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SCHEMATICS

SECTION 1: SAFETY

This Section serves two purposes:

- To explain the format of safety instructions.
- To explain safety procedures that must be practiced every time the amplifier is operated or before the amplifier is serviced.

In addition to the safety instruction in this section, safety instructions are included as they are needed through out the manual.

1.1. Safety Instruction Format

Safety instructions (Warnings, Cautions, and Notes) appear through out the manual. Examples of each follow:

WARNING!

A warning is used before instructions that expose the reader to a hazard that may cause injury or death. The hazard will be explained and instructions to avoid the hazard will be included in the warning.

CAUTION!

A Caution is used before instructions that if not performed properly, could cause equipment damage. The condition will be explained and instructions to avoid the condition will be included in the warning.

Note: A note is used when information needs special emphasis.

1.2. Safety Procedures

Model 8524 operates with 208 VAC 3 phase power.

WARNING!

The unit may carry lethal voltages whether or not main power source is connected. Do not attempt to service this unit in any manner unless you have read and understand this manual. Without strict adherence to safety procedures, attempts to repair or service model 8524 amplifier could result in fatal electrical shocks.

In addition to physical hazards to servicing personnel, certain electrical conditions could be damaging to components parts.

1.3. Disconnecting Power Supply

Before attempting any servicing of Model 8524, shut down outside power supply by :

1. Turning off power at CB1 (Item 59 on Illustration 7-1).
2. Disconnecting AC mains plug from rear of unit.

Rear Circuit Breaker CB1 may be used to temporarily shut down power unit. However, disconnecting the plug provides extra measure of safety to the service technician.

1.4. Discharging Capacitors

WARNING!
After power source has been disconnected, capacitors retain a lethal electric charge. Before performing any service work, allow capacitors to discharge and verify the discharge state.

Model 8524 includes a bleeder resistor that is designed to discharge capacitors within one minute after power shut off. Do not touch any internal part of Model 8524 until more than one minute has passed after power shutdown.

1. After shutting off power, wait one minute.
2. Remove bottom cover (Item 24 on Illustration 7-1) to expose capacitors.
3. Verify capacitor discharge by connecting a voltmeter across "+" and "-" terminals of the power supply capacitors (two places). Illustration 1-1 shows test points.
4. Voltmeter should give reading of less than 50 volts.

1.5. Floating Ground

Internal electrical components of Model 8524 Amplifier are not grounded to chassis.

WARNING!
Grounding cannot be predicted by visual inspection. Until capacitors are allowed to discharge, high voltages must be assumed present at both capacitors, in capacitor wiring and at all points connected with capacitors.

Because of this floating ground feature, all test equipment used in servicing Model 8524 should not be at earth ground. Spurious readings can occur from the use of grounded test equipment. Use an isolation transformer to float test equipment from earth ground.

1.6. Service Policies

Circuitry of Model 8524 is highly sophisticated. Design allows module substitution as a means of emergency repair. See Section 4 for complete instructions for troubleshooting and repair. See Section 7 for complete parts information.

For any service beyond that described in this manual, refer to TECHRON Service Department.

Do not allow unqualified personnel to service Model 8524.

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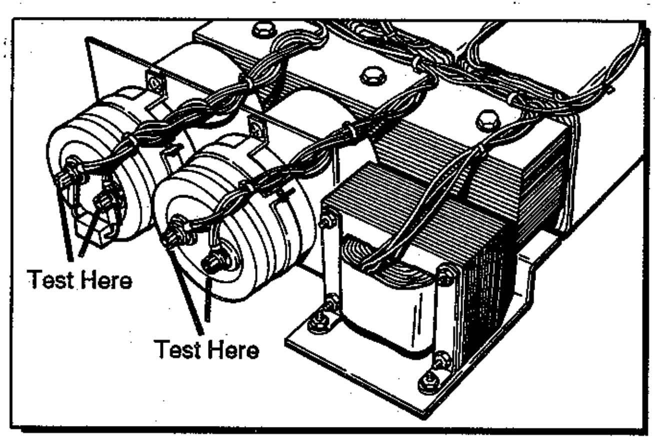


Illustration 1-1 Capacitor Test Points

SECTION 2: INSTALLATION AND OPERATION

TECHRON Model 8524, manufactured for Picker International, is configured for specific modes of operation. The discussion in this chapter will only cover items needed to perform and understand service and routine maintenance on the 8524.

Installation of Model 8524 is covered in Section 5 under replacement of the amplifier in a cabinet.

2.1. Input Connections

The 8524 signal input is located on the back panel. A twinax connector provides connections to both the inverting and non-inverting differential inputs of the 8524. This connector is paralleled with the standard TECHRON barrier block input for situations when the twinax input is not convenient.

There are three basic ways to connect an input signal to the barrier block. A true differential source is the preferred method of input to the 8524. Single ended signal sources are acceptable by following the wiring diagrams in the following Illustrations 2-1, 2-2 and 2-3.

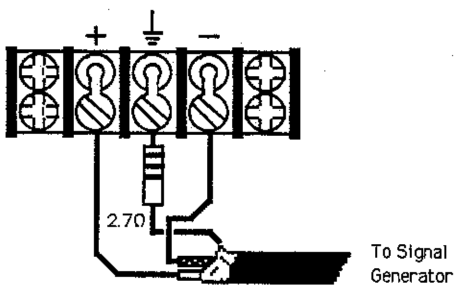


Illustration 2-1 Differential Input

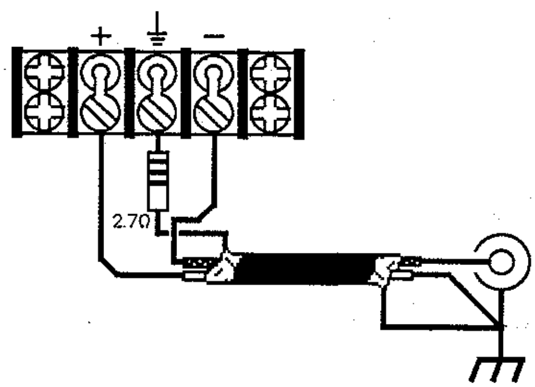


Illustration 2-2 Preferred Single Ended Input

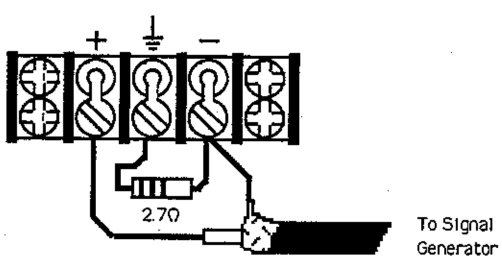


Illustration 2-3 Alternate Single Ended Input

2.2. Output Connections

Make output connections to the 8524 at the back panel. Connect the "+" side of the load to the terminal marked OUTPUT and the "-" side of the load to the terminal marked SAMPLED COMMON. The output terminals of the 8524 will accept wire up to #4 AWG.

2.3. Controls

2.3.1. AC Power

Model 8524 is equipped with a three-pole circuit breaker to disconnect the AC mains in the event of malfunction with the primary wiring. The circuit breaker is located on the rear of the amplifier. All three legs of the AC mains are disconnected when the handle of the circuit breaker is down.

2.3.2. Ready/Standby Switch

Power to the 8524 output stage is controlled by a pair of solid state relays and the Ready/Standby switch. By placing this switch in the up position the amplifier is ready for operation. By placing this switch in the down position, the amplifier is disabled and will disable all other amplifiers in the system.

2.3.3. Overload/Reset Switch

The overload/reset switch is associated with the OVERLOAD indicator and an OVERTEMP shut down. The OVERLOAD LED on the front panel is a latching indicator. Once an OVERLOAD condition has occurred, the OVERLOAD LED will remain illuminated until reset. By placing this switch in the RESET position (down), the indicator will be cleared for the next occurrence. Return the indicator to RUN for normal operation.

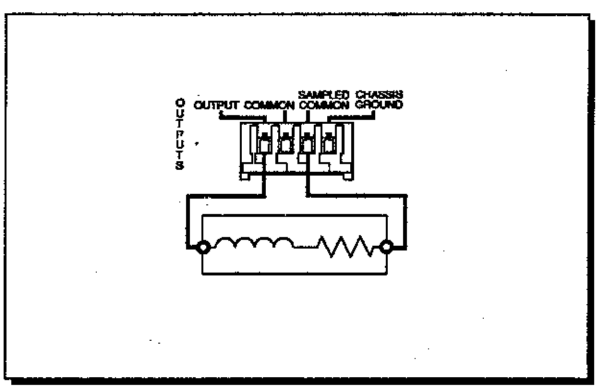


Illustration 2-4 8524 Output Connection

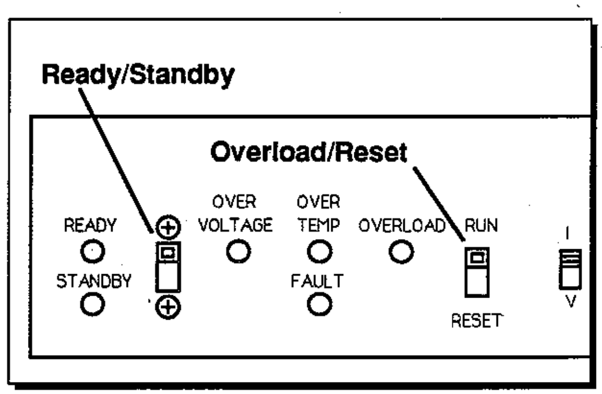


Illustration 2-5 Ready/Standby Switch

2.4. Front Panel LEDs

The 8524 amplifier has six front panel LEDs that monitor and indicate the internal condition of the amplifier.

2.4.1. READY and STANDBY

Only READY or STANDBY will be on at one time. The READY indication shows that the 8524 is available and will amplify the input signal. STANDBY indicates that the amplifier is not available. By checking the other indicators that are illuminated *and* the READY/STANDBY switch, the status of the amplifier can be determined.

2.4.2. OVERLOAD

The OVERLOAD LED is a unique indicator that shows that the output of the amplifier could not follow the input signal. This is a very sensitive indicator and not just a voltage monitor on the output of the amplifier. An OVERLOAD condition requires a manual reset.

2.4.3. FAULT

If the FAULT LED is illuminated, there is a serious problem in the amplifier. This indicator watches for abnormal current conditions in the output stage. To clear the FAULT condition, cycle the AC power. If the fault condition remains, the 8524 has suffered some serious internal damage.

2.4.4. OVERVOLTAGE

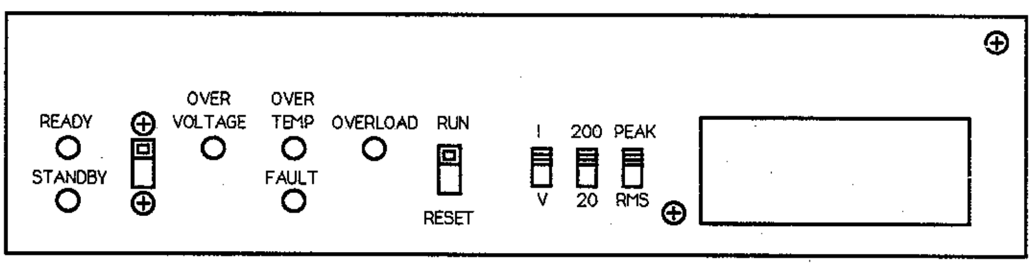
The OVERVOLTAGE LED indicates that the 8524 AC mains voltage is more than 10% above nominal. The AC mains must be brought down to the nominal value. This condition always puts the 8524 into STANDBY.

2.4.5. OVERTEMP

The 8524 monitors temperature that would damage materials as well as the internal temperature of the output transistors. Mechanical thermal switches inside of the main power transformer and on the output stage heat sinks detect conditions that would damage the insulating materials in these two sections. Solid state sensors monitor the temperature of the output transistors. OVERTEMP will cause the 8524 to latch into a STANDBY condition. Set the RUN-RESET switch down and then up to clear the OVERTEMP condition.

2.5. Connector Pin-Out

Two multi-pin connectors are located on the 8524 back panel for systems interconnection. Table 2-1 contains details of the connectors.



2-6 Front Panel Display

J5	J200	J6	J3	Description	J300 (J4)	J250	J100
			-	NC	1		
			-	NC	2		
	-	NC	3				
3			1	Amplifier Output	-		
2			2	Sampled Common	-		
1			3	Sampled Common	5		
			4	Reset + In	7		
			5	Master Error + Out	9		
			6	Overload + Out	11		
			7	Overtemp + Out	13		
			8	High Line Voltage + Out	15		
		3	9	Ready + Out	17		
			10	Supply, + 15VDC	19		
			11	Sampled Common	21		
			12	Sampled Common	23		
			13	Enable + In	25		
	8		14	Current Sum 1 (-)	27		
	12		15	Current Sum 2 (+)	29		
	10		16	Current Sum 3 (-)	31		
			17	Spare	33		8,4
			18	Spare	35		6
			19	Spare	33		8,4
			20	Common	-		
			21	+ 1 Input	4		
			22	- 1 Input	6		
			23	Reset - In	8		
			24	Master Error - Out	10		
			25	Overload - Out	12		
			26	Overtemp - Out	14		
			27	High Line Voltage - Out	16		
		4	28	Ready - Out	18		
			29	Interlock	20		
			30	Amp Ready	22		
			31	Supply, - 15VDC	24		
			32	Enable - In	26		
	11		33	Current Sum 1 (+)	28		
	9		34	Current Sum 2 (-)	30		
	13		35	Current Sum 3 (+)	32		
			36	Spare	34		7
			37	NC	-		
			-	-20 Input	36	2	
			-	+20	37	3	
			-	Signal Ground	38	4	
			-	+20 Input	39	3	
			-	-20 Input	40	2	

Table 2-1 J5 and J6 Connections;

SECTION 3. THEORY OF OPERATION

3.1. Concepts

The fundamental objective of a power amplifier is to transfer energy from an available supply to a load in a prescribed/controlled manner. Voltages in excess of +/-120 peak volts and ±160 amperes are available. The test signals require DC coupled response to the load with low noise at all frequencies. The load current may be the programmed output variable and not the voltage. This controlled current mode is useful in areas where the field produced by a coil needs to be proportional to coil current and not voltage.

3.1.1. Output Stage Topology

Illustrations 3-1 and 3-2 are block diagrams of the topologies commonly used for direct-coupled amplifiers. The totem-pole is the most common and makes available a peak voltage to the load of 1/2 of the total supply voltage (Vcc) while exposing the output stage devices to stress from the total supply voltage (2 Vcc). Only one half of the supply is used at a time, reducing the supply operating efficiency as well. The full bridge output stage as shown makes full use of the available supply voltage as the peak output to the load is 2 Vcc.

The peak-to-peak output voltage of the full bridge is actually twice the available supply voltage (4 Vcc). The maximum voltage stress to the output stage devices is the same as in the totem-pole topology (2 Vcc). The supply utilization is now total.

3.1.2. Output Stage Synchrony

Operation of the full bridge to produce a positive output current requires that the output stages one and three be increased in conductance in synchrony and output stages two and four be decreased in synchrony, decreasing as one and three are increasing.

In class AB operation, the conductance of two and four would diminish to zero and stages one and three would increase to the level required to carry the desired positive peak output current. For a negative output current the roles of the pairs one and three and two and four are interchanged with two and four ultimately carrying the negative peak output current.

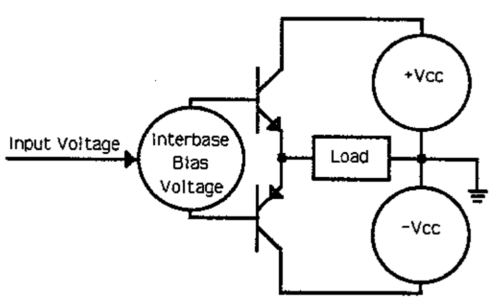


Illustration 3-1
Totem-Pole Topology

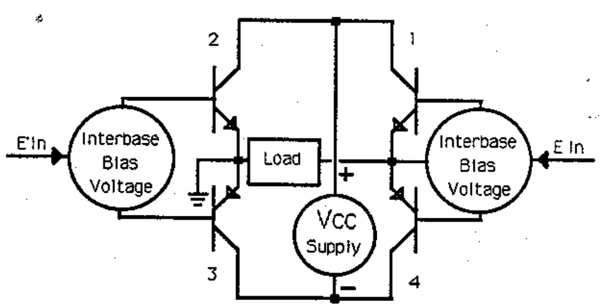


Illustration 3-2
Full Bridge Topology

3.1.3. Output Stage Terminology

The names one, two, three and four are not the names that are preferred for describing the output stages. Since the output stages are constructed with bipolar transistor devices, the preferred and more descriptive terminology is to name an output stage in terms of whether the stage acts as a giant NPN or PNP stage and whether it is on the high (output) side of the load or low (ground) side of the load. Thus stage one is generally referred to as the high side NPN stage and stage three is referred to as the low side PNP stage.

3.1.4. Transistor Topologies

There are four basic composite transistor topologies (Illustration 3-3) which may be used in any configuration which can be derived by recursive application of the forms. Other three terminal devices such as FETs could be substituted for the bipolar transistors without loss of generality. In the application of the 8524 all of the devices of the output stages are bipolar. The principal output devices are NPNs paralleled 20 times. They are driven in two groups of ten from a pair of NPN driver transistors (Darlington form). NPN stages use an NPN predriver (Darlington form) driving the drivers. PNP stages use a PNP predriver (Complementary form) driving the drivers.

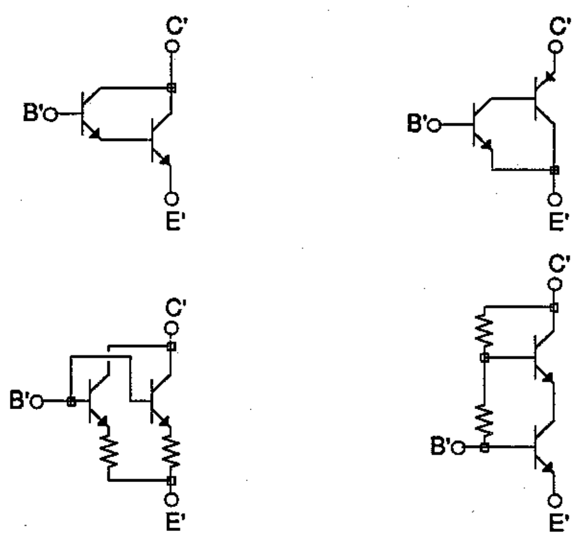


Illustration 3-3
Composite Transistor Topologies

3.1.5. Bridge Stages

The 8524 is built around a voltage amplifier which first drives the high side of the bridge. The low side of the bridge is in turn driven from the high side such that one half of the voltage of the output signal is imposed on the supply rails. This condition constitutes the proper synchrony of the stages of the bridge. Note that the amplifier dissipation is distributed evenly over 40 output devices for a single polarity of output current. Negative feedback is used liberally to acquire the control of the bridge balance and insure the required overall linearity. Wide gain-bandwidth IC op-amps are therefore used.

3.1.6. Protection Circuitry

As with all things there is a breaking point and amplifiers are no exception. Protection circuitry is used to prevent electrical stimulus from being able to reach the breaking point. When continuing a high level of output current would cause the output semiconductors to overheat, the current must be reduced to limit the junction temperature. A fundamental problem of protecting output semiconductors is that they do not have an output terminal which indicates the junction temperature. The critical parameter is sealed inside opaque metal cases.

This has led to the use of simulation methods to predict the junction temperature. An electronic analog of the heating process is created which can be monitored for excessive equivalent temperature. An electronic multiplier is used to compute instantaneous power by computing the product of the semiconductor voltage and current. Its output is applied to an electrical impedance which is designed to have the same time characteristics as the junction. After the ambient temperature is added to the output, the result is an electrical analog proportional to the absolute temperature in degrees Kelvin of the output semiconductor junctions. This temperature information is then compared to the maximum allowed junction temperature of 200 degrees Centigrade and the current drive to the output devices is reduced to prevent the temperature from becoming excessive.

Electronic power supply interlocking is used to allow multiple amplifiers to power a common load. Should any one unit of a system not be able to operate, it is imperative that none of the units be active. The amplifiers must enter the ready state in unison. A disabled amplifier could be damaged by large output signals from its companion units.

The heat sink materials are protected from excessive temperatures (over 150 degrees Centigrade) by thermal limit switches. Exceeding the instantaneous current limits of the output transistors– is prevented by electronic current limiters.

The power transformer is protected against overtemperature conditions by internal limit switches which are coupled to the interlock and power control circuitry. Fault conditions in the power supply are protected with circuit breakers. A fault in the output stages is electronically detected and the main supplies are disabled until the control circuitry is down-powered and repowered.

3.2. Output Stages

Each output stage or quadrant is built on a separate, electrically isolated, forced-air heat sink. Twenty NPN bipolar output transistors are directly mounted to each sink. By allowing each heat sink to be electrically isolated from the chassis and the other output stages, the devices are able to be connected without insulating mounting hardware directly to the heat sink. Lower junction temperature for the output transistors is provided by this mode of operation.

The twenty output devices are driven by two NPN bipolar devices, each driving ten of the outputs. The output devices are divided with ten to one side of the heat sink and ten to the other side. The driving transistors are located on the opposing sides of the heat sink. This cross-coupled orientation is used to provide thermal degeneracy on a side-to-side basis.

Wiring of the emitter and base circuits of the output devices and drivers is provided by two printed circuit boards which are placed at the bottom of the upper channel of the "H". The output device emitter wiring circuit board is below the output device base wiring circuit board. The circuit board material is a high-temperature G-30 material to allow operation to a temperature limit of 150 degrees Centigrade.

The entire output sink may be disconnected and removed from the amplifier by removing six fasteners and the connecting small signal wiring which passes over the top of the heat sinks. Two of the fasteners at the middle of the heat sink are used to connect the high-current signals to the sink. The remaining four fasteners at the ends of the sinks are provided for mechanical support.

3.2.1. Output Transistors

Referring to the Schematic J 0309-5 of the output stages, it may be seen that the high side NPN output devices are labeled Q600-609 and Q612-621. Emitter current is used to provide the needed degeneracy for paralleling by using the resistors R601-610 and R615-R624. Base current is removed from the output devices by the resistors R611 and R625 and R614 and R626. A high-frequency load is provided for this stage by using a series RC formed by R600 and C600. This structure is common to all four of the output stages.

3.2.2. Output Stage Drivers

The drivers are Q610 and Q611 respectively. Half of the output transistors on each end of the heat sink are driven by one of these two devices. Base emitter resistors, R612 and R613, are used to set the quiescent current point of the pre-driver devices and remove current from the bases of the drivers. This structure is common to all four of the output stages.

3.2.3. Output Stage Predrivers

Both drivers are driven by Q650 through a compensation network composed of L650, C650, and R650, all of which are mounted on the predriver circuit board suspended above the heat sink. Driver base current removal can be expedited by Q651 in the case of rapidly switching currents. This device will not see much action in normal use. A system would need to become unstable for this device to come into use. This topology is shared by the low side NPN stage but is different than the PNP stages.

3.2.4. Output Stage Bias

The quiescent bias current of the high side of the bridge is controlled by Q652 which is connected as a Vbe multiplier. Q652 is thermally joined to the heat sink and compensates for the base-emitter voltage temperature coefficient of the drivers and output devices. The base-emitter coefficient of the predriver is compensated by D650. R651 in series with R652 is used to adjust the bias. With no load current and 25 degrees Centigrade heat sinks, the bias may be adjusted by setting the voltage across either R611 or R614 to 0.400 VDC. R654 is used to reduce any sensitivity of the quiescent bias point to the current flowing through the bias circuitry from the last voltage amplifiers of the gain stages. C652 prevents instability in the bias servo.

The NPN low side output stage has the same construction and biasing procedures.

C654 and R655 join to the input of the high side PNP output stage. The result is reduced inductance in the input lead of each stage which improves stability in the predriver stages. C653 and C651 compensate the entire output stage and provide a capacitive load to the current limited last voltage amplifiers to form a slew rate limit mechanism.

D600 and D601 sample the stage and drive the fault detector of the high side of the bridge. Should an output device fail with a collector to emitter short, the base of the output devices will be powered by the breakdown of the base emitter junction of the failed device.

The PNP output stages are similar to each other in structure. The high side PNP stage has an identical output configuration to the NPN stage. Collector current is sampled by resistors R701-710 and R724-733. The predrivers are the major difference between NPN and PNP stages. Q750 is the predriver to the drivers, Q710 and Q711 of the high side PNP stage.

Compensation is provided by the emitter network composed of R750, L750, and C750. C701, C751 and C752 are also used for stage compensation. D750 is used to temperature compensate the base-emitter junction voltage coefficient of Q750.

Additional high frequency compensation is incorporated in the low side of bridge output stages by using RL networks in the emitter leads of the drivers. The inductors are constructed with ferrite beads. Using the low side NPN stages as an example, R857 and R858 are in parallel with the beads.

3.2.5. Temperature Sensors

IC temperature sensors U800 and U900 are used on the low side of the bridge stages to provide information to the protection circuitry. The output of each of these sensors is a current proportional to the absolute temperature. The signals +TEMP and -TEMP are scaled as 10 millivolts per degree Kelvin. Since the bridge is balanced in actual operation, the temperature of the NPN high side of the bridge should be essentially the same as the low side PNP output stage.

Overtemperature in the output heat sinks is prevented by bimetal switches (S600 and S700) mounted on the high side of bridge heat sinks.

3.2.6. Output Termination

The output stages drive the load through an output terminator network composed of L90, C90, R91, C91, R92 and C92. This network is used to provide isolation from the load and a consistent high frequency load for the amplifier in R90-92.

R90 is a resistor with a positive temperature coefficient. Rapidly rising output current will cause R90 to increase in resistance. This forces more current through L90, protecting R90 from burn out.

3.2.7. Flyback Diodes

Flyback pulses from inductive loads are prevented from reverse biasing the output stages by D607, a high current bridge rectifier mounted beneath the output shelf and next to the bus bar assembly. The bus bar assembly is used to provide a very low inductance/high current interconnect system to the output stages.

3.2.8. Output Current Sample

Output current may be sampled by attaching the load to the terminal labeled, SAMPLED COMMON. R758-R763 are used to produce a voltage for the current control circuitry of the input stages. Use of the output terminal labeled COMMON bypasses the current sampling. The amplifier uses SAMPLED COMMON as its reference.

3.3. Gain Stages

Refer to Schematic J 0304-6 for the discussion of the gain stages.

The full bridge output stage is controlled by first driving the high side of the bridge. The low side of the bridge is driven such that half of the output voltage is impressed on the Vcc supplies. The gain stages control the drive and balance of the bridge.

3.3.1. Last Voltage Amplifier

Drive to the high side of the bridge comes from the last voltage amplifier. Q212 and Q215 form this amplifier. The last voltage amplifier is current limited by D202-D204 and D205-D207. This provides a slew limit in that the load to the stage is dominated by capacitance in the output stage. Q212 and Q215 are emitter degenerated by R243-R244 and R262-R263. A partial pole removal is performed by bypassing R243 and R244 with C209. C219 likewise bypasses R262 and R263. Q209 and Q216 form emitter follower stages that drive the relatively high input capacitance of Q212 and Q215.

3.3.2. Current Limiting

Current limiting of the output stages is provided by D200 and D201 and transistors Q213 and Q214, which limit the output drive of the last voltage amplifiers. R256, R271 and R257 adjust the positive current limit and R258, R272 and R259 adjust the negative. R267 and C223, along with R268 and C224, by joining the output signals and supplies respectively, reduce the inductance of these lines by paralleling.

C211 and C212 provide high frequency feedback from the output to the input of the last voltage amplifiers. Input signals to the amplifiers are currents input to the bases of Q209 & Q216 and R206 & R241.

Currents to the input of the last voltage amplifiers are provided by the grounded base stages of Q203 and Q204. Voltage dividers R246, R247, R248 and R249 provide operating states for Q204 and Q203 which prevent the forward biasing of the base collector junctions even when the output flyback diodes are forward biased and the Vcc supplies swing slightly beyond ground.

Complementary differential amplifiers drive Q204 and Q203. Q205 and Q202 amplify the difference between the feedback signal from the output and the input signal from U202. The feedback signal is attenuated by R265, C221, R216, R213, R215, R223, and R218. The input signal is coupled through R242, R214, C205, R219, R217 and C220. The operating state of Q202 and Q205 is such that collector operating voltage is insured no matter what signal conditions prevail. Emitter degeneracy with partial pole removal is provided by R211-212 and R220-221 and C217 and C208.

Current sources which bias Q202 and Q205 make it possible to interrupt the drive to the amplifier. The protection circuitry controls these bias currents. Q205 is biased by U200, a monolithic current mirror. Biasing Q202 is Q200 and Q201 which form a mirror and function well due to emitter degeneracy using R209 and R210 in the absence of being monolithic. Controlled currents are provided by signals +LH and -LH from the protection circuits. R222 causes the input characteristic of U200 to be identical to the input characteristic of the mirror of Q200 and Q201.

3.3.3. Error Amplifier

Amplifier U202 is a high performance monolithic FET input op-amp. Local degeneracy is provided by C202. The main feedback loop around the power amplifier forms a non-inverting gain of 20 using R208, R251, C204 and R207. The -1 input used with slave operation is provided by R203, R250 and C216. U202's offset voltage is compensated by R204 through R205.

R202 and C200 function as a filter for RF input suppression. R200, R201, R253 and C215 form a non-inverting input of +1 gain for use with the slave mode of operation. R254 provides precision gain adjustment when the +1 and -1 inputs are used for amplifiers in parallel. R253 and C215 are used to provide phase compensation for the input to output transfer function.Likewise R250 and C216 compensate the -1 input phase response. S100 is used to switch between the master and slave modes of operation. In the master mode, the signal input to the power amplifier is derived from R110 via the upper half of S100. The -1 input is then grounded by the lower half of S100.

3.3.4. Bridge Balance Amp

The bridge is balanced by U203 which drives the two low side of bridge output stages through R226 & C206 and Q206 & Q207. If sufficient current is developed in the output of U203, the voltage across R225 or R227 will cause Q206 or Q207 to conduct and aid the output drive demand. C206 provides some phase lead to improve the stability margin of the bridge balance loop. Current to drive the NPN low side output stage is provided by a current mirror composed of Q210, Q211, R229 and R230. This current source may be disabled by the protection circuitry removing current from line +LL. In a similar manner, the current drive to the PNP low side output stage is provided by U201, a monolithic current mirror. U201 is driven from the protection circuit control line -LL. R231 is used to degenerate the input characteristics to mimic the NPN side mirror.

U203 drives the low side output stages such that the feedback signal through R232, C214 and R233 produces the same current that is produced by the input signal through R240 from the high side output. A DC current is flowing in R232 and R233 which is incidental to the process of monitoring the Vcc supplies. Offset errors caused by mismatch of R232 and R233 are compensated with the static balance control, R234 thru R235. Signal balancing of the bridge is accomplished by using the dynamic balance control of R236 and R237 which shunt the feedback divider resistors, R238 and R239.

The static balance is adjusted by setting +Vcc equal in magnitude to -Vcc. Adjustment of the dynamic balance is accomplished by loading the amplifier for full current when driven by clip level low frequency signals. U203 should saturate just before U202.

Local degeneracy of U203 is provided by R264. R252 is used to reduce the interaction of the dynamic balance control and the amount of output current being drawn from the amplifier. The voltage on the output of U203 is determined by the degeneracy of the output stage and the current sampling resistors in the output assembly, R758-R763.

Capacitors C201, C203, C207 and C218 bypass the 15 volt supplies to the op-amps. High frequency types such as used for U202 and U203 require local bypassing for stability.

3.4. Input Signal Processing and Current Control

Refer to Schematic J 0269-1 for the discussion of the Input and Current control stages.

The analog input is a differential input using the first half of U100 which receives its input signal from the rear panel barrier block labeled INPUT. L1 improves the common mode rejection of high frequency signals. The common mode rejection of the analog input is tuned for optimum rejection at low frequencies by adjusting the trimmer of resistance network N100. The high frequency common mode of U100 is adjusted by tuning C101 which is tuned to set C100 + C101 equal to C110.

R104, R100, R101, R105 and U100 form a limited adjustment gain stage. C102 and R106 provide proper source impedance for minimum offset drift.

3.4.1. Current Sensing

The load current of the amplifier is sensed by R758-763 in the output stage and amplified by U104 for use in the current control loop. U104 forms a differential amplifier with an adjustable gain control in the resistor network N103. Resistors R118 and R119 along with C107 and C108 compensate the sense resistors for their series inductance. The output of U104 is calibrated for 20 amperes per volt of monitor output. The offset voltage of U104 is eliminated by adjustment of R121 via R120. Z100 and Z101 are used to change the scale of the current monitor from 20 amps/volt to 10 amps/volt. U103, R123 and R124 invert the output of U104 so that the output of U103 and U104 provide a differential output. This differential output is used if the amplifier is used in a paralleled system. R125 and R127 isolate the op-amps from any capacitive load.
N101, U101, N102 and one half of U102 form a high impedance differential input mixer-averager.

The mixer stage sums current information from all paralleled amplifiers in a system. By summing the current of all amplifiers in a parallel system, current flowing between chassis due to gain mismatch of amplifiers does not effect the current of the load. The voltage at T101 is proportional to the true current in the load.

3.4.2. Constant Current Compensation

C105 and the B6 selectable network of R108 and C103 or R109 and C104 comprise the principle compensation networks which serve to control the open loop gain of the closed loop controlled current system. The network selected by B6 is taken from the output of the main amplifier to reduce the amount of charge stored in the compensation capacitor should an overload of the control amplifier be allowed. In the controlled voltage mode of operation these compensation parts are not used.

3.4.3. Current Control Amplifier

The controlled current mode works by U102-B comparing the current output of the amplifier with the desired current at the output of U100-B. The current control amplifier, U102 whose output is pin 6, is offset zeroed by R117 via R116. R103 and C106 provide the proper impedance to U102 for minimum offset drift.

3.4.4. Input Clipper

D100, D101, Q100 and Q101 form a bridge with Q100 and Q101 performing as high quality diodes. This bridge clamps the output of U102 at pin 7 if it exceeds 10.3 volts. The output level of the controlled current stage is adjusted by the value of R113, R115 and the setting of R114.

This allows the amplifier to be operated with controlled output voltage limits that are not subject to minor line voltage fluctuations if so desired.

3.5. Protection Circuitry

Refer to Schematic J 0308-7 for the discussion of the protection circuitry.

The protection circuitry furnishes the following two forms of protection to the amplifier:

1. Protection from overheating of the output semiconductors.
2. Protection from subsequent destruction as a consequence of output device failure.

Output peak current limiting was provided and discussed in the section on the gain stages. The heat sinks are protected against materials damage due to over temperature by switches discussed in the section on the output stages. The main power transformer is protected against excessive coil heat by switches discussed in the section on power supplies.

3.5.1. Output Transistor Temperature

The output semiconductors are protected by simulation methods. An analog of a worst case junction temperature is computed by taking the product of the output semiconductor current and voltage and applying this stimulus to a thermal impedance analog of a worst case output device.

The heat sink actual temperature is added to result in an absolute temperature model of the junction temperature.

The low side of the bridge is observed to compute the device temperatures. This is based on simplicity and convenience since the low side of the bridge is common to ground. The high side of the bridge is constrained by the bridge balance amplifier to have the same dissipation as the low side. The low side PNP output stage conducts simultaneously with the high side NPN stage to produce a positive output current.

Q301 functions as a two quadrant multiplier to compute the product of current and voltage in the low side PNP output stage. Voltage is converted to a current by R322 which is connected to -Vcc. The current is sensed between the lines of -ICL and -ICOM. R321, N301(7-8), R323 and R332 provide a differential input to Q301. The differential output of Q301 is converted to single-ended by an op-amp current mirror built with U300-C, N301(1-2) and N301(2-3). The output current at N301(3), a virtual ground, is combined with currents from the heat sink temperature sensor U900 and a fixed temperature offset current through N301(3-5).

The network composed of N302(8,9,10), C306, and C307 is used to simulate the thermal impedance of a worst case transistor. At 25 degrees Centigrade, the output of U300-D (T301) should be +12 Vdc. At 200 degrees Centigrade the T301 will be -9 Vdc. With a 25 degree heat sink and no excitation, the offset balance of Q301, R334 is adjusted for +12 Vdc at T301. The voltage at T303 (-TEMP) should be +2.98 Vdc +/-0.06 volts. The conversion factor of temperature to voltage is 10 millivolts per degree Centigrade. T302 of the low side NPN sensing protection circuitry should read the same voltage at 25 degrees.

The output T301 is input to two amplifiers which are saturated in normal operation. U301-C and U301-D are saturated at their positive output limits in normal operation. A current from R325 + R326 through R324 defines the temperature threshold at which U301-D will begin a controlled gain (R329 and R330) transition from the saturated state. As the output of U301-D goes negative, the available drive current to Q205 which drives the high side NPN output stage is being removed and eventually extinguished.

If T301 becomes about -9.5 Vdc, then U301-C will follow suit becoming negative and removing the drive current to U201 which drives the low side PNP output stage. This threshold is defined by a current from R325 through R326 + R324. Since this must always coincide with a higher temperature than the temperature which disabled the high side of the bridge, it is never possible for the bridge to become unbalanced due to operation of the protection circuit.

If the low side of the bridge were to be protected before the high side of the bridge, the resulting imbalance of the bridge would cause the power dissipation to not be equal in the high and low sides of the bridge. The gain of U301-C is controlled by R329 and R328. The operating current of the mirrors, U200 and U201 is determined by R331 and R327.

3.5.2. Amplifier Disable

The protection circuitry is used to disable the amplifier on command. Line DA when driven negative drives all of the sections of U301 to disable the current mirrors that they power and thus disables all of the four output stages. The signal through D303 disables positive output currents and the signal through D302 disables negative output currents. D305 is used to reduce the common mode input voltage to U301-A and U301-B which would create an inverted output if allowed to exceed the amplifiers common mode input range. In the case of U301-C and U301-D the output invoked by exceeding the common mode input range is identical to the desired output, and thus no problem. The outputs of the simulation signals are available for external analysis at T300 and T301.

3.5.3. Output Stage Fault

Should a failure occur that causes the output stages to conduct a large common mode current for more than a few microseconds, the amplifier will be disabled by the fault detection circuitry. The high side of the bridge is sampled by Q302 and Q303 to sense common mode currents. If the high side NPN stage is on, Q303 will be on. If the high side PNP stage is also on, Q302 will be on. When both Q303 and Q302 are on, a current will charge C300 across R302 and drive the opto-emitter of U302. This will trigger the SCR of U302 and latch the FAULT bar line low.

The low side of the bridge is sampled for common mode current by Q305 and Q306. The charging of C309 across R336 turns on Q304 which triggers U302 via the electrical gate input of the SCR. Whichever input triggers U302, the result is the same in that the control power supply which powers the SCR of U302 must be unpowered to unlatch U302 before operation of the main amplifier can be reattempted.

FAULT bar low places the amplifier in the standby state which removes power from the Vcc supply and thus eliminates all potentially destructive current from the apparently failed amplifier.

3.6. Status and Interlock

3.6.1. Systems Interlock

When multiple amplifiers are combined to form a larger amplifier, it is necessary to interlock the power controls of the units so that all of the units are powered simultaneously. Should one unit of a group not be enabled, it may be damaged by currents output from the other units. The basic interlock system of the 8524 requires that the INTERLOCK line be released from ground. The natural unpowered state of this line is conducting to ground through a depletion mode N-channel FET Q500. The gate of Q500 must be biased negative to open the drain to source channel.

The drains of all interlocked units will be pulled high by all of the R533s when all of the Q500s are off. The threshold for the enabling of the amplifiers is set to 10 volts and each input is low-pass filtered by R527 and C503. D503 and D502 protect the inputs against transients and dissimilar AC potentials on the grounds of the interlocked units.

