



rf/microwave instrumentation

Operating and Service Manual

1500T8G18

Model

10013552

Part Number

Serial Number

EC Declaration of Conformity

We: Amplifier Research
160 School House Road
Souderton, PA. 18964

declare that our product(s);

the Model 1500T8G18 series RF amplifiers

to which this declaration relates is in compliance with the following European directives:

Low Voltage Directive: 2014/35/EU

EMC Directive: 2014/30/EU

Supplementary Information:

Safety : EN 60215-1:1989

EN 61010-1:2010

EMC: EN 61000-6-2:2005, EN61000-6-4:2007

Year Mark Applied: 2016

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directives and Standards.

Authorized officer of the company:



Patricia Thrasher
Manager Quality, Customer Service, Purchasing

Instructions for European EMC Conformity



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

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

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



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

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

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



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

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

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

INSTRUCTIONS FOR SAFE OPERATION

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

INTENDED USE

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

SAFETY SYMBOLS

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

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

EQUIPMENT SETUP PRECAUTIONS



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

- Follow all lifting instructions specified in this document.
- Place the equipment on a hard, level surface.
- Do not use the equipment in a wet environment, for example, near a sink, or in a wet basement.
- Position your equipment so that the power switch is easily accessible.
- Leave 10.2 cm (4 in) minimum of clearance on all vented sides of the equipment to permit the airflow required for proper ventilation. Do not restrict airflow into the equipment by blocking

any vents or air intakes. Restricting airflow can result in damage to the equipment, intermittent shut-downs or safety hazards.

- Keep equipment away from extremely hot or cold temperatures to ensure that it is used within the specified operating range.
- While installing accessories such as antennas, directional couplers and field probes, take care to avoid any exposure to hazardous RF levels.
- Ensure that nothing rests on your equipment's cables and that the cables are not located where they can be stepped on or tripped over.
- Move equipment with care; ensure that all casters and/or cables are firmly connected to the system. Avoid sudden stops and uneven surfaces.

BEFORE APPLYING POWER

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



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

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



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

SAFETY GROUND



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

INSTRUCTIONS FOR SAFE OPERATION

HAZARDOUS RF VOLTAGES



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

ACOUSTIC LIMITATIONS

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

MAINTENANCE CAUTION

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

ENVIRONMENTAL CONDITIONS

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

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

EQUIPMENT CONTAINING LASERS



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

RF ANTENNAS

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

RACK MOUNTED TWT MODELS

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

LIFTING INSTRUCTIONS FOR AR EQUIPMENT

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



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

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

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

HINWEISE FÜR DEN SICHEREN GEBRAUCH









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

VORGESEHENE VERWENDUNG

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

SICHERHEITSSYMBOL

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

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

SICHERHEITSHINWEISE FÜR DEN AUFBAU DES GERÄTS



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

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

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

BEVOR SIE DAS GERÄT ANSCHLIESSEN

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



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

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



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

SYSTEMERDUNG



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

HINWEISE FÜR DEN SICHEREN GEBRAUCH

GEFÄHRLICHE HF-SPANNUNGEN



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

HÖRSCHUTZ

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

WARTUNGSHINWEISE

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

UMGEBUNGSBEDINGUNGEN

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

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

LASER-INFORMATION



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

HF-ANTENNEN

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

RACK MONTIERBARE TWT-MODELLE

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

HEBEANWEISUNGEN FÜR AR-GERÄTE

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



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

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

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

INSTRUCTIONS POUR UN FONCTIONNEMENT EN TOUTE SÉCURITÉ









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

USAGE PRÉVU


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

SYMBOLES DE SÉCURITÉ

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

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

PRÉCAUTIONS D'INSTALLATION DE L'ÉQUIPEMENT

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

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

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

AVANT LA MISE SOUS TENSION

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



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

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



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

MISE À LA TERRE DE SÉCURITÉ



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

INSTRUCTIONS POUR UN FONCTIONNEMENT EN TOUTE SÉCURITÉ

TENSIONS RF DANGEREUSES

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



LIMITES ACOUSTIQUES

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

AVERTISSEMENT CONCERNANT L'ENTRETIEN

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

CONDITIONS ENVIRONNEMENTALES

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

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

ÉQUIPEMENT CONTENANT DES LASERS



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

ANTENNES RF

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

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

MODÈLES TWT MONTÉS SUR BÂTI

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

INSTRUCTIONS DE LEVAGE POUR L'ÉQUIPEMENT AR

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



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

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

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

INSTRUCTIES VOOR VEILIG GEBRUIK

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

BEOOGD GEBRUIK

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

VEILIGHEIDSSYMBOLEN

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

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

VOORZORGSMAATREGELEN BIJ DE INSTALLATIE VAN HET APPARAAT



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

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

Revisie 0517

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

VOOR HET OPZETTEN VAN DE STROOM

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



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

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



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

AARDING



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

INSTRUCTIES VOOR VEILIG GEBRUIK

GEVAARLIJKE RF-SPANNINGEN

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



AKOESTISCHE BEPERKINGEN

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

ONDERHOUD WAARSCHUWING

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

OMGEVINGSVOORWAARDEN

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

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

APPARAAT DAT LASERS BEVAT



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

RF-ANTENNES

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

IN EEN REK GEMONTEERDE TWT-MODELLEN

Sommige TWT-modellen worden geleverd zonder de verwijderbare behuizing die wordt aangeboden voor gebruik als 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 hijsorg (vloermodel) of de zijhandgrepen (tafelmodel) om de eenheid op te tillen.
- Gebruik apparatuur met voldoende capaciteit om de eenheid op te tillen en te ondersteunen.
- Als u een vorkheftruck gebruikt om de eenheid te verplaatsen, zorg er dan voor dat de vorken lang genoeg zijn om tot voorbij de zijkant van het eenheid uit te steken.
- Volg de link hierboven voor meer informatie.

ADDITIONAL WARNINGS & NOTES



WARNING:

This equipment operates at potentially lethal voltages. Only trained, qualified personnel should operate, maintain, or service it.



CAUTION:

The information in this document was obtained from reliable sources and was believed to be accurate at the time of publication. Since subsequent modifications to the machine may have been made, use this information only as a guide. Carefully compare the unit's actual configuration and operation to the descriptions in this manual before you undertake to operate, service, or modify this machine. Any variance or modification should be noted, dated, and initialed in the discrepant part of all manuals on hand for future reference. If you have technical or editorial comments you wish to make to the manufacturer, please write them on photocopies of the relevant sheets.

NOTE: The contents of this document are the property of the manufacturer and this document is delivered on the express condition that it not be disclosed, reproduced in whole or in part, or used for manufacture for anyone other than the manufacturer without its written consent, and that no right is granted to disclose or so use any information in this document.



Suggested Periodic Maintenance for TWT Amplifiers

1. Keep monthly log of the voltages, currents and temperatures as shown on Menus. Also record Date, “Console” and “Operate” hours. Take readings in Operate mode with the gain at zero (0%) percent. Leave unit in Operate mode for 20 minutes (Max Duty if Pulsed Unit), and then record data. Review the log to identify trends and contact factory if required.
2. Keep monthly log of performance with active RF. At mid-band frequency, with Gain set to 100%, apply RF drive that will provide rated power. This will help indicate if the gain or power is changing and if the traveling wave tube or pre-amp needs service. Record the following:
 - a. RF Drive Level
 - b. Forward Power
 - c. Reverse Power
 - d. Body Current (I_w)
 - e. Sample Port Power reading (if possible).
3. Remove air intake filter and clean using compressed air and/or vacuum cleaner.
4. Ensure air inlet and outlet are unobstructed.
5. Check that AC Input connections are secure. Make sure the AC cable is not damaged or deteriorated.
6. Check that both input and output RF connections (waveguide or coax) are connected tightly and un-damaged.

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1. DESCRIPTION AND SPECIFICATIONS

This manual provides operating, interfacing and selected service information pertinent to AR RF/Microwave Instrumentation Model 1500T8G18 Broadband Microwave Amplifier. The Model 1500T8G18 is a 1,500 watt I- and J- band traveling-wave tube amplifier (TWTA). This manual supports models offering additional special features. Refer to the model specification sheet to determine the applicable features of this unit.

1.1 TWTA DESCRIPTION

The amplifier uses four 500-watt “supertube” RF modules (each consisting of two power-combined traveling wave tubes or TWTs) combined to provide a minimum 1,500 watts output over the TWT amplifier's full bandwidth. The amplifier is well suited for susceptibility and general laboratory testing where instantaneous bandwidth, high gain and moderate harmonic levels are required.

The amplifier is completely self-contained and packaged in two standard 19-inch rack cabinets provided with lifting eyes and casters. The amplifier cabinets are approximately 63 inches high including casters and lifting hooks, 22 inches wide each (44 inches total) at the base, and 33 inches deep at the base, excluding projecting rear-panel connectors.

Primary power is:

Models specified for 190-255 volts 50/60 Hz, three phase with ground (4 wire), referred to in this manual as 208VAC

Efficient switching power supplies result in minimum power consumption. A fast regulation control loop and a high degree of filtering ensure performance within specifications over a wide range of operating conditions. Service panels of the amplifier are interlocked to reduce the likelihood of accidental contact with high voltage.

1.2 SUGGESTED APPLICATIONS

- RF Susceptibility testing
- Antenna and component testing
- Equipment calibration
- General laboratory instrumentation

1.3 SPECIFICATIONS

Refer to the AR Data Sheet at the end of this section for detailed specifications.

1.4 ACCESSORIES

AR RF/Microwave Instrumentation offers a number of accessories for use with this amplifier including:

- Directional coupler
- Antenna
- Flexible transmission line

Refer to a current AR RF/Microwave Instrumentation catalog for Microwave Accessories.

1.5 TEST DATA SHEET

A Test Data Sheet for a specific unit is prepared at the time of manufacture and is included with the unit's copy of this manual.



1500T8G18

- M1 through M8
- 1500 Watts CW
- 7.5GHz–18GHz

Features

The Model 1500T8G18 is a self contained, forced air cooled, broadband traveling wave tube (TWT) microwave amplifier designed for applications where instantaneous bandwidth, high gain, moderate harmonic levels, and high power output are required. Reliable TWT subsystems provide a conservative 1500 watts minimum at the amplifier output connector. Stated power specifications are at fundamental frequency.

The amplifier's front panel digital display shows forward and reflected output plus extensive system status information accessed through a series of menus via soft keys. Status indicators include power on, warm-up, standby, operate, faults, excess reflected power warning and remote. Standard features include a built-in IEEE-488 (GPIB) interface, 0dBm input, VSWR protection, gain control, RF output sample ports, auto sleep, plus monitoring of TWT helix current, cathode voltage, collector voltage, heater current, heater voltage, baseplate temperature and cabinet temperature. Modular design of the power supply and RF components allow for easy access and repair. Use of a switching mode power supply results in significant weight reduction.

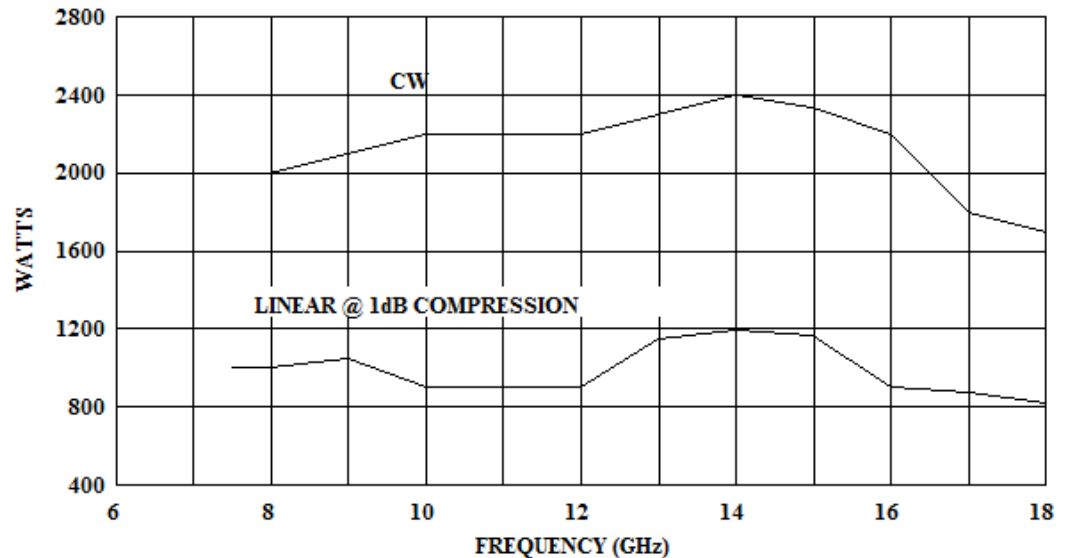
The rated power is developed by efficiently power combining the outputs from four 500 watts (nominal) microwave amplifiers, each consisting of two TWTs, that are factory matched in gain and phase, resulting in an excellent combination of wide instantaneous bandwidth with improved harmonic levels. Shipped as two cabinets, this model includes castor wheels and lifting eyes on each cabinet to facilitate positioning the amplifier, and leveling feet to stabilize the unit during operation.

The Model 1500T8G18 provides readily available RF power for a variety of applications in Test and Measurement, (including EMC RF susceptibility testing), Industrial and University Research and Development, and Service applications.

Refer to the Model Configuration chart for alternative configurations.

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.

1500T8G18 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



1500T8G18

- M1 through M8
- 1500 Watts CW
- 7.5GHz–18GHz

Specifications

POWER (fundamental) CW @ OUTPUT CONNECTOR:

Nominal 2000 watts
 Minimum 1500 watts
 Linear @ 1dB Compression 375 watts minimum

FLATNESS: ±11 dB maximum, equalized for ±6 dB maximum at rated power

FREQUENCY RESPONSE: 7.5-18 GHz instantaneously

INPUT FOR RATED OUTPUT: 1.0 milliwatt maximum

GAIN (at maximum setting): 62 dB minimum

GAIN ADJUSTMENT (continuous range): 35 dB minimum

INPUT IMPEDANCE: 50 ohms, VSWR 2.0:1 maximum

OUTPUT IMPEDANCE: 50 ohms, VSWR 2.5:1 typical

MISMATCH TOLERANCE: Output power fold back protection at reflected power exceeding 300 watts. Will operate without damage or oscillation with any magnitude and phase of source and load impedance. May oscillate with unshielded open due to coupling to input. Should not be tested with connector off.

MODULATION CAPABILITY: Will faithfully reproduce AM, FM, or pulse modulation appearing on the input signal. AM peak envelope power limited to specified power.

NOISE POWER DENSITY:

Minus 70 dBm/Hz (maximum),
 Minus 72 dBm/Hz (typical)

HARMONIC DISTORTION:

Minus 20 dBc (maximum),
 Minus 27 dBc (typical)

PRIMARY POWER: See Model Configurations

CONNECTORS:

RF input Type N (f) on rear panel
 RF output Type WRD -750D24 waveguide flange on rear panel
 RF output sample ports (forward and reverse):
 Type N (f) on rear panel
 GPIB IEEE-488 (f) on rear panel
 Interlock DB-15 (f) on rear panel

COOLING: Forced air (self contained fans), air entry and exit in rear.

WEIGHT: 546 kg (1200 lb)

SIZE (W x H x D): Two cabinets, each 56 x 160 x 84 cm (22.1 x 63 x 33 in)

EXPORT CLASSIFICATION: EAR99

Model Configurations

P Must select one primary power from the following [P1 or P2]:

- P1** 190-255 VAC, 3 phase, delta (4-wire) 50/60 Hz, 16 KVA maximum
P2 360-435 VAC, 3 phase, Wye (5-wire) 50/60 Hz, 16 KVA maximum. CE marked to comply with EMC European Directive 89/336/EEC for operation inside a shielded room.

S May select a special feature (extra cost) [S1F or S2B]

- S1F** Input, forward and reflected power sample ports on front panel.
S2B Each cabinet supplied with larger caster wheels mounted on a rugged base that facilitates use of a forklift to move the TWTAs. Add 91 kg (200 lbs) to weight; add 7.6 cm (3 in) to height.

