Operating and Service Manual

MODEL

200W1000AM3

PART NUMBER

1007726-501

SERIAL NUMBER

AMPLIFIER RESEARCH®
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Instructions for European EMC Conformity

⚠ WARNING

It is the responsibility of the user of this equipment to provide electromagnetic shielding, filtering and isolation which is necessary for EMC compliance to Directive 89/336/EEC. The equipment must therefor be operated in a shielded area which provides a sufficient level of attenuation to meet the radiated emissions and immunity specifications. All AC, DC and Control lines connected to the equipment and entering or exiting the shielded area must have sufficient isolation to meet the conducted emissions and immunity specifications. The following minimum levels are suggested for use in accordance with the rated power of the equipment.

Rated Power	Minimum shielding attenuation	Minimum line isolation
100 watts	50 dB	50 dB
101 - 1000 watts	60 dB	60 dB
1001 - 10,000 watts	70 dB	70 dB

Since this equipment is designed to generate high levels of Radio Frequency energy, it is also essential that the user read and follow the "Instructions for Safe Operation" in this manual. If other equipment is operated in the shielded room it may be disturbed by the amplifier.

⚠ ACHTUNG

Der Benutzer dieses Gerätes ist dafür verantwortlich, daß die elektromagnetische Abschirmung und Filterung gewährleistet ist, welche gemäß Richtlinie 89/336/EEC notwendig ist. Das Gerät muß deshalb in einem geschirmten Raum betrieben werden, welcher eine ausreichenden Schirmung bietet, um die Emissions- und Störfestigkeitsspezifkation einzuhalten. Alle Wechsel- und Gleichspannungsleitungen sowie Steuerleitungen, die mit dem Gerät verbunden sind und in den geschirmten Raum von außen hereingeführt werden, müssen ausreichend gefiltert sein, um die Emissionsspezifkation einzuhalten. Es werden folgenden Minimalwerte der Schirmdämpfung und Filterung in den unterschiedlichen Leistungsklassen empfohlen.

Hochfrequenzleistung	min. Schirmdämpfung	min Filterdämpfung
100 Watt	50 dB	50 dB
101-1000 Watt	60 dB	60 dB
1001-10.000 Watt	70 dB	70 dB

Falls andere elektrische oder elektronische Geräte gleichzeitig mit dem Gerät betrieben werden, kann es zu Beeinflussungen kommen. Da das Gerät zur Erzeugung von Hochfrequenzenergie dient ist es daher auch unbedingt notwendig, daß der Benutzer die Sicherheitsvorschriften in der Bedienungsanleitung liest und einhält.

⚠ AVERTISSEMENT

Il est de la responsabilité de l'utilisateur de cet équipement d'assurer la protection électromagnétique, le filtrage et l'isolation nécessaires, afin de se conformer à la directive 89/336/EEC concernant la C.E.M. Par conséquent, cet équipement doit être mis en fonctionnement dans une enceinte d'atténuation suffisante pour satisfaire aux spécifications d'émissivité et de susceptibilité. Toutes les alimentations alternatives, continues ainsi que les liaisons de contrôle connectées à cet équipement, qui entrent ou sortent de cette enceinte doivent avoir une isolation suffisante pour satisfaire aux spécifications concernant les émissions conduites et d'immunité. Pour une utilisation conforme, les niveaux d'atténuation minimums suivants sont suggérés en fonction de la puissance de sortie de l'équipement:

Puissance de sortie	Atténuation minimum de l'enceinte	Isolation minium de la ligne
100 Watts	50 dB	50 dB
101 à 1.000 Watts	60 dB	60 dB
1.001 à 10.000 Watts	70 dB	70 dB

Puisque cet équipement est destiné à générer de forts niveaux R.F., il est essentiel que l'utilisateur se conforme aux instructions de sécurité indiquées dans ce manuel. Tout autre équipement en fonctionnement dans la cage de Faraday peut-être perturbé par l'amplificateur.

⚠ INSTRUCTIONS FOR SAFE OPERATION

BEFORE APPLYING POWER

Review this manual and become familiar with all safety markings and instructions.

Verify that the equipment line voltage selection is compatible with the main power source.

Protection provided by the equipment may be impaired if used in a manner not specified by Amplifier Research.

INTENDED PURPOSES

This equipment is intended for general laboratory use in a wide variety of industrial and scientific applications. It is designed to be used in the process of generating, controlling, and measuring high levels of electromagnetic Radio Frequency (RF) energy. Therefore, the output of the amplifier must be connected to an appropriate load, such as an antenna or a field-generating device. It is the responsibility of the user to assure that the device is operated in a location which will control the radiated energy such that it will not cause injury and will not violate regulatory levels of electromagnetic interference.

HAZARDOUS RF VOLTAGES

The RF voltages on the center pin of the RF output connector can be hazardous. The RF output connector should be connected to a load before AC power is applied to the amplifier. Do not come into contact with the center pin of the RF output connector or accessories connected to it. Place the equipment in a non-operating condition before disconnecting or connecting the load to the RF output connector.

SAFETY GROUND

This equipment is provided with a protective earth terminal. The main power source to the equipment must supply an uninterrupted safety ground of sufficient size to the input wiring terminals, power cord, or supplied power cord set. The equipment **MUST NOT BE USED** if this protection is impaired.

PHYSICAL DAMAGE

The RF amplifier should not be operated if there is physical damage, missing hardware, or missing panels.

MAINTENANCE CAUTION

Adjustment, maintenance, or repair of the equipment must be performed only by qualified personnel. Hazardous energy may be present while protective covers are removed from the equipment even if disconnected from the power source. Contact may result in personal injury. Replacement fuses are required to be of specific type and current rating.

⚠ INSTRUCTIONS FOR SAFE OPERATION *(CONTINUED)*

SAFETY SYMBOLS

This symbol is marked on the equipment when it is necessary for the user to refer to the manual for important safety information. This symbol is indicated in the Table of Contents to assist in locating pertinent information.

Dangerous voltages are present. Use extreme care.

CAUTION: The caution symbol denotes a potential hazard. Attention must be given to the statement to prevent damage, destruction or harm.

Indicates protective earth terminal.

RANGE OF ENVIRONMENTAL CONDITIONS

This equipment is designed to be safe under the following environmental conditions:

Indoor use

Altitude up to 2000M

Temperature of 5°C to 40°C

Maximum relative humidity 80% for temperatures up to 31°C. Decreasing linearity to 50% at 40°C.

Mains supply voltage fluctuations not to exceed ± 10% of the nominal voltage or minimum and maximum autoranging values.

Pollution degree 2: Normally non-conductive with occasional condensation

While the equipment will not cause hazardous condition over this environmental range, performance may vary.

COOLING AIR

Care should be exercised not to block the cooling air inlets or outlets. Cooling air blockage can result in damage to the RF amplifier or intermittent shut-downs.

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SECTION I

GENERAL INFORMATION

1.1 GENERAL DESCRIPTION

The Amplifier Research (AR) Model 200W1000A is a self-contained, broadband Radio Frequency (RF) amplifier designed for laboratory applications where instantaneous bandwidth, high gain, and moderate power output are required. A front panel **GAIN** control can be used to decrease the amplifier's gain by 10 decibels (dB) or more. Solid state technology is used exclusively to offer significant advantages in reliability and cost. When used with a frequency-swept signal source, the AR Model 200W1000A will provide 200 watts of swept power output from 80–1000 megahertz (MHz). Typical applications include antenna and component testing, wattmeter calibration, electromagnetic interference (EMI) susceptibility testing, use as a driver for frequency multipliers and higher power amplifiers, and use as an RF energy source for Magnetic Resonance Imaging (MRI) studies. The Model 200W1000A can be operated locally by using the unit's front panel controls, or remotely by using its built-in IEEE-488 or RS-232 interfaces.

1.2 POWER SUPPLIES

The Model 200W1000A has two sections: a Driver Amplifier and a Final Amplifier. The Driver Amplifier contains two switching power supplies; the input voltage range to these power supplies is 90–132 Volts Alternating Current (VAC) and 180–264 VAC, 50/60Hz, universal or automatically selected. The user does not have to switch or change anything on the Driver Amplifier when changing the unit's AC input voltage. The Final Amplifier has a self-contained 120/240 VAC, 50/60 Hz, regulated power supply. The unit's AC power consumption is 3000 watts nominal. Circuit breakers on the rear of the Driver Amplifier and the front of the Final Amplifier provide primary AC circuit protection.

1.3 SPECIFICATIONS

Refer to the "Amplifier Research Data Sheet" on the following pages for detailed specifications. All voltage measurements referenced in this manual are Direct Current (DC) unless stated otherwise.

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.

⚠ **CAUTION:**

THE LEVELING FEET LOCATED AT THE FOUR BOTTOM CORNERS OF THE MODEL 200W1000A MUST BE EXTENDED FAR ENOUGH TO REMOVE THE WEIGHT FROM THE CASTERS WHEN THE UNIT IS STATIONARY. EXTENSION OF THE LEVELING FEET WILL HELP TO PREVENT TIP-OVER AND UNDESIRED MOVEMENT OF THE AMPLIFIER.

1.4 INSTALLATION *(CONTINUED)*

1.4.1 Location

Select an operating location that will permit air to circulate freely around the amplifier's cabinet. The Model 200W1000A 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 re-circulated through the unit itself.

⚠ **CAUTION:**

DO NOT LOCATE HEAT-SENSITIVE EQUIPMENT OR BOOKS, PAPERS, AND OTHER POTENTIALLY FLAMMABLE MATERIALS IN THE DIRECT PATH OF THE UNIT'S EXHAUST AIR.

1.4.2 Primary Power Connections

The Model 200W1000A can be operated on 100/110/120 VAC or 200/208/220/240 VAC, 50/60 Hz primary power. The unit has been wired at the factory for line voltage indicated on the rear chassis near the terminal block. The input line power must be connected to terminals 1 and 6 (Pin 1=Neutral) for 100–120 VAC operation, and to terminals 6 and 7 (Pin 7=Neutral) for 200–240 VAC operation. The safety ground is connected to the #10 stud located adjacent to the terminal strip. When operating on 120 VAC, a 30-ampere service is required; when operating on 240 VAC, a 15-ampere service is required.

For other primary power voltages, refer to the following chart and to Schematic Diagram Number **1007333**, "Power Supply and Housing Assembly," to determine the proper connections.

Connect TB1 and plugs as shown below in **Table 1-1** to change primary power.

