rf/microwave instrumentation

Operating and Service Manual

50W1000D

Model

10043107

Part Number

Serial Number

160 Schoolhouse Road, Souderton, PA 18964 • 215-723-8181 • Fax 866-859-0582 • www.arworld.us

rf/microwave instrumentation

Declaration of Conformity

Issue Date: October 2020
Model #/s: Model 50W1000D Series
Type of Equipment: RF Broadband Amplifier
Function: Designed to be used in a RF immunity test system or for research. The unit is intended to amplify an RF signal and inject it into a load.

The equipment described above is declared to be in conformity with the following applicable national and international standards. The conformity is valid only when equipment is used in a manner consistent with the manufacturer's recommendations and the reference documents.

EMC:
DIRECTIVE 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility
EN 61326-1:2013 Electrical equipment for measurement, control and laboratory use–EMC requirements–Part 1: General Requirements
SAFETY:
DIRECTIVE 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits
CENELEC EN 61010-1 Issued 2010/10/01 Ed: 3 Safety Requirements for Electrical Equipment for Measurement Control and Laboratory Use – Part 1: General Requirements
UL 61010-1 Issued 2012/05/11 Ed: 3 Safety Requirements for Electrical Equipment for Measurement Control and Laboratory Use – Part 1: General Requirements
CAN/CSA C22.2 #61010-1 Issued 2012/05/11 Ed: 3 Safety Requirements for Electrical Equipment for Measurement Control and Laboratory Use – Part 1: General Requirements
HAZARDOUS SUBSTANCES (RoHS):
DIRECTIVE 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast) Commission Delegated Directive (EU) 2015/863 of 31 March 2015 amending Annex II to Directive 2011/65/EU of the European Parliament and of the Council as regards the list of restricted substances **Directive (EU) 2017/2102 of the European Parliament** and of the Council of 15 November 2017 amending Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment
RECYCLING (WEEE):
DIRECTIVE 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast)
SUBSTANCES OF VERY HIGH CONCERN (REACH):
REGULATION (EC) 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Substances of Very High Concern Chemicals (SVHC)

Supporting documentation is held by AR RF/Microwave Instrumentation's Quality department in Pennsylvania, United States.

Place of issue: AR RF/Microwave Instrumentation
160 Schoolhouse Road
Souderton, Pennsylvania 18964 USA

Authorized officer of the company:

Patricia Thrasher
Manager Quality & Service

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 2014/30/EU. The equipment must therefore be operated in a shielded area which provides a sufficient level of attenuation to meet the radiated 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
100 watts	50 dB
101 - 1000 watts	60 dB
1001 - 10,000 watts	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 2014/30/EU notwendig ist. Das Gerät muß deshalb in einem geschirmten Raum betrieben werden, welcher eine ausreichenden Schirmung bietet, um die Emissions- und Störfestigkeitsspezifkation einzuhalten. Es werden folgenden Minimalwerte der Schirmdämpfung und Filterung in den unterschiedlichen Leistungsklassen empfohlen.

Hochfrequenzleistung	min. Schirmdämpfung
100 Watt	50 dB
101-1000 Watt	60 dB
1001-10.000 Watt	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 2014/30/EU 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. 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
100 Watts	50 dB
101 à 1.000 Watts	60 dB
1.001 à 10.000 Watts	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 1'amplificateur.

INSTRUCTIONS FOR SAFE OPERATION

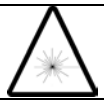
Observe the following safety guidelines to help ensure your own personal safety and to help protect your equipment and working environment from potential damage.

INTENDED USE

This equipment is intended for general laboratory use in generating, controlling, and measuring levels of electromagnetic Radio Frequency (RF) energy. Ensure that the device is operated in a location which will control the radiated energy and will not cause injury or violate regulatory levels of electromagnetic interference.

SAFETY SYMBOLS

These symbols may appear in your user manual or on equipment.

	This symbol is marked on the equipment when it is necessary for the user to refer to the manual for important safety information. The caution symbol denotes a potential hazard. Attention must be given to the statement to prevent damage, destruction, or harm.
	Dangerous voltages are present. Use extreme care.
	Indicates a terminal intended for connection to an external conductor for protection against electrical shock in case of a fault, or the terminal of a protective earth (ground) electrode.
	Indicates invisible laser radiation–do not view directly with optical instruments.
	Indicates frame or chassis ground connection terminal.
	Indicates alternating current.
	Indicates this product must not be disposed of with your other household waste.
	Indicates that the marked surface and adjacent surfaces can attain temperatures that may be hot to the touch.

EQUIPMENT SETUP PRECAUTIONS

Review the user manual and become familiar with all safety markings and instructions. Protection provided by the equipment may be impaired if used in a manner not specified by AR RF/Microwave Instrumentation (AR).

- Follow all lifting instructions specified in this document.
- Place the equipment on a hard, level surface.
- Do not use the equipment in a wet environment, for example, near a sink, or in a wet basement.
- Position your equipment so that the power switch is easily accessible.
- Leave 10.2 cm (4 in) minimum of clearance on all vented sides of the equipment to permit the airflow required for proper ventilation. Do not restrict airflow into the equipment by blocking any vents or air intakes. Restricting airflow can result in damage to the equipment, intermittent shut-downs or safety hazards.
- Keep equipment away from extremely hot or cold temperatures to ensure that it is used within the specified operating range.
- While installing accessories such as antennas, directional couplers and field probes, take care to avoid any exposure to hazardous RF levels.
- Ensure that nothing rests on your equipment's cables and that the cables are not located where they can be stepped on or tripped over.
- Move equipment with care; ensure that all casters and/or cables are firmly connected to the system. Avoid sudden stops and uneven surfaces.

BEFORE APPLYING POWER

Your AR equipment may have more than one power supply cable. Use only approved power cable(s). If you have not been provided with a power cable for the equipment or for any AC-powered option intended for the equipment, purchase a power cable that is approved for use in your country. The power cable must be rated for the equipment and for the voltage and current marked on the equipment's electrical ratings label.

Incorrectly installing or using an incompatible line voltage may increase the risk of fire or other hazards. To help prevent electric shock, plug the equipment and peripheral power cables into properly grounded electrical outlets. These cables are equipped with three-prong plugs to help ensure proper grounding. Do not use adapter plugs or remove the grounding prong from a cable.

Do not modify power cables or plugs. Consult a licensed electrician or AR trained service technician for equipment modifications. Always follow your local/national wiring rules.

Do not operate the equipment if there is physical damage, missing hardware, or missing panels.

SAFETY GROUND

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

INSTRUCTIONS FOR SAFE OPERATION

HAZARDOUS RF VOLTAGES

The RF voltages on the center pin of an RF output connector can be hazardous. The RF output connector should be connected to a load before AC power is applied to the equipment. 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.

ACOUSTIC LIMITATIONS

If equipment noise exceeds 80dB, ear protection is required.

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.

ENVIRONMENTAL CONDITIONS

Unless otherwise stated on the product specification sheet, 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 linearly to 50% at 40°C.
- Main 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, its performance may vary.

EQUIPMENT CONTAINING LASERS

AR Field Probes (FL/PL Series) and Field Analyzers (FA Series) are Class 1 laser products containing embedded Class 4 lasers. Under normal use, the laser radiation is completely contained within the fiber optic cables and poses no threat of exposure. Safety interlocks ensure that the laser is not activated unless the cables are properly connected. Always exercise caution when using or maintaining laser products. Do not view directly with optical instruments.

RF ANTENNAS

- This equipment (antenna or antenna assembly) may be heavy, requiring two persons to lift. Use caution when installing or removing unit. Follow all equipment setup and lifting instructions specified in this document.
- Ensure connectors are appropriate for intended operation. Connectors are specified in the user manual and product specification sheet.
- Do not exceed the maximum RF input level stated in the specifications. Refer to the user manual and product specification sheet to determine the applicable RF levels.
- Excessive RF input could damage the equipment or connectors, causing safety hazards.
- When in operation, the RF voltages on the antenna elements can be hazardous. Do not come into contact with the antenna or elements when the RF input connector is connected to a live RF source.
- To avoid injury to personnel and accidental damage to power amplifier or antenna, disable the RF output of power amplifier before connecting or disconnecting the input connection to the antenna.
- Perform periodic inspections of antenna and field probe systems to verify calibration due date, proper operation, and overall condition of equipment.

RACK MOUNTED TWT MODELS

Some TWT models are supplied without the removable enclosure offered for benchtop use. These rack-mountable models may be supplied with either carry handles or slides and front handles installed. Follow all lifting instructions specified in this document and installation instructions supplied in the TWT user manual.

