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rf/microwave instrumentation

Operating and Service Manual

600A400

Model

10046536

Part Number

Serial Number



Declaration of Conformity

Issue Date: December 2018
Model #/s: Model 600A400 Series
Type of Equipment: RF Broadband Amplifier
Function: Designed to be used in a RF immunity test system or for research. The unit is intended to amplify an RF signal and inject it into a load.

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

EMC:
DIRECTIVE 2014/30/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility
EN 61326-1:2013 Electrical equipment for measurement, control and laboratory use–EMC requirements–Part 1: General Requirements
SAFETY:
DIRECTIVE 2014/35/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits
CENELEC EN 61010-1 Issued 2010/10/01 Ed: 3 Safety Requirements for Electrical Equipment for Measurement Control and Laboratory Use – Part 1: General Requirements
UL 61010-1 Issued 2012/05/11 Ed: 3 Safety Requirements for Electrical Equipment for Measurement Control and Laboratory Use – Part 1: General Requirements
CAN/CSA C22.2 #61010-1 Issued 2012/05/11 Ed: 3 Safety Requirements for Electrical Equipment for Measurement Control and Laboratory Use – Part 1: General Requirements
HAZARDOUS SUBSTANCES (RoHS 3):
DIRECTIVE (EU) 2017/2105 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 November 2017 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast)
RECYCLING (WEEE):
DIRECTIVE 2012/19/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast)
SUBSTANCES OF VERY HIGH CONCERN (REACH):
REGULATION (EC) 1907/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Substances of Very High Concern Chemicals (SVHC)

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

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

Authorized officer of the company:

Patricia Thrasher
Manager Quality, Customer Service, Purchasing

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 ± 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.

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- 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 uitval van veiligheidscrisis'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 $\pm 10\%$ 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.

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1. GENERAL INFORMATION

1.1 GENERAL DESCRIPTION

The Model 600A400 is a self-contained, broadband solid-state amplifier designed for laboratory applications where instantaneous bandwidth, high gain, and moderate power output are required. A **GAIN** control, which is conveniently located on the unit's front panel, can be used to decrease the amplifier's gain by 20 decibels (dB) or more. Solid state technology is used exclusively to offer significant advantages in reliability and cost. A Model 600A400, used with a frequency-swept signal source, will provide 600 watts of swept power output from .01–400 megahertz (MHz). Typical applications include antenna and component testing, wattmeter calibration, and electromagnetic interference (EMI) susceptibility testing, as well as usage as a driver for frequency multipliers and high-power amplifiers. The Model 600A400 can be operated locally by using the unit's front panel controls, or remotely by using the unit's IEEE-488, RS-232 interface, USB, or Ethernet interface.

Special features incorporated into the Model 600A400 include the following:

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

1.2 SPECIFICATIONS

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

1.3 POWER SUPPLIES

The Model 600A400 contains three switching power supplies. The input voltage range to the power supply is 200–240 VAC, 50/60Hz. The AC input power is approximately 2950 watts.

PS1 is a multiple output supply. PS1 has a +5 volt, standby supply for the A18 control panel and the A20 Interface board used for the remote interfaces. The -15V is supplied to the A1 preamp, the A2 driver module and the A6–A13 final modules. The +24V is supplied to the B1 through B5 fan assemblies and the combiner fan assemblies. The +15V is supplied to the A2 driver module and the A6 through A13 final modules.

PS2 supplies +40V to the A2 driver module and the A10-A13 final modules.

PS3 supplies +40V to the A6 through A9 final modules. PS3 also supplies +40V to the A28 Regulator Board which in turn supplies a regulated voltage of +24V for the A1 preamp.

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

1.4 INSTALLATION

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

1.4.1 Location

Select an operating location that will permit air to circulate freely around the amplifier's cabinet. The Model 600A400 utilizes air cooling and should be located where the normal flow of air into or exiting from the unit will not be restricted, diverted, or re-circulated through the unit itself; in particular, the flow of warm air exiting the rear of the amplifier should not be impeded.

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

1.4.2 Power

The Model 600A400 is designed to operate using AC primary power of 200–240 Volts Alternating Current (VAC), 50–60 Hz, single phase, 2950 watts maximum.



CAUTION:

Dangerous voltages are present in the Model 600A400 whenever the unit is plugged into an AC outlet. Always disconnect the unit from the main power line when servicing it.

1.5 RF CONNECTIONS

1.5.1 Amplifier Input Connector

The Type N female RF Input connector for the amplifier can be located on the front or rear of the amplifier. A maximum input signal of 0dBm is recommended to achieve full rated power. The amplifier is protected to +13dBm input without damage or failure.

1.5.2 Amplifier Output Connector

The amplifier output connector is a Type 7/16 DIN female which can be located on the front or rear of the amplifier depending on ordered configuration.



CAUTION:

Placing the amplifier in the Operate mode without a load connected to the output connector is not recommended.

1.5.3 RF Sample Ports (Optional)

The Forward and Reverse power sample port connectors are Type N female and can be located on the front or rear of the amplifier depending on ordered configuration. Cables and equipment connected to these ports should exhibit resistive 50Ω impedance throughout the band. The sample ports are normally used for interfacing with external power meters. A calibration table that provides a list of external RF power meter offset values is provided. The offset values completely characterize the directional coupler forward and reverse sample port circuit attenuation across the frequency band. This table is provided electronically as part of the test data packet accompanying this manual.



600A400

- 600 Watts CW
- 10kHz–400MHz
- Class A
- Portable
- Full VSWR-tolerant
- CE & RoHS Compliant
- High Efficiency

Features

The Model 600A400 is a solid-state, self-contained, air-cooled, broadband amplifier designed for applications where instantaneous bandwidth, high gain and linearity are required. Available in a stylish, contemporary cabinet for benchtop use or with cabinet removed for rack mounting.

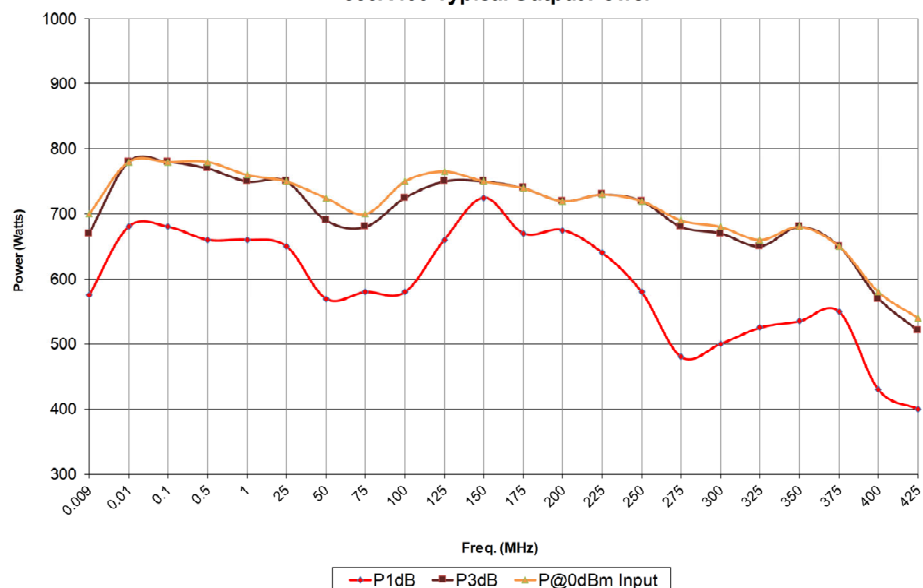
The Model 600A400, when used with a sweep generator, will provide a minimum of 600 watts of RF power from .01-250MHz, 500 watts of RF power from 250MHz-400MHz. Included is a front panel gain control which permits the operator to conveniently set the desired output level. The 600A400 is protected from RF input overdrive by an RF input leveling circuit which controls the RF input level to the RF amplifier first stage when the RF input level is increased above 0dBm. The RF amplifier stages are protected from over-temperature by removing the DC voltage to them if an over-temperature condition occurs due to cooling blockage or fan failure. The Model 600A400 is equipped with a Digital Control Panel (DCP) which provides both local and remote control of the amplifier. The DCP uses a color LCD

touch screen display 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 through the included Remotes Package. The Remotes Package includes GPIB/IEEE-488 format, RS-232 hardware and fiber optic, USB, and Ethernet. The bus interface connector is located on the back panel and positive control of local or remote operation is assured by a Local/Remote switch on the front panel of the amplifier. Also included with the Remotes Package is a safety interlock circuit for use with external safety switch interlocks. This circuit prevents the amplifier from going into operate mode unless the external connection is made. A jumper plug is provided for cases where this functionality is not needed. Optional RF sample ports are available to allow for easy forward and reverse power monitoring.

