

Operating and Service Manual

1000TP8G18

Model

10013116

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 1000TP8G18 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:

A handwritten signature in cursive script that reads "Patricia Thrasher".

Patricia Thrasher
Manager Quality, Customer Service, Purchasing

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 veiligheidswaarschuwingen.
- Houd het apparaat uit de buurt van extreem hoge of lage temperaturen om ervoor te zorgen dat het apparaat binnen het gespecificeerde werkbereik wordt gebruikt.
- Bij de installatie van accessoires zoals antennes, directionele koppelingen en terreinsondes, moet u ervoor zorgen dat blootstelling aan gevaarlijke RF-niveaus wordt voorkomen.
- Zorg ervoor dat er niets op de kabels van uw apparaat rust en dat de kabels zich niet op een plaats bevinden, waar er op getrapt kan worden of waar er over gestruikeld kan worden.
- Verplaats de apparatuur voorzichtig; zorg ervoor dat alle zwenkwielen en/of kabels stevig op het systeem zijn aangesloten. Vermijd plotselinge stops en oneffen oppervlakken.

VOOR HET OPZETTEN VAN DE STROOM

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



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

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



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

AARDING



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

INSTRUCTIES VOOR VEILIG GEBRUIK

GEVAARLIJKE RF-SPANNINGEN

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



AKOESTISCHE BEPERKINGEN

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

ONDERHOUD WAARSCHUWING

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

OMGEVINGSVOORWAARDEN

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

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

APPARAAT DAT LASERS BEVAT



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

RF-ANTENNES

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

IN EEN REK GEMONTEERDE TWT-MODELLEN

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

TILINSTRUCTIES VOOR AR-APPARATUUR

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



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

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

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

ADDITIONAL WARNINGS & NOTES



WARNING:

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

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.



CAUTION:

Adjustment, maintenance, or repair of the equipment must be performed only by qualified personnel.



CAUTION:

Replacement fuses are required to be of specific type and current rating.



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 Menu. 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 Amplifier Research Model 1000TP8G18 Broadband Microwave Amplifier. The Model 1000TP8G18 is a 1,000 watt pulse only IJ- 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 a broadband traveling-wave tube to provide a minimum of 1,000 watts peak pulsed output power from 7.5 to 18.0 GHz for the standard unit and 6.5 to 18.0 GHz for certain configurations. The amplifier is well suited for pulse susceptibility and general laboratory testing where instantaneous bandwidth and high gain are required.

For bench top use the amplifier is supplied in an enclosure with integral carrying handles.

The amplifier is completely self-contained and packaged for standard 19-inch rack mounting or bench top use. The front panel of the rack mountable amplifier is 8.75 inches high, and the overall unit is 25 inches deep, excluding the rear-panel connectors.

Primary power is 190-260VAC, 50/60 Hz, single phase. An efficient switching power supply design provides 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. The amplifier is fully enclosed, and the upper and lower panels of the enclosure are interlocked to reduce the likelihood of accidental contact with high voltage.

1.2 SUGGESTED APPLICATIONS

- Pulse RF Susceptibility testing
- Antenna and component testing
- Equipment calibration
- General laboratory pulse RF instrumentation
- Harmonic filters

1.3 SPECIFICATIONS

Refer to the Amplifier Research Data Sheet on the following pages for detailed specifications.

1.4 ACCESSORIES

Amplifier Research offers a number of accessories for use with this amplifier including:

- Directional coupler
- Antenna
- Flexible transmission line

Refer to a current Amplifier Research 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.



1000TP8G18

- Pulse Amplifier
- M1-M22
- 1000 Watts
- 7.5GHz-18GHz

Features

The Model 1000TP8G18 is a self contained, forced air cooled, broadband traveling wave tube (TWT) microwave amplifier designed for pulse applications at low to moderate duty factors where instantaneous bandwidth, and high gain are required. A reliable TWT subsystem provides a conservative 1000 watts minimum peak RF pulse power at the amplifier output connector. Stated power specifications are at the fundamental frequency.

The amplifier's front panel digital display shows forward and reflected average power output or forward and reflected peak power, 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 average or peak reflected power warning and remote. Standard features include a built-in IEEE-488 (GPIB) interface, 0 dBm input, TTL Gating, VSWR protection, gain control, RF output sample port, auto sleep, plus monitoring of TWT helix current, cathode voltage, collec-

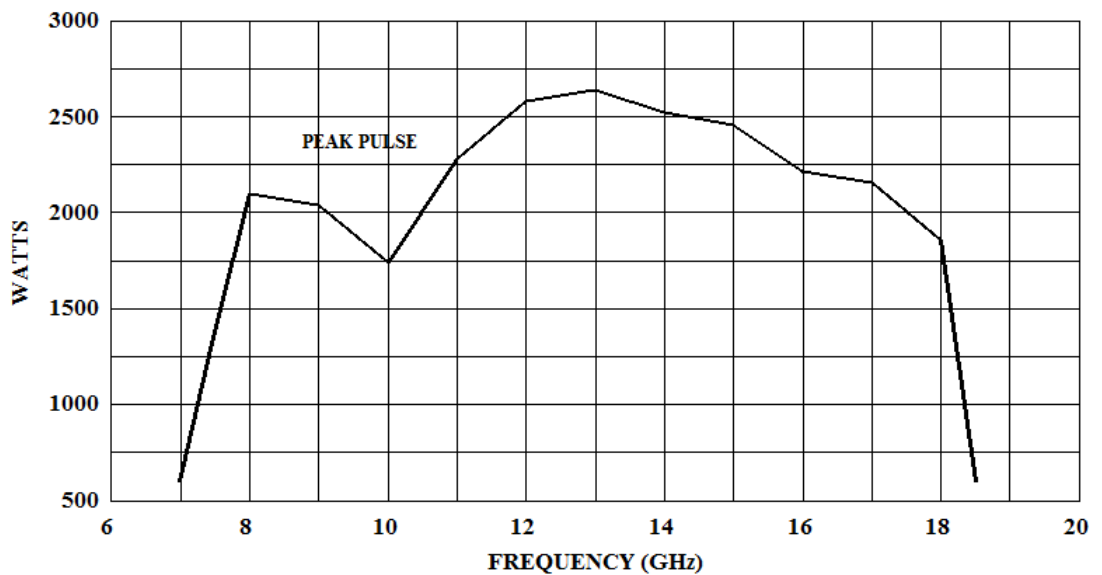
tor voltage, heater current, heater voltage, baseplate temperature and cabinet temperature. Modular design of the power supply and RF components allow for easy access and repair. Use of a switching mode power supply results in significant weight reduction.

Housed in a stylish contemporary cabinet, the Model 1000TP8G18 provides readily available pulsed RF power for a variety of applications in Test and Measurement, (including EMC RF pulse susceptibility testing), Industrial and University Research and Development, and Service applications. AR also offers a broad range of amplifiers for CW (Continuous Wave) applications.

The export classification for this equipment is 3A999.d. 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.

See Model Configurations for alternative packaging and special features.

1000TP8G18 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



1000TP8G18

- Pulse Amplifier
- M1-M22
- 1000 Watts
- 7.5GHz-18GHz

Specifications

Power (Fundamental), Peak Pulse, @ Output Connector: Nominal, 1800 watts; Minimum, 1000 watts

FLATNESS: ± 8 dB maximum, equalized for ± 3 dB maximum at rated power

FREQUENCY RESPONSE: 7.5 - 18 GHz instantaneously

INPUT FOR RATED OUTPUT: 1.0 milliwatt maximum

GAIN (at maximum setting): 60 dB minimum

GAIN ADJUSTMENT (continuous range): 35 dB minimum

INPUT IMPEDANCE: 50 ohms, VSWR 2.5:1 maximum

OUTPUT IMPEDANCE: 50 ohms, VSWR 2.5:1 typical

MISMATCH TOLERANCE: Output pulse width foldback protection at peak reflected power exceeding 500 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.

PULSE CAPABILITY:

Pulse Width	0.07 – 100 microseconds.
Pulse Rate (PRF)	100 kHz maximum
Duty Cycle	4% maximum.
RF Rise and Fall Delay	30 ns max (10% to 90%). 300 ns maximum from pulse input to RF 90%
Pulse Width Distortion	± 30 ns maximum (50% points of output pulse width compared to 50% points of input pulse width)
Pulse Off Isolation	80 dB minimum, 90 dB typical
Pulse Input	TTL level, 50 ohm nominal termination

NOISE POWER DENSITY:

(pulse on)	Minus 57 dBm/Hz (maximum), Minus 58 dBm/Hz (typical)
(pulse off)	Minus 140 dBm/Hz (typical)

HARMONIC DISTORTION: Minus 2 dBc maximum, Minus 3 dBc typical

PRIMARY POWER: 190-260 VAC, single phase, 50/60 Hz, 1.5 KVA maximum

CONNECTORS:

RF input:	Type N female, rear panel
RF output:	Type WRD 750D24 waveguide flange, rear panel
RF output forward sample port:	Type N female, rear panel
Pulse input:	Type BNC female, rear panel
GPIB:	IEEE-488 female, rear panel
Interlock:	DB-15 female, rear panel

ENVIRONMENTAL:

Operating Temperature: 0° to +40°C
Storage Temperature: -40° to +70°C

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

WEIGHT AND SIZE: See Model Configurations

EXPORT CLASSIFICATION: 3A999.d

1000TP8G18

- Pulse Amplifier
- M1-M22
- 1000 Watts
- 7.5GHz-18GHz

Model Configurations

- E** Must select one enclosure type from the following [E1 or E2 or E2S]:
- E1** removable outer enclosure, size 19.8 x 10 x 27 in., 50.3 x 25.4 x 69 cm.
- E2** without outer enclosure, size 19 x 8.75 x 27 in, 48.3 x 22.2 x 69 cm.
- E2S** without outer enclosure; slides and front handles installed for rack mounting.
- S** May select a special feature (extra cost) from the following [(S1R or S1F) and/or S2K} or S3P]
- S1R** Reflected sample port on rear panel, type N female connector. Forward and reflected sample port calibration data supplied on disk in Excel format at 51 points, evenly spaced over the specified frequency range.
- S1F** Reflected sample port on front panel, type N female connector. Input and forward sample port on front panel. Forward and reflected sample port calibration data supplied on disk in Excel format at 51 points, evenly spaced over the specified frequency range.
- S2K** Supplied with two TF type externally mountable harmonic filters and a switch kit that allows user to select an appropriate filter band, high or low, via this TWTA. Insertion loss when used with filters is maximum 1.5 dB. See TF type Filter specification table below. Dimensions and enclosures are for TWTA's only without kits and filters.
- S3P** RF output waveguide changed to WRD650. Frequency range extended down to 6.5 GHz. 6.5-7.5 GHz, 1000 watts pulse
Flatness: equalized for ±5 dB maximum from 6.5 -18 GHz at rated power. Reflected sample port on rear panel, type N female connector.
- S4R** Remote Interface: Change remote interface to Ethernet from standard IEEE-488 GPIB.
- S5C** 5m power cable, supply end unterminated, amplifier end fitted with MS3106F18-115 connector and appropriate mating connector on rear of amplifier as power inlet.
- S6D** Duty Cycle=6%.

