SPECTRUM ANALYZERS

3280 Series

Operating Manual

Document part no. 46892/766

SPECTRUM ANALYZERS
3280 SERIES
Operating Manual

3281 3 Hz–3.0 GHz
3282 3 Hz–13.2 GHz
3283 3 Hz–26.5 GHz

Not all of the features detailed in this manual are available in every model.

Manual part no. 46892/766 (PDF version)
Based on Issue 2 of the printed manual
26 July 2007

About this manual

This manual explains how to use the 3280 Series Spectrum Analyzers.

Intended audience

Persons engaged on work relating to the design and manufacture of RF and microwave sub-systems and modules, or the installation and maintenance of those systems.

It is assumed that the user is familiar with the terms used in RF and microwave measurements.

Structure

Chapter 1

Provides an introduction to the 3280 Series instruments. Also includes complete performance data and lists the versions, options and accessories available.

Chapter 2

Installation details, including location and safety observations.

Chapter 3

Describes connections to the front and rear panels of the instrument.

Chapter 4

Description of the menus available.

Chapter 5

Describes operation of the instrument.

Chapter 6

Performance test procedures to verify that the instrument is functioning correctly.

Chapter 7

Describes cleaning, storage and transportation of the instrument.

Chapter 8

Restoring the operating system.

Appendix A

WLAN option

Appendix B

Measurement guide

Document conventions

The following conventions apply throughout this manual:

CAPS	Capitals are used to identify names of controls and panel markings.
[CAPS]	Capitals in square brackets indicate hard key titles.
[Italics]	Italics in square brackets indicate soft key titles.

Associated publications

- **3280 Series Programming Manual**
  (Printed version 46882/768, PDF version 46892/768)

Contents

Precautions

WARNING **CAUTION** **Note**

These terms have specific meanings in this manual:

WARNING **information to prevent personal injury.**

CAUTION **information to prevent damage to the equipment.**

Note **important general information.**

Symbols

The meaning of hazard symbols appearing on the equipment and in the documentation is as follows:

Symbol	Description
	Refer to the operating manual when this symbol is marked on the instrument. Familiarize yourself with the nature of the hazard and the actions that may have to be taken.
	Dangerous voltage
	Toxic hazard
	Static sensitive components

General conditions of use

This product is designed and tested to comply with the requirements of IEC/EN61010-1 ‘Safety requirements for electrical equipment for measurement, control and laboratory use’, for Class I portable equipment and is for use in a pollution degree 2 environment. The equipment is designed to operate from an installation category II supply.

Equipment should be protected from the ingress of liquids and precipitation such as rain, snow, etc. When moving the equipment from a cold to a hot environment, it is important to allow the temperature of the equipment to stabilize before it is connected to the supply to avoid condensation forming. The equipment must only be operated within the environmental conditions specified in Chapter 1 in the Operating Manual, otherwise the protection provided by the equipment may be impaired.

This product is not approved for use in hazardous atmospheres or medical applications. If the equipment is to be used in a safety-related application, e.g. avionics or military applications, the suitability of the product must be assessed and approved for use by a competent person.

WARNING

Electrical hazards (AC supply voltage)

This equipment conforms with IEC Safety Class I, meaning that it is provided with a protective grounding lead. To maintain this protection the supply lead must always be connected to the source of supply via a socket with a grounded contact.

Be aware that the supply filter contains capacitors that may remain charged after the equipment is disconnected from the supply. Although the stored energy is within the approved safety requirements, a slight shock may be felt if the plug pins are touched immediately after removal.

Do not remove instrument covers as this may result in personal injury. There are no user-serviceable parts inside.

Refer all servicing to qualified personnel. See list of Service Centers at rear of manual.

WARNING

Fire hazard

Make sure that only fuses of the correct rating and type are used for replacement.

If an integrally fused plug is used on the supply lead, ensure that the fuse rating is commensurate with the current requirements of this equipment.

WARNING

Toxic hazards

Some of the components used in this equipment may include resins and other materials which give off toxic fumes if incinerated. Take appropriate precautions, therefore, in the disposal of these items.

WARNING

Beryllium copper

Some mechanical components within this instrument are manufactured from beryllium copper. This is an alloy with a beryllium content of approximately 5%. It represents no risk in normal use.

The material should not be machined, welded or subjected to any process where heat is involved.

It must be disposed of as “special waste”.

It must NOT be disposed of by incineration.

WARNING

Lithium

A Lithium battery (or a Lithium battery contained within an IC) is used in this equipment.

As Lithium is a toxic substance, the battery should in no circumstances be crushed, incinerated or disposed of in normal waste.

Do not attempt to recharge this type of battery. Do not short circuit or force discharge since this might cause the battery to vent, overheat or explode.

WARNING

Heavy equipment

The weight of the 3280 Series exceeds the 18 kg (40 lb) guideline for manual handling by a single person. To avoid the risk of injury, an assessment should be carried out prior to handling which takes account of the load, workplace environment and individual capability, in accordance with European Directive 90/269/EEC and associated National Regulations.

WARNING

Tilt facility

When the equipment is in the tilt position, it is advisable, for stability reasons, not to stack other equipment on top of it.

CAUTION

Static sensitive components

This equipment contains static sensitive components which may be damaged by handling — refer to the Maintenance part of the Service Manual for handling precautions.

CAUTION

Precision connector

The precision microwave connectors fitted to this equipment may be damaged by mating with a non-precision type. Damage to the connector may also occur if the connector interface parameters are not within specification. The connector should be checked with the appropriate gauging tool.

CAUTION

Suitability for use

This equipment has been designed and manufactured by Aeroflex to perform measurements on RF and microwave components and systems.

If the equipment is not used in a manner specified by Aeroflex, the protection provided by the equipment may be impaired.

Aeroflex has no control over the use of this equipment and cannot be held responsible for events arising from its use other than for its intended purpose.

Précautions

WARNING **CAUTION** **Note**

Les termes suivants ont, dans ce manuel, des significations particulières:

WARNING contient des informations pour éviter toute blessure au personnel.

CAUTION contient des informations pour éviter les dommages aux équipements.

Note contient d’importantes informations d’ordre général.

Symboles signalant un risque

La signification des symboles de danger apparaissant sur l'équipement et dans la documentation est la suivante:

Symbole	Nature du risque
	Reportez-vous au manuel d'utilisation quand ce symbole apparaît sur l'instrument. Familiarisez-vous avec la nature du danger et la conduite à tenir.
	Tension dangereuse
	Danger produits toxiques

Conditions générales d’utilisation

Ce produit a été conçu et testé pour être conforme aux exigences des normes CEI/EN61010-1 “Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire”, pour des équipements Classe I portables et pour une utilisation dans un environnement de pollution de niveau 2. Cet équipement est conçu pour fonctionner à partir d’une alimentation de catégorie II.

Cet équipement doit être protégé de l’introduction de liquides ainsi que des précipitations d’eau, de neige, etc... Lorsqu’on transporte cet équipement d’un environnement chaud vers un environnement froid, il est important de laisser l’équipement se stabiliser en température avant de le connecter à une alimentation afin d’éviter toute formation de condensation. L'appareil doit être utilisé uniquement dans le cadre des conditions d'environnement spécifiées au chapitre 1 ‘Performance data’ du manuel d'utilisation, toute autre utilisation peut endommager les systèmes de protection.

Ce produit n’est pas garanti pour fonctionner dans des atmosphères dangereuses ou pour un usage médical. Si l'équipement doit être utilisé pour des applications en relation avec la sécurité, par exemple des applications militaires ou aéronautiques, la compatibilité du produit doit être établie et approuvée par une personne compétente.

WARNING

Sécurité électrique (tension d'alimentation alternative)

Cet appareil est protégé conformément à la norme CEI de sécurité Classe 1, c'est-à-dire que sa prise secteur comporte un fil de protection à la terre. Pour maintenir cette protection, le câble d'alimentation doit toujours être branché à la source d'alimentation par l'intermédiaire d'une prise comportant une borne de terre.

Notez que les filtres d'alimentation contiennent des condensateurs qui peuvent encore être chargés lorsque l'appareil est débranché. Bien que l'énergie contenue soit conforme aux exigences de sécurité, il est possible de ressentir un léger choc si l'on touche les bornes sitôt après débranchement.

Ne démontez pas le capot de l'instrument, car ceci peut provoquer des blessures. Il n'y a pas de pièces remplaçables par l'utilisateur à l'intérieur.

Faites effectuer toute réparation par du personnel qualifié. Contacter un des Centres de Maintenance Internationaux dans la liste jointe à la fin du manuel.

WARNING

Risque lié au feu

Lors du remplacement des fusibles vérifiez l'exactitude de leur type et de leur valeur.
Si le câble d'alimentation comporte une prise avec fusible intégré, assurez vous que sa valeur est compatible avec les besoins en courant de l'appareil.

WARNING

Danger produits toxiques

Certains composants utilisés dans cet appareil peuvent contenir des résines et d'autres matières qui dégagent des fumées toxiques lors de leur incinération. Les précautions d'usages doivent donc être prises lorsqu'on se débarrasse de ce type de composant.

WARNING

Bronze au béryllium

Dans cet équipement,certaines pièces mécaniques sont à base de bronze au béryllium. Il s'agit d'un alliage dans lequel le pourcentage de béryllium ne dépasse pas 5%. Il ne présente aucun danger en utilisation normale.
Toutefois, cet alliage ne doit pas être travaillé, soudé ou soumis à un processus qui implique l'utilisation d'une source de chaleur.
En cas de destruction, il sera entreposé dans un container spécial. IL ne devra pas être détruit par incinération

WARNING

Lithium

Une pile au Lithium ou un CI contenant une pile au Lithium est utilisé dans cet équipement.
Le Lithium étant une substance toxique, il ne faut en aucun cas l'écraser, l'incinérer ou le jeter avec des déchets normaux.
N'essayez pas de recharger ce type de pile. Ne court-circuitez pas ou ne forcez pas la décharge de la pile car cela pourrait causer une fuite, une surchauffe ou une explosion.

WARNING

Equipement lourd

Le poids des appareils du 3280 Serie est supérieur à la limite de 18 kg (40 lb), fixée pour le transport par une seule personne. Afin d’éviter tout risque de blessure, il est nécessaire de faire, avant le transport, une évaluation de la charge, des contraintes de l’environnement et des capacités de l’individu, en conformité avec la Directive Européenne 90/269/EEC ainsi que les recommandations Nationales concernées.

WARNING

Position inclinée

Lorsque l’appareil est dans une position inclinée, il est recommandé, pour des raisons de stabilité, de ne pas y empiler d’autres appareils.

CAUTION

Utilisation

Cet équipement a été conçu et fabriqué par Aeroflex pour effectuer des mesures sur des composants et des systèmes RF et hyperfréquences

La protection de l'équipement peut être altérée s'il n'est pas utilisé dans les conditions spécifiées par Aeroflex.
Aeroflex n'a aucun contrôle sur l'usage de l'instrument, et ne pourra être tenu pour responsable en cas d'événement survenant suite à une utilisation différente de celle prévue.

Vorsichtsmaßnahmen

WARNING **CAUTION** **Note**

Diese Hinweise haben eine bestimmte Bedeutung in diesem Handbuch:

WARNING **dienen zur Vermeidung von Verletzungsrisiken.**

CAUTION **dienen dem Schutz der Geräte.**

Note **enthalten wichtige Informationen.**

Gefahrensymbole

Die Bedeutung der Gefahrensymbole auf den Geräten und in der Dokumentation ist wie folgt:

Symbol	Gefahrenart
	Beziehen Sie sich auf die Bedienungsanleitung wenn das Messgerät mit diesem Symbol markiert ist. Machen Sie sich mit der Art der Gefahr und den Aktionen die getroffen werden müssen bekannt.
	Gefährliche Spannung
	Warnung vor giftigen Substanzen

Allgemeine Hinweise zur Verwendung

Dieses Produkt wurde entsprechend den Anforderungen von IEC/EN61010-1 “Sicherheitsanforderungen für elektrische Ausrüstung für Meßaufgaben, Steuerung und Laborbedarf”, Klasse I transportabel zur Verwendung in einer Grad 2 verunreinigten Umgebung, entwickelt und getestet. Dieses Gerät ist für Netzversorgung Klasse II zugelassen.

Das Gerät sollte vor dem Eindringen von Flüssigkeiten sowie vor Regen, Schnee etc. geschützt werden. Bei Standortänderung von kalter in wärmere Umgebung sollte das Gerät wegen der Kondensation erst nach Anpassung an die wärmere Umgebung mit dem Netz verbunden werden. Das Gerät darf nur in Umgebungsbedingungen wie im Kapitel 1 ‘Lesitungstdaten (Performance data)’ der Bedienungsanleitung beschrieben, betrieben werden; ansonsten wird der vom Gerät vorgesehene Schutz des Anwenders beeinträchtigt.

Dieses Produkt ist nicht für den Einsatz in gefährlicher Umgebung (z.B. Ex-Bereich) und für medizinische Anwendungen geprüft. Sollte das Gerät für den Einsatz in sicherheitsrelevanten Anwendungen wie z.B. im Flugverkehr oder bei militaerischen Anwendungen vorgesehen sein, so ist dieser von einer für diesen Bereich zuständigen Person zu beurteilen und genehmigen.

WARNING

Elektrische Schläge (Wechselspannungsversorgung)

Das Gerät entspricht IEC Sicherheitsklasse 1 mit einem Schutzleiter nach Erde. Das Netzkabel muß stets an eine Steckdose mit Erdkontakt angeschlossen werden.

Filterkondensatoren in der internen Spannungsversorgung können auch nach Unterbrechung der Spannungszuführung noch geladen sein. Obwohl die darin gespeicherte Energie innerhalb der Sicherheitsmargen liegt, kann ein leichter Spannungsschlag bei Berührung kurz nach der Unterbrechung erfolgen.

Öffnen Sie niemals das Gehäuse der Geräte das dies zu ernsthaften Verletzungen führen kann. Es gibt keine vom Anwender austauschbare Teile in diesem Gerät.

Lassen Sie alle Reparaturen durch qualifiziertes Personal durchführen. Eine Liste der Servicestellen finden Sie auf der Rückseite des Handbuches.

WARNING

Feuergefahr

Es dürfen nur Ersatzsicherungen vom gleichen Typ mit den korrekten Spezifikationen entsprechend der Stromaufnahme des Gerätes verwendet werden.

WARNING

Warnung vor giftigen Substanzen

In einigen Bauelementen dieses Geräts können Epoxyharze oder andere Materialien enthalten sein, die im Brandfall giftige Gase erzeugen. Bei der Entsorgung müssen deshalb entsprechende Vorsichtsmaßnahmen getroffen werden.

WARNING

Beryllium Kupfer

In diesem Gerät sind einige mechanische Komponenten aus Berylium Kupfer gefertigt. Dies ist eine Verbindung welche aus einem Berylliumanteil von ca. 5 % besteht. Bei normaler Verwendung besteht kein Gesundheitsrisiko.

Das Metall darf nicht bearbeitet, geschweißt oder sonstiger Wärmebehandlung ausgesetzt werden.

Es muß als Sondermüll entsorgt werden.

Es darf nicht durch Verbrennung entsorgt werden.

WARNING

Lithium

Eine Lithium Batterie oder eine Lithium Batterie innerhalb eines IC ist in diesem Gerät eingebaut.

Da Lithium ein giftiges Material ist, sollte es als Sondermüll entsorgt werden.

Diese Batterie darf auf keinen Fall geladen werden. Nicht kurzschließen, da sie dabei überhitzt werden und explodieren kann.

WARNING

Schweres Gerät

Das Gewicht der 3280 Series Geräte liegt über der 18 kg (40 lb) Grenze für Transport durch eine einzelne Person. Zur Vermeidung von Verletzungen sollten vor einem Transport die Arbeitsumgebung und die persönlichen Möglichkeiten im Verhältnis zur Last abgewogen werden, wie in der EU-Regelung 90/269/EEC und nationalen Normen beschrieben.

WARNING

Schrägstellung

Bei Schrägstellung des Geräts sollten aus Stabilitätsgründen keine anderen Geräte darauf gestellt werden.

CAUTION

Eignung für Gebrauch

Dieses Gerät wurde von Aeroflex entwickelt und hergestellt um Messungen an HF- und Mikrowellenkomponenten und -Systemen durchzuführen

Sollte das Gerät nicht auf die von Aeroflex vorgesehene Art und Weise verwendet werden, kann die Schutzfunktion des Gerätes beeinträchtigt werden.

Aeroflex hat keinen Einfluß auf die Art der Verwendung und übernimmt keinerlei Verantwortung bei unsachgemässer Handhabung.

Precauzioni

WARNING **CAUTION** **Note**

Questi termini vengono utilizzati in questo manuale con significati specifici:

WARNING **riportano informazioni atte ad evitare possibili pericoli alla persona.**

CAUTION **riportano informazioni per evitare possibili pericoli all'apparecchiatura.**

Note **riportano importanti informazioni di carattere generale.**

Simboli di pericolo

Il significato del simbolo di pericolo riportato sugli strumenti e nella documentazione è il seguente:

Simbolo	Tipo di pericolo
	Fare riferimento al manuale operativo quando questo simbolo è riportato sullo strumento. Rendervi conto della natura del pericolo e delle precauzioni che dovrete prendere.
	Tensione pericolosa
	Pericolo sostanze tossiche

Condizioni generali d’uso

Questo prodotto è stato progettato e collaudato per rispondere ai requisiti della direttiva IEC/EN61010-1 ‘Safety requirements for electrical equipment for measurement, control and laboratory use’ per apparati di classe I portatili e per l’uso in un ambiente inquinato di grado 2. L’apparato è stato progettato per essere alimentato da un alimentatore di categoria II.

Lo strumento deve essere protetto dal possibile ingresso di liquidi quali, ad es., acqua, pioggia, neve, ecc. Qualora lo strumento venga portato da un ambiente freddo ad uno caldo, è importante lasciare che la temperatura all’interno dello strumento si stabilizzi prima di alimentarlo per evitare formazione di condense. Lo strumento deve essere utilizzato esclusivamente nelle condizioni ambientali descritte nel capitolo 1 ‘Performance data’ del manuale operativo, in caso contrario le protezioni previste nello strumento potrebbero risultare non sufficienti.

Questo prodotto non è stato approvato per essere usato in ambienti pericolosi o applicazioni medicali. Se lo strumento deve essere usato per applicazioni particolari collegate alla sicurezza (per esempio applicazioni militari o avioniche), occorre che una persona o un istituto competente ne certifichi l'uso.

WARNING

Pericoli da elettricità (alimentazione c.a.)

Quest ’apparato è provvisto del collegamento di protezione di terra e rispetta le norme di sicurezza IEC, classe 1. Per mantenere questa protezione è necessario che il cavo, la spina e la presa d’alimentazione siano tutti provvisti di terra.

Il circuito d’alimentazione contiene dei filtri i cui condensatori possono restare carichi anche dopo aver rimosso l’alimentazione. Sebbene l’energia immagazzinata è entro i limiti di sicurezza, purtuttavia una leggera scossa può essere avvertita toccando i capi della spina subito dopo averla rimossa.

Non rimuovete mai le coperture perché così potreste provocare danni a voi stessi. Non vi sono all’interno parti di interesse all’utilizzatore.

Tutte gli interventi sono di competenza del personale qualificato. Vedi elenco internazionale dei Centri di Assistenza in fondo al manuale.

WARNING

Pericolo d’incendio

Assicurarsi che, in caso di sostituzione, vengano utilizzati solo fusibili della portata e del tipo prescritti.
Se viene usata una spina con fusibili, assicurarsi che questi siano di portata adeguata ai requisiti di alimentazione richiesti dallo strumento.

WARNING

Pericolo sostanze tossiche

Alcuni dei componenti usati in questo strumento possono contenere resine o altri materiali che, se bruciati, possono emettere fumi tossici. Prendere quindi le opportune precauzioni nell’uso di tali parti.

WARNING

Rame berillio

Alcuni componenti meccanici in questo strumento sono realizzati in rame berillio. Si tratta di una lega con contenuto di berillio di circa il 5%, che non presenta alcun rischio in usi normali.

Questo materiale non deve essere lavorato, saldato o subire qualsiasi processo che coinvolge alte temperature.

Deve essere eliminato come "rifiuto speciale". Non deve essere eliminato tramite "inceneritore".

WARNING

Litio

Quest ’apparato incorpora una batteria al litio o un circuito integrato contenente una batteria al litio.

Poiché il litio è una sostanza tossica, la batteria non deve essere mai né rotta, né incenerita, né gettata tra i normali rifiuti.

Questo tipo di batteria non può essere sottoposto né a ricarica né a corto-circuito o scarica forzata. Queste azioni possono provocare surriscaldamento, fuoriuscita di gas o esplosione della batteria.

WARNING

Strumento pesante

Il peso degli strumenti serie 3280 supera i 18 kg (40 lb) raccomandati come limite per il trasporto manuale da parte di singola persona. Per evitare rischi di danni fisici è bene quindi considerare il carico complessivo, le condizioni del trasporto e le capacità individuali in accordo con la direttiva comunitaria 90/269/EEC e con eventuali regolamenti locali.

WARNING

Posizionamento inclinato

Quando lo strumento è in posizione inclinata è raccomandato, per motivi di stabilità, non sovrapporre altri strumenti.

CAUTION

Caratteristiche d'uso

Questo strumento è stato progettato e prodotto da Aeroflex eseguire misure su componenti o sistemi RF e microonde

Se lo strumento non è utilizzato nel modo specificato da Aeroflex, le protezioni previste sullo strumento potrebbero risultare inefficaci.

Aeroflex non può avere il controllo sull'uso di questo strumento e non può essere ritenuta responsabile per eventi risultanti da un uso diverso dallo scopo prefisso.

Precauciones

WARNING **CAUTION** **Note**

Estos términos tienen significados específicos en este manual:

WARNING **contienen información referente a prevención de daños personales.**

CAUTION **contienen información referente a prevención de daños en equipos.**

Note **contienen información general importante.**

Símbolos de peligro

El significado de los símbolos de peligro en el equipo y en la documentación es el siguiente:

Símbolo	Naturaleza del peligro
	Vea el manual de funcionamiento cuando este símbolo aparezca en el instrumento. Familiarícese con la naturaleza del riesgo y con las acciones que deban de tomarse.
	Voltaje peligroso
	Aviso de toxicidad

Condiciones generales de uso

Este producto ha sido diseñado y probado para cumplir los requerimientos de la normativa IEC/EN61010-1 “Requerimientos de la normativa para equipos eléctricos de medida, control y uso en laboratorio”, para equipos clase I portátiles y para uso en un ambiente con un grado de contaminación 2. El equipo ha sido diseñado para funcionar sobre una instalación de alimentación de categorías II.

Debe protegerse el equipo de la entrada de líquidos y precipitaciones como nieve, lluvia, etc. Cuando se traslada el equipo de entorno frío a un entorno caliente, es importante aguardar la estabilización el equipo para evitar la condensación. Solamente debe utilizarse el equipo bajo las condiciones ambientales especificadas en el capítulo 1 “Especificaciones” o “Performance data” del Manual de Instrucciones, en caso contrario la propia protección del equipo puede resultar dañada.

Este producto no ha sido aprobado para su utilización en entornos peligrosos o en aplicaciones médicas. Si se va a utilizar el equipo en una aplicación con implicaciones en cuanto a seguridad, como por ejemplo aplicaciones de aviónica o militares, es preciso que un experto competente en materia de seguridad apruebe su uso.

WARNING

Nivel peligroso de electricidad (tensión de red)

Este equipo cumple las normas IEC Seguridad Clase 1, lo que significa que va provisto de un cable de protección de masa. Para mantener esta protección, el cable de alimentación de red debe de conectarse siempre a una clavija con terminal de masa.

Tenga en cuenta que el filtro de red contiene condensadores que pueden almacenar carga una vez desconectado el equipo. Aunque la energía almacenada está dentro de los requisitos de seguridad, pudiera sentirse una ligera descarga al tocar la clavija de alimentación inmediatamente después de su desconexión de red.

No retire las cubiertas del chasis del instrumento, ya que pudiera resultar dañado personalmente. No existen partes que puedan ser reparadas en su interior.

Deje todas las tareas relativas a reparación a un servicio técnico cualificado. Vea la lista de Centros de Servicios Internacionales en la parte trasera del manual.

Fusibles

Se hace notar que el Equipo está dotado de fusibles tanto en el activo como el neutro de alimentación. Si sólo uno de estos fusibles fundiera, existen partes del equipo que pudieran permanecer a tensión de red.

WARNING

Peligro de incendio

Asegúrese de utilizar sólo fusibles del tipo y valores especificados como repuesto.

Si se utiliza una clavija con fusible incorporado, asegúrese de que los valores del fusible corresponden a los requeridos por el equipo. Consulte la Hoja Técnica (tras el Capítulo 1) para comprobar los requisitos de alimentación.

WARNING

Aviso de toxicidad

Alguno de los componentes utilizados en este equipo pudieran incluir resinas u otro tipo de materiales que al arder produjeran sustancias tóxicas, Por tanto, tome las debidas precauciones en la manipulación de esas piezas.

WARNING

Berilio-cobre

Algunos componentes mecánicos contenidos en este instrumento incorporan berilio-cobre en su proceso de fabricación. Se trata de una aleación con un contenido aproximado de berilio del 5%, lo que no representa ningún riesgo durante su uso normal.

El material no debe ser manipulado, soldado, ni sometido a ningún proceso que implique la aplicación de calor.

Para su eliminación debe tratarse como un "residuo especial". El material NO DEBE eliminarse mediante incineración.

WARNING

Litio

En este equipo se utiliza una batería de litio (o contenida dentro de un CI).

Dada que el litio es una substancia tóxica las baterías de este material no deben ser aplastadas, quemadas o arrojadas junto a basuras ordinarias.

No trate de recargar este tipo de baterías. No las cortocircuite o fuerce su descarga ya que puede dar lugar a que la esta emita gases, se recaliente o explote.

WARNING

Instrumento pesado

El peso de los equipos Serie 3280 es superior a la recomendación de 18 Kg (40 lb), lo que debe tenerse en cuenta. si va ser transportado manualmente por una sola persona. Para evitar el riesgo de lesiones, antes de mover el equipo deberá evaluar la carga, el entorno de trabajo y la propia capacidad, de acuerdo con la Directiva Europea 90/269/EEC y el Reglamento Nacional Asociado.

WARNING

Tener en cuenta con el equipo inclinado

Si utiliza el equipo en posición inclinada, se recomienda, por razones de estabilidad, no apilar otros equipos encima de él.

CAUTION

Idoneidad de uso

Este equipo ha sido diseñado y fabricado por Aeroflex para realizar medidas en RF y microondas en componentes y sistemas

Si el equipo fuese utilizado de forma diferente a la especificada por Aeroflex, la protección ofrecida por el equipo pudiera quedar reducida.

Aeroflex no tiene control sobre el uso de este equipo y no puede, por tanto, exigirsele responsabilidades derivadas de una utilización distinta de aquellas para las que ha sido diseñado.

Chapter 1
GENERAL INFORMATION

Contents

General

This section outlines the 3280 Series spectrum analyzer (the 'instrument') and details the optional accessories and the instrument's specifications.

Product outline

The instrument is a spectrum analyzer suited for signal analysis of high-frequency digital radio equipment.

The instrument uses a synthesized local oscillator to cover the following frequencies:

3 Hz to 3 GHz	3281
3 Hz to 13.2 GHz	3282
3 Hz to 26.5 GHz	3283

The spectrum analyzer provides excellent distortion and frequency/level accuracy performance, and easy operation, using the soft-key menu screen.

It provides excellent cost performance with a choice of options for various applications.

It is equipped with highly accurate calibration signals and attenuator, so that it can accurately calibrate switching errors of LOG/LIN scales, various resolution bandwidths, variable reference levels, etc. As frequency response data is corrected by built in calibration data, the instrument provides accurate level measurement over a wide range.

The MEASURE function performs measurements of various applications without requiring the use of an external controller. Therefore, the performance of radio equipment can be easily evaluated in terms of frequency, noise, occupied frequency bandwidth, etc.

Phase noise is measured over a selected frequency range to find the total RMS noise in a given bandwidth. Residual FM can also be displayed.

Applications

This instrument is designed for use in the production and maintenance of the following:

- AM/FM radio equipment
- Digital cellular telephones/cordless telephones
- Satellite broadcasting and TV equipment
- Small capacity microwave equipment
- Wireless LAN equipment.

Instrument configuration

Various options are available to increase the range of functions. These options are sold separately.

Options

Tracking generator

Digital demodulation with software options:

WLAN measurement suite

Connector and cable assembly

Please specify the model number, name, and quantity when ordering.

Specifications

***Note** : Allow a fifteen-minute warm-up time.*

Frequency

Frequency range	DC coupled 3 Hz–3 GHz / 13.2 GHz / 26.5 GHz
	AC coupled 10 MHz–3 GHz / 13.2 GHz / 26.5 GHz
Resolution	1 Hz
Frequency reference	
Temperature drift 0°C–50°C	± 0.1 ppm
Aging per year	± 0.3 ppm
Frequency readout	Marker resolution depending on span and measurement points (1 Hz minimum)
Accuracy	± (marker frequency * reference error + 0.5% span + 5% RBW + 0.5 * horizontal resolution)
	Horizontal resolution is span / (sweep points – 1)
Frequency counter	Resolution 1 Hz / 10 Hz / 100 Hz / 1 kHz
Accuracy	± (reference frequency accuracy * marker frequency + counter resolution ± 1 LSB) + 0.5 * last digit
	Sensitivity (for spans < 3 MHz)
	<–60 dBm for frequencies >2 MHz and <3 GHz
	<–55 dBm for frequencies >3 GHz and <13.2 GHz
	<–50 dBm for frequencies >13.2 GHz and <26.5 GHz

Frequency span

Range	0 Hz (Zero Span), 10 Hz–3 GHz, 13.2 GHz, 26.5 GHz
Resolution	1 Hz
Accuracy	±1%
Sweep	Zero span 1 μs to 2000 s, ± 0.5 %
	Span ≥10 Hz, 5 ms to 2000 s, ± 0.5 % nominal
Sweep points	
Number of points	3 to 8192 (Span = 0 Hz)
	101 to 8192 (Span ≥10 Hz)
Span trigger	
≥10 Hz	Source external, line, video, free run, RF burst
	Offset 1 μs to 500 ms
Span = 0 Hz	Source external, line, video, free run, RF burst
	Offset –150 ms to +500 ms

Spectral purity

SSB phase noise, dBc/Hz at offset:

CW freq	**Frequency offset**				
	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
10 MHz	<–78	<–102	<–113	<–113	<–135
100 MHz	<–76	<–110	<–113	<–113	<–135
1 GHz	<–76	<–100	<–113	<–113	<–136
3 GHz	<–68	<–98	<–110	<–111	<–135
6 GHz	<–60	<–83	<–107	<–110	<–135
13 GHz					
20 GHz					
26.5 GHz					

At 1 GHz:

100 Hz offset	< –76 dBc/Hz
1 kHz offset	< –97 dBc/Hz
10 kHz offset	< –115 dBc/Hz (typical)
100 kHz offset	< –115 dBc/Hz (typical)
1 MHz offset	< –136 dBc/Hz
10 MHz offset	< –144 dBc/Hz

Residual FM — Accuracy, <10 * N Hz p-p in 1 s

Resolution bandwidth (RBW)

- 3 dB bandwidths — 30 Hz to 5 MHz in a 1-2-3-5 sequence
- Bandwidth accuracy:
  - 500 Hz to 500 kHz filters — ± 1.5 %
  - 1 MHz to 5 MHz filters — ± 6 %
- Shape factor – 60 dB/ – 3 dB — < 5 (500 Hz to 5 MHz filters)
- Bandwidth switching uncertainty at 100 MHz CF reference to 5 kHz RBW — ± 0.05 dB nominal

FFT filters

- 3 dB bandwidths: — 1 Hz to 300 Hz, in 1-2-3-5 sequence
- Bandwidth accuracy: — < 1 %, nominal
- Shape factor: — –60 dB / –3 dB < 4.5, nominal

Video bandwidth (VBW) — 1 Hz to 3 MHz and none in a 1-2-3-5 sequence

Amplitude

Display range, DC coupled

DANL to + 30 dBm

Maximum input level

DC (AC coupled) ±50 V DC (Option)

DC (DC coupled) 0 V

CW RF power +30 dBm

Preamp on +20 dBm

1 dB compression point

0 dB RF attenuation, preamp offf

0 dBm 100 MHz to 3 GHz

–5 dBm up to 26.5 GHz

Preamp on –22 dBm at 1 GHz

Third–order intermodulation distortion (TOI)	For two tones of –30 dBm at the input mixer with a tone separation of >100 kHz:
	+15 dBm from 100 MHz to 26.5 GHz, +18 dBm (typical)
Second harmonic intercept (SHI)	with –30 dBm at the input
	+30 dBm for frequencies <100 MHz
	+40 dBm for frequencies 100 MHz to 1.5 GHz
	+80 dBm for frequencies 1.5 GHz to 26.5 GHz
Displayed average noise level (DANL)	0 dB RF attenuation, RBW 1 Hz, average detector, 50 ohm termination.

–90 dBm/Hz nominal	from 3 Hz to 1 kHz
–100 dBm/Hz nominal	from 1 kHz to 10 kHz
–120 dBm / Hz	from 10 kHz to 100 kHz
–125 dBm/Hz	from 100 kHz to 300 kHz
–132 dBm/Hz	from 300 kHz to 500 kHz
–137 dBm/Hz	from 500 kHz to 700 kHz
–142 dBm / Hz	from 700 kHz to 10 MHz
–151 dBm / Hz	from 10 MHz to 1 GHz
–147 dBm / Hz	from 1 GHz to 2 GHz
–146 dBm / Hz	from 2 GHz to 6.4 GHz
–143 dBm / Hz	from 6.4 GHz to 18 GHz
–138 dBm / Hz	from 18 GHz to 22 GHz
–136 dBm / Hz	from 22 GHz to 24 GHz
–133 dBm / Hz	from 24 GHz to 26.5 GHz

Response to unwanted signals	
Image frequency:	<–70 dBm with –10 dBm at the input
Intermediate frequency:	<–70 dBm with –10 dBm at the input
Residual responses (input terminated, 0 dB attenuation) :	<–95 dBm from 1 MHz to 6.4 GHz
	<–95 dBm typical from 6.4 GHz to 26.5 GHz
Other input related spurii:	< –60 dBc with –30 dBm at the input
Amplitude scale	
Log scale:	0.1 to 1 dB /div in 0.1 dB steps
	1 to 20 dB / div in 1 dB steps
Linear scale:	10 divisions
Level units	dBm, dBμV, dBmV, dBpW (log level display) μV, mV, pW, nW (linear level display)
RF input attenuator	
Range	0 dB to 55 dB in 5 dB steps
Switching accuracy	± 0.5 dB at 100 MHz (3281)
	± 0.5 dB at <13.2 GHz (3282, 3283)
	± 0.8 dB from 13.2 GHz to 26.5 GHz (3282, 3283)
Reference level	
Logarithmic range	–170 dBm to +30 dBm, 0.1 dB steps
Linear range	7.07 nV to 7.07 V in 1 % steps
Accuracy	±0.15 dB at 0 dBm ref level

Traces	
Number of traces:	3
Trace detectors:	Normal, peak, sample, negative peak, log power average, RMS, average and voltage average
Trace functions:	Clear / Write, Max Hold, Min Hold, View, Blank, Average
Frequency response	With 10 dB input attenuation, preselector centering applied, preamp off
	±0.5 dB from 1 MHz to 3.0 GHz
	±1.0 dB from 3.0 GHz to 6.4 GHz
	±1.5 dB from 6.4 GHz to 13.2 GHz
	±2.0 dB from 13.2 GHz to 22 GHz
	±2.5 dB from 22 GHz to 26.5 GHz
	Preamp on ±1.0 dB from 1 MHz to 3.0 GHz
Display non–linearity	
Logarithmic level display	± 0.1 dB total for an input mixer level of ≤–20 dBm
	± 0.13 dB total for mixer levels between –20 dBm and –10 dBm
Linear level display	5 % of reference level
Demodulated audio output	AM & FM, loudspeaker, phone jack
AM demodulation range:	0 to 100%
FM demodulation range:	0 to 100 kHz

Inputs and outputs—front panel

RF input	Type N female, 50 Ω (3.0 GHz, 13.2 GHz)
	APC 2.92 mm, 50 Ω (26.5 GHz)
	VSWR with ≥10 dB input attenuation
	<1.5:1 at 10 MHz to 3 GHz
	<1.8:1 at 3 GHz to 13.2 GHz
	<2.0:1 at 13.2 GHz to 26.5 GHz
Tracking generator output (optional version, 328X/1)	
Connector	Type N female, 50 Ω
Frequency range	9 kHz to 3.0 GHz
Output level range	0 dBm to –70 dBm
Output level resolution	0.1 dB
Level accuracy	≤±1.0 dB
Level flatness at –10 dBm (before normalization)	9 kHz to 100 kHz: ≤±4.0 dB 100 kHz to 3 GHz: ≤±2.0 dB
Level flatness at –10 dBm (after normalization)	9 kHz to 3 GHz: ≤±1.0 dB
Spurious output levels	
	Harmonics: ≤–15 dBc
	Non–harmonics: ≤–30 dBc
	Leakage signal: ≤–100 dBm
Output VSWR	≤1.5:1 at –10 dBm output level

1st LO output (for external mixer option)	SMA female, 50 Ω nominal Frequency: 3321.4–6821.4 MHz Level: +10 dBm, nominal
2nd IF Input (for external mixer option)	SMA female, 50 Ω nominal Frequency: 421.4 MHz Level: −20 dBm
Probe power supply	+15 V, −12 V, GND
Cal output	BNC female, 50 Ω nominal
Frequency	100 MHz
Level	−20 dBm ±1.0 dB
Audio output	Front panel phone jack
USB 2.0 interface	Front panel connector Type 1.1 or higher (2.0)
Mouse connector	6-pin mini DIN connector PS2 compatible
External keyboard connector	6–pin mini DIN connector PS2 compatible

Inputs and outputs—rear panel

3rd IF output	BNC female, 50 Ω nominal Frequency: 21.4 MHz Bandwidth: 16 MHz ±selected RBW Level +3 dBm nominal, top of screen
2nd IF output	SMA female, 50 Ω nominal Frequency: 421.4 MHz Bandwidth: 40 MHz Level 0 dBm nominal, top of screen
External trigger input	BNC female, 10 kΩ nominal Trigger level: TTL nominal
Sweep gate output	BNC female Trigger level: TTL nominal
Reference frequency output	BNC female Frequency: 10 MHz Required level: +5 dBm nominal
Reference frequency input	BNC female Frequency: 10 MHz Required level: −5 to +15 dBm nominal
GPIB	24 pin female connector GPIB is IEEE 488 and 488.2 compatible
Command set	SCPI 1997.0
Interface functions	SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, E2, LE0, TE0
RS–232 serial interface	9 way D–type connector, male
LAN interface	10/100 Base T, connector RJ45

USB 2.0 interface	Two rear panel connectors
Printer interface	Parallel interface, 25-way female D-type connector
External monitor output	Standard VGA, 800 x 600 color output 15-way high density D-type female connector

Hardware option:
Digital demodulation (Option 02)

Operation Modes	Two modes of operation: direct input via rear panel SMA connector or input via spectrum analyzer input with 421.4 MHz IF output linked directly to digitizer rear-panel input.

Frequency

Range	Direct input (via rear panel): 330 MHz to 3.0 GHz Through spectrum analyzer input: 10 MHz to 3280 max frequency
Resolution	1 Hz
Accuracy	As per spectrum analyzer frequency reference
Settling time	Depends upon sweep time

Level

Input coupling	AC coupled
Input power (direct input via rear panel)	Max RF input +16 dBm continuous, (+22 dBm with 8 dB of RF input attenuation) Max IF input +10 dBm with 0 dB of IF attenuation
RF input attenuator	0 to 28 dB in 4 dB steps
IF input attenuator	0 to 35 dB in 1 dB steps
Input return loss (at SMA rear panel input connector)	16 dB with 8 dB or more RF attenuation
Level accuracy (RF input, 23°C ±5°C, Auto Flatness Mode enabled)	Better than ±0.45 dB, typically 0.3 dB Valid for signals with <5 MHz occupied bandwidth at the tuned frequency and S/N ratio >40 dB
Level settling time	Typically 250 µs settled within 0.3 dB of final value
Level temperature stability	±/–0.01 dB/°C
Level repeatability	Better than ±0.05 dB after warm up following a return from a change in frequency or level. Valid for at least 2 hours and excluding temperature influence.

Spectral purity

SSB phase noise (direct input via rear panel)

Typical at 2 GHz and at ambient room temperature

Loop Bandwidth	Narrow	Wide (normal)
Offset	dBc/Hz	dBc/Hz
100 Hz	–55	–85
1 kHz	–85	–103
10 kHz	–114	–103
20 kHz	–116	–110
100 kHz	–133	–130
1 MHz	–136	–136
10 MHz	–138	–138

Phase noise at offsets of < 100 Hz is dependent upon the phase noise of the frequency reference.

Linearity and noise

(direct input via rear panel input socket)

Intermodulation

Typically 75 dB intermodulation-free dynamic range (two-tone input with maximum 0 dBm input power for each tone). Manual mode.

Adjacent channel leakage ratio (ACLR - signal applied to rear panel input)

63 dB ACLR on 3GPP (downlink test model 1). Typically 68 dB ACLR on 3GPP uplink.

Spurious

Typically < –75 dBc excluding IF image frequencies and harmonic responses

Residual responses (with no signal applied at rear panel input)

< –100 dBm with rear panel RF input terminated into 50 ohm and minimum RF and IF attenuation

Noise spectral density (with no signal applied at rear panel input)

Rear panel RF input terminated in 50 ohm and minimum RF and IF attenuation.
Below 1 GHz, < –145 dBm/Hz
1 GHz and above, < –140 dBm/Hz

A/D conversion

Resolution

14 bits

ADC clock

Fixed 103.68 MHz

Sample rate control

IF: 103.68 MHz IQ:
Variable 6328.125 S/s to 85 MS/s or 51.84 MS/s with LVDS output enabled

Sample rate resolution

Sample rate can be entered as a fraction made up of integers

Sample rate accuracy

As per 10 MHz

Note: add ±2 µHz when using generic resampling mode

Amplitude flatness (correction on — applies at rear panel input)

Flatness correction on: 0.25 dB to 33 MHz, 0.1 dB across center 5 MHz

Phase flatness (typical with correction on — applies at rear panel input)

0.03 radians pk-pk to 33 MHz

Hardware option:
LVDS data output (Option 03)

Data output	A sample data block (equal to the data capture length) can be stored to internal memory and then transferred via the internal PCI bus. Sample data can be continuously streamed out of the rear-panel LVDS connector. IF data samples have 16-bit resolution. IQ data samples can be 16- or 32-bit resolution.
Data transfer rate	Typically 10 Mwords/s (a word is 32 bits long) IQ and IF block data transfer when using 2.2 GHz embedded CPU running windows XP
Sample memory	128 M x 16-bit samples

General specifications

Display	
Size	10.4” (26.4 cm) color TFT LCD
Resolution	800 x 600 pixels
Mass memory	Hard disk 40 Gbyte
Power supply	AC supply 88 V to 135 V AC, 45 to 66 Hz 100 V to 135 V AC, 360 to 440 Hz 193 V to 269 V AC, 45 to 66 Hz or 273 V to 381 V DC, automatically selected 240 W maximum (without options)
Warm-up time	15 minutes
Environmental conditions	
Rated range of use (MIL-PRF-28800F, Class 3)	
Temperature	0ºC to +50ºC
Altitude	Up to 4600 m (15 000 feet) (altitude, operating, not to MIL-PRF-28800F, Class 3)
Conditions of storage and transportation (MIL-PRF-28800F, Class 3)	
Temperature	−40ºC to +71ºC
Altitude	Up to 4600 m (15 000 feet)
Humidity	Meets MIL-PRF-28800F, Class 3
Vibration and shock (MIL-PRF-28800F, Class 3)	Meets MIL-PRF-28800F, Class 3
Electromagnetic compatibility	EN61326, 1997 + Appendix 1, 1998 RFI suppression (EMC) EN 55011: 2001 Group 1 Class A Immunity Table 1 and Performance Criterion B
Safety	IEC/EN61010-1, 2001
Dimensions and weight	
Dimensions (W x H x D)	430 mm x 222 mm x 467 mm (17 in x 8.7 in x 18.4 in) (without handles and feet extended) 485 mm x 240 mm x 489 mm (19.1 in x 9.5 in x 19.2 in) (with handles and feet extended)
Weight	<18 kg (39.5 lb) (3281) <19.5 kg (43 lb) (3282, 3283)
Recommended calibration interval	1 year
Standard warranty	2 years

Versions and accessories

When ordering, please quote the full ordering number information.

Ordering numbers	Version
3281/0	3 Hz to 3 GHz spectrum analyzer
3281/1	3 Hz to 3 GHz spectrum analyzer with tracking generator
3282/0	3 Hz to 13.2 GHz spectrum analyzer
3282/1	3 Hz to 13.2 GHz spectrum analyzer with tracking generator
3283/0	3 Hz to 26.5 GHz spectrum analyzer
3283/1	3 Hz to 26.5 GHz spectrum analyzer with tracking generator
	Options
Option 02	Digital demodulation
Option 03	LVDS output (rear panel)
Option 11	WLAN measurement suite (Option 02 must be fitted)
	Supplied accessories
–	AC supply lead
46886/051	CD-ROM containing operating and programming manuals
	Front handles/rackmount brackets
	Keyboard
	Mouse
	Optional accessories
46882/766	3280 Series Operating Manual (paper version)
46882/768	3280 Series Programming Manual (paper version)

Chapter 2
PREPARING FOR USE

Contents

Introduction

This section explains the preparations and safety procedures that should be performed before using the instrument. The safety procedures are to prevent injury to the operator and damage to the instrument. Read these together with the safety precautions in the Preface.

Ensure that you understand the contents of the pre-operation preparations before using the instrument.

For connecting the GPIB cable and setting the GPIB address, see the remote control operation in the Programming Manual.

Installation site and environmental conditions

Locations to be avoided

The instrument operates normally at temperatures from 0 to 50ºC. However, for best performance, avoid the following situations:

- where there is severe vibration
- where the humidity is high
- where the instrument is exposed to direct sunlight
- where the instrument is exposed to active gases.

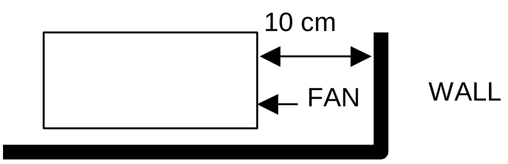
In addition to meeting the above conditions, to ensure long-term trouble-free operation, use the instrument at room temperature and in a location where the power supply voltage does not fluctuate greatly.

CAUTION

If the instrument is used at normal temperatures after it has been used or stored for a long time low temperatures, there is a risk of short-circuiting caused by condensation. To prevent this, do not turn the instrument on until it has been allowed to dry out.

CAUTION

To suppress any internal temperature increase, the instrument has a fan on the rear panel. As shown in the diagram below, leave a gap of at least 10 cm between the rear panel and wall, nearby equipment or obstructions so that fan ventilation is not blocked.



Safety measures

This paragraph explains the safety procedures, which should be followed under all circumstances to prevent the risk of an accidental electric shock, damage to the instrument or a major operation interruption.

In the following, special notes on safety procedures are extracted from other chapters.

To prevent accidents, read this chapter together with the related chapters before beginning operation.

Preparations before power-on

The instrument operates normally when it is connected to a 100 VAC to 250 VAC 50/60 Hz power supply (voltage selected automatically). To prevent the following, take the necessary procedures described on the following pages before power is supplied.

- Accidental electric shock
- Damage caused by abnormal voltage
- Ground current problems.

To protect the operator, the following WARNING and CAUTION notices are attached to the rear panel of the instrument.

WARNING

TO AVOID ELECTRIC SHOCK,

THE PROTECTIVE GROUNDING CONDUCTOR

MUST BE CONNECTED TO GROUND.

DO NOT REMOVE COVERS.

REFER SERVICING TO QUALIFIED PERSONNEL.

CAUTION

FOR CONTINUED FIRE PROTECTION

REPLACE ONLY WITH SPECIFIED

TYPE AND RATED FUSE.

WARNING

Disassembly, adjustment, maintenance, or other access inside this equipment is to be performed qualified personnel only. Maintenance of this equipment should be performed only by trained service personnel who are familiar with the risk involved of fire and electric shock. Potentially lethal voltages existing inside this equipment, if contacted accidentally, may result in personal injury or death, or in the possibility of damage to precision components.

Always follow the instructions on the following pages.

WARNING

Protective grounding

Grounding with frame ground (FG) terminal

When there is no grounded AC power-supply outlet, the protective frame ground (FG) terminal on the rear panel must be connected directly to ground potential.

WARNING

If power is applied without protective grounding, there is a risk of accidental electric shock. The protective frame ground (FG) terminal on the rear frame, or the ground pin of the supplied power cord, must be connected to ground potential before power is supplied to the equipment.

Power-on

WARNING

Before power-on:

- The instrument must be connected to protective ground. If the power is switched on without taking this precaution, there is a risk of receiving an accidental electric shock.
- Check the power source voltage.
- If an abnormal voltage that exceeds the specified value is input, there is risk of damage to the instrument, and fire.

Press the front switch on the instrument to change the state from stand-by to active.

The instrument uses the Windows operating system. Windows starts up first, before the instrument boots up.

Note*: if the instrument does not automatically start correctly, click the Aeroflex icon on the display twice.*

Use a proper power source

Do not operate this instrument from a power source that applies more than the specified voltage. Use a stable supply.

Do not operate with suspected damage

If you suspect there is damage to the instrument, protection may be impaired, so do not attempt to operate the instrument under these conditions. Have it inspected by qualified service personnel.

Object and liquid entry

Do not push any kind of object through openings into the instrument, as it may touch dangerous voltage points or short out parts that could result in a fire or electric shock. Never spill liquid of any kind on the instrument.

Do not use the instrument near water. Keep the instrument in a dry, dust-free environment.

Flammable and explosive substances

Avoid using the instrument where there are flammable or explosive substances, including gases, in the immediate vicinity.

Unstable location

Do not place the instrument on an unstable cart, stand or table. If the instrument were to fall, it could cause serious personal injury, and serious damage to the instrument. Do not place or use the instrument in a place subject to vibration.

Cleaning

Keep the power supply and cooling fan free of dust.

Clean the power inlet regularly. If dust accumulates around the power pins, there is a risk of fire.

Keep the cooling fan clean so that the ventilation holes are not obstructed. If the ventilation is obstructed, the cabinet may overheat and catch fire.

CAUTION

Input level to RF input

Frequency range:	3 Hz to 3 GHz (3281)
	3 Hz to 13.2 GHz (3282)
	3 Hz to 26.5 GHz (3283)
Measurement level:	the maximum signal level that can be applied to the RF input connector is **+30 dBm**.

The RF input circuit is not protected against excessive power:

If you apply a signal exceeding **+30 dBm**, the input attenuator and internal circuit will be damaged.
Do not input over **0 VDC** to the RF input connector.

Front panel power switch

Power-on

If the instrument is in the standby state, a momentary press of the front power switch turns on the power.

Supply interruption

If, while the instrument is in the power-on state, the power plug is removed from the outlet and then reinserted, the power will not be turned on. Also, if power is disconnected due to a momentary supply interruption or failure, the instrument will not be turned on when power is restored. This prevents incorrect data being acquired when the line is disconnected and reconnected.

(For example, if the sweep is 1.000 s and data acquisition requires a long time, a momentary power supply interruption (power failure) might occur during measurement and the instrument would then recover automatically to the power-on state. In such a case, the instrument might mistake incorrect data for correct data without recognizing the momentary power supply interruption.)

If the instrument enters the standby state due to a momentary power supply interruption or power failure, check the state of the measuring system and press the front power switch to restore power to the instrument.

CAUTION

An incorrect power-down may damage the hard disk. We recommend that you use a stable power supply.

Detection mode

This instrument is a spectrum analyzer that uses a digital storage system. The instrument makes level measurements in frequency steps obtained by dividing the frequency span by the number of measurement data points (551–8192). Optimal results are obtained by using the following detector modes with the appropriate measurements.

Measurement	Detector mode
Normal signal	POS PEAK
Random noise	SAMPLE OR AVERAGE
Pulsed noise	NORMAL
Occupied frequency bandwidth (for analog communication systems)	SAMPLE
Occupied frequency bandwidth (for digital communication systems)	POS PEAK or SAMPLE

When a measurement is specified, make it in the specified detection mode.

Replacing memory backup battery

A primary lithium battery supplies the power for CMOS backup. This battery should only be replaced by a battery of the same type (TADIRAN TL-5151). As replacement can only be made by an approved technician, please contact your local service representative when replacement is required.

Battery life is about seven years. Early battery replacement is recommended.

Dispose of the battery according to local environmental requirements.

Storage medium

Product damage precaution

This instrument stores data using a hard disk. The hard disk may be damaged by strong vibration or electrical shock.

If you need to exchange a damaged hard disk, connect your local service representative.

Alteration or deletion of important files

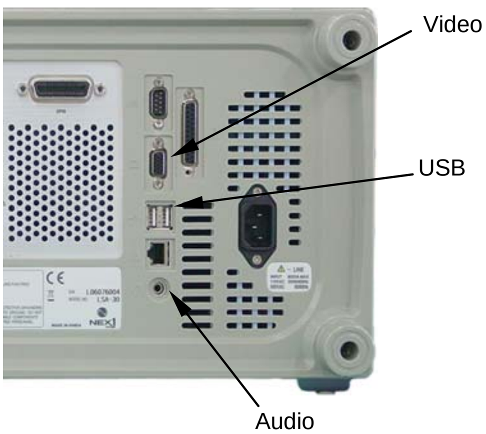
This product uses the operating system on the hard disk (C:\Program Files). Altering or deleting contents of the Windows folder may cause improper system operation.

Method for removing EMC noise

Using audio outlet

If you want to use the audio output outlet on the rear panel, fit a ferrite core to the audio line.

Using both USB and video output outlets



If you want to use both USB and video output outlets on the rear panel, fit the USB or video cable with a ferrite core (cramp type).

Chapter 3
PANEL DESCRIPTION

Contents

Introduction

This chapter describes the front (Fig. 3-1) and rear (Fig. 3-2) panels.

The following conventions apply throughout this manual:

CAPS	Capitals are used to identify names of controls and panel markings.
[CAPS]	Capitals in square brackets indicate hard-key titles.
[Italics]	Italics in square brackets indicate soft-key titles (F1–F8).
Example:	[FREQ]
	[Center]

Front and rear panel features

Table 3-1 Front and rear panel features

1	LCD	The liquid crystal display. Displays waveforms, the parameter settings, the value of marker, the soft menu keys, etc.
2	F1–F8	These are the soft keys for selecting the soft key menus linked to the panel key operation.
3	FUNCTION	
	[FREQ]	The frequency parameter data input section.
	[SPAN]	The span parameter data input section.
	[AMPL]	The amplitude parameter data input section.
	[MEASURE]	Sets the selected measurement functions.
	[Control]	Sets the measurement functions.
4	CONTROL	
	[In/Out]	Sets the coupling method.
	[Tune]	Used for the auto tuning function.
	[Source]	Selects the signal source.
	[AUX]	Sets the auxiliary functions, such as FM/AM demodulation, audio control, etc.
	[Display]	Sets the display functions, etc.
	[Limit]	Sets the limit line functions.
	[Couple]	Sets the detection mode.
	[Trigger]	Sets the trigger functions.
	[BW]	Sets the RBW, VBW.
	[Trace]	Selects the trace waveform and video average mode.
5	SWEEP	
	[Single]	One sweep is executed by pressing this key.
	[Sweep]	Sets the sweep time and the number of data.
6	SYSTEM	
	[System]	Sets the configuration of system.
	[Preset]	Sets the measurement parameters to the default values. Calibration menus arealso included under this key.
	[Mode]	Selects the measurement mode.
	[Setup]	Sets the environment pursuant to measurement modes.
	[File]	Manages the file.
	[Save]	Used for saving the waveforms' status and limit lines.
	[Print]	Used for printing.
	[Help]	Offers an explanation of each key.
7	MARKER	
	[Marker]	Sets the marker.
	[Mkr →]	Sets the marker value to a specified parameter.
	[Peak]	Related to the peak search function.
	[Func]	Sets the function which related with a marker.
8	(SCROLL KNOB)	Used for scrolling the parameters.
9	(STEP KEY)	Used for up/down the parameters.
10	RF INPUT	RF input connector.
11	PROBE POWER	RF probe power connector.

12	DATA ENTRY	Used for setting the numeric data and moving the cursor. [↵] (Backspace-key). Used to correct wrongly input data. [0…9, ‘.’, ‘+/-‘, ‘ENTER’] numeric data setting keys.
13	TGOUT	Output of tracking generator.
14	2nd IF In	Input connector for 2nd IF input signal
15	1st LO Out	Output of 1st local oscillator signal (Option)
16	CAL. OUT	Output connector for the calibration signal.
17	PHONE	Output of audio signal
18	Front USB	Connector for USB equipments.
19	MOUSE	Connector for mouse.
20	KEYBOARD	Connector for keyboard.
21	STBY/ON	Power switch. The instrument goes to power-on from the STBY condition when the key is pressed momentarily. The instrument is returned to the STBY condition from the power-on condition when the key is pressed again.
22	CD-ROM	Used for reading the CD-R.
23	REF IN 10MHz	Input connector for a reference frequency. When an external reference signal is input to this connector, the present condition is displayed on the upper right side of the display.
24	REF OUT	Output connector for a reference frequency. When other equipment is used with this instrument, the output signal of this connector is used for the reference signal.
25	3rd IF OUT	Output connector for 3rd IF signal (Option)
26	2nd IF OUT	Output connector for 2nd IF signal.
27	GPIB	For use with the GPIB interface. The connector to an external system controller.
28	EXT VGA	VGA output for an external monitor.
29	RS-232C	The RS-232C connector. Connect it to system controller.
30	PRINTER	For use with the printer.
31	(Inlet)	The AC power inlet to which the supplied power cord is connected.
32	ETHERNET	Ethernet connector for network connection.
33	Audio	Audio output of sound generated on the main processor board.
34	Rear USB	Connector for USB equipment.
35	EXT TRIG	Input connector for an external trigger.
36	SWP GATE	Output connector for a sweep gate signal.
37	(FG)	Frame ground terminal.
38	(FAN)	Cooling fan, ventilating internally-generated heat. Leave a clearance of 10 cm around the fan.

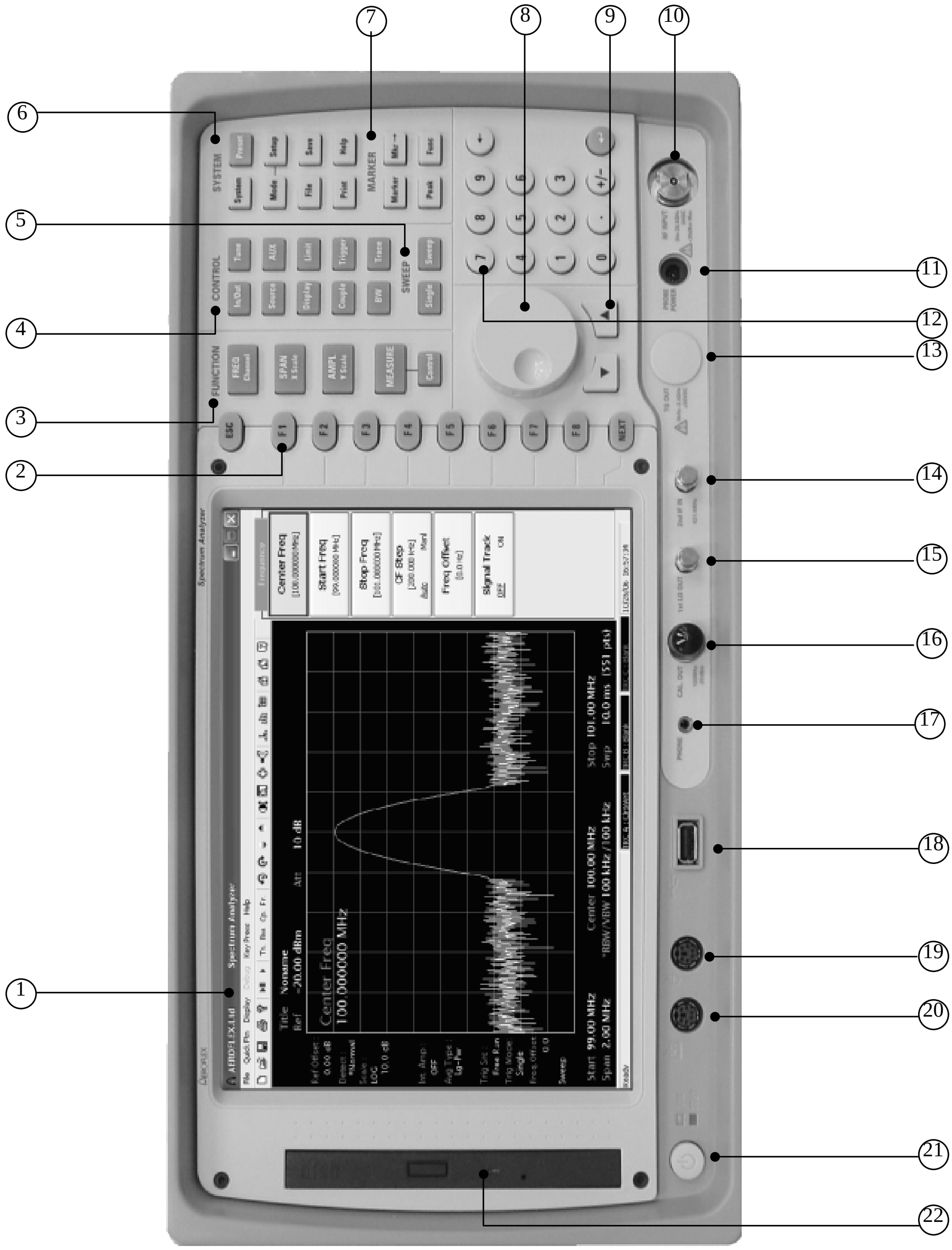


Fig. 3-1 Front panel

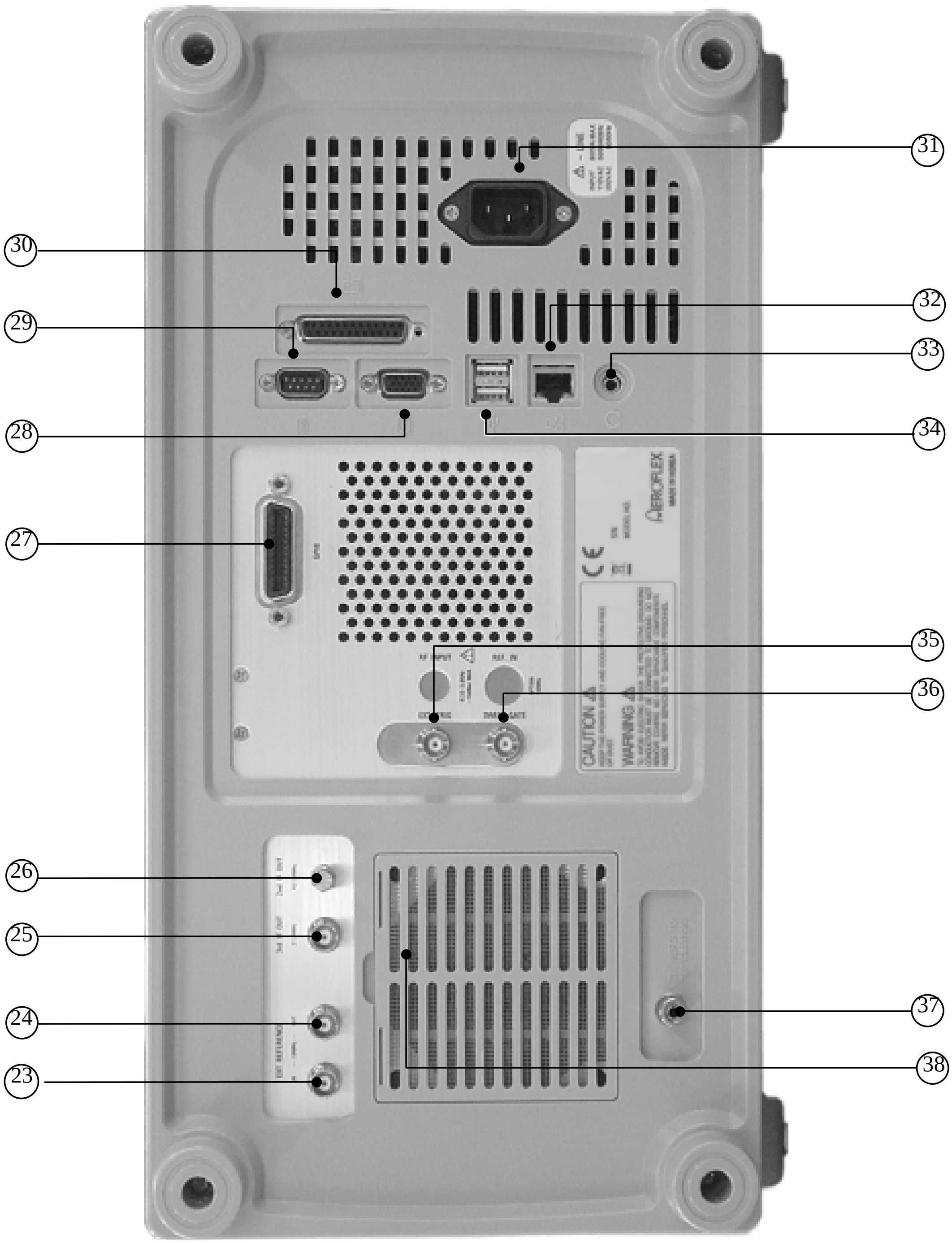


Fig. 3-2 Rear panel

I/O connectors

Table 3-2 I/O connectors

Connector	Type	In/out	Signal	Location
AC INPUT	IEC 320 socket	Input	AC power	Rear 31
RF INPUT	Type N (2.92 mm female)	Input	3 Hz–3.0/13.2/25.6 GHz	Front 10
CAL. OUT	BNC female	Output	20 MHz	Front 16
EXT TRIG	BNC female	Input	TTL level	Rear 35
SWP GATE	BNC female	Output	TTL level	Rear 36
1st LO OUT	SMA female	Output	3321.4–6821.4 MHz, 10 dBm	Front 15
2nd IF IN	SMA female	Input	421.4 MHz	Front 14
2nd IF OUT	SMA female	Output	421.4 MHz, 0 dBm	Rear 26
3rd IF OUT	BNC female	Output	21.4 MHz, 3 dBm	Rear 25
REF IN	BNC female	Input	10 MHz	Rear 23
REF OUT	BNC female	Output	10 MHz	Rear 24
GPIB	24-pin champ	In/Out	Refer to pin specification (Table 3-3)	Rear 27
PRINTER	25-pin, D-sub female	Output	Refer to screen print data specification (Table 3-5)	Rear 30
RS-232C	9-pin, D-sub male	In/Out	Refer to pin specification (Table 3-4)	Rear 29
ETHERNET	10/100 Base-T	In/Out	Refer to pin specification (Table 3-11)	Rear 32
USB	USB 2.0 support	In/Out	Refer to pin specification (Table 3-10)	Front 18 Rear 34
Power	3-pin	Input	Refer to pin specification (Table 3-7)	Front 11
Keyboard	PS/2	Input	Refer to pin specification (Table 3-8)	Front 20
Mouse	PS/2	Input	Refer to pin specification (Table 3-9)	Front 19
EXT VGA	15-Pin, D-sub female	Output	Refer to pin specification (Table 3-6)	Rear 28

GPIB connector

The IEEE-488 GPIB connector complies with ANSI/IEEE Standard 488.2-1987.