The export classification for this equipment is EAR99.

600A400 Typical Output Power



AR RF/Microwave
Instrumentation
160 School House Rd
Souderton, PA 18964
215-723-8181

For an applications engineer call: 800.933.8181

www.arworld.us

ISO 9001 Certified



Specifications

600A400

- 600 Watts CW
- 10kHz-400MHz

RATED OUTPUT POWER:

700W typical, 600W minimum; .01-250MHz
600W typical, 500W minimum, 250MHz-400MHz

POWER OUTPUT @ 3dB COMPRESSION:

650W typical, 600W minimum; .01-250MHz
600W typical, 500W minimum, 250MHz-400MHz

POWER OUTPUT @ 1dB COMPRESSION:

575W typical, 500W minimum; .01-250MHz
500W typical, 400W minimum, 250MHz-400MHz

FLATNESS: ±1.5 dB typical, ±2.0 dB maximum

FREQUENCY RESPONSE: 10kHz-400 MHz instantaneously

GAIN (at maximum setting): 57.8 dB minimum

GAIN ADJUSTMENT (Continuous Range): 20 dB minimum

INPUT IMPEDANCE: 50 ohms, VSWR 2.0:1 maximum

OUTPUT IMPEDANCE: 50 ohms nominal

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

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

THIRD ORDER INTERCEPT: 67 dBm typical

NOISE FIGURE: 7.5 dB typical

HARMONIC DISTORTION: Minus 20 dBc maximum at 500 watts

SPURIOUS: Minus 73 dBc typical

PRIMARY POWER: 200-240 VAC, 50/60Hz, 2950 watts

CONNECTORS:

RF Input: N female
RF Output: 7/16 DIN
RF Sample Ports: N female (optional)

REMOTES PACKAGE:

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

COOLING: Forced air (self contained fans)

WEIGHT:

With Cabinet 87 kg (191 lbs)
Without Cabinet 68 kg (148 lbs)

SIZE (W x H x D):

With cabinet: 50.3 x 38.1 x 75.5 cm (19.8 x 15.0 x 29.7 in)
Without Cabinet: 48.3 x 35.6 x 75.5 cm (19 x 14.0 x 29.7 in)

ENVIRONMENTAL:

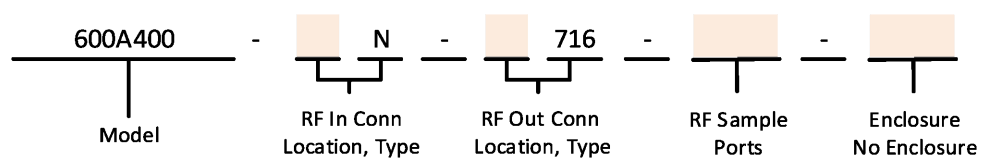
Operating Temperature: 5°C / +40°C
Operating Altitude: Up to 2000M
Shock and vibration: Normal Truck Transport

REGULATORY COMPLIANCE:

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

EXPORT CLASSIFICATION: EAR99

Ordering Options



CONNECTOR LOCATION	
Front	F
Rear	R

RF SAMPLE PORTS	
No RF Sample Ports	NSP
RF Sample Ports Front	SPF
RF Sample Ports Rear	SPR

