

# Model MT06002

## Multi-Tone Test System Operating and Service Manual

Part Number 10044263

Serial Number xxxxxxxx

Revision A



**AR RF/Microwave Instrumentation**

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# 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

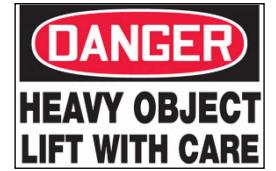
- This equipment (antenna or antenna assembly) may be heavy, requiring two persons to lift. Use caution when installing or removing unit. Follow all equipment setup and lifting instructions specified in this document.
- Ensure connectors are appropriate for intended operation. Connectors are specified 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.

## VORGESEHENEN VERWENDUNG

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

## SICHERHEITSSYMBOLE

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

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

## SICHERHEITSHINWEISE FÜR DEN AUFBAU DES GERÄTS

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

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

- Platzieren Sie Ihr Gerät so, dass der Netzschatz 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 Schutzerdungsklemme 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 hineinsehen.



## HF-ANTENNEN

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

## RACK MONTIERBARE TWT-MODELLE

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

## HEBEANWEISUNGEN FÜR AR-GERÄTE

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

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



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

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

# INSTRUCTIONS POUR UN FONCTIONNEMENT EN TOUTE SÉCURITÉ

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

## USAGE PRÉVU

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

## SYMBOLES DE SÉCURITÉ

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

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

## PRÉCAUTIONS D'INSTALLATION DE L'ÉQUIPEMENT

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

- Respectez toutes les instructions de levage indiquées dans ce document.
- Placez l'équipement sur une surface dure et plane.
- N'utilisez pas l'équipement dans un environnement humide, par exemple près d'un lavabo, ou dans un sous-sol humide.
- Positionnez votre équipement de sorte que l'interrupteur d'alimentation soit facilement accessible.

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

## AVANT LA MISE SOUS TENSION

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

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

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

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

## MISE À LA TERRE DE SÉCURITÉ

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

# INSTRUCTIONS POUR UN FONCTIONNEMENT EN TOUTE SÉCURITÉ

## TENSIONS RF DANGEREUSES

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

## LIMITES ACOUSTIQUES

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

## AVERTISSEMENT CONCERNANT L'ENTRETIEN

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

## CONDITIONS ENVIRONNEMENTALES

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

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

## ÉQUIPEMENT CONTENANT DES LASERS

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

## VOORZORGSMATREGELEN BIJ DE INSTALLATIE VAN HET APPARAAT

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

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

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



*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 veiligheisaarding van voldoende grootte leveren om de aansluitklemmen, de netvoedingskabel of de meegeleverde netvoedingskabelset aan te sluiten. **GEBRUIK dit apparaat NIET als deze bescherming is beschadigd.**

# INSTRUCTIES VOOR VEILIG GEBRUIK

## GEVAARLIJKE RF-SPANNINGEN

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

## AKOESTISCHE BEPERKINGEN

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

## ONDERHOUD WAARSCHUWING

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

## OMGEVINGSVOORWAARDEN

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

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

## APPARAAT DAT LASERS BEVAT

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

## RF-ANTENNES

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

## IN EEN REK GEMONTEERDE TWT-MODELLEN

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

## TILINSTRUCTIES VOOR AR-APPARATUUR

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



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

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

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



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## 1. GENERAL INFORMATION

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### 1.1 GENERAL DESCRIPTION

This manual provides operating, interfacing and selected service information pertinent to the MT06002 Multi-tone Test System. Hardware and software are addressed in separate sections.

The Model MT06002 (Multistar™ Multi-tone tester) is a state-of-the-art system designed to test RF Conducted and Radiated Immunity faster than ever before possible. By testing multiple frequencies (tones) at once, test times can be reduced by a factor equivalent to the number of tones selected. The number of tones is only limited by the signal generator bandwidth (1000 MHz) and the size of the amplifier used with the system.

The MT06002 contains all the instruments needed to perform radiated immunity testing for radiated and conducted immunity testing, except the required amplifiers, antennas, directional couplers and injection/monitoring probes.

Amplifiers can be sized and selected based on your required field levels and testing needs. Up to four RF amplifiers and directional couplers can be controlled and monitored and power can be delivered to up to four antennas to generate the desired fields. The system contains a vector signal transceiver, an RF pre-amplifier, an RF field probe and monitor, an RF switch matrix, and automated immunity test software. Everything is contained in a single housing, which eliminates setup issues.

The software includes automated routines to calibrate the field and maximize the speed of test (most tones possible) while still meeting the Linearity and Harmonics requirements of the test standards. In the event of an EUT failure, margin investigation (thresholding) and traditional single tone testing can be performed causing a slowing of the test only in the areas of concern. This system has the versatility needed for every test laboratory and equipment manufacturer while adding the benefit of reduced test times and greater throughput.

## 1.2 HARDWARE

The MT06002 hardware system components are as follows:

- 1pc. Model FL7006 Electric Field Probe
- 1pc. Model FM7004A Field Monitor
- 1pc. Model FI7000 Laser Probe Interface
- 1pc. Model SCP2000M1 RF System Controller
- 1pc. Model 1078 PXIe chassis with the following:
  - Vector Signal Transceiver containing Vector Signal Generator and Vector Signal Analyzer
  - Pre-Amplifier
  - Embedded Controller (PC Computer)
- 1pc. AC Power Controller
- 1pc. Monitor 23"
- 1pc. Wireless Keyboard & Mouse
- Misc. RF & Power Interface Cables

These items are all housed in a 19 inch cabinet and are designed and tested to work together as a system under the control of the MT06002 control software.

## 1.3 ACCESSORIES

While not included with the MT06002, AR offers a number of accessories for use with this system:

- RF Amplifiers
- Directional Couplers
- Antenna(s)
- Antenna Tripod
- Low Pass Filter
- Additional Field Probes
- Field Probe Stand
- Longer fiber optic cable for single length up to 100 meters
- Injection and Monitoring Probes
- Additional System Controller

Contact the Sales Department at AR for a full list of accessories.

Figure 1-1 provides a block diagram of the components of the system along with a sampling of accessories.

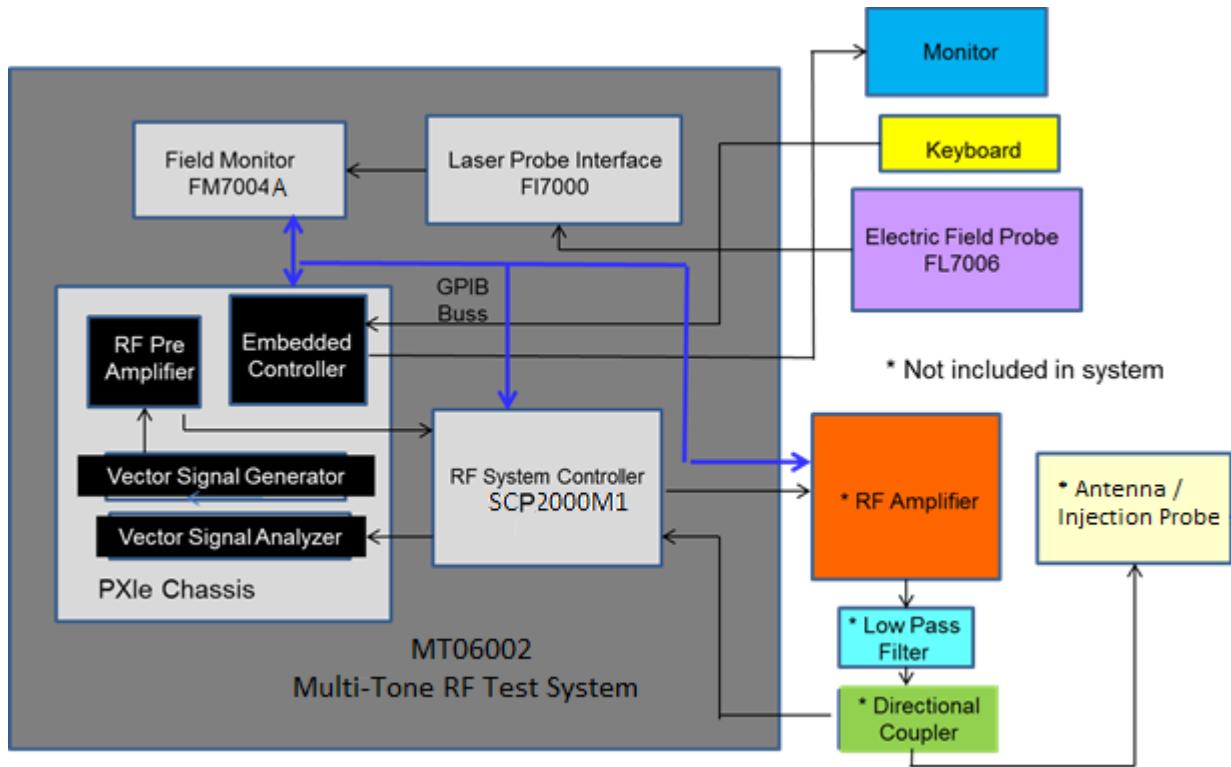


Figure 1-1.

## 1.4 SUGGESTED APPLICATIONS

RF Immunity testing using the following standards:

- MIL-STD-461D, E, F, G (CS114)
- DO160D, E, and F
- EN/IEC 60601-1-2
  - IEC/EN 61000-4-3
  - IEC/EN 61000-4-6
- EN 50130-4
  - IEC/EN 61000-4-3
  - IEC/EN 61000-4-6
- EN 61000-6-1/2
  - IEC/EN 61000-4-3
  - IEC/EN 61000-4-6
- EN 55024
  - IEC/EN 61000-4-3
  - IEC/EN 61000-4-6

## 1.5 FRONT PANEL

The front panel contains the following items:

- **SCP2000M1 System Controller** – uses software to control the routing of the RF Signals to the amplifiers, directional couplers, and antennas. The user can manually control the switches via the front panel buttons.
- **FM7004A Field Monitor** – displays the field strength readings from the field probe thru the fiber optic cable. It has the capability to read 4 field probes manually by using the touch screen display
- **FI7000 Field Probe Interface** – provides power and commands to operate the field probe (FL7006) thru the fiber optic cable. It also has a safety loopback connection to ensure proper connected cables prior to laser turn on.

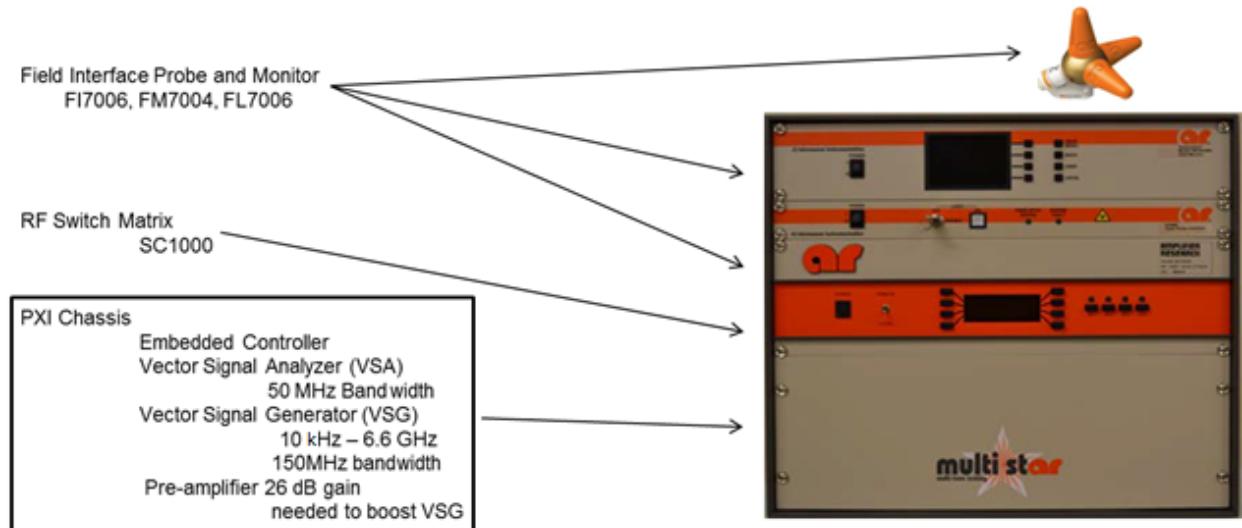


Figure 1-2. Front Panel View

## 1.6 REAR I/O PANEL

The rear panel contains the following items:

- **Signal In** – This is a Type N coaxial connector through which the external RF input signal can be routed. This connector can be used to connect an external signal source if so desired.
- **Signal Out** – This is a Type N coaxial connector which is a RF output of the vector signal generator. The signal is connected to the input of the RF amplifier.
- **Amplified Signal In** – This is a Type N coaxial connector which provides a connection to the input of the internal power amp.
- **Amplifier Signal Out (Load)** – This is a Type N coaxial connector which provides a connection to the output of the power amp. This is connected to the desired antenna.

- **Forward Power Sense** – This is a Type N coaxial connector which provides RF input signal to the vector signal analyzer. This is connected to the directional coupler forward power port to monitor the amplifier's output power.
- **GPIB Interface Connector** – This is the remote control interface that is used to control the external amplifier (if required) and EUT monitoring devices.
- **Interlock/Aux-** Connections to the safety interlocks that will disable the amplifiers when a chamber door is opened.
- **AC Power Controller Panel (Circuit Breaker)**– This panel has 3 switched section indicator lamps, a circuit breaker, a local/remote switch, 3 interface jacks (J1, J2, J3) and a 115VAC present indicator lamp. During normal operation the 115VAC/240VAC present lamp will light when the circuit breaker is turned on. The three switched section lamps will light when the Local/Remote/Off switch is in the Local position. The power sequence interface connectors J1, J2 and J3 have no connections.

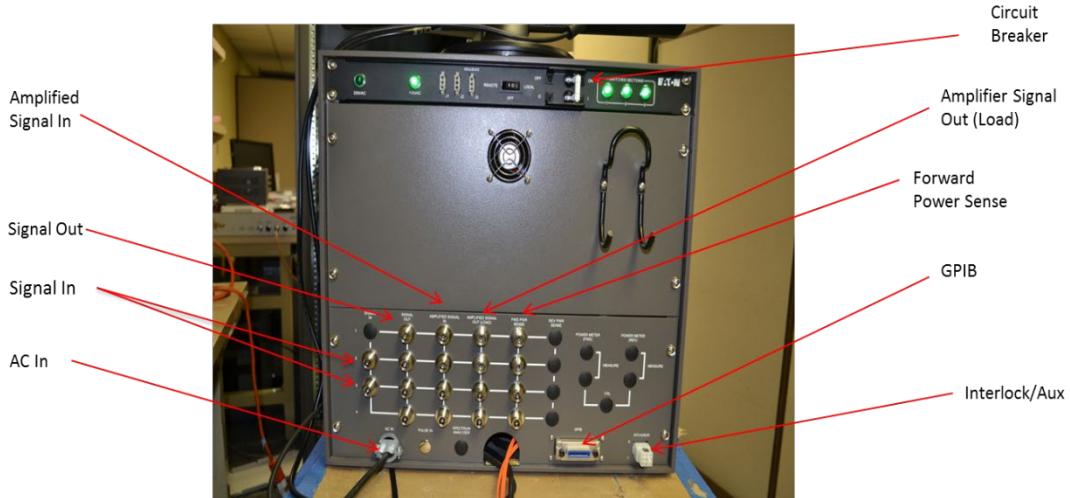


Figure 1-3. Rear Panel View

## 1.7 PRODUCT SPECIFICATIONS

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





## Features

### MT06002 MultiStar™

- Multi-Tone RF Radiated & Conducted Immunity System
- M1
- 10kHz-6GHz



Complete Testing Solutions to the following standards:

#### Radiated Immunity

- EN/IEC 61000-4-3
- ISO11452-2 Auto (ALSE)
- ISO11452-3 Auto (TEM cells)
- ISO11451-5 Auto (Strip Line)
- ISO11451-2 Full Vehicle
- DO-160 Section 20.5 (Substitution Method)
- EN/IEC 60601-1, -2
- EN 50130-4
- EN 61000-6-1/2
- EN 55024

#### Conducted Immunity

- EN/IEC 61000-4-6
- ISO11452-4 Auto (BCI Method)
- DO-160 Section 20.4 (Substitution Method)
- MIL STD 461 CS114
- EN/IEC 60601-1, -2

The Model MT06002 (Multistar™ Multi-tone tester) is a state-of-the-art system designed to test RF Radiated and Conducted immunity faster than ever before possible. By testing multiple frequencies (tones) at once, test times can be reduced by a factor equivalent to the number of tones selected. The number of tones is only limited by the signal generator bandwidth (1000MHz) and the size of the amplifier used with the system.

The MT06002 contains all the instruments needed to perform radiated and conducted immunity testing for various immunity standards except the required amplifiers, antennas and directional couplers. Amplifiers can be sized and selected based on your required field levels and testing needs. Up to 4 RF amplifiers and directional couplers can be controlled and monitored and power can be delivered to up to 4 antennas to generate the desired fields. The system contains a vector signal transceiver, an RF field probe and monitor, an RF switch matrix, and automated radiated immunity test software. Everything is contained in a single housing, which eliminates setup issues. The software includes automated routines to calibrate the field and maximize the speed of the test, by generating the most tones possible, while still meeting the Linearity and Harmonics requirements of the specification. In the event of a EUT failure, margin investigation (thresholding) and traditional single tone testing can be performed causing a slowing of the test only in the areas of concern. This system has the versatility needed for every test laboratory and equipment manufacturer while adding the benefit of reduced test times and greater throughput.

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

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**MT06002**  
**MultiStar™**

- Multi-Tone RF Radiated & Conducted Immunity System
- M1
- 10kHz–6GHz

## Specifications

Page 2

| Vector Signal Transceiver (Generator) Specifications |                      |
|--|----------------------|
| Frequency range                                      | 10 kHz to 6.0 GHz    |
| Power Out (Ave)                                      | +10 dBm              |
| Reverse Power (Max)                                  | +24 dBm (CW,RMS)     |
| Modulation   | AM, FM, Pulse, Phase |
| Instantaneous Bandwidth                              | Up to 1 GHz          |
| Hardware Platform                                    | PXIe                 |

| Vector Signal Transceiver (Analyzer) Specifications |                   |
|---|-------------------|
| Frequency Range                                     | 10 kHz to 6.0 GHz |
| Input Power (Max)                                   | +24 dBm           |
| Instantaneous Bandwidth                             | 200 MHz           |
| Hardware Platform                                   | PXIe              |

| Field Monitor/Probe Specifications |                          |
|------------------------------------|--------------------------|
| Channels                           | 4                        |
| Probe                              | 1                        |
| Type                               | Isotropic, Laser powered |
| Frequency                          | 100kHz-6GHz              |
| Range                              | 0.5–800 V/m              |

| Connections          |   |
|----------------------|---|
| RF signal input      | 4- Type N Male (rear)<br>For optional signal generators |
| RF Signal Out        | 4- Type N Male (rear) to RF amplifiers                  |
| High power RF in     | 4- Type N Male (rear) from RF amplifiers                |
| High power RF out    | 4- Type N male (rear) to antennas/loads                 |
| Fwd Power In         | 4- Type N Male (rear)<br>For forward power              |
| Rev Power In         | 4- Type N Male (rear)<br>For reverse power              |
| Monitor Power In     | 1- Type N Male (rear)<br>For monitoring test level      |
| Serial Port          | 2– USB ports  |
| Ethernet Port        | 1– RJ45 (rear)  |
| GPIB (IEEE-488) Port | 1– 24-pin female (rear)                                 |

| Embedded Controller |                               |
|---------------------|-------------------------------|
| Computer            | Intel Core i5 4400E processor |
| Operating system    | Windows 7                     |
| I/O                 | 6 USB Ports, Ethernet         |
| RAM                 | 8GB DDR3L                     |
| Hard Drive          | 250 GB                        |
| Hardware Platform   | PXIe                          |

| General                  |  |
|--------------------------|--|
| Power                    | 115/230 VAC<br>50/60 Hz, single phase<br>16A |
| Breaker                  | 2 pole, 20A                                  |
| Cooling                  | active cooling,<br>air ventilation           |
| Environmental conditions | 10°C - 40°C                                  |
| Dimensions,              | 50.3 x 47.2 x 61 cm<br>19.8 x 18.6 x 24 in   |
| Weight                   | 22.7 kg (50.0 lb)                            |
| Export Classification    | EAR99  |

| Options |  |
|---------|--|
| 1       | 3 FL7006/Kit Electric Field Probes (See NOTE)          |
| 2       | 1 FL7030 Electric Field Probe for testing below 100kHz |

NOTE: Option 1 used with standard ISO11451-2 auto full vehicle

| Model Configurations |                   |
|----------------------|-------------------|
| Model                | Description       |
| MT06002M1            | Includes Option 1 |

| Accessories                   |  |
|-------------------------------|--|
| Low Pass Filter, 80MHz-1GHz   | Absorptive filter used to remove harmonics |
| Low Pass Filter, 80MHz-4.2GHz | Absorptive filter used to remove harmonics |
| Low Pass Filter, 80MHz-6GHz   | Absorptive filter used to remove harmonics |



## 2. THEORY OF OPERATION

---

### 2.1 DESIGN OF THE MULTI-TONE SYSTEM

Using the digital instrumentation under AR's proprietary software control, a Vector Signal Generator (VSG) digitally produces multiple tones and complex modulations while a Vector Signal Analyzer (VSA) facilitates frequency selective power measurement. Thus, the multiple tones can be generated, measured and controlled.