Model Number	Features	
	P	S
1500T8G18	P1	-
1500T8G18M1	P2	
1500T8G18M2	See separate specification sheet	
1500T8G18M3	P1	S1F
1500T8G18M4	P2	S1F
1500T8G18M5	P1	S1F & S2B
1500T8G18M6	P2	S1F & S2B
1500T8G18M7	P1	S2B
1500T8G18M8	P2	S2B

2. THEORY OF OPERATION

2.1 DESIGN OF THE AMPLIFIER

The Model 1500T8G18 TWT amplifier consists of ten principal subsystems. These are the control module (A31781-000), two Supertubes (A28007-004), two Supertubes (A28007-007), the RF combiner assembly (A31796-000), and the four TWT power supplies (A28013-002). These will be discussed in greater detail below. The system is completed by a number of cables that interconnect the subsystems, and by the rack assembly.

See the build tree in section 5.1 for information about how the parts lists are structured.

2.2 CONTROL MODULE

The control module houses the microprocessor control system (control head), the data steering assembly, appropriate DC power supplies, and an AC circuit breaker for removing the AC power from the four TWT power supplies and from the control module's power supplies.

The control head consists of three boards: the display board provides the user interface (display, buttons, and rotary encoder); the CPU board contains the CPU, bus management hardware, DRAM, EPROMs, and static RAM; and the datalink board provides the I/O to the amplifier system as well as the IEEE-488 communication bus for computer interfacing.

The control head is provided with its own power supply and, other than thru the interface bus, is electrically isolated from the amplifier. Communication with the amplifier is via fiberoptic links. The single pair of links on the control head fans out to five pairs of links in the data steering assembly (A21175-000). These links go to interface boards in the RF combiner and in each of the four power supplies. The data is "steered" by an address byte in the data stream from the microprocessor. The data steering board is located such that the fiber optic links from the controller and the power supplies can plug directly into it.

2.3 DESCRIPTION OF THE SUPERTUBE ASSEMBLY

Each "Supertube" consists of a pair of 300-watt TWTs (E08114-001) in a 3U (5.25" high) chassis. Each tube is mounted on its own heat sink and cooled with its own 400 Hz fan powered by its own fan driver (A23692-000). The RF input is split by a 180° hybrid. The hybrid's sum port is terminated, and the secondaries run to the RF inputs of the TWTs via line stretchers that have been adjusted to make the electrical length of the two TWTs identical, for instantaneous phase combining across the band. This phase matching is done at the factory and is transparent to the user.

Each TWT's type WRD-750D24 output flange is connected by waveguide to a waveguide coupler used for protection from high internal reflected power, and then to the side port of a magic tee (waveguide 180° hybrid) (E20399-000). The sum port is terminated with a 500-watt load. The difference port output provides the RF output of the supertube. Because the two TWTs in the supertube share a common power supply, protective circuits, and RF input and output, the supertube serves in the system like a single TWT. The major differences between a conventional power supply and a supertube power supply is the dual grid modulators used in a supertube supply (to allow the two tubes to use the same cathode and collector supply, sometimes different grid voltages must be used), and by an additional temperature reading.

Since the fundamental frequencies are amplified 180° out of phase, the second harmonic products, which represent significant power in the lower part of the band, are largely in phase, and are dumped in the sum

port. The residual harmonics are generally lower than -20 dBc, low enough in power that they can be blocked by a reflective filter without harm to the TWTs.

2.4 DESCRIPTION OF THE RF COMBINER ASSEMBLY

Refer to the RF Block Diagram in Section 5.3 of this manual for an overview of the RF Combining.

2.5 DESCRIPTION OF THE TWT POWER SUPPLIES

Each of the four TWT power supplies are housed in individual 19" chassis, 5 rack units (8.75") high. Each power supply chassis contains a TWT power supply assembly (A22525-900), an HPA interface board (A25444-010), as well as an AC input line filter and a front panel circuit breaker. In addition, each chassis has a 400 Hz cooling fan and a fan inverter (A23692-000).

The power supply assembly is of modular construction. Low voltage power for logic and control of the entire power supply assembly is provided by the low voltage power supply module (A26452-000). Control logic and TWT protection circuits are contained in the HPA logic and Control Assembly (A23050-000).

The Heater Power Supply Module (A23054-000) powers the DC heaters of both TWTs. Bias and pulse top voltage for the TWT grid are provided by the Modulator Assembly (A21422-001), one modulator per tube.

The high voltage power supply consists of the following: the Power Factor Correction module (A23683-003) converts line voltage to DC for the high voltage switching supply. Switching transistors are on the Power Inverter Module (A27815-001), and switching is controlled by Regulation Board (A21440-001). The high voltage transformer and rectifiers are contained in the HV Rectifier (A26258-000). The high voltage DC is filtered in the HV Filter Assembly (A23044-000).

Interconnects between the power supply modules are through a motherboard. It is installed in the power supply side plate so that the entire area of the finned heat sink is available for heat transfer. In addition, a plenum on top of the power supply ducts air through several of the modules. The cooling air is provided by the 400 Hz fan just inside the air intake filter on the rear panel. The Motherboard assembly is A23013-000.

The HPA interface board permits the control module to control the power supply and monitor analog values and fault status. Control is through the F/O to RS-485 board, which converts the electrical data from the control module back to fibers to the HPA interface board.

3. OPERATION

3.1 WARNINGS AND CAUTIONS

Throughout this manual, the symbol:



WARNING:

indicates that a hazard exists that may result in personal injury or loss of life.



CAUTION:

indicates that failure to follow procedures may result in damage to the equipment.



WARNING: DANGER - High Voltage Present:

Electrical equipment in this TWTA generates and stores high-voltage energy that can result in fatal electrocution. Do not operate the TWTA with covers or the front panel removed.

Service work must be performed only by technicians thoroughly familiar with the high-voltages present in microwave tube amplifiers in general, and with this equipment in particular.

Never handle the TWT leads or the high-voltage connectors unless the unit has been unplugged and it has been positively established that the high-voltage filter capacitors have been discharged to a *known* safe level.



WARNING: Safety Ground

Improper grounding of this equipment can result in electric shock. The TWTA must be operated only with a line cord with a safety ground wire. It is the user's responsibility to ascertain that the power connector is properly wired and that the power outlet is grounded.



WARNING: Explosive Atmosphere

To avoid explosion, never operate this TWTA in an explosive atmosphere. This equipment is not certified for operation in an explosive atmosphere.

3.2 INSTALLATION

3.2.1 Unpacking

Upon receiving the TWTA, inspect the shipping container for obvious signs of external damage. If damage is observed, notify the carrier and contact an authorized service representative.

One panel of the shipping container can be used as a ramp to roll out the unit.

Save and store the shipping container in case the unit needs to be moved to another site or returned to the manufacturer for repair.

3.2.2 Mounting

The TWTA must be located on a nominally flat surface, and restrained so that it will not inadvertently roll out of position. The casters are *not* provided with brakes. Set the leveling feet when the TWTA is properly positioned for use.

When rolling the unit, fully recess the leveling feet to maximize floor clearance.

CAUTION:



Avoid pulling more than two drawers/assemblies out of the rack at the same time. Although unlikely, the weight of the drawers/assemblies may cause the rack to tip over.

3.2.3 Cooling Requirements

The TWTA is provided with a number of cooling fans. It is important that air movement around the rear of the unit be unobstructed.

CAUTION:



Do not position the TWTA in such a way that the air intakes or outlets are blocked, or that the exhaust airflow is directed into air intakes. See Paragraph 3.5 for location of air intakes and air outlets. Make sure that the intake air is 45°C or below. Great care must be taken to minimize any exhaust air restrictions. Avoid mounting heat-producing equipment near the TWTA, especially below the TWTA's air intakes. Pay special attention to the location of RF loads and lossy waveguide connected directly to the TWTA that may conduct heat back to the TWTA. Use supplemental fans as necessary to cool these components, directing this heat away from the rear of the TWTA. Failure to provide adequate cooling can result in the unit shutting down from overtemperature conditions. The TWTA dissipates approximately 15.0 kilowatts when in the Operate mode.

3.2.4 AC Line Power Connections

AC line power connection to the unit is a 5-conductor 6 AWG cable. The cable is provided unterminated, and appropriate wiring to the cable must be provided by the user. The cable conductor function is color-coded.

Color	Function
Black	Phase
Red	Phase
Orange	Phase
White	Neutral
Green	Safety ground

The TWTA is not sensitive to phase rotation. For 208VAC three phase operation the Neutral is not required and it is not connected in the TWTA.

3.2.5 RF Connections

The RF output connector is a WRD-750D24 waveguide flange.

CAUTION:



Never operate the TWTA without a matched output load rated for at least 2500 watts, continuous duty. The TWTA is not provided with an output isolator. While the TWTA is protected from excessive reflected power by foldback and VSWR circuits, it is poor practice to power the unit up without a load or an antenna. Even with no drive, "looping" oscillation can result in RF output if the TWTA is operated without a load. The VSWR detection and foldback circuit is provided to protect the tube from progressive failure or mismatch of the output load; it should not be relied on for protection from the absence of a load.

CAUTION:



Never operate the TWTA without a matched input termination or drive source. When operating the unit with an antenna and without adequate isolation to the input, use caution in selecting well-shielded input cables and signal source. Use a 6 dB or larger pad (RF attenuator) directly at the TWTA input connector to reduce risk of "looping" oscillation.

3.2.6 External Interlock Connector

The TWTA is provided with an external interlock capability via a 15-pin female D-sub connector. To enable the high-voltage power supply, it is necessary to provide continuity between pins 3 and 4. If the amplifier shuts down because the interlock was opened, it will be necessary to reset the system to return to standby (see **System Shutdown Screen** in Section 3.4). There is an internal jumper between J2 pins 1 and 2; a continuity check through these pins can be used to verify the presence of the amplifier in the instrumentation system. Users may adopt this interlock feature to disable the RF output for either equipment protection or as a backup for personnel protection.

CAUTION:



Do not rely on the external interlock for personnel protection. The intent of the external interlock feature is to disable the RF output for equipment protection. Use proper operating and safety procedures to ensure that power is removed for personnel safety.

3.3 FRONT PANEL FEATURES

Refer to Figure 3-1 below.

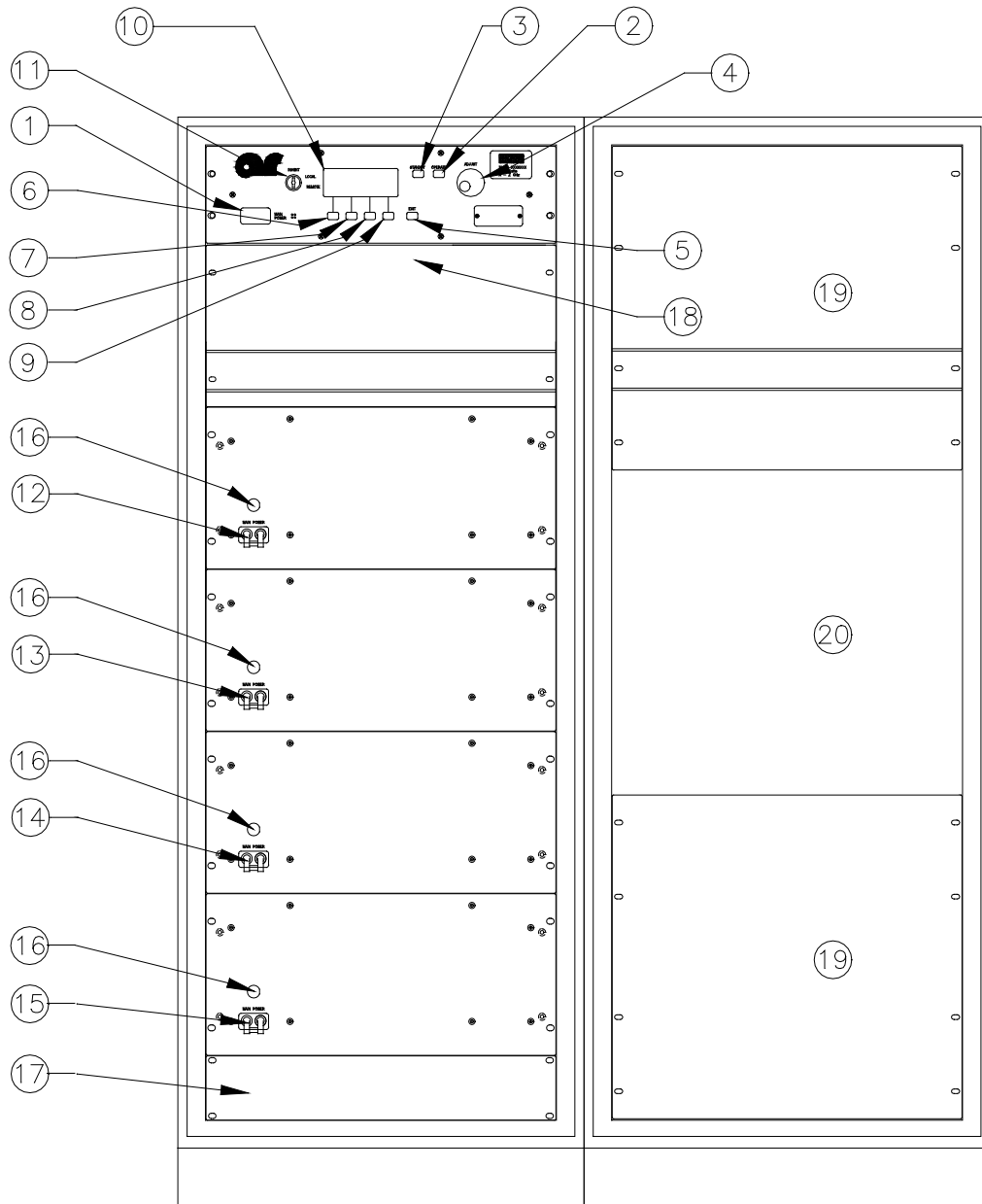


Figure 3-1. Front Panel Features

Table 3-1. Front Panel Features

Label	Title	Function
1	MAIN POWER	5 pole circuit breaker; turns on control module, providing AC to the power supply assemblies.
2	OPERATE	Push-button; turns on high voltage when all faults and heater delay are cleared.
3	STANDBY	Push-button; biases grid off and turns off high voltage.
4	ADJUST	Rotary knob used as an input device to change values of a variety of parameters.
5	EXIT	Push-button; terminates various menu selection routines and returns to the previous menu level.
6-9	S1...S4	Soft Key push-buttons; various menu selection functions.
10	Display	Displays numerous parameter values and fault messages.
11	Keylock Switch	Allows operator to inhibit the TWTA, to enable front panel control, or to enable computer control.
12	MAIN POWER, HPA #1	Switchable 20 A circuit breaker, provides AC power to power supply assembly for TWT #1.
13	MAIN POWER, HPA #2	Switchable 20 A circuit breaker, provides AC power to power supply assembly for TWT #2.
14	MAIN POWER, HPA #3	Switchable 20 A circuit breaker, provides AC power to power supply assembly for TWT #3.
15	MAIN POWER, HPA #4	Switchable 20 A circuit breaker, provides AC power to power supply assembly for TWT #4.
16	POWER ON LIGHT	Green light indicates the PS assembly is on.
17	2U BLANK PANEL	2U high blank panel (removable for optional 2U storage drawer)
18	5U BLANK PANEL	5U high blank panel (removeable for optional storage of customer provided equipment)
19	RF COMBINER ASSEMBLY	RF combiner assembly of two Supertubes (four TWTs)
20	RF COMBINER ASSEMBLY	Final RF combiner assembly of all four Supertubes (eight TWTs)

3.4 FRONT PANEL DISPLAY AND SOFT KEYS

The purpose of the front panel display is to permit the operator to access extensive information about the condition and operation of the TWTA. To accomplish this, a number of informational screens are programmed. It is important for the operator to be able to select the screen with the required information. Screen selection is accomplished by pressing an appropriate soft key or by pressing the EXIT key. When a soft key is active, its function is displayed on the bottom line of the display. Figure 3-2 provides a roadmap for navigating between the screens.