Table 3-3 Pin-out for IEEE-488 GPIB connector

Pin number	Signal	Pin number	Signal
1	DIO 1	13	DIO 5
2	DIO 2		DIO 6
3	DIO 3	15	DIO 7
4	DIO 4	16	DIO 8
5	EQI	17	REN
6	DAV	18	Ground
7	NRFD	19	Ground
8	NDAC	20	Ground
9	IFC	21	Ground
10	SRQ	22	Ground
11	ATN	23	Ground
12	Ground	24	Ground

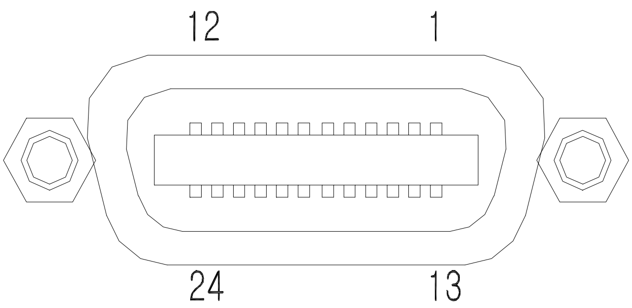


Fig. 3-3 IEEE-488 GPIB connector

RS-232C connector

Table 3-4 Pin-out for RS-232C connector

Pin number	Signal
1	DCD
2	RXD
3	TXD
4	DTR
5	Ground
6	DSR
7	RTS
8	CTS
9	RI (NC)

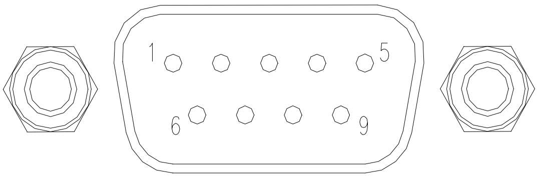


Fig. 3-4 RS-232C connector

Printer connector

Table 3-5 Pin-out for PRINTER connector

Pin number	Signal
1	$\overline{\text{STB}}$
2	PD0
3	PD1
4	PD2
5	PD3
6	PD4
7	PD5
8	PD6
9	PD7
10	$\overline{\text{ACK}}$
11	BUSY
12	PE
13	SLCT
14	$\overline{\text{AFD}}$
15	$\overline{\text{ERROR}}$
16	$\overline{\text{INIT}}$
17	$\overline{\text{SLIN}}$
18	Ground
19	Ground
20	Ground
21	Ground
22	Ground
23	Ground
24	Ground
25	Ground

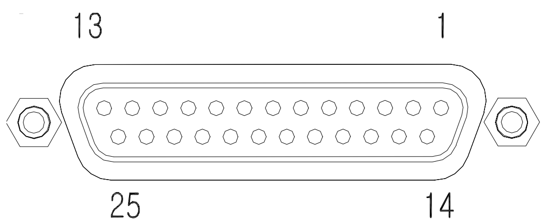


Fig. 3-5 PRINTER Connector

Ext VGA connector

Table 3-6 Pin-out for EXT VGA connector

Pin number	Signal
1	RED
2	GREEN
3	BLUE
4	ID2
5	GND
6	RGND
7	GGND
8	BGND
9	KEY
10	SGND
11	ID0
12	ID1 or SDA
13	HSYNC or CSYNC
14	VSYNC
15	ID3 or SCL

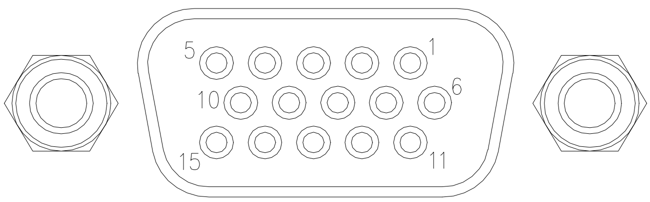


Fig. 3-6 EXT VGA connector

Probe power connector

Table 3-7 Pin-out for PROBE POWER connector

Pin number	Voltage	Current
1	+15 V ±10%	200 mA
2	–12 V ±10%	100 mA
3	GND	

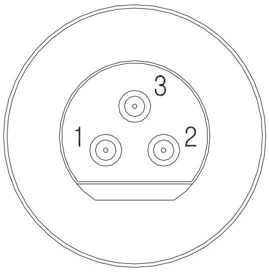


Fig. 3-7 Probe power connector

Keyboard connector

Table 3-8 Pin-out for KEYBOARD connector

Pin number	Signal
1	KBD DATA
2	NC
3	GND
4	VCC
5	KBD CLOCK
6	NC

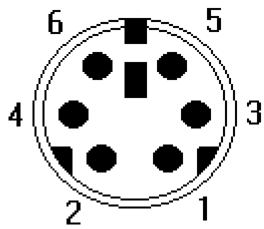


Fig. 3-8 Keyboard connector

Mouse connector

Table 3-9 Pin-out for MOUSE

Pin number	Signal
1	Mouse DATA
2	NC
3	GND
4	VCC
5	Mouse CLOCK
6	NC

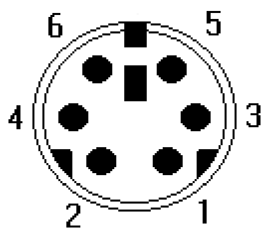


Fig. 3-9 MOUSE connector

USB connector

Table 3-10 Pin-out for USB

Pin number	Signal
1	USB VCC
2	DATA–
3	DATA+
4	USB GND

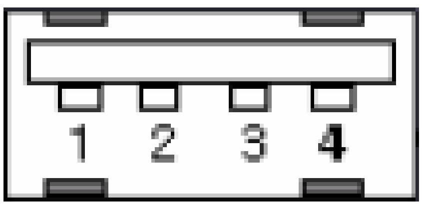


Fig. 3-10 USB connector

Ethernet connector

Table 3-11 Pin-out for ETHERNET

Pin number	Signal
1	TX+
2	TX–
3	RX+
4	NC
5	NC
6	RX–
7	NC
8	NC

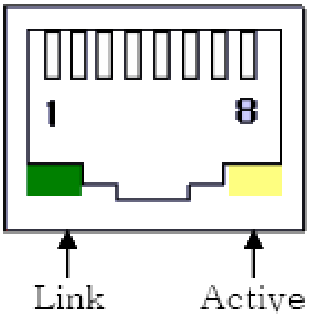


Fig. 3-11 ETHERNET connector

Chapter 4
MENU TREE

Contents

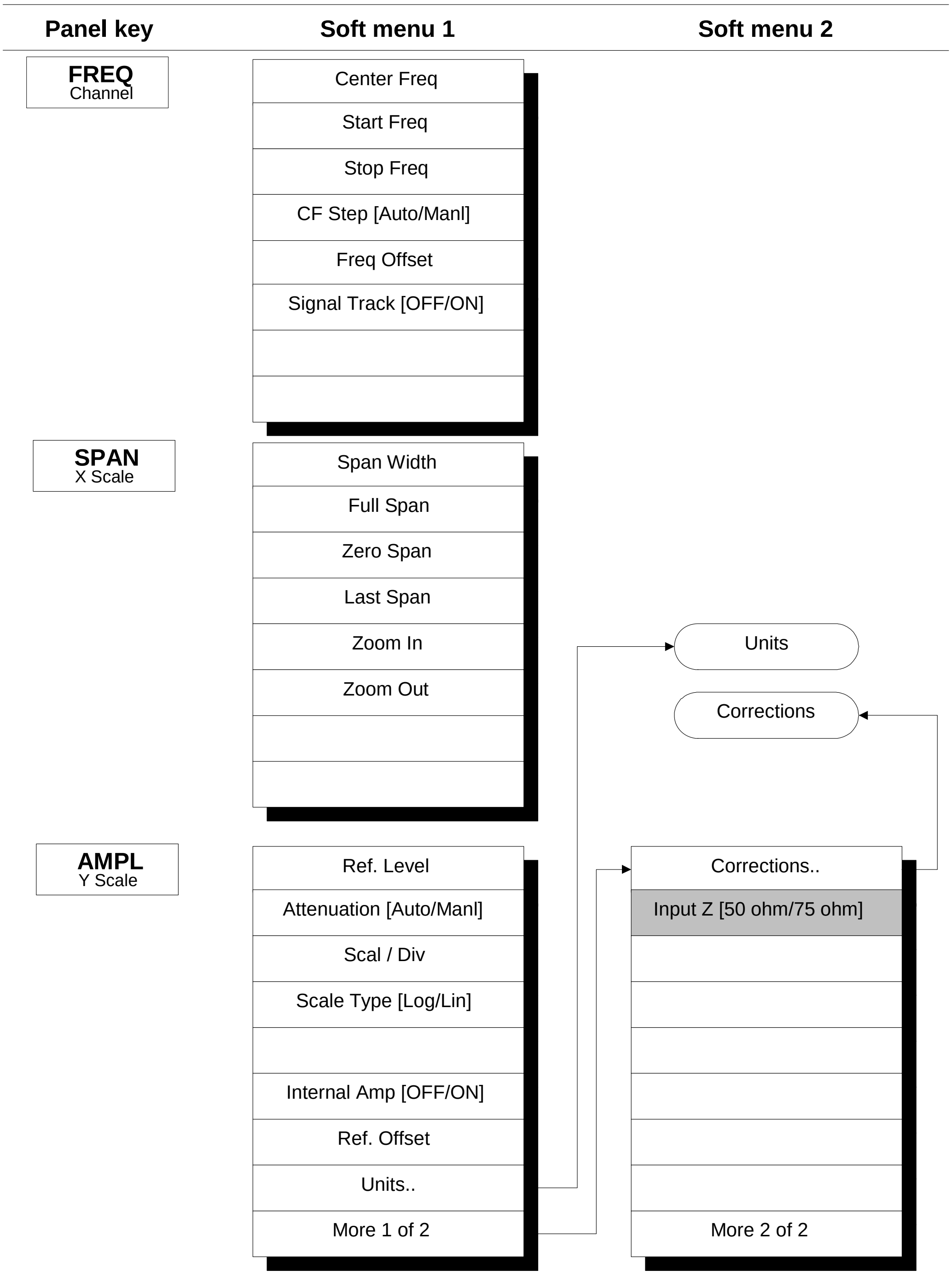
Introduction

In this section, soft menu functions and their hierarchy in the system are described using a menu tree. This is for spectrum analyzer mode only.

Note the following general operational points about the menu tree:

- **Panel Key** represents a hard key on the front panel.
- **Soft Menu 1** is displayed on the screen when the panel key is pressed. **Soft Menu 2** indicates that there is another menu below **Soft Menu 1**.
- Pressing *[Prev..]* on **Soft Menu 2** takes you back to **Soft Menu 1**.

Menu tree


Panel key
Soft menu 1
Soft menu 2
FREQ
Channel
Center Freq
Start Freq
Stop Freq
CF Step [Auto/Manl]
Freq Offset
Signal Track [OFF/ON]
SPAN
X Scale
Span Width
Full Span
Zero Span
Last Span
Zoom In
Zoom Out
Units
Corrections
AMPL
Y Scale
Ref. Level
Attenuation [Auto/Manl]
Scal / Div
Scale Type [Log/Lin]
Internal Amp [OFF/ON]
Ref. Offset
Units..
More 1 of 2
Corrections..
Input Z [50 ohm/75 ohm]
More 2 of 2

Panel key	Soft menu 1	Soft menu 2
Units	dBm	dBuV/m
	dBmV	dBuA/m
	dBuV	
	dBmA	
	dBuA	
	Volts	
	Watts	
	Amps	
	More 1 of 2	More 2 of 2

Panel key	Soft menu 1	Soft menu 2
Correction	Correction Apply [No/Yes]	Correction [OFF/ON]
	Antenna [OFF]	Point
	Cable [OFF]	Frequency
	Other [OFF]	Amplitude
	User [OFF]	Delete Point
	Delete All	Find Freq.
		Save
		Delete Corr.
	Freq. Corr [Log/Lin]	Previous

Panel key	Soft menu 1	Soft menu 2
MEASURE	Meas. Off	Meas. Off
	XdB Down	CCDF
	Adj. Channel Pwr	Harm. Distortion
	Channel Power	Spec. Emi. Mask
	Occupied BW	Spurious Emissions
	Intermodulation	Average Power
	Total Power	
	More 1 of 2 →	More 2 of 2
***[XdB Down]* Control**	Point A X[dB]	
	Point B X[dB]	
	Shape Factor [OFF/ON]	
	Meas. Average [OFF/ON]	
	Meas. Avg. Mode [EXP/REP]	
	Meas. Avg. Reset	
	Meas. Avg. Count	
	Meas. Off	
***[Adj. CP]* Control**	Span	
	Main Ch. BW	
	Adj. Ch. BW	
	Ch. Spacing	
	Max Hold [OFF/ON]	
	Trc Average [OFF/ON]	
	Adj. Ch. Num	
	Meas. Average [OFF/ON]	
	Meas. Avg. Mode	
	Meas. Avg. Reset	
	Meas. Avg. Count	

Panel key	Soft menu 1		Soft menu 1
[Channel Pwr] Control	Span	***[Total Pwr] Control***	Span
	Integ. BW		Max Hold [OFF/ON]
	Max Hold [OFF/ON]		Trc Average [OFF/ON]
	Trc Average [OFF/ON]		Meas. Average [OFF/ON]
	Meas. Average [OFF/ON]		Meas. Avg. Mode [EXP/REP]
	Meas. Avg. Mode [EXP/REP]		Meas. Avg. Reset
	Meas. Avg. Reset		Meas. Avg. Count
	Meas. Avg. Count		
[Occupied BW] Control	Span		
	Percentage		
	Max Hold [OFF/ON]		
	Trc Average [OFF/ON]		
	Meas. Average [OFF/ON]		
	Meas. Avg. Mode [EXP/REP]		
	Meas. Avg. Reset		
	Meas. Avg. Count		
[Intermodulation] Control	Span		
	Max Hold [OFF/ON]		
	Trc Average [OFF/ON]		
	Meas. Average [OFF/ON]		
	Meas. Avg. Mode [EXP/REP]		
	Meas. Avg. Reset		
	Meas. Avg. Count		

Panel key	Soft menu 1
***[CCDF]* Control**	Counts

Panel key	Soft menu 1
[Harm. Distortion Control	Harmonics
	Restart

Panel key	Soft menu 1
[Spec. Emi Mask] Control	Meas. Type
	Ref Channel..
	Offset Table..
	Radio Std.
	Trc Average [OFF/ON]
	Meas. Average [OFF/ON]
	Meas. Avg. Mode [EXP/REP]
	Meas. Avg. Reset
	Meas. Avg. Count

Panel key	Soft menu 1
[Spur. Emiss.] Control	Restart
	Range Table..
	Meas. Average [OFF/ON]
	Meas. Avg. Mode [EXP/REP]
	Meas. Avg. Reset
	Meas. Avg. Count

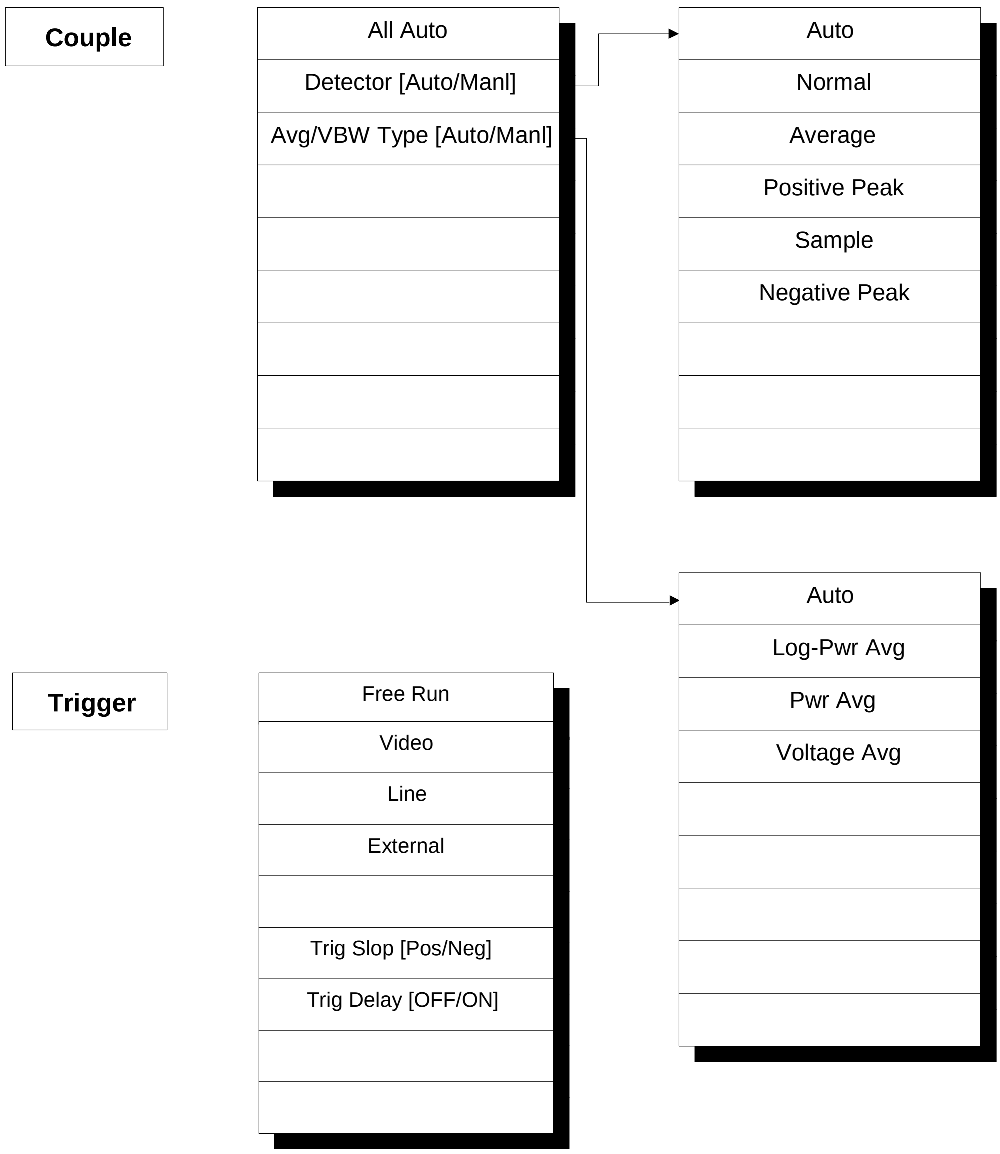
Panel key	Soft menu 1
[Av. Power] Control	Meas. Method
	Rel Threshold
	Sweep Time
	Meas. Average [OFF/ON]
	Meas. Avg. Mode [EXP/REP]
	Meas. Avg. Reset
	Meas. Avg. Count

Panel key	Soft menu 1	Soft menu 2
In/Out	RF Coupling [AC/DC] (Option)	
	2nd IF In [OFF/ON]	
	1^{st} LO Out [OFF/ON]	

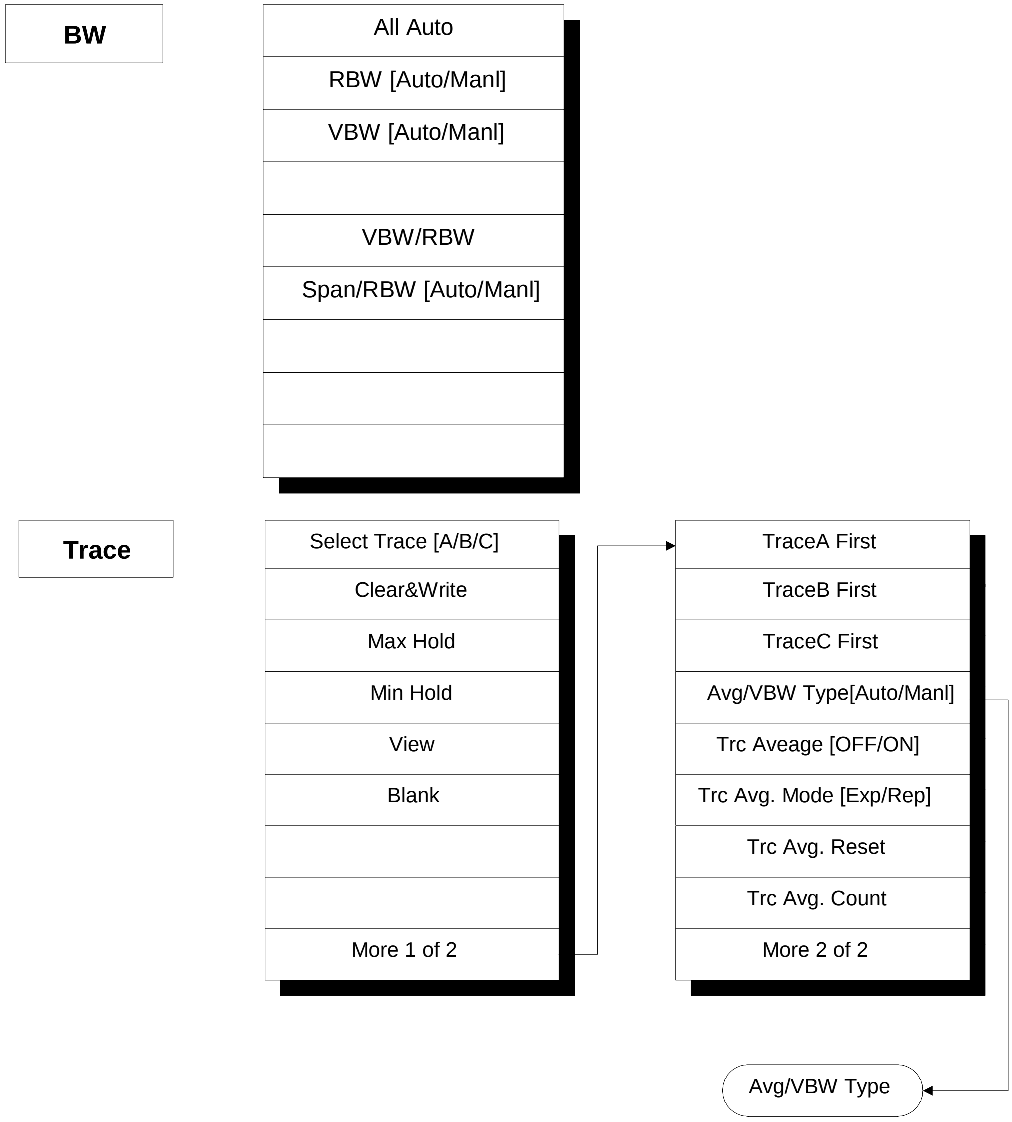
Panel key	Soft menu 1	Soft menu 2
Source	TG	Tracker [OFF/ON]
		Output Lvl
		Normal [OFF/ON]
		Power Swp [OFF/ON]
		Auto Freq. Cal
		Manual Freq. Cal
Aux	Am Demod. [OFF/ON]	
	FM Demod. [OFF/ON]	
	Audio Sound [OFF/ON]	
	Audio Level	

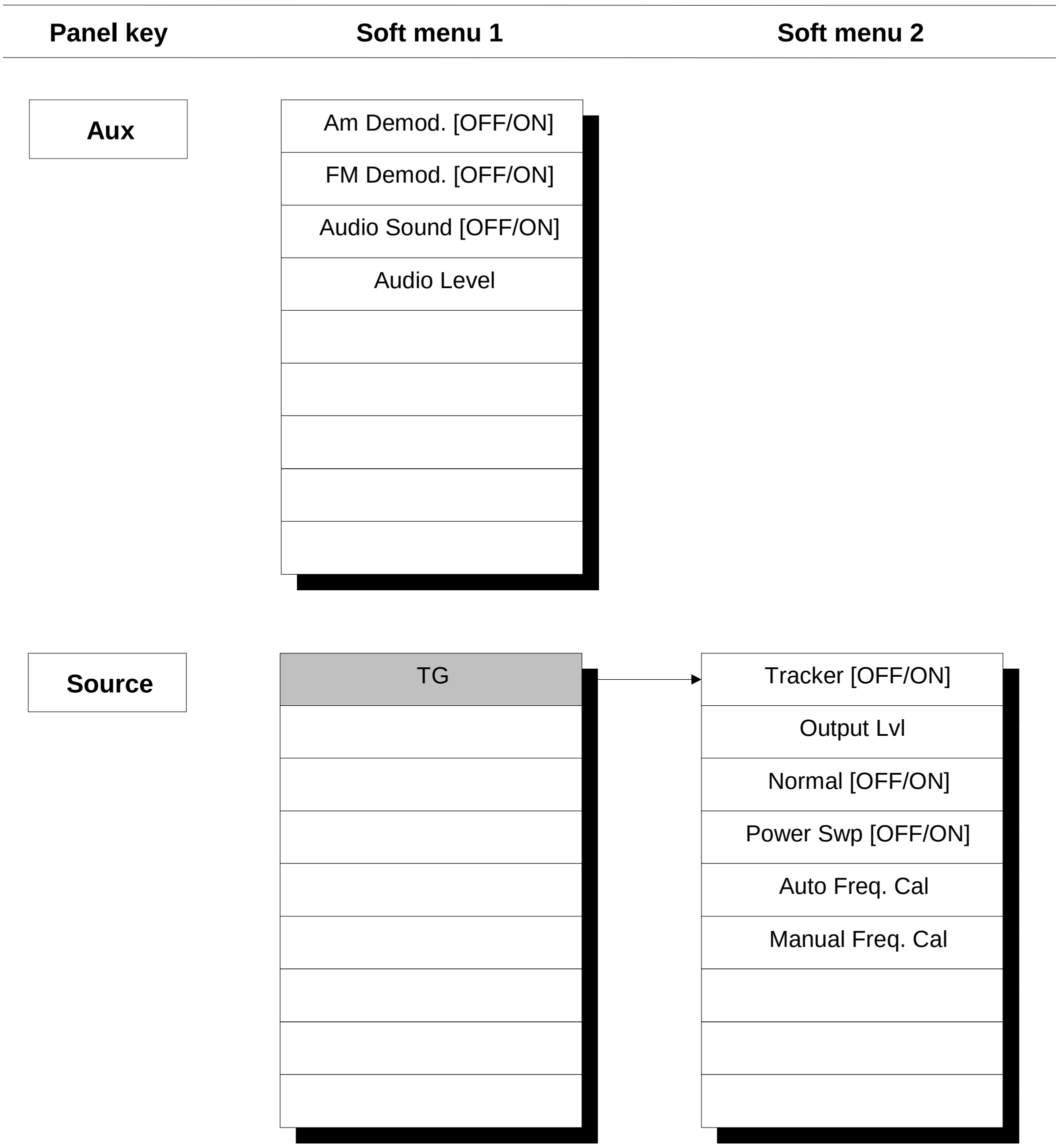
Panel key	Soft menu 1	Soft menu 2
Display	Full Screen	Screen Title.. → Character Box
	Display Value	White Mode [OFF/ON]
	Display Line [OFF/ON]	Graticule [OFF/Full/Center]
	Threshold Value	Annotation [OFF/ON]
	Threshold Line [OFF/ON]	Dual Windows [OFF/ON]
	Zoom Center	Select Window [Top/Bottom]
	Zoom Span	Text Position [Top/Center/Bottom]
	Zoom Display [OFF/ON]	
	More 1 of 2 → Soft menu 2	More 2 of 2
Limit	Up Pass Check [OFF/ON]	Select [Freq/Ampl]
	Low Pass Check [OFF/ON]	Insert Line
	Make Up Line.. → Soft menu 2	Delete Line
	Make Low Line.. → Soft menu 2	Clear
	All Clear	
	Alarm [OFF/ON]	
		Previous

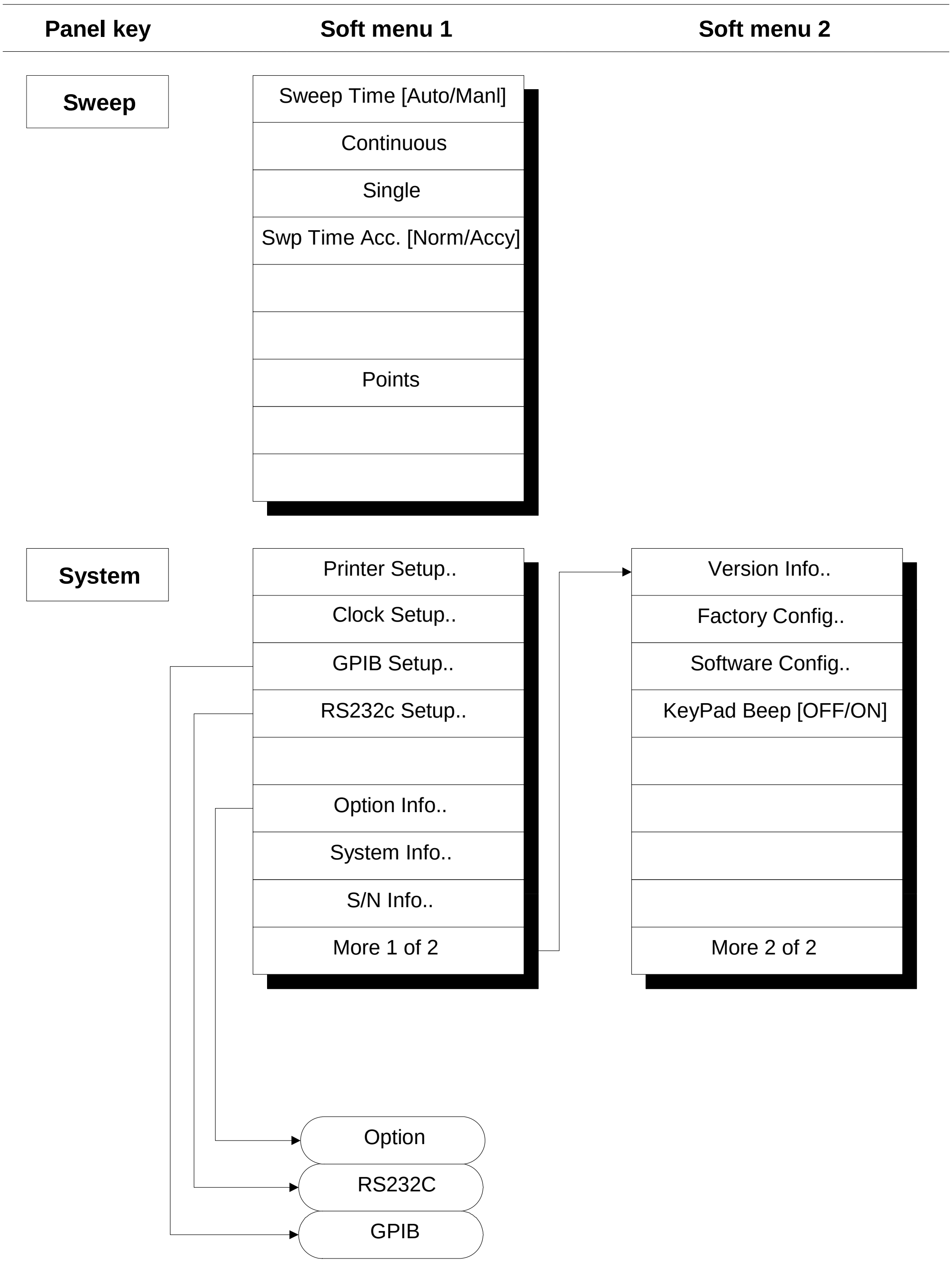
Panel key	Soft menu 1	Soft menu 2



Panel key	Soft menu 1	Soft menu 2




Panel key
Soft menu 1
Soft menu 2
Aux
Am Demod. [OFF/ON]
FM Demod. [OFF/ON]
Audio Sound [OFF/ON]
Audio Level
Source
TG
Tracker [OFF/ON]
Output Lvl
Normal [OFF/ON]
Power Swp [OFF/ON]
Auto Freq. Cal
Manual Freq. Cal


Panel key
Soft menu 1
Soft menu 2
Sweep
Sweep Time [Auto/Manl]
Continuous
Single
Swp Time Acc. [Norm/Accy]
Points
System
Printer Setup..
Clock Setup..
GPIB Setup..
RS232c Setup..
Option Info..
System Info..
S/N Info..
More 1 of 2
Version Info..
Factory Config..
Software Config..
KeyPad Beep [OFF/ON]
More 2 of 2
Option
RS232C
GPIB

Panel key	Soft menu 1	Soft menu 2
RS232C	Baud Rate	
	Data Length	
	Stop Bit	
	Parity Bit	
	Previous	
GPIB	Set Address	
	Previous	
OPTION	Option Activate	
	Previous	

Panel key	Soft menu 1	Soft menu 2
Preset	Preset	Auto Alignment [OFF/ON]
	Last State	ZNC Alignment
	Save User State	PreFilter Alignment
	Load User State	Level Alignment
	Select User State [Usr1..3]	All Alignment
	Boot On [Last/System]	
	More 1 of 2	More 2 of 2

Panel key	Soft menu 1	Soft menu 2
File	Load	Sort key
	Save	Sort Dir [Ascend/Descend]
	Delete	Attribute [Normal/ReadOnly]
	Rename	File Name [Auto/Title]
	Copy to USB	Default Folder
	File Type	Folder Up
	All Delete	Folder Down
	Close	More 2 of 2
	More 1 of 2	

Panel key	Soft menu 1	Soft menu 2
Marker	Select Marker	Readout
	Normal	Marker Table [OFF/ON]
	Delta	Edit Mkr Name.. → Character Box
	Band Pair [Start/Stop]	Default Mkr Name
	Span Pair [Span/Center]	Mkr Average [OFF/ON]
	OFF	Mkr Avg. Mode [Exp/Rep]
	Marker Trace [A/B/C]	Mkr Avg. Reset
	All OFF	Mkr Avg. Count
	More 1 of 2 → Soft menu 2	More 2 of 2
Mkr->	Marker->CF	
	Marker->CFStep	
	Marker->Start	
	Marker->Stop	
	Marker->Ref	
	dMarker->Span	
	dMarker->CF	
	dMarker->CFStep	

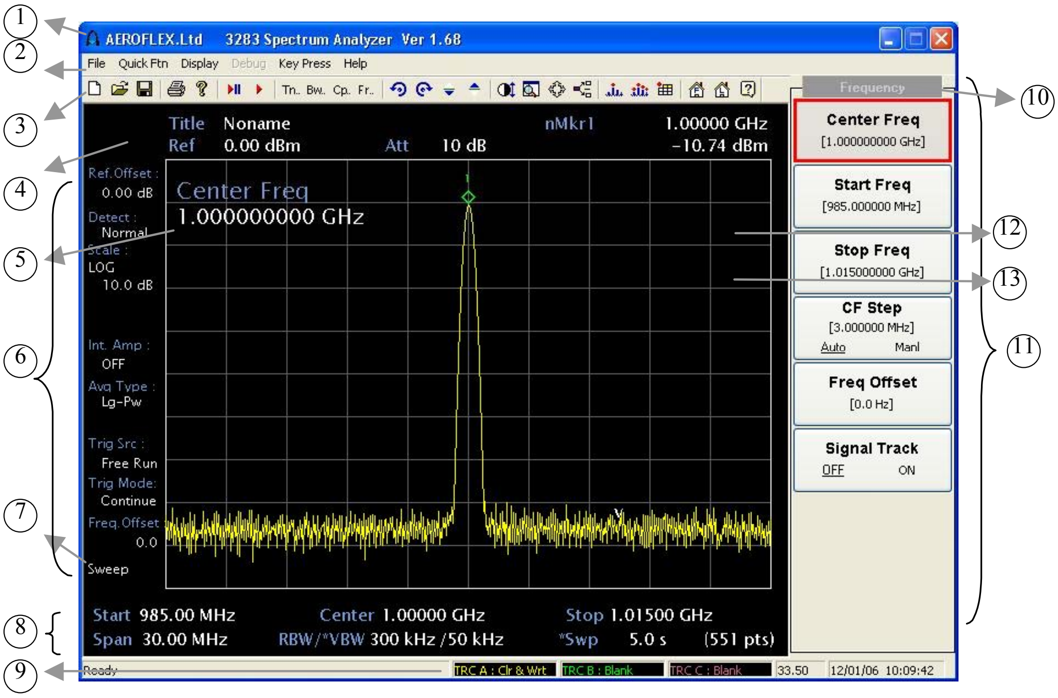
Panel key	Soft menu 1	Soft menu 2
Peak	Next Peak	Multi Pk Number
	Next Pk Left	Multi Peak
	Next Pk Right	Multi Pk Trace [A/B/C]
	Min Search	Search Param..
	Pk-Pk Search	
	Signal Track [OFF/ON]	
	Continuous [OFF/ON]	
	Marker->CF	
	More 1 of 2	More 2 of 2
Func	Marker Noise	Excursion
	Freq. Counter	Threshold
	Meas. OFF	Peak Search [Param/Max]
		Previous

Chapter 5
OPERATING PROCEDURES

Contents

Screen layout

This is the initial screen that you see at start-up.

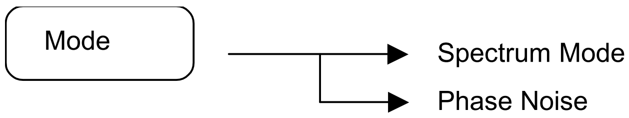


1	Title window	Manufacturer, display model
2	General menu bar	Displays general operating menu
3	Tool bar	Displays general operating menu icons
4	Upper display window	Displays screen subject, reference level, scale, attenuation and marker parameter
5	Parameter window	Displays current active menu parameter
6	Wave display window	Displays current active waveform
7	Left display window	Displays information about trigger and operating mode
8	Lower display window	Displays Freq. Info., RBW, VBW, Sweep time, number of points
9	Status display window	Displays current job processing status and waveform status
10	Menu name	Displays the current soft menu name
11	Soft key menu	Displays the available auxiliary function associated with the selected hard key
12	Effective data display	Displays the accuracy of the current signal waveform
13	Average number display	Displays the number of signal waveform averages. Displays confirmation of frequency input.

Selecting spectrum analysis or phase noise measurement mode

By default, the instrument starts up in spectrum analysis mode.

To toggle between spectrum analysis and phase noise measurement modes, do the following:



Select the [Mode] hard key on the front panel of the signal analyzer, and then press the *[Spectrum Mode]* or *[Phase Noise]* soft key to select the appropriate operating mode.

Then go to:

page 5-6 for spectrum analysis operation

page 5-65 for phase noise operation.

Instrument in spectrum analysis measurement mode

Freq/span functions

Frequency is set in either of two modes:

- Center – span mode
- Start – stop mode

The lower and upper span limits are 3 Hz to 3 GHz (3281) / 13.2 GHz (3282) / 26.5 GHz (3283).

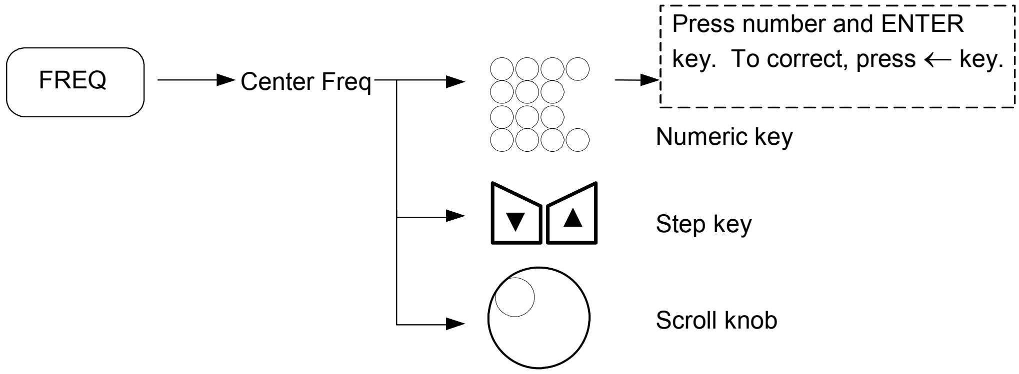
Use [FREQ] for setting frequency.

Use [SPAN] for setting frequency span.

Center-span mode frequency data entry

Setting the center frequency

To set the center frequency, do the following:



Numeric key, step key, and scroll knob are the data entry section.

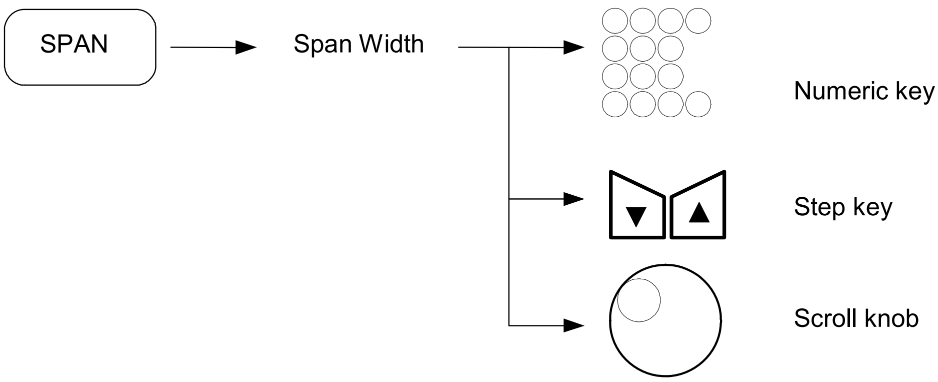
The step size of the step up/down key is 1/10 of the current frequency span (CF Step mode set to MNL, page 5-9).

The step size of the scroll knob is 1/500 of the current frequency span.

The span can be changed if the center moves too near the boundary.

Setting the frequency span

To set the frequency span, do the following:



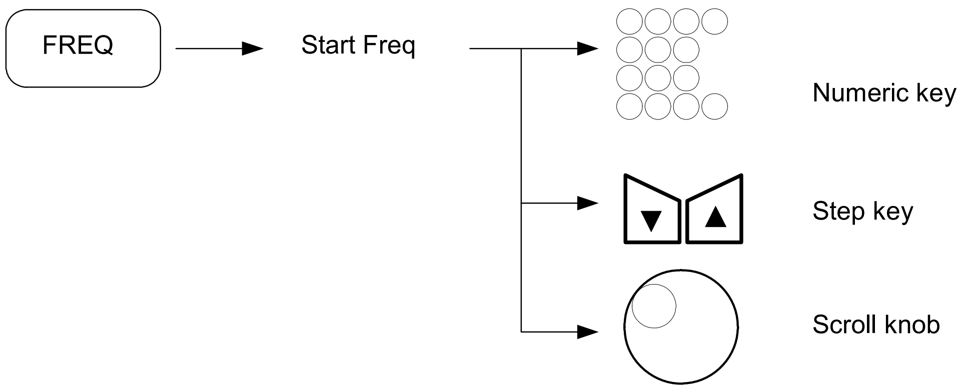
Span range is 10 Hz–3 GHz/13.2 GHz/26.5 GHz. It changes in a 1, 2, 5 step sequence: 1 k, 2 k, 5 k, ……, 100 k, 200 k, 500 k, …

The step size of the scroll knob is 1/100 of the current frequency span.

Start-stop mode frequency data entry

Setting the start frequency

To set the start frequency, do the following:

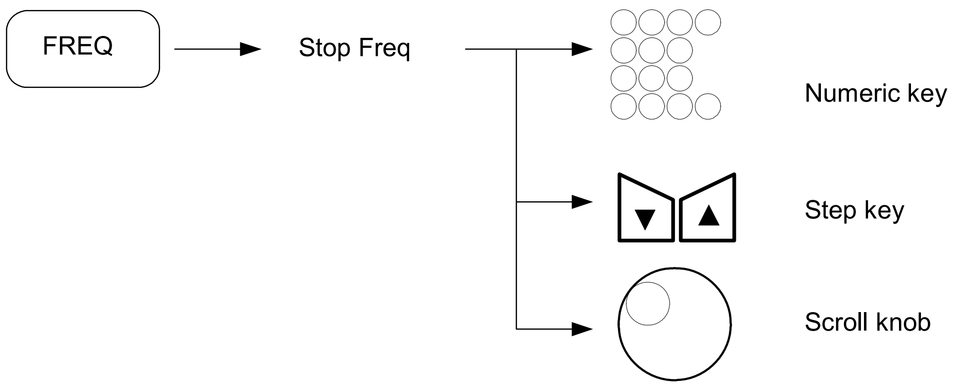


The step size of the step up/down key is 1/10 of the current frequency span.

The step size of the scroll knob is 1/500 of the current frequency span.

Setting the stop frequency

To set the stop frequency, do the following:



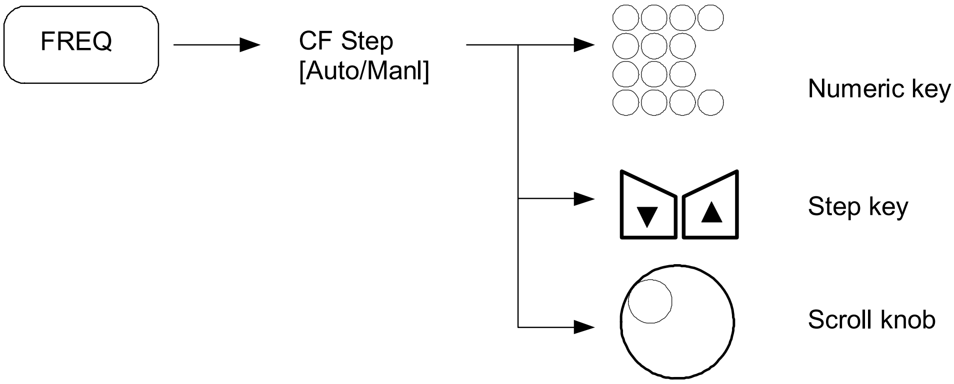
The step size of the step up/down key size is 1/10 of the current frequency span.

The step size of the scroll knob is 1/500 of the current frequency span.

Note*: the start and the stop frequency are also determined by setting the center and the span frequency. For example, if the center frequency is 40 MHz and the span frequency is 20 MHz, the start and the stop frequency are determined as 30 MHz and 50 MHz respectively.*

Setting center frequency step

To set the start frequency, do the following:



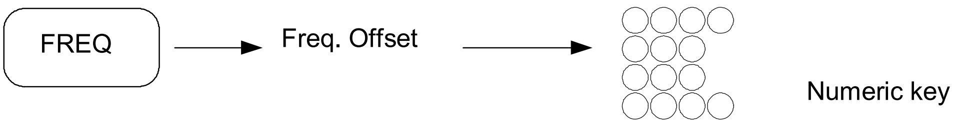
Change the CF Step mode from AUTO to MNL mode by pressing *[CF Step]*.

In CF Step MNL (Manual) mode, the step size can be set by the DATA ENTRY SECTION.

If CF Step [AUTO/MNL] 'AUTO' is selected, the CF Step size is 1/10 of the current span.

Setting frequency offset

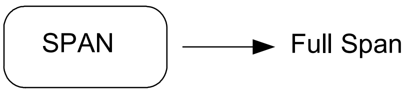
To set frequency offset, do the following:



Change the Freq. Offset mode from OFF to ON mode by pressing *[Freq. Offset]*. In Freq. Offset [ON] mode, the frequency-offset size can be set by the numeric key.

Setting full span

To set full span without affecting other parameters, do the following.



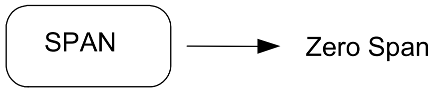
Set start frequency to 0 Hz and stop frequency to 3 GHz/13.2 GHz/26.5 GHz.

Setting zero span

This instrument can operate as a selective level meter in which the horizontal axis is changed to a time axis by setting the frequency span to 0 Hz.

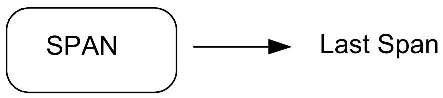
The rising and falling edges of the signal burst wave can also be observed and measured.

Do either of the following operations to allow the instrument to operate in the zero span (span = 0 Hz) mode.



Return to the previous span

The previous span is returned by the following key operation:

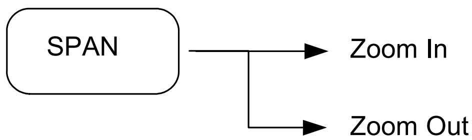


Zoom in/zoom out

The Zoom In function changes the span from the current span to 1/2 of the current span.

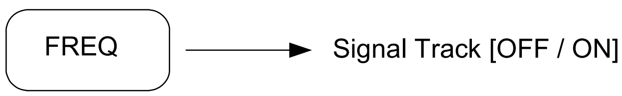
The Zoom Out function changes the span from the current span to 2 times the current span.

The center frequency does not change.



Setting signal tracking

The maximum level point always moves to the center position of the horizontal axis when signal tracking is on.



Signal tracking is ON or OFF.

***Note**: the span changes to minimum span in the following cases:*

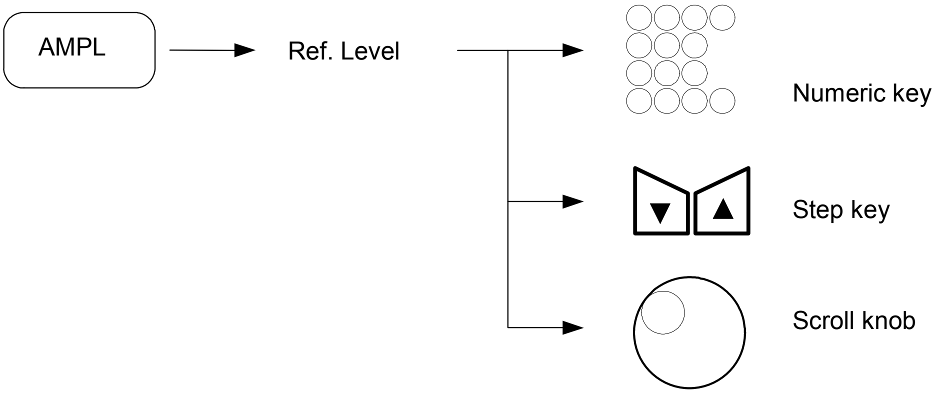
1) *if the center frequency is less than the minimum frequency (0 Hz) or is greater than the maximum frequency (3/13.2/26.5 GHz)*
2) *if the start frequency is greater than the stop frequency*
3) *if the stop frequency is less than the start frequency.*

Amplitude function

The [AMPL] hard key displays the header key for setting the amplitude.

Setting reference level

Set the reference level (top graticule) by doing the following:

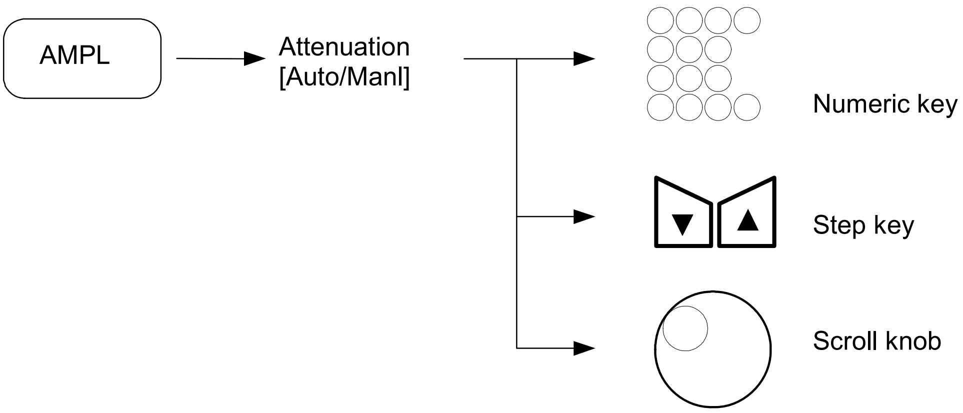


The step size is one division of the current scale (see *Setting Amplitude Scale* on page 5-12).

The step size of the scroll knob is 1 dB.

Setting input attenuation

Do the following to set the input attenuator level:



Change the Atten. mode [AUTO or MNL] by pressing *[Attenuation [Auto/Manl]]*. In Atten MNL (manual) mode, the step size of the input attenuator can be set by the numeric keys, step keys, and scroll knob (range 0 to 55 dB) (see *Input Attenuator* on page 5-16).

If Atten 'AUTO' is selected, the input attenuator is automatically coupled to the current reference level.

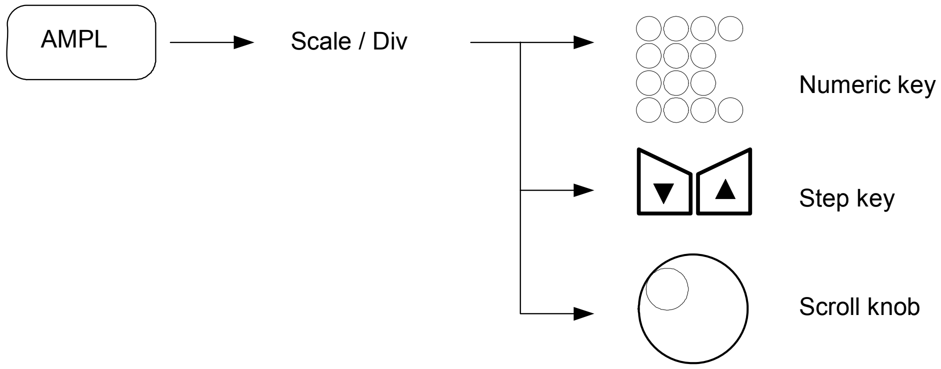
Setting amplitude scale

In log scale, this instrument provides 0.1 to 20 dB/div scales.

In linear scale, the instrument uses the full scale.

To set the amplitude scale, do the following:

- Log Detector Mode



The amplitude scale is changed into a 1, 2, 5 step sequence by pressing the step key.

The step size of the scroll knob is 0.1 (at 0.1–1.0 dB/div) and 1 (at 1.0–20.0 dB/div).

Selecting log/linear detector mode

To set the amplitude scale to log scale or linear scale, do the following:

Setting log detector

Setting linear detector

If the mode is changed between log and linear detector modes, the reference level remains constant.

Log detector mode uses the dBm reference unit, Linear detector mode uses the Volt reference unit.

Selecting input impedance

To select the input impedance, do the following:

AMPL → More 1 of 2 → Input Z [50 ohm / 75 ohm]

The *[Input Z [50/75]]* soft key sets input impedance to 50 or 75 ohm.

Setting internal amp

Set the internal amp to operate by doing the following:

AMPL → Internal Amp [OFF / ON]

This function is usable up to max. 3 GHz.

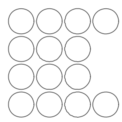
CAUTION

An input signal level greater than −20 dBm will damage the instrument.

Setting the reference level offset

Set the reference level offset by doing the following:

AMPL → Ref. Offset →



Numeric key

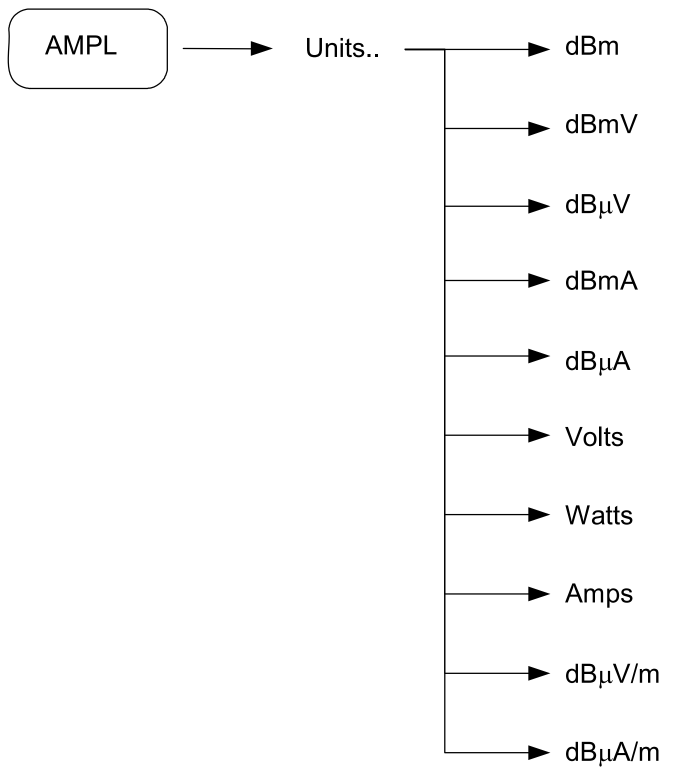
The reference level offset size is from −217.6 dB to 297.6 dB.

Setting amplitude units

In log scale, this instrument provides ten reference level units: dBm, dBmV, dBμV, dBmA, dBμA, Volts, Watts, Amps, dBμV/m, dBμA/m.

In linear scale, the only reference level unit is V.

To select one of the reference level units, do the following:



Setting amplitude correction

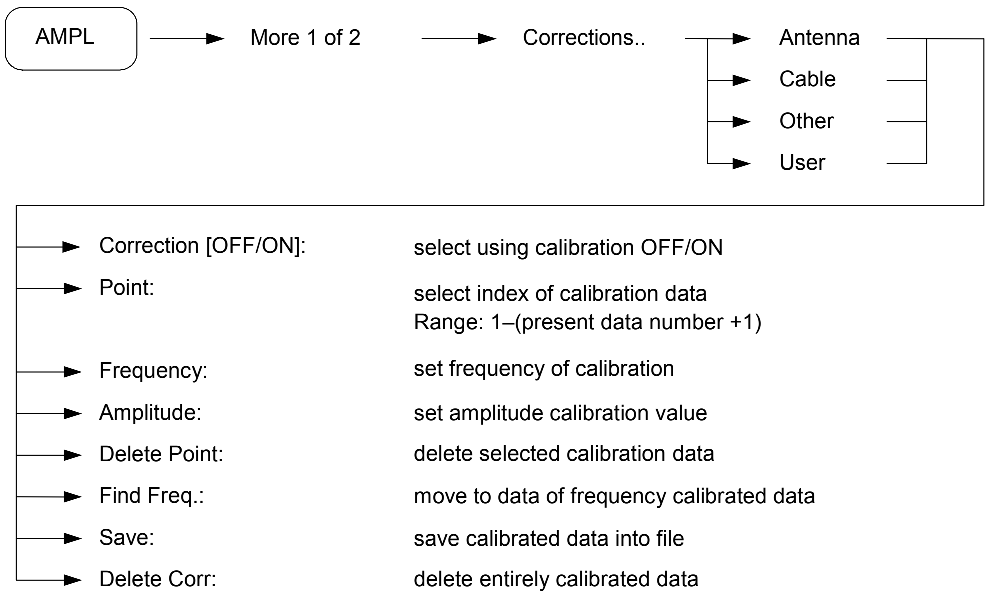
Setting amplitude correction allows you to specify correction to the measurement environment.

The instrument provides the four types of the amplitude correction.

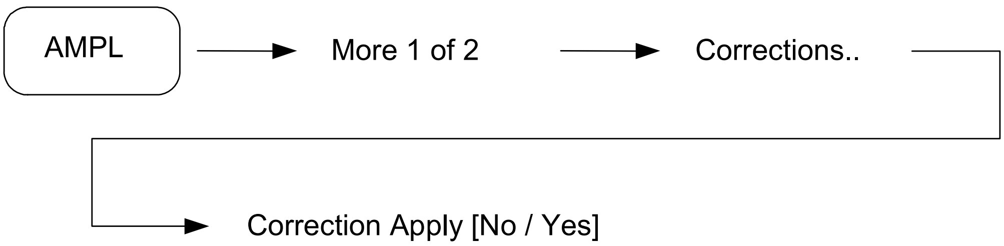
- Antenna correction
- Cable correction
- Other correction
- User correction

Amplitude correction can perform the four types of correction at the same time or individually.

To set the amplitude correction, do the following:



To apply corrections individually, do the following:



Input attenuator

To set the input attenuator, do the following:

AMPL → Attenuation [AUTO/MNL]

Auto mode

When a signal is input with the same level as the reference level, the input attenuator value in the AUTO mode is controlled so that high accuracy measurements can be made without being influenced by gain compression, and the noise level can be reduced.

While Auto is selected, the input attenuator is automatically set to the optimum value according to the reference level:

Reference level range	Attenuation Auto
25.1 dBm to 30.0 dBm	40
20.1 dBm to 25.0 dBm	35
15.1 dBm to 20.0 dBm	30
10.1 dBm to 15.0 dBm	25
5.1 dBm to 10.0 dBm	20
0.1 dBm to 5.0 dBm	15
Less than 0 dBm	10

Manual setting

When you want to measure a low-level signal by raising the sensitivity, set the input attenuator manually as shown in the table below:

Reference level range	Attenuation Manual
+30 dBm to –170 dBm	55
+30 dBm to –170 dBm	50
+30 dBm to –170 dBm	45
+30 dBm to –170 dBm	40
+25 dBm to –170 dBm	35
+20 dBm to –170 dBm	30
+15 dBm to –170 dBm	25
+10 dBm to –170 dBm	20
+5 dBm to –170 dBm	15
0 dBm to –170 dBm	10
–5 dBm to –170 dBm	5
–10 dBm to –170 dBm	0

Measurement function

The instrument provides the following measurements:

- X dB Down
- Adjacent Channel Power
- Channel Power
- Occupied Bandwidth
- Intermodulation (TOI)
- Total Power
- CCDF
- Harmonic Distortion
- Spectrum Emission Mask
- Spurious Emissions
- Average Power (Burst Power)

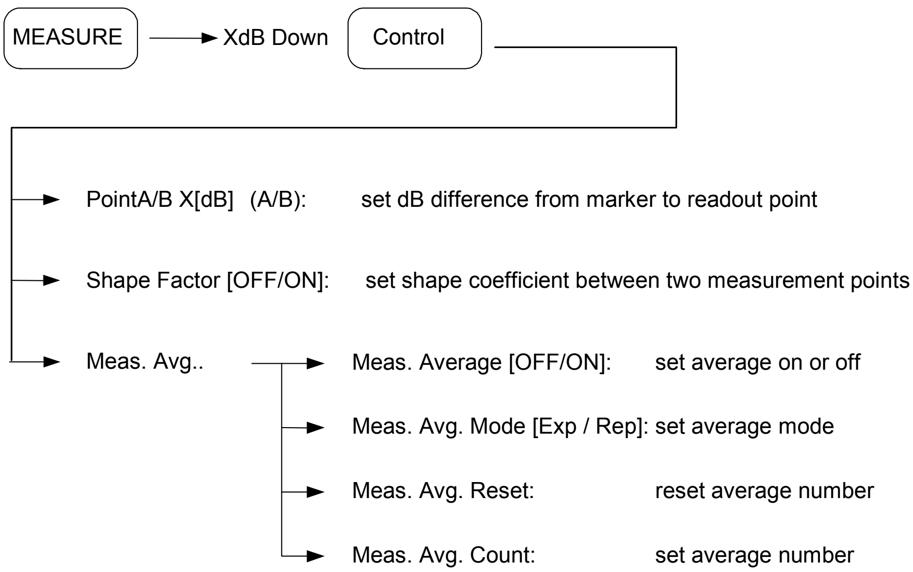
Make the measurement in single or continuous sweep mode by pressing [Sweep], *[Continuous]* or [Sweep], *[Single]*. Close each measurement by pressing the *[Meas. Off]* soft key.

X db down measurement

The X dB down function displays the frequency difference between a reference marker (◊) and another marker (⟶ ⟵) that is X dB down from the reference marker.

The relative dB range that can be specified for X from the screen dynamic range is selected using the step key or scroll knob. The default values are 3 dB and 60 dB. If the measurement of A point and B point is done at the same time, the shape factor of the signal can be measured.

To use the X dB down measurement function, do the following:



Adjacent channel power measurement

The ACP measurement function measures the center of the signal (designated by three marker lines) and the power of adjacent channels.