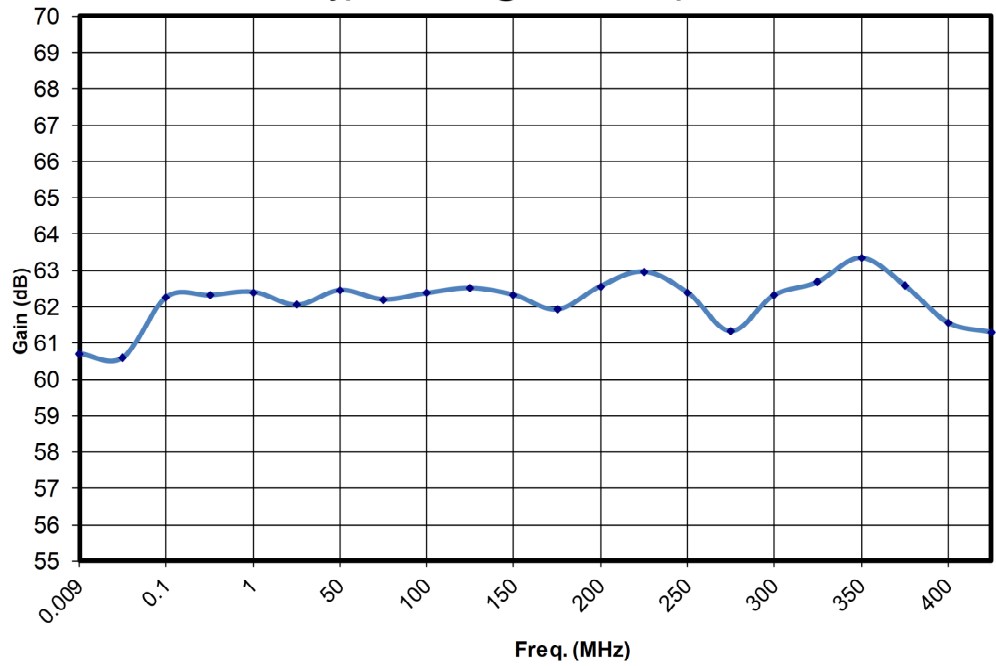
ENCLOSURE	
Enclosure	E
No Enclosure	NE

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

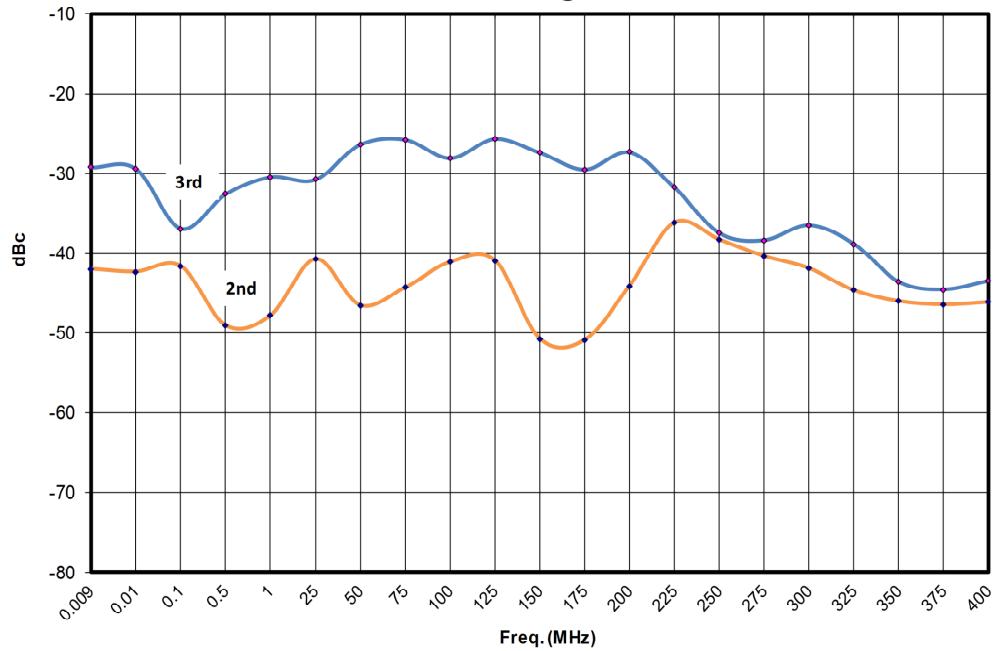
600A400

- 600 Watts CW
- 10kHz-400MHz

Typical Gain @ -20 dBm input



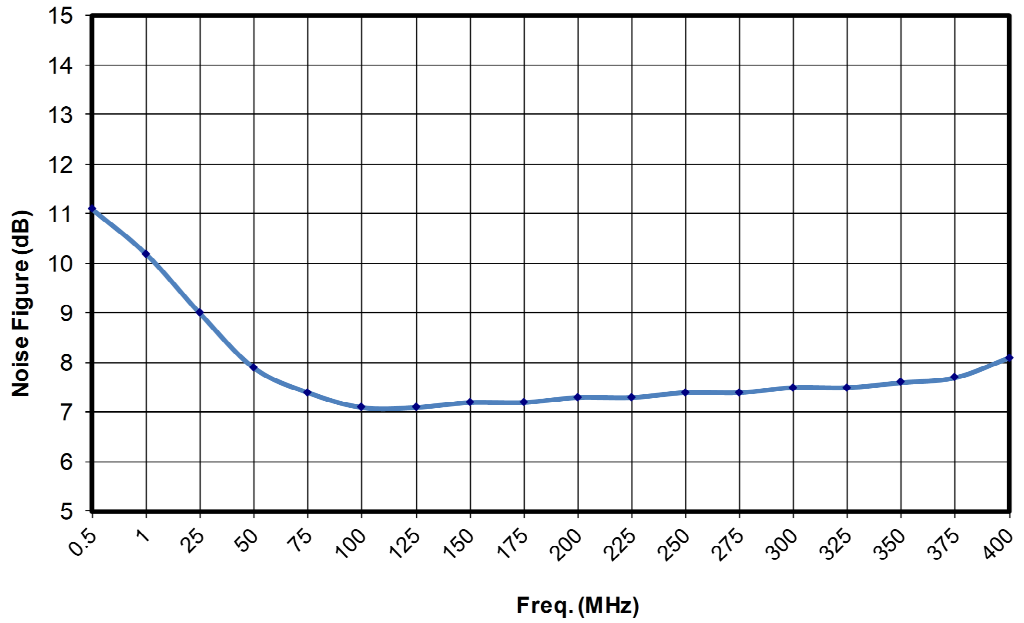
Typical Harmonics @ 500 watts



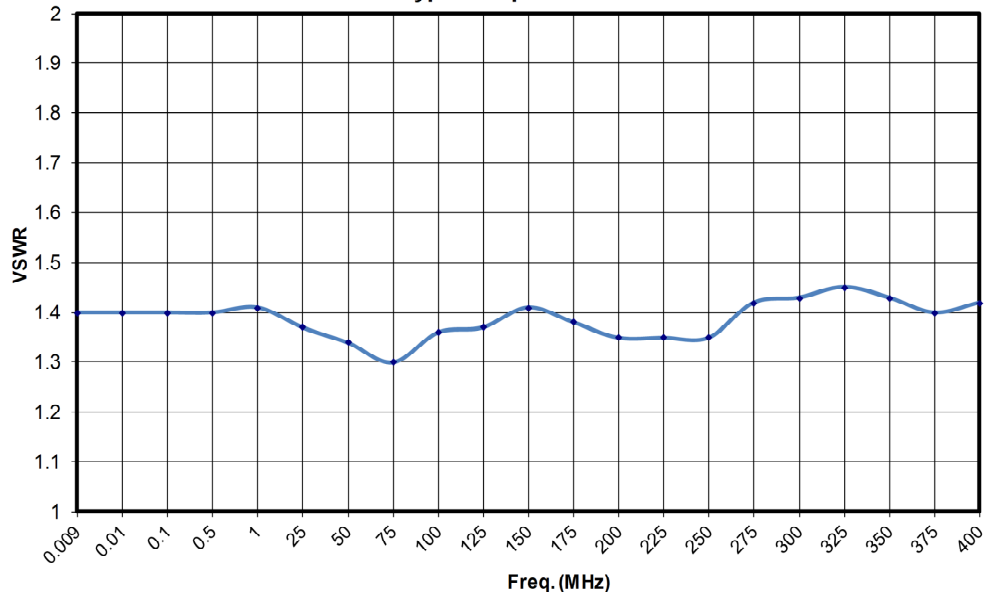
600A400

- 600 Watts CW
- 10kHz-400MHz

Typical Noise Figure vs. Frequency

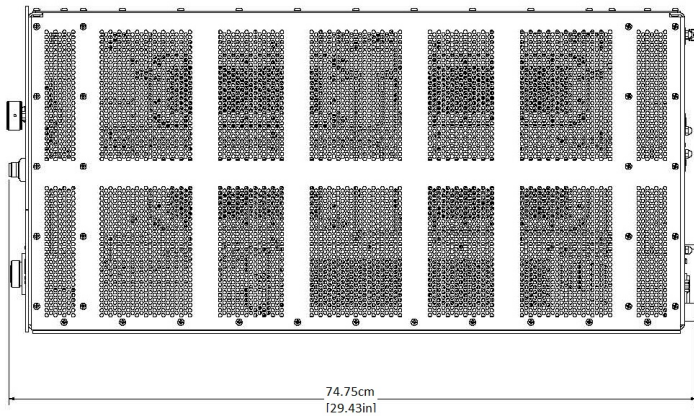
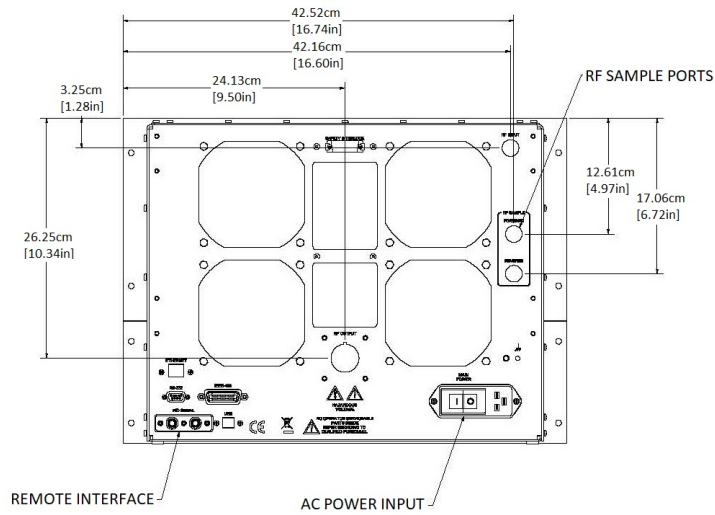
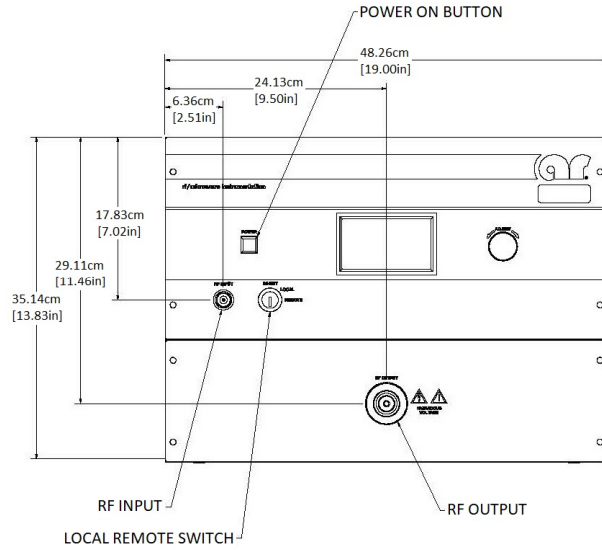


Typical Input VSWR



600A400

- 600 Watts CW
- 10kHz-400MHz



2. OPERATING INSTRUCTIONS

2.1 GENERAL

Operation of the Model 600A400 broadband amplifier is quite simple. The amplifier's input signal, whether swept or fixed in frequency, is fed into the jack marked **RF INPUT**, and the amplifier's output signal is taken from the jack labeled **RF OUTPUT**. The unit is turned on by activating the front panel **POWER** switch. In the event of a major malfunction, protection is provided by a circuit breaker located on the unit's rear panel.



CAUTION:

The Model 600A400 Amplifier will provide 100% of rated power without foldback into a mismatched load. The amplifier will operate without damage or oscillation with any magnitude and phase of source and load impedance. However, placing the amplifier in the operate mode without a load connected to the output connector is not recommended. It has also been designed to withstand, without damage, RF input power levels up to twenty (20) times its rated input of 1mW. However, signal levels higher than 20mW or transients with high peak voltages can damage the amplifier. Also, accidental connection of the Model 600A400's output to its input (either through direct connection or parasitic feedback paths) will cause oscillations that may permanently damage the unit's input transistors.

The 600A400 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 600A400 Broadband Microwave Amplifier. Figure 2-2 shows the rear panel of the Model 600A400 Broadband Microwave Amplifier.



Figure 2-1. Model 600A400 Front Panel

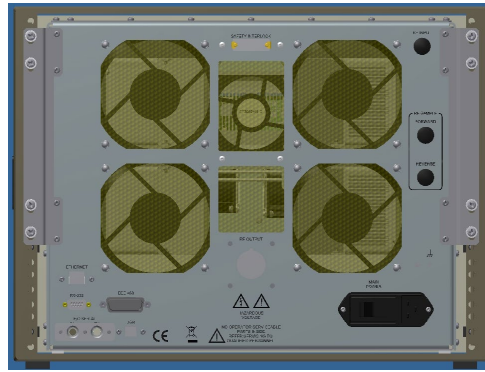


Figure 2-2. Model 600A400 Rear Panel

2.2.1 Local Control Interface

This section describes local operation of the 600A400 using the human interface items found on the control panel.

