TECHRON®

TECHNICAL MANUAL

Includes Service Information

7521
POWER SUPPLY
AMPLIFIER

Techron Division of Crown International, Inc., 1718 W. Mishawaka Road, Elkhart, IN 46517-4095

K80283-3
7/89

AE TECHRON INC.®

Limited One-Year Warranty

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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 ***AE TECHRON INC.*** 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 INC.***, 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.)

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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. We will take corrective actions within a reasonable time of the date of receipt of the defective product. 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.

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There is no warranty that 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 INC. Customer Service Department
2507 Warren St. Elkhart, IN, 46516, U.S.A.
(574) 295-9495

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SECTION 1: GENERAL INFORMATION

1.1. Introduction

The TECHRON 7521 is a single channel power supply amplifier designed for use in the most demanding high power systems. To become familiar with its many features study this manual thoroughly.

Model 7521 provides precision amplification of frequencies from DC to 25 KHz, with extremely low harmonic and intermodulation distortion and low noise. Output capability is 250* watts minimum rms into an 4 ohm load.
To enhance the amplifier's overall reliability, each of the 4 rugged 150 watt output transistors is individually tested by TECHRON to verify the safe operating area of each device.

1.2. General Operation

The push button power switch activates an amber ON lamp.

Massive black-anodized heat sinks thermally joined with the chassis enable the entire amplifier to function as a heat sink. Forced air cooling is provided by two fans.

The output transistors operate in the TECHRON-designed AB + B configuration in which 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.

Front panel monitor jacks provide monitoring capability of output voltage and current.

In the event of overheating, the thermal sensing circuit will place the amplifier in the STANDBY mode. After cooling, the unit will return to normal operation.

The rear panel provides a means for isolating or uniting chassis ground from or with electrical ground. The grounds are always connected internally with a resistance of 2.7 ohms.

Standard 19" mounting is incorporated.

1.3. Service Policies

Due to the sophisticated circuitry of Model 7521, 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 7521, 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 7521 comes complete with user's manual, four mounting screws and four nylon washers.

* *PRELIMINARY DATA*

SECTION 2: SPECIFICATIONS AND PERFORMANCE

2.1 General Specifications

Amplifier Output Protection: Short, mismatch, and open circuit proof. Limiting is instantaneous with no flyback pulses, thumps, cutouts, or other spurious signals. No premature limiting transients.

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

Low Frequency Interrupt: Interrupts output drive (standby mode) with automatic sampling every four seconds. Activates at DC outputs greater than 10V or low frequency outputs greater than 10V at 2 Hz.

Turn-On: Four-second delay with a minimum of spurious signals and no dangerous transients.

Power Supply: Heavy duty transformer with massive computer-grade filter capacitors storing over 20 joules of energy. Two regulated supplies for complete isolation and stability.

Power Requirements: Requires 50-60 Hz AC with selectable taps for 100, 120, 200, 220, and 240V ± 10% operation.

Heat Sink: Massive black-anodized heat sinks are thermally joined with the chassis, utilizing the entire amplifier as a heat sink.

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

Controls: Push-button on/off power switch. Independent Input Level control.

Displays:

- POWER: Green LED
- STANDBY: Amber LED

Connectors:

- AC line: three-wire (grounded) male connector.
- Input: BNC connectors; 3-terminal barrier block.
- Output: 3-terminal barrier block.
- Output Monitors: BNC connectors.
- Ground Selectivity: 2-lug terminal block with removable shorting strap.

Dimensions: 19" wide (standard rack mount) x 5.25" high x 10.125" deep from front panel mounting surface. (48.3cm x 13.3cm x 25.7cm)

Weight: Approximately 28 pounds net weight.

Finish: Polyester vinyl coated aluminum front panel, zinc die cast handles.

2.2 Electrical Specifications

Voltage Gain: 20.6 ± 2% or 26.3 ± 0.3 dB at maximum gain.

Input Sensitivity: *

Output Signal: Unbalanced.

Hum and Noise (20 Hz - 20 KHz): *

Input Impedance: 20 Kohm, ± 1%.

Phase Response: *

Output Power: *

Frequency Response: *

1 KHz Power: *

Harmonic Distortion: *

Slewing Rate: *

Output Impedance: *

** NOT AVAILABLE AT TIME OF MANUAL PRINTING*

SECTION 3: INSTALLATION AND OPERATION

3.1 Unpacking

Every TECHRON Model 7521 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 7521 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 7521 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.

> **Caution**
> **Do not operate Model 7521 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 7521 is capable of causing serious damage to improper loads or through improper connections. See **Section 3.9** for information on Load Protection.
2. **Never directly parallel the output of 7521 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. **Do not short the ground lead of an output cable to the input signal ground.** Oscillations may result.
4. **Operate Model 7521 from proper AC current.** Supply voltage must be 50 to 60 Hz 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 result in unreliable operation.
5. **Never connect the output to a power supply output, battery, or power main.** These connections will cause serious damage to the amplifier.
6. **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.
7. **Follow instructions for proper amplifier operation.**

> WARNING
> **Never operate Model 7521 with cover panels removed. See Section 6 for proper service procedures, including service operations with covers removed.**

3.4 Connecting Input Lines

Model 7521 incorporates BNC type connectors and a barrier strip for input. Observe the following when connecting lines:

1. Use one or the other, but not both, types of connectors.

2. To avoid "ground loops" or undesirable circulating currents in the grounding system, tie input cables together along their length, keeping them **away** from power supply lines and from output cables.
3. To protect against feedback oscillation from load current flowing in a loop, provide proper grounding and isolation of input of common AC line devices.