Table 1-1
Model 200W1000A Primary Power Connections

		INPUT LINE VOLTAGE					
		100V	120V	200V	208/220V	230V	240V
TB1 INPUT	LINE	6	6	6	6	6	6
	NEUTRAL	1	1	7	7	7	7
	SAFETY GROUND	GND STUD	GND STUD	GND STUD	GND STUD	GND STUD	GND STUD
TB1 JUMPERS		1-2-8 3-4-5 6-7	1-2-8 3-4-5 6-7	1-5 2-3 7-8	1-5 2-3 7-8	1-5 2-3 7-8	1-5 2-3 7-8
P3 FINAL		100/200	120/240	100/200	208/220	230	120/240
DRIVER AMPLIFIER		NO CHANGING REQUIRED, AUTORANGED POWER SUPPLIES					

Note: P3 is the plug in the Final Driver Amplifier (see Schematic Diagram No. **1007333**).

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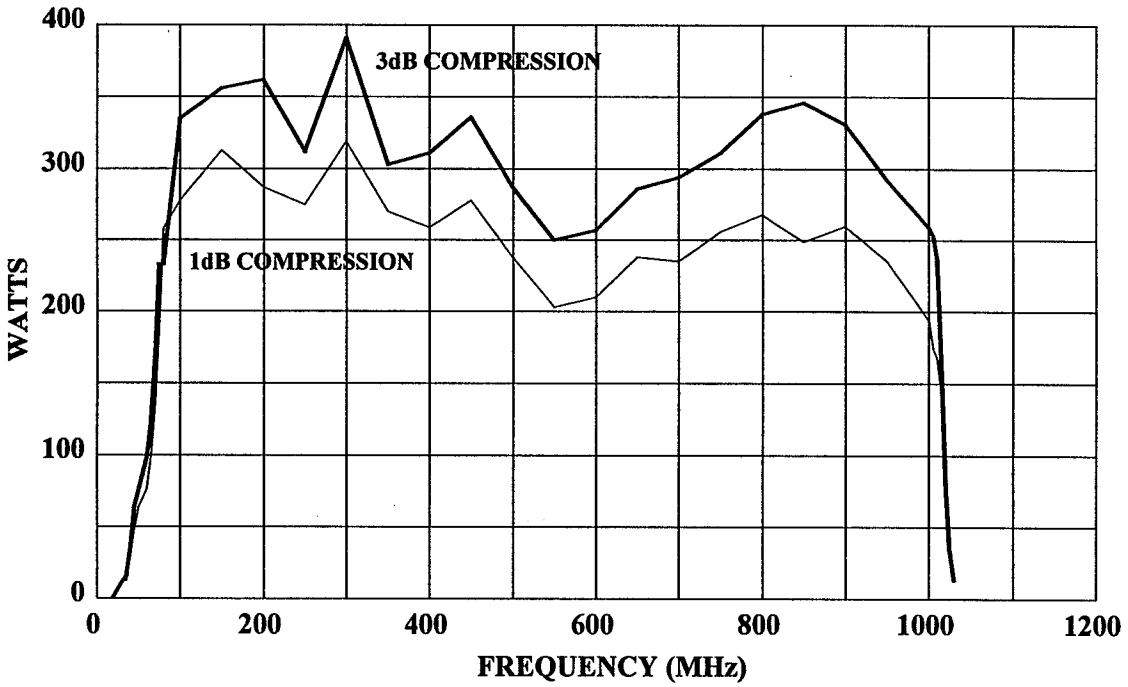
MODELS 200W1000A
M1
200 WATTS CW
80 - 1000 MHz

The Model 200W1000A is a portable, self-contained, air-cooled, broadband, solid state amplifier designed for applications where instantaneous bandwidth and high gain are required. Push-pull circuitry is utilized in the high power stages to lower distortion and improve stability. The 200W1000A, when used with an RF sweep generator, will provide a minimum of 200 watts of swept power. Included is a front panel gain control which permits the operator to conveniently set the desired output level. The 200W1000A is protected from RF input overdrive by limiting diodes and an RF input leveling circuit which controls the RF input level to the RF amplifier first stage when the RF input level is increased above 0 dBm. The RF Amplifier stages are protected from over temperature by removing the DC voltage to them if an over temperature condition occurs due to cooling blockage or fan failure. There is a digital display on the front panel to indicate the operate status and fault conditions when an over temperature, power supply, or amplifier fault has occurred. The unit can be returned to operate when the condition has been cleared. The 200W1000A includes digital control for both local and remote control of the amplifier. This 8-bit RISC microprocessor controlled board provides both IEEE-488 (GPIB) and asynchronous, full duplex RS-232 control of all amplifier functions.

200W1000A TYPICAL POWER OUTPUT



REV101698

SPECIFICATIONS
MODEL 200W1000A

POWER OUTPUT @ 3dB COMPRESSION
- *Nominal* ..... *310 watts*
- *Minimum* ..... *200 watts*

POWER OUTPUT @ 1dB COMPRESSION
- *Nominal* ..... *255 watts*
- *Minimum* ..... *180 watts (at band edges)*

FLATNESS ..... *±2.0 dB maximum*
±1.5 dB typical

FREQUENCY RESPONSE ..... *80 - 1000 MHz instantaneously*

INPUT FOR RATED OUTPUT ..... *1.0 milliwatt maximum*

GAIN (at maximum setting) ..... *53 dB minimum*

GAIN ADJUSTMENT (Continuous Range) ..... *20 dB minimum (4096 steps remote)*

INPUT IMPEDANCE ..... *50 ohms, VSWR 2.0:1 maximum*

OUTPUT IMPEDANCE ..... *50 ohms, VSWR 2.0:1 typical*

*MISMATCH TOLERANCE** ..... *100% of rated power without foldback.*
Will operate without damage or oscillation with any magnitude and phase of source and load impedance.

HARMONIC DISTORTION ..... *Minus 20 dBc maximum at 200 watts*

THIRD ORDER INTERCEPT POINT ..... *62 dBm typical*

PRIMARY POWER ..... *100/110/120/200/208/220/240 VAC ±5%*
50/60 Hz, single phase
3000 VA maximum

REMOTE INTERFACES *IEEE-488, RS-232*

CONNECTORS
- *RF* ..... *Type N female*

REMOTE CONTROL
- *IEEE-488* ..... *24 pin female*
- *RS-232* ..... *9 pin subminiature D female*
- *Remote Interlock* ..... *15 pin subminiature D female*

COOLING ..... *Forced air (self contained fans)*

WEIGHT (approximate) ..... *114 kg (251 lb)*

SIZE (WxHxD) ..... *56.1 x 74.4 x 58.4 cm*
22.1 x 29.3 x 23.0 in

** See Application Note #27*

MODEL CONFIGURATIONS

MODEL NUMBER	*RF INPUT*	*RF OUTPUT*
200W1000A	*Type N female on front panel*	*Type N female on front panel*
200W1000AM1	*Type N female on rear panel*	*Type N female on rear panel*

1.4 INSTALLATION *(CONTINUED)*

1.4.3 General CAUTION Notes

⚠ **CAUTION:**

THE MODEL 200W1000A UTILIZES A HIGH-CURRENT DC POWER SUPPLY; THIS HIGH-CURRENT CAPABILITY IS EXTREMELY DANGEROUS. SERVICE SHOULD BE PERFORMED ONLY BY PERSONNEL WHO ARE THOROUGHLY FAMILIAR WITH THE HAZARDS INHERENT TO THIS TYPE OF EQUIPMENT.

THE MODEL 200W1000A IS ALSO CAPABLE OF PRODUCING OUTPUT VOLTAGES THAT ARE CAPABLE OF CAUSING SERIOUS RF BURNS IF CONTACT IS MADE WITH THE UNIT'S RF OUTPUT. ALWAYS TURN THE AMPLIFIER OFF WHEN CONNECTING OR DISCONNECTING CABLES AND LOADS. THE AMPLIFIER IS DESIGNED TO WITHSTAND SEVERELY MISMATCHED LOADS AND WILL NOT SHUT DOWN OR BE HARMED EVEN BY LOADS THAT MAY BE ENCOUNTERED WHEN THE RF OUTPUT CABLE IS REMOVED; HOWEVER, THE OPERATOR MAY POSSIBLY BE BURNED OR INJURED.

SECTION II

OPERATING INSTRUCTIONS

2.1 GENERAL

Operation of the Model 200W1000A broadband RF amplifier is simple. The amplifier's input signal, whether swept or fixed in frequency, is fed into the jack labeled **INPUT,** and the amplifier's output signal is taken from the jack labeled **RF OUTPUT.** The unit is turned on by activating the **POWER** switch. In the event of a unit malfunction, circuit breakers in the AC power line provide protection for both the Driver Amplifier and the Final Amplifier. A polarized, three-wire AC power cord is also included with the unit to provide cabinet and chassis grounding to the power mains.

⚠ CAUTION:

OPERATION OF THE MODEL 200W1000A BROADBAND RF AMPLIFIER IS NOT CRITICAL IN REGARD TO SOURCE AND LOAD VOLTAGE STANDING-WAVE RATIO (VSWR), AND IT WILL REMAIN UNCONDITIONALLY STABLE UNDER ANY MAGNITUDE AND PHASE CONDITIONS OF SOURCE AND LOAD. IT HAS ALSO BEEN DESIGNED TO WITHSTAND INPUT POWER LEVELS UP TO TWENTY (20) TIMES ITS RATED INPUT OF 1MW WITHOUT SUSTAINING DAMAGE. HOWEVER, SIGNAL LEVELS >20MW OR TRANSIENTS WITH HIGH PEAK VOLTAGES CAN DAMAGE THE AMPLIFIER. ALSO, ACCIDENTAL CONNECTION OF THE AMPLIFIER'S OUTPUT TO ITS INPUT CAN CAUSE OSCILLATIONS THAT WILL PERMANENTLY DAMAGE ITS INPUT CIRCUITRY.

NOTE:

ALTHOUGH THE MODEL 200W1000A HAS BEEN DESIGNED FOR THE OVERDRIVE AND LOAD TOLERANCE CONDITIONS DESCRIBED ABOVE, SUBJECTING THE AMPLIFIER TO THESE CONDITIONS SIMULTANEOUSLY CAN CAUSE FAILURE OF THE UNIT'S OUTPUT TRANSISTORS. REPEATED FAILURES OF THIS NATURE WILL NOT BE COVERED UNDER THE UNIT'S WARRANTY.

