FFT ANALYZER

2309

Operating Manual

Document part no. 46892/415

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2309

100 MHz–2.4 GHz

This manual applies to instruments with software issues of 2.50 and higher.

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About this manual

This manual explains how to use the 2309 FFT Analyzer.

Intended audience

Persons engaged on work requiring very fast and accurate spectrum analysis with high resolution and wide dynamic range.

It is assumed that the reader will be familiar with telecommunication terms used in modern communication systems.

Structure

Chapter 1	Main features and performance data
Chapter 2	Installation details
Chapter 3	Local operation
Chapter 4	GPIB operation with keywords and sample programs
Chapter 5	Brief technical description
Chapter 6	Instructions for acceptance testing
Annex A	Intermodulation distortion measurement

Document conventions

The following conventions apply throughout this manual:

PROBE	Titles marked on the instrument panel are shown in capital letters.
[SPECTRUM]	Hard-key titles are as shown on the keys, within square brackets.
[Input Level]	Soft keys are shown in italics in square brackets.
Ref. Level	Messages appearing on the screen are shown in italics.

Associated publications

Other publications covering specific aspects of this equipment are:

Maintenance Manual	(46882/337)	Covers maintenance and repair of the equipment.
Service Manual	(46880/091)	Consists of Operating Manual (this document) plus Maintenance Manual.

Contents

Preface

Patent protection

The 2309 FFT Analyzer is protected by the following patents:

EP 0322139

GB 2214012

US 4870384

EP 0125790

GB 2140232

US 4609881

EP 0635176

EP 0526017

US 5668552

GB 2266018

GB 2256331

US 5392039

US 5781600

GB 2294599

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.**

Hazard 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.
	Toxic hazard

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 stabilise 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 'Performance data', 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.

Fuses

Note that the internal supply fuse is in series with the live conductor of the supply lead. If connection is made to a 2-pin unpolarized supply socket, it is possible for the fuse to become

transposed to the neutral conductor, in which case, parts of the equipment could remain at supply potential even after the fuse has ruptured.

WARNING

RF hazard

Do not disconnect RF cables which are carrying high levels of RF power. High voltages, which can cause RF burns, may be present at the end of the unterminated cables due to standing waves.

Switch off the transmitter or other source of RF power before disconnecting the cable from the equipment.

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. See under ‘Performance data’ in Chapter 1 for power requirements.

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

Beryllia

Beryllia (beryllium oxide) is used in the construction of some of the components in this equipment.

This material, when in the form of fine dust or vapor and inhaled into the lungs, can cause a respiratory disease. In its solid form, as used here, it can be handled quite safely although it is prudent to avoid handling conditions which promote dust formation by surface abrasion.

Because of this hazard, you are advised to be very careful in removing and disposing of these components. Do not put them in the general industrial or domestic waste or dispatch them by post. They should be separately and securely packed and clearly identified to show the nature of the hazard and then disposed of in a safe manner by an authorized toxic waste contractor.

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

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 Manual for handling precautions.

CAUTION

Suitability for use

This equipment has been designed and manufactured by Aeroflex to provide spectrum analysis of RF signals.

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.
	Danger produits toxiques

Conditions générales d'utilisation

Ce produit e été conçu et testé pour être conforme aux exigences des normes CEI/EN61010-1 « exigences de sécurité des équipements électriques pour la mesure, le contrôle et l'usage en 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 I, 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.

Fusibles

Notez que le fusible d'alimentation interne est en série avec la phase (fil brun) du cable d'alimentation. Si la prise d'alimentation comporte deux bornes non polarisées, il est possible de connecter le fusible au neutre. Dans ce cas, certaines parties de l'appareil peuvent rester à un certain potentiel même après coupure du fusible.

WARNING

Risque lie 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. Pour la consommation, reportez-vous au "Performance data" dans le chapitre 1.

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

Le Béryllia

Le Béryllia (oxyde de Béryllium) entre dans la composition de certains composants de cet appareil.

Cette matière peut, lorsqu'elle est inhalée sous forme de vapeur ou de fine poussière, être la cause de maladies respiratoires. Sous sa forme solide, comme c'est le cas ici, cette matière peut être manipulée sans risque, bien qu'il soit conseillé d'éviter toute manipulation pouvant entraîner la formation de poussière par abrasion de la surface.

Il est donc conseillé, pour éviter ce risque, de prendre les précautions requises pour retirer ces composants et s'en débarrasser. Ne les jetez pas avec les déchets industriels ou domestiques ou ne les envoyez pas par la poste. Il faut les emballer séparément et solidement et bien indiquer la nature du risque avant de les céder, avec précautions, à une entreprise spécialisée dans le traitement de déchets toxiques.

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

Position inclinée

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

CAUTION

Utilisation

Cet équipement a été conçu et fabriqué par Aeroflex pour analyser le spectre de signaux RF.

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.
	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 Standorterändерung 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 in Kapitel 1 "Leistungsdaten (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 I 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.

Sicherungen

Die interne Sicherung in der Spannungszuführung ist in Reihe mit der spannungsführenden Zuleitung (braun) geschaltet. Bei Verbindung mit einer zweiadrigen, nicht gepolten Steckdose kann die Sicherung in der Masseleitung liegen, so daß auch bei geschmolzener Sicherung Geräteteile immer noch auf Spannungspotential sind.

WARNING

Feuergefahr

Es dürfen nur Ersatzsicherungen vom gleichen Typ mit den korrekten Spezifikationen entsprechend der Stromaufnahme des Gerätes verwendet werden. Siehe hierzu die Leistungsdaten (Performance data) in Kapitel 1.

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 Oxid

Beryllium Oxid wird in einigen Bauelementen verwendet.

Als Staub inhaliert kann Beryllium zu Schädigungen der Atemwege führen. In fester Form kann es ohne Gefahr gehandhabt werden, wobei Staubabrieb vermieden werden sollte.
Wegen dieser Gefahren dürfen diese Bauelemente nur mit der entsprechenden Vorsicht ausgebaut und entsorgt werden. Sie dürfen nicht mit Industrie oder Hausmüll vermengt oder per Post versandt werden. Sie müssen separat verpackt und entsprechend der Gefährdung markiert werden. Die Entsorgung muß über einen autorisierten Fachbetrieb erfolgen.

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

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 Spektrumanalyse an HF Signalen 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.
	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 a c.c.)

Quest' apparato è provvisto del collegamento di protezione di terra e rispetta le norme di sicurezza IEC, classe I. 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.

Fusibili

Notare che un fusibile è posto sul filo caldo (marrone) del cavo di alimentazione. Qualora l'alimentazione avvenga tramite due poli non polarizzati, è possibile che il fusibile vada a

protezione del neutro per cui anche in caso di una sua rottura, l'apparato potrebbe restare sotto tensione.

WARNING

Pericolo d'incendio

Assicurarsi che, in caso di sostituzione, vengano utilizzati solo fusibili della portata e del tipo prescritto.

Se viene usata una spina con fusibili, assicurarsi che questi siano di portata adeguata ai requisiti di alimentazione richiesti dallo strumento. Tali requisiti sono riportati nel cap. 1 “Performance data”.

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

Berillio

Berillio (ossido di berillio) è utilizzato nella costruzione di alcuni componenti di quest’apparato.

Questo materiale, se inalato sotto forma di polvere fine o vapore, può causare malattie respiratorie. Allo stato solido, come è usato qui, può essere maneggiato con sufficiente sicurezza anche se è prudente evitare condizioni che provochino la formazione di polveri tramite abrasioni superficiali.

A cause di questi pericoli occorre essere molto prudenti nella rimozione e nella locazione di questi componenti. Questi non devono essere gettati tra i rifiuti domestici o industriali né. vanno spediti per posta. Essi devono essere impacchettati separatamente ed in modo sicuro e devono indicare chiaramente la natura del pericolo e quindi affidate a personale autorizzato.

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

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 analisi spettrale sui segnali RF.

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.
	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. Sólo debe utilizarse el aparato en las condiciones ambientales especificadas en el capítulo 1 “Especificaciones” o “Performance data” del Manual de Operación, 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 I, 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 fusible de alimentación interno está enserie con el activo (marrón) del cable de alimentación a red. Si la clavija de alimentación de red cuenta con sólo dos terminales sin

polaridad, el fusible puede pasar a estar en serie con el neutro, en cuyo caso existen partes del equipo que permanecerían a tensión de red incluso después de que el fusible haya fundido.

WARNING

Peligro de incendio

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

Si se utiliza una clavija con fusible incorporado, asegúrese de que los valores del fusible corresponden a los requeridos por el equipo. Ver sección de especificaciones del 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

Berilio (óxido de berilio) Este material es utilizado en la fabricación de alguno de los componentes de este equipo.

La inhalación de este material, en forma de polvo fino o vapor, entrando en los pulmones, puede ser causa de enfermedades respiratorias. En forma sólida, como se utiliza en este caso, puede manipularse con bastante seguridad, aunque se recomienda no manejarlo en aquellas condiciones que pudieran favorecer la aparición de polvo por abrasión de la superficie.

Por todo lo anterior, se recomienda tener el máximo cuidado al reemplazar o deshacerse de estos componentes, no tirándolos en basuras industriales o domésticas y no utilizar el correo para su envío. Deben, ser empaquetados de forma segura y separada, y el paquete debidamente etiquetado e identificado, señalando claramente la naturaleza del riesgo y ponerlo a disposición de un destructor autorizado de productos tóxicos.

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

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 análisis espectral de señales de RF.

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

Introduction

The 2309 is a precision FFT (Fast Fourier Transform) analyzer for design, production and laboratory use, covering the frequency range 100 MHz to 2.4 GHz. The instrument makes very high speed or high resolution FFT measurements, whilst its low-noise local oscillator allows accurate measurements close to the carrier or noise floor. Intermodulation measurements are possible over the full frequency range.

The 2309 includes both low-power (sensitive) and high-power DC-coupled inputs.

All parameters can be entered from a front-panel keyboard, and a rotary control can be used to adjust most settings. Microprocessor control ensures that the instrument is flexible and easy to use, and allows programming by the General Purpose Interface Bus (GPIB). The GPIB is designed to IEEE Standard 488.2. The interface allows remote control of all functions except the supply switch, and allows the instrument to be used either manually or as part of a fully-automated test system.

The instrument displays the spectrum of any signal in the 100 MHz to 2.4 GHz band. The use of a patented A-D converter gives superior dynamic range and sensitivity when compared to a superheterodyne-based spectrum analyzer.

Intermodulation measurements can be displayed both numerically and spectrally. The instrument's hardware may be set up manually or automatically to optimize measurements for low distortion or low noise. A switchable IF pre-filter further improves measurement accuracy. Intermodulation products may be displayed as absolute frequencies or relative to each other.

The 2309's architecture is based on a single-stage down-conversion. The use of a local oscillator with low phase noise and a high-performance digital IF stage results in excellent phase noise and linearity. The instrument digitizes the time domain signal, then performs an FFT in order to display in the frequency domain.

A 1 GHz active probe, available as an accessory, enables measurements to be made without loading a radio circuit.

Main features

Operation

Selection of parameters on the screen may involve one or more of the numeric, hard or menu selection keys or the rotary control knob. Parameters may be set to specific values by numeric key entry, while values may be varied in steps using the [⇩] [⇧] keys or altered by moving the control knob.

Display

The display is a 6.5 inch (16.5 cm) VGA TFT active-matrix color LCD having a resolution of 501 by 250 data points. An output for an external color monitor is provided on the rear panel.

The display is capable of being continuously or single-shot triggered.

The instrument displays the RF spectrum with a span up to 300 kHz.

Frequency selection

Frequency selection is either made directly via the keyboard or remotely via the interfaces. Frequency resolution is 1 Hz across the band.

Level

The instrument incorporates both a low-power (sensitive) input and a high-power input. Both inputs are DC coupled.

Input circuitry is protected, by means of latching relays, against accidental application of overload power: over 0.5 W for the low-power input and over 50 W for the high-power input.

Calibration

The instrument has a recommended two-year calibration interval after which it should be returned for recalibration (see address list).

A single key-press causes the instrument to carry out an internal self-calibration routine: this compensates for minor drifts due, for example, to temperature changes. More extensive realignment of individual circuits can be accomplished by GPIB control or from the front panel: these procedures are detailed in the Maintenance Manual. There are no mechanical adjustments required for realignment.

Programming

A general-purpose interface bus (GPIB) interface is fitted so that all the instrument's functions are controllable via the interface bus, which is designed to IEEE Standard 488.2. The instrument can function both as talker and listener.

GPIB commands

All GPIB programming uses SCPI-like commands and is based on a MEASURE, READ, FETCH structure. This means that programs can be written quickly using high-level commands without needing to have an in-depth knowledge of the instrument. For production test programs, low-level commands are given that enable the programmer to use service requests (SRQs) to optimize programming and minimize test time.

Cost of ownership

A module exchange policy is used for the repair of major assemblies. These assemblies are fully calibrated where possible. This means that repairs can be carried out in the shortest possible time.

MIplot measurement presentation software

MIPlot measurement presentation software provides a powerful tool to enable insertion of measurement traces into standard office PC packages. The software enables the capture of trace data from the 2309 using a PC with a standard GPIB card. The traces can be inserted in word-processed documents or graphics packages using object linking and embedding (·OLE) formatting. Once inserted in the document, the traces can be rescaled, text and markers added and colors changed.

MIPlot is an excellent tool for report generation or for presentation of results to large groups of people.

Performance data

Frequency

Frequency range	100 MHz to 2.4 GHz.
Total span	10 Hz to 300 kHz in a 1, 2, 5 sequence or continuously variable.
Equivalent noise bandwidth (digital)	Window: 5-term Blackman-Harris ENBW 0.22 to 0.44% of set span; Gaussian ENBW 0.5 to 17.5% of set span.
Phase noise (at 470 MHz)	10 kHz offset <–115 dBc/Hz; 20 kHz offset <–121 dBc/Hz; 25 kHz offset <–122 dBc/Hz; 50 kHz offset <–124 dBc/Hz.

Amplitude

Accuracy (for input attenuation >10 dB and S/N ratio >25 dB)	≤±0.5 dB (following self-calibration, 100 MHz to 1 GHz, 25°C ±5°C); ±1.0 dB all other conditions.
Maximum input	See 'RF INPUTS'.
Maximum sensitivity	–164 dBm (0.04 Hz BW)
Dynamic range	Harmonic distortion <–70 dBc for a single CW signal of –20 dBm at mixer input. Third order intermodulation-free dynamic range ≤ –85 dBc for two tones spaced ≤100 kHz at –26 dBm at mixer input. Spurious responses at offsets ≤ ±1 MHz < –80 dBc. Residual response < –110 dBm, (0 dB RF attenuation, input terminated). Linearity ±0.01 dB per 10 dB plus Thermal Linearity Factor (TLF). TLF = 0.00 dB up to 30 dBm and 0.04 dB from 30 to 47 dBm per 10 dB.
Reference level setting	High-power input: +50 dBm to –200 dBm in 0.001 dB steps. Low-power input: +30 dBm to –200 dBm in 0.001 dB steps.
Input attenuator	0 to 65 dB in 5 dB steps.
Display resolution	0.01 dB to 20 dB/division in a 1, 2, 5, 10 sequence.
Display units	dBm, dBμV, dBmV, dBV.

Features 6.5 inch VGA TFT active matrix color LCD. External VGA monitor supported via rear-panel connector.

Display	10 x 10 graticule, 501 points per trace.
Display update rate	9 updates/sec.
Traces	Max/Min hold; Max hold, Outline; Infill.
Marker resolution	0.001 dB.
Averaging	Set by user from 1 to 200 sweeps (repeat). Set by user from 1 to 20000 sweeps (single).
Markers	Frequency and level readout; Two markers; Delta marker; Peak find; Delta marker sets span; Marker sets reference level; Marker sets reference frequency; Marker to center frequency.

RF inputs

High-power input

Maximum input	40 W (+46 dBm) continuous; 50 W (+47 dBm) 50% duty cycle; 50 W continuous for 30 s after a minimum interval of 30 s with <5 W applied.
Connector	Type N (f), 50 Ω DC-coupled.
Input VSWR	<1.1:1, 100 MHz to 500 MHz; <1.22:1, 500 MHz to 1 GHz; <1.43:1, >1 GHz.

Low-power input

Maximum input	0.5 W (+27 dBm). (overload protection to 10 W).
Connector	Type N (f).
Impedance	50 Ω DC coupled.
Input VSWR (>10 dB input attenuation)	<1.22:1, <1 GHz; <1.43:1, >1 GHz.
Input VSWR (no attenuation)	<1.92:1 all frequencies.

Display — 6.5 inch VGA TFT active matrix color LCD. External VGA monitor supported via rear panel connector.

Frequency standard

Internal OCXO	10 MHz.
Ageing	$\pm 0.8 \times 10^{-7}$ per year after 30 days; $\pm 2.5 \times 10^{-8}$ per month after 30 days; $\pm 2.0 \times 10^{-8}$ per month after 60 days; $\pm 1.5 \times 10^{-9}$ per day after 30 days; $\pm 1.0 \times 10^{-9}$ per day after 60 days.
Temperature stability	$\pm 5 \times 10^{-8}$ over the temperature range 5 to 40°C.
Warm-up time	Output frequency within 2×10^{-7} of final frequency within 20 minutes after switch-on at a temperature of 20°C.

Rear panel connectors

IF input	10.71 MHz, BNC (f), 50 Ω. Input range −14 to −60 dBm.
Frequency standard	
Output:	BNC (f), 10 MHz, 2 V pk-pk into 50 Ω.
Input:	BNC (f), 1 MHz or 10 MHz. Requires an input signal of 350 mV to 1.8 V RMS into 1 kΩ.
Printer interface	Parallel (Centronics compatible). 25-way D-type (female).
Auxiliary data I/O	25-way D-type (female).
External VGA monitor	15-way compact D-type (female).
LO in	SMA (female).
LO out	SMA (female).
RS-232	Connector is 9-way D-type (male), baud rate 300 to 9600 bits per second. Handshake hardware is DTR, RTS, CTS and DSR; software is XON and XOFF. Electrical interface to EIA-232-D.
GPIB	See ‘Remote control’.

Remote control

GPIB	All major functions except power supply switch control are remotely programmable.
Capabilities	Designed in accordance with IEEE 488.2. Complies with the following subsets as defined in IEEE std 488.1: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2.

Instrument storage

Internal memory	10 non-volatile instrument setting stores.
3.5” disk drive	Not currently used.

General characteristics

Electromagnetic compatibility	Conforms to the protection requirements of Council Directive 89/336/EEC. Conforms with the limits specified in the following standards: IEC/EN 61326-1 : 1997, RF Emission Class B, Immunity Table 1, Performance Criterion B.
Safety	Conforms with the requirements of EEC Council Directive 73/23/EEC (as amended) and the product safety standard IEC/EN 61010-1 : 2001 + C1 : 2002 + C2 : 2003 for Class 1 portable equipment, for use in a Pollution Degree 2 environment. The instrument is designed to operate from an Installation Category 2 supply.
Rated range of use	Full specification is met over the temperature range +5°C to +40°C (unless otherwise stated). Humidity up to 93% over specified operating range and elevation up to 3,050 m (10,000 ft) (excluding 3.5 inch disk drive: humidity up to 80% at 30°C).
Conditions of storage	Temperature –40 to +70°C. Humidity 90% at +40°C. Altitude <4,570 m.
Calibration interval	Recommended 2 years. Realignment can be accomplished from the front panel or by GPIB control. There are no mechanical adjustments required for realignment.
Power requirements	Voltage range 100 to 240 V~ (limit 90 to 264V~). Mains frequency 50 to 60 Hz (limit 45 to 66 Hz). Power consumption 120 VA maximum.
Dimensions	Width: 419 mm (16.5”) Height: 177 mm (6.9”) Depth: 488 mm (19.2”).
Weight	<17 kg (37.5 lb).

Versions and accessories

When ordering, please quote the full ordering number information.

Ordering numbers	Versions
2309	100 MHz to 2.4 GHz FFT Analyzer.
	Supplied accessories
–	AC supply lead (see 'Power cords', Chapter 2).
46882/415	Operating Manual (this manual).
	Optional accessories
46880/091	Service Manual (consists of Operating Manual (this document) plus Maintenance Manual).
43126/012	RF connector cable, TM 4969/3, 50 Ω, 1.5 m, BNC.
54311/092	Coaxial adapter N-type (m) to BNC (f).
54311/095	RF connector cable, 1 m, N-type connectors.
43129/189	GPIB lead assembly, 1.5 m.
46884/293	Rack mounting kit (with slides) for rack cabinets with depths from 480 mm to 680 mm.
46884/294	Rack mounting kit (with slides) for rack cabinets with depths from 680 mm to 840 mm.
46884/931	Rack mounting kit containing front brackets only.
46662/614	Soft carrying case.
2388	1 GHz Active Probe.
46884/649	RS-232 cable, 9-way D-type (f) to 25-way D-type (f), 1.5 m.
46884/650	RS-232 cable, 9-way D-type (f) to 9-way D-type (f), 1.5 m.
46884/648	Cable assembly, serial port to printer, 9-way D-type (f) to 25-way D-type (m), 1.5 m.
46884/560	Cable assembly, parallel port to printer Centronics socket, 2 m.
59000/327	MIPlot measurement presentation software
87509	National Instruments 778287-01 PCI-6534 high speed digital I/O PCI module.
43139/401	Cable asssembly, 25-way D-type (male) to 68-way SCSI (female), 2.5 m.

EC Declaration of Conformity

Certificate Ref. No.: DC224

The undersigned, representing:

Manufacturer:	**Aeroflex International Ltd.**
Address:	**Longacres House, Six Hills Way,** **Stevenage, Hertfordshire, UK SG1 2AN**

Herewith declares that the product:

Equipment Description:	100 MHz to 2.4 GHz FFT Analyzer
Model No.	2309
Options:	–

is in conformity with the following EC directive(s)
(including all applicable amendments)

Reference No.	Title:
73/23/EEC	Low Voltage Directive
89/336/EEC	EMC Directive

and that the standards and/or technical specifications referenced below have been applied:

Safety:
IEC/EN61010-1 : 2001 + C1 : 2002 + C2 : 2003

EMC:
IEC/EN 61326-1:1997 + A1 : 1998 + A2 : 2001
RF Emission Class B, Immunity Table 1 and Performance Criterion B

Qualifying Notes:

Aeroflex Stevenage (Place) 23 December 2003 (Date)

(Signature)

Robert Trott — Director of Product Assurance

Chapter 2
INSTALLATION

Contents

List of figures

WARNING

Initial visual inspection

After unpacking the instrument, inspect the shipping container and its cushioning material for signs of stress or damage. If damage is identified, retain the packing material for examination by the carrier in the event that a claim is made. Examine the instrument for signs of damage; do not connect the instrument to a supply when damage is present, internal electrical damage could result in shock if the instrument is turned on.

Mounting arrangements

Excessive temperatures may affect the performance of the instrument. Completely remove the plastic cover, if one is supplied over the case, and avoid standing the instrument on or close to other equipment that is hot.

CAUTION

Installation requirements

Ventilation

This instrument is forced-air-cooled by a fan mounted on the rear panel. Air must be allowed to circulate freely through the ventilator grilles located on the side and underside of the instrument. Before switching on the instrument, ensure that the fan outlet on the rear panel is not restricted (allow clearance of at least 75 mm (3 inch) at the rear, 25 mm (1 inch) at each side, 15 mm (¾ inch) on the underside). Failure to provide adequate clearances will increase internal temperatures and reduce the instrument reliability, so that its performance may not meet specification.

Class I power cords (3-core)

General

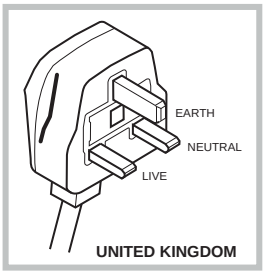
When the equipment has to be plugged into a Class II (ungrounded) 2-terminal socket outlet, the cable should either be fitted with a 3-pin Class I plug and used in conjunction with an adapter incorporating a ground wire, or be fitted with a Class II plug with an integral ground wire. The ground wire must be securely fastened to ground. Grounding one terminal on a 2-terminal socket will not provide adequate protection.

In the event that a molded plug has to be removed from a lead, it must be disposed of immediately. A plug with bare flexible cords is hazardous if engaged in a live socket outlet.

Power cords with the following terminations are available from Aeroflex. Please check with your local sales office for availability. This equipment is provided with a 3-wire (grounded) cordset, which includes a molded IEC 320 connector for connection to the equipment. The cable must be fitted with an approved plug which, when plugged into an appropriate 3-terminal socket outlet, grounds the case of the equipment. Failure to ground the equipment may expose the operator to hazardous voltage levels. Depending upon the destination country, the color-coding of the wires will differ:

British

Country	IEC 320 plug type	Part number
United Kingdom	Straight through	23422/001
United Kingdom	Right angled	23422/002



C3510

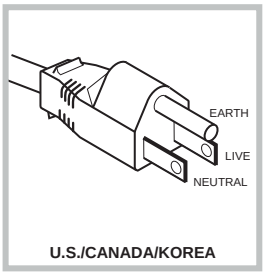
The UK lead is fitted with an ASTA approved molded plug to BS 1363.

A replaceable 13 A fuse to BS 1362 is contained within the plug. This fuse is only designed to protect the lead assembly. Never use the plug with the detachable fuse cover omitted or if the cover is damaged.

The fuse(s) or circuit breaker to protect the equipment is fitted at the back of the equipment.

North American

Country	IEC 320 plug type	Part number
North American	Straight through	23422/004
North American	Right angled	23422/005

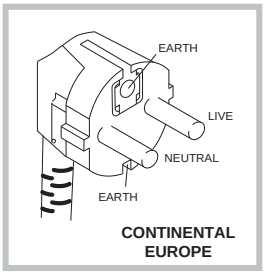


C3511

The North American lead is fitted with a NEMA 5-15P (Canadian CS22.2 No 42) plug and carries approvals from UL and CSA for use in the USA and Canada.

Continental Europe

Country	IEC 320 plug type	Part number
Europe	Straight through	23422/006
Europe	Right angled	23422/007



C3512

The Continental European lead is fitted with a right angle IEC83 standard C4 plug (CEE 7/7) which allows it to be used in sockets with either a male earth pin (standard C 3b) or side earth clips (standard C 2b); the latter is commonly called the German ‘Schuko’ plug. In common with other Schuko style plugs, the plug is not polarized when fitted into a Schuko socket. The lead carries approvals for use in Austria, Belgium, Finland, France, Germany, Holland, Italy, Norway and Sweden. Note that this plug will not fit Italian standard CEI 23-16 outlets. The lead should not be used in Denmark given that the earth connection will not be made.

Français

Le câble d’alimentation d’Europe Continentale est muni d’un connecteur mâle à angle droit type CEI83, standard C4 (CEE 7/7), qui peut être utilisé dans une prise femelle à ergot de terre (standard C 3b) ou à clips latéraux (standard C 2b), cette dernière étant communément appelée prise “Schuko” allemande. De la même façon que les autres connecteurs de type Schuko, celui-ci n’est pas polarisé lorsqu’il s’adapte à une prise femelle Schuko. Ce câble d’alimentation est homologué en Allemagne, Autriche, Belgique, Finlande, France, Hollande, Italie, Norvège et Suède. A noter que ce connecteur n’est pas compatible avec les prises de courant italiennes au standard CEI 23-16. Ce câble ne doit pas être utilisé au Danemark à cause du défaut de connexion de masse.

Deutsch

Das kontinentaleuropäische Netzkabel ist mit einem rechtwinkeligen Stecker nach IEC83 C4 (CEE7/7) Standard versehen, welcher sowohl in Steckdosen mit Erde-Stift (Standard C 3b) oder seitlichen Erdeklemmen, im allgemeinen “Schukosteckdose” genannt, paßt. Üblicherweise ist der Schukostecker bei Verwendung in Schukosteckdosen nicht gepolt. Dieses Netzkabel besitzt Zulassung für Österreich, Belgien, Finnland, Frankreich, Deutschland, Holland, Italien, Norwegen und Schweden.

Hinweis: Dieser Schukostecker paßt nicht in die italienischen Standardsteckdosen nach CEI 23-16 Norm. Dieses Netzkabel sollte nicht in Dänemark verwendet werden, da hier keine Erdeverbindung hergestellt wird.

Español

El cable de alimentación tipo Europeo Continental dispone de una clavija C4 normalizada IEC83 (CEE 7/7) que permite su utilización tanto en bases de enchufe con toma de tierra macho (tipo C 3b) o con toma de tierra mediante contactos laterales (tipo C 2b) que, en este último caso, suele denominarse “Schuko”. Al igual que cualquier otra clavija tipo Schuko, las conexiones a red no están polarizadas cuando se conectan a una base tipo Schuko. El cable lleva autorización para su uso en Austria, Bélgica, Finlandia, Francia, Alemania, Holanda, Italia, Noruega y Suecia. Observe que este cable no se adapta a la norma italiana CEI 23-16. El cable no debe utilizarse en Dinamarca en el caso de no efectuarse conexión a tierra.

Italiano

I cavi d’alimentazione per l’Europa continentale vengono forniti terminati con una spina ad angolo retto del tipo C4 secondo lo standard IEC83 (CEE 7/7) che può essere usato in prese in cui la terra può essere fornita o tramite connettore maschio (C 3b) o tramite clips laterali (C 2b), quest’ultima comunemente detta di tipo tedesca “Schuko”. Questa spina, quando collegata ad una presa Schuko, non è polarizzata.

Il cavo può essere usato in Austria, Belgio, Finlandia, Francia, Germania, Olanda, Norvegia, Svezia ed Italia. E’ da notare che per l’Italia questo non risponde allo standard CEI 23-16.

Questa spina non dovrebbe invece essere usata in Danimarca in quanto non realizza il collegamento di terra.

Goods-in checks

The following goods-in check verifies that the instrument is functioning correctly. To perform a more comprehensive test, refer to Chapter 6, ‘Acceptance testing’. For full calibration procedures that verify that the instrument conforms to the specification given in Chapter 1, refer to the relevant chapter in the Maintenance Manual.

(1) Ensure that the correct fuse is fitted (accessible from the rear panel) and connect the instrument to the supply.

(2) Switch on and check that a display is present.

(3) If the instrument appears to be completely dead, carry out the following:

Check that the mains power supply line is providing power to the instrument.

Check that the mains fuses have not blown.

Connecting to supply

Ensure that the AC supply is correctly connected to the POWER SUPPLY socket. For supplies in the range 100–120 V and 210–240 V, the PSU automatically selects the appropriate range. There is no manual voltage range selection provided.

The instrument is a Safety Class 1 product and therefore must be earthed. Use the supplied power cord or an appropriate replacement. Make sure that the instrument is plugged into an outlet socket with a protective earth contact.

Disconnecting device

The detachable power cord is the instrument's disconnecting device, but if the instrument is integrated into a rack or system, an external power switch or circuit breaker is required. Whatever the disconnecting device, make sure that you can reach it easily and that it is accessible at all times.

Fuse

For the AC voltage range of 100–240 V the fuse rating is T2AL250V. The AC fuse is a cartridge type measuring 20 mm × 5 mm.

The fuse-holder is integral with the rear panel 3-pin supply plug. For access to change the fuse, use a screwdriver to lever out the holder.

Setting the real-time clock

Press the [UTILS] key (and again if necessary) until the utility access menu shown below in Fig. 2-1 is displayed.

