SORENSEN
POWER SUPPLIES

Instruction Manual

SSD Series

HIGH PERFORMANCE SWITCHING POWER SUPPLIES

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SORENSEN
POWER SUPPLIES

instruction manual for SSD SERIES MODULAR DC POWER SUPPLIES

INCLUDES THE FOLLOWING SSD MODELS:

MODULE III		MODULE IIIA	
2-30	18-10.5	2-45	18-16
5-30	24-8.5	5-45	24-13
9-20	28-7	9-30	28-11
12-15	36-5	12-22	36-8
15-12	48-4	15-18	48-6

SORENSEN POWER SUPPLIES SORENSEN COMPANY
A RAYTHEON COMPANY
676 ISLAND POND ROAD MANCHESTER, NEW HAMPSHIRE 03103

FIVE-YEAR WARRANTY

Sorensen Company warrants all parts of equipment of its manufacture, except special purpose tubes and semi-conductor devices which carry their own manufacturer's warranty, to be free from defects caused by faulty material or poor workmanship. Sorensen Company warrants its products to conform to applicable commercial or military specifications when confirmed on the Order Acknowledgment form to be free from defects caused by faulty material or poor workmanship. Sorensen Company's obligation is limited under the warranty to repair or replacement of products in kind, or at its option to issuance of a credit of original purchase price. Returns must be accompanied by a Sorensen Company Return Material Authorization form and conform to standard conditions for adjustment. The aforesaid warranty shall expire five (5) years following the last day of the month of shipment from Sorensen Company's plant. The foregoing states the entire warranty extended by Sorensen Company. No other warranty, expressed or implied, is made and, specifically, Sorensen Company makes no warranty of merchantability or fitness for any purpose. In no case shall Sorensen Company be liable for any special or consequential damages. Authorization must be obtained prior to return of defective items.

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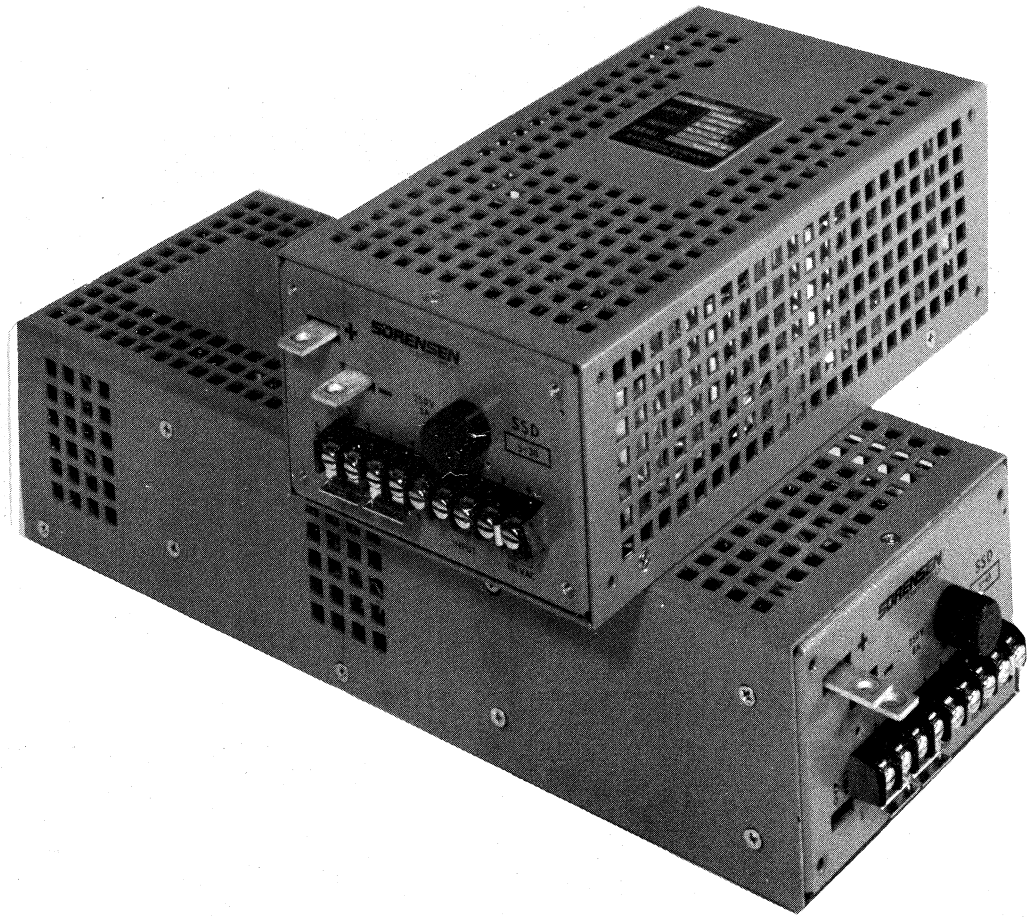


SSD Modular Switching Power Supplies
UPPER: Module Size III (3.31 X 5.13 X 9.5") (84.2 X 130.2 X 241.3mm)
LOWER: Module Size IIIA (3.31 X 5.13 X 14") (84.2 X 130.2 X 355.6mm)

1. INTRODUCTION

1.1 PURPOSE

This manual contains operation and maintenance instructions for the SSD series of high efficiency modular dc power supplies, manufactured by the Sorensen Company, Manchester, New Hampshire. The SSD models covered in this manual are similar in electrical design and physical appearance. They are grouped into two module sizes; III and IIIA, differing only in size and in power output ratings. (Refer to Table 1-1, Unit Specifications.)

1.2 GENERAL DESCRIPTION

The SSD series provides a variety of highly regulated dc outputs designed for operation on 115/220 Vac or 300 Vdc. The line also offers exceptionally high efficiency, high power density, and fast recovery times as well as characteristically low output impedances.

The supplies are designed with mounting holes on three planes: end, bottom or side. Four tapped mounting holes are provided on each face. Section 2 provides necessary installation data.

1.3 FUNCTIONAL DESCRIPTION

Operational features of the SSD series power supplies include remote sensing (regulation), voltage and resistance remote programming, overload and short-circuit protection by automatic current-limiting, and overvoltage protection through an integral electronic shutdown circuit.

1.3.1 Remote Sensing

For applications where variation in the load-lead voltage drop may adversely affect load regulation, remote sensing may be used to establish the regulating point at the load rather than at the output terminals.

1.3.2 Remote Programming

The SSD series power supply outputs may be altered from a remote location by either the resistance or the voltage programming methods. For resistance programming, a calculated value of resistance at the ratio of 1000 ohms/volt is inserted in the programming network. For voltage programming, a value of voltage at the ratio of 1:1 is inserted.

1.3.3 Series Operation

For applications requiring output voltages higher than a single unit can provide, SSD units may be connected in series to a maximum total of 100 Vdc. Regulation in series operation is the sum of the regulations of all units.

1.3.4 Parallel Operation

Direct paralleling using the current-limit mode (Figure 3-2) is permitted.

1.3.5 Over-Current Protection

In the event of an excessive current condition such as short circuit, a current-limit circuit acts to limit the unit output current. This circuit is factory-set to approximately 105% of the unit rated output current at 40°C (+104°F).

1.3.6 Overvoltage Protection (OVP)

In the event of an overvoltage condition on the output, such as would be induced by an open sense lead, an overvoltage electronic sensing circuit is actuated. This OVP acts to quickly reduce the output voltage to zero and to disable the input dc circuit.

1.3.7 Remote Shutdown

An external transistor or logic switch connected across J1-1/J1-2 at the rear of the unit may be used to shut down the supply. The unit output is restored when the shutdown signal is removed.

1.4 ACCESSORIES

Several universal rack-mount adaptors are available for the SSD series. For specific information on these adaptors, contact your service representative, or the factory.

Table 1-1A SSD Common Specifications

Input Rating:	AC: 115/220 volt nominal (98-132/187-250 volts) @ 47-63Hz/360-440Hz* DC: 300 volts nominal (limits; 255-345 volts)	
Maximum Input Current:	Nominal Input Voltage / Module III Amperes / Module IIIA Amperes	
	115 Vac / 4.2 / 5.5	
	208/220/230 Vac / 2.3 / 3.0	
	300 Vdc / 1.0 / 1.5	
Recommended Fuse, @ Nominal Input Voltage:	5A	8A
Output Ratings:		
Efficiency	To 78%	
Voltage Regulation	Line: 0.03% over full ac input range. Load: 0.03%, NL-FL	
Ripple, RMS	8mV maximum (typically 5mV)20Hz-20MHz.	
Ripple, P-P	50mV maximum (typically 20mV) 20Hz-20MHz	
Temp. Coefficient	0.008%/ ^{o}C	
Turn-ON/OFF overshoot	None (output voltage)	
Transient Response	1.0ms for half-load change/return to 1% band	
Remote Programming	1000 ohms per volt (resistance) 1V:1V (signal)	
Output Impedance	Consult factory.	
Current Limit:	Automatic, internally adjustable from 20 to 150% of rated full-load current. Factory set to approximately 105% of rated 40^{o}C) current. (See individual unit specification.)	
Overvoltage (OVP) Limit:	Automatic, adjustable shorting action, self-contained. Factory set to 1.2V or 10% (which ever is greater above nominal output voltage. (See unit specifications.) Reset requires cycling input power. (Allow 10 seconds for discharge of input capacitors.) Adjustable to within 1%. OVP action is delayed (typically) by approximately 100 micro-seconds to avoid nuisance tripping. Accurate to within 2% (for 6 months). Resolution of OVP adjustment 0.1% of output voltage rating.	
EMI (RFI):	Meets most portion of MIL-STD 461A for narrow or broadband interference. Surpasses performance of conventional regulators.	
Stability:	After one hour warm-up, 0.05% for 24 hours with all external effects held constant.	
Resolution:	0.05% of output voltage maximum.	
Parallel Operation:	May be directly paralleled without derating (in current-limit mode).	
Series Operation:	TO 100Vdc maximum.	
Remote Sensing:	The voltage drop per load lead is constrained only by the maximum rated unit output voltage. (For example, 5-volt nominal supplies have an E_o maximum of 6.5 volts. Thus, operating at an output of 5 volts, a 1.5-volt lead drop, or 0.75 volt per load lead.)	
Ambient Rating:	0 to 71^{o}C (32 to 160^{o}F). (See current ratings in unit specifications.) Storage:-55 to +85^{o}C	
Cooling:	Natural convection.	
Dimension: inches (mm)	Module III	Module IIIA
Height	3-5/16 (84)	3-5/16 (84)
Width	5-1/8 (130)	5-1/8 (130)
Depth	9-1/2 (241)	14 (356)
Weight: lbs. (kg)	5-1/2 (2.5)	7-1/2 (3.4)
Volume: cu. in.(cu. m.)	160 (2.62)	238 (3.9)
Input-Output Connections:	All connections are made to a 9-terminal barrier strip using #5-40 screws.	
Isolation:	2.1kVdc input-chassis. 500Vdc output-to-chassis.	
Fall-out Characteristics:	40msec at full load current (115/220Vac or 300Vdc). Half output for 80 ms.	

*Double rms ripple spec with 400-Hz input

Table 1-1B SSD Unit Specifications Module III

Model No.	2-30	5-30	9-20	12-15	15-12	18-10.5	24-8.5	28-7	36-5	48-4
Output Ratings (dc):										
Nominal Voltage (V)	2.0	5.0	9.0	12.0	15.0	18.0	24.0	28.0	36.0	48.0
Voltage Range (V)	1.8-3.0	4.7-6.5	6.5-9.5	9.5-13.0	13.0-17.0	16.0-21.0	20.0-26.0	25.0-33.0	32.0-43.0	42.0-56.0
Regulation (mV)*	1.25	2.5	4.5	6.0	7.5	9.0	12.0	14.0	18.0	24.0
Current (A);										
@ 40°C	30.0	30.0	20.0	15.0	12.0	10.5	8.5	7.0	5.0	4.0
@ 50°C	27.0	27.0	18.0	13.5	10.8	9.4	7.6	6.3	4.5	3.6
@ 60°C	22.5	22.5	15.0	11.2	9.0	7.8	6.3	5.2	3.7	3.0
@ 71°C	15.0	15.0	10.0	7.5	6.0	5.2	4.2	3.5	2.5	2.0
Current Limit (Adc) Factory set to;	31.5	31.5	21.0	15.8	12.6	11.0	9.0	7.4	5.3	4.2
Overvoltage Limit (Vdc) Factory set to;	3.2	6.2	10.2	13.2	16.5	19.8	26.4	30.8	39.6	52.8
Input Ratings (Typ.)** Efficiency (%)	60	68	71	75	70	73	75	75	77	78
Output Adjust Resolution (mV)	1.5	3.25	4.75	6.5	8.5	10.5	13.0	16.5	21.5	28.0

Table 1-1C SSD Unit Specifications Module IIIA

Model No.	2-45	5-45	9-30	12-22	15-18	18-16	24-13	28-11	36-8	48-6
Output Ratings (dc):										
Nominal Voltage (V)	2.0	5.0	9.0	12.0	15.0	18.0	24.0	28.0	36.0	48.0
Voltage Range (V)	1.8-3.0	4.7-6.5	6.5-9.5	9.5-13.0	13.0-17.0	16.0-21.0	20.0-26.0	25.0-33.0	32.0-43.0	42.0-56.0
Regulation (mV) *	1.25	2.5	4.5	6.0	7.5	9.0	12.0	14.0	18.0	24.0
Current (A);										
@ 40°C	45.0	45.0	30.0	22.0	18.0	16.0	13.0	11.0	8.0	6.0
@ 50°C	40.5	40.5	27.0	19.8	16.2	14.4	11.7	9.9	7.5	5.4
@ 60°C	32.8	32.8	22.5	16.5	13.5	12.0	9.8	8.3	6.0	4.5
@ 71°C	22.5	22.5	15.0	11.0	9.0	8.0	6.5	5.5	4.0	3.0
Current Limit (Adc) Factory set to;	47.5	47.5	31.5	23.1	19.0	16.8	13.7	11.6	8.4	6.3
Overvoltage Limit (Vdc) Factory set to;	3.2	6.2	10.2	13.2	16.5	19.8	26.4	30.8	39.6	52.8
Input Ratings (Typ.) ** Efficiency (%)	60	68	71	75	70	73	75	75	77	78
Output Adjust Resolution (mV)	1.5	3.25	4.75	6.5	8.5	10.5	13.0	16.5	21.5	28.0

*Combined line and load.
**At nominal line, nominal adjust, full load (40°C).
Typically 2-4% higher at high adjust, full load.

2. INSTALLATION

2.1 GENERAL

After unpacking, general inspection and preliminary check-out procedures should be performed to assure that the unit is in proper working order. If it is determined that the unit has been damaged, the carrier should be notified immediately. Repair problems may be directed to the nearest Sorensen representative, or to the Service Department, Sorensen Company, 676 Island Pond Road, Manchester, New Hampshire 03103.

2.2 INSPECTION

Check for damage incurred during shipment as follows:

1. Inspect enclosures for dents, chips and other obvious signs of damage.
2. Check condition of external terminal board TB1. Make certain that all terminal screws are in place and that links are fitted over the barrier strips between TB1 terminals -1 and -2, TB1-3 and -4, and TB1-8 and -9 (115 Vac operation only).
3. Inspect fuse holder for evidence of damage.
4. If internal damage is suspected:
   a. Remove all flat-head retaining screws from around the perimeters of the case assembly.
   b. Inspect the components and printed-circuit boards for damage.
5. Check that the circuit boards and power transistors are firmly plugged into their sockets. These are readily removable for servicing.

2.3 INPUT CONNECTIONS

SSD units are shipped ready for use with 115 Vac.

CAUTION

For 220 Vac or 300 Vdc operation, REMOVE LINK FROM TB1-8/TB1-9. For 115 Vac, this link remains in place.

For either connection, fuse F1 is in series with the input line connected to TB1 pin 7. Maximum circuit protection is provided when the high side of the input line (the black wire in standard a-c connections) is connected to this pin.

2,4 ELECTRICAL CHECK

NOTE

Before applying power to the unit, it is important that input/output isolation be checked. This may be done using a VOM set to the x10K scale. Assure maximum resistance from input at TB1-6 and -7 to case (ground), and positive output terminal to case. It is recommended that this measurement be performed each time the unit case is removed and replaced.

To perform an initial electrical check, proceed as follows:

1. Make certain that unit is located in an area where passage of air is unrestricted. Connect input leads to terminals TB1-6 and -7 (IN). Use terminal 5 (G) for input system chassis ground.
2. Connect a dc voltmeter across terminals TB1-1 and -4 (OUTPUT SENSING). Select a voltage range compatible with rated output.
3. Apply nominal rated input power.
4. Rotate VOLT control sufficiently to swing the dc voltmeter from minimum rated voltage to nominal output voltage per Table 1-1. (If overvoltage (OVP) circuit should trip, reset per paragraph 3.3.5 on page 3-2).
5. Set output voltage at its nominal value and remove input power.

NOTE

If unit dielectric capabilities must be determined, refer to page 5-6, Hi-Pot Test.

2.5 MOUNTING

SSD units may be mounted in a variety of positions and locations, plus rack mounting.

NOTES

1) Mounting screws should be No. 8-32 and just long enough to penetrate through the mounting surface, 1/4" into the unit using lock and flat washers.

(cont'd)

NOTES (cont'd)

2) Fabricate knockout panels as shown in Figure 2-2. Figure 2-1 is an overall outline drawing of the SSD modules. (Consult factory for specific mounting data.)

1. For cantilever-type mounting from a vertical panel or wall (where vertical airflow is unrestricted):

   End mounting - Use knockout per Figure 2-2. This knockout clears the terminal block and fuses.

   Side or bottom mounting - No knockout is needed. Use the four mounting holes shown in Figure 2-2.

2. For flat mounting from a horizontal surface (where vertical airflow is restricted):

   End mounting - Not recommended.

   Side mounting - Module III units, see knockout per Figure 2-2. Module IIIA units may be mounted directly with no knockout required.

   Bottom mounting - Use knockout per Figure 2-2.

Vertical panel mounting per paragraph 1 preceding is preferred since maximum airflow is assured. Horizontal surface mounting per paragraph 2 preceding, using bottom mounting with proper knockout is the second preference.

CAUTION

During installation, if two or more supplies are to be rack-mounted or otherwise stacked, the operating ambient of the upper units will be affected (not to exceed 71°C/160°F). Output current must be derated according to specifications for ambients above 40°C/104°F, typically measured midway between adjacent surfaces.

