SYSTRON DONNER
Member THORN EMI Group

M107

INSTRUMENT DIVISION

PRECISION DC VOLTAGE SOURCE
DOCUMENT NO. 120017-01

OPERATING AND SERVICE MANUAL

SYSTRON DONNER

A THORN EMI company

M107

SYSTRON DONNER

SYSTRON DONNER
INSTRUMENT DIVISION
2727 Systron Drive
Concord, California 94518
WARRANTY POLICY

INSTRUMENT DIVISION

I Warranty

Systron Donner Instrument Division warrants that at the time of shipment the products manufactured by Systron Donner and sold hereunder will be free from defects in material and workmanship and will conform to the current specifications published by Systron Donner's Instrument Division.

II Warranty

A   The warranty period will be one year from the date of shipment. This warranty is extended only to the original buyer.

III Warranty Adjustments

A. If any defect within this warranty appears, Purchaser shall notify Seller immediately.

B   Systron Donner agrees to repair or furnish a replacement for, but not install, any product which within the standard warranty shall, upon test and examination by Systron Donner, prove defective within the above warranty period.

C   No product will be accepted for return or replacement without prior approval of Systron Donner. Upon such authorization and in accordance with instructions of Systron Donner, the product will be returned to the manufacturing location, shipping charges prepaid by Purchaser.

IV Exclusions from Warranty

A   The foregoing warranty is in lieu of and excludes all other expressed or implied warranties of merchantability or fitness or otherwise.

B   Systron Donner will not be liable for any special or consequential damages or for loss, damages or expense directly or indirectly arising from the use of the products, or any inability to use them either separately or in combination with any other equipment or material, or from any other cause.

C   The warranty does not extend to any product manufactured by Systron Donner which has been subjected to misuse, neglect, accident, improper installation or to use in violation of instructions furnished by Systron Donner.

D   The warranty does not extend to or apply to any unit which has been repaired or altered at any place other than Systron Donner; by persons not expressly approved by Systron Donner; not to any unit, the serial number of which has been removed or defaced or Changed.

E   This warranty applies to new equipment only and will cover repaired or replacement items only to the extent of the balance remaining of the items original warranty period noted in Paragraph ll.

F   All freight charges will be paid for by the Purchaser.

June, 1985

PROPRIETARY RIGHTS STATEMENT

1.1 INTRODUCTION

The Systron-Donner Model M107 Precision D.C. Voltage Source is an IEEE-488 compatible, ruggedly constructed, stable D.C. voltage source. Maximum ease of operation is combined with accurate performance.

Third-generation improvements in operation and reliability are evidenced through the Model M107. Voltage, range and polarity are easily programmed manually from the front panel, or remotely from the IEEE-488 1975 Interface, standard with the Model M107. Parallel BCD programming is optional in lieu of IEEE-488.

The Model M107 is human engineered with the user in mind. For example, if the 1000V range is selected, the polarity goes to standby automatically to prevent any damage to equipment during programming. For ease in troubleshooting and maintanance, modular construction is used.

D.C. voltage is conveniently selectable by any single digit or in sequence and is displayed on a six-digit LED readout. Accuracy to ±0.002% is true throughout each range of 1, 10, 100 and 1000 volts.

1.2 SPECIFICATIONS

Table 1-1 lists the specifications applicable to the Model M107.

TABLE 1-1   SPECIFICATIONS

Output Ranges:	1V	10V	100V	1000V
Maximum Output Voltage:	0.999999	9.99999	99.9999	999.9999
Increments:	1 μV	10 μV	100 μV	1 mV

TABLE 1-1   SPECIFICATIONS (Cont'd)

Maximum Output Current:	*	50 mA	50 mA	50 mA to 120V 5 mA to 1000V
Output Resistance:	200Ω	.0002Ω	.002Ω	.02Ω to 120V .2Ω to 1000V
Noise (microvolts RMS max.)				
<150 Hz	+15 -25	20	50	200
Wideband	+25 -40	100	150	500
Common Mode Rejection (dB)				
DC	160 160	150	130	110
AC	100 70	70	60	50

Accuracy:	3 months ±0.002% of range after warm-up and stabilization at 23°C, <70% R.H. constant line and load.
Current Limit:	Continuously variable from 0 to maximum output with limit indicator lamp.
Temperature Coefficient of Output:	0.0002% of set ting, +0.0001% of range per °C, between 0°C and 50°C (32°F and 122°F).
Line Regulation:	0.0001% of range, or 10 mV 10 μV, for 10% change from nominal.
Load Regulattion:	0.0001% of range, or 10 μV for change from no load to full load.
Isolation:	The DC output can be floated up to 500 Vdc from the chassis ground.
Settling Time (mSec)	<300 <300 <400 <500 <300

*limited by 200Ω impedance.

TABLE 1-1 SPECIFICATIONS (Cont'd)

Warm-up Time:	1 hour to full specifications; 20 minutes with some degradation.
Operating Temperature:	0° to +50°C (122°F).
Relative Humidity:	To 70%.
Input Power:	115/230 Vac ±10% std; 100/200 Vac ±10% optional; 48-440 Hz, 35W 1/2 or 1/4 amp Slo-Blo fuse.
Weight:	26 lbs.
Size:	5-1/4"(H) x 19"(W) Full Rack x 17"(D).

1.3 OPTIONS

Table 1-2 lists the options available for the Model M107.

TABLE 1-2 OPTIONS

OPTION	DESCRIPTION
01, Parallel Interface:	Provides for remote control inputs to establish 6-digit output setting range and polarity.
06, 100/200 Vac:	Provides for operation on 100/200V ±10% ac line power.
07, Local Control:	Local Control only in lieu of IEEE-488

SYSTRON DONNER CORPORATION

ADDENDUM
MODEL M107

This addendum involves the options that are available for the Model M107. Refer to Table 1-2 Options on page 1-2. The updated options table below reflects the latest changes. Please note that old option number 06 is now 03; and a new option 06 added.

TABLE 1-2. OPTIONS

OPTION	DESCRIPTION
01, Parallel Interface:	Provides for remote control inputs to establish 6-digit output setting range and polarity.
03 100/200 Vac:	Provides for operation on 100/200V ±10% ac line power.
06, 100 mA Output:	Provides 100 mA maximum current output on 10V and 100V ranges.
07, Local Control:	Local Control only in lieu of IEEE-488.

CHAPTER 2

INSTALLATION

2-1. INTRODUCTION

2-2. The Model M107 Precision D.C. Voltage Source is shipped in an operational condition, and is essentially ready for use as received. This section contains unpacking, inspection, and installation information to aid in setting up the instrument. Instructions for reshipment are also included should the unit require return to Systron-Donner Corporation.

2-3. RECEIVING INSPECTION

2-4. As soon as the instrument is received, check the carton for evidence of damage or rough handling. If damage is found, or is suspected, notify the carrier and your Systron-Donner representative. Open the shipping container only in their presence. DO NOT USE THE INSTRUMENT UNTIL INSTRUCTED TO DO SO BY THE REPRESENTATIVE.

2-5. Use care in removing the instrument from the container. Check immediately for loose or broken control knobs, bent or broken connectors, and dents or scratches on the panel surfaces. If damage of any nature is found, refer to the warranty instructions in the front of this instruction manual.

2-6. All Systron-Donner instruments must pass rigid inspection tests before leaving the plant. However, upon receipt, a receiving inspection test should be performed immediately after unpacking to ensure that the instrument is still operational. (Refer to Chapter 3.)

2-7. INSTALLATION

2-8. Power

2-9. The Model M107 is provided with a 3-conductor power cord which grounds the case when connected through a compatible grounding outlet. If a standard ground outlet is not available, a 3-conductor adapter must be used which provides the necessary grounding. Make sure the rear panel 115/230 V switch is in the correct position before connecting the instrument to a power source. Also be certain that the proper fuse is installed (1/2 A 3AG). For 230 V operation, the fuse supplied with the unit should be replaced with a 1/4 A 3AG fuse to adequately protect the instrument.

2-10. IEEE-488 Interface

2-11. IEEE-488 interface connection is made to the rear panel connector as shown in Figure 2-1. Table 2-1 defines the input/output pin configuration, and Table 2-2 provides program format data.

TABLE 2-1.   IEEE DATA INTERCHANGE CONNECTOR

PIN	FUNCTION	PIN	FUNCTION
1	DIO1	13	DIO5
2	DIO2	14	DIO6
3	DIO3	15	DIO7
4	DIO4	16	DIO8
5	EOI	17	REN
6	DAV	18	Gnd DAV return
7	NRFD	19	Gnd NRFD return
8	NDAC	20	Gnd NDAC return
9	IFC	21	Gnd IFC
10	SRQ	22	Gnd SRQ return
11	ATN	23	Gnd ATN return
12	SHIELD (gnd)	24	Gnd Logic return

Notes:

1. DIO = Data Input/Output
2. EOI = End or Identify
3. DAV = Data Valid
4. NRFD = Not Ready For Data
5. NDAC = Not Data Accepted
6. IFC = Interface Clear
7. SRQ = Service Request
8. ATN = Attention
9. REN = Remote Enable
10. Ground refers to the signal ground return of the Referenced contact.
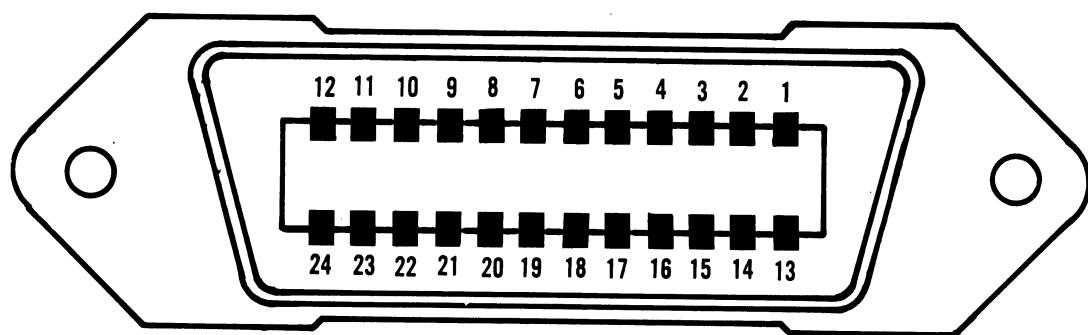
FIGURE 2-1.   IEEE-488 INTERFACE CONNECTOR

2-12. Parallel Interface Option 01

This option allows the Model M107 to accept remote control inputs in parallel
bcd format, single character serial format or group character serial format.
Table 2-3 defines the pin descriptions for the connector. Figure 2-2 shows the
Parallel Interface Connector. Mating connector is amphenol type 57-30500.

TABLE 2-2. PROGRAM FORMAT IEEE DATA INTERCHANGE

D107	D106	D105	CODE D104	D103	D102	D101	ASCII CHAR	FUNCTION	GROUP
1	0	0	0	0	0	1	A	10^5	
1	0	0	0	0	1	0	B	10^4	
1	0	0	0	0	1	1	C	10^3	Voltage
1	0	0	0	1	0	0	D	10^2	Entry
1	0	0	0	1	0	1	E	10^1	
1	0	0	0	1	1	0	F	10^0	
1	0	1	0	0	0	0	P	Polarity	
1	0	1	0	0	1	0	R	Range	
1	0	1	0	0	1	1	S	Strobe	

TABLE 2-3. PARALLEL INTERFACE CONNECTIONS

PIN	FUNCTION	PIN	FUNCTION
1	10^0 1 bit	21	Not Used
2	10^0 2 bit	22	Range & Pol Strobe
3	10^1 1 bit	23	Not Used
4	10^1 2 bit	24	Remote
5	10^2 1 bit	25	HI Reference
6	10^2 2 bit	26	10^0 4 bit
7	10^3 1 bit	27	10^0 8 bit
8	10^3 2 bit	28	10^1 4 bit
9	10^4 1 bit	29	10^1 8 bit
10	10^4 2 bit	30	10^2 4 bit
11	10^5 1 bit	31	10^2 8 bit
12	10^5 2 bit	32	10^3 4 bit
13	Not Used	33	10^3 8 bit
14	Not Used	34	10^4 4 bit
15	10^0 – Strobe In	35	10^4 8 bit
16	10^1 – Strobe In	36	10^5 4 bit
17	10^2 – Strobe In	37	10^5 8 bit
18	10^3 – Strobe In	38	Not Used
19	10^4 – Strobe In	39	Current Limit Out
20	10^5 – Strobe In	40	Not Used

TABLE 2-3. PARALLEL INTERFACE CONNECTIONS (CONT'D)

PIN	FUNCTION	PIN	FUNCTION
41	1 V Range	46	− Polarity
42	10 V Range	47	+ Polarity
43	100 V Range	48	Standby
44	1000 V Range	49	Remote
45	Not Used	50	Ground

2-13. STORAGE AND RESHIPMENT

Environmental conditions during storage and shipment should be limited to a maximum temperature of 85°C and a minimum temperature of −20°C.

To protect the instrument during shipment or storage, use the best packaging methods available. Contract packing companies are also available to provide dependable custom-packaging service on short notice.
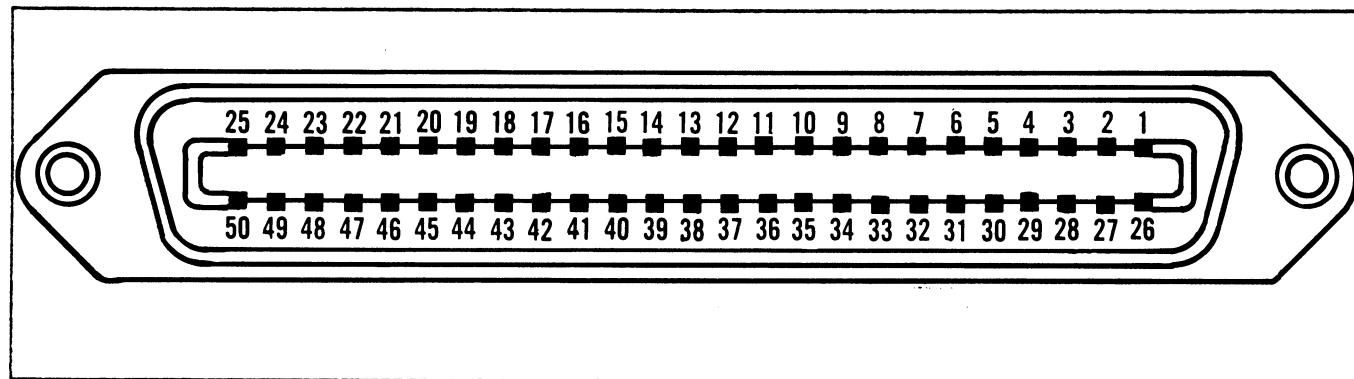

FIGURE 2-2. PARALLEL INTERFACE CONNECTOR

1. If possible, use the original shipping container designed for the instrument. Otherwise, a strong carton (350 lb. f/in^2 bursting strength) or box.

2. Wrap the instrument in heavy paper or plastic before placing it in the shipping container.

3. Completely fill the area around the instrument with packing material; protect the front panel with several sheets of cardboard.

4. Seal the package with strong tape or metal bands. Mark FRAGILE-DELICATE INSTRUMENT on the outside of the package.

5. Refer to the warranty in this manual and check with the nearest Systron-Donner field office for shipping instructions. In all correspondence, refer to the instrument by full model and serial number.

CHAPTER 3

OPERATION

3-1. INTRODUCTION

3-2. This chapter contains a description of the front and rear panel controls,
connectors and indicators along with a step-by-step operating procedure.

3-3. FRONT PANEL FUNCTIONS

3-4. The following table describes the controls, connectors, and indicators on
the front panel of the instrument. The index numbers refer to Figure 3-1.

TABLE 3-1. FRONT PANEL FUNCTIONS

| INDEX	NAME	DESCRIPTION
1	ADDRESS 5 4 3 2 1	Displays 5 bit IEEE Bus address. An illuminated LED indicates a one, an unlit LED indicates a zero.
2	REMOTE	LED indicator illuminates when the instrument is in remote control mode.
3	Digit Display	Displays the programmed output voltage. Decimal point corresponds to the VOLTAGE RANGE selected.
4	VOLTAGE ENTRY	Ten momentary pushbutton switches numbered zero through nine. Sets desired voltage when pressed.
5	CURRENT LIMIT Indicator	LED indicator illuminates when output equals the setting of the Current Limit Control.
6	CURRENT LIMIT Control	Rotary knob controlling a potentiometer, sets output current limit.
7	SENSE HI LO	Red and black binding posts, can be tied directly to the OUTPUT terminals for local sensing or wired for remote sensing.
8	OUTPUT HI LO	Red and black binding posts to the right of the SENSE binding posts provide output of selected voltage. The red OUTPUT binding post is always the same polarity as the output polarity selected.
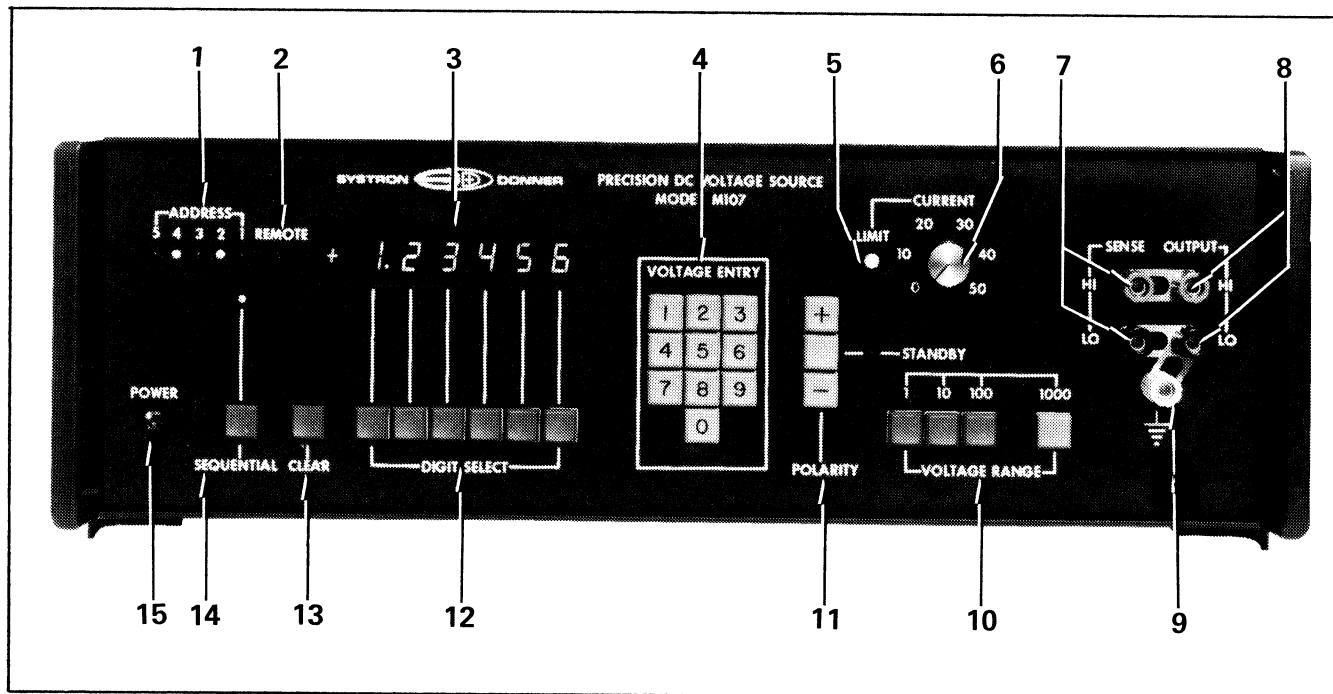
FIGURE 3-1.   MODEL M107 FRONT PANEL
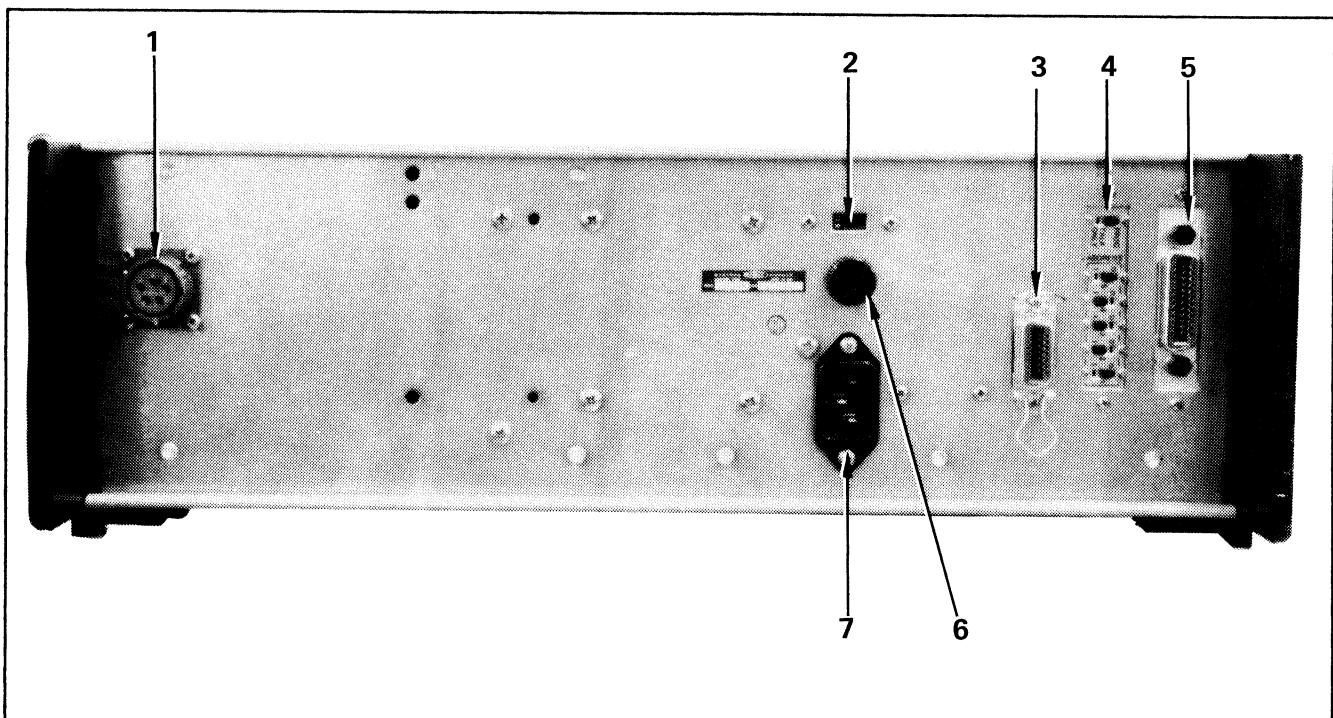
FIGURE 3-2.   MODEL M107 REAR PANEL

TABLE 3-1. FRONT PANEL FUNCTIONS (CONT'D)

INDEX	NAME	DESCRIPTION
9	Ground	The white binding post is the chassis ground.

10	VOLTAGE RANGE	Momentary-Action pushbuttons, when pressed, select the dc output range as follows:
		
		Range Max DC Output
		   1 0.999999
		  10 9.99999
		 100 99.9999
		1000 999.999

11	POLARITY, STANDBY	Pushbutton switches, when pressed, select the polarity of the output voltage, (+) positive or (-) negative. The STANDBY switch opens the power supply and applies a short across the OUTPUT terminals.
12	DIGIT SELECT	Six momentary pushbutton switches, when pressed, enable one digit to be changed without disturbing other digits. From left to right the switches control the decades in descending order: 10^5, 10^4, 10^3, 10^2, 10^1, 10^0. The digit about to be entered will begin to blink.
13	CLEAR	Momentary pushbutton switch, when pressed, clears the display and returns the output voltage to zero. If the Model M107 is in SEQUENTIAL mode, the CLEAR pushbutton will reset the sequencer.
14	SEQUENTIAL	Momentary pushbutton switch, when pressed enables the memory decades to sequentially accept the 6-digit input corresponding to the desired voltage output. The most significant digit is entered first, followed by the other figures in descending order of significance. The digit about to be entered will begin to blink.
15	POWER	Toggle switch, applies primary power to the instrument.

3-5. REAR PANEL FUNCTIONS

3-6. Table 3-2, Rear Panel Functions, describes the controls and connectors on the rear panel of the Model M107. The index numbers refer to Figure 3-2.

TABLE 3-2. REAR PANEL FUNCTIONS

INDEX	NAME	DESCRIPTION
1	OUTPUT	Five terminal jack provides rear panel connections for OUTPUT, SENSE and GROUND terminals. Wired in parallel with front panel binding posts.
2	LINE	Slide switch internally connects the power transformer to operate with either 100/115 Vac or 200/230 Vac input.
3	AUX OUTPUT	14-pin connector provides external output of current limit indicator. Pin 14 is ground, Pin 7 is current limit signal.
4	REMOTE PROGRAM (IEEE Address)	5 slide switches allow selection of IEEE-488 listen address.
5	REMOTE PROGRAM (IEEE Connector) or Parallel Interface Option 01	24-pin connector per IEEE-488 GPIB. 50-pin connector, provides for remote programming of voltage level, polarity and range. See Table 2-3 for pin assignments.
6	FUSE	Protects the Model M107 in the event of an internal overload. Use only the specified fuse: 1/2 A Slo-Blo 100/115 V 1/4 A Slo-Blo 200/230 V
7	AC POWER	Three prong plug connects the power line cord to the Model M107.

3-7. OPERATING PROCEDURES

3-8. There are two operating modes, remote and local. If the unit is commanded to go to remote mode via the IEEE or Parallel Interface, the remote indicator will light and data can then be entered from a distant operating position. Unless otherwise commanded, the unit is normally in local mode requiring manual entry of operating data.

3-9. Initial Turn-on and Checkout Procedure

3-10. Set the line switch on the rear panel to the voltage that will be used, 115 V or 230 V. Verify that 1/2 amp fuse supplied with the unit is replaced with a 1/4 amp fuse if 230 V is to be used. Connect the power cord to the rear panel and to the appropriate outlet, position the front panel switches as follows:

POWER	Set upward
RANGE	Press 10
CURRENT LIMIT	Adjust as required

3-11. Digital Section Checkout

1. Press appropriate VOLTAGE ENTRY switches to display a desired voltage. Enter the most significant digit first, followed by the other digits in descending order of significance. Press CLEAR switch. Repeat step number 1 until proper operation of all VOLTAGE ENTRY switches is verified.

2. Press the far left (10^5) DIGIT SELECT switch. Press a voltage entry switch and verify the correct placement of the entered digit. Repeat step number 2 with each successive DIGIT SELECT switch (10^4, 10^3, 10^2, 10^1, 10^0).

3-12. Analog Section Checkout

1. Depress CLEAR switch.

2. Connect a Digital Voltmeter across the OUTPUT.

3. Enter selected voltage.

4. Press the + POLARITY switch and verify the ordered voltage on the DVM.

5. Press the STANDBY switch and verify zero output.

6. Press the -- POLARITY switch and verify the ordered voltage on the DVM.

7. Repeat steps 1 through 7 using different RANGE and voltage settings. Verify the proper output on the DVM.

3-13. Load Regulation Checkout

1. Connect the proper resistance across the OUTPUT terminals:

1 V RANGE	10 MΩ 5%	1/2 W
10 V RANGE	200 Ω 5%	1/2 W
100 V RANGE	2 kΩ 5%	5 W
1000 V RANGE	200 kΩ 5%	5 W

2. Connect the DVM across the load resistor.

3. Program the maximum voltage for the RANGE under test (e.g. 99.9999 for 100 V RANGE).

4. Set the CURRENT LIMIT control to the maximum clockwise position for all ranges.

5. Read the programmed voltage on the DVM.

3-14. Local Operation

To select an output voltage:

1. With the POWER switch on and the instrument at the proper operating temperature, set the CURRENT LIMIT control to the desired output level. (Note: The numbers on the CURRENT LIMIT control are approximate.)

2. Press the SEQUENTIAL switch. This sets the input to receive the desired 6-digit output voltage entry. The far left digit will begin to blink (bright/dim/bright...).

3. Press the CLEAR switch. This sets all digits of the output to zero.

4. Press the STANDBY switch. This disconnects the power supply and connects a short across the output terminals.

5. Press the desired VOLTAGE RANGE switch. Use the lowest range that will provide the required output voltage.

6. Enter the desired voltage by pressing in sequence, the VOLTAGE ENTRY switches, most significant digit first. The digit about to be entered will appear to blink beginning with the far left digit. As each digit is entered the blinking digit progresses to the right. When the last entry is made at the far right, the digit will stop blinking. If fewer than 6 significant digits are required, zeroes may be entered to make up the 6-digit entry. This is not necessary, however, except when a zero is one of the significant digits, i.e. 10.12 V dc.

7. Press the selected POLARITY switch, (+) positive or (-) negative.

8. The programmed voltage will now be present at the OUTPUT terminals.

To program a new 6-digit output voltage:

9. Press the CLEAR switch and enter the desired voltage in the same manner as above (i.e. STANDBY, VOLTAGE RANGE, VOLTAGE ENTRY, POLARITY). Pressing the CLEAR switch sets the digits of the output to zero and resets the sequencer. The far left digit will begin to blink indicating it is ready to receive a voltage entry.

To program a new voltage changing only one digit:

10. Press the DIGIT SELECT switch below the digit to be changed. The digit to be entered will blink. The SEQUENTIAL light goes out.

11. Enter the desired new digit on the VOLTAGE ENTRY keyboard. The digit entered will blink until another digit is selected for change. SEQUENTIAL mode is enabled, or remote control mode is enabled.

To return to sequential operation:

12. Press the SEQUENTIAL switch and enter the desired voltage as described above (i.e. STANDBY, VOLTAGE RANGE, VOLTAGE ENTRY, POLARITY). The SEQUENTIAL light illuminates.

3-15. IEEE STD-488 GPIB OPERATIONAL PROCEDURES

3-16. The M107 may be remotely operated via the General Purpose Interface Bus (GPIB). The M107 can be controlled or talked to by any appropriate device or devices that are IEEE STD-488 compatible.

3-17. The M107 is a listen-only device.   It may be used in Local or Remote mode. When commanded to Remote mode over the interface bus lines, the front panel controls become inoperative and the REMOTE indicator light illuminates. The M107 may now be programmed as to voltage range, output and polarity, by receiving device dependent commands. The M107 will ignore any device dependent or independent command that it has not been programmed to respond to.

3-18. IEEE STD-488 Subsets Implemented

3-19. The following is a list of the subset configuration of the Model M107 Precision D.C. Voltage Source's GPIB.

SH-0	Source Handshake, None
AH-1	Acceptor Handshake, Full
T-0	Talk, None
TE-0	Extended Talker, None
L-2	Listen, Basic Listener
LE-0	Extended Listener, None
SR-0	Service Request, None
RL-2	Remote Local, No LLO
PP-0	Parallel Poll, None
DC-1	Device Clear, Full
DT-0	Device Trigger, None
C-0	Controller, None

3-20. GPIB Characteristics

3-21. The IEEE STD-488 GPIB system consists of a set of sixteen signal lines that are used to carry data information, interface messages and device dependent messages between different devices connected to the bus.

3-22. The GPIB is organized into three sets of signal lines:

1. Data bus, 8 signal lines (designated DIO1 through DIO8). Seven are actively used by the M107.

2. Data byte transfer control bus, 3 signal lines, DAV, NRFD, and NDAC.

3. Interface management control bus, 5 signal lines (3 are actively used by the M107). These control lines are: IFC, ATN, REN, SRQ, and EOI.

3-23. Figure 3-3 illustrates the GPIB structure and its interface capabilities.

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NOTE
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For complete details on the electrical mechanical and timing requirements, refer to IEEE STD-488 1978.

3-24. The bus interface lines are assigned IEEE STD-488 mnemonics which are defined as follows:

DIO1 through DIO8: Data Input/Output lines 1 through 8, transmitted message bytes in bit parallel, byte-serial format, asynchronously and in a bi-directional manner.

DAV: Data Valid, indicates the availability of data on the DIO lines.

NRFD: Not Ready For Data, indicates when the device is ready to accept data.

ATN: Attention, indicates how the data on the DIO lines is to be interpreted, and which devices will respond to the data.

IFC: Interface Clear, is used to set the interface system, and the devices connected to it into a known quiescent state.

NDAC: Not Data Accepted, indicates when the data received was accepted.

SRQ*: Service Request, is used to request service from a controller.

REN: Remote Enable, is used by a controller device (in conjunction with other messages generated in the local logic) to place the Device in the Remote Mode of operation.

EOI: End Or Identify is used to indicate the end of a data transfer or, with the ATN line to execute a polling sequence.

3-25. Table 3-3 provides the pin designation for the rear panel GPIB 24-pin connector.

TABLE 3-3. GPIB INTERFACE CONNECTOR

PIN NO.	IEEE STD-488 MNEMONIC
1	DIO1
2	DIO2
3	DIO3
4	DIO4

*These lines are not used by the Model M107 Precision D.C. Voltage Source, and are supplied with terminations only.
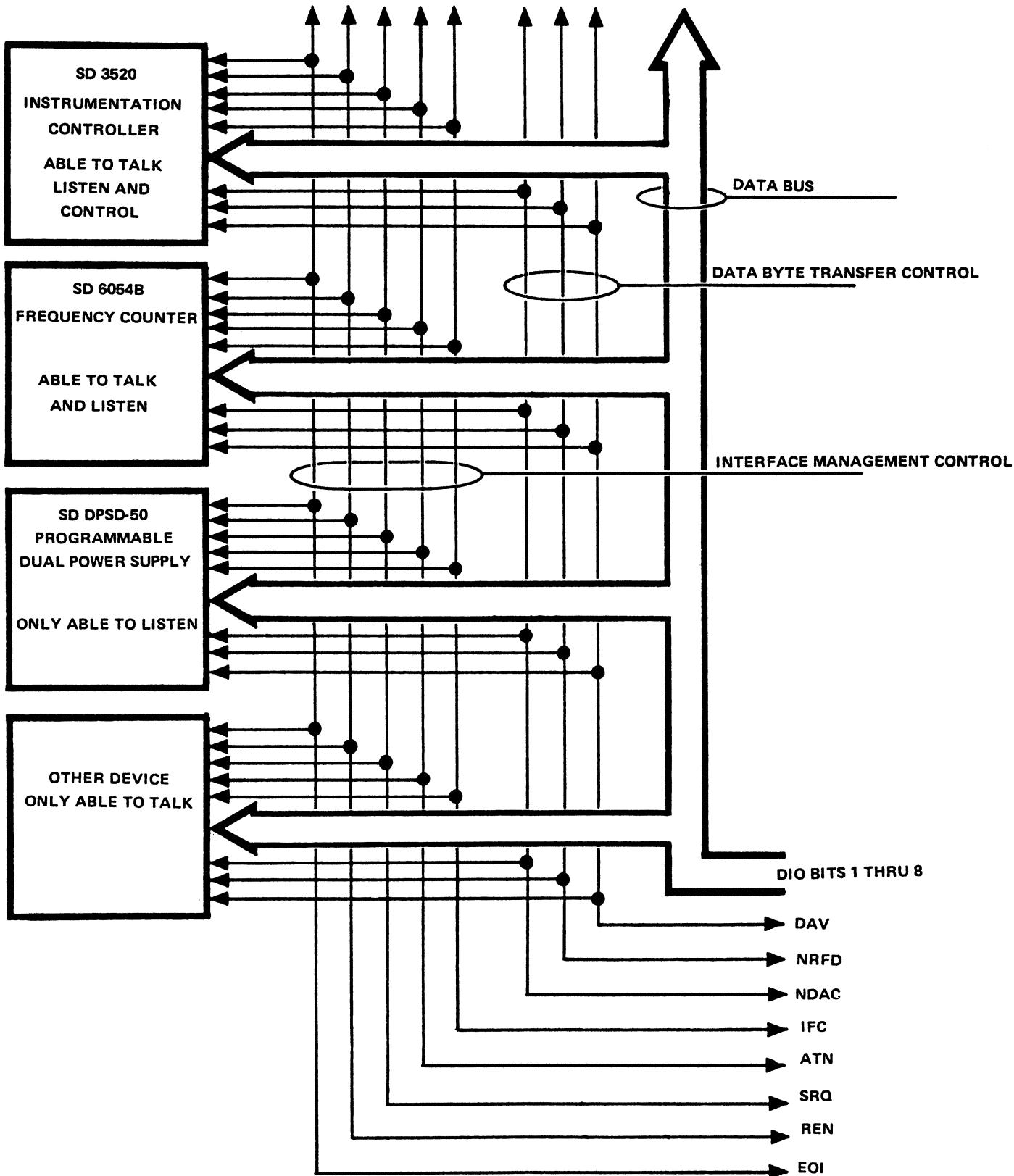
FIGURE 3-3. GPIB INTERFACE CAPABILITIES AND BUS STRUCTURE

TABLE 3-3. GPIB INTERFACE CONNECTOR (CONT'D)

PIN NO.	IEEE STD-488 MNEMONIC
5	EOI (not used)
6	DAV
7	NRFD
8	NDAC
9	IFC
10	SRQ (not used)
11	ATN
12	GND (shield)
13	DIO5
14	DIO6
15	DIO7
16	DIO8 (not used)
17	REN
18	GND (DAV Return)
19	GND (NRFD Return)
20	GND (NDAC Return)
21	GND (IFC Return)
22	GND (SRQ Return)
23	GND (ATN Return)
24	GND (Logic Return)

3-26. When the Model M107 is connected to the GPIB via its rear panel connector and commanded to Remote mode, the M107 may be controlled by an instrument controller, a calculator or any other devices that are IEEE STD-488 compatible. The "Handshake" process by which the M107 is remotely enabled is as follows:

1. The IFC command is issued by the controlling device and will cause the M107 to monitor the GPIB for further instructions. If the M107 was addressed as a listener, it will be unaddressed. The DIO1 through DIO7 lines will go to the tristate mode.

2. The REN command is issued by the controller device. If the M107 receives its listen address while the REN line is active, the M107 will enter the Remote Mode and listen for programming data. All front panel controls will become inoperative.

3. When the REN line goes inactive, the M107 will enter its Local Mode and the front panel controls will become operative.

3-27. The addressing process is controlled by the GPIB ATN line and functions as follows:

1. The M107 is addressed to listen by the Controller issuing its assigned listen address while the ATN line is set active.

2. If the M107 was addressed to listen, and the Unlisten (UNL) ASCII command is issued by the controller, the M107 will deselect itself as a listener.

3-28. Address Assignment Procedure

3-29. The Listen address is selected by the Rear Panel 5-digit address switch. The setting of the 5-digit switch determines which Listen address will be assigned to the M107. Thirty-one Listen addresses may be assigned. Refer to Table 3-4 for the address to ASCII code format.

TABLE 3-4. LISTEN ADDRESS ASSIGNMENTS VS. ASCII CHARACTER

ADDRESS SWITCH SETTING BITS					ASCII CHARACTER
5	4	3	2	1	LISTEN
0	0	0	0	0	SP
0	0	0	0	1	!
0	0	0	1	0	"
0	0	0	1	1	#
0	0	1	0	0	$
0	0	1	0	1	%
0	0	1	1	0	&
0	0	1	1	1	'
0	1	0	0	0	(
0	1	0	0	1	)
0	1	0	1	0	*
0	1	0	1	1	+
0	1	1	0	0	,
0	1	1	0	1	-
0	1	1	1	0	.
0	1	1	1	1	/
1	0	0	0	0	0
1	0	0	0	1	1
1	0	0	1	0	2
1	0	0	1	1	3
1	0	1	0	0	4
1	0	1	0	1	5
1	0	1	1	0	6
1	0	1	1	1	7
1	1	0	0	0	8
1	1	0	0	1	9
1	1	0	1	0	:
1	1	0	1	1	;

TABLE 3-4. LISTEN ADDRESS ASSIGNMENTS VS. ASCII CHARACTER (CONT'D)

ADDRESS SWITCH SETTING BITS					ASCII CHARACTER
5	4	3	2	1	LISTEN
1	1	1	0	0	<
1	1	1	0	1	=
1	1	1	1	0	>
*1	1	1	1	1	?

*Not to be device assigned. Refer to note.

NOTE

A 1-1-1-1-1 must not be assigned to any device interfacing the bus; these addresses are reserved for unlisten, ASCII(?), and the untalk, ASCII(-) commands.

3-30. IEEE STD-488 Multiline Interface Messages

3-31. The IEEE STD-488 messages relate to an ASCII code. Table 3-5 provides the DIO bit to ASCII character relationship.

TABLE 3-5. IEEE STD-488 DIO CODE TO ASCII CHARACTER

IEEE STD-488 DIO BIT							ASCII CHARACTER	
7	6	5	4	3	2	1	LISTEN	TALK
0	1	0	0	0	0	0	SP	
0	1	0	0	0	0	1	!	
0	1	0	0	0	1	0	"	
0	1	0	0	0	1	1	#	
0	1	0	0	1	0	0	$	
0	1	0	0	1	0	1	%	
0	1	0	0	1	1	0	&	
0	1	0	0	1	1	1	'	
0	1	0	1	0	0	0	(	
0	1	0	1	0	0	1	)	
0	1	0	1	0	1	0	*	
0	1	0	1	0	1	1	+	

TABLE 3-5. IEEE STD-488 DIO CODE TO ASCII CHARACTER (CONT'D)

IEEE STD-488 DIO BIT							ASCII CHARACTER	
7	6	5	4	3	2	1	LISTEN	TALK
0	1	0	1	1	0	0	,	
0	1	0	1	1	0	1	-	
0	1	0	1	1	1	0	.	
0	1	0	1	1	1	1	/	
0	1	1	0	0	0	0	0	
0	1	1	0	0	0	1	1	
0	1	1	0	0	1	0	2	
0	1	1	0	0	1	1	3	
0	1	1	0	1	0	0	4	
0	1	1	0	1	0	1	5	
0	1	1	0	1	1	0	6	
0	1	1	0	1	1	1	7	
0	1	1	1	0	0	0	8	
0	1	1	1	0	0	1	9	
0	1	1	1	0	1	0	:	
0	1	1	1	0	1	1	;	
0	1	1	1	1	0	0	<	
0	1	1	1	1	0	1	=	
0	1	1	1	1	1	0	╱	
0	1	1	1	1	1	1	?	
1	0	0	0	0	0	0		@
1	0	0	0	0	0	1		A
1	0	0	0	0	1	0		B
1	0	0	0	0	1	1		C
1	0	0	0	1	0	0		D
1	0	0	0	1	0	1		E
1	0	0	0	1	1	0		F
1	0	0	0	1	1	1		G
1	0	0	1	0	0	0		H
1	0	0	1	0	0	1		I
1	0	0	1	0	1	0		J
1	0	0	1	0	1	1		K

TABLE 3-5. IEEE STD-488 DIO CODE TO ASCII CHARACTER (CONT'D)

IEEE STD-488 DIO BIT							ASCII CHARACTER	
7	6	5	4	3	2	1	LISTEN	TALK
1	0	0	1	1	0	0		L
1	0	0	1	1	0	1		M
1	0	0	1	1	1	0		N
1	0	0	1	1	1	1		O
1	0	1	0	0	0	0		P
1	0	1	0	0	0	1		Q
1	0	1	0	0	1	0		R
1	0	1	0	0	1	1		S
1	0	1	0	1	0	0		T
1	0	1	0	1	0	1		U
1	0	1	0	1	1	0		V
1	0	1	0	1	1	1		W
1	0	1	1	0	0	0		X
1	0	1	1	0	0	1		Y
1	0	1	1	0	1	0		Z
1	0	1	1	0	1	1		[
1	0	1	1	1	0	0		\
1	0	1	1	1	0	1		]
1	0	1	1	1	1	0		⌒
1	0	1	1	1	1	1		-

3-32. GPIB Voltage Selection Data Entry Procedure

3-33. The Model M107 is remotely programmed by receiving ASCII characters on the GPIB cable that represents desired program information. To program the D.C. voltage, the M107 must receive an alphabetic character indicating the digit to be changed and a numeric character that signifies the value that digit is to receive. Table 3-6 shows the D.C. voltage programming format.

TABLE 3-6. VOLTAGE ENTRY CHARACTERS

ASCII CHARACTER	DATA FUNCTION
A	Stores following numerical character in 10^5 (MSD) register.
B	Stores following numerical character in 10^4 register.

TABLE 3-6. VOLTAGE ENTRY CHARACTERS (CONT'D)

ASCII CHARACTER	DATA FUNCTION
C	Stores following numerical character in 10^3 register.
D	Stores following numerical character in 10^2 register.
E	Stores following numerical character in 10^1 register.
F	Stores following numerical character in 10^0 (LSD) register.

Examples:

To change the 10^3 digit to a numerical 4, enter ASCII characters C4.

To change the 10^0 digit to a numerical 7, enter ASCII characters F7.

To change the 10^5 digit to a numerical 2, enter ASCII characters A2.

3-34. The above characters are stored in the interim voltage registers and are not shifted to the output until a strobe character 'S', is received (See 3-37).

3-35. GPIB Range and Polarity Selection Data Entry Procedure

3-36. Programming the range and polarity of the output voltage is much like the programming of the voltage digits. The M107 must receive an ASCII character R or P indicating range or polarity followed by a numerical character representing the function the range or polarity register is to assume. Table 3-7 shows the range and polarity programming format.

TABLE 3-7. RANGE AND POLARITY ENTRY CHARACTERS

ASCII CHARACTER	DATA RANGE REGISTER
Enter "R" followed by:	
0	1 volt range
1	10 volt range
2	100 volt range
3	1000 volt range

TABLE 3-7. RANGE AND POLARITY ENTRY CHARACTERS (CONT'D)

ASCII CHARACTER	DATA POLARITY REGISTER
Enter "P" followed by:	
0	Standby (output terminals shorted)
1	"+" Positive Polarity
2	"-" Negative Polarity

3-37. Strobe Character, Interim and Working Registers

3-38. All entries of voltage, range and polarity are stored in interim registers when entered via the GPIB cable. Only when the strobe character 'S' is entered does the data shift to the working registers. The output voltage directly follows the contents of the working registers.

Examples:

To program 27.3505 volts, 100 V Range, + Polarity:

ASCII String = A2B7C3D5E0F5R2P1S

To change output to 29.3505 volts, - Polarity:

ASCII String = B9P2S

3-39. The 'S' following the above examples causes the data to go immediately to the working registers. Any letter-number pairs entered after the strobe character will be entered only in the interim registers and will not affect the working registers or the output voltage.

3-40. The interim registers retain all information until reprogrammed or cleared by a device clear message on the IEEE Bus. If the M107 is placed in local mode, the interim registers retain their information from previous remote commands. If the M107 is returned to remote mode and given a strobe character, the output voltage will assume the value it had prior to going to local mode.

3-41. The IEEE-488 Program Format is summarized in Table 3-7.

TABLE 3-8. IEEE STD-488 1975 PROGRAMMING FORMAT MEANING

PROGRAM BITS							ASCII	
7	6	5	4	3	2	1	CHARACTER	FUNCTION
1	0	0	0	0	0	1	A	10^5 Digit
1	0	0	0	0	1	0	B	10^4 Digit
1	0	0	0	0	1	1	C	10^3 Digit

TABLE 3-8. IEEE STD-488 1975 PROGRAMMING FORMAT MEANING (CONT'D)

PROGRAM BITS							ASCII	
7	6	5	4	3	2	1	CHARACTER	FUNCTION
1	0	0	0	1	0	0	D	10 Digit
1	0	0	0	1	0	1	E	10 Digit
1	0	0	0	1	1	0	F	10 Digit
1	0	1	0	0	0	0	P	Polarity
1	0	1	0	0	1	0	R	Range
1	0	1	0	0	1	1	S	Strobe

3-42. Wake-Up States

3-43. When power is applied to the M107, all interim and working register contents are equal to 0. Thus, the M107 "wakes up" to the following conditions:

        All voltage digits = 0
        Range   1 V
        "Standby" state

3-44. When the M107 receives a device clear command, the interim and working registers are reset to the above wake-up states.

3-45. GPIB Program Example

3-46. The Model M107 may be program controlled by a number of different controller devices. The following typical program example provides the keystroke entry sequence for programming the Model M107 using the Systron-Donner 3520 Instrumentation Controller, the Hewlett-Packard HP9825A and HP9815 Desktop Computers, and the Commodore PET Computer.

3-47. In this example an ASCII * listen address is assigned to the Model M107. The assigned address is set by placing the M107's rear panel address switches to 01010. In the case of HP9825A, the Desktop Computer is addressed with its rear panel address switches (710 address is used in this example, 7 being the HP9825A's bus address and 10 being the Model M107's assigned address in decimal).

3-48. The steps of the example program are written to be keyed into the controller device one step at a time and the Model M107 will immediately respond to each step entry made.

        1. Prepare the controller for Bus operation.
        2. Clear the Bus and command the M107 to remote.
        3. Set the output to +25.0000 V.
        4. Change the polarity to "-".
        5. Set the output to -15.6667 V.