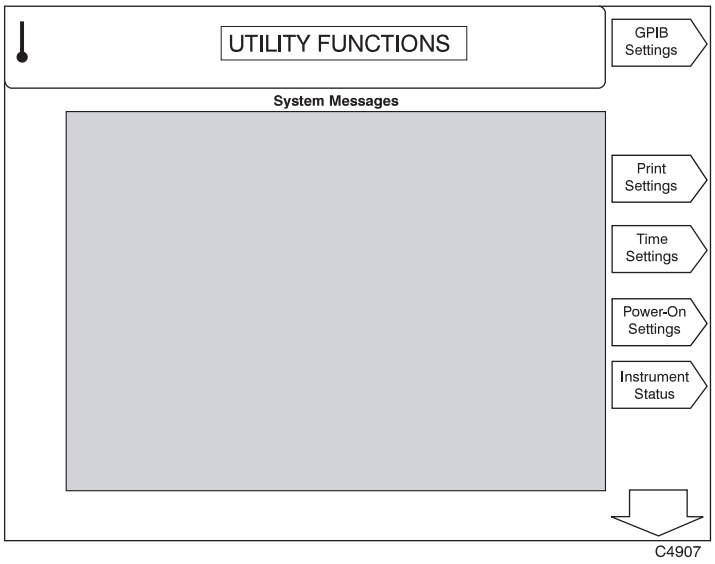


Fig. 2-1 Utilities: utility access menu – first page

Press the *[Time Settings]* soft key on the right of the screen to display the Time Settings menu as shown in Fig. 2-2 below.

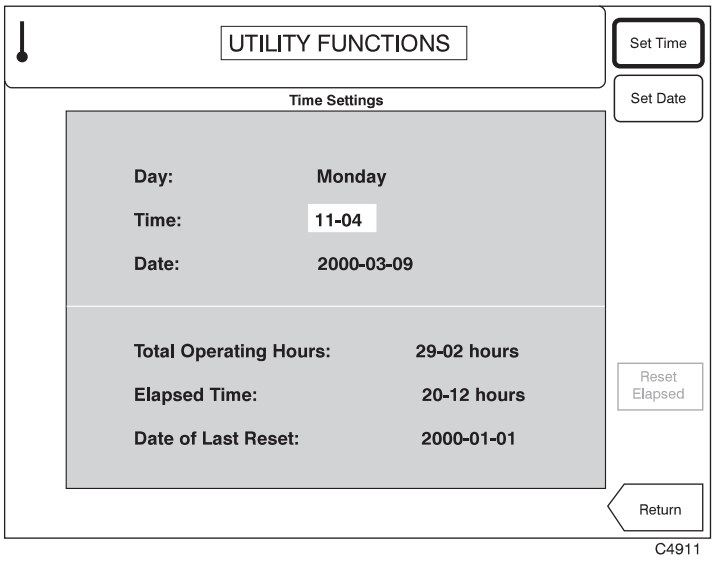


Fig. 2-2 Utilities: time settings menu

(1) To set the current time, press the *[Set Time]* soft key and enter the time on the numeric keypad in 24-hour format. Enter the time in the form HH MM; dashes are inserted automatically. Press any [ENTER] key to start the clock.

(2) To set the current date press the *[Set Date]* soft key and enter the date in the form YYYY MM DD; dashes are inserted automatically. Press any [ENTER] key to calculate and display the day.

General purpose interface bus (GPIB)

The GPIB interface built into the instrument enables it to be remotely controlled to form part of an automatic measuring system.

GPIB cable connection

Connection to other equipment that has a 24-way connector to IEEE Standard 488 is made using the rear-panel GPIB socket. For this purpose, the GPIB cable assembly, available as an optional accessory, (see Chapter 1 'Versions and accessories') may be used.

GPIB connector

The contact assignments of the GPIB cable connector are as given in the table below and shown in Fig. 2-3.

Contact	Function	Contact	Function
1	Data I/O 1	13	DataI/O 5
2	Data I/O 2	14	DataI/O 6
3	Data I/O 3	15	DataI/O 7
4	Data I/O 4	16	DataI/O 8
5	EOI	17	REN
6	DAV	18	Pair with 6
7	NRFD	19	Pair with 7
8	NDAC	20	Pair with 8
9	IFC	21	Pair with 9
10	SRQ	22	Pair with 10
11	ATN	23	Pair with 11
12	Ground shield	24	Logic ground

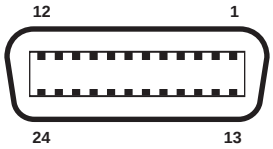


Fig. 2-3 GPIB connector contact assignments (viewed from rear panel)

IEEE to IEC conversion

An optional IEEE to IEC adapter is also available (see Chapter 1 'Versions and accessories') for interfacing with systems using a 25-way bus connector to IEC Recommendation 625. The method of use is shown in Fig. 2-4.

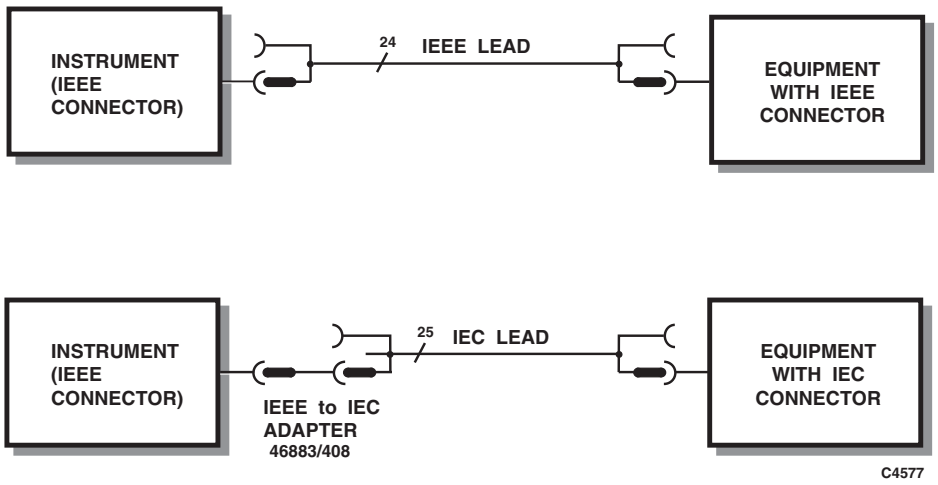


Fig. 2-4 IEEE to IEC conversion

Interface bus connection

The cables for the interface bus use special male-female connectors at both ends. This allows several connectors to be stacked one on top of another, permitting several cables to be connected to the same source and secured by a lockscrew mechanism. Too large a stack, however, may form a cantilevered structure that might cause damage and should be avoided. The piggyback arrangement permits star or linear interconnection between devices, with the restriction that the total cable length for the system must be:

(1) No greater than 20 m (65 ft).

(2) No greater than 2 m (6 ft) times the total number of devices (including the controller) connected to the bus.

RS-232 interface

The RS-232 interface built into the instrument is used to reprogram the internal flash memory.

RS-232 connector

The rear-panel male D-type RS-232 connector is shown in Fig. 2-5.

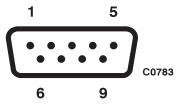


Fig. 2-5 RS-232 connector (viewed from rear panel)

The pin-outs for the 9-way RS-232 connector are shown below:

Contact		Signal
1	DCD	Data carrier detect
2	RXD	Receive data
3	TXD	Transmit data
4	DTR	Data terminal ready
5	SG	Signal ground
6	DSR	Data set ready
7	RTS	Request to send
8	CTS	Clear to send
9	RI	Ring indicator

The RS-232 interface can be connected to a personal computer's AT connector using a null-modem cable. Suitable cables are available from Aeroflex – see 'Versions and accessories' in Chapter 1. Connections to both a 9-way and a 25-way serial port on a PC are shown in Fig. 2-6 below.

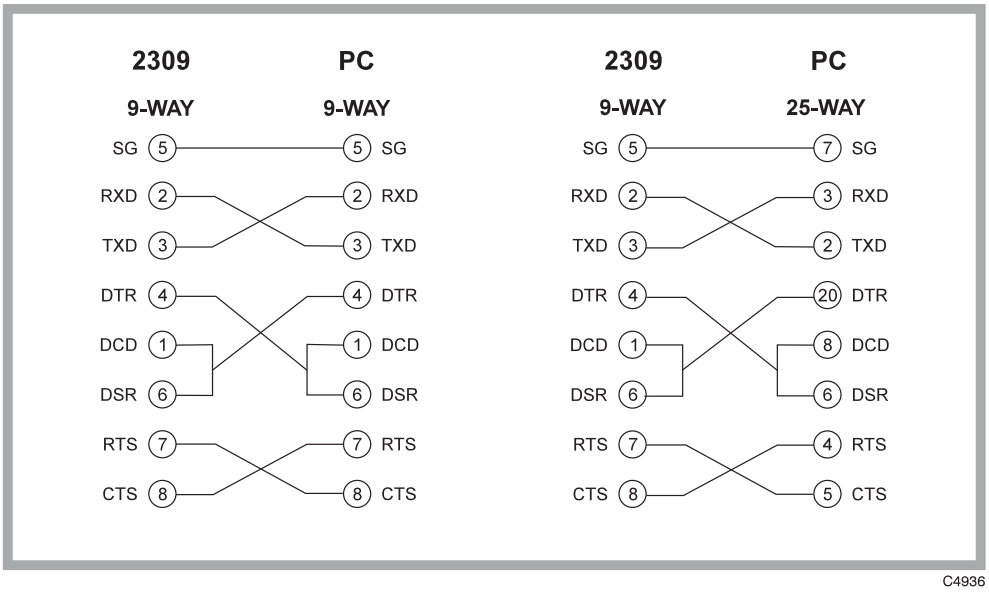


Fig. 2-6 Null modem connections

PARALLEL PORT connector

The rear panel 25-way female D-type PARALLEL PORT connector is shown in Fig. 2-7 below. This is used for connection to a Centronics or parallel type printer, using HP-PCL3.

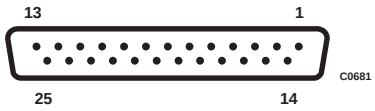


Fig. 2-7 25-way PARALLEL PORT connector (viewed from rear panel)

The functions of the socket contacts are as follows:

Contact	Function	Contact	Function
1	Strobe	10	ACK
2	Data 0	11	BUSY
3	Data 1	12	PE
4	Data 2	13	SLCT
5	Data 3	14	AUTOFD
6	Data 4	15	ERROR
7	Data 5	16	INIT
8	Data 6	17	SLCT IN
9	Data 7	18 to 25	Ground

AUXILIARY I/O connector

The rear-panel 25-way female D-type AUXILIARY I/O connector is shown in Fig. 2-8. This is used with cable assembly 43139/401 (see 'Versions and accessories' in Chapter 1). The current interface supports the National Instruments PCI-6534 data acquisition card: see accessory 87509.

The AUXILIARY I/O interface provides decimated IF data.

All outputs are TTL levels.

The transfer rate is 5 Mbytes/s.

The data is single-bit IF data.

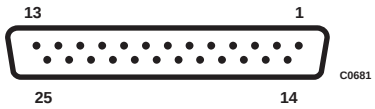


Fig. 2-8 25-way AUXILIARY I/O connector (viewed from rear panel)

The functions of the socket contacts are as follows:

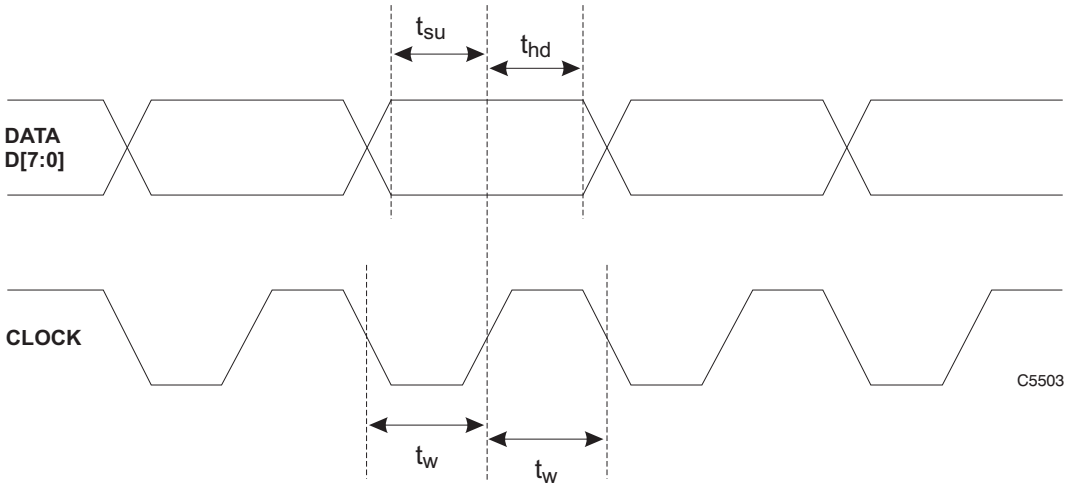
Contact	Function	Contact	Function
1	GND	14	D0
2	GND	15	D5
3	GND	16	D1
4	GND	17	D6
5	GND	18	D2
6	GND	19	D7
7	GND	20	D3
8	GND	21	D4
9	GND	22	Not used
10	CABLE DETECT	23	Not used
11	CLOCK	24	GND
12	GND	25	GND
13	Not used		

All data and clock signals are TTL/CMOS compatible.

Data format

Sample data:	Decimated IF, single-bit data transmitted in groups of 8 bits (D[7] to D[0], where D[7] is the first sample, followed by D[6], D[5], ….).
CLOCK	The data is clocked with the rising edge occurring at the center of the data.

Transmission mode



The rising edge of the CLOCK is at the center of the data.

t_{su}	setup time DATA to rising CLOCK edge	= 100 ns ± 10 ns
t_{hd}	data held after rising CLOCK edge	= 100 ns ± 10 ns
t_w	width of CLOCK high or CLOCK low	= 75 ns minimum

f_{CLOCK} = 5 MHz

MONITOR connector

The rear-panel 15-way female D-type MONITOR connector is shown in Fig. 2-9 below. This is used for connection to a monitor unit to duplicate the display.

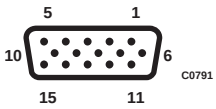


Fig. 2-9 15-way MONITOR connector (viewed from rear panel)

The functions of the socket contacts are as follows:

Contact	Function	Contact	Function
1	Video red	9	NC
2	Video green	10	NC
3	Video blue	11	No connection
4	No connection	12	No connection
5	Ground (Red)	13	HSYNC
6	Ground (Green)	14	VSYNC
7	Ground (Blue)	15	No connection

PROBE socket

Mounted on the front panel is the sub-miniature PROBE socket, which provides power for an active probe such as 1 GHz Active Probe 2388 (see Chapter 1 'Versions and accessories'). The voltage outputs are shown in Fig. 2-10 below.

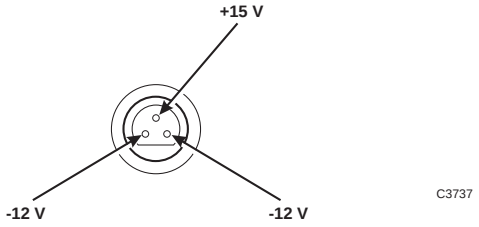


Fig. 2-10 PROBE socket showing voltage outputs (viewed from front panel)

Rack mounting

The instrument, which is normally supplied for bench mounting, may be mounted in a standard 19 inch rack (see Chapter 1 'Versions and accessories').

Battery replacement

The instrument contains a real-time clock, which is powered by a lithium battery when the normal power is removed. Although battery life can extend to five years, this will depend on conditions of use; for example, battery life is reduced as the temperature is increased. To avoid loss of data it is recommended that the battery is replaced every two years.

Replace the battery as follows:

Ensure that the instrument is switched on; this will provide power for the non-volatile memory while the battery is replaced. If this is not possible, the clock will continue to run for approximately 30 seconds whilst the replacement is made.

Using a coin or suitable tool, unscrew the battery compartment cover at the rear of the instrument.

Remove the battery, noting its orientation. Insert the replacement, then replace the battery compartment cover.

The replacement battery should be SAFT L56 or equivalent. This is a lithium 3.5 V type, rated at 1800 mAh, size AA. If a lithium battery is unobtainable an alkaline battery can be used but it will have a shorter life. A suitable battery can be obtained from Aeroflex (part number 23711/106).

CAUTION

Routine safety testing and inspection

In the UK the 'Electricity at Work Regulations' (1989) section 4(2) places a requirement on the users of equipment to maintain it in a safe condition. The explanatory notes call for regular inspections and tests together with a need to keep records.

The following electrical tests and inspection information is provided for guidance purposes and involves the use of voltages and currents that can cause injury. It is important that these tests are only performed by competent personnel.

Prior to carrying out any inspection and tests the equipment must be disconnected from the mains supply and all external signal connections removed. All tests should include the equipment's own supply lead, all covers must be fitted and the supply switch must be in the 'ON' position.

The recommended inspection and tests fall into three categories and should be carried out in the following sequence:

1. Visual inspection
2. Earth bonding test
3. Insulation resistance test.

1. Visual inspection

A visual inspection should be carried out on a periodic basis. This interval is dependent on the operating environment, maintenance and use, and should be assessed in accordance with guidelines issued by the Health and Safety Executive (HSE). As a guide, this equipment, when used indoors in a relatively clean environment, would be classified as 'low risk' equipment and hence should be subject to safety inspections on an annual basis. If the use of the equipment is contrary to the conditions specified, you should review the safety re-test interval.

As a guide, the visual inspection should include the following where appropriate:

Check that the equipment has been installed in accordance with the instructions provided (for example, that ventilation is adequate, supply isolators are accessible, supply wiring is adequate and properly routed).

- The condition of the mains supply lead and supply connector(s).
- The correct rating and type of supply fuses.
- Security and condition of covers and handles.
- Check the presence and condition of all warning labels and markings and supplied safety information.
- Check the wiring in re-wireable plugs and appliance connectors.
- Check the cleanliness and condition of any ventilation fan filters.
- Check that the mains supply switch isolates the equipment from the supply.
- Check the supply indicator functions (if fitted).

If any defect is noted this should be rectified before proceeding with the following electrical tests.

2. Earth bonding tests

Earth bonding tests should be carried out using a 25 A (12 V maximum open circuit voltage) DC source. Tests should be limited to a maximum duration of 5 seconds and have a pass limit of 0.1 Ω after allowing for the resistance of the supply lead. Exceeding the test duration can cause damage to the equipment. The tests should be carried out between the supply earth and exposed case metalwork, no attempt should be made to perform the tests on functional earths (for example, signal carrying connector shells or screen connections) as this will result in damage to the equipment.

3. Insulation tests

A 500 V DC test should be applied between the protective earth connection and combined live and neutral supply connections with the equipment supply switch in the 'on' position. It is advisable to make the live/neutral link on the appliance tester or its connector to avoid the possibility of returning the equipment to the user with the live and neutral poles linked with an ad-hoc strap. The test voltage should be applied for 5 seconds before taking the measurement.

Aeroflex employs reinforced insulation in the construction of its products and hence a minimum pass limit of 7 MΩ should be achieved during this test.

Where a DC power adapter is provided with the equipment, the adapter must pass the 7 MΩ test limit.

We do not recommend dielectric flash testing during routine safety tests. Most portable appliance testers use AC for the dielectric strength test, which can cause damage to the supply input filter capacitors.

4. Rectification

It is recommended that the results of the above tests are recorded and checked during each repeat test. Significant differences between the previous readings and measured values should be investigated.

If any failure is detected during the above visual inspection or tests, the equipment should be disabled and the fault should be rectified by an experienced Service Engineer who is familiar with the hazards involved in carrying out such repairs.

Safety critical components should only be replaced with equivalent parts, using techniques and procedures recommended by Aeroflex.

The above information is provided for guidance only. Aeroflex designs and constructs its products in accordance with International Safety Standards such that in normal use they represent no hazard to the operator. Aeroflex reserves the right to amend the above information in the course of its continuing commitment to product safety.

Cleaning

Before commencing any cleaning, switch off the instrument and disconnect it from the supply. The exterior surface of the case may be cleaned using a soft cloth moistened in water. Do not use aerosol or liquid solvent cleaners.

Cleaning the LCD window

To prevent damage to the LCD window, care should be taken not to scratch the surface during use and also when cleaning. The LCD window should be cleaned by wiping a slightly damp, soft, lint-free cloth gently over the surface.

Putting into storage

If the instrument is to be put into storage, ensure that the following conditions are maintained:

Temperature range:	–40 to 70°C (-40 to 158°F)
Humidity:	Less than 90% at 40°C (104°F)

Chapter 3
LOCAL OPERATION

Contents

List of figures

Introduction

This chapter explains how to:

- Set up the signal analyzer to perform FFT spectrum analysis.
- Use the full range of supporting utilities.

Conventions

The following conventions are used in this chapter:

PROBE	Titles marked on the instrument panel are shown in capital letters.
[SPECTRUM]	Hard-key titles are shown in square brackets.
[Input Level]	Soft-key titles are shown in italics in square brackets; for example, *[Input Level]* means the soft key adjacent to the *Input Level* title box at the side of the menu.
Ref. Level	Messages appearing on the screen are shown in italics.

Front panel controls and connectors

Parameters are selected by means of:

- hard keys, which have their function printed on them;
- soft keys, which are blank;
- a numerical keypad and a rotary control;

see Figs 3-1 and 3-2 below.

The hard keys have functions that do not change, whereas the soft-key functions are determined by the menu that is being displayed. The numerical keys are used to set parameters to specific values which can also be varied in steps by using the [⇩][⇧] keys and the rotary control.

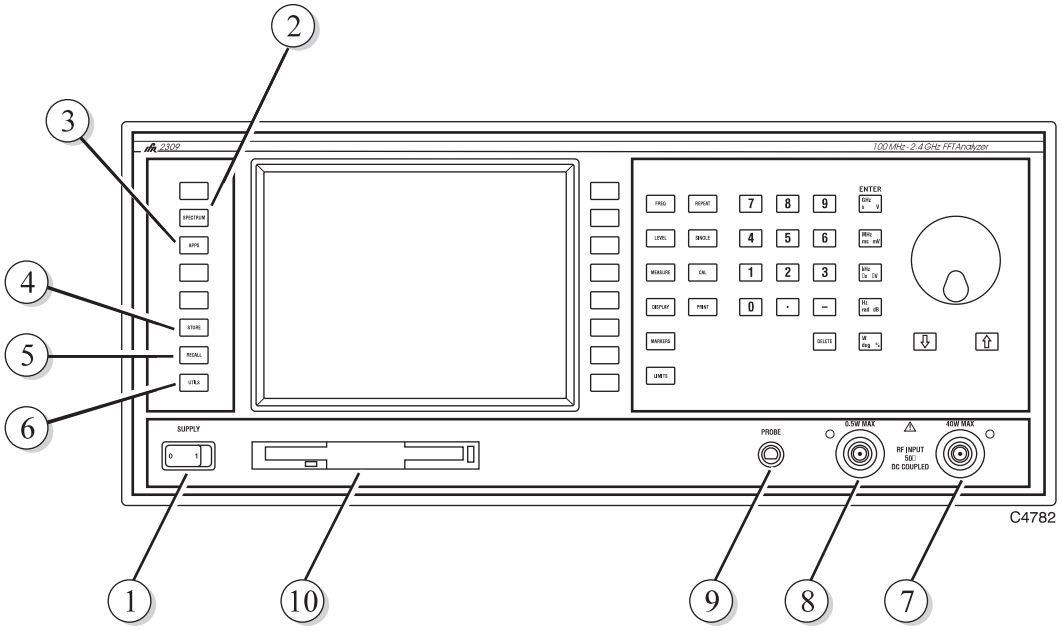


Fig. 3-1 Front panel – primary keys and connectors

1	SUPPLY	Switches the AC supply voltage on and off.
2	[SPECTRUM]	Changes the operating mode to that of a narrow-band spectrum analyzer.
3	[APPS]	Changes the operating mode to enable intermodulation measurements: see Annex A.
4	[STORE]	Enables instrument settings to be stored in NOVRAM.
5	[RECALL]	Enables instrument settings to be recalled from NOVRAM.
6	[UTILS]	Provides access to the utilities menus.
7	RF INPUT 40 W MAX	50 Ω type-N connector.
8	RF INPUT 0.5 W MAX	50 Ω type-N connector. Protected against the application of overload power of up to 10 W.
9	PROBE	Sub-miniature 3-pin socket providing power for 1 GHz Active Probe 2388. For contact allocation see 'PROBE socket' in Chapter 2.
10	Disk drive	Not currently used.
11	Soft keys	Keys which change notation as the menus change.
12	[MEASURE]	Causes the measurement soft keys to be displayed.
13	[FREQ]	Causes the frequency-related soft keys to be displayed.
14	[LEVEL]	Causes the level-related soft keys to be displayed.
15	[REPEAT]	Initiates a repetitive measurement.
16	[SINGLE]	Initiates a single measurement.

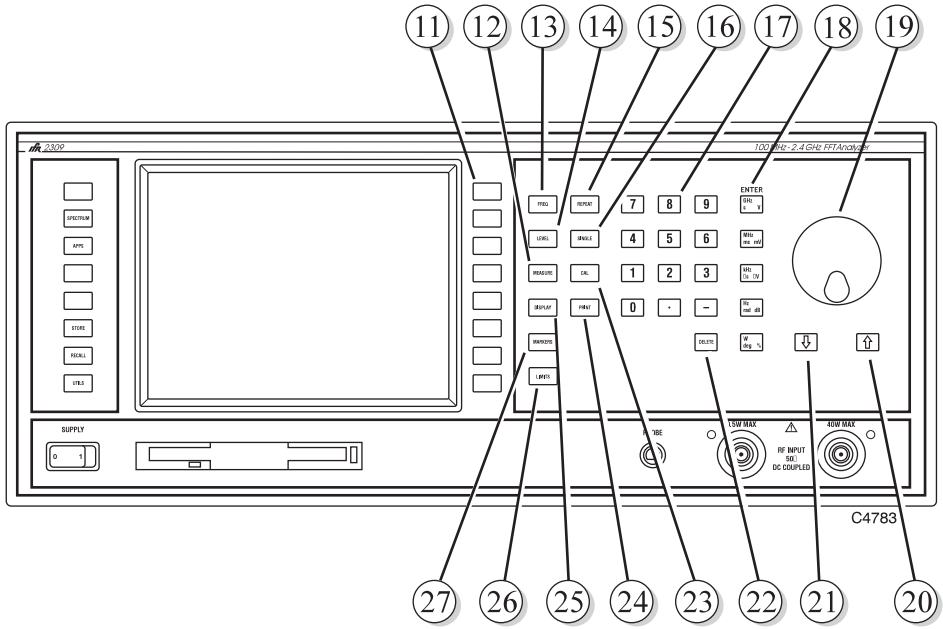


Fig. 3-2 Front panel – keyboard and rotary control

17	Numerical keypad	For entering the value of a selected parameter. Minus sign and decimal point are included.
18	ENTER/Units keys	Determine the units of the set parameters: also used to terminate numerical and textual entries.
19	Rotary control	Enables the value of the selected parameter to be continuously adjusted.
20	[⇧]	Used to increment the value of the selected parameter by a single step.
21	[⇩]	Used to decrement the value of the selected parameter by a single step.
22	[DELETE]	Used to select one of the following functions: Correct the numeric entry before the terminator is pressed Cancel hard-copy operation Remove error messages Clear a pop-up message from the display Turn display on and off.
23	[CAL]	Initiates an internal self-calibration routine. This optimizes measurement accuracy and cancels any temperature drift.
24	[PRINT]	Provides a hard copy of the current display.
25	[DISPLAY]	Used to select the way in which measurement data is presented.
26	[LIMITS]	Used to specify intermodulation limits: see Annex A.
27	[MARKERS]	Causes the ‘Markers’ soft keys to be displayed.

Rear-panel connectors

The rear-panel connectors are shown in Fig. 3-3 below.

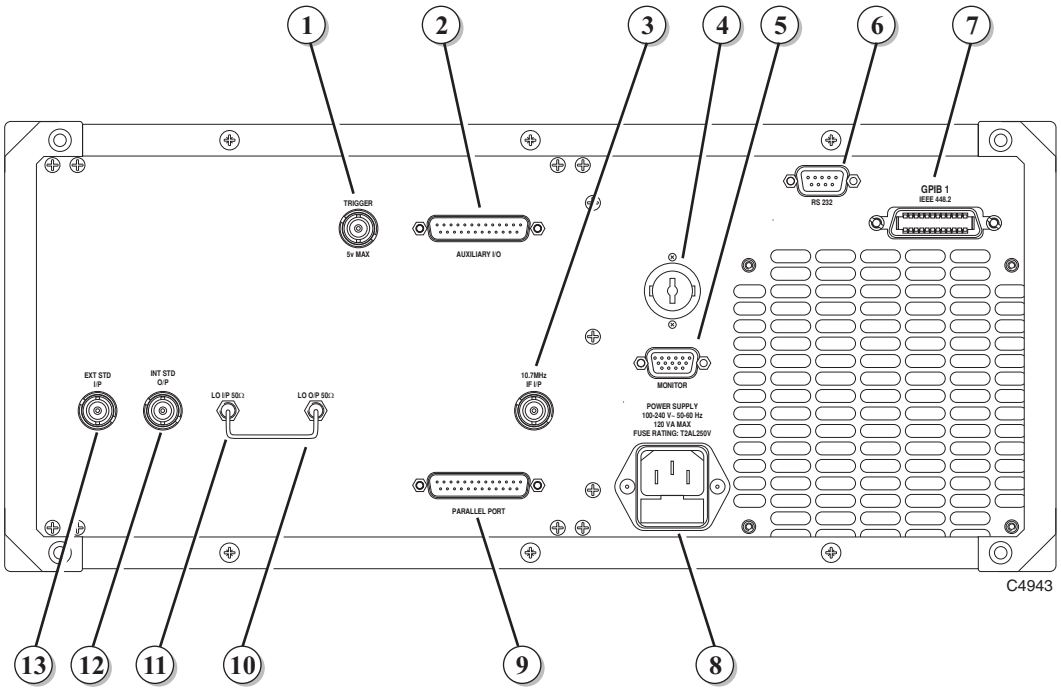


Fig. 3-3 Rear panel

1	TRIGGER	Not used.
2	AUXILIARY I/O	25-way D-type connector. For contact allocation see 'Auxiliary I/O connector' in Chapter 2.
3	10.71 MHz IF I/P	The signal from an instrument under test is available at this socket at 10.71 MHz.
4	Battery holder	Houses battery for real-time clock and NOVRAM.
5	MONITOR	15-way D-type connector. Used for connection to a monitor unit to duplicate the display. For contact allocation see 'MONITOR connector' in Chapter 2.
6	RS 232	9-way RS-232 connector primarily used during software download, to reprogram the internal flash memory. For contact allocation see 'RS-232 connector' in Chapter 2.
7	GPIB 1	24-pin socket accepts a standard IEEE connector to allow remote control of the instrument. For contact allocation see 'GPIB connector' in Chapter 2.
8	POWER SUPPLY	3-pin plug integral with fuse holder. Mates with AC supply lead socket.
9	PARALLEL PORT	25-way D-type connector. Used for connection to a Centronics- or parallel-type printer. For contact allocation see 'PARALLEL PORT connector' in Chapter 2.
10	LO O/P	50 Ω SMA connector.
11	LO I/P	50 Ω SMA connector.
12	INT STD O/P	BNC connector for the output of the internal 10 MHz standard.
13	EXT STD I/P	BNC connector for the input of an external standard frequency of either 1 MHz or 10 MHz.

Front-panel keys and soft-key menus

In this manual:

- hard keys are shown in square brackets; for example, [SPECTRUM];
- soft keys are shown in italics and square brackets; for example, *[Switching]*.

Front-panel keys are used either to change instrument functions directly or to provide access to additional functions, which are selected by soft keys.