The Model 200W1000A is protected from input overdrive by limiting diodes across the RF input and an Automatic Level Control (ALC) circuit that will limit the maximum RF level to the first gain stage (U1) of the RF amplifier to approximately 0dBm.

The Model 200W1000A's RF power transistors are protected from over-temperature by a sensor that senses the heat sink temperature near the RF output transistors. In the event of a cooling fan failure or an air flow blockage, the DC voltage will be removed from the RF stages; if and when the heat sink temperature reaches approximately 70°C, the unit's front panel vacuum fluorescent display (VFD) will read **THERMAL FAULT**. Normal operation can be resumed by resetting the Model 200W1000A after the heat sink temperature drops below 70°C.

The RF drive to the Model 200W1000A's RF Gain stages will be removed if the +20V power supply fails or if one of the fuses for the RF Final amplifiers opens on the Driver Amplifier. This will also occur if there is a voltage fault to one of the voltage regulators in the Final Amplifier. The input attenuator will go to maximum attenuation during any one of these fault conditions. The unit's front panel VFD will read **+20 VOLT FAULT**, a Fuse Fault, or an **AMP FAULT** for the Final Amplifier. The Model 200W1000A can resume normal operation (when the fuse is replaced and if no other problems exist) by resetting the amplifier.

2.2 AMPLIFIER OPERATION

Figure 2-1 shows the front panel of the Model 200W1000A broadband RF amplifier.

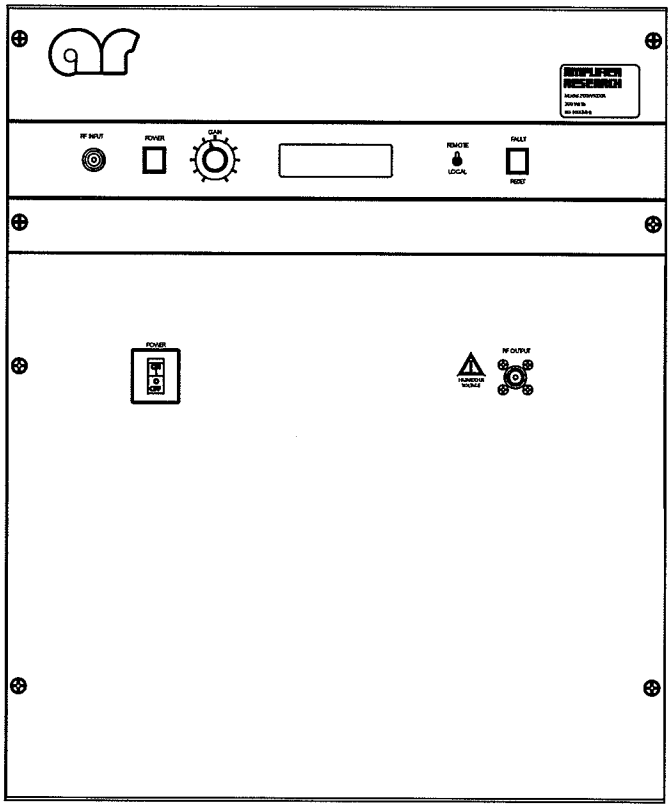


Figure 2-1
Model 200W1000A Front Panel

2.2 AMPLIFIER OPERATION *(CONTINUED)*

Figure 2-2 shows the rear panel of the Model 200W1000A broadband RF amplifier.

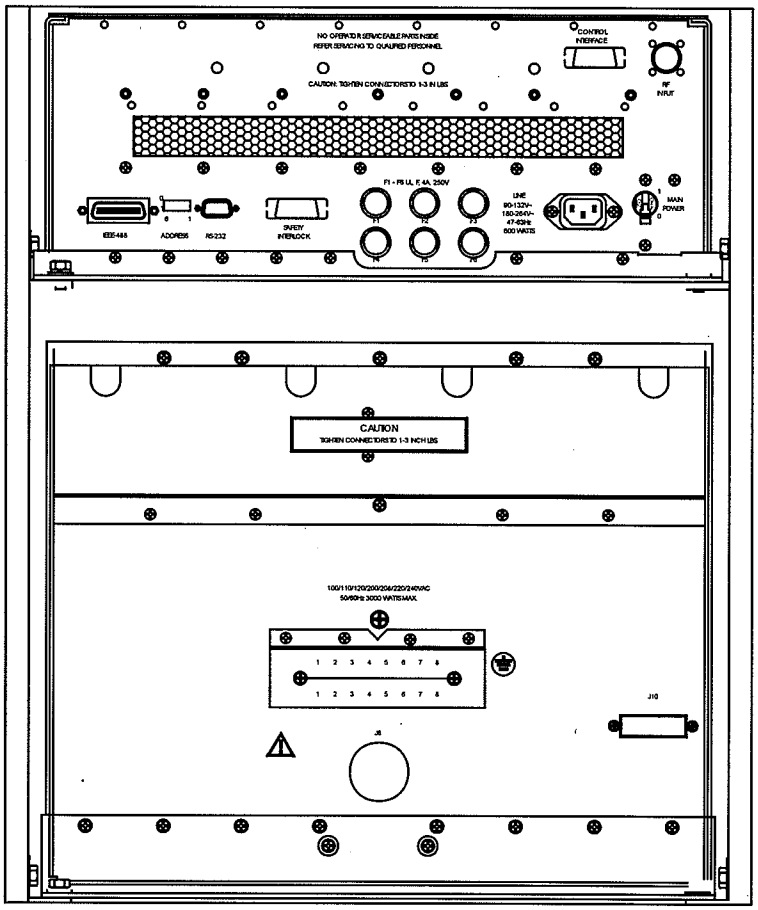


Figure 2-2
Model 200W1000A Rear Panel

2.2 AMPLIFIER OPERATION *(CONTINUED)*

2.2.1 Local Operation

Power-up Sequence:

1. Connect the input signal to the unit's **RF INPUT** connector. **The input signal level should be 0dBm maximum.**

2. Connect the load to the unit's **RF OUTPUT** connector.

3. Select either 100/110, 208/220, or 120/240 VAC operation by connecting TB1 to the rear of the Final Amplifier, using the correct plug, and per the wiring instructions detailed in subsection **1.4.2, Table 1-1**.

⚠ **CAUTION:**

WHEN CHANGING PRIMARY VOLTAGES, USE AT LEAST 14-GAUGE LINE CORD IN THE FINAL AMPLIFIER'S AC RECEPTACLE. USE OF AN INCORRECT LINE CORD OR SELECTION OF AN INCORRECT PRIMARY VOLTAGE WILL CAUSE EXTENSIVE DAMAGE TO THE FINAL AMPLIFIER.

⚠ **CAUTION:**

DO NOT CONNECT THE UNIT TO 240VAC MEASURED FROM LINE TO LINE; THIS WOULD RESULT IN ONE SIDE OF THE LINE NOT BEING FUSED, THEREBY CREATING A HAZARDOUS SITUATION. THE UNIT'S 240VAC FEATURE IS DESIGNED PRIMARILY FOR USE IN COUNTRIES HAVING 240VAC FROM LINE TO NEUTRAL.

4. Set the **REMOTE/LOCAL** switch to **LOCAL**.

5. Check to see that the **MAIN POWER** switch (circuit breaker) on the Driver Amplifier's rear panel is set to the **1** ("on") position.

6. Check to see that the **MAIN POWER** switch (circuit breaker) on the Final Amplifier's front panel is set to the **1** ("on") position.

7. Press the **POWER** switch: the front panel vacuum fluorescent display (VFD) should read **POWER ON, STATUS OK** when power is applied.

   (NOTE: The amplifier changes state each time the POWER switch is depressed—if the unit is on when the POWER switch is depressed, it will turn off; if the unit is off when the POWER switch is depressed, it will turn on.)

8. Adjust the amplifier's gain by rotating the **GAIN** knob.

9. In the event of a fault, press the **FAULT/RESET** switch; if the fault does not clear, refer to subsection **4.3** ("Troubleshooting") of this manual.

2.2 AMPLIFIER OPERATION *(CONTINUED)*

2.2.2 Remote Operation

2.2.2.1 Introduction

This subsection describes remote operation of the Model 200W1000A amplifier by utilizing either the IEEE-488 parallel interface or the RS-232 serial interface and a controlling device, such as a bus controller or a personal computer (PC).

2.2.2.2 Selecting Remote Operation

The Model 200W1000A can be placed in the remote operation mode at any time by switching the **REMOTE/LOCAL** switch on the front panel to the **REMOTE** position. In this mode, control is transferred to the selected remote interface and all front panel controls are inoperative with the exception of the **REMOTE/LOCAL** switch. The amplifier's initial state will be **Power Off, Minimum Gain**. The front panel VFD will indicate **REMOTE** until the unit is returned to the local operation mode.

2.2.2.3 Interface Selection

The Model 200W1000A can be controlled via either the IEEE-488 or RS-232 interface; which interface is active is determined by the position of Switch 6 of the rear panel Dual In-Line Package (DIP) switch located between the two interface connectors. If Switch 6 is in the "on" (**1**) position, the RS-232 interface will be active; if Switch 6 is in the "off" (**0**) position, the IEEE-488 interface will be active.

2.2.2.4 Interface Set-up

Switches 1–5 of the rear panel DIP switch are used to select either the RS-232 communication (BAUD) rate or the IEEE-488 device address, depending upon which interface is active. (**Note:** These switches are only read at device power-up. In order for changes made in these switch settings to take place, AC power must be removed and then re-applied to the Model 200W1000A's Driver Amplifier by turning off the main power switch (CB1) located on the unit's rear panel

2.2.2.4.1 RS-232 BAUD rate selection

The serial communication (BAUD) rate can be set to five different levels. Selections are made by the positions of Switches 1–5 of the rear panel DIP switch. The following is a list of the available BAUD rates and the corresponding DIP switch positions:

BAUD Rate	Switch On (1)
1200	1 only
2400	2 only
9600	3 only
19,600	4 only
76,800	5 only

(**Note:** Any other combination of switch settings will result in a BAUD rate equal to 1200.)

2.2.2 Remote Operation *(continued)*

2.2.2.4 Interface Set-up *(continued)*

2.2.2.4.2 IEEE-488 device address selection

The IEEE-488 device address can be set to any number between 1 and 30. This selection is made by setting Switches 1–5 of the rear panel DIP switch to the binary equivalent of the number. **Table 2-1** illustrates this switch selection.