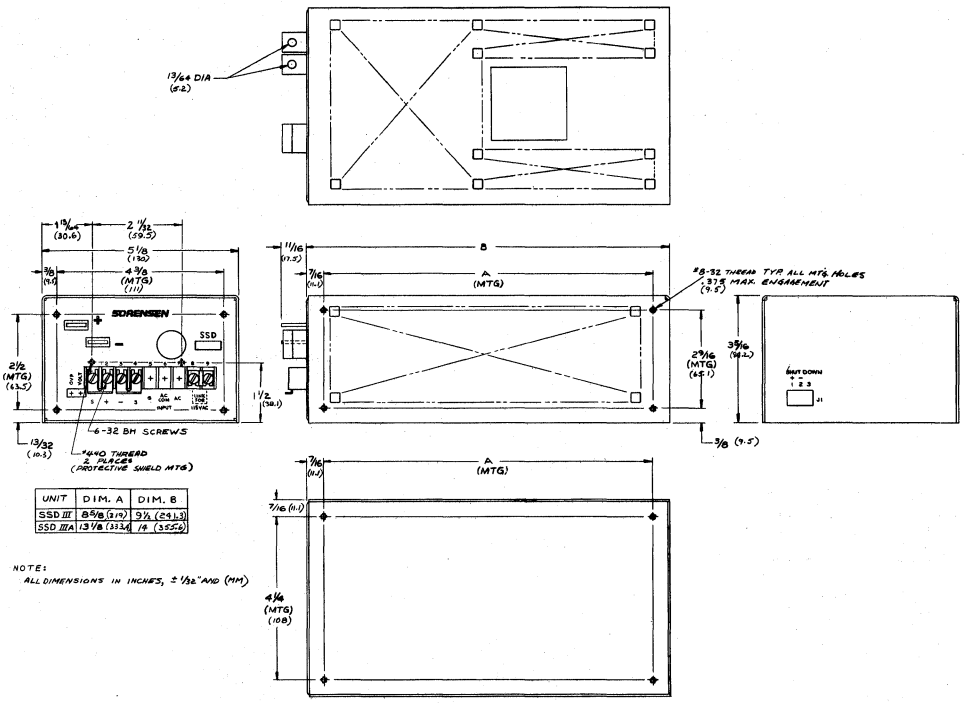
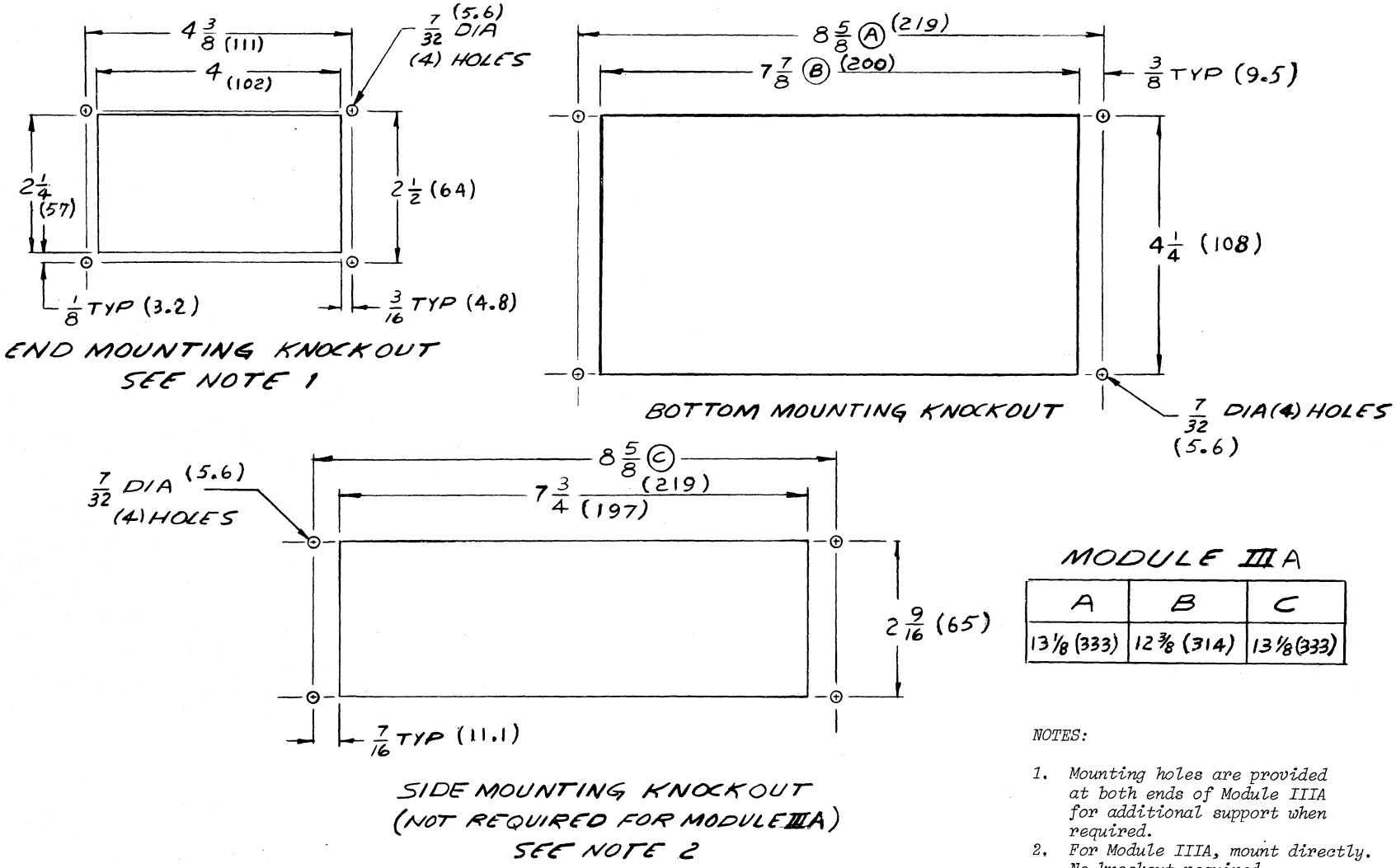


Figure 2-1
Outline Drawing, SSD Modules III and IIIA



MODULE IIIA

A	B	C
13 1/8 (333)	12 3/8 (314)	13 1/8 (333)

NOTES:

1. *Mounting holes are provided at both ends of Module IIIA for additional support when required.*
2. *For Module IIIA, mount directly. No knockout required.*
3. *Dimensions in inches and (mm).*

Figure 2-2 Knockout Dimension, SSD MODULES III AND IIIA

3. OPERATION

3.1 GENERAL

This section contains instructions on how to adapt the unit to and operate it in varied applications. These include remote sensing, remote programming, series operation, and remote shutdown.

CAUTION

The sensing and power circuits form a closed loop. Opening this loop, either by removing a terminal board link or disconnecting a sensing or programming lead will result in a high unit output and will cause the OVP circuit to operate.

3.2 CONTROLS

SSD units are equipped with two controls; the output voltage, and the overvoltage adjustment (OVP) potentiometers accessible at the terminal-board (TB1) end of the supply. The output VOLT control (R26) varies the output voltage while the OVP control (R24) sets the OVP trip point. Both are factory-set to nominal values (see Table 1-1).

3.3 PRE-OPERATION CONSIDERATIONS

3.3.1 Current Limit Setting

The current limiting point is factory-set to approximately 105% of rated 40°C current. If the unit is to be operated in other ambients, the output current is derated per Table 1-1. To assure full warranty protection, THE CURRENT-LIMIT MUST BE RESET TO 105% OF THE DERATED CURRENT VALUE.

3.3.2 Current Limit Reset

To reset the current limit proceed as follows:

1. Rotate limit adjust control R10 on circuit board A2 approximately 2/3 clockwise. Do not operate unit with R10 fully clockwise. (Control is accessible through an opening in the top of the unit.)

2. Connect a voltmeter across output terminals TB1-2 (+) and -3 (-). Apply nominal input power and adjust output VOLT control R26 for the unit's rated nominal value.

3. Remove input power and connect an ammeter and variable load resistor in series across the output terminals.

4. Reapply input power and adjust load so that the test ammeter indicates current limit determined in paragraph 3.3.1.

5. Rotate limit control A2R10 slowly counterclockwise (CCW) until both output voltage and current begin to drop.

6. Remove input power, disconnect test instruments and load.

3.3.3 Overvoltage (OVP) Trip Point

The OVP trip point is factory-set to 1.2V or 10% (whichever is greater) higher than the rated nominal output voltage (Table 1-1). However, if the output voltage will be operated in remote sensing, it may be desired to raise the trip point. When setting the OVP limit, load-lead drop must be taken into consideration.

3.3.4 OVP Trip Point Reset

To reset the OVP, proceed as follows:

1. Rotate OVP panel control R24 fully CW.

2. Rotate output VOLT control R26 on panel until the output voltage is equal to the desired trip point.

3. Rotate OVP control R24 slowly CCW until the output voltage suddenly drops to zero. This indicates that the OVP circuit has been triggered.

4. Remove the input power. Rotate VOLT control several turns CCW. Allow approximately 10 seconds for unit to discharge.

5. Apply input power. Reset output to desired operating voltage.

NOTE

The OVP circuit includes a time-delay network such that the overvoltage condition must exist for approximately 100 microseconds before the OVP fires. This delay prevents short-duration OV pulses from triggering the circuit.

3.3.5 Reset After OVP Fires

If the OVP fires, proceed to reset the circuit as follows:

1. Remove input power and disconnect load (in case OV condition is externally induced). Allow approximately 10 seconds for unit to discharge.
2. Rotate VOLT adjust R26 fully CCW (minimum voltage).
3. Apply input power and raise output voltage to desired value.

NOTE

If the OVP again trips, internal failure is indicated, or the output is set too close to operating voltage (see 3.3.4 preceding).

3.4 LOCAL SENSING

The unit is shipped ready for use in the local-sensing mode. In this mode, regulation is at the output terminals, not at the load. If variations in load-line voltage drops are expected to be prohibitive, refer to paragraph 3.5, remote sensing.

To operate the unit, proceed as follows:

1. Connect a voltmeter across output sense terminals TB1-1 (+) and TB1-4 (-).
2. Attach the input leads to terminals TB1-6 and -7. Use terminal 5 (G) to ground input system.
3. Apply nominal input power.
4. Rotate output adjust until desired output voltage is indicated on voltmeter.
5. Remove input power. Disconnect voltmeter and connect load leads to (+) and (-) output terminals. Do not remove or loosen any of the interconnecting links. Apply nominal input. Unit supplies highly regulated power to load.

3.5 REMOTE SENSING

To sense (regulate) unit output at the load rather than at output terminals, remove the links between terminals TB1-1 and -2, and TB1-3 and -4. Run a sensing lead from terminal TB1-1 to the positive side of load; connect the other lead from terminal TB1-4 to the negative side of load (Figure 3-1). Use a shielded, twisted pair of wires for sense leads. Set unit in operation per paragraph 3.4, and assure that the voltage at the output terminals does not exceed the maximum rating (per Tables 1-1B/C). A decoupling capacitor across the load will minimize the effects of high transients on the control circuitry.

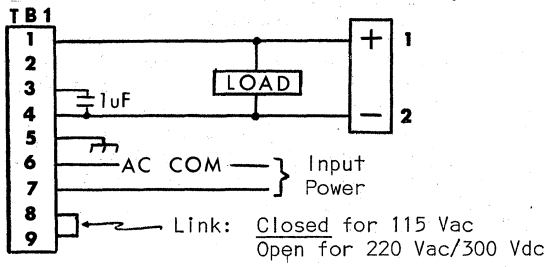


Figure 3-1
Remote Sensing Connections

3.6 REMOTE PROGRAMMING

The unit may be programmed to supply pre-determined output voltages by inserting a calculated resistance into the voltage-sensing circuit. Programming sensitivity is approximately 1000-ohms-per volt; that is 1000 ohms are required for each volt difference between the desired output and the minimum value of the unit's specified range. The programming resistor should be a 1/8-watt (or larger) precision film resistor with a 25 PPM/°C coefficient (equal to MIL style RN55E). The programming current is approximately 1 milliampere. However, a 1.0 uF capacitor in parallel with the inserted programming resistor is recommended to prevent the unit from oscillating, as shown in Figure 3-1.

To adapt the unit for remote programming, proceed as follows:

1. With normal local sensing (paragraph 3.4), set power to ON and adjust output to specified rated minimum output voltage (see Table 1-1 for particular model). For example, for a 12V module, set the output to 9.5 volts.

2. At this point, any value within rated output range (Table 1-1) can be obtained by inserting 1000 ohms-per-volt difference between the desired voltage and the minimum voltage. For example, to obtain 12.0-volt output in the preceding example, the difference is 12.0 (-) 9.5 or 2.5 volts. The program resistor should be 2.5 x 1000 or 2.5K ohms.

3. Set power to OFF. Remove the link from TB1-3 and -4 and connect programming resistor in its place. Either local or remote sensing may be used.

4. Parallel the program resistor with a 1.0uF capacitor.

5. Apply input power and verify load voltage across the (+) and (-) output terminals as the desired value (using local sense).

3.7 SERIES OPERATION

Series operation is utilized for the purpose of obtaining a higher output voltage than available from a single model. Two supplies may be connected in series to form a dual polarity (+) and (-) output system such as (±) 12V with a common return. Any amount of bridging load may be tolerated. Series operation of SSD units to a maximum of 100 Vdc is permissible.

3.8 PARALLEL OPERATION

Two or more SSD power supplies (with identical voltage ratings) may be directly paralleled without derating. Figure 3-2 illustrates the interconnections for two such units in parallel. Typically, the unit with the higher output will supply the total system current up to its limit setting. The second unit then supplies the balance of the system current requirements.

For equal current sharing, the current limit of each unit should be set to half of the desired system current level.

3.9 REMOTE SHUTDOWN FUNCTION

SSD supplies may be shut down externally by connecting 100 ohms (or less) across pins J1-1 (+) to J1-2 (-) at the rear of the unit. The shutdown circuitry, (5-volt bias voltage) is completely isolated, allowing for several methods of activation. Thus a remote relay, transistor, or logic switch can be used to reduce the supply output. The unit output is restored when the signal is removed.

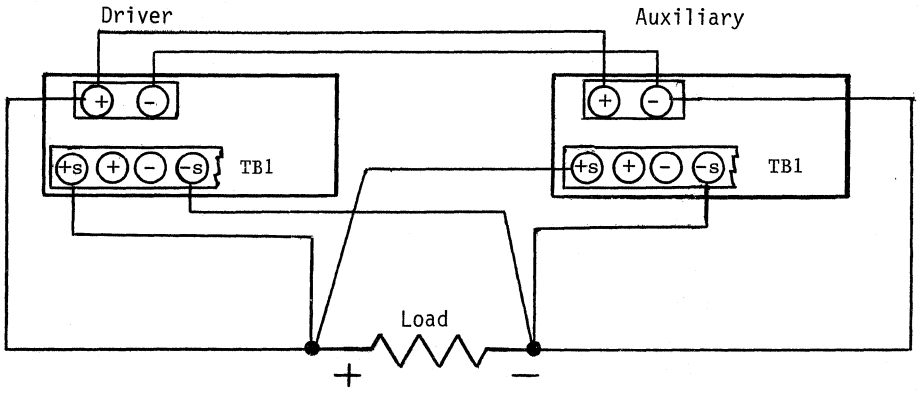


Figure 3-2
SSD Direct Parallel Connections

4. THEORY OF OPERATION

4.1 SUMMARY (Refer to Figure 4-1, Block Diagram)

SSD circuitry uses 20-kHz switching techniques to provide high efficiency and exceptional power density (high power output from a physically small package).

The proper input (115/220 Vac or 300 Vdc) is applied through input rectifiers/RFI filters and/or voltage doubler (115 Vac) where, at 300 Vdc unregulated, it is applied to a stepdown power chopper. The chopper is pulse-width modulated to produce a controlled d-c level which supplies an inverter circuit. Secondary windings on the inverter power transformer are connected to the full-wave output rectifier and output filter to produce a regulated d-c output.

The output is "sensed", and compared with a reference voltage. Any difference, or error voltage, is amplified and fed back to the chopper to control the duty cycle. Thus a closed loop is achieved, resulting in excellent line/load regulation.

Control portions of the circuitry consist of:

a. Preregulator printed-circuit board (PCB) A1; switching regulator which generates the reference frequency and system bias voltages and trigger pulses.

b. Duty-cycle control PCB A2; pulse width modulator which maintains the desired level of power-supply output, and;

c. Base Driver PCB A3; driver for power inverter, generates bias current for duty-cycle control.

4.2 INPUT CIRCUIT

NOTE

For identification of components called out in the following text, refer to Figures 6-2/-3, system schematic diagram, or Figures 6-4 thru 6-6 (circuit boards A1 thru A3) when specified.

The input is applied through input RFI choke L1 and bridge rectifier CR1: full-wave rectifying mode for dc/220 Vac (TB1-8/-9 link open), or half-wave rectifying, voltage-doubler mode for 115 Vac, (link TB1-8/-9 closed). Input capacitors C2/C3 are in series in the full-wave mode and in parallel in the doubler mode. The input appears as an unregulated 300 Vdc at stepdown chopper Q1/Q2 through soft-start RT1/RT2 and RFI chokes L2/L3. The chopper establishes the required duty cycle, whose pulse width is controlled by inputs from the A2 chopper control circuit board. Variations in power supply output are fed back as error signals to the A2 PCB, where they are processed and applied to the chopper to vary the duty-cycle pulse width. The power filter section, consisting primarily of L4 and L5, averages the duty cycle into a controlled d-c level of 120-200 volts, depending on the output load requirements.

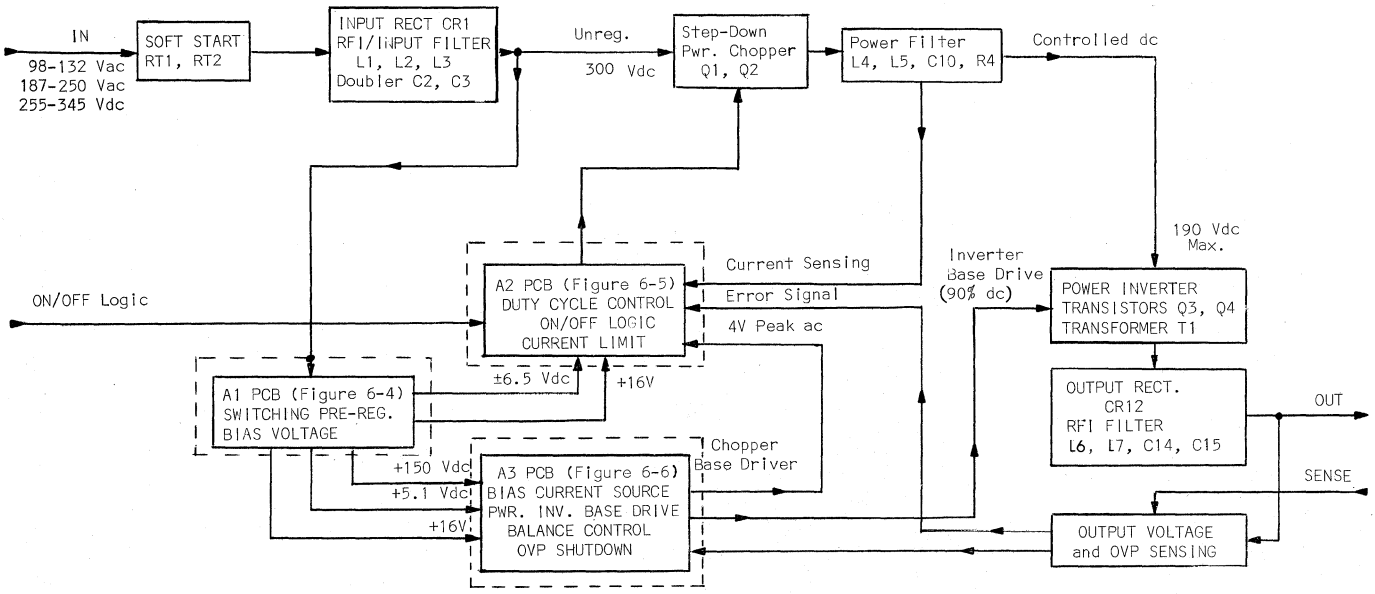


Figure 4-1 SSD Simplified Block Diagram

4.3 PREREGULATOR/BIAS SUPPLY PCB A1 (Figure 6-4)

The preregulator provides a regulated 150 Vdc to the bias inverter, and is the source of bias voltages required by the SSD system. The unregulated dc input is processed into a controlled duty-cycle pulse which establishes and maintains proper bias voltages through secondaries A-E of A1T1.

4.3.1 Input/Start-Up Circuit

The unregulated 300 Vdc at input capacitors C2/C3 (main assembly) is applied through A1F1 into the preregulator. Chopper A1Q2, under control of timer A1U2, processes the dc into a controlled duty cycle at the primary of bias transformer A1T1.

During system turn-on, "start-up circuit (A1) Q1/VR1/C1 provides starting bias for circuit operation until the proper d-c level of bias for preregulator control is established at A1T1. At that point, the start-up circuit A1Q1 is cut off.

4.3.2 Comparator (A1U2)/Chopper (A1Q2) Control

Reference clock A1U1 generates a series of 40-kHz negative pulses to trigger comparator A1U2 at pin 2. The output of the comparator at pin 3 determines the duty-cycle for step-down chopper A1Q2. The comparator operates as follows (refer to Figure 4-2):

The instantaneous voltage at A1U2-6 is a function of the (A1) R7/C5 time constant. After being triggered by the input at pin 2, this voltage increases until it reaches the d-c level at pin 5 (error signal, paragraph 4.3.3). The rise-time represents the ON period of the duty-cycle at A1Q2, and thus the A1T1 primary voltage. The voltage at pin 6 decays until a subsequent trigger at pin 2 repeats the process. The error voltage at pin 5 determines the ON time of the duty-cycle, as seen in Figure 4-2.

