Operating and Service Manual

MODEL

200L

PART NUMBER

1000890-502

AMPLIFIER RESEARCH

Souderton, PA 18964-9990 USA

NOTICE

This manual is applicable to the following models:

200L   200LM5

Whenever the words "Model 200L" are used in the text, they should be considered to be replaced by the appropriate model number.

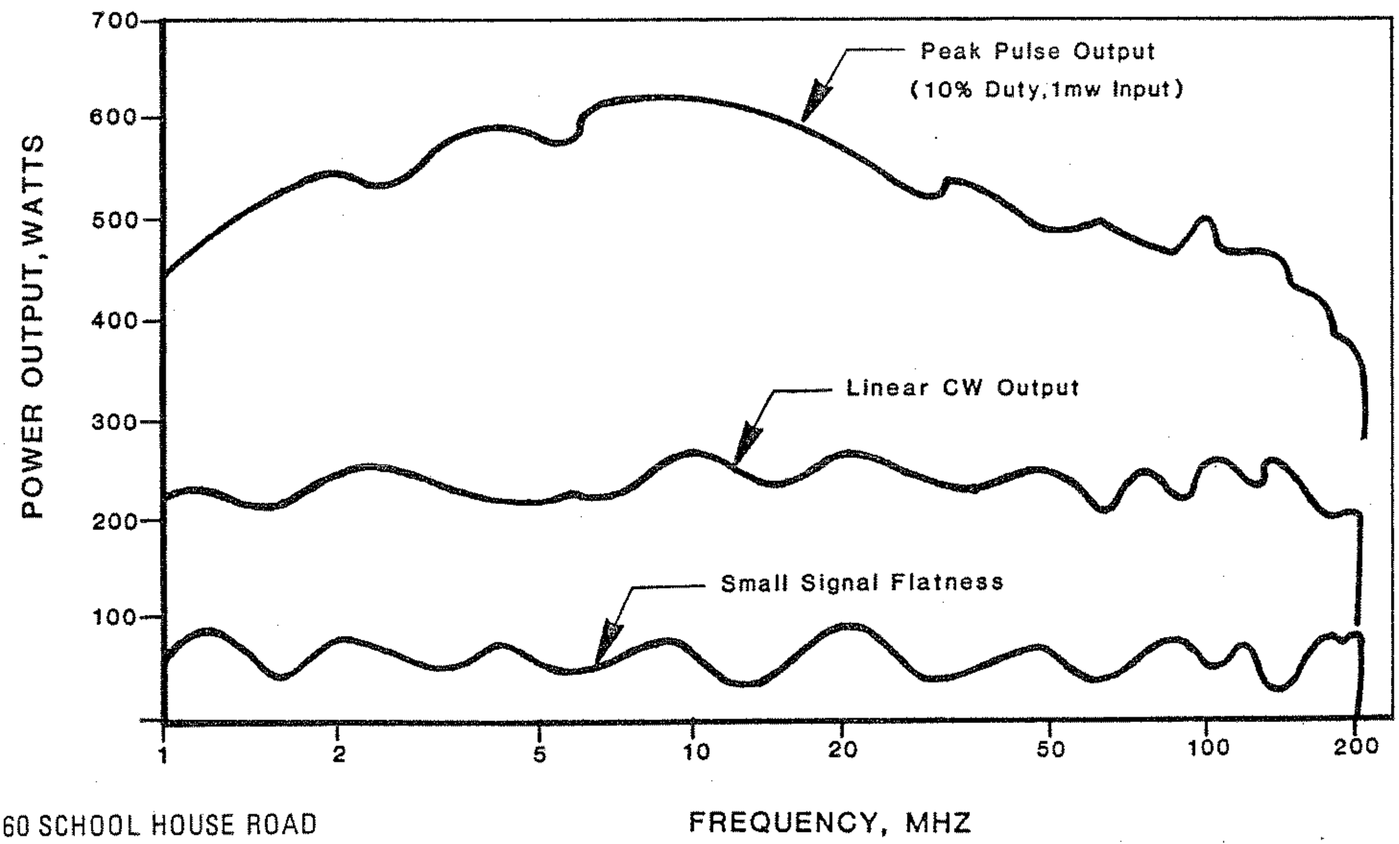
AMPLIFIER RESEARCH

MODEL 200L
200 WATTS
1-200 MHz

High Power Pulse Capability And Blanking

The Model 200L is a self-contained, air-cooled broadband amplifier that features instantaneous bandwidth, high gain, and moderate output. Designed for laboratory applications, the 200L, when used with a frequency swept signal source provides 200 watts of swept power from 1 to 200 MHz. When supplied with a pulsed RF input, the Model 200L will provide a minimum of 300 watts of output power. Over 500 watts of pulse power is available as shown in the accompanying graph. This highly versatile and reliable unit employs the latest design technology in its all-solid state, low level stage and vacuum tube final amplifier. Housed in a stylish, contemporary enclosure, the 200L weighs considerably less than competitive equipment with similar power levels. All operating controls are functionally grouped on the front panel to simplify operator use. These include modern, lighted pushbutton switches for command functions, POWER, STANDBY, and OPERATE, and a control for setting the output level of the amplifier. Provisions are included to allow blanking of the amplifier during off periods in pulse operation. Unique protective circuitry developed by Amplifier Research permits operation into any load impedance without shutdown or damage.

TYPICAL POWER OUTPUT CHARACTERISTICS



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REV0283

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SECTION I

GENERAL INFORMATION

1.1 GENERAL DESCRIPTION

The Model 200L is a self-contained, broadband amplifier intended for laboratory applications where instantaneous bandwidth, high gain, and moderate power output are required. When used with a frequency swept signal source it will provide 200 watts of linear swept power. The Model 200L employs the most up-to-date design technology in both its solid state low level amplifiers and vacuum tube final amplifier. All operating controls are functionally grouped on the front panel to simplify operator use. They include modern, lighted push button switches for the command functions, POWER, STANDBY, and OPERATE and a gain control for setting the output level of the amplifier.

Unique protective circuitry developed by Amplifier Research permits operation without shutdown or damage regardless of source and load VSWR thus making the Model 200L the most versatile unit available for laboratory use. Typical applications include antenna and component testing, wattmeter calibration, and EMI susceptibility testing.

1.2 POWER SUPPLIES

This unit has self-contained 115/208/230 VAC, 50/60 Hz, regulated and unregulated power supplies with a total power consumption of approximately 2,000 watts. A primary circuit breaker is provided.

1.3 SPECIFICATIONS

Refer to Amplifier Research Data Sheet on next page for detailed specifications.

1.4 INSTALLATION

Before proceeding, thoroughly inspect the amplifier for signs of physical damage which may have been incurred during shipment and completely read the following installation and operating instructions, paying special attention to all caution notes.

1.4.1 Location

Select an operating location which will permit free air circulation around the amplifier cabinet. The Model 200L utilizes intensive air cooling and should not be located where the normal flow of air into or exiting from the unit will be restricted, diverted, or recirculated through the unit itself. For example: Do not place the unit on a bench having a low overhead shelf as this will restrict and recirculate the air flow from the amplifier exhaust port located on the upper portion of the rear panel.

CAUTION:

UNDER NORMAL OPERATING CONDITIONS THE EXHAUST AIR TEMPERATURE FROM THE MODEL 200L MAY EXCEED 130°C. DO NOT LOCATE HEAT SENSITIVE EQUIPMENT OR BOOKS, PAPERS, AND OTHER TEMPERATURE SENSITIVE MATERIALS IN THE DIRECT PATH OF THE EXHAUST AIR.

1.4.2 Primary Power Connection

The Model 200L can be operated on either 115 VAC, 208 VAC, or 230 VAC, 50/60 Hz primary power. It has been prewired at the factory for operation on 230 VAC since this is the preferred primary power source. The amplifier can be readied for operation by attaching the 230 VAC primary power lines to terminals 6 and 7, and a ground wire to terminal 8 of the terminal block located on the rear of the power supply just inside the rear door. When operating from 230 or 208 VAC a 15 ampere service is required.

If the 230 VAC primary power is not available refer to the enclosed power supply schematic diagram 1000884, to ascertain proper connection for 115 VAC or 208 VAC operation. When operating on 115 VAC a 30 ampere service is required.

