rf/microwave instrumentation

Operating and Service Manual

12500A225A-L

Model

10040283

Part Number

Serial Number

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

rf/microwave instrumentation

Declaration of Conformity

Issue Date: December 2018
Model #/s: Model 12500A225A-L 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

⚠ WARNING ⚠

It is the responsibility of the user of this equipment to provide electromagnetic shielding, filtering and isolation which is necessary for EMC compliance to Directive 2014/30/EU. The equipment must therefore be operated in a shielded area which provides a sufficient level of attenuation to meet the radiated emissions and immunity specifications. The following minimum levels are suggested for use in accordance with the rated power of the equipment.

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

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

⚠ ACHTUNG ⚠

Der Benutzer dieses Gerätes ist dafür verantwortlich, daß die elektromagnetische Abschirmung und Filterung gewährleistet ist, welche gemäß Richtlinie 2014/30/EU notwendig ist. Das Gerät muß deshalb in einem geschirmten Raum betrieben werden, welcher eine ausreichenden Schirmung bietet, um die Emissions- und Störfestigkeitsspezifkation einzuhalten. Es werden folgenden Minimalwerte der Schirmdämpfung und Filterung in den unterschiedlichen Leistungsklassen empfohlen.

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

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

⚠ AVERTISSEMENT ⚠

Il est de la responsabilité de l'utilisateur de cet équipement d'assurer la protection électromagnétique, le filtrage et l'isolation nécessaires, afin de se conformer à la directive 2014/30/EU concernant la C.E.M. Par conséquent, cet équipement doit être mis en fonctionnement dans une enceinte d'atténuation suffisante pour satisfaire aux spécifications d'émissivité et de susceptibilité. Pour une utilisation conforme, les niveaux d'atténuation minimums suivants sont suggérés en fonction de la puissance de sortie de l'équipement:

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

Puisque cet équipement est destiné à générer de forts niveaux R.F., il est essentiel que l'utilisateur se conforme aux instructions de sécurité indiquées dans ce manuel. Tout autre équipement en fonctionnement dans la cage de Faraday peut-être perturbé par 1'amplificateur.

INSTRUCTIONS FOR SAFE OPERATION

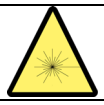
Observe the following safety guidelines to help ensure your own personal safety and to help protect your equipment and working environment from potential damage.

INTENDED USE

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

SAFETY SYMBOLS

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

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

EQUIPMENT SETUP PRECAUTIONS

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

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

BEFORE APPLYING POWER

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

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

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

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

SAFETY GROUND

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

INSTRUCTIONS FOR SAFE OPERATION

HAZARDOUS RF VOLTAGES

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

ACOUSTIC LIMITATIONS

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

MAINTENANCE CAUTION

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

ENVIRONMENTAL CONDITIONS

Unless otherwise stated on the product specification sheet, this equipment is designed to be safe under the following environmental conditions:

- Indoor use
- Altitude up to 2000m
- Temperature of 5°C to 40°C
- Maximum relative humidity 80% for temperatures up to 31°C. Decreasing linearly to 50% at 40°C.
- Main supply voltage fluctuations not to exceed ± 10% of the nominal voltage or minimum and maximum autoranging values.
- Pollution degree 2: Normally non-conductive with occasional condensation. While the equipment will not cause hazardous condition over this environmental range, its performance may vary.

EQUIPMENT CONTAINING LASERS

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

RF ANTENNAS

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

RACK MOUNTED TWT MODELS

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

LIFTING INSTRUCTIONS FOR AR EQUIPMENT

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

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

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

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

HINWEISE FÜR DEN SICHEREN GEBRAUCH

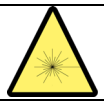
Bitte beachten Sie die folgenden Hinweise zum Schutz Ihrer persönlichen Sicherheit und um Ihre Ausrüstung und Ihren Arbeitsplatz vor möglichen Schäden zu bewahren.

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.

SICHERHEITSSYMBOLE

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 hineinsehen.
	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 ± 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 hineinsehen.

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

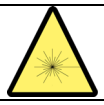
Respectez les consignes de sécurité suivantes pour veiller à votre propre sécurité et vous aider à protéger votre équipement et votre milieu de travail de dommages potentiels.

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 approuves. 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'adapteur 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

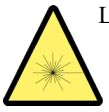
Le réglage, l'entretien ou la réparation de l'équipement doivent être effectués uniquement par un personnel qualifié. Une énergie dangereuse peut être présente lorsque les couvercles de protection sont retirés de l'équipement, même si celui-ci est déconnecté de la source d'alimentation. Un contact peut 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'autoréglage 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

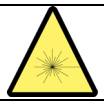
Neem de volgende veiligheidsrichtlijnen in acht om uw persoonlijke veiligheid te helpen waarborgen en uw apparaat en werkomgeving tegen mogelijke schade te beschermen.

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

VOOR HET OPZETTEN VAN DE STROOM

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

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

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

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

AKOESTISCHE BEPERKINGEN

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

ONDERHOUD WAARSCHUWING

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

OMGEVINGSVOORWAARDEN

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

- Binnengebruik
- Hoogte tot 2000 m
- Temperatuur van 5 °C to 40 °C
- Maximale relatieve vochtigheid 80% voor temperaturen tot 31 °C. Lineair afnemend tot 50% bij 40 °C.
- Schommelingen in de netspanning mogen niet groter zijn dan ± 10 % van de nominale spanning of minimum en maximum autobereikwaarden.
- Vervuilingsgraad 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-ingangsconnector 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 tafelmodel. 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 hijsoog (vloermodel) of de zijhandgrepen (tafelmodel) om de eenheid op te tillen.
- Gebruik apparatuur met voldoende capaciteit om de eenheid op te tillen en te ondersteunen.
- Als u een vorkheftruck gebruikt om de eenheid te verplaatsen, zorg er dan voor dat de vorken lang genoeg zijn om tot voorbij de zijkant van het eenheid uit te steken.
- Volg de link hierboven voor meer informatie.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. GENERAL INFORMATION

1.1 GENERAL DESCRIPTION

The Model 12500A225A-L is a self-contained, broadband, completely solid state Radio Frequency (RF) amplifier designed for applications where instantaneous bandwidth and high gain are required. The amplifier is air cooled, with internal liquid cooling of the final amplifier stages. Optionally the amplifier can be configured for external liquid cooling. Push-pull circuitry is utilized in all high-power stages to minimize distortion and improve stability. The Model 12500A225A-L, when used with an RF sweep generator, will provide a minimum of 10,000 watts of swept power covering the frequency range from 0.01 to 100 MHz and a minimum of 6000 watts of swept power from 100 MHz to 225 MHz. The Model 12500A225A-L is housed in a stylish contemporary equipment cabinet.

Special features incorporated into the Model 12500A225A-L include the following:

- **A Digital Control Panel (DCP)** that allows both local and remote (via a computer interface) control of the amplifier (including adjustment of the amplifier's RF Gain during Manual mode operation) and provides graphical displays of the amplifier's Forward and Reflected power levels.
- **Automatic Level Control (ALC)** by internal circuits; with front panel (via the unit's DCP) or remote (via the unit's computer interface) control of the ALC Threshold setting.
- **RF output level protection.**
- **A General Purpose Interface Bus (GPIB)/IEEE-488 interface** for remote control.
- **RS232 serial communications** including both wire and fiber-optic ports for remote control.
- **Ethernet communications port** for remote control.
- **USB Communication port** for remote control.
- **Protection** is provided by DC current limiting, over-current, under-current, and over-temperature shut down and RF power limiting. Flow level, along with liquid over-temperature devices, offer monitoring of the self-contained cooling system.
- **Housed in a dual bay equipment rack**, the Model 12500A225A-L provides readily available RF power for typical applications such as RF susceptibility testing, antenna and component testing, and wattmeter calibration.

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 12500A225A-L is a modular design with each section having self-contained power supplies. These power supplies are self-contained, regulated switching units.

The Driver/Control Unit (DCU) section contains a +44V supply providing DC power for the power amplifier modules. It also contains two other power supplies: a unit providing +5V, +15V, and -15V for control and logic, and a +24V unit to run the fan and the driver amp module.

Each of the four Main Power Amplifier (MPA) units has a power supply providing approximately +42VDC as the main source of power for the amplifier circuitry. Also included in this unit is a +5V supply for logic and control functions and a +24V supply that runs the coolant pump and cooling fans.

1.4 PROTECTION CIRCUITS

Features incorporated into this unit include RF output level protection circuits, thermal protection circuits, output device current monitoring and limiting of individual power amplifier modules. There is a main system AC circuit breaker and AC circuit breakers in the Driver/Control unit (DCU) and the main power amplifier (MPA) units. The main switching supplies are short circuit protected. Reaching a threshold of either of the RF forward (incident) or reverse (reflected) power limit adjustments, which are adjusted to approximately 11,000 watts and 5000 watts respectively, will initiate limiting, or smooth drive level fold-back, in the preamplifier stage of the amplifier chain. If the limiting circuits cannot keep the amplifier's levels below the limit threshold, the protection circuits will invoke a shutdown of the main power supplies and low-level drivers in the amplifier. Power amplifier modules are monitored for both over-current and under-current. A **RESET** function is provided to permit re-powering of the amplifier in case of transient or temporary activation of the amplifier's protection circuitry. The low-level drivers and output amplifier subassemblies are thermally monitored.

The cooling system is monitored and protected. Each power amplifier module incorporates a thermal switch which will shut down the power supplies in the event of an over-temperature condition. Liquid coolant is monitored for level, temperature, and flow. Any coolant fault will shut down the amplifier and send a notification to the front panel display.

The digital control panel monitors all fault signals and displays any that are invoked and asserts the required action.

1.5 INSTALLATION

Before proceeding, thoroughly inspect the 12500A225A-L 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.

1.5.1 Location

Select an operating location that will permit free air circulation around the amplifier's cabinet. The Model 12500A225A-L 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. For example, do not position the unit next to a wall or other equipment that would cause a restriction of airflow into or out of the unit.

CAUTION:

Under normal operating conditions, the exhaust air temperature may exceed 40°C. Do not locate heat sensitive equipment, objects or materials in the exhaust air stream of the unit.

1.5.2 AC Power

The Model 12500A225A-L is designed for a primary power input of 190–240 VAC, 150 Amp, 50/60 Hz, three phase Delta connection or optional 380-480 VAC, 80 Amp, 50/60 Hz, 3-phase Delta connection. (User must specify at time of order.)

CAUTION:

Dangerous voltages are present in the 12500A225A-L whenever it is plugged into an AC outlet. Always disconnect the AC power line to the amplifier before servicing the unit.

Due to the variety of power systems available, a line cord is not shipped with this unit. The user must install the recommended supply lines to the unit. The Model 12500A225A-L requires a line cord capable of 150 amps for the 190-240 VAC model or 80 Amps for the 380-480 VAC option. To install the line cord, referring to Figure 1-1. Remove the power distribution box mains cover by removing the two top and two bottom screws of the cover. Loosen the strain relief clamp nut and insert a prepared line cord of the proper gauge and size. Connect the green/yellow earth ground to the designated ground stud using the supplied hardware. Connect the phase wires to the L1, L2 and L3 studs. There is no special order for the phase wires. Replace the mains cover and tighten the strain relief connector.

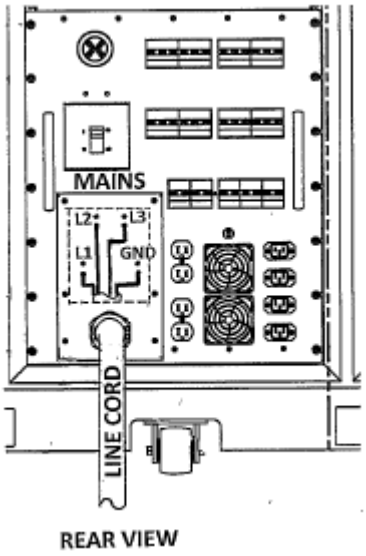


Figure 1-1. AC Mains Connections

NOTE: Illustration for reference only. Actual distribution box may vary.

CAUTION:

The primary power must be supplied through a slow-acting, 3-phase common trip circuit breaker. The use of fuses or individual breakers on each line may cause damage if only one phase is disconnected.

