

# 5205A

## Precision Power Amplifier

Instruction Manual

P/N 338434  
February 1976  
Rev. 4/76



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# WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive:

The JOHN FLUKE MFG. CO., INC., warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1-year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargeable type batteries are warranted for 90-days), or any product or parts which have been subject to misuse, neglect, accident, or abnormal conditions of operations.

In the event of failure of a product covered by this warranty, John Fluke Mfg. Co., Inc., will repair and calibrate an instrument returned to an authorized Service Facility within 1 year of the original purchase; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within 1 year of the original purchase, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident, or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. JOHN FLUKE MFG. CO., INC., SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT, OR OTHERWISE.

**If any failure occurs, the following steps should be taken:**

1. Notify the JOHN FLUKE MFG. CO., INC., or nearest Service facility, giving full details of the difficulty, and include the model number, type number, and serial number. On receipt of this information, service data, or shipping instructions will be forwarded to you.
2. On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the Service Facility and the instrument returned, transportation prepaid.

## **SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT**

All shipments of JOHN FLUKE MFG. CO., INC., instruments should be made via United Parcel Service or "Best Way" prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

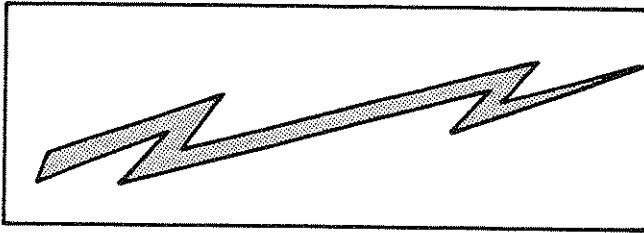
## **CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER**

The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact the nearest Fluke Technical Center.) Final claim and negotiations with the carrier must be completed by the customer.

The JOHN FLUKE MFG. CO., INC., will be happy to answer all applications or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX C9090, EVERETT, WASHINGTON 98206, ATTN: Sales Dept. For European Customers: Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands.

\*For European customers, Air Freight prepaid.

**John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, Washington 98206**



## **FIRST AID FOR ELECTRIC SHOCK**

### **RESCUE**

**FREE VICTIM FROM CONTACT WITH LIVE CONDUCTOR QUICKLY.  
AVOID CONTACT WITH EITHER LIVE CONDUCTOR OR VICTIM'S BODY.**

Shut off high voltage at once and ground circuit. If high voltage cannot be turned off quickly, ground circuit.

An ax with a dry wooden handle may be used to cut high voltage line. Use extreme caution to avoid resulting electric flash.

If circuit cannot be broken or grounded, use a dry board, dry clothing, or other nonconductor to free the victim.

### **SYMPTOMS**

**NEVER ACCEPT ORDINARY AND GENERAL TESTS FOR DEATH.**

Symptoms of electric shock may include unconsciousness, failure to breathe, absence of pulse, pallor, and stiffness, as well as severe burns. **WHENEVER VICTIM IS NOT BREATHING PROPERLY, GIVE ARTIFICIAL RESPIRATION**

### **TREATMENT**

**START ARTIFICIAL RESPIRATION IMMEDIATELY.**

Perform artificial respiration at scene of accident, unless victim's or operator's life is endangered. **IN THIS CASE ONLY**, remove victim to safe location nearby. If new location is more than a few feet away, give artificial respiration while victim is being moved.

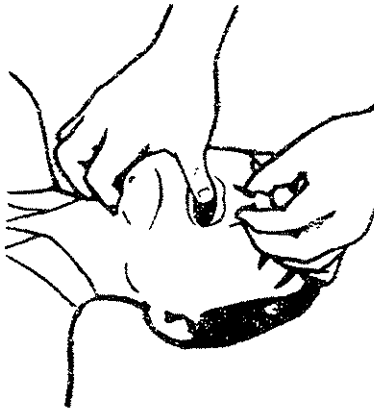
After starting artificial respiration, continue without loss of rhythm for at least **FOUR HOURS**, or until victim is breathing without help. If you have to change operators while giving artificial respiration, do so without losing rhythm of respiration.

### **AFTER VICTIM REVIVES**

Be prepared to resume artificial respiration, as he may stop breathing again.

When victim is **COMPLETELY CONSCIOUS**, give him a stimulant (**NOT AN ALCOHOLIC DRINK**) such as a teaspoonful of aromatic spirits of ammonia in a small glass of water, hot coffee, or hot tea.

Keep victim warm and lying down until he has been conscious for at least fifteen minutes.



### **POSITION VICTIM**

Place victim in face-upward position and kneel close to his ear.

### **CLEAR THROAT**

Turn head to one side and quickly wipe out any fluid, mucus, or foreign body from mouth and throat with fingers.

### **OPEN AIR PASSAGE**

Tilt head back and extend neck to open air passage.

### **LIFT JAW FORWARD**

Place thumb in victim's mouth and grasp jaw firmly. Lift jaw forward to pull tongue out of air passage. Do not attempt to hold or depress tongue.



### **PINCH NOSTRILS CLOSED**

With other hand pinch nostrils closed to prevent air leak.

### **FORM TIGHT SEAL WITH LIPS**

Rescuer's wide-open mouth completely surrounds and seals open mouth of victim. This is not a kissing or puckered position — mouth of rescuer must be wide-open.

### **BLOW**

Exhale firmly into victim's mouth until chest is seen to lift. This can be seen by rescuer without difficulty.



### **REMOVE MOUTH AND INHALE**

During this time, rescuer can hear and feel escape for air from lungs. Readjust position if air does not flow freely in and out of victim's lungs.

Continue at a rate of 12 to 20 times per minute.

Breathing should be normal in rate with only moderate increase in volume, so that rescue breathing can be continued for long periods without fatigue. Do not breathe too forcibly or too large a volume if victim is an infant or small child.

## Section 1

# Introduction & Specifications

## 1-1. INTRODUCTION

1-2. The Model 5205A Precision Power Amplifier is a dc coupled, broad band inverting amplifier with a set gain of 100. The 5205A may be used in combination with the 5200A AC Calibrator for a combined output ranging from 100 (100.000) to 1100 (1100.000) volts rms at frequencies up to 100 kHz. When the 5205A is operating as an independent amplifier ac voltages from 0V to 1100V rms at currents up to 200 mA rms may be obtained. The waveforms may vary from a large amplitude sinusoidal to complex waveforms of DC, however, peak voltage specifications limit the output to 1500 volts. DC voltages from zero to 1500 volts may be obtained at current levels of 100 mA.

1-3. Control of the 5205A can be exercised either manually from the front panel controls or by remote programming. Remote connectors for the 5200A and a customer supplied control source are provided on the rear panel. Connection of the Model 5200A AC Calibrator with the supplied factory cable provides all the analog signal and remote programming data required.

1-4. The amplifier output cable and the input for independent operations are installed on the front panel. Both may be installed on the rear panel for system operations if desired as option -07. The standard output cable is a permanently attached, three foot long, four wire, low capacitance cable which allows remote sensing, high output current and high frequency operation.

1-5. Equipment protection is provided by the Fault and the Overload circuits. Activating the fault circuit automatically reverts the unit to the Standby mode and removes any voltage present from the output. Faults can originate from procedural errors or equipment failure. A fault due to procedural error can be removed by resetting the systems and performing the restarting procedure. An overload error can be corrected by removing the overload from the circuit. Return to operate will occur automatically when the overload is removed, unless the overload is accompanied by a fault. In this case, power must be removed and restored to remove the indications.

**1-6. SPECIFICATIONS****1-7. Calibrator Mode**

These specifications apply when using the 5200A on the 1000 volt range with the 5205A and its supplied interface cable. Refer to the 5200A data sheet for other voltage ranges, frequency accuracies and slew rates.

**OUTPUT VOLTAGE RANGE**

100V to 1099.999V rms

**FREQUENCY RANGE**

DC to 100 kHz.  
(120 kHz typical)

**RESOLUTION**

1 mV

**AMPLITUDE ACCURACY**

(For 90 day, 23°C ±5°C, after 1 hour warmup)  
(Maximum Load - zero to full load)

1000V Range (X% of setting + Y% of Range)

10 Hz to 30 Hz	(0.12 + 0.005)
30 Hz to 20 kHz	(0.04 + 0.002)
20 kHz to 50 kHz	(0.08 + 0.005)
50 kHz to 100 kHz	(0.10 + 0.01)

**AMPLITUDE LIMITS WITH TEMPERATURE**

(0°C to 18°C and 28°C to 50°C)

Add ±(0.035 X Accuracy) per °C to the stated accuracy limits.

**SHORT TERM AMPLITUDE STABILITY**

The random change in rms value will be less than (0.0007% of setting + 0.0005% of range) pk-pk for the 1 kHz thru 100 kHz ranges and 0.005% pk-pk of range for the 100 Hz range over a 10 minute interval with constant line, load and temperature using an rms responding meter. (Fluke 931B or equivalent.)

**LONG TERM AMPLITUDE STABILITY**

(At Constant Line, Load and Temperature)

	<u>24 Hours</u>	<u>Six Months</u>
10 Hz to 20 kHz	0.01% of setting	0.02% of setting
20 kHz to 100 kHz	0.02% of setting	0.04% of setting

**MAXIMUM CAPACITIVE LOAD**

1500 pF (Not to exceed rated Load Current)  
(170 mA allows 270 pF at 1000V/100 kHz)

**OVERLOAD PROTECTION**

Overload Limit protects against input noise spikes and momentary output overloads.

Overload Trip protects against input overdrive conditions, steady state output overloads and short circuits.

**1-8. Amplifier (Local/Remote) Mode****MAXIMUM OUTPUT VOLTAGE**

(Under any rated line and load condition)

DC ±1500V dc

AC 1100V rms

**FREQUENCY RANGE**

DC to 100 kHz  
(120 kHz typical)

**GAIN**

X100 (Inverting)

**GAIN ACCURACY**

(For 90 days, 23°C ±5°C, after 1 hour warmup)

<u>Maximum Load</u> (Or Greater)	<u>DC to 20 kHz</u>	<u>20 kHz to 100 kHz</u>
500Ω / / 100 pF	±0.05%	±0.2%
5000Ω / / 100 pF	±0.05%*	±0.15%
1 MΩ / / 200 pF	±0.05%	±0.2%
1 MΩ / / 500 pF	±0.06%	±0.4%
1 MΩ / / 1000 pF	±0.08%	±0.8%
1 MΩ / / 1500 pF	±0.1%	±1.2%

\*±0.04%, DC to 10 kHz

**GAIN ACCURACY LIMITS WITH TEMPERATURE**

(0°C to 18°C and 28°C to 50°C)

DC to 20 kHz Add ±(0.03 x accuracy) per °C to the stated accuracy limits

20 kHz to 100 kHz Add ±(0.06 x accuracy) per °C to the stated accuracy limits.

**GAIN STABILITY**

(23°C ±5°C, after 1 hour warmup)

	<u>Max. Capacitive Load</u>	<u>24 Hours</u>	<u>Six Months</u>
DC to 20 kHz	1500 pF	0.03%	0.06%
20 kHz to 100 kHz	100 pF	0.08%	0.2%
20 kHz to 100 kHz	1500 pF	0.4%	0.8%

**MAXIMUM CAPACITIVE LOAD**

1500 pF (Not to exceed rated Load Current)  
(170 mA allows 270 pF at 1000V/100 kHz)

**MAXIMUM SLEW RATES**

(Greater than 1000V output swing)

<u>Maximum Load</u>	<u>Maximum Input Slew Rate*</u>	<u>Maximum Output Slew Rate</u>
200 mA Resistive	8.0V/usec	800V/usec
100 pF Capacitive	8.0V/usec	800V/usec
200 pF Capacitive	5.0V/usec	500V/usec

Maximum Load	Maximum Input Slew Rate*	Maximum Output Slew Rate
500 pF Capacitive	3.0V/usec	300V/usec
1000 pF Capacitive	2.0V/usec	200V/usec
1500 pF Capacitive	1.0V/usec	100V/usec

\* Faster rates may trigger overload protection circuitry.

**MAXIMUM OUTPUT OVERSHOOT**

Less than 4% of amplitude with less than maximum input slew rate and with greater than 1000V output swing.

**INPUT IMPEDANCE**

10 kΩ in parallel with less than 120 pF

**INPUT CONNECTOR**

BNC connector located on front panel.  
(Located on rear panel with option 07)

**MAXIMUM INPUT VOLTAGE**

50V dc or rms

**INPUT BIAS CURRENT**

100 nA, maximum

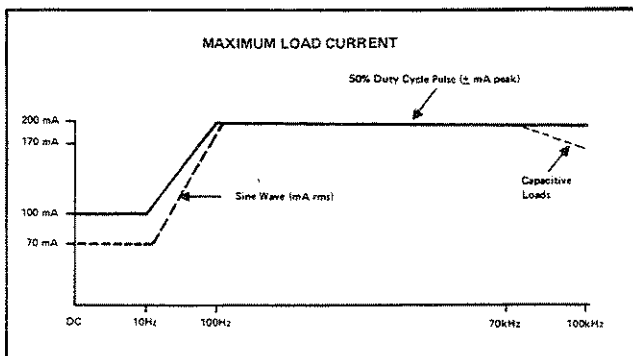
**OVERLOAD PROTECTION**

Overload Limit protects against input noise spikes and momentary output overloads.

Overload Trip protects against input overdrive conditions, steady state output overloads and short circuits.

**1-9. General**

**MAXIMUM LOAD CURRENT**



Bipolar Symmetrical wave form  
(See Graph above)

Unipolar Rectangular waveform  
(Referenced to zero volts)

±200 mA peak pulse width less than 5 msec  
period greater than 10 msec.

Linearly derating to:

±100 mA peak Pulse width greater than 50 msec  
period less than 100 msec.

Under all circumstances, the output current capability is at least ±100 mA peak

**DC OFFSET VOLTAGE**

(For 90 days, 23°C ±5°C, after 1 hour warmup)

±10 mV at the output

**DC OFFSET VOLTAGE LIMITS WITH TEMPERATURE**  
(0°C to 18°C and 28°C to 50°C)

±1.0 mV/°C at the output

**TOTAL HARMONIC DISTORTION**

(Bandwidth 10 Hz to 1MHz)

(Resistive loads greater than 1.5KΩ or Capacitive loads less than 1000 pF)

- 10 Hz to 20 kHz . . . . . (0.05% of setting)
- 20 kHz to 50 kHz . . . . . (0.07% of setting)
- 50 kHz to 100 kHz . . . . . (0.1% of setting)

(Resistive loads less than 1.5KΩ or Capacitive loads greater than 1000 pF)

- 10 Hz to 10 kHz . . . . . (0.05% of setting)
- 10 kHz to 20 kHz . . . . . (0.1% of setting)
- 20 kHz to 50 kHz . . . . . (0.17% of setting)
- 50 kHz to 100 kHz . . . . . (0.25% of setting)

**RANDOM NOISE**

(1 MHz bandwidth)

Less than 100 mV rms

**LINE RELATED NOISE**

Less than 50 mV rms

**LINE REGULATION**

±0.001% of setting for 10% change in line voltage

**INPUT POWER**

100, 115, 200, 230V ac ±10%, internal jumper selected, 50 to 60 Hz. Receptacle on rear panel for 5200A input power.

**INPUT LINE CURRENT**

The United States National Electrical Code requires that the two lines cords on the 5205A, under full load conditions, be connected to a 20A rated branch circuit with 15A rated receptacles. For international use, refer to local standards. Line currents are as listed below:

**INPUT LINE CURRENT**

(At Full Load)

		100V	115V	200V	230V	
Control Supply Cord	50 Hz	2.0A	1.8A	1.0A	0.9A	(Amp rms)
	60 Hz	1.9A	1.6A	1.0A	0.8A	
High Voltage Supply Cord	50 Hz	14.5A	12.4A	7.2A	7.1A	
	60 Hz	13.9A	12.0A	6.9A	6.6A	

**MAXIMUM ISOLATION VOLTAGE**

Output common may be floated up to  $\pm 10V$  dc or rms from chassis to reduce common mode errors.

**DIMENSIONS** (Case only)

10½" (267 mm) H x 17" (432 mm) W x 24.68" (627 mm) D

**WEIGHT**

120 pounds (54.5 kg)

**EXTENDED USAGE**

The 5205A will typically provide the following extended output voltages and frequencies when the line voltage is kept at the nominal value or above:

- 1) 1200V rms up to 120 kHz with 100 mA output current capability.
- 2)  $\pm 1600V$  dc peak

**OUTPUT CABLE**

Extends three feet beyond the front panel. Special cable is used to provide remote sensing at the covered dual banana plug (with ¾" spacing) at the end of the cable. A storage receptacle is located on the front panel to hold the output cable safely when not in use. Option 07 routes the cable out two feet beyond the rear panel.

**LOCAL/REMOTE-5200A OPERATION**

A two position switch, interlocked with either remote programming function (see programming section below) or manual programming. In the LOCAL mode, the operate control is implemented from the front panel. In REMOTE, control is obtained via the 5200A (Manual or Remote Mode) or via the remote input on the rear panel of the 5205A. Three LED indicator lamps indicate which of the three possible controlling sources is in control (LOCAL, REMOTE or 5200A.)

**SAFETY FEATURES**

When the ac power is turned on, the amplifier is automatically set to the Standby condition and a 1¼ by ½ inch red arrow (lightning bolt) is illuminated to indicate that poten-

tially dangerous output voltages could be present due to remote programming inputs. When output voltage is commanded by one of the three possible control sources, a ¼ by 1 inch red "OPERATE" lamp is illuminated.

The 5205A cannot be commanded simultaneously by more than one source. When more than one of the three possible controlling sources calls the 5205A at the same time, the 5205A is returned to Standby and the LED "FAULT" lamp is illuminated.

Two step turn-on is provided for all three possible controlling sources.

- a. Calling the 1000 volt range from the 5200A (local or remote modes) causes the 5200A to return to Standby. After a 10 millisecond delay, the 5200A operate command can then be initiated to provide an output voltage from the 5205A.
- b. Calling the 5205A from its remote input requires two commands, 10 milliseconds apart. One is the Remote Control Command followed by the Remote Operate Command.
- c. Calling the 5205A from its Local Mode requires the LOCAL/REMOTE-5200A Switch to be in the local position, the Standby/OPERATE switch to be in the STANDBY position and then to be switched to the OPERATE position.

The 5205A meets the safety requirements of IEC 348.

**CALIBRATION REQUIREMENTS**

The 5205A is calibrated at the factory by instrumentation traceable to the National Bureau of Standards. Periodic calibration of the 5205A's Calibrator Mode may be accomplished through the use of an RMS differential voltmeter (Fluke 931B) For calibrating the Amplifier Mode, a DVM such as the Fluke 8800A can be used with the equipment listed above. All other adjustments can be made with general purpose laboratory equipment.



## 1-10. Environmental

### COOLING

Forced air cooled. Air enters through a re-usable filter on the rear panel. Air exits upward from the rear panel and along both sides (Main rear panel outlet may be redirected to the right side at the rear of the instrument.)

### TEMPERATURE

0°C to +50°C operating

-40°C to +75°C storage

### RELATIVE HUMIDITY

0 to 80 percent (0°C to +40°C)

0 to 70 percent (+40°C to +50°C)

### SHOCK

15 g., 11 millisecond half-sine wave

### VIBRATION

3.1g, 10 Hz to 55 Hz

### ALTITUDE

0 to 10,000 feet (3048 meters) operating (Above 7000 ft. (2134 meters) when using 50 Hz line power derate maximum output current by 40%)

50,000 feet (15240 meters) non-operating.

## 1-11. Remote Programming

The 5205A is equipped so that it can be remotely controlled from either the 5200A Calibrator or some other remote source.

### CALIBRATOR MODE PROGRAMMING

Using the 5200A with the 5205A allows the 5200A to program the 5205A either manually from the 5200A's front

panel controls or through the 5200A's remote programming input.

The 5205A is supplied with a two-foot 5200A/5205A interface cable which will allow the 5205A to sit on either side of the 5200A or on top of the 5200A. It is not recommended to put the 5205A below the 5200A due to the upward warm air discharge

### AMPLIFIER MODE PROGRAMMING

There is a photo-isolated remote control input located on the rear panel of the 5205A. This input allows an external remote controlling source to control the Amplifier Mode of the 5205A. The mating connector is supplied with the 5205A. Programming Safety is covered in the Safety Features section above. The following table shows the pin connection and drive requirements or drive capability.

<u>PIN NUMBER</u>	<u>FUNCTION</u>	<u>DRIVE REQUIREMENTS/CAPABILITY</u>
4	Remote Control Command	16 mA drive
8	Remote Operate Command	16 mA drive
7	Remote Status Flag	1.6 mA sink; 10k $\Omega$ pull-up
1	Overload Flag	1.6 mA sink; 10 k $\Omega$ pull-up
6	+5 Volts Input	Requires 50 mA (max.)
9	Logic Common	N/A
2	Digital Guard	N/A

The Remote Commands and Remote Flags are negative true logic.

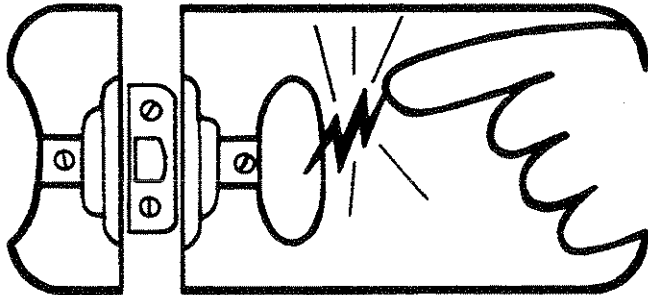




# static awareness



A Message From  
**John Fluke Mfg. Co., Inc.**



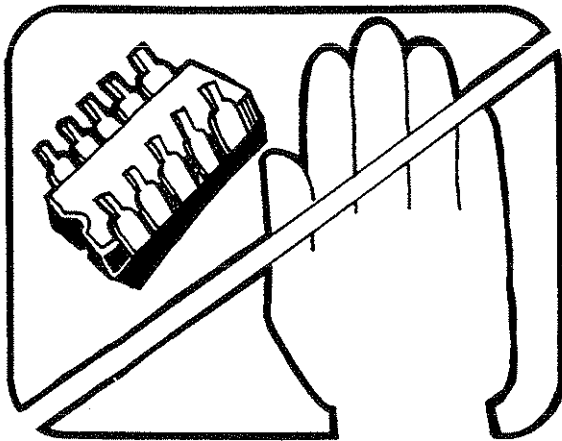
Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

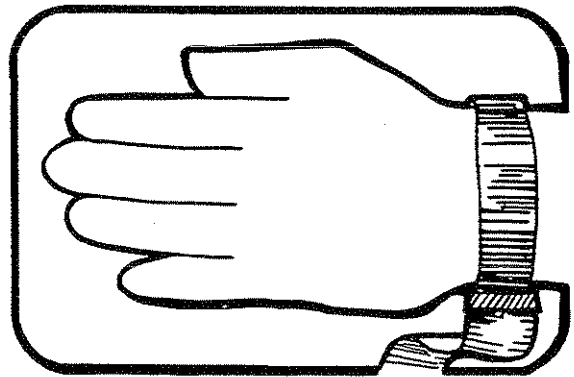
The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol



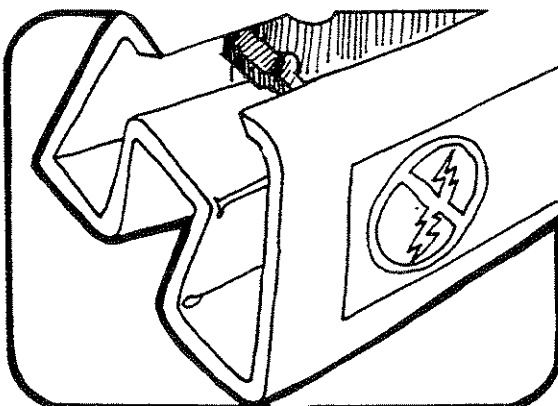
The following practices should be followed to minimize damage to S.S. devices.



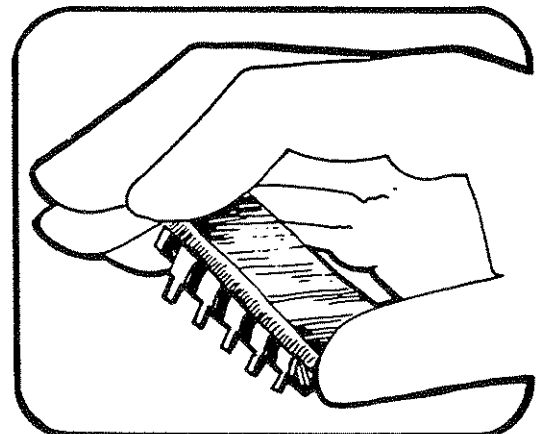
1. MINIMIZE HANDLING



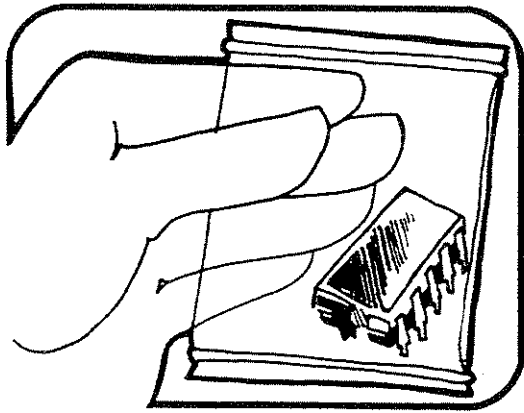
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES. USE A HIGH RESISTANCE GROUNDING WRIST STRAP.



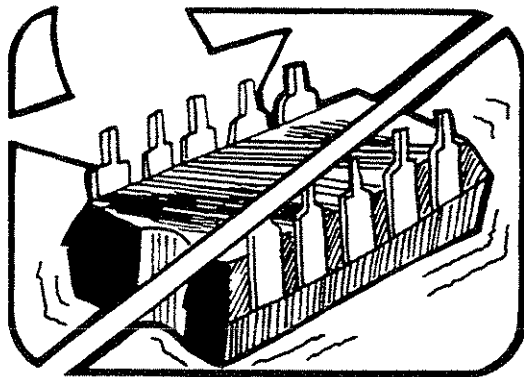
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



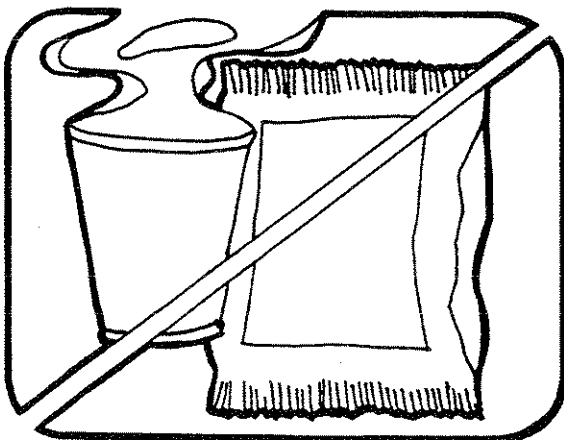
4. HANDLE S.S. DEVICES BY THE BODY



5. USE STATIC SHIELDING CONTAINERS FOR HANDLING AND TRANSPORT

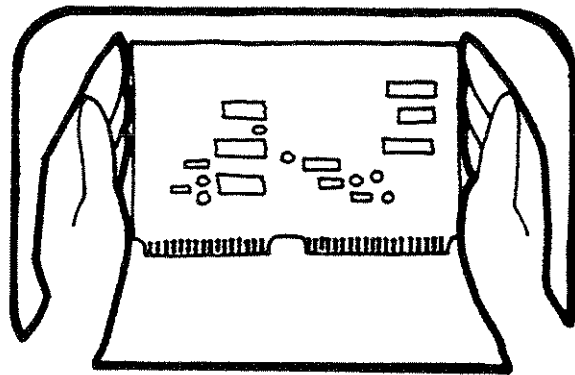


6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE

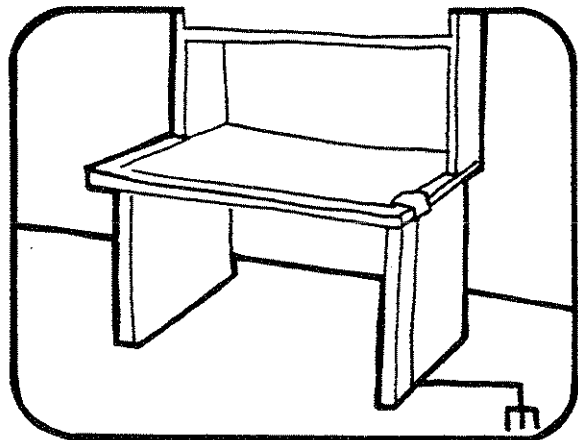


7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA

PORTIONS REPRINTED  
WITH PERMISSION FROM TEKTRONIX, INC.  
AND GENERAL DYNAMICS, POMONA DIV.



8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR HELPS TO PROTECT INSTALLED SS DEVICES.



9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION
10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.
11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

## Section 2

# Operating Instructions

### 2-1. INTRODUCTION

2-2. This section contains information essential for correct operation of the Model 5205A. Should any difficulties be encountered during operation, please contact the nearest John Fluke Sales Representative or the John Fluke Mfg. Co., Inc. A complete list of Sales Representatives is located at the rear of this manual.

### 2-3. SHIPPING INFORMATION

2-4. The Model 5205A was packaged and shipped in a foam packed cardboard carton. Upon receipt, a thorough inspection should be performed to reveal any damage in transit. Special instructions for inspection and claims are included in the carton.

2-5. If reshipment is necessary, the original container should be used. If it is not available, a new container can be obtained from the John Fluke Mfg. Co., Inc. Please reference the Model number when requesting a new container.

### 2-6. INPUT POWER

2-7. The power amplifier can be operated from either a 100, 115, 200 or 230V ac 50 or 60 Hz power line. A jumper system on the power supply section allows selection of the appropriate line voltage. Select the proper jumper and fuse combination for the local line voltage using the following procedure:

- a. Verify that neither line cord is connected to a power source.
- b. Remove the top dust cover and left inner cover from the instrument.

- c. Locate the input power terminal strips shown in Figure 2-1. The layout is also shown on the transformer cover.
- d. Connect the jumpers as shown in Figure 2-1 and Table 2-1.
- e. Replace the inner dust cover.
- f. Install 15 and 5 amp fuses if the 100 or 115 volt input line voltage has been selected or 8 and 2 amp fuses if the 200 or 230 volt input has been selected.

### 2-8. INSTALLATION

2-9. The power amplifier is designed for bench-top use or it can be installed in a standard 19 inch equipment rack with mounting brackets. Rack mounting is done as follows:

- a. Remove the vertical decals from the sides of the two front handle castings.
- b. Remove the screws from the front corner castings which match the hole patterns in the rack mounting brackets.
- c. Attach the rack mounting brackets to the corner castings with No. 8-32 PHP screws.

### 2-10. OPERATING MODES

2-11. The 5205A can operate in any one of three modes; local, remote or calibrator. Each of the modes are defined in the following paragraphs.

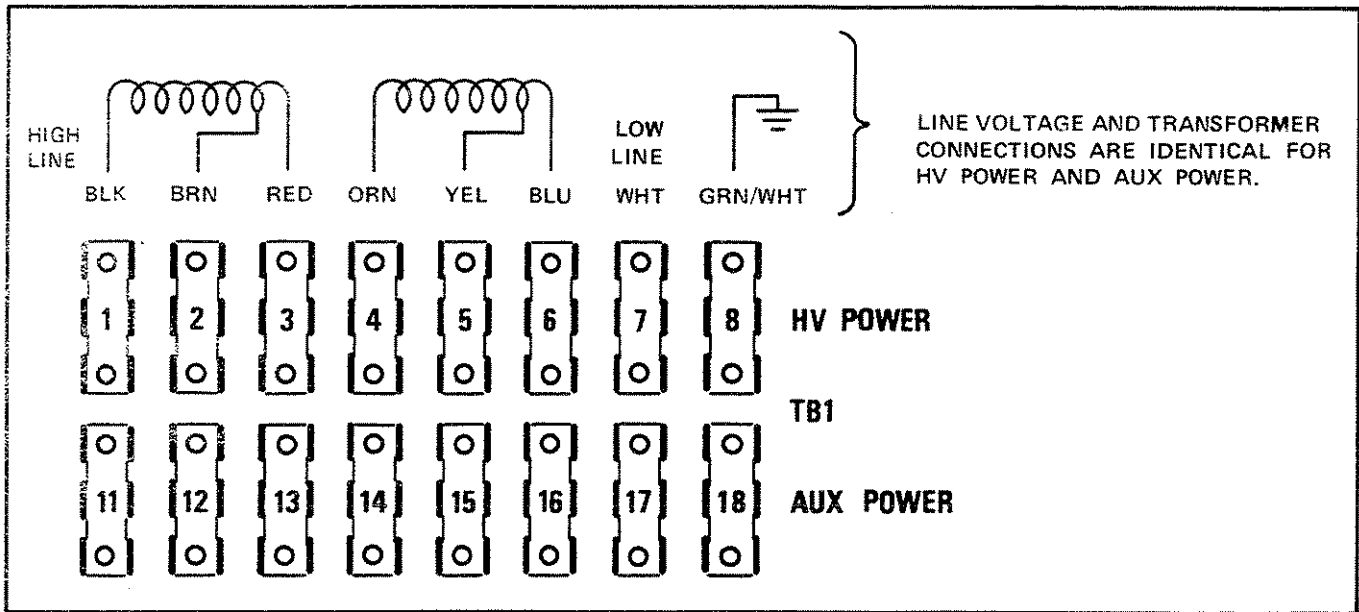


Figure 2-1. INPUT POWER TERMINAL STRIPS

Table 2-1. INPUT LINE VOLTAGE JUMPER CONNECTIONS

LINE VOLTAGE	JUMPER	HV POWER JUMPER	JUMPER
100	1 to 4	2 to 5	5 to 7
115	1 to 4	3 to 6	6 to 7
200	2 to 4	5 to 7	7 to 7
230	3 to 4	6 to 7	7 to 7
AUX POWER			
100	11 to 14	12 to 15	15 to 17
115	11 to 14	13 to 16	16 to 17
200	12 to 14	15 to 17	17 to 17
230	13 to 14	16 to 17	17 to 17

## 2-12. Local Mode

2-13. The 5205A operates as an independent stand alone inverting amplifier with a fixed gain of X100. The instrument is controlled and the status monitored from the front panel, and any signal input will be amplified 100 times, within specification limits.

## 2-14. Remote Mode

2-15. In the Remote mode the 5205A still operates as an independent X100 amplifier. However, operation is now controlled, and the status monitored, through a remote connector on the instrument's rear panel.

## 2-16. Calibrator Mode

2-17. In the Calibrator Mode the 5205A is controlled from the 5200A AC Calibrator, either from the 5200A front panel or indirectly through the 5200A Remote Control Unit. The output is the voltage selected by the 5200A on the 1000 volt range. The output sensing signal is returned to the 5200A for maximum overall accuracy.

## 2-18. OPERATING FEATURES

2-19. The location and function of all front panel controls, connectors, and indicators are shown and described in Figure 2-2, and Table 2-2. The rear panel connectors and fixtures are shown and described in Figure 2-3 and Table 2-3.

## 2-20. OPERATING NOTES

### 2-21. AC Line Connections

2-22. Power is input to the unit on two separate lines. One line provides power to the high voltage system while the other supplies the auxiliary power system. Each input line is individually fused. The voltage is selectable, as previously described and the input frequency may be either 50 or 60 Hz. Both input power cords have three prong, polarized plugs. The round pin on the plugs connect the chassis to earth ground, therefore ensure that it is connected to a high quality earth ground.

2-23. The 5205A requires a significant amount of line power. Table 2-4 contains the RMS line currents under full load conditions as controlled by line voltage setting and input frequency. The requirements for both the high voltage and auxiliary power line cords are listed. The high voltage line cord is rated at 18 amps.

Table 2-2: FRONT PANEL COMPONENT DESCRIPTIONS

REF NO.	NAME	FUNCTION
1	POWER Switch	Applies line voltage to the Auxiliary (AUX) power supplies. After approximately 30 seconds power is applied to the High Voltage (HV) supply.
2	CONTROL Switch	Selects between Local and Remote operation. Status is shown by associated indicators.
3	LOCAL Indicator	Illuminated when the power amplifier is operating in the local mode, i.e., controlled from the front panel.
4	REMOTE Indicator	Illuminated when the remote mode control line is active. The power amplifier is controlled in this condition from a customer supplied control device.
5	5200 Indicator	Illuminated when the 5200A is in the 1000 volt range to control operation of the instrument.
6	WARM-UP Indicator	Illuminated for approximately 30 seconds after the POWER switch has been turned ON. This allows the Power Amplifier time to heat the tube filaments prior to applying high voltage to the system.
7	MODE Switch	Selects the mode of operation, STDBY or OPERATE. Resets the system after a fault when returned to STDBY from OPERATE. This switch is active only in the Local Mode of operation.
8	STDBY-RESET Indicator	Illuminated when the Standby or Reset fault Mode has been selected.
9	OPERATE Indicator	Illuminated when the Operate mode has been selected.
10	FAULT Indicator	Illuminated when a fault occurs in the system. A procedural or minor fault may be corrected and the indicator extinguished by returning the unit to the Reset Fault mode. This can be accomplished by setting the MODE switch to the STDBY-RESET position and back to the OPERATE position, on the front panel in the local mode, removing and then re-applying the operate command in the remote mode or returning the 5200A mode to standby and then back to operate, either from the 5200A front panel or the RCU, in the Calibrator Mode.
11	OVERLOAD Indicator	Illuminated when an overload is placed on the power amplifier. To extinguish, power must be removed and reapplied. If accompanied by the fault indication, there is a fault condition which must be reset by turning power OFF and ON.
12	INSTRUMENT ON Indicator	Illuminated when the POWER switch is turned ON. Warns that dangerous High Voltages are present in the unit and may be present at the output terminals.

Table 2-2. FRONT PANEL COMPONENT DESCRIPTION

REF NO.	NAME	FUNCTION
13	INPUT Terminal	BNC connector for the input signal when operating in the Stand Along mode of operation.
14	OUTPUT LOW Terminal	Provides a front panel connection for OUTPUT LOW. The maximum allowable differential between Output LOW and chassis is 10 V ac rms, the maximum continuous current 50 ma, peaking at 5A for 10 milliseconds.
15	CHASSIS GROUND Terminal	Provides a front panel connection for chassis ground.
16	OUTPUT Terminals	Permanently attached 4-wire output cable, 3 feet in length. The Output HI and Sense HI wires are connected at the HI Terminal of the output connector. The Output LO and Sense LO wires are connected at the LO terminal of the output connector. This configuration provides the minimum capacitance required at High frequencies.
17	Cable Storage	This storage area is provided as a safety feature. When the output cable is not in use, the output terminals can be inserted into the internal connectors.



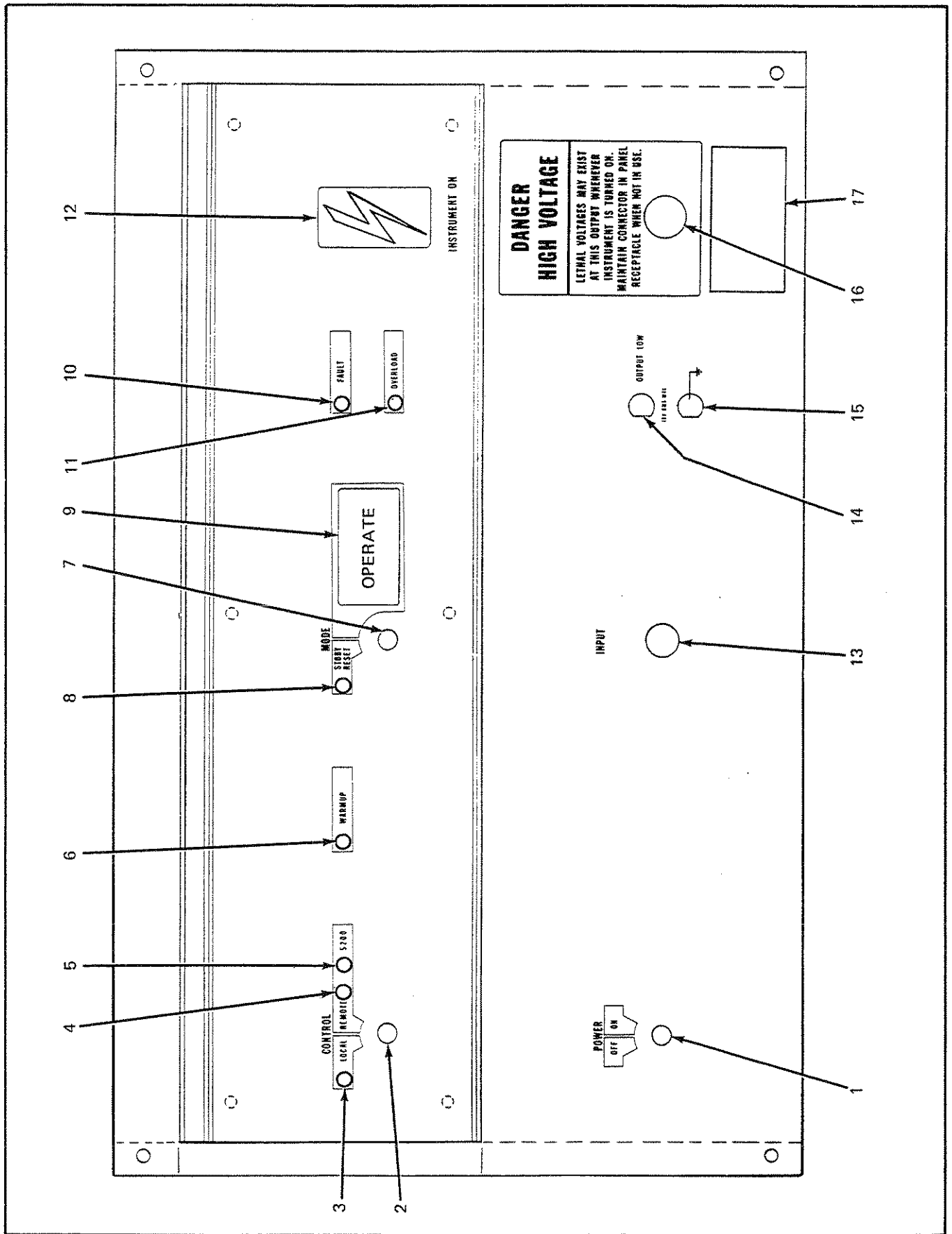


Figure 2-2. FRONT PANEL

Table 2-3. REAR PANEL COMPONENT DESCRIPTION

REF NO.	NAME	FUNCTION
1	Optional Output Terminals	This filler plug is removed and the output cable exists from this point if the -07 Option is installed. This option repositions the Input/Output connectors to the rear panel for system use.
2	Auxiliary Power Line and Fuse	The permanently attached, No. 16 AWG wire, three-prong power cord supplies the line voltage to the auxiliary power supplies and 5200A power through F2, a 5 amp Slo-Blo fuse.
3	High Voltage Power Line and Fuse	The permanently attached, No. 14 AWG wire, three-prong power cord supplies the line voltage to the High Voltage Power Supply through F1, a 15 amp Slo-Blo fuse.
4	Convenience Outlet	The power available at the convenience outlet is taken directly from the auxiliary power line input. It is a standard American style 3 prong connector.
5	Optional Input Connector	This filter plug is removed and the input BNC connector is installed at this point if the -07 Option is installed. This option repositions the Input/Output connectors to the rear panel for system use.
6	Remote 9-Pin Connector	Input for Remote Controls from a customer supplied device during Remote Mode operations.
7	5200A 25-Pin Connector	Input for signal and controls from the 5200A when operating in calibrator mode.
8	Air Intake and Filter	Washable filter to clean air used to cool the unit.
9	Air Outlet	Shield directs flow of air exhaust. Normally, exhausted air is directed upward, however, the shield can be removed and repositioned to direct the air flow to the right of the instrument, if this path of flow is obstructed in some manner. It should not be positioned to the left toward the air intake or downwards.