Model Number	Weight	Features	
		E	S
1000TP8G18	52 kg (115 lbs)	E1	-
M1	39 kg (85 lbs)	E2	
M2	41 kg (90 lbs)	E2S	-
M3	52 kg (115 lbs)	E1	S1R
M4	39 kg (85 lbs)	E2	S1R
M5	41 kg (90 lbs)	E2S	S1R
M6	52 kg (115 lbs)	E1	S1F
M7	39 kg (85 lbs)	E2	S1F
M8	41 kg (90 lbs)	E2S	S1F
M9	62 kg (135 lbs)	E1	S2K
M10	48 kg (105 lbs)	E2	S2K
M11	50 kg (110 lbs)	E2S	S2K
M12	62 kg (135 lbs)	E1	S2K, S1R
M13	48 kg (105 lbs)	E2	S2K, S1R
M14	50 kg (110 lbs)	E2S	S2K, S1R
M15	62 kg (135 lbs)	E1	S2K, S1F
M16	48 kg (105 lbs)	E2	S2K, S1F
M17	50 kg (110 lbs)	E2S	S2K, S1F
M18	52 kg (115 lbs)	E1	S3P
M19	39 kg (85 lbs)	E2	S3P
M20	41 kg (90 lbs)	E2S	S3P
M21	39 kg (85 lbs)	E2	S3P, S4R
M22	41 kg (90 lbs)	E2S	S4R, S5C, S6D

Micro-wave Filter Model	For Use with AR TWTA Model	Pass Band (GHz)	Insertion Loss (dB max)	Reject Band (GHz)	Rejection (dB min)	Power (fundamental & harmonic, watts, max)	Input connector	Output connector	Size L x W x D (cm, in max)	Weight (kg, lbs typical)	Input VSWR in Pass band (typical)	Input VSWR in Reject band (typical)
filter 1	1000TP8G18 with WRD750D24 waveguide flange, requires two filters	7.5-12.4	0.5	15-36	25	150 & 100 average, 3000 & 2000 peak	WRD750 D24 waveguide flange	WRD750 D24 waveguide flange	30 x 18 x 15 12 x 3 x 6	4.5, 10	1.3:1	2.5:1
filter 2		12.4-18	0.5	24.8-36	25	150 & 100 average, 3000 & 2000 peak			30 x 18 x 15 12 x 3 x 6	4.5, 10	1.3:1	2.5:1

2. THEORY OF OPERATION

2.1 DESIGN OF THE AMPLIFIER

The Model 1000TP8G18 TWT amplifier consists of three main parts, the microwave power assembly, the power supply, and the control. These will be described in greater detail below.

The heart of the microprocessor control system is the control head assembly (A27509-301), which consists of the CPU board (A25450-000) and the data link board (A22488-013). The microprocessor control system supervises the power supply, provides metering display, processes operator front panel inputs, and enables communication with a host computer over the IEEE-488 interface. Communication from the front panel is through the HPA display board (A22700-900).

The control head is provided with its own power supply and, other than through the IEEE-488 interface bus, is electrically isolated from the amplifier. Communication with the amplifier is via fiberoptic links to the HPA interface board (A25444-001).

2.2 DESCRIPTION OF THE RF CIRCUIT

The TWTA consists of two stages of RF amplification: a solid state preamp assembly with adjustable gain (E01247-000) and the traveling-wave tube assembly (E01859-000).

The type N RF input is fed to the input connector on the solid state pre-amp. The solid state pre-amp's output drives the RF input of the TWT. The RF output of the TWT is WRD-750 waveguide with integral dual (-30 dB/-40 dB) directional coupler, though WRD-650 waveguide is used for certain configurations.

The reflected signal from the directional coupler is connected to a detector diode, whose output is used for VSWR protection by the power supply logic board, for VSWR measurement in the leveling loop, and for reflected power measurement on the HPA interface board. With an optional reverse power sample port, an additional -10 dB coupler is connected to the reverse port of the system's dual directional coupler. The output port of the -10 dB coupler is connected to a detector diode whose output is used on the HPA interface board to measure reflected power and for VSWR foldback and protection. The coupled port of the -10 dB coupler is connected to the reverse power sample port.

The VSWR detection and reflected power Foldback circuit is provided to protect the tube from high reflected peak power that may result from *progressive* failure or mismatch of the output load. The Foldback circuit reduces the maximum pulse width of the output signal when the reflected power exceeds the factory set value. FOLDBACK ACTIVE appears on Menu 1 of the front panel display when the Foldback activates. When the reflected power is below the Foldback setting, the Foldback circuit de-activates.

The forward port output is split by a -10 dB coupler. The direct output is connected to a detector diode. The output of the detector diode is used on the HPA interface board to measure forward power. The side port of the coupler is connected to the forward type N RF sample port.

Forward and reflected power monitoring, both peak reading and average reading, are designed for use when a CW RF input is present during the entire period of the pulses applied to the external pulse input.

Amplifier gain is determined by the solid state pre-amp (SSPA), which has a voltage-controlled attenuator. The control head determines the output of a digital-to-analog converter (DAC) on the HPA interface board. The output of the DAC controls the SSPA attenuator. The emergency bypass board mounted behind the front

panel is provided with a circuit for control head bypass in the event of a failure. In emergency bypass operation the attenuator signal is provided locally by means of a potentiometer on the emergency bypass board.

RF pulsing characteristics are protected by the Pulse Monitor Board (A30750-000). This board protects the HPA from over duty and over pulse width operation. The settings of these faults are factory set prior to shipment. This board also allows for user settable warnings for over peak forward or reflected power. These warnings can be set locally or remotely.

2.3 DESCRIPTION OF THE POWER SUPPLY (A22826-914)

The TWT power supply assembly is of modular construction. Low voltage power for logic and for control of the entire power supply assembly is provided by the low voltage power supply module (A23687-001). Control logic and TWT protection circuits are contained in the HPA Logic and Control Assembly (A16485-000).

The Heater Power Supply Module (A10010-000) powers the TWT DC heater. Bias and pulse top voltage for the TWT grid are provided by the Modulator Assembly (A23684-101).

The high voltage power supply consists of the following: the Power Factor Correction module (A23683-100) converts line voltage to DC for the high voltage switching supply. Switching transistors are on the Power Board Assembly (A16487-382), and switching is controlled by the Regulation Board. The high voltage transformer and rectifiers are contained in the HV Diode/Cap Assembly (A21425-021). The unit also includes an additional Capacitor Bank (A21458-005). The high voltage DC is filtered in the HV Filter Assembly (A21458-010).

Interconnects between the power supply modules are either through a motherboard or interconnected wiring harnesses. The motherboard is installed in the power supply base plate so that the entire area of the finned heat sink is available for heat transfer. The cooling air is provided by a 400 Hz fan. Air enters through the air intake filter on the rear panel. The Motherboard assembly is A23280-000.

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.

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

3.2.2 Mounting and removing

The TWTA may be operated as a standalone benchtop unit, or it may be installed in a 19" rack.

If rack mounting is desired, first remove the module from the cabinet, then install the module in the rack.

NOTE: Due to the weight of the unit, the installation or removal of the amplifier is a two-person operation.

Before removing the amplifier, disconnect power, RF, and any other external interface connectors. On the rear of the unit, remove any screws used to connect support brackets to the amplifier. On the front of the unit, remove all of the screws holding the front panel to the cabinet. Carefully slide the entire amplifier out of the front of the cabinet.



CAUTION:

Never rack mount the TWTA using the front panel alone. The chassis is likely to be damaged unless its weight is supported. Bottom support rails or side slide rails must be used in a rack mount configuration.

See Figure 3-1 (below) for the locations of threaded holes that may be used for supplementary support of the rear of the TWTA.

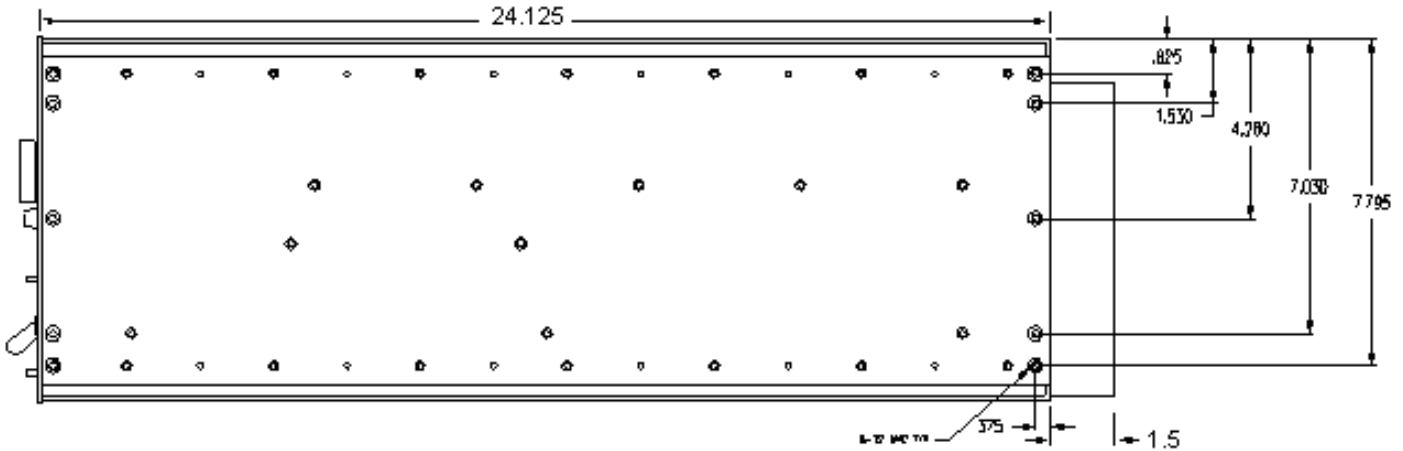


Figure 3-1. Mounting Support Holes

If bottom supports are used for rack mount installation of multiple units, the amplifiers should be separated vertically by at least 1 3/4 inches. This will allow room for necessary support rails and facilitate installation and removal of the units.

3.2.3 Cooling Requirements

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



CAUTION:

For either bench or rack mounting, do not position the TWTA in such a way that the air intakes or outlets are blocked, or that the exhaust flow is directed into the intakes. See paragraph 3.5 for location of air intake and air outlet. If the unit is rack mounted, make sure that the intake air is 45°C or below. If necessary, fabricate a short duct to direct the hot exhaust air out of the rack enclosure. Great care must be taken to minimize any flow restrictions. Avoid mounting heat-producing equipment in the same rack, especially below the TWTA. Failure to provide adequate cooling can result in the unit's shutting down from overtemperature conditions.

The TWTA dissipates approximately 1,200 watts when in the operate mode at full RF power and maximum duty cycle. Operation at lower duty cycles result in much lower total power dissipation.

3.2.4 AC Line Power Connections

AC line power connection to the amplifier is made at the Power Supply AC inlet J1, which is a female IEC-320 connector. A line cord suitable for the type of AC outlet used, and consistent with local electrical codes, must be obtained to mate with J1. Minimum wire size for the line cord is 14 gauge.

The amplifier will operate from any line voltage between 190 and 260 VAC.

3.2.5 RF Connections

The RF output is WRD-750 waveguide, though it can be WRD-650 in some configurations.



CAUTION:

Never operate the TWTA without a matched output load rated for at least 5000 watts peak, and 200 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 on the power supply/control module. 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.

3.2.7 Video Input (Pulse Gate) Connection

This amplifier is provided with a rear panel BNC connector that is used for pulsing the beam of the TWT and hence the RF output. There will be RF output only when there is RF input and a simultaneous High Level video pulse input. A TTL Level video pulse must be provided at the Pulse Gate input connector. High level (+2 to +5 V pulse) enables the TWTA. Low level (0 to 0.4 V baseline level) disables the TWTA. An open input is considered a Low level. The Pulse Gate input impedance is 50 ohms nominal.



CAUTION:

Always maintain the Video Pulse parameters at the Pulse Gate input within the specified TTL levels, Pulse Width, Pulse Rate (PRF) and Duty Cycle called out on the specification sheet for this amplifier or in this manual. Failure to comply with the specified TTL levels may result in modulator failure.

Refer to Amplifier Research Application Note No.35 for additional information on use of pulse only TWT amplifiers. A copy of this application note is included as an appendix to this manual.

3.3 FRONT PANEL FEATURES

Refer to Figure 3-2 below and Table 3-1 for descriptions.