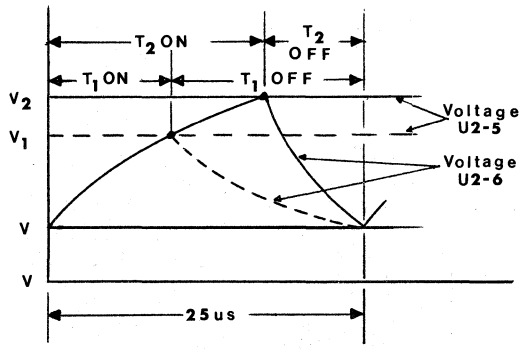


Figure 4-2 (A1) Comparator Duty Cycle Control

4.3.3 Error Amplifier (A1U3) and Bias Control

Secondary winding "A" of transformer A1T1 is actually connected to the primary winding, and serves two purposes:

a. provides bias for overall preregulator circuit operation, and

b. establishes the voltage at A1U3 which controls the error signal at A1U2-5.

The voltage across secondary A1T1-A senses any variation across the winding "A". This regulation effectively maintains the voltage across A1C15 (which functions partly as an LC filter with the A1T1 primary) at a constant 150 Vdc assuring accurate bias levels at the remaining A1T1 secondaries "B"-"E".

Potentiometer A1R15 is adjusted to set secondary winding "B" to precisely 5.1 volts. The remaining bias levels (+16V, ±6.5V, +150V) are dependent on the 5-volt bias level setting.

4.4 CHOPPER CONTROL PCB A2 (Figure 6-5)

This board contains the circuitry which controls the duty-cycle input to the power filter, thus regulating the system output level. Three primary circuit functions contribute to this control:

a. Voltage error amplifier (A2) U4/U5

b. Low voltage sensing (A2) U1-A/U1-E and logic shutdown A2U6

c. Current-limiting error amplifier A2U3.

The output of each of these circuits appears as a dc error input to OR gate (A2) CR3/4/6. The OR gate passes the larger of the three inputs into constant-current comparator circuit (A2) U2-A through -E. Here it is compared to the relatively constant 40-kHz ramp signal (developed by the trigger from preregulator board A1) appearing across A2C9. The comparator outputs at (A2) U2-D/-E are in the form of square-wave pulses, positive at A2Q1 for ON time control, and complementary negative-going turn-off pulses at A2U1-B. The resultant output at A2Q1-C is applied simultaneously to bias drivers (A2) Q2/Q3 at a 40-kHz repetition rate.

Only one of base drivers A2Q2/Q3 will be activated, as their emitters are tied across a 20-kHz, 4.5-volt secondary of bias transformer T1 on the A3 base driver circuit board (Figure 6-6). Thus, while one driver is ON, controlling its respective chopper transistor on the main assembly, the other is OFF. Since the transformer waveform is at 20-kHz, synchronized with the comparator (40-kHz), only alternate outputs are fed to choppers Q1/Q2 on the main assembly (Figure 6-2/-3).

4.4.1 Remote Logic Shutdown

A logic ON/OFF bias generated in the A3 circuit board may be externally switched to momentarily shut down the output voltage. Shorting terminals J1-1 to J1-2 at the rear of the supply connects the bias to A2J1-5/-6 to control optical isolator A2U6. When activated, the d-c OR gate level at A2CR3 increases to a level above the ramp (Figure 4-3), cutting off the duty cycle of the comparator.

4.4.2 Typical Chopper Control Operation

In a typical operating situation, any tendency of the supply output to increase is sensed through error amplifier A2U4. The A2U4 output activates optical isolator A2U5, and A2CR3, increasing the OR gate level to the comparator and thus narrowing the width of the duty-cycle pulse which controls the ON time of chopper Q1/Q2 on the main assembly.

The duty-cycle control function is illustrated in the following diagram.

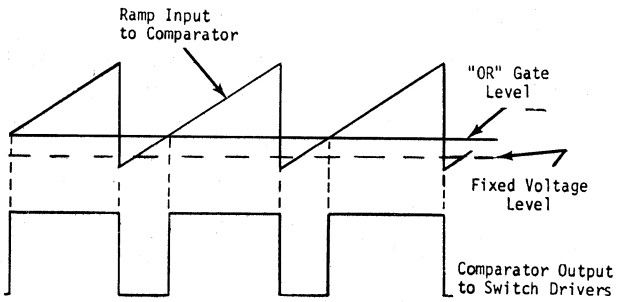


Figure 4-3 (A2) Comparator Duty Cycle Control Function

In the current mode, the voltage at A2CR6 is the controlling voltage from amplifier A2U3. A fixed voltage at A2CR4, determined by the ratio of (A2) R11/R14 establishes a maximum pulse width (minimum OR output) allowable, to prevent chopper transistors Q1 and Q2 from overlapping, and damaging transistors Q1 and Q2 by switching both ON at the same time.

Portions A and E of A2U1 (Figure 6-5) provide for cutting off the duty cycle in the event of a low bias-voltage condition. When the input bias drops below a predetermined level, A2U1-E turns ON resulting in a d-c level at CR4 greater than the ramp level. The duty-cycle output of the comparator is cut off completely, disabling power choppers Q1/Q2.

4.5 BASE DRIVER PCB A3 (Figure 6-6)

Circuit board A3 provides: base drive to the power switching transistors Q3/Q4 on the main (A4) assembly, bias current for the chopper base driver (A2), overvoltage sensing shut-off capability, and logic ON/OFF bias.

4.5.1 Start-Up Circuit

Components (A3) Q1/VR1 act as a "start-up" circuit to provide a 5-volt operating potential for (A3) U1-A/-B, and start-up voltages for (A3) U2, U3, and associated circuitry. When the voltage at A3J3-5 reaches its (+) 5-volt level (from the A1 preregulator circuit board) A3CR1 becomes reverse-biased shutting off A3Q1.

4.5.2 Clock Generator Balance Control Comparator/Error Amplifier

The trigger input from the A1 control board at A3J3-6 is used to synchronize reference clock A3U2 through A3Q2. During start-up, the reference clock free-runs until the bias voltage comes up. At this point, A3U2 synchronizes with the A1 preregulator trigger. A narrow 40-kHz clock pulse is generated at A3U2-3 which triggers flip-flop A3U1. The outputs of A3U1 at -12/-13 change state with each subsequent clock pulse, establishing the base drive for bias inverter A3Q3/Q4.

The 40-kHz clock from A3U2 is also applied to balance control comparator A3U3 at pin 2. The output duty cycle at A3U3-3 is inverted through balance error amplifier A3Q6, and applied to the bases of (A3) Q7/Q8 switch drivers. With 20kHz applied to these drivers through A3T1, and the 40-kHz pulses applied at each base, only alternate clock outputs appear as driver outputs to the main switching transistors Q3/Q4 in the power inverter.

The pulse width at A3U3-3 determines the power inverter OFF time, and establishes the proper Q3/Q4 current balance. The pulse width (typically 2.5 microseconds), and thus the OFF time, is governed by error amplifier A3Q5, which feeds back error signals to U3-5. The greater the error, the wider the pulse generated by A3U3. The proper current balance for the power inverter is therefore maintained.

4.5.3 Bias Transformer/Inverter

Transformer A3T1 is the bias current source for the following functions:

Logic ON/OFF bias

Base drive to chopper control transistors in the A2 circuit board

Base drive for the power inverter switching transistors on the main assembly

Primary drive for A3T1 occurs through bias inverter transistors A3Q3/Q4, controlled by base drive inputs from flip-flop multivibrator A3U1. A3U1 is synchronized with the 40-kHz clock from A3U2 discussed earlier. A3U1-B provides a 20-kHz push-pull output for bias inverter base drive.

4.5.4 Overvoltage (OV) Circuit

Under normal supply output conditions, pin A3U1-9 remains high, which maintains a high at "Q" outputs to the bias inverter. In the event of an overvoltage condition at the supply output, OV error amplifier A3U5 reacts through output sense lines at TB1-2/-3. Optical isolator A3U4 is activated, applying a low to A3U1 pin 6 (CLEAR). The output at pins 9 and 2 go low, removing the clock at A3U1-1, stopping the flip-flop action. Base drive to the bias inverter is removed, shutting down the supply. The input power must then be recycled to continue operation.

4.5.5 Logic ON/OFF Bias Remote Shut-down

A separate secondary on A3T1 generates the bias voltage at A3J4-1/-2 which is used to cut off the supply output as detailed in paragraph 4.4.1.

4.6 OUTPUT CIRCUIT (Figures 6-2/-3)

The controlled 120-200 volts from the input power choppers (paragraph 4.2) establishes the operating voltage for power inverter Q3/Q4/T1. Switches Q3/Q4 in the push-pull mode provide a nearly constant (90%) duty cycle to power transformer T1 (with small adjustment for current balance).

At the secondary, rectification takes place through CR12. The resultant 40-kHz signal is then filtered by L6/C14, and L7/C15, and appears as the supply output voltage. The integration function of the filtering reduces the 40-kHz component of the output to less than 3 millivolts (typically).

4.7 RADIO FREQUENCY INTERFERENCE (RFI) CONTROL

The switching action of this type of supply might be expected to create a source of RFI. The design of the SSD series has minimized this interference, using the limits specified in MIL-STD 461A as a reference.

Conducted interference on the input lines is considerably reduced by L1/L2/L3 together with C4/C5 on the main chassis. Conducted interference at the output load and sense leads is minimized by RFI chokes L8, L9, and L10 and caps C16, C17 and C18. Radiated interference is effectively minimized by the metal enclosure of the SSD series power supplies.

5. SERVICE AND REPAIR

5.1 GENERAL

This section provides unit troubleshooting data, and calibration and performance-testing procedures. The troubleshooting data should be used in conjunction with the schematic diagrams and parts location drawings in section 6 (Drawings and Parts List), plus section 4 which outlines the theory of operation. Questions pertaining to repair should be directed to the nearest Sorensen service representative or to the Service Dept., Sorensen Company, 676 Island Pond Road, Manchester, N. H. 03103. Include the model and serial numbers in any correspondence. Should it be necessary to return a unit to the factory for repair, authorization from the Sorensen service department must first be obtained. Sorensen Company will not assume responsibility for units returned without prior authorization.

Unit troubleshooting hints are provided in Table 5-1 in the form of SYMPTOM/PROBABLE CAUSE/REMEDY. Where practicable, step-by-step procedures are used to facilitate isolation of a problem area.

Care should be taken when replacing any component, even if it appears obviously defective. A failed component is generally the result of a malfunction elsewhere in the system. It is the purpose of this troubleshooting procedure to help isolate both the failed component and the cause of its failure.

5.2 PERIODIC SERVICING

The SSD models require no periodic servicing. However, when a unit is taken off line it is recommended that the enclosure be inspected and cleaned of any accumulations of dust or other debris which could impede the free flow of air through the unit.

5.3 TEST EQUIPMENT REQUIRED

Use the test equipment listed (or an equivalent)

1. Oscilloscope, dual trace, 20-200MHz bandwidth, isolated from ground (Tektronix 454 or 475 with 10X voltage probe for channel A)
2. Current probe (Tektronix P6042)
3. Digital voltmeter (Fluke 8400)
4. Differential voltage probe (Tektronix P6046)
5. True RMS voltmeter (Hewlett Packard HP-3403C) or Fluke 8400-09
6. VOM (Simpson 260)

CAUTION

1. *During testing, use an isolation transformer whenever possible. If impractical to use an isolation transformer, DO NOT GROUND TEST EQUIPMENT.*
2. *Each time the unit is opened, recheck for input and output isolation to case ground before turn-on.*

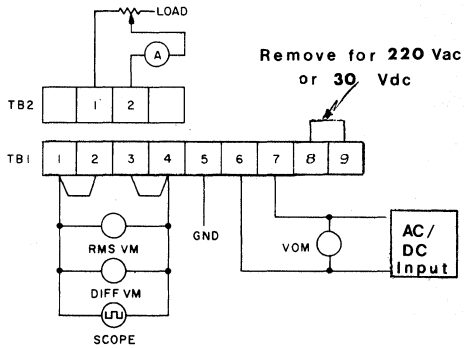


Figure 5-1
Test Equipment Setup

5.4 TROUBLESHOOTING

5.4.1 General Considerations

Before attempting repairs, the SSD unit should be carefully inspected for apparent defects, such as broken or damaged components/connectors or PCB, or for obvious heat damage or loose pin connections.

After replacing an electrical component, the Hipot test procedure as outlined in paragraph 5-6, and the simulated turn-on procedure outlined in paragraph 5.5.1 should be performed before placing the unit in service.

The physical size and shape of a replacement part can have an effect on the performance of the power supply. The part should therefore be a direct replacement whenever possible. Section 6 of this manual contains all schematics and component location drawings, plus replaceable parts along with the Sorensen and manufacturer part numbers as applicable.

5.4.2 Switching Transistors Q1-Q4

CAUTION

The casings of these transistors are "live" during operation.

1. Set input power to OFF, and remove the transistor connector.

2. With a VOM set to the R X 1 scale, measure an open circuit from the collector (+) to the emitter (-) of each power transistor. If a resistance of 15 ohms or less is encountered, remove the transistor from the circuit and repeat the resistance test. A low reading indicates a faulty transistor.

NOTE

If a transistor requires replacement, the cause of failure should be determined before re-applying input power.

5.4.3 Overvoltage Protection (OVP) Circuit

If OVP function occurs repeatedly, check for proper setting of OVP adjustment potentiometer R24 on the front panel. If necessary, reset per paragraph 3.3.4 in section 3 of this manual. Assure that the sensing links at the output connector are intact across terminals TB1-1 and -2, and TB1-3 and -4.

Continued malfunction of the OVP may indicate problems in the A3 Base Drive circuit board.

CAUTION

Whenever a component is replaced in the SSD system, perform Hi-Pot test (para 5.6) and Simulated Turn-on Procedure (para 5.5.1) before placing the unit in service.

Table 5-1 Main Chassis Troubleshooting

SYMPTOM	PROBABLE CAUSE	REMEDY
1. No Output: Input Fuse (F1) intact.	A. Remote shutdown function operational.	Remove short across J1-1/J1-2 at rear of unit.
	B. Overvoltage protection circuit tripped.	1) Reapply input voltage after approximately 10 seconds. 2) Verify proper setting of OVP trip point (R24, accessible on front panel). CW adjustment increases the output voltage trip point. If this adjustment resolves the problem, reset R24 per paragraph 3.3.4 in section 3 of this manual. 3) If OVP tripping recurs with normal output loading, or with no output, refer to OVP troubleshooting procedure (paragraph 5.4.3).
	C. Current limit improperly adjusted.	If, during unit calibration or repair, potentiometer R10 on PCB A2 has been left in the fully CCW position, no output will appear. Refer to final calibration procedure (paragraph 5.5.2).
	D. Output circuit shorted.	Check individual output circuit components.
	E. 115-volt input with TB1-8/-9 link open.	Insert link.
	F. Internal fuse (F2) on main circuit board (A4) open.	1) Remove supply case, check commutation diode CR5. 2) Check power transistor Q1, as outlined in switching transistor troubleshooting in paragraph 5.4.2.
	G. A1F1 (fuse on A1 circuit board) open (internal F2 intact).	1) Check power transistors Q1 thru Q4 per paragraph 5.4.2. 2) Check bias inverter transistors (A3) Q3/Q4 on base drive board A3.
2. No Output: All Fuses intact.	A. Power inverter transistor(s) failure.	Check Q3/Q4 per paragraph 5.4.2.
	B. Output short (unit in current-limiting mode).	Check individual output components.
	C. A3 board start-up circuit malfunction.	Check (A3) Q1/VR1.
3. No Output: Input Fuse (F1) open.	A. Input rectifier filter.	Check/replace.
	B. 220-volt input with TB1-8/-9 link intact.	Remove link (used only with 115-volt input). Check for possible damage to input capacitors C2/C3, and internal fuse F2. Also check fuse A1F1 on preregulator circuit board, (if open, refer to SYMPTOM 1.G.
	C. Input pin TB1-6 or TB1-7 shorted to ground.	Isolate input lines from chassis.

Table 5-1 Main Chassis Troubleshooting (cont'd)

SYMPTOM	PROBABLE CAUSE	REMEDY
3. No Output: Input Fuse (F1) open (cont'd).	D. Power transistor failure.	Check transistors per paragraph 5.4.2.
	E. Input circuit failure.	Proceed to simulated turn-on procedure in paragraph 5.5.1.
4. High Output:	Improper setting of VOLT adjust (R26) or OVP adjust (R24), accessible at front panel.	Reset R26 and/or R24 per paragraph 5.5.2.
5. Low Output:	Current limit (A2R10) or VOLT control (R26) improperly adjusted.	Readjust per calibration procedure (paragraph 5.5.2).
6. Excessive ripple on output:	A. Low line input.	Monitor input line voltage.
	B. Measuring instrument improperly grounded.	Ground instrument.
	C. RFI L6/L7/L8 defective.	Visually inspect for signs of deterioration or damage.
	D. C15 malfunctioning or defective.	1) Check for proper tightening of C15 hold-down screws. 2) Check C15 for short/open.
7. Poor regulation:	A. Measuring across load terminals.	Regulation must be measured across sensing terminals.
	B. Unit overload.	Load not to exceed maximum rated current specification.
	C. Current limit improperly adjusted.	Refer to adjustment procedure in paragraph 5.5.2.
8. Output Oscillates:	A. Output filter.	Check filter capacitors for damage or loose hold-down screws.
	B. 40-kHz frequency improperly adjusted (oscillation with no load).	Check frequency. Adjust A1R9 as required for 40 ±1.5kHz.*
	C. Output of voltage sense amplifier A2U4 improperly adjusted.	With nominal input (115 Vac) and maximum output at full load, check for 4.0 Vdc at test points (+) and (-) adjacent to potentiometer A2R44 on A2 circuit board. Adjust A2R44 if necessary.

NOTE

**The 40-kHz clock pulse adjustment is critical. This adjustment should be made using a frequency counter to assure in-tolerance setting.*

5.5 OPERATIONAL CHECKOUT

Whenever a component is repaired and/or replaced, the appropriate operational check procedure should be performed prior to placing the unit in service:

1. Hi-Pot test (Paragraph 5.6)
2. Output failure; final calibration cedure (paragraph 5.5.2).
3. Input or circuit board failure; simulated turn-on procedure paragraph 5.5.1 (internal fuse F2 removed to isolate power drive components) followed by final calibration.

5.5.1 Simulated Turn-on Procedure

Use the test equipment listed in paragraph 5.3 as required in the following procedures.

1. Set unit power to OFF and remove cover. REMOVE INTERNAL FUSE F2. Connect voltmeter, set to the 250-volt range, across A1C15 (C15 on regulator board A1).

2. Set current-limit control A2R10 to its approximate mid-position.

3. Connect current probe to green common-emitter wire of Q3/Q4 power transistors.

4. Set input power to ON. A1C15 voltage should be approximately 150 Vdc. (If zero volts, check A1F1; if considerably higher than 150 Vdc, a faulty A3 circuit board is indicated).

5. Q3/Q4 drive current should be approximately 300mA. Current pulse OFF time should be from 3.5 to 5.0 usec (see Figure 5-2).

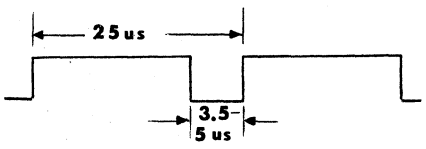


Figure 5-2
Drive Current Waveform

6. Connect current probe to green common-emitter wire of drivers Q1/Q2. This level should also be approximately 300mA, with a current pulse OFF time of 2 to 4 usec.

7. Momentarily short J1-1 to J1-2 at the rear of the supply to check the shutdown function. Q1/Q2 drive current should be cut off.

8. Set unit power to OFF, and replace internal fuse F2. Set current limit control A2R10 fully counterclockwise.

9. Apply input power. Unit will be in deep current limiting mode (zero output voltage). Turn A2R10 slowly clockwise. Output will gradually increase to a preset level. Reset current limit as described in paragraph 5.5.2.

5.5.2 Final Calibration

If the switching transistors and/or drive circuit components have been changed, perform tests per previous paragraph 5.5.1 before continuing.

1. Remove input power and connect current probe to (green) common-emitter wire of Q3/Q4 output transistors.

2. Connect the digital voltmeter and rms voltmeter across the output sensing terminals (TB1-1 and -4).

3. On front panel, set the output voltage control (R26) to its approximate mid-range, and the OVP control R24 fully clockwise.