SAME AS 25Ø

SECTION II

OPERATING INSTRUCTIONS

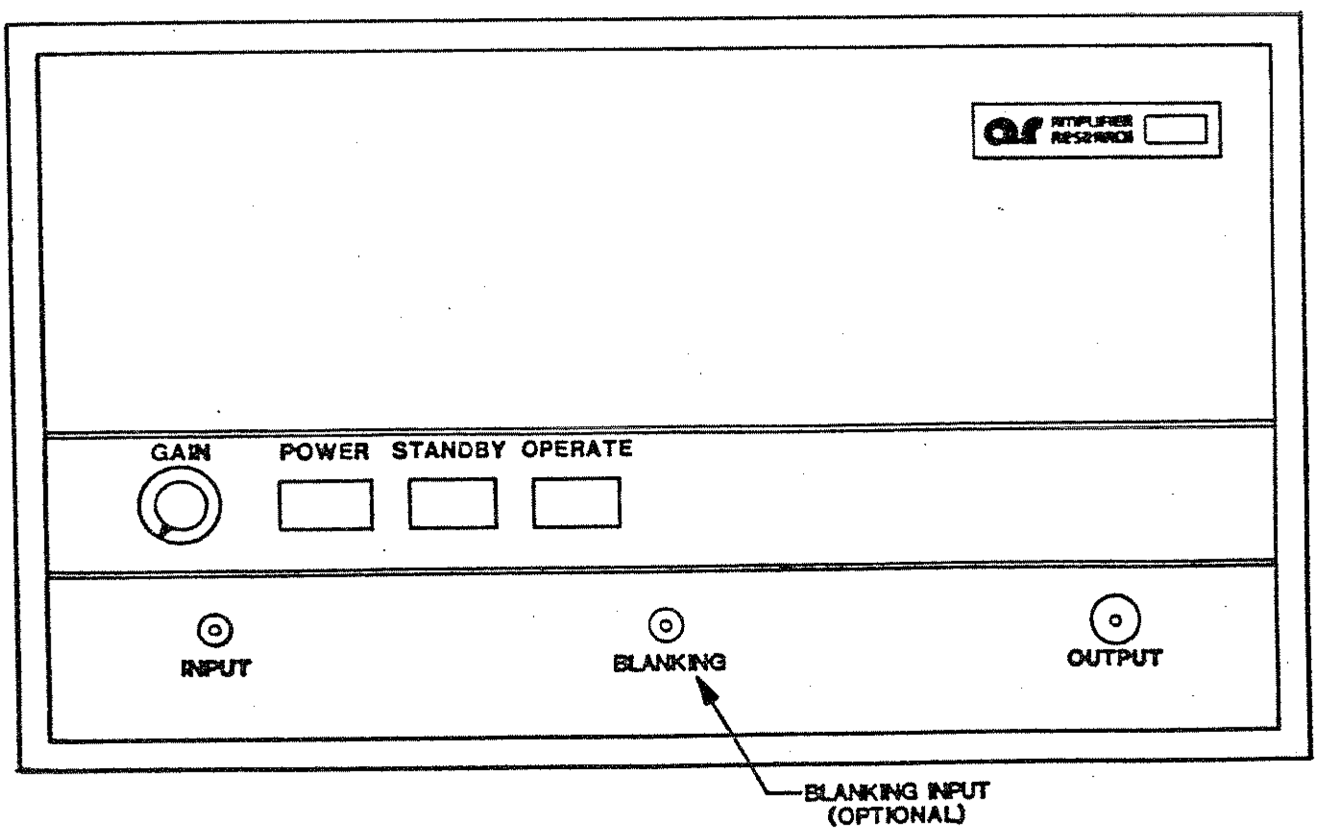
2.1 GENERAL

Operation of the Model 200L Broadband Power Amplifier is quite simple. The input signal is fed into the jack marked INPUT and the amplifier output signal is taken from the jack marked OUTPUT. The INPUT jack is a standard type BNC and the OUTPUT jack is a standard type N. The unit is activated in two stages which allows the operator to return to a STANDBY condition without fully deactivating the unit. Indication of the two stages of operation are shown by colored lights within the STANDBY and OPERATE switches.

2.2 AMPLIFIER OPERATION

Figure 2.1 shows the Model 200L Broadband Amplifier in pictorial form.

FIGURE 2.1 AMPLIFIER OPERATION



2.2 AMPLIFIER OPERATION (Continued)

1. Connect primary power as outlined in Section 1.4.2.
2. Activate the primary power switch located on front panel and observe the white power indicator light. If this light is on the amplifier is receiving primary power and has activated the filament warm up delay circuit.
3. Wait approximately 90 seconds after which time the amber STANDBY switch located on the front panel will light. This indicates that the warm up delay is complete and the amplifier is ready for operation.
4. During the initial 90 second delay time, while the filaments are warming up, the equipment operator may connect his input signal source and his output load if they have not already been connected. For initial testing, a 50 ohms dummy load is suggested with a minimum power rating of at least 300 watts. The input signals should remain off until the operator switch has been activated.
5. Activate the OPERATE switch located on the front panel. This turns on plate power to the final amplifier lighting the red OPERATE indicator light.
6. Apply input signal. The normal input signal level should be about 1.0 milliwatt. A gain control with approximately a 20 dB range is provided to simplify operation when higher input signal levels are encountered.
7. While CW output power of 200 watts minimum may be obtained, up to 300 watts of pulsed power with a 50% or less duty cycle is available. Attempting to achieve more output power will cause the unit to shut down. Furthermore, the unit will shut down for any combination of excessive power and pulse width. The maximum allowable pulse power is 300 watts at 20 milliseconds. Should the unit shut down (red OPERATE light is extinguished) reduce the input level and/or reduce the pulse width and depress the OPERATE switch to continue operation.

2.2 AMPLIFIER OPERATION (Continued)

8. When RF power is not required the amplifier should be placed in STANDBY to reduce power consumption and increase tube life. The unit is placed in standby by pushing the amber STANDBY switch which will light, indicating the unit has been returned to standby.

9. To turn amplifier OFF, first return to standby (see 9 above) and then deactivate the power switch and observe the white power indicator light. When this goes out the unit is fully turned off. However, in the case of a rapid shut down sequence, the RED operate power indicator light may still be on, indicating that the high voltage supply bleeder circuit has not fully discharged the power supply.

SECTION III

THEORY OF OPERATION

3.1 INTRODUCTION

Refer to Block Diagram No. 1000620

The amplifier basically consists of a solid state low-level amplifier and a vacuum tube Final Amplifier. The signal from the INPUT connector is first applied to the gain control and thence to the solid state amplifier. The output of the solid state amplifier is then amplified by the Final Amplifier to yield a total power gain of 57 dB. The input attenuator provides a gain variation of approximately 20 dB. Twelve forced air cooled vacuum tubes in a distributed amplifier configuration are used in the Final Amplifier.

3.2 GAIN CONTROL

Refer to Block Diagram No. 1000620

The RF signal from the front panel is first fed to a variable attenuator. This is an operator adjusted control marked GAIN on the front panel. This attenuator is designed so that it provides a 50 ohm impedance both at the input and output regardless of the attenuator setting.

3.3 LOW LEVEL AMPLIFIER

Refer to Schematic Diagram No. 1000800

The solid state amplifier consists of three (3) cascaded broadband amplifiers driving a push-pull pair. Intra-stage feedback is used to flatten the frequency response of the overall amplifier and bias stabilization of the individual stages are provided by a zener diode. Inter-stage coupling is accomplished by broadband ferrite transformers. The first stage is connected in the common emitter mode with special attention given to bypassing the emitter signal path. The output of the first transistor is fed to the base of the second stage through a ferrite transformer and coupling capacitor. The second and third stages are very similar to the first stage in the employment of the components. The output of the third stage is fed through a power splitting

3.3 LOW LEVEL AMPLIFIER (Continued)

transformer to drive the bases of the fourth stage employing two transistors connected in a push-pull configuration. The output from the fourth stage is fed through a matching transformer to the RF output.