LIFTING INSTRUCTIONS FOR AR EQUIPMENT

Because most products must be handled during distribution, assembly and use, the risk of serious injury due to unsafe product handling should be a fundamental consideration of every user. An authoritative guideline for eliminating unwarranted risk of injury caused by lifting is provided by the NIOSH Work Practices (Publication #94-110) available at:

https://www.cdc.gov/niosh/docs/94-110/pdfs/94-110.pdf.

In general, observe the following guidelines for lifting a weight of 50 lb or more:

- Use lifting eye (for floor standing) or side handles (table top) to lift unit only.
- Use equipment of adequate capacity to lift and support unit.
- If using forklift to move unit, be sure forks are long enough to extend beyond the side of the unit.
- For additional information, follow the link specified above.

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FIGURES

TABLES

1. GENERAL INFORMATION

1.1 GENERAL DESCRIPTION

The Model 50W1000D is a self-contained, broadband solid-state amplifier designed for laboratory applications where instantaneous bandwidth, high gain, and moderate power output are required. A **GAIN** control, which is conveniently located on the unit's front panel, can be used to decrease the amplifier's gain by 25 decibels (dB) or more. Solid state technology is used exclusively to offer significant advantages in reliability and cost. A Model 50W1000D, used with a frequency-swept signal source, will provide 50 watts of swept power output from 50–1000 megahertz (MHz). Typical applications include antenna and component testing, wattmeter calibration, and electromagnetic interference (EMI) susceptibility testing, as well as usage as a driver for frequency multipliers and high-power amplifiers. The Model 50W1000D can be operated locally by using the unit's front panel controls, or remotely by using the unit's IEEE-488, RS-232 interface, USB, or Ethernet interface.

Special features incorporated into the Model 50W1000D include the following:

- **A Control Panel** that allows both local and remote (via a computer interface) control of the amplifier (including adjustment of the amplifier's RF Gain during CW mode operation) and provides graphical displays of the amplifier's Forward and Reflected power levels.
- **A General Purpose Interface Bus (GPIB)/IEEE-488.2 interface** for remote control of the amplifier's operating functions.
- **RS232 serial communications** including both wire and fiber-optic ports for remote control.
- **USB Communication port** for remote control.
- **Ethernet Communication port** for remote control.
- **Protection** is provided by DC current limiting, over-temperature shut down and RF power limiting.

1.2 SPECIFICATIONS

Refer to the AR RF/Microwave Instrumentation Data Sheet at the end of this section for detailed specifications.

1.3 POWER SUPPLIES

The Model 50W1000D contains one switching power supply. The input voltage range to the power supply is 90–264 VAC, 50/60Hz, selected automatically. The AC input power is approximately 250 watts.

PS1 has a +5 volt, standby supply for the A4 Control/Fault board and the A5 Interface board used for the remote interfaces. The +5 volt supply is also for operation of the A11 ALC board.

PS1 is a multiple output supply. The main +24V, 10A supplies voltage to the RF low level and the W Final module. The +12V is for operating the cooling fan and the –12 volts DC is supplied to the A1 preamplifier.

Primary AC circuit protection is provided by the circuit breaker in the Power Entry Module.

1.4 INSTALLATION

Before proceeding, thoroughly inspect the amplifier for signs of physical damage that 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 that will permit air to circulate freely around the amplifier's cabinet. The Model 50W1000D utilizes air cooling and should be located where the normal flow of air into or exiting from the unit will not be restricted, diverted, or re-circulated through the unit itself; in particular, the flow of warm air exiting the rear of the amplifier should not be impeded.

Do not position the unit next to a wall or other equipment that would restrict the flow of air into the bottom of the unit or out of the rear of the unit.

1.4.2 Power

The Model 50W1000D is designed to operate using AC primary power of 90–264 Volts Alternating Current (VAC), 50–60 Hz single phase, 250 watts maximum.

CAUTION:

Dangerous voltages are present in the Model 50W1000D whenever the unit is plugged into an AC outlet. Always disconnect the unit from the main power line when servicing it.

50W1000D

- 50 Watts CW
- 50MHz-1000MHz
- Class A
- Portable
- Full VSWR–tolerant
- CE & RoHS Compliant
- High Efficiency

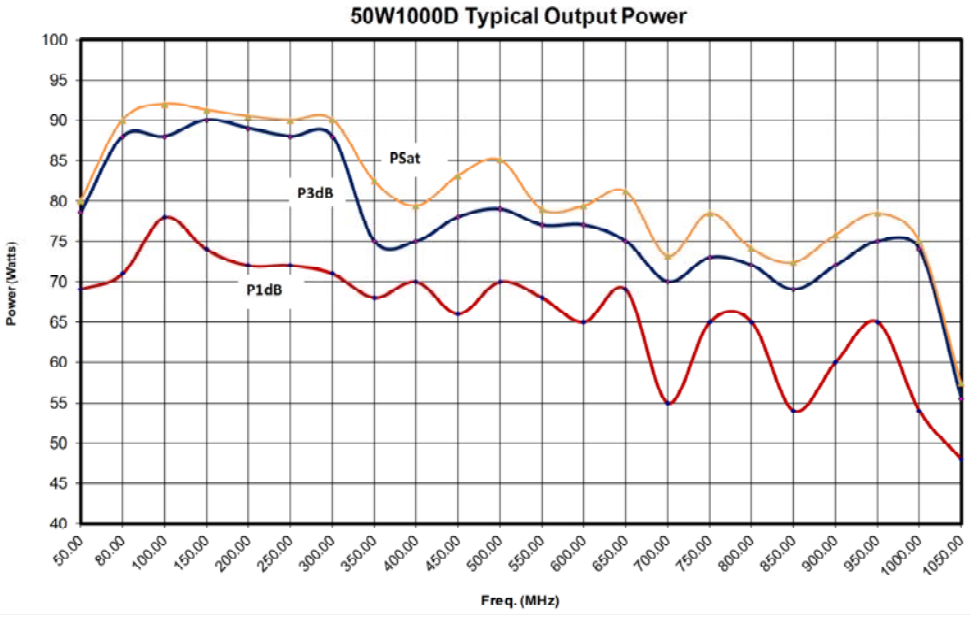
Features

The Model 50W1000D is a solid-state, self-contained, air-cooled, broadband amplifier designed for applications where instantaneous bandwidth, high gain and linearity are required. Available in a stylish, contemporary cabinet for benchtop use or with cabinet removed for rack mounting.

The Model 50W1000D, when used with a sweep generator, will provide a minimum of 50 watts of RF power. Included is a front panel gain control which permits the operator to conveniently set the desired output level. The 50W1000D is protected from RF input overdrive by 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 0dBm. 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. The front panel indicates the operate status and fault conditions if an over-temperature or power supply fault has occurred. The unit can be returned to operate when the condition has been cleared.

All amplifier control functions and status indications are available remotely through the optional Remotes Package. The Remotes Package includes GPIB/IEEE-488 format, RS-232 hardwire and fiber optic, USB, and Ethernet. The bus interface connector is located on the back panel and positive control of local or remote operation is assured by a Local/Remote switch on the front panel of the amplifier. Also included with the Remotes Package is a safety interlock circuit for use with external safety switch interlocks. This circuit prevents the amplifier from going into operate mode unless the external connection is made. A jumper plug is provided for cases where this functionality is not needed.

The export classification for this equipment is EAR99.



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ISO 9001 Certified

50W1000D

- 50 Watts CW
- 50MHz-1000MHz

Specifications

RATED OUTPUT POWER: 70 watts typical, 50 watts minimum

INPUT FOR RATED OUTPUT: 1.0 mW Max

POWER OUTPUT @ 3dB COMPRESSION:
Typical: 70 watts, Minimum: 60 watts

POWER OUTPUT @ 1dB COMPRESSION:
Typical: 60 watts, Minimum: 45 watts

FLATNESS: ±1.0 dB typical, ±1.5 dB maximum

FREQUENCY RESPONSE: 50MHz–1000 MHz instantaneously

GAIN (at maximum setting): 48 dB minimum

GAIN ADJUSTMENT (Continuous Range) : 20 dB minimum

INPUT IMPEDANCE: 50 ohms, VSWR 2.0:1 maximum

OUTPUT IMPEDANCE: 50 ohms nominal

MISMATCH TOLERANCE: 100% of rated power without foldback. Will operate without damage or oscillation with any magnitude and phase of source and load impedance. See Application Note #27.

MODULATION CAPABILITY: Will faithfully reproduce AM, FM, or Pulse modulation appearing on input signal.