MEASURE → Adj. Channel Pwr → Control

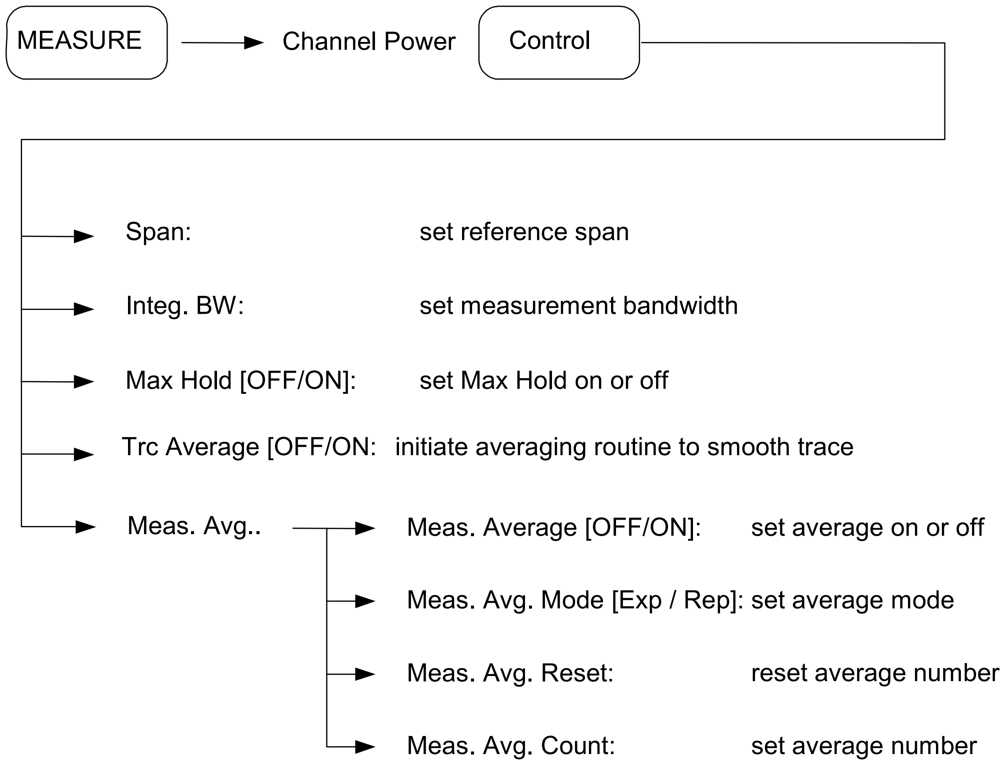
- Span: set basic span bandwidth
- Main Ch. BW: set basic channel bandwidth
- Adj. Ch. BW: set adjacent channel bandwidth
- Ch. Spacing: set distance between basic and adjacent channels
- Max Hold [OFF/ON]: set active trace to max. hold mode
- Trc Average [OFF/ON: initiate averaging routine to smooth trace
- Adj. Ch. Num: set between 1 and 6 adjacent channels
- Meas. Avg..
  - Meas. Average [OFF/ON]: set average on or off
  - Meas. Avg. Mode [Exp / Rep]: set average mode
  - Meas. Avg. Reset: reset average number
  - Meas. Avg. Count: set average number

Measurement configuration is done by using the data entry section (numeric keys, step keys or scroll knob) after each soft key is pressed. Adjust the BW and spacing by observing the messages at the bottom of the result window.

For a more stable measurement value, find the average measurement value by setting *[Meas. Average]* ON.

Channel power measurement

Measures the power and power spectral density in the channel bandwidth specified.



Configure the measurement by using the data entry section (numeric keys, step keys or scroll knob) after each soft key is pressed. The BW and spacing can be adjusted by observing the message at the bottom of the result window.

For a more stable measurement value, find the average measurement value by setting *[Meas. Average]* ON.

You must set the center frequency, reference level, and channel bandwidth.

Occupied bandwidth measurement

Measures the occupied bandwidth of the signal being displayed on the screen.

The instrument has an OBW (occupied bandwidth) measurement function that uses the measurement data displayed on the screen. It calculates the frequency band that contains a specified percentage of the total power. The default value is 98%, and a measurement range between 0.01% and 100% can be specified.

The results of the OBW and the occupied bandwidth channel power(OBW CHP) are shown in the result display area.

OBW measurement procedure

Set the center frequency and normal marker to the known carrier frequency and set the frequency, span, resolution bandwidth (RBW), and sweep time to AUTO mode.

Calculate the occupied bandwidth by doing the following:

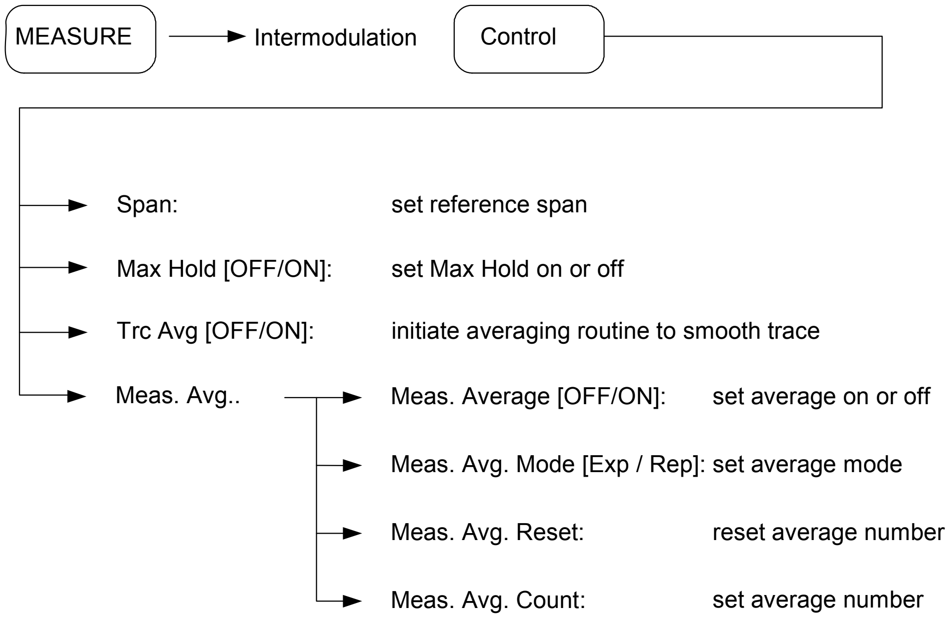
MEASURE → Occupied BW → Control →

- Span: set reference span
- Percentage: set percentage of occupied bandwidth
- Max Hold [OFF/ON]: set Max Hold on or off
- Trc Average [OFF/ON: initiate averaging routine to smooth trace
- Meas. Avg.. →
  - Meas. Average [OFF/ON]: set average on or off
  - Meas. Avg. Mode [Exp / Rep]: set average mode
  - Meas. Avg. Reset: reset average number
  - Meas. Avg. Count: set average number

To change the percentage of occupied bandwidth, use the numeric keys to set a new percentage. The measurement lines adjust automatically. Similarly, OBW Span value changes with Span value.

Intermodulation (TOI) measurement

Measures the IP3 in the span specified.

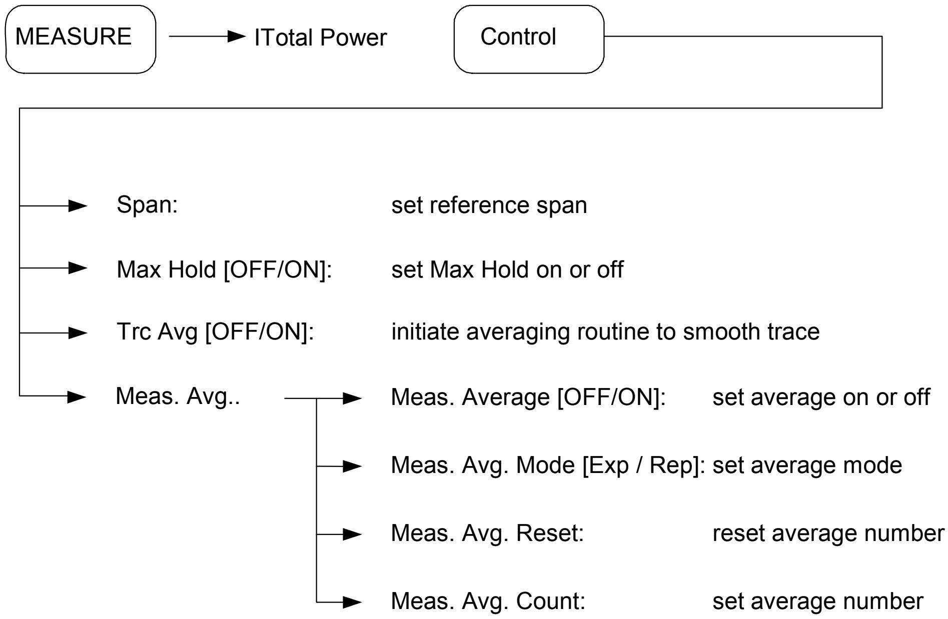


Choose the measurement configuration by using the data entry section (numeric keys, step keys or scroll knob) after each soft key is pressed. Adjust the BW and spacing by noting the warning or error message at the bottom of the results window.

For a more stable measurement value, find the average measurement value by setting *[Meas. Average]* ON.

Total power measurement

Measures the power and power spectral density in the span specified.



Choose the measurement configuration by using the data entry section (numeric keys, step keys or scroll knob) after each soft key is pressed. Adjust the BW and spacing by noting the warning or error message at the bottom of the results window.

For a more stable measurement value, find the average measurement value by setting *[Meas. Average]* ON.

You need to set the center frequency and reference level.

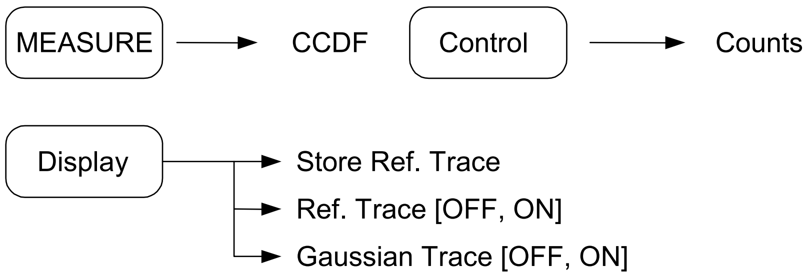
CCDF measurement

This function measures the CCDF (complementary cumulative distribution function) of the present center frequency at a span of 5 MHz.

The horizontal axis shows the dB value above average power and the vertical axis shows the time percentage value above the assigned value.

- The green line shows the Gaussian wave in the CCDF measurement display.
- The yellow line shows the present measured wave.
- Press [Display], *[Ref. Trace [ON]]* to show the reference wave as a purple line. Press [Display], *[Store Ref. Trace]* to save the present wave as the reference wave.
- Press [Control], *[Counts]*, then set the point number of the accumulated data. Input range is from 1 kpt to 4000 kpt.
- Use [BW], *[RBW]* in CCDF measurement to set the 3 dB bandwidth between 10 kHz and 5 MHz.
- Change the measured bandwidth using [SPAN], *[Scale/Div]*.

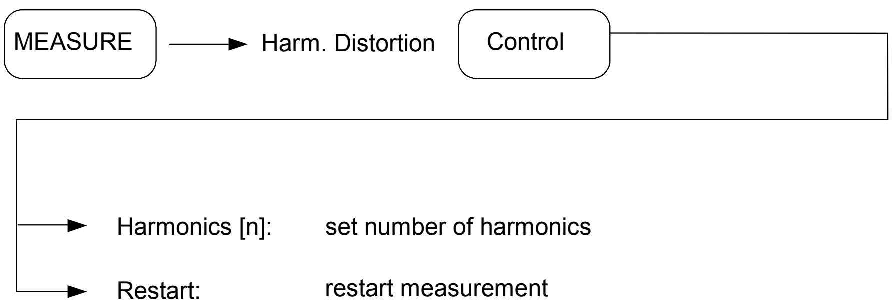
For CCDF measurement and setting the display, use the following keys:



Harmonic distortion measurement

This function measures the harmonics of a single carrier signal and computes the total harmonic distortion. The carrier signal becomes the maximum peak on the display and the total harmonic distortion is calculated from the measured harmonics.

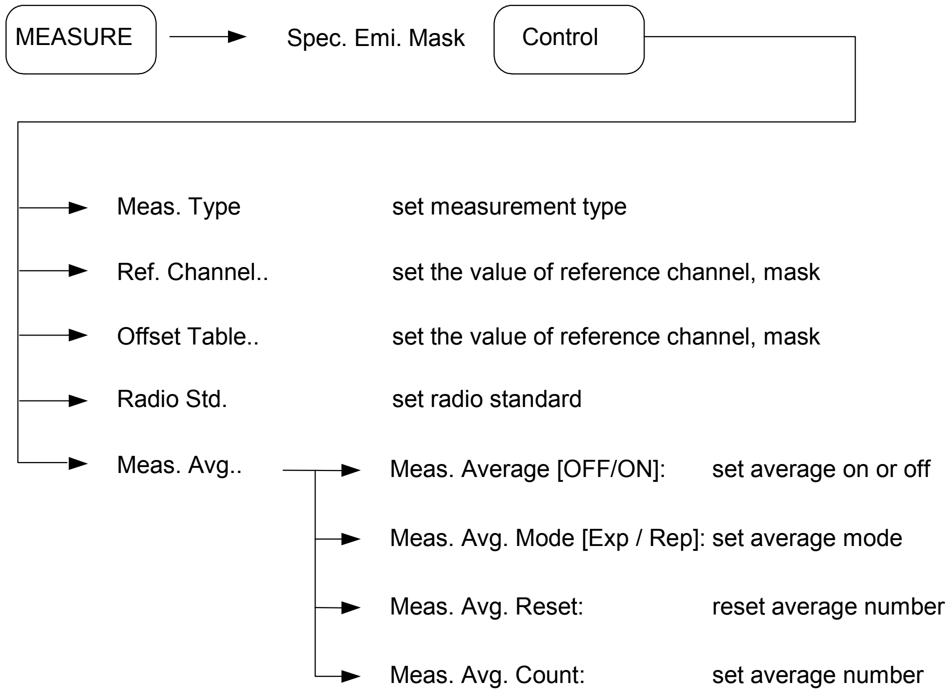
When measuring the nth harmonic, the analyzer chooses the optimum resolution bandwidth (RBW) to capture the best harmonic signal.



Harmonics number means the number of nth harmonics. Harmonics number can be set between 2 and 5. The default is 2. The recommended SPAN value is less than 4 MHz for an accurate measurement.

Spectrum emission mask measurement

Measures the pass/fail state according to the reference channel mask.

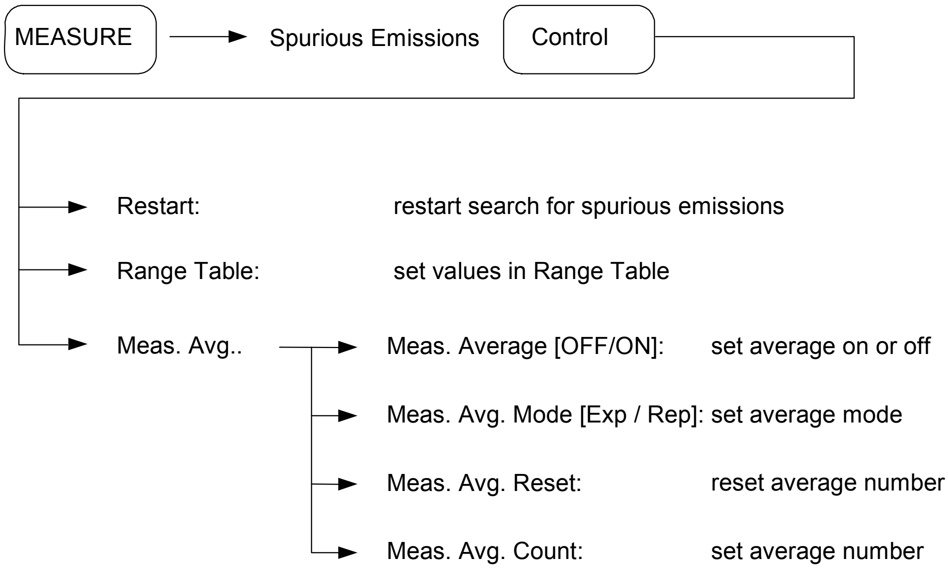


Choose the measurement configuration by using the data entry section (numeric keys, step keys or scroll knob) after each soft key is pressed. Adjust the BW and spacing by noting the warning or error message at the bottom of the results window.

For a more stable measurement value, find the average measurement value by setting *[Meas. Average]* ON.

Spurious emissions measurement

Measures the pass/fail state of spurii according to the Range Table.

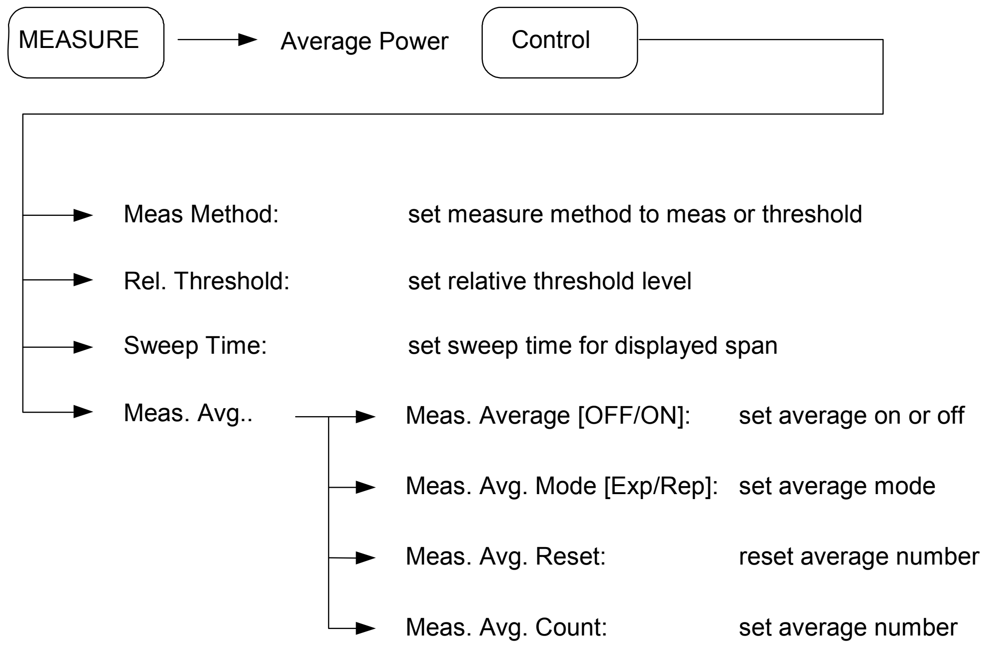


Choose the measurement configuration by using the data entry section (numeric keys, step keys or scroll knob) after each soft key is pressed. Adjust the BW and spacing by noting the warning or error message at the bottom of the results window.

For a more stable measurement value, find the average measurement value by setting *[Meas. Average]* ON.

Average power measurement

Measures the power and power spectral density in the span specified.



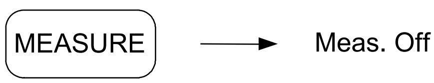
Choose the measurement configuration by using the data entry section (numeric keys, step keys or scroll knob) after each soft key is pressed. Adjust the BW and spacing by noting the warning or error message at the bottom of the results window.

For a more stable measurement value, find the average measurement value by setting *[Meas. Average]* ON.

You need to set the center frequency and reference level.

Closing the window

The present measuring window is closed and measurement mode is ended.



Input/output signal control function

The [In/Out] hard key displays the menu related to input/output signal control of the instrument.

Setting RF coupling

Use this key for setting low-frequency coupling mode.

Except for the 3281, DC Coupling mode is the default.

In/Out → RF Coupling [AC/DC]

This operation is the default for the 3281, for other models the coupling is user-selected.

Setting 2nd IF signal input

Use this key for inputting a 2nd IF input signal.

If you are using a 2nd IF input signal, do not use the RF input port.

In/Out → 2nd IF In [OFF/ON]

This operation is only possible with the external mixer option.

Setting 1st LO output signal

Use this key for selecting a 1st LO output signal.

Select 1st LO output signal, then change the 2nd IF input signal.

In/Out → 1st LO Out [OFF / ON]

This operation is only possible with the external mixer option.

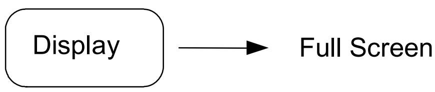
Display function

The instrument provides functions related to the screen display.

Full Screen	Displays the maximum enlarged graticule
Display Line	Displays the horizontal line at the top of the graticule
Threshold Line	Displays the horizontal line at the bottom of the graticule
Zoom Display	Displays the enlarged part of the signal waveform under the screen
Screen Title	Edits the title of the screen
White Mode	Economy mode for screen save and printing
Graticule	Sets the graticule on or off
Annotation	Displays information about the waveform in the annotation window at bottom left of the screen
Dual Windows	Divides the display into two screens. Fixes the signal waveform on one screen as a status of the view and displays the progress of the signal waveform on the other screen.
Text Position	Sets the position of the parameter window on the screen

Full Screen

Full Screen allows you to see only the maximum enlarged graticule. The left and bottom display windows and the soft keys are not displayed in Full Screen status.

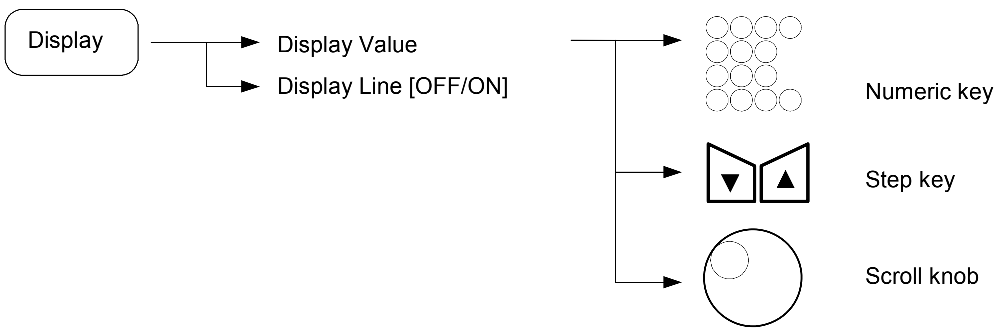


To return to normal screen status, press any key.

Display Line

The display line is a horizontal cursor line that runs across the screen for making level comparisons. *[Display Value]* allows you to set it between the reference level and the lowest level, using the numeric keys, step keys or scroll knob.

[Display Line [OFF]] removes the display line from the screen.

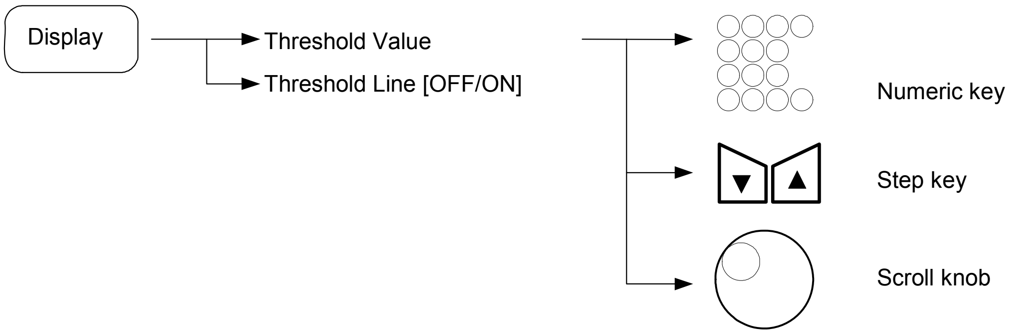


The step size of the step up/down key is 1 division of the vertical range.

The step size of the scroll knob is 0.1 dB.

Threshold Line

The threshold line is a horizontal line above which the waveform is displayed. *[Threshold Value]* allows you to set it between the reference level and the lowest level, using the numeric keys, step keys or scroll knob. *[Threshold Line [OFF]]* removes the threshold line from the screen.

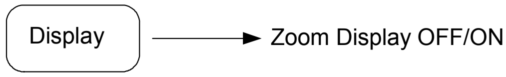


The step size of the step/up down keys is 1 division of the vertical range.

The step size of the scroll knob is 0.1 dB.

Zoom Display

You can expand part of the display about the center frequency in order to view it more clearly. The expanded part displays in a separate window.



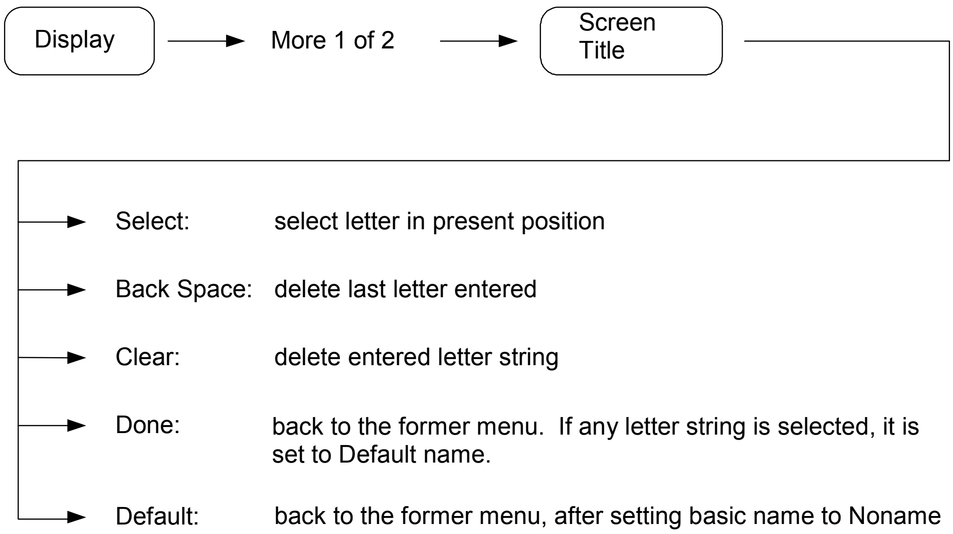
Screen Title

The current screen displaying the spectrum or the waveform can be labeled with this function. You can use the screen title as a filename for a printer and file function (see *Filename* on page 5-54).

When you press *[Screen Title]*, the screen title part changes to the edit window, and an edit menu appears in the soft menu area. Use this menu to edit the screen title.

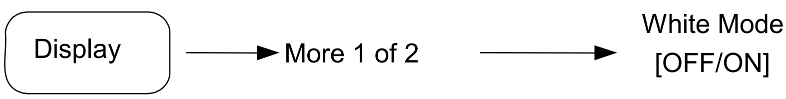
If you only want to correct a screen title, use the step key to move the cursor to the correction position. Any key operation except for the step key initializes the character bar.

Use the scroll knob to select the character for input. The character bar appears in the Status Window at the bottom of the graticule, and the character can be selected using the scroll knob.



White mode

In this mode, the screen background color changes to white to save ink or toner.



Graticule

This menu selects a full graticule, a pair of orthogonal lines that define the center of the display, or OFF.

Display → More 1 of 2 → Graticule [OFF/Full/Center]

Annotation

This key selects removes or displays all on-screen annotation. When annotation is OFF, the display is enlarged.

Display → More 1 of 2 → Annotation [OFF/ON]

Dual Window

This key divides the display into two. It fixes the signal waveform on the lower screen and displays the progress of the signal waveform on the other screen.

Display → More 1 of 2 → Dual Window [OFF/ON]

To select which window shows the changing waveform, do the following:

Display → More 1 of 2 → Select Window [Top/Bottom]

Text position

This changes the position of the signal parameter text that appears on the graticule.

Display → More 1 of 2 → Text Position [Top/Center/Bottom]

Trace function

The [Trace] hard key displays the menu for the trace function.

Select trace

The instrument provides three trace memories, A, B and C.

Trace → Select Trace [A / B / C]

Clear & Write

To change the waveform to Clear & Write status in the selected trace memory, select the following menu:

Trace → Clear&Write

Press *[Clear & Write]* to overwrite existing trace memory data with new data.

Max Hold

New data for each trace point is compared with the previous data, and the level with the higher value is stored and displayed. The signal waveform accumulates the maximum values for each point.

Trace → Max Hold

MaxHold is displayed in the status display window.

Min Hold

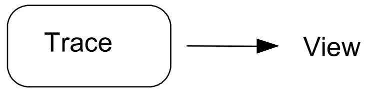
The new data for each trace point is compared with previous data, and the level with the lower value is stored and displayed. The signal waveform accumulates the minimum values for each point.

Trace → Min Hold

MinHold is displayed in the status display window.

View

When *[View]* is pressed, it saves the current trace signal waveform and displays the stored trace on the screen. The signal waveform is fixed.



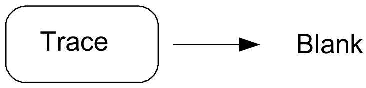
View is displayed in the status display window.

To return to the normal write mode, press *[Clear & Write]*.

Blank

When this key is pressed, trace data is erased from the screen, but the contents of the memory still remain.

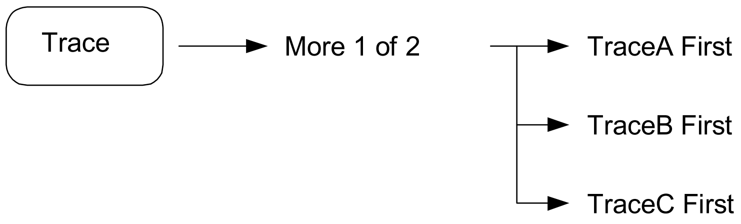
If you press *[View]*, Blank is redisplayed.



Blank is displayed in the status display window.

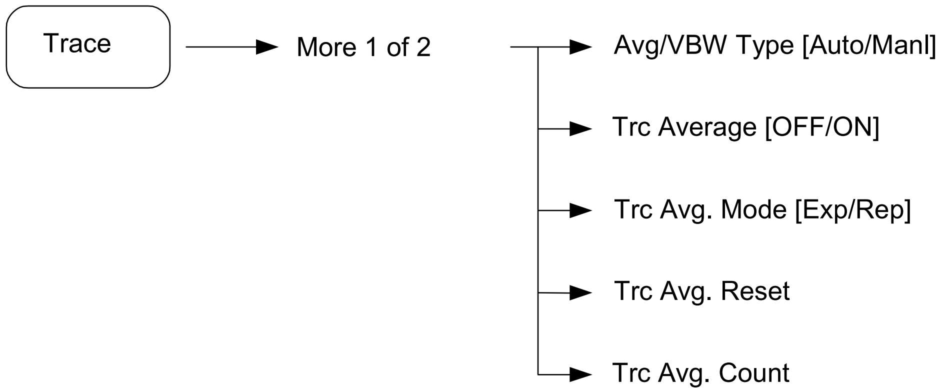
Trace Array

Trace Array selects which trace to display in front when several traces are superimposed.



Averaging function

The averaging function calculates the average data at each vertical axis point for each sweep, and displays the results. It improves the S/N ratio, depending on the averaging rate and the number of sweep repetitions.



[Avg/VBW Type[Auto/Manl]] lets you choose log power (video), RMS power or voltage averaging automatically or manually. See *Setting averaging method* on page 5-40 to learn more about this averaging method.

[Trc Average [OFF/ON]] activates an averaging function that smooths the trace display by averaging the digital data after analog to digital conversion at each sweep, without narrowing the video bandwidth (VBW).

Averaging by video filter has the disadvantage that the sweep time becomes longer when the video bandwidth is narrowed to improve the averaging effect.

Limit line function

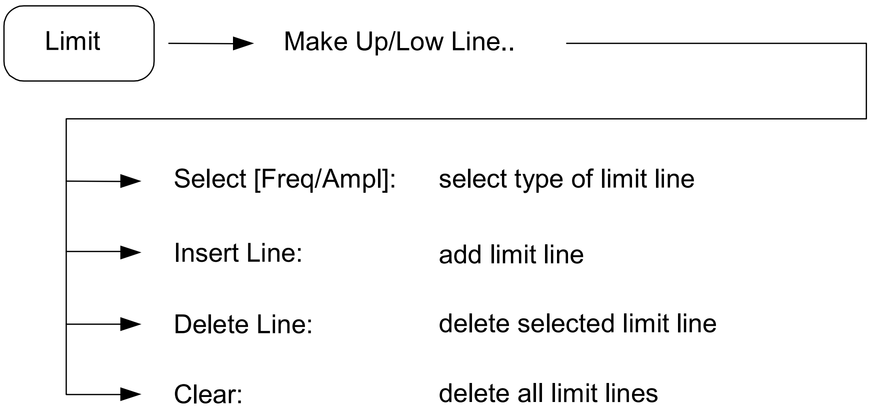
The [Limit] hard key displays the menu for the limit line function, which displays two lines that can be set to show permissible upper and lower bounds on the spectral waveform. Comparison of measured data with the limit lines is then easy.

Drawing a limit line

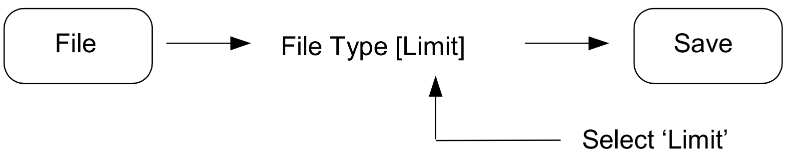
1	*[Make Up Line..]* or *[Make Low Line..]*	Displays the upper/lower limit line edit menu
2	*[Select [Freq/Ampl]]*	Selects type of limit to edit
3	*[Insert line]*	Add limit line to edit
4	Input data using keypad	
5	Repeat 1) to 4) to create further limit lines	

Whilst editing, delete unessential data using *[Delete Line]*.

Delete limit line data using *[Clear]*.



To save the limit line, do the following:



Setting the PASS/FAIL mode

The Pass/Fail result window is displayed at the top right of the screen. When the spectral waveform falls between the upper and lower limit lines, PASS is displayed on the screen; if not, FAIL is displayed. The number of occurrences of failure is displayed to the right of the FAIL sign.

Limit → Up Pass Check [OFF/ON]

When ON is selected, the signal is checked against the the upper limit line, and a fail is displayed if it is exceeded.

Limit → Low Pass Check [OFF/ON]

When ON is selected, the signal is checked against the the lower limit line, and a fail is displayed if it is exceeded.

Limit → Alarm [OFF/ON]

When ON is selected, an audible alarm sounds a beep if a fail occurs.

Turn off the Limit Line function

Limit → All Clear

When this key is selected, it turns off the limit line function.

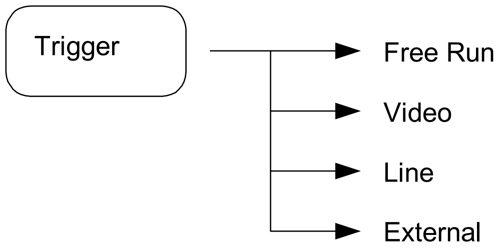
Trigger function

The [Trigger] hard key displays the menu for using the trigger function.

Trigger source

The trigger mode of the instrument is generally set to Free Run.

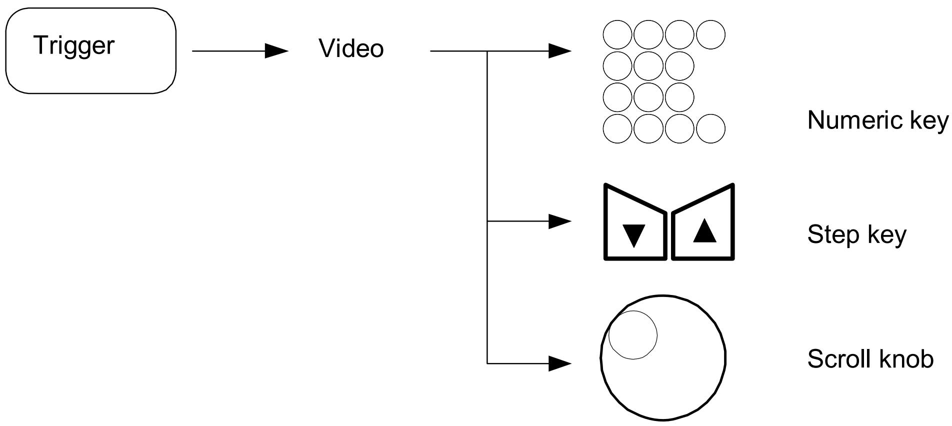
In the Triggered mode, Video, Line or External can be selected as the trigger source.



Video trigger

When the Video Trigger source is selected, the sweep is started in synchronization with a positive leading edge of the detected waveform that is greater than the trigger level.

To select video trigger level, do the following:



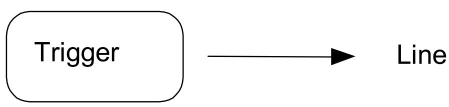
The trigger level is controlled by the step up/down keys or the scroll knob.

The trigger level is shown by a line on the screen.

Line trigger

This function starts a sweep in synchronization with the AC power line frequency.

Line trigger can be conveniently used to observe power-line related waveforms.



External

This function starts a sweep in synchronization with the external trigger source.

The sweep is started in synchronization with the positive leading edge of a signal waveform input to the EXT TRIG input connector on the rear panel.

Trigger execution requires TTL input signals.

Trigger delay

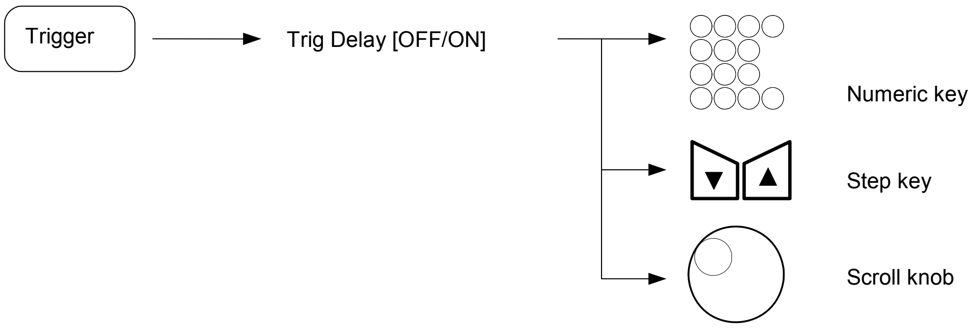
When the trigger mode is set to Triggered mode (trigger source is selected as Video, External or Line only), the trigger point is usually positioned at the left side of the screen.

However, this means that it is not possible to see the waveform before the trigger point and the waveform beyond the right end of the screen.

A waveform before the trigger point or after the end of the display can be displayed by changing the delay time.

Note*: trigger delay works in Zero Span mode only.*

To set the delay time, do the following:



The delay time is set using numeric keys, the scroll knob and the step up/down keys in Zero Span mode. The range of delay time is (–sweep time to +sweep time).

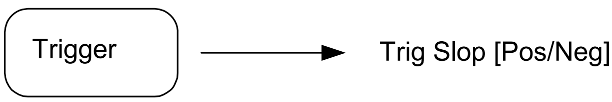
A negative value of delay time means the Pre-Trigger mode is used. It shows the waveform before the trigger point.

A positive value of delay time means the Post-Trigger mode is used. It shows the waveform after the trigger point.

Selecting trigger edge

Select the type of trigger edge.

There are two trigger edge types: Positive and Negative.



Coupled function

The [Couple] function sets the signal detection mode and the Avg/VBW type of the instrument. Modes are: All Auto function, Detector Mode and the Set Averaging method.

All Auto

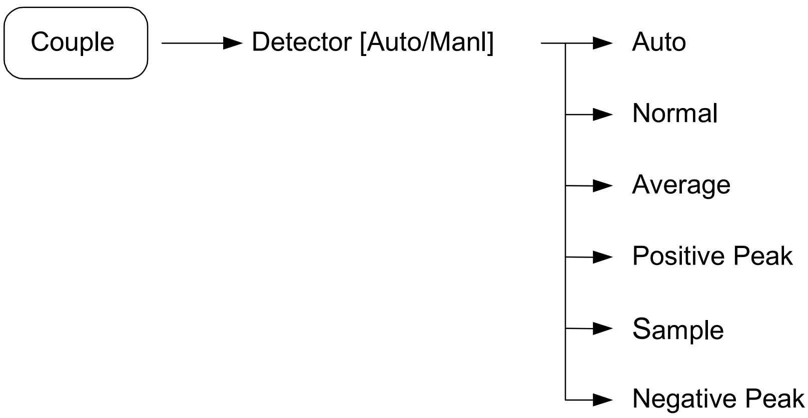
[All Auto] optimizes the coupling of the instrument for the measurement environment by setting the detector mode to Normal. If you select manual for a particular detector mode, that mode is uncoupled but other modes remain under automatic control.

Detector mode

The instrument has five signal detector modes:

- Normal
- Average
- Positive Peak
- Sample
- Negative Peak

Select the signal detect mode using the following key operations:



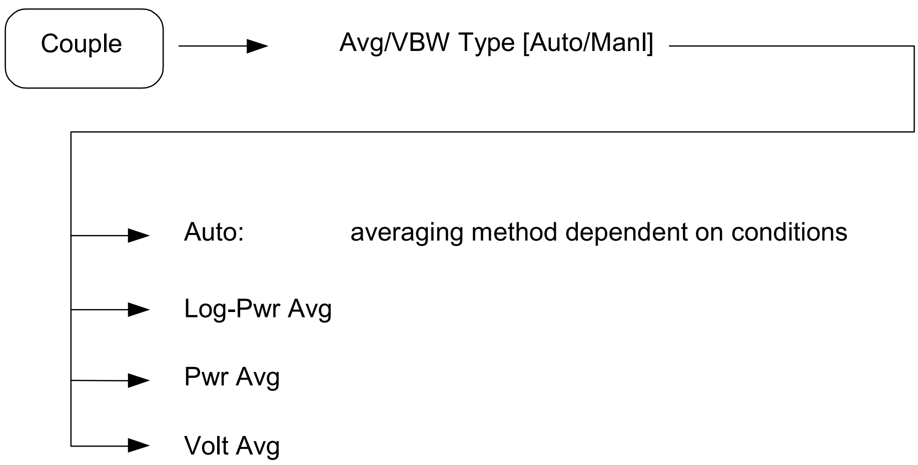
Mode	Contents
Normal	The Normal detection mode is used to detect the maxima and minima of noise-type signals and the peaks of CW-type signals. Odd-number points on the horizontal axis display the minimum value of oversampling data for each display point, and even-number points on the horizontal axis display the maximum value.
Average	The Average detection mode stores the average data between Pos Peak and Neg Peak. It reduces the random noise level without reducing the video filter bandwidth or using the trace averaging function. This allows averaged displays with faster sweep rates. Uses one of three types of averaging method: Log-Pwr, Pwr, Voltage (see below).
Pos Peak	Compares the maximum level point present between the current display point and next display point, then stores the maximum value in the trace memory corresponding to the current display point.
Sample	Stores the instantaneous signal level at each sample point in the trace memory. The Sample detection mode is primarily used for noise level and time domain measurements.
Neg Peak	Compares the minimum level point present between the current display point and next display point, then stores the minimum value in the trace memory corresponding to the current display. Neg Peak detection mode is often used to measure the lower envelope side of a modulated waveform.

Setting averaging method

The instrument supports the following three averaging methods:

- Log-Power Averaging: averages the signal waveform to dB-scale.
- Power Averaging: averages the signal waveform to power-scale(RMS). Best for measuring the true time-power relationship of complex signals.
- Volt Averaging: averages the signal waveform to voltage-scale, using the signal envelope.

Set the averaging method as follows:



BW (bandwidth) function

So that the instrument can automatically select the optimum setting, RBW, VBW, Sweep Time and Input Attenuation are initially set to Auto mode.

The bandwidth function has three hard keys:

- [BW] Bandwidth function
- [AMPL] Amplitude function
- [Sweep] Sweep function

Auto bandwidth function

In the Bandwidth Function, there are two modes: Auto mode and Manual mode.

To set RBW, VBW, Sweep Time, and Input Attenuation to Auto mode, do the following:

BW → All Auto

Auto mode, input attenuator

The input attenuator's value is set according to the amplitude of the signal waveform by the values below:

Reference level range	Attenuation Auto
25.1 dBm to 30.0 dBm	40
20.1 dBm to 25.0 dBm	35
15.1 dBm to 20.0 dBm	30
10.1 dBm to 15.0 dBm	25
5.1 dBm to 10.0 dBm	20
0.1 dBm to 5.0 dBm	15
≤ 0 dBm	10

Auto mode, Span and RBW

The ratio of Span/BW is changed to the initial value (96).

RBW Bandwidth is approximately equal to Span divided by 96.

Auto mode, Video Mode and Resolution Bandwidth

Resolution bandwidth is adjusted to Video bandwidth one to one.

Auto mode, Sweep time

Sweep time is optimally set by span, resolution bandwidth and video bandwidth.

Setting the Resolution Bandwidth

Auto Mode

If frequency span is varied, the RBW is automatically set by setting the value of the *[Span/RBW]* soft key (the standard setting value of *[Span/RBW]* = 96).

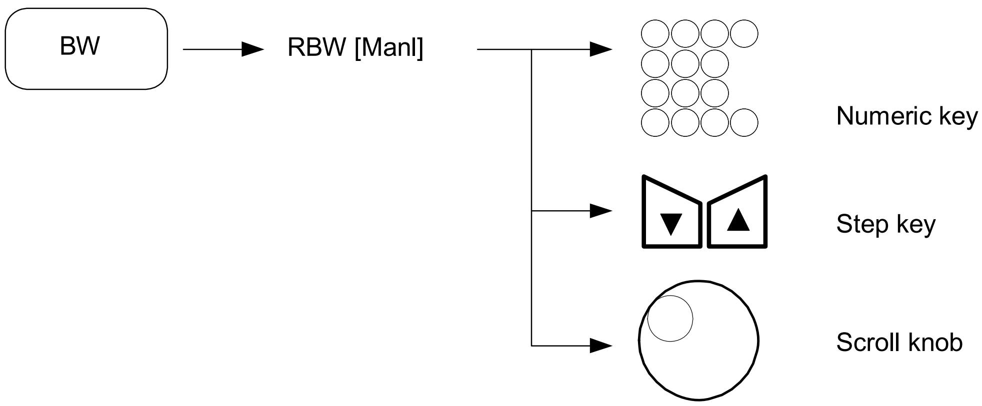
Then, if the VBW, Sweep Time, and Input Attenuator values are automatically set, the respective parameters are set to the optimum values by the following:

For Span/RBW = a, VBW/RBW = b:

> If Span > 500 MHz, RBW = 5 MHz, VBW = 3 MHz; Sweep Time = set to the optimum values.
>
> If Span <= 500 MHz, RBW = Span/a Hz, VBW = RBW * b Hz; Sweep Time = set to the optimum values.

Manual Mode

To set RBW in the manual mode, do the following:



If VBW is in Auto Mode, the VBW value is varied depending on the value of RBW. However, the RBW value does not vary even if the value of VBW changes.

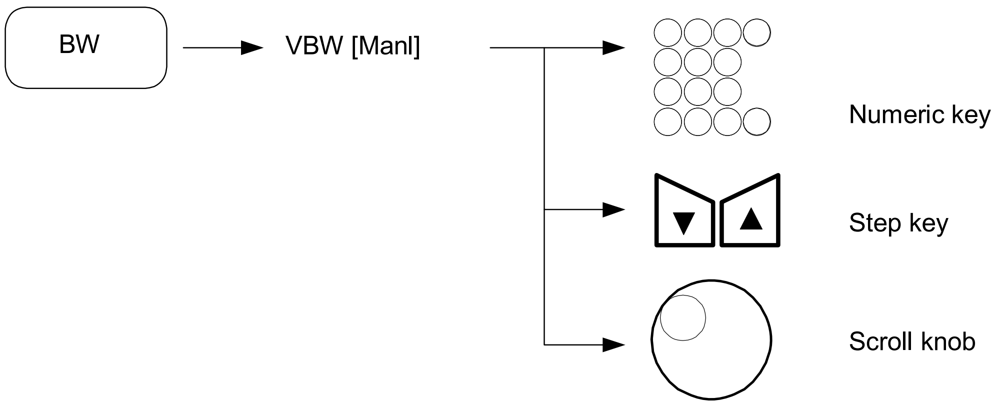
Setting the Video Bandwidth

Auto Mode

When VBW is set to Auto Mode, VBW is set according to the RBW value.

Manual Mode

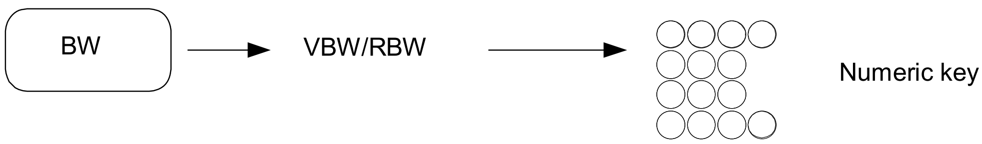
To set the VBW, do the following:



Use the MANUAL setting to average noise by making the VBW narrow without regard to RBW set value, or when wanting to make the VBW wide to observe the waveform of signals modulated at a high frequency. The VBW value can be manually set from 1 Hz to 3 MHz in 1, 2, 3, 5 steps.

Setting the ratio of VBW and RBW

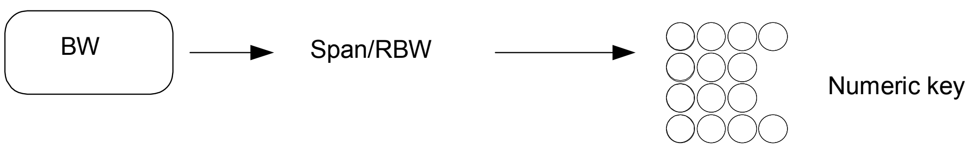
To change the RBW and VBW to regular ratio in the Auto Mode, do the following:



The possible input range is from 0.000001 to 3,000,000.

Setting the ratio of Span and RBW

To change the ratio of RBW in compliance with Span in the Auto Mode, do the following:



The possible input range is from 2 to 10,000.

Aux function

The instrument provides analog demodulation and audio monitor functions:

- AM demodulation
- FM demodulation
- Audio ON/OFF, audio level control

AM demodulation

The AM demodulation function displays the amplitude-demodulated waveform.

By pressing this key, the horizontal axis changes to a time axis. The carrier frequency is the center frequency.

To use the AM demodulation function, do the following:

AUX → AM Demod. [OFF/ON]

[AM Demod.] toggles AM demodulation ON and OFF.

FM demodulation

The FM demodulation function displays the frequency-demodulated waveform.

By pressing this key, the horizontal axis changes to the time axis. The carrier frequency is the center frequency.

To use the FM demodulation function, do the following:

AUX → FM Demod. [OFF/ON]

[FM Demod.] toggles FM demodulation ON and OFF.

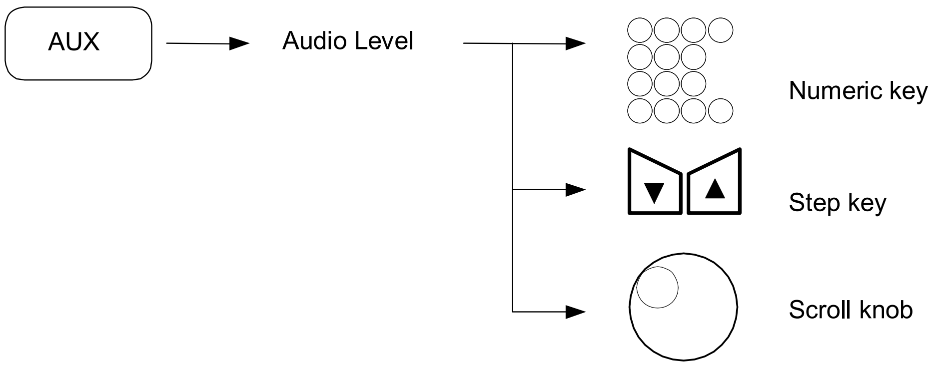
Audio monitor

The instrument has an internal speaker and phone jack on the front panel.

[Audio Sound] is used to turn ON the internal speaker.

AUX → Audio Sound [ON/OFF]

[Audio Level] controls the audio level, which can be adjusted by the Data Entry keys and knob. The possible audio level is 1–100. The default value is 3.



Auto Tune

Detects the maximum peak point in full span, displays its spectrum in the center of the screen and then changes to a small span width.

Tune

***Note**: in Auto Tune operation, input by key pad is not permitted. Signals below –70 dBm may not be searched.*

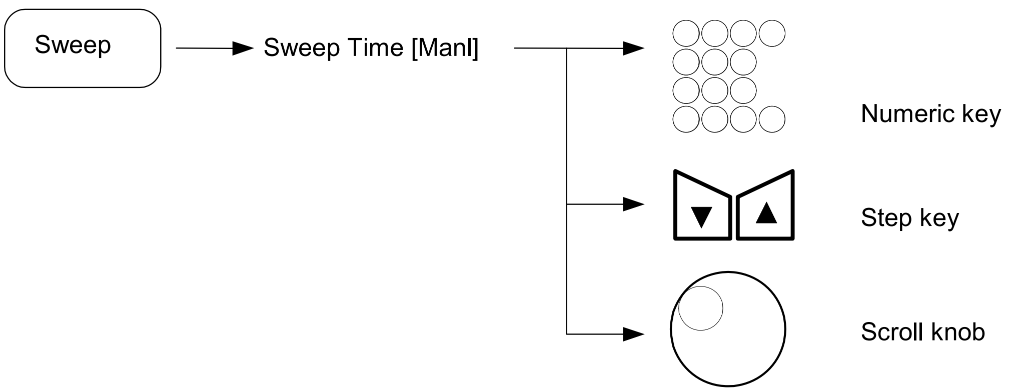
Sweep function

The Sweep function is associated with Sweep Time, Sweep Mode, and values for the instrument's display data.

- Sweep time
- Continuous sweep mode
- Single sweep mode
- Sweep time accuracy
- The number of display points

Setting the sweep time

To set the sweep time in Manual mode, do the following:



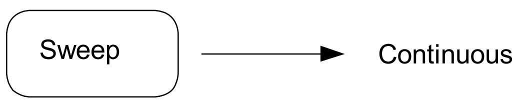
The Auto Sweep Time ranges are:

Normal Spans	5 ms–2000 s
Zero Span	50 µs–1000 s

Continuous sweep mode

When the trigger source is not Free Run, the sweep executes each time trigger conditions are met. When the trigger source is set to Free Run, the sweep executes continuously.

To set the Continuous Sweep Mode, do the following:

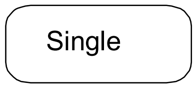


Single sweep mode

When the trigger source is set to Free Run, the sweep is executed once immediately after *[Single]* is pressed. When the trigger source is not set to Free Run, the sweep is executed only once when the trigger conditions are met.

To set the Single Sweep Mode, do the following:

or

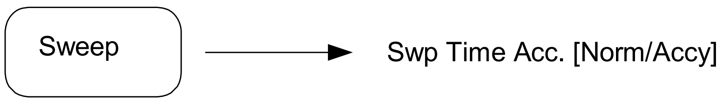


Setting the sweep time accuracy

Increasing the sweep time contributes to a more accurate measurement.

If *[Swp Time Acc]* is set to *Accy*, the current sweep time of the instrument increases automatically.

To set the Sweep Time Accuracy, do the following:

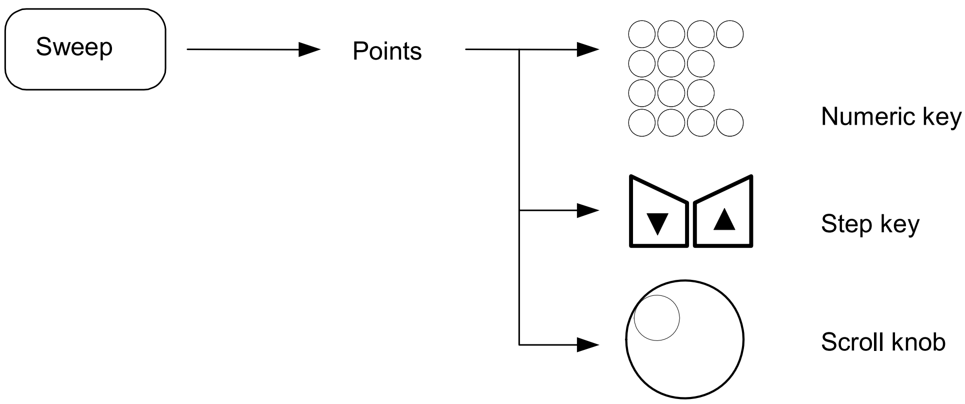


Initial value is *Normal*.

Setting the data points

To display data more accurately, the instrument can change the number of data points displaying on the screen. If the number of data points is increased, marker movement is more detailed and more accurate values can be displayed. However, this does entail more data processing time.

To set the data points, do the following:



The data point ranges are:

Normal Spans	101–8192 points
Zero Span	3–8192 points

System configuration

Set the system parameters of the instrument according to your requirements.

The [System] hard key is the header key that sets system configuration.

The instrument supports the SA (Spectrum analyzer) mode, digital, and phase noise modes. SA mode is the default, and the others are provided by options; consult your local agent for information.

GPIB address set

Set the GPIB address by using the keypad:

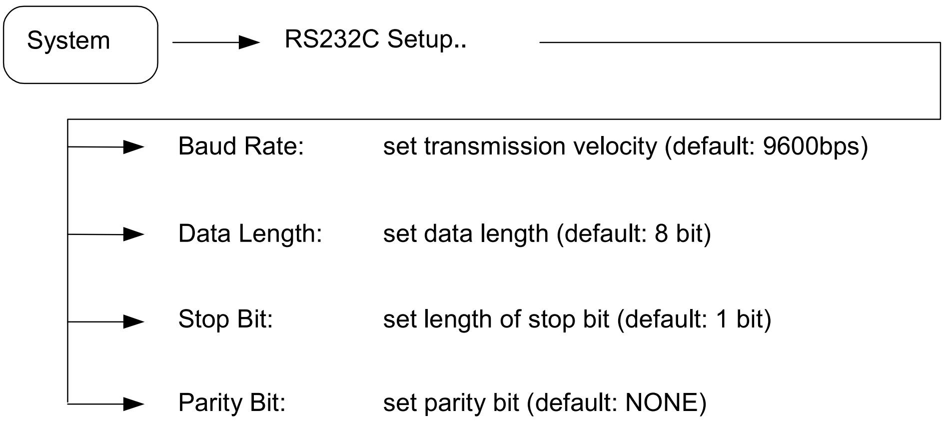
GPIB Address range: 1–30

GPIB Address default: 7

RS-232C configuration

The system can be remotely controlled using an RS-232C interface.

To set up the RS-232C protocol, do the following:



***Note**: interface settings do not change when power is removed*

System information

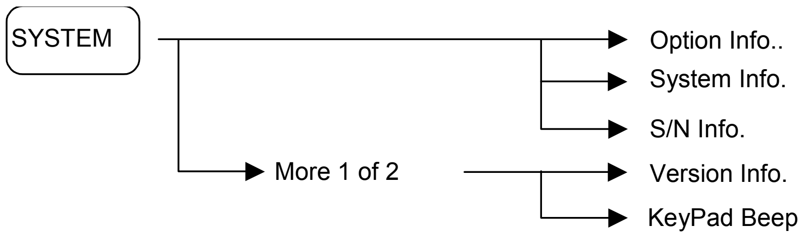
[Option Info..] displays the current option specifications.

[System Info.] shows information about modules installed in the instrument.

[S/N Info.] shows serial number information about modules installed in the instrument.

[Version Info.] shows the current software version.

[KeyPadBeep] enables a beep when you press the keypad.



Preset function

The [Preset] hard key is the header key for preset and calibration functions.

- Preset
- Last State
- Save User State
- Load User State
- Select User State [Usr1/Usr2/Usr3]
- Boot On [Last/System]
- Auto Alignment [OFF/ON]

Preset

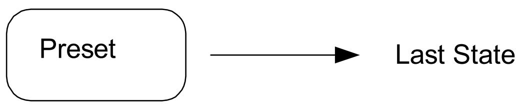
Pressing *[Preset]* returns all of the analyzer parameters to the factory initial setup values.

Factory initial setup

Center frequency:	1.5 GHz/6.6 GHz/13.25 GHz
Frequency span:	3 GHz/13.2 GHz/26.5 GHz
Reference level:	0 dBm
Detector:	LOG
Scale:	10 dB/DIV
Sweep time:	20 ms, AUTO mode
RBW:	5 MHz, AUTO mode
VBW:	3 MHz, AUTO mode
ATTEN:	10 dB, AUTO mode
Trigger:	Free Run
Marker:	OFF
Display line:	OFF
Threshold line:	OFF
Trace detector mode:	Normal

Last State

Pressing *[Last State]* returns all of the analyzer parameters to the values that existed before the last system power-off.



Save/Load User State

Pressing *[Save User State]* saves the current settings of User State into the current parameters.

Preset → Save User State

Press *[Load User State]* to read the User State saved in the current settings. If there is no saved record, an error message is displayed.

Preset → Load User State

Press *[Select User State]* to select the state to Save or Load. User State has three values.

Preset → Select User State [Usr1/Usr2/Usr3]

Boot On

This function sets the system condition for the power-on state.

When *System* is selected, every setting condition is the same as the preset state.

When *Last* is selected, the power-on state is set to the state before system power-off.

Preset → Boot On [Last / System]

Calibration mode

This function sets the system to minimize hardware variations (temperature, operation time, etc.) for more precise measurements.

Preset → More 1 of 2

- → Auto Alignment [OFF/ON]: set auto calibration off or on
- → ZNC Alignment: execute Zero Null Circuit calibration
- → Prefilter Alignment: execute Prefilter calibration
- → Level Alignment: execute level calibration
- → All Alignment: execute ZNC, Prefilter and level calibration

Note*: if a calibration is executing, the keypad is disabled.*

File and save function

The instrument can save system parameters, limit line data, and waveform data (Trace) to the internal hard disc or a removable storage device. This data can be recalled and used.

Internal memory

The internal memory uses a hard disk in the instrument

The internal memory can save the data and waveforms given in *File Type* on page 5-54.

Save parameters and waveform

The [Save] hard key is the header key for saving parameters and waveforms.

To save the current system parameters, waveform data and limit line data to the internal hard disc or storage removable device, press [Save].

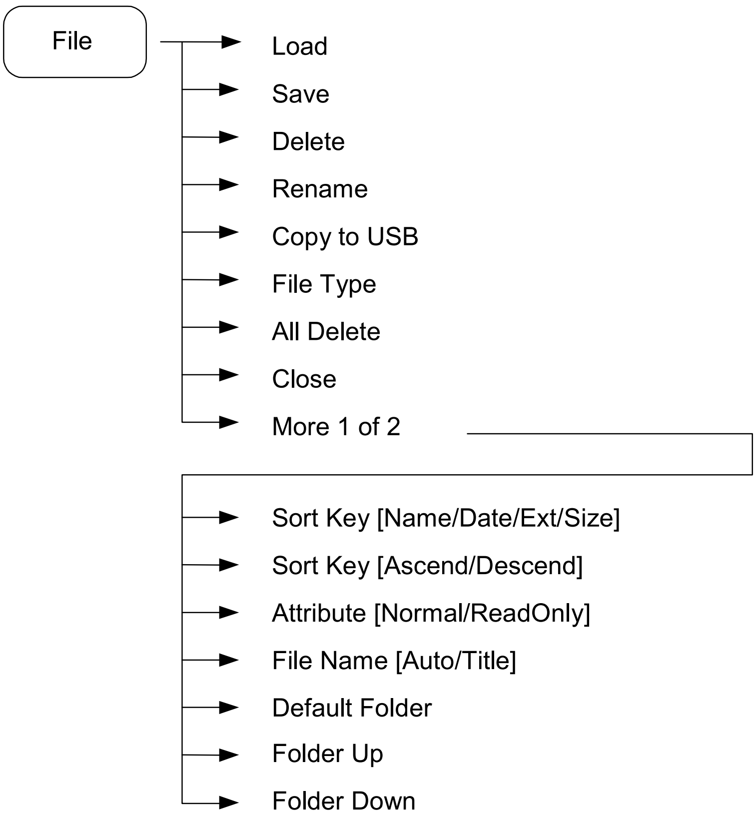
The file type and destination is then configured in compliance with the FILE Menu setting (*File Type* on page 5-54). The file name is decided by *Auto* or *Title* set by *[Filename]* (page 5-54). The Auto generation method automatically generates from FILE0000.ext to FILE9999.ext; the screen Title method generates the same filename as the current screen title.

File management

The [File] hard key displays the file management menu of the internal hard disc or removable storage device.

When [File] is pressed, the file directory window is displayed. To select the file, use the scroll knob or step key. Pressing [File] again closes the file directory window.

Do the following to access the file management menu:



Load	Loads the selected file with the system
Save	Saves the file into the selected file type
Delete	Accesses menu keys that allow you to delete selected files
Rename	Changes into file name input mode; edit menu is displayed
Copy to USB	Copies the selected file to a USB device
File Type	Selects the file type for display in the file directory window. Also decides the file type for saving when the [SAVE] hard key is pressed.

File type	Extension	Comments
All	*	All files (only for View)
Status	STS	System status file
Trace	TRC	Trace data file
Limit	LMT	Limit data file
Bitmap	BMP	Screen image file
JPEG	JPG	Screen image file
PNG	PNG	Screen image file
CSV	CSV	Trace data file
Antenna	ANT	Antenna calibration file
Cable	CBL	Cable calibration file
Other	OTH	Other calibration file
User	USR	User calibration file

All Delete	Deletes all the files in the current file directory
Close	Closes the file directory
Sort Key	Selects the sorting field in the directory. The kind of fields are filename, extension, size, date. Select fields in turn by pressing *[Sort Key]*.
Sort Direction	Chooses the direction of sorting. By pressing *[Sort Direction]*, you can select Ascend or Descend.
Attribute	Changes the current file characteristics. Normal characteristic can delete or change, Read Only characteristic cannot.
Filename	In Title mode, the filename is the screen title
Default Folder	Changes the save location into the standard folder of the standard drive (E:\SaveData)
Folder Up	Moves to a higher level folder than the current folder
Folder Down	Moves to the contents of the selected folder

Help function

The [Help] hard key shows simple help and remote control commands for a hard or soft key.

Press [Help] followed by the key about which you require information.

Marker function

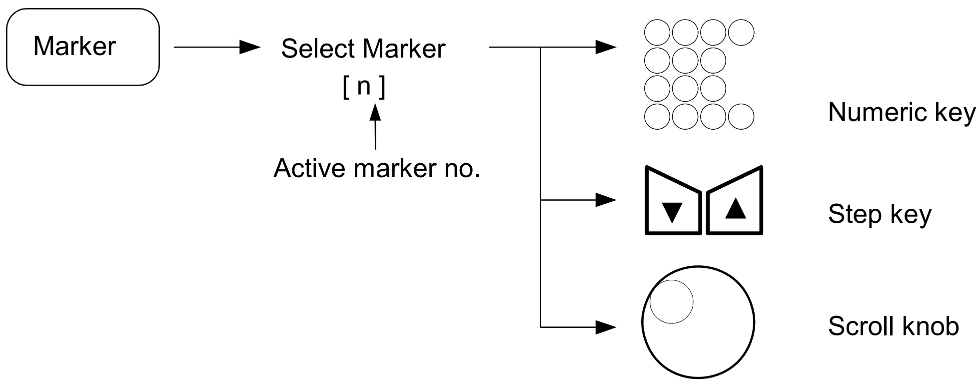
Keys related to the [Marker] hard key are the [Mkr→] and [Func] keys.