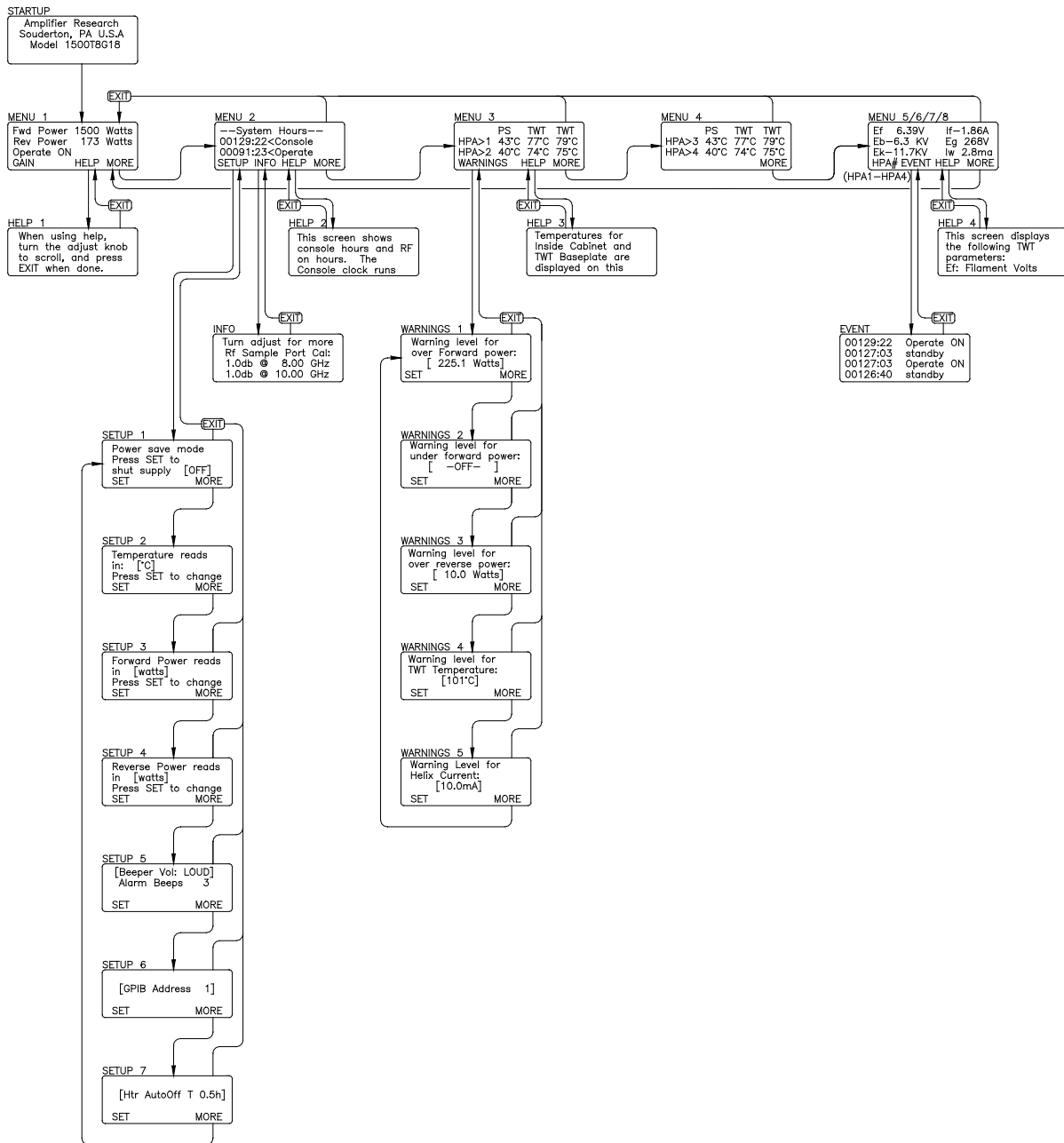


Figure 3-2. Front Panel Display Screens

Menu screens - The screens at the highest level are called menu screens. There are eight menu screens. At power on, the MENU 1 screen is displayed. Each of the menu screens has the soft key S4 labeled MORE. The MORE key (S4) causes the next menu screen to appear. From MENU 8, MORE causes MENU 1 to reappear. In short, MORE permits scrolling through the menu screens. The EXIT key returns display to MENU 1 from any other menu screen.

The menu screens display system status and parameter levels. They are configured as follows:

Menu	Description
MENU 1	Forward power (watts, dBm or bar graph)
	Reverse power (watts, dBm or % of forward power)
	System status (if a latched fault exists, MENU 1 is displayed with the system shutdown message)
MENU 2	Console hours (active when AC power is on)
	Operate hours (active when HV is on)
MENU 3	Power supply temperature (°C or °F), HPA 1 and HPA 2
	TWT baseplate temperature (°C or °F), HPA 1 and HPA 2
MENU 4	Power supply temperature (°C or °F), HPA 3 and HPA 4
	TWT baseplate temperature (°C or °F), HPA 3 and HPA 4
MENU 5	Heater voltage (Ef), HPA #1
	Heater current (If), HPA #1
	Collector voltage (Eb), HPA #1
	Grid voltage (Eg), HPA #1
	Cathode voltage (Ek), HPA #1
MENU 6	Helix current (Iw), HPA #1
	Heater voltage (Ef), HPA #2
	Heater current (If), HPA #2
	Collector voltage (Eb), HPA #2
	Grid voltage (Eg), HPA #2
MENU 7	Cathode voltage (Ek), HPA #2
	Helix current (Iw), HPA #2
	Heater voltage (Ef), HPA #3
	Heater current (If), HPA #3
	Collector voltage (Eb), HPA #3
MENU 8	Grid voltage (Eg), HPA #3
	Cathode voltage (Ek), HPA #3
	Helix current (Iw), HPA #3
	Heater voltage (Ef), HPA #4
	Heater current (If), HPA #4
	Collector voltage (Eb), HPA #4
	Grid voltage (Eg), HPA #4
	Cathode voltage (Ek), HPA #4
	Helix current (Iw), HPA #4

Help Screens - On most menu screens, soft key S3 is labeled HELP. If S3 is selected, a message describing the functions of that screen will be displayed. Use the ADJUST knob to scroll through the message. The EXIT key will return you to the screen from which the help screen was called.

Setup Screens - From MENU 2, S1 (labeled SETUP) selects the first of several setup screens, SETUP 1. This allows the user to manually shut off the heater power supply and put the HPA into Sleep Mode (see below). Pressing S1 (SET) toggles between On and OFF. Pressing MORE brings up SETUP 2, which toggles the display of temperature parameters between Fahrenheit and Celsius degrees. Pressing S1 (SET) changes the selection. The setting displayed when the screen is exited will be retained. Pressing MORE brings up SETUP 3, which allows a choice of displaying forward power in watts, dBm or bar graph. Pressing MORE brings up SETUP 4, which allows a choice of watts, dBm or % of forward power for displaying reverse power. Pressing MORE brings up SETUP 5, which allows entering the desired number of alarm beeps and the desired beep volume. S1 (SET) toggles between parameters, and the adjust knob is used to enter the data. Pressing MORE brings up Setup 6, which allows the IEEE-488 address to be set. Pressing MORE brings up SETUP 7, which allows setting the auto heater off time delay in 30 minutes intervals up to 3 hours. S1 (SET) changes the settings. Pressing MORE returns you to SETUP 1. EXIT returns you from any of the setup screens to MENU 2.

Sleep Mode - The Sleep Mode feature allows the *user* to selectively shut off the heater module of the power supplies. This can be done manually through the front panel or remotely via the computer interface. This is typically used during extended periods of *remote* operation to improve tube life, by turning off the filaments (Sleep Mode activated). This eliminates excessive STANDBY hours on the TWTs while still permitting remote capability to turn on the amplifier.

After activating the Sleep Mode: Screen will display **Cooling On** while heaters cool down. **System Off** notifies user that the amplifier is in Sleep Mode

To de-Activate Sleep Mode: Press the ON soft key to de-activate Sleep Mode. Amplifier will return to MENU 1. When de-activating the Sleep Mode the heaters will require approximately a 5 minute heater time delay. Wait the full 5 minutes prior to selecting OPERATE.

Warnings Screens - From MENU 3, S1 (labeled WARNINGS) selects WARNINGS 1 which allows the operator to enter the maximum forward power. The existing value is between brackets[]; pressing SET puts arrows >< around the value, indicating that the adjust knob is active. The effect of the warning setpoint is as follows: if the forward power exceeds the setpoint, the audible alarm will sound (if configured in SETUP 5).

This warning will be repeated every thirty seconds until the over forward power condition is cleared. In addition, a warning message will appear on line 3 (the status line) of MENU 1. In the event that the alarm is heard, the operator should go to MENU 1 to determine the cause.

Pressing more brings up WARNINGS 2, which allows the under forward power setpoint to be entered. Adjusting this to the minimum value causes -OFF- to be selected, disabling this alarm.

In WARNINGS 3, the maximum reverse power level is set. Note that these are warning levels at which the beep sounds; the actual maximum reverse power level that generates a system fault is set in hardware in the TWT power supply HPA Logic and Control module (A16485).

MORE brings up WARNINGS 4, which allows input of the maximum cabinet temperature. Entering this parameter is performed as above.

MORE brings up WARNINGS 5, identical to the previous screen except that it deals with the maximum TWT collector block temperature. If either parameter exceeds the setpoint, the audible alarm will sound every 30 seconds (if configured), and a warning message will appear on line 3 of MENU 1.

From WARNINGS 5, MORE brings up WARNINGS 6, which permits setting the maximum helix current. Any helix current above this setpoint will result in an audible alarm (if configured), repeated every 30 seconds; and a warning message is displayed on the status line of MENU 1.

Pressing MORE again returns display to WARNINGS 1. As before, pressing EXIT from any of the warnings screens returns display to MENU 3.

Info Screen - From MENU 2, S2 (labeled INFO) selects a screen that displays the RF sample port calibration factors at various frequencies across the band. In addition, this screen displays the model number, serial number and firmware revision information that may be required by a service representative when providing technical assistance. The EXIT key returns the display to MENU 2.

Event Screen - From MENU 5/6/7/8, S2 (labeled EVENT) provides a display of events specific to that HPA# logged by the control system. These events include AC power-up, heater warm-up, change from standby to operate, faults, and resets. The events are stored in a first-in-first-out (FIFO) software buffer that has room for 100 events; as new events are logged, the older ones are discarded.

System Shutdown Screen - In the event of a system shutdown due to a latched fault (i. e., a fault such as body overcurrent or power low line that requires a reset), the MENU screen is replaced by a screen indicating the nature of the fault. Softkey S4 (labeled OK) is implemented as a reset key; pressing S4 brings back the MENU screens. Line 3 of MENU 1, which normally displays the operational state of the TWTA, is used as a fault display line until the fault is cleared. When the fault clears the system will automatically resume the standby state and high voltage on will be enabled once again.

Factory Service Screens - A number of screens intended for factory service and calibration are behind passwords and are not accessible to the user.

System Malfunction Screens - A number of screens are reserved to display error messages. These messages are not normally seen and indicate a malfunction of the TWTA. System malfunction messages include the following:

- Database corrupt
- Communication failure
- Cannot restore
- CU line voltage too low to operate. System shutdown

In the event that one of these appears, shut off the TWTA and contact an authorized service representative before proceeding.

CAUTION:



Attempts to operate the TWTA despite control unit problems may result in loss of the static RAM database and calibration information.

3.5 REAR PANEL FEATURES

See Figure 3-3 below.

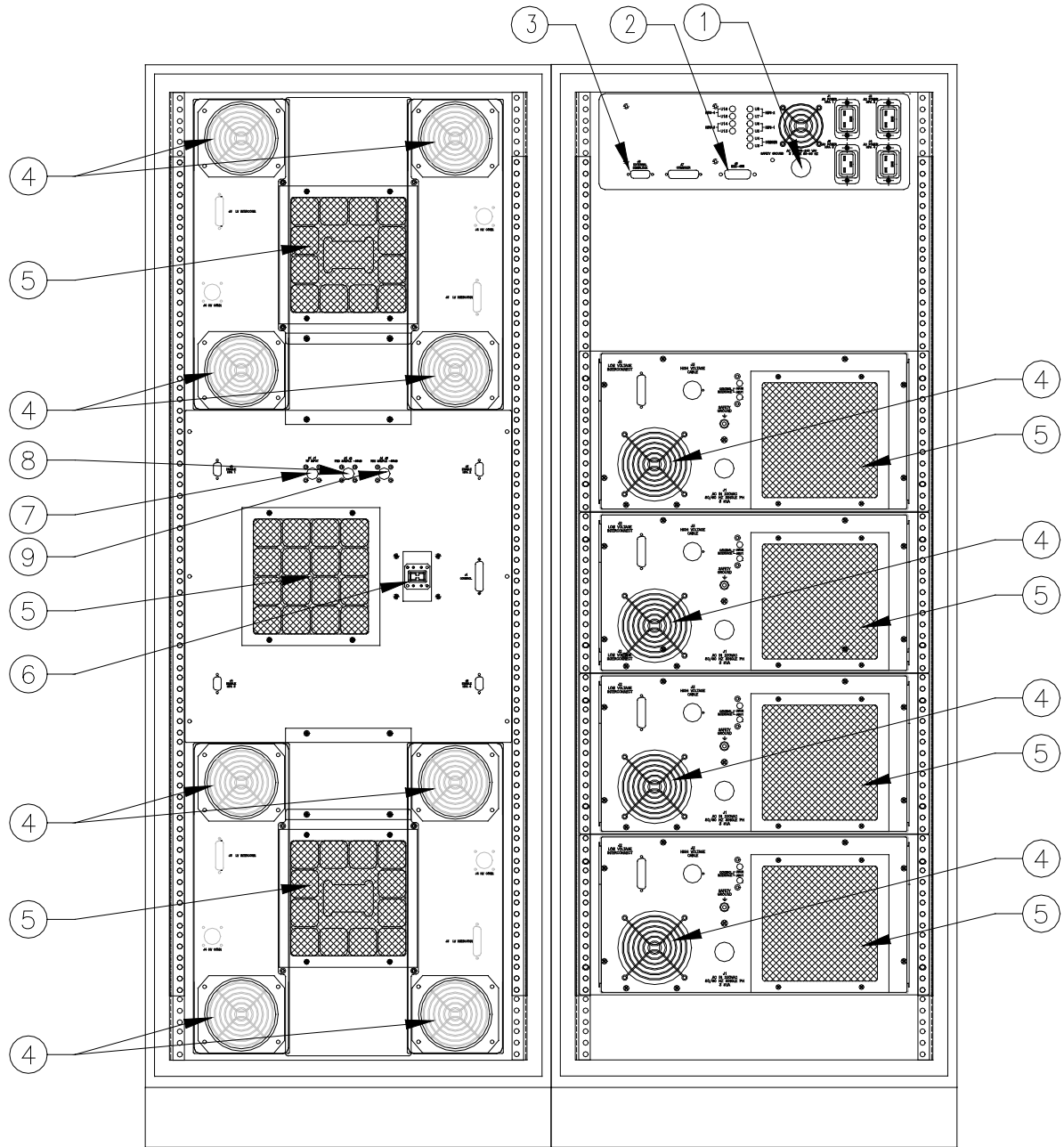


Figure 3-3. Rear Panel Features

Table 3-2. Rear Panel Features

Label	Title	Function
1	208 VAC IN	AC power input cable
2	REMOTE INTERFACE	Remote control connector. 24 pin hermaphrodite
3	EXTERNAL INTERLOCK	Connector to remote temperature switch protecting the isolator or load; D-sub 15-pin female
4		Cooling air intake outlet.
5		Cooling air outlet intake.
6	RF OUT	Type WRD-750D24 flange
7	RF IN	RF input (type N precision, female)
8	FWD SAMPLE OUT	RF sample (type N precision, female)
9	REV SAMPLE OUT	RF sample (type N precision, female)

3.6 INITIAL TURN ON AND WARM-UP PROCEDURE

Install the TWTA as discussed in Section 3.2. Provide an RF generator to the RF input Type N connector. Set RF generator level below -50dBm and set desired frequency in specified range. Connect a load suitable for 2500 watts continuous operation to the RF output flange. The load VSWR should be less than 2.0:1. A power meter and suitable attenuators may be connected to the RF sample port. (Refer to RF sample port calibration factors on the rear of the unit or on the *Info* screen in MENU 2). These show the relation between the amplifier output power and the RF sample port power as a function of frequency.