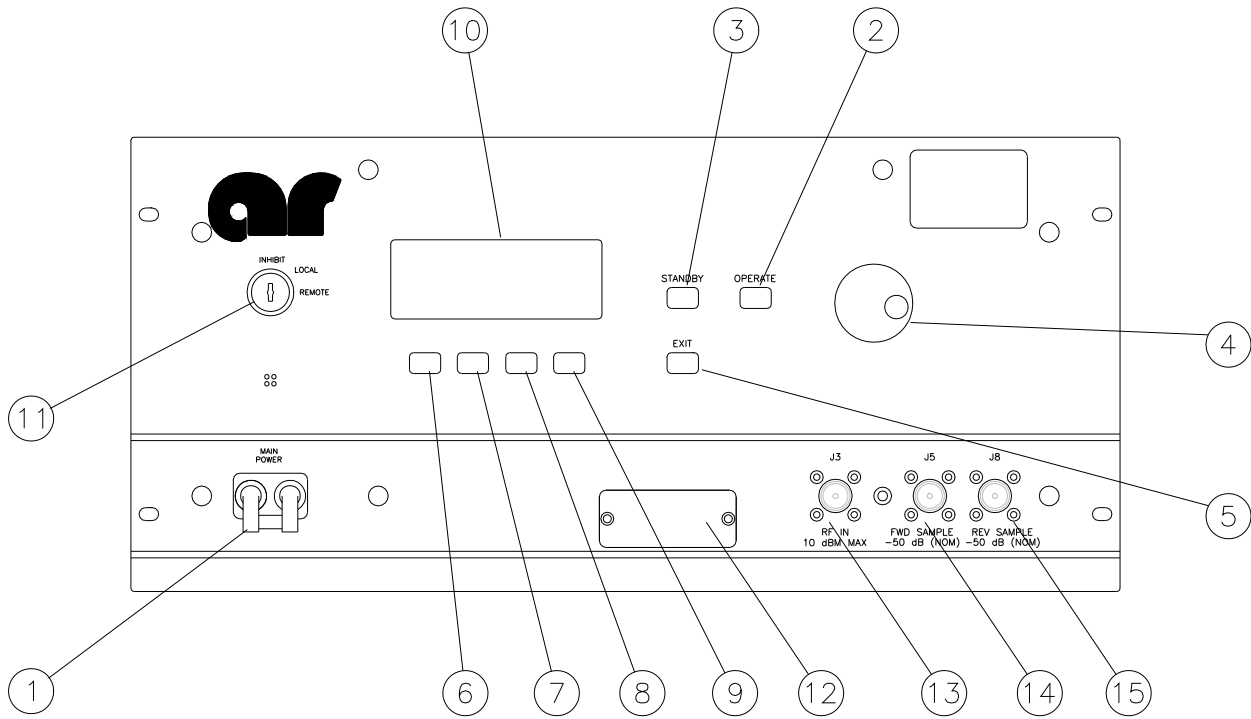


Figure 3-2. Front Panel Features

Table 3-1. Front Panel Features

Label	Title	Function
1	MAIN POWER	Switchable 7.5 A. circuit breaker; turns on control module, closes contactor 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	Emergency bypass switch cover	Provides access to emergency bypass switches, which permit manual control of the amplifier.
13	RF INPUT	Type N female connector (Front panel connector option only)
14	FWD SAMPLE OUT	Type N female connector (Front panel connector option only)
15	REV SAMPLE OUT	Type N female connector (Front panel connector option only)

NOTE: Units may have the following connectors located on the front panel or on the rear panel: RF INPUT, FWD SAMPLE OUT and optional REV SAMPLE OUT. See the model specification sheet.

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 3-3 provides a roadmap for navigating between the screens.

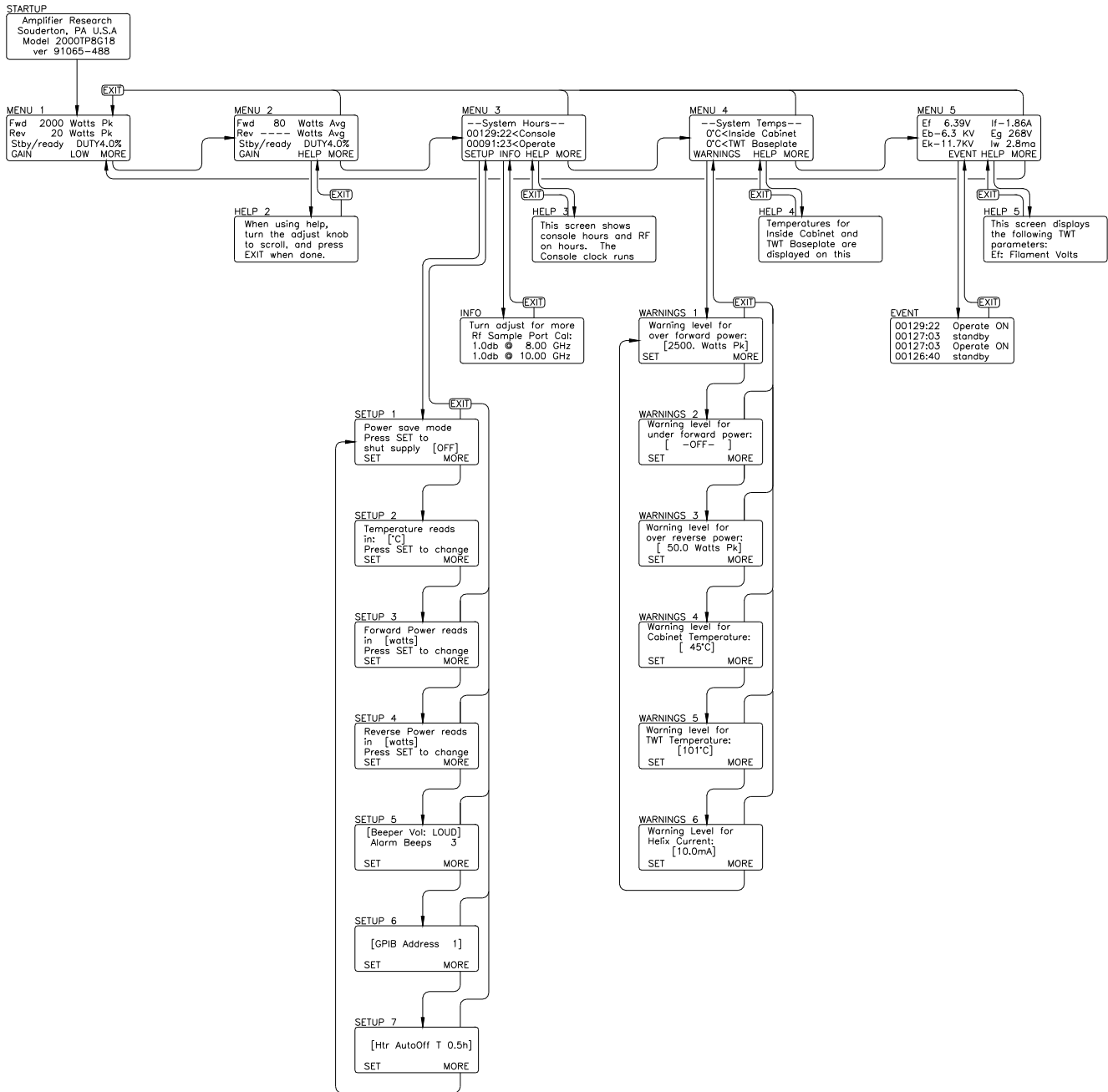


Figure 3-3. Front Panel Display Screens

Menu screens - The screens at the highest level are called menu screens. There are five 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 5, 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	FUNCTION
MENU 1	Forward power (watts or dBm)
	Reverse power (watts, dBm, or % forward power)
	Duty
	System status (if a latched fault exists, MENU 1 is displayed with the system shutdown message)
MENU 2	Forward power Average (watts or dBm)
	Reverse power Average (watts, dBm, or % of forward power)
	Duty
	System status
MENU 3	Console hours (active when AC power is on)
	Operate hours (active when HV is on)
MENU 4	Inside cabinet temperature (°C or °F)
	TWT baseplate temperature (°C or °F)
MENU 5	Heater voltage (Ef)
	Heater current (If)
	Collector voltage (Eb)
	Grid voltage (Eg)
	Cathode voltage (Ek)
	Helix current (Iw)

Help Screens - On each of the 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. Pressing S1 (SET) toggles between On and OFF. Pressing MORE brings up the SETUP 2 screen. This toggles 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 again brings up the SETUP 3 screen, which allows a choice of displaying forward power in watts or dBm. Pressing MORE again brings up SETUP 4, which allows a choice of watts, dBm or % of forward power for displaying reflected power. Pressing MORE again 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 again brings up SETUP 6, which allows the IEEE-488 address to be set. Pressing MORE again 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.

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 peak 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 peak 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 peak 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 peak 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.

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.

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 3, 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, S2 (labeled EVENT) provides a display of events 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 fault (refer to Table 3-5) 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. Most faults will turn HV off, unless otherwise specified in Table 3-5. When these faults are cleared the system will automatically resume the standby state and operate on will be enabled once again.

Some faults (O/PLS WIDTH, OVER DUTY, and EXTERNAL INHIBIT) will turn off RF while the fault is being displayed on the screen. HV will remain on during these faults. Once the fault is corrected the fault will clear and the system will turn RF back on automatically.

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 3-4 below, and Table 3-2 for descriptions.

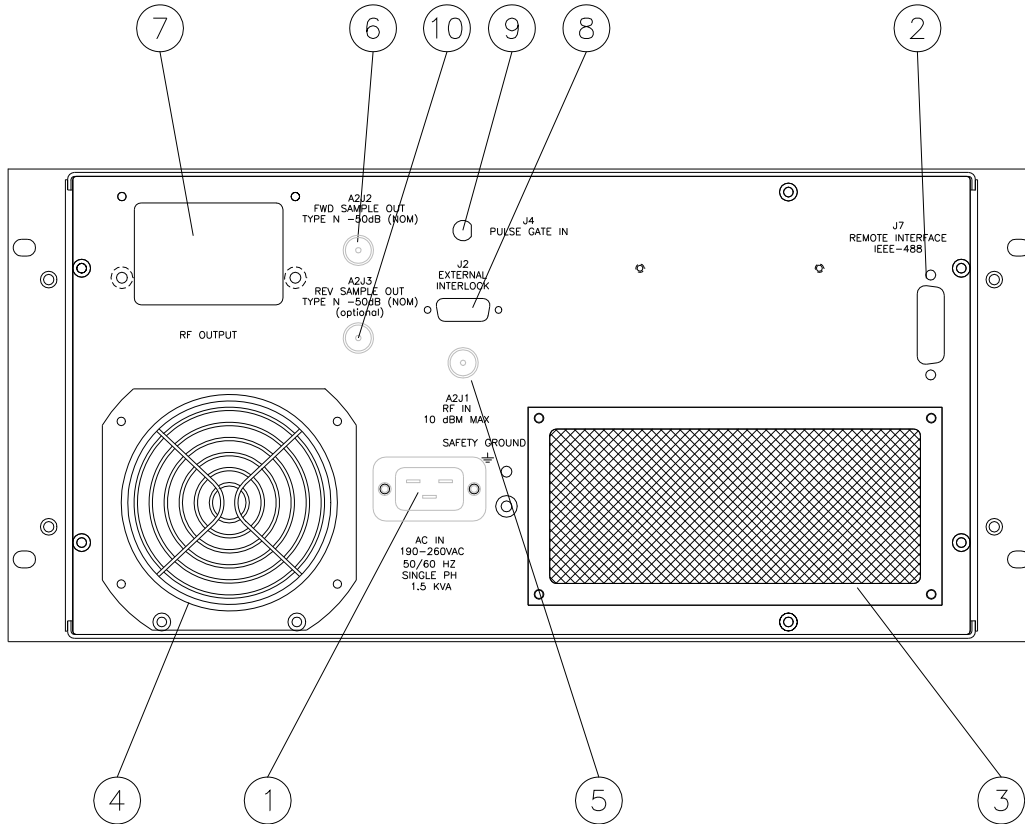


Figure 3-4. Rear Panel Features

Table 3-2. Rear Panel Features

Label	Title	Function
1	190-260 VAC IN	AC power input cable
2	IEEE-488	Remote control connector: 24-pin hermaphrodite
3	INTAKE VENT	Cooling air intake.
4	OULET VENT	Cooling air outlet.
5	RF INPUT	Type N female connector (see NOTE)
6	FWD SAMPLE OUT	Type N female connector (see NOTE)
7	RF OUT	WRD-750 Waveguide (WRD-650 in certain configurations)
8	EXTERNAL INTERLOCK/ SWITCH CONTROL	Connector to remote temperature switch protecting the isolator or load; Connector for optional RF switch control cable; D-sub 15-pin female
9	PULSE GATE IN	External pulse input; BNC connector
10	REV SAMPLE OUT	Type N female connector (Optional) (see NOTE)

NOTE: Units may have the following connectors located on the front panel or on the rear panel: RF INPUT, FWD SAMPLE OUT and optional REV SAMPLE OUT. See the model specification sheet.