Up to nine markers can be set.

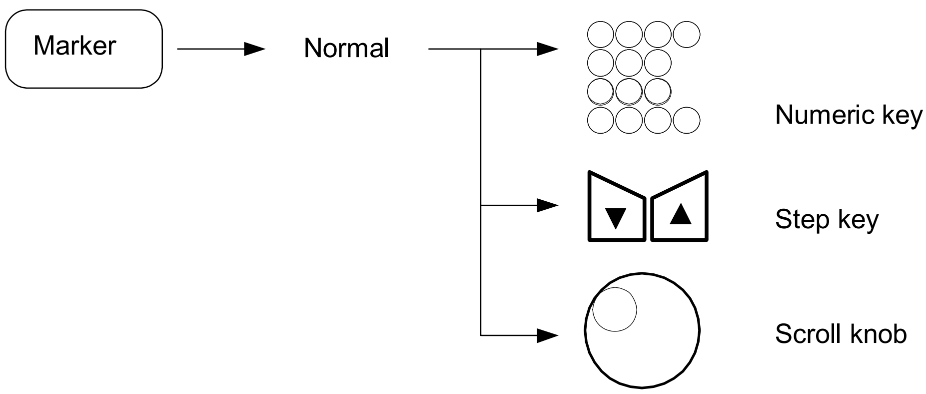
Selecting and changing marker position

Press [Marker], which activates Marker 1 as the default. A single marker is indicated by ◊ on the waveform. Use the step up/down key to move the active marker position in 1 division steps. When the up step up key is pressed, the marker moves to the right. The down step key moves it left. The scroll knob step size is 1/(data points of the horizontal line) (span). You can also use the numeric keys to position the marker.

1 Selecting marker



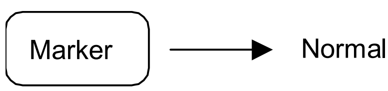
2 Moving marker



Normal marker

A normal marker is indicated by ◊ on the waveform. The frequency and level of the marker position are shown in the upper display window.

The normal marker is initially set ON. When the current state is another marker mode, or when the normal marker is set OFF, do the following to set the normal marker ON.



The normal marker displays the absolute amplitude level.

Delta marker

In the delta marker mode, the reference marker is indicated by ∇.

To set the delta marker ON, do the following:

Marker → Delta

When the delta marker is set ON, the reference marker is displayed and fixed at the normal marker position. Then the normal marker is moved, and the relative frequency (time) and level differences between the reference marker and the current marker are displayed as delta marker values.

Press *[Delta]* while in delta marker mode to reset the reference marker to the current normal marker position.

Band Pair

Use *[Band Pair]* to adjust the width between the normal and delta markers.

Select *[Band Pair [Start]]* to change the delta marker position.

Marker → Band Pair [Start]

Select *[Band Pair [Stop]]* to change the normal marker position.

Marker → Band Pair [Stop]

Span Pair

Use *[Span Pair]* to move the Normal marker and Delta marker together, maintaining a constant spacing between them; or to move them apart or together equally about a common frequency.

Select *[Span Pair [Span]]* to move the normal and delta markers apart or together about their common frequency.

Select *[Span Pair [Span]]* to move the two markers together, maintaining a constant spacing between them.

Marker off in reverse order

The markers are turned off by the following key operations:

Marker → OFF

The markers are removed in reverse order by continuously pressing *[OFF]*. If you want to turn off a specific marker, do the following:

Marker → Select Marker [no.] → Normal → OFF

(Select Marker [no.]: Select marker; Normal: Activate marker)

Setting the marker trace

The marker can be set to trace A, B or C (see *Trace Array* on page 5-33).

First, activate the marker. Set the trace for marker position by doing the following:

Marker → Marker Trace [A/B/C]

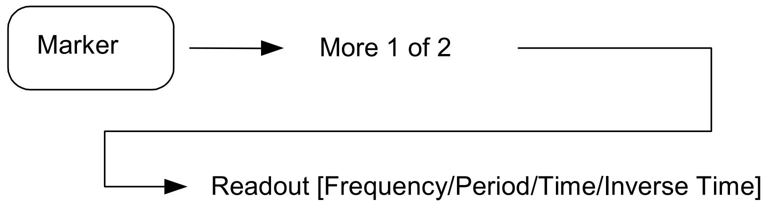
Delete all markers

To delete all markers, do the following:

Marker → All OFF

Setting the marker readout mode

The following menu keys allow you to change the active marker readout:



Frequency:	sets the marker readout to frequency.
Period:	sets the marker readout to period (inverse of frequency)
Time:	sets the marker readout to time (range: within sweep time)
Inverse Time:	sets the marker readout to inverse time.

Setting the marker table

[Marker Table] toggles the marker table ON and OFF.

When the marker table is ON, it compresses the graticule and displays marker information in a table under the screen. The information includes the marker number, marker type, frequency, amplitude and marker readout status.

Setting the marker name

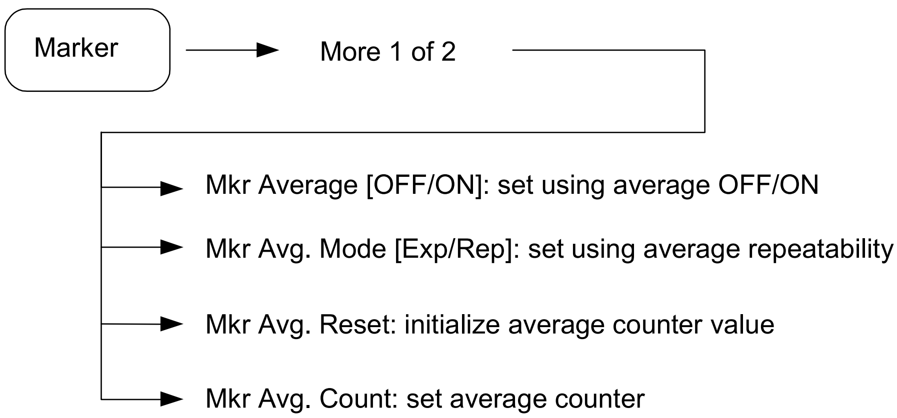
Use *[Edit Mkr Name]* to give each marker a characteristic name (see *Screen Title* on page 5-30)

Default marker name

Use *[Default Mkr Name]* to restore the default marker name (default markers are numbered 1–9).

Marker averaging function

The Marker Value Averaging function interprets the marker value by averaging the variation in marker values.



Setting parameters using marker values

The marker value can be set as the parameter value of the observed frequency/span function, reference level, and so on. This facilitates observation of the desired waveform.

To set parameters using the marker value, the following settings are possible:

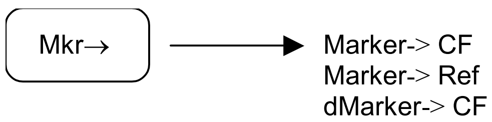
- Marker-> CF: sets the marker value to the center frequency.
- Marker-> CFstep: sets the marker value to the center frequency step size.
- Marker-> Start, Stop: sets the marker value to the start/stop frequency value.
- Marker-> Ref: sets the marker value to the reference level.
- dMarker-> Span: sets the delta marker value to the span.
- dMarker-> CFStep: sets the delta marker value to the center frequency.
- dMarker-> CFstep: sets the delta marker value to the center frequency step size.

In Zero Span Mode(= Time Domain), only Marker-> Ref is valid.

Marker-> CF/Marker-> Ref

Sets the current marker frequency or level to the center frequency or the reference level.

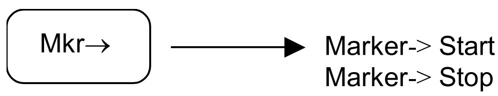
To execute the Marker Shift, do the following:



Marker-> Start/Marker-> Stop

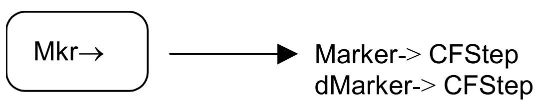
Sets the current marker frequency to the start or stop frequency.

To execute the Marker Shift, do the following:



Marker-> CFStep/dMarker-> CFStep

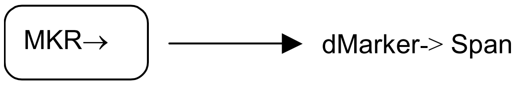
Sets the marker frequency to the center frequency step size (resolution determined by up/down keys.)



Although this action does not cause any change to appear on the screen, when the center frequency is changed with the step key, in the case of *[Marker > CFStep]* the center frequency changes with a multiple of the current frequency. This facilitates observation of harmonics.

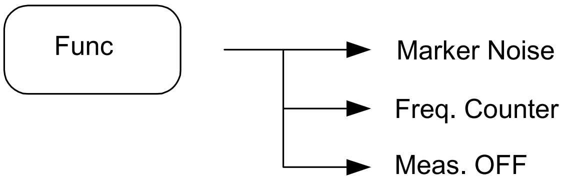
Dmarker-> Span

In the delta marker mode, this operation sets the difference frequency between the reference and current marker frequencies to span frequency.



Setting marker function

You can set the marker function to provide information about noise and frequency/amplitude at the current marker's location:



[Marker Noise]	Interprets the reference average noise level with 1 Hz noise power bandwidth.
[Freq. Counter]	Measures the accurate frequency value and amplitude of the current marker position. Marker counter resolution can be set to 1 kHz, 100 Hz, 10 Hz, 1 Hz.
[Meas. OFF]	Disables the marker function.

Peak search function

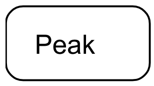
The instrument has the following marker search functions:

- Peak Search
- Next Peak Search
- Next Left Peak Search
- Next Right Peak Search
- Minimum Search
- Peak to Peak Search

Peak search

Peak search detects the maximum level point in the entire trace and moves a marker to that point.

Execute peak search by doing the following:

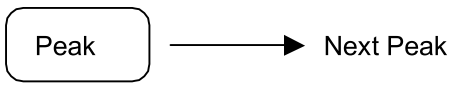


If no marker exists, Marker 1 is activated.

Next Peak search

Next Peak search detects the next largest peak relative to the current marker level, and moves the marker to that point. When there are two or more peaks with the same level on the screen, the left-most peak is detected.

Execute Next Peak search by doing the following:

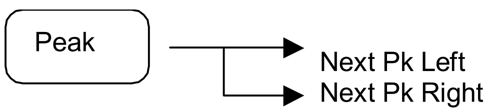


The next largest peak is detected. The marker can be moved to each peak in turn by executing the *[Next Peak]* search consecutively.

Peak Left search/Peak Right search

Peak Left search and Peak Right search detect the adjacent peak level to the right or left of the current marker and move the marker to that point.

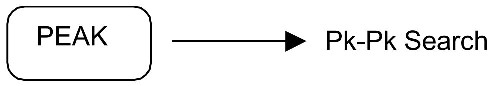
To execute Peak Left search and Peak Right search, do the following:



The adjacent peak to the right or left is detected and the marker moves to that peak by executing the *[Next Pk Left]* or *[Next Pk Right]* menu consecutively.

Peak to Peak search

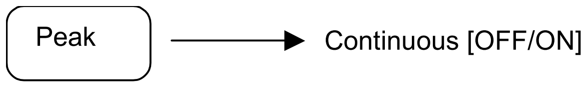
Finds and displays the frequency (or time, if in zero span) and amplitude differences between the highest and lowest trace points.



If you search Peak to Peak again, you should set the current activated marker off.

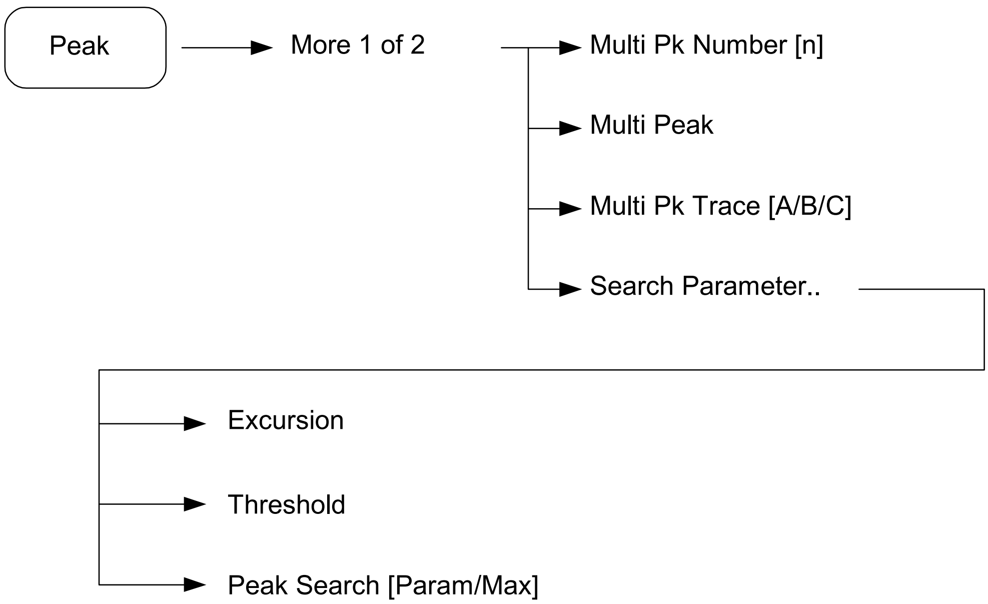
Continuous Peak search

When the *[Continuous]* soft key status is ON, the instrument continuously searches for the peak on the screen trace.



Setting the Peak Search parameters

Accesses the following menu keys:



Multi Pk Number [n]	Sets the number of search markers in the multi peak search. n = 1–9.
Multi Peak	This function is used for multiple peak searching. The set number of markers position in order of level of peak on one sweep waveform. If only one peak exists that meets the condition, all the markers (= the n markers) gather on that one peak.
Multi Pk Trace [A/B/C]	Selects the trace to execute the multi peak search.
Excursion	Sets the minimum amplitude variation of signals that the marker can identify as a peak. If a value of 10 dB is selected, the marker moves only to peaks that rise and fall more than 10 dB above the peak threshold value.To set the excursion value, use the numeric keys or scroll knob.
Threshold	Sets a lower boundary to the active trace. The value of the peak threshold level can be changed using the numeric keys or the scroll knob. The threshold level does not influence the trace memory or marker position.
Peak Search [Param/Max]	If *Param* mode is set, it finds the peak dependent on the setting value of Excursion and Threshold. If *Max* mode is set, it finds the maximum peak value of the displayed trace.

Instrument in phase noise measurement mode

Freq/span function

Frequency is set in either of two modes:

- Carrier frequency
- Carrier search

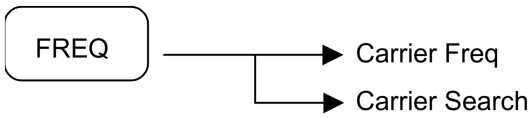
The lower and upper span limits are 3 Hz to 3 GHz (3281) / 13.2 GHz (3282) / 26.5 GHz (3283).

Use [FREQ] for setting frequency.

Use [SPAN] for setting offset frequencies for measurements.

FREQ function

The [FREQ] hard key allows you to set frequency functions for the instrument.



Carrier Freq

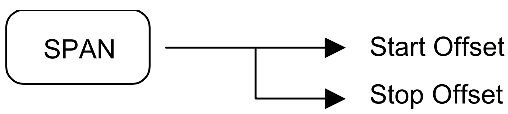
Allows you to specify the frequency of the carrier wave whose phase noise is to be measured. As long as the frequency you enter is within ±5% of the carrier signal's true frequency, the analyzer tunes to it automatically.

Carrier Search

Automatically tunes the analyzer to the strongest signal it can find. If Search Span is set to Automatic, the search is performed from a lower limit of 100 Hz to an upper limit of the analyzer's maximum capabilities. When Search Span is set to Manual, the search is performed within the frequency range specified in Search Span, centered on the current carrier frequency.

SPAN menu

The [SPAN] hard key allows you to set the span of Log Plot measurement of phase noise to be performed.



Start Offset

Allows you to specify the offset frequency at which your Log Plot measurement starts.

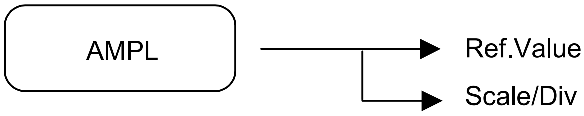
Stop Offset

Allows you to specify the offset frequency at which your Log Plot measurement stops.

AMPL function

The [AMPL] hard key displays soft keys for setting the amplitude.

These keys are used for setting functions that affect the way data on the vertical axis is displayed or corrected.



Ref.Value

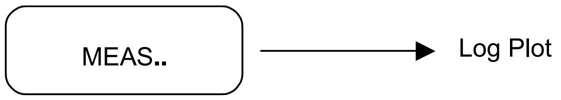
This allows you to set the value (in dBc/Hz) of a specified position on the graticule display.

Scale/Div

This allows you to set the value of the scale (in dB) for each division of the Y axis.

Measurement function

MEASURE menu

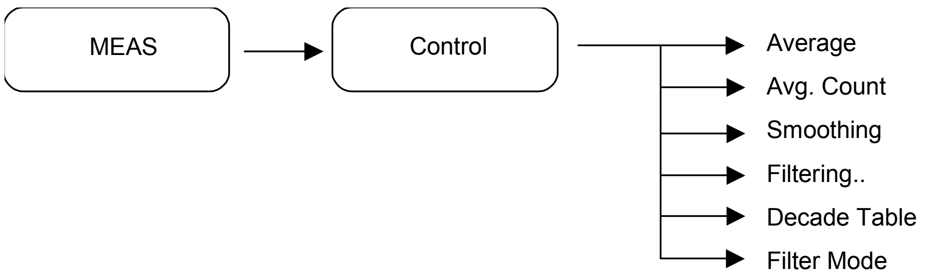


Log Plot

Displays a logarithmic plot of the measured phase noise over a range of frequency offsets.

MEASURE Control menu

Press the [MEASURE] hard key followed by the [Control] hard key to display the measurement control menu, which allows you to enter custom setup parameters for measurement. Some keys performa the same function as in Spectrum Analyzer mode (page 5-17).



Average

Determines whether you use the averaging function or not.

- ON: enables measurement averaging
- OFF: disables measurement averaging.

Avg. Count

Allows you to specify the number of measurements that are averaged.

Smoothing

Allows you to specify the amount of smoothing done to the trace after the measurement has been performed. The amount of smoothing can be varied between 0.00% and 16%. By default, both the trace of the raw data and the smoothed trace are displayed.

Filtering

Allows you to set the ratio of VBW/RBW. Ratios are: 1.0, 0.3, 0.1 and 0.03.

Decade Table

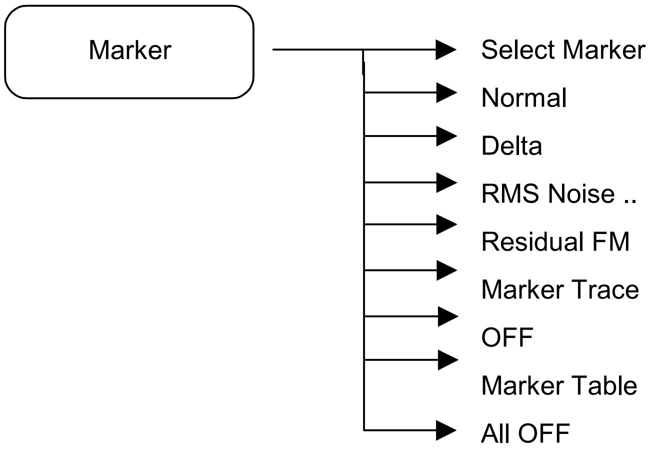
Allows you to toggle the Decade Table on and off. The Decade Table is a table of measurements that shows, for each of the analyzer's two traces (raw and smoothed), the value in dBc/Hz at the point where the traces cross each decade line on the display.

Filter Mode

Allows you to select the filter to be used in phase measurement analysis.

- Narrow: selects narrow filter
- Wide: selects wide filter.

Marker function



Select Marker

Allows you to select one of the four possible markers. Having selected one of the markers, use the other soft keys on this menu to specify the type of marker or measurement.

Normal

Sets the specified marker to be a normal marker. That is, it marks the point of the frequency offset that you specify, and then the analyzer measures and displays the phase noise at this point.

Delta

A delta marker is actually a pair of markers. By pressing *[Delta]*, you set a pair of markers at your current frequency offset. One of this pair of marker is fixed while the second of the pair can be moved using the scroll knob or the numeric keys. The frequency difference and the phase noise difference between these two points is displayed.

RMS Noise

Displays a second menu allowing access to three RMS noise functions. An RMS noise marker is actually a pair of markers. By pressing *[RMS Noise Degrees]*, you set a pair of markers at your current frequency offset. One of this pair of markers is fixed while the second of the pair can be moved using the scroll knob or the numeric keys.

[RMS Noise [Degrees]]: RMS phase noise between these two points is calculated, and is displayed in degrees.

[RMS Noise [Radians]]: RMS phase noise between these two points is calculated, and is displayed in radians.

[RMS Noise [Jitter]]: RMS jitter between these two points is calculated, and is displayed in units of time, typically in picoseconds (ps).

Residual FM

A residual FM marker is actually a pair of markers. By pressing *[Residual FM]*, you set a pair of markers at your current frequency offset. One of this pair of markers is fixed while the second of the pair can be moved using the scroll knob or the numeric keys. The RMS value of the residual FM between these two points is calculated and displayed.

Marker Trace

Allows you to select which of the two traces your currently selected marker is applied to.

OFF

Switches the specified marker off.

Marker Table

Allows you to display all of the data from all of your markers in a tabular form. For every marker you have set, the table shows the number of the trace to which it has been applied, the marker's position on the X axis, and its measured Y axis value.

- On: sets the marker table on. The table is displayed beneath the graticule
- Off: sets the marker table display off.

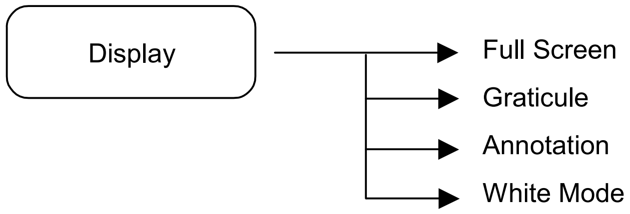
All OFF

Switches all markers off. All markers are removed from the graticule display, and if the marker table is also being displayed, all entries are removed from it.

Display function

The instrument provides functions related to the screen display.

Full Screen	Displays the maximum enlarged graticule
Graticule	Sets the graticule on or off
Annotation	Displays information about the waveform in the annotation window at bottom left of the screen
White Mode	Economy mode for screen save and printing



Full Screen

Extends the measurement window over the entire analyzer display, removing the soft key menu as it does so. To restore the soft key menu, press any key except [Print], [Save], or any of the data entry keys.

Graticule

Allows you to display or hide the graticule lines on the display.

Annotation

Allows you to display or hide some of the annotation pertaining to the current display.

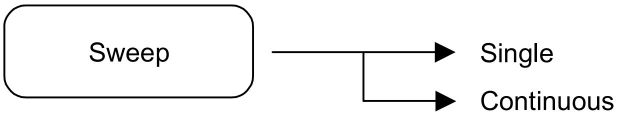
White Mode

Changes the screen background to white.

Sweep function

The Sweep function lets you choose the Sweep Mode.

- Single sweep mode
- Continuous sweep mode



Single

The analyzer performs one single measurement and then stops. Press *[Restart]* every time you want to make another measurement.

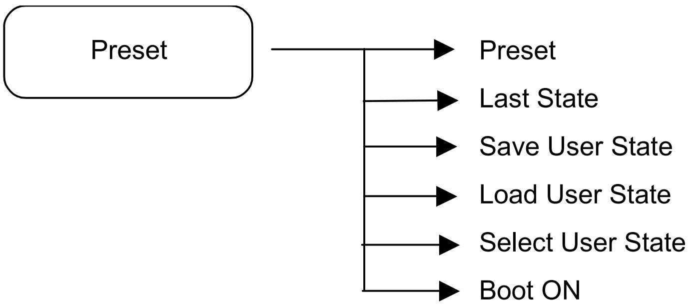
Continuous

The analyzer continuously measures the signal it is receiving and repeatedly updates the plots and the measurements.

Preset function

The [Preset] hard key is the header key for preset and calibration functions.

- Preset
- Last State
- Save User State
- Load User State
- Select User State [Usr1/Usr2/Usr3]
- Boot On [Last/System]



Apart from the *[Preset]* sub-menu (see below), sub-menus of the [Preset] hard key have the same function as in spectrum analysis mode (page 5-50); please refer to this part of the manual for information.

Preset

Pressing *[Preset]* returns the analyzer parameters to the factory initial setup values for phase noise operation.

Chapter 6
PERFORMANCE TESTS

Contents

Introduction

This chapter describes setup and operation procedures necessary for conducting performance tests.

Requirement for performance tests

Performance tests are used as preventive maintenance to prevent degradation of equipment performance before it occurs. Use the performance tests whenever necessary such as at acceptance and periodic inspection to verify performance after repair.

- Frequency span readout accuracy
- Reference oscillator frequency accuracy
- Frequency counter accuracy
- Resolution bandwidth (RBW) and selectivity and switching error
- Phase noise
- Residual FM noise
- Average noise level
- Input attenuator switching error
- Frequency response
- Spurious response
- Second harmonic distortion
- 3rd order intermodulation
- Spurious relating with input
- Input VSWR
- Trigger (ext, video, line)
- Preamplifier

Execute the performance tests at regular intervals as preventive maintenance for important evaluation items. We recommend that the performance be inspected regularly once or twice a year. If the performance test does not meet the specifications, please contact your nearest agent.

Instruments required for performance test

Recommended instrument (Model number)	Required performance: Item	Required performance: Specification	Test item
Signal generator (Agilent E8257D)	Frequency range	250 kHz–26.5 GHz	Frequency-span readout accuracy
	Resolution	1 kHz	Frequency counter accuracy
	Output level range	−130 to +18 dBm	Resolution bandwidth, selectivity
	Output level resolution	0.01 dB	Phase noise
	SSB phase noise	≤−100 dBc/Hz (at 10 kHz offset)	Residual FM noise, displayed average noise level
	External reference output	10 MHz	Input attenuator switching error frequency response
(Agilent E4432B)	Frequency range	250 kHz–3 GHz	Second harmonic distortion
	Resolution	1 kHz	3rd order intermodulation
	Output level range	−136 to +10 dBm	Spurious relating with input
	Output level resolution	0.01 dB	Input VSWR
	SSB phase noise	≤−120 dBc/Hz (at 20 kHz offset)	Preamplifier
Power meter (Agilent EPM441BB)	Frequency range	9 kHz–110 GHz	Frequency response
	Measure range	−70 dBm to +44 dBm	
	Power resolution	0.001 dB	
Power sensor (Agilent E9304A)	Frequency range	9 kHz–6 GHz	Frequency response
	VSWR (max)	1.13 (9 kHz–2 GHz) 1.19 (2 GHz–6 GHz)	
	Power range	−60 dBm to +20 dBm	
Power sensor (Agilent E4413A)	Frequency range	50 MHz–26.5 GHz	Frequency response
	VSWR (max)	1.21 (50 MHz–100 MHz) 1.19 (100 MHz–8 GHz) 1.21 (8 GHz–18 GHz) 1.26 (18 GHz–26.5 GHz)	
	Power range	−70 dBm–-+20 dBm	
50 ohm termination (Agilent 909F)	Frequency range	DC–6 GHz (– 18 GHz)	Average noise level Spurious response
	VSWR	1.005 (DC–5 GHz) 1.01 (5–6 GHz) 1.15 (6–18 GHz)	
Power splitter (Agilent 11636B)	Frequency range	DC–26.5 GHz	3rd order intermodulation
	Input / output Impedance	50 Ω	

Frequency counter (HP 5328B)	Resolution	0.1 Hz–1 MHz	Reference oscillator frequency accuracy
Network analyzer (Agilent E8363B)	Frequency range	10 MHz–40 GHz	Input VSWR
Arbitrary wave generator (Tektronix AFG310)	Frequency range	0.01 Hz–16 MHz	Trigger response

Test precautions

For tests other than for oscillator frequency stability, warm up the equipment for at least fifteen minutes and test the performance after the equipment stabilizes completely.

Also, begin measurements after taking the warm-up time of the calibration instrument into full consideration. In addition, the test should be conducted at room temperature with little AC power supply voltage fluctuation, and should be free of noise, vibration, dust humidity, etc.

Frequency span readout accuracy

Using the setup shown in Fig. 6-1, set the frequencies corresponding to the first and ninth vertical divisions from the left side of the screen scale with the signal generator. The frequency difference between the peak levels at the first and ninth vertical division is equal to the frequency span x 0.8.

Specification

Frequency span accuracy: ≤±1%

Test instrument

Signal generator: E8257D

RF cable: SMA (male)–SMA (male)

BNC cable: BNC (male)–BNC (male)

Adapter: N (male)–SMA (female)

(Reference) use additional adapter: 3.5 mm (male)–N (female) (3283 Model)

10 dB attenuator: SMA (female)–SMA (female)

Setup

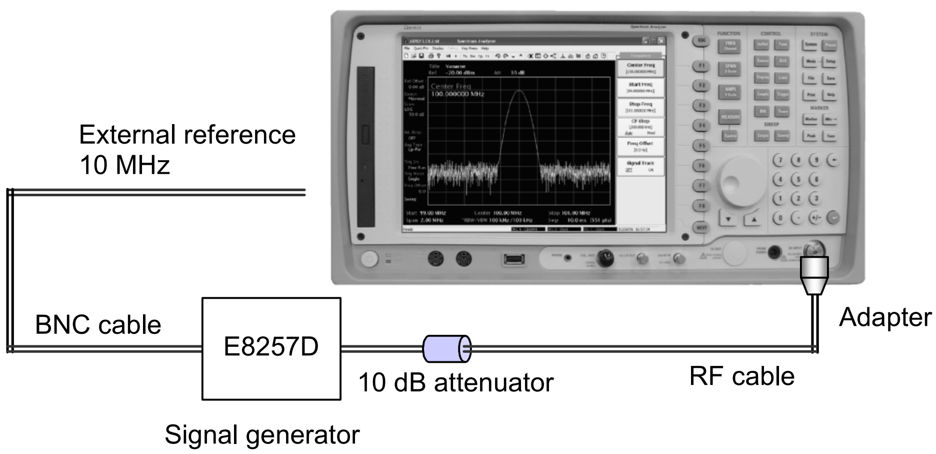


Fig. 6-1 Frequency span readout accuracy test

Procedure

1 Set the power switch on the equipment front panel to ON.

2 Press [Preset], *[Preset]*.

3 Set the equipment as follows:

Center frequency: 1500 MHz
Span: 10 MHz
RBW: Auto
VBW: Auto
Reference level: −10 dBm
Sweep time: 50 ms (Span<5 GHz), 200 ms (Span>5 GHz)

4 Set the signal generator output frequency equal to the center frequency as follows:

Frequency: 1500 MHz
Power: −15 dBm

5 Adjust the E8257D output frequency to set the signal peak at the first division from the left of the screen scale. Record the frequency of F1:
F1 = center frequency − (span/10 x 4)

6 After setting the E8257D output frequency to the F2 frequency, adjust it to set the signal peak at the ninth division. Record the frequency of F2:
F2 = center frequency + (span/10 x 4)

7 Calculate (F2 − F1) / (Span x 0.8) and check that the value is within the specified range shown in Table 6-1.

8 Calculate the frequency span accuracy by using the following equation:

$$\text{Frequency span accuracy} = \frac{(\text{Span} \times 0.8) - [\text{Frequency (F2)} - \text{Frequency (F1)}]}{(\text{Span} \times 0.8)} \times 100$$

9 Repeat steps 5 to 8 for each frequency span with a center frequency range between the maximum and minimum values shown in Table 6-1.

Table 6-1 Frequency span accuracy

Equipment		Signal generator (MHz)		Specification (±1 %)
Center frequency	**Span**	**F2**	**F1**	**Accuracy**
1500 MHz	10 MHz 50 MHz 2000 MHz 3000 MHz			
4700 MHz	10 MHz 50 MHz 2000 MHz 3000 MHz			
9700 MHz	10 MHz 40 MHz 80 MHz 2000 MHz 3000 MHz			
19700 MHz	10 MHz 50 MHz 160 MHz 2000 MHz 5000 MHz 10000 MHz 13600 MHz			

Reference oscillator frequency stability

Frequency stability is tested by measuring the 10 MHz reference oscillator. Stability is determined by measuring frequency variation at ambient temperatures of 0°C and 50°C.

Specification

Frequency: 10 MHz

Aging rate: ≤±0.1 ppm

After 24 hour warm-up at 25°C ± 5°C:

Temperature stability: ≤±0.3 / one year at 0°C and 50°C referred to the frequency measured at 25°C.

Test instruments

Frequency counter: HP 5328B

BNC cable: BNC (male)–BNC (male)

Setup

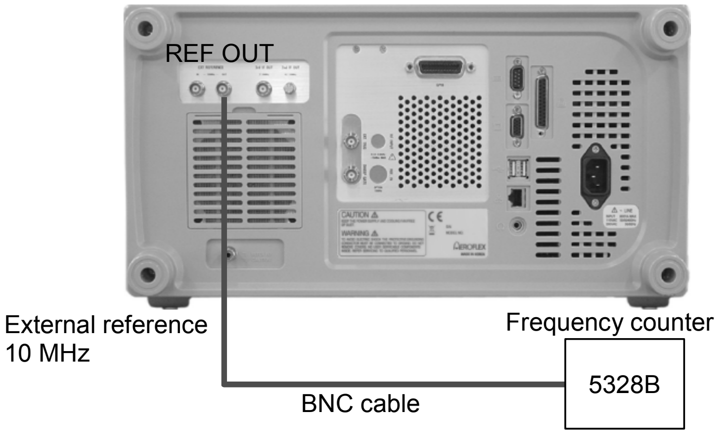


Fig. 6-2 Reference oscillator frequency stability test

Procedure

Temperature stability

Test condition: test this performance in a vibration-free variable-temperature chamber.

1 Set up the equipment in a constant-temperature chamber at 25°C.

2 Set the line and power switches on the equipment to ON and wait until the equipment's internal temperature stabilizes (approx. 1.5 hours after the chamber temperature stabilizes).

3 When the internal temperature stabilizes, measure the frequency by using the counter with 0.1 Hz resolution.

4 Change the chamber temperature to 50°C.

5 When the chamber temperature and the equipment's internal temperature stabilize, measure the frequency by using the counter.

6 Calculate the stability by using the following equation.

7 Repeat steps 5 and 6 at 0°C chamber temperature.

$$\text{Frequency Stability}\,(50^{o}\,\text{C}) = \frac{(\text{counter reading at }50^{o}\,\text{C}) - (\text{counter reading at }25^{o}\,\text{C})}{(\text{counter reading at }25^{o}\,\text{C})}$$

$$\text{Frequency Stability}(0^{o}\,\text{C}) = \frac{(\text{counter reading at }0^{o}\,\text{C}) - (\text{counter reading at }25^{o}\,\text{C})}{(\text{counter reading at }25^{o}\,\text{C})}$$

Frequency counter accuracy

Examine the frequency counter accuracy.

Specification

Accuracy:	± [(Reference frequency accuracy x Marker frequency accuracy) ± (counter resolution x 1 LSB)]
Resolution:	1 Hz, 10 Hz, 100 Hz, 1000 Hz
Sensitivity:	–60 dBm @ 2 MHz < frequency < 3 GHz (span<3 MHz)
	–55 dBm @ 3 GHz < frequency < 13.2 GHz (span<3 MHz)
	–50 dBm @ 13.2 GHz < frequency < 26.5 GHz (span<3 MHz)

Test instruments

Signal generator:	E8257D
RF cable:	SMA (male)–SMA (male)
BNC cable:	BNC (male)–BNC (male)
Adapter:	N (male)–SMA (female)
(Reference):	use additional adapter: 3.5 mm (male)–N (female) (3283)
10 dB attenuator:	SMA (female)–SMA (female)

Setup

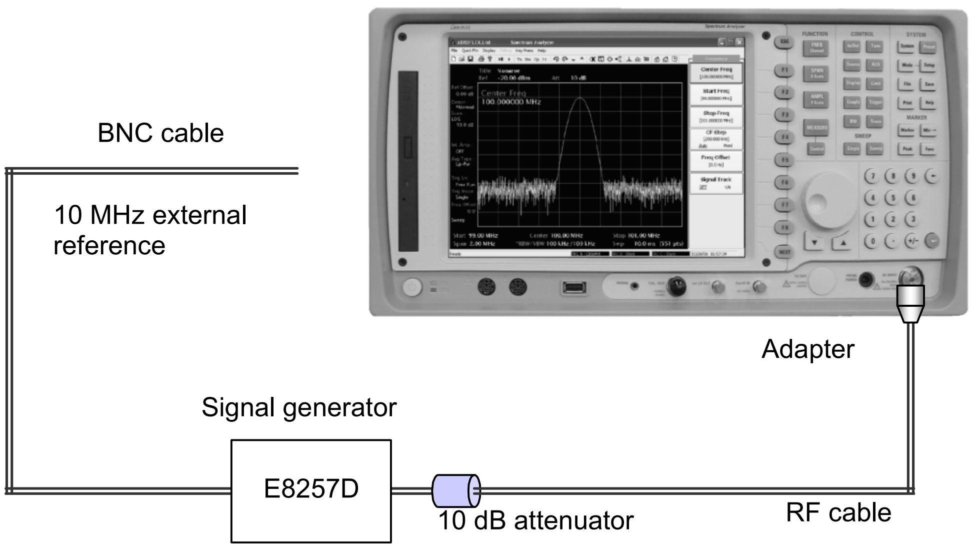


Fig. 6-3 Frequency counter accuracy test

Procedure

1 Set the power switch on the equipment front panel to ON.

2 Press [Preset], *[Preset]*.

3 Set up the equipment as shown below:

Center frequency: 2.9 GHz
Span: 200 kHz
Reference level: –20 dBm
ATT: 0 dB
RBW: Auto
VBW: Auto

4 Set the signal generator as shown below:

Frequency: 2.9 GHz
Power: –50 dBm

5 Press [Peak], [Func], *[Freq Counter]*.

6 Read out the frequency counter value.

7 Measure the frequency counter value with changing frequency generator value (1 Hz→10 Hz→100 Hz→1000 Hz) (Table 6-2).

Table 6-2 Frequency counter accuracy

Spectrum analyzer	Signal generator		Result
Center	Center	Power level	
2.9 GHz	2.9 GHz	–50 dBm	
6.3 GHz	6.3 GHz	–45 dBm	
13.1 GHz	13.1 GHz	–45 dBm	
26.4 GHz	26.4 GHz	–40 dBm	

Resolution bandwidth (RBW) and selectivity and switching error

Resolution bandwidth (RBW)

When there are two input signals with a frequency difference corresponding to the 3 dB bandwidth of the IF final stage, the signals can be resolved as two waveforms. This is called resolution bandwidth.

RBW accuracy and selectivity

The accuracy is defined by the coincidence between setting of RBW and 3 dB bandwidth of signal.

The selectivity is defined by the ratio of the filter width, in Hz, at the –60 dB point, to the filter width, in Hz, at the –3 dB point, as shown in the following formula:

To test the resolution bandwidth and selectivity, first measure the resolution bandwidth (3 dB bandwidth), then the 60 dB bandwidth and calculate the 60 dB/3 dB bandwidth ratio.

RBW switching error

The switching error is defined as the shift in amplitude when the RBW filter is switched.

Specification

Accuracy:	≤±1.5% at 3 dB (500 Hz–500 kHz, 1-2-3-5 step)
	≤±5% at 3 dB (1 MHz~5 MHz, 1-2-3-5 step)
Selectivity:	≤5:1 (1 Hz–5 MHz, 1-2-3-5 step) (60 dB/3 dB bandwidth)
Switching error:	0 dB (RBW 5 kHz reference)

Test instruments

Signal generator:	E8257D
RF cable:	SMA (male)–SMA (male)
BNC cable:	BNC (male)–BNC (male)
Adapter:	N (male)–SMA (female)

(Reference) Use additional adapter 3.5 mm (male)–N (female) (3283)

Setup

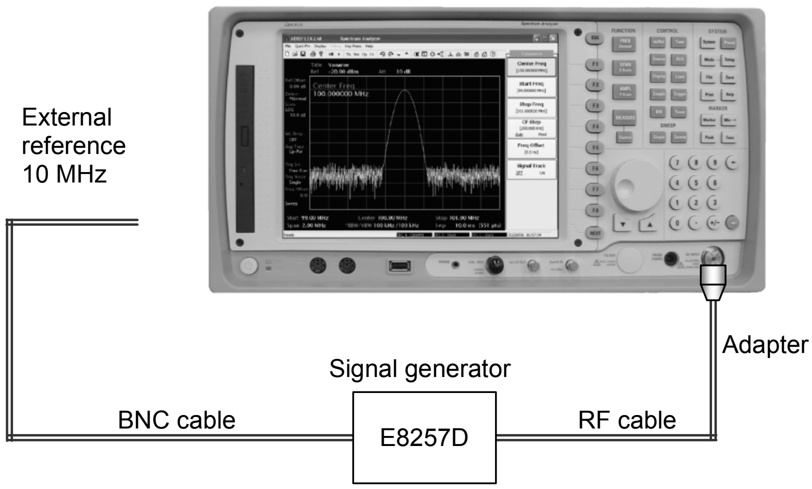


Fig. 6-4 Resolution bandwidth and selectivity and error test

Procedure

RBW accuracy

1 Set the power switch on the equipment front panel to ON.

2 Press [Preset], *[Preset]*.

3 Set up the equipment as shown below:

Center frequency: 1101 MHz
Span: 15 MHz
Reference level: −10 dBm
RBW: 5 MHz
VBW: Auto
Scale: 2 dB/div
Sweep time: 50 ms

4 Set the signal generator as shown below:

Frequency: 1101 MHz
Power: −10 dBm

5 Press [Peak], [Marker>], *[Marker>Ref]* and match the peak of the signal trace to the top line Ref Level on the screen.

6 Press [Single], *[Single]* to execute a single sweep, then check that the single sweep has been completed.

7 Press [MEASURE], *[X dB Down..]*, *[X[dB] Point [3.0]]* and then measured value.

8 Press [Sweep], *[Continuous]*.

9 Repeat steps 5 to 8 for the other resolution bandwidth according to the combinations of resolution bandwidth and frequency span shown in Table 6-3.

10 Calculate RBW filter accuracy:

$$\text{Accuracy} = \frac{(\text{RBW} - \text{Measured Value})}{\text{RBW}} \times 100\%$$

Table 6-3 RBW accuracy

Equipment			Marker Δ 3 dB bandwidth			Accuracy	Remark
Center	RBW	Span	Minimum	Measure	Maximum		
	1 kHz	3 kHz					
	2 kHz	6 kHz					
	3 kHz	9 kHz					
	5 kHz	15 kHz					
	10 kHz	30 kHz					
	20 kHz	60 kHz					
	30 kHz	90 kHz					
1101 MHz	50 kHz	150 kHz					
	100 kHz	300 kHz					
	200 kHz	600 kHz					
	300 kHz	900 kHz					
	500 kHz	1.5 MHz					
	1 MHz	3 MHz					
	2 MHz	6 MHz					
	3 MHz	9 MHz					
	5 MHz	15 MHz					
	1 kHz	3 kHz					
	2 kHz	6 kHz					
	3 kHz	9 kHz					
	5 kHz	15 kHz					
	10 kHz	30 kHz					
	20 kHz	60 kHz					
	30 kHz	90 kHz					
9501 MHz	50 kHz	150 kHz					
	100 kHz	300 kHz					
	200 kHz	600 kHz					
	300 kHz	900 kHz					
	500 kHz	1.5 MHz					
	1 MHz	3 MHz					
	2 MHz	6 MHz					
	3 MHz	9 MHz					
	5 MHz	15 MHz					

Equipment			Marker Δ 3 dB bandwidth			Accuracy	Remark
Center	RBW	Span	Minimum	Measure	Maximum		
	1 kHz	3 kHz					
	2 kHz	6 kHz					
	3 kHz	9 kHz					
	5 kHz	15 kHz					
	10 kHz	30 kHz					
	20 kHz	60 kHz					
20001 MHz	30 kHz	90 kHz					
	50 kHz	150 kHz					
	100 kHz	300 kHz					
	200 kHz	600 kHz					
	300 kHz	900 kHz					
	500 kHz	1.5 MHz					
	1 MHz	3 MHz					
	2 MHz	6 MHz					
	3 MHz	9 MHz					
	5 MHz	15 MHz					

RBW selectivity

1 Set the power switch on the equipment's front panel to ON.

2 Press [Preset], *[Preset]*.

3 Set the equipment as shown below:

Center frequency: 108 MHz
Span: 5 MHz
Reference level: –10 dBm
ATT: Auto
RBW: 1 MHz
VBW: Auto
Sweep time: 50 ms

4 Set the signal generator as shown below:

Frequency: 108 MHz

Power: 0 dBm

5 Press [Peak], [Marker>], *[Marker>Ref]* and match the peak of the signal trace to the stop line Ref Level on the screen.

6 Press [Single], *[Single]* to execute a signal sweep, then check that the single sweep has completed.

7 Press [MEASURE], *[X dB Down..]*, *[X [dB] point[60]]* and then measure the X dB Relate.

8 Press [Sweep], *[Continuous]*. Change the RBW and frequency spans according to the combinations of RBW and frequency span shown in Table 6-4.

9 For 3 dB bandwidth, used the value table (Item RBW Accuracy].

10 Calculate RBW selectivity:

$$\text{Selectivity} = \frac{\text{60 dB Bandwidth}}{\text{3 dB Bandwidth (or 6 dB Bandwidth)}}$$

Table 6-4 RBW selectivity

Equipment			3 dB BW	60 dB BW	Selectivity	Remark
Center	RBW	Span				
	300 Hz	1.8 kHz				
108 MHz	30 kHz	180 kHz				
	300 kHz	1.8 MHz				
	1 MHz	6 MHz				

RBW switching error

1 Set the power switch on the equipment front panel to ON.

2 Press [Preset], *[Preset]*.

3 Set up the equipment as shown below:

Center frequency: 100 MHz
Span: 9 MHz
Reference level: −10 dBm
ATT: Auto
RBW: 3 kHz
VBW: Auto
Scale: 10 dB/div
Sweep time: 100 ms

4 Set the signal generator as shown below:

Frequency: 100 MHz
Power: −5 dBm

5 Press [Peak], [Marker>], *[Marker > CF]* to move the signal peak to the center and the top of the screen.

6 Press [Marker], *[Delta]* to set the marker to delta marker.

7 Set RBW and SPAN sequentially as shown in Table 6-5 (300 Hz/1.5 kHz–3 MHz/15 MHz).

8 Press [Peak] to conduct a peak search and move the current marker to the peak point of the signal spectrum.

9 Read the Δ marker level value.

10 Repeat steps 7 to 9.

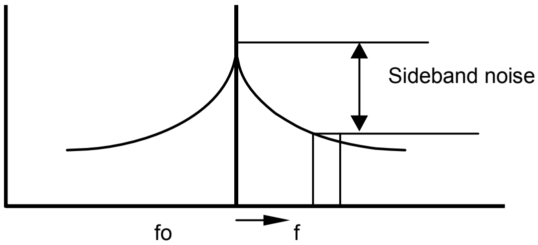
Table 6-5 RBW switching error

Equipment			3 dB BW	60 dB BW
Center	RBW	Span		
	1 kHz	3 kHz		
	2 kHz	6 kHz		
	3 kHz	9 kHz		
	5 kHz	15 kHz		
	10 kHz	30 kHz		
	20 kHz	60 kHz		
	30 kHz	90 kHz		
100 MHz	50 kHz	150 kHz		
	100 kHz	300 kHz		
	200 kHz	600 kHz		
	300 kHz	900 kHz		
	500 kHz	1.5 MHz		
	1 MHz	3 MHz		
	2 MHz	6 MHz		
	3 MHz	9 MHz		
	5 MHz	15 MHz		

Equipment			3 dB BW	60 dB BW
Center	RBW	Span		
	1 kHz	3 kHz		
	2 kHz	6 kHz		
	3 kHz	9 kHz		
	5 kHz	15 kHz		
	10 kHz	30 kHz		
	20 kHz	60 kHz		
	30 kHz	90 kHz		
9000 MHz	50 kHz	150 kHz		
	100 kHz	300 kHz		
	200 kHz	600 kHz		
	300 kHz	900 kHz		
	500 kHz	1.5 MHz		
	1 MHz	3 MHz		
	2 MHz	6 MHz		
	3 MHz	9 MHz		
	5 MHz	15 MHz		
	1 kHz	3 kHz		
	2 kHz	6 kHz		
	3 kHz	9 kHz		
	5 kHz	15 kHz		
	10 kHz	30 kHz		
	20 kHz	60 kHz		
	30 kHz	90 kHz		
19000 MHz	50 kHz	150 kHz		
	100 kHz	300 kHz		
	200 kHz	600 kHz		
	300 kHz	900 kHz		
	500 kHz	1.5 MHz		
	1 MHz	3 MHz		
	2 MHz	6 MHz		
	3 MHz	9 MHz		
	5 MHz	15 MHz		

Phase noise

Sideband noise measures the noise of a local oscillator signal at an offset from the carrier frequency. It is important to use a signal source with sideband noise performance 10 dB or better than the equipment.



Specification

Phase noise: –112 dBc/Hz @ frequency = 1 GHz, 10 kHz offset

Test instruments

Signal generator:	E8257D
RF cable:	SMA (male)–SMA (male)
BNC cable:	BNC (male)–BNC (male)
10 dB attenuator:	SMA (female)–SMA (female)
Adapter:	N (male)–SMA (female)

(Reference) use additional adapter: 3.5 mm (male)–N (female) (3283)

Setup

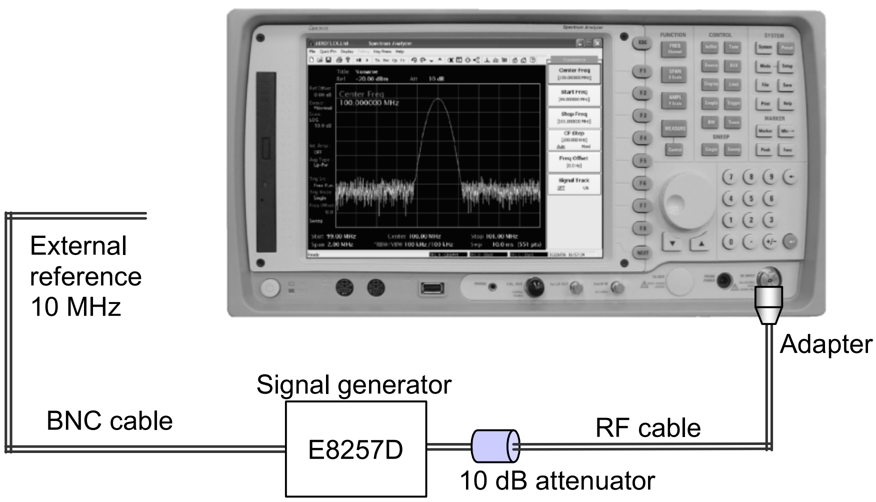


Fig. 6-5 Phase noise test

Procedure

1 Set the power switch on the equipment front panel to ON.

2 Press [Preset], *[Preset]*.

3 Set up the equipment as shown below:

Center frequency: 1 GHz
Span: 100 kHz
Reference level: −10 dBm
ATT: 0 dB
RBW: 1 kHz
VBW: Auto
Scale: 10 dB/div
Sweep time: Auto

4 Set up the signal generator as shown below:

Frequency: 1 GHz
Power: 0 dBm

5 Press [Peak], [Marker>], *[Marker>CF]* and *[Marker>Ref]* to move the signal spectrum peak to the center and the top of the screen.

6 Press [Marker], *[Delta]* in order to set to the marker to the Δ marker.

7 Set the Δ marker to a frequency of 10 kHz and read the marker value (amplitude).

8 Calculate sideband noise:

Sideband noise = Measured value (Δ marker value) − 10 log (RBW/1 Hz)

Example:

Offset frequency	RBW	Measured value	Sideband noise
10 kHz	1 kHz	−65 dBc	−95 dBc/Hz

Residual FM noise

Measures the purity of frequency.

Specification

≤ 10 x N Hz p-p, 1 s, RBW 1 kHz, VBW 1 kHz (N: LO harmonic mixing mode)

Test instruments

Signal generator:	E8257D
RF cable:	SMA (male)–SMA (male)
Adapter:	N (male)–SMA (female) (Reference) use additional adapter: 3.5 mm (male)–N (female) (3283)

Setup

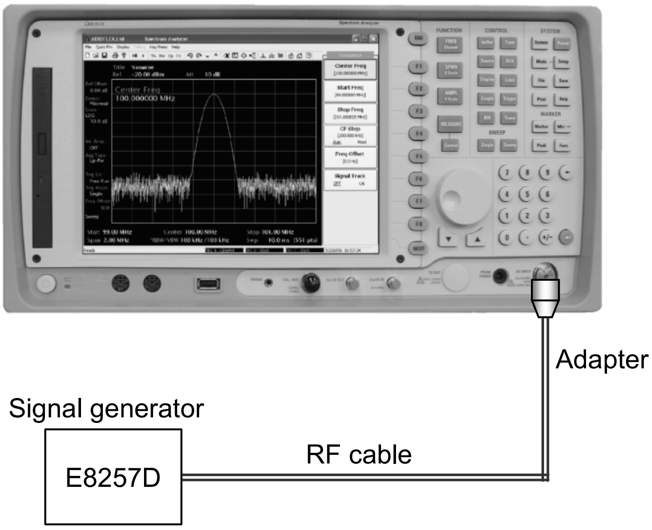


Fig. 6-6 Residual FM test

Procedure

1. Set the power switch on the equipment front panel to ON.
2. Press [Preset], *[Preset]*.
3. Set up the equipment as shown below:

   Center frequency: 3 GHz
   Reference level: –20 dBm
   Span: 10 kHz
   RBW: 1 kHz
   VBW: 1 kHz
   Sweep time: 500 ms
   Log Scale: 1 dB/div
4. Set the signal generator 83650B as shown below:

   Frequency: 3 GHz
   Power: –20 dBm
5. Press [Marker], *[Normal]* and press [SPAN], *[Zero Span]*.
6. Change the frequency of the signal generator and press [Marker], *[Delta]* when the equipment's marker level is –25 dBm.
7. Record the frequency of the signal generator (A).
8. Change the frequency until the equipment delta marker level reads –27 dBm.
9. Record the frequency of the signal generator (B).
10. Press [Single], *[Single]* and check the peak-to-peak value (C).
11. Residual FM = (B–A) / 2 x C

Average noise level

This test measures the internal noise of the instrument.

Specification

Average noise level: (RBW: 10 Hz, VBW: Auto)

≤ −80 dBm	3 Hz–1 kHz
≤ −90 dBm	1 kHz–1 MHz
≤ −140 dBm	1 MHz–10 MHz
≤ −147 dBm	10 MHz–2 GHz
≤ −146 dBm	2 GHz–6.4 GHz
≤ −143 dBm	6.4 GHz–18 GHz
≤ −138 dBm	18 GHz–22 GHz
≤ −136 dBm	22 GHz–24 GHz
≤ −133 dBm	24 GHz–26.5 GHz

Test instruments

50 ohm terminator: 909F

Setup

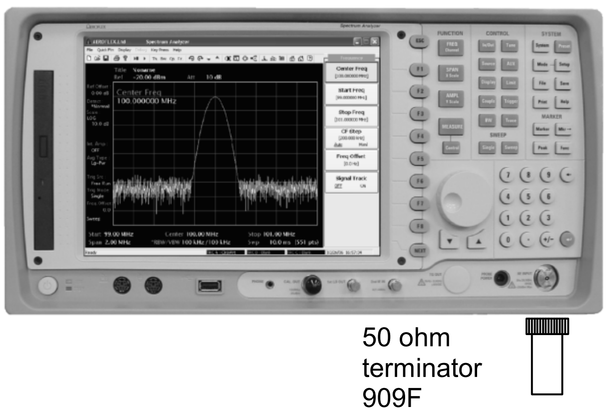


Fig. 6-7 Average noise level test

Procedure

1 Set the power switch on the equipment front panel to ON.

2 Press [Preset], *[Preset]*.

3 Set up the equipment as shown below:

Center frequency: 2.91 GHz
Span: zero
Reference level: –40 dBm
ATT: 0 dB
RBW: 3 Hz
VBW: Auto
Detector mode: Average
Sweep time: Average

4 Terminate the RF input with a 50 Ω terminator.

6 Press [Trace], *[More..]*, *[Trc Average.. [ON]]*, *[Trc Avg Count [9]]*.

7 Wait until the 9 sweeps have completed.

8 Press [Peak] to execute a peak search. At this point, read the level value at the marker. If a spurious signal exists within the span, move the marker to a flat noise region and then read the level value at the marker*.

9 Repeat steps 6 to 8, changing the center frequency. Enter the results in Table 6-6.

***Note**: *DANL (displayed average noise level) is different to residual spurious response.*

DANL is also called noise floor, that is, a flat noise level caused by the instrument's internally generated noise with no input signal.

Residual spurious response is a discrete response, that is, a CW-like noise seen on a spectrum analyzer display without input signal.

Table 6-6 Average noise level

Center frequency	Span	Average noise level	Remark
501 Hz	1 kHz		<10 MHz
11 MHz			
50 MHz			
101 MHz			
201 MHz			
301 MHz	1 kHz		>10 MHz (3281)
…			
2.9 GHz			
3.0 GHz			
3.1 GHz			
3.2 GHz			
…	1 kHz		>10 MHz (3282)
13.1 GHz			
13.2 GHz			
13.3 GHz			
13.4 GHz			
…	1 kHz		>10 MHz (3283)
26.4 GHz			
26.5 GHz			

Input attenuator switching error

This test measures the switching error when the amount of attenuation in the RF input section is switched.

Specification

Input attenuator switching error:	±0.5 dB by steps at 100 Hz (3281 only)
	±0.5 dB by steps at frequencies less than 13 GHz
	±0.8 dB by steps at 13 GHz–26.5 GHz

Test instruments

Signal generator:	E8257D
RF cable:	SMA (male)–SMA (male)
BNC cable:	BNC (male)–BNC (male)
Adapter:	N (male)–SMA (female)
(Reference) use additional adapter: 3.5 mm (male)–N (female) (3283)	
10 dB attenuator:	SMA (female)–SMA (female)

Setup

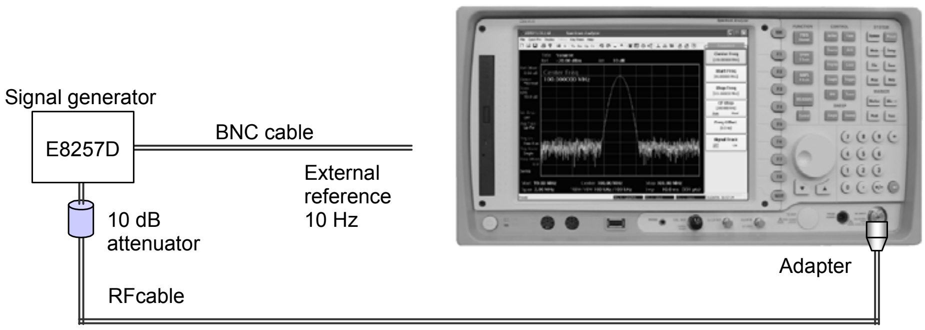


Fig. 6-8 Input attenuator switching error test

Procedure

1 Set the power switch on the equipment front panel to ON.

2 Press [Preset], *[Preset]*.

3 Set up the equipment as shown below:

Center frequency: 100 MHz
Span: 50 kHz
Reference level: −10 dBm
ATT: 0 dB
RBW: 3 kHz
VBW: 3 kHz
Sweep time: 50 ms
Average: ON

4 Set the 83650B signal generator as shown below:

Frequency: 100 MHz
Power: −10 dBm

5 Press [Peak], *[Mkr>]*, *[Mkr > CF]* and *[Mkr > Ref]* to set the spectrum waveform peak to the center and top of the screen.

6 Press [Marker], *[Delta]*, check the marker level is 0.

7 Press [AMPL], *[Attenuation [MNL]]*, increasing attenuation in 5 dB steps, read the delta marker level and enter it in Table 6-7.

8 Press [Marker], *[OFF]*.

9 Repeat steps 5 to 8 for other values in the table.

10 When you finish the measurements, compare the results with the values in the table.

Table 6-7 Average noise level

Center frequency (MHz)	Input attenuator		Delta marker level	Spec
	Before changing ATT	After changing ATT		
	0 dB	5 dB		
	5 dB	10 dB		
	10 dB	15 dB		
	15 dB	20 dB		
	20 dB	25 dB		
100	25 dB	30 dB		±0.5dB
	30 dB	35 dB		
	35 dB	40 dB		
	40 dB	45 dB		
	45 dB	50 dB		
	50 dB	55 dB		

Center frequency (MHz)	Input attenuator		Delta marker level	Spec
	Before changing ATT	After changing ATT		
	0 dB	5 dB		
	5 dB	10 dB		
	10 dB	15 dB		
	15 dB	20 dB		
	20 dB	25 dB		
2900	25 dB	30 dB		±0.5 dB
	30 dB	35 dB		
	35 dB	40 dB		
	40 dB	45 dB		
	45 dB	50 dB		
	50 dB	55 dB		
	0 dB	5 dB		
	5 dB	10 dB		
	10 dB	15 dB		
	15 dB	20 dB		
	20 dB	25 dB		
6200	25 dB	30 dB		±0.5dB
	30 dB	35 dB		
	35 dB	40 dB		
	40 dB	45 dB		
	45 dB	50 dB		
	50 dB	55 dB		
	0 dB	5 dB		
	5 dB	10 dB		
	10 dB	15 dB		
	15 dB	20 dB		
	20 dB	25 dB		
13000	25 dB	30 dB		±0.5dB
	30 dB	35 dB		
	35 dB	40 dB		
	40 dB	45 dB		
	45 dB	50 dB		
	50 dB	55 dB		

Center frequency (MHz)	Input attenuator		Delta marker level	Spec
	Before changing ATT	After changing ATT		
	0 dB	5 dB		
	5 dB	10 dB		
	10 dB	15 dB		
	15 dB	20 dB		
	20 dB	25 dB		
26500	25 dB	30 dB		±0.5dB
	30 dB	35 dB		
	35 dB	40 dB		
	40 dB	45 dB		
	45 dB	50 dB		
	50 dB	55 dB		

Frequency response

Generally, when one or more signals with a different frequency but the same amplitude are applied to the unit, the instrument displays the same amplitude for each signal on the screen.

Specification

Frequency response:	±0.5 dB from 1 MHz to 3.0 GHz
	±1.0 dB from 3.0 GHz to 6.4 GHz
	±1.5 dB from 6.4 GHz to 13.2 GHz
	±2.0 dB from 13.2 GHz to 22.0 GHz
	±2.5 dB from 22.0 GHz to 26.5 GHz
	(10 dB attenuation)

Test instruments

Signal generator:	E8257D
Power meter:	E4418B
Power sensor:	E9304A, E4413A
RF cable:	SMA (male)–SMA (male)
BNC cable:	BNC (male)–BNC (male)
Adapter:	N (male)–SMA (female), N (female)–SMA (female)

(Reference) use additional adapter: 3.5 mm (female)–N (female) (3283)

Setup

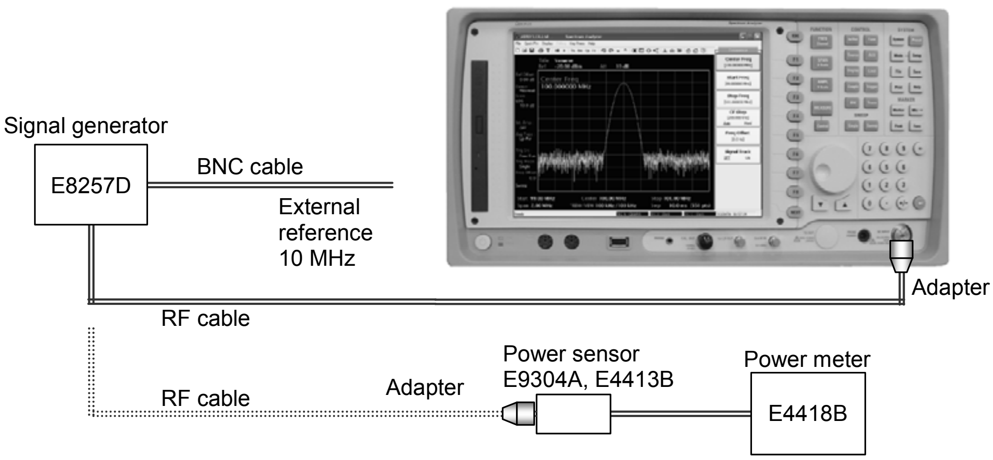


Fig. 6-9 Frequency response test

Procedure

1 Calibrate the power meter to the power sensor.

2 Connect the power sensor to the signal generator with the RF cable and adapter as shown in Fig. 6-9.

3 Set the signal generator as shown below:

Frequency: 300 kHz
Power: 0 dBm

4 Set the power meter to measure frequency 10 MHz.

5 Read the power meter display and enter the result in Table 6-8.

6 Change the signal generator output frequency and measure the power meter frequency as shown in Table 6-8 and enter the values in the table.

7 Disconnect the signal generator from the power sensor.

8 Connect the power sensor to the test equipment with the RF cable and adapter as shown in Fig. 6-9.

9 Set up the equipment as shown below:

Center frequency: 300 kHz
Reference level: 0 dBm
SPAN: 50 kHz
RBW: 3 kHz
VBW: 3 kHz
Sweep time: 50 ms

10 Press [Peak] and the marker level and enter the value in the table.

11 Change the signal generator output frequency and the test equipment frequency as shown in Table 6-8 and enter the values in the table.