Systron-Donner 3522 Entry Keystrokes:

TO BE SUPPLIED

Hewlett-Packard 9825A Entry Keystrokes:

    1.   (Not Applicable)
    2.   RESET
    3.   wrt 710, "A2B5C0D0E0F0P1R2S"
        Execute
    4.   wrt 710, "P2S"
        Execute
    5.   wrt 710, "A1C6D6E6F7S"
        Execute

Hewlett-Packard 9815A Entry Keystrokes:

    1.   CLEAR
    2.   Alpha 5 Alpha U?* Alpha
    3.   Alpha 5 Alpha Blank A2B5C0D0E0F0P1R2S
    4.   Alpha 5 Alpha Blank P2S Alpha
    5.   Alpha 5 Alpha Blank A1C6D6E6R7S Alpha

Commodore PET Entry Keystrokes:

    1.   OPEN 1, 10
    2.   (Not Applicable)
    3.   Print #1, "A2B5C0D0E0F0P1R2S"
        CR
    4.   PRINT #1, "P2S"
        CR
    5.   PRINT #1, "A1C6D6E6F7S"
        CR

3-49. Option 01 Parallel Interface

3-50. This option allows remote control of voltage output, range, and polarity. The DTL-TTL-CMOS compatible inputs are referenced to chassis ground. The ground true inputs for control of Range and Polarity have 10 k pull-up resistors and

the positive true bcd inputs for voltage programming and digit strobe inputs are provided with 10 K pull-down resistors. The remote mode may be selected by a positive true input (internal 10 K pull-down) via pin 24 or by a ground true input (internal 10 K pull-up), pin 49. A ground true current limit flag output capable of 50 mA is also provided. The input programming pin assignments are shown in table 3-9. The mating connector is Amphenol type 57-30500. (S.D. P/N 101157)

3-51. The data input lines and separate strobe input lines allow flexibility of programming format. The six digits may be programmed in full parallel operation with individual or simultaneous use of the digit strobe inputs. To reduce the number of programming interconnect wires required, the six groups of digit data lines may be tied together (i.e., tie all the 1-bit lines together, all the 2-bits together etc.) to form a single bcd digit. The six digit strobe lines are then used to program the voltage decades in serial format.

3-52. The range and polarity strobe input may be used to latch the range and polarity data or it may be connected to the HI REFERENCE (+5 V) pin so that range and polarity will "follow" the selected input data.

If the range and polarity strobe input is taken high while none of the range and polarity input lines are selected (low), a default condition of 1 V Range and standby will be programmed.

The strobe lines admit data set up on the input lines to the working storage registers. The data should be present on the lines for a minimum setup time of 2 μ Sec and the minimum strobe pulse width is 1 μ Sec.

TABLE 3-9 PARALLEL INTERFACE CONNECTIONS

PIN	FUNCTION	PIN	FUNCTION
1	10^0 1 bit	21	Not Used
2	10^0 2 bit	22	Range & Pol Strobe
3	10^1 1 bit	23	Not Used
4	10^1 2 bit	24	Remote
5	10^2 1 bit	25	HI Reference
6	10^2 2 bit	26	10^0 4 bit
7	10^3 1 bit	27	10^0 8 bit
8	10^3 2 bit	28	10^1 4 bit
9	10^4 1 bit	29	10^1 8 bit
10	10^4 2 bit	30	10^2 4 bit
11	10^5 1 bit	31	10^2 8 bit
12	10^5 2 bit	32	10^3 4 bit
13	Not Used	33	10^3 8 bit
14	Not Used	34	10^4 4 bit
15	10^0 – Strobe In	35	10^4 8 bit
16	10^1 – Strobe In	36	10^5 4 bit
17	10^2 – Strobe In	37	10^5 8 bit
18	10^3 – Strobe In	38	Not Used
19	10^4 – Strobe In	39	Current Limit Out
20	10^5 – Strobe In	40	Not Used
41	1 V Range	46	– Polarity
42	10 V Range	47	+ Polarity
43	100 V Range	48	Standby
44	1000 V Range	49	Remote
45	Not Used	50	Ground

CHAPTER 4

PRINCIPLES OF OPERATION

4-1. INTRODUCTION

4-2. This chapter contains a general functional description of the M107 Precision DC Voltage Source and corresponding functional block diagrams (Figures 4-1 and 4-2). Also included in this chapter are descriptions of each circuit board. References are made to the accompanying diagrams and to schematics in Chapter 7.

4-3. FUNCTIONAL DESCRIPTION

4-4. The Model M107 consists of two major sections: the digital section which controls/programs the output voltage, and the analog section which generates the output voltage.

4-5. DIGITAL SECTION

4-6. The digital section of the M107 (see Figure 4-1) receives voltage, range and polarity data from local or remote sources, and generates timing pulses that are output to the analog section. These operations are detailed in the following paragraphs.

4-7. In the local mode, the front panel provides control of DIGIT SELECT, VOLTAGE RANGE and POLARITY functions. This data is transferred from the digit select and voltage select boards A7 and A8 to the encoder board A2.

4-8. The encoder board A2 converts the voltage digits into bcd which are then output to the data selectors on the IEEE-488 interface board A1. If local data is desired instead of remote data, the data selectors on the IEEE-488 interface board A1 apply the local data to the working registers on the digital mother board A4. Each working register accepts data when a digit strobe from the encoder board A2 is received. From the working registers, each bcd digit is applied to the comparator on the digital analog (d/a) control board A3.

4-9. When in remote mode, the voltage data is applied to the IEEE-488 interface board A1 from connector J102. In this case, the data selectors on the A1 assembly select data from the IEEE bus instead of from the encoder board A2.

4-10. When the strobe character "S" is received on the bus, a strobe pulse (shown as 'Remote Strobe') is sent to the encoder board A2. This causes digit strobes to pass from A2 to the working registers on the digital mother board A4, which enables these registers to receive the IEEE data. From A4, the voltage data is sent to the comparator on A3.

4-11. Range and polarity data from local or remote sources is treated in a manner similar to voltage data, but does not pass through the working registers on A4.

4-12. In local mode, range and polarity data is generated on the voltage select board A8 and is fed to the encoder board A2 where it is bcd latched and encoded. From the encoder board A2, the data is routed across the digital mother board A4 to the data selectors on the IEEE-488 interface board A1. On the A1 board, REN line status determines whether local or remote data will be accepted. If the REN line is high, the local range and polarity data will be sent to the d/a control board A3.

4-13. In remote mode, if the range and polarity commands from J102 are accepted as valid; the data is stored on the IEEE-488 interface board A1. If the interface has been placed in the remote mode, the remote data is presented to the d/a control board A3.

4-14. The voltage data from the working registers on A4, and the range and polarity data stored in the latch circuit on A3, are fed to the display driver board A10 and then to the display board A9.

4-15. The d/a control board A3 generates a duty cycle or -- cycle controlled waveform whose positive and negative transitions create a time interval proportional to the ordered voltage.

4-16. The operation of the d/a control board A3 begins with a stable oscillator that drives a three-digit counter, which in turn provides a bcd signal to the comparators. After each start transition, the counter begins counting up from zero. When the counter bcd level coincides with the set-up bcd data in the working registers, the comparator applies the stop transition to the transformers T2 and T3. Pulse transformers T2 and T3 couple the start and stop transitions of the duty cycle controlled waveforms from the digital to the analog section.

4-17. Range and polarity data is also processed on the d/a control board A3. The selected range and polarity information is stored and a protection delay is generated during range and polarity changes.

4-18. From there, the range and polarity opto-isolators on A4 are energized; which in turn operates range and polarity relays on the analog board A5.

4-19. ANALOG SECTION

4-20. In the analog section, a temperature compensated precision voltage device develops a stable 6.95 V reference voltage. The 6.95 V is applied to the pulse width modulator, essentially an analog gate in the path to the filter network. A modulator start pulse (from the digital section) opens the gate and the filter will charge; a stop pulse closes the gate, disconnecting the 6.95 V charging source. The filter network smooths out this "chopped" 6.95 V to provide a steady dc output voltage to a dc buffer amplifier which drives a high voltage dc amplifier and emitter follower output stage. As the input to the buffer amplifier changes from 0 to 6.95 V, the emitter follower output changes from 0 to 100% of full scale output. The voltage is applied to the output terminals through the polarity reversing and standby relays.

4-21. A sample signal is taken from the OUTPUT terminals, via the SENSE terminals and RANGE selector (a simple resistive voltage divider), for negative feedback to the buffer amplifier. Full scale output is established by the division ratio of the voltage divider and is selected by the range relays. Four divider ratios may be set at the front panel for full range outputs of 1, 10, 100 and 1000 V dc. The dc open-loop gain of the amplifier section is >150 dB. Therefore, even at 1000 V output, the worst case loop gain is approximately 100 dB with an inherent line/load rejection of better than 1 part in 10^5.

4-22. CIRCUIT DESCRIPTIONS

4-23. The following descriptions are of the circuit boards that comprise the M107:

    a. Digit Select PC Board A7 and Voltage Select PC Board A8.

    b. Encoder PC Board A2.

    c. IEEE-488 Interface PC Board A1.

    d. Digital Mother PC Board A4.

    e. Digital/Analog (D/A) Control PC Board A3.

    f. Display PC Board A9.

    g. Display Driver PC Board A10.

    h. Analog PC Board A.

    i. High Voltage Amplifier PC Board A6.

    j. CAL Switching PC Board A11.

The above order of boards was determined by the operation of the M107 from front panel data inputs to front panel voltage outputs.

4-24. DIGIT SELECT PC BOARD A7 AND VOLTAGE SELECT PC BOARD A8

4-25. The digit select board A7 is connected to the encoder board A2 via the digital mother board A4. Whenever a DIGIT SELECT, SEQUENTIAL or CLEAR push-button is pressed, a circuit is completed that places a high (logic 1) on the corresponding input to the encoder board A2.

4-26. The voltage select board A8 works similarly. If a VOLTAGE ENTRY push-button is pressed, a circuit is completed that places a high on an input of U19, on the encoder board A2.

4-27. However, the VOLTAGE RANGE and POLARITY pushbuttons will apply a low (logic "0") to their corresponding inputs on A2. Stand-by and current limit LED indicators are located on this board and tied to circuitry on the A3 board.

4-28. ENCODER PC BOARD A2

4-29. The encoder board A2 processes control signals from the voltage select board A8 and digit select board A7 and encodes voltage, range and polarity information for the d/a control board A3. The operation of the encoder board A2 is detailed below.

4-30. When a VOLTAGE RANGE or POLARITY pushbutton switch is pressed on the voltage select board A8, the corresponding line on the encoder board A2 is held low. Gates U15 and U21 generate signals to the control latches U16. Pressing a single VOLTAGE RANGE or POLARITY pushbutton sets up a two-digit binary code on the latches which is output to the IEEE-488 interface board A1. Gates U15 and U21 also ensure that the lower of two ranges is selected if more than one pushbutton is pressed.

4-31. When a DIGIT SELECT pushbutton is pressed, a single line of the U14 priority encoder goes high, generating a binary code on the output pins. The highest data line enabled has priority so that if more than one DIGIT SELECT pushbutton is pressed, the lowest digit is selected. The binary outputs of U14 are connected to the program inputs on the U13 binary counter. When a digit is selected, U14 outputs a high pulse on the group select line enabling the debounce circuit, U5 and U6. This applies a high pulse to the preset enable line on U13, setting up the 3 bit binary code on the digit pointer code outputs [3], [4] and [5]. The digit select code output is also routed through the bcd-to-decimal decoder U3 to the digit strobe gates.

4-32. The sequential mode control line also goes high when the SEQUENTIAL pushbutton on the digit select board A7 is pressed. This sequential pulse sets the sequential flip-flop U6-8 and resets the binary counter U13-9 to zero. The reset is also accomplished when the CLEAR pushbutton is pressed; via gate U2-6. After U13 is reset, the entry of a voltage numeral clocks the counter causing it to strobe each digit in sequence. When not in sequential mode, U6-12 Q holds the clock input high preventing voltage entries from advancing the counter.

4-33. When a voltage select signal is received from the voltage select board A8, the corresponding input on U19 goes high. U19-6, 7, 9 generate bcd bits 1, 2, and 4 from inputs D0 through D7, while U18-11 generates the bcd 8 bit. U10 and U11 constitute a debounce circuit, accepting only the first contact of a VOLTAGE SELECT pushbutton. U10-6 is local strobe generator; pulsing the strobe line selected by U3 decoder. U11-2 clocks the binary counter U13-15 when sequential mode is selected.

4-34. When power is first applied to the unit, the output of inverter U4-12 goes high and remains high until C1 charges through R1. This "Power On" pulse sets latches on U16 (Pins 1, 9, 10, and 13) to the wake-up states indicated by -(*).

	U16-13 Out	U16-9 Out
*1V	0	0
10V	1	0
100V	0	1
1000V	1	1

	U16-10 Out	U16-1 Out
* Standby	0	0
'+' Polarity	1	0
'-' Polarity	0	1

4-35. The remote input D also goes high when remote is selected and re-asserts the Power-On reset condition via U7-16. When the unit is returned to local control U7-16 allows the RC circuit to charge and remove the reset signal from the encoder circuitry. This results in the M107 always returning to the "wake-up" state when local control is restored.

4-36. The remote line 3 (from A1 board) goes high when the unit is commanded to remote. This disables the local strobe decoder U3-11, the front panel CLEAR pushbutton via U17-13 and the front panel DIGIT select pushbuttons via U14-4.

4-37. IEEE-488 INTERFACE BOARD A1

4-38. The IEEE-488 Interface board A1 receives remote range, polarity and voltage information from the IEEE bus and processes it for the digital mother board A4.

| NOTE |

By definition, a high (+5 V) on the interface bus represents a logic 0, while a low (0V) represents a logic 1. After passing through the bus and into the M107 circuitry, all logic levels revert to standard TTL logic levels where a logic high = 1 (+5 V) and a logic low = 0 (0V).

4-39. POWER ON ('PON') (see Figure 4-3). When the M107 is turned on, the PON circuit R5 and C12 produces a high pulse that initiates power-on conditions.

4-40. U43-15 inverts PON to low, which inhibits gate U28-10 in the REMote circuit, causing the M107 to wake-up in the local mode. The PON from U43-15 also inhibits U28-6 in the MLA circuit, preventing the M107 from receiving MLA commands until the proper wake-up states are achieved. PON is also applied to U6-4 in the Device Clear (DCL) circuit where the DCL Line resets the U4 and U5 interim range and polarity storage and the U17 through U22 voltage storage registers, (not shown in Figure 4-3).

4-41. ROW AND COLUMN DECODERS 'ROW AND COL DEC' (see Figure 4-3). Messages on the IEEE bus arrive via the standard 24-pin connector J102. Data arrives on lines DI-01 through DI-07 in a bit-parallel byte-serial format, and is inverted by U47 and U48. The data is then fed to U14, 15 and 16 ROW AND COL DEC. These bcd to decimal decoders provide the ROW AND COL of any character on the input lines.

4-42. HANDSHAKE Circuit (see Figure 4-3). Data is transferred on the input lines according to the handshake process. If either ATN or MLA is low, the output of U31-8 will be low allowing the NRFD and NDAC lines to respond on the bus. Figure 4-4 shows the input handshake timing with references to text callouts numbered 1 through 7.
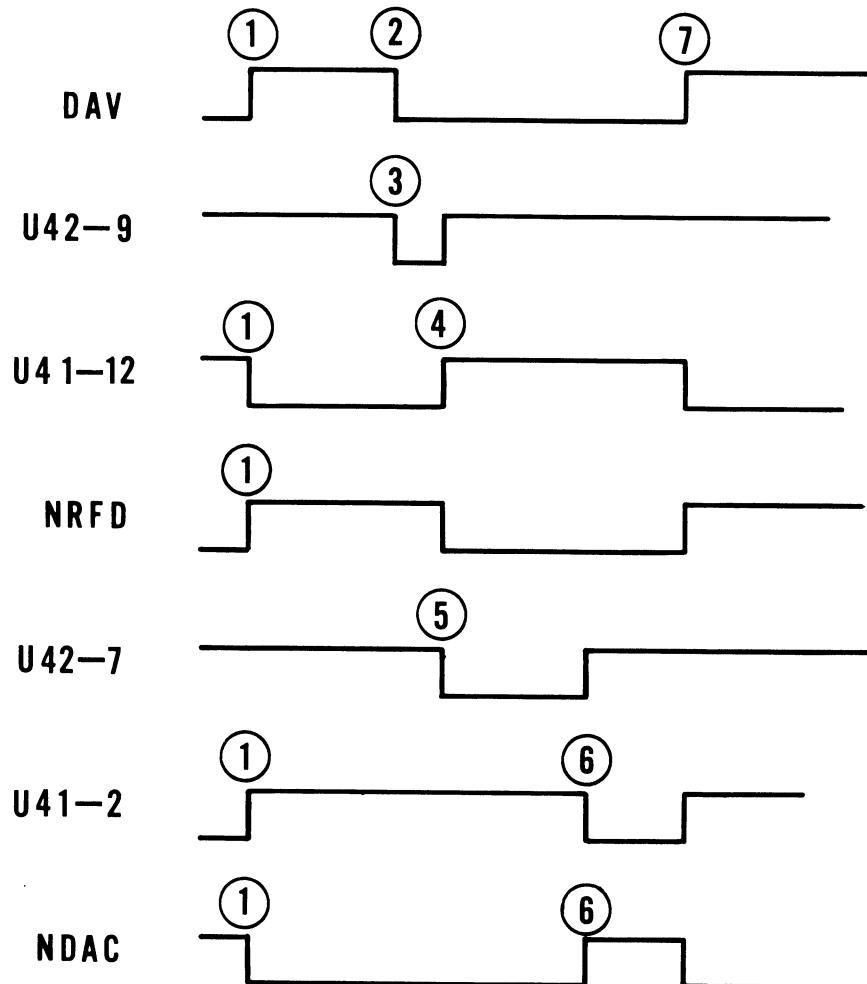
FIGURE 4-4.   IEEE-488 INPUT HANDSHAKE TIMING DIAGRAM

4-43. The controller initializes DAV high which sets U41-12 low and resets U41-2 high①.

4-44. When the controller sees NRFD high and NDAC low, data is placed on the DIO1 through DIO8 lines, and the DAV line is set low②. The low DAV triggers U42-9 low for 4 µs③. The rising edge of the pulse from U42-9 clocks U41-12 high④. The output of U41-13, triggers U42-7 low for 10 µs. The rising pulse from U42-7 clocks U41-2 low⑥. When the controller sees data accepted, it pulls the DAV line⑦ high again and puts the next byte of data on the bus. The cycle repeats for each byte of input data.

4-45. MY LISTEN ADDRESS ('MLA') Circuit (see Figure 4-4). The MLA puts the M107 into listen mode when the correct listen address is detected.

4-46. U30, U12-10, U29-10, 11, U13-1 and U45-3 compare the IEEE-488 address switches with bits DI-1, DI-2 through DI-5. If a match is detected U45-3 produces a high pulse. (U13-13 requires a valid MLA character DI-6 and DI-7 (COL 2 or 3), as well as ATN and DAV). If these conditions are met, U44-11 produces a low making U44-3 (MLA) high.

4-47. MLA remains high until an IFC, a UNL (ROW 15 DI-5, DI-6 and $\overline{DI-7}$ or PON Command is received. If any of these conditions are met, U28-6 will go low, making U44-4 high, pulling U44-3 (MLA) low.

4-48. REMOTE 'REM' Circuits (see Figure 4-5). The REMOTE line commands the voltage, range and polarity data selectors (U34 through U40) to select remote data from the bus if REM is high or local data if low.

4-49. If ATN, DAV and MLA are true, U28-9 goes high. The GTL (Go to Local) message (ROW 1, COL 0) is NAND'ed with the output of U28-9 to produce a valid $\overline{GTL}$ command. If either the $\overline{GTL}$ command is low, the REN command is false, or the unit is in PON status, U28-10 will go low, driving the $\overline{REM}$ line, U27-10, high. The M107 can be commanded to remote with a high $\overline{REN}$ and high MLA. These are implemented by NAND gate U27-4 which triggers one-shot U26-9 producing a low U27-13. (This drives the REM line, U27-11 high and the $\overline{REM}$ U27-10, low.)

4-50. DEVICE CLEAR 'DCL' Circuit (see Figure 4-5. The DCL line detects a DCL or SDC (Selected Device Clear) message on the bus and resets the voltage, range and polarity storage registers (U4, U5 and U17 through U23) to zero values.

4-51. A Pon signal will also drive the DCL line high. NAND gate U27-1 and U27-2 accepts COL 0 and MLA inputs, two of the conditions for an SDC. U12-11 requires these conditions or a COL 1 which occurs with a DCL. U3-9 requires a ROW 4 and ATN, completing the conditions for an SDC or DCL. A pon signal at U6-5 will also drive the Clear line high.

4-52. VOLTAGE Circuit (see Figure 4-5). The voltage circuit detects valid letter and number combinations and enables the appropriate voltage storage register U17 through U22.

4-53. When a letter is present on the bus (COL 4, $\overline{DI-4}$) and the MLA DAV $\overline{ATN}$ ∧= AND operation) signal is present, U10-10 provides a high pulse to the preset enable line (P_E) of U1. This sets up the output lines Q_1 through Q_3 of U1 with the data present on DI-1 through DI-3. The high pulse from U10-10 also clocks the letter-number sequencer, U9-11, via U12-4. When the DAV signal is removed, the P_E (U1) line returns to a low state but the three-digit letter code remains on U1-6, 11 and 14. Gates U12 and U29 detect a character in ROWS 0-9. Bits DI-2 and DI-3 are ORed at U12-3 and NAND'ed with bit DI-4 at U29-3. If these conditions are true along with a COL 3 and MLA DAV ATN, then U10-6 produces a high, indicating the character on the bus is a valid number 0 through 9.

4-54. If the character previously received was a letter, U9-13 will be high allowing a low 'number strobe' pulse to pass from U29-4. This line is tied to the D input of U2, the letter decoder. A low D input allows one of the lines

Q_1 through Q_6, A to F, to go high. This enables the appropriate storage register U17 through U22 to receive the number on the data lines DI-1 through DI-4. The low pulse from U29-4 also triggers the letter reset one-shot U26-4. The Q output U26-6 resets U9 to prepare for another letter-number sequence and resets U1-9 via U6-10 to accept another letter.

4-55. RANGE Circuit (see Figure 4-5). The range circuit detects a valid range command, an 'R' followed by a "0", "1", "2" or "3". This will clock the interim storage register U4, enabling it to receive data bits DI-1 and DI-2.

4-56. When a letter 'R' is received, the ROW 2 and COL 5 lines to U8-10 go high. When DAV pulse is detected, U8-10 clocks the 'R' storage register U25-11 producing a high at U24-4. This letter 'R' pulse from U8-10 also clocks the letternumber sequencer U9-11 via U12-4. A high U9-13 allows a valid number strobe to pass from U29-4 only after a letter has been received.

4-57. If the next character on the bus is a valid number, a "0", "1", "2", or "3", bits DI-3 and DI-4 will go high at U45-11 placing a high at U24-5. A number will also initiate a 'number strobe' in the voltage circuit, driving U24-6 high. This clocks storage register U4. The number strobe also triggers the 'letter reset' one-shot U26-6 (voltage circuit) which resets U25-10 via U7-10 preparing it for the next range entry.

4-58. POLARITY Circuit (see Figure 4-5). This circuit works in a manner similar to the voltage range circuit. If a 'P' followed by a "0", "1" or "2" is detected, the interim polarity storage register U5 is clocked.

4-59. When a letter 'P' is received, the COL 5 and ROW 0 lines to U8 go high. When a MLA DAV ATN pulse is detected, U8-6 clocks the 'P' storage register U25-3. This letter 'P' pulse from U8-6 also sets the letter-number sequencer U9-8 in the voltage circuit. A high U9-13 from the voltage circuit ensures that a valid number strobe will pass from U29-4 only after a letter has been received.

4-60. If the next character on the bus is a valid number, a "0", "1" or "2", then the ROW 0, ROW 1 or ROW 2 (U7-5, 1 or 2) will be high, producing a high at U24-1. This condition will also initiate a number strobe from the voltage circuit, driving U24-9 high. This clocks storage register U5. The number strobe also triggers U26-6 in the voltage circuit which resets U25-4 via U7-12, preparing it for the next polarity entry.

4-61. Range and Polarity Storage. This circuit stores remote range and polarity data from the bus and selects between the remote data and the local data provided by the Encoder board A2.

4-62. U4 and U5 are interim storage registers for remote data. When remote polarity data is present, a high pulse is applied to U5-11, 3, clocking the DI-1 and DI-2 bits into U5-9 and U5-5. Similarly, remote range data is clocked into U4-9 and U4-5 by a high pulse at U4-11, 3. When a strobe pulse is applied to U23-1, the remote data in the interim registers is transferred to the outputs of the remote working storage U23-6, 11, 14, 2. The data selector U40 chooses between the remote data from U23 (X lines) and the local data from Encoder board A2 (Y lines). A high on the REM line at U40-9 places the X inputs on the

Z output lines, U40-10, 11, 12, and 13, and a high $\overline{\text{REM}}$ line U40-14 places the Y inputs on the Z output lines.

4-63. Strobe Circuit. The strobe circuit listens for an ASCII 'S' character. When an 'S' is detected, COP 5 (U3-12) and ROW 3 (U3-13) go high. When a DAV pulse is received, U3-10 will go high. If an SDC or DCL occurs, or a valid 'S' is present, U6-3 will place a high at U3-3, 4. In the remote condition (REM line high), U3-6 will produce a high strobe pulse. This transfers data from the remote interim range and polarity register U4 and 5 to the working range and polarity register U23, and produces remote voltage strobes on the Encoder board A2.

4-64. Interim Voltage Storage and Data Selectors. The interim voltage storage registers, U17 through U22, store voltage data from the IEEE bus and transfer it to the data selectors U34-39 which select between remote and local BCD information.

4-65. Each voltage storage register receives DI-1 through DI-4 at its program input pins. If a valid letter-number program sequence is detected, one of the 'A' to 'F' lines from the voltage circuit will be momentarily high, clocking the BCD digit into the appropriate register. A DCL, SDC or pon will reset all registers setting their outputs to zero. U34 through U39 select between the remote data at the X inputs and the local data from the Encoder board A2 at the Y inputs. The status of the REM and $\overline{\text{REM}}$ lines determines which set of inputs is selected for the Z output lines.

4-66. DIGITAL MOTHER BOARD A4

4-67. The Digital Mother board A4 allows signals to pass between the IEEE-488 Interface board A1; the Encoder board A2; and the D/A Control board A3. The only IC's mounted on the Digital Mother board are opto-isolators (U1 through U4) and the working registers U9 through U14 and buffers U5-U8. The following details the operation of the working registers.

4-68. The working registers U9 through U14 are quad latches with four data inputs and four Q line outputs. The working voltage levels that are sent to the D/A Control board A3 are determined by the values on these Q line outputs. The data inputs D_0 through D_3 of the working registers are tied to the data selectors U34 through U39 on t e IEEE-Interface board A1. These four data input lines accept the 10^0 to 10^5 BCD digit data from the A1 board.

4-69. In local mode a single digit from Encoder board A2 is output on lines $\boxed{14}$ through $\boxed{17}$. This BCD digit is applied to every data selector on A1 and therefore to every working register latch U9 through U14 (A4). The appropriate latch is enabled by a single digit strobe from the Encoder board A2 on one of the lines $\boxed{6}$ through $\boxed{11}$.

4-70. In remote mode, each remote strobe 'S' enables all of the digit strobe lines $\boxed{6}$ through $\boxed{11}$. Each interim register, U17 - U22 (A1), holds a single digit of voltage information; together all interim registers on A1 store the voltage digits and apply it to all of the data lines of the working registers through data selectors U34-U39. When the remote strobe is received, lines $\boxed{6}$

through $\boxed{11}$ are all enabled, clocking all six BCD remote digits into the working registers simultaneously.

4-71. The working register data is buffered by U5 through U8 on the Digital Mother board A4 before it is applied to the D/A Control board A3 and the display boards.

4-72. D/A CONTROL BOARD A3

4-73. The D/A Control board A3 controls the D/A conversion circuitry on analog board A5 by generation timing waveforms. The 6-digit voltage BCD data is compared with the output of a running counter. At the zero count a timing waveform is initiated when the count equals the BCD voltage selected, a stop gate is triggered. The resulting waveform length is proportional to the programmed voltage. The complete operation of the D/A Control board A3 is detailed below.

4-74. The crystal oscillator Y1 generates a 2.3 MHz squarewave which is buffered through U12-10. U3-3 divides the 2.3 MHz waveform by two while U3-11 receives the same 2.3 MHz signal inverted, and divides it by two. The outputs of U3, pins 8, 9, and 5, 6, respectively, are four 1.15 MHz squarewaves, each one pulse out of phase. Gates U2-6, 3 and 11, form a four phase clock, locking at all possible combinations of the U3 outputs. (See Figure 4-6).

4-75. U3-6 provides 1.15 MHz clock pulses to three 4-digit counters; U9, 10 and 11. These counters count from zero to 999, reset to zero, and start again. Each BCD voltage select digit is tied to a four input exclusive NOR gate, U21 through U26. U21, 23 and 25 compare the BCD code of the three least significant digits (LSD) with the count from U9, 10 and 11. At the same time U22, 24 and 26 compare the three most significant digits (MSD) with the same count. When a match occurs between a BCD digit and a count digit, the output line of the exclusive NOR gate goes high. The gates are in a wired-OR configuration so that if any one of the 12 output lines is low the MSD or LSD line will remain low. If all 12 bits match, the 12 output lines will go high, producing a high MSD or LSD pulse.

4-76. Gates U5-5, U5-9, U6-5, U4-5 and U4-9 form a flip-flop chain which controls the delay timing between count cycles. U5-5 and U6-5 also generate the offset between the start of the MSD and LSD signals. U4-5 and U4-9 enable the counter stop gates for the MSD and LSD. The operation of a typical count and delay sequence is outlined in the timing diagram (Figure 4-6).

4-77. When the count from U9, 10 and 11 reaches 999, the 8-bit line to the U26 MSD comparator goes high Ⓐ. When count 000 is reached, the low going transition Ⓑ triggers the one-shot U1-1. The low output pulse from U1-4 clears the entire flip-flop chain, U5-5 and 9, U6-5, U4-5 and 9 Ⓒ. The Q line of U4-9 is tied to U2-9, (an AND gate between the 1.15 MHz clock flip-flops. The cleared (low U4-9 disables U2-9 and stops the count at 000.

4-78. The next high pulse from U3-5 starts the flip-flop sequence by clocking U5-5 Ⓓ. Each remaining flip-flop has a low data line. Therefore, each flip-flop's Q output remains low until the preceding flip-flop in the chain is clocked. The next high pulse from U3-5 clocks the high output from U5-5 into
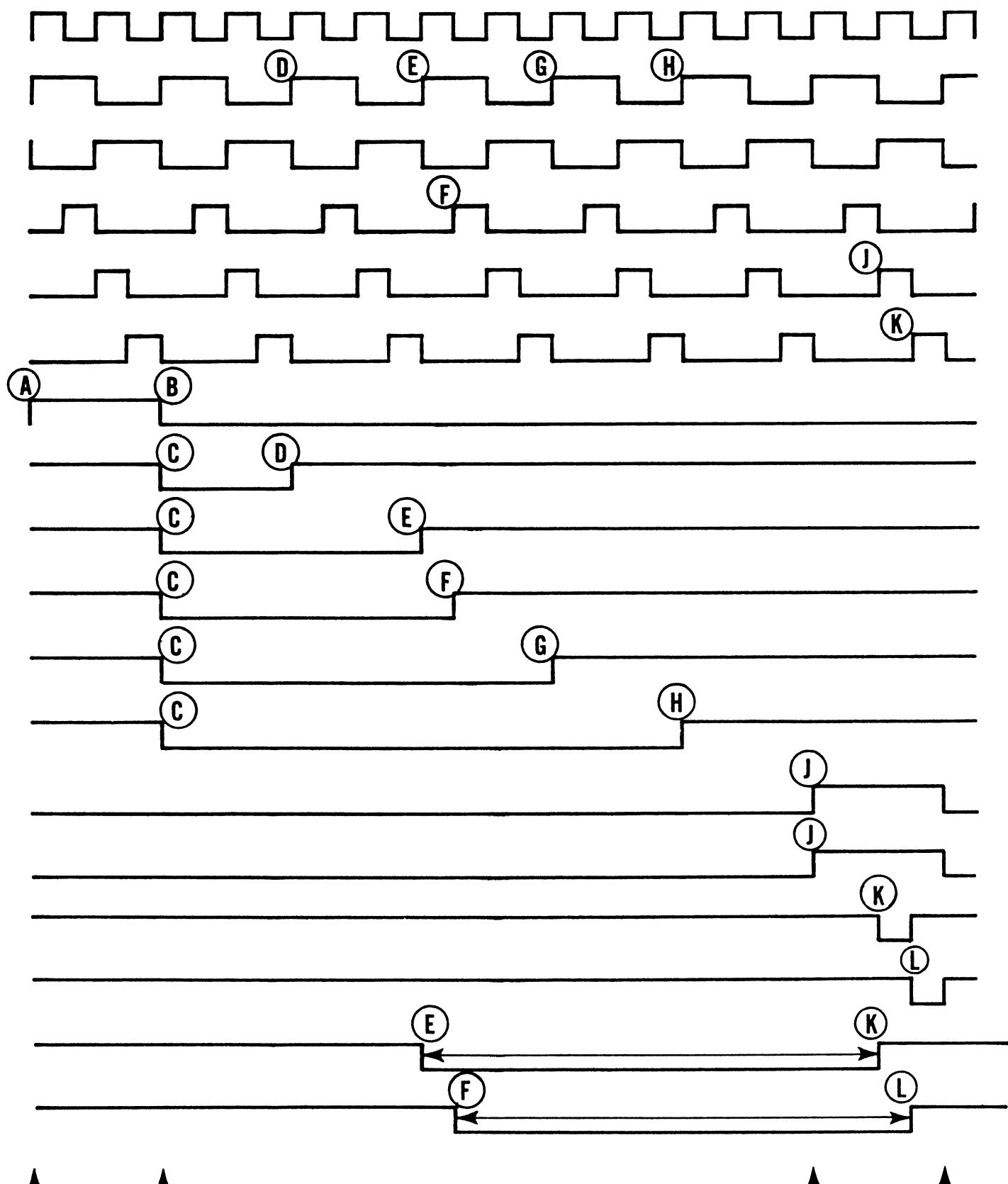
FIGURE 4-6. D/A CONTROL BOARD TIMING DIAGRAM

the data input of U5-9 E . The high Q output U5-9 provides a MSD start pulse at U7-3. U7-5 is the MSD waveform generator; when clocked, it produces a low $\overline{MSD}$ pulse via U20-6.

4-79. U2-6 clocks U6-5 high 217 ns later F . This provides the LSD start pulse to U7-11, generating the low LSD transition at U20-8. Flip-flop U6 causes a 217 ns delay between the MSD and LSD start pulses.

4-80. The next high pulse from U3-5 clocks the high Q output from U6-5 into the data (D) input of U4 Ⓖ This flip-flop lengthens the delay between the end of one count cycle and the beginning of the next count cycle. The high output of U4-5 is clocked into the data line of U4-12, with the next rising edge from U3-5. The high Q output of U4-9 Ⓗ serves several functions: It re-enables the stop gates U8-8 and U8-12, generating MSD or LSD stop pulses from U7-1 or U7-13 waveform generators, and clocks the 1.15 MHz pulse into counters 49, 10, and 11.

4-81. In the following example, 001001 is the BCD voltage select code to be set up on the comparators U21 through U26. 1.15 MHz clock pulses originating from 43 enable counters 49, 10, and 11, and initiate a count cycle starting at 000. (As the count reaches the value on the BCD voltage lines, 001, all of the comparator lines go high, producing a high MSD Comparator pulse and a high LSD Comparator pulse. Ⓙ) The same high Q from U4-9 that enabled the counters has also enabled the stop gates U8-13 and U8-10. A high pulse from U2-3 to U8-2 sends a $\overline{MSD}$ Stop pulse of 217 ns to U7-1. The low $\overline{MSD}$ Stop pulse clears U7-1 ending the MSD pulse Ⓚ . Similarly, a high U2-11 pulse enables stop gate U8-8, clearing U7-13, ending the LSD pulse Ⓛ .

4-82. The D/A Control Assembly A3 also contains a working register for range and polarity information. This data passes from the IEEE-488 Interface via A3 to relays on the Analog Assembly A5 and to the Display Driver Assembly A10. Data is sent to Standby and Current Limit annunciators on the A8 board. The circuit is examined below.

4-83. U16 in conjunction with U17, U18 and U19 serves to energize the protection and standby relay K5 on the Analog Assembly A5. U16 is used as a latch circuit. Existing range and polarity information is present at Q_0-Q_3, $\overline{Q_0}$-$\overline{Q_3}$ output lines. Any change of the data on the input lines D_0-D_3 is detected by the comparators U17-3, 4, 10 and 11, which place a low at one or more of the inputs to U18-3. A high from U18-13 triggers one-shot U19 which energizes current limit relay K5 via U27-15, U13-11 and U14-12. At the end of the 170 ms duty cycle of U19, the low going transition triggers one-shot U19. The high pulse from U19-6 clocks new range and polarity data at the D_0-D_3 inputs into the Q_0-Q_3, $\overline{Q_0}$-$\overline{Q_3}$ outputs of U16. The comparators detect the match, placing all U18 inputs high and U18-13 low in preparation for the next Range and Polarity data change. Simultaneous with clock pulse from U19-6 is a low pulse from U19-7 that keeps K5 energized for an additional 85 ms after the high from U18-13 is removed. U19, pins 10 and 7, have ensured that K5 has remained energized for 250 ms, 170 ms prior to the range and polarity change and 85 ms afterward.

4-84. The range and polarity relays on the Analog Assembly A5 are controlled by the outputs of U14-13, 14, 15 and 16. The Q lines of U16 feed these inverters the updated range and polarity information. U13-10 detects two '0's on the polarity lines, indicating the standby condition, and energizes the K5 protection relay as well as driving the K4 standby relay.

4-85. The Q outputs from U16 also provide data for the Display Driver Assembly A10. U15-2, 4, 6 and 10 convert the CMOS of A3 to TTL for the A10. The Q_2 and Q_3 outputs of U16 indicate the standby condition for the standby LED on the front panel.

4-86. The D/A Control Assembly A3 contains driver U14-11 for the current limit LED on the display. Input comes from the opto-coupler on the Digital Mother Board A4.

4-87. DISPLAY ASSEMBLY A9 AND DISPLAY DRIVER ASSEMBLY A10

4-88. The Display Assembly A9 and Display Driver Assembly A10 accept voltage data from the Digital Mother Assembly A4. Range data from the D/A Control Assembly A3 determines where the decimal point will appear and polarity data determines the sign of the 6-digit LED readout. Information for the Remote and Sequential annunciators and the IEEE-488 address indicators are also processed on the Display Driver and Display Assemblies.

4-89. The voltage select digits, 10^0 to 10^5, arrive via the Digital Mother Assembly A4 in BCD form. U3 through U8 convert the BCD to 7-segment LED Display Data. The outputs for the Display Assembly are active low. On the Display Assembly, A9, the 7-segment output is displayed on the appropriate LED.

4-90. U9 (A10) accepts range and polarity data from the D/A Control Assembly A3 via the Digital Mother Assembly A4. U9 is a 256 bit PROM. The A and B range inputs to U9 are a binary combination of one of the ranges from 1 V to 1000 V. The PROM encodes a single output, Y_1, Y_2, Y_3 or Y_4 to an active low state for one of the ranges. This single output Y_1 to Y_4 drives the decimal point on DS1, DS2, DS3 or DS4, respectively.

4-91. U9 also accepts a 2-bit binary code for polarity. These two inputs reflect the three polarity states, +, -, and standby. The PROM U9 encodes two lines; a low state on Y_5 for minus, lows on both Y_5 and Y_6 for plus. If neither line is low, the standby condition is indicated.

4-92. The blinking digit that signifies the digit about to be entered is accomplished by U1 and U2 with information from A2 and A3. U1 is a decoder. One of the lines 2 to 7 will go to the active low state depending on the digit pointer code that is applied to the A, B and C inputs. However, this is not true low level. The digit does not go out but flashes bright/dim, bright/dim, etc. The D input is normally high, but is tied to a 5.75 kHz low and to a repetition rate timer U2. The 5.75 kHz applied to U10-1 determines the brightness of the low level. The repetition rate is determined by the RC constants of the timer U2.

4-93. If the remote line to U10-9 and 10 is high, indicating the M107 is in remote status, the blinking digit must be disabled. U10-8 applies a low to U2-4, the reset pin of U2. This holds U1-12 high which disables the blinker U1.

4-94. U10-11 drives a remote annunciator. The IEEE address indicators are driven by the IEEE address code from A1.

4-95. ANALOG ASSEMBLY A5

4-96. U8 is a temperature controlled, active reference Zener device which provides a nominal Zener voltage of 6.95 V. U9 is the source of the current through the Zener. R4 and R5 act as a voltage divider causing the voltage at U9-6 to be twice that of the input U9-3. The constant current through R2 is the Zener current of 3.8 mA to U8. U7 is an LM302H op amp buffer, the output of which is a reference level to the gates of Q5 and Q8 FETS, △ ground is a power supply ground and ▽ is signal ground for the filter network, reference voltage, and main amplifier. C2 and C3 reduce noise between the grounds. The diodes CR1 and CR2 are clamps allowing no more than .6 V difference.

4-97. The following describes the development of the voltage level produced by the arrival of a MSD pulse. The LSD circuit works in a similar manner. Q5 and Q6 are series shunt choppers driven by the Q1 and Q2 flip-flop. The flip-flop state is toggled back and forth by transitions of the MSD waveforms. Q1 turns off at the start time and Q2 turns on.

4-98. When Q1 goes off, it allows the gate of Q5 to be pulled toward the voltage levels at the output of U7. This allows Q5 to turn to a low drain-to-source resistance state. When turned on it feeds current from the reference voltage through R16 and R22 to the filter input.

4-99. The LSD waveform toggles Q3 and Q4, turning Q7 and Q8 on or off. R23 and R24 provide a 1,000 X larger resistance than R16 and R22 so that when Q8 goes on, the current equals only 1/1000 as much as is provided when Q5 is on.

4-100. Where R22 and R23 connect, the MSD and LSD voltages are added together. The common tie point between R22, 23 and 36 is the summing junction for these two voltages. Q7, the shunt FET, is also tied to the negative voltage developed across R20. The drain of Q7 is tied to the source of Q8 so that either the reference voltage will flow through Q8 or the negative offset will flow through Q7. The drain of Q7 and the source of Q8 are tied together because any difference between the FET on resistances are negligible compared to R23 and R24. The R17 potentiometer is adjustable so that the effective resistances of Q6 and Q7 can be equalized. When the output is programmed to 500000 (when Q5 and Q6 are on for the same time) R17 serves as a half scale linearity compensator.

4-101. At the output of filter R37-R41, C15-C20, the voltage varies from ≈ 0 at zero programmed volts to 7 volts, the nominal value of the reference, at full scale programmed volts. This voltage is applied to the inverting input of amplifier U6. Diodes CR17 through CR24 protect the amplifier from excessive voltages. The output of U6 drives the input of the High Voltage Amplifier Assembly A6. The output of the High Voltage Amp is returned to the non-inverting input of U6 through relays K1 through K4; the resistive divider RN1; and the CAL Switching Assembly A11. The High Voltage Amplifier is an inverting amplifier. It has the effect of reversing the inverting and non-inverting inputs of U6. In this manner negative feedback occurs through the divider RN1.

4-102. On each of the three ranges, RN1 provides voltage division which results in 7 V at the tap of the Scale Factor Adjust, R50, when the output is programmed to full scale. K1 and K2 are the range selecting relays. K3 is the polarity switching relay and K4 is an output relay. The standby condition is activated

when K4 is de-energized. K1 through K4 are energized by the Darlington transistor driver U10. The inputs to U10 come from the optical couplers on the Digital Mother Board Assembly A4 via jumpers W1, 3, 4 and 6. Reed relay K5, connected across the input of the filter network, is energized by U10 pin 16 during range or polarity switching or in standby mode. When K5 is closed, the output of the high voltage amplifier is formed near zero to protect any voltage from the relay contacts during relay switching. K5 closes for 890 ms during range or polarity changes.

4-103. The output terminals are connected in the following manner:

RANGE	TERMINALS	SENSE AND OUTPUT CONNECTIONS
10 to 1000 V	LO OUT	ANALOG GND A
	LO SENSE	SIGNAL GND 1
	HI OUT	H.V. AMP OUTPUT
	HI SENSE	TAP ON RN1 FOR RANGE IN USE
IV RANGE	LO OUT	OPEN
	LO SENSE	SIGNAL GND BOTTOM OF IV DIVIDER
	HI OUT	TAP ON IV DIVIDER
	HI SENSE	OPEN

4-104. CR26 through CR29 are connected across the respective high and low sense and output terminals. They act as protection against excessive output voltages if the sense terminals are not externally connected to the output terminals.

4-105. CR30 through CR33 are connected as a full-wave bridge which develops 1400 V across C101, mounted on the rear panel. R67, 68 and 69 form a 3 MΩ bleeder network to discharge C101 when the High Voltage Amp is not installed in the unit. The 1400 V from C101 is connected to High Voltage pin 1. CR34 and CR35 form a full-wave rectifier from transformer secondary #3 that develops +140 V across C31. (Ground from the +140 V and +1400 V supplies is joined to the ground of the other analog power supplies through the current sensing resistance of R1 & CR1 on A6. CR36 through CR39 form two full-wave rectifiers which produce supplies +30 and -30 V from transformer secondary #2. U2 develops a regulated +24 V source which supplies K1 through K4 relays and the reference amps U7 through U9 and input to +15 V regulators U1 and U4. Q9 is an emitter follower developing approximately -20 V at its emitter. -15 V supplies are derived from the -20 V by U3 and U5.

4-106. HIGH VOLTAGE AMPLIFIER ASSEMBLY A6

4-107. The High Voltage Amplifier supplies the output power for all ranges. It consists of two separate power sources with an automatic crossover from low-to-high voltage output at approximately 140 V dc. The low voltage source is 140 V

input at pins 5 and 6. High voltage is from the 1400 V input at pin 1.

4-108. At outputs up to 140 V, transistors Q3 and Q12 act as a shunt to the high voltage output transistors, Q5 through Q10, and Q1 and Q2. Output is through Q4, which is both output transistor and crossover switch. The emitter of Q12 is biased at a negative voltage to enable accurate regulation at zero volts. The positive analog out signal from the amplifier on the Analog Assembly A5 turns on Q12. This voltage varies from approximately +1.79 V at zero output to +0.54 V at 1000 V output with no load. As the output voltage increases, the forward bias on the base of Q12 decreases. At an output of 140 V, bias on Q12 is reduced to the extent that the output of Q2 forward-biases the base-collector junction of Q4. At that time, the base-emitter junction of Q4 acts as a forward biased diode. Output voltage is then supplied from the high voltage supply and CR8 is reverse biased to isolate the high voltage from the +140 V supply. The shunt path comprised of Q3 and Q12 provides control for all output voltages.

4-109. R2 and CR2 establish a reverse bias for the base of Q11. The resistance setting of current limit control R101 (Front Panel) determines the amount of voltage across R1 and CR1 required to turn on Q11. Since the output current return path is through analog ground and R1, CR1 to high voltage common, Q11 will turn on when I out reaches the level determined by R101. When Q11 turns on the junction of R6 and R10 is moved in a positive direction thus increasing turn-on bias to Q12. Increased conduction in Q12 and U3 then lowers the output voltage to maintain load current at the limit value.

4-110. The High Voltage Amplifier output, pin 25, is switched and fed to the output terminals. It is also routed back to the precision divider string to provide feedback to the analog amplifier.

4-111. CAL SWITCHING ASSEMBLY A11

4-112. The CAL Switching Assembly A11 (attached to A5 Analog PC Board) works with RN1 and Scale Factor Adjusting potentiometer R50 (A5 board) to make up a voltage divider. The divider provides negative feedback to the analog amplifier, U6 (A5).

4-113. RN1 (A5) is a string of resistors which connects to A11 pins L and H. The CAL Switching Assembly A11, utilizes eight four-pole double-throw slide switches. Each switch selects a resistor when pushed up or down. Each resistor is connected into one of two signal paths, the H-G signal path or the L-Y signal path. Switches S1-S8 select resistors R1-R8, respectively, either into or out of circuit of the H-G and L-Y bus lines to provide a coarse adjustment of the scale factor calibration. Any resistance value between 0 and 394 kΩ may be selected in 1.5 kΩ increments in either the G-H or L-Y signal path. Each path is the other's compliment, the total of the two paths always approximately equal to 400 k. The voltage drop between pins H & L is 400 mV at full scale output. The voltage drop across R50 Scale Factor Adjust is ≈5 mV. Each switch on A11 moves the electrical position of R50 in the 400 mV range from RN1-2 to RN1-3. The smallest step of ±1.5 mV is provided by S1 and the largest step of ±196 mV is provided by S8.

4-114. By selecting the appropriate switches, it is possible to move the range of the resistance in conjunction with R50. R50 serves as a fine adjust and A11 serves a coarse adjustment for the scale factor.