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 200 watts continuous operation to the RF output. The load VSWR should be less than 2.0:1. A power meter and suitable attenuators may be connected to the RF power sample port. The RF sample port calibration factors on the rear of the unit or on the *Info* screen in MENU 2 show the relation between the amplifier output power and the RF sample port power as a function of frequency.

Connect a TTL level video pulse signal within the specification sheet parameters to the Pulse Gate input (Video). For test purposes, the following parameters may be set:

- Pulse Width: 10 Microseconds
- Pulse Rate: 1 kHz
- Baseline: 0V
- Peak level: +4V
- Video source impedance: 50 ohms or less.

This results in a Duty Cycle (also called duty factor) of 1%. This is within the specified range.

Set keylock to LOCAL.

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 STANDBY for extended periods of time. If the TWTA will not be used in the OPERATE mode within an hour, shut the TWTA off. The reason for this precaution is that in the STANDBY mode, the TWT's cathode runs very hot since it is 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 Standby can result in irreparable damage to TWT!*

Push S4 (MORE) four times to go to MENU 5. Verify that the heater voltage and current for the TWT are near their nominal levels. 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 peak power on the display and power meter (connected to sample port). The forward power reading will become active and reach a maximum reading when peak power output is achieved. Best performance is obtained when the input RF drive is set at or just below the level that causes the highest level of 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 with no drive and with rated RF power output mid-band are logged on the test data sheet for a specific set of pulse input drive conditions. The value of the helix current under these drive conditions is a good qualitative indicator of RF and video pulse drive input 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.

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=[]
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)		
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=[]
RDEK	Returns cathode voltage	KV	Ek=[]
RDEB	Returns collector voltage	KV	Eb=[]
RDEG	Return grid voltage	V	Eg=[]
RDEF	Returns heater voltage	V	Ef=[]
RDIF	Returns heater current	A	If=[]
RDIW	Returns helix current	mA	Iw=[]
RDTMPTWTF	Returns TWT temp (°F)	°F	TWTF=[]F
RDTMPTWTC	Returns TWT temp (°C)	°C	TWTC=[]C
RDTMPPSF	Returns power supply temp (°F)	°F	PSF=[]F
RDTMPPSC	Returns power supply temp (°C)	°C	PSC=[]C

Command	Function	Units	Response format
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 3-6)		Sys=[]
RDA	Returns gain	%	A=[]
SA	Sets gain	%	
RDHTDREM	Returns remaining heater time delay	sec.	HTD=[]s
RDPODP	Returns forward power out (dBm) Peak	dBm	Po=[]dBm Pk
RDPOWP	Returns forward power out (W) Peak	watts	Po=[]W Pk
RDPOD	Returns forward power out (dBm) Average	dBm	Po=[]dBm Avg
RDPOW	Returns forward power out (W) Average	watts	Po=[]W Avg
RDPRDP	Returns reverse power out (dBm) Peak	dBm	Pr=[]dBm Pk
RDPRWP	Returns reverse power out (W) Peak	watts	Pr=[]W Pk
RDPRD	Returns reverse power out (dBm) Average	dBm	Pr=[]dBm Avg
RDPRW	Returns reverse power out (W) Average	watts	Pr=[]W Avg
RDDUTY	Returns Duty	%	DTY=[]%
RDPOHIDP	Returns over forward power warning setpoint (dBm) Peak	dBm	Pohi=[]dBm Pk
SPOHIDP	Sets over forward power warning setpoint (dBm) Peak	dBm	
RDPOLODP	Returns under forward power warning setpoint (dBm) Peak	dBm	Polo=[]dBm Pk
SPOLODP	Sets under forward power warning setpoint (dBm) Peak	dBm	
RDPOHIWP	Returns over forward power warning setpoint (W) Peak	watts	Pohi=[]W Pk
SPOHIWP	Sets over forward power warning setpoint (W) Peak	watts	
RDPOLOWP	Returns under forward power warning setpoint (W) Peak	watts	Polo=[]W Pk
SPOLOWP	Sets under forward power warning setpoint (W) Peak	watts	
RDPRHIDP	Returns over reverse power warning setpoint (dB) Peak	dBm	Prhi=[]dBm Pk
SPPRHIDP	Sets over reverse power warning setpoint (dBm) Peak	dBm	
RDPRHIWP	Returns over reverse power warning setpoint (W) Peak	watts	Prhi=[]W Pk
SPRHIWP	Sets over reverse power warning setpoint (W) Peak	watts	
RDHTRAUTOOFF	Returns heater to 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 was 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.
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
0	No fault
7	SYSTEM FAULT
8	FIL NOT READY
9	LOW LINE
10	CATH O/VOLTAGE
11	BODY O/CURRENT
12	CATH U/VOLTAGE
13	O/PLS WIDTH (turns RF off only)
14	OVER DUTY(turns RF off only)
15	COLL U/VOLTAGE
16	INVERTER FAULT
17	INTERLK OPEN
18	TUBE ARC
19	TWT OVER TEMP(h)
20	CABINET O/TEMP(h)
22	EXTERNAL INHIBIT(turns RF off only)
23	OVER REV POWER
26	Panel Open
30	GRID O/VOLTAGE

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	Interlock open
10	(not used)
11 (MSB)	(not used)

w bit	Meaning
12 (LSB)	(not used)
13	Sleep Mode Active
14	(not used)
15 (MSB)	(not used)

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 3-3.

<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 3-3 for the units.

If remote is not enabled, set commands and commands to the system logic (e.g., 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 users 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 Amplifier Research 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 Amplifier Research 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 $[53 \text{ dBm} - 20 \text{ dBm} = 33 \text{ dB below } 200 \text{ V/M} =] 4.5$ 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 as 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.

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 and power supply voltages and currents of the amplifier should be logged on a regular basis. Maintenance should be performed if significant deviations from the logged values appear. If the unit is under warranty, contact an authorized service representative if impaired performance is suspected.

If there is accumulated dust on the air intake grill clean it with dry compressed air.

If significant dust has been noted on the air intake grill it may be desirable to vacuum the dust and debris from inside the enclosure.

To open the enclosure:

1. Remove the units from the cabinet or rack as follows:

NOTE: Due to the weight of the unit, the removal of the amplifier from the cabinet or rack is a two-person operation.

2. Disconnect power, RF, and any other interface connectors. On the rear of the unit, remove any screws used to connect brackets to the amplifier. On the front of the unit, remove all of the screws holding the front panel to the cabinet. Carefully slide the entire amplifier out of the front of the cabinet.
3. Remove the screws that secure the lower cover and the screws that secure the upper cover. Remove the covers to gain access to the interior of the amplifier.
4. Vacuum dust and debris from inside the enclosure. 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.
5. Reassemble in the reverse order.

4.4 TROUBLESHOOTING

Symptom	Possible cause
TWT or power supply overtemperature	Air inlet filter 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 Panel open interlock switch open
Control module display does not come up; unit does not beep when powered up	Shorted or defective control module power supply Control module failure
Control module does not boot	EPROM(s) missing. Control head PC board defective.
Control module "datalink failure" error appears	HPA interface failure. Fiberoptic link failure ± 15 VDC supply failure Data steering board failure.
Heater power supply does not come up	Defective low voltage power supply module Defective heater power supply module
No high voltage	Open external interlock 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 (A10010-000), the Grid modulator (A23684-101), the HV filter (A21458-010), Capacitor Bank (A21458-050) and the Diode/Cap assembly (A21425-021) 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

	A27500-914	HPA ASSY 13PIJ, 1KW PULSED HPA, IJ BAND, GPIB,
1A1	A22826-914	PULSED TWT P. SUPPLY (PFC) FOR TWT MTI-3444L
1A1A1	A23280-000	HEAT SINK/MOTHER BOARD
1A1A2	A23687-001	LOW VOLTAGE POWER SUPPLY MODULE
1A1A3	A16485-000	HPA LOGIC AND CONTROL MODULE
1A1A4	A23683-100	POWER FACTOR MODULE (500W)
1A1A4L4	A09006-000	PFC INDUCTOR FOR 100VAC-255VAC
1A1A5	A16487-382	POWER BOARD ASSEMBLY,PULSED TWTA
1A1A5L1	A09025-000	PULSED BUCK INDUCTOR
1A1A5T1 (E42)	A09402-000	XFMR,GATE DRIVE (HAND WOUND)
1A1A5T2 (E41)	A09403-000	XFMR,GATE DRIVE (HAND WOUND)
1A1A6	A21425-021	DIODED/CAP ASSY FOR TWT 3444L
1A1A6T1	A09487-000	HV XFMR FOR TWT MTI-3444L
1A1A7	A21458-010	HV FILTER
1A1A8	A23684-101	PIJ/PSC GRID MODULATOR MODULE, REGULATED
1A1A8A1	A23686-101	PIJ/PSC HV MODULATOR WITH REGULATED
1A1A8A1T1	A09227-000	PULSE TOP XFMR,HAND WOUND
1A1A8A1T2	A09228-000	FEEDBACK XFMR,HAND WOUND
1A1A8A1T3	A09229-000	BIAS XFMR,HAND WOUND
1A1A8A1T4, T5	A09230-000	XFMR,GATE DRIVE (HAND WOUND)
1A1A8A1T6	A18478-000	PULSE TOP SUPPLY TRANSFORMER
1A1A8A2	A23715-101	PIJ/PSC MODULATOR CONTROL BOARD
1A1A9	A10010-000	HEATER POWER SUPPLY MODULE
1A1A9T1	A09409-000	XFMR,HEATER FEEDBACK
1A1A9T2	A09408-000	XFMR,HEATER POWER
1A1A10	A21459-021	PWM BOARD FOR TWT 3444
1A1A11	A25398-021	FACTORY SELECT, 13PIJ
1A1A12	A21458-005	CAPACITOR BANK
1A1	A22826-914	PULSED TWT P. SUPPLY (PFC) FOR TWT MTI-3444L
1A2	A22824-332	RF COMPONENTS FOR 13PIJ, 7.5 TO 18 GHZ
1A2	A22824-333	RF COMPONENTS FOR 13PIJ, 7.5 TO 18 GHZ (W/OPTIONAL REVERSE SAMPLE PORT)
1A3	A25444-001	HPA INTERFACE BOARD (200UM GLASS FIBERS)
1A4	A27509-301	HPA CONTROL CHASSIS ASSY, GPIB/LINK
1A4A2	A25450-000	CPU BOARD W/POWERFAIL (20MHZ)
1A4A3	A22488-013	GPIB/LINK TRANSCEIVER BOARD, 5U AND 6U TWT
1A5	A30137-900	FRONT PANEL ASSY, 5U, GPIB
1A5	A30137-902	FRONT PANEL ASSY, 5U, GPIB (W/OPTIONAL FRONT PANEL RF CONNECTORS)
1A5A1	A22700-900	HPA DISPLAY BOARD
1A5A2	A24830-008	EMERGENCY BYPASS BOARD, PW FOLDBACK
1A6	A23692-000	INSULATED FAN DRIVER
1A6T1	A09594-000	FAN DRIVER TRANSFORMER
1A8	A30750-000	PULSE MONITOR BOARD
1A9	A30740-914	HPA WIRING KIT, SINGLE PHASE, IEEE-488
1A9XJ1	A30346-000	EMI MODIFICATION KIT FOR 400KU
1A9XJ1A1	A28181-000	POWER ENTRY FILTER BOARD
1A10	A27501-902	CABINET ASSY. 13PIJ SINGLE PHASE, (AR)
1A10	A27501-903	CABINET ASSY. 13PIJ SINGLE PHASE , (AR) (W/OPTIONAL FRONT PANEL RF CONNECTORS)