3.4 FINAL AMPLIFIER

Refer to Schematic Diagram No. 1000887

The RF output from the low level amplifier is fed into the input connector, and thence through a matching network This matching network converts the nominal 50 ohms input to 27 ohms for the grid line of vacuum tubes V1 to V12. Grid bias DC blocking capacitors are provided. The screen circuit of each vacuum tube is bypassed by specially constructed capacitors that are built into the tube sockets and shown as C19 to C30 in the schematic. The DC supply to the vacuum tube screens is novel in that it is so designed that a stiff regulated voltage is available to the screen up to the point of rated dissipation, then slowly falls as the screen draws more current. This keeps the product of current times voltage within the dissipation allowed. Each vacuum tube has its own dissipation protection circuit, consisting of in the case of V1, R2, and CR1. Screen voltage is derived from the plate supply through R2 and clamped with CR1 to zener diode VR1 through VR4 connected in series. Bias for the vacuum tubes is supplied through R14 and R16 and bypassed by capacitors C26, C27, and C28. R17 provides a shunt path to ground for any grid current. Inductors L2 through L14 are plate lines and terminate at the input end through L1, R1, and C1, C2 and C3. The output end terminates through C4 - C9 and the matching network to the output connector J3. The vacuum tube filaments are connected in a balanced series - parallel arrangement to null the ground current which would otherwise be about 13 amps. Two cooling blowers are provided for the vacuum tubes.

3.5 POWER SUPPLY

The self-contained power supplies in the Model 200L include a +590 VDC for the Final Amplifier; 2 regulated -28 VDC supplies; and a regulated, variable -13 VDC supply for the Final Amplifier grid bias circuit. There are in addition, a timed control and interlock circuit as well as taps to accomodate the unit to a 115, 208 or 230 volts AC primary power source. Test points are provided for critical voltages and plate current.

3.5.1 Regulated Power Supplies

Refer to Schematic Diagram No. 1000828 & 1000909.

The self-contained regulated power supplies employ a full wave rectifier utilizing solid state rectifiers CR1 and CR2. AC power to the two regulated boards is supplied from a secondary widing on transformer T2. Output from the rectifiers is filtered by C1 before passing through the series regulating transistor Q1. Integrated circuit U1 is the error sensing amplifier for the regulator and the reference voltage to it is supplied by the resistive network R1, R2, and R4. R2 is a variable resistance which is set at the factory for proper regulated DC output. Capacitors C2 and C3 are stabilizing capacitors and R5 is the overload sensing element.

3.5.2 High Voltage Power Supply

Refer to Schematic Number 1000884.

AC primary power for the +590 VDC power supply is taken from terminal strip TB1 and fed through relay K2 to the tapped primary of T1. A table in the schematic diagram shows the appropriate connections for TB1 for 115, 208 or 230 volt primary line operation. The secondary of T1 also has a set of taps to adjust the power supply output when the primary power source is either too high or too low for proper operation of the unit. A full wave bridge circuit, CR1 rectifies the AC voltage which is then filtered by C1 and C2 before passing through fuse F1 to the Final Amplifier. An overload protection circuit in the supply return circuit incorporated Relay K4 and overload control potentiometer R3. The overload circuit is set at the factory for 4.5 amperes. Resistor R1, Diode VR1 and indicator DS2 are in the high voltage bleeder circuit and serve to alert the user that voltage still exists across the filter capacitors of the supply. DS2 is part of the red OPERATE switch S3. Test points TP1 through TP5 are located on the rear to provide monitoring of plate current, plate voltage, screen voltage, and bias voltage. TP2 is connected to ground.

3.5.3 Control and Interlock Circuits

Refer to Schematic Diagram Numbers 1000887 and 1000884.

Circuit Breaker CB1 provides primary protection for the Model 200L. The control circuit is actuated by depressing S1 which closes K1 and activates the 90 second time delay relay K3 and applies primary power to T2. The secondary of T2 will now supply AC power to the fans, tube filaments, regulated power supplies, indicator DS1, and the interlock circuit. After 90 seconds, the unit is in STANDBY condition and voltage is available at STANDBY indicator DS3 and OPERATE switch S2.

Depressing OPERATE switch, S2, will now activate the amplifier by closing K2 and applying primary power to T1, provided all interlock switches located in the Final Amplifier are closed. When capacitors C1 and C2 are charged, K5 will close, removing R11 from the ground path of the diode bridge. K5 serves to limit the inrush current of the high voltage supply. Operate indicator DS2 located in the high voltage bleeder circuit will now light.

Depressing the STANDBY switch, S3, interrupts the holding voltage to K2 returning the unit to STANDBY status; however, the red operate indicator will remain on until the high voltage has been discharged. Depressing POWER switch, S1, now removes the holding voltage to relay K1 and the amplifier is completely shut down.

A thermal switch located on the grid side of the RF Assembly is provided to protect the RF Assembly in case of a cooling failure.

If the temperature of the RF Assembly rises above 100°C, the thermal switch will open; thus interrupting the voltage to the coil of K1 and removing the voltage to transformer T2. After the amplifier has cooled sufficiently, repeat section 2.2 steps 2 through 5 to reactivate the amplifier.

3.6 NOISE BLANKING OPTION

Refer to Schematic Diagram 1000896.

The noise blanking signal input connector is a type BNC female located either on the front panel or on the rear side of the power supply chassis immediately inside the rear door.

To use blanking circuit select the operating mode deisred by placing slide switch on blanking circuit board in either "0" or "1" position. (Units are shipped with switch in "0" position.) The following blanking inputs are required:

For switch position "0"......TTL "0" (10 milliamps)
For switch position "1"......TTL "1" (10 milliamps pull-up)

Several applications exist for Amplifier Research products which require the reduction of noise and/or gain on a rapid, repetitive basis. To provide this capability Amplifier Research has developed a circuit which enables the user to electronically change the gain of the Final Amplifier. When used in the Model 200L the following performance is provided:

Blanking Specifications

NOISE REDUCTION CAPABILITY.................. Over 30 dB

RF OUTPUT ATTENUATION (ON-OFF RATIO)....... 20 dB Nominal, Large Sigr
30 dB Minimum, Small Sigr

ACTIVATE TIME (Pulse ON TO RF OFF).......... 5 microseconds Maximum

DEACTIVATE TIME (Pulse OFF TO RF ON)........ 25 microseconds Typical

DUTY CYCLE.................................. Up to 100%

INPUT SIGNAL REQUIRED TO ACTIVATE

Internal Switch Position "0"............ TTL "0"(10 milliamps)

Internal Switch Position "1"............ TTL "1"(10 milliamps pull-

INPUT CONNECTOR............................. Type BNC Female

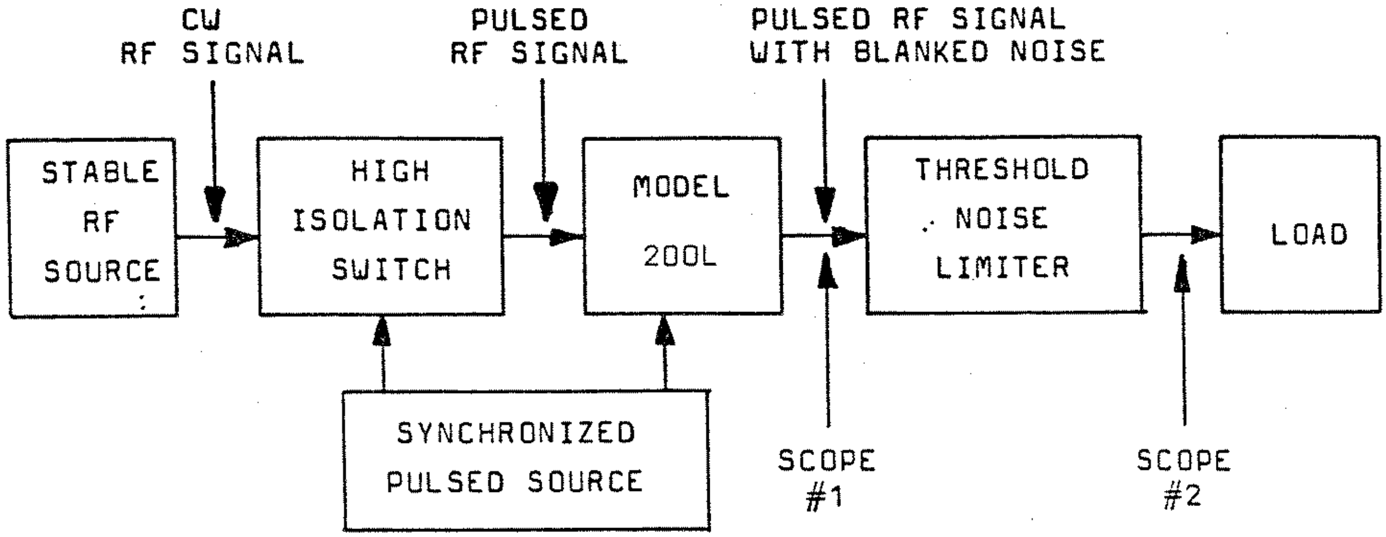
The use of the blanking circuit in Nuclear Magnetic Resonance (NMR) work is of particular interest. Since NMR applications vary widely the user should closely review the performance characteristics obtained by using blanking to determine if it offers advantages in his specific NMR application. The illustration in Figure 1 shows waveshapes which should be anticipated under various blanking situations. For applications where the RF pulse is relatively long (over 1 millisecond) it is suggested that the blanking period be kept short so that the amplifier will be on and stabilized (thereby eliminating overshoot) when the next RF pulse occurs.

