TECHRON®

TECHNICAL MANUAL

INCLUDES SERVICE INFORMATION

5515
POWER SUPPLY AMPLIFIER

Techron Division of Crown International, Inc. 1718 W. Mishawaka Road, Elkhart, IN 46517

K80140-5
6/86

AE TECHRON®

Limited One-Year Warranty

SUMMARY OF WARRANTY

AE TECHRON, of Elkhart, Indiana (Warrantor) warrants to you, the ORIGINAL COMMERCIAL PURCHASER ONLY of each NEW ***AE TECHRON*** product, for a period of one (1) year from the date of purchase, by the original purchaser (warranty period) that the product is free of defects in materials or workmanship and will meet or exceed all advertised specifications for such a product. This warranty does not extend to any subsequent purchaser or user, and automatically terminates upon your sale or other disposition of our product.

ITEMS EXCLUDED FROM WARRANTY

We are not responsible for product failure caused by misuse, accident or neglect. This warranty does not extend to any product on which the serial number has been defaced, altered, or removed. It does not cover damage to loads or any other products or accessories resulting from ***AETECHRON*** product failure. It does not cover defects or damage caused by the use of unauthorized modifications, accessories, parts, or service.

WHAT WE WILL DO

We will remedy, at our sole discretion, any defect in materials or workmanship by repair, replacement, or refund. If a refund is elected, you must make the defective or malfunctioning component available to us free and clear of all liens or other encumbrances. The refund will be equal to the actual purchase price, not including interest, insurance, closing costs, and other finance charges less a reasonable depreciation on the product from the date of original purchase. Warranty work can only be performed at our authorized service centers or at our factory. Expenses in remedying the defect will be borne by ***AE TECHRON***, including one-way surface freight shipping costs within the United States. (Purchaser must bear the expense of shipping the product between any foreign country and the port of entry in the United States and all taxes, duties, and other customs fees for such foreign shipments.)

HOW TO OBTAIN WARRANTY SERVICE

When you notify us of your need for warranty service, we will give you an authorization to return the product for service. All components must be shipped in a factory pack or equivalent which, if needed, may be obtained from us for a nominal charge. Corrective actions will be taken within a reasonable time of the date of receipt of the defective product by us. If the repairs made by us are not satisfactory, notify us immediately.

DISCLAIMER OF CONSEQUENTIAL AND INCIDENTAL DAMAGES

You are not entitled to recover from us any consequential or incidental damages resulting from any defect in our product. This includes any damage to another product or products resulting from such a defect.

WARRANTY ALTERATIONS

No person has the authority to enlarge, amend, or modify this warranty. The warranty is not extended by the length of time for which you are deprived of the use of this product. Repairs and replacement parts provided under the terms of this warranty shall carry only the unexpired portion of this warranty.

DESIGN CHANGES

We reserve the right to change the design of any product from time to time without notice and with no obligation to make corresponding changes in products previously manufactured.

LEGAL REMEDIES OF PURCHASER

There is no warranty which extends beyond the terms hereof. This written warranty is given in lieu of any oral or implied warranties not contained herein. We disclaim all implied warranties, including, without limitation, any warranties of merchantability or fitness for a particular purpose. No action to enforce this Warranty shall be commenced later than ninety (90) days after expiration of the warranty period.

AE TECHRON Customer Service Department
2507 Warren St. Elkhart IN 46516-0000 U.S.A.
(574) 295-9495

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5515 POWER SUPPLY AMPLIFIER

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SECTION 1: GENERAL INFORMATION

1-1 Introduction

The TECHRON Model 5515 is a single or dual channel power supply amplifier designed for use in medium power systems which demand high accuracy and wide frequency response. To become familiar with its many features, study this manual thoroughly.

Model 5515 is a powerful amplifier for precision amplification of frequencies from DC to 20KHz, with extremely low harmonic and intermodulation distortion, low noise, and high "damping factor". Output capability is 80 watts per channel minimum RMS into an 8 ohm load. When the amplifier is bridged and operating as a mono channel unit, output power reaches 260 watts minimum RMS into an 8 ohm load.

1-2 General Operation

The push button power switch activates an ON lamp.

Massive black-anodized heatsinks thermally joined with the chassis enable the entire amplifier to function as a heatsink. An optional cooling fan package enables continuous operation at high levels in areas of poor ventilation.

The output transistors operate in the TECHRON-designed AB + B configuration where quiescent current is carried by the driver stages until the output transistors are summoned by a large current demand. Dependable V-I current limiting provides protection against damage from shorted and low impedance loads, as well as damage from overloaded power supplies, input overload, and high frequency overloads.

In the event of overheating, a thermal switch will cut power to the unit. After cooling, the unit will return to normal operation. Frequent overheating may indicate the need for optional forced air cooling system.

Total direct coupling provides perfect, instantaneous, thump-free overload recovery even on non-symmetrical waveforms. There is no turn-on delay.

Conventional BNC connectors provide input signal to the unit. Standard MDP "banana" jacks provide connection for output signal.

An external mono/dual slide switch provides quick and easy conversion for either single or dual channel operation.

1-3 Service Policies

Due to the sophisticated circuitry of the Model 5515, have only qualified and fully trained technicians perform service work, or return to the factory in original packing for service. Replacement packing is obtainable from TECHRON. When returning Model 5515, enclose a brief letter explaining as completely as possible the problem or problems. For any service performed outside the TECHRON factory, be sure to read, understand, and follow instructions in this manual.

1-4 Accessories Supplied

Model 5515 comes complete with user's manual and four rack mounting screws. See Section 3-2 for proper rack clearance.

SECTION 2: SPECIFICATIONS AND PERFORMANCE

2-1 General Specifications

Hum and Noise (20Hz - 20KHz): 110dB below rated output.

Phase Response: +0, -15 degrees, DC-15KHz at 1 watt.

Input Impedance: 25Kohms, +/- 30%.

Amplifier Output Protection: Short, mismatched, and open circuit proof. Limiting is instantaneous with no flyback pulses, thumps, cutouts, etc. No premature limiting on transients.

Overall Protection: AC line fused. Thermal switch in AC line protects against overheating caused by insufficient ventilation. Controlled slewing-rate voltage amplifiers protect overall amplifier against RF burnouts. Input overload protection is furnished by an internal resistor at inputs of amp.

DC Output Offset (Shorted Input): 10 millivolts or less, internally adjustable to zero.

Turn-On: Instantaneous, with minimum thumps and no program delay.

Power Supply: Massive computer-grade filter capacitors store over 20 joules of energy. Two regulated supplies for complete isolation and stability.

Power Requirements: Requires 50-400HZ AC on 100, 120, 200, 220, or 240V +/-10% operation. Draws 30 watts or less on idle, 250 watts at 160 watts total output.

Heatsinking: The entire amplifier is used as a heatsink. 3/16" thick chassis acts as a heatsink along with auxiliary fins.

Chassis: All aluminum construction for maximum heat conduction and minimum weight.

Controls: Independent level controls are mounted on the front panel. Power switch with associated pilot light is on front panel. Non-interacting DC balance controls are mounted on main PC board under electronics cover. A mono-dual channel switch is located next to the input jacks on the rear panel.

Connectors: Input: BNC. Output: color-coded binding posts. AC line - 3-wire (grounded) male connector on 5 foot cable.

Dimensions: 19" (48.3cm) wide, 5-1/4" (13.3cm) high, 8-3/4" (22.2cm) deep (from mounting surface of front panel).

Weight: 24 pounds.

Finish: Polyester vinyl coated front panel with Lexan insert.

Maximum AC Current Draw: 6.25 amps.

2-2 Dual Channel Specifications

Output Power: 80 watts per channel minimum RMS (both channels operating) into an 8 ohm load over a bandwidth of 20Hz - 20KHz at a rated RMS sum total harmonic distortion of 1% of the fundamental output voltage.

Frequency Response: +/-1dB DC - 20KHz at 1 watt into 8 ohms; +/-1dB DC - 100KHz.

1KHz Power: 80 watts RMS into 8 ohms, per channel, both channels operating. 0.1% total harmonic distortion.

Harmonic Distortion: Less than 0.001% from 20Hz - 400Hz, and increasing linearly to 0.05% at 20KHz at 80 watts RMS per channel into 8 ohms.

IM Distortion: (60Hz - 7KHz 4:1): Less than 0.05% from 0.01 watts to 0.25 watts and less than 0.01% from 0.25 watts to 80 watts into 8 ohms, per channel.

Slewing Rate: 6 volts per microsecond (slewing rate is the maximum value of the first derivative of the output signal, or the maximum slope of the output signal).

Damping Factor: Greater than 400, DC - 400Hz into 8 ohms.

Output Impedance: Less than 15 milliohms in series with less than 3 microhenries.

Load Impedance: Rated for 8 ohm usage; safely drives any load, including completely reactive loads, without damage to amplifier.

Voltage Gain: 20.6 +/-2% or 26.3 +/-.2dB at maximum gain.

Input Sensitivity: 1.19 volts +/-2% for 80 watts into 8 ohms.

Output Signal: Unbalanced, dual channel.

Displays:
POWER (amber): indicates power on.
IOC (red): indicates amplifier overload conditions for either channel.

2-3 Mono Channel Specifications

Output Power: 260 watts RMS into an 8 (E1A) ohm load over a bandwidth of 20Hz-20KHz at a rated RMS sum total harmonic distortion of +/- 1%.

Frequency Response 1KHz Power: +/-.15dB DC-20KHz at 1 watt into 16 ohms; +/- 1dBDC-60KHz. 190 watts RMS into 16 ohms.

Harmonic Distortion: Less than 0.001% from 20 - 400HZ and increasing linearly to 0.05% at 20KHz at 160 watts into 16 ohms.
Slewing Rate: 12 volts per microsecond.

Damping Factor: Greater than 400, DC-400Hz into 16 ohms.

Output Impedance: Less than 30 milliohms in series with less than 6 microhenries.

Load Impedance: Rated for 16 ohm usage; safely drives any load including completely reactive loads.

Voltage Gain: 41.2 +/-2% or 32.3 +/- .2dB at maximum gain.

Input Sensitivity: 1.19 volts +/- 2% for 160 watts into 16 ohms.

Output Signal: Balanced, mono channel.