The function currently selected becomes the active function which, in some cases, can be modified by numeric entry. A function remains active until another function key is pressed; this enables you to enter, for example, a succession of frequencies.

The positions and functions of the keys are summarized in Fig. 3-4 below.

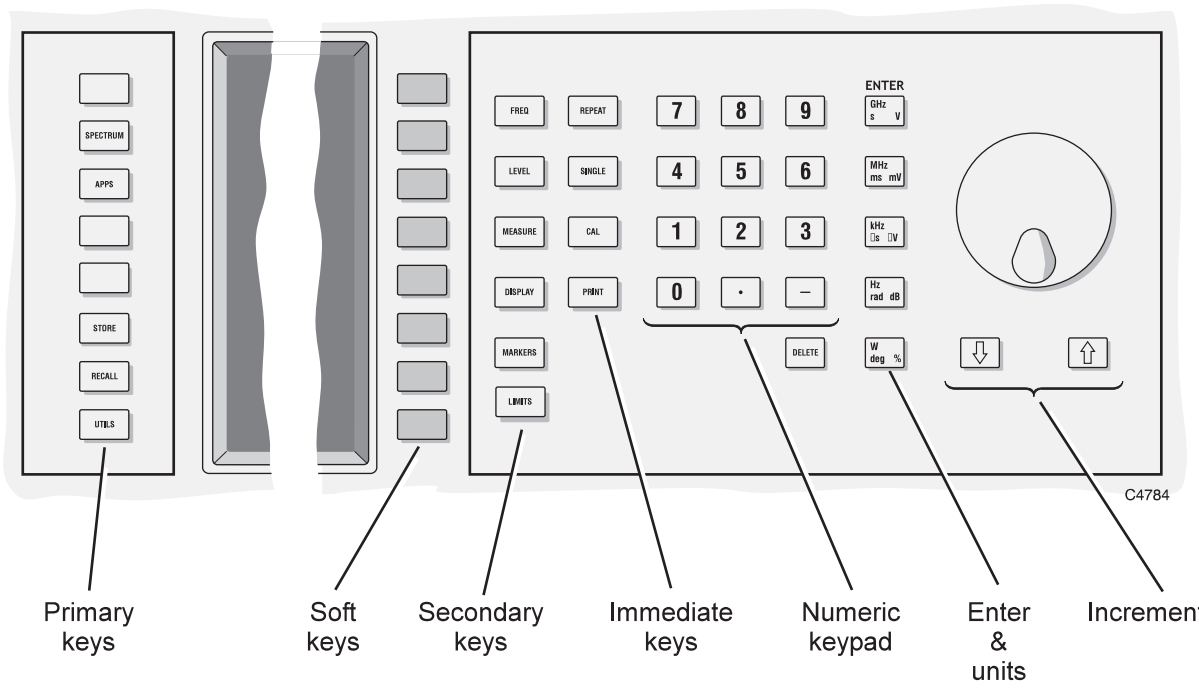


Fig. 3-4 Key functions

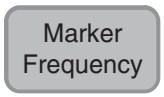
Hard keys

Primary keys	These keys change the whole screen; they bring up a new display as well as new soft keys.
Secondary keys	These keys change the soft-key functions associated with the current screen.
Immediate keys	These keys cause an immediate action.

Soft keys

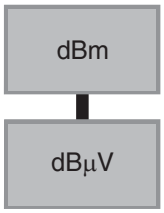
Soft-key functions are denoted by labels displayed on the screen adjacent to the keys. There are eight soft keys, located immediately to the right of the screen. The type of action performed by the key is indicated by the shape of the box enclosing the label as shown below:

A standard rectangle indicates that selecting this soft key immediately causes the instrument to perform the designated function, without any further interaction from the user.



A rectangle with rounded corners indicates that after selecting this soft key the function stays selected and takes data input.

A soft key showing a status LED indicates that selecting this soft key toggles the function on or off. The LED 'lights' to show that the function is on.

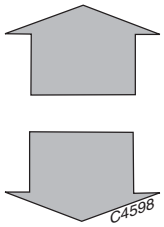


Soft keys joined by a vertical line show that they provide a 1-of-N selection.

A soft key having a right-edge arrow-head indicates that selecting this key calls up a new set of soft keys.

A soft key having a left-edge arrow-head indicates that selecting this key returns you to your previously selected screen.

A soft key that is grayed out indicates that the function is unavailable for the selected mode.



Pressing these keys extends the menu to enable you to make additional selections.

Display

Before entering any parameters, it is useful to look at the layout of the analyzer display. It is divided into a number of fields as shown in Fig. 3-5 below.

Instrument status area

This area displays the image of a thermometer to indicate the thermal condition of the high-power input socket.

Measurement parameter status 1 area

This area shows the selection parameters. The selected input socket and type of trigger are displayed, together with parameters that cannot be specified by the user; for example, resolution bandwidth when a Blackman-Harris window has been selected.

Measurement parameter status 2 area

This area provides details of the current instrument configuration and is used to display data that has previously been accepted from the input entry field. It displays channel frequency, input level, number of bursts to be averaged and the selected dB per division.

Input-entry area

This area contains the input-entry field for the currently selected function.

Measurement mode and error message area

This area is used as the title area for the measurement selected. It is also used to display error messages. When an error occurs the title text is overwritten by the error message. The error message remains until the user acknowledges the error and clears it by using the [DELETE] key.

Measurement display area

This area is used to display the selected measurement in the numerical or graphical format specified by the user. A numeric display is automatically selected when a new measurement mode is selected and the current display format is inappropriate.

Y-axis label area

This area is used for labeling the y-axis graticule lines.

X-axis label & marker status area

This area is normally used for labeling the x-axis graticule lines. When the [MARKERS] key is pressed, the x-axis field is replaced by the marker status field.

Soft-key label area

This area can hold up to eight soft-key labels.

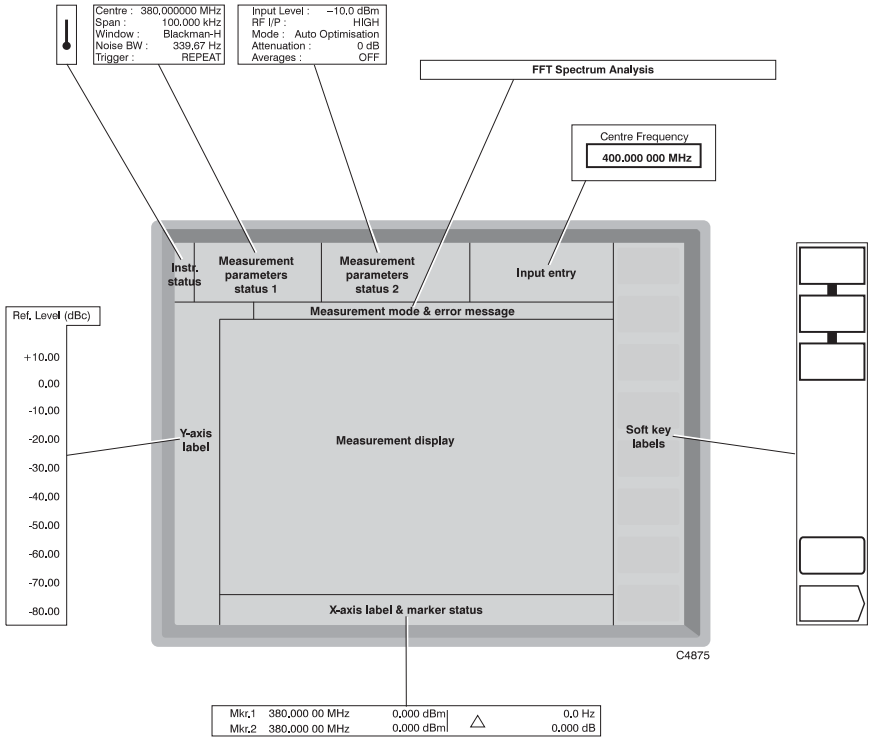


Fig. 3-5 Division of display into functional areas

Default settings

Factory default settings for spectrum analyzer operation:

Noise bandwidth	339.67 Hz
Trigger	Single
Window function	Blackman-Harris
RF input selected	High-power
Averaging	Off
Center frequency	380 MHz
RF input level	+47 dBm
Frequency span	100 kHz
dB/div	10 dB
Current function	Center frequency

Factory default setting for utilities:

User calibration auto-response	Enabled

Initialization self-test

Press the supply switch to power up the instrument. The display goes through a start-up sequence in which the screen displays *INITIALISATION SELF-TEST* as shown in Fig. 3-6 below whilst a moving-bar display shows the progress of tests 1 to 31 (taking nine seconds). The screen blanks for four seconds, after which the title screen appears. This remains for approximately 20 seconds during which time the instrument initializes, and then the application screen appears.

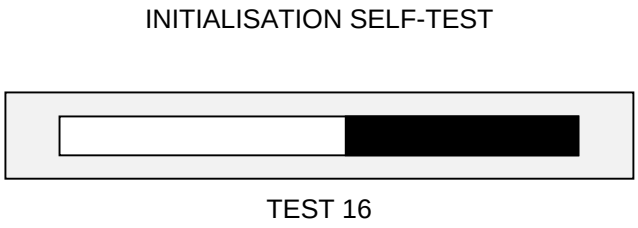


Fig. 3-6 Example of self-test in progress

Successful completion of the test gives confidence that the following CPU board peripherals are functioning:

- CPU system registers
- Xilinx FPGA boot-up
- Video BIOS
- GPIB controller communication
- Parallel port communication
- Floppy disk controller
- Real time clock
- Slow serial ports
- DRAM (SIMM)
- NOVRAM
- EEPROM
- FLASH (SIMM)

Should any faults be found, the instrument pauses to report them at the end of the self-test procedure. For fault rectification, refer to the Maintenance Manual (to order see 'Versions and accessories' in Chapter 1). To continue normal operation, press [MEASURE] as instructed on the display.

Self-calibration

This routine optimizes measurement accuracy by making corrections for changes in operating temperature and environmental conditions. As it exercises most parts of the instrument, namely the internal power reference, input attenuator, input mixer, IF strip and measurement circuits, successful completion gives a high degree of confidence that the instrument meets its specified RF performance.

When you press the [CAL] key an automatic calibration routine is initiated in which a 400 MHz, −10 dBm (within ±0.175 dBm) signal is switched into the signal path, where it is measured and path correction data is applied.

The adjustments performed are as follows:

- Digital IF resonator alignment
- Input attenuator
- IF amplifiers
- Digital IF gain
- IF flatness.

Whilst calibration is in progress the screen shown in Fig. 3-7 is displayed. Calibration takes approximately 50 seconds and disables the instrument during this time. This is an essential operation for you to perform whenever you need to make optimally accurate measurements.

On completion, check that no error messages are displayed.

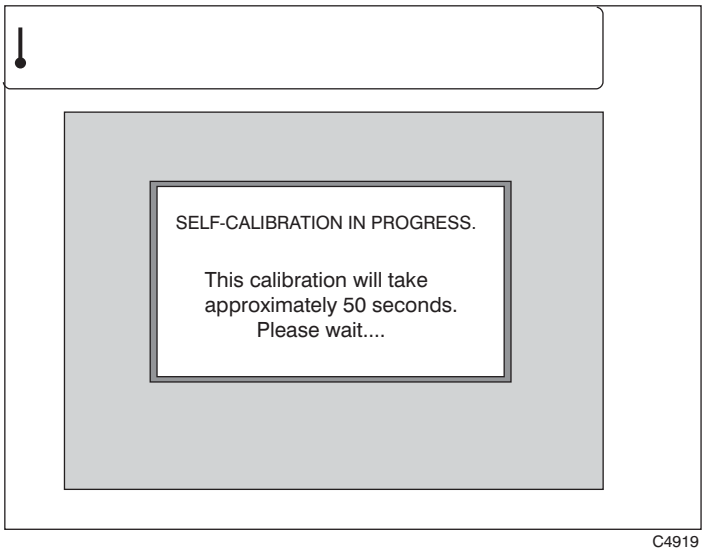


Fig. 3-7 Self-calibration screen

Printing

Pressing [PRINT] at any time outputs the results of measurements (but not of support functions such as Utilities or Limits set-up) to an external printer. The printer, which connects to the parallel port connector on the rear panel, must support HP-PCL3 or higher.

Printer output is an A4 print of all available information for the current measurement. It is not a screen dump, but an enlarged, higher-resolution version of the displayed image, together with displayed textual information plus additional relevant information that does not appear on the display. Black-and-white printing only is possible. If limits are turned on, limit lines are printed and annotated.

The *Print Settings* menu allows you to add text to the heading of each printout. The instrument precedes the text with the words 'Analysis by:'.

Input overload protection

WARNING

RF hazard

The maximum input signal level that can be applied continuously without fear of damage is 40 W to the high-power input and 0.5 W to the low-power input. However, the instrument is protected against accidental application of overload power to both these inputs by detecting the overload and disconnecting the signal input (**take care to avoid burns – see Warning in Preface**). The input switch disconnects the input path by selecting the calibration configuration after which the screen shown in Fig. 3-8 below is displayed. As instructed by the screen, remove the signal causing the overload and press *[Reset Overload]* to resume normal operation. If this key is pressed with the signal still applied, the protection circuit operates again.

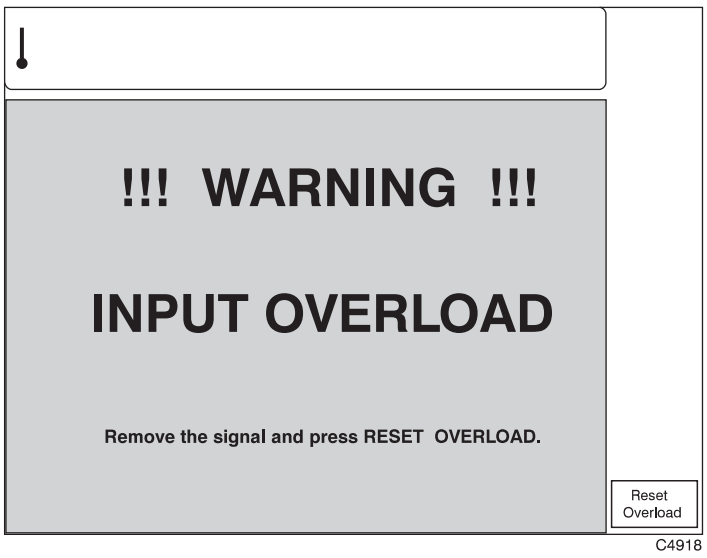


Fig. 3-8 Input overload warning screen

Operating the instrument

Press [SPECTRUM] to select the spectrum analyzer mode of operation. A spectrum analyzer screen, similar to that in Fig. 3-9 below, is displayed.

For spectrum analysis, the display shows a 10 x 10 graticule, with the vertical (level) axis on a logarithmic or linear scale, and the horizontal (frequency) axis on a linear scale.

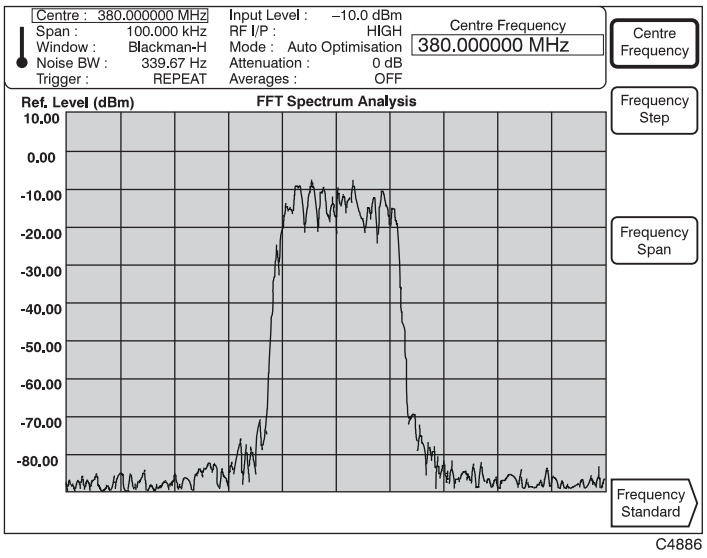


Fig. 3-9 Spectrum analyzer: FREQ selected

Frequency

Press [FREQ] to change the center frequency or frequency span or to select the type of frequency standard. The 'frequency' soft keys are displayed at the right side of the screen, as shown in Fig. 3-9 above.

(1) To change the center frequency, press *[Centre Frequency]*, which causes the current frequency to be displayed at the top of the screen. Enter your selected center frequency, in the range 100 MHz to 2.4 GHz (to 1 Hz resolution), on the keypad. Terminate using the appropriate units key.

(2) To change the increment value for the center frequency, press *[Frequency Step]*, which causes the current step value to be displayed at the top of the screen. Enter the required step value, then terminate using the appropriate units key. When the [⇧] [⇩] keys are used, the center frequency is incremented/decremented by the specified step size. Alternatively, the center frequency can be adjusted using the rotary control.

(3) Select *[Frequency Span]*, which causes the current frequency span to be displayed at the top of the screen. Enter your required total span on the keypad in the range 10 Hz to 300 kHz (to 1 Hz resolution). Terminate using the appropriate units key. When the [⇧] [⇩] keys are used, the frequency span is incremented/decremented in a 1, 2, 5 sequence. Alternatively, the span can be adjusted using the rotary control.

(4) Press *[Frequency Standard]* to display the frequency standard selection screen (see 'Frequency standard selection' below).

Frequency standard selection

Press *[Frequency Standard]* to change the frequency standard. The frequency standard selection soft keys are displayed at the right side of the screen as shown in Fig. 3-10 below.

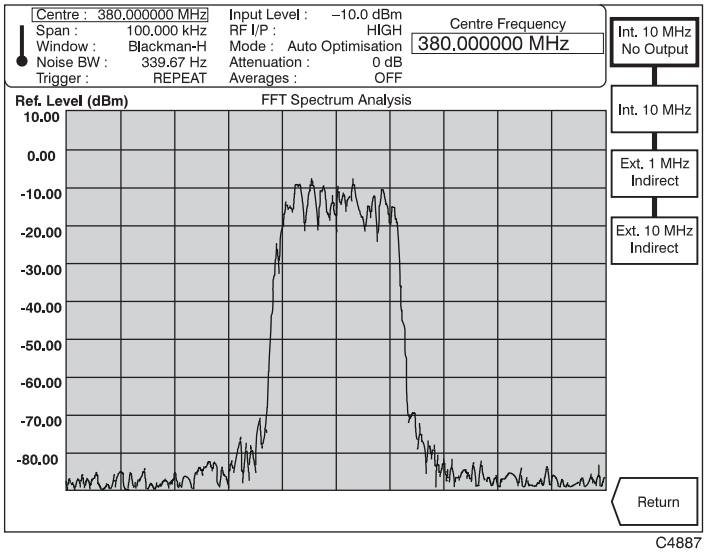


Fig. 3-10 Spectrum analyzer: Frequency Standard selected

(1) To select the instrument's internal standard, press *[Int. 10 MHz]*. When selected, the internally generated 10 MHz standard is also available from the rear panel INT STD O/P socket. To prevent output to the socket, press instead *[Int. 10 MHz No Output]*.

(2) To provide an externally generated 1 or 10 MHz standard for the instrument (for example, if the accuracy of your frequency standard is better than that of the internal standard), connect the signal to the rear panel EXT STD I/P socket, then select between *[Ext. 1 MHz Indirect]* or *[Ext. 10 MHz Indirect]*.

(3) Press *[*Return*]* to go back to the FREQ screen.

Level

Press [LEVEL] to control the input power level, to set the level offset of the device under test and to choose the RF input. The 'level' soft keys are displayed at the right side of the screen as shown in Fig. 3-11 below. Ensure that the input level is correctly set since this optimizes the input for maximum intermodulation-free dynamic range.

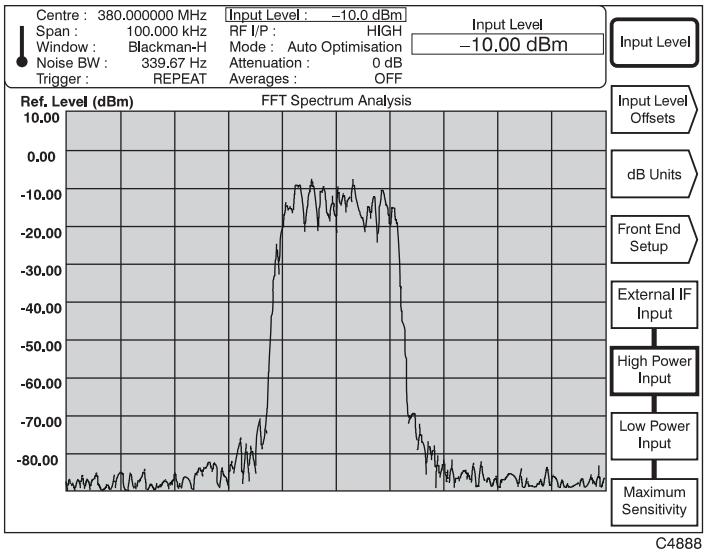


Fig. 3-11 Spectrum analyzer: LEVEL selected

(1) Setting the input level controls the hardware settings (attenuator, IF gain, A-to-D converter gain) to ensure that the A-to-D converter is not overloaded. To set the input level, press *[Input Level]*, which displays the current input level at the top of the screen. Enter your input signal level on the keypad in units that may be linear (μV, mV, V) or logarithmic (dB reference). Conversion between logarithmic and linear units is performed by pressing the appropriate units key (for example, to change dBm to mV press the [mV] key).

(2) You can adjust the displayed input level by using either the rotary control or the [⇩] [⇧] keys.

(3) Press *[*Input *Level Offsets]* to compensate for the nominal gain or loss of an external device (see 'Level offsets selection' below).

(4) Press *[dB* Units*]* to display the 'dB units' selection keys (see 'dB units selection' below).

(5) Pressing *[Front End Setup]* gives you the opportunity to configure the instrument's hardware to optimize your measurement (see 'Front-end setup' below).

(6) Press *[External IF Input]* to input a 10.71 MHz IF signal at the rear-panel IF input connector. This allows you to make accurate measurements of relative signal levels at the instrument's IF frequency, although absolute gain accuracy is not guaranteed.

(7) Select between high-power and low-power DC-coupled RF inputs by pressing either *[High* Power *Input]* or *[Low Power Input]*. When the low-power input is selected a 10 dB attenuator pad is inserted to protect the internal mixer. Press *[Maximum Sensitivity]* to select the low-power input with no mixer protection (0 dB attenuation).

Level offsets selection

The RF offset facility enables you to effectively display the RF power at the output of the device under test when an external device, such as an attenuator or amplifier, is connected between the DUT and the instrument. The displayed input level does not change but the RF front-end hardware is modified to compensate for the nominal gain or loss of the external device. In addition, the facility can be used to compensate for cable loss in a test-system configuration.

Press *[Input Level Offsets]* to display the level offset soft keys at the right side of the screen as shown in Fig. 3-12 below.

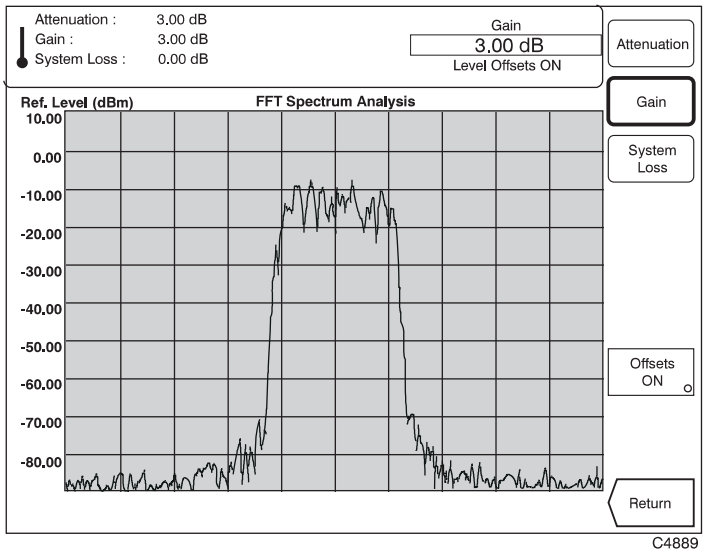


Fig. 3-12 Spectrum analyzer: Input Level Offsets selected

(1) To enter the amount of attenuation being applied, press *[Attenuation]*, enter the value using the keypad and terminate with the [dB] key.

When the [⇧] and [⇩] keys are used, the attenuation value is incremented/decremented in 1 dB steps for attenuator values ≥10 dB, and 0.1 dB steps for attenuator values <10 dB. Alternatively, fine adjustment of the attenuation setting can be made using the rotary control. One knob click represents a change in value of 0.01 dB.

(2) To enter the amount of gain being applied press *[Gain]*, enter the value using the keypad and terminate with the [dB] key.

When the [⇧] and [⇩] keys are used, the gain value is incremented/decremented in 1 dB steps for gain values ≥10 dB, and 0.1 dB steps for gain values <10 dB. Alternatively, fine adjustment of the gain setting can be made using the rotary control. One knob click represents a change in value of 0.01 dB.

(3) To compensate for power loss through cables, press *[System Loss]*. Enter the amount of cable loss occurring in the test configuration and terminate using the [dB] key.

(4) Press *[Offsets ON]* to enable or disable the offsets. When the key's green 'LED' is lit the offsets are being applied.

The average transmitter power displayed is modified by the RF offsets as follows:

Displayed average power = Measured average power + attenuation – gain + system loss.

(5) Press *[Return]* to go back to the LEVEL screen.

dB units selection

Press *[dB Units]* to select the logarithmic units. The dB units selection soft keys are displayed at the right side of the screen as shown in Fig. 3-13 below.

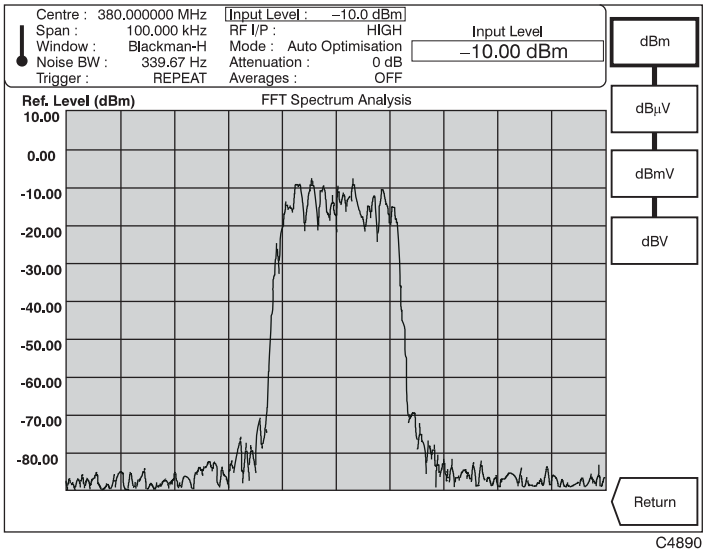


Fig. 3-13 Spectrum analyzer: dB Units selected

(1) Choose your required logarithmic units by pressing the appropriate *[dBm], [dBµV], [dBmV]* or *[dBV]* key.

(2) Press *[*Return*]* to go back to the LEVEL screen.

Front-end set-up

The hardware within the instrument can be set up automatically to favor either low-distortion or high signal-to-noise performance. Low noise optimization sets the hardware signal chain to its maximum operating level, which gives optimal noise performance at the expense of higher distortion. Low distortion optimization sets the hardware to its minimum operating level, which gives optimal distortion but degrades signal-to-noise ratio. The auto-optimization soft key balances noise and distortion for a best compromise. Maximum and minimum operating points are set within the instrument. Attenuation of the input attenuator can be set manually

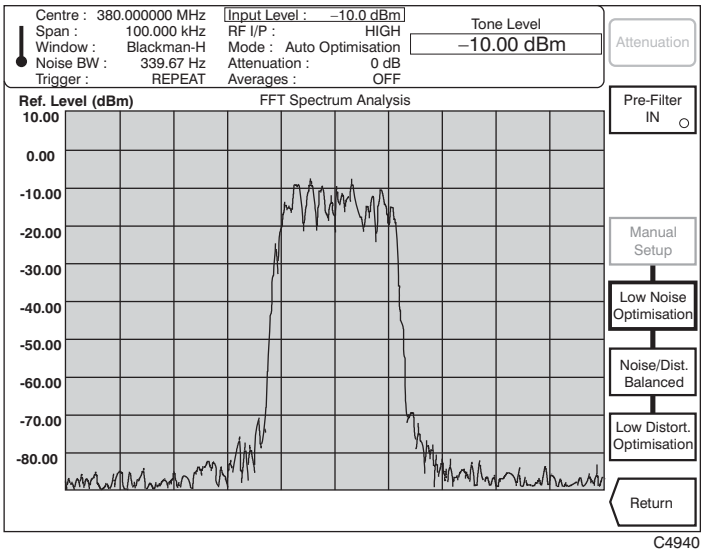


Fig. 3-14 Spectrum analyzer: Front End Setup selected

(1) Press *[Pre-Filter IN]* to pass the intermodulation components and reject the main tones. The pre-filter is a 10.7 MHz bandpass filter giving 30 dB of rejection at an offset of 400 kHz from the center of the passband. For tone spacings of 200 kHz or more, one of the main tones is attenuated by the filter by at least 30 dB and distortion performance is improved. The key's green 'LED' is lit when the filter is active.

If the filter is used with a tone spacing of less than 200 kHz, the converter may overload. A warning message appears if this is likely to happen.

(2) Press *[Manual]* to set the instrument's input attenuation manually, in the range 0 to 65 dB. This controls the gain of the input attenuator only – gains of following stages are not affected. To adjust the gain of all stages in the instrument, use *[Input Level]* on the LEVEL screen.

(3) Press *[Low Noise Optimisation]* to set the instrument's stage gains to give optimum noise performance, at the expense of an increase in distortion.

(4) Press *[Noise/Dist. Balanced]* to set the instrument's stage gains to provide the best balance of noise and distortion in the measurement.

(5) Press *[Low Distort. Optimisation]* to set the instrument's stage gains to give optimum distortion, at the expense of a decrease in signal-to-noise ratio.

(6) Press *[Return*] to go back to the LEVEL screen.

Measure

Press [MEASURE] to select the measurement mode. This enables you to control the averaging process as well as to select window function. The 'measure' soft keys are displayed at the right side of the screen as shown in Fig. 3-15 below.

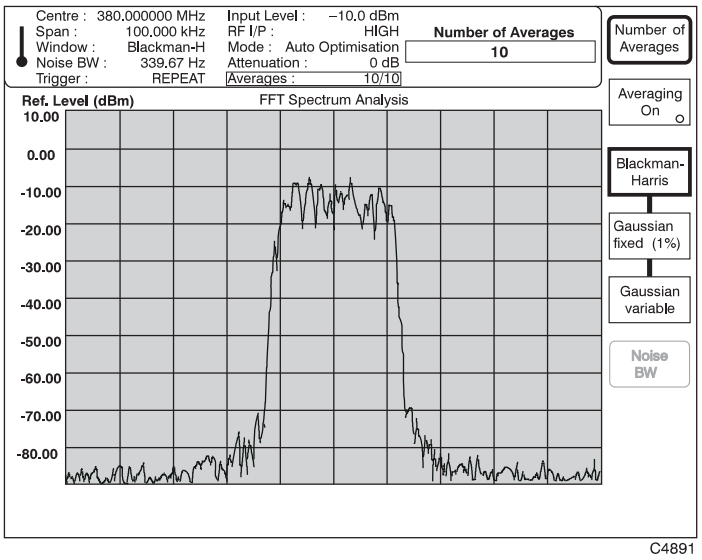


Fig. 3-15 Spectrum analyzer: MEASURE selected

(1) You can specify the number of averages being applied to the measurement by pressing *[Number of Averages]* and entering the number on the keypad in the range 1 to 20 000 (the instrument's default is 10). Terminate using any [ENTER] key.