Set keylock to LOCAL.

Switch on the circuit breakers on the four power supplies. Switch on the MAIN POWER circuit breaker. The fans will operate. The front panel display will show several identification messages and then the MENU 1 screen. The third line will indicate that the heater time delay is active.

Allow the heater warm-up delay to expire. Line three will indicate OFF/READY.

CAUTION:



Do not allow the TWTA to remain in the STANDBY state for extended periods of time. If the TWTA will not be used in the OPERATE state within an hour, shut the TWTA off. The reason for this precaution is that in the STANDBY mode, the TWTs' cathodes run very hot since they are not cooled by electrons boiling off the surface, and small amounts of out-gassing are not cleaned up by the electron beam. Extended operation in the standby state can result in irreparable damage to TWTs!

Push S4 (MORE) four times to go to MENU 5. Verify that the heater voltage and current for HPA #1 are near their nominal levels. Press MORE again to view MENU 6/7/8 and verify the values for HPA #2/3/4. The values of these parameters at the time the TWTA left the factory are logged on the test data sheet.

Push the OPERATE push-button. You will now see the cathode and the collector voltages rise. Verify that the grid, collector, and cathode voltages are near nominal. The helix current should be near the nominal value for no RF drive. Then push MORE or EXIT to go back to MENU 1.

Set the TWTA gain to maximum. Adjust the RF generator to slowly increase the RF drive toward 0 dBm to reach the desired FWD PWR on the display and power meter (connected to sample port). The display will become active, with maximum reading when the peak power output is achieved. Best performance is obtained when the input RF drive is set at or just below the level that causes peak power

output. Do not set input drive above 0 dBm (Input drive above +13 dBm may damage the unit). The reverse power level should remain below 10% of the forward power, assuming that the load is properly matched.

An alternate procedure is to pre-set the TWTA gain to minimum, set the RF generator to 0 dBm and then slowly increase the TWTA gain to set the desired RF output level.

Observe that the helix current is sensitive to the RF drive level of the TWT. It is at a minimum with no RF drive. The helix current for each supertube with no drive and with rated RF power output mid-band are logged on the test data sheet. The value of the helix current is a good qualitative indicator of RF drive present.

To shut the system down, turn down the RF generator level below -50 dBm and press STANDBY. Allow the TWTA to cool down until the TWT temperatures drops below 70°C, and then turn off main power. It is not necessary to turn off the individual power supplies.

3.7 REMOTE IEEE-488 OPERATION

The TWTA is provided with an IEEE-488 interface that permits remote emulation of OPERATE, STANDBY, and RESET push-buttons as well as access to parameter measurements, system faults, gain adjustment and control unit status. The Power Save mode (Sleep Mode) provides *remote capability* to control the TWT heater (filament) and to lower the amplifier standby power consumption during non-operational intervals.

The following tables summarize the commands and the return codes.

Table 3-3. Catalog of IEEE-488 Commands

Command	Function	Units	Response format
RDSTAT	Returns status code of processing of previous command (see Table 3-4)		STATUS=[]
RDFLT	Returns system fault code (see Table 3-5)		flt=[]
OPERATE;	Emulates OPERATE push-button		
STANDBY;	Emulate STANDBY push-button		
POWER:OFF;	Emulate STANDBY push-button		
RESET;	Emulates RESET softkey		
RDS/N	Returns serial number		s/n=[]
RDCONHR	Returns console hours		ConHr=[]
RDRFHR	Returns RF hours		RfHr=[]
RDEK1	Returns cathode voltage, HPA1	KV	Ek=[]
RDEK2	Returns cathode voltage, HPA2	KV	Ek=[]
RDEK3	Returns cathode voltage, HPA3	KV	Ek=[]
RDEK4	Returns cathode voltage, HPA4	KV	Ek=[]
RDEB1	Returns collector voltage, HPA1	KV	Eb=[]
RDEB2	Returns collector voltage, HPA2	KV	Eb=[]
RDEB3	Returns collector voltage, HPA3	KV	Eb=[]
RDEB4	Returns collector voltage, HPA4	KV	Eb=[]
RDEG1	Return grid voltage, HPA1	V	Eg=[]
RDEG2	Return grid voltage, HPA2	V	Eg=[]
RDEG3	Return grid voltage, HPA3	V	Eg=[]
RDEG4	Return grid voltage, HPA4	V	Eg=[]
RDEF1	Returns heater voltage, HPA1	V	Ef=[]
RDEF2	Returns heater voltage, HPA2	V	Ef=[]
RDEF3	Returns heater voltage, HPA3	V	Ef=[]

Command	Function	Units	Response format
RDEF4	Returns heater voltage, HPA4	V	Ef=[]
RDIF1	Returns heater current, HPA1	A	If=[]
RDIF2	Returns heater current, HPA2	A	If=[]
RDIF3	Returns heater current, HPA3	A	If=[]
RDIF4	Returns heater current, HPA4	A	If=[]
RDIW1	Returns helix current, HPA1	mA	Iw=[]
RDIW2	Returns helix current, HPA2	mA	Iw=[]
RDIW3	Returns helix current, HPA3	mA	Iw=[]
RDIW4	Returns helix current, HPA4	mA	Iw=[]
RDTMPTWT1HPA1F	Returns TWT temp (°F), HPA1, tube1	°F	TWT1HPA1F=[]F
RDTMPTWT2HPA1F	Returns TWT temp (°F), HPA1, tube2	°F	TWT2HPA1F=[]F
RDTMPTWT1HPA2F	Returns TWT temp (°F), HPA2, tube1	°F	TWT1 HPA2F=[]F
RDTMPTWT2HPA2F	Returns TWT temp (°F), HPA2, tube2	°F	TWT2 HPA2F=[]F
RDTMPTWT1HPA3F	Returns TWT temp (°F), HPA3, tube1	°F	TWT1HPA3F=[]F
RDTMPTWT2HPA3F	Returns TWT temp (°F), HPA3, tube2	°F	TWT2HPA3F=[]F
RDTMPTWT1HPA4F	Returns TWT temp (°F), HPA4, tube1	°F	TWT1 HPA4F=[]F
RDTMPTWT2HPA4F	Returns TWT temp (°F), HPA4, tube2	°F	TWT2 HPA4F=[]F
RDTMPTWT1HPA1C	Returns TWT temp (°C), HPA1, tube1	°C	TWT1HPA1C=[]C
RDTMPTWT2HPA1C	Returns TWT temp (°C), HPA1, tube2	°C	TWT2HPA1C=[]C
RDTMPTWT1HPA2C	Returns TWT temp (°C), HPA2, tube1	°C	TWT1HPA2C=[]C
RDTMPTWT2HPA2C	Returns TWT temp (°C), HPA2, tube2	°C	TWT2HPA2C=[]C
RDTMPTWT1HPA3C	Returns TWT temp (°C), HPA3, tube1	°C	TWT1HPA3C=[]C
RDTMPTWT2HPA3C	Returns TWT temp (°C), HPA3, tube2	°C	TWT2HPA3C=[]C
RDTMPTWT1HPA4C	Returns TWT temp (°C), HPA4, tube1	°C	TWT1HPA4C=[]C
RDTMPTWT2HPA4C	Returns TWT temp (°C), HPA4, tube2	°C	TWT2HPA4C=[]C
RDTMPPSHA1F	Returns power supply temp (°F), HPA1	°F	PSHPA1F=[]F
RDTMPPSHA2F	Returns power supply temp (°F), HPA2	°F	PSHPA2F=[]F
RDTMPPSHA3F	Returns power supply temp (°F), HPA3	°F	PSHPA3F=[]F
RDTMPPSHA4F	Returns power supply temp (°F), HPA4	°F	PSHPA4F=[]F
RDTMPPSHA1C	Returns power supply temp (°C), HPA1	°C	PSHPA1C=[]C
RDTMPPSHA2C	Returns power supply temp (°C), HPA2	°C	PSHPA2C=[]C
RDTMPPSHA3C	Returns power supply temp (°C), HPA3	°C	PSHPA3C=[]C
RDTMPPSHA4C	Returns power supply temp (°C), HPA4	°C	PSHPA4C=[]C
RDTWTOTF	Returns TWT overtemp warning setpoint (°F)	°F	TWTOTF=[]F
STWTOTF	Sets TWT overtemp warning setpoint (°F)	°F	
RDTWTOTC	Returns TWT overtemp warning setpoint (°C)	°C	TWTOTC=[]C
STWTOTC	Sets TWT overtemp warning setpoint (°C)	°C	
RDPSOTF	Returns power supply overtemp warning setpoint (°F)	°F	PSOTF=[]F
SPSOTF	Sets p. s. overtemp warning setpoint (°F)	°F	
RDPSOTC	Returns p. s. overtemp warning setpoint (°C)	°C	PSOTC=[]C
SPSOTC	Sets p. s. overtemp warning setpoint (°C)	°C	
RDIWOC	Returns helix overcurrent warning setpoint	mA	IwOC=[]
SIWOC	Sets helix overcurrent warning setpoint	mA	
RDLOGIC	Returns logic state code (see Table 6)		Sys=[]
RDA	Returns gain	%	A=[]
SA	Sets gain	%	
RDHTDREM	Returns remaining heater time delay	sec.	HTD=[]s
RDPOD	Returns forward power out (dBm)	dBm	Po=[]dBm
RDPOW	Returns forward power out (W)	watts	Po=[]W

Command	Function	Units	Response format
RDPRD	Returns reverse power out (dBm)	dBm	Pr=[]dBm
RDPRW	Returns reverse power out (W)	watts	Pr=[]W
RDPOHID	Returns over forward power warning setpoint (dBm)	dBm	Pohi=[]dBm
SPOHID	Sets over forward power warning setpoint (dBm)	dBm	
RDPOLOD	Returns under forward power warning setpoint (dBm)	dBm	Polo=[]dBm
SPOLOD	Sets under forward power warning setpoint (dBm)	dBm	
RDPOHIW	Returns over forward power warning setpoint (W)	watts	Pohi=[]W
SPOHIW	Sets over forward power warning setpoint (W)	watts	
RDPOLOW	Returns under forward power warning setpoint (W)	watts	Polo=[]W
SPOLOW	Sets under forward power warning setpoint (W)	watts	
RDPRHID	Returns over reverse power warning setpoint (dB)	dBm	Prhi=[]dBm
SPPRHID	Sets over reverse power warning setpoint (dBm)	dBm	
RDPRHIW	Returns over reverse power warning setpoint (W)	watts	Prhi=[]W
SPRHIW	Sets over reverse power warning setpoint (W)	watts	
SYSTEM:ON;	Emulates pressing the System ON button from System OFF (Exit Sleep Mode)		
SYSTEM:OFF;	Emulates pressing the Power Save button. (Enter Sleep Mode)		
RDHTRAUTOOFF	Returns heater auto off delay	hours	
SHTRAUTOOFF	Sets heater auto off delay (see Table 3-9)		
*IDN?;	Returns the product model number		[]
*STA?;	Returns status string (see Table 3-7)		[]
*STB?;	Returns status string (see Table 3-8)		[]

Table 3-4. Catalog of Status Codes

(The **RDSTAT** command causes the TWTA to return a string in the form **STATUS=[code]**, where **[code]** is an ASCII number whose meaning is given below)

Status Code	Meaning
0	No command was given.
1	Last command successful.
2	Last command is in process.
3	Last command failed to complete. Time-out.
10	Last command failed. Invalid command.
11	Last command failed. Data was unparseable.
20	Last set command failed. Data was beyond high limit.
21	Last set command failed. Data was beyond low limit.
22	Last set command failed. Data was out of range
23	Last set command failed. Data was wrong polarity
50	Last command failed. Local system does not have remote enabled.
51	Remote system is not ready to accept commands.
60	Command not allowed.
901	Assert error: invalid table argument.*
902	Assert error: invalid calibration.*

*Please call a service representative if you observe this error.

Table 3-5. Catalog of Fault Codes

(The **RDFLT** command causes the TWTA to return a string in the form **flt=[code]**, where **[code]** is an ASCII number whose meaning is given below)

Fault Code	Meaning	Fault Code	Meaning
0	NO FAULT	104	FIL NOT READY3
40	FIL NOT READY1	105	LOW LINE3
41	LOW LINE1	105	CATH O/VOLTAGE3
42	CATH O/VOLTAGE1	107	BODY O/CURRENT3
43	BODY O/CURRENT1	108	CATH U/VOLTAGE3
44	CATH U/VOLTAGE1	111	COLL U/VOLTAGE3
47	COLL U/VOLTAGE1	112	INVERTER FAULT3
48	INVERTER FAULT1	113	INTERLK OPEN3
49	INTERLK OPEN1	114	TUBE ARC3
50	TUBE ARC1	115	TWT OVER TEMP3(H)
51	TWT OVER TEMP1(H)	116	CABINET O/TEMP3(H)
52	CABINET O/TEMP1(H)	118	EXTERNAL INHIBIT3
54	EXTERNAL INHIBIT1	119	OVER REV POWER3
55	OVER REV POWER1	122	PANEL OPEN3
58	PANEL OPEN1	123	LATCHED FAULT3
59	LATCHED FAULT1	136	FIL NOT READY4
72	FIL NOT READY2	137	LOW LINE4
73	LOW LINE2	138	CATH O/VOLTAGE4
74	CATH O/VOLTAGE2	139	BODY O/CURRENT4
75	BODY O/CURRENT2	140	CATH U/VOLTAGE4
76	CATH U/VOLTAGE2	143	COLL U/VOLTAGE4
79	COLL U/VOLTAGE2	144	INVERTER FAULT4
80	INVERTER FAULT2	145	INTERLK OPEN4
81	INTERLK OPEN2	146	TUBE ARC4
82	TUBE ARC2	147	TWT OVER TEMP4(H)
83	TWT OVER TEMP2(H)	148	CABINET O/TEMP4(H)
84	CABINET O/TEMP2(H)	150	EXTERNAL INHIBIT4
86	EXTERNAL INHIBIT2	151	OVER REV POWER4
87	OVER REV POWER2	154	PANEL OPEN4
90	PANEL OPEN2	155	LATCHED FAULT4
91	LATCHED FAULT2		

Table 3-6. Catalog of System State Codes

(The **RDLOGIC** command causes the TWTA to send a string containing an operational state code consisting of 4 ASCII characters representing hex digits. The response is in the form **Sys:[w][x][y][z][eol]** where the hex values of *[w]*,*[x]*,*[y]* and *[z]* are formed as shown below).

z bit	Meaning
0 (LSB)	High voltage on
1	Transmit on
2	Remote mode
3 (MSB)	Fault

y bit	Meaning
4 (LSB)	Heater time delay expired
5	Under forward power warning
6	Foldback active
7 (MSB)	Inhibit mode

x bit	Meaning
8 (LSB)	External inhibit
9	(not used)
10	(not used)
11 (MSB)	(not used)

w bit	Meaning
12 (LSB)	(not used)
13	Sleep Mode Active
14	HPA #1 power supply off or failed
15 (MSB)	HPA #2 power supply off or failed

Table 3-7. STA?; Response Codes

(The command ***STA?;** causes the TWTA to send a string indicative of the current system state)

*STA?; response	Meaning
SLEEP	Sleep Mode active (heater off)
WARM-UP	System is in heater time delay.
STANDBY	System is ready to allow high voltage on
OPERATE	High voltage is on and beam is on
FAULT	High voltage is off and system requires reset

Table 3-8. *STB?; Response Codes

(The command ***STB?**; causes the TWTA to send a string containing an operational state code consisting of 2 ASCII characters representing hex digits. The response is in the form **STATUS:[x][y][eol]** where the hex values of [x] and [y] are formed as shown below.

y bit	Meaning
0 (LSB)	Power status; always 1(power on)
1	Standby status; 0 if not in standby, 1 if in standby
2	Operate status; 0 if not in operate, 1 if in operate
3 (MSB)	Fault status; 0 if no fault, 1 if fault exists

x bit	Meaning
4 (LSB)	Mode switch; always 1 (reset)
5	Blank switch; always 1 (off)
6	Blank status; always 0 (off)
7 (MSB)	Not used; always 0

Table 3-9. Catalog of Heater Auto Off Time Delay Codes

Argument	Meaning
0	0.5 hour heater auto off time delay
1	1.0 hour heater auto off time delay
2	1.5 hour heater auto off time delay
3	2.0 hour heater auto off time delay
4	2.5 hour heater auto off time delay
5	3.0 hour heater auto off time delay

Command syntax is in this form:

<command mnemonic> <parameter> <carriage return>

where;

<command mnemonic> consists of one of any valid command found in Table 3.