When INTERLOCK goes high, the output pin 14 of U501 goes low producing a current which lights the READY indicator E503 and enables the solid-state main power relays K1 and K2 (signals +SS1 and -SS2) which switch the three phase power to produce the Vcc supplies. R524 provides hysteresis of U501's switch point to insure a good trigger of the relays. Current limiting resistors R520 and R521 are in both legs of the circuit going to the relays for safety should an internal fault occur in the relays.

The gate voltage for Q500 is provided by U501 pin 13. When the output of U501 indicates that a chassis is ready, a current may be taken through R530 at INTERLOCK from INT COM. This would allow units that are not electrically common to ground to be interlocked with other units that are by using an optically isolated interlock.

3.6.2. Turn-On Delay

U501 input pins 10 and 11 are driven from a timing network. When the unit is first powered, C504 is discharged and must be charged by current through R526. When the potential on C504 exceeds the ground potential on the hysteresis feedback divider of R528 and R529, the output pin 13 of U501 will go low.

C504 may be discharged by three other detectors in the system.

3.6.3. High Mains Cutoff

U501 pin 5 detects high line voltage as evidenced on the unregulated negative supply of the control supply. If this supply is too negative as determined by the setting of R516 used with R514 and R517, output pin 2 of U501 will be held low and discharge C504 through D501. R515 and R518 provide hysteresis for the overvoltage detection process. The high voltage detector is set to disable the supplies at ten percent high line voltage. C501 prevents ripple on the unregulated supply from toggling U501's output state (pin 2).

3.6.4. Fault Detection

The FAULT line may also discharge C504 through D504. E505 and current supply resistor R523 indicate on the front panel if this state has been entered.

3.6.5. Overtemperature Shut Down

C504 may be discharged by the overtemperature protection signal which comes from U500 pin 13 or U509 pin 14 through D500.

If any one of the three coils of the three-phase main transformer or one of the two high side heat sinks exceeds its allowed temperature limits, a thermal switch will open and J400-19 will be disconnected from ground. R511 will pull this line to -15 volts and the signal through low pass filter R510 and C501 will overcome the current from the +15 supply through R508 and the output of U500 pin 13 will go low. E501, the high temperature front panel indicator will also light. Since removing the power to the main supply does not defeat the cooling fans, the unit will cool down and the overheated switch will cool enough to close and power will be restored.

U509 pins 10 and 11 receive the thermal protection shutdown signals from U300. When the thermal protection is not invoked, U509 from pin 13 holds input pin 9 high with R540 holding the input at +15. The inverting input, pin 8 of U509, is connected to ground through R512. When U509 pin 13 drives the voltage at the junction of R539 and R540 negative, the hysteresis of D506 is so large as to latch output pin 14 of U509 low. In order to release U509 pin 14 from this state it is necessary to enable S500 (manual overload reset button) overcoming the hysteresis. C506 is used to reduce the recognition speed of the latch.

3.6.6. Ready And Standby

Any time that the unit is not in the ready state (but powered), the standby state will be occupied and indicated by E504. U501 pin 1 drives E504 and is controlled by the ready signal on the output of U501 pin 14. The junction between E504 and its current limiting source resistor R522 is the DA line which is used to signal the protection circuitry to disable the amplifier. Therefore any time that the amplifier is in STANDBY, it is also disabled in all power stages and the main supply although some charge might momentarily remain on the Vcc supplies.

3.6.7. Overload Indicator

Should the amplifier be overdriven at any time, a large error signal will be produced at the output of U202 (line A1). If this signal is greater than ten volts in magnitude, it may be safely assumed that some form of overload is in process. Two sections of U500 function as window detectors to detect such a condition.

The reference potentials for detection are supplied by R500, R501 and R502. If signal A1 is outside of this voltage window, the output of U500 at pins 1 and 2 will be low. U509 is used to disable signals from reaching the overload latch while the amplifier is in standby.

Normally the input at pin 9 of U500 from the window detector (via U509, pin 1) is high with R504 holding the input at +15. The inverting input, pin 8 of U500, is connected to ground through R512. When the window detector drives the voltage at the junction of R503 and R504 negative with respect to the collector of Q501, the hysteresis of D507 is so large as to latch the output of U500 low. E500 will then be lit with the current flowing through R506. In order to release U500 pin 14 from this state it is necessary to enable S500 (manual overload reset button) overcoming the hysteresis on U500. If latching is not desired Z505 should be open. C507 is used to reduce the recognition speed of the detector.

3.6.8. Status Output

U506 provides optical isolation to report the status of the amplifier.

3.7. Power Supplies

The 8524 gradient amplifier has two classes of power supplies, control and Vcc. The control power supply provides low voltage to small signal, standby and interlock circuits of the amplifier. The Vcc power supply drives only the output stage and uses a patented switching dual supply topology.

3.7.1. Control Power Supply

AC mains for control power originates at CB1. Control transformer T2 is a single phase transformer, whose primary is protected by F1. The primary of T2 is used as an auto-former to power the four, 120 volt fans. The secondaries of T2 are Faraday shielded and connect to full-wave rectifiers.

Unregulated supplies are produced by a full-wave center tapped winding using D400, D401, D405, D406, C402 and C404. From these supplies, U400 and U401 produce regulated +15 and -15 volt DC supplies. The ground of these supplies is considered to be an analog ground. Both of the regulated supplies have reverse polarity protection diodes and bypass capacitors for low impedance at high frequencies. D401, C401, D403, C403, D404 and C405 provide these functions. The unregulated negative supply is used by the overvoltage detector of the status and interlock circuitry.

3.7.2. Vcc Power Supply

Grounded bridge amplifiers are capable of providing high voltage and large currents but not without large amounts of wasted power. The fundamental cause of this power loss is the excess available supply voltage (Vcc) on the output stages. In some applications, the need for high supply voltage is infrequent and results in poor system efficiency.

The Crown Patented BiLevel™ power supply reduces the dissipation losses across the output stages by changing the topology of the power supply. The BiLevel Vcc supply is built in two segments (V1 and V2) that switch between series and parallel topology to meet demands for high voltage or high current. Illustration 3-4 diagrams the current flow through the supply.

The implementation of the BiLevel uses multiple large-die FET transistors to switch V1 and V2. The switching is controlled by two comparators and a monostable timer. Additional components protect the FETs from abnormal sustained high current conditions.

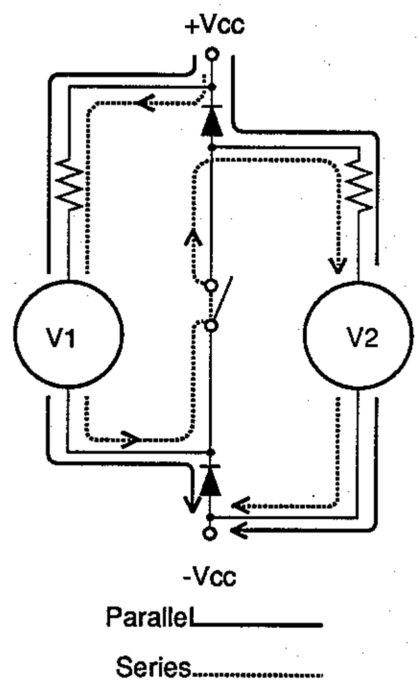


Illustration 3-4
BiLevel Block Diagram

3.7.2.1. V1 and V2

Refer to Schematic J 0249-3 for the discussion on V1 and V2.

Upon entering the chassis, the three phase power passes through a three pole, high in-rush circuit breaker, CB1, which breaks all three legs of the AC mains.

Solid state relays K1 and K2, controlled from signals +SS1 to -SS2, provide primary power to T1's delta primary windings. Control signals +SS1 to -SS2 are internally optically isolated from the AC mains.

T1 has two matched "Y" secondaries which drive full-wave rectifiers. D411, D412, D413 and C400 form supply V1. C407, C409, C410 are high frequency bypass capacitors on the AC side of D411, D412, and D413. R400 is a bleeder to discharge C400 and C412 after power is removed. V2 is of identical construction using D414, D415, D416 and associated capacitors. C408 provides local high frequency bypass for the output stage.

A normally closed thermal sensor is embedded in each of T1's three coils. These switches are wired in series and returned to the thermal protection section of the status and interlock circuitry. Like T2, T1 has a Faraday shield to prevent signals from V1 and V2 capacitively coupling to the AC mains.

3.7.2.2. BiLevel Local Power Supply

Refer to Schematic J 0320-2 for the discussion on BiLevel control.

D417 and D418 provide a local zener regulated power supply for the BiLevel control circuitry. R401 is the current limiting resistor with C419 providing power supply bypass.

The junction of D417's anode and D418's cathode provide a 6.2 volt reference to set the operating points of the various comparators within the BiLevel control circuit.

3.7.2.3. Switch Control

With small to moderate amplifier output voltages, supplies V1 and V2 are in parallel. They remain in parallel until large output voltage requirements cause the control circuit to switch to the series mode. V1 and V2 remain in series until the amplifier's output voltage drops to a level such that operation is possible in the parallel mode.

The two halves of U403 form identical comparators that monitor the available voltage of DC supply V2 and compare it to the output voltage of the amplifier. When a positive going output voltage exceeds a predetermined ratio of the available supply voltage, U403 pin 1 produces a low voltage triggering U404. When triggered, the "Q" output of U404 changes from low to high driving the gates of FETs Q400, Q401 and Q402. The other half of U403 (output on pin 7) reacts to negative going output voltage. Both halves of U403 receive V2 and amplifier output voltage differentially.

The time constant set by C418 and R416 on the input of U404 sets the maximum switch frequency of the supply. This time constant forces the supply to stay in the series mode regardless of amplifier condition for 200 S. The reset pin of U404 (pin 4) forces the output of U404 low when FET damaging conditions exist.

C416 and C417 provide hysteresis around the comparators of U405 to insure stable operation.

3.7.2.4. Switch Protection

Protecting transistors conducting high current can be troublesome in circuits that do not have convenient current sample points. FET Q400-Q402 fall into this class of problems but protection has been designed based on the following two conditions being present at the same time.

- Higher than normal on-state drain-to-source voltage
- Gate drive present

When both of the conditions exist, a reasonable assumption can be made that the FETs are operating in an area that if sustained will cause damage to the FETs. These two conditions are detected by U405 pin 7 and U405 pin 5.

U405 detects gate drive to the FETs at pin 7. Pin 6 is a reference input with the reference voltage set by R422 in series with R419.

U405 detects excessive source to drain voltage on the FETs at pin 5. R417 in series with R418 forms a voltage divider to input to pin 5 of U405. The reference is set by a voltage divider formed by R429, R420 and R422.

When both conditions are detected the outputs of U405 (pins 1 and 2) allow C420 to start charging thru R423. After 20 S, C420 will be sufficiently charged to turn on the section of U405 whose output is pin 14 discharging C421. As C421 discharges it turns on Q403 which pulls non-

3.8. Digital Panel Meter

Refer to schematic J0212-1 Rev. D and the block diagram in Illustration 3-5 for the discussion of 8524 Digital Panel Meter operation.

The Digital Panel Meter contains five functional areas:

- Attenuation
- RMS conversion
- Catch-and-Hold
- Display
- Power Supply

3.8.1. Attenuation

R1 and R2 form an input attenuator to scale the host amplifiers output voltage by a factor of 16.6. This attenuation is not needed in the current mode as the current monitor's output voltage is scaled to a value compatible with the input of the R.M.S. converter, U1. Range attenuation is performed by R3 and R4.

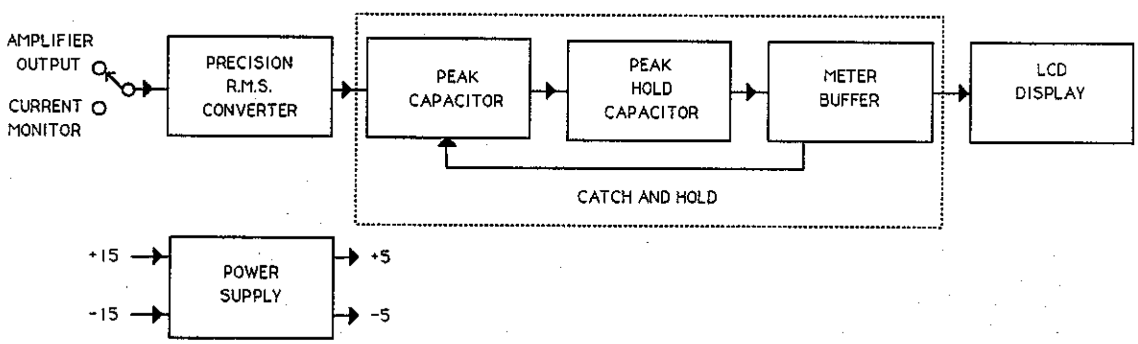


Illustration 3-5
Digital Panel Meter

3.8.2. Conversion

Ul is a precision R.M.S. convertor with a built in reference voltage. The response and conversion characteristics are set by capacitors C2 and C3, In the R.M.S. mode, C3 is the only capacitance in the circuit. When S3 is set to the Peak mode, C2 is placed in series with C3, making the effective capacitance slightly less than the value of C2. Because C2 is considerably smaller than C3, the response of Ul becomes very fast with an output voltage that is representative of the peak value of the input voltage. R5 trims the input offset via R6 while R10 and R9 trim the output offset voltage.

3.8.3. Catch-and-Hold

The catch-and-hold function begins at U2. U2A compares the input signal with the meter output through R13. Should the output signal be greater than the input signal, D1 conducts. If the opposite is true, Q1 conducts. Q1 charges C5 which is buffered by voltage follower U2B. U2B drives R13 and the input of the LCD display driver. The result is that C5 stores the largest peak value of the input signal.

The catch-and-hold discharge timing circuit consists of Q2, U3A and C4. Hold time is set by R19 and C4. When Q1 charges C5, its collector current triggers Q2 to fully charge C4. During the intervals when D1 is conducting, C4 discharges through R19. When the charge on C4 falls below 0 volts, the output of U3A changes from positive to negative discharging C5 through R15 and D2.

3.8.4. Display

The LCD display is formed by LCD display driver U4 and a 3/4", 3 1/2 digit display.

The oscillator frequency of U4 is set by R26 and C6 to 48kHz. R22, R24 and R25 set the calibration of U4. The integration and auto zero characteristics of U4 are controlled by components C7, C9, C10 and R27.

LCD displays will burn if a constant DC is applied to segments. The display driver, U4, handles this with the Back Plane (BP) signal, a square wave, connected to COM of M1. The Back Plane frequency is 1/800th of the oscillator frequency. When a segment is activated (dark) its drive signal will be out of phase with BP. When not active, segment drive is in phase with BP.

Decimal point position is controlled by the setting of S2. The Back Plane (BP) signal is exclusive "ORed" with +5 volts by U5 to drive the appropriate decimal point in M1. The Test (TST) signal of U4 is used as a negative supply for U5. When the input of the non-selected decimal point is left open by S2-B, R29 or R28 pull the input to the potential of the negative supply. When the decimal point is selected, the input is pulled to +5 by S2-B.

A buffered output of Ul (pin 8) drives the inverting input of U3A. As a result the output of U3A swings from +5 Vdc when the input signal is negative to 0 Vdc when the the input is positive. The output of U3AB is then exclusive "ORed" with the Back Plane signal in U5 to drive the "-" segment in M1.

3.8.5. Power Supplies

D4 and D5 along with R20 and R21 form conventional zener diode power supplies. On board regulation provides maximum isolation from supply loading that can occur on the + 15 volt supplies that would degrade the accuracy of the 8524 Digital Panel Meter.

SECTION 4. TROUBLESHOOTING AND REPAIR

4.1. Introduction To Troubleshooting Model 8524

This section is not intended to provide complete troubleshooting specifications for all possible Model 8524 malfunctions. Rather, it is an informal set of shortcuts that are designed to aid in getting an inoperative Model 8524 back in service as quickly as possible.

The procedures outlined in this section are limited to the identification and isolation of the more typical problems. Further, this section will only be of value in the handling of gross component failures as distinct from intermittent malfunctions.

The procedures outlined in this section are directed to an experienced electronic technician. There is no attempt made to cover all of the many details involved in setting up and conducting typical electronic repair and test procedures. If components are replaced, refer to Section 4.17 "Component Replacement" for instructions on required adjustments.

4.2. Repair Precautions

Model 8524 undergoes frequent engineering updates. As a result, modules and electronic assemblies may not be fully interchangeable between units. Particularly, the main circuit board undergoes periodic engineering modifications which could effect an interchange of two main circuit boards between Model 8524's from different production lots.

The safest field repair procedure is replacement of an individual component, and this section is designed to aid the repair technician in isolating common problems down to the component level.

4.3. Preparation For Troubleshooting And Repair

WARNING!

These procedures are performed with unit under minimum 208 vac power and with protective panels removed. Test steps must be followed precisely and technician must exercise extreme caution to avoid accidental touching of improper terminals or components. Powerful and potentially lethal electric shocks can occur as a result of accidental contact with capacitors, terminals, heatsinks and other interior components.

4.3.1. Equipment Requirements

In addition to standard hand tools and electronic test equipment, the following specialized equipment is recommended to perform the tests in this Section. Using the equipment listed will help insure that Model 8524 can be tested and adjusted to factory specifications. Any compromises in equipment could result in a compromise in performance or calibration.

4.4. Make Thorough Visual Inspection

Here is a check list of areas requiring a thorough physical inspection before powering up unit for testing:

1. Remove top, front, side and rear panels from unit.
2. Thoroughly inspect all modules for charring, breaks, deformation or other signs of physical damage.
3. Look for foreign objects that may be lodged inside the unit.
4. Inspect entire length of wires and ribbon cables to look for breaks or other indications of physical damage.
5. If the above visual inspection shows any physical damage, replace the defective parts before proceeding to the following troubleshooting procedures.

4.5. Output Continuity Test

This test will help identify a defective output transistor which will be one of the more likely causes of unit malfunction.

1. The power remains off.
2. Place red lead of ohm meter on heatsink of first output well and black lead on emitter bus strip of same well. See Illustration 4-1 for test points.
3. Test all four output wells in similar locations.
4. Compare ohm meter readings. All four readings should be very similar.
5. If meter reading on one well is lower than the others, that well contains a defective output transistor. Unsolder emitter resistors one at a time and check for shorts.
6. Replace defective transistor(s).

If meter readings on all four wells are very similar, proceed to following series of tests which presume that the problem is in the main circuit board.

- Hewlett Packard HP 400F Voltmeter
- Tektronix 2215 Scope to observe waveforms
- Fluke 8060A DVM to measure voltage
- Wavetek Signal Generator 193 as signal source
- Intermodulation Analyzer to measure distortion
- Non metallic screwdriver for adjustments GC 8276 or 8277
- Current Shunt (Typical .005 ohms)

Table 4-1 Recommended Equipment

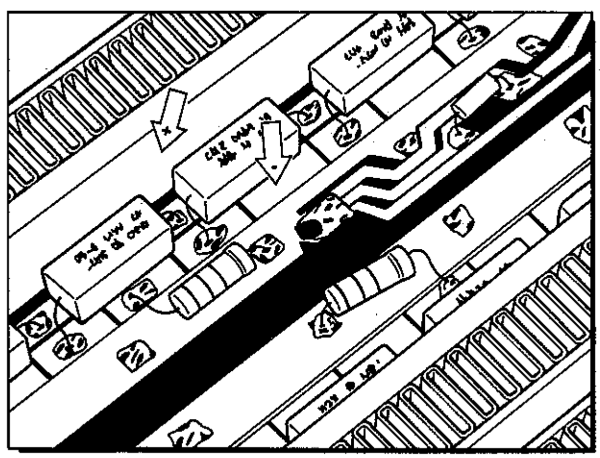


Illustration 4-1 Output Well Test Points

4.6. Preparation for Testing Under Power

The following series of troubleshooting tests are made with unit under power and with a load attached:

1. Connect input voltage of 208 VAC, 3 phase.
2. Load: connect 0.5 ohm, 0.5 mh load with positive lead at "output" terminal and negative lead connected to "sampled common".
3. Check position of jumpers B5 and B6. For testing under constant voltage, both jumpers should be in the full left position. See Illustration 4-2.

4.7. Check STANDBY Function

This test verifies that unit goes into and out of STANDBY through operation of switch S501.

1. DISABLE amplifier. Move switch S501 down to STANDBY position.
2. If unit is operating properly, the STANDBY indicator will be on. All other indicator lights should be out.
3. If STANDBY does not light, there is a problem in the STANDBY circuit. Check U501 or Q500.
4. Switch S501 up to the ENABLE position.
5. Verify that the READY indicator is on and that the OVERLOAD indicator goes off. Proceed to Section 4.8
6. If both READY and OVERLOAD indicators are on, there is a defect on the main board. Proceed to Section 4.8.
7. If unit does not come out of STANDBY from Step 4 above, there are several possibilities:
   a. If STANDBY remains on and all other indicators are off, there is a problem in the STANDBY circuit. Check U501 or Q500.
   b. If both STANDBY and OVERTEMP are on, perform tests from Sections 4.12 through 4.14.
   c. If both STANDBY and FAULT are on, the problem is likely in the output stage.
   d. If both STANDBY and OVERVOLTAGE are on, either AC Mains are too high (see Section 4) or there is a problem at V501.

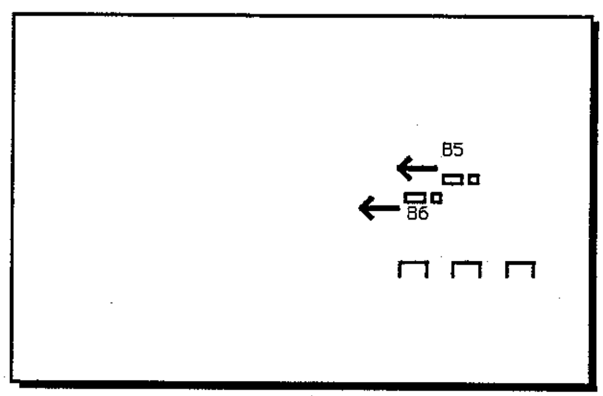


Illustration 4-2 Constant Voltage Set-up

4.8. Isolate Main Board Problem

If previous tests were normal, the cause for a defective unit is likely on the main board. The following three tests will aid in narrowing down the possible problem area.

1. Set up for main board tests as follows:
   Power: 208 VAC, 3 phase (as per previous test)
   Load: 0.5 ohm, 0.5 mh (as per previous test)
   Switch S500 up to RESET
   Switch S100 up to MASTER

2. Apply a 300 Hz toneburst, 5% duty cycle at the amp input on back panel. Connect scope to T104 and T105.

3. There are several possible signal results from this test. Proceed to subsequent tests based upon the following schedule:

4.9. Test to Isolate Gain Stage

This test is undertaken if the procedure in Section 4.8 produced a straight line at T104.

1. The test setups are:
   Input voltage: 208 VAC, 3 phase (same as previous)
   Load: 0.5 ohm, 0.5 mh (same as previous)
   Switch S100 down to SLAVE
2. Apply a 300 Hz toneburst, 5% duty cycle to input. Connect scope to ground and T100.
3. If no signal is produced at T100, the Main Board problem is likely within the input section. Try replacing U100. Check out associated resistors and capacitors in the input section. Also, double check ribbon cable leading to the input section for a physical defect that may have been overlooked previously.

4. If testing at T100 shows an appropriate sinewave, then the Main Board problem can probably be isolated to the gain stage. To verify a gain stage malfunction:
   a. Switch S100 up to MASTER. Defective waveform should reappear.
   b. Replace U202 and recheck. Then replace U203 and recheck. If neither U202 nor U203 are the cause of the problem, check all transistors in the gain stage (see Schematic J 0304-6).

	SCOPE RESULTS	INDICATION
a.	Properly formed sinewave	No apparent main board malfunction. Go to Section 4.12 and following tests.
b.	Straight Line	Make test from Section 4.9
c.	Positive or negative clipping	Indicates that problem is probably in output section. Make checks from Section 4.10.
d.	Oscillations or other erratic wave forms	Could result from a various causes. Make test from Section 4.11.

Table 4-2 T104 Test Results

4.10. Checks to Identify T104 Clipping

This test is indicated if test from Section 4.8 resulted in either positive or negative clipping of the sinewave. The most likely cause of clipping from a T104 test point is a problem in the Main Board gain stage. Check for a shorted semiconductor within section 200 of Main Board.

If there is no obvious defect within section 200 of Main Board, a clipped wave could also result from a defective output transistor. Each individual output transistor should be tested for shorts. See Illustration 4-3 for output transistor test points. Replace any output transistor reading 0.66 ohms less resistance than others.

When testing output transistors, also test emitter resistor associated with each transistor. Resistors will either be operational or obviously defective. There is no "medium level" of function for these components.

If tests in Sections 4.8, 4.9, and 4.10 have failed to isolate anything defective on the output shelf, proceed to test 4.11 for additional checkout of the output stage.

4.11. Check Out Waveform Oscillations

This test may be conducted if the test results of Section 4.8 were oscillations at test point T104. Proper conduct of the test requires a solid familiarity with Model 8524 schematics and high proficiency with electronic test procedures.

1. Attach a scope probe to T201.
2. Inject a 300 Hz tone burst, 20% duty cycle, at J1 and slowly raise the input voltage until an error signal is seen on T201.
3. Look for spurious responses up to clipping.
4. Capacitors and resistors marked as selectable on the output stage schematic may be selected within limits to keep T201 clean up to clip.

The previous tests and checks have examined for the more common problems in the output section and the gain stage of the Main Board. If all of the previous tests have proven inconclusive, the following three troubleshooting tests should be conducted.

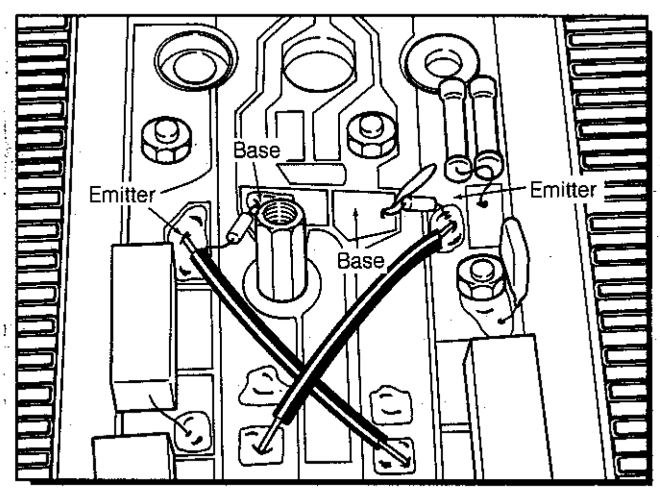


Illustration 4-3 Output Transistor Test Points

4.12. Check for Defective Thermal Switch Or Thermal Switch Wiring

To check for a defective thermal switch or associated wiring flaws, consult wiring diagram and perform a continuity test through the thermal switch wiring path. An OVERTEMP condition places the amplifier in STANDBY. If the OVERTEMP pulse is extremely short, as it would be in the case of defective wiring or switches, the OVERTEMP pulse may be too brief to see. And since the return to READY is automatic after any OVERTEMP condition is over, the READY light will return. Thus, the signal STANDBY alternating with READY for no apparent reason could indicate a possible defect in thermal switches or their wiring.

4.13. Check For Inadequate Cooling Air Flow

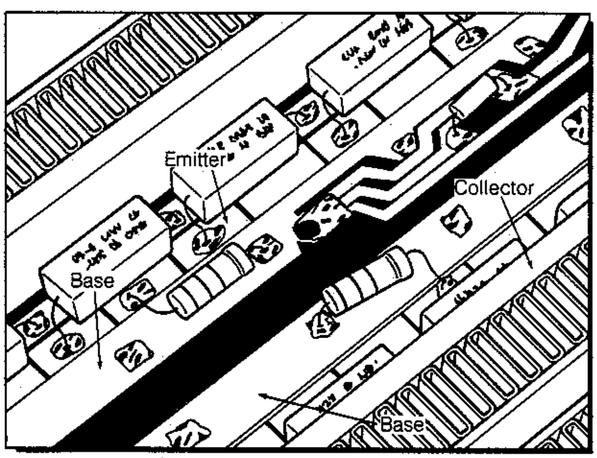
1. Check air filters.
2. Clean any filter clogged with dirt.
3. With power ON, visually inspect fans for correct operation.
4. Replace any fan not operating, operating at reduced speed, or running backwards. (Air flow must go inward at fans, and outward from front panel grille. If a replacement fan happened to be defective, it might run backwards.)

4.14. Check for Overheating of Individual Output Well

WARNING!

Do not touch output wells. Heatsinks carry electrical current and may be hot. Serious burns or electric shock may result.

1. Turn power ON.
2. Allow output well to heat up.
3. Disconnect power.
4. Place hand *near* (do not touch) output wells, one at a time.
5. Test any output well which is substantially hotter than others. See Section 5.13 for instructions on servicing of output components



4-4 Output Transistor Test Points

4.15. Further Testing Procedure For Output Fault

Section 4.10 covered procedures for testing individual output transistors. This section describes more detailed checks on other output section components.

1. Test output transistors at collector and emitter terminals. See Illustration 4-4 for location of terminals.

CAUTION!
When replacing output devices, order from TECHRON only, matching part number AND grade number AND color of stamping with devices in your unit. All output devices in each well must be matched to insure stable operation of amplifier.

2. Replace any output transistor reading 0.66 ohms less resistance than others.
3. When testing output transistors, also test emitter resistor associated with each transistor.

Note: Resistors will either be operational or obviously defective. There is no "intermediate" level of function for these.

4. Test driver transistors. See Illustration 4-5 for test points.

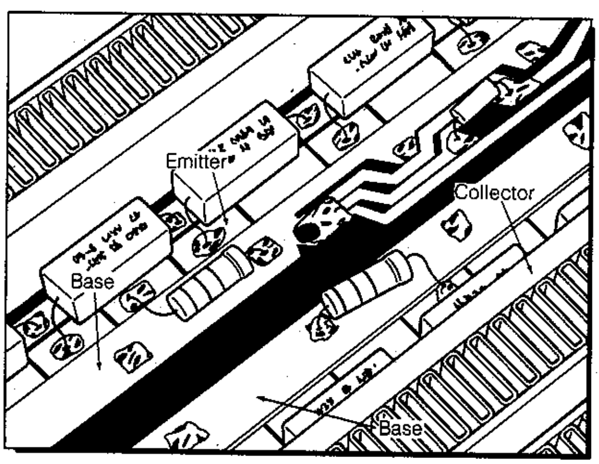


Illustration 4-5 Driver Transistor Test Points

5. Check predriver, a TO220 device, located on predriver board.

Note: Leads of predriver are arranged, as mounted, base — collector — emitter. See Illustration 4-6.

6. When testing predriver, apply leads of ohm meter as follows:
   a. NPN wells (1 and 4): Red (+) on collector; black (-) on emitter.
   b. PNP wells (2 and 3): Black (-) on collector; red (+) on emitter.
7. Readings for predrivers should show high resistance.
8. If predriver shows low resistance, replace.
9. If predriver is replaced on well 1 or 4, check bias servo, TO92 device, glued onto heatsink next to predriver board.

Note: Leads of bias servo are arranged Emitter — Base — Collector, when looking at the flat side of the device.

4.16. Further Testing

If Model 8524 is inoperative and all of the previous tests have failed to isolate the problem, you must now make a complete continuity test based upon the schematics and wiring diagram. The cause of the problem must be considered unusual or obscure.

As an alternative to a complete continuity test, the unit may be returned to Techron for factory testing repair.

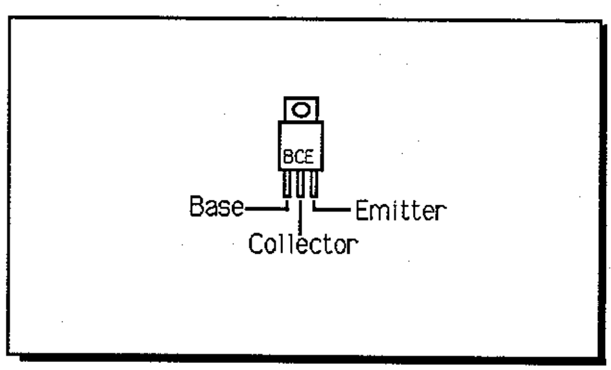


Illustration 4-6 PreDriver Transistor Test Points

4.17. Component Replacement

If any of the preceeding tests resulted in component replacement, a proper servicing effort would call for conduct of the complete Testing and Adjustment procedure (Section 8). If it is not practical to run the complete Testing and Adjustment procedure, an expedient alternative would be to check only those adjustments related to specific components. As a short-cut, temporary measure, use Table 4-3 to determine if any corresponding adjustments are required.

C100	C101	R237-240	R236
C110	C101		
C101	Adjust Same	R304	R305
		R305	Adjust Same
C103	Selected to Load	R306	R305
C104	Selected to Load		
C105	Selected to Load	R323	R334
		R334	Adjust Same
D650	R651	R335-348	NA
		R500-510	NA
N100	Adjust Same		
N300	R305	R514	R516
N301	R334	R516	Adjust Same
		R517	R516
Q300	R305		
Q301	R334	R651	Adjust Same
Q610-611	R651	R652	R651
Q650	R651	R654	R651
Q652	R651	R761-763	N102
Q810-811	R853	R812	Selected with U800
Q850	R853	R853	Adjust Same
Q852	R853		
		R854-856	R853
R1O9	Selected to Load	R923	Selected with U900
R108	Selected to Load		
R120	R121	T2	R516
R121	Adjust Same		
		U120	R121
R204	Adjust Same	U202	R204
R205	R204	U203	R234
R232-233	R236	U300	R305, R334
R234	Adjust Same		
R235	R234	U400	R148, R516
R236	Adjust Same	U800	R812
		U900	R923

Table 4-3 Component Interaction Table

SECTION 5: DISASSEMBLY AND ASSEMBLY

WARNING

Model 8524 carries potentially lethal voltages even after main power supply has been disconnected. After power shutoff, and before any service procedure, wait at least one minute for automatic capacitor discharge. Verify discharge by testing capacitor terminals or rectifier blocks.

5.1. Introduction To Disassembly And Assembly

From a mechanical standpoint, servicing of Model 8524 is straight forward. Illustration 7-1, Section 7, is the master exploded-view assembly drawing that shows the relationship of modules and assemblies.

This section has two purposes:

- To review important safety information for the protection of both equipment and servicing personnel.
- To identify several assembly and disassembly procedures that might not be apparent from a study of Illustration 7-1.

5.2. Important Safety Information

5.2.1. Introduction

Model 8524 operates from 208 volt, 3 phase AC mains. In addition to physical hazards to servicing personnel, certain electrical conditions could be damaging to component parts.

5.2.2. Disconnecting Power Supply

Before attempting any servicing of Model 8524, shut down outside power supply by :

1. Turning of power at CB1 (Item 59 on Illustration 7-1).
2. Disconnecting AC mains plug from rear of unit.

Rear Circuit Breaker CB1 may be used to temporarily shut down power unit. However, disconnecting the plug provides extra measure of safety to the service technician.

5.2.3. Discharging Capacitors

Illustration 5-1 shows power supply components as viewed from inside of Model 8524.

Model 8524 includes two bleeder resistors that are designed to discharge capacitors within one minute after power shut off. One bleeder is mounted on the capacitors and the other is mounted on a PC board. Do not touch any internal part of Model 8524 until more than one minute after power shutdown.

1. After shutting off power, wait one minute.
2. Remove bottom cover (Item 24 on Illustration 7-1) to expose the power supply capacitors.
3. Verify capacitor discharge by connecting a voltmeter across "+" and "-" terminals of the power supply capacitors (two places). Illustration 5-1 shows test points.
4. Voltmeter should give reading of less than 50 volts.

5.2.4. Floating Ground

Internal electrical components of Model 8524 are not grounded to chassis. Because of this floating ground feature, test equipment used in servicing Model 8524 should not be earth grounded. There is a possibility of erroneous readings occurring from the use of grounded test equipment. Use an isolation transformer to float test equipment from earth ground.

5.3. Removing and Installing in a Cabinet

Removing an 8524 from a cabinet requires removing all connections from the back panel as well as removing the amplifier from the cabinet. Before removing connections to the amplifier, carefully note locations of all wires and cables. System connections are not covered in this manual.

WARNING!

Do not pull more than one 8524 amplifier forward at one time. The cabinet will become unbalanced and tip forward with more than one 8524 pulled forward.

WARNING!

Disconnect the AC mains from the cabinet before removing or installing an 8524. Electrocution or electrical burns may result from contact with uninsulated terminals inside the cabinet.

To remove amplifier:

1. Remove the eight screws that hold the amplifier to the front mounting rails.
2. Pull the amplifier straight out from the cabinet until the slide reaches the stops.
3. Remove all wires and cables from the back of the amplifier.

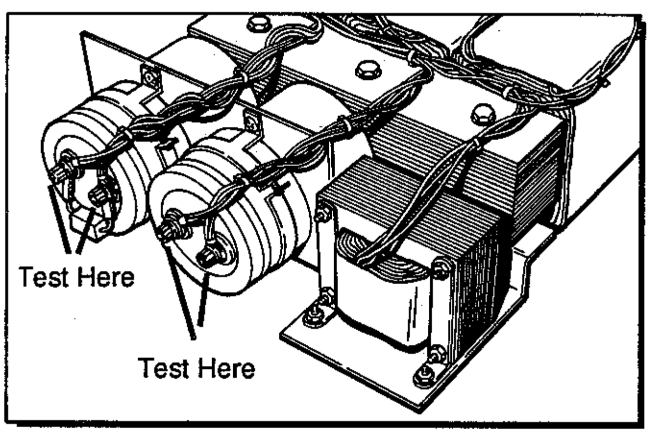


Illustration 5-1 Capacitor Test Points

WARNING
Support the amplifier with a lift device in the next step. Model 8524 cannot be safely handled by one person.

4. Release the amplifier from the slide rails.
5. Pull the amplifier straight out until the two halves of the slide rails disengage.
6. Place the amplifier on a table or bench top for service.

To install amplifier:
1. Support the amplifier with a lift device.
2. Pull slide rails out of the cabinet until they reach maximum extension.
3, Position the amplifier to engage the slide rails. Push the amplifier into the cabinet until the slide rails reach the stops.
4. Reattach the cables and wires to the back of the amplifier.
5. Release the slide rail stops and push the amplifier into the cabinet until it is flush with the other amplifier.
6. Secure the amplifier front panel with eight screws, four on each side.