THIRD ORDER INTERCEPT: 55 dBm typical

NOISE FIGURE: 8 dB typical

HARMONIC DISTORTION: Minus 20 dBc maximum at 50 watts, -30 dBc typical at 50 watts

SPURIOUS: Minus 73 dBc typical

PRIMARY POWER (Universal; selected automatically):
100-240 VAC, 50/60Hz, 250 watts

CONNECTORS:
RF Input: N female
RF Output: N female

REMOTES PACKAGE:

IEEE-488:	24-pin female
RS-232:	9-pin subminiature D (female)
Fiber optic:	ST Conn Tx and Rx RS-232
USB 2.0:	Type B
Ethernet:	RJ-45
Safety Interlock:	15-pin subminiature D

COOLING: Forced air (self contained fans)

WEIGHT:

With Cabinet	17.7 kg (39 lbs)
Without Cabinet	9.5 kg (21 lbs)

SIZE (W x H x D):
With cabinet: 50.3 x 15.5 x 55.1 cm (19.8 x 6.1 x 21.7 in)
Without Cabinet: 48.3 x 13.2 x 55.1 cm (19 x 5.2 x 21.7 in)

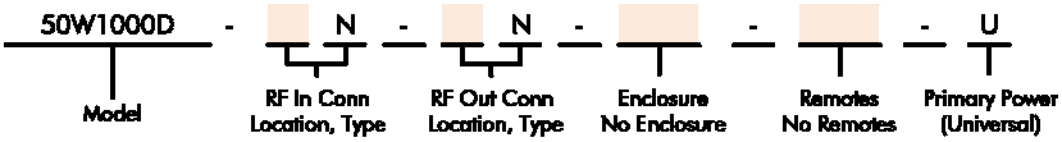
ENVIRONMENTAL:
Operating Temperature: 5°C / +40°C
Operating Altitude: Up to 2000M
Shock and vibration: Normal Truck Transport

REGULATORY COMPLIANCE:

EMC	EN 61326-1
Safety	UL 61010-1
	CAN/CSA C22.2 #61010-1
	CENELEC EN 61010-1
RoHS	DIRECTIVE 2011/65/EU

EXPORT CLASSIFICATION: EAR99

Ordering Options



CONNECTOR LOCATION	
Front	F
Rear	R

ENCLOSURE	
Enclosure	E
No Enclosure	NE

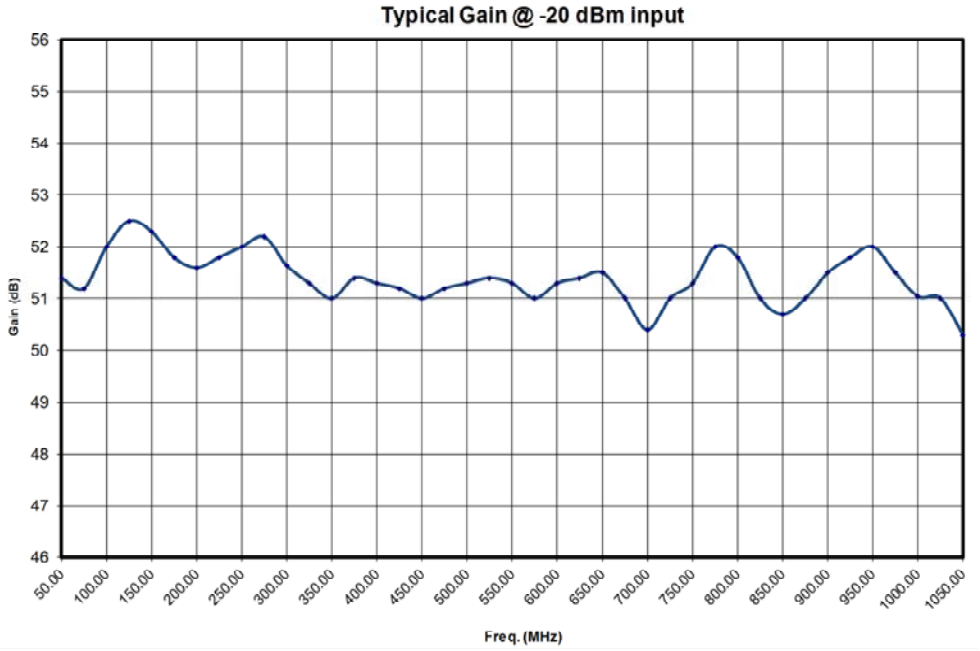
REMOTES PKG	
Remotes	R
No Remotes	NR

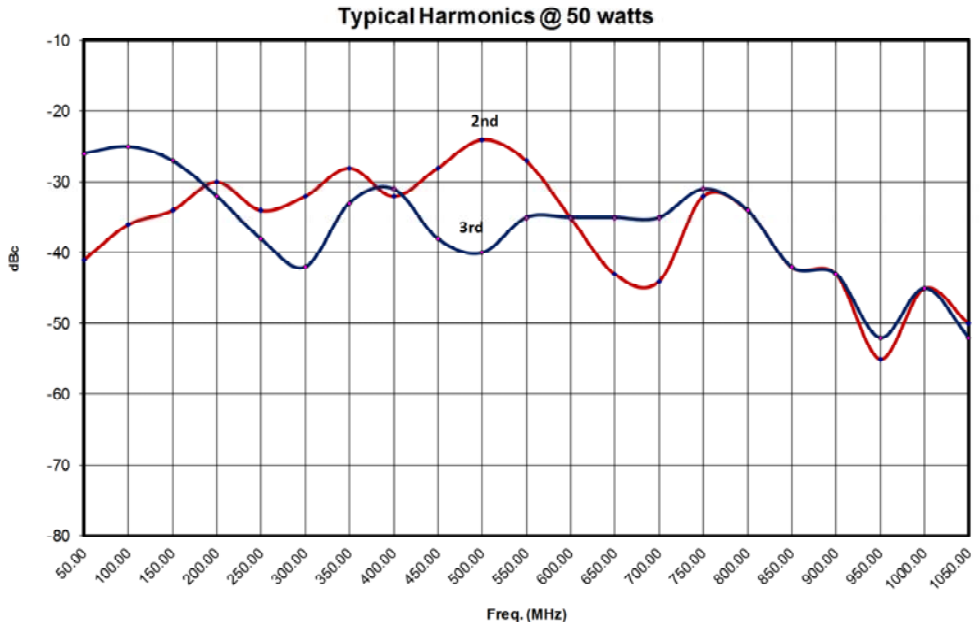
Contact your AR RF/Microwave Instrumentation Sales Associate for specific model configuration pricing.