<parameter> (as applicable) consists of one ASCII space character followed by a number.

<carriage return> consists of an ASCII carriage return.

All commands are case sensitive.

The system will return parameter values, fault codes, and status codes regardless of whether remote is enabled. The parameter value is returned as a string of 20 characters or less, consisting of a label,=, and a value. For example, outputting the command RDEF to the TWTA would result in the TWTA sending back the string **Ef=6.03** (assuming the heater voltage is 6.03 volts). Units are usually not returned; see table 3 for the units.

If remote is not enabled, set commands and commands to the system logic (i. e., OPERATE;, STANDBY;, or RESET;) will not be accepted.

It is recommended that the RDSTAT command be used to provide the host program with a report on how a command was processed.

A small sample program that can send commands and receive the strings returned by the TWTA is included in section 5.5. It is written in Hewlett-Packard's "Rocky Mountain" BASIC. The program assumes that the IEEE-488 bus is at address 7 and that the address of the TWTA is 01.

Remote operation is determined by the application (software) program in the system controller. This application program will aid the user in generating the Command Codes and displaying/monitoring the Status Codes. Consult the application program user's instructions for Remote operation procedure.

The application program should issue only one string at a time. After each functional command is issued the 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 checking the status just prior to issuing a command - since the status could have been changed by a fault condition of the amplifier or by operator activation of the amplifier. Periodic checking of the status is also recommended.

3.8 TWTA GENERAL CONSIDERATIONS

This section is intended to offer some guidelines regarding operation, storage and use of AR RF/Microwave Instrumentation TWTAs.

Storage: TWTAs, as with other electronic equipment, are best stored in a benign environment at reasonably constant temperature. Service life is not improved by periodic operation.

Availability: For critical missions, and after long periods of storage, it is recommended that TWTA operation be checked sufficiently in advance of the mission to permit repair if required. Though service life is not improved by periodic operation, users experiencing amplifier trip due to body over current may benefit by periodically operating a unit with high voltage and grid on, but no RF drive. Such operation for about one hour on a weekly basis should effectively reduce nuisance tripping. Since the cathode structure has finite life, extended periods of non-functional operation of TWTAs is not recommended. An alternate approach, if periodic trip off has been observed, is to operate the unit without RF input for 1-2 hours before planned functional operation, resetting the unit after occasional trip off.

Cooling during Operate Mode: AR TWTAs have their air outlets and inlets on the rear panels. It is important to prevent the heated air, which is expelled from the TWTA's air outlets, from being recycled into the air inlets. Applications should have a clearance behind the TWTA of at least two feet for single bench top units and at least three feet for the higher power units, or the heated air should be ducted away.

Operation in Standby Mode: Standby mode for TWTAs readies the unit for operation. In this mode the filaments are on but the high voltage is off. TWTAs should not be left in this Standby mode for extended periods. Where practical, operational procedures should limit the time on Standby mode to less than approximately one hour. (See **Explanation of....**, below)

Operate Turn on: When selecting the Operate mode, when high voltage is first turned on, there may be some internal TWT arcing which can cause protective circuits to deselect the Operate mode, thereby returning the unit to the Standby mode. There may be a report of body over-current fault. In either case, if there is no other contraindication, the Operate mode may be selected again. This procedure may be repeated, if needed up to 25 times, until the Operate mode is actually set. If this condition persists, contact AR RF/Microwave Instrumentation Service for additional assistance. (See **Explanation of...**, below)

Noise Power Density (NPD): TWTAs produce rf noise over their operating frequency range, as specified by the Noise Power Density (NPD). This noise is significantly higher than the noise produced by typical solid

state amplifiers, and is inherent in present TWTAs. The noise may surprise users new to TWTAs when it accumulates and results in a significant indication in a broadband measurement device – such as a power meter or field probe. The error produced by this indication is not significant when operating near rated TWTA power levels, but may cause difficulty when trying to operate high power TWTAs at low output power levels.

For example, consider a hypothetical typical NPD of -76 dBm/Hz, from a 4 GHz bandwidth amplifier. A broadband detector might see the NPD as $[-76 \text{ dBm/Hz} + 10 (\log 4 \times 10^9) \text{ BW factor} = -76 + 96 =] +20$ dBm, or 0.1 watts. This power is insignificant for a user operating at 200 watts (+53 dBm), but may be very noticeable to a user trying to operate below 1 watt (+30 dBm). [One watt is 0.5% of (23 dB below) rated power for a 200-watt amplifier.] A field probe user who obtains a 200 V/M field with 200 watts, may see a field as high as $[53 \text{ dBm} - 20 \text{ dBm} = 33 \text{ dB below } 200 \text{ V/M} =] 4.5 \text{ V/M}$ due to this hypothetical NPD.

For these applications the use of a lower power amplifier is highly recommended, especially when considering safety issues. Alternatively, additional power loss in the form of an added high power microwave attenuator, or preferably an increased space loss for radiated fields, may be used to lower the noise received by the broadband measurement device.

Explanation of Limiting the Time in Standby mode and of Repeated Operate Selection.

Traveling wave tubes tend to get “gassy” if they are left in a Standby mode for extended periods of time. In this Standby mode, the heater (filament) is on but there is no high voltage applied to the collector (or high voltage is applied to the collector but the grid is off). This is the normal state after a tube’s warm up time, just prior to entering the Operate mode.

In this state the cathode end of the TWT is heating up but the electron Beam is off. In other words, there is no cathode current. As the cathode heats up, gas trapped in the structure of the tube can be released, thus corrupting the vacuum of the tube. If the tube become too “gassy”, arcing may occur when the high voltage is fully applied in the Operate mode. Another possible failure mode is a body over-current fault when the beam is turned on and the tube is “gassy”.

Occasional arcing is normal for a TWT. The support components are designed to handle this, protecting both the TWT and its support circuitry. However, if the tube arcs two or three times in rapid succession, or worse yet repeatedly, a fault will be sensed that will shut the high voltage off, thus removing the unit from Operate status. The remedy usually recommended is to repeat the selection of the Operate mode until the unit remains in Operate. It has been found that most of the faults that can be cleared by this method will be cleared within 25 attempts to enter the Operate mode.

Once the tube is operating normally, gas will continue to evolve at a slow enough rate that the TWTA will not fault. This happens because the gas in the tube will interact with the beam and become ionized. As the electrons in the beam hit the gas molecules they ionize the gas, at which point it is accelerated into the collector structure and buried deep enough so that it ceases to be a problem.

To preclude this gassing problem, and thus reduce the need for repeating the Operate selection, it is recommended that the time in Standby be limited – to about one hour. Extended periods in Standby may result in an inability to clear the fault by this method. In this case, service measures may be needed to correct the unit. Thus, users should reduce the likelihood of occurrence of this problem by limiting the amount of time in the Standby mode.

The service measures involve pulsing of the tube beam current and gradually increasing the duty of the pulsing until the unit will operate continuously. Note that a similar condition can exist for tubes with grids when the TWTA is in the Operate mode (high voltage is on) but gating (control) input is set so that the grid turns off the TWT beam current. Operational procedures should also limit the time in this mode.

4. MAINTENANCE

The TWTA requires a minimum of routine maintenance. The only moving parts are the elements of switches, relays and blowers. Preventive maintenance is recommended in Section 4.3.

In the event that the TWTA needs repairs, it is recommended that the unit be returned to the factory. However, some user service organizations may choose to perform their own corrective maintenance, and under some circumstances returning the unit to the factory may be impractical. The highly modular construction of the TWTA facilitates troubleshooting to the level of readily replaced subassemblies. Section 5 provides partial technical documentation to support field repairs. Nevertheless, the factory or its service representative should be contacted before undertaking repair work on these TWTAs. **Warnings and Cautions must be observed.**

4.1 SAFETY WARNING



WARNING:

Service work must be performed only by technicians thoroughly familiar with the high voltages present in microwave tube amplifiers in general, and with this equipment in particular.

Never handle the TWT leads or the high-voltage connectors unless it has been positively established that the high-voltage filter capacitors have been discharged to a *known* safe level.



CAUTION:

A malfunctioning power supply can cause damage to the TWT. If you are troubleshooting the TWTA, remove the TWT and substitute suitable loads to prevent damage to the TWT.

4.2 UNAUTHORIZED REPAIRS



CAUTION:

Unauthorized repairs or modification of this product during the warranty period may void the warranty. In the event that the TWTA malfunctions while it is still under warranty, always contact an authorized service representative.

4.3 PREVENTIVE MAINTENANCE

The RF characteristics, power supply voltages and currents, and system temperatures of the TWTA should be logged on a regular basis. Maintenance should be performed if significant deviations from the logged values appear. For a unit still under warranty, contact an authorized service representative if impaired performance is suspected.

The air intake filters are the only items that require routine service. The frequency of service depends on the environment where the TWTA is used, and must be determined by inspection

If there is accumulated dust on any of the air intake filters, remove them and clean them with dry compressed air. If the filters show signs of deterioration, purchase replacement units.

Power Supply Chassis Maintenance:

If significant dust has been noted on the air intake filters of the power supply chassis, it may be desirable to vacuum the dust and debris from inside the enclosure. To open the power supply enclosures:

1. Remove the subassembly from the rack as follows:

NOTE: Due to the weight in excess of fifty pounds, the removal of some of the amplifier's units from the cabinet is a two-person operation.

Disconnect power. Remove any other cables. On the front of the unit, remove the four screws (two outside screws on each side) mounting the front panel to the cabinet. Carefully slide the unit out of the front of the cabinet. Depress the buttons on each slide rail to remove the unit from the rack.

2. Remove the screws that secure the upper and lower covers. Remove the covers to gain access to the interior of the unit.
3. Vacuum dust and debris from inside the enclosure. Clean dust from the unit and its flying leads. Remove any dirt from around the high voltage connectors. While the cover is off, check for loose wires, components or fasteners.
4. Reassemble in reverse order. Refer to Figure 4-1, **TWTA interconnect cabling** and Table 4-1 **Interconnect cable identification** to make sure the unit is properly reconnected.

CAUTION:



Be especially careful with small connectors, which are fragile and easily damaged when incorrectly aligned during the assembly process.

RF Chassis Maintenance:

If significant dust has been noted on the air intake filters of the RF chassis, or if maintenance is scheduled for the supertube assemblies, it may be desirable to vacuum the dust and debris from inside the enclosure. To open the RF enclosures:

1. Remove the screws that secure the upper and lower front panels of the RF cabinet (refer to Figure 3-1, panels # 19, upper and lower). Remove the covers to gain access to the interior of the unit.
2. Vacuum dust and debris from inside the enclosure of each of the supertube chassis as well as the central combiner assembly in the middle of the cabinet. The middle panel (refer to Figure 3-1, panel # 20) may be removed if necessary. If the unit includes optional front panel connectors take care that the cables are not extended too far to damage the connections. It is recommended to maintain the RF cabinet without removing the supertube chassis or moving the combiner assemblies within the rack. All interconnecting waveguide is rigid and has a risk of cracking with excessive movement. Clean dust from the TWTA and its flying leads. Remove any dirt from around the high voltage connectors. While the cover is off, check for loose wires, components or fasteners.
3. Reassemble in reverse order. Refer to figure 4-1, **TWTA interconnect cabling** and Table 4-1 **Interconnect cable identification** to make sure the unit is properly reconnected, if necessary.

CAUTION:



Be especially careful with type SMA RF connectors, which are fragile and easily damaged when incorrectly aligned during the assembly process.

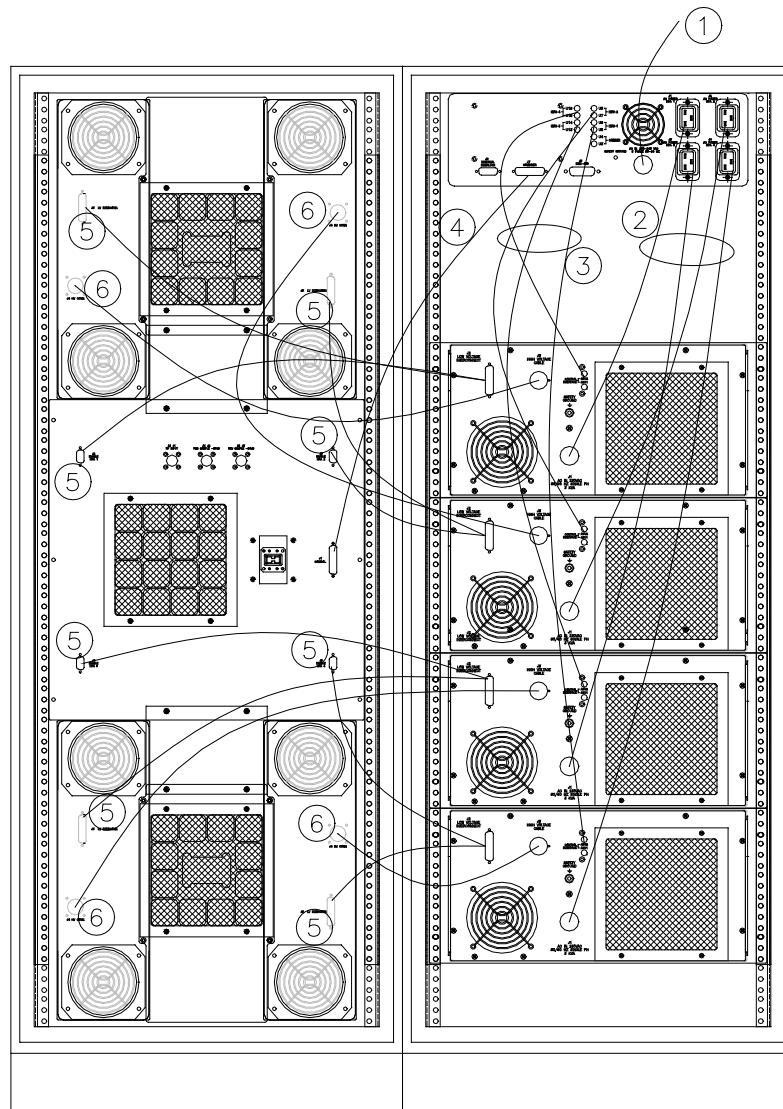


Figure 4-1. Interconnect Cabling

Table 4-1. Interconnect Cable Identification

Label	Title	Notes
1	TWTA AC power cable	Part of control module
2	AC POWER	AC power cables to power supplies #1-#4
3	Data cable to power supplies	Fiber optic data cables between controller and power supplies
4	Combiner control cable	Discrete control, DC power
5	LOW VOLTAGE INTERCONNECT	Control cable from power supplies to Supertubes and combiner assembly
6	HIGH VOLTAGE CABLE	High voltage interconnect between power supplies and TWTs

4.4 TROUBLESHOOTING

Symptom	Possible cause
TWT or power supply overtemperature	Air inlet filter(s) dirty Collector heat sink dirty Inadequate clearance behind TWTA High air inlet temperature Defective fan or fan driver
No response when main power turned on	Disconnected power cable Defective circuit breaker
Control module display does not come up; unit does not beep when powered up	Shorted or defective control module power supply
Control module does not boot	EPROM(s) missing Control head PC board defective
Control module datalink failure error appears	HPA interface failure. Data steering board failure Fiberoptic link failure ± 15 VDC supply failure
Heater power supply does not come up	Defective low voltage power supply module Defective heater power supply module
No high voltage	Keylock switch on INHIBIT or REMOTE Defective high voltage power supply.
Voltages normal, but no RF output, helix current low	No RF input Defective SSA Gain turned down

After reviewing the symptoms of the failure, the user may want to check for a loose connector or component especially after rough handling of the unit. Look externally for physical damage or loose connectors and internally for unmated or loose parts.

The service technician should become familiar with the internal mechanical construction to permit correct re-assembly. Limited troubleshooting may be conducted, with caution, based on the failure symptom and an understanding of the logic/schematic diagrams.