### 2.2 VECTOR SIGNAL TRANSCEIVER

A unit combining a vector signal generator and vector signal analyzer with FPGA-based real-time signal processing and control.

#### 2.2.1 Vector Signal Generator (VSG)

The RF VSG is a wide-bandwidth vector signal generator with a frequency range from 10 kHz to 6.6 GHz which can generate different modulated waveforms such as Amplitude modulation (AM), Pulse modulation (PM), and multi-toned signals. The VSG can provide 1000 MHz of RF bandwidth. The VSG hardware platform is a PXle platform and operating system is Windows 7. The VSG generates a variety of modulated signals using NI LabView or LabWindows/CVI.

#### 2.2.2 Vector Signal Analyzer (VSA)

The RF VSA is a wide instantaneous bandwidth analyzer with a frequency range of 10 kHz to 6.6GHz and 80 dB typical Spurious Free Dynamic Range (SFDR). The RF VSA can perform fast and accurate RF measurements. You can perform common spectrum analysis measurements quietly due to the processing power of multicore CPU's. Using a 16 bit ADC with high-performance RF front end, the VSA offers up to 80 dB of SFDR. Using LabView you can perform common measurements such as power spectrum, peak power and frequency.

### 2.3 System Controller: SCP2000M1

The AR Model SCP2000M1 is an RF test system controller designed to facilitate broadband RF testing. The signal routing capabilities allow the concurrent use of up to two signal generators, four power amplifiers with forward and reverse power feedback from four directional couplers, and four different RF loads without the need to move cables. Additionally, the RF signal can be routed from an amplifier to a load for susceptibility testing, or from a load to a receiver for emissions testing. External switches can be controlled through the use of a switched +12V supply or through the use of the four open collector outputs and the un-switched +24V supply. Interlock protection is provided by interrupting the input signal if an external switch closure is not detected. The input signal is also interrupted prior to and during any RF signal re-routing to ensure "cold switching".

The Model SCP2000M1 can be operated locally by using the unit's front panel controls, or remotely by using its built-in IEEE-488 or RS-232 interfaces.

NOTE: Refer to the *SC2000 Operating and Service* manual for additional information.

## **2.4 PXIe CHASSIS**

The PXIe is an 8-slot chassis that provides a high-bandwidth backplane up to 1GB/s dedicated bandwidth per-slot. The chassis features a built-in 10MHz reference clock, PXI trigger bus, built-in 100 MHz clock, SYNC 100 and a PXI star trigger for PXI modules.

## **2.5 FIELD MONITOR: FM7004A**

The FM7004A is a broadband electric and magnetic field monitor designed for use in radio frequency interference/electromagnetic compatibility (RFI/EMC) test system applications. It accepts inputs from up to four isotropic field probes then analyzes and displays that information on a user configurable color LCD touch display. It provides four digital interfaces (IEEE-488, RS-232, Ethernet and USB). The FM7004A is compatible with all AR FL7000 Series E and H Field Probes and Field Analyzers.

A complete FM7004A Field Monitor system consists of one to four field measurement probes, attached to the FM7004A through fiber optic cables. The FM7004A contains fiber optic receivers and transmitters to communicate with the probes, an I/O board for peripheral communication with a PC, a main processor board, and an LCD touch screen to display data and system status. USB, RS232, Ethernet and IEEE-488 ports are included for remote system operation. The FM7004A has a self-contained power supply with a universal input 110-230 VAC.

When a field strength reading is requested by the Field Monitor, the appropriate command is sent to the probe through fiber optic cable. The probe measures the signal level for all axes and transmits the data to the FM7004A. A vector addition is performed on these readings based on the enabled axes by the FM7004A processor. The main processor board then displays the data and, if desired, transmits the data to the I/O board for transmission to a remote PC.

NOTE: Refer to the *FM7004A Operating and Service* manual for additional information.

## **2.6 FIELD PROBE AND LASER PROBE INTERFACE: FL7006 & FI7000**

The Model FL7006/FL7030/FL7218/FL7040/FL7060 Probe Kit consists of two principal functional units: the probe and the probe interface (FI7000). The two units are connected by two pairs of fiber optic (F/O) cables. Power to operate the probe and commands to the probe are provided from the interface on one of the F/O cables. Responses from the probe to the interface are provided on a second F/O cable. The other F/O pair is a safety loopback connection ensuring properly connected cables prior to laser turn on.

Each probe has been calibrated at the factory in a CW field at a single frequency, and the resultant calibration tables have been loaded into probe non-volatile memory. The calibration tables provide the basis for the conversion of the digitized signal, from the sensor/detector/pre-amplifier/A to D converter path, to electric field measurements values for each axis. A composite field level is then derived by calculating the square root of the sum of the squares of the individual axis field values. This calculation method is generally quite precise relative to the extent to which

all the individual axis antenna patterns are those of very short electrical dipoles (sine function) at all frequencies.

In addition to the operating program and calibration tables (firmware), each probe's memory also contains the serial number of the probe, the revision of the probe's firmware, and the probe's most recent calibration date.

The probe interface sits between the probe and the host providing all of the specified communication protocols to the host.

*NOTE: Refer to the **FL7006/Kit Operating and Service** manual for additional information.*

## **2.7 EMBEDDED CONTROLLER**

PXle embedded controller provides a complete PC with integrated hard drive and two high speed USB and Gigabit Ethernet ports. Embedded controller hardware platform is PXle with an Intel Core 2 Duo processor with memory of 4GB DDR2 RAM which operates on Windows 7.

## **2.8 RF PRE-AMP**

Pre-Amplifier hardware platform is PXle with frequency range of 10 kHz to 8GHz with a gain of 26dB.





## 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:

The MT06002 operates from AC line voltages which may present a shock hazard.



#### WARNING: Safety Ground

Improper grounding of this equipment can result in electric shock. The unit 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 unit in an explosive atmosphere. This equipment is not certified for operation in an explosive atmosphere.

## 3.2 INITIAL CONNECTIONS

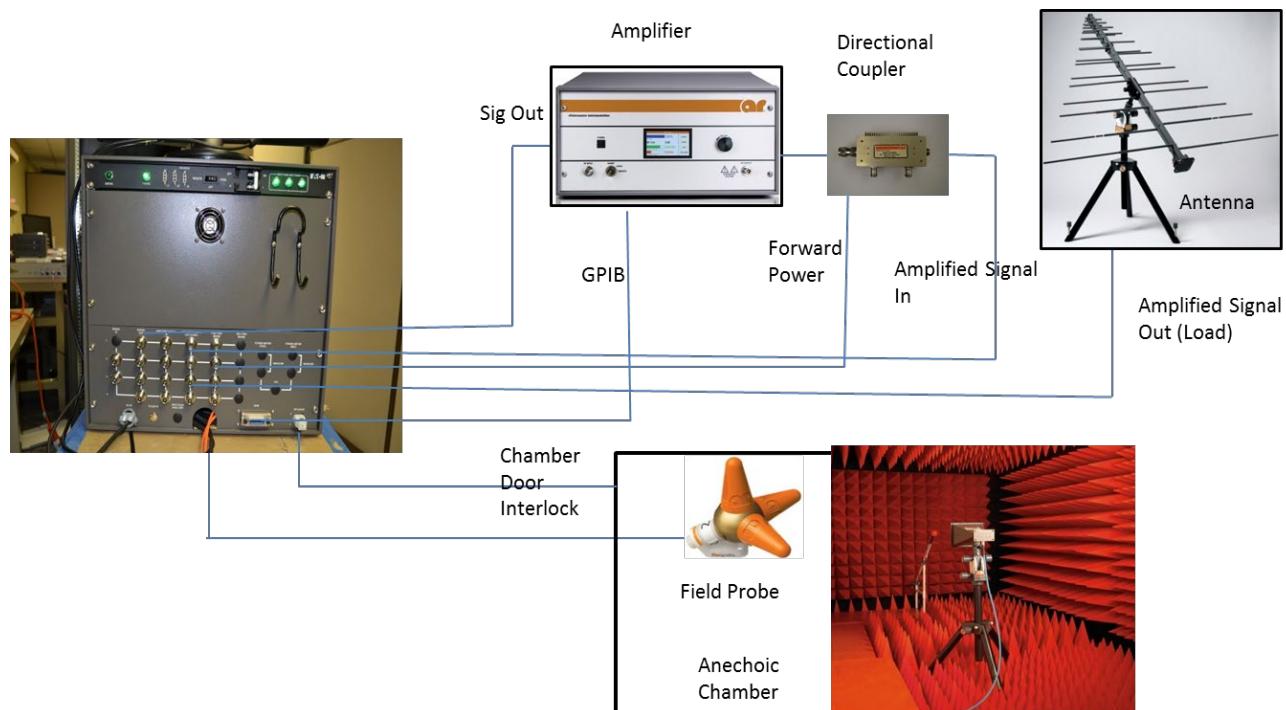


Figure 3-1. Example of Radiated Immunity Test Setup

### 3.2.1 AC Power

The MT06002 can be operated on AC voltages ranging from 90-264VAC. The system comes with an unterminated AC power cord. The AC power cord is located on the rear panel of the unit via a mouse hole. The other end of the power cord has 3 pre-stripped wire ends. The end user must provide and connect a properly rated AC power connector of their choosing to the unterminated end of the power cord.

### 3.2.2 Monitor Connections

**Video Cable** – Connect the display port cable located in the rear of the unit to the VGA monitor input.

**Monitor Power Cable** - Connect the monitor power cable located in the rear of the unit to the monitor input power connector.

### 3.2.3 RF Connections

The following RF connections can be configured in various setups depending on the equipment available (amplifier or antenna) and test parameters required. The user can set band breaks via the software Routing menu for each amplifier or antenna to accommodate the test parameter setup. Refer to Figure 3-1 for one example of a Radiated Immunity test setup.

**Signal In** – This is a RF input signal from an external signal generator. The system includes two N(M) connectors which are switched by the system controller. The routing of the switches are

controlled by the multi tone software or can be controlled manually from front buttons on the SCP2000M1. The two N(M) connectors can be connected to separate external generators. NOTE: *Sig In 1* is connected internal to the Transceiver.

**Signal Out** – This is a RF output signal from the transceiver that generates multiple tones. The system includes four N(M) connectors which are switched by the system controller. The routing of the switches is controlled by the multi tone software or can be controlled manually from front buttons on the SCP2000M1. The four N(M) connectors can be connected to separate RF Input ports of different amplifiers.

**Amplified Signal In** – This is a RF Input signal from the output of the amplifier that amplifies multiple tones. The system includes four N(M) connectors which are switched by the system controller. The routing of the switches is controlled by the multi tone software or can be controlled manually from front buttons on the SCP2000M1. The four N(M) connectors can be connected to separate directional couplers that connect to different amplifiers. Be cognizant of the amplified power applied to these connectors. The internal connectors of the SCP2000M1 are SMA; do not exceed the power rating at frequency for SMA connectors.

**Forward Power** – This is a RF Input signal from the output of the directional coupler forward power port that monitors amplifier output power of the multiple tones. The system includes four N(M) connectors which are switched by the system controller. The routing of the switches are controlled by the multi tone software or can be controlled manually from front buttons on the SCP2000M1. The four N(M) connectors can be connected to separate directional couplers forward power port that monitor forward power of different amplifiers.

**Amplified Signal Out (Load)** – This is a RF Output signal from the output of the directional coupler forward power port that monitors amplifier output power of the multiple tones. The system includes four N(M) connectors which are switched by the system controller. The routing of the switches is controlled by the multi tone software or can be controlled manually from front buttons on the SCP2000M1. The four N(M) connectors can be connected to separate antennas.

### 3.2.4 Field Probe Connections

**Field Probe** – The system includes one FL7006 field probe and with 10 meters of fiber optic cable located in the rear of the unit. The field probe has two permanently attached short fiber optics cables. The fiber optic cables are keyed & color-coded to ensure safe & proper connections. Shuttered connectors are used to prevent accidental exposure to laser radiation. The field probe is designed to mount on a non-conductive (dielectric) probe-stand supplied with 1/4-20 non-conductive screw with 1/8" to 1/4" inch thread extending beyond the mounting surface.

### 3.2.5 Interlock/Auxiliary Connections

**Interlock/Auxiliary connector** – The system includes a 9-pin Int/Aux connector located on the rear panel. There are 4 independent open collector (current sinking) outputs and a switched +12VDC output. Which may be used to control external relays or switches on chamber doors. NOTE: A jumper cable is used if the Int/Aux connector is not being used. This is required to satisfy the interlock fault.

### **3.2.6      GPIB I/O Connections**

**GPIB Connector** – The system includes a General-Purpose Interface Bus (GPIB), IEEE-488.1 located on the rear panel of the unit. This can be used to control an amplifier or connected to a EUT monitor equipment.

### **3.2.7      Ethernet**

**Ethernet Connector** – The system includes a Gigabit 10/100/1000 Ethernet connector located on the rear panel of the unit.

### **3.2.8      Keyboard and Mouse**

**Keyboard** – The system includes a wireless keyboard. *NOTE: Insure the wireless keyboard/mouse receiver unit is connected to one of the USB ports located on the front panel.* There is a power switch on the keyboard to enable the keyboard.

**Mouse** – The system includes a wireless mouse. *NOTE: Insure the wireless keyboard/mouse receiver unit is connected to one of the USB ports located on the front panel.* On the bottom of the mouse, insure the power switch is selected to the on position to enable the mouse.

*NOTE: One USB Receiver will control both the keyboard and mouse.*

### **3.2.9      Front Panel USB Connectors**

**USB Connector** – The system includes two Hi-speed USB 2.0 (4 pin series A) connectors located on the lower right hand side of the front panel of the system.

## **3.3    POWER ON PROCEDURE**

### **3.3.1      Rear Panel of the MT06002 unit**

1. Set circuit breaker on rear panel to OFF position.
2. Connect the AC power cable to the correct power source. All indicator lamps on rear panel should remain off.
3. Switch the circuit breaker to the **ON** position. The 120 VAC or 240 VAC lamp should light depending on what AC source voltage is being used. All other lamps should not be lit.
4. Switch the **Remote/Local** power switch on rear panel to the **ON** position. The three green **Switched Section** lamps on the rear panel should now be lit. The fan on the back panel should also start running.

### 3.3.2 Front Panel of the MT06002 unit

#### SCP2000M1 System Controller

1. On the front panel of the SCP2000M1 set the **Remote/Local** switch to **Local**.
2. Press the power switch on front panel and switch information shall be displayed on the front panel.
3. Switch the **Remote/Local** switch to **Remote** and the display will be blank. *NOTE: The unit is powered up when in **Remote** position, however there is no indication the SCP2000M1 power is on.*

#### FI7000 Field Probe Interface

1. On the front panel of the FI7000 field probe interface turn on the power switch and shall illuminate to indicate that prime power is applied.
2. With the laser key turn the keyswitch to enable the laser power supply.
3. Press the **Laser On** switch, it will illuminate momentary switch to start laser on sequence. Laser is on when switch is illuminated. The **Fiber Optic Status** LED will illuminate Green when the fiber optic connection is sensed. It will illuminate Red if cable fault is present. The **System Fault** LED will illuminate Red if probe communications are terminated and the fiber optic cable is still sensed. An **Off** LED indicates safe condition (no faults).

#### FM7004A

1. Press the power switch and the Main menu on the touch screen display will appear. *NOTE: The power switch controls power to the FM7004A only, it does not affect power at the field probe(s).*
2. Use the touch screen display for setup of field probe.





## 4. SYSTEM SOFTWARE SETUP

### 4.1 OVERVIEW

The test set-up begins with loading all of the test equipment into the software. Once the equipment has been loaded, it can be used for all future tests.

The steps basically flow with the headings found on the left side of the multi-tone software screen (Figure 4-1). They are:

1. Under **Equipment** you load all of your test laboratory equipment.
2. Under **Test Set-up** you load the test criteria
3. Under **Calibration** you'll perform Calibration at single tone levels
4. Under **Multi-tone Configuration**, you'll test multi-tone calibration for forward power and field strength requirements while testing for linearity and harmonics
5. Under **Run Test**, you'll run the test.

Comprehensive online definitions and descriptions are available under the **Help** tab

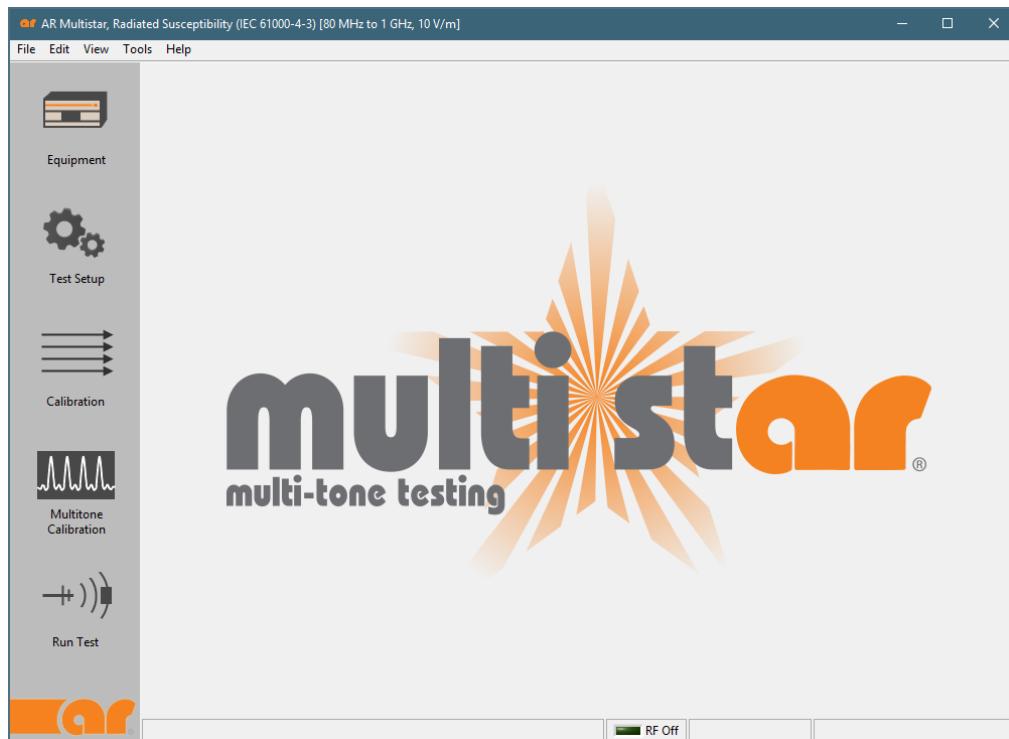


Figure 4-1.

