



rf/microwave instrumentation

# Operating and Service Manual

60S1G6

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Model

10042478

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Part Number

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Serial Number





# Declaration of Conformity

**Issue Date:** December 2018  
**Model #/s:** Model 60S1G6 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.

<b>EMC:</b>
<b>DIRECTIVE 2014/30/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL</b> of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility
<b>EN 61326-1:2013</b> Electrical equipment for measurement, control and laboratory use–EMC requirements–Part 1: General Requirements
<b>SAFETY:</b>
<b>DIRECTIVE 2014/35/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL</b> 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
<b>CENELEC EN 61010-1 Issued 2010/10/01 Ed: 3</b> Safety Requirements for Electrical Equipment for Measurement Control and Laboratory Use – Part 1: General Requirements
<b>UL 61010-1 Issued 2012/05/11 Ed: 3</b> Safety Requirements for Electrical Equipment for Measurement Control and Laboratory Use – Part 1: General Requirements
<b>CAN/CSA C22.2 #61010-1 Issued 2012/05/11 Ed: 3</b> Safety Requirements for Electrical Equipment for Measurement Control and Laboratory Use – Part 1: General Requirements
<b>HAZARDOUS SUBSTANCES (RoHS 3):</b>
<b>DIRECTIVE (EU) 2017/2105 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL</b> of 15 November 2017 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast)
<b>RECYCLING (WEEE):</b>
<b>DIRECTIVE 2012/19/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL</b> of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast)
<b>SUBSTANCES OF VERY HIGH CONCERN (REACH):</b>
<b>REGULATION (EC) 1907/2006</b> 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.

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# Instructions for European EMC Conformity



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.



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 Störfestigkeitsspezifikation 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.



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 l'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  $\pm 10\%$  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.



# HINWEISE FÜR DEN SICHEREN GEBRAUCH









Bitte beachten Sie die folgenden Hinweise zum Schutz Ihrer persönlichen Sicherheit und um Ihre Ausrüstung und Ihren Arbeitsplatz vor möglichen Schäden zu bewahren.

## VORGESEHENE VERWENDUNG

Dieses Gerät ist für den allgemeinen Einsatz im Labor bestimmt. Es dient der Erzeugung, Steuerung und Messung von elektromagnetischer Hochfrequenzenergie (RF). Stellen Sie sicher, dass das Gerät an einem Ort in Betrieb genommen wird, an dem die abgestrahlte Energie gesteuert werden kann, so dass niemand Schaden erfährt und elektromagnetische Störungen vermieden werden.

## SICHERHEITSSYMBOL

Einige dieser Symbole befinden sich sowohl in der Bedienungsanleitung als auch auf dem Gerät selbst.

	Dieses Symbol befindet sich auf dem Gerät und weist darauf hin, dass der Nutzer an dieser Stelle wichtige Sicherheitsinformationen in der Bedienungsanleitung studieren soll. Das Warnsymbol weist auf eine mögliche Gefahr hin. Zur Vermeidung von Personen- oder Sachschäden gilt es, die Hinweise zu beachten.
	Gefährliche elektrische Spannungen sind vorhanden. Höchste Vorsicht ist geboten.
	Weist darauf hin, dass an dieser Stelle eine Klemme für den Anschluss an einen Außenleiter anzubringen ist, zum Schutz vor einem Stromschlag oder im Fall einer auftretenden Störung, oder dass eine Klemme anzubringen ist, die als schützende Erdungselektrode fungiert.
	Zeigt unsichtbare Laserstrahlung an – nicht direkt hineinschauen.
	Weist auf eine Rahmen- oder Chassis-Anschlussklemme hin.
	Zeigt Wechselstrom an.
	Weist darauf hin, dass dieses Produkt nicht mit Ihrem restlichen Hausmüll entsorgt werden darf.
	Weist darauf hin, dass die markierte Oberfläche und benachbarte Flächen extrem heiße Temperaturen erreichen können und daher nicht angefasst werden sollten.

## SICHERHEITSHINWEISE FÜR DEN AUFBAU DES GERÄTS



Lesen Sie die Bedienungsanleitung aufmerksam durch und machen Sie sich mit allen Sicherheitsmarkierungen und Anweisungen vertraut. Die Sicherheit kann beeinträchtigt sein, falls das Gerät in einer anderen Weise verwendet wird, als von der AR RF/Microwave Instrumentation (AR) vorgegeben ist.

- Zum Heben und Transport folgen Sie allen in dieser Anleitung angegebenen Anweisungen.
- Platzieren Sie das Gerät auf einer harten, ebenen Oberfläche.
- Verwenden Sie das Gerät nicht in feuchter Umgebung, zum Beispiel in der Nähe einer Spüle oder in einem feuchten Keller.
- Platzieren Sie Ihr Gerät so, dass der Netzschalter leicht zugänglich ist.

- Halten Sie einen Mindestabstand von 10,2 cm (4 in) auf allen belüfteten Seiten des Geräts ein, um eine ausreichende Luftzirkulation zu gewährleisten. Beeinträchtigen Sie den Luftstrom des Geräts nicht, indem Sie Lüftungsöffnungen oder den Lufteinlass blockieren. Wird der Luftstrom eingeschränkt, kann dies zu Schäden am Gerät, periodischen Abschaltungen und anderen Gefahren führen.
- Halten Sie das Gerät von extrem heißen oder kalten Temperaturen fern, um sicherzustellen, dass es nur in dem vorgeschriebenen Bedienungsbereich verwendet wird.
- Achten Sie beim Installieren von Zubehör wie Antennen, Richtungskupplungen und Feldsonden darauf, dass sie keinen gefährlichen HF-Werten ausgesetzt sind.
- Stellen Sie sicher, dass nichts auf den Kabeln Ihres Geräts steht. Bringen Sie die Kabel so an, dass niemand darauf treten oder darüber stolpern kann.
- Seien Sie vorsichtig, wenn Sie das Gerät bewegen. Achten Sie darauf, dass alle Rollen und/oder Kabel fest mit dem System verbunden sind. Vermeiden Sie plötzliche Stopps und Oberflächen, die nicht eben sind.

## BEVOR SIE DAS GERÄT ANSCHLIESSEN

Ihre AR-Ausrüstung hat möglicherweise mehr als ein Stromversorgungskabel. Verwenden Sie nur zugelassene Stromkabel. Falls Sie kein Stromkabel oder AC-Netzkabel für dieses Gerät haben, kaufen Sie ein Stromkabel, das für den Einsatz in Ihrem Land zugelassen ist. Das Stromkabel muss für das Gerät, die Spannung und den Strom, die auf dem elektrischen Kennzeichnungsetikett des Geräts markiert sind, zugelassen sein.



Bei einer fehlerhaften Installation oder falls eine Netzspannung verwendet wird, die nicht mit dem Gerät kompatibel ist, erhöht sich die Brandgefahr. Auch andere Gefahren können auftreten. Um einen Stromschlag zu verhindern, schließen Sie das Gerät und die peripheren Stromkabel an ordnungsgemäß geerdete Steckdosen an. Die Kabel sind mit dreipoligen Steckern ausgestattet, um eine korrekte Erdung zu gewährleisten. Verwenden Sie keine Adapter. Entfernen Sie niemals die Erdungsstange eines Kabels.

Modifizieren Sie niemals die Stromkabel oder Stecker. Konsultieren Sie einen lizenzierten Elektriker oder AR-ausgebildeten Servicetechniker, falls Veränderungen am Gerät durchgeführt werden müssen. Halten Sie sich stets an die nationalen/örtlichen Verdrahtungsregeln.



**Schalten Sie das Gerät nicht ein, falls es äußerlich beschädigt ist oder Hardware-Teile oder Konsolen fehlen.**

## SYSTEMERDUNG



Dieses Gerät ist mit einer Schutzerdklemme ausgestattet. Die Netzstromquelle muss dem Gerät eine ununterbrochene Systemerdung von ausreichender Größe zur Verfügung stellen, damit Kabelklemmen, Netzkabel oder mitgeliefertes Netzkabel ordentlich befestigt werden können. **VERWENDEN SIE DIESES GERÄT NICHT, wenn dieser Schutz beeinträchtigt ist.**

# HINWEISE FÜR DEN SICHEREN GEBRAUCH

## GEFÄHRLICHE HF-SPANNUNGEN



Die HF-Spannungen am mittleren Pin eines HF-Ausgangsanschlusses können gefährlich sein. Der HF-Ausgangsanschluss sollte an eine Last angeschlossen werden, bevor das Gerät ans Stromnetz angeschlossen wird. Kommen Sie nicht mit dem Mittelstift des HF-Ausgangsanschlusses oder dem damit verbundenen Zubehör in Kontakt. Bevor Sie die Last vom HF-Ausgang trennen oder diese anschließen, stellen Sie das Gerät in einen nicht betriebsfähigen Zustand.

## HÖRSCHUTZ

Sollten die Geräusche, die das Gerät verursacht, 80dB überschreiten, ist Gehörschutz erforderlich.

## WARTUNGSHINWEISE

Einstellung, Wartung oder Reparaturen der Ausrüstung dürfen nur von qualifizierten Fachleuten durchgeführt werden. Gefährliche Spannungen können auftreten, wenn Schutzabdeckungen vom Gerät entfernt werden, auch wenn es nicht an die Stromquelle angeschlossen ist. Kontakt kann zu Verletzungen führen. Es können nur bestimmte Ersatzsicherungen mit speziellem Nennstrom verwendet werden.