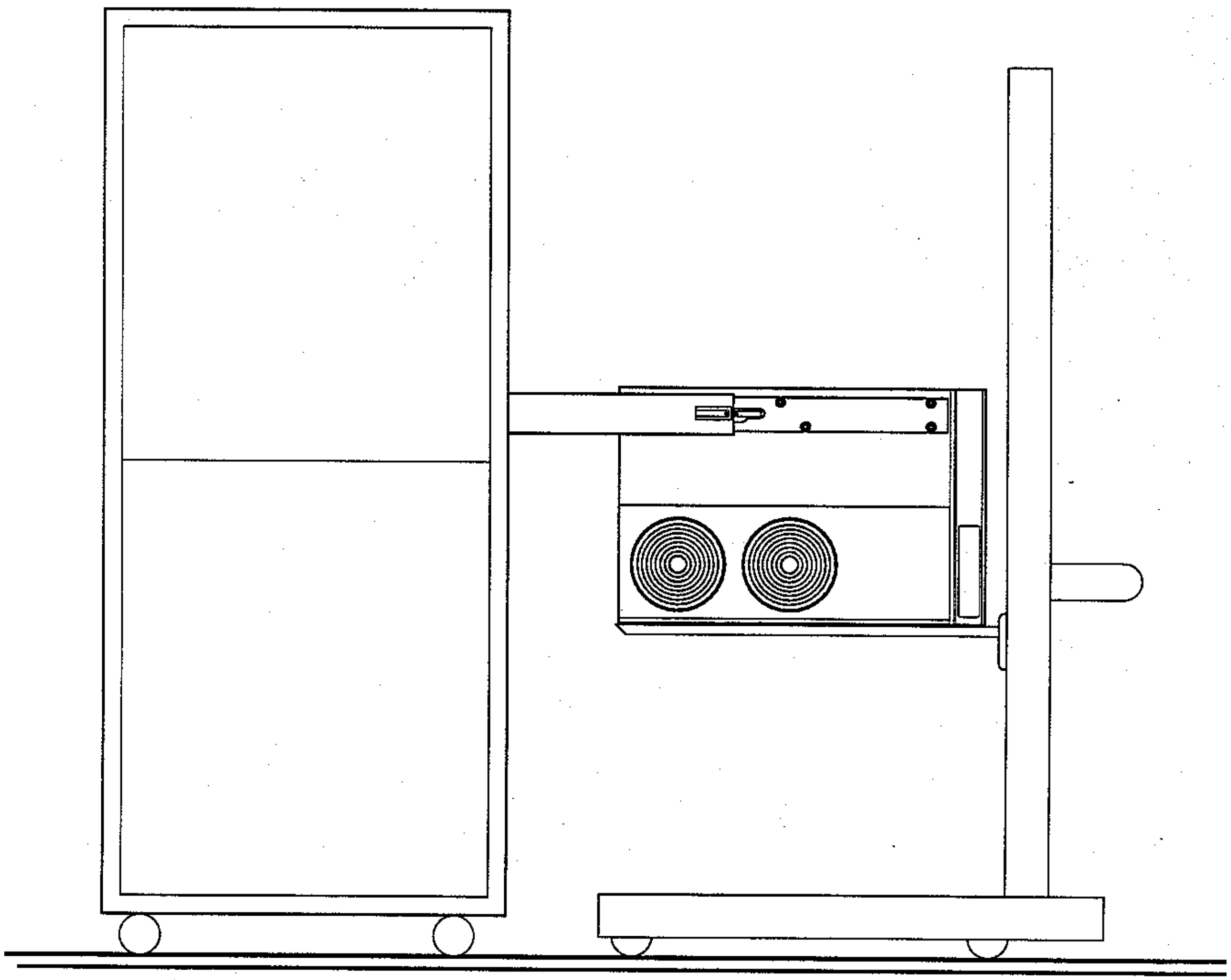


Illustration 5-2 8524 On Lift

5.4. Front Panel Removal

To remove front panel (Item 8, Illustration 7-1), loosen four screws (Item 10) until front panel can be removed. Be sure retaining washers do not fall off.

CAUTION

Ribbon cables and other connections will be damaged if they are pinched when replacing the front panel. Position all cables away from the edges of the front panel before securing the front panel.

5.5. Removal of Rear, Top, Bottom, and Side Panels

The front, top and bottom panels can be removed independently. The fan covers can also be removed individually.

WARNING!

After panels are removed, make sure capacitors are allowed to discharge before proceeding with any further service.

5.6. Service of Output Shelf Components

The output shelf (Item 67) is a frame that holds the four output wells. Removal of the output shelf is not needed to service the output wells. Remove the output shelf to service components mounted underneath the shelf.

To remove the output shelf:

1. Disable the amplifier by following the next four sub-steps:
   a. Shut off power at CB1.
   b. Disconnect the amplifier from the AC mains.
   c. Wait one minute for capacitors to discharge.
   d. Verify capacitor discharge (see Section 5.2.3).
2. Remove top panel (Item 66) and bottom panel (Item 24).
3. Using long arm 3/16" allen wrench, unscrew and remove red, blue, red/white and blue/white wires from capacitor terminals (Item 3, Illustration 7-3). Replace and finger-tighten socket cap screws to hold multiple wires in place.

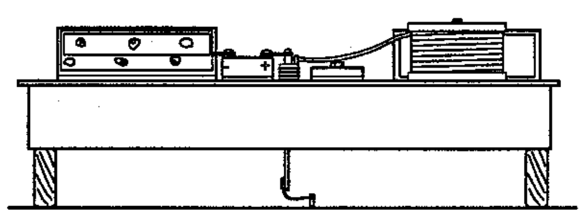


Illustration 5-3 Output Shelf Support

4. Disconnect the in-line connections in the two gray wires.
5. Disconnect the 3-conductor in-line connection.
6. Disconnect the output interconnect board from Main Circuit Board.
7. Remove back panel.

CAUTION
Be prepared to place the output shelf on blocks before removing it from the amplifier.

10. Remove output shelf assembly (Item 67) from rear of unit. Place the shelf on blocks to prevent damage to components.

Proceed to the appropriate section for individual component service.

To install output shelf assembly:
1. Slide output shelf assembly (Item 67) in from the rear. Make sure that interconnect board is not damaged as shelf and front panel come together. See Illustration 5-4.
2. Replace back panel (Item 63).
3. Reconnect interconnect board to J400 on Main Circuit Board.
4. Reconnect two gray wires with in-line connectors.

Note: Gray wires are interchangeable and may be connected to either connector.

5. Reconnect 3-conductor in-line connector.
6. Reconnect wires to terminals on capacitors (Item 3, on Illustration 7-3). Connect red on red, blue on blue, ect.

CAUTION
Finger-tightening of (socket cap) screws on capacitor terminals will result in loose connections that will overheat. Use 3/16" long arm allen wrench to securely tighten screws.

7. Tighten socket cap screws with allen wrench.

5.6.1. Flyback Diode Block, D607

(see Item 19 on Illustration 7-2; also see Illustration 5-5)

To remove:
1. Note and mark wiring connections on Flyback Rectifier Block (see Illustration 5-5).
2. Remove mounting nut and washer from captive mounting stud.
3. Unsolder red and blue wires.
4. Unplug brown and black wires.

To install:
1. Apply heat sink compound completely and lightly to flyback rectifier block mounting surface.
2. Install washer and mounting nut. Tighten.
3. Connect brown and black wires.
4. Solder red and blue wires.

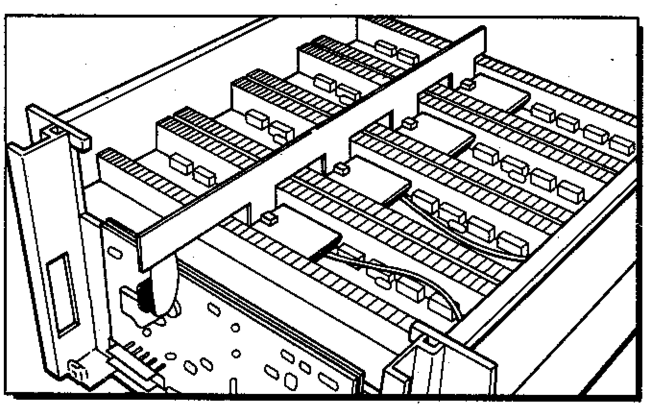


Illustration 5-4 Interconnect Board

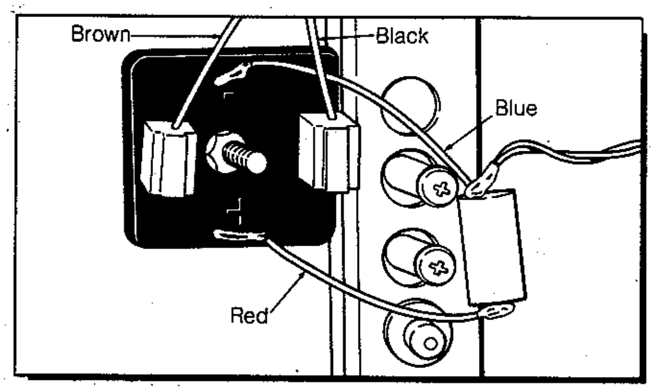


Illustration 5-5 Flyback Diode Block Detail

5.6.2. Current Sampling Resistor Assembly

The current sampling resistor assembly consist of six parallel resistors (see Item 3, Illustration 7-3). Individual resistors may be replaced.

To remove:
1. To remove current sampling resistor assembly as a unit, remove two large phillips screws on base plate.
2. Unsolder orange and black wires from bus bars.
3. Use a drill to remove the mounting rivets from individual resistors.

To install:
1. Apply heat sink compound (see Renewal Parts List) to surface of replacement resistor. Apply compound completely and lightly so that only a small amount will be squeezed out when resistor screws are tightened.
3. Install new current sampling resistor assembly with new 4-40 hardware.
4. Orange and black wires pass through holes in bus bar and are secured with heavy solder. Duplicate this soldering method when replacing these wires.
5. On center resistors, route black wires down grooves on side of resistor, one black wire on each side. Glue wires in place.

5.6.3. Servicing Bus Bar Assembly

Bus bar assembly includes four copper bus bars with insulation material between them. All bus bar assembly components are individually replaceable when removed from output shelf. See Illustration 7-3 for details of bus bar assembly.

Should insulation between individual bus bars require replacement, use only original equipment insulating material.

WARNING!
Substituting insulating material other than original specifications may result in unsafe or unstable operation of amplifier. Order replacement insulation from TECHRON (see Renewal Parts List).

5.6.4. Foam Insulation

Foam insulation between heat sinks and output shelf serves as gasket for cooling air. A gasket which is damaged or removed during service procedure must be replaced. Order replacement gasket material from TECHRON only.

5.6.5. FET Switch Service

All "Item" numbers in this section refer to Illustration 7-3.

Removal:

1. Each FET switch is connected to a copper bus bar and a PC board. (see Illustration 7-3, Items 44 and 45). Unsolder the FET from both places.
2. Remove FET mounting screws (Item 30).
3. Loosen leads, then remove faulty transistor.

Replacement:

1. Replace transistor with one having the same part number.
2. Apply heat sink compound (see Renewal Parts List) to surface of replacement transistor. Apply compound completely and lightly so that only a small amount will be squeezed out when transistor screws are tightened.
3. Install mounting screws. Tighten mounting screws before resoldering leads. Torque to 11 in./lb. (+ 20%).

CAUTION

Tightening transistor mounting screws after the leads are soldered will break internal transistor connections. Solder the transistor leads after the screws are tight.

4. Solder the leads to the bus bar (Item 44) and PC board (45).

5.6.6. Control Board Service

The power supply control board is mounted underneath the output shelf. See Illustration 7-2, Item 50.

To remove:

1. Lift up on the control board (Item 50) to remove it from the mounting pins. A slight front-to-back rocking motion will assist in removal.
2. Carefully position the board in a vertical position to gain access to both sides of the board for service.
3. Use a solder removing tool or solder wick to remove solder from the holes in the board before removing components.

CAUTION

The holes in the control board are plated. If solder is not completely removed from the hole before the component is pulled out, damage to the board will result.

To install:

4. Position the board directly over the three mounting pins.
5. Push straight down on the mounting pins until the board seats on the shoulder of the pins.

5.6.7. Switch Diode Replacement

To remove:

1. Remove two screws from the top of the diode that hold the switch bus bars.
2. Remove the screws that connect the switch bus bars to the Vcc bus bars (Item 40).
3. Shift the position of switch bus bars Items 42 and 43 slightly to one side or the other to reach diode mounting screws (Item 47).
4. Remove diode mounting screws.
5. Slide defective diode sideways to remove.

To replace:

1. Apply heat sink compound (see Renewal Parts List) to surface of replacement diode. Apply compound completely and lightly so that only a small amount will be squeezed out when transistor screws are tightened.
2. Position the replacement diode over it's mounting holes. The "+" end of the diode is towards the bus bars.
3. Replace the mounting screws and washers.

5.6.8. Termination Board Service

CAUTION

Prolonged heat applied to the termination PC board will cause damage to the board materials. Use a large wattage (500 watts) soldering iron for these procedures. A smaller iron will extend the period of time needed to heat the copper bus bars and will damage the PC board.

To Remove:

1. Remove solder from two points on each end of the termination PC board where it is soldered to the bus bar.
2. Carefully position the board to gain access to the components mounted on it.

To Install:

1. Position the board over the the two mounting prongs on the copper bus bars.
2. Use a 500 watt or larger soldering iron to quickly solder the board to the copper bus bar.

5.7. Servicing Fans

Model 8524 includes four fans (Illustration 7-1, Item 43) that provide a flow of outside air through heat sinks. Internal heat protection will shut down amplifier if cooling from fans is insufficient to dissipate heat. Fans are interchangeable with each other but not repairable. Defective or inoperative fans must be replaced.

The following instructions describe replacing fan on one side only. Procedure is identical for all four fans.

WARNING!

Verify capacitor discharge (see section 5.2.3) before servicing fans. Terminals located near fans could carry lethal voltages.

To remove fans:

1. Disable the amplifier by following the next four sub-steps:
   a. Shut off power at CB1.
   b. Disconnect the amplifier from the AC mains.
   c. Wait one minute for capacitors to discharge.
   d. Verify capacitor discharge (see Section 5.2.3).
2. Remove single screw (Item 52) on rear panel to loosen fan cover (Item 46).

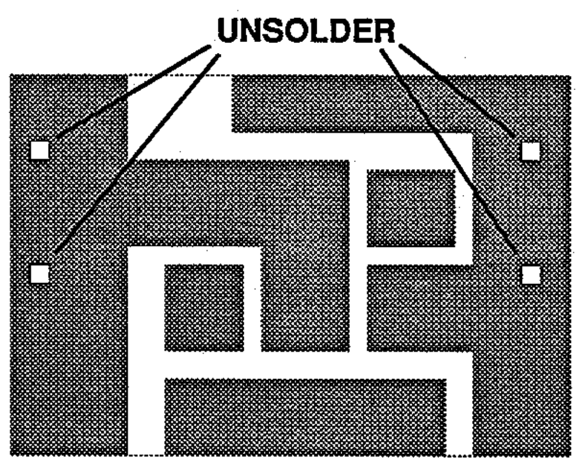


Illustration 5-6 Termination Board Solder Points

3. Slide fan cover out.
4. Verify capacitor discharge.
5. Remove four socket cap machine screws (Item 42) holding each fan in position.
6. Remove white connectors for appropriate fan. Illustration 5-7 shows correspondence between fans and connectors. Front pair of connectors power front fan. Rear pair of connectors power rear fan.

To install a new fan:
1. Connect white terminals as shown in Illustration 5-7.
2. Make sure that air flow directional arrow on fan case points in to center of unit.
3. With fan in position, insert and tighten screws (Item 42) at each corner.
4. Slide in fan covers (Item 46). Fasten with single screw (Item 52) through rear panel.

5.8. Power Supply Rectifier Blocks

(Item 39, Illustration 7-1; also see Illustration 5-8)

To remove:
1. Disable the amplifier by following the next four sub-steps:
   a. Shut off power at CB1.
   b. Disconnect the amplifier from the AC mains.
   c. Wait one minute for capacitors to discharge.
   d. Verify capacitor discharge (see Section 5.2.3).
2. Remove wires.
3. Remove phillips mounting screw. Nut is captive.

To install:
1. Solder two .1 MF capacitors in place on new rectifier (refer to C409 through C414 on schematic).
2. Apply heat sink compound to block mounting surface.
3. Install mounting screw.
4. Reattach wires as shown in Illustration 5-8. Each block has two interchangeable wires of same color along with red (+) and blue (-).

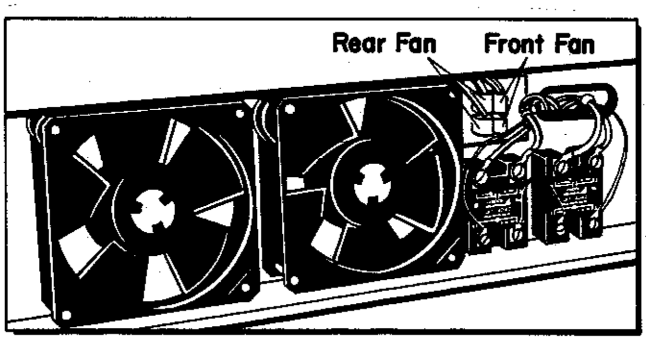


Illustration 5-7 Fan Connector Matching

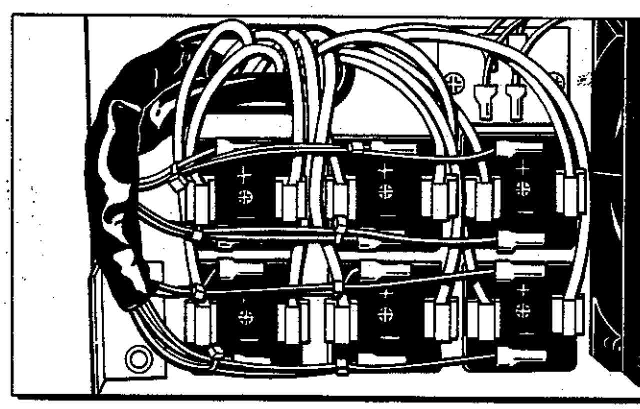


Illustration 5-8 Power Supply Rectifier

5.9. Solid State Relays

(See Item 3 on Illustration 7-1, see also Illustration 5-9)

To remove:

1. Disable the amplifier by following the next four sub-steps:
    a. Shut off power at CB1.
    b. Disconnect the amplifier from the AC mains.
    c. Wait one minute for capacitors to discharge.
    d. Verify capacitor discharge (see Section 5.2.3).
2. Disconnect wiring at screw terminals
3. Remove two mounting bolts from solid state relay. Nuts inside are captive.

To install:

1. Apply heat sink compound lightly and completely to mounting surface of solid state relay.
2. Mount relays in place on side panel.
3. Reattach wires.

5.10. Ribbon Cables Serving J5 and J6

Before removing Ribbon Cables, note routing. Reinstall according to original routing.

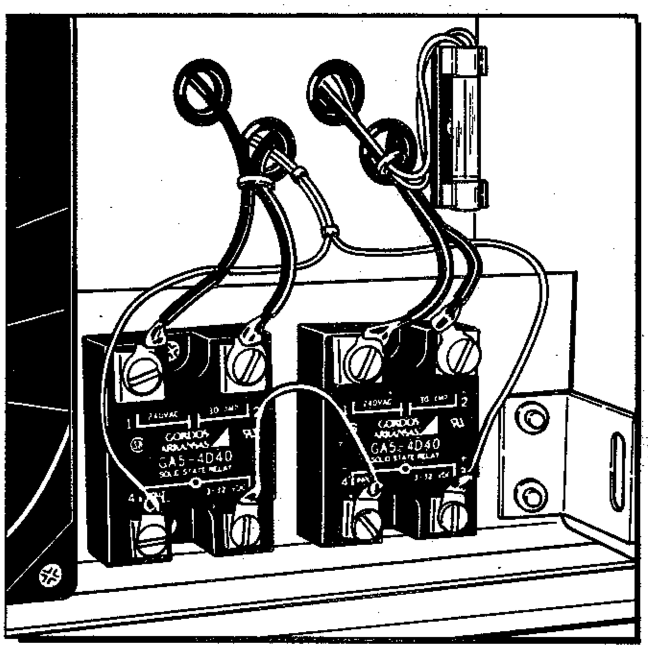


Illustration 5-9
Solid State Relays

5.11. Servicing Main Circuit Board

Removal of Main Circuit Board (Item 13) requires disconnection of ribbon cables and output board connector, disconnection of main power supply, and removal of four mounting screws.

Service Main Board components in accord with standard PC board procedures. Most Main Board ICs can be serviced without removing Main Circuit Board. Use an IC extractor to avoid damaging these components.

CAUTION
The holes in the Main Board are plated-through. Use caution and good solder removal methods to avoid damage to the plating in the holes.

CAUTION
Once ribbon cables, output board connector, and power supplies are disconnected, the Main Circuit Board is no longer protected against static electricity. Service Main Circuit Board in a static-free environment. Wear wrist static straps to guard against damage to Main Circuit Board.

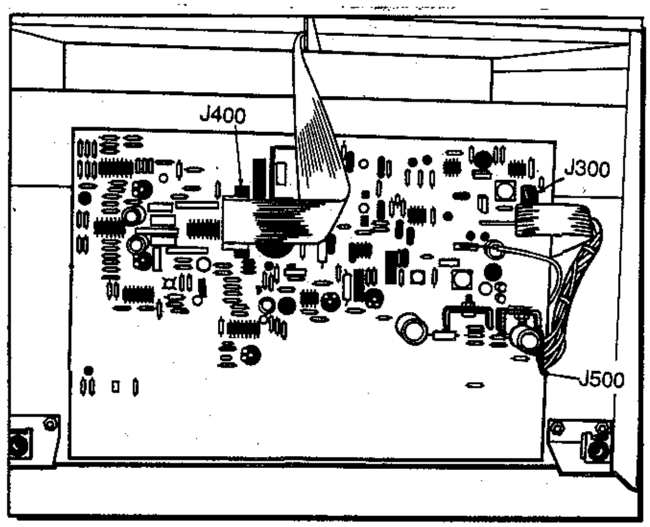


Illustration 5-10
Main Circuit Board Connections

To remove:

1. Disable the amplifier by following the next four sub-steps:
   a. Shut off power at CB1.
   b. Disconnect the amplifier from the AC mains.
   c. Wait one minute for capacitors to discharge.
   d. Verify capacitor discharge (see Section 5.2.3).
2. Remove front panel (see Section 5.4 for precautions on front panel removal and replacement).
3. Using ejector latches, disconnect ribbon cable from J300, and disconnect output connector from J400.
4. Disconnect power supply from terminal J500 on right side of circuit board.
5. After power supply is removed, inspect pins of terminal J500 and straighten any that may have become bent.

Note: Some versions of Model 8524 use a nylon washer on one or more Main Circuit Board mounting screws. Note position of washer for replacement.

6. Remove four mounting screws from Main Board.
7. Main Circuit Board and gray insulating panel (Item 14) can now be lifted off.

To install:

1. Place gray insulator panel (Item 14) over mounting holes.
2. Place Main Circuit Board (Item 13) in position and attach with four black nylon mounting screws.
3. Connect power supply cables at J500 taking care to protect connecting pins.
4. Connect ribbon cable to J300, and output connector to J400. Note that ribbon cable makes a "U-turn" over the connector. Further, note that connections will only fit in the correct location and only in the correct orientation. Only slight force should be needed to connect each of these connections. See Illustration 5-10.
5. If used, re-attach nylon washers on one or more mounting screws.
6. Refer to Section 6, Testing and Adjustment, for procedures to follow after replacement of Main Circuit Board.

5.12. Servicing Power Supply Components

Note: All "Item" references are from Illustration 7-5.

Power supply components include:
Two Capacitors (Item 19), Low Voltage Control Transformer (Item 5) and Power Transformer (Item 13).

WARNING!

Before servicing any power supply components, disconnect power by removing incoming power line. It is essential that capacitors be allowed to discharge before proceeding to any service work on power supply components. Follow safety shut down steps as explained in Section 5.1.

To service power supply components:

1. Disable the amplifier by following the next four sub-steps:
   a. Shut off power at CB1.
   b. Disconnect the amplifier from the AC mains.
   c. Wait one minute for capacitors to discharge.
   d. Verify capacitor discharge (see Section 5.2.3).
2. Remove top panel and bottom panels (see Section 5.5).
3. Remove output shelf assembly to provide access to power supply components (see Section 5.6).

5.12.1. Removal of Capacitors and Control Transformers

1. Remove mounting bracket (Item 8) which is held in position by three 1/4-20 x 2-1/2 capscrews (Item 10).

Note: In removing the capscrews take care to retain the shoulder washers that insulate mounting bolts from the bracket. There are six shoulder washers (Item 9), three on each side of the mounting bracket.

2. With capscrews removed, the entire bracket with capacitors and control transformer attached can be removed through the bottom of the unit.

5.12.2. Servicing of Capacitors

Each capacitor (Item 19) is attached to the mounting bracket (Item 8) with a capacitor mounting bracket (Item 4). A bleeder resistor (Item 1) bridges the positive and negative terminals of the left capacitor.

CAUTION

The outer surface of capacitors can be damaged by scraping or scratching. Protect the cylindrical surface from scratches, particularly when removing and inserting in compression ring.

To remove capacitors:

1. Verify discharge by connecting capacitor terminals with voltmeter. Voltmeter should show zero reading.
2. Remove the socket capscrews (Item 3) with a long arm 5/32 allen wrench.
3. Remove wires, noting mounting location for proper connection of replacement capacitors.
4. Remove bleeder resistor and bus bars.
5. Loosen bolts on capacitor brackets (Item 4).
6. Carefully slide capacitor out of capacitor bracket.

To install capacitors:

1. Carefully slide capacitor into capacitor bracket, taking care not to scratch surface of capacitor.
2. Tighten capacitor bracket.

CAUTION

Position positive and negative terminals identically on both capacitors.

4. Attach bleeder resistor (Item 1) on terminals farthest from control transformer (Item 5).
5. Attach blue (or blue/white) wires to negative(-) terminal and red (or red/white) wires to positive(+) terminals.
6. Finger-tighten terminal screws. (Red, blue, red/white and blue/white wires from the output shelf will need to be reattached before final tightening of terminal screws.)

5.12.3. Servicing of Low Voltage Control Transformer

To remove control transformer:

1. Trace the wires from transformer to their terminations. Note and mark connections to ensure proper installation of replacement transformer. Disconnect wires at termination points, unbundle, and remove low voltage control transformer.
2. Loosen four nuts (Item 9) holding control transformer to studs on large mounting bracket (Item 12).

To install control transformer:

1. Fasten control transformer (Item 11) to main mounting bracket (Item 12).
2. To reassemble inside unit, insert mounting bracket (Item 12) (with capacitors and transformer attached) through bottom of unit.
3. Insert 1/4-20 x 2-1/2 capscrews (Item 14) from bottom with shoulder washers (Item 15) on both ends. Fasten with 1/4-20 nuts and lock washers (Item 16 and 17) and tighten securely.
4. Connect wires at termination points.

5.12.4. Servicing of Power Transformer

To remove power transformer:

1. Note wire locations and mark as necessary. Particularly note the three Faraday shield wires from the transformer coils that are chassis-grounded behind the front panel. Except for the three Faraday shield leads, disconnect wires at termination points.
2. Separate the mounting bracket (Item 12) from the power transformer (Item 21)
3. Remove Main Circuit Board as described in Section 5.11.
4. Loosen, but do not remove six capscrews (Item 18) from power transformer brackets.

WARNING!

Power transformer (item 13) weighs over 40 pounds. Do not remove mounting bolts (item 15) unless transformer is supported. If servicing is taking place on a workbench, transformer can be supported from underneath.

5. After ensuring that transformer is securely supported, complete the removal of six capscrews (Item 18). Detached transformer can be removed from the bottom of main unit.

To install power transformer:

1. Insert transformer from bottom of unit. Hold in approximate position while starting bolts (6 each, Item 18) into the transformer mounting brackets.
2. Insert stripped ends of Faraday shield wires in between the chassis front panel and the aluminum shim (Item 20). Tighten all six bolts (Item 18) securely.
2. Reattach mounting bracket (Item 12) that holds capacitors and low voltage control transformer. Be sure to use shoulder washers both top and bottom.
4. Fasten capscrews with 1/4-20 nuts and tighten securely.
5. Connect wires at termination points.
6. Replace output shelf as instructed in Section 5.6.

5.13. Servicing Output Well Components

Model 8524 contains four different output wells that are located on the output shelf assembly (Illustration 7-1, Item 67). While the four different output wells appear similar, each is different and must be placed in a specific position. Illustration 5-11 shows the correct orientation of each of the four output wells and shows how the four different wells can be distinguished.

Output wells can be individually removed and installed without removing the output shelf.

5.13.1. Removing and Installing Output Wells

WARNING!

Output wells hold live current and are not earth grounded. Shock hazard exists even with ac mains disconnected. Before making any service on output wells, make sure that capacitors are allowed to discharge (see safety procedures in sections 5.2.

Refer to Illustration 7-4 for output well mounting.

To remove any individual output well:

1. Disable the amplifier by following the next four sub-steps:
   a. Shut off power at CB1.
   b. Disconnect the amplifier from the AC mains.
   c. Wait one minute for capacitors to discharge.
   d. Verify capacitor discharge (see Section 5.2.3).
2. Remove top panel as explained in Section 5.5.
3. Disconnect output interconnect board from Main Circuit Board and from predriver boards at center of output wells.
4. Remove four corner screws on output well.
5. In addition to the four corner mounting screws, each well is also fastened with two center screws, one of which may be recessed below the surface. These two center screws must also be removed.
   6. Well is now disconnected both mechanically and electrically and may be removed by pulling straight up.

To install output wells:

1. Insert center conducting screws. Note that one of the center screws in each of the middle output wells is recessed below the surface. Torque, to 10 in/lb. (±20%).
2. Insert four corner mounting screws. Maximum torque, 6 in/lb.(±20%).
3. Reconnect output interconnect board to output wells and Main Circuit Board.

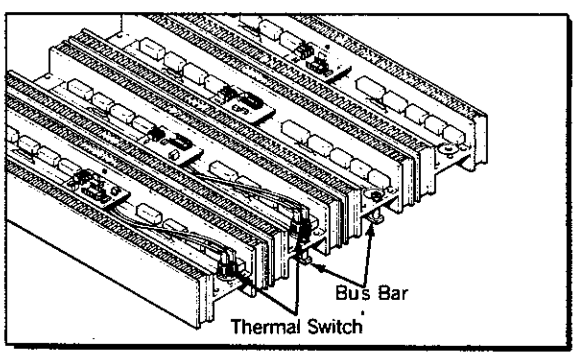


Illustration 5-11 Output Well Orientation

5.13.2. Output Transistors

To replace defective transistor:

1. Disable the amplifier by following the next four sub-steps:
   a. Shut off power at CB1.
   b. Disconnect the amplifier from the AC mains.
   c. Wait one minute for capacitors to discharge.
   d. Verify capacitor discharge (see Section 5.2.3).
2. Remove well with defective component.
3. Work from bottom of well.
4. For PNP wells (wells 2 and 3) only: Each output transistor is connected to a central bus bar via a collector resistor. (see Illustration 5-12). Unsolder collector resistor of faulty transistor from bus bar.
5. Remove transistor mounting screws. On PNP wells, resistor solder lug on one screw serves as star washer.
6. Turn output well over to work.
7. Unsolder leads of faulty transistor from center portion of gold colored base PC board and from emitter resistor lead.
8. Loosen leads, then remove faulty transistor.
9. Replace transistor with one having the same *part* and *grade* number.

CAUTION

Transistors in each output well are matched to each other. Stable amplifier operation cannot be assured unless part number and grade number are matched on all transistors in each output well.

10. Apply heat sink compound (see Renewal Parts List) to surface of replacement transistor. Apply compound completely and lightly so that only a small amount will be squeezed out when transistor screws are tightened.
11. Install mounting screws and star washers (solder lug for PNP wells). Tighten mounting screws before resoldering leads. Torque to 11 in./lb. (± 20%)

CAUTION

Tightening transistor mounting screws after the leads are soldered will break internal transistor connections. Solder the transistor leads after the screws are tight.

12. Clinch emitter resistor lead securely around emitter lead of transistor.

Note: To maintain the highest degree of dependability, emitter lead from transistor must be clinched around emitter resistor lead.

13. Solder leads in place.
14. For PNP wells only: Resolder collector resistor lead back onto bus bar as before replacement. For examples, see other collector resistors on same bus bar assembly.
15. See Testing and Adjustment Procedure, Section 6, for necessary adjustment procedures.

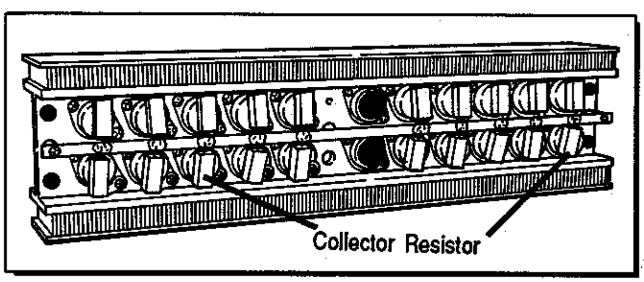


Illustration 5-12 PNP Output Wells, Bottom View

5.13.3. Driver Transistors

(See Illustration 5-13 for location of driver transistors.)

1. Disconnect the amplifier from the AC mains.
2. Wait one minute for capacitors to discharge.
3. Verify capacitor discharge (see Section 5.2.3).
4. Remove well with defective component.
5. Position output well on its side to allow access to both top and bottom.
6. A center screw holds each predriver board in place. Remove this screw, then lift predriver board carefully, allowing wiring to act as a "hinge".
7. Remove mounting bolts from driver transistors.

CAUTION
To protect solder connections from predriver board, do not move board more than necessary.

8. Unsolder leads of faulty driver transistor.
9. Apply heat sink compound to mounting surface of replacement transistor. Apply lightly and completely. Only a small amount of heat sink compound should squeeze out when tightening transistor mounting screws.
10. Bolt new driver transistor in place. Torque range is 11 in./lb. (± 20%).
11. Solder leads of new transistor in place.
12. See Testing and Adjustment Procedure for necessary calibration procedures.

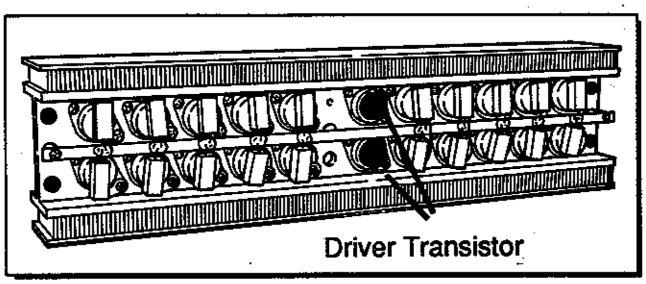


Illustration 5-13
Driver Transistor Position

5.13.4. Emitter Resistors

Note: All .33 ohm, 5 watt emitter resistors used in output wells, both top and bottom, are identical.

CAUTION
Emitter resistor characteristics are designed into the amplifier. Stable operation cannot be assured unless replacements are ordered from Techron

1. Disable the amplifier by following the next four sub-steps:
   a. Shut off power at CB1.
   b. Disconnect the amplifier from the AC mains.
   c. Wait one minute for capacitors to discharge.
   d. Verify capacitor discharge (see Section 5.2.3).
2. Unsolder resistor leads.
3. Loosen emitter resistor lead from emitter lead of transistor.

CAUTION
Emitter resistor leads are extra long and are bent in an "S" shape to improve heat dissipation. Failure to make this bend may cause solder to melt.

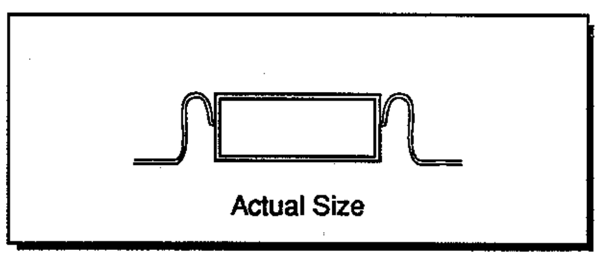


Illustration 5-14
Emitter Resistor Leads

4. Install replacement emitter resistor observing "S" shape bends (see Illustration 5-14) in leads.
5. Clinch emitter resistor lead tightly around transistor emitter lead.

Note: To insure the highest level of dependability in operation, emitter lead from transistor must be clinched around emitter resistor lead.

6. Solder emitter resistor lead to emitter lead of transistor.
7. See Testing and Adjustment Procedure, Section 8, for necessary adjustment procedures.

5.13.5. Electronic Thermal Sensors

Wells 3 and 4 only:
(see Illustration 5-15 for location)

To remove:
1. Disable the amplifier by following the next four sub-steps:
   a. Shut off power at CB1.
   b. Disconnect the amplifier from the AC mains.
   c. Wait one minute for capacitors to discharge.
   d. Verify capacitor discharge (see Section 5.2.3).
2. Unsolder leads and pull sensor up and out of recess.

To install:
1. Prepare the replacement sensor.
   a. Install 3/8" of Teflon® insulating tube over all three leads of sensor.
   b. Bend leads 90° at the bottom of tubing.
   c. Trim excess lead to .150".
   d. Fold leads down against the flat side of the transistor body.
2. Insert sensor in heat sink.
3. Solder leads.
4. Inspect 1% resistor (R812 or R923) located about two inches towards center from sensor. Replace the resistor if the color dot on the replacement sensor does not match the required value.

Note: Resistor must be matched with temperature sensor. See Table 5-1 for proper matching. Color dot on sensor indicates matching type.

5. See Testing and Adjustment Procedure, Section 7, for necessary adjustment procedures.

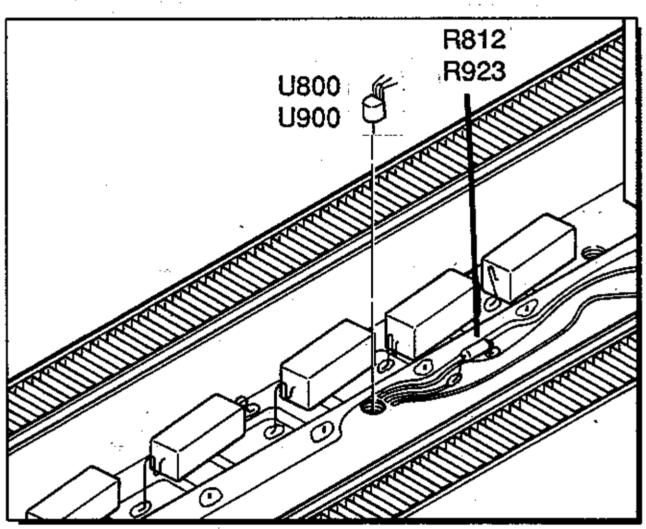


Illustration 5-15
Electronic Thermal Sensors

U800 U900	R812 R923
BLUE	236 OHMS, 1%
GREEN	227 OHMS, 1%
YELLOW	218 OHMS, 1%

Table 5-1
Resistor Color Matching

5.13.6. Thermal Switch, Wells 1 and 2 only

(see Illustration 5-16 for location.)

To remove:

1. Disable the amplifier by following the next four sub-steps:
   a. Shut off power at CB1.
   b. Disconnect the amplifier from the AC mains.
   c. Wait one minute for capacitors to discharge.
   d. Verify capacitor discharge (see Section 5.2.3).
2. Remove well with defective component.
3. Disconnect leads from thermal switch by pulling up on the plastic covered terminals..
4. Turn thermal switch counter-clockwise to remove from mounting position. Nut below is not captive.

To install:

1. Apply heat sink compound to thermal switch.
2. Install new thermal switch. Fasten nut on threaded shaft of thermal switch.
3. Reconnect black wires. Black wires are identical and interchangeable.

5.13.7. Bias Servo Transistor,

Wells 1 and 4 only. Bias servo transistors can be replaced without removing the well from the amplifier.
(see Illustration 5-17 for location)

To remove:

1. Disable the amplifier by following the next four sub-steps:
   a. Shut off power at CB1.
   b. Disconnect the amplifier from the AC mains.
   c. Wait one minute for capacitors to discharge.
   d. Verify capacitor discharge (see Section 5.2.3).
2. Remove bias servo transistor from position on side of heat sink.
3. Remove old silicon glue from heat sink.
4. Unsolder bias servo transistor leads.

To install:

1. Solder leads of new transistor in place.
2. Position new bias servo transistor with flat side touching heat sink.
3. Glue new bias servo transistor in place with silicon glue. Use other bias servo as model of proper gluing procedure.