A simplified block diagram is shown in Figure 2 to illustrate a test system similar to that used in many NMR setups. Oscilloscope position #1 shows the transients generated by activating the blankin circuit. Most of the RF energy contained in these transients is below 1 MHz and is easily removed by the threshold noise limiter (crossed diodes). Oscilloscope positions #2 shows the output after the noise limiter.

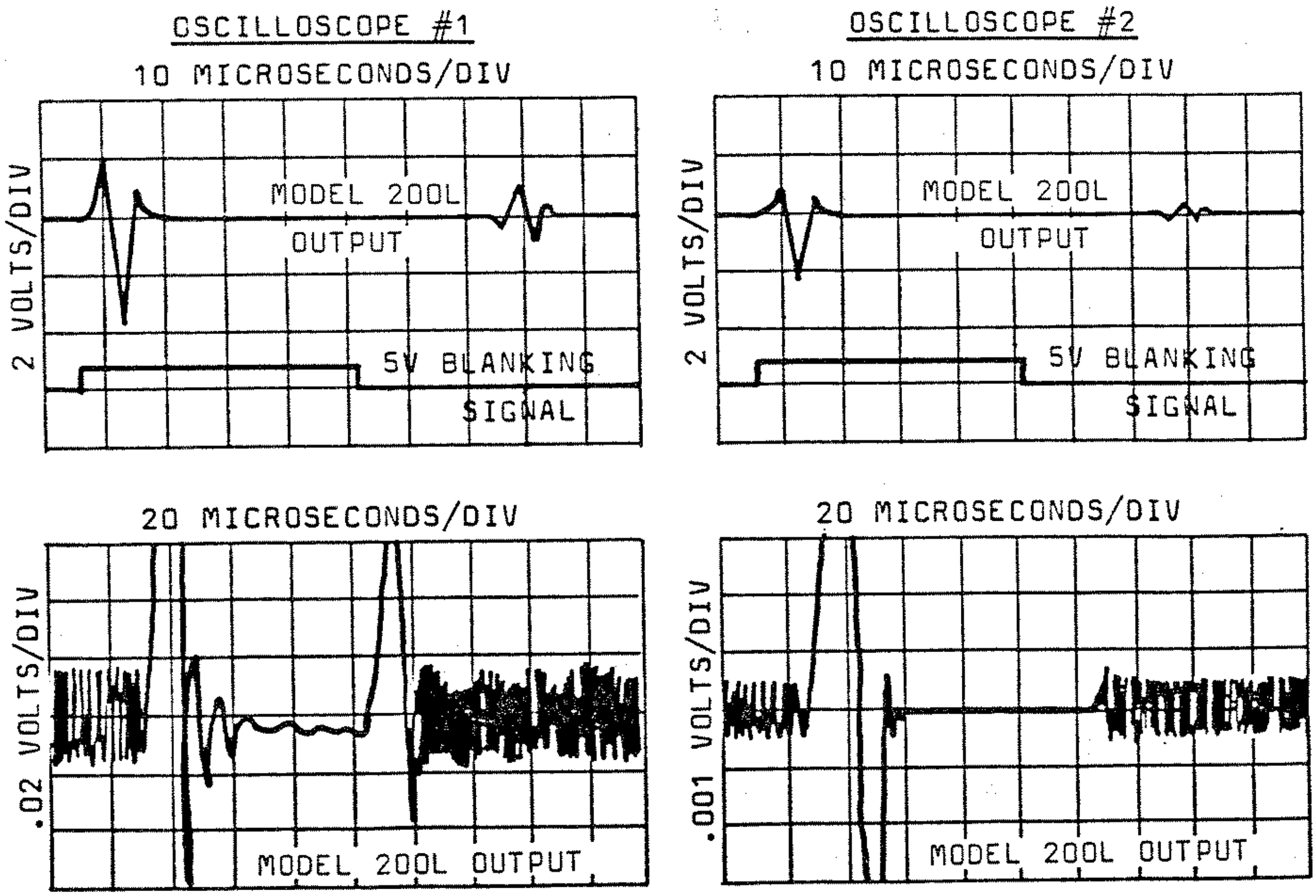
Use of the noise blanking option as illustrated, reduces noise outpu and improves the pulse on-off ratio. However, approximately 5 microseconds are required to activate the blanking circuit and have the transients die out to a level which can be removed by the threshold noise limiter.