## UMGEBUNGSBEDINGUNGEN

Sofern auf dem Produktspezifikations-Blatt nichts anderes angegeben ist, ist dieses Gerät unter folgenden Bedingungen sicher einsetzbar:

- Gebrauch in Innenräumen
- Höhe bis zu 2000m
- Temperaturen von 5°C bis 40°C
- Maximale relative Luftfeuchtigkeit 80% bei Temperaturen bis 31°C. Lineare Abnahme auf 50% bei 40°C.
- Netzspannungsschwankungen sollen nicht mehr als  $\pm 10\%$  der Nennspannung oder der minimal und maximal eingestellten Werte betragen.
- Verschmutzungsgrad 2: Normalerweise nichtleitfähige Verschmutzung mit gelegentlicher Kondensation. Das Gerät wird bei Einsatz in diesem Bereich keine Gefahr verursachen, die Leistung kann dennoch variieren.

## LASER-INFORMATION



AR - Feldsonden (FL/PL-Serie) und Feldanalysatoren (FA-Serie) sind Laserprodukte der Klasse 1 mit eingebetteten Klasse-4-Lasern. Bei normalem Gebrauch kann der Laserstrahlung nicht aus den Glasfaserkabel herausdringen. Sicherheitsverriegelungen sorgen dafür, dass der Laser nur aktiviert wird, wenn die Kabel richtig angeschlossen sind. Lassen Sie stets Vorsicht walten bei der Verwendung oder Wartung von Laserprodukten. Niemals direkt hineinschauen.

## HF-ANTENNEN

- Die Ausrüstung (Antenne oder Antennenmontage) ist mitunter schwer. Die Montage erfordert daher oft zwei Personen. Folgen Sie allen in diesem Dokument angegebenen Anweisungen zur Anbringung.
- Stellen Sie sicher, dass alle Anschlüsse für den beabsichtigten Betrieb geeignet sind. Informationen zu den Anschlüssen erhalten Sie im Benutzerhandbuch und im Produktspezifikationsblatt.
- Überschreiten Sie nicht den in Spezifikationen angegebenen maximalen HF-Eingangspegel. Informationen zum geeigneten HF-Pegel erhalten Sie im Benutzerhandbuch und im Produktspezifikationsblatt.
- Ein übermäßiger HF-Eingang könnte das Gerät oder die Anschlüsse beschädigen, was zu Sicherheitsrisiken führt.
- Im Betrieb können die HF-Spannungen an den Antennenelementen gefährlich sein. Kommen Sie nicht mit der Antenne oder Antennenelementen in Kontakt, wenn der HF-Eingang an eine live-HF-Quelle angeschlossen ist.
- Um Verletzungen an Personen, am Leistungsverstärker oder der Antenne zu vermeiden, deaktivieren Sie den HF-Ausgang des Leistungsverstärkers, bevor sie die Eingangsverbindung an die Antenne anschließen oder trennen.
- Kontrollieren Sie die Antennen und die Feldsonde regelmäßig, um die nächstfällige Kalibrierung, den ordnungsgemäßen Betrieb und den Gesamtzustand der Ausrüstung zu überprüfen.

## RACK MONTIERBARE TWT-MODELLE

Einige TWT-Modelle kommen ohne die abnehmbare Überdachung, die zur Verwendung als Tischgerät dient. Diese rack-montierbaren Modelle verfügen entweder über installierte Tragegriffe oder Rutschflächen. Befolgen Sie alle in diesem Dokument angegebenen Hebehinweise sowie die Installationsanweisungen in der TWT-Bedienungsanleitung.

## HEBEANWEISUNGEN FÜR AR-GERÄTE

Die meisten Geräte müssen während des Versands, der Montage und des Gebrauchs transportiert werden. Jeder Nutzer sollte sich über das Risiko von schweren Verletzungen durch unsachgemäße Produkthandhabung bewusst sein. Leitlinien zur Beseitigung von vermeidbaren Verletzungsrisikos, die beim Heben entstehen können, werden in den NIOSH-Arbeitspraktiken (Veröffentlichung # 94-110) zur Verfügung gestellt:



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

Beachten folgende, allgemeine Richtlinien zum Heben eines Gewichts von 50 Pfund oder mehr:

- Verwenden Sie zum Heben der Einheit eine Hebeöse (für Platzierung auf dem Boden) oder Seitengriffe (für Platzierung auf einer Arbeitsplatte).
- Verwenden Sie Geräte mit ausreichender Kapazität zum Heben und Stützen.
- Falls Sie einen Gabelstapler verwenden, achten Sie darauf, dass die Gabeln lange genug sind und über die Seiten der Einheit hinausreichen.
- Für weitere Informationen folgen Sie dem oben angegebenen Link.

# INSTRUCTIONS POUR UN FONCTIONNEMENT EN TOUTE SÉCURITÉ









Respectez les consignes de sécurité suivantes pour veiller à votre propre sécurité et vous aider à protéger votre équipement et votre milieu de travail de dommages potentiels.

## USAGE PRÉVU


Cet équipement est prévu pour un usage général en laboratoire afin de générer, contrôler et mesurer les niveaux d'énergie de radiofréquence (RF) électromagnétique. Assurez-vous que l'appareil est utilisé dans un endroit qui contrôlera l'énergie rayonnante et ne causera pas de blessure, ni ne violera les niveaux réglementaires d'interférence électromagnétique.

## SYMBOLES DE SÉCURITÉ

Ces symboles peuvent apparaître dans votre manuel d'utilisation ou sur l'équipement.

	Ce symbole est apposé sur l'équipement lorsque l'utilisateur doit se référer au manuel pour des informations importantes concernant la sécurité. Le symbole de mise en garde indique un danger potentiel. Vous devez accorder une attention à la déclaration pour éviter tout dommage, destruction ou blessure.
	Présence de tensions dangereuses, soyez très prudent.
	Indique une borne de connexion d'un conducteur externe pour une protection contre l'électrocution en cas de défaillance ou la borne d'une électrode de mise à la terre de protection.
	Indique un rayonnement laser invisible – ne regardez pas directement avec des instruments optiques.
	Indique la borne de connexion de la mise à la terre du cadre ou du châssis.
	Indique un courant alternatif.
	Indique que ce produit ne doit pas être jeté avec vos autres déchets ménagers.
	Indique que la surface marquée et les surfaces adjacentes peuvent atteindre des températures qui risquent d'être chaudes au toucher.

## PRÉCAUTIONS D'INSTALLATION DE L'ÉQUIPEMENT

 Lisez le manuel d'utilisateur et familiarisez-vous avec tous les marquages et consignes de sécurité. La protection fournie par l'équipement peut être affaiblie s'il est utilisé d'une manière non indiquée par AR RF/instrumentation à hyperfréquence (AR).

- Respectez toutes les instructions de levage indiquées dans ce document.
- Placez l'équipement sur une surface dure et plane.

- N'utilisez pas l'équipement dans un environnement humide, par exemple près d'un lavabo, ou dans un sous-sol humide.
- Positionnez votre équipement de sorte que l'interrupteur d'alimentation soit facilement accessible.
- Laissez un espace minimal de 10,2 cm (4 in) de tous les côtés ventilés de l'équipement pour permettre le flux d'air nécessaire à une bonne ventilation. Ne limitez pas le flux d'air allant dans l'équipement en bloquant tout évent ou entrée d'air. La restriction du flux d'air peut endommager l'équipement, causer des coupures intermittentes ou des dangers pour la sécurité.
- Tenez l'équipement à l'écart de températures extrêmement chaudes ou froides pour veiller à ce qu'il soit utilisé dans la plage de fonctionnement indiquée.
- Lorsque vous installez des accessoires tels que des antennes, des coupleurs directionnels et des sondes de champ, prenez soin d'éviter toute exposition à des niveaux RF dangereux.
- Assurez-vous que rien n'est posé sur les câbles de votre équipement et que les câbles ne se trouvent pas à des endroits où l'on peut marcher dessus ou trébucher.
- Déplacez l'équipement avec soin ; veillez à ce que tous les câbles et/ou roulettes soient solidement raccordés au système. Évitez les arrêts brusques et les surfaces irrégulières.

## AVANT LA MISE SOUS TENSION

Votre équipement AR peut disposer de plus d'un câble d'alimentation électrique. Utilisez uniquement un ou des câbles d'alimentation approuvés. Si un câble d'alimentation ne vous a pas été fourni avec l'équipement ou pour toute option alimentée en courant alternatif prévue pour l'équipement, achetez un câble d'alimentation qui est approuvé pour être utilisé dans votre pays. Le câble d'alimentation doit être prévu pour l'équipement et pour le courant et la tension indiqués sur l'étiquette de classement électrique de l'équipement.



Installer ou utiliser de façon incorrecte une tension de ligne incompatible peut augmenter le risque d'incendie ou d'autres dangers. Pour aider à éviter toute électrocution, branchez l'équipement et les câbles d'alimentation périphériques dans des prises électriques correctement mises à la terre. Ces câbles sont équipés de prises à trois broches pour veiller à une bonne mise à la terre. N'utilisez pas d'adaptateur de prise, ni ne retirez la broche de mise à la terre d'un câble.

Ne modifiez pas les câbles ou les prises d'alimentation. Consultez un électricien agréé ou un technicien d'entretien AR qualifié pour les modifications d'équipement. Respectez toujours les règles locales/nationales de câblage.



