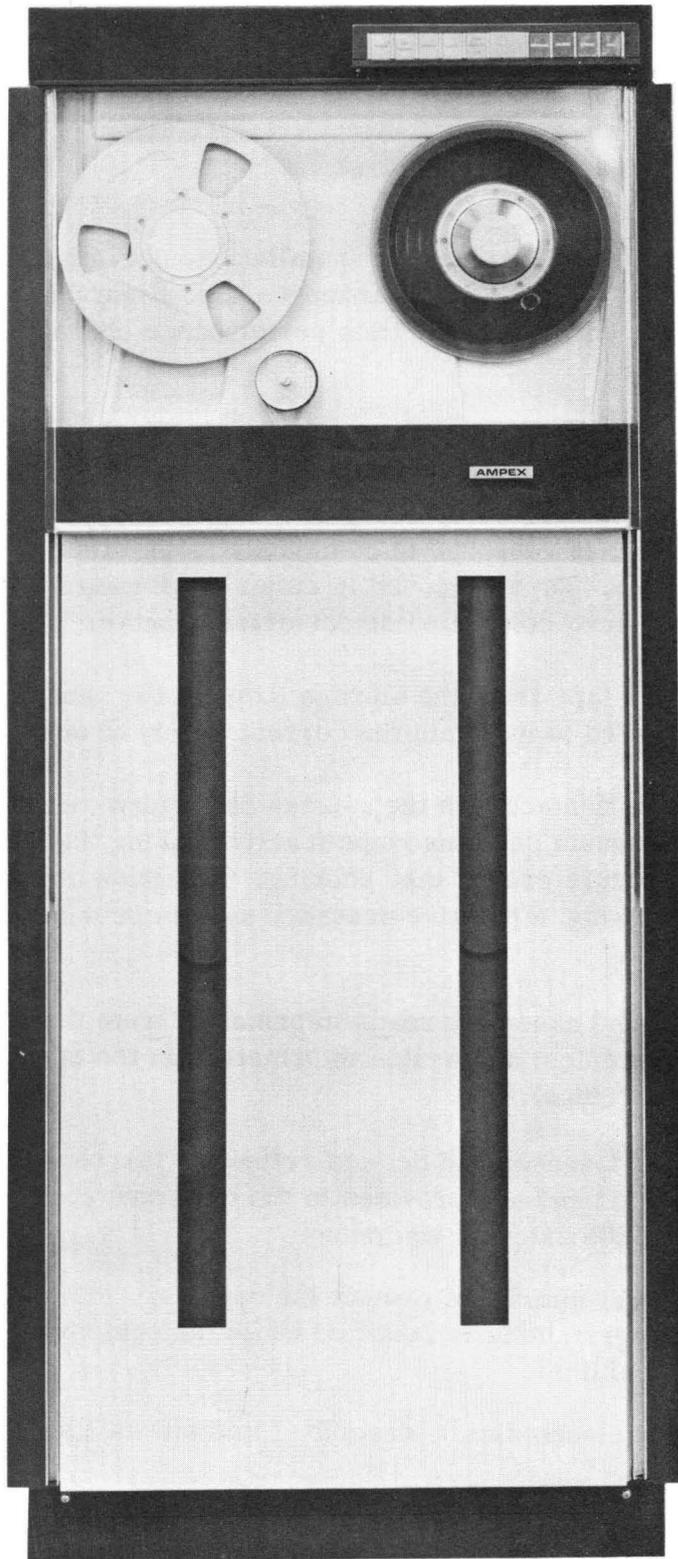


Figure 1-1  
TM-11 Tape Transport

TABLE 1-1  
TM-11 TAPE TRANSPORT PERFORMANCE CHARACTERISTICS

TAPE WIDTH	1/2 inch tape Ampex, IBM, or NAB reels
TAPE SPEEDS	120 ips standard 75 and 112.5 ips optional
REWIND SPEED	2400 ft in less than 100 seconds
START/STOP TIME	120 ips: 3.8 ms 112.5 ips: 4.0 ms 75 ips: 6.0 ms
START DISTANCE	0.225 inch nominal
STOP DISTANCE	0.225 inch nominal
LONG TERM SPEED VARIATION	±3% or less of operational speed
INSTANTANEOUS SPEED VARIATION SHORT TERM	ISV = ±3% or less of operational speed 10 ms after start command
INTERCHANNEL TIME DISPLACEMENT (STATIC SKEW + 1/2 DYNAMIC SKEW)	120 ips: 4.11 μsec max 112.5 ips: 4.40 μsec max 75 ips: 6.56 μsec max
STATIC SKEW (MAX)	120 ips = 3.36 μsec 112.5 ips = 3.60 μsec 75 ips = 5.36 μsec
DYNAMIC SKEW (P-P)	120 ips = 1.5 μsec 112.5 ips = 1.6 μsec 75 ips = 2.4 μsec
POWER REQUIREMENTS	Voltage: 115 VAC nominal (standard) 230 VAC (optional) Frequency: 48 to 62 cps

#### 1-4. MAJOR ASSEMBLIES.

The major assemblies of the TM-11 Tape Transport are the cabinet blower assembly, the cable assemblies, the capstan servo assembly, the control electronics assembly, the optional data electronics, the electronics frame, the enclosure, the input/output panel, the logic power supply, the optional operator control panel, the reel servo assembly, the tape deck, the vacuum blower housing assembly, and either the vacuum control assembly or the autotransformer assembly.

#### 1-5. AUTOTRANSFORMER ASSEMBLY.

The autotransformer assembly contains an autotransformer, a compressor unit, and two relays. The autotransformer provides operating power for the vacuum-blower motor; taps on the autotransformer provide for discrete adjustment of the tape-transport vacuum pressure by changing the voltage supplied to the vacuum-blower motor. The compressor unit provides the positive pressure used at the air-lubricated tape guides, the write-enable-switch assembly, and the magnetic head tape gate. One of the relays is used in the tape load circuit, the other is used in the door-interlock override circuit.

#### 1-6. CABINET BLOWER ASSEMBLY.

The cabinet blower assembly provides cooling for the tape transport.

#### 1-7. CABLE ASSEMBLIES.

Cable and harness assemblies are determined by transport mounting and by selection of optional features.

#### 1-8. CAPSTAN SERVO ASSEMBLY.

The capstan servo assembly provides power for the capstan motor and contains the power components of the capstan servo system. Field excitation for electromagnetic-field capstan motors is provided by a field supply furnished in the capstan servo assembly when such motors are used.

#### 1-9. CONTROL ELECTRONICS ASSEMBLY.

The control electronics assembly contains the printed circuit board (PCB) assemblies which control the tape transport.

1-10. DATA ELECTRONICS ASSEMBLY (OPTION).

The data electronics assembly contains the printed circuit board assemblies which control the writing and reading of data on the tape passing over the magnetic head assembly. The data electronics is an optional feature.

1-11. ELECTRONICS FRAME.

The electronics frame mounts into a standard 24-inch rack-type mount or into the TM-11 console cabinet. The capstan servo assembly, the reel servo assembly, the control electronics assembly, the logic power supply, the optional data electronics, and the cabinet blower assembly are mounted on the electronics frame. The frame is hinged and provides access to the console cabinet and to the assemblies mounted on the frame.

1-12. ENCLOSURES.

The TM-11 Tape Transport is designed for vertical installation in a standard 24-inch rack-type mount or for installation in the Ampex TM-11 console cabinet.

1-13. INPUT/OUTPUT PANEL.

The input/output panel provides receptacles for AC power input and distribution and for remote input and output lines. A circuit breaker on the panel provides overload protection for the AC power input to the tape transport. The panel also contains two AC convenience receptacles, which are connected directly to the AC power input. A fuse on the panel provides overload protection for the convenience receptacles. A second fuse on the panel provides overload protection for a voltage step-down transformer mounted on the input/output panel. The transformer supplies operating power for the control relay on the panel. The relay is used in the power on-off control circuit.

1-14. LOGIC POWER SUPPLY.

The logic power supply provides +24V and -24V unregulated DC voltages and +12V, -12V, and -6V regulated DC voltages for the control electronics PCB assemblies and for the optional data electronics.

1-15. OPERATOR CONTROL PANEL.

The operator control panel (OCP) provides local control for the tape transport. The OCP is an optional feature, except when the data electronics option is taken; the OCP is then furnished as standard equipment.

1-16. REEL SERVO ASSEMBLY.

The reel servo assembly provides power for the reel motors and reel brakes, and power for all 12-volt DC relays used in the tape transport.

1-17. TAPE DECK.

The tape deck consists of all tape drive components mounted on a web-reinforced precision casting. A plenum is molded into the casting, and with the addition of a ported cover plate, serves as the positive-pressure manifold for the tape deck. Also mounted on the tape deck are the tape cleaners and the photosense, magnetic head, reel hub, and write-enable-switch assemblies.

1-18. Magnetic Head Assembly. The standard magnetic head assembly is either a 7-track dual-stack read/write unit capable of reading and writing in IBM compatible format, or a 9-track unit capable of reading and writing in ASCII compatible format. An erase head is supplied as an optional feature.

1-19. Photosense Assembly. The photosense assembly provides IBM compatible BOT (beginning-of-tape; at load point) and EOT (end-of-tape) photosensing of reflective tabs on the back of the tape.

1-20. Reel Retainers. Reel retainers are a selective feature. IBM or NAB compatible screw-down reel retainers may be selected for either the fixed or the file reel. The fixed reel may be a permanently-mounted precision reel assembly.

1-21. Tape Cleaners. The tape cleaners provide for collection of shed materials from the oxide surface of the magnetic tape. A low-velocity air-flow through the tape cleaners deposits these particles in the vacuum-blower-housing plenum.

1-22. Write Enable Switch Assembly. A write enable switch assembly is provided for either the IBM or the NAB compatible file reel.

1-23. VACUUM BLOWER HOUSING ASSEMBLY.

The vacuum blower housing assembly contains the vacuum blower and a large capacity plenum, which reduces vacuum pressure fluctuation under rapid load changes. The vacuum blower provides the cooling for the capstan motor and the vacuum for the tape cleaners and the vacuum chambers.

#### 1-24. VACUUM CONTROL ASSEMBLY.

The vacuum control assembly contains the vacuum-blower-motor speed control circuit, a compressor unit, and two relays. The vacuum-blower-motor speed control circuit provides operating power for the vacuum-blower motor and maintains a preset motor speed, independent of line voltage fluctuations and minor load changes. The compressor unit provides the positive pressure used at the air-lubricated tape guides, the write-enable-switch assembly, and the magnetic head tape gate. One of the relays is used in the tape load circuit, the other is used in the door-interlock override circuit.

## **SECTION II INSTALLATION**

### 2-1. INTRODUCTION.

This section provides information for the installation of the tape transport.

### 2-2. GENERAL.

The TM-11 Tape Transport is designed for installation in the Ampex TM-11 cabinet or in a standard 24-inch rack-type enclosure.

The TM-11 Cable Diagram in Section VII is the interconnecting cabling diagram for the basic transport. When the data electronics option is taken, the TM-11211 Cable Diagram in Section VII is used as the interconnecting cabling diagram.

### 2-3. CUSTOM INSTALLATIONS.

Tape reels and overlay panels must be removed to install mounting screws for standard 24-inch rack-type tape transport installation. Table 2-1 lists the assemblies by reference designation number. See the applicable TM-11 cable diagram in Section VII for assembly locations.

### 2-4. UNPACKING.

Custom-built crates are designed for shipping Ampex equipment. When an enclosure is supplied with the equipment, the components are installed in the cabinet and are ready for installation and operation. When no cabinet is supplied, custom shipping crates are provided for the components.

Care should be exercised during unpacking and the equipment should be checked for shipping damage prior to application of power.

The input/output panel is installed with spacers to recess the front of the panel from the mounting frame during shipment. These spacers must be removed when the tape transport is installed.

### 2-5. PHYSICAL DIMENSIONS AND WEIGHTS.

Table 2-2 lists assembly dimensions and weights. The approximate weight of a system can be calculated by adding the weights of the selected assemblies.

TABLE 2-1  
REFERENCE DESIGNATION NUMBERS OF ASSEMBLIES

REFERENCE DESIGNATION NUMBER	ASSEMBLY
A1	Front frame
A1A1	Tape deck
A1A2	Vacuum control assembly (or autotransformer assembly)
A1A3	Vacuum blower housing assembly
A2	Electronics frame
A2A1	Capstan servo assembly
A2A2	Reel servo assembly
A2A3	Control electronics assembly
A2A4	Logic power supply
A2A5	Data electronics (option)
A2A6	Cabinet blower assembly
A3	Operator control panel (option)*
A4	Input/output panel

\*The operator control panel is supplied as standard equipment when the data electronics option is taken.

TABLE 2-2  
PHYSICAL DIMENSIONS AND WEIGHTS

ASSEMBLY	HEIGHT (INCHES)	DEPTH (INCHES)	WIDTH (INCHES)	WEIGHT (POUNDS)
Tape Deck and Front Frame	59-1/2	14	24	169
Vacuum Control Assy (or Autotransformer Assy)	16-1/4 16-1/4	8-3/4 8-3/4	21-1/2 21-1/2	50 70
Vacuum Blower Housing Assy	9	13	21-3/4	21
Electronics Frame	56-7/8	3	24	20
Capstan Servo Assy	10-1/2	9	19	60
Reel Servo Assy	5-1/4	9	19	45
Control Electronics Assy	7	8	19	15
Logic Power Supply	5-1/4	9	19	35
Data Electronics	14	6-1/2	19	30
Cabinet Blower Assy	8-3/4	9-1/2	19	24
Input/Output Panel	3-1/2	5	24	6
Operator Control Panel	1-3/4	3-1/2	11-7/8	10
TM-11 Cabinet Assy	68-1/2	29-1/2	30	220

## 2-6. POWER REQUIREMENTS.

The TM-11 Tape Transport is wired for 115 volt operation unless otherwise specified. Maximum operating current at 115 VAC is 24 amperes. Tapped transformers in the vacuum control assembly (or the autotransformer assembly), the servo assemblies, the input/output panel, and the logic power supply provide for operation with either 115  $\pm$ 11.5 VAC or 230  $\pm$ 23 VAC input voltage. AC input power is applied at J1 on the input/output panel. (See Figure 2-1.)

## 2-7. INPUT/OUTPUT SIGNALS AND CONNECTIONS.

The input/output signals to the tape transport consist of remote control command and status signals and read/write data signals. Connector J4 on the Ampex input/output panel (Figure 2-1) provides connections for the customer-furnished transport control cable used for the command and status signals. Table 2-3 lists the command and status signals and pin designations for the connector. Connector J5 on the input/output panel provides the connections for the read-data output signals and the write-data input signals. This connector also provides the connections for the optional erase signal. Table 2-4 lists the read- and write-data pin designations and the erase-signal pin designations for the connector. If the operator control panel is not supplied, equivalent controls should be provided for local control during tape changes and maintenance. Connector J2 on the control electronics assembly provides connections for a customer-furnished operator-control-panel equivalent; the signal requirements and pin designations are listed in Table 2-5. Refer to Section III for the description of the operator control panel functions.

When the data electronics option is taken, connector J4 on the input/output panel provides connections for all input signals from the customer to the tape transport. Connector J5 on the input/output panel provides connections for all output signals from the tape transport to the customer. These input and output signals are described in the Data Electronics Technical Manual. Table 2-6 herein lists input signals and pin designations for connector J4. Table 2-7 lists output signals and pin designations for connector J5.

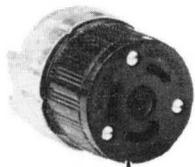
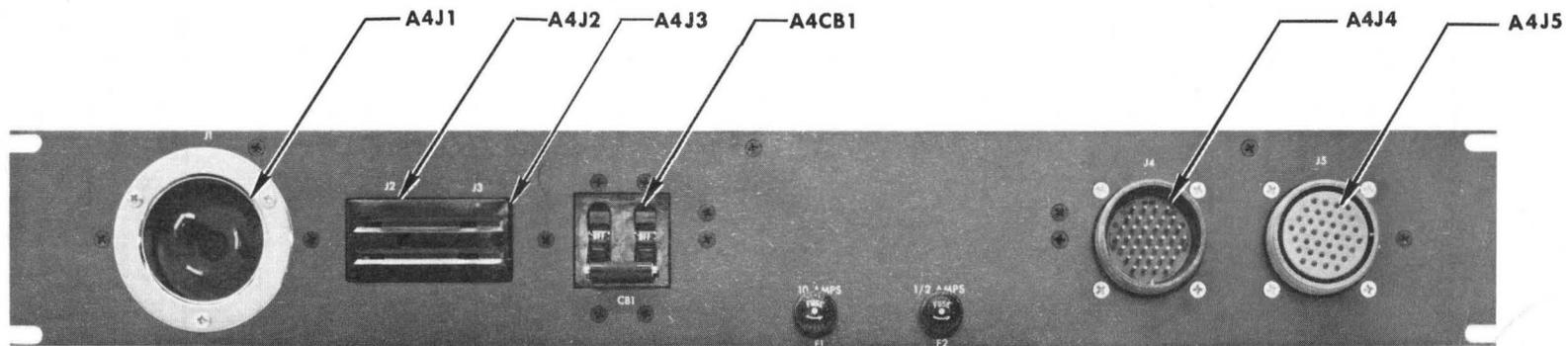
## 2-8. INPUT/OUTPUT CONNECTORS.

Mating connectors for customer fabricated cables are provided. (See Figure 2-1.)

## 2-9. COMMAND SIGNALS.

Command signals to the tape transport control electronics must fulfill the following requirements. The FALSE level must be 0  $\pm$ 1.25 volts. The TRUE level may be -10 to -14 volts. Input impedance shall not be less than 2000 ohms, nor more than 3000 ohms. Input lines from the remote source shall incorporate source ground. Command signals are listed in Table 2-3.

Figure 2-1  
Input/Output Panel



MATING  
CONNECTOR  
FOR A4J1



MATING  
CONNECTOR  
FOR A4J5



MATING  
CONNECTOR  
FOR A4J4

TABLE 2-3  
CONTROL CONNECTIONS (TRANSPORT WITHOUT DATA ELECTRONICS)

INPUT-OUTPUT PANEL A4J4 PIN NO.	SIGNAL DESCRIPTION	TYPE
A	REWINDING STATUS (-)	STATUS
B	READY STATUS (-)	STATUS
C	HIGH/LOW DENSITY STATUS (-/+)	STATUS
D	SELECT (-)	COMMAND
E	UNIT SELECT (-)	STATUS
F	SELECT AND REMOTE INDICATOR (+)	STATUS
H	HIGH/LOW DENSITY SELECT (-/+)	COMMAND (OUTPUT)
J	REWIND COMMAND (-)	COMMAND
K	REWIND AND LOCKOUT (-)	COMMAND
L	GROUND	--
M	BEGINNING-OF-TAPE (-)	STATUS
N	END-OF-TAPE (-)	STATUS
P	GROUND	--
R	FORWARD/REVERSE (-/+)*	COMMAND
S	RUN/STOP (-/+)**	COMMAND
T	GROUND	--
U	WRITE ENABLE STATUS (NC)	STATUS
V	WRITE ENABLE STATUS (C)	STATUS
W	WRITE ENABLE STATUS (NO)	STATUS
X	SHIELD	--

\*REVERSE/STOP (-/+) when Fwd/Stop-Rev/Stop logic is supplied.

\*\*FORWARD/STOP (-/+) when Fwd/Stop-Rev/Stop logic is supplied.

TABLE 2-4  
DATA INPUT CONNECTIONS (TRANSPORT WITHOUT DATA ELECTRONICS)

INPUT/OUTPUT PANEL A4J5 PIN NO.	SIGNAL DESCRIPTION
A	Write Data 1 Return
B	Write Data 2 Return
C	Write Data 1
D	Write Data 2
E	Write Data 3
F	Write Data 4
G	Write Data 5
H	Write Data 6
J	Erase Head
K	Erase Head Return
L	Write Head Ground (Grd Lug)
M	Write Head Center Tape (Option)
N	Write Data 9 Return
P	Write Data 8
R	Write Data 3 Return
S	Write Data 8 Return
T	Write Data 4 Return
U	Write Data 5 Return
V	Write Data 6 Return
W	Write Data 7 Return
Y	Write Data 6
Z	Write Data 7
a	Read Data 1
b	Read Data 2
c	Read Data 1 Return
d	Write Cable Common Shield
e	Read Data 4
f	Read Data 3
g	Read Data 4 Return
h	Read Data 5
j	Read Data 6
k	Read Data 2 Return
l	Read Data 7
m	Read Data 8
n	Read Data 7 Return
p	Read Data 8 Return
r	Read Data 9
s	Read Data 5 Return
t	Read Cable Common Shield
u	Read Data 3 Return
v	Read Data 9 Return
w	Read Head Ground
y	Read Data 6 Return

TABLE 2-5  
LOCAL CONTROL CONNECTIONS

CONTROL ELECTRONICS A2A3J2 PIN NO.	FUNCTION	REQUIREMENTS
1 and 17	Power interlock	Pin 1 connected to pin 17 when power is on
2 and 18	Power on-off	Pin 2 connected to pin 18 for power on
3	Remote select	Momentarily connected to logic ground for remote select. Otherwise, open circuit.
4	Chassis ground	---
5	Local select	Momentarily connected to logic ground for local select. Otherwise, open circuit.
6	OCP reset	Momentarily connected to logic ground during remote select, local select, or stop command. Otherwise, open circuit.
7	High/low density select	Connected to -12 volt logic bus for high density select. Connected to logic ground for low density select.
8	Forward command	Momentarily connected to OCP enable bus for forward command. Otherwise, open circuit.
9, 21, and 23	Load tape into vacuum chambers (energizes reel servo ready relay)	Pin 9 connected to pin 23 (+12 volt relay bus) when pin 8 is connected to OCP enable bus. Otherwise, connected to pin 21 (+12 volt relay interlocked bus).
10	Reverse command	Momentarily connected to OCP enable bus for reverse command. Otherwise, open circuit.

TABLE 2-5  
LOCAL CONTROL CONNECTIONS (Continued)

CONTROL ELECTRONICS A2A3J2 PIN NO.	FUNCTION	REQUIREMENTS
11	Rewind command	Momentarily connected to OCP enable bus for rewind command. Otherwise, open circuit.
12	Stop command	Momentarily connected to logic ground for stop command. Otherwise, open circuit.
13	Drives select-and-remote indicator lamp	12-volt indicator lamp connected between pin 13 and -12 volt logic bus.
14	Drives local indicator lamp	12-volt indicator lamp connected between pin 14 and -12 volt logic bus.
15	Drives remote indicator lamp	12-volt indicator lamp connected between pin 15 and -12 volt logic bus.
16	Drives file protect indicator lamp	12-volt indicator lamp connected between pin 16 and -12 volt logic bus.
17	Refer to pin 1	
18	Refer to pin 2	
19	-12 Volt logic bus	---
20	Logic ground	---
21	Refer to pin 9	
22	OCP enable bus	---
23	Refer to pin 9	

TABLE 2-5  
LOCAL CONTROL CONNECTIONS (Continued)

CONTROL ELECTRONICS A2A3J2 PIN NO.	FUNCTION	REQUIREMENTS
24	Shield connection (logic ground)	All cabling to connector A2A3J2 must be shielded. (Common shield satisfactory.)
25 through 30	Spares	---
---	High-density - select indicator	12-volt indicator lamp connected between logic ground and -12 volt logic bus when pin 7 is connected to -12 volt logic bus.
---	Low-density - select indicator	12-volt indicator lamp connected between logic ground and -12 volt logic bus when pin 7 is connected to logic ground.
---	Power-on indicator	12-volt indicator lamp connected between logic ground and -12 volt logic bus.

2-10. Select. When FALSE, the select line disables tape motion inputs to the control electronics and also disables status outputs from the control electronics. A select TRUE level will enable the remote inputs if the transport is in the ready and remote status. Transport ready requires that all interlocks are closed. Remote is TRUE when the REMOTE pushbutton, on the operator control panel, has been pressed.

2-11. Forward/Reverse.<sup>\*</sup> When TRUE, forward direction is selected. When FALSE, reverse direction is selected. The forward/reverse level must be established 5 usec prior to a RUN command. A change in level on this line, while the tape is in motion, will cause the tape to stop.

<sup>\*</sup>Used when Run/Stop-Fwd/Rev logic is supplied.

TABLE 2-6  
TYPICAL INPUT CONNECTIONS (TRANSPORT WITH DATA ELECTRONICS)

INPUT/OUTPUT PANEL A4J4 PIN NO.	SIGNAL DESCRIPTION
A	Ground
B	Ground
C	Write Data 1 (-)
D	Write Data 2 (-)
E	Write Data 3 (-)
F	Write Data 4 (-)
G	Spare
H	Ground
J	Ground
K	Ground
L	Ground
M	Write Data 5 (-)
N	Write Data 6 (-)
P	Write Data 7 (-)
R	Write Data 8 (-)
S	Write Data 9 (-)
T	Ground
U	Ground
V	Ground
W	WRITE STROBE (-)
X	WRITE RESET (-)
Y	RUN/STOP (-/+)*
Z	REWIND and LOCKOUT (-)
a	Ground
b	Ground
c	WRITE PERMIT (-)
d	READ PERMIT (-)
e	FORWARD/REVERSE (-/+)**
f	REWIND COMMAND (-)
g	Ground
h	Ground
j	Spare
k	Spare
l	ODD/EVEN PARITY (-/+)
m	Shield Ground

\*FORWARD/STOP (-/+) when Fwd/Stop-Rev/Stop logic is supplied.  
 \*\*REVERSE/STOP (-/+) when Fwd/Stop-Rev/Stop logic is supplied.

TABLE 2-7  
TYPICAL OUTPUT CONNECTIONS (TRANSPORT WITH DATA ELECTRONICS)

INPUT/OUTPUT PANEL A4J5 PIN NO.	SIGNAL DESIGNATION
A	Ground
B	Ground
C	Read Data 1 (-)
D	Read Data 2 (-)
E	Read Data 3 (-)
F	Read Data 4 (-)
G	Read Data 8 (-)
H	Ground
J	Ground
K	Ground
L	Ground
M	Read Data 5 (-)
N	Read Data 6 (-)
P	Read Data 7 (-)
R	READ CLOCK (-)
S	Ground
T	Ground
U	Ground
V	WRITE ENABLE STATUS (C)
W	BEGINNING-OF-TAPE (-)
X	END-OF-TAPE (-)
Y	REWINDING STATUS (-)
Z	READY STATUS (-)
a	WRITE ENABLE STATUS (NO)
b	WRITE ENABLE STATUS (NC)
c	WRITE CHECK ERROR (-)
d	Ground
e	HIGH/LOW DENSITY STATUS (-/+)
f	Read Data 9 (-)
g	Ground
h	PARITY ERROR (-)
j	Spare
k	UNIT SELECT (-)
l	SELECT AND REMOTE INDICATOR (+)
m	Shield Ground

2-12. Run/Stop.\* A transition to the TRUE level will cause the capstan to move the tape. The direction of the tape motion is determined by the previously established forward/reverse line. A FALSE level will cause tape motion to stop.

2-13. Forward/Stop\*\* A transition to the TRUE level on the forward/stop line will cause the capstan to move the tape in the forward direction. A change in level on this line, while the tape is in motion, will cause the tape to stop.

2-14. Reverse/Stop\*\* A transition to the TRUE level on the reverse/stop line will cause the capstan to move the tape in the reverse direction. A change in level on this line, while the tape is in motion, will cause the tape to stop.

2-15. Rewind. A TRUE level will initiate a high speed rewind cycle. The tape will rewind to the BOT photosense tab and the capstan will place the tape at the load point. The transport will remain in remote mode. High speed in the forward direction can be provided as an optional feature.

2-16. Rewind and Lockout. A TRUE level will initiate a high speed rewind cycle and return the transport to local mode. The tape will rewind to the BOT photosense tab and the capstan will place the tape at the load point. Unloading of tape from the BOT tab is done manually after operating the TAPE LOAD switch.

2-17. High/Low Density Select. This line is a command output from the operator control panel. The line is used to select the bit-packing density when the data electronics option is taken. When high-density packing is selected the line is at the TRUE level. When low-density packing is selected the line is at the FALSE level.

## 2-18. STATUS SIGNALS.

Status signals are returned to the external equipment and are provided for the operator control panel. Output levels, with a 25 foot cable, are  $-12 \pm 2$  volts (5 ma max to the load) and  $0 \pm 1.25$  volts (5 ma max from the load) for TRUE and FALSE, respectively, unless otherwise indicated. Status signals to the external equipment are enabled when in the remote mode. The indicator outputs, to the operator control panel, are active in either remote or local mode. Status signals are listed in Table 2-3.

\*Used when Run/Stop-Fwd/Rev logic is supplied.

\*\*Used when Fwd/Stop-Rev/Stop logic is supplied.

2-19. Ready. The Ready line remains at the FALSE level until all tape transport interlocks are closed. The ready output is active in the remote mode.

2-20. Unit Select. A TRUE level on the Unit Select line acknowledges that the tape transport has been selected by a TRUE level at the select input. The unit select output is active in the remote mode.

2-21. Select and Remote Indicator. This line is driven by a line driver having a passive output. The line driver must be terminated with an indicator lamp returned to -12 volts. When so terminated, the line driver output is 0 volts whenever the Unit Select line is at the TRUE level, otherwise, the line driver output is 125 ohms returned to ground.

2-22. Beginning-of-Tape (At Load-Point). A TRUE level indicates that the BOT photosense tab is being sensed. The BOT output is active in the remote mode.

2-23. End-of-Tape. A TRUE level indicates that the EOT photosense tab is being sensed. The EOT output is active in the remote mode.

2-24. Rewinding. A TRUE level indicates that the tape is rewinding. The rewind status output is active in the remote mode.

2-25. High/Low Density. The density status line acknowledges the density select level. A TRUE level indicates that high density has been selected. The density status line is active in the remote mode.

2-26. Write Enable Status. Three lines are provided to indicate the state of the write enable switch. When a file-protect condition exists, the normally closed contact is at logic ground level. When a write enable condition exists, the normally open contact is at logic ground level. These lines are active in both the remote and local mode.

2-27. DATA SIGNALS.

The magnetic head assembly is designed for writing and reading NRZI (non-return-to-zero, change on ONES) digital type information. An instantaneous change in the direction of write current causes a ONE to be written on magnetic tape. A reversal of the magnetic flux direction on the tape will be sensed by the read head and will be interpreted as a ONE.

Write current requirements and read signal outputs are provided below for Ampex 838 tape at a tape speed of 120 ips and a bit-packing density of 800 bpi, using a 7-track head. These requirements are for direct connection to the heads; refer to the Data Electronics Technical Manual for the data signal requirements when the data electronics option is taken.

2-28. Write Data. The amplitude of the write input signals shall be 60 ma peak. A DC current flow of 60 ma through the optional erase head coil will reduce all previously written data to less than 3 percent.

2-29. Read Data. The read head provides a 20 mv (peak-to-peak) output.

2-30. ENVIRONMENT.

2-31. OPERATING ENVIRONMENT.

The tape transport is designed for operation in a fixed position under the following conditions:

- Ambient Air Temperature . . . . . 32° to 100°F
- Relative Humidity . . . . . 20% to 80% (with no condensation)
- Altitude . . . . . 0 to 7500 feet

When enclosed, sufficient air must pass over the equipment in the enclosure to maintain the exhaust air temperature (above the transport at the top of the enclosure) at less than 120°F. The inlet air temperature shall be less than 90°F. Capstan motor and servo motor housing surface temperatures must not exceed 170°F. Printed circuit boards and the servo power amplifier temperatures must not exceed 120°F.

2-32. STORAGE AND SHIPPING ENVIRONMENT.

Sudden temperature changes which will cause condensation must be avoided.

- Ambient Air Temperature . . . . . -30° to +150°F
- Relative Humidity . . . . . 95% maximum
- Altitude . . . . . 0 to 40,000 feet

## **SECTION III OPERATION**

### 3-1. INTRODUCTION.

This section lists controls and indicators. Controls and interlocks are explained and tape loading instructions are presented.

### 3-2. OPERATOR CONTROL PANEL CONTROLS AND INDICATORS.

All operator controls and indicators except the TAPE LOAD and DOOR INTERLOCK OVERRIDE switches are located on the operator control panel of the transport as shown in Figure 3-1.

3-3. POWER Switch. The POWER switch is an alternate-action (push ON, push OFF) pushbutton indicator switch. When the switch is ON and power is applied to the tape transport, the POWER indicator is lighted.

3-4. FILE PROTECT Indicator. The FILE PROTECT indicator is lighted when the write enable ring is not in place. This notifies the operator that the information presently on the tape or file is protected.

3-5. REMOTE Switch. The REMOTE switch is a momentary-ON pushbutton indicator switch that switches the transport to remote or automatic control. When the pushbutton is pressed, the REMOTE indicator lights "white" to indicate REMOTE ready condition. When the transport is operating in the remote mode, the REMOTE indicator lights "red".

3-6. LOCAL Switch. The LOCAL switch is a momentary-ON pushbutton indicator switch that switches the transport to local or manual control. When the transport is in the local or manual mode of operation, the LOCAL indicator is lighted.

3-7. HIGH/LOW DENSITY Switch. The HIGH/LOW DENSITY switch is used with the optional data electronics and is an alternate-action (push HIGH, push LOW) pushbutton indicator switch controlling the density of bit packing on the tape during the write mode of operation. When the transport is in the high-density mode of operation, the HIGH portion of the HIGH/LOW DENSITY indicator is lighted. When the transport is in the low-density mode, the LOW portion of the HIGH/LOW DENSITY indicator is lighted.

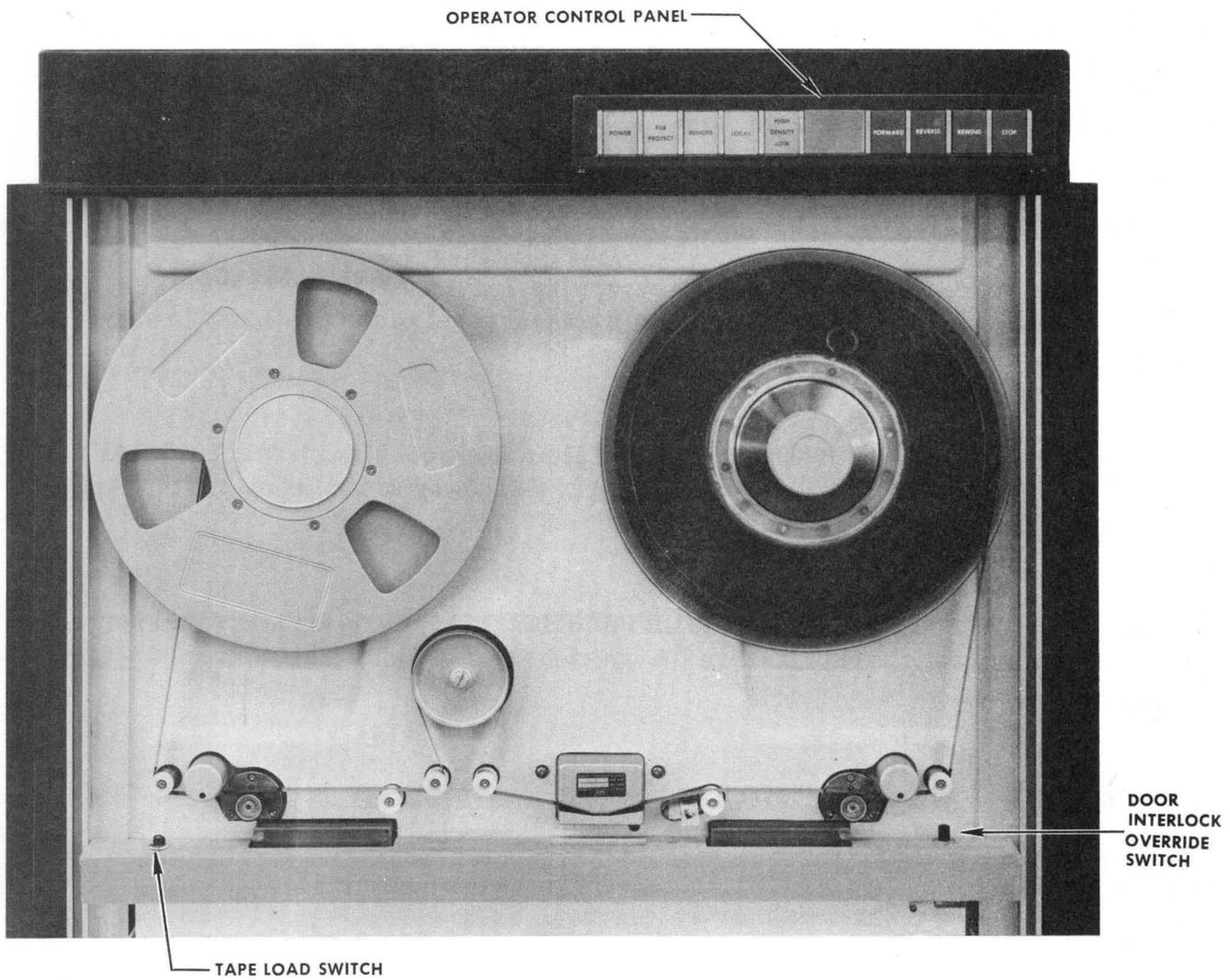


Figure 3-1  
Tape Transport Controls, Indicators, and Tape Loading Path

3-8. FORWARD Switch. The FORWARD switch is a momentary-ON pushbutton switch which initiates movement of tape in the forward direction. The FORWARD switch also bypasses the short/long loop sensors in the vacuum chambers. Thus, if the tape is loaded in the chambers but is not in the normal operating position, the reel servos are enabled to move tape into the correct operating position in the chambers by pressing the FORWARD pushbutton.

3-9. REVERSE Switch. The REVERSE switch is a momentary-ON pushbutton switch which initiates movement of tape in the reverse direction at normal operation speed.

3-10. REWIND Switch. The REWIND switch is a momentary-ON pushbutton switch which initiates movement of tape in the reverse direction at a high speed until the load point is reached.

3-11. STOP Switch. The STOP switch is a momentary-ON pushbutton switch which stops all tape movement and resets the forward/reverse control circuits. Actuation of the switch returns the transport to local mode.

3-12. TAPE LOAD AND DOOR INTERLOCK OVERRIDE SWITCHES.

3-13. TAPE LOAD Switch. The TAPE LOAD switch is a latching-type pushbutton switch and is located on the tape ledge. When the switch is actuated to ON, the reel brakes are disengaged and the vacuum and positive pressures are turned off to facilitate tape loading and unloading. The switch must be actuated to OFF to resume normal operation of the tape transport.

3-14. DOOR INTERLOCK OVERRIDE Switch. The DOOR INTERLOCK OVERRIDE switch is a momentary-ON pushbutton switch and is located on the tape ledge. Actuating the switch energizes an override relay which bypasses the reel access door interlock, thus permitting the tape transport to be operated with the reel access door open. The override circuit is disabled when the reel access door is closed.

3-15. INTERLOCKS.

If the power supply fails, the vacuum system or positive pressure system fails, the reel access door is opened, or tape is improperly positioned in the vacuum chambers, power is removed from the servomotors and the reel brakes are applied.

3-16. Power On. The vacuum and positive pressure interlocks prevent operation of the tape transport until the equipment has stabilized and the vacuum and positive pressures have reached operating levels. This takes 3 to 4 seconds.

3-17. POWER Off. When the POWER switch is actuated to the OFF position, power is removed from the transport.

3-18. Reel Access Door. The reel access door is provided with an interlock which will stop the tape transport should the access door be opened during operation.

3-19. Vacuum Failure. If the extreme limits (long or short) of permissible tape position are exceeded in the vacuum storage chamber, the transport will stop.

3-20. PHOTONSENSE TAB CONTROL.

The two channel photosense unit automatically stops the tape transport and gives an output to remote equipment when reflective tabs on the tape are sensed. Placement of reflective tabs in two channels on the tape is shown in Figure 3-2.

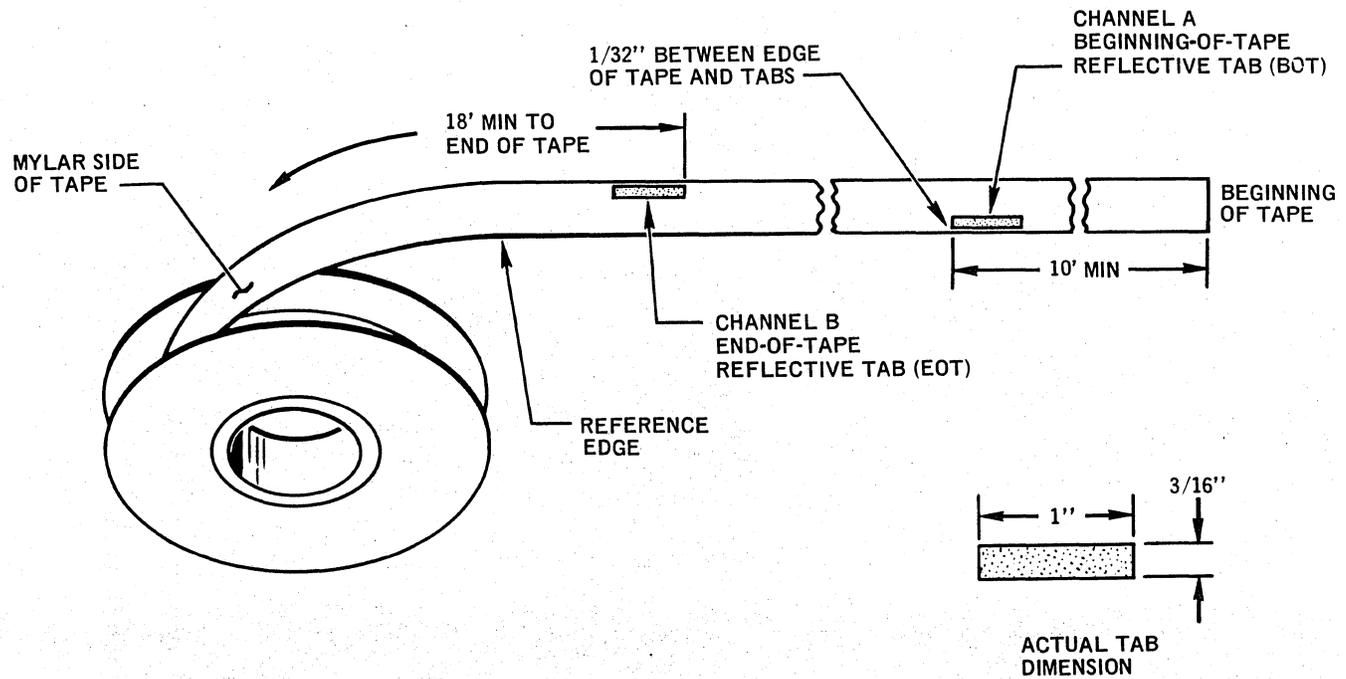


Figure 3-2  
Reflective Tab Placement Diagram

3-21. LOADING THE TAPE. (See Figure 3-1.)



Follow the procedures of paragraph 5-3 for tape deck cleaning.

Use Ampex Part No. 087-007 head cleaner and a cotton swab to clean the head and the tape guides before starting to load the tape. As the tape reel brakes must be released while the tape is being loaded, power to the transport must be switched ON during the following steps.

Step 1: (NAB Compatible Reel Retainer) Slip the file reel over the reel retainer. Hold the reel firmly against the turntable surface and rotate the retainer handle approximately 120 degrees clockwise, at which point the reel retainer handle will lock into position. Ensure that the reel is snugly mounted on the retainer, and is flush against the turntable.

(IBM Compatible Reel Retainer) Slip the file reel over the reel retainer. Hold the reel firmly against the turntable surface and rotate the retainer knob clockwise to the mechanical stop. Ensure that the reel is snugly mounted on the retainer and is flush against the turntable.

Step 2: Actuate the TAPE LOAD switch to ON; wait for the vacuum and positive pressures to reach zero.

Step 3: Unwind 3 to 5 feet of tape leader from the reel.

Step 4: Starting where the tape leaves the file reel, place the tape around the file reel right tape guide, under the tape cleaner, and over the file reel servo tachometer pulley.

Step 5: Pass the tape across the top of the vacuum chamber on the file side of the transport, over the file center tape guide, across the photosense assembly, and across the read/write heads.

Step 6: Pass the tape under the capstan file tape guide, around the capstan, and under the capstan fixed reel tape guide.

Step 7: Pass the tape over the fixed reel center tape guide, across the top of the other vacuum chamber, over the fixed reel servo tachometer pulley, under the tape cleaner and the fixed reel left tape guide, and attach it to the fixed reel (the reel rotates clockwise during wind). Wind at least three extra turns of tape on the fixed reel.

Step 8: Actuate the TAPE LOAD switch to OFF and close the reel access door.

**NOTE**

At least three seconds should be allowed between Steps 8 and 9 to let the vacuum reach a level which will pull the tape into the vacuum chamber.

Step 9: Momentarily press the FORWARD pushbutton. This will enable the reel servos to form loops in the vacuum chambers. (Refer to paragraph 3-8.)

## **SECTION IV THEORY OF OPERATION**

### 4-1. SCOPE.

This section includes details of the operation of the tape drive and the control electronics. The tape drive (Figure 4-1) is comprised of the capstan servo system and the reel servo system. Commands from the control electronics cause the tape drive to move tape forward, reverse, or keep tape at a standstill.

### 4-2. CAPSTAN SERVO SYSTEM.

In response to command from the control electronics, the capstan servo system controls the direction, acceleration, and velocity of capstan motion. The system is comprised of the capstan motor and the capstan servo control. The voltage appearing across the capstan motor is supplied to the reel servo system as a capstan direction and velocity reference (CAPSTAN VELOCITY input).

The servo system operates in two modes: steady-state or acceleration. In the steady-state mode, the capstan motor is either stopped, or running at a constant speed. In this mode, the servo system maintains constant voltage across the motor armature terminals. The induced armature voltage (back EMF) at constant speed is very large compared to the IR voltage drop in the armature windings, thus the speed of the motor under this condition is practically independent of normal load variations. In the acceleration mode, the servo system maintains constant current through the motor armature until the motor reaches the preset velocity; constant current through the motor armature provides a steady acceleration of motor speed. The armature current required to accelerate the armature and capstan inertial-mass is very large compared to the current required to overcome viscous and static friction losses, thus the acceleration of the motor speed under this condition is practically independent of normal load variations.

### 4-3. CAPSTAN MOTOR AND CAPSTAN.

The capstan motor is mounted on the tape deck casting and is a DC servomotor. The motor has a high-torque-to-low-inertia ratio which permits rapid acceleration. The capstan is mounted directly on the motor shaft. The motor is supplied with either a permanent-magnet field or electromagnetic field. Systems using the electromagnetic-field motor are provided with a constant-current field power supply which is located in the capstan servo assembly.

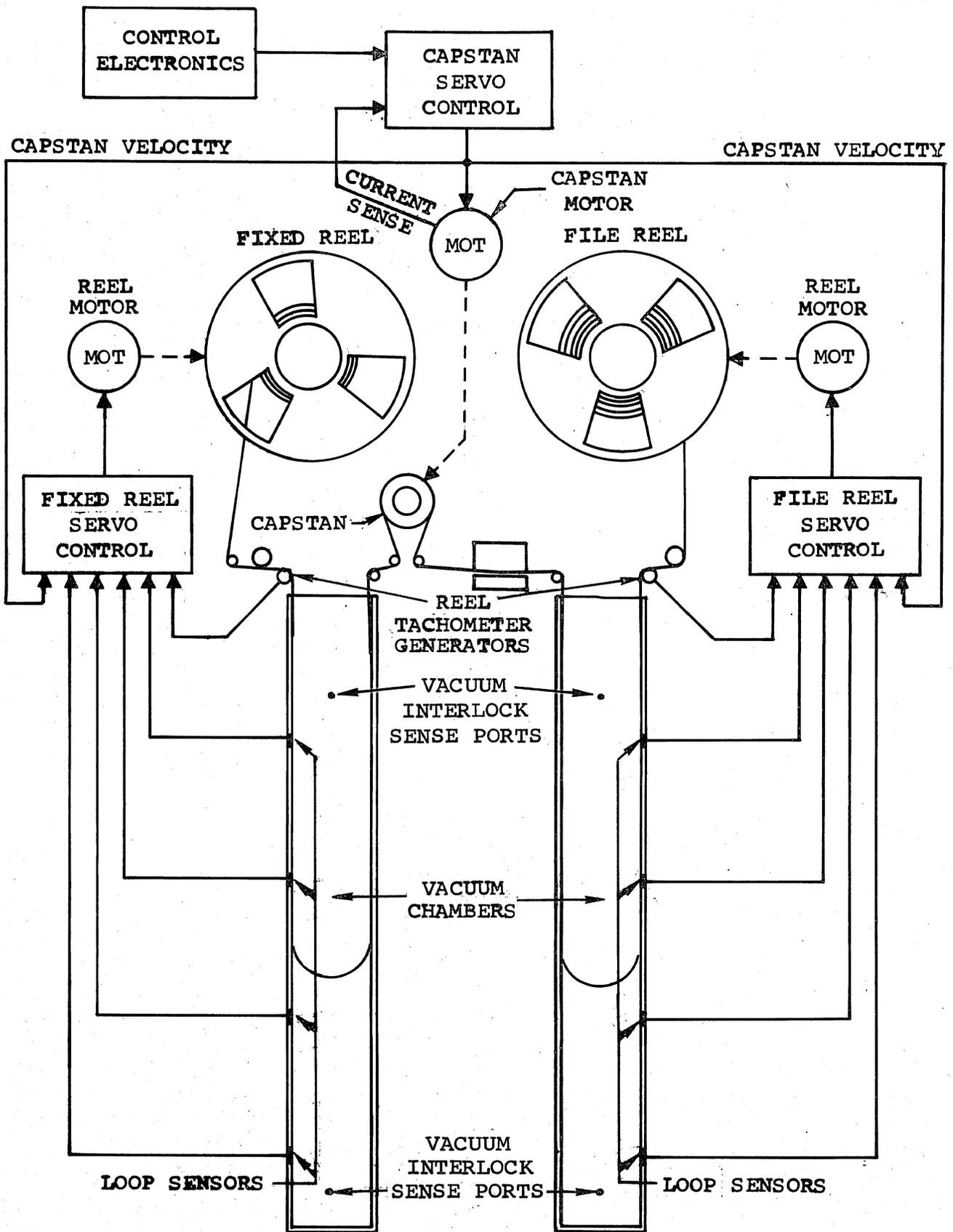


Figure 4-1  
Tape Drive, Flow Diagram

#### 4-4. CAPSTAN SERVO CONTROL.

The capstan servo control consists of a bi-polar power amplifier and three control PCB assemblies. The power amplifier is located in the capstan servo assembly and the three PCB assemblies are located in the control electronics card cage.

#### 4-5. CAPSTAN SERVO SYSTEM OPERATION. (See Figure 4-2.)

4-6. Steady-State Operation. Speed of the capstan motor during steady-state operation is principally controlled by the reference generator on the capstan velocity PCB, the control summing amplifier on the capstan acceleration PCB, and the power amplifier. The OVER-DRIVE input to the control summing amplifier is effectively at zero level, thus having no appreciable effect in the control circuit. When no forward or reverse command logic signals are applied to the reference generator, the generator outputs are at zero volts DC. When a forward command logic signal is applied at the input of the reference generator, the generator produces a REF (+) signal voltage proportional to the preset forward velocity. The voltage is approximately +0.013 volt/ips (1.56 volts at 120 ips) and is amplified in the control summing and power amplifiers and applied to the capstan motor armature, which drives the capstan in the forward direction. When a reverse command logic signal is applied to the reference generator, the generator produces a REF (-) signal voltage (with negative polarity) proportional to the preset reverse velocity. This voltage is amplified in the control summing and power amplifiers and applied to the capstan motor armature, which drives the capstan in the reverse direction. Two potentiometers in the reference generator provide for speed control; one potentiometer controls the REF (+) signal voltage (forward speed), the other controls the REF (-) signal voltage (reverse speed).

4-7. Power Amplifier. The power amplifier consists of a capstan control preamplifier stage and nonlinear emitter-follower driver and power output stages. The CAPSTAN CONTROL signal from the control summing amplifier is amplified in the capstan control preamplifier and then applied to the reverse driver stage. The reverse driver is operated class A and controls the reverse output stage and the forward driver, which are operated class B. The forward driver controls the forward output stage, which also is operated class B.

When the CAPSTAN CONTROL signal is at zero level, the reverse driver conducts at a standby level that holds both the reverse output stage and the forward driver at cut-off. When the CAPSTAN CONTROL signal voltage goes positive (reverse command), current flow through the reverse driver is increased from standby to a level that biases on the reverse output stage, which provides a negative voltage output to the capstan motor. When the CAPSTAN CONTROL signal voltage goes negative (forward command), current flow through the reverse driver is decreased from standby to a level that biases on the forward driver, which biases on the forward output stage; the forward output stage then provides a positive voltage output to the capstan motor.

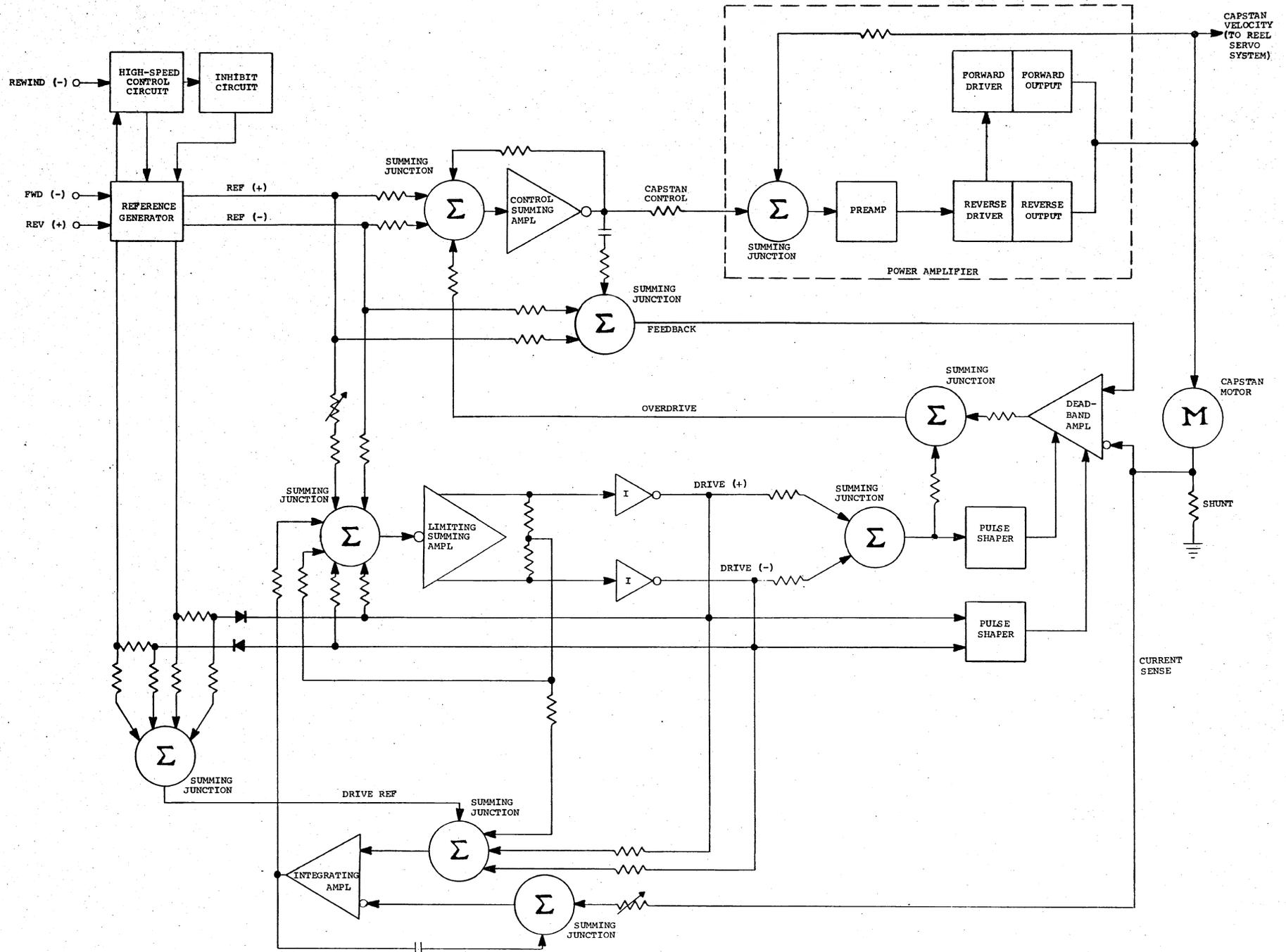


Figure 4-2  
Capstan Servo System, Flow Diagram

4-8. Acceleration Control. During steady-state operation, the output from the limiting summing amplifier is essentially zero due to the balancing action of the integrating amplifier. A nonzero output from the limiting summing amplifier causes the integrating amplifier output to change toward a voltage that will return the limiting summing amplifier output to zero.

Prior to the start of acceleration, the limiting summing amplifier is balanced and the output of the integrating amplifier is a negative analog of the applied reference signal; when the applied reference signal changes, the limiting summing amplifier is unbalanced, producing an inverted and amplified output. This output is again inverted and amplified in the drive inverter, summed with the output from the dead-band amplifier, and fed back to the input of the control summing amplifier as the OVERDRIVE signal. The reference voltage and the large OVERDRIVE signal have the same polarity, thus the total input to the control summing amplifier is very large, driving the control summing amplifier and power amplifier towards saturation. The motor armature current is sensed by the current control circuit through the CURRENT SENSE signal, which is the voltage appearing across the shunt resistor in the capstan motor return line. When the CURRENT SENSE voltage matches the preset limits of the dead-band amplifier, the amplifier produces a nonzero output which is subtracted from the signal voltage; this feedback prevents the armature current from increasing further. The loop consisting of the control summing amplifier, the power amplifier, the capstan motor, and the dead-band amplifier is then balanced and the motor armature current is maintained at a preset value, causing a steady motor acceleration. The leading and trailing edges of the drive current pulse from the dead-band amplifier are step shaped to compensate for the spring-mass energy transfer between the motor armature and the capstan. This function is performed by the two pulse shapers on the capstan current control PCB, which operate whenever the DRIVE (+) or DRIVE (-) signal from the drive inverters on the capstan acceleration PCB changes level at the start or end of an acceleration period.

The FEEDBACK signal is applied to the noninverting input of the dead-band amplifier. The FEEDBACK signal is the summed REF (+), REF (-), and AC output from the control summing amplifier. The AC output is a phase-shifted feedback, and prevents oscillation in the capstan servo system during acceleration. The REF (+) and REF (-) summed signals cause an increase in the amplitude of the OVERDRIVE signal during starting acceleration to decrease start time.

The CURRENT SENSE voltage is also applied to the inverting input of the integrating amplifier; the DRIVE (+) and DRIVE (-) signals are summed with the DRIVE REF signal and the balancing input and applied to the noninverting input of the integrating amplifier. The balancing input to the integrating amplifier, from the limiting summing amplifier, is cancelled during acceleration by the summed DRIVE (+) and DRIVE (-) signals. The DRIVE REF signal compensates the integrator for the effects of tape friction. The output of the integrating amplifier during acceleration is proportional to the time integral of the motor armature current (which is in turn proportional to the instantaneous velocity of the motor armature) with the constant of integration continuously modified by the noninverting input to the integrating amplifier. The circuit constants are such that the output of the integrating

amplifier becomes equal to the negative of the reference voltage at the time that the motor velocity reaches the preset value. At that time the limiting summing amplifier becomes balanced, removing the OVERDRIVE signal from the input of the control summing amplifier. The motor armature current then decreases to a low value, since the output of the power amplifier is almost equal to the induced voltage in the motor. The capstan servo system then operates in the steady-state mode until the reference voltage is changed.

4-9. High Speed Control. The high-speed-control circuit operates in conjunction with the reference generator to increase the voltage of the REF (+) and REF (-) signals when high speed is programmed. When a REWIND logic command is applied, the high speed control is enabled. If either the REF (+) signal is positive or the REF (-) signal is negative, the control will supply timing signals to the reference generator to control the onset of a high speed condition so as not to exceed the capability of the reel servo system. The timing signals prevent high-speed motion until normal-speed reel servo motion has stabilized (about 400 ms after initiation of a tape forward or tape reverse command). At this time, the high-speed-control signal forward biases an associated transistor in the reference generator and causes the reference voltage to increase about five volts-per-second until the preset reference voltage for high speed motion has been reached; the relatively-slow increase allows the reel servo system to follow the tape motion. A potentiometer in the reference generator provides control of the rewind speed (on CVE PCB assemblies only).

When the REWIND logic command is removed (stop high-speed motion command), the high-speed-control signals immediately reverse bias the associated transistor in the reference generator to return the reference voltage to the preset level for normal speed. At the same time, discharge of the timing capacitor in the high speed control reverse biases the transistor controlling the inhibit circuit and the inhibit signal level goes negative; the negative signal is applied to the reference generator and causes the reference voltage to immediately drop to zero. The reference voltage change causes the capstan to stop with the highest permissible deceleration. The discharge of the timing capacitor causes the inhibit signal to remain negative for about 400 ms, inhibiting forward or reverse tape commands for that time to allow the reel servo system to stabilize.

When the FWD (-) or REV (+) logic signal at the input of the reference generator is changed from a forward or reverse command to a stop command during high-speed operation, the high-speed-control signal immediately reverse biases the associated transistor in the reference generator to return the reference voltage to zero, causing the capstan to stop with the highest permissible deceleration. At the same time, the inhibit signal goes negative as previously described, and remains negative for about 400 ms, inhibiting forward or reverse tape commands for that time to allow the reel servo system to stabilize.

#### 4-10. REEL SERVO SYSTEM.

The reel servo system (Figure 4-1) consists of two separate reel servo systems. The file reel servo system includes the file reel, the file reel motor, and the file reel servo control. The fixed reel servo system includes the fixed reel, the fixed reel motor, and the fixed reel servo control. Since both systems operate identically, only one description is included. The function of the reel servo system is to maintain the proper amount of tape within the vacuum chambers at all times.

The capstan servo system accelerates or decelerates the tape from zero ips to 120 ips in 3.8 milliseconds. This high speed intermittent movement of the tape exceeds the response capability of the relatively-high-inertia reel motors, thus requiring a low-friction tape storage device at the capstan input and output. Vacuum storage chambers are used on the tape transport for this purpose and "store" sufficient tape to allow the reel motors to reach the speed required to follow capstan tape motion. Loop sensors are located along one side of each vacuum chamber and are used for tape loop position sensing.

When the tape is at a standstill, a tape loop will be formed in each vacuum chamber somewhere between the two middle loop sensors. The vacuum chamber lengths are such that when the tape is accelerated, the reel motor used for tape take-up can accelerate to the rotational speed corresponding to the final capstan tape velocity before the tape loop reaches the lower vacuum interlock port, and the reel motor used for tape feed can accelerate to the rotational speed corresponding to the final capstan tape velocity before the tape loop reaches the upper vacuum interlock port of the other vacuum chamber.

During transition from constant tape velocity in one direction to constant tape velocity in the opposite direction (e.g., forward to reverse) the vacuum chambers store sufficient tape to allow the reel motors to decelerate to zero velocity and accelerate to the required rotational speed in the opposite direction before the tape loop reaches the upper or lower vacuum interlock port, as determined by tape direction. The capstan servo system provides a 400 ms delay between high-speed commands, allowing the reel servo system to stabilize before a change in tape motion occurs.

#### 4-11. TAPE REEL AND REEL MOTOR.

The tape reel is coupled to the shaft of the reel motor. The reel motor is a DC series split-phase motor. Separate field windings control forward and reverse motion. A brake is attached to the rear of each motor. When power is removed from the brake, the brake is applied, stopping tape motion.

#### 4-12. REEL SERVO CONTROL.

The reel servo control consists of tape loop position sensing (Figure 4-3), the reel tachometer, the reel servo preamplifier, the reel servo driver, and the reel servo assembly. The function of the reel servo control is to control the motion of the reel motor.

#### 4-13. TAPE LOOP POSITION SENSING.

Four photoconductive units (loop sensors) sense the position of the tape loop in each vacuum chamber. Two loop sensors in each chamber sense the tape loop position during forward operation; these are the FEED FWD and LOOP SENSE FWD loop sensors. The other two loop sensors in each chamber sense the tape loop position during reverse operation; these are the FEED REV and LOOP SENSE REV loop sensors. A separate excitation lamp provides the light source for each sensor. When the light source is exposed by the tape loop, the loop sensor resistance decreases, effectively providing a switching action by changing the bias level on an associated transistor switch located in the reel servo preamplifier. Depending on the transistor switch function, the illuminated loop sensor changes a forward bias to reverse bias, or a reverse bias to forward bias. In forward operation, a short loop is maintained in the file reel vacuum chamber and a long loop is maintained in the fixed reel vacuum chamber. In reverse or rewind operation, a long loop is maintained in the file reel vacuum chamber and a short loop is maintained in the fixed reel vacuum chamber.

#### 4-14. REEL TACHOMETER AND PULLEY.

The reel tachometer pulley is mounted directly to the shaft of the reel tachometer, which is mounted between the vacuum chamber and the tape reel. The tachometer produces a DC output proportional to the speed of shaft rotation and monitors the velocity of tape passing between the tape reel and vacuum chamber. The high frequency component of the tachometer output is filtered out and the DC voltage is supplied to the reel servo preamplifier.

#### 4-15. REEL SERVO SYSTEM OPERATION.

Operation of the 120 ips transport reel servo system is described. Operation of the 112.5 ips, and 75 ips transports is identical, except for speed and start/stop times.

4-16. Forward Operation, Tape Initially at Rest. (See Figures 4-4 and 4-5.) When the tape is at a standstill the tape loops in the vacuum chambers rest at some point between the FEED FWD and FEED REV loop sensors. When a forward command is applied to the capstan servo system, the capstan accelerates the tape rapidly to a velocity of 120 ips. The tape loop in the file reel vacuum chamber will be drawn towards the FEED FWD loop sensor as the capstan pulls tape. When the tape loop passes the FEED FWD loop sensor, the sensor

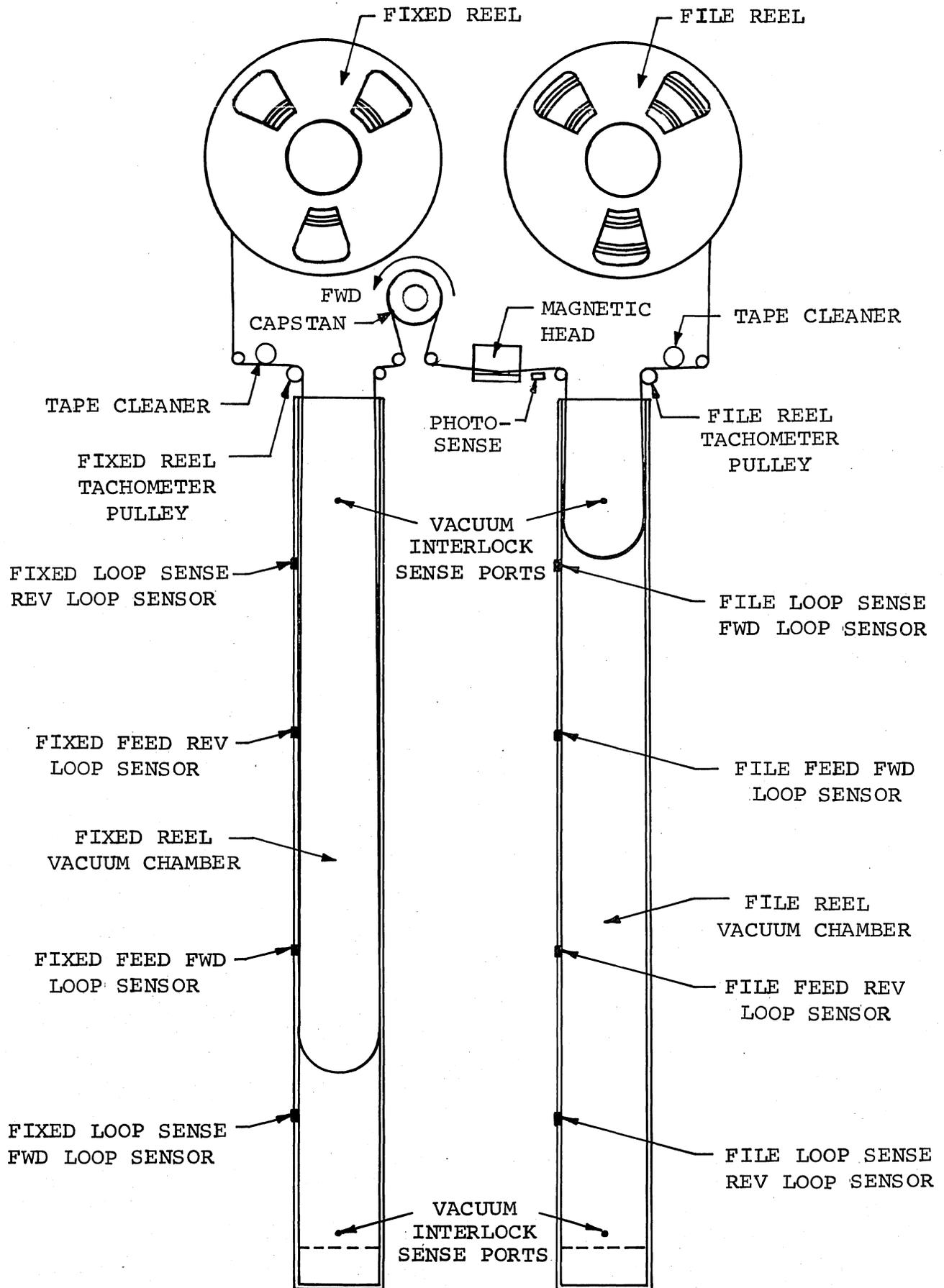
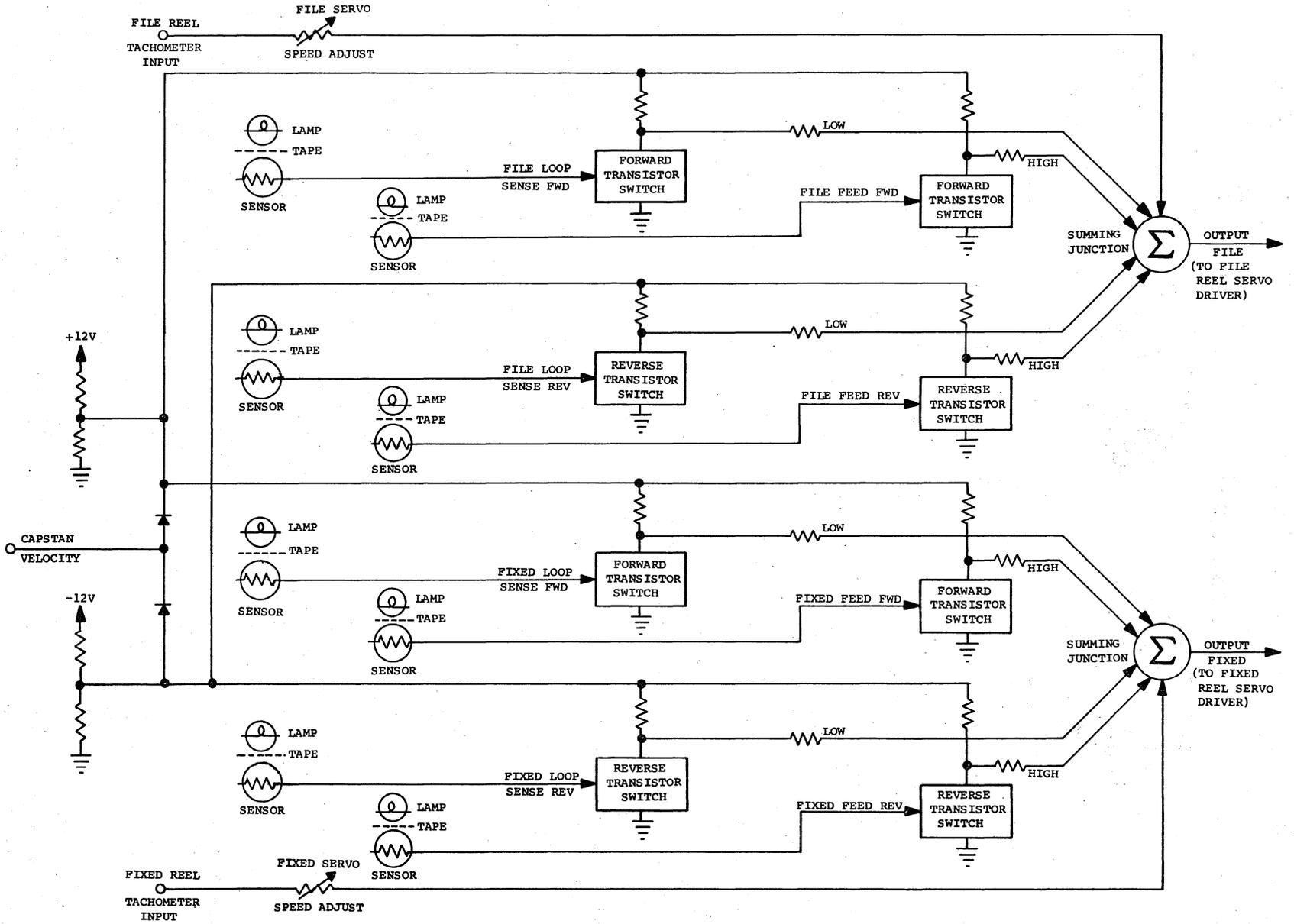


Figure 4-3  
Tape Drive Path and Reel Servo Sensors

Figure 4-4  
Reel Servo Control, Input and Preampifier Flow Diagram



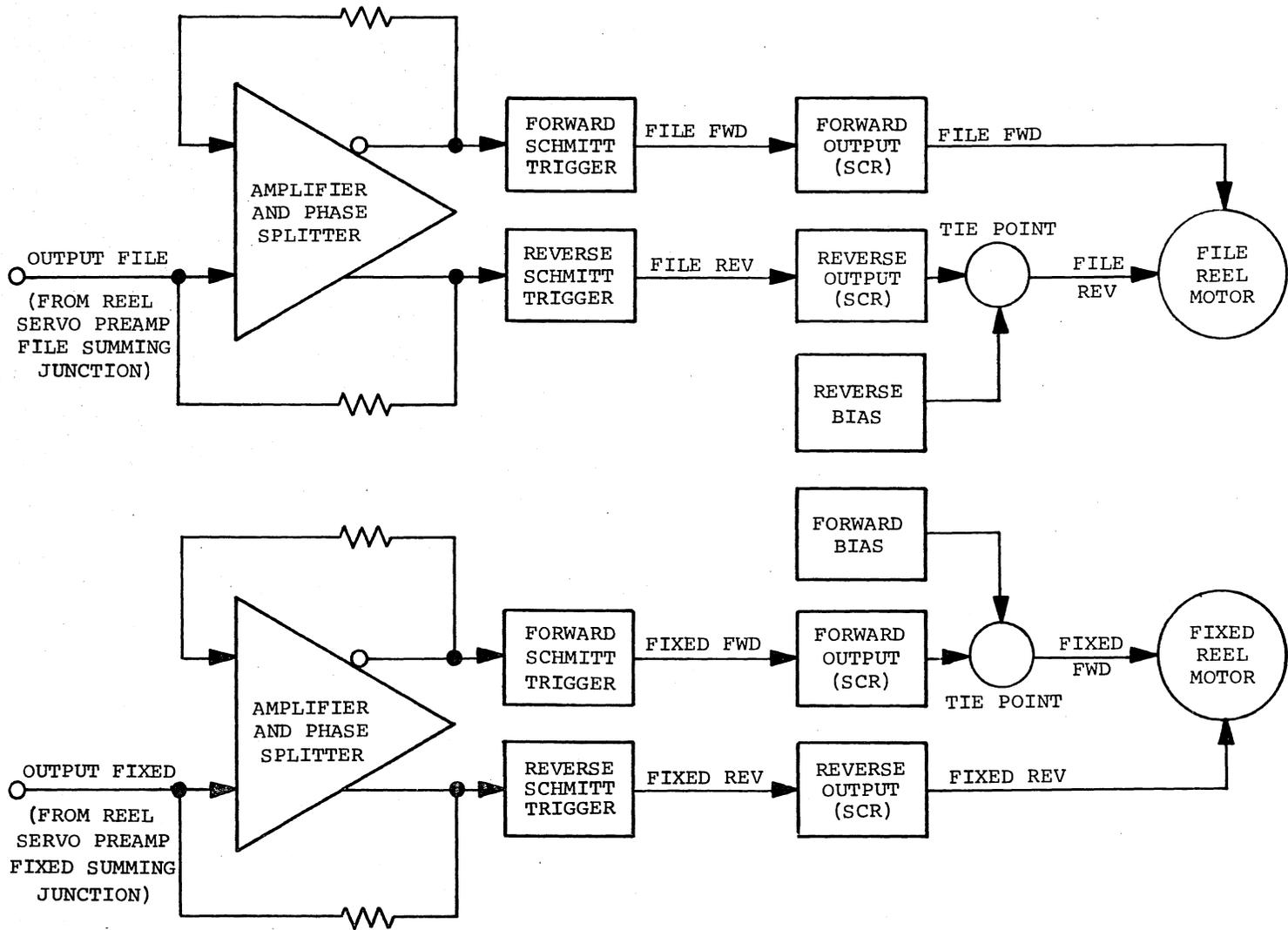


Figure 4-5  
Reel Servo Control, Driver and Output Flow Diagram

is illuminated and biases off the associated transistor switch in the reel servo preamplifier. When the transistor switch is cut off, a voltage divider circuit which had been effectively grounded by the transistor switch is enabled. The CAPSTAN VELOCITY input, which at this time is the positive voltage appearing across the capstan motor, is applied to the voltage divider as a reference of the capstan velocity. The output from the voltage divider is applied to the OUTPUT FILE summing junction. The relatively-high positive voltage at the summing junction causes a high current flow through the reel servo driver input in the positive direction. This high current flow is amplified in the reel servo driver amplifier and phase-splitter stage and applied to the input of the forward Schmitt trigger stage, where it exceeds the trigger level and turns on the Schmitt trigger. When the Schmitt trigger is on it gates on the forward output SCR in the reel servo assembly, which applies operating voltage to the file reel motor, accelerating the motor in the forward direction. The amplifier and phase-splitter stage also applies an inverted signal (negative polarity) to the input of the reverse Schmitt trigger stage, which remains cut off.

When the file reel motor starts rotating, tape is fed from the file reel into the file reel vacuum chamber. The tape passes over the file reel tachometer pulley, rotating the tachometer shaft; the tachometer produces a negative DC voltage output directly proportional to the speed of the tape being supplied from the file reel. This negative DC voltage is applied to the OUTPUT FILE summing junction, where it is summed with the output from the voltage divider circuit. Figure 4-6 shows the control voltage appearing at the input of the Schmitt trigger during tape acceleration from a standstill to a constant velocity. The outputs from the reel tachometer and the FEED FWD voltage divider are summed and produce voltage curve 1. When the tape velocity reaches speed A, the sum of the reel tachometer output and FEED FWD voltage divider output is zero, and the forward Schmitt trigger is cut off, which allows the forward output SCR to turn off. When the forward output SCR turns off, operating power is removed from the reel motor and the inertia of the reel motor maintains the forward rotation. The tape velocity from the file reel at this time is approximately 90 percent of that of the capstan velocity.

Since the tape is being supplied to the vacuum chamber at a rate 10 percent slower than it is being removed, the tape loop will continue upwards and pass the LOOP SENSE FWD loop sensor, which will then be illuminated. The illuminated sensor biases off the associated transistor switch in the reel servo preamplifier, enabling the LOOP SENSE FWD voltage divider. The two voltage divider outputs (FEED FWD and LOOP SENSE FWD) are summed with the reel tachometer output and produce voltage curve 2 shown in Figure 4-6. The resultant voltage exceeds the trigger level of the forward Schmitt trigger, turning on that circuit. The Schmitt trigger then gates on the forward output SCR and the reel motor is accelerated in the forward direction. The acceleration continues until the tape velocity reaches speed B, at which time the resultant of the FEED FWD voltage divider output, the LOOP SENSE FWD voltage divider output, and the reel tachometer output reaches zero (as shown by voltage curve 3), which cuts off the forward Schmitt trigger. When the forward Schmitt trigger is cut off, the forward output SCR turns off, which removes operating power from the reel motor. The inertia of the reel motor maintains the forward rotation. The tape velocity from the file reel at this time is approximately 110 percent of the capstan velocity.

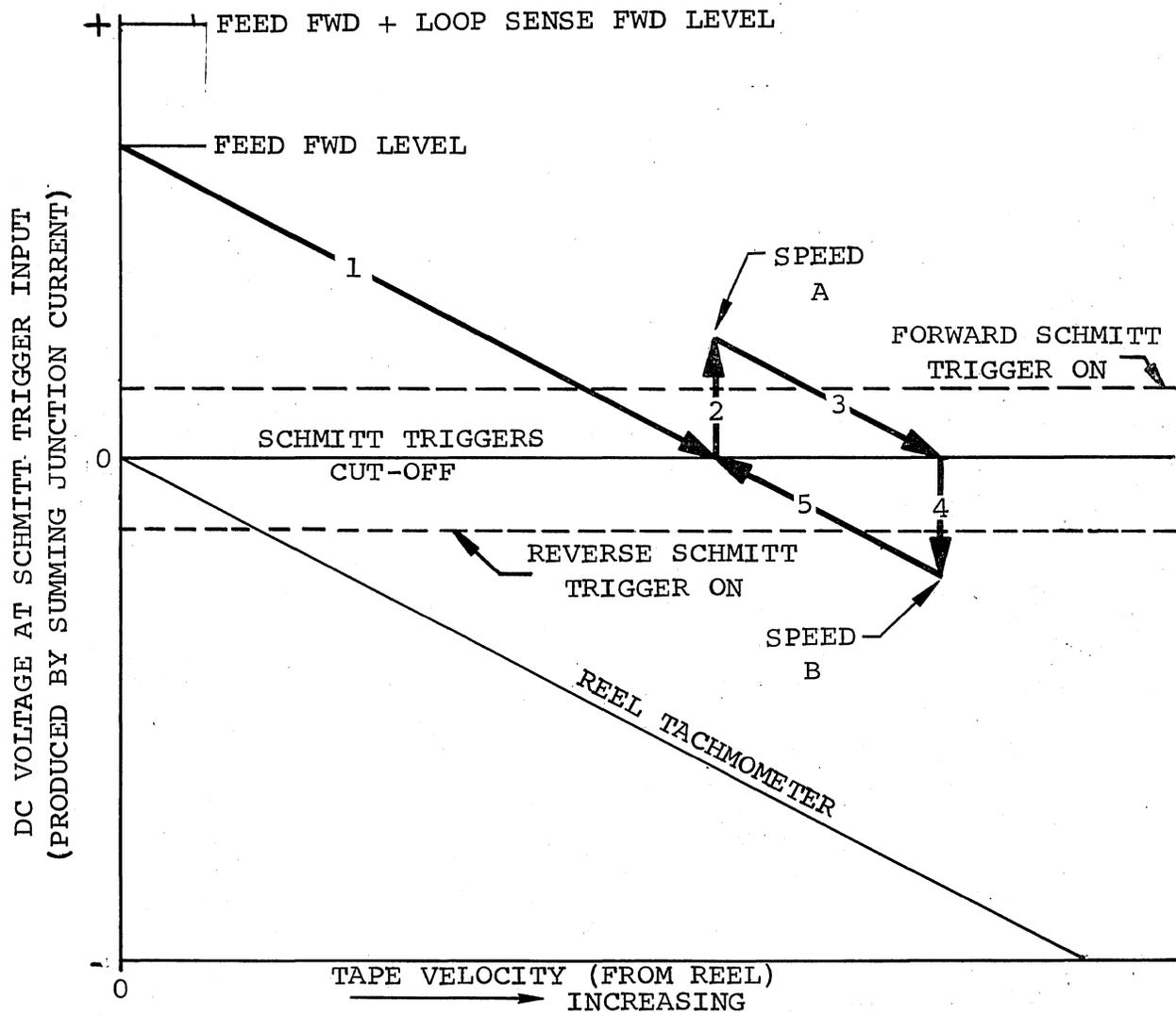


Figure 4-6  
File Reel Forward Drive, Simplified Schmitt Trigger Control Voltage Diagram

Since the tape is being supplied to the vacuum chamber at a rate 10 percent faster than it is being removed, the tape loop moves downward and covers the LOOP SENSE FWD loop sensor, which biases on the associated transistor switch in the reel servo preamplifier. That transistor is then saturated and effectively grounds the LOOP SENSE FWD voltage divider, causing the control voltage to go negative, as shown by voltage curve 4. This negative voltage holds the forward Schmitt trigger cut off. Since the amplifier and phase-splitter stage also applies an opposite polarity signal to the input of the reverse Schmitt trigger, that circuit is triggered on and gates on the reverse output SCR in the reel servo assembly. When the reverse output SCR is gated on, operating power is applied to the reverse windings of the file reel motor and the motor is decelerated. This deceleration continues until the tape velocity drops to speed A, where the sum of the reel tachometer output and FEED FWD voltage divider output is again zero, which cuts off the reverse Schmitt trigger. This allows the reverse output SCR to turn off, which removes operating power from the reel motor. The inertia of the reel motor maintains the forward rotation. The tape velocity from the file reel at this time is again approximately 90 percent of the capstan velocity.