3.5 Connecting Output Lines

Model 7521 output connector is 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 control fully counter-clockwise.

> **Important**
> **TECHRON is not liable for damage to any load due to overpowering.**

3. Use output wire gauge and length appropriate for load and signal.
4. To prevent spurious oscillations and undesired feedback, carefully lace output cables together. For the same reasons, never route output cables with input cables.
5. Do not join amplifier input and output grounds externally to the unit.
6. 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.

3.6 Connecting Power

Use third wire ground with caution, as this may introduce a ground loop in a system. If a ground loop is present, remove ground shorting strap. See **Illustration 3-1.**

> **Caution**
> **Power supply must be at 50-60 Hz AC.**

Model 7521 may be operated at various line voltages. The serial plate indicates factory voltage wiring. To convert from one voltage to another, see **Section 7.6.**

> **Caution**
> **Only a competent technician should attempt to convert from one voltage to another. Follow instructions given in Section 7 thoroughly.**

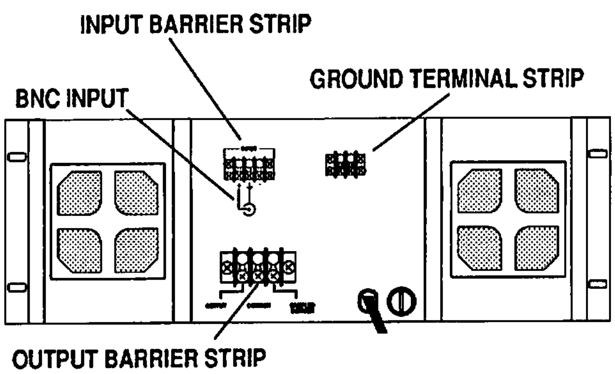

Illustration 3-1
Output Connectors

3.7 Controls and Adjustments

Model 7521 front panel controls include a CV, CC switch, an AC power switch, an input level control, voltage and current monitor. LEDs inform the operator of the operating status of the amplifier. See **Illustration 3-2**.

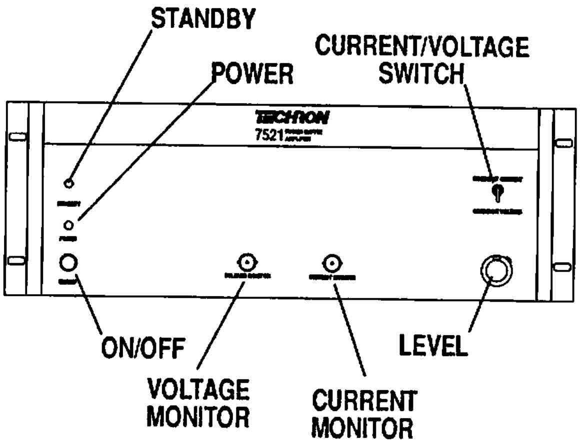

Illustration 3-2
Front Panel Controls

3.7.1 Front Panel Controls

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

Level Control:
Controls input level.

STANDBY:
STANDBY mode, as during 4-second turn-on delay or overheating shown by amber LED.

Voltage Monitor:
Test point to monitor amplifier output voltage.

Current Monitor:
Test point to monitor amplifier output current.

Constant Voltage/Constant Current Switch:
Switch changes amplifier from constant voltage mode to constant current mode.

3.7.2 Rear Panel Connections And Controls

Input Connector:
BNC connector provides easy connection and disconnection of input signals.

Input Barrier Strip:
An input barrier strip is provided as an alternative to the standard BNC input connectors. Use input barrier strip in long-term installations.

Caution
Use the BNC or barrier strip, but do not use both BNC connector and input barrier strip.

Ground Terminal Strip:
To isolate chassis ground from signal ground, remove shorting strap from ground terminal strip. Grounds are always connected internally with the resistance of 2.7 ohms.

Output Barrier Strip:
When connecting wires to this strip, tin and solder to spade lug.

Fuse:
Replace fuse whenever AC voltage conversion is made (see **Section 7.6**), or when it has blown due to excessive voltage applied to the unit.

AC Line Cord:
Model 7521 is furnished with a three-wire, heavy-duty plug as standard equipment. Follow instructions in **Section 3.6** for connecting power.

3.8 Protection Mechanisms

3.8.1 Circuitry Protection

Model 7521 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.

Note: A relatively simple internal wiring procedure is available for activating the low frequency interrupt circuit. Contact TECHRON Technical Service Department for information on this modification.

3.8.2 Fuse

The Fuse protects power supplies against overload.

> **WARNING**
> **Always turn power "Off" when changing a fuse.**

3.8.3 Thermal Protection

Each power section is independently protected against excessive internal operating temperatures. This circuitry will place the unit in the STANDBY mode in case of overheating. When sufficient cooling has taken place, operation resumes automatically.

3.9 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 little fuse 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.

SECTION 4: APPLICATIONS

4.1 Amplifier Capability

Model 7521 is a very 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.

When protection circuitry operates, placing the unit on standby, 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.

Section 5.2 describes several special operating modes for increased output capability. 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.

SECTION 5: THEORY OF OPERATION

Model 7521 is composed of four separate areas. Each area will be discussed in detail. The four areas are:

- Current Control
- Power Section
- Control and Logic
- Power Supply

5.1 Current Control Module

Refer to Schematic J0230-3 in **Section 8** for the discussion of the Current Control Module.

5.1.1 Differential Input Stage

U1C forms an active differential input stage whose gain is set by resistors R1, R2, R3, R4, and R5. The common mode rejection ratio of the input stage is controlled at low frequencies by R4. The high frequency common mode rejection ratio is controlled by C19. C19 is adjusted to set its capacitance plus the capacitance of C2 to equal the value of C1. U1C is offset zeroed by R7 via R6.