2-24. The operator must verify that local and/or national standards for outlet receptable and branch circuit are met. For example: In the United States a 20A rated branch circuit is required for a 115V ac 60 Hz source. The 5205A connectors are rated at 15A and can be plugged into either a 15A or 20A rated outlet.

### 2-25. Input Connectors

2-26. Control of the 5205A in the Remote or Calibrator Modes of operation is from one of two connectors on the rear panel. When operating with a 5200A in the Calibrator mode both input signal and controls are made through a 25-pin connector. Controls when operating in the Remote mode are input on a 9-pin connector from a customer supplied control device.

2-27. When operating independently in either the Local or Remote Mode the signal for amplification is input at a BNC connector on the front panel. As part of the -07 Option, this connector can be placed on the rear panel for system operations.

### 2-28. Output Connections

2-29. The output cable is permanently attached to the unit at the front panel. As part of the -07 Option, it can be attached at the rear panel for system operation. The 3-foot long, four-wire, low capacitance cable has a hooded protective cover for operator safety. Selection of the -07 Option for a rear connector reduces the length of the output cable to two feet. Remote sensing is accomplished by

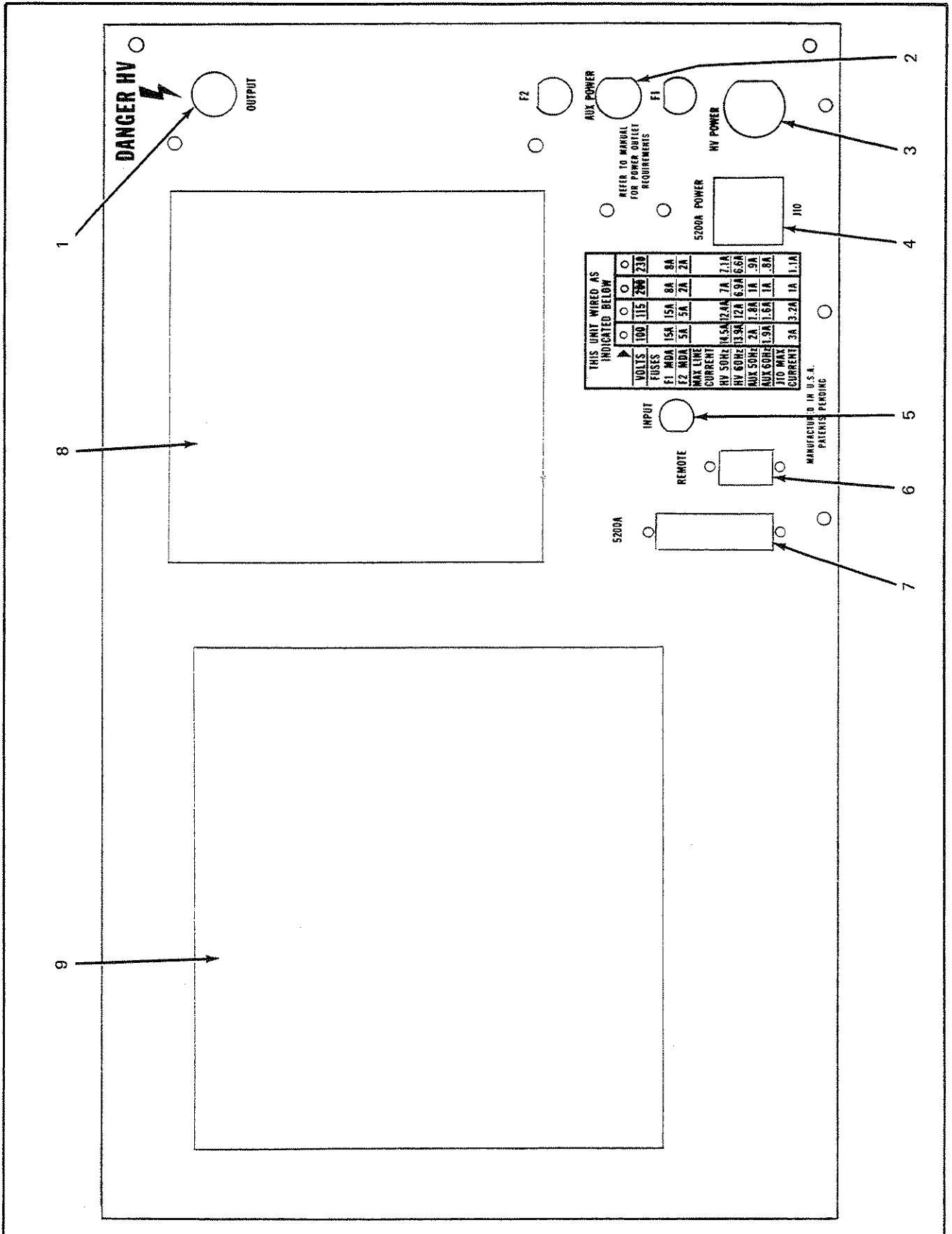


Figure 2-3. REAR PANEL

connecting the Output and Sense HI lines and the output and sense LO lines inside the sealed protective cover.

Table 2-4. INPUT LINE CURRENTS

SUPPLY	INPUT FREQ.	INPUT VOLTAGE			
		100	115	200	230
HV	60 Hz	13.9	12	6.9	6.6
AUX	60 Hz	1.9	1.6	1	0.8
HV	50 Hz	14.5	12.4	7.2	7.1
AUX	50 Hz	2	1.8	1	0.9

## 2-30. Output Capabilities

2-31. The 5205A can deliver up to 100 mA dc and 200 mA rms ac. Attempts to draw currents in excess of these amounts result in an overload which removes the output and causes the amplifier to either retry its programmed output or to return to standby. Before using the 5205A as a source, insure that the recipient unit does not load the amplifier in excess of these limits.

## 2-32. Ground Connection

2-33. If desired, the amplifier OUTPUT LOW can be grounded to the chassis at the front panel by connecting a shorting link between the two terminals. The chassis ground is connected to an earth ground through the line cords, provided the ac line cord is properly grounded. If floating the amplifier output above ground is desired, when the load cannot be disconnected from the earth ground, remove the shorting link from between the two front panel terminals and connect the OUTPUT LOW terminal to the earth ground on the load. The maximum allowable differential between OUTPUT LOW and chassis ground is 10V ac rms.

### CAUTION!

The OUTPUT LOW terminal of the 5205A should never be left floating during operation. If the strap between OUTPUT LOW and CHASSIS GROUND is not present, then verify that through the output cable and the load, a connection with CHASSIS GROUND is present.

## 2-34. Local Mode Operation

2-35. Operating in the Local Mode, the 5205A Power Amplifier will amplify and invert any signal input, (ac, dc, or complex) with a gain of 100. Use the following procedure for operation in the Local Mode.

- a. Insure the CONTROL and MODE switches are in the LOCAL and STDBY-RESET positions respectively.
- b. Connect the source to be amplified to the input connector.
- c. Insure the POWER switch is ON. The INSTRUMENT ON and LOCAL indicators are illuminated.

### NOTE

*The WARMUP Indicator is illuminated at initial power application and stays on for approximately 30 seconds.*

- d. The STDBY-RESET Indicator is illuminated when the WARMUP indicator goes off.
- e. Set the MODE switch to OPERATE.
- f. The OPERATE indicator is illuminated.
- g. The signal input is present at the output terminals with a gain of 100.

2-36. The system will not accept controls from two sources simultaneously, therefore, if a 5200A is connected while operating independently, in the Local or Remote Mode, and the 1000 volt range is selected, a fault will result. The fault can be removed and the indicator extinguished by removing the command from the 5200A and setting the MODE switch on the 5205A to STDBY-RESET and then OPERATE.

## 2-37. System or Combined Operations

2-38. While in the Calibrator Mode the 5205A can be directly combined with a 5200A for operation, or through a Remote Control Unit (RCU) controlled by a computer test system. In the Remote Mode control is through a customer supplied device which may be either manually operated or a computer in a test system

## 2-39. Calibrator Mode Operation

### NOTE

*During combined operations, the 5200A should not be positioned on top of the 5205A. Overheating can result when the 5200A intakes discharged air of the 5205A. Also, transformer coupling may result at line related frequencies.*

## 2-40. 5200A LOCAL OPERATION

2-41. Once the 5205A is prepared for operation, i.e., the 5200 Control Cable connected, the POWER switch is

ON and the CONTROL switch to the Remote position and the 5200A in the 1000V range, control of the 5205A rests with the 5200A. The following procedure can be followed to operate in the calibrator mode:

- a. Connect the control cable between the J32-5205 connector on the 5200A and the 5200A Remote Connector on the rear panel of the 5205A.
- b. Set the CONTROL switch to the REM 5200 position.
- c. Set the POWER switch to the ON position.
- d. The INSTRUMENT ON, 5200 and WARMUP Indicators are illuminated.
- e. After a delay of approximately 30 seconds the STDBY indicator is illuminated and the WARMUP indicator extinguished.
- f. Select the desired amplitude (1100V rms max) and frequency (100 kHz max) on the 5200A front panel.
- g. Set the 5200A mode switch to OPERATE.
- h. The OPER indicator on the 5200A and the OPERATE indicator on the 5205A illuminate. The STDBY indicator on the 5200A and the STDBY-RESET indicator on the 5205A are extinguished. The voltage selected on the voltage dials (100 to 1100 volts) is present at the output connector.

#### NOTE

*In case of a fault, the 5205A will return to STDBY. The 5200A will still be in the OPERATE mode, although the indicator will show STANDBY. Reset the fault by turning the STDBY-OP switch on the 5200A front panel to the STDBY position.*

#### 2-42. 5200A REMOTE OPERATION

#### NOTE

*For operation of the 5200A Remote Control Unit (RCU) see Section 6 of the 5200A manual.*

2-43. When the 5200A is controlled by an RCU during Calibrator Mode Operation, the timing of the Range Select and Operate commands becomes critical. Two separate transfers, separated by at least 10 milliseconds, are required to obtain proper operation of the 5205A. Use the following format for the two transfers.

- a. First transfer command should include:
  - 1000 Volt range
  - Standby
  - Any other controls and setting desired.
- b. Second transfer command should include:
  - 1000 Volt range
  - Operate
  - A repeat of any other controls and setting in the first transfer command.

#### NOTE

*At least ten milliseconds must elapse between the two transfer commands. The READY STATUS Flag may be used for timing between the two transfer commands or ignored.*

2-44. Changes in settings and controls, including standby and Operate are accepted in one transfer by the RCU as long as the 1000V Range is included. The RCU Ready flag delay varies with the selected frequency of the 5200A due to settling time within the instrument. If the flag is to be used for timing, check the 5200A manual for those specifications.

#### 2-45. CALIBRATOR MODE FAULT INDICATIONS

2-46. The 5205A cannot be in two states simultaneously. If the CONTROL switch is placed in the LOCAL position while the unit is under control of the 5200, a fault will result. Remove the fault and extinguish the indicator with the following procedure:

- a. Return to the Local Mode. Take the 5200A out of the 1000 volt range and proceed with the Local Mode operation instructions.
- b. Return to the Calibrator Mode. Return the 5205A CONTROL switch to the REM-5200 position and set the 5200A MODE switch to STDBY for at least 10m seconds and then to OPER to reset the system.

#### 2-47. Remote Mode Operation

2-48. The 5205A can be operated as an independent amplifier remotely from a customer supplied control device. Controls are input from the control device through the 9-pin connector on the rear panel. The pins on which the individual commands must be placed are listed in Table 2-5. The signal to be amplified is input through the BNC Connector on the front panel. Use the following procedure for remote operations:

Table 2-5. REMOTE CONNECTOR PIN ASSIGNMENTS

PIN NO.	ASSIGNMENT	FUNCTION
1	OVERLOAD	Provides overload signal to control device LO logic output to cover load true.
2	Remote Digital Guard	Connects the control unit guard through the shield of the logic pcb wiring to the photo-isolators in the 5205A Remote Interface.
3	No connection	
4	Remote Control	Control signal is supplied by control device. LO logic input for active
5	No connection	
6	+5 Volts	Logic voltage supplied by the control device 35 ma maximum current.
7	Remote Status	Status of the 5205A returned to the control device. LO logic output when remote and operate active.
8	Remote Operate	Operate command supplied by the Control device. LO logic input for operate, HI for standby.
9	+5 Return	Logic return supplied by the control device.

- a. Connect the Control device and input signal cables to the 5205A.
- b. Set the POWER switch to ON and the CONTROL switch to REM-5200A.
- c. The INSTRUMENT ON, REM and WARMUP indicators illuminate, provided the control device has an active control line.
- d. After a 30 second delay the STDBY-RESET indicator illuminates and the WARMUP indicator extinguishes.
- e. The 5205A is now ready for operation with control from the remote device.
- f. Issue an Operate Command through the Remote Control device.
- g. The OPERATE indicator illuminates and the STDBY-RESET indicator is extinguished. The signal input is present at the output terminals with a gain of X100.
- h. A status signal will be available to the Remote Control Device approximately 20 m seconds after the 5205A has reached the operate state.

2-49. If the 5200A is connected during independent remote operations and the 1000 volt range is selected for operations, a fault will result. To clear the fault and extinguish the indicator, remove the input from the 5200A and with the remote control device, remove the operate command and after at least 5 msec issue a new operate command.

### 2-50. Operate Fault

2-51. In addition to the fault resulting from two command simultaneously already discussed, a fault will result from an invalid Operate command. If the MODE switch is set to the OPERATE position prior to the expiration of the warmup period the FAULT indicator will illuminate. Clear the fault and extinguish the indicator by returning the MODE switch to STDBY-RESET and then after the WARMUP indicator has extinguished, return the MODE switch to OPERATE.

### 2-52. Equipment Faults

2-53. Fault indications also result from internal instrument failures, such as: no cooling, severe overloading of the high voltage power supplies or high voltage present during the warmup period. This type of fault disrupts the amplifier loop causing the OVERLOAD indicator to illuminate in addition to the FAULT indicator. Returning the

MODE switch to STDBY-RESET does not clear this type of fault. Restart the system by turning the POWER switch to OFF, then ON, wait 30 seconds for the WARMUP indicator to extinguish and then set the MODE switch to OP-

ERATE. If connected to the 5200A in the Calibrator Mode insure the 5200A is in Standby before starting the restart procedure. If the FAULT and OVERLOAD conditions persist, repair of the instrument is required.





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## Section 3

# Theory of Operation

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### 3-1. INTRODUCTION

3-2. This section contains the theory of operation for the Model 5205A Precision Power Amplifier. The theory description is presented first in a simplified block diagram, then a functional block diagram, and then a circuit explanation. A complete set of schematic diagrams is contained at the rear of the manual.

3-3. The 5205A Precision Power Amplifier provides Amplification at the fixed gain of minus X100 to any signal input, up to the specification limits of 1100V ac rms at 100 kHz.

### 3-4. SIMPLIFIED BLOCK DIAGRAM DESCRIPTION

3-5. Selection of the operating mode and status is done within the Logic Assembly. When power is applied the Initializing circuit readies the system while the instrument is checked for faults. The signal to be amplified may be applied either from the Front Panel connector (Rear Panel with 07 Option) or from the 5200 connector on the Rear Panel, provided the 5200A has the 1000V range selected. Control may be exercised from either the 5200A, a Remote device or the Front Panel connections to the Logic Assembly.

If more than one input or one control signal is present a fault will be detected.

3-6. Once the input signal is present at the preamplifier the only difference in operation between the 5200 or independent mode is in the sensing. The signal is amplified in the preamplifier then applied to the power amplifier. The power amplifier is a Class AB push-pull type using two tubes connected in parallel in both the upper and lower portions of the circuit to provide sufficient output current capability. The output is sensed and returned to the preamplifier to control the input, either internally, or in the case of an input from the 5200, within that instrument.

3-7. The Power Amplifier is supplied with  $\pm 2.5\text{kV}$  and the Preamplifier with  $-2.5\text{kV}$ . The various low voltage power supplies and regulator within the instrument are supplied from the Auxiliary Supplies.

### 3-8. Power Supply Assembly

3-9. Line Power is input to the Power Supply Assembly on two different line cords. Power for the high voltage circuits enters on P8 and for the Auxiliary circuits on P9. This allows operation of the Auxiliary circuits while troubleshooting and/or calibration without the danger of the high voltage circuits. The high voltage circuits output  $\pm 2.5\text{kV}$

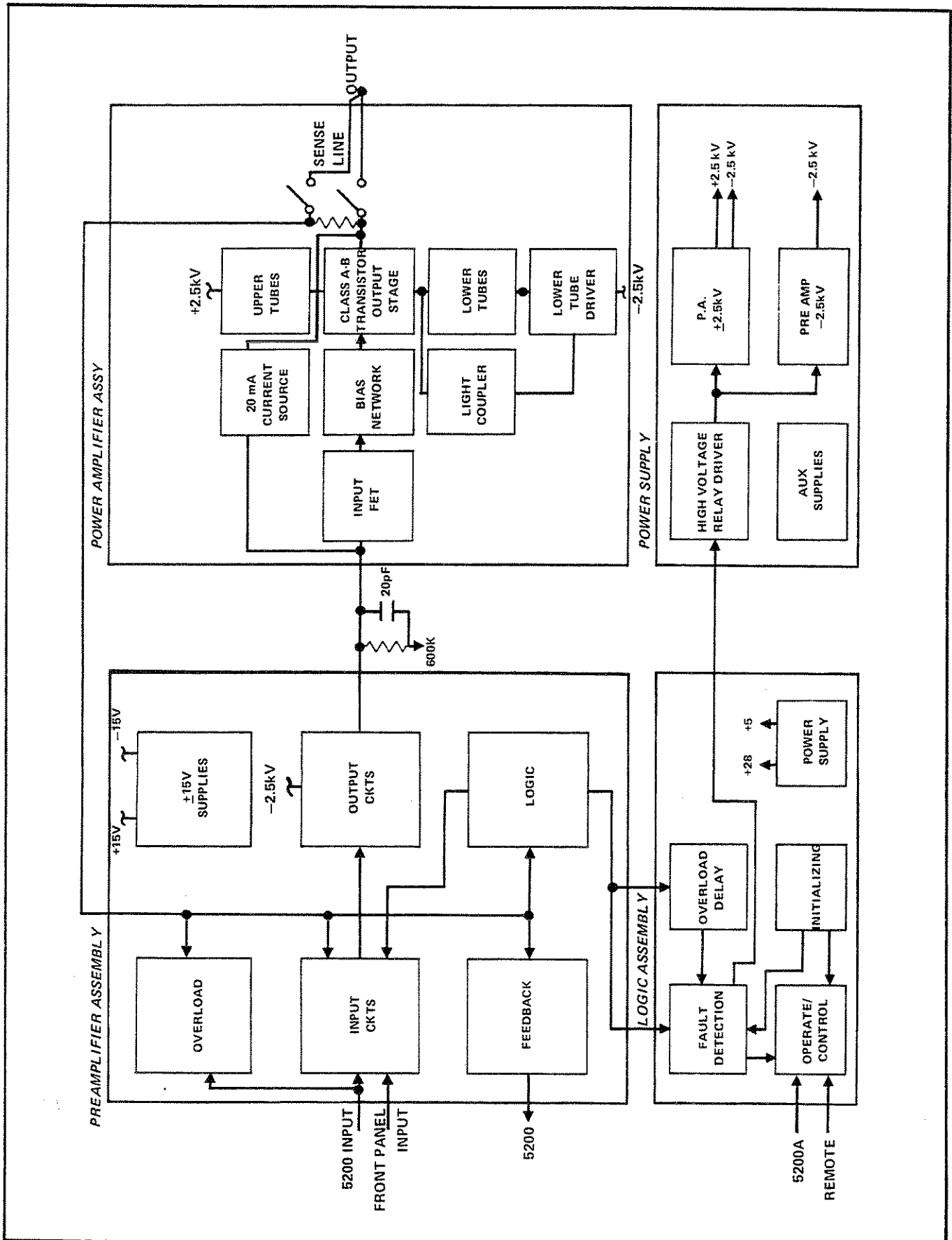


Figure 3-1. MODEL 5205A BLOCK DIAGRAM

to the Power Amplifier and  $-2.5\text{kV}$  to the Preamplifier. Details on the various portions of the high voltage circuit and the auxiliary voltages available are contained in the following sub-paragraphs.

### 3-10. HIGH VOLTAGE RELAY DRIVER

3-11. Power applied to the instrument cannot reach the High Voltage Transformer until K1 is energized. P56-8 brings in the control signal from the Logic Assembly. This signal goes low approximately 30 seconds after the POWER switch is set to the ON position. Prior to that time the Optical Isolator U1 has been cutoff, preventing K1 from energizing. Once low, U1 conducts, cuts off Q1, which causes the current source Q2 to turn on Q3 and energize K1. Q2 also supplies current to the zener VR5 to provide a regulated 110V to the relay coil, optimizing the dissipation of the relay under varying line voltages. Diodes CR1 through CR4 and C1 provide a 110V supply to the relay driver.

#### CAUTION!

The Relay Driver circuitry is located on the Primary side of the HV Transformer. Extreme care should be taken when connecting any test instruments to the circuitry.

### 3-12. POWER AMP $\pm 2.5\text{kV}$ SUPPLY

3-13. Operation of both the positive and negative supplies are identical. The positive voltage supplies V1 and V2 on the Tube Mounting Assembly while the negative supply goes to V3 and V4 on the Lower Tube Assembly. In both cases the transformer secondary is rectified by a bridge rectifier and then filtered by C11 or C12. Each Supply has a bleeder assembly connected to provide a discharge path for the filtering capacitor if the Power Amplifier is not connected to the circuit. Discharge takes approximately 30 seconds. Each circuit has a decoupling network consisting of a resistor (R22 and R12) and two diodes (CR25, CR26 and CR17, CR18). A monitor to the Logic Assembly is provided from each supply

### 3-14. PREAMP $-2.5\text{ kV}$ SUPPLY

3-15. The Preamp supply rectifies the transformer secondary with CR13 and CR14 and then filters it with C13. A bleeder assembly is provided to discharge the filtering capacitor to a safe level if the Preamp is not installed. Discharge takes approximately 30 seconds. This Voltage supplies the  $-1.9\text{kV}$  regulator on the Preamp.

### 3-16. AUXILIARY SUPPLIES

3-17. Line power input on the auxiliary power circuit is tapped to provide an outlet for the 5200A on the rear of the instrument. It also supplies inputs to primary of the

Preamplifier Auxiliary Transformer T3, the Power Amplifier Auxiliary Transformer T4 and the Low Capacity Transformer T2. Outputs from the Low Capacity transformer secondary are used on the Power Amplifier.

### 3-18. Logic PCB Assembly

3-19. When power is applied to the instrument the initializing circuits prepare the circuits for operation. Control is exercised through the operate/control stage, originating at a 5200, a Remote source or within the stage from the Front Panel Controls. Any fault and/or overload will be detected and returned to the operate control stage for appropriate action. The +5 and +28 power required for the logic and relay circuits are generated within the Logic Assembly.

### 3-20. INITIALIZING CIRCUITRY

3-21. When power is applied to the instrument U42-5 goes high from the Warm-up Delay circuit to disable U14-10, which prevents the high voltage control relay from energizing, also U2-6 goes low disabling the overload circuitry. At the same time U20-2 goes low to illuminate the Warm-Up indicator, disables U43-13 to prevent a STDBY indication, clears the Operate FF at U41-3 and enables U14-12 so that if high voltage is present it will clear the Trouble FF and generate a fault. The length of the Warm-Up period is controlled by R129/C53 and should be approximately 30 seconds. The Power Up Initialize circuit (R131/C54) generates a pulse at Power Up to set the trouble FF. It also, through the fault gate, insures the Operate FF is cleared, so both devices start in a known condition.

3-22. Once the Warm-Up delay period has passed U42-5 goes low, extinguishing the Warm-Up indicator and enabling U43-13 so that the high at U43-12 resulting from clearing the operate FF will illuminate the STDBY indicator.

### 3-23. OPERATE/CONTROL

3-24. The operate command can originate from only one of the three possible sources; the front panel, the 5200A interface, or the remote interface. The three inputs are wire ORed at U2-3 for the control line and U4-9 for the operate line. Operation from that point on is the same regardless of the signal origin.

### 3-25. Front Panel

3-26. Setting the control switch to the local position applies a low to the local indicator and sets the set/reset latch formed by half of U10 high at U10-6. This enables U3-2 for the future operate command and enables U7-4 and U7-12 for dual control error detection. U2-10 is the front panel portion of the wire "ORed" control gate. When the

mode switch is set to operate, U3-3 goes low for the front panel portion of the wire "ORed" operate gate.

3-27. To control the instrument from the 5200A or remote interface the front panel control switch must be set to remote. The resulting low at U10-6 disables U3-2, so the front panel mode switch is disabled, and disables U7-4 and U7-12 in the dual control error detection circuit.

3-28. Remote Interface

3-29. A low input at P42-6 from the remote control device activates the optical isolator U33 which in turn illuminates the remote indicator, enables U3-13 for the operate to follow, enables U7-2 for the return status, and pulls the control path low at U2-3. An operate command (P42-2 low) activates the other half of the optical isolator U33 and pulls the operate line low at U3-11, provided the control command had preceded it.

3-30. The U32 optical isolators return the status and overload conditions to the remote control device. Control of the inputs is discussed later.

3-31. 5200 Interface

3-32. This interface operates in basically the same manner as the remote except for a few additions. The control command at P41-6 activates half of U31 for a high at U4-6 which in turn is used to illuminate the 5200A indicator, enable U3-9 for the upcoming operate command, enable U3-5 for the return status, enable U7-10 and U7-5 in the dual control error detection circuit and pulls the control line low at U2-3. The first of the two additional circuits provides a high at U1-8 and P44-7 after a 33 msec delay for use in the preamplifier. The second uses the low at U8-6 to activate K1 to connect the 5200A guard to sense low in the 5205A.

3-33. Operate FF

3-34. Once U2-3 has been pulled low by one of the interfaces, R124/C44 delays the signal 3 to 9 msec. At the end of this delay the Operate FF J Input, U41-4 goes high. The operate command is delayed slightly by R121/C43 and then applied to U41-1 as a low going clock to set the  $\bar{Q}$  output low. This is used to set U5-6 high to return the status from the enabled interface, to extinguish the STDBY indicator, to output a low 5205A OPERATE COMMAND at P44-3, and to turn on Q1 and Q2 which illuminates the OPERATE incandescent lamps and outputs a low to the power amp at P43-27, 28. The high at the Q output is applied to U43-10 and U14-1 for use in fault detection.

3-35. If the control line was not high at the Operate FF prior to the arrival of the operate command the flip-flop would not be clocked and a fault would result. Since the delay in the control line appreciably exceeds that of the

operate line the control signal in any remote or 5200A operation must precede the operate command by at least 10 milliseconds.

3-36. FAULT DETECTION

3-37. Two types of faults can exist within the system. A major fault requires the removal of power to clear the fault detection system. A minor fault can be cleared by setting the mode switch to STDBY-RESET and then returning it to OPERATE.

3-38. Minor Faults

3-39. A minor fault uses the fault gate output, delayed by R122/C41, to clear the Operate FF, which returns the instrument to standby and illuminates the fault indicator. Minor fault inputs to the fault gate come from U43-8 when the operate FF is set but there is no operate command and from the dual control error detection circuit when two or more control signals are present. Inputs are also supplied from the U21 quad comparator. The output at U21-14 goes low if the -I limit sensor has a current greater than 200mA for a time period determined by R88/C23. The +I limit sensor goes low at U21-13 when the comparator senses a voltage greater than 200mV. The +5V limit sensor goes low at U21-1 when the +5 volt supply drops to 4.5 volts.

3-40. The absence of the  $\overline{\text{NEG HV}}$  signal at P44-1 from the preamp applies a low at U15-4 which clears the Operate FF, after the delay of R122/C41. The resulting low at U14-1 is combined with the low operate command at U14-2 to illuminate the fault indicator. This gate will also operate if the operate command clocks the flip-flop when there is no control signal present. Both conditions will cause a minor fault without using the fault gate.

3-42. Major Faults

3-42. A major fault clears the Trouble FF, in addition to generating a fault signal from the fault gate. The only method of setting the Trouble FF to remove the major fault is the Power-Up Initialize circuit, necessitating removing power from the system and then resetting the power switch to ON.

3-43. The quad comparator U22 activates the Trouble FF if either U22-1 or U22-2 are brought low when the Neg Supply current monitor at P43-12 or the POS Supply current monitor at P43-10, respectively, exceed their 300mA limits for 100 msec. U22-14 will go low if the signal from the Fan Switch is interrupted for approximately 6 seconds. The fourth comparator input is the overdrive which originates in the preamp. If the overdrive signal goes high, U22-13 will go low and clear the Trouble FF, shutting down the system.

3-44. If the transistors Q1 and Q2 do not operate properly, i.e. Q1 conducting and Q2 cut-off, Q3 is turned on activating the Trouble FF. The +28V limit sensor in the U21 comparator will turn Q4 on when the input drops to 20V, cutting off Q2 and activating the trouble circuit.

3-45. A major fault is also generated when high voltage is sensed at P43-8 during the Warm-Up period. The signal, if present, will turn on Q10 to enable U14-13 so that when U14-12 is low during warm-up the trouble FF is cleared.

### 3-46. OVERLOAD DELAY

3-47. The overload signal at P44-5 from the preamp illuminates the OVERLOAD indicator and activates the trip optical isolators in the selected interface device. Since it does not generate a fault and the overload pulse could be quite narrow a one-shot is installed in the circuit to give a minimum width pulse. The width of the pulse at U42-9 is determined by R126/C47 and is approximately 0.5 seconds.

### 3-48. POWER SUPPLIES

3-49. +28Vdc

3-50. The 21Vrms at P43-17, 18 and P43-19, 20 is rectified at CR18 and filtered by C28. The 21Vrms operates the incandescent lamps in the INSTRUMENT ON (lightning bolt) indicator. The +28 volts is used for the OPERATE indicators and various relays. The +28V is also used with Q5 and series regulator circuit to develop 5.6 volts for the pull-up resistor R73.

3-51. +5Vdc

3-52. U25 is a 5 volt regulator which acts on the 8.5V rms supplied from the power supply. It is rectified at CR17 and filtered by C25-C27. Up to 400mA is supplied for the use of the IC's on the logic assembly. Capacitors C1, C3, C10, C12 and C46-C56 are used for decoupling the integrated circuits on the assembly.

### 3-53. Preamplifier Assembly

3-54. The signal to be amplified enters the Preamplifier (Fig 3-2) from either the front panel input connector or the 5200 connector. Selection is made in the Input Circuits, under the control of the Logic. The input signal is amplified and internal feedback applied to set the gain at 100 within the Input Circuits. In the Output stage the instrument output voltage swing of  $\pm 1550$  Volts is set. The output is sensed and returned to the Input, Logic, Overload and Feedback Circuits. The Feedback circuit takes the sensed voltage, divides it and feeds it to the 5200A for use in stabilizing gain and control. The Overload circuits sense high output voltages or low supply to cut off the input to the preamplifier. The Logic Circuits decode control inputs and supply

status outputs to the Logic pcb. The  $\pm 15$  volt power supply provides regulated  $\pm 15$  volts dc to components on the preamplifier.

### 3-55. INPUT CIRCUITS

3-56. Input Relay

3-57. The input relay K1 is energized, through the logic block, when the input to the instrument is through the front panel connector (rear panel with the 07 Option). If the instrument is connected to the 5200A and the 1000V range on the 5200A is selected the relay is de energized and a signal can be input only through the 5200A connector.

3-58. Input and Feedback Resistor Network

3-59. The gain of the 5205A is controlled with this circuit. The ratio of the 1.009M (R302) to the input resistance gives a gain of 100. R302 (10K), R5 at mid range (50 $\Omega$ ) and the resistance of Q121 (40 $\Omega$ ) combine for an input resistance of 10.09K for the hundred to one ratio. Resistors R301 and R302 are deposited in the same substrate and mounted in a heat dissipating milled aluminum can for optimum performance.

3-60. Input FET Switch

3-61. Q121, the input FET switch interrupts the input signal when the instrument is in standby or overload. Since the resistance of Q121 is part of the input resistance any change in temperature will effect the resistance of the FET and through it the gain of the instrument. The compensation circuit, Q122 and U25 with their associated components, is used to hold the resistance of Q121 constant.

3-62. Input Amplifier

3-63. Transistors Q128, Q132, Q138, Q140, Q147 and Q148 in conjunction with the Op-Amp U123 and their associated components make up a wide band DC coupled amplifier, which is the input amplifier. The input signal and feedback is summed at Q128, routed through Q132 and Q140 and then output to the next circuit at Q148. Transistors Q138 and Q147 provide current sources of 1.8 mA and 3.6 mA respectively. C147 is adjusted so that at 20 kHz it matches the break of the resistance and capacitance at the plate of the drive tube. C143 is adjusted for the correct gain at 100 kHz. Op amp U123 keeps the instrument output offset near zero. Any dc voltage at the summing point is amplified by U123 and applied to the source of Q128, where it is amplified by the remaining stages. At the output the feedback, through R302 brings the summing point back to zero. Since the dc gain of U123 is high the dc offset of the instrument is determined by the characteristics of U123. Above 20 kHz the gain of

U123 is rolled off by C124 and R127 so that the source of Q128 is held to zero volts AC by C128. As a result the gain of the input amplifier is determined by Q128 and the load capacitance at the collector of Q132 above 20 kHz.

### 3-64. OUTPUT CIRCUITS

#### 3-65. Zener String

3-66. The zener string provides a dc path from the input amplifier across a potential of 1900 volts to the output amplifier. In the string the 50V, 100V and two of the nine 200V zeners are shorted with a jumper that can be removed to adjust the voltage on the output amplifier common to between -1850 and -1910 volts. The bias current through the string is the 3.6mA supplied by the current source Q147. Frequencies above 150 kHz are bypassed around the string by C192.

#### 3-67. Output Amplifier

3-68. After the zener string the input signal current goes to the output amplifier which provides an amplified low distortion current to the drive tube. Common for the output amplifier is kept at -1.9kVdc potential, as set by the -1.9kV regulator which allows the drive tube plate to fall to the -1550 volts required by the instrument output and still maintain the bias required on the tube. The amplifier consists of transistors Q182 through Q187 which are supplied a  $\pm 29$ Vdc from C182, C183, CR182 and the 40 rms input. Q185 is used as a current source to take 1.7 mA of current from the 3.6 mA supplied by the zener string. The remaining 1.9 mA provides the amplifier with a full scale swing of  $\pm 1.9$ mA so that when the signal swings -1.9 mA the output current to the tube is zero but the zener string remains biased to 1.7mA from the current source. This bias keeps the impedance of the zener string low and prevents the distortion that would normally occur at the knee of the zener. The output from the amplifier at the emitter of Q182 is set in magnitude by Resistor R195 and the base voltage. This is applied to the cathode of the drive tube to develop the instrument output voltage at the tube plate. Distortion in the current output of Q182 is reduced by the diode connected transistors Q184, Q186 and Q187. The same voltage should appear across R195 and R197, therefore if 1.9mA flows in R197 a current of 30mA will flow in R195 and in turn in Q182 and the drive tube, providing the normal bias for the tube.

#### 3-69. Drive Tube

3-70. The drive tube develops the instrument output voltage swing of  $\pm 1550$  volts. Current from the output amplifier changes the tube plate to cathode voltage in response to the input signal thereby generating the instrument output. The screen grid voltage is set by VR185 and the resistor string R204 through R207. The plate

load consists of R1 through R4, four 150K resistors in series, and the 20pF inherent in the tubes plate to plate shield and the coaxial cable (plate to power Amp input) capacitance.

#### 3-71. -1.9kV Regulator

3-72. Regulation of the -1.9kV at the Output Amplifier common is accomplished by regulating the input voltage to the zener string. As long as the input at the zener string is -85 volts the voltage at the junction of R151 and R158 and at U157-3 will be zero. Since U157-2 is tied to common and change in the zener string input will effect the U157 Op Amp, and in turn Q161 and the optical coupler U160. The signal is passed across the coupler to the photo transistor which drives Q177 which drives the regulator tube V2, changing the common of the output amplifier and the input to the zener string, bringing the loop into balance. Q176 is used as a current limiter for the regulator and is set for a limit of 55mA

### 3-73. FEEDBACK CIRCUITS

#### 3-74. 1000:1 Divider Network

3-75. Sense voltage for the 5200A is divided down to the required level by the 1000:1 divider network. The high voltage on the sense line is applied to the 1.0009M resistor (R304) and divided by 1.019K (R303) and the shunt resistors R8 and R9 to give a 1000:1 ratio. Resistors R303 and R304 are deposited on a substrate to provide good thermal tracking which keeps the division ratio constant with temperature and self-heating. The substrate is mounted in a milled aluminum can for heat dissipation and must be replaced as a unit.

#### 3-76. Buffer Amplifier

3-77. A unity gain amplifier (U12) is used to drive the coaxial cable carrying the divided signal to the 5200A. During instrument overload, input to the Buffer Amplifier comes from the 10:1 divider amplifier in the overload circuit. R14, R15, C14 and C15 provide frequency compensation for the divider and buffer network.

### 3-78. OVERLOAD CIRCUITS

#### 3-79. Slew Rate Sense Amplifier

3-80. If the difference in the slew rate voltage between the input amplifier rate and an output sample rate exceeds a voltage detected by a differential amplifier (125mV) a trigger is provided to the one-shot multivibrator, putting the instrument into overload. The input signal is taken from the emitter of Q148, divided 10:1 by R110 and R109 and

applied to one input of the differential amplifier Q104. The other input to Q104 is a sample of the output as developed across R108 and R111 and coupled from the sense line by C91. Q105 is a 5mA current source, provided 2.5mA to each side of the differential amplifier. Q103 and Q106 each provide 3.75 mA to the collectors of the differential amplifier. As a result both Q101 and Q102 are biased off, as long as the differential is balanced. When the differential input to the amplifier reaches 125mV either Q101 or Q102 turns on and provides an input to the one-shot multivibrator Q92 and Q93, thereby, putting the instrument into the overload mode.

### 3-81. One-shot

3-82. In the one-shots quiescent state, Q92 is conducting and A93 is cut off. When triggered by the slew rate sense amplifier a 5 Volt pulse is provided from the collector of Q93 to the gate drive circuit for a 4mSec period.

### 3-83. Gate Drive

3-84. Transistors Q37, Q42, Q43, Q44 and their associated components comprise the Gate Drive Circuit. When the one-shot is triggered the resulting pulse turns on Q42 and Q37, enabling the gate of the FET switch Q7 and connecting the 10:1 divider to the buffer amplifier. Q43 is turned on from Q42 which turns off the input FET switch and removes the input signal from the input amplifier. Q43 can also be turned on from the Logic Circuit (Q45) to prevent the input signal from reaching the input amplifier when the instrument is in standby.

### 3-85. 10:1 Divider Amplifier

3-86. With the instrument in overload it closes the loop back to the 5200A, preventing the 5200A control loop from developing large errors when there is no feedback signal from the 5205A. Gain of the amplifier, U7, is set by the ratio of R7 (5.23K) to R6 (49.9K) which equals 0.105. Application of the amplifier to the buffer amplifier is controlled by the 5200A FET switch.

### 3-87. 5200A FET Switch

3-88. When an overload condition enables the gate drive the 5200A FET Switch Q7 is turned on, providing a path for the 10:1 divider amplifier output to the 1000:1 divider network. This low impedance output overrides the signal from the 1000:1 divider network, closing the loop to the 5200A. When the overload is removed the FET Switch will automatically turn off after a 3.5 msec delay.

### 3-89. LOGIC CIRCUITS

3-90. These circuits provide the decoding logic for the control inputs and supply the status outputs to the Logic

pcb. Input are the 5200 CONTROL and 5205 OPERATE COMMAND. The former determines whether the 5200 or Front panel input will be accepted while the latter sets the mode of operation. Status signals output are called OVERDRIVE, NEG HV and OVERLOAD.

### 3-91. Logic Control

3-92. The 5200 CONTROL input is low in the local mode of operation, activating half of the Optical coupler U51, turning on Q51 and energizing the relay K1. The contacts of K1 select the point of origin for the signal into the Input FET Switch. With K1 energized the input comes from the Front Panel Connector, deenergized from the 5200A input connector. The 5205 OPERATE COMMAND is low for operate, activating the other half of U51. With the coupler transistor on, both Q45 and Q43 will be off, allowing the Input FET switch to turn on and the instrument to go into operate.

3-93. When an overload condition exists Q37 in the Gate Drive circuitry turns on, turning on Q40 and activating half of the coupler U52. With the coupler transistor on OVERLOAD goes low, providing a status output to the logic pcb.

### 3-94. $\pm 1700V$ Comparator

3-95. The output voltage is sampled and divided by R59 (9.53m) and R67 (56.2K) then applied to one input of the comparators V64 and V65. A +10V reference from the divider R63 and R64 is applied to the other input of U64. Divider R66 and R65 supply a -10V reference to comparator U65. As long as the output voltage is less than  $\pm 1700$  Volts the outputs of both U64 and U65 stay high allowing current to flow in Q62 and U62, and in U52, provided the output of U167 is low. When the output exceeds  $\pm 1700$  the appropriate comparator output goes low, turning off Q62, U62 and U52. With no current flow in U52 and U62 the OVERDRIVE and NEG HV logic signals to the Logic pcb go high, setting the NEG HV logic signals to the Logic pcb to high, setting the instrument to Standby and opening the input FET switch. With no input the output should drop to zero and Q62 turn on again for a normal overload. If the overload remains after one second it is an indication of a malfunction and a fault results.

### 3-96. Negative High Voltage Sensor

3-97. The negative high voltage is sampled by the divider R170 through R174 and R167 and applied to one input of the comparator U167. The other input has a +5 Volt reference from the zener VR166 and the divider R157, R154 and R156. As long as the negative high voltage is more negative than -2225 Volts the output of U167 is low and current flows through the coupler U52. If the output becomes less negative than -2225 a high output results at the coupler U52, setting the instrument to standby.

### 3-98. $\pm 15V$ Power Supplies

3-99. A 31V rms input from the Auxiliary power supplies is rectified by CR70 to produce  $\pm 20V$  unregulated. This is filtered by C70 then Q79 is a series pass to reduce it to +15V dc. The +15V is sampled by the divider R80, R81 and R82 and compared to the reference in U79. Any difference between the reference and the sample is amplified by U79, driving the base of Q79 to keep the output at +15 Volts. R79 is the current sense resistor which allows U79 to limit the output current to 160 mA.

3-100. The -15 Volts is obtained from the unregulated supply through the filter C71 and the series pass transistor Q76. The +15 is used as a reference and is connected to the op amp U75 through R73. The -15 is connected to U75 through R74 and since both resistors have the same value the input to the amplifier at the R73/R74 tie-point is zero when the negative output is -15 Volts. Any difference will be applied to the base of Q76 to return the negative output to -15 Volts. Q77 is a current limiter to hold the maximum output current to 80 mA.