Since the tape is again being supplied to the vacuum chamber at a rate 10 percent slower than it is being removed, the tape loop will move upwards, pass the LOOP SENSE FWD loop sensor and initiate the previously described sequence of forward and reverse power application to the reel motor. Thus, at constant capstan velocity, the reel servo system "hunts" as controlled by voltage curves 2, 3, 4, and 5 shown in Figure 4-6. This causes the tape loop to move above and below the LOOP SENSE FWD loop sensor.

The fixed reel servo control operates in the same manner as described for the file reel, except that the tape and tape loop move in the opposite direction to that described for the file reel.

4-17. Reverse Operation. (See Figures 4-4 and 4-5.) Operation of the reel servo control circuitry for reverse or rewind tape drive is identical to that described for forward operation, except that the CAPSTAN VELOCITY input voltage has a negative polarity, the tape loop position is sensed by the reverse loop sensors which control the reverse transistor switches, the reel tachometer output voltage is positive, and the tape and tape loops move in the opposite direction to that described for forward operation.

4-18. Forward to Reverse Operation. (See Figures 4-4 and 4-5.) When the tape is moving forward at a constant capstan velocity, the tape loops are moving above and below the LOOP SENSE FWD loop sensors. When the command to the capstan servo system is changed from forward to reverse, the capstan rapidly reverses direction. The CAPSTAN VELOCITY input voltage drops from the positive level to zero in 3.8 ms, then increases to the negative level in another 3.8 ms. The reel servo system changes from forward to reverse operation in the following manner (file reel servo operation will be described).

Initially, the tape velocity from the file reel is at speed B shown in Figure 4-7, and the forward output SCR has just turned off; removing operating power from the reel motor

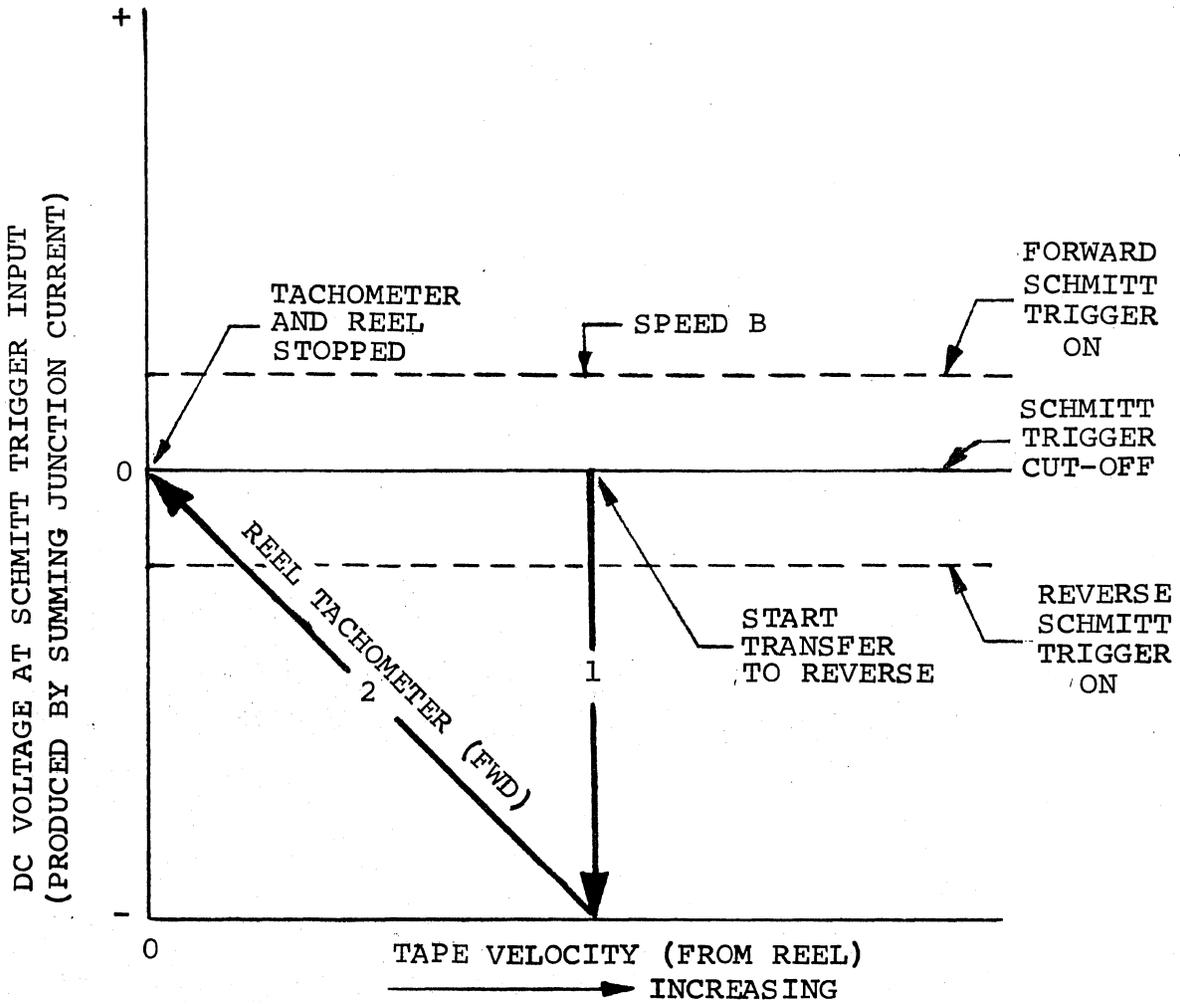


Figure 4-7  
 File Reel Forward to Reverse Drive,  
 Simplified Schmitt Trigger Control Voltage Diagram

(this condition was selected for description, the transfer from forward to reverse operation can occur at any time). The tape loop is above the LOOP SENSE FWD loop sensor. When the capstan motor reverses direction, the CAPSTAN VELOCITY input voltage goes negative, reducing the FEED FWD and LOOP SENSE FWD voltage divider outputs to a lower DC voltage, established by a biasing circuit. When this occurs, the principal input to the OUTPUT FILE summing junction will be the reel tachometer output, which is now a relatively-high negative voltage. This high negative voltage produces voltage curve 1, which triggers the reverse Schmitt trigger circuit. This in turn gates on the reverse output SCR, which applies operating power to the reverse windings of the reel motor. The reel motor then starts decelerating and the decreasing speed of the reel tachometer produces the output causing voltage curve 2. The capstan is feeding tape into the vacuum chamber at the preset velocity, causing the tape loop to move downward in the vacuum chamber (the reel motor is still rotating forward, also feeding tape into the vacuum chamber). When the reel tape velocity reaches zero, the output from the reel tachometer is zero, which cuts off the reverse Schmitt trigger. This allows the reverse output SCR to turn off, which removes operating power from the reel motor, thus allowing the reel motor to stop. The reel motor is stopped before the tape loop reaches the FEED REV loop sensor. When the tape loop moves downward past the FEED REV loop sensor, the reel servo system then operates in the same manner as previously described for reverse operation.

4-19. Reverse to Forward Operation. Reverse to forward operation of the reel servo control circuitry is identical to the forward to reverse operation previously described, with the exception of the voltage polarities of the loop sensors and transistor switches, and the tape and tape loop direction of motion.

4-20. Null Detector Circuit. (See the reel servo assembly schematic in Section VII.) Power to the reel motors is supplied from the +115 volt rms full-wave bridge rectifier circuit in the reel servo assembly. The output of the rectifier circuit is a pulsating DC voltage which has a peak value of approximately +163 volts. If a reel motor SCR is switched on when the instantaneous voltage is at or near the peak value, high frequency noise (RFI) will be generated. The amount of RFI generated can be minimized by allowing the SCR to switch on only when the pulsating DC voltage is at a low instantaneous value. A null detector circuit, consisting of Q5 and associated component parts in the reel servo assembly, performs this function.

Current flow through R4, CR14, and CR26 clamps the voltage at the emitter of Q5 to -1 volt. The base of Q5 is controlled by the pulsating DC voltage applied through R1. The voltage divider circuit consisting of R3 and R1 shifts the voltage level applied to the base of Q5 to provide a negative voltage at the base when the pulsating DC voltage is at a low positive instantaneous value. The threshold level of the null detector circuit is established by R1 and R3. CR 13 limits the negative base-to-emitter voltage differential to 0.5 volts.

When the instantaneous voltage of the +115 volt rectifier circuit is above the threshold level, the base-to-emitter voltage differential at Q5 is positive, and Q5 is saturated. CR21

is forward biased and clamps the voltage at the gate of each SCR to -0.5 volt, which reverse biases the gate-to-cathode junction of each SCR. (The cathode of each SCR is at +0.5 volt, established by current flow through CR19.) When a Schmitt trigger in the reel servo driver is triggered during the time Q5 is saturated, the SCR is prevented from conducting by the clamped gate-to-cathode negative voltage; the SCR will start conducting only when Q5 is cut off.

When the instantaneous voltage of the +115 volt rectifier circuit is below the threshold level, the base-to-emitter voltage differential at Q5 is negative, and Q5 is cut off. The collector of Q5 swings positive and CR21 is back biased. The SCR can then be gated on by the positive gate voltage from the Schmitt trigger. When the positive gate voltage is removed, the SCR stops conducting the next time the pulsating DC voltage returns to zero, since the current in the SCR is then reduced to zero.

4-21. Reel Brake Operation. During normal operation, the deenergized tape load relay (located in the autotransformer assembly) provides power to the reel brakes, causing the brakes to release. During tape loading or unloading, the tape load relay is energized, and the reel brakes are released by power provided by the deenergized reel servo ready relay (located in the reel servo assembly).

4-22. Tape Loop Positioning (Transport Stopped). When the tape transport is stopped, the tape loop is positioned between the FEED FWD and FEED REV loop sensors by the reel servo system. Since the capstan motor is not operating, the CAPSTAN VELOCITY input is zero volts, which would not trigger the Schmitt trigger circuits to start the servo action. Reel servo operation with the capstan motor stopped is provided by DC bias voltages applied to the transistor switch voltage dividers. The DC bias voltages are sufficient to trigger the Schmitt trigger circuits when the loop sensors are covered or uncovered. The bias voltages are provided by the resistance voltage dividers shown in Figure 4-4 adjacent to the CAPSTAN VELOCITY input isolation diodes. The servo action is the same as previously described, except that the tape loop is positioned and then remains stationary (no forward or reverse tape motion). When tape is loaded on the tape transport, the reel servo system will position the tape loop as described when the FORWARD pushbutton is pressed and held momentarily.

4-23. Tape Tension (Transport Stopped). Bias voltages are supplied to the reverse windings of the file reel motor and to the forward windings of the fixed reel motor to maintain a fixed tension on the tape against the vacuum pressure when the transport is stopped. The fixed tension prevents the tape loops in the vacuum chambers from moving downwards. The bias voltage is removed during tape loading and unloading when the TAPE LOAD switch is pressed.

#### 4-24. VACUUM BUFFER STORAGE.

The vacuum buffer storage isolates the capstan servo system from the reel servo system. With the capstan servo system isolated from the reel servo system, the capstan servo system accelerates a minimum of tape mass. As tape is drawn from the vacuum buffer storage, it is replaced by the reel servo system. The vacuum provides proper tape tension on both sides of the capstan. The vacuum buffer storage consists of a vacuum-blower assembly and two vacuum chamber assemblies. If the vacuum fails or the tape is in an abnormal position, the vacuum interlock switches interrupt the capstan servo system and the reel servo system, and the brakes are applied to the reel motors. If the tape loop is too short, the upper vacuum interlock switch orifice is exposed to the vacuum within the chamber, which actuates the switch. If the tape loop is too long, the lower vacuum interlock switch orifice is exposed to the air directly, which actuates the switch.

#### 4-25. VACUUM PRESSURE CONTROL (VACUUM CONTROL ASSEMBLY ONLY).

The vacuum pressure is maintained at a preset level by the vacuum-blower motor, which is operated at a constant speed by the vacuum-blower-motor speed control circuit. An SCR speed control circuit, located in the vacuum control assembly, regulates the average power applied to the motor; with constant average power applied, the motor operates at a constant speed.

The motor is connected in series with the diode bridge and the bridge load circuits. (See the vacuum control schematic diagram in Section VII.) The diode bridge consists of CR1, CR2, CR3, and CR4. The bridge load circuits consist of SCR Q1 and the gate control circuits. When SCR Q1 is not conducting, current flow through the motor is limited to a low value by the relatively-high impedance of the gate control circuits. (See Figure 4-8.) When SCR Q1 is conducting, full line voltage, less the small voltage drop across two of the bridge diodes and Q1, is applied to the motor. The average power applied to the motor is determined by the peak value of the input voltage, the input-voltage phase angle at which Q1 is gated on, and the input-voltage phase angle at which Q1 is cut off. The motor-speed control circuit controls the phase angle at which Q1 is gated on. Q1 is cut off each time the input voltage goes through the zero-voltage point and the anode current drops below the holding level. An integrating circuit senses the average power applied to the motor and changes the phase angle at which Q1 is gated on to maintain the average power at a preset level. This phase angle change holds the motor speed constant over the normal input voltage range.

The output from the bridge is a full-wave rectified pulsating DC voltage. At the beginning of each half cycle, the DC voltage from the bridge establishes 18 volts across zener diode VR1. (See Figure 4-9B.) C4 starts to charge to that voltage through R3. (See Figure 4-9C.) When C4 charges to the firing voltage of unijunction transistor Q2, Q2 conducts and C4 discharges rapidly through R4 and base B1 to emitter of Q2. The rapid discharge of C4 produces a positive voltage spike at the gate of SCR Q1, and Q1 is triggered on. (See Figure 4-9E.) (Current flow through Q1 produces the positive voltage appearing at the gate of Q1 immediately after the voltage spike.) As C4 discharges, the emitter current of Q2 drops below the holding current level and Q2 stops conducting.

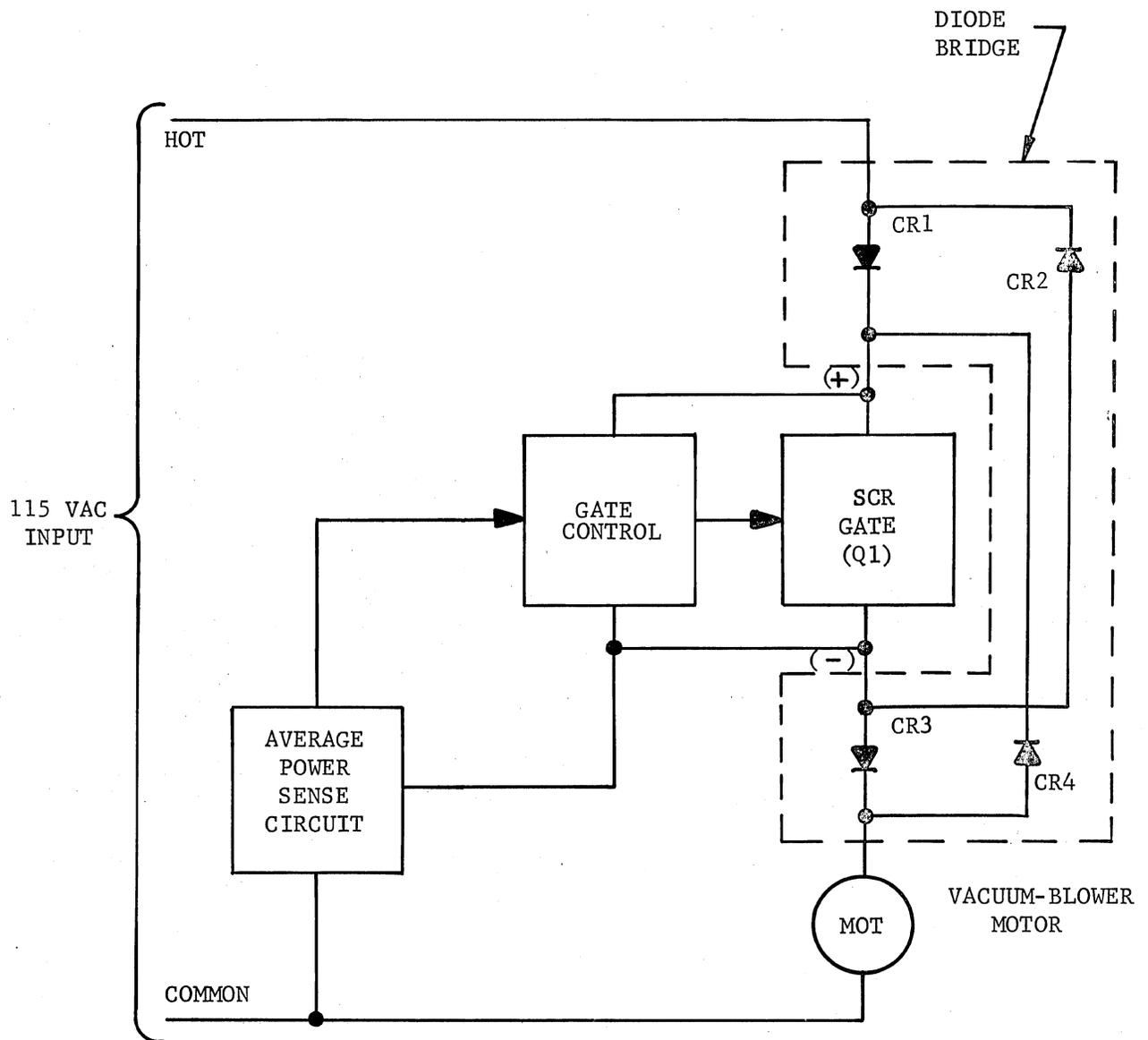


Figure 4-8  
Motor-Speed Control, Block Diagram

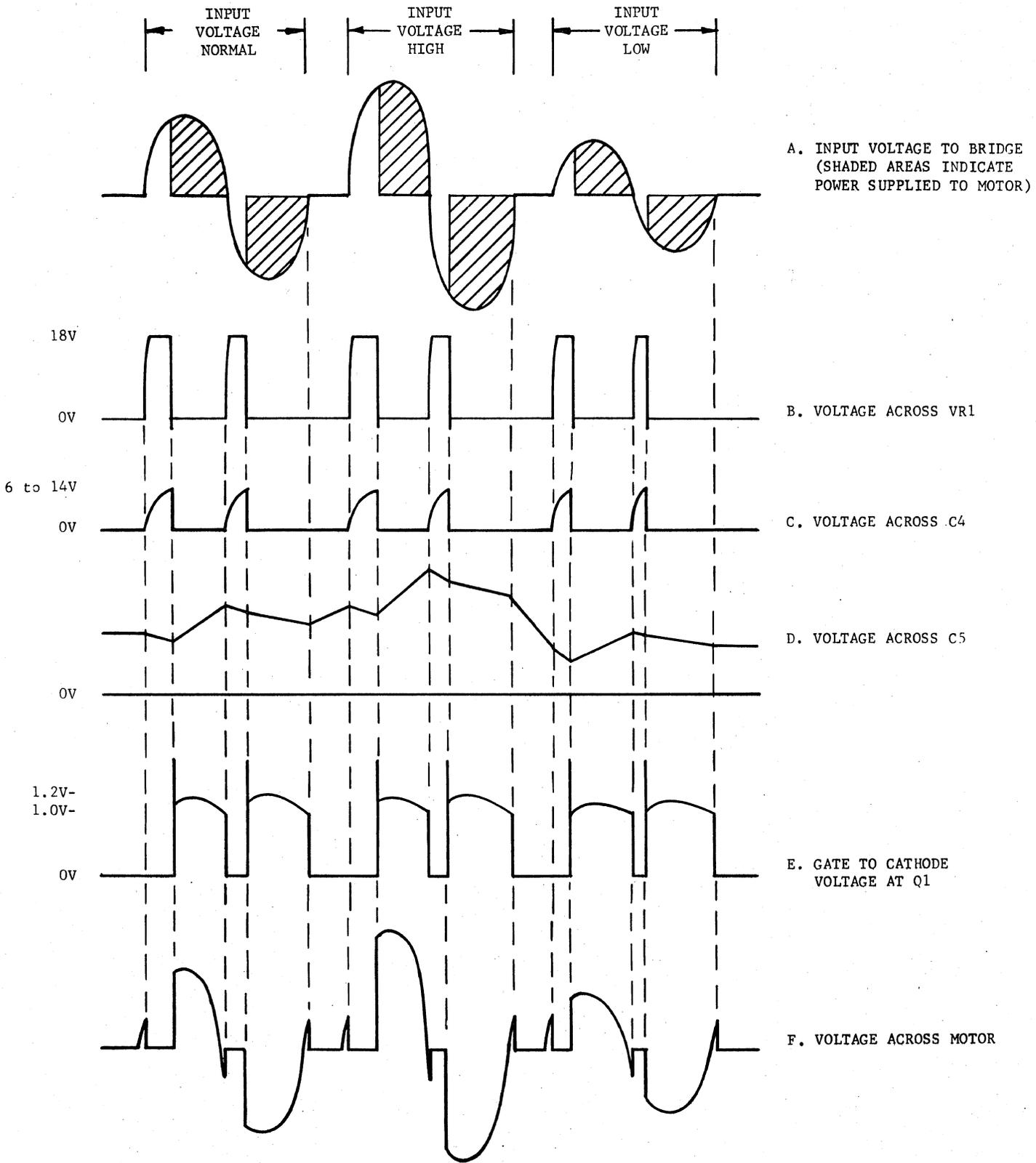


Figure 4-9  
Motor-Speed Control, Waveforms

When Q1 is gated on, the voltage across R1 and VR1 drops to a low value, and C4 remains in the discharged state. The input voltage is applied to the motor as previously described. During the positive half-cycles at the bridge input, rectifier diode CR5 is forward biased. When CR5 is forward biased, integrating capacitor C5 charges to a voltage proportional to the voltage across the motor. (See Figure 4-9D.) When Q1 is cut off, C5 starts to discharge slowly through R6 and R5.

The voltage level to which C5 charges affects the current flow through Q3, which, in turn, controls the rate at which C4 charges at the beginning of each half-cycle. When the input voltage is above the nominal value, C5 charges to a relatively-high voltage, and current flow through Q3 is also relatively high. The current flow from Q3 flows through R3. The relatively-high current flow causes more voltage drop across R3 than during a nominal input voltage condition. Since the total voltage across C4 and R3 when SCR Q1 is cut off is regulated to 18 volts by VR1, any increase in the voltage drop across R3 will reduce the voltage at C4, which causes an increase in the time required for C4 to charge to the firing voltage of Q2. Similarly, the relatively-low current flow through R3 when the input voltage is below the nominal value allows C4 to charge to the firing voltage of Q2 faster than when the input voltage is at the nominal value. This control of the C4 charging rate provides the average-power regulation that maintains a constant motor speed.

Since C5 is charged only during the Q1 on time in the positive half-cycle of the input voltage and then starts discharging through R6 and R5, the change in the voltage across C5 causes a greater current flow through Q3 at the beginning of the negative half-cycle of the input voltage than at the beginning of the positive half-cycle. This change causes the difference in the phase angle delays shown in Figure 4-9.

Potentiometer R6 is used to set the speed control circuit for an average power output corresponding to a specific motor speed. When R6 is set for minimum resistance, less of the input voltage appears across C5 and the average power output from the speed control circuit is relatively high. When R6 is set for maximum resistance, more of the input voltage appears across C5 and the average power output from the speed control circuit is relatively low.

Zener diode VR2 is used to establish the required bias range for Q3. Capacitor C3 prevents transients from gating on Q1.

#### 4-26. CONTROL ELECTRONICS.

The control electronics accepts tape input control signals from the external equipment, issues tape control commands to the tape drive system, and returns status signals to the external equipment. (See the control electronics schematic in Section VII.) Tape command interlocks are provided by the control electronics to ensure that erroneous command sequences will not cause tape damage or system malfunction. The control electronics also includes the necessary logic for rewind to load point and other computer-oriented functions. In the descriptions of the control electronics logic functions that follow, an UP

level indicates relatively positive as compared to the relatively-negative DOWN level. The operator control panel (optional equipment) provides switches and indicators to permit local operation of the tape transport for loading of tape and for maintenance.

**NOTE**

If the operator control panel option is not taken, equivalent circuitry should be connected to connector J2 of the control electronics. (See the operator control panel schematic in Section VII.)

4-27. PRINTED CIRCUIT BOARD (PCB) ASSEMBLIES.

The control electronics circuitry is on four PCB assemblies, which are located at J7, J8, J9, and J10 in the control electronics card cage. Table 4-1 lists typical printed circuit board assemblies used in the control electronics and the tape drive system. Two forward/reverse logic PCB assemblies are listed; one is used with Run/Stop-Fwd/Rev logic, the other is used with Fwd/Stop-Rev/Stop logic. Refer to Section VI for a detailed description of the operation of the circuits on the boards.

TABLE 4-1  
PRINTED CIRCUIT BOARD CROSS-REFERENCE LIST

MNEMONIC	DESCRIPTION	ASSEMBLY*	SCHEMATIC*	LOCATION
CAC	Capstan Acceleration -C	3114631-10	3114632	J13
CIA	Capstan Current Control	3114627-10	3114626	J12
CVE	Capstan Velocity -E	3119513-01	3119515	J14
FLA	Forward/Reverse Logic Run/Stop-Fwd/Rev	3107082-10	3107083	J10
FLC	Fwd/Stop-Rev/Stop	3112360-10	3112361	
LLA	Local/Remote Logic	3107102-10	3107103	J8
PHC	Photoamplifier Type C	3110237-10	3110238	J9
RLC	Rewind Logic -C	3116167-10	3116168	J7
RPB	Reel Servo Preamplifier	3116172-10	3116175	J15
RRA	Reel Servo Driver	3110143-10	3110144	J16

\*Typical for TM-11 tape transports.

#### 4-28. WRITE ENABLE SWITCH ASSEMBLY.

When no write enable ring is installed in the file reel, the write enable switch (S7) contacts are as shown in the tape deck schematic in Section VII and the write enable relay (K1) in the control electronics is deenergized. When the relay is deenergized, the FILE PROTECT indicator on the operator control panel is lighted. When the write enable ring is in place in the file reel, a sensor probe on the write enable switch assembly is forced back by the ring; a pneumatic actuator then retracts the sensor probe (when positive pressure is applied to the actuator) to prevent drag on the file reel. When the sensor probe is retracted, the write enable switch is actuated to the other position and the write enable relay is energized. Power is removed from the FILE PROTECT indicator lamp when the relay is energized.

When the positive pressure drops to ambient, the sensor probe returns to the sense position and the write enable switch contacts return to their original position.

#### 4-29. PHOTOSENSE HEAD.

The photosense head consists of a light source and the necessary photoelectric elements to sense the light reflected from the reflective markers on the tape.

#### 4-30. POWER ON SEQUENCING.

Circuit breaker CB1 on the input/output panel must be set to the ON position before the AC input power at J1 can be applied to the tape transport. When the POWER pushbutton switch on the operator control panel is in the ON position, AC relay K1 on the input/output panel is energized, and power is applied to the tape transport. The operating power for AC relay K1 is provided by transformer T1 on the input/output panel. Voltage limiter VR1 on the panel limits the peak voltage applied to the relay coil.

When power is applied to the tape transport, the transport is not ready for operation until the transport ready relay is energized through the transport-ready-relay interlock circuits. (See Figure 4-10.) The transport-ready-relay interlock circuit is complete when the power supplies are operating, the reel access door interlock switch is closed, and the vacuum and positive pressure switches sense proper vacuum and pressure. While the transport ready relay is not energized, an UP level is applied to the TRANSPORT READY input to the local/remote logic (LL) PCB. With the UP level applied to the TRANSPORT READY input, the MASTER RESET output from LL is at the UP level. The UP level MASTER RESET prevents any tape motion by resetting and inhibiting the outputs of the forward/reverse logic (FL) PCB and the rewind logic (RL) PCB. The UP level on the TRANSPORT READY input sets LL for local mode operation. When all interlocks are closed the transport ready relay is energized, applying a DOWN level to the TRANSPORT READY input of LL which causes the MASTER RESET signal to go to a DOWN level. The LOCAL pushbutton indicator is lighted, indicating

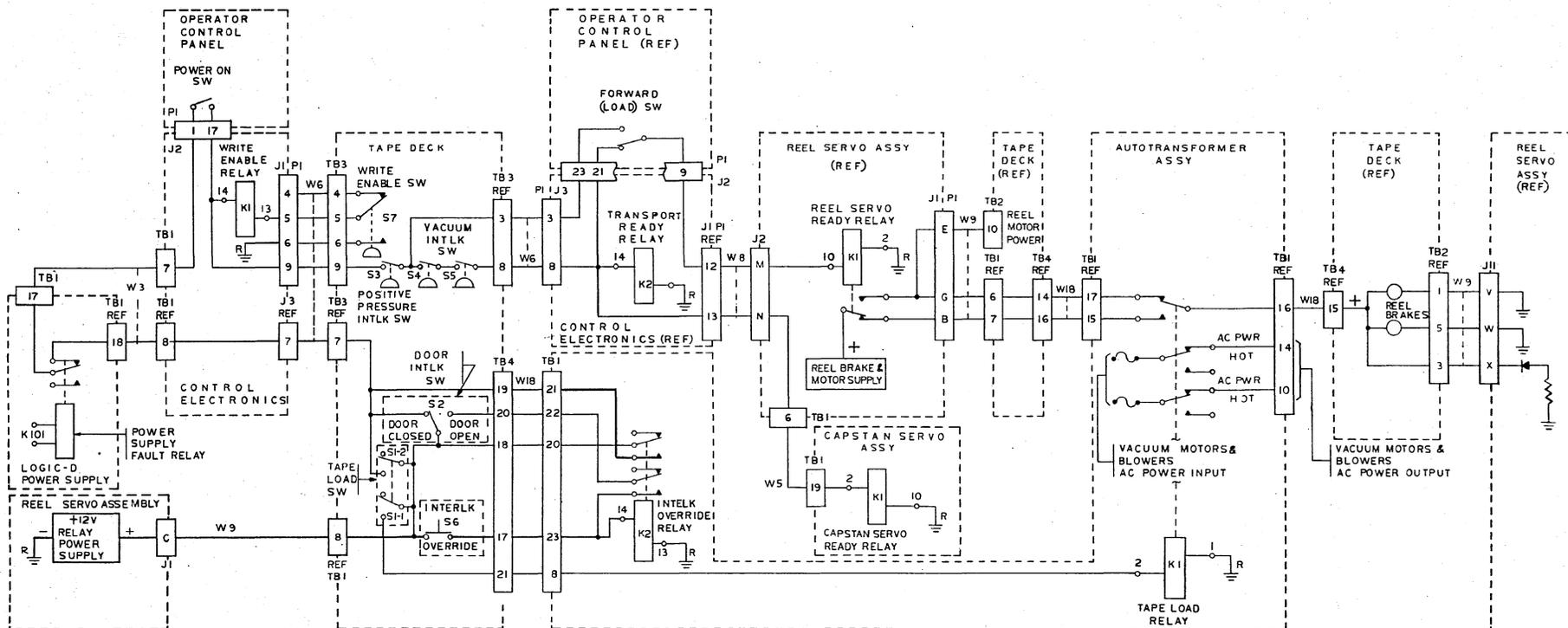


Figure 4-10  
TM-11 Interlock Circuits

that the transport is ready for operation in the local mode. The transport ready relay is deenergized whenever an interlock is opened, stopping tape motion and returning the tape transport to the local mode.

#### 4-31. LOCAL MODE OPERATION.

The local mode is selected by any of the following:

- (a) Pressing the LOCAL pushbutton. When the LOCAL pushbutton is pressed, an UP level is applied to the LOCAL PB input to LL.
- (b) Pressing the STOP pushbutton. When the STOP pushbutton is pressed, an UP level is applied to the STOP PB input to LL.
- (c) Upon receipt of a DOWN level on the REWIND AND LOCKOUT input to RL, the GO LOCAL output from RL goes to the DOWN LEVEL, resetting LL to the local mode.
- (d) When an interlock is opened or during power on sequencing, as described previously.

When the tape transport is in the local mode, the OCP ENABLE and REMOTE (-) outputs from LL go to the UP level and the LOCAL INDICATOR output is enabled. The OCP ENABLE output enables the FORWARD, REVERSE, and REWIND pushbutton switches on the operator control panel. The LOCAL INDICATOR output lights the LOCAL pushbutton indicator. The REMOTE (-) output enables the EOT input to FL. Inputs and outputs to the external equipment are disabled.

4-32. Forward. When the FORWARD pushbutton is pressed, an UP level is applied to the FORWARD PB input to FL. This sets the FWD (-) output from FL to the DOWN level, causing the tape drive system to move tape in the forward direction.

4-33. Reverse. When the REVERSE pushbutton is pressed, an UP level is applied to the REVERSE PB input to FL. This sets the REV (+) output from FL to the UP level, causing the tape drive system to move tape in the reverse direction.

4-34. Stop. Once initiated, tape motion will continue until the MASTER RESET goes to the UP level or a BOT or EOT tab is sensed. When the STOP, REMOTE, or LOCAL pushbutton is pressed, the respective PB input to LL goes to the UP level causing the MASTER RESET output to go to the UP level, which resets the FWD (-) and REV (+) outputs of FL, stopping tape motion. When the BOT tab is sensed, the BOT (+) output from the photoamplifier (PH)

PCB goes to the UP level, resetting the FWD (-) and REV (+) outputs from FL. When the EOT tab is sensed, the EOT (+) output from PH goes to the UP level, resetting the FWD (-) and REV (+) outputs from FL, stopping tape motion.

4-35. Rewind. When the REWIND pushbutton is pressed, an UP level is applied to the REWIND PB input to RL. If the BOT tab is not sensed, the UP level REWIND PB input sets the REWIND (-) output to the DOWN level. The DOWN level REWIND (-) output is applied to the tape drive system, enabling high speed tape rewind. The DOWN level REWIND (-) signal is inverted to produce an UP level REWIND (+) signal. The UP level REWIND (+) signal is coupled through diode A2A3CR3 to FL and sets the REV (+) output to the UP level, causing the tape drive system to move tape in the reverse direction at high speed. The UP level REWIND (+) signal also sets the REWINDING (+) output to the UP level, which enables the BOT (+) input to FL. Tape rewinding continues until the STOP pushbutton is pressed or the BOT tab is sensed by the photosense head. If the STOP pushbutton is pressed, tape motion is stopped as described in paragraph 4-34 (the MASTER RESET signal also resets the REWIND and REWINDING outputs from RL). As the BOT tab passes the photosense head, the BOT (+) output from PH applies an UP level to the BOT (+) inputs of RL and FL. The BOT (+) input to RL resets the REWIND outputs and triggers a time delay circuit (located on the reel servo preamplifier PCB) that will reset the REWINDING output approximately 500 milliseconds later. The 500 millisecond delay holds the REWINDING output TRUE while tape motion is stopped and the reel servo system stabilizes. The REWIND (-) output at the UP level initiates a rewind stop sequence in the tape drive system.

If the BOT tab does not overshoot the photosense head following rewind, the REWINDING output from RL is reset by the 500-millisecond time delay circuit on the reel servo preamplifier PCB and rewind is complete.

If the BOT tab overshoots the photosense head, the negative-going BOT (+) signal produced when the BOT tab overshoots resets the REV (+) and REV (-) outputs and sets the FWD (-) output of FL to the UP level, which causes the tape drive system to reverse tape motion to the forward direction as soon as the tape drive system rewind stop sequence is completed. The UP level REV (-) output enables the TIME DELAY (+) input to RL (pin 22). When the BOT tab is returned to the photosense head, the BOT (+) output from PH goes to the UP level and resets the REWINDING output from RL (through the TIME DELAY input) and the FWD output from FL; this stops tape motion and rewind is complete.

4-36. Density Control. The HIGH/LOW DENSITY pushbutton switch controls the HI/LO DENSITY SELECT output which is applied to RL and to either the data electronics when supplied or to the external equipment when the data electronics is not supplied. The input to RL is not enabled during local operation and has no effect; the HI/LO DENSITY STATUS output from RL remains at the UP level during local operation. The HI/LO DENSITY SELECT output is supplied to the external equipment through pin H of J4 on the input/output panel when the data electronics is not supplied. When the HIGH/LOW DENSITY pushbutton switch is in the HIGH position, the HI/LO DENSITY SELECT output is -12 volts; the output is 0 volts when the switch is in the LOW position.

#### 4-37. REMOTE MODE OPERATION.

Remote mode is selected when the REMOTE pushbutton is pressed. When the REMOTE pushbutton is pressed, an UP level is applied to the REMOTE PB input to LL. The REMOTE PB input disables the LOCAL INDICATOR output, resets the OCP ENABLE output to a DOWN level, and enables the REMOTE INDICATOR output and the SELECT (-) input of LL. The DOWN level OCP ENABLE output from LL removes control from the FORWARD, REVERSE, and REWIND pushbuttons on the operator control panel. The REMOTE INDICATOR output lights the REMOTE pushbutton indicator "white".

A DOWN level SELECT (-) input to LL causes the UNIT SELECT (-) and SELECT & REMOTE (-) outputs from LL to go to the DOWN level and enables the SELECT & REMOTE INDICATOR output of LL. The SELECT & REMOTE INDICATOR output lights the REMOTE pushbutton indicator "red". The SELECT & REMOTE (-) output is applied to RL and resets the UNIT SELECT (+) output from RL to an UP level. The SELECT & REMOTE (-) input to RL also enables the REWIND COMMAND (-) and REWIND AND LOCKOUT (-) inputs to RL. The UNIT SELECT (+) output from RL performs the following functions:

- (a) Enables the HI/LO DENSITY and READY (+) inputs to RL and the REWINDING (+) input to the REWINDING STATUS (-) circuit of RL. The READY (-) output from RL goes to the DOWN level when the READY (+) input is enabled.
- (b) Enables the BOT (-) and EOT (-) outputs to the external equipment.
- (c) Enables the RUN/STOP and FWD/REV inputs (or the FWD/STOP and REV/STOP inputs) to FL.

4-38. Forward and Reverse (RUN/STOP and FWD/REV Inputs). When the standard forward/reverse logic PCB is supplied, a direction level must be established prior to the run transition to move tape at normal speed in either the forward or reverse direction. An interval of 5 microseconds (minimum) should separate the commands. A DOWN level on the FWD/REV input line to FL, followed (after 5 microseconds) by a transition to the DOWN level on the RUN/STOP input line to FL, will cause the tape to run forward. An UP level on the FWD/REV line, followed by a DOWN level on the RUN/STOP line, will cause the tape to run in the reverse direction. A transition from 0 volts to -12 volts on the RUN/STOP line constitutes a run command. A transition from -12 volts to 0 volts constitutes a stop command. Forward and reverse are selected as follows:

- (a) Forward. When the FWD/REV input to FL is set to -12 volts, the RUN/STOP input controls the forward run output. The transition of the RUN/STOP input to -12 volts sets the FWD (-) output from FL to the DOWN level. A DOWN level FWD (-) output from FL causes the tape drive system to move tape in the forward direction.

- (b) Reverse. When the FWD/REV input to FL is set to 0 volts and the BOT tab is not sensed, the RUN/STOP input controls the REV (+) output from FL. If the BOT tab is sensed, the run command is ignored. The transition of the RUN/STOP input to -12 volts sets the REV (+) output from FL to the UP level. An UP level REV (+) output from FL causes the tape drive system to move tape in the reverse direction.

4-39. Forward and Reverse (FWD/STOP and REV/STOP Inputs). When the forward/reverse logic -C PCB is supplied, a level transition on one of the two direction lines establishes the direction and run command required to move tape at normal speed in either the forward or the reverse direction. A transition to the DOWN level on the FWD/STOP input line to FL will cause the tape to run forward. A transition to the DOWN level on the REV/STOP input line to FL will cause the tape to run in the reverse direction. A transition to the DOWN level on both lines will cause tape motion to stop (caused by improper input to logic circuits of the tape drive system). A transition from 0 volts to -12 volts constitutes a run command. A transition from -12 volts to 0 volts constitutes a stop command. Forward and reverse are selected as follows:

- (a) Forward. A transition to -12 volts at the FWD/STOP input to FL sets the FWD (-) output from FL to the DOWN level. A DOWN level FWD (-) output from FL causes the tape drive system to move tape in the forward direction.
- (b) Reverse. When the BOT tab is not sensed, a transition to -12 volts at the REV/STOP input to FL sets the REV (+) output from FL to the UP level. An UP level REV (+) output from FL causes the tape drive system to move tape in the reverse direction.

4-40. Stop. Once initiated, tape motion continues as long as the RUN/STOP input (or the FWD/STOP or REV/STOP input) remains at -12 volts unless the BOT tab is sensed or the STOP, REMOTE, or LOCAL pushbutton is pressed. The FWD (-) or REV (+) output from FL is reset by the BOT or MASTER RESET (+) input to FL. The FWD (-) or REV (+) output from FL is also reset by the transition of the RUN/STOP input (or the FWD/STOP or REV/STOP input) to 0 volts. The MASTER RESET (+) input to FL is set to the UP level by the respective PB input to LL when the STOP, REMOTE, or LOCAL pushbutton is pressed. When the STOP or LOCAL pushbutton is pressed, the tape transport is set to local mode.

**NOTE**

When the EOT tab is sensed in the remote mode, tape motion is not stopped. The EOT (-) output to the external equipment indicates the EOT tab is being sensed. The external equipment must set the RUN/STOP input (or the FWD/STOP input) to zero volts to stop tape motion. This is provided so that if an operation is being performed when the EOT tab is sensed, the operation can be completed before the tape is stopped.

4-41. Rewind. When the REWIND COMMAND (-) input to RL is at the DOWN level, the REWIND (-) output is set to the DOWN level, causing the tape drive system to initiate tape rewind as described in paragraph 4-35. Tape rewinding continues until the BOT tab passes the photosense head or the STOP pushbutton is pressed. If the STOP pushbutton is pressed, tape motion is stopped as described in paragraph 4-34; the MASTER RESET (+) signal also resets the tape transport to local mode. As the BOT tab passes the photosense head, the BOT (+) input from PH applies an UP level to the BOT (+) inputs of FL and RL. The BOT (+) input to RL resets the REWIND (-) outputs. The BOT (+) input to FL resets the FWD and REV outputs. This stops tape motion and rewind is complete, except as described in paragraph 4-35. The time delay circuit prevents the REWINDING (-) status signal from going FALSE for a period of 500 milliseconds after reverse tape motion stops, thus allowing the tape to be returned to the BOT tab. The BOT (-) status output is held FALSE during rewind by the REWINDING (-) signal from RL.

**NOTE**

The REWIND COMMAND (-) input must be disabled by the external equipment during forward and reverse commands. The RUN/STOP input (or the FWD/STOP and REV/STOP inputs) must be disabled by the external equipment during rewind.

4-42. Rewind and Lockout. When the REWIND AND LOCKOUT (-) input to RL is at the DOWN level, it causes the tape to be rewound as described in paragraph 4-41. The DOWN level REWIND AND LOCKOUT (-) input to RL causes the GO LOCAL (-) output to go to the DOWN level, which resets the tape transport to the local mode.

**NOTE**

The REWIND AND LOCKOUT (-) input must be disabled by the external equipment during forward and reverse commands. The RUN/STOP (or the FWD/STOP and REV/STOP inputs) must be disabled by the external equipment during the rewind and lockout operation.

4-43. Density Select Output. During remote mode operation, the HI/LO DENSITY input to RL is enabled by the SELECT & REMOTE (-) input. When the HIGH/LOW DENSITY pushbutton switch is in the HIGH position, the HI/LO DENSITY STATUS output from RL is at the DOWN level; when the switch is in the LOW position, the output is at the UP level. The HI/LO DENSITY STATUS output is supplied to the external equipment through pin C of J4 (or pin Y of J4 when the optional data electronics is supplied) on the input/output panel.

4-44. READ/WRITE HEAD ASSEMBLY.

The tape transport uses a dual-stack head assembly for read and write functions. Head operation is electrically independent of other tape transport components (except when the optional data electronics is supplied) although accurate tape contact with the head assembly is derived mechanically from related transport parts. Read/write amplifiers and detectors are required to reproduce or deliver data signals to and from the head assembly when the optional data electronics is not supplied. An erase head may be incorporated as an optional feature.

## **SECTION V MAINTENANCE**

### 5-1. GENERAL.

The TM-11 Tape Transport is designed to require minimum maintenance and service. Figures 5-1, 5-2, and 5-3 assist in rapid identification of major components. A listing of the tools and test equipment used in maintenance of the tape transport will be found in Table 5-5 at the end of this section.

### 5-2. PREVENTIVE MAINTENANCE.

A program of planned preventive maintenance will prevent unscheduled down time. Maintenance procedures may be scheduled by either the number of eight hour shifts, or by the hours of running time. (Refer to Table 5-1.)

Lubriation of the tape transport is not necessary.

### 5-3. CLEANING THE TAPE DECK.

Check the tape deck as follows:

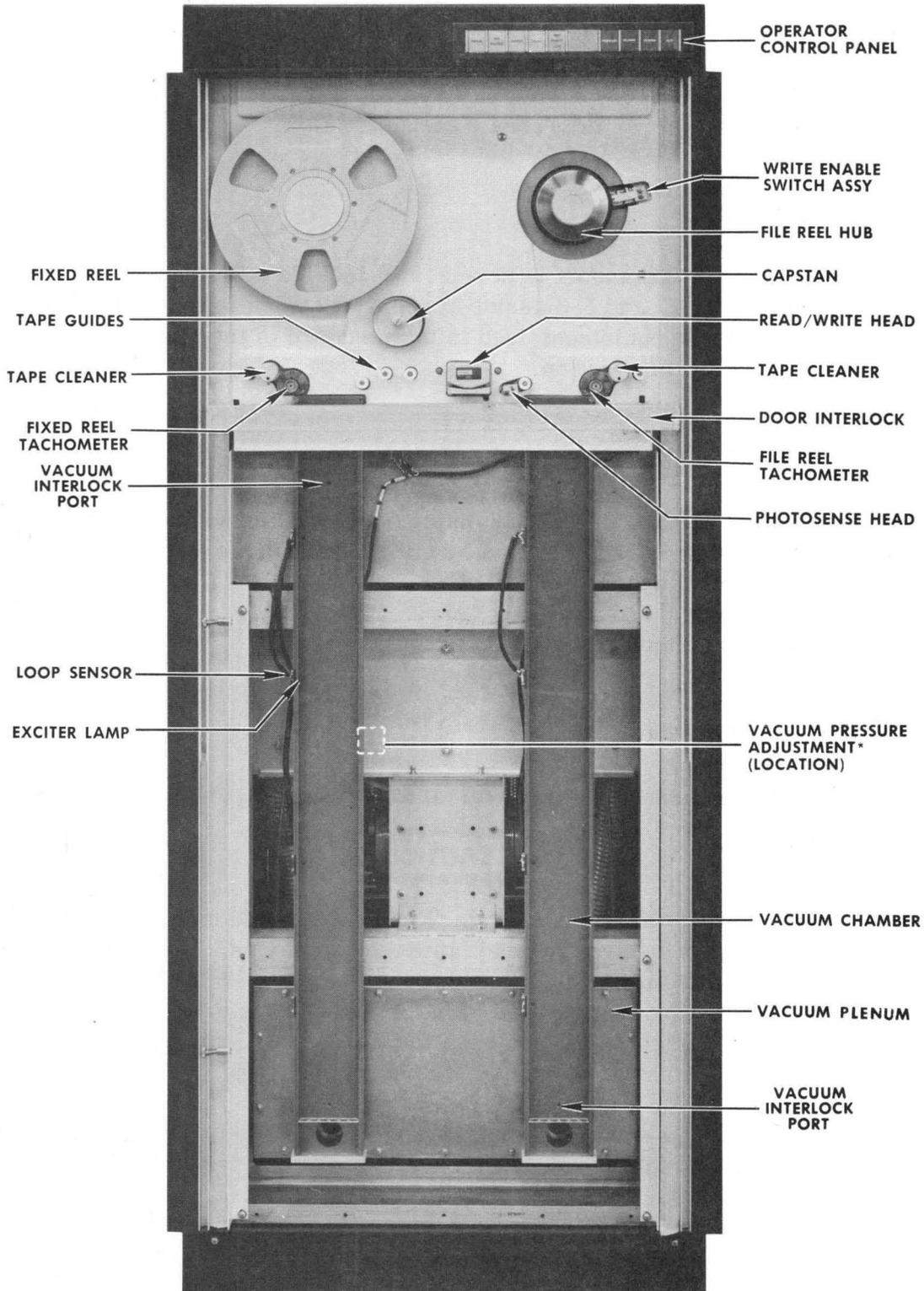


Solvents such as carbon tetrachloride may dissolve the head lamination adhesive. Use Ampex Head Cleaner (Catalog No. 087-007) for the head and metal guides. Denatured alcohol may be used for the capstan, vacuum chambers, and all rubber components.

Ampex Head Cleaner shall not be used to clean rubber parts as its use will damage the rubber.

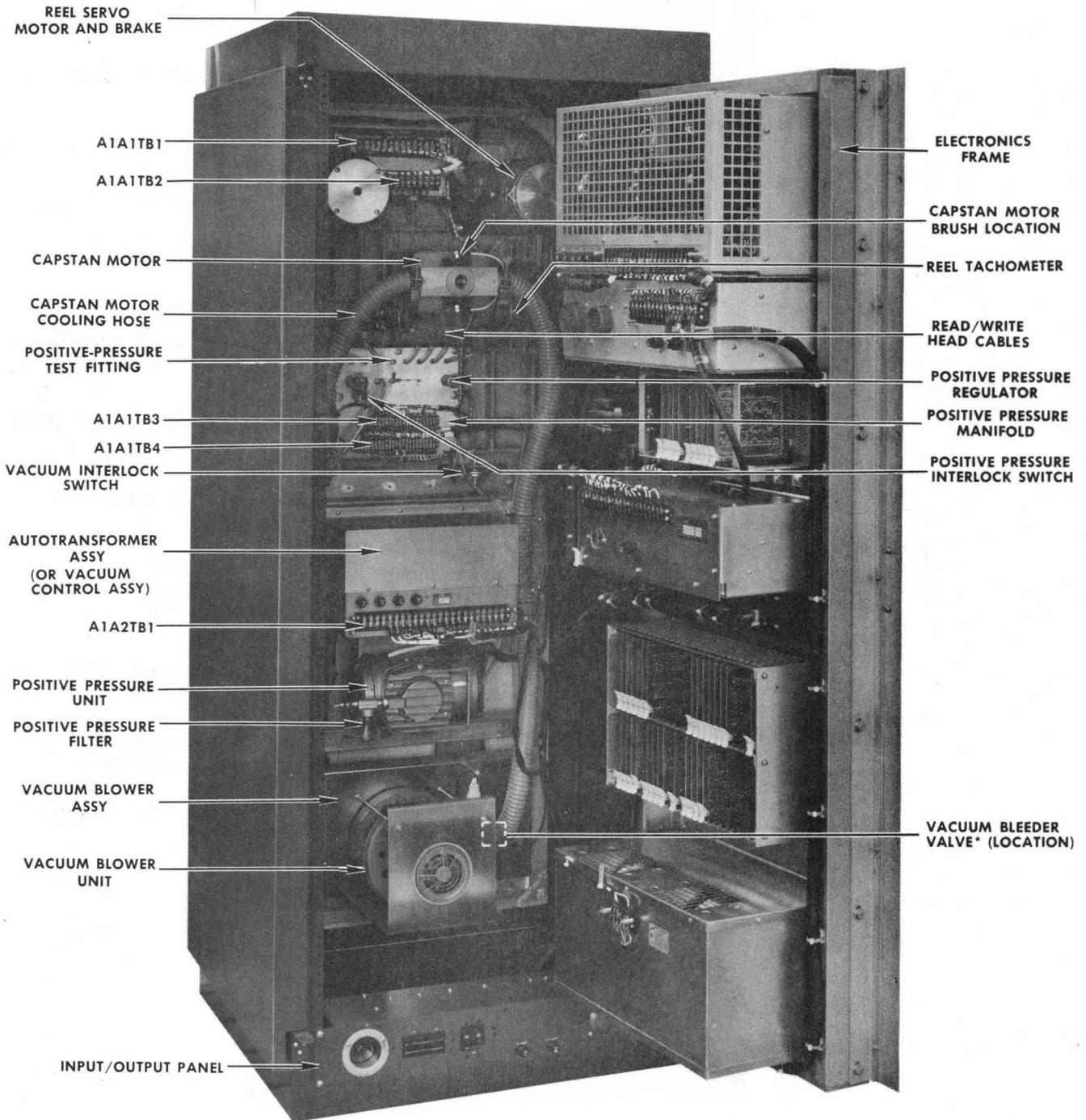
Cleaning agents must not come in contact with the tape. Cleaning agents must not be allowed to penetrate bearings.

Step 1: Use a clean, lint-free cloth or cotton swab moistened with Ampex Head Cleaner to carefully wipe off all oxide and dirt that may be gathered on or around head stacks, head cover, tape cleaner, and tape guides. Allow the cleaning agent to evaporate completely before loading tape on the transport; the fluid agent may damage the tape.



\*ON VACUUM CONTROL ASSY ONLY

Figure 5-1  
Tape Transport, Front View  
(Access Door and Lower Overlay Door Removed)



\*USED WHEN AUTOTRANSFORMER ASSY IS USED

Figure 5-2  
Tape Transport, Rear View  
(Electronics Frame in Open Position)

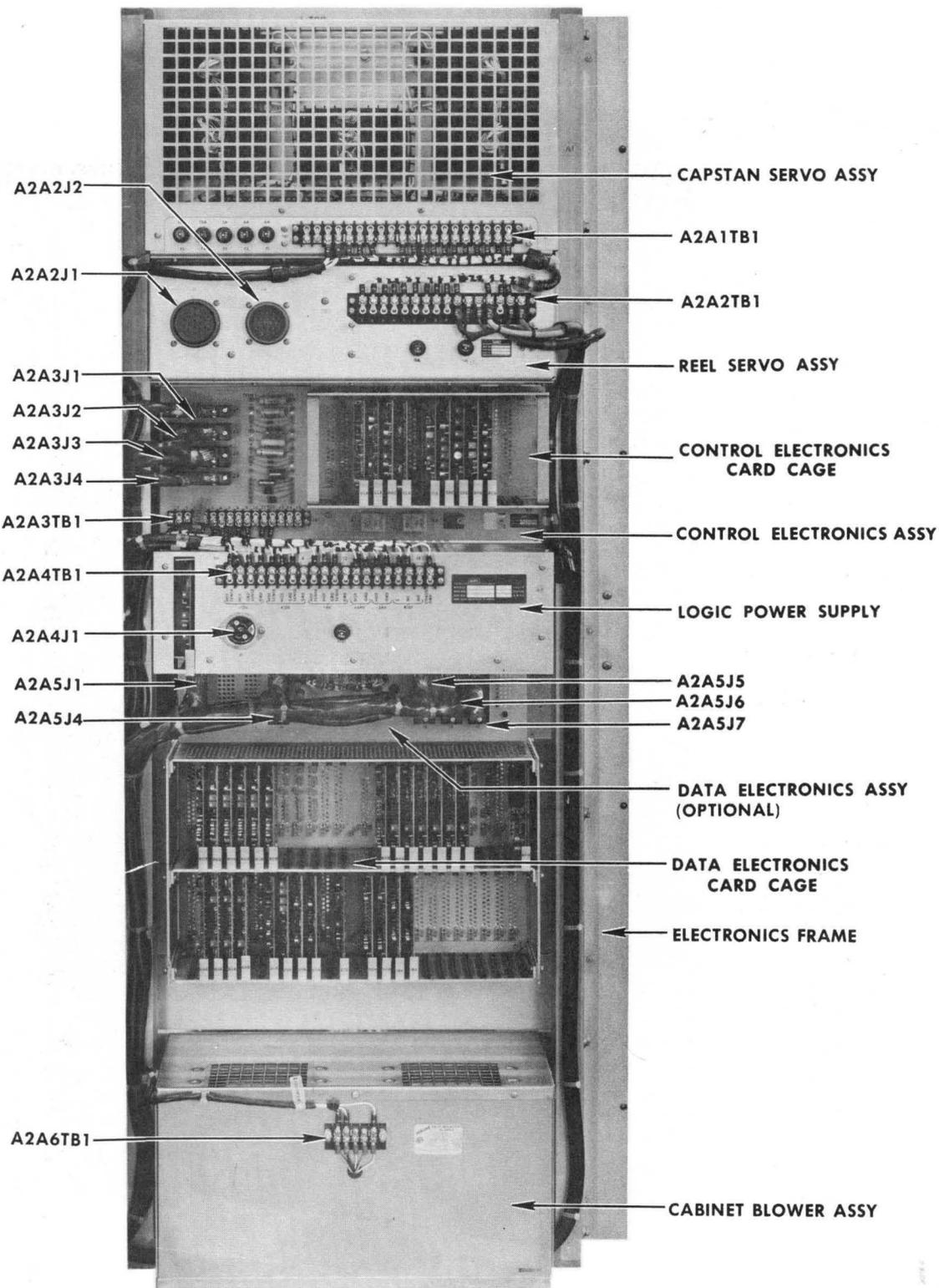


Figure 5-3  
Tape Transport Electronics Frame, Front View  
(Assemblies Mounted)

TABLE 5-1  
SCHEDULE OF PREVENTIVE MAINTENANCE

MAINTENANCE OPERATION	FREQUENCY		APPROX MIN EA	QTY	TOTAL TIME	TEXT REF
	SHIFTS	HOURS				
Clean tape deck	1	8	3	1	3	5-3
Clean positive-pressure filter	15	120	5	1	5	5-6
Clean capstan-motor filter screen	15	120	5	1	5	5-7
Clean tape cleaners	100	800	3	2	6	5-4
Clean cabinet	200	1600	10	1	10	5-5
Replace capstan motor and capstan	300	2400	10	1	10	5-10
Check vacuum-blower motor brushes	1250	10,000	3	4	12	5-17
Check reel motor brushes	625	5000	3	4	12	5-14
Replace positive-pressure unit	625	5000	15	1	15	--
Replace photosense head assembly	1250	10,000	15	1	15	5-12
Replace reel motor and reel brake	1250	10,000	20	2	40	5-13
Replace vacuum-blower unit	1250	10,000	15	1	15	5-17
Replace loop sensor assembly	1250	10,000	5	8	40	--
Replace cabinet blower unit	1250	10,000	15	1	15	--
Replace reel tachometers and pulleys	3750	30,000	10	2	20	5-18

Step 2: Carefully place a clean, lint-free cloth or cotton swab moistened with alcohol against the capstan and tachometer pulley. Rotate the capstan and pulley by hand until all oxide and dirt are removed.

Step 3: Using a clean, lint-free cloth or cotton swab moistened with alcohol, thoroughly clean inside surfaces of the vacuum chambers. Remove oxide and dirt from the loop sensors and lamp windows.

Step 4: Clean vacuum chamber covers by repeating above procedure.

Step 5: Using a clean, lint-free dry cloth or cotton swab, thoroughly clean the surface of the photosense head.

Step 6: Using a clean, lint-free dry cloth, thoroughly clean the surface of the tape ledge.

#### 5-4. CLEANING THE TAPE CLEANERS.

Clean the tape cleaners as follows:

Step 1: Remove the cleaner blades by loosening the blade retaining screws; the blades can then be removed from the cartridge.

Step 2: Using a clean, lint-free cloth or cotton swab moistened with Ampex Head Cleaner, carefully wipe off all oxide and dirt that may have gathered on or around the corners and mating surfaces.

Step 3: Reinstall blades and retaining screws, taking care that the blades are flush against the mating faces of the cartridge so that the tape path is not disturbed.

#### 5-5. CLEANING THE CABINET.

The entire cabinet housing the tape transport, the tape transport units, and the cabinet blower filter should be thoroughly cleaned.



The window of the reel access door is plastic. Clean with a soft cloth moistened with denatured alcohol. Do not clean window with dry cloth.

5-6. CLEANING THE POSITIVE-PRESSURE FILTER.

Clean the positive-pressure filter as follows:

Step 1: Remove the glass filter bowl by unscrewing the bowl from the filter body.

Step 2: Remove the felt filter element.

Step 3: Clean the filter element in alcohol and dry thoroughly.

Step 4: Reassemble by reversing the procedure followed during disassembly.

5-7. CLEANING THE CAPSTAN-MOTOR FILTER SCREEN.

Clean the capstan-motor filter screen as follows:

Permanent-Magnet-Field Motor.

**CAUTION**

Do not attempt to disassemble the capstan motor for any purpose. The field magnet is extremely powerful, and must be demagnetized before the motor can be disassembled. The motor should be returned to the manufacturer for any repairs requiring disassembly.

Using a vacuum cleaner with a small brush attachment, vacuum all dust from the 14 screened air-intake ports on the capstan motor.

Electromagnetic-Field Motor.

Step 1: Remove the filter-screen cap from the motor air intake (located between the two cooling hose fittings).

Step 2: Wash the filter-screen cap in a mild detergent solution, rinse, and then dry thoroughly.

Step 3: Replace the filter-screen cap on the motor air intake.

5-8. REMOVAL AND REPLACEMENT PROCEDURES.

5-9. UPPER OVERLAY PLATE REMOVAL AND REPLACEMENT.

An upper overlay plate covers the mechanism of the tape deck. Remove the overlay plate as follows:

Step 1: Unload the tape from the transport.

Step 2: Remove the fixed reel and hub assembly. The reel and hub assembly is held in place by three screws.

Step 3: Remove the upper overlay plate. The overlay plate is held in place by four screws; two screws are located under each tape reel.

Step 4: Reassemble by reversing the procedure followed during disassembly.

5-10. CAPSTAN-MOTOR AND CAPSTAN REMOVAL AND REPLACEMENT.

**WARNING**

Disconnect electrical power to prevent injury to personnel or damage to equipment.

Step 1: Remove the upper overlay plate by following the procedure of paragraph 5-9.

Step 2: Remove the capstan retaining screw.

**CAUTION**

The capstan is a precision device which should be handled with extreme care. Handle the capstan by the hub to avoid contact with the peripheral surfaces of the capstan. A hub-type capstan puller should be used to remove the capstan.

Step 3: Remove the capstan from the capstan motor shaft.

Step 4: Disconnect the electrical wiring from the capstan motor.

Step 5: Remove the four screws holding the capstan motor to the tape deck casting (the motor must be supported while the screws are removed). Lift the capstan motor out of the tape deck casting from the rear.

Step 6: Reassemble by reversing the procedure followed during removal.

#### 5-11. READ/WRITE HEAD REMOVAL AND REPLACEMENT.



The head assembly is a precision instrument which should be handled with extreme care.

Step 1: Remove the overlay plate by following the procedure of paragraph 5-9.

Step 2: Remove the two screws securing the read/write head assembly to the tape deck casting.

Step 3: Pull the read/write head assembly out to disconnect the electrical connectors.

Step 4: Replace the read/write head assembly by reversing the procedure followed during removal.

#### 5-12. PHOTOSENSE HEAD REMOVAL AND REPLACEMENT.



Disconnect electrical power to prevent injury to personnel or damage to equipment.

Step 1: Remove the three screws holding the tape ledge in place.

Step 2: Pull the tape ledge away from the tape deck to allow access to the two screws attaching the photosense mounting bracket to the deck. Remove the two screws.

Step 3: Disconnect the photosense head fanning-strip electrical connector from A1A1TB4.

- Step 4: Pull the photosense head electrical cable through the tape deck casting to remove the photosense head and mounting bracket.
- Step 5: Remove the two screws holding the photosense head to the mounting bracket and remove the photosense head from the bracket.
- Step 6: Replace the photosense head by reversing the procedure followed during removal.

#### 5-13. REEL RETAINER REMOVAL AND REPLACEMENT.

Remove the IBM Type reel retainer as follows.

- Step 1: Remove the reel retainer cover assembly by rotating the locking knob counterclockwise.
- Step 2: Remove the three Allen-head screws attaching the reel retainer base assembly to the reel motor turntable and remove the base assembly and turntable shims.
- Step 3: Replace the reel retainer by reversing the procedure followed during removal. Do not install the turntable shims at this time.
- Step 4: Apply power to the tape transport. Load a reel of tape on the transport.
- Step 5: Program the tape transport for forward and reverse operation. Check tape tracking at the reel of the newly installed reel retainer. Install turntable shims (removed during Step 2) as necessary to obtain proper tape tracking.

#### 5-14. REEL MOTOR ASSEMBLY REMOVAL AND REPLACEMENT.

Remove the reel motor assembly as follows:

- Step 1: Remove the reel (file or fixed) from the reel motor to be replaced. If a permanently-mounted fixed reel is used, the reel is held in place by three screws located under the dust cap at the center of the reel. Remove the three screws; remove the fixed reel and hub assembly and the turntable shims.
- Step 2: Where used, remove the reel retainer in accordance with the procedure of paragraph 5-13.
- Step 3: Remove the reel brake in accordance with the procedure of paragraph 5-15.

Step 4: Disconnect the reel motor electrical cable from terminal board A1A1TB2.

Step 5: Remove the four nuts securing the reel motor to the tape deck casting. Remove the reel motor.

**NOTE**

Note the position of any shims located under the flange of the reel motor; retain the shims for use during reassembly.

Step 6: Install the reel motor in the tape deck casting. Install the shims removed during Step 5 in the same position from which they were removed.

Step 7: Check that the turntable base is parallel within 0.002-inch to the machined face of the tape deck casting. If necessary, relocate the shims installed in Step 6.

Step 8: Install the reel brake in accordance with the procedure of paragraph 5-15.

Step 9: Replace the permanently-mounted fixed reel removed in Step 1 (or the reel retainer removed in Step 2) by reversing the procedure followed during removal. Do not install the turntable shims at this time.

Step 10: Apply power to the tape transport. Load a reel of tape on the transport.

Step 11: Program the tape transport for forward and reverse operation. Check tape tracking at the reel of the newly installed reel motor. Install turntable shims as necessary to obtain proper tape tracking.

5-15. REEL MOTOR BRAKE AND BRAKE LINING REMOVAL AND REPLACEMENT.

Remove the reel motor brake and brake lining as follows.

Step 1: Apply power to the transport and operate the TAPE LOAD switch. Ensure that the brake is in the energized position so that the reel rotates freely.

**CAUTION**

To prevent loss of parts of the assembly due to spring action, the brake should not be removed in the deenergized condition.

- Step 2: With power applied, remove the four screws from the rear of the brake housing. Remove the brake assembly from the reel motor. (See Figure 5-4.)
- Step 3: Remove the reel brake lining assembly from the reel motor hub.
- Step 4: To replace the brake lining assembly with a new part, place the new lining assembly onto the motor brake hub and reassemble the brake assembly, reversing the procedures outlined in Steps 2 and 3. Adjust the air gap in accordance with the procedure of paragraph 5-25.
- Step 5: To replace the complete brake assembly, place the brake lining assembly removed in Step 3 into the brake housing. Remove the four mounting screws from the end plate. Place the end plate on the brake housing and secure, using the four long screws removed in Step 2.
- Step 6: Remove power from the transport.
- Step 7: Disconnect the electrical cable of the brake from terminal board A1A1TB2.
- Step 8: Connect the electrical cable of the new brake assembly to terminal board A1A1TB2.
- Step 9: Apply power to the transport.
- Step 10: Install the new brake assembly by reversing the procedures outlined in Steps 2 and 5. Adjust the air gap in accordance with the procedure of paragraph 5-25.

**CAUTION**

Do not remove the four long screws from the rear of the brake assembly before applying power to the transport.

5-16. VACUUM CHAMBER REMOVAL AND REPLACEMENT.

Remove the vacuum chamber as follows.

- Step 1: Remove the reel access door in accordance with the procedure of paragraph 5-20.
- Step 2: Open the lower overlay door.

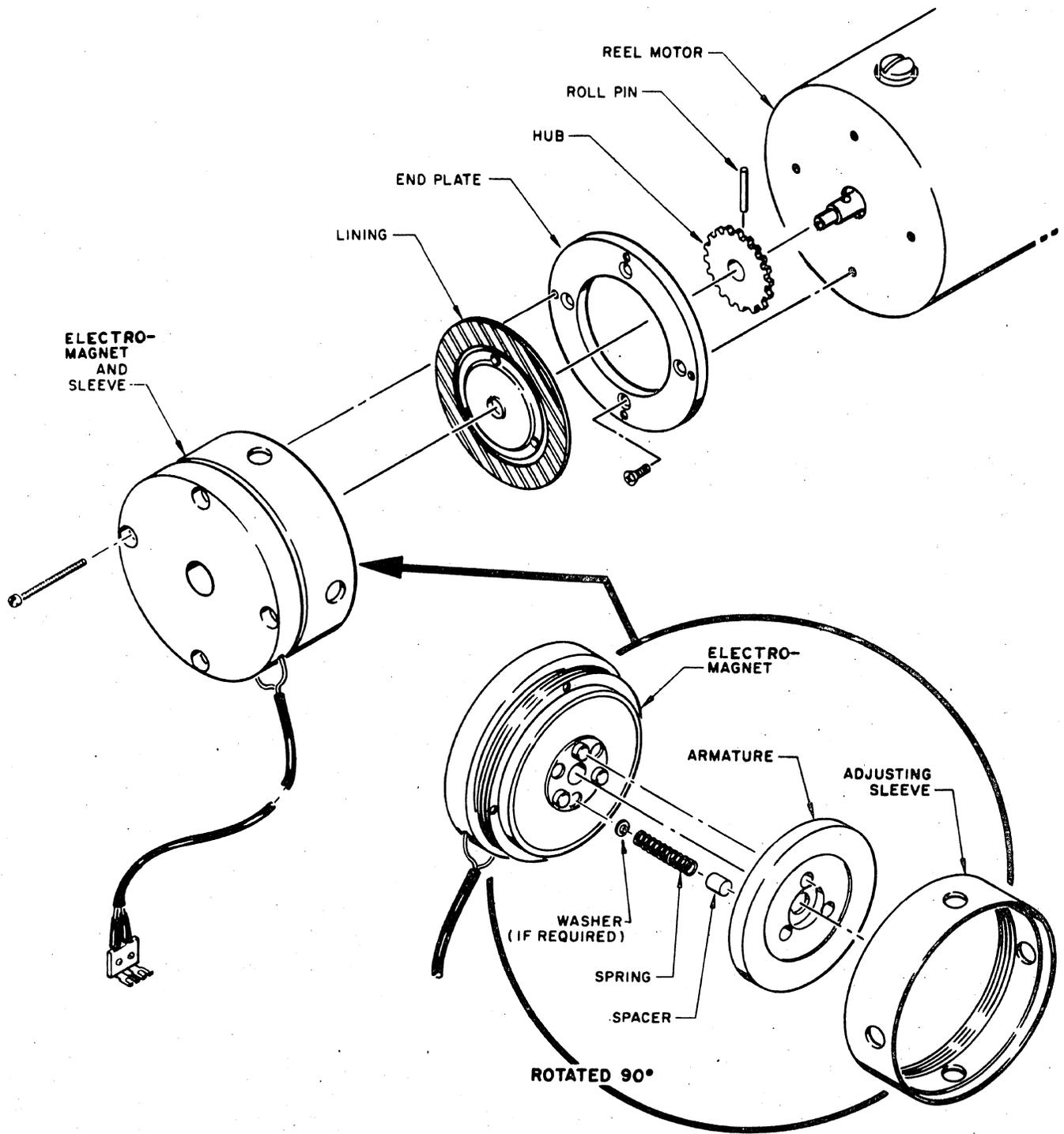


Figure 5-4  
Reel Motor Brake, Exploded View

- Step 3: Remove the vacuum chamber covers.
- Step 4: Disconnect the electrical cables of the loop sensor assemblies at terminal board A1A1TB3.
- Step 5: Disconnect the vacuum interlock tubing at the rear of the vacuum chamber.
- Step 6: Loosen the screws securing the tape ledge.
- Step 7: Remove the four screws attaching the vacuum chamber to the tape deck casting. Remove the screw at the bottom of the chamber securing the chamber bracket to the vacuum plenum. Pull the lower end of the chamber away from the tape deck to disconnect the vacuum-plenum supply tubing from the chamber outlet port.
- Step 8: Remove the vacuum chamber.
- Step 9: Replace the vacuum chamber by reversing the procedure followed during removal.

#### 5-17. CHECKING REEL MOTOR AND REPLACEMENT OF BRUSHES.

- Step 1: Remove reel.
- Step 2: Grasp holddown knob firmly, move it in and out, checking for shaft end play.
- Step 3: If any noticeable end play is felt, remove and replace reel motor in accordance with the procedure of paragraph 5-14.
- Step 4: Remove the screws holding the end dust cap on the motor and remove the dust cap.
- Step 5: Remove the brushes from the brush holders; install new brushes.
- Step 6: Reinstall the end dust cap.

#### 5-18. VACUUM-BLOWER UNIT AND MOTOR BRUSH REMOVAL AND REPLACEMENT. (See Figure 5-5.)

Steps 1 through 6 describe the procedure for removing and replacing the vacuum-blower unit. Steps 7 and 8 are used for motor brush removal and replacement.

- Step 1: Disconnect the power cable from the vacuum-blower unit.

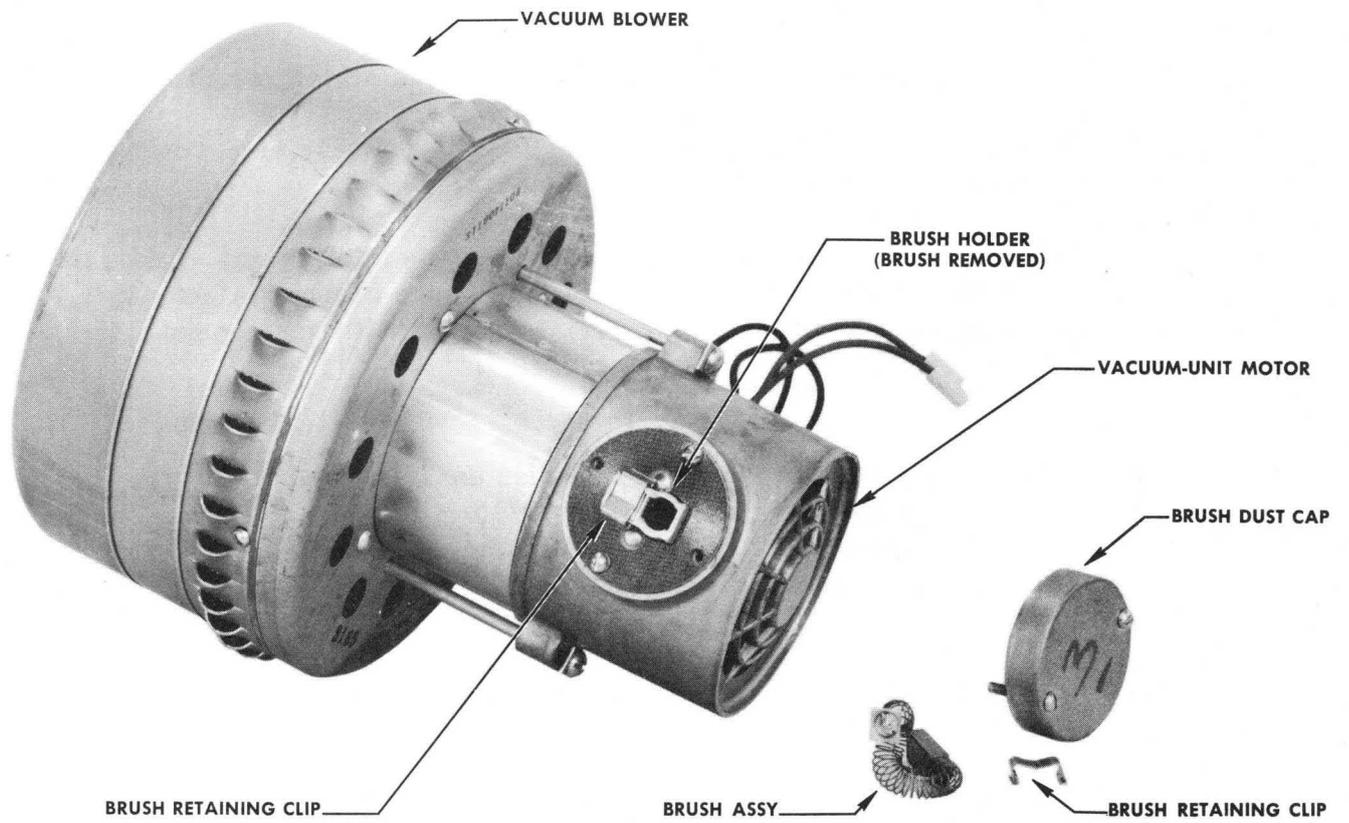


Figure 5-5  
Vacuum-Blower Unit  
(One Brush Removed)

- Step 2: Remove the power connector from the blower motor bracket by pressing the two nylon legs toward the center of the connector; then push the connector through to the inside.
- Step 3: Remove the three screws securing the blower motor bracket to the bottom of the vacuum plenum.
- Step 4: Remove the two nuts securing the blower motor bracket to the bracket support rods.
- Step 5: Remove the blower motor bracket and the vacuum-blower unit.
- Step 6: If the vacuum-blower unit is being replaced, reassemble by reversing the procedure followed during disassembly.
- Step 7: Remove the screws holding the brush dust caps in place and remove the dust caps. Remove the copper clips holding the brushes in place by gently prying out with a screwdriver. Brushes will then pop out.

**NOTE**

Replace the brush assembly when the brush does not extend at least 9/16-inch (released condition) beyond the spring of the brush assembly.

- Step 8: Replace the brushes by reversing the procedure of Step 7.

5-19. REEL TACHOMETER ASSEMBLY REMOVAL AND REPLACEMENT.

Remove and replace the tachometer assembly in the following manner.

- Step 1: Disconnect the electrical connection at the rear of the tachometer.
- Step 2: Remove the three screws holding the reel tachometer assembly to the tape deck casting. Lift the assembly out of the casting.
- Step 3: Remove the reel tachometer pulley from the shaft of the tachometer.
- Step 4: Replace the reel tachometer assembly by reversing the disassembly procedure.
- Step 5: Check the tracking of tape on the transport and adjust the position of the reel tachometer pulley as necessary.

## 5-20. REEL ACCESS DOOR REMOVAL AND REPLACEMENT.

Remove the reel access door in the following manner:

- Step 1: Remove the two screws attaching the reel access door lower stops to the side trim (one screw and stop on each side of the transport). Remove the stops.
- Step 2: Slide the reel access door down until the door clears the notch cutout in side trim and remove the door.

## 5-21. WRITE-ENABLE SWITCH ASSEMBLY REMOVAL AND REPLACEMENT.

Remove and replace the write-enable switch assembly as follows (Step 5 is unique to switch replacement and Step 6 is unique to actuator assembly replacement):

- Step 1: Disconnect the electrical cable of the write-enable switch from terminal board A1A1TB3 on the rear of the tape deck.
- Step 2: Remove the two screws attaching the write-enable switch assembly to the tape deck casting and remove the assembly from the casting.
- Step 3: Disconnect the positive-pressure supply tubing from the rear of the pneumatic actuator.
- Step 4: Remove the two screws attaching the switch to the actuator assembly and remove the switch.
- Step 5: Switch Replacement Only: Label each wire at switch to identify location, unsolder at terminals, and remove wires from switch. Attach the new switch to the actuator assembly using the two attaching screws removed in Step 4, but do not tighten the screws. Connect the wires removed from the old switch to the correct terminals on the new switch and solder the three connections.
- Step 6: Actuator Assembly Replacement Only: Attach switch to the new actuator assembly, using the two attaching screws removed in Step 4, but do not tighten the screws.
- Step 7: Position the switch to be actuated when the bottom (opposite the pivot end) of the sensor unit is moved toward the switch 2 to 5 degrees from a position parallel to the front of the assembly bracket. Tighten the two switch attaching screws.

Step 8: Replace the write-enable switch assembly by reversing the procedure followed during removal (Steps 1 through 3).

Step 9: Adjust the write-enable switch assembly in accordance with the procedure of paragraph 5-32.

5-22. ADJUSTMENTS.

5-23. VACUUM ADJUSTMENT.

Adjust the vacuum pressure as follows.

Step 1: Disconnect the tubing connecting the bottom interlock sense port of one of the vacuum chambers to the associated vacuum interlock switch at the switch end. Connect the loose end of the tubing to a vacuum gauge capable of measuring 0 to 35 in. -of-water to an accuracy of  $\pm 5\%$ .



Do not operate the tape transport in forward or reverse with the vacuum gauge connected.

Step 2: Adjust the tape loops in the file reel and fixed reel vacuum chambers so that the loops are halfway between the middle two loop sensors.

Step 3: Press the door interlock override pushbutton.

Step 4: Systems Using the Autotransformer Assembly: Measure the line voltage between terminals 11 and 12 of terminal board A1A2TB1 in the autotransformer assembly. Adjust the vacuum bleeder valves to obtain the vacuum shown in Table 5-2 for the line voltage measured. The bleeder valves are located at the back of the vacuum plenum adjacent to the capstan motor cooling hoses. (See Figure 5-2.)

Systems Using the Vacuum Control Assembly: Adjust potentiometer R6 in the vacuum control assembly for a vacuum pressure of  $23 \pm 1$  inches-of-water, as indicated on the vacuum gauge. Potentiometer R6 is located adjacent to the fixed reel vacuum chamber. (See Figure 5-1.)

Step 5: Disconnect the vacuum gauge. Reconnect the tubing to the vacuum switch.

TABLE 5-2  
VACUUM VS LINE VOLTAGE

LINE VOLTAGE (RMS)	VACUUM (INCHES OF H <sub>2</sub> O)
-10%	19 ±1
NOMINAL	23 ±1
+10%	27 ±1

5-24. LOGIC POWER SUPPLY ADJUSTMENTS.

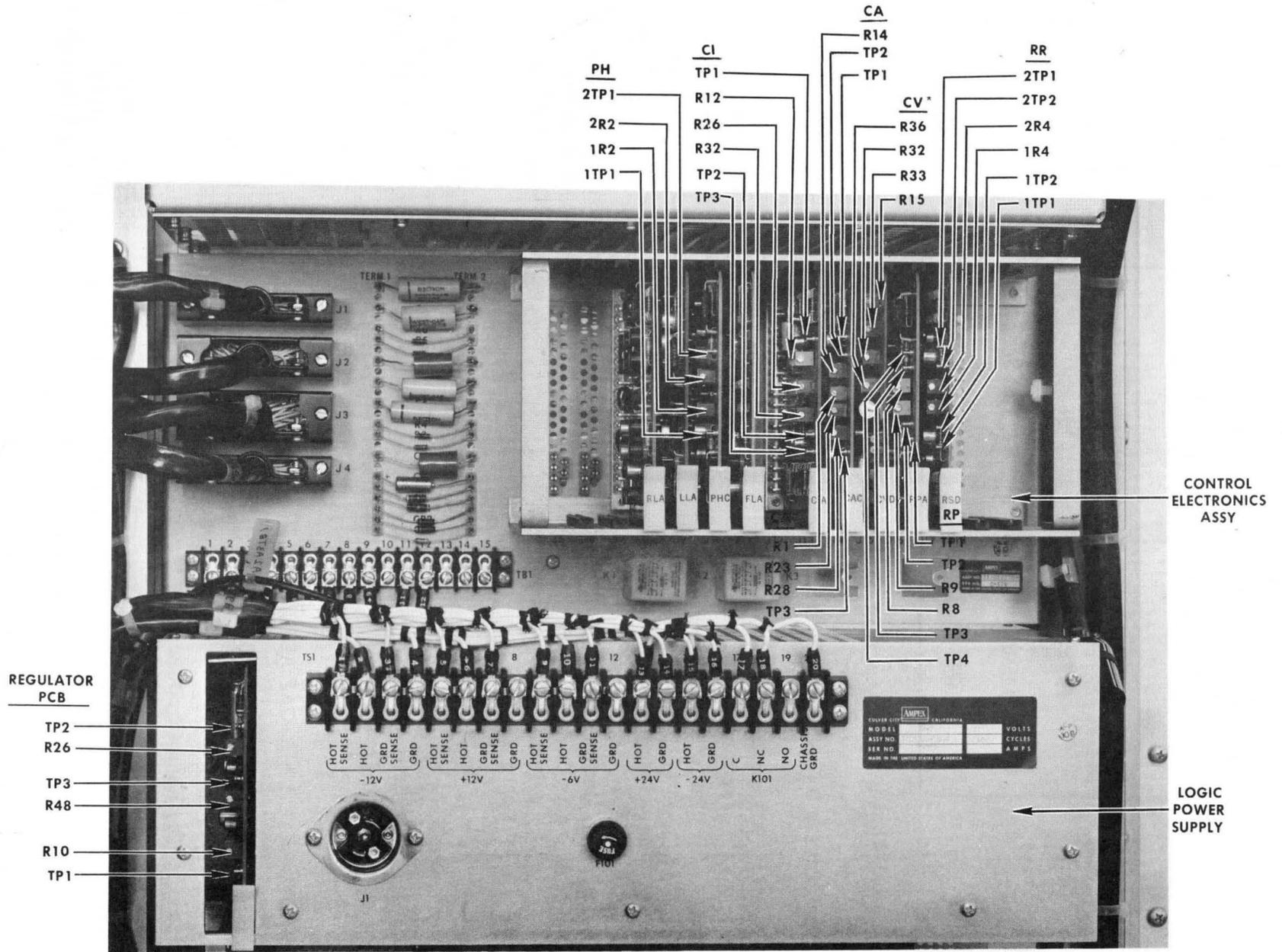
Perform the following steps. (See Figure 5-6 for potentiometer location.)