FIGURE 2

TYPICAL NMR SYSTEM USING NOISE BLANKING



OSCILLOSCOPE WAVESHAPES WITH NO RF INPUT



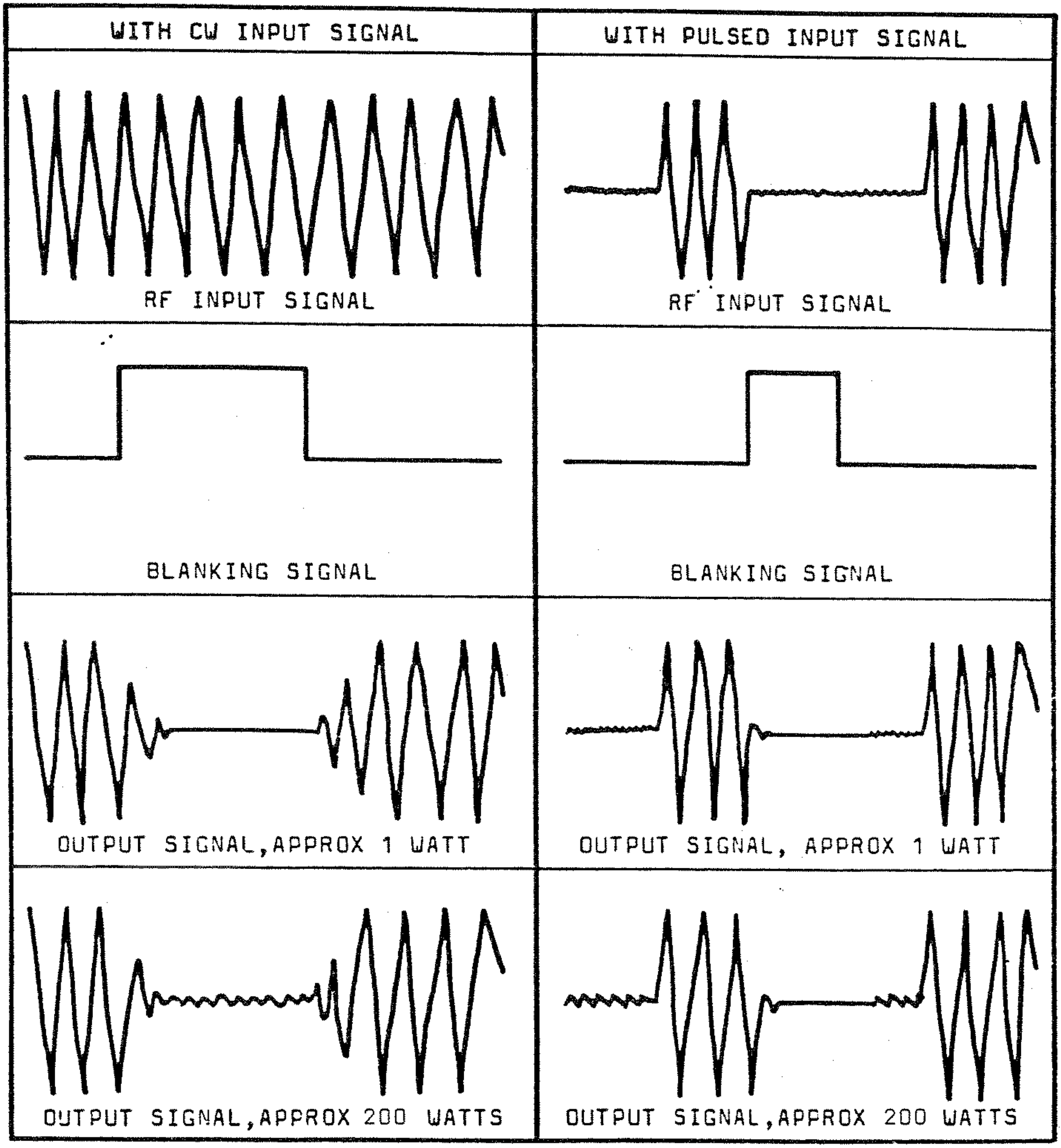


FIGURE 1

TYPICAL WAVESHAPES

SECTION IV

MAINTENANCE

4.1 GENERAL MAINTENANCE INFORMATION

The Model 200L should require very little maintenance since it is a relatively simple instrument. It is built with etched circuit wiring and, wherever possible, solid state devices which should ensure long, trouble-free life. However, should trouble occur special care must be taken in servicing to avoid damage to the devices or the etched circuit board. Since the components are soldered in place, substitution of components should not be resorted to unless there is some indication that they are faulty. However, tubes may be replaced by first removing the anode clamp and then carefully but firmly working the tube out of the sockets.

CAUTION:

DO NOT DISTURB THE COILS NEAR THE TUBE ANODES SINCE THEIR ADJUSTMENT IS CRITICAL TO THE AMPLIFIER ALIGNMENT. ALLOW TUBES TO COOL SUFFICIENTLY BEFORE REMOVAL SINCE DURING NORMAL OPERATION THEY MAY REACH TEMPERATURES IN EXCESS OF 200 DEGREES CENTIGRADE (392°F).

Take care when troubleshooting not to short voltages across the amplifier. Small bias changes in the low level stage may ruin the amplifier due to excessive dissipation or transients. Never replace fuses with ratings greater than specified.

Components within Amplifier Research instruments are conservatively operated to provide maximum instrument reliability. In spite of this, parts within an instrument may fail. Usually, the instrument must be immediately repaired with a minimum of "down time". A systematic approach can greatly simplify and thereby speed up the repair.

However, due to the importance of the amplifier alignment, it is recommended that when failure is caused by breakdown of any of the components in the signal circuits other than tubes, the amplifier be returned to the factory for part replacement and amplifier realignment.

Shipping instructions are as follows: Ship PREPAID to AMPLIFIER RESEARCH, 160 School House Road, Souderton, PA 18964.

4.2 DISASSEMBLY PROCEDURE

<u>CAUTION</u>:

TURN UNIT OFF AND DISCONNECT PRIMARY POWER CABLE BEFORE SERVICING.

4.2.1 Removal From Cabinet

1. Open door on rear of unit and disconnect the connectors on the power supply chassis. Also disconnect the RF output connector from the RF assembly.
2. Remove the 4 front panel screws and carefully slide the power supply assembly approximately 3 inches out of the cabinet.
3. Disconnect the RF input cable from the RF assembly.
4. Slide the power supply assembly completely out of the cabinet.
5. Remove the 4 panel screws securing the RF assembly to the cabinet.
6. Slide the RF assembly out of the cabinet to the rear.

4.2.2 Access For Tube Replacement

After the RF assembly has been removed from the cabinet, access for tube replacement may be accomplished merely by removing the top cover.

4.2.3 Access to Grid Line

This may be accomplished by removing the bottom cover of the RF assembly.

4.2.4 Reassembly

To reassemble the Model 200L, reverse the steps outlined in Sections 4.2.1 to 4.2.3 being certain to make all RF and power connections to the correct locations.

4.3 TROUBLESHOOTING

A good way to begin troubleshooting is to check the supply voltages at the amplifier terminals. All power supply voltages are available with the bottom cover removed.

CAUTION: 1. MAKE ALL METER CONNECTIONS NECESSARY TO MONITOR VOLTAGES PRIOR TO ACTIVATING AMPLIFIER.

CAUTION: 2. DO NOT PLACE THE UNIT IN "OPERATE" FOR MORE THAN 60 SECONDS WITH THE BOTTOM COVER REMOVED OR THE REDUCED FLOW OF COOLING AIR TO THE VACUUM TUBES WILL CAUSE PREMATURE FAILURE.

CAUTION: 3. AFTER SHUTTING UNIT DOWN ALLOW AT LEAST FIVE MINUTES FOR POWER SUPPLIES TO FULLY DISCHARGE BEFORE ATTEMPTING TO DISCONNECT METER. DANGEROUS VOLTAGES EXISTS WITHIN UNIT AS LONG AS RED OPERATE LIGHT REMAINS ON.

Under no signal conditions voltage readings should be compared to the Test Data Sheet with the following tolerances:

TP3-- PLATE VOLTAGE...................... ± 25 volts
TP4-- SCREEN VOLTAGE..................... ± 10 volts
TP5-- GRID BIAS.......................... ± 2 volts
TP1-- PLATE CURRENT...................... ±0.2 amp
TP2-- GROUND

If measurements indicate that voltages are low or nonexistent check the supply components starting with the primary circuit breaker, CB1.

If the plate voltage is outside the limits shown, check the primary power line voltage. Correct the line voltage if possible; if this cannot be done refer to paragraph 4.3.1, procedure for changing the plate transformer taps.

Incorrect low level power supply voltage can result in over dissipation of the transistors or severe distortion and nonlinearity of the amplifier. The power supply may be disconnected from the low level amplifiers to enable trouble-shooting without danger of damaging the board. The driver power supply outputs may be connected to a 25 ohm 50 watt resistor to simulate the load during test.

4.3 TROUBLESHOOTING (Continued)

Check the operation of the fan motor to determine that sufficient air flow is present to cool the transistors.

Finally, determine if the individual amplifier stages are operational by injecting a signal into the transistor base and looking for an indication of output. A reduction in output may be caused by a failure of one of the vacuum tubes in the Final Amplifier. Repeated overload shutdown cycling may indicate that there is a gaseous discharge in one of the vacuum tubes. Since this type of tube failure cannot be detected on a tube checker, the proper procedure is to substitute tubes until the defective tube is found. For this purpose it is well to have a few spare tubes on hand.

Over an extended period of use the tubes will age and it may not be possible to get maximum power output. A measurement of the plate current will serve to verify the difficulty.

See paragraph 4.3.2 for procedure for setting grid bias voltage and hence plate current. Under these circumstances tube element shorting, i.e., grid to cathode, screen to grid shorts will indicate excessive tube current measurements.

A check of open filaments or other tube replacement reasons require careful removal of the tube so that the plate line inductors are not disturbed, otherwise realignment of the amplifier will be necessary. Replacement of more than several tubes would require returning the unit to the factory for alignment if the customer wishes to obtain performance from the Model 200L.

4.3.1 Procedure For Changing Plate Transformer Taps

For best operating results the plate voltage of the Final Amplifier should not be below 565 or above 615 volts. Check voltage by measuring at the junction of F1 and Terminal J1.

<u>CAUTION:</u>

HIGH VOLTAGES ARE PRESENT AND PROPER PRECAUTIONS SHOULD BE TAKEN WHEN ATTEMPTING THIS MEASUREMENT.

4.3 TROUBLESHOOTING (Continued)

If not within the specified range attempt to correct the line voltage if possible. The unit is shipped with the secondary tap of the plate transformer T1 in the 390 V tap. If correcting the line voltage is not possible or does not result in the correct voltage, reset tap to 360 V or 330 V as required to obtain the correct plate voltage.

4.3.2 Procedure For Adjusting Final Amplifier Grid Bias

Refer to Figure 4.1 for location of grid bias adjustment control. Connect a voltmeter set to 10 VDC range across TP1 and TP2 located on rear of power supply chassis. The voltmeter will indicate 1 amp of plate current per volt of reading.