### 3-101. Power Amplifier Assembly

3-102. The Power Amplifier, as shown in Figure 3-3, is basically a class AB push-pull type amplifier. The upper tubes (V1 and V2) are connected in parallel to provide sufficient output current capability for the positive portion of the output. The Lower tubes (V3 and V4) are connected in the same manner for the negative portion of the output. The low output impedance in the output stage is achieved by using a complementary emitter-follower output driven by the Input FET Q4. Bias is provided by a network consisting of Q8 and its associated components. The upper tubes have their screen and control grids indirectly connected to the output terminals so the cathode output of the tubes is always slightly higher than the output voltage. This protects the drain of the input FET (Q4) and the collector of the NPN half (Q11) of the complementary emitter follower in the output stage. As a result, the voltage from the output terminal to the tube cathodes is in the range of 5 to 40 volts, which provides adequate breakdown protection for the solid state components. The Lower tubes and the Lower tube driver (Q150) are controlled by an auxiliary feedback loop, using the light coupler (U165). The purpose of this loop is to control the base to collector voltage of the PNP half of the emitter-follower (Q12) to approximately 5 volts. This has been accomplished by arranging the feedback so that current through the 30mA current source (Q14) remains constant, which provides the input to the zener VR15, which in turn sets the 5 volts for Q12 in the output stage. As long

as the output capability of the amplifier is not exceeded and current flows in the 30mA current source the circuit is able to hold the Q12 base-to-collector voltage almost constant.

3-103. The signal path through the circuit is detailed in the following procedure. It is assumed that the LED loop is stabilized with 30 mA of current through the LED prior to an input signal. When a small negative voltage is applied to the circuit as an input the FET Q4 acts as a source follower and translates the change in voltage directly to the bases of the output followers Q11 and Q12. The immediate response is to decrease the current in Q11 and increase it in Q12, as determined by the output load. Since the loop is stabilized the plates of the V3/V4 combination are an extremely high impedance, the increasing current in Q12 flows into the emitter of the LED driver Q14, decreasing the current through the LED. As a result, the current in the PIN half of the coupler is decreased and the net input current to the amplifier  $A_0$  is negative. This slews the input node capacitance of approximately 42pF negative, resulting in a positive output at the base of Q150, which is effectively connected in cascade with the V3/V4 combination. This increases the plate current through V3/V4, which tends to return the current through Q14 to its nominal 30mA value. The total current excursion in the LED diode is proportional to the time derivative of the total negative tube current. With the approximate transfer ratios and circuit values shown in the simplified schematic (Figure 3-3) the bandwidth of the light coupled loop is approximately 2.5MHz. In actual usage the loop bandwidth is set to 2.5 MHz by adjusting C162 for 30mA peak-to-peak in the LED with a 100 ohm load at 100 kHz.

3-104. In normal operation the nominal 2.2V dc bias (Q8 and associated components) between the bases of the complementary output followers is adjusted so that 30mA of current is flowing through Q12 and 65mA through Q11. The extra 35mA in Q11 is required to provide the current used by the current sources Q17 and CR5. The currents in these sources does not return to the output node of the amplifier but ends up flowing through the driver tube plate and the plates of the negative drive tubes. When the output load requires a very small current excursion the amplifier remains in a class A configuration with both Q11 and Q12 slightly on. As the output current raises in the positive direction the current through Q12 decreases and is completely cutoff when the output exceeds +60 mA. For more positive current all the remaining current necessary comes from Q11 and the positive drive tubes V1/V2. Conversely, Q11, is cutoff for negative output currents in excess of 130mA and the current is provided from Q12 and the plates of the negative drive tubes V3/V4.



Figure 3-3. SIMPLIFIED POWER AMPLIFIER SCHEMATIC DIAGRAM

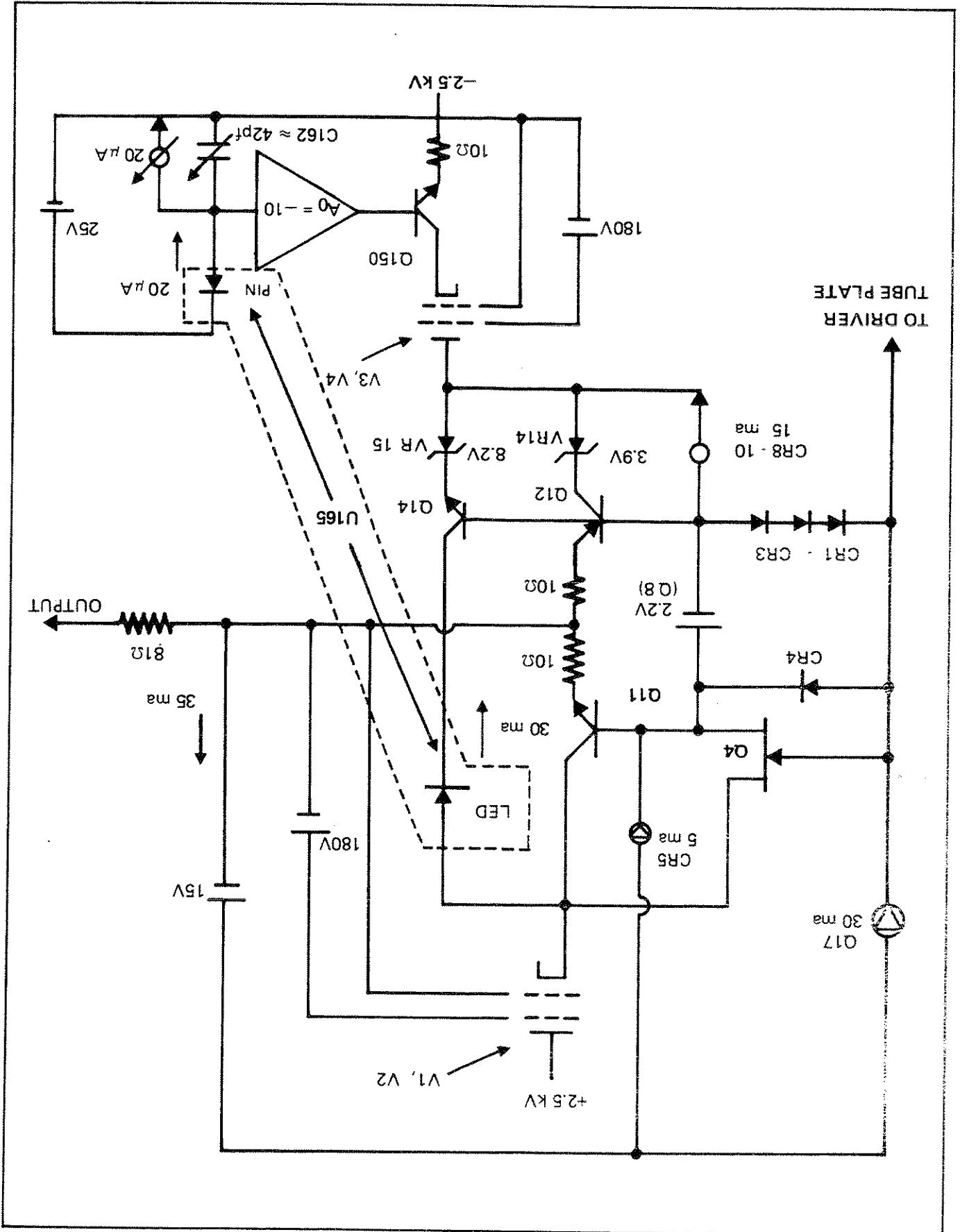
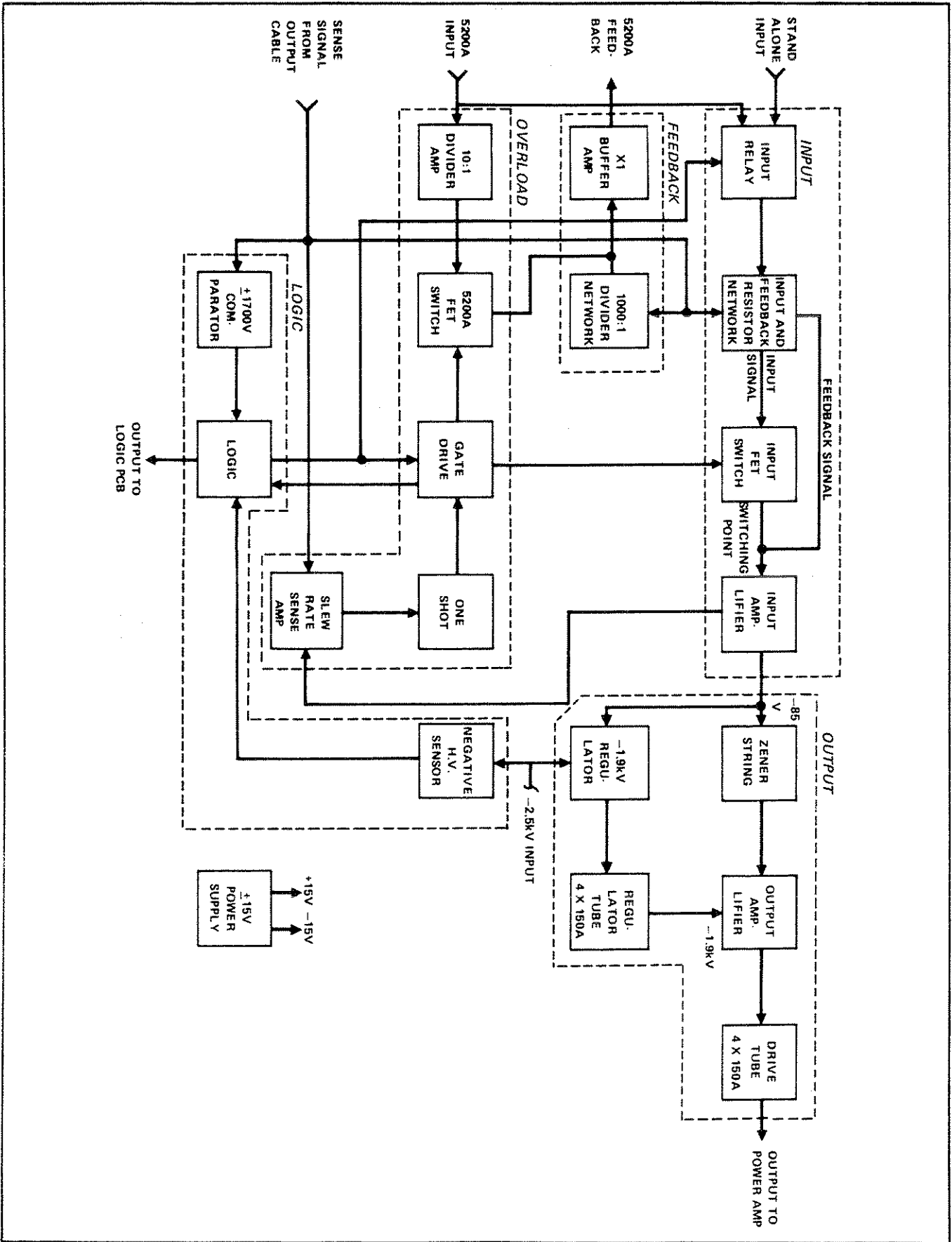


Figure 3-2. PRE-AMPLIFIER BLOCK DIAGRAM



## Section 4

# Maintenance

### WARNING!

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

#### 4.1. INTRODUCTION

4-2. This section contains information on General Maintenance, a Performance Verification test, a Calibration procedure and Troubleshooting information. The calibration procedure should be performed on a periodic basis (90 days) to detect the need for and to make required adjustments. The performance verification test can be used upon receipt of the 5205A and any other time desired to verify the correct operation of the equipment. The troubleshooting procedures will aid in the isolation of a fault to a particular pcb assembly and further, to a circuit or particular section of the pcb.

#### 4.3. SERVICE INFORMATION

4-4. Each instrument that is manufactured by the John Fluke Mfg. Co., Inc. is warranted for a period of one year upon delivery to the original purchaser. The WARRANTY is located at the front of the manual.

4-5. Factory authorized calibration and service for each Fluke product is available at various world-wide locations. A complete list of domestic service centers is located in Section 7 of this manual. Shipping information is given in Section 2. If requested, an estimate will be provided to the customer before any repair work is begun on instruments that are beyond the warranty period.

#### 4.6. GENERAL MAINTENANCE

##### 4.7. Cleaning Instructions

4-8. Periodically (at least every 90 days) clean the 5205A to remove dust, grease and other contaminants using the following procedure:

- a. Insure power is removed from the 5205A.
- b. Remove the top and bottom covers and the internal top covers from the power supply and instrument compartments.
- c. Remove the air filter from the rear of the fan compartment. Clean the filter using either low pressure clean dry air or a water and mild detergent solution.
- d. Clean the interior of the 5205A using low-pressure clean dry air or a vacuum cleaner.
- e. If required, clean the pcb assemblies by spraying them with anhydrous ethyl alcohol to loosen the dirt and then removing all residue with low pressure clean dry air. Allow at least six hours for drying time before reapplying power to the 5205A.
- f. Clean the front panel and exterior surfaces with anhydrous ethyl alcohol or a soft cloth dampened with a mild solution of detergent and water.

##### 4-9. Fuse Replacement

4-10. Listed below are the correct replacements for the Line Power Fuses. Use only the correct rating as a replacement, dependent upon the supply voltage:

- a. Line voltage 100 or 115 volts:
  - High Voltage — MDA 15 amp
  - Aux Power — MDA 5 amp
- b. Line voltage 200 or 230 volts:
  - High Voltage — MDA 8 amp
  - Aux Power — MDA 2 amp

#### 4-11. Line Voltage Selection

4-12. The 5205A can operate from any one of four possible line voltages. Selection between 100, 115, 200, or 230 is performed by a combination of jumper positionings which may be changed locally if required. The jumpers may be set to the desired configuration using the procedure given in Section 2 under the heading of Input Power.

#### CAUTION!

Lethal voltages of up to  $\pm 4000V$  are present within the instrument for up to thirty seconds after power is removed from the system. Extreme caution should be exercised any time that the inner covers are removed from the instrument for servicing

#### 4-13. Lamp Replacement

4-14. The indicators on the 5205A consists of both incandescent lamps and Light Emitting Diodes (LEDs). If replacement is required, use the following procedures:

#### 4-15. INCANDESCENT LAMP REPLACEMENT

- a. Insure power is disconnected from the 5205A.
- b. Remove the top cover.
- c. The INSTRUMENT ON and OPERATE indicators are dual incandescent lamps mounted on individual plug-in assemblies. To remove, reach down in the space between the front panel and logic board and grasp the desired pcb and remove by pulling straight up.
- d. Replace the defective lamp and reassemble the instrument in the reverse order.

#### 4-16. LED REPLACEMENT

- a. Insure power is disconnected from the 5205A.
- b. Remove the POWER, CONTROL and MODE knobs on the front panel from their shafts using a .050 allen type hex wrench.
- c. Remove the top cover and the front three screws from the bottom cover.
- d. Remove the five screws on each side from under the side decals that secure the front handles and front panel to the mainframe.
- e. The front panel is now free to be moved away from the logic pcb for access to the LEDs.

- f. Remove the LEDs requiring replacement from the extension sockets and replace.
- g. After replacement reassemble the 5205A in reverse order.

#### 4-17. Access to the Mainframe PCB Assemblies

#### 4-18. PRELIMINARY PROCEDURES

4-19. The following procedure should be performed prior to removing any pcb from the instrument.

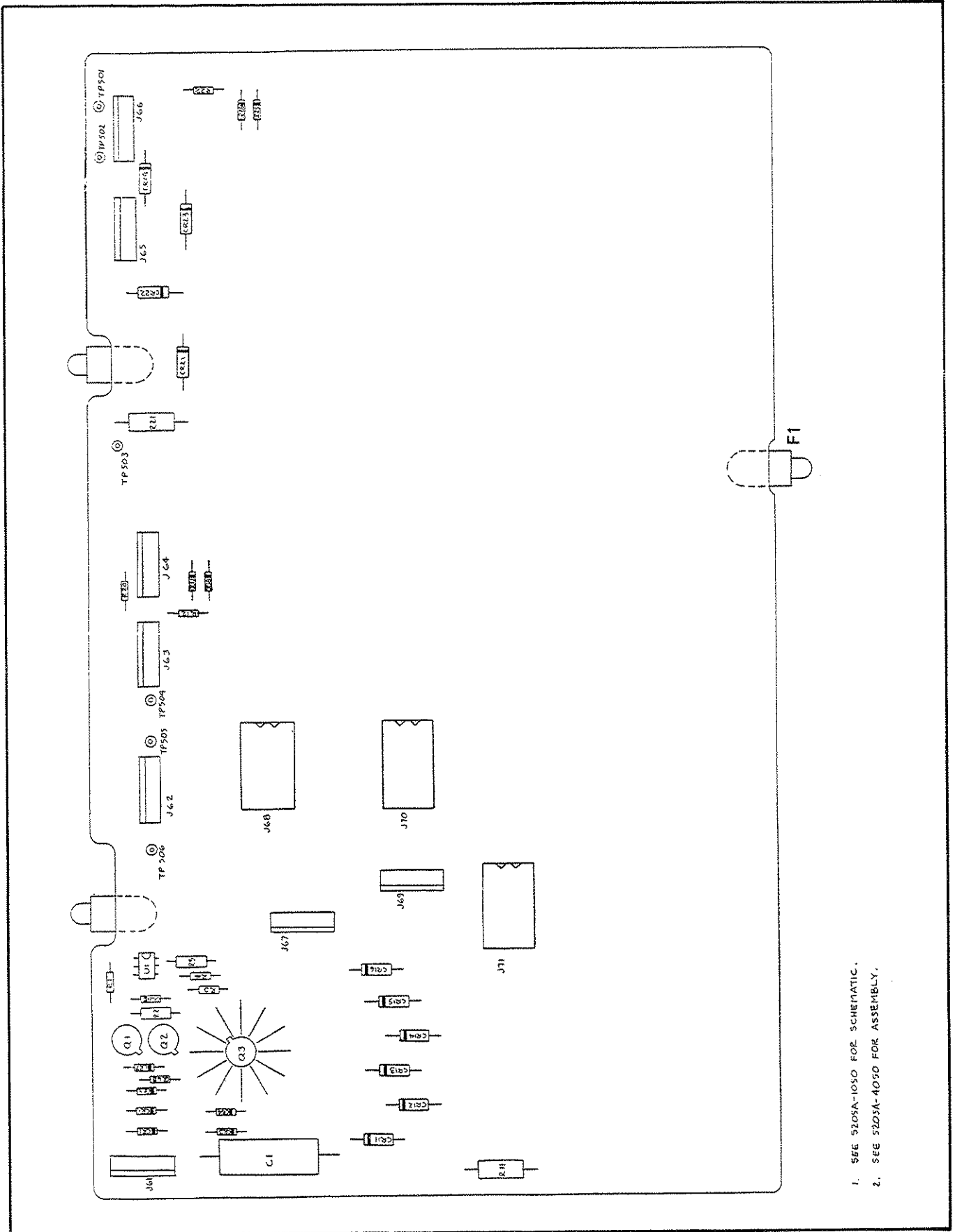
- a. Disconnect both line power cords from the line power source.
- b. Extremely hazardous voltages are present within the instrument for up to 30 seconds after removal of power. Wait for at least this period before continuing.
- c. Remove the top outer cover from the instrument.
- d. As a safety precaution, insure no stray voltages are present in the power supply, shorting TP501 to TP502, TP 504 to TP 506 and TP 505 to TP 506. These test points are on the power supply pcb and their locations are shown in Figure 4-1.
- e. Proceed to the paragraph pertaining to the particular pcb to be removed.

#### 4-20. POWER SUPPLY ASSEMBLY REMOVAL

- a. Remove the transformer cover from the left side of the instrument.
- b. Disconnect the Molex connections from the transformer and power wiring.
- c. Grasp the plastic retainers and gently rock the pcb while moving it upward. Once free of the motherboard, lift it out of the instrument compartment.
- d. Reverse the procedure to replace the pcb.

#### 4-21. PREAMPLIFIER ASSEMBLY REMOVAL

- a. Remove the Tube Chamber and Power Amplifier covers from the right side of the instrument compartment.
- b. Remove the right side panel by removing the screws, then grasp firmly at each end and pull straight up.
- c. Remove the shield over the preamplifier assembly by removing the screws and gently lifting it off.



- 1. SEE 5205A-1050 FOR SCHEMATIC.
- 2. SEE 5205A-4050 FOR ASSEMBLY.

Figure 4-1. POWER SUPPLY TEST POINT LOCATIONS

- d. Disconnect the three coaxial connectors (J24, J25, J26) from the upper front of the assembly.
- e. In the tube chamber disconnect the coaxial cable center conductor & cable shield connectors. These leads connect the preamplifier to the power amp. They should be removed by grasping the connector with a pair of pliers and pulling straight out, toward the front of the instrument.
- f. On the Power Amp Upper Tube pcb remove the four screws that retain the Sense cable coming from the preamplifier.
- g. Grasp the plastic retainers and gently rock the preamplifier assembly while moving it upward. Once free from the motherboard lift it out of the instrument compartment.
- h. Reverse the procedure to replace the assembly.

#### 4-22. POWER AMPLIFIER ASSEMBLY

- a. Remove the tube chamber and Power Amplifier chamber covers from the right side of the instrument compartment.
- b. In the Preamplifier tube chamber remove the Coaxial cable center conductor and cable shield connections. These leads connect the power amplifier to the preamplifier. They should be removed by grasping the connectors with a pair of pliers and pulling straight out, toward the front of the instrument.
- c. On the Upper Tube Assembly remove the four screws that connect the output cable to the pcb. Repeat the procedure for the sense cable to the preamplifier.
- d. Disconnect the molex connector on the Upper Tube pcb going to the Low Capacity Transformer.
- e. Grasp the plastic retainers and gently rock the assembly while moving it upward. Once free from the motherboard lift it out of the instrument compartment.
- f. If required, the assembly can be broken down to its individual pcb's. The Upper tube pcb (5205A-4030) is connected to the Lower tube pcb (5205A-4031) and the Tube Mounting Assembly (5205A-4033) with screws along the edge. The Lower Tube pcb is connected to the tube mounting assembly with screws to conducting spacers permanently attached to the tube mounting assembly.
- g. Reverse the procedure to replace the assembly.

4-4

#### NOTE

*The top inner covers have labeled adjustment ports to facilitate the calibration procedure. All calibration points can be reached through these ports. For troubleshooting the right side cover and front panel can be removed for easy access to the preamp and logic pcb's respectively.*

#### 4-23. Access to the Logic PCB Assembly

4-24. Use the following procedure for access to the logic pcb assembly.

- a. Insure power is disconnected from the 5205A.
- b. Remove the POWER, CONTROL and MODE knobs on the front panel from their shafts.
- c. Remove the top cover and the front three screws from the bottom cover.
- d. Remove the five screws, one each side, from under the side decals that secure the front handles to the front panel.
- e. Move the front panel away to gain access to the logic pcb. Insure the output cable has sufficient slack to lay the front panel down flat on the work area.
- f. Remove the seven screws connecting the pcb to the mainframe and carefully remove the pcb.
- g. Reverse the procedure to replace the Logic PCB.

#### 4-25. PERFORMANCE VERIFICATION CHECKS

##### 4-26. Introduction

4-27. The following paragraphs contain a performance verification procedure. These tests may be used as an acceptance test upon original receipt of the equipment, to verify calibration at any time prior to a scheduled calibration cycle or as an aid in troubleshooting.

4-28. The test equipment required for the performance test is listed in Table 4-1. If the recommended equipment is not available replacements with equivalent specifications may be used.

4-29. In addition to the test equipment recommended in Table 4-1, accessory items required to check the performance of the 5205A are listed in Table 4-2. These are common items which may be easily obtained or fabricated locally.

Table 4-1. TEST EQUIPMENT

<p>Test Oscillator</p> <p>RMS Differential Voltmeter</p> <p>Thermal Transfer Standard</p> <p>Coaxial Thermal Converter</p> <p>Digital Voltmeter (5½ digit)</p> <p>Digital Voltmeter* (Battery Operated)</p> <p>DC Calibrator</p> <p>Oscilloscope*</p> <p>Autotransformer*</p>	<p>Fluke Model 5200 (Calibrated within 90 days)</p> <p>Fluke Model 931B</p> <p>Fluke Model 540B</p> <p>CPD Engineering (Formerly Holt Instrument Laboratories) Model 11. Only the thermoelement (PN 90081C), the Resistor Assy (PN 90080E) and the Transfer Switch Assy (PN 85072) are required from the Model 11 series to perform these tests.</p> <p>Fluke Model 8800A</p> <p>Fluke Model 8000A or 8600A</p> <p>Fluke Model 332D or 335D</p> <p>Tektronix Model 7403 with/ 7A18 Amplifier, 7B52 Dual time base, P6042 DC Current Probe</p> <p>100:1 1500V rms rated Voltage probe</p> <p>10:1 500V rms rated Voltage probe</p> <p>Variac - rated – 18A at 100/115V - 10A at 200/230V</p>
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\* Used during Calibration only

Table 4-2. TEST ACCESSORIES

<p>1500 pF capacitive load</p> <p>250 pF capacitive load</p> <p>100 pF capacitive load</p> <p>5000Ω resistive load</p> <p>100Ω resistive load*</p> <p>50Ω termination</p> <p>Jumper pcbs (3 ea)</p> <p>Insulated Trimming Tool*</p> <p>Adaptor - Banana Jack to BNC</p> <p>Coaxial Cable</p> <p>Jumper leads*</p> <p>Thermal Transfer Standard to Thermoelement interconnect cable</p>	<p>Vitramon High Current porcelain capacitor, type VY84C152J</p> <p>Vitramon High Current porcelain capacitor, type VY82C251J</p> <p>Vitramon High Current porcelain capacitor, type VY81C101J</p> <p>2 Resistors, Wire Wound, 10,000Ω ±5%, 225W Ohmite Type 0916 connected in parallel.</p> <p>Resistor, metal film, 100Ω ±1%, 15W CADDOCK Type, MP311</p> <p>Resistor 50Ω HP-10100C or equivalent</p> <p>Used to maintain bias condition with low input line power during calibration. Three are provided with the instrument. Additional or replacement jumpers may be ordered using Fluke part number 400762 (Drawing 5205A-3080).</p> <p>Rated at 4kV minimum - Recommended: JFD Adjustment tool 5284, Fluke PN 153049</p> <p>UG 1094-U Provide Connection between 5200A output and 5205A local input</p> <p>Male BNC connector on each end – not to exceed 6 ft. in length</p> <p>Standard leads with alligator clips on both ends for jumpering test points.</p> <p>Construct an interconnect cable using the listed materials or an equivalent: Connect pin 3 of Amphenol connector 91-MC3M to pin A of connector MS3106A10SL-4S using one lead of Belden type 8422 cable not exceeding 3 feet in length. Connect the second lead between pins 1 and B respectively of the connectors. Connect the cable shield to the shell of the MS3106A10SL-4S connector. Secure the cable using clamp MS3057-4A.</p>
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\* Used during Calibration only.

### 4-30. Equipment Set-Up

4-31. Perform the following procedure prior to beginning any operation. The equipment should have a warm-up period of at least one hour prior to performing any test.

- Insure the strap connecting the 5205A OUTPUT LOW and chassis ground terminals is firmly in place.
- Insure that power is applied to the 5205A, the POWER switch is ON and the WARM-UP indicator has extinguished.
- Set the CONTROL switch to the position required for the mode to be used. LOCAL for the Local mode or REM-5200 for the Remote or Calibrator mode.
- Set the MODE switch to STDBY-RESET.

### 4-32. Local Mode

4-33. Before starting the test procedure insure the equipment set-up procedure in paragraph 4-30 has been completed. Perform each step of the test in turn, using the following procedures:

#### 4-34. RANDOM NOISE TEST

- Insure the CONTROL switch is in LOCAL.
- Terminate the 5205A input with either a 50-ohm resistor or a short circuit.
- Connect the output terminals to the AC differential voltmeter.
- Set the MODE switch to OPERATE.
- The differential voltmeter reads less than 120mV rms.
- Set the MODE switch to STDBY-RESET.

#### 4.35 DC OFFSET TEST

- Connect the output terminal to the test DVM.
- Set the MODE switch to OPERATE.
- The test DVM reads less than 10 mV dc.
- Remove the 50 ohm resistor or short from the input connector.
- The test DVM reads less than 10 mV dc.
- Set the MODE switch to STDBY-RESET.

#### 4-36. DC GAIN

- Apply +10 Volt dc input from the DC Calibrator.
- Connect the 5205A output terminals to the test DVM.
- Set the MODE switch to OPERATE.
- The Test DVM reads between -999.6V dc and -1000.4V dc.
- Set the MODE switch to STDBY-RESET.
- Remove the dc input and test DVM.

#### 4-37. MIDDLE FREQUENCY GAIN

- Connect the test equipment as shown in Figure 4-2.

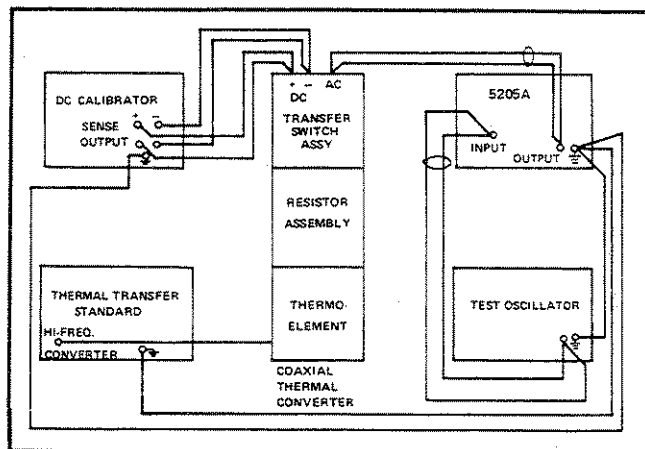


Figure 4-2. LOCAL AND REMOTE MODES CONNECTIONS.

#### NOTE

Use the Thermal Transfer Standard to adjust the Test Oscillator within the stated tolerances during the LOCAL MODE tests.

- Apply a 10V ac  $\pm 0.01\%$  20 kHz local input to the 5205A from the test oscillator.
- Set the 5205A MODE switch to OPERATE.
- Using the thermal transfer method verify the 5205A output is equal to 1000V ac  $\pm 0.04\%$ .
- Set the 5205A mode switch to STDBY.
- Wait at least 30 seconds, then apply a 5k ohm/100 pF parallel load to the 5205A output terminals.
- Repeat steps c, d and e above.
- Wait at least 30 seconds, then apply a 1500 pF load to the 5205A output terminals.



- i. Repeat steps c, d and e above, substituting 1000V ac  $\pm 0.1\%$  for the value in step d.
  - j. Remove the applied load.
- 4-38. HIGH FREQUENCY GAIN
- a. Leave the equipment connected as shown in Figure 4-2.
  - b. Change the test oscillator output frequency to 100 kHz. Verify with the Thermal Transfer Standard, the output is 10V ac  $\pm 0.01\%$ .
  - c. Set the 5205A MODE switch to OPERATE.
  - d. Using the thermal transfer method, verify the 5205A output is equal to 1000V ac  $\pm 0.14\%$ .
  - e. Set the 5205A MODE switch to STDBY.
  - f. Wait at least 30 seconds, then apply a 5K ohm/100 pF parallel load to the 5205A output terminals.
  - g. Repeat steps c, d and e above.
  - h. Set the test oscillator output at 1.8V  $\pm 0.01\%$  and verify with the thermal transfer standard.
  - i. Wait at least 30 seconds, then disconnect the thermal test equipment and connect the rms differential voltmeter across the 5205A output terminals.
  - j. Set the 5205A MODE switch to OPERATE and adjust the rms differential voltmeter for a null reading.

**WARNING!**

Observe all safety requirements before applying a load to an operating instrument. Do not come in physical contact with the load at any time.

- k. Apply the 1500 pF load to the 5205A output, insuring the deviation from the null does not exceed  $\pm 1.05\%$ .
- l. Set the 5205A MODE switch to STDBY. Wait at least 30 seconds then remove the applied load and test equipment.

**4-39. Output Current Test Procedure**

4-40. Before starting the test procedure insure the equipment set-up procedure in paragraph 4-30 has been completed. Perform each step of the test in turn using the following procedures:

- a. Terminate the 5205A output with a 250 pF load.
- b. Apply an 11V ac 105 kHz signal to the local input connector from the Test Oscillator.
- c. Set the 5205A MODE switch to OPERATE.
- d. If FAULT and/or OVERLOAD occurs perform the 5205A calibration procedure.

**4-41. Calibrator Mode Test Procedure***NOTE*

*If the 5205A will not be used in the Calibrator mode; that is, slaved to a 5200A, the Calibrator mode Test may be omitted.*

4-42. Prior to shipment each 5205A is adjusted at the factory against a reference 5200A so that the amplitude error due to the 5205A is less than approximately 0.01%. If the 5200A used in this procedure is within specifications the 1000 Volt Range will meet the accuracy specification.

4-43. Before starting the test procedure insure the equipment set-up procedure in paragraph 4-30 has been completed. Connect the previously calibrated 5200A to the 5205A using the special interconnect cable (P/N 341560) provided with the 5205A Accessory Pack. Perform each step of the test in turn using the following procedure:

- a. Initial 5205A Switch Settings  
POWER: ON (30 secs warmup period elapsed)  
CONTROL: REM-5200  
MODE: STDBY-RESET
- b. Initial 5200A Switch Settings  
POWER: ON (30 secs delay elapsed)  
MODE: STDBY  
CONTROL: LOCAL  
PHASE-LOCK: OFF  
SENSE: INT  
VOLTAGE ERROR: OFF  
VOLTAGE RANGE: 1000V  
FREQUENCY RANGE: 10 kHz  
VOLTAGE MAGNITUDE: 1000V  
FREQUENCY MAGNITUDE: 1kHz
- c. Connect the test equipment as shown in Figure 4-3.
- d. Set the 5200A MODE switch to OPER. Both the 5200A and 5205A OPERATE indicators illuminate.
- e. Using the thermal transfer method verify the 5205A output is equal to 1000V ac  $\pm 0.042\%$ .
- f. Change the 5200A output frequency to 100 kHz on the 100 kHz range.
- g. Using the thermal transfer method verify the 5205A output is equal to 1000V ac  $\pm 0.11\%$ .
- h. Set the 5200A MODE switch to STDBY and the Frequency output to 1 kHz.
- i. Wait at least 30 seconds, then apply a 5K $\Omega$ /100 pF parallel load to the 5205A output terminals.

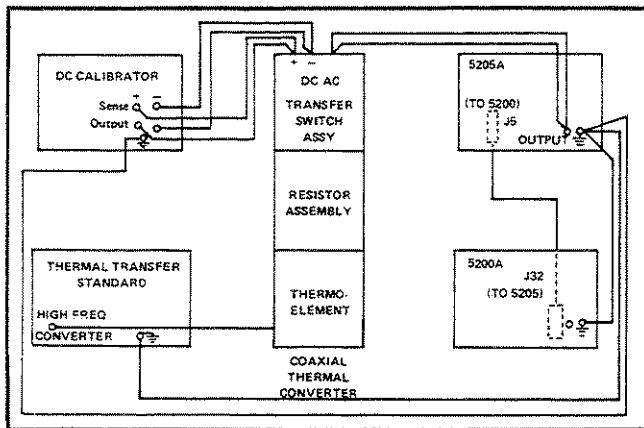


Figure 4-3. CALIBRATOR MODE CONNECTIONS

- j. Repeat step d through h.
- k. Wait at least 30 seconds, then apply a 1500pF load to the 5205A output terminals.
- l. Repeat steps d and e.
- m. Set the 5200A MODE switch to STDBY.
- n. Wait at least 30 seconds then remove the 1500 pF load and apply a 250 pF load.
- o. Repeat steps d, f and g, omitting step e.
- p. Set the 5200A MODE switch to STDBY. Wait at least 30 seconds and disconnect the test equipment.

#### 4-44. CALIBRATION PROCEDURES

##### 4-45. General

4-46. The 5205A Calibration procedure should be performed at least every 90 days or any time that a component is replaced. The recommended test equipment and accessories are listed in Tables 4-1 and 4-2. The internal layout is shown in Figure 4-4 while the test point and adjustment locations for the Power Amplifier, Preamplifier and Logic pcb are shown in Figures 4-5, 4-6 and 4-7 respectively.

4-47. Each main division in this procedure begins with a step verifying that all controls and test equipment is in the proper configuration prior to beginning the check. This added precaution is required because of the lethal voltages which can reach 4000 volts internally and 1500V on the output terminals. Since these extremely high voltages are present extra care should be taken to insure that conductive items, such as screwdrivers, pliers or fingers are not inserted into the instrument compartment. Care should also be taken to prevent foreign objects from falling into the instrument since they may decrease the voltage breakdown capability of the inner circuitry. When replacing the top cover or right side panel after adjustments check the inside of the instrument very carefully to insure there are no loose screws, pieces of solder or other objects left behind. Use only non-conductive trimming tools, rated at 4kV minimum for any internal adjustments.

#### 4-48. Oscilloscope Preparation

##### 4-49. MAINFRAME AND PROBE CALIBRATION

4-50. Prior to beginning the 5205A Calibration check the DC zero level on the scope display. Also verify the calibration and AC response of the 100:1 and 10:1 probes when they are connected to the channel on which they are to be used.

##### 4-51. CURRENT PROBE CALIBRATION

4-52. The Tektronix P6042 DC Current probe must be calibrated at zero current each time it is used. Use the following procedure to prepare the current probe for use each time it is connected to the scope mainframe.

- a. Connect the P6042 output with a 50Ω BNC cable to the oscilloscope, using an HP-10100C 50Ω feed through resistor at the oscilloscope input.
- b. Turn on the oscilloscope and current probe power and allow them to warm-up for at least five minutes, preferably 30 minutes.
- c. Set the oscilloscope controls as follows:  
Volts/div - 50 mV  
Variable (Volts/div) - Calibrated  
Input Coupling - Ground
- d. Set the Current Probe controls as follows:  
Output DC level - Midrange  
Current/div Balance - Midrange  
Current/div - 1A
- e. Center the trace vertically on the CRT, then switch the input coupling to DC.
- f. Push the thumb-controlled portion of the probe into the locked position. When the slider is in the locked position the shield around the transformer core is grounded, the PROBE UNLOCKED light is extinguished and the amplifier is ready for operation.
- g. Place the probe fully into the front-panel receptacle. Momentarily (200 milliseconds minimum) depress the DEGAUSS lever and release.
- h. Adjust OUTPUT DC LEVEL to center the trace vertically on the CRT.
- i. Set the CURRENT/DIV switch to the desired position (in most tests it is 10mA/div) and again degauss the probe.
- j. Adjust CURRENT/DIV BALANCE to center the trace vertically on the CRT.