- Step 1: Connect a DC digital voltmeter (DVM) between terminals 6 and 8 of terminal board A2A4TB1 on the logic power supply (use terminal 8 as the zero volt reference). Adjust R10 (bottom potentiometer) on the power-supply regulator PCB to obtain  $+12.00 \pm 0.06$  volts at terminal 6, as indicated on the DVM.
- Step 2: Connect the DVM between terminals 2 and 4 of A2A4TB1 (use terminal 4 as the zero volt reference). Adjust R26 (top potentiometer) on the regulator PCB to obtain  $-12.00 \pm 0.06$  volts at terminal 2, as indicated on the DVM.
- Step 3: Connect the DVM between terminals 10 and 12 of A2A4TB1 (use terminal 12 as the zero volt reference). Adjust R48 (middle potentiometer) on the regulator PCB to obtain  $-6.00 \pm 0.03$  volts at terminal 10, as indicated on the DVM.

5-25. REEL BRAKE AIR-GAP ADJUSTMENT.

Adjust the reel brake air-gap as follows. (See Figure 5-4.)

- Step 1: Remove power from the brake coil.
- Step 2: Measure the air-gap between the armature and the outer pole of the electromagnet. The gap should be  $0.015 \pm 0.003$  inch. If required, reset the air-gap in accordance with the procedures of Steps 3 through 8.
- Step 3: Apply power to the brake coil.



\*A FIFTH POTENTIOMETER (R42) IS LOCATED BETWEEN R36 AND R32 ON CVE CAPSTAN VELOCITY PCB ASSEMBLIES

Figure 5-6  
Control Electronics Assembly and Logic Power Supply  
(Potentiometer and Test Point Locations)

- Step 4: Loosen the four screws securing the brake to the end plate.
- Step 5: Rotate the adjusting sleeve to change the air-gap (one turn equals a 0.062-inch change in the air-gap).
- Step 6: Retighten the four screws loosened in Step 4.
- Step 7: Remove power from the brake coil.
- Step 8: Recheck the air-gap as described in Step 2. Repeat Steps 3 through 8 if required.

#### 5-26. POSITIVE-PRESSURE ADJUSTMENTS.

Adjust the pressure settings of the positive-pressure interlock switch and the positive-pressure regulator as follows (Step 4 is unique to setting the interlock-switch low pressure point):

- Step 1: Remove the machine screw which seals the test fitting located on the positive-pressure manifold plate. Connect a 0 to 30 psig ( $\pm 5$  percent accuracy) pressure gauge to the test fitting.
- Step 2: Apply power to the transport and press the STOP pushbutton.
- Step 3: Using a 15/16-inch wrench, loosen the locknut on the positive-pressure regulator (hold the regulator body in place with a 3/4-inch open-end wrench to prevent the regulator body from turning with the locknut).
- Step 4: Interlock-Switch Adjustment: Rotate the knurled knob on the pressure regulator in the counterclockwise direction (viewed from the knob end) to obtain a positive pressure of  $5 \pm 1$  psig, as indicated on the pressure gauge. Rotate the milled-edge wheel on the interlock switch assembly, as required, to obtain a setting where the switch is just actuated. Clockwise rotation of the wheel (viewed from the switch side) causes the switch to be actuated at a higher pressure; counterclockwise rotation causes actuation at a lower pressure.
- Step 5: Rotate the knurled knob on the pressure regulator, as required, to obtain a positive pressure of  $12 \pm 1$  psig, as indicated on the pressure gauge. Clockwise rotation of the knob (viewed from the knob end) causes an increase in pressure; counterclockwise rotation causes a decrease in pressure.
- Step 6: Tighten the locknut on the positive-pressure regulator. Ensure that the pressure setting is the same after the locknut is tightened.

Step 7: Disconnect the pressure gauge from the manifold fitting. Reseal the fitting with the machine screw removed in Step 1. Remove power from the transport.

## 5-27. CAPSTAN SERVO SYSTEM ADJUSTMENTS.

The capstan servo system adjustments are accomplished by potentiometers on the capstan servo control PCB assemblies (CA, CI, and CV). See Figure 5-6. When an electromagnetic-field capstan motor is used, an additional potentiometer located in the capstan servo assembly is used for adjustment of the field current.

### **NOTE**

Verify that power supply outputs are within 0.5 percent of nominal value before making capstan servo system adjustments.

Adjust the capstan servo system as follows. (See Figure 5-7.)

Step 1: Remove the capstan current control PCB (CI, J12) from the control electronics card cage. Adjust R12 (top potentiometer) on CI fully counterclockwise.

### **CAUTION**

Do not disconnect capstan-motor field-winding lead with armature voltage applied.

Step 2: Electromagnetic-Field Capstan Motors Only: Adjust R44 on the capstan servo assembly fully counterclockwise. Disconnect the capstan-motor field-winding lead at terminal A2A1TB1-2 on the capstan servo assembly. Connect a 0 to 5 ampere ( $\pm 5$  percent accuracy) ammeter between the disconnected lead and terminal A2A1TB1-2 (connect the positive terminal of the ammeter to terminal A2A1TB1-2).

Step 3: Connect an isolated DC voltmeter across the capstan-motor armature terminals (terminals A2A1TB1-3 and A2A1TB1-4 may be used).

Step 4: Apply power to the transport. Load a reel of tape on the transport, but do not place the tape around the capstan or capstan tape guides.

Step 5: Press the STOP pushbutton. Wait 30 seconds for the initial turn-on transient to disappear.

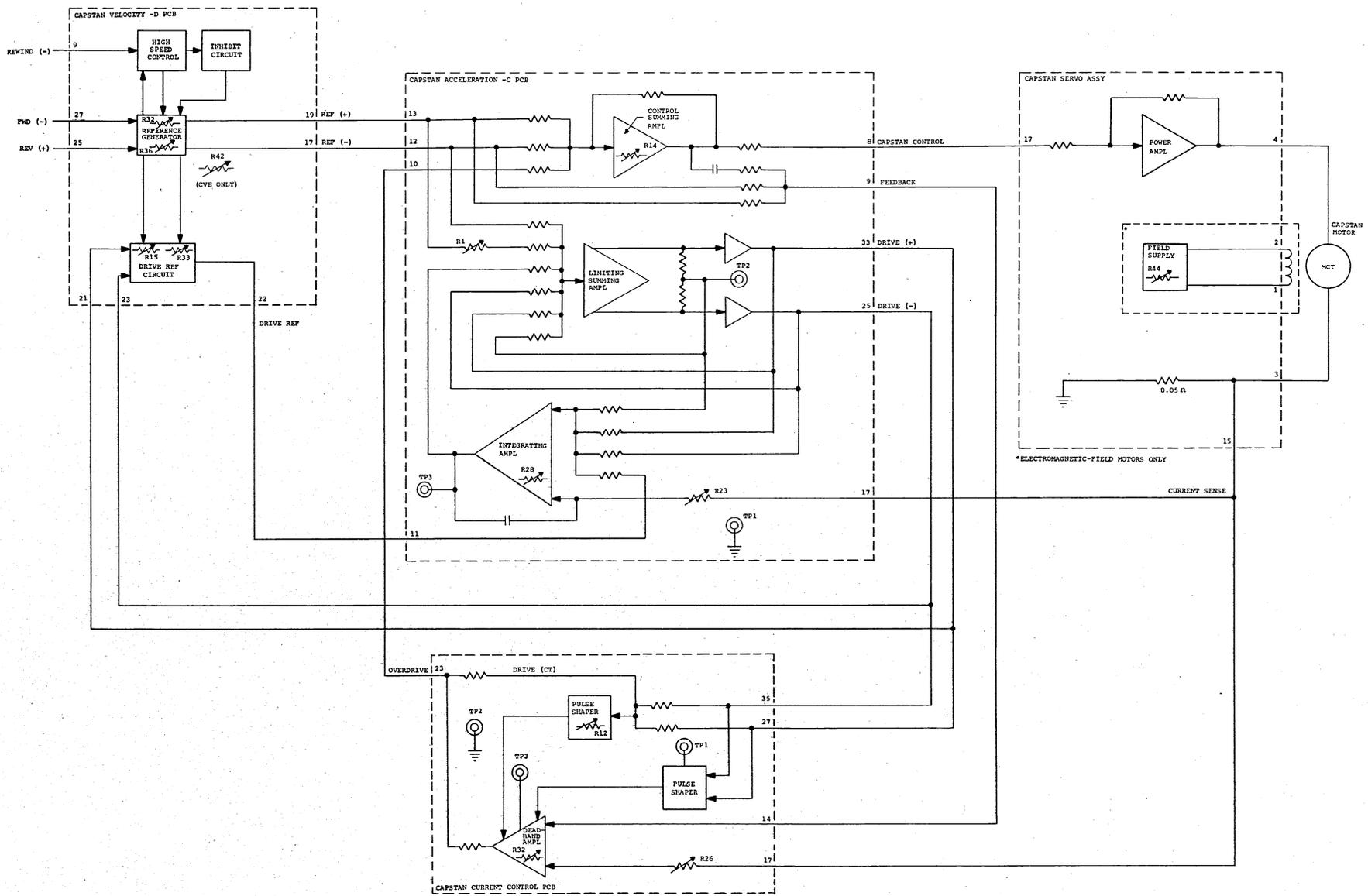


Figure 5-7  
Capstan Servo System, Flow Diagram

TABLE 5-3  
FREQUENCY VS TAPE SPEED

TAPE SPEED	COUNTS-PER-SECOND (800 BPI)*
120 ips	48,000 ±480
112.5 ips	45,000 ±450
75 ips	30,000 ±300

\*Equation used:  $(\text{Tape speed}) \times \frac{(\text{BPI of tape})}{2} = \text{counts-per-second}$   
Tolerance: ±1 percent

Step A5: Recheck the speed in the forward direction and readjust R32, if necessary. Press the STOP pushbutton.

Step A6: CVE Capstan Velocity PCB Assemblies Only: Press the FORWARD pushbutton and transfer approximately 600 feet of tape to the fixed reel. Press the STOP pushbutton. Press the REWIND pushbutton. Adjust R42 (fourth-from-top potentiometer of five potentiometers) on CVE until the frequency counter indicates 120,000 ±6000 counts-per-second (corresponding to a tape speed of 300 ±15 ips). Allow the tape to rewind completely.

Step A7: Remove power from the transport.

METHOD B. Using Stroboscope.

Step B1: Load a reel of tape on the transport.

Step B2: Press the FORWARD pushbutton. Adjust R32 (third-from-top potentiometer) on the capstan velocity PCB (CV, J14) until the capstan is rotating at the rpm (as measured with the stroboscope) listed in Table 5-4 for the applicable tape speed. Press the STOP pushbutton.

Step B3: Press the REVERSE pushbutton. Adjust R36 (bottom potentiometer) on CV as for R32, with the tape moving in the reverse direction. Press the STOP pushbutton.

Step B4: Recheck the speed in the forward direction and readjust R32, if necessary. Press the STOP pushbutton.

TABLE 5-4  
CAPSTAN RPM VS TAPE SPEED  
(CAPSTAN SPEED ADJUSTMENT)

TAPE SPEED	CAPSTAN RPM*
120 ips	918 ±10
112.5 ips	735 ±8
75 ips	574 ±6

\*Equation used:  $(7.65) \times (\text{tape speed}) = \text{RPM}$   
Tolerance: ±1 percent (rounded off)

Step B5: CVE Capstan Velocity PCB Assembly Only: Press the FORWARD pushbutton and transfer approximately 600 feet of tape to the fixed reel. Press the STOP pushbutton. Press the REWIND pushbutton. Adjust R42 (fourth-from-top potentiometer of five potentiometers) on CVE until the capstan is rotating at  $2295 \pm 115$  rpm (as measured with the stroboscope). This rpm corresponds to a tape speed of  $300 \pm 15$  ips. Allow the tape to rewind completely.

Step B6: Remove power from the transport.

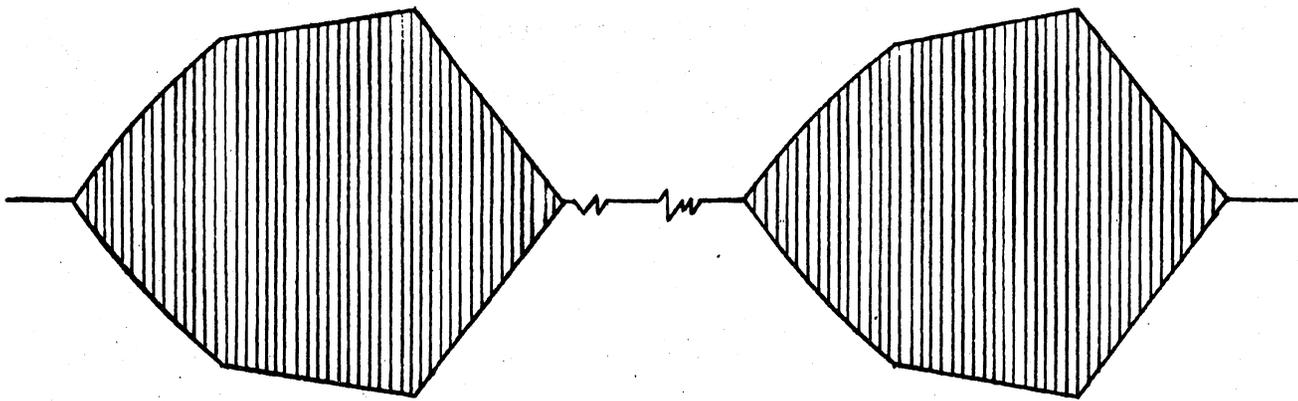
Step 9: Connect pin 10 of J13 to logic ground, using a clip lead. Insert the capstan current control PCB (CI) into J12 of the control electronics card cage. Apply power to the transport. Press the STOP pushbutton and wait 30 seconds.

Step 10: Jumper test points TP1 (top) and TP2 (center) on CI with a clip lead. Connect an oscilloscope to observe the waveform at test point TP3 (bottom) on CI. Adjust R32 (bottom potentiometer) on CI until the positive and negative peaks of the waveform at TP3 are equidistant from zero volts, as indicated on the oscilloscope.

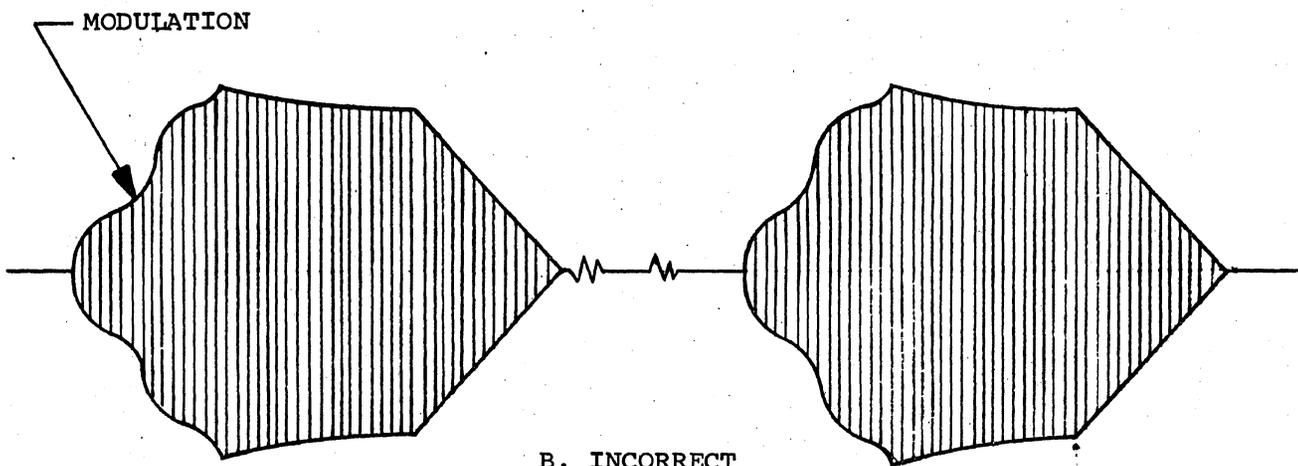
Step 11: Remove the clip lead between TP1 and TP2 on CI. The voltage at TP3 should be  $0.00 \pm 0.25$  volts, as indicated on the oscilloscope. Remove the clip lead between pin 10 of J13 and logic ground.

Step 12: Connect the oscilloscope to observe the waveform at test point TP2 (center) on CA. Adjust R28 (bottom potentiometer) on CA for zero volts at TP2, as indicated on the oscilloscope.

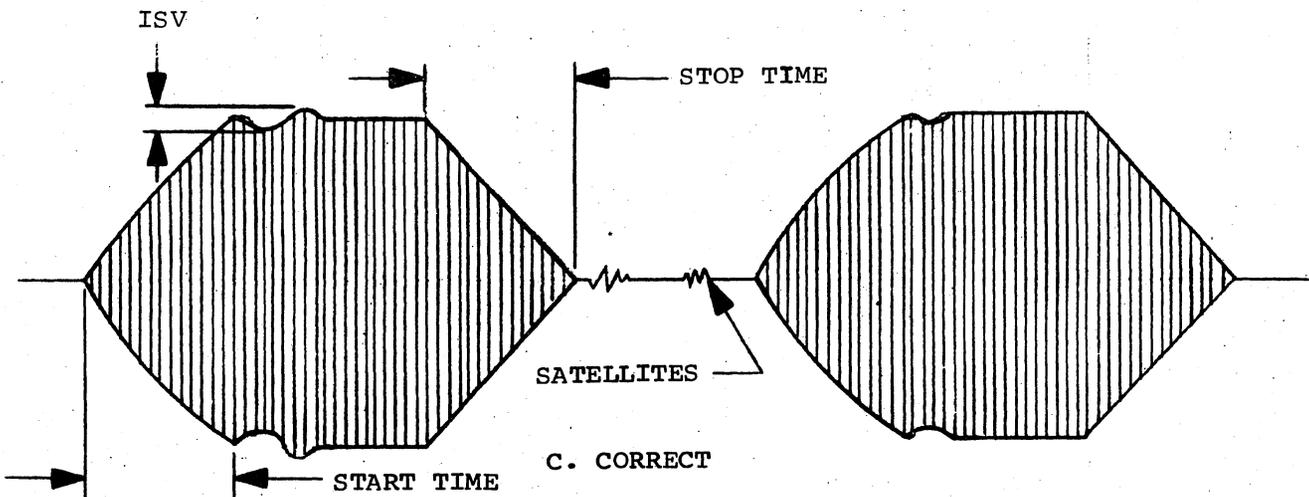
- Step 13: Load a master tape (all ONE's) on the tape transport. Press the FORWARD pushbutton. Adjust R15 (top potentiometer) on CV for zero volts at TP2 on CA, as indicated on the oscilloscope. Press the STOP pushbutton.
- Step 14: Press the REVERSE pushbutton. Adjust R33 (second-from-top potentiometer) on CV for zero volts at TP2 on CA, as indicated on the oscilloscope. Press the STOP pushbutton.
- Step 15: Press the REMOTE pushbutton. Using a programmer, program the transport to alternately drive forward for 20 ms, stop for 20 ms, drive reverse for 20 ms, and stop for 20 ms before repeating the cycle (a repetition rate of approximately 25 direction reversals per second). Connect the oscilloscope to a read head as shown in Figure 5-8. Adjust R23 (third-from-top potentiometer) on CA to obtain a waveform similar to that shown in Figure 5-9C.
- Step 16: Adjust R26 (middle potentiometer) on CI to obtain the specified start time for the applicable tape speed, as indicated on the oscilloscope. The start times for the applicable tape speeds are as follows:
- (a) 120 IPS: 3.8 ms.
  - (b) 112.5 IPS: 4.0 ms.
  - (c) 75 IPS: 6.0 ms
- Step 17: Sync the oscilloscope with the reverse STOP command. Adjust R23 (third-from-top potentiometer) on CA for minimum amplitude of any satellites present during the reverse OFF time (following the reverse stop), as indicated on the oscilloscope. (See Figure 5-9C for example of satellites.)
- Step 18: Sync the oscilloscope with the forward STOP command. Adjust R1 (second-from-top potentiometer) on CA for minimum amplitude of any satellites present during the forward OFF time (following the forward stop), as indicated on the oscilloscope.
- Step 19: Sync the oscilloscope with the forward RUN command. Adjust R12 (top potentiometer) on CI to obtain an unmodulated leading-edge on the waveform during start time, as indicated on the oscilloscope. (See Figure 5-9B for example of modulation.) Stop the transport. Press the LOCAL pushbutton.



A. INCORRECT



B. INCORRECT



C. CORRECT

Figure 5-9  
Read Amplifier Output Waveforms, Capstan Servo Adjustment

- Step 20: Connect an isolated DC voltmeter across the capstan-motor armature terminals (terminals A2A1TB1-3 and A2A1TB1-4 on the capstan servo assembly may be used). If required, adjust R14 (top potentiometer) on the capstan acceleration PCB (CA) to obtain zero volts between the capstan-motor armature terminals, as indicated on the voltmeter.
- Step 21: Connect the oscilloscope to observe the waveform at test point TP2 (center) on CA. If required, adjust R28 (bottom potentiometer) on CA for zero volts at TP2, as indicated on the oscilloscope.
- Step 22: Press the REMOTE pushbutton. Using the programmer, program the transport to alternately drive forward for 20 ms, stop for 20 ms, drive reverse for 20 ms, and stop for 20 ms before repeating the cycle (a repetition rate of approximately 25 direction reversals per second). Connect the oscilloscope to a read head as shown in Figure 5-8. Repeat Step 16, if required.
- Step 23: Repeat Steps 17 and 18 with the addition of the following adjustment: Adjust R14 (top potentiometer) on CA for minimum amplitude of any satellites occurring approximately five milliseconds after the stop (R1 and R23 are adjusted for minimum amplitude of any satellites occurring immediately after the forward and reverse stops, respectively).
- Step 24: Sync the oscilloscope with the forward RUN command. Adjust R15 (top potentiometer) on CV, if required, to obtain an instantaneous speed variation (ISV) of 10 percent or less during the 10-millisecond period following the forward start command, as indicated on the oscilloscope. (See Figure 5-9C for example of ISV.)
- Step 25: Sync the oscilloscope with the reverse RUN command. Adjust R33 (second-from-top potentiometer) on CV, if required, to obtain an ISV of 10 percent or less during the 10-millisecond period following the reverse start command, as indicated on the oscilloscope. Stop the transport. Press the LOCAL pushbutton.
- Step 26: Connect the oscilloscope to observe the voltage at test point TP2 on CA. Press the FORWARD pushbutton and monitor the voltage at TP2 on CA for several seconds. Press the STOP pushbutton. Press the reverse pushbutton and monitor the voltage at TP2 on CA for several seconds. Press the STOP pushbutton. Voltage in excess of  $0.0 \pm 0.5$  volt during continuous run in either direction indicates excessive friction in the tape path. Remove power from the transport.

## 5-28. REEL SERVO SYSTEM ADJUSTMENTS.

The reel servo system adjustments are accomplished by potentiometers on the reel servo control PCB assemblies (RP and RR). See Figure 5-6.

### **NOTE**

Verify that power supply outputs are within 0.5 percent of nominal value before making reel servo system adjustments.

5-29. Preliminary Adjustments. This portion of the adjustment procedure is to be followed only when the reel servo preamplifier PCB (RP) has been replaced.

- Step 1: Remove the reel servo preamplifier PCB (RP) from J15 of the control electronics card cage.
- Step 2: Connect an ohmmeter between terminals 1 and 2 of R8 (top potentiometer) on the reel servo preamplifier PCB (RP). Adjust R8 to obtain a resistance of 5000 ohms, as indicated on the ohmmeter.
- Step 3: Connect the ohmmeter between terminals 1 and 2 of R9 (bottom potentiometer) on the PCB. Adjust R9 to obtain a resistance of 5000 ohms, as indicated on the ohmmeter.
- Step 4: Insert the reel servo preamplifier PCB (RP) into J15 of the control electronics card cage.

5-30. Final Adjustments. This portion of the procedure is followed after the capstan servo system has been properly adjusted.

- Step 1: Apply power to the transport and load a reel of tape. Press the STOP pushbutton. Ensure that the tape loop in each vacuum chamber is between the FEED FWD and FEED REV loop sensors.
- Step 2: Reel servo zero balance adjustment: Connect a DC voltmeter across test points 2TP1 and 2TP2 on the reel servo driver PCB (RR). Adjust 2R4 (top potentiometer) on RR for zero volts, as indicated on the voltmeter. Connect the voltmeter across test points 1TP1 and 1TP2 on RR. Adjust 1R4 (bottom potentiometer) on RR for zero volts, as indicated on the voltmeter.

Step 3: Fixed reel servo speed adjustment: Jumper test points TP1 and TP2 (bottom test points) on the reel servo preamplifier PCB (RP) with a clip lead. Press the FORWARD pushbutton. Adjust R8 (top potentiometer) on RP so that the tape loop in the fixed reel vacuum chamber remains between the LOOP SENSE FWD and FEED FWD loop sensors (located at the lower end of the vacuum chamber). Press the STOP pushbutton. Remove the clip lead.

Step 4: File reel servo speed adjustment: Jumper test points TP3 and TP4 (top test points) on the reel servo preamplifier PCB (RP) with a clip lead. Press the REVERSE pushbutton. Adjust R9 (bottom potentiometer) on RP so that the tape loop in the file reel vacuum chamber remains between the LOOP SENSE REV and FEED REV loop sensors (located at the lower end of the vacuum chamber). Press the STOP pushbutton. Remove the clip lead.

#### 5-31. PHOTOSENSE THRESHOLD ADJUSTMENT.

Adjust the photosense threshold as follows. (See Figure 5-6.)

Step 1: Apply power to the transport. Load a test tape (with BOT and EOT reflective tabs attached) on the transport. (See Figure 3-2 for correct tab placement.) Position the tape so that a BOT tab is over the outer section (away from the tape deck) of the photosense head.

Step 2: Connect a DC VTVM or an oscilloscope to measure the voltage at pin 17 of J9. Adjust 1R2 (bottom potentiometer) on the photoamplifier PCB (PH, J9) until the voltage measured at pin 17 just switches from a negative voltage (approximately -6 volts) to  $0.0 \pm 0.2$  volts. Adjust 1R2 two full turns clockwise from the transition point setting.

Step 3: Position the tape so that no reflective tab is over the photosense head. The voltage measured at pin 17 of J9 should switch from  $0.0 \pm 0.2$  volts to a negative voltage when the BOT tab is moved off the photosense head.

Step 4: Position the tape so that an EOT tab is over the inner section (adjacent to tape deck) of the photosense head.

Step 5: Connect the DC VTVM or the oscilloscope to measure the voltage at pin 20 of J9. Adjust 2R2 (top potentiometer) on PH until the voltage measured at pin 20 just switches from a negative voltage (approximately -6 volts) to  $0.0 \pm 0.2$  volts. Adjust 2R2 two full turns clockwise from the transition point setting.

Step 6: Position the tape so that no reflective tab is over the photosense head. The voltage measured at pin 20 of J9 should switch from  $0.0 \pm 0.2$  volts to a negative voltage when the EOT tab is moved off the photosense head.

5-32. WRITE-ENABLE SWITCH ASSEMBLY ADJUSTMENT.

Adjust the write-enable switch assembly as follows:

Step 1: Loosen the two screws attaching the assembly to the tape deck casting. Adjust the assembly to position the sensor probe in the file reel write enable groove (ring removed). Tighten the two screws.

**NOTE**

The sensor probe used with an IBM type reel consists of a headless screw located in the forward face of the hinged sensor unit at reel groove level. This headless screw is removed when an NAB type reel is used and the lower section of the sensor unit (from which the screw is removed) serves as the sensor probe.

5-33. CHECKING OPERATIONAL PARAMETERS.

5-34. START- AND STOP-TIME CHECKOUT.

5-35. Start Time Definition. Start time is defined as the time from the application of a RUN command until the tape passing over the read/write head has obtained the nominal speed. Start time is 3.8 ms maximum for 120 ips.

5-36. Stop Time Definition. Stop time is defined as the time from the application of a STOP command until all tape motion over the read/write head has ceased. Stop time is 3.8 ms maximum for 120 ips.

5-37. Checkout Procedure. Start and stop times are checked by observing the output from a read head. The following equipment is required to check start and stop time.

- (a) Calibrated oscilloscope (Tektronix 535 or equivalent).
- (b) Master tape, recorded at 800 bpi.

- (c) Read amplifier.
- (d) Start-stop programmer.

Check the start and stop time as follows:

- Step 1: Apply power to the transport. Load the test tape on the transport. Press the STOP pushbutton.
- Step 2: Connect the equipment as shown in Figure 5-10.
- Step 3: Using the programmer, program the transport to start-stop in the forward and reverse directions at a rate of approximately 50 cycles per second. (10 ms forward, 10 ms stop, 10 ms reverse, and 10 ms stop.)
- Step 4: Trigger the oscilloscope with the programmer output to observe the start and stop characteristics. The leading edge of the read amplifier output must reach terminal voltage within 3.8 ms\* from initiation of RUN command, as shown in Figure 5-11. The trailing edge of the read amplifier output must intersect the zero axis within 3.8 ms\* from initiation of STOP command.

#### 5-38. INTERCHANNEL TIME DISPLACEMENT ERROR (ITDE) CHECKOUT.

The following procedure permits measurement of interchannel time displacement error of any data track from any other data track or reference track. The procedure does not permit separation of errors introduced by write and read electronics.

The following equipment is required to measure ITDE:

- (a) Master tape recorded at 800 bpi.
- (b) Dual trace oscilloscope.
- (c) Read amplifiers.

Check ITDE as follows:

- Step 1: Connect the test equipment as shown in Figure 5-12.
- Step 2: Load the tape on the transport.
- Step 3: Press the FORWARD pushbutton. A display such as is shown in Figure 5-13 should appear on the oscilloscope.

\*For 120 ips.

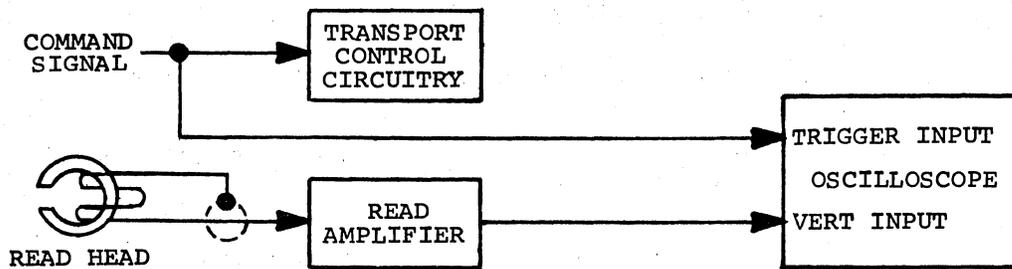
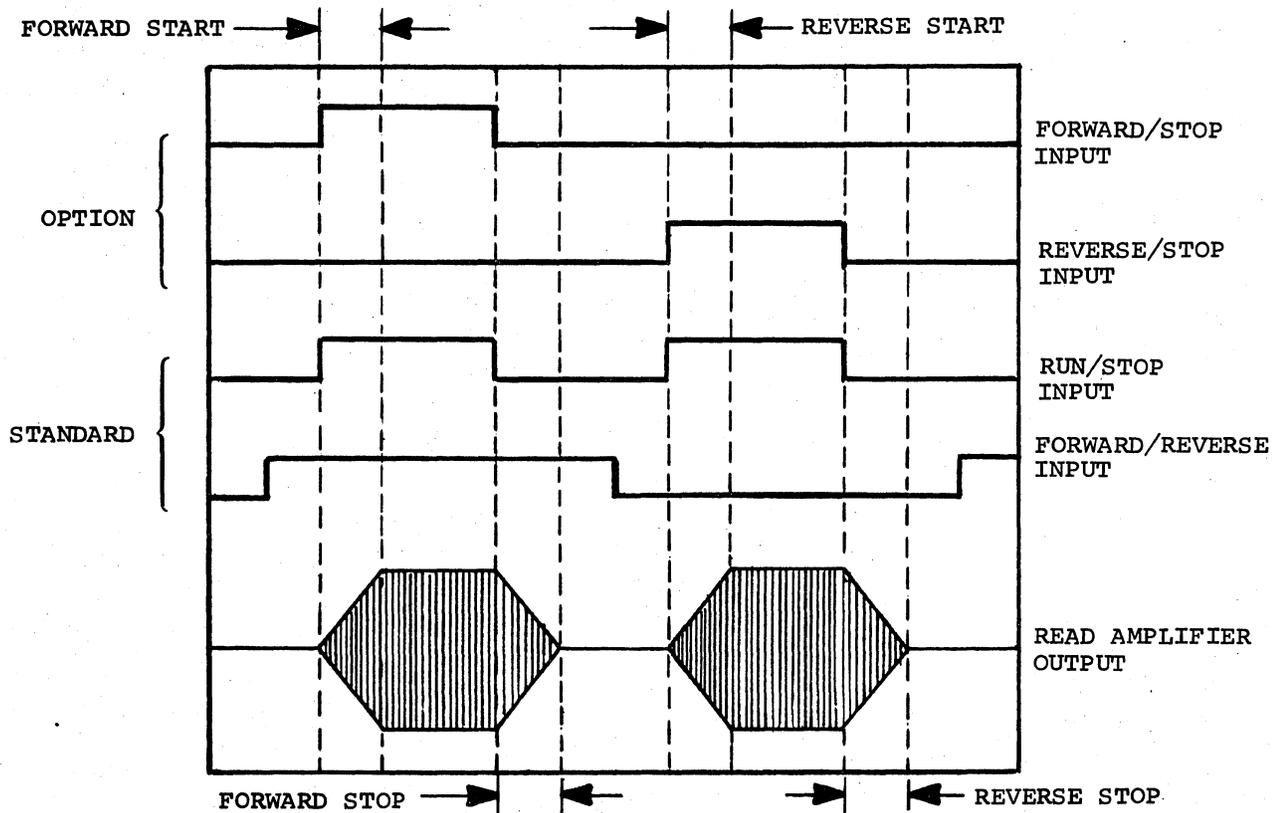


Figure 5-10  
Start- and Stop-Time Measurement, Test Setup



NOTE: All start and stop times to be 3.0 ms max

Figure 5-11  
Start- and Stop-Time Measurement, Waveshape

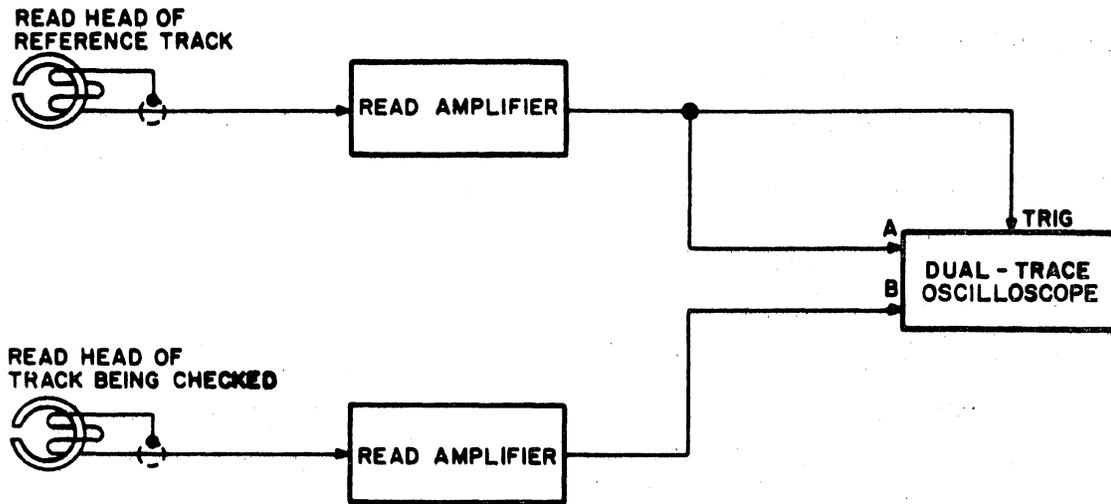


Figure 5-12  
Interchannel Time Displacement Error, Test Setup

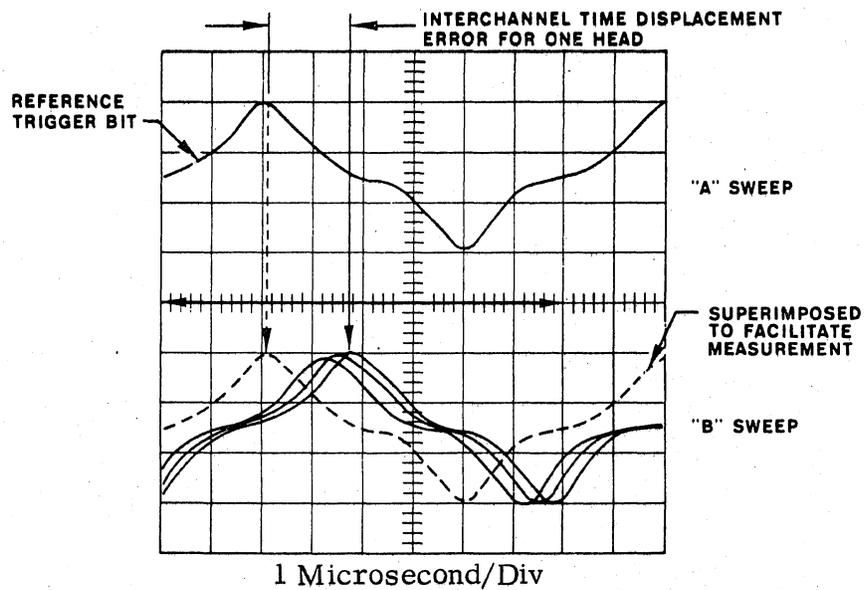


Figure 5-13  
Interchannel Time Displacement Error, Typical Waveshape

Step 4: Switch the non-reference input of the oscilloscope to the other tracks in turn to measure the ITDE of each track with respect to the reference track. The ITDE must be as specified in Section I.

5-39. PHOTONSENSE CHECKOUT.

A test tape with reflective tabs attached is required to perform the following test.

Check the photosense as follows:

Step 1: Load the tape on the transport.

Step 2: Run the tape through completely. The tape transport should operate without interruption, but must stop whenever a tab passes over the photosense head.

5-40. TOOLS AND TEST EQUIPMENT.

Table 5-5 lists the general nature of tools and test equipment required to maintain the TM-11. Manufacturer's names and numbers are given only as a guide; any equivalent tool or test equipment may be used.

TABLE 5-5  
SUGGESTED TOOLS

TOOL	RECOMMENDED EQUIPMENT
Capstan puller, hub type Gauge, thickness Mirror, inspection Penlight, heavy duty Pliers, diagonal cutting, 5"	Ampex #3115577-10 Starrett #66 G.C. #5090 Eveready #315 Klein #202-5
Pliers, internal ring, 45° Pliers, long nose, 6" Pliers, needle nose, 6" Pliers, 7-1/2" Pressure gauge, 0 to 30 psig, ±5%	Truarc #21 Klein #303-6 Utica #777-6 Proto #242 Ampex #090-101
Scale, steel, 6" Scissors, 2-1/2" blade Screwdriver, screw starter Screwdriver set, Phillips Screwdriver set, standard	Starrett #384 Wiss #173 Pearson #3 Proto #9600A Snap-On #SD-130K
Screwdriver, stub, large Screwdriver, stub, medium Screwdriver, stub, small Scribe Soldering aid	Xcelite #R-5166 Xcelite #R-3164 Xcelite #R-184 Starrett #70A Walsco #2530
Soldering iron, low-voltage Stripper, wire Vacuum gauge, 0 to 35 in. H <sub>2</sub> O, ±5% Wrench, adjustable, 6" Wrench, bristol	Weller #W-TCP Miller #100 Ampex #090-028 Crescent #AT16 Allen #DS-060
Wrench set, Allen, handled, 0.35" through 9/64" Wrench set, open end, 15° and 75°, 3/16" through 3/4"	Allen #DS6075 Williams #1143PR

## **SECTION VI CIRCUIT DESCRIPTIONS**

### 6-1. INTRODUCTION.

This section contains detailed circuit descriptions of typical printed circuit board assemblies used in the transport electronics. The circuit descriptions are in alphabetical sequence by the mnemonic code of the PCB. Block diagrams and logic diagrams are included as an aid to the detailed explanation of the operation of each circuit. Schematic diagrams and assembly drawings of the PCB assemblies are located in Section VII.

Circuit descriptions of special board assemblies, when required, are included in special addenda.

## 1. GENERAL DESCRIPTION.

The capstan acceleration -C PCB assembly contains a summing amplifier, a limiting summing amplifier, an integrating amplifier, and two inverter stages. (See Figure 1.) Signal levels used in the following circuit descriptions are nominal.

## 2. THEORY OF OPERATION.

Summing Amplifier. Transistors Q1, Q2, and Q3, and associated component parts form an operational summing amplifier. The REF (+) and REF (-) inputs are applied to the input summing junction of the amplifier through R6 and R7, respectively. The OVERDRIVE input is applied to the summing junction through R5, CR1, and CR2. Diodes CR1 and CR2 are used to isolate the summing junction from noise on the OVERDRIVE line. All the inputs are summed at the junction and balanced by inverse feedback through R10. The output of the summing amplifier is applied to an external power amplifier through isolating resistor R22. Potentiometer R14 is used to adjust the initial balance of the summing amplifier, and is adjusted for zero volts across the capstan motor armature in the stopped condition. Resistors R18 and R19 compensate the summing amplifier for the effects of supply voltage variations.

FEEDBACK Output (Pin 9). The FEEDBACK output signal is derived in a summing junction having three inputs: the REV (+) input applied through R4, the REF (-) input applied through R8, and an AC signal from the summing amplifier applied through C5 and R9. All the inputs are summed at the junction and form the FEEDBACK output signal.

Limiting Summing Amplifier. Transistors Q7, Q8, and Q9, zener diode VR1, and associated component parts form a limiting summing amplifier. Six inputs are applied to the input summing junction of the amplifier; the REF (+) input through R1 and R2, the REF (-) input through R3, the DRIVE (+) feedback through R39, the DRIVE (-) feedback through R40, inverse feedback through R41, and the output from the integrating amplifier through R38. All the inputs are summed at the junction and applied to base B1 of Q8.

The amplifier has two outputs; one from the cathode of VR1, the other from the anode of VR1. The outputs are offset from each other by 4 volts. Diode CR5 prevents the output at the cathode of VR1 from going more negative than approximately 0.6 volts, by establishing heavy feedback through R42. Similarly, diode CR6 prevents the output at the anode of VR1 from becoming more positive than 0.6 volt. Resistors R53 and R54 form a voltage divider to establish a voltage between the two output voltages, which is used as the inverse feedback through R41. Resistor R41 establishes the gain of the amplifier at approximately 10. The connection point between R53 and R54 is offset electrically from the static midpoint between the two outputs because the 4 volt offset between outputs varies slightly over the dynamic range of the amplifier, as the current through VR1 changes. This feedback is also applied to the non-inverting input of the integrating amplifier.

2. THEORY OF OPERATION. (Continued)

Potentiometer R1 is used to set the limiting summing amplifier output level produced by the REF (+) input signal. This effectively controls the constant of integration of the integrating amplifier during forward tape acceleration by setting the amplitude of the DRIVE (+) signal feedback to the integrating amplifier.

Integrating Amplifier. Transistors Q4, Q5, and Q6, and associated component parts form an operational integrating amplifier. The integrating feedback network consists of R24 and C7. Resistor R24 represents motor damping torque, and capacitor C7 represents motor inertial load. Resistor R37 is used to prevent instability at high frequency by establishing adequate phase margins. The amplifier has two input points; one inverting, the other non-inverting. The CURRENT SENSE input is applied through R23 and R25 to the inverting input of the amplifier. Four inputs are applied to the summing junction at the non-inverting input of the amplifier; the DRIVE (+) signal through R33, the DRIVE (-) signal through R34, the DRIVE REF input through direct coupling, and the feedback from the limiting summing amplifier through R31 (the feedback signal is a non-inverting self-balancing input).

Inverter Stages. Transistors Q10 and Q11, and associated component parts form two separate inverter stages. When the output of the limiting summing amplifier at the anode of VR1 goes approximately 2 volts more positive than the quiescent point, CR8 is forward biased and Q11 is cut off. The DRIVE (-) output follows the collector of Q11 to -12 volts. When the limiting summing amplifier is returned to a balanced condition, Q11 is biased on and the DRIVE (-) output goes to 0 volts.

When the output of the limiting summing amplifier at the cathode of VR1 goes approximately 2 volts more negative than the quiescent point, CR7 is forward biased and Q10 is cut off. The DRIVE (+) output follows the collector of Q10 to +12 volts. When the limiting summing amplifier is returned to a balanced condition, Q10 is biased on and the DRIVE (+) output goes to 0 volts.

3. POWER REQUIREMENTS.

VOLTAGE	CURRENT
+12 VDC $\pm 3\%$	60 ma max
-12 VDC $\pm 3\%$	45 ma max

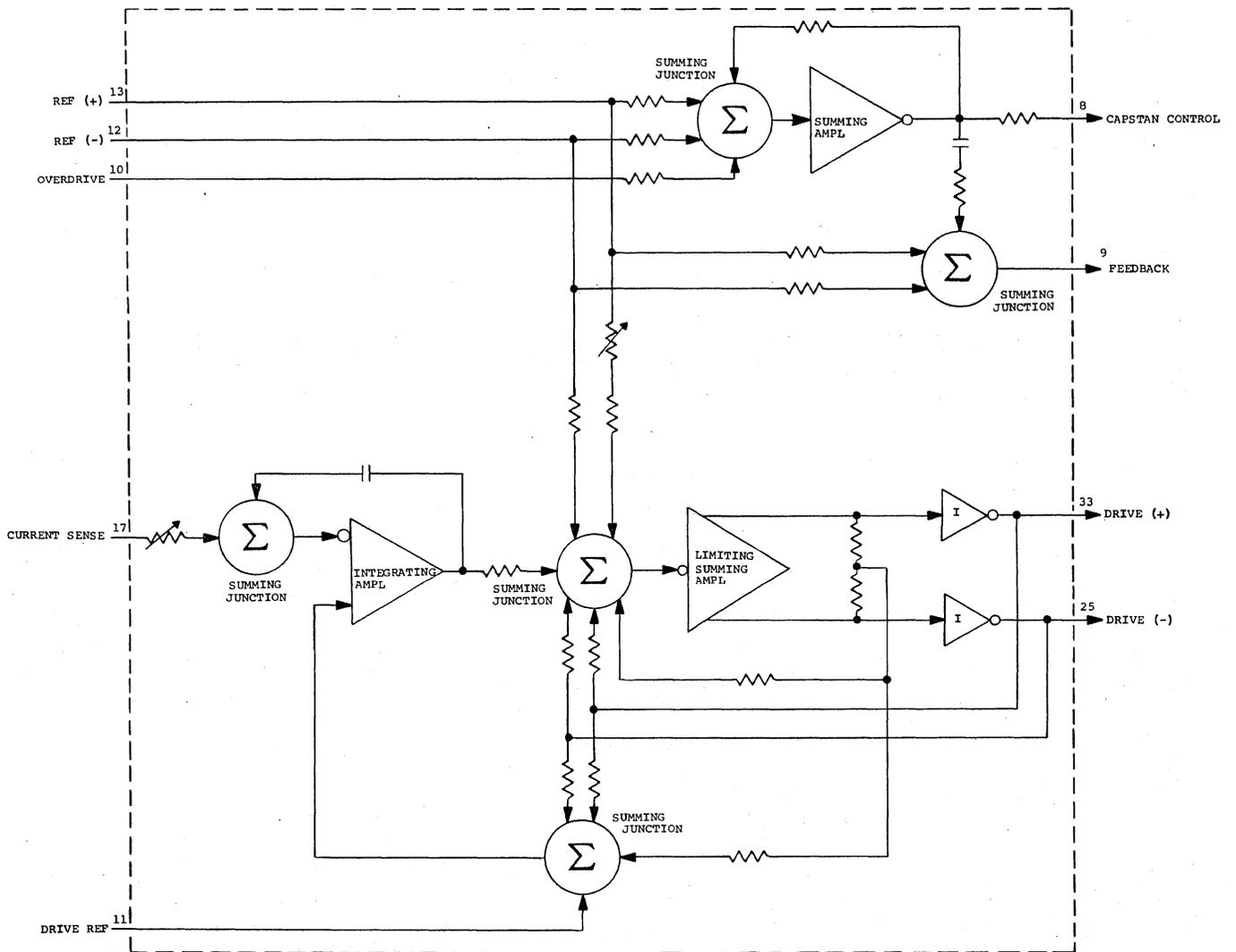


Figure 1  
Capstan Acceleration -C, Block Diagram

## 1. GENERAL DESCRIPTION.

The capstan current control PCB assembly contains a dead-band amplifier and two pulse shaper circuits. (See Figure 1.) Signal levels used in the following circuit descriptions are nominal.

## 2. THEORY OF OPERATION.

The capstan current control produces the OVERDRIVE signal, which is summed with the REF (+) and REF (-) signals and applied to the control summing amplifier on the capstan acceleration PCB assembly. The OVERDRIVE signal regulates the shape (of the leading and trailing edges) and the amplitude of the driving current pulse used to accelerate and decelerate the capstan motor. Circuit operation will be discussed for the forward acceleration mode; operation in the other modes is identical, except as noted in the description.

Dead-Band Amplifier. The dead-band amplifier is comprised of Q9, Q10, Q11, and associated component parts. The amplifier is similar to a conventional operational amplifier with the addition of the dead-band circuit consisting of CR8, CR9, CR10, CR11, R21, R22, R23 and R24. The primary input junction of the dead-band amplifier is the junction at base B1 of Q10. In the quiescent state, CR8, CR9, CR10, and CR11 are forward biased and CR12 and CR13 are reverse biased; in this condition, no current flows through R25. The DRIVE (+) and DRIVE (-) inputs are at zero volts, thus no current flows through R3. The OVERDRIVE output current is zero, since no current flows through R3 or R25.

Leading- and Trailing-Edge Pulse Shaper. The leading- and trailing-edge pulse shaper is comprised of Q1, Q2, Q3, and associated component parts. When the DRIVE (+) and DRIVE (-) inputs are at zero volts, Q1, Q2, and Q3 conduct. Current flow from Q1 through R4 establishes a negative voltage at the base of Q3, which causes Q3 to conduct. The voltage at the collector of Q3 swings positive and forward biases CR1. Q2 is driven to saturation by the positive base-to-emitter voltage differential; the collector of Q2 swings to a low negative voltage. Diodes CR2 and CR3 are reverse biased and no current flows to the junction at base B1 of Q10.

Trailing-Edge Pulse Shaper. The trailing-edge pulse shaper is comprised of Q4, Q5, Q6, Q7, Q8, and associated component parts. When the DRIVE (+) and DRIVE (-) inputs are at zero volts, Q4 and Q5 conduct. R15 has less resistance than R17, thus a negative base-to-emitter voltage differential is established at Q6. Q6 conducts and establishes a positive voltage at the base of Q8. Q8 is cut off by the positive voltage at the base which is limited to approximately +0.5 volt by CR7. When Q8 is cut off, no current can flow through Q7. When Q7 and Q8 are cut off, the trailing-edge pulse shaper is effectively out of the dead-band circuit.

2. THEORY OF OPERATION. (Continued)

Leading-Edge Shaping and Pulse Amplitude Control. When forward acceleration or reverse deceleration is programmed, the DRIVE (+) input goes to approximately +8 volts. The DRIVE (-) input remains at zero volts. The DRIVE (CT) signal is derived through the voltage divider circuit consisting of R1 and R2, which is connected between the DRIVE (+) and DRIVE (-) inputs. The DRIVE (CT) signal is approximately +4 volts at this time, which causes a 400-microampere current flow in the OVERDRIVE output (through R3).

When DRIVE (CT) goes positive, emitter-follower Q1 couples the positive pulse through C5 to the emitter of Q2; the positive pulse cuts off Q2. Q2 remains cut off until C5 discharges through R10 and R8. Potentiometer R10 is used to preset the cut-off time of Q2 to approximately 500 microseconds. When Q2 is cut off, CR2 is forward biased, and the current flowing through R13 is added to that at the junction at base B1 of Q10. This action generates a step in the leading edge of the driving current pulse to the capstan motor by reducing the amount of current flow in the OVERDRIVE signal for the 500 microsecond period.

The 400-microampere current flow in the OVERDRIVE output (through R3) causes the control summing amplifier on the capstan acceleration PCB to increase the amplitude of the CAPSTAN CONTROL signal, which causes an increase in the voltage applied to the capstan motor. The increased capstan-motor voltage results in increased armature current, which causes the CURRENT SENSE input to become positive. The CURRENT SENSE input is the voltage analog of the capstan-motor armature current, and is approximately 50 millivolts-per-ampere. The positive-voltage CURRENT SENSE input causes a current to flow through R27 and R26 and the junction at base B1 of Q10. This, in turn, causes the voltage at TP3 to swing slightly more negative, which transfers conduction from CR8 to CR10 and from CR11 to CR9. When the current through R27 and R26 increases to the point at which it is equal to the current through R23 and R24, less the amount of current through R13, CR8 and CR11 become reverse biased and CR12 becomes forward biased. Current flows through R25, subtracting from the current through R3 at the OVERDRIVE output and preventing further increase in capstan-motor voltage and current.

When Q2 conducts after being cut off for 500 microseconds, CR2 is again reverse biased, and the current through R13 is removed from the junction at base B1 of Q10. Removal of this positive input produces a negative-going change at base B1 of Q10; the dead-band amplifier inverts the negative-going signal, causing the voltage at TP3 to swing slightly positive. The positive voltage at TP3 causes CR8 and CR11 to conduct again and causes CR12 to become reverse biased. When CR12 is reverse biased, the current through R27 and R26 is removed from the OVERDRIVE output, which returns to the relatively-large 400-microampere current flow supplied through R3. This high-current signal causes the capstan-motor voltage and current to increase, which causes the current through R27 and R26 to increase. When the current through R27 and R26 increases to the point at which it is equal to the current through R23 and R24, CR8 and CR11 become reverse biased and CR12 becomes forward biased. Current flows through R25, subtracting from the current through R3 at the OVERDRIVE output and preventing further increase in capstan-motor voltage and current. At this point, the

## 2. THEORY OF OPERATION. (Continued)

capstan-motor current is stabilized on the flat-top-portion of the pulse and the motor is undergoing constant acceleration. The amplitude of the pulse is controlled by the setting of potentiometer R26.

During generation of the driving current pulse, the summed FEEDBACK and STOP CONTROL inputs are applied at base B2 of Q10. The FEEDBACK input is a positive voltage during forward operation; the positive voltage causes the voltage at TP3 to swing slightly more positive during forward acceleration, thus causing an increase in the amplitude of the driving current pulse. The increased amplitude pulse increases the rate of acceleration, which causes the capstan-motor to reach forward speed faster than reverse speed.

The STOP CONTROL input is not presently used.

Trailing-Edge Shaping. At the end of the acceleration period, the DRIVE (+) input returns to zero volts. The DRIVE (CT) signal goes to zero volts, which stops the 400-microampere current flow through R3 (and the OVERDRIVE output).

When the DRIVE (+) input goes to zero volts, Q1 is cut off by the negative base-to-emitter voltage differential established by the charge on C5. Q1 remains cut off until C5 is discharged through R5, which takes approximately 500 microseconds. When Q1 is cut off, Q3 is cut off by the positive voltage at its base. When Q3 is cut off, CR1 is reverse biased, CR3 is forward biased, and the current through R14 is added to that at the junction at base B1 of Q10. This action generates a step in the trailing edge of the driving current pulse to the capstan-motor by providing an opposing current flow to that caused by the CURRENT SENSE input (the dead-band amplifier has no dead-band at this time).

When the DRIVE (+) input goes to zero volts, Q5 is cut off by the negative base-to-emitter voltage differential established by the discharge of C6 through R18, CR4, Q4, and R15. Q5 remains cut off until C6 is discharged; the discharge time of C6 is fixed at approximately 1.5 milliseconds. When Q5 is cut off, Q6 is cut off by the positive voltage at the base. When Q6 is cut off, the voltage at the base of Q8 goes to a negative level, causing Q8 to be saturated, which establishes a positive base-to-emitter voltage differential at Q7. Q7 is saturated and the collectors of both Q8 and Q7 are at zero volts, which establishes a zero-voltage-drop condition across R22 and R23; CR8 and CR9 are reverse biased. When CR8 and CR9 are reverse biased, the dead-band amplifier functions as a normal operational amplifier, and establishes a current through R25 (and the OVERDRIVE output) that causes the current through R27 and R26 (caused by the CURRENT SENSE input) to balance the current through R14 at the junction at base B1 of Q10. The current through R27 and R26 is approximately one-half the magnitude of the dead-band current.

2. THEORY OF OPERATION. (Continued)

When Q1 conducts after being cut off for 500 microseconds, Q3 conducts, CR1 is forward biased, CR3 is reverse biased, and the current through R14 is removed from the junction at base B1 of Q10. The amplifier establishes a current through R25 (and the OVERDRIVE output) that causes the current through R27 and R26 to drop to zero (CURRENT SENSE input at zero volts). The amplifier causes the current through R27 and R26 to remain at zero for 1.0 millisecond, which is the discharge time remaining for C6 after Q1 conducts. When C6 is discharged, Q5 conducts, which causes Q6 to conduct. When Q6 conducts, Q8 and Q7 are cut off. All circuits are then in the quiescent state.

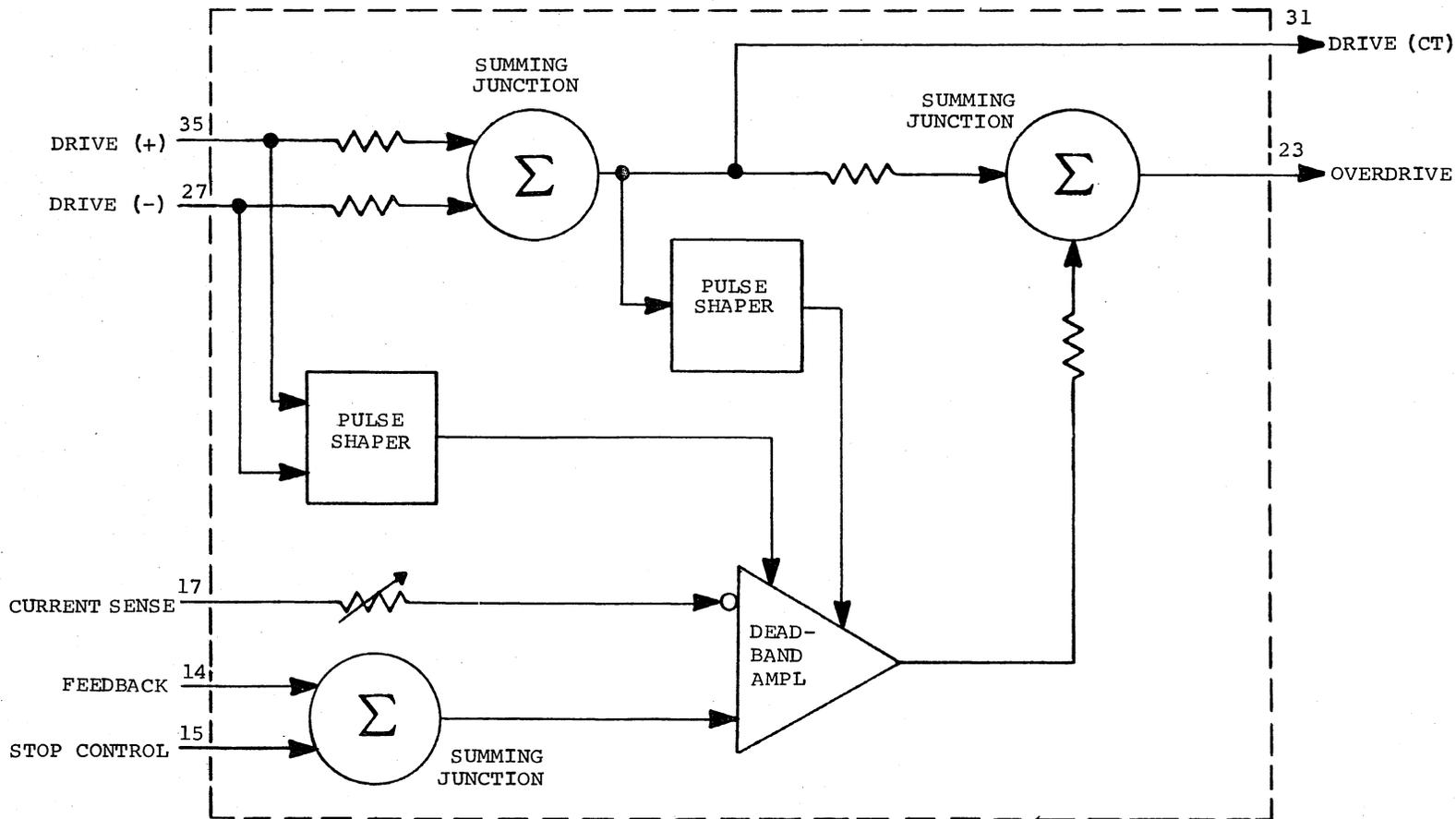
Potentiometer R32 is used to adjust the zero set of the dead-band amplifier, which, in turn, controls the zero current condition following a driving current pulse.

Reverse-Acceleration and Forward-Deceleration Operation. Operation of the circuits during reverse acceleration and forward deceleration is similar to that previously described except that most of the signal polarities are the opposite (the OVERDRIVE output is negative instead of positive), current flow through the dead-band diodes follows the opposite path, the cut off periods of Q1 and Q2 are reversed, and Q4 is cut off instead of Q5.

3. POWER REQUIREMENTS.

VOLTAGE	CURRENT
+12 VDC $\pm 3\%$	40 ma max
-12 VDC $\pm 3\%$	25 ma max

Figure 1  
Capstan Current Control, Block Diagram



1. GENERAL DESCRIPTION.

The capstan velocity -D PCB assembly contains a reference generator having (+) and (-) reference sections, a high-speed-control circuit, an inhibit circuit, and a drive reference circuit. (See Figure 1.)

2. THEORY OF OPERATION.

Reference Generator, (+) Section. The (+) section of the reference generator is comprised of Q1, Q7, Q8, VR2, and associated component parts. Transistor Q1 is a logic gate which is normally saturated due to base current through R9. When the FWD (-) and REV (+) inputs are at the negative logic level, the current flow through R11, R10, and VR1 exceeds that through R9; turning Q1 off. When Q1 is cut off, emitter follower Q7 couples the voltage divider consisting of R38, R32, and R34 to (+) zener diode VR2, providing a positive (+) reference output at the adjustable contact of potentiometer R32.

The resistance of R38 is selected to provide the (+) reference output required for the desired nominal capstan speed. Transistor Q8 is cut off unless biased on by the high-speed-control circuit. When Q8 is biased on, R38 is bypassed and the (+) reference output increases to the value required for high speed operation (approximately +4 volts). The (+) section of the reference generator has three possible steady state outputs; zero volts, forward run reference, and fast forward reference.

Reference Generator, (-) Section. The (-) section of the reference generator is comprised of Q2, Q9, Q10, VR3, and associated component parts. The (-) section is the complement of the (+) section and operates in the same way, except that it provides negative (-) rather than positive (+) outputs, and is used for reverse motion. Transistor Q2 is normally saturated, and is cut off when REV (+) and FWD (-) inputs are at the zero volt logic level. The (-) reference is enabled when Q2 is cut off.

High-Speed-Control Circuit. The high-speed-control circuit is comprised of Q5, Q6, and associated component parts. When the FAST (-) input is at the zero volt logic level, CR19 and CR20 are back biased and Q5 is biased on to saturation. The collector of Q5 is at 0 volts, which holds the base of Q6 negative through voltage divider resistors R28 and R29, and Q6 is saturated. When Q5 and Q6 are saturated, C6 and C5 are discharged.

When the FAST (-) input is at the negative logic level, CR19 and CR20 are forward biased and Q5 is cut off. When Q5 is cut off, Q6 is cut off by the positive voltage applied through voltage divider resistors R27, R28, and R29. If Q2 is conducting (reverse run not

2. THEORY OF OPERATION. (Continued)

programmed), CR8 is forward biased, holding one side of C5 at zero volts. CR21 is forward biased and clamps the collector of Q6 at approximately +1 volt, thus, the FAST (-) input has no effect on the reverse reference (-) circuit, since Q9 remains cut off. If Q2 is cut off (reverse run programmed), CR8 is back biased and timing capacitor C5 starts to charge to a negative level through R16 and CR7. This negative-going voltage is coupled through CR21 to the base of Q9. When the voltage at C5 reaches approximately -2 volts (400-millisecond charge time), Q9 begins to conduct, which reduces the impedance between the anode of VR3 and the junction of R39 and R36. This action increases the reverse reference (-) output voltage. The reverse reference (-) output voltage then follows the charge voltage at C5 (approximately 5- volts-per-second increase) until Q9 is saturated. When Q9 is saturated, the reverse reference (-) output voltage is at the preset level for high-speed-reverse tape motion.

When high-speed-reverse tape motion is to be stopped, the FAST (-) input is changed to the zero volt logic level. This causes Q5 and Q6 to saturate; CR8 is forward biased and the negative side of C5 is clamped to near zero volts. This voltage is coupled through CR21 to the base of Q9 and Q9 is cut off; the reverse reference (-) output voltage drops to the normal speed level. At the same time, C5 starts to discharge through R17, producing a positive-going pulse. CR11 and CR13 couple the positive-going pulse to the base of Q4 to initiate inhibit circuit operation.

High speed in forward (optional) is controlled by the components associated with C6. If Q1 is conducting (forward run not programmed) when the FAST (-) input is at the negative logic level, CR9 is forward biased, holding one side of C6 at zero volts. CR17 is back biased and the positive voltage at the collector of Q5 has no effect on the forward reference (+) circuit. If Q1 is cut off (forward run programmed), CR9 is back biased and timing capacitor C6 starts to charge to a positive level through CR16 and R22. This positive-going voltage is coupled through CR22 to the base of Q8. When the voltage at C6 reaches approximately +2 volts (400-millisecond charge time), Q8 begins to conduct, which reduces the impedance between the cathode of VR2 and the junction of R38 and R32. This action increases the forward reference (+) output voltage. The forward reference (+) output voltage then follows the charge voltage at C6 (approximately 5-volts-per-second increase) until Q8 is saturated. When Q8 is saturated, the forward reference (+) output voltage is at the preset level for high-speed forward tape motion.

When the high-speed-forward tape motion is to be stopped, the FAST (-) input is changed to the zero volt logic level. This causes Q5 and Q6 to saturate; CR9 is forward biased and the voltage at the positive side of C6 is clamped to near zero volts. This voltage is coupled through CR22 to the base of Q8 and Q8 is cut off; the forward reference (+) output voltage drops to the normal speed level. At the same time, C6 starts to discharge through R23 and a negative voltage is developed at the emitter of Q4 which initiates inhibit circuit operation.

2. THEORY OF OPERATION. (Continued)

Inhibit Circuit. The inhibit circuit is comprised of Q3, Q4, and associated component parts; and is controlled by the high-speed-control circuit. The inhibit circuit is in the quiescent state when capacitors C6 and C5 are discharged. Current flow through CR16 and CR17, respectively, produces +0.5 volt at the emitter of Q4 and -0.5 volt at the base of Q4. Q4 is saturated and Q3 is cut off, which enables the input circuit to the reference generator.

When high-speed-forward tape motion is stopped, C6 discharges through R23, and the negative voltage produced at the emitter of Q4 causes Q4 to be cut off; Q3 conducts. When Q3 conducts, Q1 and Q2 are saturated regardless of the state of the FWD (-) and REV (+) logic inputs. The reference voltage output goes to zero volts. The discharge time of C6 is such that Q1 and Q2 are held saturated for approximately 400-milliseconds following a stop from high speed. This delay inhibits forward or reverse commands for the 400-millisecond period to allow reel servo recovery. When C6 is discharged, Q4 starts conducting and Q3 is cut off. Transistors Q1 and Q2 are again controlled by the FWD (-) and REV (+) logic input signals.

When high-speed-reverse tape motion is stopped, C5 discharges through R17, and the positive voltage produced is coupled through CR11 and CR13 to the base of Q4. Q4 is cut off and Q3 conducts, which inhibits the reference generator input as described for the discharge of C6. The discharge time of C5 is the same as for C6.

STOP CONTROL Output (Pin 13). When high-speed-forward tape motion is stopped, the negative voltage produced by the discharge of C6 through R23 is coupled through CR15 and CR14 to pin 13 of the PCB. This provides a negative STOP CONTROL signal during the discharge time of C6.

When high-speed-reverse tape motion is stopped, the positive voltage produced by the discharge of C5 through R17 is coupled through CR10 and CR12 to pin 13 of the PCB. This provides a positive STOP CONTROL signal during the discharge time of C5.

The STOP CONTROL output is not presently used.

Drive Reference Circuit. The drive reference circuit produces the DRIVE REF signal, which is used to compensate for tape friction occurring in the tape path. Potentiometers R15 and R33 are connected to the outputs of forward gate Q1 and reverse gate Q2, respectively. This provides a positive voltage at R15 when forward drive is programmed and a negative voltage at R33 when reverse drive is programmed; otherwise, the voltage at R15 and R33 is at zero volts. The voltage at the wiper of R15 is applied through R3 to a

2. THEORY OF OPERATION. (Continued)

summing junction. The voltage at the wiper of R33 is applied through R6 to the same summing junction. The output of the summing junction is the DRIVE REF signal. Separate gate circuits in parallel with R3 and R6 reduce the level of the signal applied to the summing junction when the DRIVE (+) and DRIVE (-) inputs are at zero volts.

During forward acceleration or reverse deceleration periods, the DRIVE (+) signal is approximately +8 volts and back biases CR1; when CR1 is back biased, the gate circuit through R1 and R2 is enabled and the level of the signal from R15 that is applied to the summing junction is increased. Enabling the gate circuit during reverse deceleration periods has no effect since the voltage at R15 is then zero volts.

During reverse acceleration or forward deceleration periods, the DRIVE (-) signal is approximately -8 volts and back biases CR2; when CR2 is back biased, the gate circuit through R5 and R4 is enabled and the level of the signal from R33 that is applied to the summing junction is increased. Enabling the gate circuit during the forward deceleration periods has no effect since the voltage at R33 is then zero volts.

3. POWER REQUIREMENTS.

VOLTAGE	CURRENT
+12 VDC $\pm 3\%$	30 ma max
-12 VDC $\pm 3\%$	30 ma max

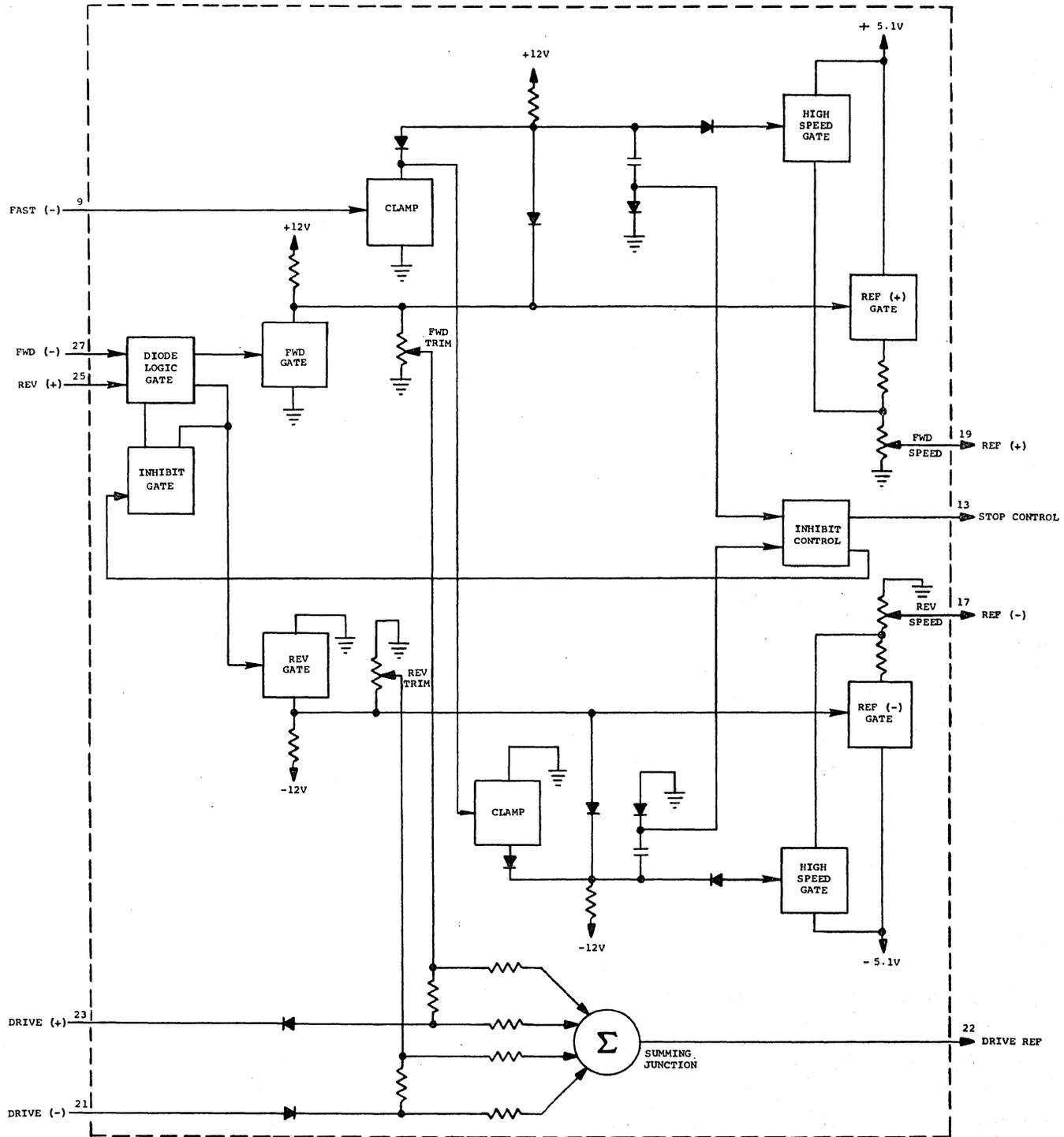


Figure 1  
Capstan Velocity -D, Block Diagram



1. GENERAL DESCRIPTION.

The capstan velocity -E PCB assembly contains a reference generator having (+) and (-) reference sections, a high-speed control circuit, an inhibit circuit, and a drive reference circuit. (See Figure 1.) Signal levels used in the following circuit descriptions are nominal.

2. THEORY OF OPERATION.

Reference Generator, (+) Section. The (+) section of the reference generator is comprised of Q1, Q7, Q8, VR2, and associated component parts. Transistor Q1 is a logic gate which is normally saturated due to the base current through R9. When the FWD (-) and REV (+) inputs are at the negative logic level, the current flow through R11, R10, and VR1 exceeds that through R9, turning Q1 off. When Q1 is cut off, emitter follower Q7 couples the voltage divider consisting of R38, R32, and R34 to (+) zener diode VR2, providing a positive (+) reference output at the wiper of potentiometer R32.

Transistor Q8 is cut off unless biased on by the high-speed-control circuit. When Q8 is biased on, R41 is added in parallel with R38 and part of R32 and the (+) reference output increases to the value required for high speed operation (approximately +4 volts). The (+) section of the reference generator has three possible steady state outputs: zero volts, forward run reference, and fast forward reference.

Reference Generator (-) Section. The (-) section of the reference generator is comprised of Q2, Q9, Q10, VR3, and associated component parts. The (-) section is the complement of the (+) section and operates in the same way, except that it provides negative (-) rather than positive (+) outputs, and is used for reverse motion. Transistor Q2 is normally saturated, and is cut off when REV (+) and FWD (-) inputs are at the zero volt logic level. The (-) reference is enabled when Q2 is cut off.

Transistor Q9 is cut off unless biased on by the high-speed-control circuit. When Q9 is biased on, potentiometer R42 is added in parallel with R39 and part of R36. Potentiometer R42 provides control of the rewind speed.

High-Speed-Control Circuit. The high-speed-control circuit is comprised of Q5, Q6, and associated component parts. When the REWIND (-) input is at the zero volt logic level, CR19 and CR20 are reverse biased and Q5 is biased on to saturation. The collector of Q5 is at 0 volts, which holds the base of Q6 negative through voltage divider resistors R28 and R29, and Q6 is saturated. When Q5 and Q6 are saturated, C6 and C5 are discharged.

2. THEORY OF OPERATION. (Continued)

When the REWIND (-) input goes to the negative logic level, CR19 and CR20 are forward biased and Q5 is cut off. When Q5 is cut off, Q6 is cut off by the positive voltage applied through voltage divider resistors R27, R28, and R29. If Q2 is conducting (reverse run not programmed) CR8 is forward biased, holding one side of C5 at zero volts. CR21 is forward biased and clamps the collector of Q6 at approximately +1 volt, thus the REWIND (-) input has no effect on the reverse reference (-) circuit, since Q9 remains cut off. If Q2 is cut off (reverse run programmed), CR8 is reverse biased and timing capacitor C5 starts to charge to a negative level through R16 and CR7. This negative-going voltage is coupled through CR21 to the base of Q9. When the voltage at C5 reaches approximately -2 volts (400-millisecond charge time), Q9 begins to conduct, which reduces the impedance between the anode of VR3 and the wiper of R36. This action increases the reverse reference (-) output voltage. The reverse reference (-) output voltage then follows the charge voltage at C5 (approximately 5-volts-per-second increase) until Q9 is saturated. When Q9 is saturated, the reverse reference (-) output voltage is at the preset level for high-speed-reverse tape motion.

When high-speed-reverse tape motion is to be stopped, the REWIND (-) input is changed to the zero volt logic level. This causes Q5 and Q6 to saturate; CR8 is forward biased and the negative side of C5 is clamped to near zero volts. This voltage is coupled through CR21 to the base of Q9 and Q9 is cut off; the reverse reference (-) output voltage drops to the normal speed level. At the same time, C5 starts to discharge through R17, producing a positive-going pulse. CR11 and CR13 couple the positive-going pulse to the base of Q4 to initiate inhibit circuit operation.

High speed in forward (optional) is controlled by the components associated with C6. If Q1 is conducting (forward run not programmed) when the REWIND (-) input is at the negative logic level, CR9 is forward biased, holding one side of C6 at zero volts. CR17 is reverse biased and the positive voltage at the collector of Q5 has no effect on the forward reference (+) circuit. If Q1 is cut off (forward run programmed), CR9 is back biased and timing capacitor C6 starts to charge to a positive level through CR16 and R22. This positive-going voltage is coupled through CR22 to the base of Q8. When the voltage at C6 reaches approximately +2 volts (400-millisecond charge time), Q8 begins to conduct, which reduces the impedance between the cathode of VR2 and the wiper of R32. This action increases the forward reference (+) output voltage. The forward reference (+) output voltage then follows the charge voltage at C6 (approximately 5-volts-per-second increase) until Q8 is saturated. When Q8 is saturated, the forward reference (+) output voltage is at the preset level for high-speed-forward tape motion.

When high-speed-forward tape motion is to be stopped, the REWIND (-) input is changed to the zero volt logic level. This causes Q5 and Q6 to saturate; CR9 is forward biased and the voltage at the positive side of C6 is clamped to near zero volts. This voltage

2. THEORY OF OPERATION. (Continued)

is coupled through CR22 to the base of Q8 and Q8 is cut off; the forward reference (+) output voltage drops to the normal speed level. At the same time, C6 starts to discharge through R23 and a negative voltage is developed at the emitter of Q4 which initiates inhibit circuit operation.

Inhibit Circuit. The inhibit circuit is comprised of Q3, Q4, and associated component parts; and is controlled by the high-speed-control circuit. The inhibit circuit is in the quiescent state when capacitors C6 and C5 are discharged. Current flow through CR16 and CR17, respectively, produces +0.5 volt at the emitter of Q4 and -0.5 volt at the base of Q4. Q4 is saturated and Q3 is cut off, which enables the input circuit to the reference generator.

When high-speed-forward tape motion is stopped, C6 discharges through R23, and the negative voltage produced at the emitter of Q4 causes Q4 to be cut off; Q3 conducts. When Q3 conducts, Q1 and Q2 are saturated regardless of the state of the FWD (-) and REV (+) logic inputs. The reference voltage output goes to zero volts. The discharge time of C6 is such that Q1 and Q2 are held saturated for approximately 400-milliseconds following a stop from high speed. This delay inhibits forward or reverse commands for the 400-millisecond period to allow reel servo recovery. When C6 is discharged, Q4 starts conducting and Q3 is cut off. Transistors Q1 and Q2 are again controlled by the FWD (-) and REV (+) logic input signals.

When high-speed-reverse tape motion is stopped, C5 discharges through R17, and the positive voltage produced is coupled through CR11 and CR13 to the base of Q4. Q4 is cut off and Q3 conducts, which inhibits the reference generator input as described for the discharge of C6. The discharge time of C5 is the same as for C6.

STOP CONTROL Output (Pin 13). When high-speed-forward tape motion is stopped, the negative voltage produced by the discharge of C6 through R23 is coupled through CR15 and CR14 to pin 13 of the PCB. This provides a negative STOP CONTROL signal during the discharge time of C6.

When high-speed-reverse tape motion is stopped, the positive voltage produced by the discharge of C5 through R17 is coupled through CR10 and CR12 to pin 13 of the PCB. This provides a positive STOP CONTROL signal during the discharge time of C5.

The STOP CONTROL output is not presently used.

2. THEORY OF OPERATION. (Continued)

Drive Reference Circuit. The drive reference circuit produces the DRIVE REF signal which is used to compensate for tape friction occurring in the tape path. Potentiometers R15 and R33 are connected to the outputs of forward gate Q1 and reverse gate Q2, respectively. This provides a positive voltage at R15 when forward drive is programmed and a negative voltage at R33 when reverse drive is programmed; otherwise, the voltage at R15 and R33 is at zero volts. The voltage at the wiper of R15 is applied through R3 to a summing junction. The voltage at the wiper of R33 is applied through R6 to the same summing junction. The output of the summing junction is the DRIVE REF signal. Separate gate circuits in parallel with R3 and R6 reduce the level of the signal applied to the summing junction when the DRIVE (+) and DRIVE (-) inputs are at zero volts.

During forward acceleration or reverse deceleration periods, the DRIVE (+) signal is approximately +8 volts and reverse biases CR1; when CR1 is reverse biased, the gate circuit through R1 and R2 is enabled and the level of the signal from R15 that is applied to the summing junction is increased. Enabling the gate circuit during reverse deceleration periods has no effect since the voltage at R15 is then zero volts.

During reverse acceleration or forward deceleration periods, the DRIVE (-) signal is approximately -8 volts and reverse biases CR2; when CR2 is reverse biased, the gate circuit through R5 and R4 is enabled and the level of the signal from R33 that is applied to the summing junction is increased. Enabling the gate circuit during the forward deceleration periods has no effect since the voltage at R33 is then zero volts.