R15 provides the operator with a gain control.

5.1.2 Current Control

The controlled current mode works by U1D comparing the current output of the amplifier with the desired current waveform at the output of U1C. The combined output current of the power section is sensed by R42 and amplified by U1B for use in the current control loop.

U1B forms a differential amplifier with an adjustable gain control, R21. The output of U1B is calibrated for .1 volt per ampere of output current. The dc offset of U1B is eliminated by the adjustments of R26 via R24.

The current control amplifier, U1D, is offset zeroed by R8 via R9. R10 and C3 provide the proper source impedance to U1D for minimum offset drift.

5.1.3 Current Monitor

The current monitor output is made available at the front panel BNC jack. U1A is a unity gain invertor to provide a differential output. The current monitor outputs are isolated from capacitive loads by R27 and R30 The monitor output amplifier, U1A, is offset zeroed by R31 via R32. R33 and C10 provide the proper source impedance to U1A for minimum offset drift.

C5, C6 and R16 comprise the principle compensation network which serves to control the open loop gain of the closed loop controlled current system. In the controlled voltage mode of operation these compensation parts are not used. U1D becomes a unity gain stage when S1 switches in R14 to operate the 7521 in the constant voltage mode.

Q1 and Q2 allow U1D to recover quickly from any overloads that might occur.

The DC supplies are regulated by Q3 and Q4. Supply voltage is set by D1 and D2 to +15 volts DC.

The signal is now routed to the main board for power amplification.

5.2 Power Section

Two identical power sections, operating in tandem, provide voltage and current amplification for 7521. Discussion here is centered on the power section that is numbered starting with 100. Refer to Schematic in **Section 8** for the discussion of the power section.

5.2.1 Input

RF signals are kept from the front end circuitry by an 800 kHz low-pass filter consisting of R103 and C101. From there the signal travels to the non-inverting input of U1A, a wide bandwidth low noise op amp.

Connected to the inverting input of U1A, pin 6, are the components of the main feedback loop, R106, R109, and C103. These set the gain and determine the frequency response of the amplifier while providing a path for the error correction signal explained next.

5.2.1.1 Error Signal

The main purpose of op amp U1 is to compare the input signal (pin 5) to a portion of the output stage signal fed back through a feedback path appearing on pin 6. The result is an "error signal" from the output of U1, pin 7. This "error signal" deviates from the input signal in a way that forces the output signal to always be exactly twenty times the input signal. C102 is part of the frequency compensation circuitry used to help in stabilization of the circuit.

5.2.1.2 DC Offset Controls

To control any variable DC offset that may occur as a result of the input stage, R108 is used for obtaining a minimum DC offset at the output of the amplifier. This is achieved by applying a small current signal to pin 6 of IC U1 and adjusting R108 for 0 VDC (+/- 10mv) at the output of the amplifier.

5.2.2 Voltage Amplification Stage

R110, 111, 112, and 113 form a voltage divider string, providing a bias voltage ultimately for the Signal Translator transistors Q101 and Q102. Between these two sections, however, are transmission gates U2A and U2B. These transmission gates electronically control the signal path. When not activated, the bias voltage generated in the voltage divider string cannot reach the Signal Translator stage. This means all the stages that follow Q101 and Q102 will be dormant, including the path to the output of the amplifier. This electronic switching is the basis for the turn-on delay, the thermal protection, and the optional low frequency protection, described later in this section.

An intermediate feedback loop, encompassing everything from the Signal Translator stage to the output stage, consists of R115, R121, and C106. R118 and R119 are emitter resistors, which stabilize the operating point of the Signal Translator transistors.

The Signal Translator stage, as well as the Last Voltage Amplifier stage, is of the push-pull type, providing a convenient method of utilizing the transmission gates. With this design, turn-on and turn-off occur without strange noises or pops. The push-pull circuit design also helps to cancel distortion, and is capable of developing twice the current of other circuit designs to drive the output stage. The complementary signal translator circuitry, Q101 and Q102, develops the "voltage based" input signal into a "current based" signal at its collectors, free from the effects of power supply ripple. At R117 and R120, it is converted back to a voltage signal which drives the Last Voltage Amplifier stage.

Q104 and Q106, the Last Voltage Amplifiers, are the main source of voltage amplification in the unit. As already described, the input signals developed across R117 and R120 are the signals fed to the base of Q104 and Q106. Q103 and Q105 are current limiting transistors that protect Q104 and Q106 from unsafe power dissipation levels. As the base-emitter voltage developed across R122 and R126 increases beyond 0.65V, Q103 and Q105 turn on, shunting or "pulling" the drive signal away from the last voltage amplifier transistors.

5.2.3 Output Stage

5.2.3.1 General Output Description

The output signal from the Last Voltage Amplifier transistors provides the drive to the predrivers (Q130, Q132), drivers (Q133, Q134), and output transistors (Q135 and Q136.) This output configuration is referred to as the CROWN Multi-Mode circuit. At low output signal levels, the circuit functions in the Class A mode (predriver and driver stages, biased on), mid levels in the Class A+B mode (predrivers and drivers operate in Class A while output stage moves smoothly into Class B operation), and at high levels, in Class B (predrivers and drivers operate in Class AB while output stage operates in Class B).

At each level, the Multi-Mode circuit offers optimum performance in terms of extremely low distortion and circuit efficiency.