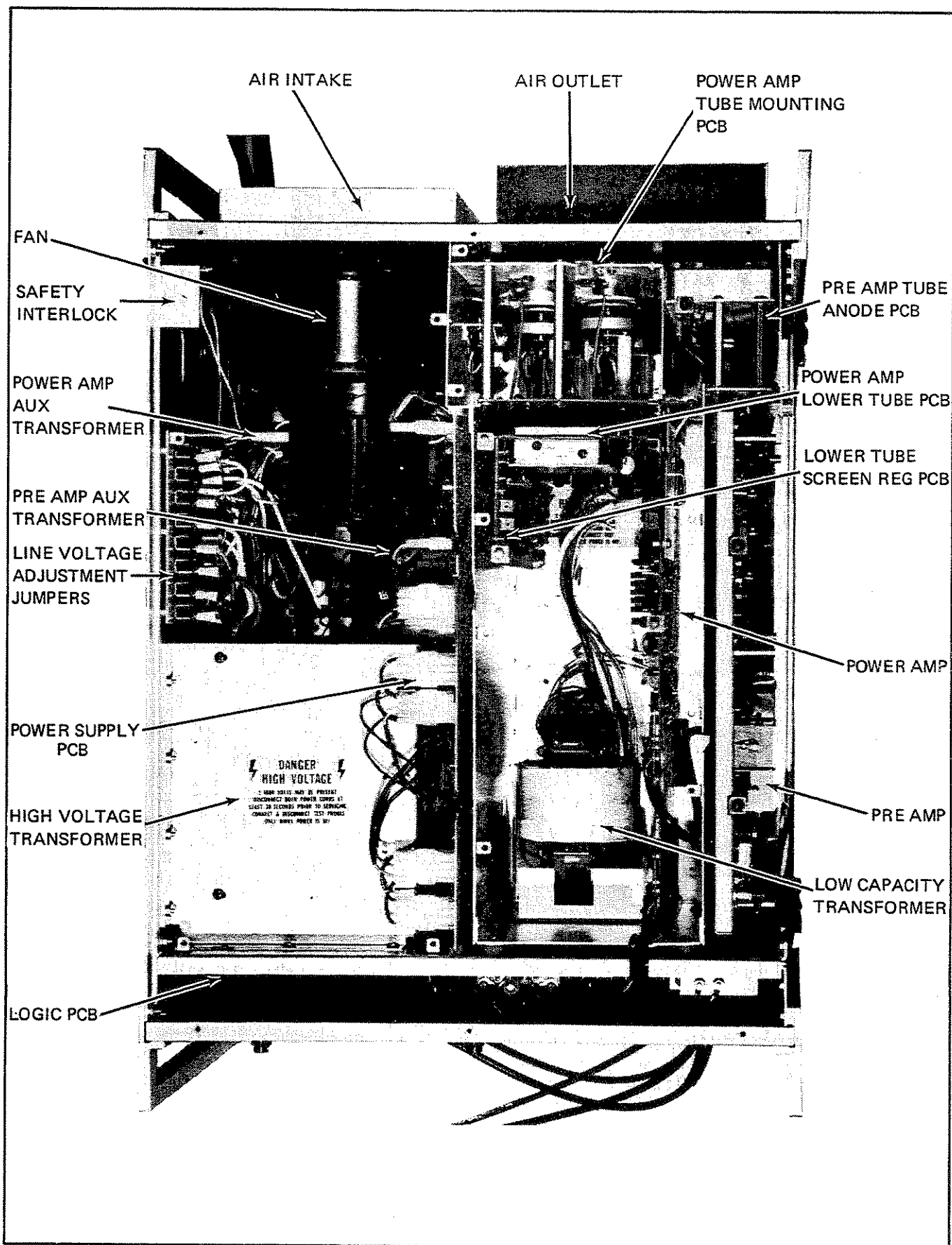


Figure 4-4. INTERNAL LAYOUT

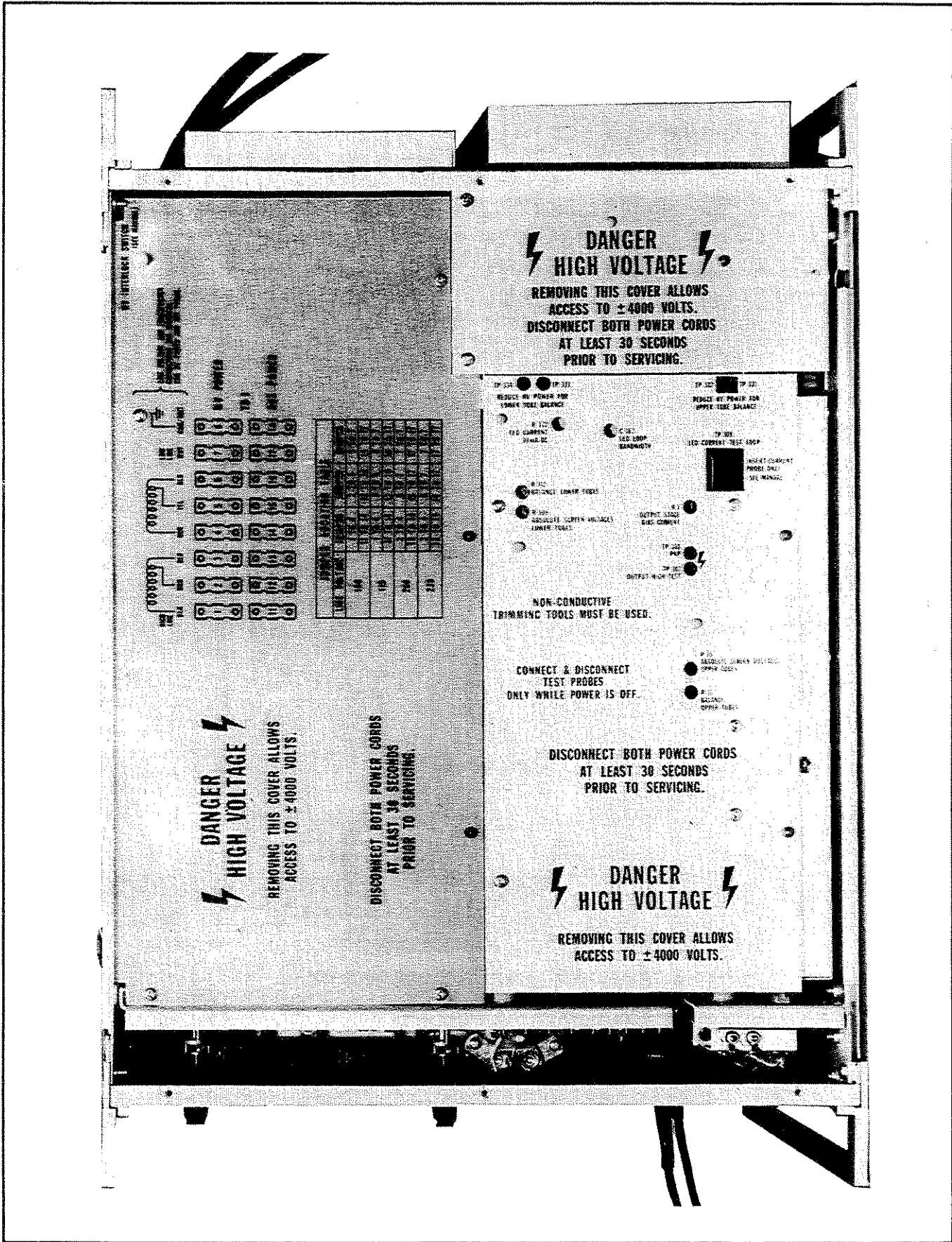


Figure 4-5. POWER AMPLIFIER ADJUSTMENT PORTS

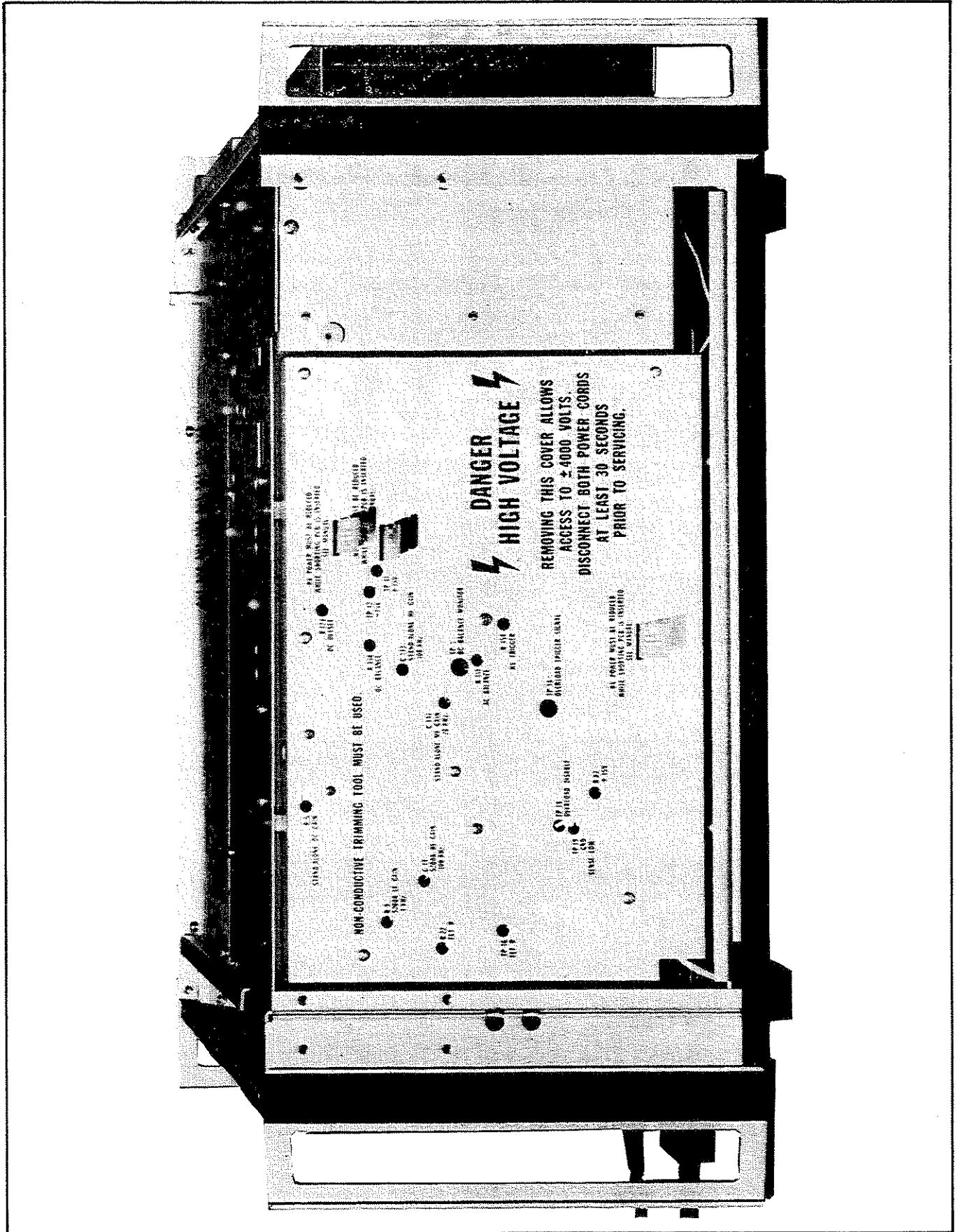
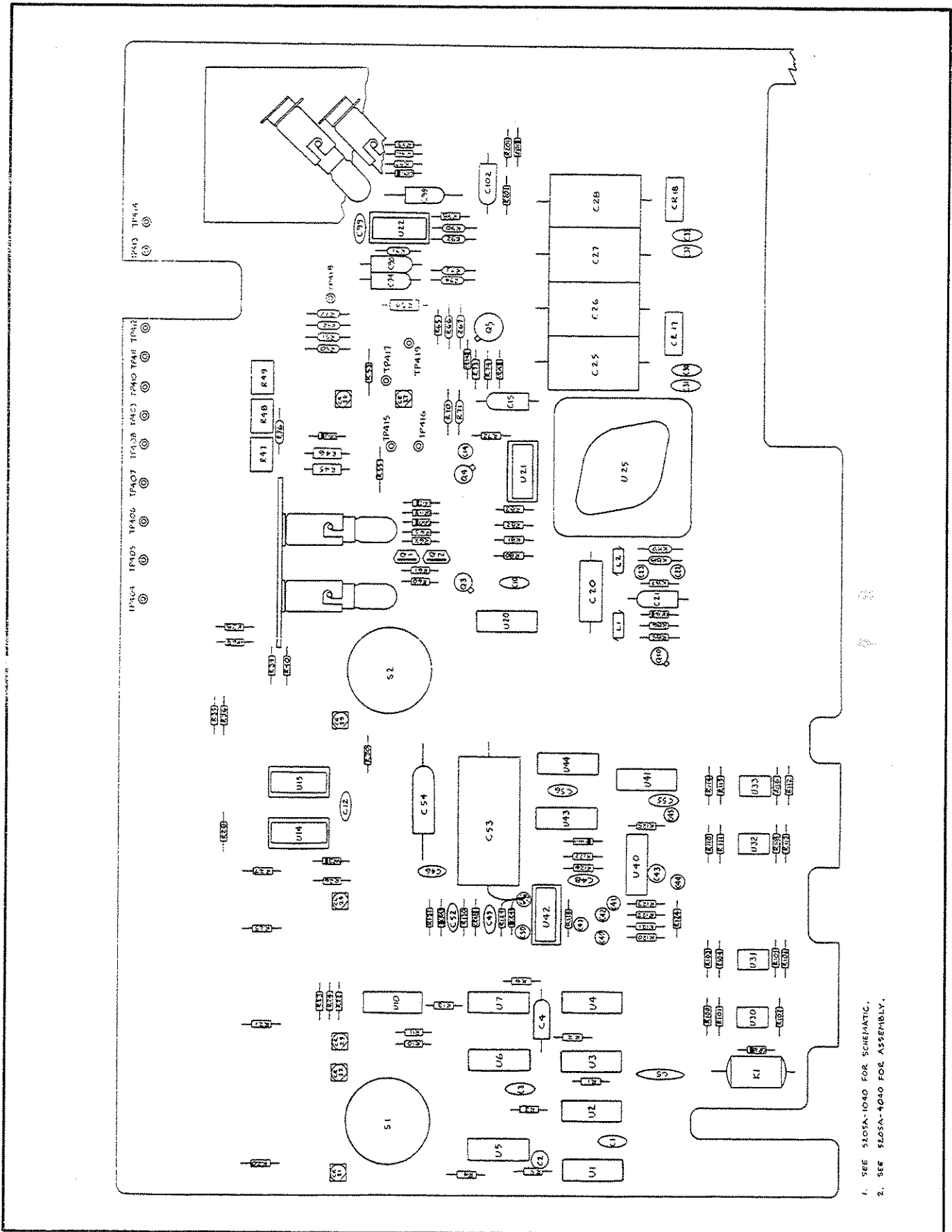


Figure 4-6. PREAMPLIFIER ADJUSTMENT PORTS



1. SEE 5205A-1040 FOR SCHEMATIC.
2. SEE 5205A-1040 FOR ASSEMBLY.

Figure 4-7. LOGIC PCB TEST POINT LOCATION

- k. Remove the probe from the front-panel receptacle, move the slider back, and place the probe around the conductor under test. Push the slider forward into the locked position. With the oscilloscope deflection factor set at 50 mV/div, the amplitude of the current waveform may be read directly from the front panel of the P6042.

**NOTE**

*The current probe calibration procedure is necessary after initial turn-on and after making current measurements in excess of the dynamic range of the P6042. To degauss, lock the probe and place it in the panel receptacle and press the DEGAUSS lever.*

**4-53. Equipment preparation**

- 4-54. Prepare the instrument for calibration using the following procedure:
- Insure both power cords are disconnected from the AC power line.
  - Insure that the POWER switch on the 5205A front panel is OFF, the CONTROL switch is to LOCAL and the MODE switch is to STDBY-RESET.
  - Remove the top cover of the instrument.
  - Remove the right side cover to expose the preamplifier adjustments by removing the seven holding screws and pulling the side cover straight up.
  - Using the shorting link provided insure the OUTPUT LOW and chassis ground terminals are connected and firmly in place (on front panel).
  - Disable the HV interlock by pulling the center rod of the interlock switch up. The interlock switch is located in the left rear corner of the instrument protruding through the transformer compartment cover.
  - Set the autotransformer for zero output.
  - Connect the autotransformer input to the nominal AC line voltage for which the instrument is rated. (Be sure variac is rated for the line voltage and current being used.)

**CAUTION!**

All test points and adjustments on the pre-amplifier are accessible through openings in the shields covering the instrument compartments. Do not remove these shields during the calibration procedure. Always be sure to use a non-conductive screwdriver rated to 4kV to make these adjustments.

**4-55. Output Stage Calibration**

4-56. A portion of the calibration procedure contained in the following subparagraphs is performed with the high voltage line power supply input reduced to 25% of nominal. This reduces the high voltages present in the instrument to approximately 600 volts. The bias states are properly maintained in this condition with a jumper system. This feature lessens the danger associated with calibrating or servicing a potentially lethal instrument. All line power input voltages are given as a percentage of the nominal line voltage for which the instrument is wired.

4-57. The balance readings are or may be at a high potential. The reading should be taken with a floating DVM, that is, a battery operated meter with no connection to ground through the line cord, to reduce common mode measurement errors. Care should be taken that the DVM chassis is well separated from any conducting material to prevent voltage breakdown. Do not touch the DVM when the 5205A power is on.

4-58. When the three jumper pcb's are required to maintain bias during operation with less than normal input voltage, insert them in the marked slots in the preamplifier shield.

4-59. Personnel performing the calibration procedure should be aware of the hazardous voltages present and observe good safety precautions at all times.

**4-60. OUTPUT STAGE INITIAL SET-UP**

4-61. Connect a 100:1 probe to the Oscilloscope input channel. Prepare the oscilloscope to read 5 mV per division (corresponding to 0.5V per division at the probe tip) using DC coupling. Connect the probe to TP307 OUTPUT HIGH TEST through the Power Amp shield. Connect the scope ground lead to chassis.

4-62. Battery Operated DVM: Prepare the DVM to read less than 2 Volts dc. Connect the HI input lead to TP331 and the LO lead to TP332 through the Power Amp shield.

**CAUTION**

Insure the floating DVM case is well away from all conductive material to prevent short circuits. Although the procedure is safe when performed as described, under extremely abusive conditions a hazardous situation might occur. Verify the probe leads are properly insulated to preclude any shorts or arcing to the Power amp shield or chassis.

4-63. Autotransformer: set the output to zero volts and connect the power line cord to the nominal line voltage.

4-64. 5205A: Insure the equipment preparation procedure

in paragraph 4-53 is complete. Install the three jumper pcbs through the Preamplifier shield. Connect the Auxiliary Power line cord to the nominal line voltage and the High Voltage line cord to the autotransformer.

## 4-65. UPPER TUBE BALANCE

**WARNING!**

Do not touch the DVM with hands or body any time that power is applied to the 5205A.

4-66. Perform the calibration using the following procedure.

- a. Insure the autotransformer output is set to zero.
- b. Set the 5205A POWER switch to ON.

**NOTE**

With the INSTRUMENT ON, either the LOCAL, REM or 5200, and the WARM-UP indicators illuminate. After a 30 second delay the WARM-UP indicator extinguishes and the STDBY-RESET indicator illuminates. This time delay occurs each time power is applied to the instrument after it has been removed. If the MODE switch is set to OPERATE before the time delay expires a FAULT indication results.

- c. After the warm-up period raise the autotransformer output voltage to approximately 25% of the nominal line voltage ( $25\% \times 115V = 29V$ ).
- d. Verify the voltage displayed on the oscilloscope is  $0 \pm 100$  mV dc at the probe tip (less than  $\pm 0.2$  division on the display). If the display is greater than  $\pm 100$  mV the circuit is defective.

**NOTE**

The above reading is adjusted during the DC OFFSET CALIBRATION later in this procedure. If it exceeds the listed tolerance it is beyond the adjustment range and should be repaired at this time. Use the Troubleshooting procedure in Table 4-3 starting at step 86.

- e. Adjust R33 BALANCE UPPER TUBES for a minimum reading on the DVM. The maximum allowable reading is  $0 \pm 10$  mVdc.
- f. If the reading exceeds the allowable, remove power, set R35 ABSOLUTE SCREEN VOLTAGES UPPER TUBES to approximately mid-range, reapply power, then repeat the test. If the reading still exceeds the allowable, the instrument is defective.

- g. Set the autotransformer output voltage to zero, set the POWER switch to OFF and disconnect both power cords. Wait at least 30 seconds for the Power Supply to discharge and disconnect the DVM from test points 331 and 332.

## 4-67. LOWER TUBE BALANCE

4-68. Make the following equipment changes:

- a. Connect the Battery Operated DVM HI input lead to TP333 and the LO lead to TP334 through the Power Amp shield.

**CAUTION**

Insure the floating DVM case is well away from any conductive material to prevent short circuits. Although the procedure is safe when performed as described, under extremely abusive conditions a hazardous situation might occur. Verify the probe leads are properly insulated to preclude any shorts or arcing to the Power amp shield or chassis.

- b. Reconnect the Auxiliary Power line cord to the nominal line voltage and the High Voltage line cord to the autotransformer.

**WARNING!**

Do not touch the DVM with hands or body any time that power is applied to the 5205A.

4-69. Perform the calibration using the following procedure:

- a. Insure the autotransformer output is set to zero.
- b. Set the 5205A POWER switch to ON.
- c. After the Warm-up period raise the autotransformer output voltage to approximately 25% of the nominal line voltage ( $25\% \times 115V = 29V$ ).
- d. Verify the voltage displayed on the oscilloscope is  $0 \pm 100$  mV dc at the probe tip (less than  $\pm 0.2$  division on the display). If greater than  $\pm 100$  mV the instrument is defective.

**NOTE**

The above reading is adjusted during the DC OFFSET CALIBRATION later in this procedure. If it exceeds the listed tolerance it is beyond the adjustment range and should be repaired at this time. Use the troubleshooting procedure in Table 4-3 starting at step 86.

- e. Adjust R112 BALANCE LOWER TUBES for a minimum reading on the DVM. The maximum allowable reading is  $0 \pm 10$  mV dc.



- f. If the reading exceeds the allowable, remove power, set R109 ABSOLUTE SCREEN VOLTAGES LOWER TUBES to approximately mid-range, reapply power, then repeat the test. If the reading still exceeds the allowable the instrument is defective.
- g. Set the autotransformer output voltage to zero, set the POWER switch to OFF and disconnect both power cords. Wait at least 30 seconds for the Power Supply to discharge and disconnect the DVM from test points 333 and 334.

#### 4-70. OUTPUT STAGE BIAS CURRENT

4-71. Make the following equipment changes:

- a. Connect the Battery Operated DVM HI input lead to TP307 OUTPUT HIGH TEST and the LO lead to TP308 PNP through the Power Amp shield. Both the DVM and Scope HI input leads are now connected to this test point.

#### CAUTION

Insure the floating DVM case is well away from any conductive material to prevent short circuits. Although the procedure is safe when performed as described, under extremely abusive conditions a hazardous situation might occur. Verify the probe leads are properly insulated to preclude any shorts or arcing to the Power amp shield or chassis.

- b. Reconnect the Auxiliary Power line cord to the nominal line voltage and the High Voltage line cord to the autotransformer.

#### WARNING!

Do not touch the DVM with hands or body any time that power is applied to the 5205A.

- 4-72. Perform the calibration using the following procedure.
- a. Insure the autotransformer output is set to zero.
- b. Set the 5205A POWER switch to ON.
- c. After the Warm-up period raise the autotransformer output voltage to approximately 25% of the nominal line voltage ( $25\% \times 115V = 29V$ ).
- d. Verify the voltage displayed on the oscilloscope is  $0 \pm 100$  mV dc at the probe tip (less than  $\pm 0.2$  division on the display). If the display is greater than  $\pm 100$  mV the circuit is defective.

#### NOTE

The above reading is adjusted during the DC OFFSET CALIBRATION later in this procedure.

*If it exceeds the listed tolerance it is beyond the adjustment range and should be repaired at this time. Use the Troubleshooting procedure in Table 4-3 starting at step 86.*

- e. Adjust R7 OUTPUT STAGE BIAS CURRENT for a reading between +220mV and +240mV on the DVM.
- f. Set the autotransformer output voltage to zero, set the POWER switch to OFF and disconnect both power cords. Wait at least 30 seconds for the Power Supply to discharge and disconnect the DVM from test points 307 and 308.

#### 4-73. LED LOOP BIAS CURRENT

4-74. Make the following equipment changes:

- a. Insure the P6042 current probe is calibrated for a zero indication and a current sensitivity of 10 mA/division as described in the Current Probe Calibration procedure.
- b. Connect the current probe around TP309 LED CURRENT TEST LOOP with the arrow on the probe pointing to the front of the instrument. Also insure the probe is properly locked and the PROBE UNLOCKED indicator is extinguished as described in the Current Probe Calibration.
- c. Set the oscilloscope current channel controls for DC coupling with sensitivity of 50 mV/division.
- d. Reconnect the Auxiliary Power line cord to the nominal line voltage and the High Voltage line cord to the auto transformer.

4-75. Perform the calibration using the following procedure:

- a. Insure the autotransformer output is set to zero.
- b. Set the 5205A POWER switch to ON.
- c. After the Warm-up period raise the autotransformer output voltage to approximately 25% of the nominal line voltage ( $25\% \times 115V = 29V$ ).
- d. Verify the voltage displayed on the Oscilloscope is  $0 \pm 100$  mV dc at the probe tip (less than  $\pm 0.2$  division on the display). If greater than  $\pm 100$  mV the instrument is defective.

#### NOTE

The above reading is adjusted during the DC OFFSET CALIBRATION later in this procedure. If it exceeds the listed tolerance it is

beyond the adjustment range and should be repaired at this time. Use the troubleshooting procedure in Table 4-3 starting at step 86.

- e. Display the LED Current and carefully adjust R172 LED CURRENT for a display of  $-30 \text{ mA} \pm 1 \text{ mA}$  (3 div  $\pm 0.1$  div).
- f. Lower the autotransformer voltage to zero, dropping the LED Current to zero, and verify the current probe zero adjustment.
- g. Raise the autotransformer output voltage back to the previous setting of approximately 25% of the nominal line voltage.
- h. Verify the LED current is  $-30 \text{ mA} \pm 1 \text{ ma}$ . Re-adjust R172 if required.
- i. Set the autotransformer output to zero. Set the POWER switch to OFF and disconnect both Power cords. Wait at least 30 seconds for the Power Supply to discharge then disconnect the voltage and current probes and the three jumper pcb's from the instrument.

#### 4-76. LED LOOP BANDWIDTH

4-77. Make the following equipment changes:

- a. Set the Oscilloscope current channel controls for AC Coupling remaining at 50 mV/division sensitivity, then center the trace baseline.
  - b. Disconnect the 100:1 probe from the oscilloscope voltage channel. Replace it with a 10:1 probe connected across the 5205A output terminals. Set the scope controls for DC coupling, 1V/division sensitivity (corresponding to 10V at the probe tip) and a Time Base of 2 usec/division.
  - c. Connect a Test Oscillator (TO) to the 5205A input using coaxial cable with the applicable connectors. Do not exceed six feet of cable.
  - d. Verify removal of the three jumper pcb from the pre-amplifier.
  - e. Disable the  $\pm 200 \text{ mA}$  current trips on the 5205A Logic pcbs by connecting TP410 ( $I_{L+}$ ) to TP409 (+5V) with a jumper to disable the positive HV supply current trip and TP408 ( $I_{L-}$ ) to TP407 (GND) to disable the negative HV supply current trip.
  - f. Connect the 100 $\Omega$  15W load resistor across the 5205A output terminals.
  - g. Reconnect the Auxiliary Power line cord to the nominal line voltage and the High Voltage line cord to the autotransformer.
- 4-78. Perform the calibration using the following procedure:

- a. insure the autotransformer output is set to zero.
- b. Apply an input of  $0.283 \pm 2\%$  volts rms at 100 kHz from the Test Oscillator.
- c. Set the 5205A POWER switch to ON.
- d. After the Warm-up period quickly raise the autotransformer output voltage to 100% of the nominal line voltage.

#### NOTE

*OVERLOAD and FAULT indications will result if the autotransformer output is raised to slowly.*

- e. Set the 5205A MODE switch to OPERATE.
- f. The scope voltage channel probe displays an eight division peak-to-peak sinusoidal waveform, corresponding to approximately 800 mA pp output current. Since the gain has not yet been set the magnitude of the display will not be exact.
- g. Adjust C162 LED LOOP BANDWIDTH so that the current channel waveform is 30 mA pp between the positive and negative peaks. The waveform should appear as shown in Figure 4-8.

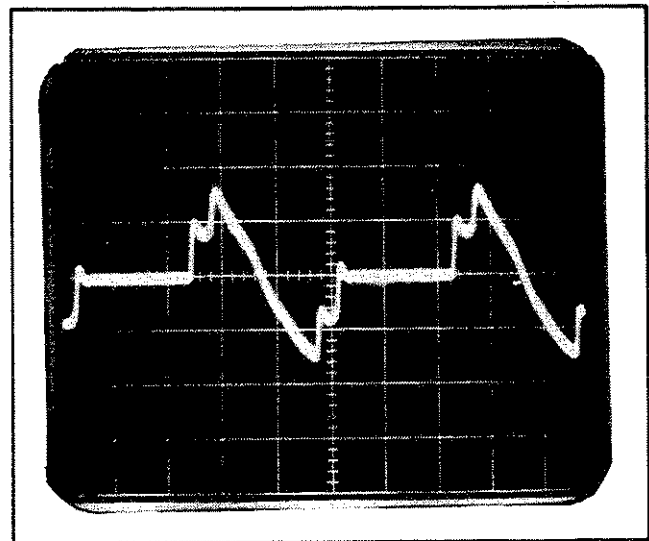


Figure 4-8. LED LOOP CURRENT WAVEFORM

#### NOTE

*The current displayed is essentially proportional to the derivative of the total current drawn by the Power Amplifier lower Output tubes.*

- h. Set the 5205A MODE switch to STDBY-RESET. Remove the Test Oscillator input to the 5205A.

Set the autotransformer output to zero. Set the POWER switch to OFF and disconnect both power cords. Wait at least 30 seconds for the Power Supply to discharge and disconnect the oscilloscope voltage and current probes from the instrument.

#### 4-79. SCREEN VOLTAGE CALIBRATION

4-80. Make the following equipment changes:

- a. Prepare the DVM to monitor the nominal AC line Voltage and connect the input leads across the autotransformer output.
- b. Prepare the Oscilloscope for operation with sensitivity of 2V/division (corresponding to 20V/division at the probe tip), a time base of 20 usec/division and dc coupling.
- c. Accurately adjust the oscilloscope probe AC compensation using the oscilloscope calibrator.
- d. Set the vertical gain of the oscilloscope by applying an external 56.57Vrms  $\pm 1\%$  (56.01 - 57.13) 10 kHz signal to the 10:1 input probe. Adjust the scope channel variable gain for a display of exactly 8 divisions peak-to-peak (at 20V/division sensitivity equal to 160V p-p).
- e. Disable the 5205A overload circuits by connecting TP18 OVERLOAD DISABLE to TP19 GND (SENSE LOW) with a jumper. The test points can be reached through the Preamplifier shield.
- f. Reconnect the Auxiliary Power line cord to the nominal line voltage and the High Voltage line cord to the auto transformer.

4-81. Perform the calibration using the following procedure:

#### NOTE

*For correct adjustment of the current limits it is important to check the zero base line for drift both before and after the procedure. If any drift occurs the procedure should be repeated.*

- a. Raise the autotransformer output voltage to nominal plus ten percent ( $110\% \times 115V = 126.5V$ ).
- b. Apply an input of  $0.45 \pm 2\%$  volts rms (0.441 - 0.459 Vrms) at 10 kHz from the test oscillator.
- c. Set the 5205A POWER switch to ON.

#### NOTE

*The 5205A internal power dissipation is very high when it is in the OPERATE mode. Maintain this status only as long as necessary to make the required adjustment.*

- d. After the warm-up period, set the 5205A MODE switch to OPERATE.
- e. Adjust R109 ABSOLUTE SCREEN VOLTAGES LOWER TUBES through the power amplifier shield until the scope displays a waveform where the flat portion of the negative peak is at exactly -60 volts (-3.0 divisions).
- f. Check the zero base line setting the 5205A MODE switch to STDBY RESET and then back to OPERATE. The adjusted peak voltage should remain as set in step e above.
- g. Set the Test oscillator voltage magnitude to 0.39V rms.
- h. Adjust R35 ABSOLUTE SCREEN VOLTAGES UPPER TUBES through the power Amplifier shield until the scope displays a waveform where the flat portion of the positive peak is at exactly +52 Volts (+2.6 divisions).
- i. Check the zero base line by setting the 5205A MODE switch to STDBY RESET and then back to OPERATE. The adjusted peak voltage should remain as set in step h above.
- j. Set the MODE switch to STDBY-RESET and the POWER Switch to OFF. Remove the Test Oscillator input to the 5205A. Set the autotransformer output voltage to zero and disconnect both power cords. Remove the oscilloscope and DVM leads.

#### 4-82. POSITIVE CURRENT TRIP LEVEL ADJUSTMENT

4-83. Make the following equipment changes:

- a. Insure a jumper connects TP408 ( $I_{L-}$ ) and TP407 (GND) on the Logic pcb. Remove the other jumpers previously installed between test points on the Logic and Preamplifier pcb's. The jumper remaining disables the negative current trip while setting the positive trip level.
- b. Connect the DVM HI input lead to TP411 ( $I_+$ ) and the LO lead to TP407 (GND) on the Logic pcb. Prepare the DVM to read less than 2 Volts dc.
- c. Reconnect the Auxiliary Power line cord to the nominal line voltage and the High Voltage line cord to the autotransformer.

4-84. Perform the calibration as follows:

- a. Insure the autotransformer output is set to zero.
- b. Set the 5205A POWER Switch to ON.
- c. After the warm-up period, raise the autotransformer output voltage to the nominal line voltage.
- d. Set the 5205A MODE switch to OPERATE.
- e. Apply an input of 0.285 Volts rms at 100 kHz from the Test Oscillator.
- f. Observe the DVM reading and slowly increase the Test Oscillator output until the 5205A trips into FAULT and STDBY-RESET.
- g. The DVM should read between  $-210$  and  $-214$  mVolts when it trips. If the DVM reading is within tolerance set the 5205A MODE Switch to STDBY-RESET, the POWER switch to OFF, the Autotransformer output to zero and then proceed to the Negative Current Trip Level Adjustment in the following paragraph. If the reading is not acceptable continue with step h of this paragraphs.
- h. Reduce the Test Oscillator output to a level less than 0.285 Volts to prevent a FAULT condition.
- i. Rotate R49 fully counter-clockwise.
- j. Set the 5205A MODE Switch to STDBY-RESET and then OPERATE.
- k. Adjust the test oscillator output level for a reading on the DVM between  $-211$  and  $-213$  millivolts.
- l. Very slowly rotate R49 clockwise until the 5205A trips into FAULT and drops back to STDBY-RESET.
- m. Decrease the output level of the test oscillator slightly and reset the FAULT on the 5205A by setting the 5205A MODE switch first to STDBY-RESET and then to OPERATE.
- n. Slowly increase the test oscillator output until the 5205A trips into FAULT, verifying that it occurs between  $-210$  and  $-214$  millivolts.
- o. Set the 5205A MODE switch to STDBY-RESET and the POWER switch to OFF. Set the autotransformer output voltage to zero.

4-85. NEGATIVE CURRENT TRIP LEVEL ADJUSTMENT

- a. Reduce the Test Oscillator output to 0.285V rms, remaining at 100 kHz.
- b. Remove the jumper between TP407 and TP408 and connect it between TP410 ( $I_{L+}$ ) and TP409 (+5) to disable the Positive current trip while setting the negative trip level.
- c. Transfer the DVM HI input lead to TP412 ( $I_{-}$ ) on the Logic pcb.

4-87. Perform the calibration as follows:

- a. Set the 5205A POWER switch to ON.
- b. After the warm-up period, raise the autotransformer output voltage to the nominal line voltage.
- c. Set the 5205A MODE switch to OPERATE.
- d. Observe the DVM reading and slowly increase the test oscillator output until the 5205A trips into FAULT and STDBY-RESET.
- e. The DVM should read between  $+210$  and  $+214$  mVolts when it trips. If the DVM reading is within tolerance proceed to the following paragraph. If the reading is not acceptable continue with step f of this paragraph.
- f. Reduce the test oscillator output to a level less than 0.285 Volts to prevent a FAULT condition.
- g. Rotate R48 fully counter-clockwise.
- h. Set the 5205A MODE switch to STDBY-RESET then OPERATE.
- i. Adjust the test oscillator output for a reading on the DVM between  $+211$  and  $+213$  millivolts.
- j. Very slowly rotate R48 clockwise until the 5205A trips into FAULT and drops back to STDBY-RESET.
- k. Decrease the output level of the test oscillator just slightly and reset the FAULT on the 5205A by setting the 5205A MODE switch first to STDBY-RESET and then to OPERATE.
- l. Slowly increase the test oscillator output until the 5205A trips into FAULT, verifying that it occurs between  $+210$  and  $+214$  millivolts.

4-88. The Output stage portion of the Calibration is complete. Set the 5205A MODE Switch to STDBY-RESET and the POWER Switch to OFF. Set the autotransformer output

voltage to zero. Remove any jumpers installed in the instrument. Disconnect both power cords. Wait at least 30 seconds for the power supply to discharge then disconnect the DVM, the Test Oscillator and the Output load from the instrument.

#### 4-89. Preamplifier Calibration

4-90. This portion of the procedure contains the information necessary to calibrate the preamplifier section of the 5205A. As in the output stage calibration, all adjustments should be made through the indicated ports in the preamplifier shield. The shield should not be removed at any time since voltages up to 4000V are present within the instrument any time power is applied. Insert the output cable terminal into its safety area any time it is not in use. No jumpers or jumper pobs are used during this test and should be removed if installed. The shorting link between the front panel OUTPUT LOW and Chassis ground terminals should be installed at all times.

#### 4-91. PREAMPLIFIER INITIAL SET-UP

4-92. DVM: Prepare the DVM to read less than 20 Volts DC. Connect the HI input lead to TP11 +15V and the LO lead to TP19 GND (SENSE LOW).

4-93. Autotransformer: Set the output to zero volts and connect the power line cord to the nominal line voltage.

4-94. 5205A: Insure the equipment preparation procedure in paragraph 4-53 is complete and that all jumper wires or pobs are removed from the instrument. Connect the Auxiliary Power line cord to the nominal line voltage.

#### 4-95. PREAMPLIFIER $\pm$ 15 VOLT SUPPLY VOLTAGE

4-96. Perform the calibration as follows:

- a. Set the 5205A POWER switch to ON.
- b. Adjust R82 +15V for a reading on the DVM between +14.95 and 15.05 volts.
- c. Move the DVM HI input lead to TP12 -15V.
- d. The DVM reads between -14.65 and -15.35 volts. There is no adjustment.
- e. Set the 5205A POWER switch to OFF
- f. Remove the DVM test leads.

#### 4-97. MINIMUM NEGATIVE HIGH VOLTAGE TRIGGER LEVEL

4-98. Make the following equipment changes:

- a. Prepare the DVM to monitor the nominal line voltage and connect the input leads across the autotransformer output.
  - b. Terminate the 5205A input with a 50 ohm load.
  - c. Connect the High Voltage line cord to the autotransformer.
- 4-99. Perform the calibration as follows:
- a. Insure the autotransformer is set to zero.
  - b. Set the 5205A POWER Switch to ON.
  - c. After the Warm-up period raise the autotransformer output voltage to the nominal line voltage.
  - d. Set the 5205A MODE Switch to OPERATE.
  - e. Observe the DVM reading and slowly decrease the autotransformer output until the 5205A trips into FAULT and STDBY-RESET.
  - f. When tripped the DVM should read between 98.0 and 98.6 Volts AC.
  - g. Set the 5205A MODE Switch to STDBY-RESET, the POWER Switch to OFF, the autotransformer output to zero.
  - h. If the DVM reading is within tolerance proceed to the Input FET switch Impedance Calibration in the next paragraphs. If the reading is not acceptable continue with the procedure in step i of this paragraph.
  - i. Rotate R154 HV TRIGGER fully counterclockwise.
  - j. Set the 5205A Power Switch to ON.
  - k. After the warmup period, raise the autotransformer output voltage to the nominal line voltage less 14.5% ( $115V - (115 \times 14.5\%) = 98.3V$ ).
  - l. Set the 5205A MODE Switch to OPERATE.
  - m. Slowly rotate R154 clockwise until the 5205A trips into FAULT and drops in status to STDBY-RESET.
  - n. Raise the autotransformer output voltage to the nominal line voltage.
  - o. Reset the FAULT on the 5205A by setting the 5205A MODE switch first to STDBY-RESET and

then to OPERATE. The OPERATE indicator illuminates without a FAULT resulting.

- p. Set the MODE switch to STDBY-RESET and the POWER switch to OFF. Lower the autotransformer output voltage to zero. Disconnect the DVM test leads from the autotransformer output.

#### 4-100 INPUT FET SWITCH IMPEDANCE CALIBRATION

4-101. Make the following equipment changes:

- a. Prepare the DVM to read less than 20 Volts dc.
- b. Connect the DVM HI input lead to TP16 FETR and the LO lead to TP19 GND (SENSE LO).

4-102. Perform the calibration as follows:

- a. Insure the autotransformer is set to zero.
- b. Set the 5205A POWER switch to ON.
- c. After the warm-up period, raise the autotransformer output voltage to the nominal line voltage.
- d. Adjust R22 FET R for a DVM reading between 7.9 and 8.1 volts.
- e. Set the POWER switch to OFF. Lower the autotransformer output voltage to zero. Disconnect the DVM test leads from the preamplifier.

#### 4-103. OVERLOAD TRIGGER BALANCE CALIBRATION

4-104. Make the following equipment changes:

- a. Connect a Test Oscillator (TO) to the 5205A input using coaxial cable with the applicable connectors. Do not exceed six feet of cable.
- b. Connect a 10:1 probe to the oscilloscope input channel. Prepare the oscilloscope to read 5mV/division (corresponding to 50mV/division at the probe tip) using dc coupling. Connect the probe to TP1 DC BALANCE MONITOR through the preamplifier shield. Connect the scope ground lead to TP19 GND (SENSE LOW).

4-105. Perform the calibration as follows:

- a. Insure the autotransformer is set to zero.
- b. Set the 5200A POWER switch to ON.
- c. After the warmup period, raise the autotransformer voltage to the nominal line voltage.

- d. Ground the oscilloscope input channel and set the trace to the middle of the CRT.
- e. Remove the ground and adjust R130 DC BALANCE for a minimum display on the CRT, not to exceed  $0 \pm 5$  millivolts.
- f. Apply an 11 Volt rms 110 kHz input to the 5205A from the Test Oscillator.
- g. Select AC Coupling on the oscilloscope and move the probe to TP 13 OVERLOAD TRIGGER SIGNAL.

#### WARNING!

Verify the output connector is stored in its safety area in the Front Panel. Dangerous voltages are present at the output terminals during this adjustment.

- h. Set the 5205A MODE switch to OPERATE.
- i. Adjust R111 AC BALANCE for a minimum peak-to-peak amplitude as displayed on the CRT.
- j. Set the 5205A MODE switch to STDBY-RESET and the POWER switch to OFF. Lower the autotransformer output voltage to zero. Remove the oscilloscope probe and T.O. input from the instrument.

#### 4-106. Calibration Point Adjustments

4-107. This section of the Calibration Procedure contains the steps required to set the calibration points. It is assumed that calibration of the output stage and preamplifier have already been completed.

4-108. When the Calibrator Mode portion of the procedure is performed, it should be done in conjunction with the 5200A with which the 5205A is normally used. Also, the 5200 should be calibrated immediately preceding the 5205A.

#### NOTE

*If the 5205A is calibrated with one 5200A and used with a different 5200A, it is possible it will not meet specifications.*

#### 4-109. LOCAL/REMOTE MODE CALIBRATION

4-110. Steps in the following procedure must be performed in sequence. If a readjustment of any previous step is required, the entire procedure should be repeated, starting at the beginning. During the procedure the jumper pcbs are not installed and no jumpers between test points used. Also, the autotransformer is not used, both power cords are applied directly to line power.

4-111. Certain requirements are placed on the Test Oscillator (TO) used in this portion of the 5205A Calibration. This can be of critical importance due to the high voltages and frequencies involved. In most cases the TO used will be a 5200A, however, either it or its equivalent must be accurately calibrated and the correction factor known at 1kHz, 20 kHz and 100 kHz with 10 volts output on the 10 Volt range.

4-112. DC Offset

4-113. Prepare the equipment for the test as follows:

- a. Prepare the 5205A for the procedure by setting the power switch to ON, after verifying that the CONTROL switch is in LOCAL and the MODE switch in STDBY-RESET. Also insure the shorting link connecting the front panel OUTPUT LOW and chassis ground terminals is installed and firmly in place.

*NOTE*

*The 5205A should have power applied continuously for at least one hour prior to beginning the follow procedures.*

- b. Prepare the test DVM to read DC volts on its most sensitive scale (resolution of at least 100  $\mu$ V) and connect the 5205A output connector to the DVM input terminals. The 5205A HIGH terminal, marked with the lightning bolt, should connect to the DVM HI terminal.

4-114. Perform the calibration as follows:

- a. Verify there is no input to the Local input connector and the one hour minimum warm-up period for stability has elapsed.
- b. Set the 5205A MODE switch to OPERATE.
- c. Check for an output voltage of  $0 \pm 2$ mV.
- d. Terminate the 5205A Local input with either a short or 50 ohm resistor.
- e. Check for an output voltage of  $0 \pm 2$  mV.
- f. If both readings are within tolerance, set the 5205A mode switch to STDBY-RESET, remove the terminating input and proceed to the LOCAL/REMOTE Mode DC Gain procedure in the next paragraph. If either reading is not acceptable continue with step g of this paragraph.
- g. Set the 5205A MODE switch to STDBY-RESET and remove the terminating input.

- h. Set the 5205A Mode Switch to OPERATE.
- i. Adjust R123 DC OFFSET for an output Voltage of  $0 \pm 1$  mV.
- j. Terminate the 5205A Local input with either a short or 50 ohm resistor.
- k. Verify the DC output voltage reads  $0 \pm 2$ mV.

- l. Set the 5205A MODE Switch to STDBY-RESET and remove the terminating input.

4-115. LOCAL/REMOTE Mode DC Gain

4-116. Make the following equipment changes:

- a. Connect the DC Calibrator to the 5205A Local input and select a +10 volt dc output.
- b. Prepare the DVM to read 1000 Volts dc.

4-117. Perform the calibration as follows:

- a. Set the 5205A MODE switch to OPERATE.
- b. Adjust R5 STAND-ALONE DC GAIN for a reading between  $-999.99$  and  $-1000.01$  volt dc on the DVM.
- c. Set the 5205A MODE switch to STDBY-RESET.
- d. Select, or reverse the leads if required, a  $-10$  volt dc output from the DC Calibrator.
- e. Set the 5205A MODE switch to OPERATE.
- f. Verify the DVM reads between  $+999.98$  and  $+1000.02$  volts dc.
- g. Set the 5205A MODE switch to STDBY-RESET.
- h. Disconnect the DC Calibrator and the DVM from the instrument.

4-118. LOCAL/REMOTE Mode Middle and High Frequency Gain

4-119. Make the following equipment changes:

- a. Connect the 5205A to the test equipment as shown in Figure 4-2.
- b. Set the T.O. for a 10 Volt rms output at 20 kHz.

4-120. Perform the calibration as follows:

- a. Set the 5205A MODE switch to OPERATE.
- b. Perform the transfer test, adjusting C147 STAND-ALONE MF GAIN (20 kHz) for a transfer standard null at  $0 \pm 0.01\%$ , taking the correction factors into account.
- c. Set the TO for a 10 Volt rms output at 100 kHz.
- d. Perform the transfer test, adjusting C143 STAND-ALONE HF GAIN (100 kHz) for a transfer standard null at  $0 \pm 0.02\%$ , taking the correction factor into account.
- e. Set the 5205A MODE switch to STDBY-RESET.

4-121. If the Calibrator Mode portion of these procedures as described in the following major division are not performed calibration is complete. Set the POWER switch to OFF and disconnect the test equipment.

#### 4-122. CALIBRATOR MODE

##### NOTE

*This portion of the Calibration Procedure can be omitted if the 5205A will not be operated in the Calibrator MODE, i.e., slaved to a 5200A.*

#### 4-123. Calibrator Adjustments Preparation

4-124. To insure maximum accuracy in the Calibrator Mode, the 5205A should always be calibrated in conjunction with the 5200A with which it will be teamed. Calibrate the 5200A immediately prior to calibration of the 5205A and the 5200A/5205A team.

4-125. A special interconnect cable is provided with the 5205A for operation in the Calibrator Mode. This cable connects the rear of the 5200A (J32, labeled 5205A) to the rear of the 5205A (25-pin connector labeled 5200A).

4-126. Prepare the equipment shown in Figure 4-3 for the calibration procedure by performing or verifying the following steps.