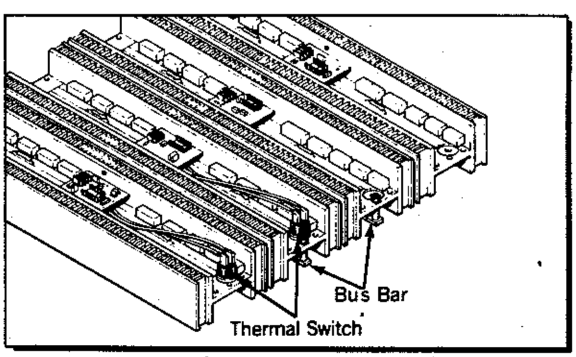


Illustration 5-16 Thermal Switch Location

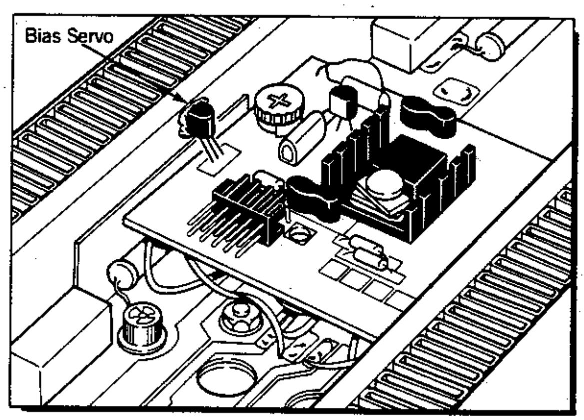


Illustration 5-17 Bias Servo

5.14. Servicing Digital Panel Meter

Refer to Illustration 7-2 in Section 7 for assembly detail.

To Remove:

1. Disable the amplifier by following the next four sub-steps:
   a. Shut off power at CB1.
   b. Disconnect the amplifier from the AC mains.
   c. Wait one minute for capacitors to discharge.
   d. Verify capacitor discharge (see Section 5.2.3).
2. Remove the amplifier front panel
3. Remove the display plate by removing four #6 screws from the locations shown in Illustration 5-18.
4. Unplug the Display Interconnect Cable (Item 6, Illustration 7-2) from the main board.
5. Remove the following display board hardware:
   a. Upper left with #6 Hex Nut (Item 4) and #6 star washer (Item 5)
   b. Upper right with #6 hex standoff (Item 11) and #6 lock washer.

CAUTION

In the next step, use a screwdriver narrower than the slotted standoff. A wide screwdriver will crack the meter display and damage it beyond repair.

   c. Lower middle - with slotted standoff (Item 12) and #6 lock washer.

To Install:

1. Locate the interconnect cable (Item 6) and plug it into J150 on the main board.
2. Place the display board insulator (Item 9) over the nylon standoffs.
3. Place the display board over the insulator and the nylon standoffs.
4. Secure the display board with the following hardware:
   a. Upper left with #6 Hex Nut (Item 4) and #6 star washer (Item 5)
   b. Upper right with #6 hex standoff (Item 11) and #6 lock washer.

CAUTION

In the next step, use a screwdriver narrower than the slotted standoff. A wide screwdriver will crack the meter display and damage it beyond repair.

   c. Lower middle - with slotted standoff (Item 12) and #6 lock washer.
5. Tighten all hardware.
6. Plug the interconnect cable into J1 on the meter display board.
7. Replace the mainboard on the amplifier and reconnect all cables.
8. Install the display plate. Secure it at the four mounting points shown in Illustration 5-18 with #6 machine screws (Item 1).
9. Replace the amplifier front panel.

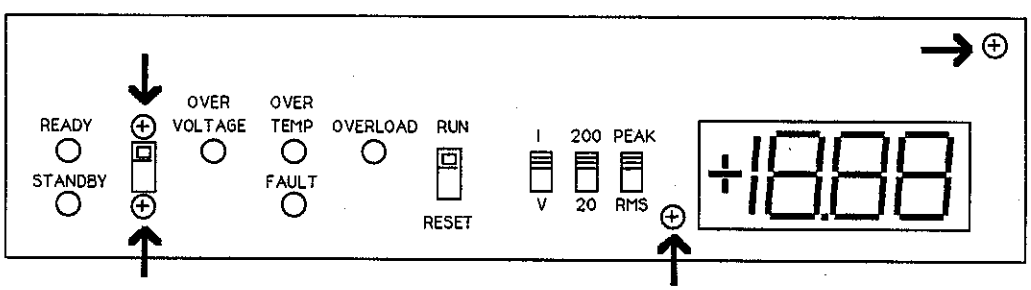


Illustration 5-18 Digital Panel Meter Mounting Screws

SECTION 6. TESTING AND ADJUSTMENT

6.1. Introduction to Testing and Adjustment

The procedures outlined in this section must be performed following service to the Model 8524 amplifier. Procedures in this section are NOT REQUIRED following replacement of fan. Table 6-1 lists procedures required after replacement of internal modules.

6.2. Equipment Requirements

In addition to standard hand tools and electronic test equipment, the following specialized equipment is recommended to perform the tests in this Section. Using the equipment listed will help insure that Model 8524 can be tested and adjusted to factory specifications. Any compromises in equipment could result in a compromise in performance or calibration.

- Repair/Replacement of any output well component: 6-4 through 6-7, 6-9.
- Replacement of main circuit board or any component or part of main circuit board: 6-4 through 6-25.

Table 6-1 Test Procedures After Repairs

1.	Oscilloscope Dual Channel Vert. Sensitivity - 2mV/div Vert. Frequency DC-15 MHz	Tektronix 2215A Hewlett-Packard Phillips PM3207
2.	Audio Signal Generator Sine/Square Output-3 Volts RMS into 600 ohm load, 1%THD	Wavetek 193 Khrohn-Hite 1000,1200
3.	AC Voltmeter 20Hz-4Mhz Sensitivity-100µV FS ±1% Accuracy 20-20kHz	Hewlett-Packard 400F Amber 3501 Sound Technology 170B/1710A
6.	Digital Voltmeter AC/DC Volts-1mV-100v AC/DC Amps-10mAmps-10 Amps Ohms-.1 ohm-10Mohms	Data Precision 248/1350,1351 Fluke 8020B Fluke 8060 series
7.	Intermodulation Distortion Analyzer IM capable of .003% 60Hz/7kHz THD capable of .01% 20Hz-20kHz	Amber 3501 Technology 17701A, 1700 series Hewlett-Packard 339A
8.	Bandpass Filter 20-20kHz 18dB/Octave rolloff	Sound Technology 170 or equivalent.
9.	Resistive Load 4 ohms-2kW	Construct from Dale Model NH250.
11.	Non metallic screwdriver to make adjustments	GC 8276 or 8277
12.	Precision Current Shunt	Construct from 1% Resistors
13.	Current limited DC power supply 60 volts at 1.0 amperes.	Lambda LQD 423

Table 6-2 Recommended Equipment

6.3. Preparation for Testing

WARNING!

These tests and adjustments are performed with unit powered by 208 volt AC Mains and with protective panels removed. Test steps must be followed precisely and technician must exercise extreme caution to avoid accidental touching of improper terminals or components. Powerful and potentially lethal electric shocks can occur as a result of accidental contact with capacitors, terminals, heat sinks and other interior components.

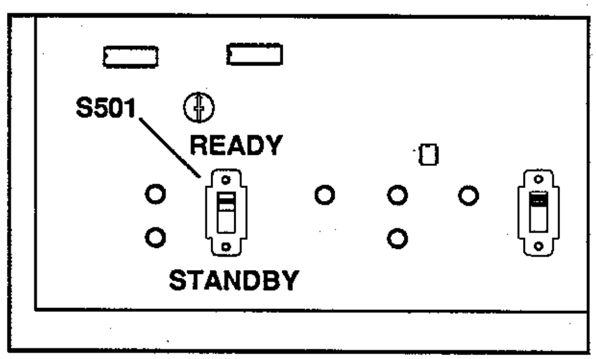
Preparation steps:

1. Remove front, top and side panels.
2. Inspect wires, cables, connections, terminals and other visible components to check for breaks or broken parts. Generally check to see if unit appears to be in proper mechanical condition.

Note: All adjustments have been sealed at the factory. The seals must be broken in order to make new adjustments.

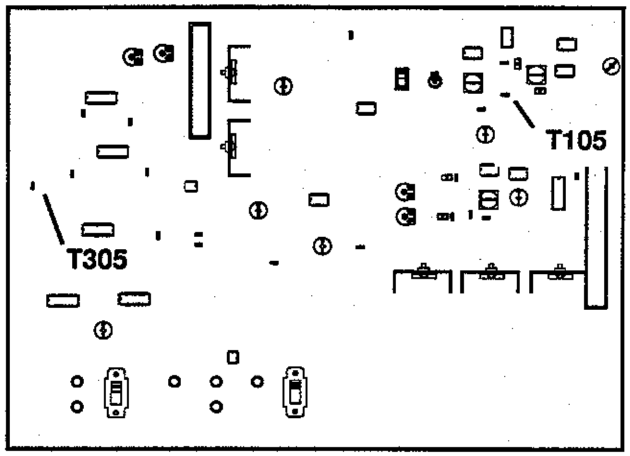
6.3.1. Enable/Disable Amplifier

Test instructions will call for amplifier to be enabled or disabled. This instruction refers to the position of switch S501. To Enable amplifier, switch S501 should be up in the READY position. To Disable the amplifier, switch S501 should be down in STANDBY position.



6.3.2. Ground Pins

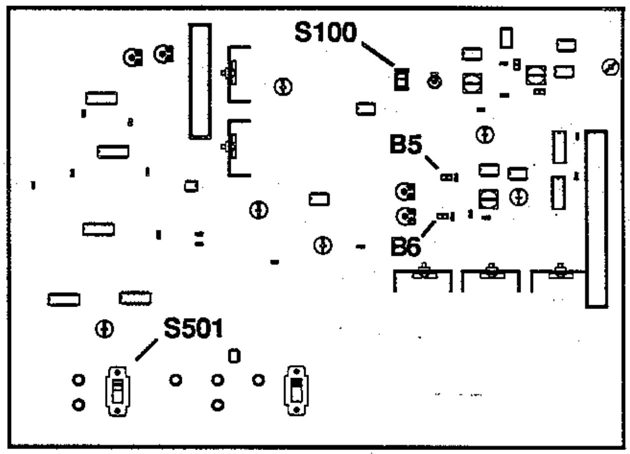
Throughout the test procedures, the common probe of test equipment is usually connected to a ground pin. Unless instructions specify otherwise, these ground pins are the test probe locations for all amplifier tests.



6.3.3. Jumper Locations

Begin test procedures with jumpers and switches in the following positions:

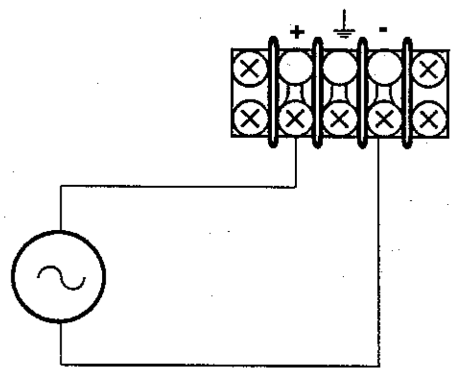
B5	Voltage/Current Mode	Left
B6	Compensation	Right
S501	Enable/Disable	Down
S100	Master/Slave	Up



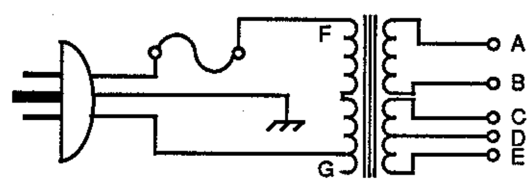
6.4. Power Supply Pretest

WARNING!
Do not proceed until the 8524 has been disconnected from the AC mains. Dangerous voltage points are exposed in the next steps. Failure to disconnect AC could result in injury or death.

1. Remove loads and input signal.
2. Connect a signal generator to the amplifier input. Set for 1kHz continious sine wave.



3. Connect a temporary control transformer to J500 on the main board. Use Crown Part Number M20643-9 (XFMR, ISA 208/240V PREP #2) to construct temporary transformer.



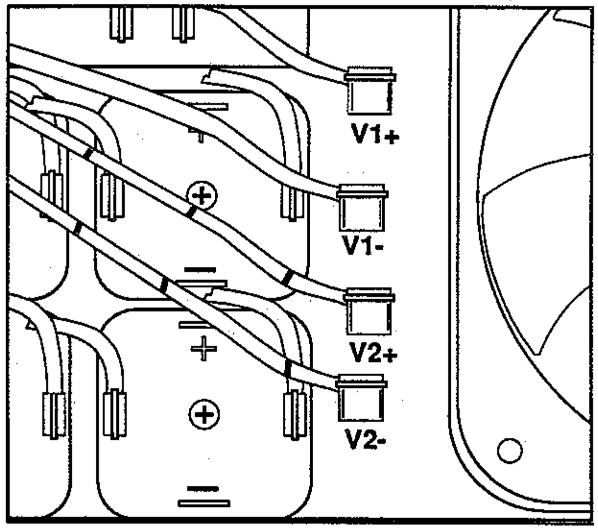
A	Orange	J500-5
B	Orange	J500-4
C	Red	J500-3
D	Yellow	J500-2
E	Red	J500-1
F	Black/Red	208 Vac
G	Black/Brown	208 Vac Neutral

Temporary Control Transformer

Continued on next page

Continued

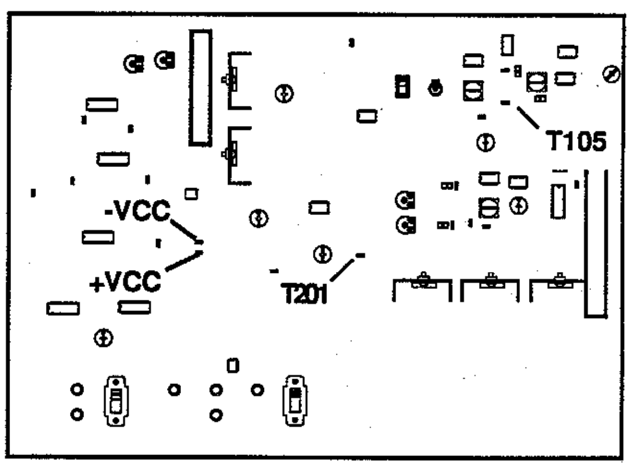
4. Remove the internal Vcc connections and connect a current limited power supplies by following the next steps:
   a. Remove the right side fan panel
   b. Locate the rectifier blocks nearest the fan. Disconnect the Vcc supplies from points "+" and "-".
   c. Connect voltage and current limited DC supplies to "V1+","V1-", "V2+" and "V2-" connection points. Set the supplies to limit at 60 volts and 0.3 amperes.



5. Connect a two channel oscilloscope to -Vcc and +Vcc. Set Channel 2 for Invert and Add.

CAUTION!

Do not connect scope ground leads to amplifier. Improper measurements will result.



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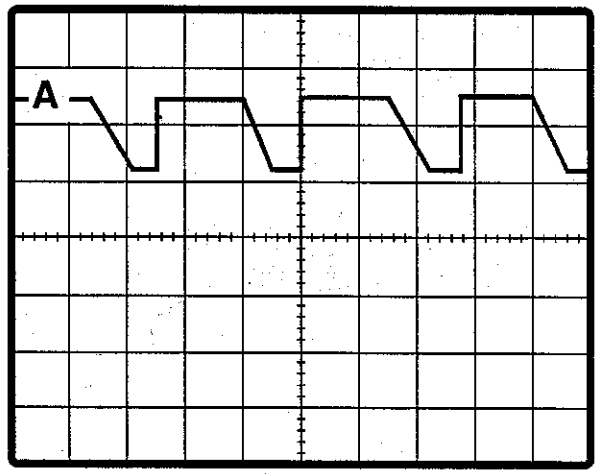
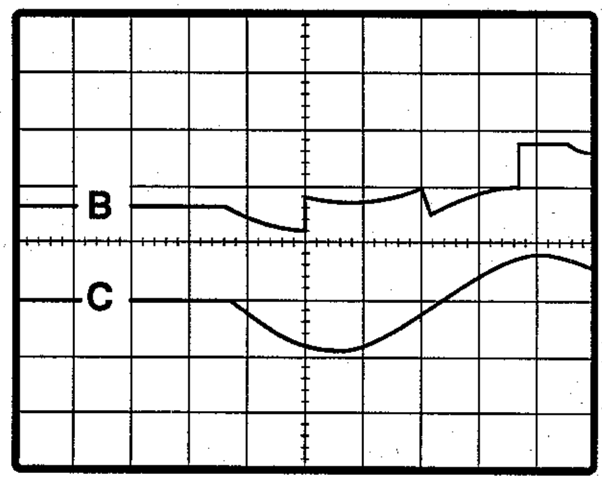
6. Turn on the temporary control transformer and the DC supplies.
7. Increase the input signal and observe the oscilloscope for wave form A.
8. Set S100 down to SLAVE.
9. Connect Chanel 1 scope probe to +Vcc and Channel 2 probe to T201. Connect the ground lead to T105.
10. Turn off the DC supplies. Wait 20 seconds for the power supply capacitors to discharge.
11. Place a short from "V1+" to "V2+".

CAUTION!
Be prepared to immediately set S100 down if the 8524 behaves abnormally in the next step.

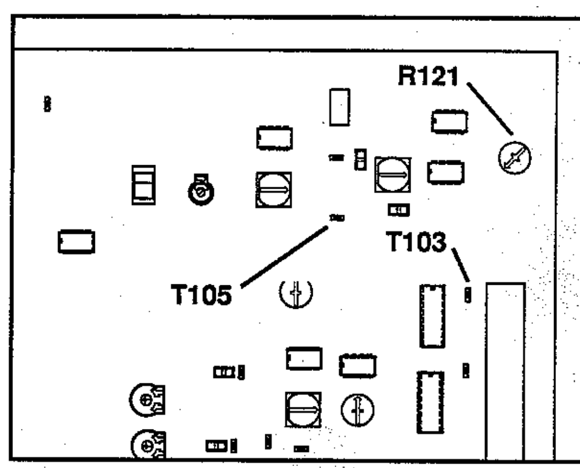
12. Set S100 up to MASTER.
13. Observe the scope. Wave form should be similar to (B) and (C).
14. Turn off the AC power to the DC supplies and the temporary transformer. Restore original wiring to J500 and to the Vcc supply.
15. Replace the fan cover.





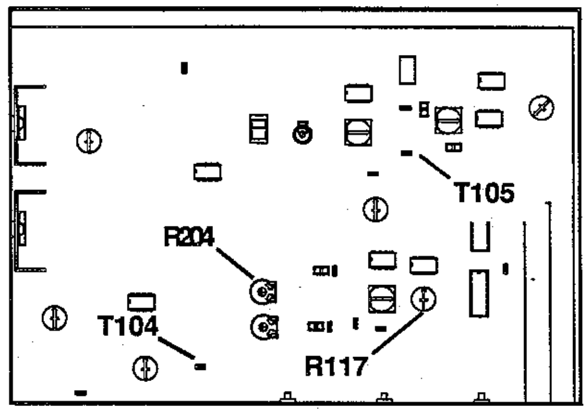
6.5. Adjust Current Monitor Zero

1. Remove loads and input signal.
2. Connect positive voltmeter lead to T103; negative lead to T105.
3. Set S101 up to READY.
4. Adjust R121 to obtain 0.00VDC (±.02 VDC) reading.
5. Set S501 down to STANDBY.



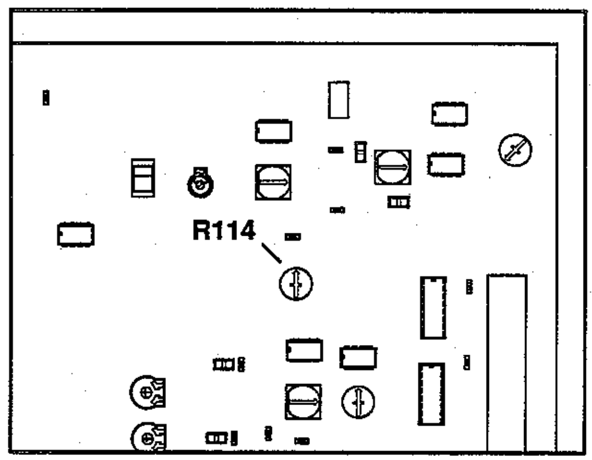
6.6. Adjust Output Offset Voltage

1. Connect positive voltmeter to T104; negative lead to T105.
2. Set S100 down to SLAVE.
3. Set S101 up to READY.
4. Adjust R204 for 0.000 Vdc (±.01 Vdc).
5. Set S100 up to MASTER.
6. Short the input by connecting all three input screw terminals together.
7. Adjust R117 for 0.000 VDC (±.01 Vdc).
8. Set S501 down to STANDBY.



6.7. Adjust Clip Level

1. Adjust R114 fully clockwise.



6.8. Adjust Multiplier Zero

This adjustment is influenced by the internal temperature of the unit at the time of the test. If the unit has recently been operating under load, allow ten minutes of cool-down time (with fans operating) to obtain readings consistent with the ambient temperature.

1. Disconnect loads and input signal.

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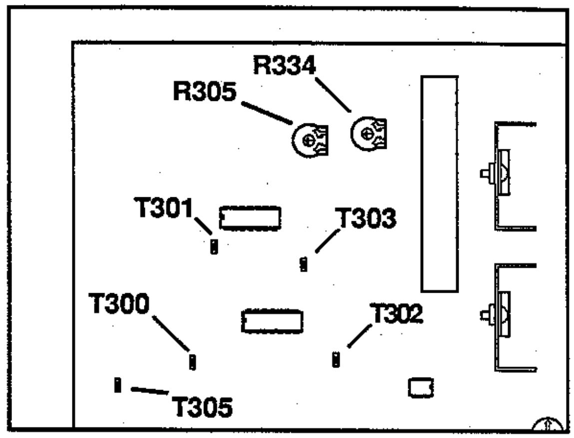
Continued

2. Set switch S100 down to SLAVE.
3. Connect voltmeter positive lead to T302; negative lead to T305.
4. VDC reading at T302 should be in the range of 2.90 to 3.10. Locate actual value in third column of Table 6-3 and also mark the corresponding value in fourth column.

Note: This reading reflects the unit's internal temperature according to the formula °K/100.

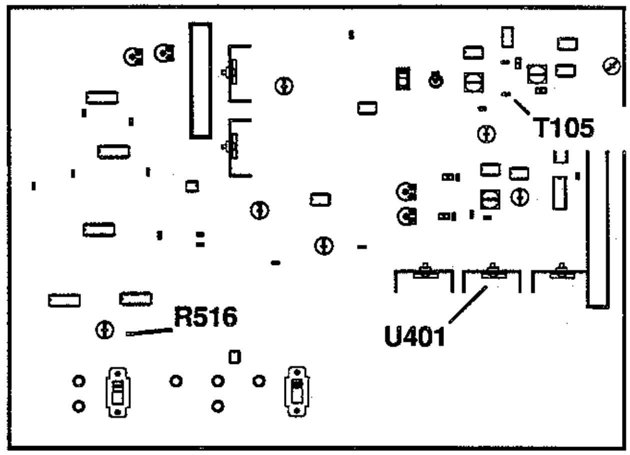
5. Move positive voltmeter lead to T300.
6. Adjust R305 to obtain the appropriate - VDC reading from fourth column of Table 6-3.
7. Move positive voltmeter lead to T303. VDC reading should be the same as step 4.
8. Move positive lead to T301.
9. Adjust R334 to obtain the appropriate + VDC reading from fourth column of Table 6-3.



°C	°K	T302 T303	T300 T301	°C	°K	T302 T303	T300 T301
16	289	2.89	SAT	34	307	3.07	10.92
17	290	2.90	12.96	35	308	3.08	10.80
18	291	2.91	12.84	36	309	3.09	10.68
19	292	2.92	12.72	37	310	3.10	10.56
20	293	2.93	12.60	38	311	3.11	10.44
21	294	2.94	12.48	39	312	3.12	10.32
22	295	2.95	12.36	40	313	3.13	10.20
23	296	2.96	12.24	41	314	3.14	10.08
24	297	2.97	12.12	42	315	3.15	9.96
25	298	2.98	12.00	43	316	3.16	9.84
26	299	2.99	11.88	44	317	3.17	9.72
27	300	3.00	11.74	45	318	3.18	9.60
28	301	3.01	11.64	46	319	3.19	9.48
29	302	3.02	11.52	47	320	3.20	9.36
30	304	3.04	11.28	48	321	3.21	9.24
32	305	3.05	11.16	49	322	3.22	9.12
33	306	3.06	11.04	50	323	3.23	9.00

Table 6-3 Temperature to Voltage Conversion Table

6.9. Adjust High Voltage Cutoff



Note: This test requires control of AC mains voltage and normally cannot be performed in the field. It should be performed if AC mains control is available.

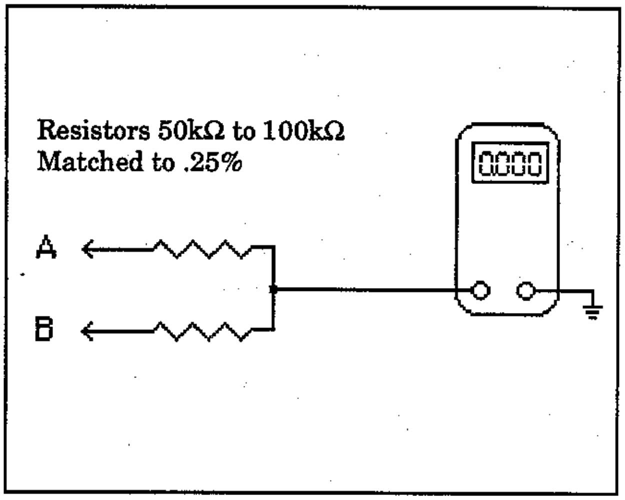
1. Remove loads and input signal.
2. Set S501 up to READY.
3. Connect positive voltmeter lead to middle lead or mounting screw of U401; negative lead to T105.
4. Adjust AC mains for DVM reading of 26.8 volts.
5. Observe OVERVOLTAGE light on front of unit.
6. Adjust R516 to the point at which OVERVOLTAGE light comes on.

Note: Light should be steady, not partially lit or flickering. The adjustment is correct just at the point when the light comes on. The STANDBY light should also be on.

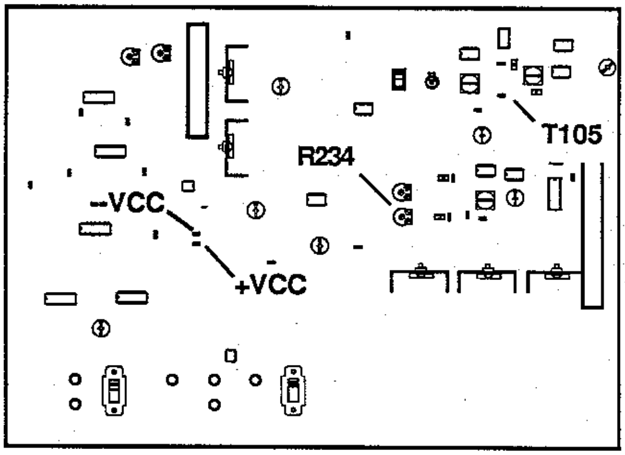
6. Return AC mains back to normal level (meter reads 24.4 volts DC). STANDBY should go out, READY light should come on.
7. Set S501 down to STANDBY.

6.10. Adjust Static Balance

1. Remove loads and short the input.
2. Connect voltmeter to matched resistors (see illustration).



3. Connect resistor (A) to -Vcc, resistor (B) to +Vcc and voltmeter ground to T105.
4. Set switch S501 up to READY.
5. Adjust R234 to 0. 0 VDC (±0.2 VDC).
6. Set switch S501 down to STANDBY.



6.11. Adjust Output Stage Bias Voltage

This procedure tests each output well with voltmeter and adjusts for correct reading. Wells are to be tested in pairs (front two, then rear two); adjustments are for each pair in tandem.

Note: Allow output well heat sinks to cool to ambient temperature before performing this test.

1. Set switch S100 down to slave.
2. Set switch S501 up to READY.

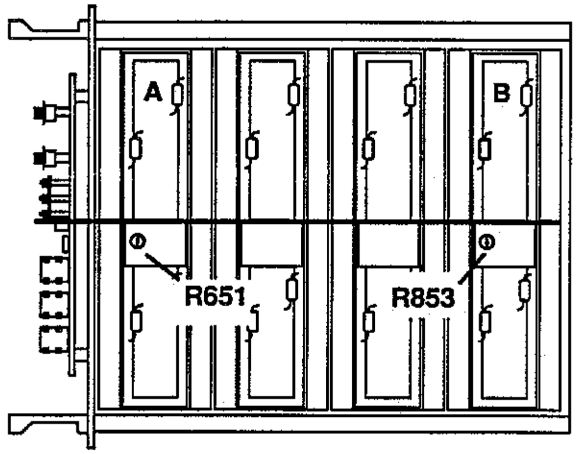
For rear pair of output wells:

3. Connect voltmeter across 12 ohm resistor at (B).
4. Adjust R853 on predriver board #4 for reading of .40 VDC (±.01) volt.

For front pair of output wells:

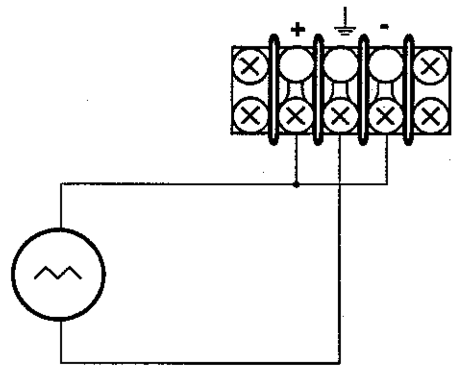
5. Connect voltmeter across 12 ohm resistor at (A).
6. Adjust R651 on predriver board #1 for reading of .40 VDC (±.01) volt.

Note: This adjustment must be balanced between the two output wells controlled by each adjustment point. Measure all four points and identify the median values. Adjust R651 and R853 to bring the median values to .40 VDC.



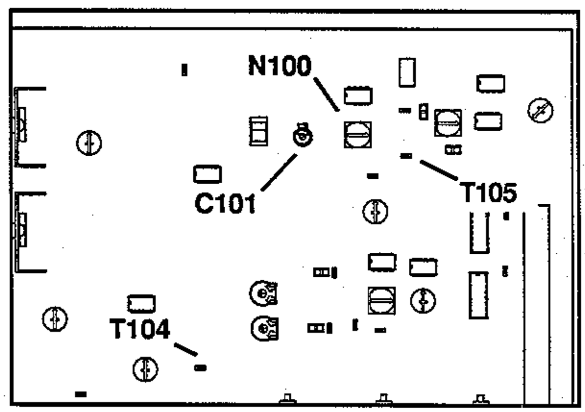
6.12. Adjust CMRR on Input Amplifier

1. Remove load.
2. Connect signal generator to input (see illustration). Adjust for 1 kHz continuous triangle wave signal, 10 volt peak to peak, but below clip level.
3. Connect scope probe to T104 and ground lead to T105.
4. Adjust N100 to eliminate angles on wave form.



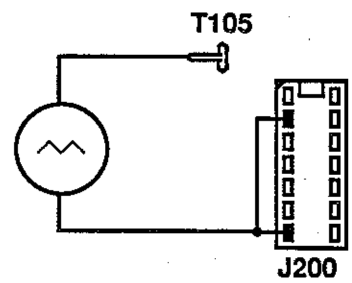
Note: Use non-metallic screwdriver for the following adjustment.

5. Adjust C101 to make wave into a straight line.
6. Repeat 4 and 5 until there is minimum interaction.

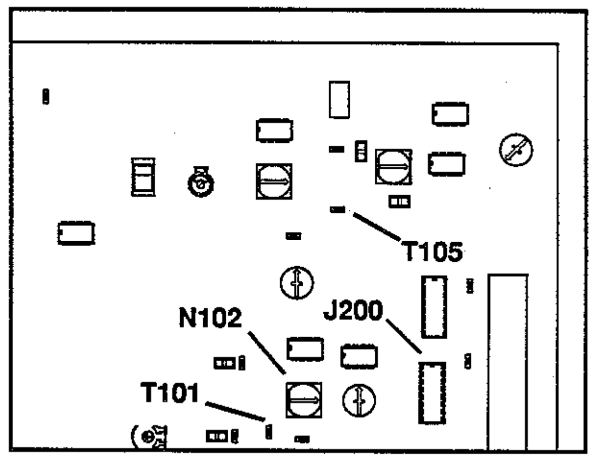


6.13. Adjust CMRR on Current Sensing Amplifier

1. Remove loads and input signal.
2. Connect pins 2 and 7of J200 to output of the signal generator, ground to T105. Adjust for continious triangle output.

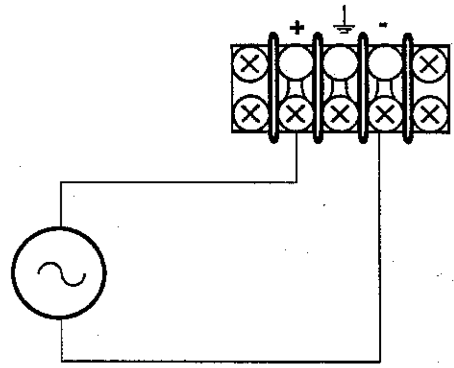


3. Connect scope probe to T101 and ground lead to T105.
4. Adjust N102 to make wave into a straight line.

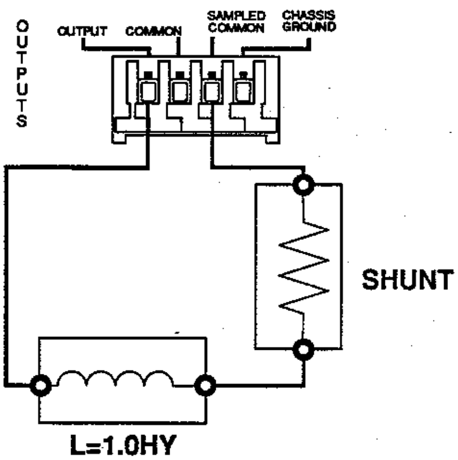


6.14. Adjust Current Monitor

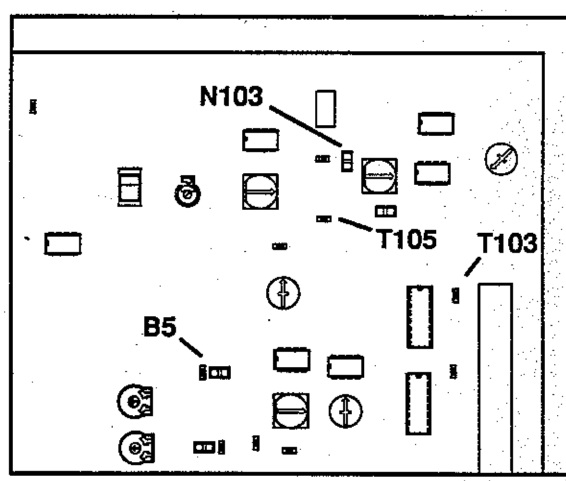
1. Connect signal generator to input and adjust for 300 Hz continuous sinewave.



2. Connect 1.0 mHy load and shunt to amplifier output.



3. Move Jumper B5 to right two pins.
4. Connect voltmeter leads to shunt output. Adjust input signal for 20.0 amps through the shunt.
5. Connect voltmeter positive lead to T103, negative lead to T105.
6. Set switch S501 to READY.
7. Adjust N103 for 1.0 volts at T103.
8. Set switch S501 down to STANDBY.



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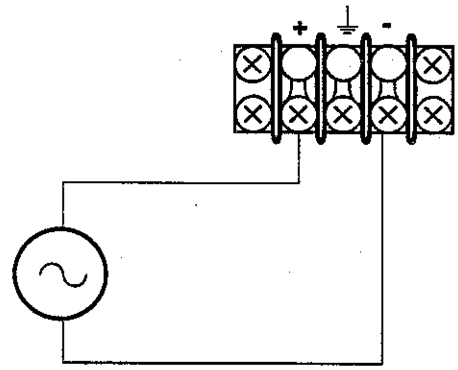
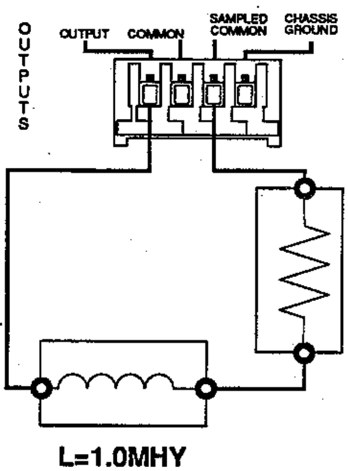
6.15. Adjust Voltage Gain

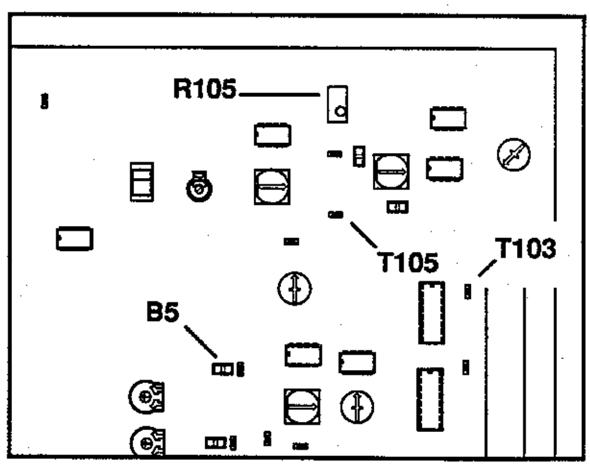
1. Connect signal generator to input and adjust for 300 Hz continuous sinewave.



2. Connect 1.0 mHy load and shunt to amplifier output.

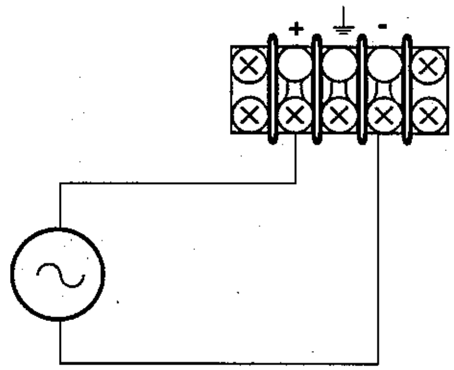


3. Move Jumper B5 to right two pins.
4. Connect voltmeter leads to shunt output. Adjust input signal for 20.0 amps through the shunt.
5. Connect voltmeter positive lead to T103, negative lead to T105.
6. Measure the voltage at pin 1 and multiply by 1.5. Record the result.
7. Set switch S501 to READY.
8. Connect positive probe to T100.
9. Adjust R105 until the meter displays the result of step 6.
10. Set S501 down to STANDBY.
11. Return B5 to right pair of pins.

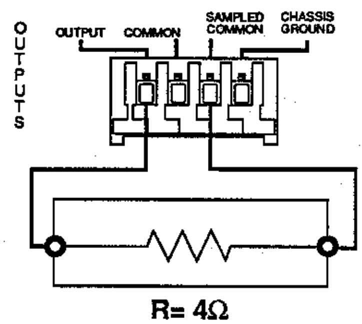


6.16. Adjust Dynamic Balance

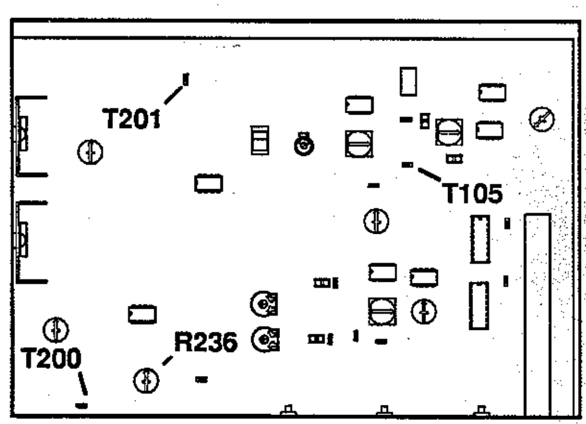
1. Connect signal generator to amplifier input and adjust for 1kHz continuous sinewave.