*N'utilisez pas l'équipement s'il est physiquement endommagé ou s'il manque des pièces ou des panneaux.*

## MISE À LA TERRE DE SÉCURITÉ



Cet équipement est fourni avec une borne de mise à la terre de protection. La source d'alimentation secteur à l'équipement doit fournir une mise à la terre de sécurité ininterrompue de taille suffisante pour attacher les bornes de câblage, le cordon d'alimentation ou l'ensemble de câbles d'alimentation fourni. **N'UTILISEZ PAS cet équipement si cette protection est affaiblie.**

# INSTRUCTIONS POUR UN FONCTIONNEMENT EN TOUTE SÉCURITÉ

## TENSIONS RF DANGEREUSES

Les tensions RF sur la broche centrale d'un connecteur de sortie RF peuvent être dangereuses. Le connecteur de sortie RF doit être connecté à une charge avant que l'équipement ne reçoive l'alimentation en courant alternatif. N'entrez pas en contact avec la broche centrale du connecteur de sortie RF ou des accessoires raccordés à celle-ci. L'équipement doit être dans un état de non fonctionnement avant de déconnecter ou de connecter la charge au connecteur de sortie RF.



## LIMITES ACOUSTIQUES

Si le bruit de l'équipement dépasse 80dB, une protection auditive est nécessaire.

## AVERTISSEMENT CONCERNANT L'ENTRETIEN

Le réglage, l'entretien ou la réparation de l'équipement doivent être effectués uniquement par un personnel qualifié. Une énergie dangereuse peut être présente lorsque les couvercles de protection sont retirés de l'équipement, même si celui-ci est déconnecté de la source d'alimentation. Un contact peut causer des blessures. Les fusibles de remplacement doivent être d'un type et courant nominal spécifiques.

## CONDITIONS ENVIRONNEMENTALES

Sauf mention contraire sur la fiche signalétique du produit, cet équipement est conçu pour être sécuritaire dans les conditions environnementales suivantes :

- Utilisation à l'intérieur
- Altitude jusqu'à 2000 m
- Température de 5°C à 40°C
- Humidité relative maximale de 80 % pour les températures jusqu'à 31°C. Décroissance linéaire à 50 % à 40°C.
- Les fluctuations de tension d'alimentation principale ne doivent pas dépasser  $\pm 10$  % de la tension nominale ou des valeurs d'autorégulation minimales et maximales.
- Degré de pollution 2 : Normalement non conducteur avec une condensation occasionnelle. Bien que l'équipement ne cause pas de condition dangereuse dans cette gamme environnementale, sa performance peut varier.

## ÉQUIPEMENT CONTENANT DES LASERS



Les sondes de champ AR (série FL/PL) et les analyseurs de champ (série FA) sont des produits laser de classe 1 contenant des lasers intégrés de classe 4. Lors d'une utilisation normale, le rayonnement laser est entièrement contenu dans les câbles à fibres optiques et ne pose aucun risque d'exposition. Des verrouillages de sécurité veillent à ce que le laser ne soit pas activé à moins que les câbles ne soient correctement raccordés. Soyez toujours prudent lorsque vous utilisez ou entretenez des produits laser. Ne regardez pas directement avec des instruments optiques.

## ANTENNES RF

- Cet équipement (antenne ou ensemble antenne) peut être lourd nécessitant deux personnes pour le soulever. Soyez prudent lorsque vous installez ou retirez l'unité. Respectez toutes les instructions concernant l'installation et le levage de l'équipement indiquées dans ce document.

- Assurez-vous que les connecteurs sont appropriés pour l'utilisation prévue. Les connecteurs sont indiqués dans le manuel d'utilisation et la fiche signalétique du produit.
- Ne dépassez pas le niveau d'entrée RF maximal indiqué dans les spécifications. Référez-vous au manuel d'utilisation et à la fiche signalétique du produit pour déterminer les niveaux RF applicables.
- Une entrée RF excessive pourrait endommager l'équipement ou les connecteurs causant des dangers pour la sécurité.
- Lorsque l'équipement fonctionne, les tensions RF sur les éléments de l'antenne peuvent être dangereuses. N'entrez pas en contact avec l'antenne ou les éléments lorsque le connecteur d'entrée RF est connecté à une source RF active.
- Pour éviter que le personnel ne se blesse et que l'amplificateur de puissance ou l'antenne ne soit endommagé, désactivez la sortie RF de l'amplificateur de puissance avant de brancher ou débrancher la connexion d'entrée à l'antenne.
- Effectuez des inspections périodiques de l'antenne et des systèmes de sondes de champ pour vérifier la date d'échéance de la calibration, le bon fonctionnement et l'état global de l'équipement.

## MODÈLES TWT MONTÉS SUR BÂTI

Certains modèles TWT sont fournis sans le boîtier amovible proposé pour l'utilisation sur un plan de travail. Ces modèles montés sur bâti peuvent être fournis avec des poignées de transport ou des coulisses et poignées frontales. Respectez toutes les instructions de levage indiquées dans ce document et les instructions d'installation fournies dans le manuel d'utilisation TWT.

## INSTRUCTIONS DE LEVAGE POUR L'ÉQUIPEMENT AR

Comme la plupart des produits doivent être manipulés pendant la distribution, l'assemblage et l'utilisation, le risque de blessures graves en raison d'une manipulation dangereuse du produit doit être une considération fondamentale pour chaque utilisateur. Une directive faisant autorité pour éliminer le risque injustifié de blessures causées par le levage est fournie par les méthodes de travail de NIOSH (publication n° 94-110) disponibles sur :



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

De façon générale, respectez les directives suivantes pour lever un poids de 50 lb (22 kg) ou plus :

- Utilisez uniquement l'anneau de levage (si posé au sol) ou les poignées latérales (si sur la table) pour soulever l'unité.
- Utilisez un équipement de capacité adéquate pour soulever et supporter l'unité.
- Si vous utilisez un chariot élévateur pour déplacer l'unité, assurez-vous que les fourches sont assez longues pour s'étendre au-delà du côté de l'unité.
- Pour plus d'informations, suivez le lien indiqué ci-dessus.

# INSTRUCTIES VOOR VEILIG GEBRUIK

Neem de volgende veiligheidsrichtlijnen in acht om uw persoonlijke veiligheid te helpen waarborgen en uw apparaat en werkomgeving tegen mogelijke schade te beschermen.

## BEOOGD GEBRUIK

Dit apparaat is bedoeld voor algemeen laboratoriumgebruik bij het genereren, regelen en meten van niveaus van elektromagnetische radiofrequentie(RF)-energie. Zorg ervoor dat het apparaat wordt gebruikt op een locatie die de uitgestraalde energie controleert, geen letsel veroorzaakt of de reglementaire niveaus van elektromagnetische interferentie schendt.

## VEILIGHEIDSSYMBOLEN

Deze symbolen kunnen in uw gebruikershandleiding of op uw apparaat verschijnen.

	Dit symbool staat op het apparaat als de gebruiker de handleiding moet raadplegen voor belangrijke veiligheidsinformatie. Het waarschuwingssymbool geeft een mogelijk gevaar aan. Er moet aandacht worden besteed aan de verklaring om schade, vernietiging of letsel te voorkomen.
	Er zijn gevaarlijke elektrische spanningen aanwezig. Wees uiterst voorzichtig.
	Wijst op een terminal aan die bedoeld is voor aansluiting op een externe geleider voor bescherming tegen elektrische schokken in het geval van een storing, of de terminal van een veiligheidselektrode (aarding).
	Wijst op een onzichtbare laserstraling - bekijk niet rechtstreeks met optische instrumenten.
	Wijst op het frame of het chassis van de aardingsterminal.
	Wijst op wisselstroom.
	Geeft aan dat dit product niet bij het huishoudelijk afval mag worden weggegooid.
	Geeft aan dat het gemarkeerde oppervlak en de aangrenzende oppervlakken temperaturen kunnen bereiken, die warm aanvoelen.

## VOORZORGSMAATREGELEN BIJ DE INSTALLATIE VAN HET APPARAAT



Raadpleeg de gebruikershandleiding en leer alle veiligheidsmarkeringen en -instructies kennen. De bescherming die door het apparaat wordt geboden, kan worden belemmerd bij gebruik op een manier die niet wordt vermeld door AR RF/Microwave Instrumentation (AR).

- Respecteer alle tilinstructies die in dit document vermeld zijn.
- Plaats het apparaat op een hard, waterpas oppervlak.
- Gebruik het apparaat niet in een natte omgeving, bijvoorbeeld in de buurt van een gootsteen of in een vochtige kelder.
- Plaats uw apparaat zodanig dat de aan/uit-schakelaar gemakkelijk bereikbaar is.

Revisie 0517

- Laat een vrije ruimte van 10,2 cm (4 inch) aan alle geventileerde zijden van het apparaat om de luchtstroom die nodig is voor goede ventilatie mogelijk te maken. Belemmer de luchtstroom in het apparaat niet door ventilatieopeningen of luchtinlaten te blokkeren. Het belemmeren van de luchtstroom kan leiden tot schade aan het apparaat, onregelmatige uitvallen of veiligheidsrisico's.
- Houd het apparaat uit de buurt van extreem hoge of lage temperaturen om ervoor te zorgen dat het apparaat binnen het gespecificeerde werkbereik wordt gebruikt.
- Bij de installatie van accessoires zoals antennes, directionele koppelingen en terreinsondes, moet u ervoor zorgen dat blootstelling aan gevaarlijke RF-niveaus wordt voorkomen.
- Zorg ervoor dat er niets op de kabels van uw apparaat rust en dat de kabels zich niet op een plaats bevinden, waar er op getrapt kan worden of waar er over gestruikeld kan worden.
- Verplaats de apparatuur voorzichtig; zorg ervoor dat alle zwenkwielen en/of kabels stevig op het systeem zijn aangesloten. Vermijd plotselinge stops en oneffen oppervlakken.