- a. Connect the 5200A and 5205A with the special interconnect cable provided.
- b. Set the 5200A front panel controls to the following positions:  
 POWER Switch to ON. After the STDBY indicator illuminates, continue.  
 MODE switch to STDBY.  
 CONTROL switch to LOCAL.  
 PHASE LOCK switch to OFF.  
 SENSE switch to INT.

VOLTAGE ERROR switch to OFF.  
 VOLTAGE RANGE at 1000V.  
 FREQUENCY RANGE at 1KHz.  
 VOLTAGE Magnitude at 1000V.  
 FREQUENCY Magnitude of 1 kHz.

- c. Verify that there are no jumper pcbs or jumpers installed.  
 Verify the shorting link is connected between the OUTPUT LOW and chassis ground terminals.  
 Verify both power cords are connected to line power.  
 Verify or set the 5205A controls to the following positions.  
 The POWER switch is ON and the INSTRUMENT ON indicator illuminated.  
 The CONTROL switch to 5200A/REM.  
 The MODE switch to STDBY-RESET

#### 4-127. Low and High Frequencies Gain Adjustment.

4-128. Use the following procedure to calibrate the low and high frequencies gain.

- a. Set the 5200A MODE switch to OPERATE. The 5200A and 5205A OPERATE indicators illuminate.
- b. Perform the transfer test, adjusting R9 5200A LF GAIN (1kHz) for a transfer standard null at  $0 \pm 0.01\%$  taking the correction factor into account.
- c. Remaining in the 1000 Volt range set the 5200A output frequency to 100 kHz.
- d. Perform the transfer test, adjusting C14, 5200A HF GAIN (100 kHz) for a transfer standard null at  $0 \pm 0.01\%$  taking the correction factor into account.
- e. Set the 5200A MODE switch to STDBY.
- f. Set the 5200A and 5205A POWER switches to OFF and disconnect the test equipment.

#### 4-129. Calibrator Mode Interconnect

4-130. An interconnect cable for use during the calibrator mode is supplied with each 5205A. The cable connects J32 on the rear of the 5200A to the connector labeled 5200A on the rear of the 5205A. A diagram of the pin connections is shown in Figure 4-9.



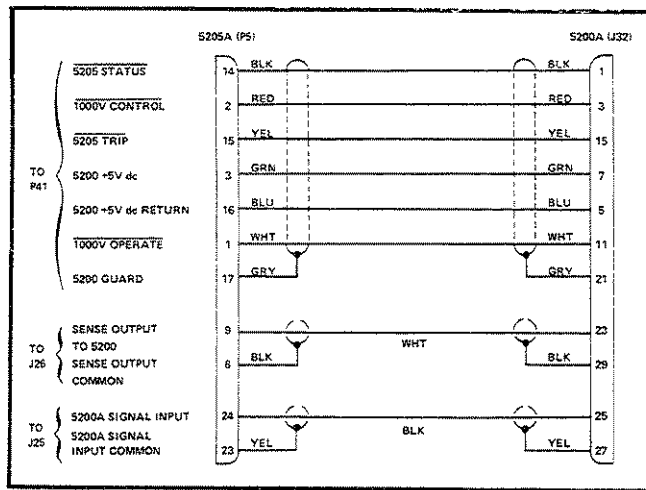


Figure 4-9. CALIBRATOR MODE INTERCONNECTIONS

### 4-131. Logic Trip Adjustment

#### NOTE

*This setting monitors the logic supply voltage and is adjusted at the factory. It should not require normal calibration, however, adjustment could be required if drift within the circuit is sufficient to trip the instrument into FAULT.*

4-130 If required, adjust the logic trip circuit using the following procedure:

- Verify that there are no jumper pcbs or jumpers installed in the 5205A and both power cords are connected to the line source.
- Connect the DVM HI input to TP 409 (+5) and the LO input to TP 407 (GND). Prepare the DVM to read +5 volts dc. Both test points are located on the logic pcb.

- Connect a jumper between TP 418 and TP 417. (Located near the FAULT and OVERLOAD indicators on the Logic pcb.)
- Set the POWER switch to ON and wait 30 seconds for the warm-up period to expire.
- The DVM should read between 4.75 and 5.25V dc.
- Rotate R47 fully clockwise and then very slowly adjust until the fault indicator extinguishes.
- Check at high & low line voltage limits (nominal  $\pm 10\%$ ) that the Logic circuits +5 Volts is between +4.75 and +5.25 Volts dc and the instrument does not trip into FAULT.
- Set the POWER switch to OFF and disconnect the test equipment and jumper.

### 4-133. TROUBLESHOOTING

4-134. Troubleshooting for the 5205A consists of the tabular flow chart in Table 4-3. When a step on the flow chart is completed check for a decision transfer. If no decision is required perform the next step of the table in sequence.

#### WARNING!

Lethal voltages up to 2.5K Volts are present within the instrument during troubleshooting. In addition, the voltage may be present for up to 30 seconds after power is removed from the instrument. Before coming into physical contact with any component use a voltmeter and 5kV probe to insure there is no voltage present between tp502 (+2.5kV) and tp503(LO), between tp504 (-2.5kV) and tp506 LO), and between tp505 (-2.5kV) and tp506 (LO). All test points are on the Power Supply pcb. Extreme caution should be exercised at all times when working with this instrument.

Table 4-3. TROUBLESHOOTING

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
1	Prepare the 5205A for troubleshooting by performing Equipment Preparation in paragraph 4-53. In addition remove the Preamplifier and Power Amplifier shields, then connect the Auxiliary Power line cord only to the line voltage supply. Do not connect the HV Power Line cord to a supply at this time.		
2	Verify the Front Panel LOW and Ground terminals are connected with a shorting link, the POWER switch is in the OFF position, the CONTROL switch is in the LOCAL position and the MODE switch is in the STDBY-RESET position.		
3	Set the POWER switch to the ON position.		
4	With the test DVM LO connected to TP22 on the Preamp check for $+15 \pm 0.1V$ dc adjustable with R82 at tp11 and for $-15 \pm 0.4V$ dc at tp12.		
5	Are both voltages within tolerance?	7	6
6	Check the 31V rms input from the Auxiliary Power Supply. Check the rectifier CR70, the applicable filter, series pass transistor, divider and the regulator circuit. Repair as required then repeat the test starting at step 4.		
7	With the test DVM LO input at tp9 of the Preamplifier check for $+25 \pm 1V$ dc at tp10.		
8	Is the reading within tolerance?	10	9
9	Check the 21V rms input from the auxiliary power supply, the rectifier CR175 and its associated components. Repair as required then repeat the test starting at step 7.		
10	With the test DVM LO input at tp7 of the Preamplifier check for $-31 \pm 1V$ dc at tp17 and $+30.5 \pm 1V$ dc at tp8.		
11	Are both readings within tolerance?	13	12
12	Check the 40V rms input from the auxiliary power supply, the rectifier CR182 and its associated components. Repair as required then repeat the test starting at step 10.		
13	With the test DVM LO input at tp315 of the Power Amplifier check for $+450 \pm 5V$ dc at tp325, $-25 \pm 0.5V$ dc at tp321 and $+24 \pm 0.5V$ dc at tp 322.		
14	Are all three voltages within tolerance?	16	15
15	Check the 171V rms and 38V rms inputs from the auxiliary power supply. Check the rectifiers and their associated components. Repair as required then repeat the test starting at step 13.		
16	With the test DVM LO input at tp303 of the Power Amplifier check for $+440 \pm 5V$ dc at tp304 and $+14.5 \pm 0.2V$ dc at tp 305.		

Table 4-3. TROUBLESHOOTING (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
17	Are both voltages within tolerance?	19	18
18	Check the 171V rms and 12V rms inputs from the Auxiliary Power Supply. Check the rectifier circuits and their associated components. Repair as required then repeat the test starting at step 16.		
19	With the test DVM LO input at tp407 of the Logic Assembly check for $+34 \pm 1V$ dc at tp405 and $+5 \pm 0.25V$ dc at tp409.		
20	Are both voltages within tolerance?	22	21
21	Check the 21V rms and 8.5V rms inputs from the Auxiliary Power Supply. Check the respective rectifiers CR18 and CR17 and their associated components. Repair as required then repeat the test starting at step 19.		
22	Set the POWER switch to OFF.		
23	Perform or verify the preparation portion of the calibration procedure contained in paragraphs 4-44 through 4-59. Insure the Preamplifier and Power Amplifier shields are replaced.		
24	Connect the HV Power Line cord to the autotransformer and set the autotransformer output voltage to the nominal line voltage.		
25	Verify the Power switch is OFF, the CONTROL switch in the LOCAL position and the MODE switch is in the STDBY-RESET position.		
26	Set the POWER switch to ON.		
27	Did the INSTRUMENT ON, LOCAL and WARMUP indicators illuminate, are all other indicators extinguished and is the fan audible? (A momentary flash of the FAULT indicator is normal.)	31	28
28	Is the trouble the absence of a valid response?	29	30
29	If the fan is not audible check the input auxiliary power, the POWER switch, the power jumper connections and the fan itself. If none of the indicators illuminate check the outputs of Transformer T3 in the Power Supply. If the incandescent lamp indicator INSTRUMENT ON does not illuminate check the bulbs and the +28V Power Supply on the Logic Assembly. For the LED indicators check the LEDs and the +5V Power Supply. Check the Warm-Up Delay circuit and CR24 if the WARMUP indicator does not illuminate and CR21 if the LOCAL indicator does not illuminate. Repair as required then repeat the test beginning at step 23.		
30	Perform the applicable portions of the following step for the presence of an invalid response. If the FAULT indicator illuminates and stays illuminated check the logic inputs to the Fault Gate (U44 Logic Assy), including the signals that effect the gate by clearing the Trouble FF, or for the presence of an Operate Command from the Interface circuits. Use the Logic Trip Adjustment procedure in paragraph 4-129 to set the indication for the +5 volts if applicable.		

Table 4-3. TROUBLESHOOTING (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
30 (cont)	If the FAULT indicator illuminates after a delay of approximately 6 seconds check the Fault Gate input from the switch controlled by the Fan air speed. If the OVERLOAD indicator illuminates check the disabling circuit between the Warm-Up Delay circuit and U8-11 on the Logic Assy. Repair as required then repeat the test beginning at step 23.		
31	After a delay of approximately 30 seconds does the WARMUP indicator extinguish, the FAULT and OVERLOAD indicator remain extinguished and the STDBY-RESET indicator illuminate?	41	32
32	Does the STDBY-RESET indicator remain extinguished and the WARMUP indicator remain illuminated?	33	34
33	Check the enabling circuitry from the Warm-Up Delay. Repair as required then repeat the test beginning at step 23.		
34	Are both the STDBY-RESET and WARMUP indicators extinguished?	35	36
35	Check the Operate Flip Flop and its associated components. Repair as required then repeat the test beginning at step 23.		
36	Are both the STDBY-RESET and FAULT indicators illuminated and the OVERLOAD indicator extinguished?	37	38
37	Check the inputs to the Fault Gate, especially the $\pm$ Supply Current Monitor input to the comparator from the power supply assy. Repair as required then repeat the test beginning at step 23.		
38	Are both the STDBY-RESET and OVERLOAD indicators illuminated and the FAULT indicator extinguished?	39	40
39	Check the Overload Delay circuitry on the Logic Assy and its input from the Overload and Logic circuitry on the Preamplifier assembly. Repair as required then repeat the test beginning at step 23.		
40	When the STDBY-RESET, FAULT and OVERLOAD indicators are illuminated check the Overload Delay circuitry on the Logic Assy and its input from the Overload and Logic circuitry on the Preamplifier assembly. Check the inputs to the comparators that control the Fault Gate and Trouble Flip Flop. Repair as required and then repeat the test beginning at step 23.		
41	Set the MODE switch to OPERATE.		
42	Does the OPERATE indicator illuminate, the STDBY-RESET indicator extinguish and the FAULT and OVERLOAD indicators remain extinguished? (Disregard momentary flashes of the FAULT and OVERLOAD indicators during switching.)	50	43

Table 4-3. TROUBLESHOOTING (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
43	Does the OPERATE indicator fail to illuminate, the STDBY-RESET indicator remains illuminated and the FAULT and OVERLOAD indicators remain extinguished?	44	45
44	Check the Operate Command through the Interface circuits and the Operate Flip Flop. Repair as required then repeat the test beginning at step 41.		
45	Does the OPERATE indicator illuminate momentarily then extinguish, the STDBY-RESET indicator extinguish momentarily then illuminate, and the FAULT indicators illuminate?	47	46
46	For an OVERLOAD indication without a FAULT indication, check the input to the Overload Delay circuitry from the Preamplifier and the Input and Output stages of the Preamplifier and the Output stage of the Power Amplifier for loading.		
47	To isolate the problem determine whether the fault is major or minor, as defined in the Theory of Operation, paragraph 3-36 through 3-45. Set the MODE switch to STDBY-RESET. If the FAULT indicator extinguishes the fault is minor and the MODE switch may be set to OPERATE. If the FAULT indicator remains illuminated the fault is major and the POWER switch must be set to OFF to clear the fault. Then resume operations by setting the POWER switch to ON and after the Warmup period the MODE switch to OPERATE.		
48	Does the Fault remain after the circuitry has been reset at least once?	49	50
49	For a minor fault determine whether the input at U15-3, U15-4 or U15-5 is clearing the Operate FF, and from there back to the Fault Gate (U44), NEG HV or the Warm-Up Delay circuitry respectively. For an OVERLOAD indication in addition to the FAULT indication check the NEG HV and OVERLOAD inputs to the Fault and Overload Delay Circuitry from the Preamplifier Logic Circuitry. For a major fault determine whether the input at U15-9, U15-10 or U15-11 is clearing the Trouble FF, and from there back to the Operate Circuit U21 comparator, U22 comparator or SENSE HV circuitry respectively. Repair as required then repeat the test beginning at step 41.		
50	Set the MODE switch to STDBY-RESET, the POWER switch to OFF and the Autotransformer output to zero volts.  <b>WARNING!</b> <b>Lethal voltages are present during the following tests. Read the Test preparation and prepare the equipment as described in paragraphs 4-56 through 4-64 before continuing.</b>		
51	Perform the Upper Tube Balance calibration starting at paragraph 4-65.		
52	Are the readings on the oscilloscope and DVM adjustable with the stated tolerances?	54	53
53	Check the Upper Tube stage and its regulating circuit. Repair as required then repeat the test beginning at step 51.		
54	Perform the Lower Tube Balance calibration starting at paragraph 4-67.		

Table 4-3. TROUBLESHOOTING (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
55	Are the readings on the oscilloscope and DVM adjustable within the stated tolerances?	57	56
56	Check the Lower Tube stage and its regulated circuit. Repair as required then repeat the test beginning at step 54.		
57	Perform the Output Stage Bias Current Calibration starting at paragraph 4-70.		
58	Are the readings on the oscilloscope and DVM adjustable within the stated tolerance?	60	59
59	Check the output stage class AB Amplifier (Q11 and Q12) and their associated components. Repair as required then repeat the test beginning at step 57.		
60	Perform the LED Loop Bias Current Calibration starting at paragraph 4-73.		
61	Is the oscilloscope current display adjustable to within the stated tolerance?	63	62
62	Check the Power Amplifier 30mA current source stage. Repair as required then repeat the test beginning at step 60.		
63	Perform the LED Loop Bandwidth Calibration starting at paragraph 4-76.		
64	Is the oscilloscope current display adjustable to within the stated tolerance?	66	65
65	Check the Power Amplifier 30 mA current source stage. Repair as required then repeat the test beginning at step 63.		
66	Perform the Screen Voltage Calibration starting at paragraph 4-79.		
67	Is the Lower Tubes Absolute Screen Voltage adjustable within the stated tolerance?	69	68
68	Check the Lower Tubes screen regulator circuitry. Repair as required then repeat the test beginning at step 65.		
69	Is the Upper Tube Absolute Screen Voltage adjustable within the stated tolerance?	71	70
70	Check the Upper Tubes Screen Regulator Circuitry. Repair as required then repeat the test beginning at step 66.		
71	Perform the Positive and Negative Current Trip Level Adjustment in paragraphs 4-82 thru 4-87.		
72	Are the Current Trip Circuits adjustable within the stated tolerance?	74	73
73	Check the Logic Assembly Fault and Comparator circuits and the input from the Power Supply. Repair as required then repeat the test starting at step 71.		
74	Perform the Preampifier $\pm 15$ Supply Voltage Calibration. Start with the preparation procedure in paragraph 4-89.		
75	Are the $\pm 15$ Volt supplies adjustable within the stated tolerances?	77	76
76	Check the $\pm 15$ Volt power supply and its 31V rms input from the Auxiliary supply. Repair as required then repeat the test starting at step 74.		
77	Perform the Preampifier Minimum Negative High Voltage Trigger Level Calibration starting at paragraph 4-97.		

Table 4-3. TROUBLESHOOTING (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
78	Is the result of the test acceptable?	80	79
79	Check the $-2.5\text{kV}$ input to the Preamp, the Logic Stage of the Preamp and the Fault circuits on the Logic Assembly. Repair as required then repeat the test starting at step 77.		
80	Perform the Input FET Switch Impedance Calibration starting at paragraph 4-100.		
81	Is the FET switch impedance adjustable within the stated tolerance?	83	82
82	Check the Preamp Input stage, in particular the input FET switch and its compensating network. Repair as required then repeat the test starting at step 80.		
83	Perform the Preamp Overload Trigger Balance Calibration starting at paragraph 4-103.		
84	Is the DC Balance adjustable within the stated tolerance?	86	85
85	Check the Power Amp 30 mA current source the Preamp output stage and the Preamp Input stage (input amp in particular). Repair as required then repeat the test starting at step 83.		
86	Is the AC Balance adjustable within the stated tolerance?	88	87
87	Check the Preamp Input and Overload stages, in particular check the Slew Rate Sense Amplifier. Repair as required then repeat the test starting at step 83.		
88	Prepare the instrument for further calibration as outlined in the Calibration Point Adjustments (paragraph 4-106) and LOCAL/Remote Mode Calibration (paragraph 4-109) procedures.		
89	Perform the DC Offset Calibration starting at paragraphs 4-112.		
90	Is the DC Offset adjustable within the stated tolerance?	92	91
91	Check the Preamp Input stage the Input amplifier in particular. Repair as required then repeat the test starting at step 89.		
92	Perform the LOCAL/Remote Mode DC Gain calibration starting at paragraph 4-115.		
93	Is the LOCAL/Remote Mode DC Gain within the stated tolerance?	95	94
94	Check the Preamp Input stage, the Input and Feedback Resistor Network in particular. Repair as required then repeat the test starting at step 92.		
95	Perform the LOCAL/Remote Mode Middle and High Frequency Gain Calibration starting at paragraph 4-118.		
96	Is the transfer standard null obtainable to the stated tolerances?	98	97

Table 4-3. TROUBLESHOOTING (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
97	Check the Preamplifier input stage the Input Amplifier in particular. Repair as required then repeat the test starting at step 93.		
98	Will the 5205A be used in conjunction with a 5200 AC Calibrator and is one available?	99	102
99	Perform the Calibrator Mode Procedure starting at paragraph 4-122.		
100	Is the transfer standard null obtainable to the stated tolerances?	102	101
101	Check the Preamplifier feedback circuits. If the 5205A has maximum output regardless of the 5200A setting check the sensing circuits (op amp, divider, cables and associated components). Repair as required then repeat the test starting at step 99.		
102	Troubleshooting of the 5205A Power Amplifier is complete. If any component was replaced or an adjustment changed a calibration procedure should be performed.		



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## Section 5

# Lists of Replaceable Parts

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## 5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. Components are listed alpha-numerically by assembly. Electrical components are listed by item number. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

- a. Reference Designation or Item Number.
- b. Description of each part.
- c. Fluke Stock Number.
- d. Federal Supply Code for Manufacturers.  
(See Section 7 for Code-to-Name list.)
- e. Manufacturer's Part Number or Type.
- f. Total Quantity per assembly of component.
- g. Recommended Quantity: This entry indicates the recommending number of spare parts necessary to support one to give instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked. In the case of optional sub-assemblies, plug-ins, etc. that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended quantity of the item in that particular assembly.

h. Use Code is provided to identify certain parts that have been added, deleted or modified during production of the instrument. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity, paragraph 5-7.

## 5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information:

- a. Quantity.
- b. FLUKE Stock Number.
- c. Description.
- d. Reference Designation or Item Number.
- e. Printed Circuit Board Part Number.
- f. Instrument Model and Serial Number.

## 5-7. USE CODE EFFECTIVITY LIST

USE CODE	SERIAL NUMBER EFFECTIVITY
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Table 5-1. FINAL ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	<b>FINAL ASSEMBLY (Figure 5-1 thru 5-9) Power Switches View (Figure 5-1)</b>						
101	Angle, Power Switch	336701	89536	336701	1		
102	Bracket, Angle	356030	89536	356030	1		
103	Bracket, Center	400887	89536	400887	1		
104	Bracket, Power Switch	336693	89536	336693	1		
105	Coupler, Disc.	360537	89536	360537	1		
106	Switch, Toggle	326363	27191	8822K20	2		
	<b>Rear Panel View (Figure 5-2)</b>						
201	Bushing, Strain Relief, Aux line	436394	28520	SR6P3-4	1		
202	Bushing, Strain Relief, HV Line	102194	28520	SR-8P-2	1		
203	Connector, Female, 3 prong	247015	73586	M-1538GS	1		
204	Cord Set, Auxiliary	409920	89536	409920	1		
205	Cord Set, High Voltage	409912	89536	409912	1		
206	Fuse Holder	407775	75915	341-001AL	2		
207	Fuse, Slo-Blow, 5A (Aux Supply)	109215	71400	MDA-TYPE	1		
208	Fuse, Slo-Blow, 15A (HV Supply)	392936	71400	MDA-TYPE	1		
209	Handle, Corner	295691	89536	295691	4		
210	Hole Plug, Snap Button, 1/2"	441311	HEYCO	P-375	1		
211	Hole Plug, Snap Button, 5/8"	407502	HEYCO	P-625	1		
212	Panel, Rear	336446	89536	336446	1		
213	Plate, Rear	336495	89536	336495	1		
214	Plate, Spacer	336966	89536	336966	1		
215	Strap, Rubber, Mousetail	104794	98159	2829-115-3	1		

NOTE: ITEMS ILLUSTRATED BUT NOT CALLED OUT ARE COMMON HARDWARE.

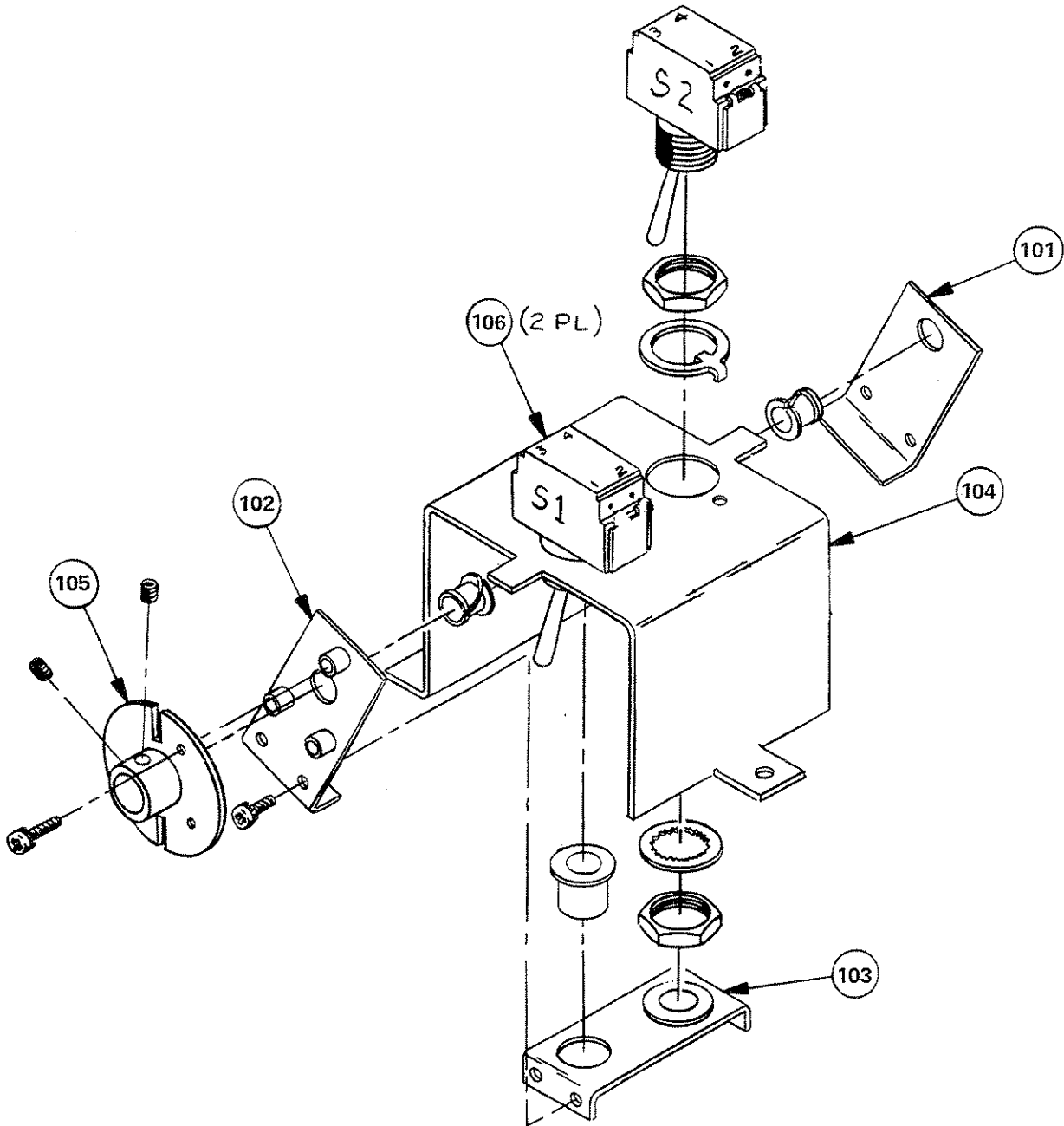


Figure 5-1. POWER SWITCHES VIEW

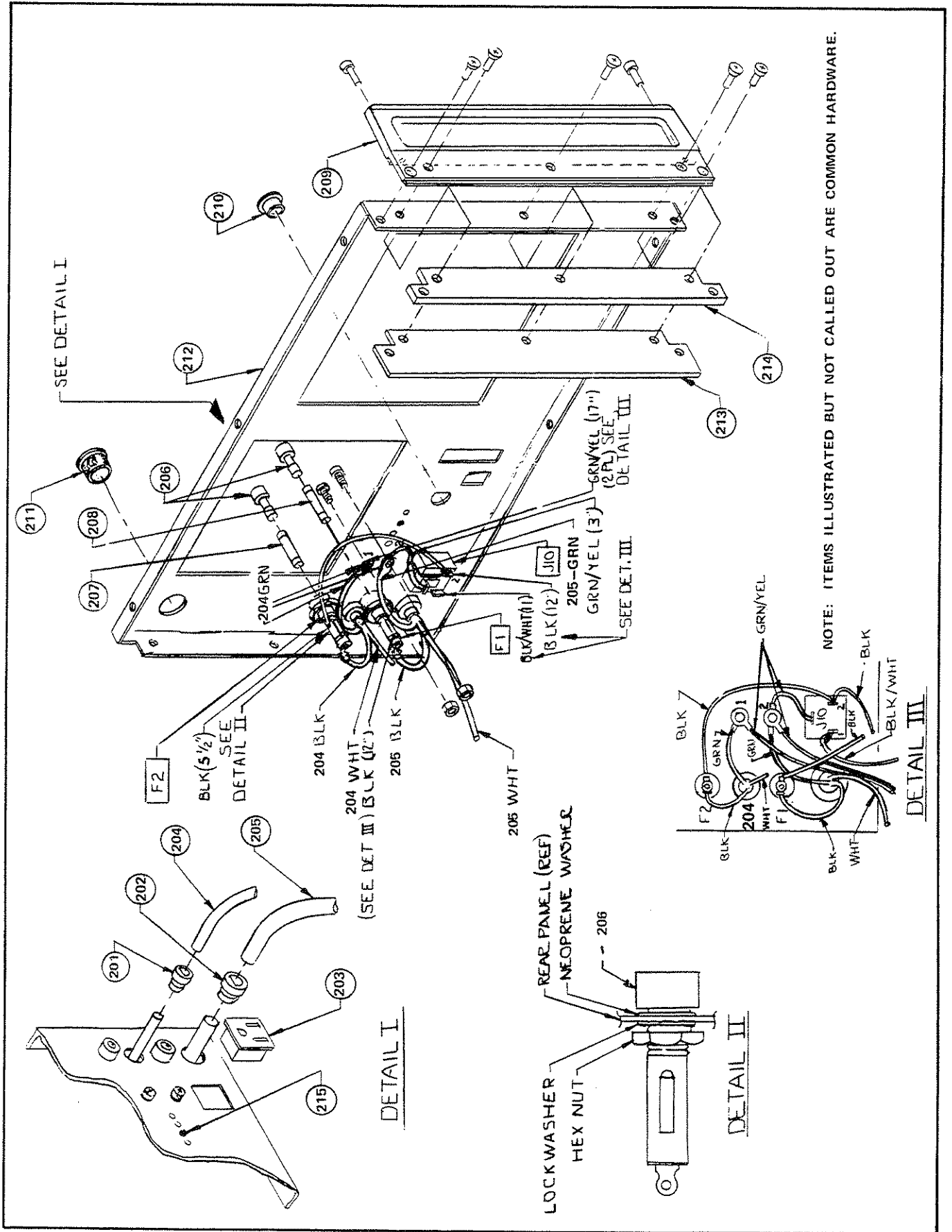


Figure 5-2. REAR PANEL VIEW

Table 5-1. FINAL ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
<b>Front Panel View (Figure 5-3)</b>							
301	Betel, Window, HV Symbol	341768	89536	341768	1		
302	Betel Window, Operate	367656	89536	367656	1		
303	Bracket, corner angle	298141	89536	298141	2		
304	Binding Post, Black	275560	32767	820-45	1		
305	Binding Post, White	275586	32767	820-25	1		
306	Cable, local input	349597	89536	349597	1		
307	Clamp, cable storage	346742	89536	346742	1		
308	Connector, BNC, Female, 1/2 x 28 or Connector, BNC, Female, 3/8 x 24	386888 414201	91836 02660	KC76-67 31-010	1 1		
	NOTE: Check diameter of hole in Front Panel before ordering replacement connector.						
309	Decal, Fluke Logo and Ser. No.	194183	89536	194183	1		
310	Decal Title	343368	89536	343368	1		
311	Diffuser	351338	89536	351338	2		
312	Extrusion, Front Panel, Screened	341750	89536	341570	1		
313	Housing, Cable Plug	346536	89536	346536	1		
314	Panel Front	336438	89536	336438	1		
315	Shorting Link	190728	83330	21171	1		
316	Spacer, Cable Storage	346726	89536	346726	2		
<b>Tube Chamber View (Figure 5-4)</b>							
401	Card Guide	229047	23880	1800F	8		
402	Switch, Air	417602	89536	417402	1		
403	Tube Chamber Assy.	337402	89536	337402	1		
<b>Left Side View (Figure 5-5)</b>							
501	Bracket, Angle	166322	73734	1552	1		
502	Cable, Assy.	349589	89536	349589	1		
503	Relay Armature	387415	78290	425BXXW	1		
504	Sidewall, Left	336529	89536	336529	1		
505	Switch, Pushbutton	408500	01963	E69-30A	1		
506	Tap Board	336743	89536	336743	1		

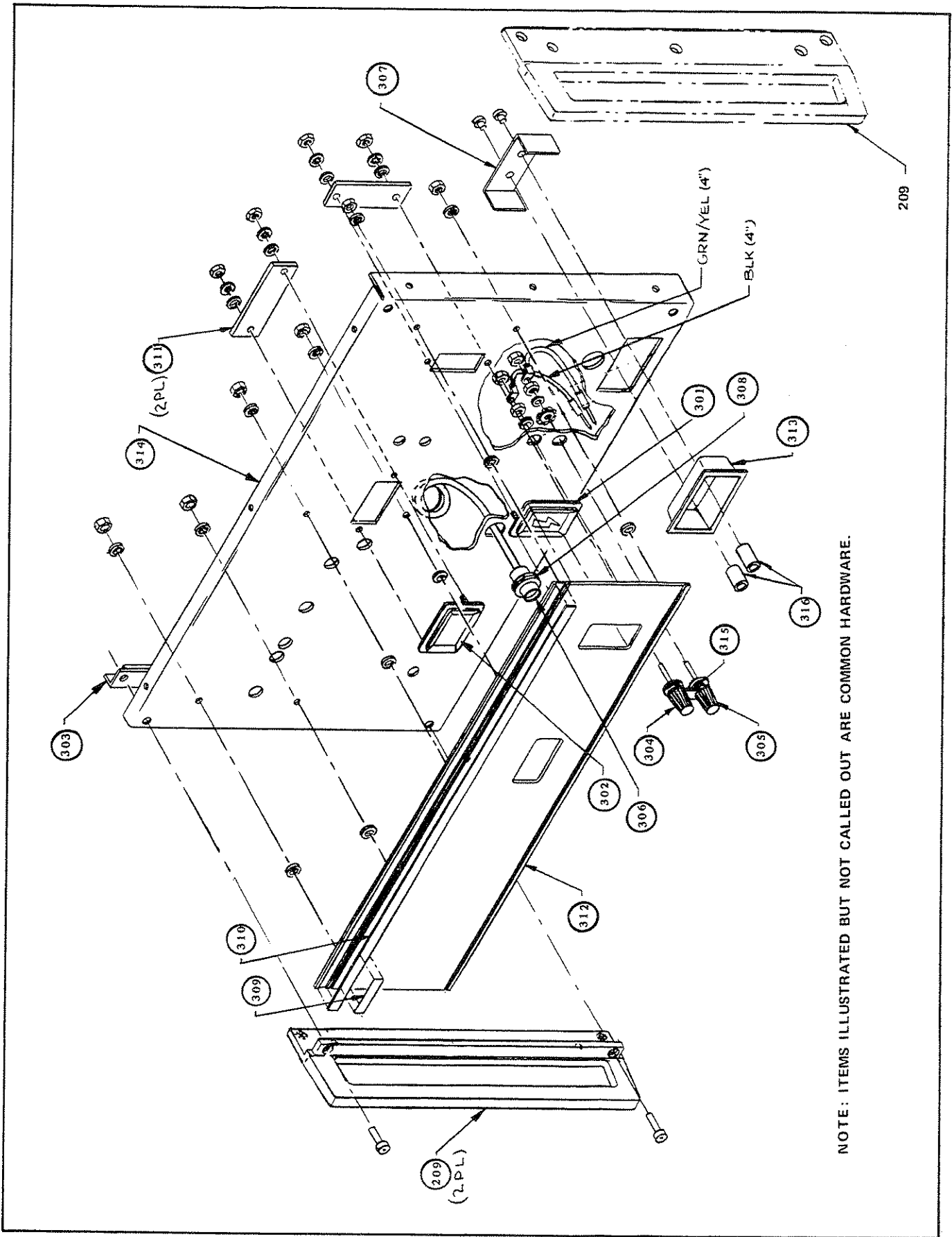


Figure 5-3. FRONT PANEL VIEW

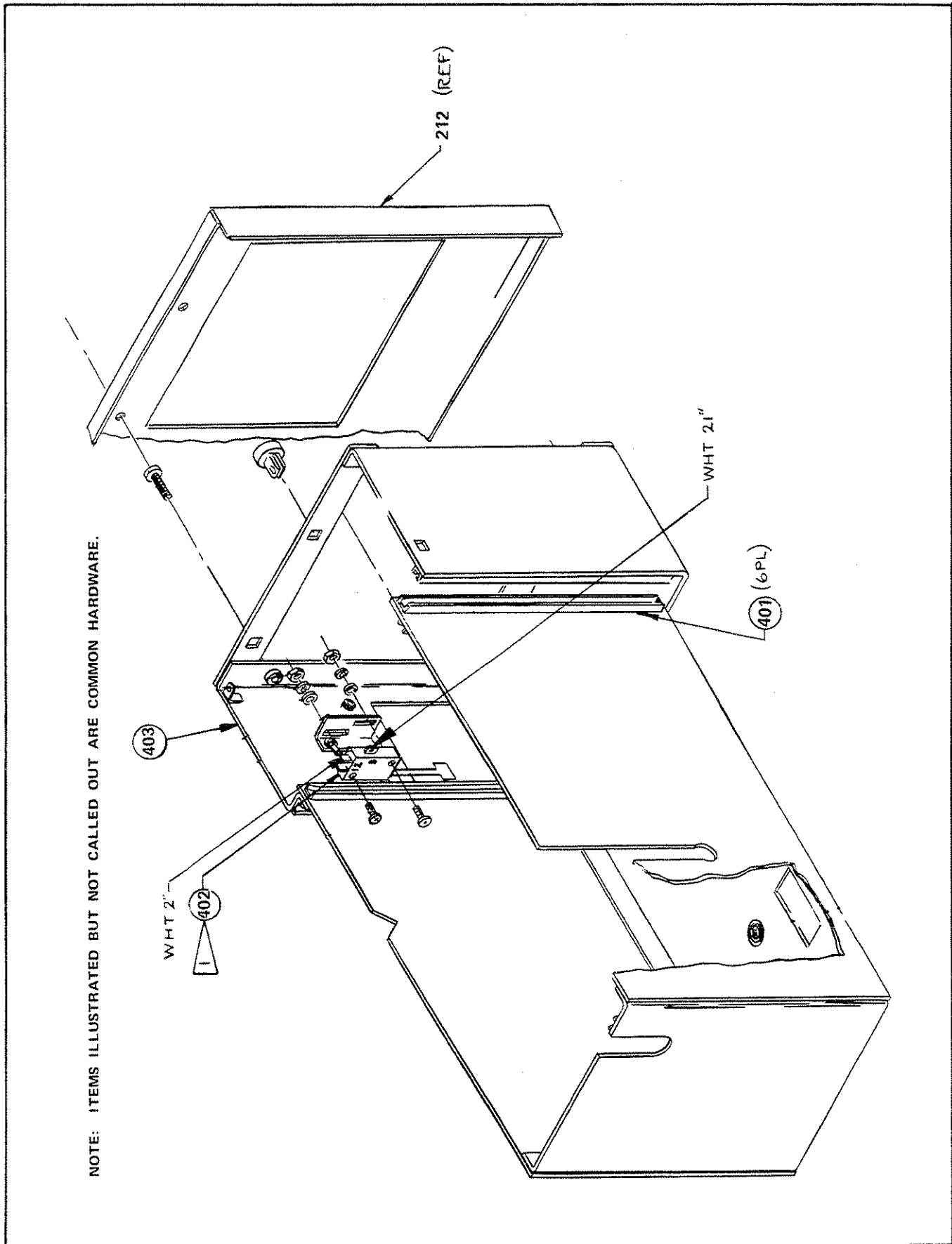


Figure 5-4. TUBE CHAMBER VIEW



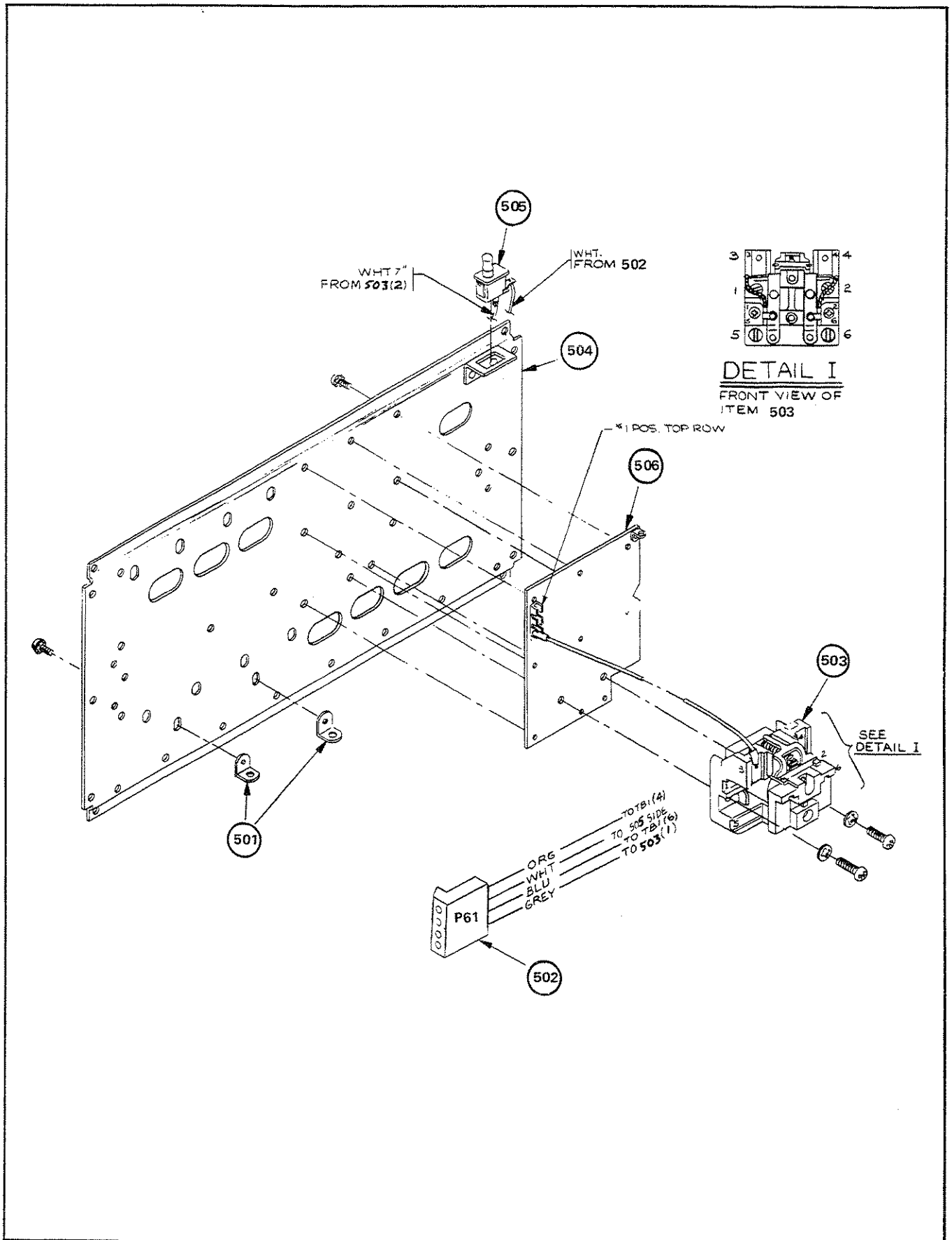


Figure 5-5. LEFT SIDE VIEW.