5.2.3.2 Bias Servo Circuit

Q129 is the heart of a thermally sensitive bias circuit, working to maintain a constant quiescent current through the driver stage, even when operating temperatures fluctuate. This bias-servo circuit also includes component parts R123, R124, R125, and R187. It controls the voltage supplied to the base of the predrivers as the unit's temperature varies. By doing so, it avoids thermal runaway.

5.2.3.3 Predrivers

The predrivers, Q130 and Q132, provide the correct "charge" current to the base of the driver transistors when called upon by the front end stage. R190 and Q131 discharge or turn off the driver stage according to the signal polarity requirements. Part of the charge flows out through R190, while the rest flows across "charge-dumping" transistor Q131. This provides a smooth on/off action of the output stage without current spiking.

5.2.3.4 Slew Rate Limiting

Capacitors C133 and C134, connected across the predrivers, determine the slew rate limiting point for the maximum frequency that the output stage can tolerate.

All output transistors are NPN devices. Emitter resistors R194 and R195 stabilize the operating point in the output stage.

5.2.3.5 RF Protection at Output

R196, R199, T102 and C137 form a terminator circuit providing a load for the output stage at high frequencies. This also helps eliminate RF signals at the output stage.

5.2.3.6 Protection

The V-I Protection circuitry is composed of Q107 & Q108, with R131, R135, R128, and R129. In the positive portion of the push- pull circuit, R131 and R128 form a voltage divider developing a voltage across the base of transistor Q107. Before the output current becomes dangerously high, Q107 is activated, shunting the current away from the predriver transistors. The negative portion of the push-pull circuit operates in the same way. C111 and C112 allow larger peak power signals to be handled by the output stages for short periods of time. If C111 and C112 are charged in a more positive direction, less current will be required to activate Q107 and Q108. But if C111 and C112 are charged in a less positive direction, more current will be required to activate the protection circuit. Thus, the history of the output is taken into account before limiting takes place. D101 and D102 prevent improper flow through this circuit. C109, C110 and R127 help stabilize the protection circuit, particularly at low load impedances (below 2 ohms) where oscillations could occur.

5.3 Control Stage

This stage is responsible for three areas of operation: thermal protection, low frequency protection, and turn-on delay. A majority of the operation of this stage depends on the function of the logic circuitry.

5.3.1 Logic

The transmission gates in U2 are responsible for smoothly interrupting the signal path to the output stages and silencing the amplifier's output. The output from U5C, a triple AND gate, is connected to pins 12 and 6 of U2. In order for this AND gate to produce a logic "high" output, U5C must receive a logic "high" at all three of its inputs. This is the desirable state for U5C during normal operation, so all three sections of the control stage must be functioning properly, and thus sending a "high" signal to the appropriate input.

5.3.1.1 Thermal Protection

Q111 provides electronic thermal protection in Model 7521. Q111 is mounted on the output stage heat sinks and converts the temperature of the heat sink to a calibrated voltage. U4C, a comparator op amp, compares the signal established by the divider network R3, R4, and R5 (all fed to pin 4), to the signal from Q111 (fed to pin 5). When the signal voltage from Q111 is lower than the threshold voltage established with the wiper of R4, the output of U4C (pin 2) will be logic "low." The reverse is true when Q111 sends a higher signal voltage than that of the threshold point, forcing the output of U4C "high" (normal operation). Finally, to prevent erratic switching, U4D is connected to U4C, providing a "hysteresis" in the comparator circuit.

5.3.1.2 Low Frequency Protection

Note: Model 7521 is shipped with Low Frequency Protect feature disabled. To enable, remove jumpers across capacitors C115 & C215.

The Low Frequency Protection circuitry consists of U6B (an exclusive OR gate) and its closely related components. If both of the inputs of U6B (pins 5 and 6) are logic "high" or both are "low," then the output (pin 4) will be logic "low." If one input is high and the other low, the output will be high. Under normal operation, the output is high. This meets the requirements of U5C, described in **Section 2**. For example, if no DC or low frequency information is detected at the input of U6B, the voltage potential on pin 5 will be more positive than that of the voltage on pin 6. This is due to the voltage divider networks R145, R147, and R146, R148 connected to the +Vcc supplies. With the difference of potential now across the input of U6B, the output will be logic high and the conditions for normal operation (from the standpoint of low frequency protection) will have been met. However, should a DC voltage exist at the input, both pin 5 and pin 6 will appear as logic high, forcing the output at pin 4 to become logic low. With one of the inputs of U5C now low, the output will also be low, shutting down the transmission gates and removing the signal to the output stage. The operating point of the Low Frequency Protection is set by R114 and C115. The circuit will activate when the output frequency is less than 2 Hz and the output voltage is greater than 10 volts.

5.3.1.3 Delay

Turn-on delay is accomplished with U5A. C5 and R17 form a timing circuit, responsible for the four-second delay upon power-up. When the unit is turned on, K1 is energized, removing the short from C5. This in turn allows C5 to slowly become charged from R17. When fully charged, a logic high signal will appear at pin 11 of U5A. Since pins 12 and 13 are tied together to the +9V supply (logic high), the output of U5A, pin 10 will appear high, satisfying the input conditions for U5C. When the output of U6B is low, signifying a low frequency input problem, it pulls the charge away from C5 through D109. This causes the output of U5A to go low, thus causing the transmission gates to remove signal to the output stage. Because the output stage is no longer active, the Low Frequency Protect circuit, when activated, will not sense a problem, and the four-second, turn-on delay cycle will automatically repeat. This process will continue as long as low frequency is present at the output of the amplifier.

R15, R16, C12, and C13 are decoupling components for the +9V supply, providing additional filtering.