4.5 NON-REPAIRABLE MODULES

The Heater power supply (A23054-000), the Grid modulator (A21422-000 and A21422-001), the 5 KV 3 KW HV filter (A23044-000), the Tank module (A27818-000), and the HV rectifier (A26258-000) are encapsulated modules and are not repairable. Contact an authorized service representative if replacement modules are needed.

5. TECHNICAL DOCUMENTATION

NOTE: The purpose of this technical documentation section is to provide a guide to the TWTA for technician-level servicing. It is intended for use by qualified technical personnel who must troubleshoot and repair the TWTA in the field. Such repairs are typically limited to replacement of modules or major components. For this reason, only documentation pertaining to the highest levels of the system and to system control logic is included.

5.1 TOP LEVEL BUILD TREE

	A31795-000	1500 W TWTA IJ-BAND, CONTINUOUS, 208 VAC 3-PHASE (AR
1A1	A31796-000	RF COMBINER ASSEMBLY, IJ-BAND, FOUR COMBINED
	A31818-000	MECHANICAL PARTS, COMBINER ASSEMBLY, IJ-BAND,
1A1A1	A31801-000	RF COMPONENTS, IJ BAND, FOUR COMBINED 500W
1A1A2	A27444-001	1000T COMBINER VPC INTERFACE BOARD, COMPONENT
1A1A2U10	A31346-000	DAC REPLACEMENT BOARD FOR U00725. DUAL
1A1A9	A31819-000	WIRING KIT, COMBINER ASSEMBLY I/J BAND
1A2	A31781-000	CONTROL UNIT/AC DISTRIBUTION, 50A, 4-AC OUT,
1A2A1	A25403-301	TWTA CONTROL ASSY, 20 CIJ/50X/1000T (GLASS
1A2A1A1	A25450-000	CPU BOARD W/POWERFAIL (20MHZ)
1A2A1A2	A25425-000	HPA DISPLAY BOARD
1A2A1A3	A22488-007	GPIB/LINK TRANSCEIVER BOARD, 200UM FIBERS
1A2A2	A29184-003	7 CHANNEL DATA STEERING BOARD (NO SOCKETS, CH
1A2A11	A31782-000	CONTROL MODULE WIRING KIT
1A2A12	A31783-000	CONTROL MODULE CABINET ASSY AR, 4 AC OUT, 208
1A3-A6	A28013-002	POWER SUPPLY, SUPERTUBE I/J-BAND, AR, FIBER TO
1A3-A6A1	A22525-900	1000T I/J-BAND HV POWER SUPPLY
1A3-A6A1A1	A23054-000	HEATER POWER SUPPLY MODULE
1A3-A6A1A1T1	A09553-000	XFMR,HEATER FEEDBACK
1A3-A6A1A1T2	A09000-000	XFMR,HEATER POWER
1A3-A6A1A2	A27784-000	MODULATOR HARNESS MODULE
1A3-A6A1A3	A23683-003	AVR CURRENT MODE PFC, 3KW , 200-250VAC INPUT (
1A3-A6A1A3L4	A09006-000	PFC INDUCTOR FOR 100VAC-255VAC
1A3-A6A1A4	A23044-000	H.V.FILTER
1A3-A6A1A5	A27818-000	TANK MODULE (NO CAPS)
1A3-A6A1A5A1-A2	A09510-000	RESONANT INDUCTOR
1A3-A6A1A6	A26258-000	HIGH VOLTAGE RECTIFIER & XFMR MODULE
1A3-A6A1A6T1	A09524-000	HV XFMR WINDING SET FOR MEC18
1A3-A6A1A7	A27815-001	POWER INVERTER MODULE,USED WITH PFC
1A3-A6A1A7A1	A21449-000	POWER BOARD (3.5KW HPA)
1A3-A6A1A7A1T2	A09529-000	GATE TRANSFORMER
1A3-A6A1A7A1T3	A09527-000	GATE TRANSFORMER
1A3-A6A1A7A2	A21440-001	REGULATION BOARD,USED WITH PFC
1A3-A6A1A7A3	A30113-000	EXTERNAL CAPACITOR BOARD, 3.5KW RESONANCE
1A3-A6A1A8	A23050-000	HPA LOGIC AND CONTROL MODULE
1A3-A6A1A9	A26452-000	LOW VOLTAGE POWER SUPPLY MODULE
1A3-A6A1A10	A23065-001	INPUT FILTER MODULE, PHASE LOST DETECTION NOT
1A3-A6A1A11	A23013-000	MOTHER BOARD
1A3-A6A1A12	A28495-900	FACTORY SELECT PARTS
1A3-A6A2	A21422-000	GRID MODULATOR MODULE
1A3-A6A2A1	A18415-000	MODULATOR HIGH VOLTAGE BOARD
1A3-A6A2A1T1	A09227-000	PULSE TOP XFMR,HAND WOUND
1A3-A6A2A1T2	A09228-000	FEEDBACK XFMR,HAND WOUND
1A3-A6A2A1T3	A09229-000	BIAS XFMR,HAND WOUND
1A3-A6A2A1T4-T5	A09230-000	XFMR,GATE DRIVE (HAND WOUND)
1A3-A6A2A2	A23715-000	MODULATOR CONTROL BOARD
1A3-A6A3	A21422-001	MODULATOR,ASSY STANDALONE
1A3-A6A3A1	A18415-000	MODULATOR HIGH VOLTAGE BOARD
1A3-A6A3A1T1	A09227-000	PULSE TOP XFMR,HAND WOUND
1A3-A6A3A1T2	A09228-000	FEEDBACK XFMR,HAND WOUND
1A3-A6A3A1T3	A09229-000	BIAS XFMR,HAND WOUND
1A3-A6A3A1T4-T5	A09230-000	XFMR,GATE DRIVE (HAND WOUND)
1A3-A6A3A2	A23715-000	MODULATOR CONTROL BOARD
1A3-A6A4	A25444-001	HPA INTERFACE BOARD (200UM GLASS FIBERS)
1A3-A6A4U15	A31346-000	DAC REPLACEMENT BOARD FOR U00725. DUAL
1A3-A6A4	A25444-010	HPA INTERFACE BOARD (200UM GLASS FIBER
1A3-A6A4U15	A31346-000	DAC REPLACEMENT BOARD FOR U00725. DUAL
1A3-A6A5	A30697-001	OPTIC CONVERTER BOARD
1A3-A6A6	A23692-000	INSULATED FAN DRIVER

1A3-A6A6T1	A09594-000	FAN DRIVER TRANSFORMER
1A3-A6A7	A26874-000	DUAL MODULATOR LV HARNESS
1A3-A6A9	A28047-002	WIRING KIT, POWER SUPPLY, 3KW SUPERTUBE I/J BAND
1A3-A6A10	A27773-002	CABINET, POWER SUPPLY, SUPERTUBE IJ-BAND, AR,
	A27773-003	CABINET, POWER SUPPLY, SUPERTUBE IJ-BAND, AR,
1A7	A31797-001	RF SUBASSEMBLY, IJ-BAND, TWO COMBINED 500W
	A31799-001	MECHANICAL PARTS, IJ-BAND, TWO COMBINED 500W
1A7A1	A28007-004	500 WATT RF SUBASSEMBLY, IJ-BAND, NO RACK
1A7A1A7	A32126-000	SUPERTUBE LOP BOARD
1A7A1A8	A31263-000	HIGH VOLTAGE BOX AND HARNESS, 700 WATT
1A7A1A9	A28049-000	WIRING KIT, 500W I/J SUPERTUBE
1A7A1A10	A28037-005	CHASSIS ASSEMBLY, 500 WATT RF SUBASSEMBLY,
1A7A1A12-A13	A23692-000	INSULATED FAN DRIVER
1A7A1A12-A13T1	A09594-000	FAN DRIVER TRANSFORMER
1A7A2	A28007-007	500 WATT RF SUBASSEMBLY, IJ-BAND, NO RACK
1A7A2A7	A32126-000	SUPERTUBE LOP BOARD
1A7A2A8	A31263-000	HIGH VOLTAGE BOX AND HARNESS, 700 WATT
1A7A2A9	A28049-000	WIRING KIT, 500W I/J SUPERTUBE
1A7A2A10	A28037-008	CHASSIS ASSEMBLY, 500 WATT RF SUBASSEMBLY,
1A7A2A12-A13	A23692-000	INSULATED FAN DRIVER
1A7A2A12-A13T1	A09594-000	FAN DRIVER TRANSFORMER
1A7A3	A31798-000	RF COMPONENTS, IJ-BAND, TWO COMBINED 500W
1A8	A31797-000	RF SUBASSEMBLY, IJ-BAND, TWO COMBINED 500W
	A31799-000	MECHANICAL PARTS, IJ-BAND, TWO COMBINED 500W
1A8A1	A28007-004	500 WATT RF SUBASSEMBLY, IJ-BAND, NO RACK
1A8A1A7	A32126-000	SUPERTUBE LOP BOARD
1A8A1A8	A31263-000	HIGH VOLTAGE BOX AND HARNESS, 700 WATT
1A8A1A9	A28049-000	WIRING KIT, 500W I/J SUPERTUBE
1A8A1A10	A28037-005	CHASSIS ASSEMBLY, 500 WATT RF SUBASSEMBLY,
1A8A1A12-A13	A23692-000	INSULATED FAN DRIVER
1A8A1A12-A13T1	A09594-000	FAN DRIVER TRANSFORMER
1A8A2	A28007-007	500 WATT RF SUBASSEMBLY, IJ-BAND, NO RACK
1A8A2A7	A32126-000	SUPERTUBE LOP BOARD
1A8A2A8	A31263-000	HIGH VOLTAGE BOX AND HARNESS, 700 WATT
1A8A2A9	A28049-000	WIRING KIT, 500W I/J SUPERTUBE
1A8A2A10	A28037-008	CHASSIS ASSEMBLY, 500 WATT RF SUBASSEMBLY,
1A8A2A12-A13	A23692-000	INSULATED FAN DRIVER
1A8A2A12-A13T1	A09594-000	FAN DRIVER TRANSFORMER
1A8A3	A31798-000	RF COMPONENTS, IJ-BAND, TWO COMBINED 500W
1A9-A12	A28038-000	TWT CONTROL CABLE, I/J BAND
1A17-A18	A32092-000	CABINET ASSEMBLY, DUAL 19" X 30" DEEP X 52" TALL
	A30921-000	CABINET KIT 1000T
1XA3, XA4, XA5, XA6	A32248-000	POWER CABLE, SPS-300 POWER SUPPLY FOR SUPERTUBE

5.2 SCHEMATICS

10-23050-000	HPA Logic and Control (A23050-000)
10-25444-123	HPA Interface (A25444-123)
10-27444-007	Switcher/Combiner Interface Board (A27444-007)
10-28007-004	IJ-Band Supertube Assembly (A28007-004 and A28007-007)
10-28013-000	Power Supply, Supertube, IJ-Band (A28013-000)
10-31781-000	Control Module, 4-AC Out, 200-240 VAC (A31781-000)
10-31796-000	RF Combiner Assy, Four Combined Supertubes (A31796-000)

5.3 BLOCK DIAGRAM

25-31796-000

RF Combiner Assembly (A31796-000)

5.4 PARTS LISTS

A23050-000	HPA Logic and Control
A25444-123	HPA Interface
A27444-007	Switcher/Combiner Interface Board
A28007-004	IJ-Band supertube Assembly
A28013-000	Power Supply, Supertube, IJ-Band
A31781-000	Control Module, 4-AC Out, 200-240 VAC
A31795-000	1500W IJ-Band TWTA
A31796-000	RF Combiner Assy, Four Combined Supertubes

5.4.1 Parts List, HPA Logic and Control Module, A23050-000

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
	B23050-000	LOGIC & CONTROL BOARD	2
C48, C49	C06103-000	CAP,10MF,25V,20%,SOLID TANT,RADIAL,(AVX TAP106M025HSB)	4
C11	C16333-000	CAP,33MF,25V,AERL,(NICHICON UVX1E330M)	2
C47	C17104-000	CAP,100MF,50V,AERL,(NICHICON UVX1J101MPA)	2
C2, C5, C15	C31028-000	CAP,1000PF,200VDC,10%,CER,1% FAILURE,(KEMET CKR05 SERIES W/"V" OPTION)	6
C3, C9, C13, C14, C17, C19, C21, C22, C23, C27, C28, C29, C30, C31, C33, C36, C41, C46	C31032-000	CAP,0.01MF,200VDC,10%,CER,1% FAILURE,(KEMET CKR06 SERIES W/"V" OPTION)	36
C10, C24, C101	C31036-000	CAP,0.1MF,100VDC,10%,CER,1% FAILURE,(KEMET CKR06 SERIES W/"V" OPTION)	6
C1, C4, C6, C7, C16, C18, C25, C26, C32, C34, C37-C41, C43, C44, C45, C50	C31040-000	CAP,1MF,50VDC,10%,CER,1% FAILURE,(KEMET CKR06 SERIES W/"V" OPTION)	38
C100	C31065-000	CAP,2.7MF,50V,10%,CER,1% FAILURE,(KEMET CSR13G275KM)	2
D16, D23, D31	D10965-000	ZENER,15V,(DIODES INC 1N965B)	6
D1, D3, D4, D5, D7, D8, D9, D10, D11, D12, D13, D17, D18, D19, D20, D21, D22, D25, D26, D28, D30, D33, D35, D37, D38, D29	D14454-000	DIODE,AXIAL,(MOTOROLA 1N4454)	52
D32	D14728-000	ZENER,3.3V,1W,10%,AXIAL,(MOTOROLA 1N4728)	2
D36	D14733-000	ZENER,5.1V,1W,10%,AXIAL,(MOTOROLA 1N4733)	2
J2	J10370-000	CONN,37 PIN,MALE,D-SUB,PCB RIGHT ANGLE, (AMP 747252-4)	2
J7	J12294-000	CONN RIGHT ANGLE MALE 29 PIN,(SAME AS J12291 W/NO MODIF),(HYPERTRONIC KA29/127BPMC10T,&HARDWARE	2
	J18075-000	MALE SCREW LOCK,FOR D SUBMIN CONN,(AMP 205817-1)	2
J4, J5	J18086-000	CONN,,SMA,JACK RECEPTACLE,RIGHT ANGLE,0-18GHZ,PC MOUNT [JOHNSON COMPONENTS 142-0701-301]	4
L1	L00200-000	WIDE BAND CHOKE,(VK200 10/3B FERROXCUBE)	2
	N23061-000	MODULE CHASSIS LOGIC	2
Q2	Q22907-000	TRANSISTOR,PNP,2N2907A,TO-18	2
R1, R9, R19, R37, R44, R50	R00100-000	RES,10 OHM,1/4W,5%,CC,(A/B RC07GF100J)	12
R4, R20, R27, R29, R39	R01100-000	RES,100 OHM,1/4W,5%,CC,(A/B RC07GF101J)	10
R5, R7, R17, R18, R28, R34, R45, R49, R53, R59, R71, R72, R87	R02100-000	RES,1K,1/4W,5%,CC,(A/B RC07GF102J)	26
R6	R02270-000	RES,2.7K,1/4W,5%,CC,(A/B RC07GF272J)	2
R43	R02330-000	RES,3.3K,1/4W,5%,CC,(A/B RC07GF332J)	2
R30, R31, R36	R02470-000	RES,4.7K,1/4W,5%,CC,(A/B RC07GF472J)	6
R35	R05820-000	RES,8.2M,1/4W,5%,CC,(A/B RC07GF825J)	2
R23	R21143-000	RES,1.43K,1/2W,1%,MF,100PPM,(DALE RN55D)	2
R10	R21301-000	RES,3.01K,1/2W,1%,MF,100PPM,(DALE RN55D)	2
R67	R21402-000	RES,4.02K,1/2W,1%,MF,100PPM,(DALE RN55D)	2