4. Remove load from output.

5. Set current limit adjust A2R10 fully counterclockwise.

6. Apply nominal input power and turn A2R10 slowly clockwise. The output voltage should increase and the current waveform on oscilloscope should appear as in pattern of Figure 5-3.

7. Set output voltage to desired level.

8. Reset current limit control A2R10 to 105% of rated 40°C current, and reset OVP to the greater of 1.2 volts or 10% above rated output voltage. Both procedures are outlined in section 3, Operation.

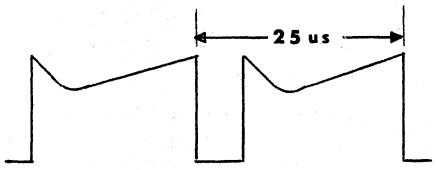


Figure 5-3
Output Current Waveform

5.6 HI-POT TEST PROCEDURE

It is recommended that this test be performed only if a component has been repaired or replaced which could affect the dielectric capability of the unit.

Note: If unit has been in service for an extended period, it should first be cleaned of dust or any other accumulations.

A. Test Limits:

Input - 2100 Vdc
Output - 500 Vdc

B. Test Equipment Required:

Hi-Pot Tester - Electrospace Model 650 "Megpot" or equivalent.

Jumpers/Clip Leads as required.

C. Equipment Set-up:

1. Isolate unit input line cord from power source and chassis.
2. Connect input terminals TB1-6, -7, -8 and -9 together.
3. Connect all output terminals together.
4. Set hi-pot tester switch to ON.

D. Input Test:

1. Connect the unit output terminals to chassis ground.
2. Set the trip current control on the hi-pot tester to 100 microamperes, and voltage control to 0.
3. Connect the hi-pot tester from the input terminals to chassis ground.
4. Gradually increase the hi-pot voltage from 0 volts to input test limit (paragraph A. preceding).
5. Hold maximum specified level for at least five seconds. No breakdown shall occur during test.
6. Decrease hi-pot voltage to 0 volts.

CAUTION

Charged capacitors must not be shorted to ground to remove the charge. This voltage must be discharged slowly thru a 47K, 2W resistor. Failure to follow this instruction can result in damage to semiconductors resulting in immediate or subsequent unit failure.

7. Disconnect hi-pot leads from power supply input terminals.
8. Remove output terminal ground.

E. Output Test:

1. Connect the unit input terminals to chassis ground.
2. Set the trip current control on the hi-pot tester to 100 microamperes, and output voltage control to 0 volts.
3. Connect the hi-pot tester from the output terminals to chassis ground.
4. Gradually increase the hi-pot voltage from 0 volts to output test limit (paragraph A. preceding).
5. Hold maximum specified level for at least five seconds. No breakdown shall occur during test.
6. Decrease hi-pot voltage to 0 volts.

CAUTION

Charged capacitors must not be shorted to ground to remove the charge. This voltage must be discharged slowly thru a 47K, 2W resistor. Failure to follow this instruction can result in damage to semiconductors resulting in immediate or subsequent unit failure.

7. Disconnect hi-pot leads from power supply output.
8. Remove input terminal ground.
9. Remove input and output terminal jumpers.

6 DRAWINGS AND PARTS LISTS

6.1 INTRODUCTION

This section contains system and sub-system schematic diagrams, component location diagrams and coded "replaceable parts list" tables, keyed to Figures 6-1 through 6-8. Following Figures 6-2 through 6-6 are the part numbers of all identified components. Table 6-1 covers all components in the module III group (Figure 6-2) and Table 6-2 covers all components in the module IIIA group (Figure 6-3).

Figures 6-4 through 6-6 depict plug-in printed-circuit boards common to all models in the module III and IIIA series.

6.2 TABLE HEADINGS DEFINED

6.2.1 Circuit Symbol

This is an alpha-numeric identification of the component as called out on the unit drawings.

6.2.2 Sorensen P/N

This number should be used when ordering parts direct from:

Sorensen Company
Replacement Parts Dept.
676 Island Pond Road
Manchester, N. H. 03103

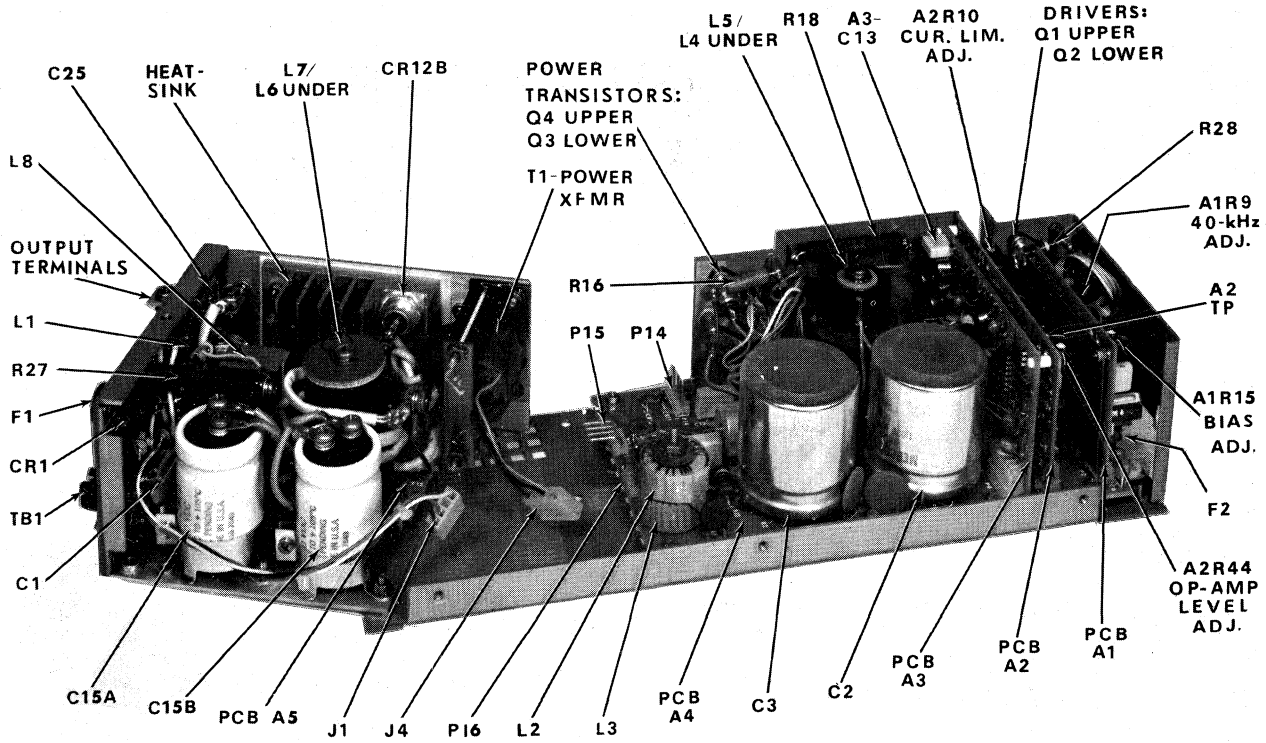
6.2.3 Mfr., Type

This is the basic group or series under which the part is listed by a manufacturer. The coded identification of representative manufacturers is summarized below, listed alphabetically.

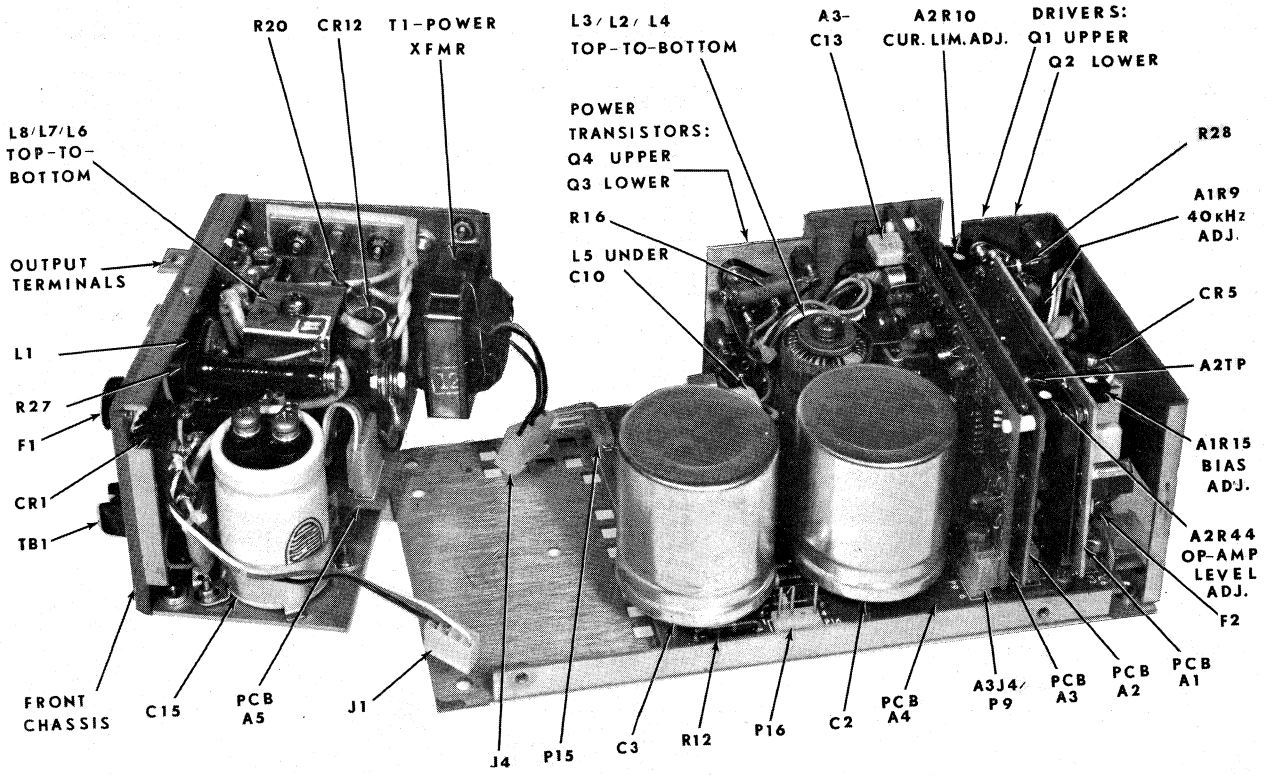
MANUFACTURER CODES

Mfr. Code	Manufacturer
AB	Allen Bradley Co.
AC	Acushnet Capacitor Co.
AER	Aerovox Corp.
BNS	Bourns, Incorporated
BUS	Bussman Mfg./Div. McGraw-Edison
CD	Cornell-Dublier Corp.
CG	Corning Glass Works
CL	Clarostat Corp.
CTS	CTS Corporation
ELA	Electra/Midland
EMC	Electromotive Mfg. Co.
GE	General Electric Co.
GI	General Illuminating Co.
IND	Industrial Devices
IR	International Rectifier
ITT	International Telephone
KEM	Kemet Div. Union Carbide Corp.
KC	Keystone Carbon
LF	Littelfuse Corporation
MA	Motorola
MAL	P. R. Mallory Co.

Mfr.	Manufacturer
MG	Magnetics, Inc.
NS	National Semiconductor
RAM	RAM Electronics
RCA	RCA Corporation
RCL	RCL Electronics
RDM	Radio Material Co./Div. P.R. Mallory
SAN	Sangamo Electric
SE	Seacor, Incorporated
SEM	Semtech Corporation
SIG	Signetics Corp.
SP	Sprague Electric
SR	Sorensen Company
ST	Solitron Devices
STM	STM Corporation
TEL	Teledyne Semiconductor Division
TRW	TRW
UC	Union Carbide
WH	Westinghouse Semiconductor Division
WL	Ward Leonard



TYPICAL - MODULE SIZE IIIA



TYPICAL - MODULE SIZE III

Figure 6-1
SSD Component Location Drawings

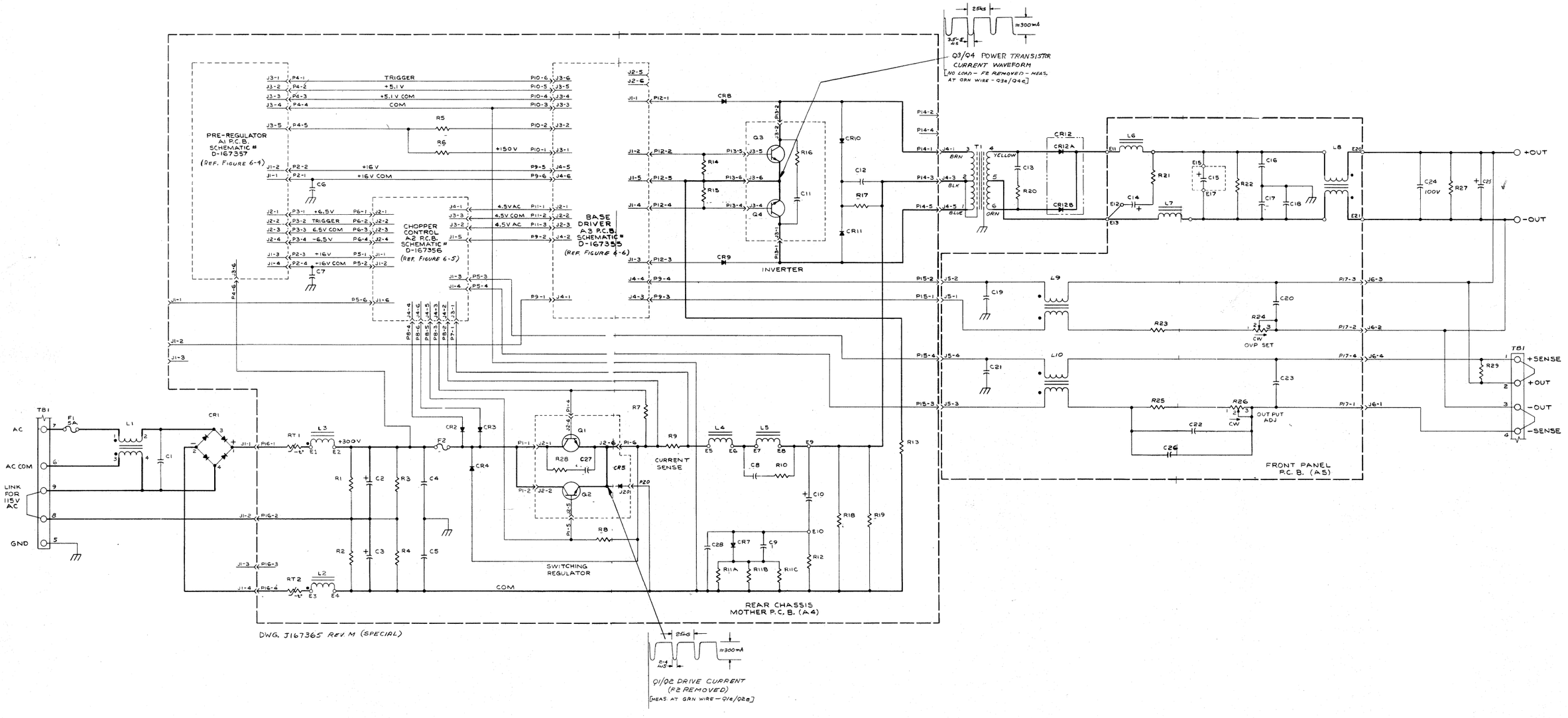


Figure 6-2
SSD Module III System Schematic Diagram

TABLE 6-1
REPLACEABLE PARTS LIST
SSD MODULE III, MAIN ASSEMBLY*

CIRCUIT SYMBOL	SSD MODEL 2-30	5-30	9-20	12-15	15-12	18-10.5	24-8.5	28-7	36-5	48-4	DESCRIPTION	SORENSEN PART NUMBER	MANUFACTURER, TYPE
											Capacitors (uF except as noted)		
C1	x	x	x	x	x	x	x	x	x		0.01, 500V	235-7207P41	SP, Y5V
C2	x	x	x	x	x	x	x	x	x		1,000, 200V	586052-1	STM, 91C
C3	x	x	x	x	x	x	x	x	x		1,000,200V	586052-1	STM, 91C
C4	x	x	x	x	x	x	x	x	x		4,700, 2kV	235-7207P24	SP, Y5U
C5	x	x	x	x	x	x	x	x	x		4,700, 2kV	235-7207P24	SP, Y5U
C6	x	x	x	x	x	x	x	x	x		0.001, 1kV	235-7421P14	RDM, JF
C7	x	x	x	x	x	x	x	x	x		0.001, 1kV	235-7421P14	RDM, JF
C8	x	x	x	x	x	x	x	x	x		330pF, 500V	235-7053P306	SAN, 015
C9	x	x	x	x	x	x	x	x	x		1.0, 500V	24-2037-19	SE, MMK
C10	x	x	x	x	x	x	x	x	x		50, 300V	167816-1	SR
C11	x	x	x	x	x	x	x	x	x		390pF, 500V	235-7053P314	SAN, 015
C12	x	x	x	x	x	x	x	x	x		0.22, 250V	24-2015-17	SE, MMK
C13	x	x	x	x							0.001, 1kV	235-7421P14	RDM, JF
				x	x	x	x	x	x		Not used		
C14	x	x									220, 10V	586057-10	UC, MIL
			x	x							100, 20V	586385-10	UC, T110
				x	x	x					47, 35V	586058-27	UC, MIL
							x				18, 50V	585071-44	UC, MIL
								x	x		10, 75V	586386-8	UC, MIL
C15	x	x									13,000,10V	167817-1	MG
			x								7,600, 15V	167817-2	MG
				x							6,400, 20V	167817-3	MG
					x	x					4,700, 25V	167817-4	MG
							x				4,100, 30V	167817-5	MG
								x			3,000, 40V	167817-6	MG
									x		2,200, 50V	167817-7	MG
										x	1,200, 75V	167817-8	MG
C16	x	x	x	x	x	x	x	x	x	x	0.1, 500V	235-7207P41	SP, Y5V
C17	x	x	x	x	x	x	x	x	x	x	0.1, 500V	235-7207P41	SP, Y5V
C18	x	x									0.1, 500V	235-7207P41	SP, Y5V
			x	x	x	x	x	x	x	x	Not used		
C19	x	x	x	x	x	x	x	x	x	x	0.001, 1kV	235-7421P14	RDM, JF
C20	x	x	x	x	x	x	x	x	x	x	0.22, 100V	24-2037-11	SE, MMK
C21	x	x	x	x	x	x	x	x	x	x	0.001, 1kV	235-7421P14	RDM, JF
C22	x				x	x	x		x	x	0.22, 100V	24-2037-11	SE, MMK
		x						x			0.1, 100V	24-2037-7	SE, MMK
			x	x				x			0.15 100V	24-2037-9	SE, MMK
C23	x	x	x	x	x	x	x	x	x	x	0.22, 100V	24-2037-11	SE, MMK
C24	x	x	x	x	x	x	x	x	x	x	0.22, 100V	24-2037-11	SE, MMK
C25	x	x									220, 10V	586057-10	UC, MIL
			x	x							100, 20V	586385-10	UC, T110
					x	x					47, 35V	586058-27	UC, MIL
							x	x			18, 50V	585071-44	UC, MIL
									x	x	10, 75V	586386-8	UC, MIL
C26	x										0.1, 100V	24-2037-7	SE, MMK
		x									0.033, 100V	24-2037-1	SE, MMK
			x				x	x	x	x	0.068, 250V	24-2015-11	SE, MMK
				x	x						0.047, 250V	24-2015-9	SE, MMK
						x					Not used		
C27	x	x	x	x	x	x	x	x	x	x	220pF, 500V	235-7053P286	SAN, 015
C28	x	x	x	x	x	x	x	x	x	x	0.22, 100V	587626-3	SE, 105