Table 5-1. FINAL ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
<b>Power Supply View (Figure 5-6)</b>							
C11, C12	Cap, Oil filled 4 uF $\pm$ 15%, 400V	387431	00646	CKM2-40-4M53	2		
C13	Cap, Oil filled, 1 uF $\pm$ 10%, 400V	387423	00686	CKM2-40-1M	1		
T3	Transformer, Preamp	336917	89536	336917	1		
T4	Transformer, Power Amp	397844	89536	397844	1		
601	Assy, PCB, Mother	336818	89536	336818	1		
602	Assy, Bleeder Power Amp	401000	89536	401000	2		
Ri thru R5	Res, comp, 1M $\pm$ 10%, 2W	136671	01121	HB3341	5		
603	Assy, Bleeder, Preamp	400994	89536	400994	1		
R1 thru R5	Res, comp, 330k $\pm$ 10%, 2W	208227	01121	HB1051	5		
604	Bracket, fan	336552	89536	336552	1		
605	Bracket, Transformer	336453	89536	336453	1		
606	Cable Assy, Preamp HV	349517	89536	349517	1		
607	Cable Assy, Neg HV	346601	89536	346601	1		
608	Cable Assy, Pos HB	346569	89536	346569	1		
609	Clamp, HV	419473	89536	419473	1		
610	Instrument Bottom	336479	89536	336479	1		
611	Shaft, Power Switch	400960	89536	300960	1		
<b>Low Capacity View (Figure 5-7)</b>							
T2	Transformer, Lo Cap	336909	89536	336909	1		
701	Bulkhead, Central	336461	89536	336461	1		
702	Clamp, Lo Cap Xfmr	400895	89536	400895	1		
703	Screen	401034	89536	401034	1		

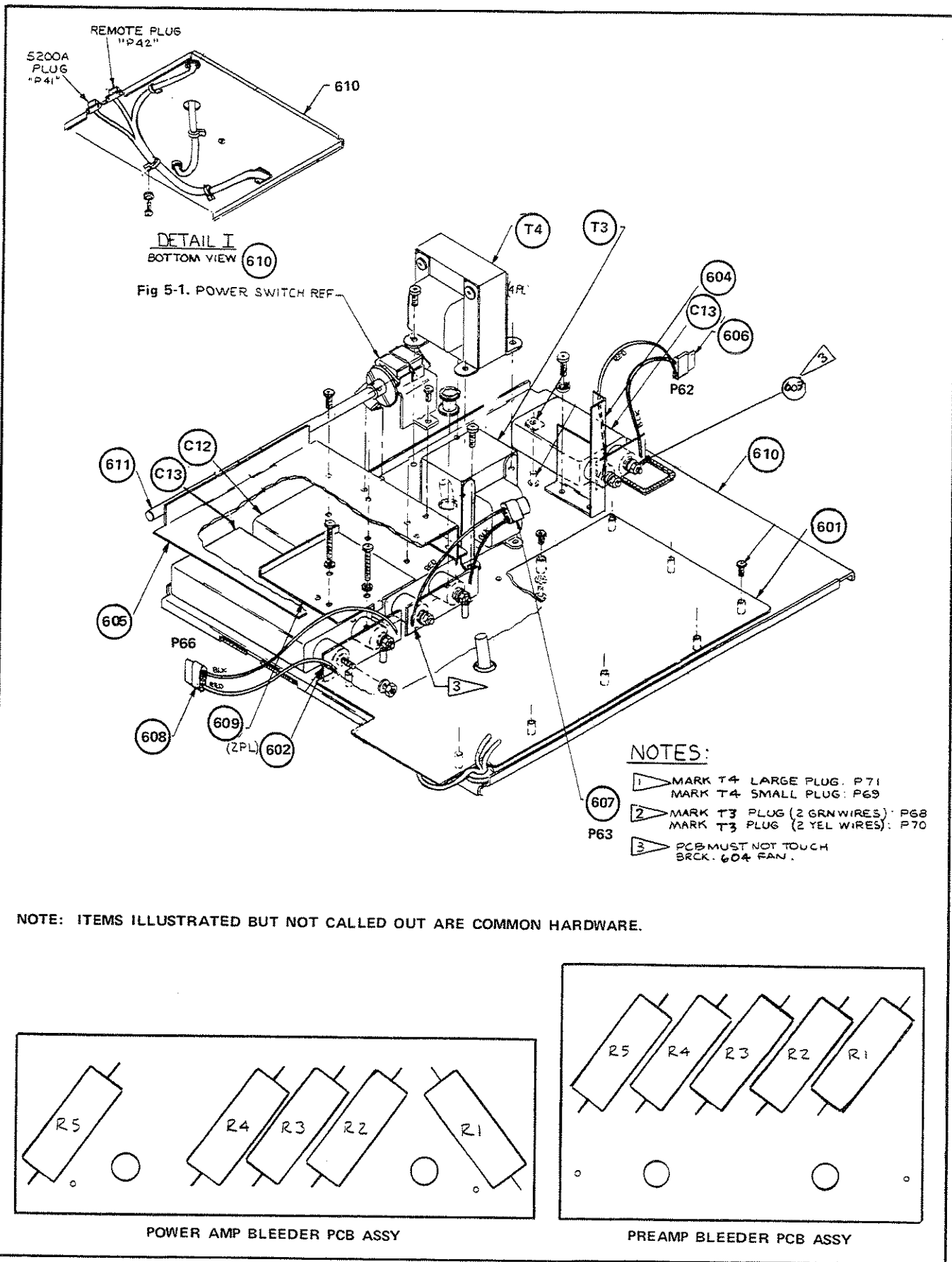


Figure 5-6. POWER SUPPLY VIEW

NOTE: ITEMS ILLUSTRATED BUT NOT CALLED OUT ARE COMMON HARDWARE.

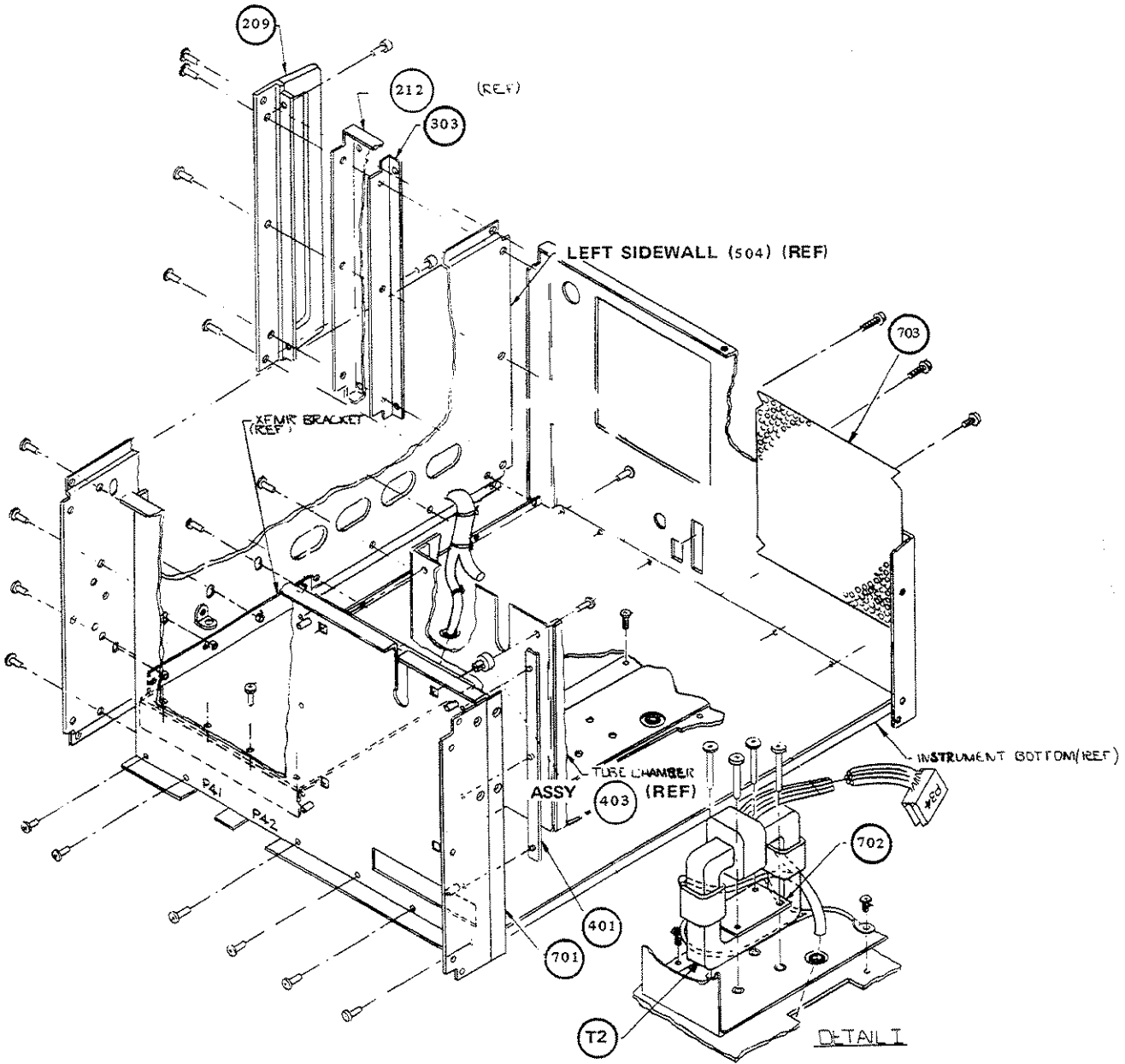


Figure 5-7. LOW CAPACITY VIEW

Table 5-1. FINAL ASSEMBLY, (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	<b>Interior View (Figure 5-8)</b>						
T1	Transformer, Hi-Voltage	336891	89536	336891	1		
801	Assy, Power Amp.	341511	89536	341511	1		
802	Assy, Preamp	397836	89536	397836	1		
803	Assy, Logic PCB	336826	89536	336826	1		
804	Assy, Power Supply PCB	362111	89536	362111	1		
805	Air duct	400861	89536	400861	1		
806	Blower	330068	82877	VS37A2-12	1		
807	Cable Assy, Control, (P5 to P41, J25 & J26)	346544	89536	346544	1		
808	Cable Assy, Output	341552	89536	341552	1		
809	Cable Assy, Remote (P7 to P42)	346056	89536	346056	1		
810	Clamp, Cable, Nylon (Not illustrated rear of Front Panel)	102265	06383	SST-2	1		
811	Cover, bottom	336677	89536	336677	1		
812	Decal, Danger	336859	89536	336859	2		
813	Decal, Knob, Black	341453	89536	341453	2		
814	Decal, Knob, Green	341339	89536	341339	1		
815	Fan Intake, Bellmouthed	336503	89536	336503	1		
816	Fan nut plate	336545	89536	336545	1		
817	Filter intake	402834	89536	402834	1		
818	Frame, Filter	400945	89536	400945	1		
819	Foot, Bail Stand	292870	89536	292870	6		
820	Foot insert, Nonskid	420422	89536	420422	6		
821	Plate, Power Transformer	400309	89536	400309	1		
822	Plate, Spacer	336966	89536	336966	1		
823	Spring Clip	330134	02660	17-529	2		
824	Spacer	403071	89536	403071	1		

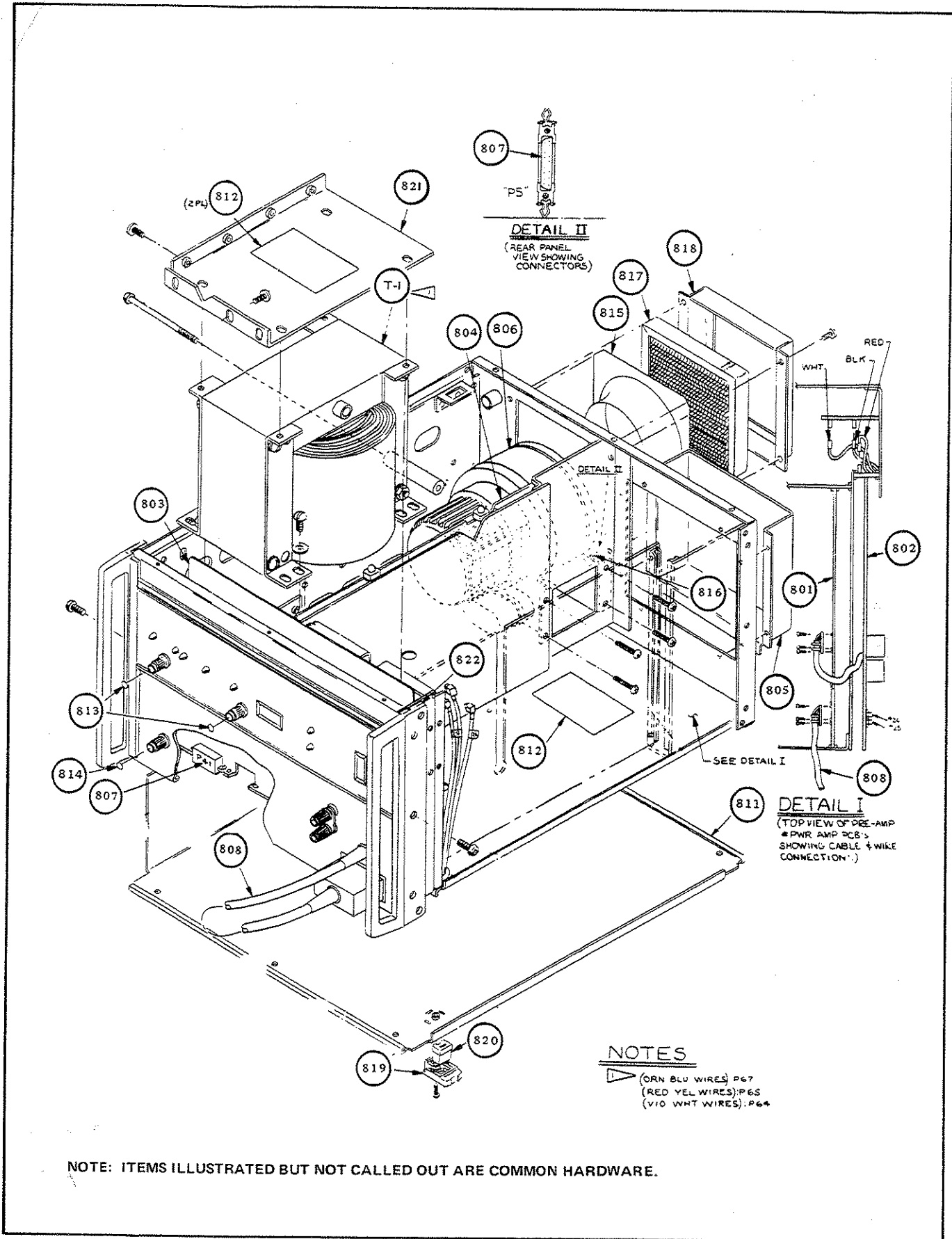


Figure 5-8. INTERIOR VIEW

Table 5-1. FINAL ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	<b>Exterior View (Figure 5-9)</b>						
901	Cover, Low Capacity Chamber	336636	89536	336636	1		
902	Cover, Right Side	337410	89536	337410	1		
903	Cover, Top	336669	89536	336669	1		
904	Cover, Transformer	336644	89536	336644	1		
905	Cover, Tube Chamber	336594	89536	336594	1		
906	Decal, Corner	296293	89536	296293	4		
907	Decal, Handle Trim	295527	89536	295527	4		
908	Decal, Side Trim	295402	89536	295402	2		
909	Decal, Danger	336719	89536	336719	2		
910	Decal, HV	349464	89536	349464	1		
911	Decal, Ground	349456	89536	349456	1		
912	Shield, Preamp	353425	89536	353425	1		
913	Sidewall, Right	336537	89536	336537	1		
914	Kit Accessory (Not illustrated)	346528	89536	346528	1		
	Cable Assy Interconnect (5205A to 5200A)	341560	89536	341560	1		
	PCB, shorting	400762	89536	400762	3		
	(Following 3 items are supplied for local manufacture of a remote connector, if required.)						
	Connector, cable, plug w/socket	347625	71468	DE-9S	1		
	Connector, back shell	352724	02660	17-1370	1		
	Spring Clip	330134	02660	17-529	1		

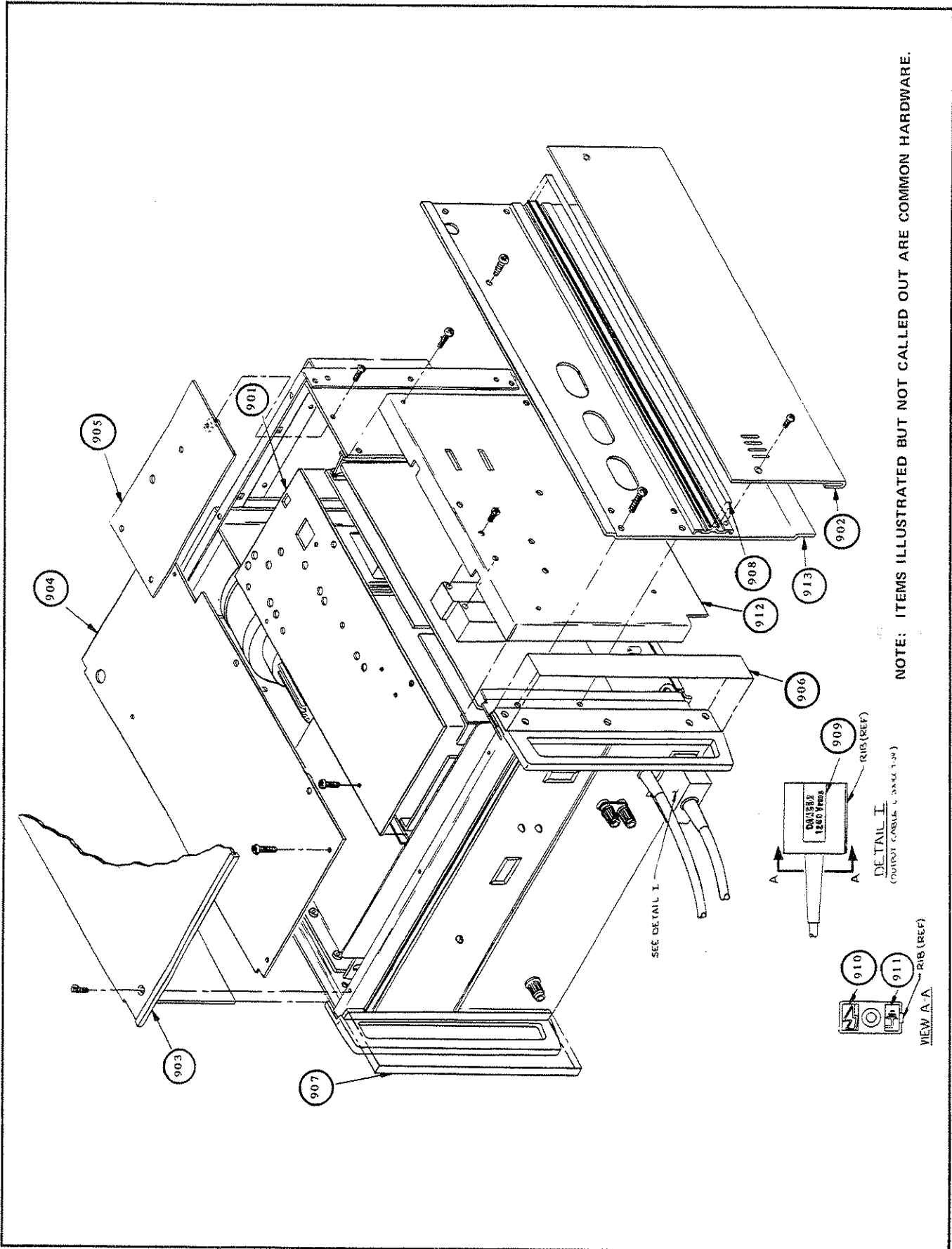


Figure 5-9. EXTERIOR VIEW



Table 5-2. PCB ASSEMBLY, MOTHERBOARD

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	<b>PCB ASSY. MOTHERBOARD (Figure 5-10)</b>	336818	89536	336818	REF		
E1	Protector, Spark Gap	198507	25088	B1F90	1		
J20, J21	Connector, 9 position/2 removed	352682	00779	583694-2	2		
J22	Connector, 3 position	291625	00779	583650-1	1		
J23	Connector, 6 position	291898	00779	583650-2	1		
J30	Connector 5 position/1 removed	404020	00779	583694-7	1		
J31	Connector 20 position/6 removed	403980	00779	583694-3	1		
J43	Connector 15 position	291948	00779	583650-7	1		
J44, J45	Connector 5 position	403964	00779	583407-6	2		
J50	Connector 11 position/2 removed	404012	00779	583694-6	1		
J51	Connector 9 position/4 removed	403998	00779	583694-4	1		
J52	Connector 11 position/2 removed	404004	00779	583694-5	1		
J53	Connector 7 position	403972	00779	583407-8	1		
J54, J56	Connector 4 position/	354951	00779	583407-5	2		
OL	Connector, Black	149112	74970	105-0753	1		
Chas GND	Connector, Green	149120	74970	105-0754	1		
VR1, VR2	Diode Zener	113365	31483	69-4978	2		

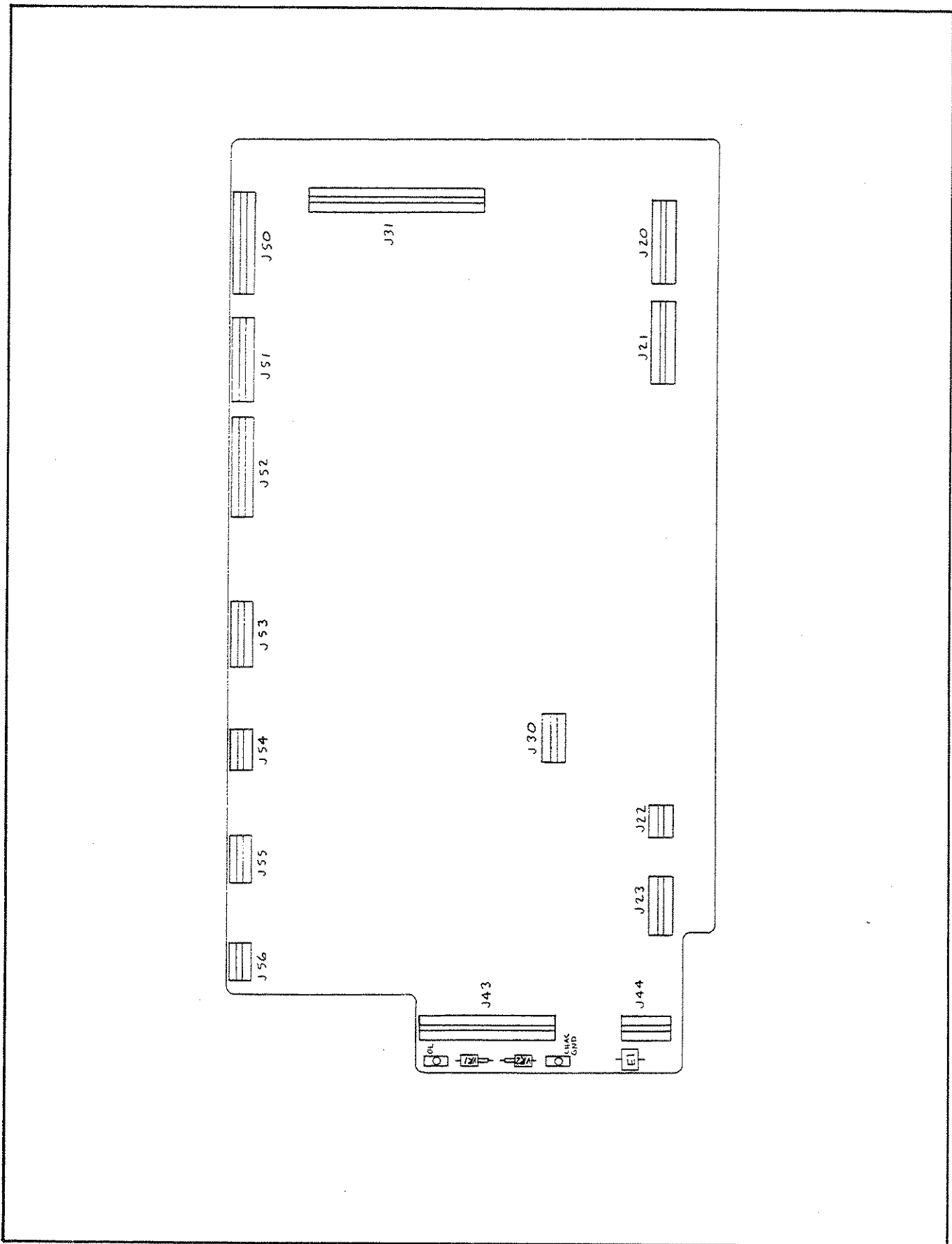


Figure 5-10. PCB ASSY. MOTHERBOARD

Table 5-3. PCB ASSY. POWER SUPPLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	PCB ASSY, POWER SUPPLY (Figure 8-2)	362111	89536	362111	REF		
C1	Capacitor, elect, 10 $\mu$ f $\pm$ , 300V	340885	56289	500D106F- 300DC7	1		
CR1 thru CR4, CR7, CR17, CR18, CR25, CR26	Diode	368738	04713	1N4004	9		
CR6, CR8	Diode	203323	07919	TD 8253	2		
CR11 thru CR16, CR21 thru CR24	Diode	268433	04713	MR250-5	10		
J61, J64	Connector, 4 pin	385443	27264	09-65=1041	2		
J62, J63, J65, J66, J67, J69	Connector, 2 pin	413914	27264	09-65-1041	6		
J68, J70, J71	Connector, 15 pin	310094	27254	03-09-2151	3		
Q1, Q3	Transistor	218511	95303	65120	2		
Q2	Transistor	284448	89536	284448	1		
R1, R20	Res, comp, 220 $\pm$ 5%, $\frac{1}{4}$ W	147959	01121	CB2215	2		
R2	Res, comp, 220k $\pm$ 5%, $\frac{1}{2}$ W	108217	01121	CB2245	1		

Table 5-3 PCB ASSY. POWER SUPPLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R3	Res, com, 8.2k $\pm$ 5%, $\frac{1}{4}$ W	160796	01121	CB8225	1		
R4	Res, comp, 3.3k $\pm$ 5%, $\frac{1}{4}$ W	148056	01121	CB3325	1		
R5	Res, comp, 470k $\pm$ 5%, $\frac{1}{2}$ W	108969	01121	EB4745	1		
U1	Opto-Isolator	380014	29013	MCT-2	1		
VR5	Diode, zener, 110V	392878	07910	1N986B	1		
	Connector Pin	342998	27269	02-09-1118	31		
	Guide, retainer	341115	89536	341115	3		
	Heat Sink (Q3)	104562	05820	NF-209	1		
	Transipad (Q1, Q2, Q3)	152207	07047	10123DAP	3		

Table 5-4. PCB ASSEMBLY, LOGIC

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	PCB ASSY, LOGIC (Figure 8-4)	346338	89536	346338	REF		
	Assy, LED Standoff	341594	89536	341594	7		
	Assy, High Voltage Lamps	400986	89536	100986	1		
	Bracket, HV Lamps	400747	89536	400747	1		
	Plug, Banana	352716	83330	431	2		
	Socket, Bayonet Base	103523	95213	7-08	2		
	Assy, Operate Lamps	400978	89536	400978	1		
	Mounting, Operate Lamps	400739	89536	400739	1		
	Plug, Banana	352716	83330	431	3		
	Socket, Lamp	184002	95263	7-12	2		
C1,C3, C10, C12, C46, C49, C55, C56, C99	Cap, fxd, cer, 0.05 $\mu$ f $\pm$ 20%, 100V	149161	56289	55C23A1	9		
C2	Cap, fxd, Ta, 15 $\mu$ f $\pm$ 20%, 6V	161935	56289	196D156X- 0006	1		
C4,C15, C21, C90, C94	Cap, fxd, Ta, 6.8 $\mu$ f $\pm$ 10%, 35V	182782	56289	150D685X903- 582	5		
C5,C30 thru C33	Cap, fxd, cer, 0.1 $\mu$ f $\pm$ 20%, 100V	149146	56289	33C416B	5		
C14, C22, C23, C44	Cap, fxd, Ta, 1 $\mu$ f $\pm$ 20%, 35V	161919	56289	196D001X- 03582	4		
C20	Cap, elect, 47 $\mu$ f $-10/+50%$ , 25V	168823	25403	ET470X0025 A4	1	1	
C25, C26, C27	Cap, elect, 1000 $\mu$ f $-10/\pm 50%$ , 16V	193896	25403	ET102X016 A02	3	1	

Table 5-4. PCB ASSEMBLY, LOGIC, (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
C23	Cap, elect, 470 $\mu$ F-10/+50%, 40V	185868	25403	ET471X040-A02	1	1	
C40	Cap, fxd, Ta 2.2 $\mu$ F $\pm$ 20%, 15V	364216	56289	196D225X015-HA1	1		
C41	Cap, fxd, Ta, 0.33 $\mu$ F $\pm$ 20%, 35V	408690	56289	196D334X035-HA	1		
C42, C45	Cap, fxd, Ta, 0.47 $\mu$ F $\pm$ 20%, 35V	161349	56289	196D474X035-HA1	2		
C43	Cap, fxd, Ta, 4.7 $\mu$ F $\pm$ 20%, 25V	161943	56289	196D475X025-KA1	1		
C47, C50	Cap, fxd, TA, 10 $\mu$ F $\pm$ 20%, 10V	176214	56289	196D106X010-KA1	2		
C48, C52	Cap, fxd, cer, 0.01 $\mu$ F -20/+80%, 100V	105668	00656	C023B501J103M	2		
C53	Cap, fxd, plastic, 5 $\mu$ F $\pm$ 5%, 150V	364190	20908	Type X564	1		
C54	Cap, Ta, elect, 220 $\mu$ F $\pm$ 10%, 10V	182840	56289	150D227X901-0S2	1	1	
C98, C102	Cap, Ta, elect, 68 $\mu$ F $\pm$ 10%, 15V	182824	56289	150D686X901-5R2	2	1	
CR10 thru CR13, CR16, CR30, CR40, CR42, CR43, CR74, CR97, CR101	Diode, Si, Hi-Speed switching	203323	07910	TD8253	12	3	
CR17, CR18	Rectifier, bridge	296509	09423	FB200	2	1	
CR21 thru CR27	Diode, light emitting	309617	07263	FLV102	7	2	
CR41	Diode, Si	348177	07263	FD7223	1	1	

Table 5-4. PCB ASSEMBLY, LOGIC (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
D1 thru DS4	Lamp, Incandescent	186346	71744	CM1819	4		
K1	Relay, dry reed	357566	71707	UF40069	1		
L1,L2	Choke, H turn	379222	89536	379222	2		
Q1,Q2	Xstr, Si, NPN, power	343970	04713	MPS-U06	2	1	
Q3,Q10	Xstr, Si, NPN	218396	04713	2N3904	2	1	
Q4	Sxtr, Si, PNP	288761	01295	SK6808	1	1	
Q5	Xstr, Si, NPN	203489	03508	11C-2322	1	1	
R1,R2, R4,R13	Res, fxd, comp, 2k $\pm$ 5%, $\frac{1}{4}$ W	202879	01121	CB2025	4		
R3,R21, R25, R27, R28, R38, R39, R40, R65, R83	Res, fxd, comp, 4.7k $\pm$ 5%, $\frac{1}{4}$ W	148072	01121	CB4725	10		
R5, R120, R122 thru R125	Res, fxd, comp, 33 $\pm$ 5%, $\frac{1}{4}$ W	175034	01121	CB3305	6		
R6,R10, R11,R20, R26, R30, R35, R36, R100, R101, R105, R106, R110, R111, R112, R116, R127	Res, fxd, comp, 220 $\pm$ 5%, $\frac{1}{4}$ W	147959	01121	CB2215	17		

Table 5-4. PCB ASSEMBLY, LOGIC (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R22, R23, R24, R73, R85, R86, R102, R103, R104, R113, R114, R115, R118, R128, R131	Res, fxd, comp, 10k $\pm$ 5%, $\frac{1}{4}$ W	148106	01121	CB1035	15		
R45, R46	Res, fxd, comp, 270 $\pm$ 5%, $\frac{1}{2}$ W	159616	01121	EB2715	2		
R47	Res, var, cermet, 20k $\pm$ 10%, $\frac{1}{2}$ W	355529	11236	362S203AZ	1		
R48, R49	Res, var, cermet, 100k $\pm$ 10%, $\frac{1}{2}$ W	355537	11236	362S104AZ	2		
R50	Res, fxd met film, 30.1k $\pm$ 1%, 1/8W	168286	91637	MFF1-83012F	1		
R51	Res, fxd, met film, 365k $\pm$ 1%, 1/8W	289520	91637	MFF1-83653F	1		
R52	Res, fxd, met film, 383k $\pm$ 1%, 1/8W	288498	91637	MFF1-83833F	1		
R53, R55, R74, R98	Res, fxd, comp, 100 $\pm$ 5%, $\frac{1}{4}$ W	147926	01121	CB1015	4		
R54	Res, fxd, comp, 3.3k $\pm$ 5%, $\frac{1}{2}$ W	165761	01121	CB3325	1		
R60	Res, fxd, comp, 2.2k $\pm$ 5%, $\frac{1}{4}$ W	148049	01121	CB2225	1		
R61	Res, fxd, comp, 5.6k $\pm$ 5%, $\frac{1}{4}$ W	148080	01121	CB5625	1		
R62, R63, R95	Res, fxd, comp, 22k $\pm$ 5%, $\frac{1}{4}$ W	148130	01121	CB2235	3		
R66	Res, fxd, met film, 187k $\pm$ 1%, 1/8W	289462	91637	MFF1-81873F	1		
R67	Res, fxd, met film, 48.7k $\pm$ 1%, 1/8W	267385	91637	MFF1-81502F	7		
R70, R71, R76, R88, R89, R90, R94	Res, fxd, met film, 15k $\pm$ 1%, 1/8W	285296	91637	MFF1-81502F	7		



Table 5-4. PCB ASSEMBLY, LOGIC (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R72, R80, R202	Res, fxd, comp, 1k $\pm$ 5%, 1/4W	148023	01121	CB1025	3		
R77	Res, fxd, mat film, 909 $\pm$ 1%, 1/8W	312629	91637	MFF1-89090F	1		
R81,R R82, R121	Res, fxd, comp, 390 $\pm$ 5%, 1/4W	147975	01121	CB3915	3		
R87	Res, fxd, comp, 10 $\pm$ 5%, 1/4W	147868	01121	CB1005	1		
R91	Res, fxd, met film, 22.1k $\pm$ 1%, 1/8W	235234	91637	MFF1-82212F	1		
R92	Res, fxd, met film, 421k $\pm$ 1%, 1/8W	276626	91637	MFF1-84223F	1		
R93	Res, fxd, met film, 316k $\pm$ 1%, 1/8	289496	91637	MFF1-83163F	1		
R96	Res, fxd, comp, 33k $\pm$ 5%, 1/8W	148155	01121	CB3335	1		
R97	Res, fxd, comp, 100k $\pm$ 5%, 1/4W	148189	01121	CB1045	1		
R126, R130	Res, fxd, comp, 56k $\pm$ 5%, 1/4W	170738	01121	CB5635	2		
R129	Res, fxd, comp, 6.8M $\pm$ 5%, 1/4W	394064	01121	CB6865	1		
R201	Res, fxd, comp, 30k $\pm$ 5%, 1/4W	193417	01121	CB3035	1		
S1,S2	Switch, gain and Cont.	335687	89536	335687	2		
U1	IC, TTL, Dig. Dual NAND	352690	01295	SN7413N	1	1	
U2	IC, TTL, Hex, Inverter	379305	01295	SN7405N	1	1	
U3, U7	IC, TTL, Dig. Quad 2-input positive NAND Gates	292961	01295	SN7403N	2	1	
U4	IC, TTL, Hex Inverter	292979	01295	SN7404N	1	1	
U5,U20	IC, TTL, Hex Inverter, Buffer & Driver	288605	01295	SN7416N	2	1	
U8	IC, TTL, Quad, 2-Input, Positive NAND	310201	01295	SN7438N	1	1	
U10, U43	IC, TTL, Quad, 2-Input	292953	01295	SN7400N	2	1	
U14	IC, TTL, Quad, 2-Input Pos OR Gate	342709	01295	SN7432N	1	1	
U15	IC, TTL, Triple-3-Input Positive NAND	363465	01295	SN7412N	1	1	
U21, U22	IC, Linear, Quad comparator	387233	12040	LM339N	2	1	
U25	IC, Linear, Voltage Regulator	327981	12040	LM309K	1	1	

Table 5-4. PCB ASSEMBLY, LOGIC (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U30 thru U33	Opto Isolator	387076	50579	ILD-74	4	1	
U40	IC, TTL, SSI, Hex/Quad	354886	01295	SN7414N	1	1	
U41	IC, TLT, Dual J-K Triggered, Flip-Flops	293100	01295	SN74H106N	1	1	
U42	IC, Linear, Dual Timer	387407	18324	NESS6A	1	1	
U44	IC, TTL Positive NAND Gates, 8-Input	293019	01295	SN7430N	1	1	
VR3, VR6	Diode, zener	180455	07910	IN749A	2	1	
VR14	Diode, zener	172148	12065	1N3496	1	1	
XU14, XU15, XU22, XU42	Socket, IC	291542	00779	583527-1	5		
	Bracket, lamp	400754	89536	400754	2		
	Heatsink	342675	13103	600382	1		
	Jack, banana, nylon	162065	74970	108-902	5		
	Transipad, Xstr	152207	07047	10123DAP	1		

Table 5-5. PRE AMPLIFIER ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	<b>Assembly, Pre-amplifier (Figure 5-11)</b>	397836	89536	397836	1		
1	PCB Assembly; Pre Amp (Refer to Table 5-6)	353656	89536	353656	1		
2	PCB Assembly; Pre Amp Tube Anode (Refer to Table 5-7)	397281	89563	397281	1		
3	Cable Assembly, Sense	349555	89536	349555	1		
4	Fence, Pre Amp	337444	89536	337444	1		

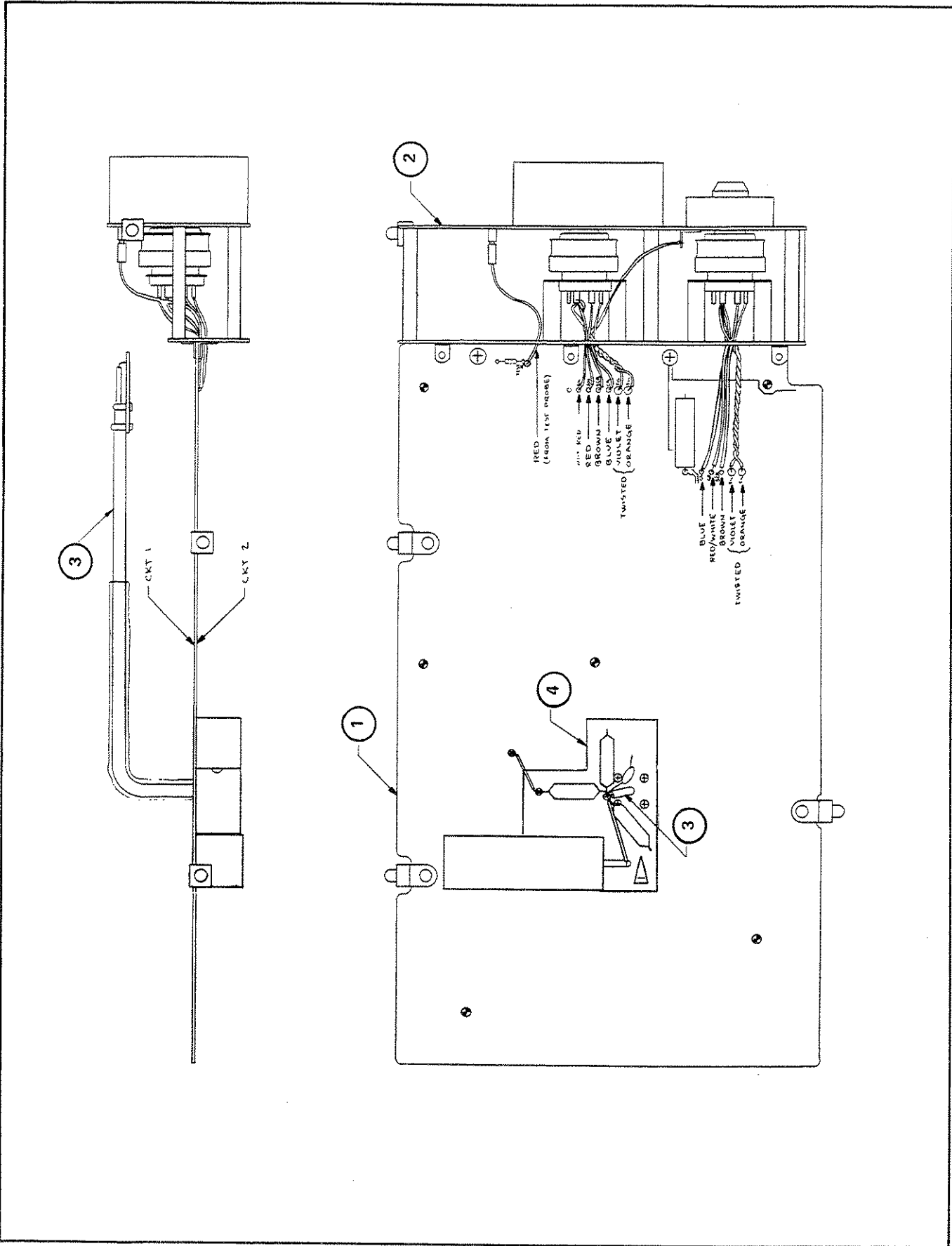


Figure 5-11. PREAMPLIFIER ASSEMBLY LOCATIONS

Table 5-6. PRE AMP PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	<b>PCB ASSEMBLY, PRE AMP (Figure 8-6a)</b>	353656	89536	353656	REF		
	<b>PCB Assembly, Zener String (See end of table)</b>	362129	89536	362129	1		
C1	Cap, fxd, Ta, 22 uF $\pm 20\%$ , 35V	394775	56289	196D226X0035 T	1		
C6,C8, C9,C26, C121, C133, C176	Cap, fxd, cer, 0.01 uF $\pm 20\%$ , 100V	149153	56289	C023B101F103 M	7		
C7, C200	Cap, fxd, mica, 22 pF $\pm 5\%$ , 500V	148551	71236	DM15C220J	2		
C10, C124	Cap, fxd, mica, 150 pF $\pm 5\%$ , 500V	148478	71236	DM15F151J	2		
C11, C12, C84 thru C87	Cap, fxd, Ta, 22 uF $\pm 20\%$ , 20V	357780	56289	196D226X0020 P	6		
C13	Cap, fxd, mica, 8 pF $\pm 10\%$ , 500V	216986	71236	DM15C080K	1		
C14, C143	Cap var, poly propyl, 2 - 22 pF	369207	80031	C010KA/20E	2		
C15, C79, C123	Cap, fxd, mica, 100 pF $\pm 5\%$ , 500V	148494	71236	DM15F101J	3		
C25	Cap, fxd, mica, 1000 pF $\pm 5\%$ , 500V	148387	71236	DM19F102J	1		
C27	Cap, fxd, plstc, 0.01 uF $\pm 10\%$ , 50V	309906	06001	75F1R4A001	1		
C41	Cap, fxd, plstc, 0.0039 uF $\pm 10\%$ , 50V	386847	06001	75F1R5A392	1		
C46, C51	Cap, fxd, Ta, 6.8 uF $\pm 20\%$ , 35V	363713	56289	196D685X0035 K	2		
C64, C65, C156	Cap, fxd, cer, 0.05 uF $\pm 20\%$ , 100V	149161	56289	55C23A1	3		
C67	Cap, fxd, mica, 56 pF $\pm 5\%$ , 500V	148528	71236	DM15E560J	1		
C70, C71	Cap, fxd, elect, 470 uF $-10/+50\%$ 40V	185868	73445	ET471X040A02	2	1	