R38	R21523-000	RES,5.23K,1/2W,1%,MF,100PPM,(DALE RN55D)	2
R24	R21549-000	RES,5.49K,1/2W,1%,MF,100PPM,(DALE RN55D)	2
R52, R73	R21887-000	RES,8.87K,1/2W,1%,MF,100PPM,(DALE RN55D)	4
R75	R21990-000	RES,9.76K,1/2W,1%,MF,100PPM,(DALE RN55D)	2
R98	R22105-000	RES,10.5K,1/2W,1%,MF,100PPM,(DALE RN55D)	2
R42, R46, R47, R48, R60, R61, R74, R78	R23100-000	RES,100K,1/2W,1%,MF,100PPM,(DALE RN55D)	16
R54	R23169-000	RES,169K,1W,1%,MF,100PPM,(DALE RN60D)	2
R40	R23499-000	RES,499K,1/2W,1%,MF,100PPM,(DALE RN55D)	2
R33, R55	R23698-000	RES,698K,1/2W,1%,MF,100PPM,(DALE RN55D)	4
R41	R23750-000	RES,750K,1/2W,1%,MF,100PPM,(DALE RN55D)	2
R21	R23845-000	RES,845K,1/2W,1%,MF,100PPM,(DALE RN55D)	2
R66	R23953-000	RES,953K,1/2W,1%,MF,100PPM,(DALE RN55D)	2
R62	R30035-000	RES,10K,1/2W,1%,MF,100PPM,(DALE RN55D)	2
R32	R31091-000	RES,47K,1/4W,5%,CC,<=1% FAIL,(A/B RCR07)	2
R11	R32004-000	TRIMPOT,1K,1/2W,10%,CERMET,20T,SIDE ADJ,(BECKMAN 67X)	2
R12, R15, R16	R32020-000	TRIMPOT,10K,1/2W,10%,CERMET,20T,SIDE ADJ,(BECKMAN 67X)	6
R13, R14	R32049-000	TRIMPOT,5K,1/2W,10%,CERMET,20T,SIDE ADJ,(BECKMAN 67X)	4
U4, U5, U6	U02390-000	IC,QUAD COMPARATOR,(NAT LM139J)	6
U7	U03240-000	IC,LOW POWER OP AMP,(NAT LM324)	2
U9	U10070-000	REFERENCE,PRECISION 10V [LINEAR TECH LT1031DCH]	2
U8	U17805-000	IC,5V REGULATOR,TO-220,(NAT LM340T-5.0)	2
U1, U2, U3	U20148-000	IC,HEX INVERTER,SCHMIDTT TRIGGER,(74HC14) (SSD)	6
RP4, RP8	U30106-000	IC,10K,RES NETWORK,6 PIN,SIP (DALE MSP06A- 01-103G)	4
RP1-2, RP5-7, RP9	U30410-000	IC,10K,2%,0.40A,10 PIN,ISOLATED RESISTORS (DALE MSP10C-03-103G OR BOURNS 4610H-102- 103)	12
	W12803-000	WIRE,SOLID,TEFLON,28 AWG,250V,(ALPHA 2842/1-GREEN)	2

5.4.2 Parts List, HPA Interface Board (200UM Glass), A25444-123

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
U15	A31346-000	DAC REPLACEMENT BOARD FOR U00725. DUAL CHANNEL	4
	B25444-000	HPA INTERFACE BOARD	4
C161	C03105-000	CAP,0.01MF,100V,CER,10%,RADIAL,(AVX SR201C103KAA)	4
C171	C04223-000	CAP,0.22MF,35V,TANT,RADIAL, [JAMCO 33507]	4
C20, C32, C100	C05153-000	CAP,1.5MF,35V,TANT,RADIAL,(AVAX, TAP155K035SCS)	16
C129, C163	C05223-000	CAP,2.2MF,35V,10%,SOLID SEALED TANT,RADIAL,(SPRAGUE 199D225X9035BA1)	8
C80, C81, C164	C06103-000	CAP,10MF,25V,20%,SOLID TANT,RADIAL,(KEMET, T356E106K025AS)	12
C15	C06220-000	CAP,22MF,16V,SOLID TANT,RADIAL,(AVX TAP226K016SCS)	4
C99	C16103-000	CAP,10MF,35V,AERL,(NICHICON UVR1V100MDA)	4
C101	C17472-000	CAP,470MF,16V,AERL,(NICHICON UVX1C471M)	4
C47, C67	C17474-000	CAP,470UF,50V,AERL,[PANASONIC P5279]	8
C44	C30066-000	CAP 47 MF, 35V, SOLID TANT. RADIAL, (KEMET T356M476K035AS)	4
C6, C7, C9, C13, C16, C39, C43, C69, C165, C166	C31016-000	CAP,100PF,200VDC,10%,CER,1% FAILURE,(KEMET CKR05 SERIES W/"V" OPTION)	40
1, 2, 3, 4, 5, 10, 11, 22, 23, 24, 25, 26, 28, 30, 33, 35, 40, 41, 42, 48, 49, 50, 51, 53, 62, 63, 64, 65, 70, 71, 73, 77, 79, 83, 85, 87, 88, 89, 91, 94, 96, 97, 98, 102, 103, 105, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 121, 125, 132	C31036-000	CAP,0.1MF,100VDC,10%,CER,1% FAILURE,(KEMET CKR06 SERIES W/"V" OPTION)	240
C12, C14, C17, C18, C19, C21, C27, C29, C31, C34, C36, C38, C45, C46, C52, C54, C55, C56, C57, C58, C59, C60, C61, C66, C68, C72, C75, C82, C84, C86, C90, C92, C93, C95, C104, C106, C119, C120, C122, C123, C124, C133, C168, C169	C31040-000	CAP,1MF,50VDC,10%,CER,1% FAILURE,(KEMET CKR06 SERIES W/"V" OPTION)	176
D8, D10, D12, D14, D15, D16, D18, D19	D14007-000	DIODE,1000V,1A,AXIAL,(MOTOROLA 1N4007)	32
D1-D7	D14454-000	DIODE,AXIAL,(MOTOROLA 1N4454)	28
D9, D17	D14733-000	ZENER,5.1V,1W,10%,AXIAL,(MOTOROLA 1N4733)	8
I1	I10074-000	LED,GREEN,ALGAAS,NON-DIFFUSED,(HEWLETT PACKARD HLMP-1540)	4
J5	J10021-000	HEADER,2 PIN,MALE,RIGHT ANGLE,SERIES 7478 (MOLEX 22-05-3021)	4
J6	J10084-000	CONN-HEADER,8 PINS,MALE,RIGHT ANGLE,SQUARE FRICTION LOCK,0.100 CNTR,SERIES 7478,[MOLEX 22-05-3081]	4
J1	J10371-000	D-SUB,37 PIN MALE,PCB MOUNT,STRAIGHT (POSITRONICS MD37M3S000)	4
XU17	J14161-000	SKT,DIP,16 PIN,MACH SLEEVES,(AUGAT 516-AG11D)	4
XU26	J14202-000	SKT,DIP,20 PIN,MACH SLEEVES,(SAMTEC ICA-320-SGT)	4
XU15	J14281-000	SKT,DIP,28 PIN,MACH SLEEVES,(SAMTEC ICA-628-SGT)	4
TP0	J16210-000	TEST JACK,BLACK,VERTICAL,(EF JOHNSON 105-0853-001)	4
TP1	J16211-000	TEST JACK,BROWN,VERTICAL,(EF JOHNSON 105-0858-001)	4

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
TP2	J16212-000	TEST JACK,RED,VERTICAL,(EF JOHNSON 105-0852-001)	4
TP3	J16213-000	TEST JACK,ORANGE,VERTICAL,(EF JOHNSON 105-0856-001)	4
TP4	J16214-000	TEST JACK,YELLOW,VERTICAL,(EF JOHNSON 105-0857-001)	4
TP5	J16215-000	TEST JACK,GREEN,VERTICAL,(EF JOHNSON 105-0854-001)	4
J4	J18167-000	D-SUB,37 PIN,FEMALE,PCB MOUNT,RIGHT ANGLE (AMP 745784-4)	4
J3	J18180-000	CONN,D-SUB,15 PIN,MALE,STRAIGHT,PCB MOUNT (POSITRONIC MD15M3000)	4
J2	J31013-000	CONN,D-SUB,25 PIN,MALE,RIGHT ANGLE,PCB MOUNT,[AMP 747238-4]	4
XJ1-XJ4	J31014-000	SPRING LATCH KIT,D-SUB,(AMPHENOL 17-529)	16
K1-K6	K02009-000	RELAY,DPDT,5VDC,125V @ 0.5A / 30VDC @ 1A CONTACTS,PCB TERMINALS,SEALED (OMRON G6H-2-DC5)	24
L1-L4	L00200-000	WIDE BAND CHOKE,(VK200 10/3B FERROXCUBE)	16
Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8	Q22222-000	TRANSISTOR,NPN,2N2222A,TO-18	32
R2	R01220-000	RES,220 OHM,1/4W,5%,CC,(A/B RC07GF221J)	4
R1	R04200-000	RES,200K,1/4W,5%,CC,(A/B RC07GF204J)	4
R6, R8, R58	R20100-000	RES,100 OHM, 1%,MF,100PPM,(DALE RN55D)	12
R57	R20200-000	RES,200 OHM, 1%,MF,100PPM,(DALE RN55D)	4
R59	R22332-000	RES,33.2K, 1%,MF,100PPM,(DALE RN55D)	4
R4, R7	R23100-000	RES,100K, 1%,MF,100PPM,(DALE RN55D)	8
R3, R5	R30071-000	TRIMPOT,10K,1/2W,10%,CERMET,100PPM,20T,TOP ADJ,(BECKMAN 67W)	8
R9, R12, R15, R22, R35, R40, R44	R30103-000	RES,10K,1/8W,1%,MF,AXIAL,100PPM,(DALE CMF-50 / RN50C1002F)	28
R17, R18, R19, R20, R21, R23, R25, R28, R31, R42, R43, R46	R30140-000	RES,1K,1/8W,1%,MF,50PPM,(DALE RN50C)	48
R13, R14, R24, R26, R27, R29, R32, R37, R38, R39, R47, R100	R31164-000	RES,100K,1/20W,1%,FILM,AXIAL,100PPM,MIL,(DALE RN50C1003F)	48
U7, U8	U00027-000	IC,ULTRA LOW NOISE PRECISION OP AMP,(ANALOG DEVICES OP27GP)	8
U26	U00029-000	CONVERTER,NO OIL,16BIT,A TO D,SERIAL OUT,[BURR-BROWN ADS7809PB,PB],[ANALOG DEVICES AD977CN]	4
U17	U00524-000	IC,INSTRUMENTATION AMP,(ANALOG DEVICES AD524A) (SSD)	4
U9, U10, U18	U04090-000	IC,4CH ANALOG MULTIPLEXER,(DATEL MXD-409)	12
DP2, DP4, DP5, DP8, DP9	U08010-000	IC,8 COMMON CATHODE CLAMPING DIODES,9 PIN SIP,(ROHM DAN801)	20
DP1, DP3, DP6, DP7, DP10	U08011-000	IC,8 COMMON ANODE CLAMPING DIODES,9PIN SIP,(ROHM DAP801)	20
U27	U11165-000	IC,6.5536MHZ CLOCK OSCILLATOR,1/2 SIZE,(ECLIPTEK EC1100HS-6.5536MHZ) (SSD)	4
U36	U17545-000	DRIVER,OIL,DS75451N,DUAL AND,[NATIONAL SEMICONDUCTOR DS75451N]	4
U6, U19, U34, U39, U60	U20148-000	IC,HEX INVERTER,SCHMIDTT TRIGGER,(74HC14) (SSD)	20
U42	U20738-000	IC,DUAL J-K FLIP-FLOP W/RESET,(74HCT73 OR 74HC73) (SSD)	4
U51	U21328-000	IC,QUAD 2 INPUT NAND,SCHMIDTT TRIGGER,(74HC132) (SSD)	4
U52	U21388-000	IC,3 TO 8 DECODER/DEMULTIPLEXER, INVERTING,(74HC138) (SSD)	4
U32	U21536-000	IC,DUAL 4 INPUT DIGITAL MULTIPLEXER,(74F153) (SSD)	4
U35	U22598-000	IC,8 BIT ADDRESSABLE LATCH W/RESET,(74HC259) (SSD)	4

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
U47	U23909-000	IC,DUAL 4 BIT BINARY/BIQUINARY COUNTER (74HCT390) (SSD)	4
U41, U48	U24018-000	IC,JOHNSON DECADE COUNTER W/10 DECODED OUTPUTS,(74HC4017) (SSD)	8
U45	U24138-000	IC,8 BIT BINARY DOWN COUNTER,(74HC40103) (SSD)	4
U43	U26889-000	IC,8 BIT MAGNITUDE COMPARATOR,(74HCT688) (SSD)	4
U22, U24, U57	U28008-000	IC,QUAD 2 INPUT AND,(74HC08) (SSD)	12
U4, U49, U58	U28032-000	IC,QUAD 2 INPUT OR,(74HC32) (SSD)	12
U44, U46	U28040-000	IC,12 BIT DECADE COUNTER,(74HCT4040) (SSD)	8
U5, U13, U14, U23, U25, U33, U50	U28074-000	IC,DUAL D FLIP FLOP W/RESET,(74HC74) (SSD)	28
U2	U28123-000	IC,DUAL RETRIGGERABLE 1-SHOT,(74HC123) (SSD)	4
U31, U53	U28164-000	IC,8 BIT SERIAL IN PARALLEL OUT SHIFT REGISTER,(74HC164) (SSD)	8
U3, U12, U28, U37, U38	U28165-000	IC,8 BIT PARALLEL IN SERIAL OUT SHIFT REGISTER,(74HC165) (SSD)	20
RP6	U32001-000	IC,1K FEED-THROUGH RES NETWORK,16 PIN DIP,(A/B 316B102)	4
RP1-RP5	U32103-000	IC,10K FEED-THROUGH RES NETWORK,16 PIN DIP,(A/B 316B103)	20
U56	U40008-000	REGULATOR,OIL,5V,100MA,TO-92,[MOTOROLA MC78L05ABP]	4
U55	U40012-000	FLIP-FLOP,OCTAL D-TYPE LATCH WITH RESET,[NATIONAL MM74HC273N]	4

5.4.3 Parts List, 1000T Combiner VPC Interface, A27444-007

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
REVD	B27444-000	COMBINER INTERFACE	1
C13, C49	C04105-000	CAP,0.1MF,100V,20%,MON,(KEMET C331C104M1R5CA)	2
C144, C148	C04223-000	CAP,0.22MF,35V,TANT,RADIAL, [JAMCO 33507]	2
C1, C19, C24	C05153-000	CAP,1.5MF,35V,TANT,RADIAL,(JAMECO TM1.5/35)	3
C142, C143	C05223-000	CAP,2.2MF,35V,10%,SOLID SEALED TANT,RADIAL,(SPRAGUE 199D225X9035BA1)	2
C43	C06220-000	CAP,22MF,16V,SOLID TANT,RADIAL,(AVX TAP226K016SCS)	1
C138, C139	C06473-000	CAP,47MF,25V,SOLID TANT,RADIAL,(KEMET T356K476K025AS)	2
C30	C16103-000	CAP,10MF,35V,AERL,(NICHICON UVX1V100)	1
C5	C17222-000	CAP,220MF,16V,AERL,(ILL CAP 227RAR016A)	1
C10, C23	C17224-000	CAP,220MF,50V,AERL,(ILL CAP 227RAR050A)	2
C60, C64, C81, C83, C86, C89, C95, C97, C140, C141	C31016-000	CAP,100PF,200VDC,10%,CER,1% FAILURE,(KEMET CKR05 SERIES W/"V" OPTION)	10
C48	C31028-000	CAP,1000PF,200VDC,10%,CER,1% FAILURE,(KEMET CKR05 SERIES W/"V" OPTION)	1
152, 151, 150, 149, 147, 146, 136, 132, 131, 130, 129, 123, 118, 111, 110, 109, 108, 94, 93, 80, 77, 74, 71, 63, 62, 59, 53, 52, 50, 47, 46, 42, 38, 35, 34, 32, 31, 29, 28, 27, 26, 22, 21, 20, 18, 17, 16, 15, 14, 11, 9, 8, 7, 6, 3, 2	C31036-000	CAP,0.1MF,100VDC,10%,CER,1% FAILURE,(KEMET CKR06 SERIES W/"V" OPTION)	56
145, 135, 134, 133, 128, 127, 126, 125, 124, 122, 121, 120, 119, 117, 116, 115, 114, 113, 107, 106, 105, 104, 103, 102, 101, 100, 99, 98, 96, 92, 91, 90, 88, 87, 85, 84, 82, 78, 76, 75, 73, 72, 70, 69, 68, 67, 66, 65, 61, 58, 57, 56, 51, 45, 44, 40, 39, 37, 12, 4	C31040-000	CAP,1MF,50VDC,10%,CER,1% FAILURE,(KEMET CKR06 SERIES W/"V" OPTION)	60
D4, D5, D7-D20	D14007-000	DIODE,1000V,1A,AXIAL,(MOTOROLA 1N4007)	16
D1-D3, D6	D14454-000	DIODE,AXIAL,(MOTOROLA 1N4454)	4
I1	I10074-000	LED,GREEN,ALGAAS,NON-DIFFUSED,(HEWLETT PACKARD HLMP-1540)	1
J1	J10371-000	D-SUB,37 PIN MALE,PCB MOUNT,STRAIGHT (POSITRONICS MD37M3S000)	1
XU34	J14161-000	SKT,DIP,16 PIN,MACH SLEEVES,(AUGAT 516-AG11D)	1
XU64	J14202-000	SKT,DIP,20 PIN,MACH SLEEVES,(SAMTEC ICA-320-SGT)	1
XU10	J14281-000	SKT,DIP,28 PIN,MACH SLEEVES,(SAMTEC ICA-628-SGT)	1
TPO	J16210-000	TEST JACK,BLACK,VERTICAL,(EF JOHNSON 105-0853-001)	1
TP1	J16211-000	TEST JACK,BROWN,VERTICAL,(EF JOHNSON 105-0858-001)	1
TP2	J16212-000	TEST JACK,RED,VERTICAL,(EF JOHNSON 105-0852-001)	1
TP3	J16213-000	TEST JACK,ORANGE,VERTICAL,(EF JOHNSON 105-0856-001)	1
TP4	J16214-000	TEST JACK,YELLOW,VERTICAL,(EF JOHNSON 105-0857-001)	1
TP5	J16215-000	TEST JACK,GREEN,VERTICAL,(EF JOHNSON 105-0854-001)	1
J2	J18167-000	D-SUB,37 PIN,FEMALE,PCB MOUNT,RIGHT ANGLE (AMP 745784-4)	1