1.5.3 Coolant Connections

The Model 12500A225A-L is cooled by means of an external chilled water source. This source is to be capable of supplying and maintaining a flow of 20 GPM (75 liters/minute) at a temperature between 15°C and 30°C. The cooling capacity of this external source shall be 40,000 watts minimum.

The external chilled water must be connected to the coolant inlet on the coolant drawer assembly shown in Figure 1-2. The return back to the chilled water source is through the coolant return fitting. Mating fittings are supplied with the amplifier: EATON B8HKP for coolant inlet and EATON B8KP36 for coolant return.

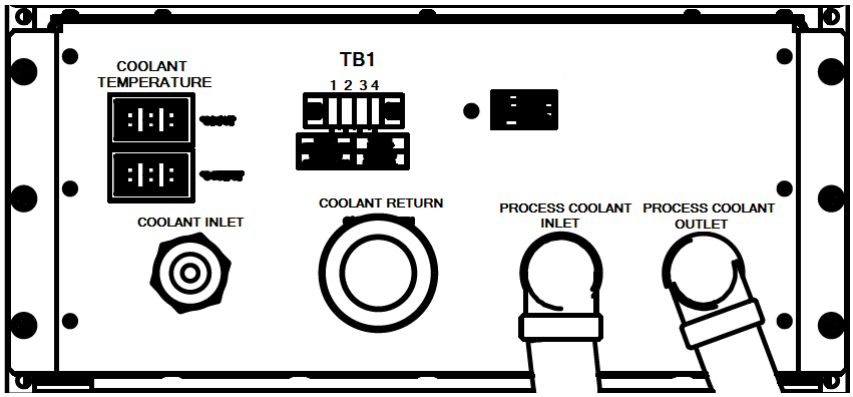


Figure 1-2. Coolant Connections

1.5.3.1 External Coolant Source Control

Control of the external water source can be done through TB1, located on the coolant drawer rear panel. TB1 contacts 1 and 2 are closed (shorted) for a chiller ON condition; contacts 1 and 2 are open for a chiller OFF condition. When the amplifier POWER ON button is pushed, contacts 1 and 2 will short. They will open when a POWER OFF condition is initiated.

TB1 contacts 3 and 4 are shorted with a wire jumper from the factory. These contacts can be used to monitor the fault status of the external coolant source. Shorting contacts 3 and 4 will indicate normal (fault free) operation. An open between contacts 3 and 4 will indicate a coolant source fault and place the amplifier in a Standby/RF OFF condition.

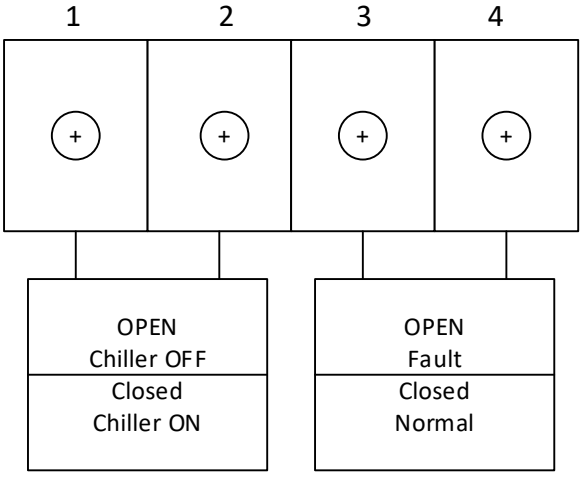


Figure 1-3. TB1

1.6 OTHER CONNECTIONS

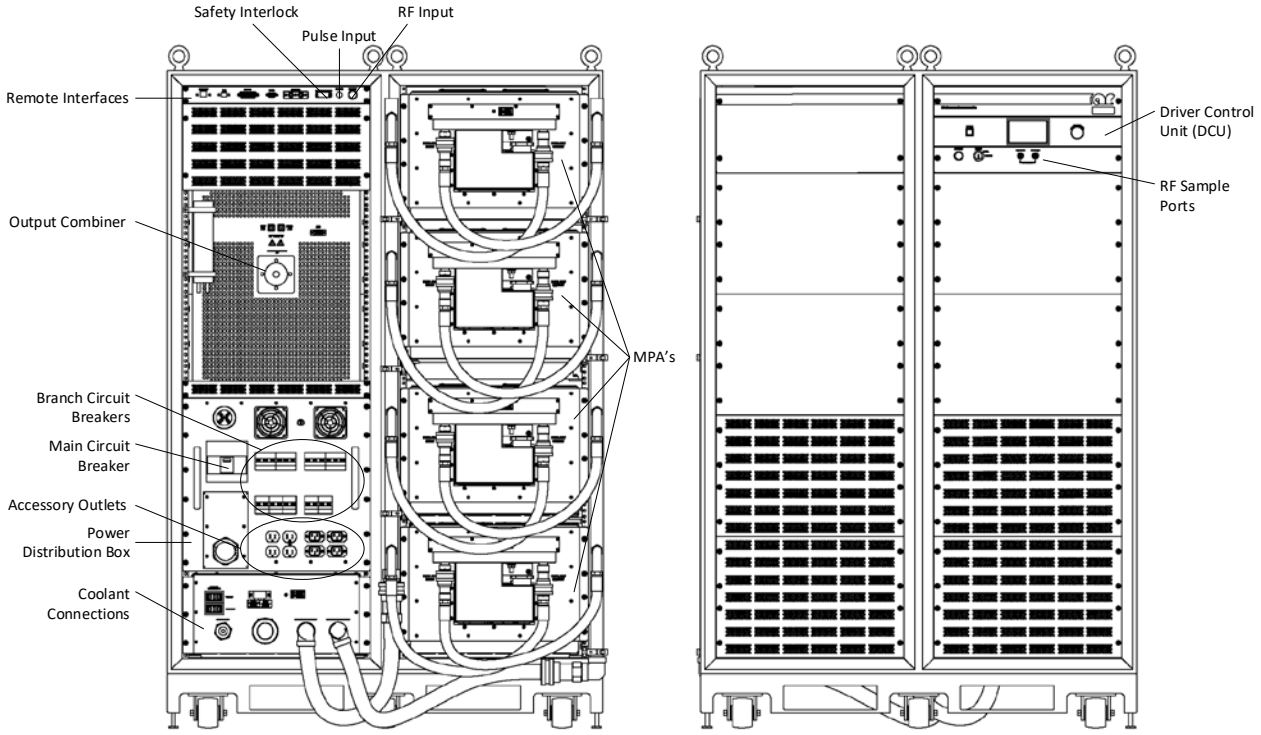


Figure 1-4. Model 12500A225A-L Connector Locations (Rear View Left, Front View, Right)

1.6.1 RF Input Connector

The RF input connector for the amplifier can be located on the front or rear of the driver/control unit.

1.6.2 RF Sample Ports

The Forward and Reverse power sample port connectors are located on the front of the driver/control unit. Cables and equipment connected to these ports should exhibit resistive 50-ohm impedance throughout the band. They are normally used for operating external power meters. A calibration table is provided with the Model 12500A225A-L that provides a list of external RF power meter offset values. The offset values completely characterize the directional coupler/forward sample port circuit attenuation across the frequency band, and are available in electronic form.

1.6.3 RF Output Connector

The amplifier RF output connector is a Type EIA 1 5/8 male located on the rear of the amplifier.

CAUTION:

Placing the amplifier in the Operate (RF On) mode without a load connected to the output connector is not recommended. Always shut off the amplifier prior to removing hardware connections.

1.6.4 Safety Interlock Connector

Located on the rear of the driver/control unit is the amplifier I/O panel, which includes remote interface connectors and safety interlock connectors. The 15-pin D-sub miniature female safety interlock connector provides two separate interlock loops. Pins 1 and 8 are used for situations where the amplifier can be left on, but forced into STANDBY (RF Off) mode. This interlock is called Inhibit Interlock. Pins 10 and 14 are used for situations that demand the safest possible condition, with the AC power to all main circuits disconnected. This interlock is called AC Interlock. Both loops must be closed, or jumpered, for normal operation.

1.6.5 Communications Connectors

The remote communication connectors are located on the Remote Interface panel assembly (schematic 10037770).

1.6.5.1 RS232 Wire

Standard 9-pin D-subminiature female connector

1.6.5.2 RS232 Fiber-optic

A pair of ST female bayonet connectors is provided, for transmit and receive.

1.6.5.3 IEEE-488

A standard 44-pin female IEEE-488 (GPIB) connector.

1.6.5.4 USB

A standard USB-B connector.

1.6.5.5 Ethernet

A standard Ethernet connector.

12500A225A–L

- 12,500 Watts CW
- 10kHz–225MHz

Features

The Model 12500A225A-L is a self-contained, broadband, completely solid state amplifier designed for applications where instantaneous bandwidth and high gain are required. The amplifier is liquid-cooled for high performance and reliability (majority of the heat is removed via liquid cooling). Push-pull LDMOS circuitry is utilized in all high power stages in the interest of lowering distortion and improving stability.

The Model 12500A225A-L 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 and a single rotary knob to offer status reporting and control capability. The display provides operational presentation of Forward Power and Reflected Power plus control status and reports of internal amplifier status. Special features include a gain control, pulse input capability, forward RF sample port, and a reflective RF sample port for convenient power measurements.

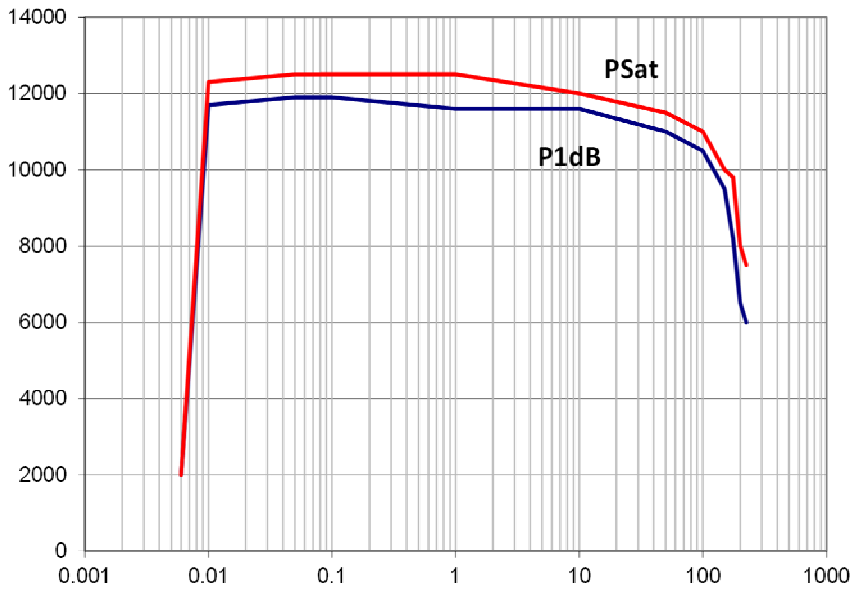
All amplifier control functions and status indications are available remotely in GPIB/IEEE-488, RS-232, RS-232 fiber optic, Ethernet and USB format. The buss interface connectors are located on the back panel and positive control of local or remote operation is assured by a switch on the front panel of the amplifier.

High efficiency universal input, power factor corrected switching power supplies provides DC to all internal sub-assemblies.

Housed in a stylish, contemporary enclosure, the Model 12500A225A-L provides readily available RF power for typical applications such as RF susceptibility testing, antenna and component testing, watt meter calibration, particle accelerators, plasma generation and communications.

The export classification for this equipment is EAR99. These commodities, technology or software are controlled for export in accordance with the U.S. Export Administration Regulations. Diversion contrary to U.S. law is prohibited.

MODEL 12500A225A-L TYPICAL POWER OUTPUT



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

12500A225A-L

- 12,500 Watts CW
- 10kHz-225MHz

Specifications

RATED OUTPUT POWER:
Nominal: 12,500 watts
Minimum: 10,000 watts, .01-100 MHz
6000 watts, 100–225 MHz

INPUT FOR RATED OUTPUT: 1.0 milliwatt maximum

POWER OUTPUT @ 1 dB COMPRESSION:
Nominal: 11,000 watts
Minimum: 10,000 watts, .01-100 MHz
5000 watts, 100–225 MHz

FREQUENCY RESPONSE: 10kHz-225MHz instantaneously

GAIN (at maximum setting): 70 dB minimum

FLATNESS: ±3.0dB maximum; ±1.0dB with internal leveling

GAIN ADJUSTMENT: 20 dB minimum

INPUT IMPEDANCE: 50 ohms, VSWR 2.0:1 maximum

OUTPUT IMPEDANCE: 50 ohms, nominal

MISMATCH TOLERANCE: 100% rated power without foldback up to 6.0:1 mismatch above which may limit to 5000 watts reflected power from 10kHz-100MHz. Limited to 3000 watts reflected power from 100MHz-225MHz.