CIRCUIT SYMBOL	SSD MODEL 2-30	5-30	9-20	12-15	15-12	18-10.5	24-8.5	28-7	36-5	48-4	DESCRIPTION	SORENSEN PART NUMBER	MANUFACTURER, TYPE
											Diodes		
CR1	x	x	x	x	x	x	x	x	x	x	Bridge Rect.	980893-3	VARO, VK647
CR2	x	x	x	x	x	x	x	x	x	x	600V, 1A	586379-8	SEM, S1F6
CR3	x	x	x	x	x	x	x	x	x	x	600V, 1A	586379-8	SEM, S1F6
CR4	x	x	x	x	x	x	x	x	x	x	600V, 1A	586379-8	SEM, S1F6
CR5	x	x	x	x	x	x	x	x	x	x	400V, 6A	165360-5	MA, IN3883
CR6	x	x	x	x	x	x	x	x	x	x	Not used		
CR7	x	x	x	x	x	x	x	x	x	x	200V, 1A	586379-4	SEM, S1F2
CR8	x	x	x	x	x	x	x	x	x	x	600V, 1A	586379-8	SEM, S1F6
CR9	x	x	x	x	x	x	x	x	x	x	600V, 1A	586379-8	SEM, S1F6
CR10	x	x	x	x	x	x	x	x	x	x	600V, 1A	586379-8	SEM, S1F6
CR11	x	x	x	x	x	x	x	x	x	x	600V, 1A	586379-8	SEM, S1F6
CR12	x	x	x	x							~~Not used~~	165196-1	IR
					x	x	x	x	x	x	200V	586462-3	SEM, SCPA2F
CR12 A/B	x	x	x	x							SD51	165196-1	TRW, SD51
					x	x	x	x	x	x	Not used		
											Fuses		
F1	x	x	x	x	x	x	x	x	x	x	5A, 250V	226-7176P57	BUS, MTH
F2	x	x	x	x	x	x	x	x	x	x	3A, 250V	226-7176P68	BUS, AGC
											Inductors		
L1	x	x	x	x	x	x	x	x	x	x	Input RFI Choke	167350-1	SR
L2/3/4	x	x	x	x	x	x	x	x	x	x	Non-Saturating Choke Ass'y	166745-1	SR
L5	x	x	x	x	x	x	x	x	x	x	Saturating Choke Ass'y	1682266-1	SR
L6/7/8	x	x									Output Choke Stack	167338-1	SR
			x									167338-2	SR
				x								167338-3	SR
					x							167338-4	SR
						x						167338-5	SR
							x					167338-6	SR
								x				167338-7	SR
									x			167338-8	SR
										x		167338-9	SR
L9	x	x	x	x	x	x	x	x	x	x	Choke	586471-1	SR
L10	x	x	x	x	x	x	x	x	x	x	Choke	586471-1	SR
											Transistors		
Q1	x	x	x	x	x	x	x	x	x	x	2N6545 (TO-3)	167372-4	IR
Q2	x	x	x	x	x	x	x	x	x	x	2N6545 (TO-3)	167372-4	IR
Q3	x	x	x	x	x	x	x	x	x	x	2N6545 (TO-3)	167372-4	IR
Q4	x	x	x	x	x	x	x	x	x	x	2N6545 (TO-3)	167372-4	IR

*Includes components on the A4 (Rear Chassis), and the A5 (Front Panel) circuit boards (Figures 6-7/6-8)

TABLE 6-1
REPLACEABLE PARTS LIST
SSD MODULE III, MAIN ASSEMBLY *

CIRCUIT SYMBOL	SSD MODEL 2-30	5-30	9-20	12-15	15-12	18-10.5	24-8.5	28-7	36-5	48-4	DESCRIPTION	SORENSEN PART NUMBER	MANUFACTURER, TYPE
											Resistors (ohms)		
R1	x	x	x	x	x	x	x	x	x	x	220K, 1/2W, 2%	585326-227	CG, C5
R2	x	x	x	x	x	x	x	x	x	x	220K, 1/2W, 2%	585326-227	CG, C5
R3	x	x	x	x	x	x	x	x	x	x	220K, 1/2W, 2%	585326-227	CG, C5
R4	x	x	x	x	x	x	x	x	x	x	220K, 1/2W, 2%	585326-227	CG, C5
R5	x	x	x	x	x	x	x	x	x	x	10K, 5W, 5%	586054-61	RCL, T5
R6	x	x	x	x	x	x	x	x	x	x	68, 1/2W, 10%	280-1145P32	AB, EB
R7	x	x	x	x	x	x	x	x	x	x	150, 1/2W, 2%	585326-75	CG, C5
R8	x	x	x	x	x	x	x	x	x	x	150, 1/2W, 2%	585326-75	CG, C5
R9	x	x	x	x	x	x	x	x	x	x	0.33, 3W, 10%	27-397-13	WL, 3X
R10	x	x	x	x	x	x	x	x	x	x	680, 1W, 2%	167059-108	CG, C6
R11A-C	x	x	x	x	x	x	x	x	x	x	10, 1W, 2%	167059-19	CG, C6
R12	x	x	x	x	x	x	x	x	x	x	27, 1W, 5%	280-1180P16	CG, C6
R13	x	x	x	x	x	x	x	x	x	x	0.56, 3W, 10%	27-397-19	WL, 3X
R14	x	x	x	x	x	x	x	x	x	x	150, 1/2W, 2%	585326-75	CG, C5
R15	x	x	x	x	x	x	x	x	x	x	150, 1/2W, 2%	585326-75	CG, C5
R16	x	x	x	x	x	x	x	x	x	x	680, 5W, 5%	586054-47	RCL, T5
R17	x	x	x	x	x	x	x	x	x	x	56K, 2W, 10%	280-1147P137	AB, HB
R18	x	x	x	x	x	x	x	x	x	x	30K, 2W, 2%	585109-56	CG, C42S
R19	x	x	x	x	x	x	x	x	x	x	30K, 2W, 2%	585109-56	CG, C42S
R20	x	x	x	x							10, 1/2W, 10%	280-1145P2	AB, CB
					x	x	x	x	x	x	Not used		
R 21	x	x									0.1, 3W, 10%	27-397-1	WL, 3X
			x	x							0.18, 3W, 10%	27-297-7	WL, 3X
					x	x	x				0.33, 3W, 10%	27-397-13	WL, 3X
								x			1.0, 3W, 5%	27-397-25	W1, 3X
									x	x	2.2, 3W, 5%	27-397-33	WL, 3X
R22	x	x	x	x	x	x	x				Not used		
								x			1.2K, 2W, 10%	585109-48	CG. C42S
									x	x	Not used		
R 23	x										2.2K, 1/4W, 2%	585108-27	CG, C4
		x									3.3K, 1/4W, 2%	585108-35	CG, C4
			x								6.8K, 1/4W, 2%	585108-51	CG, C4
				x	x						10K, 1/4W, 2%	585108-59	CG, C4
						x					15K, 1/4W, 2%	585108-109	CG, C4
							x				20K, 1/4W, 2%	585108-115	CG, C4
								x			27K, 1/4W, 1%	585108-121	CG, C4
									x		30K, 1/4W, 1%	585108-123	CG, C4
										x	43K, 1/4W, 1%	585108-131	CG, C4
R 24	x	x	x	x							5K, 3/4W, 10%(VAR)	586371-6	BNS, 3006P
					x	x	x	x			10K, 3/4W, 10%(VAR)	586371-7	BNS, 3006P
									x	x	20K, 3/4W, 10%(VAR)	586371-8	BNS, 3006P
R25	x										1.54K, 1/8W, 1%	586055-83	ELA, MF4
		x									4.42K, 1/8W, 1%	586055-105	ELA, MF4
			x								6.19K, 1/8W, 1%	586055-112	ELA, MF4
				x	x						9.09K, 1/8W, 1%	586055-120	ELA, MF4
						x					14.7K, 1/8W, 1%	586055-130	ELA, MF4
							x	x			18.7K, 1/8W, 1%	586055-135	ELA, MF4
									x		28.7K, 1/8W, 1%	586055-144	ELA, MF4
										x	40.2K, 1/8W, 1%	586055-151	ELA, MF4
R26	x	x	x	x							5K, 3/4W, 10%(VAR)	586371-6	BNS, 3006P
					x	x	x				10K, 3/4W, 10% (VAR)	586371-7	BNS, 3006P
								x	x	x	20K, 3/4W, 10% (VAR)	586371-8	BNS, 3006P
R27	x										1.2, 10W, 5%	167828-1	WL,12/10F
		x									5.6, 10W, 5%	167828-2	WL, 12/10F
			x								12, 10W, 5%	280-7226P9	SP, 10E
				x							22, 10W, 5%	167828-3	WL, 12/10F
					x						40, 10W, 5%	280-7226P15	SP, 10E
						x					60, 10W, 5%	167828-4	WL, 12/10F

*Includes components on the A4 (Rear Chassis), and the A5 (Front Panel) Circuit boards (Figures 6-7/6-8)

TABLE 6-1
REPLACEABLE PARTS LIST
SSD MODULE III, MAIN ASSEMBLY *

CIRCUIT SYMBOL	SSD MODEL 2-30	5-30	9-20	12-15	15-12	18-10.5	24-8.5	28-7	36-5	48-4	DESCRIPTION	SORENSEN PART NUMBER	MANUFACTURER, TYPE
											Resistors (ohms)(cont'd)		
R27						x					90, 10W, 5%	167828-5	WL, 12/10F
(cont'd)							x				135, 10W, 5%	167828-6	WL, 12/10F
								x			250, 10W, 5%	280-7226P23	SP, 10E
									x		400, 10W, 5%	280-7226P26	SP, 10E
R28	x	x	x	x	x	x	x	x	x	x	100, 1W, 2%	167059-67	CG, C6
R29	x	x	x	x	x	x	x	x	x	x	220, 1/4W, 2%	585108-71	CG, C4
RT1	x	x	x	x	x	x	x	x	x	x	Thermistor	167060-1	RODAN, 5DA5RO
RT2	x	x	x	x	x	x	x	x	x	x	Thermistor	167060-1	RODAN, 5DA5RO
T1	x										Transformer	167349-1	SR
		x										167349-2	SR
			x									167349-3	SR
				x								167349-4	SR
					x							167349-5	SR
						x						167349-6	SR
							x					167349-7	SR
								x				167349-8	SR
									x			167349-9	SR
										x		167349-10	SR
											Miscellaneous		
A1	x	x	x	x	x	x	x	x	x	x	Preregulator PCB Ass'y	167033-1	SR
A2	x	x	x	x	x	x	x	x	x	x	Chopper Control PCB Ass'y	167035-1	SR
A3	x	x	x	x	x	x	x	x	x	x	Base Drive PCB Ass'y	167037-1	SR
A4	x	x	x	x	x	x	x	x	x	x	Rear Chassis PCB Ass'y	166720-1	SR
A5	x										Front Panel PCB Ass'y	166718-1	SR
		x										166718-2	SR
			x									166718-3	SR
				x								166718-4	SR
					x							166718-5	SR
						x						166718-6	SR
							x					166718-7	SR
								x				166718-8	SR
									x			166718-9	SR
										x		166718-10	SR
TB1	x	x	x	x	x	x	x	x	x	x	Terminal Strip	587423-9	Kulka, 1599

*Includes components on the A4 (Rear Chassis), and the A5 (Front Panel) Circuit boards (Figures 6-7/6-8)

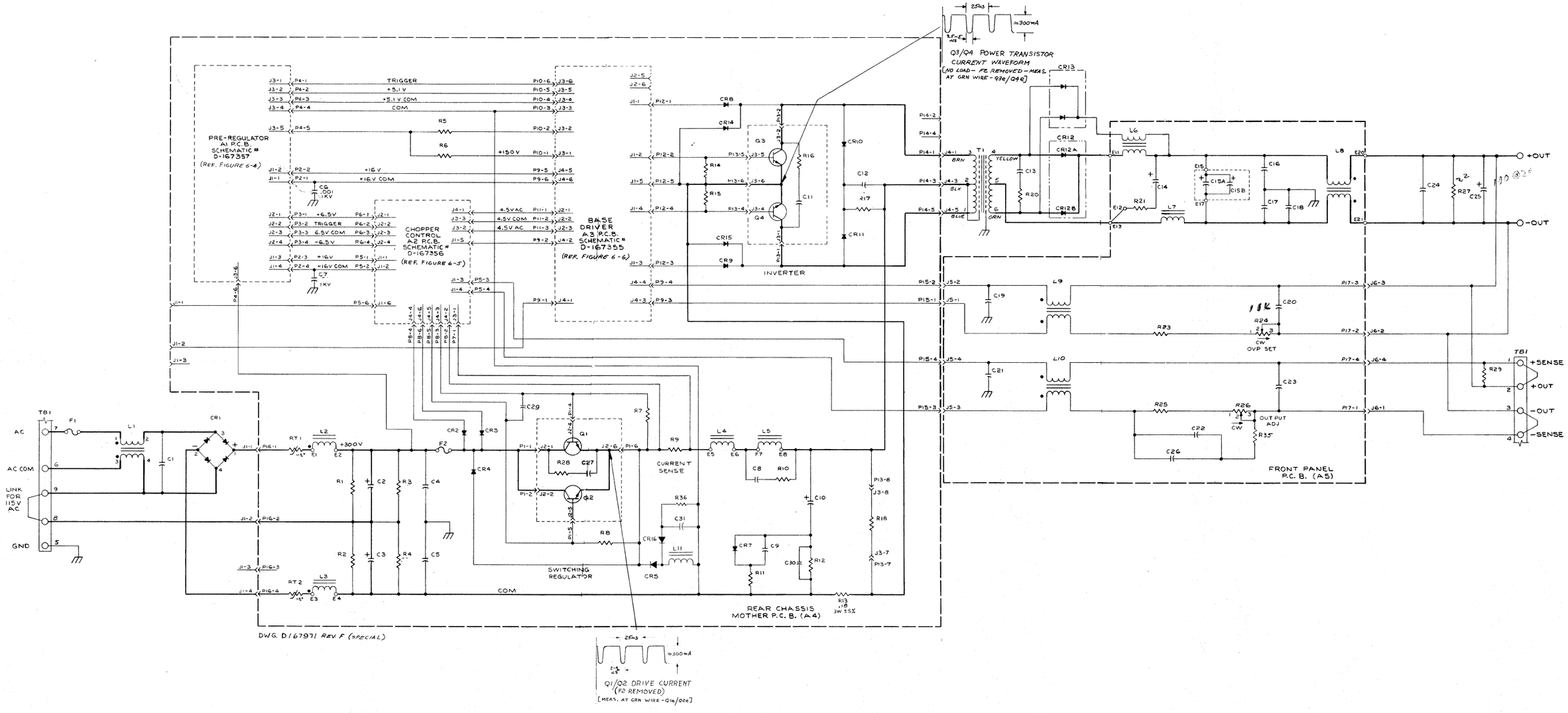


Figure 6-3
SSD Module IIIA System Schematic Diagram

TABLE 6-2
REPLACEABLE PARTS LIST
SSD MODULE IIIA, MAIN ASSEMBLY*

CIRCUIT SYMBOL	SSD MODEL 2-45	5-45	9-30	12-22	15-18	18-16	24-13	28-11	36-8	48-6	DESCRIPTION	SORENSEN PART NUMBER	MANUFACTURER, TYPE
											Diodes		
CR1	x	x	x	x	x	x	x	x	x	x	Bridge, Rect.	980893-3	VARO, VK647
CR2	x	x	x	x	x	x	x	x	x	x	600 V, 1A	586379-8	SEM, S1F6
CR3	x	x	x	x	x	x	x	x	x	x	600 V, 1A	586379-8	SEM, S1F6
CR4	x	x	x	x	x	x	x	x	x	x	600V, 1A	586379-8	SEM, S1F6
CR5	x	x	x	x	x	x	x	x	x	x	400V, 6A	165360-5	MA, 1N3883
CR6	x	x	x	x	x	x	x	x	x	x	Not used		
CR7	x	x	x	x	x	x	x	x	x	x	200V, 1A	586378-1	SEM, 3SF1
CR8	x	x	x	x	x	x	x	x	x	x	600V, 1A	586379-8	SEM, S1F6
CR9	x	x	x	x	x	x	x	x	x	x	600V, 1A	586379-8	SEM, S1F6
CR10	x	x	x	x	x	x	x	x	x	x	600V, 1A	586379-8	SEM, S1F6
CR11	x	x	x	x	x	x	x	x	x	x	600V,1A	586379-8	SEM, S1F6
CR12	x	x	x	x							Not used		
					x	x	x	x	x	x	200V	586462-3	SEM, SCPA2F
CR12A/B	x	x	x	x							SD51	165196-1	TRW, SD51
					x	x	x	x	x	x	Not used		
CR13	x	x	x	x							Not used		
					x	x	x				200V	586462-3	SEM, SCPA2F
								x	x	x	Not used		
CR14	x	x	x	x	x	x	x	x	x	x	600V, 1A	586379-8	SEM, S1F6
CR15	x	x	x	x	x	x	x	x	x	x	600V, 1A	586379-8	SEM, S1F6
CR16	x	x	x	x	x	x	x	x	x	x	SEN-R-42	586378-4	SEM, 3SF1
											Fuses		
F1	x	x	x	x	x	x	x	x	x	x	8A, 250V	42-430	BUS, ABC
F2	x	x	x	x	x	x	x	x	x	x	4A, 250V	226-7176P56	BUS, MTH
											Inductors		
L1	x	x	x	x	x	x	x	x	x	x	Input RFI Choke	168217-1	SR
L2	x	x	x	x	x	x	x	x	x	x	RFI Choke	167944-1	SR
L3	x	x	x	x	x	x	x	x	x	x	RFI Choke	167944-1	SR
L4	x	x	x	x	x	x	x	x	x	x	Input Filter	167942-1	SR
L5	x	x	x	x	x	x	x	x	x	x	Input Filter	167941-1	SR
L6	x	x									Output Filter	167951-1	SR
			x									167952-1	SR
				x								167953-1	SR
					x							167954-1	SR
						x						167955-1	SR
							x					167956-1	SR
								x				167957-1	SR
									x			167958-1	SR
										x		167959-1	SR
L7	x	x									Output Filer	167962-1	SR
			x	x								167219-1	SR
					x	x	x					167963-1	SR
								x				167964-1	SR
									x	x		167965-1	SR
L8	x	x									Output RFI	167968-1	SR
			x	x								167968-2	SR
					x	x	x	x	x	x		167968-3	SR
L9	x	x	x	x	x	x	x	x	x	x	Choke	586471-1	SR
L10	x	x	x	x	x	x	x	x	x	x	Choke	586471-1	SR

CIRCUIT SYMBOL	SSD MODEL 2-45	5-45	9-30	12-22	15-18	18-16	24-13	28-11	36-8	48-6	DESCRIPTION	SORENSEN PART NUMBER	MANUFACTURER, TYPE
											Capacitors (uF except as noted)		
C1	x	x	x	x	x	x	x	x	x	x	0.10, 500V	235-7207P41	SP, Y5V
C2	x	x	x	x	x	x	x	x	x	x	1,000, 200V	586052-1	STM, 91C
C3	x	x	x	x	x	x	x	x	x	x	1,000, 200V	586052-1	STM, 91C
C4	x	x	x	x	x	x	x	x	x	x	0.01, 1.6KV	235-7207P30	SP, Y5U
C5	x	x	x	x	x	x	x	x	x	x	0.01, 1.6KV	235-7207P30	SP, Y5U
C6	x	x	x	x	x	x	x	x	x	x	0.001, 1KV	235-7421P14	RDM, JF
C7	x	x	x	x	x	x	x	x	x	x	0.001, 1kV	235-7421P14	RDM, JF
C8	x	x	x	x	x	x	x	x	x	x	470pF, 300V	235-7053P156	SAN, 015
C9	x	x	x	x	x	x	x	x	x	x	1.0, 100V	24-2037-19	SE, MMK
C10	x	x	x	x	x	x	x	x	x	x	75. 300V	167816-2	SAN, 066
C11	x	x	x	x	x	x	x	x	x	x	390pF, 500V	235-7053P314	SAN, 015
C12	x	x	x	x	x	x	x	x	x	x	0.22, 250V	24-2015-17	SE, MMK
C13	x	x	x	x							0.001, 1kV	235-7421P14	RDM, JF
					x	x	x	x	x	x	Not used		
C14	x	x									220, 10V	586057-10	UC, MIL
			x	x							100,20V	586385-10	UC, T110
					x	x	x				47, 35V	586058-27	UC, MIL
								x			18, 50V	585071-44	UC, MIL
									x	x	10, 75V	586386-8	UC, MIL
C15A/B	x	x									13,000, 10V	167817-1	MG
			x								7,600, 15V	167817-2	MG
				x							6,400, 20V	167817-3	MG
					x	x					4,700, 25V	167817-4	MG
							x				4,100, 30V	167817-5	MG
								x			3,000, 40V	167817-6	MG
									x		2,200, 50V	167817-7	MG
										x	1,200, 75V	167817-8	MG
C16	x	x	x	x	x	x	x	x	x	x	0.1, 500V	235-7207P41	SP, Y5V
C17	x	x	x	x	x	x	x	x	x	x	0.1, 500V	235-7207P41	SP, Y5V
C18	x	x									0.1, 500V	235-7207P41	SP, Y5V
			x	x	x	x	x	x	x	x	Not used		
C19	x	x	x	x	x	x	x	x	x	x	0.001, 1kV	235-7421P14	RDM, JF
C20	x	x	x	x	x	x	x	x	x	x	0.22, 100V	24-2037-11	SE, MMK
C21	x	x	x	x	x	x	x	x	x	x	0.001, 1kV	235-7421P14	RDM, JF
C22	x	x	x	x	x	x	x	x	x	x	0.22, 100V	24-2037-11	SE, MMK
C23	x	x	x	x	x	x	x	x	x	x	0.22, 100V	24-2037-11	SE, MMK
C24	x	x	x	x	x	x	x	x	x	x	0.22, 100V	24-2037-11	SE, MMK
C25	x	x									220, 10V	586057-10	UC, MIL
			x	x							100, 20V	586385-10	UC, T110
					x	x					47, 35V	586058-27	UC, MIL
							x	x			18, 50V	585071-44	UC, MIL
									x	x	10, 75V	586386-8	UC, MIL
C26	x	x									Not used		
			x				x				,068, 250V	24-2015-11	SE, MMK
				x	x	x		x	x	x	0.033, 200V	24-2015-7	SE, MMK
C27	x	x	x	x	x	x	x	x	x	x	220pF, 500V	235-7053P286	SAN, 015
C28	x	x	x	x	x	x	x	x	x	x	Not used		
C29	x	x	x	x	x	x	x	x	x	x	0.01, 200V	24-2409-7	AC, V146XR
C30	x	x	x	x	x	x	x	x	x	x	0.56, 100V	587626-6	SE, 105
C31	x	x	x	x	x	x	x	x	x	x	0.47, 250V	24-2015-21	SE, MMK