(2) Select the type of averaging (fixed or rolling) you require using one of the following keys:

[SINGLE] – The fixed number of bursts is averaged and then the measurement process is halted. The trace is updated only at the end of the averaging process. To initiate a new measurement cycle, press [SINGLE] once again.

[REPEAT] – The displayed average is updated each time a set number of bursts (determined by the update rate of the instrument) have been received. This process is repeated until the specified number of bursts have been measured. The display is thus modified by the averaging process during successive traces.

(3) Press *[Averaging On]* to enable or disable the averaging process. When *On* the key's green 'LED' is lit.

(4) To select the Blackman-Harris (five-term) window function, press *[Blackman-Harris]*. This is usually used when a measurement requires high dynamic range. The noise bandwidth is less than or equal to 0.44% of the set span.

(5) To select the Gaussian window function, press *[Gaussian fixed (1%)]*. This is usually used for high amplitude-accuracy measurements. The noise bandwidth is at a fixed percentage (1%) of the set span.

(6) Pressing *[Gaussian variable]* also selects a Gaussian window function but with the span and resolution bandwidth uncoupled. To set the noise bandwidth, press *[Noise BW]* and enter the value on the numeric keypad. Terminate using the [Hz] or [kHz] keys.

Display

Press [DISPLAY] to select the display mode. This enables you to set the top-of-screen reference, choose between a stored or an active trace, and select the type of format for the display. The 'display' soft keys are displayed at the right side of the screen as shown in Fig. 3-16 below.

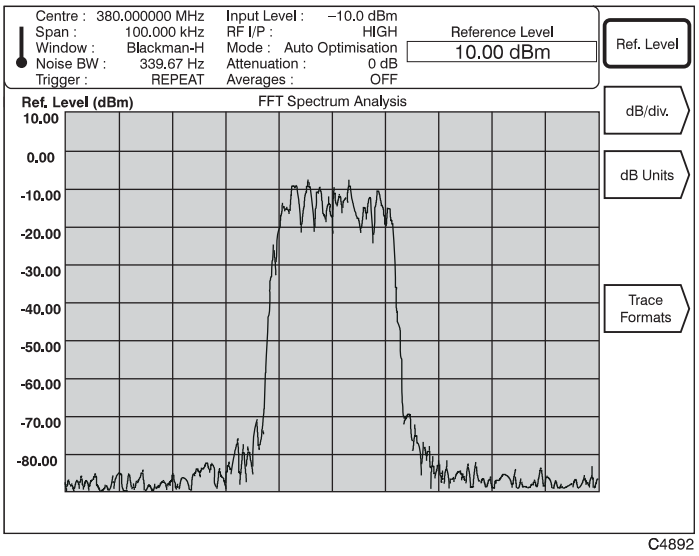


Fig. 3-16 Spectrum analyzer: DISPLAY selected

(1) To set the top-of-screen reference level, select *[Ref. Level]*. Enter your reference level on the keypad in units that may be linear (μV, mV, V) or logarithmic (dB reference). Conversion between logarithmic and linear units is performed by pressing the appropriate units key (for example, to change dBm to mV press the [mV] key). By specifying the top of screen in relation to the set input level, the instrument is able to analyze small signals in the presence of much larger signals without overloading the front end of the instrument. The reference level may be adjusted using either the rotary control or [⇩] [⇧] keys.

(2) You can change the dB-per-graticule-division setting by pressing *[dB/div.]* (see 'dB/div. setting' below).

(3) You can change the level units by pressing *[dB Units]*. This displays the level units selection keys (see 'dB units selection' on page 3-21).

(4) Press *[Trace Formats]* to select the type of trace as outline or infilled (see 'Trace formats' below).

dB/div. setting

Press *[dB/div.]* to change the dB/division setting for the display graticule. The dB/division selection soft keys are displayed at the right side of the screen as shown in Fig. 3-17 below.

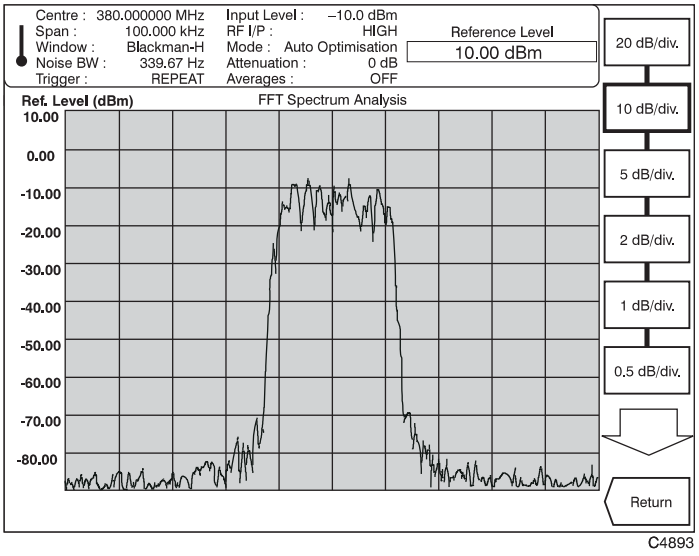


Fig. 3-17 Spectrum analyzer: dB/div. selected

(1) Press *[⇩]* to call up a second display which extends the menu so that you can select dB/division in the range 0.01 to 20 dB/division. The keys are marked in a 1, 2, 5 multiple sequence.

(2) Press *[*Return*]* to go back to the DISPLAY screen.

Trace formats

Press *[Trace Formats]* to change the type of trace for the displayed signal. The trace selection soft keys are displayed at the right side of the screen as shown in Fig. 3-18 below.

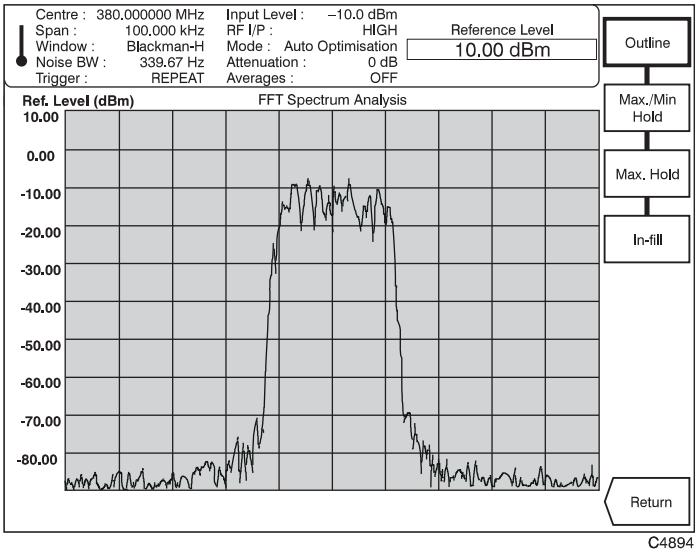


Fig. 3-18 Spectrum analyzer: Trace Formats selected

(1) Select the type of trace using one of the following keys:

[Outline] – This is the normal trace format in which only the signal outline is displayed.

[Max./Min. Hold] – The maximum and minimum signal levels recorded at each memory location are retained for as long as this mode is selected. A shadowing effect is displayed.

[Max. Hold] – The maximum signal levels recorded at each memory location are retained for as long as this mode is selected.

[In-fill] – Either or both traces are in-filled instead of the normal outline presentation. This facility can be used to highlight the difference between the active and stored traces.

(2) Press *[Return]* to go back to the DISPLAY screen.

Markers

Using the rotary control, two markers can be steered independently across the trace, providing amplitude and frequency readouts for each marker. Readouts of the difference in frequency and level between the two markers are also displayed. Additionally, by key control, a marker can be directed immediately to the peak of the largest signal on the display.

Press [MARKERS] to select the markers function. The 'markers' soft keys are displayed at the right side of a screen similar to that shown in Fig. 3-19 below.

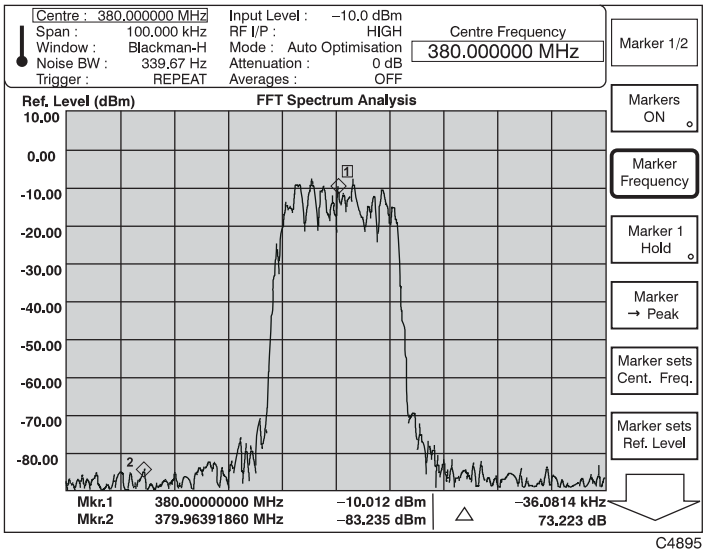


Fig. 3-19 Spectrum analyzer: MARKERS selected

(1) Press *[Markers ON]* to enable or disable both markers. When *ON* (indicated by the key's green 'LED' being lit), a status table is displayed at the bottom of the screen and the marker numbers appear on the display.

(2) Pressing *[Marker 1/2]* – when enabled – toggles between selecting Marker 1 and Marker 2 as the active marker. The active marker number appears on the trace outlined in a box. Using the rotary control, you can position the active marker anywhere on the display, with the marker following the outline of the trace. The marker status table shows the frequency and level of the signal at each marker position as well as, against Δ , the absolute, unsigned, difference in both frequency and level between Marker 1 and Marker 2.

(3) To set the active marker to a specified frequency, press *[Marker Frequency]* and enter the frequency using the keypad.

(4) Press *[Marker 1 Hold]* to lock Marker 1 to its current value, regardless of any signal change. When enabled, the key's 'LED' is lit. This function must be disabled to return to normal operation.

(5) Press *[Marker → Peak]* to position the active marker at the peak of the largest signal on the display.

(6) Press *[Marker sets Cent. Freq.]* to set the center frequency to the frequency of the active marker.

(7) Press *[Marker sets Ref. Level]* to set the top-of-screen reference level to the level of the active marker.

(8) Press *[⇩]* to call up a second screen (shown in Fig. 3-20) which extends the menu so that you can select the additional functions *[Markers set Span]* and *[Markers Locked]*.

(9) Press *[Markers set Span]* to set the frequency span to the frequency difference between Marker 1 and Marker 2.

(10) Press *[Markers Locked]* to lock the marker spacing when the key's green 'LED' is lit. This enables ganged movement of the markers using the rotary control.

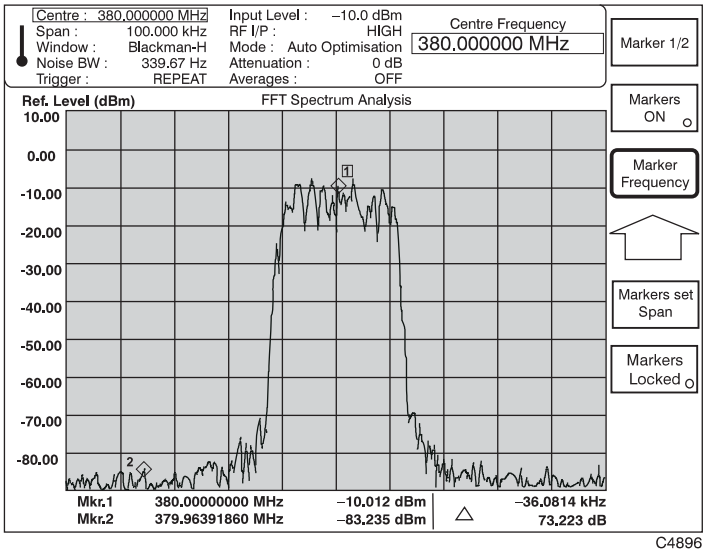


Fig. 3-20 Spectrum analyzer: MARKERS second screen

Press *[⇧]* to go back to the first MARKERS screen.

Store and recall

Storing to, and recalling from, memory

The instrument allows you to store and view up to 20 instrument configurations in named store locations. The names of stores can be edited at the time of data entry, or subsequently. You can quickly set up the instrument to replicate a stored configuration by using the memory recall function.

Selecting a store

Press [STORE] to gain access to the instrument's 'configuration storage' option. A screen similar to that in Fig. 3-21 below is displayed. This shows the status of each of the instrument's stores, numbered 1 to 20. Scroll through the table using the up/down arrow soft keys.

Against each memory number, the table provides a description of the store's contents and the date of storage. If the store contains nothing, *empty* is displayed, and two dashes appear in the 'Date Stored' column.

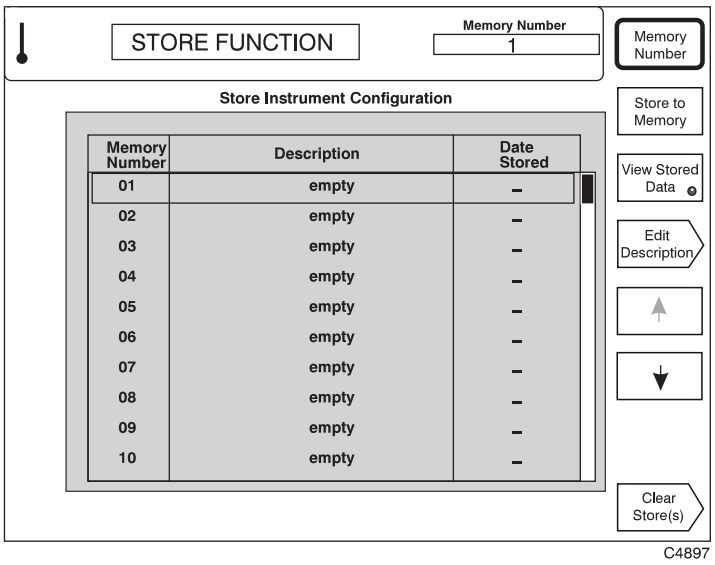


Fig. 3-21 Store instrument configuration: top-level menu

Storing to memory

To store the current settings of the instrument, press *[Store to Memory]*. The settings are stored and the current date is added, as shown in Fig. 3-22 (the instrument's real-time clock must have been set correctly).

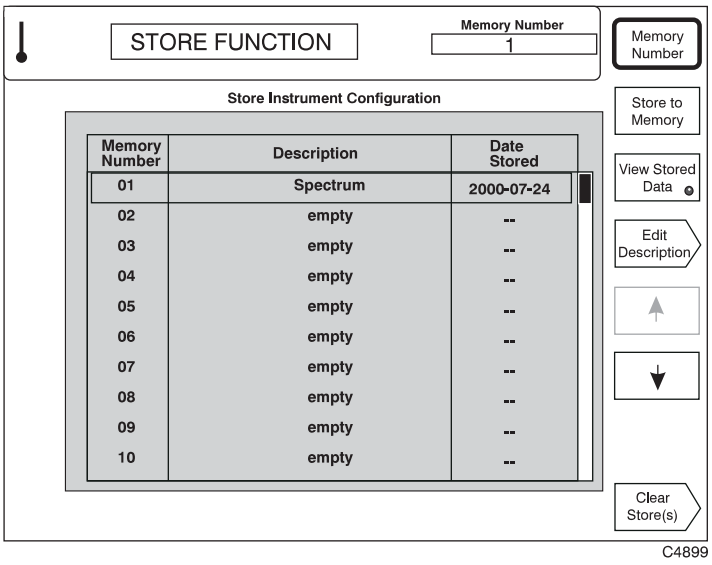


Fig. 3-22 Store instrument configuration: storing instrument settings

Entering a store description

To enter a description for the store in which the current settings of the instrument are held, press *[Edit Description]*. An editing screen appears, as shown in Fig. 3-23. Use the rotary control to select characters from the list at the top of the screen, and enter them using *[Insert Character]*. Use *[Insert Space]* to create spaces, remove characters with [DELETE], and finish by pressing any [ENTER] key. Press *[Abort]* to return to the main store screen without making any changes.

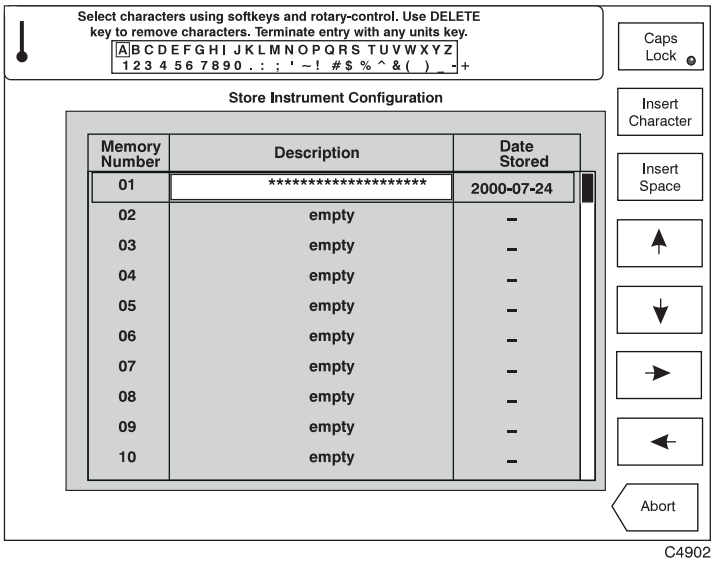


Fig. 3-23 Store instrument configuration: description editing screen

When you press any [ENTER] key, the screen changes back to show the newly-entered description and the currently-selected memory number, as shown in Fig. 3-24.

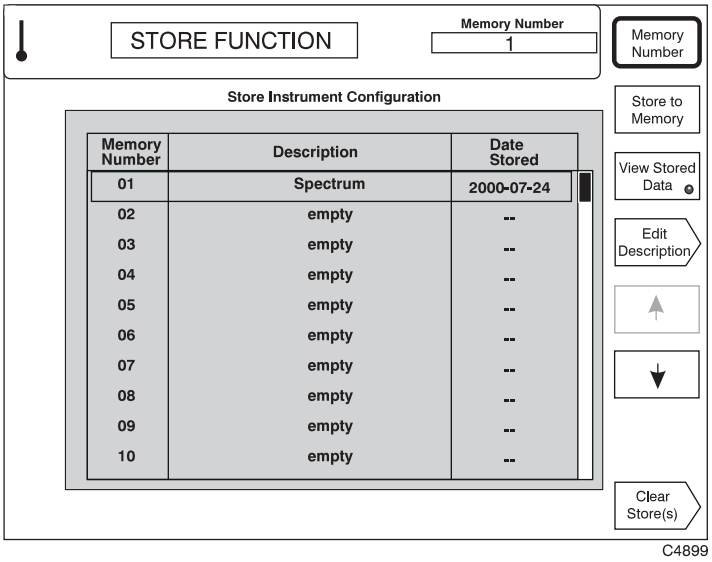


Fig. 3-24 Store instrument configuration: editing finished

Viewing stored settings

To view the instrument settings stored at a particular memory location, first select the location by pressing *[Memory Number]*, entering the memory location's number, and pressing any [ENTER] key. Then press *[View Stored Data]*, to display a screen similar to that shown in Fig. 3-25.

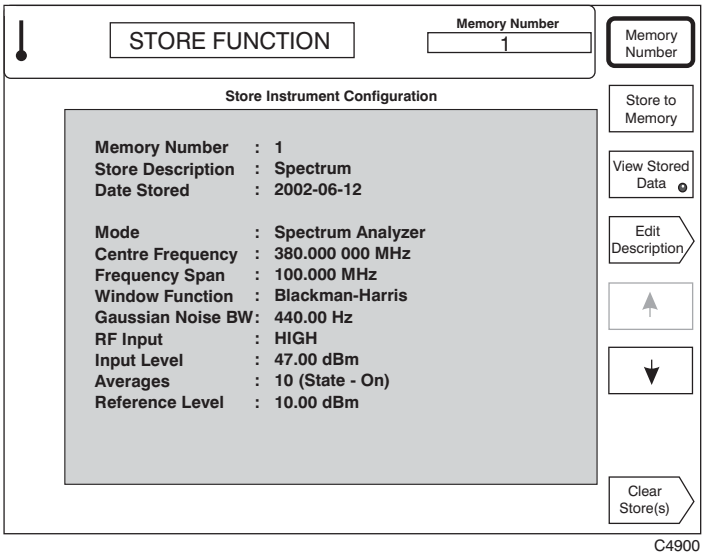


Fig. 3-25 Store instrument configuration: viewing stored data

Editing a store description

To edit the description of the store, press *[Edit Description]*. An editing screen appears, as shown in Fig. 3-26. Use the rotary control to select characters from the list at the top of the screen, and enter them using *[Insert Character]*. Use *[Insert Space]* to create spaces, remove characters with [DELETE], and finish by pressing any [ENTER] key. Press *[Abort]* to return to the main store screen without making any changes.

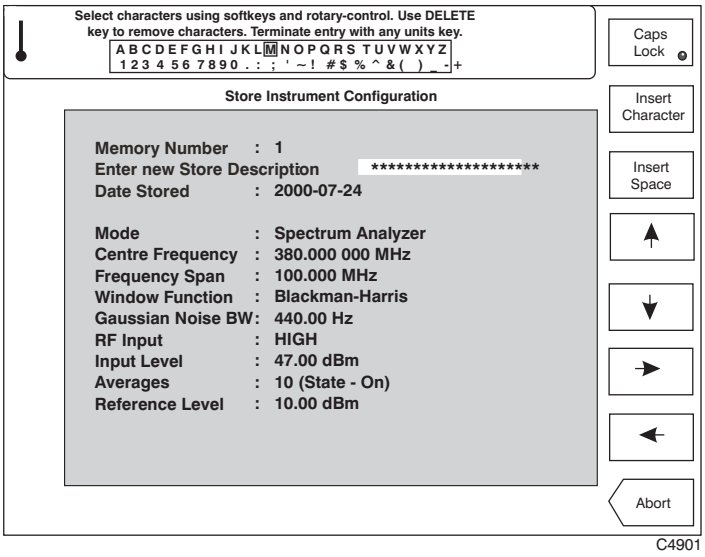


Fig. 3-26 Store instrument configuration: editing description of store

Clearing stored configurations

It is possible to erase the contents of one or all of the stores. Press *[Clear Stores(s)]*, and the soft keys shown in Fig. 3-27 appear. To clear the contents of a selected store, press *[Clear Sel'd Store]* when the chosen store is displayed. To clear the contents of all the stores, press *[Clear All Stores]*.

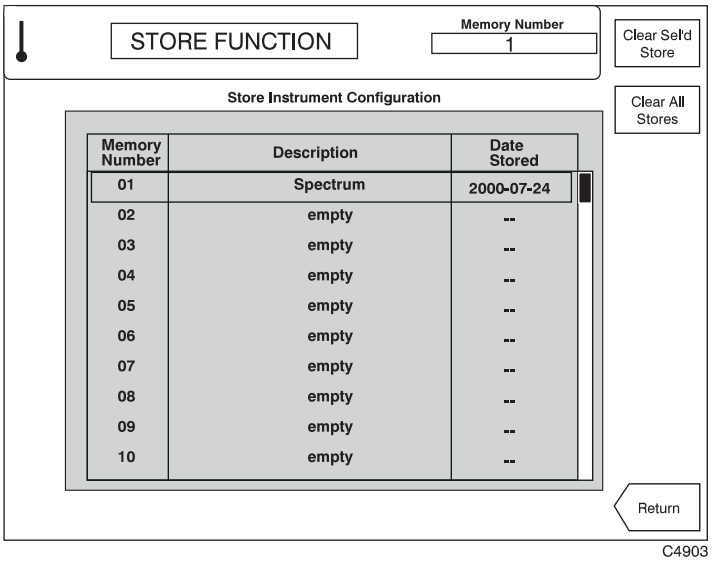


Fig. 3-27 Store instrument configuration: clearing store contents

Press *[Return]* to go back to the stored data screen.

Recalling stored configurations

Press [RECALL] to gain access to the instrument's 'recall configuration' option. You can use this to set the instrument up quickly to replicate a previously stored configuration. A screen similar to that in Fig. 3-28 below is displayed.

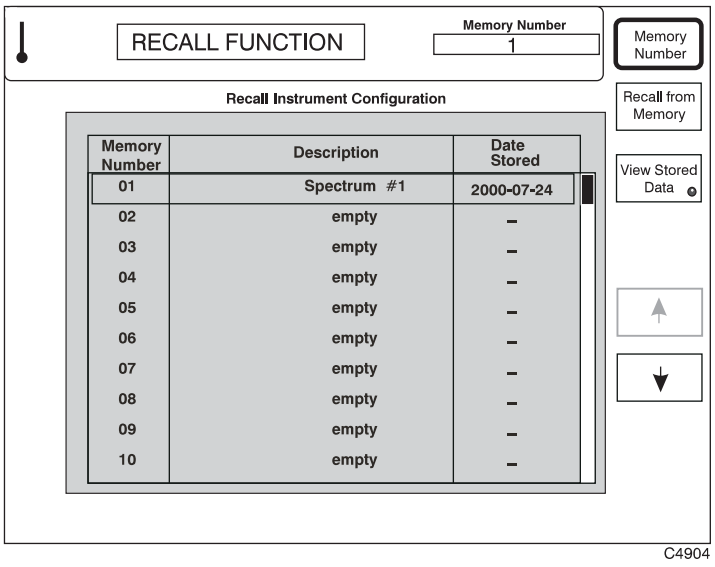


Fig. 3-28 Recall instrument configuration: top-level menu

Viewing stored data

To look at the currently stored configurations of the instrument, select a particular store by pressing *[Memory Number]*. Press *[View Stored Data]*: a summary is given of the settings in that store, as shown in Fig. 3-29.

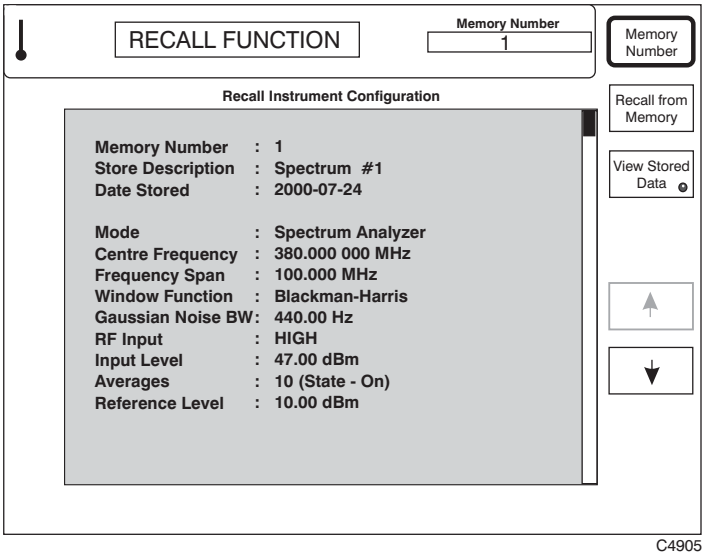


Fig. 3-29 Recall instrument configuration: viewing instrument settings

Recalling from memory

To recall a particular configuration from memory, ensure that the chosen configuration is displayed. Press *[Recall from Memory]*; the instrument sets itself up to the displayed configuration. A message appears while this is happening, as shown in Fig. 3-30.

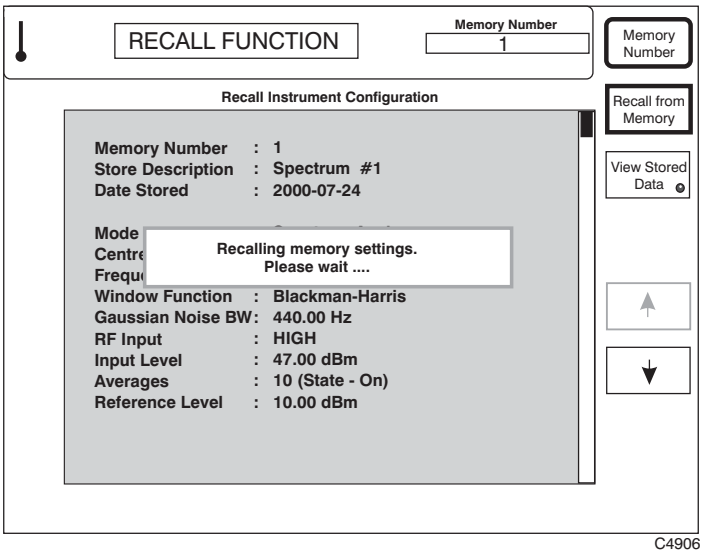


Fig. 3-30 Recall instrument configuration: recalling a stored configuration

Utilities

Utility selection

Press [UTILS] to gain access to the utilities options. Some of the utilities are concerned with diagnostic and maintenance functions, and their uses are therefore described in full in the Maintenance Manual.

Press [UTILS] following a power-up, and you are taken to the top-level utility access menu.

Press [UTILS] at any other time, and the last utility used is recalled. A second press then takes you to the top-level utility access menu.

Utility access

This is the top-level menu, which enables you to access all the other utility menus. Press [UTILS] (and again if necessary) until the utility access menu shown below in Fig. 3-31 is displayed.

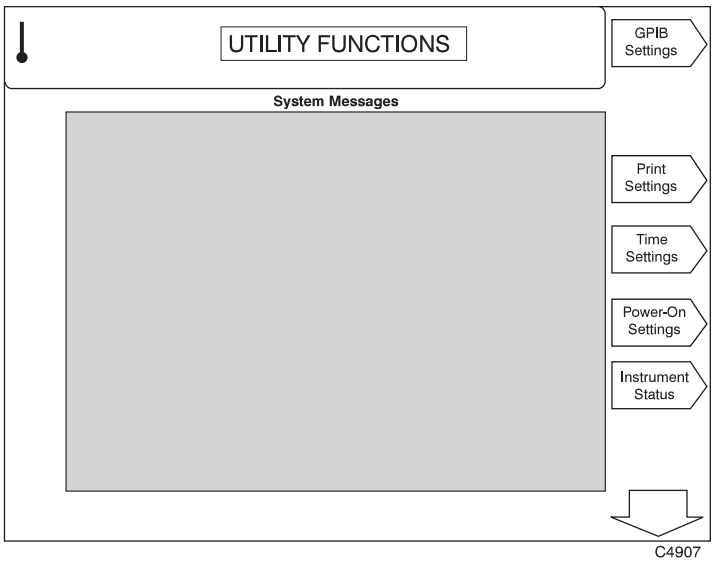


Fig. 3-31 Utilities: utility access menu – first page

Utilities – first page

The first page of the menu is displayed together with any system messages (background error messages). Press *[⇩]* to display additional soft keys on a second page.

(1) You can set up the GPIB address by pressing *[GPIB Settings]* (see 'GPIB settings' below).

(2) You can check the print settings and edit the name that appears on the print by pressing *[Print Settings]* (see 'Print settings' below).

(3) You can set the time and date by pressing *[Time Settings]* (see 'Time and date settings' below).

(4) You can define the settings that the instrument uses at power-on by pressing *[Power-On Settings]* (see 'Power-on settings' below).

(5) You can display the instrument's status by pressing *[Instrument Status]* (see 'Instrument status' below).

GPIB settings

Press *[GPIB Settings]* to display the GPIB Settings menu as shown in Fig. 3-32 below.