## 4.2 LOADING EQUIPMENT

The following pages demonstrate how to load each type of equipment into the software. Note that with the exception of the directional couplers and antennas, the components need to be physically connected to the GPIB bus. This includes amplifiers, field monitors, antenna controllers, turn table controllers, probe positioners, system controllers and EUT monitoring devices.

Once the equipment is connected, look at the Main Menu of the software (Figure 4-1), highlight the type of equipment on the left side of the screen and then click on the green “plus sign” on the right side of the screen. From the main menu, select **Equipment**. The equipment list is categorized by type of equipment and then serial number and then calibration due date (Figure 4-2).

*Notice that if a piece of equipment is out of calibration, the ‘Cal due date’ is listed in red. Also please note that you can have identical equipment with different serial numbers.*

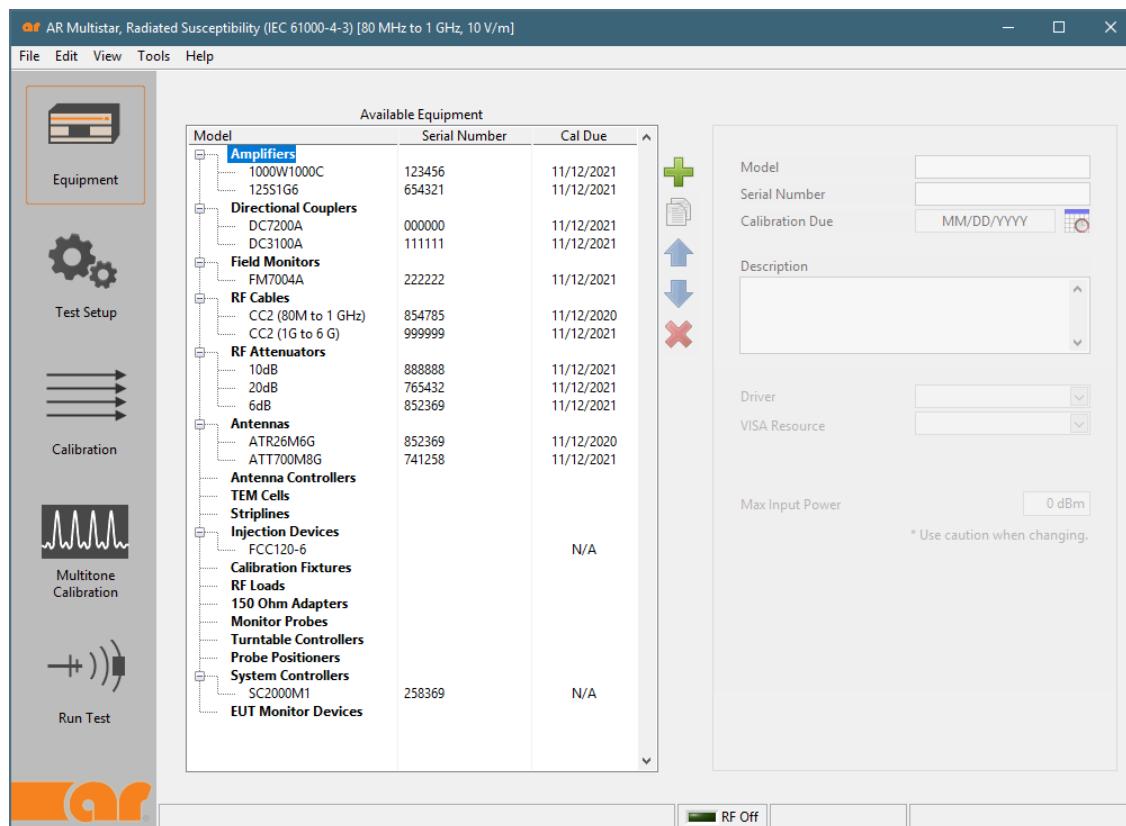


Figure 4-2.

## 4.2.1 Loading Amplifiers

To add an amplifier, under available equipment, select **Amplifier** then the plus sign. From there you can input the model, serial number and calibration due date along with any special description. When adding an amplifier, there are some special considerations that you should keep in mind. If the amplifier can be remotely controlled, for example, a driver needs to be selected. The amplifier GPIB address is selected by clicking the VISA Resource and finding the address on the bus. If amplifier is not remotely controlled, then select **Manual** for the driver. Since the pre-amp has a gain of about 30 dB, the **Max Drive** should be set to -30 dBm which gives a max output power of 0 dBm at the **Signal Out** connection located in the back of the multi-tone system.

To test the amplifier remotely select the **Test** button and the **Amplifier Test Panel** (Figure 4-3) will be displayed.

With the amplifier test panel, you can turn the amplifier power on and turn the RF on by selecting the **Operate** mode.

You can also control the gain of the amplifier using the gain knob or enter the gain in percentage with the **Set** button. The **Check** button will check for interlock or amplifier faults. If everything checks out, then you can move on to the next piece of equipment.

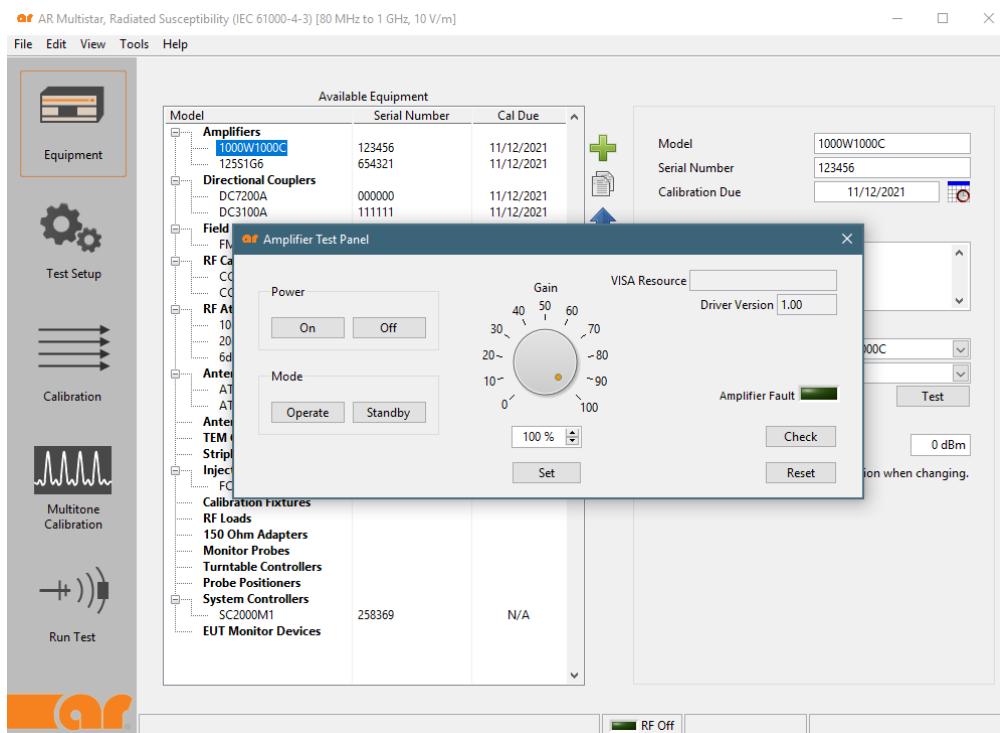


Figure 4-3.

## 4.2.2 Loading Directional Couplers

You can load the directional coupler in a similar fashion to amplifiers (Figure 4-4). Again, you can enter the model, serial number and calibration due date along with a brief description. This description will appear on the reports.

You can load the correction factors by selecting **Import Table** to import a **csv** table. If you need to save the loaded correction factors it can be saved by selecting the **Export Table** button.

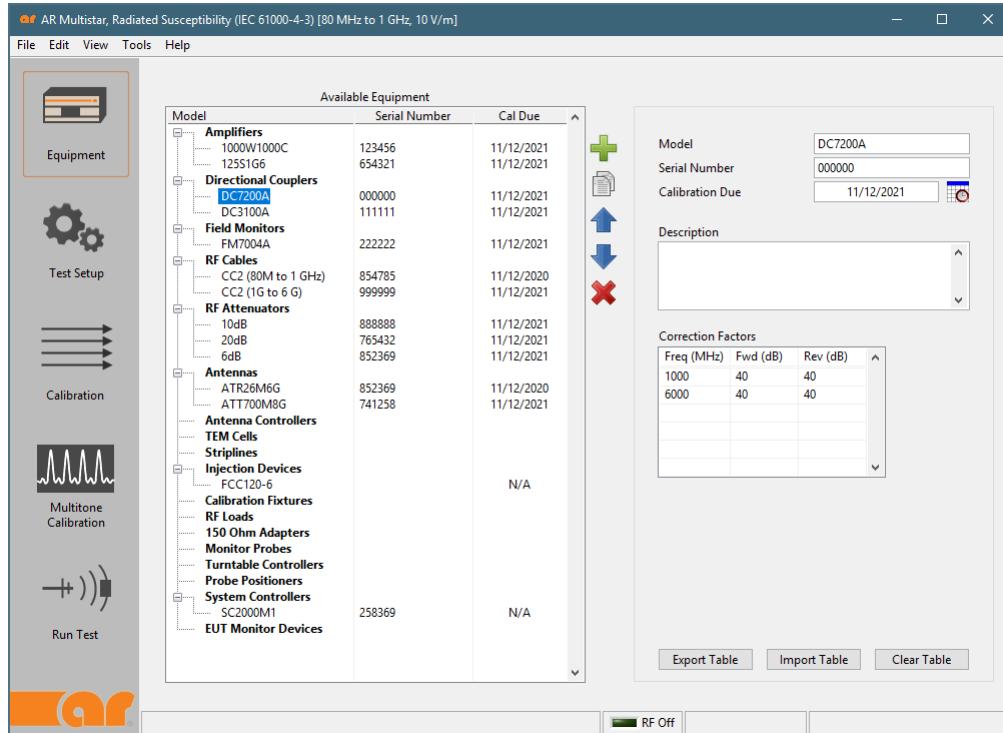


Figure 4-4.

### 4.2.3 Loading Field Monitors

Adding the field monitor follows the same procedures as the amplifier (Figure 4-5).

Note that the driver and GBIB address need to be selected. The correction factors, composite, or x, y and z parameters can be entered manually or by importing a **csv** file by selecting import table. To save the correction factor table to a **csv** file, select **Export Table** button. The **Clear Table** button will remove all the parameters in the correction factor table.

You have the option of selecting a check box titled **Use internal correction**, which uses the correction factors stored in the field monitor.

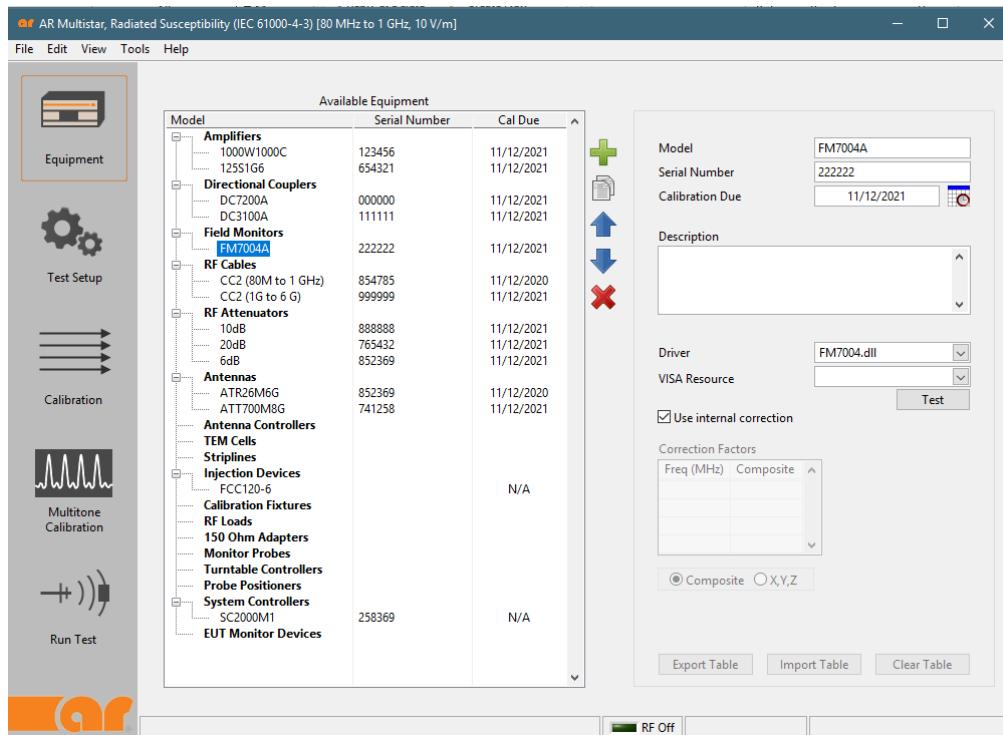
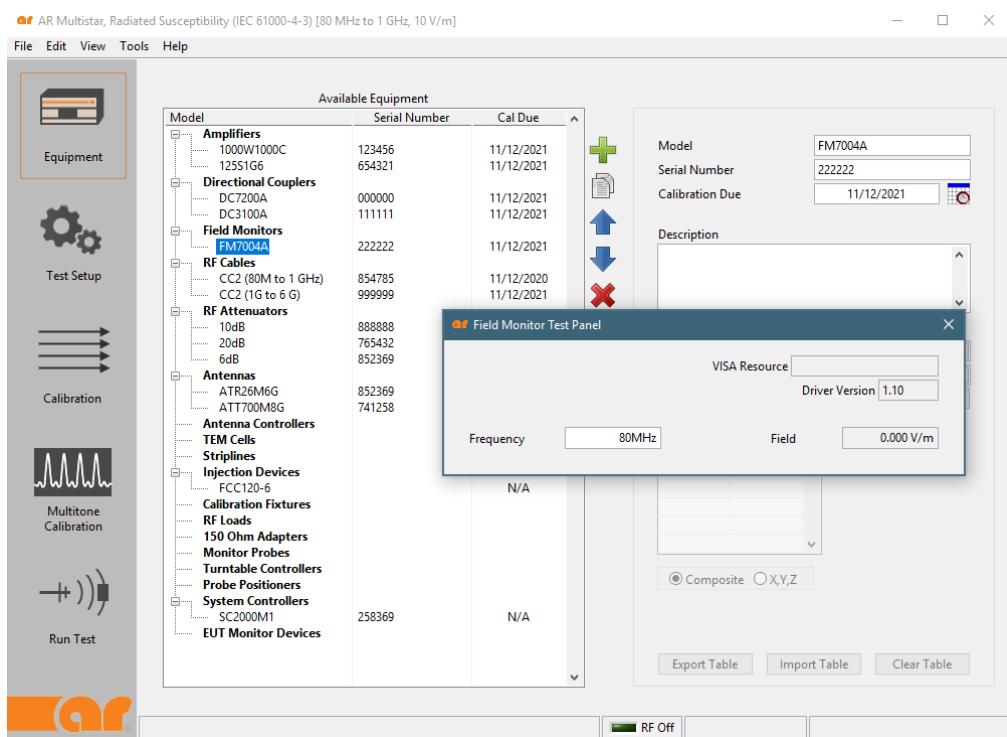


Figure 4-5.

Like the amplifier, you can test the field monitor by selecting the **Test** button. This will display the **Field Monitor Test Panel** (Figure 4-6).

At this point, the user can type in the frequency of interest, and the software will display the field strength from the field monitor probe. This test demonstrates that the field monitor and field probe are communicating with the multi-tone software.



**Figure 4-6.**

## 4.2.4 Loading Antennas and Antenna Controllers

Like the directional coupler, you can add all of the antennas in the lab (Figure 4-7). Again, the user can manually enter the model, serial number, calibration due date and a brief description which will appear on the report.

The antenna gain factors can be entered manually or by selecting **Import Table** button to import a csv file. Antenna gain factors can be saved to a csv file via the **Export Table** button.

The horizontal and vertical height should be entered especially if an Antenna Controller is used. The antenna controller uses this information to set the antenna position when going between horizontal and vertical heights.

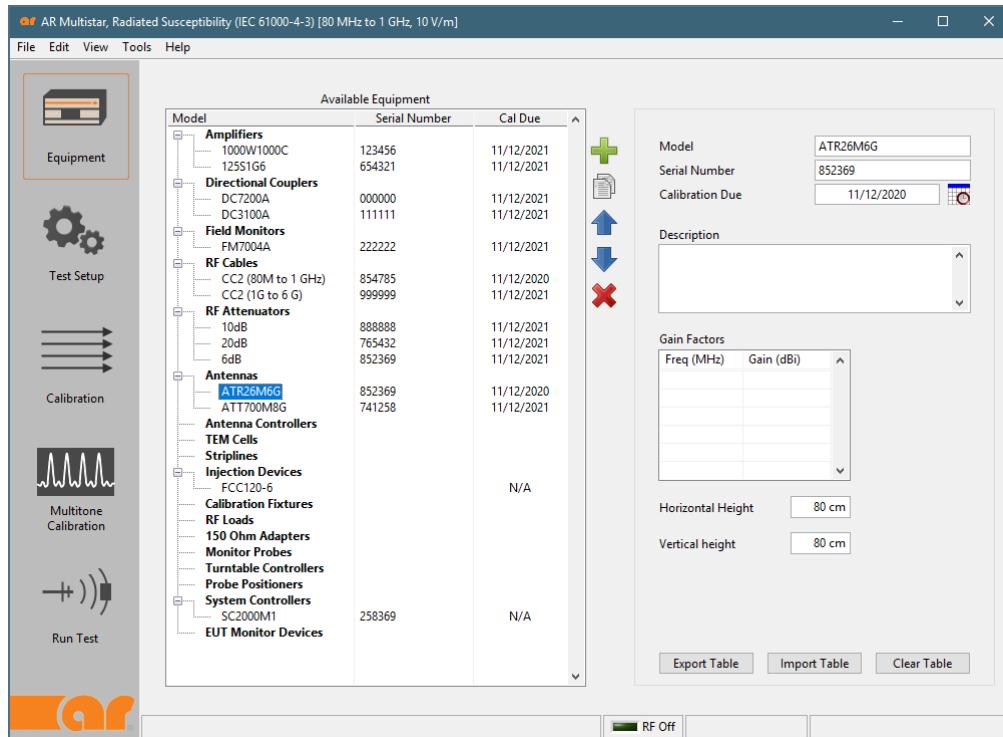


Figure 4-7.

The antenna controllers can be added in the same fashion as the other equipment.

Like the amplifier, you can test the antenna controller by selecting the **Test** button. This will display the **Antenna Controller Test Panel** (Figure 4-8).

The user can set the **Polarization** and **Upper & Lower** limits plus the **Height** in centimeters.

Next, select the **Set** button. The antenna should rotate to the entered polarization and height. The **Current Height** will display the antennas height in centimeters.