CHAPTER 5

CALIBRATION

5-1 INTRODUCTION

Allow adequate warm-up time with bottom shield, top shield, and top cover installed. The bottom cover may be removed or loosely fitted in place with the six #10 screws removed. One hour of warm-up time should suffice, two hours or more is preferred. Access to the calibration adjustments is through the bottom shield, except for the three factory set adjustments which are located on the top side of the A5, Analog PC Board, inside the top shield. A separate procedure section describes the adjustment of the factory set calibration points: 10V Zero R8, FET SW Zero R74, and CAL Switching Assembly A11.

In the calibration procedure, each adjustment affects only the conditions for subsequent calibration steps and has no effect on other adjustments. If one calibration adjustment is repeated, only the later steps need to be checked and readjusted. After the 10V Range adjustments are completed, the 1V, 100V and 1000V Range adjustments may be made independently and in any sequence.

WARNING: PERSONNEL HAZZARD

Due to the high voltage power supplies present on the Analog and High Voltage Amplifier PC boards the following cautions must be observed:

1)   Top and Bottom Shields must be in place

2)   Calibrate only with positive polarity output selected.

3)   Use an insulated adjustment tool.

Make sure the shorting links are securely installed between the respective sense and output terminals. If rear panel output or remote sensing is used with the front panel output, best accuracy is obtained by calibrating the M107 with the same sensing connections that will be used in the particular application.

5-2 CALIBRATION PROCEDURE

1)   Select 1000V RANGE, + POLARITY and CLEAR. Adjust 1 kV ZERO (R44) for Zero Volts output ±1 mV. If R44 will not reach Zero or is at one end of rotation, see the separate section for adjustment of FET Switch Zero (R74).

2)   Select 10V RANGE, + POLARITY, and CLEAR. Check output for Zero Volts ±20 μV. If adjustment is needed to balance 10V Zero with 1000V Zero, see separate section for adjustment of 10V ZERO ADJ (R8).

3)   Select 10V RANGE, + POLARITY and program 9.99999V. Adjust SCALE FACTOR ADJ (R50) for 9.99999V ±20 μV output. If R50 will not allow the required output to be reaced, refer to the CAL Switching Assembly procedure.

4)   Select 10V RANGE, + POLARITY, and program 9.99000V. Use MSD ADJ (R27) to set output to 9.99000V ±20 μV.

5)   Select 10V RANGE, + POLARITY and program 5.00000V. Adjust 1/2 SCALE ADJ (R17) for 5.00000V ±20 μV output.

6)   Select 10V RANGE, + POLARITY and program 0.00999V. Adjust LSD ADJ (R24) for 9.99 mV ±20 μV output.

7)   Select 1V RANGE, + POLARITY and program .999999V. Adjust 1V ADJ (R63) for .999999V ±2 μV output.

8)   Select 100V RANGE, + POLARITY and program 99.9999V. Adjust 100V ADJ (R60) for 99.9999V ±200 μV output.

9)   Use CAUTION with High Voltage Output — Select 1000 V RANGE, + POLARITY and program 999.999V. Adjust 1 kV ADJ (R59) for 999.999V ±2 mV output.

5-3 SPECIAL PROCEDURES: FACTORY SET CALIBRATION

The following three special procedures require removal of the top cover and top shield to access adjustments on the A5, Analog Board. When the top shield is removed observe cautions.

CAUTION

The Power Transistors and Heatsinks on the A6, High Voltage Amplifier PC Board have voltages in excess of 1000 Vdc.

FET Switch Zero Adjust (R74)

NOTE

This adjustment should be made only if 1 kV ZERO ADJ in Step 1) did not allow zero output to be reached, or if the 1 kV zero point is near one end of R44's adjustment range where resolution is poor.

1)   Select 1000V RANGE, +POLARITY and CLEAR.

2)   Center the 1 kV ZERO ADJ potentiometer R44 to its electrical center as follows: turn R44 to its CW and CCW rotation limits and note the output voltage at each end. Set R44 for an output voltage at the algebraic mid-point between the two output limits.

3)   Adjust the FET SW ZERO potentiometer R74 for Zero Volts output ± 2 mV.

4)   Replace top shield and top cover and allow unit to re-stabilize (approximately 15 to 20 minutes) before returning to Step 1) in the Calibration procedure.

10V Zero Adjust (R8)

The purpose of this adjustment is to make the 10V RANGE zero output voltage "track" with the 1000V RANGE zero offset. Thus, if the 1 kV zero output is -3 mV, for example, the 10V RANGE zero output should be set to -30 μV with 10V zero potentiometer (R8). The 1 kV Zero adjustment will then set the zero output for all ranges.

1)   Select 1 kV RANGE, + POLARITY and CLEAR. Adjust 1 kV ZERO R44, if necessary, for zero output ±1 mV.

2)   Select 10V RANGE, + POLARITY and CLEAR. Remove the top cover and top shield. Observe caution with the exposed high voltage as noted above. Adjust 10V ZERO (R8) for zero output ± 10 μV.

3)   Replace top shield and top cover and allow unit to re-stabilize (approximately 15 to 20 minutes) before returning to Step 1) in the Calibration procedure.

CAL Switching Assembly (A11)

The switches on the CAL Switching PC Assembly (A11) provide a coarse adjustment of the scale factor calibration. This adjustment requires some internal disassembly of the unit and can not be done as part of a final calibration.

This adjustment is factory set and will not require changing under normal conditions. The adjustment will probably be needed if the reference A5-U8 or the feedback divider A5-RN1 if replaced.

Procedure:

1)   Select 10V RANGE, + POLARITY and program 9.99999V.

2)   Adjust Scale Factor ADJ, R50, for the voltage output midway between the outputs at the extreme CW and CCW settings of R50.

3)   Turn off the unit and remove the top cover, top shield, and the two shield cans on the A5, Analog PC Board.

Switch	Approximate Effect on Full Scale Output	
A11-S1	±225	ppm
A11-S2	±450	ppm
A11-S3	±900	ppm
A11-S4	±1800	ppm
A11-S5	±3600	ppm
A11-S6	±7200	ppm
A11-S7	±14400	ppm
A11-S8	±28800	ppm

WARNING
PERSONNEL HAZZARD

The Heatsinks and Transistors on High Voltage Amplifier A6, have voltages up to 1500 Vdc on their exposed surfaces. Use great care in moving the switch positions on A11, CAL Switching Assembly to avoid touching the A6 Heatsinks or Transistors.

4) Turn on the unit and program +9.99999V (10V RANGE). Using the following table as a guide, find the combination of A11 switch positions that gives an output voltage as close as possible to +9.99999V. The up and down switch positions correspond to higher and lower outputs respectively.

5) After the proper setting of A11 switch is obtained, turn off power to the unit. Allow about 30 seconds for the high voltage supplies to discharge and then replace the shield cans, top shield and top cover. The unit may now be warmed up for the final calibration of Section 5-2.

REPLACEABLE PARTS

6-1 INTRODUCTION

This chapter contains the spare parts list for each assembly in the Model M107 Precision D.C. Voltage Source. Chapter 7 shows the assemblies where the listed parts are installed. Ordering information is included and should be used when purchasing parts from the factory. Explanation of the column listings and Table 6-1 Manufacturer's Code-To-Name Name Index are also included.

6-2. PART ORDERING INFORMATION

To order a part from the Replaceable Parts List, state the Systron-Donner part number, and incicate the quantity required and address the order to the nearest Systron-Donner Sales or Service Center.

To order a part not listed in the Replaceable Parts List, state the instrument model number, instrument serial number, the description and function of the part and the number of parts required. Address the order to the nearest Systron-Donner Sales or Service Center.

6-3. PARTS LIST

The replaceable parts lists are placed in A numbered sequence.

Each column in the parts lists provide specific information relating to the listed parts as follows:

(1) DESIGNATOR: Reference numbers applicable to assemblies are listed in alpha-numeric order.

(2) COMPONENT NOMENCLATURE AND DESCRIPTION: Component names and specifications are provided in these columns and include value, tolerance, wattage rating, working voltages, construction, etc.

(3) MANUFACTURER'S CODE: H4-2 Federal Supply Code numbers are listed to identify component manufacturers. A Manufacturer's Index is provided in this chapter for cross-reference.

(4) MANUFACTURER'S PART NUMBER: True manufacturer part numbers are listed in this column.

(5) SD STOCK NUMBER: The Systron-Donner stock number is listed in this column.

(6) T/Q (Total Quantity): This quantity, appearing after an item entry, indicates the number of times the component is used in that assembly. The total quantity for each part is given only once — at the first appearance of the part number in the list.

TABLE 6-1 MANUFACTURER'S CODE-TO-NAME INDEX

Code	Name & Address	Code	Name & Address
00809	Croven Ltd. 500 Beech Street Whitby Ontario, Canada	06383	Panduit Corp. 17301 Ridgeland Tinley Park, IL 60477
01121	Allen-Bradley Co. 1201 So. 2nd Street Milwaukee, WI 53204	06540	Amatom Electronic Hardware Division of Mite Corp. 81 Rockdale Avenue New Rochelle, NY 10806
01295	Texas Instruments Inc. Semiconductor & Components Div. 13500 No. Central Expressway Dallas, TX 75231	07293	Bratu Engineering Co. 2048 Rascher Avenue Chicago, IL 60625
02660	Bunker Ramo Corp. Amphenol Connector Division 2801 So. 25th Avenue Broadview, IL 60153	08289	Delbert Blinn Co. Inc. P.O. Box 2007 1678 Mission Blvd. Pomona, CA 91766
02735	RCA Corp. Solid State Division Route 202 Somerville, NJ 08876	09353	C and K Components Inc. 103 Morse Newton, MA 02158
03296	Nylon Molding Corp. 40 Brown Street Springfield, NJ 07081	11236	CTS of Berne Inc. 406 Parr Road Berne, IN 46711
03508	General Electric Co. Semiconductor Products Dept. Electronics Park Syracuse, NY 13201	12014	Chicago Rivet & Machine Co. 950 So. 25th Avenue Bellwood, IL 60104
03877	Transitron Electronic Corp. 168 – 186 Albion Street Wakefield, MA 01880	13103	Thermalloy Co. 2021 W. Valley View Lane Dallas, TX 75234
03888	Pyrofilm Corp. 60 So. Jefferson Road Whippany, NJ 07981	16299	Corning Glass Works Electronic Components Division 3900 Electronics Drive Raleigh, NC 27604
04713	Motorola Semiconductor Products Inc. 5005 E. McDowell Road Phoenix, AZ 85008	18324	Signetics Corp. 811 E. Arques Sunnyvale, CA 94086
05245	Corcom Inc. 2857 No. Halsted Street Chicago, IL 60657	19701	Mepco/Electra Inc. Electra Division P.O. Box 760 Mineral Wells, TX 76067
05574	Viking Industries Inc. 21001 Nordhoff Chatsworth, CA 91311	24796	Parelco Inc. P.O. Box 116 San Juan Capistrano, CA 92675

TABLE 6-1 MANUFACTURER'S CODE-TO-NAME INDEX (Cont'd)

Code	Name & Address	Code	Name & Address
24655	General Radio 300 Baker Avenue Concord, MA 01742	71279	Cambridge Thermonic Corp. 445 Concord Avenue Cambridge, MA 01238
27264	Molex Products Co. 5224 Katrine Avenue Downers Grove, IL 60515	71400	Bussmann Mfg. Division of McGraw-Edison Co. 2536 W. University Street St. Louis, MO 63017
27556	IMB Electronic Products Inc. 15401-E Carmenita Road Santa Fe Springs, CA 90670	71590	Globe-Union Inc. Centralab Electronics Division 5757 No. Green Bay Avenue Milwaukee, WI 53201
28480	Hewlett-Packard Co. 1501 Page Mill Road Palo Alto, CA 94304	71785	TRW Electronic Components Cinch Connector Operations 1501 Morse Avenue Elk Grove Village, IL 60007
28520	Heyman Mfg. Co. 147 No. Michigan Avenue Kenilworth, NJ 07033	73138	Beckman Instruments Inc. Helipot Division 2500 Harbot Blvd. Fullerton, CA 92634
30146	A P Inc. 72 Corwin Drive Painesville, OH 44077	73734	Federal Screw Products Inc. 3917 No. Kenzie Avenue Chicago, IL 60618
31918	International Electro Exchange Inc. 8081 Wallace Road Eden Prairie, NM 55343	73803	Texas Instruments Inc. Metallurigical Meterials Division Attleboro, MA 02703
51495	R & D Plastics 780 – 32nd Street Richmond, CA 94804	73957	Groov-Pin Corp. 1125 Hendricks Causeway Ridgefield, NJ 07657
50522	Monsanto Co. Electronics Special Products 10131 Bubb Road Cupertino, CA 95014	75915	Littlefuse Inc. 800 E. Northwest Highway Des Plaines, IL 60016
52542	Systron-Donner Corp. Instrument Division 2727 Systron Drive Concord, CA 94518	76381	Minnesota Mining and Mfg. Co. 3-M Center St. Paul, MN 55101
55210	Gettig Engineering & Mfg. P.O. Box 85 Off Route 45 Spring Mill, PA 16875	77342	AMF Inc. Potter & Bumfield Division P.O. Box 522 - 1200 E. Broadway Princeton, IN 47570
56289	Sprague Electronic Co. North Adams, MA 01247	78189	Illinois Tool Works Inc. Elgin, IL 60120
70903	Gelden Corp. 415 So. Kilpatrick Chicago, IL 60644		

TABLE 6-1 MANUFACTURER'S CODE-TO-NAME INDEX (Cont'd)

Code	Name & Address	Code	Name & Address
79727	C-W Industries P.O. Box 96 550 Davisville Road Warminister, PA 18974	91418	Radio Materials Co. 4242 W. Bryn Mawr Chicago, IL 60646
79963	Zierick Mfg. Co. Radio Circle Mt. Kisco, NY 10549	91506	Augat Inc. 33 Perry Avenue Attleboro, MA 02703
80294	Bourns Inc. Instrument Division 6135 Magnolia AVenue Riverside, CA 92506	91637	Dale Electronics Inc. P.O. Box 609 Columbus, NB 68601
81349	MIL STD	91737	ITT Cannon/German 922 So. Lyon Street Santa Ana, CA 72705
82389	Switchcraft Inc. 5555 No. Elston Avenue Chicago, IL 60630	95146	ALCO Electronic Product Inc. P.O. Box 1348 Lawrence, MA 01842
83330	Herman H. Smith Inc. 812 Snediker Avenue Brooklyn, NY 11207	96733	San Fernando Electric Mfg. Co. 1509 First Street San Fernando, CA 91341
86797	Rogan Corp. 3455 Woodhead Drive Northborrk, IL 60062	96906	MIL STD
88245	Litton Systems Inc. USECO Division 13536 Saticoy Street Van Nuys, CA 91409	98978	International Electronic Research Corp. 135 W. Magnolia Avenue Burbank, CA 91502
90201	Mallory Capacitor Co. P.O. Box 372 3029 E. Washington Street Indianapolis, IN 46206	99392	S T M Corp. 2904 Chapman Street Oakland, CA 94601
		99779	Bunker Ramo Corp. 24 No. Lansdowne Avenue Lansdowne, PA 19050

REPLACEABLE PARTS LIST

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
TITLE		MODEL M107 SHIPPING ASSEMBLY #067530 Rev A				
		ASSEMBLY, Final	52542	075129	075129	1
		LINE CORD	70903	BR-1736	102407	1
		CONNECTOR, Rectangular 14-pin Plug	02660	57-30140	101181	1

REPLACEABLE PARTS LIST

TITLE		MODEL M107 FINAL ASSEMBLY #075129 Rev C				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
1		ASSEMBLY, Test	52542	06786101	06786101	1
2		COVER, Bottom	52542	067815	067815	1
3		COVER, Top	52542	067814	067814	1
4		STRIP, Trim	52542	033762	033762	2
5		LABEL, High Voltage	52542	067542	067542	1
6		BAIL	52542	067499	067499	1
7		TRIM, Side	52542	067868	067868	2
8		HANDLE	52542	067440	067440	2
9		SHIELD, Top	52542	067839	067839	1
10		SHIELD, Bottom	52542	067840	067840	1
11		FOOT	52542	067498	067498	4
12		SHIELD, AC	52542	067882	067882	1
14		SCREW, PHMS 4-40 x 1/4	96906	MS51957-13	10062604	6
15		SCREW, PHMS 6-32 x 5/16	96906	MS51957-27	10063205	15
16		SCREW, FHMS 6-32 x 1/2	96906	MS24693-C28	10073108	8
17		SCREW, FHMS 6-32 x 7/16	96906	MS24693-C27	10073107	8
18		SCREW, Cap Socket Head 8-32 x 3/8		KS17-832	103382	4
19		SCREW, FHMS 10-32 x 1/2	96906	MS24693-C272	10075808	12
21		WASHER, Split-Lock #4	96906	MS35338-135	100711	6
22		WASHER, Internal Tooth #6	96906	MS35333-71	100647	15
24		NUT, Kep 6-32	78189	511-061800-01	112472	4

REPLACEABLE PARTS LIST

TITLE		MODEL M107 TEST ASSEMBLY #067861 Rev E				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
1		ASSEMBLY, Front Subpanel	52542	067860	067860	1
2		ASSEMBLY, Cross Member Front	52542	067887	067887	1
3		ASSEMBLY, Center Brace Front	52542	067896	067896	1
4		ASSEMBLY, Cross Member Rear	52542	067738	067738	1
5		GUSSET, Right	52542	067678	067678	1
6		GUSSET, Left	52542	067677	067677	1
7		ASSEMBLY, Rear Panel	52542	067859	067859	1
8		GUIDE, Card	52542	02134011	02134011	3
9	A1	ASSEMBLY, IEEE-488 Interface PC	52542	06769901	06769901	1
10	A2	ASSEMBLY, Encoder PC	52542	06775001	06775001	1
11	A3	ASSEMBLY, D/A Control PC	52542	06775501	06775501	1
12	A6	ASSEMBLY, High Voltage Amp PC	52542	06777001	06777001	1
13	A4	ASSEMBLY, Digital Mother Board PC	52542	06775301	06775301	1
14	A5	ASSEMBLY, Analog PC	52542	06781701	06781701	1
15		TAPE, Cable 20-pin	30146	922521-20-02-14	117401	1
16		TAPE, Cable 34-pin 6"	30146	922521-34-02-06	117913	2
17		TAPE, Cable 34-pin 15"	30146	922521-34-02-15	117914	1
18		SHIELD, Top (Not Shown)	52542	075251	075251	1
20	K1 thru K4	RELAY, 6 pole (26 V)	77342	R10-E1112-2	101295	4
21		SPRING, Relay	24796	20C251	10242601	4
22		GROMMET, Caterpillar	03296	G51H-A	102749	A/R
24		RESISTOR Shield	52542	067865	067865	1
25		AMPLIFIER Shield	52542	067813	067813	1
26		FOAM, Block	52542	075209	075209	1
27		SUPPORT, PC	52542	075208	075208	2
28		BUSHING, Snap	28520	5B-375-4	100781	2
29		KNOB	86797	RS-67-1-DC-M-L	100976	1
30		JUMPER	55210	L-2007-1	102879	10
32		TIE, Cable	06383	SSTIM	100753	A/R
33	U15,U16	INTEGRATED CIRCUIT, Voltage Regulator	04713	MC7805CP	045256	2
42		SCREW, PHMS 4-40 x 7/16	96906	MS51957-16	10062607	2
43		SCREW, PHMS 6-32 x 5/16	96906	MS51957-27	10063205	29
44		SCREW, PHMS 6-32 x 1/2	96906	MS51957-30	10063208	4
45		SCREW, FHMS 6-32 x 3/8	96906	MS24693-C26	10073106	8
46		SCREW, FHMS 8-32 x 1/4	96906	MS24693-C46	10074304	6
47		SCREW, FHMS 8-32 x 3/8	96906	MS24693-C48	10074306	6
50		WASHER, Flat #6	86928	5710-23-10	100662	25
51		WASHER, Split-Lock #6	96906	MS35338-136	100712	31
53		NUT, Kep #4	78189	511-041800-00	100941	2
54		NUT, Kep #6	78189	511-061800-01	112472	2

REPLACEABLE PARTS LIST

TITLE		MODEL M107 FRONT PANEL ASSEMBLY #067860 Rev D				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
1		PANEL, Sub	52542	067720	067720	1
2	R101	RESISTOR, Variable 10 k 20%, 1/2W	52542	075106	075106	1
3		POST, Red Binding	05276	3770-0	117885	2
4		POST, Black Binding	05276	3770-2	117886	2
5		POST, White Binding	05276	3770-9	117887	1
6	A8	ASSEMBLY, Voltage Select PC	52542	06771901	06771901	1
7	A7	ASSEMBLY, Digit Select PC	52542	06771701	06771701	1
8	A10	ASSEMBLY, Display Driver PC	52542	06773101	06773101	1
9	A9	ASSEMBLY, Display PC	52542	06772601	06772601	1
10		NUT, Hex 4-40	96906	NAS671C4	100622	10
11		WASHER, Flat #4	96906	MS15795-803	100703	14
12		WASHER, Split-Lock #4	96906	MS35338-135	100711	14
13		SCREW, PHMS 4-40 x 1/2	96906	MS51957-17	10062608	2
14		SCREW, PHMS 4-40 x 5/16	96906	MS51957-14	10062605	2
15		PANEL, Decorative	52542	067778	067778	1
16		TAPE, Adhesive	76381	950	117910	A/R
18		SWITCH, Toggle Power	08353	92015H3ZQ	117147	1
19		NUT, Dress 1/4-40	09353	B7099N	101086	1
20		LINK, Shorting	24655	0938-9503	100561	3
21	C102, C103	CAPACITOR, Ceramic .01 μF 20%, 2 kV	56289	BL-S10	100362	2

REPLACEABLE PARTS LIST

TITLE		MODEL M107 REAR PANEL ASSEMBLY #067859 Rev D				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
1		PANEL, Rear	52542	067732	067732	1
2	S102	SWITCH, Slide	82389	46206LFE	102340	1
3	XF101	POST, Fuse	75915	345002	117381	1
4	F101	FUSE, 1/2A	71400	MDL 1/2	100589	1
5	Z101	FILTER, Line	05245	3EF1	102461	1
6	T101	TRANSFORMER	52542	067743	067743	1
7	C101	CAPACITOR,	16727	KMOC2M2	117920	1
8		BRACKET, Mounting Capacitor	16727	By Description	117925	1
9		LUG, Solder #8	78189	2104-08-00	102961	1
10		LUG, Solder #4	83330	1416-4	100509	1
11		NUT, Kep 8-32	78189	511-081800-00	100940	6
12		NUT, Kep 4-40	78189	511-041800-00	100941	2
14		NUT, Hex 8-32	73734	70208	100659	1
15		NUT, Hex 4-40	96906	NAS671C4	100622	1
16		WASHER, Split-Lock #4	96906	MS35338-135	100711	4
18	J101	CONNECTOR, Rear Panel Input	91737	KPT00A14-5S	117696	1
19		SCREW, PHMS 4-40 x 1/4	96906	MS51957-13	10062604	3
20		SCREW, PHMS 4-40 x 5/16	96906	MS51957-14	10062605	1
21		SCREW, PHMS 4-40 x 3/8	96906	MS51957-5	10062606	4
22		SCREW, PHMS 4-40 x 7/16	96906	MS51957-16	10062607	2
23		SCREW, PHMS 8-32 x 7/16	96906	MS51957-44	10064207	4
24		SCREW, PHMS 8-32 x 1/2	96906	MS51957-45	10064208	2
25		SCREW, PHMS 8-32 x 1/4	96906	MS51957-41	10064204	1
32		ASSEMBLY, IEEE-488 Interface Cable	52542	067884	067884	1
35	J103	CONNECTOR, Rectangular 14-pin	02660	57-40140	101180	1
36		SCREW, PHMS 2-56 x 1/4	96906	MS51957-3	10062504	5
37		SCREW, PHMS 2-56 x 3/8	96906	MS51957-5	10062506	1
38		WASHER, Split-Lock #2	96906	MS35337-77	100661	6
39		NUT, Hex 2-56	96906	MS35649-224	100636	1

REPLACEABLE PARTS LIST

TITLE		MODEL M107 IEEE-488 INTERFACE CABLE ASSEMBLY #067884 Rev B				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
2		ASSEMBLY, Switch Plate	52542	067886	067886	1
3		CONNECTOR, Rectangular 24-pin	02660	57-20240-2 (383)	117054	1
4		CONNECTOR, Mounting Plate	52542	067541	067541	1
5		WASHER, Split-Lock #8	96906	MS35338-137	100713	2
6		STUD, Mounting Connector	52542	057361	057361	2
7		TIE, Cable	06383	SSTIM	100753	A/R
8		LUG, Solder #2	79963	341-.093	100759	1
		SWITCH PLATE ASSEMBLY	**52542**	**067886**	**067886**	Ref
1		PLATE, Switch	52542	067535	067535	1
2		SWITCH, Slide SPDT	79727	G-111-SPDT	102325	5
3		RIVET	12014	R-3484x1/8 NICL	100924	10

REPLACEABLE PARTS LIST

TITLE	A1, IEEE-488 INTERFACE BOARD PC ASSEMBLY #06769901 Rev A					
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	C1 thru C4	CAPACITOR, Ceramic .05 µF +80-20%, 10V	71590	UK10-503	100122	6
	C5	CAPACITOR, DP Ceramic 330 pF 5%, 100V	96733	DB45BY331J	117636	3
	C6	CAPACITOR, Ceramic .001 µF 20%, 50V	71590	CW15C102M	100251	1
	C7	Same as C1				
	C8	Same as C5				
	C9	Same as C5				
	C10	Same as C1				
	C11	CAPACITOR, Tant 39 µF 10%, 10V	56289	150D396X9010B2	100183	2
	C12	Same as C11				
	R1	RESISTOR, CC 10 k 5%, 1/4W	01121	CB1035	101570	3
	R2	Same as R1				
	R3	RESISTOR, CC 33 k 5%, 1/4W	01121	CB3335	101576	2
	R4	Same as R1				
	R5	Same as R3				
	RN1	RESISTOR, Module 8 x 3k/6.2k, 2%	73138	785-5-R-3K/6.2K	117500	2
	RN2	Same as RN1				
	RN3	RESISTOR, Module 13 x 10 k, 2%	11236	760-1-R10K	117241	1
	RN4	RESISTOR, Module 5 x 15 k, 2%	73138	783-1-R15K	117559	1
	U1	INTEGRATED CIRCUIT, CMOS Binary Up/Down Counter	04713	MC14516BCP	117113	8
	U2	INTEGRATED CIRCUIT, CMOS BCD-to-Decimal Decoder	04713	MC14028BCP	045286	4
	U3	INTEGRATED CIRCUIT, CMOS 3-Input AND Gate	04713	MC14073B	117380	5
	U4	INTEGRATED CIRCUIT, CMOS Dual D Flip-Flop	04713	MC14013BCP	103199	5
	U5	Same as U4				
	U6	INTEGRATED CIRCUIT, CMOS 3-Input OR Gate	04713	MC14071CP	103940	3

REPLACEABLE PARTS LIST

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
		TITLE A1, IEEE-488 INTERCONNECT BOARD PC ASSEMBLY #06769901 (Cont'd)				
	U7	Same as U6				
	U8	Same as U3				
	U9	Same as U4				
	U10	Same as U3				
	U11	INTEGRATED CIRCUIT, CMOS 3-Input NAND Gate	04713	023BCP	116099	1
	U12	Same as U6				
	U13	INTEGRATED CIRCUIT, CMOS Dual 4-Input AND Gate	04713	MC14082BCP	117111	1
	U14 thru U16	Same as U2				
	U17 thru U23	Same as U1				
	U24	Same as U3				
	U25	Same as U4				
	U26	INTEGRATED CIRCUIT, CMOS Dual Multivibrator	04713	MC14528BCP	045289	2
	U27	INTEGRATED CIRCUIT, CMOS 4 2-Input NAND Gate	04713	MC14011CP	103937	3
	U28	Same as U3				
	U29	Same as U27				
	U30	INTEGRATED CIRCUIT, CMOS 4 2-Input Exclusive NOR Gate	04713	MC14077B	117672	1
	U31	INTEGRATED CIRCUIT, TTL SSI Quad 2-Input AND Gate	01295	SN74LS08N	103967	1
	U32	INTEGRATED CIRCUIT, CMOS Hex Inverter Buffer	02735	MC14049BCP	103217	3
	U33	Same as U32				
	U34	INTEGRATED CIRCUIT, CMOS 4-Bit AND/OR Selector	04713	MC14519BCP	045288	7
	U35 thru U40	Same as U34				
	U41	Same as U4				
	U42	Same as U26				
	U43	Same as U32				
	U44	Same as U27				

TITLE		A1, IEEE-488 INTERCONNECT BOARD PC ASSEMBLY #06769901 (Cont'd)				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	U45	INTEGRATED CIRCUIT, CMOS 4 2-Input AND Gate	01295	MC14081BCP	116101	1
	U46	INTEGRATED CIRCUIT, TTL SSI Dual Positive OR Gate	01295	SN75453BP	045291	1
	U47	INTEGRATED CIRCUIT, TTL SSI 6 Inverter Schmitt	01295	SN74LS14N	117083	2
	U48	Same as U47				
		PIN, Spring	˙3957	50-094-0250	100752	2
		EXTRACTOR	51495	1743	100865	1
		EXTRACTOR, Stamped A1	52542	03984201	03984201	1
		BOARD, PC	52542	067699	067699	1

REPLACEABLE PARTS LIST

TITLE		A2, ENCODER BOARD PC ASSEMBLY #06775001 Rev B				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	C1	CAPACITOR, Tant 22 μF 10%, 15V	56289	150D226X9015B2	100125	2
	C2	CAPACITOR, Ceramic .001 μF 20%, 1 kV	91418	TYPE B	100076	4
	C3	Same as C2				
	C4	CAPACITOR, Ceramic .05 μF +80-20%, 10V	71590	UK10-503	100122	2
	C5	Same as C2				
	C6	Same as C2				
	C7	Same as C4				
	C8	Same as C1				
	R1	RESISTOR, CC 47 k 5%, 1/4W	01121	CB4735	101574	1
	R2	RESISTOR, CC 22 k 5%, 1/4W	01121	CB2235	101572	4
	R3	Same as R2				
	R4	Same as R2				
	R5	RESISTOR, CC 4.7 k 5%, 1/4W	01121	CB4725	101598	1
	R6	Same as R2				
	RN1	RESISTOR, Module 13 x 10k	11236	760-1-R10K	117241	3
	RN2	Same as RN1				
	RN3	Same as RN1				
	U1	INTEGRATED CIRCUIT, CMOS 4 2-Input AND Gate	04713	MC14081BCP	116101	6
	U2	Same as U1				
	U3	INTEGRATED CIRCUIT, CMOS BCD-to-Decimal Decoder	04713	MC14028BCP	045286	1
	U4	INTEGRATED CIRCUIT, CMOS Hex Inverter Buffer	02735	MC14049BCP	103217	1
	U5	INTEGRATED CIRCUIT, CMOS Dual Multivibrator	04713	MC14528CP	045289	2
	U6	INTEGRATED CIRCUIT, CMOS Dual D Flip-Flop	04713	MC14013BCP	103199	2
	U7	INTEGRATED CIRCUIT, LIN MSC Darlington NPN 500 mA	04713	MC1413P	117558	1
	U8	INTEGRATED CIRCUIT, CMOS 3-Input OR Gate	04713	MC14071CP	103940	3

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
TITLE		**A2, ENCODER BOARD PC ASSEMBLY #06775001 (Cont'd)**				
	U9	Same as U8				
	U10	Same as U5				
	U11	Same as U6				
	U12	Same as U8				
	U13	INTEGRATED CIRCUIT, CMOS Binary Up/Down Counter	04713	MC14516BCP	117113	1
	U14	INTEGRATED CIRCUIT, CMOS 8-Bit Priority Encoder	04713	MC14532BCP	116213	2
	U15	Same as U1				
	U16	INTEGRATED CIRCUIT, CMOS R-S NAND Latch	04713	MC14044B	117379	1
	U17	Same as U1				
	U18	INTEGRATED CIRCUIT, CMOS Quad 2-Input NOR Gate	04713	MC14001CP	045283	1
	U19	Same as U14				
	U20	Same as U1				
	U21	Same as U1				
		PIN, Spring	73957	50-094-0250	100752	2
		EXTRACTOR	51495	1743	100865	1
		EXTRACTOR, Stamped A2	52542	03984202	03984202	1
		BOARD, PC	52542	067750	067750	1

REPLACEABLE PARTS LIST

TITLE			A3, D/A CONTROL BOARD PC ASSEMBLY #06775501 Rev B			
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	C1	CAPACITOR, Ceramic .05 μF +80-20%, 10V	71590	UK10-503	100122	6
	C2	CAPACITOR, DP Ceramic 22 pF 5%, 100V	96733	DB44BY220J	117641	2
	C3	Same as C2				
	C4	Same as C1				
	C5	Same as C1				
	C6	CAPACITOR, Ceramic .1 μF 20%, 50V	56289	5C023104X0500C5	100178	1
	C7	CCAPACITOR, DP Ceramic 330 pF 5%, 100V	96733	DB45BY331J	117636	1
	C8	Same as C1				
	C9	Same as C1				
	C10	CAPACITOR, Tant 22 μF 10%, 15V	56289	150D226X9015B2	100125	1
	C11	Same as C1				
	C12	CAPACITOR, Tant .001 μF 20%, 1 kV	91418	TYPE B	100076	2
	C13	Same as C12				
	C14	CAPACITOR, Tant 2.2 μF 10%, 25V	56289	196D225X9025HA1	103495	1
	CR1	DIODE, Signal 50V	03508	1N4151	100385	2
	CR2	Same as CR1				
	CR3	DIODE, Signal 70V	28480	5082-2800	100442	2
	CR4	Same as CR3				
	R1	RESISTOR, CC 6.8 k 5%, 1/4W	01121	CB6825	101544	2
	R2	Same as R1				
	R3	RESISTOR, CC 2.2 k 5%, 1/4W	01121	CB2225	101562	2
	R4	Same as R3				
	R5	RESISTOR, CC 1 k 5%, 1/4W	01121	CB1025	101569	2
	R6	Same as R5				
	R7	RESISTOR, CC 4.7 k 5%, 1/4W	01121	CB4725	101598	2
	R8	RESISTOR, CC 330 Ω 5%, 1/4W	01121	CB3315	101536	2

REPLACEABLE PARTS LIST

TITLE	A3, D/A CONTROL BOARD PC ASSEMBLY #06775501 (Cont'd)					
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R9 thru R13	RESISTOR, CC 470 Ω 5%, 1/4W	01121	CB4715	101625	5
	R14	Same as R8				
	R15	Same as R7				
	R16	RESISTOR, CC 10 k 5%, 1/4W	01121	CB1035	101570	3
	R17	Same as R16				
	R18 thru R21	RESISTOR, CC 270 Ω 5%, 1/4W	01121	CB2715	101542	4
	R22	Same as R16				
	R23	RESISTOR, CC 22 k 5%, 1/4W	01121	CB2235	101572	1
	U1	INTEGRATED CIRCUIT, TTL SSI Dual Rectifier One Shot	01295	SN74LS123N	103976	1
	U2	INTEGRATED CIRCUIT, TTL SSI Quad 2-Input AND Gate	01295	SN74LS08N	103967	1
	U3 thru U7	INTEGRATED CIRCUIT, TTL SSI Dual D Flip-Flop	01295	SN74LS74N	103132	5
	U8	INTEGRATED CIRCUIT, TTL SSI 3-Input NAND Gate	01295	SN74LS10N	103968	1
	U9	INTEGRATED CIRCUIT, TTL MSI Synchronous 4-bit Counter	01295	SN74LS160AN	117871	3
	U10	Same as U9				
	U11	Same as U9				
	U12	INTEGRATED CIRCUIT, TTL SSI Hex Inverter	01295	SN74LS04N	103749	1
	U13	INTEGRATED CIRCUIT, CMOS 4 2-Input NAND Gate	04713	MC14011CP	103937	1
	U14	INTEGRATED CIRCUIT, LIN MSC Darlington NPN 500 mA	04713	MC1413P	117558	1
	U15	INTEGRATED CIRCUIT, CMOS Hex Inverter Buffer	02735	MC14049BCP	103217	1
	U16	INTEGRATED CIRCUIT, CMOS Quad Latch	04713	MC14042BCP	116187	1
	U17	INTEGRATED CIRCUIT, CMOS 4 2-Input Exclusive NOR Gate	04713	MC14077B	117672	1

REPLACEABLE PARTS LIST

TITLE	A3, D/A CONTROL BOARD PC ASSEMBLY #06775501 (Cont'd)					
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	U18	INTEGRATED CIRCUIT, CMOS 2 4-Input NAND Gate	04713	MC14012CP	103938	1
	U19	INTEGRATED CIRCUIT, CMOS Dual Multivibrator	04713	MC14528BCP	045289	1
	U20	INTEGRATED CIRCUIT, TTL SSI Hex Inverter	01295	SN7404N	025779	1
	U21	INTEGRATED CIRCUIT, TTL SSI Quad 2-Input NOR Gate	01295	SN74LS266N	117378	6
	U22 thru U26	Same as U21				
	U27	INTEGRATED CIRCUIT, CMOS 12-Bit Binary Counter	04713	MC14040BCP	117143	1
	XY1	SOCKET, Crystal	91506	8000-DG2	100769	1
	Y1	CRYSTAL, 2.3 MHz	00809	A061EHF-32	102458	1
		PIN, Spring	73957	50-094-0250	100752	2
		EXTRACTOR	51495	1743	100865	1
		EXTRACTOR, Stamped A3	52542	03984203	03984203	1
		RIVET	12014	R-3484XY8NICL	100924	2
		BOARD, PC	52542	067766	067755	1

REPLACEABLE PARTS LIST

TITLE		A4, DIGITAL MOTHER BOARD PC ASSEMBLY #06775301 Rev A				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	C1	CAPACITOR, El Can 5000 μF, 15V	99392	23C15TS53	106459	1
	C2 thru C5	CAPACITOR, Tant 1 μF 10%, 35V	56289	150D105X9035A2	100082	4
	C6	CAPACITOR, Tant 39 μF 10%, 10V	56289	150D396X9010B2	100183	1
	CR1	DIODE, Rectifier 50V	81349	30S05	103252	2
	CR2	Same as CR1				
	J1	CONNECTOR, Header 34-pin	30146	929836-01-17	117178	3
	J2	Same as J1				
	J3	CONNECTOR, Header 20-pin	30146	922584-20	117211	1
	J4	Same as J1				
	U1 thru U4	INTEGRATED CIRCUIT Optoisolator Dual	50522	MCT6	102858	4
	U5 thru U8	INTEGRATED CIRCUIT, MCOS Inverter Buffer	04713	MC14050	103492	4
	U9 thru U14	INTEGRATED CIRCUIT, CMOS Quad Latch	04713	MC14042BCP	116187	6
	U15	INTEGRATED CIRCUIT Voltage Regulator +5V	04713	MC7805CT	045256	2
	U16	Same as U16				
		CONNECTOR, PC Edge 50-pin	71785	252-25-30-012	101239	2
		CONNECTOR, PC Edge 36-pin	05574	2VK18D/4-12	103190	4
		SOCKET, Transistor	27264	10-18-2031	117324	2
		TERMINAL, Swage	88245	2000B	100482	4
		BOARD, PC	52542	067753	067753	1

REPLACEABLE PARTS LIST

TITLE		A5, ANALOG BOARD PC ASSEMBLY #06781701 Rev E				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	C1	CAPACITOR, Tant 6.8 μF 20%, 35V	56289	196D865X0035KE3	106515	1
	C2	CAPACITOR, Ceranic .01 μF +80-20%, 100V	91418	TA110	100103	2
	C3	CAPACITOR, Tant 10 μF 10%, 20V	56289	196D106X9020JA1	103715	5
	C4	Same as C3				
	C5	Same as C2				
	C6	Same as C3				
	C7	CAPACITOR, DP Ceramic 47 pF 5%, 100V	96733	DB44BY470J	117359	4
	C8	Same as C7				
	C9	CAPACITOR, DP Ceramic 15 pF 5%, 100V	96733	DB44BY150J	117624	2
	C10	CAPACITOR, El Can 220 μF, 35V	90201	VTT220K35	100308	1
	C11	Same as C7				
	C12	Same as C7				
	C13	Same as C9				
	C14	CAPACITOR, Ceramic .001 μF 20%, 1 kV	91418	TYPE B	100076	6
	C15	CAPACITOR, Polypr .0033 μF 20%, 600V	27556	GA2G332	100356	6
	C16 thru C20	Same as C15				
	C21	CAPACITOR, DP Ceramic 22 pF 5%, 100V	96733	DB44BY220J	117641	1
	C22	CAPACITOR, Ceramic .005 μF 20%, 500V	91418	SM250	100077	1
	C23	CAPACITOR, DP Ceramic .001 μF 10%, 100V	96733	DB45BY102J	117639	1
	C24	Same as C14				
	C25	CAPACITOR, Polypr .047 μF 5%, 600V	27556	GA2G473J	100352	2
	C26	Same as C25				
	C27	CAPACITOR, Polypr .1 μF 5%, 200V	27556	GA2C104J	100345	1
	C28	Same as C14				

REPLACEABLE PARTS LIST

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
TITLE		**A5, ANALOG BOARD PC ASSEMBLY #06781701 (Cont'd)**				
	C29	Same as C14				
	C30	Same as C3				
	C31	CAPACITOR, El Can 350 μF +50-10%, 250 V	56289	36D351F250AB2A	117919	1
	C32	CAPACITOR El Can 1500 μF, 50 V	99392	23C50TS152	106468	2
	C33	Same as C32				
	C34	CAPACITOR, Tant 1 μF 10%, 50 V	56289	150D105X0050A2	103275	2
	C35 thru C39	CAPACITOR, Tant Axial Lead 1 μF 10%, 35 V	56289	150D105X9035A2	100082	5
	C40 thru C42	CAPACITOR, Tant Rad. Lead 1 μF 10%, 35 V	56289	196D105X9035HA1	103716	3
	C43	CAPACITOR, Tant 47 μF 20%, 20 V	56289	196D476X020LA1	106514	3
	C44	Same as C3				
	C45	CAPACITOR, Ceramic .01 μF 20%, 2 k V	56289	BL-S10	100362	1
	C46	Same as C34				
	C47	Same as C43				
	C48	Same as C43				
	C49	Same as C14				
	C50	Same as C14				
	CR1	DIODE, Signal 50 V	03508	1N4151	100385	18
	CR2	Same as CR1				
	CR3	Not Used				
	CR4	Not Used				
	CR5 thru CR7	Same as CR1				
	CR8 thru CR10	Not Used				
	CR11	Same as CR1				
	CR12	Same as CR1				

REPLACEABLE PARTS LIST

TITLE		A5, ANALOG BOARD PC ASSEMBLY #06781701 (Cont'd)				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	CR13	Not Used				
	CR14	Not Used				
	CR15	Same as CR1				
	CR16	Not Used				
	CR17	DIODE, Selected 2N3563	52542	037769	037769	5
	CR18	Same as CR17				
	CR19	Same as CR1				
	CR20 thru CR22	Same as CR17				
	CR23 thru CR29	Same as CR1				
	CR30 thru CR33	DIODE, Rectifier 3 kV	04713	MR250-3	100466	5
	CR34 thru CR39	DIODE, Rectifier 400 V	12969	IN5617	116594	6
	CR40	Not Used				
	CR41	Same as CR1				
	CR42	Same as CR1				
	CR43	Same as CR30				
	K5	RELAY, Reed	21317	EAC1A05Y500	1I7557	1
	Q1 thru Q4	TRANSISTOR, SINPN 15 V	02763	PN4275-18	102716	4
	Q5 thru Q8	TRANSISTOR, J-FET N Channel 40 V	04713	2N4091	101409	3
	Q9	TRANSISTOR, SIPNP	04713	2N5193	101405	1
	Q10	TRANSISTOR, SIPNP 40 V	04713	2N3906	101378	1
	Q11	TRANSISTOR, SIPNP 50 V	07263	2N5087	106575	1
	Q12	TRANSISTOR, INPN	04713	MPS6521	101430	1
	R1	RESISTOR, CC 10 M 5%, 1/4 W	01121	CB1065	101564	1

REPLACEABLE PARTS LIST

			MFR'S	MANUFACTURER'S	SD STOCK	
TITLE		A5, ANALOG BOARD PC ASSEMBLY #06781701 (Cont'd)				
ITEM	REF	COMPONENT DESCRIPTION	CODE	PART NUMBER	NUMBER	T/Q
	R2	RESISTOR, MF 1.82 k 1%, 1/8 W	81349	RN60C1821F	106170	1
	R3	RESISTOR, CC 2.2 k 5%, 1/4 W	01121	CB2225	101562	11
	R4	RESISTOR, MF 8.66 k 1%, 1/8 W	19701	MF5C-E-8661	102044	2
	R5	Same as R4				
	R6	RESISTOR, CC 4.7 k 5%, 1/4 W	01121	CB4725	101598	2
	R7	RESISTOR, MF 3.57 k 1%	19701	MF5C-E-3571-F	101927	2
	R8	RESISTOR, Variable 5 k 10%	73138	68WR5K	117235	1
	R9 thru R12	Same as R3				
	R13	RESISTOR, CC 3.9 k 5%, 1/4 W	01121	CB3925	101601	1
	R14	RESISTOR, CC 18 k 5%, 1/4 W	01121	CB1835	101579	5
	R15	Same as R14				
	R16	RESISTOR, MF 63.4 Ω 1%, 1/8 W	19701	MF5C-D-63R4-F	102133	1
	R17	RESISTOR, Variable 100 Ω 10%, 1 W	80294	3059L-1-101M	117921	2
	R18	Not Used				
	R19	Same as R3				
	R20	RESISTOR, MF 10 Ω 1%, 1/8 W	16299	NA60	106210	1
	R21	Not Used				
	R22	RESISTOR, MF 953 Ω 1%, 1/8 W	16299	NA60	116668	1
	R23	RESISTOR, MF 1 M 1%, 1/8 W	03888	PME60T9	101966	1
	R24	RESISTOR, Variable 100 k 10%, 3/4 W	73138	78LBWR100K	102877	3
	R25	Same as R3				

REPLACEABLE PARTS LIST

TITLE		A5, ANALOG BOARD PC ASSEMBLY #06781701 (Cont'd)				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R26	Same as R14				
	R27	Same as R24				
	R28 thru R31	Same as R3				
	R32	Same as R14				
	R33	Same as R14				
	R34	Not Used				
	R35	RESISTOR, CC 4.7 M 5%, 1/4 W	01121	CB4755	101661	1
	R36	RESISTOR, MF 324 k 1%, 1/8 W	19701	MF5C-D-3243-F	102225	6
	R37 thru R41	Same as R36				
	R42	RESISTOR 274 k 1%, 1/8 W	19701	MF5C-D-2743-F	102101	2
	R43	RESISTOR, MF 127 Ω 1%, 1/8 W	19701	MF5C-D-1270-F	102134	2
	R44	RESISTOR, Variable 1 k 10%, 1 W	80294	3059L-1-102M	117923	2
	R45	Same as R43				
	R46	RESISTOR, CC 10 k 5%, 1/4 W	01121	CB1035	101570	1
	R47	Not Used				
	R48	Not Used				
	R49	Same as R42				
	R50	RESISTOR, Variable 5 k 10%, 1 W	80294	3059L-1-502M	117924	1
	R51 thru R57	Not Used				
	R58	RESISTOR, CC 47 k 5%, 2 W	01121	HB4725	101654	1
	R59	Same as R44				
	R60	Same as R17				

REPLACEABLE PARTS LIST

TITLE		A5, ANALOG BOARD PC ASSEMBLY #06781701 (Cont'd)				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R61	RESISTOR, CC 1 k 5%, 1/4 W	01121	CB1025	101569	1
	R62	RESISTOR, MF 1.21 M 1%, 1/4 W	81349	RN65C1214F	102287	1
	R63	Same as R24				
	R64	RESISTOR, MF 150 k 1%, 1/8 W	19701	5043RD150KF	117617	1
	R65	RESISTOR, Set 2 k	52542	067722	067722	1
	R66	P/O R65 222.2 Ω, .05%				
	R67	RESISTOR, MF 1 M 5%, 1 W	01121	GB1055	102210	3
	R68	Same as R67				
	R69	Same as R67				
	R70	RESISTOR, CC 1.5 k 5%, 1/4 W	01121	CB1525	101577	1
	R71	RESISTOR, CC 47 k 5%, 1/4 W	01121	CB4735	101574	1
	R72	RESISTOR, CC 1.8 k 5%, 1/4 W	01121	CB1825	101602	1
	R73	RESISTOR, MF 4.12 k 1%	81349	RN55D4121F	117577	1
	R74	RESISTOR, Variable 1 k 10%, 5W	80294	68WR1K	117336	1
	R75	Same as R7				
	R76	Same as R6				
	R77	RESISTOR, MF 4.53 k 1%, 1/8 W	81349	RN60D4531F	106323	1
	RN1	RESISTOR, Network	52542	067721	067721	1
	U1	INTEGRATED CIRCUIT Voltage Regulator	04713	MC78L15ACP	117260	2
	U2	INTEGRATED CIRCUIT Voltage Regulator +24 V	07263	MC7824CT	045246	1
	U3	INTEGRATED CIRCUIT Voltage Regulator, 15 V	04713	MC7915CT	103040	1
	U4	Same as U1				
	U5	INTEGRATED CIRCUIT Voltage Regulator	04713	MC79L15ACP	117261	1