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
J3	J31010-000	CONN,D-SUB,15 PIN,MALE,RIGHT ANGLE,PCB MOUNT,[AMPHENOL 617-A015P-AJ121]	1
J4	J31013-000	CONN,D-SUB,25 PIN,MALE,RIGHT ANGLE,PCB MOUNT,[AMP 747238-4]	1
XJ4	J31014-000	SPRING LATCH KIT,D-SUB,(AMPHENOL 17-529)	1
K1-K16	K02009-000	RELAY,DPDT,5VDC,125V @ 0.5A / 30VDC @ 1A CONTACTS,PCB TERMINALS,SEALED (OMRON G6H-2-DC5)	16
L1-L4	L00200-000	WIDE BAND CHOKE,(VK200 10/3B FERROXCUBE)	4
Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q11, Q12, Q13, Q14, Q15, Q16	Q22222-000	TRANSISTOR,NPN,2N2222A,TO-18	16
R1, R7, R26	R01100-000	RES,100 OHM,1/4W,5%,CC,(A/B RC07GF101J)	3
R4	R01220-000	RES,220 OHM,1/4W,5%,CC,(A/B RC07GF221J)	1
R9	R01680-000	RES,680 OHM,1/4W,5%,CC,(A/B RC07GF681J)	1
R11	R04200-000	RES,200K,1/4W,5%,CC,(A/B RC07GF204J)	1
R5, R6	R05820-000	RES,8.2M,1/4W,5%,CC,(A/B RC07GF825J)	2
R27	R20200-000	RES,200 OHM,1/2W,1%,MF,100PPM,(DALE RN55D)	1
R28	R22332-000	RES,33.2K,1/2W,1%,MF,100PPM,(DALE RN55D)	1
R2, R3	R30071-000	TRIMPOT,10K,1/2W,10%,CERMET,100PPM,20T,TOP ADJ,(BECKMAN 67W)	2
R8, R10, R13, R14, R15, R16, R17, R18, R19, R20, R21	R30103-000	RES,10K,1/8W,1%,MF,AXIAL,100PPM,(DALE CMF-50 / RN50C1002F)	11
R204-R206	R31164-000	RES,100K,1/20W,1%,FILM,AXIAL,100PPM,MIL,(DALE RN50C1003F)	3
RP4, RP8, RP14	R32104-000	RES NET,100K,200MW,1%,FILM,7 RES,PCB MNT,0.01PPM,(DALE MSP08A-01-1003F)	3
U1, U13	U00027-000	IC,ULTRA LOW NOISE PRECISION OP AMP,(ANALOG DEVICES OP27GP)	2
U64	U00029-000	CONVERTER,NO OIL,16BIT,A TO D,SERIAL OUT,[BURR-BROWN ADS7809PB,PB],[ANALOG DEVICES AD977CN]	1
U34	U00524-000	IC,INSTRUMENTATION AMP,(ANALOG DEVICES AD524A) (SSD)	1
U10	U00725-000	IC,DUAL 16 BIT DIGITAL TO ANALOG CONVERTER,(BURR-BROWN DAC-725) (SSD)	1
U43, U46, U53	U04090-000	IC,4CH ANALOG MULTIPLEXER,(DATEL MXD-409)	3
DP2, DP4, DP6, DP7, DP10	U08010-000	IC,8 COMMON CATHODE CLAMPING DIODES,9 PIN SIP,(ROHM DAN801)	5
DP1, DP3, DP5, DP8, DP9	U08011-000	IC,8 COMMON ANODE CLAMPING DIODES,9PIN SIP,(ROHM DAP801)	5
U14	U11165-000	IC,6.5536MHZ CLOCK OSCILLATOR,1/2 SIZE,(ECLIPTEK EC1100HS-6.5536MHZ) (SSD)	1
U32	U11537-000	IC,VERSALINK TRANSMITTER,VERTICAL,(200UM FIBER) (HP HFBR-1537)	1
U35	U12531-000	IC,FIBER OPTIC RECEIVER,VERTICAL,(HP HFBR-2531) (SSD)	1
U65	U17545-000	DRIVER,OIL,DS75451N,DUAL AND,[NATIONAL SEMICONDUCTOR DS75451N]	1
U15, U29, U51, U58, U66	U20148-000	IC,HEX INVERTER,SCHMIDTT TRIGGER,(74HC14) (SSD)	5
U47	U20730-000	IC,DUAL J-K FLIP FLOP W/RESET,(7473) (SSD)	1
U37	U21328-000	IC,QUAD 2 INPUT NAND,SCHMIDTT TRIGGER,(74HC132) (SSD)	1
U5	U21388-000	IC,3 TO 8 DECODER/DEMULTIPLEXER,INVERTING,(74HC138) (SSD)	1
U55	U21536-000	IC,DUAL 4 INPUT DIGITAL MULTIPLEXER,(74F153) (SSD)	1
U3	U22598-000	IC,8 BIT ADDRESSABLE LATCH W/RESET,(74HC259) (SSD)	1
U18	U23909-000	IC,DUAL 4 BIT BINARY/BIQUINARY COUNTER (74HCT390) (SSD)	1

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
U28, U52	U24018-000	IC,JOHNSON DECADE COUNTER W/10 DECODED OUTPUTS,(74HC4017) (SSD)	2
U2	U24138-000	IC,8 BIT BINARY DOWN COUNTER,(74HC40103) (SSD)	1
U11	U26889-000	IC,8 BIT MAGNITUDE COMPARATOR,(74HCT688) (SSD)	1
U16, U48, U68	U28008-000	IC,QUAD 2 INPUT AND,(74HC08) (SSD)	2
U17, U38, U67	U28032-000	IC,QUAD 2 INPUT OR,(74HC32) (SSD)	3
U22, U25	U28040-000	IC,12 BIT DECADE COUNTER,(74HCT4040) (SSD)	2
U12, U26, U27, U39, U49, U54, U56	U28074-000	IC,DUAL D FLIP FLOP W/RESET,(74HC74) (SSD)	7
U33	U28123-000	IC,DUAL RETRIGGERABLE 1-SHOT,(74HC123) (SSD)	1
U4, U6, U19	U28164-000	IC,8 BIT SERIAL IN PARALLEL OUT SHIFT REGISTER,(74HC164) (SSD)	3
U23, U36, U44, U50, U57	U28165-000	IC,8 BIT PARALLEL IN SERIAL OUT SHIFT REGISTER,(74HC165) (SSD)	5
RP1, RP2, RP10, RP11	U32001-000	IC,1K FEED-THROUGH RES NETWORK,16 PIN DIP,(A/B 316B102)	4
RP5, RP7, RP9, RP13, RP15	U32103-000	IC,10K FEED-THROUGH RES NETWORK,16 PIN DIP,(A/B 316B103)	5
U63	U40008-000	REGULATOR,OIL,5V,100MA,TO-92,[MOTOROLA MC78L05ABP]	1
U61, U62	U40012-000	FLIP-FLOP,OCTAL D-TYPE LATCH WITH RESET,[NATIONAL MM74HC273N]	2
W1-W16	W12400-000	WIRE,24 AWG,BLUE,TEFLON,(BELDEN)	1

5.4.4 Parts List, 500 Watt RF Subassembly, IJ-Band, A28007-004

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
A12, A13	A23692-000	INSULATED FAN DRIVER	8
A10	A28037-005	CHASSIS ASSEMBLY, 500 WATT RF SUBASSEMBLY, I/J-BAND SUPERTUBE, NO RACK MOUNTING FLANGES, RIGHT	4
A9	A28049-000	WIRING KIT, 500W I/J SUPERTUBE	4
A8	A31263-000	HIGH VOLTAGE BOX AND HARNESS, 700 WATT TRI-BAND	4
A7	A32126-000	SUPERTUBE LOP BOARD	4
A6	E00325-000	RF LOAD, 500W, WRD-750, AIR COOLED(MDC, 21750-200)	4
	E00326-000	90 DEG. OFFSET JOGGLE, WRD-750 (PER ETM DWG. E00326)	4
	E01963-000	COUPLER, WRD-750, BEND ASSEMBLY, 7.5-18.0 GHZ [MDC, 16750-177]	8
A3, A4	E08114-001	TWT, 7.5-18.0 GHZ, 300 W, GRID, +/-2 DB EQ PHASE COMB, NC/ISO THERMO [MEC-5407, GRID, +/-2DB EQ SPL]	8
	E20130-000	ADAPTER, SMA MALE TO SMA FEMALE, RIGHT ANGLE (SV MICROWAVE, 2994-6002SF (SST FINISH))	8
FL1, FL2	E20145-118	FILTER, LOW PASS, 18.0 GHZ, (MICROLAB FXR LA 180F)	8
D1, D2	E20284-000	ZERO-BIAS SCHOTTKY DETECTOR, 10MHZ-18.5GHZ, POSITIVE OUT PUT POLARITY, (RLC, M-3747)	8
A5	E20399-000	MAGIC TEE, WRD-750, [MDC 10750-139]	4
	H00600-000	WAVEGUIDE FLANGE GASKET, WRD-650, WRD-750, (MDC, 30650-001)	28
	N31104-000	BRACE, RF LOAD	4
	N31105-000	CLAMP, RF LOAD	4
	N31242-000	SUPPORT BAR	4
	N31285-000	SPACER	4

5.4.5 Parts List, Power Supply, Supertube I/J-Band, A28013-000

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
A2	A21422-000	GRID MODULATOR MODULE	4
A3	A21422-001	MODULATOR,ASSY STANDALONE	4
A1	A22525-900	1000T I/J-BAND HV POWER SUPPLY	4
A6	A23692-000	INSULATED FAN DRIVER	4
A4	A25444-010	HPA INTERFACE BOARD (200UM GLASS FIBER RESISTORS, HEADER IN PLACE OF TRANSMITTER/RECIEVER)	4
A7	A26874-000	DUAL MODULATOR LV HARNESS	4
A10	A27773-002	CABINET, POWER SUPPLY, SUPERTUBE IJ-BAND, AR, FIBER TO REAR	4
A9	A28047-002	WIRING KIT, POWER SUPPLY, 3KW SUPERTUBE I/J BAND	4
A5	A30697-001	OPTIC CONVERTER BOARD	4

5.4.6 Parts List, Control Unit/AC Distribution, 50A, A31781-000

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
A1	A25403-301	TWTA CONTROL ASSY, 20 CIJ/50X/1000T (GLASS FIBERS)	1
A2	A29184-003	7 CHANNEL DATA STEERING BOARD (NO SOCKETS, CH 1 = HORZ OPTICS, CH 2-7 = VERT OPTICS)	1
A11	A31782-000	CONTROL MODULE WIRING KIT	1
A12	A31783-000	CONTROL MODULE CABINET ASSY AR, 4 AC OUT, 208 VAC	1
A3	E00765-000	P.S.,85-264VAC,47-440HZ TO 5VDC & 3.0A,(KEPCO FAW 5-3K/CA 24)	1
A5	E00810-000	POWER SUPPLY,+5V,+/-15VDC, 35W, 115V/230V, 50/60HZ, W/COVER, (KEPCO, MRW161KV WITH CA20)	1
A4	E00881-000	P.S.15V@6.6A,85 TO 264VAC- W/COVER,NO OIL, [KEPCO FAW 15-6.6K / CA27]	1

5.4.7 Parts List, 1500 W TWTA IJ-Band, Continuous, 208, A31795-000

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
A3, A4, A5, A6	A28013-002	POWER SUPPLY, SUPERTUBE I/J-BAND, AR, FIBER TO REAR	4
A9, A10, A11, A12	A28038-000	TWT CONTROL CABLE, I/J BAND	4
A2	A31781-000	CONTROL UNIT/AC DISTRIBUTION, 50A, 4-AC OUT, 200-240VAC, 3-PHASE (AR)	1
A1	A31796-000	RF COMBINER ASSEMBLY, IJ-BAND, FOUR COMBINED 500W SUPERTUBES, W/O SUBBAND SWITCHING	1
A8	A31797-000	RF SUBASSEMBLY, IJ-BAND, TWO COMBINED 500W SUPERTUBES	1
A7	A31797-001	RF SUBASSEMBLY, IJ-BAND, TWO COMBINED 500W SUPERTUBES, WITH AR STRIPE	1
A17, A18	A32092-000	CABINET ASSEMBLY, DUAL 19" X 30" DEEP X 52" TALL	1
XA3, XA4, XA5, XA6	A32248-000	POWER CABLE, SPS-300 POWER SUPPLY FOR SUPERTUBE	4
A13, A14, A15, A16	E08143-008	HIGH VOLTAGE CABLE ASSY, 8', [CONNECTRONICS PER ETM DRAWING E08143-008]	4

5.4.8 Parts List, RF Combiner Assembly, IJ-Band, A31796-000

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
A2	A27444-001	1000T COMBINER VPC INTERFACE BOARD, COMPONENT SIDE CONNECTORS	1
A1	A31801-000	RF COMPONENTS, IJ BAND, FOUR COMBINED 500W SUPERTUBES, NO SWITCHES OR FILTERS	1
	A31818-000	MECHANICAL PARTS, COMBINER ASSEMBLY, IJ- BAND, FOUR COMBINED 500W SUPERTUBES, W/O SUBBAND SWITCHING	1
A9	A31819-000	WIRING KIT, COMBINER ASSEMBLY I/J BAND	1

5.5 SAMPLE PROGRAM FOR IEEE-488 COMMUNICATION

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1000 ! *****
1010 ! *      IEEE-488 COMMUNICATIONS SOFTWARE      *
1030 ! *      7/24/92  AARON D. McCLURE          *
1040 ! *****
1041 DIM F$(80)
1042 DIM A$(80)
1050 CLEAR SCREEN
1060 INPUT "INPUT COMMAND TO SEND TO POWER SUPPLY.  EXIT TO QUIT.",A$
1070 IF A$="EXIT" THEN 1130
1080 OUTPUT 701;A$
1090 IF A$[1,2]<>"RD" THEN GOTO 1060
1095 IF A$[1,1]="*" THEN GOTO 1100
1100 ENTER 701;F$
1110 PRINT "OUTPUT FROM COMMAND ",A$," IS ",F$
1120 GOTO 1060
1130 CLEAR SCREEN
1140 END
```


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.