Table 2-1
Model 200W1000A IEEE-488 Device Address Selection

Device Address	Switch 5	Switch 4	Switch 3	Switch 2	Switch 1
1	off (0)	off (0)	off (0)	off (0)	on (1)
2	off (0)	off (0)	off (0)	on (1)	off (0)
3	off (0)	off (0)	off (0)	on (1)	on (1)
4	off (0)	off (0)	on (1)	off (0)	off (0)
5	off (0)	off (0)	on (1)	off (0)	on (1)
:					
:					
30	on (1)	on (1)	on (1)	on (1)	off (0)

2.2.2.5 Command Set Format

Each command is composed of one alpha character, up to four numeric parameters, and a command termination character. The command termination character is the "line feed" command, which is denoted and entered as <LF>. Commands are case-sensitive and must be entered in upper case only in order to be recognized.

2.2.2.6 IEEE-488 Communications

For IEEE-488 communications, the "End or Identify" (EOI) control line may also be used for command termination. When sending commands to the Model 200W1000A via the IEEE-488 bus, terminate each command with a <LF>, an EOI, or both. No characters are permitted after the <LF> or EOI; the Model 200W1000A interprets characters following the <LF> or EOI as the start of the next command. When an error condition is present at the Model 200W1000A, the "Service Request" (SRQ) line is asserted; the operator can then perform a serial poll operation. The Model 200W1000A error code (in binary) is contained in the returned serial poll status byte (STB). These error codes are defined in **Table 2-2**.

2.2.2 Remote Operation *(continued)*

2.2.2.6 IEEE-488 Communications *(continued)*

Table 2-2
Model 200W1000A Remote Error Codes/Messages

IEEE-488 Serial Poll Response (STB) (binary/decimal)	Model 200W1000A Error Condition	RS-232 Error Message
(01000001) 65	BAD COMMAND	E1*
(01000010) 66	BAD PARAMETER	E2*
(01000011) 67	INTERLOCK FAULT	E3
(01000100) 68	THERMAL FAULT (DRIVER AMPLIFIER)	E4
(01000101) 69	THERMAL FAULT (FINAL AMPLIFIER)	E5
(01000110) 70	VOLTAGE FAULT (FINAL AMPLIFIER)	E6
(01000111) 71	+ 20 VOLT FAULT	E7
(01001000) 72	FUSE 1 FAULT (F1)	E8
(01001001) 73	FUSE 2 FAULT (F2)	E9
(01001010) 74	FUSE 3 FAULT (F3)	E10
(01001011) 75	FUSE 4 FAULT (F4)	E11
(01001100) 76	FUSE 5 FAULT (F5)	E12
(01001101) 77	FUSE 6 FAULT (F6)	E13
**********	TRANSMISSION ERROR	E14*

* Not yet implemented on the Model 200W1000A.

2.2.2.7 RS-232 Communications

If the RS-232 interface is active, the Model 200W1000A will test for a properly connected RS-232 interface when it is switched into the remote operation mode. In order for the Model 200W1000A to recognize an RS-232 connection, the "Data Carrier Detect" (DCD) line must be asserted. This line is sampled continuously to determine if the RS-232 connection is broken; therefore, it must remain asserted in order for the RS-232 interface to function. The "Clear To Send" (CTS) line is also used to gate information from the Model 200W1000A. This line must be asserted in order to receive information from the Model 200W1000A. The CTS line can be used as a "handshake" line to inform the Model 200W1000A when it is permissible to send information. If the CTS line is de-asserted in the middle of a transmission, the character in the process of being transmitted will be completed and further transmission will halt until the CTS line is re-asserted. The Model 200W1000A itself asserts two lines: "Data Terminal Ready" (DTR) and "Request To Send" (RTS). The DTR line is continuously asserted, while the RTS line is used to gate information into the Model 200W1000A. Connector pin-out information is given in **Table 2-3**.

2.2.2 Remote Operation *(continued)*

2.2.2.7 RS-232 Communications *(continued)*

Table 2-3
Model 200W1000A RS-232 Connector Pin-Outs

Pin No.	Signal	Data Direction*	Description
1	DCD	<	Device Carrier Detect
2	RD	<	Receive Data
3	TD	>	Transmit Data
4	DTR	>	Data Terminal Ready
5	GND	N/A	Ground
6	NC	N/A	No Connection
7	RTS	>	Ready To Send
8	CTS	<	Clear To Send
9	NC	N/A	No Connection

***Note:**
> = Output from the Model 200W1000A
< = Input to the Model 200W1000A

Special Note: A null modem cable or adapter is required in order to properly interface the Model 200W1000A to a standard serial port on a computer.

Once the RS-232 interface is established, commands are processed in the same manner as that of the IEEE-488 interface. The command structure is identical, except that there is no EOI line. Therefore, all commands are terminated with a line feed (<LF>). Since this is a full-duplex asynchronous interface, if the Model 200W1000A detects an error, the error message is immediately transmitted to the host controller. These error messages are defined in **Table 2-2.**

2.2.2.7.1 RS-232 port settings

The RS-232 port settings used for communication with the Model 200W1000A are as follows.

Word Length: 8 bits

Stop Bits: 1

Baud Rate: 1200–76,800 (switch-selectable)

Parity: None

2.2.2.8 Remote Commands

The following commands are available to the user for remote communication and operation of the Model 200W1000A. In the descriptions of these commands, a lower-case "x" is used to signify a numeric value or parameter.

2.2.2 Remote Operation *(continued)*

2.2.2.8 Remote Commands *(continued)*

2.2.2.8.1 Power On/Off

Controls the power on/off state of the Model 200W1000A.

Syntax: Px

Parameters: 0 = power off

1 = power on

Example: To turn the power on, send the following command:

P1<LF>

2.2.2.8.2 Gain

Sets the remote gain level of the Model 200W1000A with 4095 steps of resolution.

Syntax: Gxxxx

Parameters: 0000 = maximum gain

:

:

4095 = minimum gain

Example: To set the Model 200W1000A to minimum gain, send the following command:

G4095<LF>

2.2.2.8.3 Reset

Resets the Model 200W1000A, clearing all faults, if possible.

Syntax: R

Parameters: None

Example: To clear a fault, send the following command:

R<LF>

SECTION III

THEORY OF OPERATION

3.1 INTRODUCTION

The Model 200W1000A broadband RF amplifier consists of two sections: a Driver Amplifier and a Final Amplifier. The Driver Amplifier consists of an 80–1000 MHz RF Amplifier located on the heat sink and a Power Supply/Operate/Fault Detection circuit mounted on a chassis assembly located opposite the heat sink. The RF Amplifier assemblies can be accessed through the top of the unit; the Power Supply and Operate/Fault Detection circuits can be accessed through the bottom of the unit.

The RF Amplifier section consists of four stages of low-level gain, a two-stage driver, a four-way splitter, and four final amplifiers.

The Power Supply section consists of an AC input filter; a circuit breaker; +5V, +12V, and -12V power supplies; a +20V power supply; an Operate/Control circuit; and an interface board.

The Final Amplifier consists of an RF section and a power supply section consisting of four identical RF heat sinks; each heat sink assembly consists of a four-way splitter and four RF final amplifiers. The Final Amplifier also has a 16-way combiner that recombines the output of the final amplifiers on the four RF heat sinks to provide the Model 200W1000A's 200-watt RF output. The Final Amplifier also has its own self-contained power supply and employs full-wave rectifiers and regulators to provide stable, low-ripple, regulated output voltages.

3.2 RF AMPLIFIER OPERATION

3.2.1 A1 Driver Amplifier

3.2.1.1 A1A1 Low-Level Driver with Input Leveling (Schematic Diagram No. 1009967)

The A1A1 Low-Level Driver is detailed on Schematic Diagram Number **1009967**.

The RF input signal is fed to the first gain stage (U1) through the input attenuator, diodes CR1, CR2, and CR3. Diodes CR4 and CR5 are the RF input limiter diodes. The output of U1 is fed to gain stage U2 and detector diode CR6 through a fixed RF attenuator formed by R27, R28, and R40. Diode CR6 detects the RF output level of U1.

The detected signal is fed to U3A, which amplifies the detected signal. The output of U3A is fed to U3B, which is used as a voltage comparator. The output of the voltage comparator is fed to the variable RF input attenuator through the manual gain control, which is located on the Model 200W1000A's front panel. When the RF input level to U1 reaches approximately 0dBm, the current through the series diodes CR2 and CR3 decreases, maintaining the RF level to U1 at approximately 0dBm. This helps to protect the RF stage from damage that could result from RF overdrive on the input. The manual gain control can be used to reduce the gain of the Model 200W1000A or to lower the RF output level. Transistor Q6 sets the RF input attenuator to maximum attenuation by turning off the output of the voltage comparator (U3B) when Q6 is turned on. This is used when one of the fuses to the RF amplifier stages opens.

3.2 RF AMPLIFIER OPERATION *(CONTINUED)*

3.2.1 A1 Driver Amplifier *(continued)*

3.2.1.1 A1A1 Low-Level Driver with Input Leveling (Schematic Diagram No. 1009967) *(continued)*

Integrated circuit (IC) U2 further amplifiers the RF signal from U1 and provides RF input to Q4, which amplifies the RF signal and provides RF input to Q3. The output of Q3 is fed to the gain equalizer (C10, R22, R23, L9, R24), which helps to reduce the low-frequency gain. The output of the gain equalizer is fed to the first driver stage. Transistors Q1 and Q2 are used to maintain the collector current through RF stages Q4 and Q3 at a constant value.

3.2.1.2 A1A2 10-Watt Driver Stage (Schematic Diagram No. 1009970)

The A2 driver stage consists of push-pull RF stages Q3 and Q4. Transformer T4 is a phase splitter that provides signals of the correct phase to the base of Q3. T1 is a matching transformer between the output of Q3 and the input of Q4. Resistor/capacitor network C4, R14 and R15, C29, and R25 and R26 help to reduce the excess low-frequency gain of the amplifier. Transformers T2 and T3 match the collector of Q4 to 50Ω. Transistors Q1, Q2, Q5, and Q6 sense the collector current of Q3 and Q4 and help to maintain constant collector currents. Q3 is set to 0.9 amps per side; Q4 is set to 1.5 amps per side. The output of Q4 is fed to the input of the Four-Way Splitter (A3) in the output stage.