TITLE	A5, ANALOG BOARD PC ASSEMBLY #06781701 (Cont'd)				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	U6	INTEGRATED CIRCUIT Operational Amplifier	24335	52K	117917	1
	U7	INTEGRATED CIRCUIT Voltage Follower	27014	LM302H	025721	1
	U8	INTEGRATED CIRCUIT Voltage Reference	27014	LM299AH	117537	1
	U9	INTEGRATED CIRCUIT Operational Amplifier	07263	741TC	106621	1
	U10	INTEGRATED CIRCUIT, LIN MSC Darlington NPN	04713	MC1413P	117558	1
	VR1	Diode, Zener	03877	IN748A	100384	1
	VR2	Diode, Zener	03877	IN4744A	100422	1
	VR3	Diode, Zener	04713	IN968B	100409	1
	VR4	Diode, Zener	04713	IN958B	102992	1
		HEATSINK	98978	PSD1-2ND	117107	2
		CONNECTOR, PC Edge 25-pin	71785	252-25-30-012	101239	1
		PIN, Socket	06776	PS-402-44	102430	9
		SPACER, Swage 6-32 x 1/4	88245	1530 B 1/4	100783	4
		SPACER, Swage 6-32 x 1-1/4	06540	9640B-B-0632-3A	101096	2
		SPACER, Threaded 6-32 x 1-1/2	83330	8349	100944	2
		SPACER, Swage 6 x 1/8	88245	1530 B 5/8	100517	2
		TERMINAL, Swage	88245	2000B	100482	4
		TERMINAL, Swage	88245	1309B-1	100508	10
		TERMINAL, Swage	88245	1309B-1	100508	10
		SOCKET, Transistor 3-pin	27264	10-18-2031	117324	2
		SOCKET, Relay	24796	A11-S006	102426	4
		SPACER, Mtg. Cover	52542	067864	067864	1
	A11	ASSEMBLY, CAL Switching PC	52542	06785701	06785701	1
		SCREW, PHMS 10-32 x 5/16	96906	MS51958-60	10064405	2
		SCREW, PHMS 6-32 x 7/16	96906	MS51957-29	10063207	4
		SCREW, PHMS 6-32 x 5/16	96906	MS51957-27	10063205	4
		SCREW, PHMS 4-40 x 5/16	96906	MS51957-14	10062605	1
		SCREW, PHMS 4-40 x 3/8	96906	MS51957-15	10062606	1
		WASHER, Flat #10	96906	MS15795-808	100648	2
		WASHER, Split-Lock #10	96906	MS35338-138	100714	2
		WASHER, Internal Tooth #6	96906	MS35338-70	100647	2
		WASHER, Flat #6	86928	5710-23-10	100662	8
		WASHER, Split-Lock #6	96906	MS35338-136	100712	8
		WASHER, Dome #4	04713	B52200F003	103351	1
		NUT, , Kep 4-40	78189	511-041800-00	100941	2
		JUMPER	55210	L-2007-1	102879	1
		BOARD, PC	52542	067817	067817	1

REPLACEABLE PARTS LIST

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
TITLE		**A6, HIGH VOLTAGE AMPLIFIER BOARD PC ASSEMBLY #06777001 Rev C**				
	C1	CAPACITOR, Ceramic .01 µF +80-20%, 100V	91418	TA110	100103	1
	C2	CAPACITOR, Tant 10 µF 10%, 10V	56289	196D106X902JA1	103715	1
	C3	CAPACITOR, Tant 6.8 µF 20%, 35V	56289	196D685X0035KE3	106515	1
	C4	CAPACITOR, Ceramic .01 µF 20%, 2 kV	56289	BL-S10	100362	1
	CR1	DIODE, Rectifier 400V	04713	1N5395	100413	2
	CR2	DIODE, Signal 50V	03508	1N4151	100385	4
	CR3	Same as CR2				
	CR4	Same as CR1				
	CR5	Same as CR2				
	CR6	Same as CR2				
	CR7	DIODE, Rectifier 3 kV	04713	MR250-3	100466	2
	CR8	Same as CR7				
	Q1	TRANSISTOR, SINPN 1500V	04713	BU205	117915	3
	Q2	Same as Q1				
	Q3	Same as Q1				
	Q4	TRANSISTOR, SINPN 100V	01295	2N4240	101428	1
	Q5 thru Q10	TRANSISTOR, SINPN 350V	04713	2N3439	117916	6
	Q11	TRANSISTOR, SIPNP 60V	07293	PN4250-18	102725	1
	Q12	TRANSISTOR, SINPN	02735	2N3440	101420	1
	R1	RESISTOR, CC 100 Ω 5%, 1/4W	01121	CB1015	101609	1
	R2	RESISTOR, CC 39 k 5%, 1/4W	01121	CB3935	101561	1
	R3	RESISTOR, CC 10 k 5%, 1/4W	01121	CB1035	101570	2
	R4	Same as R3				
	R5	RESISTOR, CC 2.2 k 5%, 1/4W	01121	CB2225	101562	2
	R6	RESISTOR, CC 15 k 5%, 1/4W	01121	CB1535	101552	1
	R7	Same as R5				
	R8	Not Used				

REPLACEABLE PARTS LIST

	TITLE	A6, HIGH VOLTAGE AMPLIFIER BOARD PC ASSEMBLY #06777001 (Cont'd)				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R9	Not Used				
	R10	RESISTOR, CC 3.3 k 5%, 1/4W	01121	CB3325	101559	1
	R11	RESISTOR, CC 180 Ω 5%, 1/4W	01121	CB1815	10166801	1
	R12	RESISTOR, CC 68 Ω 5%, 1/2W	01121	EB6805	102238	1
	R13	RESISTOR, CC 4.7 k 5%, 1/4W	01121	CB4725	101598	2
	R14	RESISTOR, CC 220 k 5%, 1/2W	01121	EB2245	101458	1
	R15	RESISTOR, CC 430 k 5%, 1/2W	01121	EB4345	101465	2
	R16	Same as R15				
	R17	RESISTOR, CC 68 k 5%, 1/2W	01121	EB6835	101462	1
	R18	RESISTOR, CC 560 Ω 5%, 1/2W	01121	EB5615	101631	1
	R19	Same as R13				
	R20	RESISTOR, CC 180 k 5%, 1/2W	01121	EB1845	101470	6
	R21 thru R25	Same as R20				
	VR1	DIODE, Zener 5.1V	03877	1N751A	100378	1
	VR2	DIODE, Zener 15V	03877	1N4744A	100422	1
	VR3	Not Used				
	VR4	DIODE, Zener 5.6V	03877	1N752A	100376	1
	VR5	DIODE, Zener 8.2V	04713	1N959B	100429	1
		SPACER, Swage 6-32 x 3/16	88245	1530 B 3/16	100511	8
		HEATSINK, TO-3	98978	UP-TO3	100936	
		PAD, Transistor	08289	501-000-D	100666	7
		SCREW, PHMS 6-32 x 3/8	96906	MS51957-28	10063206	8
		WASHER, Split-Lock #6	96906	MS35338-136	100712	8
		BOARD, PC	52542	067770	067770	1

REPLACEABLE PARTS LIST

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
TITLE		A7, DIGIT SELECT BOARD PC ASSEMBLY #06771701 Rev A				
	S1 thru S8	SWITCH, Pushbutton	31918	MDP W/AG CONT	117899	8
		BUTTON, Keytop Dark Gray	31918	By Description	117939	8
		SPACER, Swage #6	52542	067718	067718	5
		BOARD, PC	52542	067717	067717	1

REPLACEABLE PARTS LIST

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
TITLE		**A8, VOLTAGE SELECT BOARD PC ASSEMBLY #06771901 Rev A**				
	DS1	LED, Red	50522	MV5753	117227	1
	DS2	LED	50522	MV5774B	117487	1
	S1 thru S17	SWITCH, Pushbutton	31918	MDP W/AG CONT	117899	17
		BUTTON, Lt Gray Marked "0"	52542	06775410	06775410	1
		BUTTON, Lt Gray Marked "1"	52542	06775401	06775401	1
		BUTTON, Lt Gray Marked "2"	52542	06775402	06775402	1
		BUTTON, Lt Gray Marked "3"	52542	06775403	06775403	1
		BUTTON, Lt Gray Marked "4"	52542	06775404	06775404	1
		BUTTON, Lt Gray Marked "5"	52542	06775405	06775405	1
		BUTTON, Lt Gray Marked "6"	52542	06775406	06775406	1
		BUTTON, Lt Gray Marked "7"	52542	06775407	06775407	1
		BUTTON, Lt Gray Marked "8"	52542	06775408	06775408	1
		BUTTON, Lt Gray Marked "9"	52542	06775409	06775409	1
		BUTTON, Lt Gray Marked "+"	52542	06775411	06775411	1
		BUTTON, Lt Gray Marked "-"	52542	06775412	06775412	1
		BUTTON, Dark Gray	31918	By Description	117939	3
		BUTTON, Lt Gray	31918	By Description	117938	1
		BUTTON, Red	31918	By Description	117940	1
		CONNECTOR, PC 34-pin	30146	929836-01-17	117178	1
		SPACER, Swage #6	52542	067718	067718	1
		SPACER, Nylon	06540	9207-N091	117941	1
		BOARD, PC	52542	067719	067719	1

REPLACEABLE PARTS LIST

TITLE		A9, DISPLAY BOARD PC ASSEMBLY #06772601 Rev A				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	DS1	DISPLAY, LED 5-Segment	50522	MAN4630	10339201	1
	DS2 thru DS7	DISPLAY, LED 7-Segment	50522	MAN4610A	10317201	6
	DS8 thru DS14	DISPLAY, LED		MV5774B	117487	7
		SOCKET, IC 14-pin	73803	C83-14-02	117040	7
		SPACER, Nylon	06540	9211-N091	117942	7
		SCREW, PHMS 2-56 x 1/4	96906	MS51957-3	10062504	2
		SCREW, PHMS 2-56 x 7/16	96906	MS51957-6	10062507	2
		WASHER, Flat #2	96906	MS15795-802	100614	4
		WASHER, Split-Lock #2	96906	MS35337-77	100661	4
		BOARD, PC	52542	067726	067726	1

REPLACEABLE PARTS LIST

TITLE		A10, DISPLAY DRIVER BOARD PC ASSEMBLY #06773101 Rev B				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	C1	CAPACITOR, Tant 2.2 µF 10%, 25V	56289	196D225X9025HA1	103495	1
	C2	CAPACITOR, Tant 22 µF 10%, 15V	56289	150D226X9015B2	100125	1
	J1	CONNECTOR, Header 39-pin	30146	929836-01-17	117178	2
	J2	Same as J1				
	R1	RESISTOR, CC 27 k 5%, 1/4W	01121	CB2735	101587	1
	R2	RESISTOR, CC 220 k 5%, 1/4W	01121	CB2245	101610	1
	RN1 thru RN8	RESISTOR, Network 7 x 270 Ω	73138	899-3-R270	117896	8
	U1	INTEGRATED CIRCUIT, TTL MSI BCD-to-Dec Decoder	01295	SN74LS42N	103131	1
	U2	INTEGRATED CIRCUIT, LIN MSC Wide Range Timer	18324	NE555V	045208	1
	U3 thru U8	INTEGRATED CIRCUIT 4-7 Decade Counter	01295	SN74LS247N	103166	6
	U9	INTEGRATED CIRCUIT PROM SN74188AN	52542	067749	067749	1
	U10	INTEGRATED CIRCUIT, TTL SSI Quad 2-Input NAND Gate	01295	SN74LS00N	103130	1
		SPACER, Swage	71279	350-7423-11-19	103297	2
		BOARD, PC	52542	067731	067731	1

REPLACEABLE PARTS LIST

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
TITLE		**A11, CAL SWITCHING ASSEMBLY #06785701 Rev A**				
	R1	RESISTOR, MF 1.5 k 1%, 1/8W	91637	MFF-1/8-T9	102251	1
	R2	RESISTOR, MF 3.01 k 1%, 1/8W	19701	MF5C-D-3011-F	101896	1
	R3	RESISTOR, MF 6.19 k 1%, 1/8W	91637	MFF 1/8 T1	102199	1
	R4	RESISTOR, MF 12.4 k 1%, 1/8W	81349	RN60E1242F	102045	1
	R5	RESISTOR, MF 24.9 k 1%, 1/8W	81349	RN60E2492F	102297	1
	R6	RESISTOR, MF 49.9 k 1%, 1/8W	81349	RN60E4992F	102296	1
	R7	RESISTOR, MF 100 k 1%, 1/8W	81349	RN60E1003F	101967	1
	R8	RESISTOR, MF 196 k 1%, 1/8W	81349	RN60E1963F	102295	1
	S1 thru S8	SWITCH, Slide 4-position	95146	MSS-4200	117918	8
		BRACKET, Right Angle	79963	176	100849	2
		RIVIT	12014	R-3472X1/8NICL	100645	2
		BOARD, PC	52542	067857	067857	1

REPLACEABLE PARTS LIST

TITLE		OPTION 01, TEST ASSEMBLY #075134 Rev D				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
1		ASSEMBLY, Front Panel	52542	075143	075143	1
2		ASSEMBLY, Cross Member Front	52542	067887	067887	1
3		ASSEMBLY, Center Brace	52542	067896	067896	1
4		CROSS MEMBER, Rear	52542	067738	067738	1
5		GUSSET, Right	52542	067678	067678	1
6		GUSSET, Left	52542	067677	067677	1
7		ASSEMBLY, Rear Panel	52542	075135	075135	1
8		GUIDE, Card	52542	01234011	01234011	3
9	A1	ASSEMBLY, Parallel Interface PC	52542	06790301	06790301	1
10	A2	ASSEMBLY, Encoder PC	52542	06775001	06775001	1
11	A3	ASSEMBLY, D/A Control PC	52542	06775501	06775501	1
12	A6	ASSEMBLY, High Voltage Amp PC	52542	06777001	06777001	1
13	A4	ASSEMBLY, Digital Mother Board PC	52542	06775301	06775301	1
14	A5	ASSEMBLY, Analog PC	52542	06781701	06781701	1
15		TAPE, 20-pin Cable	30146	922521-20-02-14	117401	1
16		TAPE, 34-pin Cable 6"	30146	922521-34-02-06	117913	2
17		TAPE, 34-pin Cable 15"	30146	922541-34-02-15	117914	1
18		ASSEMBLY, Shield	52542	075251	075251	1
20	K1 - K4	RELAY, 6-pole 26V	77342	R10-E1112-2	101295	4
21		SOCKET, Relay 20-pin	24796	A11-5006	10242601	4
22		STRIP, Caterpillar	03296	G51H-A	102749	A/R
23		NAMEPLATE, (Not Shown)	52542	045435	045435	1
24		SHEILD, Resistor	52542	067865	067865	1
25		SHIELD, Amp	52542	067813	067813	1
26		FOAM, Block	52542	075209	075209	1
27		SUPPORT, PC	52542	075208	075208	2
28		BUSHING, Snap	28520	SB-375-4	100781	2
29		KNOB	86797	RB-67-1-DC-M-L	100976	1
30		JUMPER	55210	L-2007-1	102879	10
32		TIE, Cable	06383	SSTIM	100753	A/R
33	U15,U16	INTEGRATED CIRCUIT Voltage Regulator	04713	MC7805CT	045256	2
38		ASSEMBLY, Parallel Interface Cable	52542	067936	067936	1
39		ADHISIVE			116566	A/R
42		SCREW, PHMS 4-40 x 7/16	96906	MS51957-16	10062607	1
43		SCREW, PHMS 6-32 x 5/16	96906	MS51957-27	10063205	29
44		SCREW, PHMS 6-32 x 1/2	96906	MS51957-30	1--63208	4
45		SCREW, FHMS 6-32 x 3/8	96906	MS24693-C26	10073106	8
46		SCREW, FHMS 8-32 x 1/4	96906	MS24693-C46	10074304	6
47		SCREW, FHMS 8-32 x 3/8	96906	MS24693-C48	10074306	6
50		WASHER, Flat #6	78189	511-061800-00	100862	25
51		WASHER, Split-Lock #6	96906	MS35338-136	100712	31
52		NUT, Kep #4	78189	511-041800-00	100941	2
54		NUT, Kep #6	78189	511-061800-00	112472	2

REPLACEABLE PARTS LIST

TITLE		OPTION 01, FRONT PANEL ASSEMBLY #075143 Rev A				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
1		PANEL, Sub	52542	067720	067720	1
2	R101	RESISTOR, Variable 10 k	52542	075106	075106	1
3	J6,J7	BINDING POST, Red	05276	3770-0	117885	2
4	J8,J9	BINDING POST, Black	05276	3770-2	117886	2
5	J10	BINDING POST, White	05276	3770-9	117887	1
6	A8	ASSEMBLY, Voltage Select PC	52542	06771901	06771901	1
7	A7	ASSEMBLY, Digit Select PC	52542	06771701	06771701	1
8	A10	ASSEMBLY, Display Driver PC	52542	06773102	06773102	1
9	A9	ASSEMBLY, Display PC	52542	06772601	06772601	1
10		NUT, Hex 4-40	96906	NAS671C4	100622	10
11		WASHER, Flat #4	96906	MS15795-803	100703	14
12		WASHER, Split-Lock #4	96906	MS35338-135	100711	14
13		SCREW, PHMS 4-40 x 1/2	96906	MS51957-17	10062608	2
14		SCREW, PHMS 4-40 x 5/16	96906	MS51957-14	10062605	2
15		PANEL, Decorative	52542	067778	067778	1
16		ADHESIVE	26066	950	117910	A/R
17		WINDOW, (Not Whown)	52542	067780	067780	1
18	S101	SWITCH, Toggle Power	09353	9201SH32Q	117147	1
19		NUT, Dress	09353	B7099N	101086	1
20		LINE, Shorting	24655	0938-9503	100561	2

REPLACEABLE PARTS LIST

TITLE		OPTION 01, REAR PANEL ASSEMBLY #075135 Rev A				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
1		PANEL, Rear	52542	067732	067732	1
2		SWITCH, DPDT Slide	82389	46206LFE	102340	1
3	XF101	POST, Fuse	75915	345002	117381	1
4	F101	FUSE, 3-AGSB 1/2-A	71400	MDL 1/2	100589	1
5	Z101	FILTER, Line	05245	3EF1	102461	1
6	T101	TRANSFORMER	52542	067743	067743	1
7	C101	CAPACITOR, 2 μF 2000V	16727	KMOC2M2	117920	1
8		BRACKET, Mtg. Cap	16727	By Description	117925	1
9		LUG, Solder #8	78189	2104-08-00	102961	1
10		LUG, Solder #4	83330	1416-4	100509	1
11		NUT, Kep 8-32	78189	511-081800-00	100940	6
12		NUT, Kep 4-40	78189	511-041800-00	100941	2
14		NUT, Hex 8-32	73734	70208	100659	1
15		NUT, Hex 4-32	96906	NAS671C4	100622	1
16		WASHER, Split-Lock #4	96906	MS35338-135	100711	4
18	J101	CONNECTOR, Rear Panel Output	71468	KPT00A14-5S	117696	1
19		SCREW, PHMS 4-40 x 1/4	96906	MS51957-13	10062604	3
20		SCREW, PHMS 4-40 x 5/16	96906	MS51957-14	10062605	1
21		SCREW, PHMS 4-40 x 3/8	96906	MS51957-15	10062606	4
22		SCREW, PHMS 4-40 x 7/16	96906	MS51957-16	10062607	2
23		SCREW, PHMS 8-32 x 7/16	96906	MS51957-44	10064207	4
24		SCREW, PHMS 8-32 x 1/2	96906	MS51957-48	10064208	2
25		SCREW, PHMS 8-32 x 1/4	96906	MS51957-41	10064204	1
32		ASSEMBLY, Parallel Interface Cable	52542	067936	067936	1
34		PLATE, Cover	52542	067540	067540	1
35		PLATE, Cover	52542	067542	067542	1
36		SCREW, PHMS 2-56 x 1/4	96906	MS51957-3	10062504	4
37		SCREW, PHMS 2-56 x 3/8	96906	MS51957-5	10062506	2
38		WASHER, Split-Lock #2	96906	MS35337-77	100661	6
39		NUT, Hex 2-56	96906	MS35694-224	100636	2

REPLACEABLE PARTS LIST

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
TITLE		OPTION 01, A1, PARALLEL INTERFACE PC ASSEMBLY #06790301 Rev A				
	C1	CAPACITOR, Ceramic .001 µF 20%, 1 kV	91418	TYPE B	100076	1
	C2	CAPACITOR, Tant 39 µF 10%, 10V	56289	150D396X9010B2	100183	2
	C3	Same as C2				
	C4	CAPACITOR, Ceramic .05 µF +80-20%, 10V	71590	UK10-503	100122	4
	C5 thru C7	Same as C4				
	R1	RESISTOR, CC 22 k 5%, 1/4W	01121	CB2235	101572	1
	R2	RESISTOR, CC 33 k 5%, 1/4W	01121	CB3335	101576	1
	R3	RESISTOR, CC 15 k 5%, 1/4W	01121	CB1535	101552	1
	R4	RESISTOR, CC 100 Ω 5%, 1/2W	01121	EB1015	101498	1
	RN1 thru RN4	RESISTOR, Network 10k x 13	11236	760-1-R10K	117241	4
	U1	INTEGRATED CIRCUIT, CMOS 4 2-Input AND Gate	04713	MC14081BCP	116101	3
	U2	INTEGRATED CIRCUIT, CMOS 4 2-Input OR Gate	04713	MC14071BCP	103940	2
	U3	Same as U2				
	U4	INTEGRATED CIRCUIT, CMOS Dual D Flip-Flop	04713	MC14013BCP	103199	1
	U5	INTEGRATED CIRCUIT, CMOS 4 2-Input NAND Gate	04713	MC14011BCP	103937	1
	U6	INTEGRATED CIRCUIT, CMOS Dual Monostability Multiplier	04713	MC14528BCP	045289	1
	U7	Same as U1				
	U8	INTEGRATED CIRCUIT, CMOS 3 3-Input AND Gate	04713	MC14073B	117380	1
	U9	INTEGRATED CIRCUIT, CMOS 2 4-Input NAND Gate	04713	MC14012BCP	103938	1
	U10 thru U15	INTEGRATED CIRCUIT, CMOS 6-Inverter Buffer	04713	MC14050BP	103492	7

REPLACEABLE PARTS LIST

TITLE		OPTION 01, A1, PARALLEL INTERFACE PC ASSEMBLY #06790301 (Cont'd)				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	U16 thru U22	INTEGRATED CIRCUIT, CMOS 4-Bit AND/OR Selector	04713	MC14519BCP	045288	7
	U23	INTEGRATED CIRCUIT, CMOS Hex Inverter Buffer	04713	MC14049BCP	103217	1
	U24	INTEGRATED CIRCUIT, CMOS Binary Up/Down Counter	04713	MC14516BCP	117113	1
	U25	INTEGRATED CIRCUIT, CMOS R-S NAND Latch	04713	MC14044B	117379	1
	U26	Same as U1				
	U27	Same as U10				
		PIN, Spring	73957	50-094-0250	100752	2
		EXTRACTOR	51495	1743	100865	1
		EXTRACTOR, Stamped A1	52542	03984201	03984201	1
		BOARD, PC	52542	067903	067903	1

REPLACEABLE PARTS LIST

			MFR'S	MANUFACTURER'S	SD STOCK	
TITLE		OPTION 01, A6, HIGH VOLTAGE AMPLIFIER #06777002 Rev C				
ITEM	**REF**	**COMPONENT DESCRIPTION**	**MFR'S CODE**	**MANUFACTURER'S PART NUMBER**	**SD STOCK NUMBER**	**T/Q**
	C1	CAPACITOR, Ceramic .01 µF +80-20%, 100V	91418	TA110	100103	1
	C2	CAPACITOR, Tant 10 µF 10%, 20V	56289	196D106X9020JA1	103715	1
	C3	CAPACITOR, Tant 6.8 µF 20%, 35V	56289	196D685X0035KE3	106515	1
	C4	CAPACITOR, Ceramic .01 µF 20%, 2 kV	56289	BL-S10	100362	1
	CR1	DIODE, Rectifier 400V	04713	1N5395	100413	2
	CR2	DIODE, Signal 50V	03508	1N4151	100385	4
	CR3	Same as CR2				
	CR4	Same as CR1				
	CR5	Same as CR2				
	CR6	Same as CR2				
	CR7	DIODE, Rectifier 3 kV	04713	MR250-3	100466	2
	CR8	Same as CR7				
	Q1	Not Used				
	Q2	TRANSISTOR, SINPN 1500V	04713	BU205	117915	2
	Q3	Same as Q2				
	Q4	TRANSISTOR, SINPN 300V	02735	2N4240	101428	1
	Q5 thru Q9	Not Used				
	Q10	TRANSISTOR, SINPN 350V	04713	2N3439	117916	1
	Q11	TRANSISTOR, SIPNP 60V	07263	PN4250-18	102725	1
	Q12	TRANSISTOR, SINPN	02735	2N3440	101420	1
	R1	RESISTOR, CC 100 Ω 5%, 1/4W	01121	CB1015	101609	1
	R2	RESISTOR, CC 39 k 5%, 1/4W	01121	CB3935	101561	1
	R3	RESISTOR, CC 10 k 5%, 1/4W	01121	CB1035	101570	2
	R4	Same as R3				
	R5	RESISTOR, CC 2.2 k 5%, 1/4W	01121	CB2225	101562	2
	R6	RESISTOR, CC 15 k 5%, 1/4W	01121	CB1535	101552	1
	R7	Same as R5				

REPLACEABLE PARTS LIST

TITLE		OPTION 01, A6, HIGH VOLTAGE AMPLIFIER #06777002 (Cont'd)				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
	R8	Not Used				
	R9	Not Used				
	R10	RESISTOR, CC 3.3 k 5%, 1/4W	01121	CB3325	101559	1
	R11	RESISTOR, CC 180 Ω 5%, 1/4W	01121	CB1815	10166801	1
	R12	RESISTOR, CC 68 Ω 5%, 1/2W	01121	EB6805	102238	1
	R13	RESISTOR, CC 4.7 k 5%, 1/4W	01121	CB4725	101598	2
	R14	RESISTOR, CC 220 k 5%, 1/2W	01121	EB2245	101458	1
	R15	RESISTOR, CC 430 k 5%, 1/2W	01121	EB4345	101465	2
	R16	Same as R15				
	R17	RESISTOR, CC 68 k 5%, 1/2W	01121	EB6835	101462	1
	R18	RESISTOR, CC 560 Ω 5%, 1/2W	01121	EB5615	101631	1
	R19	Same as R13				
	R20 thru R24	Not Used				
	R25	RESISTOR, CC 180 k 5%, 1/2W	01121	EB1845	101470	1
	VR1	DIODE, Zener 5.1V	03877	1N751A	100378	1
	VR2	DIODE, Zener 15V	03877	1N4744A	100422	1
	VR3	Not Used				
	VR4	DIODE, Zener 5.6V	03877	1N752A	100376	1
	VR5	DIODE, Zener 8.2V	04713	1N959B	100429	1
		SPACER, Swage 6-32 x 3/16	88245	1530 B 3/16	100511	6
		HEATSINK, TO-66	98978	UP-TO66-B	101107	1
		HEATSINK, TO-3	98978	UP-TO3	100936	1
		PAD, Transistor TO-5	08289	501-000-D	100666	2
		SCREW, PHMS 6-32 x 3/8	96906	MS51957-28	10063206	6
		WASHER, Split-Lock #6	96906	MS35338-136	100712	6
		BOARD, PC	52542	067770	067770	1

REPLACEABLE PARTS LIST

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
TITLE		OPTION 01, A10, DISPLAY DRIVER PC ASSEMBLY #06773102 Rev B				
	C1	CAPACITOR, Tant 2.2 μF 10%, 10V	56289	196D226X9010JA1	103495	1
	C2	CAPACITOR, Tant 22 μF 10%, 15V	56289	150D226X9015B2	100125	1
	J1	CONNECTOR, Header 34-pin	30146	929836-01-17	117178	2
	J2	Same as J1				
	R1	RESISTOR, CC 27 k 5%, 1/4W	01121	CB2735	101587	1
	R2	RESISTOR, CC 220 k 5%, 1/4W	01121	CB2245	101610	1
	R3	RESISTOR, CC 270 Ω 5%, 1/8W	01121	BB2715	101703	2
	R4	Same as R3				
	RN1 thru RN7	RESISTOR, Network 7 x 270 Ω	73138	899-3-R270	117896	7
	U1	INTEGRATED CIRCUIT, TTL MSI BCD-DEC Decoder	01295	SN74LS42N	103131	1
	U2	INTEGRATED CIRCUIT, LIN MSC Wide Range Timer	18324	NE555V	045208	1
	U3 thru U8	INTEGRATED CIRCUIT, TTL MSI 4-7 Decade/Divider	01295	SN74LS247N	103166	6
	U9	INTEGRATED CIRCUIT PROM	52542	067749	067749	1
	U10	INTEGRATED CIRCUIT, TTL SSI Quad 2-Input NAND Gate	01295	SN74LS00N	103130	1
		SPACER, Swage	71279	350-7423-11-19	103297	2
		BOARD, PC	52542	067731	067731	1

REPLACEABLE PARTS LIST

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
TITLE		OPTION 06, HIGH VOLTAGE AMPLIFIER PC ASSEMBLY #06777003 Rev B				
	C1	CAPACITOR, Ceramic .01 μF +80-20%, 100V	91418	TA110	100103	1
	C2	CAPACITOR, Tant 10 μF 10%, 20V	56289	196D106X9020TA1	103715	1
	C3	CAPACITOR, Tant 6.8 μF 20%, 35V	56289	196D685X0035KE3	106515	1
	C4	CAPACITOR, Ceramic .01 μF 20%, 2 kV	56289	BL-S10	100362	1
	C5 thru C10	Not Used				
	C11	CAPACITOR, Ceramic .001 μF 20%, 1 kV	91418	TYPE B	100076	1
	CR1	DIODE, Rectifier 400V	04713	1N5395	100413	2
	CR2	DIODE, Signal 50V	03508	1N4151	100385	4
	CR3	Same as CR2				
	CR4	Same as CR1				
	CR5	Same as CR2				
	CR6	Same as CR1				
	CR7	DIODE, Rectifier 3 kV	04713	MR250-3	100466	2
	CR8	Same as CR7				
	Q1	TRANSISTOR, SINPN	04713	BU205	117915	3
	Q2	Same as Q1				
	Q3	Same as Q1				
	Q4	TRANSISTOR	04713	MJ3042	116608	1
	Q5 thru Q10	TRANSISTOR, SINPN 350V	04713	2N3439	117916	6
	Q11	TRANSISTOR, SIPNP 60V	07293	2N4250-18	102725	1
	Q12	TRANSISTOR, SINPN	02735	2N3440	101420	1
	R1	RESISTOR, CC 47 Ω 5%, 1/2W	01121	EB4705	101575	1
	R2	RESISTOR, CC 39 k 5%, 1/4W	01121	CB3935	101561	1
	R3	RESISTOR, CC 10 k 5%, 1/4W	01121	CB1035	101570	2
	R4	Same as R3				
	R5	RESISTOR, CC 2.2 k 5%, 1/4W	01121	CB2225	101562	2

REPLACEABLE PARTS LIST

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
TITLE		OPTION 06, HIGH VOLTAGE AMPLIFIER PC ASSEMBLY #06777003 (Cont'd)				
	R6	RESISTOR, CC 15 k 5%, 1/4W	01121	CB1535	101552	1
	R7	Same as R5				
	R8	Not Used				
	R9	Not Used				
	R10	RESISTOR, CC 3.3 k 5%, 1/4W	01121	CB3325	101559	1
	R11	RESISTOR, CC 180 Ω 5%, 1/4W	01121	CB1815	10166801	1
	R12	RESISTOR, CC 18 Ω 5%, 1/2W	01121	EB1805	101863	1
	R13	RESISTOR, CC 4.7 k 5%, 1/4W	01121	CB4725	101598	2
	R14	RESISTOR, CC 220 k 5%, 1/2W	01121	EB2245	101458	1
	R15	RESISTOR, CC 430 k 5%, 1/2W	01121	EB4345	101465	2
	R16	Same as R15				
	R17	RESISTOR, CC 68 k 5%, 1/2W	01121	EB6835	101462	1
	R18	RESISTOR, CC 560 Ω 5%, 1/2W	01121	EB5615	101631	1
	R19	Same as R13				
	R20 thru R25	RESISTOR, CC 180 k 5%, 1/2W	01121	EB1845	101470	6
	VR1	DIODE, Zener 5.1V	03877	1N751A	100378	1
	VR2	DIODE, Zener 15V	03877	1N4744A	100422	1
	VR3	Not Used				
	VR4	DIODE, Zener 5.6V	03877	1N752A	100376	1
	VR5	DIODE, Zener 8.2V	04713	1N959B	100429	1
		SPACER, Swage	88245	1530 B 3/16	100511	8
		HEATSINK, TO-3	98978	UP-TO3	100936	2
		HEATSINK, TO-5	13103	1115B	101071	6
		PAD, Transistor TO-5	08289	501-000-D	100666	7
		SCREW, PHMS 6-32 x 3/8	96906	MS51957-28	10063206	8
		WASHER, Split-Lock #6	96906	MS35338-136	100712	8
		BOARD, PC	52542	067770	067770	1

REPLACEABLE PARTS LIST

TITLE		OPTION 07, TEST ASSEMBLY (Local Control) #075145 Rev C				
ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
1 1		ASSEMBLY, Front Sub-Panel	52542	067860	067860	1
2		ASSEMBLY, Cross Member Front	52542	067887	067887	1
3		ASSEMBLY, Center Brace	52542	067896	067896	1
4		CROSS MEMBER, Rear	52542	067738	067738	1
5		GUSSET, Right	52542	067678	067678	1
6		GUSSET, Left	52542	067677	067677	1
7		ASSEMBLY, Rear Panel	52542	067859	067859	1
8		GUIDE, Card	52542	01234011	01234011	1
9	A1	ASSEMBLY, Jumper Board	52542	067902	067902	1
10	A2	ASSEMBLY, Encoder PC	52542	06775001	06775001	1
11	A3	ASSEMBLY, D/A Control PC	52542	06775501	06775501	1
12	A6	ASSEMBLY, High Voltage Amp PC	52542	06777001	06777001	1
13	A4	ASSEMBLY, Mother Board PC	52542	06775301	06775301	1
14	A5	ASSEMBLY, Analog PC	52542	06781701	06781701	1
15		TAPE, 20-pin Cable	30146	922521-20-02-14	117401	1
16		TAPE, 34-pin Cable 6"	30146	922521-34-02-06	117913	2
17		TAPE, 34-pin Cable 15"	30146	922521-34-02-15	117914	1
18		ASSEMBLY, Shield	52542	075251	075251	1
20	K1 - K4	RELAY, 6-pole 26V	77342	R10-E112-2	101295	4
21		SPRING, Relay	24796	20C251	10242601	4
22		STRIP, Caterpillar	03296	G51H-A	102749	A/R
23		NAMEPLATE	52542	045435	045435	1
24		SHIELD, Resistor	52542	067865	067865	1
25		SHIELD, Amp	52542	067813	067813	1
26		FOAM, Block	52542	075209	075209	1
27		SUPPORT, PC	52542	075208	075208	2
28		BUSHING, Snap	28520	SB-375-4	100781	2
29		KNOB	86797	RB-67-1-DC-M-L	100976	1
30		JUMPER	55210	L-2007-1	102879	10
32		TIE, Cable	06383	SSTIM	100753	A/R
33	U15,U16	INTEGRATED CIRCUIT Voltage Regulator	04713	MC7805CT	045256	2
39		ADHESIVE			116566	A/R
42		SCREW, PHMS 4-40 x 1/2	96906	MS51957-17	10062608	2
43		SCREW, PHMS 6-32 x 5/16	96906	MS51957-27	10063205	29
44		SCREW, PHMS 6-32 x 3/8	96906	MS51957-28	10063206	4
45		SCREW, FHMS 6-32 x 3/8	96906	MS24693-C26	10073106	8
46		SCREW, FHMS 8-32 x 1/4	96906	MS24693-C46	10074304	6
47		SCREW, FHMS 8-32 x 3/8	96906	MS24693-C48	10074306	6
50		WASHER, Flat #6	86928	5710-23-10	100662	14
51		WASHER, Split-Lock #6	96906	MS35338-136	100712	31
53		NUT, Kep #4	78189	511-041800-00	100941	2
54		NUT, Kep #6	78189	511-061800-01	112472	2

REPLACEABLE PARTS LIST

ITEM	REF	COMPONENT DESCRIPTION	MFR'S CODE	MANUFACTURER'S PART NUMBER	SD STOCK NUMBER	T/Q
TITLE		OPTION 07, REAR PANEL ASSEMBLY #075144 Rev A				
1		PANEL, Rear	52542	067732	067732	1
2	S102	SWITCH, Slide DPDT	82389	46206LFE	102340	1
3	XF101	POST, Fuse	75915	345002	117381	1
4	F101	FUSE, 3-AGSB 1/2-A	71400	MDL 1/2	100589	1
5	Z101	FILTER, Line	05245	3EF1	102461	1
6	T101	TRANSFORMER	52542	067743	067743	1
7	C101	CAPACITOR, 2 μF, 2000V	16727	KMOC2M2	117920	1
8		BRACKET, Mtg. Cap.	16727	By Description	117925	1
9		LUG, Solder #8	78189	2104-08-00	102961	1
10		LUG, Solder #4	83330	1416-4	100509	1
11		NUT, Kep 8-32	78189	511-081800-00	100940	6
12		NUT, Kep 4-40	78189	511-041800-00	100941	2
14		NUT, Hex 8-32	73734	70208	100659	1
15		NUT, Hex 4-40	96906	NAS671C4	100622	1
16		WASHER, Split-Lock #4	96906	MS35338-135	100711	4
18	J101	CONNECTOR, Rear Panel Output	71468	KPT00A14-5S	117696	1
19		SCREW, PHMS 4-40 x 1/4	96906	MS51957-13	10062604	3
20		SCREW, PHMS 4-40 x 5/16	96906	MS51957-14	10062605	1
21		SCREW, PHMS 4-40 x 3/8	96906	MS51957-15	10062606	4
22		SCREW, PHMS 4-40 x 7/16	96906	MS51957-16	10062607	2
23		SCREW, PHMS 8-32 x 7/16	96906	MS51957-44	10064207	4
24		SCREW, PHMS 8-32 x 1/2	96906	MS51957-45	10064208	2
25		SCREW, PHMS 8-32 x 1/4	96906	MS51957-41	10064204	1
33		PLATE, Cover	52542	067540	067540	2
35	J103	CONNECTOR, Rectangular 14-pin	02660	57-40140	101180	1
36		SCREW, PHMS 2-56 x 1/4	96906	MS51957-3	10062504	4
38		WASHER, Split-Lock #2	96906	MS35337-77	100661	6
39		NUT, Hex 2-56	96906	MS35649-224	100636	1

CHAPTER 7

DRAWINGS

7-1. INTRODUCTION

This chapter contains final assembly and schematic drawings for the Model M107 Precision D.C. Voltage Source. The schematic diagrams relate to the detailed circuit descriptions located in Chapter 4 of this manual. The parts list contained in Chapter 6 relate to the reference designation callouts on the diagrams. Table 7-1 provides a list by figure number of the drawings, with title, drawing numbers and manual page number.

TABLE 7-1. LIST OF DRAWINGS

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TABLE 7-1. LIST OF DRAWINGS (Cont'd)

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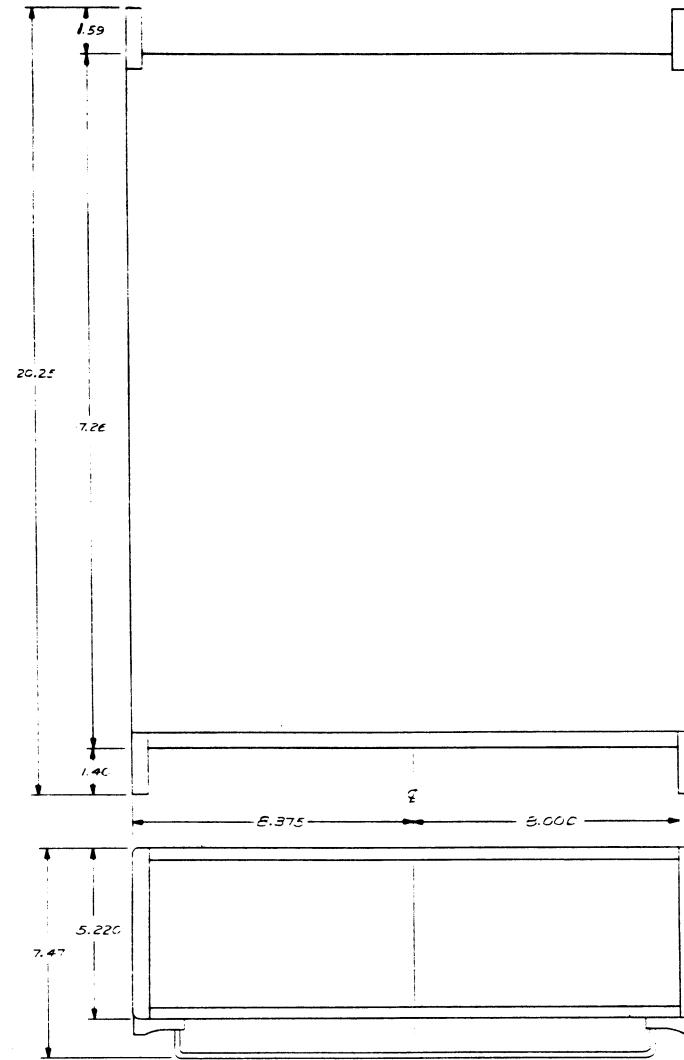
FIGURE 7-1
M107 OUTLINE
ASSEMBLY #075253 Rev A
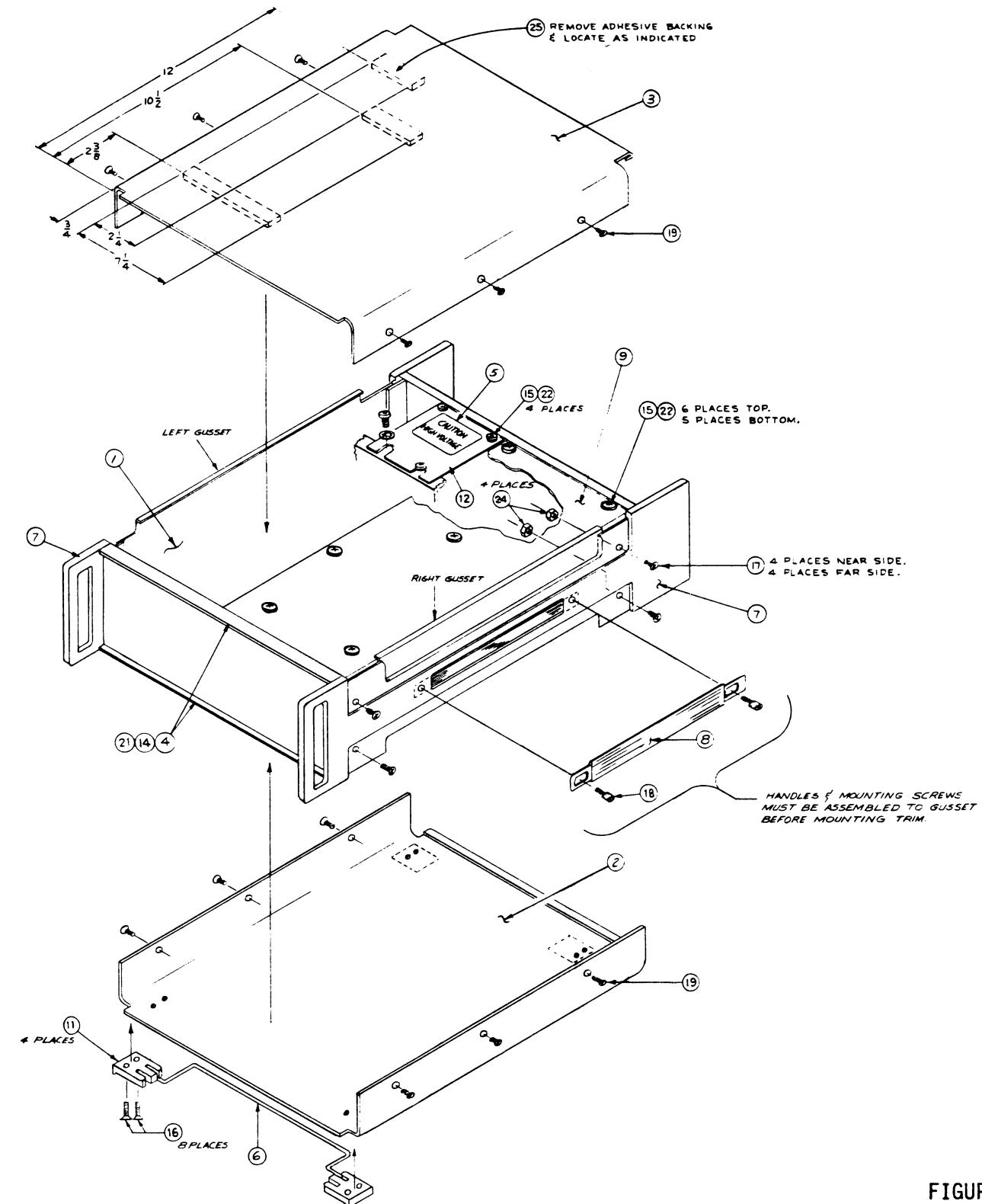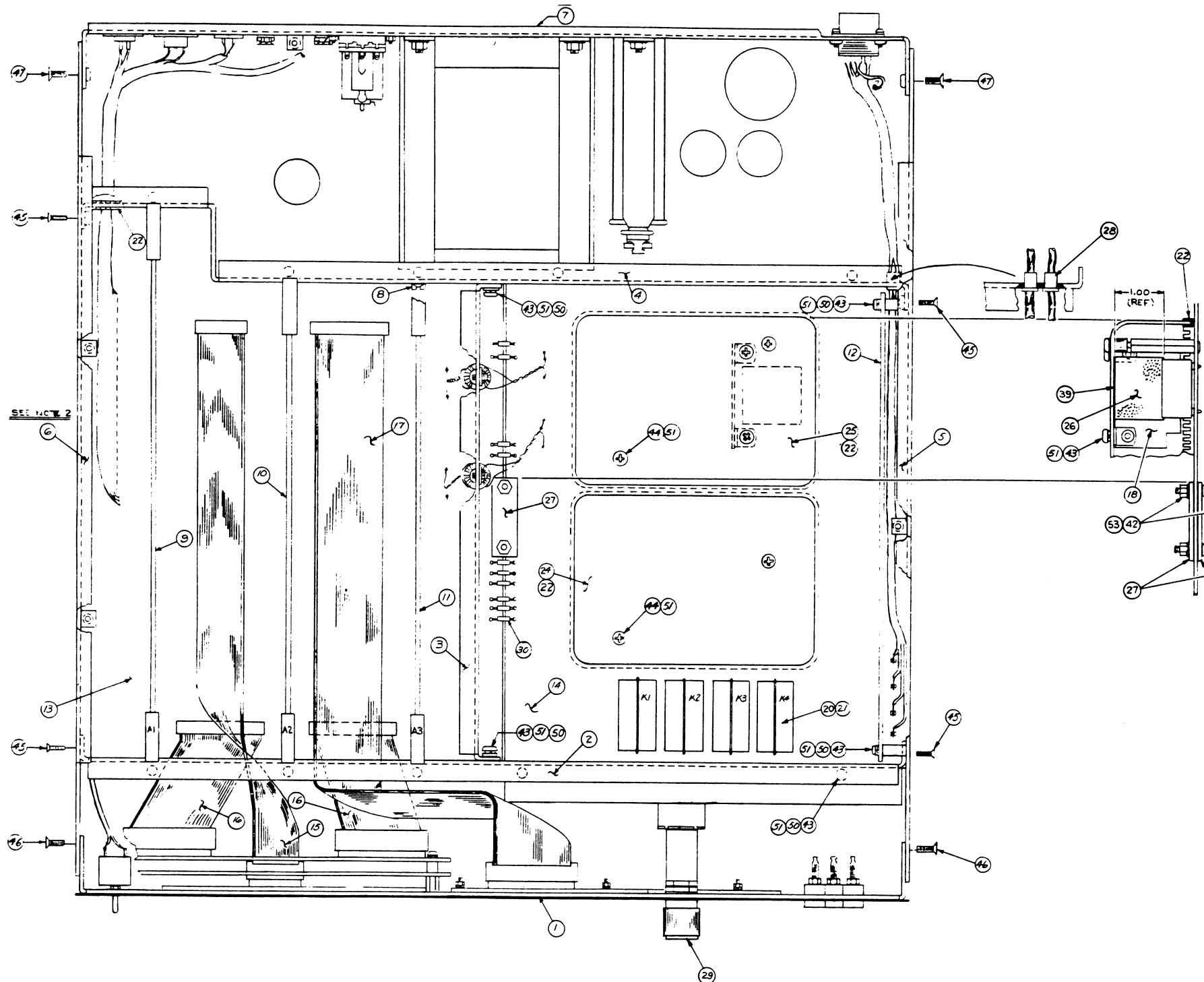
FIGURE 7-2
M107 FINAL ASSEMBLY
#075129 Rev C₁