12 Calculate the frequency response.

13 Error = display maker peak value (B) – power meter value (A)

Table 6-8 Frequency response

Signal generator	Frequency	Power Meter value (dBm)	Marker peak value (dBm)	Error	Remark
	1 MHz				
	10 MHz				
	50 MHz				
E8257D	100 MHz				3281
	200 MHz				
	…				
	2.9 GHz				
	3.0 GHz				
	3.1 GHz				
	3.2 GHz				
E8257D	…				3282
	13.1 GHz				
	13.2 GHz				
	13.3 GHz				
	13.4 GHz				
E8257D	…				3283
	26.4 GHz				
	26.5 GHz				

Spurious response

This test measures spurious frequency levels in the equipment.

The RF input is terminated and 0 dB input attenuation is selected.

Specification

≤–95 dBm (input terminated, 0 dB attenuation)

Test instruments

50 ohm termination: 909F

Setup

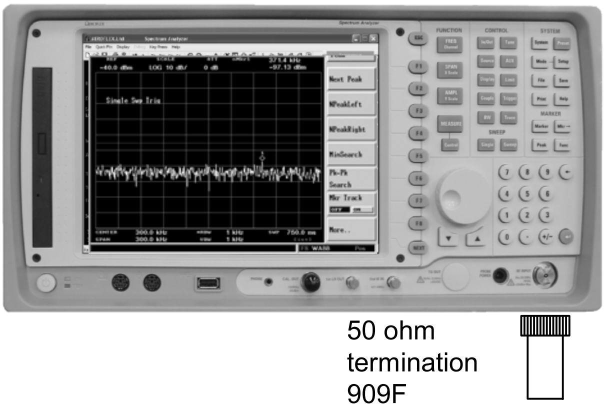


Fig. 6-10 Residual response test

Procedure

1. Set the power switch on the equipment front panel to ON.
2. Press [Preset], *[Preset]*.
3. Set up the equipment as shown below:

   Center frequency: 10 MHz
   Span: 10 MHz
   Reference level: –30 dBm
   ATT: 0 dB
   RBW: 10 kHz
   VBW: 1 kHz
   Sweep Time: Auto
4. Terminate the RF input with a 50 Ω terminator.
5. Press [Display], *[Disp Line [ON]]*, *[Disp Value]* and rotate knob to display –95 dBm.
6. Press [Single], *[Single]*. Wait for completion of the sweep.

   Any residual responses must be below the display line.
7. Press [Peak] and record the marker amplitude in Table 6-9.
8. Set the center frequency step to 9 MHz using [FREQ], *[CF Step [MNL]]*, *[CF Step]* and change the center frequency.
9. Repeat steps 7 and 8.

Table 6-9 Spurious response

Frequency	Marker amplitude (dBm)	Equipment spec. (dBm)
10 MHz		< –95
to		
13.2 GHz		
to		< –95
26.45 GHz		

Second harmonic distortion

The main point of the test is to apply a signal with harmonic distortion that is at least 20 dB lower than the equipment's internal harmonic distortion to the equipment, and to measure the level difference between the fundamental signal and the second harmonic.

A low-distortion signal source can be obtained by applying a signal to the equipment after passing the signal through a low-pass filter (LPF).

Specification

IP2 (Second Order Intercept Point: −30 dBm input, 0 dB attenuation):

≥+30 dBm, less than 100 MHz

≥+40 dBm, 100 MHz–1.5 GHz

≥+80 dBm, 1.5 GHz–26.5 GHz

Test instruments

Signal generator:	E8257D
RF cable 1:	N (male)–N (male)
RF cable 2:	SMA (male)–SMA (male)
BNC cable:	BNC (male)–BNC (male)
LPF:	with attenuation of 70 dB or more at twice the fundamental frequencies
Adapter:	N (male)–SMA (female)

(Reference) use additional adapter: 3.5 mm (male)–N (female) (3283)

Setup

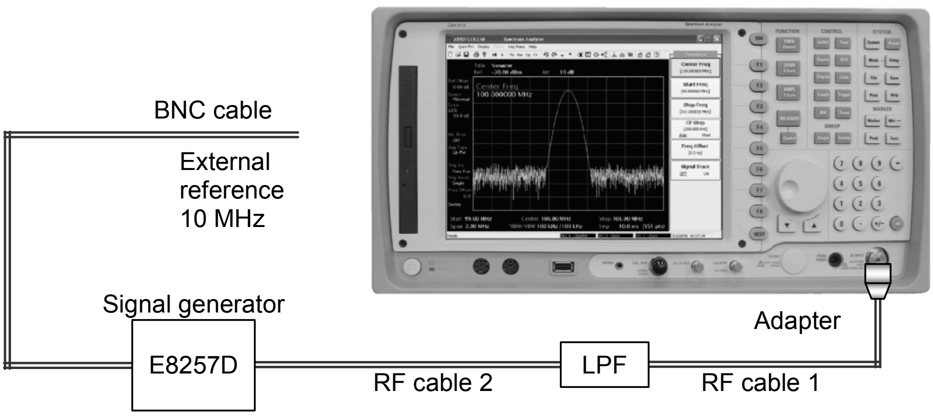


Fig. 6-11 Second harmonic distortion test

Procedure

1 Set the power switch on the equipment front panel to ON.

2 Press [Preset], *[Preset]*.

3 Set up the equipment as shown below:

Center frequency: 95 MHz
Span: 10 kHz
Reference level: −10 dBm
ATT: 0 dB
RBW: 1 kHz
VBW: 30 Hz
Sweep time: Auto

4 Set the signal generator as shown below:

Frequency: 95 MHz
Power: −30 dBm

5 Adjust the signal generator level so that the signal measured is –30 dBm on the equipment.

6 Set the center frequency to twice the fundamental frequency to display the second harmonic on the screen.

7 Press [Peak], *[Mkr>]*, *[Marker > CF]* and calculate the difference from −30 dBm. Enter this in Table 6-10.

8 Adjust the frequency and LPF as indicated in the table and repeat steps 3 to 7.

Table 6-10 Second harmonic distortion

Signal generator		Second harmonic		
Output power	**Frequency**	**Marker level**	**dBc**	**Frequency**
–30 dBm	95 MHz			190 MHz
	245 MHz			490 MHz
	495 MHz			990 MHz
	995 MHz			1990 MHz

Third-order intermodulation

Two signal generators provide the signals required for measuring third-order intermodulation.

It becomes difficult when the input level is –30 dBm, as the intermodulation signal is very close in level to the noise.

Specification

(IP3: Third Order Intercept Point, −15 dBm input)

≥+13 dBm, less than 100 MHz

≥+15 dBm, more than 100 MHz

Test instruments

Signal generator 1,2:	E8257D
Power splitter:	11636B
RF cable 1,2,3:	SMA (male)–SMA (male)
BNC cable 1,2:	BNC (male)–BNC (male)
Adapter:	T-BNC (female), N (male)–SMA (female)

(Reference) use additional adapter: 3.5 mm (male)–N (female) (3283)

3 dB, 6 dB attenuator: SMA (female)–SMA (female)

Setup

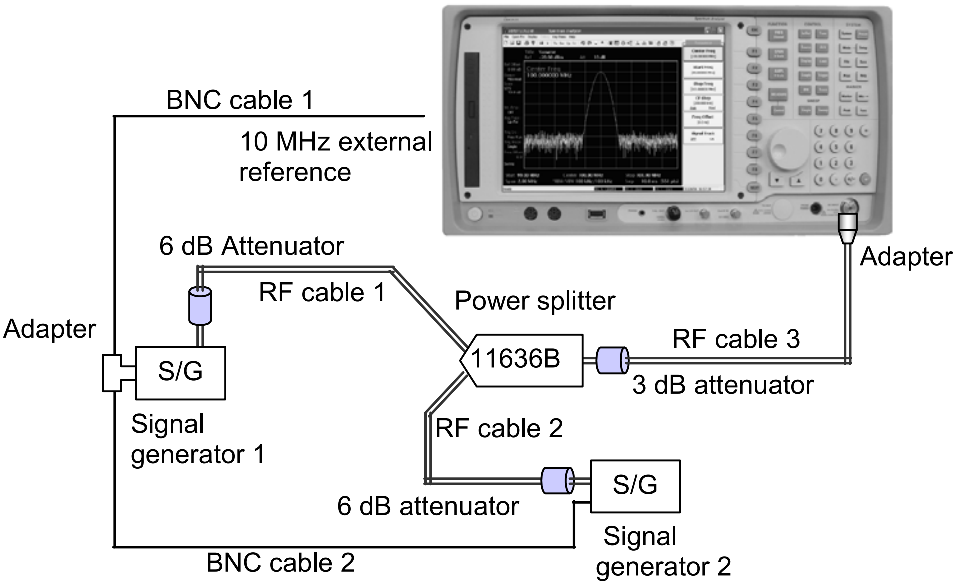


Fig. 6-12 Third-order intermodulation test

Procedure

Power meter calibration

1 Set up synthesized signal generators as shown in Fig. 6-12.

Signal generator 1:

Frequency: 10 MHz
Power: –5 dBm

Signal generator 2:

Frequency: 10.1 MHz
Power: –5 dBm

2 Set up the equipment as shown below:

Center frequency: 100 MHz
Reference level: –10 dBm
Span: 500 kHz
ATT: 0 dB
RBW: 3 kHz
VBW: 50 Hz

3 Adjust signal generator 1, 2 level so that power meter reads –15 dBm.

4 Press [Peak] to set the normal marker to one of the two signals at –15 dBm.

5 Press [Marker], *[Delta]*.

6 Move the normal marker to the peak of the intermodulation product signal (left side of signal generator 1). Read the level difference and enter it in Table 6-11.

7 Repeat steps 3 to 6 for other frequencies in Table 6-11.

Table 6-11 Third-order intermodulation

Signal generator (–15 dBm)		Third-order Intermodulation distortion	
Number 1 (MHz)	Number 2 (MHz)	Δ marker (dBc)	Specification (dBc)
10	10.1		
20	20.1		–50
…	…		
80	80.1		(below 100 MHz)
90	90.1		
100	100.1		
200	200.1		–55
…	…		
25300	25300.1		(above 100 MHz)
25400	25400.1		

Spurious relating to input

This test measures the spurious frequency level relating to the input of the equipment.

Specification

≤–60 dBc (input level –30dBm, 0 dB attenuation)

Test instruments

Signal generator:	E8257D
RF cable:	SMA (male)–N (female)
BNC cable:	BNC (male)–BNC (male)
LPF:	N (male)–N (female)
Adapter:	N (male)–N (male)

(Reference) use additional adapter: 3.5 mm (male)–N (female) (3283)

10 dB attenuator:	SMA (female)–SMA (female)

Setup

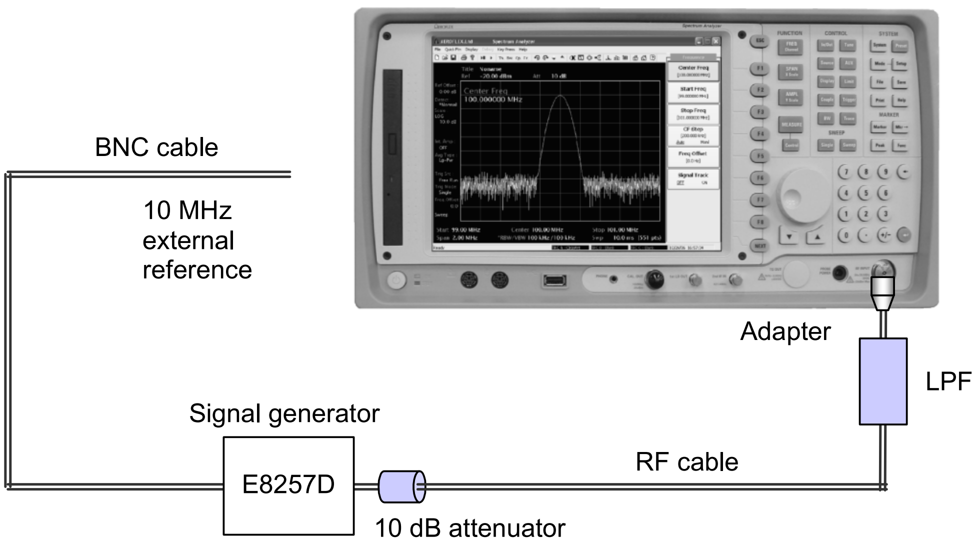


Fig. 6-13 Spurious relating to input test

Procedure

1. Set the power switch on the equipment front panel to ON.
2. Press [Preset], *[Preset]*.
3. Set up the equipment as shown below:

   Center frequency: 100 MHz
   Span: 50 MHz
   Reference level: –20 dBm
   ATT: 0 dB
   RBW: 10 kHz
   VBW: 1 kHz
4. Set the signal generator as shown below:

   Frequency: 100 MHz
   Power: –20 dBm
5. Press [Peak], [Marker], *[Marker > Ref]*, then set the peak value of the spectrum analyzer to the reference level.
6. Measure spurious level in the ±10.7 MHz delta frequency, then record frequencies greater than –60 dBc and the spurious level.
7. Repeat steps 5 and 6, increasing by 100 MHz frequency steps to 26.5 GHz on the spectrum analyzer and signal generator.

Input VSWR

This test verifies the input VSWR of the equipment.

Specification

10 MHz–3.0 GHz ≤1.5: 1 @ 10 dB attenuation

3.0 GHz–13.2 GHz ≤1.8: 1 @ 10 dB attenuation

13.2 GHz–26.5 GHz ≤2.0: 1 @ 10 dB attenuation

Test instruments

Network analyzer:	E8363B
Frequency range:	10 MHz–40 GHz
Calibration cable:	85133-60016 (2.4 mm –2.92 mm, female)
	85131-60017 (2.4 mm –2.92 mm, male)
Calibration kit:	N4692-6003
Adapter:	SMA (female)–N (male)

(Reference) use additional adapter: 3.5 mm (male)–N (female) (3283)

Setup

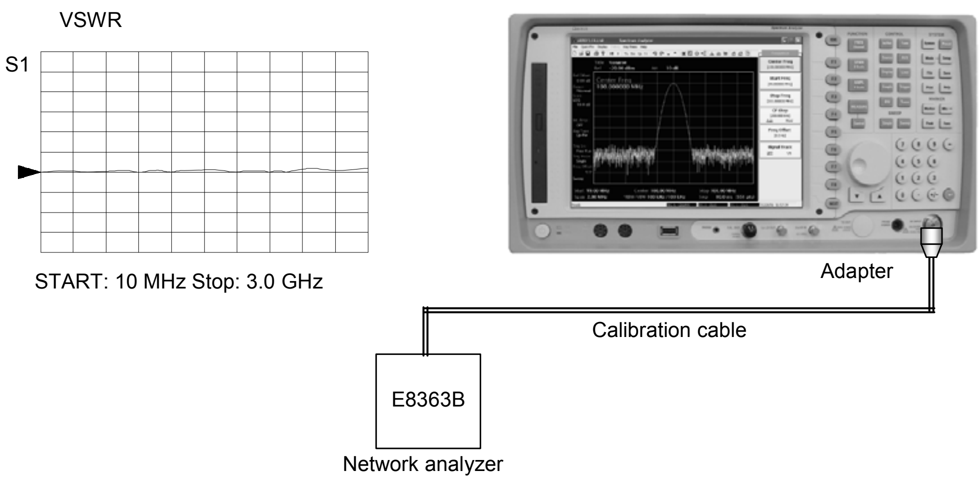


Fig. 6-14 Input VSWR test

Procedure

1 Set the power switch on the equipment front panel to ON.

2 Press [Preset], *[Preset]*.

3 Set up the equipment as shown below:

Center frequency: 100 MHz
ATT: 10 dB
Reference level: −10 dBm
Span: Zero span

4 Set up the network analyzer (E8363B) as shown below:

Start frequency: 10 MHz
Stop frequency: 3.0 GHz
Output level: −20 dBm

5 Connect the cable to the network analyzer and calibrate, following each equipment calibration procedure.

6 Connect the cable from the network analyzer to the instrument and measure the VSWR. Compare with the specification (Table 6-12).

7 Set up the network analyzer (E8363B) as shown below:

Start frequency: 3.0 GHz
Stop frequency: 6.4 GHz
Output Level: −20 dBm

8 Repeat steps 5 and 6.

9 Repeat steps 7 and 8 in Band 2, 3.

Table 6-12 Input VSWR

Frequency range		Measurement (max)	Specification
Band 0	10 MHz–3.0 GHz		≤1.5:1
Band 1	3.0 GHz–6.4 GHz		≤1.8:1
Band 2	6.4 GHz–13.2 GHz		≤1.8:1
Band 3	13.2 GHz–26.5 GHz		≤2.0:1

Trigger (EXT, Video, Line)

This test tests standard operation of the equipment's trigger.

Specification

EXT, Video, Line

Test instruments

Arbitrary function generator: AFG310

RF cable: SMA (male)–BNC (male)

BNC cable: BNC (male)–BNC (male)

Adapter: N (male)–SMA (female)

(Reference) use additional adapter: 3.5 mm (male)–N (female) (3283)

Setup

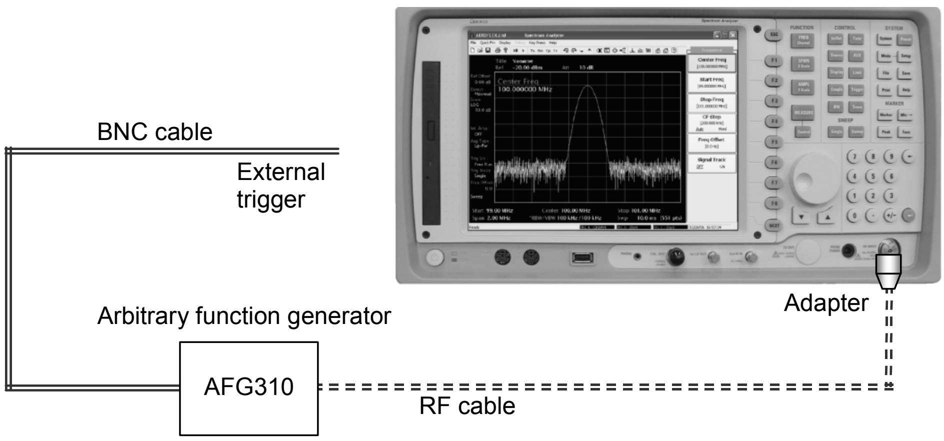


Fig. 6-15 Trigger test

Procedure 1 (EXT Trigger)

The following is a procedure for examining the EXT Trigger.

1 Set up the equipment as shown below:

Center frequency: 10 MHz
Span: 10 MHz
Reference level: 0 dBm
ATT: Auto
RBW: 30 kHz
VBW: 30 kHz
Trigger: Free Run

2 Set the arbitrary function generator as shown below:

Function: SQUA
Frequency: 0.5 Hz
Amplitude: 3.3 V

3 Set the Trigger to External on the equipment.

4 Check that the noise level on the screen is refreshed.

Procedure 2 (Line Trigger)

The following is a procedure for examining the Line Trigger.

1 Set up the equipment as shown below:

Center frequency: 10 MHz
Span: 10 kHz
Reference level: 0 dBm
ATT: Auto
RBW: 30 kHz
VBW: 30 kHz
Trigger: Free Run

2 Set the arbitrary function generator as shown below:

Function: SQUA
Frequency: 0.5 Hz
Amplitude: 3.3 V

3 Set the Trigger to Line on the equipment.

4 Check the noise level on the screen refreshes in a similar manner to Free Run trigger mode.

Procedure 3 (Video Trigger)

The following is a procedure for examining the Video Trigger.

1 Set up the equipment as shown below:

Center frequency: 10 MHz
Span: Zero Span
Reference level: 0 dBm
ATT: Auto
RBW: 30 kHz
VBW: 30 kHz
Sweep Time: 2 ms
Trigger: Free Run
Trig Slop: Pos
Trig Delay: 0 µsec

2 Set the arbitrary function generator as shown below:

Function: SQUA
Frequency: 10 MHz
Amplitude: 0.1 V
Modulation: FM
FM Modulation: Sine
FM Frequency: 1 kHz
FM Deviation: 50 kHz

3 Set the Trigger to Video on the equipment.

4 By adjusting the Trigger level, check that the starting point of the sine wave on the screen is on the upper line of the Video Trigger.

5 Press [Trigger], *[Trig Slop] [>NEG]*

6 By adjusting the Trigger level, check that the starting point of the sine wave on the screen is on the lower line of the Video Trigger.

7 Check the Trigger delay.

[Trigger], *[Trig Delay]*, *[On >]* → –1>0>0>µsec, →1>0>0>µsec.

Preamplifier

Checks the preamplifier for normal operation.

Specification

Peak: < ±1 dBm

Noise level: >10 dBc

Test instruments

Signal generator: E8257D

RF cable: SMA (male)–N (male)

BNC cable: BNC (male)–BNC (male)

Adapter: N (male)–N (male)

(Reference) use additional adapter: 3.5 mm (male)–N (female) (3283)

10 dB attenuator: SMA (female)–SMA (female)

LPF: N (female)–N (male)

Setup

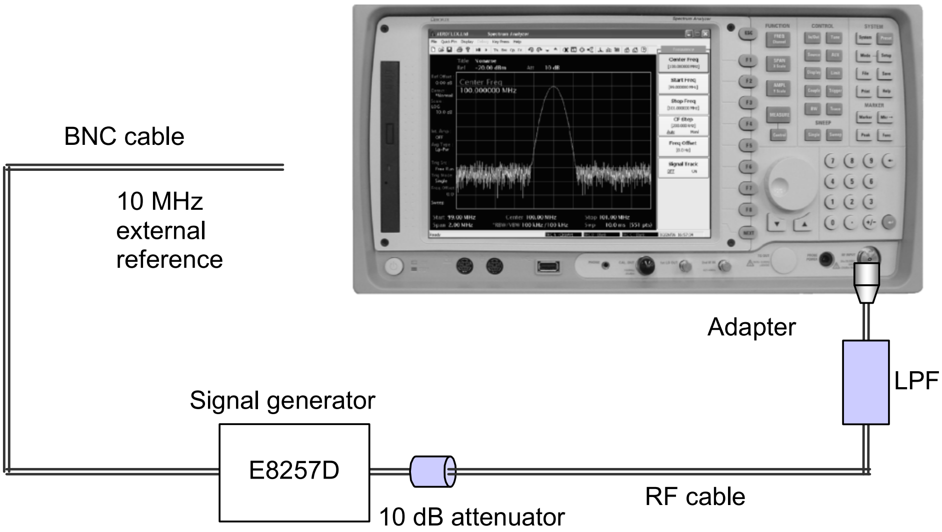


Fig. 6-16 Preamplifier test

Procedure

1. Set the power switch on the equipment front panel to ON.
2. Press [Preset], *[Preset]*.
3. Set up the equipment as shown below:

   Center frequency: 100 MHz
   Reference level: –40 dBm
   ATT: Auto
   Span: 10 MHz
   RBW: Auto
   VBW: Auto
   Sweep Time: Auto
   Average: On
4. Set the signal generator as shown below:

   Frequency: 100 MHz
   Power: -50 dBm
5. Turn PreAmp OFF, then measure Peak level after 10 Averages.
6. Shift 2.5 MHz at the Peak frequency, then measure noise level.
7. Turn PreAmp ON after setting Average OFF
8. Measure Peak level after 10 Averages.
9. Shift 2.5 MHz at the Peak frequency, then measure noise level.
10. Repeat steps 5 to 9 according to the frequency (1500 MHz, 2900 MHz).

Chapter 7
STORAGE AND TRANSPORTATION

Contents

Introduction

This section describes the long-term storage, repacking and transportation of the instrument as well as regular care procedures and their timing.

Cleaning

Always turn the instrument’s POWER switch OFF and disconnect the power plug from the AC power inlet before cleaning the cabinet.

To clean the case exterior:

- Wipe using a soft, dry cloth
- Use a cloth moistened with diluted neutral cleaning liquid if the instrument is very dirty or before long-term storage. After insuring that the cabinet has been thoroughly dried, use a soft, dry cloth for wiping off.
- Use a coin to separate the fan cover on the rear panel, and brush away dust from the filter.
- Tighten any loose screws.

CAUTION

Never use benzene, thinner, or alcohol to clean the cabinet: it may damage the coating, or cause deformation or discoloration.

Storage precautions

This paragraph describes the precautions to take for long-term storage of the instrument.

Precautions before storage

Before storage, wipe dust, finger marks, and other dirt off the instrument.

Avoid storing the instrument where:

- it may be exposed to direct sunlight or high dust levels
- it may be exposed to active gases
- it may be exposed to extreme temperatures (>50°C) or high humidity (>90%).

Recommended storage precautions

The recommended storage conditions are:

Temperature: 0 to 50°C

Humidity: 10% to 60%

Repacking and transportation

Take the following precautions if the instrument must be returned for servicing.

Repacking

Use the original packing materials. If the instrument is packed in other materials, observe the following packing procedure:

- wrap the instrument in plastic sheet or similar material
- remove handles from the instrument, if fitted
- use a corrugated paper or wooden box, or aluminum case, which allows shock-absorbent material to be inserted on all sides of the instrument
- secure the container with packing straps, adhesive tape or bands.

Transportation

Do not subject the instrument to severe vibration during transport. It should be transported under the recommended storage conditions.

Service

If the instrument is damaged or does not operate as specified, contact your nearest agent. If you request a repair, provide the following information:

- model number and serial number on rear panel
- fault description: symptoms, operation carried out before the fault ocurred (include peripheral equipment and a drawing of the circuit), circumstances (temperature, humidity, time, date, place), any suggestions, etc.
- a name and contact details for when a fault is confirmed or at completion of repair.

Chapter 8
SYSTEM RESTORATION

Contents

Introduction

This section contains information about restoring the system if errors occur in the software.

Operating system

The spectrum analyzer uses Microsoft's Windows XP™ as the basic operating system.

The Windows™ OS is easy to use but errors have been known to occur. Therefore, although the instrument does not repair the Windows operation system, it has a restoration solution in hard memory to recover the initial state.

CAUTION

Take this course of action only if actions such as reinstalling Windows and inspecting the disk do not restore correct operation.

Recovering the booting system

Phoenix Recover Pro 6

The internal restoration solution for this instrument is *Recover Pro 6 MFG*, manufactured by Phoenix.

Recover Pro 6 consists of *Phoenix Always* (which always reboots regardless of the state of the operating system) and *Phoenix Recover Pro* (which backs up and restores the system).

You can find more detailed information at Phoenix's website: www.phoenix.com

System restoration using *Recover Pro*

You can return the instrument to its default state by carrying out the following steps.

Note*:* *If you proceed, the system driver is initialized into the basic driver (C:Drive). Any stored data will disappear.*

Steps for system restoration

1 Connect a mouse and keyboard.

2 Press the power button located on the front panel of the signal generator.

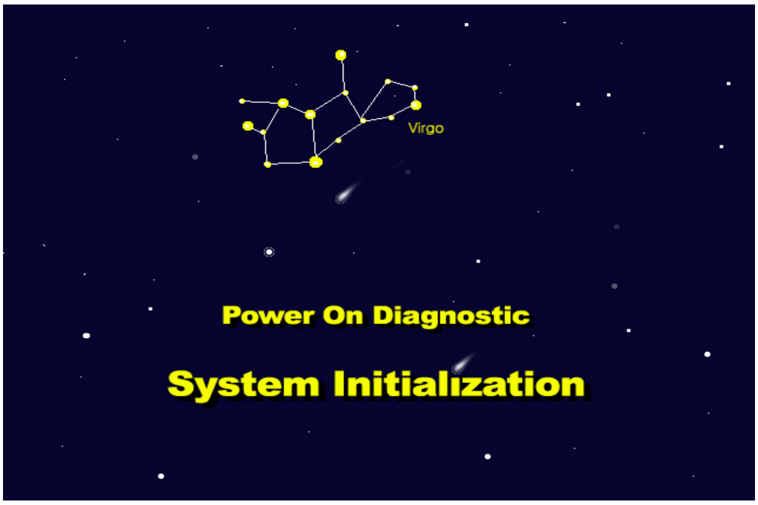


Fig. 8-1 Recover Pro *initial screen*

3 If Fig. 8-1 appears in the display window, press [ESC] and press F4 several times.

4 When the booting sequence display appears, select *Hard Disk*.

5 A display about *Phoenix Always* should appear.

If the Windows booting display appears instead, press the power button to put the instrument into the stand-by state and repeat steps 3 and 4.

6 From the Always menu (Fig. 8-2), select *Protect / Recover*.

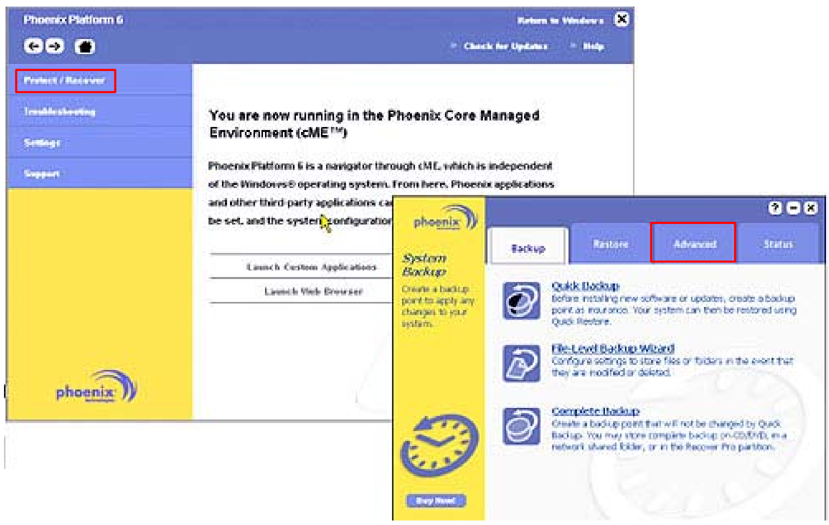


Fig. 8-2 Phoenix Always *screen*

7 Select the *Phoenix Recover Pro 6* menu.

8 Select the *Advanced* tab.

9 Select *Factory Restore*.

10 If a caution appears about system restarting, press *OK*.

11 When the system reboots, operate the *Phoenix Recover Pro* program.

12 Select *Recover Boot Partition*.

13 If there is a request for confirmation, select *Yes*.

14 After completing the system restoration, start Windows.

Virus elimination

We provide our customers with a vaccine program for virus detection and elimination.

- Vaccine program: *Kaspersky® Antivirus 6.0* (included on CD)
- Vaccine activation code: included in packing.

Note: a license is supplied with the instrument, if bought through Aeroflex or one of its agents. This license is valid for 1 year. If you want to extend the period, visit the web site (http://usa.kaspersky.com/).

Kaspersky® antivirus installation

To install the Antivirus 6 vaccine program, carry out the following steps.

1 Connect a mouse and keyboard.

2 Insert the CD.

3 Double click the file (*D:\Util\kav6.0.0.303en.msi*).

4 Install using the following figures:

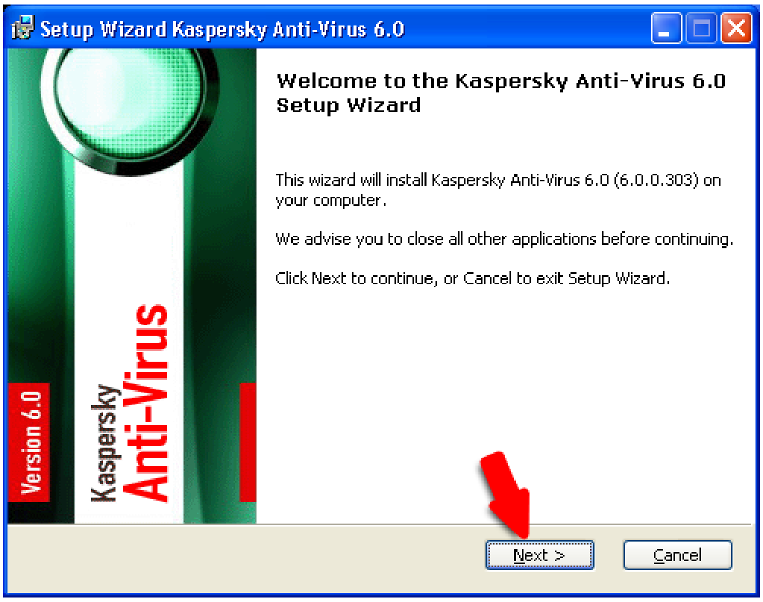


Fig. 8-3 Setup message

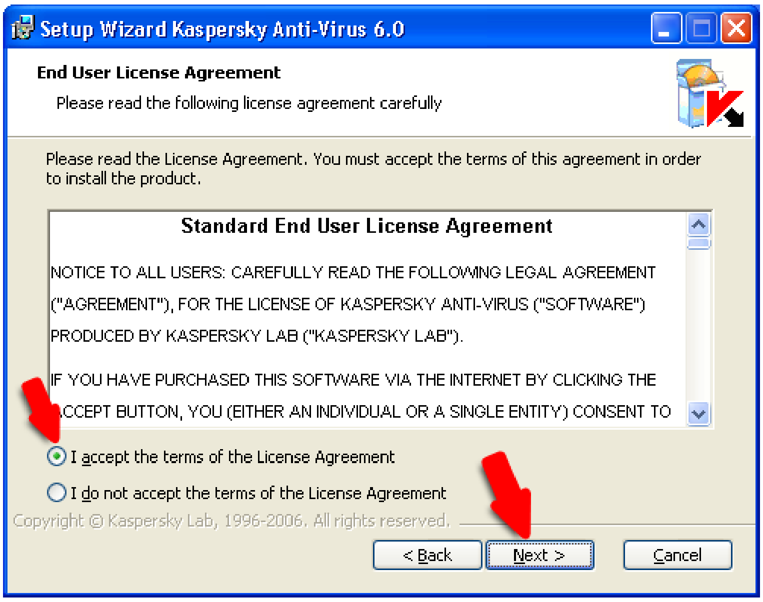


Fig. 8-4 License agreement

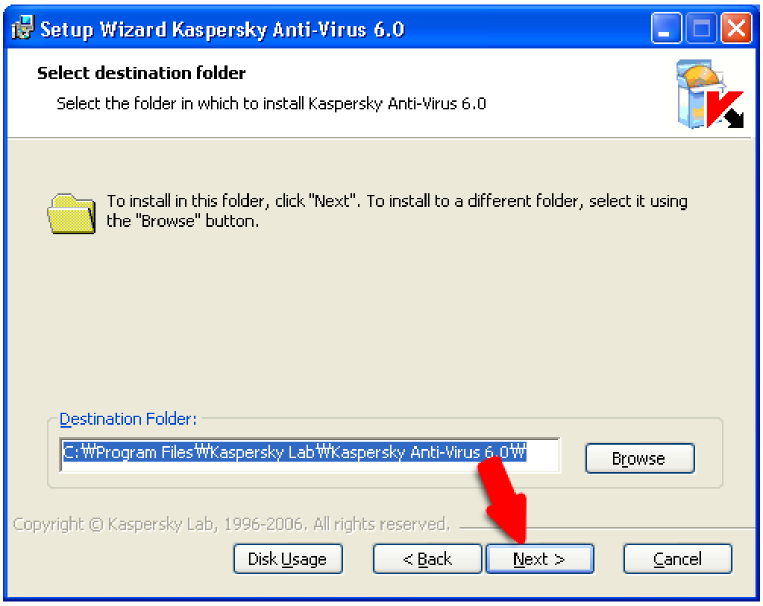


Fig. 8-5 Select destination folder

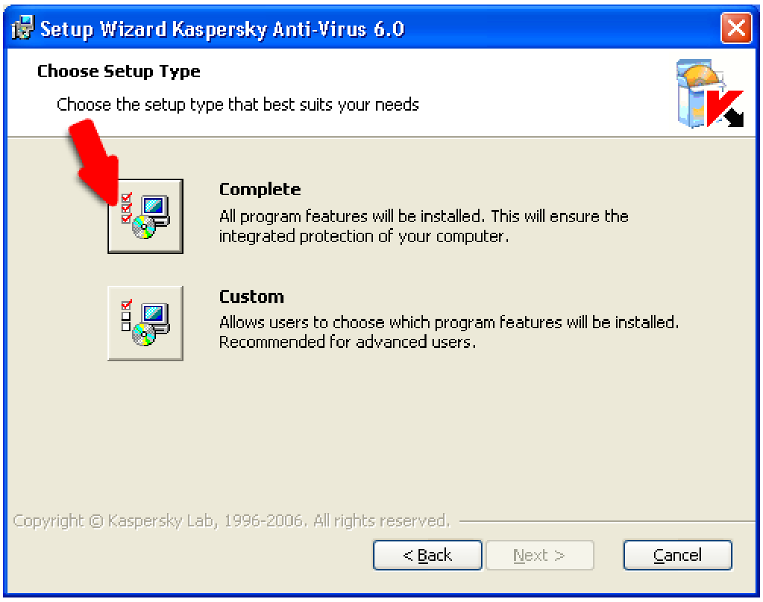


Fig. 8-6 Choose setup type

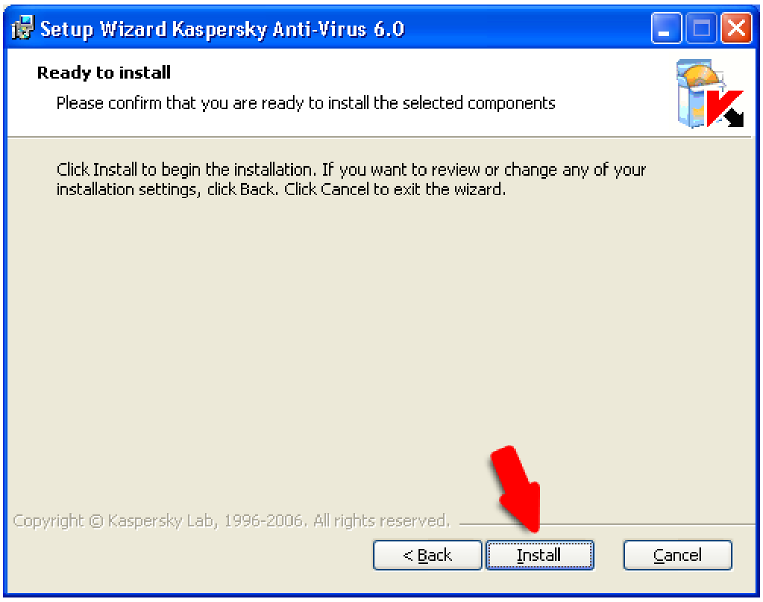


Fig. 8-7 Install

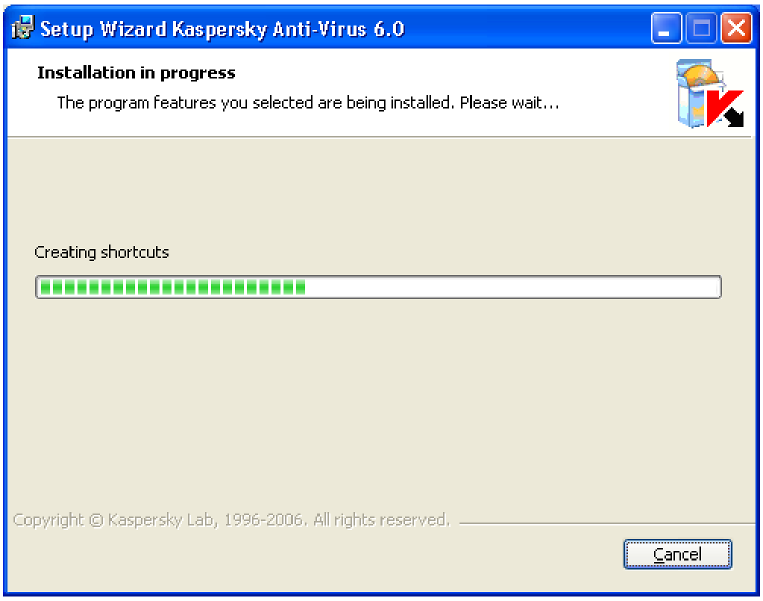


Fig. 8-8 Installation in progress

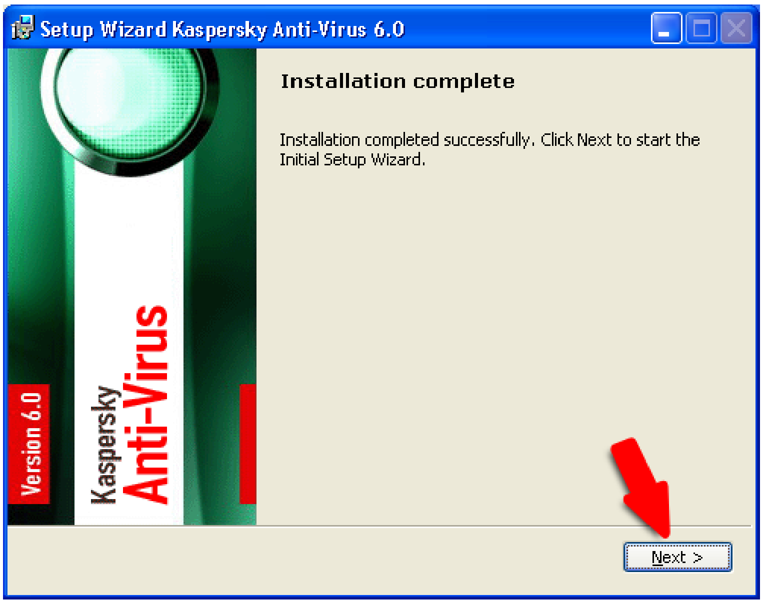


Fig. 8-9 Installation complete

5 Refer to *How to Activate Kaspersky Lab Product* to activate.

Appendix A
WLAN OPTION

Contents

General

This option enables you to perform OFDM and DSSS power, spectrum and modulation measurements in accordance with WLAN standards ‘IEEE 802.11a, b PMD 1999’ and ‘IEEE 802.11g PMD 2003’.

You can make the following measurements:

- Transmit Power
- Transmit Spectrum Mask
- Power versus Time
- Spectral Flatness (802.11a / 802.11g only)
- Modulation Accuracy (Constellation, EVM)
- Power Statistics CCDF
- Spectrum (Freq Domain)
- ACP (802.11b only)
- Numerical result: System type, Data rate, Frequency error, Modulation type, Chip clock error (802.11b), Number of PSDU Bits/Symbol, Carrier Leakage, EVM RMS, EVM Data (802.11a),, EVM Pilot (802.11a), EVM Peak (802.11b), Symbol Clock Error.

Specifications

This wide-band RF Digitizer module is optimized for complex signal analysis applications in communications system test.

Frequency

Frequency range 330 MHz to 3 GHz

Bandwidth 36 MHz

Resolution 1 Hz

Level

Input coupling AC Coupling

Input power Max RF input +16 dBm continuous, +22 dBm with 8 dB of RF input attenuation)

RF input attenuator 0 to 28 dB in 4 dB steps

IF input attenuator 0 to 35 dB in 1 dB steps

RF input return loss 16 dB with 8 dB or more RF attenuation

Level accuracy (RF input, 23°C ±5°C, Auto Flatness Mode enabled) Better than ±0.45 dB, typically 0.3 dB, valid for signals with <5 MHz occupied bandwidth at the tuned frequency and S/N ratio >40 dB

Level temperature stability ±/-0.01 dB/°C

Level repeatability Better than ±0.05 dB after warm-up following a return from a change in frequency or level. Valid for at least 2 hours and excluding temperature influence.

Spectral purity (SSB phase noise)

The table shows phase noise values at 2 GHz and at ambient room temperature.

Loop Bandwidth (Offset)	Narrow (dBc/Hz)	Wide (normal) (dBc/Hz)
100 Hz	−55	−85
1 kHz	−85	−103
10 kHz	−114	−103
20 kHz	−116	−110
100 kHz	−133	−130
1 MHz	−136	−136
10 MHz	−138	−138

Linearity and noise

Intermodulation Typically 75 dB intermodulation-free dynamic range (2 tone input with maximum 0 dBm input power for each tone), Manual mode

Adjacent channel leakage ratio (ACLR) 63 dB ACLR on 3GPP (downlink test model 1). Typically 68 dB ACLR on 3GPP uplink.

Spurious Typically −75 dBc excluding IF image frequencies and harmonic responses

Residual responses (no signal input) −100 dBm with RF input terminated into 50 ohms and minimum RF and IF attenuation

Noise spectral density (no signal input) RF input terminated in 50 ohms and minimum RF and IF attenuation. Below 1 GHz, <−145 dBm/Hz; 1 GHz and above, <−140 dBm/Hz.

IF output

Frequency — Center 77.76 MHz

Level — Typically −3 dB relative to RF input (0 dB input attenuation selected)

Bandwidth — Typically >100 MHz (−3 dB)

A/D conversion

Resolution — 14 bits

ADC clock — Fixed 103.68 MHz

Sample rate control — IF103.68 MHz, IQ Variable 6328.125 s/s to 85 Ms/s

Sample rate accuracy — 0.1 μHz

Amplitude flatness (correction on) — Flatness correction on 0.25 dB to 33 MHz, 0.1 dB across center 5 MHz

Phase flatness (typical with correction on) — 0.03 radians pk-pk to 33 MHz

Data output — A sample data block (equal to the data capture length) can be stored in the memory internal to the 3030 and then transferred to the controller via the PCI bus. Sample data can be continuously streamed out of the LVDS connector. IF data samples have 16 bit resolution. IQ data samples can be 16 or 32 bit resolution.

Data transfer rate — Typically 10 Mwords/s (a word is 32 bits long), IQ and IF block data transfer, when using 2.2 GHz embedded CPU running Windows XP

Sample memory — 128 X 16 bit samples

Triggering

Trigger mode — Single, Repeat

Trigger type — Edge, Gated, NONE (software triggered)

Hardware trigger sources — Internal (IF, derived from IQ data with user defined level control), External (LVDS, LBL, Trig Bus, Star Trigger, TTL)

Trigger polarity — +ve or −ve (Edge trigger) Gate High, Gate Low (Gated trigger)

Trigger functions — Pre-trigger 0 to sample length

Delayed trigger −10 to + 2 G samples — Trigger latency 0 to 1 sample at the output sample rate

Installing WLAN measurement personality

To license your WLAN measurement personality us the following procedure.

***Note**: when you add a new option, or update an existing option, you will get the updated version of all your current options because they are reloaded simultaneously. This process may also require you to update the signal analyzer program so that it is compatible with the new option.*

If your analyzer came with the WLAN measurement licensed, you can skip the licensing.

You must keep a copy of your license key number in a secure location. If you lose your license key number, call your nearest service or sales office for assistance.

If you bought the digitizer with this option, it must be sent to manufacturer. All hardware and software installations will be completed by manufacturer and the instrument returned to you.

1 Connect keyboard and mouse to the PS2 ports or the USB ports.

2 Turn on the instrument. Wait until the instrument completes its power-up sequence.

3 Press [System], *[Option Info.]*, *[Option Activate]*.

4 Select *WLAN* field in the license active dialog window.

***Note: a**ll purchased options must be selected.*

5 Enter the letters/digits of your 32-character license code using the mouse or the keyboard. The license key number is a hexadecimal number.

6 Press *[Activate]*.

7 If licensing completes successfully then the *Activation Success* dialog window displays. If *Invalid License!* is displayed, enter the correct license code again.

8 Press *OK* or press any keypad, then exit from the license menu.

Measurement guide

This section provides a guide to making measurements of WLAN signals. Using the procedures specified in this section, you can get WLAN signal analysis results in the spectrum, code and modulation domains.

In the case of 802.11a signals, additional hardware is required to cover its 5 GHz signal band range.

Preparation for measurement

Before connecting a signal to the instrument, make sure the instrument can safely accept the signal level provided. The maximum RF input level is +16 dBm. If the RF input attenuator level is set to 8 dB, the input level can be increased to +22 dBm. Connect a 10 MHz reference input to synchronize the analyzer with a signal source. Get triggered data from the DUT and signal source from the external trigger input. Fig. A-1 shows the instrument set up for testing a WLAN device.

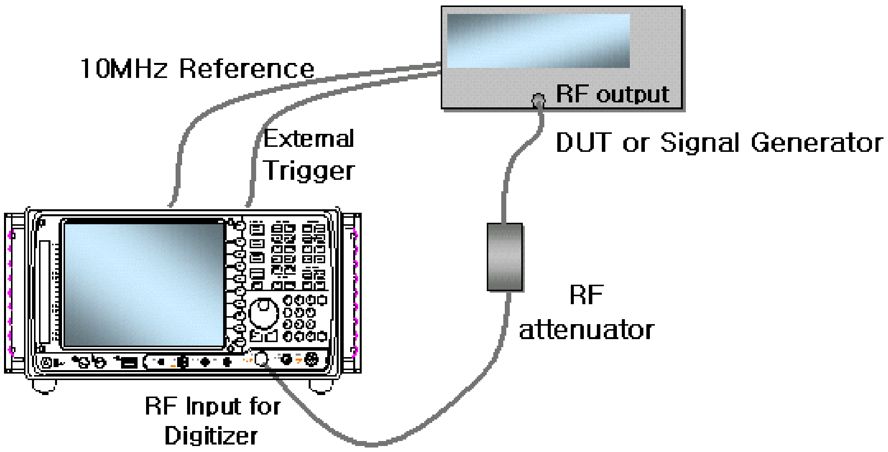


Fig. A-1 Experimental set-up for WLAN device

General steps in making a measurement

All measurements performed in 'WLAN options' can be performed with the following steps.

Select the measurement option

Press [Mode]. All of the installed and licensed options become available and are shown.

Press *[WLAN]* or *[Basic]*. Analyze the signal in WLAN standard format or in non-standard format (see the Basic mode).

Press [Mode] [Setup]. Select the standard from WLAN standards 802.11a, 802.11b and 802.11g.

Set RF attenuator and IF attenuator level by using RF input level

Press [AMPL], select *[RF Input Lev]*, and adjust attenuator value by referring to the following rules. The table below shows example settings of the attenuator.

- The RF attenuator step size is 4 dB and the range is 0 to 28 dB
- The IF attenuator step size is 1 dB and the range is 0 to 35 dB
- RF input level (set by user) − (RF attenuator value + IF attenuator value) = −13 dB

RF input level	RF att value	IF att value	RF input – (RF att + IF att)
22	24	11	–13
21	24	10	–13
20	24	9	–13
19	24	8	–13
18	20	11	–13
17	20	10	–13
16	20	9	–13
15	20	8	–13

Select measurement to be performed

Press [MEASURE]. There are various measurement menus related to WLAN standards, from which you can select specific measurements to be performed. When the trigger conditions are satisfied, digitized WLAN signals are acquired and analyzed instantly.

Press [MEASURE] [Control]. Set up the specific parameters which relate to selected WLAN measurement items.

Analyze displayed analysis results

Depending on what measurement is selected, you can adjust the results display using the [Trace], [Display] menu. Set the scale of the X and Y axe using SPAN and [AMPL].

802.11b measurement guide

802.11b operates at 2.4 GHz and uses DSSS techniques to spread the energy in a single carrier over a wider spectrum. Two coding schemes are used by 802.11b to spread the spectrum of a single carrier. Complementary code keying (CCK) is mandatory, while packet binary convolutional coding (PBCC) is optional. CCK is used to increase the 802.11b peak data rate to 11 Mbps using QPSK modulation. PBCC makes use of forward error correction to improve the link performance when noise is the limitation.

802.11b allows 1 Mbps, 2 Mbps, 5.5 Mbps and 11 Mbps operation using various modulation schemes. The 1 Mbps and 2 Mbps rates use DBPSK and DQPSK modulation schemes. For 5.5 Mbps and 11 Mpbs operation, CCK modulation is used.

Fig. A-2 shows the 802.11b signal format, which includes High Rate PLCP preamble, the High Rate PLCP header, and the PSDU. The PLCP preamble contains the following fields: synchronization (Sync) and start frame delimiter (SFD). The PLCP header contains the following fields: signaling (SIGNAL), service (SERVICE), length (LENGTH), and CCITT CRC-16.

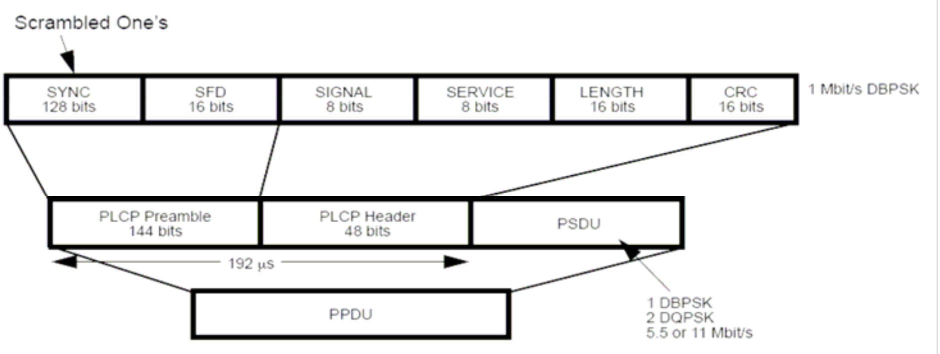


Fig. A-2 PPDU data format in 802.11b standard

Spectral mask

Purpose of test

This test ensures that the DUT does not influence other WLAN devices transmitting in adjacent channels. This may result in a bad, or even no, connection.

The 802.11b standard does not define a transmitter filter, but it does require that a transmit spectrum mask be passed. So the design of the output filter is up to the manufacturer, but they must conform with the spectrum mask.

Test procedure

From the steps below you can measure the Spectral Mask of an 802.11b WLAN signal.

1 Confirm the input signal level is below the maximum allowed input level (+16 dBm with no RF input attenuator).

2 Set the following parameter to measure Spectral Mask in *[WLAN]* mode.

Press [Mode] and select *[WLAN]* mode.

Press [Mode] [Setup] and select *[802.11b std]*.

Press [MEASURE] and select Spectral Mask.

Press [MEASURE] [Control] and set the *[Capture Time]*.

3 Set the following parameter in *[WLAN]* mode to adjust the input signal.

Press [FREQ] and select *[Center]*. Set the center frequency to the same value as the RF input frequency.

Press [AMPL] and select *[Ref.Level]*. Set the Reference level to the maximum expected RF level.

By using the [SPAN] and [Marker] functions, you can adjust the waveform so that it can be analyzed effectively.

Test result

The Spectral Mask measurement allows for IEEE standard-based pass/fail measurements, as specified by the IEEE 802.11b PMD 1999 standard.

The transmit spectrum mask is shown below in Fig. A-3. As depicted in this figure, the transmitted spectral products shall be less than –30 dBr (dB relative to the SINx/x peak) for:

$$f_c - 22MHz < f < f_c - 11MHz; \quad \textit{and} \quad f_c + 11MHz < f < f_c + 22MHz;$$

and shall be less than –50 dBr for:

$$f < f_c - 22MHz; \quad \textit{and} \quad f > f_c + 22MHz$$

where f_c is the channel center frequency.

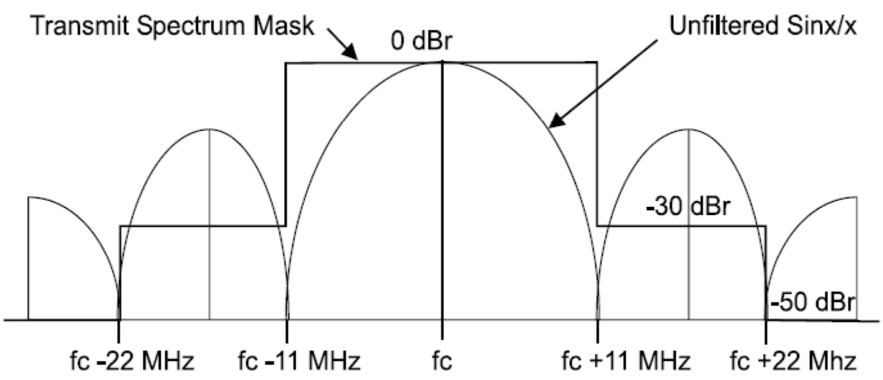


Fig. A-3 Transmit spectrum mask

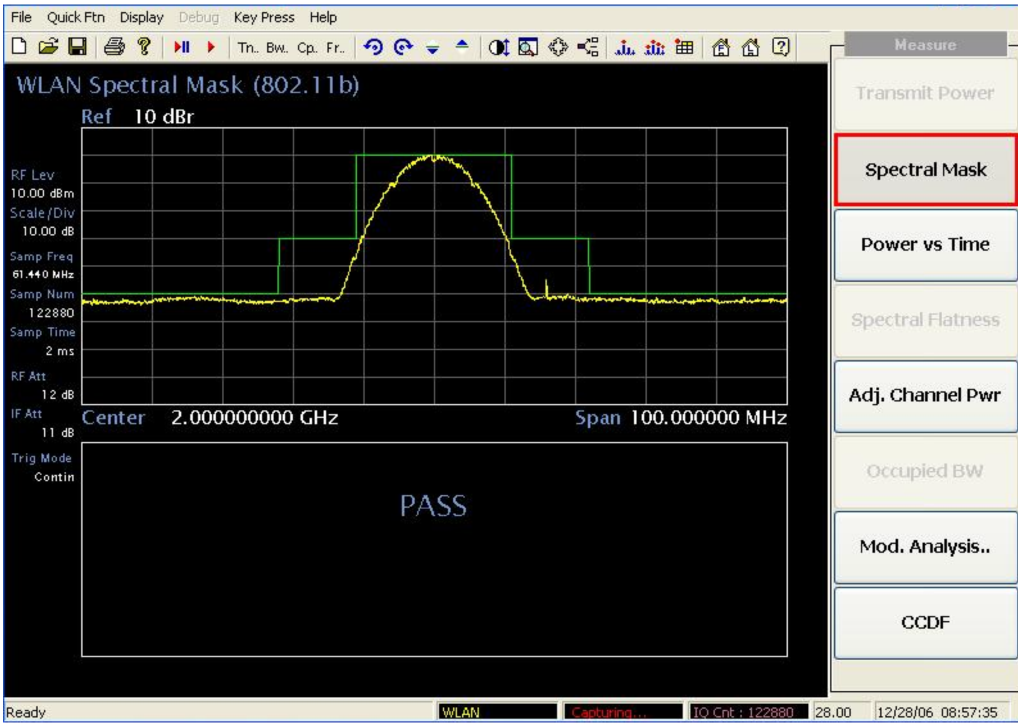


Fig. A-4 Result of measuring transmit power for 802.11b signal

Power versus time

Test purpose

The power versus time measurement is used to test power-on and power-down transition for 802.11b. To prevent the interference caused by bursting the RF carrier, the associated standard specifies a power versus time regulation to which a device must conform. This regulation defines the burst length, the rising and falling edges, the masks for regions of power on and power off.

Test procedure

From the steps below you can measure the power versus time of an 802.11b WLAN signal. This measurement include ‘burst length’, rising and falling time (in µs units).

1. Confirm the input signal level is below the maximum allowed input level (+16 dBm with no RF input attenuator)
2. Set the following parameters to measure Transmit Power in *[WLAN]* mode:

   Press [Mode] and select *[[WLAN]]* mode.

   Press [Mode] [Setup] and select *[[802.11b std]]*.

   Press [MEASURE] and select *[Power vs Time]*.

   Press [MEASURE] [Control] and set the *[Capture Time]*.
3. Capture at least one burst of data to analyze the signal accordingly.
4. Set the following parameters in *[WLAN]* mode to adjust analysis.

   Press [FREQ] and select *[Center]*. Set the center frequency to the same value as the RF input frequency.

   Press [AMPL] and select *[Ref. Level]*. Set the Reference level to maximum expected RF level.

Test results

This measurement indicates whether the timing of the transmission of the 802.11b/g signal is consistent with the WLAN 802.11b/g standard. The transmit power-on ramp for 10% to 90% of maximum power shall be no greater than 2 µs as specified in the 802.11b/g standard. The transmit power-down ramp for 90% to 10% maximum power shall be no greater than 2 µs. Transmit power-up and power-down ramps are shown in Fig. A-5 and Fig. A-6.

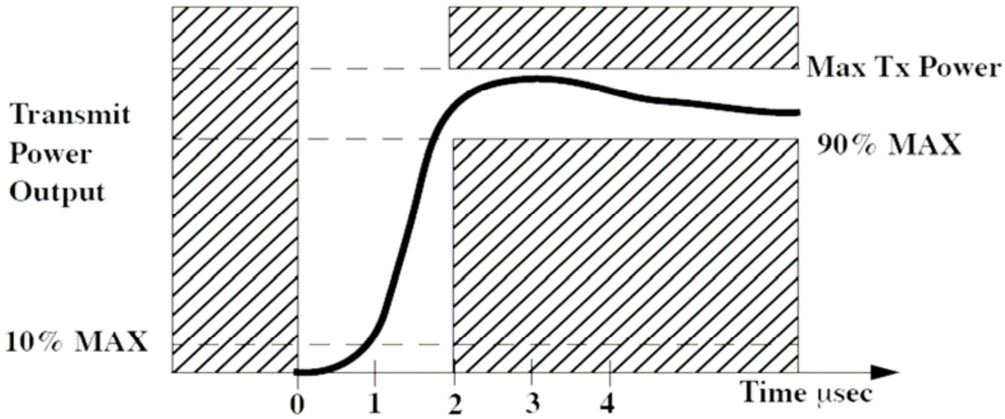


Fig. A-5 Transmit power-on ramp

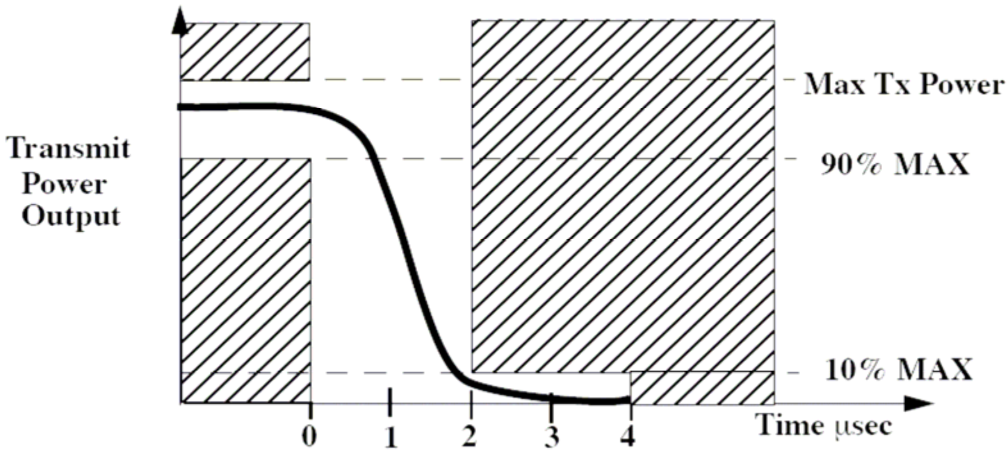


Fig. A-6 Transmit power-down ramp

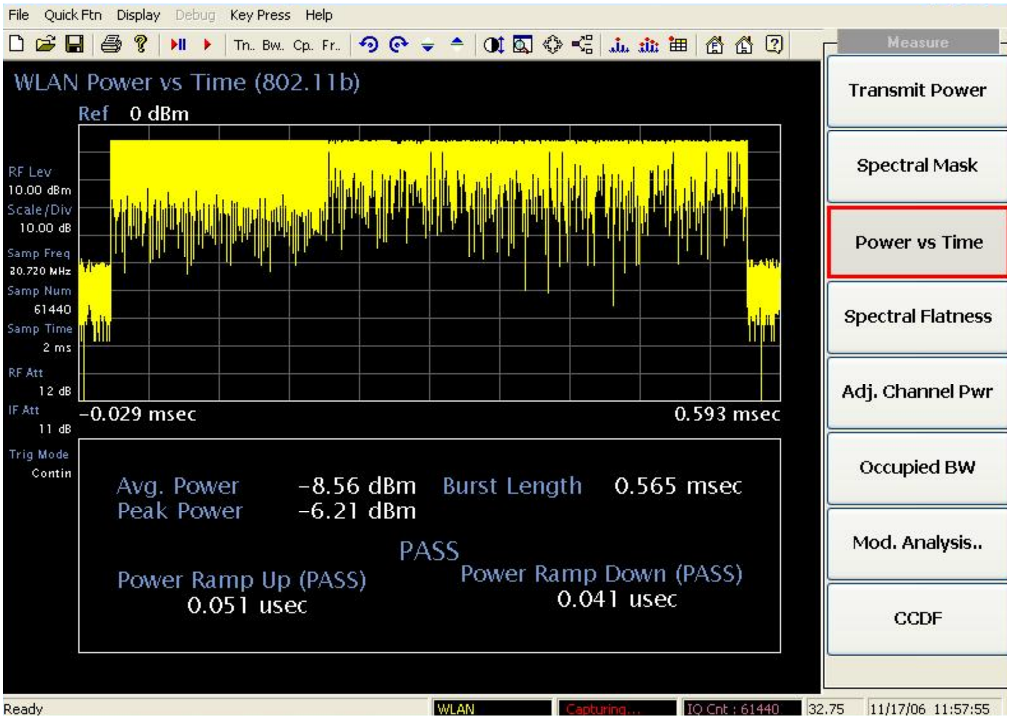


Fig. 2-6 Result of measuring power vs time for 802.11b signal

Adjacent channel power

Test purpose

Systems that use CDMA multiple access techniques use ACP (Adjacent Power Ratio) for the linearity test for power amps. ACP is defined as a ratio of main channel power level versus leakage power level generated by its own signal; that is, when a specific channel signal goes on, how much disturbing signal is generated by non-linearity of the power amp. The ACP in this WLAN option measures the power ratio based on the IEEE 802.11b Std.-1999 spectral mask definition. Fig. 2-7 shows the measurement definition.