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

HARMONIC DISTORTION: Minus 20 dBc maximum at 8000 watts power output

THIRD ORDER INTERCEPT POINT: 77 dBm typical

RF POWER DISPLAY: 0–15,000 watts full scale

RF RISE/FALL TIME: 150 nanoseconds maximum

PRIMARY POWER (User must specify):
190-240 VAC, Delta (4 wire)
380-480 VAC, Delta (4 wire)
47-63 Hz, 3-phase
45,000 watts maximum at .95 P.F. typical

CONNECTORS:

RF Input:	N female, rear
RF Output:	EIA 1-5/8 male, rear
Forward Sample:	N female, front (coupling factor 80dB typical)
Reverse Sample:	N female, front (coupling factor 80dB typical)
Pulse Modulation Input:	BNC female, rear
Safety Interlock:	15 pin female Type D on rear panel

REMOTE CONTROL:

IEEE-488:	24 pin female, rear
RS-232:	9 pin female D, rear
RS-232 (fiber optic):	Type ST, rear
USB 2.0:	Type B female, rear
Ethernet:	RJ-45

COOLING REQUIREMENTS:
Forced air (self-contained fans) 5000W maximum;
Liquid cooling 20 GPM (75 liters/minute) minimum, 15-30°C maximum, cooling capacity 40,000W minimum

WEIGHT (maximum): 500 kg (1100 lb)

SIZE (W x D x H): 112.1 x 82.4 x 165.3 cm (44.12 x 32.43 x 65.1 in)

EXPORT CLASSIFICATION: EAR99

2. OPERATING INSTRUCTIONS

2.1 GENERAL

Operation of the Model 12500A225A-L broadband amplifier is quite simple. The amplifier's input signal, whether swept or fixed in frequency, is fed into the connector marked **RF INPUT,** and the amplifier's output signal is taken from the connector 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 12500A225A-L Amplifier is *typically* not critical in regard to source and load Voltage Standing Wave Ratio (VSWR) and will remain unconditionally stable with any magnitude and phase of source and load VSWR. *However, placing the amplifier in the operate (RF On) 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 +13 dBm (20 mW). However, signal levels higher than 20mW or transients with high peak voltages can damage the amplifier. Also, accidental connection of the Model 12500A225A-L'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.

2.2 CONTROL AND INDICATOR FUNCTIONS

The Model 12500A225A-L's front panel is shown in Figure 2-1.

2.2.1 Keylock Switch

The Keylock Switch is provided for protection from unauthorized use or unexpected remote control of the 12500A225A-L. The 12500A225A-L can only be turned on locally when the Keylock Switch is in the LOCAL position. Likewise, the unit can only be turned on or controlled remotely when the Keylock Switch is in the **REMOTE** position. Placing the Keylock Switch in the **INHIBIT** position places the 12500A225A-L into an RF off state and prohibits any control of the 12500A225A-L. All remote queries are processed and responded to in any of the three Keylock switch positions.

2.2.2 Power Switch

The momentary POWER button turns the main power to the 12500A225A-L on and off. The status of the green light-emitting diode (LED) in the switch indicates whether the 12500A225A-L's 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 12500A225A-L driver rack power entry module is on.

CAUTION:

It is recommended to leave the 12500A225A-L in a standby (RF OFF) condition to allow the internal components to cool and stabilize after using in RF ON for periods greater than 10 minutes. Recommended standby (RF Off) time is one minute prior to powering off.

If necessary to power on immediately after power off, wait 10 seconds after power off to allow all pumps and circuits to bleed down and stabilize, then power on.

2.2.3 Touch Screen Display

The Touch Screen is a color Liquid Crystal Display (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.

2.2.4 Adjust Knob

The **ADJUST** knob is used to set the value of several parameters available through the Touch Screen menu options. These parameters are **RF Gain**, **ALC Threshold**, **ALC Detector Gain**, and **ALC Response**. The **Select** Menu is used to select which parameter the **ADJUST** knob is able to adjust. The range of RF Gain, ALC Threshold, and ALC Detector Gain is 0 to 100 percent. The range of the ALC Response is 1 to 7. The **ADJUST** knob can be rotated both clockwise and counterclockwise 360 degrees.

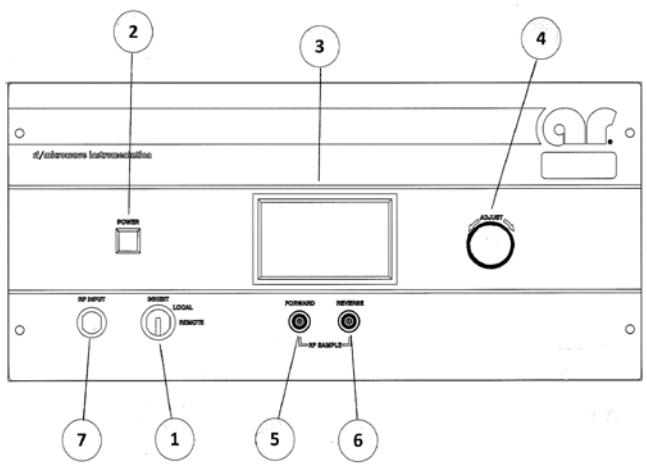


Figure 2-1. Driver/Controller Front Panel

Table 2-1. Digital Control Panel (DCP) Features

Item	Title	Function
1	INHIBIT, LOCAL, REMOTE	Keylock Switch, 3-position; key removal in INHIBIT position only
2	POWER	POWER control with indicator LED
3	DISPLAY (TOUCH SCREEN)	Numerous parameter values and fault messages, plus manual input control
4	ADJUST	Adjust knob to change selected variables
5	FWD Sample Port	Type BNC female connector
6	REV Sample Port	Type BNC female connector
7	RF INPUT	Optional Location; Type N female connector

2.2.5 Main Power Distribution Box

The Main Power AC circuit breaker is located on the rear panel of the power distribution box with the branch circuit breakers (See Figure 1-2). The Driver Control Unit accessory outlets and each main power assembly (MPA) has its own dedicated circuit breaker. Accessory outlets are provided for powering external coupler fans, test equipment, or test support equipment. There are four 120VAC and four 240 VAC IEC outlets.

2.3 DIGITAL CONTROL PANEL (DCP) OPERATIONS

The operations described in this section assume that the user is performing these operations from the amplifier's front panel with the Keylock Switch in the LOCAL position. Computer access to command and status functions is also available when the Keylock Switch is set to REMOTE.

Amplifier functions are visually monitored on the front panel display. POWER is controlled by a dedicated push-button switch to the left of the display. The safety Keylock Switch is located to the lower left of the display.

In the center of the digital control panel is the graphic touch display. It is used to provide amplifier status information and a set of menu functions for controlling the amplifier. The menu selections are typically found as software generated buttons on the right side of the display screen. In some cases, these buttons can also be found in other areas of the screen. From the MAIN MENU the user can access the RF ON/OFF

button. The RF ON/OFF button causes the power amplifier sections to produce RF output power from the output connector, based on the various settings and the input level to the amplifier. The main amplifier fans will be heard when this function is active.

To the far right is an ADJUST knob. This knob is used to adjust most of the variables shown on the graphic touch display.

The graphic touch display is active and illuminated whenever AC power is supplied to the unit and the main circuit breaker is on.

At the top of the Main Menu screen is a bar graph and numeric value (blue) which is used to indicate whichever user adjustable parameter is selected. These parameters are RF Gain, ALC Threshold Level, ALC Detector Gain, and ALC Response. The Select button from the Main Menu is used to select these parameters.

Below the adjustment value section is an indicator for the RF state and the amplifier mode. The RF state can be changed using the RF On/Off button found in the lower right of the Main Menu.

Below the RF state indicator is the amplifier mode indicator. Possible modes are Manual, Pulse, and ALC Internal. The amplifier mode can be changed using the Mode button from the Main Menu.

Toward the bottom of the display are two bar graphs and two numeric values used to indicate the forward and reflected power (green and red respectively). These indications are created using a dual-directional coupler located within the amplifier near the RF output port, and should be used as un-calibrated indicators of approximate power level.

General Display Navigation is shown in Figure 2-2, **Touch Panel Display Menu Map**.

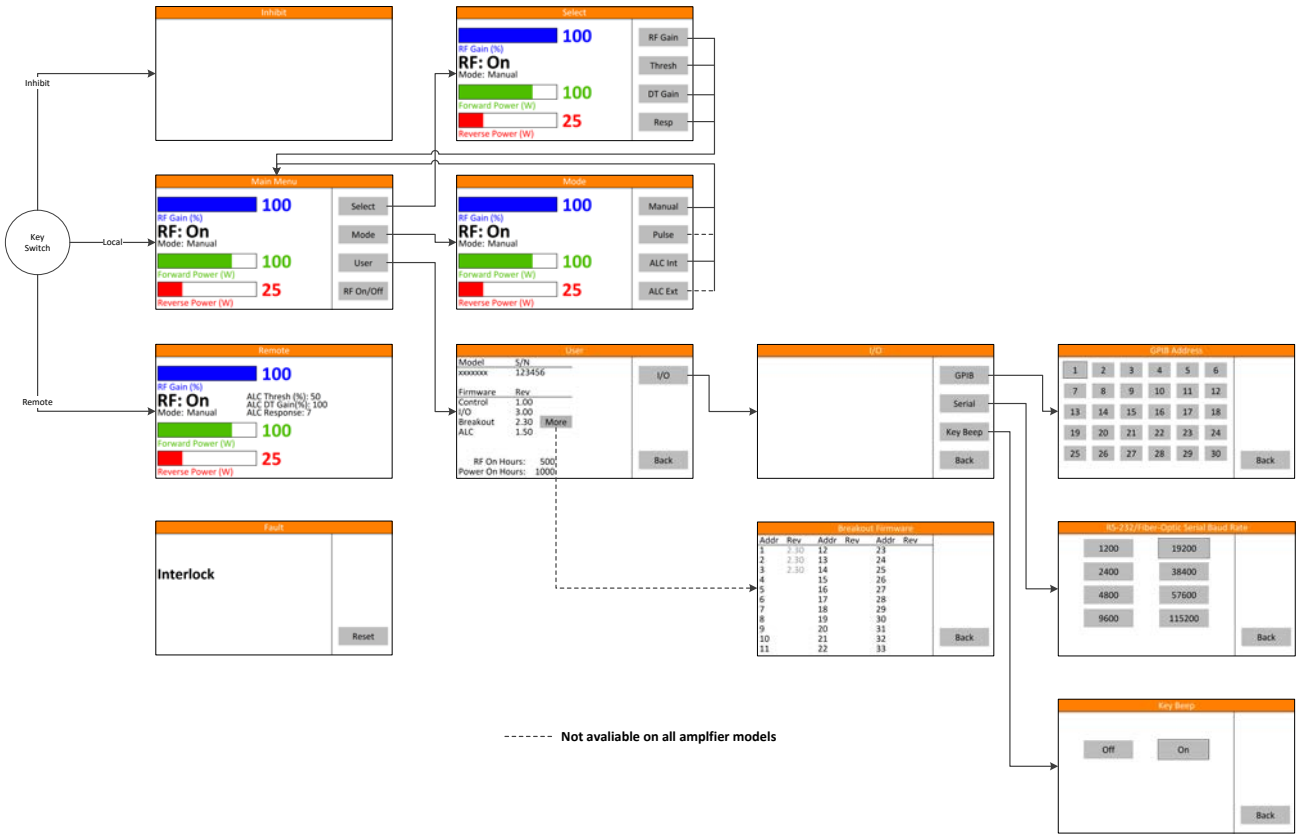


Figure 2-2. LCD Touch Display Menu Map

2.3.1 Inhibit Screen

The Inhibit screen is used as an indication to the user that the amplifier in an inhibited mode. In inhibit mode the POWER button cannot be used, and no Touch Screen menu options are available. In addition, the ADJUST knob is disabled.