2. Connect a 4 ohm, 2000 watt load to output terminals.



3. Connect channel 1 of a dual trace scope to T201. Set scope to 50 volts/division.
4. Connect channel 2 to T200. Set scope at 5 volts/division.
5. Set switch S501 up to READY.



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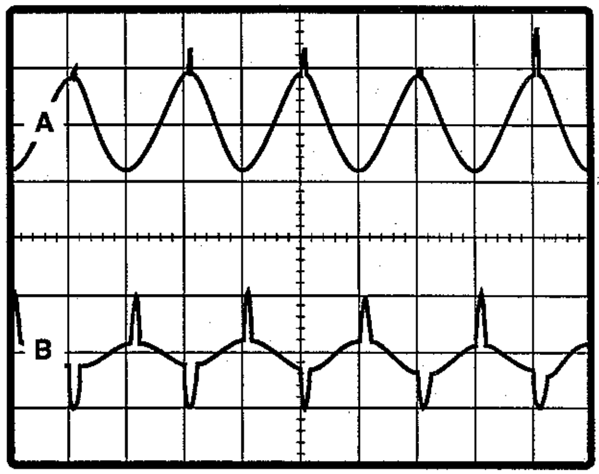
6. Increase input signal until channel 1 resembles wave form “A”.
7. Adjust R236 until channel 2 resembles wave form “B”.

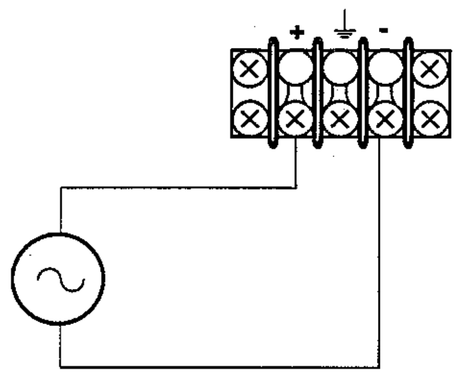
Note: Proper adjustment may require R236 to be fully clockwise.

8. Set S501 down to STANDBY.

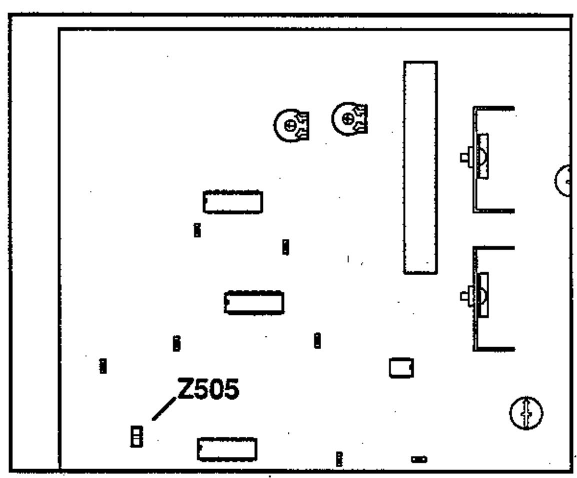


6.17. Verify Overload Latch

1. Connect signal generator to input. Set for 1kHz continuous sine wave input.

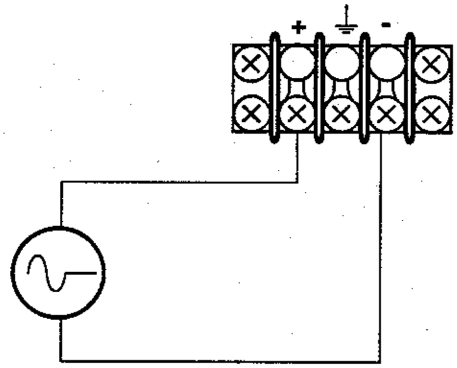


2. Short pins of Z505 together.
3. Set switch S501 up to READY.
3. Increase the input until the OVERLOAD LED comes on. The amplifier should go into STANDBY.
4. Set S500 down to RESET. Observe that the amplifier returns to READY.
5. Set S501 down to STANDBY.
6. Remove the short at Z505.

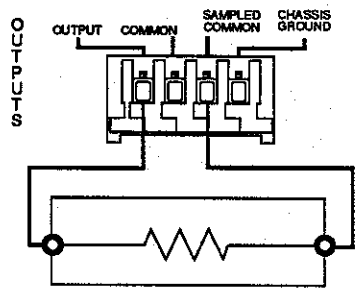


6.18. Adjust Current Limit

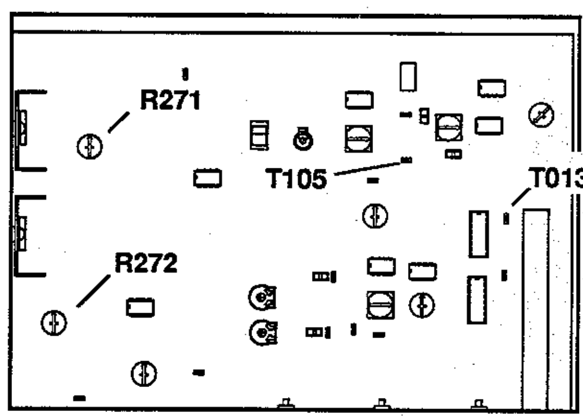
1. Connect a signal generator to the amplifier input. Set the generator for 1 kHz, sine wave burst, less than 1% duty cycle.



2. Connect a 0.5 Ohm (or less) load to the amplifier output terminals.



3. Connect scope probe to T103 and ground lead to T105.



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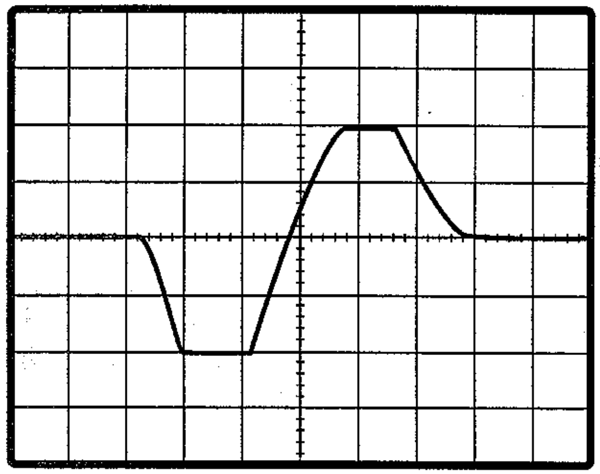
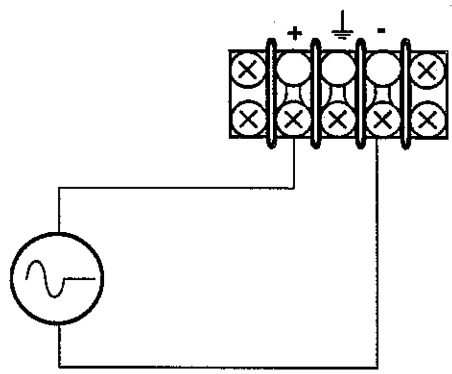
4. Increase the input signal until the amplifier is in current limit and the wave form on the scope resembles the illustration.
5. Adjust R271 bring the positive peak on the scope to be between 0.9 and 1.0 Vdc.
6. Adjust R272 bring the negative peak on the scope to be between -0.9 and -1.0 Vdc.



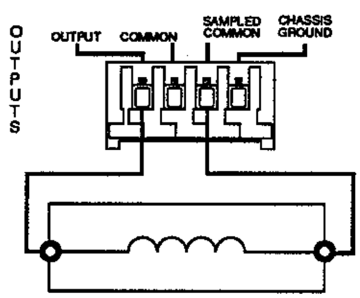
6.19. Spurious Response

This procedure verifies the stability of the amplifier. If oscillations are observed while performing these tests, capacitors and resistors marked “selectable” on the output stage schematic may be changed.

1. Connect signal generator to amplifier input. Adjust for 300Hz, 20% duty cycle tone burst.



2. Connect 1.0 mH load to amplifier output.



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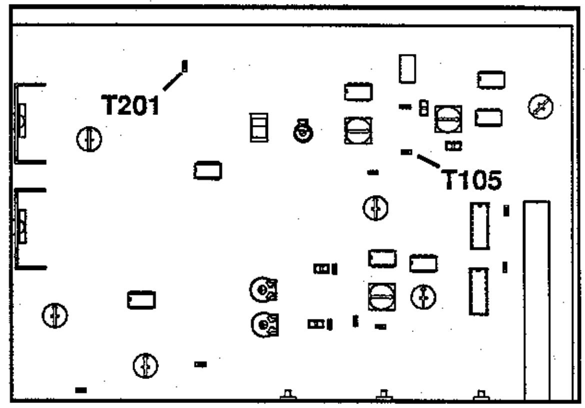
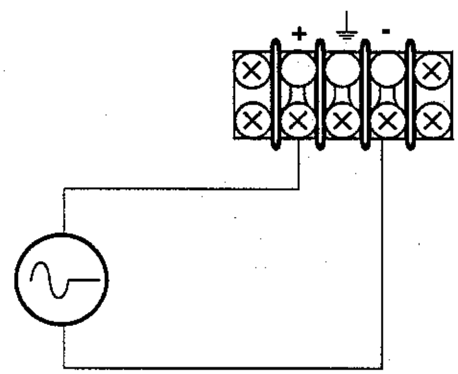
3. Connect scope probe to T201; ground lead to T105.
4. Set switch S100 up (MASTER).
5. Set switch S501 up to READY.
6. Gradually increase input signal until an distortion is seen at T201.
7. Look for oscillations.
8. Adjust the input frequency to 50Hz. Watch for oscillations.
9. Set switch S501 down to STANDBY.

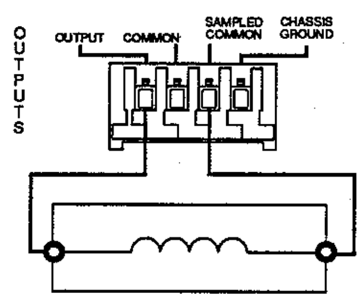


6.20. Verify Constant Current Mode

1. Connect signal generator to amplifier input. Adjust for 300Hz, 20% duty cycle tone burst.



2. Connect 1.0 mH load to amplifier output.



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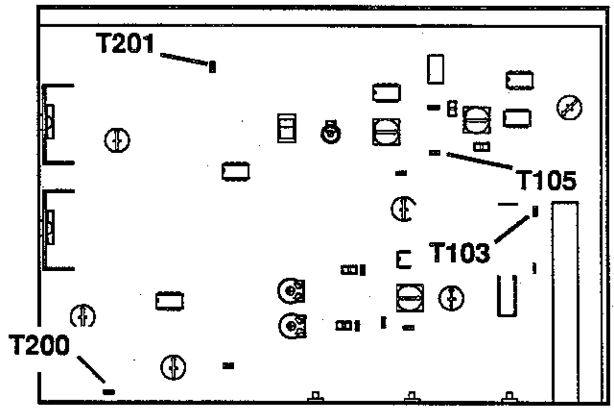
3. Connect scope probes to T200 and T201, ground leads at T105.
4. Set S501 up to READY.
5. Increase input signal level until wave forms distort. Observe for oscillations and spikes.
6. Adjust generator for 100Hz square wave.
7. Connect scope probe to T103. The wave form should be be clean and square without overshoot.
8. Set S500 down to STANDBY.
9. Connect a .25mHy load to the output of the amplifier.
10. Set S500 up to READY.
11. The wave form at T103 should be be clean and square without overshoot.
12. Set S501 down to standby.

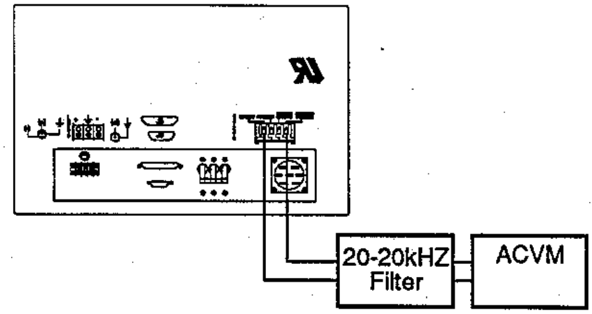


6.21. Measure IMD

1. Use the distortion test setup shown in your IM analyzer manual.
2. Calibrate the distortion analyzer and set the IM analyzer output signal for 60 HZ and 7 kHz, 4/1 ratio.
3. Connect a 4 ohm load to the output of the amplifier.
4. Set S501 up to READY.
5. Measure the IM distortion at 5 dB intervals from 1550 watts output down to 35 dB below 1550 watts.
6. Maximum distortion allowed is .03%.
7. Set S501 down to standby

6.22. Measure Output Voltage Noise

1. Remove loads from the amplifier and short the input.
2. Connect AC voltmeter to rear output terminals: positive to positive output; negative lead of voltmeter to sampled common terminal.
3. Set S501 up to READY.
4. Typical value is 0.4 mv. Acceptable range is .2 mv to .8 mv. (Bandwidth of 10 Hz to 100 KHz).
5. Set S501 down to STANDBY



6.23. Measure Current Monitor Noise

1. Remove loads from the amplifier and short the input.
2. Connect voltmeter positive lead to T103, negative to T105.
3. Typical value is .02 mv. Acceptable range is .01 mv to .04 mv. (Bandwidth of 10 Hz to 100 KHz.)

6.24 Verify Operation of Fault Circuit

1. Remove loads from the amplifier and short the input.
2. Set switch S501 up to READY.

WARNING!

Do not leave the resistor in place during step 3 any longer than necessary!

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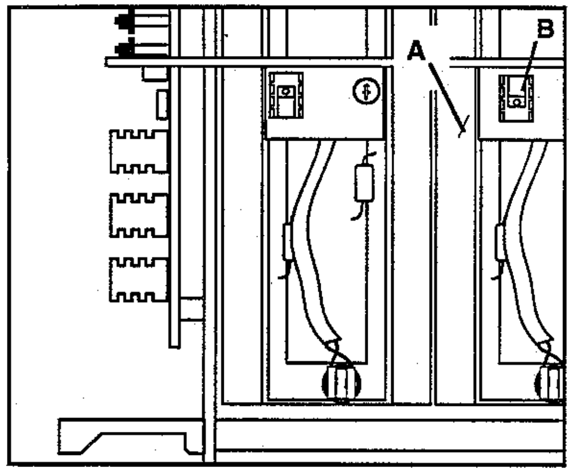
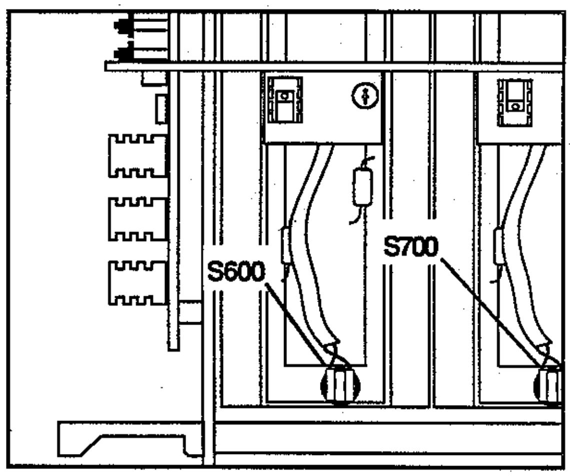
3. Using 1 K ohm, 2 watts resistor, with leads bent as needed, connect heat sink of high side PNP (well #2) (A) to collector (mounting screw) of PNP predriver (B).
4. Amplifier should instantly enter STANDBY with FAULT LED on.
5. Remove resistor *immediately*.
6. Turn amplifier power OFF, then back ON.
7. Repeat step 5 to test low side PNP (well #3). Amplifier should enter STANDBY with FAULT LED on.
8. Set switch S501 down to STANDBY.



6.25. Verify Operation of Mechanical Thermal Switches

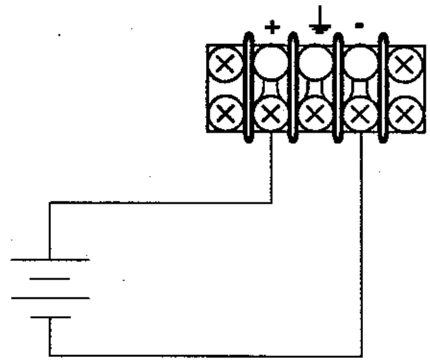
WARNING!
Heat sinks are live.
Use caution!

1. Remove the loads and input signal.
2. Set switch S501 up to READY.
3. Disconnect S600 (front thermal switch).
4. Observe LEDs. STANDBY, and OVERTEMP LEDs should light.
5. Reconnect S600. LEDs should go out.
6. Test S700 via steps 1-5.
7. Set switch S501 down to STANDBY.



6.26. Verify Die Temperature Protection

1. Connect a 2.5 DC input to J1.



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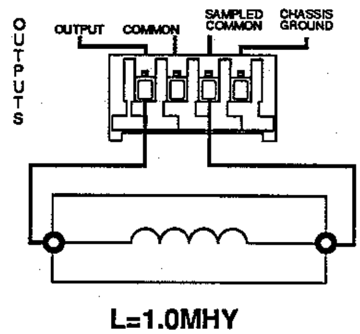
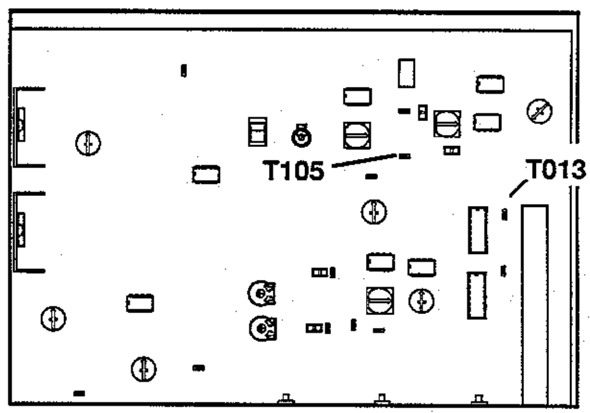
2. Connect a 1.0mHy load to the amplifier output terminals.

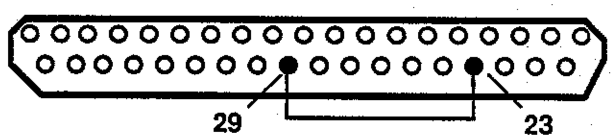


3. Connect a DC voltmeter; (+) to T103, (-) to T105.
4. Set switch S501 up to READY.
5. Observe the voltage on the meter. The voltage will cycle from 3.75 volts output to 0 volts output over a period of about 1 minute.
6. Set switch S501 down to STANDBY.
7. Reverse the polarity of the DC input.
8. Repeat Steps 4-7.
9. Set switch S501 up to READY.
10. Short the pins of Z504.
11. Enable the amplifier. When the amplifier reaches OVERTEMP, it will remain in standby.
12. Set switch S501 down to STANDBY.



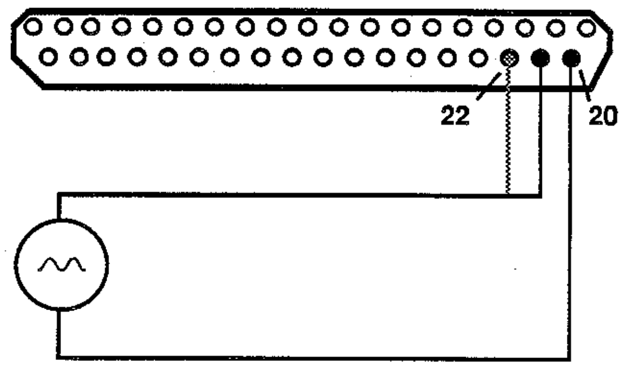
6.27. Verify Interlock

1. Set switch S501 to READY.
2. Connect a shorting wire to J3 pin 23 and J3 pin 29.
3. Amplifier should go into STANDBY.
4. Remove shorting wire.
5. STANDBY lights should go out.
6. Set switch S501 down to STANDBY.



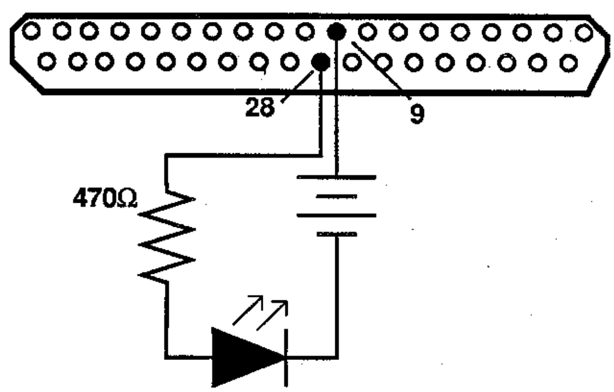
6.28. Check MASTER/SLAVE Mode

1. Set MASTER/SLAVE to SLAVE mode.
2. Connect signal generator to to pin 21 of J3 (rear 37 pin interlock connector) and ground to pin 20.
3. Set switch S501 up to READY.
4. Observe for an output wave form equal amplitude as the input signal.
5. Move input to J3 pin 22.
6. Observe for an inverted output wave form equal amplitude as the input signal.
7. Set switch S501 down to STANDBY



6.29. Verify Remote Ready Status

1. Connect resistor, LED and battery in series to J3-9 and J3-28.
2. Set switch S501 up to READY.
3. The LED in the test circuit should come on.
4. Set switch S501 down to STANDBY
5. The LED in the test circuit should go off.



6.30. Testing and Adjustment of the Digital Panel Meter

Perform these procedures following service to Model 8524 Digital Panel Meter.

1. Turn off power to the amplifier by setting the main circuit breaker on the back panel down.
2. Remove the front panel of the amplifier and the control panel plate (Illustration 7-2, Item 2).
3. Disconnect loads from the amplifier output terminal and remove connections from the amplifier interlock.

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Note: Always test the digital panel meter without loads. Loads connected to the output of the amplifier may distort waveforms and limit the accuracy of calibration.

4. Short the inverting and non-inverting inputs of the amplifier to the input common.
5. Set the controls and switches on the amplifier main board to the following positions:

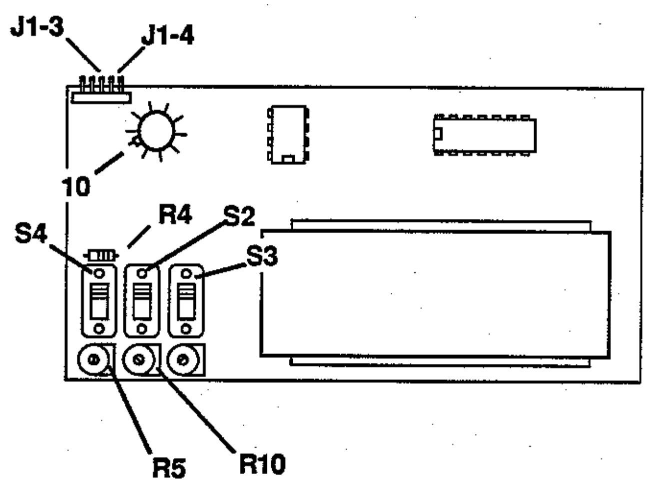
S501	Down	(standby)
S100	UP	(master)
B5	Left	(constant voltage mode)

6.30.1 Meter Zero

1. Plug the amplifier into the 3 phase AC line and turn on the rear panel circuit breaker.
2. Set S501 Up (to the Ready position).
3. Connect the negative lead of the digital voltmeter (DVM) to J1 pin 3 and the positive lead to J1 pin 4. If there is more than ±.003 volts DC present, perform offset adjustments to the 8524.
4. Set the Meter switches as follows:

S4	Volts	(Down)
S2	200	(UP)
S3	Peak	(Up)

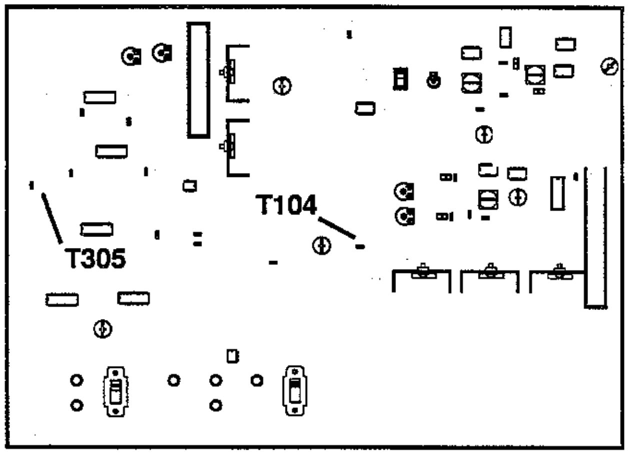
5. Connect the negative lead of the DVM to the right side of R4 and the positive lead to pin 10 of U1.
6. Set the DVM to read DC volts on the 200 mV range.
7. Adjust R5 on the Digital Panel Meter to get the most negative (or least positive) reading on the DVM.
8. Adjust R10 to zero out any offset voltage remaining on the DVM.



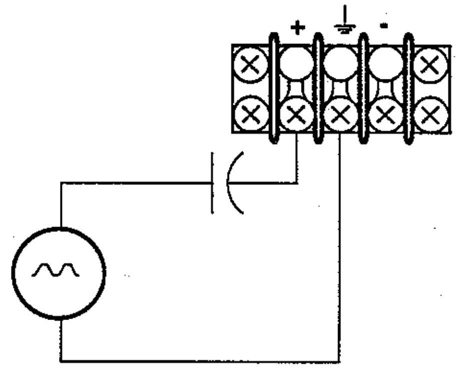
6.30.2 Calibration

Note: This procedure calibrates the Digital Panel Meter to a known value. The accuracy of this adjustment is proportional to the accuracy of the digital voltmeter measuring the output of the amplifier.

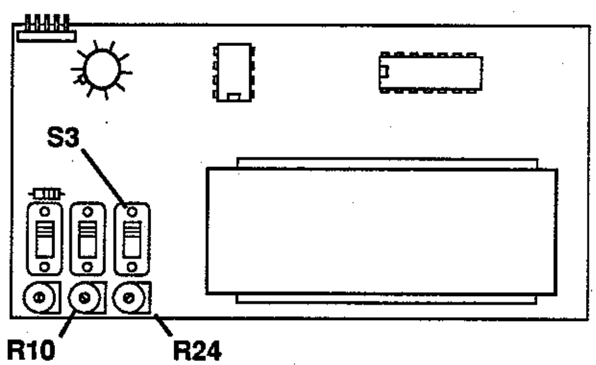
1. Connect the negative lead to the main board ground (T305) and the positive lead to T104 (amplifier output). Set the meter to measure AC volts on the 200 volt range.



2. Connect a 22µF non-polar capacitor in series with the generator output and then to the amplifier input. Set the generator to 100 Hz sine wave. Adjust the input signal level so that the DVM reads 80 VAC Rms (± 5 volts).



3. Set S3 down (RMS).
4. Adjust R24 until the Digital Panel Meter reads the same as the DVM, (± 0.1) volts.
5. Set the output voltage of the amplifier to 8.0 VAC (±0.5 VAC) by attenuating the input signal by 20 dB.
6. Adjust R10 until the Digital Panel Meter reads the same as the DVM (± 0.1) volts.
7. Repeat steps 2 through 10 until the meter module agrees with the DVM.
8. Set the output voltage of the amplifier to 25.3 VAC (± 1.6 VAC) (10 dB down from 80 VAC).



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9. The Digital Panel Meter must read the same voltage as the DVM (±0.1 VAC).
10. Turn the amplifier off at the back panel circuit breaker.

6.31. Final Procedure

1. Use standard latex paint to seal all adjustment points. This will protect adjustments against vibration or accidental movement.

CAUTION!
Keep sealant away from control elements.

2. Set appropriate switches for master or slave operation.
3. Install jumper at Z505
4. Replace all covers and front panel.

SECTION 7. EXPLODED VIEWS AND PARTS LIST

7.1. General Parts Information

This section contains illustrations, parts list, and schematics for the 8524 Gradient Amplifier. This information should be used with the service, repair and adjustment procedures in Section 6.

Mechanical and structural type parts are illustrated and indexed on an exploded view drawing. Electrical and electronic parts are listed and indexed in both the exploded view drawing and the schematic parts lists.

The quantity of each part used in each location is shown for the exploded view parts listing.

7.2. Standard and Special Parts

Many electrical an electronic parts used in the 8524 are standard items stocked by and available from electronic supply houses. However, some electronic parts that appear to be standard, are actually special. A part ordered from TECHRON will assure a workable replacement. Structural items are available only from TECHRON.

7.3. Ordering Parts

TECHRON, a division of Crown International Inc., supplies parts through the Crown International Parts Department. Replacement parts are obtained from the address below.

When ordering parts, be sure to give the model and serial number and include the part description and Crown Part Number (CPN) from the parts list. Price quotes are available upon request.

7.4. Shipment

Shipment will be made by UPS or best method unless a preferred method is specified.

Shipments are made F.O.B. Elkhart Indiana only. Established accounts will have large orders shipped freight prepaid and billed. All other shipped freight collect.

7.5. Terms

Normal terms are C.O.D., Master Card or Visa unless the order is prepaid. If prepaying please add an amount for the freight charge. $1.60 is average for an order under one pound.

Net 30 day terms apply only to established accounts. Parts prices are subject to change without notice. New parts returned for credit are subject to a 10% restocking charge.

You must receive authorization from the Crown Parts Department before returning parts for credit.

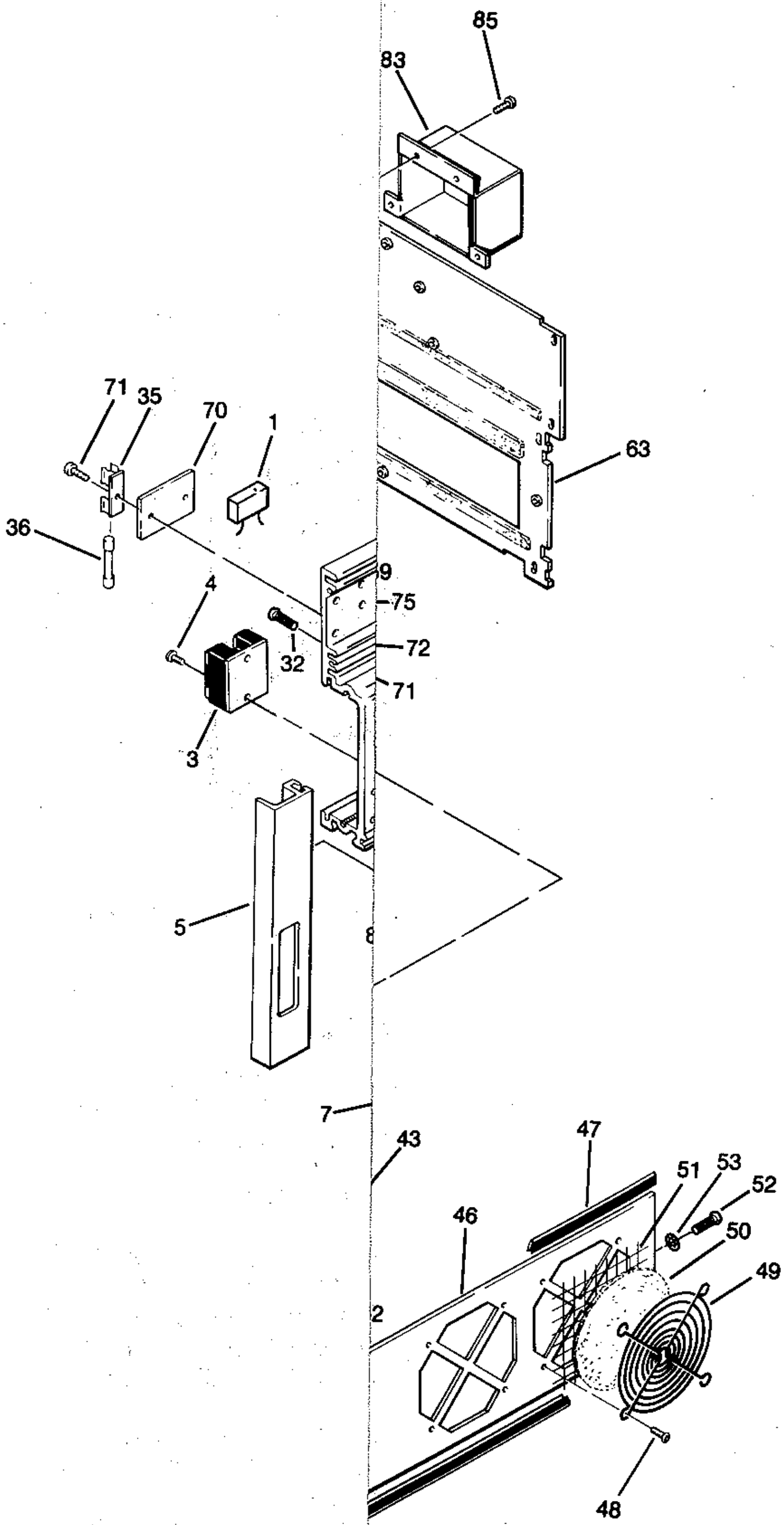
Crown International Parts Department
1718 W. Mishawaka Road
Elkhart, Indiana 46517-4095
(219) 294-8210
TWX 810 294-2160
FAX (219) 294-8329

7.6. Main Exploded View and Parts List

ITEM #	PART #	QTY.	DESCRIPTION
1	C 7099-2	2	0.47MF 250V AC
2	F11197J4	1	PANEL, ISA B-L LEFT SIDE FINIS
3	C 7308-7	2	SCR SS RELAY 40A 240VAC
4	C 2228-2	5	8-32 X .62 RDHD PH MSCR Z
5	F10785K4	1	HANDLE, 8520 LEFT
6	C 7256-8	4	5/16-18 X 7/8 HX CAP SCR Z 5GR
7	D 7111-4	2	HANDWELL, 8522/23/24
8	F11425J9	1	PANEL, FRONT 8524
9	F11491J1	1	BEZEL 8520 FRONT PANEL FINISH
10	C 2155-7	4	8-32 X .5" Pan Head Machine Screw
11	C 7667-6	4	#8U-Clip
12	D 6999-3	4	#8 Fiber Retainer Washer
13	Ref		Main Board
14	D 6146-1	1	INSULATOR, 11 X7.5X.031 VULCAN
15	M20475L0	1	8520 SUB FRONT SKIN FINISH BT
16	F10869K6	1	PANEL,ISA SUBFRONT BTM PAINTED
17	B 5564-8	4.5	.1875 X .1875 CONTINUOUS GROMM
18	C 4014-4	1	OCB.500 SNAP BUSHING
19	C 7256-8	4	5/16-18 X 7/8 HX CAP SCR Z 5GR
20	C 6519-0	4	.312 SPLIT RING LOCKWASHR ZINC
21	M20677J6	1	Top Right Mounting Bracket
22	F10493J8	2	BRKT, FRONT PANEL ISA
23	F10786K2	1	HANDLE, 8520 RIGHT
24	F10762J6	1	CVR, BTM 8520 FINISHED
25	C 5099-4	2	R 8-32 X .37 B S MSCR
26	M20676J8	1	Top Left Mounting Bracket
27	C 6519-0	4	.312 SPLIT RING LOCKWASHR ZINC
28	C 6524-0	4	5/16-18 Z HEX NUT
29	C 2279-5	2	#10 INT.TOOTH LOCKWASHER ZINC
30	C 5305-5	2	10-32 X .5 FLTHD PH MSCR
31	F11196J6	1	PANEL, ISA B-L RIGHT SIDE FINI
32	C 2049-2	3	T10 32 .50 A S MSCR
33	C 2279-5	2	#10 INT.TOOTH LOCKWASHER ZINC
34	M20339-4	1	A-P BRKT,BTM SI ISA
35	C 3776-9	1	3823-1 FUSE BLOCK

ITEM #	PART #	QTY.	DESCRIPTION
36	C 4875-8	1	FUSE, 1A 3AG SLO-BLOW"
37	C 5594-4	10	#6 INT.STAR WASHER ZINC
38	C 1954-4	2	6-32 X .25 RDHD PH MSCR
39	C 4305-6	6	MDA3502 35A BRIDGE RECTIFIER
40	C 4252-0	6	8-32 X .87 RDHD PH MSCR
41	C 7436-6	1	GROMMET 2.0 OD 1.5 ID (2034)
42	C 7864-9	16	6-32 X .5 SOCKET CAP MCSR ZINC
43	C 7858-1	4	FAN, 4.7" BALL BEARING 4715-FS
44	C 5297-4	4	8-32 X .37 #7 TRUSS PH MCSR
45	C 1951-0	4	#8 INT.STAR LOCKWASHER
46	F10761J8	2	PNL,ISA SIDE FAN PAINTED
47	F10494-7	4	SLIDE, ISA FAN PANEL"
48	D 6309-5	16	6-32 X.235 HEX HD TRI-LOBE BLK
49	C 6596-8	4	FAN COVER ISA
50	D 5459A7	4	Foam, Fan Filter
51	F10639J6	4	Wire Mesh, Fan Filter
52	C 6078-7	2	6-32 X .375 RDHD PH B
53	C 6860-8	1	#10 EXTERNAL STAR LOCKWASHER
54	M20616J4	1	PANEL, 8524 BACK CONN FINSH #2
55	D 2934-4	2	389SOLDR LUG.218HOLE
56	C 7408-5	1	BREAKER, 3P 20A HI INRUSH 250V
57	C 5594-4	10	#6 INT.STAR WASHER ZINC
58	C 2176-3	8	6-32 X .50 RDHD PH MSCR Z
59	C 7074-5	4	SCRLOK W/.312 THD LG #205818-2
60	C 6876-4	1	7-PIN PWR CONN AMP#206137-1
	C 6903-6	4	CPC CONN PIN #12-14 WIRE
61	C 5594-4	14	#6 INT.STAR WASHER ZINC
62	C 4758-6	6	R 6-32 X .25 B S MSCR
63	M20582J8	1	PANEL, 8524/25 BACK PAINT SS
64	C 6916-8	8	10-24X.375 PAN PHIL STSCR BLK
65	C 1889-2	4	6 X32 HEX NUT
66	F10766J7	1	CVR, TOP 8520 FINISHED
67	Ref		Shelf
68			Power Supply
69	C 2170-6	1	10/32 HEX NUT, ZINC PLATING
70	M43851-1	1	BI-LEVEL FAN TERMINATOR ASM
	M43851-1	1	BI-LEVEL FAN TERMINATOR ASM

ITEM #	PART #	QTY.	DESCRIPTION
71	C 3842-9	1	3 POS BARRIER BLOC
72	C 2176-3	1	6-32 X .50 RDHD PH MSCR Z
73	NA		
74	Q42646-2	1	MOD, 8524 BI-LEVEL INPUT
75	C 6877-2	1	TWINAX BNC AMPHENOL #31-223
	C 6885-5	2	INSULATOR,BNC/TWIN AMP227223-1
76	C 5297-4	4	8-32 X .37 #7 TRUSS PH MCSR
77	C 1951-0	4	#8 INT.STAR LOCKWASHER
78	C 7087-7		#8 RING BRL CONN #12-#10 WIRE
79	C 1951-0	4	#8 INT.STAR LOCKWASHER
80	C 1986-6	2	8 X32 HEX NUT
81	C 1811-6	50	4" CABLE TIE
82	C 5594-4	10	#6 INT.STAR WASHER ZINC
83	F11234J5	1	COVER, ISA BI LEVEL OUTPUT
84	NA		Deleted
85	C 5099-4	2	R 8-32 X .37 B S MSCR
	C 6860-8	1	#10 EXTERNAL STAR LOCKWASHER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7.7. Digital Panel Meter Exploded View and Parts List