3. POWER REQUIREMENTS.

VOLTAGE	CURRENT
+12 VDC $\pm 3\%$	30 ma max
-12 VDC $\pm 3\%$	30 ma max

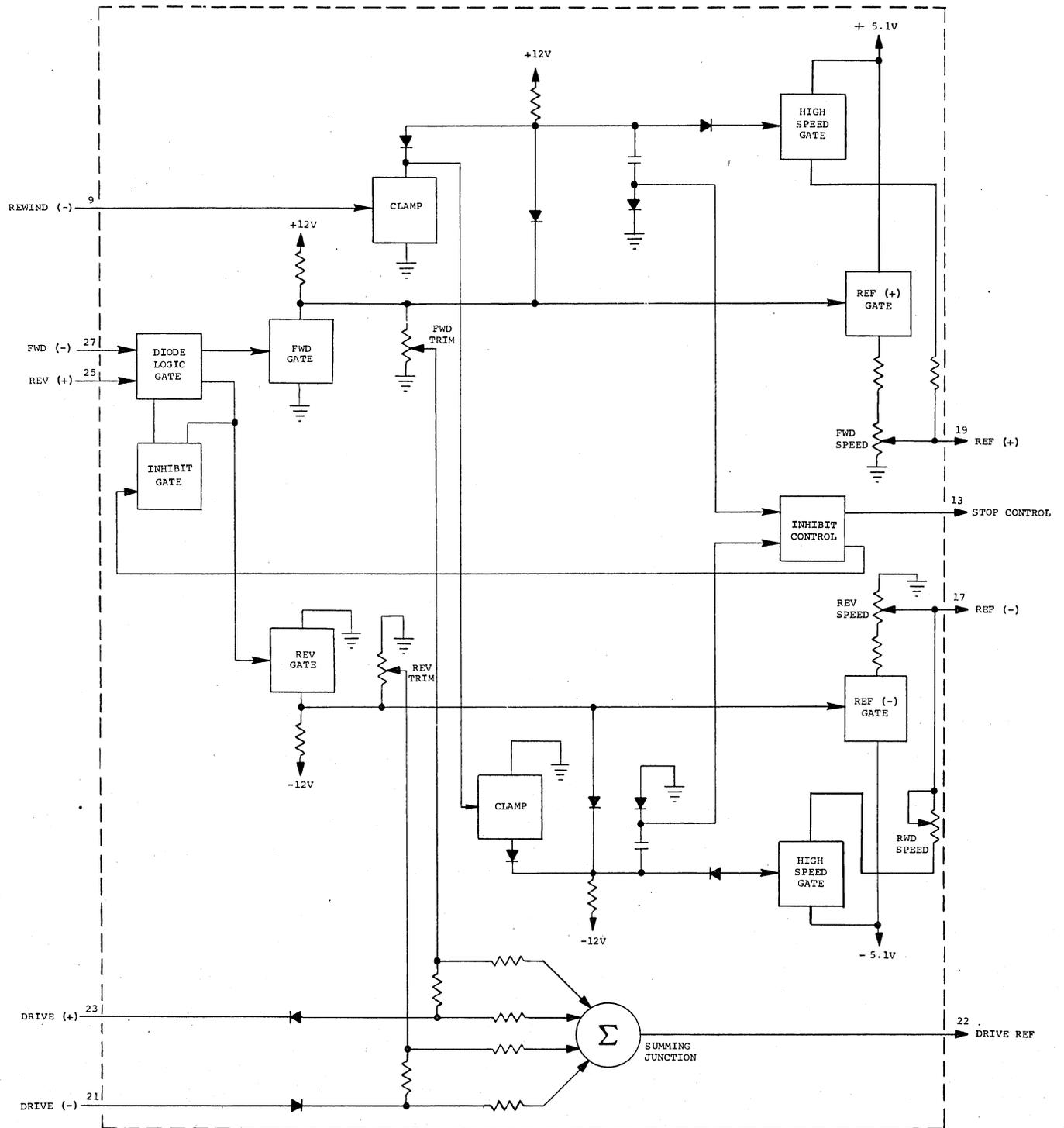


Figure 1  
Capstan Velocity -D, Block Diagram



1. GENERAL DESCRIPTION.

The forward/reverse logic PCB provides all logic necessary to perform the forward/reverse function. Nine input signals are mechanized to provide four output signals for forward/reverse operation. Signal levels used in the following circuit descriptions are nominal. Tables 1 and 2 list operating signal levels. FWD/REV input signals are programmed to be selected 5 microseconds before RUN/STOP input signals.

2. THEORY OF OPERATION. (See Figure 1.)

FWD (-) Output (Pin 28). FWD (-) output can be affected by FORWARD PB input, MASTER RESET input, BOT input, or mechanization of one of the following logic equations:

- (a)  $FWD (-) = (FWD) (RUN) (UNIT\ SELECT)$
- (b)  $FWD (-) = (BOT\ going\ off\ tab) (REWINDING)$
- (c)  $\overline{FWD} (-) = (STOP) (UNIT\ SELECT)$
- (d)  $\overline{FWD} (-) = (EOT) (LOCAL)$

When the FORWARD PB input momentarily goes to zero volts, CR9 is forward biased and the voltage at the base of Q4 swings positive, which causes Q4 to be cut off. The negative-going voltage at the collector of Q4 is coupled through R10 to the base of Q5; the negative-going voltage drives Q5 to saturation. The forward flip-flop, consisting of Q4 and Q5, is then in the set state. The FWD (-) output is at -6 volts.

When the MASTER RESET input momentarily goes to zero volts, CR6 is forward biased and the voltage at the base of Q5 swings positive, which causes Q5 to be cut off. The negative-going voltage at the collector of Q5 is coupled through R11 to the base of Q4; the negative-going voltage drives Q4 to saturation. The forward flip-flop is then in the reset state. The FWD (-) output is at zero volts.

When the BOT input makes a positive transition from -6 volts to 0 volts, a +6 volt pulse is produced by the differentiator circuit comprised of R18 and C12 and is coupled through OR gate diode CR13 to the base of Q5; the positive pulse resets the forward flip-flop. The FWD (-) output is at zero volts.

\*Run/Stop and Fwd/Rev inputs.

2. THEORY OF OPERATION. (Continued)

For mechanization of logic equation (a), the FWD/REV input must be at -12 volts, the UNIT SELECT input must be at 0 volts, and the RUN/STOP input must make a negative transition from 0 volts to -12 volts. With the FWD/REV input at -12 volts, Q9 is cut off. When Q9 is cut off, AND gate transistor Q10 is cut off, which allows control of the AND gate output by the input to AND gate diode CR21. When the RUN/STOP input goes to -12 volts, Q6 and Q7 are cut off; CR21 is forward biased and Q8 is biased to saturation. The UNIT SELECT input at 0 volts enables the differentiator AND gate circuit comprised of R20 and C14 and a +6 volt pulse is coupled through OR gate diode CR11 to the base of Q4; the positive pulse sets the forward flip-flop. The FWD (-) output is at -6 volts. The negative pulse from C13 back biases OR gate diode CR12 and has no effect on the forward flip-flop circuit. When Q9 is cut off, AND gate diode CR23 is forward biased, which causes Q11 to be cut off. The negative pulse from C15 back biases CR19 and has no effect on the reverse flip-flop circuit.

For mechanization of logic equation (b), the REWINDING input must be at 0 volts and the BOT input must make a negative transition from 0 volts to -6 volts. When the BOT input goes to -6 volts, Q3 is biased to saturation. The REWINDING input at 0 volts enables the differentiator AND gate circuit comprised of R14 and C10 and a +6 volt pulse is coupled through OR gate diode CR10 to the base of Q4; the positive pulse sets the forward flip-flop. The FWD (-) output is at -6 volts.

For mechanization of logic equation (c), the UNIT SELECT input must be at 0 volts and the RUN/STOP input must make a positive transition from -12 volts to 0 volts. When the RUN/STOP input goes to 0 volts, Q6 and Q7 are biased to saturation and Q8 is cut off. The UNIT SELECT input at 0 volts enables the differentiator AND gate circuit comprised of R19 and C13 and a +6 volt pulse is coupled through OR gate diode CR12 to the base of Q5; the positive pulse resets the forward flip-flop. The FWD (-) output is at 0 volts. The negative pulse from C14 back biases OR gate diode CR11 and has no effect on the forward flip-flop circuit.

For mechanization of logic equation (d), the LOCAL input must be at 0 volts and the EOT input must make a positive transition from -6 volts to 0 volts. The LOCAL input at 0 volts enables the differentiator AND gate circuit comprised of R15 and C11 and a +6 volt pulse is coupled through OR gate diode CR14 to the base of Q5; the positive pulse resets the forward flip-flop. The FWD (-) output is at 0 volts.

FWD (+) Output (Pin 26). FWD (+) output is the complement signal of FWD (-). Output voltages and their derivations are the same.

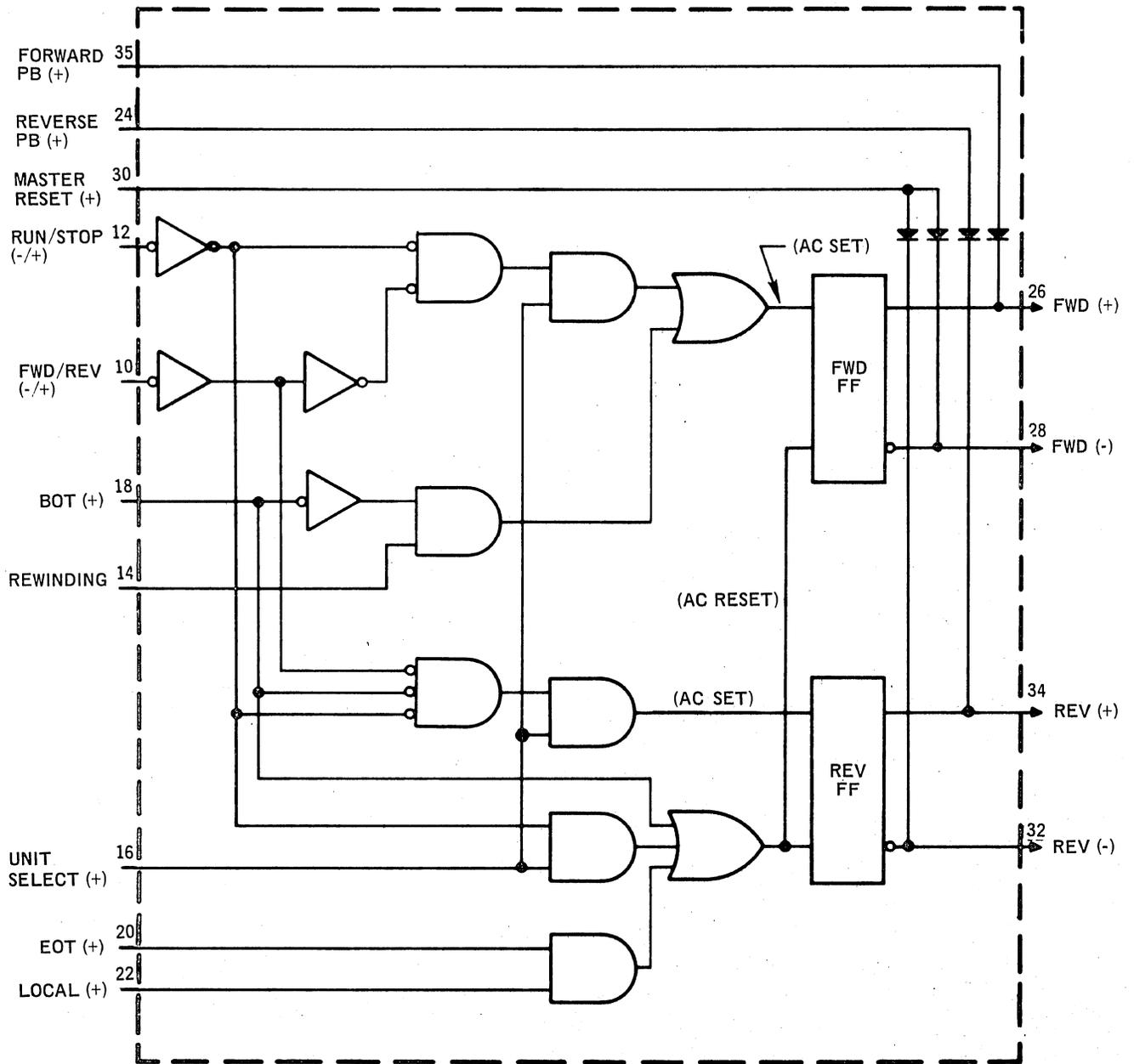


Figure 1  
 Forward/Reverse Logic, Logic Diagram  
 (3107082-10)

2. THEORY OF OPERATION. (Continued)

REV (+) Output (Pin 34). REV (+) output can be affected by REVERSE PB input, MASTER RESET input, BOT input, or mechanization of one of the following logic equations:

$$(a) \text{ REV (+) = (REV) (RUN) (UNIT SELECT) } \overline{\text{(BOT)}}$$

$$(b) \overline{\text{REV (+)}} = \text{(STOP) (UNIT SELECT)}$$

$$(c) \overline{\text{REV (+)}} = \text{(EOT) (LOCAL)}$$

When the REVERSE PB input momentarily goes to zero volts, CR4 is forward biased and the voltage at the base of Q1 swings positive, which causes Q1 to be cut off. The negative-going voltage at the collector of Q1 is coupled through R2 to the base of Q2; the negative-going voltage drives Q2 to saturation. The reverse flip-flop, consisting of Q1 and Q2, is then in the set state. The REV (+) output is at zero volts.

When the MASTER RESET input momentarily goes to zero volts, CR1 is forward biased and the voltage at the base of Q2 swings positive, which causes Q2 to be cut off. The negative-going voltage at the collector of Q2 is coupled through R3 to the base of Q1; the negative-going voltage drives Q1 to saturation. The reverse flip-flop is then in the reset state. The REV (+) output is at -6 volts.

When the BOT input makes a positive transition from -6 volts to 0 volts, a +6 volt pulse is produced by the differentiator circuit comprised of R18 and C12 and is coupled through OR gate diode CR16 to the base of Q2; the positive pulse resets the reverse flip-flop. The REV (+) output is at -6 volts.

For mechanization of logic equation (a), the FWD/REV input must be at 0 volts, the UNIT SELECT input must be at 0 volts, the BOT input must be at -6 volts, and the RUN/STOP input must make a negative transition from 0 volts to -12 volts. With the FWD/REV input at 0 volts, Q9 is biased to saturation. When Q9 is saturated, AND gate diode CR23 is back biased, and AND gate transistor Q10 is biased to saturation. When Q10 is saturated, the AND gate comprised of Q10 and CR21 is disabled and Q8 is cut off. The BOT input at -6 volts back biases AND gate diode CR24; since CR23 is also back biased, the AND gate output is controlled by the input to AND gate diode CR22. When the RUN/STOP input goes to -12 volts, Q6 and Q7 are cut off; CR22 is back biased, which causes Q11 to be biased to saturation. The UNIT SELECT input at 0 volts enables the differentiator AND gate circuit comprised of R21 and C15 and a +6 volt pulse is coupled through CR19 to the base of Q1; the positive pulse sets the reverse flip-flop. The REV (+) output is at zero volts. The negative pulse from C13 back biases OR gate diode CR15 and has no effect on the reverse flip-flop circuit. The negative pulse from C14 back biases OR gate diode CR11 and has no effect on the reverse flip-flop circuit.

2. THEORY OF OPERATION. (Continued)

For mechanization of logic equation (b), the UNIT SELECT input must be at 0 volts and the RUN/STOP input must make a positive transition from -12 volts to 0 volts. When the RUN/STOP input goes to 0 volts, Q6 and Q7 are biased to saturation and Q11 is cut off. The UNIT SELECT input at 0 volts enables the differentiator AND gate circuit comprised of R19 and C13 and a +6 volt pulse is coupled through OR gate diode CR15 to the base of Q2; the positive pulse resets the reverse flip-flop. The REV (+) output is at -6 volts. The negative pulse from C15 back biases CR19 and has no effect on the reverse flip-flop circuit.

For mechanization of logic equation (c), the LOCAL input must be at 0 volts and the EOT input must make a positive transition from -6 volts to 0 volts. The LOCAL input at 0 volts enables the differentiator AND gate circuit comprised of R15 and C11 and a +6 volt pulse is coupled through OR gate diode CR17 to the base of Q2; the positive pulse resets the reverse flip-flop. The REV (+) output is at -6 volts.

REV (-) Output (Pin 32). REV (-) output is the complement signal of REV (+). Output voltages and their derivations are the same.

3. POWER REQUIREMENTS.

VOLTAGE	CURRENT
+12 VDC $\pm 3\%$	32 ma max
-12 VDC $\pm 3\%$	82 ma max
-6 VDC $\pm 4\%$	40 ma max

TABLE 1  
FORWARD/REVERSE LOGIC, INPUT SIGNAL LEVELS

PIN NO.	SIGNAL DESIGNATION	HIGH LEVEL	LOW LEVEL
10	Fwd/Rev (-/+)	0 to -1 volt	-8.5 to -12 volts
12	Run/Stop (-/+)	0 to -1 volt	-8.5 to -12 volts
14	Rewinding (+)	0 to -0.5 volt	-5.8 to -7 volts
16	Unit Select (+)	0 to -0.5 volt	-5 to -6.2 volts
18	BOT (+)	0 to -1 volt	-5.9 to -6.6 volts
20	EOT (+)	0 to -1 volt	-5.9 to -6.6 volts
22	Local (+)	0 to -0.5 volt	-5 to -6.2 volts
24	Reverse PB (+)	0 volts	Open circuit
30	Master Reset (+)	0 to -0.5 volt	-7 to -12.36 volts
35	Forward PB (+)	0 volts	Open circuit

TABLE 2  
FORWARD/REVERSE LOGIC, OUTPUT SIGNAL LEVELS

PIN NO.	SIGNAL DESIGNATION	HIGH LEVEL	LOW LEVEL
26	Fwd (+)	0 to -1 volt	-5.9 to -6.6 volts
28	Fwd (-)	0 to -1 volt	-5.9 to -7 volts
32	Rev (-)	0 to -1 volt	-5.9 to -6.6 volts
34	Rev (+)	0 to -1 volt	-5.9 to -7 volts

1. GENERAL DESCRIPTION.

The forward/reverse logic PCB provides all logic necessary to perform the forward/reverse function. Ten input signals are mechanized to provide four output signals for forward/reverse operation. Signal levels used in the following circuit descriptions are nominal. Tables 1 and 2 list operating signal levels.

2. THEORY OF OPERATION. (See Figure 1.)

FWD (-) Output (Pin 28). FWD (-) output can be affected by FORWARD PB input, MASTER RESET input, BOT input, or mechanization of one of the following logic equations:

- (a)  $FWD (-) = (FWD) (UNIT\ SELECT)$
- (b)  $FWD (-) = (BOT\ going\ off\ tab) (REWINDING)$
- (c)  $\overline{FWD} (-) = (STOP) (UNIT\ SELECT)$
- (d)  $\overline{FWD} (-) = (EOT) (LOCAL)$

When the FORWARD PB input momentarily goes to zero volts, CR13 is forward biased and the voltage at the base of Q1 swings positive, which causes Q1 to be cut off. The negative-going voltage at the collector of Q1 is coupled through R2 to the base of Q2, causing Q2 to saturate. The forward flip-flop, consisting of Q1 and Q2, is then in the set state. The FWD (-) output is at -6 volts.

When the MASTER RESET input momentarily goes to zero volts, CR1 is forward biased and the voltage at the base of Q2 swings positive, which causes Q2 to be cut off. The negative-going voltage at the collector of Q2 is coupled through R3 to the base of Q1, causing Q1 to saturate. The forward flip-flop is then in the reset state. The FWD (-) output is at zero volts.

When the BOT input makes a positive transition from -6 volts to 0 volts, a +6 volt pulse is produced by the differentiator circuit comprised of C12 and R23 and is coupled through OR gate diode CR12 to the base of Q2; the positive pulse resets the forward flip-flop. The FWD (-) output is at zero volts.

For mechanization of logic equation (a), the UNIT SELECT input must be at 0 volts and the FWD/STOP input must make a negative transition from 0 volts to -12 volts. When the FWD/STOP input goes to -12 volts, Q6 and Q7 are cut off and Q8 is saturated. The UNIT SELECT input at 0 volts enables the differentiator circuit comprised of C14 and R21 and a

\* Fwd/Stop and Rev/Stop inputs.

2. THEORY OF OPERATION. (Continued)

+6 volt pulse is coupled through OR gate diode CR9 to the base of Q1; the positive pulse sets the forward flip-flop. The FWD (-) output is at -6 volts. The negative pulse from C13 back biases OR gate diode CR10 and has no effect on the forward flip-flop circuit.

For mechanization of logic equation (b), the REWINDING input must be at 0 volts and the BOT input must make a negative transition from 0 volts to -6 volts. When the BOT input goes to -6 volts, Q3 is biased to saturation. The REWINDING input at 0 volts enables the differentiator circuit comprised of C10 and R18 and a +6 volt pulse is coupled through OR gate diode CR8 to the base of Q1; the positive pulse sets the forward flip-flop. The FWD (-) output is at -6 volts.

For mechanization of logic equation (c), the UNIT SELECT input must be at 0 volts and the FWD/STOP input must make a positive transition from -12 volts to 0 volts. When the FWD/STOP input goes to 0 volts, Q6 and Q7 are saturated and Q8 is cut off. The UNIT SELECT input at 0 volts enables the differentiator circuit comprised of C13 and R19 and a +6 volt pulse is coupled through OR gate diode CR10 to the base of Q2; the positive pulse resets the forward flip-flop. The FWD (-) output is at zero volts. The negative pulse from C14 back biases OR gate diode CR9 and has no effect on the forward flip-flop circuit.

For mechanization of logic equation (d), the LOCAL input must be at 0 volts and the EOT input must make a positive transition from -6 volts to 0 volts. The LOCAL input at 0 volts enables the differentiator circuit comprised of C11 and R22 and a +6 volt pulse is coupled through OR gate diode CR11 to the base of Q2; the positive pulse resets the forward flip-flop. The FWD (-) output is at zero volts.

FWD (+) Output (Pin 26). FWD (+) output is the complement signal of FWD (-). Output voltages and their derivations are the same.

REV (+) Output (Pin 34). REV (+) output can be affected by REVERSE PB input, MASTER RESET input, BOT input, or mechanization of one of the following logic equations:

$$(a) \text{ REV (+) = (REV) (UNIT SELECT) } \overline{\text{(BOT)}}$$

$$(b) \overline{\text{REV (+)}} = \text{(STOP) (UNIT SELECT)}$$

$$(c) \overline{\text{REV (+)}} = \text{(EOT) (LOCAL)}$$

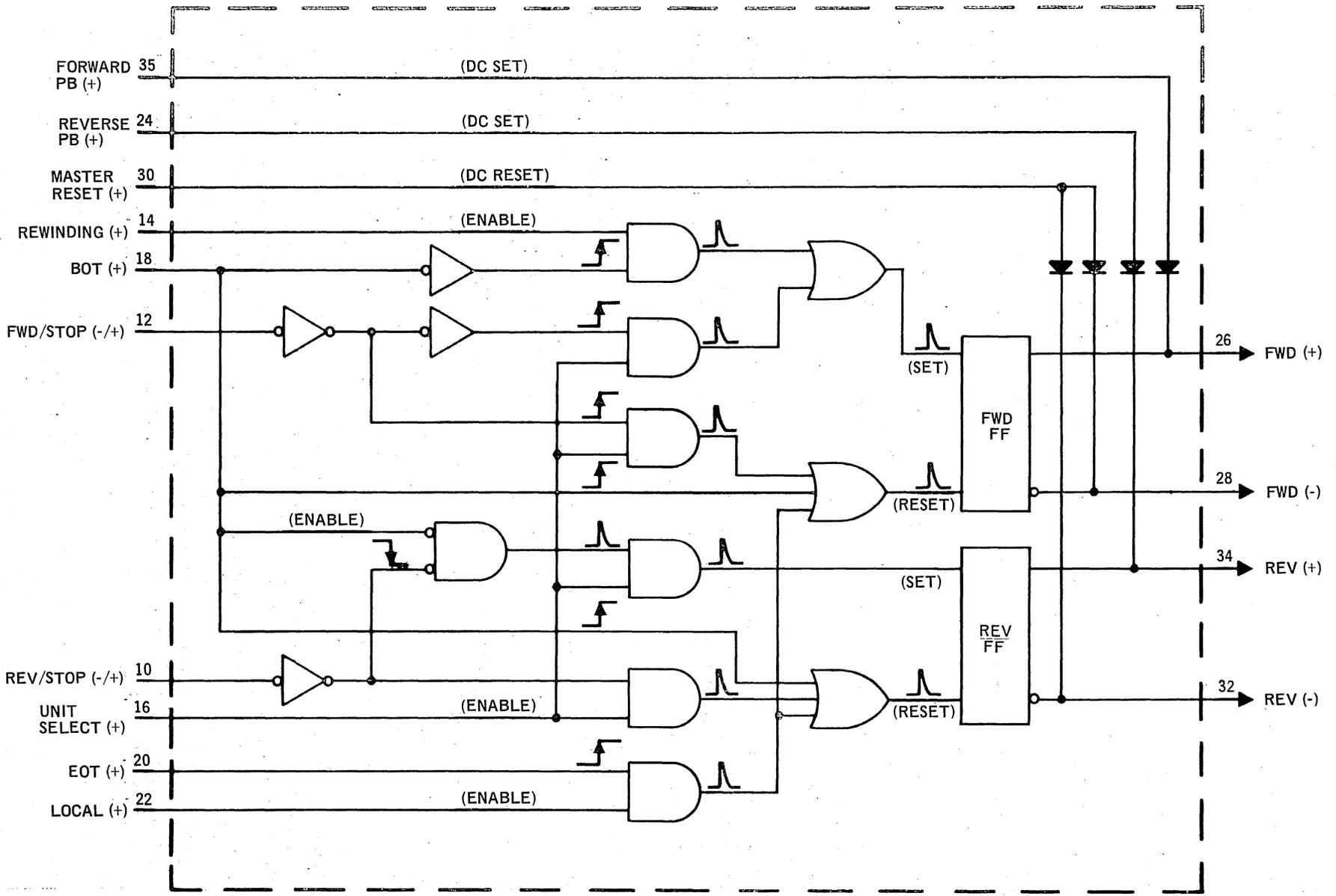


Figure 1  
 Forward/Reverse Logic -C, Logic Diagram  
 (3112360-10)

## 2. THEORY OF OPERATION. (Continued)

When the REVERSE PB input momentarily goes to zero volts, CR6 is forward biased and the voltage at the base of Q4 swings positive, which causes Q4 to be cut off. The negative-going voltage at the collector of Q4 is coupled through R9 to the base of Q5, causing Q5 to saturate. The reverse flip-flop, consisting of Q4 and Q5, is then in the set state. The REV (+) output is at zero volts.

When the MASTER RESET input momentarily goes to zero volts, CR4 is forward biased and the voltage at the base of Q5 swings positive, which causes Q5 to be cut off. The negative-going voltage at the collector of Q5 is coupled through R10 to the base of Q4, causing Q4 to saturate. The reverse flip-flop is then in the reset state. The REV (+) output is at -6 volts.

When the BOT input makes a positive transition from -6 volts to 0 volts, a +6 volt pulse is produced by the differentiator circuit comprised of C12 and R23 and is coupled through OR gate diode CR13 to the base of Q5; the positive pulse resets the reverse flip-flop. The REV (+) output is at -6 volts.

For mechanization of logic equation (a), the UNIT SELECT input must be at 0 volts, the BOT input must be at -6 volts, and the REV/STOP input must make a negative transition from 0 volts to -12 volts. The BOT input at -6 volts back biases AND gate diode CR22, which allows the input at AND gate diode CR21 to control Q11. When the REV/STOP input goes to -12 volts, Q9 and Q10 are cut off. CR21 is back biased, which allows the voltage at the base of Q11 to go positive; Q11 becomes saturated. The UNIT SELECT input at 0 volts enables the differentiator circuit comprised of C16 and R24 and a +6 volt pulse is coupled through CR16 to the base of Q4; the positive pulse sets the reverse flip-flop. The REV (+) output is at zero volts. The negative pulse from C15 back biases OR gate diode CR15 and has no effect on the reverse flip-flop circuit.

For mechanization of logic equation (b), the UNIT SELECT input must be at 0 volts and the REV/STOP input must make a positive transition from -12 volts to 0 volts. When the REV/STOP input goes to 0 volts, Q9 and Q10 are saturated. The UNIT SELECT input at 0 volts enables the differentiator circuit comprised of C15 and R20 and a +6 volt pulse is coupled through OR gate diode CR15 to the base of Q5 the positive pulse resets the reverse flip-flop. The REV (+) output is at -6 volts. If CR22 is back biased, Q11 is cut off. The negative pulse from C16 back biases CR16 and has no effect on the reverse flip-flop circuit.

2. THEORY OF OPERATION. (Continued)

For mechanization of logic equation (c), the LOCAL input must be at 0 volts and the EOT input must make a positive transition from -6 volts to 0 volts. The LOCAL input at 0 volts enables the differentiator circuit comprised of C11 and R22 and a +6 volt pulse is coupled through OR gate diode CR14 to the base of Q5; the positive pulse resets the reverse flip-flop. The REV (+) output is at -6 volts.

REV (-) Output (Pin 32). REV (-) output is the complement signal of REV (+). Output voltages and their derivations are the same.

3. POWER REQUIREMENTS.

VOLTAGE	CURRENT
+12 VDC $\pm 3\%$	32 ma max
-12 VDC $\pm 3\%$	82 ma max
- 6 VDC $\pm 4\%$	40 ma max

TABLE 1  
FORWARD/REVERSE LOGIC -C, INPUT SIGNAL LEVELS

PIN NO.	SIGNAL DESIGNATION	LOW LEVEL	HIGH LEVEL
10	Rev/Stop (-/+)	0 to -1 volt	-8.5 to -12 volts
12	Fwd/Stop (-/+)	0 to -1 volt	-8.5 to -12 volts
14	Rewinding (+)	0 to -0.5 volt	-5.6 to -6.6 volts
16	Unit Select (+)	0 to -0.5 volt	-5 to -6.2 volts
18	BOT (+)	0 to -1 volt	-5.9 to -6.6 volts
20	EOT (+)	0 to -1 volt	-5.9 to -6.6 volts
22	Local (+)	0 to -0.5 volt	-5 to -6.2 volts
24	Reverse PB (+)	0 volts	Open circuit
30	Master Reset (+)	0 to -0.5 volt	-7 to -12.36 volts
35	Forward PB (+)	0 volts	Open circuit

TABLE 2  
FORWARD/REVERSE LOGIC -C, OUTPUT SIGNAL LEVELS

PIN NO.	SIGNAL DESIGNATION	LOW LEVEL	HIGH LEVEL
26	Fwd (+)	0 to -1 volt	-5.9 to -6.6 volts
28	Fwd (-)	0 to -1 volt	-5.9 to -7 volts
32	Rev (-)	0 to -1 volt	-5.9 to -6.6 volts
34	Rev (+)	0 to -1 volt	-5.9 to -7 volts

1. GENERAL DESCRIPTION.

The local/remote logic PCB provides all logic necessary to perform the local/remote functions. Seven input signals are mechanized to provide ten output signals for local/remote operation. REMOTE PB input is the only input which permits transfer from local to remote operation. Transfer from remote to local is accomplished in several ways as explained in the text. Signal levels used in the following circuit descriptions are nominal. Refer to Tables 1 and 2 for operating signal levels.

2. THEORY OF OPERATION. (See Figure 1.)

TRANSPORT READY (-) Input (Pin 13). The TRANSPORT READY (-) input must be at -12 volts before normal tape drive will be enabled. When the TRANSPORT READY (-) input is at 0 volts, Q4 conducts and -6 volts is applied through forward biased CR10 to the base of Q6. The READY (+) output is -6 volts. Q6 conducts and the MASTER RESET (+) output goes to 0 volts. The MASTER RESET (+) output sets the flip-flops in the forward/reverse logic PCB to the stop condition, preventing tape motion. The 0 volt output from Q6 also forward biases CR9 and CR12, which disables the LOCAL INDICATOR (+) and REMOTE INDICATOR (+) outputs.

When the TRANSPORT READY (-) input is at -12 volts, Q4 is cut off and the READY (+) output goes to +6 volts, developed by voltage divider resistors R31 and R30. Q6 is cut off and the MASTER RESET (+) output goes to -12 volts. CR9 and CR12 are back biased, enabling the input to the LOCAL INDICATOR (+) and REMOTE INDICATOR (+) circuits. CR7 is back biased, enabling the local/remote flip-flop circuit.

When the TRANSPORT READY (-) input goes to 0 volts, Q4 conducts and -6 volts is applied through CR7 and R10 to the base of Q1 and Q1 conducts. When Q1 conducts, Q2 is cut off and Q3 conducts. The OCP ENABLE (+) and the LOCAL (+) outputs go to 0 volts. CR14 is forward biased and disables the SELECT (-) input.

LOCAL PB Input (Pin 30). When the LOCAL PB input is at 0 volts and TRANSPORT READY (-) input is at -12 volts, Q2 is cut off by the voltage applied through CR3 and R4. With Q2 cut off, Q1 and Q3 are conducting, and the OCP ENABLE (+) and LOCAL (+) outputs go to 0 volts. CR8 and CR9 are back biased and enable the local indicator driver circuit. Q7 and Q8 are conducting and the LOCAL INDICATOR (+) output is 0 volts. CR14 is forward biased and disables the SELECT (-) input. Q14 conducts and the SELECT & REMOTE (-) output is 0 volts. The SELECT & REMOTE INDICATOR (+) output driver circuits are disabled. Q12 conducts and Q13 is cut off. The UNIT SELECT (-) output goes to 0 volts. The LOCAL (-) output goes to -6 volts. CR11 is forward biased and disables the REMOTE INDICATOR (+) driver circuit.

2. THEORY OF OPERATION. (Continued)

RESET PB Input (Pin 28). When the RESET (STOP) PB input is at 0 volts and the TRANSPORT READY (-) input is at -12 volts, Q2 is cut off by the voltage applied through CR5 and R4. The circuit then operates the same as described for LOCAL PB input.

GO LOCAL (-) Input (Pin 22). When the GO LOCAL (-) input is at -6 volts and the TRANSPORT READY (-) input is at -12 volts, Q1 is biased on by the voltage applied through CR6 and R10. The circuit then operates the same as described for LOCAL PB input.

REMOTE PB Input (Pin 26). When the REMOTE PB input is at 0 volts and the TRANSPORT READY (-) input is at -12 volts, Q1 is cut off by the voltage applied through CR4 and R5. When Q1 is cut off, Q2 conducts and Q3 is cut off. The OCP ENABLE (+) output goes to 0 volts. CR8 is forward biased and disables the LOCAL INDICATOR driver circuit. CR11 and CR12 are back biased and enable the REMOTE INDICATOR circuit. Q9 and Q10 are conducting and the REMOTE INDICATOR (+) output is 0 volts. CR14 is back biased and the SELECT (-) input is enabled.

SELECT (-) Input (Pin 9). When the circuits are in the condition described for REMOTE PB input and the TRANSPORT READY (-) is at -12 volts, a SELECT (-) input at -12 volts cuts off Q11. When Q11 is cut off, Q12 is cut off and Q13 conducts. The UNIT SELECT (-) output goes to -6 volts. Q14 is cut off and Q15 and Q16 are conducting. The SELECT & REMOTE (-) output goes to -12 volts and the SELECT & REMOTE INDICATOR (+) output goes to 0 volts.

OCP RESET (+) Input (Pin 11). When the OCP RESET (+) input is at 0 volts, Q5 conducts and the READY (+) output goes to -6 volts. Q6 conducts and the MASTER RESET (+) output goes to 0 volts. CR9 and CR12 are forward biased and disable the local and remote indicator driver circuits.

When the OCP RESET (+) input is at -12 volts, Q5 is cut off.

3. POWER REQUIREMENTS.

VOLTAGE	CURRENT
+12 VDC $\pm 3\%$	8 ma max
-12 VDC $\pm 3\%$	43 ma max
- 6 VDC $\pm 4\%$	11 ma max

TABLE 1  
LOCAL/REMOTE LOGIC, INPUT SIGNAL LEVELS

PIN NO.	SIGNAL DESIGNATION	HIGH LEVEL	LOW LEVEL
9	Select (-)	0 $\pm$ 1.25 volts	-12 $\pm$ 2 volts
11	OCP Reset (+)	0 volts	Open circuit
13	Transport Ready (-)	Open circuit	-10.0 to -12.36 volts
22	Go Local (-)	0 to -1 volt	-5.8 to -7 volts
26	Remote PB (+)	0 volts	Open circuit
28	Reset PB (+)	0 volts	Open circuit
30	Local PB (+)	0 volts	Open circuit

TABLE 2  
LOCAL/REMOTE LOGIC, OUTPUT SIGNAL LEVELS

PIN NO.	SIGNAL DESIGNATION	HIGH LEVEL	LOW LEVEL
15	Ready (+)	+4 to +6 volts	-4 to -6.2 volts
16	Unit Select (-)	0 to -1 volt	-5 to -6.2 volts
17	Select & Remote (-)	0 to -0.5 volt	1.15K $\pm$ 10% returned to -11 volts $\pm$ 3 volts
18	Select & Remote Indicator (+)	0 to -0.5 volt	125 ohms $\pm$ 3% returned to ground
19	Local Indicator (+)	0 to -0.5 volt	125 ohms $\pm$ 3% returned to ground
20	Remote Indicator (+)	0 to -0.5 volt	125 ohms $\pm$ 3% returned to ground
24	Local (+)	0 to -0.5 volt	-5 to -6.2 volts
32	Local (-)	0 to -0.5 volt	-5 to -6.2 volts
34	OCP Enable (+)	0 to -0.5 volt	-10 to -12.36 volts
35	Master Reset (+)	0 to -0.5 volt	-7 to -12.36 volts



## 1. GENERAL DESCRIPTION.

The photoamplifier PCB assembly contains two identical circuits; one circuit is used in the BOT tab sense circuit, the second circuit is used in the EOT tab sense circuit. Each circuit comprises an input amplifier, a Schmitt trigger, an output driver, and a NAND gate/driver. (See Figure 1.) The NAND gate/driver is used with positive-logic input.

In the following circuit description, the BOT circuit is described. Operation of the EOT circuit is identical. Signal voltages used in the circuit description are nominal; refer to Tables 1 and 2 for operating voltage levels.

## 2. THEORY OF OPERATION.

Input Amplifier. Transistor Q1 is used in a common base configuration and operates class A, with the emitter voltage clamped to approximately -0.6 volt. The current through R3 is determined by the setting of potentiometer R2 since the common base configuration maintains constant voltage across R2 and R3. The current through R2 and R3 is provided by two parallel sources, Q1 and the photovoltaic cell (BOT sensor). As the amount of light striking the sensor increases, the current through it increases proportionally, thus decreasing the current demand on Q1 and decreasing the current through R1.

The back of the tape reflects a small amount of light, producing an off-tab or "gray" current. Potentiometer R2 is adjusted to provide output voltage levels from the input amplifier that will trigger the Schmitt trigger during the on-tab input condition, and permit the Schmitt trigger to return to the quiescent state during the off-tab input condition.

The output of transistor Q1 appears across collector load resistor R1 and is directly coupled to the base of Q2. Q2 isolates and amplifies the output of Q1. Capacitor C1 filters noise spikes from the output of Q1. The output of Q2 is coupled through R6 to the base of transistor Q3 in the Schmitt trigger.

Schmitt Trigger. When the current from the sensor is at the off-tab level, Q3 is saturated and Q4 is cut off. When the current increases to the on-tab level, Q3 is cut off by the negative-going voltage from Q2. Q4 is saturated and biases on Q5, the output driver. When Q5 conducts, the BOT (+) output goes to 0 volts. Q5 is cut off when the photocell current is at the off-tab level and the BOT (+) output is at -6 volts.

2. THEORY OF OPERATION. (Continued)

NAND Gate/Driver. CR1, CR2, and CR5 are the NAND gate/driver inputs. When the inputs to the NAND gate/driver are all 0 volts, Q6 is cut off and Q7 is saturated. The BOT (-) output is at -12 volts. When any of the NAND gate/driver inputs goes to -6 volts, Q6 conducts and Q7 is cut off. The BOT (-) output is at 0 volts.

An open-circuit input to the NAND gate/driver has the same effect as a 0 volt input.

Exciter Lamp (Pins 34 and 35). R1 is used as a dropping resistor when a 5-volt photocell exciter lamp is used. The lamp is driven by the -6 volt supply.

3. POWER REQUIREMENTS.

VOLTAGE	CURRENT
+12 VDC $\pm 3\%$	25 ma max
-12 VDC $\pm 3\%$	50 ma max

TABLE 1  
PHOTOAMPLIFIER TYPE C, INPUT SIGNAL LEVELS

PIN NO.	SIGNAL DESIGNATION	HIGH LEVEL	LOW LEVEL
9	BOT Sensor (+)	90 $\mu$ a min increase over low level (on tab)	0 to 100 $\mu$ a (off tab)
10	BOT Sensor Return		
11	REWINDING (-)	0 to -1 volt	-5.8 to -7 volts
12	UNIT SELECT (+)	0 to -1 volt	-5 to -6.2 volts
25	---*	0 to -1 volt	-5 to -12 volts
26	UNIT SELECT (+)	0 to -1 volt	-5 to -6.2 volts
28	EOT Sensor (+)	90 $\mu$ a min increase over low level (on tab)	0 to 100 $\mu$ a (off tab)
30	EOT Sensor Return		

\*Not presently used

TABLE 2  
PHOTOAMPLIFIER TYPE C, OUTPUT SIGNAL LEVELS

PIN NO.	SIGNAL DESIGNATION	HIGH LEVEL	LOW LEVEL
17	BOT (+)	0 to -0.5 volt	-6.5 volts min with 865 $\pm$ 86.5 ohm source impedance
18	BOT (-)	0 to -1.5 volts	-9.6 to -12.5 volts
19	EOT (-)	0 to -1.5 volts	-9.6 to -12.5 volts
20	EOT (+)	0 to -0.5 volt	-6.5 volts min with 865 $\pm$ 86.5 ohm source impedance

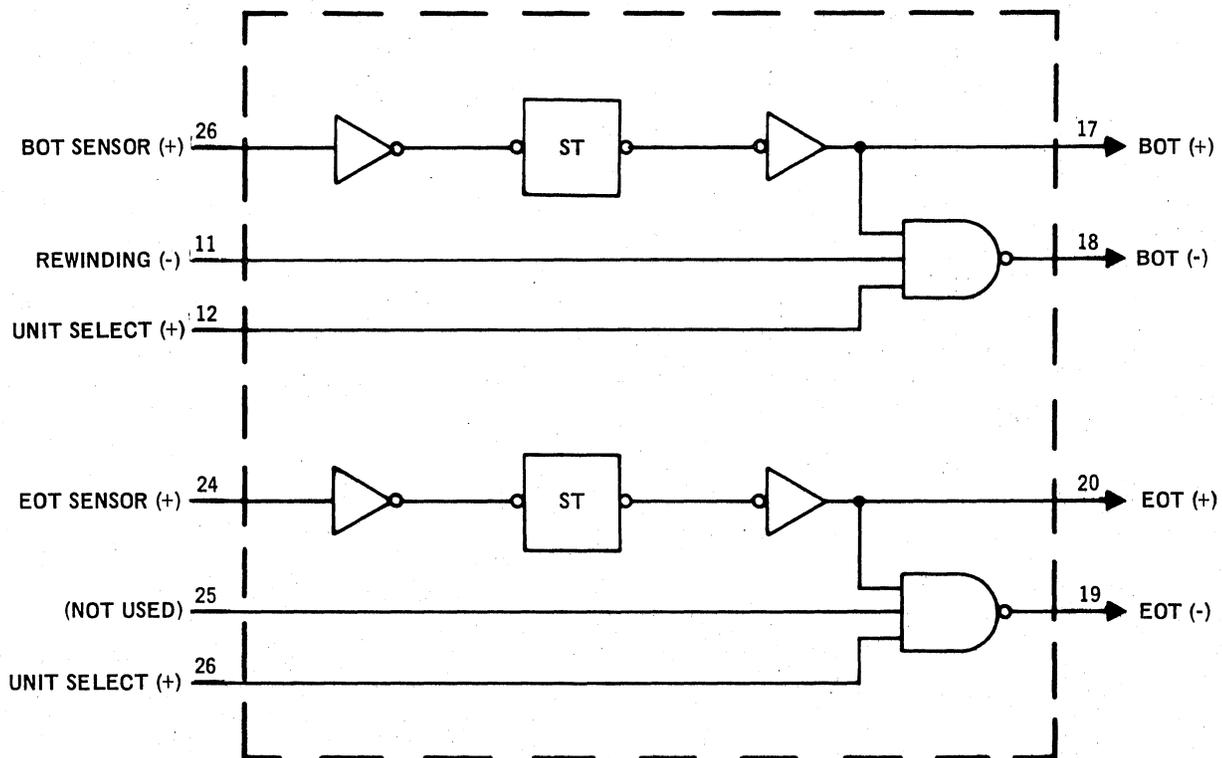


Figure 1  
Photoamplifier -C, Logic Diagram

1. GENERAL DESCRIPTION.

The rewind logic PCB assembly provides the logic necessary to perform the rewind function. Several unit select logic circuits are also located on the PCB assembly. (See Figure 1.) Signal levels used in the following circuit descriptions are nominal. Refer to Tables 1 and 2 for operating signal levels.

2. THEORY OF OPERATION.

REWIND (-) Output (Pin 28). The REWIND (-) output can be affected by the REWIND PB input, the MASTER RESET input, the BOT input, or the mechanization of one of the following logic equations.

$$(a) \text{ REWIND (-) } = (\text{REWIND COMMAND}) (\text{SELECT \& REMOTE})$$

$$(b) \text{ REWIND (-) } = (\text{REWIND \& LOCKOUT}) (\text{SELECT \& REMOTE})$$

When the REWIND PB input momentarily goes to zero volts, CR6 is forward biased and the voltage at the base of Q1 swings positive, which causes Q1 to be cut off. The negative-going voltage at the collector of Q1 is coupled through R2 to the base of Q2, causing Q2 to saturate. The rewind flip-flop, consisting of Q1 and Q2, is then in the set state. The REWIND (-) output is at -6 volts.

When the MASTER RESET input momentarily goes to zero volts, OR gate diode CR2 is forward biased and the voltage at the base of Q2 swings positive, which causes Q2 to be cut off. The negative-going voltage at the collector of Q2 is coupled through R4 to the base of Q1, causing Q1 to saturate. The rewind flip-flop is then in the reset state. The REWIND (-) output is at zero volts.

When the BOT input goes to zero volts, OR gate diode CR3 is forward biased and the rewind flip-flop is reset as described for the MASTER RESET input. The REWIND (-) output is at zero volts.

For mechanization of logic equation (a), the REWIND COMMAND and SELECT & REMOTE inputs must be at -12 volts. When the REWIND COMMAND input is at -12 volts, Q6 is cut off; AND gate transistor Q8 is also cut off. The SELECT & REMOTE input at -12 volts reverse biases AND gate diode CR13, thus allowing the collector voltage of Q8 to swing negative. The negative voltage is coupled through OR gate diode CR14 to the base of Q2; the negative voltage sets the rewind flip-flop. The REWIND (-) output is at -6 volts.

2. THEORY OF OPERATION. (Continued)

For mechanization of logic equation (b), the REWIND & LOCKOUT and SELECT & REMOTE inputs must be at -12 volts. When the REWIND & LOCKOUT input is at -12 volts, Q7 and Q9 are cut off. AND gate diode CR17 is reverse biased. The SELECT & REMOTE input at -12 volts reverse biases AND gate diode CR15, thus allowing negative voltage to be coupled through R32, OR gate diode CR16, and R31 to the base of Q2. The negative voltage sets the rewind flip-flop. The REWIND (-) output is at -6 volts.

REWIND (+) Output (Pin 26). The REWIND (+) output is the complement signal of the REWIND (-) output, and is derived by applying the REWIND (-) signal through inverter Q3. The output from Q3 is either 0 volts or -6 volts.

REWINDING (-) Output (Pin 32). The REWINDING (-) output can be affected by the MASTER RESET input, the transition to the set state of the rewind flip-flop, or the mechanization of the following logic equation.

$$\overline{\text{REWINDING (-)}} = (\text{FORWARD}) (\text{TIME DELAY})$$

When the MASTER RESET input momentarily goes to zero volts, CR8 is forward biased and the voltage at the base of Q5 swings positive, which causes Q5 to be cut off. The negative-going voltage at the collector of Q5 is coupled through R15 to the base of Q4, causing Q4 to saturate. The rewinding flip-flop, consisting of Q4 and Q5, is then in the reset state. The REWINDING (-) output is at zero volts.

When the rewind flip-flop goes from the reset to the set state, the positive-going voltage swing at the collector of Q3 is coupled (as a positive pulse) through C8 and CR9 to the base of Q4. The positive pulse cuts off Q4. The negative-going voltage at the collector of Q4 is coupled through R13 to the base of Q5, causing Q5 to saturate. The rewinding flip-flop is then in the set state. The REWINDING (-) output is at -6 volts.

For mechanization of the logic equation, the FORWARD (+) input must be at 0 volts and the TIME DELAY input must make a positive transition from -6 volts to 0 volts. The FORWARD (+) input at 0 volts enables the differentiator AND gate circuit comprised of R18 and C4 and a +6 volt pulse is coupled through CR12 to the base of Q5; the positive pulse resets the rewinding flip-flop. The REWINDING (-) output is at zero volts.

REWINDING (+) Output (Pin 30). The REWINDING (+) output is the complement signal of REWINDING (-). Output voltages and their derivations are the same.

2. THEORY OF OPERATION. (Continued)

GO LOCAL (-) Output (Pin 9). The GO LOCAL (-) output is affected by mechanization of the following logic equation.

$$\text{GO LOCAL (-)} = (\text{REWIND \& LOCKOUT}) (\text{Rewind FF set})$$

For mechanization of the logic equation, the REWIND & LOCKOUT input must be at -12 volts and the rewind flip-flop must be in the set state. The REWIND & LOCKOUT input at -12 volts cuts off Q7 and Q9. When Q9 is cut off, AND gate diode CR18 is reverse biased. When the rewind flip-flop is in the set state, AND gate diode CR19 is reverse biased. With both AND gate diodes reverse biased, the GO LOCAL (-) output goes to -6 volts.

UNIT SELECT (+) Output (Pin 17). The UNIT SELECT (+) output is controlled by the SELECT & REMOTE input. When the SELECT & REMOTE input is at -12 volts, Q10 is biased to saturation and the UNIT SELECT (+) output is at 0 volts. When the SELECT & REMOTE input is at 0 volts, Q10 is cut off and the UNIT SELECT (+) output goes to -6 volts.

REWINDING STATUS (-) Output (Pin 34). The REWINDING STATUS (-) output is affected by mechanization of the following logic equation.

$$\text{REWINDING STATUS (-)} = (\text{SELECT \& REMOTE}) (\text{Rewinding FF set})$$

For mechanization of the logic equation, the SELECT & REMOTE input must be at -12 volts and the rewinding flip-flop must be in the set state. The SELECT & REMOTE input at -12 volts causes Q10 to be saturated and 0 volts to be applied to AND gate diode CR21. When the rewinding flip-flop is in the set state, 0 volts is applied to AND gate diode CR20. With 0 volts applied to both AND gate diodes, Q12 is cut off and line-driver Q15 is biased to saturation. The REWINDING STATUS (-) output is -12 volts (through 125 ohm resistor R48).

When the input to either AND gate diode is negative, Q12 is biased to saturation and Q15 is cut off. The REWINDING STATUS (-) output is zero volts (through CR26).

HI/LO DENSITY STATUS (-/+ ) Output (Pin 19). The HI/LO DENSITY STATUS output is affected by the SELECT & REMOTE input and the HI/LO DENSITY input.

When the SELECT & REMOTE input is at -12 volts, Q10 is biased to saturation and 0 volts is applied to AND gate diode CR25. When the HI/LO DENSITY input is at -12 volts,

2. THEORY OF OPERATION. (Continued)

AND gate transistor Q11 is cut off. With the AND gate transistor cut off and 0 volts applied to the AND gate diode, Q14 is cut off and line driver Q17 is biased to saturation. The HI/LO DENSITY STATUS output is -12 volts (through 125 ohm resistor R50).

When either the SELECT & REMOTE input or the HI/LO DENSITY input is at 0 volts, Q14 is biased to saturation and Q17 is cut off. The HI/LO DENSITY STATUS output is zero volts (through CR28).

READY (-) Output (Pin 20). The READY (-) output is controlled by a three-input AND gate, consisting of diodes CR22, CR23, and CR24. When the inputs to the three AND gate diodes are all at 0 volts, Q13 is cut off and line driver Q16 is biased to saturation. The READY (-) output is -12 volts (through 125 ohm resistor R49).

When the input to any of the three AND gate diodes is at -6 volts (or more negative), Q13 is biased to saturation and Q16 is cut off. The READY (-) output is 0 volts (through CR27).

The input to CR22 is from the collector of Q10, which is at 0 volts when the SELECT & REMOTE input is at -12 volts. The input to CR23 is the READY (+) input. The input to CR24 is the READY INHIBIT (-) input.

3. POWER REQUIREMENTS.

VOLTAGE	CURRENT
+12 VDC $\pm 3\%$	8 ma max
-12 VDC $\pm 3\%$	81 ma max
-6 VDC $\pm 4\%$	18 ma max

TABLE 1  
REWIND LOGIC -C, INPUT SIGNAL LEVELS

PIN NO.	SIGNAL DESIGNATION	HIGH LEVEL	LOW LEVEL
11	REWIND & LOCKOUT (-)	0 $\pm$ 1.25 volts	-12 $\pm$ 2 volts
12	REWIND COMMAND (-)	0 $\pm$ 1.25 volts	-12 $\pm$ 2 volts
14	REWIND PB (+)	0 volts	Open circuit.
15	READY INHIBIT (-)	0 to -1 volt	-5.9 to -12 volts
16	SELECT & REMOTE (-)	0 to -1 volt	-10 to -12.36 volts
18	HI/LO DENSITY (-/+)	0 volts	-12 volts
21	BOT (+)	0 to -0.5 volt	-5.9 to -6.6 volts
22	TIME DELAY (+)	0 to -0.5 volt	-5.9 to -6.6 volts
24	FWD (+)	0 to -1 volt	-5.9 to -6.6 volts
33	READY (+)	+4 to +6.2 volts	-4.6 to -6.3 volts
35	MASTER RESET (+)	0 to -1 volt	-7 to -12.36 volts

TABLE 2  
REWIND LOGIC -C, OUTPUT SIGNAL LEVELS

PIN NO.	SIGNAL DESIGNATION	HIGH LEVEL	LOW LEVEL
9	GO LOCAL (-)	0 to -1 volt	-5.8 to -7 volts*
17	UNIT SELECT (+)	0 to -1 volt	-5 to -6.2 volts
19	HI/LO DENSITY STATUS (-/+)	0 to -1 volt	-10 to -12.36 volts
20	READY (-)	0 to -1 volt	-10 to -12.36 volts
26	REWIND (+)	0 to -1 volt	-5.8 to -7 volts
28	REWIND (-)	0 to -1 volt	-5.8 to -7 volts
30	REWINDING (+)	0 to -1 volt	-5.8 to -7 volts
32	REWINDING (-)	0 to -1 volt	-5.8 to -7 volts
34	REWINDING STATUS (-)	0 to -1 volt	-10 to -12.36 volts

\*Established by current flow through external circuits.

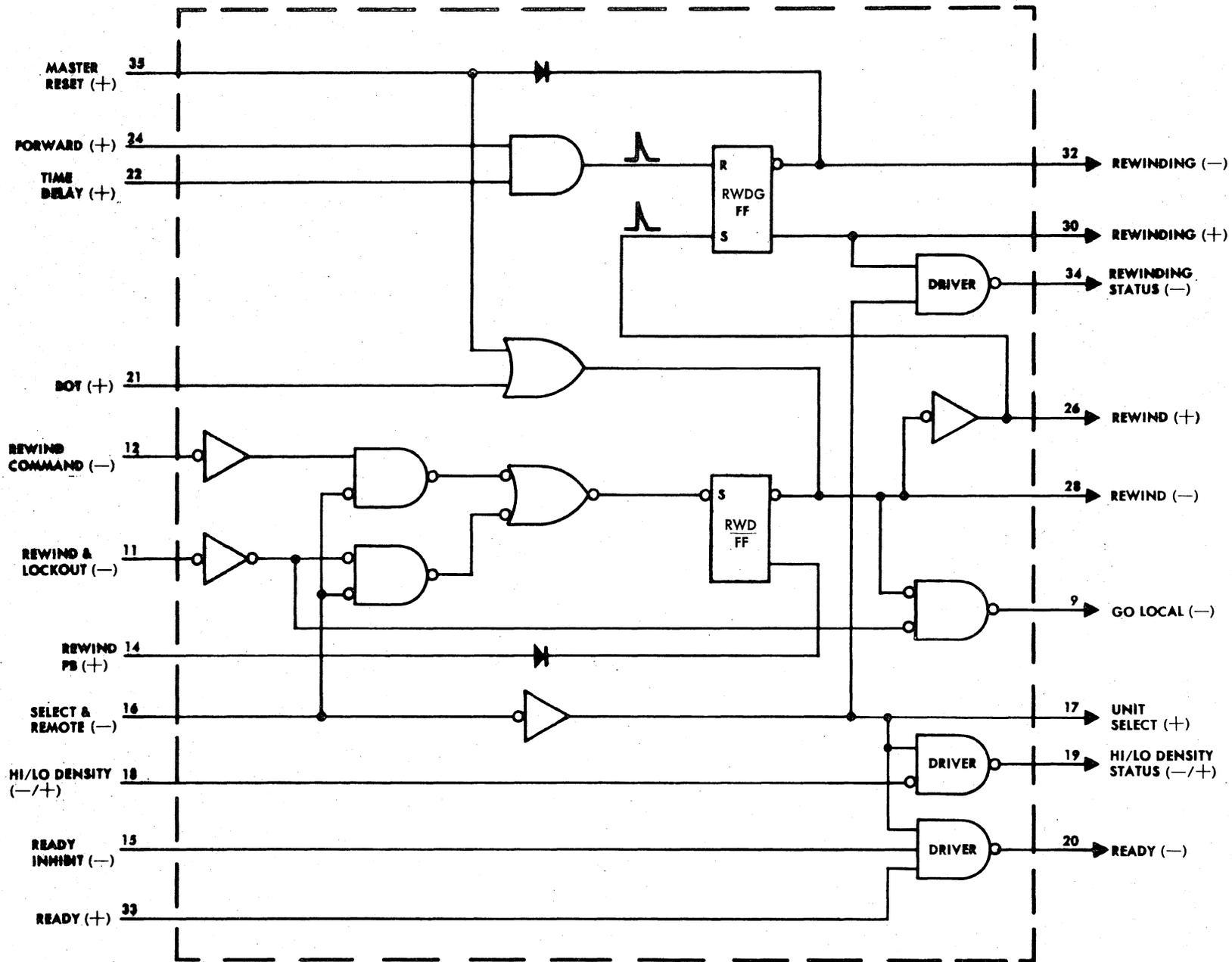


Figure 1  
Rewind Logic -C, Logic Diagram

## 1. GENERAL DESCRIPTION.

The reel servo preamplifier PCB assembly contains two similar preamplifiers and a time-delay circuit. (See Figure 1.) Each preamplifier consists of four switching circuits, a tachometer input circuit, and an output summing junction. The switching circuits are controlled by photoconductive cells located external to the PCB. One preamplifier functions in the file reel servo loop; the other functions in the fixed reel servo loop. In the following circuit descriptions, only the file reel servo circuit is discussed. Operation of the fixed reel servo circuit is identical except for reversal of the switching circuit input polarities.

## 2. THEORY OF OPERATION.

Photoconductive Cell Inputs (Pins 9, 10, 28, and 29). The inputs at pins 9, 10, 28, and 29 consist of separate photoconductive cells returned to -12 volts. The cell resistance is high or low depending on whether the cell is dark or illuminated. When the cell is dark, the resistance is 22K min. When the cell is illuminated, the resistance is 8.2K max.

FILE REEL TACH Input (Pin 15). The FILE REEL TACH input is a DC voltage that is proportional to the speed of the tape being supplied or taken up by the file reel. The voltage is negative for forward tape motion and positive for reverse tape motion. The input is approximately 0.08 volt/ips. Potentiometer R9 on the PCB assembly provides for adjustment of the current supplied to the output summing junction, thus providing speed control of the file reel tape motion.

CAPSTAN VELOCITY Input (Pin 19). The CAPSTAN VELOCITY input is a DC voltage directly proportional to the capstan velocity. The voltage is positive for forward tape motion and negative for reverse tape motion. The input voltage range is 0 to 24 volts. The CAPSTAN VELOCITY input is applied to the forward and reverse transistor switching circuits through isolation diodes CR2 and CR3.

Forward and Reverse Bias Voltage. Bias voltages are applied to the forward and reverse transistor switching circuits to provide a controlling output from the PCB assembly when the CAPSTAN VELOCITY and FILE REEL TACH inputs are at 0 volts. The bias voltages are provided by voltage divider resistors R4, R5, R7, and R12. R4 and R5 provide a positive voltage to the forward control circuits; R7 and R12 provide a negative voltage to the reverse control circuits.

## 2. THEORY OF OPERATION. (Continued)

Transistor Switching Circuits. Transistors Q10, Q11, Q14, and Q15 are the file reel transistor switches. Each transistor applies 0 volts at the center of a separate voltage divider circuit when the transistor conducts, effectively grounding the voltage applied to the input of the voltage divider circuit. Q10 and Q14 control voltage dividers that are supplied voltage by the positive CAPSTAN VELOCITY input and the forward bias circuit. Q11 and Q15 control voltage dividers that are supplied voltage by the negative CAPSTAN VELOCITY input and the reverse bias circuit.

Forward Operation. During forward operation, the FILE FEED REV (-) and FILE LOOP SENSE REV (-) inputs are at the low level (photocells illuminated) and Q11 and Q15 are biased on, disabling their respective voltage dividers. The FILE REEL TACH input is a negative voltage applied to the OUTPUT FILE output summing junction. The CAPSTAN VELOCITY input voltage is positive, and is applied through CR2 to R45 and R56, which are voltage divider resistors associated with Q10 and Q14, respectively. When both the FILE FEED FWD (-) and FILE LOOP SENSE FWD (-) inputs are at the high level (photocells dark), Q10 and Q14 are biased on, disabling their respective voltage dividers. The only input to the OUTPUT FILE output summing junction is the negative voltage from the FILE REEL TACH input, which produces a negative current flow from the summing junction to the external load (input circuit of reel servo driver).

When the FILE FEED FWD (-) input is at the low level (photocell illuminated), Q14 is cut off, enabling the associated voltage divider circuit. The CAPSTAN VELOCITY input voltage is then applied through the voltage divider circuit to the OUTPUT FILE output summing junction, where it is summed with the negative voltage from the FILE REEL TACH input. The voltage divider associated with Q14 provides an output voltage from the CAPSTAN VELOCITY input that is approximately equal to the voltage produced by the reel tachometer at a speed corresponding to 90 percent of the capstan tape velocity. Thus, when the reel tachometer tape speed is equal to 90 percent of the capstan tape velocity, the summed signal at the OUTPUT FILE output summing junction is zero, with no current flow into or out of the junction. When the reel tachometer tape speed is less than 90 percent of the capstan tape velocity, the summed signal at the OUTPUT FILE output summing junction is positive, with current flow into the junction from the external load; when the reel tachometer tape speed is greater than 90 percent of the capstan tape velocity, the summed signal is negative, with current flow out of the junction to the external load.

When the FILE LOOP SENSE FWD (-) input is also at the low level (photocell illuminated), Q10 is cut off, enabling the associated voltage divider circuit. The voltage dividers associated with Q10 and Q14 provide an output voltage from the CAPSTAN VELOCITY input that is approximately equal to the voltage produced by the reel tachometer at a tape speed

2. THEORY OF OPERATION. (Continued)

corresponding to 110 percent of the capstan tape velocity. Thus, when the reel tachometer tape speed is equal to 110 percent of the capstan tape velocity, the summed signal at the OUTPUT FILE output summing junction is zero, with no current flow into or out of the junction. When the reel tachometer tape speed is less than 110 percent of the capstan tape velocity, the summed signal at the OUTPUT FILE output summing junction is positive, with current flow into the junction from the external load; when the reel tachometer tape speed is greater than 110 percent of the capstan tape velocity, the summed signal is negative, with current flow out of the junction to the external load.

Reverse Operation. Reverse operation is identical to forward operation, except that Q11 and Q15 are the controlling transistor switches, with the voltage polarities reversed. Thus, reel tachometer tape speed less than the applicable 90 or 110 percent of capstan tape velocity produces a negative summed signal, with current flow out of the junction to the external load; reel tachometer tape speed greater than the applicable 90 or 110 percent of capstan tape velocity produces a positive summed signal, with current flow into the junction from the external load. The reel tachometer input is positive.

Stop Operation. When the CAPSTAN VELOCITY and FILE REEL TACH inputs are at zero volts, the forward and reverse bias voltages applied to the transistor switch voltage divider circuits allows the transistor switches to control the output voltage. When the FILE FEED FWD (-) input is at the low level, the voltage at the OUTPUT FILE output summing junction is positive; when the FILE FEED REV (-) input is at the low level, the voltage at the OUTPUT FILE output summing junction is negative. Current flow at the junction is not less than 40 microamperes in either direction.

OUTPUT FILE Output. When loaded by the input circuit of the reel servo driver PCB, the output current is between -400 and +400 microamperes, depending on the state of the transistor switches, the CAPSTAN VELOCITY input, and the FILE REEL TACH input. A current of 40 microamperes or more is required to "switch on" circuits in the reel servo driver PCB assembly. Zero current flow "switches off" the circuits in the reel servo driver PCB assembly.

Time-Delay Circuit. The time-delay circuit is comprised of an input buffer, a timing circuit coupled to a Schmitt trigger stage, a positive-level bypass circuit around the timing circuit and Schmitt trigger stage, and an output buffer stage.

2. THEORY OF OPERATION. (Continued)

When the REWIND (-) input at pin 8 is at -6 volts, input buffer Q1 is biased on. When Q1 conducts, Q2 and Q5 are biased on. Conduction through bypass circuit transistor Q2 establishes a negative voltage at the base of Q12; the negative voltage causes Q12 to conduct. When Q12 conducts, Q13 is cut off. The DELAYED REWIND (-) output at pin 14 is at -12 volts.

When Q5 conducts, timing capacitor C6 discharges rapidly through the relatively-low-resistance path of CR9, CR8, Q5, and R22. When C6 is discharged, the Schmitt trigger stage, consisting of Q8 and Q9 and component parts, is in the off condition; Q8 is cut off and Q9 is conducting.

When the input at pin 8 goes to zero volts, Q1, Q2, and Q5 are cut off. Q12 is held in conduction by the negative voltage established at its base by current flow through Q9. When Q5 is cut off, timing capacitor C6 starts charging through R28. After approximately 500 milliseconds, C6 is charged to the trigger voltage level of the Schmitt trigger stage. Diode CR12 is forward biased and diode CR13 is reversed biased, thus establishing a positive-voltage base-to-emitter condition at Q8. Q8 is biased on and cuts off Q9. When both Q9 and Q2 are cut off, Q12 is cut off and Q13 is biased to saturation. Thus, the DELAYED REWIND (-) output at pin 14 goes to zero volts approximately 500 milliseconds after the REWIND (-) input at pin 8 goes to zero volts.

3. POWER REQUIREMENTS.

VOLTAGE	CURRENT
+12 volts $\pm 3\%$	22 ma max
-12 volts $\pm 3\%$	22 ma max

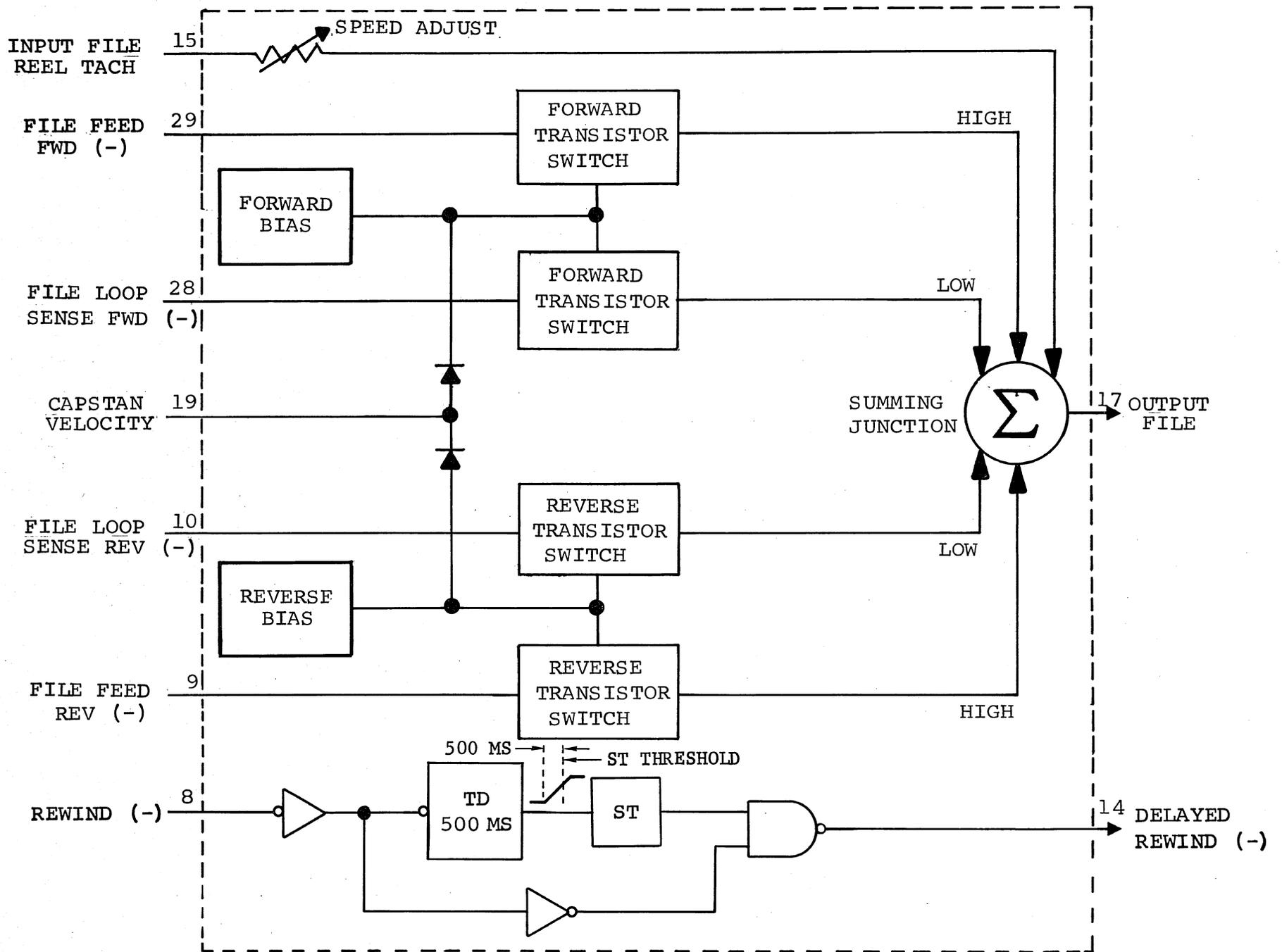


Figure 1  
Reel Servo Preamplifier, Block Diagram (Typical)

1. GENERAL DESCRIPTION.

The reel servo driver PCB assembly contains two identical sections; each section consists of a differential feedback amplifier stage and two trigger stages. (See Figure 1.)

2. THEORY OF OPERATION.

Differential Feedback Amplifier. The differential feedback amplifier consists of Q1, Q2, Q3, Q4, Q5, Q6, and associated component parts. The input circuit consists of dual transistor Q1, which is used in an emitter-coupled phase splitter configuration. Potentiometer R4 is adjusted for 0 volts between TP1 and TP2 with the input grounded (0 volt level). The input signal consists of a dc voltage varying from the zero volt level to a positive or negative voltage level. Emitter followers Q2 and Q6 isolate amplifier driver transistors Q3 and Q5 from the differential input circuit. R2 and R7 are the feedback resistors. Q4 stabilizes driver transistors Q3 and Q5 against drift caused by temperature variations and component aging. Capacitors C1 and C2 prevent high-frequency oscillation in the amplifier stage.

When the input signal is positive, current through emitter E1 of Q1 increases from the quiescent level. Collector C1 swings negative; collector C2 swings positive due to the emitter-coupled input change. Conduction through Q6 is decreased; conduction through Q2 is increased. Q5 conducts harder and the amplifier output at TP2 (forward drive) swings positive; Q3 conducts less and the output at TP1 (reverse drive) swings negative. The output at TP1 is applied to the input of the reverse trigger stage. The output at TP2 is applied to the input of the forward trigger stage.

When the input signal is negative, the output at TP1 swings positive and the output at TP2 swings negative.

Trigger Stages. The forward trigger stage consists of Q9, Q10, and associated component parts. The reverse trigger stage consists of Q7, Q8, and associated component parts. R17 and R25 in the input circuits establish the dead zone of the trigger stages and are selected to stabilize the loop gain of the reel servo system, thus preventing oscillation in the system.

When a positive input signal causes the current through R1 to exceed 40 microamperes (approximate) in the forward direction, the voltage at TP2 swings positive over the dead zone level and Q9 conducts. When Q9 conducts, Q10 is cut off and the voltage at output B goes up. The voltage at TP1 swings negative and Q7 remains cut off. When Q7 is cut off, Q8 conducts and the voltage at output A is zero volts.

2. THEORY OF OPERATION. (Continued)

When a negative input signal causes the current through R1 to exceed 40 microamperes (approximate) in the reverse direction, the reverse trigger is triggered on in the same manner as described for the forward trigger and the output A voltage goes up. Output B voltage remains at zero volts.

The input signal must return to zero volts (no current through R1) to cut off Q9 or Q7 once they have been conducting. When this occurs, output A or output B returns to the zero volt level.

3. POWER REQUIREMENTS.

VOLTAGE	CURRENT
+12 VDC $\pm 3\%$	250 ma max
-12 VDC $\pm 3\%$	250 ma max

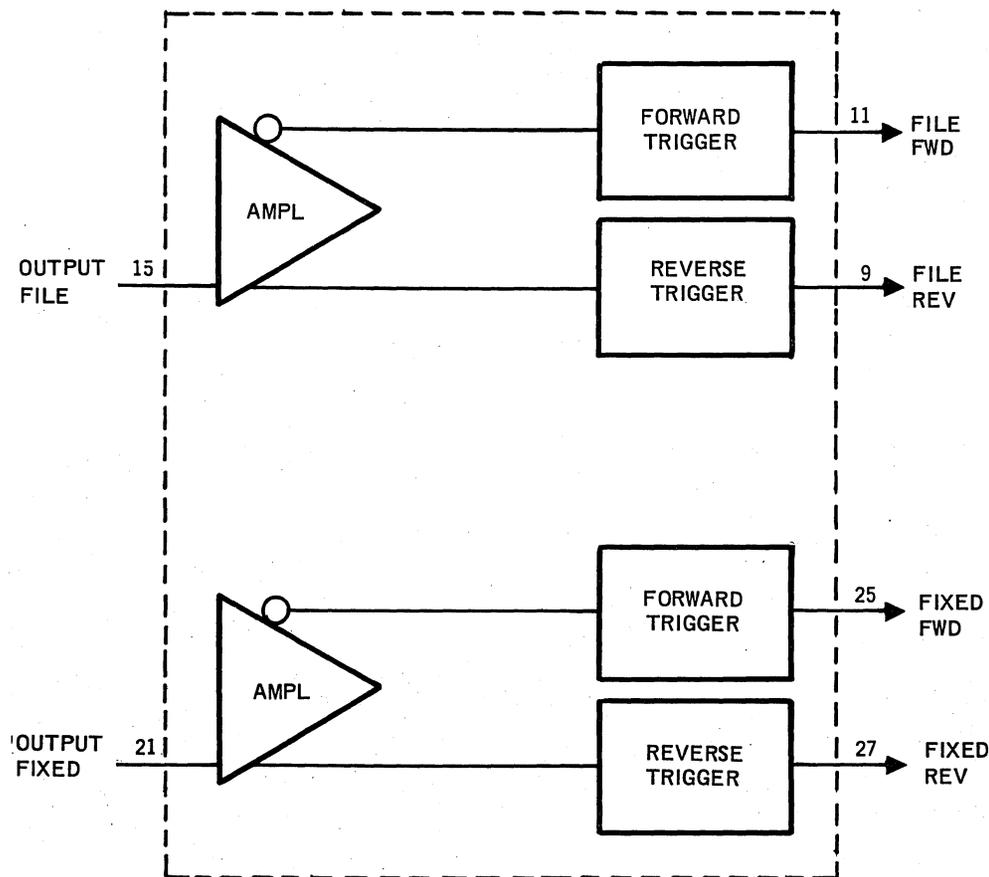


Figure 1  
Reel Servo Driver, Block Diagram

## SECTION VII DRAWINGS

### 7-1. INTRODUCTION.

Drawings in this section are located in the sequence shown in the following list. The control electronics logic diagrams are located at the end of the section.

#### LIST OF DRAWINGS

	<u>SCHEMATIC</u>	<u>ASSY DWG</u>
<u>Assemblies</u>		
Autotransformer	3110227	3110226
Blower (Specification)	---	3110287
Capstan Servo Supply		
Part No. 3110038-10	3110042	3110039
Part No. 3110037-10	3110041	3110039
Capstan Control Preamp CBA		
Part No. 3110049-10	*	3110049
Part No. 3110296-10	**	3110296
Control Electronics	3110105	3110102
Input/Output Panel	3110223	3110124
Logic Power Supply	3117242	3117241
Regulator Board PCB	***	3109853
Operator Control Panel	3110035	3110172
Reel Servo Electronics	3110138	3110218
Transport, Basic (Tape Deck)	3110036	3110020
Vacuum Blower	3115546	3115546
Vacuum Control	3114694	3114693
Vacuum Control Heat Sink	****	3114515
<u>Cable Diagrams</u>		
TM-11 (Without Data Electronics)	---	3110277
TM-11211 (With Data Electronics)	---	3110013

\*Circuit shown in Capstan Servo Supply schematic 3110042.

\*\*Circuit shown in Capstan Servo Supply schematic 3110041.

\*\*\*Circuit shown in Logic Power Supply schematic 3117242.

\*\*\*\*Circuit shown in Vacuum Control schematic 3114694.

LIST OF DRAWINGS  
(Continued)

<u>DESCRIPTION</u>	<u>SCHEMATIC</u>	<u>ASSY DWG</u>
<u>Outline and Installation Diagram</u>		
TM-11 & TM-12	---	3110012
<u>Printed Circuit Board Assemblies</u>		
CAC Capstan Acceleration -C	3114632	3114630
CIA Capstan Current Control	3114626	3116813
CVD Capstan Velocity -D	3114638	3114639
CVE Capstan Velocity -E	3119515	3119514
FLA Forward/Reverse Logic	3107083	3119599
FLC Forward/Reverse Logic -C	3112361	3118158
LLA Local/Remote Logic	3107103	3107260
PHC Photoamplifier -C	3110238	3110237
RLC Rewind Logic -C	3116168	3116183
RPB Reel Servo Preamplifier	3116175	3116174
RRA Reel Servo Driver	3110144	3113161
<u>Schematic Diagrams</u>		
TM-11 (Without Data Electronics)	3110023	---
TM-11211 (With Data Electronics)	3115575	---
<u>Control Electronics Logic Diagrams</u>		
Run/Stop-Fwd/Rev Logic	3110107	---
Fwd/Stop-Rev/Stop Logic	3115572	---

REVISIONS

ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
C	ECN 164-K	PRD	2 m 3/22/61	lee
D	ECN 4388		10/1/61	R.L.