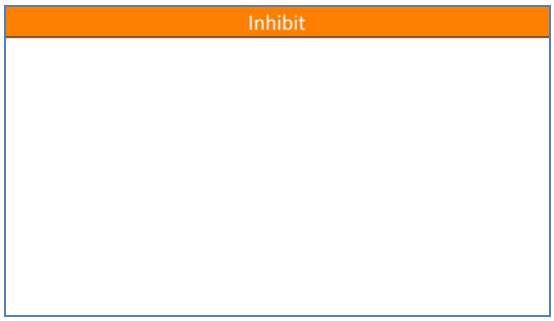


Figure 2-3. Inhibit Screen

2.3.2 Main Menu Screen

The Main Menu screen is only available when the Keylock switch is in the LOCAL position.

At the top of the screen is the RF Gain, ALC Threshold, ALC Detector Gain, or ALC Response value in the form of a blue bar graph and associated blue numeric value.

In the left center of the screen is the Automatic Leveling Control (ALC) Mode which can be Manual, Pulse, or ALC Internal.

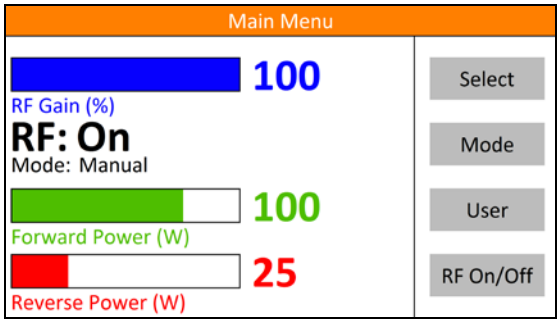


Figure 2-4. Main Menu Screen

The RF state is shown in bold lettering which can be either **Off**, **Biasing**, or **On**.

At the bottom of the screen are the forward and reverse power indicator bar graphs and associated values in Watts. The scale of the bar graphs is based on a range of 0 to rated power. For the 12500A225A-L rated power is 10,000Watts. The forward power is always indicated in green while the reverse power is indicated in red.

The menu options available from the main menu are **Select**, **Mode**, **User**, and **RF On/Off**.

Select brings up the selection menu for the assignment of the ADJUST knob. Mode brings up the menu for the selecting the ALC mode. User brings up the User screen and menu.

RF On/Off enables or disables the RF path through the 12500A225A-L. Pressing RF On will first put the 12500A225A-L into a biasing state. When the biasing process is complete (approximately 7 to 10 seconds in duration) the 12500A225A-L will go to an RF On state.

2.3.3 Select Screen

The Select screen is the same as the Main Menu screen with the exception of the menu options. The menu options in this screen allow the user to select what parameter the ADJUST knob can adjust. Once a selection is made, the screen will automatically change back to the Main Menu screen. The blue bar graph and associated value will change to reflect the value of the selected item.

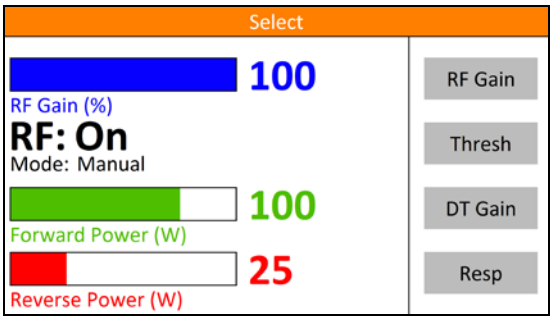


Figure 2-5. Select Screen

2.3.4 Mode Screen

The Mode screen is the same as the Main Menu screen with the exception of the menu options. The menu options in this screen allow the user to select the ALC mode. Once a selection is made, the screen will automatically change back to the Main Menu screen. The Mode indicator will change to reflect the selected mode.

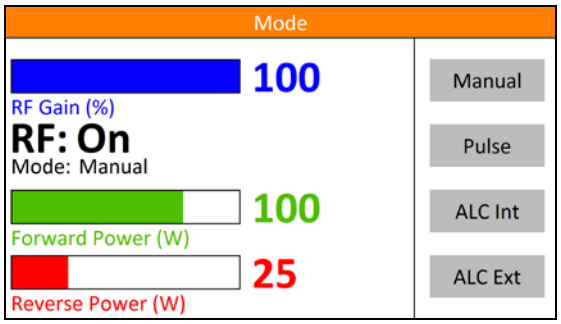


Figure 2-6. Mode Screen

2.3.5 User Screen

The User screen presents the user with the revision levels of all the firmware that is running on all the main control system components. For the Switch Breakout Board (SBB) assemblies, only the piggy-back assembly firmware is listed. The More button allows the user to see the firmware revisions for all of the fiber-optically connected instances of these assemblies. At the bottom of the screen both the Power On and RF On Operating Hours are displayed. A menu option is provided for accessing the settings for the remote I/O ports.

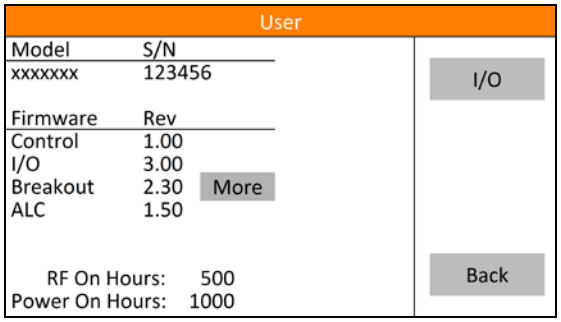


Figure 2-7. User Screen

2.3.6 More Screen

The More screen shows the firmware revisions for all of the fiber-optically connected instances of SBB assemblies. The address numbers represent the position of each SBB assembly in the fiber-optic serial chain.

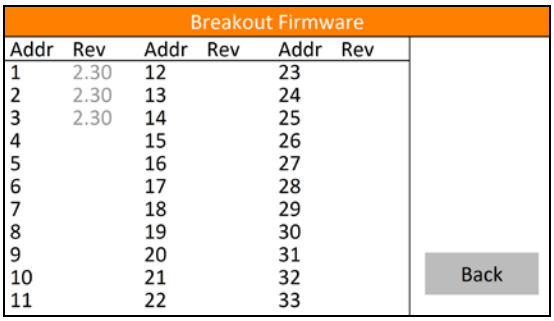


Figure 2-8. More Screen

2.3.7 I/O Screen

The I/O screen is used to present the user with menu options pertaining to the remote I/O ports and the interaction with the Touch Screen. These options include the GPIB address, RS-232 Serial Baud Rate, and key beep.

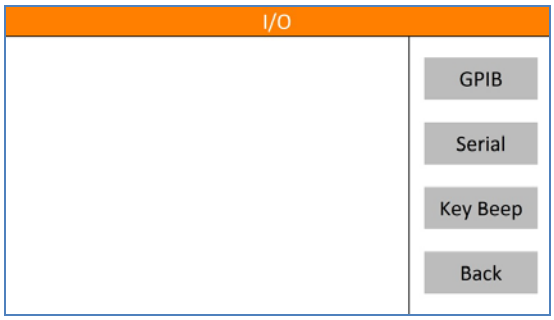


Figure 2-9. I/O Screen

2.3.8 GPIB Address Screen

The GPIB address screen is used to select the GPIB address. 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.

Figure 2-10. GPIB Address Screen

2.3.9 RS-232 Serial Baud Rate Screen

The RS-232/Fiber-Optic Serial Baud Rate screen is used to select the baud rate used by both the RS-232 port and the Fiber-Optic Serial port. 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.

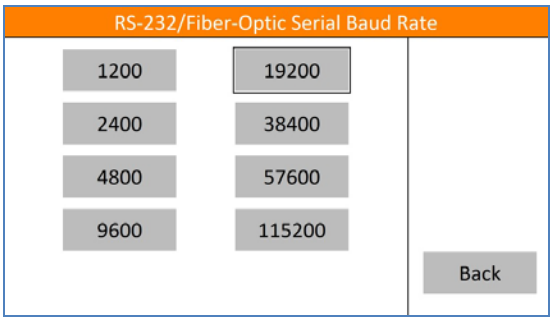


Figure 2-11. RS-232/Fiber-Optic Serial Baud Rate Screen

2.3.10 Key Beep Screen

The Key Beep screen allows the user to turn on or off the audible beep that occurs when a valid touch event takes place. This setting is only stored in volatile memory and will be lost when power to the driver rack is cycled. The default value for this setting is On.

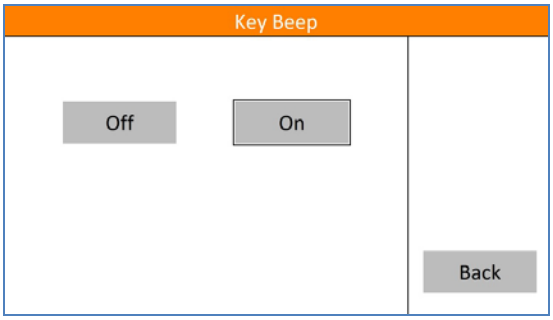


Figure 2-12. Key Beep Screen

2.3.11 Remote Screen

When the Keylock switch is set to the REMOTE position the Remote screen appears. This screen has all the same information as the Main Menu screen except that the blue bar graph and associated value are only for the RF Gain value. Because of this, the ALC Threshold, ALC Detector Gain, and ALC Response values are displayed separately in black toward the center of the screen.

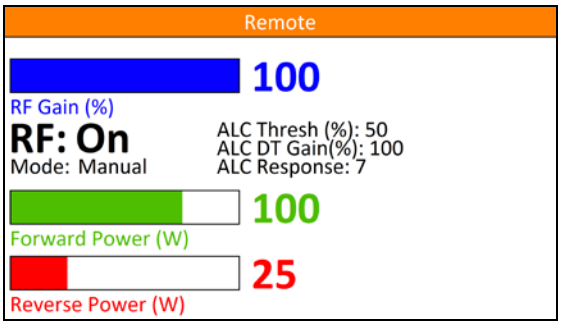


Figure 2-13. Remote Screen

2.3.12 Fault Screen

The Fault screen will appear anytime that a fault condition is met as long as the Keylock switch is not in the INHIBIT position. The name of the fault is shown toward the center of the screen. In either LOCAL or REMOTE Keylock switch positions, a Reset button will appear allowing local resetting of the fault condition. Faults can also be reset remotely. If the fault reset is successful, the screen will return to the Main Menu or Remote screen depending on the Keylock switch position.

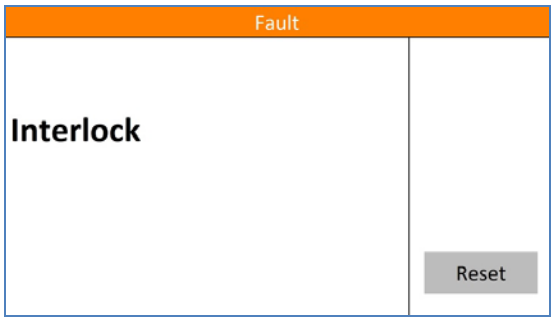


Figure 2-14. Fault Screen

2.4 Inputs and Outputs

The input and output connectors described in the following sections are located on the unit's front or rear panels; refer to Figure 1-2).

2.4.1 RF Input

This Type N connector is the RF input to the amplifier. It should be connected to a RF signal generator or sweep generator.

2.4.2 RF Output

This Type EIA 1 5/8 male connector, located at the rear of the amplifier is the RF output of the amplifier.

CAUTION:

Do not connect or disconnect any loads or cables from the amplifier's RF Output when the amplifier is in the Operate (RF On) mode. Dangerous voltages that could cause serious injury to the user exist at the RF Output when the amplifier is outputting power.

2.4.3 IEEE-488, USB, Ethernet, and RS-232 Interfaces

The Model 12500A225A-L's remote interfaces allow remote control, via a computer, of all functions (except for the Keylock Switch position) that can be controlled from the front panel. When the unit is in the Remote mode (as determined by the position of the Keylock Switch), a special Remote display is shown (see Figure 2-13). Front panel controls are deactivated, except for the Keylock Switch, which can be rotated to LOCAL or INHIBIT in order to prevent remote control commands from being executed.