2.2.1.1. Toggle Switch

The Toggle Switch is provided for protection from unexpected remote control of the 600A400. The 600A400 can only be turned on locally when the Toggle Switch is in the LOCAL position. Likewise, the unit can only be turned on or controlled remotely when the Toggle Switch is in the REMOTE position. All remote queries are processed and responded to in either of the two Toggle Switch positions.

2.2.1.2 Power Button

The momentary POWER button turns the main power to the 600A400 on and off. The status of the green light-emitting diode (LED) in the switch indicates whether the 600A400 power is on or off. The main power supply fans are active when power is on. The LCD touch display is active as long as the main circuit breaker for the 600A400 power entry module is on.

2.2.1.3 Adjust Knob

The ADJUST knob is used to set the RF Gain of the amplifier. The range of RF Gain is 0 to 100 percent. The ADJUST knob can be rotated both clockwise and counterclockwise 360 degrees.

2.2.1.4 Touch Screen

The Touch screen is a color LCD that can accept single touch events from soft blunt objects such as a human finger. The mechanism that registers touch events is resistive based and relies on pressure not capacitance. Menu options presented on the touch screen are typically gray in color with a black text label in the center. When a valid touch event is registered, a thin black box appears around the valid touch location and an optional audible beep will occur.

2.2.1.5 Menu Map

Figure 2-3 shows the menu map for the 600A400. The screens depicted are only example screens. The actual values and settings will be different on the actual amplifier depending on user settings and operating conditions.

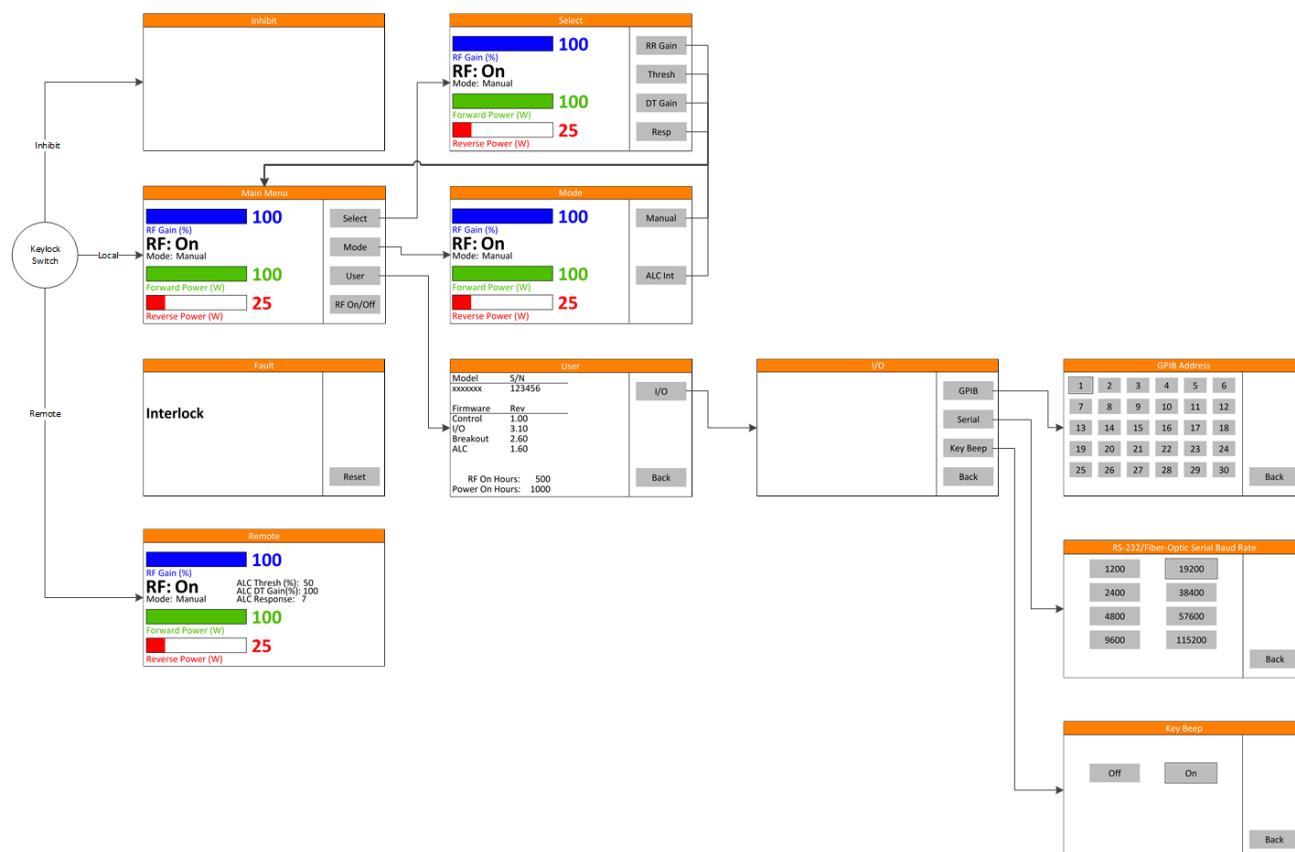


Figure 2-3. Menu Map

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 (on) position.
5. Press the POWER switch.
6. Place the unit in the Operate mode by pressing the RF ON/OFF touch screen button.
7. Adjust the amplifier's gain by pressing the Select button on the Main Menu, then the RF Gain button in the subsequent menu. Adjust the value using the Adjust knob rotating the ADJUST knob.
8. In the event of a fault, press the RESET touch screen button; if the fault does not clear, refer to section 4.3 **Troubleshooting** of this manual.

2.4 REMOTE CONTROL INTERFACE

This section describes remote operation of the 600A400 using the provided General Purpose Interface Bus (GPIB), RS-232, Fiber-Optic Serial, Universal Serial Bus (USB), and Ethernet 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 Toggle switch on the control panel of the 600A400 allows it to be controlled using remote communications. All remote queries will work in any Toggle switch position, but all remote commands will only work when the position is set to REMOTE. When the Toggle switch is set to REMOTE all front panel controls are disabled unless otherwise specified.

2.4.1 GPIB (IEEE-488) Communication

For GPIB operation, the device address is set using the front panel touch screen. Ensure that each device connected to the GPIB is set to a unique address.

To send commands be sure that the 600A400's address is set properly and that the controller has correctly identified it as a "listening" device.

When sending commands via the GPIB interface, terminate with an EOI and a Line Feed character. The 600A400 will ignore characters following the termination.

2.4.1.1 Setting the GPIB (IEEE-488) Address

The GPIB device address can be set to any number between 1 and 30. This selection is made by navigating to the GPIB address selection screen (Section 3.3.1.5.4). To get there from the Main Menu, touch the User menu button followed by the I/O menu button and finally the GPIB menu button. Touching any of the buttons labeled 1 to 30 immediately sets the GPIB address to the corresponding value. A thin black outline indicates the present GPIB address selection. When the back button is pushed the address selection is stored to non-volatile memory. Therefore, if power is lost prior to hitting the back button any address selection changes will be lost. The default GPIB address is 1.

2.4.2 RS-232 Communication

The RS-232 port is a serial communications bus. All commands and queries through this port must be terminated with a Line Feed character. 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 message followed by a Line Feed character is sent out from this port.

The baud rate for the RS-232 port is user selectable from the RS-232/Fiber-Optic Serial Baud Rate selection screen. To get there from the Main Menu, touch the User menu button followed by the I/O menu button and finally the Serial menu button. A thin black outline indicates the present baud rate selection. When the back button is pushed the baud rate selection is stored to non-volatile memory. Therefore, if power is lost prior to hitting the back button any baud rate selection changes will be lost. The default baud rate is 19200.

NOTE: This baud rate setting is shared by both the RS-232 port and the Fiber-Optic serial port.

The RS-232 port is setup as a Data Circuit-terminating Equipment (DCE) port. When connecting to a Personal Computer (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 2-1. RS-232 Port Settings

Word Length	8 bits
Stop Bits:	1
Baud Rate:	User selectable (default is 19200)
Parity:	None
HW Handshake:	None

Table 2-2. 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	DSR
Pin 7	CTS
Pin 8	RTS
Pin 9	Unused

2.4.3 Fiber-Optic Serial Communication

The Fiber-Optic port is a serial communications bus. All commands and queries through this port must be terminated with a Line Feed character. 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 message followed by a Line Feed is sent out from this port.