*Includes components on rear chassis (A4) and front panel (A5) circuit boards (Figures 6-7/6-8)

TABLE 6-2
REPLACEABLE PARTS LIST
SSD MODULE IIIA, MAIN ASSEMBLY*

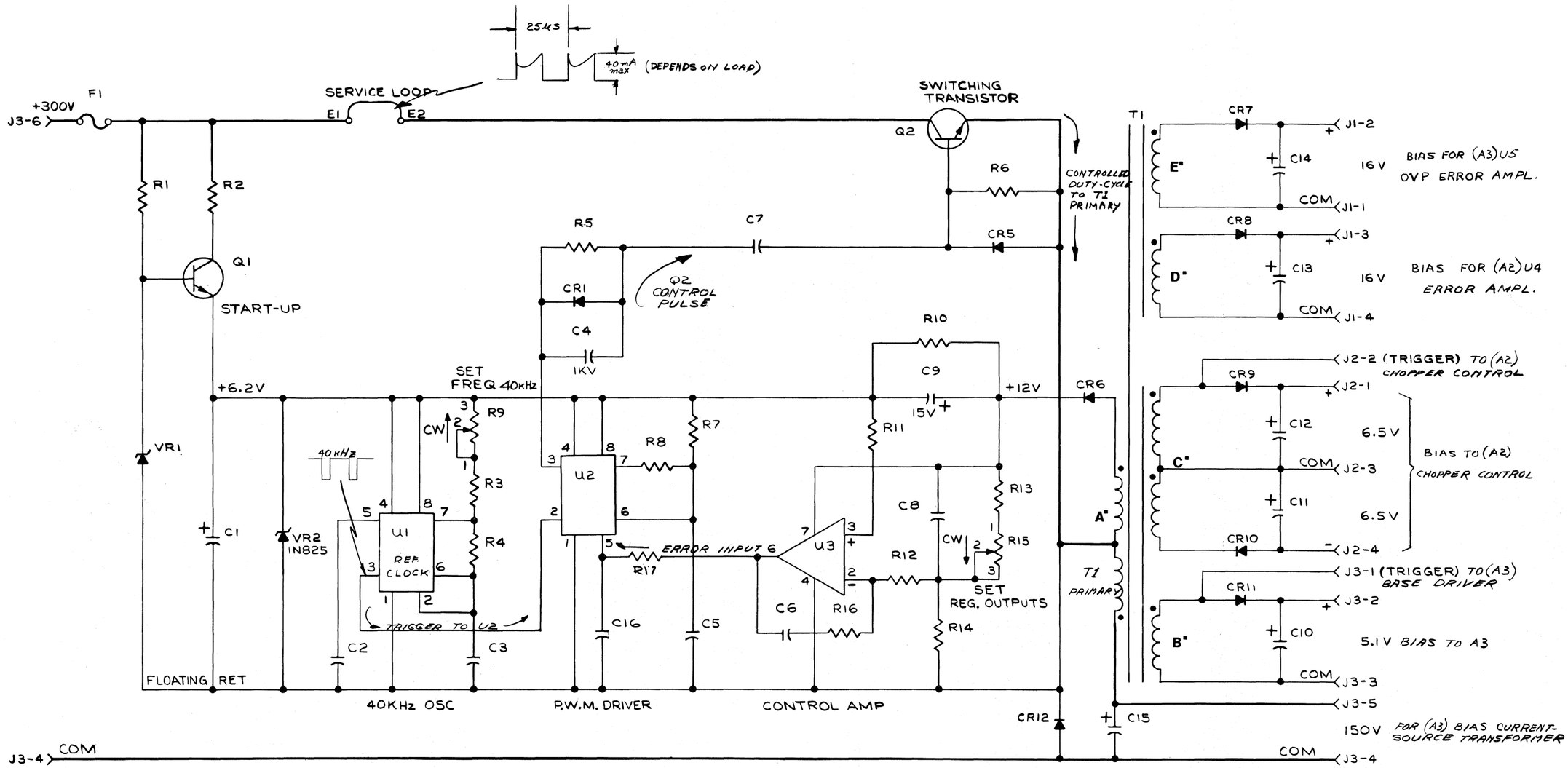
CIRCUIT SYMBOL	SSD MODEL 2-45	5-45	9-30	12-22	15-18	18-16	24-13	28-11	36-8	48-6	DESCRIPTION	SORENSEN PART NUMBER	MANUFACTURER, TYPE
											Inductors (cont'd)		
L11	x	x	x	x	x	x	x	x	x	x	Ferrite Core	169514-1	SR
											Transistors		
Q1	x	x	x	x	x	x	x	x	x	x	2N6545 (TO-3)	167372-4	IR
Q2	x	x	x	x	x	x	x	x	x	x	2N6545 (TO-3)	167372-4	IR
Q3	x	x	x	x	x	x	x	x	x	x	2N6545 (TO-3)	167372-4	IR
Q4	x	x	x	x	x	x	x	x	x	x	2N6545 (TO-3)	167372-4	IR
											Resistors (ohms)		
R1	x	x	x	x	x	x	x	x	x	x	220K, 1/2W, 2%	585326-227	CG, C5
R2	x	x	x	x	x	x	x	x	x	x	220K, 1/2W, 2%	585326-227	CG, C5
R3	x	x	x	x	x	x	x	x	x	x	220K, 1/2W, 2%	585326-227	CG, C5
R4	x	x	x	x	x	x	x	x	x	x	220K, 1/2W, 2%	585326-227	CG, C5
R5	x	x	x	x	x	x	x	x	x	x	10K, 5W, 5%	586054-61	RCL, T5
R6	x	x	x	x	x	x	x	x	x	x	68, 1/2W, 10%	280-1145P32	AB, EB
R7	x	x	x	x	x	x	x	x	x	x	150, 1/2W, 2%	585326-75	CG, C5
R8	x	x	x	x	x	x	x	x	x	x	150, 1/2W, 2%	585326-75	CG, C5
R9	x	x	x	x	x	x	x	x	x	x	0.22, 3W, 10%	27-397-9	WL, 3X
R10	x	x	x	x	x	x	x	x	x	x	470, 2W, 10%	280-1147P62	AB, HB
R11	x	x	x	x	x	x	x	x	x	x	2.2, 5W, 5%	586054-17	RCL, T5
R12	x	x	x	x	x	x	x	x	x	x	6.8, 5W, 5%	586054-23	RCL, T5
R13	x	x	x	x	x	x	x	x	x	x	0.22, 3W, 10%	27-397-9	WL, 3X
R14	x	x	x	x	x	x	x	x	x	x	150, 1/2W, 2%	585326-75	CG, C5
R15	x	x	x	x	x	x	x	x	x	x	150, 1/2W, 2%	585326-75	CG, C5
R16	x	x	x	x	x	x	x	x	x	x	680, 5W, 5%	586054-47	RCL, T5
R17	x	x	x	x	x	x	x	x	x	x	56K, 2W, 10%	280-1147P137	AB, HB
R18	x	x	x	x	x	x	x	x	x	x	5.6K, 12.5W, 5%	27-591-16	WL, 12.5X
R19	x	x	x	x	x	x	x	x	x	x	30K, 2W, 2%	585109-56	CG, C42S
R20	x	x	x	x							10, 1/2W, 10%	280-1145P2	AB, CB
					x	x	x	x	x	x	Not used		
R21	x	x									0.1, 3W, 10%	27-397-1	WL, 3X
			x	x							0.18, 3W, 10%	27-397-7	WL, 3X
					x	x	x				0.33, 3W, 10%	27-397-13	WL, 3X
								x			1.0, 3W, 5%	27-397-25	WL, 3X
									x	x	2.2, 3W, 5%	27-397-33	WL, 3X
R22	x	x	x	x	x	x	x	x	x	x	Not used		
R23	x										2.2K, 1/4W, 2%	585108-27	CG, C4
		x									3.3K, 1/4W, 2%	585108-35	CG, C4
			x								6.8K, 1/4W, 2%	585108-51	CG, C4
				x	x						10K, 1/4W, 2%	585108-59	CG, C4
						x					15K, 1/4W, 2%	585108-109	CG. C4
							x				20K, 1/4W, 2%	585108-115	CG, C4
								x			27K, 1/4W, 2%	585108-121	CG, C4
									x		30K, 1/4W, 2%	585108-123	CG, C4
										x	43K, 1/4W, 2%	585108-131	CG, C4
R24	x	x	x	x							5K, 3/4W, 10% (VAR)	586371-6	BNS, 3006P
					x	x	x	x			10K, 3/4W, 10% (VAR)	586371-7	BNS, 3006P
									x	x	20K, 3/4W, 10% (VAR)	586371-8	BNS, 3006P
R25	x										1.54, 1/8W, 1%	586055-83	ELA, MF4
		x									4.42K, 1/8W, 1%	586055-105	ELA, MF4
			x								6.19K, 1/8W, 1%	586055-112	ELA, MF4
				x	x						9.09K, 1/8W, 1%	586055-120	ELA, MF4
						x					14.7K, 1/8W, 1%	586055-130	ELA, MF4
							x	x			18.7K, 1/8W, 1%	586055-135	ELA, MF4
									x		28.7K, 1/8W, 1%	586055-144	ELA, MF4

*Includes components on rear chassis (A4) and front panel (A5) circuit boards (Figures 6-7/6-8)

TABLE 6-2
REPLACEABLE PARTS LIST
SSD MODULE IIIA, MAIN ASSEMBLY*

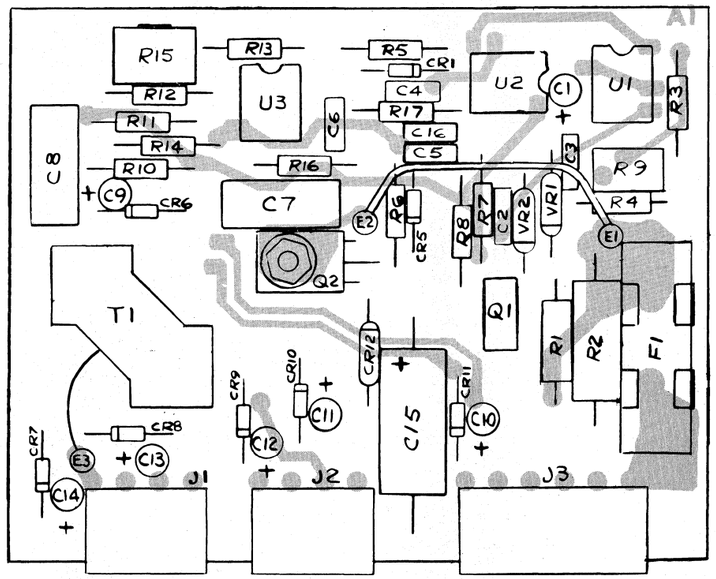
CIRCUIT SYMBOL	SSD MODEL 2-45	5-45	9-30	12-22	15-18	18-15	24-13	28-11	36-8	48-6	DESCRIPTION	SORENSEN PART NUMBER	MANUFACTURER, TYPE
R25 (cont'd)											Resistors (ohms) cont'd)		
									x		40.2K, 1/8W, 1%	586055-151	ELA, MF4
R26	x	x	x	x							5K, 3/4W, 10% (VAR)	586371-6	BNS, 3006P
					x	x	x				10K, 3/4W, 10% (VAR)	586371-7	BNS, 3006P
								x	x	x	20K, 3/4W, 10% (VAR)	586371-8	BNS, 3006P
R27	x										1.2, 10W, 5%	167828-1	WL, 12/10F
		x									5.6, 10W, 5%	167828-2	WL, 12/10F
			x								12, 10W, 5%	280-7226P9	SP, 10E
				x							22, 10W, 5%	167828-3	WL, 12/10F
					x						40, 10W, 5%	280-7226P15	SP, 10E
						x					60, 10W, 5%	167828-4	WL, 12/10F
							x				90, 10W, 5%	167828-5	WL, 12/10F
								x			135, 10W, 5%	167828-6	WL, 12/10F
									x		250, 10W, 5%	280-7226P23	SP, 10E
										x	400, 10W, 5%	280-7226P26	SP, 10E
R28	x	x	x	x	x	x	x	x	x	x	100, 1W, 2%	167059-67	CG, C6
R29	x	x	x	x	x	x	x	x	x	x	220, 1/4W, 2%	585108-71	CG, C4
R36	x	x	x	x	x	x	x	x	x	x	100, 10W, 5%	280-7226P18	SP, 10E
RT1	x	x	x	x	x	x	x	x	x	x	Thermistors, 5 ohms	167060-1	RODAN, 5DA5R0
RT2	x	x	x	x	x	x	x	x	x	x	Thermistors, 5 ohms	167060-1	RODAN, 5DA5R0
T1	x										Transformer	167940-1	SR
		x									Transformer	167940-2	SR
			x								Transformer	167940-3	SR
				x							Transformer	167940-4	SR
					x						Transformer	167940-5	SR
						x					Transformer	167940-6	SR
							x				Transformer	167940-7	SR
								x			Transformer	167940-8	SR
									x		Transformer	167940-9	SR
										x	Transformer	167940-10	SR
											Miscellaneous		
A1	x	x	x	x	x	x	x	x	x	x	Preregulator PCB Ass'y	167033-1	SR
A2	x	x	x	x	x	x	x	x	x	x	Chopper Control PCB Ass'y	167035-1	SR
A3	x	x	x	x	x	x	x	x	x	x	Base Drive PCB Ass'y	167037-1	SR
A4	x	x	x	x	x	x	x	x	x	x	Rear Chassis PCB Ass'y	167927-1	SR
A5	x										Front Panel PCB Ass'y	167949-1	SR
		x										167949-2	SR
			x									167949-3	SR
				x								167949-4	SR
					x							167949-5	SR
						x						167949-6	SR
							x					167949-7	SR
								x				167949-8	SR
									x			167949-9	SR
										x		167949-10	SR
TB1	x	x	x	x	x	x	x	x	x	x	Terminal Strip	587423-9	Kulka, 1599
TB2	x	x	x	x	x	x	x	x	x	x	Terminal Strip	587878-13	Kulka, 1599

*Includes components on rear chassis (A4) and front panel (A5) circuit boards (Figure 6-7/6-8)

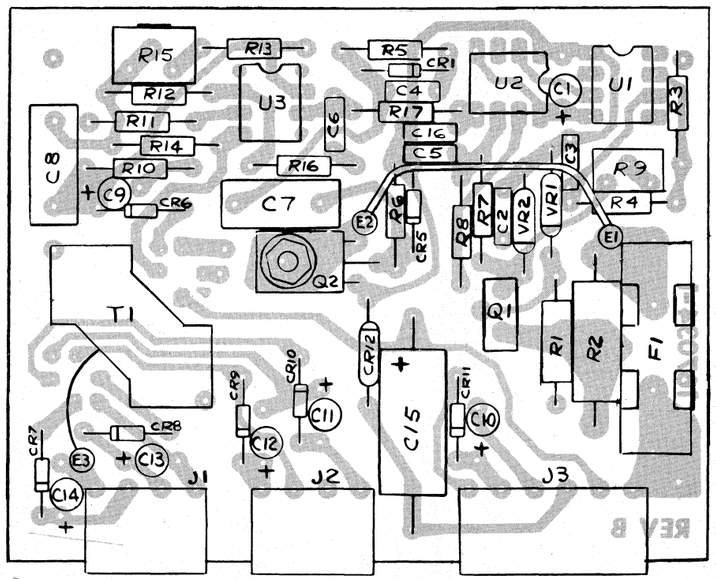


DWG. D 167357 REV D (SPECIAL)

Figure 6-4
(A1) Preregulator Circuit Board Diagram
Module III and IIIA



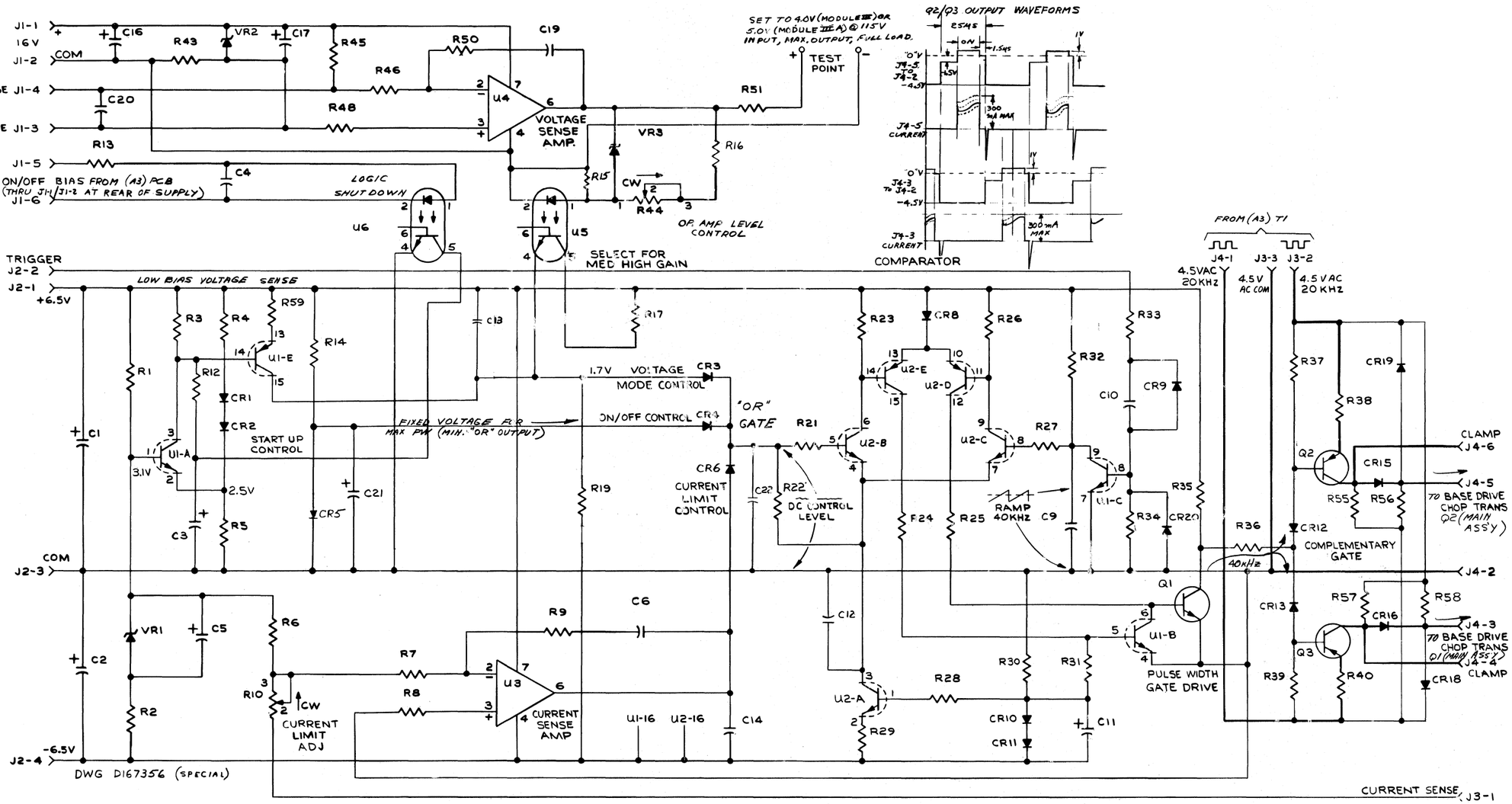
Component Side



Circuit Side

Table 6-3
Replaceable Parts List
(A1) Circuit Board Assembly 167033-1
All SSD Models