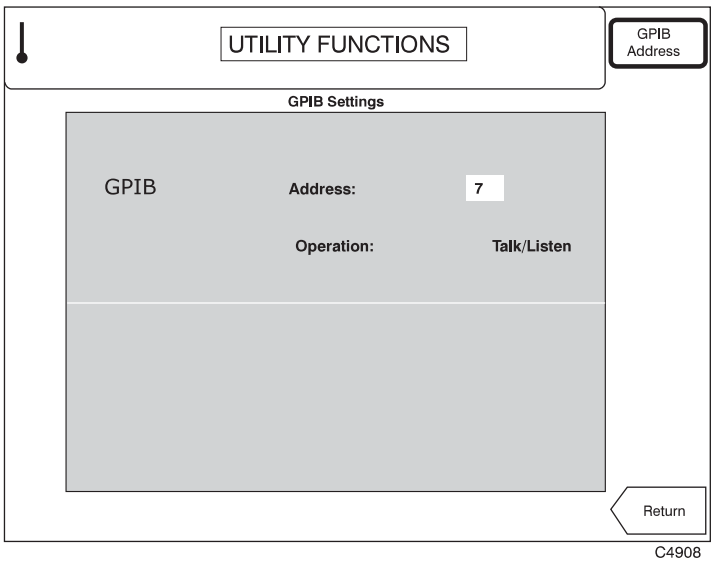


Fig. 3-32 Utilities: GPIB settings menu

(1) Press *[GPIB Address]* to enter the instrument's GPIB address, which must be in the range 1 to 30. The address must be unique to the instrument.

(2) Press *[Return]* to go back to the utility access menu.

Print settings

Press *[Print Settings]* to display the Print Settings menu as shown in Fig. 3-33 below.

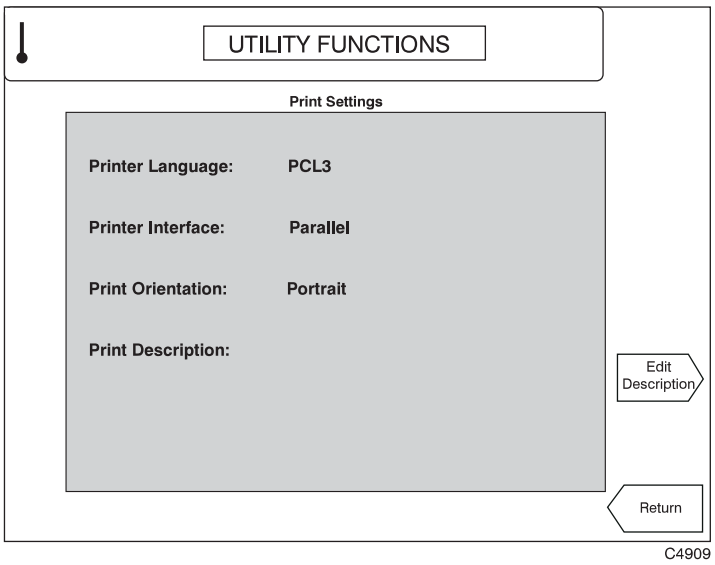


Fig. 3-33 Utilities: print settings menu

(1) To enter a description of the company or individual making the print, press *[Edit Description]*. An editing screen appears, as shown in Fig. 3-34. Use the rotary control to select characters from the list at the top of the screen, and enter them using *[Insert Character]*. Use *[Insert Space]* to create spaces, remove characters with [DELETE], and finish by pressing any [ENTER] key. The instrument inserts the words 'Analysis by:' before the text when printing. Press *[Abort]* to return to the Print Settings menu without making any changes.

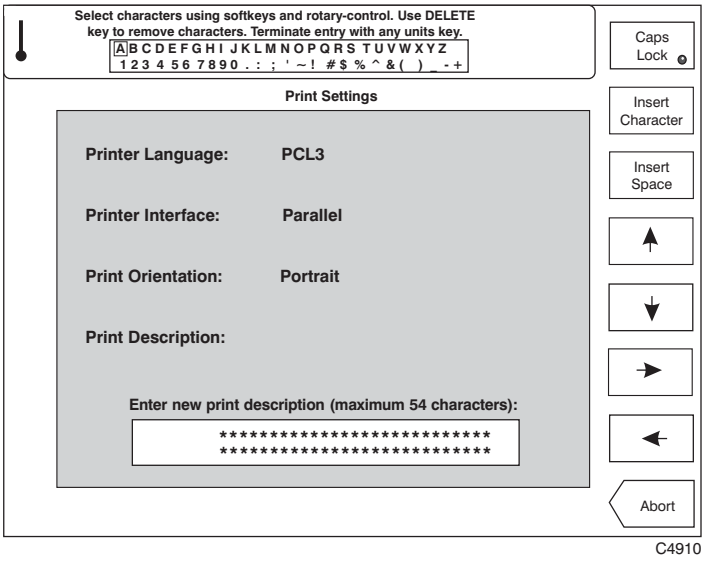


Fig. 3-34 Utilities: print description editing screen

Time and date settings

Press *[Time Settings]* to display the Time Settings menu as shown in Fig. 3-35 below.

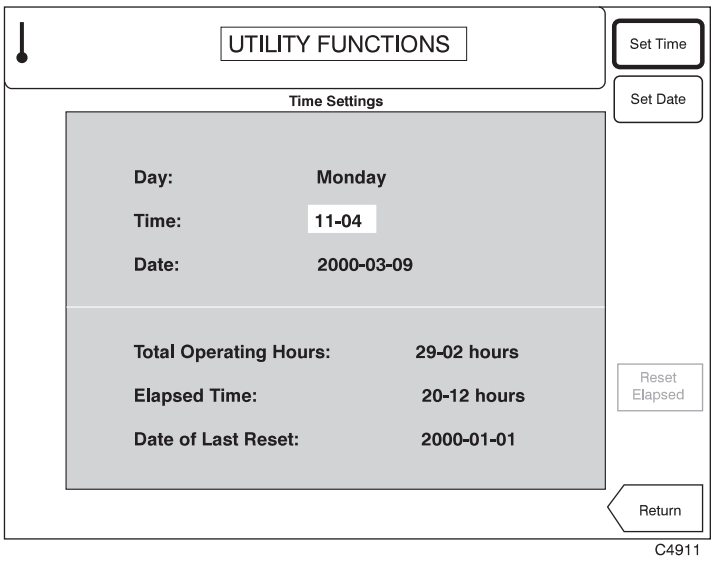


Fig. 3-35 Utilities: time settings menu

(1) To set the current time, press *[Set Time]* and enter the time in 24-hour format. Enter the time in the form HH MM; dashes are inserted automatically. Press any [ENTER] key to start the clock.

(2) To set the current date press *[Set Date]* and enter the date in the form YYYY MM DD; dashes are inserted automatically. Press any [ENTER] key to calculate and display the day.

(3) Press *[Return]* to go back to the utility access menu.

Note: make sure that you have set the time correctly before enabling the *User Calibration Auto-response* utility (page 3-50).

Power-on settings

Press *[Power-On Settings]* to display the Power-On Settings menu as shown in Fig. 3-36 below. This allows you to define the configuration in which the instrument starts at its next power-up.

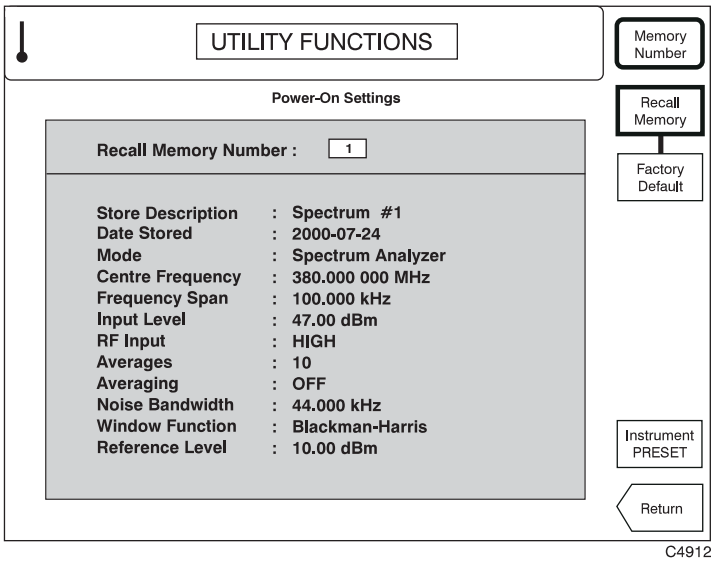


Fig. 3-36 Utilities: power-on settings menu

(1) To set the instrument to its factory default settings at the next power-up (see 'Default settings' on page 3-12), press *[Factory Default]*. A message confirms that the Factory Default mode has been selected.

(2) To set the instrument to its factory default settings immediately, press *[Instrument PRESET]*.

To set the instrument to settings stored earlier using the Store and Recall feature (page 3-29), press *[Recall Memory]*. The *[Memory Number]* key now becomes available. Enter the chosen memory location's number using the numeric keypad, followed by any [ENTER] key. This memory location's settings are used at subsequent power-ups.

Press *[Return]* to go back to the utility access menu.

Instrument status

Press *[Instrument Status]* to display information about the instrument's software, fitted options, any special hardware information, and relevant patents.

(1) Pressing *[Software Status]* gives important information about the instrument, as shown in Fig. 3-37. This includes its serial and ID numbers, which you need to quote if requesting the instrument's flash download password.

Press *[Return]* to go back to the utility access menu.

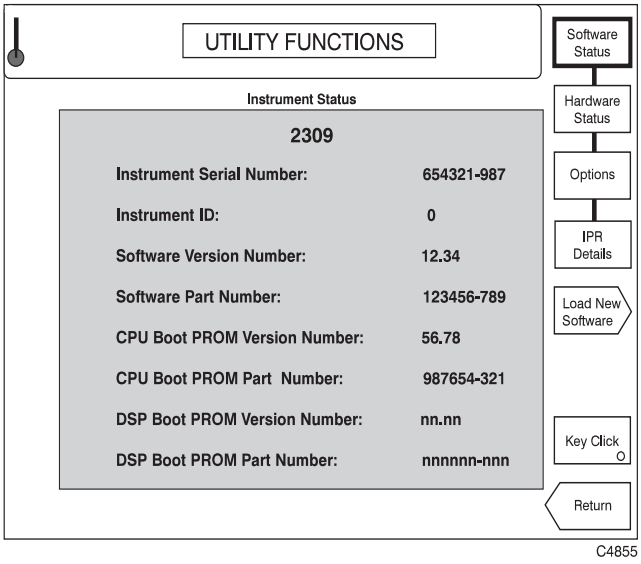


Fig. 3-37 Utilities: software status

(2) Pressing *[Hardware Status]* gives important information about the instrument, as shown in Fig. 3-38. This repeats its serial and ID numbers and includes any hardware information that may be relevant to this instrument.

Press *[Return]* to go back to the utility access menu.

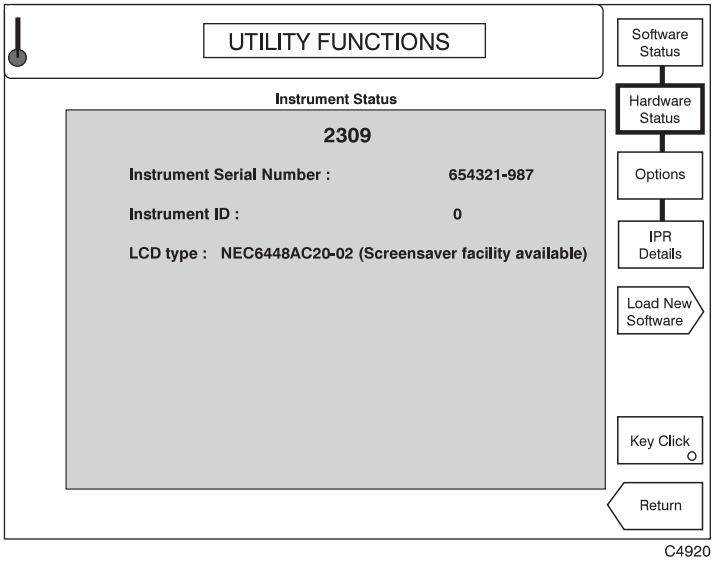


Fig. 3-38 Utilities: hardware status

(3) To show which options are provided with the instrument, press *[Options]*. A display similar to that in Fig. 3-39 is shown.

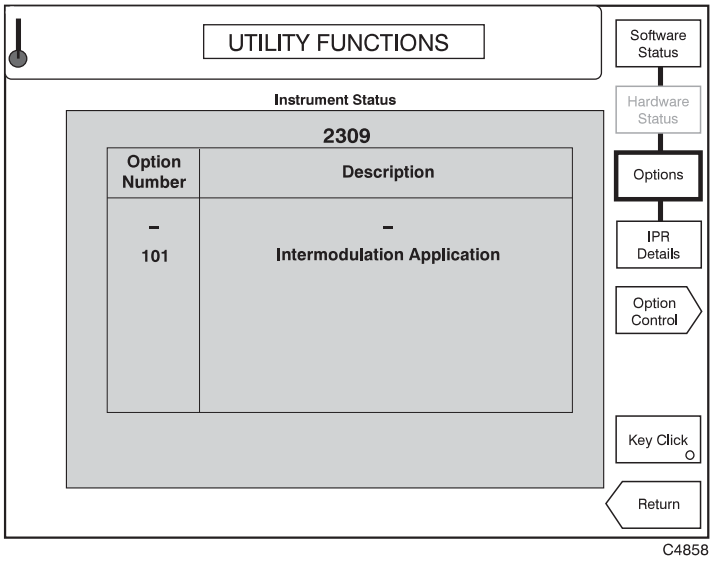


Fig. 3-39 Utilities: options screen

Press *[Option Control]* to display a further screen (Fig. 3-40), which allows you to enable or disable options. Scroll up and down to select an option, and press*[Enable Option]* or *[Disable Option]*. You are prompted to enter a password. If you do not know the password, contact your nearest Service Center.

Press *[Return]* to go back to the utility access menu.

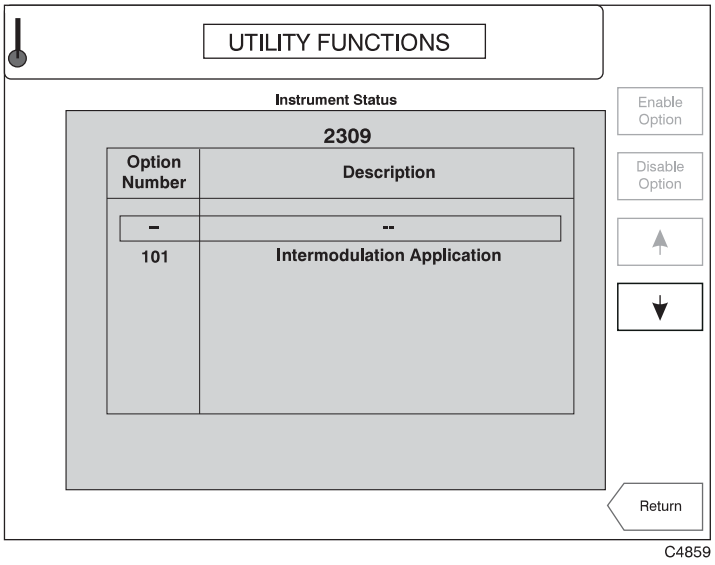


Fig. 3-40 Utilities: option control screen

(4) To display the more important patent information press *[IPR Details]*. A display similar to that in Fig. 3-41 is shown.

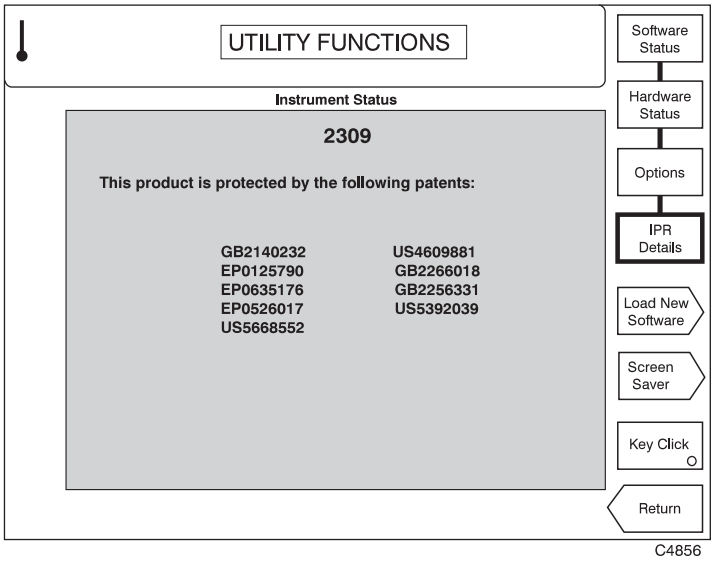


Fig. 3-41 Utilities: patent information

(5) The *[Load New Software]* menu is no longer used. The RS232 interface is now used to reprogram the internal flash memory. This is performed by authorized distributors or Aeroflex personnel. Please contact your local representative if a software upgrade is required.

(6) To set up the screen saver, press *[Screen Saver]*. A display similar to that in Fig. 3-43 is shown.

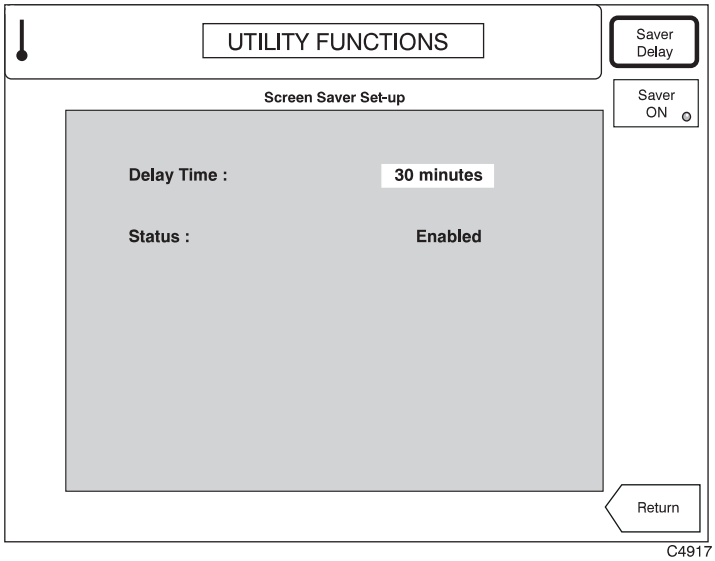


Fig. 3-43 Utilities: screen saver set-up

(7) You can specify a time delay of between one and 30 minutes before the instrument's screen saver activates. The screen saver can be enabled or disabled using *[Saver ON]*: however, to maximize the life of the LCD, we recommend that the screen saver remains enabled when possible.

The screen is blank when the screen saver is active. However, one of the RF INPUT LEDs remains lit to show that the instrument is active.

Press any key to reactivate the screen. That key-press is otherwise ignored by the instrument.

(9) On the instrument status screen, you can use *[Key Click]* to enable or disable a sound that is audible each time you press a key. When enabled, the key's 'LED' is lit.

(9) Press *[Return]* to go back to the utility access menu.

Utilities – second page

Press *[⇩]* to call up the second page of the top-level utility access menu. This extends the menu to enable access to the additional utilities shown in Fig. 3-44.

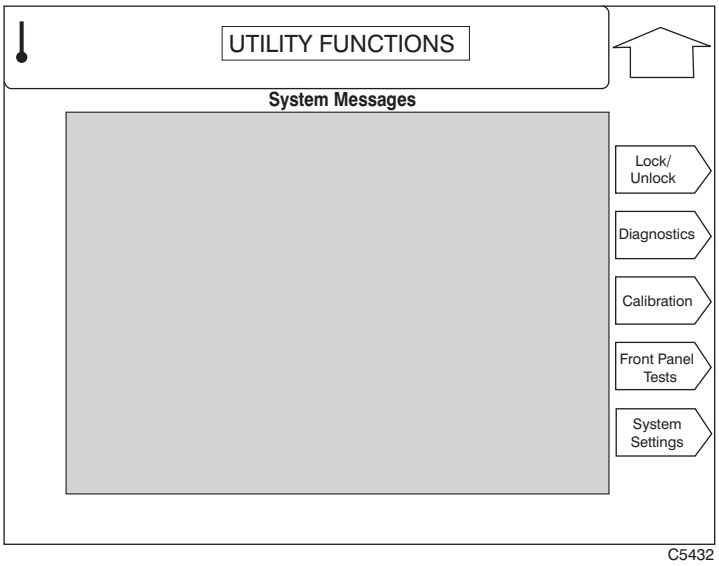


Fig. 3-44 Utilities: utility access menu – second page

(1) You can lock or unlock the protection by pressing *[Lock/Unlock]* (see 'Lock/Unlock' below). The operation of this menu is explained in detail in the Maintenance Manual.

(2) To select the diagnostics utilities press *[Diagnostics]*. The operation of this menu is explained in detail in the Maintenance Manual.

(3) To select the calibration utilities press *[Calibration]*. The operation of this menu is explained in detail in the Maintenance Manual.

(4) You can test for correct front panel operation by pressing *[Front Panel Tests]* (see 'Front panel tests' below).

(5) You can set the instrument to perform a user calibration automatically when it is needed, by pressing *[System Settings]* (see 'System settings' below).

(6) Press *[⇧]* to return to the first page of the utility access menu.

Lock/unlock

With this utility you can lock the instrument to prevent unauthorized use, or unlock it to access sensitive operations such as changing memory settings, altering the instrument's calibration, and diagnostic functions. Use this utility also to reset the password.

These activities are beyond the scope of this Operating Manual; refer to the Maintenance Manual (part no. 46882/337) for further information.

Lock/unlock

With this utility you may lock the instrument to prevent unauthorized use, or unlock it to access sensitive operations such as changing memory settings, altering the instrument's calibration, and diagnostic functions. It can also be used to reset the password.

These activities are beyond the scope of this Operating Manual; refer to the Maintenance Manual (part no. 46882/337) for further information.

Front-panel tests

With this utility you can test both the functioning of the front-panel controls and the operation of the display. Press *[Front Panel Tests]* on the utility access menu to display the front-panel test screen shown in Fig. 3-45.

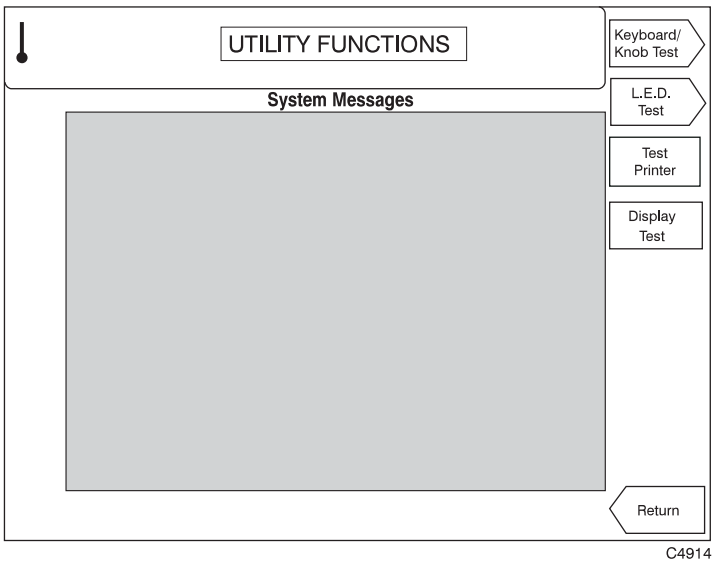


Fig. 3-45 Utilities: front panel test screen

(1) You can test the keyboard and control knob operation by pressing *[Keyboard/Knob Test]* (see 'Keyboard and control knob test' below).

(2) You can test the LED operation by pressing *[LED Test]* (see 'Front-panel LED test' on page 3-47).

(3) You can test the operation of the printer by pressing *[Test Printer]*. A short message containing details of the instrument is output on any HP-PCL3 printer connected to the instrument's parallel port.

(4) You can test the operation of the display by pressing *[Display Test]* (see 'Display pixel test' on page 3-48).

(5) Press *[Return]* to go back to the utility access menu.

Keyboard and control knob test

Press *[Keyboard/Knob Test]* on the front panel test menu to display the Keyboard and Knob Test screen shown in Fig. 3-46.

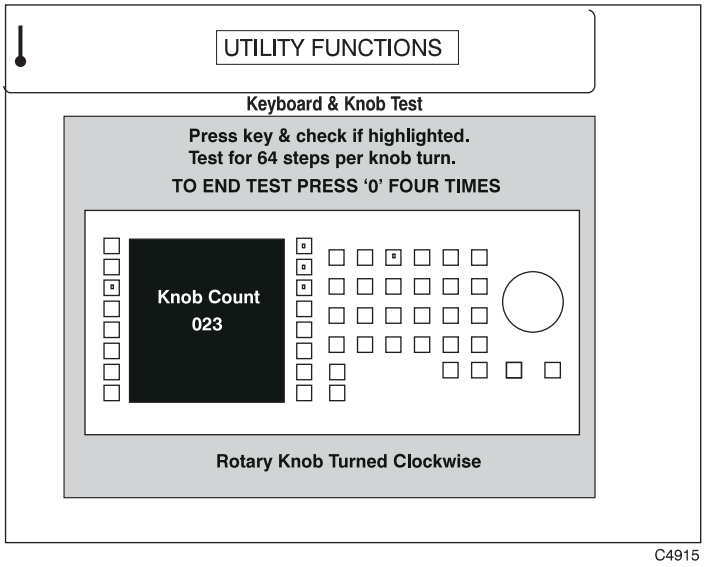


Fig. 3-46 Utilities: Keyboard and Knob Test screen

(1) Press and release each of the front-panel keys (both hard and soft) in turn and check that the correct key is highlighted on the display.

(2) Turn the rotary control knob clockwise and check from the *Knob Count* shown on the screen that there are 64 steps in each complete knob turn.

(3) As instructed by the screen, press the [0] key four times to end the test and return to the front panel test menu.

Front-panel LED test

Press *[L.E.D. Test]* on the front-panel test menu to display the Front-Panel L.E.D. Test screen shown in Fig. 3-47.

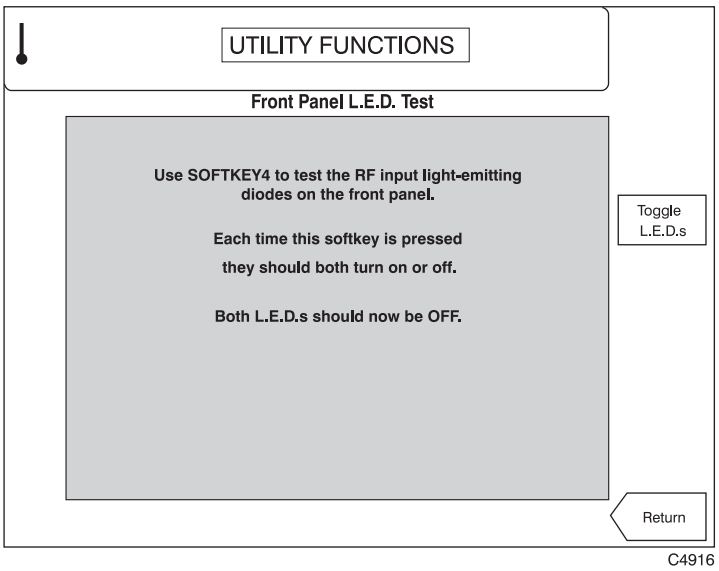


Fig. 3-47 Utilities: Front-Panel LED Test screen

(1) To test the operation of the two LEDs at the sides of the RF INPUT connectors press *[Toggle L.E.D.s]* as instructed by the screen. Both LEDs should now light up. Press again and both LEDs should now go out.

(2) Press *[Return]* to go back to the front-panel test menu.

Display pixel test

Press *[Display Test]* on the front-panel test menu to display the Display Pixel Test screen shown in Fig. 3-48.

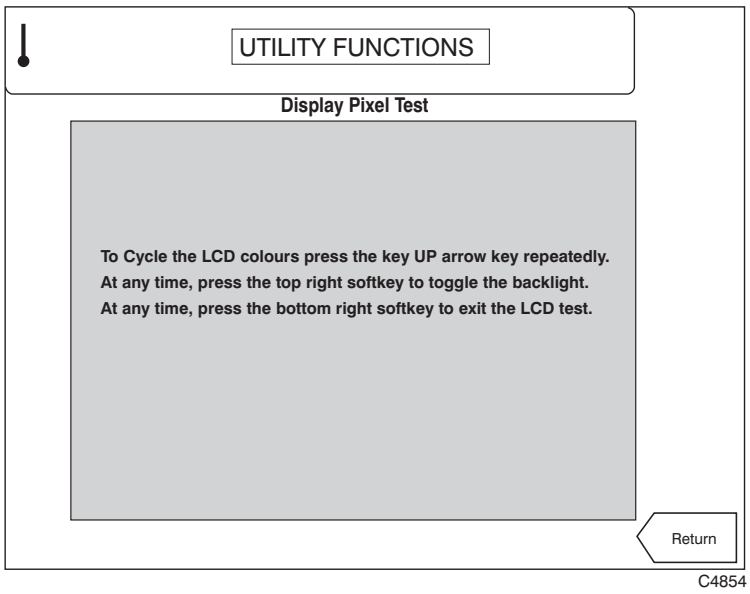


Fig. 3-48 Utilities: Display Pixel Test screen

(1) To test the LCD colors, repeatedly press the [⇧] key. Check that this causes the display to cycle through the colors in the order red, green, blue, white, black.

(2) Press *[Return]* to go back to the front-panel test menu.

System settings

This utility allows you to enable or disable automatic user calibration. Press *[System Settings]* on the utility access menu to display the system settings screen shown in Fig. 3-49.

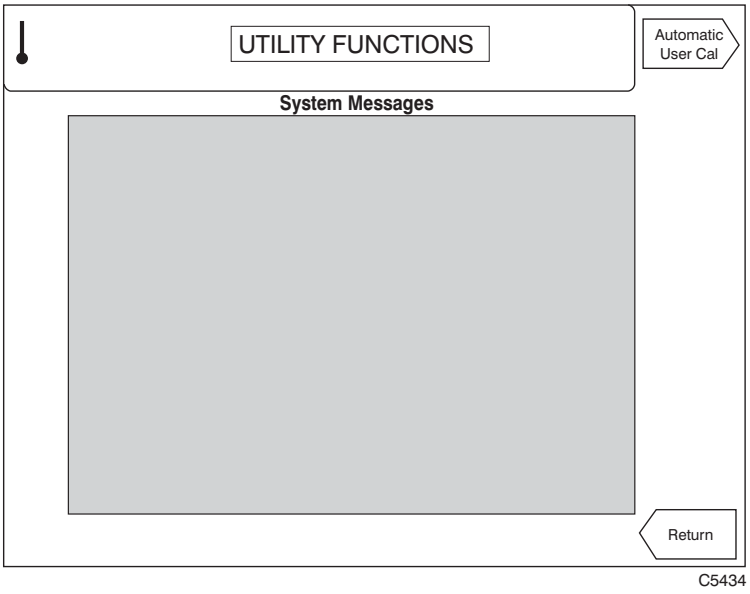


Fig. 3-49 Utilities: system settings screen

(1) You can enable automatic user calibration by pressing *[Automatic User Cal]* (see 'User calibration auto-response' below).

(2) Press *[Return]* to go back to the utility access menu.

User calibration auto-response

Press *[Automatic User Cal]* on the system settings menu to display the User Calibration Auto-response Configuration screen shown in Fig. 3-50.