## Model MT06002

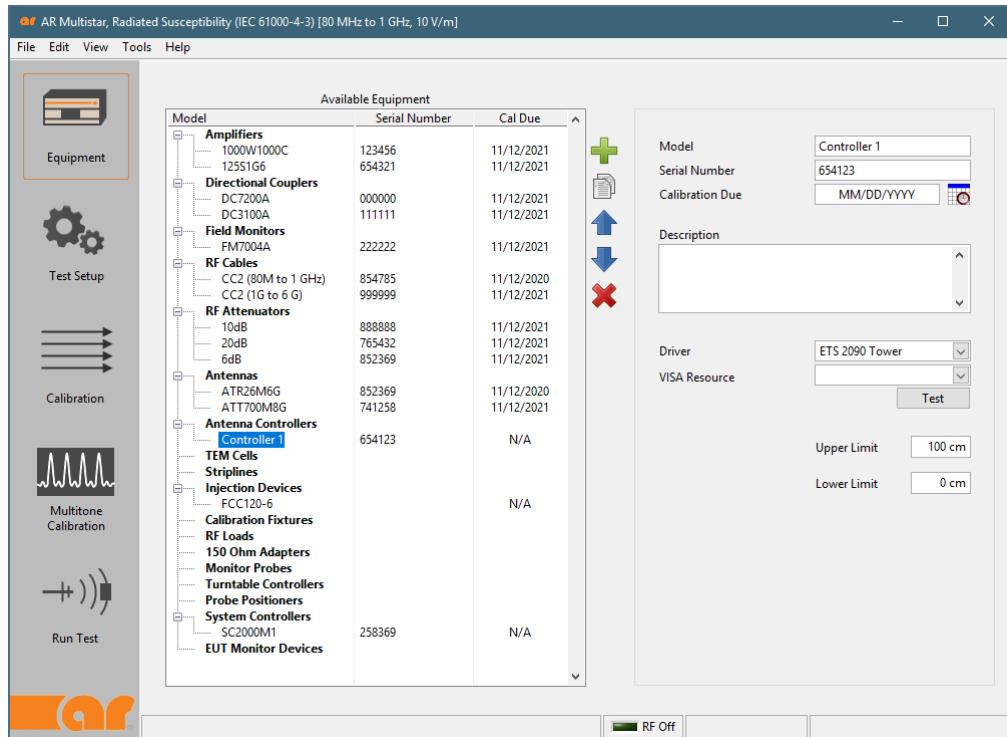


Figure 4-8.

## 4.2.5 Loading the Turntable Controller

Again, the user can manually enter the model, serial number, calibration due date and description of the turntable controller (Figure 4-9).

You'll need to select a driver for the turntable controller and the GPIB address. Then you are ready to test the turntable controller by selecting the **Test** button.

The turntable controller test panel will be displayed. The user can set the clockwise and counter clockwise limits plus the position in degrees.

Next, select the **Set** button. The turntable should rotate to the entered position and should display the corresponding "set" position in degrees.

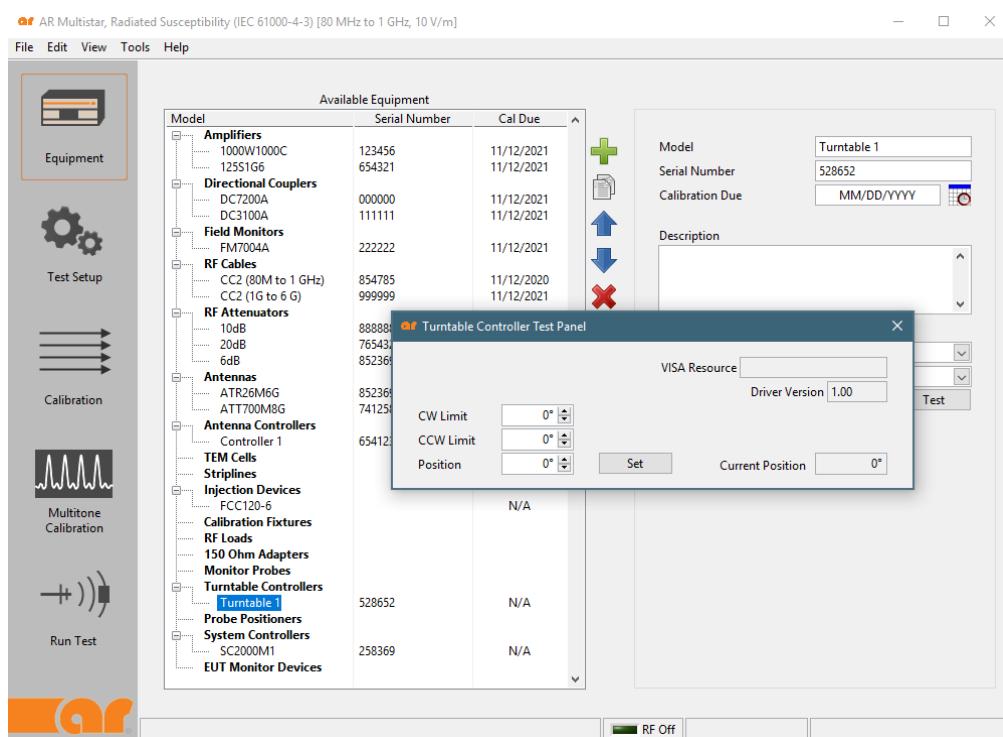


Figure 4-9.

## 4.2.6 Loading the Probe Positioner

Moving on to the probe positioner, again, the user can manually enter the model, serial number, calibration due date and description, and select the probe positioner driver along with the GPIB address.

To test the setup, select the **Test** button and the **Probe Positioner Test Panel** will be displayed (Figure 4-10).

Enter the position information and select the **Move** command. The probe positioner should move to the entered position.

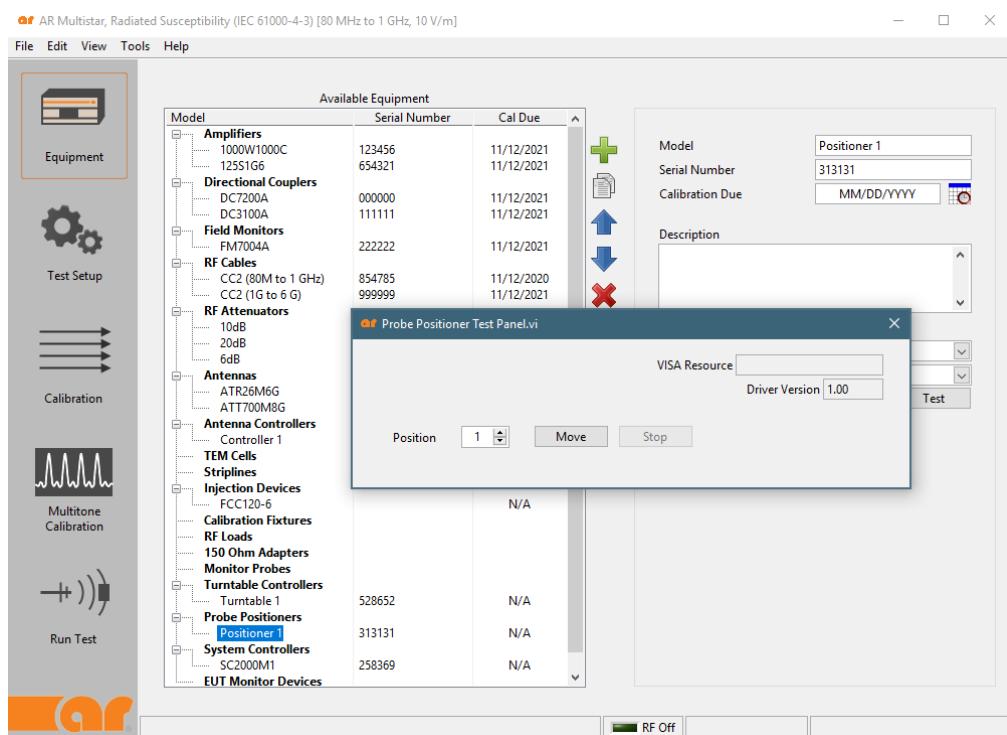


Figure 4-10.

## 4.2.7 Loading System Controller

The system controller information can be entered under the system controller folder including the model, serial number, calibration due date and description (Figure 4-11). Like most other components, you'll need to select the driver and GPIB address, and test the setup. After selecting the **Test** button, the system controller test panel will be displayed.

Select a position for each switch (1 thru 7) and then select the **Set Switches** button.

If successful, you will hear the switches moving and the **Switches set successfully** status will appear.

The interlock can be checked by removing the interlock jumper plug located in the back of the multi-tone system. The status box should report an **interlock fault**.

Reinstall the interlock plug and check the status. The interlock fault should disappear. Use the **Reset** button to reset the switches to the default position.

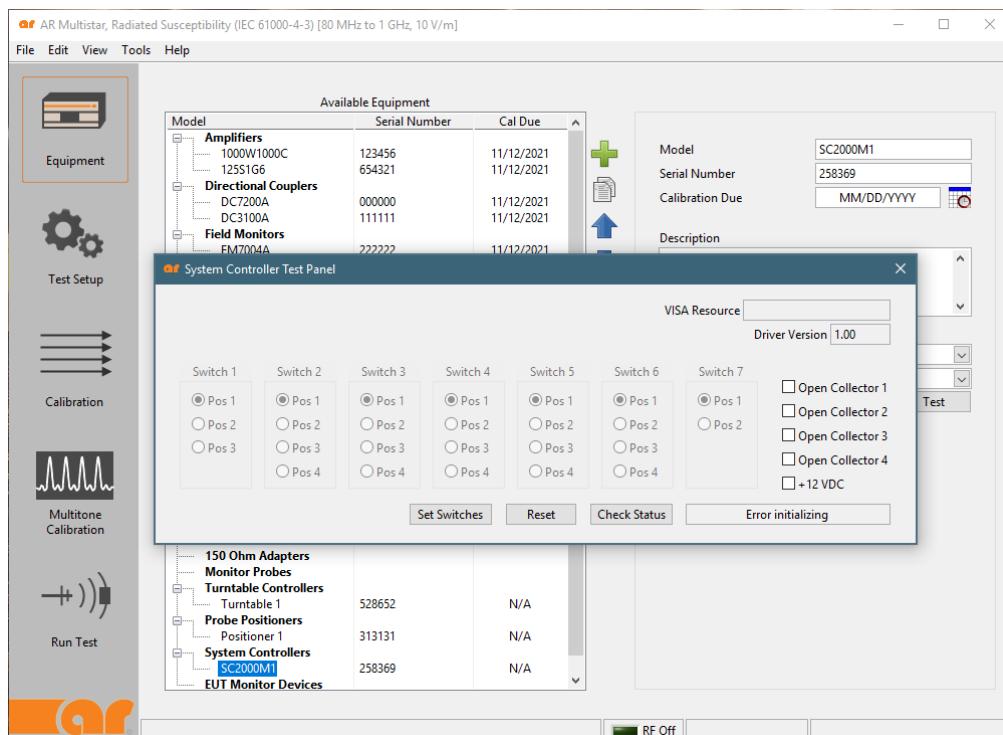
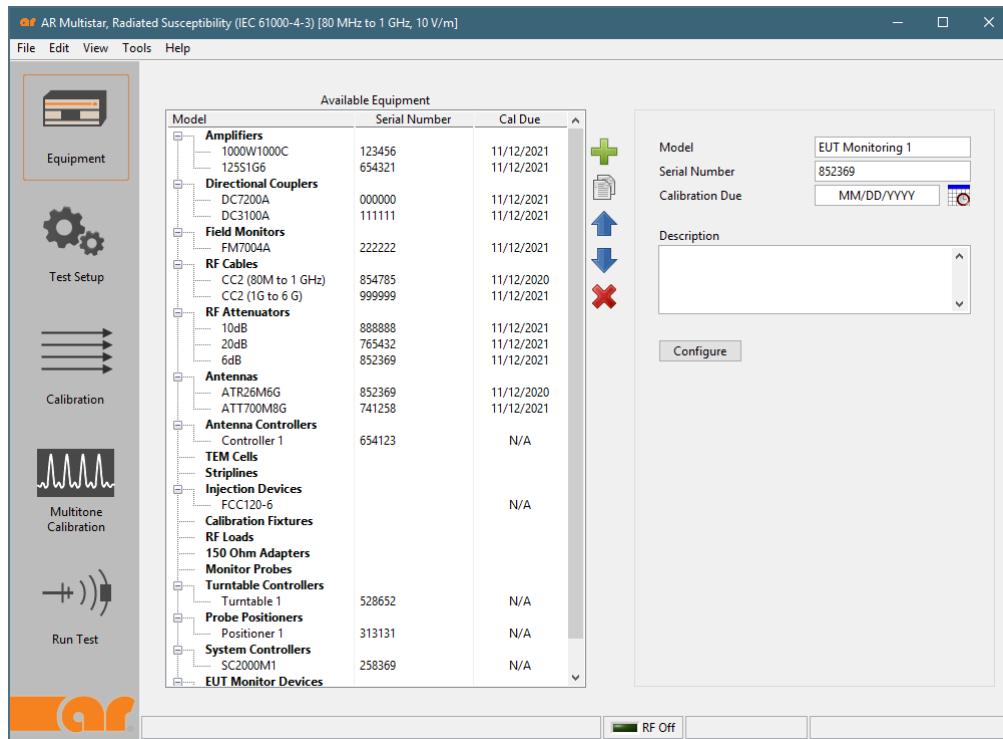


Figure 4-11.

## 4.2.8 Loading End User Testing Monitoring Device

Add all of the remaining EUT test monitor equipment under the EUT Monitor Device folder entering the model, serial number, calibration due date and description (Figure 4-12).



|                 |                  |
|-----------------|------------------|
| Model           | EUT Monitoring 1 |
| Serial Number   | 852369           |
| Calibration Due | MM/DD/YYYY       |

|             |
|-------------|
| Description |
|-------------|

Configure

Figure 4-12

Select the **Configure** button. The **Edit EUT Monitor Device** display will be enabled (Figure 4-13).

Custom commands can be programmed to the EUT monitor equipment during various **Actions** listed on the left side of the screen. For example, a power meter initialization command could be sent during the **Start of Test** action, or a command to read the power meter could be sent during the **During the Dwell** action. You can even set the GPIB bus or serial port settings on the EUT Monitoring Devices. The flexibility gives the user unlimited customization options.

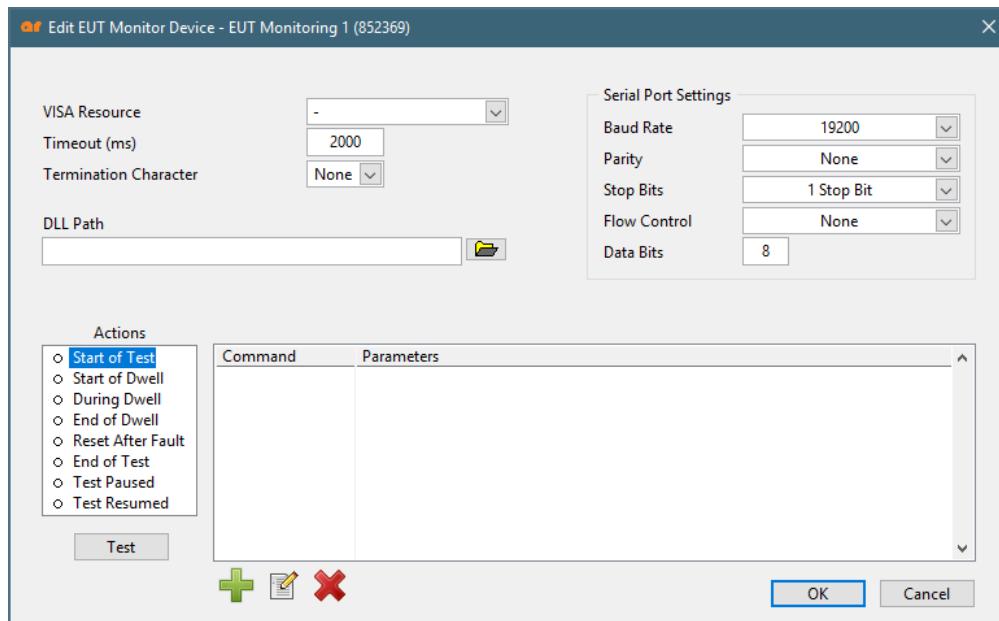


Figure 4-13.

## 4.3 TEST SETUP

### 4.3.1 Load Test Parameters

Select **Test Setup** from the left side of the screen (Figure 4-14).

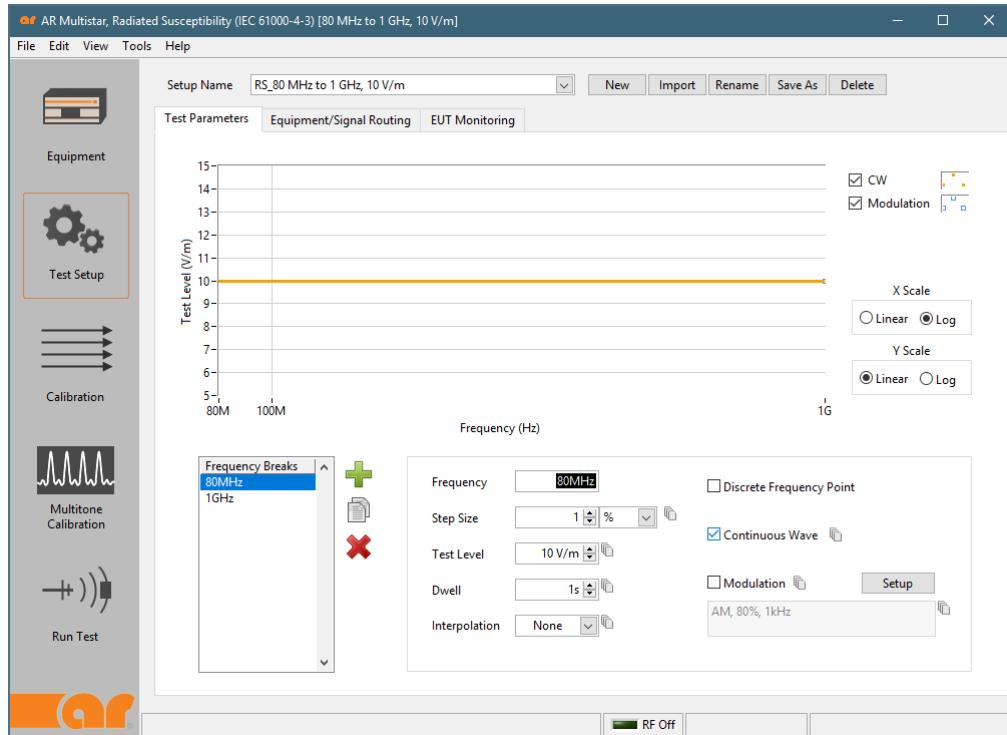


Figure 4-14.

Using the green plus sign, you can set frequency breaks by entering the frequency in the frequency box. The step size can be set in either percent or fixed frequency step size.

Interpolation between frequency steps can be set as either **None**, **Linear** or **Log**. You can use the **Discrete Frequency Point** to set a custom clock frequency or any other frequency required for testing.

Select **Continuous Wave** for **CW**. The graph will plot each segment based on step sizes, field strength and interpolation between frequency steps.

The graph has selectable scales (linear or log).

Under **Test Set-up**, select **New** to display the **New Test Setup** menu.

### 4.3.2 Selecting Test Setup

The **New Test Setup** menu (Figure 4-15) has three options: first option is to **Use a predefined standard**, second **Copy an existing test setup**, or third to **Create a new, blank test setup**.

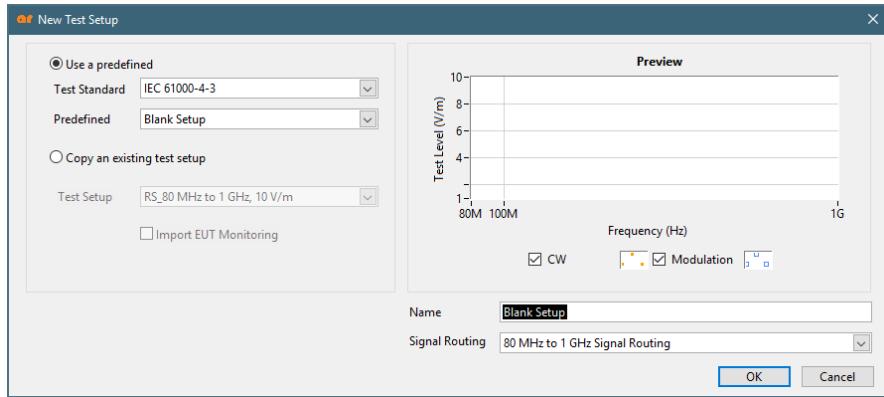


Figure 4-15.

### 4.3.3 Modulation Setup

From the bottom right corner of the screen, select the **Modulation Setup** button (Figure 4-16). A pop-up titled **Edit Modulation** will appear. In this screen, you can select **AM** or **Pulse** Modulation.

Under AM Modulation, constant peak can be selected (Automotive). In addition, the modulation depth and frequency can be selected from drop down menus.

Under Pulse Modulation, the user needs to input both the Duty Cycle and Period.