The baud rate for the Fiber-Optic Serial port is user selectable from the RS-232/Fiber-Optic Serial Baud Rate selection screen. To get there from the Main Menu, touch the User menu button followed by the I/O menu button and finally the Serial menu button. A thin black outline indicates the present baud rate selection. When the back button is pushed the baud rate selection is stored to non-volatile memory. Therefore, if power is lost prior to hitting the back button any baud rate selection changes will be lost. The default baud rate is 19200.

NOTE: This baud rate setting is shared by both the Fiber-Optic serial port and the RS-232 port.

The Fiber-Optic port provides the user with the ability to optically isolate the controlling PC from the 600A400. This can be useful in an environment where RF/Microwave energy could be coupled onto a connection to one of the “wired” communications ports and fed back to the controlling PC.

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

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

This port can be used in conjunction with either an AR model IF7000 RS-232 to Fiber-Optic Interface (1200 to 9600 baud only) or an AR model IF7001 USB to Fiber-Optic Interface (19200 baud only). 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 Fiber Instrument Sales (FIS). Their web-site can be found at www.fiberinstrumentsales.com. An example cable that will work for this connection is FIS Part Number D615M7FIS. The 7 in the part number refers to the length of the cable. In this case the length is 7 meters.

Table 2-3. Fiber-Optic Serial Port Settings

Word Length	8 bits
Stop Bits:	1
Baud Rate:	User selectable (default is 19200)
Parity:	None
HW Handshake:	None

2.4.4 USB Communication

The USB port is a USB 2.0 port. It also complies with the USB Test and Measurement Class (USBTMC) 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 Line Feed character.

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. It should be noted that the USBTMC driver provided by National Instruments is a Virtual Instrument Software Architecture (VISA) driver which can be used with other programming languages besides LabView. For more information on this please consult the National Instruments Website found at www.ni.com.

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

2.4.5 Ethernet Communication

The Ethernet port allows remote control through a Transmission Control Protocol (TCP) data channel. All commands and queries through this port must be terminated with a Line Feed character.

By default this port is setup to work on a network with a Dynamic Host Configuration Protocol (DHCP) server. Upon connection, an Internet Protocol (IP) address is assigned based on the internal Media Access Control (MAC) address. The MAC address is printed on a label located near the Ethernet port.

If the connected network does not have DHCP enabled then the device can be assigned an IP address by the user. To do this, download the utility called DeviceInstaller™ from www.Lantronix.com. For assistance using this utility please consult the 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 is a protocol used to assign a dynamic IP address to a device. Network server software will assign an available IP address to a device when it is connected and powered on. Different IP addresses may be assigned at different times.

2.4.6 Remote Commands

- If a command or query is unrecognized it is echoed back out the port it came in on.
- All commands and queries are terminated with a Line Feed character.
- A Line Feed character is indicated by <LF> in subsequent command and query definitions.
- All queries can be sent when the Toggle switch is in the LOCAL or REMOTE position.
- All commands can only be sent when the Toggle switch is in the REMOTE position.
- All spaces in command and query definitions are indicated by <space>.
- If a query is recognized, its associated response is echoed out the port it came in on.

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 assembly and the Multipurpose Board (MPB) assembly is broken.

The development of application programs requires an understanding of the operation of the 600A400 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 600A400'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 status.

The application program should facilitate the checking of the 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 2-4. Relationship between 600A400 Controls and Remote Communication

AC Power and Circuit Breaker		Power		Keylock Switch			Remote Communication	
On	Off	On	Off	INHIBIT	LOCAL	REMOTE	Command	Query
	√						X	X
√			√			√	√	√
√		√				√	√	√
√		√			√		X	√
√		√		√			X	√
√			√		√		X	√
√			√	√			X	√

X = No, √ = Yes

2.4.6.1 Power On/Off

This command controls the power on/off state of the 600A400.

Syntax: **POWER:x**

Parameters: State(x):

OFF = power off

ON = power on

Response Format: None (No query for this command)

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

POWER:ON<LF>

To turn the power off, send the following command:

POWER:OFF<LF>

2.4.6.2 RF On/Off

This command controls the RF on/off state of the 600A400.

Syntax: **RF:x**

Parameters: State(x):

OFF = power off

ON = power on

Response Format: None (No query for this command)

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

RF:ON<LF>

To turn the RF off, send the following command:

RF:OFF<LF>

2.4.6.3 Reset Faults

This will clear all faults, if possible.

Syntax: **RESET**

Parameters: None

Response Format: None (No query for this command)

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

2.4.6.4 Mode Select

This command sets the ALC mode of the amplifier.

Syntax: **MODE:x**

Parameters: Mode(x):
MANUAL = Set to Manual/CW mode
ALC<space>INT = Set to ALC Internal mode

Response Format: None (No query for this command)

Example: To set the ALC mode to ALC Internal mode, send the following command:
MODE:ALC INT<LF>

2.4.6.5 Level Adjust

This command sets the RF gain, detector gain, ALC threshold, and ALC Response Time of the amplifier.

Syntax: **LEVEL:xy**

Parameters: Parameter(x):
GAIN = RF Gain
DET = Detector Gain
THR = ALC Threshold
RESP = Response Time
Value(y):
For RF Gain, Detector Gain, and ALC Threshold:
0 = Minimum
100 = Maximum
For Response Time:
0 = Minimum
7 = Maximum

Response Format: None (No query for this command)

Example: To set the RF Gain to minimum, send the following command:
LEVEL:GAIN0<LF>

To set the RF Gain to 50%, send the following command:
LEVEL:GAIN50<LF>

To set the ALC Response Time to max, send the following command:
LEVEL:RESP7<LF>

2.4.6.6 Identity

Query to identify the 600A400.

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 600A400, send the following command:
***IDN?<LF>**

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

2.4.6.7 IO Board Firmware Revision

Query to get the firmware revision of the I/O 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 I/O Board, send the following command:
***IOB?<LF>**

Response: **INTERFACE_BOARD_SW_REV3.10<LF>**

2.4.6.8 State

Query to find the state of the amplifier.

Syntax: **STATE?**

Parameters: None

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

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

Table 2-5. States

	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 Keylock Switch position
y	0	POWER STATUS	OFF	POWER ON	
	1	STANDBY STATUS	OFF	STANDBY	Also known as RF OFF
	2	OPERATE STATUS	OFF	OPERATE	Also known as RF ON
	3	FAULT STATUS	OFF	FAULT EXISTS	
z	0	KEYLOCK INHIBIT	OFF	INHIBITED	Response to keylock switch position
	1	(NOT USED)			
	2	(NOT USED)			
	3	(NOT USED)			
a	0	MODE MANUAL	DISABLED	ENABLED	Also known as CW MODE
	1	(NOT USED)			
	2	MODE ALC INTERNAL	DISABLED	ENABLED	
	3	(NOT USED)			

Example: To read the state, send the following query.

STATE?<LF>

Response: **STATE=<space>8301<LF>** (*Remote Mode, Power On, RF OFF, and Manual Mode*)

2.4.6.9 Forward Power

Query to get the forward power.

Syntax: **FPOW?**

Parameters: None

Response Format: **FPOW=x<LF>**

Where:

x = 0 to 99999

Values are corrected and linearized. They can be up to five digits in length. Leading zeros are read as spaces. Units are Watts.

Example: To find out the forward power, send the following query.

FPOW?<LF>

Response: **FPOW=<space><space><space>54<LF>** (*54 Watts of forward power*)

2.4.6.10 Reverse Power

Query to get the reverse power.

Syntax: **RPOW?**

Parameters: None

Response Format: **RPOW=x<LF>**

Where:

x = 0 to 99999

Values are corrected and linearized. They can be up to five digits in length. Leading zeros are read as spaces. Units are Watts.

Example: To find out the reverse power, send the following query.

RPOW?<LF>

Response: **RPOW=<space><space><space><space>9<LF>** (*9 Watts of reverse power*)

2.4.6.11 RF Gain

Query to get the RF gain.

Syntax: **RFG?**

Parameters: None

Response Format: **RFG=<space>x<LF>**

Where:

x = 0000 to 0100

Example: To find out the RF gain of the 600A400, send the following query:

RFG?<LF>

Response: **RFG=<space>0075<LF>** (75% Gain)

2.4.6.12 Faults

Query to find the faults that have occurred with the 600A400.