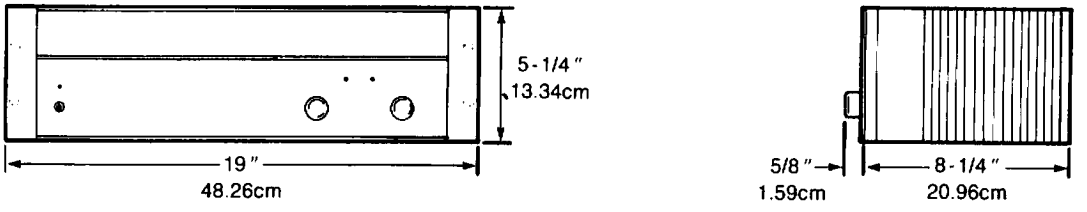

Illustration 2-1
Mounting Dimensions

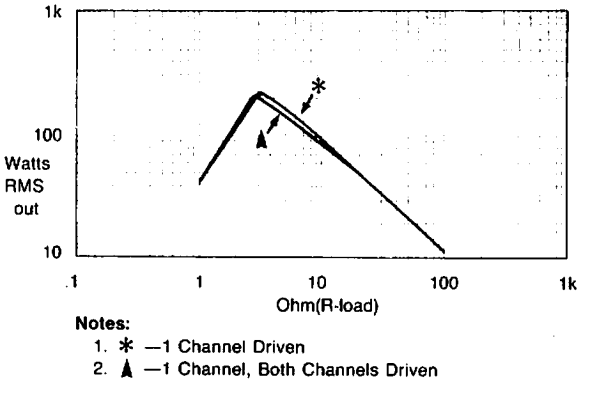

Illustration 2-2
Output vs. Load at 1KHz

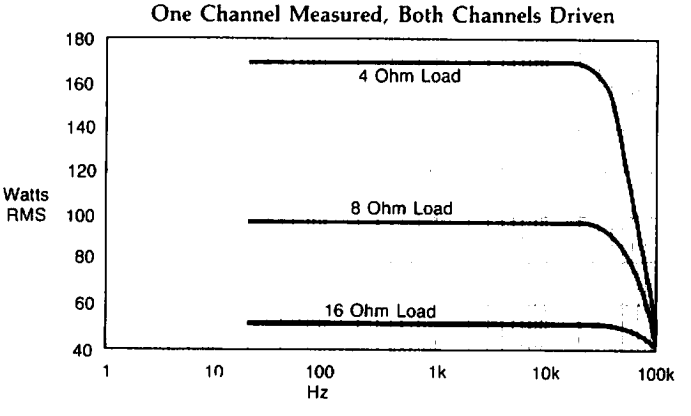

Illustration 2-3
Typical Power Output at Clip Point

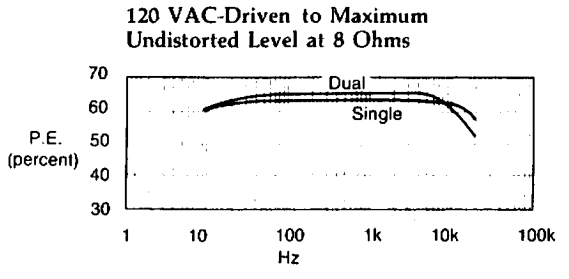

Illustration 2-4
Typical Power Efficiency

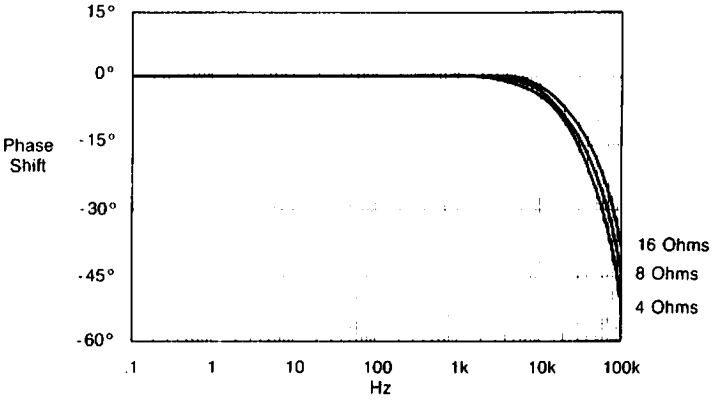

Illustration 2-5
Phase Response

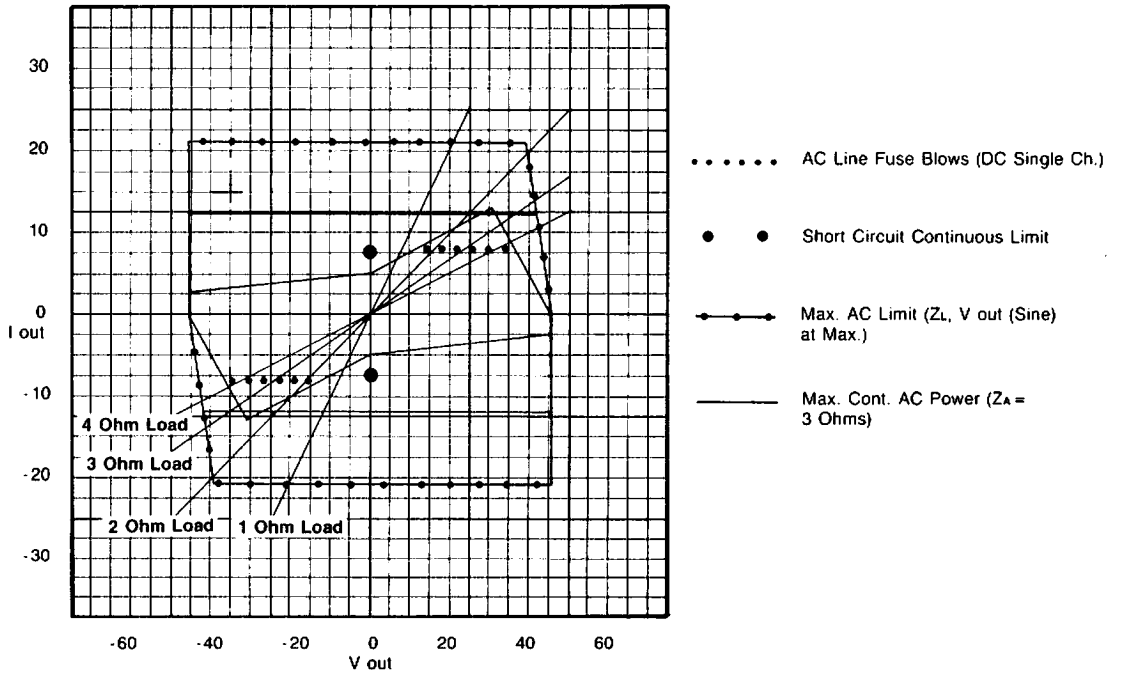

Illustration 2-6
V-I Graph

(See Illustration 4-1 for more detailed information on the 5515 V-I Graph)

SECTION 3: INSTALLATION AND OPERATION

3-1 Unpacking

Every TECHRON Model 5515 is carefully inspected and tested prior to leaving the factory. Carefully unpack and inspect the unit for damage in shipment. If damage is found, notify the transportation company immediately. Save the shipping carton and packing materials as evidence of damage for the shipper's inspection. TECHRON will cooperate fully in the case of any shipping damage investigation.

In any event, save the packing materials for later use in transporting or shipping the unit. Replacement packing materials are available from TECHRON. Never ship this unit without proper packing.

3-2 Mounting

Model 5515 may be mounted in a standard 19" rack. Use mounting washers and screws supplied with unit whenever possible. For proper cooling, allow a rack clearance of 1-3/4" above and below the unit, along with adequate ventilation in the mounting rack area. If two or more Model 5515 amplifiers are mounted above one another, allow 1-3/4" clearance below the bottom amplifier, 1-3/4" above the top amplifier and 3" between amplifiers. In applications requiring long sustained signals at high power levels, use optional cooling fan unit Model 55C01, which is custom designed and easy to install. See Section 3-11.

CAUTION

Do not operate Model 5515 in a small sealed chamber of any kind. Improper operation and overheating will result.

3-3 Operating Precautions

1. Use care in making connections, selecting signal sources, and controlling output level. Model 5515 is capable of causing serious damage to improper loads or through improper connections. See Section 3-10 for information on load protection.

2. Never directly parallel the output of Model 5515 with any other amplifier's output. This connection may cause serious damage to the amplifier and/or load and will not result in increased power output.

3. Never drive a transformer coupled device or any other device which appears as a low frequency short (less than 3 ohms at DC) without a series isolating capacitor. Such operation may damage the device and/or needlessly waste output power.

4. Do not short the ground lead of an output cable to the input signal ground. Oscillations may result.

5. Operate Model 5515 from proper AC current. Supply voltage must be 50 to 400Hz (Cooling fan unit requires 60Hz maximum) and no more than 10% above or below the selected line voltage. Failure to comply with these frequency limits may damage the unit and will invalidate the warranty.

6. Never connect the output to a power supply output, battery, or power main. These connections will cause serious damage to the amplifier.

7. Do not permit unqualified personnel to tamper with circuitry. Do not make unauthorized circuit modifications. Serious damage to the amplifier and/or safety hazards may result.

8. Follow all instructions for proper amplifier operation.

WARNING

NEVER OPERATE MODEL 5515 WITH COVER PANELS REMOVED. SEE SECTION 6 FOR PROPER SERVICE

PROCEDURES INCLUDING SERVICE OPERATIONS WITH COVERS REMOVED.

3-4 Connecting Output Lines

Model 5515 output connectors are located at the rear of the amplifier as shown in Illustration 3-1. While making connections, follow this procedure:
1. Turn unit power off.
2. Turn input level controls fully counterclockwise.
3. Connect output lines via "banana plugs" or via binding post direct connection. When using banana plugs, be sure connections are snug-fitting.

CAUTION
TECHRON is not liable for damage to any load due to overpowering.

4. Use proper output wire gauge and length. Keep wires as short as possible. At higher power levels, larger diameter wire is preferable.
5. To prevent spurious oscillations and undesired feedback, carefully lace output cables together. For the same reasons, never route output cables with input cables.
6. Do not join amplifier input and output grounds externally to the unit.
7. In installations where the output and input signals are attached to AC powered devices, it may be necessary to low-pass filter the input to the amplifier in order to eliminate capacitive coupling through AC mains.

3-5 Connecting Input Lines

Model 5515 incorporates BNC type connectors for input. When connecting input lines observe the following precautions:
1. To avoid "ground loops" or undesirable circulating currents in the grounding circuit, tie input cables together along their length, keeping them **away** from power supply lines and from output cables.
2. To protect against feedback oscillation from load current flowing in a loop, provide proper grounding and isolation of input from devices using the same AC supply line as the amplifier.

3-6 Mono Channel Operation

A mono-dual slide switch on the rear panel below input jacks allows Model 5515 to operate in either dual channel or mono channel configuration, with no internal modification. Switching to the mono position alters input circuitry of Model 5515 so that the two internal amplifiers work as a team for mono channel output. Follow this procedure for mono channel operation:
1. Connect input line to channel 1 input connector. Adjust level with channel 1 input level control only.
2. Disconnect any input from channel 2 and turn channel 2 input level control (front panel) fully counterclockwise.

Note: In mono channel operation, channel 2 input jack and level control are not defeated but **may not** be used. Adding channel 2 input to channel 1 input will result in distortion, while channel 2 input alone will result in low power output.

3. Connect output lines as shown in Illustration 3-2, connecting positive terminals of one channel to positive terminal of load and positive terminal of the other channel to negative terminal of load.

Note: Mono output is balanced and is isolated from the chassis and from the input grounds. Thus, both output leads are connected to the red or "hot" connectors only.

CAUTION
Be certain that all equipment (meters, switches, etc.) connected to the mono output lines is ungrounded. Both sides of the line must be totally isolated from the input grounds to the Model 5515. Failure to observe this precaution will result in severe oscillation.

Note: Use of ungrounded test equipment may violate local codes.

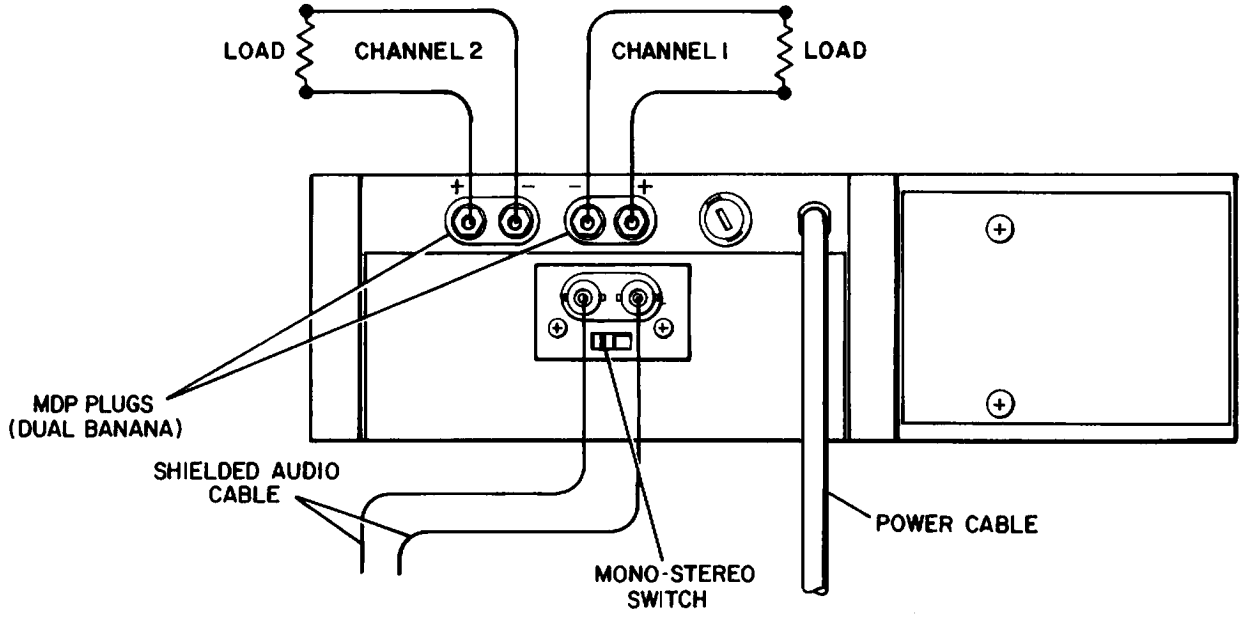

Illustration 3-1
Rear Panel Connectors

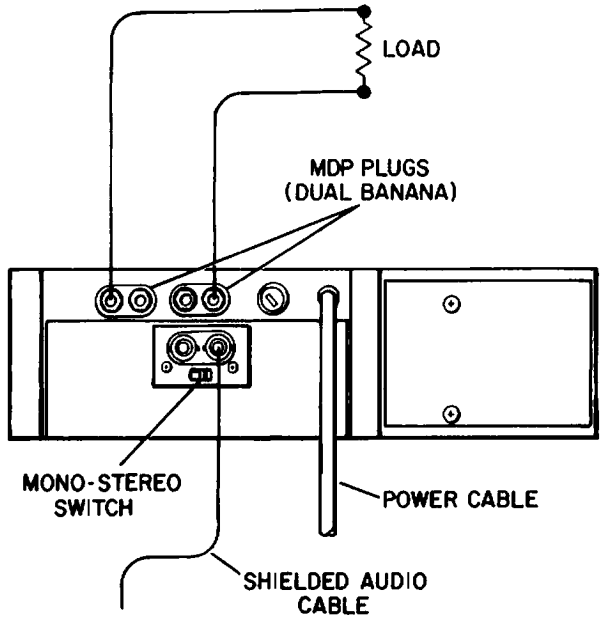

Illustration 3-2
Output Connections: Mono Channel

3-7 Connecting Power

3-7-1 AC Connector

Model 5515 uses a three-wire AC line system. At times, the third wire ground may introduce a ground loop into the system. If ground loop is present, use a 3-2 adapter on the AC line cord.