Table 5-6. PRE AMP PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
C72, C83	Cap, fxd, cer, 2000 pF $\pm$ gmV, 11KV	105569	71590	DA140-139CB	2		
C73	Cap, fxd, mica, 30 pF $\pm$ 5%, 500V	340570	71236	DM15E300J	1		
C75	Cap, fxd, Ta, 1uF $\pm$ 20%, 35V	161919	56289	196D105X0035	1		
C91	Cap, fxd, cer, 1pF $\pm$ 20%, 4000V	393892	32897	858-000-C0K10 9M	1		
C92	Cap, fxd, plstc, 0.22 uF $\pm$ 10%, 50V	271874	06001	75F4R5A224	1		
C94	Cap, fxd, Ta, 15 uF $\pm$ 20%, 6V	161935	56289	196D156X0006	1		
C105, C106	Cap, fxd, mica, 360 pF $\pm$ 1%, 500V	170407	71236	DM15F361F	2		
C128, C161	Cap, fxd, cer, 0.1 uF $\pm$ 20%, 100V	149146	56289	33C41B6	2		
C132	Cap, fxd, mica, 5.6 pF $\pm$ 5%, 500V	329631	71236	DM15C560J	1		
C135	Cap, fxd, Ta, 4.7 uF $\pm$ 20%, 25V	161943	56289	196D475X0025 J	1		
C145, C146	Cap, fxd, mica, 33 pF $\pm$ 5%, 500V	160317	71236	DM15E330J	2		
C147	Cap, va ri, polypropl, 5 - 50 pF $\pm$ , 100V	408245	80031	HT10MA/550	1		
C148	Cap, fxd, mica, 480 pF $\pm$ 1%, 500V	182931	71236	DM19E481F	1		
C155	Cap, fxd, mica, 2200 pF $\pm$ 5%, 500V	148346	71236	DM19F222J	1		
C157	Cap, fxd, mica, 27 pF $\pm$ 5%, 500V	177998	71236	DM15E270J	1		
C159	Cap, fxd, mica, 4700 pF $\pm$ 5%, 500V	208975	71236	DM19F472J	1		
C174, C185	Cap, fxd, cer, 0.1 uF $-20/+80%$ 500V	105684	56289	41C92	2		
C175	Cap, fxd, elect, 50 uF $-10/+75%$ , 50V	105122	56289	30D505G050BC	1	1	
C180, C193	Cap, fxd, MTL Polyester, 0.01 uF $\pm$ 20%, 4KV	403048	84411	X663F010204K V	2		
C181	Cap, fxd, cer, 100 pF $\pm$ 20%, 2KV	306357	04222	HVD4-100202K V1	1		
C182, C183	Cap, elect, 220 uF $-10/+50%$ , 40V	178616	73445	ET221X040A01	2	1	
C192	Cap, fxd, ceram, 47 pF $\pm$ 10%, 2KV	282145	04222	HVD3-47102KV	1		

Table 5-6. PRE AMP PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
CR35, CR36, CR51, CR53, CR54, CR103 thru CR106, CR125, CR126, CR132, CR151, CR152, CR157, CR183, CR185, CR192, CR202, thru CR209	Diode, Hi-speed, switching	203323	07910	TD8253	26	5	
CR70, CR175, CR182	Diode, Rectifier bridge	296509	09423	FB200	3	1	
CR92, CR121 thru CR124, CR154, CR155	Diode, Si, low cap	375907	07263	FD7222	7	2	
CR101, CR102	Diode, Si, Schottky Barrier Switching	313247	51174	HP5082-6264	2	1	
J24,J25, J26	Conn, Coax	394239	98291	51-151-0000	3		
K1	Relay, dry reed	387290	71707	UF40081	1		
L11,L12 L51,L85 L86	Choke, 6 turn	320911	89536	320911	5		
Q7	Xstr, FET, D-MOS, N-Channel	394122	18324	SD210	1	1	

Table 5-6. PRE AMP PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q37, Q42, Q44, Q45, Q77, Q101, Q102, Q103, Q106, Q147	Xstr, Si, PNP	195974	04713	2N3906	10	2	
Q40, Q51, Q92, Q93, Q105, Q138, Q161, Q176, Q183, Q184, Q185	Xstr, Si, NPN	218396	04713	2N3904	11	3	
Q43	Xstr, Si, NPN	329698	07263	2N2484	1	1	
Q50, Q62	Xstr, Si, NPN	203489	07910	CDQ10656	2	1	
Q76	Xstr, Si, PNP, pwr	325753	03508	D45C5	1	1	
Q79	Xstr, Si, NPN, pwr	325761	03508	D44C5	1	1	
Q104	Xstr, Si, NPN	295717	24355	00117	1	1	
Q121, Q122	Xstr, FET, D-MOS, N-channel	393587	18324	CP302	1	1	
Q128	Xstr, FET, Junction, N-channel	288324	12040	SF50070	1	1	
Q132	Xstr, Si, PNP	229898	04713	MPS6522	1	1	
Q140	Xstr, Si, NPN	333898	04713	MPSH10	1	1	
Q148	Xstr, Si, PNP	392985	07263	2N3931	1	1	
Q177, Q182, Q186, Q187	Xstr, Si, NPN	346916	07263	2N2219A	4	1	
R1,R2	Res, fxd, comp, 750 $\pm$ 5%, 1/4W	218024	01121	CB7515	2		



Table 5-6. PRE AMP PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R3,R41, R44, R92, R97	Res, fxd, comp, 1.5K $\pm$ 5%, $\frac{1}{4}$ W	148031	01121	CB1525	5		
R5	Res, var, cer, 100 $\pm$ 10%, $\frac{1}{2}$ W	381913	32997	3299W-1-101	1		
R6	Res, fxd, met film, 49.9K $\pm$ 1%, 1/8W	268821	91637	MFF1-84992F	1		
R7	Res, fxd, met film, 5.23K $\pm$ 1%, 1/8W	294876	91637	MFF1-85231F	1		
R8	Res, fxd, met film, 71.5K $\pm$ 1%, 1/8W	291435	91637	MFF1-87152F	1		
R9, R123	Res, var, cer, 200K $\pm$ 10%, $\frac{1}{2}$ W	381921	32997	3299W-1-204	2		
R11	Res, fxd, comp, 27K $\pm$ 5%, $\frac{1}{4}$ W	148148	01121	CB2735	1		
R12, R83	Res, fxd, comp, 51K $\pm$ 5%, $\frac{1}{4}$ W	193334	01121	CB5135	2		
R14	Res, fxd met film, 1K $\pm$ 1%, 1/8W	168229	91637	MFF1-81001F	1		
R15	Res, fxd, met film, 2.55K $\pm$ 1%, 1/8W	325498	91637	MFF1-82551F	1		
R21	Res, fxd, met film, 14K $\pm$ 1%, 1/8W	379057	91637	MFF1-81402F	1		
R22	Res, var, cer, 1K $\pm$ 10%, $\frac{1}{2}$ W	393728	32997	3299W-1-102	1		
R23	Res, fxd, met film, 63.4 $\pm$ 1%, 1/8W	393421	91637	MFF1-863R4F	1		
R24, R25	Res, fxd, met film, 15K $\pm$ 1%, 1/8W	328161	91637	MFF1-81502F	2		
R26, R197	Res, fxd, met film, 806 $\pm$ 1%, 1/8W	223552	91637	MFF1-88060F	2		
R27, R28, R137, R158, R190	Res, fxd, comp, 1M $\pm$ 5%, $\frac{1}{4}$ W	182204	01121	CB1055	5		
R29, R48, R159, R164	Res, fxd, comp, 10K $\pm$ 5%, $\frac{1}{4}$ W	148106	01121	CB1035	4		
R35, R45	Res, fxd, comp, 68K $\pm$ 5%, $\frac{1}{4}$ W	148171	01121	CB6835	2		
R36	Res, fxd, comp, 220K $\pm$ 5%, $\frac{1}{4}$ W	160937	01121	CB2245	1		

Table 5-6. PRE AMP PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R37, R93, R203	Res, fxd, comp, 4.7K $\pm 5\%$ , $\frac{1}{4}W$	148072	01121	CB4725	3		
R38, R53, R54, R136	Res, fxd, comp, 220 $\pm 5\%$ , $\frac{1}{4}W$	147959	01121	CB2215	4		
R40, R127	Res, fxd, comp, 47K $\pm 5\%$ , $\frac{1}{4}W$	148163	01121	CB4735	2		
R42, R46, R47, R75, R121, R128, R185, R191	Res, fxd, comp, 100 $\pm 5\%$ , $\frac{1}{4}W$	147926	01121	CB1015	8		
R43, R52	Res, fxd, comp, 22K $\pm 5\%$ , $\frac{1}{4}W$	148130	01121	CB2235	2		
R49	Res, fxd, comp, 2.2K $\pm 5\%$ , $\frac{1}{4}W$	148049	01121	CB2225	1		
R50	Res, fxd, comp, 1.2K $\pm 5\%$ , $\frac{1}{4}W$	190371	01121	CB1225	1		
R51	Res, fxd, comp, 5.6K $\pm 5\%$ , $\frac{1}{4}W$	148080	01121	CB5625	1		
R59, R91	Res, fxd, met film, 9.53M $\pm 1\%$ , 1W	394098	91637	MFF1-89534F	2		
R60	Res, fxd, comp, 2K $\pm 5\%$ , $\frac{1}{2}W$	169854	01121	EB2025	1		
R61, R62	Res, fxd, comp, 1.2K $\pm 5\%$ , 1W	109892	01121	CB1225	2		
R63, R66	Res, fxd, met film, 10K $\pm 1\%$ , 1/8W	168260	91637	MFF1-81002F	2		
R64, R65	Res, fxd, met film, 20K $\pm 1\%$ , 1/8W	291872	91637	MFF1-82002F	2		
R67	Res, fxd, met film, 56.2K $\pm 1\%$ , 1/8W	271346	91637	MFF1-85622F	1		
R72	Res, fxd, comp, 120K $\pm 5\%$ , $\frac{1}{4}W$	193458	01121	CB1245	1		
R73, R74, R133, R134, R156	Res, fxd, met film, 7.5K $\pm 1\%$ , 1/8W	223529	91637	MFF1-87501F	5		

Table 5-6. PRE AMP PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R76	Res, fxd, comp, 2K $\pm$ 5%, 1/4W	202879	01121	CB2025	1		
R77	Res, fxd, comp, 8.2 $\pm$ 5%, 1/4W	246751	01121	CB82G5	1		
R78	Res, fxd, comp, 2.4K $\pm$ 5%, 1/4W	193433	01121	CB2425	1		
R79	Res, fxd, comp, 3.9 $\pm$ 5%, 1/4W	268722	01121	CB39G5	1		
R80	Res, fxd, met film, 5.11K $\pm$ 1%, 1/8W	294868	91637	MFF1-85111F	1		
R81	Res, fxd, met film, 4.22K $\pm$ 1%, 1/8W	168245	91637	MFF1-84221F	1		
R82, R154	Res, var, cer, 1K $\pm$ 10%, 1/2W	275750	71450	360T102A	2		
R94, R95, R140, R141, R151	Res, fxd, comp, 1K $\pm$ 5%, 1/4W	148023	01121	CB1025	5		
R96, R106, R107, R157	Res, fxd, met film, 1.5K $\pm$ 1%, 1/8W	313098	91637	MFF1-81501F	4		
R98	Res, fxd, comp, 33K $\pm$ 5%, 1/4W	148155	01121	CB3335	1		
R101, R102, R143, R193	Res, fxd, met film, 1.82K $\pm$ 1%, 1/8W	293670	91637	MFF1-81821F	4		
R103	Res, mxid, met film, 3.01K $\pm$ 1%, 1/8W	312645	91637	MFF1-83011F	1		
R104, R105	Res, fxd, met film, 40.2 $\pm$ 1%, 1/8W	245373	91637	MFF1-840R2F	2		
R108	Res, fxd, met film, 147 $\pm$ 1%, 1/8W	288415	91637	MFF1-81470F	1		
R109	Res, fxd, met film, 267 $\pm$ 1%, 1/8W	386821	91637	MFF1-82670F	1		
R110	Res, fxd, met film, 2.37K $\pm$ 1%, 1/8W	293720	91637	MFF1-82371F	1		
R111	Res, var, cer, 100 $\pm$ 10%, 1/2W	275735	11236	360T101AZ	1		
R122	Res, fxd, met film, 150K $\pm$ 1%, 1/8W	241083	91637	MFF1-81503F	1		
R124	Res, fxd, met film, 10 $\pm$ 1%, 1/8W	268789	91637	MFF1-8A100F	1		
R125	Res, fxd, comp, 5.1K $\pm$ 5%, 1/4W	193342	01121	CB5125	1		
R126, R129	Ref, fxd, met film, 1.91K $\pm$ 1%, 1/8W	236877	91637	MFF1-81911F	2		
R130	Res, var, cer, 500 $\pm$ 10%, 1/2W	325613	11236	360T501AZ	1		

Table 5-6. PRE AMP PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R132	Res, fxd, comp, 3.9K $\pm 5\%$ , $\frac{1}{4}W$	148064	01121	CB3925	1		
R135	Res, fxd, comp, 1.3K $\pm 5\%$ , $\frac{1}{4}W$	234252	01121	CB1325	1		
R138	Res, fxd met film, 3.74K $\pm 1\%$ , 1/8W	272096	91637	MFF1-83741F	1		
R139	Res, fxd, comp, 10K $\pm 10\%$ , 1W	109389	01121	GB1031	1		
R142, R155	Res, fxd, comp, 15K $\pm 5\%$ , $\frac{1}{4}W$	148114	01121	CB1535	2		
R144, R146	Res, fxd, met film, 8.25K $\pm 1\%$ , 1/8W	294959	91637	MFF1-88251F	2		
R147	Res, fxd, met film, 100K $\pm 1\%$ , 1/8W	340166	91637	MFF1-81003F	1		
R151	Res, fxd, comp, 5.6M $\pm 5\%$ , $\frac{1}{4}W$	358077	01121	CB5655	1		
R152, R153	Res, fxd, comp, 1M $\pm 5\%$ , 2W	268227	01121	HB1011	2		
R160	Res, fxd, comp, 150K $\pm 5\%$ , $\frac{1}{4}W$	182212	01121	CB1545	1		
R161	Res, fxd, comp, 680 $\pm 5\%$ , $\frac{1}{4}W$	148007	01121	CB6815	1		
R162, R177	Res, fxd, comp, 510 $\pm 5\%$ , $\frac{1}{4}W$	218032	01121	CB5115	2		
R163	Res, fxd, comp, 39 $\pm 5\%$ , $\frac{1}{4}W$	193391	01121	CB3905	1		
R165	Res, fxd, comp, 510 $\pm 5\%$ , $\frac{1}{2}W$	108951	01121	EB5115	1		
R166	Res, fxd, comp, 910 $\pm 5\%$ , $\frac{1}{4}W$	203851	01121	CB9115	1		
R167	Res, fxd, met film 590 $\pm 1\%$ , 1/8W	261883	91637	MFF1-85900F	1		
R170 thru R174	Res, fxd, met film, 200K $\pm 1\%$ , 1W	387449	91637	MFF1-2003F	5		
R175	Res, fxd, comp, 200 $\pm 5\%$ , 1W	190603	01121	GB2015	1		
R176	Res, fxd, comp, 1.5K $\pm 5\%$ , $\frac{1}{2}W$	266353	01121	EB1525	1		
R178, R179, R184, R186	Res, fxd, comp, 270 $\pm 5\%$ , $\frac{1}{4}W$	160804	01121	CB2715	4		
R180	Res, fxd, comp, 51 $\pm 5\%$ , $\frac{1}{4}W$	221879	01121	CB5105	1		
R181	Res, fxd, comp, 10 $\pm 5\%$ , $\frac{1}{4}W$	147868	01121	CB1035	1		
R182, R183	Res, fxd, comp, 680K $\pm 10\%$ , 1W	109694	01121	GB6811	2		

Table 5-6. PRE AMP PCB ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R192	Res, fxd, comp, 2.7K $\pm$ 5%, $\frac{1}{2}$ W	109074	01121	EB2725	1		
R194, R202	Res, fxd, met film, 2.43 $\pm$ 1%, 1/8W	312637	91637	MFF1-82341F	2		
R195	Res, fxd, met film, 49.9 $\pm$ 1%, 1/8W	305896	91637	MFF1-849R9F	1		
R196	Res, fxd, met film, 249 $\pm$ 1%, 1/8W	168203	91637	MFF1-82490F	1		
R198	Res, fxd, met film, 121K $\pm$ 1%, 1/8W	229396	91637	MFF1-81213F	1		
R199	Res, fxd, comp, 820 $\pm$ 5%, 1W	266379	01121	GB8215	1		
R201	Res, fxd, comp, 620 $\pm$ 5%, $\frac{1}{2}$ W	108704	01121	EB6215	1		
R204	Res, fxd, comp, 100K $\pm$ 5%, 2W	285056	01121	HB1045	1		
R205, R206, R207	Res, fxd, comp, 200K $\pm$ 5%, 2W	392696	01121	HB2245	3		
R301, R302	Resistor, Assy, can	416354	89536	416354	1	1	
R303, R304	Resistor, Assy, Divider	401372	89536	401372	1	1	
U7	IC, Op Amp Linear	329912	12040	LM318H	1	1	
U12	IC, Op Amp, Fast setting	403063	24355	AD509J	1	1	
U25	IC, Op Amp	225961	34333	SG8023	1	1	
U51, U52	Op to, Isolator, xstr	387076	50579	ISO-LIT-D74	2	1	
U62	Op to, Isolator, xstr	380014	01295	TIL116	1	1	
U64, U65, U167	IC, Linear, Vol Comparator	352195	12040	LM311N	3	1	
U75, U157	IC, Op, Amp	271502	12040	LM301A	2	1	
U79	IC, Linear, Vol Regulator	313106	07263	U5R7723393	1	1	
U123	IC, Linear, Op Amp	418368	12040	LM208A	1	1	
U160	Op to Isolator, xstr	393900	07374	OPI1078	1	1	
VR1, VR2, VR199	Diode, zener	277236	07910	1N752A	3	1	
VR50	Diode, zener	246033	07910	1N965A	1	1	

Table 5-6. PRE AMPLIFIER ASSEMBLY (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
VR98	Diode, zener	113332	07910	1N966A	1	1	
VR99	Diode, zener	113316	07910	1N748	1	1	
VR101	Diode, zener	342527	07910	333719	1	1	
VR152	Diode, zener	353284	12969	UZ8113	1	1	
VR155 VR202	Diode, zener	172148	12065	1N3496	2	1	
VR174	Diode, zener	358184	12969	UZ8112	1	1	
VR176	Diode, zener	159780	07910	1N759	1	1	
VR182	Diode, zener	387092	07910	1N975A	1	1	
VR105	Diode, zener	358176	12969	UZ8110	1	1	
VR193	Diode, zener	386839	04713	1N5388	1	1	
XU12	Socket, IC, 8-pin	408450	*	A23-2017	1		
	Conn, card edge, modified	408005	00779	583694-9	3		
	Heat sink (Q177)	104646	05820	207-AB	1		
	Heat sink (Q182)	104562	05820	NF-209	1		
	Heat sink (Q79)	407890	98978	PA1-1R	1		
	Retainer, guide	339754	89536	339754	3		
	Spacer, Mtg, xstr	152207	07047	10123DAP	8		
	PCB Assembly, Zener String (Figure 8-6b)						
VR1 thru VR9	Diode, zener, uncomp, 50V	386839	04713	1N5388B	9	2	
VR10	Diode, zener, uncomp, 100V	358176	12969	UZ8110	1	1	
VR11	Diode, zener, uncomp, 200V	358150	12969	UZ8750	1	1	
*	Manufactured By:  Jermyn 712 Montgomery San Francisco, CA 94111						

Table 5-7. PCB ASSEMBLY, PRE AMP TUBE ANODE

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	<b>PCB ASSY, PRE AMP, TUBE ANODE (Figure 8-6c)</b>	397281	89536	397281	REF		
R1,R2, R3,R4	Res, fxd, met film 150K $\pm$ 0.5%, 1W	393397	91637	MFF1-11503D	4		
V1,V2	Tube, vacuumn	339762	06980	7034-4X150A	2	2	
XV1, XV2	Socket, Tube, loctal	340927	13511	88-8X	2		
	Clamp, cap mtg	357715	56289	4586-97B	2		
	Cover, driver shield	349548	89536	349548	1		
	Plug, probe	295295	98291	011-4017	1		
	Retainer, guide	339754	89536	339754	1		

Table 5-8. POWER AMPLIFIER ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	<b>ASSY; POWER AMP (Figure 5-12)</b>	341511	89536	341511	1		
1	PCB Assy, Power Amp, Upper Tube (Refer to Table 5-9)	336875	89536	336875	1		
2	PCB Assy, Power Amp, Lower Tube (Refer to Table 5-10)	336800	89536	336800	1		
3	PCB Assy, Power Amp, Lower Tube Screen Regulator (Refer to Table 5-11)	362137	89536	362137	1		
4	PCB Assy, Power Amp, Tube Mounting (Refer to Table 5-12)	336834	89536	336834	1		
5	Cable Assy, Power Amp Input	346551	89536	346551	1		
	Cable, coax RG188A/U	190322	70903	8269	6 in.		
	Probe, Teflon, yellow	295295	98291	011-4017	2		
6	Decal	360545	89536	360545	1		
7	Insulator	338608	89536	338608	1		
8	Shield, Front	336750	89536	336750	1		
9	Shield, Rear	337428	89536	337428	1		



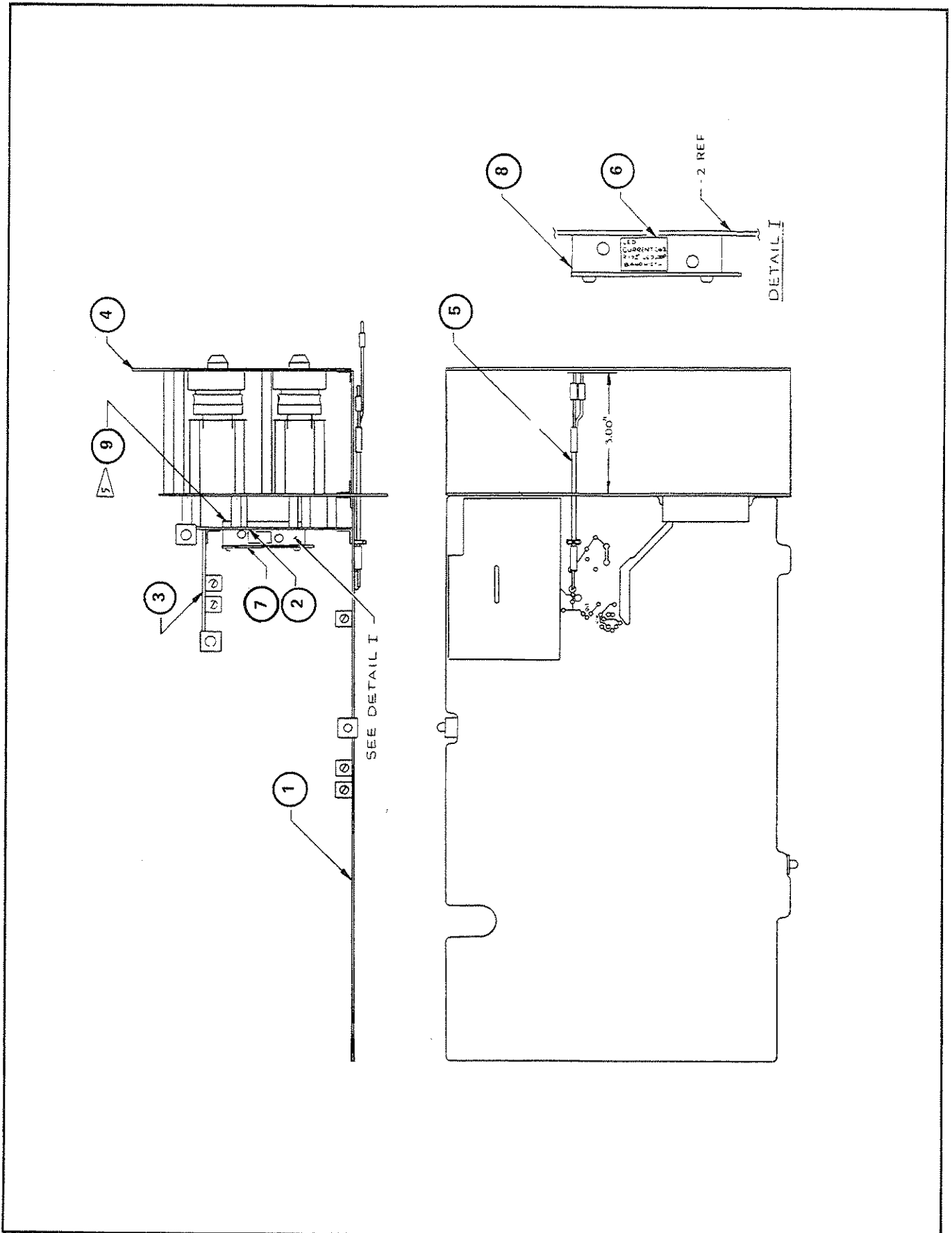


Figure 5-12. POWER AMPLIFIER ASSEMBLY LOCATIONS

Table 5-9. PCB ASSEMBLY, POWER AMP UPPER TUBE

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	<b>PCB ASSY, POWER AMP, UPPER TUBE (Figure 8-8)</b>	336875	89536	336875	REF		
C2	Cap, fxd, mica, 12 pF $\pm 5\%$ , 500V	175224	71236	DM15C 120J	1		
C4	Cap, fxd, mica, 4pF $\pm 5\%$ , 500V	190397	71236	DM15C040J	1		
C8	Cap, fxd, cer, 0.05 uF $-20/+80\%$ , 25V	148924	72982	5855Y5U5032	1		
C10,C11	Cap, fxd, mica, 510 pF $\pm 5\%$ , 500V	148411	71236	DM19E511J	2		
C25	Cap, elect, 2200 uF $-10/+100\%$ , 25V	392720	99392	39CS25HJ252	1	1	
C26, C41	Cap, fxd, polyester 0.047 uF $\pm 10\%$ , 250V	162008	73445	C280MAE/A47K	2		
C27	Cap, fxd, Ta, 6.8 uF $\pm 20\%$ , 35V	363713	56289	196D685X0035	1		
C28,C39	Cap, fxd, plstc, 0.0047 uF $\pm 10\%$ , 50V	260844	06001	75F1R5A472	2		
C30,C37	Cap, fxd, cer, 4700 pF $\pm 10\%$ , 500V	106724	71590	CF472	2		
C42,C43	Cap, fxd, elect, 10 uF $-10/+50\%$ , 300V	340885	56289	500D106F300D C	2	1	
CR1 thru CR4, CR18, CR28, CR29, CR36, CR37	Diode, Hi-speed switching	203323	07910	TD8253	9		
CR5, CR7 thru CR10	Diode, FET, Cur, Reg	334714	07910	TCR5315	5	2	
CR6	Diode, FET, current regulator	284927	01295	TCR5305	1	1	
CR25	Rectifier, bridge	296509	09423	FB200	1	1	
CR42, CR43	Diode, Si, 1 amp	112383	05277	1N4822	2	1	
K1,K2	Reed, switch	184440	12617	DRVT-10	2		
	Coil, Reed Relay	387258	71707	SP24HP	2		
	Foil Shield	336685	89536	336685	2		
L12	Choke, 4 turn	379222	89536	379222	1		
L14	Choke, 2 turn	417196	89536	417196	1		

Table 5-9. PCB ASSEMBLY, POWER AMP UPPER TUBE (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
L17	Choke, 6 turn	320911	89536	320911	1		
P34	Conn, plug, 15 pin	310094	27264	03-09-2151	1		
	Pin, Terminal	342998	27264	02-09-2133	7		
Q4	Xstr, FET, N-channel junction	387050	12040	SF51108	1	1	
Q8	Xstr, Si, NPN	242065	04713	2N5089	1	1	
Q11	Xstr, Si, NPN, pwr	343970	04713	MPS-U06	1	1	
Q12	Xstr, Si, PNP, pwr	343988	04713	MPS-U56	1	1	
Q14	Xstr, NPN, Hi-voltage	393926	04713	MM3008	1	1	
Q16	Xstr, Si, NPN	218396	04713	2N3904	1	1	
Q17, Q18	Xstr, Si, PNP	329607	07263	2N3964	2	1	
Q26, Q40	Xstr, Si, NPN	218511	95303	40327	2	1	
R2	Res, fxd, comp, 100K $\pm$ 10%, 1W	109397	01121	GB1041	1		
R7	Res, var, cer, 500 $\pm$ 10%, $\frac{1}{2}$ W	291120	71450	360S-501A	1	1	
R8	Res, fxd, comp, 470 $\pm$ 5%, $\frac{1}{4}$ W	147983	01121	CB4715	1		
R9	Res, fxd, comp, 1.5K $\pm$ 5%, $\frac{1}{4}$ W	148031	01121	CB1525	1		
R10, R11, R27	Res, fxd, comp, 100 $\pm$ 5%, $\frac{1}{4}$ W	147926	01121	CB1015	3		
R12, R13	Res, fxd, comp, 10 $\pm$ 10%, $\frac{1}{2}$ W	108092	01121	EB1001	2		
R14, R15	Res, fxd, comp, 1.5M $\pm$ 10%, 1W	109439	01121	GB1551	2		
R16	Res, fxd, comp, 10K $\pm$ 5%, $\frac{1}{4}$ W	148106	01121	CB1035	1		
R18	Res, fxd, met film, 137 $\pm$ 1%, $\frac{1}{2}$ W	151142	91637	MFF1-21370F	1		
R19	Res, fxd, comp, 1M $\pm$ 10%, 2W	268227	01121	HB1051	1		
R24, R34	Res, fxd, met film, 22.6K $\pm$ 1%, 1/8W	288431	91637	MFF1-82262F	2		
R25, R41	Res, fxd, comp, 33 $\pm$ 5%, $\frac{1}{4}$ W	175034	01121	CB3305	2		
R26, R40	Res, fxd, comp, 8.2K $\pm$ 5%, 2W	330555	01121	HB8225	2		

Table 5-9. PCB ASSEMBLY, POWER AMP UPPER TUBE (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R28, R39	Res, fxd, comp, 5.6K $\pm$ 5%, 1/4W	148080	01121	CB5625	2		
R29, R36	Res, fxd, met film, 14.3K $\pm$ 1%, 1/8W	291617	91637	MFF1-81432F	2		
R30, R37	Res, fxd, met film, 499K $\pm$ 1%, 1/2W	151332	91637	MFF1-24993F	2		
R31, R38	Res, fxd, ww, pwr 40K $\pm$ 5%, 10W	392688	91637	CW104002J	2		
R32	Res, fxd, met film, 1.21K $\pm$ 1%, 1/8W	229146	91637	MFF1-81211F	1		
R33, R35	Res, var, cermet, 5K $\pm$ 10%, 1/2W	355503	11236	362S502AZ	2	1	
R42, R43, R44	Res, fxd, pwr, 27 $\pm$ 5%, 3W	393413	91637	Type FP37	3		
R45	Res, fxd, comp, 270 $\pm$ 5%, 1/4W	160804	01121	CB2715	1		
T43	Xfmr	401380	89536	401380	1		
U28, U39	IC, Op, Amp	271502	12040	LM301A	2	1	
VR13, VR26, VR41	Diode, zener	159798	07910	1N748	3	1	
VR14	Diode, zener	386995	04713	1N5335B	1	1	
VR15	Diode, zener	355073	12969	UZ8708	1	1	
VR19	Diode, zener	407825	12969	UZ8740	1	1	
VR33	Diode, zener	172148	12065	1N3496	1	1	
VR37 thru VR40	Diode, zener	358184	12969	UZ8112	4	1	
XQ17	Socket, Xstr	285262	71785	133-23-92-039	1		
	Guide, retainer	341099	89536	341099	2		
	Heat sink (Q4 & Q17)	354993	98978	TXC20CB	2		
	Heat sink (Q14)	104562	05820	NF-209	1		
	Heat sink (Q11)	349019	98978	UP-TO126-83CB	1		
	Heat sink (Q12)	407890	98978	PA1-1R	1		

Table 5-9. PCB ASSEMBLY, POWER AMP UPPER TUBE (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	Heat sink (Q26 & Q40)	104646	05820	207-AB	2		
	Jack, Horizontal, conn	149112	74970	105-0753	4		
	Safety, guard	402040	89536	402040	1		
	Transipad, xstr (Q14, Q26 & Q40)	152207	07047	10123DAP	3		

Table 5-10. PCB ASSEMBLY, POWER AMP LOWER TUBE

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	PCB ASSY, POWER AMP LOWER TUBE (Figure 8-10a)	341586	89536	341586	REF		
C59, C185	Cap, fxd, pstrc, 0.047 uF $\pm$ 20%, 4KV	393389	56289	430P	2		
C162	Cap, var, cer, 5 - 50 pF $\pm$ 250V	404301	91293	9335	1		
C170	Cap, fxd, mica, 33 pF $\pm$ 5%, 500V	160317	71236	DM15E330J	1		
C171	Cap, fxd, Ta, 0.22 uF $\pm$ 20%, 35V	161331	56289	196D224X0035 HA1	1		
C180	Cap, elect, 220 uF -10/+50%, 40V	178616	73445	ET221X040A01	1	1	
C181	Cap, elect, 1000 uF -10/+100%, 40V	340901	99392	39C40HH13	1	1	
C182, C183	Cap, fxd, Ta, 6.8 uF $\pm$ 20%, 35V	363713	56289	196D685X0035 HA1	2		
CR158, CR160, CR170	Diode, Hi-speed switching	203323	07910	TD8253	3	1	
CR180	Rectifier, bridge	296509	09423	FB200	1	1	
U32	Conn, board edge recpt, 6	291625	00779	583650-1	1		
U37	Conn, board edge recpt, 10	403964	00779	583407-6	1		
L50, L185	Choke, 4 turn	379222	89536	379222	2		
L155	Inductor, sub-mini	249078	24759	MR10	1		
L182, L183	Choke, 6 turn	320911	89536	320911	2		
Q150	Xstr, Si, NPN	343970	04713	MPS-U06	1	1	
Q155, Q161	Xstr, FET, N-Channel	403089	12040	SF58014	2	1	
Q158	Xstr, Si, PNP	195974	04713	2N3906	1	1	
Q160	Xstr, Si, PNP	329607	07263	2N3964	1	1	
Q165	Xstr, Si, NPN	242065	04713	2N5089	1	1	
R50, R185	Res, fxd, comp, 10 $\pm$ 5%, 1W	166298	01121	GB1005	2		
R151	Res, fxd, met film, 10 $\pm$ 1%, 1/2W	151043	91637	MFF1-210R0F	1		

Table 5-10. PCB ASSEMBLY, POWER AMP LOWER TUBE (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R152	Res, fxd, comp, 2.7K $\pm$ 5%, 1/2W	109074	01121	DB2725	1		
R155	Res, fxd, comp, 510 $\pm$ 5%, 1W	157578	01121	GB5115	1		
R156	Res, fxd, comp, 4.3K $\pm$ 5%, 1/2W	403337	01121	DB4325	1		
R157, R174	Res, fxd, comp, 1K $\pm$ 5%, 1/4W	148023	01121	CB1025	2		
R158	Res, fxd, comp, 3.3K $\pm$ 5%, 1/4W	148056	01121	CB3325	1		
R160	Res, fxd, met film, 422 $\pm$ 1%, 1/2W	150821	91637	MFF1-24220F	1		
R161	Res, fxd, comp, 39 $\pm$ 5%, 1/4W	193391	01121	CB3905	1		
R162	Res, fxd, comp, 5.1K $\pm$ 5%, 1/2W	109108	01121	EB5125	1		
R170	Res, fxd, met film, 10K $\pm$ 1%, 1/8W	168260	91637	MFF1-81002F	1		
R171	Res, fxd, met film, 59K $\pm$ 1%, 1/8W	261677	91637	MFF1-85902F	1		
R172	Res, var, cermet, 2K $\pm$ 10%, 1/2W	285163	71450	360S202A	1		
R173	Res, fxd, met film, 909 $\pm$ 1%, 1/8W	312629	91637	MFF1-89090F	1		
R175	Res, fxd, comp, 2.4K $\pm$ 5%, 1/2W	108902	01121	DB2425	1		
U165	Opto - Coupler	351734	89536	351734	1	1	
U170	IC, Op Amp	271502	12040	LM301A	1	1	
VR156	Diode, zener	340695	12969	UZ8710	1	1	
VR159	Diode, zener	260695	07910	1N754	1	1	
VR161	Diode, zener	246611	07910	1N961B	1	1	
VR175	Diode, zener	172148	12065	1N3496	1	1	
	Guide	341099	89536	341099	1		
	Heat sink (Q150)	349019	98978	UP-TO126-83CB	1		

Table 5-11. PCB ASSEMBLY, LOWER TUBE SCREEN REGULATOR

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	<b>PCB ASSY, LOWER TUBE SCREEN REGULATOR (Figure 8-10b)</b>	362137	89536	362137	REF		
C101, C102	Cap, elect, 10 uF -10/+50%, 300V	340885	56289	500D106F300D C7	2	1	
C103, C117	Cap, fxd, polyester 0.047 uF ±10%, 250V	162008	73445	C280MAE/A47K	2		
C104	Cap, fxd, Ta, 6.8 uF ±20%, 35V	363713	56289	196D685X0035	1		
C105, C114	Cap, fxd, cer 0.0047 uF ±10%, 1KV	106724	71590	CF472	2		
C106, C115	Cap, fxd, plstc, 0.0047 uF ±10%, 50V	260844	06001	75F1R5A472	2		
CR101, CR102	Diode, Si, 2 Amp	112383	05277	1N4822	2	1	
CR104, CR110, CR113, CR114	Diode, Hi-speed switching	203323	07910	TD8253	4	2	
Q101, Q116	Xstr, Si, NPN	218511	95303	65120	2	1	
R101, R116	Res, fxd, comp, 8.2K ±5%, 2W	330555	01121	HB8225	2		
R102, R117	Res, fxd, comp, 33 ±5%, ¼W	175034	01121	CB3305	2		
R103	Res, fxd, comp, 100 ±5%, ¼W	147926	01121	CB1015	1		
R104, R108	Res, fxd, pwr, ww, 40K ±5%, 10W	392688	91637	CW10X000D40 R00J	2		
R105, R114	Res, fxd, met film, 499K ±1%, ½W	151332	91637	MFF1-24993F	2		
R106, R115	Res, fxd, comp, 5.6K ±5%, ¼W	148080	01121	CB5625	2		
R107	Res, fxd, met film, 2.26K ±1%, ½W	262006	91637	MFF1-22261F	1		
R109, R112	Res, var, cermet, 5.0K ±10%, ½W	355503	11236	362S502	2		
R110, R113	Res, fxd, met film, 14.3K ±1%, 1/8W	291617	91637	MFF1-81432F	2		



Table 5-11. PCB ASSEMBLY, LOWER TUBE SCREEN REGULATOR (Cont.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R111, R118	Res, fxd, met film, 22.6K $\pm$ 1%, 1/8W	288431	91637	MFF1-82262	2		
U101, U114	IC, Op Amp	271502	18324	LM301A	2	1	
VR103, VR117	Diode, zener	159798	07910	1N751A	2	1	
VR105, VR106, VR107, VR108	Diode, zener	358184	12969	UZ8112	4	1	
VR112	Diode, zener	172148	12065	1N3496	1	1	
	Guide, Retainer	341099	89536	341099	1		
	Heat sink	104646	90372	207AB	2		
	Transipad, xstr	152207	07047	10123DAP	2		

Table 5-12. PCB ASSEMBLY, POWER AMP TUBE MOUNTING

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	<b>PCB ASSY, POWER AMP TUBE MOUNTING (Figure 8-10c)</b>	336834	89536	336834	REF		
J38	Conn, receptacle	404053	00779	583694-8	1		
R201, R208, R221, R225, R229, R230	Res, fxd, comp, 200 $\pm$ 5%, $\frac{1}{2}$ W	169839	01121	EB2015	6		
R202, R207	Res, fxd, comp, 47 $\pm$ 5%, $\frac{1}{2}$ W	159608	01121	EB4705	2		
R203, R206, R231, R232	Res, fxd, comp, 1.5M $\pm$ 10%, 1W	109439	01121	GB1551	4		
R204, R205, R224, R226	Res, fxd, met film, 10 $\pm$ 1%, $\frac{1}{2}$ W	151043	91637	MFF1-2A100F	4		
R222, R223, R227, R228	Res, fxd, power, 360 $\pm$ 5%, 3W	393405	91637	TYPEFP37	4		
V1,V2, V3,V4	Tube, vacuum, Tetrode	339762	08594	4X150A	4	4	
XV1, XV2, XV3, XV4	Socket, tube	340927	02660	88-8X	4		
	Baffle, pwr Amp board	341727	89536	341727	1		
	Baffle, pwr Amp	400796	89536	400796	1		
	Guide, Retainer	341099	89536	341099	1		

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## Section 6

# Option & Accessory Information

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### 6-1. INTRODUCTION

6-2. This section of the manual contains information pertaining to the accessories and options available for the 5205A.

### 6-3. ACCESSORY INFORMATION

6-4. A rack mounting kit, Model Number M10-205-600, is available for the 5205A. Instructions for use accompany the kit.

### 6-5. OPTION -07, REAR PANEL OUTPUT AND INPUT.

6-6. Option 07 provides rear panel input and output connectors for use in system applications. The output cable is routed out the rear panel and the hole plug moved from the rear to front panels. The repositioning shortens the length of output cable available from three feet to approximately two feet. The input connector is also moved from the front to rear panel, however, the connecting cables are changed slightly. The two cable assemblies 5205A-4404 (PN 346544) and 5205A-4408 (PN 349597) used in the standard version are replaced with a single cable assembly 5205A-4415 (PN, 415141) in the rear panel version. As with the output connector, the hole plug is moved to the instrument's front panel. Operation of the instrument and all other parts are identical with the Standard front panel input/output version.