50W1000D

- 50 Watts CW
- 50MHz-1000MHz

Graphs

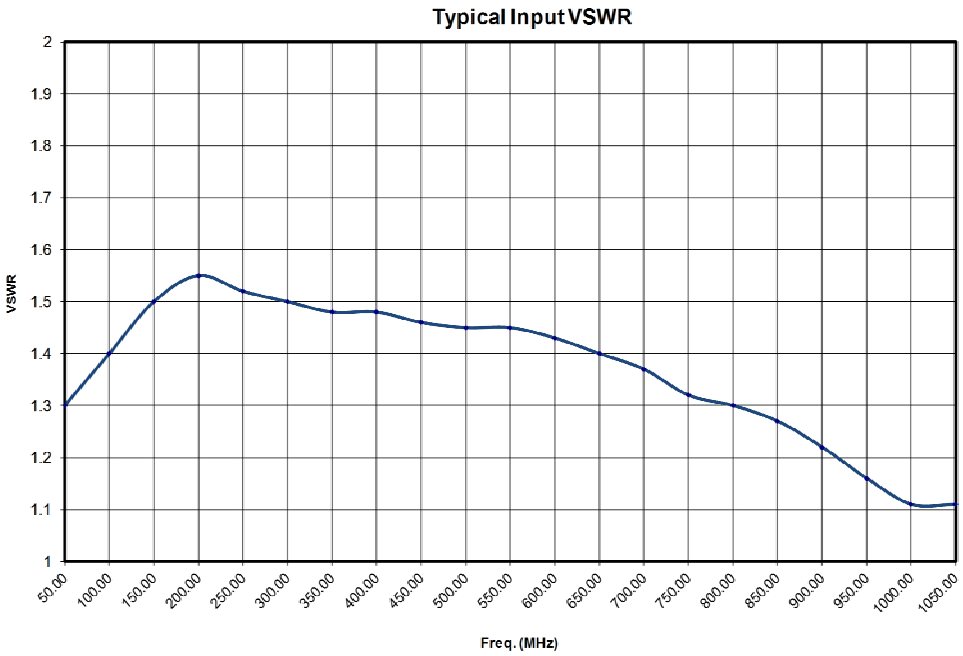


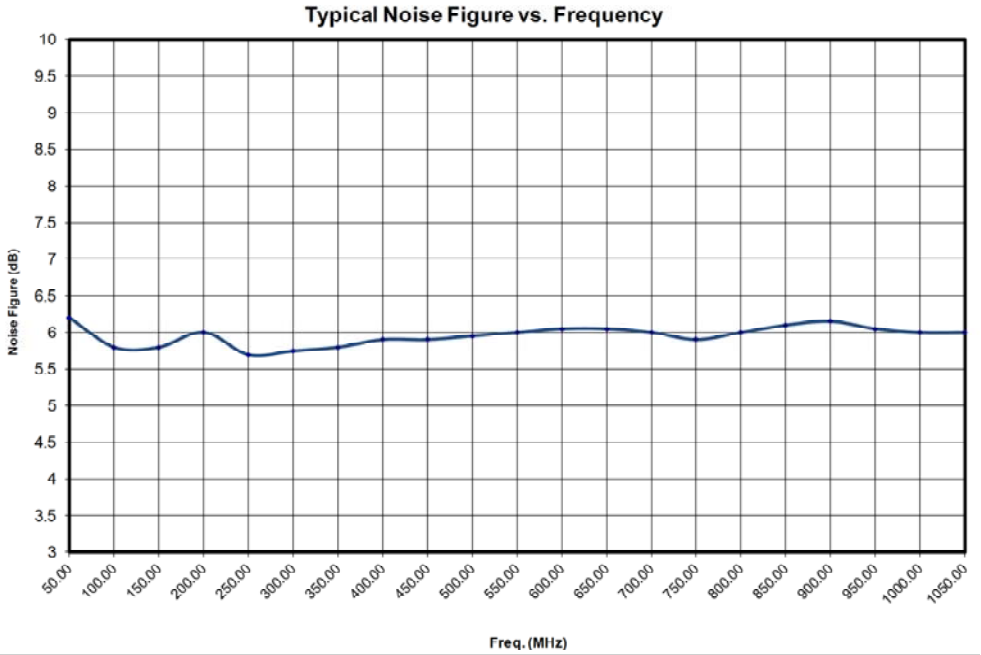


50W1000D

- 50 Watts CW
- 50MHz-1000MHz

Graphs

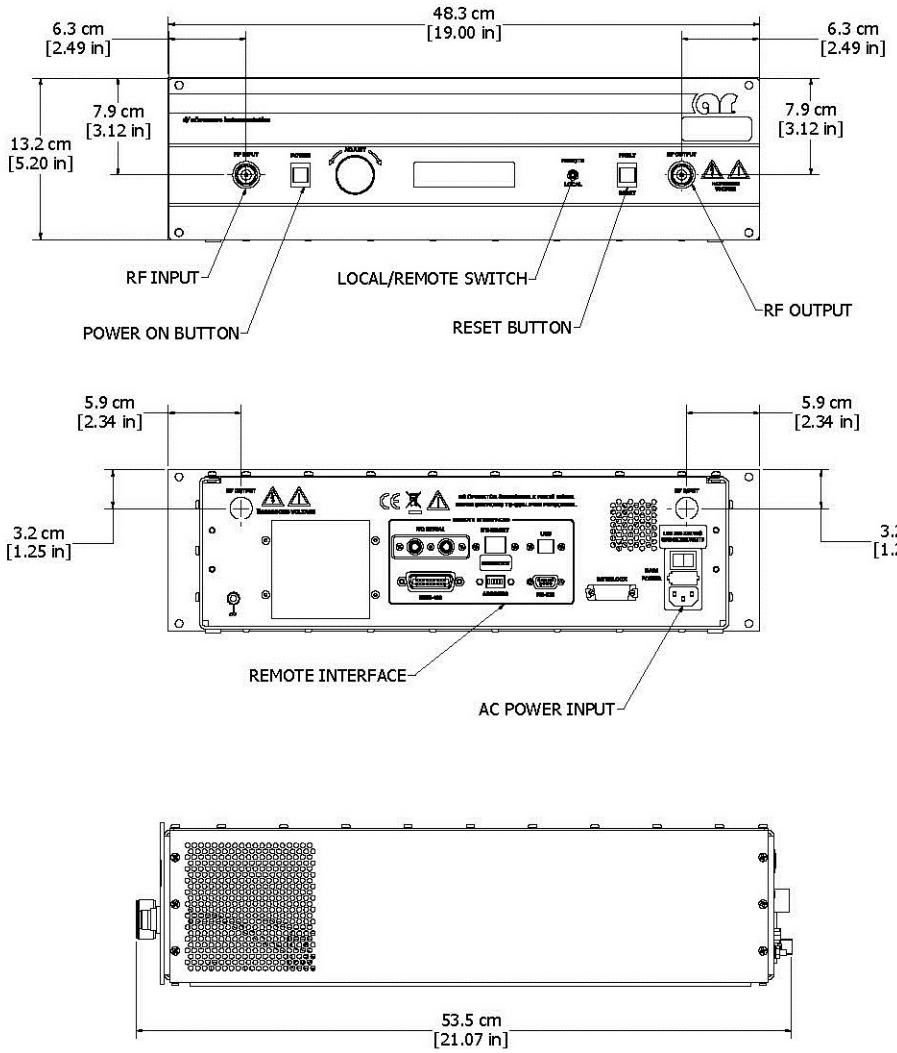




50W1000D

- 50 Watts CW
- 50MHz-1000MHz

Envelope Drawing



2. OPERATING INSTRUCTIONS

2.1 GENERAL

Operation of the Model 50W1000D broadband amplifier is quite simple. The amplifier's input signal, whether swept or fixed in frequency, is fed into the jack marked **RF INPUT,** and the amplifier's output signal is taken from the jack labeled **RF OUTPUT**. The unit is turned on by activating the front panel **POWER** switch. In the event of a major malfunction, protection is provided by a circuit breaker located on the unit's rear panel.

CAUTION:

The Model 50W1000D Amplifier is *typically* not critical in regard to source and load Voltage Standing Wave Ratio (VSWR) and will remain unconditionally stable with any magnitude and phase of source and load VSWR. *However, placing the amplifier in the operate mode without a load connected to the output connector is not recommended*. It has also been designed to withstand, without damage, RF input power levels up to twenty (20) times its rated input of 1mW. However, signal levels higher than 20mW or transients with high peak voltages can damage the amplifier. Also, accidental connection of the Model 50W1000D's output to its input (either through direct connection or parasitic feedback paths) will cause oscillations that may permanently damage the unit's input transistors.

The 50W1000D RF power transistors are protected from over temperature by sensing the chassis temperature near the RF output transistors. In the event of a cooling fan failure or an airflow blockage, the DC voltage will be removed from the RF stages, when the chassis temperature reaches approximately 70°C.

Normal operation can be resumed after the chassis temperature drops below 70° C.

2.2 AMPLIFIER FRONT AND REAR PANELS

Figure 2-1 shows the front panel of the Model 50W1000D Broadband Microwave Amplifier. Figure 2-2 shows the rear panel of the Model 50W1000D Broadband Microwave Amplifier.

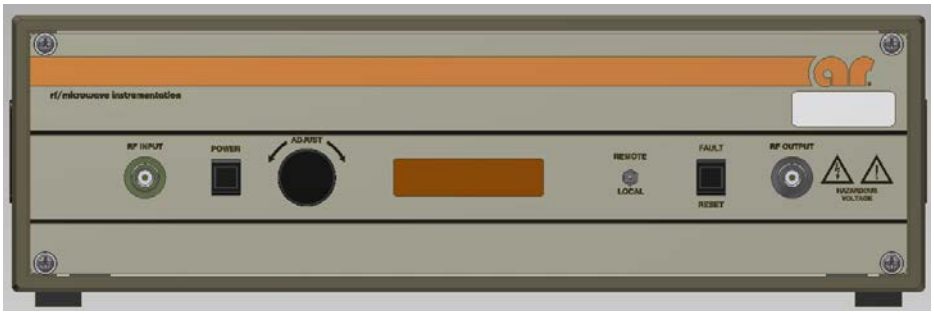


Figure 2-1. Model 50W1000D Front Panel

Figure 2-2. Model 50W1000D Rear Panel

2.3 LOCAL OPERATION

2.3.1 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. Set the REMOTE/LOCAL switch to LOCAL.
4. Check to see that the MAIN POWER switch on the unit's rear panel is set to the 1 (on) position.
5. Press the POWER switch: the front panel vacuum fluorescent display (VFD) should read **POWER ON**, 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.
6. Adjust the amplifier's gain by rotating the GAIN knob.
7. 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.