Note: Operating amplifier with a 3-2 adapter may violate local codes.

CAUTION

Power supply must be at 50-400Hz AC. (60Hz maximum with optional cooling fan package.)

Model 5515 may be operated at various line voltages. The serial plate indicates factory voltage wiring. To convert from one voltage to another, see Section 3-7-2.

CAUTION

Only a competent technician should attempt to convert from one voltage to another. Follow instructions given in Section 3-7-2 thoroughly.

3-7-2 Line Voltage Conversion

Model 5515 may be operated at various line voltages. The serial plate indicates factory voltage wiring.

CAUTION

Only a competent technician should attempt to convert from one voltage to another. Follow instructions thoroughly.

1. Make appropriate change in jumpers for the desired operation voltage. See Table 3-1.
2. For 100 or 120 VAC, the fuse is a 6.25A type MDX fuse. For 200, 220, or 240 VAC, the fuse is a 3A type MDA fuse.
3. Change the line cord tag to read the correct voltage.

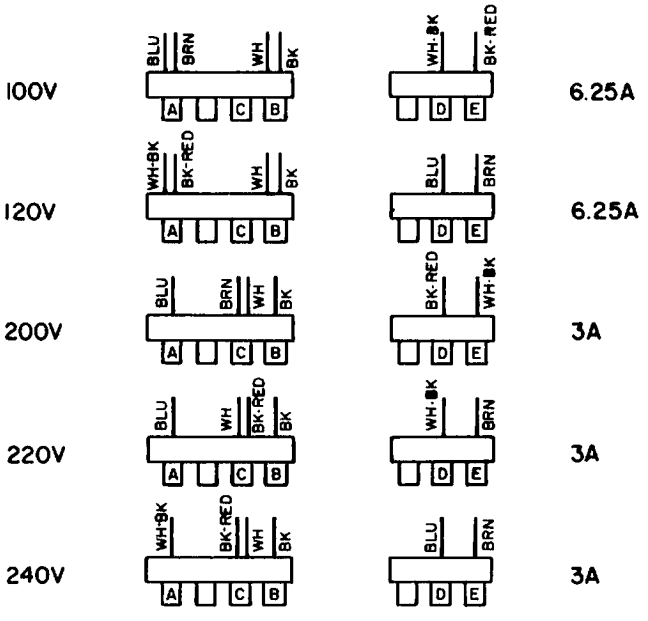

Table 3-1
Line Voltage Conversion Table

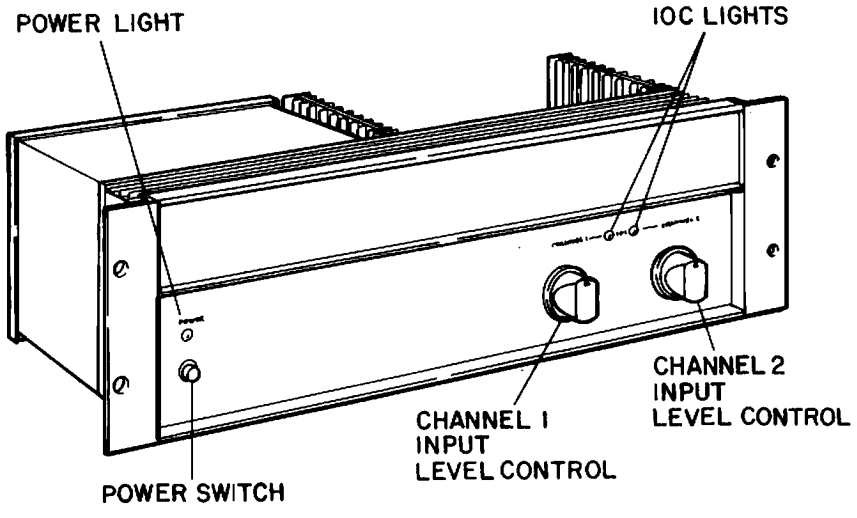

Illustration 3-3
Front Panel Controls

3-8 Controls and Adjustments

Model 5515 front panel controls include an AC power switch, a channel 1 input level control, and a channel 2 input level control. LEDs inform the operator of the operating status of the amplifier. (See Illustration 3-3).

Functions of Controls and Indicators

3-8-1 Front Panel Controls

AC Power Switch: Push-button On/Off control. When AC Power Switch is ON, power indicator light should be on unless power is disconnected or an internal problem is present.

Level Controls (Channel One, Channel Two): Controls for input levels, each channel.

IOC (Input/Output Comparator) Indicators: Will light at times of excessively high input level, improper load impedance, or when amplifier develops internal problem. Will light when power is turned off and will stay lit about one minute.

3-8-2 Rear Panel Connections and Controls

Standard Input Connectors: BNC connectors provide for easy connection and disconnection of input signals.

Mono/Dual Slide Switch: Determines dual channel or mono channel operation. See Sections 3-4 through 3-6 for proper input/output connection.

Output Connectors: Model 5515 includes standard binding posts which accommodate MDP "dual-banana" plugs.

Fuse: Replace fuse whenever AC voltage conversion is made (see Section 3-9-4), or when it has blown due to excessive voltage applied to the unit.

AC Line Cord: Model 5515 is furnished with a three-wire, heavy-duty plug as standard equipment. Follow instructions in Section 3-7 for connecting power.

Model 5515 may be operated on 5 different AC operating voltages. Only a competent technician should convert AC voltage. See Section 3-7-2 for conversion instructions.

3-9 Protection Mechanisms

3-9-1 Circuitry Protection

Model 5515 is well protected against hazards common to high power amplifiers, including shorted, open, or mismatched loads, overloaded power supplies, excessive temperature, input overload damage, and high frequency overload damage.

The CROWN-developed SPACE (Signal Programmed Automatic Current Executor) control circuit protects the amplifier against shorted and low impedance loads. It functions as an automatic current limiter at audio frequencies and as a V-I limiter at subaudio frequencies. The threshold of current limiting depends on the history of the signal, yet the no-signal threshold of current limiting is high enough to allow full power tone bursting at 4 ohms and higher. (With very low impedance loads, full power tone bursting is possible, but initial cycles in each burst are limited.) The net result is total amplifier protection with a maximum of output power.

3-9-2 Thermal Protection

The chassis includes a thermal switch which protects the amplifier against overheating due to insufficient ventilation. If the chassis becomes too hot, the thermal switch will interrupt AC line power. After sufficient cooling, operation will resume automatically. During thermal shut-down, the AC power pilot light will be out and the front panel (part of chassis heatsink) will feel warm to the touch.

3-9-3 Other Protection Circuitry

All of the amplifier's voltage-amplifier circuitry is designed to be inherently current limited. If any output device should fail, no damage will occur to the rest of the stages.

A series limiting resistor protects the input stage against overdrive damage should the input signal level become excessive.

A controlled slewing rate, coupled with the SPACE controller, protects the amplifier from blowups when fed large RF input signals.

3-9-4 Fuse

The fuse protects the power supplies against overload.

For 100 or 120 VAC, the fuse is a 6.25A type MDX fuse. For 200, 220, or 240 VAC, the fuse is a 3A type MDA fuse.

Use correct fuse sizes for proper amplifer operation and protection.

WARNING
TURN POWER OFF BEFORE CHANGING FUSES.

3-10 Load Protection Methods

The most common method of load protection is a fuse in series with the load. A single fuse may be used, or multiple fuses may be used in the case of multiple phase loads. Ordinary fuses will help prevent damage due to a prolonged overload. To protect against large transients, use high-speed instrument fuses such as Littlefuse 361000 in series. If the load is susceptible to damage by overheating, use a fuse or circuit breaker having the same slow thermal response as the load, for example, a slow-blow fuse.

CAUTION

Whenever an OVERLOAD condition is known to be present, take the following steps as applicable to protect amplifier and load:

1. **Reduce or limit input level.**
2. **Disconnect load from amplifier.**

3-11 Optional Accessories

Cooling Fan (55C01): Provides extra cooling in areas of poor air circulation and enables continuous high powered operation with reduced risk of overheating. Fan package comes with complete instructions for easy installation.

SECTION 4: APPLICATIONS

4-1 Amplifier Capability

Model 5515 is a high-powered power supply/amplifier. It is capable of delivering precision power levels in a wide range of demands, and with a variety of loads.

TECHRON provides the V-I graph (Illustration 4-1) to show the range of operation tolerated by the protection circuitry in Model 5515. Study the V-I graph carefully to understand the capabilities of Model 5515. Remember, the protection circuitry will not permit harm to the amplifier, even when demands are excessive or load is mismatched, shorted, or otherwise improper. The V-I graph will allow the user to tailor the demands to the amplifier's capability or to explain operation of the protection circuitry.

Further, when protection circuitry shuts unit down, normal operation will resume immediately when the excessive demand or other problem is removed.

There is never any danger to the amplifier when protection circuitry is activated.

When demands exceed the limits shown in the V-I graph, use one of the two special operating modes described in Section 4-2 for increased output current or voltage. If these special operating modes are still unable to meet the needed power capability, contact TECHRON engineering, and/or consider using a TECHRON model or models with higher power handling capacity.

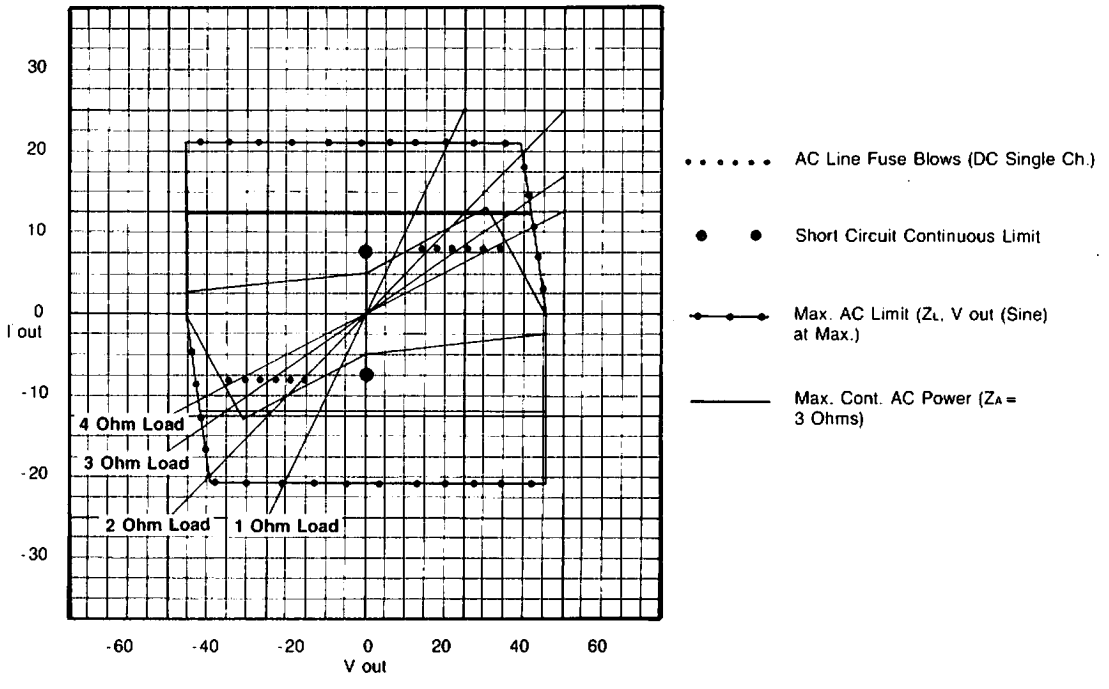

Illustration 4-1
V-I Graph

Definition & Explanation of V-I Graph Terms

AC Line Fuse Blows: A demand for continuous DC, 8 amp out put will cause the line fuse to blow. Protection circuitry allows excursions of AC (even square wave) output demands well beyond this point.