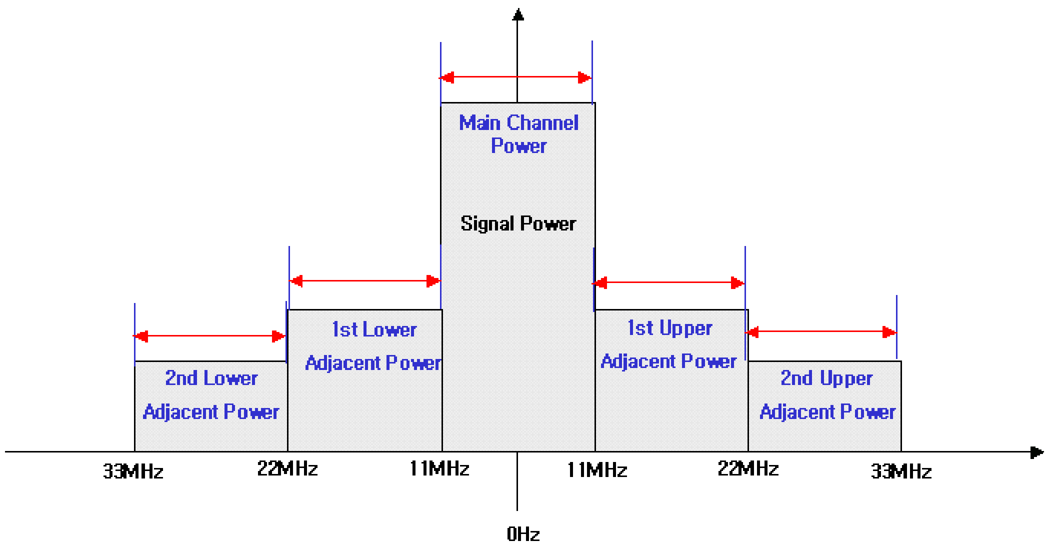


Fig. 2-7 Measurement definition of ACP for 802.11b signals

Test procedure

The steps below allow you to measure the ACP of an 802.11b WLAN signal.

1 Confirm the input signal level is below the maximum allowed input level (+16 dBm with no RF input attenuator).

2 Set the following parameters to measure ACP in *[WLAN]* mode:

Press [Mode] and select *[WLAN]* mode.

Press [Mode] [Setup] and select *[802.11b std]*.

Press [MEASURE] and select *[ACP]*.

Press [MEASURE] [Control] and set the *[Capture Time]*.

3 Set the following parameters in *[WLAN]* mode to adjust analysis:

Press [FREQ] and select *[Center]*. Set the center frequency to the same value as the RF input frequency.

Press [AMPL] and select *[Ref.Level]*. Set the Reference level to the maximum expected RF level.

Test results

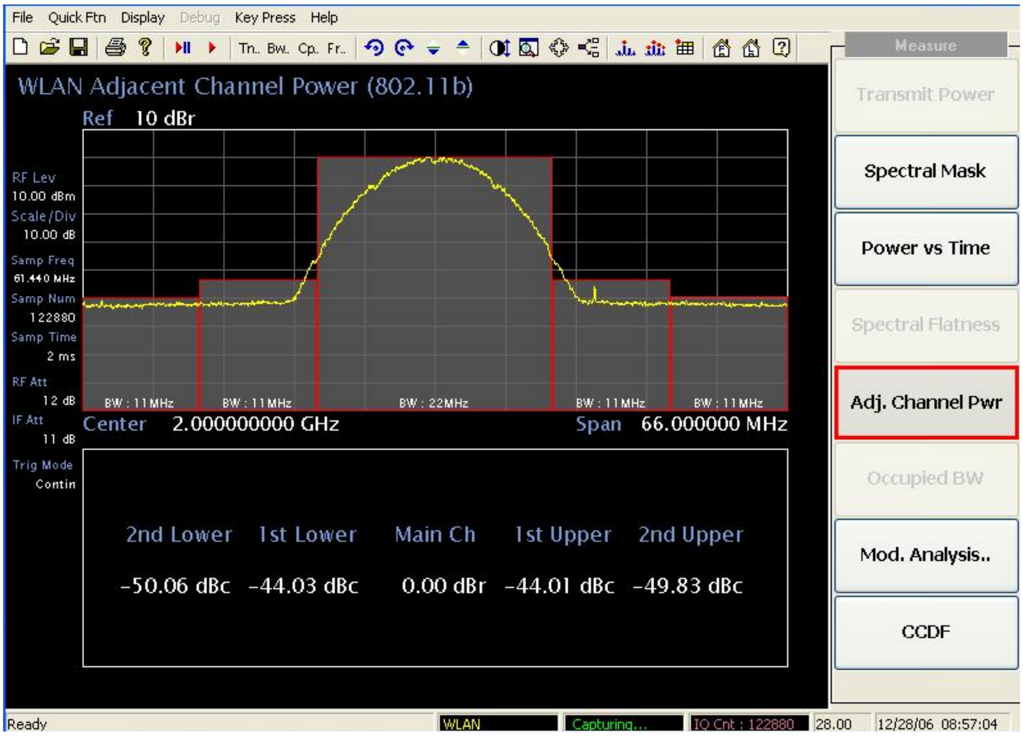


Fig. A-7 Result of measuring ACP for 802.11b signal

CCDF (Complementary Cumulative Distribution Function)

Test purpose

Many of the digitally modulated signals now look noise-like in the time and frequency domain. This means that statistical measurements of the signals can be a useful characterization. Power Complementary Cumulative Distribution Function (CCDF) curves characterize the higher-level power statistics of a digitally modulated signal. The curves can be useful in determining design parameters for digital communications systems.

Test procedure

The steps below allow you to measure the CCDF of an 802.11b WLAN signal.

1 Confirm the input signal level is below the maximum allowed input level (+16 dBm with no RF input attenuator)

2 Set the following parameters to measure CCDF in *[WLAN]* mode:

Press [Mode] and select *[WLAN]* mode.

Press [Mode] [Setup] and select *[802.11b std]*.

Press [MEASURE] and select *[CCDF]*.

Press [MEASURE] [Control] and set the *[Capture Time]*.

3 Set the following parameters in *[WLAN]* mode to adjust analysis:

Press [FREQ] and select *[Center]*. Set the center frequency to the same value as the RF input frequency.

Press [AMPL] and select *[Ref.Level]*. Set the Reference level to the maximum expected RF level.

Test results

Power Complementary Cumulative Distribution Function (CCDF) curves characterize the higher-level power statistics of a digitally modulated signal. The results are displayed graphically as well as in the metrics window, as shown in Fig. A-8.

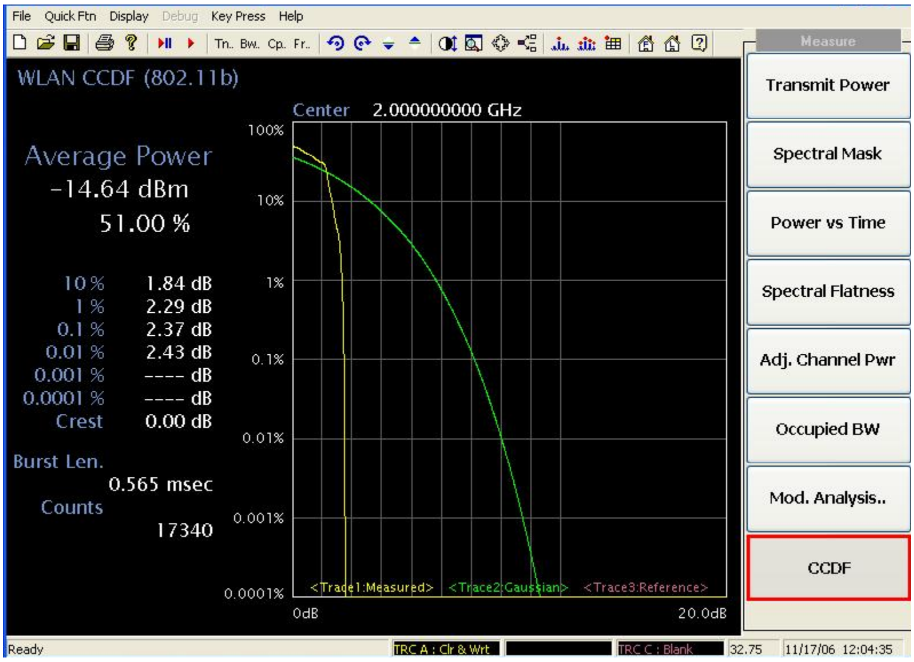


Fig. A-8 Result of measuring CCDF for 802.11b signal

Modulation analysis

Constellation

Test purpose

WLAN signals use the following modulation formats from the IEEE 802.11a,b,g standard. This constellation menu shows the modulation format and modulation quality graphically.

Table A-1 List of modulation formats for WLAN signals

WLAN standard	Carrier type	Modulation format
802.11a	OFDM	BPSK
		QPSK
		16 QAM
		64 QAM
802.11b	DSSS	DSSS(DPBSK) 1 Mbps
		DSSS(DQPSK) 2 Mbps
		CCK 5.5 Mbps
		CCK 11 Mbps
		PBCC 5 Mbps
		PBCC 11 Mbps
802.11g	DSSS	DSSS(DPBSK) 1 Mbps
		DSSS(DQPSK) 2 Mbps
		CCK 5.5 Mbps
		CCK 11 Mbps
		PBCC 5 Mbps
		PBCC 11 Mbps
		PBCC 22 Mbps, PBCC 33 Mbps
	OFDM	BPSK
		QPSK
		16 QAM
		64 QAM

Test procedure

The steps below allow you to measure the constellation of WLAN signals.

1 Confirm the input signal level is below maximum allowed input level (+16dBm with no RF input attenuator)

2 Set the following parameters to measure constellation in *[WLAN]* mode.

Press [Mode] and select *[WLAN]* mode.

Press [Mode] [Setup] and select *[802.11b std]*.

Press [MEASURE], select *[Mod.Analysis..]* and then select *[Constellation]*.

Press [MEASURE], [Control] and set the *[Capture Time]*. The required capture time to analyze a WLAN signal differs with the modulation type.

3 Set the following parameters in *[WLAN]* mode to adjust analysis:

Press [FREQ] of the front panel and select *[Center]*. Set the center frequency to the same value as the RF input frequency.

Press [AMPL] and select *[Ref.Level]*. Set the Reference level to the maximum expected RF level.

Test results

Fig. A-9 displays the constellation diagram of a WLAN 802.11b signal (with 11 Mbps CCK). The left side displays the numerical results related to modulation accuracy.

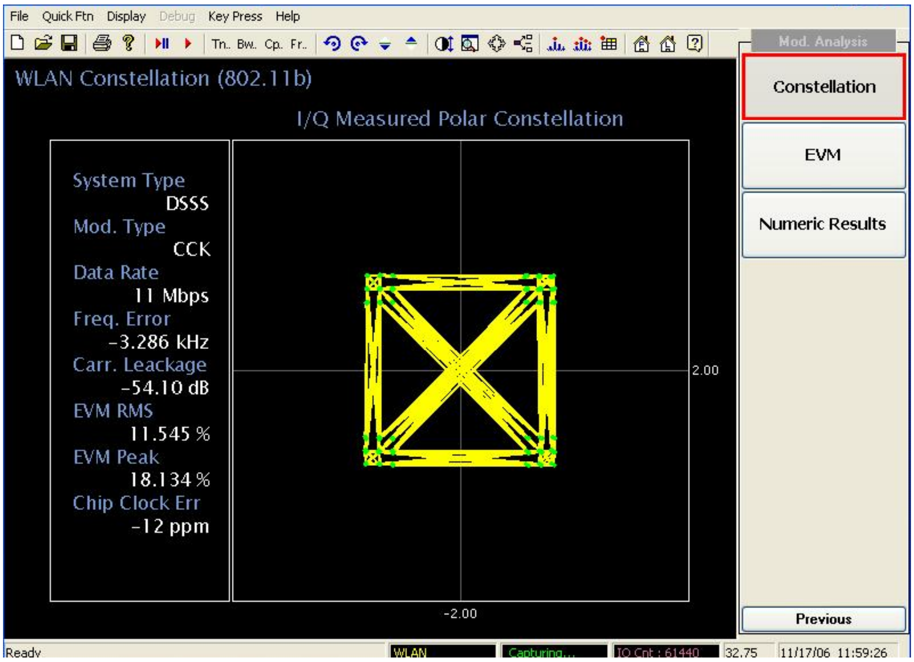


Fig. A-9 Result of measuring constellation for 802.11b signal

EVM (Error Vector Magnitude)

Test purpose

Error Vector Magnitude (EVM) is a very common modulation quality metric widely used in digital communication systems. EVM is the scalar distance between the measured signal and the time-aligned reference signal. In most standards, EVM is defined as the root-mean-square of error values at the symbol decision positions. Fig. A-10 describes the physical meaning of EVM in a digital communications system.

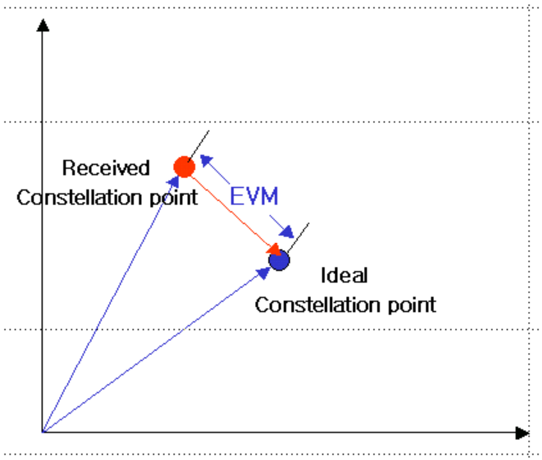


Fig. A-10 EVM description for general digitally modulated signal

Test procedure

The steps below allow you to measure the EVM of an 802.11b WLAN signal.

1 Confirm the input signal level is below the maximum allowed input level (+16 dBm with no RF input attenuator).

2 Set the following parameters to measure EVM in *[WLAN]* mode:

Press [Mode] and select *[WLAN]* mode.

Press [Mode], [Setup] and select *[802.11b std]*.

Press [MEASURE], select *[Mod.Analysis..]* and then select EVM.

Press [MEASURE], [Control] and set the *[Capture Time]*.

3 Set the following parameters in *[WLAN]* mode to adjust analysis:

Press [FREQ] and select *[Center]*. Set the center frequency to the same value as the RF input frequency.

Press [AMPL] and select *[Ref.Level]*. Set the Reference level to the maximum expected RF level.

Test results

Fig. A-11 displays the results of *EVM vs chip*, *Constellation diagram* and *Numerical result*. *Numerical results* shows the result of modulation accuracy.

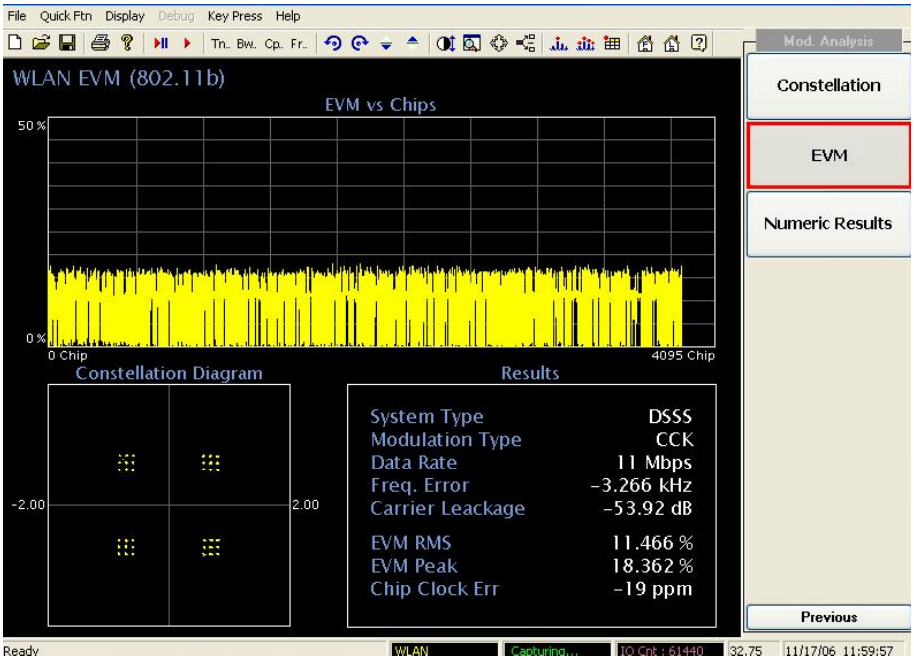


Fig. A-11 Result of measuring EVM vs Chips for 802.11b signal

Numerical results

Test purpose

By analyzing an 802.11b burst signal you can get various numerical results. The following list shows the analysis results.

System type: signal which adopts the 802.11b standard and uses the DSSS (Direct Sequence Spread Spectrum) spreading technique.

Modulation type: depending on the data transfer rate of the signal, the modulation type of the WLAN signal changes.

Data rate: data rate has a subordinate relationship to modulation type.

Frequency error: the transmit carrier frequency error should be within ± 25 ppm maximum relative to the center frequency. This is equivalent to a maximum error of 71.2 kHz for the highest assigned 802.11b transmission frequency (2.848 GHz).

Number of PSDU Bits/Symbols: Fig. A-12 shows the format for the PPDU(Long and Short), including the High Rate PLCP preamble, the High Rate PLCP header, and the PSDU. The number of PSDU bits differs with the modulation method and is defined in the *SIGNAL* field.

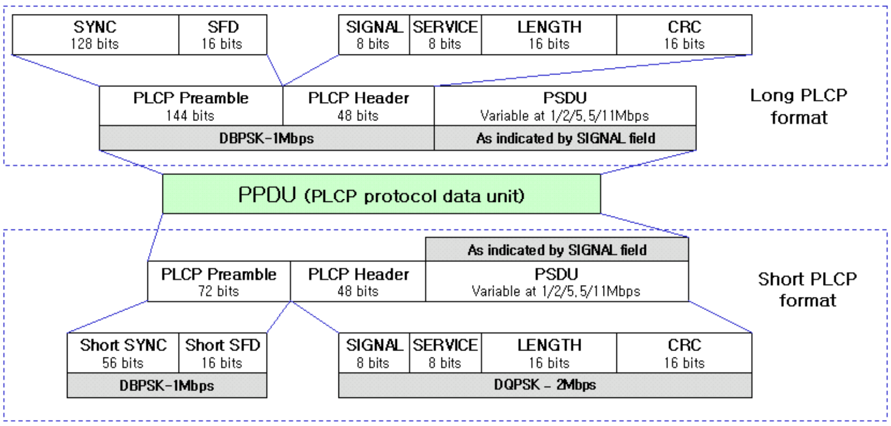


Fig. A-12 802.11b packet format

Carrier leakage: the average signal power with modulation vs average signal power without modulation (units of dB). This result derives from the modulation process and uses the gated spectrum method.

EVM RMS/Peak: shows the numerical result of EVM RMS/Peak value (scaled to a percentage).

Chip clock error: the PN code chip clock frequency error must be better than ±25 ppm maximum. This is equivalent to a maximum error of 275 Hz for the highest-assigned 802.11b symbol clock frequency (11 MHz). It is highly recommended that the chip clock and the transmit frequency be locked (coupled) for optimum demodulation performance.

Test procedure

The steps below allow you to measure the numerical results of an 802.11b WLAN signal.

1 Confirm the input signal level is below the maximum allowed input level (+16 dBm with no RF input attenuator).

2 Set the following parameters to measure numerical results in *[WLAN]* mode:

Press [Mode] and select *[WLAN]* mode.

Press [Mode], [Setup] and select *[802.11b std]*.

Press [MEASURE], select *[Mod.Analysis..]* and then select *[Numerical Results]*.

Press [MEASURE], [Control] and set the *[Capture Time]*.

3 Set the following parameter in *[WLAN]* mode to adjust analysis:

Press [FREQ] and select *[Center]*. Set the center frequency to the same value with RF input frequency.

Press [AMPL] and select *[Ref.Level]*. Set the Reference level to the maximum expected RF level.

Test results

Fig. A-13 shows the modulation analysis results of an 802.11b signal. From these numerical results, the modulation quality of the signal can be investigated at a glance.

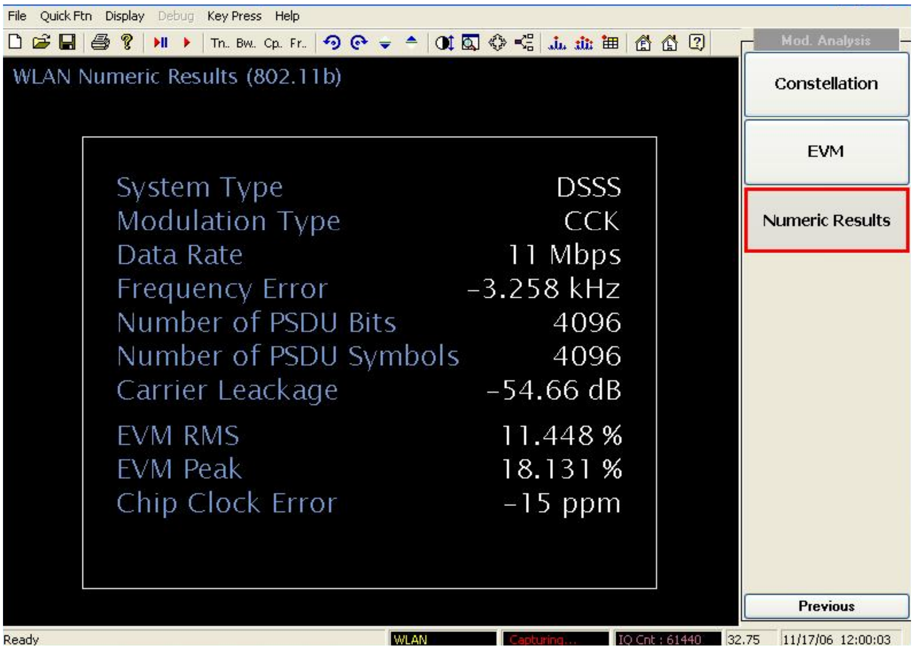


Fig. A-13 Result of measuring numerical results for 802.11b signal

802.11a measurement guide

802.11a operates in the 5 GHz band and uses OFDM as its transmission scheme. The 802.11a offers 6, 12 and 24 Mbps and optionally 9, 18, 36, 48 and 54 Mbps bit-rates. The OFDM physical layer uses 52 sub-carriers with 0.3125 MHz spacing, of which 48 are used to carry data and four are used as pilots. The occupied bandwidth is 16.6 MHz. Forward error correction coding (convolutional coding) is used with a coding rate of 1/2, 2/3, or 3/4. The modulation of the individual carriers in the OFDM depends on the data rates. For 6 and 9 Mbps, BPSK is used, 12 and 18 Mbps operation uses QPSK, 24 and 36 Mbps operation uses 16 QAM, and 48 and 54 Mbps operation uses 64 QAM.

The OFDM system uses a fixed modulation formats for its preamble. Varying data rates are achieved by changing the modulation for the data transmission portion of a packet. The modulation format changes during the data transmission. Simpler modulation formats (such as BPSK) are often used in the early part of the burst, which contains important information such as frequency and burst length, because these formats are less prone to bit errors.

The figure below shows the format for the PPDU including the OFDM PLCP preamble, OFDM PLCP header, PSDU, tail bits, and pad bits. The PLCP header contains the following fields: LENGTH, RATE, a reserved bit, an even parity bit, and the SERVICE field. In terms of modulation, the LENGTH, RATE, reserved bit, and parity bit (with 6 ‘zero’ tail bits appended) constitute a separate single OFDM symbol, denoted SIGNAL, which is transmitted with the most robust combination of BPSK modulation and a coding rate of R = 1/2. The SERVICE field of the PLCP header and the PSDU (with 6 ‘zero’ tail bits and pad bits appended), denoted as DATA, are transmitted at the data rate described in the RATE field and may constitute multiple OFDM symbols. The tail bits in the SIGNAL symbol enable decoding of the RATE and LENGTH fields immediately after the reception of the tail bits. The RATE and LENGTH are required for decoding the DATA part of the packet. In addition, the CCA mechanism can be augmented by predicting the duration of the packet from the contents of the RATE and LENGTH fields, even if the station does not support the data rate.

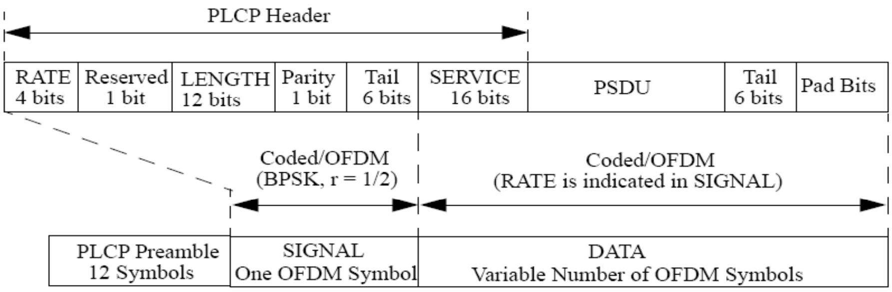


Fig. A-14 Data format in 802.11a Std.

Spectral mask

Test purpose

This test ensures that the DUT does not influence other WLAN devices transmitting in adjacent channels. Interference may result in bad or even no connection. The 802.11a standard does not define a transmitter filter, but only a transmit spectrum mask to be passed. Therefore, the design of the individual output filter is up to the manufacturer of the DUT. The design must be appropriate to ensure a pass of the spectrum mask and good performance in transmission.

Test procedure

The steps below allow you to can measure the spectral mask of an 802.11a WLAN signal.

Confirm the input signal level is below the maximum allowed input level (+16 dBm with no RF input attenuator).

1 Set the following parameters to measure spectral mask in *[WLAN]* mode:

Press [Mode] and select *[WLAN]* mode.

Press [Mode], [Setup] and select *[802.11a std]*.

Press [MEASURE] and select *[Spectral Mask]*.

Press [MEASURE], [Control] and set the *[Capture Time]*.

2 Set the following parameters in *[WLAN]* mode to adjust the input signal:

Press [FREQ] and select *[Center]*. Set the center frequency to the same value as the RF input frequency.

Press [AMPL] and select *[Ref.Level]*. Set the Reference level to the maximum expected RF level.

By using the [SPAN] and [Marker] functions you can adjust the signal so that it can be analyzed effectively.

Test results

The Spectral Mask measurement allows for IEEE standard-based pass/fail measurements, as specified by the IEEE 802.11a PMD 1999 standard.

The transmitted spectrum must have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth not exceeding 18 MHz, –20 dBr at 11 MHz frequency offset, –28 dBr at 20 MHz frequency offset and –40 dBr at 30 MHz frequency offset and above. The transmitted spectral density of the transmitted signal must fall within the spectral mask, as shown in Fig. A-15. The measurement must be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth.

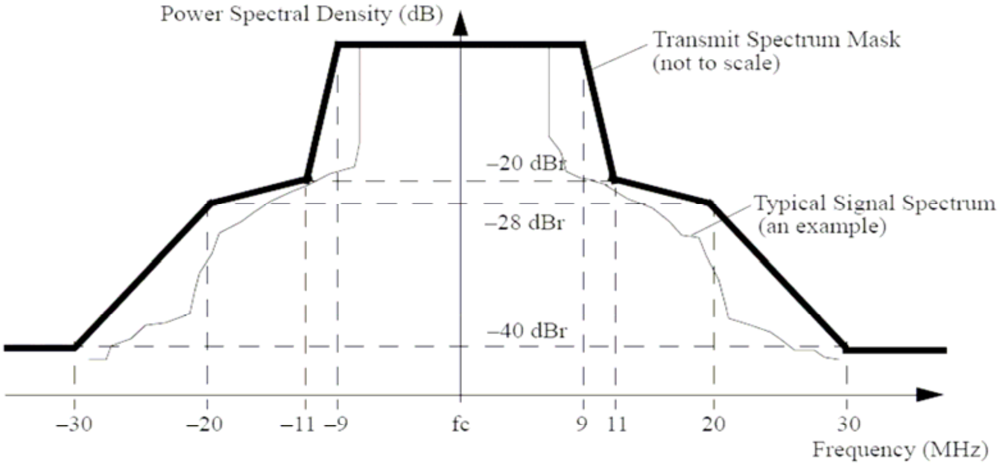


Fig. A-15 Transmit spectral mask of 802.11a signal

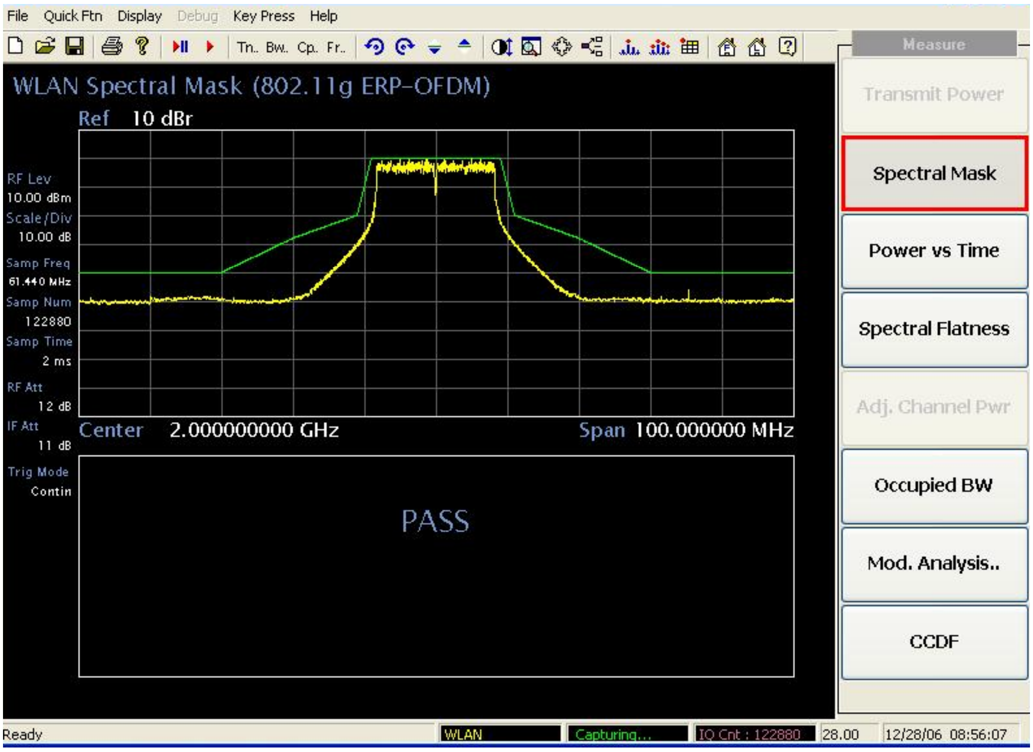


Fig. A-16 Result of measuring spectral mask for 802.11a signal

Power versus time

Test purpose

To find the burst characteristic of an 802.11a signal, it is necessary to investigate the signal's power in the time domain.

Test procedure

The steps below allow you to measure the power vs time of a WLAN 802.11a signal.

1 Confirm the input signal level is below the maximum allowed input level (+16 dBm with no RF input attenuator).

2 Set the following parameters to measure transmit power in *[WLAN]* mode:

Press [Mode] and select *[WLAN]* mode.

Press [Mode], [Setup] and select *[802.11a std]*.

Press [MEASURE] and select *[Power vs Time]*.

Press [MEASURE], [Control] and set the *[Capture Time]*.

Capture at least one burst data to analyze the signal accordingly.

3 Set the following parameter in *[WLAN]* mode to adjust analysis:

Press [FREQ] and select *[Center]*. Set the center frequency to the same value as the RF input frequency.

Test results

Fig. A-17 shows the results of a signal power analysis in the time domain. From this function you can see the average power, peak power and burst length.

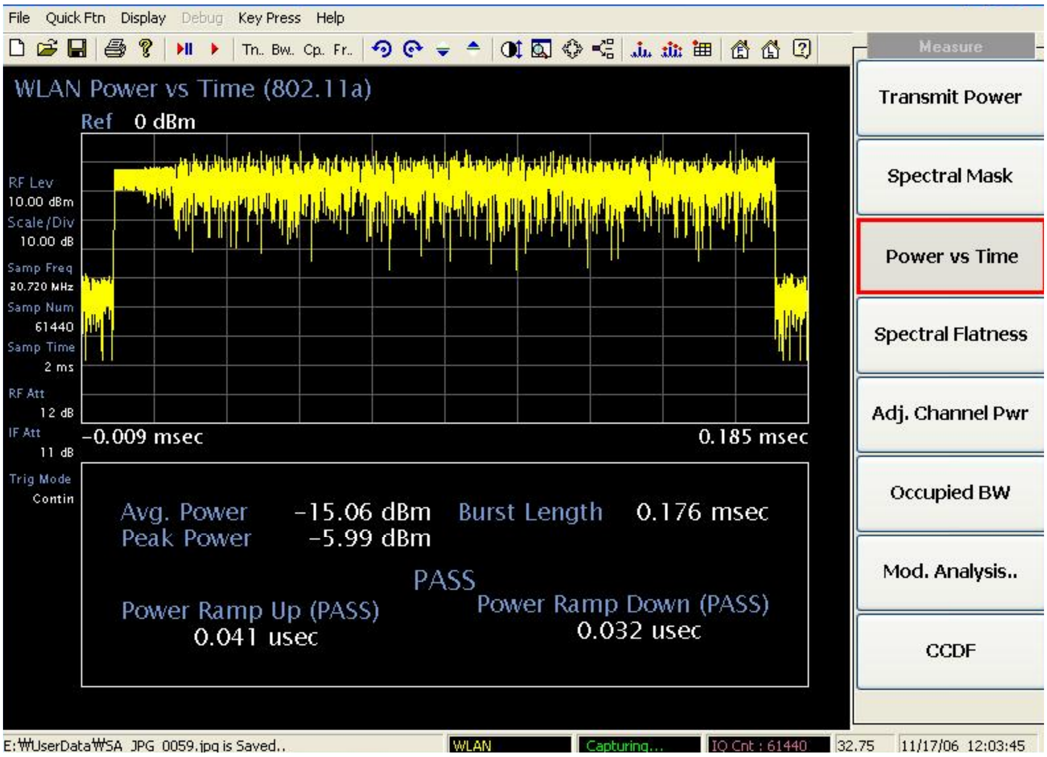


Fig. A-17 Result of measuring power vs time for 802.11a signal

Spectral flatness

Test purpose

Variation in carrier flatness of OFDM signals in IEEE 802.11a/g reduce demodulation margins and degrade link performance. This measurement applies to test carrier flatness of OFDM signals in IEEE 802.11a/g.

Test procedure

The steps below allow you to measure the spectral flatness of a WLAN signal (802.11a/g).

1 Confirm the input signal level is below the maximum allowed input level (+16 dBm with no RF input attenuator).

2 Set the following parameters to measure transmit power in *[WLAN]* mode:

Press [Mode] and select *[WLAN]* mode.

Press [Mode], [Setup] and select *[802.11a std]*.

Press [MEASURE] and select *[Spectral Flatness]*.

Press [MEASURE], [Control] and set the *[Capture Time]*.

Capture at least one burst data to analyze the signal accordingly.

3 Set the following parameters in *[WLAN]* mode to adjust analysis:

Press [FREQ] and select *[Center]*. Set the center frequency to the same value as RF input frequency.

Press [AMPL] and select *[Ref.Level]*. Set the Reference level to the maximum expected RF level.

Test results

The spectrum flatness measurement measures energy flatness of sub-carriers in OFDM system. The average energy of the constellations in each of the spectral lines –16… –1 and +1… +16 will deviate no more than ± 2 dB from their average energy. The average energy of the constellations in each of the spectral lines –26… –17 and +17… +26 will deviate no more than +2/–4 dB from the average energy of spectral lines –16… –1 and +1… +16. The average energy can be computed by averaging energy on the sub-carriers from –16 to 16. Zero sub-carrier is not included in this computation phase.

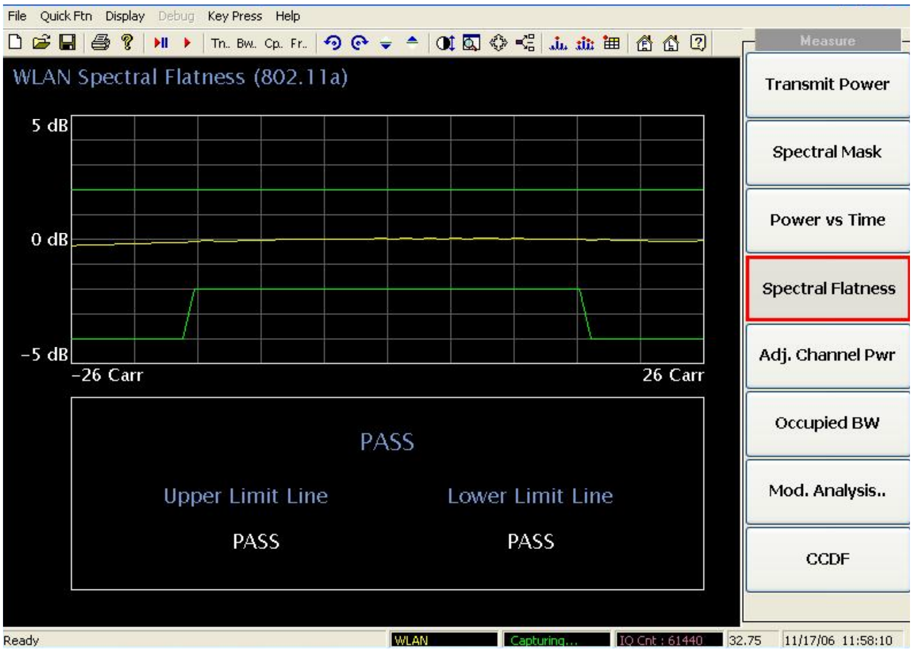


Fig. A-18 Result of measuring spectral flatness for 802.11a signal

Occupied bandwidth

Test purpose

This test ensures that the transmitter filter is well designed, and the clock of the DUT is working properly. If the clock rate is too high, this may result in a wide occupied bandwidth (OBW) and malfunction of the DUT.

Test procedure

The steps below allow you to measure the occupied bandwidth of an 802.11a WLAN signal.

1 Confirm the input signal level is below the maximum allowed input level (+16 dBm with no RF input attenuator).

2 Set the following parameter to measure occupied bandwidth in *[WLAN]* mode:

Press [Mode] and select *[WLAN]* mode.

Press [Mode], [Setup] and select *[802.11a std]*.

Press [MEASURE] and select *[Occupied BW]*.

Press [MEASURE], [Control] and set the *[Capture Time]*.

3 Set the following parameters in *[WLAN]* mode to adjust analysis:

Press [FREQ] and select *[Center]*. Set the center frequency to the same value as the RF input frequency.

Press [AMPL] and select *[Ref.Level]*. Set the Reference level to the maximum expected RF level.

Test results

Fig. A-19 shows the result of measuring occupied bandwidth for an 802.11a signal. This is the bandwidth occupied by 99% of the total power in a 34 MHz band where the signal resides.

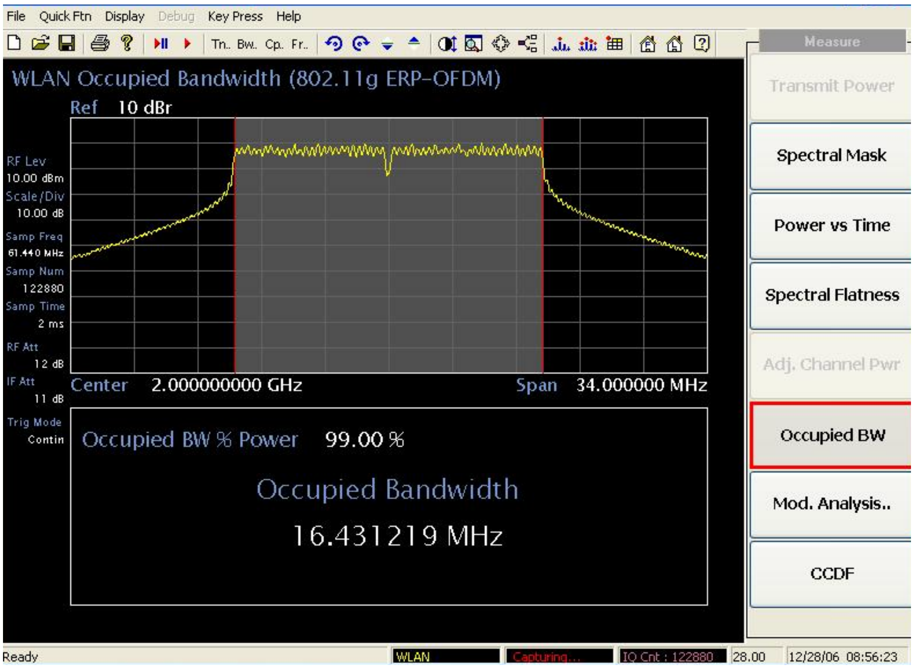


Fig. A-19 Result of measuring occupied BW for 802.11a signal

CCDF (Complementary Cumulative Distribution Function)

Test purpose

Many of the digitally modulated signals now look noise-like in the time and frequency domain. This means that statistical measurements of the signals can be a useful characterization. Power Complementary Cumulative Distribution Function (CCDF) curves characterize the higher-level power statistics of a digitally modulated signal. The curves can be useful in determining design parameters for digital communication systems.

Test procedure

The steps below allow you to measure the CCDF of an 802.11a WLAN signal.

1 Confirm the input signal level is below the maximum allowed input level (+16 dBm with no RF input attenuator).

2 Set the following parameters to measure CCDF in *[WLAN]* mode:

Press [Mode] and select *[WLAN]* mode.

Press [Mode], [Setup] and select *[802.11a std]*.

Press [MEASURE] and select *[CCDF]*.

Press [MEASURE], [Control] and set the *[Capture Time]*.

3 Set the following parameters in *[WLAN]* mode to adjust analysis:

Press [FREQ] and select *[Center]*. Set the center frequency to the same value as the RF input frequency.

Press [AMPL] and select *[Ref.Level]*. Set the Reference level to the maximum expected RF level.

Test results

The Power Complementary Cumulative Distribution Function (CCDF) curve characterizes the higher-level power statistics of a digitally modulated signal. The results are displayed graphically as well as in the metrics window, as shown in Fig. A-20.

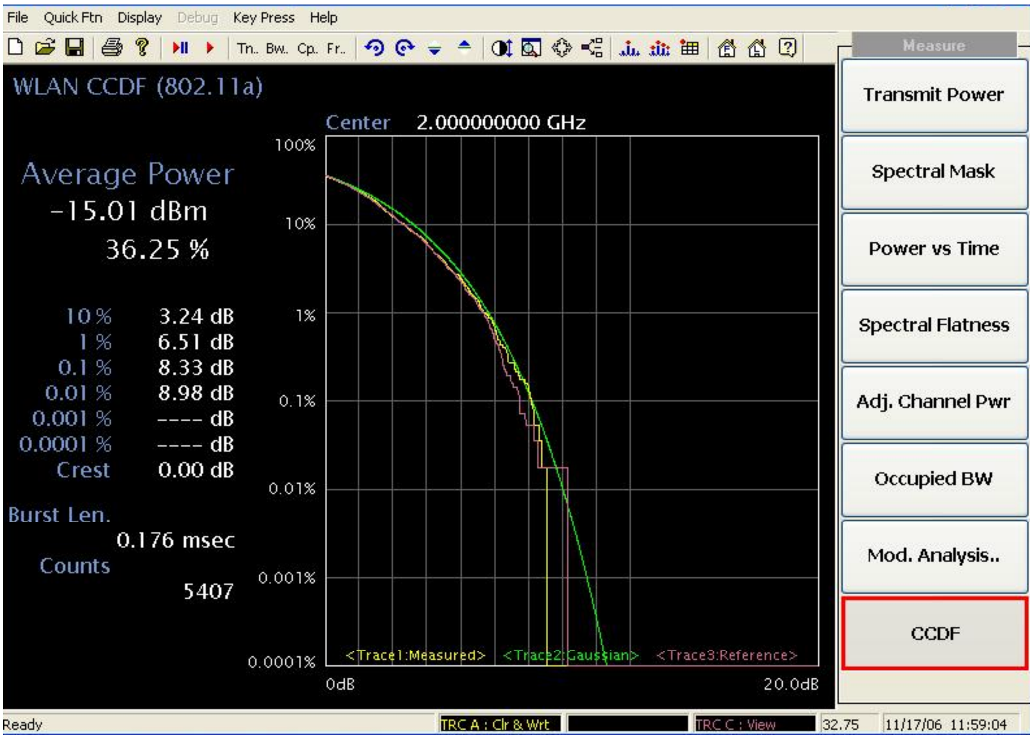


Fig. A-20 Result of measuring CCDF for 802.11a signal

Modulation analysis

Constellation

Test purpose

This constellation menu displays the modulation format and modulation quality graphically (refer to Table A-1).

Test procedure

The steps below allow you to measure the constellation of an 802.11a WLAN signal.

1 Confirm the input signal level is below the maximum allowed input level (+16 dBm with no RF input attenuator).

2 Set the following parameters to measure constellation in *[WLAN]* mode:

Press [Mode] and select *[WLAN]* mode.

Press [Mode], [Setup] and select *[802.11a std]*.

Press [MEASURE], *[Mod.Analysis..]* and then select *[Constellation]*.

Press [MEASURE], [Control] and set the *[Capture Time]*.

The required *[Capture Time]* to analyze WLAN signals differs with modulation type.

3 Set the following parameters in *[WLAN]* mode to adjust analysis:

Press [FREQ] and select *[Center]*. Set the center frequency to the same value as the RF input frequency.

Press [AMPL] and select *[Ref.Level]*. Set the Reference level to the maximum expected RF level.

Test result

Fig. A-21 displays the constellation diagram of a WLAN 802.11a signal (with 54 Mbps and 64 QAM). The left side displays the numerical results related to modulation accuracy.

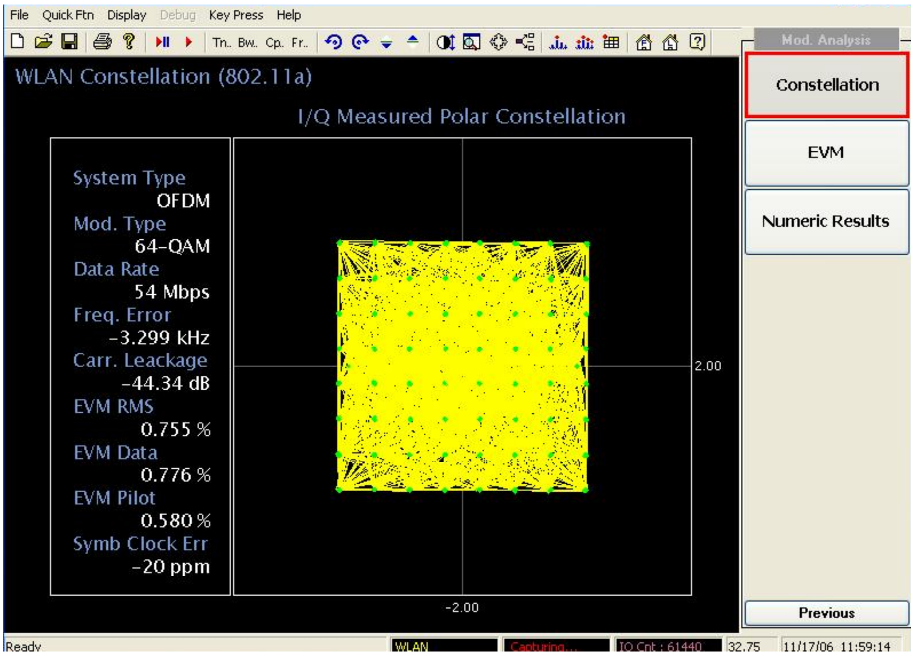


Fig. A-21 Result of measuring constellation for 802.11a signal

EVM (Error Vector Magnitude)

Test purpose

Error Vector Magnitude (EVM) is a very common modulation quality metric widely used in digital communication systems. EVM is the scalar distance between the measured signal and the time-aligned reference signal. In most standards, EVM is defined as the root-mean-square of error values at the symbol decision positions.

Test procedure

The steps below allow you to measure the EVM of a WLAN signal.

1 Confirm the input signal level is below the maximum allowed input level (+16 dBm with no RF input attenuator).

2 Set the following parameters to measure EVM in *[WLAN]* mode.

Press [Mode] and select *[WLAN]* mode.

Press [Mode], [Setup] and select *[802.11a std]*.

Press [MEASURE], *[Mod.Analysis..]* and then select *[EVM]*.

Press [MEASURE], [Control] and set the *[Capture Time]*.

3 Set the following parameter in *[WLAN]* mode to adjust analysis:

Press [FREQ] and select *[Center]*. Set the center frequency to the same value as the RF input frequency.

Press [AMPL] and select *[Ref.Level]*. Set the Reference level to the maximum expected RF level.

Test results

Fig. A-22 displays the results of ‘EVM vs Symbols & Sub-carriers’, ‘Constellation diagram’ and ‘Numerical result’. The ‘Numerical results’ shows the test results that relate to modulation accuracy.

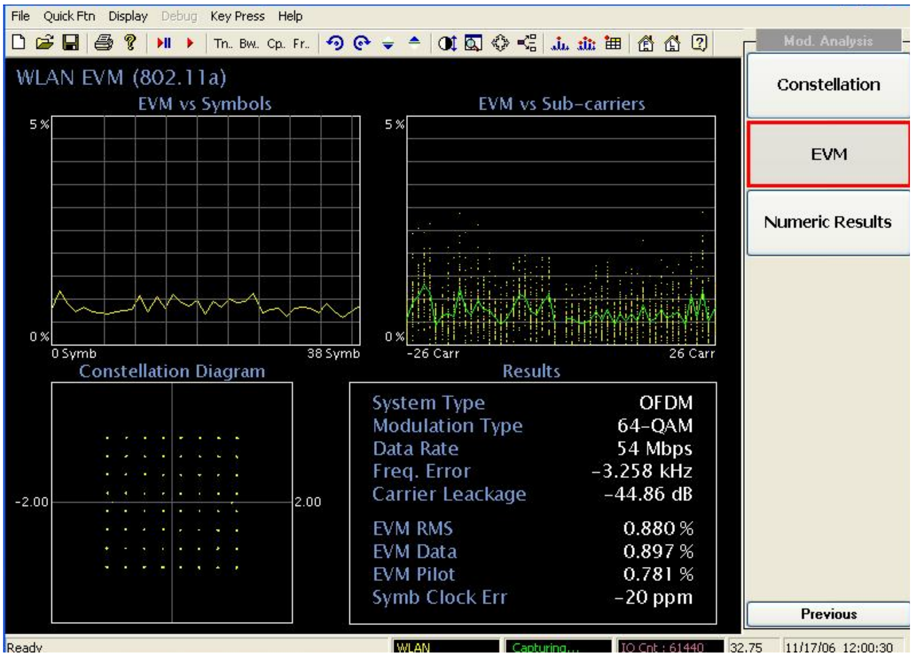


Fig. A-22 Result of measuring EVM vs Symbols & Sub-carrier for 802.11a signal

Numerical results

Test purpose

By analyzing an 802.11a burst signal you can get various numerical results. The following list shows the analysis results.

System type: signal which adopts the 802.11a standard and uses the OFDM (Orthogonal Frequency Division Multiplexing) technique for its signal transmission.

Modulation type: depending on the data transfer rate of signal, the modulation type of WLAN (802.11a standard) signal changes.

Data rate: data rate has a subordinate relationship to modulation type. In the case of 802.11a, the data rate changes from 6 Mbps to 54 Mbps.

Frequency error: the transmitted center frequency tolerance must be ± 20 ppm maximum. The transmit center frequency and the symbol clock frequency are derived from the same reference oscillator. This is equivalent to a maximum error of +/-100 kHz for the 802.11a carrier frequency of 5 GHz.

Number of PSDU Bits/Symbols: Fig. A-23 describes the signal frame structure of an 802.11a signal. The number of PSDUs varies with the data rate and is specified in SIGNAL field.

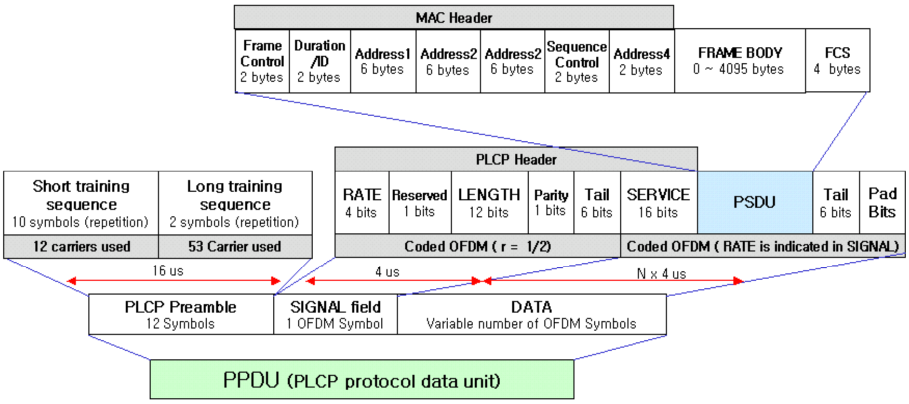


Fig. A-23 Data format of 802.11a signal

Table A-2 Rate-dependent parameters

Data rate (Mbits/s)	Modulation	Coding rate (R)	Coded bits per subcarrier (N_{BPSC})	Coded bits per OFDM symbol (N_{CBPS})	Data bits per OFDM symbol (N_{DBPS})
6	BPSK	1/2	1	48	24
9	BPSK	3/4	1	48	36
12	QPSK	1/2	2	96	48
18	QPSK	3/4	2	96	72
24	16-QAM	1/2	4	192	96
36	16-QAM	3/4	4	192	144
48	64-QAM	2/3	6	288	192
54	64-QAM	3/4	6	288	216

Carrier leakage: an OFDM system is more sensitive to phase noise compared to other communication techniques. The phase noise is an additional modulation that modifies the sin(x)/x spectrum, reducing the depth of the nulls, and creating interference to other carriers. This interference causes the carrier leakage.

EVM RMS, **EVM Data**, **EVM Pilot**: show the numerical results of EVM RMS , EVM Data and EVM Pilot (scaled to percentage).

Symbol clock error: the symbol clock frequency tolerance must be ± 20 ppm maximum. The transmit center frequency and the symbol clock frequency are derived from the same reference oscillator. This is equivalent to a maximum error of +/-5 Hz for the 802.11a clock frequency of 250 kHz (4 µs).

Test procedure

The steps below allow you to view numerical results of a WLAN signal.

1 Confirm the input signal level is below the maximum allowed input level (+16 dBm with no RF input attenuator).

2 Set the following parameters to measure numerical results in *[WLAN]* mode:

Press [Mode] and select *[WLAN]* mode.

Press [Mode], [Setup] and select *[802.11a std]*.

Press [MEASURE], *[Mod.Analysis..]* and then select *[Numerical Results]*.

Press [MEASURE], [Control] and set the *[Capture Time]*.

3 Set the following parameters in *[WLAN]* mode to adjust analysis:

Press [FREQ] and select *[Center]*. Set the center frequency to the same value as the RF input frequency.

Press [AMPL] and select *[Ref.Level]*. Set the Reference level to the maximum expected RF level.

Test results

Fig. A-24 shows the modulation analysis results of an 802.11a signal. From these numerical results, the modulation quality of the signal can be investigated at a glance.

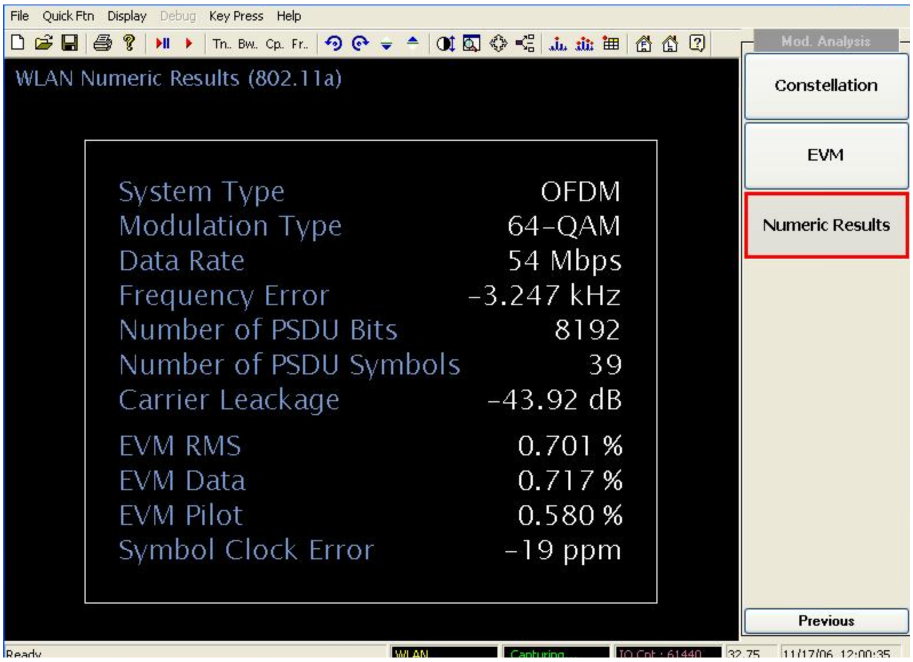


Fig. A-24 Result of measuring numerical results for 802.11a signal

802.11g measurement guide

IEEE 802.11g is an extension of the 802.11b standard, so the 802.11g system can interoperate with the 802.11b system. The 802.11g standard adds 802.11a OFDM transmission modes to the 802.11b standard. This provides the 802.11a throughput improvement in the 2.4 GHz band. In addition to the 802.11a OFDM modes, 802.11g also defines optional modes of increased throughput PBCC utilizing 8 PSK, and an optional CCK-OFDM mode, which combines the 802.11b preamble with an OFDM packet.

In addition to the data rates that 802.11b supports, 802.11g also allows various data rates using various modulation schemes, such as 11 Mbps using PBCC-11, 22 Mbps using PBCC-22 or CCK-PBCC, 33 Mbps operation using PBCC-33, respectively. For 54 Mpbs operation, CCK-OFDM modulation is used.

In a similar manner to 802.11a, 802.11g OFDM modes map data symbols using BPSK and QPSK for lower data rates and QAM for faster bit rates.

Table A-3 shows the list of supported parts among the 802.11g standard.

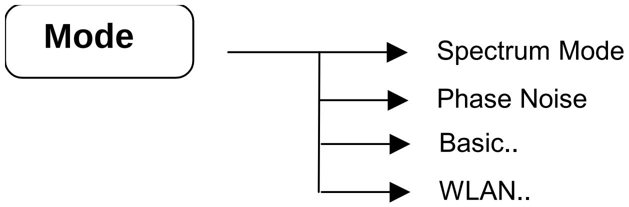
Table A-3 Available data format for 802.11g standard

802.11g standard family	Modulation	Data rate	Possible to measure
802.11a Part	OFDM	6–54 Mbps	Supported
802.11b Part	DSSS	1, 2 Mbps	Supported
	CCK	5.5 Mbps, 11 Mbps	Supported
	PBCC	5.5 Mbps, 11 Mbps	Supported
New Part	PBCC	22 Mbps	Supported
		33 Mbps	Not supported
	DSSS-OFDM	1–54 Mbps	Not supported

Menu descriptions

WLAN measurement mode

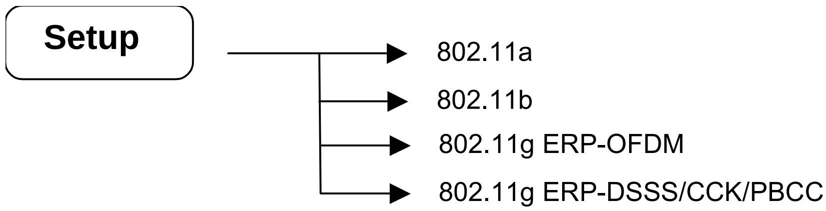
To use WLAN measurement options, first set the system to WLAN mode:



Select [Mode], then press *[WLAN]* mode at the right side of the screen.

Mode setup

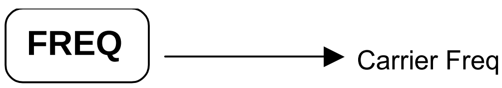
Press [Setup] in WLAN mode:



802.11a	Select IEEE 802.11a Std for WLAN analysis mode.
802.11b	Select IEEE 802.11b Std for WLAN analysis mode.
802.11g ERP-OFDM	Select IEEE 802.11g ERP-OFDM Std for WLAN analysis mode. (Has the same menu structure as 802.11a)
802.11g ERP-DSSS /CCK/PBCC	Select IEEE 802.11g ERP-DSSS /CCK/PBCC Std for WLAN analysis mode. (Has the same menu structure as 802.11b)

Frequency channel menu

Press [FREQ] in WLAN mode:

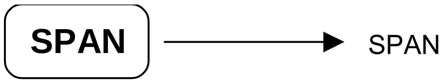


You can access frequency functions from this menu.

Carrier Freq	Allows you to specify the frequency of an input WLAN signal. In the case of 802.11b, default frequency is 2.4 GHz; for 802.11a, it is 5 GHz.

Span menu

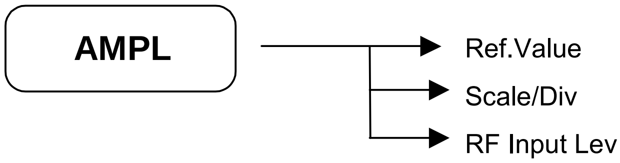
Press [SPAN] in WLAN mode:



SPAN	Specify the measurement span for the WLAN input signal to be measured.

Amplitude menu

Press [AMPL] in WLAN mode:

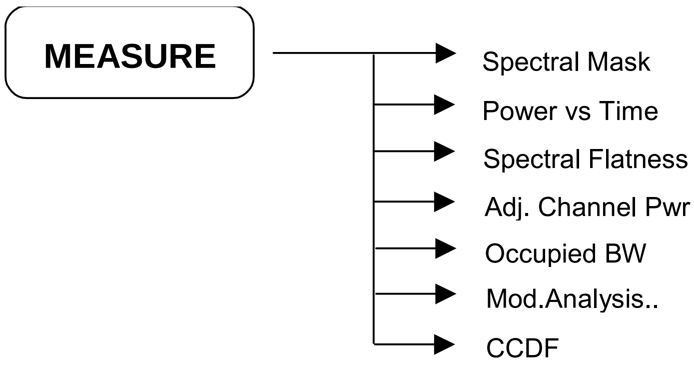


Amplitude menu keys are used for setting functions that affect the way data on the vertical axis is displayed or corrected.

Ref.Value	This allows you to set the value in dBc/Hz of a specified position on the graticule display.
Scale/Div	This allows you to set the value of scale in dB for each division of Y-axis.
RF Input Lev	The maximum allowable RF input is 22 dBm with RF attenuation of 24 dB. From this menu you can set the RF attenuation and IF attenuation automatically. The RF attenuator has 4 dB step size and the range is 0 dB to 24 dB. The IF attenuator has 1 dB step size and the range is 0 dB to 11 dB. The rule for the automatic attenuator setting is: * RF Input Lev – (RF Att + IF Att) = –13 dB

Measure menu

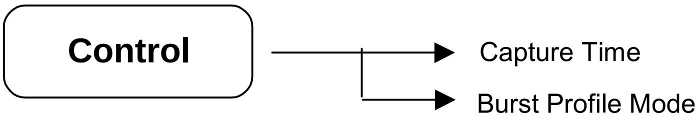
Press [MEASURE] in WLAN mode:



Spectral Mask	Measures the Spectral Mask of the WLAN signal. The Pass/Fail result (based on IEEE Std Spectral Mask) is measured and displayed (IEEE 802.11a/b/g Std only).
Power vs Time	Measures the Power vs Time of the WLAN signal. In the case of an 802.11b(g) signal, the Pass/Fail result for the power up/down ramp is measured and displayed, based on IEEE 802.11b Std (IEEE 802.11b/g Std only)
Spectral Flatness	Measures the Spectral Flatness of an 802.11a/g WLAN signal for its sub-carrier. The Pass/Fail result for carrier flatness is measured and displayed (IEEE 802.11a/g Std only).
Adj. Channel Pwr	Measures the Adjacent Channel Power of an 802.11b/g WLAN signal. A ratio of main channel power level versus Leakage power is shown at the bottom of the measurement window (IEEE 802.11b/g Std only).
Occupied BW	Measures the Adjacent Channel Power of an 802.11a/g WLAN signal. This is the bandwidth occupied by 99% of the total power in a 34 MHz band where the signal resides (IEEE 802.11a/g Std only).
Mod.Analysis	Measures the parameter which is related to modulation accuracy. The submenu for this modulation analysis is: Constellation: measures the constellation diagram for the WLAN input signal. The modulation-related numerical result is shown on the left side of the window. EVM: measures the Error Vector Magnitude for the WLAN input signal. In 802.11a Std the ‘EVM vs Symbols’ and ‘EVM vs Sub-carriers’ is shown. In 802.11b Std the ‘EMM vs Chips’ is shown. Numeric Results: shows the numerical results which relate to modulation accuracy (IEEE 802.11a/b/g Std).
CCDF	Measures the CCDF (Complementary Cumulative Distribution Function) of the WLAN signal (IEEE 802.11a/b/g Std).

Measure control menu

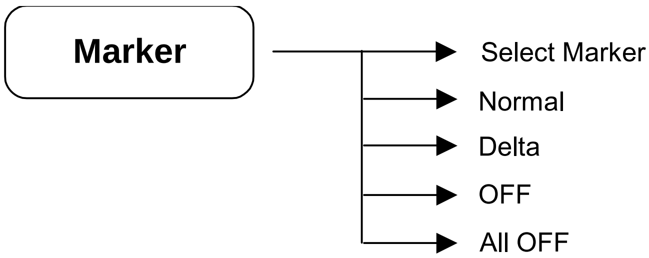
Press [Control] in WLAN mode:



Capture Time	Specifies the time to be captured for WLAN signal analysis. The maximum capture time is 26.182 ms and the minimum is 0.1 ms.
Burst Profile Mode	When the signal analyzer performs a 'Power vs Time' function in WLAN mode, the user can set the Burst profile mode (activated only in 'Power vs Time' measure in WLAN mode). It determines the value used to calculate the 10% and 90% power levels when measuring the burst rising and falling edge times. Peak: use Burst Peak Power for calculating burst rising & falling time Average: use Burst Average Power for calculating burst rise & fall times.

Marker menu

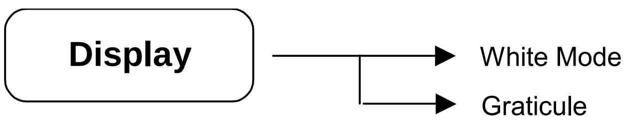
Press [Marker] in WLAN mode:



Select Marker	Allows you to select one of the four possible markers. Having selected one of the markers, use the other soft keys on this menu to specify the type of marker or measurement.
Normal	Sets the specified marker to be a normal marker.
Delta	A delta marker is actually a pair of markers. By pressing Delta, you set a pair of markers at your current frequency offset. One of this pair of markers is fixed while the second of the pair can be moved using the scroll knob or the numeric keys. The frequency difference and the amplitude difference between these two points is displayed.
Marker Trace	Allows you to select which of the two traces your currently selected marker is applied to.
OFF	Switches the specified marker off.
All OFF	Switches all markers off. All markers are removed from the graticule display, and if the marker table is also being displayed, all entries are removed from it.