SECTION 6: MAINTENANCE AND REPAIR

6.1 Introduction

This section contains technical information which will guide the technician through effective service of Model 7521. It includes disassembly and reassembly procedures, lists of required test equipment, check out procedures and helpful repair notes. Along with this section, consult schematic/board layout diagrams, parts lists, and exploded view drawings located in **Section 8**.

Note: Model 7521 includes many stock electrical and electronic parts which are available from electronic supply houses. However, some electronic parts that appear to be standard are actually special. Order parts from TECHRON to assure acceptable replacement and reliable operation. Structural items, covers, and panels are available from TECHRON only.

6.2 Required Test Equipment

Most service and repair procedures for Model 7521 require only limited test equipment. However, in order to return the unit to its original factory specifications, use the equipment listed in **Table 6-1** . 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.

	Equipment	Recommendation
1.	Oscilloscope Dual Channel Vert. Sensitivity - 2mV/div Vert. Frequency DC - 15 MHz	Tektronix 2215A Hewlett-Packard 1740A 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 - 100mμV FS +/- 1% Accuracy 20-20kHz	Hewlett-Packard 400F Amber 3501 Sound Technology 170B/1710A
4.	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
5.	Intermodulation Distortion Analyzer IM capable of .003% 60Hz/7kHz THD capable of .01% 20Hz-20kHz	Amber 3501 Technology 17701A, 1700 series Hewlett-Packard 339A
6.	Variac or Autotransformer 0-140 volts 20 Amp capacity 0-26- volts 10 Amp capacity	Various Gen Rad. Models, Superior Electric Models or equivalent
7.	Peak Equivalent Line Voltage	See schematic for construction details.
8.	Bandpass Filter 20-20kHz 18dB/Octave rolloff	Sound Technology 170 or equivalent.
9.	Resistive Loads 1 ohm-1kW 4 ohms-2kW 2 ohms-500 W	Construct from Dale NH-250 series, 1% resistors.
10.	Non metallic screwdriver to make adjustments	GC 8276 or 8277

Table 6-1
Required Test Equipment

6.3 Disassembly and Discharge

> **WARNING**
> **Model 7521 contains possibly harmful or fatal electrical charges even when power supply is disconnected. Discharge capacitors whenever covers are removed. Follow discharge instructions exactly.**

6.3.1 Visual Inspection

Visually inspect Model 7521 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 fuse.
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 top and bottom covers as outlined 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, charring, or looseness of internal components may indicate damage from severe shock, from being dropped, or from previous improper repair procedures.

6.3.2 Top Cover Removal and Installation

1. Turn unit off and disconnect AC supply line.
2. Remove five machine (10) and seven sheet metal screws (8) and washers (9 & 11) from top cover. Be sure to keep these screws separate according to type.
3. Gently lift and remove top cover.

> **WARNING**
> **Failure to follow discharge procedure may cause serious injury to service personnel and severe damage to electrical components.**

4. Discharge capacitors as follows:

Place a 50 ohm/10 watt resister across the positive and negative terminals of each capacitor for at least five seconds. Do not touch capacitors or resistor leads during discharge procedure.

Top Cover Installation

5. Carefully align top cover for installation of mounting screws.
6. Install five machine (10) and seven sheet metal screws (8) and washers (9 & 11). Be sure not to exchange sheet metal and machine screws.
7. Tighten screws securely, but do not overtighten.

6.3.3 Bottom Cover Removal and Installation

1. Turn power off and disconnect AC supply lines.
2. Turn unit bottom side up.
3. Remove the five machine (61) and seven sheet metal screws (63) and washers (60 & 62) from bottom cover.
4. Gently lift and remove cover.

5. Discharge capacitors as follows:

Place a 50 ohm/10 watt resistor across the positive and negative terminals of each resistor for at least five seconds. Do not touch capacitors or resistor terminals during discharge.

> **WARNING**
> **Failure to follow discharge procedure may cause serious injury to personnel.**

Bottom Cover Installation

6. Carefully align bottom cover.
7. Install five machine (61) and seven sheet metal screws (63) and washers (60 & 62).
8. Tighten screws securely, but do not overtighten.

6.4 Servicing Internal Components

6.4.1 Main Board Module Removal

1. Remove top and bottom covers as described in **Sections 6.3.2** and **6.3.3**.
2. Remove the six phillips head screws (14) and internal star washers (13) which secure rear panel (19).
3. Slide rear panel to either side as far as it will go, permitting the opposite end of the panel to clear its mounting slot.
4. Allow the rear panel to drop down as far as the connecting wires will allow.
5. Gently lift the four release tabs of the main board support brackets (31) located in each corner of the main board.
6. Pull board away from the mounting pegs, applying equal pressure to the edges.
7. For more complete removal of main board, note locations of soldered wires and disconnect.

6.4.2 Front Panel Removal and Installation

(provides access to display board, bridge rectifier block, and output monitor jacks.)

1. Remove sheet metal screws and loosen the machine screws at the edge of the top and bottom covers as described in **Sections 6.3.2** and **6.3.3**.
2. Remove the four phillips head mounting screws (54) and internal star washers (55) (2 on each side) which mount front panel to side panels.
3. Taking care not to damage internal wiring still connected to front panel, gently pull front panel straight back, away from the unit.
4. Display board (34), bridge rectifier block (12), output monitor jacks (2), and input level control (4) are now exposed.
5. To remove display board, squeeze small release levers of each mounting peg, and pull display board straight out, away from mounting pegs.
6. For complete removal of display board, unsolder three multi-colored wires, noting locations for reconnection. Refer to component board and schematics in **Section 8** for reconnection locations.