## Section 7

# General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable Parts contained in Section 5.

## Federal Supply Codes for Manufacturers

<p>D9816 Westermann Wilhelm Augusta-Anlage Mannheim-Nackarau Germany</p>	<p>01101 Wabash Inc (Formerly Wabash Magnetics) Wabash, IN</p>	<p>02697 Parker-Hannifin Corp. O-Ring Div Lexington, KY</p>	<p>04423 Telonic Beckley Inc. Laguna Beach, CA</p>
<p>S0482 Sony Corp. Tokyo, Japan</p>	<p>01121 Allen Bradley Co. Milwaukee, WI</p>	<p>02735 RCA-Solid State Div. Somerville, NJ</p>	<p>04713 Motorola Inc. Semiconductor Group Phoenix, AZ</p>
<p>S3774 Oshino Electric Lamp Works Tokyo, Japan</p>	<p>01281 TRW Electronics &amp; Defense Sector R F Devices Lawndale, CA</p>	<p>02768 ITW (IL Tool Works) Fastex Division Des Plaines, IL</p>	<p>04946 Standard Wire and Cable Rancho Dominguez, CA</p>
<p>0AD86 IN General El Paso, TX</p>	<p>01295 TX Instruments Inc. Semiconductor Group Dallas, TX</p>	<p>02799 Arco Electronics Inc. Chatsworth, CA</p>	<p>05173 General Radio NY, NY. Replaced by:</p>
<p>0AE89 Autosplice Inc. Woodside, NY</p>	<p>01526 Genicom Waynesboro, VA</p>	<p>03296 Nylon Molding Corp. Monrovia, CA</p>	<p>24655 Genrad, INC. Concord, MA</p>
<p>0BW21 Noritake Co. Inc. Burlington, MA</p>	<p>01537 Motorola Communications &amp; Electronics Inc. Franklin Park, IL</p>	<p>03445 Lercon Electronics Inc Burbank, CA</p>	<p>05236 Jonathan Mfg. Co. Fullerton, CA</p>
<p>0ANF0 Topaz Semiconductor Inc San Jose, CA</p>	<p>01686 RCL Electronics/Shallcross Inc. Electro Components Div. Manchester, NH</p>	<p>03508 General Electric Co. Semiconductor Products &amp; Batteries Auburn, NY</p>	<p>05245 Corcom Inc. Libertyville, IL</p>
<p>0DSM7 Conductive (Pkg) Containers Inc. Brookfield, WI</p>	<p>01884 Sprague Electric Co. (Now 56289)</p>	<p>03797 Genisco Technology Corp. Electronics Div. Rancho Dominguez, CA</p>	<p>05276 ITT Pomona Electronics Div. Pomona, CA</p>
<p>0CLN7 Emhart Fastening Group Shelton, CT</p>	<p>01961 Varian Associates Inc. Pulse Engineering Div. Convoy, CT</p>	<p>03877 Gilbert Engineering Co. Inc Incon Sub of Transatron Electronic Corp. Glendale, AZ</p>	<p>05277 Westinghouse Elec. Corp. Semiconductor Div. Youngwood, PA</p>
<p>0FB81 S-Mos Systems Inc. San Jose, CA</p>	<p>01963 Cherry Electrical Products Corp Waukegan, IL</p>	<p>03888 KDI Electronics Inc. Pyrofilm Div. Whippany, NJ</p>	<p>05347 Ultronix Inc Grand Junction, CO</p>
<p>0FFP1 Eveready LTD Ever Ready Special Battery Div. Dawley Telford Salep UK</p>	<p>02111 Spectrol Electronics Corp. City of Industry, CA</p>	<p>03911 Clairtex Corp. Clairtex Electronics Div. Mount Vernon, NY</p>	<p>05397 Union Carbide Corp. Materials Systems Div. Cleveland, OH</p>
<p>00199 Marcon Electronics Corp Keamy, NJ</p>	<p>02114 Amperex Electronic Corp. Ferrox Cube Div. Saugerties, NY</p>	<p>03980 Muirhead Inc. Mountainside, NJ</p>	<p>05571 Sprague Electric Co. (Now 56289)</p>
<p>00213 Nytronics Comp. Group Inc. Dartington, NC</p>	<p>02131 General Instrument Corp. Government Systems Div. Westwood, MA</p>	<p>04009 Cooper Industries, Inc. Arrow Hart Div. Hartford, CT</p>	<p>05574 Viking Connectors Inc Sub of Criton Corp. Chatsworth, CA</p>
<p>00327 Welwyn International Inc. Westlake, OH</p>	<p>02395 Sonar Radio Corp. Hollywood, FL</p>	<p>04217 Essex International Inc. Wire &amp; Cable Div. Anaheim, CA</p>	<p>05791 LYN-TRON Burbank, CA</p>
<p>00656 Aerovox Corp. New Bedford, MA</p>	<p>02533 Leigh Instruments Ltd. Frequency Control Div. Don Mills, Ontario, Canada</p>	<p>04221 Midland-Ross Corp. Midtex Div. N. Mankato, MN</p>	<p>05820 EG &amp; G Wakefield Engineering Wakefield, MA</p>
<p>00686 Film Capacitors Inc. Passaic, NJ</p>	<p>02606 Fenwal Labs Division of Travenal Labs Morton Grove, IL</p>	<p>04222 AVX Corp. AVX Ceramics Div. Myrtle Beach, SC</p>	<p>05839 Advance Electrical Chicago, IL</p>
<p>00779 AMP, Inc. Harrisburg, Pennsylvania</p>	<p>02660 Bunker Ramo-Eltra Corp. Amphenol NA Div. Broadview, IL</p>	<p>05972 Loctite Corp. Newington, CT</p>	
<p>00853 Sangamo Weston Inc Components Div Pickens, NC</p>			
<p>01091 Allied Plastics Co. Los Angeles, CA</p>			

## Federal Supply Codes for Manufacturers (cont)

06001 General Electric Co. Electric Capacitor Product Section Columbia, SC	07047 Ross Milton Co., The Southampton, PA	08111 MF Electronics New Rochelle, NY	1B715 (United Shoe & Nylock Corp) -Nylock Fastener Corp.- Paramus, NJ
06141 Fairchild Weston Systems Inc. Data Systems Div. Sarasota, FL	07138 Westinghouse Electric Corp. Industrial & Government Tube Div. Horseheads, NY	08235 Industro Transistor Corp. Long Island City, NY	10059 Barker Engineering Corp. Kenilworth, NJ
06192 La Deau Mfg. Co. Glendale, CA	07233 Benchmark Technology Inc. City of Industry, CA	08261 Spectra-Strip An Eltra Co. Garden Grove, CA	10389 IL Tool Works Inc. Licon Div. Chicago, IL
06229 Electrovert Inc. Elmsford, NY	07239 Biddle Instruments Blue Bell, PA	08445 Electri-Cord Mfg., Inc Westfield, PA	11236 CTS Corp. Resistor Products Div. Bene, IN
06383 Panduit Corp. Tinley Park, IL	07256 Silicon Transistor Corp. Sub of BBF Inc. Chelmsford, MA	08530 Reliance Mica Corp. Brooklyn, NY	11237 CTS Corp of CA Electro Mechanical Div. Paso Robles, CA
06473 Bunker Ramo Corp. Amphenol NA Div. SAMS Operation Chatsworth, CA	07261 Avnet Corp. Culver City, CA	08718 ITT Cannon Electric Phoenix Div. Phoenix, AZ	11295 ECM Motor Co. Schaumburg, IL
06540 Mite Corp Amatom-Electrical Div	07263 Fairchild Semiconductor North American Sales Ridgeview, CT	08806 General Electric Co. Miniature Lamp Products Cleveland, OH	11358 Columbia Broadcasting System CBS Electronic Div. Newburyport, MA
06555 Beede Electrical Instrument Penacook, NH	07344 Bircher Co. Inc., The Rochester, NY	08863 Nylomatic Fallsington, PA	11403 Vacuum Can Co. Best Coffee Maker Div. Chicago, IL
06665 Precision Monolithics Sub of Bouns Inc. Santa Clara, CA	07374 Optron Corp Woodbridge, CT	08988 Skottie Electronics Inc. Archbald, PA	11502 (can also use 35009) TRW Inc. TRW Resistive Products Div. Boone, NC
06666 General Devices Co. Inc. INpolis, IN	07557 Campion Co. Inc. Philadelphia, PA	09021 Airo Inc. Airo Electronics Bradford, PA	11503 Keystone Columbia Inc. Freemont, IN
06739 Electron Corp. Littleton, CO	07597 Bundy Corp. Tape/Cable Div. Rochester, NY	09023 Cornell-Dublier Electronics Fuquay-Varina, NC	11532 Teledyne Relays Teledyne Industries Inc. Hawthorne, CA
06743 Gould Inc. Foil Div. Eastlake, OH	07716 TRW Inc. (Can use 11502) IRC Fixed Resistors/ Burlington Burlington, VT	09214 General Electric Co. Semiconductor Products Dept. Auburn, NY	11711 General Instrument Corp. Rectifier Div. Hicksville, NY
06751 Components Inc. Sencor Div. Phoenix, AZ	07792 Lerma Engineering Corp. Northampton, MA	09353 C and K Components Inc. Newton, MA	11726 Qualidyne Corp. Santa Clara, CA
06776 Robinson Nugent Inc. New Albany, IN	07810 Bock Corp. Madison, WI	09423 Scientific Components Inc. Santa Barbara, CA	12014 Chicago Rivet & Machine Co. Naperville, IL
06915 Richeo Plastic Co. Chicago, IL	07910 Teledyne Semiconductor Min. View, CA	09922 Bundy Corp. Norwalk, CT	12020 Ovenaire Div. of Electronic Technologies Charlottesville, VA
06961 Vermtron Corp. Piezo Electric Div. Bedford, OH	07933 Raytheon Co. Semiconductor Div. Mountain View, CA	09969 Dale Electronics Inc. Yankton, SD	12038 Simco (Div of Ransburg Corp) Hatfield, PA
06980 EIMAC (See Varian) San Carlos, CA	08FG6 Calmos Systems Inc. Kanata, Ont. Canada	09975 Burroughs Corp. Electronics Components Detroit, MI	12040 National Semiconductor Corp. Danbury, CT
	080A9 Dallas Semiconductor Dallas, TX	1A791 LFE Electronics Danvers, MA	

## Federal Supply Codes for Manufacturers (cont)

<p>12060 Diodes Inc. Northridge, CA</p>	<p>13050 Potter Co. Wesson, MS</p>	<p>14704 Crydom Controls (Division of Int Rectifier) El Segundo, CA</p>	<p>16473 Cambridge Scientific Industries Div. of Chemed Corp. Cambridge, MD</p>
<p>12136 PHC Industries Inc. Formerly Philadelphia Handle Co. Camden, NJ</p>	<p>13103 Thermalloy Co., Inc. Dallas, TX</p>	<p>14752 Electro Cube Inc. San Gabriel, CA</p>	<p>16733 Cablewave Systems Inc. North Haven, CT</p>
<p>12300 AMF Canada Ltd. Potter-Brumfield Guelph, Ontario, Canada</p>	<p>13327 Solitron Devices Inc. Tappan, NY</p>	<p>14936 General Instrument Corp. Discrete Semi Conductor Div. Hicksville, NY</p>	<p>16742 Paramount Plastics Fabricators Inc. Downey, CA</p>
<p>12323 Practical Automation Inc. Shelton, CT</p>	<p>13511 Bunker-Ramo Corp. Amphenol Cadre Div. Los Gatos, CA</p>	<p>14949 Trompeter Electronics Chatsworth, CA</p>	<p>16758 General Motors Corp. Delco Electronics Div. Kokomo, IN</p>
<p>12327 Freeway Corp. Cleveland, OH</p>	<p>13606 Sprague Electric Co. (Use 56289)</p>	<p>15412 Amtron Midlothian, IL</p>	<p>17069 Circuit Structures Lab Burbank, CA</p>
<p>12406 Elpac Electronics Inc. Santa Ana, CA</p>	<p>13689 SPS Technologies Inc. Hatfield, NJ</p>	<p>15542 Scientific Components Corp. Mini-Circuits Laboratory Div. Brooklyn, NY</p>	<p>17117 Electronic Molding Corp. Woonsocket, RI</p>
<p>12443 Budd Co.,The Plastics Products Div. Phoenixville, PA</p>	<p>13764 Micro Plastics Flippin, AZ</p>	<p>15636 Elec-Trol Inc. Saugus, CA</p>	<p>17338 High Pressure Eng. Co. Inc. OK City, OK</p>
<p>12581 Hitachi Metals International Ltd. Hitachi Magna-Lock Div. Big Rapids, MO</p>	<p>13919 Burr-Brown Research Corp. Tucson, AZ</p>	<p>15782 Bausch &amp; Lomb Inc. Graphics &amp; Control Div. Austin, TX</p>	<p>17504 Aluminum Filter Co. Carpinteria, CA</p>
<p>12615 US Terminals Inc. Cincinnati, OH</p>	<p>14099 Semtech Corp. Newbury Park, CA</p>	<p>15801 Fenwal Electronics Inc. Div. of Kidde Inc. Framingham, MA</p>	<p>17545 Atlantic Semiconductors Inc. Asbury Park, NJ</p>
<p>12617 Hamlin Inc. LaKe Mills, WI</p>	<p>14140 McGray-Edison Co. Commercial Development Div. Manchester, NH</p>	<p>15818 Teledyne Inc. Co. Teledyne Semiconductor Div. Mountain View, CA</p>	<p>17745 Angstrom Precision, Inc. Hagerstown, MD</p>
<p>12673 Wesco Electrical Greenfield, MA</p>	<p>14189 Ortronics, Inc. Orlando, FL</p>	<p>15849 Useco Inc. (Now 88245)</p>	<p>17856 Siliconix Inc. Santa Clara, CA</p>
<p>12697 Clarostat Mfg. Co. Inc. Dover, NH</p>	<p>14193 Cal-R-Inc. Santa Monica, CA</p>	<p>15898 International Business Machines Corp. Essex Junction, VT</p>	<p>18178 E G &amp; Gvactee Inc. St. Louis, MO</p>
<p>12749 James Electronic Inc. Chicago, IL</p>	<p>14301 Anderson Electronics Hollidaysburg, PA</p>	<p>16068 International Diode Div. Harrison, NJ</p>	<p>18235 KRL/Bantry Components Inc. Manchester, NH</p>
<p>12856 MicroMetals Inc. Anaheim, CA</p>	<p>14329 Wells Electronics Inc. South Bend, IN</p>	<p>16162 MMI Southfield, MI</p>	<p>18310 Concord Electronics New York, NY</p>
<p>12881 Metex Corp. Edison, NJ</p>	<p>14482 Watkins-Johnson Co. Palo Alto, CA</p>	<p>16245 Conap Inc. Olean, NY</p>	<p>18324 Signetics Corp. Sacramento, CA</p>
<p>12895 Cleveland Electric Motor Co. Cleveland, OH</p>	<p>14552 Microsemi Corp. (Formerly Micro-Semiconductor) Santa Ana, CA</p>	<p>16258 Space-Lok Inc. Burbank, CA</p>	<p>18377 Pudex Corp. Methuen, MA</p>
<p>12954 Microsemi Corp. Components Group Scottsdale, AZ</p>	<p>14604 Elmwood Sensors, Inc Pawucket, RI</p>	<p>16352 Codi Corp. Linden, NJ</p>	<p>18520 Sharp Electronics Corp. Paramus, NJ</p>
<p>12969 Unitrode Corp. Lexington, MA</p>	<p>14655 Cornell-Dublier Electronics Div. of Federal Pacific Electric Co. Govt Cont Dept. Newark, NJ</p>	<p>16469 MCL Inc. LaGrange, IL</p>	<p>18542 Wabash Inc. Wabash Relay &amp; Electronics Div. Wabash, IN</p>



## Federal Supply Codes for Manufacturers (cont)

18565 Chrometec Inc. Woburn, MA	2Y384 North American Philips Lighting Corp. Van Wert, OH	23732 Tracor Applied Sciences Inc. Rockville, MD	26402 Lumex Inc. Bayshore, NY
18612 Vishay Intertechnology Inc. Vishay Resistor Products Group Malvern, PA	20584 Enochs Mfg. Inc. INpolis, IN	23880 Stanford Applied Engineering Santa Clara, CA	26629 Frequency Sources Inc. Sources Div. Chelmsford, MA
18632 Norton-Chemplast Santa Monica, CA	20891 Cosar Corp. Dallas, TX	23936 William J. Purdy Co. Pamotor Div. Burlingame, CA	26806 American Zetler Inc. Irvine, CA
18677 Scanbe Mfg. Co. Div. of Zero Corp. El Monte, CA	21317 Electronics Applications Co. El Monte, CA	24347 Penn Engineering Co. S. El Monte, CA	27014 National Semiconductor Corp. Santa Clara, CA
18736 Voltronics Corp. East Hanover, NJ	21604 Buckeye Stamping Co. Columbus, OH	24355 Analog Devices Inc. Norwood, MA	27167 Corning Glass Works Corning Electronics Wilmington, NC
18786 Micro-Power Long Island City, NY	21845 Solitron Devices Inc. Semiconductor Group Riviera Beach, FL	24444 General Semiconductor Industries, Inc. Tempe, AZ	27264 Molex Inc. Lisle, IL
18927 GTE Products Corp. Precision Material Products Business Parts Div. Titusville, PA	21847 Aerotech Now TRW Microwave Inc. Sunnyvale, CA	24546 Bradford Electronics Bradford, PA	27440 Industrial Screw Products Los Angeles, CA
19080 Robinson Electronics Inc. San Luis Obispo, CA	21962 Vectron Corp. Replaced by: S.W. Electronics	24618 Trancon Mfg. Now: D.J. Associates Inc.	27494 Staffall, Inc. Providence, RI
19112 Garry Corp. Langhorne, PA	22526 DuPont, El DeNemours & Co. Inc. DuPont Connector Systems Advanced Products Div. New Cumberland, PA	24655 Genrad Inc. (Replaced General Radio 05173) Concord, MA	27745 Associated Spring Barnes Group Inc. Syracuse, NY
19315 Bendix Corp., The Navigation & Control Group Terboro, NJ	22626 Micro Semiconductor (Now 14552)	24759 Lenox-Fugle Electronics Inc. South Plainfield, NJ	27918 Component Parts Corp. Bellmore, NY
19451 Perine Machine Tool Corp. Kent, WA	22670 GM Nameplate Seattle, WA	24796 AMF Inc. Potter & Brumfield Div. San Juan Capistrano, CA	27956 Relcom (Now 14482)
19482 Delta Electronics Alexandria, VA	22767 ITT Semiconductors Palo Alto, CA	24931 Specialty Connector Co. Greenwood, IN	28175 Alpha Metals Chicago, IL
19613 MN Mining & Mfg. Co. Textool Products Dept. Electronic Product Div. Irving, TX	22784 Palmer Inc. Cleveland, OH	24995 ECS Granis Pass, OR	28198 Positronic Industries Springfield, MO
19647 Caddock Electronics Inc. Riverside, CA	23050 Product Comp. Corp. Mount Vernon, NY	25088 Siemen Corp. Isilen, NJ	28213 MN Mining & Mfg. Co. Consumer Products Div. 3M Center Saint Paul, MN
19701 Mepco/Centralab Inc. A N. American Philips Co. Mineral Wells, TX	23223 CTS Microelectronics Lafayette, NY	25099 Cascade Gasket Kent, WA	28309 Kaiser Minette, AL
2B178 Wire Products Cleveland, OH	23237 I.R.C., Inc. Microcircuits Division Philadelphia, PA	25403 Amperex Electronic Corp. Semiconductor & Micro-Circuit Div. Slatersville, RI	28425 Serv-O-Link Eules, TX
2K262 Boyd Corporation Portland, OR	23302 S.W. Electronics & Mfg. Corp. Cherry Hill, NJ	25435 Moldtronics, Inc Downers Grove, IL	28478 Deltrol Corporation Deltrol Controls Div. Milwaukee, WI
	23730 Mark Eyelet and Stamping Inc. Wolcott, CT	25706 Daburn Electronic & Cable Corp. Norwood, NJ	28480 Hewlett Packard Co. Corporate HQ Palo Alto, CA

## Federal Supply Codes for Manufacturers (cont)

28484 Emerson Electric Co. Gearmaster Div. McHenry, IL	31433 Kemet Electronics Corp. Simpsonville, NC	33246 Epoxy Technology Inc. Billerica, MA	36701 Van Waters & Rogers Valley Field, Quebec, Canada
28520 Heyco Molded Products Kenilworth, NJ	31448 Army Safeguard Logistics Command Huntsville, AL	33292 Pioneer Sterilized Wiping Cloth Co. Portland, OR	37942 Mallory Capacitor Corp. Sub of Emhart Industries INpolis, IN
28932 Lumax Industrial, Inc Altoona, PA	31471 Gould Inc Semiconductor Div Santa Clara, CA	33297 NEC Electronics USA Inc. Electronic Arrays Inc. Div. Mountain View, CA	39003 Maxim Industries Middleboro, MA
29083 Monsanto Co. Santa Clara, CA	31522 Metal Masters Inc. Baldwin, MS	33919 Nortek Inc. Cranston, RI	4F434 Plastic Sales Los Angeles, CA
29604 Stackpole Components Co. Raleigh, NC	31746 Cannon Electric Woodbury, TN	34114 Oak Industries Rancho Bernardo, CA	40402 Roderstein Electronics Inc. Statesville, NC
29907 Omega Engineering Inc. Stamford, CT	31827 Budwig Ramona, CA	34263 CTS Electronics Corp. Brownsville, TX	42498 National Radio Melrose, MA
3D536 Aimco Inc. Seattle, WA	31918 ITT-Schadow Eden Prairie, MN	34333 Silicon General Inc. Garden Grove, CA	43543 Nyttronics Inc. (Now 53342)
30035 Jolo Industries Inc. Garden Grove, CA	32293 Intersil Cupertino, CA	34335 Advanced Micro Devices (AMD) Sunnyvale, CA	43744 Panasonic Industrial Co. San Antonio, TX
30045 Solid Power Corp. Farmingdale, NY	32539 Mura Corp. Westbury, Long Island, N.Y.	34359 MN Mining & Mfg. Co. Commercial Office Supply Div. Saint Paul, MN	43791 Datron Systems Wilkes Barre, PA
30146 Symbex Corp. Painesville, OH	32559 Bivar Santa Ana, CA	34371 Harris Corp. Harris Semiconductor Products Group Melbourne, FL	44655 Ohmite Mfg. Co. Skokie, IL
30148 AB Enterprise Inc. Ahoskie, NC	32719 Siltronics Santa Ana, CA	34576 Rockwell International Corp. Newport Beach, CA	47001 Lumberg Inc. Richmond, VA
30161 Aavid Engineering Inc. Laconia, NH	32767 Griffith Plastics Corp. Burlingame, CA	34641 Instrument Specialties Euless, TX	47379 ISOCOM Campbell, CA
30315 Itron Corp. San Diego, CA	32879 Advanced Mechanical Components Northridge, CA	34649 Intel Corp. Santa Clara, CA	49569 IDT (International Development & Trade) Dallas, TX
30323 IL Tool Works Inc. Chicago, IL	32897 Murata Erie North America Inc. Carlisle Operations Carlisle, Pennsylvania	34802 Electromotive Inc. Kenilworth, NJ	49671 RCA Corp. New York, NY
30800 General Instrument Corp. Capacitor Div. Hicksville, NY	32997 Bourns Inc. Trimpot Div. Riverside, CA	34848 Hartwell Special Products Placentia, CA	49956 Raytheon Company Executive Offices Lexington, MA
30838 Fastec Chicago, ILL	33025 M/A ComOmni Spectra, Inc. (Replacing Omni Spectra) Microwave Subsystems Div. Tempe, AZ	35009 Renfrew Electric Co. Ltd. IRC Div. Toronto, Ontario, Canada	5D590 Mostek Corp. Replaced by: SGS Thompson Microelec- tronics
31019 Solid State Scientific Inc. Willow Grove, PA	33096 CO Crystal Corp. Loveland, CO	35986 Amrad Melrose Park, IL	5F520 Panel Components Corp. Santa Rosa, CA
31091 Alpha Industries Inc. Microelectronics Div. Hatfield, PA	33173 General Electric Co. Owensboro, KY	36665 Mitel Corp. Kanata, Ontario, Canada	5P575 Nobel Electronics Suffern, NY
31323 Metro Supply Company Sacramento, CA			5W664 NDK Div. of Nihon Dempa Kogyo LTD Lynchburg, VA

## Federal Supply Codes for Manufacturers (cont)

5U802 Dennison Mfg. Co. Framingham, MA	51499 Amtron Corp. Boston, MA	52840 Western Digital Corp. Costa Mesa, CA	54937 DeYoung Mfg. Bellevue, WA
50088 SGS - Thomson Microelectronics Inc. Carrollton, TX	51506 Accurate Screw Machine Co. (ASMCO) Nutley, NJ	53021 Sangamo Weston Inc. (See 06141)	54590 RCA Corp. Electronic Components Div. Cherry Hill, NJ
50120 Eagle-Picher Industries Inc. Electronics Div. CO Springs, CO	51605 CODI Semiconductor Inc. Kenilworth, NJ	53036 Textool Co. Houston, TX	55026 American Gage & Machine Co. Simpson Electric Co. Div. Elgin, IL
50157 Midwest Components Inc. Muskegon, MS	51642 Centre Engineering Inc. State College, PA	53184 Xciton Corp. Lathan, NY	55112 Plessey Capacitors Inc. (Now 60935)
50356 Teac Corp. of America Industrial Products Div Montebello, CA	51705 ICO/Rally Palo alto, CA	53217 Technical Wire Products Inc. Santa Barbara, CA	55261 LSI Computer Systems Inc. Melville, NY
50364 MMI, Inc. (Monolithic Memories Inc) Military Products Div. Santa Clara, CA	51791 Statek Corp. Orange, CA	53342 Opt Industries Inc. Phillipsburg, NJ	55285 Beroquist Co. Minneapolis, MN
50472 Metal Masters, Inc. City of Industry, CA	51984 NEC America Inc. Falls Church, VA	53673 Thompson CSF Components Corp. (Semiconductor Div) Conaga Park, CA	55322 Samtech Inc. New Albany, IN
50541 Hypertronics Corp. Hudson, MA	52063 Exar Integrated Systems Sunnyvale, CA	53718 Airmold/W. R. Grese & Co. Roanoke Rapids, NC	55408 STI-CO Industries Co Buffalo, NY
50558 Electronic Concepts, Inc. Eatontown, NJ	52072 Circuit Assembly Corp. Irvine, CA	53848 Standard Microsystems Hauppauge, NY	55464 Central Semiconductor Corp. Hauppauge, NY
50579 Litronix Inc. Cupertino, CA	52152 MN Mining & Mfg. Saint Paul, MN	53894 AHAM Inc. RanchoCA, CA	55557 Microwave Diode Corp. W. Stewartstown, NH
50891 Semiconductor Technology Stuart, FL	52333 API Electronics Haugpauge, Long Island, NY	53944 Glow-Lite Pauls Valley, OK	55566 R A F Electronic Hardware Inc. Seymour, CT
50934 Tran-Tec Corp Columbus, NE	52361 Communication Systems Piscataway, NJ	54178 Plasmetex Industries Inc. San Marcos, CA	55576 Synertek Santa Clara, CA
51167 Aries Electronics Inc. Frenchtown, NJ	52500 Amphenol, RF Operations Burlington, MA	54294 Shalleross Inc. Smithfield, NC	55680 Nichicon/America/Corp. Schaumburg, IL
51284 Mos Technology Norristown, PA	52525 Space-Lok Inc. Lercio Div. Burbank, CA	54453 Sullins Electronic Corp. San Marcos, CA	55943 D J Associates, Inc (Replaced Transcon Mfg.-24618) Fort Smith, AZ
51249 Heyman Mfg. Co. Cleveland, OH	52531 Hitachi Magnetics Edmore, MO	54473 Matsushita Electric Corp. (Panasonic) Secaucus, NJ	56282 Utek Systems Inc. Olathe, KS
51372 Verbatim Corp. Sunnyvale, CA	52745 Timco Los Angeles, CA	54492 Cinch Clamp Co., Inc. Santa Rosa, CA	56289 Sprague Electric Co. North Adams, MA
51398 MUPAC Corp. Brockton, MA	52763 Stettner-Electronics Inc. Chattanooga, TN	54583 TDK Garden City, NY	56365 Square D Co. Corporate Offices Palatine, IL
51406 Murata Erie, No. America Inc. (Also see 72982) Marietta, GA	52769 Sprague-Goodman Electronics Inc. Garden City Park, NY	54590 RCA Corp Distribution & Special Products Cherry Hill, NJ	56375 WESCORP Div. Dal Industries Inc Mountain View, CA
	52771 Moniterm Corp. Amstrom Div. Santa Clara, CA	54869 Pihler International Corp. Arlington Heights, IL	

## Federal Supply Codes for Manufacturers (cont)

56481 Shugart Associates Sub of Xerox Corp. Sunnyvale, CA	59610 Souriau Inc Valencia, CA	60911 Inmos Corp. CO Springs, CO	64537 KDI Electronics Whippany, NJ
56637 RCD Components Inc. Manchester, NH	59635 HV Component Associates Howell, NJ	60935 Westlake Capacitor Inc. Tantalum Div. Greencastle, IN	64782 Precision Control Mfg. Inc. Bellevue, WA
56708 Zilog Inc. Campbell, CA	59640 Supertex Inc. Sunnyvale, CA	60958 ACIC Intercomp Wire & Cable Div. Hayesville, NC	64834 West M G Co. San Francisco, CA
56856 Varnistor Corp. of TN Sevierville, TN	59660 Tusonix Inc. Tucson, AZ	61271 Fujitsu Microelectronics Inc San Jose, CA	64961 Electronic Hardware LTD North Hollywood, CA
56880 Magnetics Inc. Baltimore, MD	59730 Thomas and Betts Corp. IA City, IA	61394 SEEQ Technology Inc. San Jose, CA	65092 Sangamo Weston Inc. Weston Instruments Div. Newark, NJ
57026 Endicott Coil Co. Inc. Binghamton, NY	59831 Semtronics Corp. Watchung, NJ	61429 Fox Electronics Cape Coral, FL	65786 Cypress Semi San Jose, CA
57053 Gates Energy Products Denver, CO	6H053: American Components Inc. an Insilco Co. RPC Div. Hayesville, NC	61529 Aromat Corp. New Providence, NJ	65940 Rohm Corp & Whatney Irvine, CA
57170 Cambridge Thermionic Cambridge, MA Replaced by: 71279 Interconnection Products Inc.	6L611 Allen, Robert G. Inc. Van Nuys, CA	61752 IR-ONICS Inc Warwick, RI	65964 Evox Inc. Barnockburn, IL
57668 R-ohm Corp Irvine, CA	6U850 Burgess Switch Co., Inc Northbrook, IL	61772 Integrated Device Technology Santa Clara, CA	66150 Entron Inc. Winslow Teltronics Div. Glendale, NY
57962 SGS - Thomson Microelectronics Inc Montgomeryville, PA	6U095 AMD Enterprises, Inc. Roswell, GA	61802 Toshiba Houston, TX	66302 VLSI Technology Inc. San Jose, CA
58014 Hitachi Magnalock Corp. (Now 12581)	6X403 SGS/ATES Semiconductor Corp. INpolis, IN	61857 SAN-O Industrial Corp. Bohemia, Long Island, NY	66419 Exel San Jose, CA
58104 Simco Atlanta, GA	6Y440 Micron Technology Inc. Boise, ID	61935 Schurter Inc. Petaluma, CA	66450 Dyna-Tech Electronics, Inc Walled Lake, MI
58364 BYCAP Inc. Chicago, IL	60046 Power Dynamics Inc West Orange, NJ	62351 Apple Rubber Lancaster, NY	66608 Bering Industries Freemont, CA
58451 Precision Lamp Cotat, CA	60197 Precicontact Inc. Langhorne, PA	62643 United Chemicon Rosemont, IL	66891 BKC International Electronics Lawrence, MA
58474 Superior Electric Co. Bristol, CT	60386 Squires Electronics Inc Cornelius, OR	62712 Seiko Instruments Torrance, CA	66958 SGS Semiconductor Corp. Phoenix, AZ
58614 Communications Instruments Inc. Fairview, NC	60395 Xicor Inc. Milpitas, CA	62793 Lear Siegler Inc. Energy Products Div. Santa Ana, CA	66967 Powerex Inc Auburn, NY
59124 K.O.A-Speer Electronics Inc. Bradford, PA	60399 Torin Engineered Blowers Div. of Clevepak Corp. Torrington, CT	63743 Ward Leonard Electric Co.Inc. Mount Vernon, NY	67183 Altera Santa Clara, CA
59422 Holmberg Electronics Irvine, CA	60496 Micrel Inc. Sunnyvale, CA	64154 Lamb Industries Portland, OR	68919 WIMA % Harry Levinson Co. Seattle, WA
	60705 Cera-Mite Corp. (formerly Sprague) Grafton, WI	64155 Linear Technology Milpitas, CA	

## Federal Supply Codes for Manufacturers (cont)

7F361 Richmond-Division of Dixico % Zellerbach Paper Co. Seattle, WA	71468 ITT Cannon Div. of ITT Fountain Valley, CA	73138 Beckman Industrial corp. Helipot Div. Fullerton, CA	75042 TRW Inc. IRC Fixed Resistors Philadelphia, PA
7F844 Moore Business Forms, Inc Seattle, WA	71482 General Instrument Corp. Clarc Div. Chicago, IL	73168 Fenwal Inc. Ashland, MA	75297 Kester Solder Div. Litton Systems, Inc Des Plaines, IL
7G902 Textron Inc. Camecar Div. Rockford, IL	71590 Mepco/Centralab A North American Philips Co. Fort Dodge, IA	73293 Hughes Aircraft Co. Electron Dynamics Div. Torrance, CA	75376 Kurz-Kasch Inc. Dayton, OH
7J395 Universal Plastics Welschpool, WA	71707 Coto Corp. Providence, RI	73445 Amprex Electronic Corp. Hicksville, NY	75378 CTS Knights Inc. Sandwich, IL
7J696 AMD Plastics East Lake, OH	71744 General Instrument Corp. Lamp Div/Worldwide Chicago, IL	73559 Carlingswitch Inc. Hartford, CT	75382 Kulka Electric Corp. (Now 83330) Mount Vernon, NY
7K354 Omni Spectra Inc Los Altos, CA	71785 TRW Inc. Cinch Connector Div. Elk Grove Village, IL	73586 Circle F Industries Trenton, NJ	75569 Performance Semiconductor Corp. Sunnyvale, CA
7Z884 ALPS Seattle, WA	71984 Dow Coming Corp. Midland, MI	73734 Federal Screw Products Inc. Chicago, IL	75915 Litelfuse Tracor (Formerly: Tracor-Litelfuse) Des Plaines, IL
7X634 Duracell USA Div. of Dart & Kraft Inc. Valdese, NC	72005 AMAX Specialty Metals Corp. Newark, NJ	73743 Fischer Special Mfg. Co. Cold Spring, KY	76854 Oak Switch Systems Inc. Crystal Lake, IL
70290 Almetal Universal Joint Co. Cleveland, OH	72136 Electro Motive Mfg. Corp. Florence, NC	73893 Microdot Mt. Clemens, MS	77122 TRW Assemblies & Fasteners Group Fastener Div. Moutainside, NJ
70485 Atlantic India Rubber Works Inc. Chicago, IL	72228 AMCA International Corp. Continental Screw Div. New Bedford, MA	73899 JFD Electronic Components Div. of Murata Erie Oceanside, NY	77342 AMF Inc. Potter & Brumfield Div. Princeton, IN
70563 Amperite Company Union City, NJ	72259 Nytronics Inc. New York, NY	73905 FL Industries Inc. San Jose, CA	77542 Ray-O-Vac Corp Madison, WI
70903 Cooper-Belden Corp. Geneva, IL	72619 Amperex Electronic Corp. Dialight Div. Brooklyn, NY	73949 Guardian Electric Mfg. Co. Chicago, IL	77638 General Instrument Corp. Rectifier Div. Brooklyn, NY
71002 Bimbach Co. Inc. Farmingdale, NY	72653 G C Electronics Co. Div. of Hydrometals Inc. Rockford, IL	74199 Quam Nichols Co. Chicago, IL	77900 Shakeproof Lock Washer Co. (Now 78189)
71034 Bibley Electric Co. Erie, PA	72794 Dzus Fastner Co. Inc. West Islip, NY	74217 Radio Switch Co. Marlboro, NJ	77969 Rubbercraft Corp. of CA Ltd. Torrance, CA
71183 Westinghouse Electric Corp. Bryant Div. Bridgeport, CT	72928 Gulton Industries Inc. Guderman Div. Chicago, IL	74306 Piezo Crystal Co. Div. of PPA Industries Inc. Carlisle, PA	78189 IL Tool Works Inc. Shakeproof Div. Elgin, IL
71279 Interconnection Products Inc. Formerly Midland-Ross Cambion Div. Santa Ana, CA	72962 Elastic Stop Nut Div. of Harrard Industries Union, NJ	74445 Holo-Krome Co. Elmwood, CT	78277 Sigma Instruments Inc. South Braintree, MA
71400 Bussman Manufacturing Div. McGraw-Edison Co. St. Louis, MO	72982 Erie Specialty Products, Inc Formerly: Murata Erie Erie, PA	74542 Hoyt Elect.Instr. Works Inc. Penacook, NH	78290 Struthers Dunn Inc. Pitman, NJ
71450 CTS Corp. Elkhart, IN		74970 Johnson EF Co. Waseca, MN	78553 Eaton Corp. Engineered Fastener Div. Cleveland, OH

Federal Supply Codes for Manufacturers (cont)

78592 Stoeger Industries South Hackensack, NJ	81439 Therm-O-Disc Inc. Mansfield, OH	83315 Hubbell Corp. Mundelein, IL	87034 Illuminated Products Inc. (Now 76854)
79497 Western Rubber Co. Goshen, IN	81483 International Rectifier Corp. Los Angeles, CA	83330 Kulka Smith Inc. A North American Philips Co. Manasquan, NJ	87516 Standard Crystal KS City, KS
79727 C - W Industries Southampton, PA	81590 Korry Electronics Inc. Seattle, WA	83478 Rubbercraft Corp. of America West Haven, CT	88044 Aeronautical Standards Group Dept. of Navy & Air Force
79963 Zierick Mfg. Corp. Mount Kisco, NY	81741 Chicago Lock Co. Chicago, IL	83553 Associated Spring Barnes Group Gardena, CA	88219 GNB Inc. Industrial Battery Div. Langhorne, PA
8C798 Ken-Tronics, Inc. Milan, IL	82227 Aixpax Corp. Cheshire Div. Cheshire, CT	83740 Union Carbide Corp. Battery Products Div. Danbury, CT	88245 Winchester Electronics Litton Systems-Useco Div. Van Nuys, CA
8D528 Baumgartens Atlanta, GA	82240 Simmons Fastner Corp. Albany, NY	84171 Arco Electronics Commack, NY	88486 Triangle PWC Inc. Jewitt City, CT
8F330 Eaton Corp. Cutler Hammer Product Sales Office Mountain View, CA	82305 Palmer Electronics Corp. South Gate, CA	84411 American Shizuki TRW Capacitors Div. Ogallala, NE	88690 Essex Group Inc. Wire Assembly Div. Dearborn, MI
8T100 Tellabs Inc. Naperville, IL	82389 Switchcraft Inc. Sub of Raytheon Co. Chicago, IL	84613 FIC Corp. Rockville, MD	88786 Atlantic India Rubber Co. Goshen, IN
80009 Tektronix Beaverton, OR	82415 Aixpax Corp. Frederick Div. Frederick, MD	84682 Essex Group Inc. Peabody, MA	88978 Philips (Now Fluke) Mahwah, NJ
80031 Mepco/Electra Inc. Morristown, NJ	82872 Roanwell Corp. New York, NY	84830 Lee Spring Co. Inc Brooklyn, NY	89020 Amrace Corp. Buchanan Crimpool Products Div. Union, NJ
80032 Ford Aerospace & Communications Corp. Western Development Laboratories Div. Palo Alto, CA	82877 Rotron Inc. Custom Div. Woodstock, NY	85367 Bearing Distributing Co. San Francisco, CA	89265 Potter-Brumfield (See 77342)
80145 LFE Corp. Process Control Div. Clinton, OH	82879 ITT Royal Electric Div. Pawtucket, RI	85372 Bearing Sales Co. Los Angeles, CA	89462 Waldes Truarc, Inc. Long Island, NY
80183 Sprague Products (Now 56289)	83003 Varo Inc. Garland, TX	85480 W. H. Brady Co. Industrial Product Milwaukee, WI	89536 John Fluke Mfg. Co., Inc. Everett, WA
80294 Bouns Instruments Inc. Riverside, CA	83014 Hartwell Corp. Piacentia, CA	85840 Brady WH Co Industrial Products Div Milwaukee, WI	89597 Fredericks Co. Huntingdon Valley, PA
80583 Hammerlund Mfg. Co. Inc. Paramus, NJ	83055 Signalite Fuse Co. (Now 71744)	85932 Electro Film Inc. Valencia, CA	89709 Bunker Ramo-Eltra Corp. Amphenol Div. Broadview, IL
80640 Computer Products Inc. Stevens-Arnold Div. South Boston, MA	83058 TRW Assemblies & Fasteners Group Fasteners Div. Cambridge, MA	86577 Precision Metal Products Co. Peabody, MA	89730 General Electric Lamp Div. Newark, NJ
81073 Grayhill Inc. La Grange, IL	83259 Parker-Hannifin Corp. O-Seal Div. Culver City, CA	86684 Radio Corp. of America (Now 54590)	9R216 Data Composition Svc, Inc Laurel, MD
81312 Litton Systems Inc. Winchester Electronics Div. Watertown, CT	83298 Bendix Corp. Electric & Fluid Power Div. Eatonville, NJ	86928 Seastrom Mfg. Co. Inc. Glendale, CA	9S171 Port Plastics Tukwila, WA

## Federal Supply Codes for Manufacturers (cont)

9W423 Amatom El Mont, CA	91934 Miller Electric Co. Woonsocket, RI	95573 Campion Laboratories Inc. Detroit, MI	98278 Maico A Microdot Co. South Pasadena, CA
90201 Mallory Capacitor Co. Sub of Emhart Industries Inc. Indianapolis, IN	91967 National Tel-Tronics Div. of electro Audio Dynamics Inc Meadville, PA	95712 Bendix Corp. Electrical Comp. Div. Franklin, IN	98291 Sealectro Corp. BICC Electronics Trumbull, CT
90215 Best Stamp & Mfg. Co. KS City, MO	91984 Maida Development Co. Hampton, VA	95987 Weckesser Co. Inc. (Now 85480)	98372 Royal Industries Inc. (Now 62793)
90303 Duracell Inc. Technical Sales & Marketing Bethel, CT	91985 Norwalk Valve Co. S. Norwalk, CT	96733 SFE Technologies San Fernando, CA	98388 Lear Siegler Inc. Accurate Products Div. San Deigo, CA
91094 Essex Group Inc. Suflex/IWP Div. Newmarket, NH	92218 Wakefield Corp., The Wakefield, ME	96853 Gulton Industries Inc. Measurement & Controls Div. Manchester, NH	98978 IERC (International Electronic Research Corp.) Burbank, CA
91247 IL Transformer Co. Chicago, IL	92527 VTC Inc. Bloomington, MN	96881 Thomson Industries Inc. Port WA, NY	99120 Plastic Capacitors Inc. Chicago, IL
91293 Johanson Mfg. Co. Boonton, NJ	92607 Tensolite Co. Div. of Carlisle Corp. Buchanan, NY	97464 Industrial Retainer Ring Irvington, NJ	99217 Bell Industries Inc. Elect. Distributor Div. Sunnyvale, CA
91462 Alpha Industries Inc. Logansport, IN	92914 Alpha Wire Corp. Elizabeth, NJ	97525 EECO Inc. Santa Ana, CA	99378 ATLEE of DE Inc. N. Andover, MA
91502 Associated Machine Santa Clara, CA	93332 Sylvania Electric Products Semiconductor Products Div. Woburn, MA	97540 Whitehall Electronics Corp. Master Mobile Mounts Div. Fort Meyers, FL	99392 Mepco/Electra Inc. Roxboro Div. Roxboro, NC
91506 Augat Alcoswitch N. Andover, MA	94144 Raytheon Co. Microwave & Power Tube Div. Quincy, MA	97913 Industrial Electronic Hardware Corp. NY, NY	99515 Electron Products Inc. Div. of American Capacitors Duarte, CA
91507 Froeliger Machine Tool Co. Stockton, CA	94222 Southco Inc. Concordville, PA	97945 Pennwalt Corp. SS White Industrial Products Piscataway, NJ	99779 Bunker Ramo- Eltra Corp. Barnes Div. Lansdown, PA
91637 Dale Electronics Inc. Columbus, NE	94988 Wagner Electric Corp. Sub of McGraw-Edison Co. Whippany, NJ	97966 CBS Electronic Div. Danvers, MA	99800 American Precision Industries Delevan Div. East Aurora, NY
91662 Elco Corp. A Gulf Western Mfg. Co. Connector Div. Huntingdon, PA	95146 Alco Electronic Products Inc. Switch Div. North Andover, MA	98094 Machlett Laboratories Inc. Santa Barbara, CA	99942 Mepco/Centralab A North American Philips Co. Milwaukee, WI
91737 ITT Cannon/Gremar (Now 08718)	95263 Leecraft Mfg. Co. Long Island City, NY	98159 Rubber-Teck Inc. Gardena, CA	
91802 Industrial Devices Inc. Edgewater, NJ	95275 Viuramon Inc. Bridgeport, CT		
91833 Keystone Electronics Corp. NY, NY	95303 RCA Corp. Receiving Tube Div. Cincinnati, OH		
91836 King's Electronics Co. Inc. Tuckahoe, NY	95348 Gordo's Corp. Bloomfield, NJ		
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## Section 8

# Schematic Diagrams

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