FIGURE 7-3
M107 TEST ASSEMBLY
#067861 Rev E (Sheet 1 of 2)
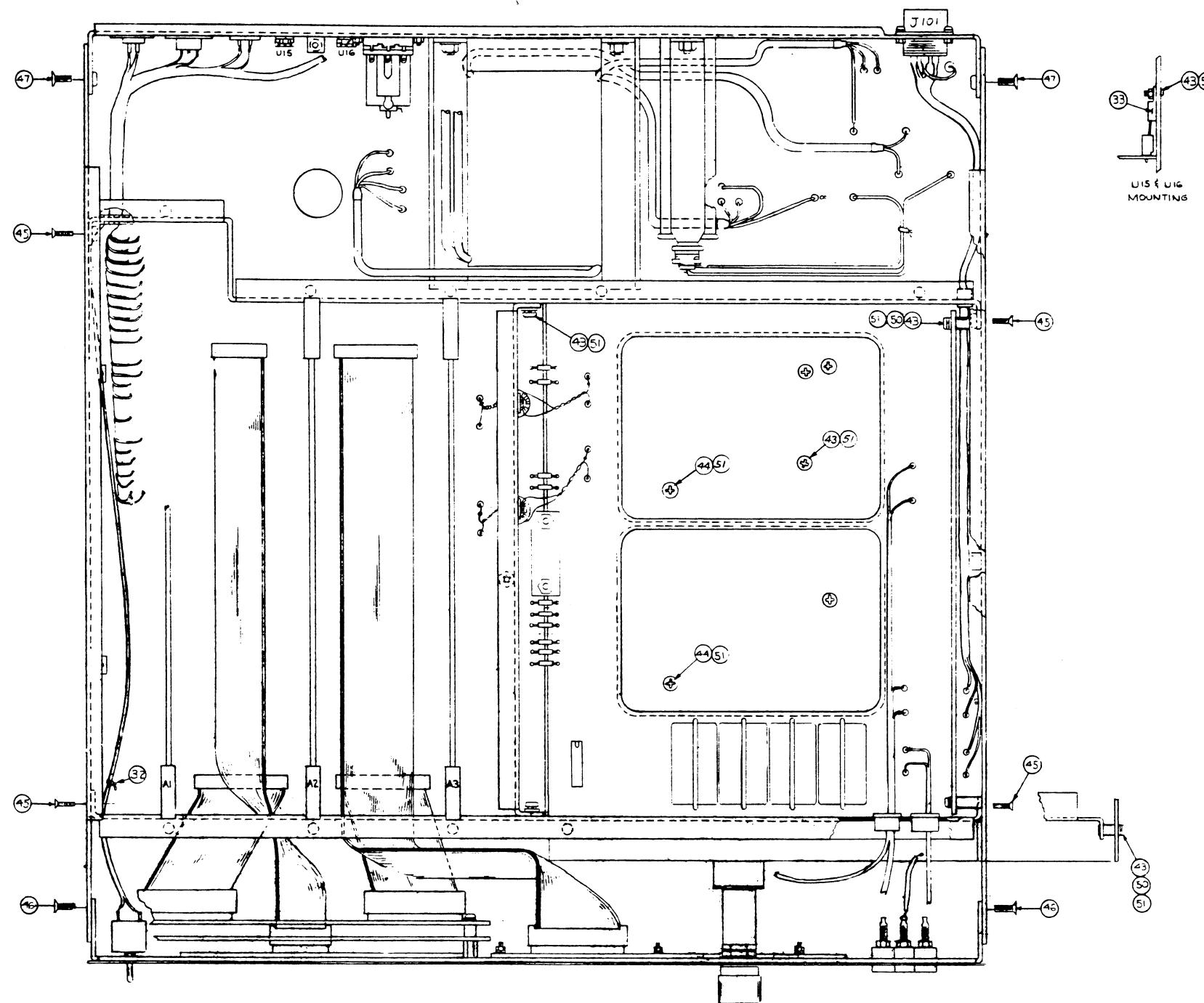
FIGURE 7-4
M107 TEST ASSEMBLY
#067861 Rev E (Sheet 2 of 2)
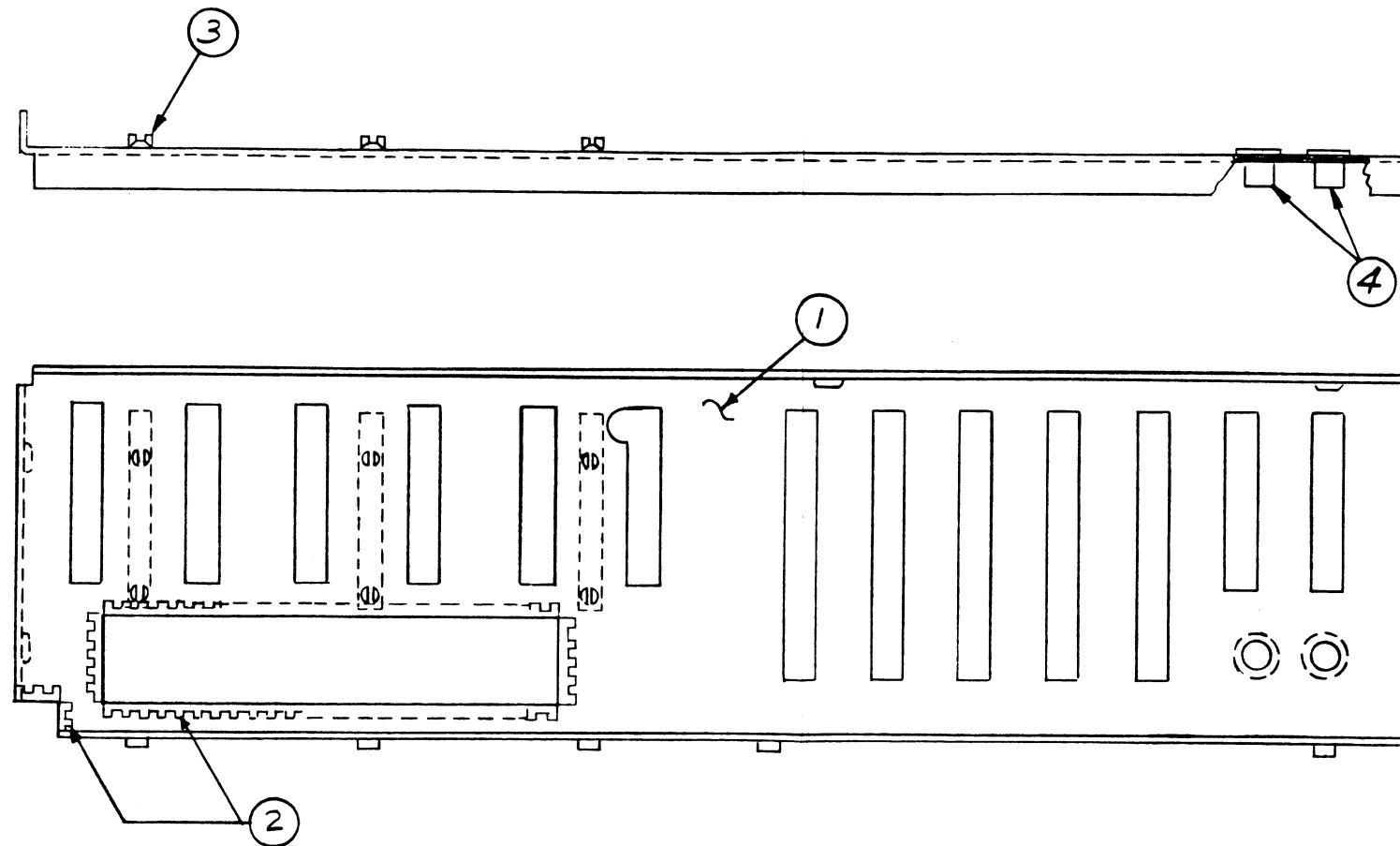
FIGURE 7-5
FRONT CROSS MEMBER ASSEMBLY
#067887 Rev A
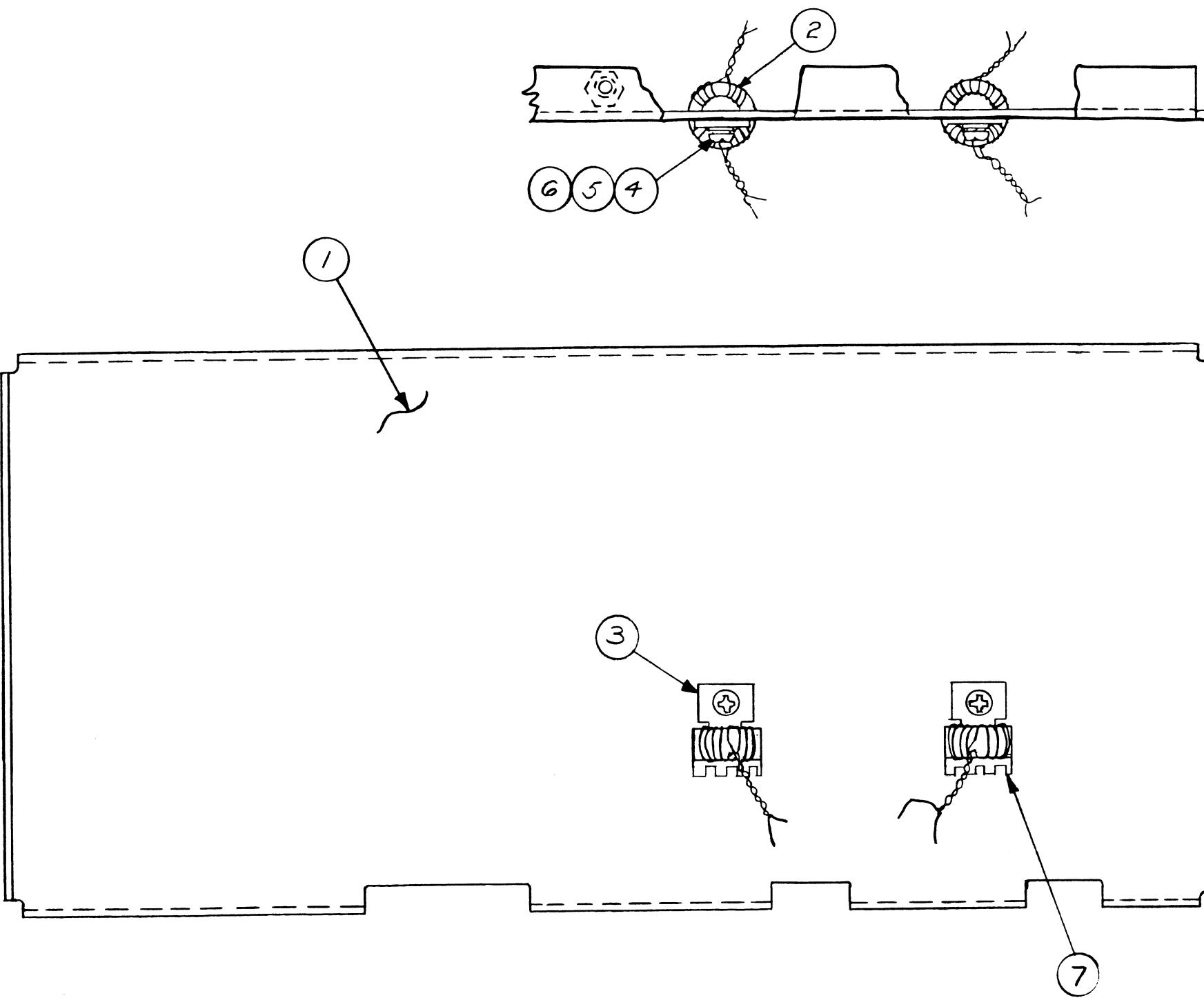
FIGURE 7-6
CENTER BRACE ASSEMBLY
#067896 Rev A
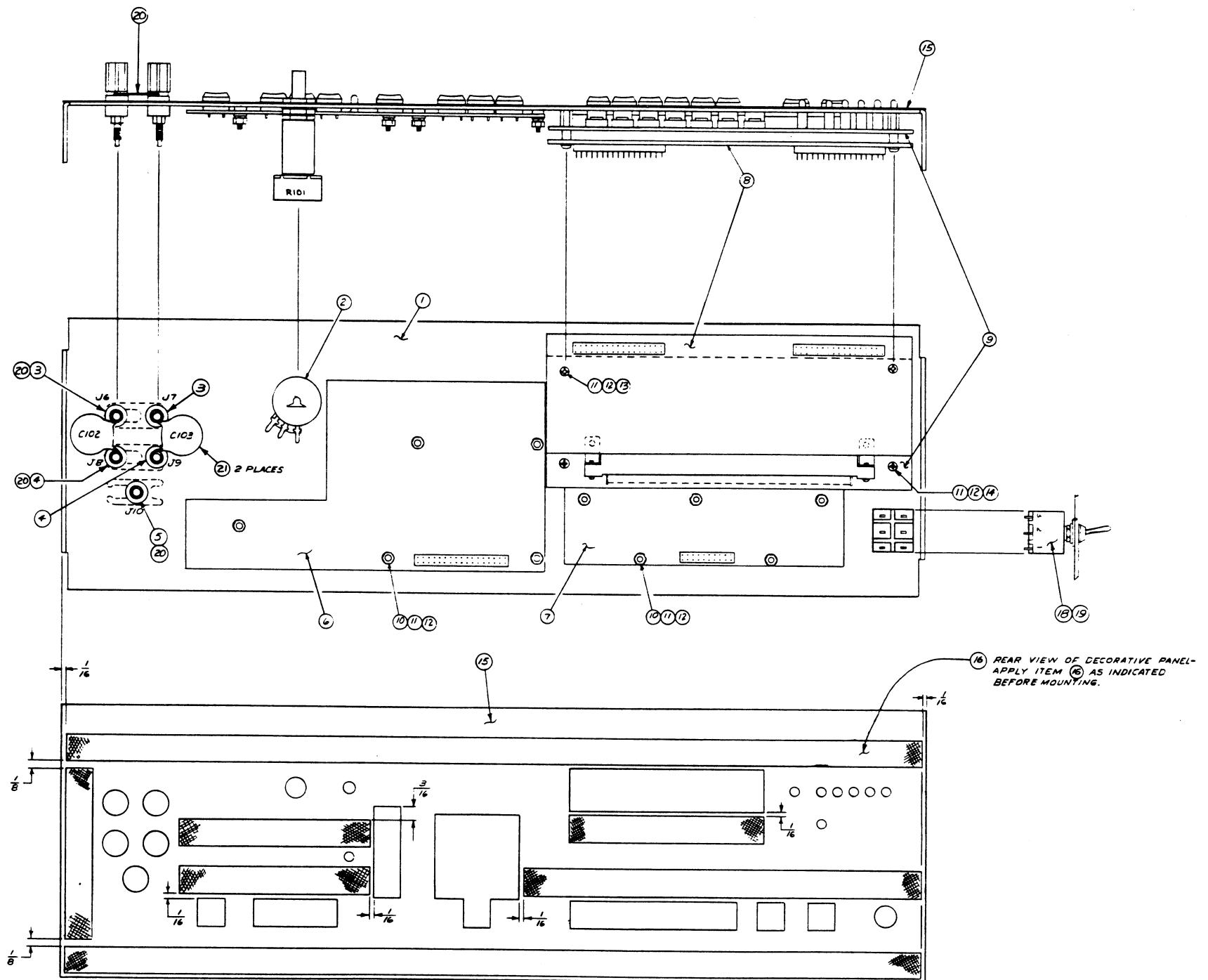
FIGURE 7-7
FRONT PANEL ASSEMBLY
#067860 Rev D
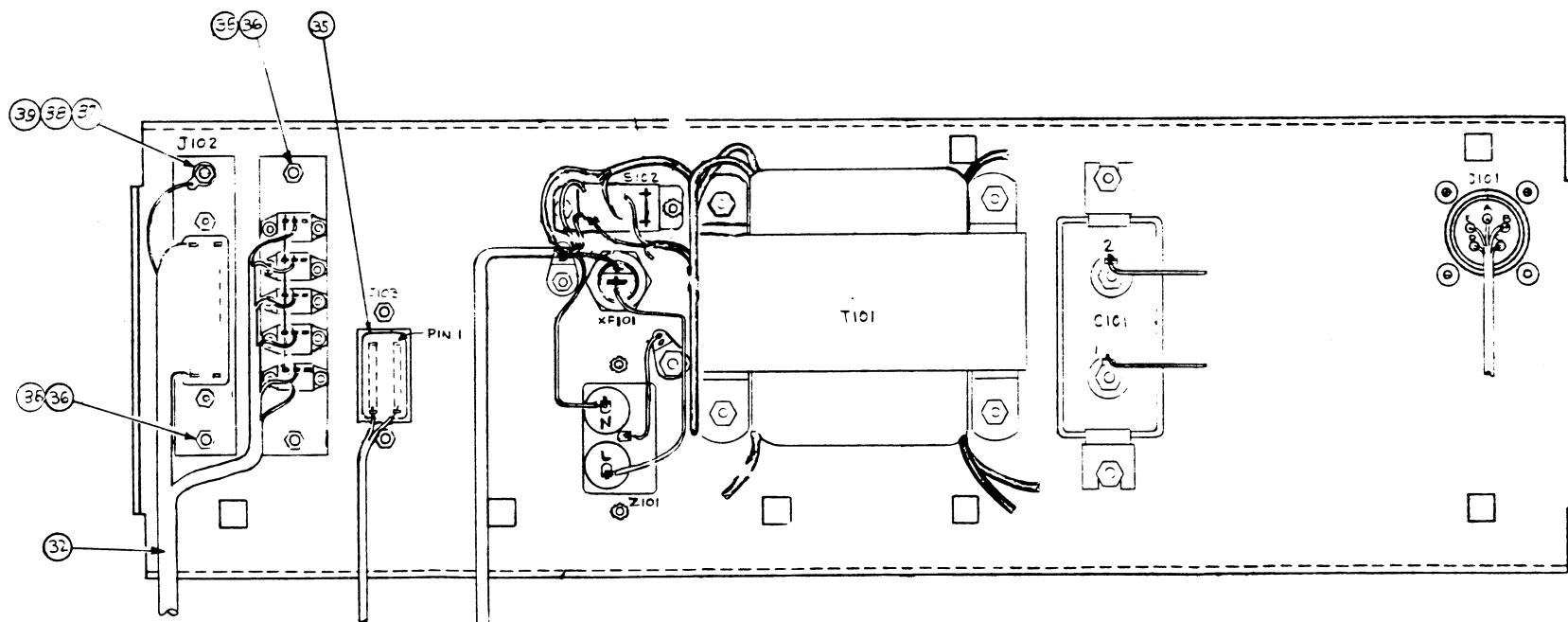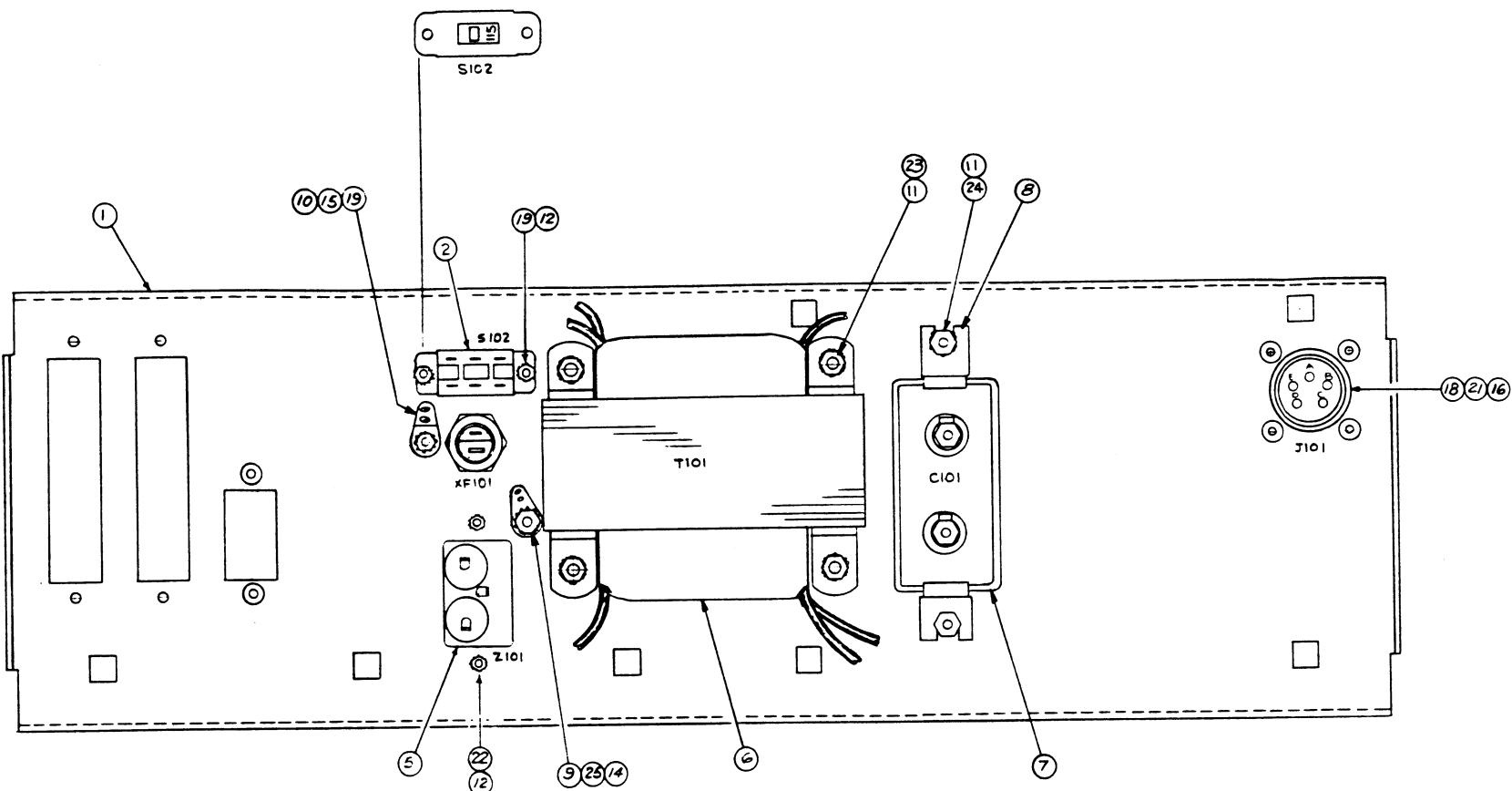
FIGURE 7-8
REAR PANEL ASSEMBLY
#067859 Rev D

ADDRESS

SWITCH PLATE
ORIENTATION

FIG. 1

J102

FIG. 2

SWITCH #1

PIN 1
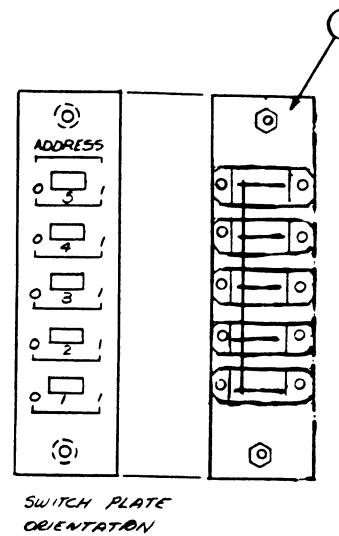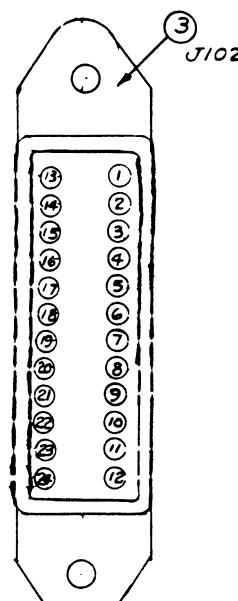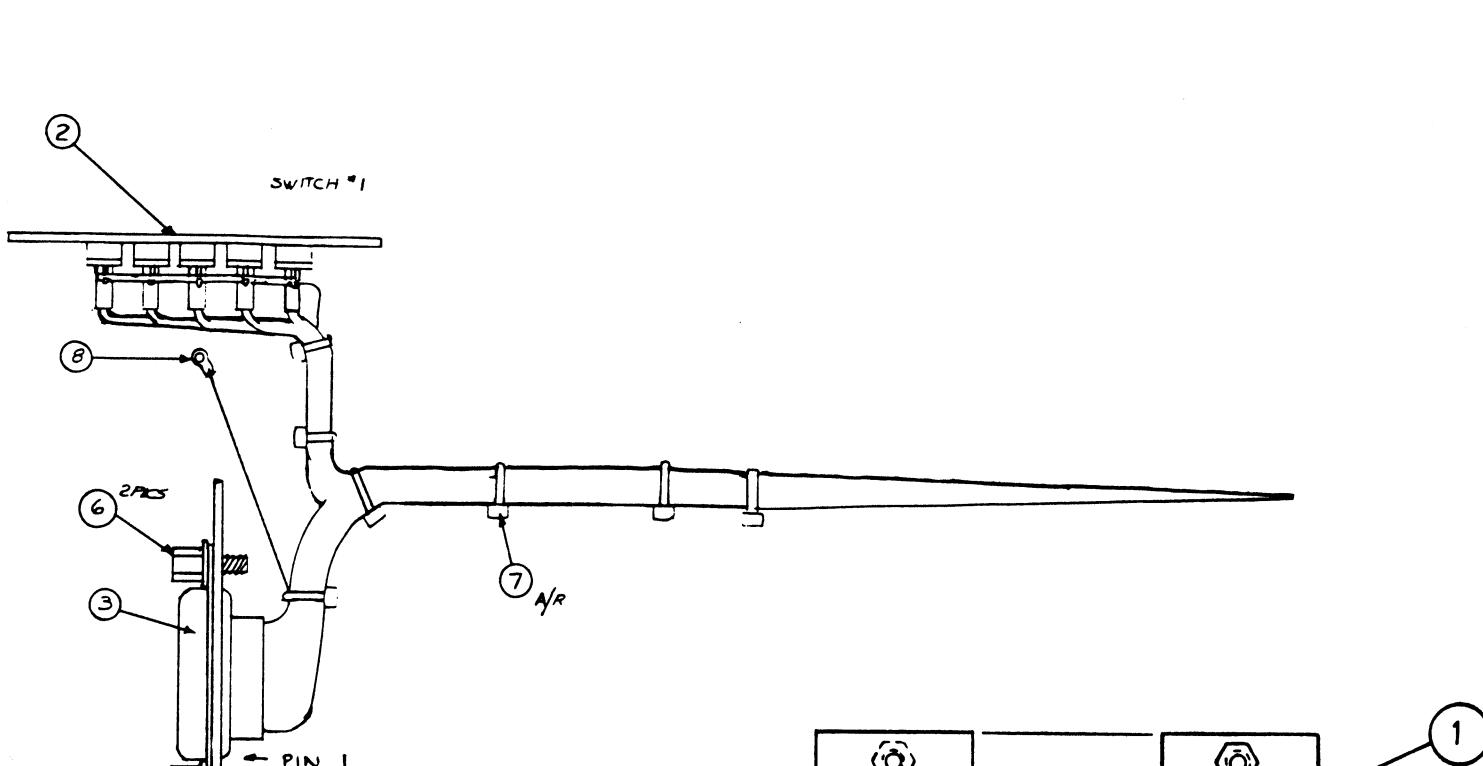
FIGURE 7-9
IEEE-488 INTERFACE CABLE
ASSEMBLY #067884 Rev B
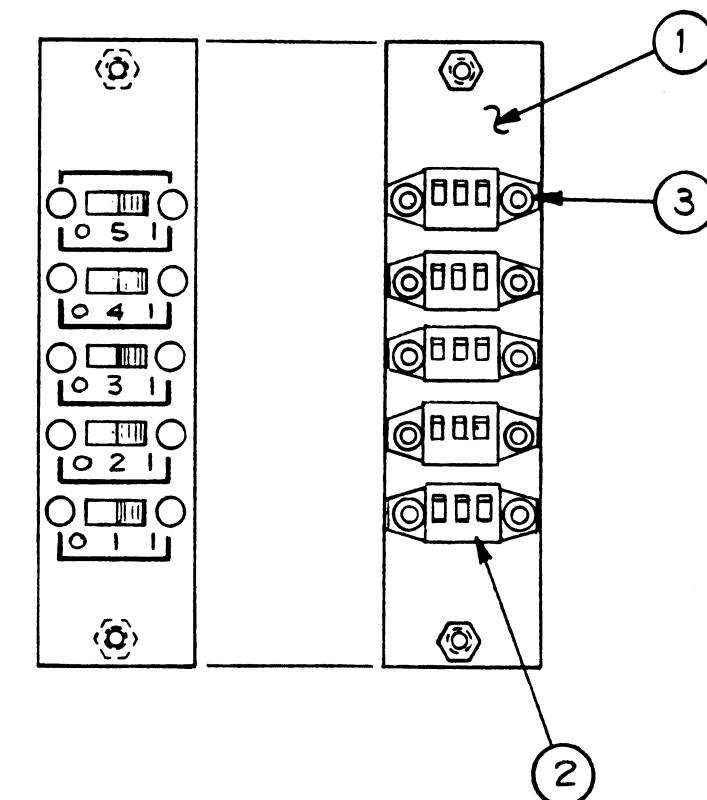
FIGURE 7-10
SWITCH PLATE ASSEMBLY
#067886 Rev A
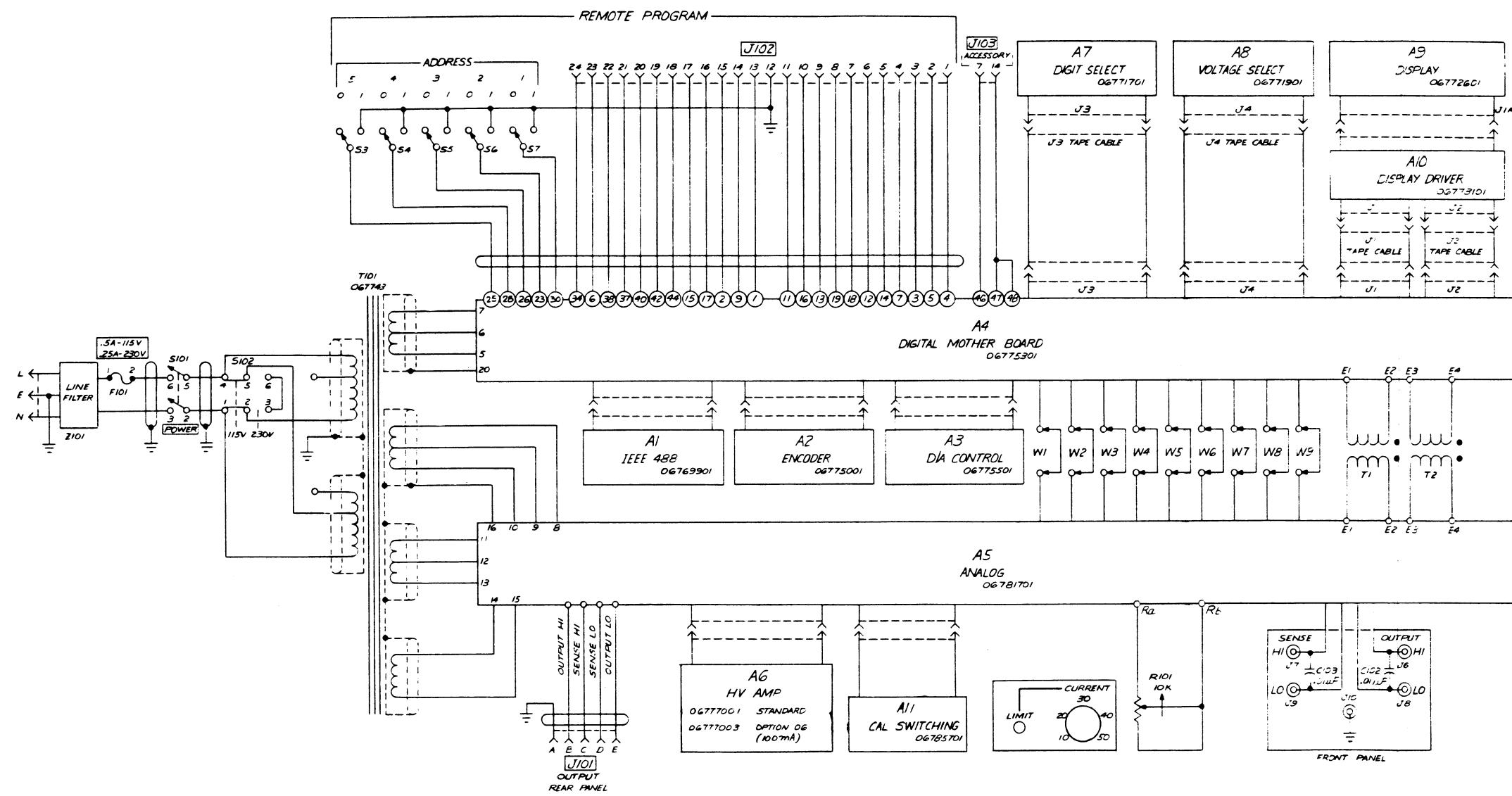
FIGURE 7-11
BLOCK DIAGRAM (Standard)
#067881 Rev E
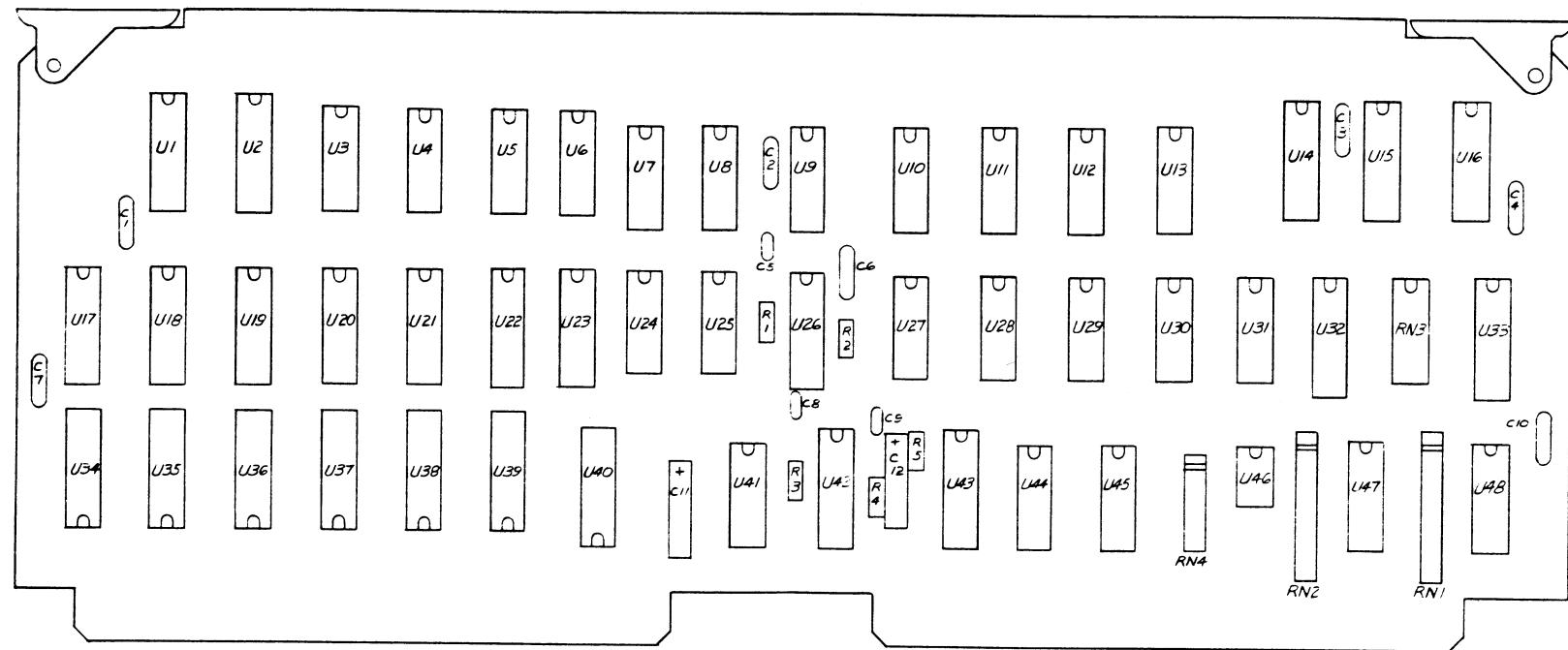
FIGURE 7-12
A1, IEEE-488 INTERFACE
PC ASSEMBLY #06769901 Rev E
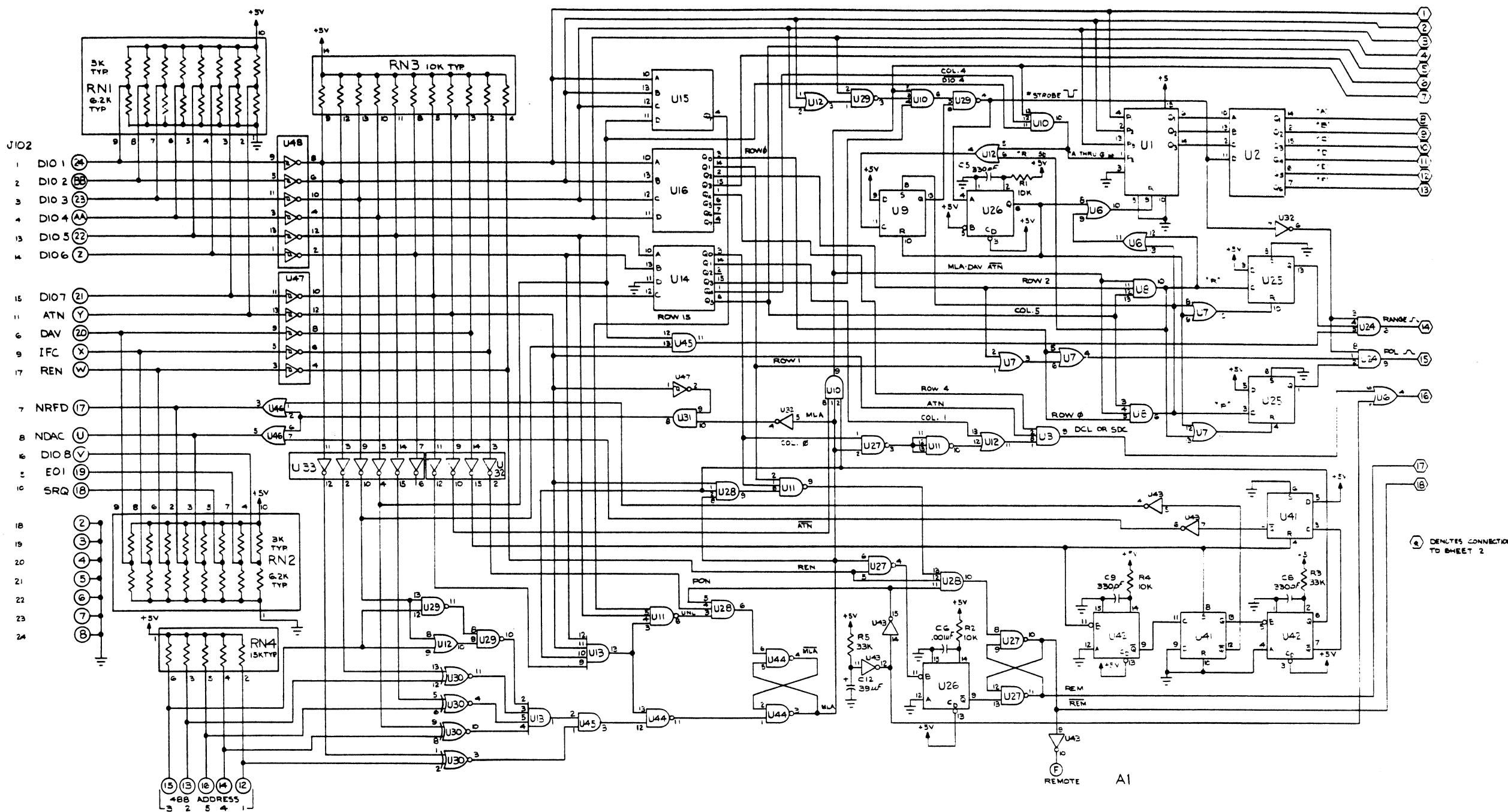
FIGURE 7-13
A1, IEEE-488 INTERFACE SCHEMATIC
#7-06769901 Rev B (Sheet 1 of 2)
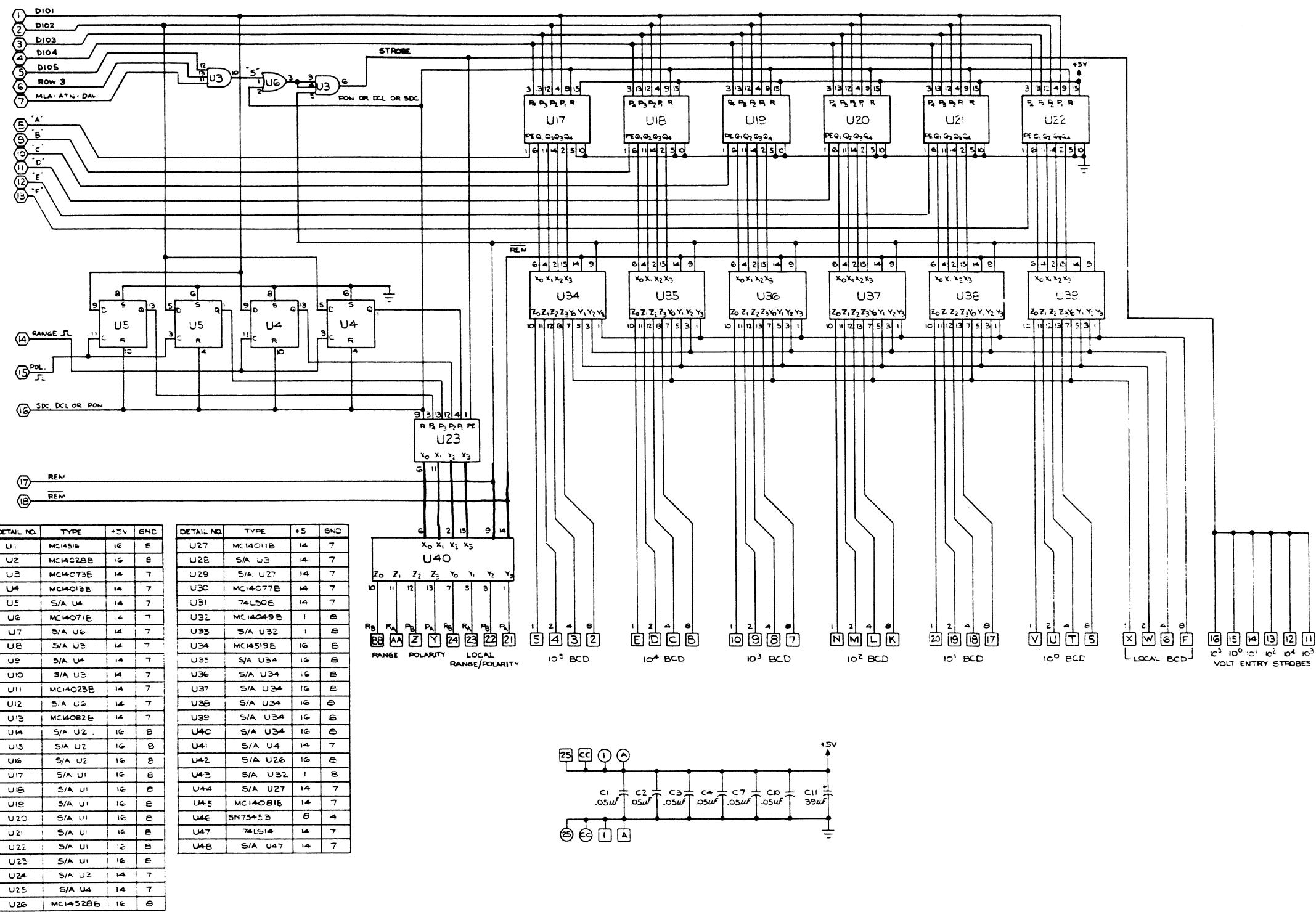
FIGURE 7-14