Refer to Section 2.6 for information on remote operation of the amplifier.

2.4.4 Safety Interlock Connector

The safety interlock connector interface provides for external safety switch interlocks that will prevent the amplifier from entering or being placed in the Operate (RF On) mode unless an external connection is made. A connection between Pins 1 and 8 must be completed to operate the amplifier. A second interlock circuit removes primary AC power from the main power supplies when it is not closed. This circuit is found on pins 10 and 14.

2.5 AMPLIFIER OPERATION

2.5.1 Manual Mode

This section describes how the amplifier would be setup and calibrated in the Manual mode. For a block diagram of a typical setup, see Figure 2-15, **Typical Setup—Manual Mode**.

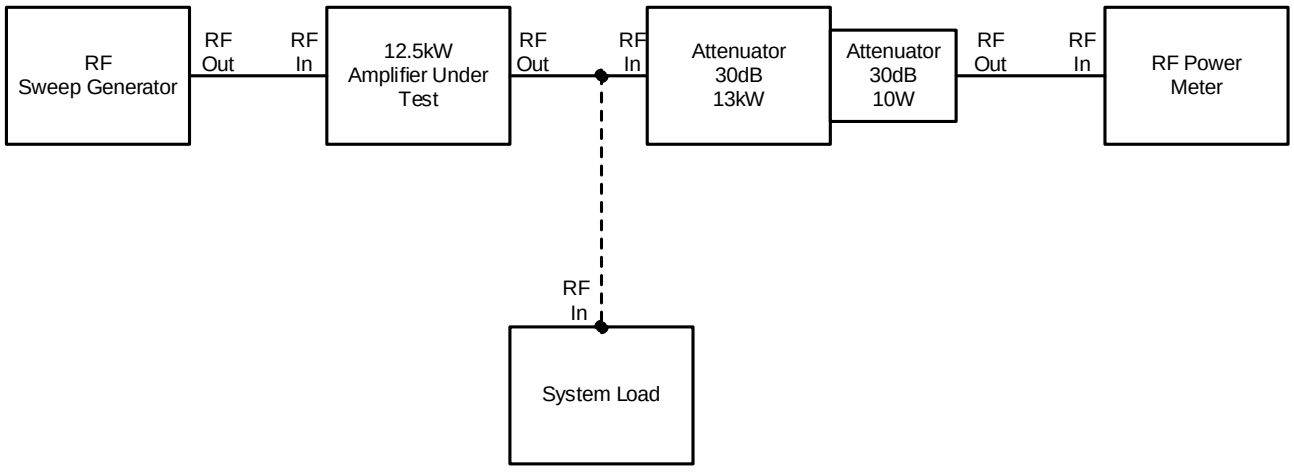


Figure 2-15. Typical Setup—Manual Mode

2.5.1.1 Preliminary Settings

RF GAIN: 0%

POWER: ON

MODE: Manual

2.5.1.2 Calibration

Set the RF generator output power to approximately **0 dBm** (1mW CW). Place the unit in the Operate (RF On) mode (by pressing the **RF ON/OFF** button). Adjust the manual gain control for the desired signal output level, as measured on the RF wattmeter. You are now calibrated for a given output power from the Model 12500A225A-L. Place the amplifier in the Standby (RF Off) mode (by pressing the **RF ON/OFF** button).

CAUTION:

Do not connect or disconnect any loads or cables from the amplifier's RF Output when the amplifier is in the Operate (RF On) mode. Dangerous voltages that could cause serious injury to the user exist at the RF Output when the amplifier is outputting power.

2.5.1.3 Connecting the RF Load

You may now disconnect the amplifier RF output from the attenuator and connect it to the test load (dotted line). After the load has been connected to the Model 12500A225A-L, the amplifier can now be placed in the Operate (RF On) mode by pressing the **RF ON/OFF** button.

2.5.1.4 Repeat the Procedures in Sections 2.5.1.1 through 2.5.1.3 at Each Test Frequency.

2.5.2 Pulse Mode Operation

This section describes how the amplifier would be set up and calibrated in the Pulse mode. For a block diagram of a typical setup, see Figure 2-16, **Typical Setup—Pulse Mode**.

For pulse operation, the amplifier can be in either CW or ALC mode. A TTL level pulse of +3 to +6V is applied to the pulse input connector.

The pulse input can be used to gate the amplifier to create RF pulses. A low input reduces the amplifier gain by 25 dB (minimum); this input is TTL level-compatible. A logical one (<0.4 VDC) corresponds to no pulse (gain reduced by 25 dB), and a logical high (>2.5 VDC) causes the amplifier to be at full gain as set by the GAIN control.

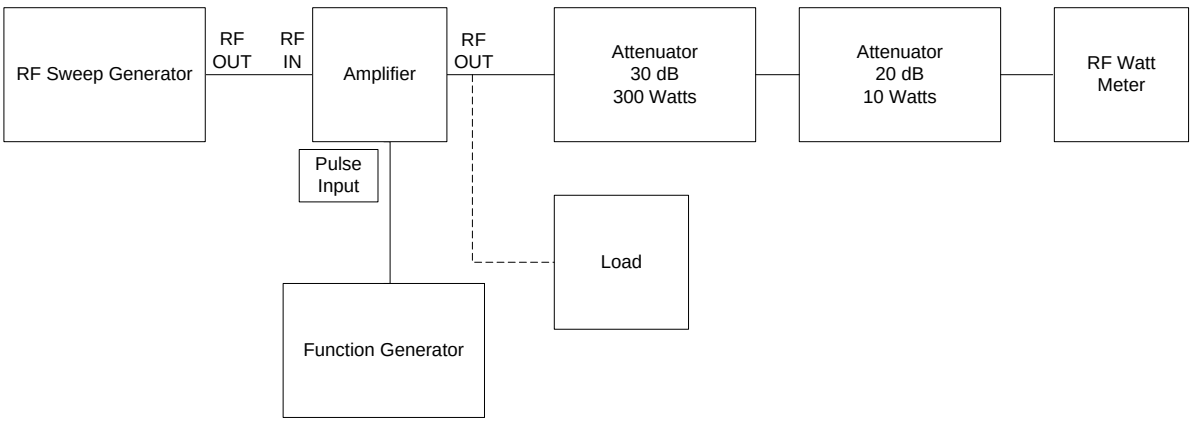


Figure 2-16. Typical Setup—Pulse Mode

2.5.3 Automatic Level Control (ALC) Modes

In these modes, the amplifier is operated in an Automatic Leveling mode, that is, the amplifier's RF output level is controlled by the THRESHOLD, RF GAIN and DETECTOR GAIN controls. The ALS input (feedback) for this mode uses the internal detector to achieve an output flatness of ±1 dB.

2.5.3.1 THRESHOLD Control

This control is used to adjust the output RF signal level in the ALC mode only; leveling will not occur if there is not sufficient RF input power to the amplifier. The THRESHOLD control is not used in the Manual or Pulse modes.

To adjust the ALC Threshold, select the ALC operating mode. Press the **THRESH** button. Adjust the value using the adjust knob. Please note that the display panel is limited in resolution compared to the control signals, which are generated and sent to the ALC Threshold control electronics. A small rotation that may not show any change on the display may, in fact, cause very small, precise changes in the amplifier's RF output.

2.5.3.2 DETECTOR GAIN Control

This control is used to compensate for gain variations of the ALC loop caused by differences in the detectors that can be used to provide level feedback to the automatic leveling loop.

To adjust the ALC Detector Gain, select the ALC operating mode. Press the DGAIN button. Adjust the value using the knob. Please note that the display panel is limited in resolution compared to the control signals, which are generated and sent to the Detector Gain control electronics. A small rotation that may not show any change on the display may, in fact, cause very small, precise changes in the Detector Gain. For Internal ALC operation, this control may be set to approximately 50%. If more precise leveling is desired, the Detector Gain may be set up to 100%.

2.5.3.3 ALC RESPONSE Control

The ALC RESPONSE control is used to adjust the frequency response of the ALC loop. This control is particularly useful if the input to the amplifier is a swept signal. By adjusting the speed of the ALC loop, critical damping-without oscillation-can be obtained. A level of 1 is the fastest time constant and a level of 6 is the slowest.

2.6 REMOTE COMMUNICATIONS

This section describes remote operation of the 12500A225A-L 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 Keylock switch on the control panel of the 12500A225A-L allows it to be controlled using remote communications. All remote queries will work in any Keylock switch position, but all remote commands will only work when the position is set to REMOTE. When the Keylock switch is set to REMOTE, all front panel controls are disabled unless otherwise specified.

2.6.1 IEEE-488 (GPIB) Communications

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 12500A225A-L'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 12500A225A-L will ignore characters following the termination.

2.6.1.1 Setting the IEEE-488 (GPIB) 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. 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.

2.6.2 RS-232 Communications

The RS-232 port is a serial communications bus. All commands and queries through this port must be terminated with a 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 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.

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 2-2. RS-232 Port Settings

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

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

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

2.6.3 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 50000A30. 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 2-4. Fiber-Optic Serial Port Settings

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

2.6.4 USB Communications

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.

2.6.5 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.

2.6.6 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 Keylock switch is in the INHIBIT, LOCAL, or REMOTE position.
- All commands can only be sent when the Keylock 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 12500A225A-L 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 12500A225A-L'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 2-5. Relationship between 12500A225A-L 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

2.6.6.1 Power On/Off

This command controls the power on/off state of the 12500A225A-L.

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>

2.6.6.2 RF On/Off

This command controls the RF on/off state of the 12500A225A-L.

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>

2.6.6.3 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>

2.6.6.4 Mode Select

This command sets the ALC mode of the 12500A225A-L.

Syntax: **MODE:x**

Parameters: Mode(x):

MANUAL = Set to CW mode
PULSE = Set to Pulse mode
ALC<space>INT = Set to ALC Internal mode

Response Format: None (No query for this command)

Example: To set the ALC mode to Pulse mode, send the following command:

MODE:PULSE<LF>

2.6.6.5 Level Adjust

This command sets the RF gain, detector gain, ALC threshold, and ALC Response Time of the 12500A225A-L.

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:
1 = 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>

2.6.6.6 Identity

Query to identify the 12500A225A-L.

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 12500A225A-L, send the following command:

***IDN?<LF>**

Response: **AR-RF/MICROWAVE-INST,12500A225A,1.0<LF>**

2.6.6.7 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_REV3.00<LF>**

2.6.6.8 Machine State

This query reads the RF gain, detector gain, ALC threshold, and ALC response time of the 12500A225A-L.

Syntax: **MSB?**

Parameters: None

Query only (always requires a ? character)

Response Format: **RF<space>GAIN=x,**
DT<space>GAIN=x,
THRES=x,
RESP=y<LF>

Value(x) [***x*** is always 3 characters in length, padded with leading spaces]:

For RF Gain, Detector Gain, and ALC Threshold:
0 = Minimum
100 = Maximum

Value(y) [***y*** is always one character in length]:

For Response Time:
1 = Minimum
7 = Maximum

Response Time Setting	Time (mS)
1	5
2	10
3	30
4	100
5	1000
6	3000
7	3000

Example: To get the machine state, send the following command:

MSB?<LF>

Response: **RF<space>GAIN=100,DT<space>GAIN=<space>50,THRES=<space>75,RESP=1<LF>**

(RF gain is 100%, Detector Gain is 50%, ALC Threshold is 75%, and ALC Response Time is set to 5mS)

2.6.6.9 State

Query to find the state of the 12500A225A-L.

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 12500A225A-L. The definitions of these bit positions can be found in the table below.

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

	BIT POSITION	BIT DESCRIPTION	BIT STATE 0	BIT STATE 1	NOTES:
x	0	PULSE STATUS	OFF	PULSE	
	1	(NOT USED)			
	2	(NOT USED)			
	3	REMOTE CONTROL	DISABLED	ENABLED	Response to key-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 key-switch position
	1	ALC ALERT	OK	FOLD BACK	ALC fold back inidication
	2	RF AUTO BIASING	INACTIVE	ACTIVE	Biasing state
	3	(NOT USED)			
a	0	MODE MANUAL	DISABLED	ENABLED	Also known as CW MODE
	1	MODE PULSE	DISABLED	ENABLED	
	2	MODE ALC INTERNAL	DISABLED	ENABLED	
	3	MODE ALC EXTERNAL	DISABLED	ENABLED	

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)*

2.6.4.10 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)*

2.6.4.11 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)*

2.6.4.12 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 12500A225A-L, send the following query:

RFG?<LF>

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

2.6.4.13 Faults

Query to find the faults that have occurred with the 12500A225A-L.