Installation of Front Panel-Mounted Components and Front Panel

7. To install display board, carefully align on mounting pegs and press gently until pegs latch.

Note: If wires have been unsoldered from display board, consult previously noted wire locations, component board, or hard wiring schematics for exact locations.

8. Using care to protect attached wires, place front panel in position on unit.
9. Install two phillips head mounting screws and internal star washers on each side of the front panel. Tighten securely, but do not overtighten.
10. Install sheet metal screws and tighten machine screws on the top and bottom covers as described in **Sections 6.3.2** and **6.3.3**.

6.4.3 Control Module Removal

1. Remove top cover as described in **Section 6.3.2**.
2. Locate the control module (38) at the front left of the unit.
3. For adequate access to control module, remove 4 phillips head screws and washers from left side panel (49).
4. Squeeze release levers of mounting pegs and pull board upward away from mounting plate.
5. For complete removal of control module, disconnect the multi-colored wires soldered to it, noting their location for reconnection.

Control Module Installation

6. If wires have been disconnected from control module, refer to previously noted locations, or component board layout, or check accuracy of schematic in **Section 8**. Following these notes, solder wires to correct locations on control module board.
7. Carefully align control module board on mounting pegs and gently press into place.
8. Install left side panel using 4 phillips head screws and their respective internal star washers.
9. Install top cover as described in **Section 6.3.2**.

6.4.4 Output Module Removal

(includes output transistors removal)

1. Remove top and bottom covers as described in **Sections 6.3.2** and **6.3.3**.
2. For easy access to output boards, detach heat sink assembly by removing three phillips head mounting screws on the rear panel (19) and the three mounting screws on the side panel (49).
3. Remove output transistor cover panels (12) by sliding them up and out of their slots.
4. To remove an individual output transistor:
   - Unsolder the two leads of the transistor,
   - Remove its two phillips head mounting screws (1) and star washers (2).
5. To remove an entire output board:
   - Remove two output transistors as described in step 4.
   - Disconnect all wires connected to this board, noting their location for future reconnection.

Output Module Installation

(includes output transistor installation)

6. To install a complete output board:
   - Refer to noted wiring locations or schematics in **Section 8** for wiring locations.
   - Attach wires to proper locations on output board.
   - To mount board on heat sink, install output transistors as described in step 7 below.

Note: Output transistor mounting screws hold output board in place.

7. To mount an output transistor:
   - Apply heat sink compound lightly and completely to transistor mounting surface as well as both sides of insulating wafer.
   - With insulating wafer between transistor and heat sink surface, attach transistor to heat sink using two phillips head mounting screws and star washers.

> **Caution**
> **To avoid damage to foil traces on output board, do not overtighten transistor mounting screws.**

   - Solder output transistor leads in place.

6.4.5 Thermal Sensor Transistor Removal

1. Observe bending of thermal sensor transistor leads for ease in installing replacement.
2. Pull thermal sensor transistor out of recess.
3. Unsolder leads and remove.

Thermal Sensor Transistor Installation

4. Bend leads to fit recess, observing previously installed thermal sensor transistor for pattern.
5. Apply heat sink compound to transistor body.
6. Insert into recess.
7. Solder leads.

6.4.6 Bias Servo Transistor Removal

Bias Servo is located near Thermal Sensor Transistor. Removal and installation are similar. See **Section 6.4.5** for Bias Servo Transistor Removal and Installation.

6.4.7 Power Supply Capacitor Removal

1. Remove top and bottom covers as described in **Sections 6.3.2** and **6.3.3**.

> **WARNING**
> **Power supply capacitors carry hazardous electrical charges. Follow discharge instructions exactly when working near capacitors.**

2. Discharge capacitors as follows:
   Place 50 ohm/10 watt resistor across positive and negative terminals of each capacitor for at least 5 seconds. Do not touch capacitor terminals or resistor leads during discharge procedure.
3. Remove front panel as described in **Section 6.4.2**, steps 1 and 4.
4. Remove phillips head screw (10) supporting bridge rectifier block.

Note: This relieves the nut (16) and solder lug (17) that are attached to the back side of this panel and in turn to the capacitor board.

5. Remove right side panel by removing two #10 machine screws, three #10 sheet metal screws, two #8 machine screws and star washers. Be sure to keep screws sorted for later installation.
6. Using diagonal cutters, snip each of the four heavy duty tie wraps (14) supporting the capacitors.
7. For access to capacitor screw terminals, slide assembly sideways.
8. For complete removal of capacitor assembly, disconnect wires soldered to board, noting their location for reconnection.

Power Supply Capacitor Installation

9. If wires have been unsoldered from board, refer to previous notes or schematic in **Section 8** for proper wire location. Solder wires in place.
10. Using four heavy duty tie wraps (these are standard heavy duty tie wraps and are generally available), secure capacitor assembly snugly in place. Trim any excess from tie wraps.
11. Install right side panel, using seven phillips head screws and star washers.
12. Install phillips head screw in bridge rectifier block. Place solder lug attached to resistor R1 over mounting screw, then attach nut and tighten.
13. Install front panel as described in **Section 6.4.2** steps 8, 9 and 10.
14. Install top and bottom covers as described in **Sections 6.3.2** and **6.3.3**.

6.4.8 Power Transformer Removal

Power transformer failure is highly unlikely in this unit and transformer replacement involves virtually complete disassembly of the amplifier. The most effective method of servicing this component is to return the amplifier to TECHRON Service Department. If transformer replacement must be made outside the TECHRON Service Department, follow all disassembly instructions in this section carefully, noting all wire locations and using care in sorting and labeling parts for reassembly.