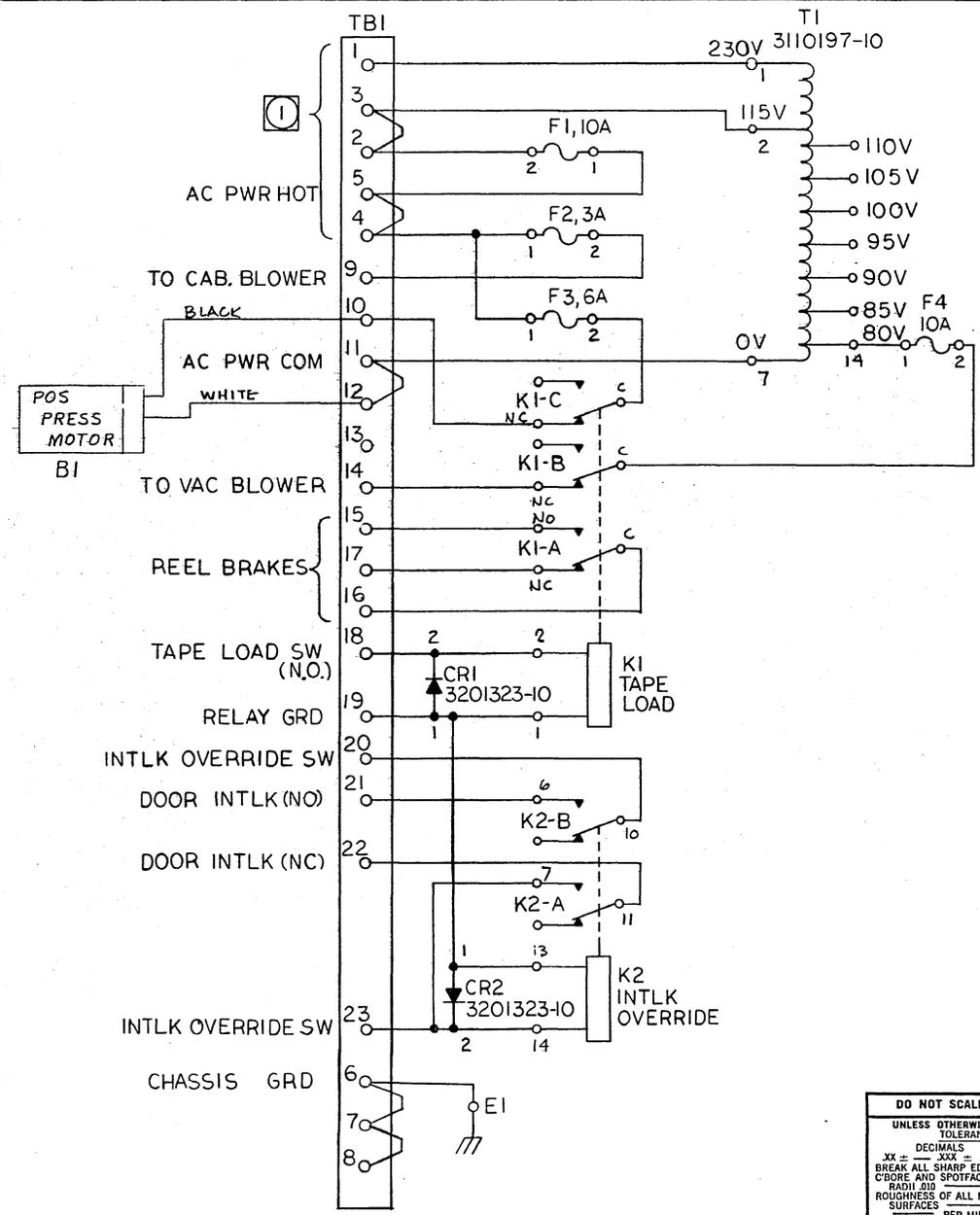
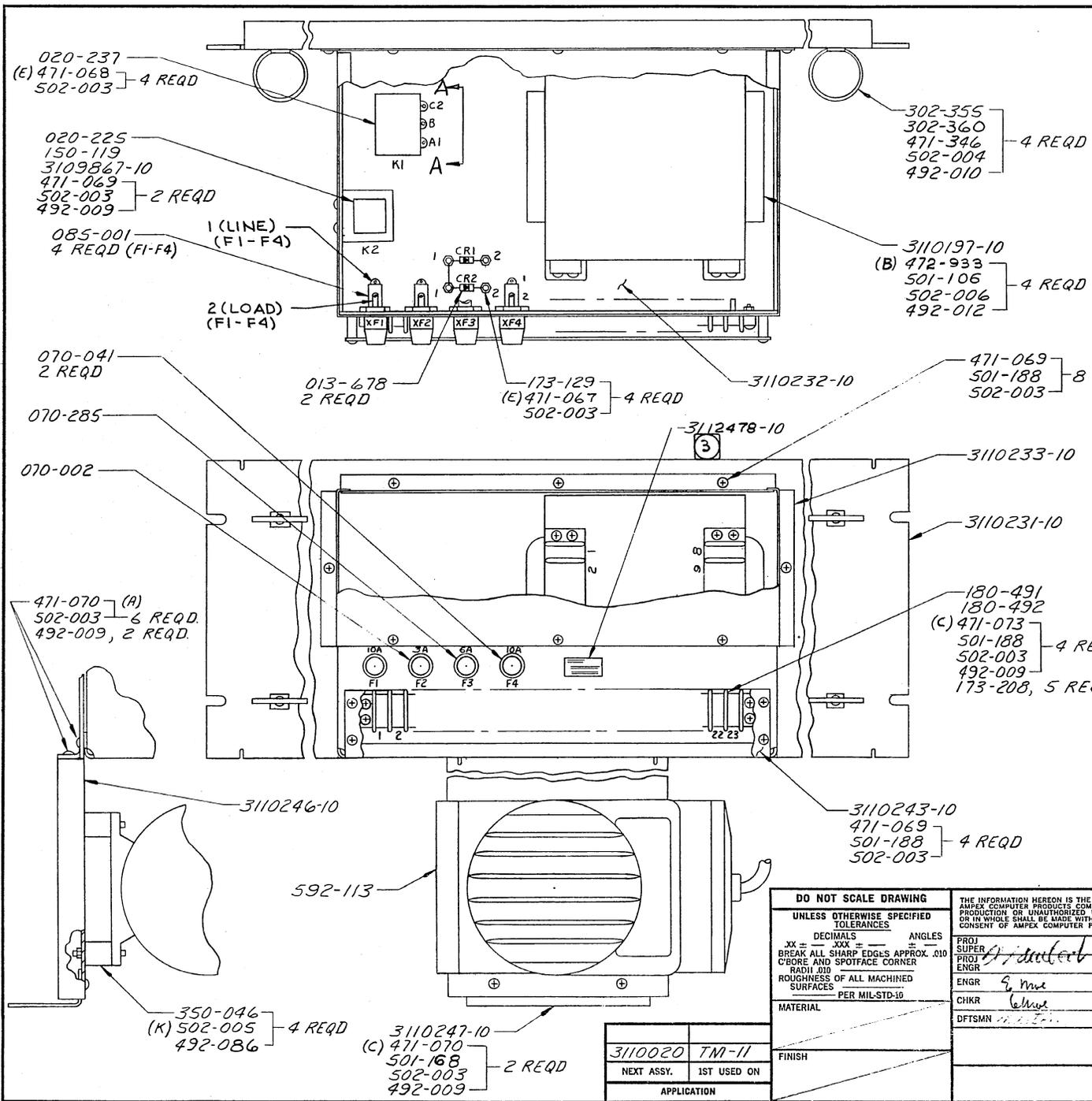


TABLE I

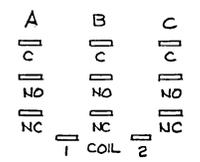
INPUT VAC	TBI CONNECTIONS	
	FROM	TO
115	PIN 2 PIN 4	PIN 3 PIN 5
230	PIN 1 PIN 3	PIN 2 PIN 4

① SEE TABLE I.  
NOTE :

<p><b>DO NOT SCALE DRAWING</b></p> <p>UNLESS OTHERWISE SPECIFIED TOLERANCES</p> <p>DECIMALS .xxx = .xxx ANGLES =</p> <p>BREAK ALL SHARP EDGES APPROX. .010</p> <p>C/BORE AND SPOTFACE CORNER RADI .010</p> <p>ROUGHNESS OF ALL MACHINED SURFACES PER MIL-STD-19</p> <p>MATERIAL</p>		<p>THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY. NO REPRODUCTION OR UNAUTHORIZED USE IN PART OR IN WHOLE SHALL BE MADE WITHOUT WRITTEN CONSENT OF AMPEX COMPUTER PRODUCTS CO.</p> <p>PROJ SUPER <i>A. J. ...</i> 4/16/61</p> <p>PROJ ENGR <i>A. J. ...</i> 4/21/61</p> <p>ENGR <i>A. J. ...</i> 4/21/61</p> <p>CHKR <i>2</i> 12/1/61</p> <p>DFTSMAN <i>R. A. ...</i> 10/27/64</p>		<p><b>AMPEX</b> AMPEX COMPUTER PRODUCTS COMPANY 0/1</p> <p>9937 JEFFERSON BLVD. CULVER CITY, CALIFORNIA</p>	
<p>3110226 TM11</p> <p>NEXT ASSY. 1ST USED ON</p> <p>APPLICATION</p>		<p>TITLE</p> <p><b>SCHEMATIC, AUTOTRANSFORMER ASSY</b></p>		<p>CODE IDENT. NO. SIZE DWG. NO. ISSUE</p> <p>C 3110227 D</p>	
<p>SCALE NONE</p>		<p>SHEET 1 OF 1</p>			



REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
B	ECN 169-K	PROD	8/1/65	SLW
C	ECN 4388		9/21/65	ACR
D	ECN 4449	J.M. O'Connell	7/26/65	SLW
E	ECN 4582	B. Grant	10/8/65	ACR
F	ECN 4670	B. Grant	11/19/65	ACR

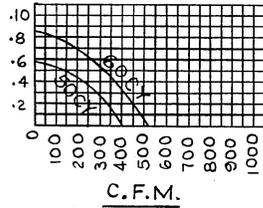


DETAIL A-A

2. PART NO. TO BE 3110226-10  
1. ASSEMBLE PER MFG. PRACTICE MANUAL  
NOTES:

<b>DO NOT SCALE DRAWING</b> UNLESS OTHERWISE SPECIFIED TOLERANCES DECIMALS — ANGLES .XX ± .005 — .XX ± .005 BREAK ALL SHARP EDGES APPROX. .010 C/BORE AND SPOTFACE CORNER RADI .010 ROUGHNESS OF ALL MACHINED SURFACES PER MIL-STD-10		THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY. NO REPRODUCTION OR UNAUTHORIZED USE IN PART OR IN WHOLE SHALL BE MADE WITHOUT WRITTEN CONSENT OF AMPEX COMPUTER PRODUCTS CO.	
MATERIAL FINISH		AMPEX AMPEX COMPUTER PRODUCTS COMPANY 9937 JEFFERSON BLVD. CULVER CITY, CALIFORNIA	
APPLICATION 3110020 TM-11 NEXT ASSY. 1ST USED ON		PROJ SUPER ENGR ENGR S. M. ... CHKR ... DFTSMN ...	
TITLE AUTOTRANSFORMER ASSY		CODE IDENT. NO. SIZE DWG. NO. ISSUE C 3110226 F	
SCALE 1/2		SHEET 1 OF 1	

STATIC PRESSURE  
IN H<sub>2</sub>O @ SEA LEVEL



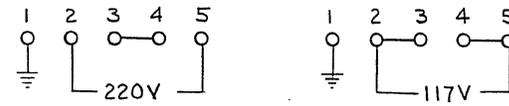
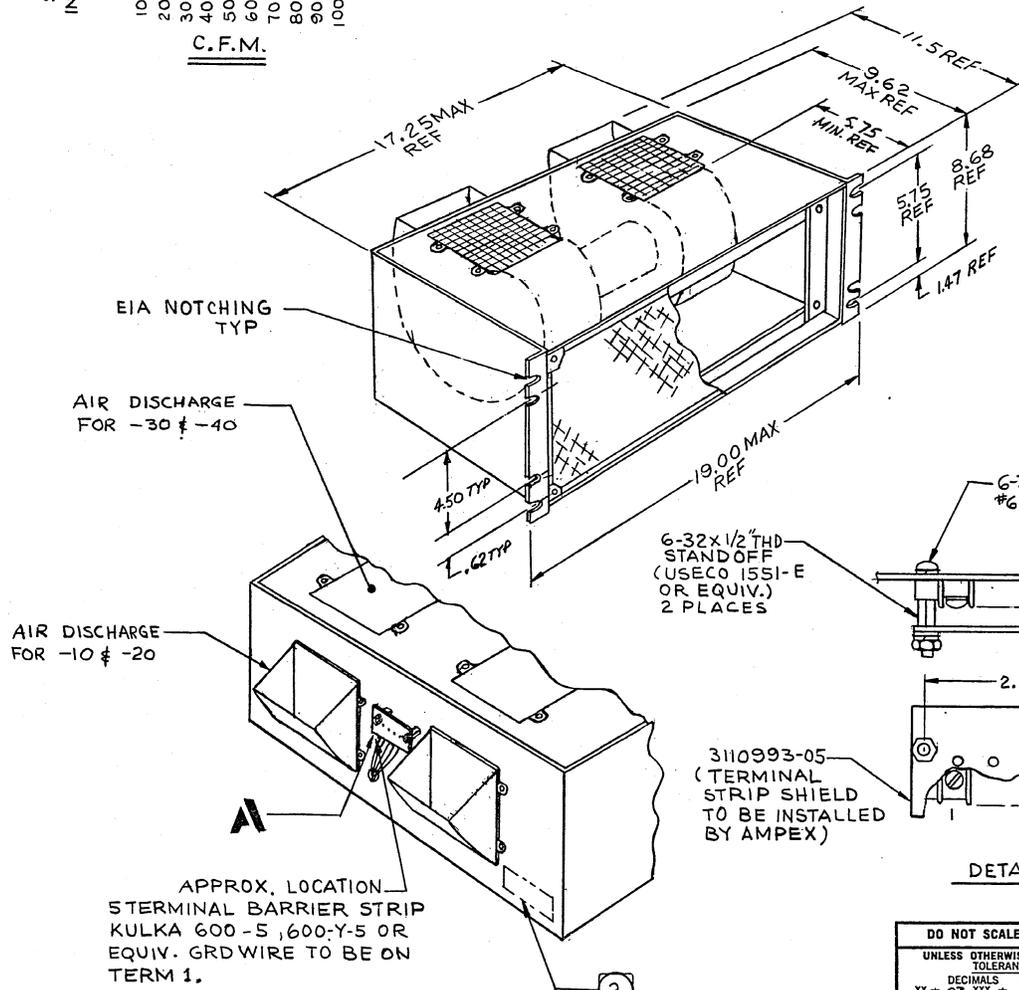
**SPECIFICATION**

7500 HRS LIFE, MIN  
AMBIENT 40°C  
2.0 AMPS MAX.  
NO LUBRICATION REQD

REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
A	ECN 4160 PROD REL	<i>[Signature]</i>	25 Mar 65	<i>[Signature]</i>
B	ECN 4207	<i>[Signature]</i>	14 Apr 65	<i>[Signature]</i>

**VERSION TABLE**

PART NO.	VOLTAGE	AIR DISCHARGE
3110287-10	117 ± 10%	REAR
-20	220 ± 10%	REAR
-30	117 ± 10%	TOP
-40	220 ± 10%	TOP



**HOOK UP OPTIONS**

5. FILTER, BLOWER, P/N 3110757-10, ASHLAND ELEC. P/N 7003-2, TO BE USED AS SPARE FOR BLOWERS FROM EITHER VENDOR.
  4. A. 3110287-10 (MAY BE PURCHASED FROM ASHLAND ELECTRIC P/N 8A500A-4 OR McLEAN ENGR. LABS P/N 2EB512A-36V.  
B. 3110287-30 (MAY BE PURCHASED FROM ASHLAND ELECTRIC - P/N 8A500C-4 OR McLEAN ENGR. LABS P/N 2EB512C-36V.
  3. FURNISH 2 JUMPERS KULKA 600 OR EQUIVALENT.
  2. MARK PART NO. AND REF. DESIGNATION, 12 HIGH CHARACTERS, COLOR BLACK, PER MIL-STD-130.
  1. PART NO., TO BE AS SHOWN IN VERSION TABLE.
- NOTES:

**REAR VIEW**

3/10/21	TM-11
FINAL B/M	TM-7
NEXT ASSY.	1ST USED ON
APPLICATION	

**DO NOT SCALE DRAWING**

UNLESS OTHERWISE SPECIFIED TOLERANCES

DECIMALS ANGLES

XX ± .03 XXX ± .005

BREAK ALL SHARP EDGES APPROX. .010

CHORE AND SPOTFACE CORNER RADIUS .010

ROUGHNESS OF ALL MACHINED SURFACES PER MIL-STD-10

MATERIAL

FINISH PER AMPEX SPEC CAD PLATE 13-52

CLASS B, TYPE II, YELLOW

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PROJ SUPER *[Signature]* 3/11/65

PROJ ENGR *[Signature]* 3/19/65

ENGR *[Signature]* 3/19/65

CHKR *[Signature]* 3/19/65

DFTSMN *[Signature]* 3-15-65

**AMPEX** AMPEX COMPUTER PRODUCTS COMPANY

9937 JEFFERSON BLVD. CULVER CITY, CALIFORNIA

TITLE

**BLOWER ASSY-SPECIFICATION**

117/220V, 50/60 CYCLES

CODE IDENT. NO. SIZE DWG. NO. ISSUE

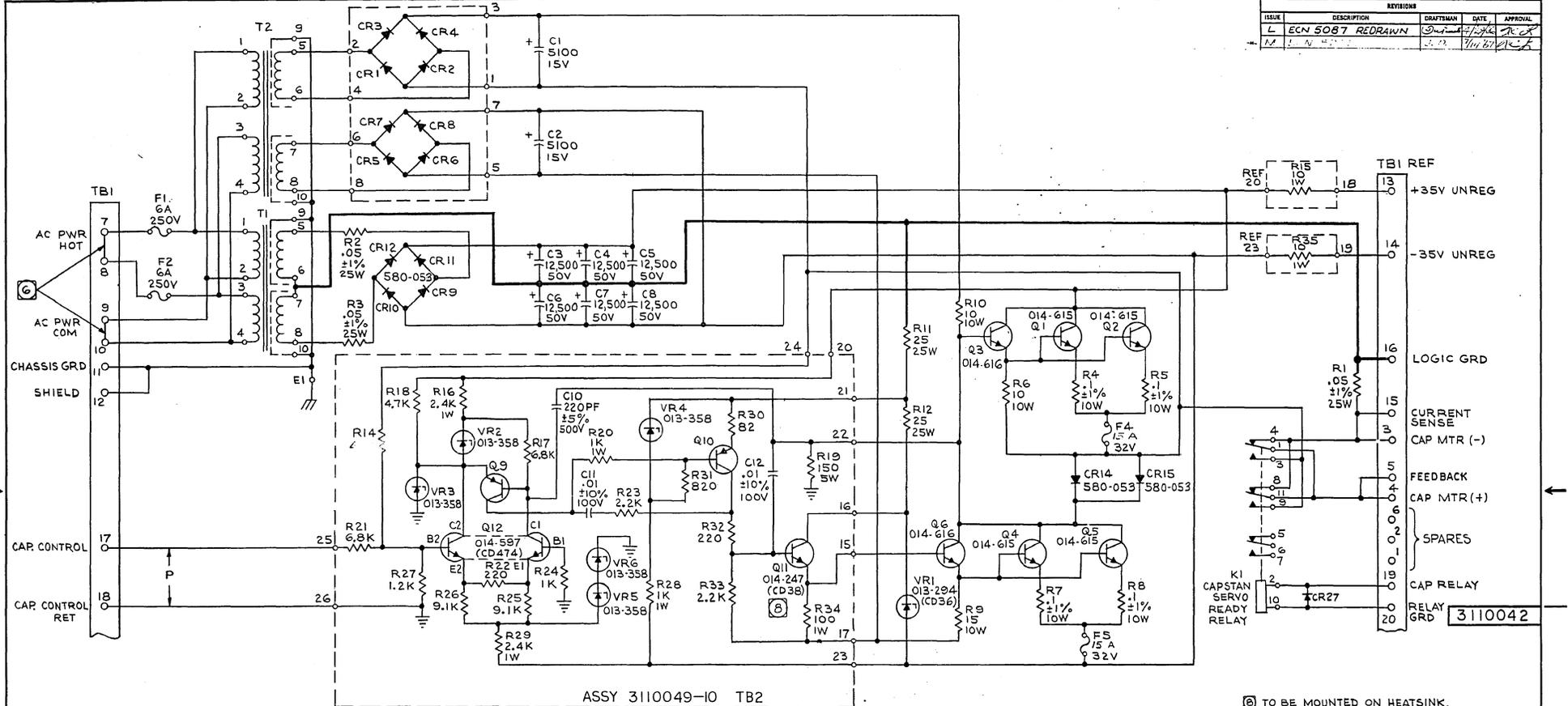
C 3110287 B

SCALE NONE SHEET 1 OF 1

3110042

D. C. 220

REVISIONS				
ISSUE	DESCRIPTION	CRAFTSMAN	DATE	APPROVAL
L	ECN 5087 REDRAWN	<i>[Signature]</i>	1/14/64	<i>[Signature]</i>
M		<i>[Signature]</i>	1/22/64	<i>[Signature]</i>



- ⑥ TO BE MOUNTED ON HEATSINK.
  - ⑦ CIRCUITS INSIDE DOTTED LINE LOCATED ON PRINTED CIRCUIT BOARD 3110049-10.
  - ⑧ JUMPERS SHOWN FOR 115VRMS INPUT FOR 230VRMS JUMPER ONLY TBI-B TO TBI-9.
  - 5. ALL TRANSISTORS TO BE 014-364 (CD43B)
  - 4. ALL DIODES TO BE 013-678 (CD451)
  - 3. ALL RESISTOR VALUES ARE IN OHMS ±5%, 1/4W
  - 2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
  - 1. FOR ASSEMBLY SEE 311003B.
- NOTES: UNLESS OTHERWISE SPECIFIED.

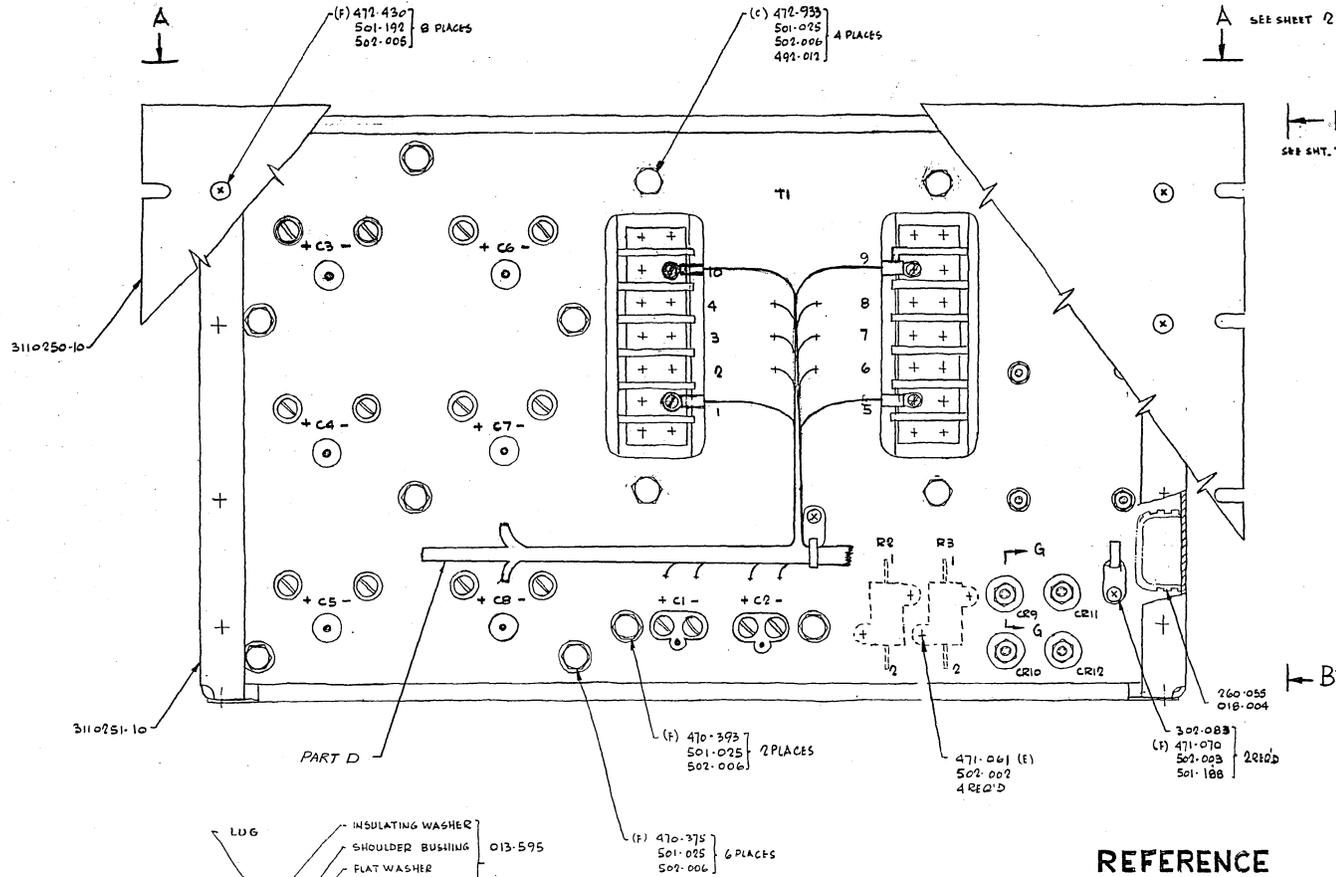
REFERENCE DESIGNATION	
LAST USED	DELETED
R35	R13
C12	C9
CR27	CR16, CR26
VR6	Q7, Q8
TB2	
T2	
F5	F3

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TELEVISIONS: 2X = 1/8" = 1/4" = 1/2" = 3/4" = 1" = 1 1/2" = 2" = 3" = 4" = 6" = 8" = 12" = 18" = 24" = 36" = 48" = 60" = 72" = 84" = 96" = 108" = 120" = 144" = 168" = 192" = 216" = 240" = 264" = 288" = 312" = 336" = 360" = 384" = 408" = 432" = 456" = 480" = 504" = 528" = 552" = 576" = 600" = 624" = 648" = 672" = 696" = 720" = 744" = 768" = 792" = 816" = 840" = 864" = 888" = 912" = 936" = 960" = 984" = 1008" = 1032" = 1056" = 1080" = 1104" = 1128" = 1152" = 1176" = 1200" = 1224" = 1248" = 1272" = 1296" = 1320" = 1344" = 1368" = 1392" = 1416" = 1440" = 1464" = 1488" = 1512" = 1536" = 1560" = 1584" = 1608" = 1632" = 1656" = 1680" = 1704" = 1728" = 1752" = 1776" = 1800" = 1824" = 1848" = 1872" = 1896" = 1920" = 1944" = 1968" = 1992" = 2016" = 2040" = 2064" = 2088" = 2112" = 2136" = 2160" = 2184" = 2208" = 2232" = 2256" = 2280" = 2304" = 2328" = 2352" = 2376" = 2400" = 2424" = 2448" = 2472" = 2496" = 2520" = 2544" = 2568" = 2592" = 2616" = 2640" = 2664" = 2688" = 2712" = 2736" = 2760" = 2784" = 2808" = 2832" = 2856" = 2880" = 2904" = 2928" = 2952" = 2976" = 3000" = 3024" = 3048" = 3072" = 3096" = 3120" = 3144" = 3168" = 3192" = 3216" = 3240" = 3264" = 3288" = 3312" = 3336" = 3360" = 3384" = 3408" = 3432" = 3456" = 3480" = 3504" = 3528" = 3552" = 3576" = 3600" = 3624" = 3648" = 3672" = 3696" = 3720" = 3744" = 3768" = 3792" = 3816" = 3840" = 3864" = 3888" = 3912" = 3936" = 3960" = 3984" = 4008" = 4032" = 4056" = 4080" = 4104" = 4128" = 4152" = 4176" = 4200" = 4224" = 4248" = 4272" = 4296" = 4320" = 4344" = 4368" = 4392" = 4416" = 4440" = 4464" = 4488" = 4512" = 4536" = 4560" = 4584" = 4608" = 4632" = 4656" = 4680" = 4704" = 4728" = 4752" = 4776" = 4800" = 4824" = 4848" = 4872" = 4896" = 4920" = 4944" = 4968" = 4992" = 5016" = 5040" = 5064" = 5088" = 5112" = 5136" = 5160" = 5184" = 5208" = 5232" = 5256" = 5280" = 5304" = 5328" = 5352" = 5376" = 5400" = 5424" = 5448" = 5472" = 5496" = 5520" = 5544" = 5568" = 5592" = 5616" = 5640" = 5664" = 5688" = 5712" = 5736" = 5760" = 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3110039

D.C. 313

ISSUE	DESCRIPTION	REVISIONS	DRAFTSMAN	DATE	APPROVAL
C	ECN 164E	PRD	W	3/1/67	W
D	ECN 4249		W	4-23-67	W
E	ECN 4360		W	3/1/67	W
F	ECN 4376		W	3/1/67	W
G	ECN 4543		W	4/1/67	W
H	ECN 4663		W	4/1/67	W
J	ECN 8201		W	7/6-67	W
K	ECN 8719		W	7/2-67	W



SEE SHEET 2.  
SEE SMT. 3.

PART NO	REFERENCE DESIGNATION
043-268	R49
043-388	R9
047-731	R47
311052-10	T1
3110249-10	T2
014-615	Q1, Q2, Q4, Q5, Q7
014-616	Q3, Q6, Q8
580-053	CR9 TO CR12, CR14 TO CR17
013-294	VR1
020-210	K1
031-396	C1, C2
031-444	C3 TO C8
047-864	R1, R2, R3
047-862	R4, R5, R7, R8
047-863	R6, R10
047-398	R13
047-179	R11, R12
070-077	F4, F5
070-079	F3
070-285	F1, F2
013-678	CR27

- 1 HEAT SINKS 3110261-10 TO 40, 3110262-10, 3110263-10 TO BE INSULATED FROM CHASSIS WITH WASHERS 503-012 & 503-035. 3110039
  - 2 MARK P/N -12 HIGH COLOR BLACK PER MIL-STD-130. DO NOT IMPRESSION STAMP
  - 3 PART NO TO BE AS SHOWN ON B/M
  - 4 ADHESIVE SIDE OF PART 3110258-10 AND 3110260-10 TO BE TOWARD PART 3110251-10 AND 3110259-10 RESPECTIVELY.
  - 5 APPLY SILICON GREASE PART NO. 087-388 BETWEEN ALL TRANSISTOR OR DIODE MTA SURFACES.
  - 6 FOR WIRELIST AND SCHEMATIC SEE B/M
  - 7 PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH UNIT NUMBER OR SUB-ASSY. DESIGNATIONS.
  - 8 ASSEMBLE PER PRODUCTION PRACTICES MANUAL
- NOTES:

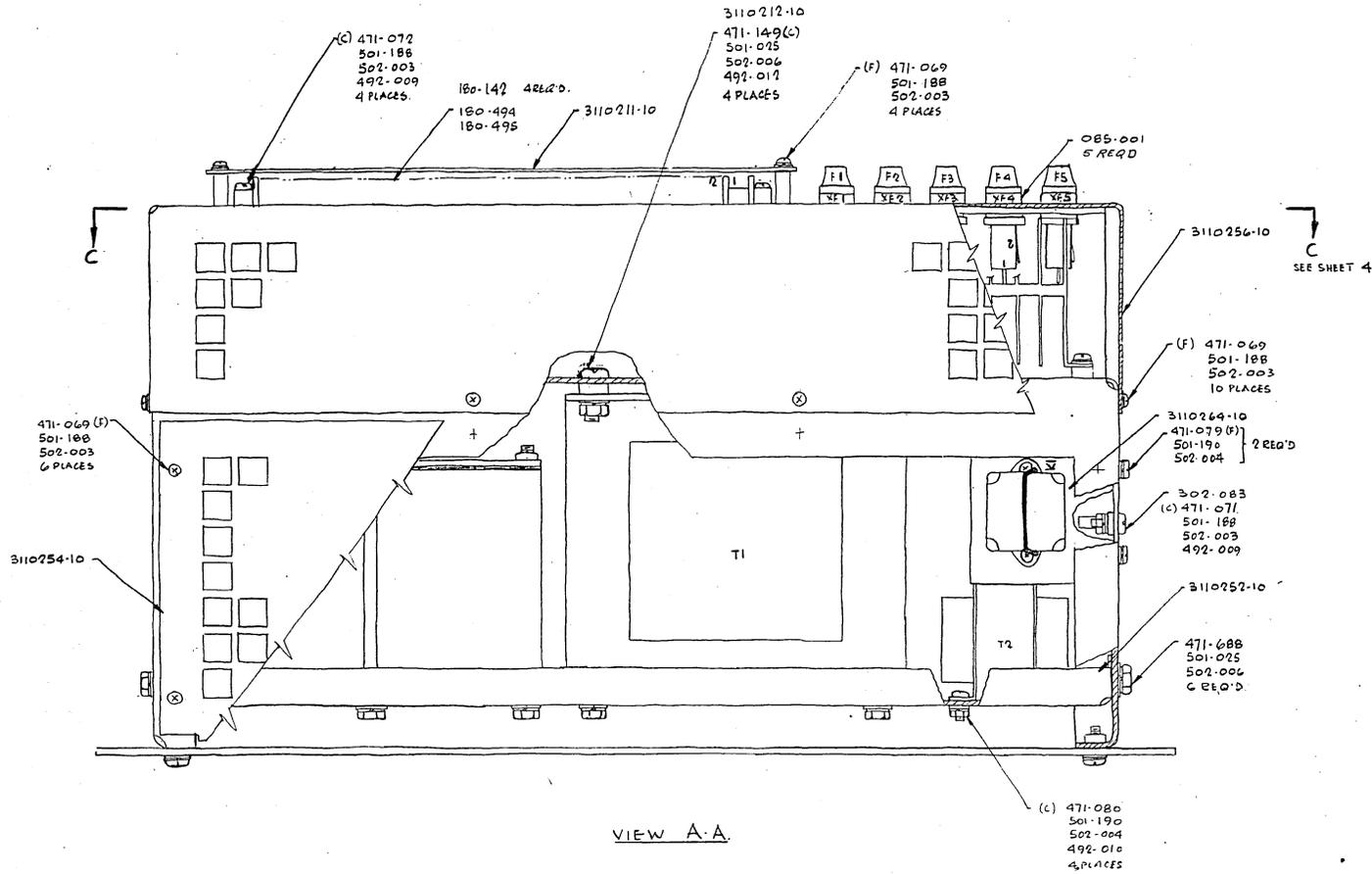
REFERENCE

DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED TOLERANCES DECIMALS — ANGLES XX ± .001 BREAK ALL SHARP EDGES APPROX. 2:10 CHAMFER AND SPOTFACE CORNERS RADIUS .010 ROUGHNESS OF ALL MACHINED SURFACES PER MIL-STD-130	THE INFORMATION HEREON IS THE PROPERTY OF AMPER COMPUTER PRODUCTS COMPANY AND IS TO BE KEPT CONFIDENTIAL. NO PARTS OR SERVICES SHALL BE MADE WITHOUT THE WRITTEN CONSENT OF AMPER COMPUTER PRODUCTS CO.	<table border="1"> <tr><td>DATE</td><td>3/1/67</td></tr> <tr><td>DESIGNER</td><td>W</td></tr> <tr><td>ENGR</td><td>W</td></tr> <tr><td>CHECKED</td><td>W</td></tr> <tr><td>APPROVED</td><td>W</td></tr> </table>	DATE	3/1/67	DESIGNER	W	ENGR	W	CHECKED	W	APPROVED	W	<table border="1"> <tr><td>TITLE</td><td>CAPSTAN SERVO ASSY</td></tr> <tr><td>CODE IDENT. NO.</td><td>D</td></tr> <tr><td>SIZE</td><td>1/1</td></tr> <tr><td>ENG. NO.</td><td>3110039</td></tr> <tr><td>ISSUE</td><td>K</td></tr> </table>	TITLE	CAPSTAN SERVO ASSY	CODE IDENT. NO.	D	SIZE	1/1	ENG. NO.	3110039	ISSUE	K
DATE	3/1/67																						
DESIGNER	W																						
ENGR	W																						
CHECKED	W																						
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SIZE	1/1																						
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ISSUE	K																						
<table border="1"> <tr><td>3110037</td><td>TM11</td></tr> <tr><td>3110038</td><td>TM11</td></tr> <tr><td>NEXT ASSY.</td><td>1ST USED ON</td></tr> <tr><td>APPLICATION</td><td></td></tr> </table>	3110037	TM11	3110038	TM11	NEXT ASSY.	1ST USED ON	APPLICATION		<table border="1"> <tr><td>MATERIAL</td><td>FINISH</td></tr> <tr><td></td><td></td></tr> </table>	MATERIAL	FINISH			<table border="1"> <tr><td>AMPER</td><td>AMPER COMPUTER PRODUCTS COMPANY</td></tr> <tr><td colspan="2">901 JEFFERSON BLVD. GLENVIEW CITY, CALIFORNIA</td></tr> </table>	AMPER	AMPER COMPUTER PRODUCTS COMPANY	901 JEFFERSON BLVD. GLENVIEW CITY, CALIFORNIA		<table border="1"> <tr><td>SCALE</td><td>1/1</td></tr> <tr><td>SHEET</td><td>1 OF 4</td></tr> </table>	SCALE	1/1	SHEET	1 OF 4
3110037	TM11																						
3110038	TM11																						
NEXT ASSY.	1ST USED ON																						
APPLICATION																							
MATERIAL	FINISH																						
AMPER	AMPER COMPUTER PRODUCTS COMPANY																						
901 JEFFERSON BLVD. GLENVIEW CITY, CALIFORNIA																							
SCALE	1/1																						
SHEET	1 OF 4																						

3110039

D.C. 230

REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
C	ECN 164 E	PRO	1/18/68	66
	SEE SHEET 1		3/11/68	66



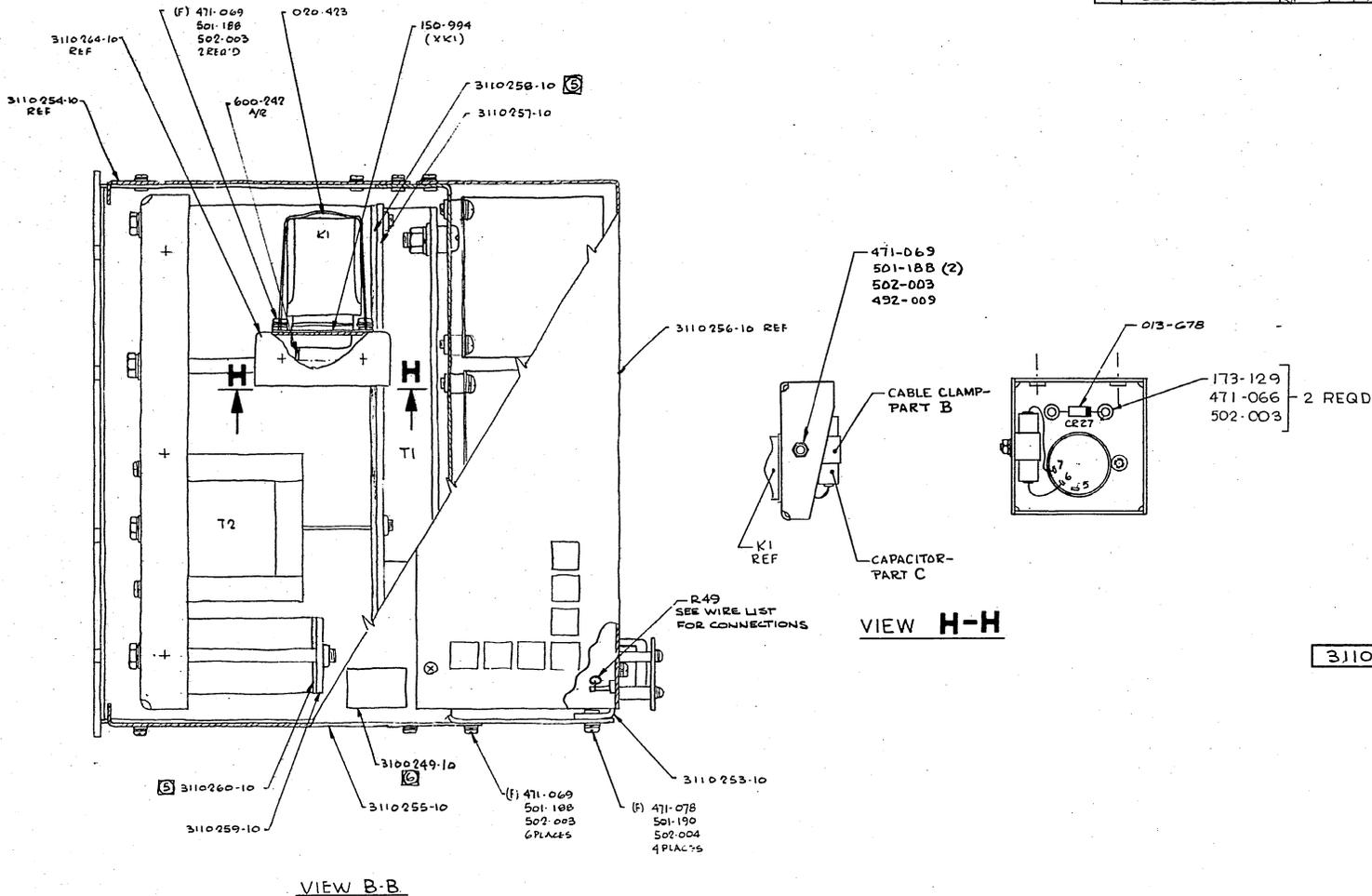
3110039

<b>DO NOT SCALE DRAWING</b> UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DECIMALS - ANGLES HOLE - .001 BREAK ALL SHARP EDGES APPROX. .015 CHAMFER ALL SPOTFACE CORNERS FINISHES OF ALL MACHINED SURFACES PER MIL-STD-13		THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY, INC. AND IS TO BE USED ONLY FOR THE PURPOSES SPECIFIED HEREON. IT IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF AMPEX COMPUTER PRODUCTS COMPANY.	
MATERIAL: PER MIL-STD-13 FINISH: 131 USED ON APPLICATION		<b>AMPEX</b> AMPEX COMPUTER PRODUCTS COMPANY 937 JEFFERSON BLVD. CULVER CITY, CALIFORNIA	
TITLE: CAPSTAN SERVO ASSY		CODE IDENT. NO. D SIZE 3110039 ISSUE K	
SCALE 1/1		SHEET 2 OF 4	

3110039

D.C. 230

REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
C	ERN 169E	PROD	F M	3/16/61
	SEE SHEET 1		3/16/61	



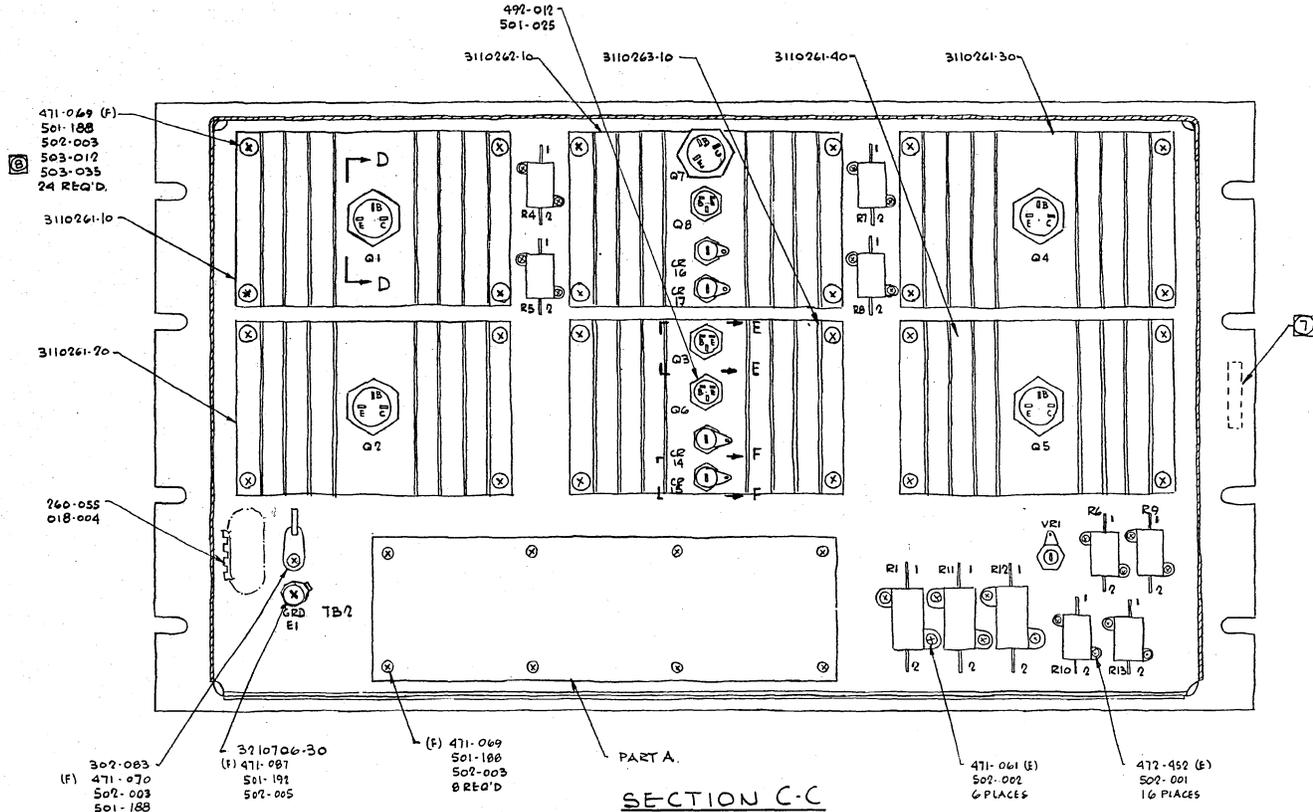
3110039

DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED		THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE WRITTEN CONSENT OF AMPEX COMPUTER PRODUCTS CO.		AMPEX AMPEX COMPUTER PRODUCTS COMPANY 1707 JEFFERSON BLVD. OAKLAND, CALIFORNIA	
DECIMALS	ANGLES	FINISH	DATE	TITLE	
1/16	1/16	1/16	3/16/61	CAPSTAN SERVO ASSY	
BREAK ALL SHARP EDGES APPROX. .010	RADIUS	ENGR	CHKR	CODE IDENT. NO.	
CRUISE AND SPOTFACE CORNER	RADIUS	ENGR	CHKR	D 3110039	
RADIUS OF ALL MACHINED SURFACES	PER MIL-STD-10	ENGR	CHKR	SIZE	
MATERIAL	PER MIL-STD-10	ENGR	CHKR	Dwg. No.	
				K	
3110037 IM II				SCALE 1/1	
3110038 IM II				SHEET 3 OF 4	
NEXT ASSY.	1ST USED ON	APPLICATION			

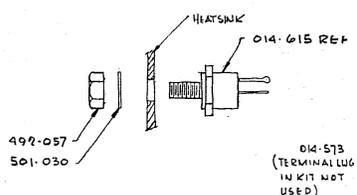
3110039

D.C.220

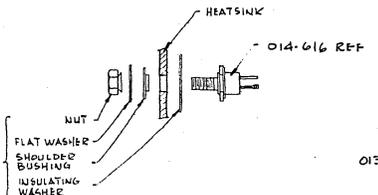
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ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
C	ECN 16A E	PROD	3/10/65	ldc
SEE SHEET 1		ldc	4/1/65	ldc



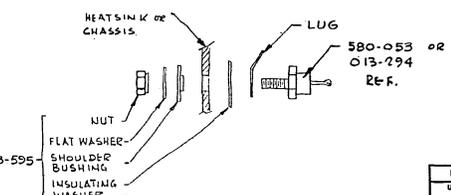
3110039



SECTION D-D  
TYPICAL FOR Q1, 2, 4, 5, 7



SECTION E-E  
TYPICAL FOR Q3, 8



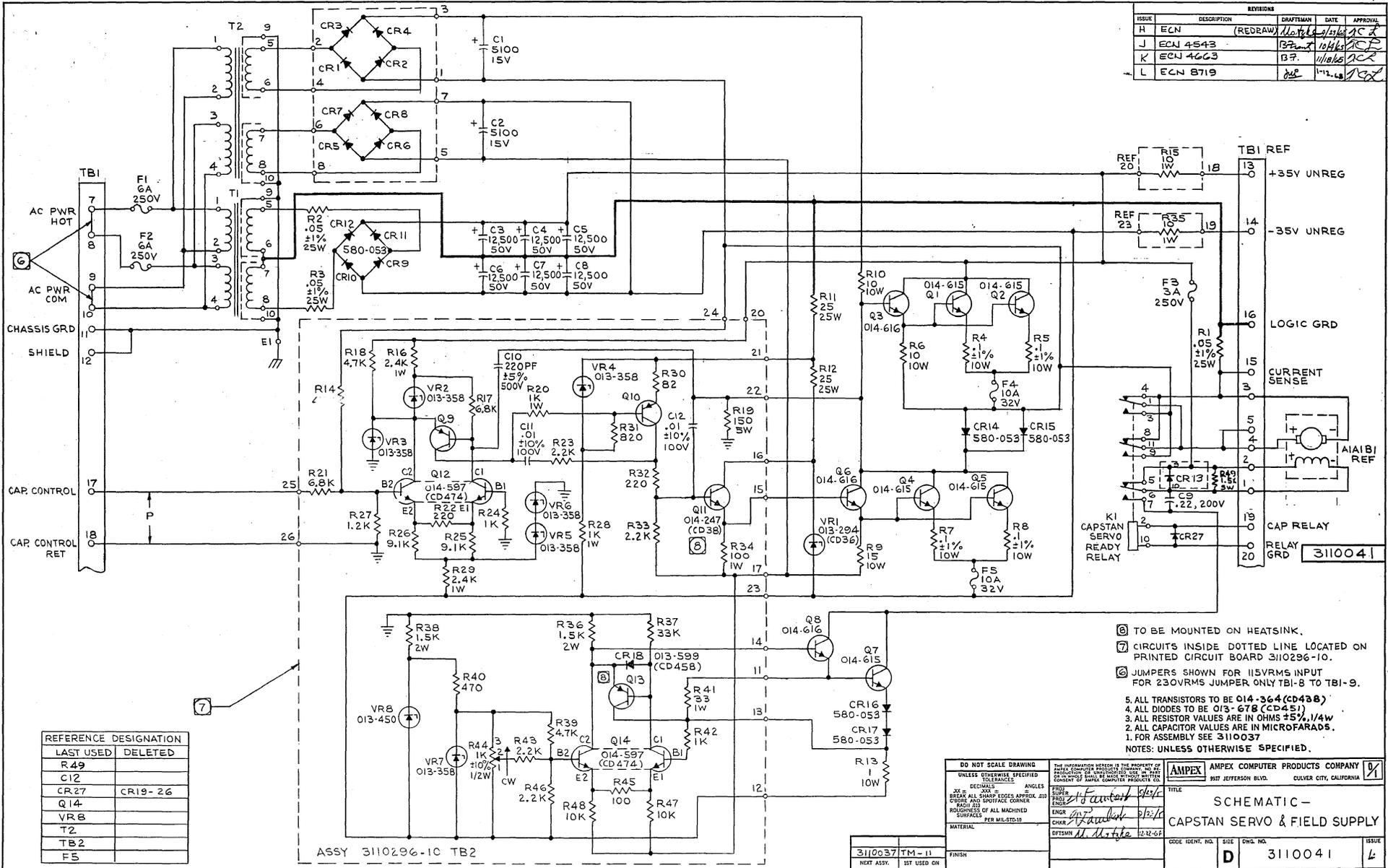
SECTION F-F  
TYPICAL FOR CR14, 15, 16, 17, 18, 19

DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED TOLERANCES	THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY, INC. AND IS TO BE KEPT CONFIDENTIAL. IT IS TO BE USED ONLY FOR THE DEVELOPMENT, MANUFACTURE, AND SUPPORT OF AMPEX COMPUTER PRODUCTS FOR THE U.S. GOVERNMENT.	AMPEX AMPEX COMPUTER PRODUCTS COMPANY 907 JEFFERSON BLVD. SILVER CITY, CALIFORNIA
3110031 TM11	3110030 TM11	FINISH	TITLE CAPSTAN SERVO ASSY
NEXT ASSY.	1ST USED ON	APPLICATION	CODE IDENT. NO. SIZE DWG. NO. ISSUE D 3110039 K
SCALE 1/1		SHEET 3 OF 4	

3110041

D.C. 320

ISSUE	DESCRIPTION	REVISIONS	DRAFTSMAN	DATE	APPROVAL
H	ECN (REDRAW)		W. H. H. / J. C. F.	11/16/61	J. C. F.
J	ECN 4543		B. F. / W. H. H. / J. C. F.	11/16/61	J. C. F.
K	ECN 4623		B. F. / W. H. H. / J. C. F.	11/16/61	J. C. F.
L	ECN 8719		J. C. F.	1-12-68	J. C. F.

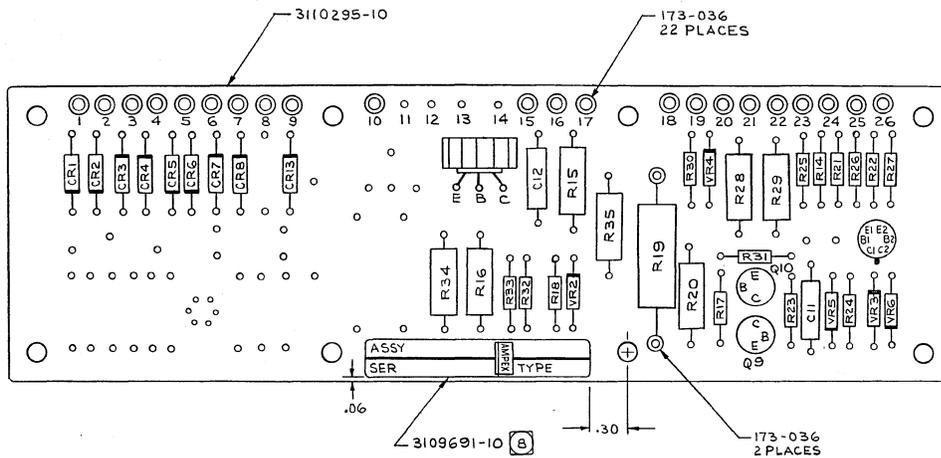


REFERENCE DESIGNATION	LAST USED	DELETED
R49		
C12		
CR27		CR19-26
Q14		
VR8		
T2		
TB2		
F5		

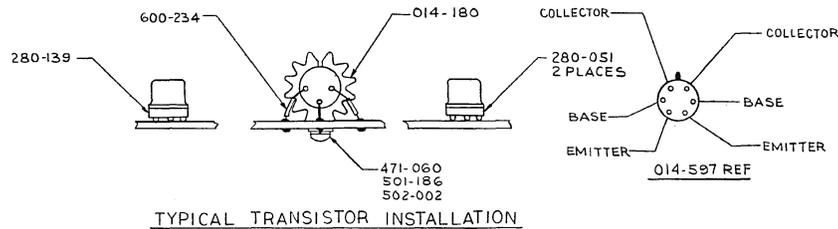
- ⑥ TO BE MOUNTED ON HEATSINK.
  - ⑦ CIRCUITS INSIDE DOTTED LINE LOCATED ON PRINTED CIRCUIT BOARD 3110296-10.
  - ⑧ JUMPERS SHOWN FOR 115VRMS INPUT FOR 230VRMS JUMPER ONLY TBI-8 TO TBI-9.
  - 5. ALL TRANSISTORS TO BE 014-364 (CD43B)
  - 4. ALL DIODES TO BE 013-678 (CD451)
  - 3. ALL RESISTOR VALUES ARE IN OHMS ±5%, 1/4W
  - 2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
  - 1. FOR ASSEMBLY SEE 3110037
- NOTES: UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED TOLERANCES: DIMENSIONS: ANGLES: HOLE: .005" ± .001" BREAK ALL SHARP EDGES APPROX. .015" RADI ALL GROOVES AND SPOTFACE CORNERS FINISH: PER MIL-STD-19	THE INFORMATION HEREON IS THE PROPERTY OF AMPLEX COMPUTER PRODUCTS COMPANY AND IS TO BE USED ONLY IN THE PRODUCTION OF AMPLEX COMPUTER PRODUCTS FOR THE UNITED STATES GOVERNMENT.	AMPEX AMPEX COMPUTER PRODUCTS COMPANY 9317 JEFFERSON BLVD. CULVER CITY, CALIFORNIA
TITLE: SCHEMATIC - CAPSTAN SERVO & FIELD SUPPLY	DATE: 12-12-61	ISSUE: 4
CODE IDENT. NO. D	SIZE: 3110041	SHEET 1 OF 1

REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
B	ECN 164 J	Matye	1/16/67	NZ
C	ECN 4249	Matye	4-25-65	McP
D	ECN 4381	Matye	6-21-67	McP



PART NO.	REFERENCE DESIGNATION
014-364	Q10, Q9
014-247	Q11
014-597	Q12
013-678	CR1 THRU CR8, CR13
035-219	C11, C12
041-095	R15, R35
041-096	R34
013-358	VR2, THRU VR6
041-410	R24
041-411	R14
041-413	R17, R21
041-414	R23, R33
041-396	R22, R32
041-440	R27
041-412	R18
041-514	R25, R26
041-537	R30
041-506	R31
041-337	R16, R29
041-102	R20, R28
047-832	R19



3110049

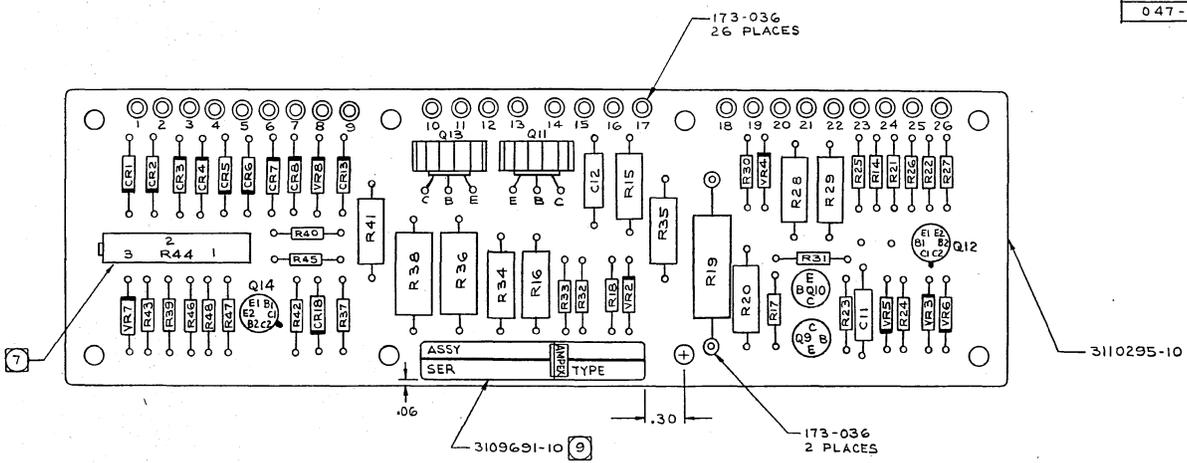
- 8 MARK PART NO. & NAMEPLATE INFORMATION PER MIL-STD-130.
- PART NO. TO BE 3110049-10.
  - SEAL PRINTED CIRCUIT SIDE ONLY WITH HUMI-SEAL TYPE 1B15 COLUMBIA TECH. OR EQUIV.
  - HEAVY LINE ON DIODE INDICATES CATHODE.
  - COMPONENT DESIGNATIONS ARE FOR REFERENCE ONLY.
  - ASSEMBLE PER PRODUCTION PRACTICES MANUAL.
  - FOR ASSEMBLY SPECIFICATION SEE
  - FOR SCHEMATIC SEE 3110042.

NOTES:

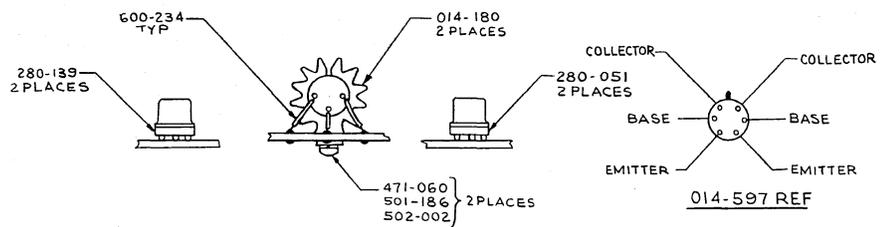
DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED		ALL INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY, INC. AND IS LOANED TO YOU BY THE COMPANY. IT IS TO BE KEPT IN CONFIDENTIALITY AND NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM.		AMPEX COMPUTER PRODUCTS COMPANY 937 JEFFERSON BLVD. CULVER CITY, CALIFORNIA	
DIMENSIONS XX = .010 MAX ±.010 ±.005 BREAK ALL SHARP EDGES APPROX. .010 CHAMFER AND SPOTFACE CORNER .010 RADIUS FINISHES OF ALL MACHINED SURFACES PER MIL-STD-113	ANGLES UNLESS OTHERWISE SPECIFIED 45°	PROFILES UNLESS OTHERWISE SPECIFIED .005 .010 .015 .020 .025 .030 .035 .040 .045 .050 .055 .060 .065 .070 .075 .080 .085 .090 .095 .100	FINISH UNLESS OTHERWISE SPECIFIED 125 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1000	TITLE CAPSTAN BOARD ASSY- CAPSTAN CONTROL PREAMP	
3110049 NEXT ASSY. APPLICATION	TM-11 1ST USED ON	CODE DEPT. NO. D	SIZE 3110049	DWG. NO. D	ISSUE D
SCALE 2:1		SHEET 1 OF 1			

REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
A	ECN 164 J	M. Matzke		
B	ECN 4249	M. Matzke	4-23-68	M. J.
C	ECN 4381	M. Matzke	12-20-68	M. J.
D	ECN 4809	M. Matzke	12-11-68	M. J.

PART NO.	REFERENCE DESIGNATION	PART NO.	REFERENCE DESIGNATION
044-309	R44	014-247	Q11
047-832	R19	014-364	Q10, Q13, Q9



014-597	Q12, Q14
013-678	CR1 THRU CR8, CR13
013-358	VR2,3,4,5,6,7
013-450	VR8
013-599	CR18
041-408	R47, R48
035-219	C11, C12
041-095	R15, R35
041-096	R34
041-410	R24, R42
041-411	R14
041-412	R18, R39
041-413	R17, R21
041-414	R23, R33, R43, R46
041-419	R45
041-428	R40
041-440	R27
041-518	R37
041-396	R22, R32
041-821	R41
041-994	R36, R38
041-514	R25, R26
041-537	R30
041-506	R31
041-337	R16, R29
041-102	R20, R28



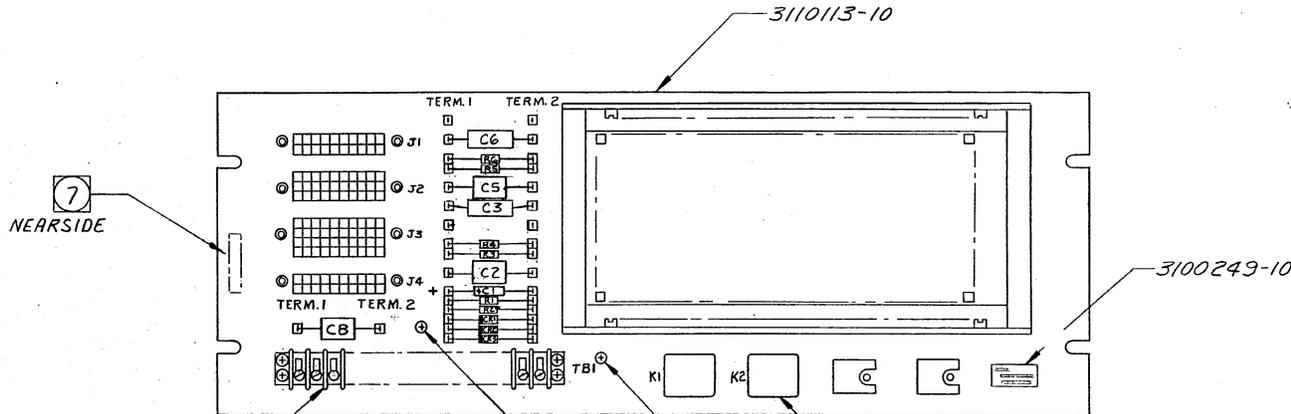
TYPICAL TRANSISTOR INSTALLATION

- 3110296
- MARK PART NO. & NAMEPLATE INFORMATION PER MIL-STD-130.
  - PART NO. TO BE 3110296-10.
  - TRIMPOTS NOT TO BE SUBMERGED IN WATER.
  - SEAL PRINTED CIRCUIT SIDE ONLY WITH HUMI-SEAL TYPE IBIS COLUMBIA TECH. OR EQUIV.
  - HEAVY LINE ON DIODE INDICATES CATHODE.
  - COMPONENT DESIGNATIONS ARE FOR REFERENCE ONLY.
  - ASSEMBLE PER PRODUCTION PRACTICES MANUAL.
  - FOR ASSEMBLY SPECIFICATION SEE
  - FOR SCHEMATIC SEE TABLE I.
- NOTES:

TABLE I			AMPEX		AMPEX COMPUTER PRODUCTS COMPANY	
3114660	3114652	TM-12	9177 JEFFERSON BLVD.	CULVER CITY, CALIFORNIA		
3112519	3112517	TM-11M	CIRCUIT BOARD ASSY - CAPSTAN CONTROL PREAMP			
3110041	3110037	TM-11				
SCHMATIC	PCBT ASSY.	1ST USED ON APPLICATION	CODE IDENT. NO.	SIZE	DWG. NO.	ISSUE
			D		3110296	D
			SCALE 2:1			SHEET 1 OF 1



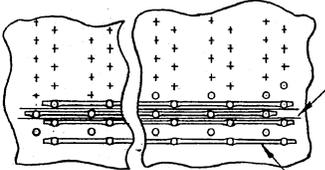
REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
F	ERN 164 CC PROD	D. Watson	5/7/65	lu
G	ECN 4482	Conerly	5/9/65	lu
H	ECN 4597	dw	10/12/65	RCF
J	ECN 4996	dw	3/14/66	RCF
K	ECN 5727	dw	7/14/66	RCF
L	ECN 822B	J. A.	8/2/67	RCF



180-446  
(A) 471-072  
502-003  
492-009 } 4 REQD

020-225  
492-020 } 2 REQD.

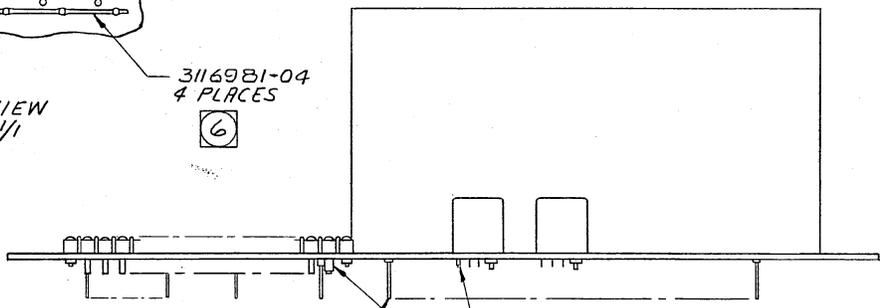
471-072  
502-003  
492-009  
171-066 } 2 REQD



923-122  
AIR

3116981-04  
4 PLACES

REAR VIEW  
SCALE 1/1



172-178 (6 PLC'S)

600-186 TYP  
AIR

PART NO.	REF. DESIG.
013-678	CR1, CR2
013-599	CR3
041-283	R1
041-245	R2
041-508	R3, R5
041-410	R4, R6
037-089	C1
055-059	C2, C5, C8
033-130	C3, C6

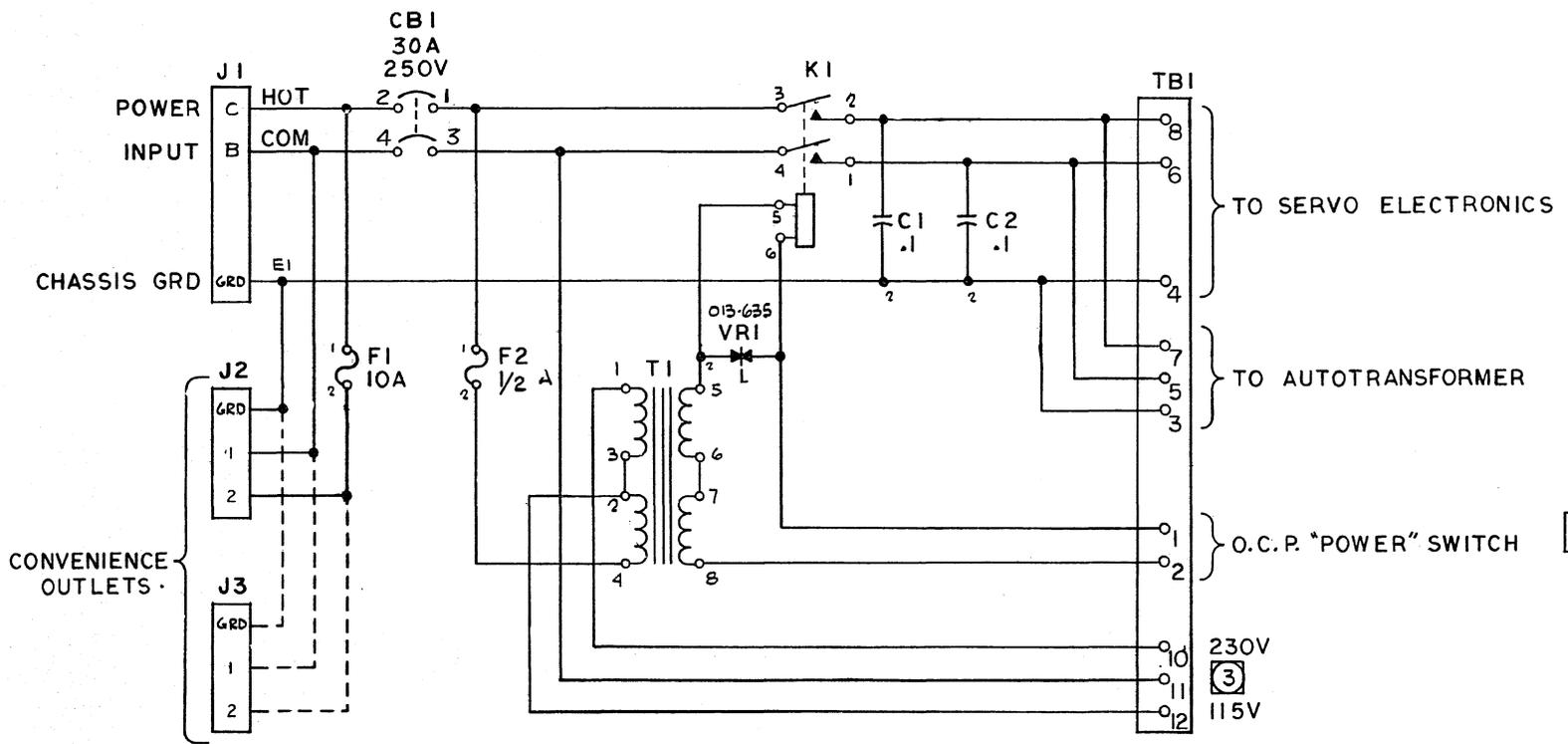
3110102

7. MARK PIN .12 HIGH CHARACTERS COLOR BLACK PER MIL-STD-130. DO NOT IMPRESSION STAMP.
- 6 J5 THRU J18 PINS 1  
J5 THRU J18 PINS 3  
J5 THRU J18 PINS 4  
J5 THRU J18 PINS 5
5. PART NO. TO BE 3110102-10
4. FOR WIRE LIST SEE 311011
3. FOR SCHEMATIC SEE 3110105
2. SCHEMATIC REF. DESIG. ARE FOR REF ONLY.
1. ASSEMBLE PER MANUFACTURING PRACTICE MANUAL NOTES:

<b>DO NOT SCALE DRAWING</b> UNLESS OTHERWISE SPECIFIED TOLERANCES DECIMALS .XX ± .XXX ± ANGLES SUPER (BREAK ALL SHARP EDGES APPROX. .010 CHORE AND SPOTFACE CORNER RADI .010 ROUGHNESS OF ALL MACHINED SURFACES PER MIL-STD-10 MATERIAL FINISH APPLICATION		THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY. NO RE- PRODUCTION OR UNAUTHORIZED USE IN PART OR IN WHOLE SHALL BE MADE WITHOUT WRITTEN CONSENT OF AMPEX COMPUTER PRODUCTS CO.	<b>AMPEX</b> AMPEX COMPUTER PRODUCTS COMPANY 9937 JEFFERSON BLVD. CULVER CITY, CALIFORNIA
3110001 TM-11 NEXT ASSY. 1ST USED ON APPLICATION	TITLE CONTROL ELECTRONICS ASSY-STD	CODE IDENT. NO. SIZE DWG. NO. ISSUE C 3110102 L	SCALE 1/2 SHEET 1 OF 1

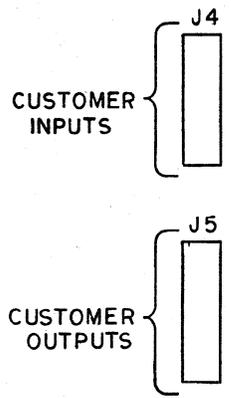
x 502 B/M

REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
B	ECN 164E	PRD	Em	3/10/65 ZL
C	ECN 4278		C.M	5/3/65 KCL
D	ECN 7377		2/10/67	RCZ



3110223

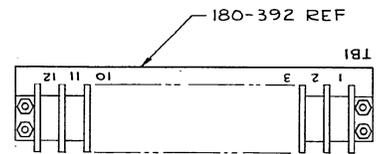
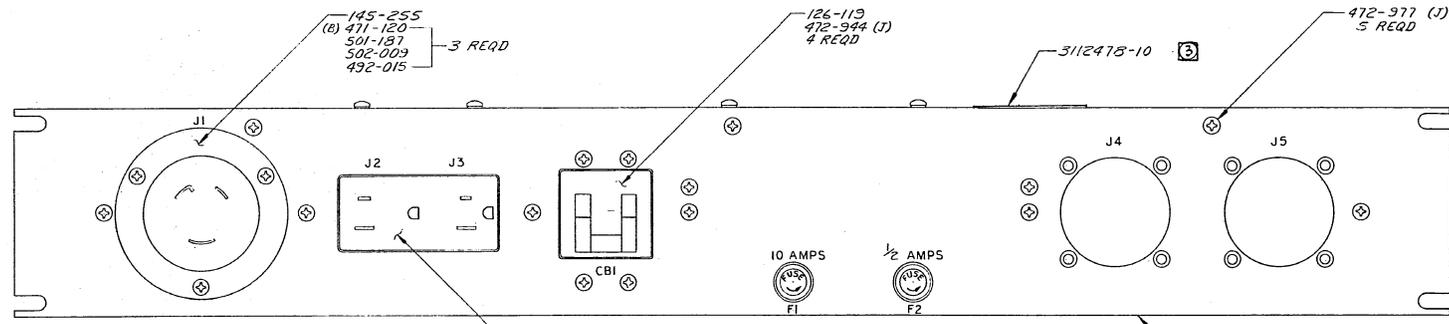
- ③ FOR 230V CONNECT PINS 10 & 11, FOR 115V CONNECT PINS 11 & 12.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS  $\pm 20\%$ , 400V.
1. FOR ASSEMBLY SEE 3110124-10
- NOTES: UNLESS OTHERWISE SPECIFIED.



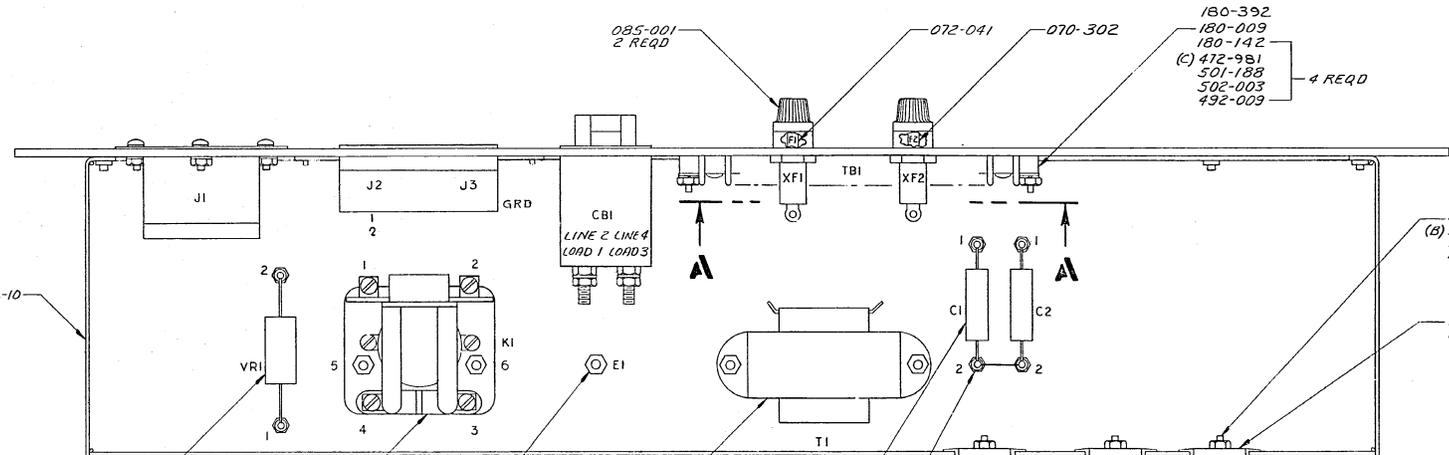
3110124	TM-11,12
NEXT ASSY.	1ST USED ON
APPLICATION	

DO NOT SCALE DRAWING		UNLESS OTHERWISE SPECIFIED TOLERANCES:		DECIMALS .xxx ±		ANGLES ±		PROJ SUPER		AMPEX		AMPEX COMPUTER PRODUCTS COMPANY		9937 JEFFERSON BLVD. CULVER CITY, CALIFORNIA		01	
BREAK ALL SHARP EDGES APPROX. .010		C'BORE AND SPOTFACE CORNER RADI .010		ROUGHNESS OF ALL MACHINED SURFACES PER MIL-STD-10		MATERIAL		ENGR		CHKR		DFTSMAN		TITLE		SCHEMATIC - INPUT/OUTPUT PANEL	
FINISH		3110124		TM-11,12		SCALE NONE		CODE IDENT. NO. C		SIZE DWG. NO. 3110223		ISSUE D		SHEET 1 OF 1			

REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
C	ECN 164E PKD	S.M.	3/10/61	2 M
D	ECN 4278	C.M.	3/16/61	18 F
E	ECN 4360	A.H.	3/16/61	18 F
F	ECN 4388	A.H.	3/16/61	18 F
G	ECN 7377	A.H.	3/16/61	18 F



VIEW A-A



471-070  
(B) 501-188  
502-003  
492-009 } 3 REQD

260-055  
018-004 } AIR

- 3110124
5. FOR WIRE LIST SEE 3110224.  
4. FOR SCHEMATIC SEE 3110223.  
3. MARK FIN .12 HIGH CHARACTERS COLOR WHITE PER MIL-STD-130. DO NOT IMPRESSION STAMP.  
2. PART NO. TO BE 3110124-10.  
1. ASSEMBLE PER MANUFACTURING PRACTICE MANUAL.
- NOTES:

3110126-10

013-635

020-395  
(B) 471-073  
501-188  
502-003  
492-009 } 2 REQD

560-183  
(B) 471-070  
501-188  
502-003  
492-009 } 2 REQD

033-153  
2 REQD

173-462  
(F) 471-066  
502-003  
501-188 } 6 REQD

471-073  
502-003  
492-003 } 2 REQD

DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED	DECIMALS	ANGLES
XX 8 - 30X	BLOCK ALL SHARP EDGES APPROX .250	CHAMFER AND SPOTFACE SCHEMATIC	RADIUS .250
	BOLDNESS OF ALL MACHINED SURFACES PER MIL-STD-130		
MATERIAL	FIN SH		
FINAL 5/10	FIN SH		
NEXT ASSY.	EST USED ON		
APPLICATION			

THE INFORMATION HEREON IS THE PROPERTY OF AMPLEX COMPUTER PRODUCTS COMPANY AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM.	AMPEX	AMPEX COMPUTER PRODUCTS COMPANY	9310 JEFFERSON BLVD. GILVER CITY, CALIFORNIA
TITLE	110 PANEL ASSY		
DRAWN	DATE	BY	CHKD
11/15/61	11/16/61	A.H.	A.H.
DATE	DATE	BY	CHKD
11/15/61	11/16/61	A.H.	A.H.
DATE	DATE	BY	CHKD
11/15/61	11/16/61	A.H.	A.H.

CODE IDENT. NO.	SIZE	QTY. NO.	ISSUE
D	3110124	9	9
SCALE	1/1		SHEET 1 OF 1

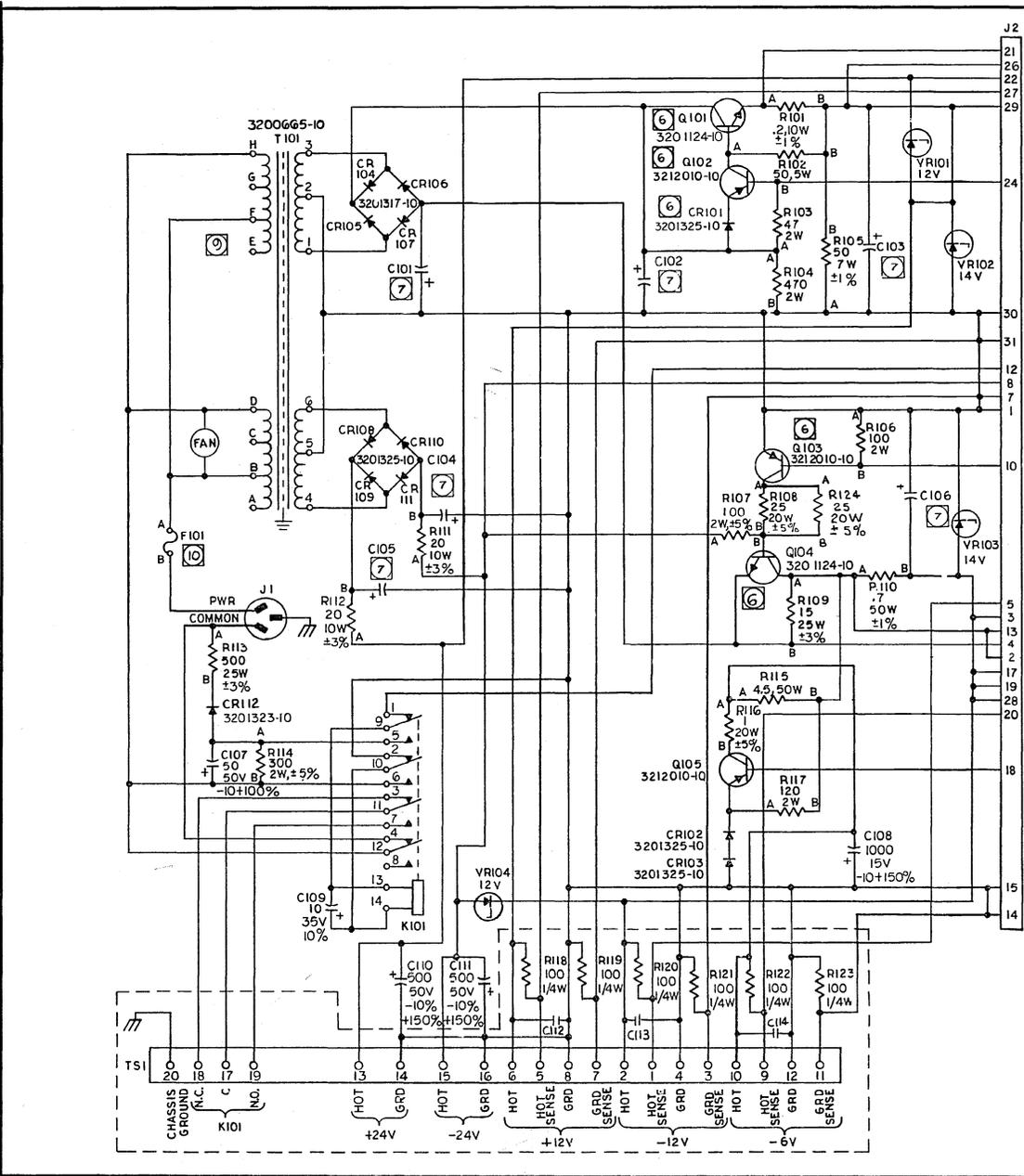
REVISIONS				
ISSUE	DESCRIPTION	DATE	DESIGNER	APPROVAL
A	ECN 5066	4/15/66	Reiss	
B	ECN 5983	7/1/66	Amel	
C	ECN 7099	12/13/66	DW S. Litz	
D	ECN 7189	12/22/66	REISS	
E	ECN 7259	1/6/67		

TABLE I

INPUT POWER	CONNECT		JUMPER				FUSE
	F101A TO	K101-12 TO	FROM	TO	FROM	TO	
100V	T101B	T101C	T101B	T101F	T101C	T101G	3A
110V	T101A	T101C	T101A	T101E	T101C	T101G	3A
125V	T101A	T101D	T101A	T101E	T101D	T101H	3A
200V	T101B	T101G	T101C	T101F			2A
210V	T101A	T101G	T101C	T101F			
215V	T101B	T101G	T101D	T101F			
220V	T101A	T101G	T101C	T101E			
225V	T101A	T101G	T101D	T101F			
230V	T101B	T101H	T101D	T101F			
235V	T101A	T101G	T101D	T101E			
240V	T101A	T101H	T101D	T101F			
250V	T101A	T101H	T101D	T101E			2A

VALUE CHART	
REFERENCE DESIGNATION	VALUE
C101	28,500 $\mu$ F, -10%, +150%, 25V
	OR
	35,000 $\mu$ F, -10%, +100%, 25V
C102	11,500 $\mu$ F, -10%, +150%, 25V
	OR
	14,000 $\mu$ F, -10%, +100%, 25V
C103	5,200 $\mu$ F, -10%, +150%, 25V
	OR
C106	6,500 $\mu$ F, -10%, +100%, 25V
C104	3,300 $\mu$ F, -10%, +150%, 35V
	OR
C105	4,500 $\mu$ F, -10%, +100%, 35V

- ⑩ SEE TABLE I
  - ⑨ TRANSFORMER IS SHOWN WIRED FOR 115V AC INPUT. FOR INPUT VOLTAGES OTHER THAN 115VAC SEE TABLE I.
  - 8. C112, C113, & C114 TO BE 2.2 MFD 25V  $\pm$  20%.
  - ⑦ SEE VALUE CHART.
  - ⑥ TO BE MOUNTED ON HEAT SINK.
  - 5. ALL DIODES TO BE 3Z63028-10.
  - 4. ALL TRANSISTORS TO BE 3212091-10.
  - 3. ALL RESISTOR VALUES ARE IN OHMS  $\pm$  5%, 1/2 W.
  - 2. ALL CAPACITOR VALUES ARE IN MICROFARADS  $\pm$  20%, 35V.
  - 1. FOR ASSEMBLY SEE 3117240 & 3117245.
- NOTES: UNLESS OTHERWISE SPECIFIED



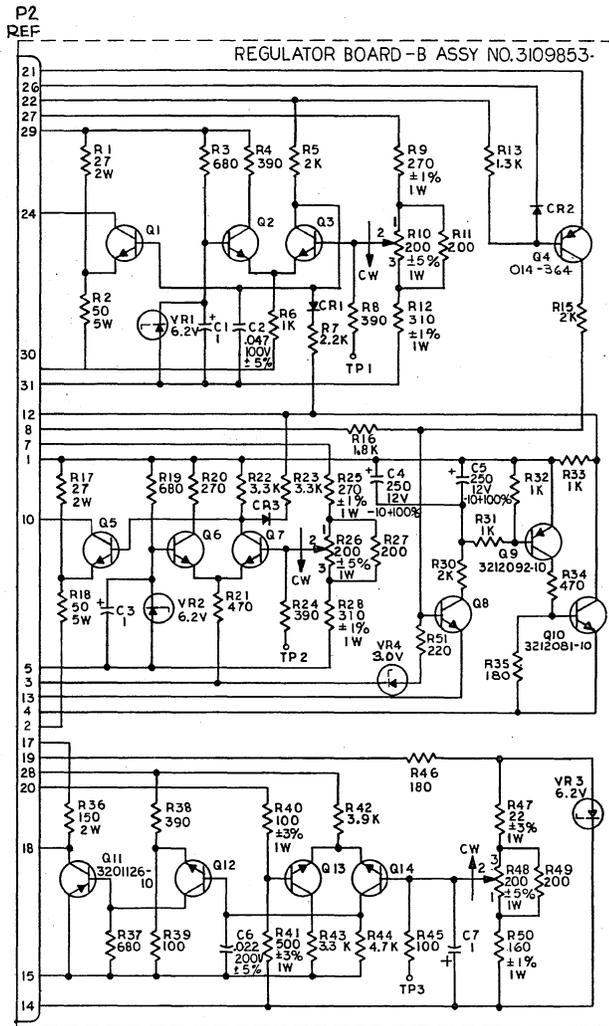
DO NOT SCALE DRAWING  
UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
DECIMALS TOLERANCES ANGLES  
XX ± .XX ± .XX ± .XX  
BREAK ALL SHARP EDGES APPROX. 510° CHAMFER  
RADIUS SPOTFACE CORNER RADIUS APPROX. 0.10  
SURFINESS OF ALL MACHINED SURFACES SEE ALL DIM.  
MATERIAL

THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS DIVISION AND IS LOANED OR UNAUTHORIZED USE IN PART OR IN WHOLE SHALL BE MADE WITHOUT WRITTEN CONSENT OF AMPEX COMPUTER PRODUCTS DIV.  
DATE: 11/1/67  
DRAWN: [ ]  
CHECKED: [ ]  
ENGR: [ ]  
DESIGN: [ ]  
DATE: [ ]

<b>AMPEX</b> COMPUTER PRODUCTS DIVISION P.O. BOX 388, CULVER CITY, CALIF.	
TITLE <b>SCHEMATIC LOGIC PWR SUPPLY</b>	
SHEET NO. <b>D 09150</b>	DWG. NO. <b>3117242</b>
SCALE	PRINT 1 OF 2

3117240 TN-7-1-11-72  
3117245 TN-7-1-11-72  
NEXT ASSY. 1ST CSD CH.  
APPLICATION

REVISIONS				
ISSUE	DESCRIPTION	DATE	DRAFTSMAN	APPROVAL
D	SEE SHEET #1			
E	SEE SHEET #1			



<b>DO NOT SCALE DRAWING</b> UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DECIMALS TOLERANCES ANGLES .XX ± .0002 ± .0002 ± .0002 BREAK ALL SHARP EDGES APPROX. 0.10 C ROUN AND SPITALLE CORNRS EACH APPROX. 0.10 ROUNDNESS OF ALL MACHINED SURFACES — SEE SPECIFICATIONS MATERIAL		THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS DIVISION AND BEING LOANED OR UNAUTHORIZED USE IN PART OR IN WHOLE SHALL BE MADE WITHOUT WRITTEN CON- SENT OF AMPEX COMPUTER PRODUCTS DIV.	<b>AMPEX</b> COMPUTER PRODUCTS DIVISION P.O. BOX 3284, CULVER CITY, CALIF.
3117240 1M-5-7-11-12 3117245 1M-7-1-11-12 NEXT ASSY. 1ST USED ON APPLICATION		TITLE <b>SCHEMATIC          LOGIC PWR SUPPLY</b>	SIZE CODE IDENT. NO. DWG. NO. <b>D 09150 3117242</b>
SCALE		SHEET <b>2 OF 2</b>	

DC 313 | 3117241

REVISIONS				
ISSUE	DESCRIPTION	DATE	DRAFTSMAN	APPROVAL
A	ECN 5056	15-11-64	D.W. 5.668	J.S.M.
B	ECN 7027	9-22-64	D.W. 5.668	J.S.M.
C	ECN 7099	10-13-64	D.W. 5.668	J.S.M.