**NOTE:** The AM Modulation and Pulse Modulation can be selected concurrently.

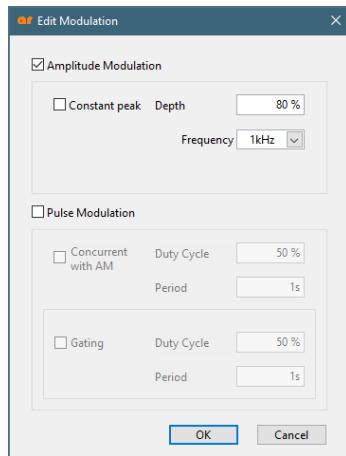


Figure 4-16.

### 4.3.4 Defining Equipment and Signal Routing

Now that you've established the test parameters, it's time to select the equipment for the test. Under the **Equipment/Signal Routing** tab (Figure 4-17), select the system controller, field monitor, probe positioner, and turntable controller. Note that all of the equipment that you loaded earlier will pre-populate this table.

In addition, the system controller (SCP2000M1) and field monitor (FM7004A) are part of the multi-tone system so these will be preloaded as well.

You can click on the plus sign to set up the connection for the antenna, amplifier, antenna controller and directional coupler.

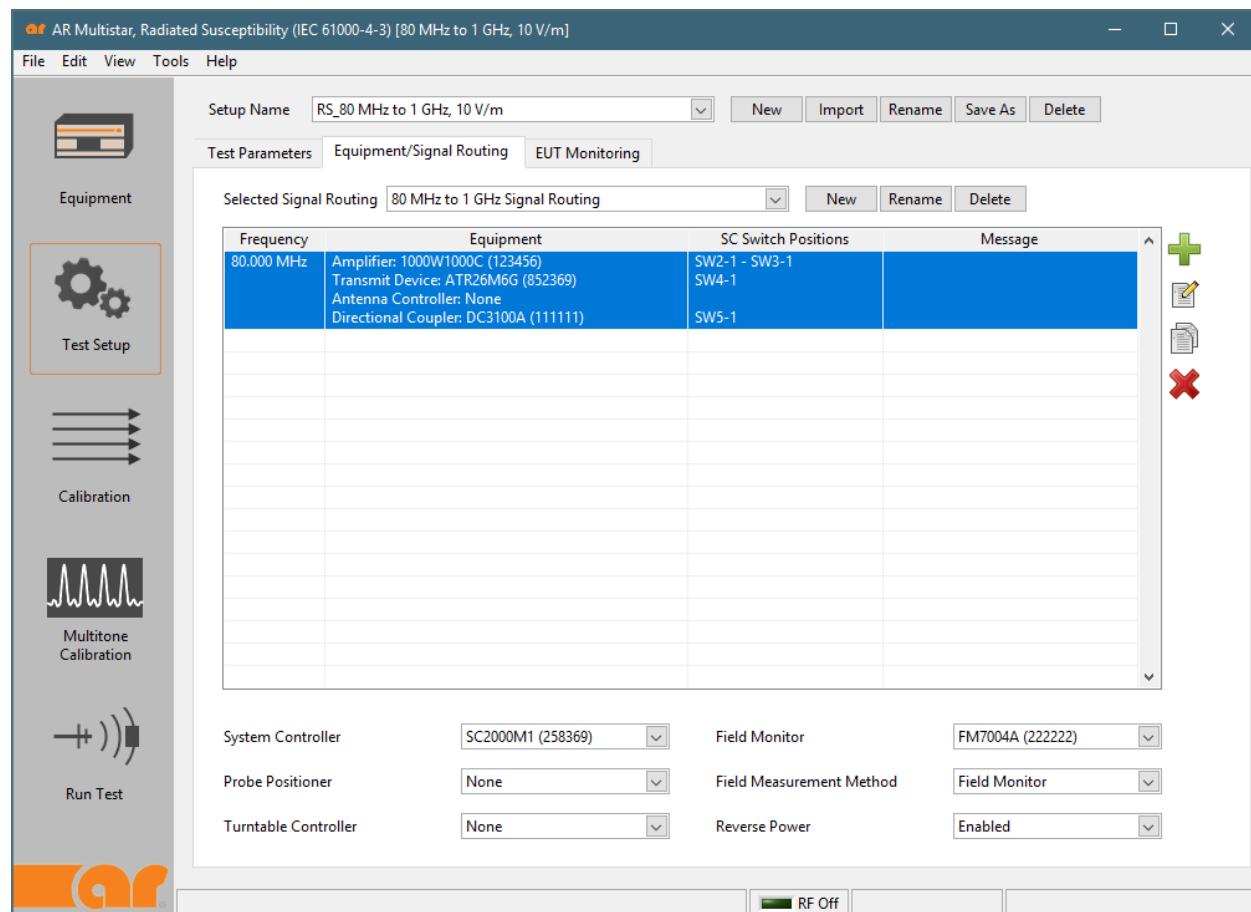


Figure 4-17.

### 4.3.5 Setting Signal Routing Break

Under the Equipment/Signal Routing tab, when you click the plus sign, the **Edit Signal Routing Break** menu will be displayed (Figure 4-18).

From here, you'll: enter the start frequency, assign the appropriate amplifier signal out from the vector signal generator, direct the output of the amplifier to the appropriate antenna, select the antenna controller, and route the directional coupler (located on the output of the amplifier) forward power to the vector signal analyzer to measure amplifier output power.

The SCP2000M1 has auxiliary inputs if custom monitoring is required.

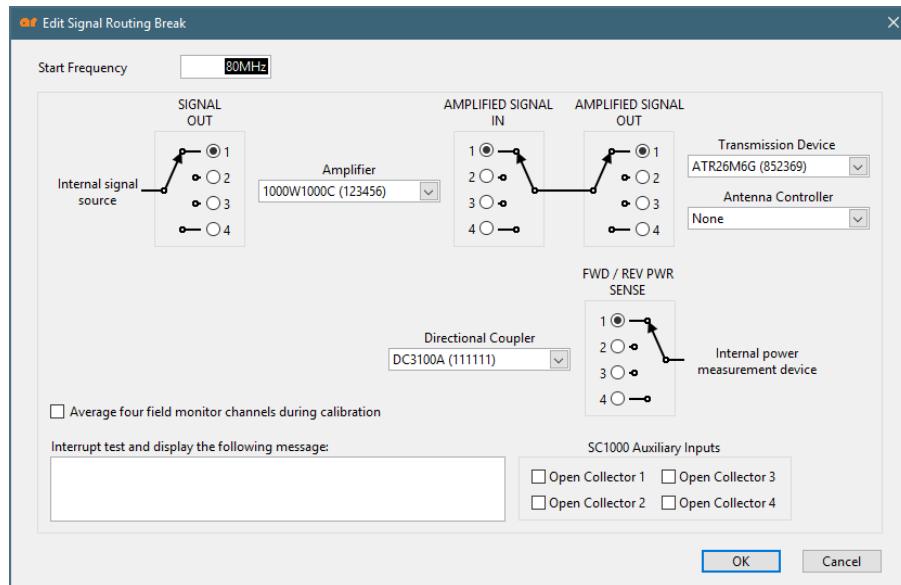


Figure 4-18.

### 4.3.6 Selecting Dwell Settings

If EUT monitoring equipment is used, the user can customize any equipment that interfaces via the GPIB or serial buses. In addition, you can customize the EUT Reset by either sending a command or manually resetting the EUT (Figure 4-19).

Note that in the lower left portion of the screen, you have the option to preselect the behavior should a failure be detected during the dwell. Your choices are: to automatically switch to test individual tones, to pause the test and display the Report event window, or to mark the failure and continue with the next set of tones.

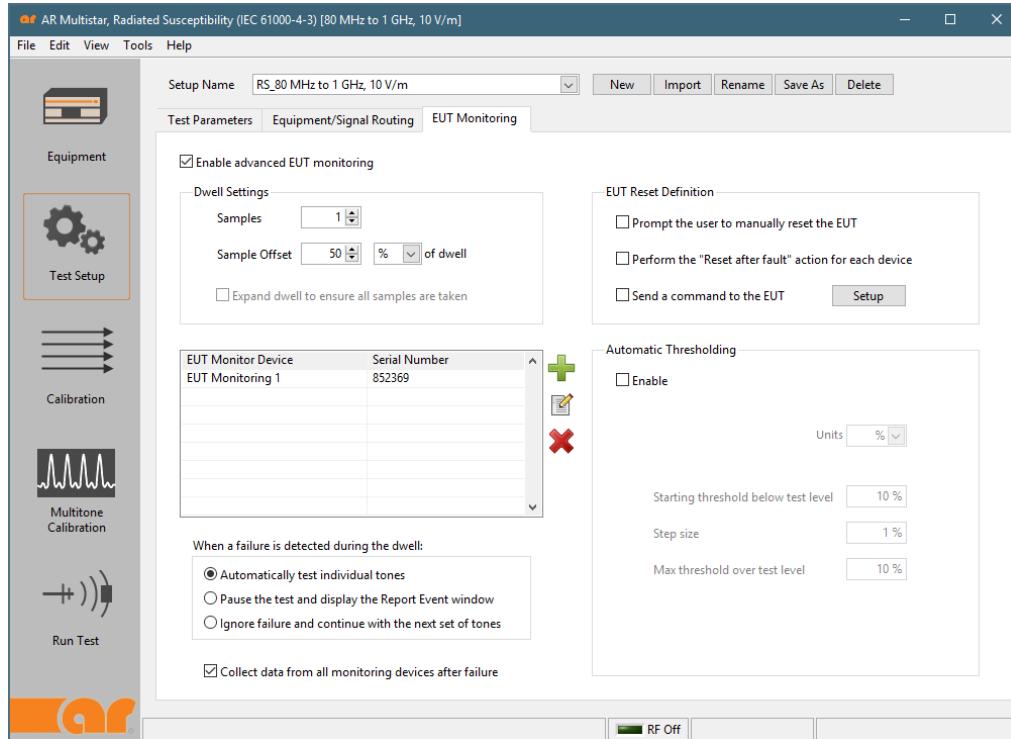


Figure 4-19.

## 4.4 CALIBRATION OF FIELD UNIFORMITY

Select the **Field uniformity** option and then select the **Play** button. The field uniformity options menu will be displayed (Figure 4-20). The user has the option of leveling on constant field or constant power.

The number of positions is selectable from 1 to 16 positions. The power level between frequency steps can be **Unchanged**, or **Drop and Re-level**. The drop and re-leveled power is reduced by the user-selected level.

The starting drive level can be set, but this only applies to the first frequency step. At this point, the field leveling tolerance and power leveling tolerance can be set as well.

Select the **Next** button and additional field uniformity options will be displayed.

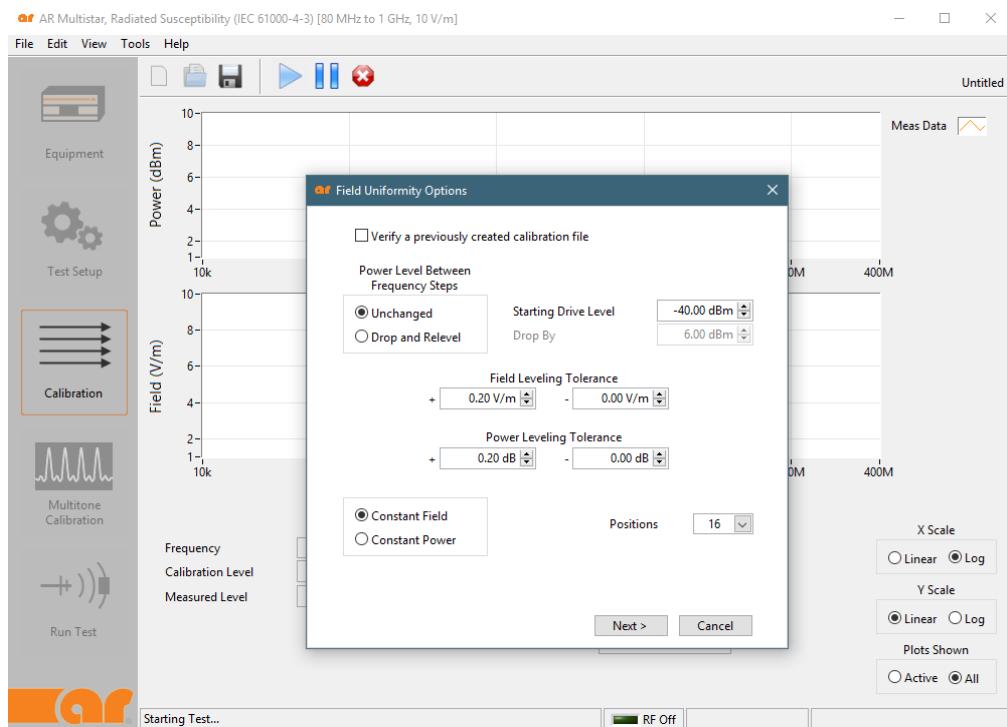


Figure 4-20.

#### 4.4.1 Select Antennas to Calibrate and Antenna Polarization

From here, you will select the antennas and associated polarization to be calibrated (Figure 4-21).

The antenna polarization is selected from the following options:

- vertical only
- horizontal only
- vertical then horizontal
- horizontal then vertical

In this example, the antenna's vertical position will be calibrated first then the horizontal position.

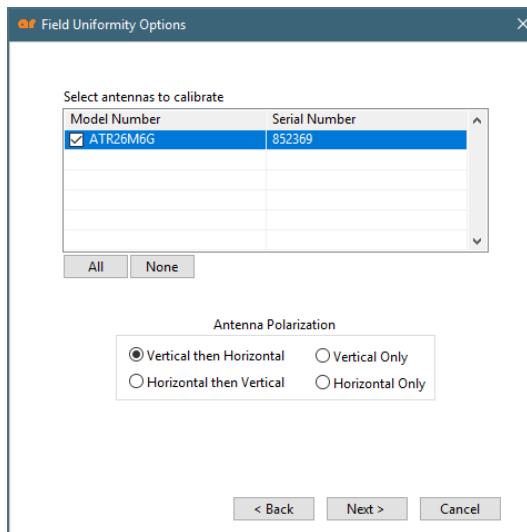


Figure 4-21.

#### 4.4.2 Loading EUT Test Information

On the Test Information screen (Figure 4-22), you will enter the test information that will appear on the calibration test report. Once you press Run, you will return to the Field Uniformity screen.

Figure 4-22.

### 4.4.3 Running Calibration, Field Uniformity

The calibration is now ready to run (Figure 4-23).

Since in this example, the field probe will be placed in four positions, you will be prompted to set the probe to **position 1**. After you set the field probe to position 1, press **Continue**.

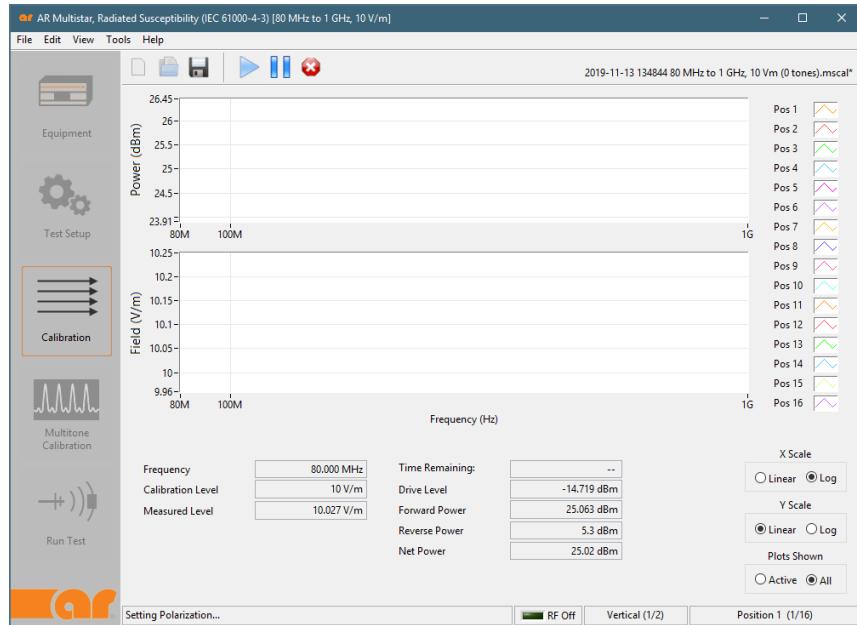


Figure 4-23.

Once you press **Continue**, the Calibration (field uniformity) test will begin. Based on one tone, the objective is to level the field strength based on test setup calibration requirements within the field strength tolerances defined earlier.

The amplifier's forward power and the field probe's measured field strength are plotted.

In addition, the drive level from the VSG, amplifier forward power and field strength are measured and recorded in tabular form.

A series of status bars are listed across the bottom of the screen.

These displays indicate:

- what the software is doing (measuring field and power)
- whether or not RF is On by the color of the LED being green or red
- the position of the field probe
- the polarization of the antenna

In this example, vertical polarization was selected first (Figure 4-24).

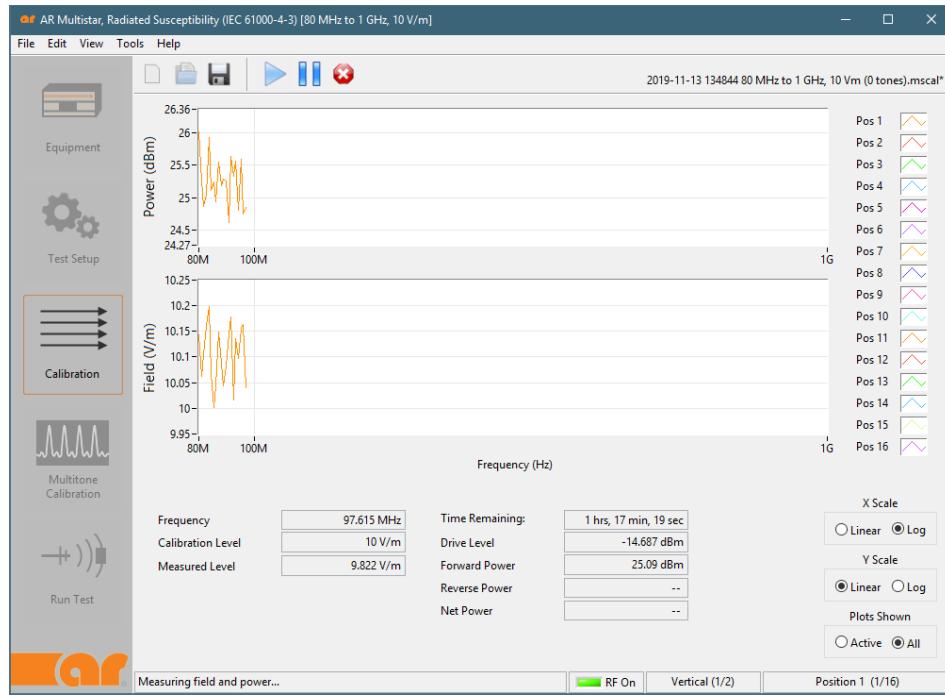


Figure 4-24.

After completion of position 1, the software will prompt the user to move the field probe to the next position. (In this case position 2.) Click **Continue** and the software will repeat the measurements at **Position 2**. This process will be repeated for each position and polarity.

After the field uniformity test is completed a message at the bottom of the screen will display: **Calibration finished**.

After the calibration is completed, the software will prompt the user to select a file name to save the field uniformity calibration file (Figure 4-25).