> CAUTION: HIGH VOLTAGES ARE PRESENT AND PROPER PRECUATIONS SHOULD BE TAKEN WHEN ATTEMPTING THIS MEASUREMENT.

The Grid bias adjustment should be rotated counter clockwise to increase plate current and clockwise to reduce plate current. The correct plate current reading should be 2.0 amperes ± 0.2 amperes. Refer to paragraph 4.3 for possible causes for not obtaining this reading.

4.4 SERVICING ETCHED CIRCUIT BOARDS

When soldering leads, use a hot forty (40) watt or smaller iron. Apply heat sparingly to the leads, not to the printed wiring on the board. Before installing new parts clean holes to receive new part without forcing. Have new leads tinned to receive solder quickly with a minimum of heat and without residue.

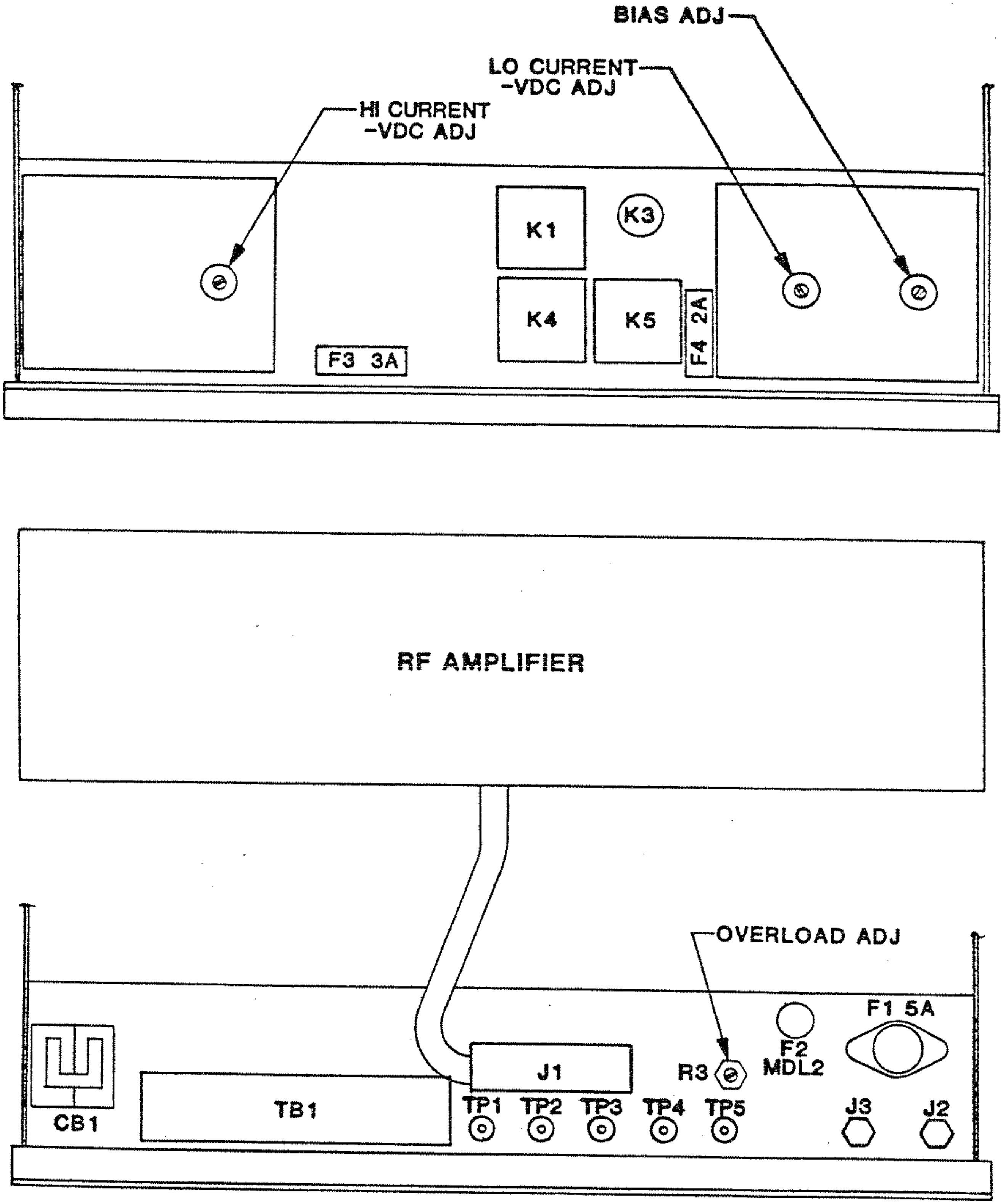


FIGURE 4.1
ADJUSTMENT LOCATIONS

Highest-power linear amplifiers at 10 kHz to 220 MHz

Series L

The L Series of AR amplifiers offers broadband capability in the power range from 150 watts to 10 kilowatts. The entire series is linear, and uses class A or AB output stages for minimum distortion.

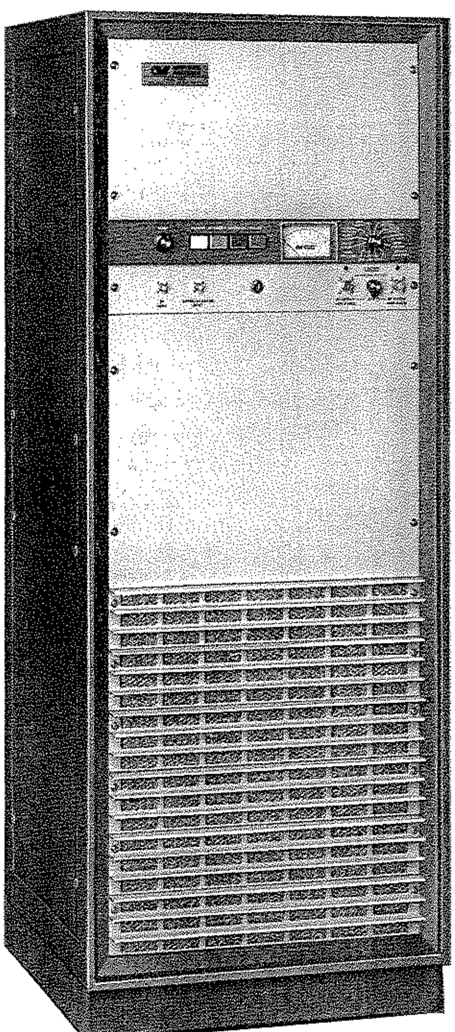
AR design techniques result in compact, rugged amplifiers, conservatively rated for stable, predictable operation over their entire bandwidth. L-Series amplifiers are unconditionally stable, and will tolerate infinite VSWR without damage or shutdown.

L-Series amplifiers use a hybrid design, with solid-state initial stages driving vacuum-tube outputs. Output tubes are arranged in a distributed amplifier configuration to achieve the desired bandwidth with linearity.

Most of the L-Series amplifiers are cooled by air, incorporating an internal fan system to maintain an even airflow in the enclosure. In addition to the fan, Model 10,000L is internally oil-cooled with an oil/water heat exchanger (utilizing ordinary tap water), and Models 2500L and 2500LM8 are cooled with either an oil/air or oil/water heat exchanger.

The accompanying graph shows representative power curves for typical L-Series amplifiers.

The L Series covers the bandwidth from 10 kHz to 220 MHz. With some exceptions, the number preceding the L designation indicates the model's cw output power.