A1, IEEE-488 INTERFACE SCHEMATIC

#7-06769901 Rev B (Sheet 2 of 2)
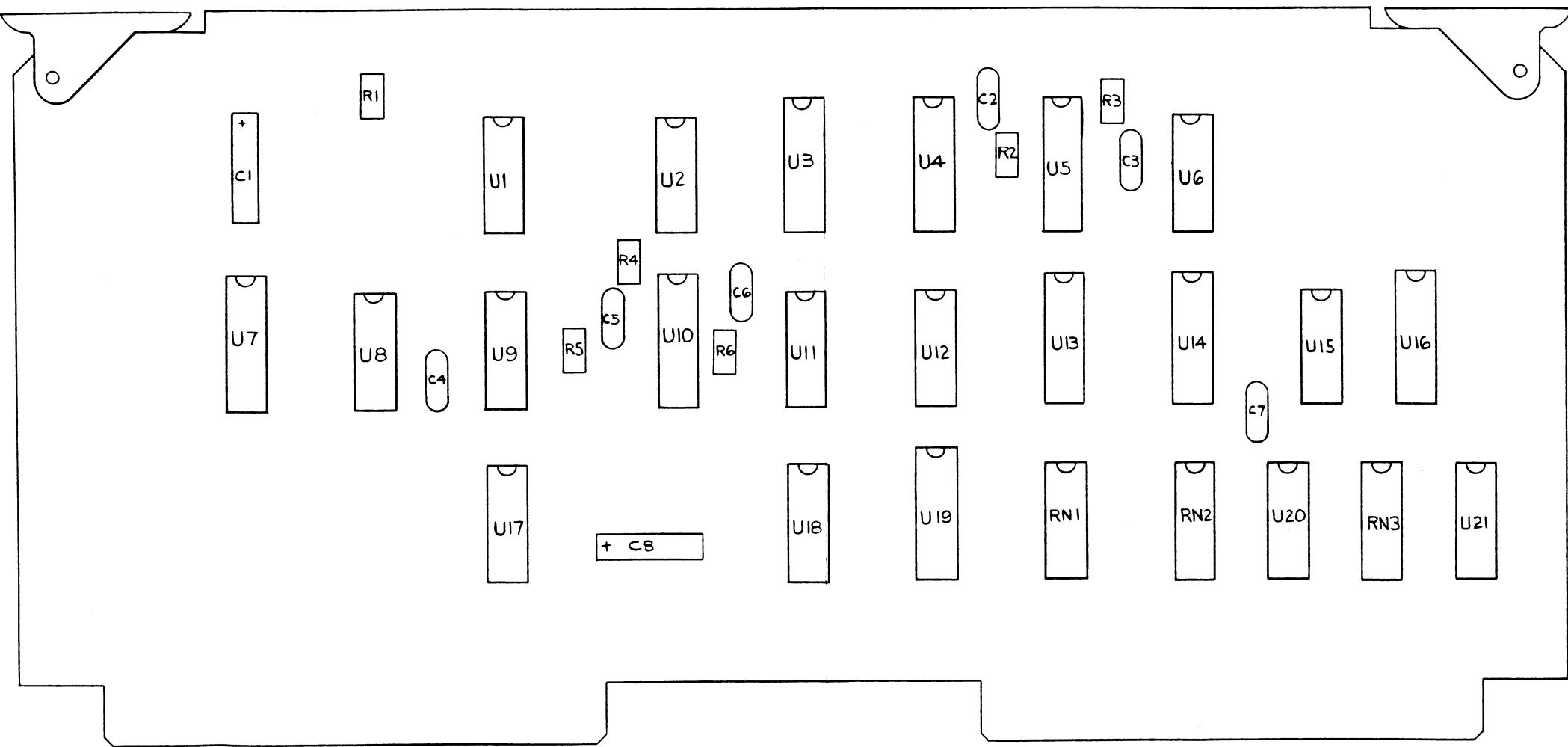
FIGURE 7-15
A2, ENCODER PC ASSEMBLY
#06775001 Rev B
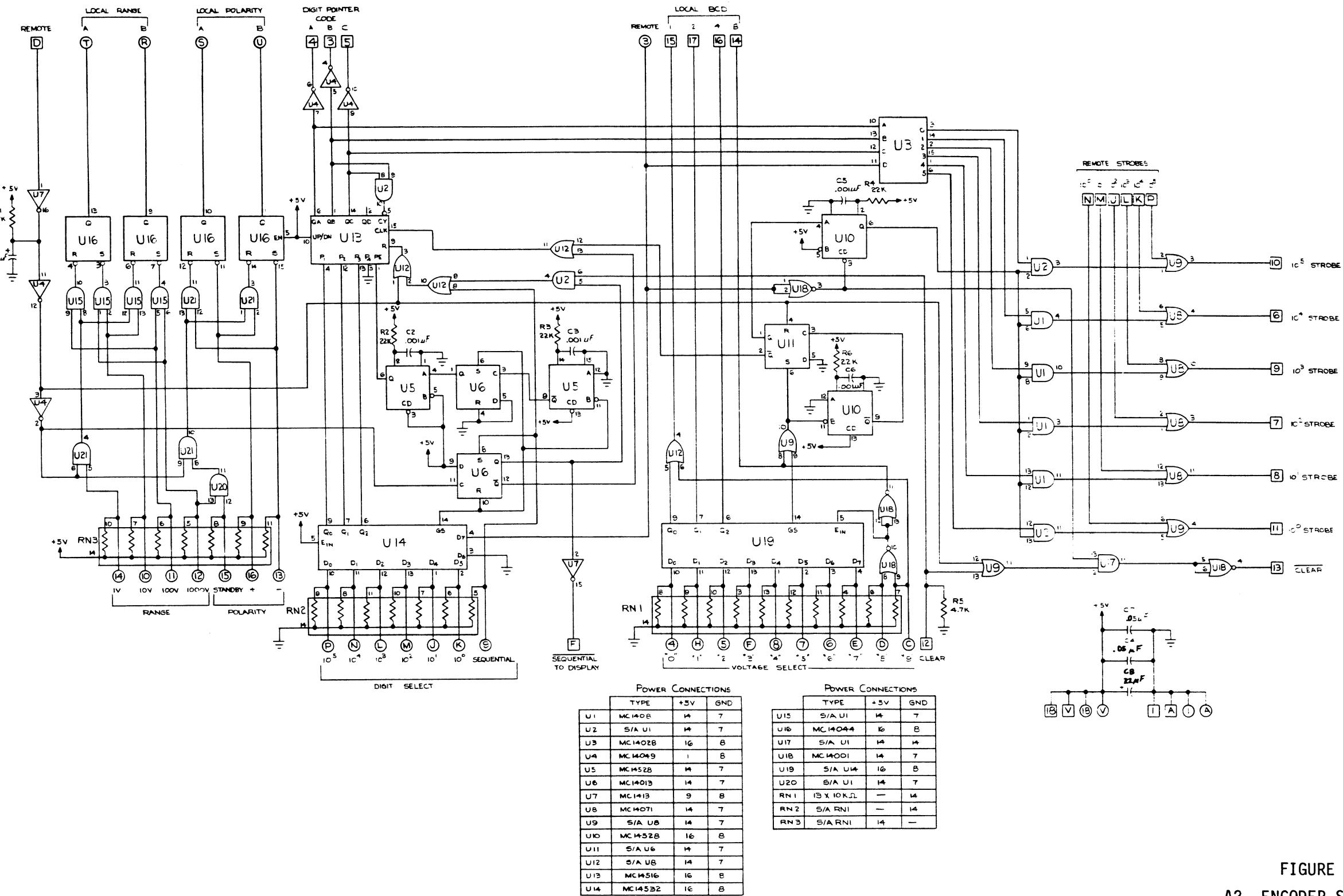
FIGURE 7-16
A2, ENCODER SCHEMATIC
#7-06775001 Rev B
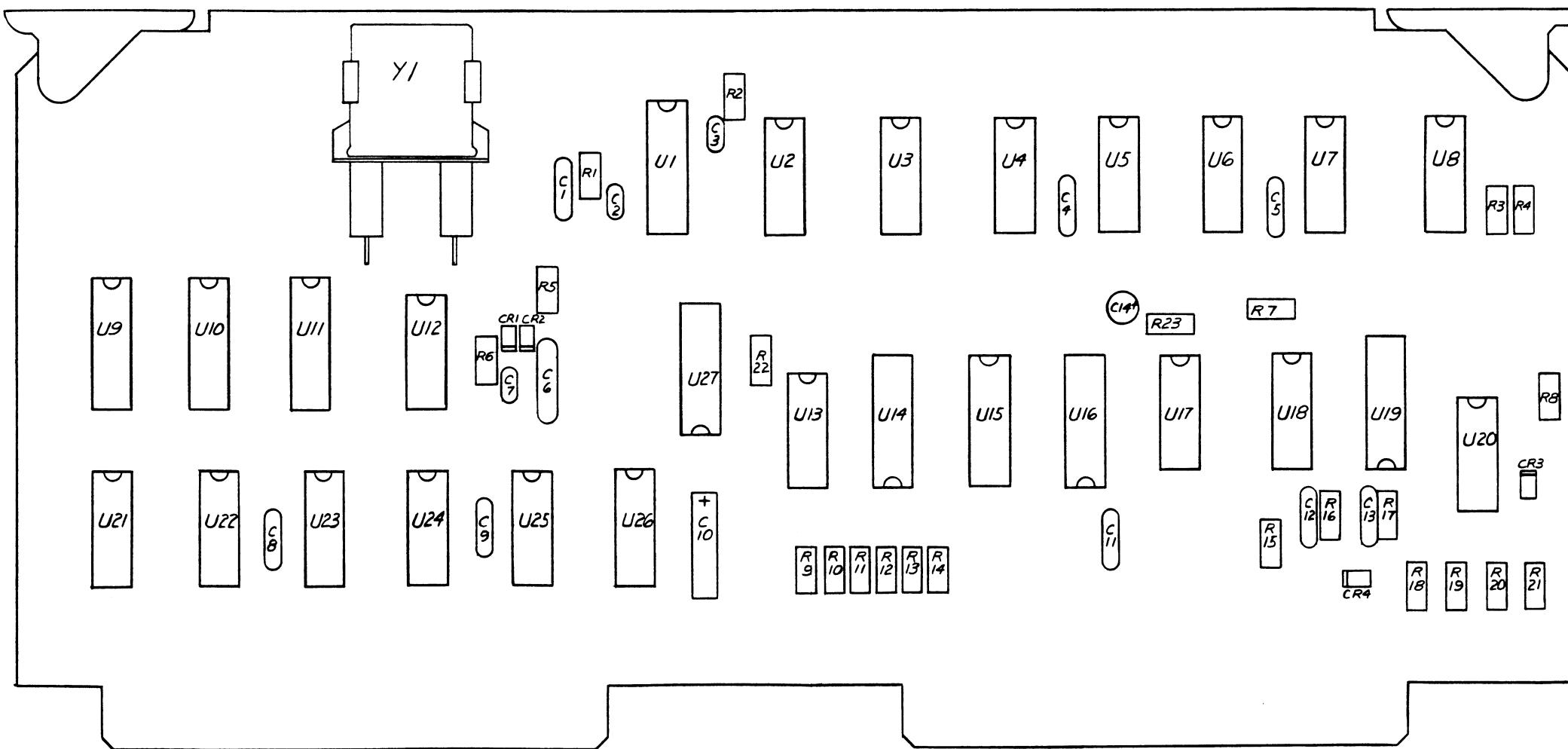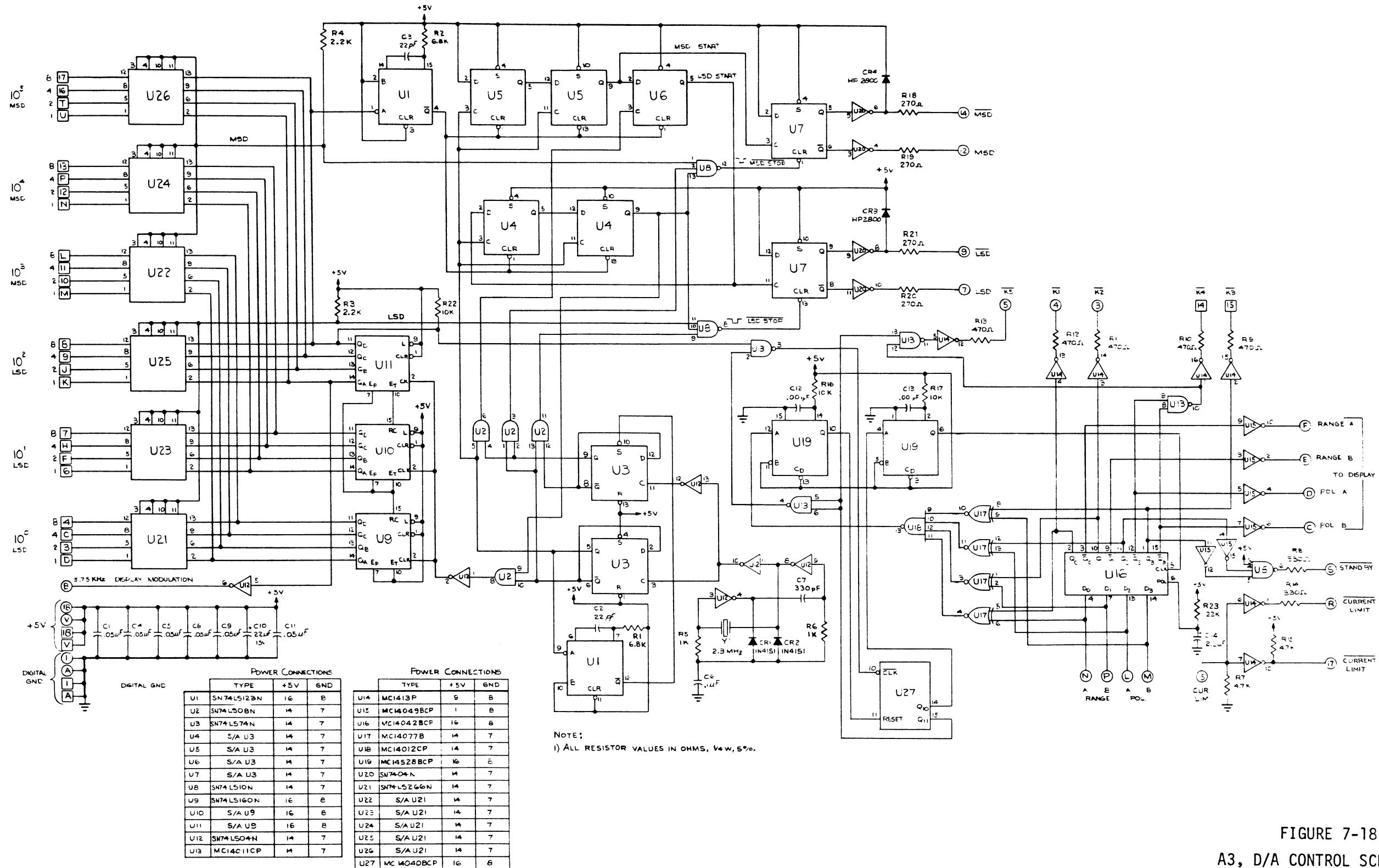
FIGURE 7-17
A3, D/A CONTROL PC ASSEMBLY
#06775501 Rev C

FIGURE 7-18
A3, D/A CONTROL SCHEMATIC
#7-06775501 Rev C
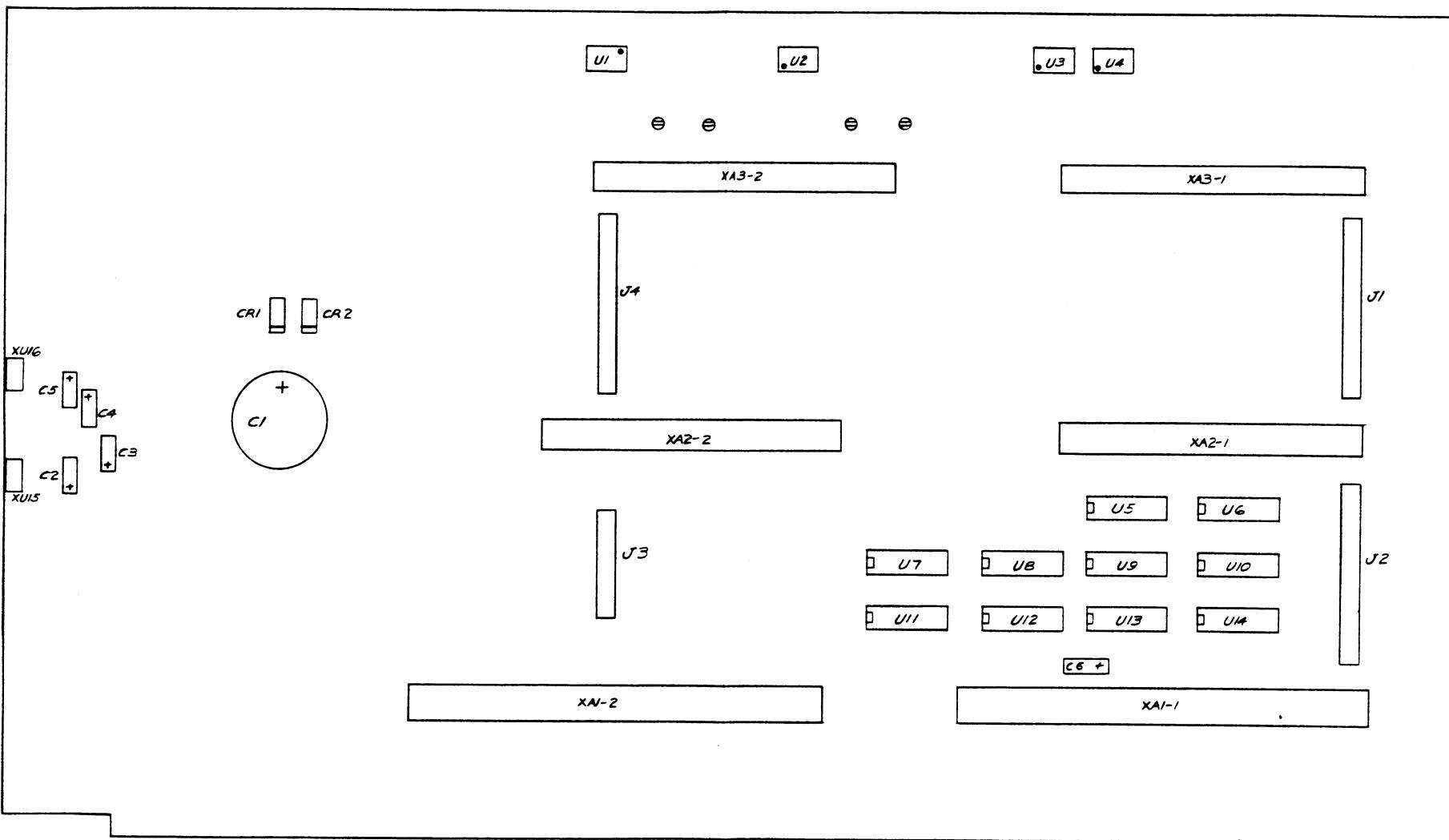
FIGURE 7-19
A4, DIGITAL MOTHER BOARD
PC ASSEMBLY #06775301 Rev C$_1$
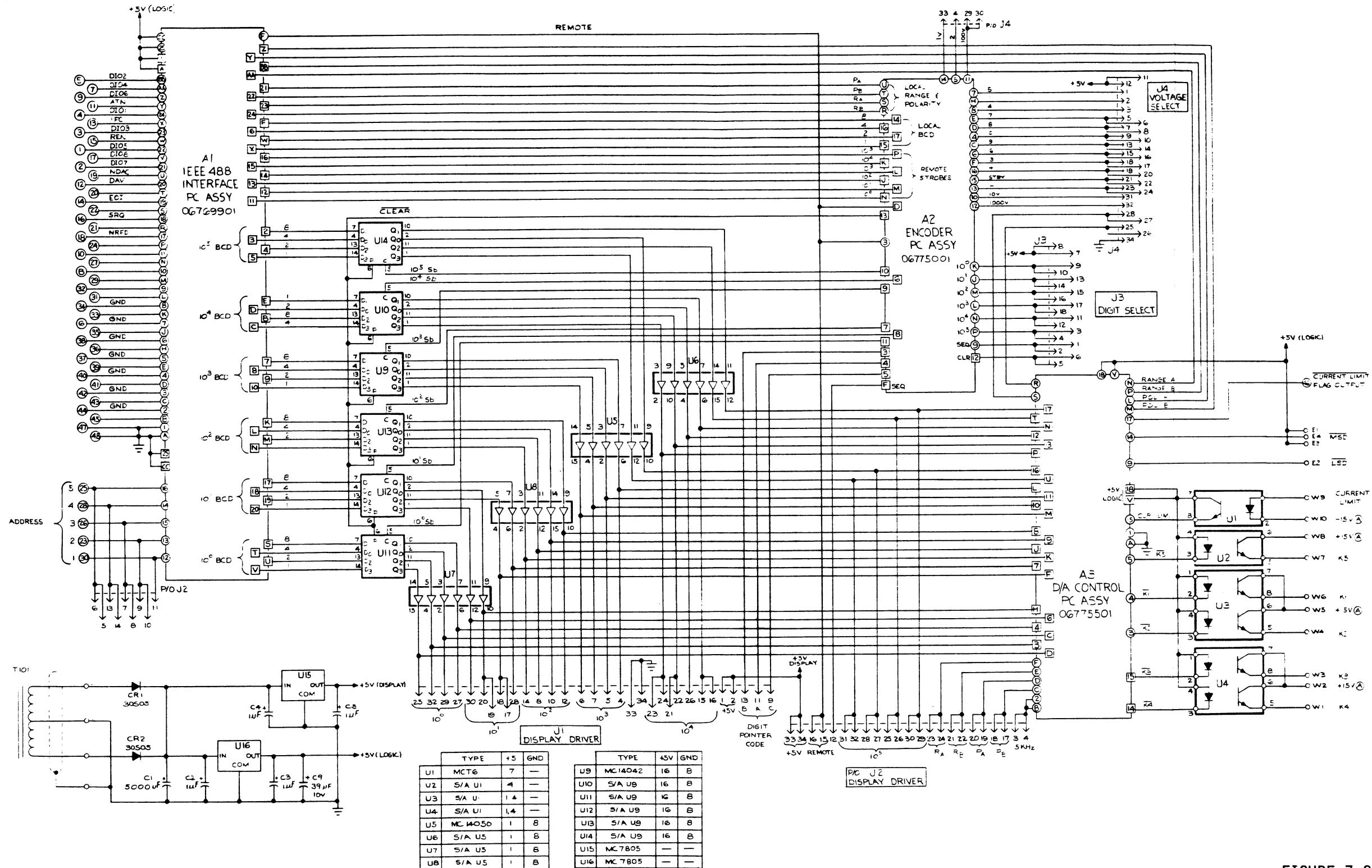
FIGURE 7-20
A4, DIGITAL MOTHER BOARD
SCHEMATIC #7-06775301 Rev C
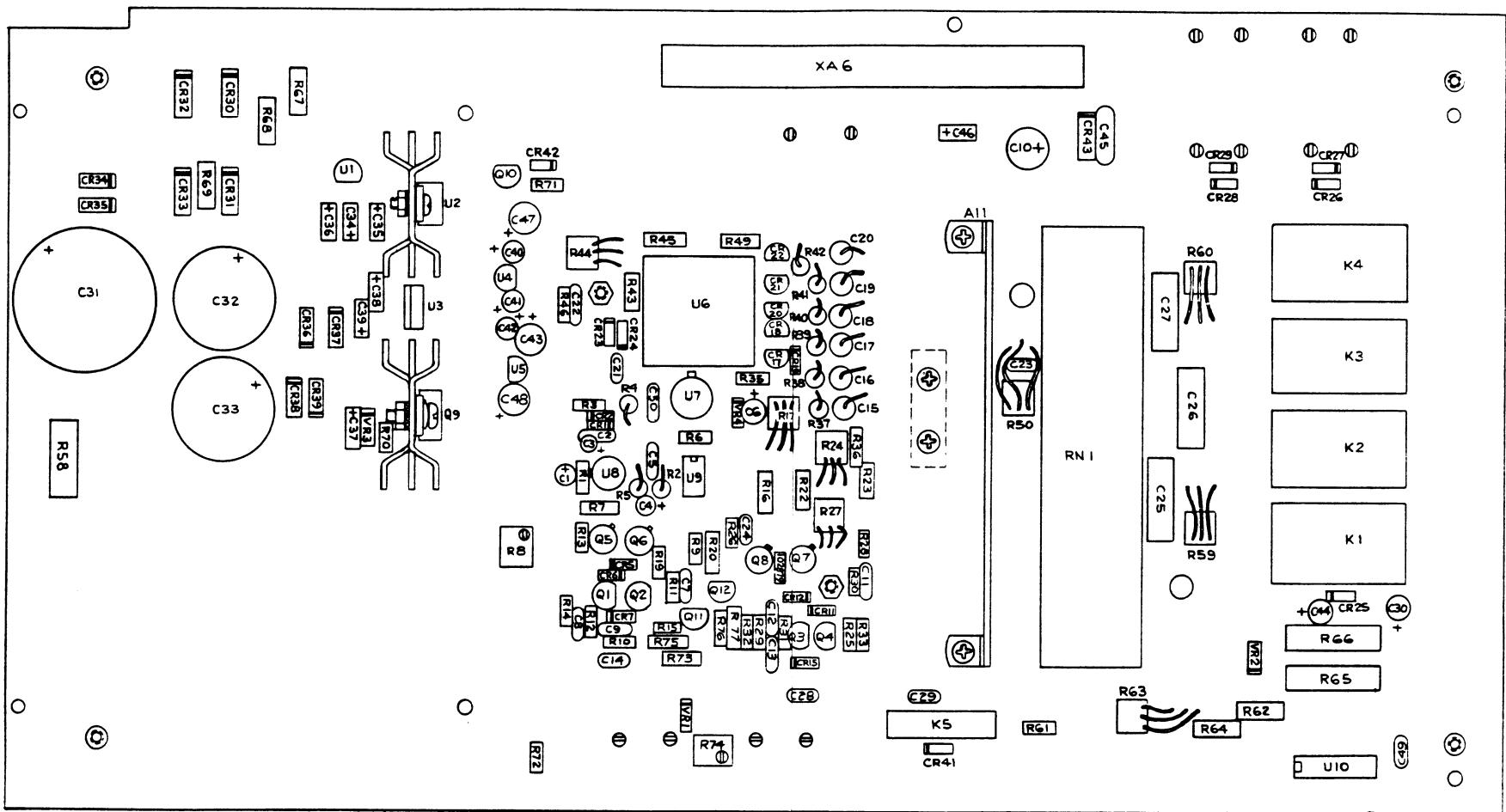
FIGURE 7-21
A5, ANALOG PC ASSEMBLY
#06781701 Rev H
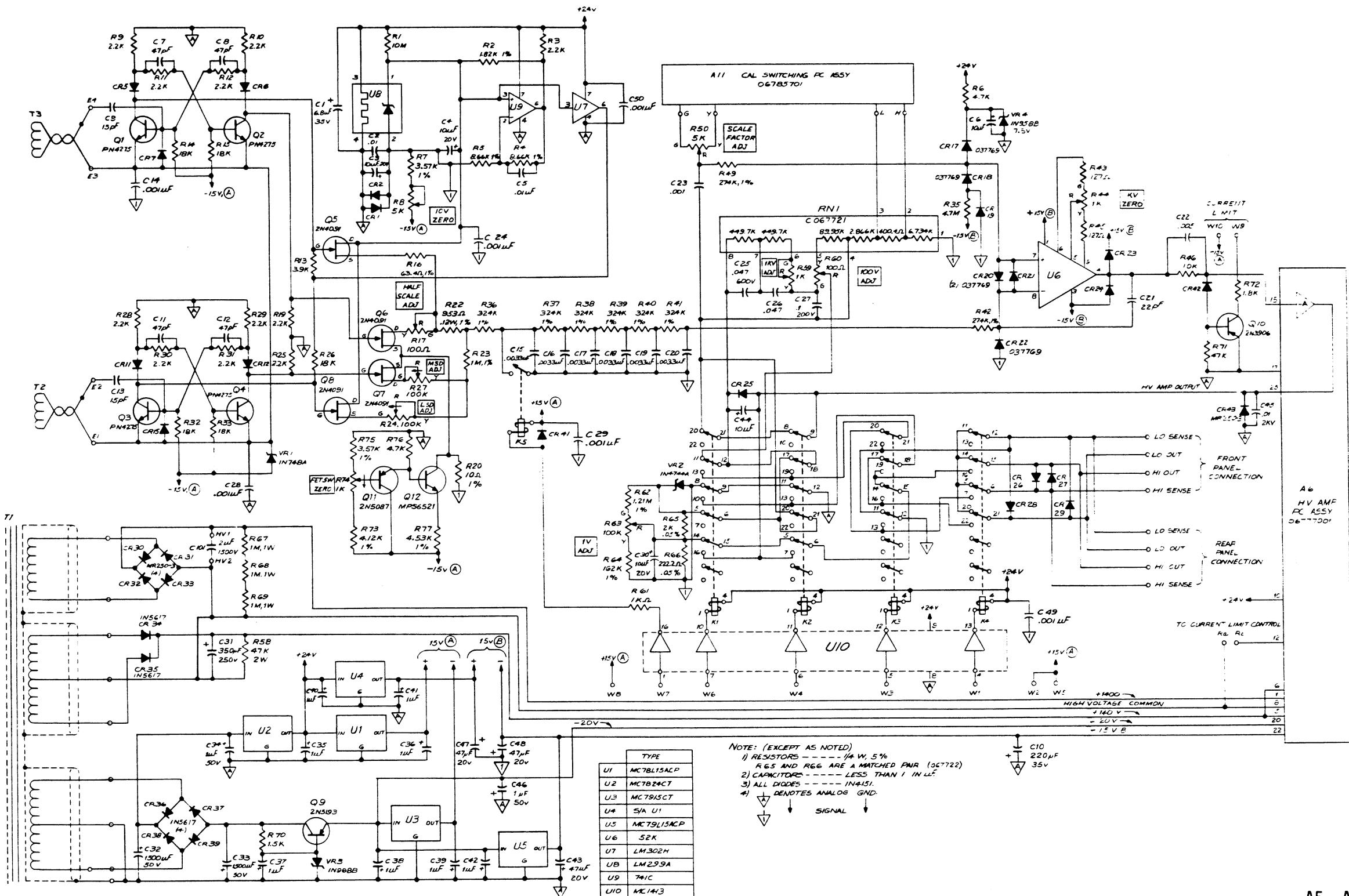
FIGURE 7-22
A5, ANALOG SCHEMATIC
#7-06781701 Rev E
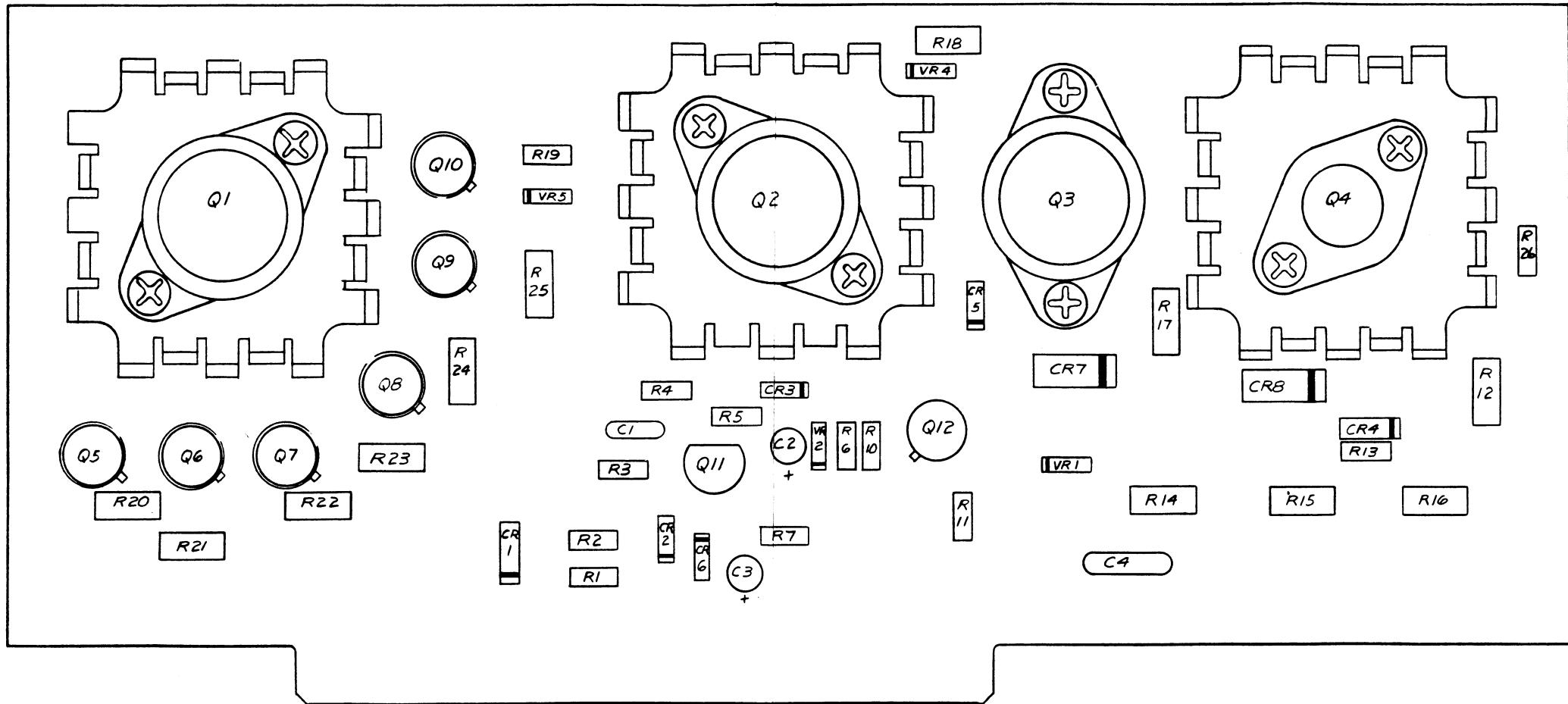
FIGURE 7-23
A6, HIGH VOLTAGE AMP
PC ASSEMBLY #06777001 Rev F
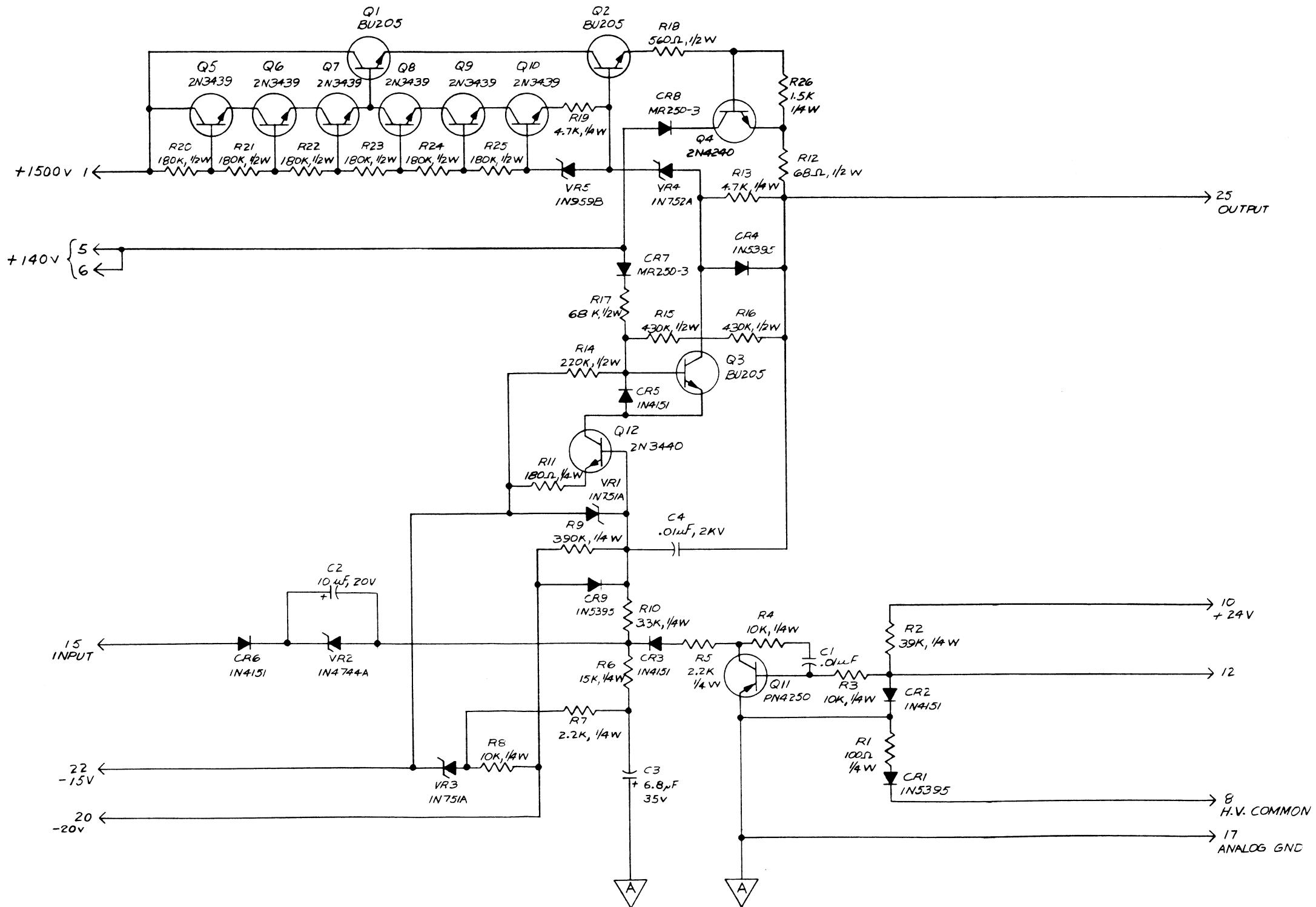
FIGURE 7-24
A6, HIGH VOLTAGE AMP
SCHEMATIC #7-06777001 Rev D
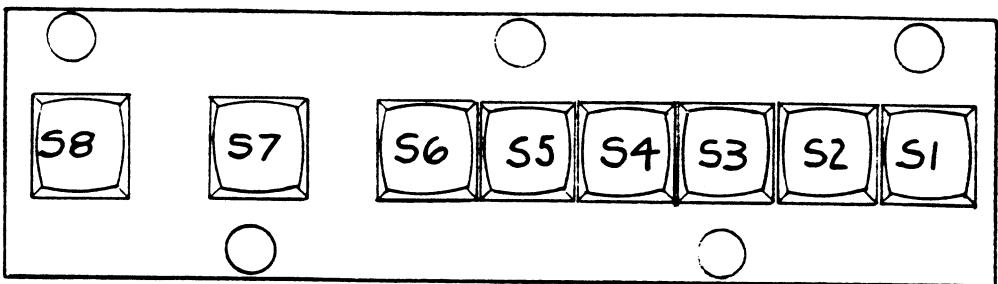
FIGURE 7-25
A7, DIGIT SELECT PC ASSEMBLY
#06771701 Rev A
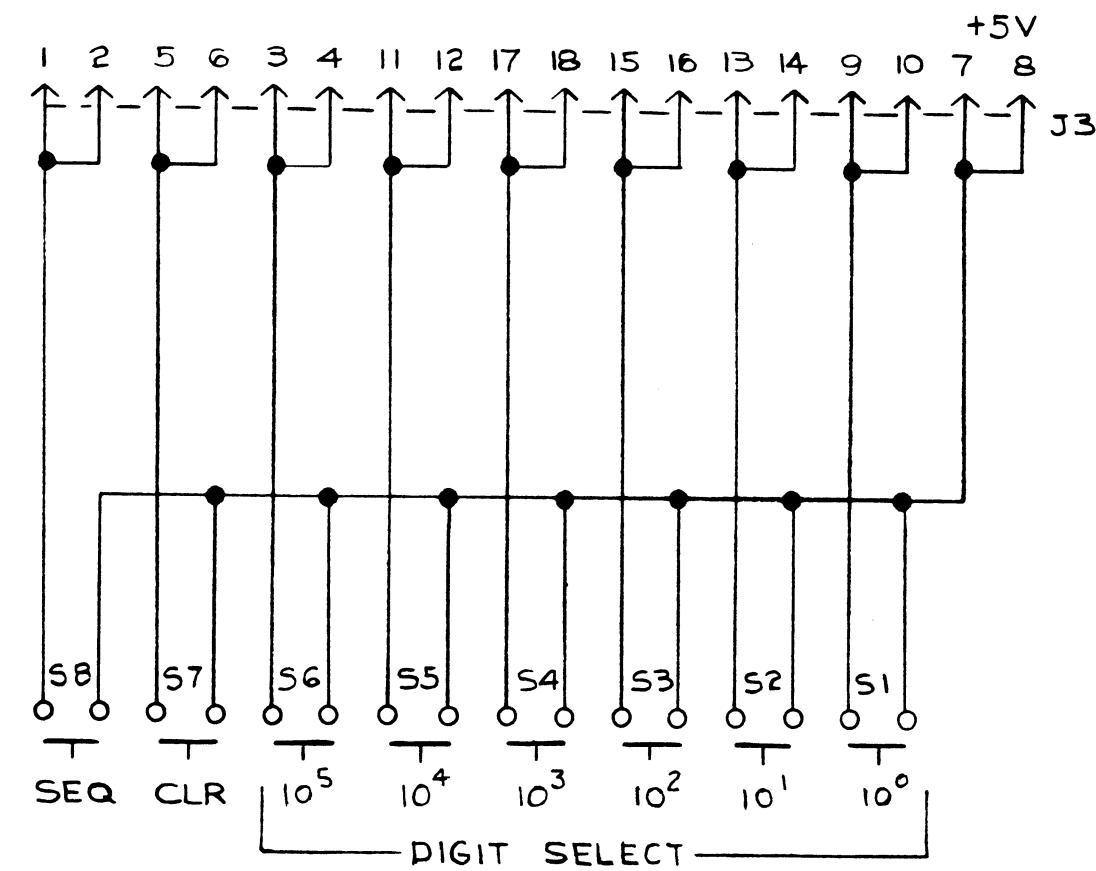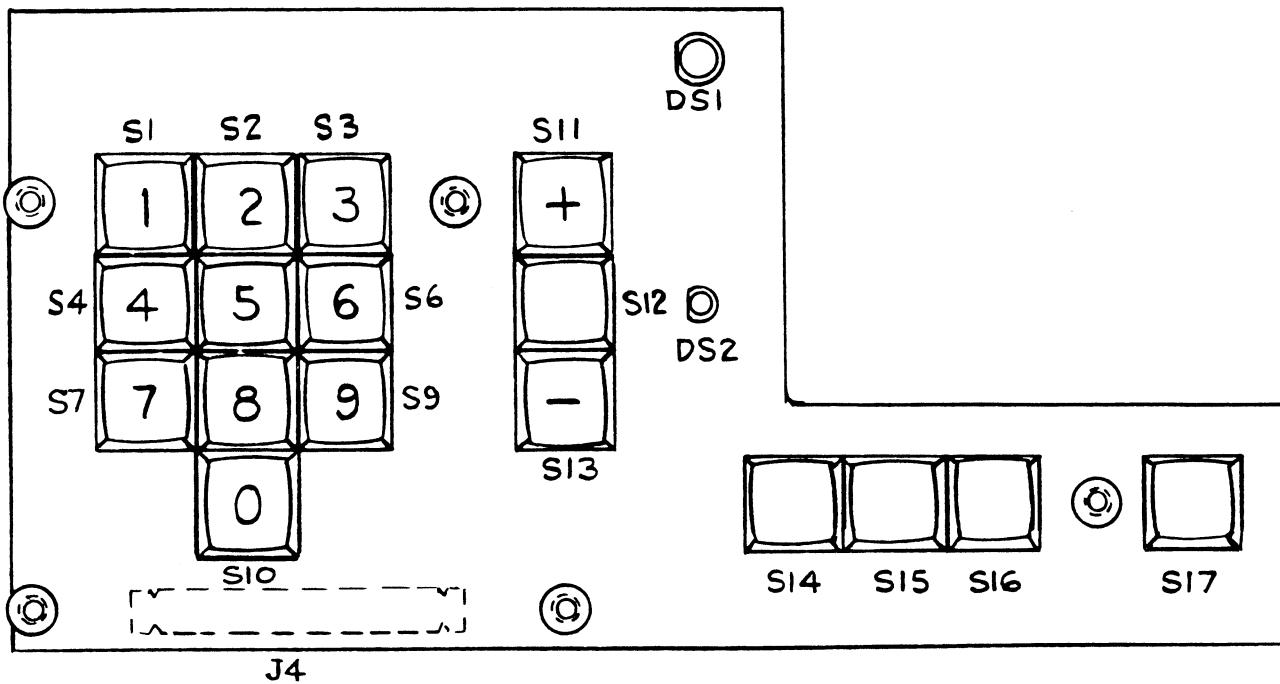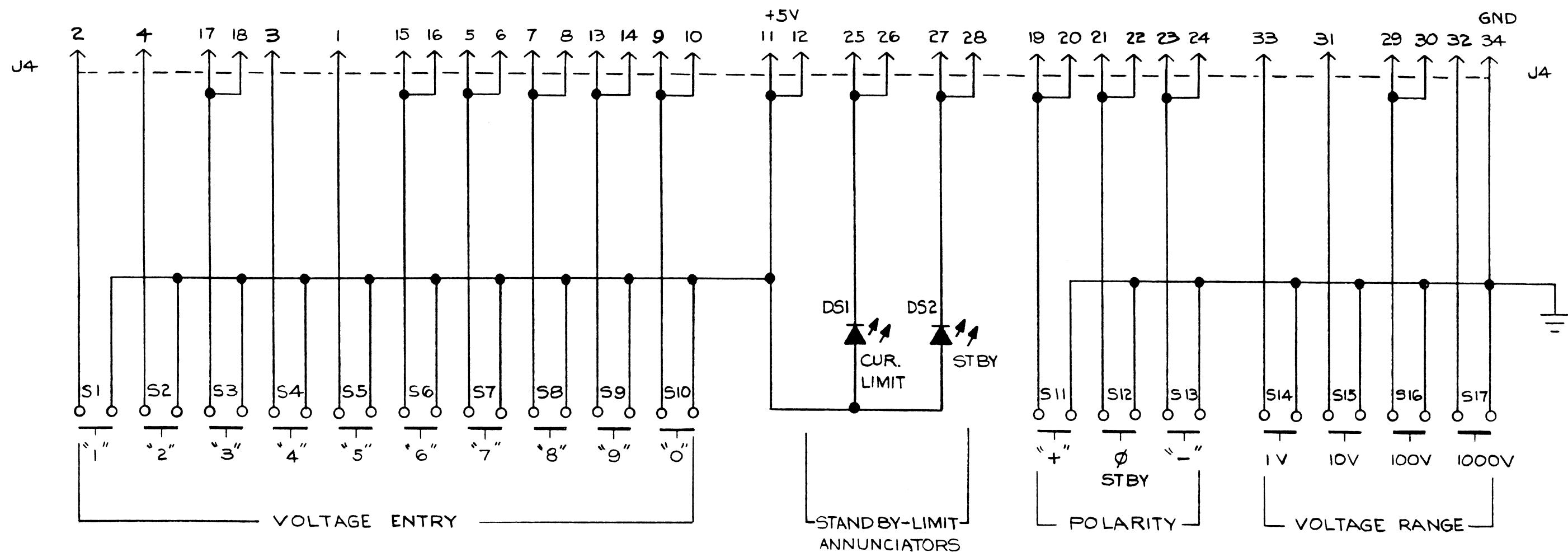
FIGURE 7-26
A7, DIGIT SELECT SCHEMATIC
#7-06771701 Rev A