PART NO	REFERENCE DESIGNATIONS
3201124-10	Q101, Q104
3212010-10	Q102, Q103
3201325-10	C R101
031-385 OR 031-661	C101
031-383 OR 031-651	C102
031-494 OR 031-643	C103, C106
031-495 OR 031-660	C104, C105
041-453	R104
041-419	R118, R119, R120, R121, R122, R123
SEE VERSION TABLE	F101
3200665-10	T101
047-799	R110
030-223	C112, C113, & C114
043-847	R105

VERSION TABLE

PART NO.	INPUT POWER	CONNECT		JUMPER				FUSE SLOW BLOW	FUSE PART "A"
		F101A TO	K101-12 TO	FROM	TO	FROM	TO		
3117240-01	100V	T101B	T101C	T101B	T101F	T101C	T101G	3A	070-002
↑	-02 110V	T101A	T101C	T101A	T101E	T101C	T101G	3A	070-002
↑	-03 115V	AS WIRE PER WIRE LIST							
3117240-04	125V	T101A	T101D	T101A	T101E	T101D	T101H	3A	070-002
3117245-01	200V	T101B	T101G	T101C	T101F	---	---	2.0A	070-312
↑	-02 210V	T101A	T101G	T101C	T101F	---	---	↑	↑
↑	-03 215V	T101B	T101G	T101D	T101F	---	---	↑	↑
↑	-04 220V	T101A	T101G	T101C	T101E	---	---	↑	↑
↑	-05 225V	T101A	T101G	T101D	T101F	---	---	↑	↑
↑	-06 230V	T101B	T101H	T101D	T101F	---	---	↑	↑
↑	-07 235V	T101A	T101G	T101D	T101E	---	---	↑	↑
↑	-08 240V	T101A	T101H	T101D	T101F	---	---	↑	↑
3117245-09	250V	T101A	T101H	T101D	T101E	---	---	2.0A	070-312

- WIRES FROM FAN (BLK & WHT TWIST PAIR) REMAIN ON T101 D & E IN ALL CASES.
- ALL FOUR (4) DASH VERSIONS OF 3117240 HAVE IDENTICAL PARTS ONLY VARIATION IS JUMPER & CONNECTIONS ON T101 TERMINALS.
- ALL NINE (9) DASH VERSIONS OF 3117245 HAVE IDENTICAL PARTS. ONLY VARIATION IS JUMPER & CONNECTIONS ON T101 TERMINALS.
- ON ASSY: 3109859-20 MUST BE FLUSH TO SIDE OF 3109858-20 IN LOCATION, INDICATED TO INSURE CIRCUIT CARD CONN. AND GUIDE ALIGN.
- MARK NAMEPLATE INFORMATION PER MIL-STD-130.
- PART NO. TO BE AS SHOWN ON VERSION TABLE
- MARK REFERENCE DESIGNATIONS, .12 HIGH CHARACTERS, COLOR WHITE, PER MIL-STD-130.
- COAT BOTH SIDES OF MICA WASHERS AND METAL WASHERS WITH SILICON GREASE 087-061.
- FOR POWER SUPPLY SPECIFICATION SEE 3117244.
- FOR WIRE LIST SEE 3117243. WIRING IS FOR 115V AC INPUT. ISSUE B
- FOR SCHEMATIC SEE 3117242. ISSUE C
- ASSEMBLE PER PRODUCT PRACTICES MANUAL.

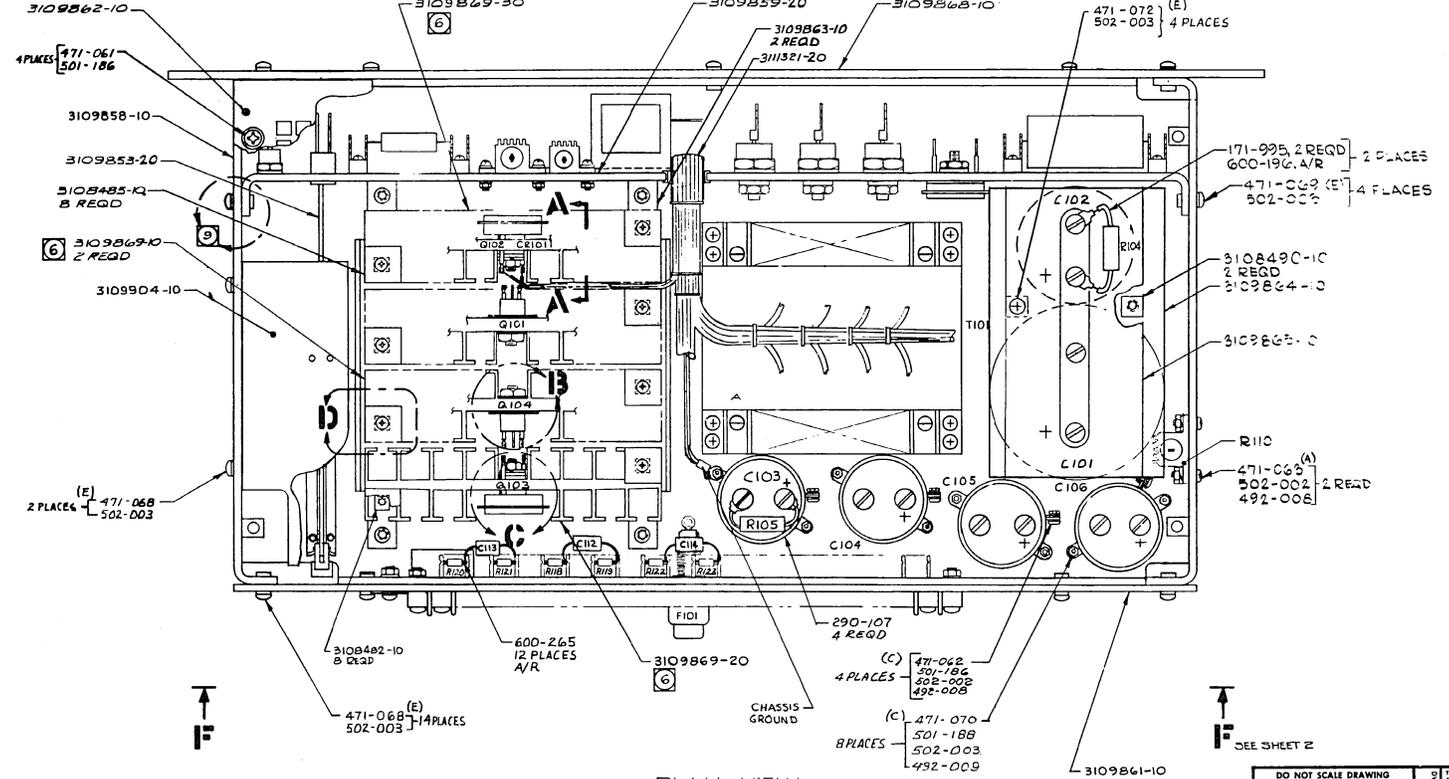
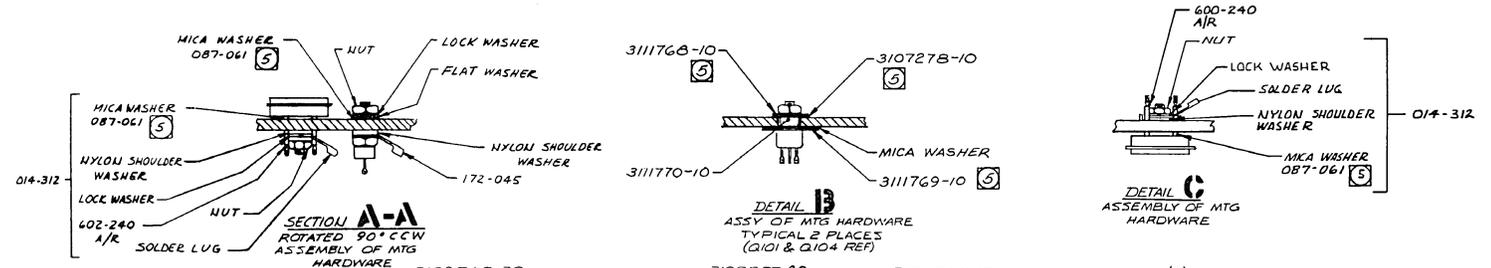
REFERENCE

NOTES:

DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		TOLERANCES ANGLES		DECIMALS		FRACTIONS		THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS DIVISION AND IS NOT TO BE REPRODUCED OR UNAUTHORIZED USE IN WHOLE OR IN PART OR IN ANY MANNER WITHOUT WRITTEN CONSENT OF AMPEX COMPUTER PRODUCTS DIV.		AMPEX COMPUTER PRODUCTS DIVISION P.O. BOX 328, CULVER CITY, CALIF.	
FACE ±.004		HOLE ±.004		±.004		±.004		TITLE		LOGIC POWER SUPPLY ASSY	
NEAR ALL SHARP EDGES APPROX. 50% CHAMFER		RADIUS ±.004		±.004		±.004		DATE		09150 3117241	
SPOTFACE CORNER RADIUS APPROX. 50%		±.004		±.004		±.004		SCALE		1:1	
SURFACES UNLESS OTHERWISE SPECIFIED		±.004		±.004		±.004		SHEET		1 OF 3	
MATERIAL		MATERIAL		MATERIAL		MATERIAL		DRAWN		DATE	
3117245 TN 7.9-11		3117240 TN 7.9-11		3117240 TN 7.9-11		3117240 TN 7.9-11		CHECK		DATE	
NEXT ASSY.		1ST USED ON		APPLICATION		APPLICATION		DATE		DATE	

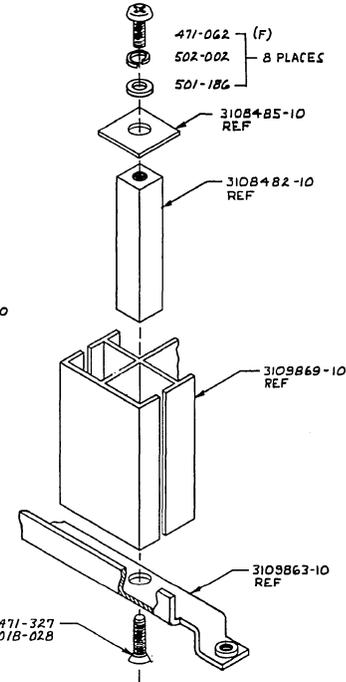
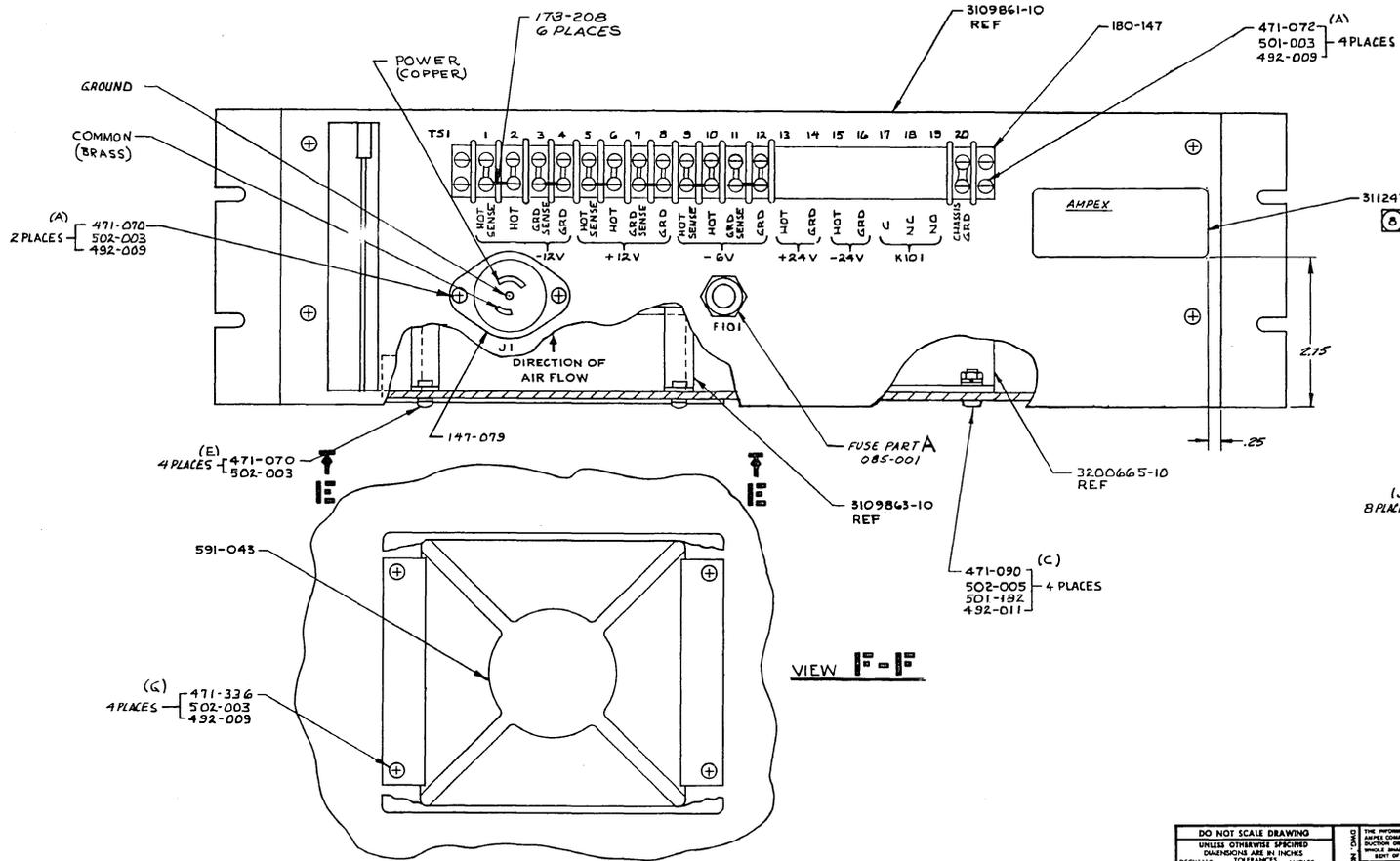
3117241

REVISIONS				
ISSUE	DESCRIPTION	DATE	DRAFTSMAN	APPROVAL
C	SEE SHEET 1			



DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DECIMALS - TOLERANCES - ANGLES xxx. - .xxx ± .x SEEK ALL SHARP EDGES APPROX. 210 CROWN AND SPOTFACE CORNER RADIUS APPROX. 010 ROUGHNESS OF ALL MACHINED SURFACES - 48 RA-312-12 MATERIAL		THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS DIVISION. NO REPRO- DUCTION OR UNAUTHORIZED USE IN PART OR IN WHOLE SHALL BE MADE WITHOUT WRITTEN CON- SENT OF AMPEX COMPUTER PRODUCTS DIV.	
AMPEX COMPUTER PRODUCTS DIVISION P.O. BOX 388, CULVER CITY, CALIF.		TITLE LOGIC POWER SUPPLY ASSY	
3117240	TMT 9-11	SIZE	CODE IDENT. NO.
3117240	TMT 9-11	D	09150
NEXT ASSY. 1ST USED ON		3117241	
APPLICATION		SCALE	1:1
		SHEET 2 OF 3	

REVISIONS				
ISSUE	DESCRIPTION	DATE	DRAFTSMAN	APPROVAL
C	SEE SHEET 1			



(E) 4 PLACES  
471-070  
502-003

(G) 4 PLACES  
471-336  
502-003  
492-009

(C) 4 PLACES  
471-090  
502-005  
501-182  
492-011

(A) 4 PLACES  
471-072  
501-003  
492-009

(F) 8 PLACES  
471-062  
502-002  
501-186

(J) 8 PLACES  
471-327  
501-028

**DETAIL D**  
TYPICAL  
SCALE: NONE

FAN INSTALLATION  
VIEW I-I

VIEW I-I

DO NOT SCALE DRAWING  
UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
DECIMALS TOLERANCES ANGLES  
FRACTIONS TOLERANCES ANGLES  
FINISH — SEE —  
BREAK ALL SHARP EDGES APPROX. .010 CROSSL  
AND NOTICE CORNER RADIUS APPROX. .010  
ROUGHNESS OF ALL MACHINED  
SURFACES — PER MIL STD 10  
MATERIAL

3117245  
3117240  
3117241

DATE: 11/24/64  
DRAWN: [Signature]  
CHECKED: [Signature]  
APPROVED: [Signature]

AMPEX COMPUTER PRODUCTS DIVISION  
P.O. BOX 388, CULVER CITY, CALIF.

TITLE  
**LOGIC POWER SUPPLY ASSY**

SIZE: CODE IDENT. NO. DRWG. NO.  
**D 09150 3117241**

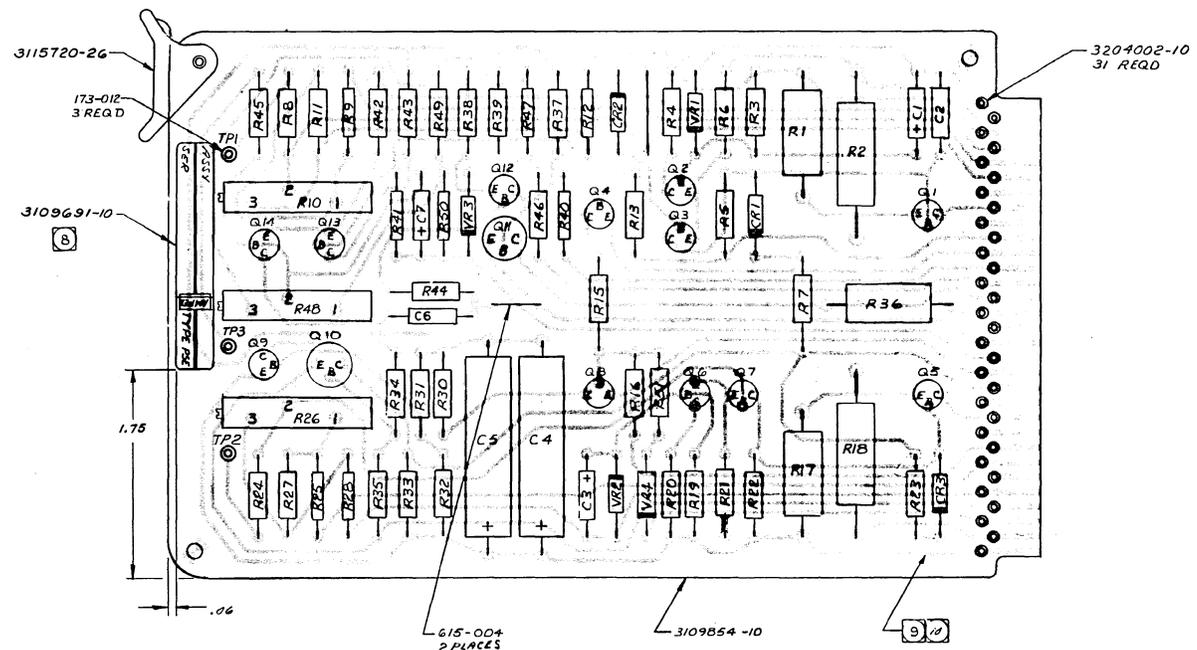
SCALE: 1:1 SHEET 3 OF 3

3117245 TMT, 9.11  
3117240 TMT, 9.11  
NEXT ASSY. 1ST USED ON

APPLICATION

REVISIONS				
ISSUE	DESCRIPTION	DRAWN	DATE	APPROVAL
Z	ECN 8658	U. Ford	1-8-68	[Signature]

REVISIONS				
ISSUE	DESCRIPTION	DRAWN	DATE	APPROVAL
A	ECN 91193	DEV PRO	4-20-68	[Signature]
B	ECN 31105		5-13-68	[Signature]
C	ECN 701-L	PROD.	4-16-68	[Signature]
D	ECN 3385		5-23-68	[Signature]
E	ECN 3544		5-23-68	[Signature]
F	ECN 4901		6-10-68	[Signature]
G	ECN 5056		4-22-66	[Signature]
H	ECN 5983		9/16	[Signature]
J	ECN 7189	REISS	11/14/68	[Signature]
K	ECN 7259		2/16/69	[Signature]

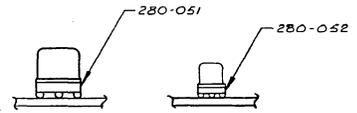


PART NO.	REFERENCE DESTINATION
320126-10	Q11
3212091-10	Q1, 2, 3, 5, 6, 7, 8, 12, 13, 14
3212092-10	Q9
3263028-10	CR1, 2, 3
013-202	VR1, 2, 3
031-220	C4, 5
037-994	C1, C3, C7
041-003	R45, 39
041-010	R5, 15, 30
041-013	R44
041-239	R7
041-245	R6, 33, 31, 32
041-364	Q4
041-273	R30
055-232	C2
041-303	R42
041-009	R16
041-331	R22, 23, 43
041-336	R21, 34
041-343	R3, 19, 37
041-344	R4, 8, 24, 38
041-424	R36
041-461	R35, 46
041-462	R13
041-670	R1, 17
044-827	R10, 26, 48
047-703	R47
047-704	R40
047-800	R50
047-802	R12, 28
047-801	R9, 25
047-708	R41
047-709	R2, 18
3312081-10	Q10
013-587	VE4
041-004	EE1
041-334	EE11, 27, 49
030-094	C6

3109853

- ⑩ SEAL PRINTED CIRCUIT SIDE ONLY WITH HUMI-SEAL TYPE 1B15, COLUMBIA TECH. OR EQUIVALENT.
- ⑨ CIRCUITRY ON DIP SIDE.
- ⑧ MARK PART NO. AND NAMEPLATE INFORMATION PER MIL-STD-130.
- 7. PART NO. TO BE AS SHOWN IN VERSION TABLE
- 6. PLUS SIGN ON CAPACITOR INDICATES POSITIVE.
- 5. COMPONENT DESIGNATIONS ARE FOR REFERENCE ONLY.
- 4. HEAVY LINE ON DIODE INDICATES CATHODE
- 3. ASSEMBLE PER MANUFACTURING PRACTICES MANUAL.
- 2. FOR ASSEMBLY SPECIFICATION SEE 311724G
- 1. FOR SCHEMATIC SEE 3117242

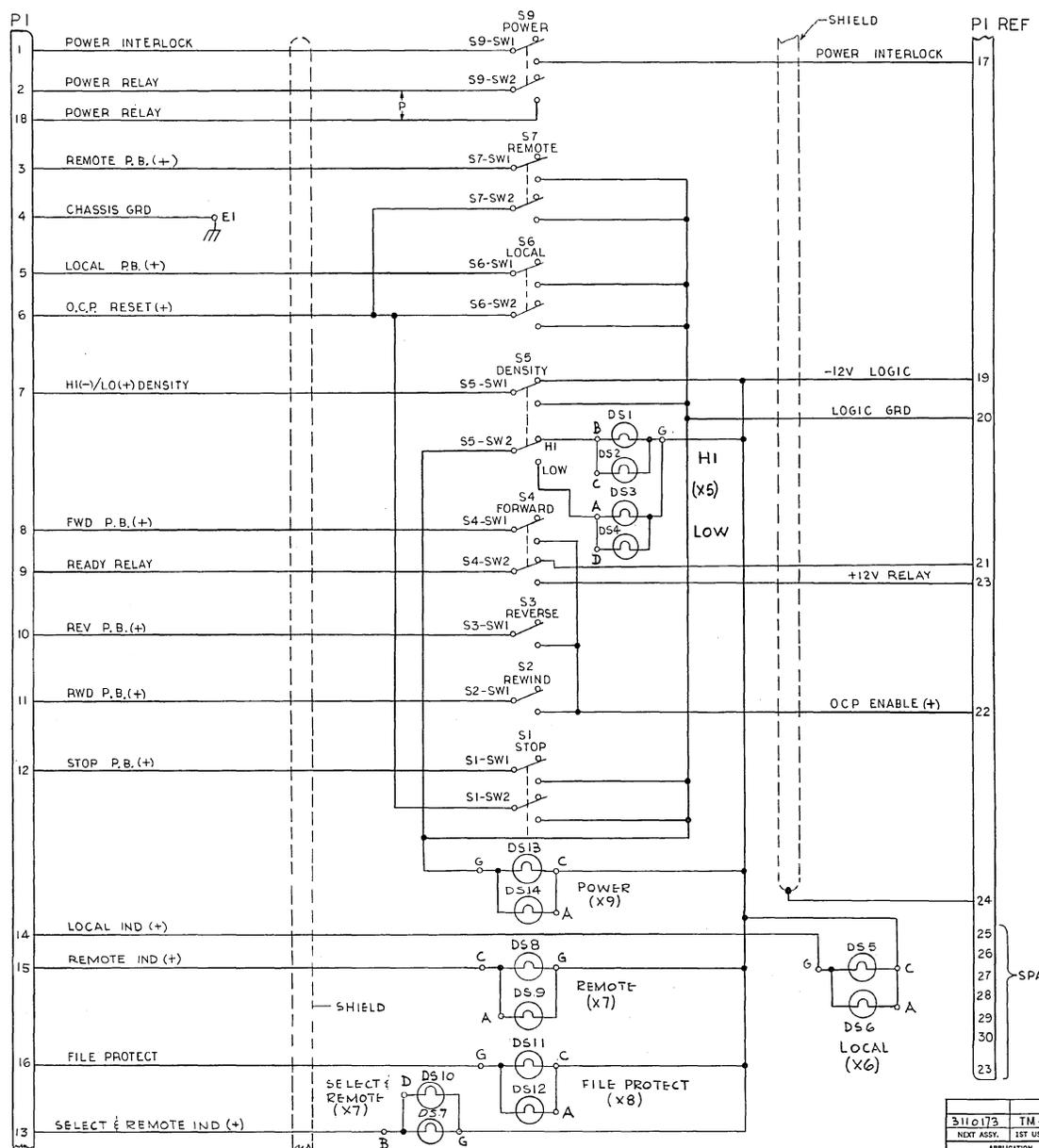
VERSION TABLE		
PART NO.	USE	USED ON
3109853-10	FIELD SERVICE BUILT TO ISSUE F	3109850 3111340
3109853-20	PRODUCTION	3117240 3117245



TYPICAL TRANSISTOR INSTALLATION

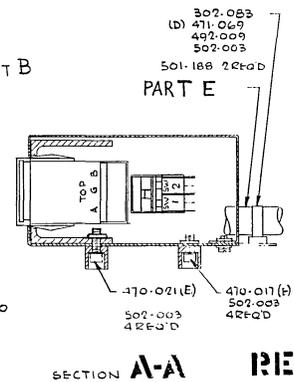
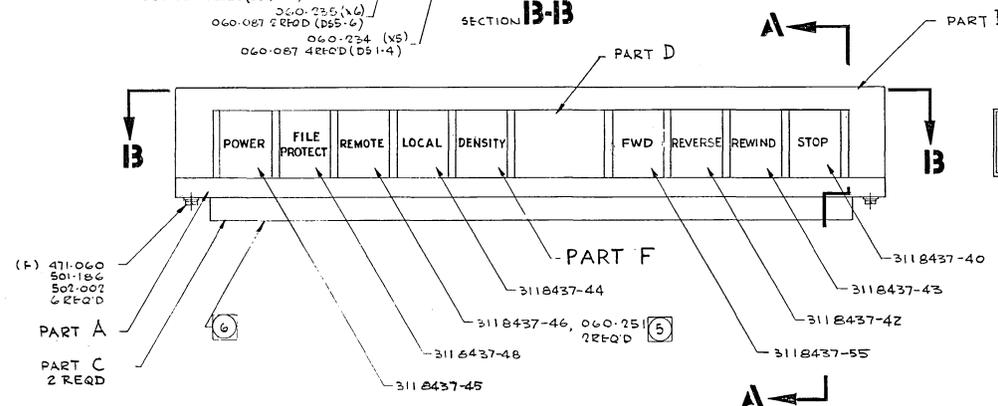
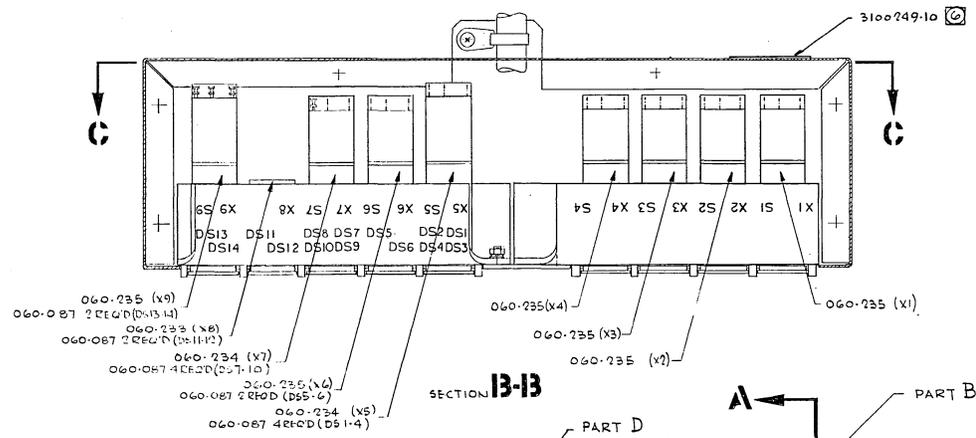
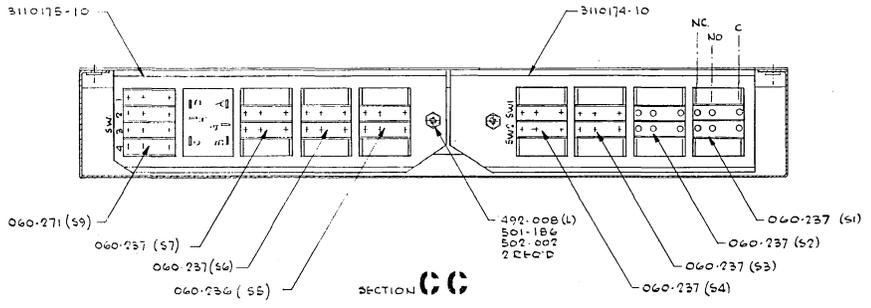
DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED TOLERANCES		THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY AND IS TO BE KEPT CONFIDENTIAL AND NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE WRITTEN CONSENT OF AMPEX COMPUTER PRODUCTS CO.		AMPEX AMPEX COMPUTER PRODUCTS COMPANY 917 JEFFERSON BLVD. CULVER CITY, CALIFORNIA	
3X = .003	4X = .002	ANGLES	PROT	DATE	TITLE
BREAK ALL SHARP EDGES APPROX .010	ROUND ALL CHAMFER AND SPOTFACE CORNER	PER MIL-STD-19	CHKR	DATE	CIRCUIT BOARD ASSY - REGULATOR BOARD -B
MATERIAL	FINISH	SCALE	SIZE	DWG. NO.	ISSUE
3109850	T.M-7	2/1	D	3109853	L
APPLICATION	DATE	SHEET 2/1		SHEET 1 OF 1	

REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
A	REVISED	PEOP	5/15/64	SM
B	ECN 4236	SM	8/21/64	SM



REQD.	PART NO.	DESCRIPTION	REFERENCE	ZONE	ITEM
DO NOT SCALE DRAWING					
UNLESS OTHERWISE SPECIFIED					
DIMENSIONS ARE IN INCHES					
DECIMALS = 0.10 ANGLES					
XX = 90 XX = 90					
BREAK ALL SHARP EDGES APPROX. 0.10					
RADIUS AND SPOTFACE CORNER					
FINISH					
SURFACES					
PER MIL STD 10					
MATERIAL					
FORM 348-107 REV. 8-63					
THIS INFORMATION HEREON IS THE PROPERTY OF					
AMPEX COMPUTER PRODUCTS COMPANY AND IS					
NOT TO BE REPRODUCED OR TRANSMITTED IN ANY					
FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL,					
INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY					
INFORMATION STORAGE AND RETRIEVAL SYSTEM.					
AMPEX		AMPEX COMPUTER PRODUCTS COMPANY			
9937 JEFFERSON BLVD.		CULVER CITY, CALIFORNIA			
TITLE					
SCHEMATIC -					
OPERATOR CONTROL PANEL					
CODE INCH. NO.		SIZE		DWG. NO.	
3110173		TM-11		3110035	
NEXT ASSY.		1ST USED ON		ISSUE	
APPLICATION		FINISH		SCALE NONE	
DFTSMAN		CHKR		DATE	
A. H. 2/24		5/2/64		B	

REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
D	ERN 164E	PROD	3/16/69	ll
E	ECN 9236	ll	4/11/69	ll
F	ECN 9839	C.M.	11/16/69	A.C.R.
G	ECN 8043	ZM	10/26/69	ll



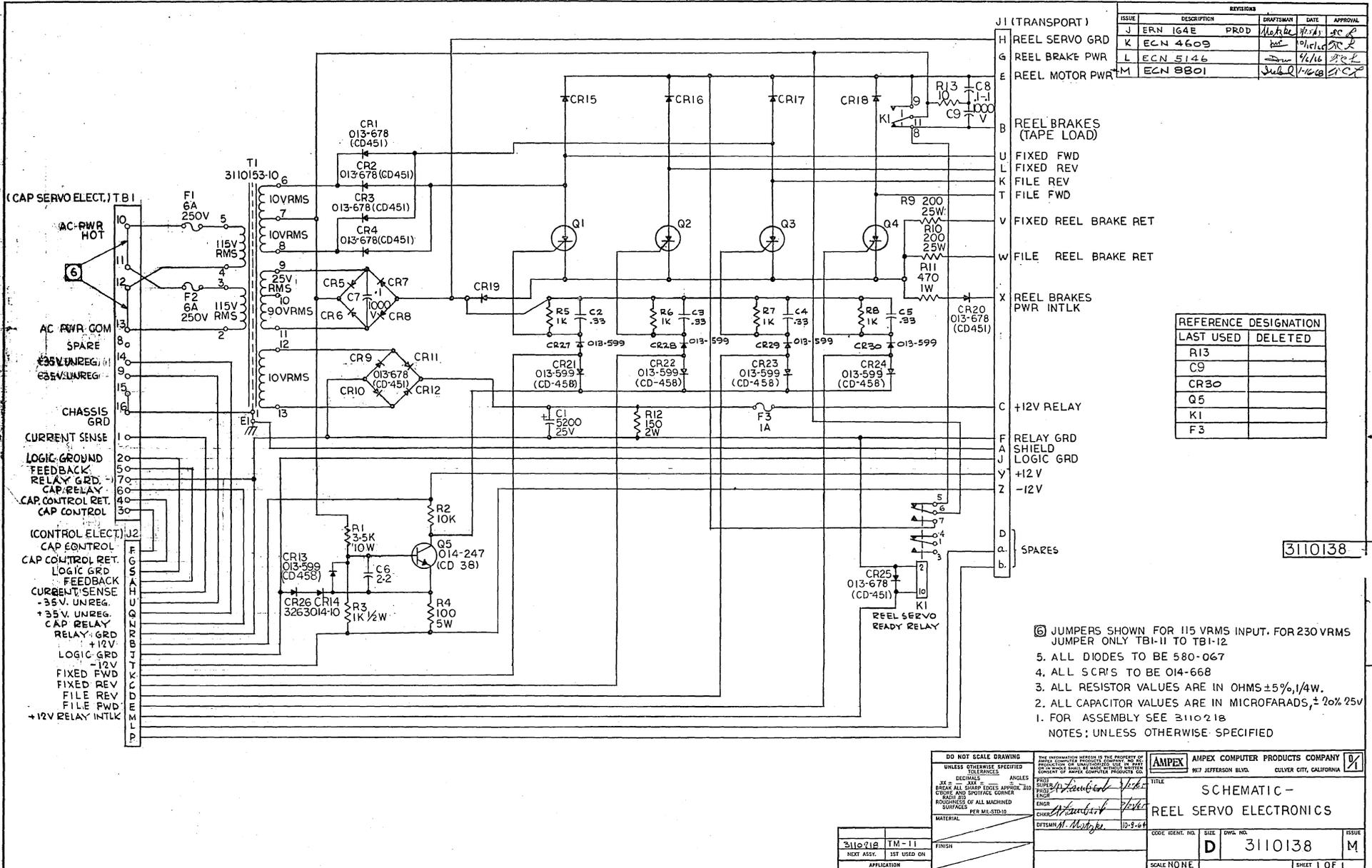
- 3110172
- 6 MARK PART NO. 1/2 HIGH CHARACTERS COLOR BLACK PER MIL STD 130 DO NOT IMPRESSION STAMP.
  - 5 INSTALL RED BOOT AMPLEX P/N 060-251 OVER LAMPS DS7 AND DS10 (LAMPS ASSOCIATED WITH X7 PIN B/D).
  - 4 PART NO TO BE AS PER B/M
  - 3 FOR WIRELIST SEE 3110160
  - 2 FOR SCHEMATIC SEE 3110035
  - 1 ASSEMBLE PER MANUFACTURING PRACTICE MANUAL.

**REFERENCE**

DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED TOLERANCES DECIMALS ANGLES XX ± .005 ± .005 BREAK ALL SHARP EDGES APPROX .010 CHAMFER AND SPOTFACE CORNER ROUGHNESS OF ALL MACHINED SURFACES PER MIL-STD-113		THIS INFORMATION DESIGN IS THE PROPERTY OF AMPLEX COMPUTER PRODUCTS COMPANY, INC. AND IS TO BE KEPT IN CONFIDENTIALITY. NO PART OF THIS DOCUMENT IS TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE WRITTEN PERMISSION OF AMPLEX COMPUTER PRODUCTS COMPANY.		<b>AMPEX</b> AMPEX COMPUTER PRODUCTS COMPANY 9917 JEFFERSON BLVD. CULVER CITY, CALIFORNIA	
3116829 TM-12 3116830 TM-13 3115582 TM-11 3110172 TM-11 NEXT ASSY. 1ST USED ON APPLICATION		TITLE <i>Atkinson</i> <i>ll</i> ENGR C. <i>ll</i> CHR R. <i>ll</i> DESIGNED S. <i>ll</i>		OPERATOR CONTROL PANEL CODE IDENT. NO. <b>D</b> DWG. NO. <b>3110172</b> ISSUE <b>G</b>	
SCALE 1/1		SHEET 1 of 1			

3110138

DC 320

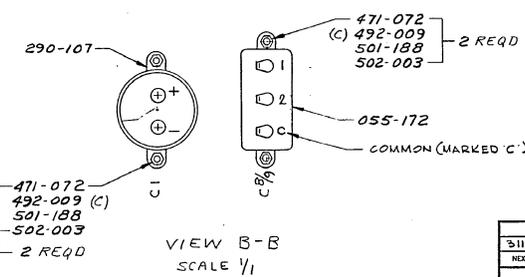
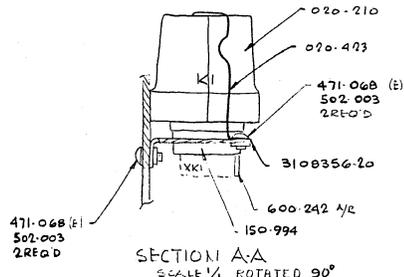
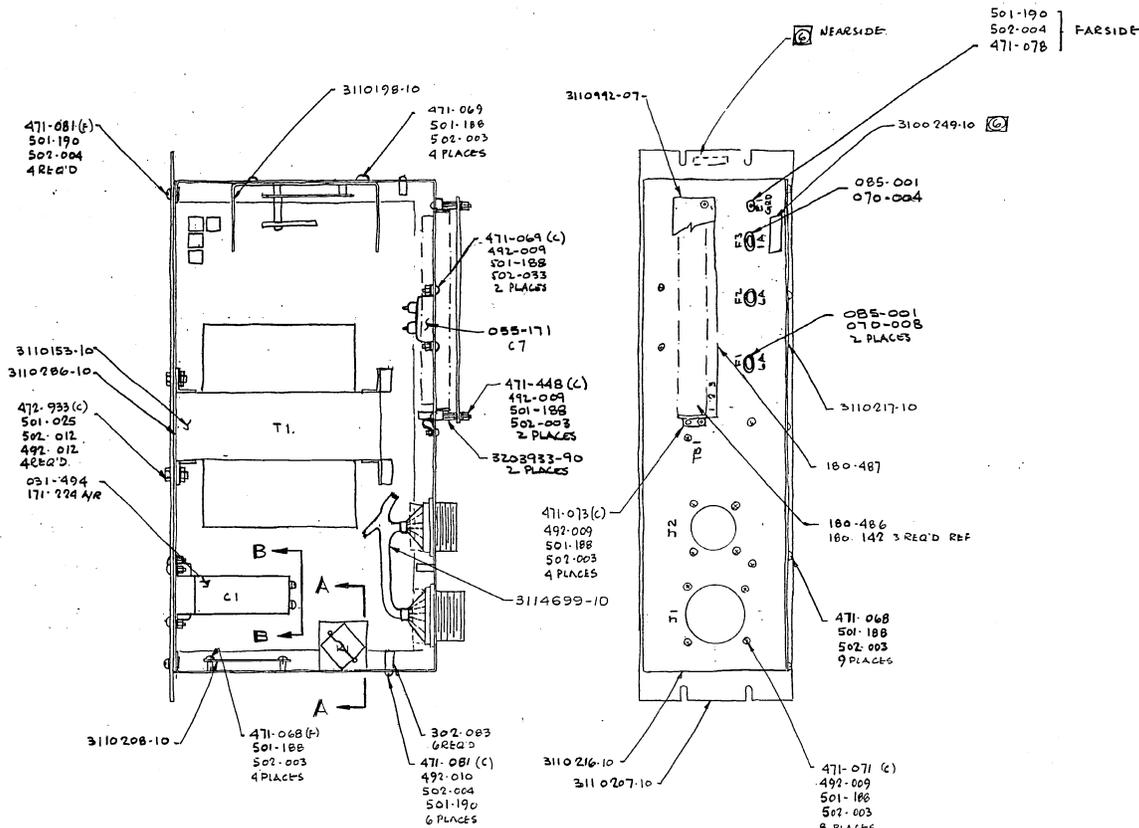


DO NOT SCALE DRAWING		UNLESS OTHERWISE SPECIFIED TOLERANCES:		PROT. ANGLES: 30°		THE INFORMATION HEREON IS THE PROPERTY OF AMPLEX COMPUTER PRODUCTS COMPANY AND IS TO BE USED ONLY IN THE MANUFACTURE OF AMPLEX COMPUTER PRODUCTS FOR THE COMPANY.	
3110218		TM-11		FINISH		AMPEX AMPLEX COMPUTER PRODUCTS COMPANY 907 JEFFERSON BLVD. CULVER CITY, CALIFORNIA	
NEXT ASSY. 1ST USED ON		APPLICATION		TITLE		SCHEMATIC - REEL SERVO ELECTRONICS	
SCALE NONE		SHEET 1 OF 1		CODE IDENT. NO. D		DWG. NO. 3110138	
				ISSUE		M	

3110218

DC 230

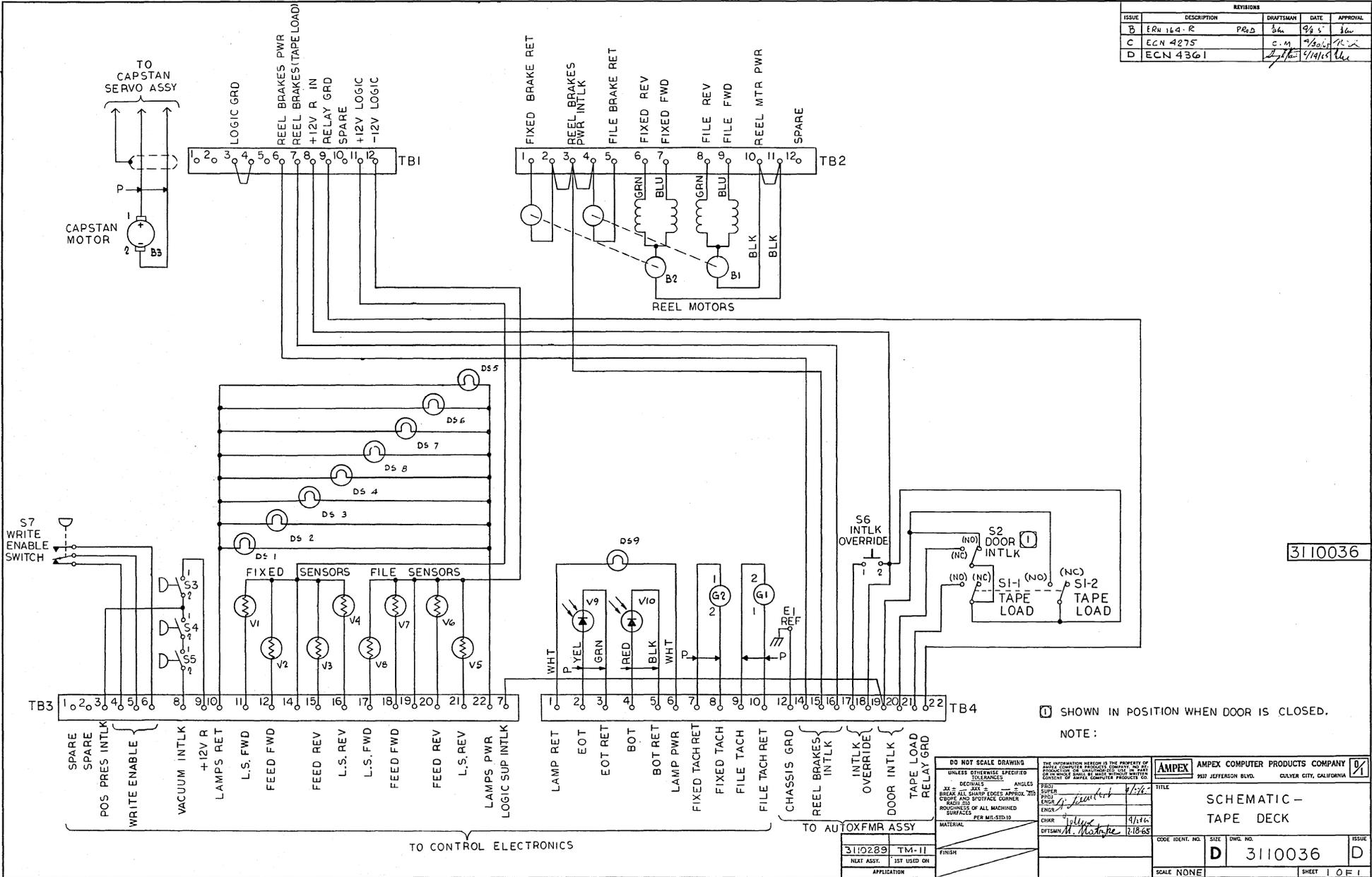
REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
B	ERN 164 E	PROD	1/6/66	1/6
C	ECN 4420	1/6/66	7 6 45	1/6
D	ECN 4609	1/6/66	1/6/66	1/6
E	ECN 5923	1/6/66	1/6/66	1/6
F	ECN 7630	1/6/66	1/6/66	1/6
G	ECN 8801	1/6/66	1/6/66	1/6



- 1 MARK PART NO. 12 HIGH, COLOR BLACK, PER MIL-STD-130, DO NOT IMPRESSION STAMP.
  - 5 PART NO TO BE 3110218-10
  - 4 FOR WIRING LIST AND SCHEMATIC SEE B/M
  - 3 FOR COMPONENT REFERENCE DESIGNATIONS NOT SHOWN SEE RESPECTIVE SUB-ASSY.
  - 2 PARTIAL REFERENCE DESIGNATIONS ARE SHOWN FOR COMPLETE DESIGNATION PREFIX WITH UNIT NO OR SUB-ASSY DESIGNATION.
  - 1 ASSEMBLE PER MANUFACTURING PRACTICE MANUAL.
- NOTES:

DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED TOLERANCES	THE INFORMATION HEREON IS THE PROPERTY OF AMPLEX COMPUTER PRODUCTS COMPANY. IN PART OR WHOLE IT SHALL BE LOANED, REPRODUCED, COPIED, OR OTHERWISE USED IN ANY MANNER WITHOUT THE WRITTEN CONSENT OF AMPLEX COMPUTER PRODUCTS CO.	AMPEX 917 JEFFERSON BLVD. CULVER CITY, CALIFORNIA
XX = DECIMALS ANGLES BREAK ALL SHARP EDGES APPROX. .010 CHAMFER AND SPOTFACE CORNER FINISH MATERIAL PER MIL-STD-35	PROJ. NO. 11/10/65 SUPER. BY 11/10/65 ENGR. BY 11/10/65 CHKD. BY 11/10/65 DFTSMAN C. 11/10/65	TITLE REEL SERVO ASSY
3110218 NEXT ASSY. 1ST USED ON APPLICATION	FINISH MATERIAL PER MIL-STD-35	CODE IDENT. NO. D SIZE 3110218 DWS. NO. 3110218 ISSUE
		SCALE 1/2 SHEET 1 OF 1

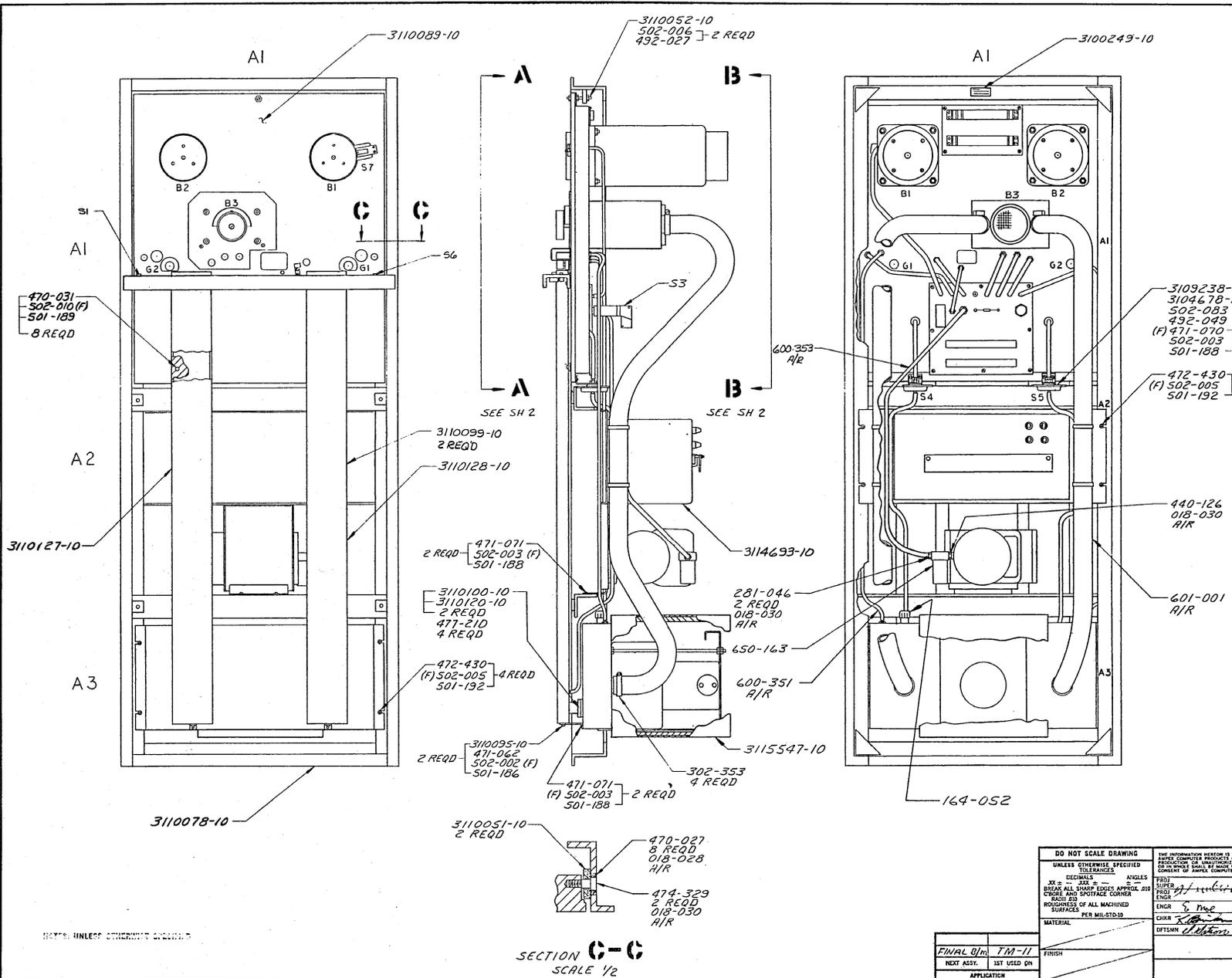
REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
B	ERN 144-R	PERD	8/8/64	8/8/64
C	ECN 4275	C.M.	9/30/64	
D	ECN 4361		1/14/65	



3110036

NOTE:  SHOWN IN POSITION WHEN DOOR IS CLOSED.

<small>DO NOT SCALE DRAWING</small> <small>UNLESS OTHERWISE SPECIFIED</small> <small>ALL DIMENSIONS ARE IN INCHES</small> <small>ANGLES</small> <small>AXES - UNLESS OTHERWISE SPECIFIED - ARE TO BE DRAWN AT SHARP EDGES APPROX. 20° TO 30°</small> <small>CHAMFER AND SPOTFACE CORNER ROUNDS</small> <small>ROUGHNESS OF ALL MACHINED SURFACES - PER MIL-STD-113</small>	<small>THIS INFORMATION RESIDES IN THE PROPERTY OF AMPEX CORPORATION OR AMPEX COMPUTER PRODUCTS COMPANY. IT IS TO BE KEPT CONFIDENTIAL AND NOT TO BE DISCLOSED TO ANY OTHER PARTY WITHOUT THE WRITTEN CONSENT OF AMPEX COMPUTER PRODUCTS COMPANY.</small>	<b>AMPEX</b> AMPEX COMPUTER PRODUCTS COMPANY <small>9537 JEFFERSON BLVD. CULVER CITY, CALIFORNIA 90230</small>	
		TITLE <b>SCHEMATIC - TAPE DECK</b>	
MATERIAL: PER MIL-STD-113 FINISH:	CODE IDENT. NO. <b>D</b>	SHEET NO. <b>3110036</b>	ISSUE <b>D</b>
3110289 TM-11 <small>NEAT ASSY. 1ST USED ON APPLICATION</small>	SCALE: NONE	SHEET 1 OF 1	



REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
C	ERN 164-BB PROO.	W. Clark	9/5/65	Wm
D	ECN 4419	Wm	7/1/65	Wm
E	ECN 4497	G. C. Smith	8/16/65	Wm
F	ECN 4543	B. J. Miller	11/1/65	Wm
G	ECN 4647	Wm	11/8/65	Wm
H	ECN 4681	Wm	11/21/65	Wm
J	ECN 5183	Wm	6/24/66	Wm
K	ECN 7269	Wm	3/2/67	Wm

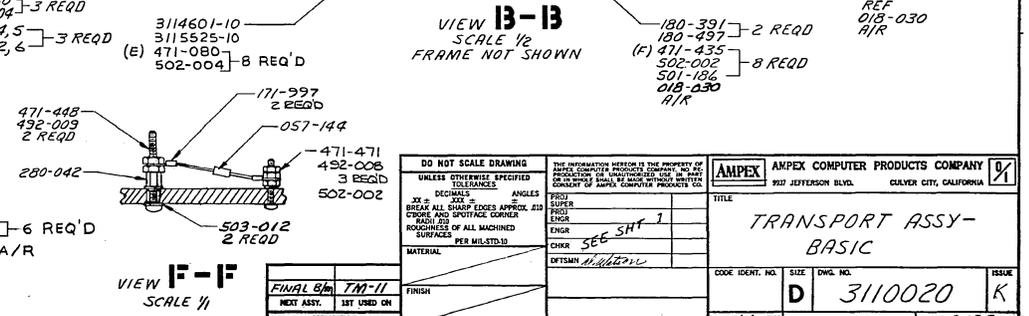
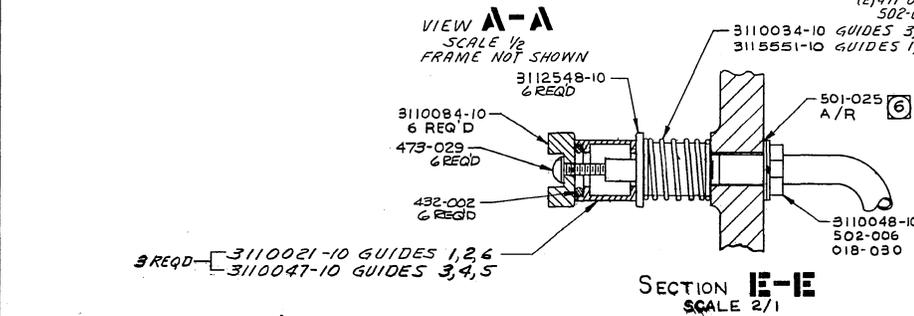
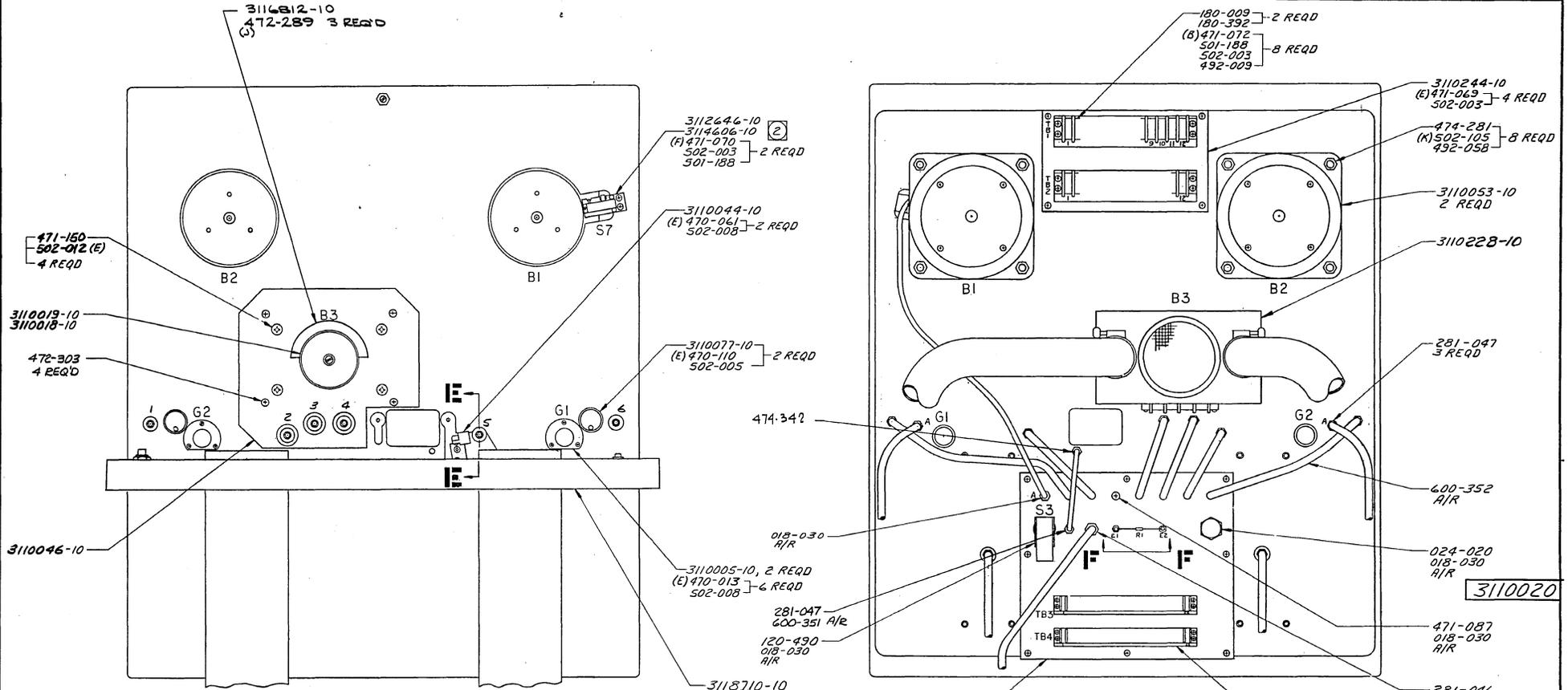
3110020

- FOR SCHEMATIC SEE 3110036.
  - FOR W/L SEE 3114617.
  - FOR CABLE CONNECTION SEE 3110193.
  - 3114606-10 (SPACER) NOT REQ'D FOR HUB REEL USAGE.
  - ASSEMBLE PER PROD. PRACTICE MANUAL.
- NOTES:

NOTE: UNLESS OTHERWISE SPECIFIED

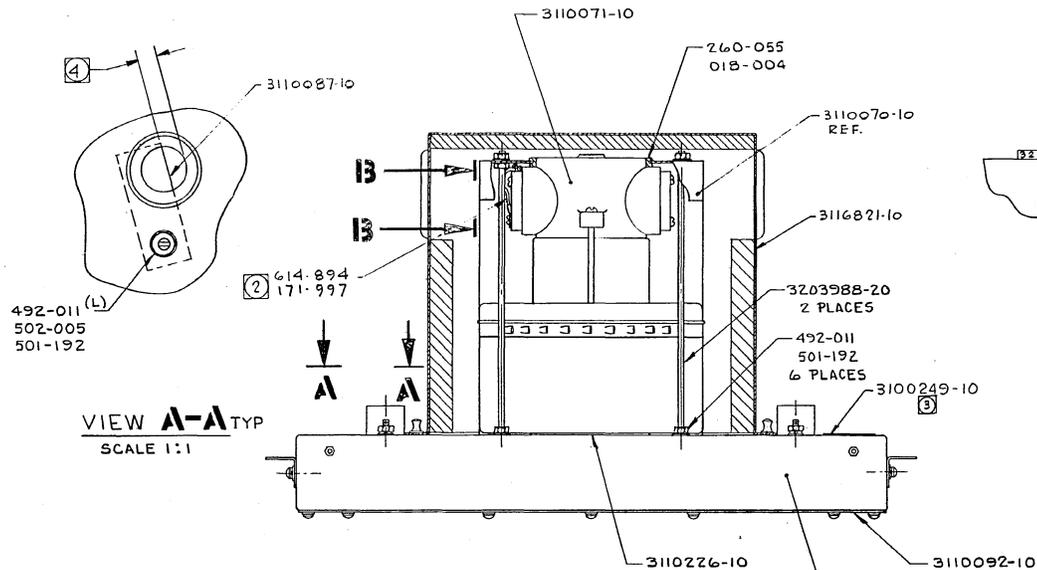
DO NOT SCALE DRAWING		UNLESS OTHERWISE SPECIFIED TOLERANCES		THE INFORMATION HEREON IS THE PROPERTY OF AMPLEX COMPUTER PRODUCTS COMPANY AND IS UNCLASSIFIED UNLESS INDICATED OTHERWISE BY A NOTICE FROM THE COMPANY.		<b>AMPEX COMPUTER PRODUCTS COMPANY</b> 9377 JEFFERSON BLVD. SILVER CITY, CALIFORNIA	
DECIMALS ANGLES BREAK ALL SHARP EDGES APPROX .010 CHAMF AND SPOTFACE CORNER FINISHES OF ALL MACHINED SURFACES PER MIL-STD-12	ANGLES FINISH FIRST SUPER ENGR CHECK OFFMAN	TITLE <b>TRANSPORT ASSY BASIC</b>	CODE IDENT. NO. <b>D</b>	SIZE <b>3110020</b>	DWG. NO. <b>K</b>	ISSUE <b>1 OF 2</b>	SHEET 1 OF 2

REVISIONS				
ISSUE	DESCRIPTION	DRAWSMAN	DATE	APPROVAL
1	SEE SHEET 1	<i>A. Wilson</i>		

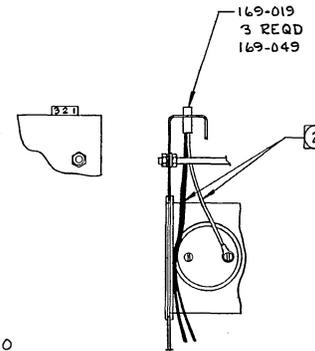


<p>DO NOT SCALE DRAWING</p> <p>UNLESS OTHERWISE SPECIFIED TOLERANCES:</p> <p>SIZE - DECIMALS</p> <p>ANGLES - SUPER</p> <p>BREAK ALL SHARP EDGES APPROX. 0.125</p> <p>SPRUE AND SPOTFACE CORNER - R0.125</p> <p>ROUNDEDNESS OF ALL MACHINED SURFACES - PER MIL-STD-12</p> <p>MATERIAL -</p> <p>FINISH -</p> <p>FINAL BOM - TM-11</p> <p>NEXT ASSY. - 1ST USED ON</p> <p>APPLICATION -</p>		<p>THE INFORMATION HEREON IS THE PROPERTY OF AMPLEX COMPUTER PRODUCTS COMPANY AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM.</p> <p>AMPEX COMPUTER PRODUCTS COMPANY 9312 JEFFERSON BLVD. GLENVIEW CITY, CALIFORNIA</p> <p>TITLE <b>TRANSPORT ASSY-BASIC</b></p> <p>CODE IDENT. NO. - D</p> <p>SIZE - 3110020</p> <p>DWG. NO. - K</p> <p>ISSUE - K</p> <p>SCALE - SHEET 2 OF 2</p>	
--	--	---	--

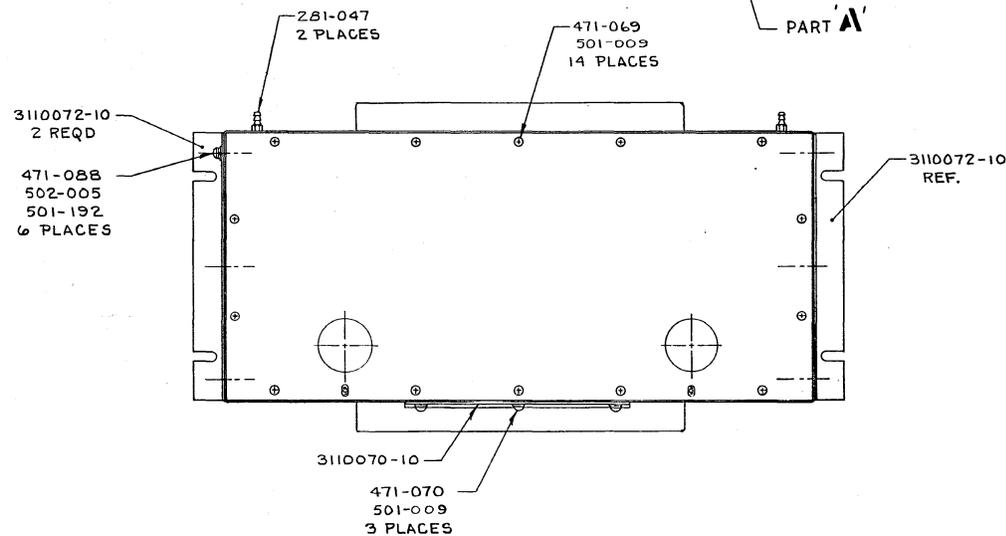
REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
A	ECN 4541	C.M.	7/16/68	[Signature]
B	ECN 4647	E.H.	11/8/68	[Signature]
C	ECN 5135	E.M.	3/26/69	[Signature]



VIEW A-A TYP  
SCALE 1:1



VIEW B-B  
ROTATED 90° C.C.W.

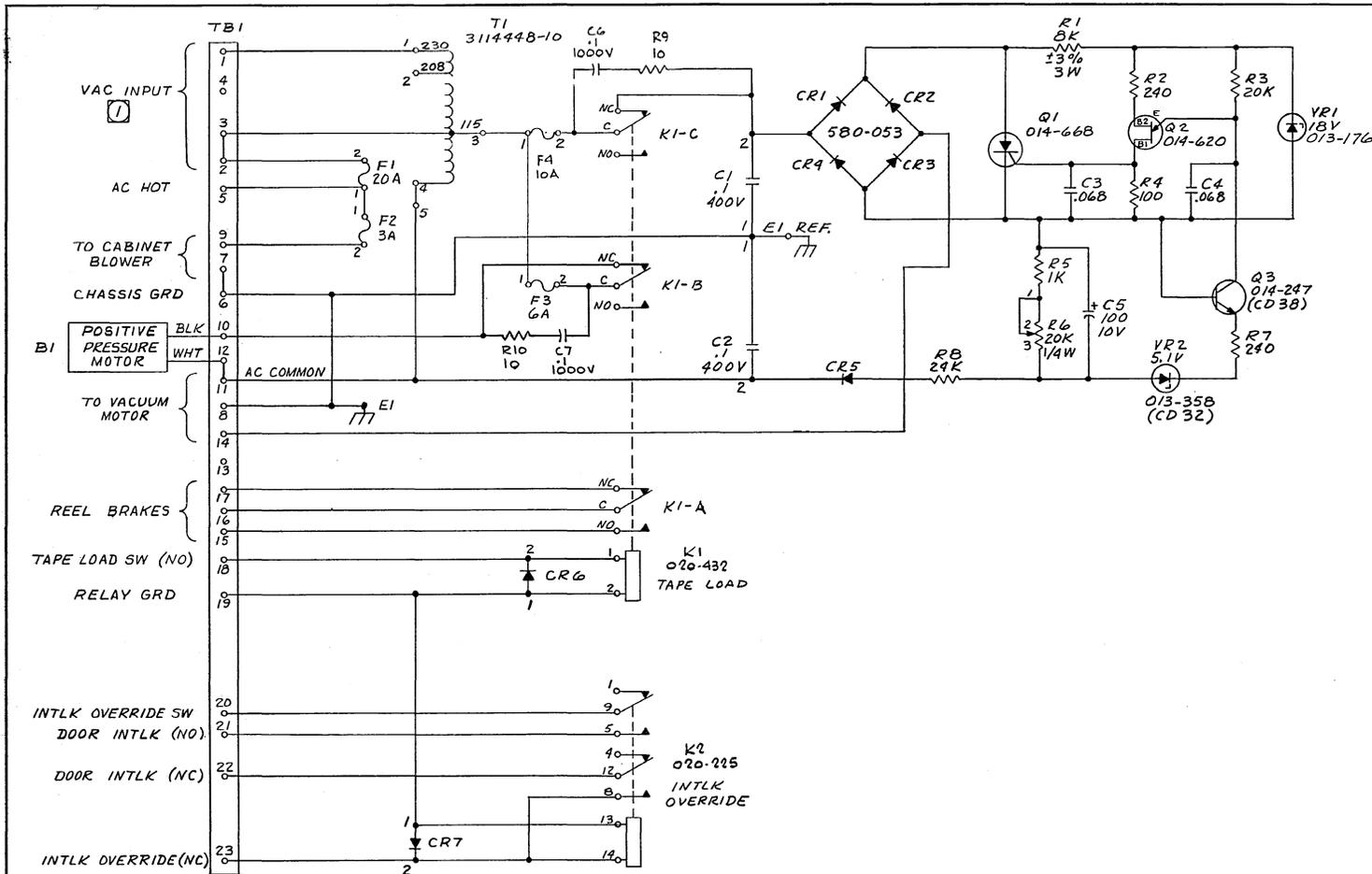


3115546

- ④ THROTTLES P/N 3110087-10 TO BE LOCATED AS SHOWN, USE THROTTLE GAGE 3117177-10 FOR SETTING.
  - ③ PART NO. TO BE AS SHOWN ON B/M.
  - ② CONNECT (2) TWO BLACK MOTOR LEADS TO CONN. TERMINALS NO. 2 & 3. WHITE WIRE (GRD) TO TERMINAL NO. 1 & AS SHOWN.
1. ASSEMBLE PER PROD. PRACTICES MANUAL.

**REFERENCE**

DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED TOLERANCES: XX = DECIMALS XX = .XX BREAK ALL SHARP EDGES APPROX .010 FILLS AND SPOTFACE CORNER FINISH ROUGHNESS OF ALL MACHINED SURFACES PER MIL-STD-12 MATERIAL	THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY, INC. AND IS TO BE USED ONLY IN CONNECTION WITH THE PRODUCTION OF AMPEX COMPUTER PRODUCTS CO.	AMPEX AMPEX COMPUTER PRODUCTS COMPANY 937 JEFFERSON BLVD. CULVER CITY, CALIFORNIA	DATE 4/1/69	TITLE HOUSING ASSY - VACUUM BLOWER	ISSUE C
3115547 TM-12 3110119 TM-11 NEXT ASST. 1ST USED ON APPLICATION	PROJ. SUPER. J. Butcher ENGR. S.C. CHKR	10-14 24	CODE IDENT. NO. D	DWG. NO. 3115546	SHEET 1 OF 1
	OFFSMN J. BUTTERWORTH 12-7		SCALE 1:2		



REVISIONS				
ISSUE	DESCRIPTION	DRAWN	DATE	APPROVAL
A	ERN 144 G4 PROD	REES	6/20/61	REES
B	ECN 4543	B.F.	10/4/62	REES
C	ECN 4637	B.M.	10/29/62	REES
D	ECN 7262	REES	1/4/67	REES

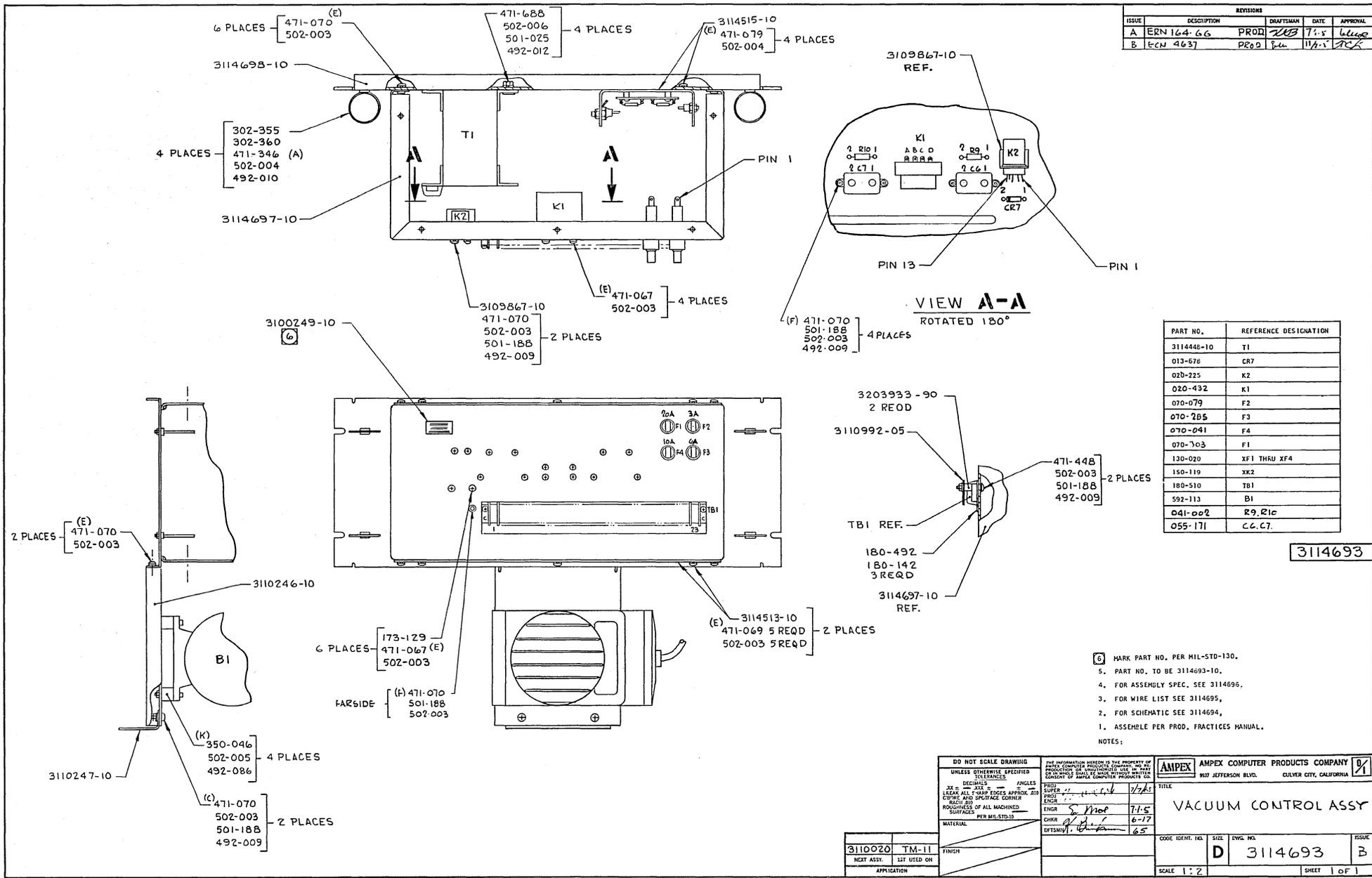
INPUT VAC	TBI CONNECTION FROM	TO
115	2	3
230	1	2

LAST USED	DELETED
B1	
C7	
CR7	
VR2	
F4	
K2	
Q3	
R10	
T1	
TBI.	

3114694

- ALL FUSES ARE 250 V MEDIUM BLOW.
  - ALL DIODES TO BE 013-678 (CD451).
  - ALL CAPACITOR VALUES ARE IN MICROFARADS ± 20%, 25 V.
  - ALL RESISTOR VALUES ARE IN OHMS, ± 5%, 1/2 W.
  - FOR ASSEMBLY SEE 3114693.
- ① SEE TABLE 1.
- NOTES: UNLESS OTHERWISE SPECIFIED

DO NOT SCALE DRAWING		THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY, INC. AND IS TO BE USED ONLY FOR THE PRODUCTION OF AMPEX COMPUTER PRODUCTS COMPANY'S EQUIPMENT.		AMPEX AMPEX COMPUTER PRODUCTS COMPANY 101 JEFFERSON BLVD. CULVER CITY, CALIFORNIA	
UNLESS OTHERWISE SPECIFIED TOLERANCES:		DECIMALS ANGLES		TITLE	
.XX = .001		.XX = .001		SCHEMATIC - VACUUM CONTROL	
.XXX = .0005		.XXX = .0005		CODE IDENT. NO. SIZE DWG. NO. ISSUE	
.XXXX = .0001		.XXXX = .0001		D 3114694 D	
.0000 = .00005		.0000 = .00005		SCALE NONE SHEET 1 OF 1	
MATERIAL PER MIL-STD-113		FINISH		APPLICATION	
3114693 TM-11		NEXT ASSY. 1ST USED ON			



REVISIONS				
ISSUE	DESCRIPTION	DRAWNMAN	DATE	APPROVAL
A	ERN 164-66	PROD	7/15	Wiley
B	ECN 4637	PRD	11/15	RCZ

PART NO.	REFERENCE DESIGNATION
3114448-10	T1
013-678	CR7
028-225	K2
020-432	K1
070-079	F2
070-285	F3
070-041	F4
070-703	F1
130-020	XF1 THRU XF4
150-119	XX2
180-510	TBI
592-113	B1
041-002	R9, R1c
055-171	CC, CT

- (G) MARK PART NO. PER MIL-STD-130.
5. PART NO. TO BE 3114693-10.
4. FOR ASSEMBLY SPEC. SEE 3114695.
3. FOR WIRE LIST SEE 3114695.
2. FOR SCHEMATIC SEE 3114694.
1. ASSEMBLE PER PROD. PRACTICES MANUAL.
- NOTES:

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED TOLERANCES:

XX = DECIMALS

XX° = ANGLES

XX = SUPER

BREAK ALL CHAMFER EDGES APPROX. 20°

XX = RADIUS

XX = SQUARE CORNER

ROUGHNESS OF ALL MACHINED SURFACES PER MIL-STD-130

MATERIAL: PER MIL-STD-130

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AMPEX COMPUTER PRODUCTS COMPANY  
9517 JEFFERSON BLVD. CULVER CITY, CALIFORNIA

TITLE: VACUUM CONTROL ASSY

DATE: 7/15

ENGR: S. Moe

CHKR: [Signature]

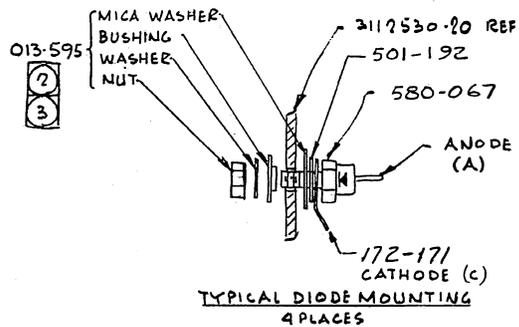
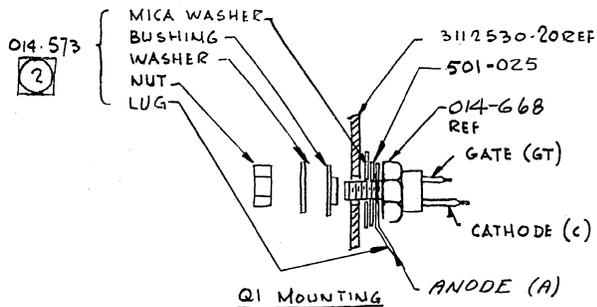
DATE: 6-17

DATE: 6-5

CODE IDENT. NO. SIZE DWG. NO. ISSUE

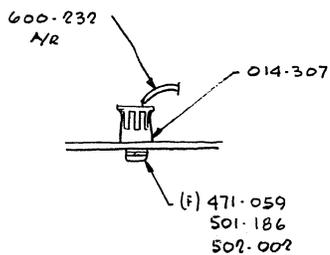
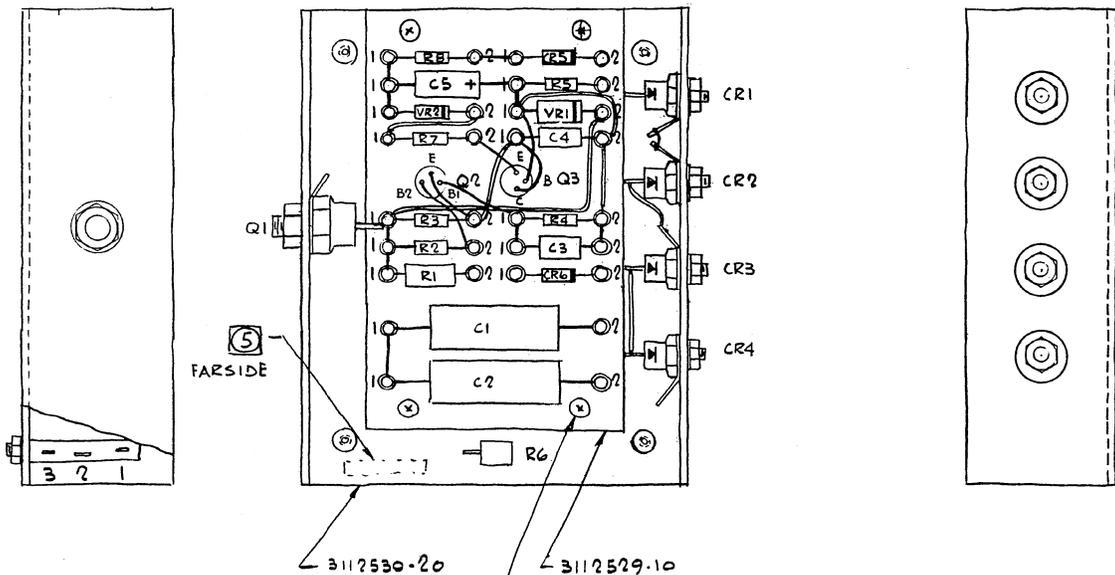
3110020 TM-11 D 3114693 B

SCALE 1:2 SHEET 1 OF 1



REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
D	ERN16466	PRoD	7-1-5	JCP
E	ECN 4543		10/4/69	JCP
F	ECN 5125		9/28/66	JCP
G	ECN 5918		8/18/66	JCP
H	ECN 7262		1/6/66	JCP

PART No.	REF. DESIGNATION.
014-668	Q1
014-620	Q2
013-176	VR1
013-358	VR2
014-247	Q3
580-067	CR1-4
013-678	CR5,6
035-069	C1,2
030-215	C3,4
037-099	C5
043-515	R1
041-473	R2,7
041-529	R3
041-245	R5
044-922	R6
041-498	R8
041-003	R4



Q2 & Q3 MOUNTING

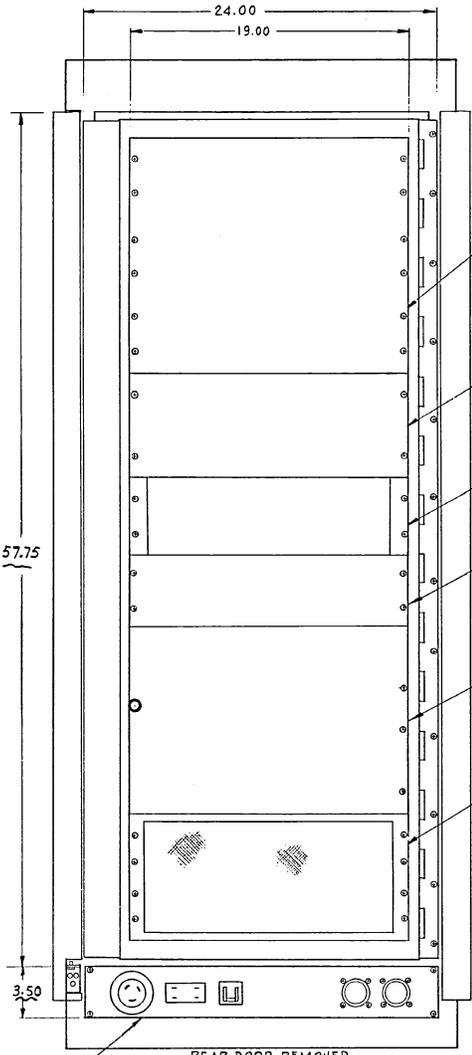
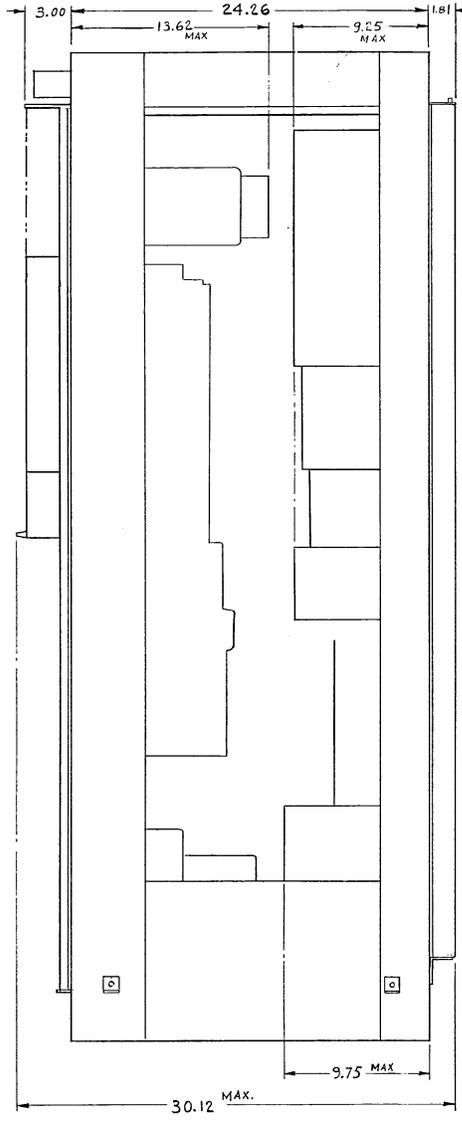
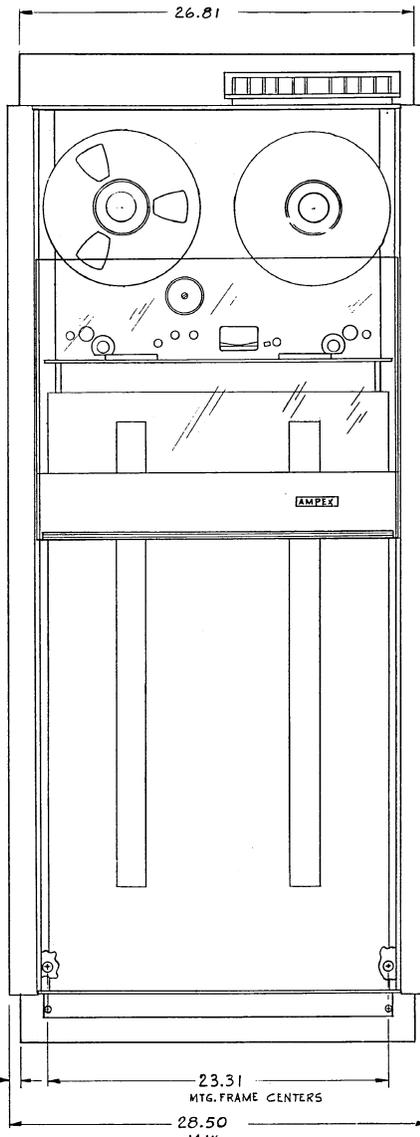
6. FOR W/L SEE 3114514
  5. MARK PART No. .12 HIGH COLOR WHITE PER MIL-STD-130, DO NOT IMPRESSION STAMP
  4. PART No. TO BE 3114515-10
  3. REPLACE TERMINAL LUG IN KIT 013-595 WITH SOLDER LUG AS SHOWN
  2. APPLY 087-388 TO BOTH SIDES OF MICA WASHER IN KIT 014-573 & 013-595
  1. ASSEMBLE PER MFG PRACTICES MANUAL
- NOTES:

3114507	TM-12
3114693	TM-11
NEXT ASSY.	1ST USED ON
APPLICATION	

DO NOT SCALE DRAWING		UNLESS OTHERWISE SPECIFIED TOLERANCES		THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY. NO REPRODUCTION OR UNAUTHORIZED USE IN PART OR IN WHOLE SHALL BE MADE WITHOUT WRITTEN CONSENT OF AMPEX COMPUTER PRODUCTS CO.		AMPEX AMPEX COMPUTER PRODUCTS COMPANY 9937 JEFFERSON BLVD. CULVER CITY, CALIFORNIA	
DECIMALS	ANGLES	PROJ	DATE	TITLE			
XX ± .001	XXX ± .001	SUPER	7/1/65	HEAT SINK ASSY			
BREAK ALL SHARP EDGES APPROX. .010		PROJ		VACUUM CONTROL			
C/BORE AND SPOTFACE CORNER RADI .010		ENGR		CODE IDENT. NO.	SIZE	DWG. NO.	ISSUE
ROUGHNESS OF ALL MACHINED SURFACES PER MIL-STD-10		CHKR		C	3/4"	3114515	H
MATERIAL		DFTSMN		SCALE	1/1	SHEET 1 OF 1	
FINISH							







REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
C	ERN 164-FF PROD			
D				

- CAPSTAN SERVO SUPPLY
- REEL SERVO SUPPLY
- CONTROL ELECTRONICS
- LOGIC SUPPLY
- DATA ELECTRONICS
- BLOWER

3110012

.75 TYP  
 23.31 MTG. FRAME CENTERS  
 28.50 MAX.