2.4 REMOTE COMMUNICATIONS

This section describes remote operation of this product using the installed communications ports connected to a remote device such as a personal computer. All ports are active at all times, however only one port may be used at a time. Communicating through two or more ports at one time will cause data collisions and lost commands or queries.

The **REMOTE**/**LOCAL** switch on the front panel allows for the amplifier to be controlled using the remote communications ports or the front panel controls depending on its position. All remote queries will work in either switch position. All remote commands will only work when the switch is set to **REMOTE**. When the switch is set to **REMOTE** all front panel controls are disabled.

NOTE: Some of the following ports may not be installed on your amplifier.

2.4.1 IEEE-488 (GPIB) Communications

For IEEE-488 operation, the device address is set using the dip switches on the rear panel of the amplifier. It is set to address 1 at the factory. If another device on the IEEE-488 bus is already using address 1, reset the switch to a vacant address. (Resetting the address requires re-booting the unit).

Specific IEEE-488 bus commands depend on which software package you are using. To send commands be sure that the amplifier's address is set properly and that the controller has correctly identified the unit as a "listening" device.

When sending commands to the unit via the GPIB interface, terminate the command with a **<LF>**, an **EOI**, or both. The system ignores characters following the termination.

2.4.1.1 Setting the IEEE-488 (GPIB) Address

The IEEE-488 device address can be set to any number between 1 and 30. This selection is made by setting Switches 1 to 5 of the rear panel DIP switch to the binary equivalent of the number. Table 2-1 illustrates this switch selection. Please note that although addresses 0 and 31 can be entered, neither address is valid for this device, and therefore should be avoided.

Table 2-1. IEEE-488 Address Selection

Device Address	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5
0	DO NOT USE - (RESERVED FOR CONTOLLER)				
1	on (1)	off (0)	off (0)	off (0)	off (0)
2	off (0)	on (1)	off (0)	off (0)	off (0)
3	on (1)	on (1)	off (0)	off (0)	off (0)
4	off (0)	off (0)	on (1)	off (0)	off (0)
5	on (1)	off (0)	on (1)	off (0)	off (0)
:					
30	off (0)	on (1)	on (1)	on (1)	on (1)
31	DO NOT USE				

2.4.2 RS-232 Communications

The RS-232 port is a serial communications bus. All commands and queries through this port must be terminated with a **<LF>.** When a valid query is received, it is processed and the result is immediately transmitted back over the RS-232 interface. This port is designed to time-out if there is no activity on the bus for more than 5 seconds. At this time the internal buffer is cleared and a **TIMEOUT_ERROR<LF>** message is sent out from this port.

The RS-232 port is setup as a **DCE** port. When connecting to a PC a straight one-to-one cable should be used. A null modem is **NOT** needed. The settings and pinout diagram for this port can been found below.

Table 2-2. RS-232 Port Settings

Word Length	8 bits
Stop Bits:	1
Baud Rate:	19.2 kbps
Parity:	None
HW Handshake:	None

Table 2-3. RS-232 (DCE) Port Pinout Diagram DB-9 Female

Pin 1	DCD
Pin 2	TD
Pin 3	RD
Pin 4	DTR
Pin 5	GND
Pin 6	DCR
Pin 7	CTS
Pin 8	RTS
Pin 9	Unused

2.4.3 Fiber-Optic Communications

The Fiber-Optic port is a serial communications bus. All commands and queries through this port must be terminated with a <LF>. When a valid query is received, it is processed and the result is immediately transmitted back over the Fiber-Optic interface. This port is designed to time-out if there is no activity on the bus for more than 5 seconds. At this time the internal buffer is cleared and a TIMEOUT_ERROR<LF> message is sent out from this port.

The Fiber-Optic port provides the user with the ability to optically isolate the controlling PC from the amplifier. This can be useful where the amplifier is placed in an environment where RF/Microwave energy could be coupled onto a connection to one of the “wired” communications ports and fed back to the controlling PC.

Both optical connections (Tx and Rx) are optimized to work with light at a wavelength of 820nm. For more detailed specifications on this port, consult the Avago HFBR series datasheet found at www.avagotech.com.

A glass, multi-mode, fiber-optic cable of 200um is recommended, however fiber-optic cable as small as 50um can be used. The connector type for this port is ST.

This port can be used with either an AR IF7000 RS-232 to Fiber-Optic Interface or an AR IF7001 USB to Fiber-Optic Interface. Note that these devices use SMA connectors so a fiber-optic cable is needed with ST connectors on one end and SMA connectors on the other. This cable can be obtained from a fiber-optic cable distributor such as FIS. Their web-site can be found at www.fiberinstrumentsales.com. An example cable that will work for this connection is FIS Part Number D615M7FIS. The 7 in the part number refers to the length of the cable. In this case the length is 7 meters.

Table 2-4. Fiber-Optic Port Settings

Word Length	8 bits
Stop Bits:	1
Baud Rate:	19.2 kbps
Parity:	None
HW Handshake:	None

2.4.4 USB Communications

The USB port on this product is a USB 2.0 port. It also complies with the USB Test and Measurement Class Standard. Communications with this port requires the host computer to have a USBTMC driver available. All commands and queries through this port must be terminated with a **<LF>.**

The cable required to make this connection is a USB 2.0 A-B peripheral device cable. The cable can be no longer than 5 meters. If a longer distance is required a USB hub must be used. A cable carrying the official USB logo is recommended.

When connected to a PC running Windows 2000 or XP a window will pop-up labeled Hardware Wizard. If this PC has National Instruments LabView installed it will have a USBTMC driver that will work with this port. This driver will allow the device to be easily controlled using National Instruments Measurement and Automation Explorer or LabView. If a user wishes to write code in a different programming language, a custom driver can be requested from AR. It should be noted that the USBTMC driver provided by National Instruments is a VISA driver which can be used with other programming languages besides LabView. For more information on this please consult the National Instruments Website found at www.ni.com.

NOTE: All firmware updates are done through the USB port.

2.4.5 Ethernet Communications

The Ethernet port on this product allows it to be remotely controlled through a TCP data channel. All commands and queries through this port must be terminated with a **<LF>.**

By default this port is setup to work on a network with a DHCP server. Upon connection, an IP address is assigned to the device based on its hardware address. The hardware address is printed on a label located near the Ethernet port.

If the connected network does not have DHCP enabled then the device can be assigned an IP address by the user. To do this, download the utility called DeviceInstaller™ from www.Lantronix.com. For assistance using this utility please consult this utility's embedded help file.

The DeviceInstaller™ utility will scan the network and find all connected Lantronix Ethernet devices. This list of found devices will include any connected AR Ethernet devices. By selecting one of the connected devices from the list, its IP address and subnet mask can be changed along with a number of other settings. One should use caution in adjusting any settings he/she is unfamiliar with as doing so may cause the port to become unresponsive. By default the port for the TCP data channel is 10001.

* DHCP (Dynamic Host Configuration Protocol) is a protocol used to assign a dynamic IP address to the unit. The network server software assigns an available IP address to the unit when the instrument is turned on. A different IP address may be assigned at different times.

2.4.6 Remote Commands

All commands are available to the user for remote operation of the amplifier.

If a command is unrecognized it is echoed back out the port it came in on.

- All commands and queries are terminated with a **<LF>**.
- All queries can be sent in Remote or Local mode
- All commands can only be sent in Remote mode
- All spaces in commands and queries are indicated by <space>

A **COMMUNICATIONS_ERROR<LF>** can occur if the time between commands or queries is too short, or the internal RS-485 link between the IO Board and the Control Board is broken.

The development of application programs requires an understanding of the operation of the amplifier as well as the intended application.

An application program on the computer/controller should issue only one character string (command or query) at a time. After each functional command is issued, the amplifier's status should be checked to ensure that the command has been properly executed. The application program should allow sufficient time for the function to be completed before checking the amplifier's status.

The application program should facilitate the checking of the amplifier's status just prior to issuing a command, since the status could have been changed by a fault condition or by operator actions.

Variables represented by wild card characters i.e. x, y, z etc. do not indicate or delimit the number of characters actually specified.

Table 2-5. Relationship between Amplifier Controls and Responses

X=NO, √=YES

AC POWER AND CIRCUIT BREAKER		POWER		MODE SWITCH		REMOTE COMMUNICATION	
ON	OFF	ON	OFF	LOCAL	REMOTE	COMMAND	QUERY
	√					X	X
√			√		√	√	√
√		√			√	√	√
√		√		√		X	√
√			√	√		X	√

2.4.6.1 Power On/Off

This command controls the power on/off state of the amplifier.