Short Circuitry Continuous Limit: The 5515's protection circuity will permit a short circuit at the output up to 7 amps. However, overheating will result and the 5515's thermal switches will turn the amplifier off.

Max AC Limit: With a sine wave input, and low load impedance, the protection circuitry allows this output for a very short time.

Max. Continuous AC Power: Self-explanatory. Applies to loads above 2.7 ohms.

Load Impedance and Inductance: Because input signal frequency, load inductance, load impedance all affect output limits, use the V-I Graph as a guide to amplifier performance. Contact **TECHRON** Engineering for assistance in difficult or innovative applications.

4-2 Special Operation Modes for Increased Output

Model 5515 may be operated in the usual, dual-channel mode or in one of two special modes.

4-2-1 Push-Pull Operation for Increased Voltage

Switching the "Dual-Mono" switch to the "Mono" position automatically places Model 5515 in the Push-Pull configuration. The load will be balanced in reference to ground. Connect the load across both red ("hot") terminals when using the Mono mode. See Section 3-6 for complete instructions on Mono operation.

4-2-2 Paralleling Channels for Increased Current

Ordinarily, the two channels of dual-channel amplifier may not be operated in parallel. However, parallel operation of the two channels of Model 5515 is possible if the following steps are taken:

1. Connect a .1 to .25 ohm, 50 watt, 1% resistor to the (+) output of each channel.
2. Connect (+) outputs, after resistors, together, and then to (+) terminal of load.
3. Connect (-) outputs together, and then to (-) terminal of load.
4. Connect input to input filter, if any is used, and then to the input of each channel.
5. Adjust channel 1 input knob to the "3 o'clock" position.
6. Carefully adjust channel 2 input knob to achieve equal output from each channel, using channel 1 as the reference value.

Note: This adjustment will be very fine and may be quite difficult to achieve. It is possible, however, with care and patience.

7. Note changes in value:
   V (voltage) remains the same as with one amplifier
   I (current) is multiplied by two
   Z (impedance) equals the number of amplifiers times the R value of the load, plus the numerical value of the added resistor.

Illustration 4-2 shows proper connections.

CAUTION

Never attempt to operate more than ONE dual-channel amplifier in parallel. The absence of an interlock circuit exposes amplifiers to severe damage from such operation.

Note: Recommended resistor for outputs as described above: Dale brand, Model NH50. Other resistors of equal value and precision are perfectly acceptable.

4-3 Cooling Needs

Model 5515 uses convection cooling in normal operation. An optional fan package (55C01) provides extra cooling capacity in installations where this is needed (crowded rack mountings, high ambient temperatures, constant high power demands, etc.).

Convection or fan cooling will be ample in nearly every instance. If overheating continues to be a problem, select one or more of the following or similar methods for improved cooling:

1. In crowded rack mountings, a vent tube to the outside of the rack is often helpful.
2. A fan mounted in a crowded rack will add to air circulation.
3. Locate Model 5515 away from other heat-producing devices whenever possible.

CAUTION

When the optional fan package is installed, AC current must be at 50-60Hz.

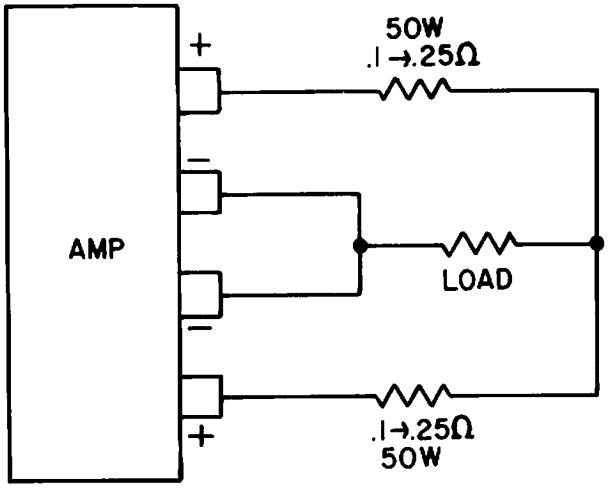

Illustration 4-2
Parallel Channel Operation

SECTION 5: THEORY OF OPERATION

Illustration 7-5 shows complete schematic diagram for Model 5515. Since both channels 1 and 2 are essentially identical, channel 1 is described here.

5-1 Input Stage

After entering the BNC input jack, the input signal level is adjusted to a desired input amplitude through R300, then applied to the IC operational amplifier U100 (channel 1). This op amp is a low noise, large gain bandwidth type which uses feedback circuit loops throughout and ultimately results in extremely low distortion values. The direct input signal is applied to the non-inverting input (pin 3) of U100 and the feedback signal is applied to the inverting input (pin 2).

Both signals entering U100 will be in phase with each other because of the feedback path and will thus produce an output (pin 6) of almost zero. The IC op amp will always try to keep a zero potential difference between both inputs. Any type of non-linearity will cause the op amp to produce a large output, and therefore a substantial size correction signal in order to retain the small output level.

5-2 Voltage Amplification

The operation of Model 5515 front-end circuitry, IC op amp through Q105, is to basically provide voltage amplification. However, the signal translator transistor Q101 provides no voltage amplification itself, but instead converts the ground referenced input signal to a signal with a reference to the negative supply (-45V). The result is a higher voltage swing capability from Q105, the final voltage amplifier.

The final voltage amplification transistor Q105 is the main source of voltage amplification in Model 5515. R116 in the base circuit of this transistor serves two purposes, namely, to provide collector current for Q101, and to allow the signal on the collector of Q101 to be developed and thus amplified.

As this development is in process, Q105 emitter voltage is developed across R124. When this voltage reaches a positive .6V, Q106 turns on and "pulls" the drive away from the last voltage amplifier, thus acting as a current limiter for Q105.

5-3 Output Section

Basically, the output of the final voltage amplifier provides the signal drive to the predriver, Q107, Q112, driver, Q300, Q302, and output transistors Q301, Q303, in order to amplifiy the current for final output power. The correct bias supply bias transistor Q111 voltage of 2.15V DC is distributed throughout the current amplification stages in the following manner:

1. Base to emitter junction of negative predriver Q112 is .6V.
2. Base to emitter junction of positive driver Q300 and predriver Q107 is .6V. Negative driver Q302 and output transistor Q303 have a fixed base-emitter bias in reference to the negative supply and are not involved with the bias servo circuitry.
3. .315V is present across the positive output-base to emitter resistor R131.

The base-emitter voltage of .315 in the output transistors means that these are at a "sub turn-on" voltage. This form of biasing is known as class AB+B, where the driver transistors carry the bias current, while the output transistors serve only as boosters. The output transistors sense when the driver transistors are developing a significant current drawn from the load and thus take over and deliver the needed current.

The result of this format is maximum efficiency with minimum crossover notch distortion and idling amplifier heat. Since the output circuit is not temperature-tolerance critical, there is no bias current adjustment.

5-4 Protection Circuitry

Model 5515's protection circuitry is the CROWN-developed SPACE (Signal Programmed Automatic Current Executor) control circuit. R301, R303 are current sensing resistors which carry the output current from the output transistors to the positive and negative limiting transistors Q103, Q104. Before the output current becomes dangerously high, the limiting transistor is activated, which in turn limits the drive voltage at the base of the predriver. When the predriver current and the limiter current are equal to the current available from Q102, current is limited until the overload is removed.

5-5 Bootstrap Supply

The bootstrap supply is a full wave rectifier and filter that provides a constant current source for the predriver, bias and voltage amplifier sections of Model 5515. A 10V zener diode D3 provides a constant 10V distribution across the combination R111 and Q102. This allows Q102 to remain on, providing a current path to the predriver, bias, and voltage amplifier sections.

The constant current source is necessary in order to attain maximum voltage swing from the voltage amplifier stage as well as help to isolate the front end input stage supply from the rail supply. This, in turn, helps prevent front-end overload.

5-6 Temperature Compensation/Offset Circuitry

The output offset adjustments R100 provide a bias voltage for the noninverting (pin 3) and inverting (pin 2) inputs of op amp U100. The output offset adjustments are set (with the level controls R105 either full open or closed) so there is zero DC voltage across the output of the amplifier. With the level controls either open or closed, the noninverting input is at 0 volts. The output offset adjustments R100 then can vary the bias voltage on the inverting input to match this for zero output.

Q1 is used as a heat compensation transistor (similar to the operation of the bias servo). As the temperature of the amplifier rises, bias voltages tend to drift, causing a DC offset within the IC op amp and thus DC voltage across the output of the amplifier.

As the temperature of Q1 changes, the base to emitter voltage changes and a compensation voltage of 2.2mV per degree centigrade is applied to the offset adjustment potentiometers.

5-7 IOC (Input-Output Comparator)

The IOC display is actually a window comparator circuit using two operational amplifiers U1C, U1D, and LED indicator E301.

Any small nonlinearity in the amplifier causes an error in the feedback loop to appear at the inverted input of the main IC op amp U100. This means the main IC output (pin 6) will rise above its normal value in an attempt to correct the problem. This signal then raises the bias voltage on U1C, U1D and activates Q116, which illuminates E301.

SECTION 6: MAINTENANCE AND CHECKOUT PROCEDURES

6-1 Introduction

This section contains technical information which will guide the technician through effective maintenance and checkout of Model 5515. It includes disassembly and reassembly procedures, lists of required test equipment, checkout procedures. Along with this section, consult schematic/board layout diagrams, parts lists, and exploded view drawings. See Section 7.

6-2 Required Test Equipment

Most service and repair procedures for Model 5515 require only limited test equipment. However, in order to return the unit to its factory new specifications, use the equipment listed in the table below. When the "suggested supplier and model" is not available, use "requirements" to determine a proper substitute.

CAUTION

To avoid ground loops in test equipment, do not connect output ground to input ground. This is especially important when measuring distortion.

CROWN AUTHORIZED SERVICE CENTER: RECOMMENDED TEST EQUIPMENT LIST

ITEM	RECOMMENDED
1. Oscilloscope Dual Channel Vert. Sensitivity-2mv/div Vert. Frequency DC-15MHz Ext. Sync DC-25MHz	Tektronix SC501, 2213A Hewlett-Packard 1740A Phillips PM3207
2. Audio Signal Generator Sine/Square 10Hz-100Khz Output+3V into 600 ohm load 1% THD	Wavetek 131A, 180 Series Krohn-Hite 1000, 1200
3. AC Voltmeter 20Hz-4MHz Sensitivity-100 microvolt FS +1% Accuracy 20-20KHz	Hewlett-Packard 400F Amber 3501 Sound Technology 170B/1710A
4. Digital Multimeter (DMM) AC/DC Volts-1 mv-100v Range AC/DC amps-10 MA- 10 A Range OHMS-.1 ohm-10 M ohms	Data Precision 248/1350, 1351 Fluke 70 series, 8020B series Fluke 8060 series
6. Intermodulation Distortion Analyzer or THD Analyzer IMA capable of .003% readings 60Hz/7Khz THD capable of .01% readings 20Hz to 20 KHz	Amber 3501 Technology 17701A, 1700 series Hewlett-Packard 339A
7. Variac, Autotransformer 0-140 V 20 Amp Cap	Various Gen. Rad. Models Superior Electric Models or equivalent
9. Peak Equivalent Line Voltage Monitor 0-200 V Scale	See Schematic 6-9 for details on circuit construction
10. Band pass Filter 20-20 KHz 18 db/octave rolloff	Sound Technology 170 or equivalent
11. Resistive Loads-2 for stereo 1-250W @8 ohms 1-500W @4 ohms Bridging for 500 W @16 ohms Bridging for 1000 W @ 8 ohms	4 Dale 8 ohms @250 per channel

Table 6-1

6-3 Disassembly and Discharge

WARNING
MODEL 5515 CONTAINS POSSIBLY HARMFUL OR FATAL ELECTRIC CHARGES EVEN WHEN POWER SUPPLY IS DISCONNECTED. DISCHARGE CAPACITORS WHENEVER COVERS ARE REMOVED. FOLLOW DISCHARGE INSTRUCTIONS EXACTLY. (SEE SECTION 6-3-2.)