5.2 SCHEMATICS

10-16485-000	HPA Logic and Control (A16485-000)
10-16487-000	Power Board Assembly (A16487-382)
10-23683-100	Power Factor Module (A23683-100)
10-23687-001	LV Power Supply Module (A23687-001)
10-24830-008	Remote Control Board, Foldback only (A24830-008)
10-25444-001	HPA Interface (A25444-001)
10-27500-914	1000W Pulsed TWT Amplifier, IJ-Band, AR (A27500-914)
10-27500-918	1000W Pulsed TWT Amplifier, IJ-Band, AR (A27500-918) (w/optional reverse sample port)
10-30750-000	Pulse Monitor Board (A30750-000)

5.3 PARTS LISTS

A16485-000	HPA Logic and Control
A22824-332	Microwave Power Assembly
A22824-333	Microwave Power Assembly (w/optional reverse sample port)
A22826-914	Pulsed TWT Power Supply
A24830-008	Remote Control Board, Foldback
A25444-001	HPA interface
A27500-914	TWTA 1kW Pulsed IJ-Band
A27500-918	TWTA 1kW Pulsed IJ-Band (w/optional reverse sample port and front panel RF connectors)
A27500-927	TWTA 1kW Pulsed IJ-Band (w/optional 6.5-18.0 GHz frequency range and WRD650 waveguide output)
A30740-914	Wiring Kit, Single Phase, IEEE-488

5.3.1 Parts List, HPA Logic and Control Module, A16485-000

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
	B16485-000	HPA LOGIC AND CONTROL BOARD	1
C11	C16333-000	CAP,33MF,25V,AERL,(NICHICON UVX1E330M)	1
C2, C5, C15, C58	C31028-000	CAP,1000PF,200VDC,10%,CER,1% FAILURE,(KEMET CKR05 SERIES W/"V" OPTION)	4
C3, C9, C10, C13, C14, C17, C19, C21, C22, C27, C28, C30, C31, C33, C36, C46	C31032-000	CAP,0.01MF,200VDC,10%,CER,1% FAILURE,(KEMET CKR06 SERIES W/"V" OPTION)	16
C61	C31033-000	CAP,0.022MF,100VDC,10%,CER,1% FAILURE,(KEMET CKR06B223K W/V OPTION)	1
C24, C60	C31036-000	CAP,0.1MF,100VDC,10%,CER,1% FAILURE,(KEMET CKR06 SERIES W/"V" OPTION)	2
C1, C4, C6, C7, C16, C18, C25, C26, C32, C34, C37, C38, C39, C40, C41, C43, C44, C45, C48, C49	C31040-000	CAP,1MF,50VDC,10%,CER,1% FAILURE,(KEMET CKR06 SERIES W/"V" OPTION)	20
D16, D23, D31	D10965-000	ZENER,15V,(DIODES INC 1N965B)	3
D1, D3, D4, D5, D7, D8, D9, D10, D11, D12, D13, D17, D18, D19, D21, D22, D25, D26, D28, D30, D35, D37, D36	D14454-000	DIODE,AXIAL,(MOTOROLA 1N4454)	24
	D14733-000	ZENER,5.1V,1W,10%,AXIAL,(MOTOROLA 1N4733)	1
	F00010-000	WASHER,#2,LOCK,SST	3
	F10086-000	PHP,2-56 X 3/16SST	3
J2	J10370-000	CONN,37 PIN,MALE,D-SUB,PCB RIGHT ANGLE,(AMP 747252-4)	1
	J18075-000	MALE SCREW LOCK,FOR D SUBMIN CONN,(AMP 205817-1)	1
J4, J5	J18086-000	CONN,SMA,JACK RECEPTACLE,RIGHT ANGLE,0-18GHZ,PC MOUNT [JOHNSON COMPONENTS 142-0701-301]	2
J1	N25003-000	HYPERTRONICS CONN,29 PIN MALE RIGHT ANGLE,(CUT ENDS)	1
Q2	Q22907-000	TRANSISTOR,PNP,2N2907A,TO-18	1
R1, R9, R19, R37, R44, R50	R00100-000	RES,10 OHM,1/4W,5%,CC,(A/B RC07GF100J)	6
R4, R20, R27, R29	R01100-000	RES,100 OHM,1/4W,5%,CC,(A/B RC07GF101J)	4
R5, R17, R18, R28, R34, R45, R49, R53, R54, R59, R71, R88	R02100-000	RES,1K,1/4W,5%,CC,(A/B RC07GF102J)	12
R6	R02270-000	RES,2.7K,1/4W,5%,CC,(A/B RC07GF272J)	1
R30, R31, R36	R02470-000	RES,4.7K,1/4W,5%,CC,(A/B RC07GF472J)	3
R86, R87	R02510-000	RES,5.1K,1/4W,5%,CC,(A/B RC07GF512J)	2
R75	R02560-000	RES,5.6K,1/4W,5%,CC,(A/B RC07GF562J)	1
R38, R77, R90	R03100-000	RES,10K,1/4W,5%,CC,(A/B RC07GF103J)	3
R32	R03470-000	RES,47K,1/4W,5%,CC,(A/B RC07GF473J)	1
R35	R05820-000	RES,8.2M,1/4W,5%,CC,(A/B RC07GF825J)	1
R13, R14	R10002-000	TRIMPOT,5K,1/2W,10%,CERMET,20T,SIDE ADJ,(BOURNS 3296X-1-502)	2
R76	R21499-000	RES,4.99K,1/2W,1%,MF,100PPM,(DALE RN55D)	1
R10	R21523-000	RES,5.23K,1/2W,1%,MF,100PPM,(DALE RN55D)	1
R16	R21866-000	RES,8.66K,1/2W,1%,MF,100PPM,(DALE RN55D)	1
R52, R73	R21887-000	RES,8.87K,1/2W,1%,MF,100PPM,(DALE RN55D)	2

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
R67	R21953-000	RES,9.53K,1/2W,1%,MF,100PPM,(DALE RN55D)	1
R47, R48	R22200-000	RES,20K,1/2W,1%,MF,100PPM,(DALE RN55D)	2
R79, R80	R22470-000	RES,47K,1/2W,1%,MF,100PPM,(DALE RN55D)	2
R42, R60, R61, R89	R23100-000	RES,100K,1/2W,1%,MF,100PPM,(DALE RN55D)	4
R33, R55	R23698-000	RES,698K,1/2W,1%,MF,100PPM,(DALE RN55D)	2
R41	R23750-000	RES,750K,1/2W,1%,MF,100PPM,(DALE RN55D)	1
R21	R23845-000	RES,845K,1/2W,1%,MF,100PPM,(DALE RN55D)	1
R66	R23953-000	RES,953K,1/2W,1%,MF,100PPM,(DALE RN55D)	1
R12, R15	R32020-000	TRIMPOT,10K,1/2W,10%,CERMET,20T,SIDE ADJ,(BECKMAN 67X)	2
U4, U5, U6	U02390-000	IC,QUAD COMPARATOR,(NAT LM139J)	3
U7	U03240-000	IC,LOW POWER OP AMP,(NAT LM324)	1
U9	U10070-000	REFERENCE,PRECISION 10V [LINEAR TECH LT1031DCH]	1
U8	U17805-000	IC,5V REGULATOR,TO-220,(NAT LM340T-5.0)	1
U1, U2, U3	U20148-000	IC,HEX INVERTER,SCHMIDTT TRIGGER,(74HC14) (SSD)	3
RP8	U30106-000	IC,10K,RES NETWORK,6 PIN,SIP (DALE MSP06A-01- 103G)	1
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)	6
RP4	U31020-000	IC,1K RES NETWORK,SIP,(BECKMAN L061C102G)	1
W3-W8	W12200-000	WIRE, 22 AWG, BLU, 600V, TEFLON, (BELDEN 83006)	6

5.3.2 Parts List, RF Components For 13PIJ, 7.5 to 18, A22824-332

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
A2	E00324-000	DUAL BROADWALL COUPLER, WRD-750 -40, -40 DB [MDC,12750-232]	1
	E00888-007	CABLE,RF FLEX, 7,SMA,MALE TO MALE,20 GHZ,50 OHM,BLACK,FEP TEFLON (DICAR EZ402-2121-07)	1
	E00888-009	CABLE,RF FLEX, 9,SMA,M TO M,20 GHZ,50 OHM,BLACK,0.141 CABLE,INSULATED JACKET,[SRC 150-150-150090]	1
	E00888-015	CABLE,RF FLEX,15,SMA,M TO M,20 GHZ,50 OHM,BLACK,0.141 CABLE, INSULATED JACKET, [SRC 150-150-150150]	2
	E00888-020	CABLE,RF FLEX,20,SMA,M TO M,20 GHZ,50 OHM,BLACK,0.141 CABLE, INSULATED JACKET,[SRC 150-150-150200]	2
	E01015-000	EQUALIZER,8-18 GHZ,13PIJ,[INMET EQTBD-3]	1
A1	E01247-000	SSPA, IJ BAND 6.0-18GHZ, 20DBM, 20DB GAIN,35DB VGA, [CPI CMA6018A3]	1
	E01535-000	GASKET, CONDUCTIVE O-RING, WRD-650 [MDC TBD]	1
	E01598-000	WAVEGUIDE, WRD-750, 3.5", STRAIGHT,[HNL PER ETM DRAWING]	1
	E01859-000	TWT, 7.5-18.0 GHZ, 1.5KW PULSED, 6%, WRD-750+/- 2 DB EQ (TELEDYNE, MTI-3444L, 6%, +/- 2 DB EQ)	1
	E20072-000	ATTENUATOR,20DB,2W, DC-18GHZ,SMAIN-OUT,MINIATURE,(INMET, 18B-20)	1
A3	E20129-000	COUPLER,10DB,4-18GHZ,SMA, (ATM, C12FH-10)	1
	E20130-000	ADAPTER,SMA MALE TO SMA FEMALE,RIGHT ANGLE (CDI 5490CCSF / PASTERNAK PE9262)	3
D1, D2	E20284-000	ZERO-BIAS SCHOTTKY DETECTOR,10MHZ-18.5GHZ,POSITIVE OUT PUT POLARITY,(RLC, M-3747)	2
	J18160-000	CONN,1 PIN,FEMALE,20KV,10A,0.180 DIA. LEAD,[CONNECTRONICS 11039-02]	5
	N31830-000	WAVEGUIDE CLAMP UPPER WRD-650	1
	N31830-001	WAVEGUIDE CLAMP LOWER WRD-650	1