Syntax: **FSTA?**

Parameters: None

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

Where:

xx = 00 to 1A (Hexadecimal)

Table 2-6. Faults

xx	Decimal	Description	xx	Decimal	Description
00	0	No Fault	0E	14	PS2 Thermal
01	1	PS3	0F	15	Amp A13
02	2	Interlock	10	16	Amp A12
03	3	PS1	11	17	Amp A11
04	4	PS2	12	18	Amp A10
05	5	Therm A13	13	19	Amp A9
06	6	Therm A12	14	20	Amp A8
07	7	Therm A11	15	21	Amp A7
08	8	Therm A10	16	22	Amp A6
09	9	Therm A9	17	23	Amp A2
0A	10	Therm A8	18	24	PS3 Thermal
0B	11	Therm A7	19	25	485 Error
0C	12	Therm A6	1A	26	ALC
0D	13	Therm A2			

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

FSTA?<LF>

Response: **FSTA= 0002<LF>** (Interlock fault)

2.4.6.13 Operating Hours (RF On)

Query to get the RF On operating hours.

Syntax: **OH?**

Parameters: None

Response Format: **OH=x<LF>**

Where:

x = 0 to 100000

Units are Hours. Values can be up to six digits in length. Leading zeros are read as spaces.

Example: To find out the RF On operating hours, send the following query.

OH?<LF>

Response: **OH=<space><space><space><space>37<LF>** *(The system has spent 37 Hours in an RF On state)*

2.4.6.14 Operating Hours (Power On)

Query to get the Power On operating hours.

Syntax: **OHP?**

Parameters: None

Response Format: **OHP=x<LF>**

Where:

x = 0 to 100000

Units are Hours. Values can be up to six digits in length. Leading zeros are read as spaces.

Example: To find out the Power On operating hours, send the following query.

OHP?<LF>

Response: **OHP=<space><space><space>428<LF>**
(The system has spent 428 Hours in a Power On state)

2.4.6.15 ALC Board Firmware Revision

Query to get the firmware revision of the ALC board assembly.

Syntax: ***ALC?**

Parameters: None
Query only (always requires a ? character)

Response Format: **ALC_SW_REVx<LF>**

Where:

x = firmware revision

Example: To get the firmware rev. of the ALC board assembly, send the following command:

***ALC?<LF>**

Response: **ALC_SW_REV1.60<LF>**

2.4.6.16 SBB (Piggyback) Firmware Revision

Query to get the firmware revision of the piggyback SBB assembly.

Syntax: ***SBB?**

Parameters: None
Query only (always requires a ? character)

Response Format: **SBB_SW_REVx<LF>**

Where:

x = firmware revision

Example: To get the firmware rev. of the piggyback SBB assembly, send the following command:

***SBB?<LF>**

Response: **SBB_SW_REV2.60<LF>**

2.4.6.17 System Serial Number

Query to get the serial number of the system.

Syntax: **SN?**

Parameters: None
Query only (always requires a ? character)

Response Format: **x<LF>**
Where:
x = serial number (6 to 8 characters)

Example: To get the serial number, send the following command:
SN?<LF>

Response: **1234567<LF>**

2.4.6.18 AC Power-On Defaults

Default settings that are applied at AC mains power-on can be changed by adding the following prefix to select commands.

Syntax: **DEFAULT:**

Compatible commands:

Level Adjust

LEVEL:GAIN	
LEVEL:DET	(Not available on all models)
LEVEL:THR	(Not available on all models)
LEVEL:RESP	(Not available on all models)

Mode Select

MODE:MANUAL	(Not available on all models)
MODE:PULSE	(Not available on all models)
MODE:ALC<space>INT	(Not available on all models)
MODE:ALC<space>EXT	(Not available on all models)

NOTES:

1. Use the command **DEFAULT:FACTORY** to reset all applicable settings back to their factory defaults.
2. All applicable defaults can be queried, except **DEFAULT:FACTORY**, by adding a ? character in place of the setting parameter.
3. If the ALC Lockout Feature (not available on all models) is engaged, the default ALC values set with this command will not be used.

Example 1: To set the default RF Gain to 75%, send the following command:
DEFAULT:LEVEL:GAIN75<LF>

Example 2: To query the default RF Gain setting, send the following command:

DEFAULT:LEVEL:GAIN?<LF>

Response: **DEFAULT:LEVEL:GAIN75<LF>**

Example 3: To set the default mode to manual, send the following command:

DEFAULT:MODE:MANUAL<LF>

2.4.7 Interlocks

The 600A400 has one interlock circuit that is wired to the rear panel Safety Interlock connector. This interlock requires a normally closed external circuit to allow the unit to function.

2.4.7.1 Inhibit Interlock

This interlock circuit inhibits RF amplification by disabling the low level (A1) and Power (A2 and A6 through A13) amplifier stages.

The Inhibit Interlock is wired to the rear panel interlock connector pins 1 and 8. A closed circuit from interlock connector pin 1 to pin 8 is required for normal operation. Opening the Inhibit Interlock connection will inhibit the amplifier and display **Fault:Interlock** on the front panel Touch Display.

When the Inhibit Interlock circuit is restored to a closed condition, the Inhibit Interlock fault can be cleared by pressing the **RESET** button on the front panel LCD or by using the remote reset command (when the Toggle Switch is set to **REMOTE**).

3. THEORY OF OPERATION

3.1 INTRODUCTION

The Model 600A400 RF amplifier consists of a .01-400 MHz RF amplifier assembly. The RF amplifier assembly consists of a Pre-Amplifier (Pre-Amp), one driver amplifier module, and eight final amplifier modules.

The power supply section consists of an AC input line filter circuit breaker, +5V, -15V, +24V, two +40V power supplies, an Operate/Control circuit, and an interface board.

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

3.2 RF AMPLIFIER OPERATION

3.2.1 A1 Pre-Amplifier Assembly (Schematic No. 10045472, 10041352, 10045475)

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

3.2.1.1 A1 Pre-Amplifier Assembly (Schematic 10045472)

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

3.2.1.2 A2 Switch Assembly (Schematic 10041352)

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

3.2.1.3 A3 Output Amplifier Assembly (Schematic 10045475)

The Output Amplifier Assembly has a single gain stage (U1) that has a gain of approximately 15 dB.

3.2.2 A2 100W 400MHz Driver Module Assembly (Schematic 10039874)

The 100W 400MHz Module Assembly consists of RF matching circuits, an RF transistor (Q1), a bias control circuit, and a fault detection circuit.

The RF input is fed to a 4:1 balun transformer composed of T1 and T2. The output signal of the 4:1 transformer is connected to the gates of Q1. The drains of Q1 are connected to a 4:1 balun transformer composed of T3 and T4. Q1 has approximately 40 VDC applied to both drains at a total current of 7.5A. The RF stage has approximately 21 dB of gain and an output compression point of 75W or greater.

The current through Q1 is monitored by U1. The output of U1 is fed to an op amp (U3) which has a reference voltage on the non-inverting input. U3 compares the output of U1 to the reference voltage and generates an error signal. This error signal varies the gate voltages of Q1 which in turn controls Q1's current draw.

U5 is a comparator that monitors the output of U1 and generates a fault signal if the drain current varies outside normal operating conditions. It also monitors the module temperature via a thermistor (R31) and generates a fault signal if the module heatsink exceeds approximately 80°C.

3.2.3 A3 Two-Way Splitter

The Two-Way Splitter is a broadband splitter. The input signal is split into two equal-amplitude equal-phase signals. The amplitude of each signal is 3-3.5 dB below the input signal when all outputs are terminated into 50Ω loads.

3.2.4 A4, A5 Four-Way Splitter

The Four-Way Splitter is a broadband 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 all outputs are terminated into 50Ω loads.

3.2.5 A6–A13 100W 400MHz Module Assembly (Schematic 10039874)

The 100W 400MHz Module Assembly consists of RF matching circuits, an RF transistor (Q1), a bias control circuit, and a fault detection circuit.

The RF input is fed to a 4:1 balun transformer composed of T1 and T2. The output signal of the 4:1 transformer is connected to the gates of Q1. The drains of Q1 are connected to a 4:1 balun transformer composed of T3 and T4. Q1 has approximately 40 VDC applied to both drains at a total current of 7.5A. The RF stage has approximately 21 dB of gain and an output compression point of 75W or greater.