6-3-1 Visual Inspection

Visually inspect Model 5515 regularly during normal operation, and at the beginning of any troubleshooting procedure. For a complete yet efficient visual inspection, follow these instructions:

1. Check all external screws. Be sure these are tight and that none are missing.
2. Check all fuses and circuit breakers.
3. Check switches, knobs, jacks, and other connections. Be sure these operate smoothly and properly and that none are loose.
4. Inspect line cord for possible damage to cap, jacket, and conductors.
5. Remove front panel and board electronics cover as described in Sections 6-3-2 and 6-3-3.
6. Check all attaching parts for internal circuits. Be sure these are tight and that none are missing.
7. Inspect wiring and internal components for evidence of charring or discoloration. These may indicate previous overheating.
8. Check all electrical connections, including wire terminals, screw and stud type terminals, and all soldered connections.
9. Check for obvious destruction of internal structural parts.

Note: Physical distortion or charring of wiring or other internal components may indicate damage from severe shock, being dropped, improper operation, or previous improper repair procedures.

6-3-2 Front Panel Removal

1. Remove 6 phillips head mounting screws (3 top, 3 bottom) from panel edges.
2. Gently lift front panel, taking care not to damage wiring attached to rear side of front panel.

Note: Wire length allows front panel to move approximately 4" away from unit without damage to wiring.

3. Discharge capacitors by placing a 50 ohm 10 watt resistor across the terminals of each capacitor (total of 2) for at least 5 seconds each.

WARNING
FAILURE TO FOLLOW DISCHARGE PROCEDURE MAY RESULT IN SERIOUS INJURY TO SERVICE PERSONNEL AND SEVERE DAMAGE TO ELECTRONIC COMPONENTS.

Front Panel Installation

4. Taking care not to damage internal wiring, set front panel in place.
5. Install mounting screws (3 top, 3 bottom) and tighten securely.

6-3-3 Board Electronics Cover Removal

1. Remove two (2) mounting screws.
2. Remove board electronics cover.

Board Electronics Cover Installation

3. Set board electronics cover in place.
4. Install two (2) mounting screws and tighten securely.

6-3-4 Transformer Cover Removal

1. Remove two (2) mounting screws.
2. Note proper cover orientation for later installation, then remove cover.

Transformer Cover Installation

3. Set cover in place. Note proper orientation: shorter side to front panel; split side to PC Board.
4. Install two (2) mounting screws and tighten securely.

6-3-5 Servicing Input Jacks and Dual/Mono Switch

1. Remove board electronics cover as described in Section 6-3-3.

Note: Discharge of capacitors is not necessary for this service.

2. Remove two screws from top of switch mounting plate.
3. Taking care not to place unnecessary strain on wiring behind, carefully lift plate upwards to access terminals and wiring on rear.
4. To reinstall backing plate, carefully position and install two mounting screws.
5. Install board electronics cover as described in Section 6-3-3.

6-3-6 Input Level Control Removal

1. Remove front panel as described in Section 6-3-2.

Note: Capacitor discharge is not necessary for this repair.

2. Note wire locations on input level control to be replaced and unsolder.
3. Pull knob straight off input level control being serviced. (No setscrew present.)
4. Remove mounting nut from input control being serviced and remove control from front panel.

Input Level Control Installation

5. Set new input level control in place.
6. Install and finger tighten mounting nut.
7. Attach wires to previously noted locations.
8. Check position of input control and adjust so that indicator on control knob will be in the correct position.
9. Tighten mounting nut.
10. Install control knob in proper position.
11. Install front panel as described in Section 6-3-2.

6-3-7 Thermal Switch Removal

1. Remove front panel as described in Section 6-3-2.
2. Remove board electronic cover as described in Section 6-3-3.
3. Unplug two Faston connectors from thermal switch terminals.
4. Remove screws, hex nuts, star washers, and solder lugs, (2 each) and remove thermal switch from chassis.

Thermal Switch Installation

5. Apply heatsink compound to thermal switch, then set thermal switch in place and align mounting screw holes.
6. Install screws, hex nuts, star washers, and solder lugs (2 each).
7. Connect two Faston connectors to switch terminals.
8. Install board electronics cover as described in Section 6-3-3.
9. Install front panel as described in Section 6-3-2.

6-3-8 Bridge Rectifier Removal

1. Remove front panel as decribed in Section 6-3-2.
2. Remove transformer cover as described in Section 6-3-4.

WARNING
FOLLOW DISCHARGE PROCEDURE AS DESCRIBED IN SECTION 6-3-2 BEFORE PROCEEDING.

3. Disconnect four Faston connectors from terminals of bridge rectifier.
4. Remove mounting screw, hex nut, and washer holding bridge rectifier in place.
5. Remove .1mF capacitor from old Bridge Rectifier Block for reuse in new installation.

Bridge Rectifier Installation

6. Mount bridge rectifier using mounting screw, washer, and hex nut.

7. Install .1mF capacitor from old Bridge Rectifier Block on new Bridge Rectifier Block.
8. Connect four Faston connectors to terminals of bridge rectifier (red positive, blue negative).
9. Install transformer cover as described in Section 6-3-4.
10. Install front panel as described in Section 6-3-2.

6-3-9 Capacitor Removal

1. Remove front panel as described in Section 6-3-2.

WARNING
FOLLOW DISCHARGE PROCEDURE AS DESCRIBED IN SECTION 6-3-2 BEFORE PROCEEDING.

2. Remove transformer cover as described in Section 6-3-4.
3. Remove one Faston connector from capacitor terminal.
4. Remove two screws, one solder lug, two panel washers, and two fiber shoulder washers from capacitor terminals.

Note: Work on one capacitor at a time, using the other for reference in reassembly.

Capacitor Installation

5. Set new capacitor in place. Be sure to observe polarity (- blue, + red).
6. Install screws, solder lug, panel washers, and fiber shoulder washers.

Note: Refer to Illustration 6-1 and/or to opposite capacitor for assembly detail.

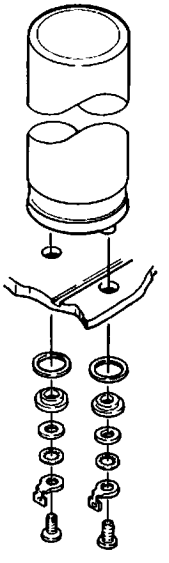

Illustration 6-1
Detail, Capacitor Mounting Screw

7. Connect Faston connector to capacitor terminals.
8. Install transformer cover as described in Section 6-3-4.
9. Install front panel as described in Section 6-3-2.

6-3-10 Output and Driver Transistor Removal

1. Remove front panel as described in Section 6-3-2.
2. Remove board electronics cover as described in Section 6-3-3.
3. Note location of all wires connected to transistor being serviced.
4. Unsolder all wires connected to transistor being serviced EXCEPT wires attached to solder lugs.
5. Hold hex nut still with nut driver and remove mounting screw at each end of transistor.
6. Save insulating wafer for reuse.

Output and Driver Transistor Installation

7. Apply heatsink compound thoroughly to both sides of insulating wafer.
8. Place insulating wafer between transistor and heatsink surface, then install transistor mounting bolts and solder lugs. Hold hex nuts still while turning screws to tighten securely.
9. Connect solder wires to previously noted locations. Refer to Illustration 6-2 for mounting details.
10. Install board electronics cover as described in Section 6-3-3.
11. Install front panel as described in Section 6-3-2.

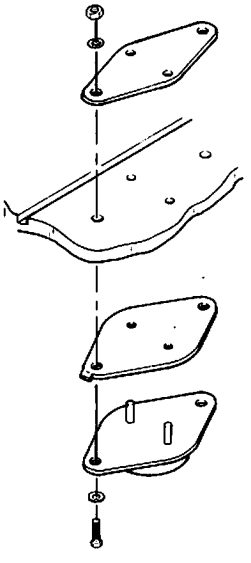

Illustration 6-2
Transistor Mounting

6-3-11 Power Transformer Removal

1. Remove front panel as described in Section 6-3-2.
2. Remove transformer cover as described in Section 6-3-4.

WARNING
FOLLOW DISCHARGE INSTRUCTIONS (SECTION 6-3-2) BEFORE PROCEEDING.

3. Trace transformer wires to terminals throughout amplifier, note locations and disconnect.
4. Pull wires back through hole in chassis.
5. Remove four transformer mounting screws, along with hex nuts and star washers.
6. Remove rubber grommets and retain for reuse.
7. Remove transformer.

Power Transformer Installation

8. Using old transformer as model, cut leads on new transformer to length matching corresponding leads on defective transformer.
9. Install rubber grommets in mounting holes of new transformer.
10. Stabilize transformer by installing upper outside and lower inside mounting screws, washers, and hex nuts.
11. Install pilot light assembly on lower outside transformer mounting screw, and tighten securely.
12. Install terminal strip on upper inside mounting screw and tighten securely.
13. Pull transformer wires through hole in chassis to bottom side of chassis.
14. Connect 7 transformer wires to terminals previously noted.
15. Install transformer cover as described in Section 6-3-4.
16. Install front panel as described in Section 6-3-2.

6-4 Checkout Procedures

This section describes procedures for testing proper amplifier operation. Follow these procedures after any repair involving amplifier circuitry, or to help identify the cause of a particular problem.

6-4-1 Bias Level Check and Adjustment

PROCEDURE:

1. Remove main board cover. See Section 6-3-3.

2. Turn on AC power and allow amplifier to warm up fully (at least 15 minutes).
3. Measure voltage across R136, R236. Correct reading is between 310 and 345mV. If voltage is outside this range, adjust R128, R228.

6-4-2 Output/Offset-Bias Adjustment

PROCEDURE:
Refer to Illustration 6-3. Adjustments are located in the main PC board and are sometimes called DC balance controls. Channel 1: R100; Channel 2: R200. These seldom, if ever, need adjustment, but may be adjusted by following this procedure:

1. Remove main board cover from amplifier. See Section 6-3-3.
2. Turn AC power on and allow at least 15 minutes for full warm-up.
3. Set Channel 1 input level control fully counterclockwise.
4. Remove input signal from channel 1.
5. Place a sensitive DC voltmeter across Channel 1 output terminals.
6. Adjust R100 with a small, flat-bladed screwdriver, until 0 reading shows on DC voltmeter.

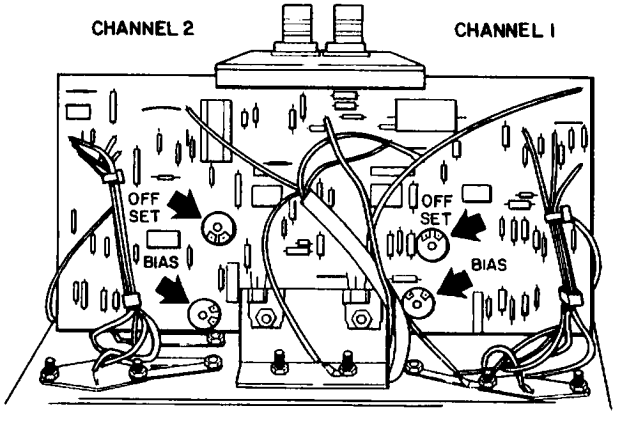

Illustration 6-3
Output/Offset-Bias Adjustment

6-4-3 Test 1KHz Operation Without Load

PROCEDURE: Connect 1KHz sine wave, 1.5V to the input, without load. Monitor output with oscilloscope. Turn level control up, monitoring oscilloscope throughout. Waveform should appear undistorted at all amplitudes until clipping occurs. Clipping should be sharp and free of ringing or other oscillation, about 30V RMS, no load.

6-4-4 Test 1KHz Operation with Load

PROCEDURE:
1. Connect an 8 ohm resistive load, having less than 10% reactive components at any frequency up to five times the highest test frequency, to the output.
2. Monitor output with an oscilloscope and an accurate AC voltmeter. Monitor at the output terminals, and not along the output cables.
3. Connect an 1KHz sine wave, 1.5V to the input. Turn up the level of the channel being tested.

CORRECT OPERATION:
The output should clip at over 98 watts or 28V RMS. Waveform should be clean throughout the test, and clipping should be even and symmetrical with no ringing or other distortion.

6-4-5 1KHz Clip Test

PROCEDURE:
This test is similiar to previous test 6-4-4, but with different load and output values.

1. Connect a 4 ohm resistive load, having less than 10% reactive components at any frequency up to five times the highest test frequency, to the output.
2. Monitor output with an oscilloscope and an accurate AC voltmeter. Monitor at the output terminals, and not along the output cables.