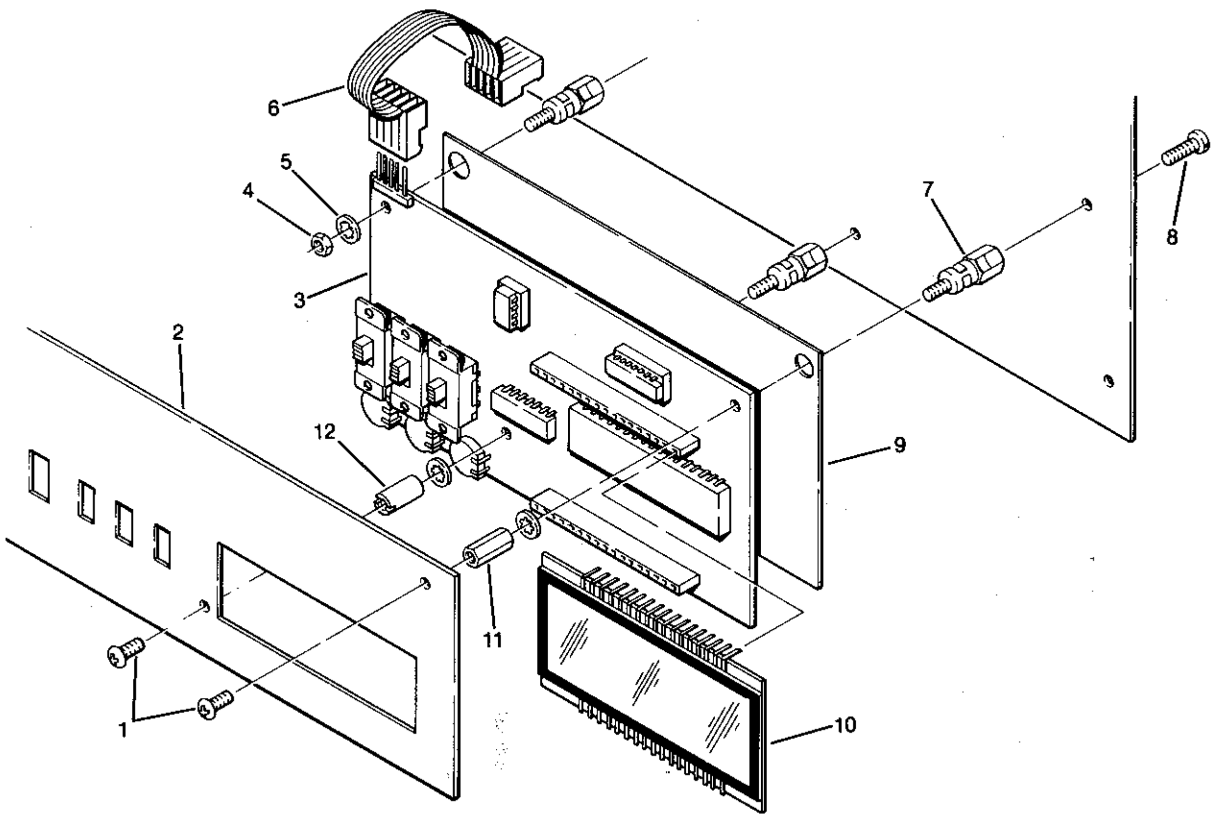


Illustration 7-2 Digital Panel Meter Exploded View

ITEM #	PART #	QTY.	DESCRIPTION
1	C 1954-4	2	6-32 X .25 RDHD PH MSCR
2	F11018J2	1	PLATE, 8522/23 DISPLAY W/METER
3	Q42631-4	1	MOD, 77M01 (A) DISPLAY
4	C 1889-2	1	6 X32 HEX NUT
5	C 1823-1	3	#6 INT.STAR WASHER BLACK
6	H42740-3	1	CABLE, 7700 DISPLAY INTERCONN
	B 5616-6	1.85	10 COND 24 AWG GRY RIB CBL
	C 6827-7	2	5POS .1" CENTERS #22GA MTA CONN
7	C 6961-4	3	.5 NYLON STANDOFF CBS-TFM-801
8	C 2620-0	3	6-32 X .38 BLACK NYLON MSCR
9	D 6408A3	1	INSULATOR, 7780 DISPLAY BD
10	C 6866-5	1	M5735-H4 3.5 DIGIT LCD 3/4"
11	D 6350-9	1	.413 HEX STANDOFF 6/32
12	D 6379-8	1	7/32 X .413 SLOTTED STANDOFF

7.8. Shelf Exploded View and Parts List

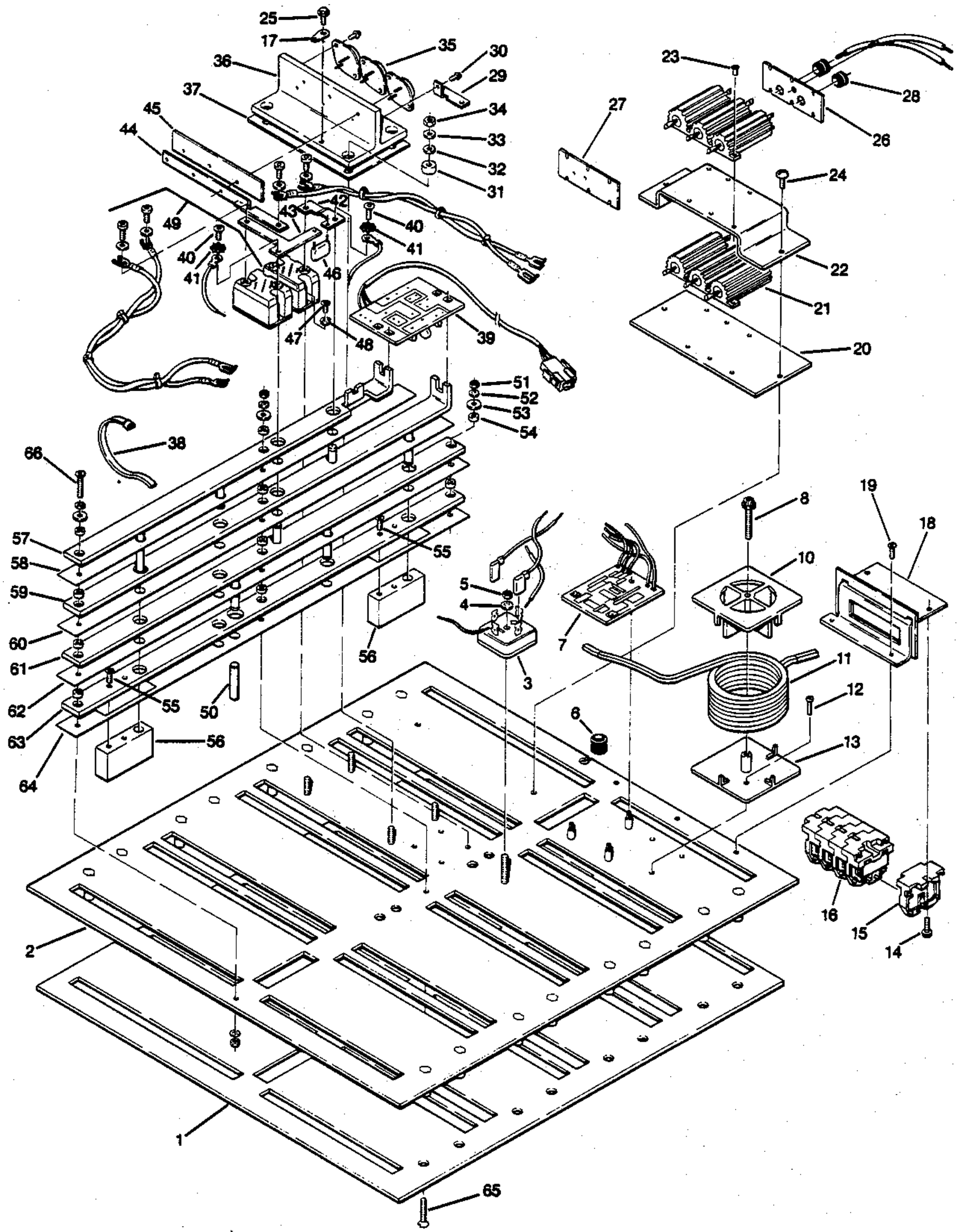


Illustration 7-3 Shelf Exploded View

ITEM #	PART #	QTY.	DESCRIPTION
1	D 6837-5	1	INSULATOR, SILICON B-L SHELF
2	M20618-1	1	"HEATSINK, 8524/8607 SHELF"
3	C 4305-6	1	MDA3502 35A BRIDGE RECTIFIER
4	C 2279-5	1	#10 INT.TOOTH LOCKWASHER ZINC
5	C 2170-6	1	10/32 HEX NUT, ZINC PLATING
6	C 1566-6	3	GROM .375 GROOVED
7	M43849-5	1	ISA POST SLDR TERM BD ASM
8	C 3634-0	1	6-32 X 1.25 PNHD PH MSCR
8	C 7604-9	1	8-32X 1 1/2 SLOT HEX WSHR MSCR
9			Deleted
10	D 6941-5	1	BRKT, TOP COIL MOUNT ISA B-L
11	D 6831-8	1	COIL, ISA B-L OUTPUT W3"
12	C 5297-4	2	8-32 X .37 #7 TRUSS PH MCSR
13	F11382-3	1	BRKT,BTM COIL MOUNT B-L TAPPED
14	C 7437-4	2	8-32 X .5 IND HEX WSHR HD ZINC
15	C 7168-5	1	#8 AWG BARRIER BLOCK END
16	C 7167-7	4	#8 AWG 3 TERM BARRIER BLOCK
17	C 3163-0	4	505SOLDR LUG #6 HOLE
18	M20633J9	1	BRKT, ISA B-L BARRIER BLOCK #2
18	F11360-9	1	PLATE, ISA B-L BARR BLOCK BRKT
19	C 7437-4	2	8-32 X .5 IND HEX WSHR HD ZINC
20	M20585-2	1	HEATSINK,ISA B-L LOWER CURR SENSE
21	C 6299-9	3	0.1 OHM 50W 1% WIRE
22	M20584-5	1	HEATSINK,ISA B-L UPPER CURR SENSE
23	C 7533-0	6	GS4-9 .121 X .281 BRASS EYELET
24	C 2228-2	2	8-32 X .62 RDHD PH MSCR Z
25	D 6315-2	1	6-32 X.235 TORX HD TRI-LOBE Z
26	F11206-4	1	REAR BUSSBAR CURR SENSE B-L
27	F11205-6	1	FRONT BUSSBAR CURR SENSE B-L
28	C 1566-6	3	GROM .375 GROOVED
29	F11307-0	1	BUSSBAR, ISA B-L SWITCH 'D'
30	D 6315-2	1	6-32 X.235 TORX HD TRI-LOBE Z
31	C 7556-1	4	#8 X 5/16 OD X 1/4 L SPACER
32	C 7555-3	4	#8 NYLON WASHER .171ID X.437OD
33	C 2101-1	4	#8 TYPE A WASHER ZINC
34	C 1986-6	4	8 X32 HEX NUT
35	C 7405-1	3	MTM55N10 FET SWITCH
- 36	F11335-1	1	HEATSINK, ISA B-L SWITCH 'T'#2
37	D 6918-3	2	INSULATOR, BI-LEVEL SWITCH #2
38	C 1812-4	2	7" CABLE TIE
39	Ref		Bilevel Control Board
40	C 2155-7		8-32 X .37 TRHD PH MSCR ZINC

ITEM #	PART #	QTY.	DESCRIPTION
41	C 6860-8	4	#10 EXTERNAL STAR LOCKWASHER
42	F11304-7	1	BUSSBAR, ISA B-L SWITCH 'A'
43	F11306-2	1	BUSSBAR, ISA B-L SWITCH 'C'
44	F11305-4	1	BUSSBAR, ISA B-L SWITCH 'B'
45	P10160-3	1	BD, ISA B-L GATE CONNECTION SW
46	C 7502-5	1	0.47MF250V STK FILM CA
47	C 6077-9	1	6-32 X .375 RDHD PH MSCR ZINC
48	C 5594-4		#6 INT.STAR WASHER ZINC
49	C 7501-7	2	DIODE, IRT70HFL10S10 70A 100V
50	B 4782-7	11.2	.250 SHRINK TUBE BLACK EXPANDE
51	C 1889-2	3	6 X32 HEX NUT
52	C 5594-4	3	#6 INT.STAR WASHER ZINC
53	C 3575-5	6	500OD X 195ID FIBER WASHER
54	C 5963-1	10	141X250X125 NYL SPCR
55	C 2274-6		8-32 X .37 FLTHD PH MSCR Z
56	F10526-6	2	+VCC CONCTG BLOC ISA
57	M20576-1	1	BUSSBAR, ISA B-L OUTPUT WELDED
58	D 6823-5	1	INSULATOR, OTPT BUSSBAR ISA BL
59	M20577-9	1	BUSSBAR,ISA B-L COMMON WELDED
60	D 6824-3	1	INSULATOR, COM BUSSBAR ISA B-L
61	M20579-5	1	BUSSBAR, ISA B-L -VCC WELDED
62	D 6822-7	1	INSULATOR, -VCC BUSSBAR ISA BL
63	M20578-7	1	BUSSBAR, ISA B-L +VCC WELDED
64	D 6783-1	1	INSULATOR, ISA SHELF-SCR MYLAR
	D 6851-6	1	INSULATOR, +VCC ISA BI-LEVEL
65	C 6345-0	2	6-32 X 1 FLTHD PH MSCR Z
66	C 3634-0	1	6-32 X 1.25 PNHD PH MSCR

7.9. Output Well Exploded View and Parts List

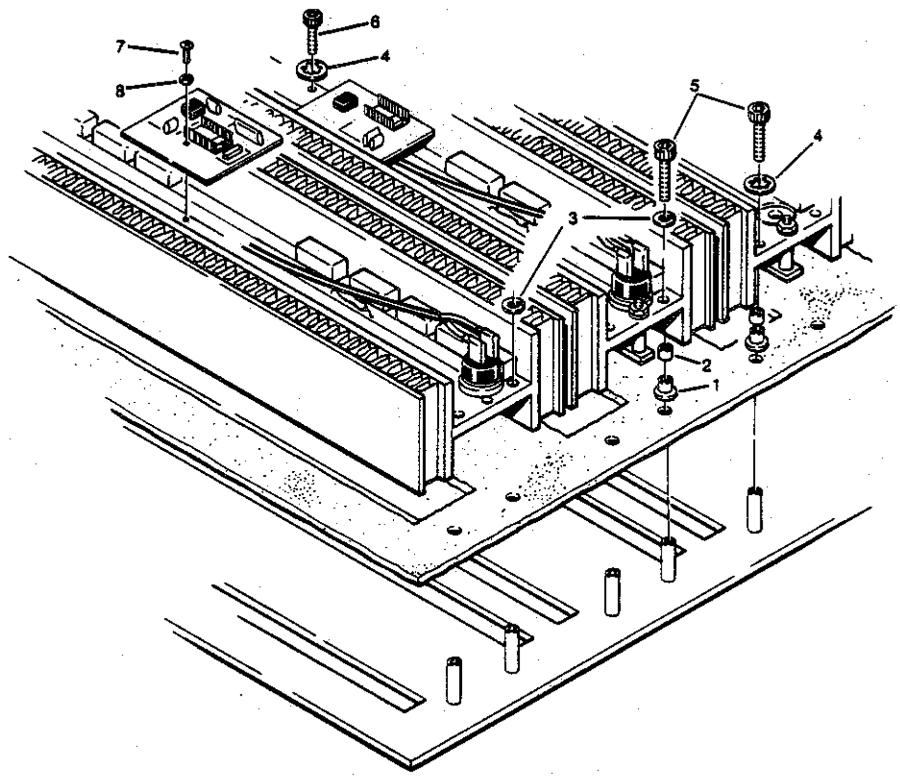


Illustration 7-4 Output Well Exploded View

ITEM #	PART #	QTY.	DESCRIPTION
1	C 6729-5	4	#8 SHOULDER WSHR .375OD X .171
2	C 6612-3	4	25ODX.171IDX.187L FIBER SPACE
3	C 6559-6		#8 SPLIT RING LOCKWASHER
4	C 1951-0	2	#8 INT.STAR LOCKWASHER
5	C 5024-2		8-32 X .75 SOCKET HD CAP ZINC
6	C 6529-9	8	8-32 X.5 O S MSCR
7	C 7009-1	4	6-32 X .3125 RDHD PH MSCR
8	C 6897-0	4	HDS 3.5 SAFETY WSHR ZINC PLATE

7.10. Power Supply Exploded View and Parts List

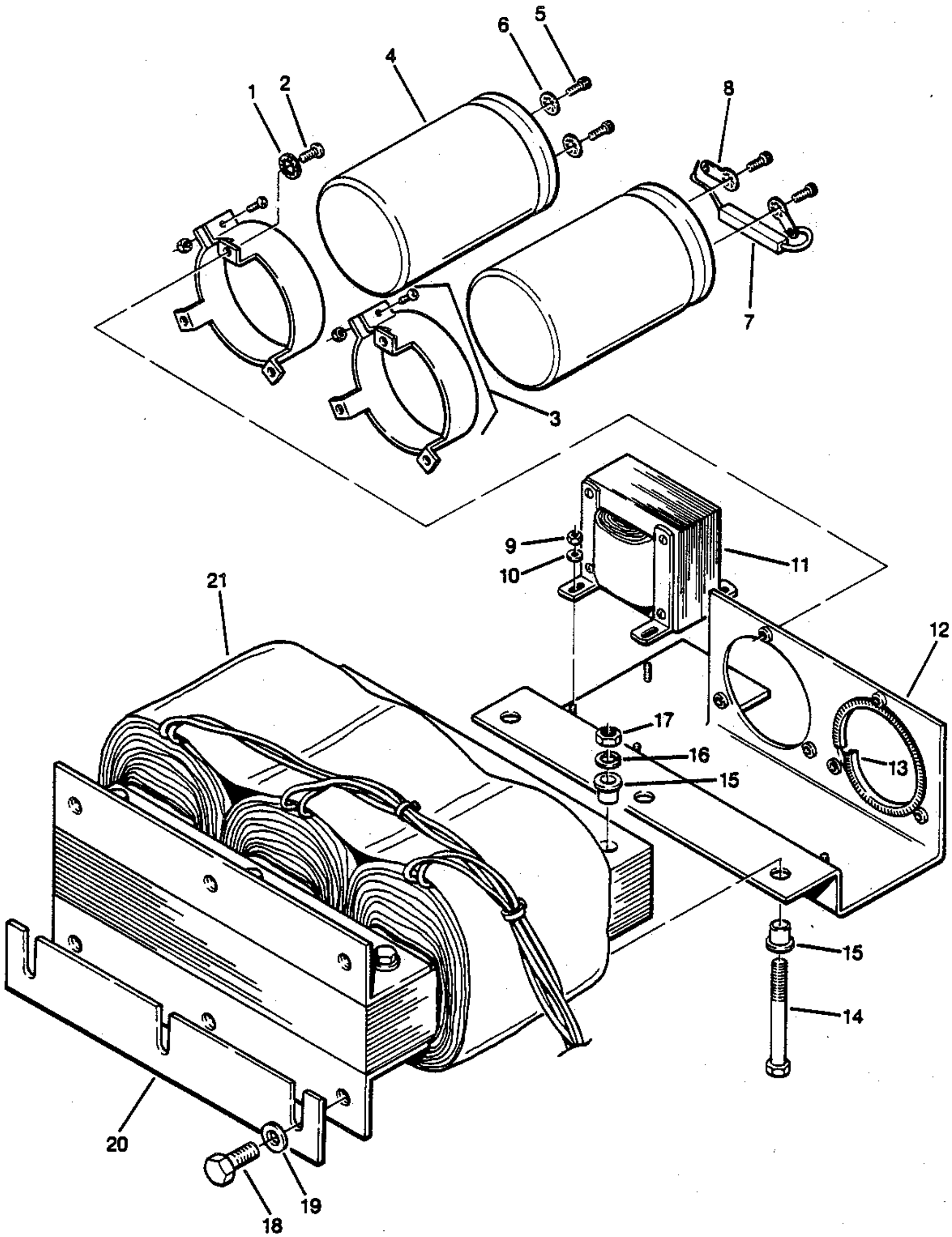


Illustration 7-5 Power Supply Exploded View

ITEM #	PART #	QTY.	DESCRIPTION
1	C 1951-0	5	#8 INT.STAR LOCKWASHER
2	C 2271-2	5	8-32 X .25 TRHD PH MSCR ZINC
3	C 7612-2	2	"BRKT, CAPACITOR 3" VR12
4	C 7406-9	2	20000MFD 90VDC ELECTROLYTIC
5	C 7599-1	4	1/4-28 X .375 SOCKET HD MSCR
6	C 2279-5	4	#10 INT.TOOTH LOCKWASHER ZINC
7	C 7852-4	1	2.5 KOHM 5W 5% WIREWOUND
8	D 3515-0	2	762SOLDR LUG.250HOLE
9	C 1889-2	4	6 X32 HEX NUT
10	N/A		
11	M20643-9	1	XFMR, ISA 208/240V PREP #2
12	M20337-8	2	BRKT, XFMR 3P ISA
12	M20645-4	1	BRKT, BI-LEVEL XFMR/CAP
13	B 5564-8	19.2	.1875 X .1875 CONTINUOUS GROMM
14	C 6521-6	3	1/4-20X3.5 HEX CAP SCRW 5GRD
15	C 6502-6	6	INSULATOR,.25IDX.5HD,.375LSBU
16	C 6518-2	3	.25 SPLIT RING LOCKWASHER ZINC
17	C 6523-2	3	1/4-20 Z HEX NUT
18	C 7256-8	4	5/16-18 X 7/8 HX CAP SCR Z 5GR
19	C 6519-0	4	.312 SPLIT RING LOCKWASHR ZINC
20	F11019-1	2	SHIM, 7700 XFMR
21	D 6795-5	1	XFMR, 8522/23B MAIN W/BRKT P35

7.11. Schematics Parts List

LOCATION #	PART #	DESCRIPTION
B1	C 7858-1	FAN, 4.7" BALL BEARING 4715-FS
B2	C 7858-1	FAN, 4.7" BALL BEARING 4715-FS
B3	C 7858-1	FAN, 4.7" BALL BEARING 4715-FS
B4	C 7858-1	FAN, 4.7" BALL BEARING 4715-FS
B5	C 6419-3	SHUNT,.025 SQ POST 2 POS
	C 6420-1	.025 SQ POST, #87307-2
B6	C 6419-3	SHUNT,.025 SQ POST 2 POS
	C 6420-1	.025 SQ POST, #87307-2
B800	C 6513-3	LOSSY BEAD FITS #16
B801	C 6513-3	LOSSY BEAD FITS #16
B900	C 6513-3	LOSSY BEAD FITS #16
B901	C 6513-3	LOSSY BEAD FITS #16
C90	C 3977-3	0.022MF 200V 5% FLM MYLAR, CAP
C91	C 3978-1	0.047MF200V 5% FILM MYLAR CAPC
C92	C 3978-1	0.047MF200V 5% FILM MYLAR CAPC
C100	C 3410-5	100PF DIPPED SILVER MICA
C101	C 5058-0	30PF PC MNT.TRIMMER CAP
C102	C 6130-6	0.1MF 50V MONO
C103	D 4292-5	.0587MF200V 2.5%CARB
C104	D 4290-9	0.234MF200V 2.5%CARB
C105	C 3409-7	47PF DIPPED SILVER MICA
C106	C 6130-6	0.1MF 50V MONO
C107	C 3190-3	0.068MF200V 10%FILM
C108	C 3190-3	0.068MF200V 10%FILM
C109	C 6130-6	0.1MF 50V MONO
C110	C 3290-1	120PF DIPPED SILVER MICA
C200	C 3410-5	100PF DIPPED SILVER MICA
C201	C 6130-6	0.1MF 50V MONO
C202	C 6227-0	20PF MICA #D155E200JO
C203	C 6130-6	0.1MF 50V MONO
C204	C 3409-7	47PF DIPPED SILVER MICA
C205	N/A	N/A
C206	C 4151-4	.0039MF200V FILM
C207	C 6130-6	0.1MF 50V MONO
C208	N/A	N/A
C209	N/A	N/A

LOCATION #	PART #	DESCRIPTION
C210	C 6130-6	0.1MF 50V MONO
C211	C 2342-1	27PF DIPPED SLVR MICA CAPC,
C212	C 2342-1	27PF DIPPED SLVR MICA CAPC,
C213	C 6130-6	0.1MF 50V MONO
C214	C 2820-6	5.0PF MICA #D155C050D0
C215	D 4448-3	56PF160V 2.5%STYR
C216	C 3409-7	47PF DIPPED SILVER MICA
C217	N/A	N/A
C218	C 6130-6	0.1MF 50V MONO
C219	N/A	N/A
C220	N/A	N/A
C221	C 2342-1	27PF DIPPED SLVR MICA CAPC,
C222	C 3411-3	200PF DIPPED SILVER MICA
C223	C 1751-4	0.01MF500V DISC
C224	C 1751-4	0.01MF500V DISC
C226	C 3411-3	200PF DIPPED SILVER MICA
C227	C 2820-6	5.0PF MICA #D155C050D0
C300	C 3729-8	100MF 16V VERT
C301	C 6130-6	0.1MF 50V MONO
C302	C 7283-2	8.9MF 35V 10% NP VERT ELECYTIC
C303	C 7281-6	.27 MF METAL POLYESTER 10%
C305	C 6130-6	0.1MF 50V MONO
C306	C 7283-2	8.9MF 35V 10% NP VERT ELECYTIC
C307	C 7281-6	.27 MF METAL POLYESTER 10%
C309	C 3729-8	100MF 16V VERT
C400	C 7406-9	20000MFD 90VDC ELECTROLYTIC
C401	C 3728-0	10MF 50V VERT
C402	C 6888-9	470MF 35V .4 X 1.2 CAPACITOR
C403	C 3728-0	10MF 50V VERT
C404	C 6888-9	470MF 35V .4 X 1.2 CAPACITOR
C405	C 3729-8	100MF 16V VERT
C406	C 6674-3	3300MF 16V AXIAL CAP
C407	C 2938-6	0.1MF200V 10%FILM
C408	C 7502-5	0.47MF250V STK FILM CAP
C409	C 2938-6	0.1MF200V 10%FILM
C410	C 2938-6	0.1MF200V 10%FILM
C412	C 7406-9	20000MFD 90VDC ELECTROLYTIC
C413	C 2938-6	0.1MF200V 10%FILM
C414	C 2938-6	0.1MF200V 10%FILM
C415	C 2938-6	0.1MF200V 10%FILM

LOCATION #	PART #	DESCRIPTION
C416	C 2821-4	10PF MICA
C417	C 2821-4	10PF MICA
C418	C 3411-3	200PF DIPPED SILVER MICA
C419	C 3728-0	10MF 50V VERT
C420	C 3411-3	200PF DIPPED SILVER MICA
C421	C 6683-4	4700PF 50V 10% POLY FILM
C422	C 5050-7	4.7MF100V AXIAL LYTIC
C423	C 5050-7	4.7MF100V AXIAL LYTIC
C424	C 5050-7	4.7MF100V AXIAL LYTIC
C425	C 5050-7	4.7MF100V AXIAL LYTIC
C426	C 5050-7	4.7MF100V AXIAL LYTIC
C427	C 5050-7	4.7MF100V AXIAL LYTIC
C428	C 5050-7	4.7MF100V AXIAL LYTIC
C429	C 5050-7	4.7MF100V AXIAL LYTIC
C501	C 1751-4	0.01MF500V DISC
C502	C 6130-6	0.1MF 50V MONO
C503	C 1751-4	0.01MF500V DISC
C504	C 6096-9	3.3MF 50V LOW LEAK
C505	C 6130-6	0.1MF 50V MONO
C506	C 1751-4	0.01MF500V DISC
C507	C 7870-6	0.33MF100V 10%POLY
C600	C 4404-7	0.047MF250V 5%CARB
C650	C 3063-2	.0082MF100V 10% POLYESTER
C651	C 3411-3	200PF DIPPED SILVER MICA
C652	C 3480-8	0.001MF200V 10% FILM
C653	C 7422-6	750PF 300V MICA CAP CD
C654	C 3480-8	0.001MF200V 10% FILM
C655	C 3996-3	.0047MF200V 5%FILM
C700	C 4404-7	0.047MF250V 5%CARB
C750	C 3063-2	.0082MF100V 10% POLYESTER
C751	C 3411-3	200PF DIPPED SILVER MICA
C752	C 7422-6	750PF 300V MICA CAP CD
C753	C 3288-5	0.015MF100V 10%FILM
C754	C 1751-4	0.01MF500V DISC
C800	C 3977-3	0.022MF 200V 5% FLM MYLAR, CAP
C850	C 6804-6	.1MF 100V AXIAL CER T/R 104
C851	C 3411-3	200PF DIPPED SILVER MICA
C852	C 3480-8	0.001MF200V 10% FILM
C853	C 3480-8	0.001MF200V 10% FILM

LOCATION #	PART #	DESCRIPTION
C900	C 3977-3	0.022MF 200V 5% FLM MYLAR, CAP
C950	C 3063-2	.0082MF100V 10% POLYESTER
C952	C 1751-4	0.01MF500V DISC
C953	C 3480-8	0.001MF200V 10% FILM
C954	C 3411-3	200PF DIPPED SILVER MICA
CB1	C 7408-5	BREAKER, 3P 20A HI INRUSH 250V
D100	C 3181-2	DIODE, 1N4148
D101	C 3181-2	DIODE, 1N4148
D102	C 5900-3	DIODE, 1N960B ZENER 9.1
D103	C 2851-1	RECTIFIER, 1N4004 SILICON
D104	C 2851-1	RECTIFIER, 1N4004 SILICON
D200	C 3181-2	DIODE, 1N4148
D201	C 3181-2	DIODE, 1N4148
D202	C 3181-2	DIODE, 1N4148
D203	C 3181-2	DIODE, 1N4148
D204	C 3181-2	DIODE, 1N4148
D205	C 3181-2	DIODE, 1N4148
D206	C 3181-2	DIODE, 1N4148
D207	C 3181-2	DIODE, 1N4148
D300	C 3181-2	DIODE, 1N4148
D302	C 3181-2	DIODE, 1N4148
D303	C 3181-2	DIODE, 1N4148
D304	C 3181-2	DIODE, 1N4148
D305	C 3181-2	DIODE, 1N4148
D400	C 2851-1	RECTIFIER, 1N4004 SILICON
D401	C 2851-1	RECTIFIER, 1N4004 SILICON
D402	C 2851-1	RECTIFIER, 1N4004 SILICON
D403	C 2851-1	RECTIFIER, 1N4004 SILICON
D404	C 2851-1	RECTIFIER, 1N4004 SILICON
D405	C 2851-1	RECTIFIER, 1N4004 SILICON
D406	C 2851-1	RECTIFIER, 1N4004 SILICON
D407	C 2851-1	RECTIFIER, 1N4004 SILICON
D408	C 2851-1	RECTIFIER, 1N4004 SILICON
D409	C 2851-1	RECTIFIER, 1N4004 SILICON
D410	C 2851-1	RECTIFIER, 1N4004 SILICON
D411	C 4305-6	MDA3502 35A BRIDGE RECTIFIER
D412	C 4305-6	MDA3502 35A BRIDGE RECTIFIER
D413	C 4305-6	MDA3502 35A BRIDGE RECTIFIER
D414	C 4305-6	MDA3502 35A BRIDGE RECTIFIER

LOCATION #	PART #	DESCRIPTION
D415	C 4305-6	MDA3502 35A BRIDGE RECTIFIER
D416	C 4305-6	MDA3502 35A BRIDGE RECTIFIER
D417	C 3549-0	DIODE, 1N961B 10V ZENER
D418	C 6578-6	DIODE, 1N4735 6.2V ZENER
D419	C 7501-7	DIODE, IRT70HFL10S10 70A 100V
D420	C 7501-7	DIODE, IRT70HFL10S10 70A 100V
D500	C 3181-2	DIODE, 1N4148
D501	C 3181-2	DIODE, 1N4148
D502	C 3181-2	DIODE, 1N4148
D503	C 3181-2	DIODE, 1N4148
D504	C 3181-2	DIODE, 1N4148
D505	C 3181-2	DIODE, 1N4148
D506	C 3181-2	DIODE, 1N4148
D507	C 3181-2	DIODE, 1N4148
D508	C 3181-2	DIODE, 1N4148
D600	C 3181-2	DIODE, 1N4148
D601	C 3181-2	DIODE, 1N4148
D607	C 4305-6	MDA3502 35A BRIDGE RECTIFIER
D650	C 2851-1	RECTIFIER, 1N4004 SILICON
D750	C 2851-1	RECTIFIER, 1N4004 SILICON
D751	C 2851-1	RECTIFIER, 1N4004 SILICON
D800	C 3181-2	DIODE, 1N4148
D801	C 3181-2	DIODE, 1N4148
D850	C 2851-1	RECTIFIER, 1N4004 SILICON
D950	C 2851-1	RECTIFIER, 1N4004 SILICON
D951	C 2851-1	RECTIFIER, 1N4004 SILICON
E500	C 4342-9	AMBER LED GI #MV5153
E501	C 4342-9	AMBER LED GI #MV5153
E502	C 4342-9	AMBER LED GI #MV5153
E503	C 7863-1	T 1.75 GREEN LED
E504	C 4431-0	YELLOW L.E.D.
E505	C 4341-1	T 1.75 RED L.E.D.
F1	C 4875-8	FUSE, 1A 3AG SLO-BLOW
J100	C 4508-5	IC SOCKET,16PIN DIP 2-640358-3
J150	C 6851-7	5POS.1CENTER RT ANGLE MTA HDR
J200	C 3450-1	IC SOCKET, 14PIN DIP
J300	C 6463-1	STRAIT.EJECT 26P HDR

LOCATION #	PART #	DESCRIPTION
J400	C 6884-8	40 PIN EJECT HEADER #102332-9
	D 6346-7	7780 HARDBOARD INTERCONN CABLE
J500	C 6481-3	AMPMOD4 8PIN HEADER
J600	C 6564-6	10P DBLROW UNSHD HDR 87230-5
J600	C 6563-8	10P DBLROW BD-MT RECP #86418
J700	C 6564-6	10P DBLROW UNSHD HDR 87230-5
J700	C 6563-8	10P DBLROW BD-MT RECP #86418-9
J800	C 6564-6	10P DBLROW UNSHD HDR 87230-5
J800	C 6563-8	10P DBLROW BD-MT RECP #86418-9
J900	C 6564-6	10P DBLROW UNSHD HDR 87230-5
J900	C 6563-8	10P DBLROW BD-MT RECP #86418-9
K1	C 7308-7	SCR SS RELAY 40A 240VAC
K2	C 7308-7	SCR SS RELAY 40A 240VAC
L1	D 6844-1	CHOKE, 8524 B-L COMMON MODE
L650	C 3510-2	CHOKE, .5 MH AXIAL 470 UH
L750	C 3510-2	CHOKE, .5 MH AXIAL 470 UH
L850	C 3510-2	CHOKE, .5 MH AXIAL 470 UH
L90	D 6831-8	COIL, ISA B-L OUTPUT W3
L950	C 3510-2	CHOKE, .5 MH AXIAL 470 UH
N100	D 4669-4	D-75 BAL INPUT RES TRIM
N101	D 6234-5	RESISTOR NETWORK #20
N102	D 6213-9	RESISTOR/TRIMER NETWORK #4
N103	D 6214-7	RESISTOR/TRIMER NETWORK #3
N300	D 4922-7	RESISTOR NETWORK #16
N301	D 4922-7	RESISTOR NETWORK #16
N302	D 6709-6	RESISTOR NETWORK #21
Q100	C 5135-6	2N5770 NPN
Q101	C 5135-6	2N5770 NPN
Q200	C 3625-8	2N4125 PNP
Q201	C 3625-8	2N4125 PNP
Q202	D 4837-7	SEL IT132 PNP
Q203	C 3578-9	MPSA93 PNP
Q204	C 3810-6	MPSA43/A42 NPN

LOCATION #	PART #	DESCRIPTION
Q205	D 4838-5	SEL IT129 NPN
Q206	C 3954-2	MPSA-56 TRANSISTOR
Q207	C 3528-4	MPSA06 NPN
Q209	C 3528-4	MPSA06 NPN
Q210	C 3625-8	2N4125 PNP
Q211	C 3625-8	2N4125 PNP
Q212	C 5453A1	2SA1006BR TO-220 PNP
Q213	D 2962-5	MPS8097 NPN(ALTERNATE MPSA18)
Q214	C 3786-8	PN4250A PNP
Q215	C 6436-7	2SC2336BR TO-220 NPN
Q216	C 3954-2	MPSA-56 TRANSISTOR
Q300	D 4837-7	SEL IT132 PNP
Q301	D 4838-5	SEL IT129 NPN
Q302	D 2961-7	SEL 2N3859A, SPS8010 NPN
Q303	C 3625-8	2N4125 PNP
Q304	C 3625-8	2N4125 PNP
Q305	D 2961-7	SEL 2N3859A, SPS8010 NPN
Q306	C 3625-8	2N4125 PNP
Q400	C 7405-1	MTM55N10 FET SWITCH
Q401	C 7405-1	MTM55N10 FET SWITCH
Q402	C 7405-1	MTM55N10 FET SWITCH
Q403	D 2961-7	SEL 2N3859A, SPS8010 NPN
Q500	C 6049-8	J-310 JFET
Q501	D 2961-7	SEL 2N3859A, SPS8010 NPN
Q600-Q609	C 7614-8	DUAL DIE TRANSISTOR SJ4429
Q610	C 5869-0	2SD555RA PWR NPN
Q611	C 5869-0	2SD555RA PWR NPN
Q612-Q621	C 7614-8	DUAL DIE TRANSISTOR SJ4429
Q650	C 6436-7	2SC2336BR TO-220 NPN
Q651	C 3625-8	2N4125 PNP
Q652	D 2961-7	SEL 2N3859A, SPS8010 NPN
Q700-Q709	C 7614-8	DUAL DIE TRANSISTOR SJ4429
Q710	C 5869-0	2SD555RA PWR NPN
Q711	C 5869-0	2SD555RA PWR NPN
Q712-Q721	C 7614-8	DUAL DIE TRANSISTOR SJ4429
Q750	C 5453A1	2SA1006BR TO-220 PNP

LOCATION #	PART #	DESCRIPTION
Q800-809	C 7614-8	DUAL DIE TRANSISTOR SJ4429
Q810	C 5869-0	2SD555RA PWR NPN
Q811	C 5869-0	2SD555RA PWR NPN
Q812-Q821	C 7614-8	DUAL DIE TRANSISTOR SJ4429
Q850	C 6436-7	2SC2336BR TO-220 NPN
Q851	C 3625-8	2N4125 PNP
Q852	D 2961-7	SEL 2N3859A, SPS8010 NPN
Q900-Q909	C 7614-8	DUAL DIE TRANSISTOR SJ4429
Q910	C 5869-0	2SD555RA PWR NPN
Q911	C 5869-0	2SD555RA PWR NPN
Q912-Q921	C 7614-8	DUAL DIE TRANSISTOR SJ4429
Q950	C 6436-7	2SC2336BR TO-220 NPN
R90	C 7102-4	4.7 OHM 140VPTH POSISTOR MURA
R91	C 6625-5	5.6 OHM 5W 5% METAL OXIDE
R92	C 6625-5	5.6 OHM 5W 5% METAL OXIDE
R100	C 5702-3	75. KOHM .25W 1 MF
R101	C 6349-2	16.9KOHM .25W 1 MF
R102	C 4859-2	10. KOHM .25W 1 MF
R103	C 5163-8	5.1 KOHM .25W 5 CF
R104	C 4859-2	10. KOHM .25W 1 MF
R105	C 6886-3	10KOHM 20-TURN CERMET TRIMPOT
R106	C 3616-7	2.4 KOHM .25W 5 CF
R107	C 4859-2	10. KOHM .25W 1 MF
R108	C 2885-9	270.KOHM .25W 5% CF25
R109	C 4916-0	68.1KOHM .5W 1 MF
R110	C 4859-2	10. KOHM .25W 1 MF
R111	C 5046-5	20. KOHM .25W 5 CF
R112	C 5046-5	20. KOHM .25W 5 CF
R113	C 4753-7	910. OHM .25W 5 CF
R114	C 3672-0	2KOHM HELIPOT TRIM
R115	C 2876-8	1.5 KOHM .25W 5% CF
R116	C 4915-2	7.5 MOHM .25W 5 CF
R117	C 4843-6	100KOHM CERMET TRIMPOT
R118	C 3753-8	10.0 OHM .25W 5% CF
R119	C 3753-8	10.0 OHM .25W 5% CF
R120	C 6878-0	47. MOHM .25W 5% CF
R121	C 4843-6	100KOHM CERMET TRIMPOT
R122	C 5163-8	5.1 KOHM .25W 5 CF
R123	C 4859-2	10. KOHM .25W 1 MF
R124	C 4859-2	10. KOHM .25W 1 MF