5.3.2 Parts List, RF Components For 13PIJ, 7.5 to 18, A22824-333

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
A3	E00324-000	DUAL BROADWALL COUPLER, WRD-750 -40, -40 DB [MDC,12750-232]	1
	E00888-009	CABLE,RF FLEX, 9,SMA,M TO M,20 GHZ,50 OHM,BLACK,0.141 CABLE,INSULATED JACKET,[SRC 150-150-150090]	1
	E00888-015	CABLE,RF FLEX,15,SMA,M TO M,20 GHZ,50 OHM,BLACK,0.141 CABLE, INSULATED JACKET, [SRC 150-150-150150]	2
	E00888-020	CABLE,RF FLEX,20,SMA,M TO M,20 GHZ,50 OHM,BLACK,0.141 CABLE, INSULATED JACKET,[SRC 150-150-150200]	1
	E01015-000	EQUALIZER,8-18 GHZ,13PIJ,[INMET EQTBD-3]	1
A1	E01247-000	SSPA, IJ BAND 6.0-18GHZ, 20DBM, 20DB GAIN,35DB VGA, [CPI CMA6018A3]	1
	E01535-000	GASKET, CONDUCTIVE O-RING, WRD-650 [MDC TBD}	2
	E01598-000	WAVEGUIDE, WRD-750, 3.5", STRAIGHT,[HNL PER ETM DRAWING]	1
A2	E01859-000	TWT, 7.5-18.0 GHZ, 1.5KW PULSED, 6%, WRD-750+/- 2 DB EQ (TELEDYNE, MTI-3444L, 6%, +/-2 DB EQ)	1
	E20014-000	ATTENUATOR,14DB,2W, SUB-MINIATURE,(INMET, 18A-14)	1
	E20066-000	ATTENUATOR,10DB,DC-18 GHZ,2W, SUB- MINIATURE,(INMET, 18A-10)	1
	E20072-000	ATTENUATOR,20DB,2W, DC-18GHZ,SMAIN- OUT,MINIATURE,(INMET, 18B-20)	1
A4, A5	E20129-000	COUPLER,10DB,4-18GHZ,SMA, (ATM, C12FH-10)	2
	E20130-000	ADAPTER,SMA MALE TO SMA FEMALE,RIGHT ANGLE (CDI 5490CCSF / PASTERNAK PE9262)	3
D1, D2	E20284-000	ZERO-BIAS SCHOTTKY DETECTOR,10MHZ- 18.5GHZ,POSITIVE OUT PUT POLARITY,(RLC, M- 3747)	2
	J11249-000	CONN,1 PIN,FEMALE,PLUG,10KVDC,10A,0.150 DIA. LEAD,[REYNOLDS 167-9219]	1
J3, J5, J8	J17264-000	ADAPTER, TYPE N FEMALE TO SMA FEMALE, PANEL MOUNT,[ASTROLAB 29047]	3
	J18160-000	CONN,1 PIN,FEMALE,20KV,10A,0.180 DIA. LEAD,[CONNECTRONICS 11039-02]	4
	N26122-000	WAVEGUIDE COVER PLATE WRD-750	1
	N31830-000	WAVEGUIDE CLAMP UPPER WRD-650	1
	N31830-001	WAVEGUIDE CLAMP LOWER WRD-650	1

5.3.3 Parts List, Pulsed TWT P. Supply (PFC) for TWT, A22826-914

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
A9	A10010-000	HEATER POWER SUPPLY MODULE	1
A3	A16485-000	HPA LOGIC AND CONTROL MODULE	1
A5	A16487-382	POWER BOARD ASSEMBLY,PULSED TWTA	1
A6	A21425-021	DIODED/CAP ASSY FOR TWT 3444L	1
A12	A21458-005	CAPACITOR BANK	1
A7	A21458-010	HV FILTER	1
A10	A21459-021	PWM BOARD FOR TWT 3444	1
A1	A23280-000	HEAT SINK/MOTHER BOARD	1
A4	A23683-100	POWER FACTOR MODULE (500W)	1
A8	A23684-101	PIJ/PSC GRID MODULATOR MODULE, REGULATED REFERENCE	1
A2	A23687-001	LOW VOLTAGE POWER SUPPLY MODULE	1
A11	A25398-021	FACTORY SELECT, 13PIJ	1

5.3.4 Parts List, Emergency Bypass Board, Pulse, A24830-008

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
	B24830-000	EMERGENCY BYPASS BOARD	1
C6	C30010-000	CAP,10MF,35V,TANT,RADIAL,(NEMCO TB10-35K1)	1
C7	C31040-000	CAP,1MF,50VDC,10%,CER,1% FAILURE,(KEMET CKR06 SERIES W/"V" OPTION)	1
I2, I3	I10066-000	LED,RED,HIGH EFFICIENCY,HIGH BRIGHTNESS	2
I1	I10096-000	LED,GREEN,DIFFUSED,T1-3/4 (XC55G)	1
J2	J18086-000	CONN,,SMA,JACK RECEPTACLE,RIGHT ANGLE,0-18GHZ,PC MOUNT [JOHNSON COMPONENTS 142-0701-301]	1
J1	J18180-000	CONN,D-SUB,15 PIN,MALE,STRAIGHT,PCB MOUNT (POSITRONIC MD15M3000)	1
	J31014-000	SPRING LATCH KIT,D-SUB,(AMPHENOL 17-529)	2
Q1-Q3	Q22222-000	TRANSISTOR,NPN,2N2222A,TO-18	3
R18	R01100-000	RES,100 OHM,1/4W,5%,CC,(A/B RC07GF101J)	1
R9	R02100-000	RES,1K,1/4W,5%,CC,(A/B RC07GF102J)	1
R3, R5, R7	R02220-000	RES,2.2K,1/4W,5%,CC,(A/B RC07GF222J)	3
R4, R6, R8	R03100-000	RES,10K,1/4W,5%,CC,(A/B RC07GF103J)	3
R1	R12107-000	TRIMPOT,1K,1/2W,10%,CERMET,1T,SIDE ADJ,(BECKMAN 72XL)	1
S2, S3	S22004-000	SWITCH,TOGGLE,DPDT,PC MNT,(AUGAT MTA-206N-PC)	2
S1	S22010-000	SWITCH,TOGGLE,4PDT,ON-NONE-ON,125V @ 6A,(AUGAT MTA-406N-PC)	1
U1	U17805-000	IC,5V REGULATOR,TO-220,(NAT LM340T-5.0)	1

5.3.5 Parts List, HPA Interface Board (200UM Glass), A25444-001

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
	B25444-000	HPA INTERFACE BOARD	1
C161	C03105-000	CAP,0.01MF,100V,CER,10%,RADIAL,(AVX SR201C103KAA)	1
C171	C04223-000	CAP,0.22MF,35V,TANT,RADIAL, [JAMCO 33507]	1
C20, C32, C100	C05153-000	CAP,1.5MF,35V,TANT,RADIAL,(AVAX, TAP155K035SCS)	4
C129, C163	C05223-000	CAP,2.2MF,35V,10%,SOLID SEALED TANT,RADIAL,(SPRAGUE 199D225X9035BA1)	2
C80, C81, C164	C06103-000	CAP,10MF,25V,20%,SOLID TANT,RADIAL,(KEMET, T356E106K025AS)	3
C15	C06220-000	CAP,22MF,16V,SOLID TANT,RADIAL,(AVX TAP226K016SCS)	1
C99	C16103-000	CAP,10MF,35V,AERL,(NICHICON UVR1V100MDA)	1
C101	C17472-000	CAP,470MF,16V,AERL,(NICHICON UVX1C471M)	1
C47, C67	C17474-000	CAP,470UF,50V,AERL,[PANASONIC P5279]	2
C44, C168, C169	C30066-000	CAP 47 MF, 35V, SOLID TANT. RADIAL, (KEMET T356M476K035AS)	3
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)	10
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, 167	C31036-000	CAP,0.1MF,100VDC,10%,CER,1% FAILURE,(KEMET CKR06 SERIES W/"V" OPTION)	61
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, C118, C119, C120, C122, C123, C124, C133	C31040-000	CAP,1MF,50VDC,10%,CER,1% FAILURE,(KEMET CKR06 SERIES W/"V" OPTION)	43
D8, D10, D12, D14, D15, D16, D18, D19	D14007-000	DIODE,1000V,1A,AXIAL,(MOTOROLA 1N4007)	8
D1-D7	D14454-000	DIODE,AXIAL,(MOTOROLA 1N4454)	7
D9, D17	D14733-000	ZENER,5.1V,1W,10%,AXIAL,(MOTOROLA 1N4733)	2
I1	I10074-000	LED,GREEN,ALGAAS,NON-DIFFUSED,(HEWLETT PACKARD HLMP-1540)	1
J5	J10021-000	HEADER,2 PIN,MALE,RIGHT ANGLE,SERIES 7478 (MOLEX 22-05-3021)	1
J1	J10371-000	D-SUB,37 PIN MALE,PCB MOUNT,STRAIGHT (POSITRONICS MD37M3S000)	1
XU17	J14161-000	SKT,DIP,16 PIN,MACH SLEEVES,(AUGAT 516-AG11D)	1
XU26	J14202-000	SKT,DIP,20 PIN,MACH SLEEVES,(SAMTEC ICA-320-SGT)	1
XU15	J14281-000	SKT,DIP,28 PIN,MACH SLEEVES,(SAMTEC ICA-628-SGT)	1
TP0	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

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
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
J4	J18167-000	D-SUB,37 PIN,FEMALE,PCB MOUNT,RIGHT ANGLE (AMP 745784-4)	1
J3	J18180-000	CONN,D-SUB,15 PIN,MALE,STRAIGHT,PCB MOUNT (POSITRONIC MD15M3000)	1
J2	J31013-000	CONN,D-SUB,25 PIN,MALE,RIGHT ANGLE,PCB MOUNT,[AMP 747238-4]	1
XJ1-XJ4	J31014-000	SPRING LATCH KIT,D-SUB,(AMPHENOL 17-529)	4
K1-K6	K02009-000	RELAY,DPDT,5VDC,125V @ 0.5A / 30VDC @ 1A CONTACTS,PCB TERMINALS,SEALED (OMRON G6H-2-DC5)	6
L1-L4	L00200-000	WIDE BAND CHOKE,(VK200 10/3B FERROXCUBE)	4
Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8	Q22222-000	TRANSISTOR,NPN,2N2222A,TO-18	8
R41	R00680-000	RES,68 OHM,1/4W,5%,CC,(A/B RC07GF680J)	1
R2	R01220-000	RES,220 OHM,1/4W,5%,CC,(A/B RC07GF221J)	1
R1	R04200-000	RES,200K,1/4W,5%,CC,(A/B RC07GF204J)	1
R4, R7	R05820-000	RES,8.2M,1/4W,5%,CC,(A/B RC07GF825J)	2
R6, R8, R58	R20100-000	RES,100 OHM,1/2W,1%,MF,100PPM,(DALE RN55D)	3
R57	R20200-000	RES,200 OHM,1/2W,1%,MF,100PPM,(DALE RN55D)	1
R59	R22332-000	RES,33.2K,1/2W,1%,MF,100PPM,(DALE RN55D)	1
R3, R5	R30071-000	TRIMPOT,10K,1/2W,10%,CERMET,100PPM,20T,TOP ADJ,(BECKMAN 67W)	2
R9, R12, R15, R22, R35, R40, R44	R30103-000	RES,10K,1/8W,1%,MF,AXIAL,100PPM,(DALE CMF-50 / RN50C1002F)	7
R17, R18, R19, R20, R21, R23, R25, R28, R31, R42, R43, R46	R30140-000	RES,1K,1/8W,1%,MF,50PPM,(DALE RN50C)	12
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)	12
U7, U8	U00027-000	IC,ULTRA LOW NOISE PRECISION OP AMP,(ANALOG DEVICES OP27GP)	2
U26	U00029-000	CONVERTER,NO OIL,16BIT,A TO D,SERIAL OUT,[BURR-BROWN ADS7809PB,PB],[ANALOG DEVICES AD977CN]	1
U17	U00524-000	IC,INSTRUMENTATION AMP,(ANALOG DEVICES AD524A) (SSD)	1
U15	U00725-000	IC,DUAL 16 BIT DIGITAL TO ANALOG CONVERTER,(BURR-BROWN DAC-725) (SSD)	1
U9, U10, U18	U04090-000	IC,4CH ANALOG MULTIPLEXER,(DATEL MXD-409)	3
DP2, DP4, DP5, DP8, DP9	U08010-000	IC,8 COMMON CATHODE CLAMPING DIODES,9 PIN SIP,(ROHM DAN801)	5
DP1, DP3, DP6, DP7, DP10	U08011-000	IC,8 COMMON ANODE CLAMPING DIODES,9PIN SIP,(ROHM DAP801)	5
U27	U11165-000	IC,6.5536MHZ CLOCK OSCILLATOR,1/2 SIZE,(ECLIPTEK EC1100HS-6.5536MHZ) (SSD)	1
U40	U11528-000	IC,VERSALINK TRANSMITTER,HORIZONTAL,(200UM FIBER) (HEWLETT PACKARD HFBR-1528)	1
U54	U12521-000	IC,FIBER OPTIC RECEIVER,HORIZONTAL,(HP HFBR-2521) (SSD)	1
U36	U17545-000	DRIVER,OIL,DS75451N,DUAL AND,[NATIONAL SEMICONDUCTOR DS75451N]	1
U6, U19, U34, U39, U60	U20148-000	IC,HEX INVERTER,SCHMIDTT TRIGGER,(74HC14) (SSD)	5
U42	U20730-000	IC,DUAL J-K FLIP FLOP W/RESET,(7473) (SSD)	1
U51	U21328-000	IC,QUAD 2 INPUT NAND,SCHMIDTT TRIGGER,(74HC132) (SSD)	1
U52	U21388-000	IC,3 TO 8 DECODER/ DEMULTIPLEXER, INVERTING,(74HC138) (SSD)	1