Circuit Symbol	Description	Sorensen P/N	Mfr., Type
Capacitors (uF unless noted)			
C1	22, 15V	235-7395P40	UC
C2	0.01, 25V	235-7426P1	RDM, M25
C3	4700pF, 200V	167058-3	AER, CKO6
C4	1000pF, 1kV	235-7421P14	RDM, JF
C5	4700pF, 200V	167058-3	AER, CKO6
C6	0.01, 25V	235-7426P1	RDM, M25
C7	0.068, 250V	24-2015-11	EMC, DM15
C8	0.1, 100V	24-2037-7	EMC, DM15
C9	22, 15V	235-7395P40	UC
C10	22, 15V	235-7395P40	UC
C11	22, 15V	235-7395P40	UC
C12	22, 15V	235-7395P40	UC
C13	6.8, 25V	235-7395P64	SP, 196D
C14	6.8, 25V	235-7395P64	SP, 196D
C15	1.0, 350V	166706-6	SR
C16	0.01, 25V	235-7426P1	RDM, M25
Diodes			
CR1	1N4148	322-7220P1	ITT
CR2	Not Used		
CR3	Not Used		
CR4	Not Used		
CR5	1N4148	322-7220P1	ITT
CR6	1N4606	585155-1	ITT
CR7	1N4148	322-7220P1	ITT
CR8	1N4148	322-7220P1	ITT
CR9	1N4148	322-7220P1	ITT
CR10	1N4148	322-7220P1	ITT
CR11	1N4606	585155-1	ITT
CR12	Rect/Diode, S1F6	586379-8	SEM
F1	Fuse, 0.1A, 250V	226-7176P8	BUS, AGX
J1	Conn PC Card	586288-4	SR
J2	Conn PC Card	586288-4	SR
J3	Conn PC Card	586288-5	SR
Q1	Transistor, SJE2300	982992-1	MA
Q2	Transistor, SJE2300	982992-1	MA
Resistors (ohms, 1/4 watt, ±2% unless noted)			
R1	150K, 1/2W	585326-219	CG, C5
R2	15K, 1W	167059-171	CG, C6
R3	3.3K	585108-35	CG, C4
R4	150	585108-63	CG, C4
R5	680	585108-95	CG, C4
R6	680	585108-95	CG, C4
R7	3.3K	585108-35	CG, C4
R8	2.2K	585108-27	CG, C4
R9	5K, 1/2W, Variable	586370-6	BNS, 3389H
R10	390	585108-83	CG, C4
R11	1K	585108-11	CG, C4
R12	1K	585108-11	CG, C4
R13	5.1K	585108-45	CG, C4
R14	5.6K	585108-47	CG, C4
R15	1K, 1/2W, Variable	586370-4	BNS, 3389H
R16	33K	585108-125	CG, C4
R17	15K	585108-109	CG, C4
T1	Pre-Regulator Transformer	167360-1	SR
U1	IC555	587995-1	SIG, NE555V
U2	IC555	587995-1	SIG, NE555V
U3	IC, LM741CN	586372-1	NS, LM741CN
VR1	Diode, Zener 1N5234B	588101-9	MA
VR2	Diode, 1N825	588105-3	MA



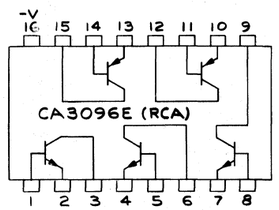
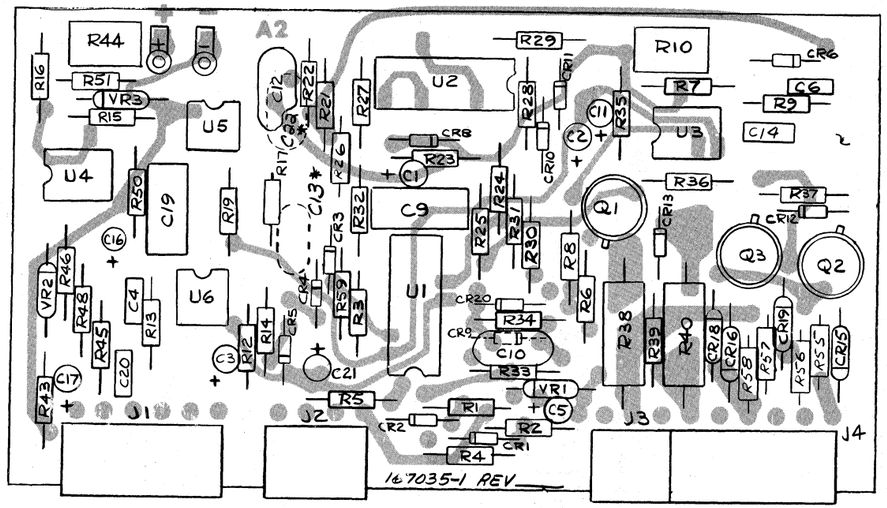
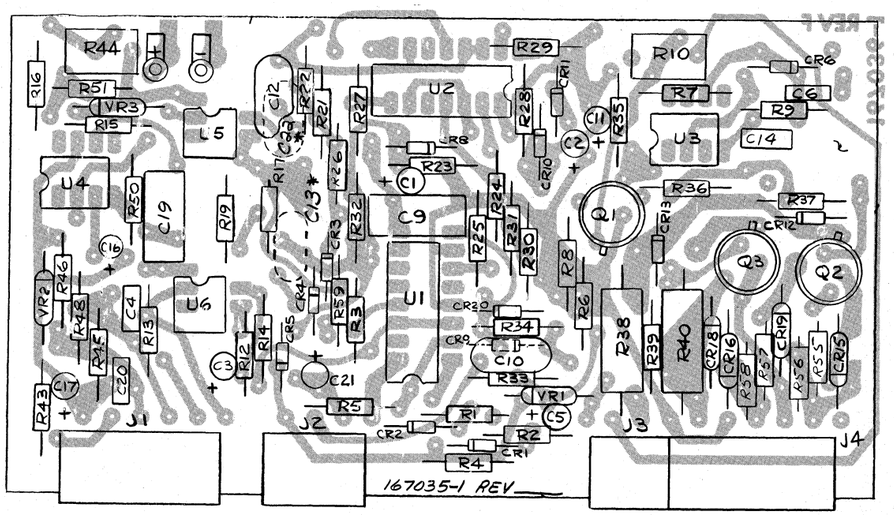


Figure 6-5
(A2) Chopper Control Circuit Board Diagram
Madules III and IIIA



Component Side



Circuit Side

Table 6-4
Replaceable Parts List
(A2) Circuit Board Assembly 167035- 1/-2*

Circuit Symbol	Description	Sorensen P/N	Mfr., Type
Capacitors	(uF unless noted)		
C1	22, 15V	235-7395P40	SP, 196D
C2	22, 15V	235-7395P40	SP, 196D
C3	10, 10V	235-7395P23	SP, 196D
C4	0.01, 25V	235-7426P1	RDM, M25
C5	6.8, 25V	235-7395P64	SP, 196D
C6	0.01, 25V	235-7426P1	RDM, M25
C7	Not Used		
C8	Not Used		
C9	0.01, 250V	24-2015-1	SE, MMK
C10	680pf, 300V	235-7053P326	EMC, DM15
C11	10, 10V	235-7395P23	SP, 196D
C12	330pf, 300V (Module III)	235-7053P140	SAN, 015
	Not Used (Module IIIA)		
C13	Not Used (Module III)		
	0.001, 100V (Module IIIA)	235-7355P259	EMC, DM15
C14	0.01, 25V	235-7426P1	RDM, M25
C15	Not Used		
C16	6.8, 25V	235-7395P64	SP, 196D
C17	10, 10V	235-7395P23	SP, 196D
C18	Not Used		
C19	0.015, 250V	24-2015-3	SE, MMK
C20	0.01, 25V	235-7426P1	RDM, M25
C21	6.8, 25V	235-7395P64	SP, 196D
C22	Not Used (Module III)		
	1000pF (Module IIIA)	235-7355P259	EMC, DM15
Diodes			
CR1	1N4148	322-7220P1	ITT
CR2	1N4148	322-7220P1	ITT
CR3	1N4148	322-7220P1	ITT
CR4	1N4148	322-7220P1	ITT
CR5	1N4148	322-7220P1	ITT
CR6	1N4148	322-7220P1	ITT
CR7	Not Used		
CR8	1N4148	322-7220P1	ITT
CR9	1N4148	322-7220P1	ITT
CR10	1N4148	322-7220P1	ITT
CR11	1N4148	322-7220P1	ITT
CR12	1N4148	322-7220P1	ITT
CR13	1N4148	322-7220P1	ITT
CR14	Not Used		
CR15	Rect/Diode, S1F2	586379-4	SEM
CR16	Rect/Diode, S1F2	586379-4	SEM
CR17	Not Used		
CR18	Rect/Diode, S1F2	586379-4	SEM
CR19	Rect/Diode, S1F2	586379-4	SEM
CR20	1N4148	322-7220P1	ITT
Connectors			
J1	Conn PC Card	586288-5	SR
J2	Conn PC Card	586288-4	SR
J3	Conn PC Card	586288-3	SR
J4	Conn PC Card	586288-5	SR
	A2 PC Card Extender	166769-1	SR
Q1	Transistor, 2N2219A	386-7249P32	GE
Q2	Transistor, 2N2905A	386-7249P40	GE
Q3	Transistor, 2N2905A	386-7249P40	GE
Resistors	(ohms, 1/4 watt, ±2% unless noted)		
R1	470	585108-87	CG, C4
R2	470	585108-87	CG, C4
R3	10K	585108-59	CG, C4
R4	1.8K	585108-23	CG, C4
R5	1.5K	585108-19	CG, C4
R6	4.7K	585108-43	CG, C4

Circuit Symbol	Description	Sorensen P/N	Mfr., Type
Resistors	(ohms, 1/4 watt, ±2% unless noted)(cont'd)		
R7	5.6K	585108-47	CG, C4
R8	5.6K	585108-47	CG, C4
R9	22K	585108-117	CG, C4
R10	1K, 1/2W, Variable	586370-4	BNS, 3389H
R12	10K	585108-59	CG, C4
R13	150	585108-63	CG, C4
R14	4.7K	585108-43	CG, C4
R15	1K	585108-11	CG, C4
R16	680	585108-95	CG, C4
R17	1K	585108-11	CG, C4
R19	4.7K	585108-43	CG, C4
R21	1K (Module III)	585108-11	CG, C4
	10 (Module IIIA)	585108-151	CG, C4
R22	3.3K (Module III)	585108-35	CG, C4
	5.6K (Module IIIA)	585108-47	CG, C4
R23	5.6K (Module III)	585108-47	CG, C4
	2.2K (Module IIIA)	585108-27	CG, C4
R24	1K	585108-11	CG, C4
R25	1K	585108-11	CG, C4
R26	5.6K (Module III)	585108-47	CG, C4
	2.2K (Module IIIA)	585108-27	CG, C4
R27	1.0K (Module III)	585108-11	CG, C4
	10 (Module IIIA)	585108-151	CG, C4
R28	1K	585108-11	CG, C4
R29	330	585108-79	CG, C4
R30	1K	585108-11	CG, C4
R31	5.6K	585108-47	CG, C4
R32	10K	585108-59	CG, C4
R33	680	585108-95	CG, C4
R34	1K	585108-11	CG, C4
R35	2.2K	585108-27	CG, C4
R36	10	585108-151	CG, C4
R37	330	585108-79	CG, C4
R38	10, 1W (Module III)	167059-19	CG, C4
	8.2, 1W (Module IIIA)	167059-15	CG, C4
R39	330	585108-79	CG, C4
R40	10, 1W (Module III)	167059-19	CG, C4
	8.2, 1W (Module IIIA)	167059-15	CG, C4
R43	1.5K	585108-19	CG, C4
R44	2K, 1/2W, Variable	586370-5	BNS, 3389H
R45	619K, 1/8W, 1%	586055-112	EMF, MF4
R46	10 (Module III)	585108-151	CG, C4
	33 (Module IIIA)	585108-175	CG, C4
R48	2.2K	585108-27	CG, C4
R50	6.8K	585108-51	CG, C4
R51	10K	585108-59	CG, C4
R55	680	585108-95	CG, C4
R56	680	585108-95	CG, C4
R57	680	585108-95	CG, C4
R58	680	585108-95	CG, C4
R59	1K	585108011	CG, C4
U1	IC, CA3096E	589782-1	RCA
U2	IC, CA3096E	589782-2	RCA
U3	IC, LM741CN	586372-1	NS
U4	IC, LM741CN	586372-1	NS
U5	OPTO Isolator	586463-3	TI, L114
U6	OPTO Isolator	586463-2	TI, L114
VR1	Diode 1N825	588105-3	MA
VR2	Diode 1N825	588105-3	MA
VR3	Zener 1N5235B(Module III)	588101-10	MA
	Zener 1N5240B(Module IIIA)	588101-13	MA

*Module Size III/Module Size IIIA

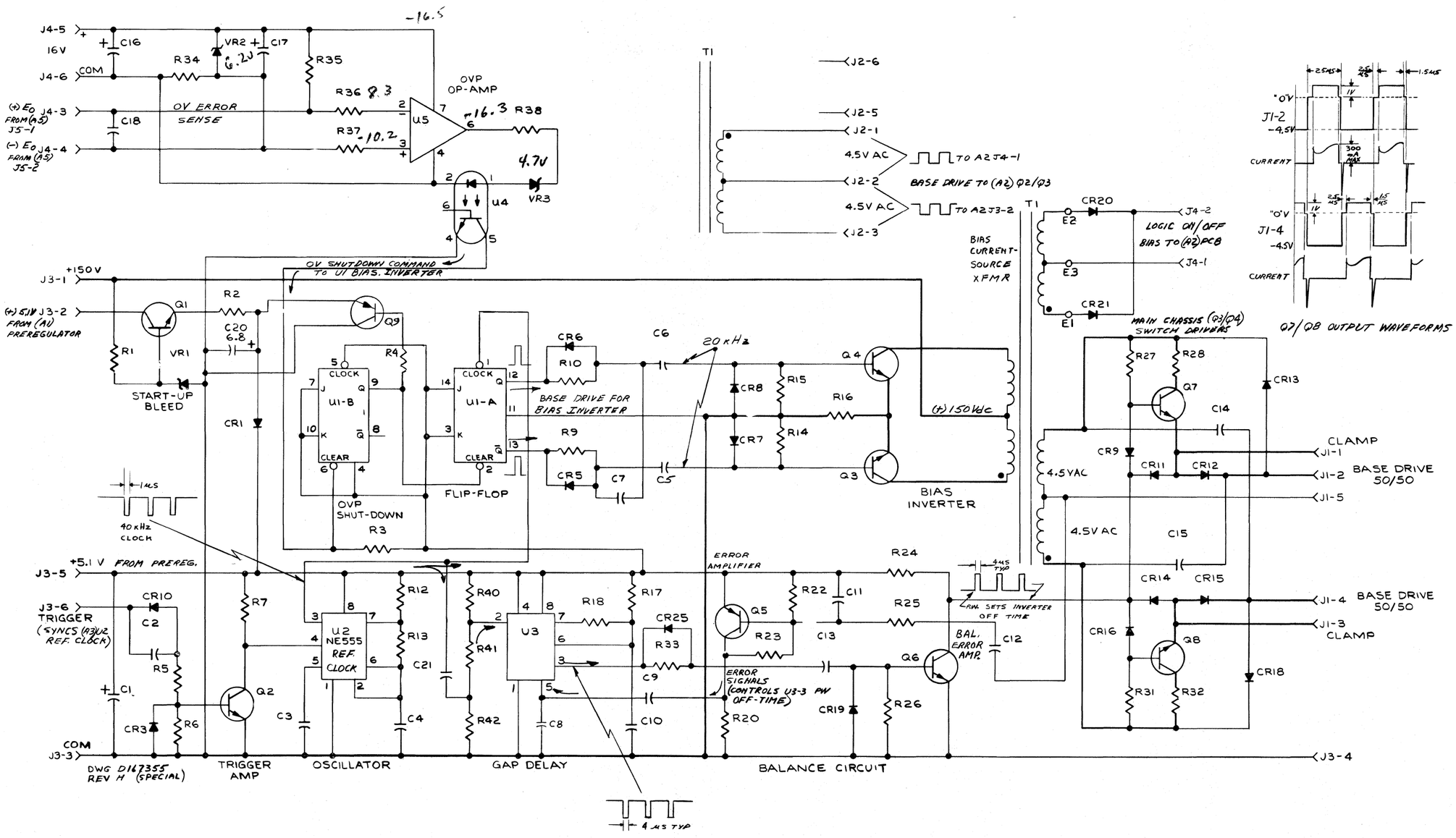
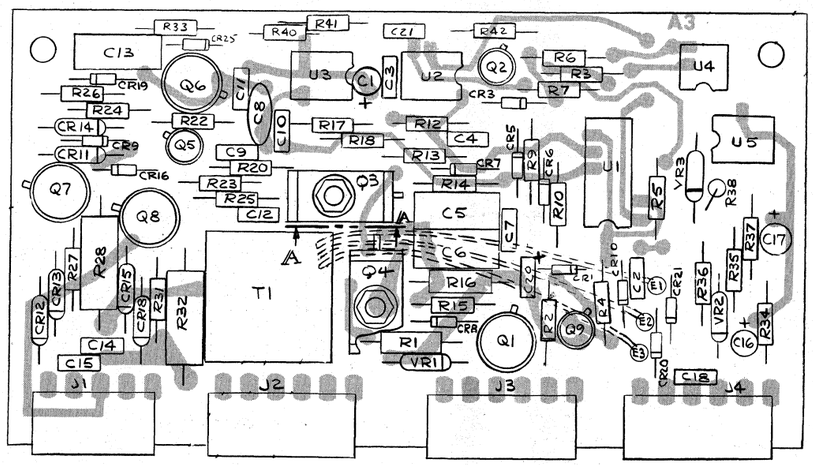
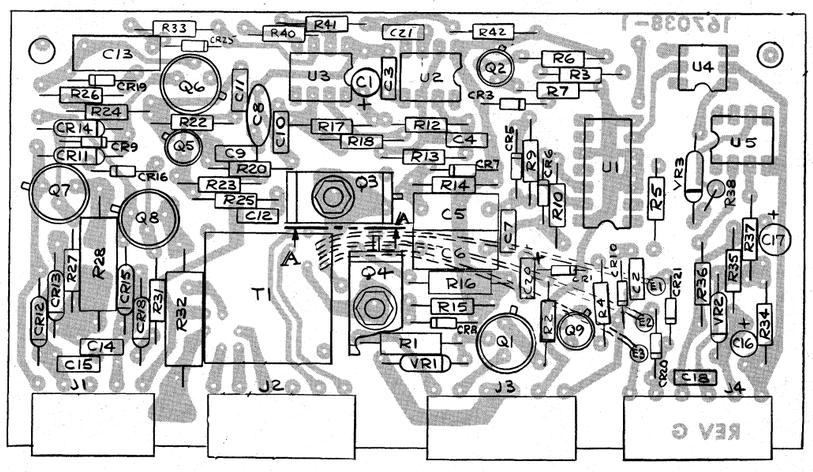