Syntax: **Px**

Parameters: **State(x):**

0 = power off
1 = power on

Response Format: None (No query for this command)

Example: To turn the power on, send the following command: **P1<LF>**

To turn the power off, send the following command: **P0<LF>**

2.4.6.2 Gain

This command sets the gain level of the amplifier with 4095 steps of resolution.

Syntax: **Gxxxx**

Parameters: **Gain(xxxx)**:

xxxx = **0000** to **4095**

Where:

0000 = Minimum gain
4095 = Maximum gain

Response Format: Same as command syntax

Example: To set the amplifier to minimum gain, send the following command: **G0000<LF>**

To set the amplifier to 50% Gain, send the following command:**G2048<LF>**

To find out the gain setting of the amplifier, send the following query: **G?<LF>**

Response: **G3075<LF>** ***(3072 = 75% Gain)***

2.4.6.3 Reset

This will clear all faults, if possible.

Syntax: **R**

Parameters: None

Response Format: None (No query for this command)

Example: To clear any faults, send the following command: **R<LF>**

2.4.6.4 Identity

Query to identify the amplifier:

Syntax: ***IDN?**

Parameters: None

Query only (always requires a ? character)

Response Format: **f,m,n,<LF>**

Where:

f = manufacturer
m = model designation
n = firmware revision

Example: To get the identity of the amplifier, send the following command: ***IDN?<LF>**

Response: **AR-RF/MICROWAVE-INST,50W1000D,1.0<LF>**

2.4.6.5 IO Board Firmware Revision

Query to get the firmware revision of the IO Board.

Syntax: ***IOB?**

Parameters: None

Query only (always requires a ? character)

Response Format: **INTERFACE_BOARD_SW_REVx<LF>**

Where:

x = firmware revision

Example: To get the firmware rev. of the IO Board, send the following command: ***IOB?<LF>**

Response: **INTERFACE_BOARD_SW_REV2.01<LF>**

2.4.6.6 State

Query to find the state of the amplifier.

Syntax: **STATE?**

Parameters: None

Response Format: **STATE=<space>xyza**

Where:

x, **y**, **z**, and **a** are each an ASCII character representing a hexadecimal character. They can be 0 to 9 or A to F.

Each hexadecimal character represents a 4-bit binary number. This 4-bit number is a bit pattern which contains information about the state of the amplifier. The definitions of these bit positions can be found in the table below.

Note: Bits labeled NOT USED may be read as a bit state of 1 or 0

	BIT POSITION	BIT DESCRIPTION	BIT STATE 0	BIT STATE 1	NOTES:
x	0	(NOT USED)			
	1	(NOT USED)			
	2	(NOT USED)			
	3	REMOTE CONTROL	DISABLED	ENABLED	Response to mode switch position
y	0	POWER STATUS	OFF	POWER ON	
	1	(NOT USED)			
	2	(NOT USED)			
	3	FAULT STATUS	OFF	FAULT EXISTS	
z	0	(NOT USED)			
	1	(NOT USED)			
	2	(NOT USED)			
	3	(NOT USED)			
a	0	(NOT USED)			
	1	(NOT USED)			
	2	(NOT USED)			
	3	(NOT USED)			

Example: To read the state of the amplifier, send the following query: **STATE?<LF>**

Response: **STATE= 8100<LF>** ***(Remote Mode and Power On)***

2.6.6.13 Faults (50W1000D)

Query to find the faults that have occurred with the amplifier.

Syntax: **FSTA?**

Parameters: None

Response Format: **FSTA=<space>00xx**

Where:

xx = **00** to **34 (Hexadecimal)**

xx	Dec	Description
00	0	No Fault
01	1	Interlock
03	3	Thermal A2
04	4	Amp A2

Example: To find out what faults have occurred, send the following query. **FSTA?<LF>**

Response: **FSTA= 0001<LF>** *(Interlock Fault)*

3. THEORY OF OPERATION

3.1 INTRODUCTION

The Model 50W1000D RF amplifier consists of a 10-250 MHz RF amplifier assembly. The RF amplifier assembly consists of a Pre-Amplifier (Pre-Amp), and one final amplifier module.

The power supply section consists of an AC input filter, a circuit breaker, +5V, +15V, and -15V power supplies; a +24V power supply, voltage regulator circuity, an Operate/Control circuit, and an interface board.

The control system consists of a Control/Fault Board, an Interface Board and remote interfaces for IEEE-488, RS-232, USB, and Ethernet.

3.2 RF AMPLIFIER OPERATION

3.2.1 A1 2W Pre-Amplifier Assembly (Schematic No. 10041189, 10041352, 10041054)

The 2W Pre-Amplifier Assembly consists of 3 sub-assemblies: the A1 Pre-Amplifier Assembly, the A2 Switch Assembly, and the A3 2W Amplifier Assembly.

3.2.1.1 A1 Pre-Amplifier Assembly (Schematic 10041189)

The Pre-Amplifier PWB Assembly consists of a variable attenuator circuit (Q1-Q4), a gain stage (U4), a resistive splitter (R13, R14, R16), an RF power detector (U6), and associated control circuitry. The overall gain of the pre-amplifier assembly is approximately 6-8 dB at minimum attenuation. The power detector (U6) is used to sense the input RF power and it increases the attenuation of the variable attenuator circuit if an input overdrive condition is detected.

3.2.1.2 A2 Switch Assembly (Schematic 10041352)

The Switch Assembly is made up of a variable attenuator circuit (Q1-Q4) and associated control circuitry. The switch can either be in an on or off state depending on the Inhibit input signal (E4). In the off state, when E4 is pulled low, the switch will reduce the amplifier gain by approximately 40 dB.

3.2.1.3 A3 2W Amplifier Assembly (Schematic 10041054)

The 2W Amplifier Assembly has two gain stages (U1 and Q1) that have a combined gain of approximately 30 dB. The output RF power is greater than 2W at the 1 dB compression point.

3.2.2 A2 W Module (Schematic 10036697)

The W Module consists of RF matching circuits, an RF transistor a DC current control circuit, a DC switching circuit and a fault detection circuit.

The RF input is fed to a 4:1 transformer composed of T1, T2, and T3. The push-pull output signal of the 4:1 transformer is connected to the gates of push-pull connected Q1. The drains of Q1 are connected to a 4:1 transformer composed of T4, T4 and T6. The RF transistor , Q1, has approximately 24 VDC applied to the drains at 7 amps current. The RF stage has approximately 18 dB of gain and an output compression point of 50 watts or greater from final amplifiers.

Voltage comparator U1 senses the presence of the –8 VDC. The output of U1 is high if the –8V supply is –5.5 or less. The output of U1 pulls low when the –8 volts is present turning on Mosfet Q2 which supplies the DC voltages to the drain of Q1.

The current through Q1 is monitored by U2. The output of U2 is fed to an op amp (U5) which has a reference voltage on the non-inverting input and it compares the output of U2 to the reference voltage and generates an error signal to vary the gate voltage of the RF transistor Q1 which controls the drain current.

U3 is a positive 5V regulator. It supplies DC to the current sense circuit, U2, the op amp, U5, and the fault detection circuit, U6. SW1 is a thermal switch. It closes at a heat sink temperature of approximately 70° to protect the module in the event of an over-temperature condition.

3.3 POWER SUPPLIES (PS1, PS2)

Power supply PS1 supplies a +5VDC housekeeping supply for the control system assemblies A4 Control/Fault Board and A5 Interface Board.

PS1 also supplies +15 VDC at 2.5 amps and -15 VDC at 1 amp. PS1 is a switching supply that automatically sets the AC input circuits to the correct connections for the line voltage 90-264 VAC input ranges 47-440 Hz.

The +15 VDC at 2.5 amp power supply is fed to the A10 Voltage Regulator board.

The –15 V at 1 amp power supply is fed to the A1 Pre-Amplifier and A2 final module to provide gate voltage for these modules.

Power Supply PS2 is a single output supply which provides +24VDC to the RF final stage and to the A10 Voltage Regulator board. Primary AC circuit protection is provided by the circuit breaker in the Power Entry Module.