The current through Q1 is monitored by U1. The output of U1 is fed to an op amp (U3) which has a reference voltage on the non-inverting input. U3 compares the output of U1 to the reference voltage and generates an error signal. This error signal varies the gate voltages of Q1 which in turn controls Q1's current draw.

U5 is a comparator that monitors the output of U1 and generates a fault signal if the drain current varies outside normal operating conditions. It also monitors the module temperature via a thermistor (R31) and generates a fault signal if the module heatsink exceeds approximately 80°C

3.2.6 A24, A25, A26 A27 Two-Way Combiners

A24, A25, A26 and A27 are Two-Way combiners with impedance matching. The combiners operate in a zero-degree configuration. The combiners are designed to tolerate loss of input signals at full output power.

3.2.7 A14 Four-Way Combiner

The Four-Way Combiner operates in zero-degree configuration with a broadband range of .01-400 MHz. The combiner is designed to tolerate loss of input signals at full power.

3.2.8 A15 Bi-Directional Coupler

The A15 Bi-Directional Coupler takes a sampling of the forward and reverse RF output signal for use in the automatic level control and display circuitry. The RF coupling of the forward and reverse coupled ports is approximately 60 dB.

3.2.9 A16 Detector (Schematic 10045651)

The A16 Detector converts the RF signals from the bi-directional coupler to a DC voltage for use in the automatic leveling, sample ports, and display circuitry.

3.3 POWER SUPPLIES (PS1, PS2, PS3)

Power supply PS1 supplies a +5VDC housekeeping supply for the control system assemblies A18 Control/Fault Board and A20 Interface Board.

PS1 also supplies -15 VDC at 2.5 amps. PS1 is a switching supply that automatically sets the AC input circuits to the correct connections for the line voltage 200-240 VAC input ranges 50/60 Hz.

The -15 VDC at 2.5 amp power supply is fed to the A1 Pre-Amp, and A2 driver and A6-A13 power modules.

The +24 VDC at 7.5 amps power supply is fed to all fan assemblies.

Power Supply PS2 is a single output supply which provides +40VDC to the A2 driver and A10 through A13 power modules. Primary AC circuit protection is provided by the circuit breaker in the Power Entry Module.

Power Supply PS3 is a single output supply which provides +40VDC to the A6 through A9 power modules, and the A28 regulator assembly. Primary AC circuit protection is provided by the circuit breaker in the Power Entry Module.

3.4 CONTROL SYSTEM

3.4.1 A18 Control/Fault Board (Schematic #10042218)

The A12 Control/Fault board consists of one 16-bit microcontrollers and several other ICs that monitor and indicate the status of the amplifier. Power is supplied using only a single 5-volt power supply. The board offers the following:

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

3.4.2 A20 Interface Board (Schematic #10020073)

The A20 Interface board connects the remote control ports to the A18 controller.

3.4.3 A17 ALC

The A17 Level Control Assembly performs the following functions:

- Provides automatic level control of the amplifier's output when placed in ALC mode.
- Limits RF input level to the amplifier when forward or reflected power levels exceed specified limits.
- Drives forward and reflective indicators on the display panel.

3.5 SAMPLE PORTS

The signals appearing at the sample ports produce a level of approximately -1dBm at 600W. Both forward and reverse signals have the same scaling at this point. The sample ports are measured during final alignment of the amplifier and a correction table is provided with enough measured points to adequately characterize the sample ports across the full bandwidth of the amplifier. When used with a power meter, sample ports are intended to be a general guide to the forward and reverse power being produced. If more accuracy or calibration is required an external directional coupler is recommended.

4. MAINTENANCE

4.1 GENERAL MAINTENANCE INFORMATION

The Model 600A400 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. Despite 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 side and bottom covers can be removed to gain access to the RF assemblies, power supply and control system.

4.3 TROUBLESHOOTING



CAUTION:

The transistors used in the Model 600A400 amplifier are LDMOS transistors. These devices are very reliable when installed in a suitable circuit, but they can be easily damaged by improper troubleshooting or handling techniques.

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



CAUTION:

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

Troubleshooting the Model 600A400 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 600A400 troubleshooting symptoms and remedies are described in the sections that follow

- 4.3.1—General-Reading Faults
- 4.3.2—The Unit Cannot be Operated Remotely
- 4.3.3—Thermal Fault
- 4.3.4—Interlock Fault
- 4.3.5—Amplifier Faults
- 4.3.6—Low or No Power Output (DC Tests)
- 4.3.7—Low or No Power Output (RF Test)

4.3.1 General - Reading Faults

The Model 600A400 incorporates relatively simple fault detection circuitry, which makes use of the digital display panel to alert the user or technician which component(s) need service. Use of these indications can usually expedite troubleshooting of the amplifier. Most faults can be immediately determined down to the assembly level. If a reset is still indicated, turn off the RF power signal to the input of the amplifier, read and record the fault indication displayed on the digital control panel for later reference. Then, use the RESET function to see if the fault clears. If the fault clears, slowly bring the amplifier's drive level back up and ensure that recommended RF power levels are not exceeded. If the fault indication is no longer visible, the fault may have been brought about by a temporary transient condition, component thermal condition or excessive RF drive to the amplifier's input. If the fault does not clear with the RF drive off, some other problem exists in the amplifier.

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 via the control software on the front panel touch screen as shown in Figure 2-3 herein. Check to see that these switches are properly set for either RS-232 or IEEE-488 operation, as desired. (See Section 2 of this manual for the proper ADDRESS switch settings.)

4.3.3 Thermal Fault (Schematic Diagram Nos. 10045748, 10039874)

During a Thermal Fault, the front panel touch screen interface should read Ax THERMAL FAULT.

1. Try to reset the unit; if the unit resets and operates normally, check to see that the cooling fans (B1 through B5) 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 is operating normally, check the voltage at the A18 Control/Fault Board, J5, pins 19 through 27 should be $\leq 0.1V$.
3. If the voltage, on A18 J5, pins 19 through 27, is high, check the connection to J3-6 and FL3 on the suspect module assembly.

4.3.4 Interlock Fault (Schematic Diagram No. 10044770)

The Model 600A400 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 600A400 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 touch screen interface 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 button on the touch screen interface.
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 J1 in the rear panel).
5. Check the voltage on A12 J5, pin 30; it should be $\leq 0.1V$.
6. If the voltage on A12 J5, pin 30 is high, check the interlock line to ground.

4.3.5 Amplifier Faults (Schematic Diagram Nos. 10045748, 10039874)

1. The fault output of the A2, A6 through A12 modules is sensed on A18, J5, pins 9 through 17. A fault will measure $\leq 0.1V$. Under normal operation, these lines will measure $4.9V \pm 0.2V$.
2. Verify the correct voltages to the modules. Troubleshoot any incorrect voltages.

FL1 = $+40 \pm 0.3V$
FL5 = $-15 \pm 0.3V$
FL4 = $+15 \pm 0.3V$

4.3.6 Low or No Power Output (DC Tests) (Schematic Diagram No. 10045748)

All indicators are normal, the front panel display reads **Power On RF On**, and the cooling fans (B1–B5) 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 P15 Pin 1	+15 V	$\pm 0.3 V$
PS1 P15 Pin 13	-15 V	$\pm 0.3 V$
PS1 P15 Pin 8, 9, 10, 20, 21	+24V	$\pm 0.3 V$
PS1 P15 Pin 3	+5 V	$\pm 0.3 V$

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

FL2	+24 V	$\pm 0.3 V$
FL3	-15 V	$\pm 0.3 V$
FL1	+4.7 V	$\pm 0.3 V$
FL4	+3.3 V	$\pm 0.3 V$

6. Check the voltages on the feed-thru caps of A6 through A13.

FL1	+40.0 V	$\pm 0.3 V$
FL5	-15.0 V	$\pm 0.3 V$
FL4	+15.0 V	$\pm 0.3 V$

4.3.7 Low or No Power Output (RF Test) (Schematic Diagram Nos. 10045748 and 10039874)

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

1. The Model 600A400's typical gain response at -20 dBm input and 0 dBm input is shown in Figure 4-1 and Figure 4-2. The actual gain may vary considerably from that shown in Figure 4-1 but should be ≥ 57.8 dBm at 0dBm input.