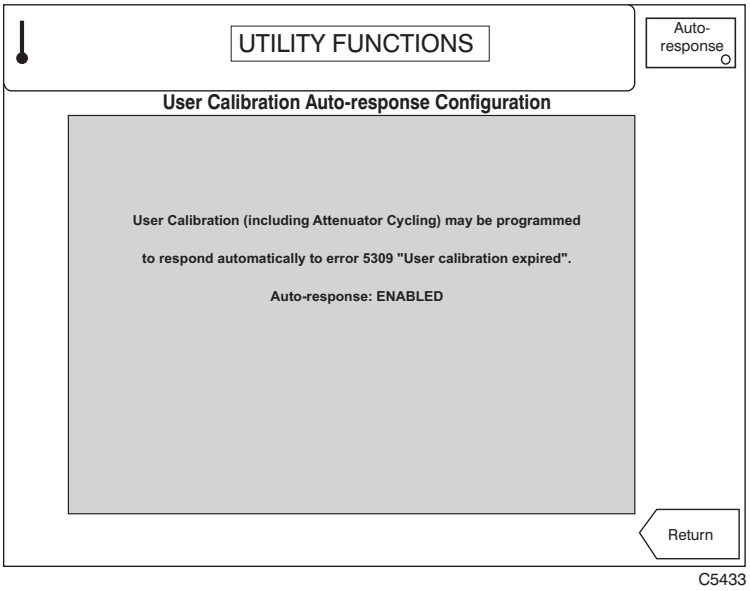


Fig. 3-50 Utilities: User Calibration Auto-response Configuration screen

(1) In order to exercise the attenuator pads and input switches of the instrument, the user calibration should be run regularly. The instrument generates error 5039 "*User calibration expired*" whenever a calibration is required. This occurs after the instrument has been powered on for 30 minutes, if it is on at 23:59 each day, or as a result of instrument conditions. This error message prompts you to perform a user calibration manually. Alternatively, you can set the instrument to respond to this error message and perform a user calibration automatically.

Note that when the auto-response mode is enabled, user calibration will run automatically in the following modes of operation:

- FFT spectrum analysis mode (in both single and continuous modes).
- Intermodulation measurement mode once a measurement has completed or aborted, but not during a measurement.
- In a non-measurement mode (for example, when in a utility screen).

(2) Press *[Auto-response]* to enable or disable the user calibration auto-response. The screen shows the current state. When auto-response is enabled, the key's 'LED' is lit.

(3) Press *[Return]* to go back to the system settings menu.

Error messages

List of error messages

The following tables contain all the error messages occurring in the instrument. Negative error codes are reserved in the SCPI standard and are grouped to indicate ‘generic’ error conditions (for example, command errors, device-specific errors). Positive error codes indicate an error specific to the instrument. An error value of zero indicates that no error has occurred.

Errors are displayed as a single line of text above the measurement display area. In order that error conditions can be monitored via the GPIB, the errors are placed into an error queue as they occur. Up to 50 error events can be retained. The queue performs a first in, first out operation. If the queue overflows, the most recent error in the queue is replaced with error

–350, ‘Queue overflow’.

Errors remain in the queue until they are read by the ERR? or :SYSTem:ERRor? query, or by the error queue being cleared by one of the following:

- power−up
- receipt of a *CLS command
- reading the last item from the queue.

In addition to the error queue entry, the appropriate bit in the Event Status Register is set.

SCPI-specific error messages

The table below contains the error code in the left column. The center column shows the associated text message. The right column provides a brief explanation as to the possible cause of the error condition.

Error code	Error text	Error explanation
0	No error	This message is output if the instrument has no errors to report (the queue is empty).

Command error

An error number in the range –199 to –100 indicates that an IEEE 488.2 syntax error has been detected by the instrument's parser (for example, an unrecognized header). The occurrence of any error in this class causes the command error bit (bit 5) in the Event Status Register (ESR) to be set.

These errors generally occur as a result of an incorrectly-entered or invalid command. The remedy is to re-enter the command correctly. Such an error should not affect the correct operation of the instrument once the command is re-entered.

Error code	Error text	Error explanation
–100	Command error	The command is faulty or invalid. This is a generic syntax error that is only used for devices that cannot detect more specific errors.
–101	Invalid character	The command contains an invalid character e.g. '&'.
–102	Syntax error	An unrecognized command or data type was received e.g. the command contains block data that the instrument does not accept.
–103	Invalid separator	The parser was expecting a separator and encountered an illegal character e.g. a semicolon is missing after the command.
–104	Data type error	The command contains a data element different from that allowed. e.g. numeric or string data was expected but block data was encountered.
–105	GET not allowed	A Group Execute Trigger was received within a command line.
–108	Parameter not allowed	The command contains too many parameters.
–109	Missing parameter	The command contains too few parameters.
–110	Command header error	A generic error indicating that the header of the command is faulty. This error should only be used when the device cannot detect the more specific errors –111 to –119.
–111	Header separator error	The header contains an illegal separator e.g. no 'white space' followed the header.
–112	Program mnemonic too long	The header contains more than 12 characters.
–113	Undefined header	The header is syntactically correct but is not defined for the instrument.
–114	Header suffix out of range	The header contains an invalid numeric suffix e.g. SPECtrum2
–120	Numeric data error	A generic error indicating that the command contains a faulty numeric parameter. This error is only used when the device cannot detect the more specific errors –121 to –129.
–121	Invalid character in number	A number contains an invalid character e.g. 'A' in a decimal number or '9' in an octal number.
–123	Exponent too large	The magnitude of the exponent is greater than 32,000.
–124	Too many digits	The number includes too many digits.
–128	Numeric data not allowed	The command includes a number that is not allowed in this position.
		contd./...

Command error *(continued)*

Error code	Error text	Error explanation
−130	Suffix error	A generic error code indicating a suffix error. This error is only used when the device cannot detect the more specific errors −131 to −139.
−131	Invalid suffix	The suffix does not follow the syntax or the suffix is invalid for the instrument.
−134	Suffix too long	The suffix contains more than 12 characters.
−138	Suffix not allowed	A suffix was detected after a numeric element that does not allow suffixes.
−140	Character data error	A generic error code indicating an invalid text parameter. This error is only used when the device cannot detect more specific errors −141 to −149.
−141	Invalid character data	The text parameter either contains an invalid character or it is invalid for the command sent.
−144	Character data too long	The text parameter contains more than 12 characters.
−148	Character data not allowed	A text parameter is not allowed for the command or at the position in the command.
−150	String data error	A generic error code indicating a invalid string. This error is only used when the device cannot detect more specific errors −151 to −159.
−151	Invalid string data	A string data element was expected, but was invalid for some reason e.g. an END message was received before the terminal quote character.
−158	String data not allowed	The command contains a valid string at a position that is not permitted.
−160	Block data error	A generic error code indicating a faulty block data. This error is only used when the device cannot detect more specific errors −161 to −169.
−161	Invalid block data	A block data element was expected, but was invalid for some reason e.g. an END message was received before the block length was satisfied.
−168	Block data not allowed	The command contains valid block data at a position that is not permitted.
−170	Expression error	A generic error code indicating an invalid mathematical expression. This error is only used when the device cannot detect more specific errors −171 to −179.
−171	Invalid expression	The command contains an invalid mathematical calculation e.g. due to an illegal character.
−178	Expression data not allowed	A valid mathematical expression was encountered at an incorrect parsing level.
−180	Macro error	A generic error code indicating either an incorrect macro definition or incorrect execution of a macro. This error is only used when the device cannot detect more specific errors −181 to −189.
−181	Invalid outside macro definition	A macro parameter placeholder was encountered outside a macro definition.
−183	Invalid inside macro definition	A macro definition is syntactically incorrect.
−184	Macro parameter error	A command inside the macro definition has either the incorrect number or type of parameters.

Execution error

An error number in the range −299 to −200 indicates an error on the execution of a command (for example, the parameter value specified lies outside the range of the instrument). The occurrence of any error in this class causes the execution error bit (bit 4) in the Event Status Register (ESR) to be set.

These errors generally occur as a result of asking the instrument to carry out a command that it is incapable of performing (for example, to make a measurement outside its specification limits), or of asking the instrument to perform an invalid combination of commands. Such an error should not affect the correct operation of the instrument once the cause is removed.

Error code	Error text	Error explanation
−200	Execution error	A generic error code indicating an error on execution of the command. This error is only used when the device cannot detect more specific errors.
−201	Invalid while in local	The command is not executable while the device is in local due to a hard local control.
−202	Setting lost due to rtl	A setting associated with hard local control was lost when a Return To Local was performed.
−203	Command protected	A valid command or query could not be executed because it was password protected.
−210	Trigger error	An error occurred on triggering the device.
−211	Trigger ignored	A Group Execute Trigger or *TRG was ignored because of device timing considerations e.g. the device was not ready to respond.
−212	Arm ignored	An arming signal was ignored.
−213	Init ignored	Measurement initialization was ignored as another measurement was already in progress.
−214	Trigger deadlock	The trigger source for measurement initiation is set to GET and a subsequent measurement query is received. The measurement cannot be started until a GET is received, but the GET would cause an INTERRUPTED error.
−215	Arm deadlock	The arm source for measurement initiation is set to GET and a subsequent measurement query is received. The measurement cannot be started until a GET is received, but the GET would cause an INTERRUPTED error.
−220	Parameter error	A generic error code indicating that the command contains a faulty or invalid parameter. This error is only used when the device cannot detect more specific errors −221 to −229.
−221	Setting conflict	There is a conflict between the setting of the parameter and the instrument state.
−222	Data out of range	Valid program data was received but the parameter value lies outside the range of the instrument.
−223	Too much data	The command contains too much data for the instrument.
−224	Illegal parameter value	The parameter value is invalid.
−225	Out of memory	The instrument has insufficient memory to perform the requested operation.
−226	Lists not same length	Attempted to use LIST structure having individual LISTs of unequal length.
−230	Data corrupt or stale	The data is incomplete or invalid.
−231	Data questionable	The measurement accuracy is suspect.
		contd./...

Execution error *(continued)*

Error code	Error text	Error explanation
−232	Invalid format	
−233	Invalid version	
−240	Hardware error	A generic error code indicating that the command could not be executed due to instrument hardware problems. This error is only used when the device cannot detect more specific errors −241 to −249.
−241	Hardware missing	A valid command could not be executed because of missing hardware e.g. option not installed.
−250	Mass storage error	A generic error code indicating that a mass storage error occurred. This error is only used when the device cannot detect more specific errors −251 to −259.
−251	Missing mass data	A valid command could not be executed because of missing mass storage e.g. option not installed.
−252	Missing media	A valid command could not be executed because of missing media e.g. no floppy disk installed.
−253	Corrupt media	A valid command could not be executed because of corrupt media e.g. bad or wrongly formatted floppy disk.
−254	Media full	A valid command could not be executed because the media are full e.g. no room on the floppy disk.
−255	Directory full	A valid command could not be executed because the media directory is full.
−256	File name not found	A valid command could not be executed because the file name could not be found on the media.
−257	File name error	A valid command could not be executed because of an incorrect file name e.g. an attempt was made to copy to a duplicate file name.
−258	Media protected	A valid command could not be executed because the media were protected e.g. the write protect tab on a floppy disk was present.
−260	Expression data	A generic error code indicating that the expression contains an error. This error is only used when the device cannot detect more specific errors −261 to −269.
−261	Math error in expression	A syntactically correct expression contains a mathematical error e.g. divide by zero
−270	Macro error	A generic error code indicating that an error occurred on the execution of a macro. This error is used only when the device cannot detect more specific errors −271 to −279.
−271	Macro syntax error	The macro definition contains a syntax error.
−272	Macro execution error	The macro definition contains an error.
−273	Illegal macro label	An illegal macro label is defined in the *DMC command e.g. label is too long or is the same as a common command header.
−274	Macro parameter error	The macro definition improperly uses a macro parameter placeholder.
−275	Macro definition too long	The macro definition is too long for the instrument.
−276	Macro recursion error	The command sequence defined in a macro is trapped in a program loop.
		contd./...

Execution error *(continued)*

Error code	Error text	Error explanation
–277	Macro redefinition not allowed	The macro label defined in the *DMC command is already defined.
–278	Macro header not found	The macro label in the *GMC? Query is not defined.
–280	Program error	A generic error code indicating that a downloaded program–related execution error has occurred. This error is only used when the device cannot detect more specific errors –281 to –289.
–281	Cannot create program	The program cannot be created possibly due to insufficient memory.
–282	Illegal program name	The name of the program is invalid possibly due to redefining an existing program.
–283	Illegal variable name	The variable does not exist in the program.
–284	Program currently running	The command is not permitted while the program is running e.g. deleting a program currently in progress.
–285	Program syntax error	The downloaded program contains a syntax error.
–286	Program runtime error	
–290	Memory use error	A user request has directly or indirectly caused an error related to memory.
–291	Out of memory	
–292	Referenced name does not exist	
–293	Referenced name already exists	
–294	Incompatible type	The type of structure of a memory is inadequate.

Device-specific error

An error number in the range –399 to –300 indicates that the instrument has detected some device operation that did not properly complete (for example, due to an abnormal hardware or firmware condition). The occurrence of any error in this class causes the device-specific error bit (bit 3) in the Event Status Register (ESR) to be set.

Such an error indicates a hardware or firmware problem, either in the instrument or in connected cables or peripheral devices. If the problem is in the instrument, and you cannot resolve it, please contact your nearest Service Center.

Error code	Error text	Error explanation
–300	Device-specific error	A generic error code indicating that a device-dependent error has occurred. This error is used only when the device cannot detect more specific errors.
–310	System error	A device-specific error termed ‘system error’ has occurred.
–311	Memory error	An error in the instrument memory has occurred.
–312	PUD memory lost	The Protected User Data saved by the *PUD command has been lost.
–313	Calibration memory lost	Non-volatile calibration data used by the *CAL? command has been lost.
		contd./...

Device-specific error *(continued)*

Error code	Error text	Error explanation
–314	Save/recall memory lost	Non-volatile data saved by the *SAV command has been lost.
–315	Configuration memory lost	Non-volatile configuration data saved by the instrument has been lost.
–320	Storage fault	
–321	Out of memory	An internal operation required more memory than was available.
–330	Self-test failed	
–340	Calibration failed	
–350	Queue overflow	This error code is inserted in the error queue in place of the actual error code. This code indicates that the queue is full and that an error occurred but was not recorded.
–360	Communication error	A generic error code indicating that an instrument communication error occurred. This error is used only when the device cannot detect more specific errors –261 to –269.
–361	Parity error in program message	Parity bit not correct when data received e.g. on the serial port.
–362	Framing error in program message	No stop bit detected when data received e.g. a baud rate mismatch on the serial port.
–363	Input buffer overrun	Software or hardware buffer on serial port overflows due to incorrect pacing.

Query error

An error number in the range –499 to –400 indicates that a data request error has been detected (for example, an attempt is being made to read data from the output queue when no output data is available). The occurrence of any error in this class causes the query error bit (bit 2) in the Event Status Register (ESR) to be set.

Such an error occurs as a result of requesting a reading back over the GPIB when a fault exists in the programming or execution of the command. Such an error should not affect the correct operation of the instrument once the cause is removed.

Error code	Error text	Error explanation
–400	Query error	A generic error code occurs when data is requested using a query. This error is used only when the device cannot detect more specific errors.
–410	Query INTERRUPTED	The query has been interrupted.
–420	Query UNTERMINATED	The query is incomplete.
–430	Query DEADLOCK	The query cannot be processed. Both the input and output buffers are full, so preventing the continuation of the operation.
–440	Query UNTERMINATED after indefinite response	A query is in the same command line as a query requesting an indefinite response.

Instrument-specific error messages

A positive error number ≥5000 indicates that an error condition has occurred that is specifically related to the instrument. The occurrence of any error in this class causes the device-specific error bit (bit 3) in the Event Status Register (ESR) to be set.

Such errors indicate a fault within the instrument. It may be possible to resolve this by re-calibrating the instrument (refer to the Maintenance Manual). If this is not possible, please contact your nearest Service Center.

Error code	Error text	Error explanation
5000	EEPROM Failure	CPU is unable to communicate with its EEPROM.
5001	EEPROM Checksum	Calibration data in EEPROM is incomplete or corrupted.
5020	High Power Attenuator too Hot	Cal & control board reported input power attenuator too hot.
5021	Over Power Protection Trip	Cal & control board reported input power attenuator too high.
5022	LO Fractional-N Out of Lock	Fractional-N chip on LO board failing to lock to set frequency.
5023	LO Fractional-N Loop Low	LO board reported fractional-N frequency is too low.
5024	LO Fractional-N Loop High	LO board reported fractional-N frequency is too high.
5025	LO VCXO Loop Low	LO board reported voltage controlled loop is too low.
5026	LO VCXO Loop High	LO board reported voltage controlled loop is too high.
5027	LO Output Unleveled	LO board reported its output is unleveled.
5028	LO Filter Output Low	LO board reported its voltage tune filter output is too low.
5029	LO VCO Calibration Failed	VCO synthesizer calibration on LO board failed.
5030	LO VTF calibration Failed	VTF synthesizer calibration on LO board failed.
5031	Digital IF VCXO Loop High	Digital IF board reported VCO is too high.
5032	Digital IF VCXO Loop Low	Digital IF board reported VCO is too low.
5033	Digital IF Overload	Digital IF board reported its input signal is too high.
5034	External Standard Failed	External standard at rear of instrument has failed or is missing.
5035	External Freq. Standard High	External standard frequency is too high.
5036	External Freq. Standard Low	External standard frequency is too low.
5037	DSP Communication Failure	DSP is not responding to commands from the CPU.
5038	Calibration Signal Failure	Internal calibrator signal was not available during a calibration.
5039	User Calibration expired, press CAL	Measurements unreliable, outside time-out period since cal last performed.
5040	DSP self test failure	DSP hardware failure.
5041	Failed file checksum	Checksum error occurred when loading software.
5042	Input ADC level overload	Input level to ADC is outside permitted limits.
5043	User calibration failure	No response from DSP – press CAL again.
5044	User Cal Failed: Mixer Temperature	Mixer hardware fault: temperature is out of range.
5045	User Cal Failed: Reference Level	Calibrated power level is outside limits.
5046	User Cal Failed: Attenuator Pads	Edgeline attenuator is outside limits.
5047	User Cal Failed: IF Gain, Filter Out	IF amplifier gain value is outside limits when bandpass filter switched out.
5048	User Cal Failed: IF Gain, Filter In	IF amplifier gain value is outside limits when bandpass filter switched in.
5049	User Cal Failed: High Power Pad Temp	High-power pad-temperature sensor is generating voltage level outside limits.
5050	User Cal Failed: Digif Stages	
5050	User Cal Failed: IF Slope Stages	Result generated by measurement of power variation across 300 kHz band of IF is outside limits.

Chapter 4
REMOTE OPERATION

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Introduction

This instrument is equipped for remote operation via the GPIB interface, which conforms to IEEE 488.1 and IEEE 488.2. The interface performs instrument control with full talk and listen capability.

The following provides an introduction to the GPIB command structures used in this instrument, with explanations and examples of data and response types, queries and terminators, and an overview of status reporting.

Before operating the instrument under GPIB control you should already be familiar with making measurements using the instrument under local control, and with the general operation of the GPIB.

Abbreviations

The elements of a compound header feature a long and a short form. Either the long or the short form can be entered as a command; other abbreviations are not permissible.

Example

```
:FREQuency:REFerence 380MHz
```

is interpreted the same as

```
:FREQ:REF 380MHz
```

The short form is marked by upper-case letters, the long form corresponds to the complete word. Upper-case and lower-case serve the above purpose only; the instrument itself does not make any distinction between upper-case and lower-case letters.

Queries always return the short form; or a numeric response in those cases where the command provides a choice of numeric or character data.

For a complete list of abbreviations see under ‘Remote operation tables’ on page 4-121.

Queries always return the short form; or a numeric response in those cases where the command provides a choice of numeric or character data.

Bracketed elements

Square brackets

Some elements within the compound common program header structure are enclosed within square brackets, [and]. This shows that these elements are optional and therefore may be omitted; the instrument processes the command in the same manner whether the bracketed element is included or not.

Example:

```
[:SOURce]:POWer[:LEVel][:IMMediate][:AMPlitude]
```

is interpreted the same as

```
:POWer
```

This applies to parameters also. The ability to recognize the full command length ensures that the instrument is compatible with the SCPI standard.

Curly brackets (braces)

Parameters included within curly brackets, { and }, can be included any number of times or not at all.

Case

The software is not case-sensitive. Upper and lower case characters are completely interchangeable. There is no conflict between milli (m) and mega (M) as both cannot be applied to the same data.

Choices

The vertical bar (|)

separates a choice of parameters: (0 | 1 means ‘0 or 1’)

or

separates commands which have an identical effect.

Example:

```
:SOURce:FREQuency[:CW|:FIXed]
```

can be interpreted as

```
:SOURce:FREQuency[:CW] 10E3
```

or

```
:SOURce:FREQuency[:FIXed] 10E3
```

Both set the carrier to 10 kHz.

Compound command program headers

Compound common program headers allow a complex set of commands to be built up from a smaller set of basic elements in a tree structure. The elements of a compound common program header are separated by a colon (:), each colon representing a change of level in the hierarchy. Each subsystem in this instrument is organized as a separate tree structure.

The compound command program header may optionally, be followed by a parameter encoded as a program data functional element.

Example:

```
:OUTput:ATTenuation:AUTO 0
```

Program data

Program data functional elements contain the parameters related to the command header(s). The following program data functional elements are accepted by the instrument:

<CPD> (also known as <CHARACTER PROGRAM DATA>)
<NRf> (also known as <DECIMAL NUMERIC PROGRAM DATA>)
<STRING PROGRAM DATA>

These functional elements are defined in IEEE 488.2.

A single space must separate the command header(s) and the program data.

<CPD>

Character program data is used to set a parameter to one of a number of states that are best described by short alphanumeric strings.

Example:

ON

<NRf>

Flexible numeric representation covers integer and floating point representations.

Examples:

–466	Integer value
4.91	Explicitly placed decimal point
59.5E+2	Mantissa and exponent representation

The format is known as ‘flexible’ because any of the three representations may be used for any type of numeric parameter.

Examples:

Where a parameter requires an integer value in the range 1 to 100, and the user needs to set its value to 42, the following values will be accepted by the instrument:

42	Integer
42.0	Floating point
4.2E1, 4200E–2	Floating point – Mantissa/exponent
41.5	Rounded up to 42
42.4	Rounded down to 42

<STRING PROGRAM DATA>

String program data consists of a number of ASCII characters enclosed in quotes. Either a pair of single (‘ASCII 39’) or double (“ASCII 34”) quotes may be used. If the quote character chosen to mark the beginning and end of the string also appears within it, it must be doubled.

Example:

‘This string contains the word “Hello”’

will be interpreted as the string

This string contains the word ‘Hello’.

Response data

The following response data functional elements are generated by the instrument:

<CRD> (also known as <CHARACTER RESPONSE DATA>)
<NR1>
<NR2>
<NR3>
<STRING RESPONSE DATA>

<CRD>

This type of response is returned when reading the value of a parameter that can take a number of discrete states. States are represented by short alphanumeric strings.

Example:

ON

<NR1>

This type of numeric response is used when returning the value of integer parameters, such as an averaging number or the number of measurement points.

Examples:

15
+3
–57

<NR2>

This type of numeric response includes an explicitly placed decimal point, but no exponent.

Examples:

17.91
–18.27
+18.83

<NR3>

This type of numeric response includes an explicitly placed decimal point and an exponent.

Examples:

1.756E+2
182.8E–3

<STRING RESPONSE DATA>

This takes a similar form to <STRING PROGRAM DATA> except that the delimiting character is always a double quote (“ASCII 34”).

Terminators

A **<PROGRAM MESSAGE TERMINATOR>** (as defined in IEEE 488.2) can be a newline character (ASCII 10), a newline character with the ^END message asserted at the same time, or an ^END message asserted with the final character of the <PROGRAM MESSAGE>. The terminator may be preceded by any number of 'white space' characters – any single ASCII–encoded byte in the range 0 to 9 and 11 to 32 decimal.

A **<RESPONSE MESSAGE TERMINATOR>** (as defined in IEEE 488.2) is a newline character with the ^END message asserted at the same time.

Many GPIB controllers terminate program messages with a newline character and, by default, accept newline as the response message terminator. When transferring binary data, which may contain embedded newline characters, it is necessary to ensure that the controller uses only ^END messages. Usually this means that the controller's GPIB must be set up to generate and detect ^END. Refer to the documentation supplied with the controller.

SCPI compatibility

The GPIB commands are divided into a number of subsystems. The form of these subsystems in general follows that used for the SCPI (Standard Commands for Programmable Instruments) standard. The SCPI standard employs a hierarchical model (shown in Fig. 4-1) to get the results from a measuring instrument. But note that this hierarchy is just conceptual. It is not mirrored in the GPIB tree; MEASure, READ, FETCh, INITiate and CONFigure are all subsystems at the root level.

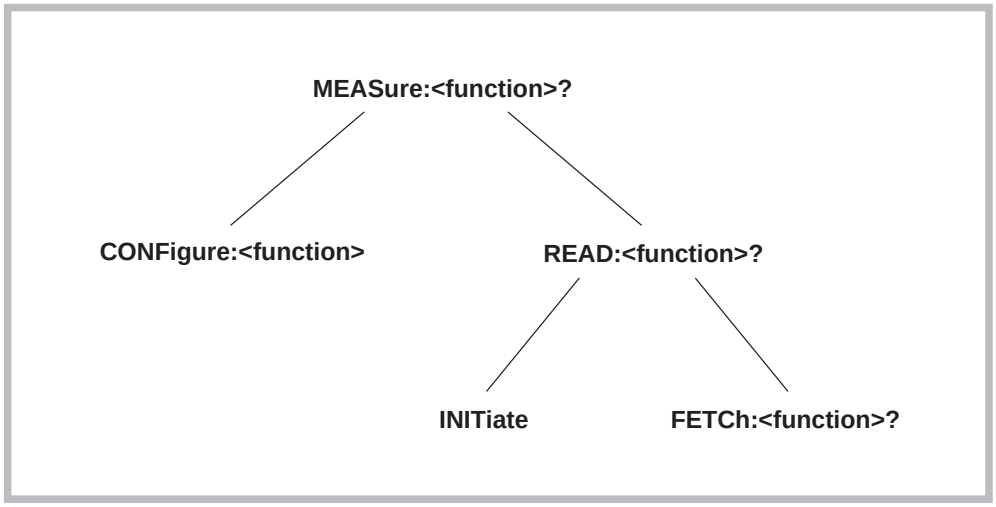


Fig. 4-1 SCPI hierarchical concept for the instrument

As shown in the figure above, the GPIB uses a MEASure-READ-FETCh model. At the top level the MEASure query will always return the requested result if at all possible. The MEASure queries provide a simple way for the user to get results from the instrument without having to have detailed knowledge of the instrument. On receipt of a MEASure the instrument will stop what it is doing, alter its configuration so as to be able to perform the measurement function requested, start the measurement process and then return the result when it is available.

A level below is the CONFigure command root to set up a measurement, and READ which initiates the configured measurement function and returns the result when available.

The two elements of READ exist as INITiate and FETCh? FETCh? allows the same results to be returned several times. More usefully, it allows different quantities calculated from the same captured data to be returned.

Query header

The position of the mnemonic elements in the query header will provide the user with the first indication of which functions may be FETChed from the same captured data. A query header would consist of three elements AA:BB:CC? Element AA is either MEASure, READ or FETCh. Element BB indicates the data capture process. Element CC defines the measurement function, that is, the calculations to be made on the data. So for given AA:BB elements, all the allowed CC elements may be FETChed from a given capture of data.

Example

:MEAS:<Spectrum>:<MarkerFrequency>?;:FETC:<Spectrum>:<Marker Level>?

All the queries return a single numeric value with the exception of trace dumps which return a set of values that represent the trace values.

Query parameters

SCPI has a number of optional parameters to the queries. These include expected value (to set the range in the most general manner) and resolution. For spectrum measurements other query parameters may be used as follows:

`:MEAS:<spectrumfn>:<fn>? <frequency>, <level>, <span>`

`:READ:<spectrumfn>:<fn>?` *none*

`:FETC:<spectrumfn>:<fn>?` *none*

The top-level MEASure allows you to specify all the main characteristics of the signal to be analyzed. Below that, READ does not reconfigure the instrument, therefore frequency, level and span cannot be altered; but new data is captured. The FETCh query operates on data already captured, so none of these quantities may be changed (FETCh accepts no parameters). These parameters are in addition to any other parameters demanded by the query. The parameters must be separated from the query header by a ‘white space’.

Configure

The CONFigure subsystem allows the setup part of each of the defined MEASure queries to be implemented alone.

Status reporting

The instruments within a GPIB system contain a set of registers that reflect the current state of the instrument and whether a particular event has occurred. It is also sometimes necessary for an instrument to generate an alert if that condition exists or if that event has occurred.

The instrument's status registers contain information about the condition of the instrument and its measurements. Using these registers, it is possible to find out whether an error has occurred with a command, if averaging has completed for a particular measurement, if a measurement is out of limits, and other problems or conditions that may make a measurement unreliable. These registers can be used either by reading the contents directly when needed, or by configuring them to generate an interrupt signal (SRQ, service request) when the condition of interest occurs. The status system consists of seven readable registers, as shown in Fig. 4-2. These registers are described below, and in greater detail on pages 4-13 onwards. Logic level '1' represents a set bit.

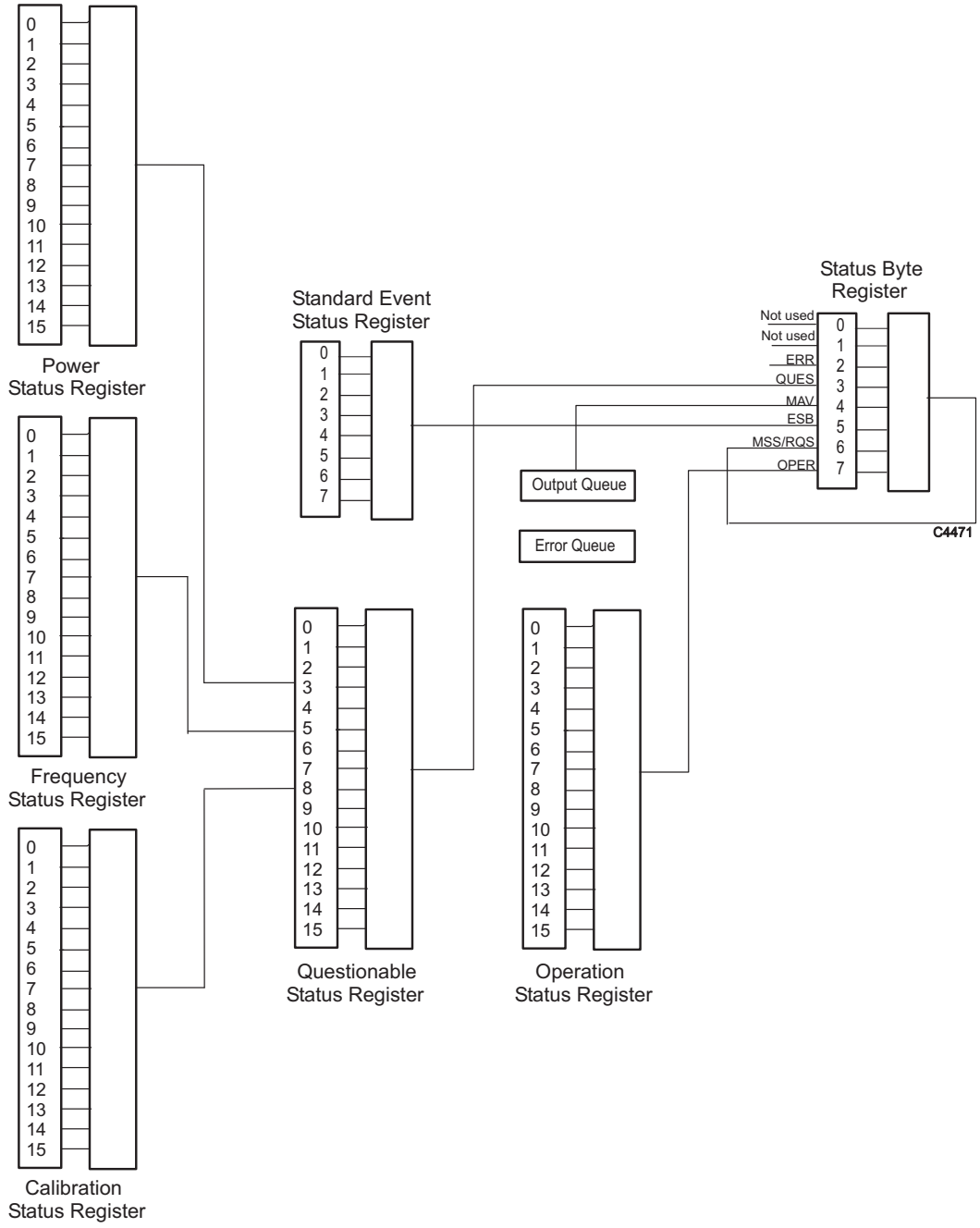


Fig. 4-2 Simplified status register structure

Status byte register. This 8-bit register (pages 4-13 and 4-14) is used to represent particular conditions or events in an instrument. The status byte register (defined by IEEE 488.1) is read by using the *STB? command or by serial poll. When read by serial poll, an SRQ (service request) is generated which interrupts the controller. Associated with the status byte register is the service request enable register, which allows control over which bits of the status byte contribute towards the generation of the SRQ signal. When read by *STB?, bit 6 of the status byte is known as the *master summary status* function (MSS), and is the OR function of the other seven bits of the register.