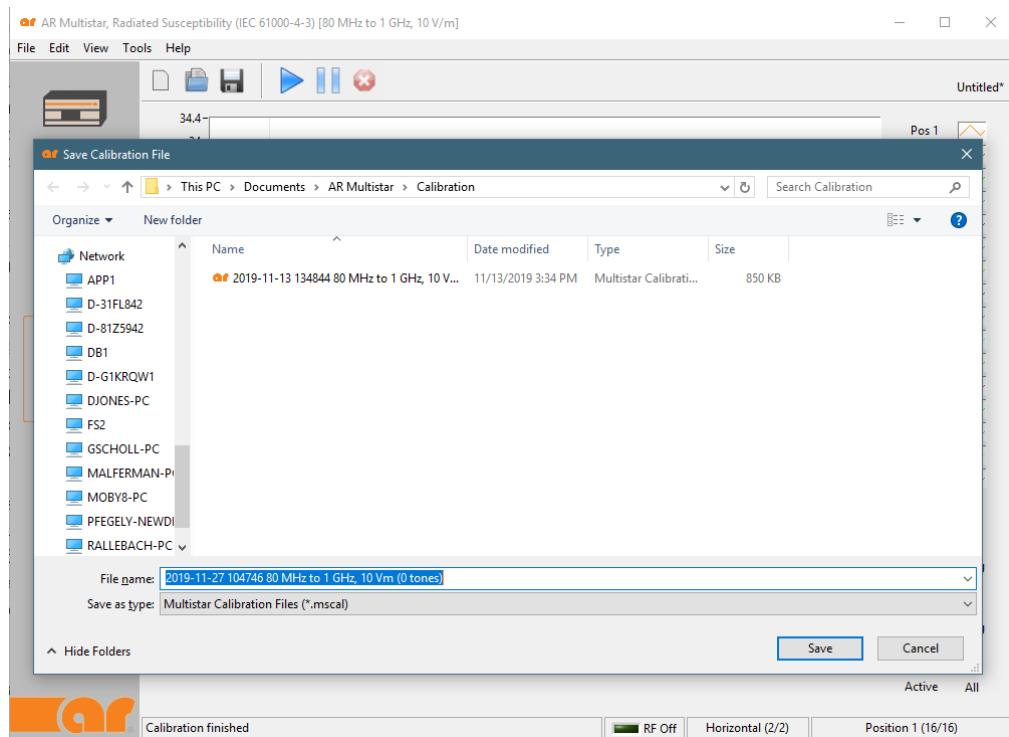


Figure 4-25.

Up to now, the calibration of Field Uniformity has been per the IEC Standard 61000-4-3. With the Multi-tone system, the Field Uniformity calibration will be faster than conventional equipment because of the speed of the built in PXIe bus.

The second part of the calibration is to calibrate the tones as a set, which is the only step required above and beyond the IEC Standard.

## 4.5 MULTI-TONE CALIBRATION

It is important, at this point, to check the linearity at the 2dB compression point and check the harmonics level.

To begin, from the left side of the screen, select **Multi-tone Calibration**.

Select the **Play** button and on the display **Multi-tone calibration** options will appear.

The user has the choice of how the calibration can run.

- One method is to start with one tone and increase the level, until the limit is exceeded.
- The second method is to start with multiple tones (based on what the user has selected) and decrease (if necessary) until within limits. This is the preferred way because it is faster because all the tones are tested at the same time instead of one at a time.

The user can select the number of tones per each set, in addition to establishing the linearity and harmonic limits.

The default values are **3.1dB** for linearity and **6dBc** for harmonics.

Finally, the positive and negative power level tolerances can also be entered.

### 4.5.1 Selecting Calibration Options

Under **Multi-tone calibration**, set calibration option, input linearity, harmonic limits and input power leveling tolerance (Figure 4-26).

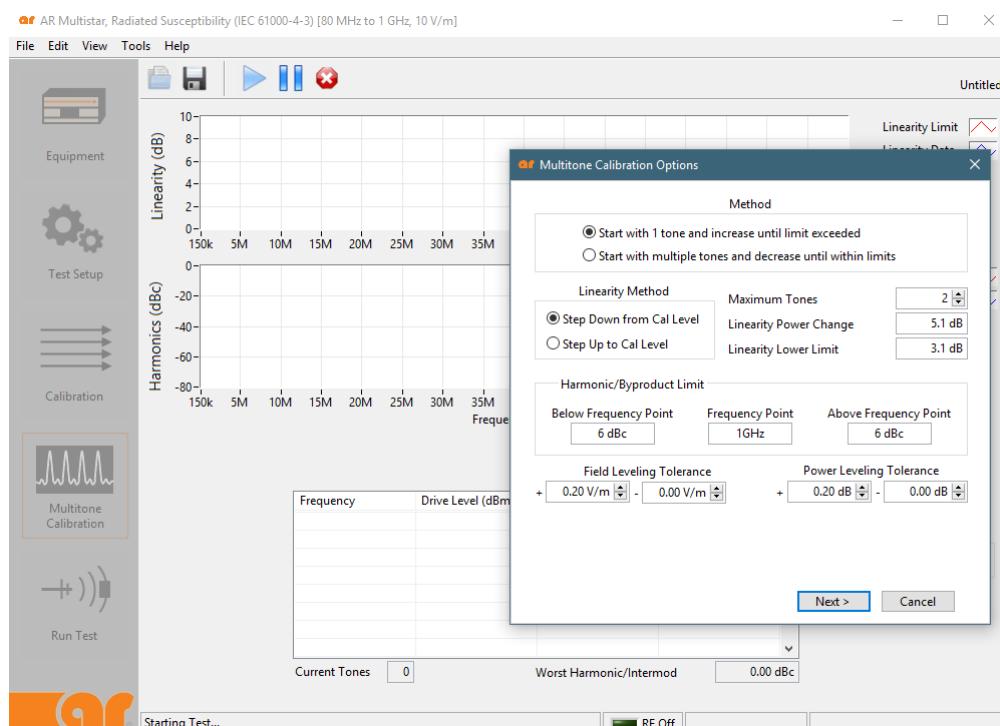


Figure 4-26.

## 4.5.2 Selecting Antenna to be Calibrated and Antenna Polarization in Multi-Tone Environment

Click **Next** for additional calibration options. The user needs to select the antennas to be calibrated. (Figure 4-27)

In addition, the antenna polarization vertical or horizontal options need to be selected. Under **Multi-tone Calibration**, select the antenna to be calibrated and polarization type and sequence.

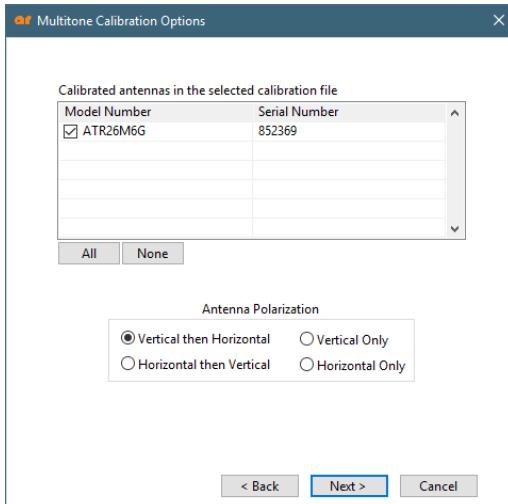


Figure 4-27.

The test information needs to be filled out for the calibration test report (Figure 4-28). Then click **Run**

Under **Multi-tone Calibration**, complete test information for test report.

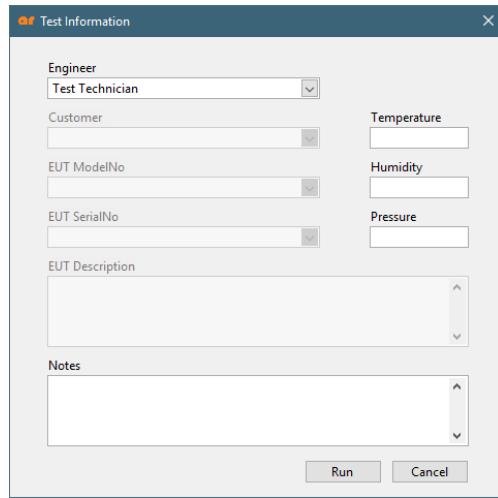


Figure 4-28.

The software will prompt the user for the antenna polarization that needs to be setup. Select **Continue**.

Under **Multitone Calibration**, set up polarization type.

Based on the number of tones the user selected, the predefined linearity, harmonic criteria, and the testing method, the software will test for linearity and harmonics with as many tones as will pass.

Note that when you selected the multi-tone calibration options, you determined whether to start with one tone and add additional tones or start with multiple tones and eliminate one tone at a time.

The number of tones is based on two things: amplifier power and the tone spacing not larger than 150 MHz.

The software will record:

- the frequency in each set
- the VSG drive level
- the amplifier forward power
- the linearity
- the worst harmonic/intermod in that set of frequencies

Under **Multitone Calibration**, under the first polarization type, test the linearity and harmonics (Figure 4-29).

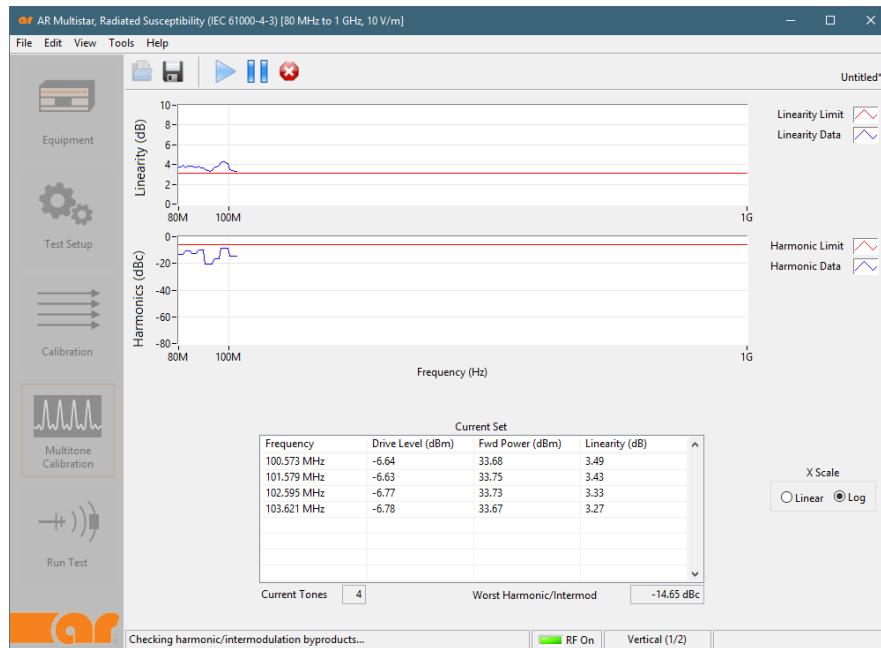


Figure 4-29.

The linearity and harmonic will be recorded for each set of frequencies across the band.

After vertical polarization is completed, the software will prompt you to set up the antenna to the horizontal position.

Click **Continue**.

Under **Multitone Calibration**, the software will record the linearity and harmonics and prompt for the antenna's second polarization type.

The software will repeat the linearity and harmonic measurement in the horizontal position.

Under **Multitone Calibration**, the software will prompt for the second polarization type, and measure the linearity and harmonics.

After calibration is completed, you are ready to save the multi-tone calibration by selecting the **Yes** button.

## 4.6 RUNNING A MULTI-TONE TEST

On the left side of the main screen, Select **Run Test** and then select **Play** button.

Under Run Test, we're ready to run the test. (Figure 4-30)

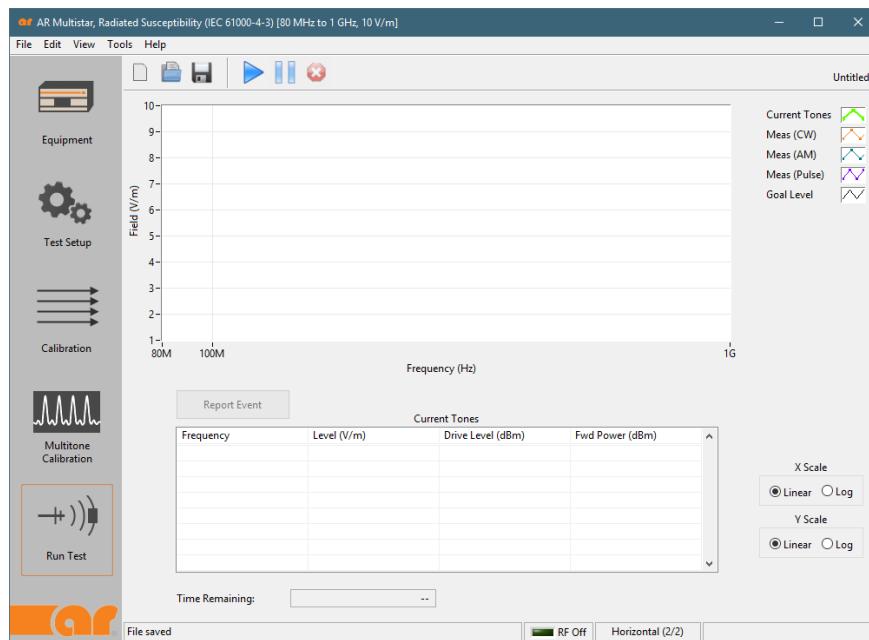


Figure 4-30.

After selecting the play button, the final test options will be displayed.

### 4.6.1 Selecting Calibration File, Total Number of EUT Sides, and Entering Test Information

The **Calibration File** needs to be selected. The user chooses between the following two test options:

- select EUT sides before changing antenna polarization, or
- select polarization before changing EUT sides

The **Total Number of EUT Sides** needs to be selected. A side is equivalent to an EUT surface. If all EUT sides are not requested, the user can specify the EUT sides that need to be tested. The dwell time and the power leveling tolerance are set here.

Click **Next**. (Figure 4-31)

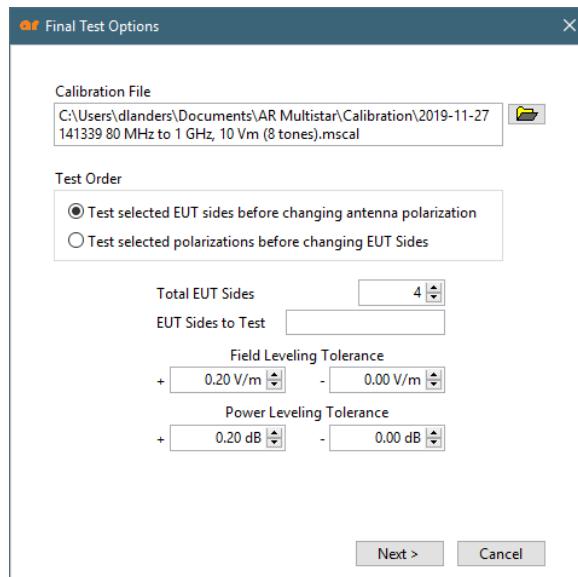


Figure 4-31.

The information for the antenna can be selected here (Figure 4-32).

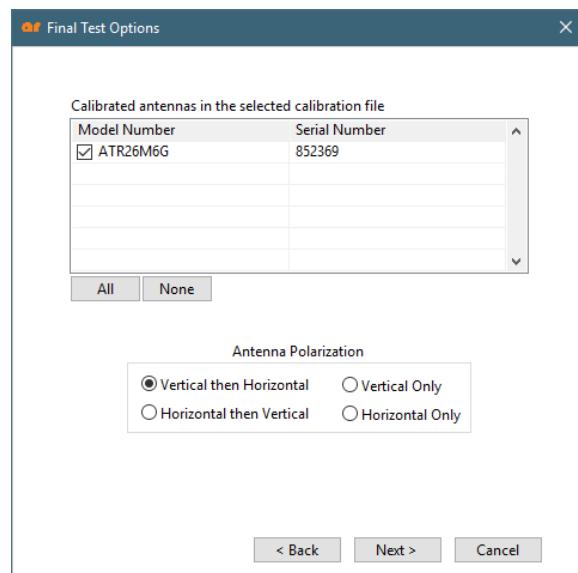


Figure 4-32.

The test information for the test report can be entered here (Figure 4-32).

Click **Run**.

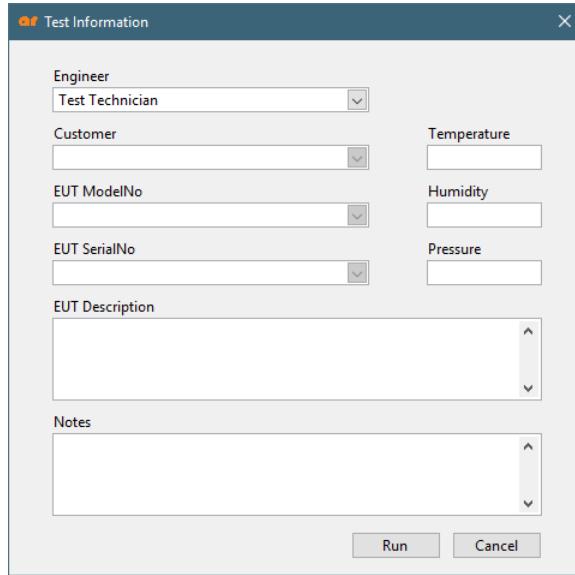


Figure 4-33.

The software will set the number of tones per the calibration and re-level to the calibration level.

After the set of tones are re-leveled, the software will dwell for the amount of time set by the user.

#### 4.6.2 Running the Test and EUT Failure (Report Event)

Under Run Test, the test will begin (Figure 4-34).

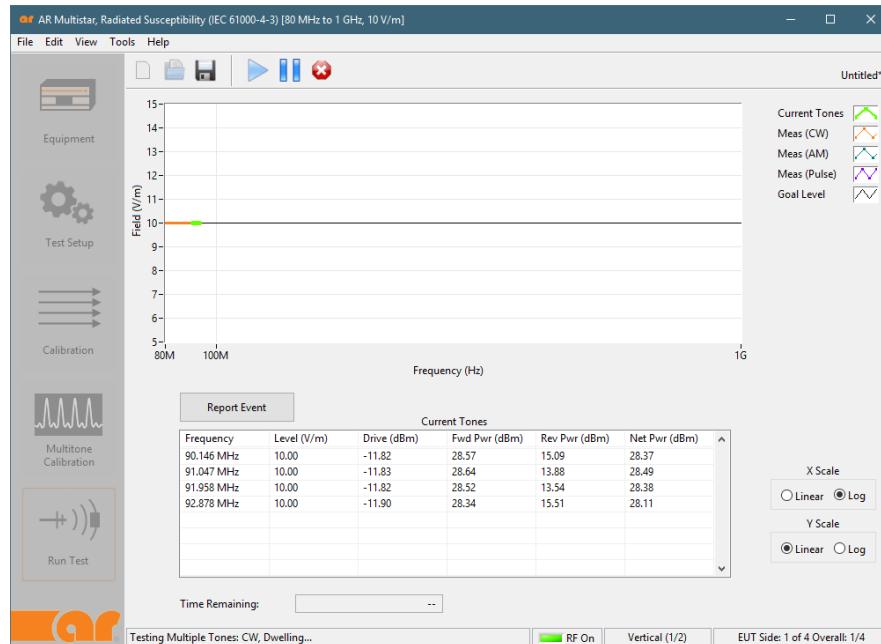


Figure 4-34.

After each set of tones is completed, the software will plot the frequency coverage for that set in blue, and the number of current tones being generated in green.

If there is a EUT failure during these set of tones, the **Report Event** button can be selected to isolate which frequency is causing the problem (Figure 4-35).

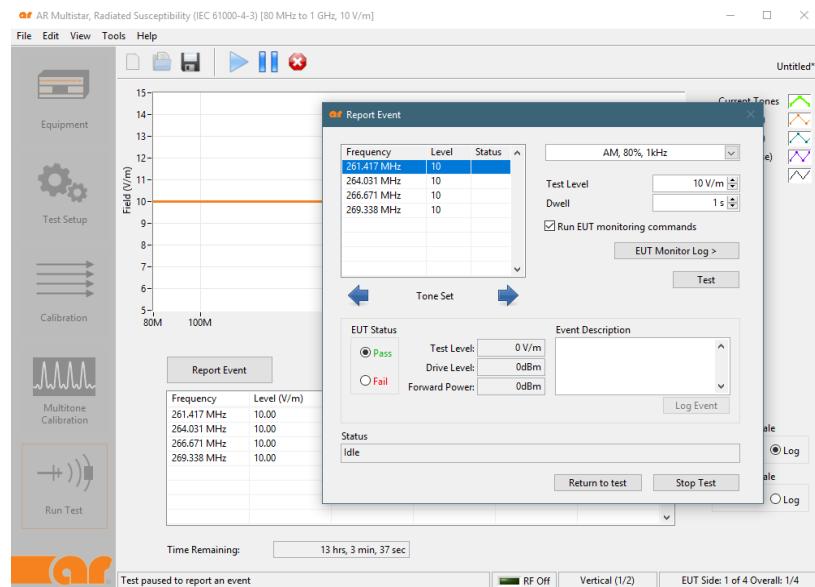


Figure 4-35.