3. Connect an 1KHz sine wave, 1.5V to the input. Turn up the level of the channel being tested.

CORRECT OPERATION:
The output should clip at approximately 175 watts or 26.5V RMS. Wave form should look like illustration 6-4

6-4-6 Test Limiting Portion of Protection Circuit

PROCEDURE:
1. Set amplifier output at approximately 20V.
2. Switch load to 2 ohms.
3. Slow oscilloscope trace to look for power supply ripple at the clip level. If present, this indicates that power supply sag is causing clipping, rather than protection circuit. If power supply appears to be causing clipping, continue:
4. Switch load to 1 ohm. If oscilloscope still shows only power supply clipping, protection circuitry is defective.
5. The waveform should be sharp and clean with no oscillations. See Illustration 6-5 for proper wave form.

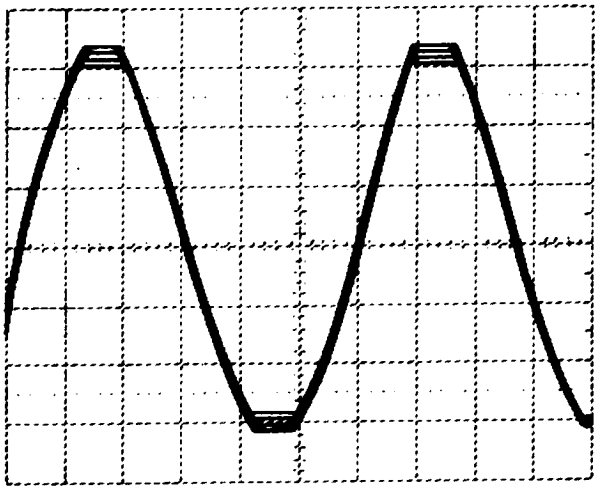

Illustration 6-4
Clip Test Waveform

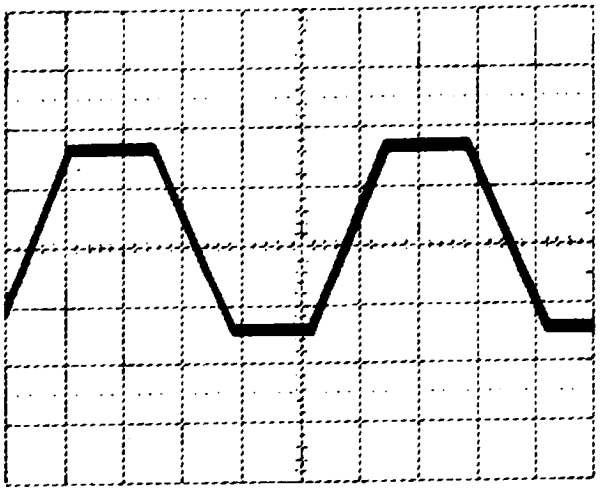

Illustration 6-5
Test Limiting Waveform

6-4-7 Test Memory Portion of Protection Circuit

1. Connect 1KHz signal to the input.
2. Connect an 8 ohm load to the output.
3. Connect a 159mH coil in parallel with an 8 ohm load. See Illustration 6-6 for proper waveform.

6-4-8 Test 10KHz Square Wave Operation

PROCEDURE:

1. Connect 10KHz square wave, 1V, to the input.
2. Connect an 8 ohm load to the output.
3. Set input level at maximum.
4. See Illustration 6-7 for proper waveform.

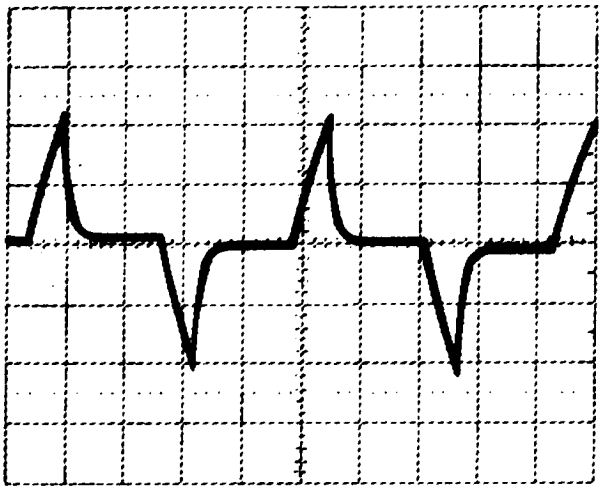

Illustration 6-6
Protection Circuit Memory Waveform

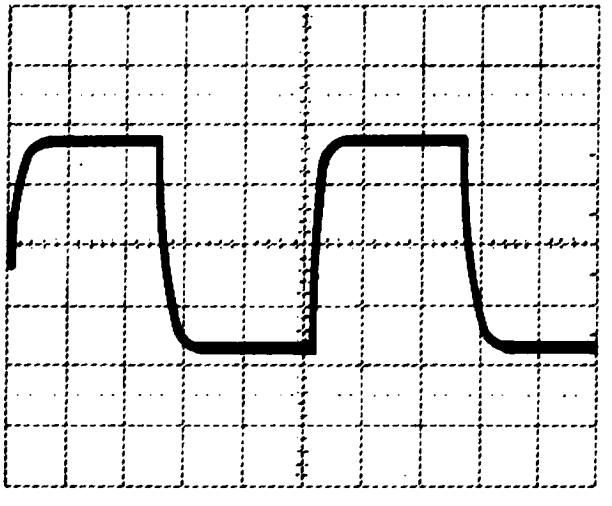

Illustration 6-7
Correct Square Wave Operation

6-4-9 Test 20KHz Operation

PROCEDURE:
1. Connect 20KHz sine wave, 1.5V to the input.
2. Connect 8 ohm load to the output.
3. Monitor output with oscilloscope.
4. Turn input level up until clipping occurs. Clipping must occur at over 80 watts (25 volts).
5. Waveform must not distort anywhere before clipping.

6-4-10 IM (Inter-modulation) Distortion Test

PROCEDURE:
1. Use the distortion test setup shown in your IM analyzer manual.
2. Calibrate the distortion analyzer and set up the IM input signal at 60-7KHz, 4:1 ratio.
3. Connect an 8 ohm load to the output of the amplifier.
4. Measure the IM distortion at 5dB intervals from 80 watts output to 8mW as shown below.

DB OF ATTENUATION	WATTS AT OUTPUT	AMPLIFIER OUTPUT IN VOLTS	MAXIMUM DISTORTION
0 DB	80.0W	25.2V	.004%
- 5	25.3	14.2	.01
-10	8.0	8.0	.01
-15	2.53	4.4	.01
-20	0.8	2.5	.01
-25	0.253	1.4	.01
-30	0.080	0.8	.03
-35	0.025	0.44	.03
-40	0.008	0.25	.03

Table 6-2
IM Test Values

6-4-11 20-20KHz Hum and Noise Test

PROCEDURE:

1. Use the noise test set-up shown in Illustration 6-8.
2. Short amplifier inputs.
3. Set level controls fully clockwise.
4. Measure the noise level relative to 80 watts. The hum and noise level must be 110dB or more below the full 80 watt output power. A typical value is -115dB.

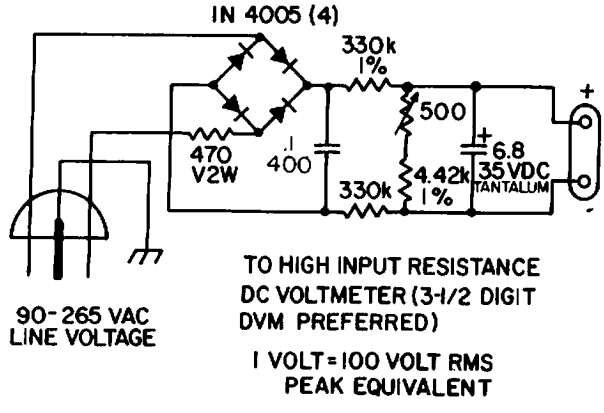

Illustration 6-9
Peak Equivalent Line Voltage Monitor

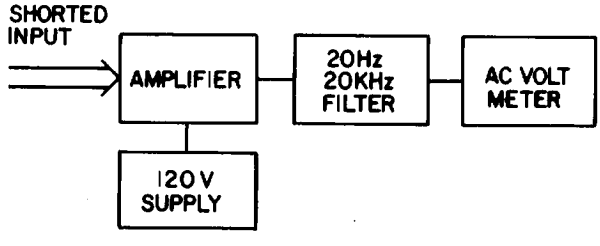

Illustration 6-8
Noise Test Setup

SECTION 7: ILLUSTRATED PARTS LIST

7-1 General Information

Section 7 contains illustrations and parts lists for the 5515. This information should be used with the service, repair and adjustment procedure in Section 6.

Most of the mechanical and structural type parts are illustrated and indexed on exploded view drawings. Electrical and electronic parts on these illustrations are also identified by the circuit schematic designation next to the illustration. Both the index number and the schematic designation are included in the parts list in separate columns. The schematic designations correspond to those shown in schematic diagrams.

Electrical and electronic parts located on printed circuit boards are illustrated by schematic symbols on the component side. Schematic designations also appear on these diagrams.

7-2 Standard and Special Parts

Many electrical and electronic parts used in the 5515 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 an acceptable replacement. Structural items, covers and panels are available from Techron only.

7-3 Ordering Parts

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

7-4 Shipment

1. Shipment will be made by UPS or best method unless you specify a preferred method.

2. Shipments are made F.O.B. Elkhart, Indiana only.

3. Established Techron accounts will be freight prepaid and billed unless shipped by truck or air freight.

4. All others will be shipped freight collect.

7-5 Terms

Note: Part prices are subject to change without notice.