Syntax: **FSTA?**

Parameters: None

Response Format: **FSTA=<space>xxxx<LF>**

Where:
xxxx = 0000 to 0133 (Hexadecimal)

Dec	xxxx	Fault Text	Description	RF State After Fault Reset	
0	0000	N/A	No Fault	N/A	
1	0004	Interlock	Interlock	Off	
5	0005	PS2 Driver	Power Supply 2 (Driver Box)	**On**	
6	0006	PS1 Driver	Power Supply 1 (Driver Box)	**On**	
8	0008	AC Interlock	AC Interlock	Off	
17	0011	Therm A5 Driver	Module A5 Over Temperature (Driver Box)	Off	
18	0012	Amp A5 Driver	Module A5 Amp Fault (Driver Box)	Off	
19	0013	Amp A4 Driver	Module A4 Amp Fault (Driver Box)	Off	
20	0014	Therm A4 Driver	Module A4 Over Temperature (Driver Box)	Off	System
25	0019	485 Error	Internal RS-485 Communication Bus Error	Off	
26	001A	ALC	ALC at max attenuation but output still over limit	**On**	
27	001B	Bias Confirm Error	One or more Bias Board Assemblies did not echo back their assigned current value	Off	
30	001E	System Error	Fiber-Optic Communication Bus Error	Off	
213	00D5	Chiller Fault	Chiller Fault	Off	
224	00E0	Flow	Flow	Off	
227	00E3	Incoming Coolant Temp	Incoming Coolant Temp	Off	
229	00E5	Outgoing Coolant Temp	Outgoing Coolant Temp	Off	
40	0028	MPA1 A1-UC	Module A1 Under Current	**On**	
41	0029	MPA1 A2-UC	Module A2 Under Current	**On**	
42	002A	MPA1 A3-UC	Module A3 Under Current	**On**	
43	002B	MPA1 A4-UC	Module A4 Under Current	**On**	
44	002C	MPA1 A1-OC	Module A1 Over Current	**On**	
45	002D	MPA1 A2-OC	Module A2 Over Current	**On**	
46	002E	MPA1 A3-OC	Module A3 Over Current	**On**	
47	002F	MPA1 A4-OC	Module A4 Over Current	**On**	
50	0032	MPA1 Coolant Lvl	Coolant Level	Off	
51	0033	MPA1 PS2	Power Supply 2	Off	MPA1
58	003A	MPA1 Comb Therm	Combiner Thermal	Off	
60	003C	MPA1 A4-TH	Module A4 Thermal	Off	
61	003D	MPA1 A3-TH	Module A3 Thermal	Off	
62	003E	MPA1 A1-TH	Module A1 Thermal	Off	
63	003F	MPA1 A2-TH	Module A2 Thermal	Off	
64	0040	MPA1 Flow	Coolant Flow (Driver MPA)	Off	
65	0041	MPA1 485 Error	MPA Internal RS-485 Communication Bus Error	**On**	
67	0043	MPA1 Coolant Tmp	Coolant Temperature	Off	

The fault tables for MPA's 2 through 4 are identical, however they are offset by a value of 40 decimal (0028 hexadecimal). MPA2 for example, would have the same faults but starting at 80 decimal (0050 hexadecimal).

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

FSTA?<LF>

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

2.6.4.14 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)

2.6.4.15 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)

2.6.4.16 Initiate MPA Coolant Temperature and Transistor Currents

Command to initiate the process of acquiring the MPA coolant temperature and transistor currents.

Syntax: **MPA01**

Parameters: None

Response Format: None (No Query for this command)

Example: To initiate the process of finding out the coolant temperature and transistor currents for MPA 1, send the following command:

MPA01<LF>

2.6.4.17 Query MPA Coolant Temperature and Transistor Currents

Query to get the MPA coolant temperature and transistor currents that was initiated using the MPA Coolant Temperature and Transistor Current initiation command.

Syntax: **MPA?**

Response Format: **MPA01=t,a1,a2,a3,a4,b1,b2,b3,b4,c1,c2,c3,c4,d1,d2,d3,d4<LF>**

T = 0.0 to 999.0 (temperature of the MPA coolant in Celsius)

a1 to d4 = 0.0 to 99.9 (transistor current in Amps)

a1 to a4 are transistors 1 to 4 of module 1.

B1 to b2 are transistors 1 to 4 of module 2.

C1 to c4 are transistors 1 to 4 of module 3.

D1 to d4 are transistors 1 to 4 of module 4.

Leading zeroes are read as spaces. (Total return string length is 95 characters)

Example: To find out the coolant temperature and transistor currents for MPA 1, send MPA01 and then send the following query.

MPA?<LF>

Response: **MPA01=80.5, 5.4, 5.3, 5.4, 5.4, 5.5, 5.6, 5.4, 5.3, 5.4, 5.3, 5.4, 5.4, 5.5, 5.6, 5.4, 5.3<LF>**

2.6.4.18 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_REV1.50<LF>**

2.6.4.19 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_REV2.30<LF>**

2.6.4.20 SBB (Optical) Firmware Revision

Query to get the firmware revisions (groups of twenty) of the SBB assemblies that are fiber-optically connected to the MPB assembly.

Syntax: ***SBB1?**

Parameters: None

Query only (always requires a ? character)

Response Format: **SBB_SW_REVx<LF>**

Where:

x = firmware revision

Example: To get the firmware revisions of the fiber-optically connected SBB assembly, send the following command:

***SBB1?<LF>**

Response: **SBB_SW_REV2.30,2.30,2.30,,,,,,,,,,,,,,,,<LF>**

2.6.4.21 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>**

2.6.4.22 Remote Operating Timeout

Command to set the period between required communications to maintain an RF On state while in remote mode.

Syntax: **ROPTOx**

Parameters: x = 0 to 500 in seconds (default on power up is 0 which is the disabled state)

Query: **ROPTO?**

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

Example: To set the required period between communications that must be maintained once RF On has been initiated, send the following command.

ROPTO10<LF>

To find out what the period between communications that must be maintained once RF On has been initiated, send the following query.

ROPTO?<LF>

Response: **ROPTO=6<LF>**

2.6.4.23 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>

3. THEORY OF OPERATION

3.1 GENERAL

The Model 12500A225A-L amplifier can be a relatively simple unit to understand. The amplifier chain is a straightforward design, with a few control elements in the lineup. The unit's power supply, control and fault detection circuits can be easily understood by anyone with a minimal understanding of analog and digital circuitry.

3.2 AMPLIFIER

Refer to Interconnect Diagram 10040279, Driver Schematic 10037917 and the schematics referred to below.

3.2.1 Amplifier RF Input

From the RF input, the signal path is as follows. From the Type N input connector, the signal travels to the preamp-leveler, which is a self-contained, RF-tight assembly. There may be a fixed attenuator ahead of the preamp-leveler, which optimizes the overall RF gain of the amplifier.

3.2.2 Preamp-Leveler

Refer to Schematic 10030429. The input signal is fed, through input level protection diodes and an internal attenuator, to the voltage-variable attenuators U3 and U4. The voltage-variable attenuators adjust the gain of the amplifier and are controlled by the manual gain control on the front panel. U6 provides the proper control voltages for U3 and U4. The attenuators are followed by MMIC amplifier U7, and RF inhibit switch U11. Finally the signal feeds MMIC amplifier U13. MMIC amplifier U10 feeds a detector circuit that is adjusted to limit the preamp output power, providing overdrive protection for the rest of the amplifier. The preamp-leveler is powered by +5, +15VDC and -15VDC. Also included in the preamp is a pulse gating circuit when used in Pulse mode. U17 and U21 control the enabling of switch U18 when a pulse is applied to the Pulse In connector. The Pulse Out connector goes to the detector to allow for proper ALC protection using a sample and hold circuit.

3.2.3 Driver Low-Level Amplifier

The low-level driver amplifier is a 2-stage design with a single transistor driving a push-pull pair. Refer to schematic 10039024. With approximately 30 dB of gain, the driver amplifier is used for gain and flatness tuning. The driver amplifier is powered by +24 volts supplied by PS-2 inside the driver assembly.

3.2.4 Power Amplifier

The next element is the power amplifier modules (Schematic 10040505), also located in the driver assembly. These amplifiers have approximately 25dB of gain. They are powered by +44VDC, supplied by the main power supply in the driver/control unit. The power amplifier has a maximum power output capability of about 150 Watts, but operates linearly at a maximum level of about 25 Watts. The amplifier is a single-stage design with a single transistor push-pull pair. Bias levels and fault reporting are performed by the bias board which is plugged into the amplifier module.

3.2.5 Combiner/Splitter

The output of the power module is split two ways. The one feeds the control rack MPAs and the other split feeds the combiner rack MPA's.

3.2.6 8-Way Splitter

Two 8-way splitters in the control rack and one in the combiner rack take the driver RF signals and distribute them to the four MPA modules.

3.2.7 Main Power Amplifier Unit (MPA)

Four MPA units provide the rated output power. Refer to Schematic 10039459. The MPA consists of four liquid-cooled power amplifier modules (A1-A4), power supplies, and a cooling system. The cooling system, including a pump, heat exchanger, and a cooling fan, circulates a mixture of water and propylene-glycol coolant through the amplifier modules. Each of the four amplifier modules has a gain of approximately 21 dB, and each has its output fed to the front panel connectors of the MPA. The total output of the four modules in combination is sufficient to meet the specified output power of the 12500A225A-L. Primary power to the MPA is from the AC power distribution unit. It is switched by the breaker on the MPA rear panel, as well as the contactor internal to the MPA which is controlled from the driver/control unit. Fault detection signals are gathered from the four modules by the switch breakout board A5 and fed to the driver/control unit. Control signals from the driver/control unit are fed to A5 and distributed to the four amplifier modules.

3.2.8 Liquid-Cooled Module

The Liquid-cooled module (schematic 10038146) consists of two pair of push-pull transistors, for a total of four transistors (Q1-Q4). The transistors are mounted on a copper plate through which liquid coolant is circulated. Transistor bias is set and controlled by the automatic bias board which plugs into the module. The bias levels and fault detection levels (over-current, under-current, and current limit) for each transistor are factory-programmed into the bias board, and set to correct levels each time DC power is applied to the amplifier. Current through each RF transistor is monitored by hall-effect sensors U1-U4 (corresponding to Q1-Q4). The output signal of each hall-effect sensor is fed to the bias board through J1; the bias board applies the appropriate bias voltage to each transistor based on its current as read by the sensors. The bias board also reports faults to the control panel through the transmit board as described in the previous section. Each bias board (one per module) also has four LED's corresponding to each transistor to aid in fault location. Thermal switch SW1 senses over-temperature locally and 1) sends a signal to the control panel to shut down the amplifier and 2) as a failsafe and backup to the control panel, disconnects the +5V supply from the bias circuitry. Power combination from the four transistor stages is achieved through a series of balun transformers in the output section.

3.2.9 Output Combiner/Directional Coupler, Detector Assembly

The outputs from the amplifier modules in the MPAs are combined into one output in the 16-way output combiner. The combiner operates in a zero/180 degree configuration. The combiner is designed to tolerate loss of input signals at full output power. The single output then passes through a dual directional coupler (internal to the combiner), the output of which is the main output connector of the amplifier. The forward and reflected ports of the directional coupler are at a level of about –60 dB relative to the main output signal. The RF detectors for converting the amplifier's Forward and Reflected RF signals to usable DC signals are located in the driver/control unit. The detected signals are used by the ALC, fault detection/control circuits and by the Forward and Reflected power display on the Digital Control Panel (DCP).

The detector assembly is located inside the Driver/Control Unit. Inside the detector assembly (Schematic 10030554), a combination of attenuators and MMIC amplifiers process the signal to feed the output the sample signal to the front panel sample ports. Active detectors are used to provide DC signals to the ALC board for amplifier control and also to provide the analog signal to the control panel providing the power level readings on the display.