The **Report Event** menu will be displayed. The test is paused and the user can select a frequency from the set of tones displayed.

The test level and dwell setting can be adjusted if required. A pass or fail EUT status can be selected and event description can be entered.

Select the **Test** button. The test level and dwell will run the level and the amount of time selected.

Select the **Continue** button and the test will go to the next set of tones.

Under **Run Test**, select **Report Event** (Figure 4-36).

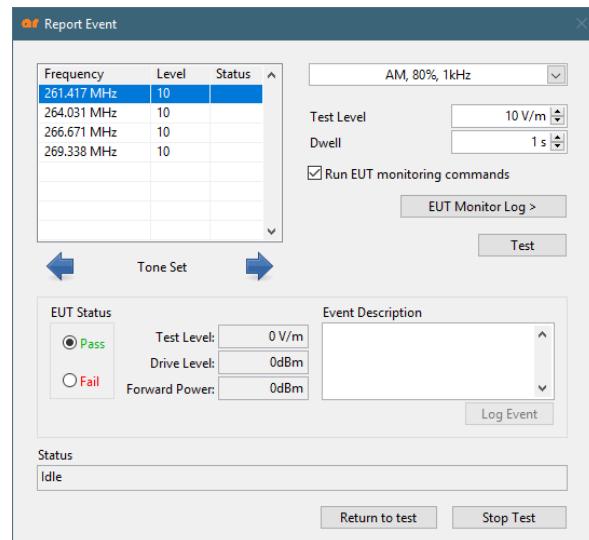


Figure 4-36.

### 4.6.3 Saving the Test Results to a File

After the test is completed, select a file name to save the test.

Under **Run Test**, select of create the file name to save the test results (Figure 4-37).

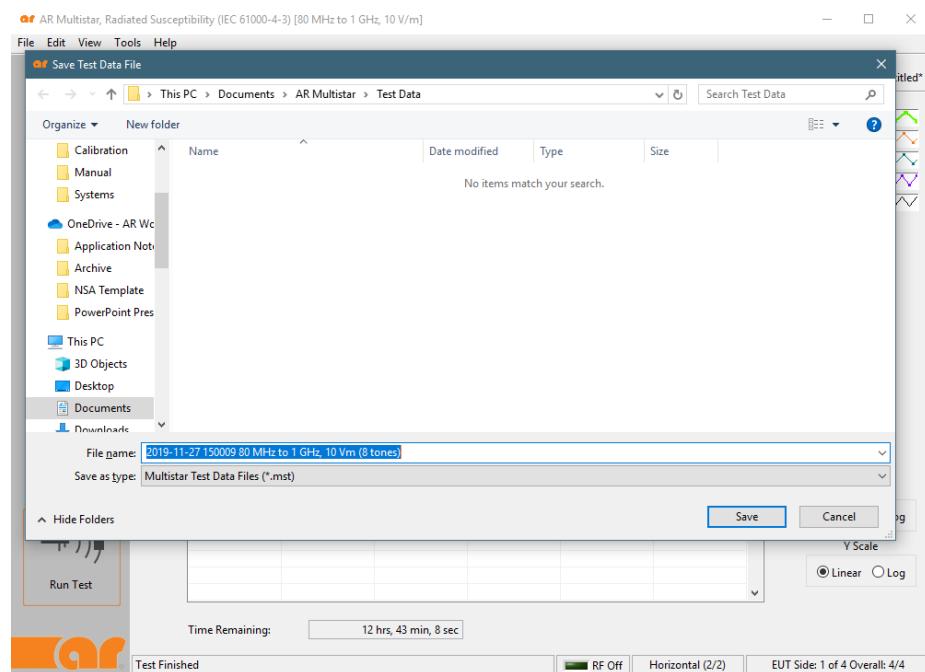


Figure 4-37.

## 4.7 CALIBRATION VERIFICATION

Once the calibration tests are completed, the user has the option to verify the field uniformity test at his or her leisure.

To verify field uniformity, check the box **Verify a previously created calibration file**.

Under the calibration file, select the calibration file that will be verified.

Set the field verification tolerance, specify the probe position, and then click **Next**.

Under **Field Uniformity**, select **Options**. (Figure 4-38)

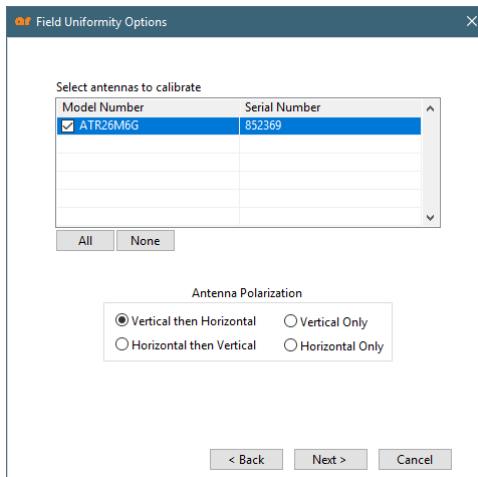


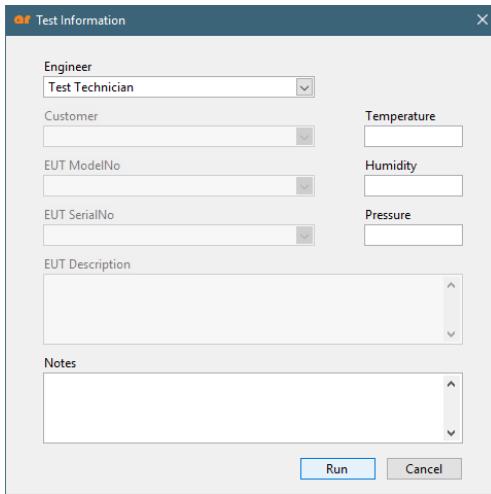
Figure 4-38.

You now need to select the antenna to be verified under **Select antennas to calibrate**. Select the antenna polarization.

In this example antenna **ATR26M6G** and polarization **Vertical then Horizontal**

Select the **Next** button to continue.

The test information entered on this screen will be used to populate the verification report.

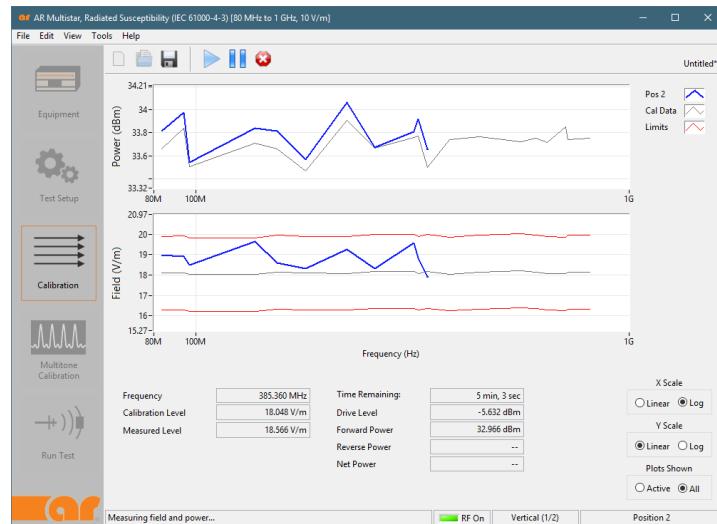


**Figure 4-39**

This next screen provides a great deal of information.

The top graph compares the power in dBm of the previous historical calibration (in gray) to the current verification power (in blue) across the frequency band.

The bottom graph displays the previous historical field strength (in gray) with upper and lower limit lines (in red). The measured field strength is then graphed in blue.



**Figure 4-40.**

After verification is complete, if there are any failures, the verification data is displayed in a tabular form.

Select **Close**.

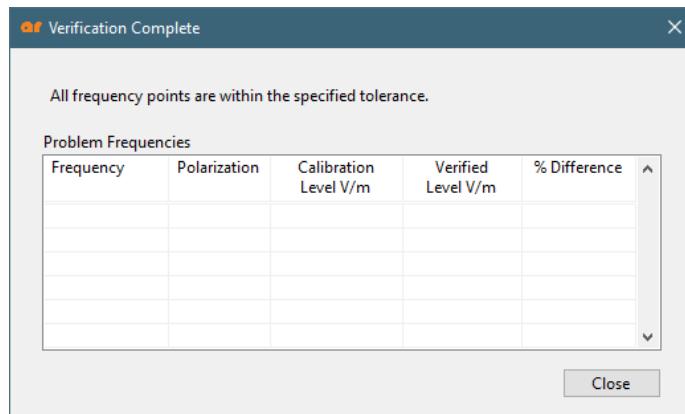
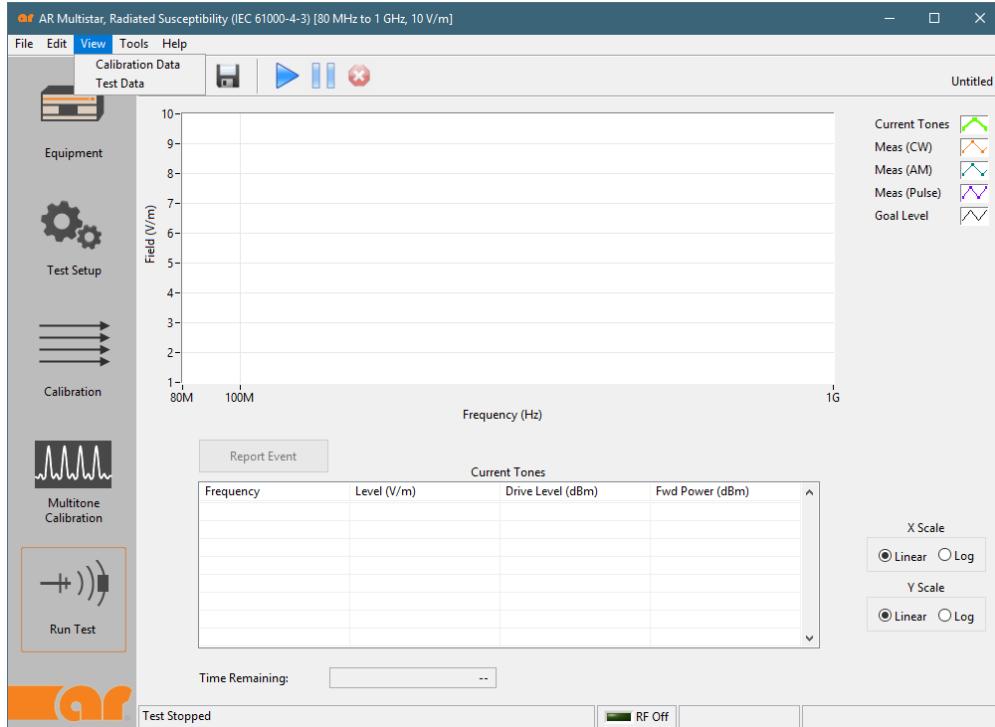


Figure 4-41.

## 4.8 VIEWING CALIBRATION AND TEST DATA

Select **View** on the Tool Bar, then **Calibration** to view the calibration data (Figure 4-42).



**Figure 4-42.**

The user can view the field strength calibration data measured with the field probe.

The graphs show the forward power and the field strengths at each position across the band.

The table below shows roughly the same data as the graphs with the addition of the VSG drive level just in tabular form.

Under **File**, select **Probe Data** (Figure 4-43).

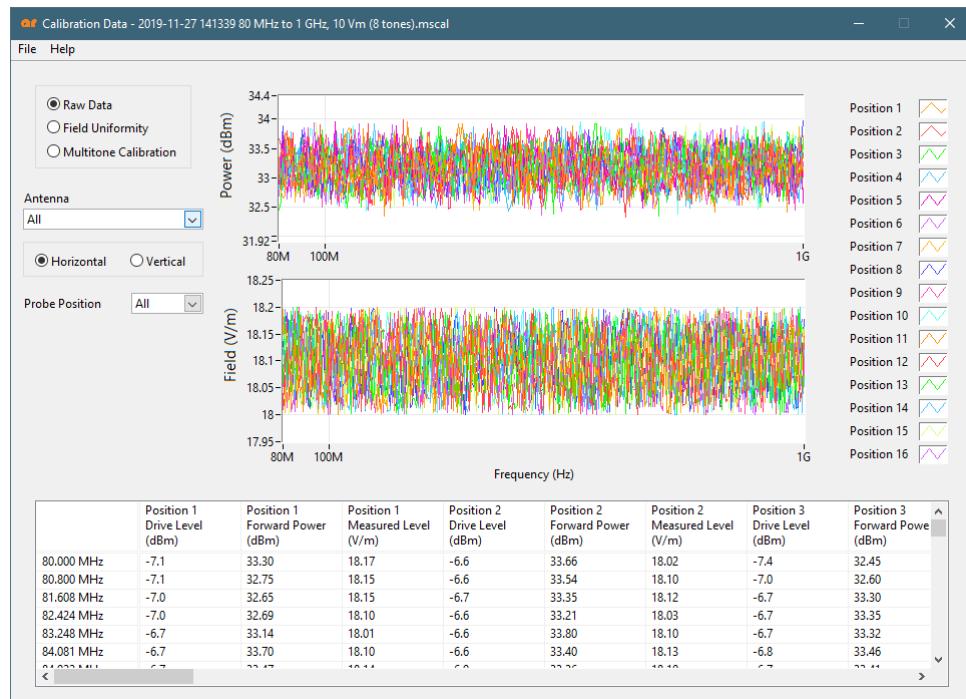


Figure 4-43.

The field uniformity calibration data can be viewed in graphical and tabular forms including the frequency, VSG drive level, amplifier forward power, measured field strength for the probe position.

Note that the table will also include whether the field uniformity passed or failed.

Under **File**, select **Field Uniformity** (Figure 4-44).

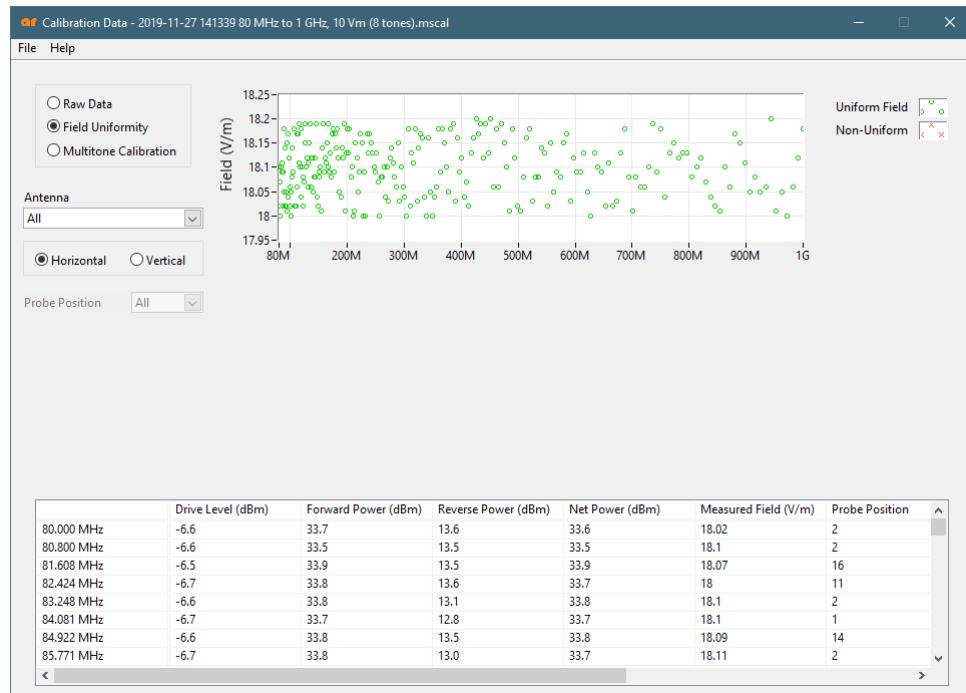


Figure 4-44.

## 4.8.1 How the Multi-Tone Calculates the Field Uniformity

The Multi-tone system calculates the field uniformity based of the IEC 61000-4-3 standard

The field uniformity area is subdivided into grid points from 4 to 16 points. The usable number of grid points is determined by the following:

- The beamwidth of the antenna
- The distance between the radiating antenna and EUT
- The size of the EUT

A grid of 16 points is illustrated.

There are two methods to calculate field uniformity: **Constant Power** and **Constant Field**.

- With the **Constant Power** method, the forward power is kept constant and the field strength is measured using a field probe.
- With the **Constant Field** method, the field strength is kept constant and the forward power is measured with a directional coupler.

The criteria for field uniformity is that, at each frequency, a field is considered uniform if its magnitude measured at each of the grid points is within 6 dB of the nominal value. The total number of grid points (within the 6 dB window) has to be at least 75% or more for the specified frequency range.

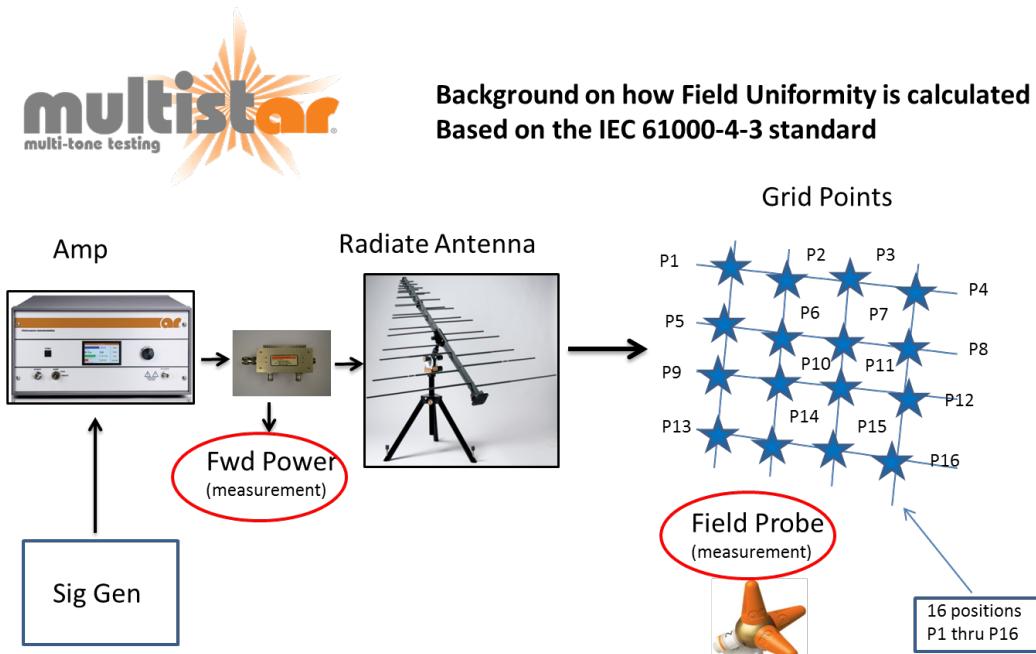


Figure 4-45.

## 4.8.2 Calculating Field Uniformity using the Constant Field Method

The following describes how field uniformity is calculated using the constant field method using a 16 point grid at one of the frequency steps. This example uses 80 MHz as a frequency).