3.4 CONTROL SYSTEM

3.4.1 A4 Control/Fault Board (Schematic #10042218)

The A4 Control/Fault board consists of one 16-bit microcontrollers and several other ICs that monitor and indicate the status of the amplifier. Power is supplied using only a single 5-volt power supply. The board offers the following:

Feature	Quantity
Open drain outputs	4
Digital outputs	6
Digital inputs (5-volt tolerant)	24
Analog outputs	2
2-channel encoder input	1
Inputs for a keypad	6
Display connectors	1
Serial communication jacks	2

3.4.2 A5 Interface Board (Schematic #10020073)

3.5 A10 VOLTAGE REGULATOR BOARD

The A10 Voltage Regulator Board contains two adjustable positive voltage circuits employing Linear Regulator ICs U4 and U5. U4 accepts a +24 VDC input and outputs the +24 VDC Drain Voltage for the A1 preamp module. U5 accepts a +24 VDC input and outputs the +24 VDC supply voltage for the B1 Fan Assembly.

4. MAINTENANCE

4.1 GENERAL MAINTENANCE INFORMATION

The Model 50W1000D requires very little maintenance since it is a relatively simple instrument. It is built with etched circuit wiring and solid state devices that will 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. In addition, take care when troubleshooting, not to short voltages across the amplifier. Small bias changes may ruin the amplifier due to excessive dissipation or transients.

Components in AR 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's alignment, it is recommended that when failure is caused by breakdown of any of the components in the signal circuits, the amplifier be returned to the factory for part replacement and amplifier realignment. Shipping instructions are as follows.

To return an item, contact AR Customer Service for an RMA number and shipping instructions. Returns from outside the United States are not permitted without prior authorization. If shipping from outside of the United States, closely follow all directions on the RMA form for return shipping and marking. See warranty statement at rear of manual.

4.2 DISASSEMBLY PROCEDURE

CAUTION:

Extreme caution should be exercised when troubleshooting this unit, particularly when measuring voltages in the power supply section of the unit. Hazardous voltages do exist in the unit that could cause serious injury to any personnel performing the measurements.

The amplifier can be removed from the housing by removing four screws from the front panel and four screws from the rear securing brackets. The amplifier can then be slid from the housing. The top cover can be removed to gain access to the RF assemblies, power supply and control system.

4.3 TROUBLESHOOTING

CAUTION:

The transistors used in the Model 50W1000D amplifier are GaN HEMT transistor. These devices are very reliable when installed in a suitable circuit, but they can be easily damaged by improper troubleshooting or handling techniques.

The gate junctions of the GaN HEMTs have a high input impedance and are susceptible to static damage or damage due to the use of an ungrounded soldering iron. Do not try to check the GaN HEMTs with an ohmmeter.

Use caution when troubleshooting the GaN HEMTs; do not short the gate to the ground or to the drain.

CAUTION:

Use care when unpacking new GaN HEMTs. The GaN HEMT packaging should only be opened at Electrostatic Discharge (ESD)-approved workstations, by individuals who are familiar with the handling of microwave GaN HEMTs and other ESD-sensitive devices.

Troubleshooting the Model 50W1000D 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 50W1000D troubleshooting symptoms and remedies are described in the sections that follow

- 4.3.1—Power On Indication Doesn't Display on Front Panel Vacuum Fluorescent Display (VFD) when POWER Switch is Depressed
- 4.3.2—The Unit Cannot be Operated Remotely
- 4.3.3—Thermal Fault
- 4.3.4—Interlock Fault
- 4.3.5—Amplifier Faults
- 4.3.6—Low or No Power Output (DC Tests)
- 4.3.7—Low or No Power Output (RF Test)

4.3.1 Power On Indication Doesn't Display on Front Panel Vacuum Fluorescent Display (VFD) when POWER Switch is Depressed (Schematic Diagram No. 10042686)

1. If the Model 50W1000D is operating in an otherwise normal fashion, the front panel VFD or the wiring to it could be defective.

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 AC switch on the unit's rear panel; it must be set to the "1" (ON) position. Check the AC fuses in the power entry module.

3. If the POWER ON indication is not displayed and the cooling fan (Blower B1) is not running, check to see that the unit is plugged into a live outlet and that the AC line cord is plugged securely into the unit.

4. Check the +5V housekeeping output voltage from PS1; this voltage should be as follows:

   PS1, P7, Pin 1 + 5.0 ± 0.2VDC

5. If output voltage is not present on PS1, check the AC input to PS1.

6. Check the voltage to the A4 Control/Fault Board on connector J3; the voltages should be as follows:

   J3, Pin 1 + 5.0 ± 0.2VDC

7. Check the voltage on A4 J1, Pin 9; it should be ≥3.3V when the **POWER** switch (S1) is in the normal position and <0.1V when S1 is depressed. S1 is normally open; it is closed only when it is depressed. The amplifier should change state every time the **POWER** switch is depressed.

8. If all voltages are correct and the unit still does not operate, contact AR to arrange for repair or replacement of the A4 Control/Fault Board.

4.3.2 The Unit Cannot Be Operated Remotely

1. Verify that the front panel LOCAL/REMOTE switch is set to the REMOTE position.
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 4.3.1 of this manual.
3. Check the position of the ADDRESS switch assembly (A10); this assembly can be accessed through the unit's rear panel. Check to see that these switches are properly set for either RS-232 or IEEE-488 operation, as desired. (See Section 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 (Schematic Diagram No 10042686, 10036697)

During a Thermal Fault, the front panel VFD should read THERMAL FAULT.

1. Try to reset the unit; if the unit resets and operates normally, check to see that the cooling fan (B1) is operating normally and that the air inlet on the bottom of the unit and the air outlets on the rear of the unit are not blocked.
2. If the unit does not reset and the cooling fans is operating normally, check the voltage at the A4 Control/Fault Board, J13, Pin 28 should be ≤0.1V.
3. If the voltage on A4 J13, pin 28 is high, check the connection to J3-5 and C53.

4.3.4 Interlock Fault (Schematic Diagram No. 10042686)

The Model 50W1000D is equipped with an interlock connector, which is located on the rear panel. 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 50W1000D 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.

1. In the event of an Interlock Fault, the front panel VFD should read INTERLOCK FAULT**.**
2. Check to see if it is safe to be power up the unit—are there personnel present in the screen room, or are doors to the screen room open?
3. After checking for safety, try to clear the Interlock Fault from the front panel by using the RESET switch.
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 mate with J3 in the rear panel).
5. Check the voltage on A4 J13, pin 30; it should be $\leq$ 0.1V.
6. If the voltage on A4 J13, pin 30 is high, check the interlock line to ground.

4.3.5 Amplifier Faults (Schematic Diagram Nos. 10042686 and 10036697)

1. The fault output the A2 W module is sensed on A4, J13, pin 9.
2. The Amplifier Fault LED (DS2) should be lit, indicating a module failure.
3. Verify the correct voltages to the modules. Troubleshoot any incorrect voltages.

   C50 = +24 ± 0.2V
   C51 = –120 ± 0.2V

4.3.6 Low or No Power Output (DC Tests) (Schematic Diagram No. 10042686)

All indicators are normal, the front panel display reads **Power On**, and the cooling fan (B1) is operating.

1. Check the position of the RF Gain control—is it set to maximum gain?
2. Check the RF input to the unit—is it the correct amplitude and frequency?
3. Check the RF output connection from the unit—is it correctly connected to the load? Is the coaxial cable okay?
4. Check the following voltages on the Power Supply. If any of the voltages are out of tolerance, correct them before further troubleshooting.

PS1 J18 Pin 5	+15 V	±0.5 V
PS1 J18 Pin 8	-15 V	±0.5 V

5. Check the voltage on the feed thru caps of the A1 Pre-Amp, with the RF gain control at maximum gain. Troubleshoot any incorrect voltages.

FL2	+24 V	±0.5 V
FL3	-15 V	±0.5 V
FL4	+4.7 V	±0.5 V

6. Check the voltages on the feed-thru caps of A2.

FL1	+40.0 V	±0.3 V
FL4	+15 V	±0.3 V
FL5	–15.0 V	±0.3 V

4.3.7 Low or No Power Output (RF Test) (Schematic Diagram No. 10042686)

NOTE: The DC Tests specified in Section 4.3.8 should be completed before conducting the RF tests specified in the following sections.

1. The Model 50W1000D's typical gain response at 0 dBm input and -20 dBm input is shown in Figure 4-1. The actual gain may vary considerably from that shown in Figure 4-1 but should be ≥ 47 dBm at 0dBm input (TR2).