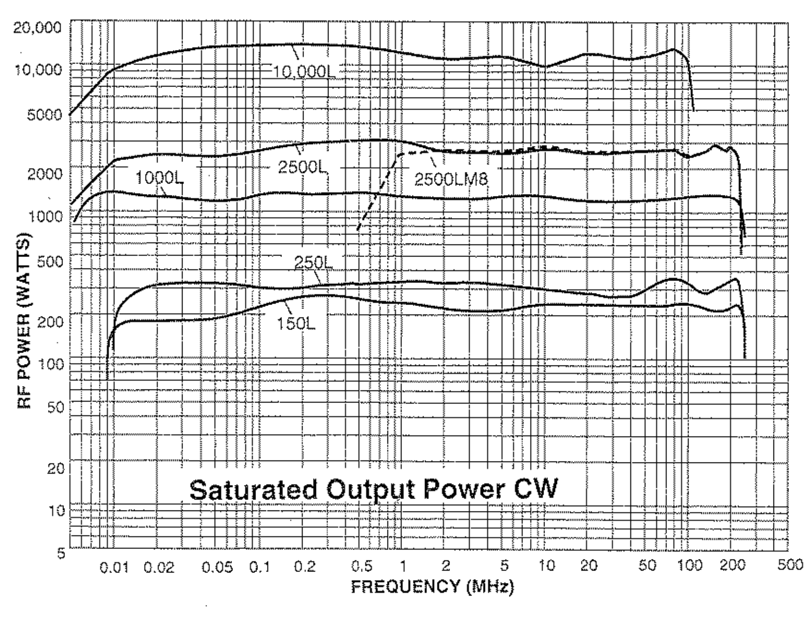


1000L

MODEL	FREQUENCY RANGE	RF POWER (WATTS) CW/PULSE	FLATNESS (dB)	INPUT FOR RATED OUTPUT (mW)	MINIMUM GAIN (dB)	BLANKING	GAIN CONTROL
150L	10kHz-220MHz	150[1]/200	±1.5	1.0	52	STD	STD
200L	1-200MHz	200[1]/400	±1.5	1.0	53	STD	STD
250L	10kHz-220MHz	250/750	±1.5	1.0	54	STD	STD
1000L	10kHz-220MHz	1000/2500	±1.5	1.0	60	STD	STD
1000LM8	1-220MHz	1000/2500	±1.5	1.0	60	STD	STD
1000LP	2-220MHz	200/1000	±1.5	1.0	53	STD	STD
2500L	10kHz-220MHz	2500/4000	±1.5	1.0	64	STD	STD
2500LM8	1-220MHz	2500/4000	±1.5	1.0	64	STD	STD
5000LP	1-150MHz	400/5000	±1.5	1.0	67	STD	STD
10,000L	10kHz-100MHz	10,000	±1.5	1.0	70	STD	STD
10,000LP	9-180MHz	2000/10,000	±1.5	1.0	70	STD	STD

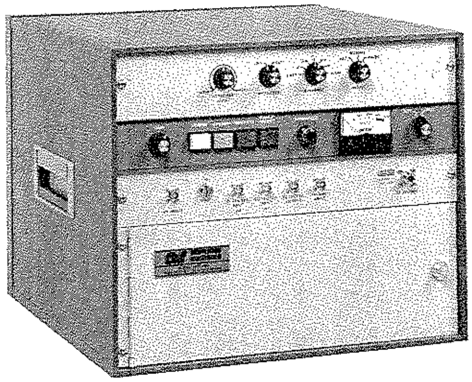
1. Measured at less than 1.0 dB compression

For more detailed information, request individual specification sheets.

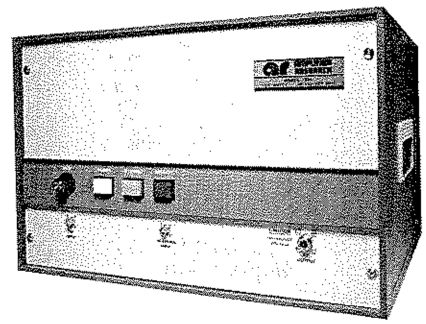


Blanking of amplifier output for NMR applications

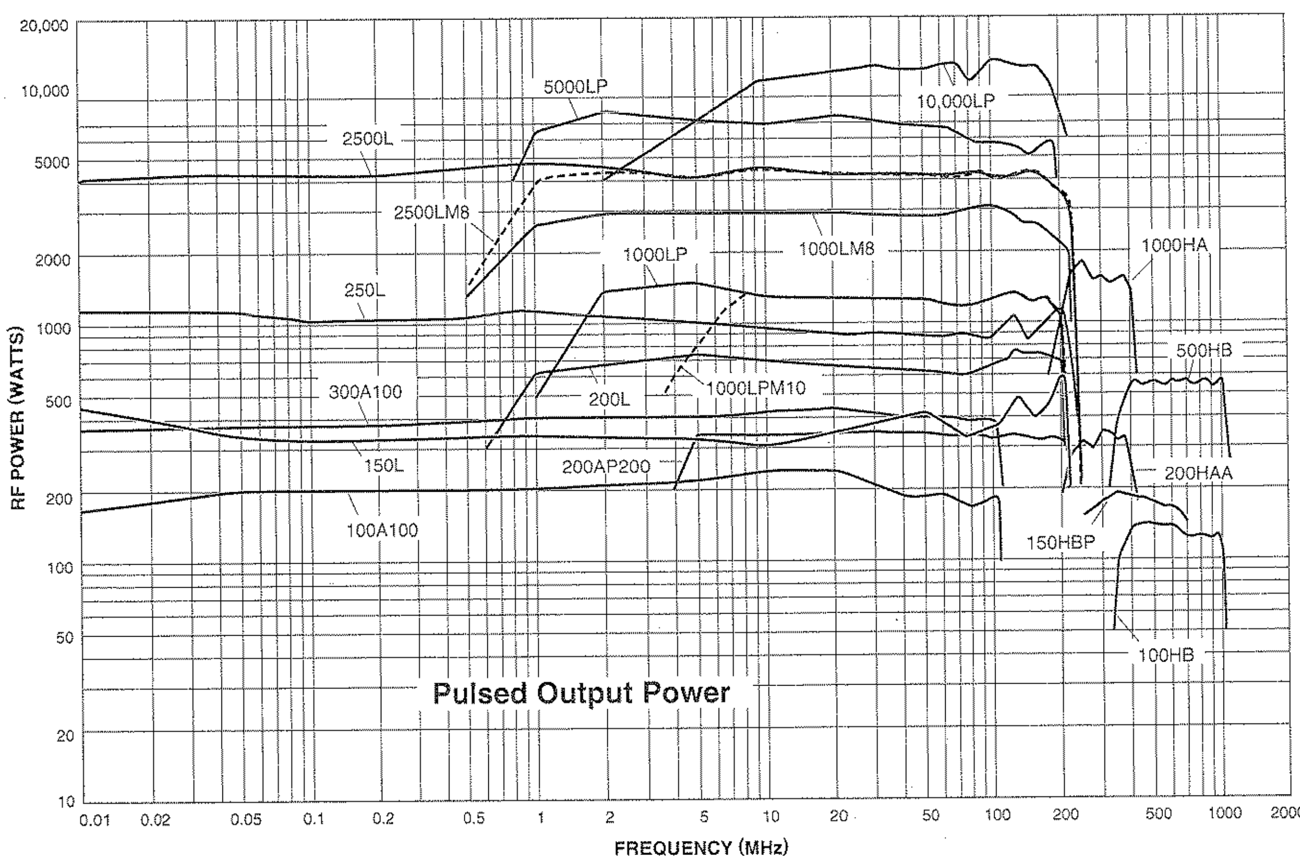
Certain situations require that the output from the amplifier be rapidly blanked. In NMR spectroscopy, for example, the amplifier must be shut down for instantaneous noise suppression so that sensitive receivers may operate between pulses. Many AR amplifiers with pulse output (chart below) assure quick, complete blanking for this and similar applications. See pages 3 and 11 of this booklet, and call our applications engineering department to discuss a particular case.