3.2.1.3 A4, A5, A6, and A7 RF Final Amplifiers (Schematic Diagram No. 1007312)

The RF Final Amplifier stages (A4, A5, A6, and A7) are push-pull gain stages. Transformer T1 is a phase splitter that provides signals of the correct phase to the inputs of Q2. Transformers T2 and T3 match the collectors of Q2 to 50Ω. Transistors Q1 and Q2 sense and regulate the collector currents of Q2 at 1.5 amps per side.

3.2.1.4 Four-Way Splitter

The Four-Way Splitter splits the input signal into four equal-amplitude, in-phase signals that are fed to the RF Final Amplifier stages. The amplitude of each output signal should be **6–7dB** below the input signal when they are terminated into 50Ω.

3.2.2 A2 Final Amplifier (Schematic Diagram Nos. 1007314, 1006062, 1006066, 1005964)

Refer to Schematic Diagram Nos. **1007314**, "RF Amplifier Assembly," **1006062**, "RF Board Assembly," and **1006066**, "RF Board Assembly," and to Block Diagram No. **1005964**, "RF Amplifier."

The Final RF Amplifier is shown in Block Diagram No. **1009961** and consists of four (4) RF amplifiers (A1, A2, A3, and A4) and one (1) output power combiner (A5).

3.2 RF AMPLIFIER OPERATION *(CONTINUED)*

3.2.2 A2 Final Amplifier (Schematic Diagram Nos. 1007314, 1006062, 1006066, 1005964) *(continued)*

The RF amplifiers are identical and are shown in Schematic Diagram No. **1007314**. The input RF is split into four (4) equal paths by the A1 splitter, and is amplified by the A3, A5, A7, and A9 amplifiers. These four outputs, along with the outputs from the other three (3) RF amplifier assemblies, are combined in the A5 16-Way Combiner. (Only one RF amplifier board assembly is detailed herein.)

The RF amplifier stages are push-pull gain stages. Transformer T1 is a phase splitter that provides signals of the correct phase to the inputs of Q2. Transformers T2 and T3 match the collector current of Q2 to 50Ω. Transistors Q1 and Q3 sense and regulate the collector currents of Q2 at 15 amps per side.

3.3 POWER SUPPLY SECTION

3.3.1 A1 Power Supply (Driver Amplifier) (Schematic Diagram No. 1009962)

The Power Supply Assembly consists of two switching power supplies: PS1 and PS2. PS1 is a 25-watt, triple-output power supply with three regulated outputs: +5V, +12V, and -12V. PS1 has a universal input range of 85–264VAC, 50/60Hz. PS1 supplies +12V to supply power to the Operate/Control Board and the Interface Board relays K1 and K2, and to operate relay K1, which switches the AC input power to PS2 for both local and remote operation. PS1 also supplies +5V and -12V to power the Operate/Control Board. PS2 is a 20V, 400-watt power supply with a Power Factor Corrected front end; it will operate over an input voltage range of 85–264VAC, 50/60Hz. PS2 supplies +20V, which is fused through fuses F1–F6. The outputs of these fuses supply DC power to all of the RF Amplifier gain stages. PS2 also supplies +20V to operate Blowers B1 and B2, which supply air flow to cool the heat sink and the power supplies.

3.3.2 A2 Power Supply (Final Amplifier) (Schematic Diagram No. 1007333)

Refer to Schematic Diagram No. **1007333**, "Power Supply and Housing Assembly." Input AC power is connected to TB1 for the proper line voltage. The AC power is then fed through FL1 before being switched by the main power switch, CB1 and K2. Voltage select plug P3 selects the primary tap configuration of T1 for operation on either 120VAC or 240VAC.

⚠ **CAUTION:**

DO NOT CONNECT THE UNIT TO 240VAC MEASURED LINE TO LINE; DOING SO WOULD RESULT IN ONE SIDE OF THE LINE NOT BEING FUSED, THEREBY CREATING A HAZARDOUS SITUATION. THE UNIT'S 240VAC FEATURE IS DESIGNED PRIMARILY FOR USE IN COUNTRIES HAVING 240VAC MEASURED LINE TO NEUTRAL.

THE SECONDARY TAP CONFIGURATION OF T1 SUPPLIES AC POWER TO OUTPUT CONNECTORS J1–J4. THE 16 VOLTAGE REGULATOR ASSEMBLIES ARE IDENTICAL AND ARE LOCATED IN THE FINAL HEAT SINK ASSEMBLIES, SO ONLY ONE WILL BE DESCRIBED HEREIN.

3.3 POWER SUPPLY SECTION *(CONTINUED)*

3.3.2 A2 Power Supply (Final Amplifier) (Schematic Diagram No. 1007333) *(continued)*

3.3.2.1 Voltage Regulator Assembly (Schematic Diagram No. 1007322)

Refer to Schematic Diagram No. **1007322**. The AC input of the voltage regulator is connected through fusible links F1 and F2 to the rectifier, CR1. The DC output of the voltage regulator is filtered by C3 and is connected to U1 and Q1. U1 is a linear IC with adjustable output current and output voltage, and Q1 is a current boost transistor. R2 adjusts the output current of U1 and R3 adjusts the output voltage of U1. U1 also contains power limiting, thermal shutdown, and input over-voltage protection. The unit's front panel VFD will display **"FAULT: AMP FINAL"** if one of the regulator's outputs has a voltage fault.

3.3.3 A9 Operate/Control Board (Schematic Diagram No. 1008597)

The A9 Operate/Control Board is a microcontroller-based printed wiring board (PWB) assembly that allows sensing and control of internal signals as well as remote personal computer (PC) control via on-board RS-232 and IEEE-488 data communications ports. The A9 Operate/Control Board utilizes a state-of-the-art, Reduced Instruction Set Computing (RISC) microcontroller that can quickly and reliably perform all front panel control and monitoring tasks, thereby allowing real-time control of the Model 200W1000A via either remote bus. Besides being reported remotely, all amplifier faults are continuously monitored and indicated via the unit's front panel VFD.

3.3.4 A10 Interface Board (Schematic Diagram No. 1009973)

The A10 Interface Board is composed of relays and a linear op-amp IC.

3.3.4.1 Relay K1 is energized by the A9 Operate/Control board whenever the Model 200W1000A is turned on, either locally or remotely. When energized, relay K1 supplies DC power to Relay K1 in the A1 Power Supply (Driver Amplifier), and to Relay K2 of the A2 Power Supply (Final Amplifier).

SECTION IV

MAINTENANCE

4.1 GENERAL MAINTENANCE INFORMATION

The Model 200W1000A is a relatively simple instrument that should require very little maintenance. It is built with printed wiring boards (PWBs) and solid state components in order to ensure long, trouble-free life. However, should a malfunction occur, special care must be taken when servicing the unit in order to avoid damaging the solid state components or the PWBs.

Since the unit's solid state components are soldered in place, substitution of components should not be resorted to unless there is some indication that they are faulty. In addition, care must be taken when troubleshooting to avoid shorting amplifier voltages. Small bias changes may cause excessive dissipation or transients that could ruin the amplifier.

All components utilized in Amplifier Research instruments are conservatively operated to ensure maximum instrument reliability. Despite this, parts within an instrument may fail. In most cases, the instrument may be repaired immediately with a minimum of "down time." A systematic approach to troubleshooting can greatly simplify and thereby speed up the required repairs.

However, due to the critical importance of maintaining the amplifier's alignment, it is recommended that the unit be returned to the factory for part replacement and amplifier realignment whenever failure is caused by a breakdown of any of the components in the amplifier's RF signal circuits. Shipping instructions are as follows.

Please ship the unit **PREPAID** via United Parcel Service (UPS) to:

Amplifier Research Corporation
160 School House Road
Souderton, PA 18964-9990 USA

4.2 DISASSEMBLY PROCEDURES

The Model 200W1000A consists of a Driver Amplifier and a Final Amplifier; each one will be treated separately in this section.

⚠ CAUTION:

ALWAYS REMOVE THE UNIT'S POWER CORD FROM THE POWER LINE BEFORE SERVICING IT. DO NOT BLOCK AIR FLOW INTO THE UNIT WHEN IT IS OPERATING. EXTREME CAUTION SHOULD BE EXERCISED WHEN TROUBLESHOOTING THIS UNIT, PARTICULARLY WHEN MEASURING VOLTAGES IN THE POWER SUPPLY SECTION, SINCE HAZARDOUS VOLTAGES EXIST IN THE UNIT THAT COULD CAUSE SERIOUS INJURY TO ANY PERSONNEL PERFORMING THE MEASUREMENTS.

4.2 DISASSEMBLY PROCEDURES *(CONTINUED)*

4.2.1 To Remove the Driver Amplifier Assembly

1. Remove the four (4) front panel screws.
2. Remove the rear panel of the cabinet.
3. Remove the seven (7) shipping bracket screws.
4. Disconnect the four (4) coaxial cables on the rear of the Driver Amplifier.
5. Disconnect the control interface cable.
6. Remove the power cord from the line filter receptacle.
7. Slide the Driver Amplifier forward out of the case.

The top cover of the Driver Amplifier can be removed to gain access to the RF assemblies; the bottom cover can be removed to gain access to the power supplies.

4.2.2 To Remove the Final Amplifier Assembly

1. Remove the four (4) front panel screws.
2. Remove the rear panel from the cabinet.
3. Remove the line cord from TB1.
4. Remove the eight (8) shipping bracket screws.
5. Disconnect the four (4) coaxial RF cables on the rear of the Final Amplifier.
6. Disconnect the control interface cable.
7. Slide the Final Amplifier forward out of the case. Remove the side and top covers to gain access to the RF amplifiers.

4.2.2.1 To Remove the RF Amplifier Assembly

1. Remove the six (6) mounting screws.
2. Disconnect the output cables to the 16-Way Combiner.
3. Disconnect the P1 power supply connector.
4. Carefully lift the RF assembly out of the unit.

To reassemble the RF Amplifier, simply reverse the procedures detailed above.

4.3 TROUBLESHOOTING

Troubleshooting the Model 200W1000A in a logical manner can speed the solution to a problem. The settings of potentiometers ("pots"), capacitors ("caps"), or other variables should not be disturbed until other problems have been eliminated. Comparing the measured DC voltages to those shown on the schematics can solve many problems. Before measuring circuit voltages, first verify that the voltages to the circuits are correct.