6.4.9 Rear Panel Component Parts Replacement

1. Loosen two screws on both the top and bottom covers.
2. Remove rear panel as described in **Section 6.4.1**, steps 2, 3, and 4.
3. Rear panel components are now accessible and may be repaired or removed, using ordinary repair and removal procedures.

SECTION 7: TESTING AND ADJUSTMENT

7.1 Introduction

The following instructions outline an orderly checkout and adjustment procedure for the Model 7521. Perform this procedure after any repair, or as a troubleshooting routine when a problem proves difficult to diagnosis.

> **WARNING:**
> **Most adjustments are made with protective covers removed. This means prior to any non-AC-powered testing, discharge both power capacitors, C2 and C3 (See discharge instructions, Section 6.3) Use extreme caution while making any internal adjustments when the unit is powered.**

7.2 Four Second Delay Test

Load: None.

With the power switch in the "Off" (out) position, connect the required input line power and check accuracy with a digital voltmeter. Turn the unit on and then off again while listening for the "click" of the relay becoming activated. This process should take about four seconds each time the unit is turned on.

Note the amber STANDBY light; it should remain on during the four second delay period.

7.3 DC Output Offset

Input: None.

Turn amplifier on (no load).

7.3.1 On Current Control Module:

Set the offsets on the current control module (CCM) according to following steps:

1. Short the positive and negative input to ground.
2. Set gain control at maximum.
3. Zero the offset on pin 8 of U1 with R7.
4. Zero pin 14 with R8.
5. Zero pin 7 with R26.
6. Zero pin 1 with R31.

7.3.2 On Main Board:

Set the output offset of power section 1 and 2 on main board (R108 & R208) as follows:

1. Measure from ground to the circuit board side of heat sink resistor R22. Adjust R108 for 0VDC ± 10mVDC.
2. Measure from ground to the circuit board side of heat sink resistor R21. Adjust R208 for 0VDC ± 10mVDC.

These controls (R108 and R208) may interact, therefore, rechecking after adjustment is necessary.

7.4 Gain Adjuster

Load: None
Signal: 1 kHz sine wave

Set the gain trim pot R28 by either adjusting it for minimum quiescent power <u>or</u> minimum AC output measured between output wells at the circuit board side of R21 and R22.

Following Gain Adjust, recheck R108 and R208 readings as described in **7.3.2** above for power section 1 and 2.

7.5 Check Bias Voltage

Load: None

Measure the bias voltage across Output Board resistors R172 and R272. Voltage should read 430mV ± 20mV. If reading is out of range, re-adjust the bias controls R124 and R224 on Main Board.

7.6 Set Thermal Voltage

The proper thermal voltage setting depends upon the grade number of the specific thermal sensor installed in the unit under test. **Table 7-1** shows the relationship between sensor grades and thermal voltage.

1. Locate the thermal sensor grade number (Q 111; Q 211). The number is either printed on a white label attached to the output board or clearly inscribed on the sensor itself.
2. Measure voltage between ground and wiper of R4 (on Control Board). Adjust voltage to proper level as per **Table 7-1**.

Thermal Sensor Grade Number	VDC
596	0.485
597	.486
598	.487
599	.488
600	.489
601	.490
602	.492
603	.493

Table 7-1
Thermal Sensor Voltage Chart

7.7 Set Common Mode Rejection

Load: None
Signal: Begin with a 1 kHz square wave

1. Generate from ground to inverting and non-inverting inputs.
2. Adjust R4 for minimum output of amplifier.
3. Change signal to a 20 kHz square wave.
4. Adjust C19 for minimum output of amplifier.

7.8 Power Response (at 120VAC)

Load: Begin with 4 ohm
Signal: Begin with 1 kHz sine wave

Under various loads and different signals, you will apply input voltage and observe the resulting waveforms. The cross-references in **Table 7-2** summarize the different test components and expected results. With all signals except the 10 kHZ square wave, power input will be approximately 2V rms. For the final test with the 10 kHZ square wave, peak power input should be about 1.0V rms.

Load (Ohms)	Signal	Minimum VAC Before Clipping	Waveform Expected	Note
4	1 kHZ sine	35	Illus. 7-1	
2	1 kHZ sine	33	Illus. 7-1	
1	1 kHZ sine	limit waveform	Illus. 7-2	Observe signal momentarily; fuse may blow.
4	20 kHZ sine	35	Illus. 7-1	
4	10 kHZ square	___	Illus. 7-3	Waveform should appear as Illustration with no overshoot or ringing