## VOOR HET OPZETTEN VAN DE STROOM

Uw AR-apparatuur kan meer dan een netvoedingskabel bezitten. Gebruik alleen goedgekeurde netvoedingskabel(s). Koopt een netvoedingskabel die is goedgekeurd voor gebruik in uw land als u geen netvoedingskabel hebt ontvangen voor de apparatuur of voor een door wisselstroom aangedreven optie, die bedoeld is voor de apparatuur. De netvoedingskabel moet geschikt zijn voor het apparaat en voor de spanning en stroomsterkte die op het label met de elektrische classificatie van het apparaat staat vermeld.



Het verkeerd installeren of gebruiken van een incompatibele netspanning kan het risico op brand of andere gevaren verhogen. Sluit het apparaat en de perifere netvoedingskabels aan op geaarde stopcontacten om elektrische schokken te helpen voorkomen. Deze kabels zijn uitgerust met driepolige stekkers om voor een goede aarding te zorgen. Gebruik geen adapterstekkers of verwijder de aardingspen van een kabel niet.

Pas geen netvoedingskabels of stekkers aan. Raadpleeg een bevoegde elektricien of een door AR opgeleide servicemonteur voor aanpassingen van de apparatuur. Respecteer altijd uw lokale/nationale bedravingsreglementering.



**Gebruik de apparatuur niet als er sprake is van fysieke schade, ontbrekende hardware of ontbrekende panelen.**

## AARDING



Deze apparatuur is voorzien van een beschermende aardingsterminal. De stroombron van de apparatuur moet een ononderbroken veiligheidsaarding van voldoende grootte leveren om de aansluitklemmen, de netvoedingskabel of de meegeleverde netvoedingskabelset aan te sluiten. **GEBRUIK dit apparaat NIET als deze bescherming is beschadigd.**

# INSTRUCTIES VOOR VEILIG GEBRUIK

## GEVAARLIJKE RF-SPANNINGEN

De RF-spanning op de middelste pin van een RF-outputconnector kan gevaarlijk zijn. De RF-uitgangconnector moet op een massa worden aangesloten voordat er wisselstroom op het apparaat wordt geplaatst. Raak de middelste pin van de RF-outputconnector of de accessoires die erop zijn aangesloten, niet aan. Plaats het apparaat in een niet-werkende staat voordat u de massa loskoppelt of verbindt met de RF-outputconnector.



## AKOESTISCHE BEPERKINGEN

Als het geluid van het apparaat 80dB overschrijdt, is gehoorbescherming vereist.

## ONDERHOUD WAARSCHUWING

Aanpassing, onderhoud of reparatie van de apparatuur mag alleen worden uitgevoerd door gekwalificeerd personeel. Er kan gevaarlijke energie aanwezig zijn terwijl beschermende afdekkingen van de apparatuur worden verwijderd, zelfs als deze van de stroombron is losgekoppeld. Contact kan tot persoonlijk letsel leiden. Wisselzekeringen moeten van het hetzelfde type en dezelfde stroomsterkte zijn.

## OMGEVINGSVOORWAARDEN

Tenzij anders op het productspecificatieblad is vermeld, is dit apparaat ontworpen om veilig te zijn onder de volgende omgevingsomstandigheden:

- Binnengebruik
- Hoogte tot 2000 m
- Temperatuur van 5 °C to 40 °C
- Maximale relatieve vochtigheid 80% voor temperaturen tot 31 °C. Lineair afnemend tot 50% bij 40 °C.
- Schommelingen in de netspanning mogen niet groter zijn dan ± 10 % van de nominale spanning of minimum en maximum autobereikwaarden.
- Vervuilinggraad 2: Normaal niet-geleidend met incidentele condensatie. Hoewel het apparaat geen gevaarlijke toestand veroorzaakt boven dit omgevingsbereik, kunnen de prestaties variëren.

## APPARAAT DAT LASERS BEVAT



AR-terreinsondes (FL/PL-serie) en terreinanalysatoren (FA-serie) zijn laserproducten van klasse 1 met ingesloten klasse 4-lasers. Bij normaal gebruik is de laserstraling volledig vervat in de glasvezelkabels en vormt ze geen bedreiging voor blootstelling. Veiligheidsvergrendelingen zorgen ervoor dat de laser niet wordt geactiveerd, tenzij de kabels correct zijn aangesloten. Wees altijd voorzichtig bij het gebruik of het onderhoud van laserproducten. Bekijk niet rechtstreeks met optische instrumenten.

## RF-ANTENNES

- Dit apparaat (antenne of antenne-set) kan zwaar zijn, waardoor er twee personen nodig zijn om het op te tillen. Wees voorzichtig bij het installeren of verwijderen van het apparaat. Respecteer alle instructies voor het instellen en optillen van de apparatuur, die in dit document worden vermeld.
- Zorg ervoor dat de connectoren geschikt zijn voor de beoogde werking. De connectoren worden gespecificeerd in de gebruikershandleiding en in het productspecificatieblad.
- Overschrijd het maximale RF-ingangsniveau niet, dat in de specificaties is vermeld. Raadpleeg de gebruikershandleiding en het productspecificatieblad om de toepasselijke RF-niveaus te bepalen.
- Een overmatige RF-input kan het apparaat of de connectoren beschadigen en veiligheidsrisico's veroorzaken.
- De RF-spanningen op de antenne-elementen kunnen gevaarlijk zijn tijdens het gebruik. Raak de antenne of elementen niet aan wanneer de RF-ingangconnector is aangesloten op een actieve RF-bron.
- Om persoonlijk letsel en onopzettelijke schade aan de vermogensversterker of antenne te voorkomen, schakelt u de RF-output van de vermogensversterker uit voordat u de inputaansluiting op de antenne aansluit of loskoppelt.
- Voer periodieke inspecties uit van de antenne- en terreinsondesystemen om de vervaldatum van de kalibratie, de juiste werking en de algehele conditie van de apparatuur te controleren.

## IN EEN REK GEMONTEERDE TWT-MODELLEN

Sommige TWT-modellen worden geleverd zonder de verwijderbare behuizing die wordt aangeboden voor gebruik als tafemodel. Deze modellen die in een rek kunnen worden gemonteerd, kunnen worden geleverd met handgrepen of sledes en handgrepen die aan de voorkant zijn geïnstalleerd. Volg alle tilinstructies in dit document en de installatie-instructies in de gebruikershandleiding van de TWT.

## TILINSTRUCTIES VOOR AR-APPARATUUR

Omdat de meeste producten tijdens de distributie, de assemblage en het gebruik moeten worden behandeld, moet het risico op ernstig letsel als gevolg van een onveilige behandeling van het product een fundamentele overweging voor elke gebruiker zijn. Een gezaghebbende richtlijn voor het elimineren van ongerechtvaardigd risico op letsel veroorzaakt door tillen, wordt aangeboden door de NIOSH-Work Practices (publicatie # 94-110) en is beschikbaar op:



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

Neem in het algemeen de volgende richtlijnen in acht voor het optillen van een gewicht van 25 kg of meer:

- Gebruik alleen het hijsorg (vloermodel) of de zijhandgrepen (tafelmodel) om de eenheid op te tillen.
- Gebruik apparatuur met voldoende capaciteit om de eenheid op te tillen en te ondersteunen.
- Als u een vorkheftruck gebruikt om de eenheid te verplaatsen, zorg er dan voor dat de vorken lang genoeg zijn om tot voorbij de zijkant van het eenheid uit te steken.
- Volg de link hierboven voor meer informatie.