1. Normal terms are C.O.D. unless the order is prepaid.

2. Net 30 days terms apply only to those firms who have an established line of credit with Techron.

3. If prepaying please add an amount for the freight charge. $2.50 is average for an order under one pound.

4. New parts returned for credit are subject to a 10% restocking charge.

5. You must receive authorization from the Parts Dept. before returning parts for credit.

6. We are not a general parts warehouse! Parts are available for servicing Techron products only.

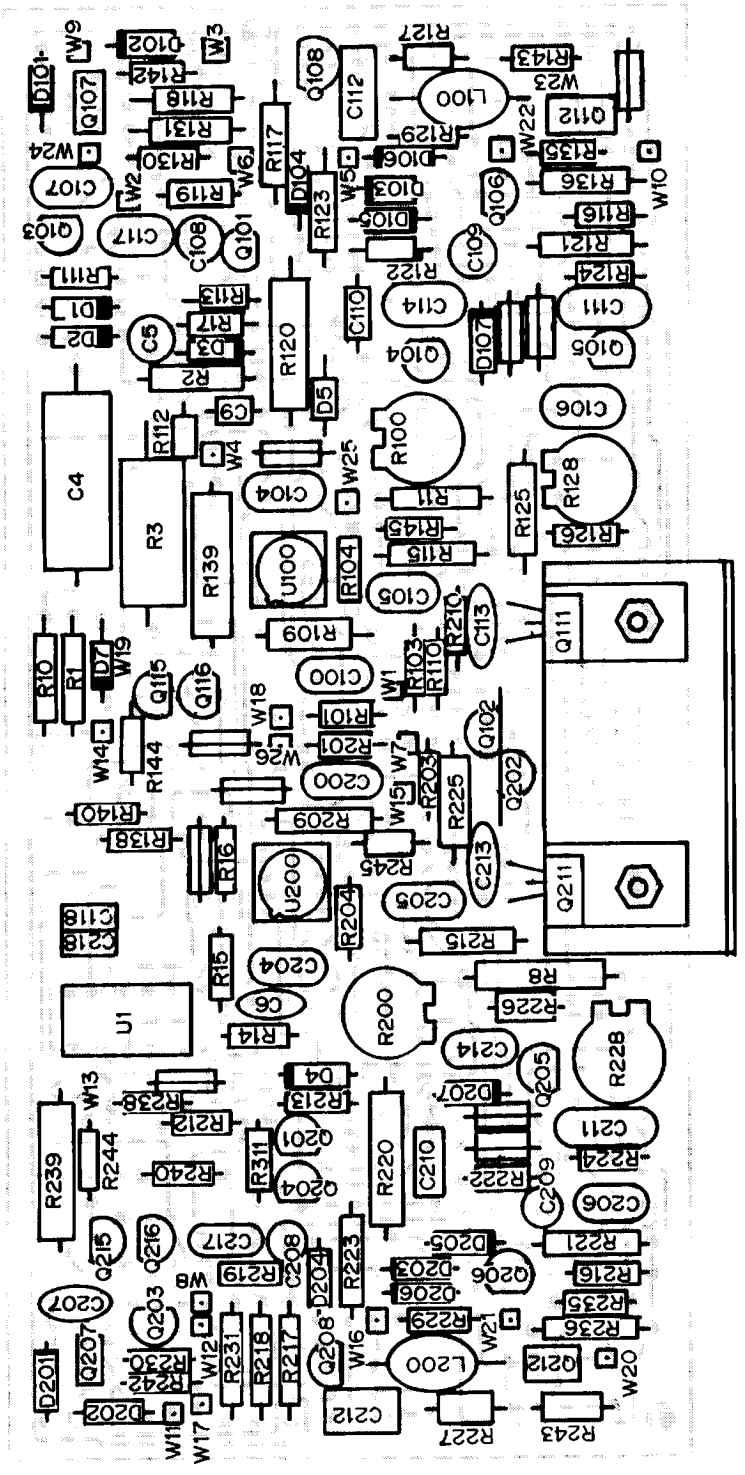

Illustration 7-1
Main Board Component Side

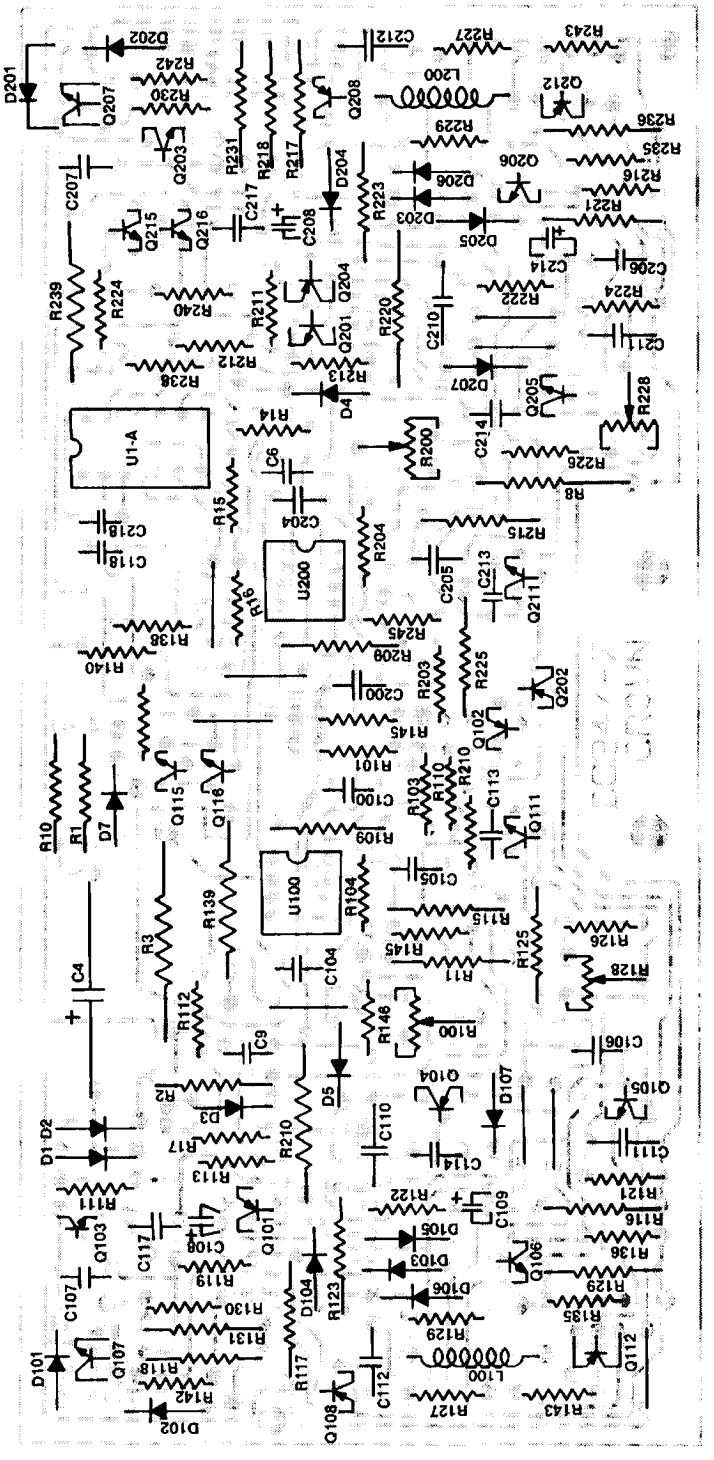

Illustration 7-2
Main Board Foil Side

5515 MAIN MODULE

Location #	Description	Part #
CAPACITORS		
C4	10MF 160V	C 2796-8
C5	10MF 50V Vertical	C 3728-0
C6	.01MF Disc	C 1751-4
C9	.1MF Disc	C 5639-7
C10 *	.01MF Disc	C 1751-4
C100	100PF Mica	C 3410-5
C104	47PF Mica	C 3409-7
C105	120PF Mica	C 3290-1
C106	100PF Mica	C 3410-5
C107	200PF Mica	C 3411-3
C108	10MF 50V Vertical	C 3728-0
C109	10MF 50V Vertical	C 3728-0
C110	.0027MF 200V Film	C 3481-6
C111	470PF Mica	C 2511-1
C112	.001MF 200V Film	C 3480-8
C113	.01MF Disc	C 1751-4
C114	200PF Mica	C 3411-3
C117	47PF Mica	C 3409-7
C200	100PF Mica	C 3410-5
C204	47PF Mica	C 3409-7
C205	120PF Mica	C 3290-1
C206	100PF Mica	C 3410-5
C207	200PF Mica	C 3411-3
C208	10MF 50V Vertical	C 3728-0
C209	10MF 50V Vertical	C 3728-0
C210	.0027MF 200V Film	C 3481-6
C211	470PF Mica	C 2511-1
C212	.001MF 200V Film	C 3480-8
C213	.01MF Disc	C 1751-4
C214	200PF Mica	C 3411-3
C217	47PF Mica	C 3409-7

*Mounted on Foil Side Board

5515 MAIN MODULE (cont'd)

Item #	Description	Part #
DIODES		
D1	IN4004	C 2851-1
D2	IN4004	C 2851-1
D3	IN961B 10V Zener	C 3549-0
D4	IN961B 10V Zener	C 3549-0
D5	IN961B 10V Zener	C 3549-0
D101	IN4148	C 3181-2
D102	IN4004	C 2851-1
D103	IN4148	C 3181-2
D104	IN4148	C 3181-2
D105	IN4148	C 3181-2
D106	IN4004	C 2851-1
D107	IN270	D 6212-1
D201	IN4148	C 3181-2
D202	IN4004	C 2851-1
D203	IN4148	C 3181-2
D204	IN4148	C 3181-2
D205	IN4148	C 3181-2
D206	IN4004	C 2851-1
D207	IN270	D 6212-1
INTEGRATED CIRCUITS		
U1	LM339N	C 4345-2
U100	LF357N	C 6527-3
U200	LF357N	C 6527-3
L100	.5 Microhenry Coil	C 3510-2
L200	.5 Microhenry Coil	C 3510-2
RESISTORS		
R1	2.2K ohm .5W 5%	C 1036-0
R2	2.2K ohm .5W 5%	C 1036-0
R3	1.5K ohm 2W 10%	C 3303-2
R8	1.5K ohm 2W 10%	C 3303-2
R10	390 ohm .5W 5%	C 2609-3
R11	10K ohm .5W 1%	C 2343-9
R14	33K ohm .25W 5%	C 4346-0
R15	150K ohm .25W 5%	C 4216-5
R16	33K ohm .25W 5%	C 4346-0
R17	200K ohm .25W 5%	C 3622-5

5515 MAIN MODULE (cont'd)

Location #	Description	Part #
RESISTORS (cont'd)		
R100	100K ohm Trim Pot	C 5062-2
R101	2M ohm .25W 5%	C 3199-4
R103	1K ohm .25W 5%	C 2627-5
R104	240K ohm .25W 5%	C 4220-7
R109	510 ohm .5W 1%	C 3304-0
R110	2.4K ohm .25W 5%	C 3616-7
R111	56K ohm .25W 5%	C 2882-6
R112	8.2K ohm .25W 5%	C 2877-6
R113	5.6K ohm .25W 5%	C 3220-8
R115	10K ohm .5W 1%	C 2343-9
R116	820 ohm .25W 5%	C 3301-6
R117	33K ohm .5W 5%	C 3137-4
R118	120 ohm .5W 5%	C 3837-9
R119	82 ohm .25W 5%	C 3960-9
R120	5.1K ohm 1W 5%	C 2808-1
R121	22.1K ohm .5W 1%	C 3855-1
R122	82 ohm .25W 5%	C 3960-9
R123	120 ohm .5W 5%	C 3837-9
R124	82 ohm .25W 5%	C 3960-9
R125	2.2K ohm .5W 5%	C 1036-0
R126	750 ohm .25W 5%	C 3803-1
R127	15 ohm .25W 5%	C 3614-2
R128	500 ohm Trim Pot	C 6048-0
R129	100 ohm .25W 5%	C 2872-7
R130	180 ohm .25W 5%	C 2873-5
R131	5.6 ohm .5W 5%	C 3299-2
R135	180 ohm .25W 5%	C 2873-5
R136	5.6 ohm .5W 5%	C 3299-2
R138	150K ohm .25W 5%	C 4216-5
R139	2.7K ohm 1W 10%	C 1079-0
R140	56K ohm .25W 5%	C 2882-6
R142	13K ohm .25W 5%	C 4300-7
R143	13K ohm .25W 5%	C 4300-7
R144	4.7K ohm .25W 5%	C 3939-3
R145	825 ohm .25W 1%	C 6556-2

5515 MAIN MODULE (cont'd)

Location #	Description	Part #
RESISTORS (cont'd)		
R200	100K ohm Trim Pot	C 5062-2
R201	2M ohm .25W 5%	C 3199-4
R203	1K ohm .25W 5%	C 2627-5
R204	240K ohm .25W 5%	C 4220-7
R205	25K ohm Trim Pot	D 2942-7
R209	510 ohm .5W 1%	C 3304-0
R210	2.4K ohm .25W 5%	C 3616-7
R211	56K ohm .25W 5%	C 2882-6
R212	8.2K ohm .25W 5%	C 2877-6
R213	5.6K ohm .25W 5%	C 3220-8
R215	10K ohm .5W 1%	C 2343-9
R216	820 ohm .25W 5%	C 3301-6
R217	33K ohm .5W 5%	C 3137-4
R218	120 ohm .5W 5%	C 3837-9
R219	82 ohm .25W 5%	C 3960-9
R220	5.1K ohm 1W 5%	C 2808-1
R221	22.1K ohm .5W 1%	C 3855-1
R222	82 ohm .25W 5%	C 3960-9
R223	120 ohm .5W 5%	C 3837-9
R224	82 ohm .25W 5%	C 3960-9
R225	2.2K ohm .5W 5%	C 1036-0
R226	750 ohm .25W 5%	C 3803-1
R227	15 ohm .25W 5%	C 3614-2
R228	500 ohm Trim Pot	C 6048-0
R229	100 ohm .25W 5%	C 2872-7
R230	180 ohm .25W 5%	C 2873-5
R231	5.6 ohm .5W 5%	C 3299-2
R235	180 ohm .25W 5%	C 2873-5
R236	5.6 ohm .5W 5%	C 3299-2
R238	150K ohm .25W 5%	C 4216-5
R239	2.7K ohm 1W 10%	C 1079-0
R240	56K ohm .25W 5%	C 2882-6
R242	13K ohm .25W 5%	C 4300-7
R243	13K ohm .25W 5%	C 4300-7
R244	4.7K ohm .25W 5%	C 3939-3
R245	825 ohm .25W 1%	C 6556-2