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
U32	U21536-000	IC,DUAL 4 INPUT DIGITAL MULTIPLEXER,(74F153) (SSD)	1
U35	U22598-000	IC,8 BIT ADDRESSABLE LATCH W/RESET,(74HC259) (SSD)	1
U47	U23909-000	IC,DUAL 4 BIT BINARY/BIQUINARY COUNTER (74HCT390) (SSD)	1
U41, U48	U24018-000	IC,JOHNSON DECADE COUNTER W/10 DECODED OUTPUTS,(74HC4017) (SSD)	2
U45	U24138-000	IC,8 BIT BINARY DOWN COUNTER,(74HC40103) (SSD)	1
U43	U26889-000	IC,8 BIT MAGNITUDE COMPARATOR,(74HCT688) (SSD)	1
U22, U24, U57	U28008-000	IC,QUAD 2 INPUT AND,(74HC08) (SSD)	3
U4, U49, U58	U28032-000	IC,QUAD 2 INPUT OR,(74HC32) (SSD)	3
U44, U46	U28040-000	IC,12 BIT DECADE COUNTER,(74HCT4040) (SSD)	2
U5, U13, U14, U23, U25, U33, U50	U28074-000	IC,DUAL D FLIP FLOP W/RESET,(74HC74) (SSD)	7
U2	U28123-000	IC,DUAL RETRIGGERABLE 1-SHOT,(74HC123) (SSD)	1
U31, U53	U28164-000	IC,8 BIT SERIAL IN PARALLEL OUT SHIFT REGISTER,(74HC164) (SSD)	2
U3, U12, U28, U37, U38	U28165-000	IC,8 BIT PARALLEL IN SERIAL OUT SHIFT REGISTER,(74HC165) (SSD)	5
RP6	U32001-000	IC,1K FEED-THROUGH RES NETWORK,16 PIN DIP,(A/B 316B102)	1
RP1-RP5	U32103-000	IC,10K FEED-THROUGH RES NETWORK,16 PIN DIP,(A/B 316B103)	5
U56	U40008-000	REGULATOR,OIL,5V,100MA,TO-92,[MOTOROLA MC78L05ABP]	1
U55	U40012-000	FLIP-FLOP,OCTAL D-TYPE LATCH WITH RESET,[NATIONAL MM74HC273N]	1

5.3.6 Parts List, HPA Assy 13PIJ, 1KW Pulsed HPA, IJ, A27500-914

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
A2	A22824-332	RF COMPONENTS FOR 13PIJ, 7.5 TO 18 GHZ	1
A1	A22826-021	PULSED TWT P. SUPPLY (PFC) FOR TWT MTI-3444L	1
A6	A23692-000	INSULATED FAN DRIVER	1
A3	A25444-001	HPA INTERFACE BOARD (200UM GLASS FIBERS)	1
A10	A27501-902	CABINET ASSY. 400 C SINGLE PHASE,LITTON TWT, (AR)	1
A4	A27509-301	HPA CONTROL CHASSIS ASSY, GPIB/LINK TRANSCIVER BOARD, 200UM HCS FIBERS	1
A5	A30137-900	FRONT PANEL ASSY, 5U, FRONT PANEL MOUNT, GPIB (AR)	1
A9	A30740-914	HPA WIRING KIT, SINGLE PHASE, IEEE-488	1
A8	A30750-000	PULSE MONITOR BOARD	1

5.3.7 Parts List, HPA Assy 13PIJ, 1KW Pulsed HPA, IJ, A27500-918

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
A2	A22824-333	RF COMPONENTS FOR 13PIJ, 7.5 TO 18 GHZ	1
A1	A22826-021	PULSED TWT P. SUPPLY (PFC) FOR TWT MTI-3444L	1
A6	A23692-000	INSULATED FAN DRIVER	1
A3	A25444-001	HPA INTERFACE BOARD (200UM GLASS FIBERS)	1
A10	A27501-903	CABINET ASSY. 400 C SINGLE PHASE,LITTON TWT, (AR)	1
A4	A27509-301	HPA CONTROL CHASSIS ASSY, GPIB/LINK TRANSCIVER BOARD, 200UM HCS FIBERS	1
A5	A30137-902	FRONT PANEL ASSY, 5U, FRONT PANEL MOUNT, GPIB (AR)	1
A9	A30740-914	HPA WIRING KIT, SINGLE PHASE, IEEE-488	1
A8	A30750-000	PULSE MONITOR BOARD	1

5.3.8 Parts List, HPA Assy 13PIJ, 1KW Pulsed HPA, IJ, A27500-927

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
A2	A22824-335	RF COMPONENTS FOR 13PIJ, 6.5 TO 18 GHZ	1
A1	A22826-021	PULSED TWT P. SUPPLY (PFC) FOR TWT MTI-3444L E01859-000	1
A6	A23692-000	INSULATED FAN DRIVER	1
A3	A25444-001	HPA INTERFACE BOARD (200UM GLASS FIBERS)	1
A10	A27501-005	CABINET ASSY. 500 SC SINGLE PHASE AR	1
A4	A27509-301	HPA CONTROL CHASSIS ASSY, GPIB/LINK TRANSCIVER BOARD, 200UM HCS FIBERS	1
A5	A30137-900	FRONT PANEL ASSY, 5U, FRONT PANEL MOUNT, GPIB (AR)	1
A9	A30740-914	HPA WIRING KIT, SINGLE PHASE, IEEE-488	1
A8	A30750-000	PULSE MONITOR BOARD	1

5.3.9 Parts List, HPA Wiring Kit, Single Phase, A30740-914

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
XJ1	A30346-000	EMI MODIFICATION KIT FOR 400KU	1
B1	E01120-000	FAN, 11000 RPM, 400HZ, MODEL 1284DH, [AMETEK 010182 MODIFIED PER DRAWING]	1
A11	E20282-000	EMI LINE FILTER,(SAE POWER INC STD-20)	1
A15	E30078-000	CURRENT TRANSDUCER,100A RMS,+/-4VDC OUT,1%,(LEM USA HAL 100-S)	1
	H10066-000	CABLE TIE MOUNT #8 SCREW,(PANDUIT TA1S8-C)	25
	H10067-000	FLAT CABLE MOUNT,2WIDE,(PRO-STAINLESS, 859365)	2
	H11072-000	STRAIN RELIEF FOR LINE CORD,(PANEL COMPONENTS 85910051)	1
	H14012-000	FUSE HOLDER,(BUSSMAN HTB-44I)	1
	H17039-000	SERIAL NUMBER STICKER FOR AR PRODUCTS,(AR NA)	1
	H17040-000	MADE IN USA STICKER FOR AR PRODUCTS,(AR NA)	1
P30	J00010-000	CONN,1 PIN,FEMALE,(MOLEX 03-09-1011)	1
P14, P15	J00020-000	CONN,PIN & SOCKET,2 PIN,FEM,(MOLEX 03-09-1027)	2
P10	J00021-000	CONN,FEMALE 2 PIN .063,(MOLEX 03-06-1023)	1
P27	J00023-000	CONN,HOUSING,FEMALE,02 PIN,(MOLEX 5197-N 10- 01-3026)	1
P16	J00025-000	HOUSING,2 PIN,FEMALE,0.1 SPACING,7880 SERIES,(MOLEX 10-11-2023)	1
P25	J00033-000	CONN,FEMALE 3 PIN,.063,(MOLEX 03-06-1032)	1
	J00034-000	CONN,HOUSING,FEMALE,03 PIN,(MOLEX 5197-N 10- 01-3036)	1
	J00040-000	CONN,PIN & SOCKET,4 PIN,FEM,STR,(MOLEX 03-09- 1041)	1
	J00046-000	CONN,HOUSING,FEMALE,4 PIN,0.1SPACING,7880 SERIES,(MOLEX 10-11-2043)	2
P29	J01010-000	CONN,1 PIN,MALE,250V (MOLEX 03-09-2011)	1
XP15, 28880	J01020-000	CONN,PIN & SOCKET,2 PIN,MALE,(MOLEX 03-09-2021)	1
P11	J01021-000	CONN,MALE 2 PIN .063,(MOLEX 03-06-2023)	1
	J01040-000	CONN,PIN & SOCKET,4 PIN,MALE,STR,(MOLEX 03-09- 2041)	1
XP11	J03013-000	CONN,PIN MALE,.063,(MOLEX 002-06-2103)	3
XP10	J04013-000	CONN,PIN FEMALE .063,(MOLEX 002-06-1103)	3
XP12, XP16	J04014-000	TERMINAL PIN HIGH PRESSURE MOLEX 7879 SERIES [MOLEX 08-50-0005] (FOR SERIES 7880 HOUSING 10- 11-XXXX)	12
XP27, XP28	J04015-000	PIN,TERMINAL FOR HOUSING CONNECTOR 5.08MM,(MOLEX 5194 SERIES 08-70-1030)	5
P31	J10264-000	CONN,FEM SOCKET,26 PIN,IDC MASS TERMINATION,(THOMAS & BETTS 609-2601M)	1
J7	J11240-000	CONN,RIBBON,24 PIN,FEMALE,1A CONTACTS,BLUE,[3M 3549-1000-SR-3448-61]	1
P5, P6	J11370-000	CONN,D-SUB,37 PIN,FEMALE,RIBBON (THOMAS & BETTS 609-375-M)	2
P1	J12031-000	CONN,D-SUB,FEMALE,3 PIN,#8 AWG,PLUG,HI POWER [ITT CANNON DAM-3W3S]	1
P9	J12091-000	CONN,D-SUB,9 PIN,FEMALE,CRIMP (ITT CANNON DEU-9S)	1
P2	J12250-000	CONN,D-SUB,25 PIN,FEMALE,CRIMP	2
	J17102-000	BNC,BULKHEAD RECEPTACLE,GROUNDED,(AMPHENOL 31-221)	1