# TABLE OF CONTENTS

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<b>TABLE OF CONTENTS</b> .....	<b>ii</b>
<b>1. GENERAL INFORMATION</b> .....	<b>1</b>
1.1 General Description .....	1
1.2 Power Supplies.....	1
1.3 Specifications .....	1
<b>2. OPERATING INSTRUCTIONS</b> .....	<b>5</b>
2.1 General .....	5
2.2 Amplifier Front and Rear Panels.....	6
2.3 Local Operation.....	6
2.3.1 Power-up Sequence .....	6
2.4 Remote Communications .....	7
2.4.1 IEEE-488 (GPIB) Communications .....	7
2.4.2 RS-232 Communications .....	8
2.4.3 Fiber-Optic Communications .....	8
2.4.4 USB Communications.....	9
2.4.5 Ethernet Communications .....	9
2.4.6 Remote Commands .....	10
<b>3. THEORY OF OPERATION</b> .....	<b>15</b>
3.1 Introduction .....	15
3.2 RF Amplifier Operation .....	15
3.2.1 A1 Pre-Amp .....	15
3.2.2 A3 Driver Amp.....	16
3.2.3 A5-A8 Output Power Amps .....	16
3.2.4 A4 Four-Way Splitter.....	16
3.2.5 A9 Four-Way Combiner.....	16
3.3 Power Supply .....	16
3.3.1 A13 Regulator Board (Schematic #10031647) .....	17
3.4 Control System.....	17
3.4.1 A14 Control/Fault Board (Schematic #10025460) .....	17
<b>4. MAINTENANCE</b> .....	<b>19</b>
4.1 General Maintenance Information .....	19
4.2 Disassembly Procedure .....	19
4.3 Troubleshooting .....	20
4.3.1 Power On Indication Doesn't Display on Front Panel Vacuum Fluorescent Display (VFD) when POWER Switch is Depressed (Schematic Diagram No. 10032325).....	21
4.3.2 The Unit Cannot Be Operated Remotely .....	22
4.3.3 Thermal Fault (Schematic Diagram No. 10042172).....	22
4.3.4 Interlock Fault (Schematic Diagram No. 10042172) .....	22
4.3.5 PS1 Fault (Schematic Diagram No. 10042172).....	23
4.3.6 Amplifier Faults (Schematic Diagram No. 10042172).....	23
4.3.7 Low or No Power Output (DC Tests) (Schematic Diagram No. 10042172).....	23
4.3.8 Low or No Power Output (RF Test) (Schematic Diagram No. 10042172) .....	24

**FIGURES**

2-1	Model 60S1G6 Front Panel.....	6
2-2	Model 60S1G6 Rear Panel.....	6
4-1	Typical Response @ 0dBm Input and -20 dBm Input .....	24
4-2	Typical Response from the A3 Quad Amplifier Input to the Main RF Output ...	25
4-3	Typical Quad Amp Response.....	25
4-4	Typical 4-Way Splitter Insertion Loss and Return Loss.....	26
4-5	Typical 4-Way Combiner Insertion and Return Loss .....	26
4-6	Typical Quad Amp Response.....	27
4-7	Typical A1 Pre-Amp Response.....	27

**TABLES**

2-1	IEEE-488 Device Address Selection.....	7
2-2	RS-232 Port Settings .....	8
2-3	RS-232 (DCE) Port Pinout Diagram DB-9 Female .....	8
2-4.	Fiber-Optic Port Settings.....	9
2-5.	Relationship between Amplifier Controls and Responses.....	10



# 1. GENERAL INFORMATION

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## 1.1 GENERAL DESCRIPTION

The Model 60S1G6 is a self-contained, broadband microwave 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 10 decibels (dB) or more. Solid state technology is used exclusively to offer significant advantages in reliability and cost. A Model 60S1G6, used with a frequency-swept signal source, will provide 60 watts of swept power output from 0.7–6 gigahertz (GHz). 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 60S1G6 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.

## 1.2 POWER SUPPLIES

The Model 60S1G6 contains a switching power supply. The input voltage range to the power supply is 90–250 VAC, 50/60Hz, selected automatically.

PS1 is a multiple output supply. The main +25.7 volts DC supplies voltage to the RF low level and final stages. The secondary +24 volts DC is for operating the cooling fans and the –24 volts DC is supplied to the (A13) Regulator board. Primary AC circuit protection is provided by the AC fuses in the Power Entry Module.

## 1.3 SPECIFICATIONS

Refer to the AR Data Sheet at the end of this section for detailed specifications. All voltage measurements referenced in this manual are Direct Current (DC) unless stated otherwise.





## 60S1G6

- M1-M5
- 60 Watts CW
- 0.7-6GHz



### Features

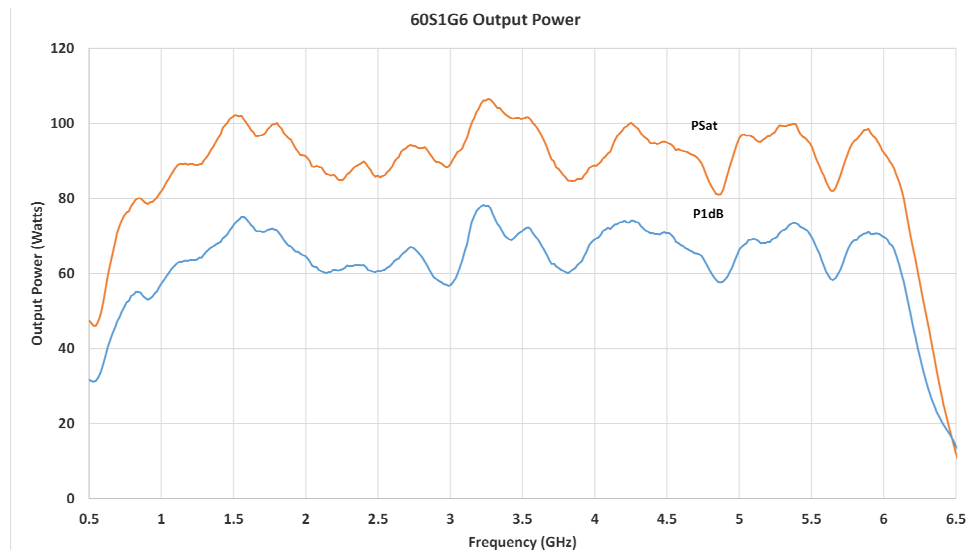
The Model 60S1G6 is a solid-state, Class A design, self-contained, air-cooled, broadband amplifier designed for applications where instantaneous bandwidth, high gain and linearity are required. Housed in a stylish contemporary cabinet, the unit is designed for benchtop use, but can be removed from the cabinet for immediate equipment rack mounting.

The 60S1G6, when used with a sweep generator, will provide a minimum of 60 watts of RF power. Included is a front panel gain control which permits the operator to conveniently set the desired output level. The 60S1G6 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 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 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 in 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.

The low level of spurious signals and linearity of the Model 60S1G6 make it ideal for use as a driver amplifier in testing wireless and communication components and subsystems. It can be used as a test instrument covering multiple frequency bands and is suitable for a variety of communication technologies such as CDMA, W-CDMA, TDMA, GSM etc. It is also suitable for EMC Test applications where undistorted modulation envelopes are desired.

The export classification for this equipment is 3A001. These commodities, technology or software are controlled for export in accordance with the U.S. Export Administration Regulations. Diversion contrary to U.S. law is prohibited.



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# 60S1G6

- M1-M5
- 60 Watts CW
- 0.7-6GHz

## Specifications

**RATED POWER OUTPUT:** 60 watts minimum (0.7-6 GHz)

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

**POWER OUTPUT @ 3dB COMPRESSION:** Nominal, 80 watts; Minimum, 65 watts

**POWER OUTPUT @ 1dB COMPRESSION:** Nominal, 60 watts; Minimum, 50 watts

**SMALL SIGNAL GAIN FLATNESS:** ±1.5 dB typical; ±2.5 dB maximum

**FREQUENCY RESPONSE:** 0.7-6 GHz instantaneously

**GAIN (at maximum setting):** 48 dB minimum

**GAIN ADJUSTMENT:** (Continuous Range; 4096 steps remote) 10 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 the input signal

**THIRD ORDER INTERCEPT:** 56 dBm typical

**NOISE FIGURE:** 10 dB typical

**HARMONIC DISTORTION:** Minus 20 dBc maximum at 60 watts, (0.7-6.0 GHz)

**SPURIOUS:** Minus 73 dBc Typ.

**PHASE LINEARITY:** ±1.0 deg/100 MHz, Typ

**PRIMARY POWER (Selected Automatically):** 90-132, 180-250 VAC; 50/60 Hz, single phase 550 watts maximum

### CONNECTORS:

RF: Type N female

### REMOTE INTERFACES:

IEEE-488: 24 pin

RS-232: 9 pin Subminiature D

RS-232 (fiber optic): Type ST

USB 2.0: Type B

Ethernet: RJ-45

**SAFETY INTERLOCK:** 15 pin Subminiature D

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

**EXPORT CLASSIFICATION:** 3A001

## Model Configurations

MODEL	RF INPUT	RF OUTPUT	WEIGHT	SIZE (W x H x D)
60S1G6	Type N female, front	Type N female, front	28.4 kg (62.5 lbs)	50.3 x 20.3 x 54.6 cm 19.8 x 8.0 x 21.5 in
60S1G6M1	Type N female, rear	Type N female, rear	28.4 kg (62.5 lbs)	50.3 x 20.3 x 54.6 cm 19.8 x 8.0 x 21.5 in
60S1G6M2	Same as 60S1G6 with enclosure removed for rack mounting		20.2 kg (44.5 lbs)	48.3 x 17.8 x 54.6 cm 19.0 x 7.0 x 21.5 in
60S1G6M3	Same as 60S1G6M1 with enclosure removed for rack mounting		20.2 kg (44.5 lbs)	48.3 x 17.8 x 54.6 cm 19.0 x 7.0 x 21.5 in
60S1G6M4	Same as 60S1G6M5 with enclosure removed for rack mounting		20.2 kg (44.5 lbs)	48.3 x 17.8 x 54.6 cm 19.0 x 7.0 x 21.5 in
60S1G6M5	Type N female, front	Type N female, rear	28.4 kg (62.5 lbs)	50.3 x 20.3 x 54.6 cm 19.8 x 8.0 x 21.5 in

## 2. OPERATING INSTRUCTIONS

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### 2.1 GENERAL

Operation of the Model 60S1G6 broadband amplifier is simple. The input signal, whether swept or fixed in frequency, is fed into the jack marked INPUT and the amplifier output signal is taken from the jack labeled OUTPUT. The unit is turned ON by activating the power switch. In the event of a unit malfunction, protection is provided by a circuit breaker located in the AC input receptacle. A polarized, three (3) wire AC power cord is also included with the unit to provide cabinet and chassis grounding to the power mains.