Display menu

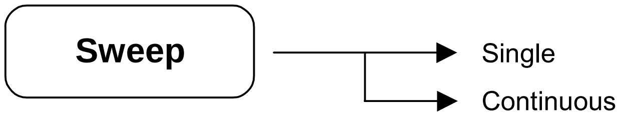
Press [Display] in WLAN mode:



White Mode	Change the screen background to white.
Graticule	Allows you to display or hide the graticule lines on the display.

Sweep menu

Press [Sweep] in WLAN mode:

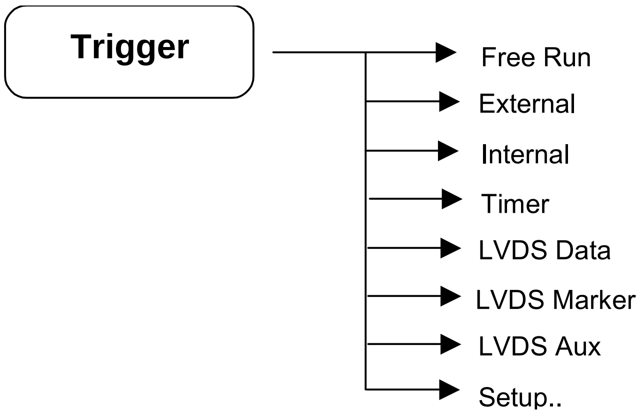


Single — The analyzer performs one single measurement and then stops. You have to press [Restart] every time you want to make another measurement.

Continuous — The analyzer continuously measures the signal it is receiving and repeatedly updates the plots and the measurements.

Trigger menu

Press [Trigger] in WLAN mode:



Free Run — Captures the sample data when in Single/Repeat mode, without waiting for any external events.

External — Captures the sample data when in Single/Repeat mode, when an external trigger signal is input and the specified trigger condition is satisfied.

The setup menu for External trigger is:

Trigger Type: selects edge or gate as a trigger type.

Trig.Polarity: sets the polarity of trigger (Positive or Negative).

Offset Delay Samp: sets the external trigger offset delay in terms of numbers of samples. This setting can be used to adjust external trigger timing for the data capture.

Pre-Trig.Samp: sets the number of samples to capture before the edge trigger event in the capture buffer (when edge trigger type selected).

Post-Trig.Samp: sets the number of post-trigger samples present in the captured buffer (when Gate trigger type selected).

Internal — Captures the sample data when in Single/Repeat mode, when the internal level trigger condition is satisfied.

The setup menu for Internal trigger is:

Trigger Type: selects edge or gate as a trigger type.

Trig.Polarity: sets the polarity of trigger (Positive or Negative).

Int.Trig.Mode: sets the internal trigger mode to Absolute mode or Relative mode.

Absolute: internal level trigger is generated as soon as detected level is above the absolute level threshold specified in dBm

Relative: internal level trigger is generated as soon as detected level is 'changed' by specified relative level threshold specified in dB

Offset Delay Samp.: sets the external trigger offset delay in terms of numbers of samples. This setting can be used to adjust internal trigger timing for the data capture.

Pre-Trig.Samp.: sets the number of samples to capture before the edge trigger event in the capture buffer (when edge trigger type selected).

Post-Trig.Samp.: sets the number of post-trigger samples present in the captured buffer (when Gate trigger type selected).

Abs.Threshold.: sets or returns the relative level threshold, in units of dB, for 'Relative' level internal trigger mode.

Abs.TimeConst.: sets or returns the absolute time constant, in units of ms, for 'Absolute' level internal trigger mode.

Timer — Gets the trigger source from the internal timer.

Trigger Type: selects edge or gate as a trigger type.

Trig.Polarity: sets the polarity of trigger (Positive or Negative).

Offset Delay Samp.: sets the external trigger offset delay in terms of numbers of samples. This setting can be used to adjust internal trigger timing for the data capture.

Pre-Trig.Samp.: sets the number of samples to capture before the edge trigger event in the capture buffer (when edge trigger type selected).

Post-Trig.Samp.: sets the number of post-trigger samples present in the captured buffer (when Gate trigger type selected).

Timer Period: sets the period of the internal timer (5% mark/space ratio).

Timer Phase: adjusts the phase of the internal timer in multiples of the resampled sample clock period for the selected modulation mode. This allows you to synchronize the timer trigger with external events.

LVDS Data — Takes its trigger input from the Spare 0 input bit on the LVDS data bus. Ensure that Setting/LVDS/Data Mode is set to Input. Because the data bus is set to receive when this trigger is used, it is not then possible to output on the DATA connector.

Trigger Type: selects edge or gate as a trigger type.

Trig.Polarity: sets the polarity of trigger (Positive or Negative).

Offset Delay Samp.: sets the LVDS trigger offset delay in terms of numbers of samples. This setting can be used to adjust internal trigger timing for the data capture.

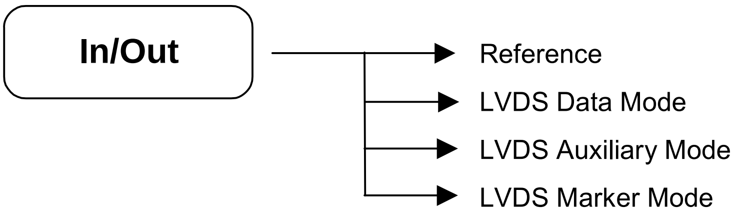
Pre-Trig.Samp.: sets the number of samples to capture before the edge trigger event in the capture buffer (when edge trigger type selected).

Post-Trig.Samp.: sets the number of post-trigger samples present in the captured buffer (when Gate trigger type selected).

LVDS Marker	Takes its Trigger from any of four Marker bits on the DATA connector. Ensure that Settings/LVDS/Marker Mode is set to Input. Trigger Type: selects edge or gate as a trigger type. Trig.Polarity: sets the polarity of trigger (Positive or Negative). Offset Delay Samp.: sets the LVDS trigger offset delay in terms of numbers of samples. This setting can be used to adjust internal trigger timing for the data capture. Pre-Trig.Samp.: sets the number of samples to capture before the edge trigger event in the capture buffer (when edge trigger type selected). Post-Trig.Samp.: sets the number of post-trigger samples present in the captured buffer (when Gate trigger type selected).
LVDS Aux	Takes its Trigger from any of five Auxiliary input bits on the DATA connector. Ensure that Settings/LVDS/Auxiliary Mode is set to Input. Trigger Type: selects edge or gate as a trigger type. Trig.Polarity: sets the polarity of trigger (Positive or Negative). Offset Delay Samp.: sets the LVDS trigger offset delay in terms of numbers of samples. This setting can be used to adjust internal trigger timing for the data capture. Pre-Trig.Samp.: sets the number of samples to capture before the edge trigger event in the capture buffer (when edge trigger type selected). Post-Trig.Samp.: sets the number of post-trigger samples present in the captured buffer (when Gate trigger type selected).
Setup	Sets up the specific parameters for each trigger source.

In/Out menu

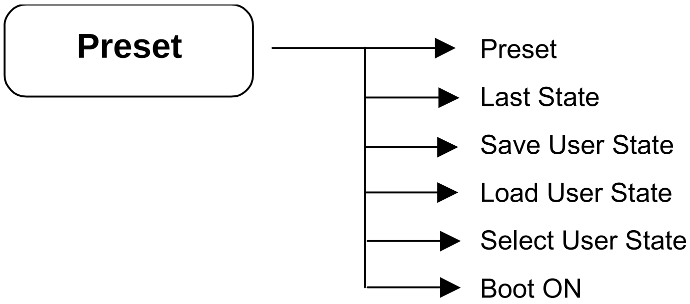
Press [In/Out] in WLAN mode:



Reference	Selects reference 10 MHz signal for synchronization. External: selects external 10 MHz and locks system to it. Internal: selects internal clock for its synchronization, and system operates in free-run mode.
LVDS Data Mode	Sets or returns the direction of the LVDS Data Mode as input, output or tri-state.
LVDS Auxiliary Mode	Sets or returns the direction of the LVDS Auxiliary Mode as input, output or tri-state.
LVDS Marker Mode	Sets or returns the direction of the LVDS Marker Mode as input, output or tri-state.

Preset menu

Press [Preset] in WLAN mode:



The sub menus of [Preset] have the same function as in the basic spectrum analysis mode. Please refer to the Spectrum Analyzer Operation Manual for other soft key functions.

Appendix B
MEASUREMENT GUIDE

Contents

General

Introduction

This chapter demonstrates basic analyzer measurements with examples of typical measurements; each measurement focuses on different functions. This chapter does not focus on testing the instrument's performance; examples use the least amount of extra equipment and show the instrument's basic functions. For more specific information refer to the operating manual.

Comparing signals

Using the analyzer, you can easily compare frequency and amplitude differences between signals, such as radio or television signal spectra. The analyzer delta marker function lets you compare two signals when both appear on the screen at one time or when only one appears on the screen.

Example: delta marker function

Measure the difference between two signals on the same display screen.

1 Connect 10 MHz REF OUT from the rear panel of the signal generator to the spectrum analyzer's front-panel RF INPUT.

2 Set the center frequency to 30 MHz and the span to 50 MHz by pressing [FREQ] 30 MHz, [SPAN] 50 MHz.

3 Set the reference level to 10 dBm by pressing [AMPL] 10dBm.
The 10 MHz reference signal and its harmonics appear on the display.

4 Press [Peak] to place a marker at the highest peak on the display (the *[Next Pk Right]* and *[Next Pk Left]* soft keys are available to move the marker from peak to peak). The marker should be on the 10 MHz reference signal, as shown in Fig. B-1.

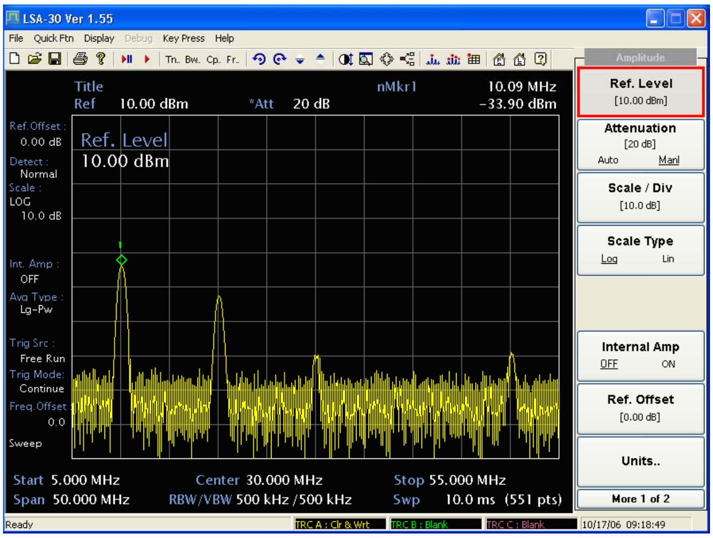


Fig. B-1 Placing a marker on the 10 MHz signal

5 Press [Marker], *[Delta]*, to activate a second marker at the position of the first marker. Move the second marker to another signal peak using the knob, or by pressing [Peak], *[Next Peak]*.

6 The amplitude and frequency difference between the markers is displayed in the active function block and in the upper right corner of the screen.

7 Press *[OFF]* to turn the markers off.

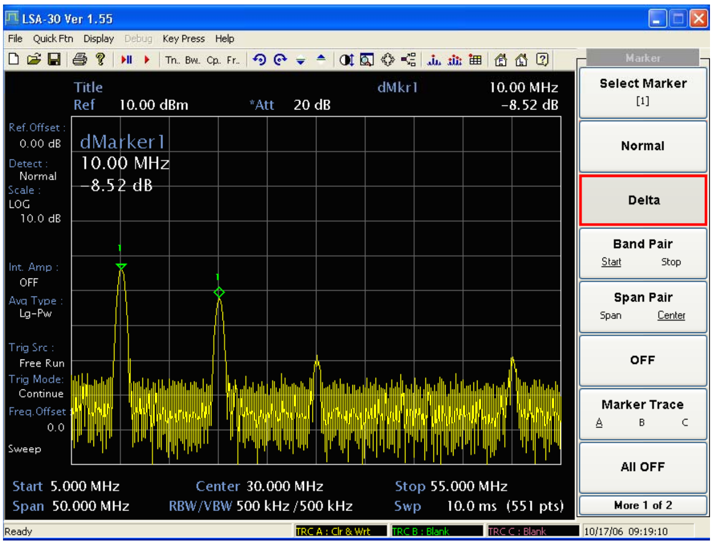


Fig. B-2 Using the marker delta function

Resolving signals of equal amplitude

Two equal-amplitude input signals that are close in frequency can appear as one on the analyzer's display. Responding to a single-frequency signal, a swept-tuned analyzer traces out the shape of the selected internal IF (intermediate frequency) filter. As you change the filter bandwidth, you change the width of the displayed response. If a wide filter is used and two equal-amplitude input signals are close enough in frequency, then the two signals appear as one. Thus, signal resolution is determined by the IF filters inside the analyzer.

The bandwidth of the IF filter tells us how close together equal-amplitude signals can be and still be distinguished from each other. The resolution bandwidth function selects an IF filter setting for a measurement. Resolution bandwidth is defined as the 3 dB bandwidth of the filter.

Generally, to resolve two signals of equal amplitude, the resolution bandwidth must be less than or equal to the frequency separation of the two signals. If the bandwidth is equal to the separation and the video bandwidth is less than the resolution bandwidth, a dip of approximately 3 dB is seen between the peaks of the two equal signals, and it is clear that more than one signal is present. See Fig. B-4.

In order to keep the analyzer measurement calibrated, sweep time is automatically set to a value that is inversely proportional to the square of the resolution bandwidth (for resolution bandwidths ≥ 1 kHz). So, if the resolution bandwidth is reduced by a factor of 10, the sweep time is increased by a factor of 100 when sweep time and bandwidth settings are coupled (sweep time is proportional to $1/BW^2$). For shortest measurement times, use the widest resolution bandwidth that still permits discrimination of all desired signals. The analyzer allows you to select from 1 kHz to 3 MHz resolution bandwidths in a 1, 3, 10 sequence for maximum measurement flexibility.

Option Digital RBW adds narrower resolution bandwidths, from 30 Hz to 5 MHz, in a 1-2-3-5 sequence. These bandwidths are digitally implemented and have a much narrower shape factor than the wider, analog resolution bandwidths. Also, the auto coupled sweep times when using the digital resolution bandwidths are much faster than analog bandwidths.

Example: selection RBW

Resolve two signals of equal amplitude with a frequency separation of 100 kHz.

1 Connect two sources to the analyzer's RF INPUT as shown in Fig. B-3.

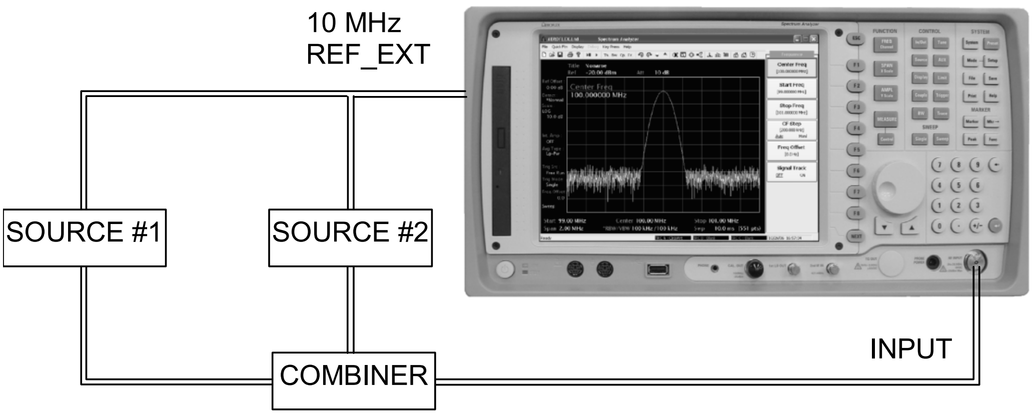


Fig. B-3 Setup for obtaining two signals

2 Set one source to 300 MHz. Set the frequency of the other source to 300.1 MHz. The amplitude of both signals should be approximately −10 dBm.

3 On the analyzer, press [Preset], *[Preset]*. Set the center frequency to 300 MHz, the span to 1 MHz, and the resolution bandwidth to 300 kHz by setting [FREQ] 300 MHz, [SPAN] 1 MHz, then [BW], *[RBW Manl]*, *[RBW]* 50 kHz. A single signal peak is visible.

***Note**: if the signal peak cannot be found, increase the span to 10 MHz by pressing [SPAN] 10 MHz. The signal should be visible. Press [Peak], [MKR→],* [Mkr→CF]*, then [SPAN] 1 MHz to bring the signal to center screen.*

4 Since the resolution bandwidth must be less than or equal to the frequency separation of the two signals, a resolution bandwidth of 50 kHz must be used. Change the resolution bandwidth to 50 kHz by setting [RBW] 50 kHz. Two signals are now visible as shown in Fig. B-4. Use the knob or step keys to further reduce the resolution bandwidth and better resolve the signals.

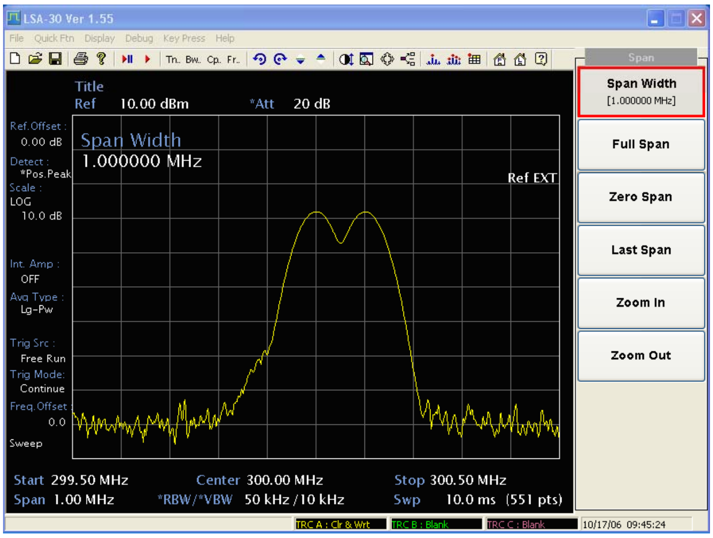


Fig. B-4 Resolving signals of equal amplitude

5 Decrease the video bandwidth to 10 kHz by pressing [BW], *[VBW Manl]*, *[VBW]* 10 kHz. As the resolution bandwidth is decreased, resolution of the individual signals is improved and the sweep time is increased. For fastest measurement times, use the widest possible resolution bandwidth. Under couple conditions, the resolution bandwidth is "coupled" (or linked) to the span.

6 Since the resolution bandwidth has been changed from the coupled value, a * mark appears next to RBW in the lower-left corner of the screen, indicating that the resolution bandwidth is uncoupled.

Note*: to resolve two signals of equal amplitude with a frequency separation of 200 kHz, the resolution bandwidth must be less than the signal separation, and resolution of 100 kHz must be used. The next larger filter, 300 kHz, would exceed the 200 kHz separation and would not resolve the signals.*

Resolving small signals hidden by large signals

When dealing with the resolution of signals that are close together and not equal in amplitude, you must consider the shape of the IF filter of the analyzer, as well as its 3 dB bandwidth (see ‘Resolving signals of equal amplitude’ on pageB-4 for more information). The shape of a filter is defined by the selectivity, which is the ratio of the 60 dB bandwidth to the 3 dB bandwidth. If a small signal is too close to a larger signal, the smaller signal can be hidden by the skirt of the larger signal. To view the smaller signal, you must select a resolution bandwidth such that k is less than a: see Fig. B-5.

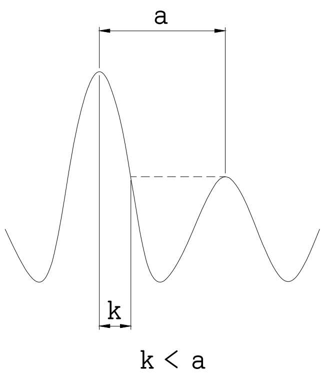


Fig. B-5 Resolution bandwidth requirements for resolving small signals

The separation between the two signals (a) must be greater than half the filter width of the larger signal (k) measured at the amplitude level of the smaller signal.

Example: selection RBW

Resolve two input signals with a frequency separation of 200 kHz and different amplitude.

1 To obtain two signals with a 200 kHz separation, connect the equipment as shown in Fig. B-3. Set one source to 300 MHz at 0 dBm.

2 Set the analyzer center frequency to 300 MHz and the span to 1 MHz: press [FREQ] 300 MHz, then [SPAN] 1 MHz.

Note*: if the signal peak cannot be found, increase the span to 10 MHz by pressing [SPAN] 10 MHz. The signal should be visible. Press [Peak], [MKR→],* [Mkr→CF] *to bring the signal to center screen, then [SPAN], 1 MHz.*

3 Set the second source to 300.200 MHz, so that the signal is 200 kHz higher than the first signal. Set the amplitude of the signal to –60 dBm (60 dB below the first signal).

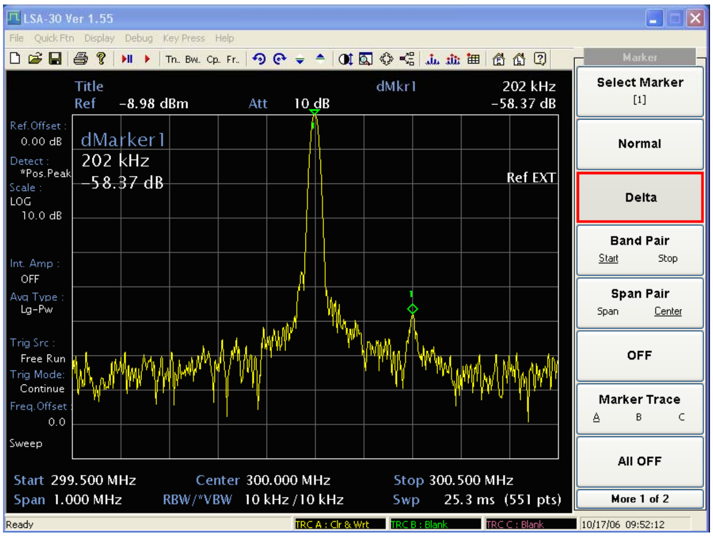


Fig. B-6 Signal resolution with a 10 kHz resolution bandwidth

4 Set the 300 MHz signal to the reference level by pressing [Peak], then [MKR→], *[Marker→Ref]*. If a 10 kHz filter with a typical shape factor 15:1 is used, the filter will have a bandwidth of 150 kHz at the 60 dB point, the half-bandwidth (75 kHz) is narrower than the frequency separation, so the input signals will be resolved: see Fig. B-6.

5 Place a marker on the smaller signal by pressing [Marker], *[Delta]*, [Peak], *[Next Pk Right]*. If a 30 kHz filter is used, the 60 dB bandwidth could be as wide as 450 kHz. Since the half-bandwidth (225 kHz) is wider than the frequency separation(200 kHz), the signals most likely will not be resolved (Fig. B-7). (In this example, we used the 60 dB bandwidth value. To determine resolution capability for intermediate values of amplitude level differences, assume the filter skirts between the 3 dB and 60 dB points are approximately straight.)

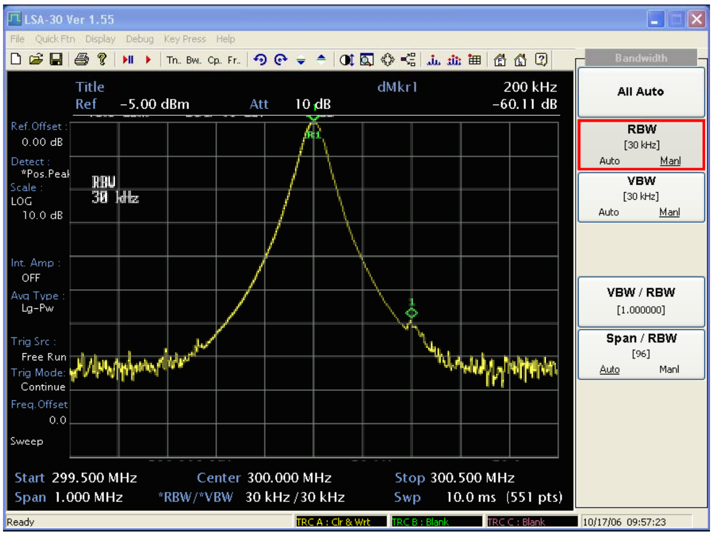


Fig. B-7 Signal resolution with a 30 kHz resolution bandwidth

Making better frequency measurements

A built-in frequency counter increases the resolution and accuracy of the frequency readout.

Example: marker counter function

Increase the resolution and accuracy of the frequency readout on the signal of interest.

1 Connect CAL. OUT to RF INPUT with BNC-BNC cable and N-BNC adapter in front panel.

2 Set the center frequency to 100 MHz by pressing [FREQ] 100 MHz.

3 Set the span to 10 MHz by pressing [SPAN] 10 MHz.

4 Press [Func], *[Freq. Counter]*. The count result appears at the bottom of the screen.

5 Move the marker to the peak of the signal by pressing [Peak].

Note*: marker count functions properly only on CW signals with discrete spectral components and whose level is more than –70 dBm.*

6 Increase the counter resolution by pressing [Func], *[Freq. Counter]* and then setting the desired resolution using the step keys or the knob. The marker counter readout is in the upper-right corner of the screen. The resolution can be set from 1 Hz to 1 kHz in decade steps.

7 The marker counter remains on until turned off. Turn off the marker counter by pressing *[Meas. OFF]*.

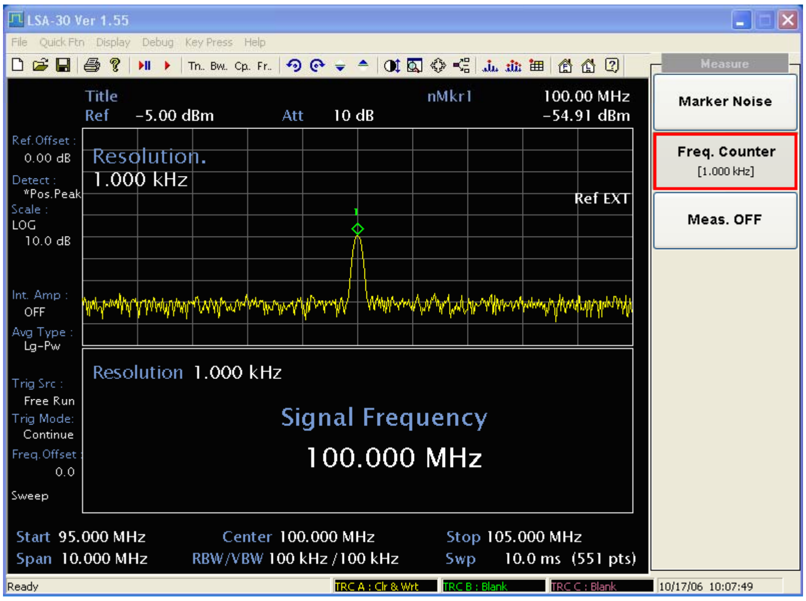


Fig. B-8 Using marker counter

Decreasing the frequency span around the signal

Using the analyzer signal tracking function, you can quickly decrease the span while keeping the signal at center frequency. This is a fast way to take a closer look at the area around the signal to identify signals that would otherwise not be resolved.

Example: signal track function

Examine a signal in a 200 kHz span.

1 Connect CAL. OUT to RF INPUT with BNC-BNC cable and N-BNC adapter in front panel.

2 Set the center frequency to 100 MHz by pressing [FREQ], *[Center Freq]* 100 MHz.

3 Press [Peak] to place a marker at the peak.

4 Press [Peak], *[Signal Track On]* and the signal moves to the center of the screen, if it is not already positioned there. (Note that the marker must be on the signal before turning signal tracking on.) Because the signal tracking function automatically maintains the signal at the center of the screen, you can reduce the span quickly for a closer look. If the signal drifts off of the screen as you decrease the span, use a wider frequency span.

5 Press [SPAN] 500 kHz. The span decreases in steps as automatic zoom is completed (Fig. B-9). You can also use the scroll knob or step keys to decrease the span or use the *[Zoom]* function under [SPAN]. Press [Peak], *[Signal Track OFF]* (so that OFF is highlighted) to turn off the signal tracking function.

***Note**: when you are finished with the example, turn off the signal tracking function.*

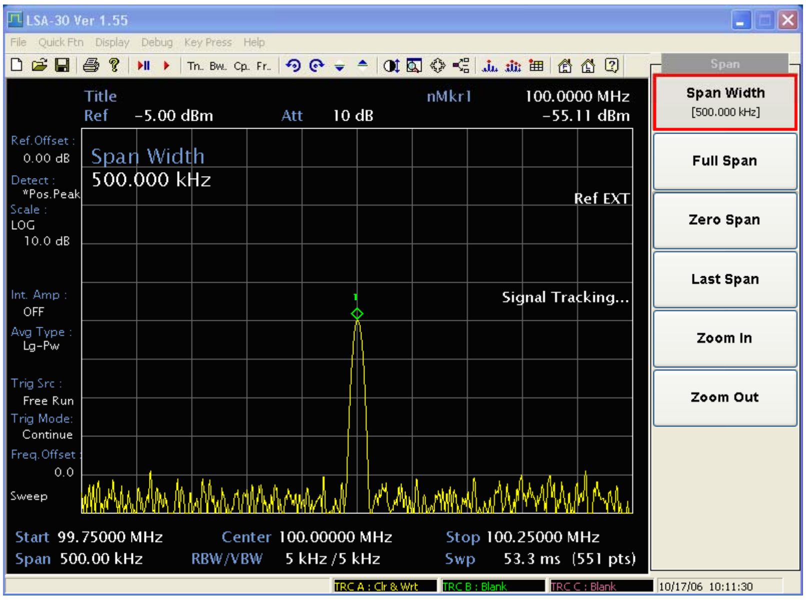


Fig. B-9 After zoom-in on the signal

Tracking drifting signals

The signal tracking function is useful for tracking drifting signals that drift relatively slowly.

[Peak], *[Signal Track]* may be used to track these drifting signals. Use [Peak] to place a marker on the signal you wish to track. Pressing [Peak], *[Signal Track ON]* brings that signal to the center frequency of the graticule and adjusts the center frequency every sweep to bring the selected signal back to the center.

Note that the primary function of the signal tracking function is to track unstable signals, not to track a signal as the center frequency of the analyzer is changed. If you choose to use the signal tracking function when changing center frequency, check to ensure that the signal found by the tracking function is the correct signal.

Example 1: signal track function

Use the signal tracking function to keep a drifting signal at the center of the display and monitor its change.

This example requires a signal generator. The frequency of the signal generator will be changed while you view the signal on the display of the analyzer.

1. Connect a signal generator to the analyzer's RF INPUT. Press [Preset], *[Preset]*.
2. Set the signal generator frequency to 300 MHz with an amplitude of –20 dBm.
3. Set the center frequency of the analyzer to 300 MHz by pressing [FREQ] 300 MHz.
4. Press [Peak] to move the marker to the peak of your signal.
5. Press [SPAN] 500 kHz.
   Notice that the signal has been held in the center of the display.
6. The signal frequency drift can be read from the screen if both the signal tracking and marker delta functions are active. Press [Peak], *[Signal Track ON]*. The marker readout indicates the change in frequency and amplitude as the signal drifts.
7. Tune the frequency of the signal generator. Notice that the center frequency of the analyzer changes in < 10 kHz increments, centering the signal with each increment; see Fig. B-10.

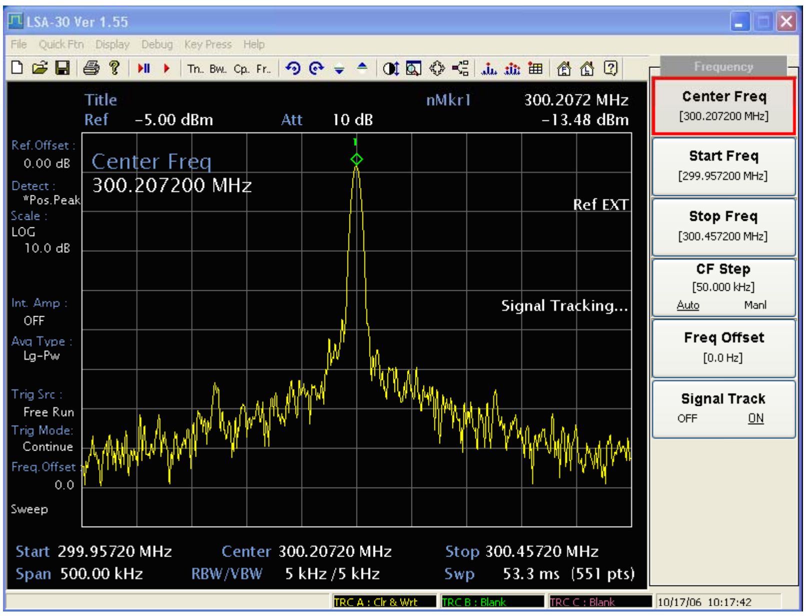


Fig. B-10 Using signal tracking to track a drifting signal

Example 2: max hold function

The analyzer can measure the short-and long-term stability of a source. The maximum amplitude level and the frequency drift of an input signal trace can be displayed and held by using the maximum-hold function. Yon can also use the maximum hold function if you want to determine how much of the frequency span a signal occupies.

1 Connect a signal generator to the analyzer RF INPUT. Press [Preset], *[Preset]*.

2 Set the signal generator frequency to 300 MHz with an amplitude of –10 dBm.

3 Set the center frequency of the analyzer to 300 MHz by pressing [FREQ] 300 MHz.

4 Press [Peak] to move the marker to the peak of your signal.

5 Press [SPAN] 500 kHz.

6 To measure the excursion of the signal, press [Trace] then *[Max Hold]*. As the signal varies, maximum hold maintains the maximum responses of the input signal. Annotation on the left side of the screen indicates the trace mode (MAX HOLD).

7 Press *[Select Trace B]* to select trace B (trace B is selected when A changes to B in the menu). Press *[Clear&Write]* to place trace B in clear-write mode, which displays the current measurement results as it sweeps. Trace A remains in maximum hold mode, showing the frequency shift of the signal.

8 Slowly change the frequency of the signal generator ±50 kHz. Your analyzer display should look similar to Fig. B-11.

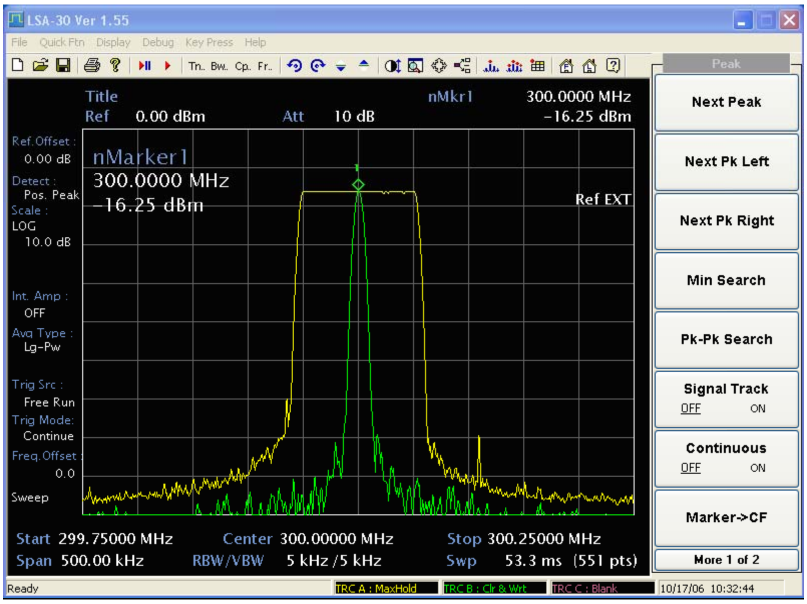


Fig. B-11 Viewing a drifting signal with max hold and clear & write

Measuring low-level signals

The ability of the analyzer to measure low-level signals is limited by the noise generated inside the analyzer. A signal may be masked by the noise floor so that it is not visible. This sensitivity to low-level signals is affected by the measurement setup.

The analyzer's input attenuator and bandwidth settings affect the sensitivity by changing the signal-to-noise ratio. The attenuator affects the level of a signal passing through the instrument, whereas the bandwidth affects the level of internal noise without affecting the signal. In the first two examples in this section, the attenuator and bandwidth settings are adjusted to view low-level signals.

If, after adjusting the attenuation and resolution bandwidth, a signal is still near the noise, visibility can be improved by using the video bandwidth and video averaging functions, as demonstrated in the third and fourth examples.

Example 1: set input attenuation

If a signal is very close to the noise floor, reducing input attenuation brings the signal out of the noise. Reducing the attenuation to 0 dB maximizes signal power in the analyzer.

CAUTION

The total power of all input signals at the analyzer's input must not exceed the maximum power level for the analyzer.

1 Connect a signal generator to the analyzer RF INPUT. Press [Preset], *[Preset]* on the analyzer.
2 Set the signal generator frequency to 300 MHz with an amplitude of –50 dBm.
3 Set the center frequency of the analyzer to 300 MHz by pressing [FREQ] 300 MHz.
4 Set the span to 5 MHz by pressing [SPAN] 5 MHz.
5 Set the reference level to –20 dBm by pressing [AMPL], *[Ref Level]* −20 dBm.
6 Set the attenuation level to 0 dB by pressing [AMPL], *[Attenuation Manl]* and then using the step-down key (▼).
7 Place the signal at center frequency by pressing [Peak], [MKR→], *[Mkr→CF]*.
8 Reduce the span to 1 MHz. Press [SPAN], and then use the step-down key (▼). See Fig. B-12.

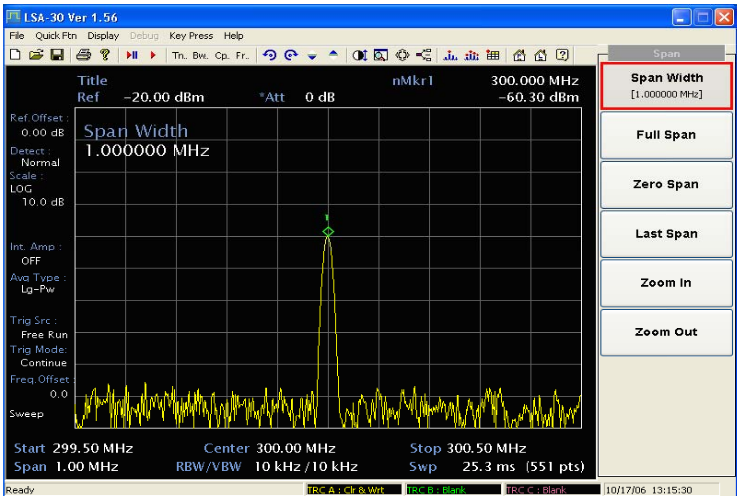


Fig. B-12 Using 0 dB attenuation

9 Press [AMPL], *[Attenuation Manl]*. Press the step-up key (▲) to select 10 dB attenuation. Increasing the attenuation moves the noise floor closer to the signal. See Fig. B-13. A '*' appears next to the ATT annotation at the top of the display, indicating that the attenuation is no longer coupled to other analyzer settings.

10 To see the signal more clearly, enter 0 dB or *[Attenuation Manl]*. Zero attenuation makes the signal more visible.

CAUTION

Before connecting other signals to the analyzer input, increase the RF attenuation to protect the analyzer input.

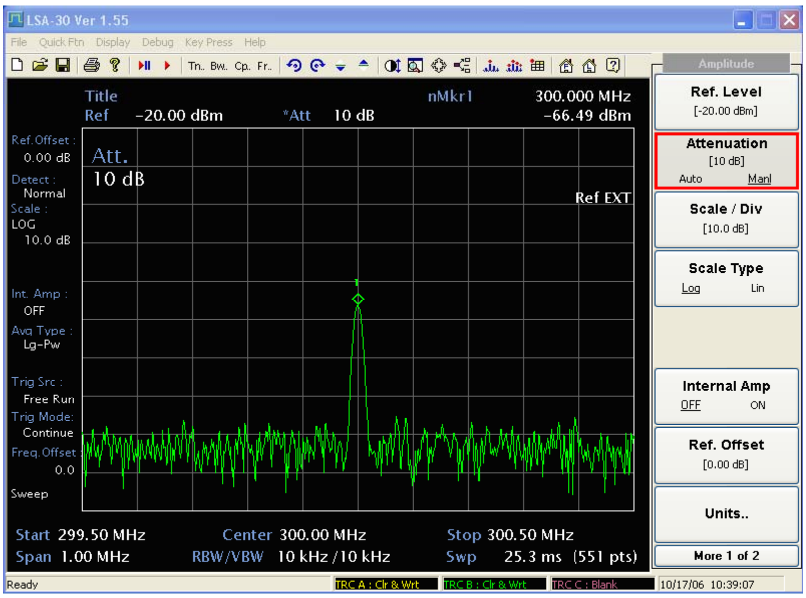


Fig. B-13 Low-level signal with 10 dB attenuation

Example 2: selection RBW

The resolution bandwidth can be decreased to view low-level signals.

1 As in the previous example, set the analyzer to view a low-level signal. Connect a signal generator to the analyzer RF INPUT. Press [Preset], *[Preset]* on the analyzer.

2 Set the signal generator frequency to 300 MHz with an amplitude of –60 dBm.

3 Set the center frequency of the analyzer to 300 MHz by pressing [FREQ], 300 MHz.

4 Set the span to 1 MHz by pressing [SPAN] 1 MHz.

5 Set the reference level to –20 dBm by pressing [AMPL], *[Ref Level]* –20 dBm.

6 Set the attenuation level to 0 dB by pressing [AMPL], *[Attenuation Manl]* and then using the step-down key (▼).

7 Press [BW], *[RBW Manl]*, *[RBW]* and the step-down key (▼) to decrease RBW. The low-level signal appears more clearly because the noise level is reduced. See Fig. B-14.

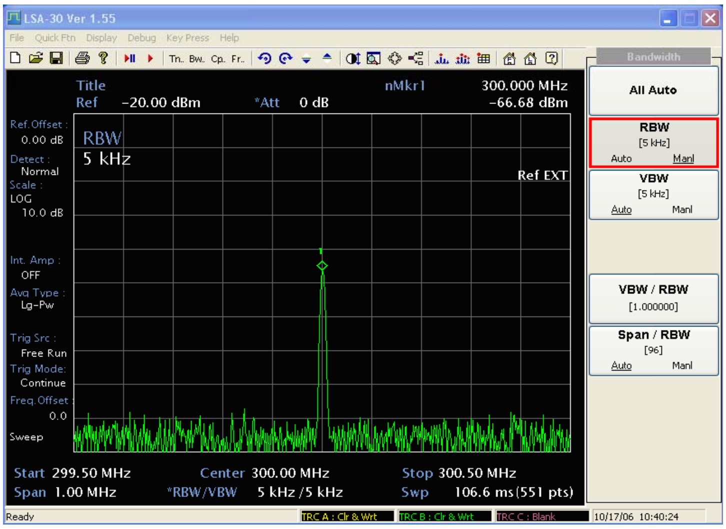


Fig. B-14 Decreasing resolution bandwidth

8 A '*' appears next to the RBW annotation at the lower center of the screen, indicating that the resolution bandwidth is uncoupled.

9 As the resolution bandwidth is reduced, the sweep time is increased to maintain calibrated data.

Example 3: selection VBW

Narrowing the video filter can be useful for noise measurements and observation of low-level signals close to the noise floor. The video filter is a post-detection low-pass filter that smooths the displayed trace. When signal responses near the noise level of the analyzer are visually masked by the noise, the video filter can be narrowed to smooth this noise and improve the visibility of the signal. Reducing video bandwidths requires slower sweep times to keep the analyzer calibrated.

Using the video bandwidth function, measure the amplitude of a low level signal.

1 As in the previous example, set the analyzer to view a low-level signal. Connect a signal generator to the analyzer RF INPUT. Press [Preset], *[Preset]* on the analyzer.

2 Set the signal generator frequency to 300 MHz with an amplitude of –60 dBm.

3 Set the center frequency of the analyzer to 300 MHz by pressing [FREQ] 300 MHz.

4 Set the span to 1 MHz by pressing [SPAN] 1 MHz.

5 Set the reference level to –20 dBm by pressing [AMPL], *[Ref Level]* –20 dBm.

6 Set the attenuation level to 0 dB by pressing [AMPL], *[Attenuation Manl]* and then using the step-down key (▼).

7 Set the video bandwidth to 100 Hz by pressing [BW], *[VBW Manl]*, *[VBW]* and the step-down key (▼). This clarifies the signal by smoothing the noise, which allows better measurement of the signal amplitude.

8 A '*' appears next to the VBW annotation at the bottom of the screen, indicating that the video bandwidth is not coupled to the resolution bandwidth. See Fig. B-15.

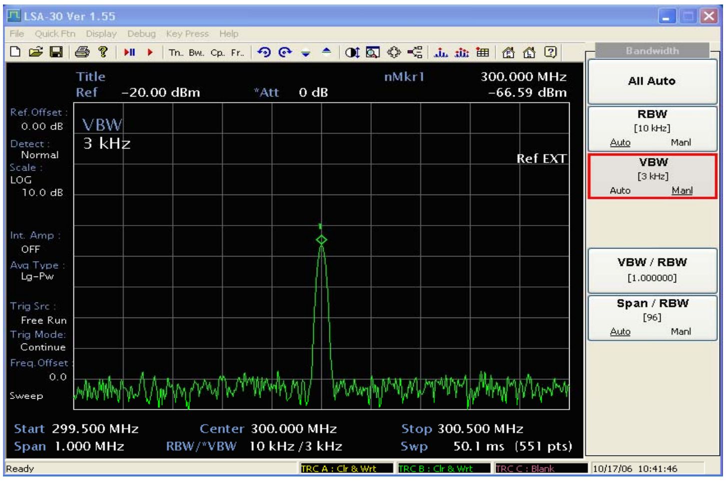


Fig. B-15 Decreasing video bandwidth

9 Instrument preset conditions couple the video bandwidth to the resolution bandwidth so that the video bandwidth is equal to the resolution bandwidth. If the bandwidths are uncoupled when video bandwidth is the active function, pressing *[VBW AUTO]* (so that AUTO is highlighted) recouples the bandwidths.

Note*: the video bandwidth must be set wider than the resolution bandwidth when measuring impulse noise levels.*

Example 4: video average function

If a signal level is very close to the noise floor, video averaging is another way to make the signal more visible.

Note*: the time required to construct a full trace that is averaged to the desired degree is approximately the same when using either the video bandwidth or the video averaging technique. The video bandwidth technique completes the averaging as a slow sweep is taken, whereas the video averaging technique takes many sweeps to complete the average. Characteristics of the signal being measured, such as drift and duty cycle, determine which technique is appropriate.*

Video averaging is a digital process in which each trace point is averaged with the previous trace-point average. Video averaging clarifies low-level signals in wide bandwidths by averaging the signal and the noise.

1 As in the previous example, set the analyzer to view a low-level signal. Connect a signal generator to the analyzer RF INPUT. Press [Preset], *[Preset]* on the analyzer.

2 Set the signal generator frequency to 300 MHz with an amplitude of –60 dBm.

3 Set the center frequency of the analyzer to 300 MHz by pressing [FREQ] 300 MHz.

4 Set the span to 1 MHz by pressing [SPAN] 1 MHz.

5 Set the reference level to –20 dBm by pressing [AMPL], *[Ref Level]* –20 dBm.

6 Set the attenuation level to 0 dB by pressing [AMPL], *[Attenuation Manl]* and then using the step-down key (▼).

7 Press [Trace], *[More..]*, *[Trc Average]* then [ON]. When ON is highlighted, the video averaging routine is initiated. As the averaging routine smooths the trace, low-level signals become more visible. *Trc Avg. Count [8]* appears on the upper left screen. The number represents the number of samples (or sweeps) taken to complete the averaging routine.

8 To set the number of samples, press *[Trc Avg. Count]* and use the numbers keypad. For example, press *[Average ON]*, *[Trc Avg. Count]* (so that ON is highlighted), 2, 5, ENTER. *[Trc Avg. Reset]* initializes the current average and starts averaging.

9 During averaging, the current sample number appears in the right-upper screen. The sampling also restarts if video averaging is turned off and then on again. Once the set number of sweeps has been completed, the analyzer continues to provide a running average based on this set number.

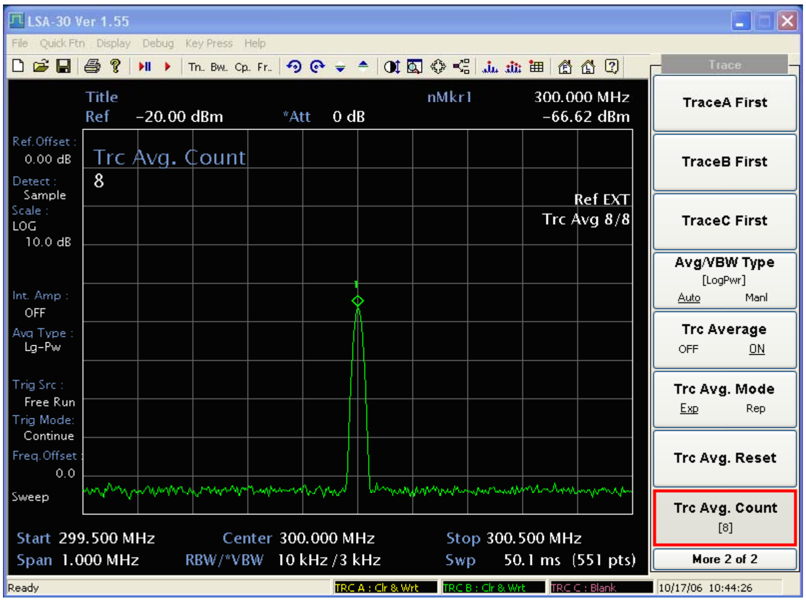


Fig. B-16 Using the video averaging function

Identifying distortion products

Distortion from the analyzer

High level input signals may cause analyzer distortion products that could mask the real distortion measured on the input signal.

Example: delta marker function

Using a signal from a signal generator, determine how many harmonic distortion products are generated by the analyzer. Fine distortion measurement is possible when suppressing the input signal's distortion.

1 Connect a signal generator to the analyzer RF INPUT. Set the signal generator frequency to 250 MHz and the amplitude to 0 dBm.

2 Set the center frequency of the analyzer to 500 MHz and the span to 600 MHz by pressing [FREQ] 500 MHz, [SPAN] 600 MHz.

3 To measure the second harmonic distortion, press [Peak]: the marker then locates on the highest-level signal, the 200 MHz fundamental. Press [Marker], *[Delta]* 250 MHz, then the marker locates in the second harmonic signal. The signal shown in Fig. B-17 produces harmonic distortion products in the analyzer input mixer.

Note that you must consider the harmonic distortion product when measuring the high-level signal.

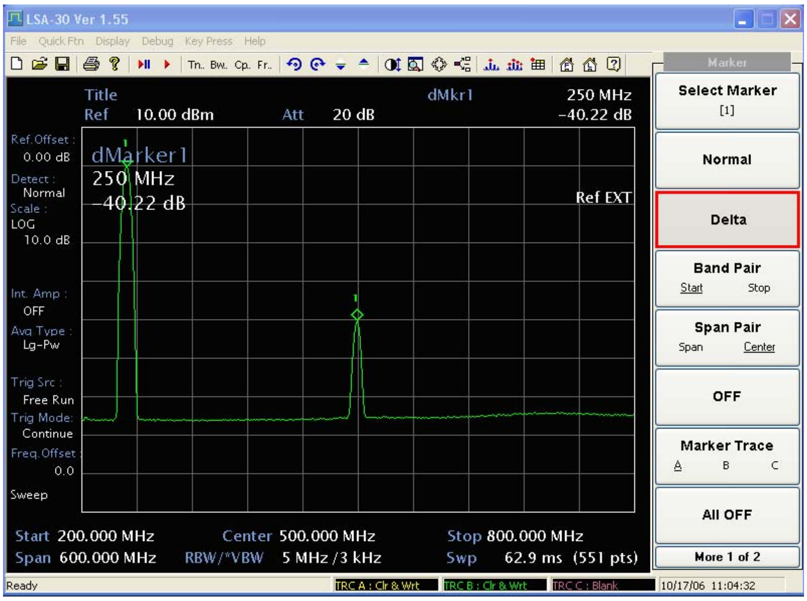


Fig. B-17 Harmonic distortion

Third-order intermodulation distortion

Two-tone, third-order intermodulation distortion is a common test in communication systems. When two signals are present in a non-linear system, they can interact and create third-order intermodulation distortion products that are located close to the original signals. These distortion products are generated by system components such as amplifiers and mixers.

Example: delta marker function

Test a device for third-order intermodulation.

This example uses two sources, one set to 300 MHz and the other to approximately 301 MHz. Other source frequencies may be substituted, but try to maintain a frequency separation of approximately 1 MHz.

1 Connect the equipment as shown in Fig. B-18. Press [Preset], *[Preset]*.

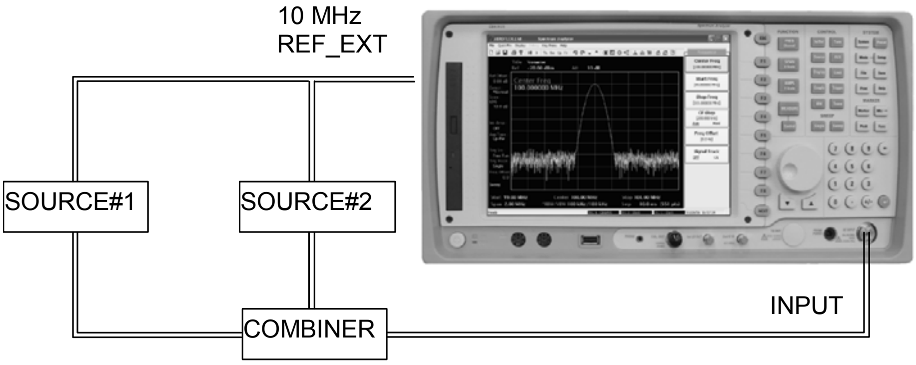


Fig. B-18 Third-order intermodulation equipment setup

***Note**: the combiner should have a high degree of isolation between the two input ports so that the sources do not intermodulate.*

1 Set one source to 300 MHz and the other source to 301 MHz, for a frequency separation of 1 MHz. Set the sources equal in amplitude (in this example, they are set to –5 dBm).

2 Tune both signals onto the screen by setting the center frequency to 300.5 MHz. Then, using the knob, center the two signals on the display. Reduce the frequency span to 5 MHz. This is wide enough to include the distortion products on the screen. To be sure the distortion products are resolved, reduce the resolution bandwidth until the distortion products are visible.

3 Press [BW], *[RBW Manl]*, *[RBW]*, and the used the step-down key (▼) to reduce the resolution bandwidth until the distortion products are visible.

4 To measure a distortion product, press [Marker] to place a marker on a source signal. To activate the second marker, press [Marker], *[Delta]*. Using the knob, adjust the second marker to the peak of the distortion product that is beside the test signal. The difference between the markers is displayed in the upper-right screen.

5 To measure the other distortion product, press [Peak], *[Next Pk Left]* or *[Next Pk Right]*. This places a marker on the next highest peak, which, in this case, is the other source signal. To measure the difference between this test signal and the second distortion product, press [Marker], *[Delta]* and use the knob to adjust the second marker to the peak of the second distortion product: see Fig. B-19.

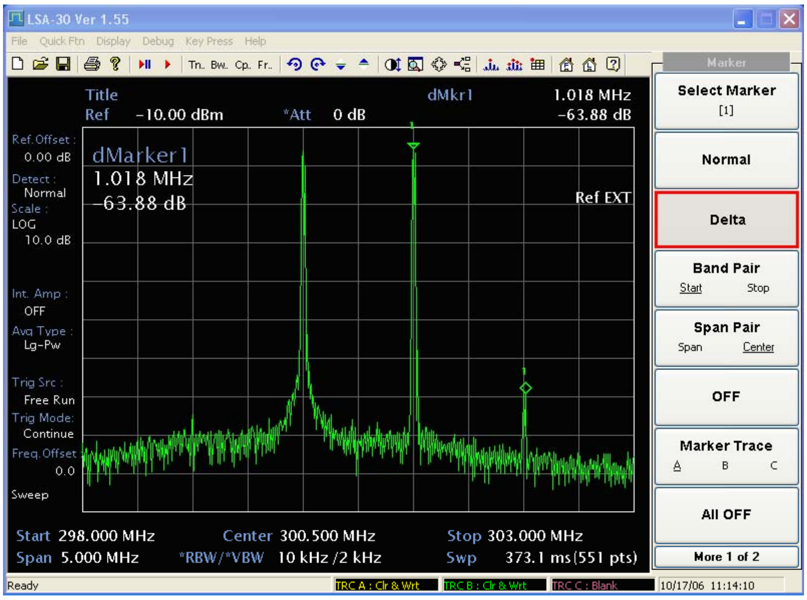


Fig. B-19 Measuring the distortion product

Making noise measurements

There are a variety of ways to measurement noise power. The first decision you must make is whether you want to measure noise power at a specific frequency or the total power over a specified frequency range, for example over a channel bandwidth.

Example 1: MKR noise function

Using the marker function, MKR Noise, is a simple method to make a measurement at a single frequency. In this example, attention must be paid to the potential errors due to discrete signals (spectral components). This measurement is made near the 100 MHz amplitude reference signal to illustrate the use of MKR Noise.

1 Connect CAL. OUT to RF INPUT with BNC-BNC cable and N-BNC adapter in front panel.

2 Tune the analyzer to the frequency of interest. In this example we are using the reference signal. Press [FREQ] 99.98 MHz.

3 Set the span the 50 kHz by pressing [SPAN] 100 kHz.

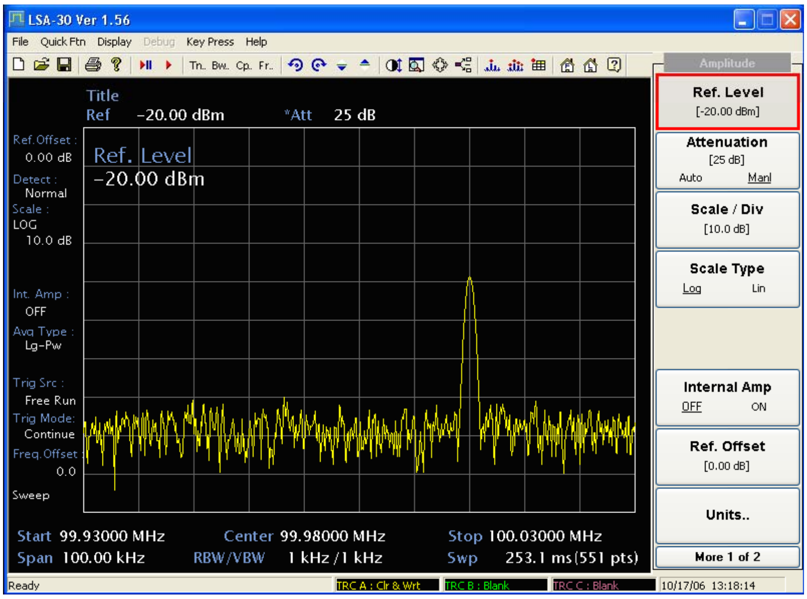


Fig. B-20 Setting the input attenuator

4 Set the reference level to –10 dBm by pressing [AMPL], *[Ref Level]* –10 dBm. See Fig. B-20. Note that if the signal is much higher than shown, adjust the input attenuator. In this example the input attenuation was set to 30 dB by pressing *[Attenuation. Manl]* 30 dB.

5 Activate the noise marker by pressing [Marker], *[Marker Noise]*.

Note that the display detection changes to sample, the marker floats between the maximum and the minimum of the noise. The marker readout is in dBm or dBm per bandwidth. See Fig. B-21. For noise power in a different bandwidth, add 10×log (BW). For example, for noise power in a 1 kHz bandwidth, add 10×log (1000) or 30 dB to the noise marker value.

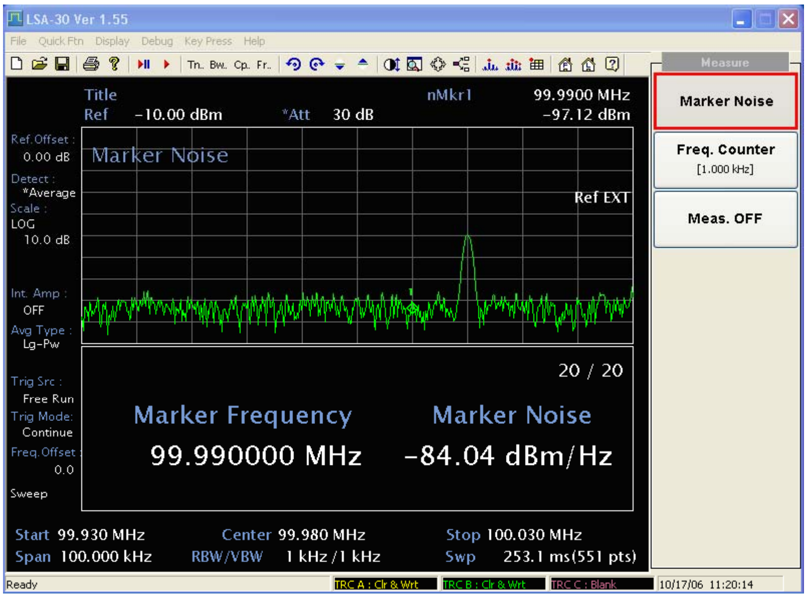


Fig. B-21 Activating the noise marker function

6 Video filtering can be introduced to reduce the variations of the sweep-to-sweep marker value. Set the video filter by pressing [BW], *[VBW Manl]*, *[VBW]*, 100 Hz.

Notice that these variations are to be expected due to the nature of the signal. We can reduce the variations by introducing video filtering. Since reducing the video bandwidth filter impacts sweep time, it is recommended to limit the degree of filtering.

Example 2: video filtering/average

The normal marker can also be used to make a signal frequency measurement as described in the previous example, again using video filtering or averaging to obtain a reasonably stable measurement.

While video averaging automatically selects the sample display detection mode, video filtering does not. With sufficient filtering that results in a smooth trace, there is no difference between the sample and peak modes because the filtering takes place before the signal is digitized.

Be sure to account for the fact that the averaged noise is displayed approximately 2 dB too low for a noise bandwidth equal to the resolution bandwidth. Therefore, you must add 2 dB to the marker reading. For example, if the marker indicates –100 dBm, the actual noise level is –98 dBm.

Example 3: channel power measurement

You may want to measure the total power of a noise-like signal that occupies some bandwidth. For example, you may want to determine the power in a communications channel. If the signal is noise and is flat across the band of interest, you can use the noise marker as described in example 1 and add 10×log (channel BW). However, if you are not certain of the characteristics of the signal, or if there are discrete spectral components in the band of interest, we can use the Channel Power routine. In this example, you will use the noise of the analyzer, then add a discrete tone to see what happens and assume a channel bandwidth of 50 kHz. If desired, a specific signal may be substituted.

1 Reset the analyzer by pressing [Preset], *[Preset]*.

2 Connect CAL. OUT to RF INPUT with BNC-BNC cable and N-BNC adapter in front panel.

3 Tune the analyzer to the frequency of 100 MHz. In this example we are using the amplitude reference signal. Press [FREQ] 100 MHz.

4 Set the span to 100 kHz by pressing [SPAN] 1 MHz.

5 Set the reference level to –20 dBm by pressing [AMPL], *[Ref Level]* –20 dBm.

6 Set the input attenuation to 30 dB by pressing [AMPL], *[Attenuation Manl]* 30 dB.

7 Set the analyzer to setup the channel-power measurement by pressing [MEASURE], *[Channel Power]*.

8 Set the integration bandwidth to 500 kHz by pressing [Control], *[Integ. BW]* 500 kHz.

9 Set the span to 1 MHz by pressing [SPAN] 1 MHz.

***Note**: the display detection mode has been set to sample mode and the video bandwidth has been set to be ten times wider than the resolution bandwidth. This setting is important to prevent any averaging. You can reduce the sweep-to-sweep variation in the power reading by averaging over a number of sweeps.*

10 The channel power reading is essentially equal to the 100 MHz calibration signal. The total noise power is far enough below that of the tone that the noise power contributes very little to the total.

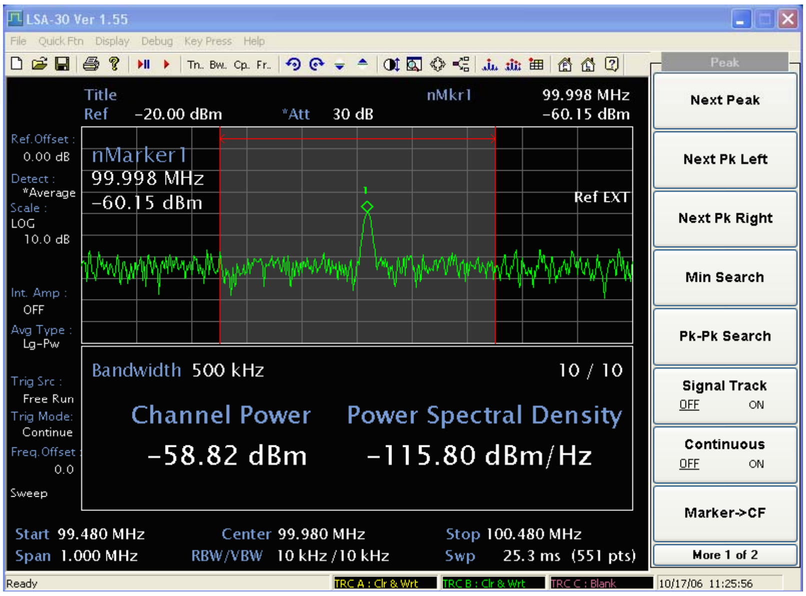


Fig. B-22 Measuring channel power

The algorithm that computes the total power compensates for the fact that some of the trace points on the response to the continuous wave tone may be at or very close to the peak value of the tone and so yields the correct value whether the signal comprises just noise, a tone, or both.