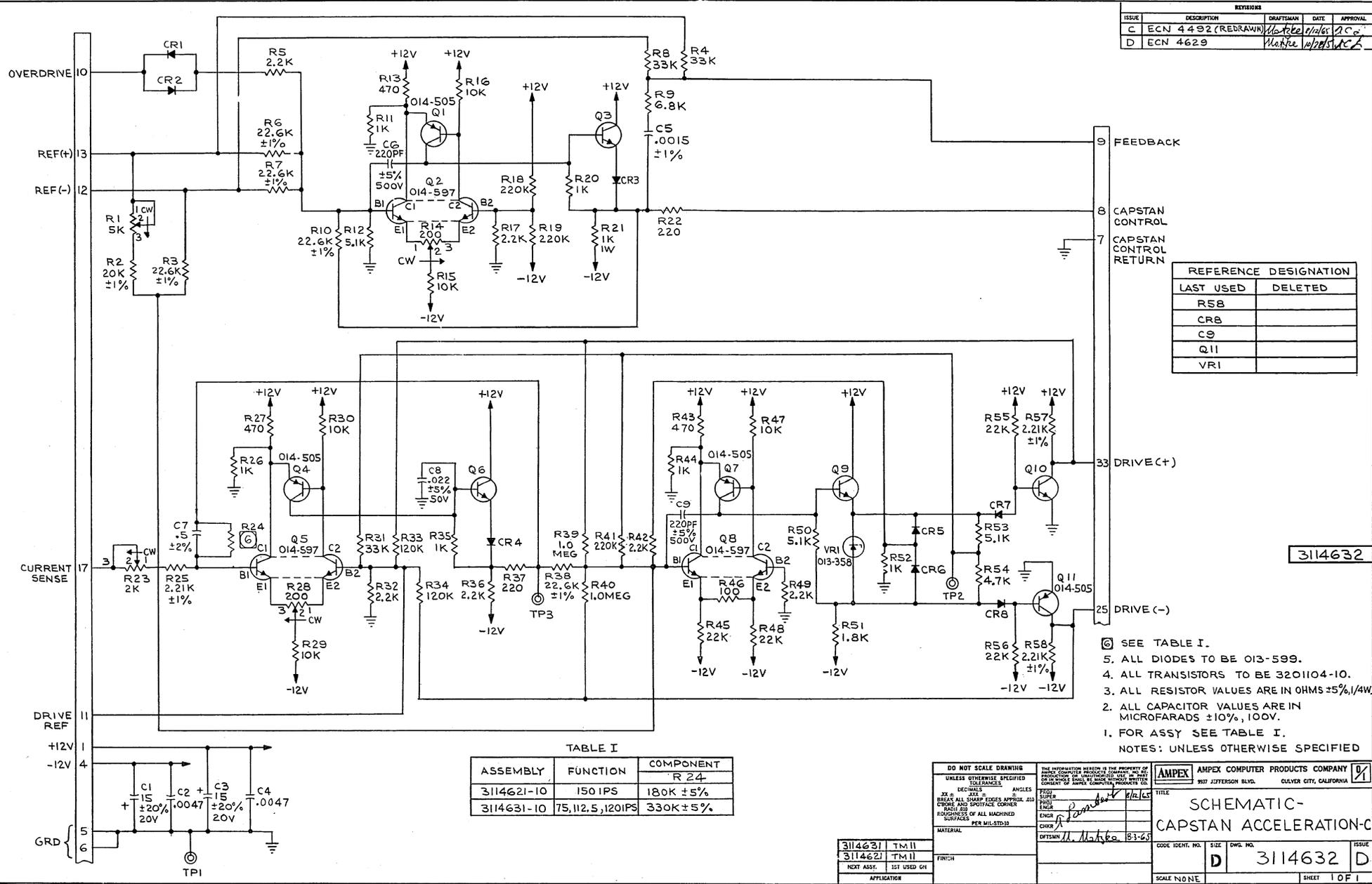
SKIN-SIDE REMOVED

REAR DOOR REMOVED

1/0 PANEL

DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED		TOLERANCES		ANGLES		FINISH	
DECIMALS	ANGLES	FEEL	SPRUE	SPRUE	SPRUE	SPRUE	SPRUE
±.01	±.5	±.005	±.005	±.005	±.005	±.005	±.005
BREAK ALL SHARP EDGES APPROX. .010		REMOVE ALL BURRS AND SCRAPES		REMOVE ALL BURRS AND SCRAPES		REMOVE ALL BURRS AND SCRAPES	
MATERIAL		PER MIL-STD-30		MATERIAL		PER MIL-STD-30	
DESIGN		C. M.		DATE		4/6/63	
APPLICATION		TM-12		TM-11		FINISH	
NEXT ASSY.		1ST USED ON		SCALE		1/4	
THE INFORMATION HEREON IS THE PROPERTY OF AMPLEX COMPUTER PRODUCTS COMPANY, INC. AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE WRITTEN PERMISSION OF AMPLEX COMPUTER PRODUCTS CO.		AMPLEX COMPUTER PRODUCTS COMPANY		9321 JEFFERSON BLVD.		CULVER CITY, CALIFORNIA	
TITLE		OUTLINE & INSTALLATION		TM-11 & TM-12		CODE IDENT. NO.	
SIZE		D		Dwg. NO.		3110012	
ISSUE		D		SHEET		1 OF 1	

REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
C	ECN 4492 (REDRAWN)	<i>Monte</i>	<i>1/15/63</i>	<i>P.C.</i>
D	ECN 4629	<i>Monte</i>	<i>1/22/63</i>	<i>P.C.</i>



REFERENCE DESIGNATION	
LAST USED	DELETED
R58	
CR8	
C9	
Q11	
VR1	

3114632

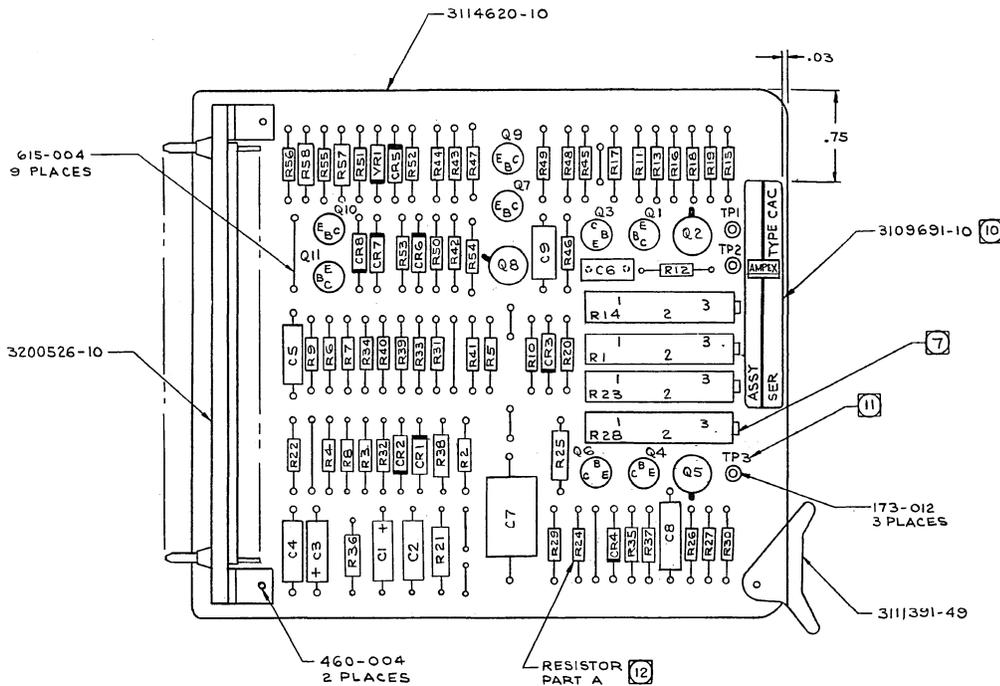
- ① SEE TABLE I.  
 5. ALL DIODES TO BE 013-599.  
 4. ALL TRANSISTORS TO BE 3201104-10.  
 3. ALL RESISTOR VALUES ARE IN OHMS  $\pm 5\%$ , 1/4W.  
 2. ALL CAPACITOR VALUES ARE IN MICROFARADS  $\pm 10\%$ , 100V.  
 1. FOR ASSY SEE TABLE I.  
 NOTES: UNLESS OTHERWISE SPECIFIED

TABLE I

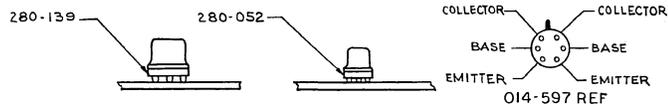
ASSEMBLY	FUNCTION	COMPONENT
3114621-10	150IPS	R 24
3114631-10	75,112.5,120IPS	330K $\pm 5\%$

DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED TOLERANCES: DIMENSIONS: ANGLES FINISH: SUPER BREAK ALL SHARP EDGES APPROX. 0.125 CROSE AND SPOTFACE CORNER ROUNDEDNESS OF ALL MACHINED SURFACES PER MIL-STD-118	THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE WRITTEN CONSENT OF AMPEX COMPUTER PRODUCTS CO.	AMPEX AMPEX COMPUTER PRODUCTS COMPANY 317 JEFFERSON BLVD. CULVER CITY, CALIFORNIA
TITLE SCHEMATIC- CAPSTAN ACCELERATION-C	DATE 1/22/63	ISSUE D
MATERIAL DWTSMN. <i>A. Makiba</i> 83-63	FINISH	SCALE NO. NONE
3114631 TM11 3114621 TM11	CODE IDENT. NO. D	SHEET 1 OF 1
NEXT ASSY. 1ST USED GH	SIZE 3114632	
APPLICATION	ENG. NO. 3114632	

REVISED				
ISSUE	DESCRIPTION	APPROD.	DATE	APPROVAL
B	ERN 106-BU	PROO.	10/11/65	AC
C	ECN 4437		11/16/65	AC
D	ECN 4492		12/16/65	AC
E	ECN 4521		9/10/66	AC
F	ECN 4589		10/19/66	AC
G	ECN 4629		10/16/66	AC



PART NO.	REFERENCE DESIGNATION	PART NO.	REFERENCE DESIGNATION
035-796	C8	3201104-10	Q3, Q9, Q10, Q6
041-561	R12, R50, R53	013-599	CR1 THRU CR8
041-396	R22, R37	013-358	VR1
044-476	R14, R28	014-597	Q2, Q8, Q5
044-366	R1	014-505	Q1, Q4, Q7, Q11
048-707	R3, R6, R7, R10, R3B	034-240	C6, C9
043-607	R21	035-989	C2, C4
042-423	R25, R57, R58	037-990	C1, C3
PART A	R24	055-026	C7
044-310	R23	035-509	C5
048-175	R2	041-393	R39, R40
		041-406	R45, R48, R55, R56
		041-408	R15, R16, R29, R30, R47
		041-410	R11, R20, R26, R35, R44, R52
		041-412	R54
		041-414	R5, R17, R42, R49, R32, R36
		041-419	R46
		041-428	R13, R27, R43
		041-432	R18, R19, R41
		041-434	R51
		041-413	R9
		041-484	R33, R34
		041-518	R4, R8, R31



TYPICAL TRANSISTOR INSTALLATION

TABLE I  
B/M REFERENCE TABLE

ASSEMBLY	FUNCTION	PART A
3114621-10	1501PS	041-515
3114631-10	75,112,5,1201PS	041-469

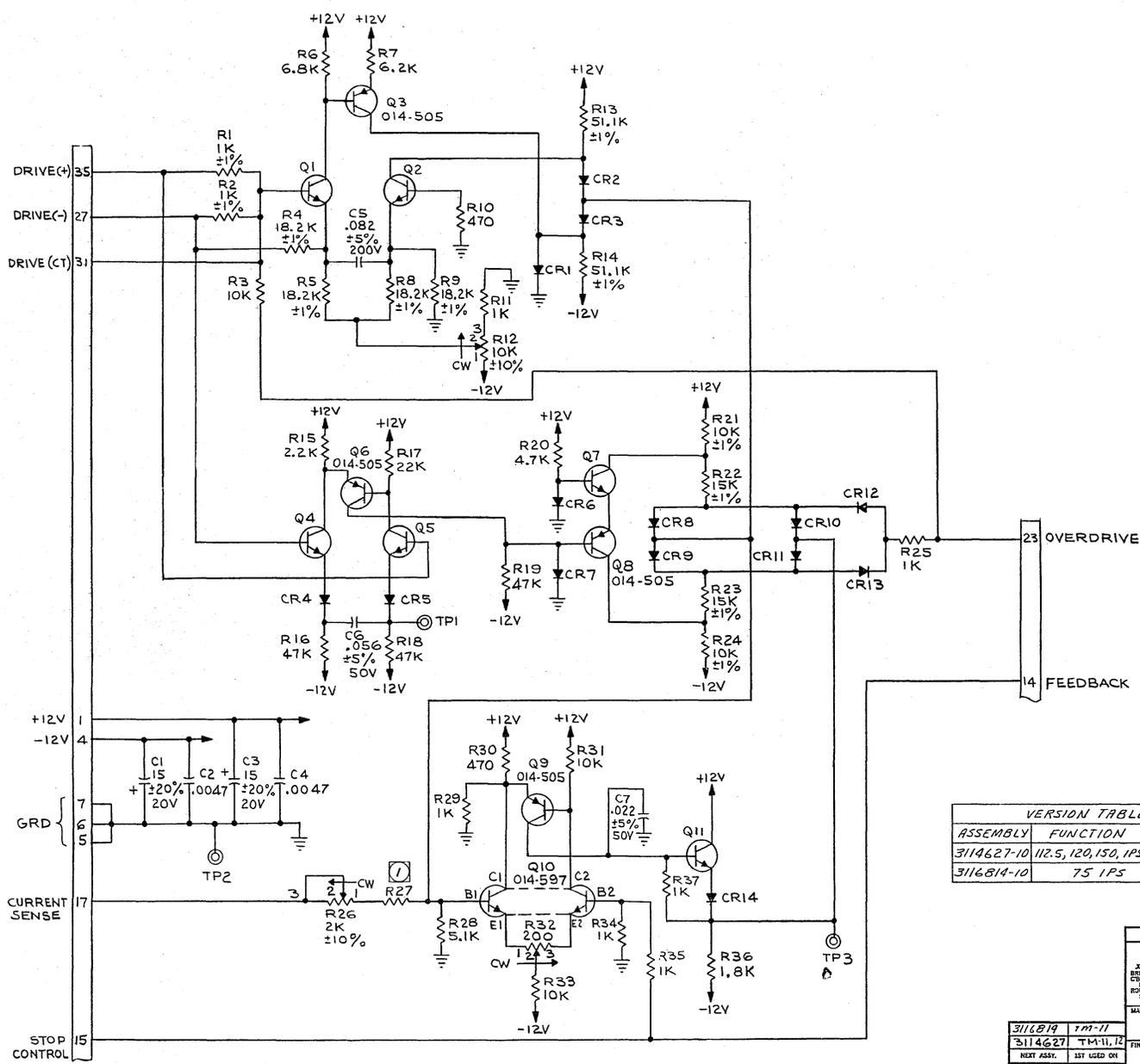
## REFERENCE

- ② INSTALL PART 'A' PER TABLE I.
  - ⑩ MARK TP REF. NOS., 12-HIGH CHARACTERS, COLOR WHITE, PER MIL-STD-130. DO NOT IMPRESSION STAMP. **3114630**
  - ⑪ MARK PART NO. & NAMEPLATE INFORMATION PER MIL-STD-130.
  9. PART NO. TO BE AS SHOWN ON BILL OF MATERIAL.
  8. SEAL PRINTED CIRCUIT SIDE ONLY WITH HUMISEAL TYPE 1B15 COLUMBIA TECH. OR EQUIV.
  - ⑦ TRIMPOTS NOT TO BE SUBMERGED IN WATER.
  6. PLUS SIGN ON CAPACITOR INDICATES POSITIVE.
  5. HEAVY LINE ON DIODE INDICATES CATHODE.
  4. COMPONENT DESIGNATIONS ARE FOR REFERENCE ONLY.
  3. ASSEMBLE PER PRODUCTION PRACTICES MANUAL.
  2. FOR ASSY SPECIFICATION SEE 3114618.
  1. FOR SCHEMATIC SEE 3114632.
- NOTES:

3114631	TM II
3114621	TM II
NEXT ASSY.	1ST USED ON
APPLICATION	

<p>DO NOT SCALE DRAWING</p> <p>UNLESS OTHERWISE SPECIFIED TOLERANCES</p> <p>DECIMALS = .010 ANGLE BREAK AT CHAMFER EDGES APPROX. 1/16" CHAMFER AND SPOTFACE CORNER EACH END ROUGHNESS OF ALL MACHINED SURFACES PER MIL-STD-130</p>	<p>THIS INFORMATION IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY. IT IS TO BE KEPT IN CONFIDENCE AND NOT TO BE DISCLOSED TO ANY OTHER PARTY WITHOUT THE WRITTEN PERMISSION OF AMPEX COMPUTER PRODUCTS COMPANY.</p> <p>DATE: 11/16/65 BY: [Signature]</p> <p>ENG CHKR DFTSMAN: M. [Signature] 5565</p>	<p>AMPEX AMPEX COMPUTER PRODUCTS COMPANY 9327 JEFFERSON BLVD. CULVER CITY, CALIFORNIA</p> <p>TITLE <b>CIRCUIT BOARD ASSY - CAPSTAN ACCELERATION-C</b></p> <p>CODE IDENT. NO. SIZE DWG. NO. ISSUE <b>D 3114630 G</b></p> <p>SCALE 2:1 SHEET 1 OF 1</p>
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REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
C	ECN 4492 (REDRAWN)	M. Lambert	1/1/68	1/1/68
D	ECN 4629	M. Lambert	1/1/68	1/1/68
E	ECN 4684	M. Lambert	1/1/68	1/1/68
F	ECN 5079	M. Lambert	1/1/68	1/1/68



REFERENCE	DESIGNATION
LAST USED	DELETED
R37	
Q11	
CR14	
C7	

3114626

VERSION TABLE		
ASSEMBLY	FUNCTION	Q R27
3114627-10	112.5, 120, 150, 1PS	1KΩ ± 1%
3116814-10	75 IPS	JUMPER

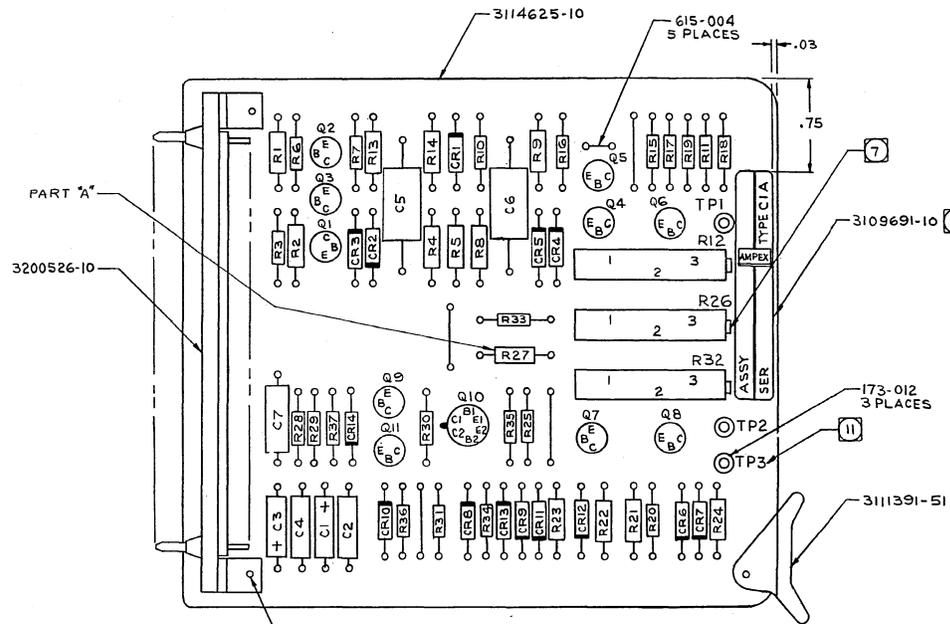
5. ALL DIODES TO BE 013-599.
4. ALL TRANSISTORS TO BE 3201104-10.
3. ALL RESISTOR VALUES ARE IN OHMS ± 5%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS ± 10%, 100V.
1. FOR ASSEMBLY SEE VERSION TABLE

NOTES: UNLESS OTHERWISE SPECIFIED.

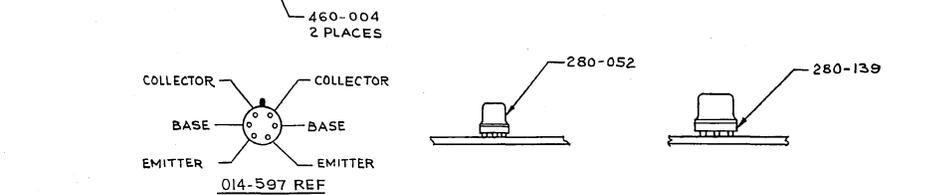
3116814	TM-11
3114627	TM-11, 12
NEXT ASSY.	1ST USED ON
APPLICATION	

DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED DIMENSIONS	THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY, INC. AND IS TO BE KEPT IN CONFIDENTIALITY. IT IS TO BE USED ONLY FOR THE PURPOSES FOR WHICH IT WAS PROVIDED. IT IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF AMPEX COMPUTER PRODUCTS CO.	AMPEX AMPEX COMPUTER PRODUCTS COMPANY 937 JEFFERSON BLVD. CULVER CITY, CALIFORNIA
DECIMALS = ANGLES = XX = 1/16" ± .0005 BREAK ALL SHARP EDGES APPROX. .010" CHAMFER AND SPOTFACE CORNER RAU 1/16" FINISHES OF ALL MACHINED SURFACES PER MIL-STD-13	DATE: 1/1/68 DRAWN BY: M. Lambert CHECKED BY: T. Lambert ENGR: M. Lambert CHGR: M. Lambert	TITLE SCHEMATIC - CAPSTAN CURRENT CONTROL
MATERIAL:	FINISH:	CODE IDENT. NO. SIZE DWG. NO. ISSUE
		D 3114626 F
		SCALE NONE SHEET 1 OF 1

REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
A	ERN 164-VV	PROD	12/16/64	ATC



PART NO.	REFERENCE DESIGNATION	PART NO.	REFERENCE DESIGNATION
044-610	R12	3201104-10	Q1, Q2, Q4, Q5, Q7, Q11
035-796	C7	014-597	Q10
055-089	C5	013-599	CR1 THRU CR14
PART A	R27	014-505	Q3, Q6, Q8, Q9
		035-989	C2, C4
		037-990	C1, C3
		035-716	C6
		041-410	R11, R25, R29, R37, R34, R35
		041-411	R16, R18, R19
		041-412	R20
		041-413	R6
		041-414	R15
		041-408	R3, R31, R33
		041-406	R17
		041-428	R10, R30
		041-434	R36
		041-538	R7
		041-561	R28
		042-803	R4, R5, R8, R9
		042-491	R22, R23
		042-419	R1, R2
		048-054	R21, R24
		048-191	R13, R14
		044-476	R32
		044-310	R26



TYPICAL TRANSISTOR INSTALLATION

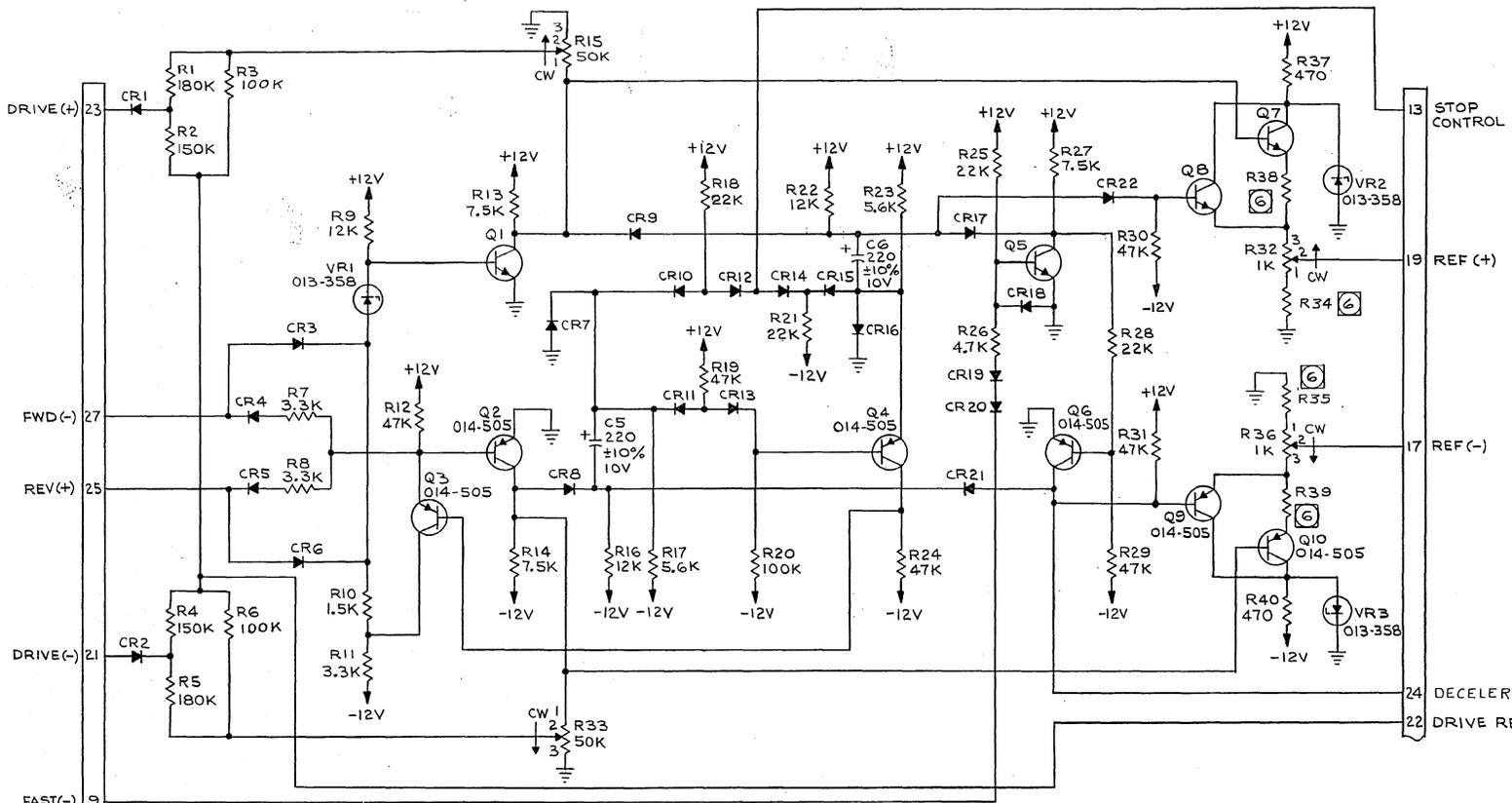
TABLE 1

BIM REFERENCE TABLE		
ASSEMBLY	FUNCTION	PART A
3114627-10	112.5, 120, 150, 1PS	012-419
3116814-10	75 IPS	JUMPER

REFERENCE

- FOR SCHEMATIC SEE 3114626.
- FOR ASSEMBLY SPECIFICATION SEE 3114623.
- ASSEMBLE PER PRODUCTION PRACTICES MANUAL.
- COMPONENT DESIGNATIONS ARE FOR REFERENCE ONLY.
- HEAVY LINE ON DIODE INDICATES CATHODE.
- PLUS SIGN ON CAPACITOR INDICATES POSITIVE.
- TRIMPOTS NOT TO BE SUBMERGED IN WATER.
- PART NO. TO BE PER B/M
- SEAL PRINTED CIRCUIT SIDE ONLY WITH HUMISEAL TYPE IB15 COLUMBIA TECH, OR EQUIV.
- MARK PART NO. & NAMEPLATE INFORMATION PER MIL-STD-130.
- MARK TP & POT. REF. NO.'S, .12 HIGH CHARACTERS, COLOR WHITE, PER MIL-STD-130. DO NOT IMPRESSION STAMP.
- INSTALL PART "A" PER TABLE 1.

DO NOT SCALE DRAWING		UNLESS OTHERWISE SPECIFIED TOLERANCES		THE INFORMATION HEREON IS THE PROPERTY OF AMPER COMPUTER PRODUCTS COMPANY AND IS TO BE KEPT CONFIDENTIAL. IT IS TO BE USED ONLY FOR THE PURPOSES SPECIFIED HEREIN. CONSULT WITH AMPER COMPUTER PRODUCTS CO.		AMPX AMPER COMPUTER PRODUCTS COMPANY 912 JEFFERSON BLVD. CULVER CITY, CALIFORNIA	
XX ± 0.3 MAX. ± 0.10 ± 1/16		DECIMALS ANGLES		PROF. SUPP. 1/16" 1/8" 1/4" 3/8" 1/2" 5/8" 3/4" 1" 1 1/4" 1 1/2" 2" 2 1/2" 3" 3 1/2" 4" 4 1/2" 5" 5 1/2" 6" 6 1/2" 7" 7 1/2" 8" 8 1/2" 9" 9 1/2" 10" 10 1/2" 11" 11 1/2" 12" 12 1/2" 13" 13 1/2" 14" 14 1/2" 15" 15 1/2" 16" 16 1/2" 17" 17 1/2" 18" 18 1/2" 19" 19 1/2" 20" 20 1/2" 21" 21 1/2" 22" 22 1/2" 23" 23 1/2" 24" 24 1/2" 25" 25 1/2" 26" 26 1/2" 27" 27 1/2" 28" 28 1/2" 29" 29 1/2" 30" 30 1/2" 31" 31 1/2" 32" 32 1/2" 33" 33 1/2" 34" 34 1/2" 35" 35 1/2" 36" 36 1/2" 37" 37 1/2" 38" 38 1/2" 39" 39 1/2" 40" 40 1/2" 41" 41 1/2" 42" 42 1/2" 43" 43 1/2" 44" 44 1/2" 45" 45 1/2" 46" 46 1/2" 47" 47 1/2" 48" 48 1/2" 49" 49 1/2" 50" 50 1/2" 51" 51 1/2" 52" 52 1/2" 53" 53 1/2" 54" 54 1/2" 55" 55 1/2" 56" 56 1/2" 57" 57 1/2" 58" 58 1/2" 59" 59 1/2" 60" 60 1/2" 61" 61 1/2" 62" 62 1/2" 63" 63 1/2" 64" 64 1/2" 65" 65 1/2" 66" 66 1/2" 67" 67 1/2" 68" 68 1/2" 69" 69 1/2" 70" 70 1/2" 71" 71 1/2" 72" 72 1/2" 73" 73 1/2" 74" 74 1/2" 75" 75 1/2" 76" 76 1/2" 77" 77 1/2" 78" 78 1/2" 79" 79 1/2" 80" 80 1/2" 81" 81 1/2" 82" 82 1/2" 83" 83 1/2" 84" 84 1/2" 85" 85 1/2" 86" 86 1/2" 87" 87 1/2" 88" 88 1/2" 89" 89 1/2" 90" 90 1/2" 91" 91 1/2" 92" 92 1/2" 93" 93 1/2" 94" 94 1/2" 95" 95 1/2" 96" 96 1/2" 97" 97 1/2" 98" 98 1/2" 99" 99 1/2" 100" 100 1/2" 101" 101 1/2" 102" 102 1/2" 103" 103 1/2" 104" 104 1/2" 105" 105 1/2" 106" 106 1/2" 107" 107 1/2" 108" 108 1/2" 109" 109 1/2" 110" 110 1/2" 111" 111 1/2" 112" 112 1/2" 113" 113 1/2" 114" 114 1/2" 115" 115 1/2" 116" 116 1/2" 117" 117 1/2" 118" 118 1/2" 119" 119 1/2" 120" 120 1/2" 121" 121 1/2" 122" 122 1/2" 123" 123 1/2" 124" 124 1/2" 125" 125 1/2" 126" 126 1/2" 127" 127 1/2" 128" 128 1/2" 129" 129 1/2" 130" 130 1/2" 131" 131 1/2" 132" 132 1/2" 133" 133 1/2" 134" 134 1/2" 135" 135 1/2" 136" 136 1/2" 137" 137 1/2" 138" 138 1/2" 139" 139 1/2" 140" 140 1/2" 141" 141 1/2" 142" 142 1/2" 143" 143 1/2" 144" 144 1/2" 145" 145 1/2" 146" 146 1/2" 147" 147 1/2" 148" 148 1/2" 149" 149 1/2" 150" 150 1/2" 151" 151 1/2" 152" 152 1/2" 153" 153 1/2" 154" 154 1/2" 155" 155 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REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
D	ECN 4492 (REDRAW)	Matthei	11/1/55	AC
E	ECN 4684			AC
F	ECN 5014		3/18/66	AC
G	ECN 7298		1/22/67	AC

INACTIVE  
FOR NEW DESIGN  
SEE ASSY 3119513

REFERENCE	DESIGNATION
LAST USED	DELETED
R40	
Q10	
CR22	
C6	
VR3	

3114638

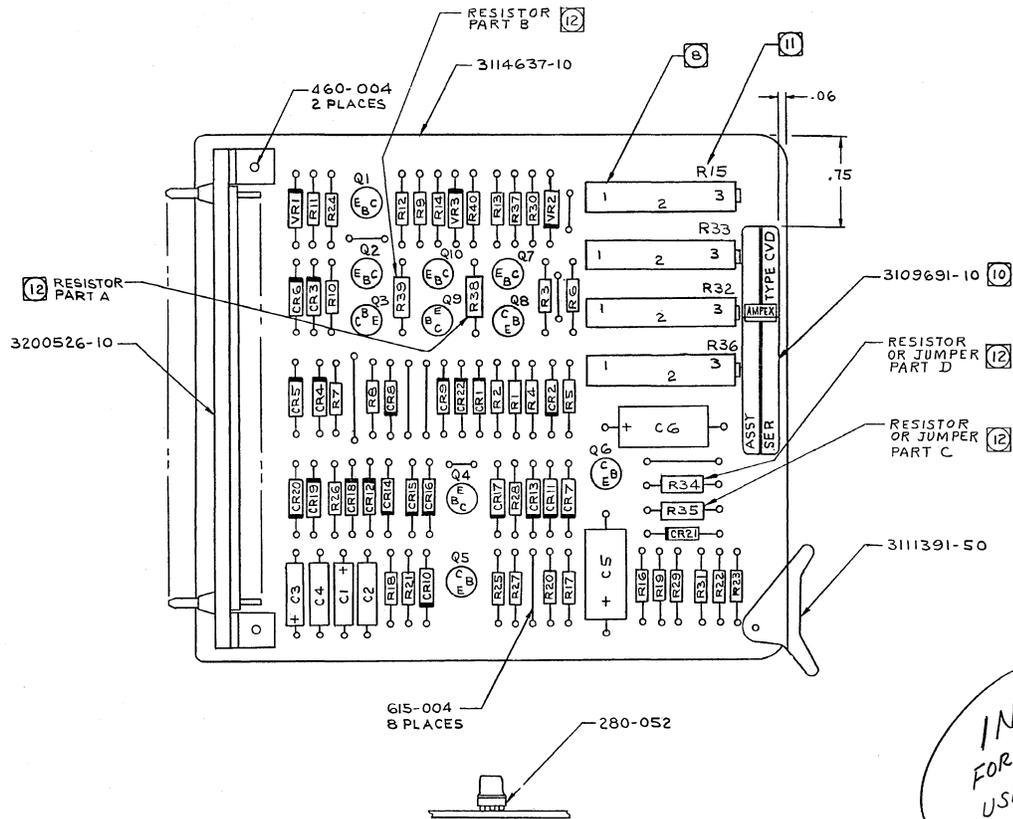
- SEE TABLE I.
- ALL DIODES TO BE 013-599.
  - ALL TRANSISTORS TO BE 3201104-10.
  - ALL RESISTOR VALUES ARE OHMS  $\pm 5\%$ ,  $1/4W$ .
  - ALL CAPACITOR VALUES ARE IN MICROFARADS,  $\pm 10\%$ ,  $100V$ .
  - FOR ASSEMBLY SEE TABLE.
- NOTES: UNLESS OTHERWISE SPECIFIED

TABLE I

ASSEMBLY	FUNCTION	COMPONENTS			
		R38	R39	R35	R34
3114643-10	150 IPS	2.21K $\pm 1\%$	2.21K $\pm 1\%$	1.78K $\pm 1\%$	1.78K $\pm 1\%$
3114642-10	120 IPS	3.32K $\pm 1\%$	3.32K $\pm 1\%$	1.78K $\pm 1\%$	1.78K $\pm 1\%$
3114641-10	112.5 IPS	3.65K $\pm 1\%$	3.65K $\pm 1\%$	1.78K $\pm 1\%$	1.78K $\pm 1\%$
3114640-10	75 IPS	2.0 K $\pm 1\%$	2.0 K $\pm 1\%$	JUMPER	JUMPER

DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED	THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY, INC. AND IS TO BE KEPT IN CONFIDENTIALITY AND NOT REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM.	AMPEX AMPEX COMPUTER PRODUCTS COMPANY 9117 JEFFERSON BLVD. CULVER CITY, CALIFORNIA
3% = DECIMALS X = ANGLES B = BREAK ALL SHARP EDGES APPROX. 2:10 C = CHISEL AND SQUARE CORNER P = RADIUS D = DIMENSIONS OF ALL MACHINED SURFACES PER MIL-STD-10	PROJ. ENGR. T. L. AMBROSE CHKD. T. L. AMBROSE MATERIAL	TITLE SCHEMATIC - CAPSTAN VELOCITY-D	CODE IDENT. NO. D SIZE 3114638 SCALE NONE
SEE TABLE TM-11 NEXT ASST. 1ST USED ON APPLICATION	FINISH	DATE 8-4-66	ISSUE G SHEET 1 OF 1

REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
B	ERN 106-BU	PROD.	Amold	slates
C	ECN 4492		Mothe	slates
D	ECN 4521		Conway	8/10/65
E	ECN 4684		Don	1/9/65
F	ECN 5014		Don	1/16/65
G	ECN 7298		Don	1/23/67



TYPICAL TRANSISTOR INSTALLATION

TABLE I

B/M REFERENCE TABLE					
ASSEMBLY	FUNCTION	PART A	PART B	PART C	PART D
3114640-10	75 IPS	048-044	048-044	JUMPER	JUMPER
3114641-10	112.5IPS	048-169	048-169	042-855	042-855
3114642-10	120 IPS	042-428	042-428	042-855	042-855
3114643-10	150 IPS	042-423	042-423	042-855	042-855

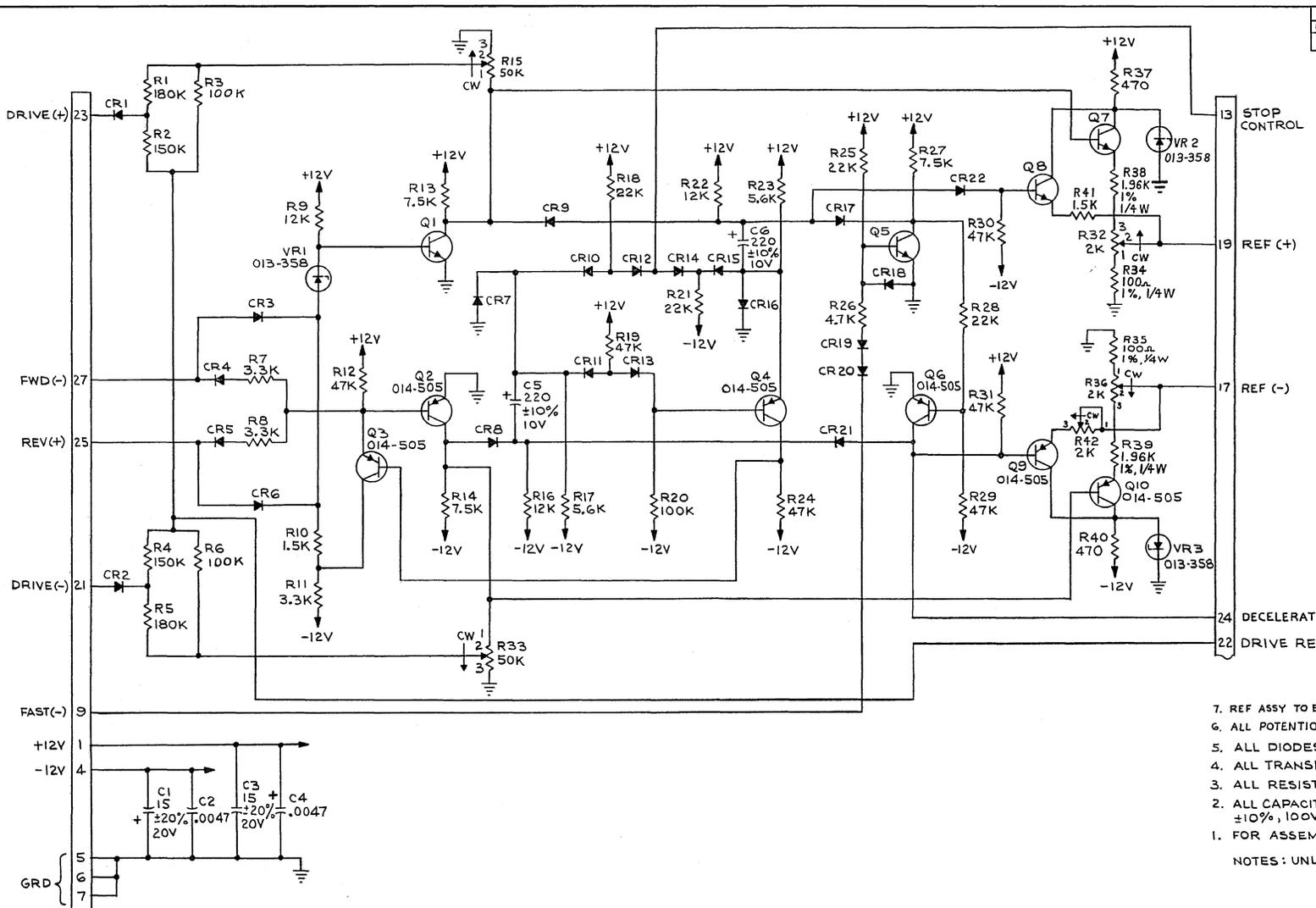
PART NO.	REF. DESIGNATION	PART NO.	REFERENCE DESIGNATION
PART B	R39	3201104-10	Q1, Q5, Q7, Q8
PART C	R35	014-505	Q2, Q3, Q4, Q6, Q9, Q10
PART D	R34	013-358	VR1, VR2, VR3
		013-599	CR1 THRU CR22
		037-237	C5, C6
		035-989	C2, C4
		037-990	C1, C3
		041-406	R25, R28, R18, R21
		041-407	R7, R8, R11
		041-411	R12, R19, R24, R30, R31, R29
		041-412	R26
		PART A	R38
		041-430	R10
		041-428	R37, R40
		041-482	R9, R22, R16
		041-520	R13, R14, R27
		041-507	R17, R23
		041-394	R20, R3, R6
		044-309	R32, R36
		041-431	R2, R4
		041-515	R1, R5
		044-312	R15, R33

INACTIVE FOR NEW DESIGN USE ASSY 3119513

1. FOR SCHEMATIC SEE 3114638.
2. FOR ASSEMBLY SPECIFICATION SEE 3114635.
3. ASSEMBLE PER PRODUCTION PRACTICES MANUAL.
4. COMPONENT DESIGNATIONS ARE FOR REFERENCE ONLY.
5. HEAVY LINE ON DIODE INDICATES CATHODE.
6. PLUS SIGN ON CAPACITOR INDICATES POSITIVE.
7. SEAL PRINTED CIRCUIT SIDE ONLY WITH HUMI-SEAL TYPE IBIS COLUMBIA TECH. OR EQUIV.
8. TRIMPOTS NOT TO BE SUBMERGED IN WATER.
9. PART NO. TO BE AS SHOWN ON BILL OF MATERIAL.
10. MARK PART NO. & NAMEPLATE INFORMATION PER MIL-STD-130.
11. MARK POT. REF. NO., 12-HIGH CHARACTERS, COLOR WHITE, PER MIL-STD-130. DO NOT IMPRESSION STAMP.
12. INSTALL PART 'A' 'B' 'C' 'D' PER TABLE I

REFERENCE

DO NOT SCALE DRAWING		UNLESS OTHERWISE SPECIFIED TOLERANCES:		THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE WRITTEN CONSENT OF AMPEX COMPUTER PRODUCTS CO.	
DECIMALS: .010 ± .005		ANGLES: ± .5°		AMPEX AMPEX COMPUTER PRODUCTS COMPANY 907 JEFFERSON BLVD. CULVER CITY, CALIFORNIA	
BREAK ALL SHARP CORNERS		RADIUS AND SPOTFACE CORNERS: RACH .015		TITLE: CIRCUIT BOARD ASSY - CAPSTAN VELOCITY-D	
FINISH: PER MIL-STD-130		MATERIAL:		DRAWN: M. Mothe 43065	
SEE TABLE	TM-11	FINISH:		CODE IDENT. NO.	SIZE
NEXT ASSY.	1ST USED ON			D	3114639 G
APPLICATION:				SCALE 2:1	SHEET 10 F1



REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
A	ERN 164-CP	PROD	4/11/64	

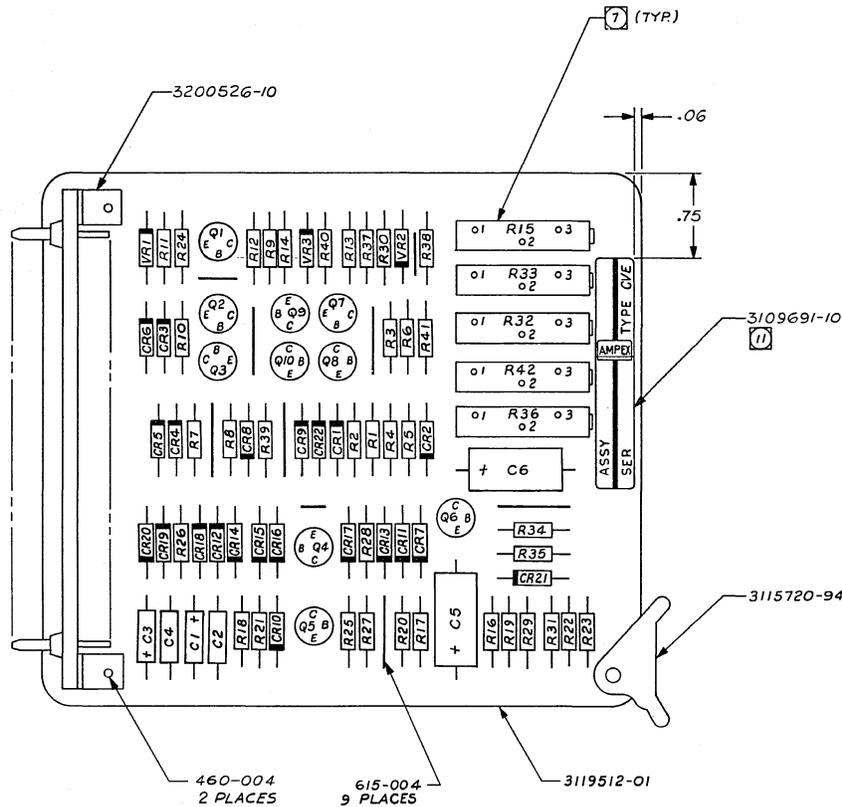
REFERENCE DESIGNATION	
LAST USED	DELETED
R42	
Q10	
CR22	
C6	
VR3	

3119515

7. REF ASSY TO BE 3119514.
  6. ALL POTENTIOMETER TOL TO BE ±10%, 1/2W.
  5. ALL DIODES TO BE O13-599.
  4. ALL TRANSISTORS TO BE 3201104-10.
  3. ALL RESISTOR VALUES ARE DHMS ±5%, 1/4W.
  2. ALL CAPACITOR VALUES ARE IN MICROFARADS, ±10%, 100V.
  1. FOR ASSEMBLY SEE 3119513-01.
- NOTES: UNLESS OTHERWISE SPECIFIED

DO NOT SCALE DRAWING		UNLESS OTHERWISE SPECIFIED TOLERANCES		AMPEX COMPUTER PRODUCTS COMPANY 937 JEFFERSON BLVD. GULFVIEW CITY, CALIFORNIA	
ANGLES UNLESS OTHERWISE SPECIFIED 90° AND 45° ONLY BREAK ALL SHARP EDGES APPROX. 2:1 CHAMFER AND SHARP EDGE CORNER RADIUS 2:1 FINISHES OF ALL MACHINED SURFACES PER MIL-STD-12		FINISH T-11-1/2 1ST USED ON APPLICATION		TITLE <b>SCHEMATIC -          CAPSTAN VELOCITY-E</b>	
CODE IDENT. NO. <b>D</b>		SIZE <b>3119515</b>		ISSUE <b>A</b>	
SCALE NONE		SHEET 1 OF 1			

REVISIONS					
DATE	DESCRIPTION	DATE	DRAFTSMAN	DATE	APPROVAL
A	ERN 1G4-CP	PROD	3/6/67	Amundt	



PART NO.	REFERENCE DESIGNATION
3201104-10	Q1, Q5, Q7, Q8
014-505	Q2, Q3, Q4, Q6, Q9, Q10
013-358	VR1, VR2, VR3
013-599	CR1 THRU CR22
037-237	C5, C6
035-989	C2, C4
037-990	C1, C3
041-406	R18, R21, R25, R28
041-407	R7, R8, R11
041-412	R26
041-411	R12, R19, R24, R29, R30, R31
041-430	R10, R41
041-428	R37, R40
041-431	R2, R4
041-482	R9, R16, R22
041-515	R1, R5
041-520	R13, R14, R27
041-507	R17, R23
041-394	R3, R6, R20
042-857	R38, R39
057-616	R34, R35
044-310	R32, R36, R42
044-312	R15, R33

1. MARK PART NO. AND NAMEPLATE INFORMATION PER MIL-STD-130.

10. PART NO. TO BE AS SHOWN ON B/M.

9. SEAL PRINTED CIRCUIT SIDE ONLY WITH HUMISEAL TYPE 1B15 COLUMBIA TECH. CORP. OR EQUIV.

2. TRIMPOTS NOT TO BE SUBMERGED IN WATER.

6. COMPONENT DESIGNATIONS ARE FOR REF. ONLY.

5. PLUS SIGN ON CAPACITOR INDICATES POSITIVE.

4. HEAVY LINE ON DIODES INDICATES CATHODE.

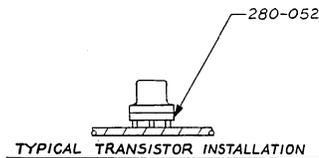
3. ASSEMBLE PER PRODUCTION PRACTICES MANUAL.

2. FOR ASSEMBLY SPECIFICATION SEE 3119516.

1. FOR SCHEMATIC SEE 3119515.

NOTES:

## REFERENCE



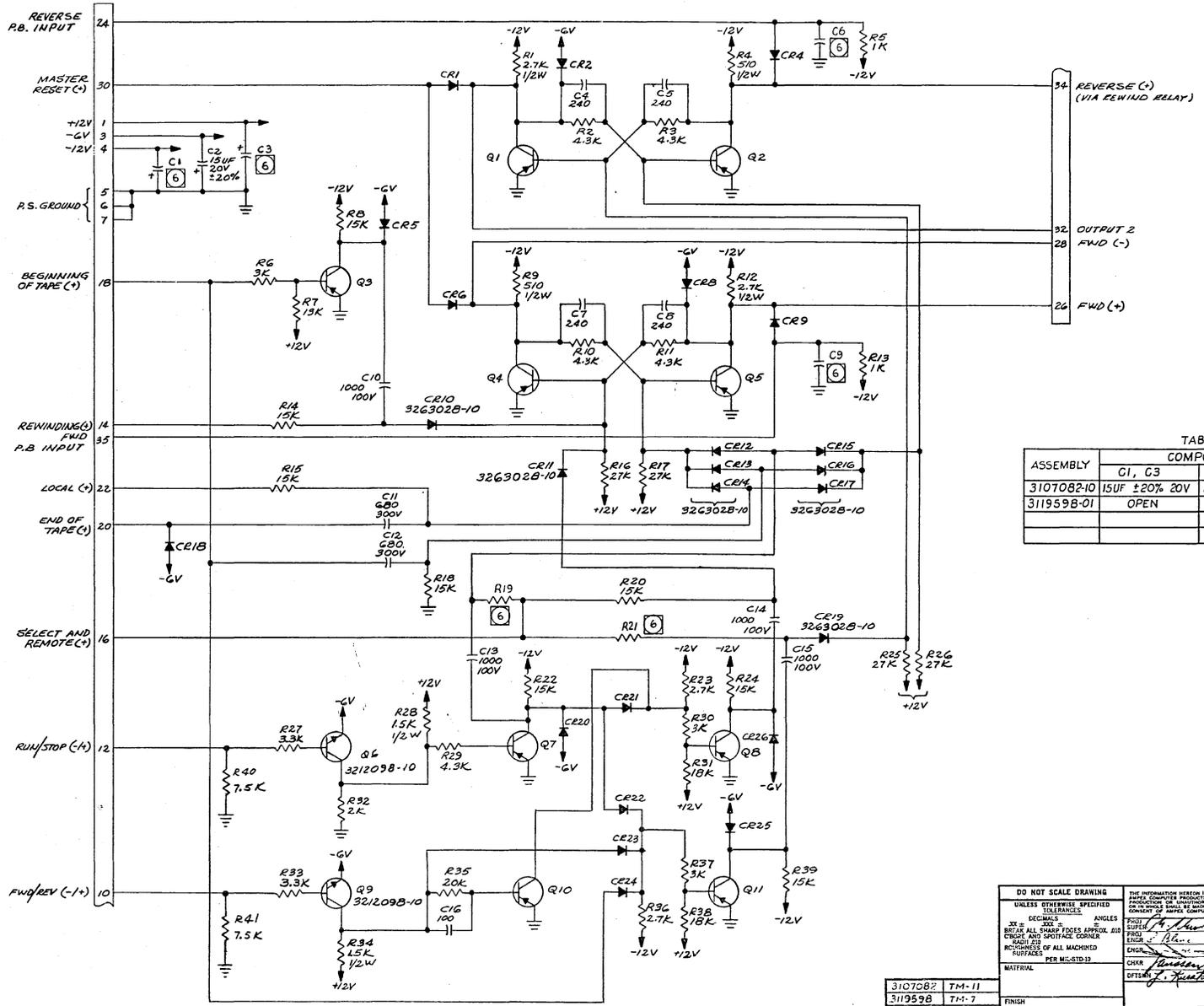
DO NOT SCALE DRAWING  
UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
DECIMALS TOLERANCES ANGLES  
XXX± XXX± ±  
BREAK ALL SHARP EDGES APPROX. .010 CROWN  
AND SPOTFACE CORNER RADIUS APPROX. .010  
ROUGHNESS OF ALL MACHINED SURFACES PER MIL-STD-19  
MATERIAL

THE INFORMATION HEREON IS THE PROPERTY OF  
AMPEX COMPUTER PRODUCTS DIVISION. NO REPRODUCTION OR UNAUTHORIZED USE IN PART OR IN WHOLE SHALL BE MADE WITHOUT WRITTEN CONSENT OF AMPEX COMPUTER PRODUCTS DIV.  
DATE: 3/3/67  
DFTSMAN: [Signature] 1/27/67

**AMPEX COMPUTER PRODUCTS DIVISION**  
P.O. BOX 308, CULVER CITY, CALIF.

**CIRCUIT BOARD ASSY—  
CAPSTAN VELOCITY-E**

3119513	TM-11/12	FINISH	DATE	CODE IDENT. NO.	DRWG. NO.
NEXT ASSY.	1ST USED ON			<b>D</b> 09150	3119514
APPLICATION				SCALE 2:1	SHEET 1 OF 1



REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
A	ECN 911-19 Rev New (r-c)	Yoshida	10-18	CRB
B	ECN 911-519	CRB		
C	ECN 911-513	CRB		
D	ECN 911-63	CRB	10/19	CRB
E	ECN 911-68	CRB	11-16	CRB
F	ECN 911-AA	PRODA	11/11	CRB
G	ECN 7815	V. Bono	1/2/68	CRB

TABLE I

ASSEMBLY	COMPONENTS		
	C1, C3	C6, C9	R19, R21
3107082-10	15UF ±20% 20V	1000PF 10% 100V	15K
3119598-01	OPEN	OPEN	2K

3107083

- ⑥ SEE TABLE I.
- ALL DIODES TO BE 32G3028-10.
  - ALL TRANSISTORS TO BE 3201100-10.
  - ALL RESISTOR VALUES ARE IN OHMS ± 5%, 1/4W.
  - ALL CAPACITOR VALUES ARE IN PICOFARADS ± 10%, 50V.
  - FOR ASSEMBLY SEE TABLE I.

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED USE DIMENSIONS

DECIMALS ANGLES

XX IN. BEFORE ALL DIMENSIONS APPROX. DIM. SURFACES

CHAMFER AND SPOTFACE CORNER RADIUS

FINISH OF ALL MACHINED SURFACES

PER MIL-STD-13

MATERIAL

OPTIONAL

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AMPEX COMPUTER PRODUCTS COMPANY  
9117 JEFFERSON BLVD. CULVER CITY, CALIFORNIA

TITLE  
**SCHMATIC-  
FWD/REV LOGIC**

CODE IDENT. NO. SIZE DWG. NO. ISSUE  
**D 3107083 G**

DATE 2-17-68  
PROJ. ENGR. 2/15/68  
CHKD. 2/15/68  
DATE 1/2/68

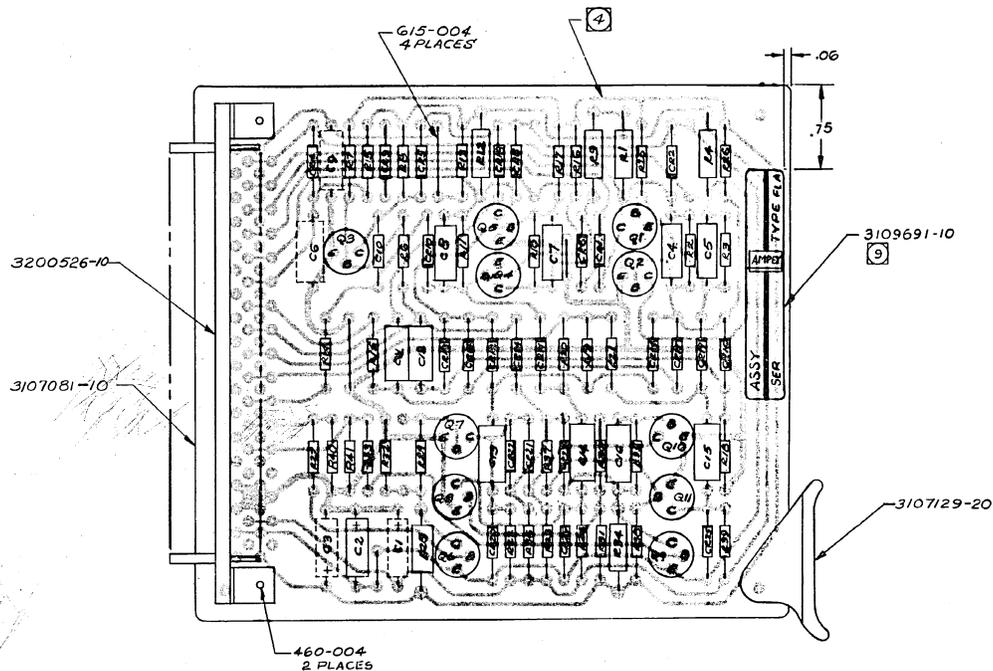
3107082 TM-11  
3119598 TM-7  
NEXT ASSY. ISS USED ON APPLICATION

APPLICATION

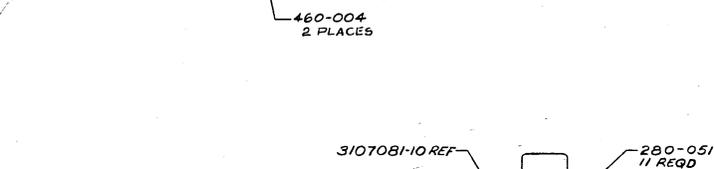
**TABLE I**  
B/M REFERENCE TABLE

ASSEMBLY	PART A	PART B	PART C
3107082-10	037-990	034-67B	041-409
3119598-01	NOT USED	NOT USED	041-560

ISSUE	DESCRIPTION	DESIGNED BY	DATE	APPROVAL
A	ECN 7815 PROD REL	Chapman	4/14/67	



PART NO.	REFERENCE DESIGNATION
3212098-10	Q6, 9
3201100-10	Q1 THRU 5, Q7, 8, 10, 11
3263024-10	C11, 2, 4, 6, 8, 9, C12 THRU 26, C10, C15
3263025-10	C10 THRU 17, 19
034-417	C16
034-529	C4, 5, 7, 8
034-67B	C10, 13, 14, 15
034-519	C11, 12
037-990	C2
041-278	R1, 12
041-404 f	R4, 9
041-008	R18, R34
041-409	R8, R18, R20, 22, 14, 15, 24, 39
041-436	R31, 38
041-442	R23, 36
041-483	R16, 17, 25, 26
041-508	R35
041-549	R7
041-550	R6, 30, 37
041-560	R32
041-584	R2, 3, 10, 11, 29
041-407	R27, 33
041-410	R3, 25
041-620	R40, 41
PART A	C1, C3
PART B	C6, C9
PART C	R19, R21



TYPICAL TRANSISTOR INSTALLATION

**REFERENCE**

① INSTALL PARTS A, B & C PER TABLE I. 3119599

② SEAL PRINTED CIRCUIT SIDE ONLY WITH HUMI-SEAL TYPE 1815, COLUMBIA TECH. CORP., OR EQUIV.

③ MARK PART NO. AND NAMEPLATE INFORMATION PER MIL-STD 130.

8. PART NO. TO BE AS SHOWN ON B/M.

7. HEAVY LINE ON DIODE INDICATES CATHODE.

6. PLUS SIGN ON CAPACITOR INDICATES POSITIVE.

5. COMPONENT DESIGNATIONS ARE FOR REFERENCE ONLY.

④ CIRCUITRY ON FAR SIDE.

3. ASSEMBLE PER MANUFACTURING PRACTICE MANUAL.

2. FOR ASSEMBLY SPECIFICATION SEE 3107084.

1. FOR SCHEMATIC SEE 3107083.

NOTES: UNLESS OTHERWISE SPECIFIED

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED

XX 0 DECIMALS 0 ANGLES

XX 0 SIZE 0 SUPER

XX 0 RADIUS 0 ENGR

XX 0 SURFACES 0 ENGR

XX 0 PER MIL-STD-130

MATERIAL

FINISH

APPLICATION

THE INFORMATION HEREON IS THE PROPERTY OF AMPLEX COMPUTER PRODUCTS COMPANY AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE WRITTEN PERMISSION OF AMPLEX COMPUTER PRODUCTS CO.

PROJ: \_\_\_\_\_

DATE: \_\_\_\_\_

ENGR: \_\_\_\_\_

CHEK: \_\_\_\_\_

DFTSMAN L. KURATANI 4/14/67

**AMPLEX** AMPLEX COMPUTER PRODUCTS COMPANY  
800 JEFFERSON BLVD. CULVER CITY, CALIFORNIA

TITLE

CIRCUIT BOARD ASSY - FWD/REV. LOGIC

CODE IDENT. NO. SIZE DWG. NO. ISSUE

D 3119599 A

SCALE 2:1 SHEET 1 OF 1

3107082 TM-11

3119598 TM-7

NEXT ASSY. IS USED ON

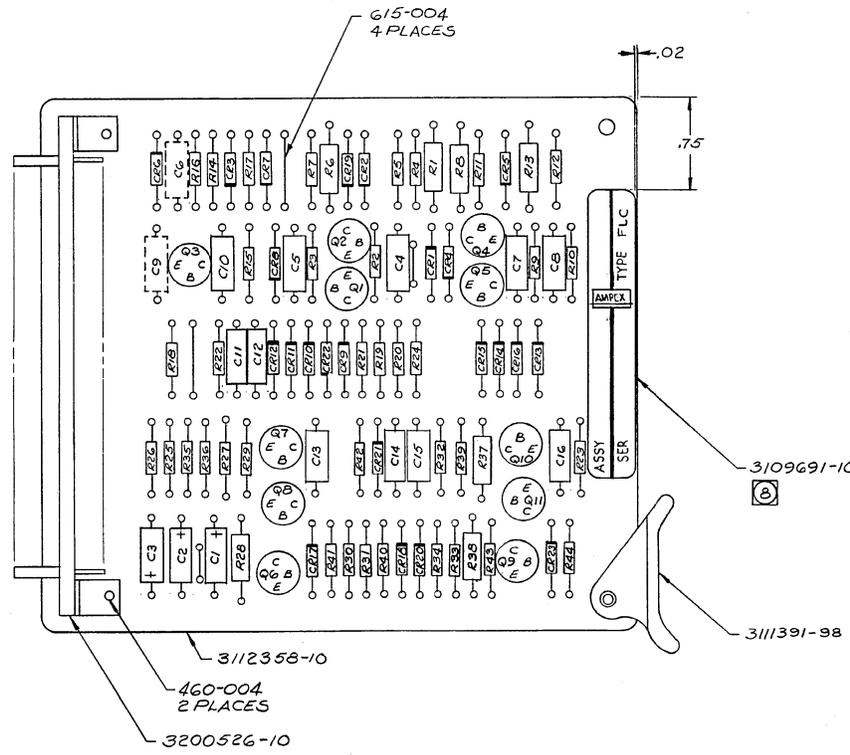
APPLICATION



REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
A	ECN 5060 PROD.REL	Arnold	11/66	[Signature]
B	ECN 5074	Arnold	4/66	[Signature]
C	ECN 7341	Arnold	7/61	[Signature]
D	ECN 7588	Arnold	10/63	[Signature]

TABLE I  
B/M REFERENCE TABLE

ASSEMBLY	USED ON	PART A	PART B	PART C	PART D	PART E	PART F	PART G
3112360-10	TM-7	034-678	326302410	041-409	041-409	041-409	037-990	034-678
3118157-07	TM12213	034-319	OPEN	041-560	041-560	041-934	037-990	034-678
3119529-07	TM-9212	034-678	326302410	041-560	041-560	041-409	NOT USED	NOT USED



PART NO.	REFERENCE DESIGNATION	PART NO.	REFERENCE DESIGNATION
041-407	R26, R36	3201100-10	Q1 THRU Q5, Q7, Q8, Q10, Q11
041-409	R17 THRU R20, R22, R23, R30, R40	3212098-10	Q6, Q9
041-410	R7, R14	326302410	CR1 THRU CR7, CR17, CR19 THRU CR22
041-436	R33, R43	326302810	CR8 THRU CR16
041-442	R31, R41	034-519	C1, C12
041-483	R4, R5, R11, R12	034-529	C4, C5, C7, C8
041-520	R25, R35	034-678	C10, C13, C15
041-549	R16	037-990	C2
041-550	R15, R32, R42	041-008	R28, R38
041-560	R27	041-010	R37
041-584	R2, R3, R9, R10, R29, R39	041-278	R6, R8
PART A	C14, C16		
PART B	CR18, CR23	PART D	R24
041-404	R1, R13	PART E	R34, R44
PART C	R21	PART F	C1, C3
PART G	C6, C9		

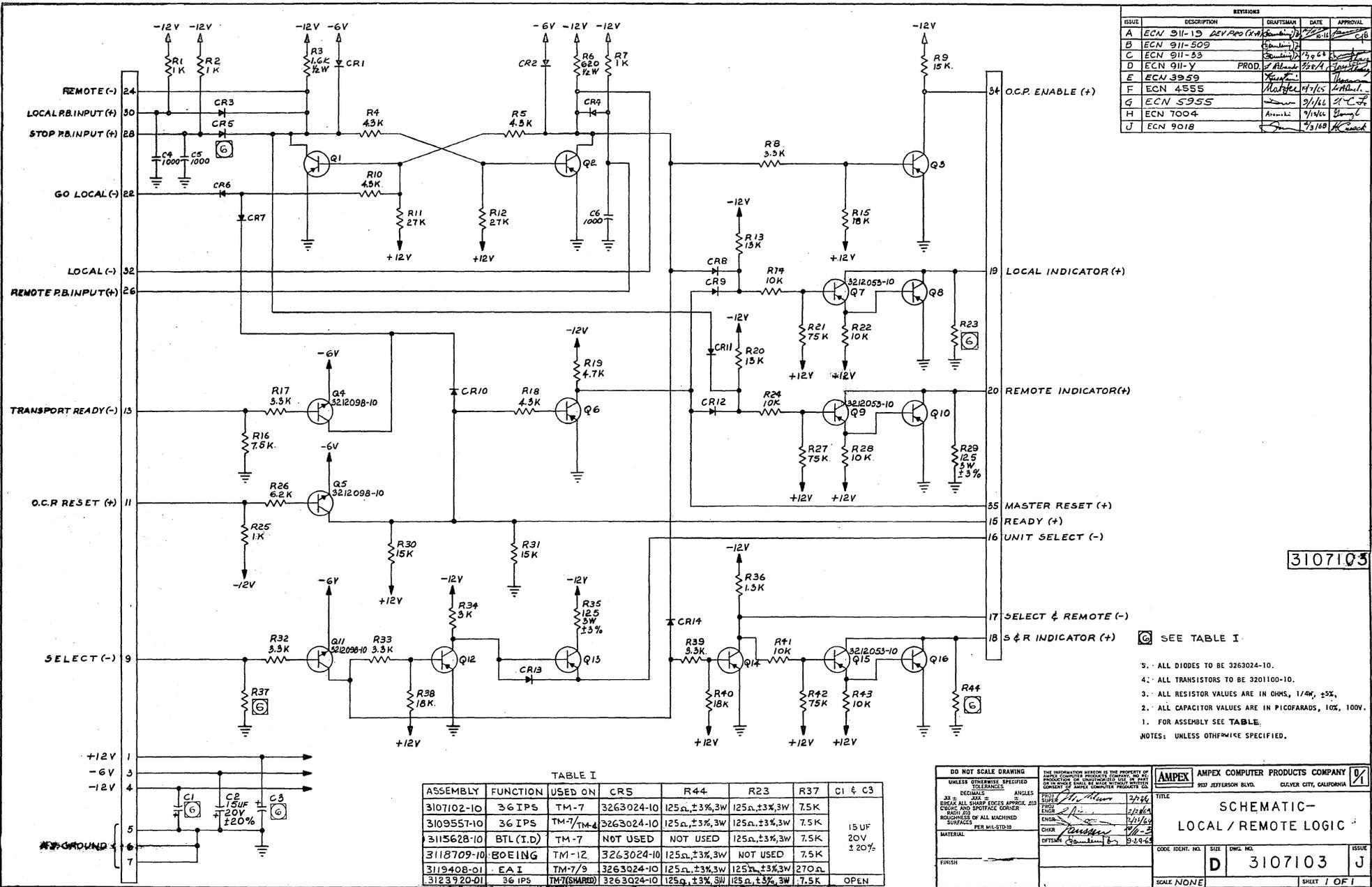
9. SEAL PRINTED CIRCUIT SIDE ONLY WITH HUMI-SEAL TYPE 1B15, COLUMBIA TECH. CORP., OR EQUIV.
  10. MARK PART NO. AND NAMEPLATE INFORMATION PER MIL-STD-130. ISSUE LETTER TO BE MARKED IN UPPER RIGHT CORNER OF NAMEPLATE.
  7. PART NO. TO BE AS SHOWN ON TABLE I.
  6. HEAVY LINE ON DIODE INDICATES CATHODE.
  5. PLUS SIGN ON CAPACITOR INDICATES POSITIVE.
  4. COMPONENT DESIGNATIONS ARE FOR REFERENCES ONLY.
  3. ASSEMBLE PER PRODUCTION PRACTICES MANUAL.
  2. FOR ASSEMBLY SPEC SEE 3112361.
  1. FOR SCHEMATIC SEE 3112361
- NOTES:

**REFERENCE**

10. INSTALL PART A THRU G PER TABLE I.



DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED TOLERANCES DECIMALS = ANGLES FRONT VIEW = SUPER BREAK ALL DIMENSIONS APPROX. 2:10 CHAMFER AND SPOTFACE CORNER RADIUS OF ALL MACHINED SURFACES PER MIL-STD-19		THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY AND IS UNCLASSIFIED EXCEPT WHERE SHOWN OTHERWISE BY A MARKING METHOD OF AMPEX COMPUTER PRODUCTS CO.		AMPEX AMPEX COMPUTER PRODUCTS COMPANY 912 JEFFERSON BLVD. CULVER CITY, CALIFORNIA	
TITLE CIRCUIT BOARD ASSY - FWD/REV LOGIC-C		DATE 11/66		DRAWN BY 11/66	
CHECKED BY S. [Signature]		DATE 11/66		DRAWN BY 11/66	
FINAL B/M TM-7	APPLICATION	CODE IDENT. NO. D	SIZE 3118158	DWG. NO. D	ISSUE D
NEXT ASSY. 1ST USED ON		SCALE 2/1		SHEET 1 OF 1	



REVISIONS				
ISSUE	DESCRIPTION	DRAWN BY	DATE	APPROVAL
A	ECN 911-15 DEV APP (K.A.)	[Signature]	10/11	[Signature]
B	ECN 911-509	[Signature]	10/11	[Signature]
C	ECN 911-535	[Signature]	10/11	[Signature]
D	ECN 911-Y	PROD	10/11	[Signature]
E	ECN 39-59	[Signature]	10/11	[Signature]
F	ECN 4555	[Signature]	10/11	[Signature]
G	ECN 5955	[Signature]	9/16	[Signature]
H	ECN 7004	[Signature]	9/16	[Signature]
J	ECN 9018	[Signature]	7/16	[Signature]

3107103

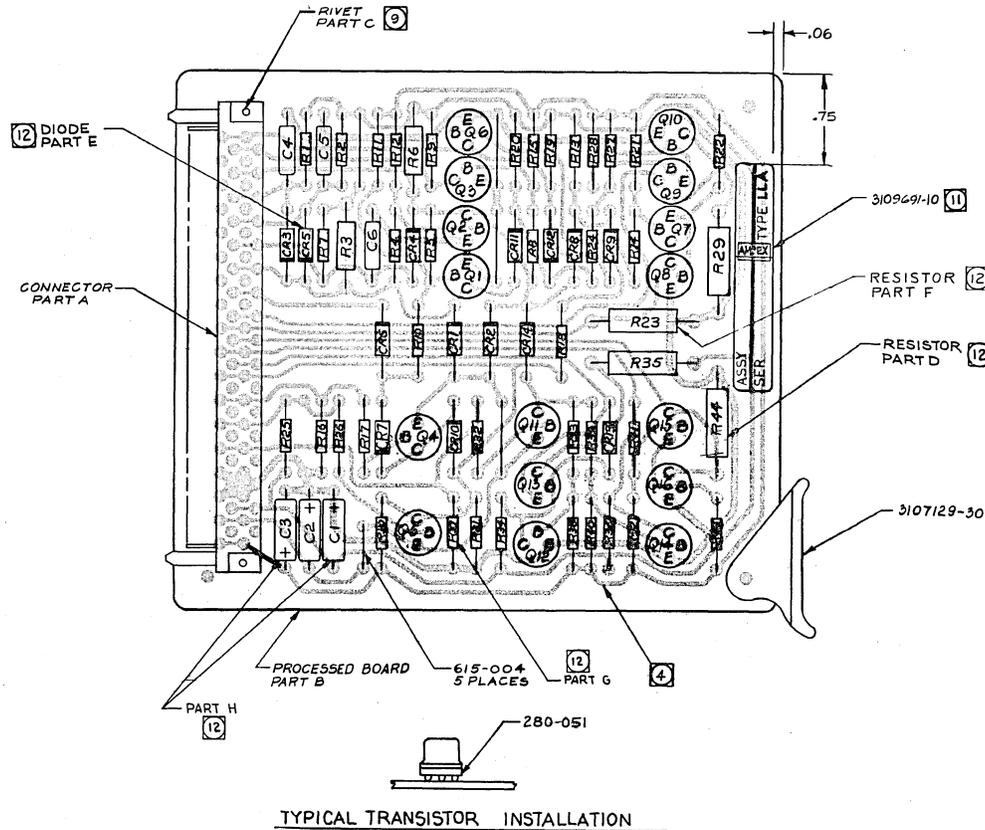
SEE TABLE I

- 3. ALL DIODES TO BE 3263024-10.
- 4. ALL TRANSISTORS TO BE 3201100-10.
- 5. ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ±5%.
- 2. ALL CAPACITOR VALUES ARE IN PICOFARADS, 10%, 100V.
- 1. FOR ASSEMBLY SEE TABLE.
- NOTES: UNLESS OTHERWISE SPECIFIED.

ASSEMBLY	FUNCTION	USED ON	CRS	R44	R23	R37	C1 & C3
3107102-10	36 IPS	TM-7	3263024-10	125Ω, ±3%, 3W	125Ω, ±3%, 3W	7.5K	
3109551-10	36 IPS	TM-7/TM-4	3263024-10	125Ω, ±3%, 3W	125Ω, ±3%, 3W	7.5K	
3115628-10	BTL (I.D.)	TM-7	NOT USED	NOT USED	125Ω, ±3%, 3W	7.5K	15 UF 20V ±20%
3118709-10	BOEING	TM-12	3263024-10	125Ω, ±3%, 3W	NOT USED	7.5K	
3119408-01	EAI	TM-7/9	3263024-10	125Ω, ±3%, 3W	125Ω, ±3%, 3W	270Ω	
3123920-01	36 IPS	TM-7 (SHARD)	3263024-10	125Ω, ±3%, 3W	125Ω, ±3%, 3W	7.5K	OPEN

DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED TOLERANCES DECIMALS ANGLES BREAK ALL SHARP CORNERS CHAMFER AND SPOTFACE CORNER FINISH ROUNDEDNESS OF ALL MACHINED SURFACES MATERIAL PER MIL-STD-12	THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY, INC. AND IS LOANED TO YOU FOR YOUR INFORMATION ONLY. IT IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF AMPEX COMPUTER PRODUCTS COMPANY.	<b>AMPEX</b> AMPEX COMPUTER PRODUCTS COMPANY 9137 JEFFERSON BLVD. CULVER CITY, CALIFORNIA
TITLE <b>SCHMATIC- LOCAL / REMOTE LOGIC</b>	DATE 10/11	DRAWN BY [Signature]
CODE IDENT. NO. <b>D</b>	SIZE <b>3107103</b>	DWG. NO. <b>J</b>
SCALE NONE	SHEET 1 OF 1	ISSUE <b>J</b>

ISSUE	DESCRIPTION	DRAWN BY	DATE	APPROVAL
A	ECN 911-33 DEV PRO	...	...	...
B	ECN 911-Y PROD.	...	...	...
C	ECN 3959	...	...	...
D	ECN 4555	...	...	...
E	ECN 5955	...	...	...
F	ECN 7004	...	...	...
G	ECN 9018	...	...	...