Figure 6-6
(A3) Base Driver Circuit Board Diagram
Modules III and IIIA



Component Side

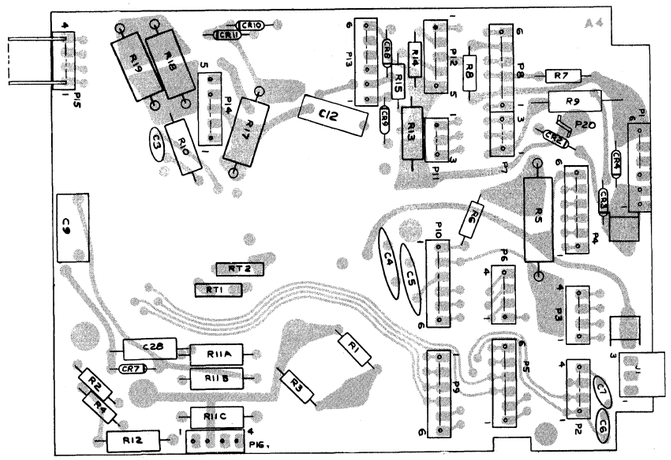


Circuit Side

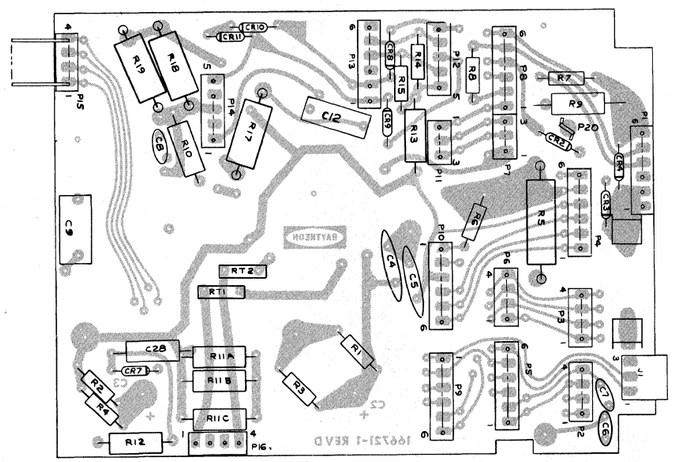
Table 6-5
Replaceable Parts List
(A3) Circuit Board Assembly 167037-2

Circuit Symbol	Description	Sorensen P/N	Mfr., Type
Capacitors (uF unless noted)			
C1	22, 15V	235-7395P40	UC
C2	470pF, 300V	235-7053P157	SAN, 015
C3	0.01, 25V	235-7426P1	RDM, M25
C4	0.0047, 200V	167058-3	AER, CKO6
C5	0.22, 100V	24-2037-11	SE, MMK
C6	0.22, 100V	24-2037-11	SE, MMK
C7	0.0022	235-7193P2	IEC
C8	0.01, 25V	235-7426P1	RDM, M25
C9	0.01, 25V	235-7426P1	RDM, M25
C10	0.001, 100V	235-7355P259	EMF, DM
C11	0.01, 25V	235-7426P1	RDM, M25
C12	0.001, 300V	235-7355P259	RDM, M25
C13	0.22, 100V	24-2037-11	SE, MMK
C14	0.001, 1kV	235-7421P14	RDM, JF
C15	0.001, 1kV	235-7421P14	RDM, JF
C16	6.8, 25V	235-7395P64	SP, 196D
C17	10, 10V	235-7395P23	SP, 196D
C18	0.01, 25V	235-7426P1	RDM, M25
C20	6.8, 25V	235-7395P64	SP, 196D
C21	470pF, 300V	235-7053P157	SAN, 015
Diodes			
CR1	1N4148	322-7220P1	ITT
CR3	1N4148	322-7220P1	ITT
CR5	1N4148	322-7220P1	ITT
CR6	1N4148	322-7220P1	ITT
CR7	1N4148	322-7220P1	ITT
CR8	1N4148	322-7220P1	ITT
CR9	1N4606	585155-1	ITT
CR10	1N4148	322-7220P1	ITT
CR11	S1F2	586379-4	SEM
CR12	S1F2	586379-4	SEM
CR13	S1F2	586379-4	SEM
CR14	S1F2	586379-4	SEM
CR15	S1F2	586379-4	SEM
CR16	1N4606	585155-1	ITT
CR18	S1F2	586379-4	SEM
CR19	1N4148	322-7220P1	ITT
CR20	1N4148	322-7220P1	ITT
CR21	1N4148	322-7220P1	ITT
CR25	1N4148	322-7220P1	ITT
Connectors			
J1	Conn PC Card	586288-10	SR
J2	Conn PC Card	586288-5	SR
J3	Conn PC Card	586288-5	SR
J4	Conn PC Card	586288-5	SR
Transistors			
Q1	2N3440	386-7249P13	GE
Q2	2N2222A	386-7249P57	GE
Q3	SJE2300	982992-1	MA
Q4	SJE2300	982992-1	MA

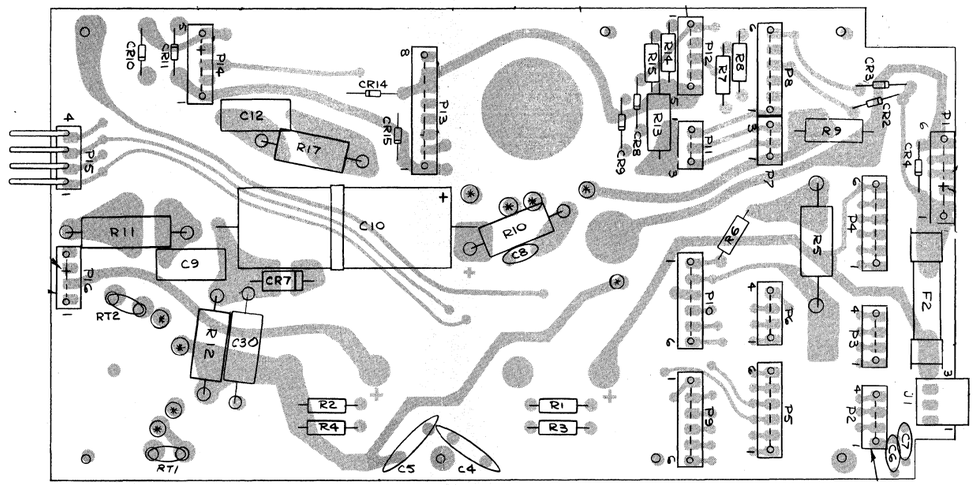
Circuit Symbol	Description	Sorensen P/N	Mfr., Type
Transistors (cont'd)			
Q5	2N2907A	386-7249P58	GE
Q6	2N2219A	386-7249P32	GE
Q7	2N2219A	386-7249P32	GE
Q8	2N2219A	386-7249P32	GE
Q9	2N2907A	386-7249P58	GE
Resistors (ohms, 1/4 watt, ±2% unless noted)			
R1	150K, 1/2W	585326-219	CG, C5
R2	10	585108-151	CG, C4
R3	5.6K	585108-47	CG, C4
R4	2.2K	585108-27	CG, C4
R5	680	585108-95	CG, C4
R6	1K	585108-11	CG, C4
R7	5.6K	585108-47	CG, C4
R8	Not Used		
R9	330	585108-79	CG, C4
R10	330	585108-79	CG, C4
R11	Not Used		
R12	6.2K	585108-49	CG, C4
R13	150	585108-63	CG, C4
R14	680	585108-95	CG, C4
R15	680	585108-95	CG, C4
R16	4.7, 1/2W	585326-3	CG, C5
R17	5.6K	585108-47	CG, C4
R18	3.3K	585108-35	CG, C4
R19	Not Used		
R20	4.7K	585108-43	CG, C4
R21	Not Used		
R22	47K	585108-133	CG, C4
R23	100K	585108-149	CG, C4
R24	2.2K	585108-27	CG, C4
R25	10K	585108-59	CG, C4
R26	680	585108-95	CG, C4
R27	100	585108-8	CG, C4
R28	10, 1 W	167059-19	CG, C6
R29	Not Used		
R30	Not Used		
R31	100	585108-8	CG, C4
R32	10, 1W	167059-19	CG, C6
R33	680	585108-95	CG, C4
R34	1.5K	585108-19	CG, C4
R35	6.19K, 1/8W, 1%	586055-112	EMF, MF4
R36	1K	585108-11	CG, C4
R37	1K	585108-11	CG, C4
R38	680	585108-95	CG, C4
R39	Not used		
R40	2.2K	585108-27	CG, C4
R41	1K	585108-11	CG, C4
R42	2.2K	585108-27	CG, C4
T1	Bias Current Transformer	167354-1	SR
U1	IC, SN74LS73N	167825-1	TI
U2	IC555	587995-1	SIG, NE555V
U3	IC555	587995-1	SIG, NE555V
U4	OPTO Isolator	586463-2	TI, L114
U5	IC, LM741CN	586372-1	NS, LM741CN
VR1	Diode, 1N5234B	588101-9	MA
VR2	Diode, 1N825	588105-3	MA
VR3	Diode, 1N5230B	588101-6	MA



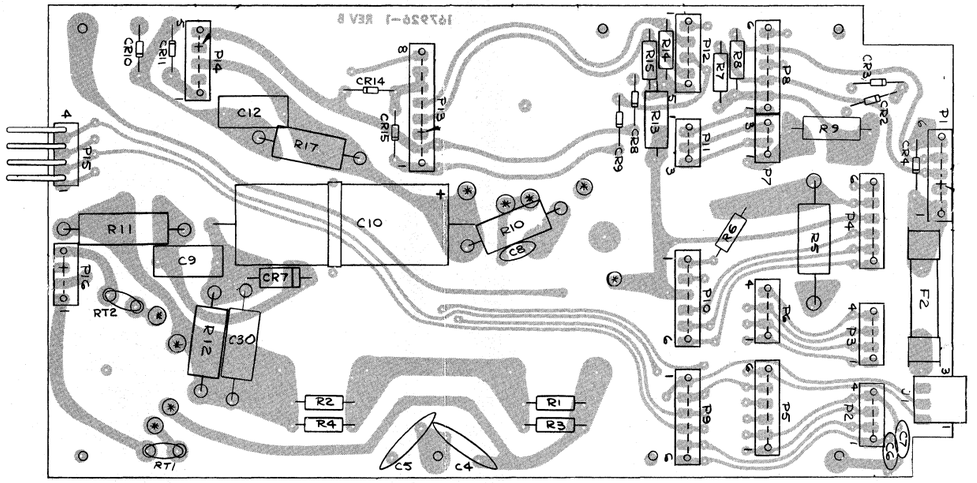
Component Side (Module III)



Circuit Side (Module III)

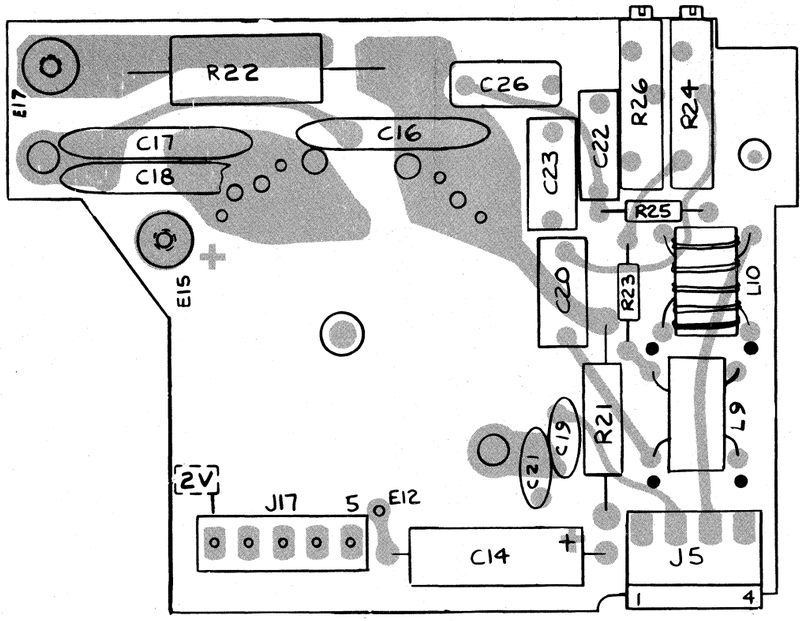


Component Side (Module IIIA)

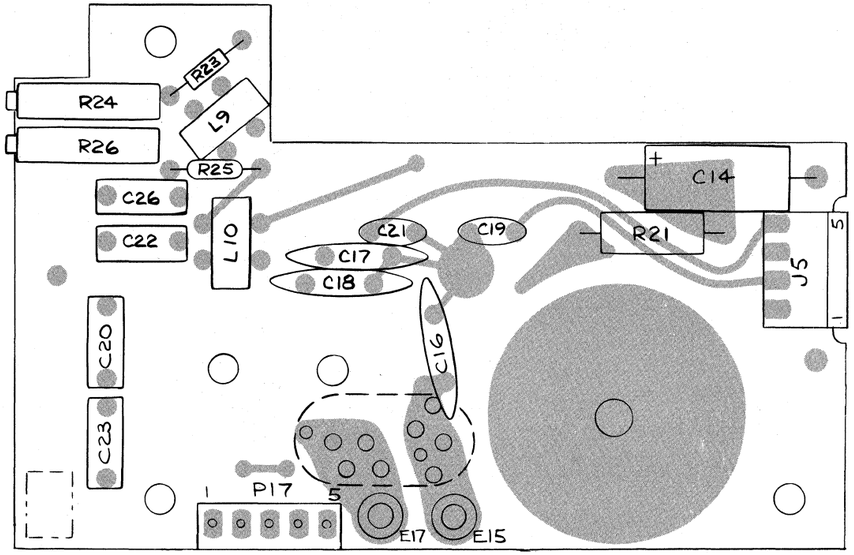


Circuit Side (Module IIIA)

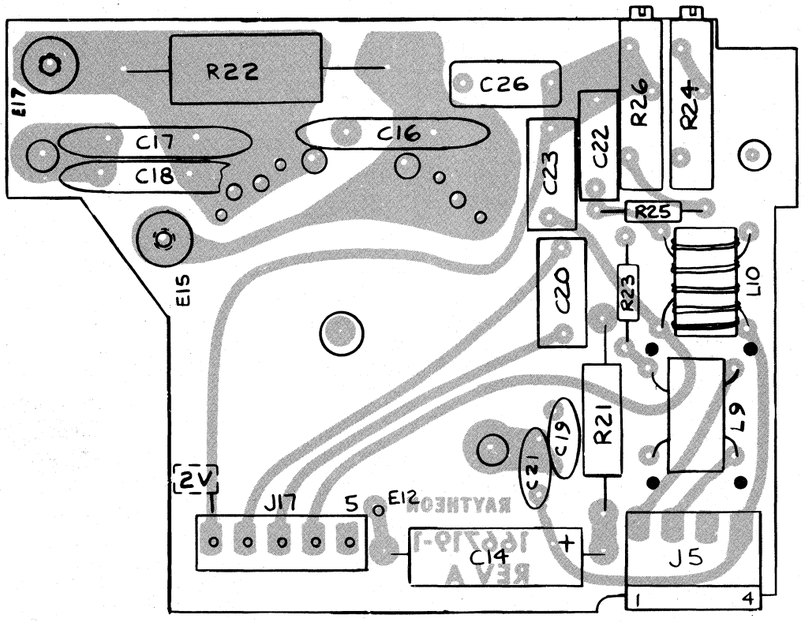
Figure 6-7
(A4) Rear Chassis Circuit Board Assembly
(Parts Listed in Table 6-1/6-2)



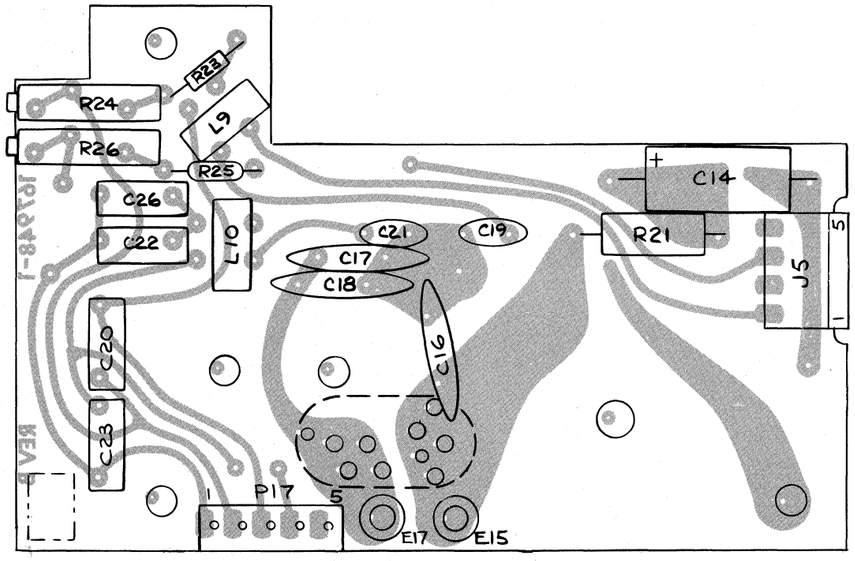
Component Side (Module III)



Component Side (Module IIIA)



Circuit Side (Module III)



Circuit Side (Module IIIA)

Figure 6-8
(A5) Front Panel Circuit Board Assembly
(Parts Listed in Tables 6-1/6-2)

SERVICE NOTES

FIELD SERVICE REPRESENTATIVES

WESTERN AREA

Ball Aerospace Systems
Boulder Industrial Park
Boulder, Colorado 80302
Tel: 303/441-4786

John Fluke Mfg. Company
Northwest Technical Center
9028 Evergreen Way
Everett, Washington 98024
Tel: 206/774-2238 or
774-2206

General Electric Instrumentation Service
3840 W. Clarendon Street
Phoenix, Arizona 85017
Tel: 602/278-8515

General Electric Instrumentation Service
4690 South Park Avenue
Tucson, Arizona 85714
Tel: 602/294-3139

ISI Fluke Western Technical Center
2020 North Lincoln Street
Burbank, California 91504
Tel: 213/849-4641

ISI Fluke Western Technical Center
2359 De La Cruz Blvd.
Santa Clara, California 95050
Tel: 408/985-1200

Missouri Research Labs Inc.
630 Haines Avenue N. W.
Albuquerque, New Mexico 87102
Tel: 505/243-6772

Pivan Engineering Company
3535 W. Peterson Avenue
Chicago, Illinois 60645
Tel: 312/539-4838

Certified Test Equipment Sales Inc.
601 Easy Street
Garland, Texas 75042
Tel: 214/494-3446

EASTERN AREA

Ampower Electronic Instrument Co., Inc.
500 Union Boulevard
Totowa, New Jersey 07512
Tel: 201/790-6750

Ampower Electronic Instrument Co., Inc.
59 Central Avenue
Unit 3
Farmingdale, New York 11735
Tel: 516/752-1078

Ampower Electronic Instrument Co., Inc.
1161 Brighton-Henrietta Town Line Road
Rochester, New York 14623
Tel: 716/424-1220

Applied Metrology Inc.
10067 N. 2nd Street
Laurel, Maryland 20810
Tel: 301/953-1010

BCS Associates, Inc.
P. O. Box 6578
940 North Fern Creek Avenue
Orlando, Florida 32803
Tel: 305/896-4881

BCS Associates, Inc.
P. O. Box 9619
1210 Beaman Place
Greensboro, North Carolina 27408
Tel: 919/273-1918

Comtel Standards Laboratory
21186 Bridge Street
P. O. Box 5034
Southfield, Michigan 48037
Tel: 313/398-2100

Comtel Instrument Company
5827 Mayfield Road
Cleveland, Ohio 45429
Tel: 216/442-8080

Valley Instrument Company
491 Clover Mill Road
Exton, Pennsylvania 19341
Tel: 215/363-2650

NEW ENGLAND AREA

Sorensen Company
676 Island Pond Road
Manchester, N. H. 03103
Tel: 603/668-4500

FOREIGN AREA

CANADA

Associated Test Equipment Ltd.
3530 Pharmacy Avenue
Scarborough, Ontario
Canada M1W 2S7
Tel: 416/497-2208

ENGLAND

Best Products Ltd.
Electronic Division
Ranelagh House
Felixstowe, Suffolk
England IP11 7HB
Tel: Felixstowe (039-42) 3154

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Tel: 056 2651 16