Demodulating AM signals

The zero span mode can be used to recover amplitude modulation on a carrier signal. The analyzer operates as a fixed-tuned receiver in zero span to provide time domain measurements.

The center frequency in the swept-tuned mode becomes the tuned frequency in zero span. The horizontal axis of the screen becomes calibrated in time only, rather than both frequency and time. Markers display amplitude and time values.

The following functions establish a clear display of the waveform:

- Trigger stabilizes the waveform trace on the display by triggering on the modulation envelope. If the modulation of the signal is stable, video trigger synchronizes the sweep with the demodulated waveform.
- Linear mode should be used in amplitude modulation (AM) measurements to avoid distortion caused by the logarithmic amplifier when demodulating signals.
- Sweep time adjusts the full sweep time from 20 ms to 1000 s (from 25 µs to 15 s in zero span). The sweep time readout refers to the full 10-division graticule. Divide this value by 10 to determine sweep time per division.
- Resolution and video bandwidth are selected according to the signal bandwidth.

Each of the coupled function values remains at its current value when zero span is activated. Video bandwidth is coupled to resolution bandwidth. Sweep time is not coupled to any other function.

Example: AM demod. function

View the modulation waveform of an AM signal in the time domain.

To obtain an AM signal, you can either connect a source to the analyzer input and set the source for amplitude modulation, or connect an antenna to the analyzer input and tune to a commercial AM broadcast station. This example uses a source. If you are using a commercial broadcast station as your signal, press [AUX], *[AM Demod. ON]* to turn on AM demodulation. Then press *[Audio Sound ON]*, and the analyzer operates as a radio.

1. Connect a signal generator output to the analyzer RF INPUT.
2. Set the source output frequency to 300 MHz, AM rate to 400 Hz and AM depth to 50%.
3. Set the center frequency of the analyzer to 300 MHz by pressing [FREQ] 300 MHz.
4. To demodulate the AM, press [AUX], *[AM Demod. ON]*. See Fig. B-23.

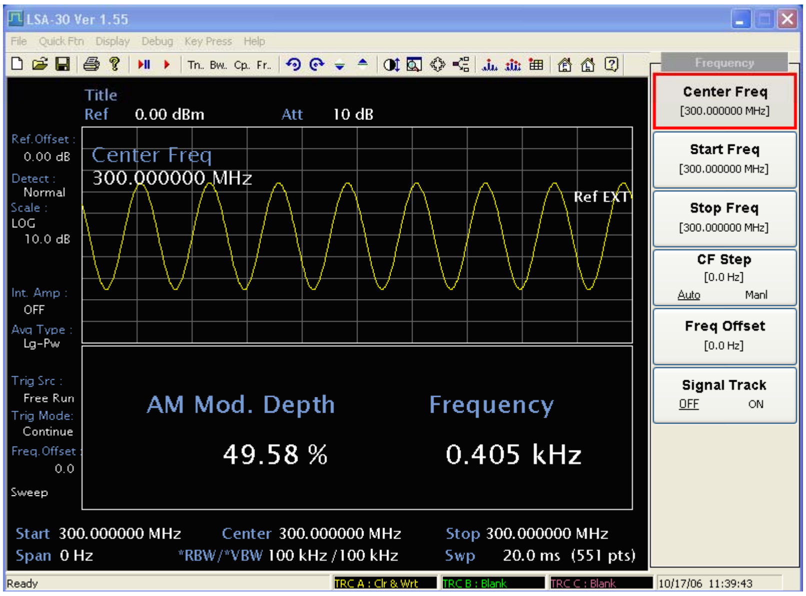


Fig. B-23 Measuring modulation using AM demodulation function

Another method to demodulate the AM signal is to use zero span by repeating steps 1 to 4 and performing the following:

5 Set the span to 20 MHz by pressing [SPAN] 20 MHz.

6 Set the resolution bandwidth to 1 MHz by pressing [BW], *[RBW Manl]*, *[RBW]* 1 MHz. See Fig. B-24.

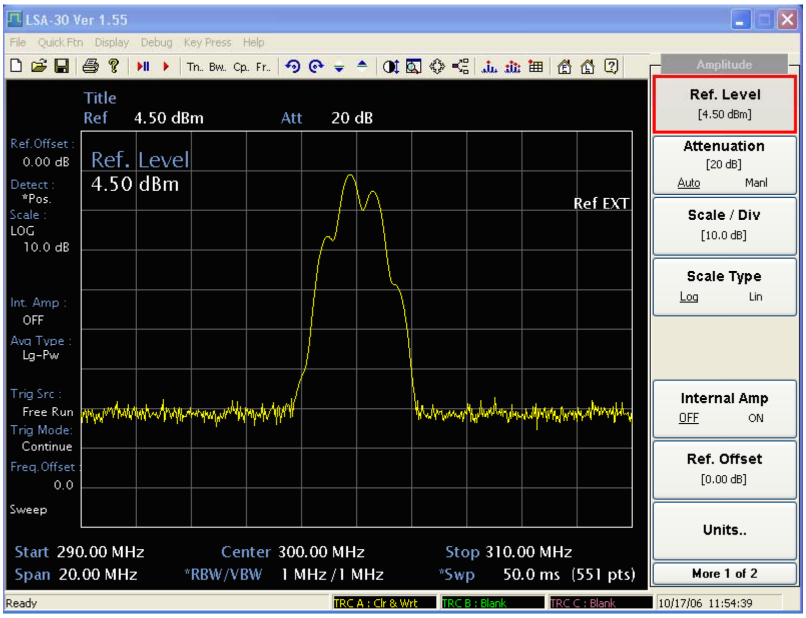


Fig. B-24 Viewing an AM signal

7 To select zero span, either press [SPAN] 0 Hz, or press [SPAN], Zero Span.

8 Next, position the signal peak near the reference level and select a linear voltage display. Press [AMPL], *[Scale Type Lin]*, *[Ref Level]* to adjust the reference level.

9 Adjust the sweep time to change the horizontal scale by pressing [BW], *[Sweep Time]* 10 ms. See Fig. B-25.

10 If the modulation is a steady tone, for example from a signal generator, use the video trigger to trigger on the waveform and stabilize the display. (If you are viewing an off-the-air signal you will not be able to stabilize the waveform.)

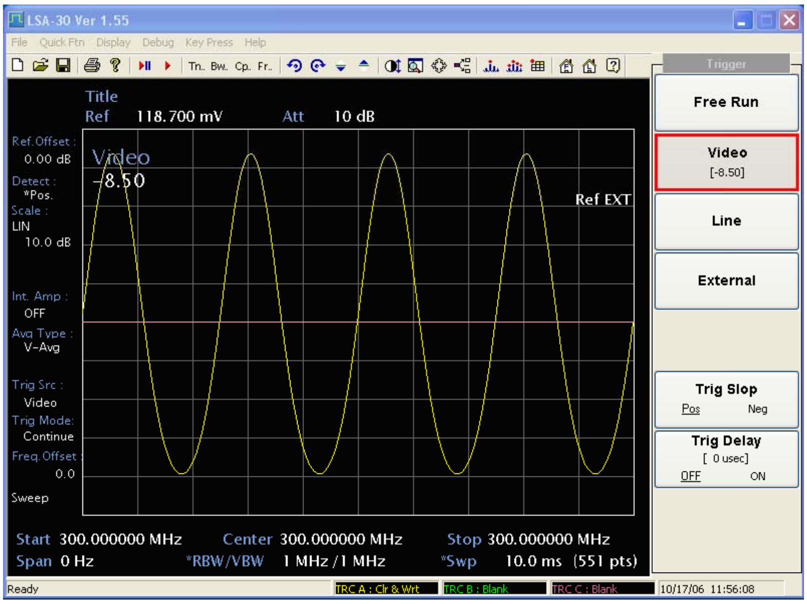


Fig. B-25 Measuring modulation in zero span

11 Use markers and delta markers to measure the time parameters of the waveform.

Demodulating FM signals

As with amplitude modulation you can utilize zero span to demodulate a FM signal. However, unlike the AM case, you cannot simply tune to the carrier frequency and widen the resolution bandwidth. The reason is that the envelope detector in the analyzer responds only to amplitude variations, and there is no change in amplitude if the frequency changes of the FM signal are limited to the flat part of the resolution bandwidth.

You can demodulate FM signals by using the FM demodulation function.

On the other hand, if you tune the analyzer slightly away from the carrier, you can utilize slope detection to demodulate the signal by performing the following steps:

1 Determine the correct resolution bandwidth.

2 Find the center of the linear portion of the filter skirt (either side).

3 Tune the analyzer to put the center point at mid screen of the display.

4 Select zero span.

The demodulated signal is now displayed; the frequency changes have been translated into amplitude changes. To listen to the signal, turn on AM demodulation and the speaker.

In this example you will demodulate a broadcast FM signal that has a specified 75 kHz peak deviation.

Example 1: delta marker function

Determine the correct resolution bandwidth. With a peak deviation of 75 kHz, your signal has a peak-to-peak excursion of 150 kHz. So we must find a resolution bandwidth filter with a skirt that is reasonably linear over that frequency range.

Connect CAL. OUT to RF INPUT with BNC-BNC cable and N-BNC adapter on the front panel.

1 Tune the analyzer to 100 MHz. In this example we are using the amplitude reference signal. Press [FREQ] 100 MHz.

2 Set the span to 1 MHz by pressing [SPAN] 1 MHz.

3 Set the reference level to –30 dBm by pressing [AMPL], *[Ref Level]* –30 dBm.

4 Set the resolution bandwidth to 100 kHz by pressing [BW], *[RBW Manl]*, *[RBW]* 100 kHz. The skirt is reasonably linear starting about half a division down from the peak.

5 Select a marker by pressing [Marker], then move the marker approximately half a division down the right of the peak (high frequency) using the front-panel knob.

6 Place a delta marker 150 kHz from the first marker by pressing *[Delta]* 150 kHz. The skirt looks reasonably linear between markers.

7 Determine the offset from the signal peak to the desired point on the filter skirt by moving the delta marker to the midpoint. Press 75 kHz to move the delta marker to the midpoint. See Fig. B-26.

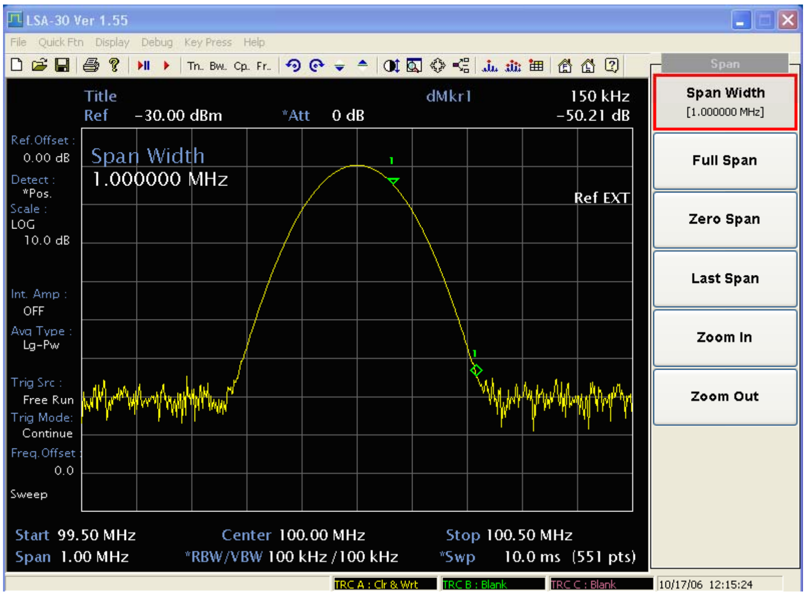


Fig. B-26 Determining the offset

8 Press *[Delta]* to make the active marker the reference marker.

9 Press [Peak] to move the delta marker to the peak. The delta value is the desired offset, for example 130 kHz.

Example 2: FM demod. function

1 Connect a signal generator output to the analyzer RF INPUT.

2 Set a source frequency to 300 MHz, amplitude to 0 dBm, FM deviation to 75 kHz, and FM rate to 1 kHz.

3 Reset the analyzer by pressing [Preset], *[Preset]*.

4 Tune the analyzer to 300 MHz by pressing [FREQ] 300 MHz.

First, demodulate the FM signal by using the FM demodulation function.

5 Demodulate the FM signal by pressing [AUX], *[FM Demod. ON]*.

6 To listen to the signal (1 kHz), press *[Audio Sound ON]*.

7 Adjust the sweep time by pressing [Sweep], *[Sweep Time]* 10 ms. See Fig. B-27.

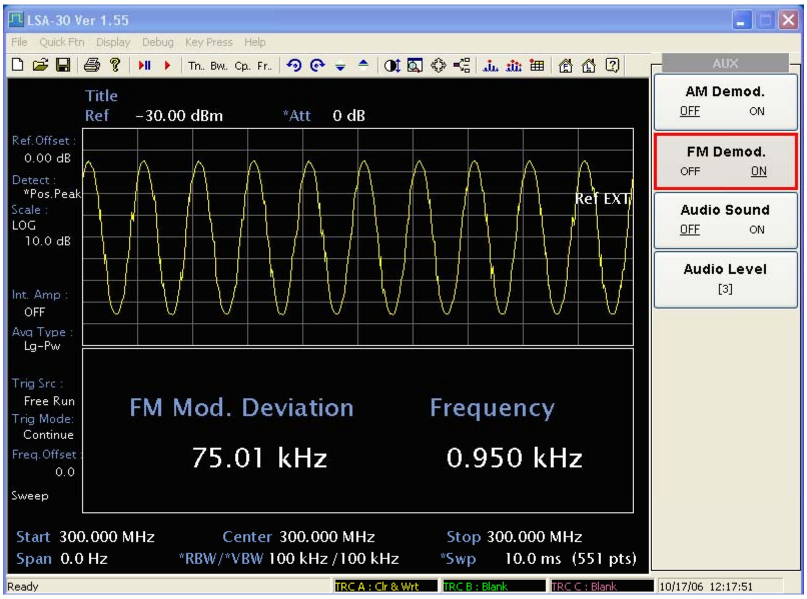


Fig. B-27 Measuring modulation using FM demodulation function

Another method is to use zero span by repeating steps 1 to 4 and then performing the following:

8 Tune above or below the FM signal by the offset noted above, in this example 130 kHz. Press [FREQ], *[CF Step Manl]*, *[CF Step]* 130 kHz, *[Center]* then use the step-up key (▲) or step-down key (▼).

9 Set the resolution bandwidth to 100 kHz, then go to zero span by pressing [BW], *[RBW Manl]*, *[RBW]* 100 kHz, [SPAN], and *[Zero Span]*.

10 Activate signal sweep by pressing [Single], *[Single]*.

11 Listen to the demodulated signal through the speaker by pressing [AUX], *[Audio Level]*, then adjusting the volume using the front-panel knob or the step-key.

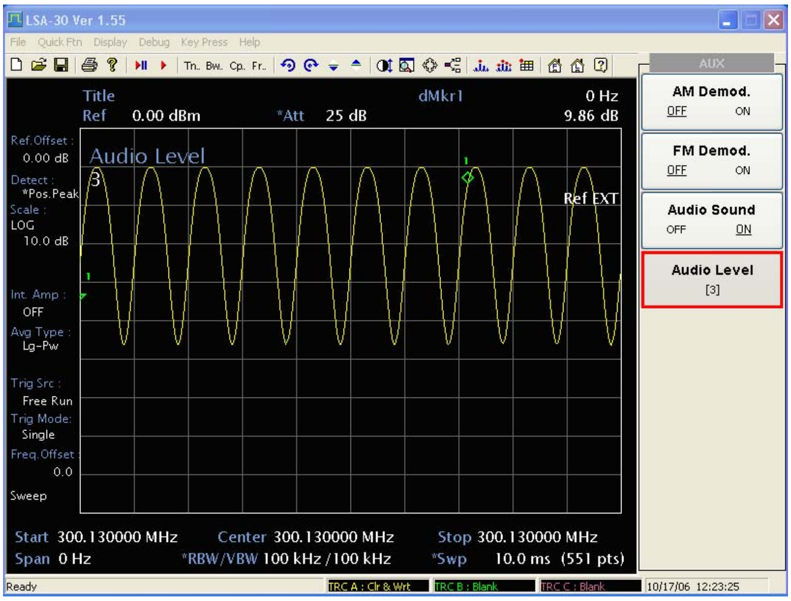


Fig. B-28 Measure the demodulation in zero span

Detailed description of commands

General

This section gives detailed descriptions of the device messages for the spectrum analyzer in functional order. The following example shows the command format.

Note that ‘ ’ = blank throughout this document.

SA command

SCPI command

	Command Name
Function	The explanation of the command.
Remote Command	SA Command□sw
	SA Command□f
	SA Command?
	SCPI Command□sw
	SCPI Command□f
	SCPI Command?
Response Message	sw or f
	(Depending on command)
Value of f	Range of sw or f
	(Depending on command)
Suffix code	Unit of f
	(Depending on command)
Initial setting	Initial value for SA System
Example	SA Command sw;
	SA Command f;
	SA Command?;
	SCPI Command sw;
	SCPI Command f;
	SCPI Command?;

Amplitude

RL

:DISPlay:WINDow:TRACe:Y[:SCALe]:RLEVel

	Reference Level
Function	Sets the reference level value.
Remote Command	RL□f
	RL?
	:DISPlay:WINDow:TRACe:Y[:SCALe]:RLEVel□f
	:DISPlay:WINDow:TRACe:Y[:SCALe]:RLEVel?
Response Message	Reference Level (dBm)
Value of f	–170 dBm to 30 dBm (Step : 0.01 dBm)
Suffix code	None : dBm
	DBM : dBm
Initial setting	0 dBm
Example	RL 10;
	RL 30DBM;
	RL ?;
	DISP:WIND:TRAC:Y:RLEV 10;
	DISP:WIND:TRAC:Y:RLEV 30DBM;
	DISP:WIND:TRAC:Y:RLEV?;

RFL

:DISPlay:LPLot:WINDow:TRACe:Y:RF:LEVel

	RF Level
Function	Sets the RF Level value.
Remote Command	RFL□f
	RFL?
	:DISPlay:LPLot:WINDow:TRACe:Y:RF:LEVel□f
	:DISPlay:LPLot:WINDow:TRACe:Y:RF:LEVel?
Response Message	RF Level (dBm)
Value of f	–99 dBm to 22 dBm (Step : 1 dBm)
Suffix code	None : dBm
	DBM : dBm
Initial setting	0 dBm
Example	RFL 10;
	RFL –30DBM;
	RFL ?;
	DISP:LPL:WIND:TRAC:Y:RF:LEV 10;
	DISP:LPL:WIND:TRAC:Y:RF:LEV –30DBM;
	DISP:LPL:WIND:TRAC:Y:RF:LEV?;

SD

:DISPlay:LPLot:WINDow:TRACe:Y[:SCALe]:PDIVision

	Scale/Divide
Function	Sets the scale/divide value.
Remote Command	SD□f
	SD?
	:DISPlay:LPLot:WINDow:TRACe:Y[:SCALe]:PDIVision□f
	:DISPlay:LPLot:WINDow:TRACe:Y[:SCALe]:PDIVision?
Response Message	Scale/Divide (dB/div)
Value of f	0.1 dB to 1 dB (step : 0.1 dB)
1dB to 20dB (step : 1dB)	
Suffix code	None : dB/div
	DB : dB/div
Initial setting	10 dB/div
Example	SD 5;
	SD 10DB;
	SD?;
	DISP:LPL:WIND:TRAC:Y:PDIV 5;
	DISP:LPL:WIND:TRAC:Y:PDIV 10DB;
	DISP:LPL:WIND:TRAC:Y:PDIV?;

Display

GRAT

:DISPlay:WINDow:TRACe:GRATicule:GRID[:STATe]

	Graticule
Function	Sets the display graticule to Type1 or Type2 or OFF.
Remote Command	GRAT□sw
	GRAT?
	:DISPlay:WINDow:TRACe:GRATicule:GRID[:STATe]□sw
	:DISPlay:WINDow:TRACe:GRATicule:GRID[:STATe]?
Response Message	TYPE1 : Type1
	TYPE2 : Type2
	OFF : OFF
Value of sw	TYPE1 : Type1
	TYPE2 : Type2
	OFF : OFF
Initial setting	TYPE1
Example	GRAT TYPE1;
	GRAT?
	DISP:WIND:TRAC:Y:GRAT:GRID TYPE1;
	DISP:WIND:TRAC:Y:GRAT:GRID?;

WH

:DISPlay:WINDow:WHITe

	White Mode	
Function	Turns the white mode ON or OFF.	
Remote Command	WH□n	
	WH□sw	
	WH?	
	:DISPlay:WINDow:WHITe□n	
	:DISPlay:WINDow:WHITe□sw	
	:DISPlay:WINDow:WHITe?	
Response Message	1	: ON
	0	: OFF
Value of n	1	: ON
	0	: OFF
Value of sw	ON	: ON
	OFF	: OFF
Initial setting	0	
Example	WH 1;	
	WH ON;	
	WH?	
	DISP:WIND:WHIT 1;	
	DISP:WIND:WHIT ON;	
	DISP:WIND:WHIT?;	

File

FREAD

:MMEMory:CATalog

	File Read
Function	Reads files in the selected folder.
Remote Command	FREAD? 'file_folder'
	:MMEMory:CATalog? 'file_folder'
Value of file_folder	File Folder
Response Message	File Name,,File Size.
Example	FREAD? 'C:';
	FREAD? 'D:\Temp';
	MMEM:CAT? 'C:';
	MMEM:CAT? 'D:\Temp';

FSAVE

:MMEMory:STORe

	File Save
Function	Saves the file, type defined by the extension.
Remote Command	FSAVE□'file_name'
	:MMEMory:STORe□'file_name'
Value of file_name	File Path + File Name
Supported Extension	sts : Status
	bmp : Bitmap
	jpg : jpeg
	png : png
	Example FSAVE 'C:\demo1.sts';
	FSAVE 'C:\demo2.trc';
	MMEM:STRO 'C:\demo1.sts';
	MMEM:STRO 'C:\demo2.trc';

FLOAD

:MMEMory:LOAD

	File Load
Function	Loads the selected file.
Remote Command	FLOAD□‘file_name’
	:MMEMory:LOAD□‘file_name’
Value of file_name	File Path + File Name
Supported Extension	sts : Status
Example	FLOAD ‘C:\demo1.sts’;
	MMEM:LOAD ‘C:\demo1.sts’;

FDEL

:MMEMory:DELete

	File Delete
Function	Deletes the selected file.
Remote Command	FDEL□‘file_name’
	:MMEMory:DELete□‘file_name’
Value of file_name	File Path + File Name
Example	FDEL ‘C:\demo1.sts’;
	MMEM:DEL ‘C:\demo1.sts’;

FCOPY

:MMEMory:COPY

	File Copy
Function	Copies the selected file.
Remote Command	FCOPY□'src_file_name', 'dest_file_name'
	:MMEMory:COPY□'src_file_name', 'dest_file_name'
Value of src_file_name, dest_file_name	File Path + File Name
Example	FCOPY 'C:\demo1.sts','D:\demo1.sts';
	MMEM:COPY 'C:\demo1.sts','D:\demo1.sts';

FRENAME

:MMEMory:MOVE

	File Rename
Function	Renames the selected file.
Remote Command	FRENAME□‘src_file_name’,‘dest_file_name’
	:MMEMory:MOVE□‘src_file_name’,‘dest_file_name’
Value of src_file_name, dest_file_name	File Path + File Name
Example	FRENAME ‘C:\demo1.sts’,‘C:\demo1_1.sts’;
	MMEM:MOVE ‘C:\demo1.sts’,‘C:\demo1_1.sts’;

FMOVE

MMEMory:DATA

	File Move
Function	Sends or receives binary data of the selected file. The maximum size of the sent file is 2 Mbyte, and the maximum size of the received file is 30 Mbyte.
Remote Command	FMOVE□‘file_name’,definite_length_block
	FMOVE?□‘file_name’
	MMEMory:DATA□‘file_name’,definite_length_block
	MMEMory:DATA?□‘file_name’
Value of file_name	File Path + File Name
Value of definite_length_block	# + number of file size + file size + file data
Example	FMOVE ‘C:\Sended_Sample.txt’,#14abcd; cf) #+1+4+abcd
	FMOVE? ‘C:\Received_Sample.txt’;
	MMEM:DATA ‘C:\ Sended_Sample.txt’,#14abcd;
	MMEM:DATA? ‘C:\ Received_Sample.txt’;

Frequency

CF

[:SENSe]:FREQuency:CENTer

	Center Frequency
Function	Sets the center frequency.
Remote Command	CF□f
	CF?
	[:SENSe]:FREQuency:CENTer□f
	[:SENSe]:FREQuency:CENTer?
Response Message	Center Frequency (□)
	(Range : 330 MHz to 3.0 GHz)
Value of f	330 MHz to 3.0 GHz
Suffix code	None : Hz (10^0)
	HZ : Hz (10^0)
	KHZ : kHz (10^3)
	MHZ : MHz (10^6)
	GHZ : GHz (10^9)
Initial setting	2 GHz
Example	CF 123456;
	CF 50MHZ;
	CF?;
	FREQ:CEN7T 123456;
	FREQ:CENT 50MHZ;
	FREQ:CENT?;

In/Out

REF

:INPut:REFerence

	Reference
Function	Sets to 10 MHz Reference.
Remote Command	REF□sw
	REF?
	:INPut:REFerence□sw
	:INPut:REFerence?
Response Message	INT : Internal
	EXT : External
Value of sw	INTernal : Internal
	EXTernal : External
Initial setting	INT
Example	REF INT;
	RFC?
	INP:REF INT;
	INP:REF?

LVDSDATA

:INPut:LVDS:DATA

	LVDS Data	
Function	Sets to State of LVDS Data.	
Remote Command	LVDSDATA□sw	
	LVDSDATA?	
	:INPut:LVDS:DATA□sw	
	:INPut:LVDS:DATA?	
Response Message	IN	: Input
	TRI	: Tri-State
	OUT	: Output
Value of sw	Input	: Input
	TRIstate	: Tri-State
	OUTput	: Output
Initial setting	TRI	
Example	LVDSDATA TRI;	
	LVDSDATA?	
	INP:LVDS DATA TRI;	
	INP:LVDS:DATA?	

LVDSMKR

:INPut:LVDS:MARKer

	LVDS Marker	
Function	Sets to State of LVDS Marker.	
Remote Command	LVDSMKR□sw	
	LVDSMKR?	
	:INPut:LVDS:MARKer□sw	
	:INPut:LVDS:MARKer?	
Response Message	IN	: Input
	TRI	: Tri-State
	OUT	: Output
Value of sw	Input	: Input
	TRIstate	: Tri-State
	OUTput	: Output
Initial setting	TRI	
Example	LVDSMKR TRI;	
	LVDSMKR?	
	INP:LVDS MARK TRI;	
	INP:LVDS:MARK?	

LVDSAUX

:INPut:LVDS:AUXiliary

	LVDS Auxiliary	
Function	Sets to State of LVDS Auxiliary.	
Remote Command	LVDSAUX□sw	
	LVDSAUX?	
	:INPut:LVDS:AUXiliary□sw	
	:INPut:LVDS:AUXiliary?	
Response Message	IN	: Input
	TRI	: Tri-State
	OUT	: Output
Value of sw	Input	: Input
	TRIstate	: Tri-State
	OUTput	: Output
Initial setting	TRI	
Example	LVDSAUX TRI;	
	LVDSAUX?	
	INP:LVDS AUX TRI;	
	INP:LVDS:AUX?	

Marker

MS[1~9]

:CALCulate:MARKer[1~9]:STATe

	Marker State	
Function	Sets the selected marker state.	
Remote Command	MS[1~9]□n	
	MS[1~9]□sw	
	MS[1~9]?	
	:CALCulate:CCDF:MARKer[1~9]:STATe□n	
	:CALCulate:CCDF:MARKer[1~9]:STATe□sw	
	:CALCulate:CCDF:MARKer[1~9]:STATe?	
Response Message	1	: ON
	0	: OFF
Value of n	1	: ON
	0	: OFF
Value of sw	ON	: ON
	OFF	: OFF
Initial setting	0	
Example	MS 1;	
	MS5 1;	
	MS5?;	
	CALC:CCDF:MARK:STAT 1;	
	CALC:CCDF:MARK5:STAT ON;	
	CALC:CCDF:MARK5:STAT?	

MM[1~9]

:CALCulate:MARKer[1~9]:MODE

	Marker Mode	
Function	Sets the selected marker to Normal, Delta Mode.	
Remote Command	MM[1~9]□sw	
	MM[1~9]?	
:	CALCulate:MARKer[1~9]:MODE□sw	
	:CALCulate:MARKer[1~9]:MODE?	
Response Message	POS	: Normal
	DELT	: Delta
	OFF	: OFF
Value of sw	POSition	: Normal
	DELTa	: Delta
	BAND	: Band Pair
	SPAN	: Span Pair
	OFF	: OFF
Initial setting	OFF	
Example	MM POS;	
	MM5?;	
	CALC:CCDF:MARK:MODE POS;	
	CALC:CCDF:MARK5:MODE?	

MF[1~9]

:CALCulate:MARKer[1~9]:X

	Marker Frequency	
Function	Sets the marker frequency of the selected marker. If the marker mode is the delta mode, sets the difference value of the marker frequency and the delta marker frequency.	
Remote Command	MF[1~9]□f	
	MF[1~9]?	
	:CALCulate:MARKer[1~9]:X□f	
	:CALCulate:MARKer[1~9]:X?	
Response Message	Marker Frequency (Hz)	
Value of f	Start Frequency to Stop Frequency	
Suffix code	None	: Hz (10^0) (when Readout is Freq or ITime)
	HZ	: Hz (10^0)
	KHZ	: kHz (10^3)
	MHZ	: MHz (10^6)
	GHZ	: GHz (10^9)
Initial setting	Center Frequency	
Example	MF 123456;	
	MF5?;	
	CALC:MARK:X 123456;	
	CALC:MARK5:X 1GHZ;	
	CALC:MARK5:X?	

MA[1~9]

:CALCulate:MARKer[1~9]:Y

	Marker Amplitude
Function	Returns on the amplitude data.
Remote Command	MA[1~9]?
	:CALCulate:MARKer[1~9]:Y?
Response Message	Marker Amplitude (Hz in FREQ or ITIME, sec in PER or TIME)
Example	MA?;
	MA5?
	CALC:MARK:Y?
	CALC:MARK5:Y?

MAO

:CALCulate:LPLot:MARKer:AOFF

	Marker All OFF
Function	Turns off all markers.
Remote Command	MAO
	:CALCulate:LPLot:MARKer:AOFF
Example	MAO;
	CALC:LPL:MARK:AOFF;

Measurement

MEA

:MEASure:STARt

	Measure Start	
Function	Starts the measurement.	
Remote Command	MEA□sw	
	MEA?	
	:MEASure:STARt□sw	
	:MEASure:STARt?	
Response Message	SEM	: Spectral Mask
	PVT	: Power vs Time
	FLAT	: Spectral Flatness
	ACP	: Adjacent Channel Power
	OBW	: Occupied Bandwidth
	CCDF	: CCDF
	CONST	: Constellation
	EVM	: EVM
	NUME	: Numeric Results
Value of sw	SEM	: Spectral Mask
	PVT	: Power vs Time
	FLAT	: Spectral Flatness
	ACP	: Adjacent Channel Power
	OBW	: Occupied Bandwidth
	CCDF	: CCDF
	CONST	: Constellation
	EVM	: EVM
	NUME	: Numeric Results
Example	MEA SEM;	
	MEA?;	
	MEAS:STAR SEM;	
	MEAS:STAR?;	

MEAT

:MEASure:TIME

	Capturing Time
Function	Sets to Capturing Time.
Remote Command	MEAT□f
	MEAT?
	:MEASure:TIME□f
	:MEASure:TIME?
Response Message	Capturing Time (s)
Value of f	1 ms to 20 ms
Suffix	None : s (10^0)
	kSEC : ks (10^3)
	SEC : s (10^0)
	MSEC : ms (10^-3)
Initial setting	2 ms
Example	MEAT 0.001;
	MEAT 1MSEC;
	MEAT?;
	MEA:TIME 0.001;
	MEA:TIME 1MSEC;
	MEA:TIME?;

SEMOUT

:FETCh|MEASure|READ:SEMask

	Spectrum Emission Mask Output
Function	Returns to SEM results table.
Remote Command	SEMOUT?
	:FETCh|MEASure|READ:SEMask?
Response Message	Pass/Fail State, Fail Frequency (Hz), Fail Level (dBm)
Example	SEMOUT?;
	MEAS:SEM?;

PVTOUT

:FETCh|MEASure|READ:PVTime

	Power vs Time Output
Function	Power vs Time
Remote Command	PVTOUT?
	:FETCh|MEASure|READ:PVTime?
Response Message	Average Power(dBm), Peak Power(dBm), Length(s), Pass/Fail State, Rising Pass/Fail State, Rising Time(s), Falling Pass/Fail State, Falling Time(s)
Example	PVTOUT?;
	MEAS:PVT?;

FLATOUT

:FETCh|MEASure|READ:FLATness

	Spectral Flatness
Function	Spectral Flatness
Remote Command	FLATOUT?
	:FETCh|MEASure|READ:FLATness?
Response Message	Pass/Fail State, Upper Pass/Fail State, Lower Pass/Fail State
Example	FLATOUT?;
	MEAS:FLAT?;

ACPOUT

:FETCh|MEASure|READ:ACPower

	ACP Measurement Output
Function	Returns the main channel power level value, the lower adjacent channel power level value and the upper adjacent channel power level value.
Remote Command	ACPOUT?
	:FETCh|MEASure|READ:ACPower?
Response Message	Lower 2nd ACP, Lower 1st ACP, Main CHP, Upper 1st ACP, Upper 2nd ACP(dBm)
Example	ACPOUT?;
	MEAS:ACP?;

OBWOUT

:FETCh|MEASure|READ:OBWidth

	Occupied Bandwidth Output
Function	Occupied Bandwidth
Remote Command	OBWOUT?
	:FETCh|MEASure|READ:OBWidth?
Response Message	Occupied Bandwidth(Hz)
Example	OBWOUT?;
	MEAS:OBW?;

CONSTOUT

:FETCh|MEASure|READ:CONSTellation

	Constellation Output
Function	Constellation
Remote Command	CONSTOUT?
	:FETCh|MEASure|READ:CONSTellation?
Response Message	System Type, Modulation Type, Data Rate(bps), Frequency Error(Hz),Carrier Leakage(dB), EVM RMS(%), EVM Data(%), EVM Pilot(%), Symbol Clock Error(ppm): 802.11a/g
Example	CONSTOUT?;
	MEAS:CONST?;

NUMEOUT

:FETCh|MEASure|READ:NUMEric

	Numeric Results Output
Function	Numeric Results
Remote Command	NUMEOUT?
	:FETCh|MEASure|READ:NUMEric?
Response Message	System Type, Modulation Type, Data Rate(bps), Frequency Error(Hz), Number of PSDU Bits, Number of PSDU Symbols, Carrier Leakage(dB), EVM RMS(%), EVM Peak(%), Chip Clock Error(ppm): 802.11b/g
Example	NUMEOUT?;
	MEAS:NUME?;

CCDFOUT

FETCh|MEASure|READ:CCDF

	CCDF Measurement Output
Function	Returns the Average Power and Average Percent.
Remote Command	CCDFOUT?
	FETCh|MEASure|READ:CCDF?
Response Message	Average Power(dBm), Average Power Percent(%), 10% Level Difference(dB), 1% Level Difference(dB), 0.1% Level Difference(dB), 0.01% Level Difference(dB), 0.001% Level Difference(dB), 0.0001% Level Difference(dB), Crest Level Difference(dB), Burst Length(s), Counts
Example	CCDFOUT?;
	MEAS:CCDF?;

Mode

MODE

:INSTrument[:SELect]

	Mode	
Function	Sets Current Mode.	
Remote Command	MODE□sw	
	MODE?	
	:INSTrument[:SELect]□sw	
	:INSTrument[:SELect]?	
Response Message	SA	: Spectrum Mode
	BASIC	: Basic Mode
	WLAN	: WLAN Mode
Value of sw	SA	: Spectrum Mode
	BASIC	: Basic Mode
	WLAN	: WLAN Mode
Initial setting	SA	
Example	MODE SA;	
	MODE?;	
	INST SA;	
	INST?;	

PRST

:SYSTem:PRESet

	Preset
Function	Executes preset. All instrument parameters are set to default values.
Remote Command	PRST
	:SYSTem:PRESet
Example	PRST;
	SYST:PRES;

Printer

HCOPY

:HCOPy[:IMMediate]

	Hard Copy
Function	Prints entire screen image.
Remote Command	HCOPY
	:HCOPy[:IMMediate]
Example	HCOPY;
	HCOP;

Sweep

CO

:INITiate:CCDF:CONTinuous

	Continuous Sweep
Function	Sets the continuous sweep mode. Repeats active sweep.
Remote Command	CO
	:INITiate:CONTinuous
Example	CO;
	INIT:CONT;

SI

:INITiate[:IMMediate]

	Single Sweep
Function	Sets the single sweep mode. After activating sweep, stops sweep repeating.
Remote Command	SI
	:INITiate[:Immediate]
Example	SI;
	INIT;

Trigger

TSO

:TRIGger[:SEQuence]:SOURce

	Trigger Source
Function	Sets the trigger switch and the trigger source.
Remote Command	TSO□sw
	TSO?
	:TRIGger[:SEQuence]:SOURce□sw
	:TRIGger[:SEQuence]:SOURce?
Response Message	IMM : Selects the Free-run mode
	EXT : Selects the External mode
	INT : Selects the Internal mode
	TIME : Selects the Timer mode
	LDATA : Selects the LVDS Data mode
	LMKR0~4 : Selects the LVDS Marker mode
	LAUX0~4: Selects the LVDS Auxiliary mode
Value of sw	IMMediate : Selects the Free-run mode
	EXTernal : Selects the External mode
	INTernal : Selects the Internal mode
	TIME : Selects the Timer mode
	LDATA : Selects the LVDS Data mode
	LMKR0~4 : Selects the LVDS Marker mode
	LAUX0~4 : Selects the LVDS Auxiliary mode
Initial setting	IMM
Example	TSO IMM;
	TSO?;
	TRIG:SOUR IMM;
	TRIG:SOUR?;

GPIB Common Commands

*CLS

	Clear Status Command
Function	Clears the status byte register.
Remote Command	*CLS
Example	*CLS;

*ESE

	Standard Event Status Enable
Function	Sets the standard event status enable register.
Remote Command	*ESE□n
	*ESE?
Response Message	Register Value
Value of n	0 to 255 : Represents the sum of the bit-weighted values.
Example	*ESE 20:
	*ESE?;

*ESR?

	Standard Event Status Register Query
Function	Returns the current value in the standard event status register.
Remote Command	*ESR?
Response Message	Register Value
Example	*ESR?;

*IDN?

	Identification Query
Function	Returns the model name, etc of the equipment
Remote Command	*IDN?
Response Message	Company, Model, Serial, Version
Example	*IDN?;

*OPC

	Operation Complete Command
Function	Sets the standard event register bit 0 to 1 when the requested action is complete.
Remote Command	*OPC
Example	*OPC;

*OPC?

	Operation Complete Query
Function	Sets the output queue to 1 to generate a MAV summary message when all pending select device operations have completed.
Remote Command	*OPC?
Response Message	1
Example	*OPC?;

*RST

	Rest Command
Function	Resets the device.
Remote Command	*RST
Example	*RST;

*SRE

	Service Request Enable Command
Function	Sets the bits in the service request enable register.
Remote Command	*SRE□n
	*SRE?
Response Message	Register Value
Value of n	0 to 255 : Represents the sum of the bit-weighted values.
Example	*SRE 32;
	*SRE?;

*STB?

Returns Status Byte Command

Function — Returns the current values of the status bytes including the MSS bit.

Remote Command — *STB?

Response Message — Register Value

Bit	Bit Weight	Bit Name	Condition of status byte register
7	128	----	0 = Not used
6	64	MSS	0 = Service not requested 1 = Service requested
5	32	ESB	0 = Event status not generated 1 = Event status generated
4	16	MAV	0 = No data in output queue 1 = Data in output queue
3	8	ESB2	0 = Event status not generated 1 = Event status generated
2	4	----	0 = Not used
1	2	----	0 = Not used
0	1	----	0 = Not used

Example — *STB?;

GPIB Common Command - Others

ESE2

	Event Status Enable (End)
Function	Allows the End Event Status Enable Register to select which bit in the corresponding Event Register cause a TRUE ESB summary message bit 3 when set.
Remote Command	ESE2□n
	ESE2?
Response Message	Register Value
Value of n	0 to 255 : Represents the sum of the bit-weighted values.
Example	ESE2 1;
	ESE2?;

ESR2?

	Event Status Register (End) Query
Function	Allows the sum of binary-weighted event bit values of the End Event Status Register to be read out by converting them to decimal. After readout, the End Event status Register is reset to 0.
Remote Command	ESR2?
Response Message	Register Value

Bit	Bit Weight	Event	Description
7	128	Not used	Not used
6	64	Not used	Not used
5	32	Not used	Not used
4	16	Measurement completed	Measurement has completed (Peak search, OBW, X dB, Noise marker, Freq. Counter, Limit Pass/Fail..)
3	8	AUTO TUNE completed	AUTO TUNE has completed.
2	4	Averaging completed	Sweeping according to the specified AVERAGE number has completed.
1	2	Calibration completed	Temp Cal, Pre-Filter Cal, ZNC Cal,. Level Cal.. has completed.
0	1	Sweep completed	A single sweep has completed or is in standby.

Example ESR2?;

ERR

	Error Code
Function	Returns the error code of the current function. The error code is cleared.
Remote Command	ERR?
Response Message	Error code
Example	ERR?;

Remote commands

< Catalog Order (WLAN Mode) >

<table>
<tr><th>Index</th><th>Description</th><th>SA Command</th><th>SCPI Command</th><th>Suffix</th></tr>
<tr><td>Amplitude</td><td>Ref. Level</td><td>RL</td><td>:DISPlay:WINDow:TRACe:Y[:SCALe]:RLEVel</td><td><amplitude>|?</td></tr>
<tr><td>Amplitude</td><td>RF Level</td><td>RFL</td><td>:DISPlay:WINDow:TRACe:Y:RF:LEVel</td><td><amplitude>|?</td></tr>
<tr><td>Amplitude</td><td>Scale/Div</td><td>SD</td><td>:DISPlay:WINDow:TRACe:Y[:SCALe]:PDIVision</td><td><amplitude>|?</td></tr>
<tr><td>Display</td><td>Graticule</td><td>GRAT</td><td>:DISPlay:WINDow:TRACe:GRATicule:GRID[:STATe]</td><td>OFF|ON|0|1|?</td></tr>
<tr><td>Display</td><td>White Mode</td><td>WH</td><td>:DISPlay:WINDow:WHITe</td><td>OFF|ON|0|1|?</td></tr>
<tr><td>File</td><td>Read</td><td>FREAD</td><td>:MMEMory:CATalog</td><td>? <`directory_name'></td></tr>
<tr><td>File</td><td>Save</td><td>FSAVE</td><td>:MMEMory:STORe</td><td><`file_name'></td></tr>
<tr><td>File</td><td>Load</td><td>FLOAD</td><td>:MMEMory:LOAD</td><td><`file_name'></td></tr>
<tr><td>File</td><td>Delete</td><td>FDEL</td><td>:MMEMory:DELete</td><td><`file_name'></td></tr>
<tr><td>File</td><td>Copy</td><td>FCOPY</td><td>:MMEMory:COPY</td><td><`file_name1'>,<`file_name2'></td></tr>
<tr><td>File</td><td>Rename</td><td>FRENAME</td><td>:MMEMory:MOVE</td><td><`file_name1'>,<`file_name2'></td></tr>
<tr><td>File</td><td>Move</td><td>FMOVE</td><td>:MMEMory:DATA</td><td><`file_name'>,definite_length_block|? <'file_name></td></tr>
<tr><td>Frequency</td><td>Center Frequency</td><td>CF</td><td>[:SENSe]:FREQuency:CENTer</td><td><frequency>|?</td></tr>
<tr><td>In/Out</td><td>Reference</td><td>REF</td><td>:INPut:REFerence</td><td>INTernal|EXTernal|?</td></tr>
<tr><td>In/Out</td><td>LVDS Data</td><td>LVDSDATA</td><td>:INPut:LVDS:DATA</td><td>Input|TRIstate|OUTput|?</td></tr>
<tr><td>In/Out</td><td>LVDS Maker</td><td>LVDSMKR</td><td>:INPut:LVDS:MARKer</td><td>Input|TRIstate|OUTput|?</td></tr>
<tr><td>In/Out</td><td>LVDS Aux</td><td>LVDSAUX</td><td>:INPut:LVDS:AUXiliary</td><td>Input|TRIstate|OUTput|?</td></tr>
<tr><td>Marker</td><td>Marker State</td><td>MS[1~9]</td><td>:CALCulate:MARKer[1~9]:STATe</td><td>OFF|ON|0|1|?</td></tr>
</table>

Index	Description	SA Command	SCPI Command	Suffix
Marker	Marker Mode	MM[1~9]	:CALCulate:MARKer[1~9]:MODE	POSition|DELTa|BAND|SPAN|OFF|?
Marker	Marker Freq	MF[1~9]	:CALCulate:MARKer[1~9]:X	<frequency>|?
Marker	Marker Amplitude	MA[1~9]	:CALCulate:MARKer[1~9]:Y	?
Marker	Marker All Off	MAO	:CALCulate:LPLot:MARKer:AOFF	none
Measurement	Meas. Start	MEA	:MEASure:STARt	SEM|PVT|FLAT|ACP|OBW|CCDF|CONST|EVM|NUME|?
Measurement	Meas. Time	MEAT	:MEASure:TIME	<time>|?
Measurement	Spectral Mask Output	SEMOUT	:FETCh|MEASure|READ:SEMask	?
Measurement	Power vs Time Output	PVTOUT	:FETCh|MEASure|READ:PVTime	?
Measurement	Spectral Flatness	FLATOUT	:FETCh|MEASure|READ:FLATness	?
Measurement	Adjacent Channel Power	ACPOUT	:FETCh|MEASure|READ:ACPower	?
Measurement	Occupied Bandwidth	OBWOUT	:FETCh|MEASure|READ:OBWidth	?
Measurement	EVM OUTPUT	EVMOUT	:FETCh|MEASure|READ:EVM	?
Measurement	Constellation Output	CONSTOUT	:FETCh|MEASure|READ:CONSTellation	?
Measurement	Numeric Results Output	NUMEOUT	:FETCh|MEASure|READ:NUMEric	?
Measurement	CCDF Output	CCDFOUT	:FETCh|MEASure|READ:CCDF	?
Mode	Mode	MODE	:INSTrument[:SELect]	SA|BASIC|WLAN|?
Preset	Preset	PRST	:SYSTem:PRESet	none
Printer	Hard Copy	HCOPY	:HCOPy[:IMMediate]	none
Sweep	Single	SI	:INITiate:LPLot[:IMMediate]	none
Sweep	Continuous	CO	:INITiate:LPLot:CONTinuous	OFF|ON|0|1|?
Trigger	Trigger Source	TSO	:TRIGger[:SEQuence]:SOURce	IMMediate|EXTernal|INTernal|TIME|LDATA|LMKR0~4|LAUX0~4|?
Common	*CLS	*CLS	*CLS	none
Common	*ESE	*ESE	*ESE	<integer>|?
Common	*ESR	*ESR	*ESR	?

Index	Description	SA Command	SCPI Command	Suffix
Common	*IDN	*IDN	*IDN	?
Common	*OPC	*OPC	*OPC	?
Common	*RST	*RST	*RST	none
Common	*SRE	*SRE	*SRE	<integer>|?
Common	*STB	*STB	*STB	?
Others	ESE2	ESE2		<integer>|?
Others	ESR2	ESR2		?
Others	Error Code	ERR		?

< SA Command Order (WLAN Mode) >

Index	Description	SA Command	SCPI Command	Suffix
Common	*CLS	*CLS	*CLS	none
Common	*ESE	*ESE	*ESE	<integer>|?
Common	*ESR	*ESR	*ESR	?
Common	*IDN	*IDN	*IDN	?
Common	*OPC	*OPC	*OPC	?
Common	*RST	*RST	*RST	none
Common	*SRE	*SRE	*SRE	<integer>|?
Common	*STB	*STB	*STB	?
Measurement	Adjacent Channel Power	ACPOUT	:FETCh|MEASure|READ:ACPower	?
Measurement	CCDF Output	CCDFOUT	:FETCh|MEASure|READ:CCDF	?
Frequency	Center Frequency	CF	[:SENSe]:FREQuency:CENTer	<frequency>|?
Sweep	Continuous	CO	:INITiate:LPLot:CONTinuous	OFF|ON|0|1|?
Measurement	Constellation Output	CONSTOUT	:FETCh|MEASure|READ:CONSTellation	?
Others	Error Code	ERR		?
Others	ESE2	ESE2		<integer>|?
Others	ESR2	ESR2		?
Measurement	EVM OUTPUT	EVMOUT	:FETCh|MEASure|READ:EVM	?
File	Copy	FCOPY	:MMEMory:COPY	<`file_name1'>,<`file_name2'>
File	Delete	FDEL	:MMEMory:DELete	<`file_name'>
Measurement	Spectral Flatness	FLATOUT	:FETCh|MEASure|READ:FLATness	?
File	Load	FLOAD	:MMEMory:LOAD	<`file_name'>
File	Move	FMOVE	:MMEMory:DATA	<`file_name'>,definite_length_block|? <'file_name>

Index	Description	SA Command	SCPI Command	Suffix
File	Read	FREAD	:MMEMory:CATalog	? <`directory_name'>
File	Rename	FRENAME	:MMEMory:MOVE	<`file_name1'>,<`file_name2'>
File	Save	FSAVE	:MMEMory:STORe	<`file_name'>
Display	Graticule	GRAT	:DISPlay:WINDow:TRACe:GRATicule:GRID[:STATe]	OFF|ON|0|1|?
Printer	Hard Copy	HCOPY	:HCOPy[:IMMediate]	none
In/Out	LVDS Aux	LVDSAUX	:INPut:LVDS:AUXiliary	Input|TRIstate|OUTput|?
In/Out	LVDS Data	LVDSDATA	:INPut:LVDS:DATA	Input|TRIstate|OUTput|?
In/Out	LVDS Maker	LVDSMKR	:INPut:LVDS:MARKer	Input|TRIstate|OUTput|?
Marker	Marker Amplitude	MA[1~9]	:CALCulate:MARKer[1~9]:Y	?
Marker	Marker All Off	MAO	:CALCulate:LPLot:MARKer:AOFF	none
Measurement	Meas. Start	MEA	:MEASure:STARt	SEM|PVT|FLAT|ACP|OBW|CCDF|CONST|EVM|NUME|?
Measurement	Meas. Time	MEAT	:MEASure:TIME	<time>|?
Marker	Marker Freq	MF[1~9]	:CALCulate:MARKer[1~9]:X	<frequency>|?
Marker	Marker Mode	MM[1~9]	:CALCulate:MARKer[1~9]:MODE	POSition|DELTa|BAND|SPAN|OFF|?
Mode	Mode	MODE	:INSTrument[:SELect]	SA|BASIC|WLAN|?
Marker	Marker State	MS[1~9]	:CALCulate:MARKer[1~9]:STATe	OFF|ON|0|1|?
Measurement	Numeric Results Output	NUMEOUT	:FETCh|MEASure|READ:NUMEric	?
Measurement	Occupied Bandwidth	OBWOUT	:FETCh|MEASure|READ:OBWidth	?
Preset	Preset	PRST	:SYSTem:PRESet	none
Measurement	Power vs Time Output	PVTOUT	:FETCh|MEASure|READ:PVTime	?
In/Out	Reference	REF	:INPut:REFerence	INTernal|EXTernal|?
Amplitude	RF Level	RFL	:DISPlay:WINDow:TRACe:Y:RF:LEVel	<amplitude>|?
Amplitude	Ref. Level	RL	:DISPlay:WINDow:TRACe:Y[:SCALe]:RLEVel	<amplitude>|?
Amplitude	Scale/Div	SD	:DISPlay:WINDow:TRACe:Y[:SCALe]:PDIVision	<amplitude>|?

Index	Description	SA Command	SCPI Command	Suffix
Measurement	Spectral Mask Output	SEMOUT	:FETCh|MEASure|READ:SEMask	?
Sweep	Single	SI	:INITiate:LPLot[:IMMediate]	none
Trigger	Trigger Source	TSO	:TRIGger[:SEQuence]:SOURce	IMMediate|EXTernal|INTernal|TIME|LDATA|LMKR0~4|LAUX0~4|?
Display	White Mode	WH	:DISPlay:WINDow:WHITe	OFF|ON|0|1|?

< SCPI Command Order (WLAN Mode) >

Index	Description	SA Command	SCPI Command	Suffix
Common	*CLS	*CLS	*CLS	none
Common	*ESE	*ESE	*ESE	<integer>|?
Common	*ESR	*ESR	*ESR	?
Common	*IDN	*IDN	*IDN	?
Common	*OPC	*OPC	*OPC	?
Common	*RST	*RST	*RST	none
Common	*SRE	*SRE	*SRE	<integer>|?
Common	*STB	*STB	*STB	?
Marker	Marker All Off	MAO	:CALCulate:LPLot:MARKer:AOFF	none
Marker	Marker Mode	MM[1~9]	:CALCulate:MARKer[1~9]:MODE	POSition|DELTa|BAND|SPAN|OFF|?
Marker	Marker State	MS[1~9]	:CALCulate:MARKer[1~9]:STATe	OFF|ON|0|1|?
Marker	Marker Freq	MF[1~9]	:CALCulate:MARKer[1~9]:X	<frequency>|?
Marker	Marker Amplitude	MA[1~9]	:CALCulate:MARKer[1~9]:Y	?
Display	Graticule	GRAT	:DISPlay:WINDow:TRACe:GRATicule:GRID[:STATe]	OFF|ON|0|1|?
Amplitude	RF Level	RFL	:DISPlay:WINDow:TRACe:Y:RF:LEVel	<amplitude>|?
Amplitude	Scale/Div	SD	:DISPlay:WINDow:TRACe:Y[:SCALe]:PDIVision	<amplitude>|?
Amplitude	Ref. Level	RL	:DISPlay:WINDow:TRACe:Y[:SCALe]:RLEVel	<amplitude>|?
Display	White Mode	WH	:DISPlay:WINDow:WHITe	OFF|ON|0|1|?
Measurement	Adjacent Channel Power	ACPOUT	:FETCh|MEASure|READ:ACPower	?
Measurement	CCDF Output	CCDFOUT	:FETCh|MEASure|READ:CCDF	?
Measurement	Constellation Output	CONSTOUT	:FETCh|MEASure|READ:CONSTellation	?
Measurement	EVM OUTPUT	EVMOUT	:FETCh|MEASure|READ:EVM	?

Index	Description	SA Command	SCPI Command	Suffix
Measurement	Spectral Flatness	FLATOUT	:FETCh|MEASure|READ:FLATness	?
Measurement	Numeric Results Output	NUMEOUT	:FETCh|MEASure|READ:NUMEric	?
Measurement	Occupied Bandwidth	OBWOUT	:FETCh|MEASure|READ:OBWidth	?
Measurement	Power vs Time Output	PVTOUT	:FETCh|MEASure|READ:PVTime	?
Measurement	Spectral Mask Output	SEMOUT	:FETCh|MEASure|READ:SEMask	?
Printer	Hard Copy	HCOPY	:HCOPy[:IMMediate]	none
Sweep	Continuous	CO	:INITiate:LPLot:CONTinuous	OFF|ON|0|1|?
Sweep	Single	SI	:INITiate:LPLot[:IMMediate]	none
In/Out	LVDS Aux	LVDSAUX	:INPut:LVDS:AUXiliary	Input|TRIstate|OUTput|?
In/Out	LVDS Data	LVDSDATA	:INPut:LVDS:DATA	Input|TRIstate|OUTput|?
In/Out	LVDS Maker	LVDSMKR	:INPut:LVDS:MARKer	Input|TRIstate|OUTput|?
In/Out	Reference	REF	:INPut:REFerence	INTernal|EXTernal|?
Mode	Mode	MODE	:INSTrument[:SELect]	SA|BASIC|WLAN|?
Measurement	Meas. Start	MEA	:MEASure:STARt	SEM|PVT|FLAT|ACP|OBW|CCDF|CONST|EVM|NUME|?
Measurement	Meas. Time	MEAT	:MEASure:TIME	<time>|?
File	Read	FREAD	:MMEMory:CATalog	? <`directory_name'>
File	Copy	FCOPY	:MMEMory:COPY	<`file_name1'>,<`file_name2'>
File	Move	FMOVE	:MMEMory:DATA	<`file_name'>,definite_length_block|? <'file_name>
File	Delete	FDEL	:MMEMory:DELete	<`file_name'>
File	Load	FLOAD	:MMEMory:LOAD	<`file_name'>
File	Rename	FRENAME	:MMEMory:MOVE	<`file_name1'>,<`file_name2'>
File	Save	FSAVE	:MMEMory:STORe	<`file_name'>
Preset	Preset	PRST	:SYSTem:PRESet	none
Trigger	Trigger Source	TSO	:TRIGger[:SEQuence]:SOURce	IMMediate|EXTernal|INTernal|TIME|LDATA|LMKR0~4|LAUX0~4|?

Index	Description	SA Command	SCPI Command	Suffix
Frequency	Center Frequency	CF	[:SENSe]:FREQuency:CENTer	<frequency>|?

AEROFLEX INTERNATIONAL LTD.
SOFTWARE LICENCE AND WARRANTY

This document is an Agreement between the user of this Licensed Software, the Licensee, and Aeroflex International Limited, the Licensor. By opening this Software package or commencing to use the software you accept the terms of this Agreement. If you do not agree to the terms of this Agreement please return the Software package unopened to Aeroflex International Limited or do not use the software.

1. DEFINITIONS

The following expressions will have the meanings set out below for the purposes of this Agreement:

Add-In Application Software	Licensed Software that may be loaded separately from time to time into the Equipment to improve or modify its functionality
Computer Application Software	Licensed Software supplied to run on a standard PC or workstation
Designated Equipment	the single piece of Equipment upon which the licensed software is installed
Downloaded Software	any software downloaded from an Aeroflex web site
Embedded Software	Licensed Software that forms part of the Equipment supplied by Aeroflex and without which the Equipment cannot function
Licence Fee	the consideration ruling at the date of this Agreement for the use of one copy of the Licensed Software on the Designated Equipment
Licensed Software	All and any programs, listings, flow charts and instructions in whole or in part including Add-in, Computer Application, Downloaded and Embedded Software supplied to work with Designated Equipment

2. LICENCE FEE

The Licensee shall pay the Licence Fee to Aeroflex in accordance with the terms of the contract between the Licensee and Aeroflex.

3. TERM

This Agreement shall be effective from the date hereof and shall continue in force until terminated under the provisions of Clause 9.

4. LICENCE

4.1 Unless and until terminated, this Licence confers upon the Licensee the non-transferable and non-exclusive right to use the Licensed Software on the Designated Equipment.

4.2 The Licensee may not use the Licensed Software on other than the Designated Equipment, unless written permission is first obtained from Aeroflex and until the appropriate additional Licence Fee has been paid to Aeroflex.

4.3 The Licensee may not amend or alter the Licensed Software and shall have no right or licence other than that stipulated herein.

4.4 The Licensee may make not more than two copies of the Licensed Software (but not the Authoring and Language Manuals) in machine-readable form for operational security and shall ensure that all such copies include Aeroflex's copyright notice, together with any features which disclose the name of the Licensed Software and the Licensee. Furthermore, the Licensee shall not permit the Licensed Software or any part to be disclosed in any form to any third party and shall maintain the Licensed Software in secure premises to prevent any unauthorised disclosure. The Licensee shall notify Aeroflex immediately if the Licensee has knowledge that any unlicensed party possesses the Licensed Software. The Licensee's obligation to maintain confidentiality shall cease when the Licensed Software and all copies have been destroyed or returned. The copyright in the Licensed Software shall remain with Aeroflex. The Licensee will permit Aeroflex at all reasonable times to audit the use of the Licensed Software.

4.5 The Licensee will not disassemble or reverse engineer the Licensed Software, nor sub-licence, lease, rent or part with possession or otherwise transfer the whole or any part of the Licensed Software.

5 WARRANTY

5.1 Aeroflex certifies that the Licensed Software supplied by Aeroflex will at the time of delivery function substantially in accordance with the applicable Software Product Descriptions, Data Sheets or Product Specifications published by Aeroflex.

5.2 The warranty period (unless an extended warranty for Embedded Software has been purchased) from date of delivery in respect of each type of Licensed Software is:

Embedded Software	12 months
Add-In Application Software	90 days
Computer Application Software	90 days
Downloaded Software	No warranty

5.3 If during the appropriate Warranty Period the Licensed Software does not conform substantially to the Software Product Descriptions, Data Sheets or Product Specifications Aeroflex will provide:

5.3.1 In the case of Embedded Software and at Aeroflex's discretion either a fix for the problem or an effective and efficient work-around.

5.3.2 In the case of Add-In Application Software and Computer Application Software and at Aeroflex's discretion replacement of the software or a fix for the problem or an effective and efficient work-around.

5.4 Aeroflex does not warrant that the operation of any software will be uninterrupted or error free.

6 The above Warranty does not apply to:

6.1 Defects resulting from software not supplied by Aeroflex, from unauthorised modification or misuse or from operation outside of the specification.

6.2 Third party produced Proprietary Software which Aeroflex may deliver with its products, in such case the third party Software Licence Agreement including its warranty terms shall apply.

7 The remedies offered above are sole and exclusive remedies and to the extent permitted by applicable law are in lieu of any implied conditions, guarantees or warranties whatsoever and whether statutory or otherwise as to the software all of which are hereby expressly excluded.

8. INDEMNITY

8.1 Aeroflex shall defend, at its expense, any action brought against the Licensee alleging that the Licensed Software infringes any patent, registered design, trademark or copyright, and shall pay all Licensor's costs and damages finally awarded up to an aggregate equivalent to the Licence fee provided the Licensee shall not have done or permitted to be done anything which may have been or become any such infringement and shall have exercised reasonable care in protecting the same failing which the Licensee shall indemnify Aeroflex against all claims costs and damages incurred and that Aeroflex is given prompt written notice of such claim and given information, reasonable assistance and sole authority to defend or settle such claim on behalf of the Licensee. In the defence or settlement of any such claim, Aeroflex may obtain for the Licensee the right to continue using the Licensed Software or replace it or modify it so that it becomes non-infringing.

8.2 Aeroflex shall not be liable if the alleged infringement:

8.2.1 is based upon the use of the Licensed Software in combination with other software not furnished by Aeroflex, or

8.2.2 is based upon the use of the Licensed Software alone or in combination with other software in equipment not functionally identical to the Designated Equipment, or

8.2.3 arises as a result of Aeroflex having followed a properly authorised design or instruction of the Licensee, or

8.2.4 arises out of the use of the Licensed Software in a country other than the one disclosed to Aeroflex as the intended country of use of the Licensed Software at the commencement of this Agreement.

8.3 Aeroflex shall not be liable to the Licensee for any loss of use or for loss of profits or of contracts arising directly or indirectly out of any such infringement of patent, registered design, trademark or copyright.

9. TERMINATION

9.1 Notwithstanding anything herein to the contrary, this Licence shall forthwith determine if the Licensee:

9.1.1 As an individual has a Receiving Order made against him or is adjudicated bankrupt or compounds with creditors or as a corporate body, compounds with creditors or has a winding-up order made against it or

9.1.2 Parts with possession of the Designated Equipment.

9.2 This Licence may be terminated by notice in writing to the Licensee if the Licensee shall be in breach of any of its obligations hereunder and continue in such breach for a period of 21 days after notice thereof has been served on the Licensee.

9.3 On termination of this Agreement for any reason, Aeroflex may require the Licensee to return to Aeroflex all copies of the Licensed Software in the custody of the Licensee and the Licensee shall, at its own cost and expense, comply with such requirement within 14 days and shall, at the same time, certify to Aeroflex in writing that all copies of the Licensed Software in whatever form have been obliterated from the Designated Equipment.

10. THIRD PARTY LICENCES

The software or part thereof may be the proprietary property of third party licensors. In such an event such third party licensors (as referenced on the package or the Order Acknowledgement) and/or Aeroflex may directly enforce the terms of this Agreement and may terminate the Agreement if the Licensee is in breach of the conditions contained herein.

11. EXPORT REGULATIONS

The Licensee undertakes that where necessary the Licensee will conform with all relevant export regulations imposed by the Governments of the United Kingdom and/or the United State of America.

12. NOTICES

Any notice to be given by the Licensee to Aeroflex shall be addressed to:

Aeroflex International Limited, Longacres House, Six Hills Way, Stevenage, SG1 2AN, UK.

13. LAW AND JURISDICTION

This Agreement shall be governed by the laws of England and shall be subject to the exclusive jurisdiction of the English courts. This agreement constitutes the whole Contract between the parties and may be changed only by memorandum signed by both parties.

CHINA Beijing
Tel: [+86] (10) 6539 1166
Fax: [+86] (10) 6539 1778

CHINA Shanghai
Tel: [+86] (21) 5109 5128
Fax: [+86] (21) 5150 6112

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 8131 2926-0
Fax: [+49] 8131 2926-130

HONG KONG
Tel: [+852] 2832 7988
Fax: [+852] 2834 5364

INDIA
Tel: [+91] 80 5115 4501
Fax: [+91] 80 5115 4502

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SPAIN
Tel: [+34] (91) 640 11 34
Fax: [+34] (91) 640 06 40

UK Burnham
Tel: [+44] (0) 1628 604455
Fax: [+44] (0) 1628 662017

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (316) 522 4981
Fax: [+1] (316) 522 1360
Toll Free: (800) 835 2352

web **www.aeroflex.com** Email **info-test@aeroflex.com**

November 2005