3.2.10 Sample Ports

The signals appearing at the sample ports produce a level of approximately –10dBm at 10,000W. 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.

3.3 POWER SUPPLY

Refer to Interconnect Diagram, 12500A225A-L (Schematic 10040279). Main power to the unit is supplied by three phase AC power within the proper range. In series with the line voltage is the Main circuit breaker, located on the rear panel. This circuit breaker supplies AC line voltage to the power distribution box. The driver/control unit and the main power amplifier units are fed from outlets in the power distribution box. The Driver/control unit and the MPA each have internal AC contactors. The contactors are controlled by the front panel Power ON/Off switch and interrupted manually by the three-position key-switch labeled **Inhibit – Local – Remote**. The contactors feed AC directly to the primary inputs of the main power supplies. When the main circuit breaker is on, AC power is fed to the low level/bias supply PS1 in the driver/control unit. Therefore, when the circuit breaker is turned on, the control panel and basic low-power supplies are alive, and the amplifier is armed for Power On. At this time, the front panel display is illuminated and the control circuitry is active.

3.4 CONTROL CIRCUITS

3.4.1 Fiber-Optic System Control Link

The 12500A225A-L control system uses a fiber-optic communication system to link each of the MPA's back to the Driver/Controller unit. The Digital Control Panel (DCP) uses this link to send information to the system MPA's and read fault conditions. Therefore this link is critical to the operation of the amplifier system. When the system is powered up, the DCP goes through an addressing process in which a communication link is established for each item in the serial chain. If this process fails, a fault condition is generated.

An LED is installed on the rear of each MPA to indicate the state of this link. See Table 3-1 below for the link states. This information is also indicated on a label next to the LED.

Table 3-1. Link States

LED	F/O LINK
OFF	NONE
BLINK	LOCAL
ON	SYSTEM

If the LED is off, then either there is no power to the MPA or the internal Switch Breakout Board (SSB) assembly failed to initialize.

If the LED is blinking, it means that locally the MPA is powered and the SBB is initialized.

If the LED is on solid, the communications link has been established with the DCP.

For the amplifier to be able to go to an RF on state, all MPA link LED's must be on solid.

3.4.2 Power On/Operate Circuits

This section describes the functioning of the switches, relays and controls in the AC/DC power distribution system. See Interconnect Diagram, 12500A225A-L (Schematic 10040279) and 10037917, **Interconnect, Driver Amp**.

The power distribution unit has 10 circuit breakers. The main circuit breaker disconnects all circuits from the AC mains. The following description assumes that the main breaker is closed, making AC power available to the amplifier components. In the DCU, +5VDC and +15VDC from PS3 are connected to the digital control panel and the ALC board whenever CB1 on the DCU rear panel is closed.

Relays K1 and K2 in the DCU control AC power to the main power supplies in the DCU and the MPAs for amplifier operation. K1 applies power to the main power supply PS1 and the auxiliary supply PS2 in the DCU. K2 controls the interlock contactor in the MPA, which applies AC power to the MPA's, PS2, the main power supply to the MPA modules. Control for relays K1 and K2 loops through the interlock connector P9/J1 to the control panel. The relays have +15V applied to their coils, and a "low" signal from the control panel (P6-2) to the other side of the coils sinks current, activating the relays.

Note that in order to complete the circuit through K1 and K2, the external AC interlock circuit must be closed. The I/O panel Safety Interlock connector provides pins 10 and 14 for this purpose. Another interlock circuit, provided in the same connector, is used for RF inhibit, pins 1 and 8, if the user so desires. Both types can be used simultaneously in their respective circuits. If the AC interlock circuit is open, a direct logic signal will be applied to the Control Panel to display **AC Interlock** on the display when Power On is attempted. If the Inhibit interlock is open, **Interlock** will be displayed.

The energized relay K2 will energize the MPA contactor, applying the AC mains to the MPA main power supply. The unit will then be in the STANDBY (RF Off) condition. In this state, all RF Power stages in the DCU and the MPA are without DC power, making it impossible to produce any RF power. Power supply and main cooling fans will be heard even though no DC is output from the main power supplies. The DC output power from the main power supplies (PS1 in the DCU and PS2 in the MPA) when AC is supplied to them, is toggled on and off by the "RF ON" and "RF OFF" function.

Note that upon selecting "RF ON" there is a delay of a few seconds for the amplifier to produce output. This time is required for stabilization and confirmation of proper bias current levels to each transistor in the system.

If the Keylock Switch is in the REMOTE position, the Power and Operate functions are the same except that they can only be performed remotely (i.e., from the user's computer), since the front panel controls are locked out when the amplifier is in the Remote mode.

3.4.3 Automatic Level Control Circuits

This section describes the operation of the Automatic Level Control (ALC) circuit board. Refer to schematic diagram number 10023927, **Schematic, Digital ALC Board**.

The ALC board performs the following general functions:

- It limits the RF drive level to the amplifier stages and sounds an audible alarm when the amplifier's Forward or Reflected power levels try to exceed preset levels.
- It sends a fault signal to the Digital Control Panel (DCP) if the limiting previously described fails to control the amplifier's Forward or Reflected power levels. This fault signal ultimately inhibits the amplifier.
- Allows the user the means to level at a set output power level.

3.5 FAULT DETECTION CIRCUITS

This section describes the function and theory of the Model 12500A225A-L's fault detection circuits.

The output power modules are controlled by an automatic bias circuit. This circuit board is plugged into a socket on the DCU's amplifier module PCB. In addition to establishing proper bias levels at turn-on, this board performs current limiting and senses over-current and under-current faults for each transistor. Bias, limit, and fault sense levels are factory programmed into the bias board.

Faults from the MPA's are transmitted to the DCP by the Switch Breakout Board (SBB), A6 in the MPA. The SBB assembly processes fault information from all four RF amplifier modules within the MPA. The faulty module location is displayed, and a red LED indicator lights on the module at fault. There are four LED indicators on each bias board, one for each power transistor.

Note that after a fault condition has been invoked, the circuit breaker and DCU circuit breakers must be left on to keep the temporary memory active, until all faults can be manually recorded for diagnostic purposes. Faults may be recorded by the host system if the host software is written to respond to fault conditions. Fault conditions may be queried at any time during normal operation of the 12500A225A-L.

Detected fault signals are recorded in temporary (volatile) memory before the amplifier control circuits act to protect the amplifier, sometimes resulting in RF inhibit or shut down. In some cases, inputs are read multiple times to prevent a transient signal from causing an unwarranted action. Note that after a fault condition has been invoked, the circuit breaker CB1 must be left on to keep the temporary memory active, so that all faults can be manually recorded for diagnostic purposes. Faults may be recorded by the host system if the host software is written to respond to fault conditions. Fault conditions may be queried at any time during normal operation of the amplifier.

3.5.1 Thermal Faults

Each of the 500 watt modules contains thermal sensor switches. In the case of a thermal fault, the line will go high. The control panel displays the module designator and **TH**, and the main power supplies will be inhibited to allow the modules to cool down.

Additional thermal sensing is done in the MPA reservoir tanks and coolant drawer assembly. A fault will occur if, at any time, the temperature exceeds a maximum temperature factory setting. The fault will be displayed on the digital control panel along with its location.

3.5.2 Current Faults

Detailed theory of operation of the RF Power Amplifier module is covered in Section 3.2.7. Parts dealing with faults are explained here.

Refer to schematic diagram 10029409, **500 Watt Module**. There are two possible faults that will signal the control system. They are Over-current (OC), Under-current (UC) faults.

3.5.2.1 Over-current

On each 500 watt module, a current-sensing IC delivers an output voltage which is proportional to the current being drawn. This voltage is compared to an adjustable reference voltage by an op-amp. If the output voltage exceeds the reference voltage, the op amp's output goes high to indicate that too much current is being drawn. This causes the control panel to display the module designator and **OC**, as well as inhibiting the main power supplies.

3.5.2.2 Under-current

Each 500 watt module has an op-amp which compares the current sense output voltage to an adjustable reference voltage such that it detects an undercurrent condition. If the output voltage drops below the reference voltage, the op amp's output goes high to indicate that too little current is being drawn. This causes the control panel to display the module designator and **UC**, as well as inhibiting the RF signal.

3.5.3 Power Supply Faults

The main power supplies in the DCU and MPA's are monitored internally. If a supply fails to produce DC voltage within its specification, a logic signal will signal the fault board, resulting in an instant shut down. The power supply faults and inhibit signals are routed to the Control Panel. The fault signal is a logic high (+5VDC) when all is well, switching to a logic low if a fault occurs.

3.5.4 ALC Fault

An ALC fault is invoked whenever the forward or reverse power limit controls do not function, causing the RF power to exceed one of the preset limits. The ALC fault is a logic low when invoked. The logic low from the ALC board signals the digital control panel, which, in turn, disables the RF output by inhibiting the main supply, PS1.

3.5.5 Interlocks

The Model 12500A225A-L Driver has two interlocks that are wired to the rear panel Safety Interlock connector. The interlocks are separate circuits. Both interlocks require normally closed external circuits to allow the amplifier to function.

3.5.5.1 Inhibit Interlock

For interlock applications where the amplifier is not required to shut down totally (AC Off), this interlock circuit inhibits RF amplification by disabling the preamp in the DCU and power supplies and forcing the amplifier into the Standby (RF Off) condition. 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 connection will inhibit the Driver and display **Interlock** on the front panel. When the inhibit interlock has been opened, the Driver returns to the Standby (RF Off) condition, forcing the re-assertion of the Operate (RF On) command returns the unit to normal operation.

3.5.5.2 AC Interlock

For interlock applications where it is desired to disconnect the AC power source from the main power supplies, the AC interlock can be used to disconnect the amplifier from the AC mains. This interlock circuit is connected directly in series with the relay coils K1 and K2 in the DCU, which actuate the contactors for the main power supplies in the DCU and MPA. Rear panel Interlock connector Pins 10 and 14 are for this purpose. Pin 10 provides the activation signal from the control panel P2-2 to the relay coils. Opening the AC interlock connection will disconnect AC primary power to all major circuits and display **AC Interlock** on the front panel.

Fault conditions can be reset by pressing the **RESET** button displayed on the Touch Screen located on the front panel or by sending the RESET remote command from the user's computer (when the Keylock Switch is set to **REMOTE**). Either of these conditions causes the 12500A225A-L's DCU to return to normal conditions. Forcing the user to reassert the Operate command (RF On) after a fault or interlock condition is a safety feature that prevents an unexpected burst of RF when the fault or interlock condition has been restored. Fault conditions that require the MPA to be disconnected from the AC mains will be reset automatically upon re-energizing the amplifier. Only fault conditions that continue to be valid will be displayed after the AC mains have been disconnect via the circuit breaker or external disconnection.

3.5.6 System Error (F/O Link Fault)

The fiber-optic serial link must be established before the amplifier system can go to an RF On state. This link is established immediately upon power on of the driver box. It is for this reason that all sub-amplifier breakers must be powered on before the driver rack is powered on. If the link fails to be established with all MPA's, a fault condition is generated. The LED's on the rear of each MPA can be used to determine where the link is broken.

3.5.7 Flow Faults

There are five flow sensors within the 12500A225A-L: one in each MPA coolant loop and one in the main coolant loop of the coolant drawer. At any time if the coolant flow drops below a factory preset level, the amplifier will shut down and display a coolant fault and its location.

3.5.8 Level Fault

Each MPA reservoir has a level sensor to detect when the fluid has dropped below a safe level. A level fault and its location will be displayed on the digital control panel.

CAUTION:

Amplifier must be cooled down to room temperature prior to removing reservoir pressure cap for refilling.

4. TROUBLESHOOTING AND REPAIR

4.1. GENERAL

Because it is a relatively simple instrument, the Model 12500A225A-L should require very little maintenance. It is built with solid state devices and printed wiring boards (PWBs) that should ensure long, trouble-free life. Should trouble occur, special care must be taken when servicing the unit to avoid damaging the solid state devices and PWBs.

Since the 12500A225A-L's components are soldered in place, substitution of components should not be resorted to unless there is some indication that they are faulty. In addition, care must be taken not to short voltages across the amplifier when troubleshooting, because small bias changes may damage the unit due to excessive dissipation or transients.