Model 200W1000A Troubleshooting Categories:

Subsection 4.3.1—Front Panel Display Doesn't Indicate **"Power On"** when the **POWER** Switch is Depressed

Subsection 4.3.2—The Unit Cannot be Operated Remotely

Subsection 4.3.3—Thermal Fault (Driver Amplifier)

Subsection 4.3.4—Interlock Fault

Subsection 4.3.5—Voltage Faults (Driver Amplifier)

Subsection 4.3.6—Thermal Fault (Final Amplifier)

Subsection 4.3.7—Voltage Fault (Final Amplifier)

Subsection 4.3.8—Low or No Power Output (DC Tests)

Subsection 4.3.9—Low or No Power Output (RF Tests)

4.3.1 Front Panel Vacuum Fluorescent Display (VFD) Doesn't Indicate "Power On" when the POWER Switch is Depressed (Schematic Diagram No. 1009962)

4.3.1.1 If the Model 200W1000A is operating in an otherwise normal fashion, the unit's front panel vacuum fluorescent display (VFD) or the wiring to it could be defective.

4.3.1.2 Check the **LOCAL/REMOTE** switch on the unit's front panel; it must be set to the **LOCAL** position in order to operate the front panel **POWER** switch. Check the circuit breaker on the Driver Amplifier's rear panel; it must be set to the "**1**" ("ON") position. Check the circuit breaker on the Final Amplifier's front panel; it, too, must be set to the "**1**" ("ON") position.

4.3.1.3 If the **"Power On"** indication is not displayed and the cooling fans (Blowers B1, B2) are not running, check to see that the unit is plugged into a live outlet, the AC line cord is properly connected to TB1, and the line cord to the Driver Amplifier is completely plugged in.

4.3.1.4 Check the output voltages from PS1; these voltages should be as follows:

PS1 J2, Pin 1	+12.0 ± 0.3VDC
PS1 J2, Pin 2	+ 5.0 ± 0.2VDC
PS1 J2, Pin 6	-12.0 ± 0.3VDC

If output voltages are not present on PS1, check the AC input to PS1.

4.3 TROUBLESHOOTING *(CONTINUED)*

4.3.1 Front Panel Display Doesn't Indicate "Power On" when the POWER Switch is Depressed (Schematic Diagram No. 1009962) *(continued)*

4.3.1.5 Check the voltages to the A9 Operate/Control Board on connector A9 J2; the voltages should be as follows:

A9 J2, Pin 16	-12.0 ± 0.3VDC
A9 J2, Pin 29	+ 5.0 ± 0.2VDC
A9 J2, Pin 31	+12.0 ± 0.3VDC

4.3.1.6 Check the voltage on A9 J2, Pin 6; it should be ≥4V when the **POWER** switch (S3) is in the normal position and <0.1V when S3 is depressed. S3 is normally open; it is closed only when it is depressed. The amplifier should change state every time the **POWER** switch is depressed.

4.3.1.7 If all voltages are correct and the unit still does not operate, contact Amplifier Research to arrange for repair or replacement of the A9 Operate/Control Board.

4.3.2 The Unit Cannot be Operated Remotely

4.3.2.1 Verify that the front panel **LOCAL/REMOTE** switch is set to the **REMOTE** position.

4.3.2.2 Verify that the unit operates locally by resetting the **LOCAL/REMOTE** switch to the **LOCAL** position; if the unit does not operate locally, see subsection **4.3.1** of this manual.

4.3.2.3 Check the position of the **"ADDRESS"** switch assembly (SW1) on the A9 Operate/Control Board; this assembly can be accessed through the Driver Amplifier's rear panel. Check to see that these switches are properly set for either RS-232 or IEEE-488 operation, as desired. (See subsection **2.2.2** of this manual for the proper **"ADDRESS"** switch settings.) (**Note:** Address switches are only read at unit power-up; remove and re-apply AC power (i.e., reset the circuit breaker) after changes are made.)

4.3.3 Thermal Fault (Driver Amplifier) (Schematic Diagram No 1009962)

During a Driver Amplifier Thermal Fault, the front panel VFD should read **"THERMAL FAULT: DRIVER."**

4.3.3.1 Try to reset the unit; if the unit resets and operates normally, check to see that the cooling fans (Blowers B1, B2) are operating normally and that the air inlet on the bottom of the Driver Amplifier and the air outlets on the rear of the unit are not blocked.

4.3.3.2 If the unit does not reset and the cooling fans are operating normally, check the voltage at the A9 Operate/Control Board, J2, Pin 4; it should be ≤**0.1V**.

4.3.3.3 If the voltage on A9 J2, Pin 4 is high, check the thermal daisy chain through S2 and S1 to ground.

4.3 TROUBLESHOOTING *(CONTINUED)*

4.3.4 Interlock Fault (Schematic Diagram No. 1009962)

The Model 200W1000A is equipped with an interlock connector, which is located on the rear panel of the Driver Amplifier. The interlock circuit can be used to sense the openings of doors to screen rooms, test chambers, and so forth, and to turn off RF energy when these doors are opened.

Note: The Model 200W1000A is shipped with a mating connector, which has a jumper between Pins 1 and 8, installed in the rear panel interlock connector. The unit will not operate unless the interlock circuit is closed.

4.3.4.1 In the event of an Interlock Fault, the unit's front panel VFD should indicate **"INTERLOCK FAULT."**

4.3.4.2 Check to see if it is safe to power up the unit—are there personnel present in the screen room, or are doors to the screen room open?

4.3.4.3 After checking for safety, try to clear the Interlock Fault from the front panel by using the **RESET** switch.

4.3.4.4 If the Interlock Fault will not clear, check for continuity in the External Interlock Circuit (Pin 1 to Pin 8 in the connector, which mates with J2 in the rear panel).

4.3.4.5 Check the voltage on A10 J1, Pin 10; it should be ≥**4.0V**.

4.3.4.6 Check the voltage on A9 J1, Pin 20; it should be ≥**4.0V**.

4.3.4.7 If all of the above voltages are correct and the unit still will not reset, check for defective wiring and/or PWB connections, then try the **RESET** switch again. If the unit still will not reset, the A9 Operate/Control Board is defective. Contact Amplifier Research to arrange for repair or replacement of the A9 Operate/Control Board.

4.3.5 Voltage/Amplifier Faults (Driver Amplifier) (Schematic Diagram Nos. 1009962 and 1009973)

The Model 200W1000A's fault circuits sense a +20V power supply fault and six fused amplifier faults. The fuse fault circuits are located on the A10 Interface Board.

4.3.5.1 +20V Faults: +20V faults are sensed by a fault circuit on the A9 Operate/Control Board.

4.3.5.2 If there is a +20V fault that cannot be cleared, check the voltage on A9J1, Pin 10. If the voltage on A9J1, Pin 10 is >**18.7V** and the fault will not clear, check the adjustment of R23 on the A9 Operate/Control Board.

4.3.5.3 If the voltage on A9J1, Pin 10 is normal and the fault cannot be cleared by adjusting R23, then the A9 Operate/Control Board is defective. Contact Amplifier Research to arrange for repair or replacement of the A9 Operate/Control Board.

4.3 TROUBLESHOOTING *(CONTINUED)*

4.3.5 Voltage/Amplifier Faults (Driver Amplifier) (Schematic Diagram Nos. 1009962 and 1009973) *(continued)*

4.3.5.4 Fuse faults: Fuse faults are sensed by voltage dividers located on the A10 Interface Board; the outputs of the voltage dividers are then fed to the A9 Operate/Control Board via the following pins on A9J1:

Pin 25—Fuse F1	Pin 42—Fuse F4
Pin 40—Fuse F2	Pin 43—Fuse F5
Pin 41—Fuse F3	Pin 44—Fuse F6

The output voltage should normally be **+5.0VDC**.

4.3.5.5 If a fused amplifier stage continues to blow fuses after they are replaced, refer to the correct RF stage schematic diagram to perform troubleshooting:

Fuse F1—RF Stage A1 (Schematic Diagram No. **1009969**)

Fuse F2—RF Stage A2 (Schematic Diagram No. **1009970**)

Fuses F3 through F6—RF Stages A4 through A7 (Schematic Diagram No. **1007312**)

4.3.5.6 If a fuse fault is indicated on the front panel VFD but the fuse indicated is not blown, check to see that the high (+5V) signal to the A9 Operate/Control Board is present. If the high signal to the A9 Operate/Control Board is not present, check the wiring from the A9 Operate/Control Board to the A10 Interface Board. If the high signal to the A9 Operate/Control Board is present but the fault cannot be cleared, and the amplifier cannot be reset, then the A9 Operate/Control Board is defective. Contact Amplifier Research to arrange for repair or replacement of the A9 Operate/Control Board.

4.3.6 Thermal Fault (Final Amplifier) (Schematic Diagram Nos. 1009962 and 1007333)

During a Final Amplifier Thermal Fault, the unit's front panel VFD should read **"THERMAL FAULT FINAL."**

4.3.6.1 Try to reset the amplifier; if the unit resets and operates normally, check the air inlets on the bottom of the unit and the air outlet on the rear of the unit to see if there are any blockages to air flow.

4.3.6.2 If the Thermal Fault will not clear and the amplifier will not reset, check the voltage at the A9 Operate/Control Board, J2, Pin 3; it should be **≤0.1V**.

4.3.6.3 If the voltage on A9J2, Pin 3 is high, check the thermal daisy chain through the A2 Final Amplifier's A1–A4 heat sinks, and the A5 16-way Combiner's thermal switch to ground.

4.3 TROUBLESHOOTING *(CONTINUED)*

4.3.7 Voltage/Amplifier Faults (Final Amplifier) (Schematic Diagram Nos. 1009962, 1007333, and 1007322)

The 16 final amplifiers in the A2 Final Amplifier are equipped with overload fault sensors. If one of these stages develops a fault condition, the unit's VFD will read **"FAULT: AMP FINAL."**

4.3.7.1 To determine which Final Amplifier stage has failed, check the Final Amplifier regulators for any fault indicator LEDs that are lit.

4.3.7.2 If any of the fault indicator LEDs are lit, check the corresponding Final Amplifier regulator for the proper +20VDC output.

4.3.7.3 If the corresponding Final Amplifier regulator is okay, the problem could be a damaged Final Amplifier output transistor.

4.3.8 Low or No Power Output (DC Tests) (Schematic Diagram No. 1009962)

All indicators on the Model 200W1000A's VFD are normal, the VFD indicates **"POWER ON"** and **"STATUS OK,"** and all of the cooling fans in both the Driver Amplifier and the Final Amplifier are operating.