5515 MAIN MODULE (cont'd)

Location #	Description	Part #	Reference
TRANSISITORS			
Q101	PN4250A PNP	C 3786-8	
Q102	MPS93 PNP	C 3578-9	
Q103	SEL 2N3859 NPN	D 2961-7	
Q104	2N4125 PNP	C 3625-8	
Q105	MPSL01 NPN	C 3232-3	
Q106	SEL 2N3859 NPN	D 2961-7	
Q107	D40P3 NPN	C 5065-5	
Q108	2N4125 PNP	C 3625-8	
Q111	SEL 2N3859 NPN	D 2961-7	
Q112	NDS206 PNP	C 4116-7	
Q115	SEL 2N3859 NPN	D 2961-7	
Q116	SEL 2N3859 NPN	D 2961-7	
Q200	2N4125 PNP	C 3625-8	
Q201	PN4250A PNP	C 3786-8	
Q202	MPS93 PNP	C 3578-9	
Q203	SEL 2N3859 NPN	D 2961-7	
Q204	2N4125 PNP	C 3625-8	
Q205	MPSL01 NPN	C 3232-3	
Q206	SEL 2N3859 NPN	D 2961-7	
Q207	D40P3 NPN	C 5065-5	
Q208	2N4125 PNP	C 3625-8	
Q211	SEL 2N3859 NPN	D 2961-7	
Q212	NDS206 PNP	C 4116-7	
Q215	SEL 2N3859 NPN	D 2961-7	
Q216	SEL 2N3859 NPN	D 2961-7	
MISCELLANEOUS			
	14 Pin IC Socket	C 3450-1	for U1
	8 Pin IC Socket	C 3451-9	for U100, U200
	Dual TO-92 Cooler	C 3493-1	for Q102, Q202
	TO-92 D-Clips	C 3953-4	for Q111, Q211

MISCELLANEOUS ELECTRICAL PARTS NOT INCLUDED ON PC BOARDS

Location #	Description	Part #	Reference
R300	25K ohm Log Pot	D 2942-7	Level Control
R301	.1 ohm 5W	C 4761-0	
R302	2.7 ohm 5W	C 1001-4	
R303	.1 ohm 5W	C 4761-0	
R400	25K ohm Log Pot	D 2942-7	Level Control
R401	.1 ohm 5W	C 4761-0	
R402	2.7 ohm 1W	C 1001-4	
R403	.1 ohm 5W	C 4761-0	
R500	1.2K ohm 2W	C 3649-8	
R501	1 ohm .5W	C 3612-6	
R502	1.2K ohm 2W	C 3649-8	
L300	3 Microhenry	M43121-9	
L400	3 Microhenry	M43121-9	
Q300	MJE15028 PWR NPN	C 5890-6	
Q301	MJ15011 PWR NPN	D 5841-8	
Q302	MJE15028 PWR NPN	C 5890-6	
Q303	MJ15011 PWR NPN	D 5841-8	
Q400	MJE15028 PWR NPN	C 5890-6	
Q401	MJ15011 PWR NPN	D 5841-8	
Q402	MJE15028 PWR NPN	C 5890-6	
Q403	MJ15011 PWR NPN	D 5841-8	
C300	.01MF	C 1751-4	
C301	.1MF	C 2938-6	
C400	.01MF	C 1751-4	
C401	.1MF	C 2938-6	
C500	.1MF	C 2938-6	
C501	9400MF	C 3309-9	
C502	9400MF	C 3309-9	
T500	Transformer	D 4380-8	
D500	Rectifier	C 4305-6	
S500	Thermal Switch	C 2799-2	
S501	On-Off Switch	D 5699A8	
S502	Mono Switch	M20105-9	
F500	6.25A Fuse	C 4307-2	for 100 - 120V AC
F500	3A Fuse	C 4384-1	for 200 - 240V AC

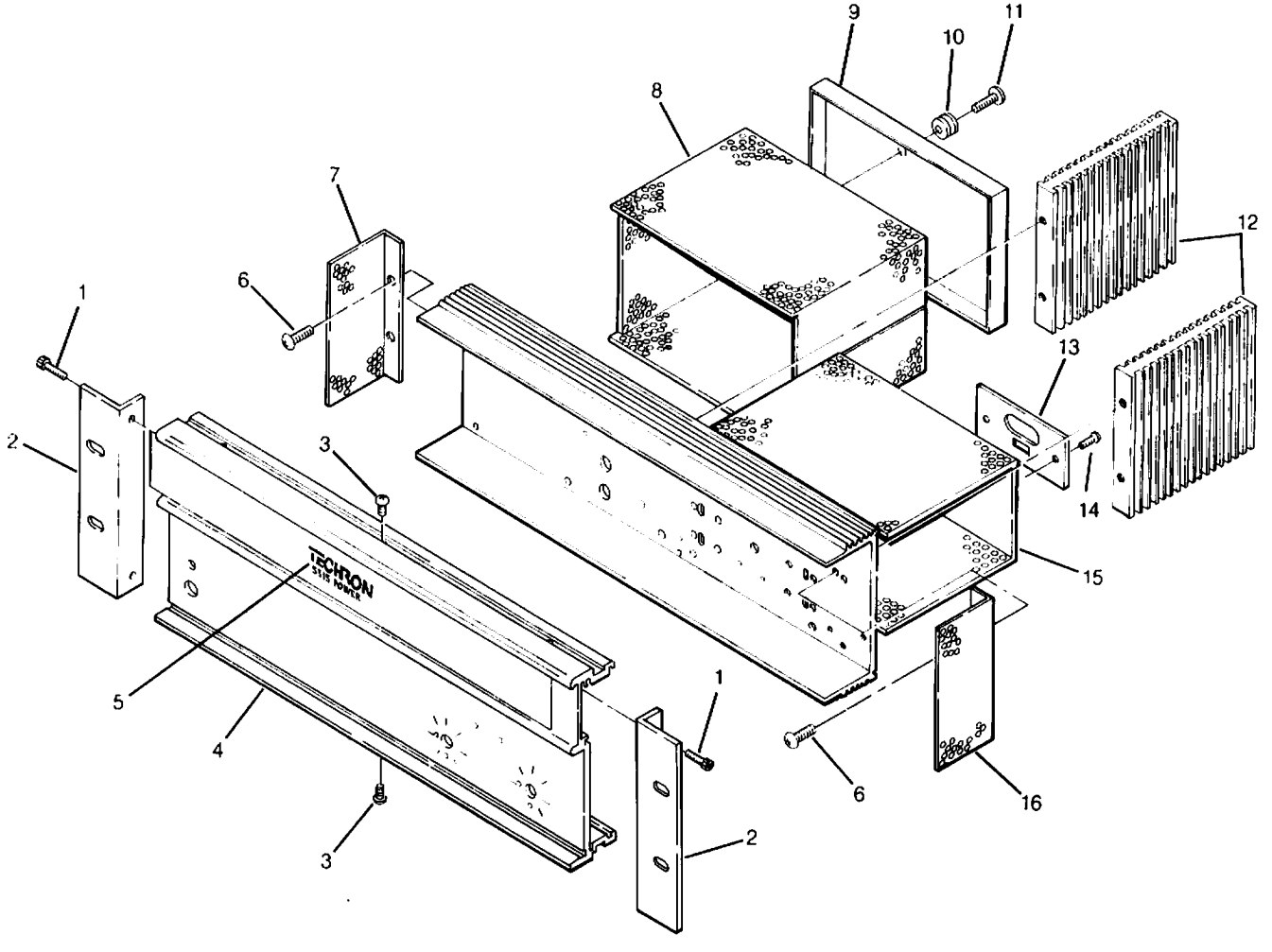

Illustration 7-3
Chassis Exploded View

INTERNAL PARTS LIST (refer to Illustration 7-4)

Item #	Description	Part #	Reference
1	Flag Housing	C 3297-6	
2	Flag Terminal	C 3901-3	
3	6-32 Hex Nut	C 1889-2	
4	#6 Internal Star Washer	C 5594-4	
5	SPST Power Switch	D 5699A8	S501
6	6-32 x .37 Hex Screw	C 3322-2	
7	.5 x .195 Fiber Washer	C 3575-5	
8	Power LED Board	P10068B4	
9	Amber Power LED	C 4342-9	
10	6-32 x .25" Screw	C 4758-6	
11	PB Switch Collar	D 4108-3	
12	Pushbutton	D 5954J8	
13	Plunger	D 4808A6	
14	Switch Bracket	F10042A2	
15	6-32 x .37 Self Tap Screw	C 4320-6	
16	6-32 x 1" Screw	C 2138-3	
17	Red LED	C 5905-2	E301, E401
18	IOC LED Board	P 9988-0	
19	Level Control Knob	D 5953J0	
20	.375 Hex Nut	C 1288-7	
21	Cable Strain Relief	D 2828-8	
22	Level Control	D 5696-6	R400 (shown); R300
23	5 1/4" Rack Mount	D 5952J2	
24	6-32 x .75 Socket Cap Screw	C 1858-7	
25	10-24 x .75 Self Tap Screw	C 4017-7	
26	Terminal Strip G2	D 5366-6	
27	Terminal Strip 2G1	D 3323-9	
28	Power Transformer	D 4380-8	T500
29	Rubber Gromet	C 1566-7	
30	#10 Flat Washer	C 2101-1	
31	#10 Internal Star Washer	C 2279-5	
32	10-32 Hex Nut	C 2170-6	
33	1.2K ohm 2W	C 3649-8	R500, R502
34	10-32 x .5" Screw	C 2049-2	
35	Solder Lug .218	D 2934-4	
36	.312 Fiber Shoulder Washer	C 3320-6	
37	.3 x .525 x .125 Nylon Washer	C 1657-3	
38	9300uf Filter Capacitor	C 5888-0	C501
39	9300uf Filter Capacitor	C 5888-0	C502
40	.1uf	C 2938-6	C500

INTERNAL PARTS LIST (cont'd)

Item #	Description	Part #	Reference
41	Bridge Rectifier	C 4305-6	D500
42	Strain Relief	C 2803-2	
43	AC Line Cord	D 6505-8	
44	Fuse Holder	C 5597A5	
45	6.25A MDX Fuse	C 4307-2	F500, 100-120V AC
	3A Fuse	C 4384-1	F500, 200-240V AC
46	.1 ohm Parallel 2.7 ohm	C 4761-0	R303
47	6-32 x .62 Screw	C 3879-1	
48	#6 Solder Lug	C 3163-0	
49	MJ15003 NPN	C 7064-6	Q303
50	MJ15003 NPN	C 7064-6	Q301
51	Anodized TO3 Insulator	D 4039-1	
52	Plastic TO3 Insulator	D 4071-3	
53	TO220 Torque Spreader	C 654104	
54	TO220 MJE15028	C 5890-6	Q300
55	TO220 Mica Insulator	C 6067-0	
56	1.1" Jumper Lug	D 5587-7	
57	TO220 MJE15028	C 5890-6	Q302
58	TO66 Plastic Insulator	D 4113-3	
59	.1 ohm Parallel 2.7 ohm	C 4761-0	R301
60	.1uf	C 2938-6	C402
61	8-32 Hex Nut	C 1986-6	
62	.87 x .18 Fiber Washer	D 3609-1	
63	3uh Coil	M43121-9	L300
64	3uh Coil	M43121-9	L400
65	#8 Internal Star Washer	C 1951-0	
66	8-32 x 1.75" Stud	C 3324-8	
67	#8 Solder Lug	D 2935-1	
68	4.1" Hex Standoff	D 3961-6	
69	Solder Lug .375	D 2828-8	
70	Fiber Sholder Washer .375	C 1306-7	
71	Control Assembly	M20105-9	Incl. 71, 76-79
72	.62 x .375 Fiber Washer	C 1646-6	
73	8-32 x .25 Screw	C 2136-7	
74	.62 x .375 Bright Washer	C 2189-6	
75	BNC Connector	S 3249-0	

INTERNAL PARTS LIST (cont'd)

Item #	Description	Part #	Reference
76	Steel Eyelet	C 3529-2	
77	Foam Tape	S 2859-7	Specify length
78	DPDT Slide Switch	C 4110-0	S502
79	Solder Lug .130	C 6818-6	
80	1 ohm .25W	C 6392-2	R501
81	6-32 x .37 Screw	C 4329-6	
82	Board Mount Bracket	F 9562-4	
83	Main Board	Q42531-6	
84	4.7uf @ 100V	C 5050-7	C300
85	4.7uf @ 100V	C 5050-7	C400
86	160^0 Thermal Switch	C 2799-2	S500
87	TO220 Power Transistor	C 5890-6	Q402 MJE15028
88	TO220 Power Transistor	C 5890-6	Q400 MJE15028
89	.1 ohm 5W Parallel 2.7 ohm	C 4761-0	R403
90	MJ15003 NPN	C 7064-6	Q401
91	MJ15003 NPN	C 7064-6	Q403
92	.1 ohm 5W Parallel 2.7 ohm	C 4761-0	R401
93	2.7 ohm 1W	C 1001-4	R302
94	.1uf	C 2938-6	C301
95	.1uf	C 2938-6	C401
96	2.7 ohm 1W	C 1001-4	R402
97	Dual Binding Post	C 2823-0	