**CAUTION:**

**The Model 60S1G6 amplifier is not critical in regard to source and load VSWR and will remain unconditionally stable with any magnitude and phase of source and load VSWR. It is designed to withstand, without damage, RF input power 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 60S1G6 output to the input causes oscillations which will permanently damage the input circuitry.**



**CAUTION:**

**Although designed for overdrive and load tolerance described above, subjecting the amplifier to these conditions simultaneously can cause failure of the output transistor. Repeated failures of this nature will not be covered under warranty.**

The 60S1G6 Amplifier is protected from input overdrive by an automatic level control circuit which will limit the maximum RF level to the first gain stage of the RF Amplifier to approximately 0 dBm. *NOTE: The amplifier requires 30 minutes of warm-up time to avoid any gain or power drift.*

The 60S1G6 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 60S1G6 Broadband Microwave Amplifier. Figure 2-2 shows the rear panel of the Model 60S1G6 Broadband Microwave Amplifier.

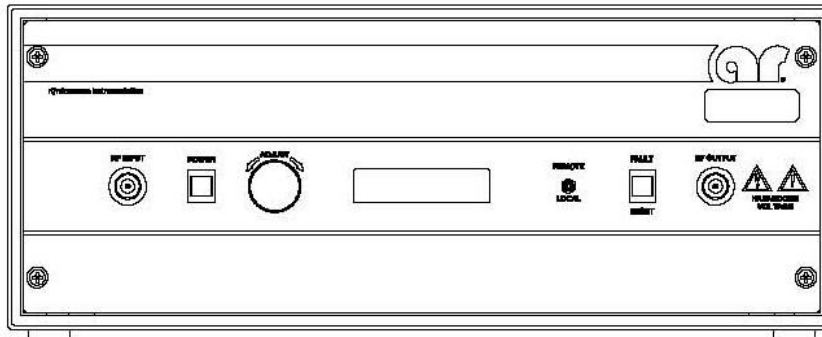


Figure 2-1. Model 60S1G6 Front Panel

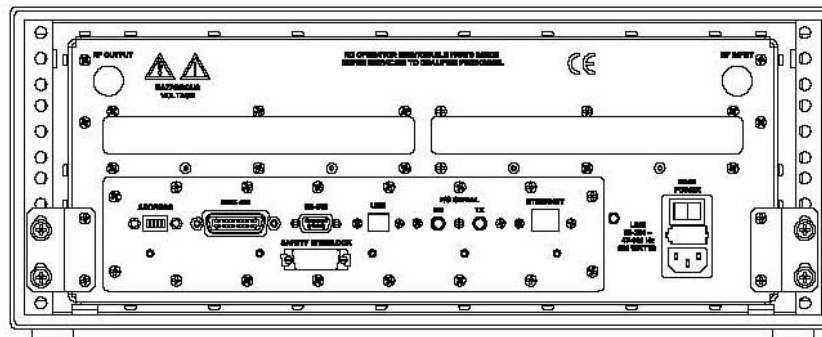


Figure 2-2. Model 60S1G6 Rear Panel

## 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. *NOTE: The amplifier requires 30 minutes of warm-up time to avoid any gain or power drift.*
7. In the event of a fault, press the FAULT/RESET switch; if the fault does not clear, refer to section 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 CONTROLLER)				
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 be 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](http://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](http://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](http://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](http://www.Lantronix.com). For assistance using this utility please consult this utilities 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	√

### 2.4.5.1 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>**

### 2.4.5.2 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)

### 2.4.5.3 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>**

#### 2.4.5.4 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,60S1G6,1.0<LF>**

#### 2.4.5.5 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>**

### 2.4.5.6 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		NOTES:
			0	1	
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*)

### 2.4.5.7 Faults

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

Syntax: **FSTA?**

Parameters: None

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

Where:

**xx = 00 to 0B (Hexadecimal)**

<b>xx</b>	<b>Dec</b>	<b>Description</b>
00	0	No Fault
01	1	Interlock
02	2	PS1
03	3	Thermal Driver
04	4	Thermal Final
06	6	Amp A3
08	8	Amp A5
09	9	Amp A6
0A	10	Amp A7
0B	11	Amp A8

Example: To find out what faults have occurred, send the following query.

**FSTA?<LF>**

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

## **3. THEORY OF OPERATION**

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### **3.1 INTRODUCTION**

The Model 60S1G6 RF amplifier consists of a 0.7–6 GHz RF amplifier assembly. The RF amplifier assembly consists of a Pre-Amplifier (Pre-Amp), one (1) Quadrature-Coupled Amplifier (Quad Amp) used as a driver and four (4) Quad Amps used as final amplifier stages.

The power supply section consists of an AC input filter with fuses and a switch, a switching power supply, and a regulator circuit.

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 Pre-Amp**

The Pre-Amp is assembled on PTFE composite printed wiring boards. The RF input signal is fed to the A1 Pre-Amp. The pre-amp consists of a GaAs Attenuator, MMICs and a Wilkinson splitter. The attenuator is used for manual gain control using the front panel gain control and to attenuate RF input signals above 0 dBm by utilizing internal voltages.

U2 is a broadband GaAs Monolithic Microwave Integrated Circuit (MMIC) and is the first stage of gain in the amplifier. The output of U2 is fed to the input of the Wilkinson Two-Way Splitter.

The Wilkinson Two-Way Splitter splits the signal into two paths. One output is fed to the input of the A3 Driver Amp and the other output is fed to a detector. The detector output is used to protect the unit in the event of input overdrive.

The output driver is fed to another MMIC to boost the gain. Total gain is about 30dB.

### **3.2.2 A3 Driver Amp**

The Driver Amp is assembled on thin film substrates. It has two (2) GaN amplifier sections. Each section is input and output DC isolated by coupling capacitors. A 90° quad coupler combines the RF outputs. 50Ω termination resistors absorb any difference signals and help to improve the input and output VSWR of the module. The module has a gain of approximately 10dB and delivers 20 watts of RF power. Active bias circuitry regulates the DC current through RF devices. The nominal DC current for this amplifier is approximately 3.2A from a 25.7V supply. Logic low voltage on the fault pin indicates a low or high current condition exists on GaN FET 1 (bottom) or FET 2 (top).

### **3.2.3 A5-A8 Output Power Amps**

The output power amplifiers are identical in construction and performance to the driver amplifiers described in 3.2.2.

### **3.2.4 A4 Four-Way Splitter**

The Four-Way splitter is a multi-section, broadband, Wilkinson splitter. The input signal is split into four equal-amplitude, equal-phase signals. The amplitude of each signal is 6–6.5dB below the input signal when both outputs are terminated into 50Ω loads.

### **3.2.5 A9 Four-Way Combiner**

The Four-Way T-combiner is impedance-matching. When the outputs of the four quad amplifiers are fed to the four-way combiner, the combined output will be approximately 6dB above the output of a single quad amplifier.

## **3.3 POWER SUPPLY**

Power supply PS1 supplies a +5VDC housekeeping supply for the control system assemblies A14 Control/Fault Board and A12 Interface Board.

PS1 also supplies +25.7 VDC at 16.0 amps, +24 VDC at 7 amps, -24 VDC at 2 amps. 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 +25.7 VDC at 16.0 amps power supply is fed to the A3 Driver and the A5-A8 quad amps and supplies the FET drain voltage for these amplifiers. The +24 VDC at 7 amps is for fan B1 and the regulator assembly, where it is regulated to +15V.

The -24 V at 2 amps power supply is regulated to -12 V and -5 V through the A13 regulator board and is also regulated to -12V in the A1 pre-amplifier.



### 3.3.1 A13 Regulator Board (Schematic #10031647)

The A13 regulator board filters the +24 VDC and the -24 VDC and has four (4) regulators for the RF amplifier stages.

U1 is a switched 15VDC regulator. This regulator supplies voltage for the A1 pre-amplifier.

U3 is a -12VDC regulator. This regulator supplies voltage for the A1 pre-amplifier.

U4 is a -5VDC regulator. This regulator supplies the gate voltage for stages A1-A3 and A5-A8.

## 3.4 CONTROL SYSTEM

### 3.4.1 A14 Control/Fault Board (Schematic #10025460)

The A14 Control/Fault board consists of two 16-bit microcontrollers and about nine 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	2
Digital outputs	12
Digital inputs (5-volt tolerant)	24
Analog outputs	2
Mixed signal inputs	4
2-channel encoder input	1
Inputs for a keypad	8
Display connectors	2
Serial communication jacks	2



## 4. MAINTENANCE

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### 4.1 GENERAL MAINTENANCE INFORMATION

The Model 60S1G6 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. The power supply and remote interfaces are accessible by removing the bottom cover.

## 4.3 TROUBLESHOOTING



**CAUTION:**

The microwave transistors used in the Model 60S1G6 amplifier are GaAs FETs. 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 GaAs FETs 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 GaAs FETs with an ohmmeter.

Use caution when troubleshooting the GaAs FETs; do not short the gate to the ground or to the drain.