Standard event register. This 8-bit register (page 4-17) extends the status reporting structure to cover various other events, defined by IEEE 488.2. The register is read by *ESR? The standard event enable register allows control over which bits of the standard event register affect the summary bit output (ESB). The summary bit is recorded in bit 5 of the instrument's status byte.

Operation status register. This 16-bit register (page 4-18), defined in SCPI, further extends the status reporting structure by providing information about what the instrument is doing. It is read by the :STATus:OPERation:CONDition? or :STATus:OPERation[:EVENt]? command. The summary bit output of the register is recorded in bit 7 of the status byte.

Questionable status register. This 16-bit register (page 4-19), also defined in SCPI, gives information about factors affecting the quality of measurements or signal generation. It is read by the :STATus:QUEStionable:CONDition? or :STATus:QUEStionable[:EVENt]? command. The summary bit output of the register is recorded in bit 3 of the status byte.

Power status register. This 16-bit register (page 4-20) further extends the questionable status register by providing power condition information. It is read by the :STATus:POWer:CONDition? or :STATus:POWer[:EVENt]? command and recorded in bit 3 of the questionable status register.

Frequency status register. This 16-bit register (page 4-21) further extends the questionable status register by providing frequency condition information. It is read by the :STATus:FREQuency:CONDition? or :STATus:FREQuency[:EVENt]? command and recorded in bit 5 of the questionable status register.

Calibration status register. This 16-bit register (page 4-22) further extends the questionable status register by providing calibration condition information. It is read by the :STATus:CALibration:CONDition? command and recorded in bit 8 of the questionable status register.

The **output queue** (page 4-15) temporarily stores responses to query commands received by the instrument until they can be read by the controller. The **error queue** (page 4-15) temporarily stores up to 20 error messages. Each time the instrument detects an error, it places a message in the queue; each item contains an error number, defined in SCPI, and an error message. When the :SYSTem:ERRor? query is sent, the message at the head of the error queue is moved to the output queue so it can be read by the controller.

Register structures

The operation and questionable register structures consist of condition, event, transition and enable registers.

The **condition registers** continuously monitor the instrument's hardware and firmware status. Bits in a condition register are not latched but are updated in real time (so that they represent the actual state of the instrument at all times) and are read by the above commands.

The bits of the **event registers** (read by :STATus:OPERation:EVENt? and :STATus:QUEStionable :EVENt?) are set on events. For example, the averaging bit in the operation register only indicates if the measurement is being performed with averaging enabled, while the associated event register shows that the averaging has completed.

A set of transition filters (**transition register**) control what type of change in a condition register will set the corresponding bit in the event register. The type of transition filter – negative, positive or both – is fixed for each bit. For example, the averaging bits in the operation register structure have negative transition filters so that the bits in the event register are set when averaging is complete. When the event register bits are set they remain set, even if the corresponding condition bits change. They are reset after being read by the query commands :STATus:OPERation:EVENt? and :STATus:QUEStionable :EVENt?, or when the *CLS (clear status) common command is issued. Transition registers are read-write, and are unaffected by query commands or *CLS.

The ability of each bit in the event registers to affect the summary bit in the status byte register can be enabled or disabled by corresponding bits in the event **enable registers**. These can be set and read by the commands/queries :STATus:OPERation:ENABle\? and STATus:QUEStionable:ENABle\? The enabled bits are combined in a logical OR operation to produce the summary bit (summary bits are recorded in the instrument's status byte). Enable registers are cleared by *CLS.

The above status-reading commands return the decimal number equivalent of the register contents.

The events and conditions that are monitored by the instrument's status registers, and the commands for reading and writing to them, are described in more detail in 'Remote status reporting structure' on pages 4-13 and following.

Reading status information

As already stated, two techniques are used to interact with the status reporting structure:

Direct-read method. In many cases it is adequate and convenient for the controller simply to read the appropriate registers when necessary to determine the required status information. This technique does not involve the use of SRQ and therefore does not require any interrupt handling code in the application program. The following steps are used to monitor a condition:

(1) Determine which register contains the bit that monitors the condition.

(2) Send the query command that reads the register.

(3) Examine the bit to see if the condition has changed.

The direct-read method works well when it is not necessary to know about changes the moment they occur. A program that uses this method to detect changes in a condition as soon as possible would need to continuously read the registers at very short intervals; the SRQ method is better suited to this type of need.

Service request (SRQ) method. In the SRQ method the instrument plays a more active role, in that it tells the controller when there has been a condition change without the controller asking. The following steps are required to monitor a condition:

(1) Determine which register sets and which of its bits monitors the condition.

(2) Determine how that bit reports to the request service (RQS) bit of the status byte (some report directly while others may report indirectly through other register sets).

(3) Send remote commands to enable the bit that monitors the condition and to enable the summary bits that report the condition to the RQS bit.

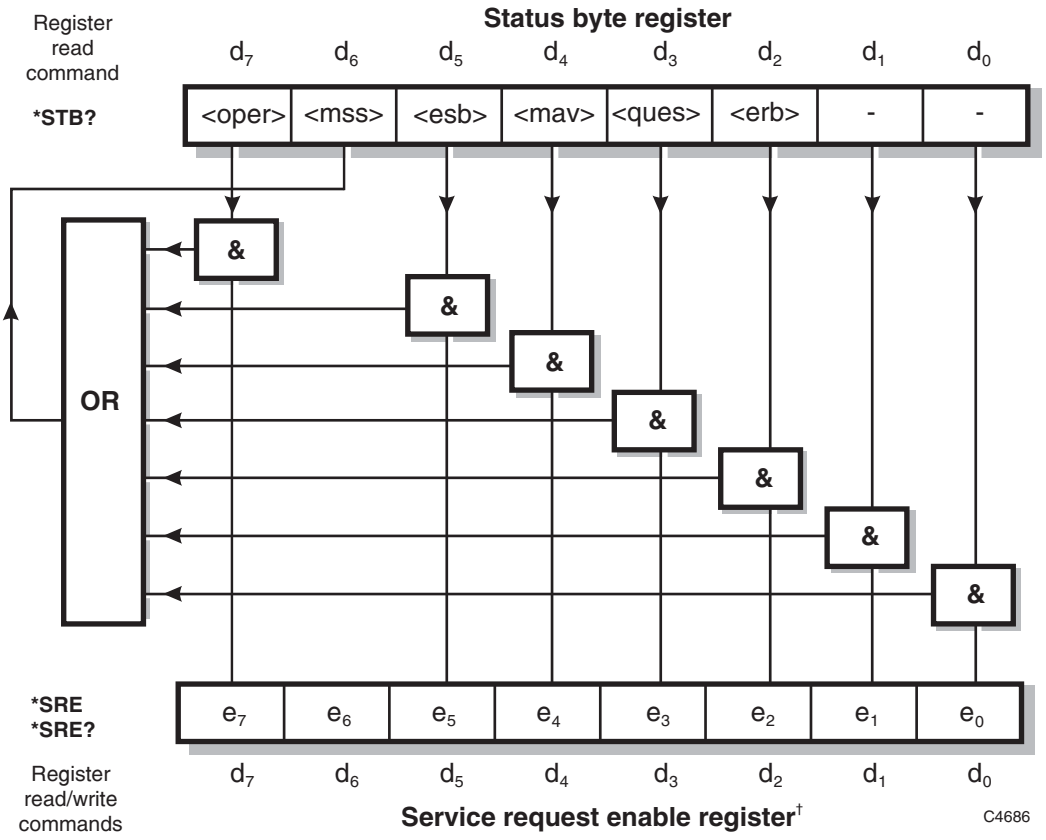
(4) Enable the controller to respond to service requests.

When the condition changes, the instrument sets its RQS bit (bit 6) and the GPIB's SRQ line; the controller is informed of the change as soon as it occurs. Setting the SRQ line informs the controller that some device on the bus requires service. The GPIB program then instructs the controller to perform a serial poll; each device on the bus returns the contents of its statue byte register in response to this poll. The device whose RQS bit is set to '1' is the device that requested service. After the status byte is read the RQS bit is reset to '0'; the other bits are not affected.

Another reason for using SRQ is the need to detect errors in the various devices within the instrument. Since the timing of errors may not be known in advance, and it is not practical for the program to check the status of every device frequently, an interrupt handling routine can be used to detect and investigate any SRQ generated.

REMOTE STATUS REPORTING STRUCTURE

Status byte when read by *STB?



† Bit 6 in this register ignores data sent by *SRE and always returns '0' in response to *SRE?

<rqs>, <esb> and <mav> are defined in IEEE 488.2.

<erb> is as device-defined queue summary bit, indicating that the error queue is non-empty (see 'Queue flag details' on page 4-15).

<mss> is true when (status byte) AND (enable register) > 0.

<esb> is the standard event register summary bit.

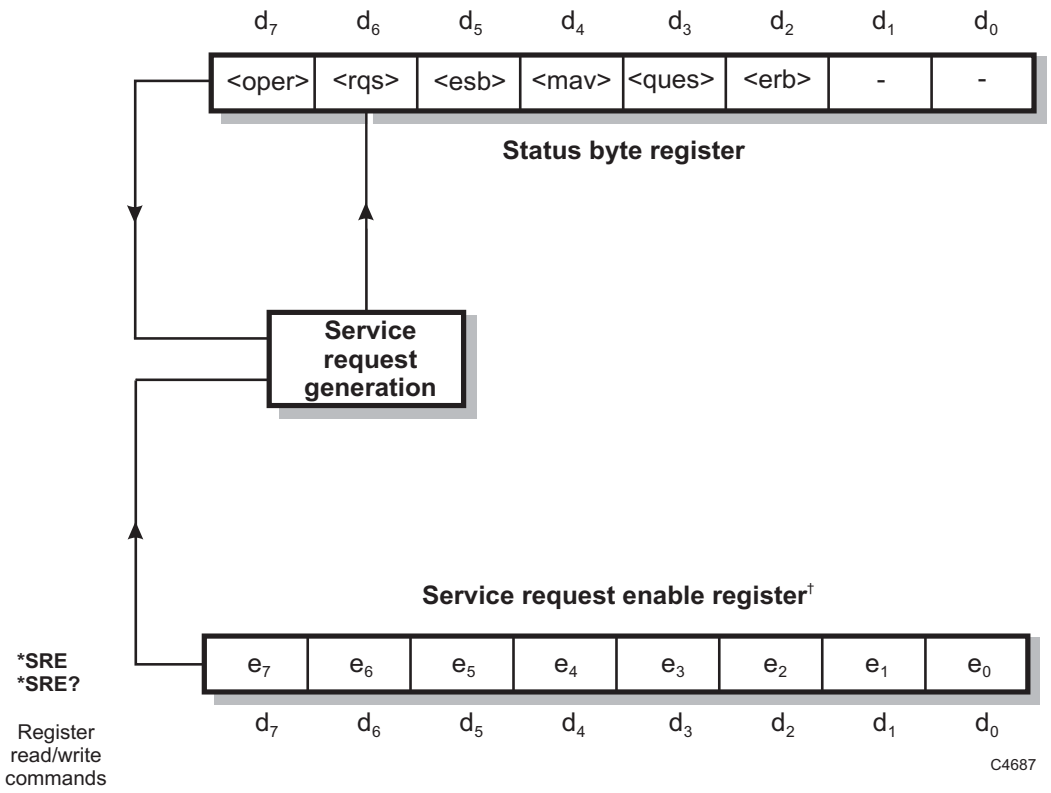
<mav> is 'message available', indicating that the output queue is non-empty (see 'Queue flag details' on page 4-15).

<oper> is the operation status register summary bit.

<ques> is the questionable status register summary bit.

Note: The status byte register is not cleared by the *STB? query.

Status byte when read by serial poll



† Bit 6 in this register ignores data sent by *SRE and always returns '0' in response to *SRE?

<rqs>, <esb> and <mav> are defined in IEEE 488.2.

<erb> is as device-defined queue summary bit, indicating that the error queue is non-empty.

<rqs> is set by request for service and is cleared by the poll.

<esb> is the standard event register summary bit.

<mav> is 'message available', indicating that the output queue is non-empty.

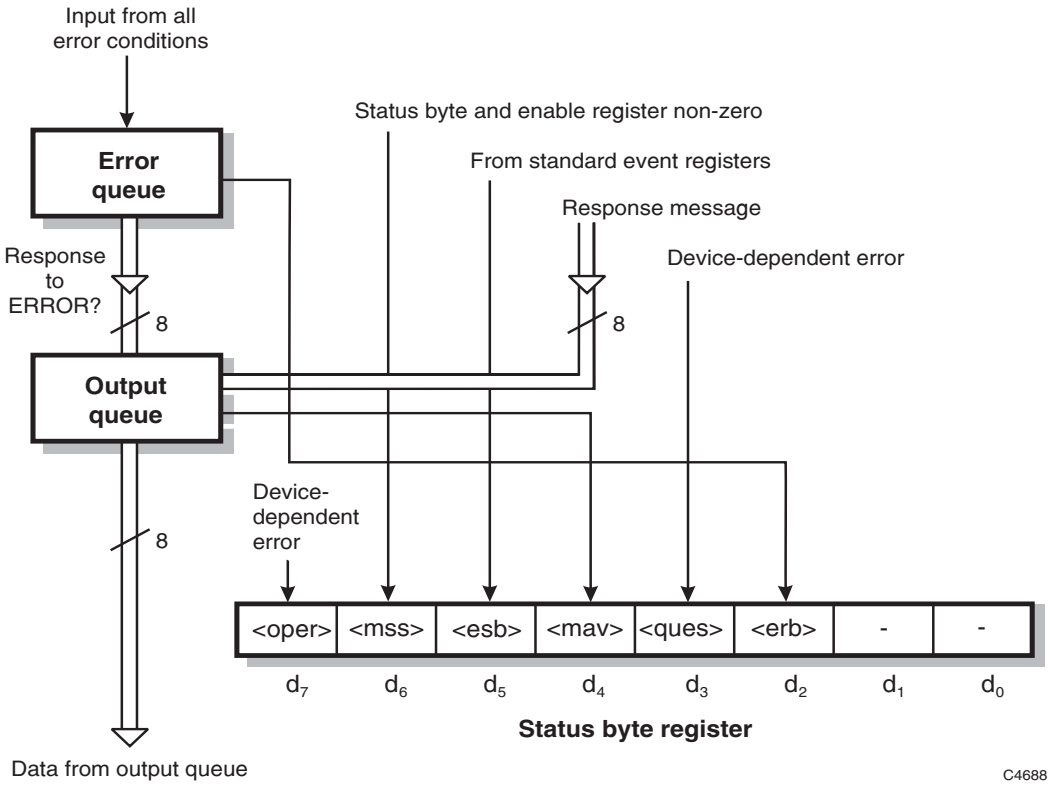
<oper> is the operation status register summary bit.

<ques> is the questionable status register summary bit.

<rqs> (request for service) produces an SRQ at the controller. It is set by a change to either the status byte or the service enable register that results in a new reason for service. It is cleared when <mss> goes FALSE (no reason for service) or by serial poll.

Note: The status byte register is not cleared by the *STB? query.

Queue flag details

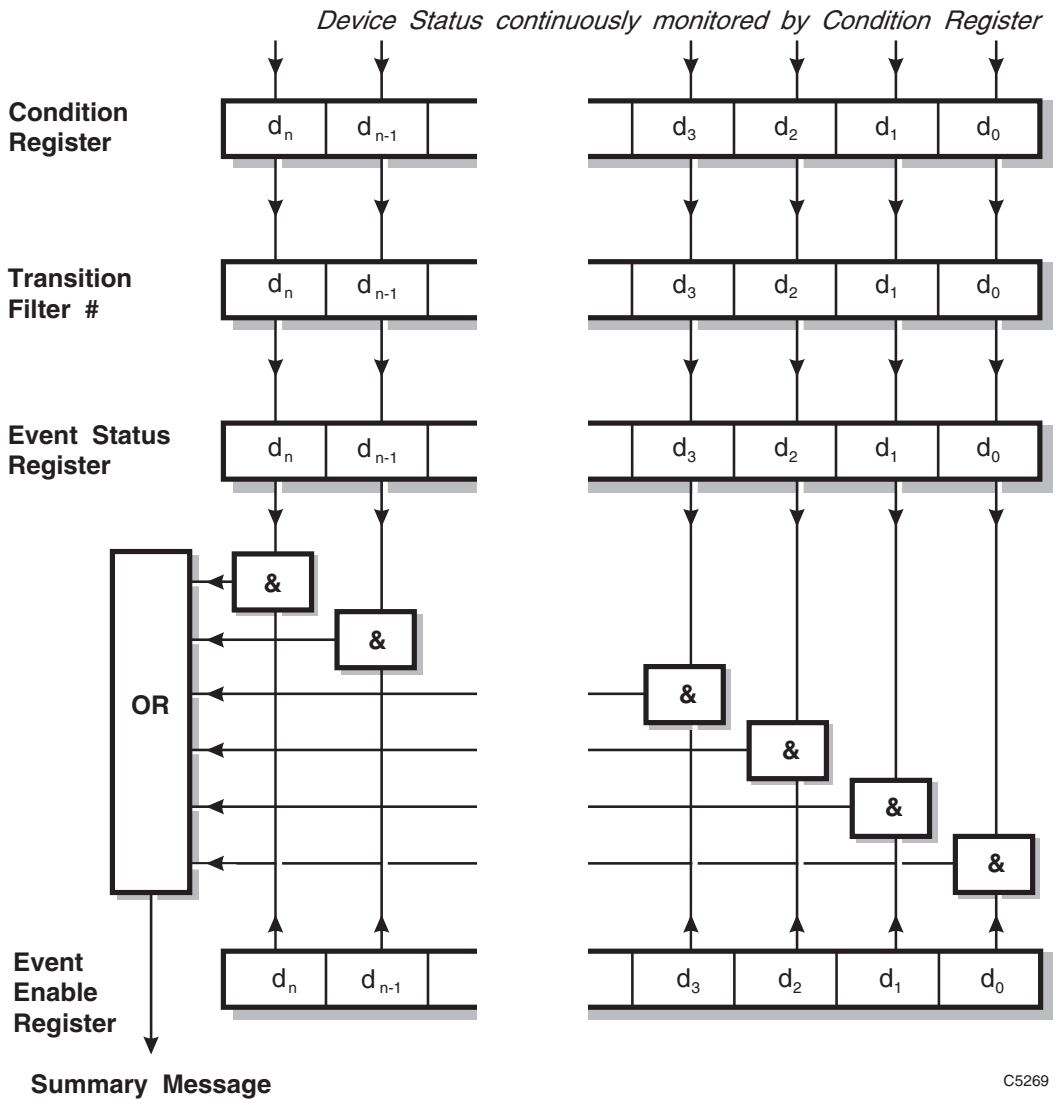


The <mav> status bit is set when one or more bytes are available to be read from the output queue.

The <erb> status bit is set when one or more errors are present in the error queue. The ERROR? query will place an NR1 response message in the output queue representing the error at the head of the queue. If the queue is empty, this message is 0.

Status data structure – register model

Below is a generalized model of the register set which funnels the monitored data into a single summary bit to set the appropriate bit in the status byte.



The device status is continuously monitored by the condition register. If a query to read a condition register is provided, the response represents the status of the instrument at the moment the response is generated. A condition register cannot be written to.

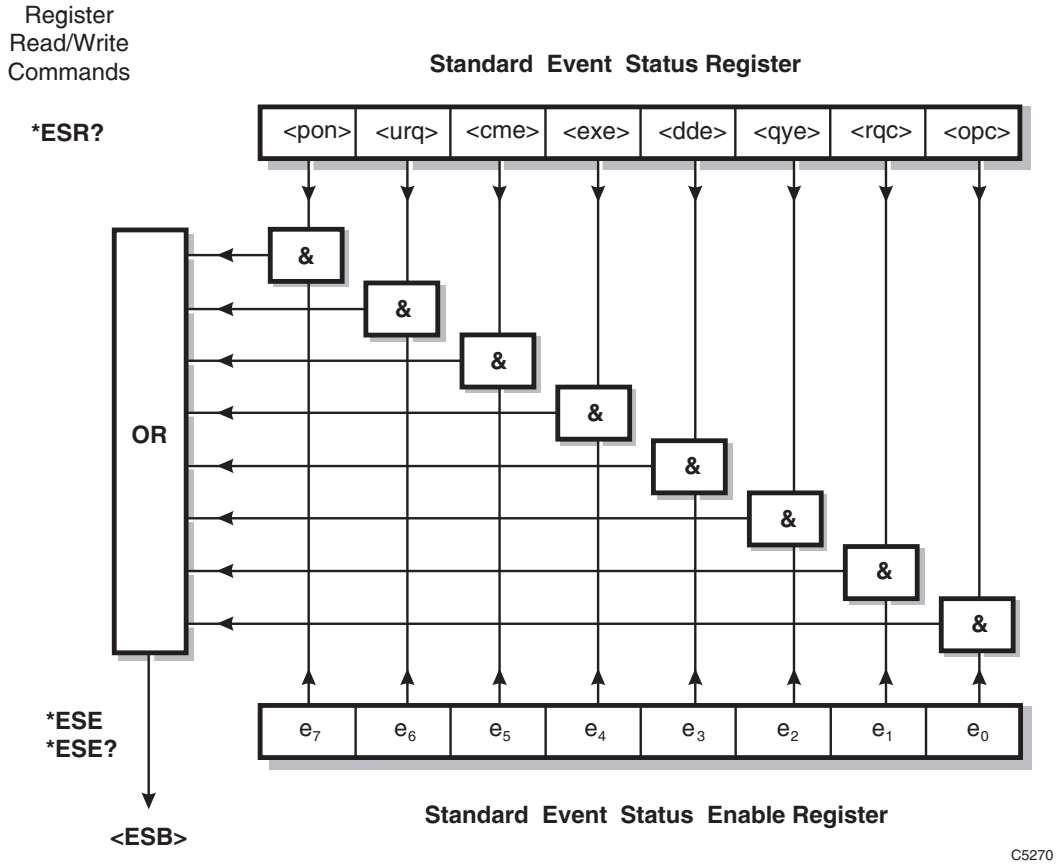
The transition filter determines which transition of the condition register data bits will set the corresponding bit in the event status register. The condition register data bits are pre-set as either positive or negative, as described in the following pages.

The bits in an event status register are 'latched'. Once set they remain set, regardless of subsequent changes in the associated condition bit until the event status register is cleared by being read or by the *CLS common command. Once cleared, an event register bit will only be set again if the appropriate change in the condition bit occurs.

The event enable register may be both written to and read from. It is bitwise AND-ed with the event register and if the result is non-zero the summary message is true, otherwise the summary message is false. Enable registers are not affected by *CLS but are however clear at power-on.

Standard event status registers

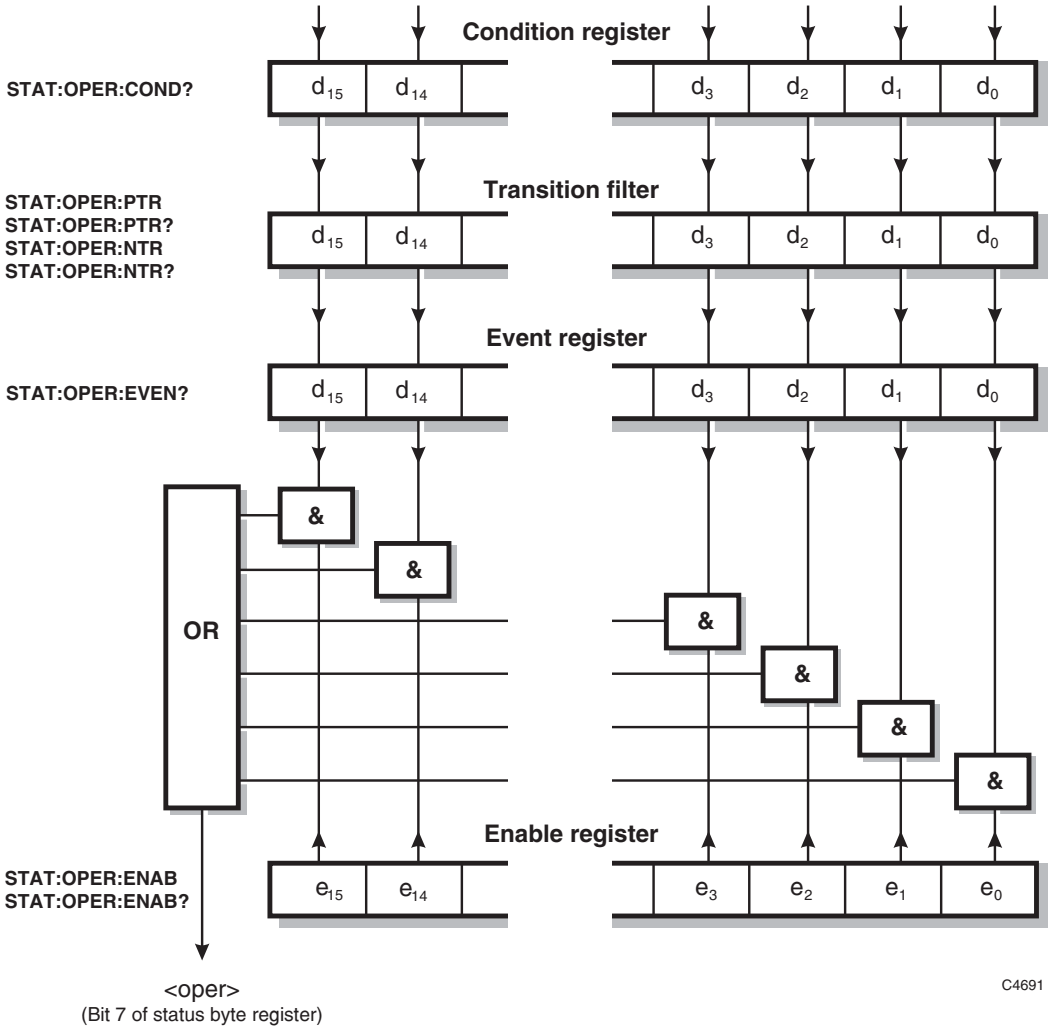
This register is defined by IEEE 488.2 and each bit has the meaning shown below:



<pon>	power on
<urq>	user request – not implemented in this instrument
<cme>	command error
<exe>	execution error
<dde>	device-dependent error
<qye>	query error
<rqc>	request control – not implemented in this instrument
<opc>	operation complete – set in response to the *OPC command for synchronization.
<esb>	standard event register summary bit

Operation status condition register

This is a device-dependent register and the bits have meanings as shown below.

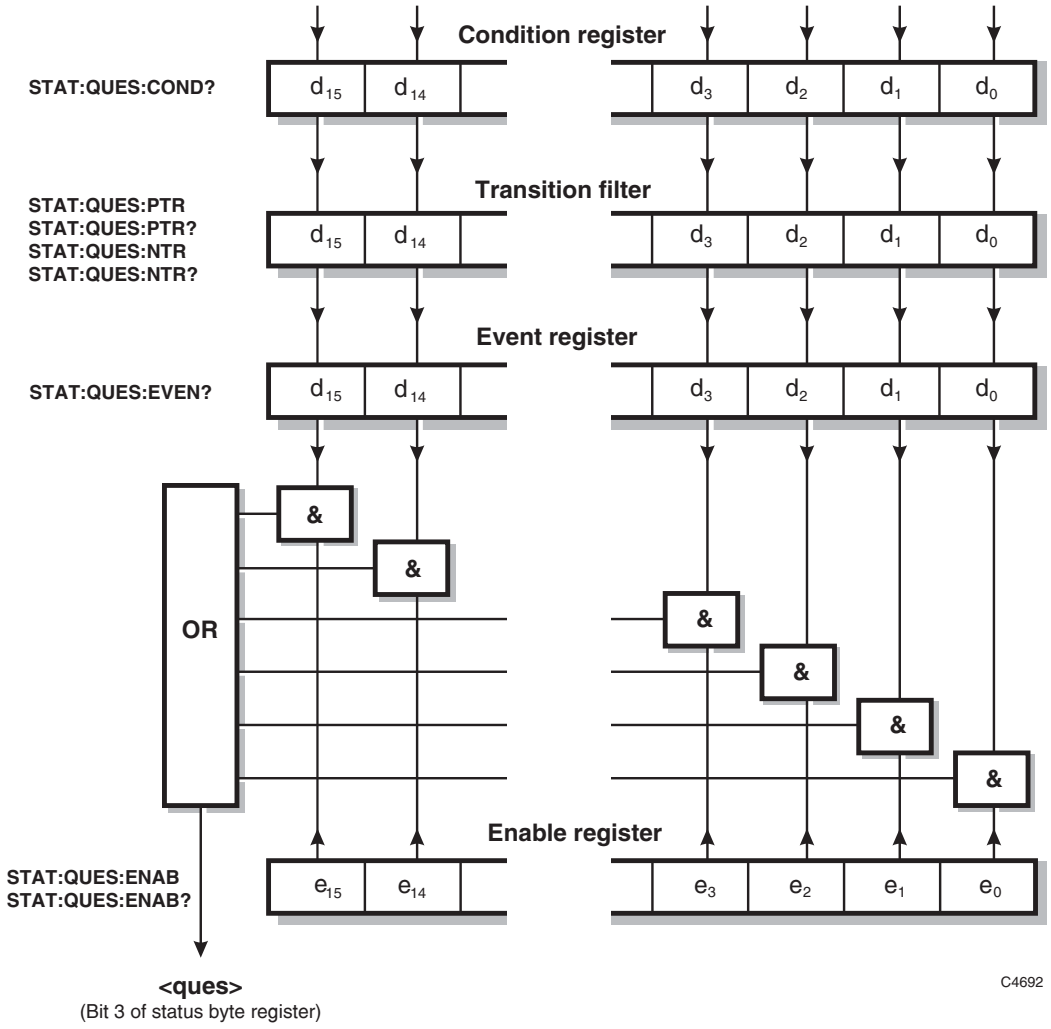


d_0	calibrating (user cal.)	d_8	–
d_1	–	d_9	–
d_2	–	d_{10}	–
d_3	–	d_{11}	printing
d_4	measuring	d_{12}	no training sequence found (–SRQ)*
d_5	–	d_{13}	–
d_6	–	d_{14}	–
d_7	–	d_{15}	–

*Refer to Table 4-1 for explanation of bit d_{12}

Questionable status condition register

This is a device-dependent register and the bits have meanings as shown below.