FIGURE 7-27
A8, VOLTAGE SELECT PC ASSEMBLY
#06771901 Rev A1

FIGURE 7-28
A8, VOLTAGE SELECT SCHEMATIC
#06771901 Rev A

DS8 DS9 DS10 DS11 DS12 DS14

DS13

DS1 DS2 DS3 DS4 DS5 DS6 DS7

J1
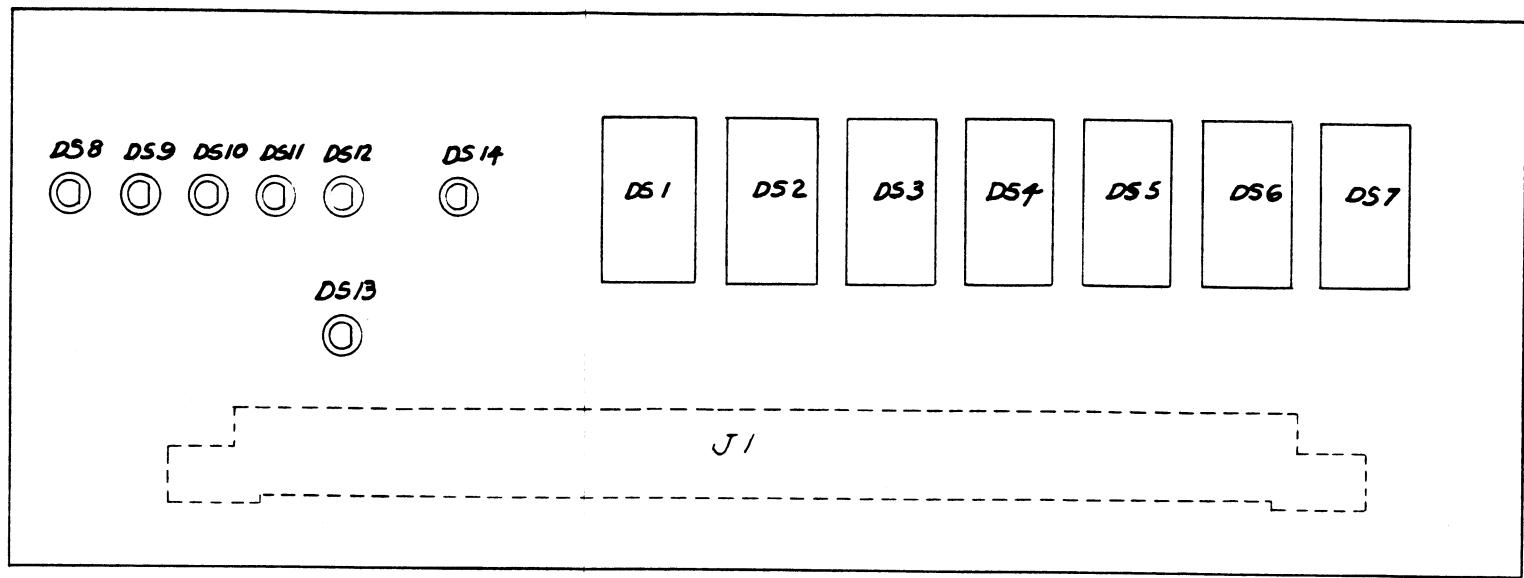
FIGURE 7-29
A9, DISPLAY PC ASSEMBLY
#06772601 Rev B
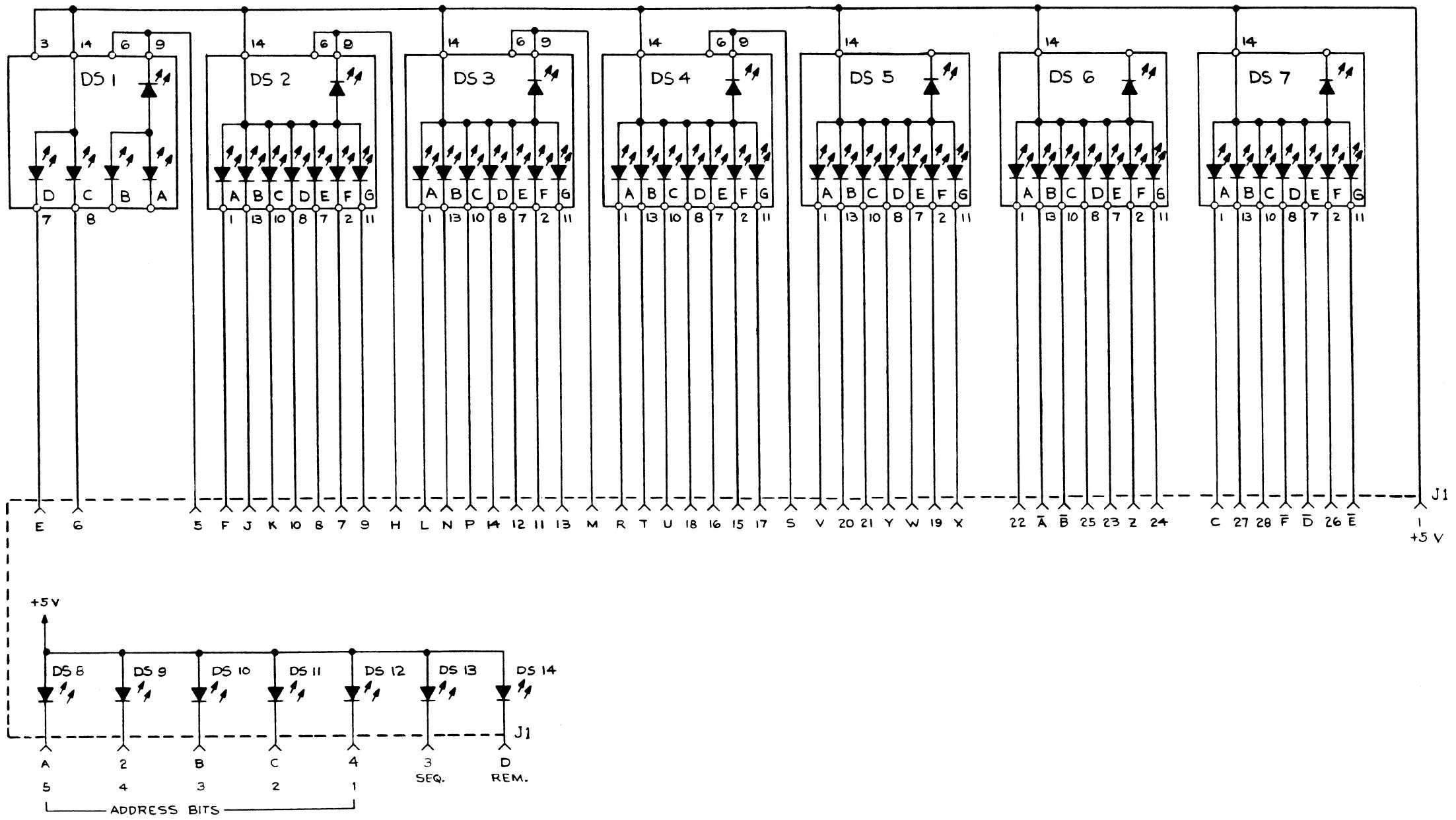
FIGURE 7-30
A9, DISPLAY SCHEMATIC
#7-06772601 Rev A
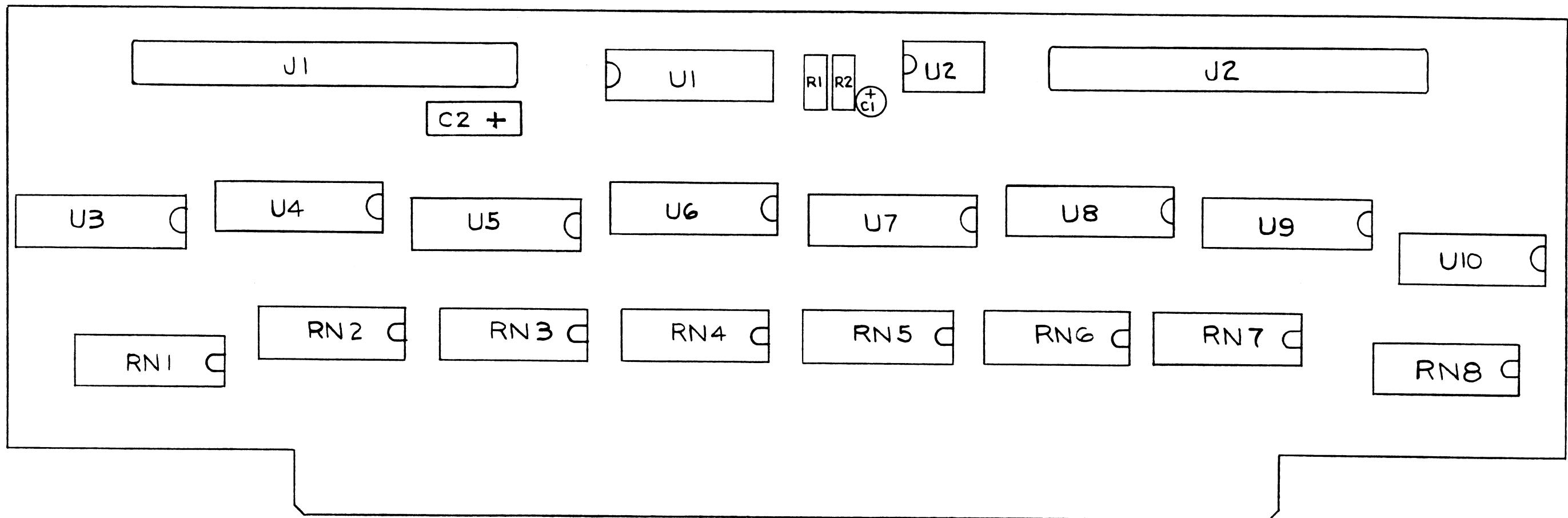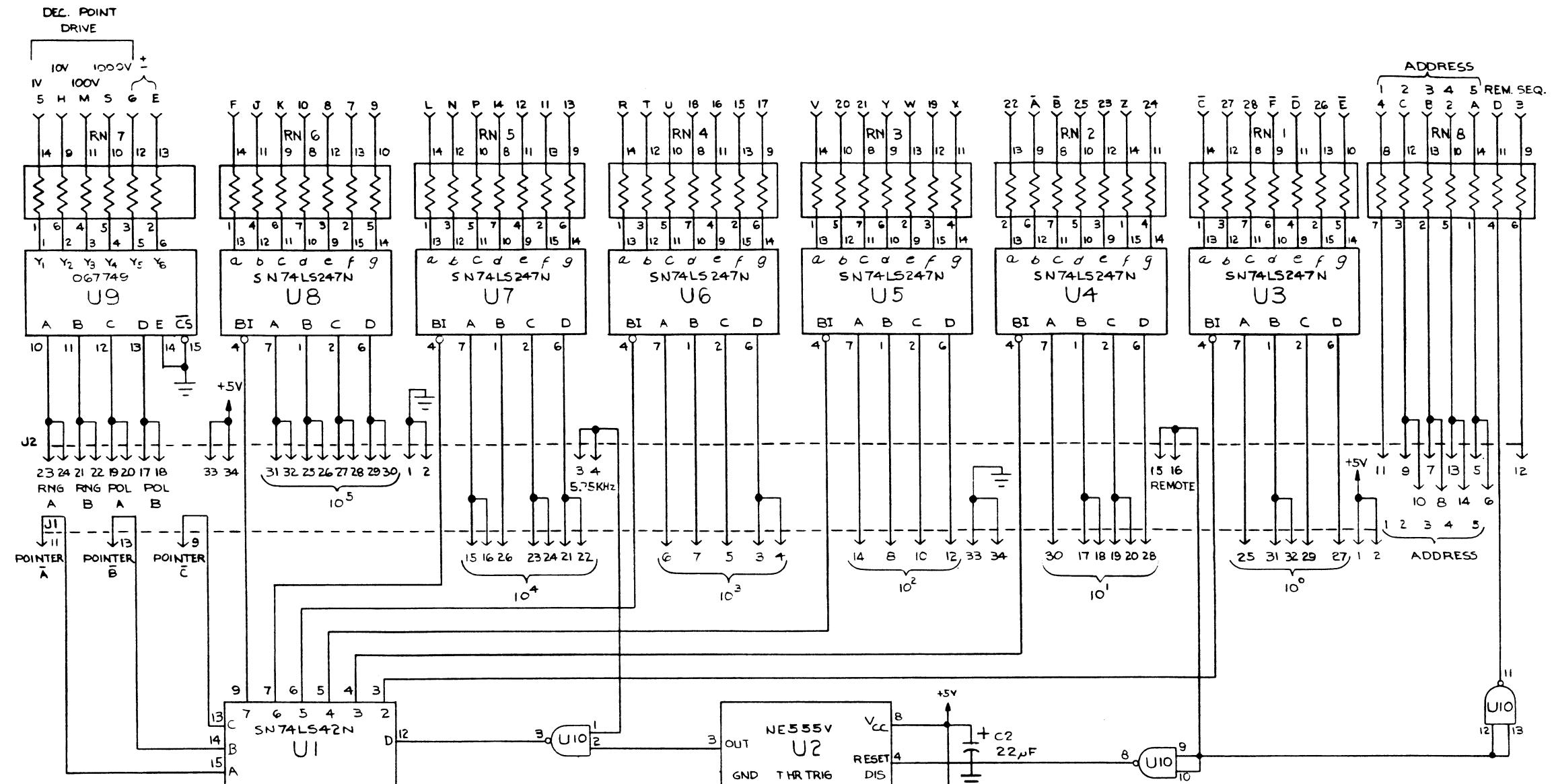
FIGURE 7-31
A10, DISPLAY DRIVER PC ASSEMBLY
#06773101 Rev C

FIGURE 7-32
A10, DISPLAY DRIVER SCHEMATIC
#7-06773101 Rev C
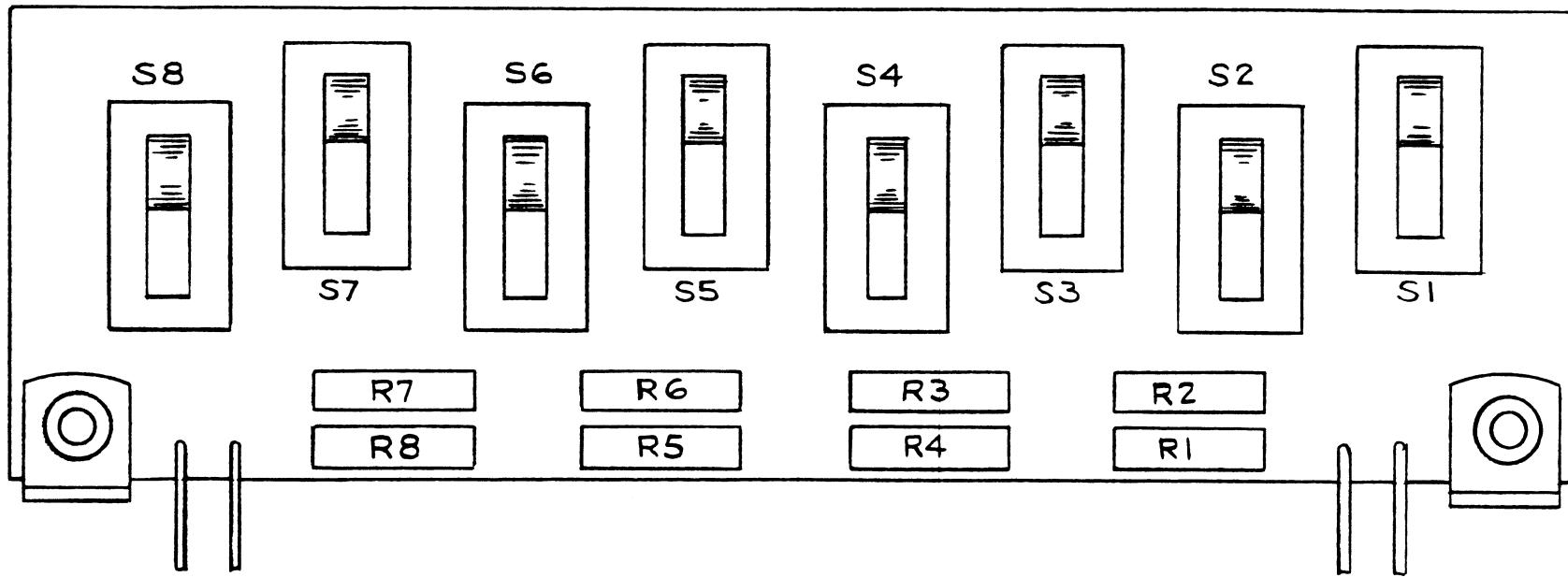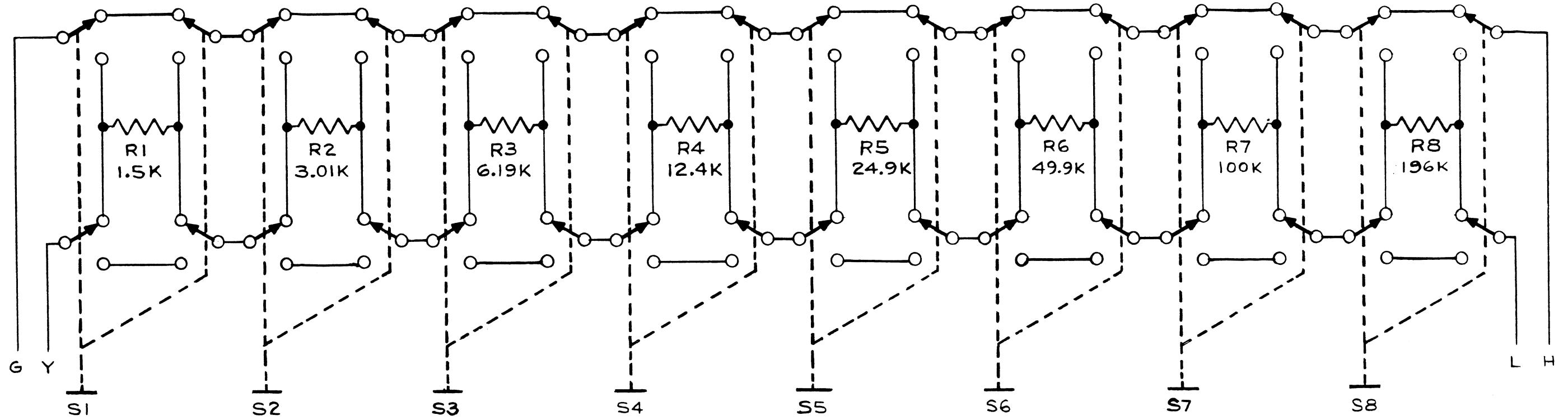
FIGURE 7-33
A11, CAL SWITCHING PC ASSEMBLY
#06785701 Rev C

NOTE:
1) ALL RESISTORS .12W, 1%.

FIGURE 7-34
A11, CAL SWITCHING SCHEMATIC
#7-06785701 Rev A
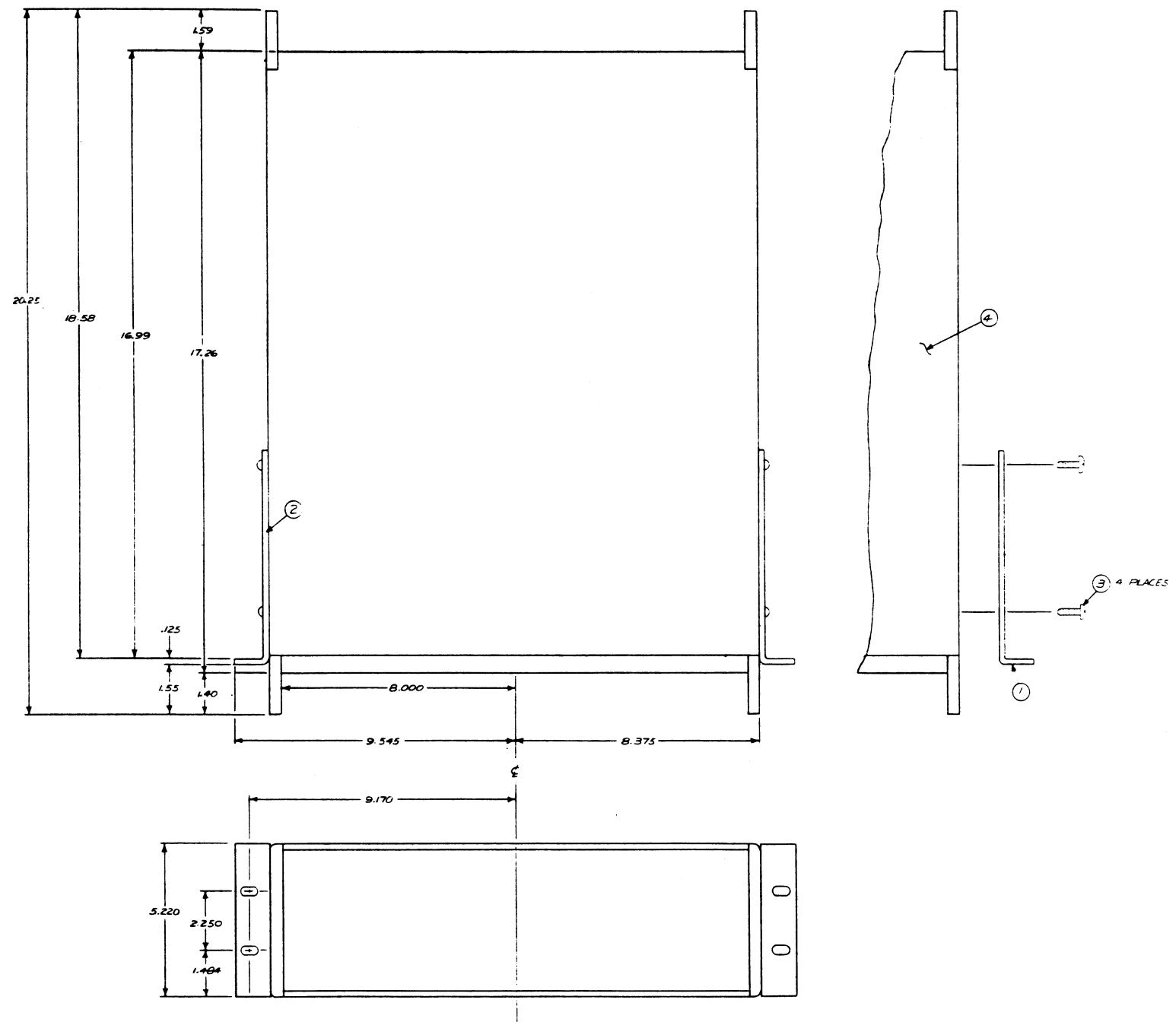
FIGURE 7-35
M107R RACK MOUNT ASSEMBLY
#075120 Rev B
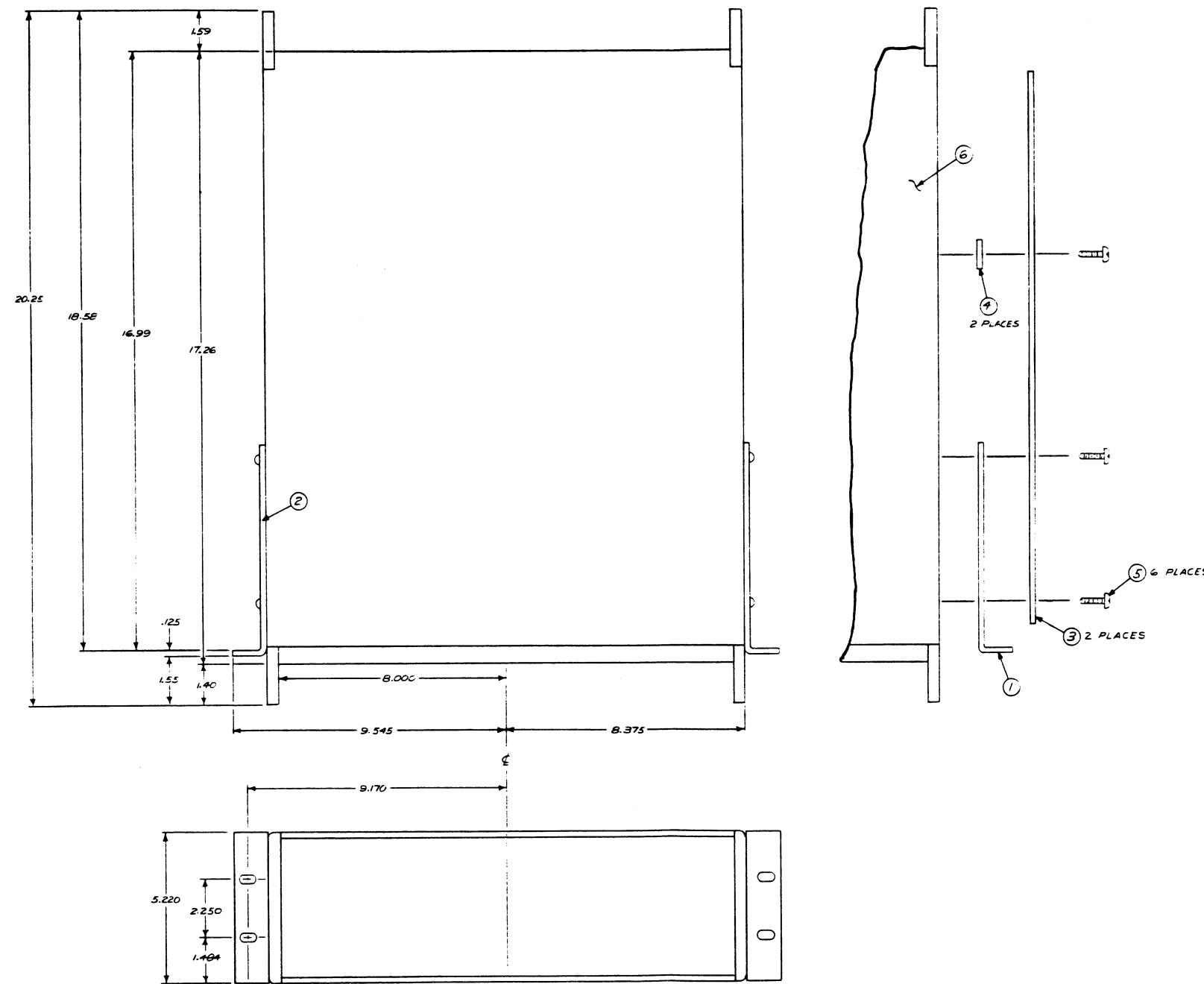
FIGURE 7-36
M107R SLIDE MOUNTING ASSEMBLY
#075249 Rev A
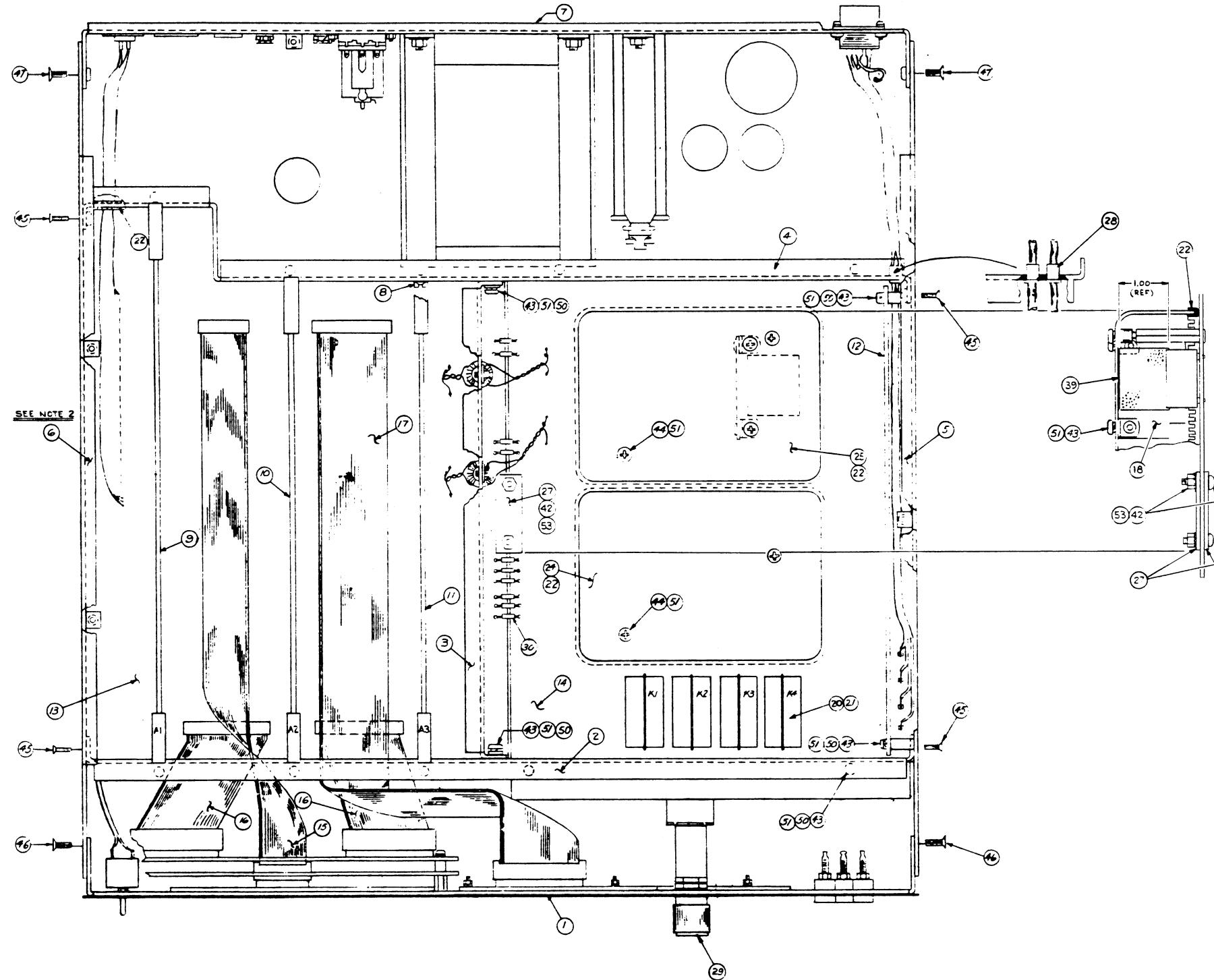
FIGURE 7-37
OPTION 01, TEST ASSEMBLY
#075134 Rev E (Sheet 1 of 2)
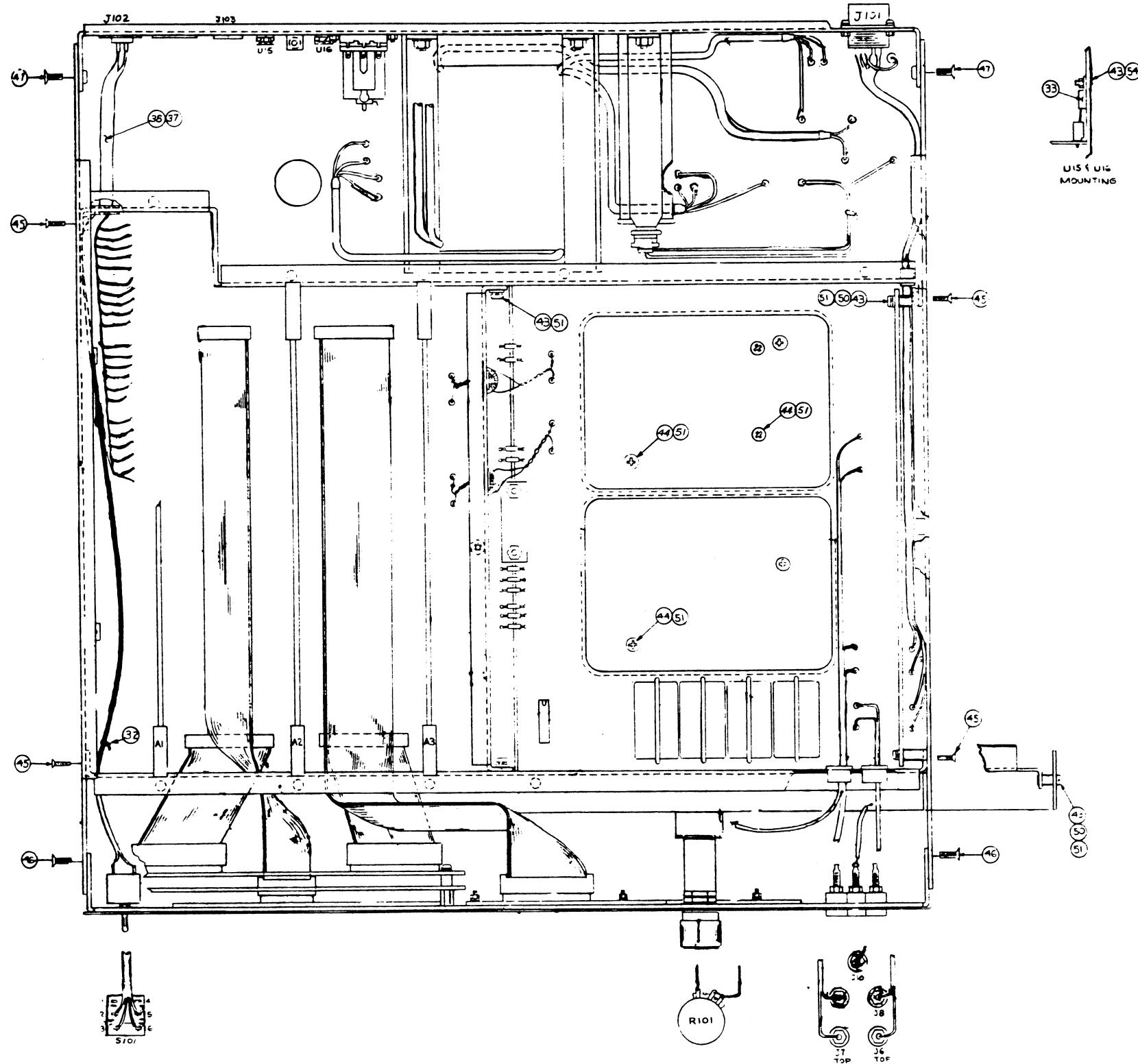
FIGURE 7-38
OPTION 01, TEST ASSEMBLY
#075134 Rev E (Sheet 2 of 2)

(16) REAR VIEW OF DECORATIVE PANEL-
APPLY ITEM (8) AS INDICATED
BEFORE MOUNTING.
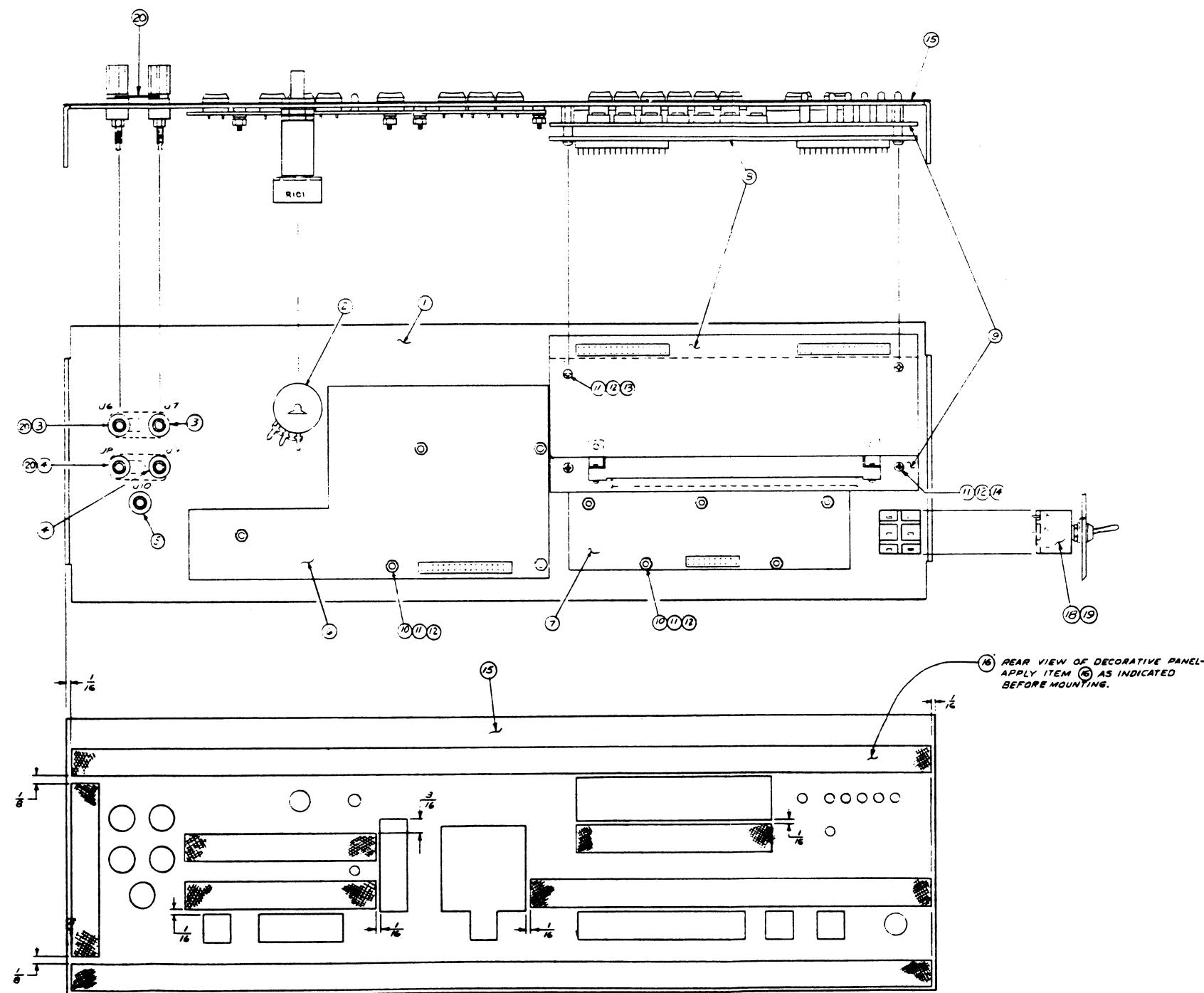
FIGURE 7-39
OPTION 01, FRONT PANEL ASSEMBLY
#075143 Rev A
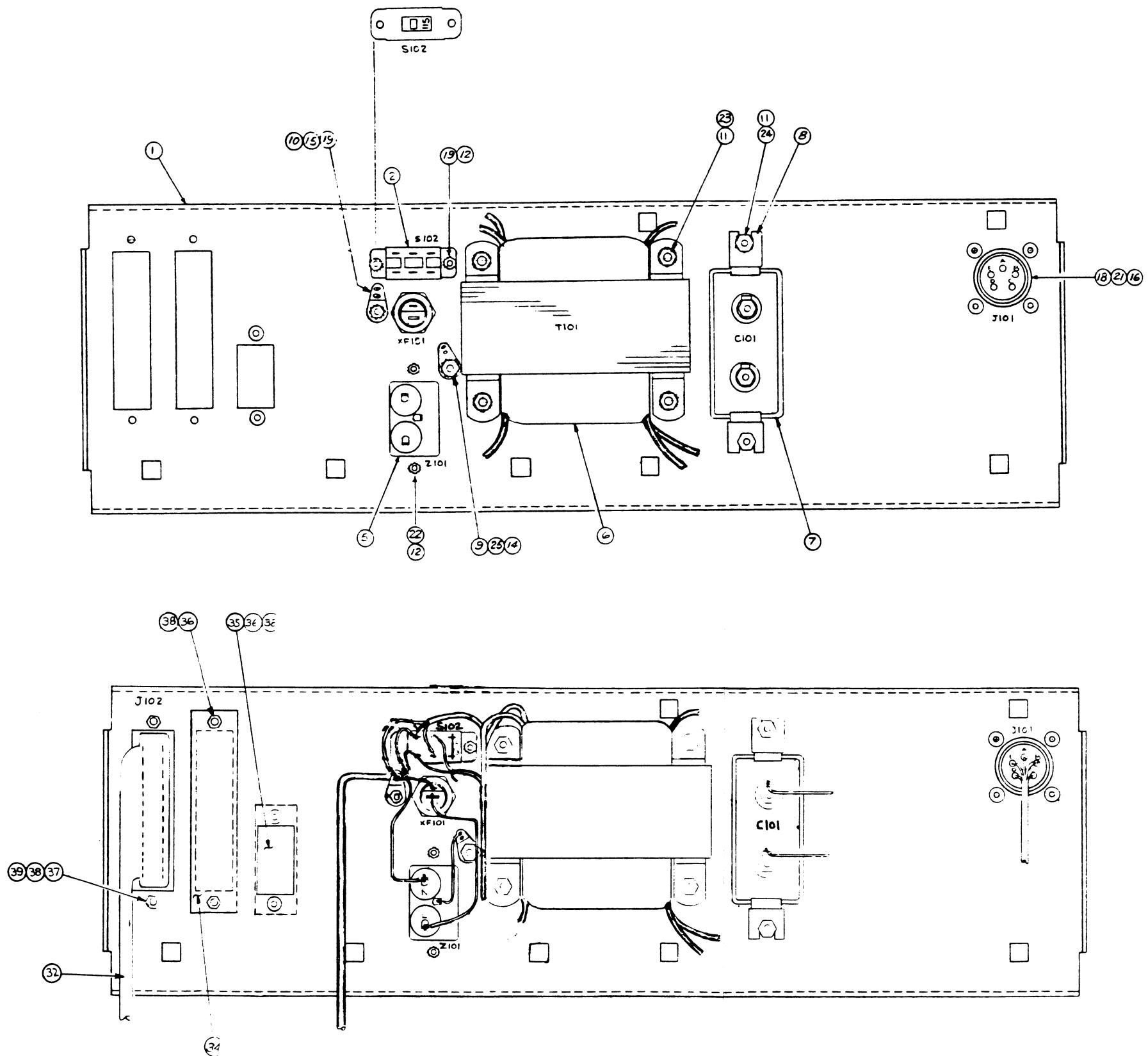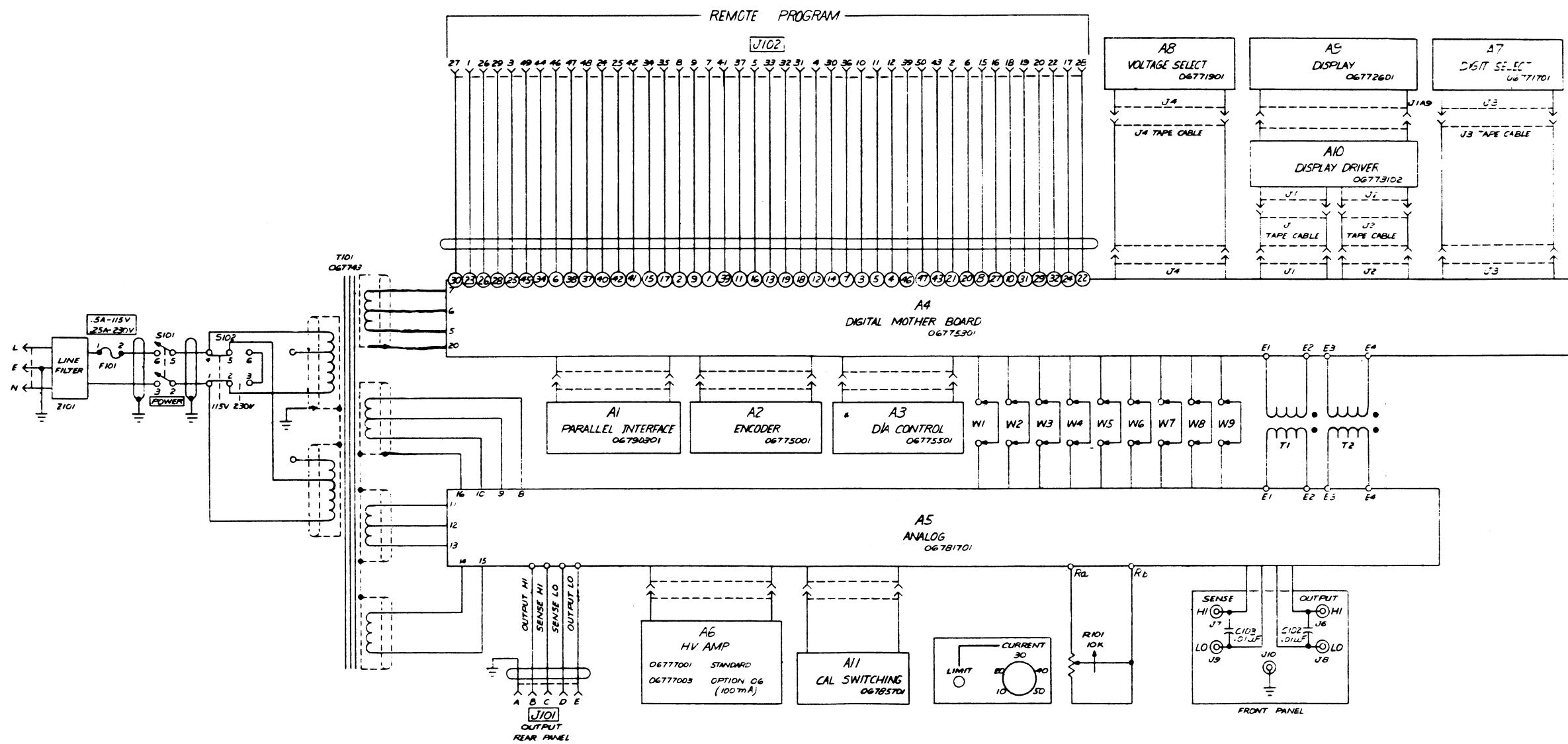
FIGURE 7-40
OPTION 01, REAR PANEL ASSEMBLY
#075135 Rev B

FIGURE 7-41
OPTION 01, BLOCK DIAGRAM
#075141 Rev E
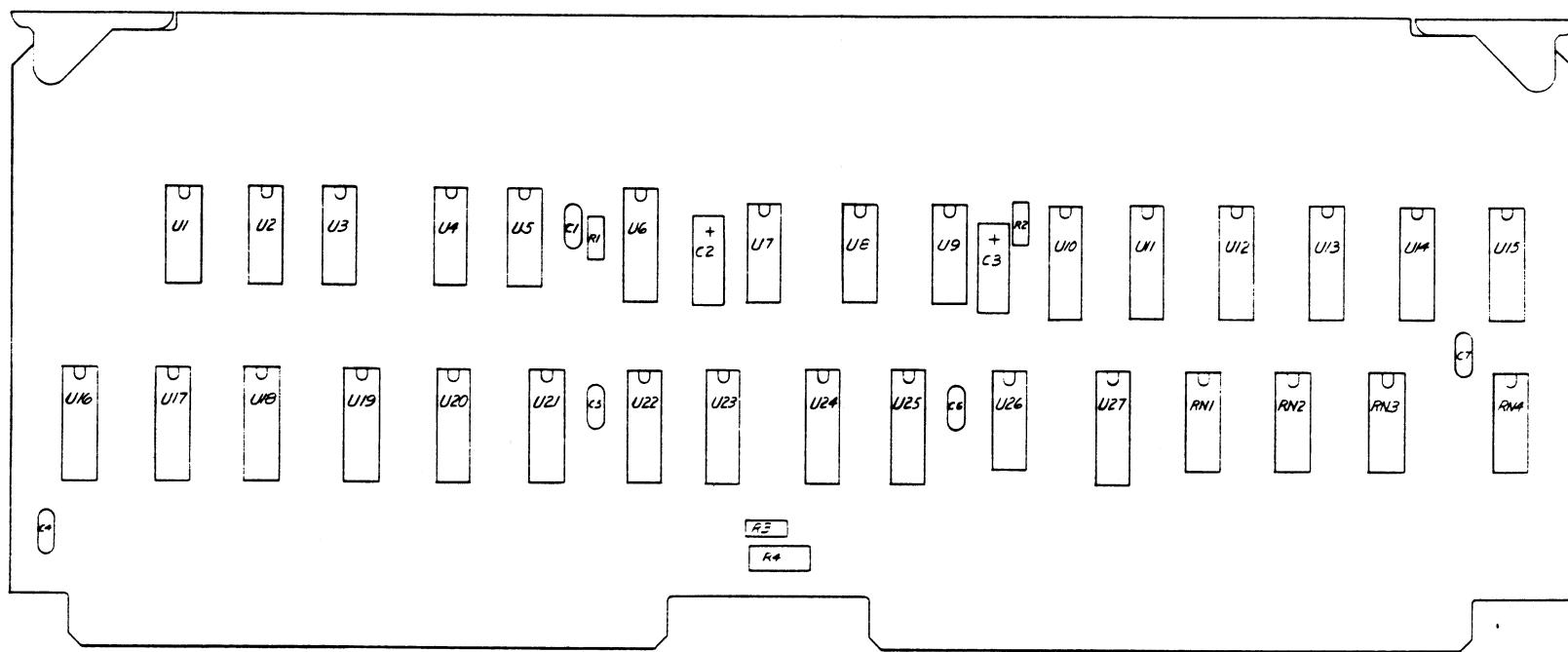
FIGURE 7-42
OPTION 01, A1, PARALLEL INTERFACE
PC ASSEMBLY #06790301 Rev B
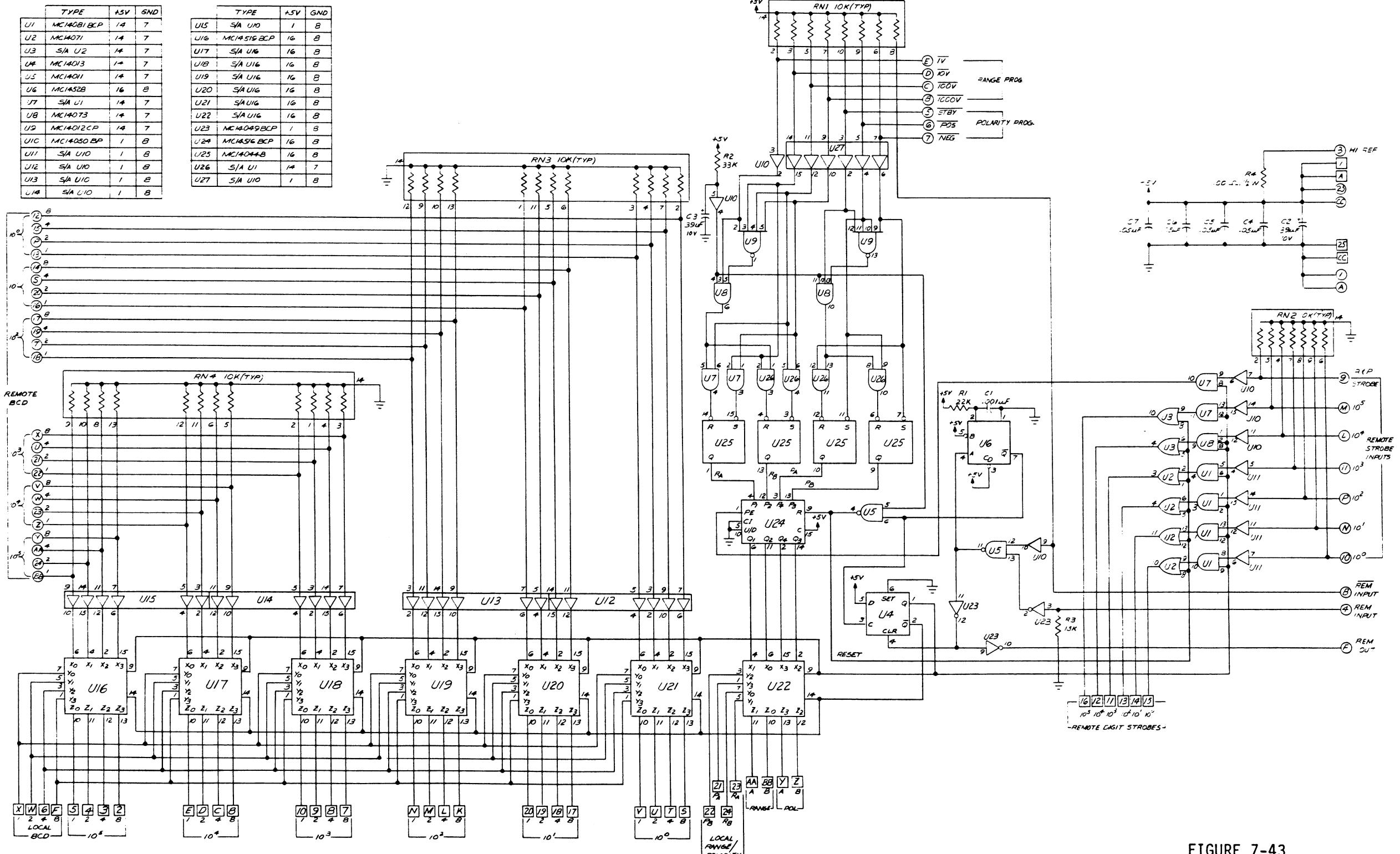
FIGURE 7-43