LOCATION #	PART #	DESCRIPTION
R125	C 4867-5	49.9 OHM .25W 1 MF
R126	C 2627-5	1.0 KOHM .25W 5% CF
R127	C 4867-5	49.9 OHM .25W 1 MF
R144	C 2631-7	10. KOHM .25W 5% CF
R145	C 3299-2	5.6 OHM .5W 5 CF
R146	C 6089-4	5.6 OHM .25W 5% CF
R200	C 6482-1	24.9KOHM 1W.5% MF
R201	C 6177-7	1.31KOHM .25W.5% MF
R202	C 2627-5	1.0 KOHM .25W 5% CF
R203	C 6482-1	24.9KOHM 1W.5% MF
R204	C 4843-6	100KOHM CERMET TRIMPOT
R205	C 5170-3	2.2 MOHM .25W 5 CF
R206	C 2874-3	560. OHM .25W 5% CF25
R207	C 6399-7	1.38KOHM .25W.5% MF
R208	C 6482-1	24.9KOHM 1W.5% MF
R209	C 3800-7	200. OHM .25W 5 CF
R210	C 3800-7	200. OHM .25W 5 CF
R211	C 6400-3	232. OHM .25W 1% MF CRB14FX
R212	C 6400-3	232. OHM .25W 1% MF CRB14FX
R213	C 4852-7	2.49KOHM .25W 1 MF
R214	C 3686-0	4.99KOHM .25W 1 MF
R215	C 3686-0	4.99KOHM .25W 1 MF
R216	C 2627-5	1.0 KOHM .25W 5% CF
R217	C 3686-0	4.99KOHM .25W 1 MF
R218	C 3686-0	4.99KOHM .25W 1 MF
R219	C 4852-7	2.49KOHM .25W 1 MF
R220	C 6400-3	232. OHM .25W 1% MF CRB14FX
R221	C 6400-3	232. OHM .25W 1% MF CRB14FX
R222	C 2872-7	100. OHM .25W 5% CF
R223	C 4852-7	2.49KOHM .25W 1 MF
R224	C 4479-9	22.0 OHM .25W 5 CF
R225	C 2872-7	100. OHM .25W 5% CF
R226	C 5169-5	330. OHM .25W 5 CF
R227	C 2872-7	100. OHM .25W 5% CF
R228	C 4479-9	22.0 OHM .25W 5 CF
R229	C 2872-7	100. OHM .25W 5% CF
R230	C 2872-7	100. OHM .25W 5% CF
R231	C 6402-9	51.0 OHM .25W 5% CF
R232	C 6403-7	51. KOHM 1W 5% CF
R233	C 6403-7	51. KOHM 1W 5% CF
R234	C 4843-6	100KOHM CERMET TRIMPOT

LOCATION #	PART #	DESCRIPTION
R235	C 3621-7	91. KOHM .25W 5% CF
R236	C 3093-9	10KOHM CERMET TRIM
R237	C 2627-5	1.0 KOHM .25W 5% CF
R238	C 5039-0	100. OHM .25W 1 MF
R239	C 4496-3	90.9 OHM .25W 1 MF
R240	C 6403-7	51. KOHM 1W 5% CF
R241	C 2874-3	560. OHM .25W 5% CF25
R242	C 4852-7	2.49KOHM .25W 1 MF
R243	C 3057-4	18.0 OHM .25W 5% CF
R244	C 3057-4	18.0 OHM .25W 5% CF
R245	C 2872-7	100. OHM .25W 5% CF
R246	C 2876-8	1.5 KOHM .25W 5% CF
R247	C 2876-8	1.5 KOHM .25W 5% CF
R248	C 3619-1	6.2 KOHM .25W 5 CF
R249	C 3619-1	6.2 KOHM .25W 5 CF
R250	C 2630-9	3.9 KOHM .25W 5% CF
R251	C 2630-9	3.9 KOHM .25W 5% CF
R252	C 4346-0	33. KOHM .25W 5% CF
R253	C 3804-9	2.0 KOHM .25W 5 CF
R255	C 6880-6	33. KOHM 1W 5% CF
R256	C 4753-7	910. OHM .25W 5 CF
R257	C 3799-1	150. OHM .25W 5 CF
R258	C 6034-0	270. OHM .25W 5% CF
R259	C 3803-1	750. OHM .25W 5 CF
R261	C 2872-7	100. OHM .25W 5% CF
R262	C 3057-4	18.0 OHM .25W 5% CF
R263	C 3057-4	18.0 OHM .25W 5% CF
R264	C 2880-0	47. KOHM .25W 5% CF25
R265	C 6482-1	24.9KOHM 1W.5% MF
R266	C 3616-7	2.4 KOHM .25W 5 CF
R267	C 6089-4	5.6 OHM .25W 5% CF
R268	C 6089-4	5.6 OHM .25W 5% CF
R271	C 3683-7	200 OHM HELIPOT TRIM
R272	C 3683-7	200 OHM HELIPOT TRIM
R273	C 3753-8	10.0 OHM .25W 5% CF
R274	C 6401-1	24. KOHM 1W 5% CF CF200S
R275	C 6401-1	24. KOHM 1W 5% CF CF200S
R300	C 2626-7	470. OHM .25W 5% CF
R301	C 2626-7	470. OHM .25W 5% CF
R302	C 2626-7	470. OHM .25W 5% CF
R303	C 4916-0	68.1KOHM .5W 1 MF
R304	C 2885-9	270.KOHM .25W 5% CF25

LOCATION #	PART #	DESCRIPTION
R305	C 5062-2	100KOHM LINEAR TRIMPOT
R306	C 5039-0	100. OHM .25W 1 MF
R307	C 4859-2	10. KOHM .25W 1 MF
R308	C 5235-4	110. OHM .25W 5 CF
R309	C 3939-3	4.7 KOHM .25W 5% CF
R310	C 4225-6	470.KOHM .25W 5% CF
R311	C 4225-6	470.KOHM .25W 5% CF
R312	C 3220-8	5.6 KOHM .25W 5% CF
R313	C 5662-9	16.2KOHM .25W 1 MF
R321	C 5039-0	100. OHM .25W 1 MF
R322	C 4916-0	68.1KOHM .5W 1 MF
R323	C 5039-0	100. OHM .25W 1 MF
R324	C 4859-2	10. KOHM .25W 1 MF
R325	C 5662-9	16.2KOHM .25W 1 MF
R326	C 5235-4	110. OHM .25W 5 CF
R327	C 3220-8	5.6 KOHM .25W 5% CF
R328	C 4225-6	470.KOHM .25W 5% CF
R329	C 2631-7	10. KOHM .25W 5% CF
R330	C 4225-6	470.KOHM .25W 5% CF
R331	C 3939-3	4.7 KOHM .25W 5% CF
R332	C 6406-0	8.15KOHM .25W 1% MF
R333	C 2885-9	270.KOHM .25W 5% CF25
R334	C 5062-2	100KOHM LINEAR TRIMPOT
R335	C 5165-3	27. KOHM .25W 5 CF
R336	C 2626-7	470. OHM .25W 5% CF
R337	C 2626-7	470. OHM .25W 5% CF
R338	C 2626-7	470. OHM .25W 5% CF
R346	C 5165-3	27. KOHM .25W 5 CF
R347	C 5039-0	100. OHM .25W 1 MF
R348	C 2631-7	10. KOHM .25W 5% CF
R400	C 7852-4	2.5 KOHM 5W 5% WIREWOUND
R401	C 7852-4	2.5 KOHM 5W 5% WIREWOUND
R402	C 7441-6	90.9KOHM .25W 1% MF RESISTOR
R403	C 5707-2	100.KOHM .25W 1 MF
R404	C 7440-8	27.4KOHM .25W 1% MF RESISTOR
R405	N/A	N/A
R406	C 5707-2	100.KOHM .25W 1 MF
R407	C 7441-6	90.9KOHM .25W 1% MF RESISTOR
R408	C 5707-2	100.KOHM .25W 1 MF
R409	C 7440-8	27.4KOHM .25W 1% MF RESISTOR

LOCATION #	PART #	DESCRIPTION
R410	N/A	N/A
R411	C 5707-2	100.KOHM .25W 1 MF
R412	C 6317-9	953. OHM .25W 1% MF
R413	C 6317-9	953. OHM .25W 1% MF
R414	C 4850-1	1.0 KOHM .25W 1 MF
R415	C 4850-1	1.0 KOHM .25W 1 MF
R416	C 3198-6	1.0 MOHM .25W 5 CF
R417	C 3620-9	68. KOHM .25W 5% CF
R418	C 2631-7	10. KOHM .25W 5% CF
R419	C 3939-3	4.7 KOHM .25W 5% CF
R420	C 2632-5	15. KOHM .25W 5% CF
R421	C 2873-5	180. OHM .25W 5% CF25
R422	C 4167-0	43. KOHM .25W 5% CF
R423	C 3622-5	200.KOHM .25W 5 CF
R424	C 6090-2	62. KOHM .25W 5% CF
R425	C 3804-9	2.0 KOHM .25W 5 CF
R426	C 7654-4	3.9MOHM .25W 5% CF
R427	C 5975-5	680. OHM .25W 5% CF
R428	C 2883-4	100.KOHM .25W 5% CF25
R500	C 2631-7	10. KOHM .25W 5% CF
R501	C 6407-8	39. KOHM .25W 5% CF
R502	C 2631-7	10. KOHM .25W 5% CF
R503	C 2631-7	10. KOHM .25W 5% CF
R504	C 4219-9	220.KOHM .25W 5% CF
R506	C 5168-7	2.7 KOHM .25W 5 CF
R508	C 5170-3	2.2 MOHM .25W 5 CF
R509	C 4225-6	470.KOHM .25W 5% CF
R510	C 2883-4	100.KOHM .25W 5% CF25
R511	C 2632-5	15. KOHM .25W 5% CF
R512	C 2883-4	100.KOHM .25W 5% CF25
R513	C 5168-7	2.7 KOHM .25W 5 CF
R514	C 5046-5	20. KOHM .25W 5 CF
R515	C 5165-3	27. KOHM .25W 5 CF
R516	C 3093-9	10KOHM CERMET TRIM
R517	C 2881-8	51. KOHM .25W 5 CF25
R518	C 4661-2	15. MOHM .25W 5 COMP
R519	C 5168-7	2.7 KOHM .25W 5 CF
R520	C 2627-5	1.0 KOHM .25W 5% CF
R521	C 2627-5	1.0 KOHM .25W 5% CF

LOCATION #	PART #	DESCRIPTION
R522	C 5168-7	2.7 KOHM .25W 5 CF
R523	C 5168-7	2.7 KOHM .25W 5 CF
R524	C 4236-3	1.8 MOHM .25W 5% CF
R525	C 2883-4	100.KOHM .25W 5% CF25
R526	C 4220-7	240.KOHM .25W 5% CF
R527	C 4219-9	220.KOHM .25W 5% CF
R528	C 2872-7	100. OHM .25W 5% CF
R529	C 2632-5	15. KOHM .25W 5% CF
R530	C 5168-7	2.7 KOHM .25W 5 CF
R531	C 4216-5	150.KOHM .25W 5% CF
R533	C 2883-4	100.KOHM .25W 5% CF25
R534	C 3622-5	200.KOHM .25W 5 CF
R535	C 6090-2	62. KOHM .25W 5% CF
R536	C 6407-8	39. KOHM .25W 5% CF
R537	C 6407-8	39. KOHM .25W 5% CF
R538	C 6090-2	62. KOHM .25W 5% CF
R539	C 3939-3	4.7 KOHM .25W 5% CF
R540	C 2632-5	15. KOHM .25W 5% CF
R541	C 2883-4	100.KOHM .25W 5% CF25
R542	C 2883-4	100.KOHM .25W 5% CF25
R543	C 2631-7	10. KOHM .25W 5% CF
R600	C 6625-5	5.6 OHM 5W 5% METAL OXIDE
R601-R610	C 3583-9	0.33 OHM 5W 5 WIRE
R611	C 3931-0	12.0 OHM 2W 5% CF
R612	C 2872-7	100. OHM .25W 5% CF
R613	C 2872-7	100. OHM .25W 5% CF
R614	C 3931-0	12.0 OHM 2W 5% CF
R615-R624	C 3583-9	0.33 OHM 5W 5 WIRE
R625	C 3931-0	12.0 OHM 2W 5% CF
R626	C 3931-0	12.0 OHM 2W 5% CF
R650	C 3960-9	82.0 OHM .25W 5% CF
R651	C 3672-0	2KOHM HELIPOT TRIM
R652	C 3803-1	750. OHM .25W 5 CF
R653	C 2627-5	1.0 KOHM .25W 5% CF
R654	C 6517-4	24.0 OHM .25W 5% CF
R655	C 3753-8	10.0 OHM .25W 5% CF
R656	C 6089-4	5.6 OHM .25W 5% CF
R700	C 6625-5	5.6 OHM 5W 5% METAL OXIDE
R701-R710	C 3583-9	0.33 OHM 5W 5 WIRE
R711-R720	C 3583-9	0.33 OHM 5W 5 WIRE
R721	C 3931-0	12.0 OHM 2W 5% CF

LOCATION #	PART #	DESCRIPTION
R722	C 2872-7	100. OHM .25W 5% CF
R723	C 2872-7	100. OHM .25W 5% CF
R724-R733	C 3583-9	0.33 OHM 5W 5 WIRE
R734	C 3931-0	12.0 OHM 2W 5% CF
R735-R744	C 3583-9	0.33 OHM 5W 5 WIRE
R745	C 3931-0	12.0 OHM 2W 5% CF
R746	C 3931-0	12.0 OHM 2W 5% CF
R750	C 1011-3	47.0 OHM .25W 5 CF
R751	C 6089-4	5.6 OHM .25W 5% CF
R752	C 5038-2	39.0 OHM .25W 5 CF
R758	C 6299-9	0.1 OHM 50W 1% WIRE
R759	C 6299-9	0.1 OHM 50W 1% WIRE
R760	C 6299-9	0.1 OHM 50W 1% WIRE
R761	C 6299-9	0.1 OHM 50W 1% WIRE
R762	C 6299-9	0.1 OHM 50W 1% WIRE
R763	C 6299-9	0.1 OHM 50W 1% WIRE
R800	C 3931-0	12.0 OHM 2W 5% CF
R801-R810	C 3583-9	0.33 OHM 5W 5 WIRE
R811	C 3931-0	12.0 OHM 2W 5% CF
R812	C 5342-8	236. OHM .5W 1% MF
R812	C 5343-6	227. OHM .5W 1% MF
R812	C 5344-4	218. OHM .5W 1% MF
R813	C 2872-7	100. OHM .25W 5% CF
R814	C 2872-7	100. OHM .25W 5% CF
R815	C 3931-0	12.0 OHM 2W 5% CF
R816	C 5662-9	16.2KOHM .25W 1 MF
R817-R827	C 3583-9	0.33 OHM 5W 5 WIRE
R828	C 3931-0	12.0 OHM 2W 5% CF
R829	C 3931-0	12.0 OHM 2W 5% CF
R833	C 5662-9	16.2KOHM .25W 1 MF
R850	C 5168-7	2.7 KOHM .25W 5 CF
R851	C 1011-3	47.0 OHM .25W 5 CF
R852	C 5168-7	2.7 KOHM .25W 5 CF
R853	C 3672-0	2KOHM HELIPOT TRIM
R854	C 2627-5	1.0 KOHM .25W 5% CF
R855	C 2627-5	1.0 KOHM .25W 5% CF
R856	C 6517-4	24.0 OHM .25W 5% CF
R857	C 2857-8	2.7 OHM .5W 5% CF50
R858	C 2857-8	2.7 OHM .5W 5% CF50

LOCATION #	PART #	DESCRIPTION
R900	C 3931-0	12.0 OHM 2W 5% CF
R901-R910	C 3583-9	0.33 OHM 5W 5 WIRE
R911-R920	C 3583-9	0.33 OHM 5W 5 WIRE
R921	C 3931-0	12.0 OHM 2W 5% CF
R922	C 2872-7	100. OHM .25W 5% CF
R923	C 5342-8	236. OHM .5W 1% MF
R923	C 5343-6	227. OHM .5W 1% MF
R923	C 5344-4	218. OHM .5W 1% MF
R924	C 2872-7	100. OHM .25W 5% CF
R925-R934	C 3583-9	0.33 OHM 5W 5 WIRE
R935	C 3931-0	12.0 OHM 2W 5% CF
R936-R945	C 3583-9	0.33 OHM 5W 5 WIRE
R946	C 3931-0	12.0 OHM 2W 5% CF
R947	C 3931-0	12.0 OHM 2W 5% CF
R950	C 5168-7	2.7 KOHM .25W 5 CF
R951	C 2872-7	100. OHM .25W 5% CF
R952	C 5168-7	2.7 KOHM .25W 5 CF
R953	C 5038-2	39.0 OHM .25W 5 CF
R954	C 2857-8	2.7 OHM .5W 5% CF50
R956	C 2857-8	2.7 OHM .5W 5% CF50
S100	C 7363-2	DPDT GOLD CONTACT PC SLIDE SW
S500	D 6470-5	DPDT MOMENTARY SWITCH
S501	D 5016-7	DPDT 11/16 PC MOUNT SWITCH
S600	C 6737-8	SPSTNC THERMSW 150C 6/32 .5 ST
S700	C 6737-8	SPSTNC THERMSW 150C 6/32 .5 ST
T1	D 6795-5	XFMR, 8522/23B MAIN W/BRKT P35
T2	M20643-9	XFMR, ISA 208/240V PREP #2
T100	C 6420-1	.025 SQ POST, #87307-2
T101	C 6420-1	.025 SQ POST, #87307-2
T102	C 6420-1	.025 SQ POST, #87307-2
T103	C 6420-1	.025 SQ POST, #87307-2
T104	C 6420-1	.025 SQ POST, #87307-2
T105	C 6420-1	.025 SQ POST, #87307-2
T200	C 6420-1	.025 SQ POST, #87307-2
T201	C 6420-1	.025 SQ POST, #87307-2
T300	C 6420-1	.025 SQ POST, #87307-2
T301	C 6420-1	.025 SQ POST, #87307-2
T302	C 6420-1	.025 SQ POST, #87307-2

LOCATION #	PART #	DESCRIPTION
T303	C 6420-1	.025 SQ POST, #87307-2
T500	C 6420-1	.025 SQ POST, #87307-2
U100	C 5881-5	NE5532N DUAL OP AMP
U101	C 5881-5	NE5532N DUAL OP AMP
U102	C 5881-5	NE5532N DUAL OP AMP
U103	C 7075-2	OP27GN8 LINEAR TECH OP AMP
U104	C 7075-2	OP27GN8 LINEAR TECH OP AMP
U200	C 6421-9	TI TL011CLP CURRENT SOURCE
U201	C 6421-9	TI TL011CLP CURRENT SOURCE
U202	C 7621-3	LF357 OP AMP MOTOROLA
U203	C 7621-3	LF357 OP AMP MOTOROLA
U300	C 4696-8	TLO74CN QUAD OP AMP
U301	C 4160-5	HA1-4741-5 QUAD OP AMP
U302	C 6411-0	H11C2 OPTO SCR
U400	C 5095-2	MC7815CT +15V.REGLTR
U401	C 5096-0	MC7915CT -15V.REGLTR
U402	C 5094-5	MC7805CT +5V.REGULTR
U403	C 7444-0	LM393 DUAL OP AMP
U404	C 7445-7	ICM 7555 TIMER
U405	C 4345-2	LM339N VOLTCOMPARATR
U500	C 4345-2	LM339N VOLTCOMPARATR
U501	C 4345-2	LM339N VOLTCOMPARATR
U506	C 6901-0	MOC8021 OPTO-ISOLATOR
U509	C 4345-2	LM339N VOLTCOMPARATR
U800	C 5826-0	LM334Z THERMAL SENSE
U900	C 5826-0	LM334Z THERMAL SENSE
Z100	C 5868-2	0.0 OHM .25W O WIRE
Z101	C 5868-2	0.0 OHM .25W O WIRE
Z102	C 5868-2	0.0 OHM .25W O WIRE
Z500	C 5868-2	0.0 OHM .25W O WIRE
Z501	C 5868-2	0.0 OHM .25W O WIRE
Z502	C 5868-2	0.0 OHM .25W O WIRE

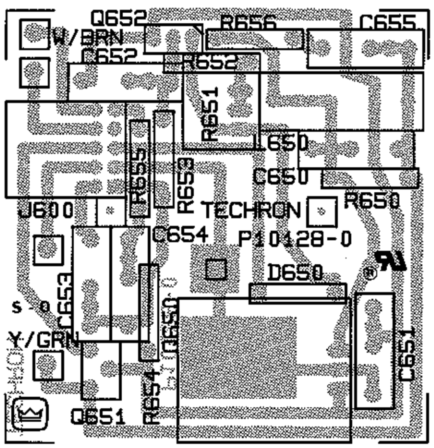


Illustration 7-6
Hi NPN Predriver Circuit Board

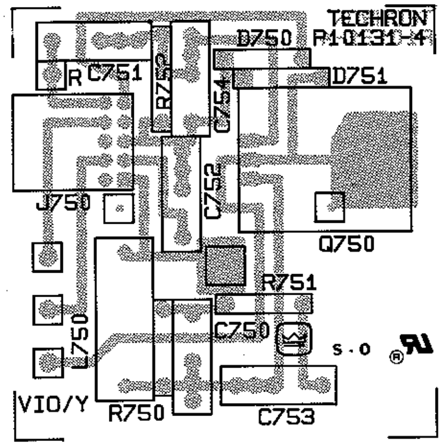


Illustration 7-7
Hi PNP Predriver Circuit Board

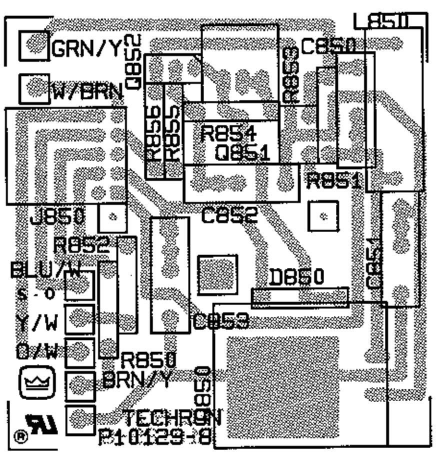


Illustration 7-8
Low NPN Predriver Circuit Board

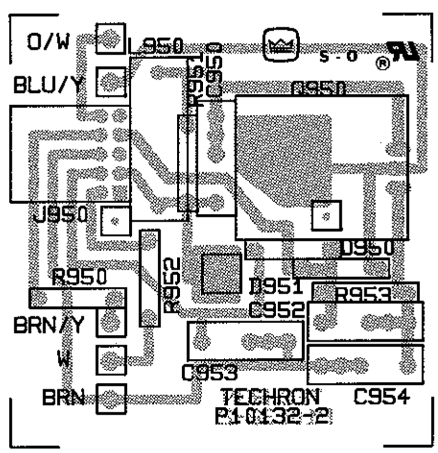


Illustration 7-9
Low PNP Predriver Circuit Board

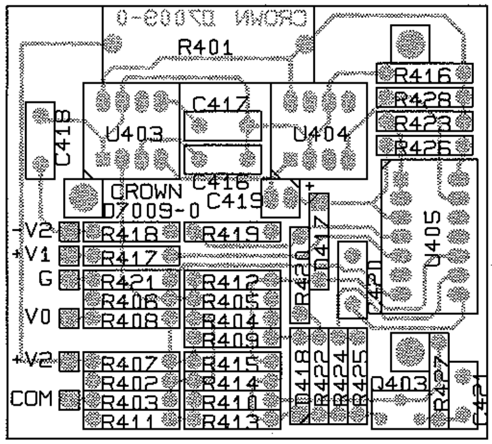


Illustration 7-10
BiLevel Control Circuit Board

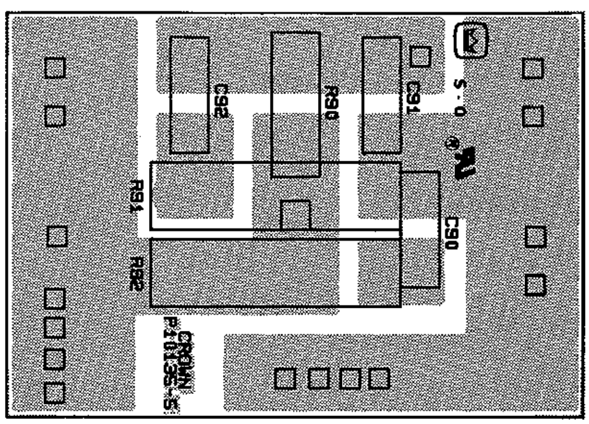


Illustration 7-11
Terminator Circuit Board

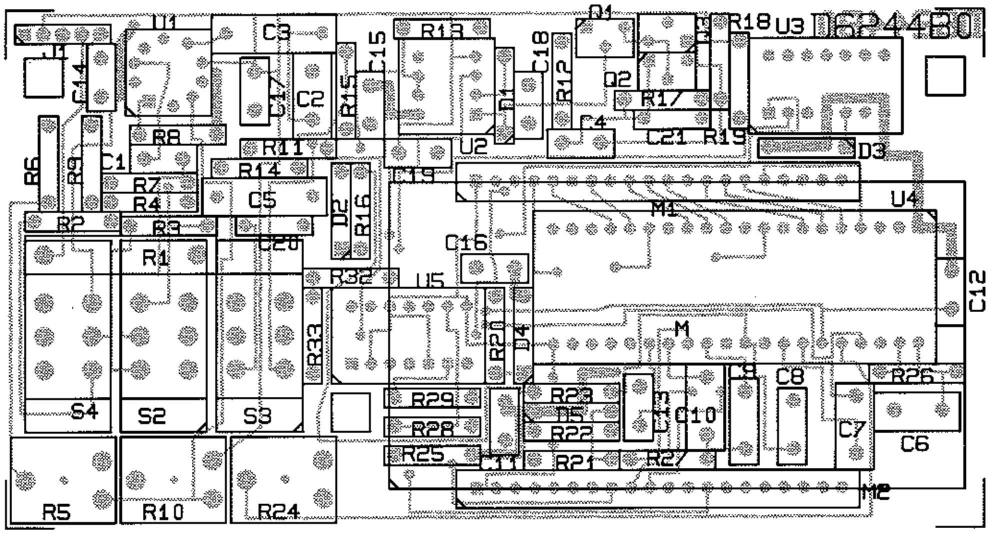


Illustration 7-12
Digital Display Circuit Board

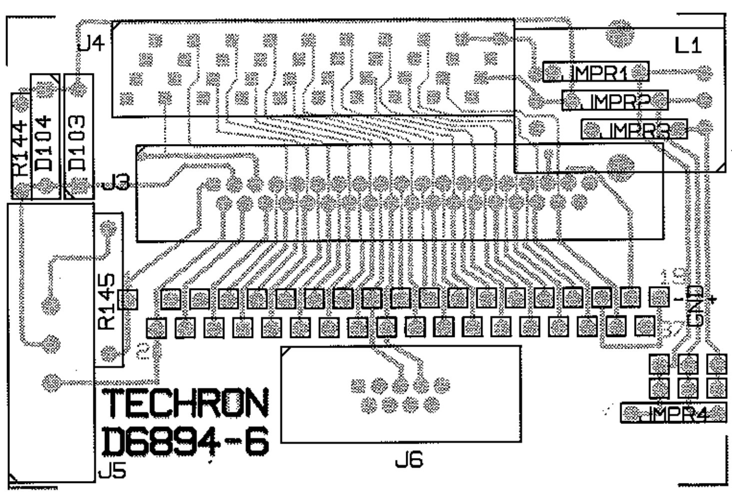
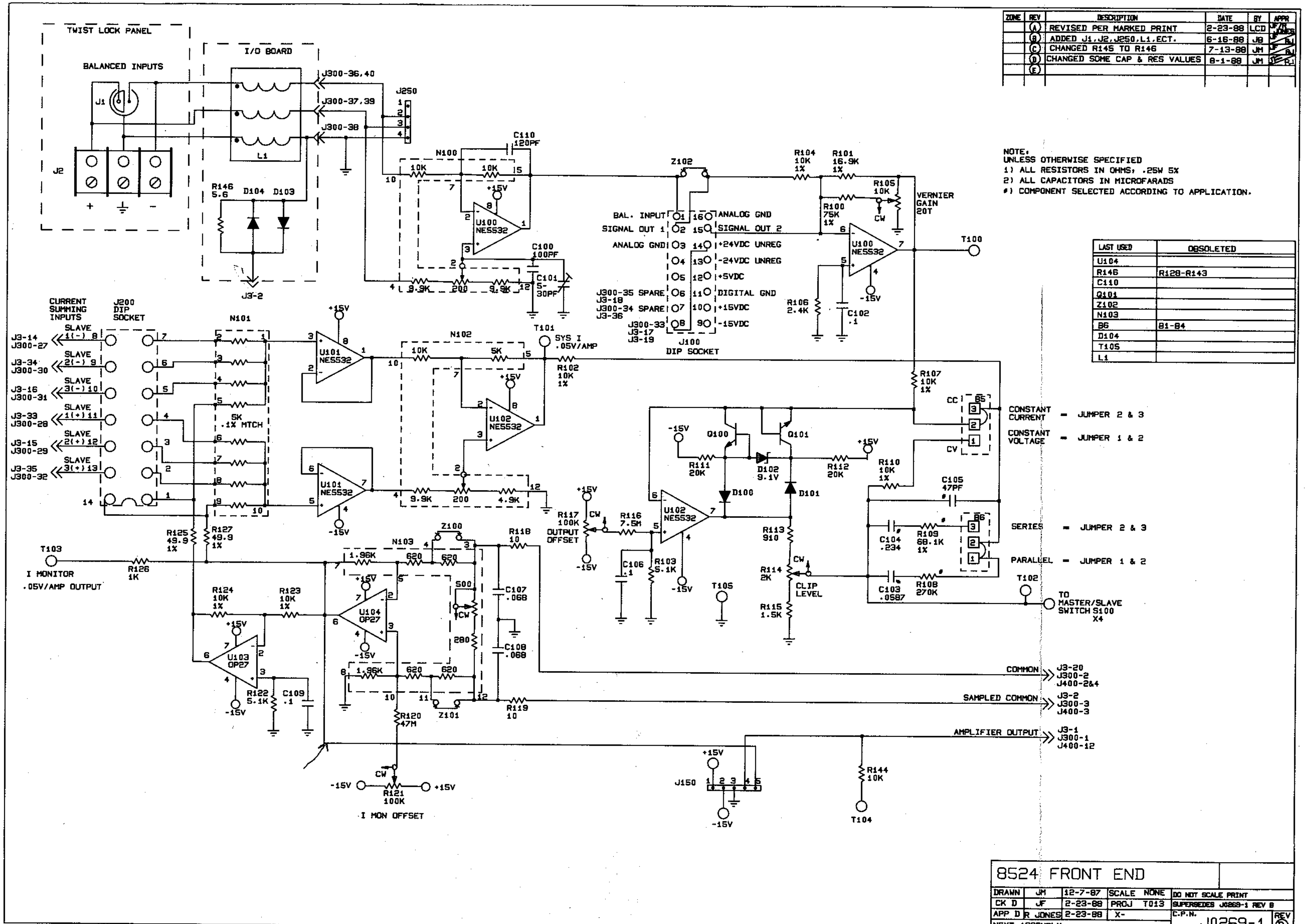


Illustration 7-13
Input Connection Circuit Board


ZONE REV DESCRIPTION DATE BY APPR
A REVISED PER MARKED PRINT 2-23-88 LCD
B ADDED J1,J2,J250,L1,ECT. 6-16-88 JB
C CHANGED R145 TO R146 7-13-88 JM
D CHANGED SOME CAP & RES VALUES 8-1-88 JM
E
NOTE:
UNLESS OTHERWISE SPECIFIED
1) ALL RESISTORS IN OHMS, .25W 5%
2) ALL CAPACITORS IN MICROFARADS
*) COMPONENT SELECTED ACCORDING TO APPLICATION.
LAST USED OBSOLETED
U104
R146 R128-R143
C110
Q101
Z102
N103
B6 B1-B4
D104
T105
L1
TWIST LOCK PANEL
BALANCED INPUTS
I/O BOARD
CURRENT SUMMING INPUTS
J200 DIP SOCKET
J100 DIP SOCKET
BAL. INPUT
SIGNAL OUT 1
ANALOG GND
ANALOG GND
SIGNAL OUT 2
+24VDC UNREG
-24VDC UNREG
+5VDC
DIGITAL GND
+15VDC
-15VDC
VERNIER GAIN 20T
SYS I .05V/AMP
OUTPUT OFFSET
CLIP LEVEL
I MONITOR .05V/AMP OUTPUT
I MON OFFSET
CONSTANT CURRENT - JUMPER 2 & 3
CONSTANT VOLTAGE - JUMPER 1 & 2
SERIES - JUMPER 2 & 3
PARALLEL - JUMPER 1 & 2
TO MASTER/SLAVE SWITCH S100 X4
COMMON J3-20 J300-2 J400-2&4
SAMPLED COMMON J3-2 J300-3 J400-3
AMPLIFIER OUTPUT J3-1 J300-1 J400-12
8524 FRONT END
DRAWN JM 12-7-87 SCALE NONE DO NOT SCALE PRINT
CK D JF 2-23-88 PROJ T013 SUPERSEDES J0269-1 REV B
APP D R JONES 2-23-88 X-
NEXT ASSEMBLY
C.P.N. J0269-1 REV D