4.3.8.1 Check the position of the RF Gain control—is it set to maximum gain?

4.3.8.2 Check the RF input to the unit—is it the correct amplitude and frequency?

4.3.8.3 Check the RF output connection from the unit—is it correctly connected to the load? Is the coaxial cable okay?

Note: The Model 200W1000A is capable of 300 watts or greater power output at many points over its frequency range. Attenuators used to measure the unit's RF power output must be capable of dissipating this level of RF power; take care not to damage the test equipment used.

4.3.8.4 Check the RF Gain of the Model 200W1000A; it should be **≥53dB** with the unit's RF Gain control set at maximum gain (CW).

4.3.8.5 Check the RF power output from the Model 200W1000A; it should be **≥200 watts** with **0dBm (1mw)** RF power input.

4.3.8.6 If the RF Gain or RF power output is low, check the following DC voltages with the unit's RF Gain control set to maximum gain (CW).

4.3 TROUBLESHOOTING *(CONTINUED)*

4.3.8 Low or No Power Output (DC Tests) (Schematic Diagram No. 1009962) *(continued)*

4.3.8.7 Check the voltages at the following locations. Troubleshoot any incorrect voltages.

Driver Amplifier Feed-through Cap.	Normal Voltage	Remarks
A1 C1	18.0V min.	Gain control at Max. CW
A1 C2	18.0V min.	Power in is <0dBm
A1 C3	0.5V max.	"Inhibit" signal
A1 C4	20V	Low-Level Stages
A2 C5	20V	Pre-Driver
A2 C6	20V	Driver Stage
C7	20V	A4 Output Stage
C8	20V	A5 Output Stage
C9	20V	A6 Output Stage
C10	20V	A7 Output Stage

Note: The locations of the feed-through capacitors can be found on the RF Assembly Drawing (Schematic Diagram No. **1009966**).

Final Amplifier: Check to see that all +20VDC outputs from the voltage regulators are present on all RF Final Amplifier assemblies.

4.3.9 Low or No Power Output (RF Tests) (Schematic Diagram No. 1009961)

Note: The DC Tests specified in subsections **4.3.8.1–4.3.8.7** should be completed before conducting the RF tests specified in the following subsections.

Phase matching must be maintained from the input of the A3 Four-Way Splitter located in the A1 Driver Amplifier to the inputs of the A5 16-Way Combiner located in the A2 Final Amplifier; if coaxial cables are removed, they must be reinstalled in the same locations from which they were removed. Replacement coaxial cable assemblies must be the same lengths as the original ones.

4.3.9.1 The Model 200W1000A's typical small signal Gain Response is shown in **Figure 4.3.9.1**. The actual gain may vary considerably from that shown in Figure 4.3.9.1, but it should be **≥58dB**.

4.3.9 Low or No Power Output (RF Tests) (Schematic Diagram No. 1009961) *(continued)*

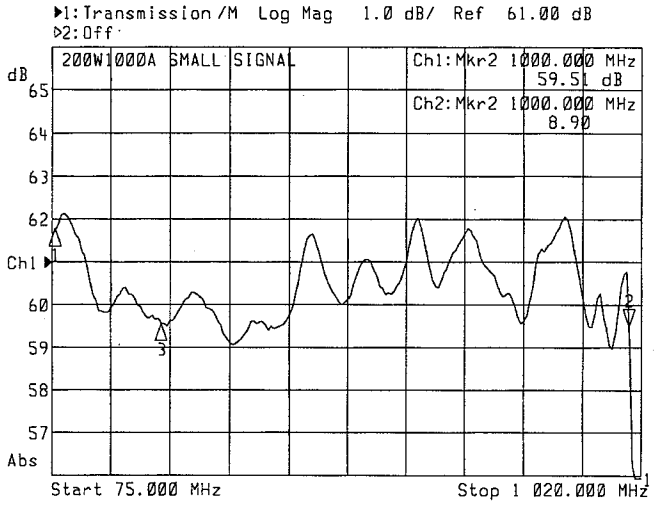


Figure 4.3.9.1
Typical Gain Response: Model 200W1000A Amplifier

Note: If the overall gain is low, the amplifier chain can be separated at the input to the A3 Four-Way Splitter and the gain can be checked from the input to the A3 Four-Way Splitter to the **RF OUTPUT** connector on the Final Amplifier's front panel.

4.3.9.2 Remove the coaxial cable from the output of the A2 Driver Amplifier to the input of the A3 Four-Way Splitter. The typical response from the input of the A3 Four-Way Splitter to the **RF OUTPUT** connector on the Final Amplifier's front panel is shown in **Figure 4.3.9.2**.

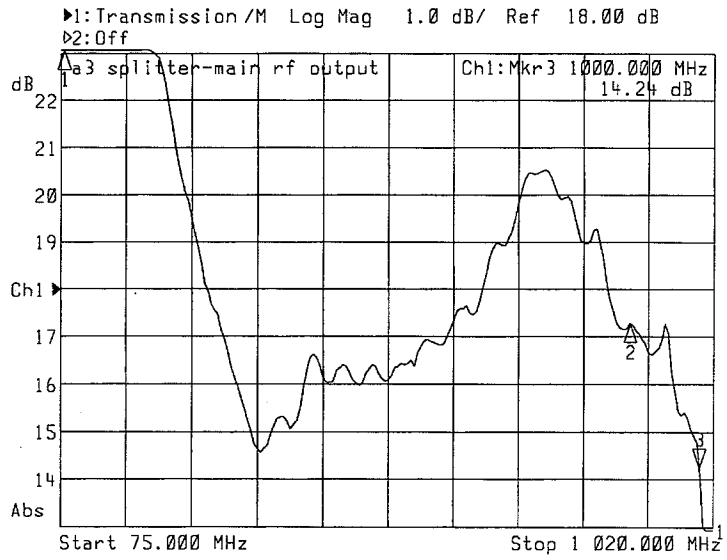


Figure 4.3.9.2
Typical Response: Input–A3 Splitter to Front Panel RF Output

If the response is normal, see subsection **4.3.9.11**. If the response is abnormal, perform the following tests.

4.3.9 Low or No Power Output (RF Tests) (Schematic Diagram No. 1009961) *(continued)*

4.3.9.3 If the gain is slightly low (i.e., several dB below typical), try checking the gain of the Driver Amplifier's RF Final Amplifiers (A4–A7). The output signals can be taken from the output connectors on the Driver Amplifier's rear panel. The swept response should be similar to that shown in **Figure 4.3.9.3**.

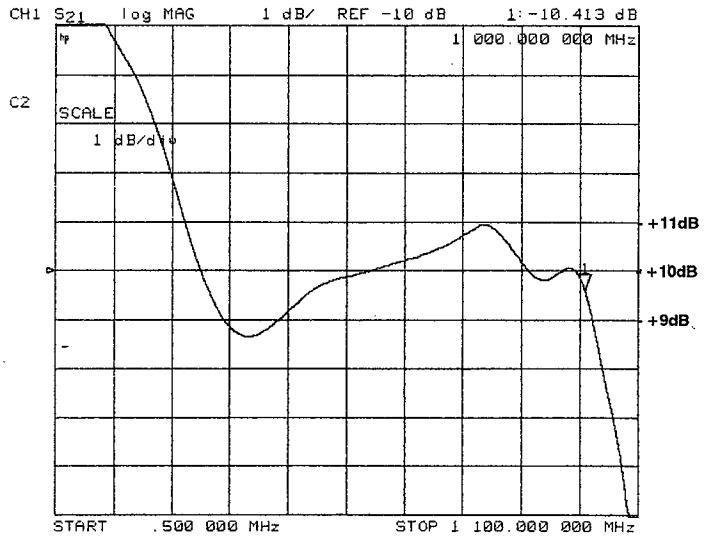


Figure 4.3.9.3
Typical RF Driver's Final Amplifier Response

4.3.9.4 Any RF Driver Amplifier's Final Amplifier stage that does not contribute to the amplifier's final output could be caused by any one or more of the following conditions:

- A defective coaxial cable or a bad cable connection
- A defective port on the A3 Four-Way Splitter
- A failed A4–A7 Final Amplifier

Compare the DC voltages to the voltages shown on Schematic Diagram No. **1009446**, and inspect for defective connections or components.

4.3.9.5 A typical Four-Way Splitter Insertion Loss is shown in **Figure 4.3.9.5**. The unused ports must be terminated into 50Ω when checking the insertion loss.

4.3.9 Low or No Power Output (RF Tests) (Schematic Diagram No. 1009961) *(continued)*

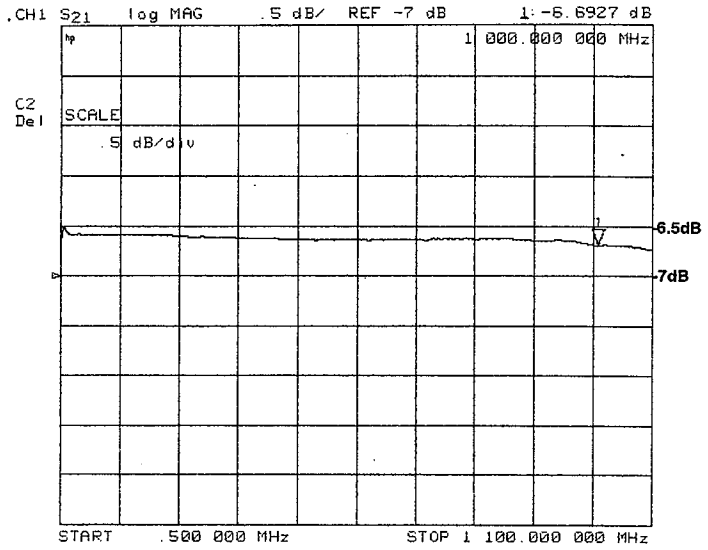


Figure 4.3.9.5
Typical Four-Way Splitter Insertion Loss

4.3.9.6 If all Driver Amplifier final voltages are normal and the A3 Four-Way Splitter is okay, check the gain of the Final Amplifier's output heat sinks (see RF Assemblies on Schematic Diagram No. **1007314**).

4.3.9.7 With the RF input signal still connected to the input of the A3 Four-Way Splitter, and the RF output signal taken from the main RF output, disconnect one of the four RF cables (W5–W8) that connect the Driver Amplifier's outputs to the Final Amplifier's inputs.

4.3.9.8 The typical gain drop observed should be approximately **2–3dB**; repeat this step for the remaining three RF Final Amplifier heat sinks to determine which one is causing the problem.