PART NO.	REFERENCE DESIGNATION
3201100-10	Q1, 2, 3, 6, 8, 10, 12, 13, 14, 15
3212053-10	Q7, 9, 15
3212098-10	Q4, 5, 11
3269024-10	CR1, 2, 3, 4; CR6 THRU CR14
037-990	C2
034-678	C4, 5, 6
041-407	R8, 17, 32, 33, 39
041-408	R14, 22, 24, 25, 41, 43
041-409	R9, 30, 31
041-412	R19
041-438	R15, 38, 40
041-483	R11, 12
041-526	R3
041-539	R26
041-549	R13, 20
041-550	R34
041-572	R21, 27, 47
041-584	R4, 5, 10, 15
041-744	R35
047-302	R29, 35
041-520	R16
041-416	R1, 2, 7, 25
041-006	R5
PART D	R44
PART E	CR5
PART F	R23
PART G	R37
PART H	C1, C3

- 12 INSTALL PARTS A THRU H PER TABLE I.
- 11 MARK PART NO. AND SERIAL NO. PER MIL-STD-100. 3107260
10. PART NO. TO BE AS SHOWN ON BILL OF MATERIAL.
9. RIVET PART C USED ONLY ON 3200526 CONNECTOR.
8. SEAL PRINTED CIRCUIT SIDE ONLY WITH HUMISEAL TYPE 1815, COLUMBIA TECH. CORP., OR EQUIVALENT.
7. PLUS SIGN ON CAPACITOR INDICATES POSITIVE.
6. COMPONENT DESIGNATIONS ARE FOR REFERENCE ONLY
5. ASSEMBLE PER AMPEX STANDARD
4. CIRCUITRY ON FAR SIDE.
3. HEAVY LINE ON DIODE INDICATES CATHODE.
2. FOR 'PERF' SPECIFICATION SEE 3107104.
1. FOR SCHEMATIC SEE 3107103
- NOTES:

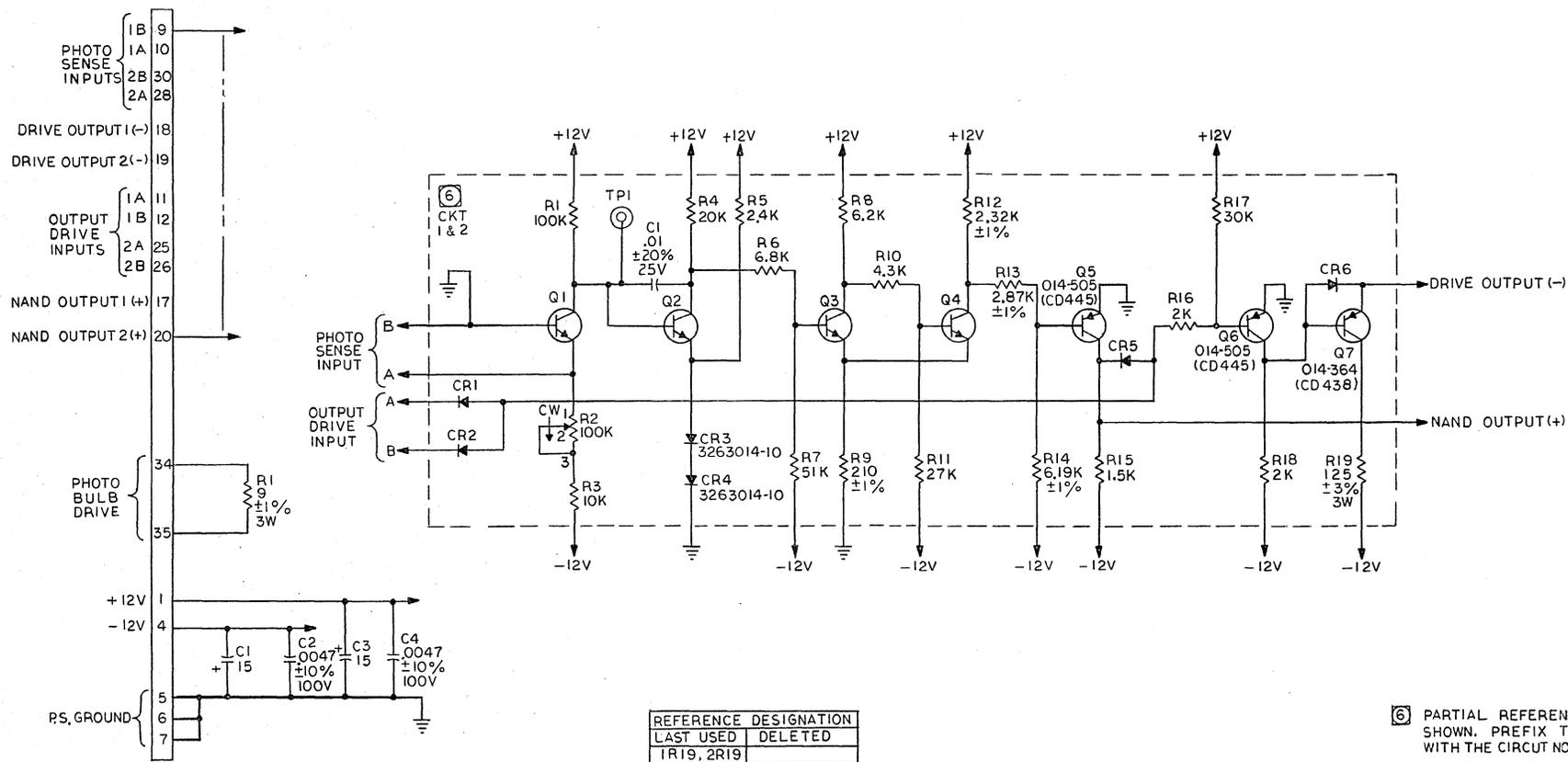
TABLE I

USED ON	FUNCTION	ASSEMBLY	B/M REFERENCE TABLE							
			PART A	PART B	PART C	PART D	PART E	PART F	PART G	PART H
TM-7	36 IPS	3107102-10	3200526-10	3107101-10	460-004	047-302	3263024-10	047-302	041-520	037-990
TM-7/TM-4	36 IPS	3109557-10	3200504-10	3107101-10	NOT USED	047-302	3263024-10	047-302	041-520	
TM-7	BTL (I.D.)	3115628-10	3200526-10	3107101-20	460-004	NOT USED	NOT USED	047-302	041-520	
TM-12	BOEING	3118709-10	3200526-10	3107101-10	460-004	047-302	3263024-10	NOT USED	041-520	
TM-7/TM-9	EAI	3119408-01	3200526-10	3107101-20	460-004	047-302	3263024-10	047-302	041-503	
TM-T (SHARED)	36 IPS	3123920-01	3200526-10	3107101-20	460-004	047-302	3263024-10	047-302	041-520	NOT USED

REFERENCE

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UNLESS OTHERWISE SPECIFIED TOLERANCES ARE: DIMENSIONS ANGLES DECIMALS .005" .010" .015" .020" .030" .040" .050" .060" .070" .080" .090" .100" .125" .150" .175" .200" .250" .300" .375" .500" .625" .750" .875" 1.000" FRACTIONS 1/16" 1/8" 1/4" 3/8" 1/2" 5/8" 3/4" 7/8" 1.000" SURFACES UNLESS OTHERWISE SPECIFIED TO BE MACHINED SURFACES PER MIL-STD-100	PROJ. NO. 3107260 DATE 12/22/66 ENGR. J. J. ... CHKD. ... DET. ...	TITLE CIRCUIT BOARD ASSY - LOCAL / REMOTE LOGIC
MATERIAL	FINISH	CODE SHEET NO. D SIZE 3107260 SHEET 1 OF 1

REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
C	ECN 164 - E	PROD	11/27/64	100



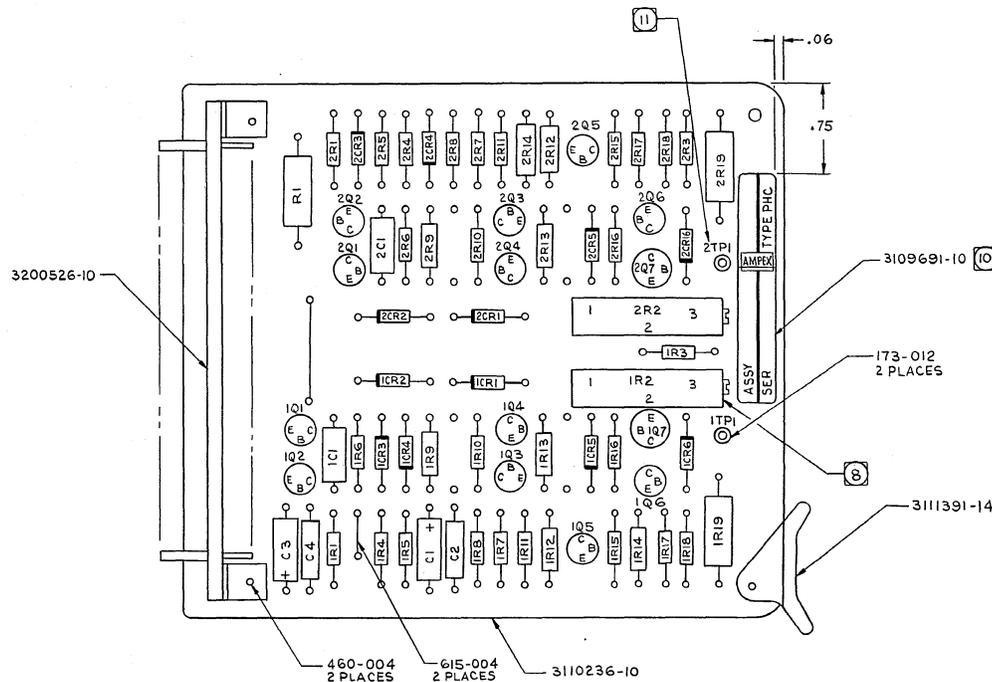
3110238

REFERENCE	DESIGNATION
LAST USED	DELETED
1R19, 2R19	
1CR6, 2CR6	
R 1	
IC1, 2C1	
IQ7, 2Q7	
C4	

- ⑥ PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX THE REFERENCE NUMBER WITH THE CIRCUIT NO. FOR COMPLETE DESIGNATION.
- ALL TRANSISTORS TO BE 320104-10.
  - ALL DIODES TO BE 013-599(CD458).
  - ALL RESISTOR VALUES ARE IN OHMS,  $\pm 5\%$ , 1/4W.
  - ALL CAPACITOR VALUES ARE IN MICROFARADS,  $\pm 20\%$ , 20V.
  - FOR ASSEMBLY SEE 3110237.
- NOTES: UNLESS OTHERWISE SPECIFIED,

DO NOT SCALE DRAWING		UNLESS OTHERWISE SPECIFIED TOLERANCES		AMPEX COMPUTER PRODUCTS COMPANY 912 JEFFERSON BLVD. CULVER CITY, CALIFORNIA	
30 = .001	30 = .001	30 = .001	30 = .001	PROJ: <i>[Signature]</i> DESIGNED: <i>[Signature]</i> CHECKED: <i>[Signature]</i> ENGR: <i>[Signature]</i> DATE: 11/27/64	TITLE: SCHEMATIC - PHOTO AMPLIFIER TYPE C CODE IDENT. NO.: 3110238 SIZE: D SHEET: 1 OF 1
3110237	TM-11	FINISH	APPLICATION	SCALE: NONE	ISSUE: C

REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
D	ECN 164-E PROD	Mozfke	1/1/62	ac
E	ECN 7282	SA	1/1/62	Proh...



PART NO.	REFERENCE DESIGNATION
3201104-10	1Q1, 2Q1, 1Q2, 2Q2, 1Q3, 2Q3, 1Q4, 2Q4
3263014-10	1CR3, 2CR3, 1CR4, 2CR4
013-599	1CR1, 2CR1, 1CR2, 2CR2, 1CR5, 2CR5, 1CR6, 2CR6
014-364	1Q7, 2Q7
014-505	1Q5, 2Q5, 1Q6, 2Q6
030-438	1C1, 2C1
035-989	C2, C4
037-990	C1, C3
041-394	1R1, 2R1
041-408	1R3, 2R3
041-413	1R6, 2R6
041-430	1R15, 2R15
041-483	1R11, 2R11
041-508	1R4, 2R4
041-538	1R8, 2R8
041-560	1R18, 2R18, 1R16, 2R16
041-570	1R5, 2R5
041-572	1R7, 2R7
041-584	1R10, 2R10
041-612	1R17, 2R17
047-302	1R19, 2R19
047-375	R1
042-881	1R14, 2R14
044-279	1R2, 2R2
048-173	1R12, 2R12
048-973	1R9, 2R9
042-865	1R13, 2R13

3110237

⑩ MARK PART NO. & NAMEPLATE INFORMATION PER MIL-STD-130.

9. PART NO. TO BE 3110237-10.

⑧ TRIMPOTS NOT TO BE SUBMERGED IN WATER.

7. SEAL PRINTED CIRCUIT SIDE ONLY WITH HUMISEAL TYPE 1B15 COLUMBIA TECH CORP. OR EQUIV.

6. PLUS SIGN ON CAPACITOR INDICATES POSITIVE.

5. HEAVY LINE ON DIODE INDICATES CATHODE.

4. COMPONENT DESIGNATIONS ARE FOR REFERENCE ONLY.

3. ASSEMBLE PER PRODUCTION PRACTICES MANUAL.

⑪ MARK ALL TEST POINT REF. NUMBERS .12 HIGH CHARACTERS, COLOR, WHITE PER MIL-STD-130. DO NOT IMPRESSION STAMP.

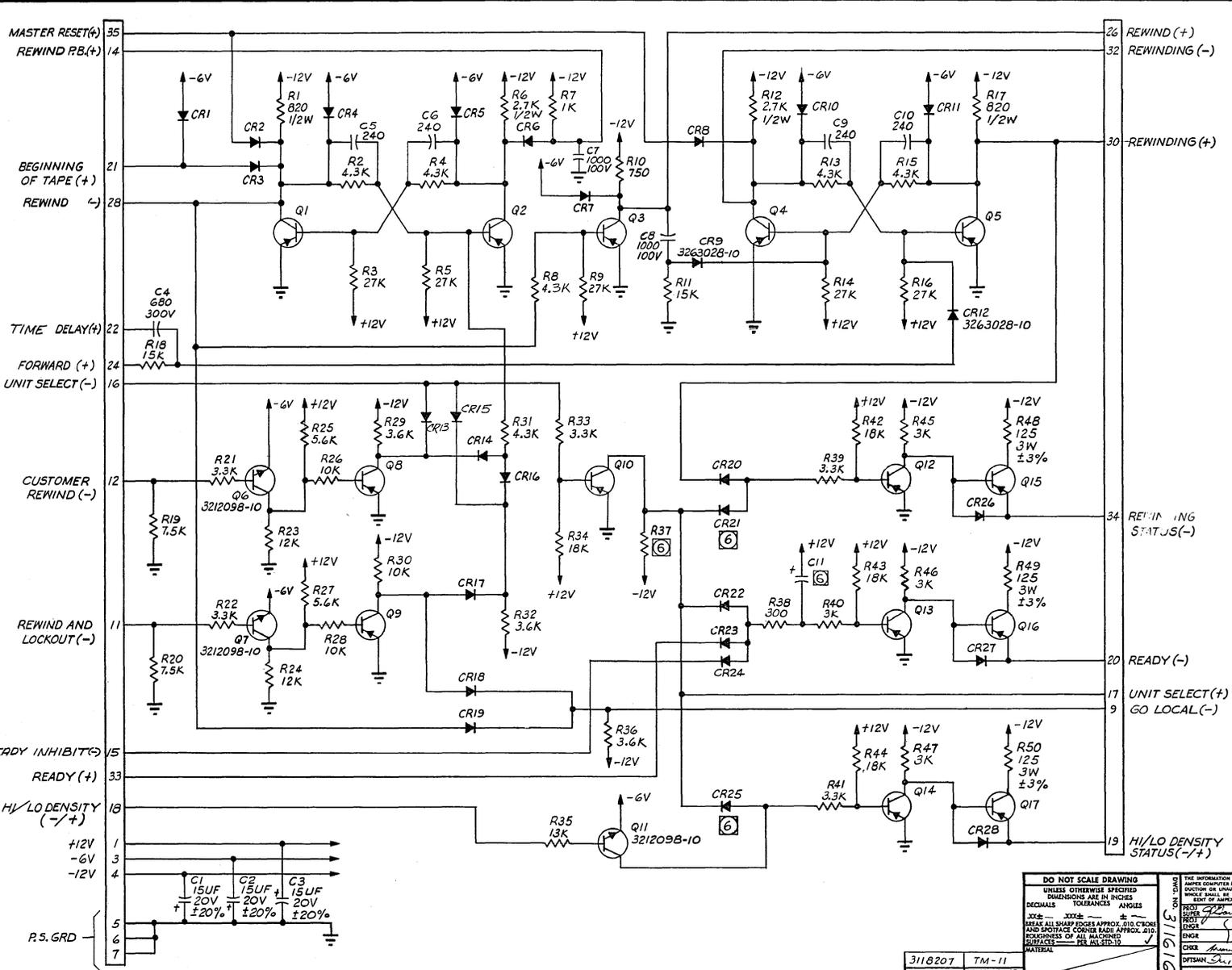
2. FOR ASSEMBLY SPECIFICATION SEE 3110239, 155, 'A'.

1. FOR SCHEMATIC SEE 3110238, ISSUE C.

NOTES:

TYPICAL TRANSISTOR INSTALLATION

<b>DO NOT SCALE DRAWING</b> UNLESS OTHERWISE SPECIFIED TOLERANCES DECIMALS — ANGLES XX ± 0.3 MAX BREAK ALL SHARP EDGES APPROX. 20° CHAMFER AND SPOTFACE CORNER RADI 200 ROUGHNESS OF ALL MACHINED SURFACES PER MIL-STD-130		THIS INFORMATION HEREON IS THE PROPERTY OF AMPER COMPUTER PRODUCTS COMPANY. NO PARTS OR PORTIONS SHALL BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE WRITTEN CONSENT OF AMPER COMPUTER PRODUCTS CO.		<b>AMPEX</b> AMPER COMPUTER PRODUCTS COMPANY 9517 JEFFERSON BLVD. CULVER CITY, CALIFORNIA
MATERIAL FINISH APPLICATION		TITLE <b>CIRCUIT BOARD ASSY - PHOTO AMPLIFIER TYPE C</b>		CODE IDENT. NO. <b>D</b> SIZE <b>3110237</b> SCALE 2:1
NEXT ASSY. EST USED ON APPLICATION		DATE 11-22-64		ISSUE <b>E</b> SHEET 1 OF 1



REVISIONS					
ISSUE	DESCRIPTION	DATE	DRAFTSMAN	DATE	APPROVAL
A	ERN 106-DA PROD	2/4/66	Spencer	7/1/66	Spencer
B	ECN 4989	2/25/66	C.M.	2/25/66	Spencer
C	ECN 5061	9/10/66	Amachi	9/10/66	Spencer
D	ECN 5074	9/10/66	Amachi	9/10/66	Spencer
E	ECN 5158	9/10/66	Spencer	10/10/66	Spencer

TABLE I

ASSEMBLY	COMPONENTS			
	C11	CR21	CR25	R37
311617-10	.22UF, 5%, 35V	USED	USED	820Ω, ±5%, 1/4W
3116189-10	OPEN	OPEN	OPEN	560Ω, ±5%, 1/2W
3118207-01	.22UF, ±1%, 35V	USED	OPEN	820Ω, ±5%, 1/4W

LAST USED	DELETED
R50	
C11	
Q17	
CR28	

⑥ SEE TABLE I  
 5. ALL TRANSISTORS TO BE 3220100-10.  
 4. ALL DIODES TO BE 3263028-10.  
 3. ALL RESISTOR VALUES ARE IN OHMS ±5%, 1/4W.  
 2. ALL CAPACITOR VALUES ARE IN PICOFARADS ±10%.  
 1. FOR ASSEMBLY SEE 3116167.  
 NOTES:

**DO NOT SCALE DRAWING**

UNLESS OTHERWISE SPECIFIED  
 DIMENSIONS ARE IN INCHES  
 DECIMALS TOLERANCES ANGLES

FINISH ——— PER UNLESS NOTED

3118207 TM-11  
 3116189 TM-122/3  
 3116167 TM-11

NEXT ASSY. 1ST USED ON APPLICATION

THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS DIVISION. NO REPRODUCTION OR UNAUTHORIZED USE IN PART OR IN WHOLE SHALL BE MADE WITHOUT WRITTEN CONSENT OF AMPEX COMPUTER PRODUCTS DIV.

**AMPEX** COMPUTER PRODUCTS DIVISION  
 P.O. BOX 358, CULVER CITY, CALIF.

**SCHEMATIC - REWIND LOGIC - C**

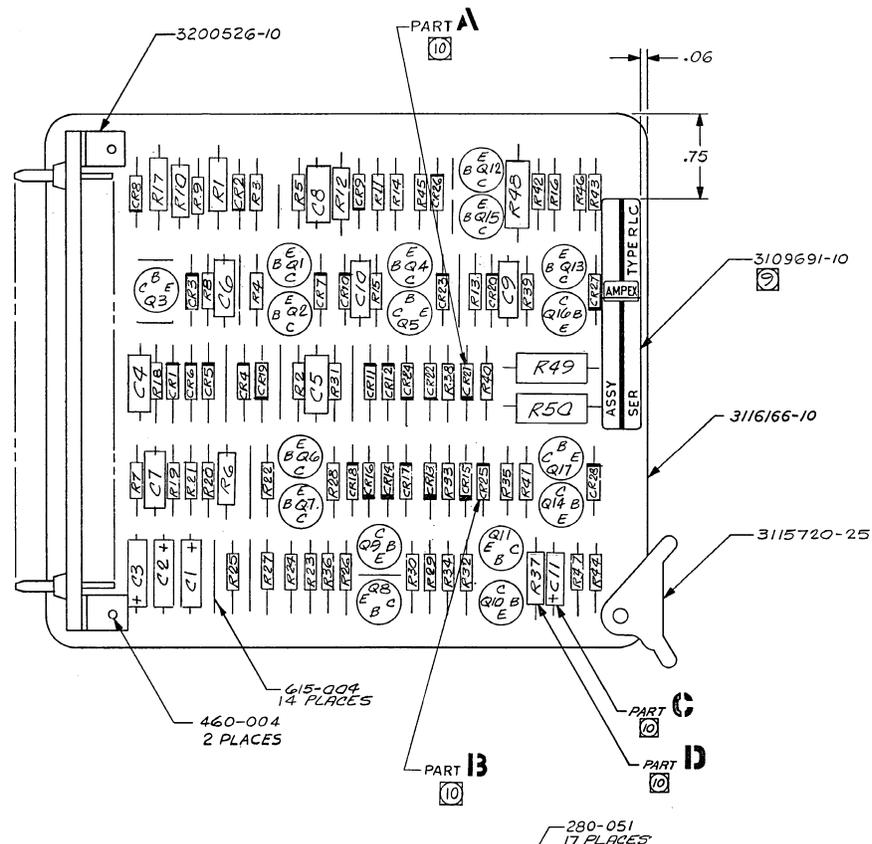
DATE: 1/11/66  
 DRAFTSMAN: Spencer  
 CHECKED: Amachi  
 APPROVED: Spencer

SIZE: D CODE IDENT. NO. DWG. NO. 3116168  
 SCALE: NONE SHEET: 1 OF 1

**TABLE I**  
**B/M REFERENCE TABLE**

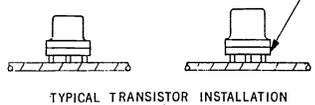
ASSEMBLY	PART A	PART B	PART C	PART D
3116167-10	3263024-10	3263024-10	037-217	041-317
3116189-10	OPEN	OPEN	OPEN	041-256
3118207-01	3263024-10	OPEN	037-217	041-317

REVISIONS					
ISSUE	DESCRIPTION	DATE	DRAFTSMAN	DATE	APPROVAL
A	ECN 4989 PROD.	3/5/66			
B	ECN 5074	9/16/66	Amaldi	11/11/66	Longf...
C	ECN 5061	9/16/66	Amaldi	11/11/66	Longf...
D	ECN 5074	9/16/66	Amaldi	11/22/66	Longf...
E	ECN 5158	9/16/66	Amaldi	11/22/66	Longf...
F	ECN 7081	10/16/66	Reiser	11/22/66	Longf...



PART NO.	REF DESIGNATIONS	PART NO.	REF DESIGNATIONS
3201100-10	Q1-Q5, Q8-Q10, Q12-Q17	041-410	R7
3212098-10	Q6, Q7, Q11	041-436	R3, R42, R43, R44
3263024-10	CR1-CR8, CR10, CR11, CR13-CR20, CR22-CR28	041-482	R23, R24
3263028-10	CR9, CR12	041-483	R3, R5, R9, R14, R16
034-519	C4	041-507	R25, R27
034-529	C5, C6, C9, C10	041-520	R19, R20
034-678	C7, C8	041-549	R35
037-990	C1, C2, C3	041-550	R40, R43, R46, R47
041-278	R6, R12	041-569	R38
041-317	R1, R17	041-571	R29, R32, R36
041-407	R21, R22, R33, R34, R35	041-584	R24, R5, R13, R26, R31
041-408	R26, R28, R30	047-302	R48, R49, R50
041-409	R11, R18	041-531	R10
PART A	CR 21	PART D	R37
PART B	CR 25		
PART C	C11		

- 10 INSTALL PT. A THRU D PER TABLE I.
- 20 MARK PART NO. & NAMEPLATE INFORMATION PER MIL-STD-130.
- 21 PART NO. SEE B/M
- 22 SEAL PRINTED CIRCUIT SIDE ONLY WITH HUMISEAL TYPE 1E15 COLUMBIA TECH. OR EQUIV.
- 23 COMPONENT DESIGNATIONS ARE FOR REF. ONLY.
- 24 PLUS SIGN ON CAPACITOR INDICATES POSITIVE.
- 25 HEAVY LINE ON DIODES INDICATES CATHODE.
- 26 ASSEMBLE PER PRODUCTION PRACTICES MANUAL.
- 27 FOR ASSEMBLY SPECIFICATION SEE 3116169.
- 28 FOR SCHEMATIC SEE 3116168.



**REFERENCE**

DO NOT SCALE DRAWING  
UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
DECIMALS TOLERANCES ANGLES  
.005 ± .001, .002 ± .010 ± 1/2°  
BREAK ALL SHARP EDGES APPROX. 0.015" RADIUS  
AND SPOTFACE CORNER RADI APPROX. 0.010"  
ROUGHNESS OF ALL MACHINED SURFACES — PER MIL-STD-10 MATERIAL

THE INFORMATION HEREON IS THE PROPERTY OF AMPLEX COMPUTER PRODUCTS DIVISION. NO REPRODUCTION OR TRANSMISSION IS TO BE MADE WITHOUT WRITTEN CONSENT OF AMPLEX COMPUTER PRODUCTS DIV.

**AMPEX** COMPUTER PRODUCTS DIVISION  
P.O. BOX 385, CULVER CITY, CALIF.

TITLE: **CIRCUIT BOARD ASSY - KEWIND LOGIC - C**

DESIGNER: *R. D. Anderson* 10/16/66

CHECKED: *[Signature]*

DRAFTSMAN: *R. D. Anderson* 10/16/66

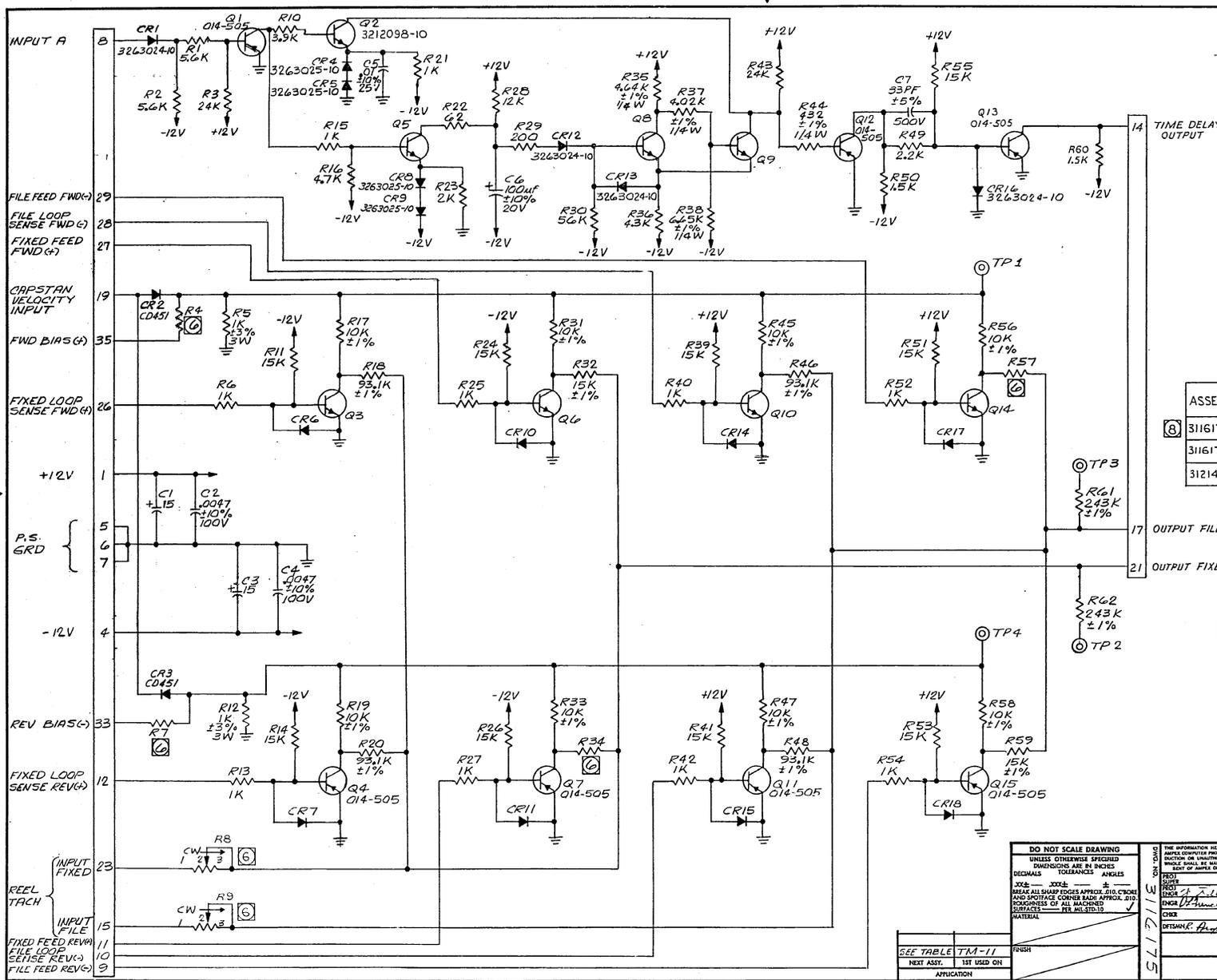
SIZE: **D** CODE IDENT. NO.: **09450** DWG. NO.: **3116183**

SCALE: **2/1** SHEET: **1 OF 1**

SEE TABLE	FINISH
NEXT ASSY.	1ST USED ON
APPLICATION	

DC320 3116175

REVISIONS				
ISSUE	DESCRIPTION	DATE	DRAFTSMAN	APPROVAL
B	ECN 7685 PROD	5/16/71	W. J. ...	W. J. ...
C	ECN 8504	4/4/71	Amundson	W. J. ...
D	ECN 10038	7/6/71	Amundson	W. J. ...



REFERENCE DESIGNATION	
LAST USED	DELETED
R62	
C7	
CR18	
Q15	

TABLE I

ASSEMBLY	FUNCTION	COMPONENTS		
		R4 & R7	R34 & R57	R8, R9
3116172-01	75, 112.5, 120IPS	2.4K	15K ± 1%	10K
3116173-01	ALL SPEEDS TM-11	330Ω ± 3%, 1W	16.2K ± 1%	10K
3121468-01	ALL SPEEDS TM-16	330Ω ± 3%, 1W	16.2K ± 1%	25K

9. FOR REF ASSY SEE 3116174
- ⑧ INACTIVE. ASSY 3116172-10 IS REPLACED BY 3116173-10
7. TRANSISTOR P/N 014-505 REF TO CD445.
- ② SEE TABLE I.
5. ALL TRANSISTORS TO BE 3201104-10
4. ALL DIODES TO BE 013-599(CD458).
3. ALL RESISTOR VALUES ARE IN OHMS ± 5%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 20%, 20V.
1. FOR ASSEMBLY SEE TABLE I.
- NOTES:

REEL TACH  
INPUT FILE  
INPUT FIXED  
FIXED FEED REV(A)  
FILE LOOP SENSE REV(A)  
ETISE REV(A)  
FILE FEED REV(B)

DO NOT SCALE DRAWING  
UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
DECIMALS TOLERANCES ANGLES  
XXX ± .0005 ± .0005 ± .0005  
BREAK ALL SHARP CORNERS APPROX. 50% CROSS  
AND SPOTFACE CORNER RADIUS APPROX. 210°  
ROUNDEDNESS OF ALL MACHINED SURFACES PER MIL-STD-10 MATERIAL

3 THE INFORMATION HEREON IS THE PROPERTY OF  
AMPEX COMPUTER PRODUCTS DIVISION. NO REPRODUCTION OR UNAUTHORIZED USE IN WHATEVER FORM OR BY ANY MEANS IS PERMITTED WITHOUT THE WRITTEN CONSENT OF AMPEX COMPUTER PRODUCTS DIV.

PROJ: 3116175  
DRAWN: W. J. ...  
CHECKED: ...  
DATE: 5/16/71  
DESIGNED BY: W. J. ...

**AMPEX** COMPUTER PRODUCTS DIVISION  
P.O. BOX 328, CULVER CITY, CALIF.

TITLE: SCHEMATIC-REEL SERVO PREAMP-B

SIZE: D  
CODE IDENT. NO.: 09150  
SCALE: NONE

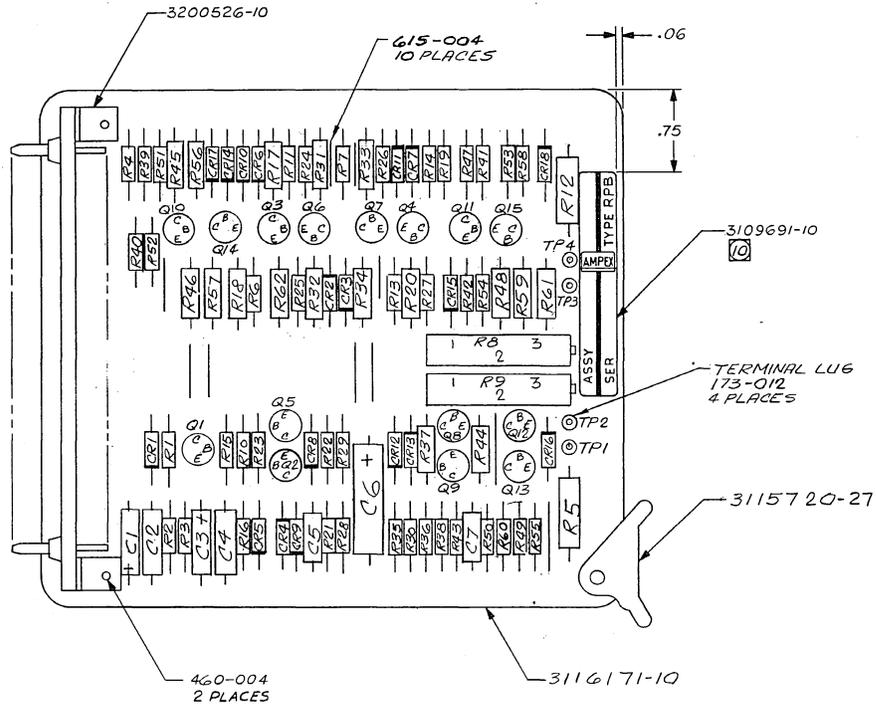
ISSUED: 3116175  
DATE: 5/16/71  
DRAFTSMAN: W. J. ...  
APPROVAL: W. J. ...

SHEET 1 OF 1

**TABLE I**  
**B/M REFERENCE TABLE**

ASSEMBLY	FUNCTION	PART 'A'	PART 'B'	PART 'C'
3116172-10	75, 112, 5, 120 IPS	041-570	042-491	044-610
3116173-10	ALL SPEEDS TM-11	047-706	048-183	044-610
3121468-01	ALL SPEEDS TM-16	047-706	048-183	058-269

REVISIONS				
ISSUE	DESCRIPTION	DATE	DRAFTSMAN	APPROVAL
C	ECN 7685 PADD	5-1-57	Walter B...	J.C.F.
D	ECN 8504	7/1/57	Amaldi	Walter B...
E	ECN 10038	7/25/57	Amaldi	J.C.F.

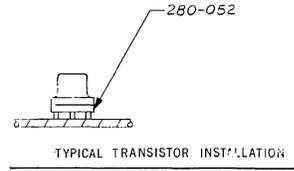


PART NO.	REFERENCE DESIGNATION
3201104-10	Q3, Q5, Q6, Q8, Q9, Q10, Q14
014-505	Q1, Q4, Q7, Q11, Q12, Q13, Q15
3263024-10	CR1, CR2, CR3, CR16
3263025-10	CR4, CR5, CR8, CR9
013-599	CR6, CR7, CR10, CR11, CR14, CR15, CR17, CR18
030-212	C5
034-359	C7
035-989	C2, C4
037-990	C1, C3
037-145	C6
041-409	R11, R14, R24, R26, R39, R41, R51, R53, R55
041-410	R6, R13, R15, R21, R25, R27, R40, R42, R52, R54
041-412	R16
041-414	R49
041-430	R50, R60
041-482	R28
041-507	R1, R2
041-511	R10
041-519	R30
041-560	R23
041-584	R36
041-734	R22
041-740	R29
042-449	R35
042-491	R32, R59
042-872	R37
043-340	R5, R12
PART C	R8, R9
048-054	R17, R19, R33, R45, R47, R56, R58, R31
048-763	R61, R62
048-972	R18, R20, R46, R48
041-750	R3, R43
048-966	R38
057-463	R44
PART A	R4, R7
PART B	R34, R57
013-678	CR2, CR3
3212098-01	Q2

- ① INACTIVE. ASSY 3116172-10 IS REPLACED BY 3116173-10
- ② MARK PART NO. NAMEPLATE INFORMATION PER MIL-STD-130.
3. PART NO. TO BE AS SHOWN ON B/M.
8. SEAL PRINTED CIRCUIT SIDE ONLY WITH HUMISEAL TYPE 1B15 COLUMBIA TECH CORP OR EQUIV.
7. TRIMPOTS NOT TO BE SUBMERGED IN WATER.
6. COMPONENT DESIGNATIONS ARE FOR REF. ONLY.
5. PLUS SIGN ON CAPACITOR INDICATES POSITIVE.
4. HEAVY LINE ON DIODES INDICATES CATHODE.
3. ASSEMBLE PER AMPLEX STANDARDS
2. FOR PERF SPECIFICATION SEE 3116176.
1. FOR SCHEMATIC SEE 3116175.
- NOTES:

**REFERENCE**

12. INSTALL PARTS A THRU C PER TABLE I.



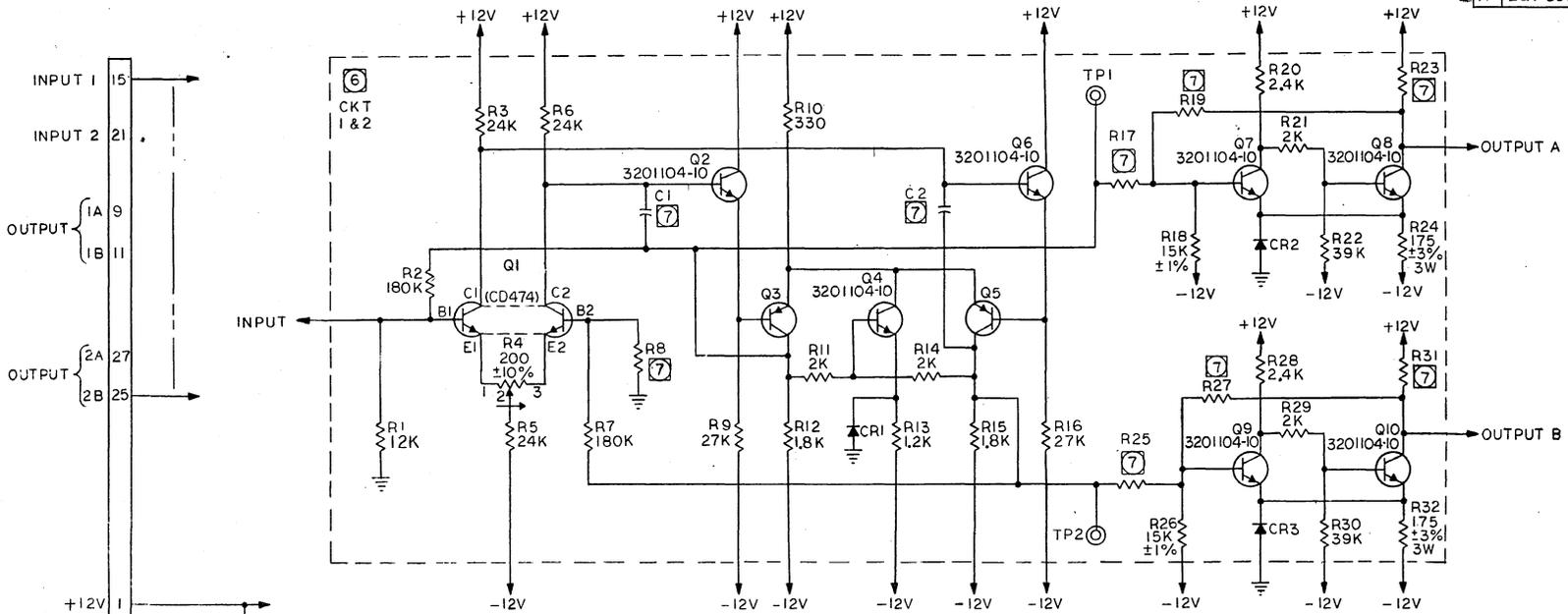
<p><b>DO NOT SCALE DRAWING</b></p> <p>UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES</p> <p>DECIMALS ANGLES</p> <p>XX.0 .03XXX ± .010 ± 1/16</p> <p>APPROX ALL SHARP EDGES APPROX .015 C ROUNE</p> <p>AND SPOTFACE CORNER RADIUS APPROX .010</p> <p>ROUGHNESS OF ALL MACHINED SURFACES PER MIL-STD-12</p> <p>MATERIAL</p>		<p>THE INFORMATION HEREIN IS THE PROPERTY OF AMPLEX COMPUTER PRODUCTS DIVISION, INC. IT IS TO BE USED ONLY FOR THE PURPOSES SPECIFIED HEREIN AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM.</p> <p>DATE: 7/1/57</p> <p>ENGR: W. Amaldi</p> <p>CHKR: R.A. Amaldi</p> <p>DFTSMAN: R.A. Amaldi 7/5/57</p>	
<p>SEE TABLE TM-11</p> <p>NEXT ASSY. 1ST USED ON</p> <p>APPLICATION</p>		<p><b>AMPEX COMPUTER PRODUCTS DIVISION</b> P.O. BOX 388, CULVER CITY, CALIF.</p> <p>TITLE: <b>CIRCUIT BOARD ASSY. REEL SERVO PREAMP-B</b></p> <p>SCALE: 2/1</p> <p>CODE IDENT. NO.: 09150</p> <p>DWG. NO.: 3116174</p> <p>SHEET: 1 OF 1</p>	

3110144

CD 320

DC 320

REVISIONS				
ISSUE	DESCRIPTION	DESIGNED BY	DATE	APPROVAL
C	ECN 164-E	PROD	Moyle 1/16/5	ACD
D	ECN 4191		Moyle 1/16/5	
E	ECN 4415		Moyle 1/16/5	
F	ECN 4691		Moyle 1/16/5	
G	ECN 5008		Moyle 1/16/5	
H	ECN 7337		REISS 2-7-6	
J	ECN 7673		H/B/aro 4-29-67	
K	ECN 8976		H/B/aro 3-11-68	



REFERENCE DESIGNATIONS	
LAST USED	DELETED
IR32 & 2R32	
1Q10 & 2Q10	
1CR3 & 2CR3	
1C2 & 2C2	

- 6 PARTIAL REFERENCE DESIGNATIONS ARE SHOWN, PREFIX THE REFERENCE NUMBER WITH THE CKT NO. FOR COMPLETE DESIGNATION.
- ALL TRANSISTORS TO BE 014-505 (CD445).
  - ALL DIODES TO BE 013-599 (CD458).
  - ALL RESISTOR VALUES ARE IN OHMS ±5%, 1/4W.
  - ALL CAPACITOR VALUES ARE IN MICROFARADS.
  - FOR ASSEMBLY SEE TABLE I.
- NOTES: UNLESS OTHERWISE SPECIFIED.

- 9 INACTIVE, ASSY 3110143-10 REPLACED BY 3113160-10
- B. ASSY REF TO BE 3113161.
- 7 SEE TABLE I.

ASSEMBLY	TYPE	FUNCTION	IR17, 2R17, 1R25, 2R25	IR19, 2R19, 1R27, 2R27	IR23, 2R23, 1R31, 2R31	C1, C2	IC1, 2C1, IC2, 2C2	IR8, 2R8
3110143-10	RRA	75, 112, 5, 120 IPS	2.74K ±1%	2K	300Ω	15UF	100 PF ±10%	12K
3113160-10	RRA	ALL SPEEDS	5.36K ±1%	2K	±1%, 3W	±20%, 20V	500V	4.3K
3116101-10	RRA	75 IPS	3.32K ±1%	16K				12 K
3119528-01	RRA	75 IPS	6.81K ±1%	OPEN	10K	OPEN	.0033UF ±10%, 200V	12 K
3123113-01	RRA	ALL SPEEDS	5.36K ±1%	2K	300Ω ±1%, 3W	±20%, 20V	100 PF ±10%, 350V	4.3K

3119526	TM-9
3116101	TM-9
3110143	TM-11
3113160	TM-11

DO NOT SCALE DRAWING UNLESS OTHERWISE SPECIFIED TOLERANCES DECIMALS ANGLES BREAK ALL SHARP EDGES APPROX 250 RADIUS AND SPOTFACE CORNER ROUGHNESS OF ALL MACHINED SURFACES PER MIL-STD-189

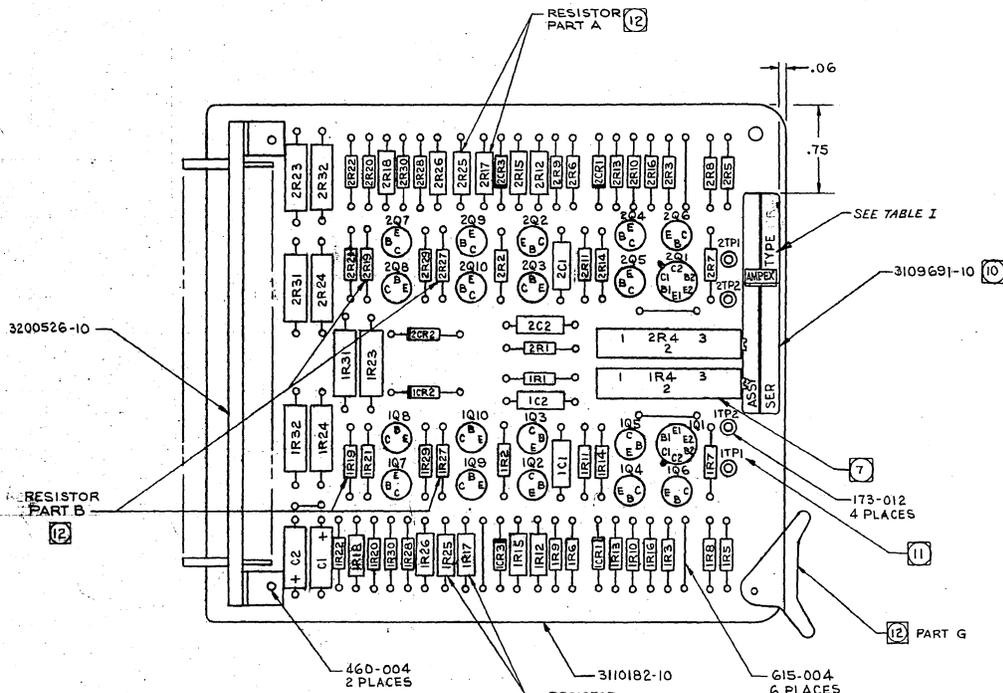
THE INFORMATION HEREON IS THE PROPERTY OF AMPEX COMPUTER PRODUCTS COMPANY, INC. AND IS LOANED TO YOU FOR YOUR INFORMATION USE ONLY. IT IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE WRITTEN PERMISSION OF AMPEX COMPUTER PRODUCTS CO.

AMPEX AMPEX COMPUTER PRODUCTS COMPANY		9
937 JEFFERSON BLVD. CULVER CITY, CALIFORNIA		
TITLE SCHEMATIC - REEL SERVO DRIVER		
CODE IDENT. NO.	SIZE	ISSUE
D	3110144	15
SCALE NONE		SHEET 1 OF 1

3113161

DC 311

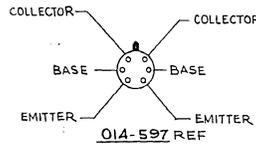
REVISIONS				
ISSUE	DESCRIPTION	DRAFTSMAN	DATE	APPROVAL
A	ECN 4191	M. Marks	1/1/65	gresh
B	ECN 4482	J. Conroy	8/14/65	gresh
C	ECN 4504	J. Conroy	9/29/65	gresh
D	ECN 4691	Shaw	11/16/65	DC
E	ECN 7113	Arnold	1/1/66	Whitman
F	ECN 7337	Shaw	7/6/67	Whitman
G	ECN 7673	H. Brown	7-23-67	Whitman
H	ECN 8976	H. Brown	3/1/68	Whitman



PART NO.	REFERENCE DESIGNATIONS	PART NO.	REFERENCE DESIGNATIONS
PART F	1R8, 2R8	3201104-10	1Q7, 2Q7, 1Q8, 2Q8, 1Q9, 2Q9, 1Q10, 2Q10, 1Q2, 2Q2, 1Q4, 2Q4, 1Q6, 2Q6
		013-599	1CR1, 2CR1, 1CR2, 2CR2, 1CR3, 2CR3
		014-505	1Q5, 2Q5, 1Q3, 2Q3
		014-597	1Q1, 2Q1
		PART E	1C1, 2C1, 1C2, 2C2
		PART D	1C1, 2C1
		041-427	1R10, 2R10
		041-440	1R13, 2R13
		041-443	1R30, 2R30, 1R22, 2R22
		041-482	1R1, 2R1
		041-483	1R9, 2R9, 1R16, 2R16
		041-515	1R7, 2R7, 1R2, 2R2
		041-560	1R11, 2R11, 1R14, 2R14, 1R21, 2R21, 1R29, 2R29
		041-570	1R28, 2R28, 1R20, 2R20
		041-750	1R3, 2R3, 1R5, 2R5, 1R6, 2R6
		041-434	1R12, 2R12, 1R15, 2R15
		042-491	1R18, 2R18, 1R26, 2R26
		PART C	1R23, 2R23, 1R31, 2R31
		044-476	1R4, 2R4
		047-407	1R24, 2R24, 1R32, 2R32
		PART A	1R25, 2R25, 1R17, 2R17
		PART B	1R19, 2R19, 1R27, 2R27

TABLE I

B/M REFERENCE TABLE									
ASSEMBLY	FUNCTION	TYPE	PART A	PART B	PART C	PART D	PART E	PART F	PART G
3110143-10	75, 112.5, 201PS	RRA	048-186	041-560	043-528	037-990	034-417	041-482	
3113160-10	ALL SPEEDS	RRA	048-181	041-560	043-528	037-990	034-417	041-584	
3116101-10	75 IPS	RRA	042-428	041-749	043-528	037-990	034-417	041-482	3111391-04
3119526-01	75 IPS (FT GRADE)	RRA	042-883	NOT USED	041-408	NOT USED	030-201	041-482	
3123913-01	ALL SPEEDS	RRB	048-181	041-560	043-528	037-990	034-417	041-584	3119570-37



INACTIVE, ASSY 3110143-10 IS REPLACED BY 3113160-10.

INSTALL PART A & PART G PER TABLE I.

MARK TEST POINT REF. NUMBER, .12 HIGH CHARACTERS, COLOR; WHITE PER MIL-STD-130. DO NOT IMPRESSION STAMP.

MARK PART NO. & NAMEPLATE INFORMATION PER MIL-STD-130.

PART NO. TO BE AS SHOWN ON BILL OF MATERIAL.

SEAL PRINTED CIRCUIT SIDE ONLY WITH HUMISEAL TYPE 1B15 COLUMBIA TECH. OR EQUIV.

TRIMPTS NOT TO BE SUBMERGED IN WATER.

PLUS SIGN ON CAPACITOR INDICATES POSITIVE.

HEAVY LINE ON DIODE INDICATES CATHODE.

COMPONENT DESIGNATIONS ARE FOR REFERENCE ONLY.

ASSEMBLE PER PRODUCTION PRACTICES MANUAL.

FOR ASSY SPECIFICATION SEE 3110145.

FOR SCHEMATIC SEE 3110144.

NOTES:

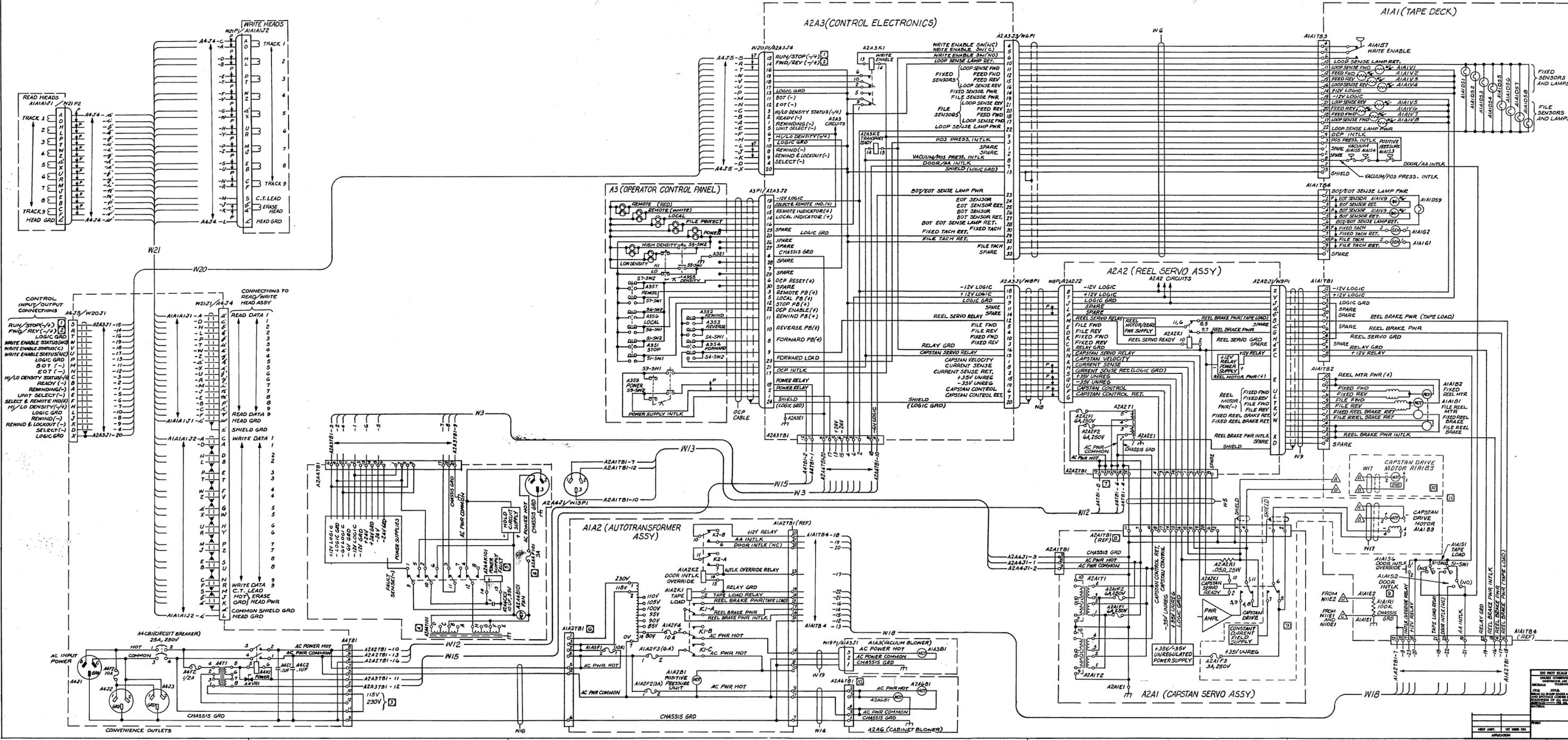
280-139 280-052

TYPICAL TRANSISTOR INSTALLATION

REFERENCE

3116101	TM-9
3113160	TM-11
3110143	TM-11
TEXT AS SHOWN	131 USED ON APPLICATION

DO NOT SCALE DRAWING		UNLESS OTHERWISE SPECIFIED TOLERANCES:		ANGLES		FINISH		MATERIAL		PER MIL-STD-130	
BY - 23 344	BREAK ALL SHARP EDGES APPROX. .015 RADIUS	DRILL AND SPOTFACE CORNER	FINISH	MATERIAL	PER MIL-STD-130	THE INFORMATION HEREON IS THE PROPERTY OF AMPLEX COMPUTER PRODUCTS COMPANY AND IS TO BE KEPT CONFIDENTIAL AND NOT TO BE REPRODUCED OR DISCLOSED TO ANY OTHER COMPANY WITHOUT THE WRITTEN CONSENT OF AMPLEX COMPUTER PRODUCTS COMPANY		AMPLEX COMPUTER PRODUCTS COMPANY		9137 JEFFERSON BLVD. CULVER CITY, CALIFORNIA	
DATE	DESIGNED BY	DRAWN BY	CHECKED BY	APPROVED BY	DATE	TITLE	CODE IDENT. NO.	SIZE	DWG. NO.	ISSUE	
						CIRCUIT BOARD ASSY - REEL SERVO DRIVER	D		3113161	H	
SCALE 2:1							SHEET 1 OF 1				



- 11 MOTOR WITH FIELD SUPPLY USED ON TM-12. MOTOR WITHOUT FIELD SUPPLY USED ON TM-11.
- 10 CONNECTIONS BETWEEN TERMINALS 2 AND 3 AND TERMINALS 4 AND 5 OF TERMINAL BOARD A2A1B1 ARE USED FOR 115-VOLT OPERATION. TERMINAL 3 IS CONNECTED TO TERMINAL 4 FOR 230-VOLT OPERATION.
- 9 DOOR-INTERLOCK SWITCH A1A1S2 SHOWN IN THE DOOR-CLOSED POSITION.
- 8 CONNECTIONS BETWEEN TERMINALS 7 AND 8 AND TERMINALS 9 AND 10 OF TERMINAL BOARD A2A1B1 ARE USED FOR 115-VOLT OPERATION. TERMINAL 8 IS CONNECTED TO TERMINAL 9 FOR 230-VOLT OPERATION.
- 7 CONNECTIONS BETWEEN TERMINALS 10 AND 11 AND TERMINALS 12 AND 13 OF TERMINAL BOARD A2A1B1 ARE USED FOR 115-VOLT OPERATION. TERMINAL 11 IS CONNECTED TO TERMINAL 12 FOR 230-VOLT OPERATION.
- 6 CONNECTIONS BETWEEN TERMINALS 4 AND 5 AND TERMINALS 2 AND 3 OF TERMINAL BOARD A2A1B1 ARE USED FOR 115-VOLT OPERATION. TERMINAL 1 IS CONNECTED TO TERMINAL 2 AND TERMINAL 3 IS CONNECTED TO TERMINAL 4 FOR 230-VOLT OPERATION.
- 5 RELAY A2A4K101 IS NORMALLY DEENERGIZED AND THE HOLD CIRCUIT SUPPLY IS SHORTED OUT. WHEN A POWER SUPPLY FAULT IS SENSED, THE FAULT SENSE LINE GOES NEGATIVE AND CHARGES CAPACITOR A2A4K103. RELAY A2A4K101 IS ENERGIZED BY THE VOLTAGE ACROSS THE CAPACITOR AND THEY HOLD ENERGIZED BY THE HOLD CIRCUIT SUPPLY. THE RELAY REMAINS ENERGIZED UNTIL THE AC INPUT POWER IS REMOVED FROM THE ASSEMBLY.
- 4 CONNECTIONS TO TRANSFORMER A2A4T101 AND RATING OF FUSE A2A4F101 ARE FOR 115-VOLT OPERATION. SEE DWG. NO. 310952 FOR CONNECTIONS AND FUSE RATING USED FOR OPERATION AT OTHER VOLTAGES.
- 3 CONNECTION BETWEEN TERMINALS 10 AND 11 OF TERMINAL BOARD A4T1 IS USED FOR 115-VOLT OPERATION. TERMINAL 11 IS CONNECTED TO TERMINAL 12 FOR 230-VOLT OPERATION.
- 2 FWD/REV WHEN RUN/STOP LOGIC IS USED. REV/STOP WHEN FORWARD/STOP LOGIC IS USED.
- 1 RUN/STOP WHEN RUN/STOP LOGIC IS USED. FWD/STOP WHEN FORWARD/STOP LOGIC IS USED.

DO NOT REAR DRIVING UNLESS OTHERWISE SPECIFIED. SIGNALS SHOWN AS NEGATIVE UNLESS OTHERWISE SPECIFIED. ALL WIRING SHALL BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND ALL APPLICABLE REGULATIONS.

DATE: 1/6/68

SCALE: 1:1

REV: 1

APP: J

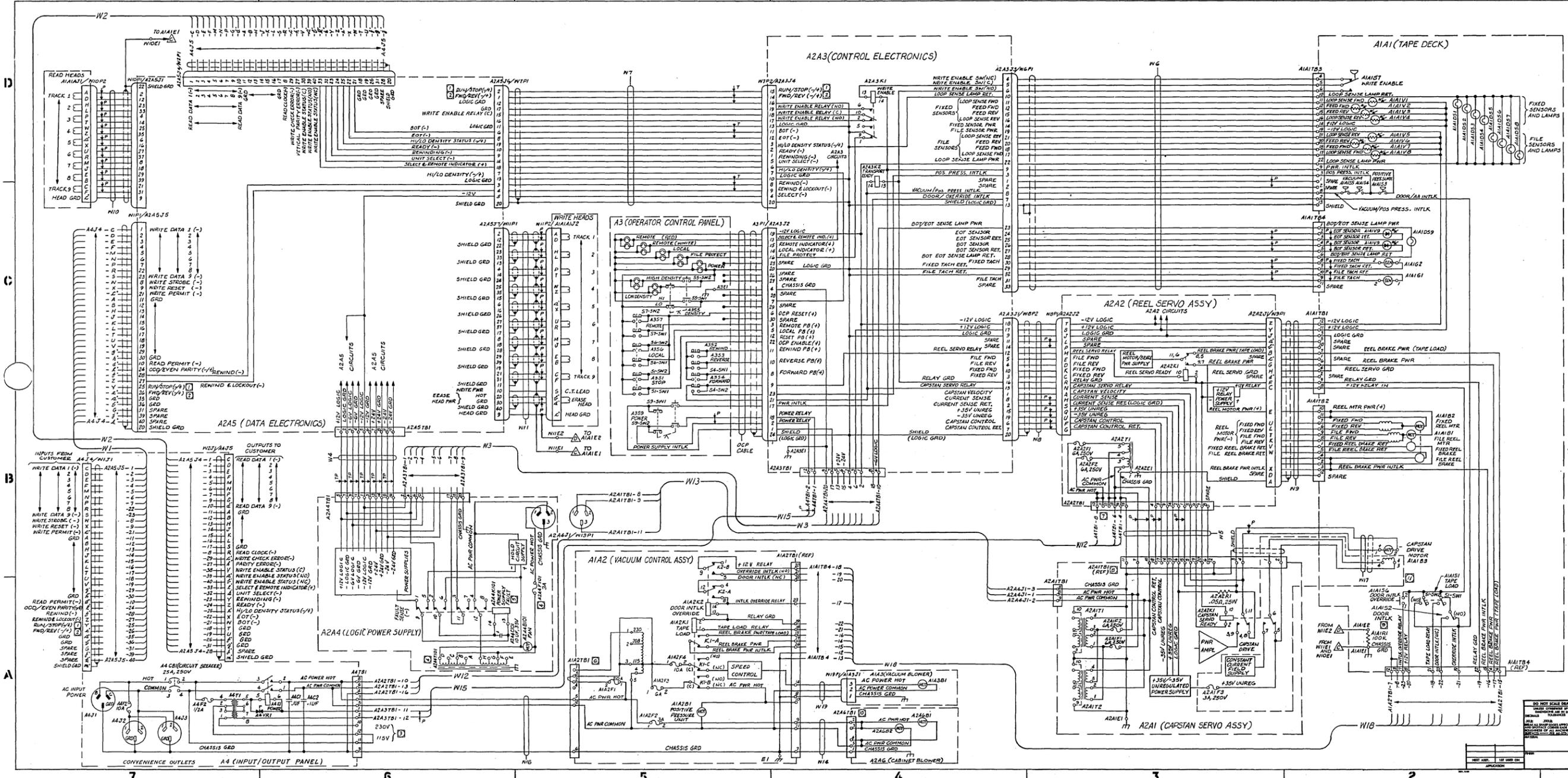
AMPEX COMMUNICATIONS DIVISION  
SCHAUMBURG, ILL. 60196

SCHEMATIC DIAGRAM -  
TM-11, TM-12

FILE NO: 3110023

REV: 1 OF 1

REVISIONS	
NO.	DESCRIPTION
1	REVISED TO ACCORD WITH REVISED SPECIFICATIONS
2	REVISED TO ACCORD WITH REVISED SPECIFICATIONS
3	REVISED TO ACCORD WITH REVISED SPECIFICATIONS
4	REVISED TO ACCORD WITH REVISED SPECIFICATIONS
5	REVISED TO ACCORD WITH REVISED SPECIFICATIONS
6	REVISED TO ACCORD WITH REVISED SPECIFICATIONS
7	REVISED TO ACCORD WITH REVISED SPECIFICATIONS
8	REVISED TO ACCORD WITH REVISED SPECIFICATIONS



- 11 FIELD CIRCUITRY USED WITH ELECTROMAGNETIC-FIELD MOTOR ONLY.
- 10 CONNECTIONS BETWEEN TERMINALS 2 AND 3 AND TERMINALS 4 AND 5 OF TERMINAL BOARD AZ41B1 ARE USED FOR 115-VOLT OPERATION. TERMINAL 3 IS CONNECTED TO TERMINAL 4 FOR 230-VOLT OPERATION.
- 9 DOOR-INTERLOCK SWITCH AZ41E SHOWN IN THE DOOR-CLOSED POSITION.
- 8 CONNECTIONS BETWEEN TERMINALS 7 AND 8 AND TERMINALS 9 AND 10 OF TERMINAL BOARD AZ41B1 ARE USED FOR 115-VOLT OPERATION. TERMINAL 9 IS CONNECTED TO TERMINAL 10 FOR 230-VOLT OPERATION.
- 7 CONNECTIONS BETWEEN TERMINALS 10 AND 11 AND TERMINALS 12 AND 13 OF TERMINAL BOARD AZ41B1 ARE USED FOR 115-VOLT OPERATION. TERMINAL 11 IS CONNECTED TO TERMINAL 12 FOR 230-VOLT OPERATION.
- 6 CONNECTIONS BETWEEN TERMINALS 2 AND 3 AND TERMINALS 4 AND 5 OF TERMINAL BOARD AZ41B1 ARE USED FOR 115-VOLT OPERATION. TERMINAL 3 IS CONNECTED TO TERMINAL 4 FOR 230-VOLT OPERATION.
- 5 RELAY AZ41K1 IS NORMALLY DEENERGIZED AND THE HOLD CIRCUIT SUPPLY IS SHORTED OUT. WHEN A POWER SUPPLY FAULT IS DETECTED, THE FAULT SENSE LINE GOES NEGATIVE AND CHARGES CAPACITOR AZ41M1; RELAY AZ41K1 IS ENERGIZED BY THE "PLUG" ACROSS THE CAPACITOR AND IS HELD ENERGIZED BY THE HOLD CIRCUIT SUPPLY. THE RELAY REMAINS ENERGIZED UNTIL THE AC INPUT POWER IS REMOVED FROM THE ASSEMBLY.
- 4 CONNECTIONS TO TRANSFORMER AZ41M1 AND RATINGS OF FUSE AZ41M1 ARE FOR 115-VOLT OPERATION. SEE DWG. NO. 311242 FOR CONNECTIONS AND FUSE RATING USED FOR OPERATION AT OTHER VOLTAGES.
- 3 CONNECTION BETWEEN TERMINALS 11 AND 12 OF TERMINAL BOARD AZ41B1 IS USED FOR 115-VOLT OPERATION. TERMINAL 10 IS CONNECTED TO TERMINAL 11 FOR 230-VOLT OPERATION.
- 2 FWD/REV WHEN RUN/STOP LOGIC IS USED. REV/STOP WHEN FORWARD/STOP LOGIC IS USED.
- 1 RUN/STOP WHEN RUN/STOP LOGIC IS USED. FWD/STOP WHEN FORWARD/STOP LOGIC IS USED.

DO NOT SCALE DRAWING

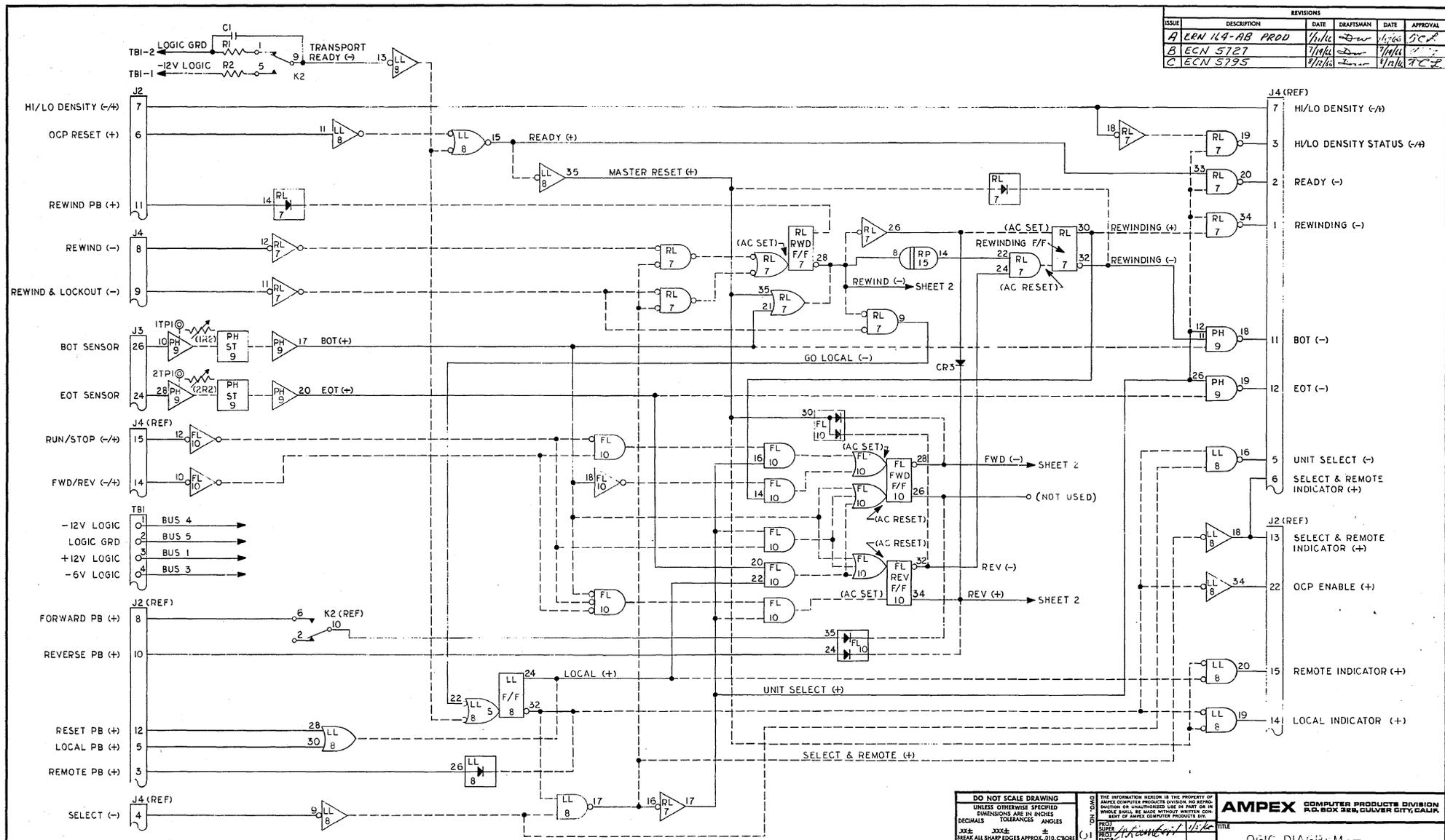
AMPEX COMPUTER PRODUCTS DIVISION  
SCHAUMBURG, ILLINOIS

**SCHEMATIC DIAGRAM - TM-11211/1211**

J 09150 3115575

REV. 10/68

REVISIONS					
ISSUE	DESCRIPTION	DATE	DRAFTSMAN	DATE	APPROVAL
A	ERN 149-AB PROD	1/14/64	...	1/16/64	JCP
B	ECN 5721	1/14/64	...	1/14/64	...
C	ECN 5795	1/16/64	...	1/16/64	...



**DO NOT SCALE DRAWING**  
 UNLESS OTHERWISE SPECIFIED  
 DIMENSIONS ARE IN INCHES  
 TOLERANCES ANGLES  
 DECIMALS  
 FRACTIONS  
 3X5 ± .006  
 BREAK ALL SHARP EDGES APPROX. .010 CORNERS  
 AND SPOTFACE CORNER RADIUS APPROX. .010  
 FINISHES OF ALL MACHINED SURFACES  
 MATERIAL

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 OR UNAUTHORIZED USE IN PART OR IN WHOLE  
 SHALL BE MADE WITHOUT WRITTEN CONSENT  
 OF AMPEX COMPUTER PRODUCTS DIV.  
 DATE: 1/16/64  
 DRAWN: JFC/mro  
 CHECKED: JFC/mro  
 DATE: 8 Dec 65

**AMPEX** COMPUTER PRODUCTS DIVISION  
 P.O. BOX 3984 CHAMBERLAIN CITY, CALIF.

LOGIC DIAGRAM -  
 CONTROL ELECTRONICS  
 FWD/REV - RUN/STOP

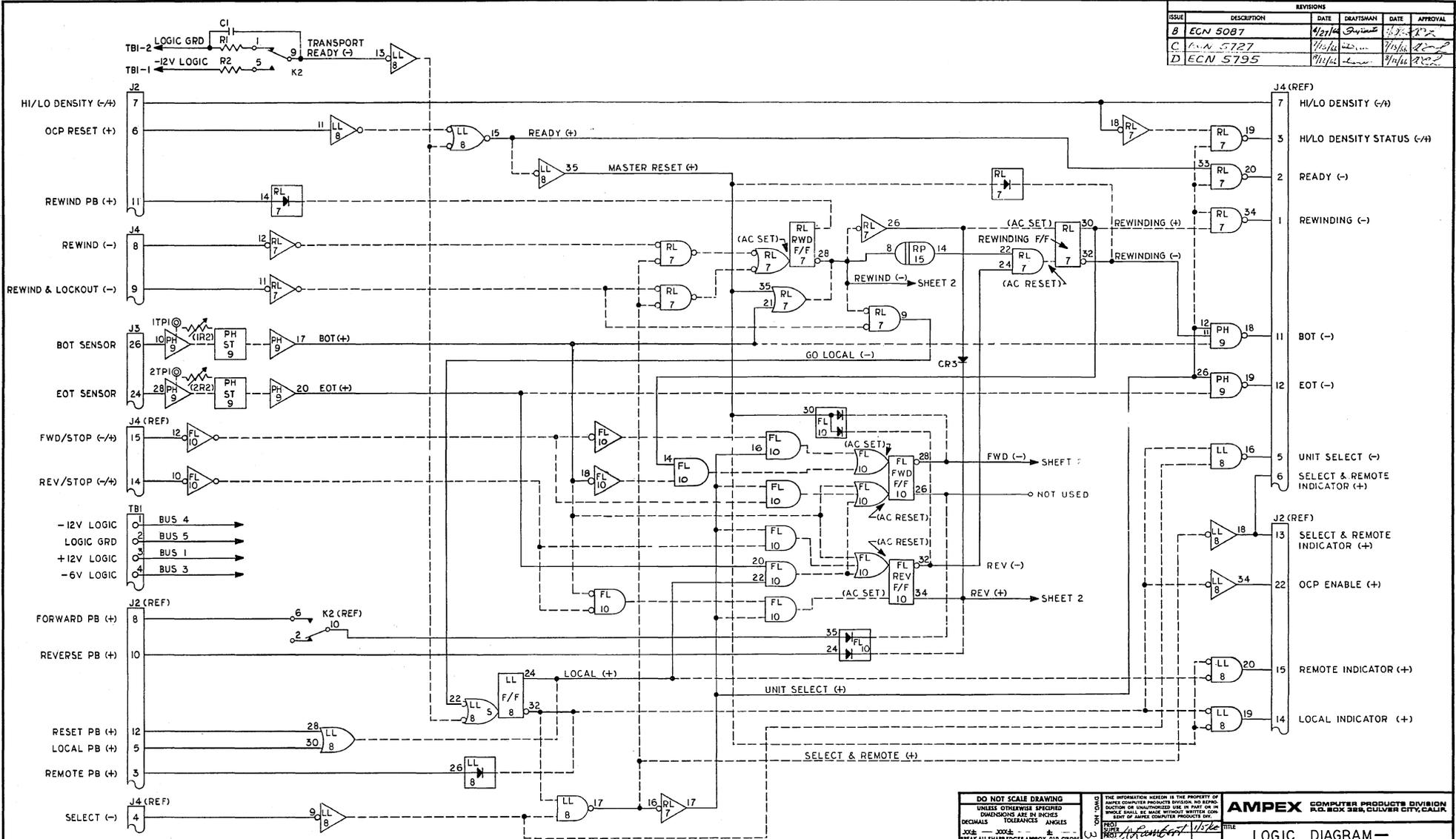
3110102	TM-11	FINISH
NEXT ASSY.	1ST USED ON	
APPLICATION		

3110107

SIZE	CODE IDENT. NO.	DWG. NO.
D	09150	3110107
SCALE		SHEET 1 OF 2



REVISIONS					
ISSUE	DESCRIPTION	DATE	DRAFTSMAN	DATE	APPROVAL
B	ECN 5087	4/22/64	Shaw	4/22/64	[Signature]
C	ECN 5727	7/15/64	[Signature]	7/15/64	[Signature]
D	ECN 5795	7/15/64	[Signature]	7/15/64	[Signature]



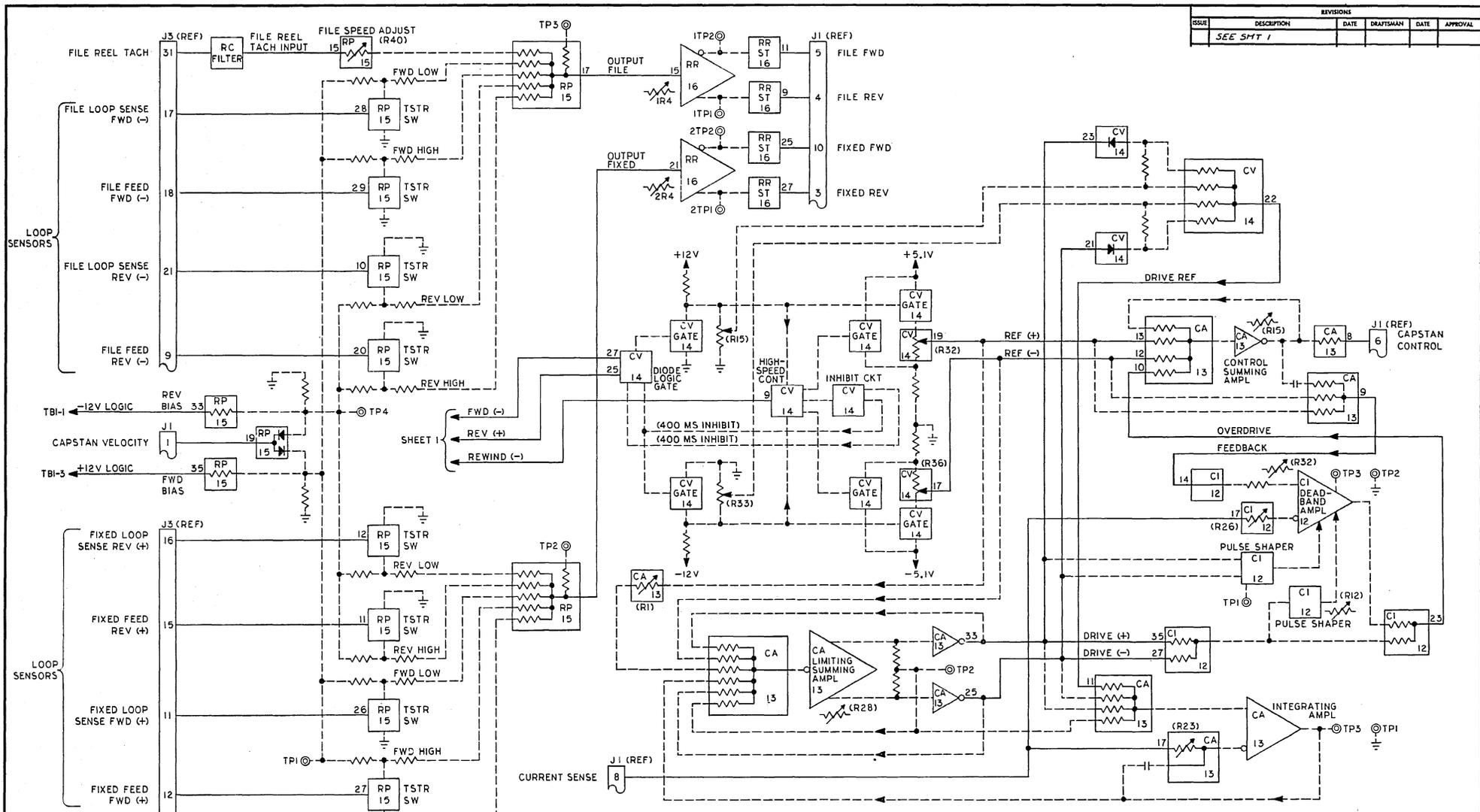
FINAL B/M	TW-118-12	FINISH
NEXT ASSY.	1ST USED ON	
APPLICATION		

DO NOT SCALE DRAWING  
UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
DECIMALS TOLERANCES ANGLES  
BREAK ALL SHARP EDGES APPROX. .010 CORNERS  
AND SPACED CORNERS RADIUS APPROX. .010  
ROUGHNESS OF ALL MACHINED SURFACES  
MATERIAL

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DATE: 11/15/72  
BY: [Signature]  
TITLE: LOGIC DIAGRAM - CONTROL ELECTRONICS FWD/STOP-REV/STOP  
DTSMAN: [Signature]

<b>AMPEX</b> COMPUTER PRODUCTS DIVISION P.O. BOX 388, CULVER CITY, CALIF.	
TITLE: LOGIC DIAGRAM - CONTROL ELECTRONICS FWD/STOP-REV/STOP	
SIZE: <b>D</b>	CODE IDENT. NO.: 09150
SCALE: 1:1	DWG. NO.: 3115572
SHEET 1 OF 2	

REVISIONS				
ISSUE	DESCRIPTION	DATE	DRAFTSMAN	APPROVAL
SEE SHT 1				



**DO NOT SCALE DRAWING**  
UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
DECIMALS TOLERANCES ANGLES

XXX ± .0004 ± .0008  
BREAK ALL SHARP EDGES APPROX .010 FROM  
AND SPOTFACE CORNERS RADIUS APPROX .010  
ROUNDEDNESS OF ALL MACHINED  
SURFACES PER MIL-STD-113  
MATERIAL

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AMPEX COMPUTER PRODUCTS DIV.

**AMPEX** COMPUTER PRODUCTS DIVISION  
P.O. BOX 988, CULVER CITY, CALIF.

LOGIC DIAGRAM —  
CONTROL ELECTRONICS  
FWD/STOP REV/STOP

DATE: 4/26/66  
DRAFTSMAN: JH:tdo  
CHECKER: [blank]  
ENGINEER: [blank]  
DESIGNER: [blank]  
SUPERVISOR: [blank]  
PROJECT: [blank]

SCALE: [blank]  
CODE IDENT. NO.: [blank]  
DWG. NO.: 3115572  
SHEET 2 OF 2

SEE SHT 1	FRONT
NEXT ASSY.	1ST USED ON
APPLICATION	