Specification ± 2.00 dB Measured ± 1.46 dB

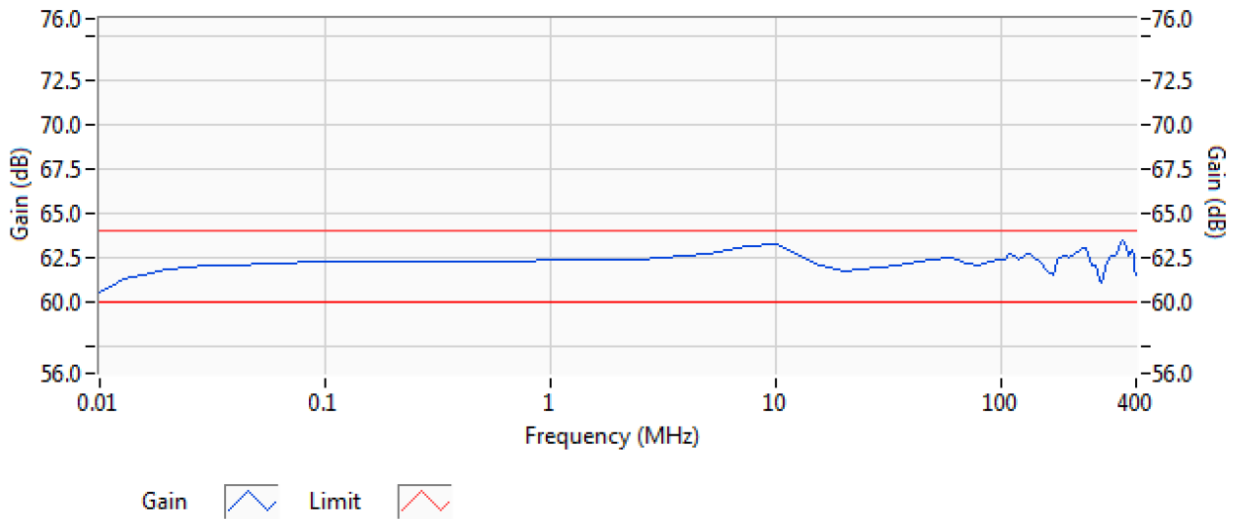


Figure 4-1. Typical Response at -20dBm Input

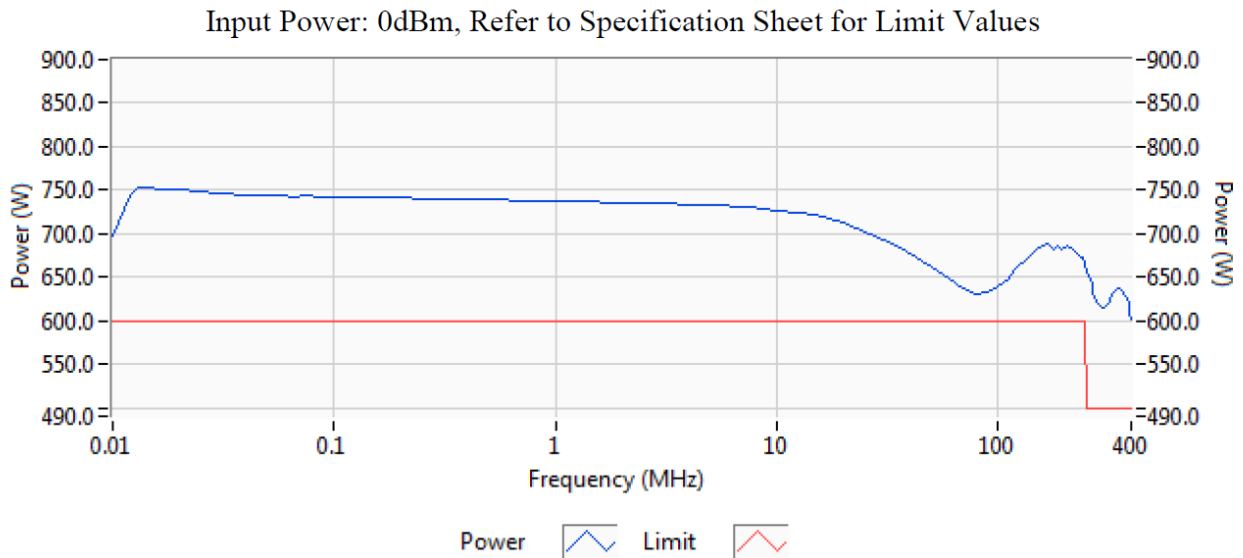


Figure 4-2. Typical Response at 0 dBm Input

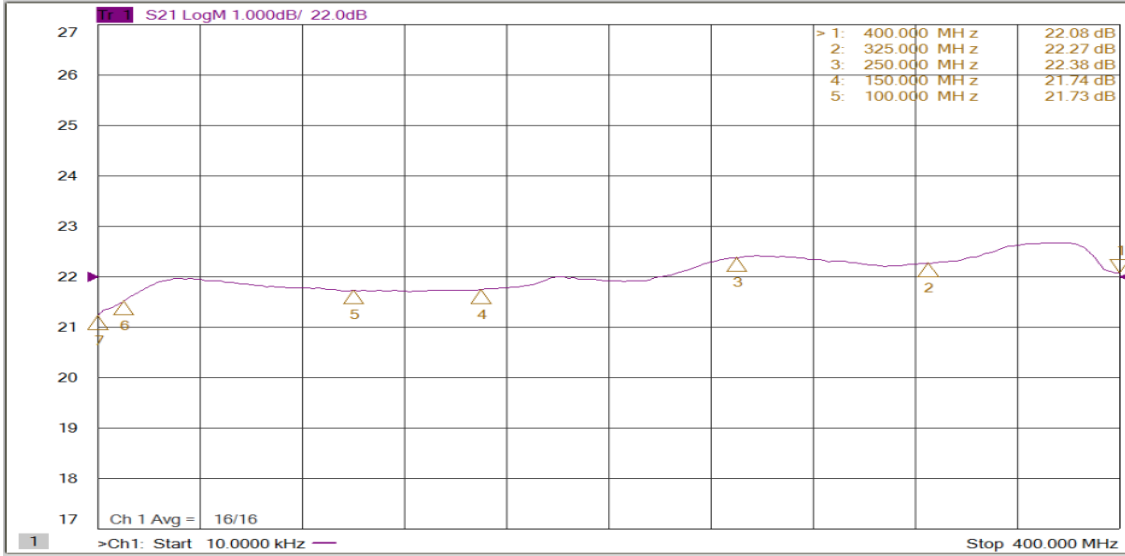


Figure 4-3. Typical A Module Response

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

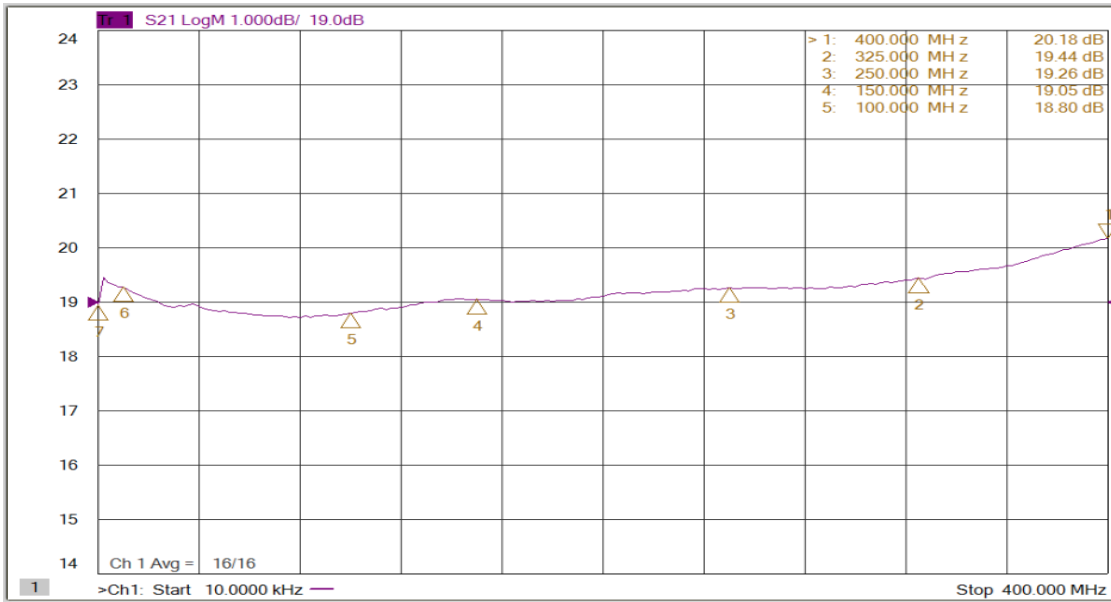


Figure 4-4. Typical A1 Pre-Amplifier Response

WARRANTIES: LIMITATION OF LIABILITY

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

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

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

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

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

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

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