- The IEC procedure is to level on a fixed-field strength for every grid point (in this example 16 points) and measure the forward power.
- Multi-tone software measures and records the forward power for each grid point and for each frequency step.
- Multi-tone software arranges the forward power for each grid point from highest to lowest. Starting with the highest forward power value, the software determines if at least 75 % of the grid points (in this example 12 out of 16) are within a 6 dB range. If not, then the software selects the next highest value. Software keeps repeating this until 75% of the grid points are in a 6 dB range. If not, then the field uniformity fails.
- In this example 40 dBm is the first highest forward power, and its 6 dB range is from 40 to 34 dBm (which is range 1). Of the 16-point samples, only five fall in this 6 dB range, which represents only 31.25%. Thus, this does not meet the 75% criteria and the software has to check the next highest power which is 37 dBm, range 2.
- The 6 dB forward power range is from 37 dBm to 31 dBm (Range 2). Of the 16-point samples, only eight out of 16 points fall in this 6 dB window which represents 50%. This does not meet the 75% criteria and the software has to check the next highest forward power which is 35 dBm, range 3.
- The 6 dB forward power range is from 35 dBm to 29 dBm (Range 3). Of the 16-point samples 12 out of 16 points fall in this 6 dB window, which represents 75%. This does meet the 75% criteria.
- Since this meets the 75% of the points are within 6 dB, use grid point 11 with forward power of 35 dBm to expose the EUT.
- The software will report a pass condition and record the grid point position and forward power.
- If 75% are not within 6 dB then the software will report fail.

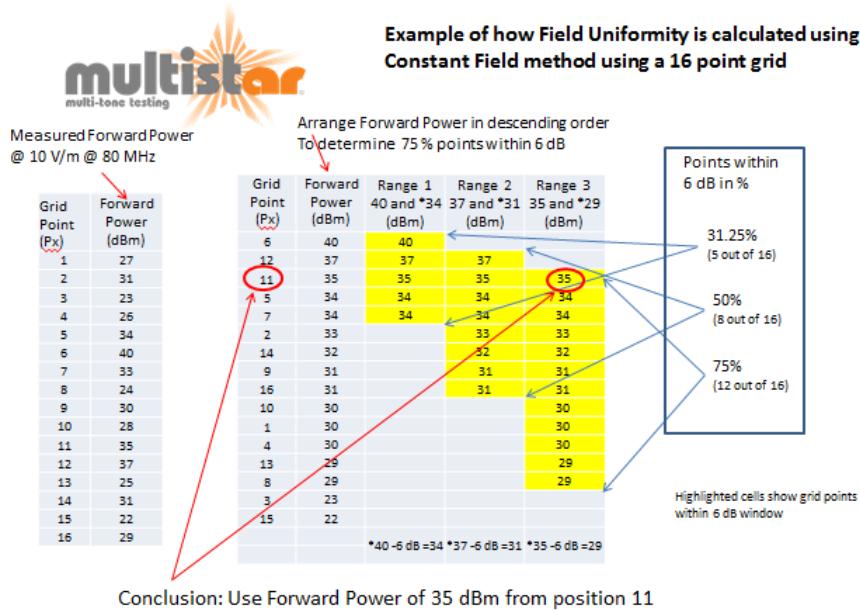


Figure 4-46.

#### 4.8.3 Calculating Field Uniformity using Constant Power Method

This section describes how the Multi-tone system calculates field uniformity using the constant power method for a 16 point grid at one of the frequency steps (using 80 MHz with a field strength of 10 V/m).

- The IEC procedure is to level on a predetermined field strength (in this example 10 V/m) and measure the forward power at the first point (NOTE: the user could select any point). Record the forward power. The recorded forward power value is used to level the other grid points. After the forward power is achieved the field strength is measured and recorded.
- In this example forward power of 29 dBm is used to level all the other grid points. Using 29 dBm the software records the field strength for each of the grid points.
- The Multi-tone software uses the first grid point field strength as reference (0 dBm) and calculates the field strength delta for each grid point. In this example, grid point 2's field strength is 14 V/m and grid point 1's field strength is 10 V/m. The relative field strength delta is 4 dB.
- After the relative field strength of position 1 is calculated, the Multi-tone software arranges each grid point field strength for each frequency step (80 MHz) from lowest to highest. In this example position 15 is the lowest (2V/m) and position 2 is the highest (14V/m).



Measured Field Strength  
Based on 10 V/m @ 80 MHz

| Grid Point (Px) | Forward Power (dBm) | Field Strength V/m | Field Strength Related to position 1 (V/m) |
|-----------------|---------------------|--------------------|--|
| 1               | 29                  | 10                 | 0  |
| 2               | 29                  | 14                 | 4  |
| 3               | 29                  | 9                  | -1   |
| 4               | 29                  | 9                  | -1   |
| 5               | 29                  | 10                 | 0  |
| 6               | 29                  | 8                  | -2   |
| 7               | 29                  | 7                  | -3   |
| 8               | 29                  | 7                  | -3   |
| 9               | 29                  | 4                  | -6   |
| 10              | 29                  | 5                  | -5   |
| 11              | 29                  | 6                  | -4   |
| 12              | 29                  | 6                  | -4   |
| 13              | 29                  | 3                  | -7   |
| 14              | 29                  | 5                  | -5   |
| 15              | 29                  | 2                  | -8   |
| 16              | 29                  | 2                  | -8   |

**Example of how Field Uniformity is calculated  
Constant Power method using a 16 point grid**

Arrange Field Strength in ascending order  
To determine 75% points within -6 dB

| Grid Point (Px) | Forward Power (dBm) | Field Strength V/m | Field Strength Related to position 1 Range 1 -8 to -2 (V/m) | Field Strength Related to position 1 Range 2 -7 to -1 (V/m) | Field Strength Related to position 1 Range 3 -6 to 0 (V/m) |
|-----------------|---------------------|--------------------|---|---|--|
| 15              | 29                  | 2                  | -8  | -8  | -8   |
| 16              | 29                  | 2                  | -8  | -8  | -8   |
| 13              | 29                  | 3                  | -7  | -7  | -7   |
| 9               | 29                  | 4                  | -6  | -6  | -6   |
| 10              | 29                  | 5                  | -5  | -5  | -5   |
| 14              | 29                  | 5                  | -5  | -5  | -5   |
| 11              | 29                  | 6                  | -4  | -4  | -4   |
| 12              | 29                  | 6                  | -4  | -4  | -4   |
| 8               | 29                  | 7                  | -5  | -5  | -3   |
| 7               | 29                  | 7                  | -3  | -3  | -3   |
| 6               | 29                  | 8                  | -2  | -2  | -2   |
| 3               | 29                  | 8                  | -1  | -1  | -1   |
| 4               | 29                  | 9                  | -1  | -1  | -1   |
| 5               | 29                  | 9                  | -1  | 0   | 0  |
| 1               | 29                  | 10                 | 0   | 0   | 0  |
| 2               | 29                  | 14                 | 4   | 4   | 4  |

$-8 + 6 \text{ dB} = -2$     $-7 + 6 \text{ dB} = -1$     $-6 + 6 \text{ dB} = 0$

Points within -6 dB in %  
 68.75% (11 out of 16)  
 68.75% (11 out of 16)  
 75% (12 out of 16)

Conclusion: Use Forward Power of **35 dBm**      (29 dBm + 6 dB = 35 dBm)

**Figure 4-47.**

The multi-tone calibration can be viewed in graphical and tabular formats.

The linearity and harmonic data and limit lines are plotted in the graphs.

#### 4.8.4 Viewing Calibration Data

The table shows the frequencies in sets, the recorded VSG drive level, amplifier forward power, linearity and worst harmonic in that frequency set.

On the tabular portion, please note that the shading depicts the breaks between the frequency groupings.

Under **File**, select **Calibration Data** (Figure 4-48).



Figure 4-48.

## 4.8.5 Viewing Test Data

The test data can be viewed in both graphical and tabular forms.

You can choose the view based on horizontal or vertical antenna position as well as EUT side and modulation.

The table also includes the drive level, forward power, field strength and Event status and description.

Under **File**, select **Test Data** (Figure 4-49).

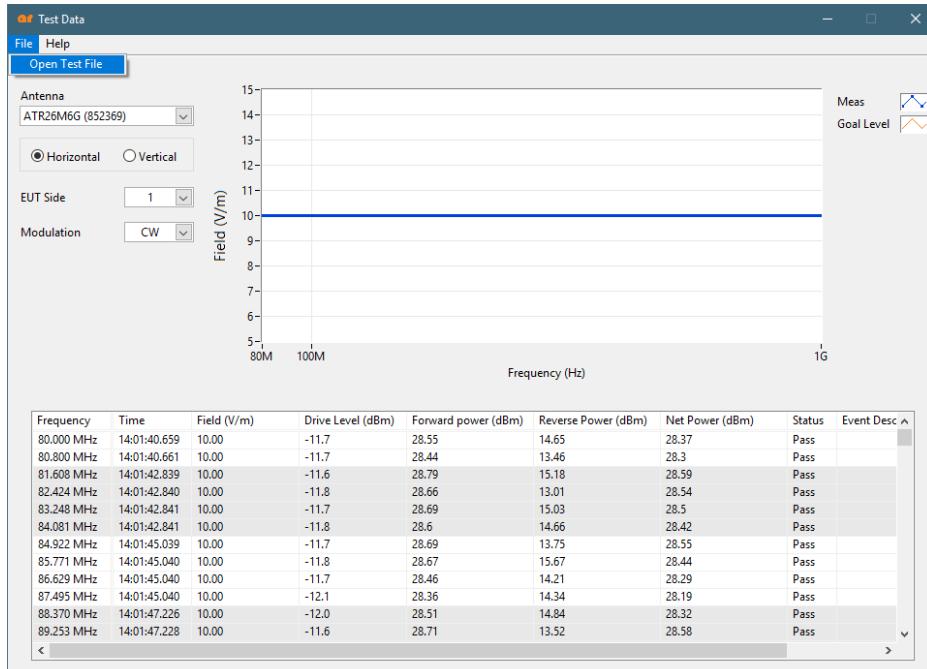


Figure 4-49.

After you run a test, you have the option to create a report based on your saved calibration and final test data.

From the Main Menu, **File** and then **Create Report**.

## 4.8.6 Creating Reports

After you run a test, you have the option to create the following reports:

- Calibration
- Verification
- Final test

You can create a report based on your saved calibration and final test data.

You can also create a report based on a previously saved file.

From Main Menu, **Create Report** (Figure 4-50).

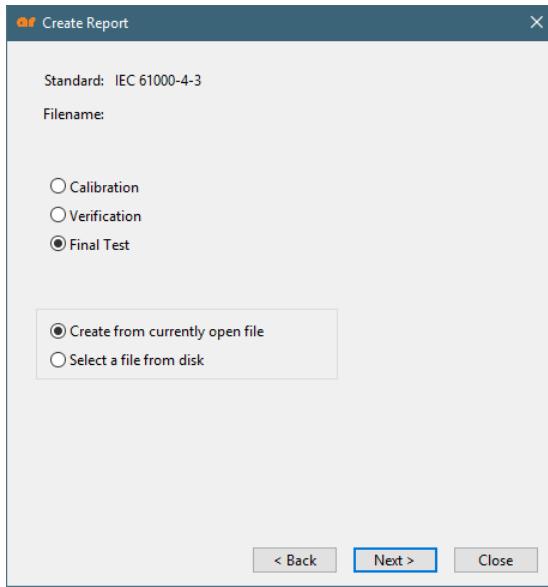


Figure 4-50.

You can customize the content of your report.

You can choose to include:

- Vertical or horizontal antenna position
- EUT monitoring sides
- All data or only failures including the graph

Select **Next** button and choose additional report options.

Under **Create Report**, customize your Report (Figure 4-51):

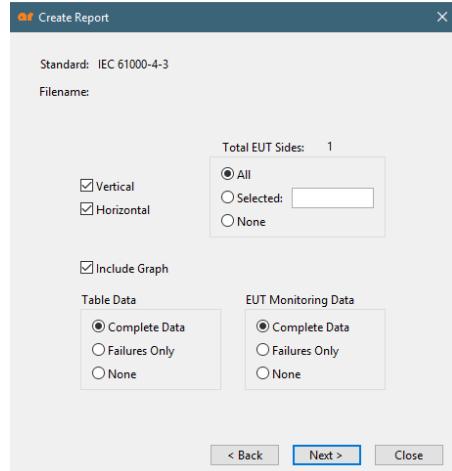


Figure 4-51.

The options are to include test setup or equipment information as well as to select log or linear for the X and Y scales. Select the **Create** button (Figure 4-52).

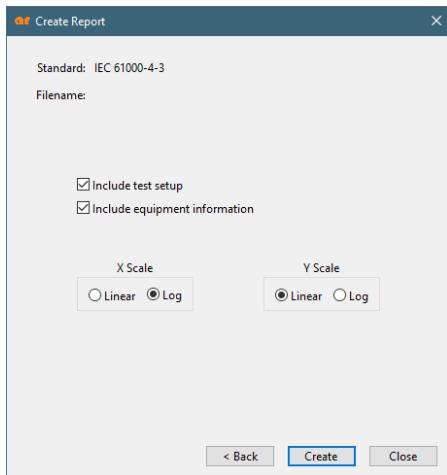


Figure 4-52.

The **creating report** message will be displayed. Note this could take several minutes based on the size of the report.

Under **Create Report**, the **Final Report** is now being created (Figure 4-53).

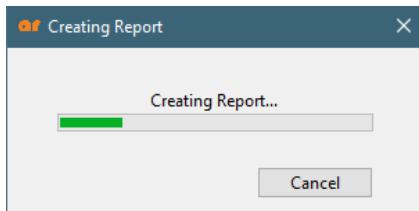


Figure 4-53.

The report will be generated only in a Word document. This report can be edited like any other Word document.

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The final report is ready and downloadable (Figure 4-54).

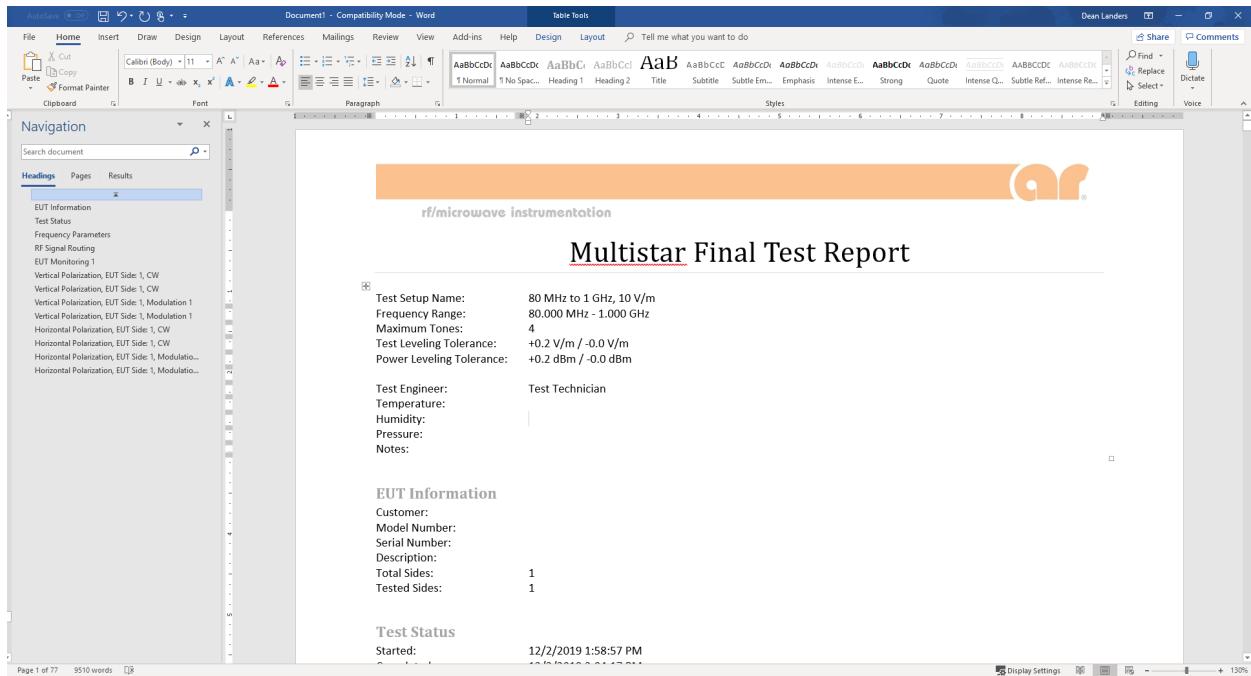


Figure 4-54.

The report will generate test data in graph form (Figure 4-55).

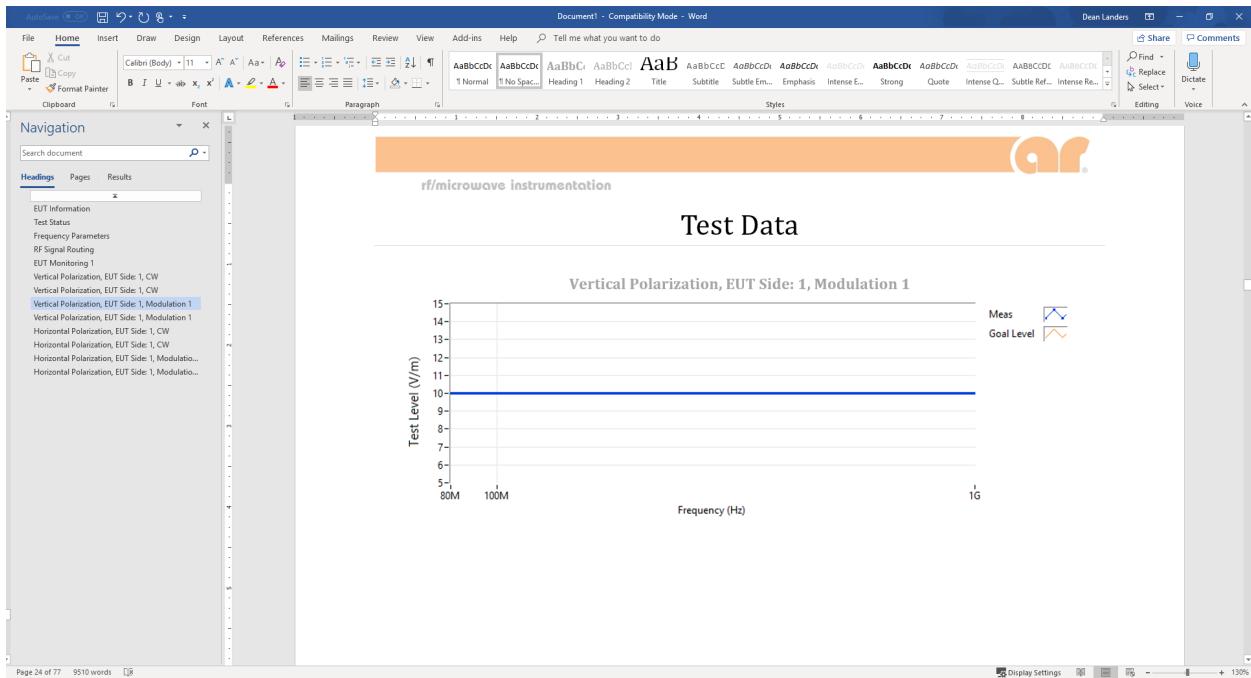


Figure 4-55.

The test report will also generate test data in tabular form.



## 5. GENERAL INFORMATION

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### 5.1 RETURN PROCEDURE

To return the MT06002 to AR, contact AR Customer Service for an RMA number and shipping instructions. Returns from outside the United States are not permitted without prior authorization. If shipping from outside of the United States, closely follow all directions on the RMA form for return shipping and marking. See warranty statement at rear of manual.

1. Contact the AR Customer Service Department and provide the following information. Briefly describe the problem in writing. Give details regarding the observed symptom(s), and whether the problem is constant or intermittent in nature. Include the serial number of the item being returned. An RMA number will be issued.
2. Package the system carefully. Use the original boxes and packing materials, if possible.
3. After obtaining an RMA #, ship the system to:

AR RF/Microwave Instrumentation  
160 Schoolhouse Rd  
Souderton PA USA 18964  
Attn: Customer Service

If the system is still under warranty, refer to the Limited Warranty for additional information about your return. The RMA # should be clearly visible on the outside of the package.

### 5.2 UPGRADE POLICIES

AR Software is periodically upgraded to enhance functionality. Contact AR Software Engineering department to check on the upgrade status for your software.



## **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.