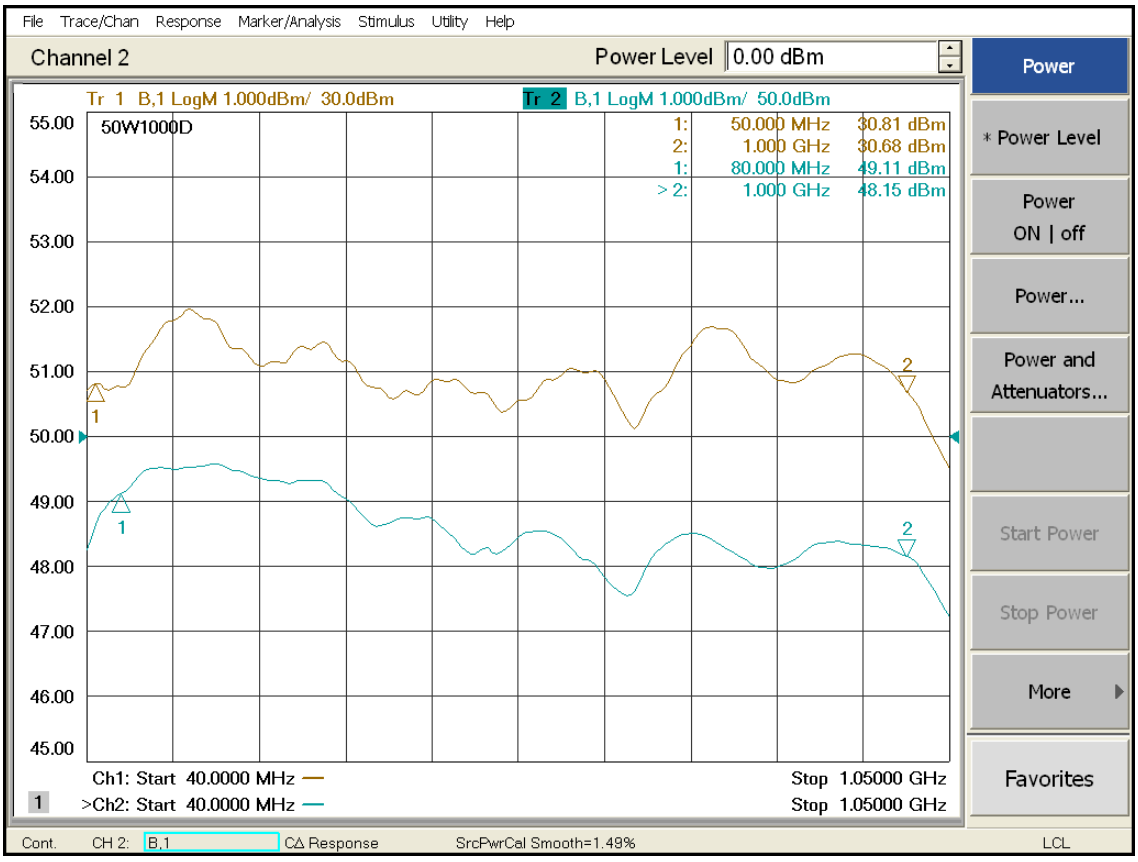


Figure 4-1. Typical Response at -20dBm Input and 0 dBm Input

2. Typical Module response is shown in Figure 4-2.

Figure 4-2. Typical W Module Response

3. The typical response for the A1 Pre-Amplifier (at maximum gain setting) is shown in Figure 4-3.

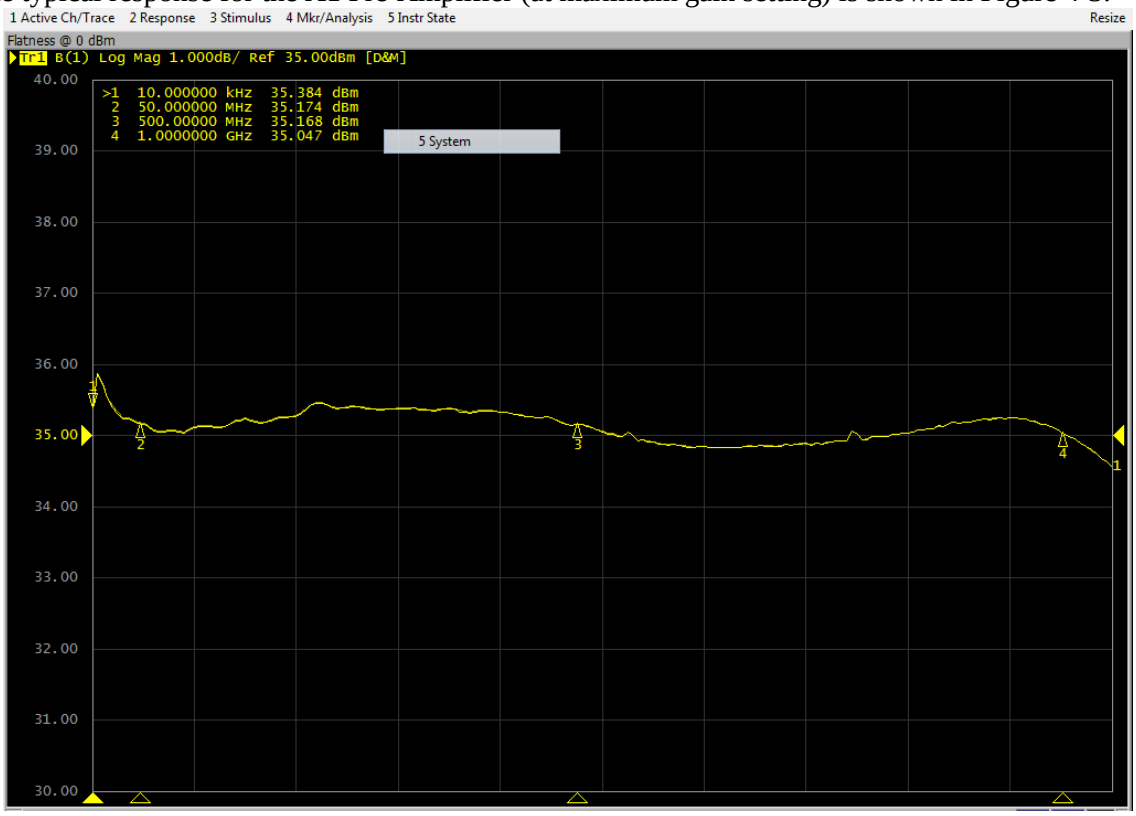


Figure 4-3. Typical A1 Pre-Amplifier Response

WARRANTIES: LIMITATION OF LIABILITY

Seller warrants (i) that seller has title to the goods sold and (ii) that Amplifiers (all parts excluding traveling wave and vacuum tubes), Antennas, field monitors, field probes, field analyzers, field analyzer processor units, system controllers, system interlock, power meters, leak detectors, RF conducted probes, RF conducted clamps, Multi-tone, EMI receiver systems, RF down converters, RF conducted immunity systems, conducted immunity accessories, radiated immunity test systems, safety meters, safety sensor heads, tripods, directional couplers, waveguide adapters, termination loads, load attenuators, impedance stabilization networks, and coaxial cables will be free from defects in material and workmanship for a period of three (3) years from date of shipment shown on AR RF/Microwave Instrumentation invoice.

All modules, used in the amplifiers for the 1-6 GHz, 4-18 GHz, 6-18 GHz, all HPM products, and other applications, are hermetically-sealed. This sealing process protects the internal hybrid circuitry from humidity that could compromise the long term reliability of the product. These modules are not field-repairable and should *never* be opened outside of AR's Microelectronics Lab. The modules in these product lines have a security label on two sides of the modules between the housing and lid/cover. If the security label is removed and or cut, the warranty of the module will be voided.

Vacuum tubes in the 'L' series amplifiers, traveling-wave tubes in TWT amplifiers, and power heads will be free from defects in material and workmanship for a period of one (1) year.

Contact AR RF/Microwave Instrumentation for warranty information regarding items not listed.

Seller's sole responsibility in fulfilling these warranties shall be to repair or replace any goods which do not conform to the foregoing warranties or, at seller's option, to give buyer credit for defective goods. The warranty is valid only when used in the country specified at time of order. Warranty service must be obtained from the repair facility designated at that time. If warranty service is not available in the country where the equipment is to be used, it must be returned to AR RF/Microwave Instrumentation. Warranty service will be provided only for defective goods which are returned within the warranty period, freight costs prepaid to AR RF/Microwave Instrumentation or its designated repair facility.

There are no other warranties, express or implied, including any warranty of merchantability or fitness. Seller shall not be responsible for any incidental or consequential damages arising from any breach of warranty.

No person other than an officer of Amplifier Research Corporation, has any authority to bind seller to any affirmation, representation or warranty except as specifically included in the preceding terms and conditions.

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