Table 7-2
Power Response Testing

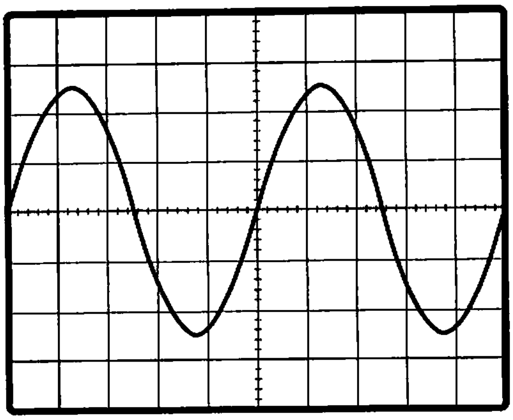

Illustration 7-1
Sine

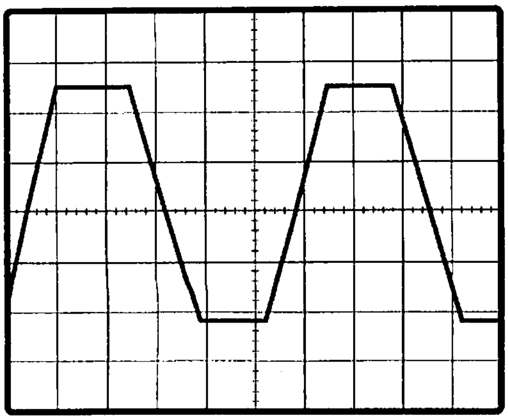

Illustration 7-2
Limit

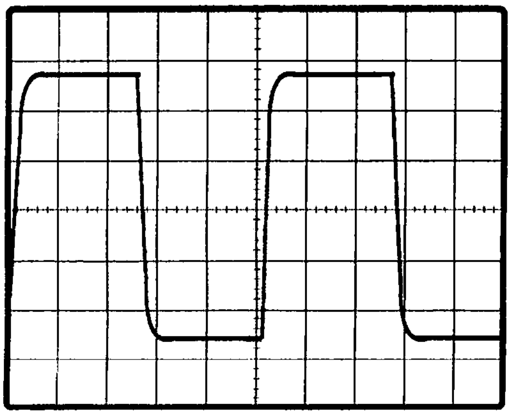

Illustration 7-3
Square

7.9 Protection - Thermal Test

Check both thermal shut-off output transistors Q111 and Q211 by shorting the emitter to the collector. The unit should go into standby. The Standby signal should go on and should remain lighted until short is removed.

7.10 Protection - Inductive Load

Load: 4 ohm in parallel with an inductive load of 80 uh.
Signal: 1 kHz sine wave.
At input of approximately 2V rms, you should obtain an inductive distortion-free waveform as shown in **Illustration 7-4**.

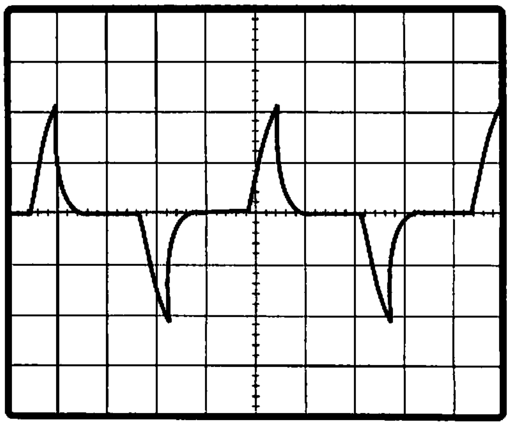

Illustration 7-4
Inductive Waveform

7.11 Protection - Short Circuit

Signal: .5 Hz square wave

Set input level to 2V rms. Short positive and negative outputs together. Continue test until automatic shut down. Standby light will remain lit until unit cools. Unit should start up again after cooling.

7.12 IM Distortion

Load: 4 ohms
Signal: See **Illustration 7-5** for the hook-up schematic of a 60 Hz/7 kHz signal summed in a 4:1 ratio.

Adjust input level for output voltage of **20V**. Readings on an Intermodulation Analyzer should be less than .01% from 0-25 db, and less than .05% from 30-40 db.

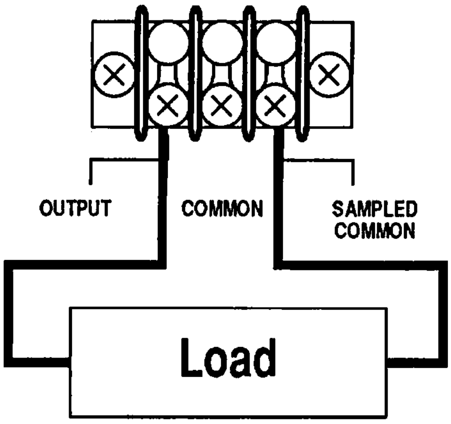

Illustration 7-5
60 Hz Hook-up Schematic

7.13 Signal to Noise Ratio

1. See **Illustration 7-6** for hook-up schematic of 1K input terminator.
2. Install a 20 Hz - 20 kHz bandpass filter ahead of the voltmeter. Turn input level control both fully clockwise and fully counterclockwise. Output signal should be no more than **0.6mV** of noise.

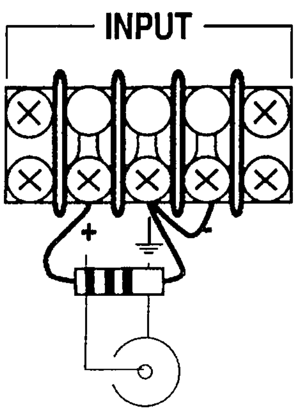

Illustration 7-6
1K Input Terminator Hook-up

7.14 Quiescent Power

Load: None

The quiescent power of the unit should be approximately **60** watts.

7.15 Voltage Monitor Output

Load: None
Signal: 1 kHZ sine wave

At power input of approximately **1V** rms, check the voltage monitor output. The signal should be present at the same amplitude and phase as the output signal. Loads of less than **50** ohms should not be connected to the monitor.

7.16 Phase Test

Signal: 1 kHZ sine wave

Apply signal to the inverting input. Voltage monitor signal should be 180° out of phase with the input signal. If the noninverting input is not grounded, the output amplitude will be lower.

7.17 Constant Current Test

Load: Use the sampled common ground and the proper resistance and inductance. (Unless otherwise specified by customer, standard load is 4 ohms in series with 500 microhenries coil.)
Signal: 1 kHz sine wave

Check the amplifier in the constant current mode. Check for a proper sine wave at the current monitor output. Adjust the generator so that there is .1VAC on the current monitor. Adjust R21 on the CCM so there is 1 amp across the resistive portion of the load.