Components used in AR instruments are conservatively operated to provide maximum instrument reliability. In spite of this, parts 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 repairs. The Model 12500A225A-L incorporates fault control and detection circuits, including display panel indications that can expedite troubleshooting of the unit. For a description of how these indications can be used to assist in troubleshooting the unit, please see section 4.2, **Fault Signal Interpretation and Diagnosis.**

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 FAULT SIGNAL INTERPRETATION AND DIAGNOSIS

CAUTION:

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

4.2.1 General - Reading Faults

The Model 12500A225A-L incorporates relatively simple fault detection circuitry, which makes use of the digital touch display to alert the user or technician which component(s) need service. Use of these indications can usually expedite troubleshooting of the unit. 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 DCP 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 Driver's input. If the fault does not clear with the RF drive off, some other problem exists in the unit.

4.2.2 Power Supply Faults

Indication **– PS(x)**

The main power supply within one of the MPA's has failed to produce DC voltage within the design range of the power supply.

4.2.3 Thermal Faults

Indication – **TH**

MPA and RF module thermal faults are detected and reported back to the DCP.

4.2.4 ALC Fault

Indication – **ALC**

As stated previously, the power limit controls could not limit either the forward or reverse power to the preset threshold. This can be a transient type of problem, if the fault can be cleared. If the fault cannot be cleared with no RF input drive power, then there is a malfunction in the ALC board or associated circuit.

4.2.5 RF Module Faults

Any RF module fault will trigger amplifier shut down, including main power supplies. There are three possible module faults – Over-current, Under-current and Thermal. Module faults are displayed as **OC**, **UC** or **TH**, where **OC**=Over-Current, **UC**=Under-Current and **TH**=Thermal.

Thermal faults usually indicate ambient temperature is too high, there is inadequate water-flow through the module heat sinks or there is a problem with the sensor in the module.

Over-current faults usually indicate there is a short circuit that would not clear on the module printed wiring or component, or the module current limit is not adjusted correctly. Under-current faults usually indicate that one of the output devices is defective and/or not drawing enough current.

CAUTION:

The MPA unit's housing is specially designed to route cooling air over the modules' components. Operation with any covers removed should be limited to one-(1) minute intervals with a two (2) minute cool down, especially at frequencies above 100MHz.

4.2.6 Fiber-Optic System Control Fault

If there is a point in the fiber-optic system control loop where one or more MPA's did not link properly, the source of the problem can be pin pointed by using the LED's found on the rear of each MPA. Starting at the driver/controller unit, the fiber-optic loop can be traced while paying attention to the LED state on each MPA. The issue in the loop will be found just prior to wherever the first MPA is found to have a blinking or off LED. Issues with the loop functionality can be caused by a damaged fiber-optic cable.

4.3 DIAGNOSING AND REPLACING AMPLIFIER MODULES

4.3.1 Locating Modules

Liquid cooled modules are easily accessible with the removal of MPA side panel.
See Figure 4-1.

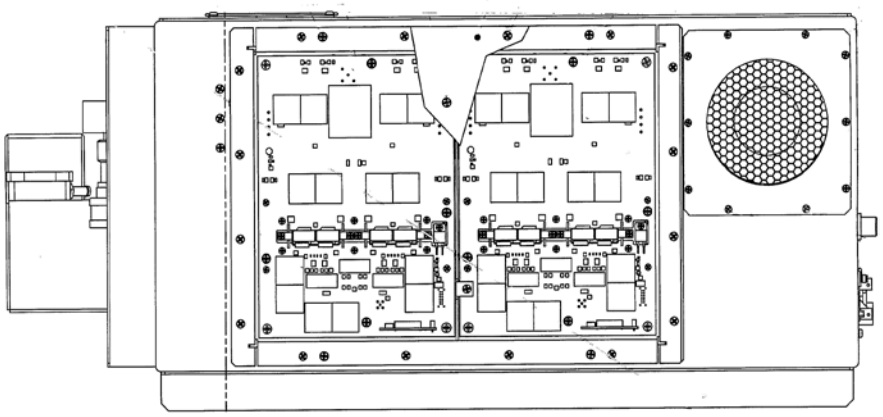


Figure 4-1. 12500A225A-L Module Locations (MPA Side View)

4.3.2 Module Replacement

If, after troubleshooting, it has been determined that one of the liquid-cooled modules has failed, the following procedure should be followed if a spare module for the unit is available.

CAUTION:

Power to the unit must be turned off before performing any repair work; this should be done by unplugging the unit from the line voltage source. Failure to disconnect the unit from the line voltage source prior to servicing would present a hazard to service personnel and could result in damage to the amplifier.

Before pulling out the MPA, MPA-retaining hardware must be removed. Removal from the cabinet requires the removal of a mechanical stop. Also, cables and connectors must be disconnected. Side panels or the top panels may need to be removed. Providing that the filler caps for the liquid coolant are left in place, the unit may be turned on its side or on its top for service.

After cover removal, the signal connector, the two heavy DC power supply connectors and the RF input and output connectors can be disconnected from the module being serviced. The liquid coolant connectors will not spill coolant and may be disconnected along with the other connections. Take note of any connector that is found loose. To remove the module, remove the six screws that hold the module into the frame and gently lift the module out. The module is relatively heavy with its copper cold plate. Be careful not to damage wires or RF cables, and not to hold the module by its magnetic cores, during the removal process. Be especially careful with SMT components that may be location along the edge of the PWB.

A module is installed in the reverse order, making sure that all connections are tight. Use an appropriate open-end wrench to tighten the SMA RF connector.

4.3.3 Cooling System

The liquid cooling system is a closed system which will operate for years without maintenance. The coolant level should extend into the coolant reservoir, with the heat exchanger full for optimum cooling. The coolant is a mixture of 30% standard propylene- glycol anti-freeze and 70% water. This will provide protection to 5° F (-15° C) for operation and -20 ° F (-29° C) for storage. Quick-disconnect leak-proof connectors are incorporated to allow removal of modules and major system components with no leakage of fluid. In the event that coolant is removed from the system for any reason, the pump should not be activated; damage to the pump can occur if it is run without fluid.

CAUTION:
EYE AND SKIN IRRITANT
Contains propylene glycol. Do not swallow. Do not allow eye contact or prolonged skin contact. For additional information, refer to Material Safety Data Sheet.

Appendix A. Installing Software Upgrades

A.1 FIRMWARE UPDATES

Most digital assemblies within the 12500A225A-L control system have the ability to have their firmware updated by the end user. Some of these assemblies require hardware re-configuration while others do not. All firmware updates have some risk associated with them. It is for this reason that all firmware updates should be discussed with the AR Customer Service department before being performed.

All firmware updates will require a PC and a standard USB peripheral device cable (A-B connectors). It is recommended that the PC be 64-bit running Windows 7 or Windows 8 64-bit.

1. Download the AR Firmware Upgrade Utility from the AR website. There are two versions available for download. One version is for 32-bit operating systems and one version is for 64-bit operating systems. Select the appropriate version and download it to the PC that will be used to perform firmware updates.

2. Un-zip the Firmware Upgrade Utility file that was downloaded and run the installer executable. This will install the AR Firmware Upgrade Utility on the PC.

The following are assemblies that can be updated using the AR Firmware Upgrade Utility. Since updates for these assemblies are slightly different from one another each of their associated processes are listed separately. All of these updates can be performed in any order unless otherwise instructed by the AR Customer Service Department.

A.2 CONTROL - MULTI-PURPOSE BOARD ASSEMBLY FIRMWARE (X1)

1. Power off the entire 12500A225A-L system.

2. Go to the AR website and download the firmware file for the model 12500A225A-L.

3. Once the download completes, unzip the firmware file on the PC that will be used to perform the firmware update. Do not change the names of the folder or files that are unzipped.

4. Run the AR Firmware Upgrade Utility and follow the instructions it provides.

5. Once the utility successfully connects to the 12500A225A-L Driver Box, click the Update button for the Control firmware. The utility will step through an additional setup process similar to the one that was previously done. Follow these instructions exactly. When asked to power on the device, only power on the Driver Box.

6. When the utility confirms that the 12500A225A-L is in the correct state, it will prompt for the model specific firmware file which was unzipped in the steps above. Select this file and allow the utility to complete the update process.

7. After the update is complete, cycle power to the entire 12500A225A-L system.

A.3 I/O - INPUT OUTPUT BOARD ASSEMBLY FIRMWARE (X1)

1. Power off the entire 12500A225A-L system.

2. Go to the AR website and download the IO firmware.

3. Once the download completes, unzip the firmware file on the PC that will be used to perform the firmware update. Do not change the names of the folder or files that are unzipped.

4. Run the AR Firmware Upgrade Utility and follow the instructions it provides. When asked to power on the device, only power on the Driver Box.

5. Once the utility successfully connects to the 12500A225A-L Driver Box, click the Update button for the I/O firmware.

6. The utility will prompt for the IO firmware file which was unzipped in the steps above. Select this file and allow the utility to complete the update process.

7. After the update is complete, cycle power to the entire 12500A225A-L system.

A.4 BREAKOUT - PIGGY-BACK CONNECTED SWITCH BREAKOUT BOARD (SBB) ASSEMBLY FIRMWARE (X1)

1. Power off the entire 12500A225A-L system.

2. Go to the AR website and download the SBB firmware.

3. Once the download completes, unzip the firmware file on the PC that will be used to perform the firmware update. Do not change the names of the folder or files that are unzipped.

4. Run the AR Firmware Upgrade Utility and follow the instructions it provides. When asked to power on the device, only power on the Driver Box.

5. Once the utility successfully connects to the 12500A225A-L Driver Box, double click the 12500A225A-L model number in the upper right corner of the utility.

6. Enter the password 2157238181. This will uncover additional update options.

7. Click the Update button for the SBB Piggyback firmware.

8. The utility will prompt for the SBB firmware file which was unzipped in the steps above. Select this file and allow the utility to complete the update process.

9. After the update is complete, cycle power to the entire 12500A225A-L system.

A.5 BREAKOUT - FIBER-OPTIC CONNECTED SWITCH BREAKOUT BOARD (SBB) ASSEMBLY FIRMWARE IN MPAS (X4)

1. Power off the entire 12500A225A-L system.
2. Disconnect the TX and RX F/O SYS CONTROL connections from rear panel of the Driver Box.
3. Using a pair of fiber-optic cables, attach the TX and RX connections of the F/O SYS CONTROL found on the rear panel of the Driver Box, to the RX and TX connections on any MPA. (TX to RX and RX to TX).
4. Go to the AR website and download the SBB firmware.
5. Once the download completes, unzip the firmware file on the PC that will be used to perform the firmware update. Do not change the names of the folder or files that are unzipped.
6. Run the AR Firmware Upgrade Utility and follow the instructions it provides.
7. Once the utility successfully connects to the 12500A225A-L, double click the 12500A225A-L model number in the upper right corner of the utility.
8. Enter the password 2157238181. This will uncover additional update options.
9. Click the Update button for the SBB Optical firmware.
10. The utility will prompt for the SBB firmware file which was unzipped in the steps above. Select this file and allow the utility to complete the update process.
11. After the update is complete, power off the entire 12500A225A-L system and restore all fiber-optic connections then power on the 12500A225A-L.

A.6 AUTOMATIC LEVELING CONTROL (ALC) ASSEMBLY FIRMWARE (X1)

1. Power off the entire 12500A225A-L system.
2. Go to the AR website and download the ALC firmware.
3. Once the download completes, unzip the firmware file on the PC that will be used to perform the firmware update. Do not change the names of the folder or files that are unzipped.
4. Run the AR Firmware Upgrade Utility and follow the instructions it provides. When asked to power on the device, only power on the Driver Box.
5. Once the utility successfully connects to the 12500A225A-L Driver Box, double click the 10000A225A model number in the upper right corner of the utility.
6. Enter the password 2157238181. This will uncover additional update options.
7. Click the Update button for the ALC firmware.

8. The utility will prompt for the ALC firmware file which was unzipped in the steps above. Select this file and allow the utility to complete the update process.

A.7 ASSEMBLIES THAT REQUIRE PHYSICAL REPLACEMENT TO UPDATE FIRMWARE

The following assemblies can only have their firmware updated by swapping physical assemblies:

- BB - Bias Board Assembly (x4) - *Found in the MPA's*

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.

Rev 1216