**CAUTION:**

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

Troubleshooting the Model 60S1G6 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 60S1G6 troubleshooting symptoms and remedies are described in the sections that follow

- 4.3.1—Power On Indication Doesn't Display on Front Panel 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—PS1 Fault
- 4.3.6—Amplifier Faults
- 4.3.7—Low or No Power Output (DC Tests)
- 4.3.8—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. 10032325)

1. If the Model 60SIG6 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, P12, 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 A14 Control/Fault Board on connector J3; the voltages should be as follows:  
J3, Pin 2    + 5.0 ± 0.2VDC
7. Check the voltage on A14 J10, Pin 1; 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 A14 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 (A19); 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 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 (Schematic Diagram No 10042172)

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 cooling fans B1 and B2 are 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 are operating normally, check the voltage at the A14 Control/Fault Board, J13, Pins 27 & 28 should be  $\leq 0.1V$ .
3. If the voltage on A14 J13, pins 27 or 28 is high, check the connection through S1 to ground and S3 to ground.

### 4.3.4 Interlock Fault (Schematic Diagram No. 10042172)

The Model 60SIG6 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 60SIG6 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 P19 in the rear panel).
5. Check the voltage on A14 J13, pin 30; it should be  $\leq 0.1V$ .
6. If the voltage on A14 J13, pin 30 is high, check the interlock line to ground.

### 4.3.5 PS1 Fault (Schematic Diagram No. 10042172)

The PS1 power supply has DC OK output which is normally low ( $\leq 0.1\text{V}$ ) to the A14 J13, pin 29. If any of the PS1 outputs fail, this output will go high ( $\geq 4.0\text{V}$ ) and inhibit the A1 Pre-Amplifier.

### 4.3.6 Amplifier Faults (Schematic Diagram No. 10042172)

1. The individual fault outputs for the Quadrature-Coupled Amplifier (Quad Amp) (A3 and A5-A8) are sensed on the A14 Control/Fault Board, J13, pins 9 through 15.
2. The amplifier's top cover can be removed to allow access to the A3 Quad Amp.
3. The Amplifier Fault LED (DS1) should be lit, indicating the Quad Amp has failed.
4. Verify the correct voltages to the Quad Amp. Troubleshoot any incorrect voltages.

$$C1 = +25.7 \pm 0.5\text{V}$$

$$C4 = -5.0 \pm 0.4\text{V}$$

### 4.3.7 Low or No Power Output (DC Tests) (Schematic Diagram No. 10042172)

All indicators on the Model 60S1G6 are normal, the front panel vacuum fluorescent display (VFD) reads **Power On**, and the cooling fans (B1 and B2) are 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 C Module	+25.7 V	$\pm 0.5$ V
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PS1 DB Module Channel 1	+24 V	$\pm 0.5$ V
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PS1 DB Module Channel 2	-24 V	$\pm 0.5$ V
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5. Check the voltage on the feed thru caps of the Quad Amps. Troubleshoot any incorrect voltage.

C1	+25.7 V	$\pm 0.5$ V
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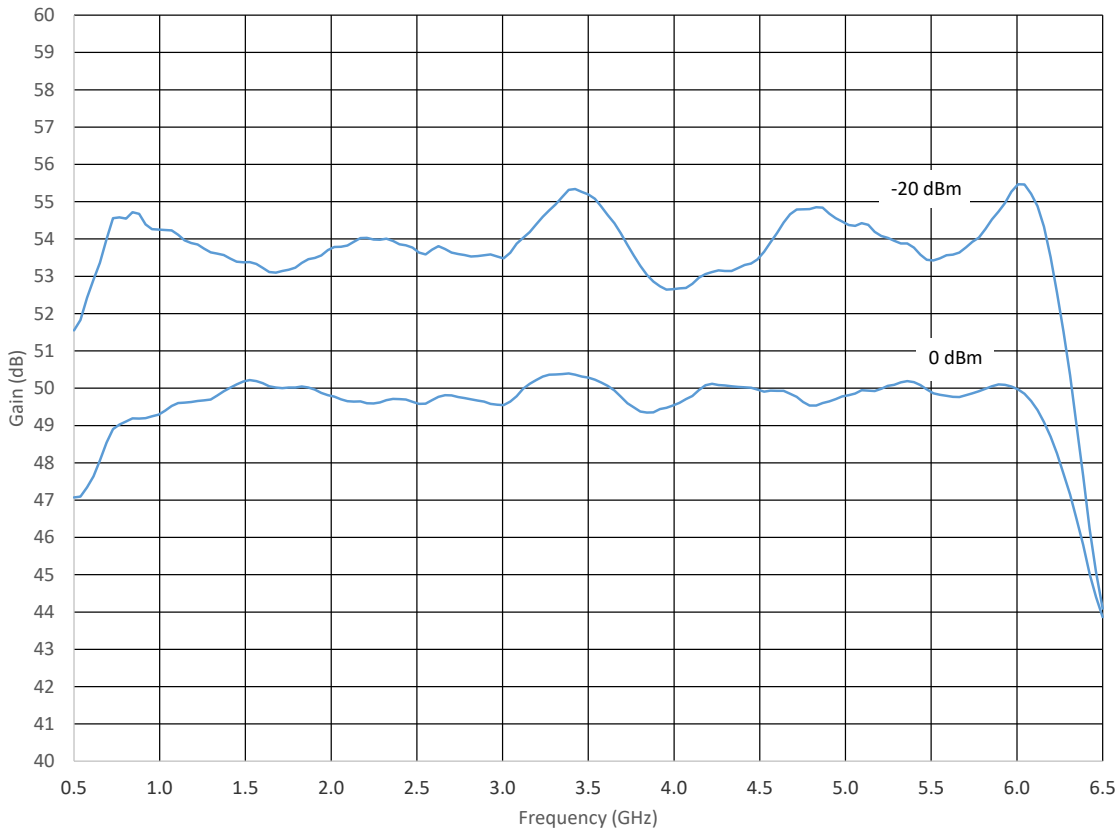
C2	-5 V	$\pm 0.5$ V
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6. Check the voltage on the feed thru caps of the A1 Pre-Amp, with the RF gain control at maximum gain. Troubleshoot any incorrect voltages.

### 4.3.8 Low or No Power Output (RF Test) (Schematic Diagram No. 10042172)

*NOTE: The DC Tests specified in Section 4.3.7 should be completed before conducting the RF tests specified in the following sections.*

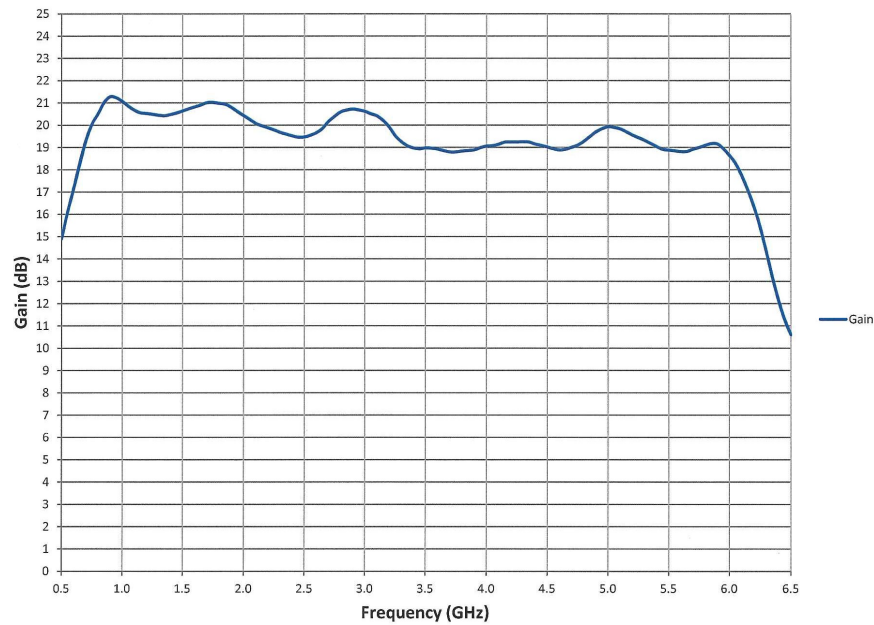
1. The Model 60S1G6’s typical gain response at 0 dBm input and -20 dBm input is shown in Figure 4-1. The actual gain may vary considerably from that shown in Figure 4-1 but should be  $\geq 47$  at 0dBm input and  $\geq 0V$  at -20 dBm input. *NOTE: If the overall gain is low, the amplifier chain can be separated at the input of the A3 Splitter.*



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

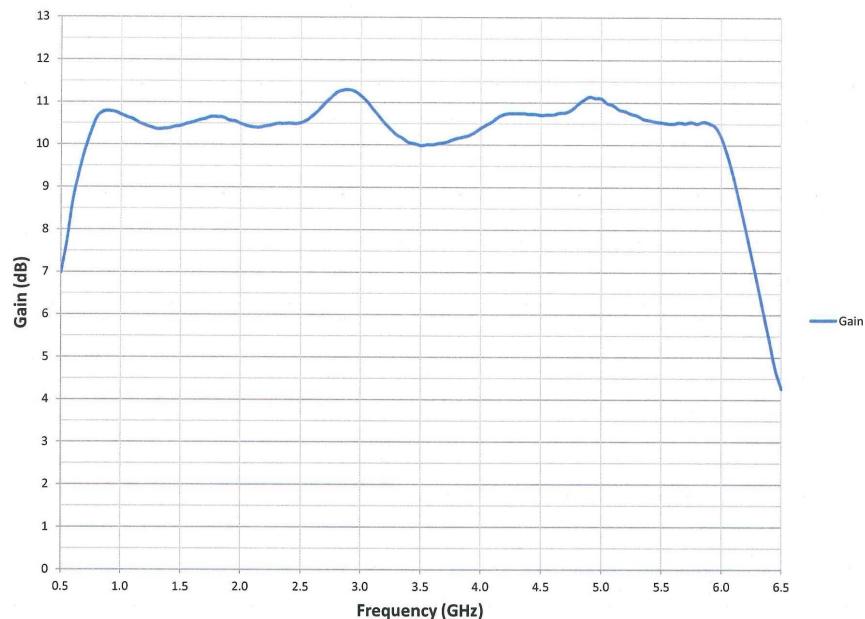


- With the W3 cable disconnected from the input of A3, check the response from the input of A3 to the Main RF output of the amplifier. Typical A3 Quad Amp Response is shown in Figure 4-2.