OPTION 01, A1, PARALLEL INTERFACE

SCHEMATIC #7-06790301 Rev B
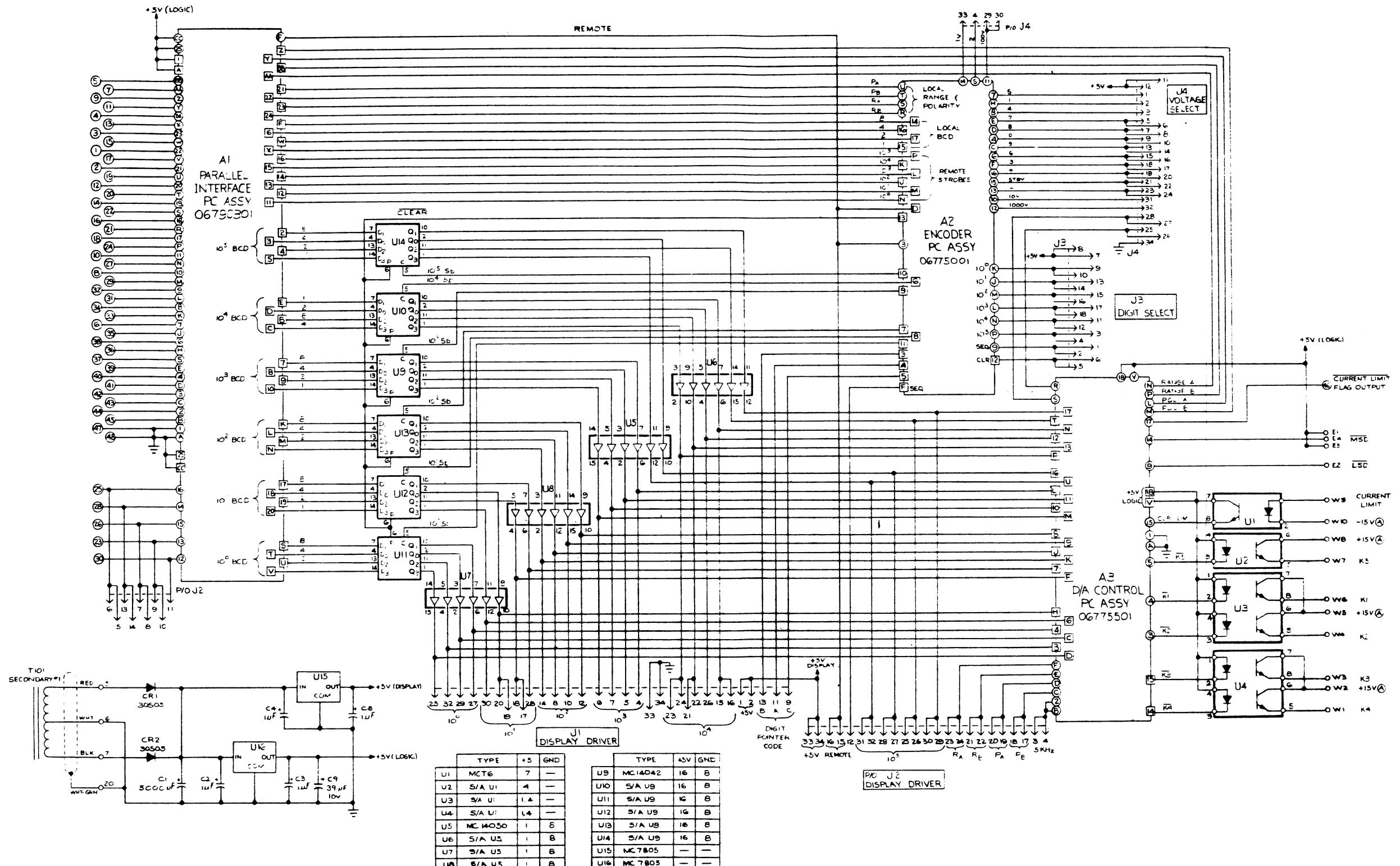
FIGURE 7-44
OPTION 01, A4, DIGITAL MOTHER BOARD
SCHEMATIC #7-06775302 Rev B
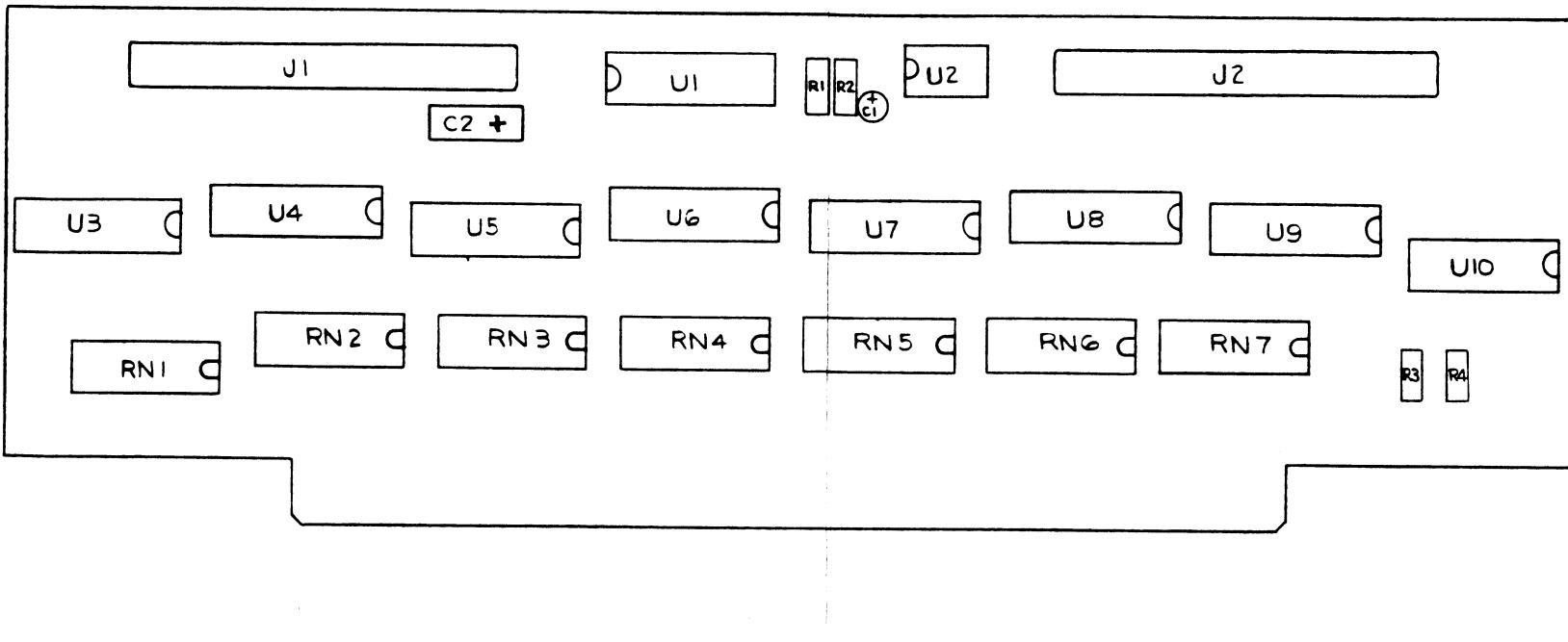
FIGURE 7-45
OPTION 01, A10, DISPLAY DRIVER
PC ASSEMBLY #06773102 Rev B
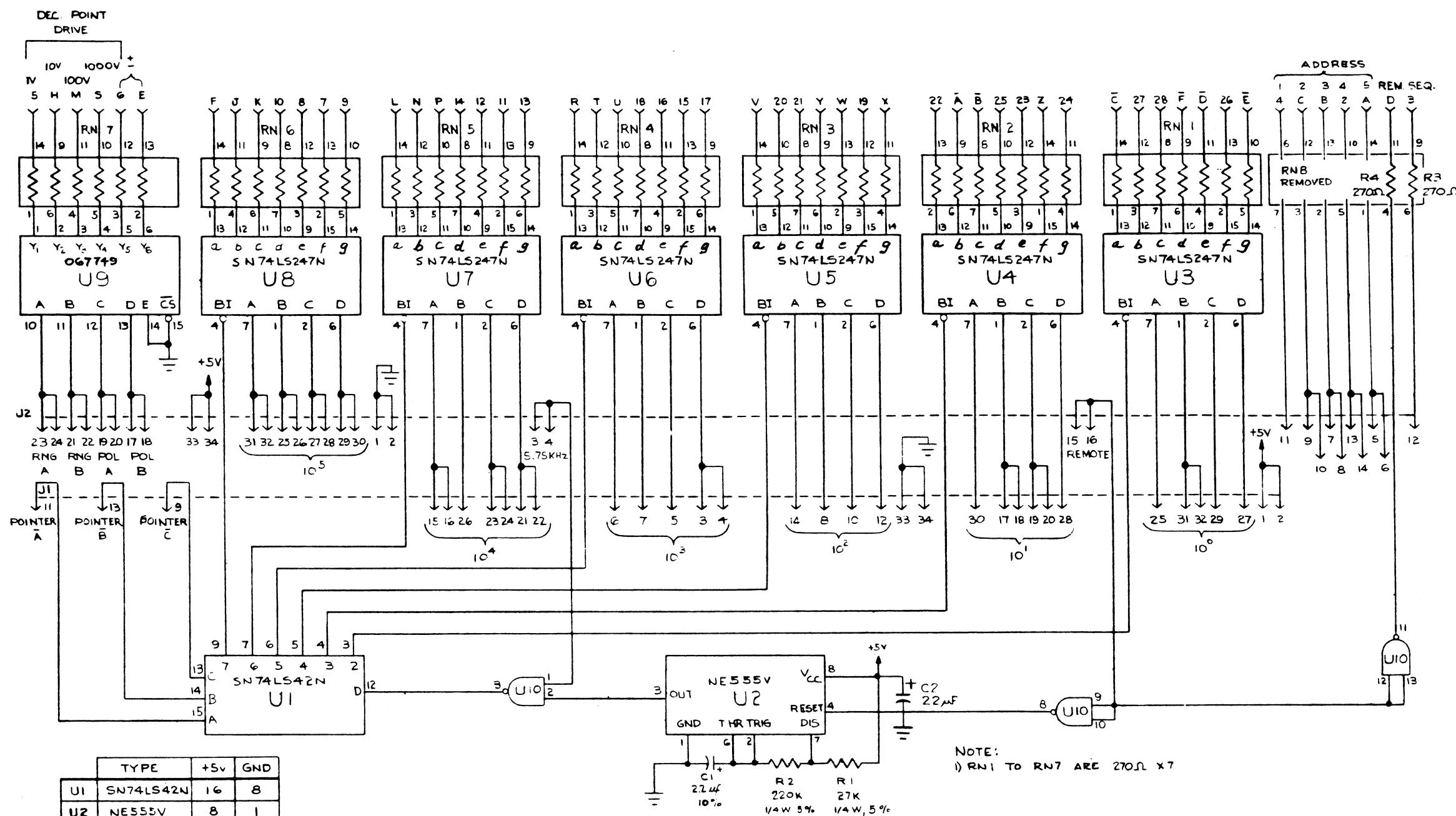
FIGURE 7-46
OPTION 01, A10, DISPLAY DRIVER
SCHEMATIC #7-06773102 Rev B
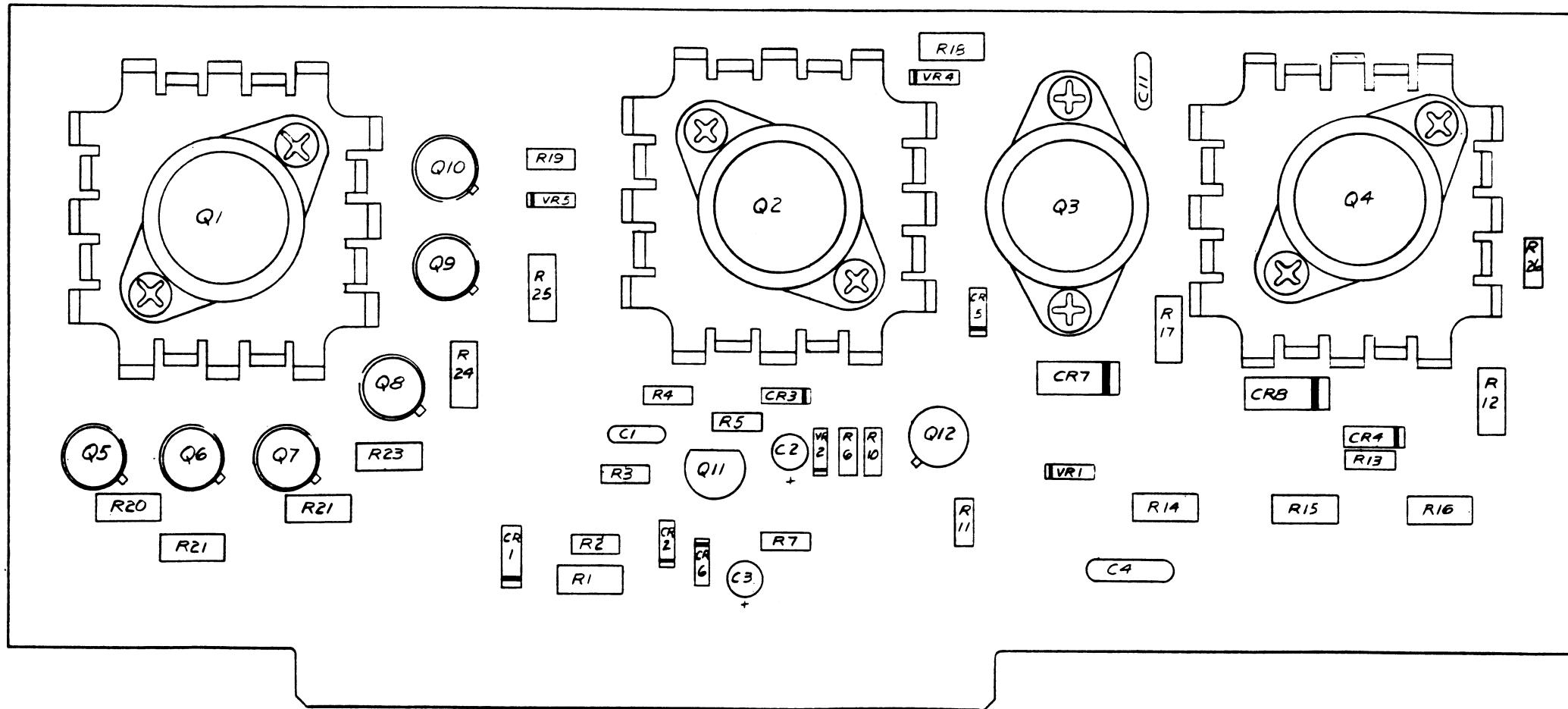
FIGURE 7-47
OPTION 06, A6, HIGH VOLTAGE AMP
PC ASSEMBLY #06777003 Rev D
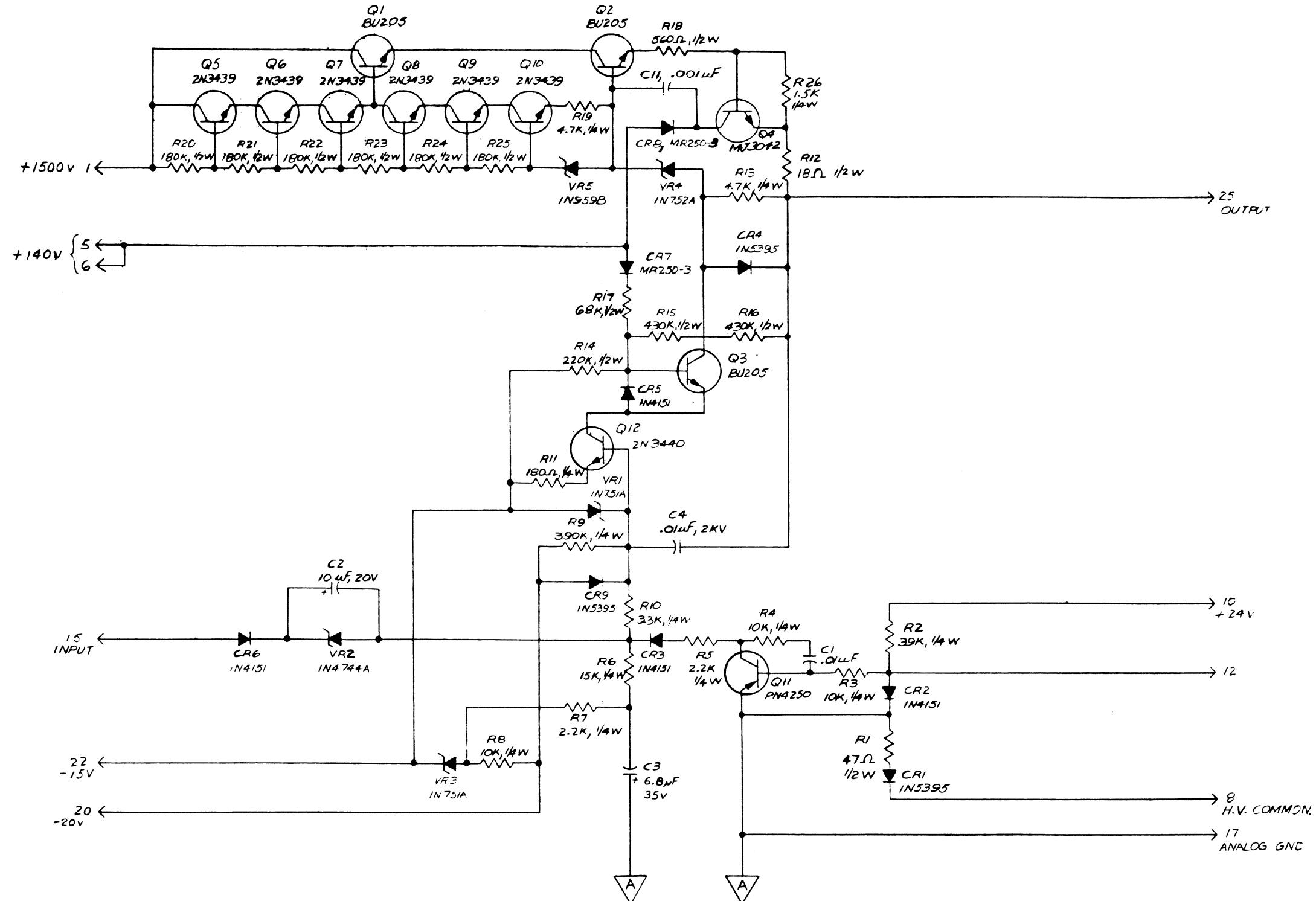
FIGURE 7-48
OPTION 06, A6, HIGH VOLTAGE AMP
SCHEMATIC #7-06777003 Rev C
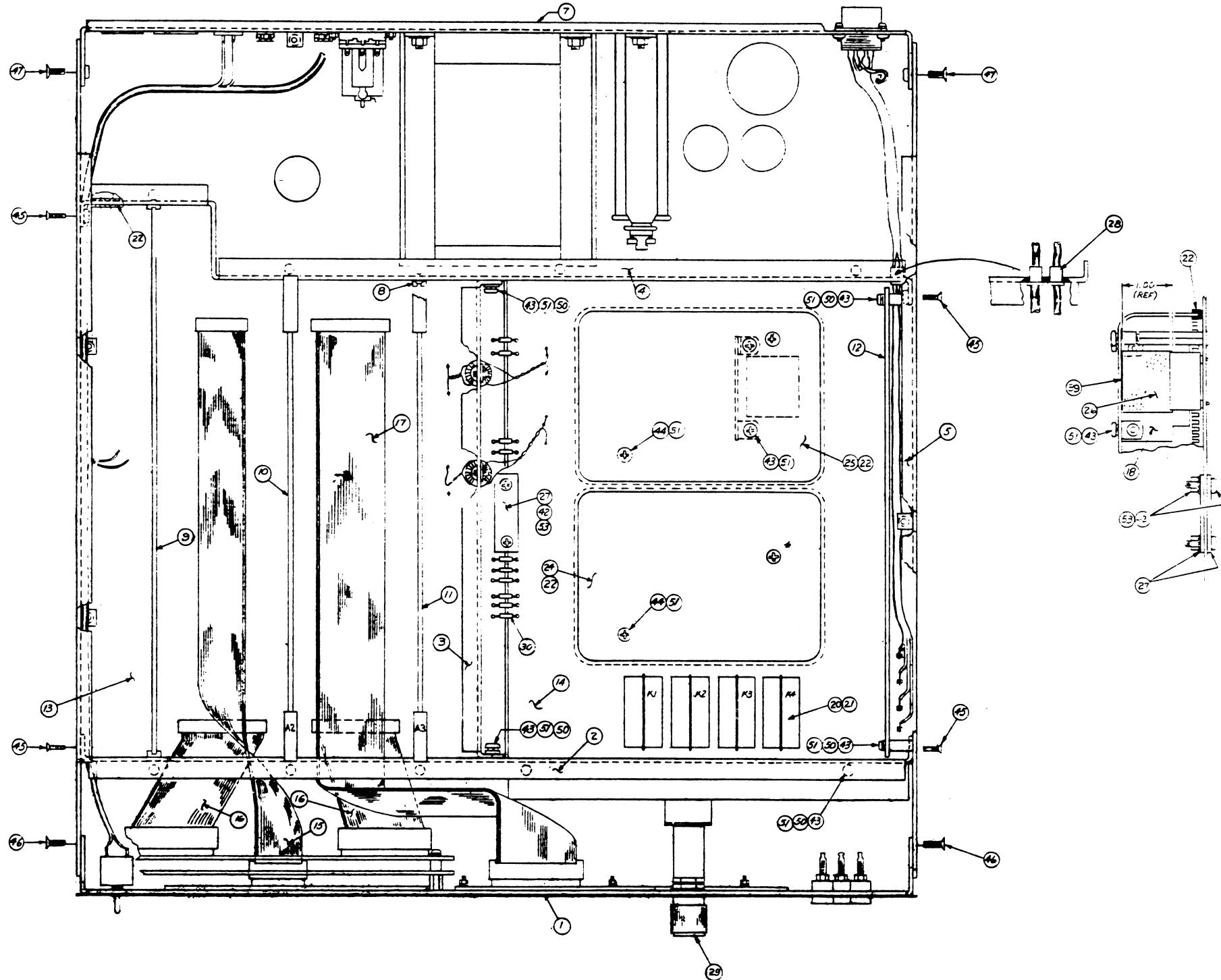
FIGURE 7-49
OPTION 07, TEST ASSEMBLY
#075145 Rev D (Sheet 1 of 2)
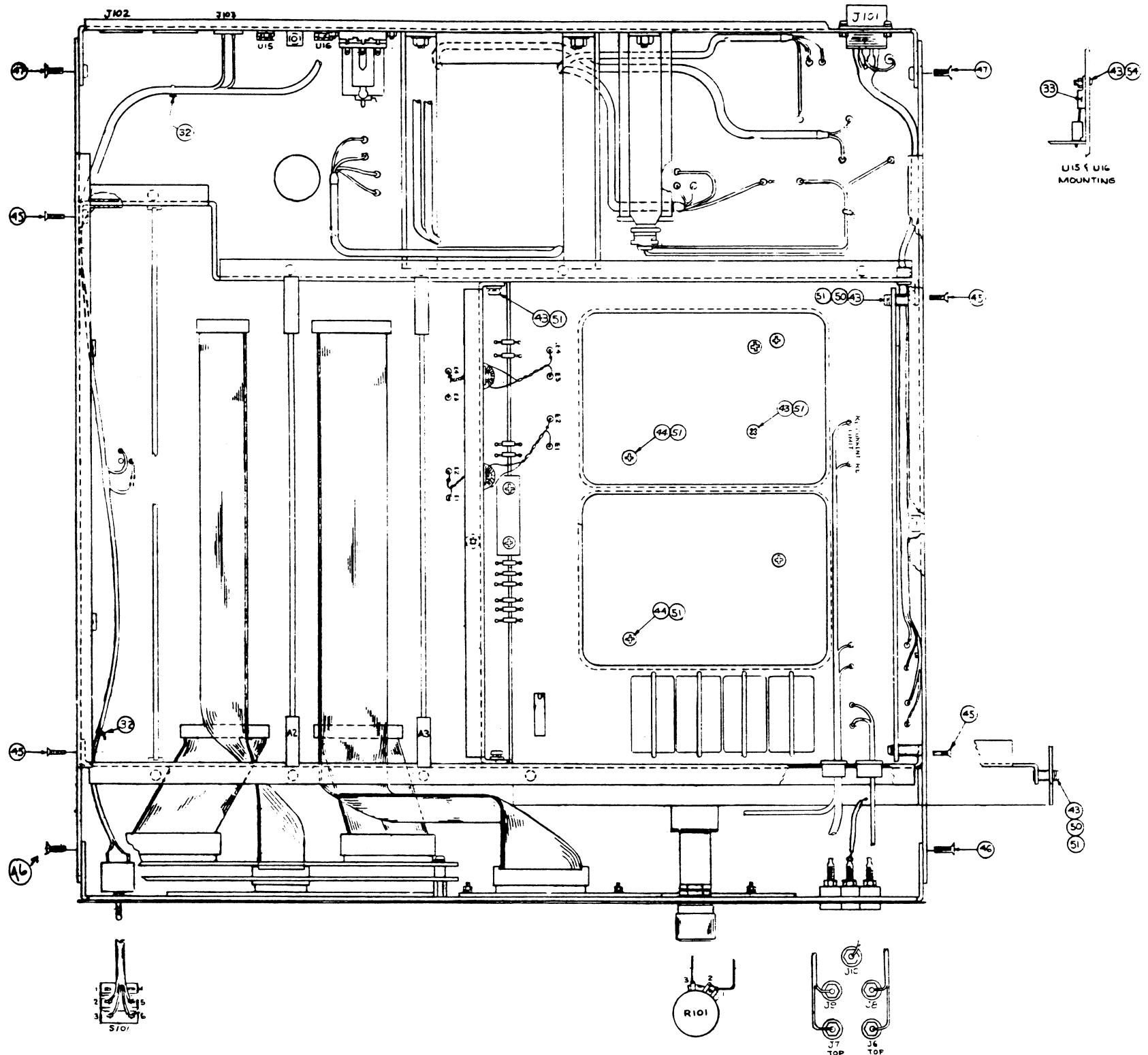
FIGURE 7-50
OPTION 07, TEST ASSEMBLY
#075145 Rev D (Sheet 2 of 2)
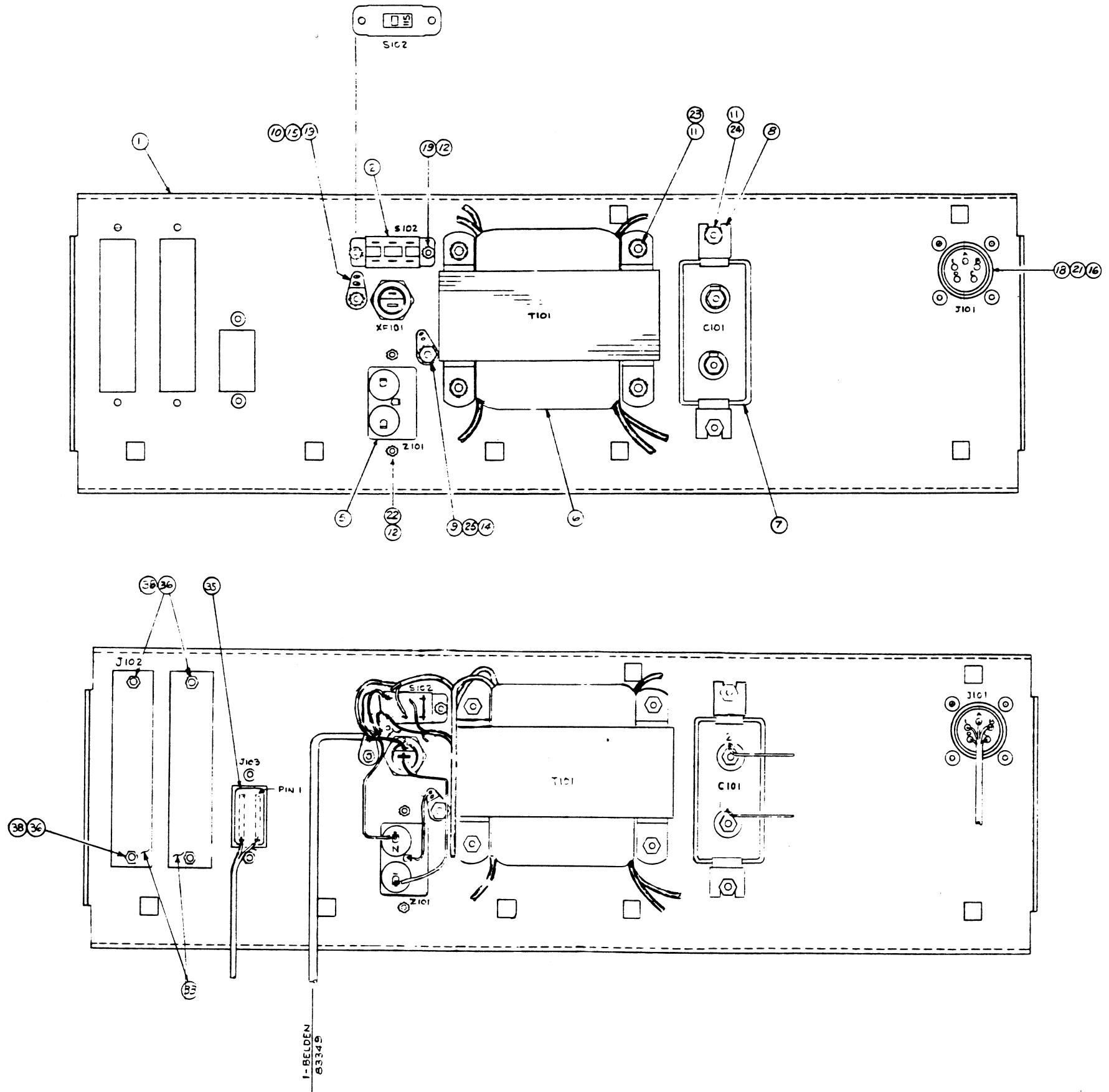
FIGURE 7-51
OPTION 07, REAR PANEL ASSEMBLY
#075144 Rev B
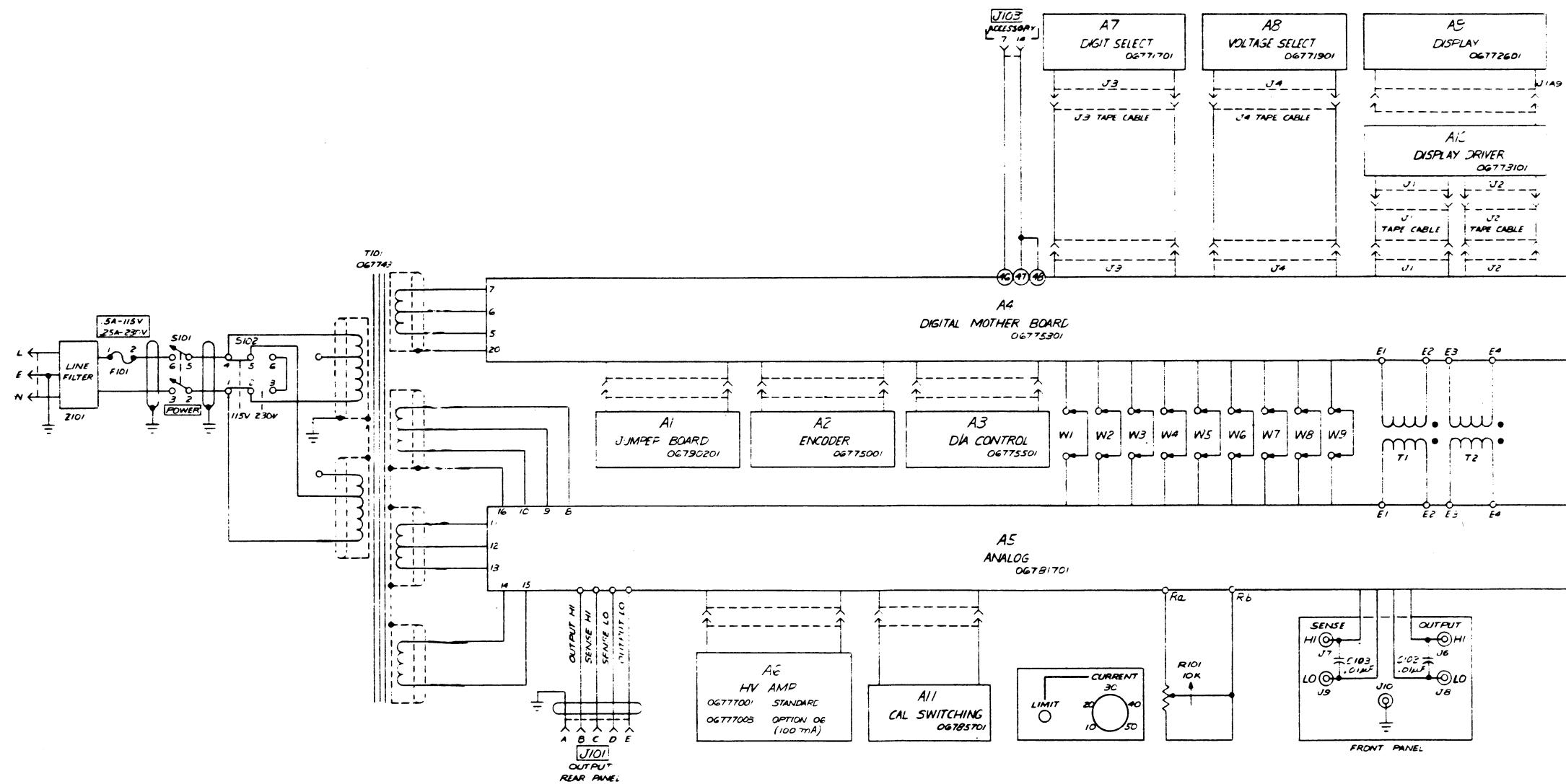
FIGURE 7-52
OPTION 07, BLOCK DIAGRAM
#075163 Rev C
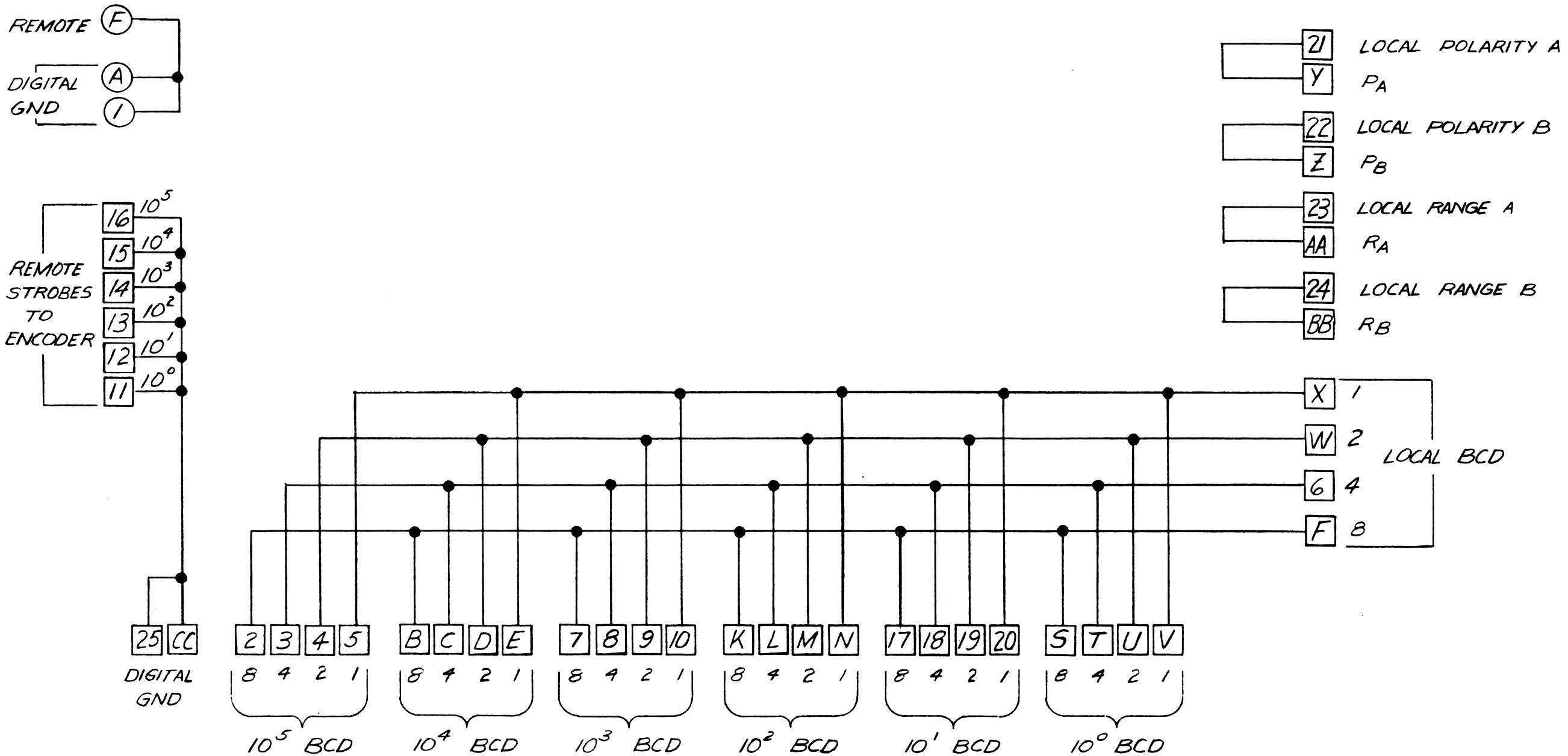
FIGURE 7-53
OPTION 07, JUMPER BOARD
SCHEMATIC #7-067902 Rev B

M107-11-81
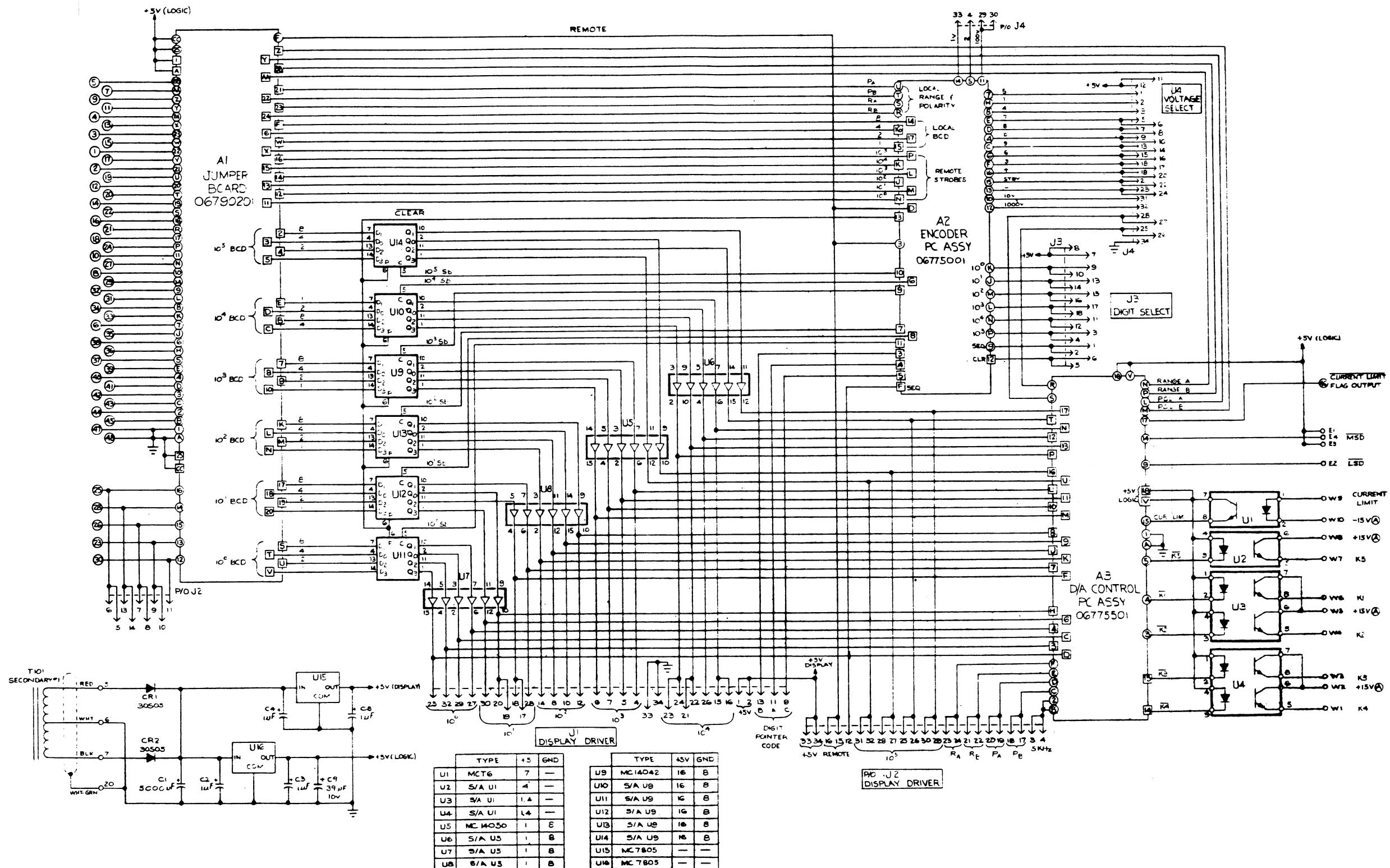
FIGURE 7-54
OPTION 07, A4, MOTHER BOARD
SCHEMATIC #7-06775303 Rev B
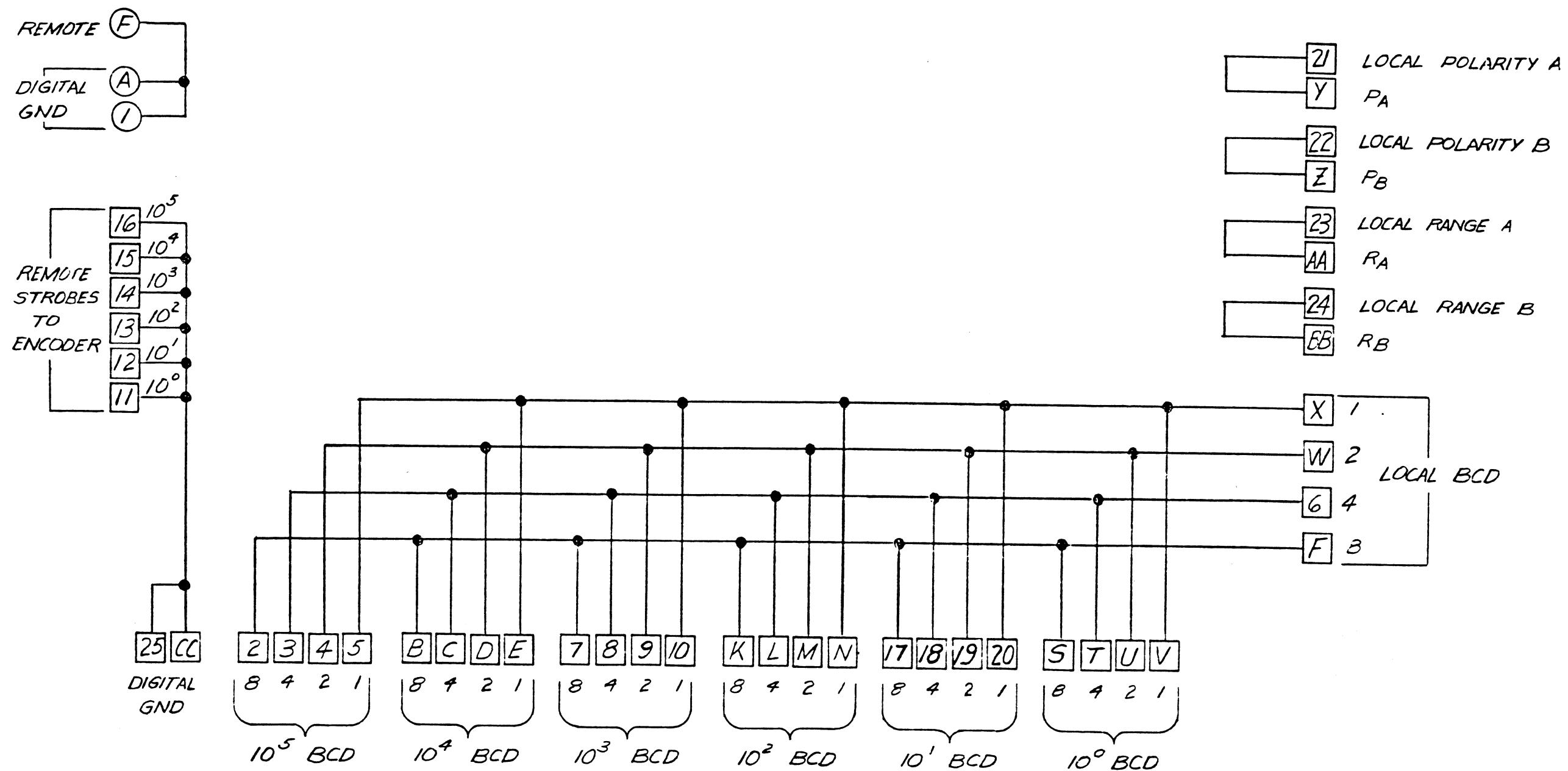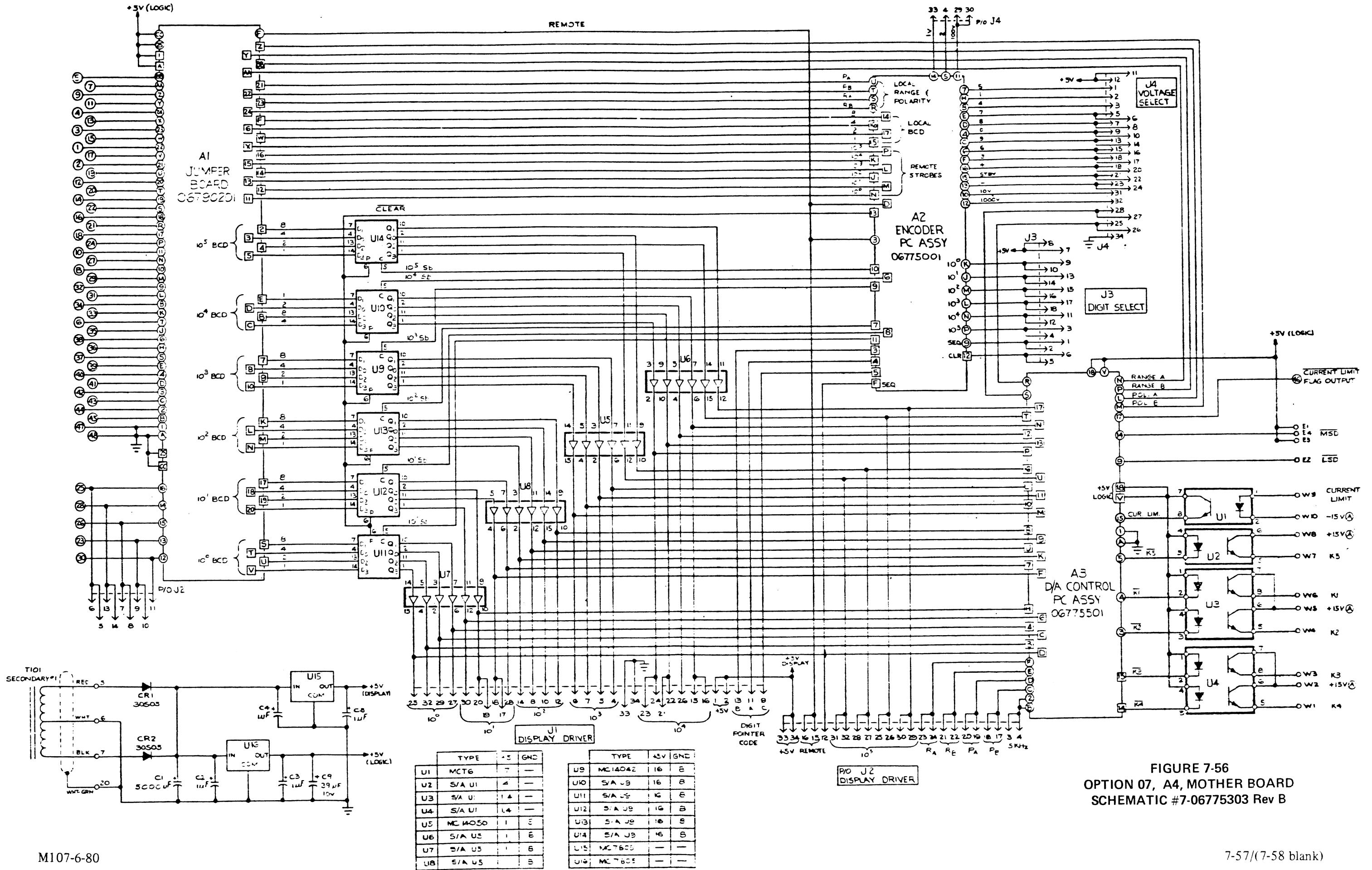
**FIGURE 7-55**
**OPTION 07, JUMPER BOARD**
SCHEMATIC #7-067902 Rev B

FIGURE 7-56
OPTION 07, A4, MOTHER BOARD
SCHEMATIC #7-06775303 Rev B

TYPE	+5	GND
U1	MCT6	7	—
U2	S/A U1	4	—
U3	S/A U1	14	—
U4	S/A U1	14	—
U5	MC14050	1	8
U6	S/A U5	1	8
U7	S/A U5	1	8
U8	S/A U5	1	8

TYPE	+5V	GND
U9	MC14042	16	8
U10	S/A U9	16	8
U11	S/A U9	16	8
U12	S/A U9	16	8
U13	S/A U9	16	8
U14	S/A U9	16	8
U15	MC7805	—	—
U16	MC7805	—	—

M107-6-80

7-57/(7-58 blank)

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                    U9_SN74188AN_eb4.bin
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S00600004844521B
S1130000FEFDFBF7CECDCBC7EEEDEBE7FEFDFBF738
S1130010000000000000000000000000000000DC
S9030000FC
------------------------------------------------
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