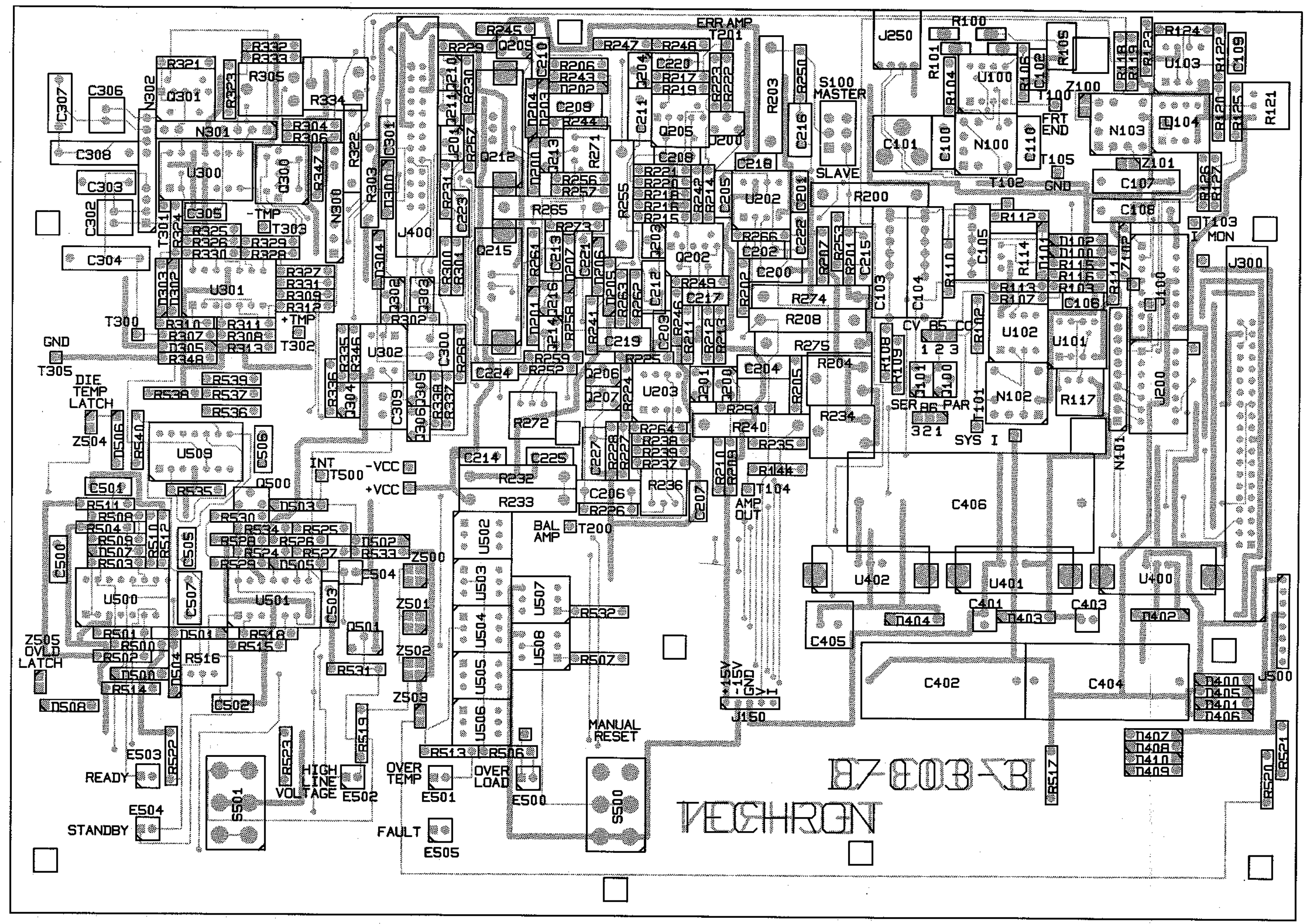
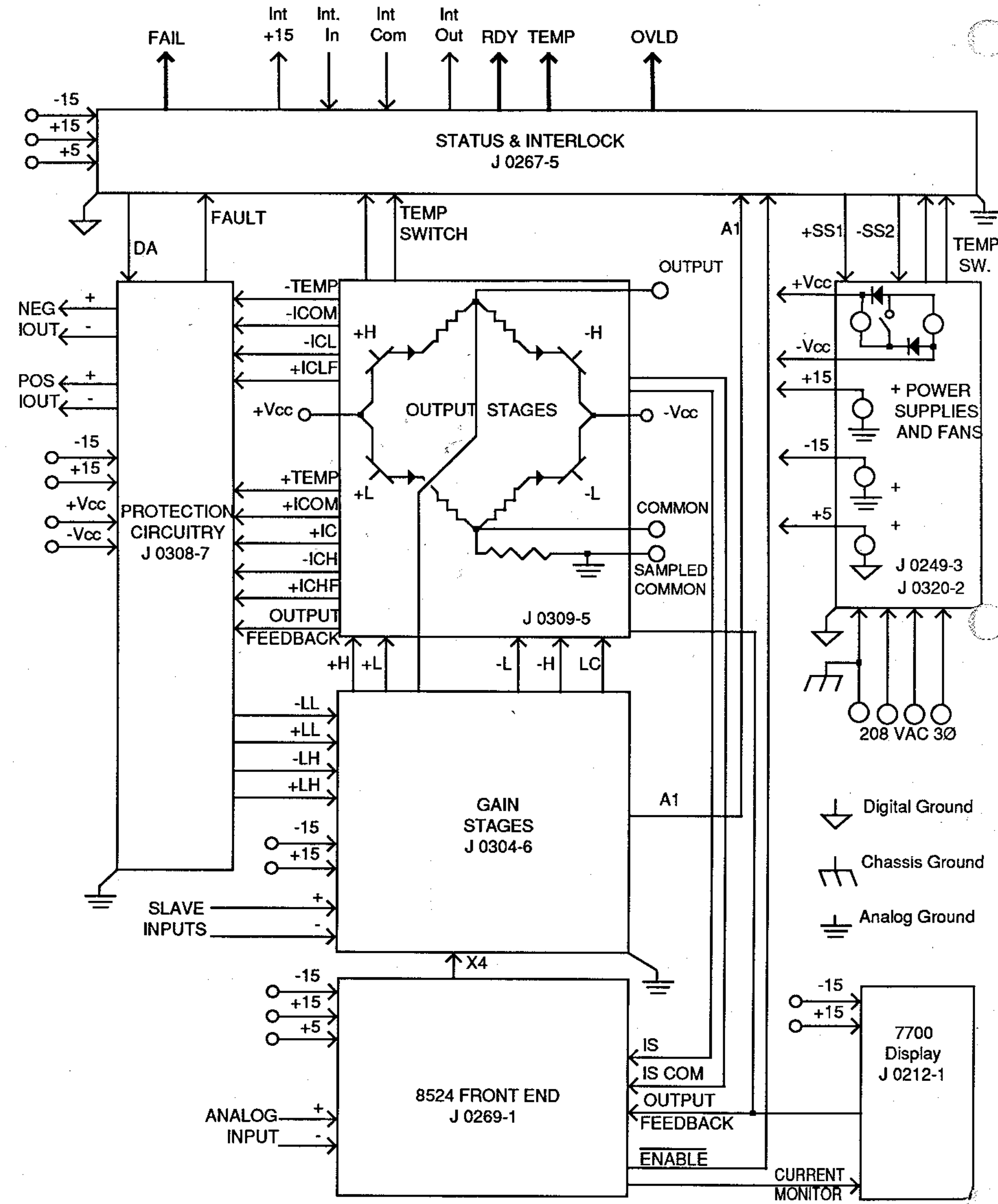
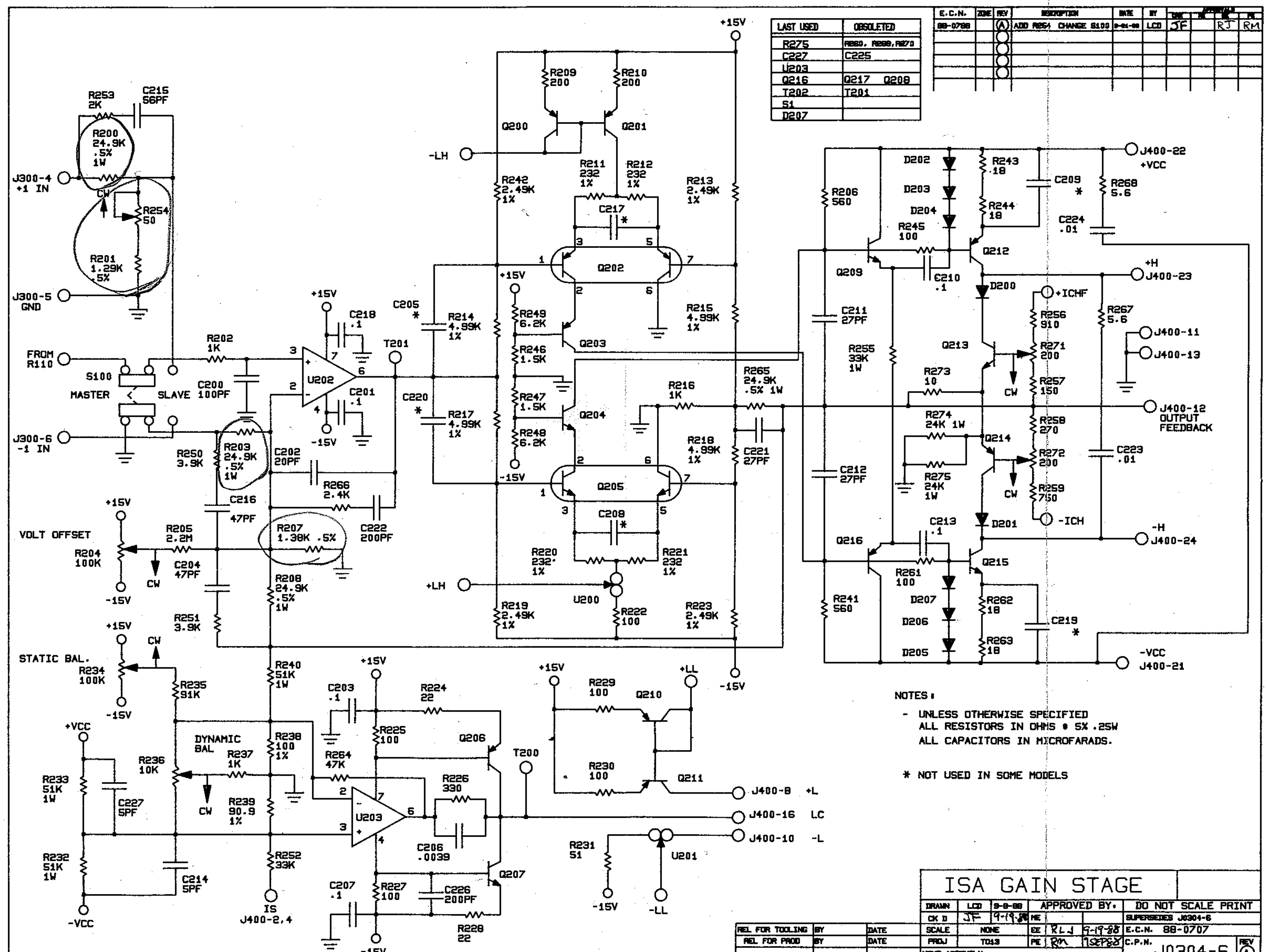
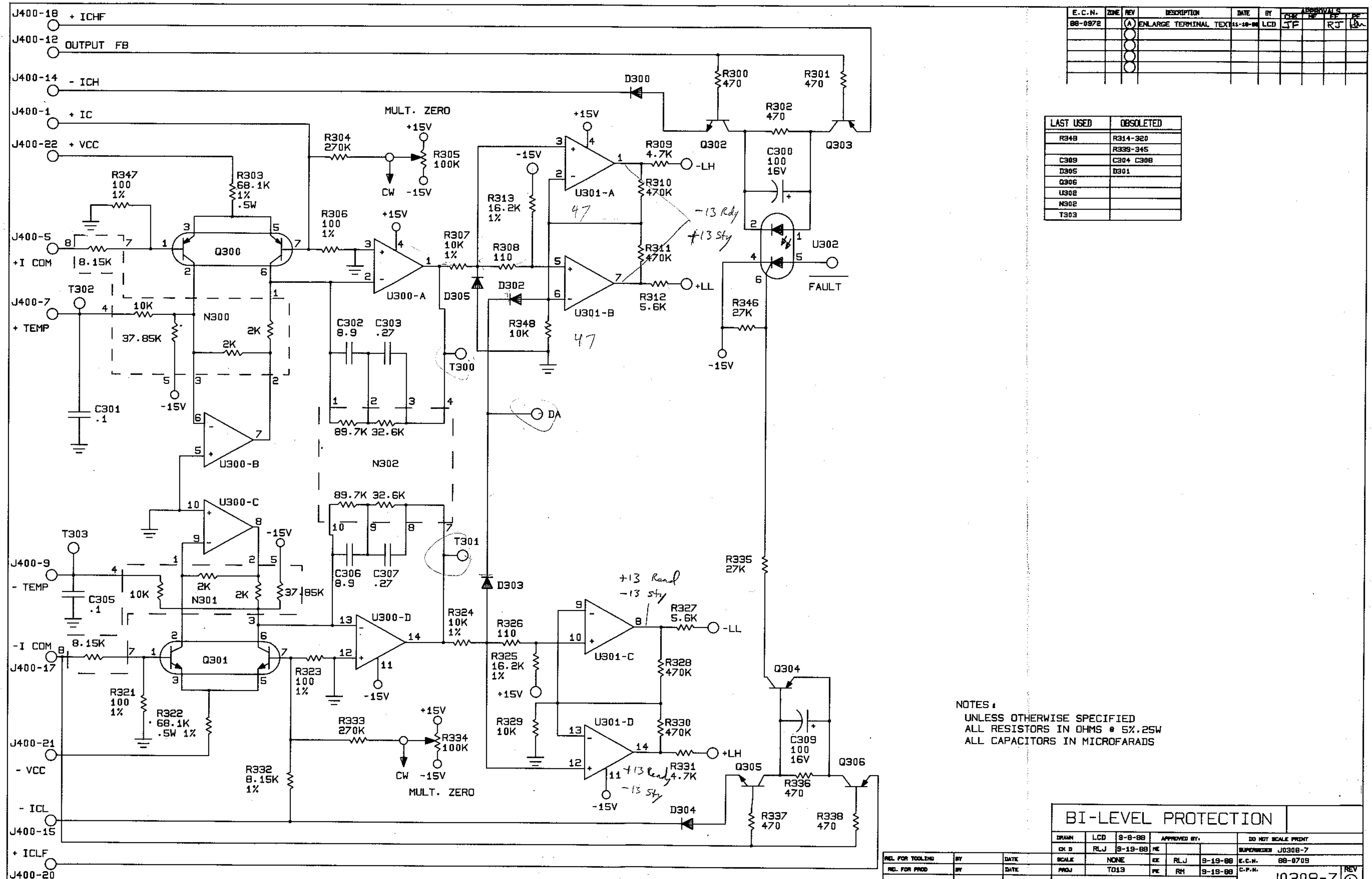


Illustration 7-14
Main Circuit Board

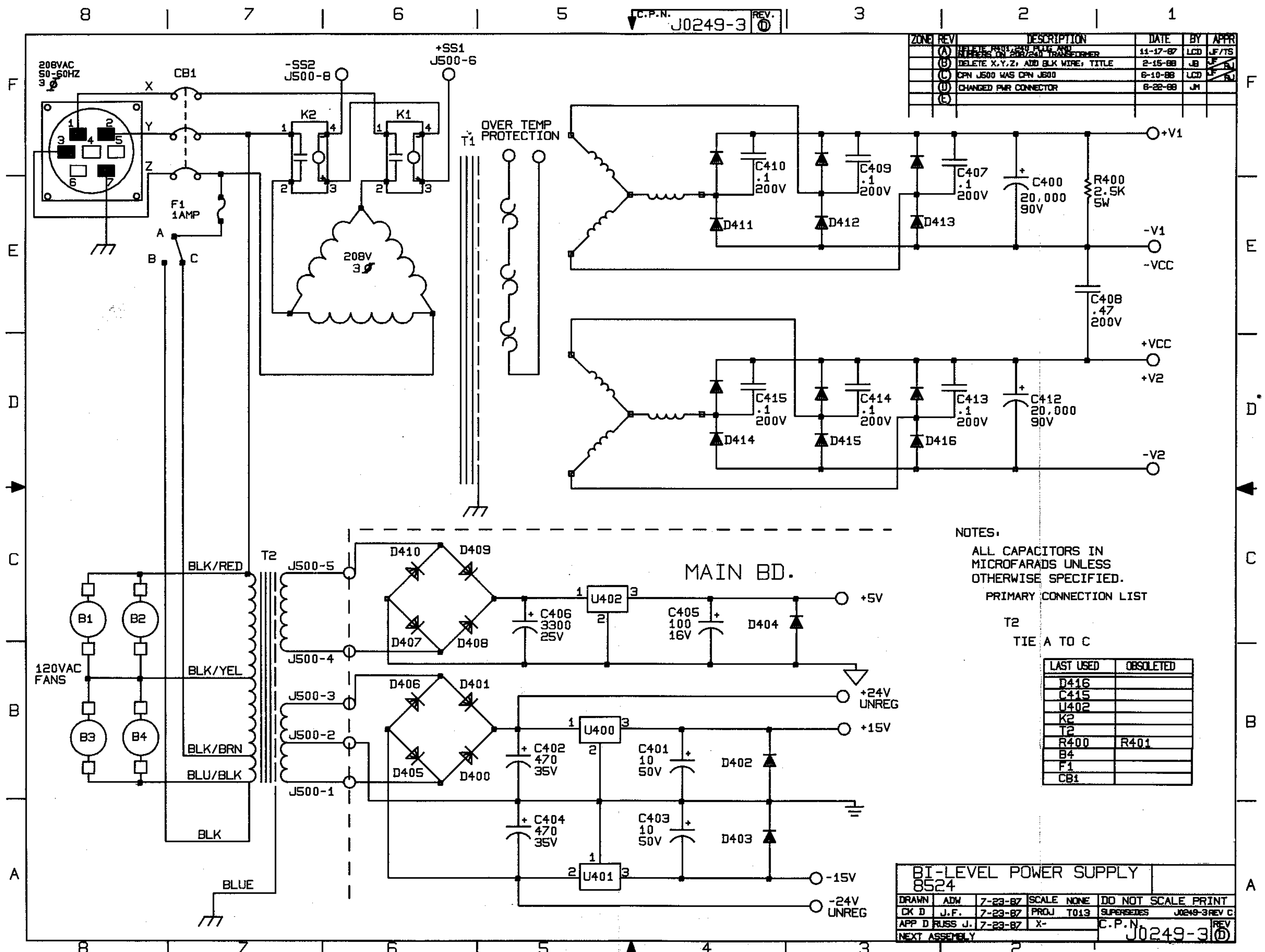


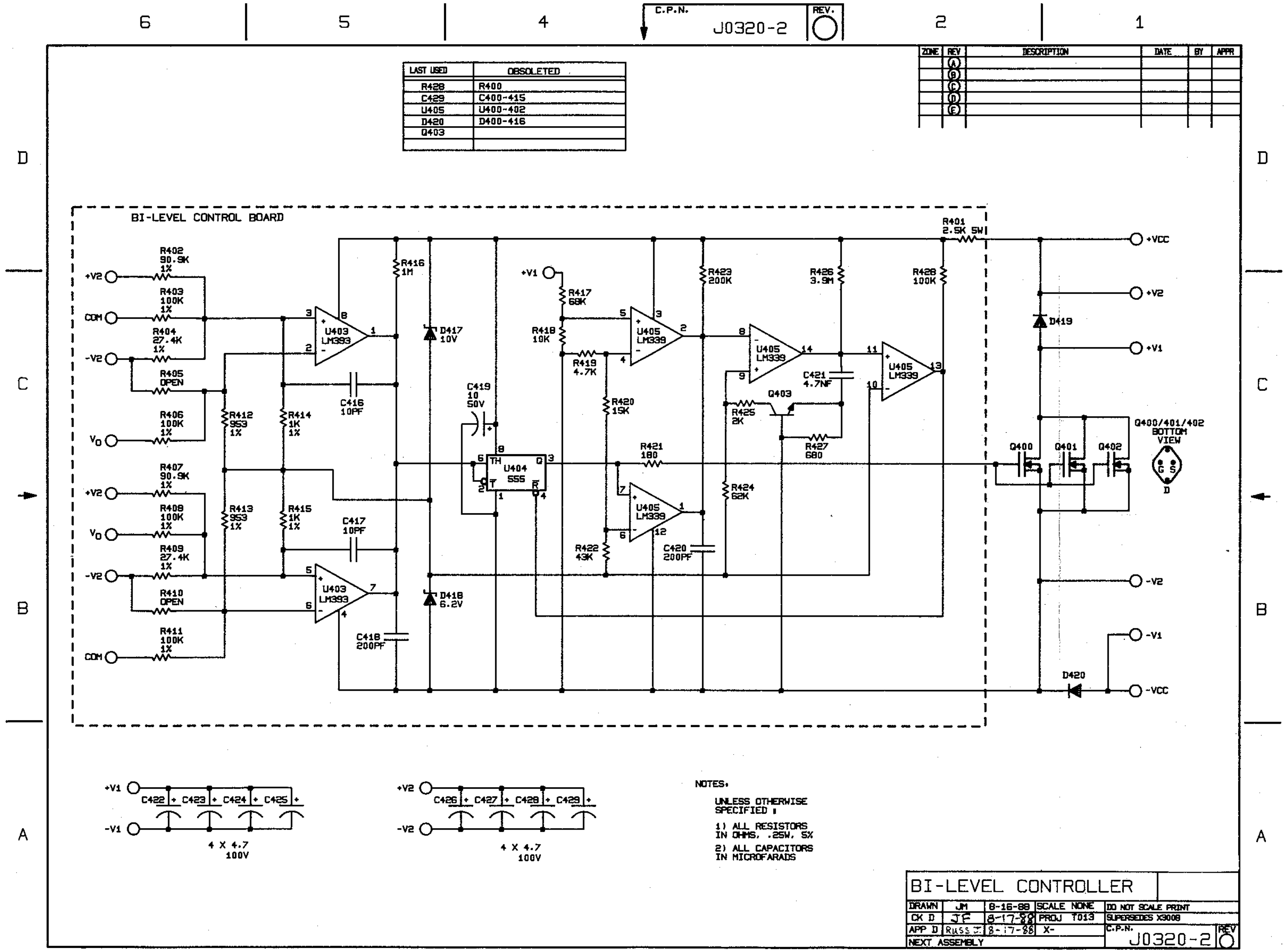
Schematic, 8524 Block Diagram

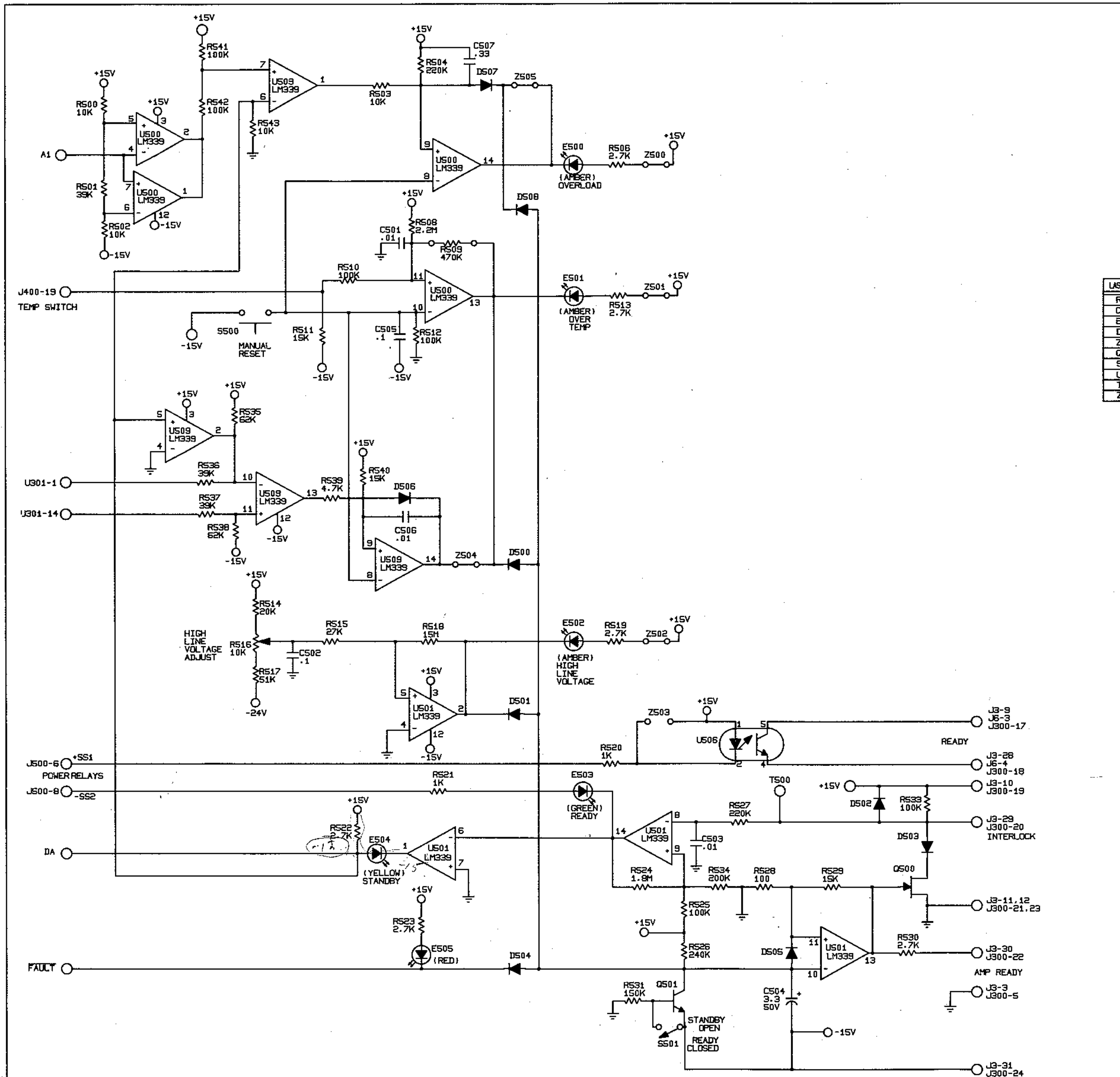

ISA GAIN STAGE
J0304-6
DO NOT SCALE PRINT
E.C.N. 88-0707
SUPERSEDES J0304-6
DRAWN LCD 9-8-88
APPROVED BY:
SCALE NONE
PROJ T013
NEXT ASSEMBLY
REL FOR TOOLING
REL FOR PROD
LAST USED
OBSOLETED
R275
C227
U203
Q216
T202
S1
D207
ADD R254 CHANGE S100
NOTES:
- UNLESS OTHERWISE SPECIFIED
ALL RESISTORS IN OHMS ± 5% .25W
ALL CAPACITORS IN MICROFARADS.
* NOT USED IN SOME MODELS
J300-4 +1 IN
J300-5 GND
FROM R110
S100
MASTER
SLAVE
J300-6 -1 IN
VOLT OFFSET
STATIC BAL.
DYNAMIC BAL
J400-22 +VCC
J400-23 +H
J400-11
J400-13
J400-12 OUTPUT FEEDBACK
J400-24 -H
J400-21 -VCC
J400-8 +L
J400-16 LC
J400-10 -L
IS J400-2,4
+ICHF
-ICH
U202
U203
U200
U201
-LH
+LH
+LL
-LL
+15V
-15V



J400-18 + ICHF
J400-12 OUTPUT FB
J400-14 - ICH
J400-1 + IC
J400-22 + VCC
J400-5 +I COM
J400-7 + TEMP
J400-9 - TEMP
-I COM J400-17
J400-21 - VCC
- ICL J400-15
+ ICLF J400-20
MULT. ZERO
R304 270K
R305 100K
CW -15V
R347 100 1%
R303 68.1K 1% .5W
Q300
N300
U300-A
U300-B
U300-C
U300-D
N302
N301
Q301
R306 100 1%
R307 10K 1%
R308 110
R313 16.2K 1%
U301-A
U301-B
U301-C
U301-D
D300
D302
D303
D304
D305
R300 470
R301 470
R302 470
Q302
Q303
Q304
Q305
Q306
C300 100 16V
C309 100 16V
U302
FAULT
R346 27K
R335 27K
R309 4.7K
R310 470K
R311 470K
R312 5.6K
R348 10K
-LH
+LL
-LL
+LH
T300
T301
T302
T303
DA
C301 .1
C305 .1
C302 8.9
C303 .27
C306 8.9
C307 .27
89.7K 32.6K
R321 100 1%
R322 68.1K .5W 1%
R323 100 1%
R324 10K 1%
R325 16.2K 1%
R326 110
R327 5.6K
R328 470K
R329 10K
R330 470K
R331 4.7K
R332 8.15K 1%
R333 270K
R334 100K
R336 470
R337 470
R338 470
NOTES:
UNLESS OTHERWISE SPECIFIED
ALL RESISTORS IN OHMS @ 5%.25W
ALL CAPACITORS IN MICROFARADS
LAST USED | OBSOLETED
R348 | R314-320
 | R339-345
C309 | C304 C308
D305 | D301
Q306
U302
N302
T303
E.C.N. 88-0972 (A) ENLARGE TERMINAL TEXT LCD
BI-LEVEL PROTECTION
DRAWN LCD 9-8-88
CK D RLJ 9-19-88
SCALE NONE
PROJ T013
SUPERSEDES J0308-7
E.C.N. 88-0709
J0308-7 (A)


C.P.N. J0249-3 REV. D
ZONE REV DESCRIPTION DATE BY APPR
B DELETE X,Y,Z, ADD BLK WIRE, TITLE 2-15-88 JB
C CPN J500 WAS CPN J600 6-10-88 LCD
D CHANGED PWR CONNECTOR 6-22-88 JM
208VAC 50-60HZ 3Ø
CB1
X
Y
Z
-SS2 J500-8
+SS1 J500-6
K2
K1
F1 1AMP
A
B
C
208V 3Ø
T1
OVER TEMP PROTECTION
C410 .1 200V
C409 .1 200V
C407 .1 200V
C400 20,000 90V
R400 2.5K 5W
+V1
-V1
-VCC
D411
D412
D413
C408 .47 200V
+VCC
+V2
C415 .1 200V
C414 .1 200V
C413 .1 200V
C412 20,000 90V
D414
D415
D416
-V2
NOTES:
ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
PRIMARY CONNECTION LIST
T2
TIE A TO C
LAST USED
OBSOLETED
D416
C415
U402
K2
T2
R400 R401
B4
F1
CB1
MAIN BD.
BLK/RED
T2
J500-5
J500-4
D410
D409
D407
D408
U402
C406 3300 25V
C405 100 16V
D404
+5V
B1
B2
B3
B4
120VAC FANS
BLK/YEL
BLK/BRN
BLU/BLK
BLK
BLUE
J500-3
J500-2
J500-1
D406
D401
D405
D400
+24V UNREG
U400
+15V
C402 470 35V
C401 10 50V
D402
C404 470 35V
C403 10 50V
D403
U401
-15V
-24V UNREG
BI-LEVEL POWER SUPPLY 8524
DRAWN ADW 7-23-87
CK D J.F. 7-23-87
APP D RUSS J. 7-23-87
NEXT ASSEMBLY
SCALE NONE
PROJ T013
X-
DO NOT SCALE PRINT
SUPERSEDES J0249-3 REV C
C.P.N. J0249-3 REV D


C.P.N.
J0320-2
REV.
LAST USED
OBSOLETED
R428
R400
C429
C400-415
U405
U400-402
D420
D400-416
Q403
ZONE
REV
DESCRIPTION
DATE
BY
APPR
BI-LEVEL CONTROL BOARD
R402 90.9K 1%
R403 100K 1%
R404 27.4K 1%
R405 OPEN
R406 100K 1%
R407 90.9K 1%
R408 100K 1%
R409 27.4K 1%
R410 OPEN
R411 100K 1%
R412 953 1%
R413 953 1%
R414 1K 1%
R415 1K 1%
R416 1M
R417 68K
R418 10K
R419 4.7K
R420 15K
R421 180
R422 43K
R423 200K
R424 62K
R425 2K
R426 3.9M
R427 680
R428 100K
R401 2.5K 5W
C416 10PF
C417 10PF
C418 200PF
C419 10 50V
C420 200PF
C421 4.7NF
D417 10V
D418 6.2V
D419
D420
U403 LM393
U404 555
U405 LM339
Q403
Q400
Q401
Q402
Q400/401/402 BOTTOM VIEW
+VCC
+V2
+V1
-V2
-V1
-VCC
COM
V_0
C422 C423 C424 C425
C426 C427 C428 C429
4 X 4.7 100V
NOTES:
UNLESS OTHERWISE SPECIFIED:
1) ALL RESISTORS IN OHMS, .25W, 5%
2) ALL CAPACITORS IN MICROFARADS
BI-LEVEL CONTROLLER
DRAWN JM 8-16-88
CK D JF 8-17-88
APP D RUSS J 8-17-88
SCALE NONE
PROJ T013
X-
DO NOT SCALE PRINT
SUPERSEDES X3008
NEXT ASSEMBLY
C.P.N. J0320-2
REV



ZONE	REV	DESCRIPTION	DATE	BY	APPR
	(A)	REVISED PER MARKED PRINT	3-16-88	JM	JF/RJ
	(B)	REVISED PER MARKED PRINT	5-26-88	JM	JF/RJ
	(C)	REVISED PER MARKED PRINT	6-2-88	JM	JF/RJ
	(D)	REVISED PER MARKED PRINT	8-16-88	JM	JF/RJ
	(E)				

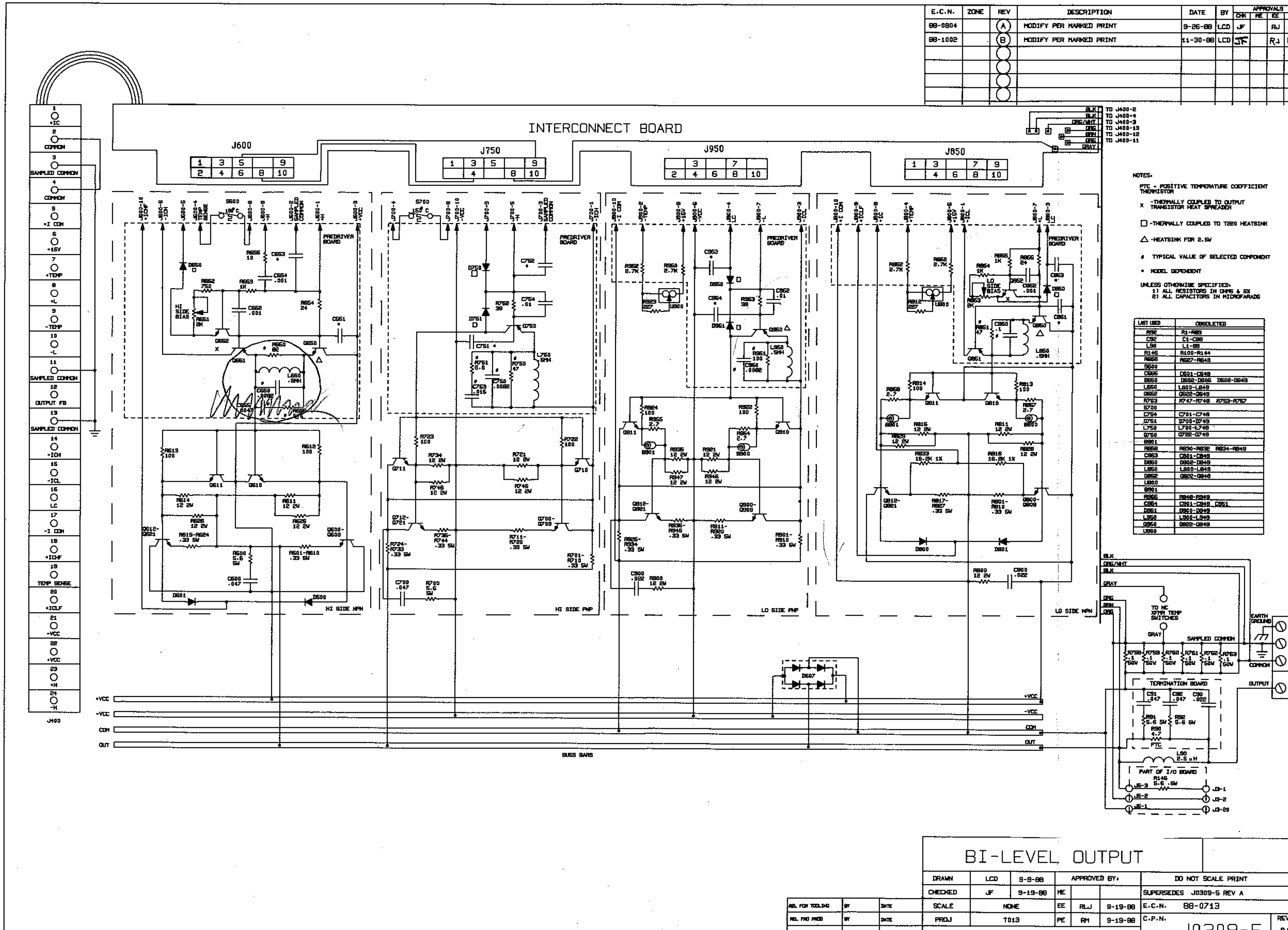
LAST USED	OBSOLETED
R543	R505 R507 R532
C507	C500
E505	
D508	
Z505	
Q501	
S501	
U509	U502-U505 U507 U508
T500	
Z505	

NOTES:

UNLESS OTHERWISE SPECIFIED,

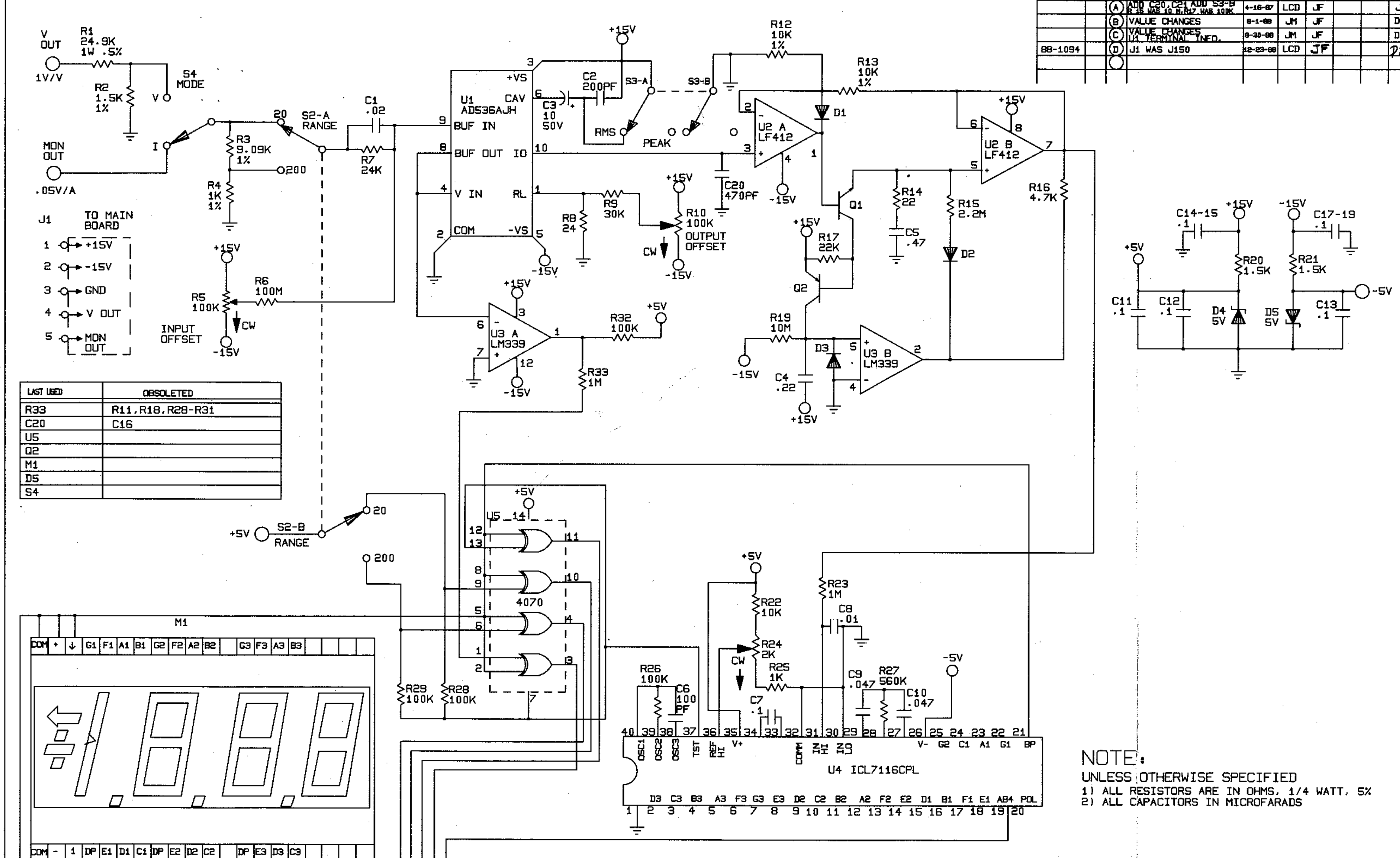
1) ALL RESISTORS .25W IN OHMS AT 5%
2) ALL CAPACITORS IN MICROFARADS
3) INSTALL Z505 TO LATCH OVERLOAD SIGNAL
4) INSTALL R509 TO LATCH OVERTEMP SIGNAL
5) INSTALL Z504 TO LATCH TRANSISTOR JUNCTION OVERTEMPERATURE

8524 STATUS AND INTERLOCK				
DRAWN	LCD	12-9-87	SCALE NONE	DO NOT SCALE PRINT
CK D	JF	12-10-87	PROJ T013	SUPERSEDES J0267-5 REV C
APP D	PAT	10-1-86	X-	C.P.N. J0267-5 REV (D)
NEXT ASSEMBLY				



E.C.N. | ZONE | REV | DESCRIPTION | DATE | BY | APPROVALS
88-0804 | A | MODIFY PER MARKED PRINT | 9-26-88 | LCD
88-1002 | B | MODIFY PER MARKED PRINT | 11-30-88 | LCD
INTERCONNECT BOARD
J600
J750
J950
J850
PREDRIVER BOARD
HI SIDE NPN
HI SIDE PNP
LO SIDE PNP
LO SIDE NPN
BUSS BARS
TERMINATION BOARD
PART OF I/O BOARD
J400
NOTES:
PTC = POSITIVE TEMPERATURE COEFFICIENT THERMISTOR
UNLESS OTHERWISE SPECIFIED:
1) ALL RESISTORS IN OHMS & 5%
2) ALL CAPACITORS IN MICROFARADS
LAST USED
OBSOLETED
BI-LEVEL OUTPUT
DRAWN LCD 9-9-88
CHECKED JF 9-19-88
APPROVED BY:
DO NOT SCALE PRINT
SUPERSEDES J0309-5 REV A
E.C.N. 88-0713
SCALE NONE
PROJ T013
NEXT ASSEMBLY
J0309-5
REV B1

E.C.N.	ZONE	REV	DESCRIPTION	DATE	BY	APPROVALS CHK	ME	EE	PE
		(A)	ADD C20,C21 ADD S3-B R 15 WAS 10 M,R17 WAS 100K	4-16-87	LCD	JF			JR
		(B)	VALUE CHANGES	8-1-88	JM	JF			DTM
		(C)	VALUE CHANGES U1 TERMINAL INFO.	8-30-88	JM	JF			DTM
88-1094		(D)	J1 WAS J150	12-23-88	LCD	JF			DTM
		( )							



LAST USED	OBSOLETED
R33	R11,R18,R28-R31
C20	C16
U5	
Q2	
M1	
D5	
S4	

NOTE:
UNLESS OTHERWISE SPECIFIED
1) ALL RESISTORS ARE IN OHMS, 1/4 WATT, 5%
2) ALL CAPACITORS IN MICROFARADS

3 1/2 DIGIT
LCD DISPLAY
TRUE RMS
AND PEAK

7700 SERIES DISPLAY									
			DRAWN	PAMM	12/3/84	APPROVED BY:			DO NOT SCALE PRINT
			CK D	R.J.	12/3/84	ME			SUPERSEDES J0212-1 REV C
REL FOR TOOLING	BY	DATE	SCALE	NONE		EE	R.JONES	12/3/84	E.C.N.
REL FOR PROD	BY DTM	DATE 12-27-87	PROJ	D106		PE			C.P.N. J0212-1 REV (D)
			NEXT ASSEMBLY						