**Figure 4-2. Typical Gain Response from the A3 Quad Amplifier Input to the Main RF Output**

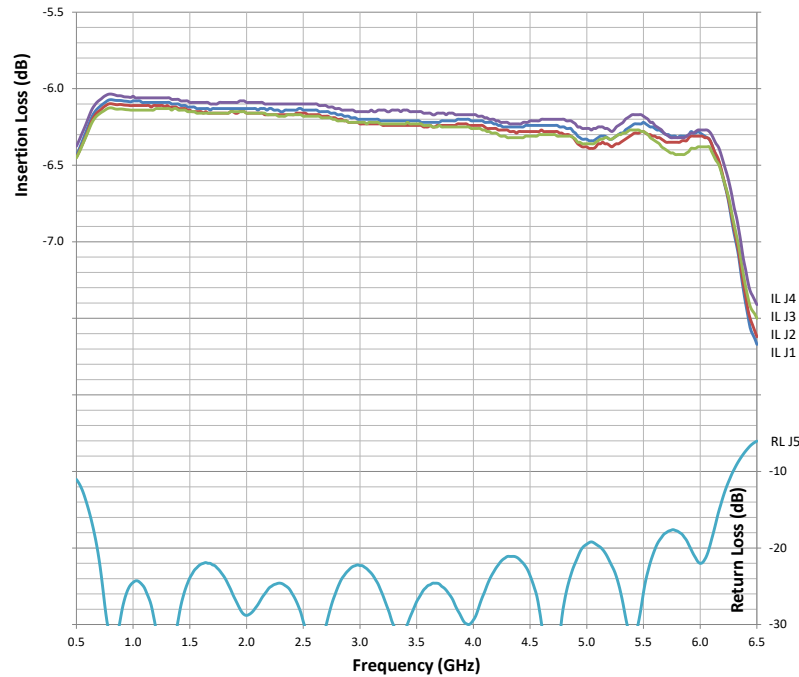
- If the gain is slightly low (i.e., several dB below typical), try disconnecting the input and output cables from the A3, A5-A8 Quad Amps and checking the individual gain. Typical Quad Amp response is shown in Figure 4-3.



**Figure 4-3. Typical Quad Amp Response**

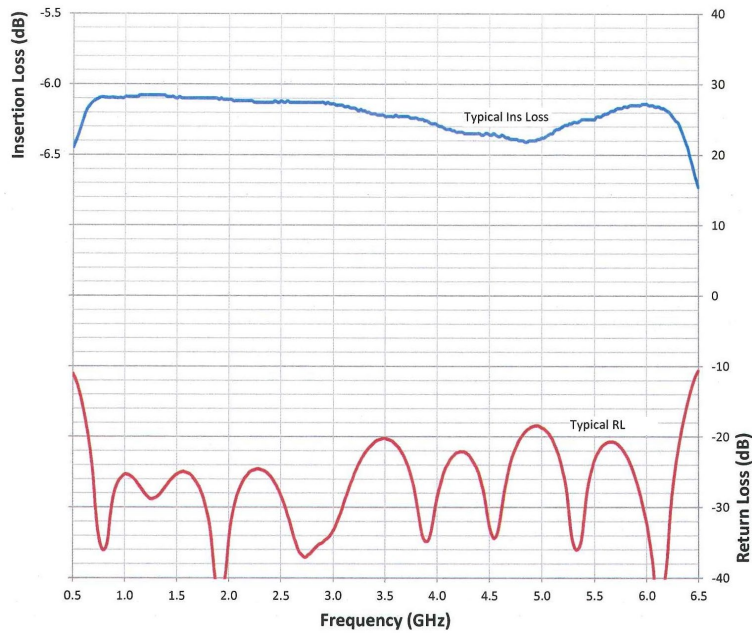
- If the response of the A3, A5-A8 Quad Amps is normal, check the A4 Four-Way Splitter and the A9 Four-Way Combiner.

- A typical Four-Way Splitter insertion loss is shown in Figure 4-4. The unused ports must be terminated when checking the insertion loss. Typical combined port return loss is shown in Figure 4-4.



**Figure 4-4. Typical 4-Way Splitter Insertion Loss and Return Loss**

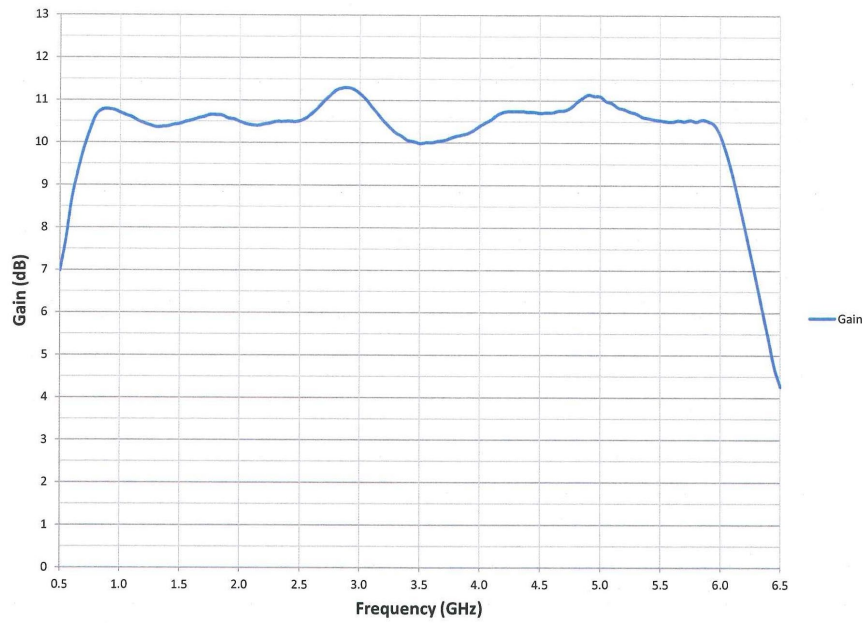
- A typical Four-Way Combiner insertion loss is shown in Figure 4-5; a typical combined port return loss is shown in Figure 4-5. The unused port must be terminated when checking the insertion loss.



**Figure 4-5. Typical 4-Way Combiner Insertion and Return Loss**

*NOTE: The return loss of the Four-Way Combiner's combined output port is typically better than 17 dB (See Figure 4-5).*

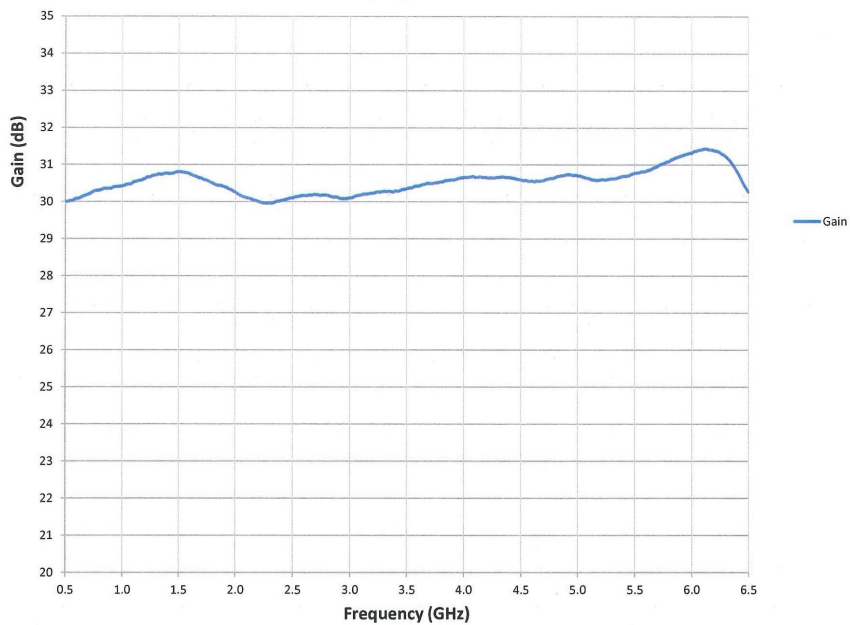
7. If the response of the output stages (i.e., A3 Quad Amp input to front panel RF output) is normal, check the response of the A2 Quad Amp (see Figure 4-6).



**Figure 4-6. Typical Quad Amp Response**

*NOTE: The A1 Preamplifier's response may differ considerably, particularly in flatness, from the typical response shown in Figure 4-7.*

8. The typical response for the A1 Pre-amplifier is shown in Figure 4-7.



**Figure 4-7. Typical A1 Preamplifier 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.