4.3.9.9 If all four RF Final Amplifier heat sinks are normal, go to subsection **4.3.9.10**; if there is a gain problem, check the following:

(a) Check the A3 Four-Way Splitter; refer to subsection **4.3.9.5** for typical operation.

(b) Check the four RF Final Amplifier assemblies (A3, A5, A7, and A9) for typical gain response; see **Figure 4.3.9.9** for typical gain response.

4.3.9 Low or No Power Output (RF Tests) (Schematic Diagram No. 1009961) *(continued)*

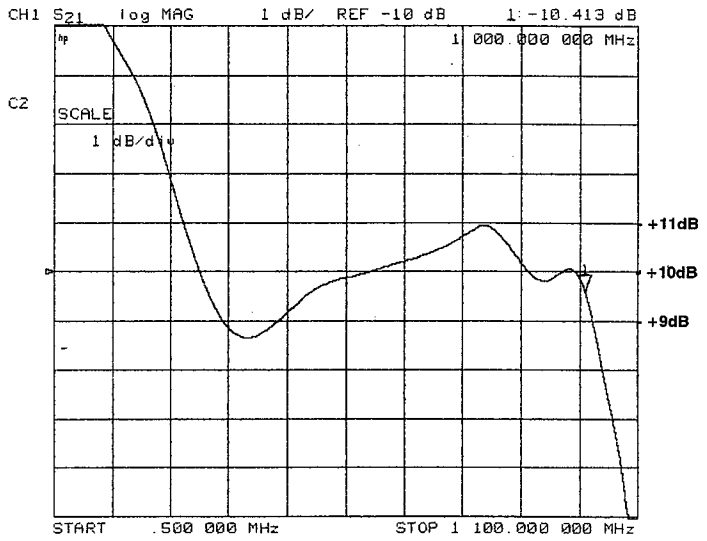


Figure 4.3.9.9
Typical Response: RF Final Amplifier

4.3.9.10 A typical 16-Way Combiner Insertion Loss is shown in **Figure 4.3.9.10**; a typical Combined Port Return Loss is shown in **Figure 4.3.9.10a**. The unused port must be terminated into 50Ω when checking the insertion loss.

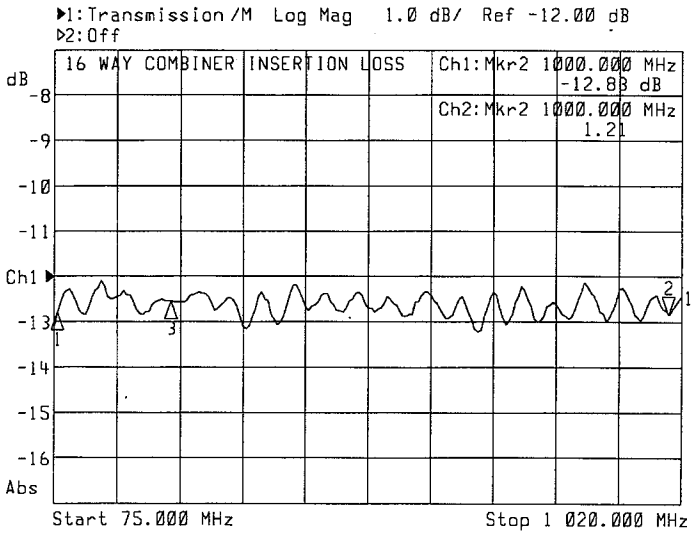


Figure 4.3.9.10
Typical 16-Way Combiner Insertion Loss

4.3.9 Low or No Power Output (RF Tests) (Schematic Diagram No. 1009961) *(continued)*

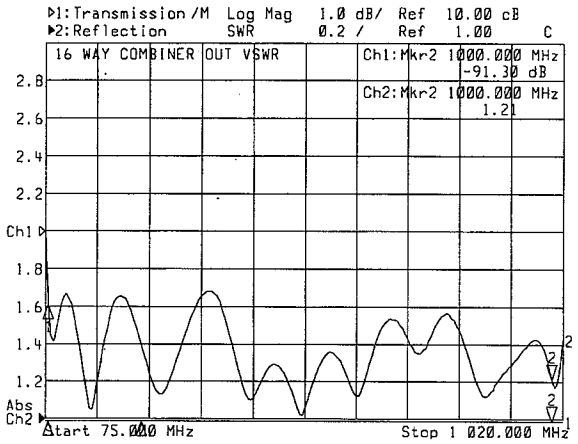


Figure 4.3.9.10a
Typical 16-Way Combiner Return Loss: Combined Output Port

4.3.9.11 If the response of the output stages (i.e., A3 Four-Way Splitter input to front panel RF Output) is normal, check the response from the RF input of the Low-Level Amplifier (A1 J1) to the RF output of the Driver Amplifier (A2 J2). The typical response for the Low-Level and Driver Amplifier stage is shown in **Figure 4.3.9.11**.

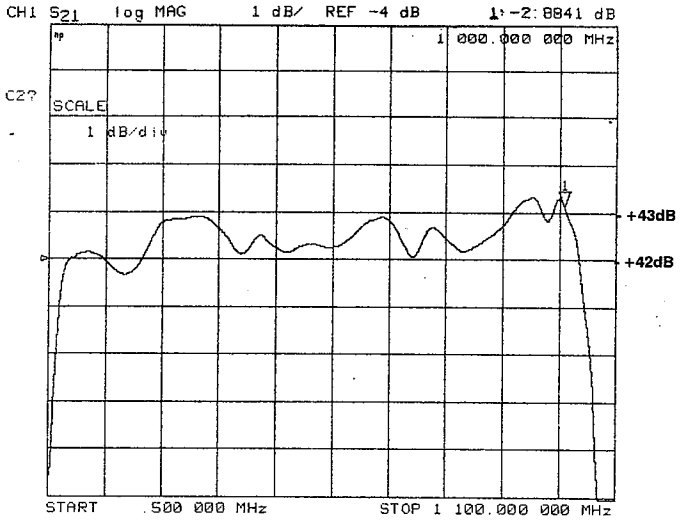


Figure 4.3.9.11
Typical Low-Level and Driver Amplifier Response

Note: The A2 Ten (10)-Watt Amplifier's response or the A1 Low-Level Amplifier's response may differ considerably—particularly in flatness—from the typical responses shown in **Figure 4.3.9.12** and **Figure 4.3.9.13**.

4.3.9 Low or No Power Output (RF Tests) (Schematic No. 1009961) *(continued)*

4.3.9.12 The typical response for the A2 Ten (10)-Watt Amplifier is shown in **Figure 4.3.9.12.**

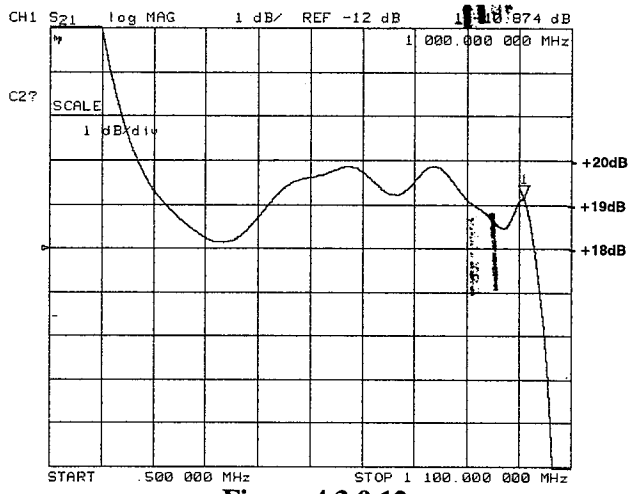


Figure 4.3.9.12
Typical A2 Ten (10)-Watt Amplifier Response

4.3.9.13 The typical response for the A1 Low-Level Amplifier (at maximum gain setting) is shown in **Figure 4.3.9.13.**

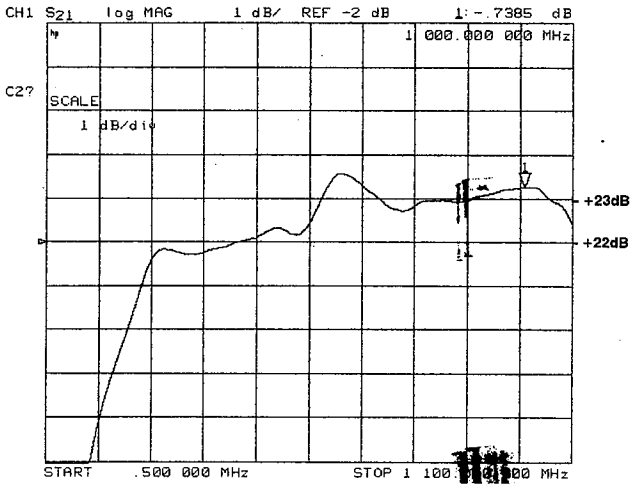


Figure 4.3.9.13
Typical A1 Low-Level Amplifier Response

If the RF gain is appreciably lower than it should be, remove the covers from A1A1 and A2A2. Inspect the amplifier stages for defective solder joints and burned or broken parts. Compare the voltages measured to the voltages shown on Schematic Diagram Nos. **1009967** and **1009970**.

4.3.9 Low or No Power Output (RF Tests) (Schematic No. 1009961) *(continued)*

Note: To troubleshoot amplifier stages with active bias, do the following:

1. Measure the DC input voltage.
2. Measure the DC voltage drop across the low-value resistor from VCC to the emitter of the active-bias transistor; is the voltage drop measured similar to the voltage drop shown on the schematic diagram? If the voltage drop is correct, the DC parameters of the amplifier stage are probably correct.
3. Measure the base voltage of the active-bias transistor; is the base voltage measured similar to the base voltage shown on the schematic diagram?
4. Measure the collector voltage of the RF transistor; is the collector voltage measured similar to the collector voltage shown on the schematic diagram?
5. Measure the base voltage of the RF transistor and compare it to the base voltage shown on the schematic diagram:
   - Higher than Normal (with low emitter voltage)—Indicates an open base emitter junction.
   - Lower than Normal—Indicates a short to ground or a shorted base emitter junction.

Note: To replace the stud mount transistors (Q3 or Q4), do the following:

1. Remove the unit's bottom panel.
2. Remove PS1 from the Power Supply Assembly to get to the access holes.
3. The nuts for Q3 or Q4 can be removed through the access holes.