REF. DESIG.	ETM P/N	DESCRIPTION	QUANTITY
	J18012-000	CONN,FIBER OPTIC,GRAY,W/CRIMP RING,(HP HFBR-4501)	3
	J18013-000	CONN,FIBER OPTIC,BLUE,W/CRIMP RING,(HP HFBR-4511)	3
XP1	J18054-000	CONTACT,FEMALE,HI PWR,20 AMP,UP TO 12AWG WIRE,[ITT CANNON DM53744-6]	2
	J18073-000	MALE SCREW LOCK,D SUB CONN,(AMP 205980-1)	1
	J18075-000	MALE SCREW LOCK,FOR D SUBMIN CONN,(AMP 205817-1)	2
P20, P21, P22, P23, P24, P28	J18124-000	CONN, SMA MALE SOLDER ATTACHMENT FOR RG188, (PASTERNAK PE4036)	7
J1	J18162-000	POWER INLET,MALE,16A,250VAC, IEC-320 (PANEL COMPONENTS CORP 83011340)	1
J2	J18176-000	CONN,D-SUB,15 PIN,FEMALE,CRIMP,(ITT CANNON DAU-15S)	1
XJ2	J18184-000	D-SUB,15 PIN MALE,CRIMP (ITT CANNON DAU-15P)	1
P4	J31011-000	D-SUB,37 PIN,MALE,CRIMP,5A,20 AWG (ITT CANNON DCU-37P)	2
P7, P8	J31012-000	CONN,D-SUB,15 PIN,FEMALE,RIBBON CABLE,W/STRAIN RELIEF,PLASTIC,[AMPHENOL 841-17-DAFR-B15S]	2
	J31014-000	SPRING LATCH KIT,D-SUB,(AMPHENOL 17-529)	8
L1	L50503-000	EMI SUPPRESSION CORE,0.25HOLE,WITH CASE,(FAIR-RITE 0443164251)	1
	N24373-000	CONNECTOR COVER	1
XA11	N27418-000	COVER TERMINAL EMI FILTER	2
	N27728-000	HPA INTERFACE SHIELD	1
S2, S3	S25002-000	SWITCH,PUSHBUTTON,SPDT,SAFETY DOOR INTERLOCK,DEFEATABLE,(MICRO SWITCH 3AC6)	2
S1	S26016-000	C/B,2 POLE,30A,250V,50HZ,(AIRPAX IEGH-66-1-61-30.0-21)	1
U1, U2	U00052-000	PRECISION CELSIUS TEMP SENSOR, TO-220 [NATIONAL LM35DT]	2
	W01880-000	WIRE,26 AWG,COAXIAL,RG-188A/U,900V (BELDEN 83269)	4
	W11400-000	WIRE,14 AWG,600V,BLUE,(ALPHA 5859)	4
	W11600-000	WIRE,16 AWG,BLUE,TFE,(BELDEN 83010-6)	2
	W11800-000	WIRE,18 AWG,BLUE,(BELDEN 83009)	3
	W12000-000	WIRE,20 AWG,BLUE,(BELDEN 83007)	4
	W12200-000	WIRE, 22 AWG, BLU, 600V, TEFLON, (BELDEN 83006)	5
W3	W12209-000	CABLE,25 COND,AWG 22,STRANDED,W/FOIL SHIELD,(ALPHA WIRE 1299/25C)	1
	W21201-000	POWER CORD,12 AWG,5 COND,NEOPRENE COVERED,(ROYAL ELECTRIC 4A-1205)	10
	W22210-000	WIRE,22AWG,3 COND SHIELD,(BELDEN 8771)	3
W1, W2, W6	W30020-000	CABLE,FIBER OPTIC,1000UM POF, [NISSHO WAI AMERICAN CORP GH-4001]	3
F1	Z20020-000	FUSE,2A,250V,3AG,SB,(LITTELFUSE 313.002)	1
Z1	Z31022-000	SURGE ARRESTOR,(CPCLARE AC240L)	1
Z2	Z31024-000	TRANZORB, 440V, 1.5KE440CA (GI 1.5KE440CA)	1

5.5 SAMPLE PROGRAM FOR IEEE-488 COMMUNICATION

```
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
```



Application Note #35 Pulse Traveling Wave Tube Amplifiers

By: Applications Engineering

AR RF/Microwave Instrumentation's pulse traveling wave tube amplifiers (TWTAs) offer a cost-effective source of high RF power for applications in which only a low to moderate RF duty cycle is required, i.e., where the RF power is on for only a small percentage of the time. A typical application is electromagnetic compatibility (EMC) RF pulse susceptibility testing. This Application Note discusses the unique specifications and characteristics applicable to pulse TWTAs.

Pulse-rated TWTAs use a traveling wave tube (TWT) incorporating a control grid that can be used to turn on and off the TWT's beam current. The TWT acts as an RF amplifier only when the beam is turned on. Turning the beam off when no RF output is needed results in a significant reduction in power consumption, and hence reduces the amount of heat to be dissipated.

When compared to a continuous wave (CW)-rated amplifier with similar power specifications, a low to moderate duty cycle PULSE TWTAs typically: uses less AC input power, produces less heat, is smaller and lighter, costs less, has lower noise power output during the pulse off time, and allows use of peripheral components (connectors, cables or waveguide, directional couplers, loads, and so forth) with lower CW power ratings. AR's pulse TWTAs are designed specifically for pulsed applications. They cannot be used to produce CW output. AR's TP series of pulse TWTAs do incorporate many of the excellent features of AR's T series of CW TWTAs such as: foldback protection, bright 4 line by 20 character alphanumeric display and extensive remote status and control via a GPIB (IEEE-488) interface. For CW applications, contact AR RF/Microwave Instrumentation for information on its extensive line of CW-rated amplifiers.

Unique Specification for Pulse TWTAs

Some unique specification characteristics (those not commonly specified for CW rated amplifiers) of AR RF/Microwave Instrumentation's pulse TWTAs are listed below, along with a set of typical parameter values. An explanation of their significance follows.

PULSE CAPABILITY

Pulse Width.....	0.07-30 microseconds
Pulse Rate (PRF)	100 kHz maximum
Duty Cycle	4% maximum
RF Rise and Fall	30ns maximum (10% to 90%)
Delay	300ns maximum from pulse input to RF 90%
Pulse Width Distortion	±30ns max (50% point of output pulse width compared to 50% points of input pulse width)
Pulse Off Isolation.....	80 dB minimum, 90 dB typical
NOISE POWER DENSITY	(Pulse on) xxxx
.....	(Pulse off) Minus 140dBm/Hz (typical)

CONNECTORS

Pulse Input	Type BNC female on rear panel
-------------------	-------------------------------

Delay, RF Rise and Fall time and the Pulse Input

The beam is turned on and off in response to a TTL-level input (typically from an external Pulse Generator) applied to the Pulse Input Connector. A positive level (logical 1) turns on the beam. If RF had been applied to the TWTA input prior to the positive (logical 1) TTL input, the RF output would reach 90% of its final value within 300ns (Delay) with an observed RF Rise time of up to 30ns (10% to 90%). (See Figure 1.)

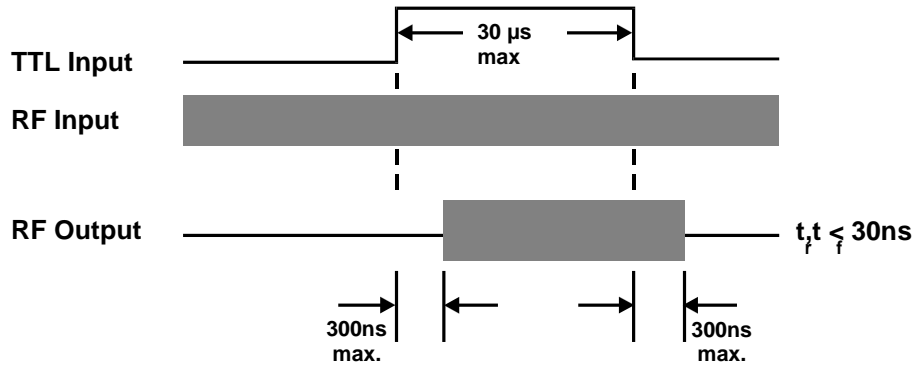


Figure1: CW RF Input

After this initial delay in enabling the RF output, the RF output level will respond to the level of the RF input. As with a CW amplifier, the subsequent RF rise and fall times are inversely related to the RF bandwidth of the specific TWTA, with typical rise and fall times in the low- or sub-nanosecond range.

If the RF input remains and the TTL level goes low (logical 0), then the RF output would reach 10% of its prior "on" value within 300ns (Delay). The observed RF Fall time would be less than 30ns (10 to 90%). (See Figure 1.) Using the TTL input to modulate the RF output may result in some small distortion of the output pulse width (usually shrinkage), as compared to the TTL-level input pulse width, and therefore is not recommended for producing pulses lasting less than 0.2 microseconds, or for applications where the pulse width must be accurately preserved. Alternately, the RF input can be turned off prior to the end of the TTL pulse to obtain a fast and well-defined RF fall time.

To obtain well-defined RF timing while minimizing power consumption, the RF and TTL-level inputs should be timed as shown in Figure 2:

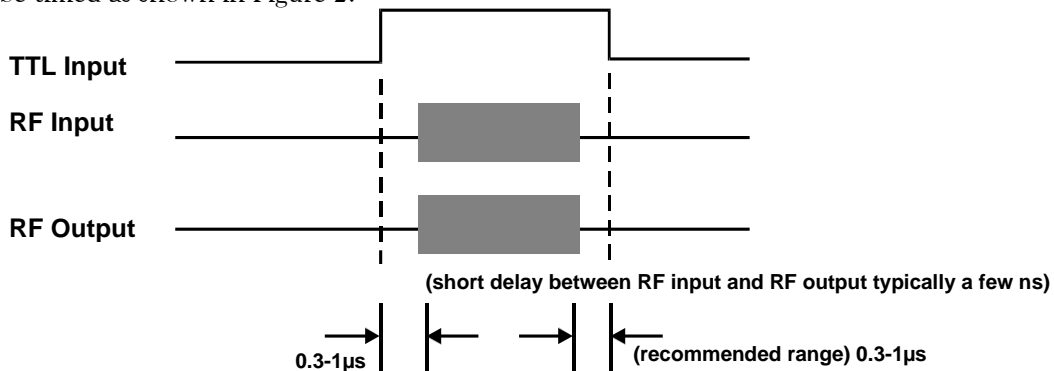


Figure 2: Pulse RF Input

Pulse Width

The Pulse Width specification (0.07-30 microseconds) defines the range of acceptable pulse widths that must be presented at the TTL input to operate the TWTA. The maximum value (30 microseconds) describes the greatest RF pulse width available from the TWTA. RF output pulse widths less than 0.2 microseconds can best be produced by providing a correspondingly short RF pulse at the RF input, with timing as shown in Figure 2.

The Pulse Width Distortion specification further defines the maximum pulse width distortion at the 50% points of the output pulse width compared to 50% points of the input pulse width when using the pulse input. Lower distortion can be obtained with timing as shown in Figure 2.

Pulse Rate

The Pulse Rate (PRF) specification (100 kHz max.) defines the rate of the maximum continuous pulse stream that may be fed to the TTL-level input. In other words, each succeeding TTL-level input pulse (of a continuous stream of pulses) must begin no sooner than 100 microseconds (1/10,000 sec.) following the beginning of the previous pulse. There is no minimum rate specification. Users should contact AR RF/Microwave Instrumentation regarding any specific requirements they may have for non-continuous pulse-stream applications with higher burst rates.

Duty Cycle

The Duty Cycle specification (4% max.) is an additional limitation on the TTL-level input that must be observed by the user. This specification defines the maximum percentage of the time that the TTL-level input can be allowed to remain positive (logical 1). For example, if the chosen PRF is 5 kHz, then the maximum allowable TTL input pulse width is reduced to 8 microseconds (1/5,000 x .04 sec.).

Pulse Off Isolation

Pulse off isolation specifies the reduction of signal level, input to output, when the Pulse Input is not high (i.e. in the pulse-off condition), causing the beam to be off.

Noise Power Density

Noise Power Density describes the noise level at the TWTA's output. TWTs typically produce considerable broadband RF noise when they are operating (TTL high). When the TTL-level input is not high, (i.e. in the pulse-off condition) the TWT noise is significantly reduced. A typical Noise Power Density level is thus indicated.

Forward and Reflected Peak Power

AR RF/Microwave Instrumentation Pulse TWTA's feature a display for peak RF power output to supplement the usual display for average RF power output. This display is developed from a measurement of the peak RF and is especially convenient for setting the peak power level when using a varying duty cycle. This feature operates when the pulse width is greater than 1 microseconds and the RF input is present before the start of the TTL pulse.

Peak power measurements using laboratory power meters are typically accomplished by measuring the average power and then calculating the peak power using the known duty cycle:

$$\text{Peak Power} = \text{Average Power} \div \text{Duty Cycle.}$$

For accurate indirect measurements of peak power, it may be desirable to measure the actual RF output pulse width to determine the duty cycle.

Summary

This Application Note has discussed some features of AR RF/Microwave Instrumentation's Pulse high power TWTAs and their unique specifications, those not commonly specified for CW rated amplifiers. A number of conditions have been defined which must be observed to obtain proper operation of these Pulse TWTAs (though TWTA design prevents damage when these conditions are exceeded). Be sure to refer to the appropriate AR Data Sheet for detailed amplifier specifications.

Users should contact AR RF/Microwave Instrumentation at 215-723-8181 to discuss any specific application requirements for high burst rates, low off-level noise and special off-level timing (such as in NMR spectroscopy applications), Peak Power measurement of narrow pulses or other characteristics.

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.