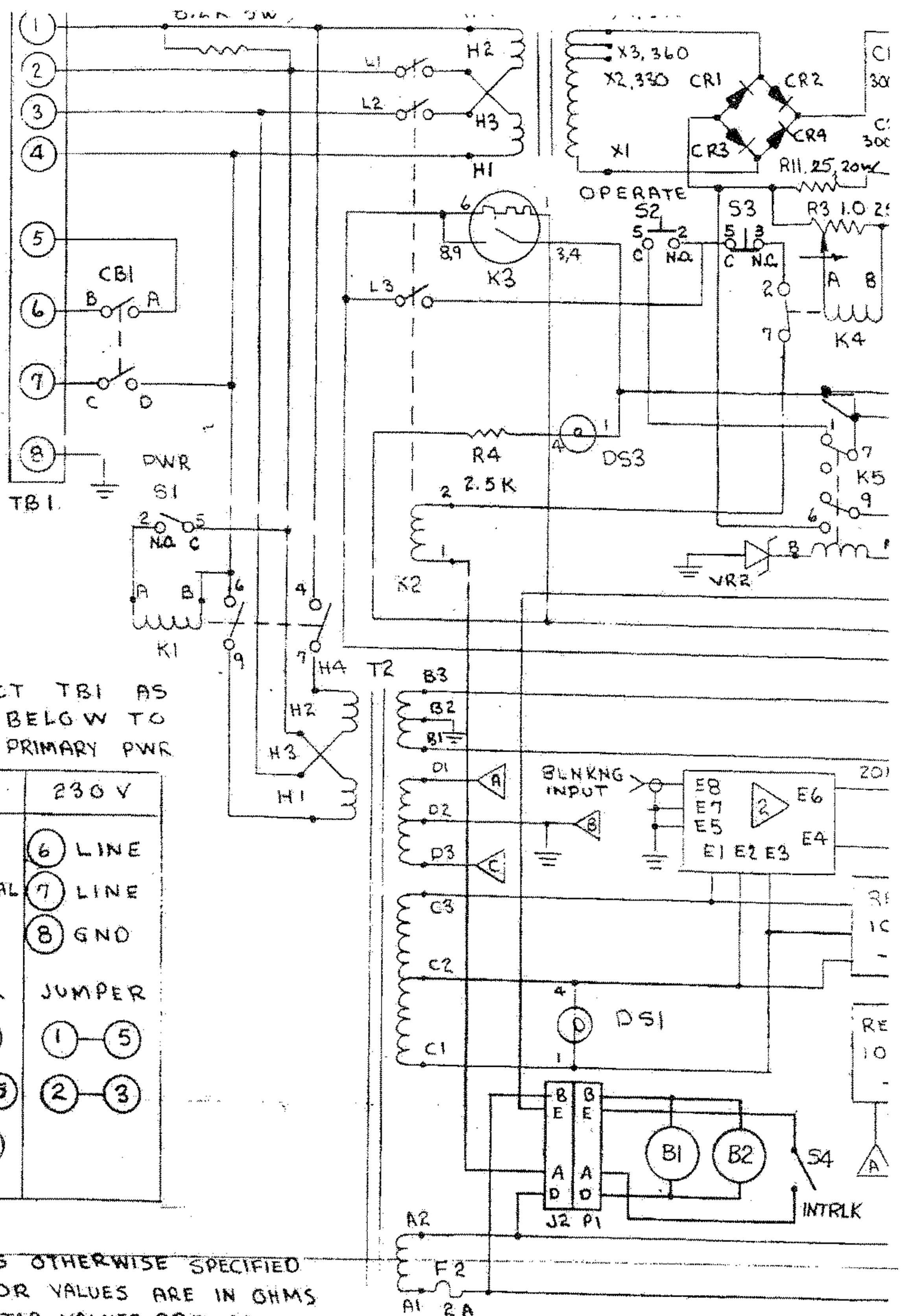


300A100



150L





CONNECT TB1 AS SHOWN BELOW TO CHANGE PRIMARY PWR

115 V	230 V
(6) LINE	(6) LINE
(1) NEUTRAL	(7) LINE
(8) GND	(8) GND
JUMPER	JUMPER
(1)—(2)	(1)—(5)
(3)—(4)—(5)	(2)—(3)
(6)—(7)	

NOTES

1.0 UNLESS OTHERWISE SPECIFIED

1.1 RESISTOR VALUES ARE IN OHMS

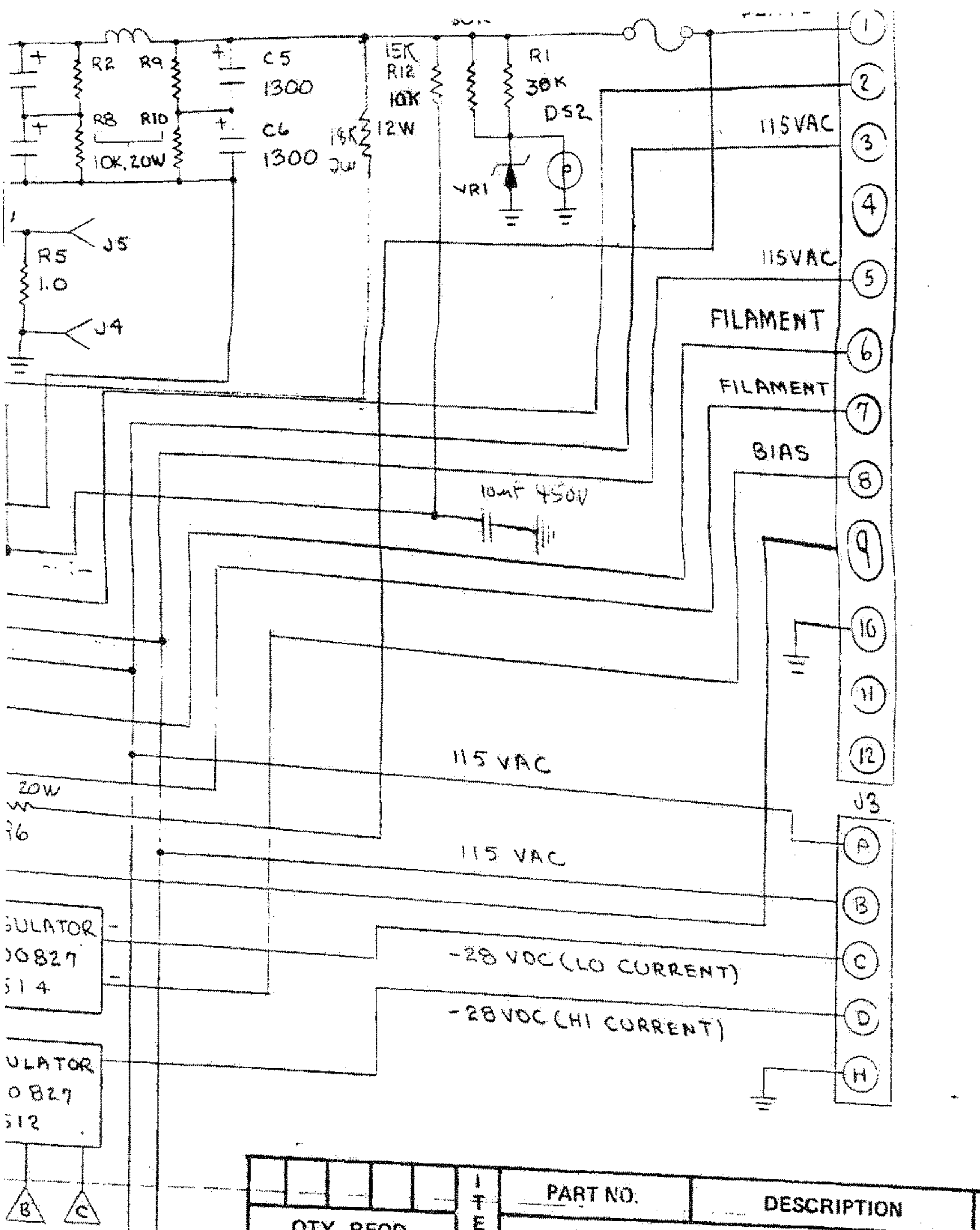
1.2 CAPACITOR VALUES ARE IN MICROFARADS

2.0 BLANKING CIRCUIT. USED ONLY WITH BLANKING OPTION

REFERENCE DESIGNATI[ONS]

LAST USED			NOT USE[D]
B2	F2	R13	C3, C4
C6	J5	S4	
CB1	K5	T2	
CR4	L1	TB1	

18 Aug 77 C
24 Jan 78 D
12 July 78 E
24 July 79 F



	ITEM	PART NO.	DESCRIPTION	MARK	FIN	MATL
QTY. REQD.		PARTS LIST				

UNLESS OTHERWISE SPECIFIED
DO NOT SCALE DRAWING.
DIMENSIONS ARE IN INCHES AND INCLUDE PLATING THICKNESS.
ALL THREADS ARE UNIFIED NATIONAL SERIES CLASS

DRAWN DW Roth
DATE 12 Mar 76
CHKD
DATE
MECH

AMPLIFIER RESEARCH

SCHEMATIC
POWER SUPPLY