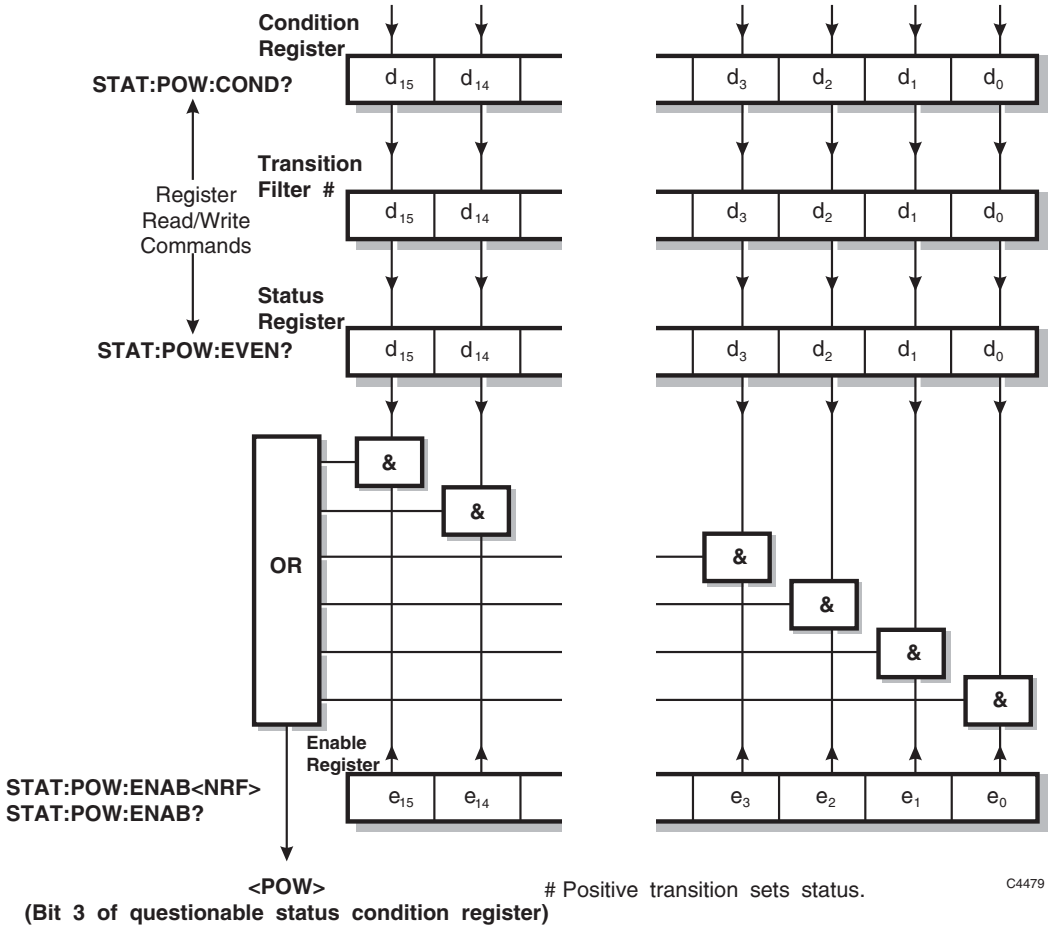


d_0	–	d_8	–
d_1	–	d_9	–
d_2	–	d_{10}	–
d_3	power	d_{11}	–
d_4	–	d_{12}	no training sequence found (+SRQ)*
d_5	frequency	d_{13}	–
d_6	–	d_{14}	–
d_7	modulation	d_{15}	–

*Refer to Table 4-1 for explanation of bit d_{12}

Power status condition register

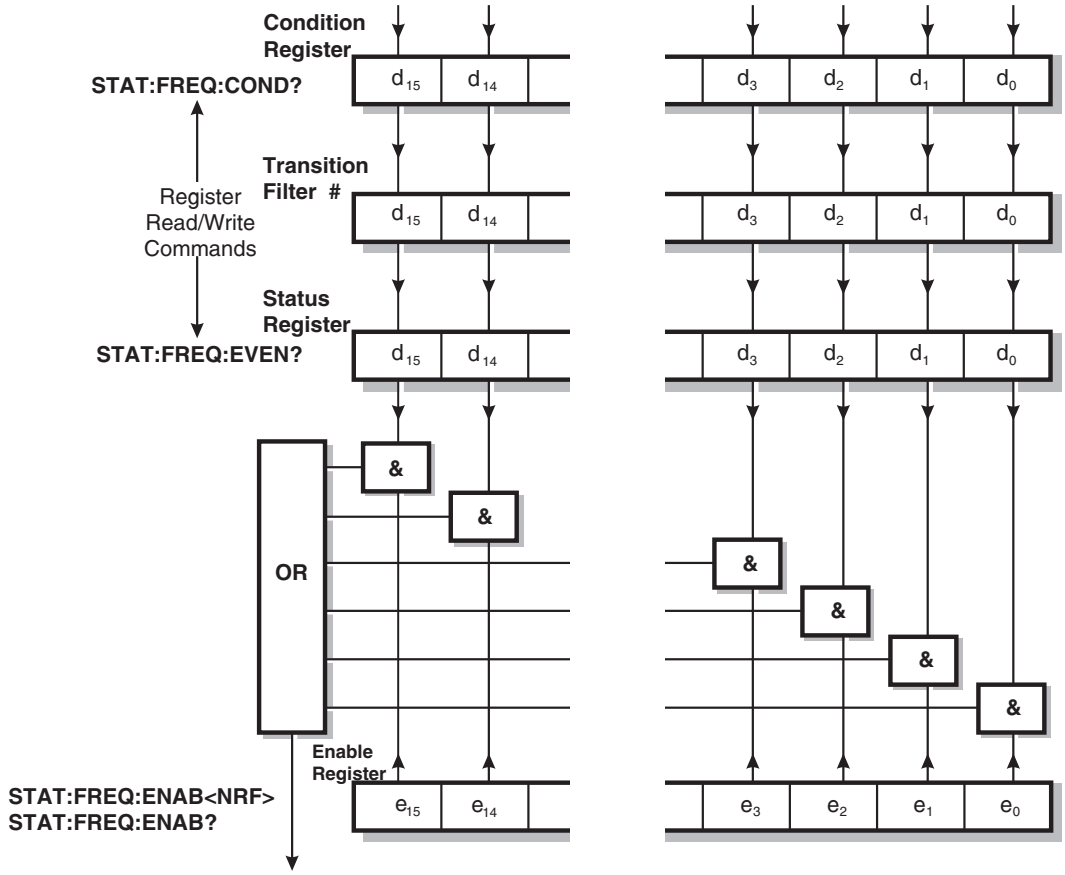
This is a device-dependent register and the bits have meanings as shown below.



d_0	local oscillator output unleveled	d_8	–
d_1	filter unleveled	d_9	–
d_2	digital IF overload	d_{10}	–
d_3	power attenuator pad temp. high	d_{11}	–
d_4	over-power protection trip	d_{12}	–
d_5	–	d_{13}	–
d_6	–	d_{14}	–
d_7	–	d_{15}	–

Frequency status condition register

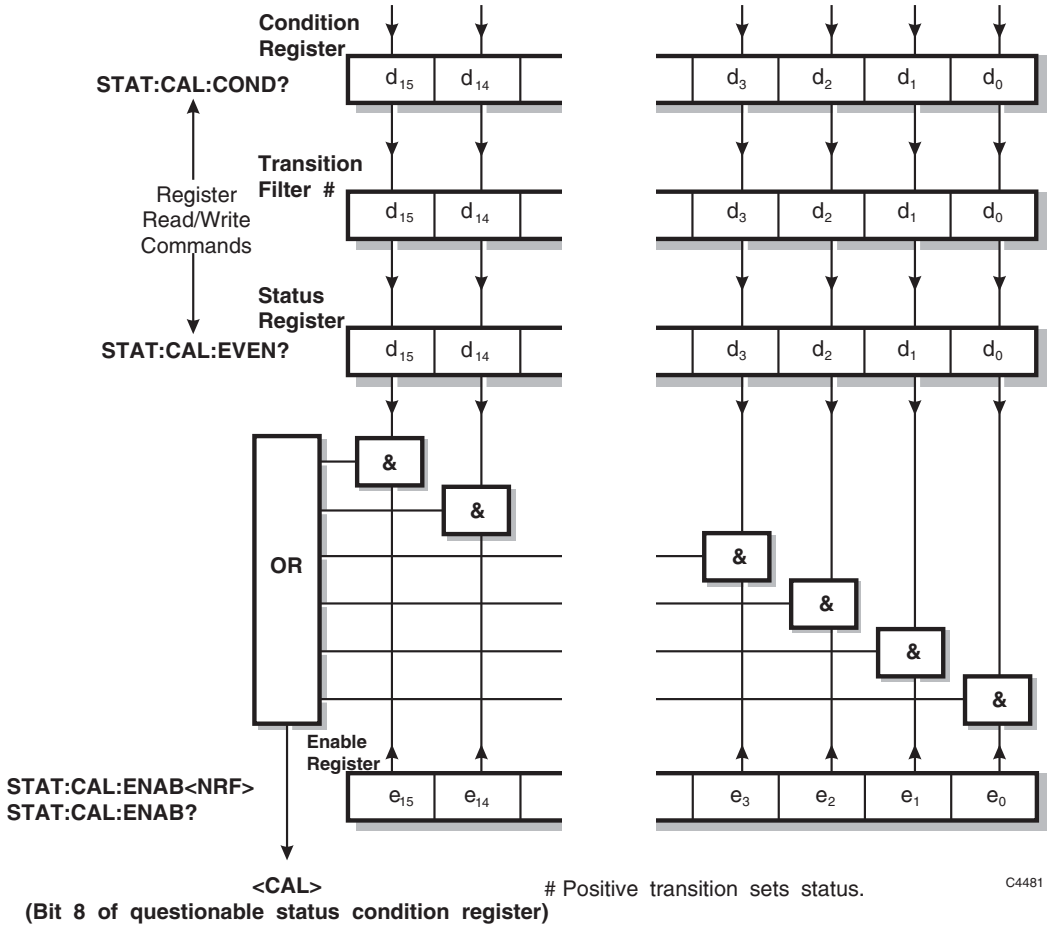
This is a device-dependent register and the bits have meanings as shown below.



d_0	local oscillator fractional-N loop low	d_8	external standard failure (OCXO)
d_1	local oscillator fractional-N loop high	d_9	–
d_2	local oscillator VCXO loop low	d_{10}	–
d_3	local oscillator VCXO loop high	d_{11}	–
d_4	digital IF VCXO loop low	d_{12}	–
d_5	digital IF VCXO loop high	d_{13}	–
d_6	internal standard low	d_{14}	–
d_7	internal standard high (OCXO)	d_{15}	–

Calibration status condition register

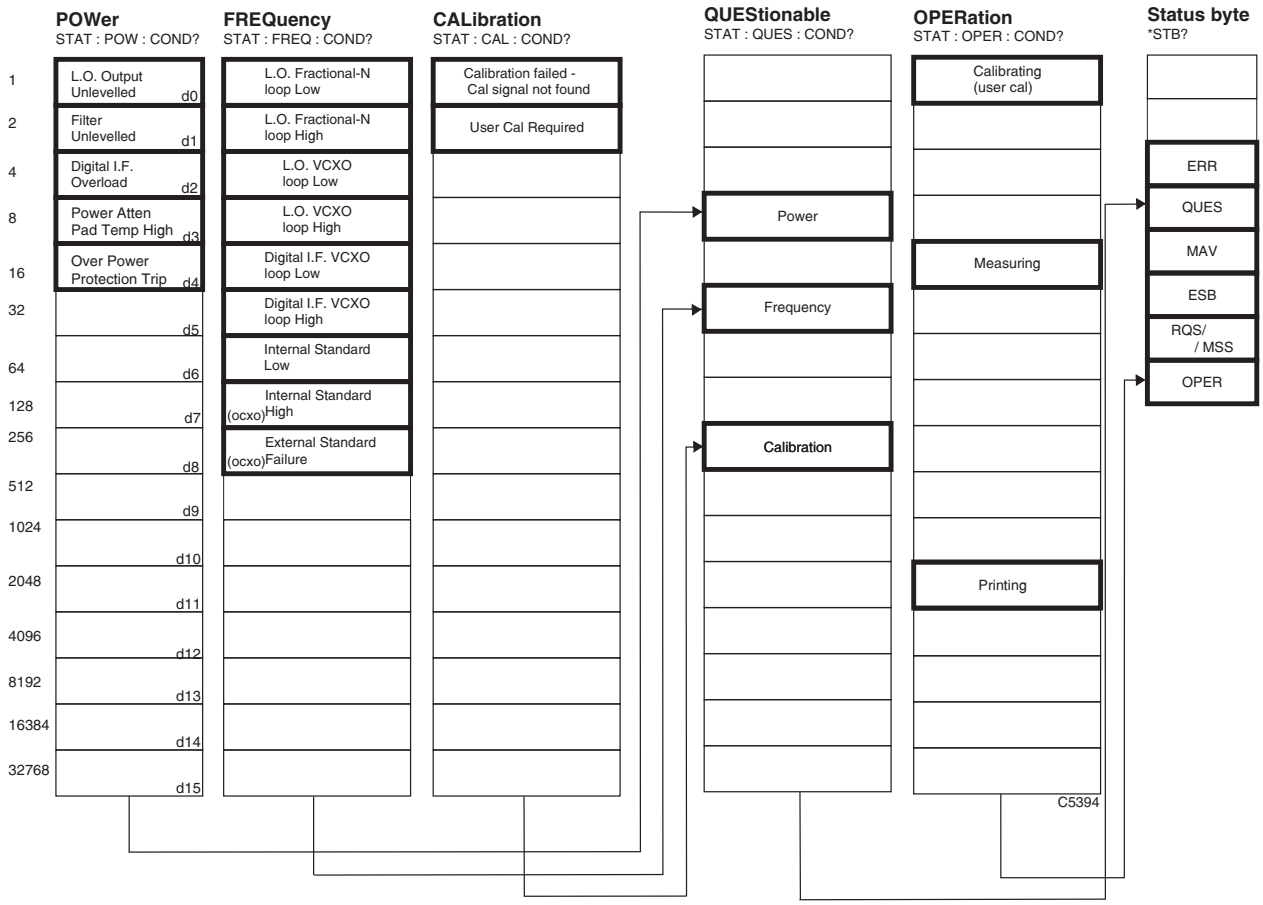
This is a device-dependent register and the bits have meanings as shown below.



d_0	calibration failed – cal signal not found	d_8	–
d_1	user cal required	d_9	–
d_2	–	d_{10}	–
d_3	–	d_{11}	–
d_4	–	d_{12}	–
d_5	–	d_{13}	–
d_6	–	d_{14}	–
d_7	–	d_{15}	–

Note: Bit 0 will be set for any user cal failure; the actual cause can be determined through the event reporting mechanism.

Table 4-1 Bit identification in status registers



Notes: Questionable status bits, when enabled by STAT:QUES:ENAB, allow SRQ to be generated when the specified event occurs (when the status bit is set).

Operational status bits, when enabled by STAT:OPER:ENAB, allow SRQ to be generated when the specified condition terminates (when the status bit is cleared).

The No Training Sequence status bit appears in both QUES and OPER status registers so that the user can choose to enable either (or both) in order to generate SRQ on the disappearance of Training Sequence (QUES) or on the detection of a Training Sequence (OPER). In the case of a discontinuous burst, this bit indicates that no ramp has been found.

COMMON COMMANDS SUBSYSTEM

The common commands are taken from the IEEE 488.2 standard. The commands have the same effect on different instruments. The headers of these commands consist of an asterisk (*) followed by three letters. Many common commands refer to the status reporting system.

***CLS**
***ESE\?**
***ESR?**
***IDN?**
***OPC\?**
***OPT?**
***RST**
***SRE\?**
***STB?**
***TST?**

*CLS

Parameters: None.

Description: CLear Status clears the standard event register, the error queue, the operation event register and the questionable event register.

Example: `*CLS`

Clear the status reporting structure.

*ESE

Parameters: <NRf>
Mask.

Valid values: Mask: integer. Valid values are 0 to 255. Values outside range are rejected and an error generated.

Description: The Event Status Enable command sets the standard event status enable register to the value specified. This is an eight-bit register.

Example: `*ESE 4`

Set the standard event status enable register to 4 (00000100 in binary). This will allow query error messages generated by the instrument to be reported in the event summary bit.

*ESE?

Parameters: None.

Response: <NR1>

Returned values: Mask: integer. Values are in the range 0 to 255.

Description: Reads the Event Status Enable register. This is an eight-bit register. The contents of the register are returned in decimal form.

Example: `*ESE?` `24`

*ESR?

Parameters: None.

Response: <NR1>

Returned values: Register contents: integer. Values are in the range 0 to 255.

Description: Reads the value of the standard Event Status Register. This is an eight-bit register. The contents of the register are returned in decimal form. Subsequently the register is set to zero.

Example:
```
*ESR?                                   32
```

*IDN?

Parameters: None.

Response: <arbitrary ASCII response data>
Manufacturer, model, serial no., software part no. and issue no.

Returned values: Manufacturer: string
Always returns 'IFR'

Model: string
This is the instrument's model number: '2309'.

Serial no.: string
This is in the form ssssss/sss *where* s *is an* ASCII digit *in the range* 0 to 9.

Software part no. and issue no.: string
This is in the form ppppp/ppp/ii.ii *where* p *and* i *are* ASCII digits *in the range* 0 to 9.

Description: The identification query command allows information about the instrument to be read.

Example:
```
*IDN?
```

Read information on the instrument.

*OPC

Parameters: None.

Description: The OPeration Complete command sets the operation complete bit (bit 0) in the standard event status register when execution of the preceding operation is complete. This bit can be used to initiate a service request.

*OPC should be the final <program message unit> of the <program message>.

Example:
```
:CAL; *OPC
```

Initiate a level calibration. The operation complete bit will be set in the standard event status register when the instrument has finished.

*OPC?

Parameters: None.

Response: <NR1>

Returned values: Operation complete: integer. Value is 1.

Description: The OPeration Complete query returns a '1' when the preceding operation has completed.

*OPC? should be the final <query message unit> of the <program message>.

Example:
```
:CAL; *OPC?                                    1
```

Initiate a calibration. When the instrument has finished calibrating, the value '1' will be placed in the output queue.

*OPT?

Parameters: None.

Response: <arbitrary ASCII response data>

Returned values: Options: string.

Description: Reads hardware options present. If no options are present a single '0' is returned, otherwise the response is up to six strings separated by commas.

Example:
```
*OPT?                                          0
```

*RST

Parameters: None.

Description: Resets the instrument to a known configuration appropriate for remote operation. This configuration is given in Chapter 3 (see 'Default settings').

Example: `*RST`

Reset instrument to known state.

*SRE

Parameters: <NRf>

Valid values: Mask: integer. Valid values are 0 to 255. Values outside range are rejected and an error generated.

Description: Sets the Service Request Enable register. This is an eight-bit register.

Example: `*SRE 32`

Sets the service request enable register to 32 (0010 0000 in binary) to enable service requests when the standard event status register summary bit is set.

*SRE?

Parameters: None.

Response: <NR1>

Returned values: Mask: integer. Values are in the range 0 to 255.

Description: Reads the Service Request Enable register. This is an eight-bit register.

Example: `*SRE?` `56`

*STB?

Parameters: None.

Response: <NR1>

Returned values: Status byte: integer. Values are in the range 0 to 255.

Description: Reads the STatus Byte. This is an eight-bit register.

Example: `*STB?` `48`

*TST?

Parameters: None.

Response: <NR1>

Returned values: Self test completed: integer. Value is 0.

Description: Self test query. Returns a ‘0’ when the remote control interface and processor are operating.

Example: `*TST?` `0`

Confirm remote control system working correctly.

ABORt SUBSYSTEM

:ABORt

:ABORt

Parameters: None.

Description: This command aborts the current intermodulation measurement.

Example: :ABOR

CALibration SUBSYSTEM

:CALibrate
:ALL\?

:CALibrate[:ALL]

Synonym for :CALibrate

Parameters: None.

Description: Sets the automatic calibration routine in progress, during which time the instrument is disabled.

Example: `:CAL:ALL`

Note: If *RST is issued whilst this command is executing, *RST is acknowledged immediately but its execution is delayed until after the CAL sequence finishes.

:CALibrate[:ALL]?

Synonym for :CALibrate?

Parameters: None.

Response: <integer>

Returned values: 0 (after approximately 50 s).

Description: A returned ‘0’ indicates that the calibration has completed.

Example: `:CAL?` `0`

CONFigure SUBSYSTEM

The CONFigure subsystem has the following command format:

```
:CONFigure:<function> <parameters>
```

The CONFigure command sets up the instrument in order to perform the measurement <function>. It will set some of the instrument state variables to a predetermined condition.

<function> defines the measurement operation to be used by MEASure?, READ? or FETCh? operations.

<parameters> are optional parameters which describe the essential characteristics of the measurement <function>. These parameters are the same as those specified and described in the MEASure subsystem. If parameters are omitted, they are assumed to be those currently in use. Parameters may be defaulted from the right by omitting them, or anywhere by substituting the keyword DEFault.

:CONFigure
- **:IMOD**
  - **:NORMal**
  - **:USER**
- **:SPECtrum**

:CONFigure:IMOD:NORMal

Parameters: [<NRf> [, <NRf> [, <NRf>]]]
[<F1 frequency> [, <F2 frequency> [, <tone level>]]]

Description: Configures the instrument to a predefined state in order to perform intermodulation measurements in the Normal mode.

Example:
```
:CONF:IMOD
:CONF:IMOD:NORM 380MHZ
:CONF:IMOD:NORM 380E6,490E6
:CONF:IMOD:NORM 380E6,490E6,10DBM
```

The :CONF:IMOD:NORMal command presets the instrument to the following configuration:

`:IMOD:MODE NORM`	intermodulation measurement mode set to Normal.
`:INIT:CONT OFF`	trigger system set to idle (i.e. single).
`:POW:INP HIGH`	high-power input selected.
`:IMOD:AVER 10`	number of averages set to 10.
`:IMOD:WIND BHAR`	Blackman-Harris selected as the window function.
`:IMOD:DISP NUM`	intermodulation display type set to Numeric.
`:IMOD:DISP:NORM:ORD 7`	instrument set to measure and display 3rd-, 5th- and 7th-order products.
`:IMOD:DISP:NORM:EXP 0`	expanded display of intermodulation products switched off.
`:IMOD:DISP:FREQ:ABS 0`	intermodulation frequencies display as values relative to F1.
`:IMOD:DISP:LEV:ABS 0`	intermodulation levels display as values relative to F1's level.
`:IMOD:DISP:TOP 10`	reference level for the Spectrum at Offset display set to 10 dBc.
`:IMOD:DISP:VRES 10`	vertical resolution of display set to 10 dBm/div.
`:IMOD:FREQ:FON`	F1 set, if parameter is specified.
`:IMOD:FREQ:FTW`	F2 set, if parameter is specified.
`:IMOD:INP:TON`	input tone level set, if parameter is specified.

:CONFigure:IMOD:USER

Parameters: [<NRf> [, <NRf>]]]
[<F1 frequency> [, <tone level>]]]

Description: Configures the instrument to a predefined state in order to perform intermodulation measurements in the User mode.

Example:
```
:CONF:IMOD
:CONF:IMOD:USER 380MHZ
:CONF:IMOD:USER 380E6,10DBM
```

The :CONF:IMOD:USER command presets the instrument to the following configuration:

`:IMOD:MODE USER`	intermodulation measurement mode set to User.
`:INIT:CONT OFF`	trigger system set to idle (i.e. single).
`:POW:INP HIGH`	high-power input selected.
`:IMOD:AVER 10`	number of averages set to 10.
`:IMOD:WIND BHAR`	Blackman-Harris selected as the window function.
`:IMOD:DISP NUM`	intermodulation display type set to Numeric.
`:IMOD:DISP:FREQ:ABS 0`	intermodulation frequencies display as values relative to F1.
`:IMOD:DISP:LEV:ABS 0`	intermodulation levels display as values relative to F1's level.
`:IMOD:DISP:TOP 10`	reference level for the Spectrum at Offset display set to 10 dBc.
`:IMOD:DISP:VRES 10`	vertical resolution of display set to 10 dBm/div.
`:IMOD:FREQ:FON`	F1 set, if parameter is specified.
`:IMOD:INP:TON`	input tone level set, if parameter is specified.

:CONFigure:SPECtrum

Parameters: [<NRf> [, <NRf> [, <NRf>]]]
[<frequency> [, <level> [,]]]

Description: Configures the instrument to a predefined state in order to perform spectrum analysis measurements.

Example:
```
:CONF:SPEC
:CONF:SPEC 150MHZ
:CONF:SPEC 150E6,5DBM
:CONF:SPEC 150E6,5DBM,10KHZ
```

The :CONF:SPEC command presets the instrument to the following configuration:

`:INST:SEL SPEC`	basic operating mode of the instrument set to spectrum analyzer.
`:INIT:CONT OFF`	trigger system set to idle (i.e. single).
`:SPEC:WIND BHAR`	Blackman-Harris selected as the window function.
`:SPEC:AVER 10`	number of averages set to10.
`:SPEC:AVER: 1`	averaging OFF.
`:SPEC:DISP:TOP 10DBM`	top of screen (reference level) set to 10 dBm.
`:SPEC:DISP:VRES 10`	vertical resolution set to 10 dBm/div.
`:POW:INP HIGH`	high-power input selected.
`:FREQ:REF`	sets the center frequency (if parameter specified).
`:FREQ:SPAN`	sets the frequency span (if parameter specified).
`:POW:REF`	sets the input level (if parameter specified).

FETCh SUBSYSTEM

The FETCh subsystem has the following command format:

```
:FETCh:<function>?
```

The FETCh? query is used to return the result of a measurement that has already been configured and initiated.

<function> defines the measurement operation to be used by FETCh? It is also used in the CONFigure, MEASure? and READ? subsystems.

By specifying a <function> as part of a compound header, the device will retrieve the value of the function requested derived from the data taken by the last INITiate command.

As the FETCh? query operates on data already captured for a particular measurement configuration, no parameters are specified.

The FETCh? query will return data at any time as long as the last reading is valid.

:FETCh
- **:IMOD**
  - **:NORMal**
    - **:ATTenuation?**
    - **:ATTenuation**
      - **:FAIL?**
    - **:FAIL?**
    - **:FONe?**
    - **:FONe**
      - **:TPOWer?**
    - **FTWo?**
    - **:FTWo**
      - **:TPOWer?**
    - **:LIMit?**
    - **:TRACe**
      - **:ASCii?**
      - **:BINary?**
  - **:USER**
    - **:ATTenuation?**
    - **:ATTenuation**
      - **:FAIL?**
    - **:FAIL?**
    - **:FONe?**
    - **:FONe**
      - **:TPOWer?**
    - **:LIMit?**
    - **:TRACe**
      - **:ASCii?**
      - **:BINary?**

:FETch
- **:SPECtrum**
  - **:FAIL?**
  - **:FREQ?**
  - **:LEVel?**
  - **:TRACe**
    - **:ASCii?**
    - **:BINary?**

:FETCh:IMOD:NORM:ATTenuation?

Parameters: <NRf>
<product no.>

<product no.> is in the range 1–60; see Table 4-3.

Response: <NR2> (format dependent on command `:IMOD:DISP:LEV:ABS`)

Returned values: (dBc)

Description: Returns the attenuation measurement at the specified intermodulation product.

Example: `:FETC:IMOD:NORM:ATT? 4` `–32.34`

:FETCh:IMOD:NORM:ATTenuation:FAIL?

Parameters: <NRf>
<product no.>

<product no.> is in the range 1–60; see Table 4-3.

Response: <NR1>

Returned values: 0 | 1

Description: Tests whether the attenuation measurement passes (‘0’) or fails (‘1’) when compared with the limit at the specified intermodulation product.

Example: `:FETC:IMOD:NORM:ATT:FAIL? 4` `1`

:FETCh:IMOD:NORMal:FAIL?

Parameters: None.

Response: <NR1>

Returned values: 0 | to | 32767 – for bit significance see Table 4-4.

Description: Returns the intermodulation status word. 0 signifies a pass, any other result signifies a failure: for example, 1024 denotes an input-level overload.

Example: `:FETC:IMOD:NORM:FAIL?` `0`

:FETCh:IMOD:NORMal:FONe?

Parameters: None.

Response: <NR2>

Returned values: (Hz)

Description: Returns the actual measured frequency at F1.

Example: `:FETC:IMOD:NORM:FON?` `379993415`

:FETCh:IMOD:NORMal:FONe:TPOWer?

Parameters: None.

Response: <NR2>

Returned values: (dBm)

Description: Returns the tone power at F1 during the intermodulation measurement.

Example: `:FETC:IMOD:NORM:FON:TPOW?` `–41.5`

:FETCh:IMOD:NORMal:FTWo?

Parameters: None.

Response: <NR2>

Returned values: (Hz)

Description: Returns the actual measured frequency at F2.

Example: `:FETC:IMOD:NORM:FTW?` `389413543`

:FETCh:IMOD:NORMal:FTWo:TPOWer?

Parameters: None.

Response: <NR2>

Returned values: (dBm)

Description: Returns the tone power at F2 during the intermodulation measurement.

Example: `:FETC:IMOD:NORM:FTW:TPOW?` `–43.5`

:FETCh:IMOD:NORM:LIMit?

Parameters: <NRf>
<product no.>

< product no.> is in the range 1–60; see Table 4-3.

Response: <NR2> (format dependent on command `:IMOD:DISP:LEV:ABS`)

Returned values: (dBc)

Description: Returns the limit used at the specified intermodulation product.

Example: `:FETC:IMOD:NORM:LIM 4?` `–35.00`

:FETCh:IMOD:NORM:TRACe:ASCii?

Parameters: None.

Response: Array of 501 <NR2> comma-separated values (dBm).

Returned values: (dBc) (ASCII)

Description: Returns the Spectrum at Offset trace data in ASCII format.

Example: `:FETC:IMOD:NORM:TRAC:ASC?`

:FETCh:IMOD:NORM:TRACe:BINary?

Parameters: None.

Response: <nnn-form> (in dBm) – see page 4-125.

Returned values: (mBc, equivalent to 0.01 dBc) 16-bit signed 2’s-complement binary values.

Description: Returns the Spectrum at Offset trace data in binary format.

Example: `:FETC:IMOD:NORM:TRAC:BIN?`

:FETCh:IMOD:USER:ATTenuation?

Parameters: <NRf>
<point no.>

<point no.> is in the range 1–50.

Response: <NR2> (format dependent on command `:IMOD:DISP:LEV:ABS`)

Returned values: (dBc)

Description: Returns the attenuation measurement at the specified point.

Example: `:FETC:IMOD:USER:ATT? 19` `–32.34`

:FETCh:IMOD:USER:ATTenuation:FAIL?

Parameters: <NRf>
<point no.>

<point no.> is in the range 1–50

Response: <NR1>

Returned values: 0 | 1

Description: Tests whether the attenuation measurement passes (‘0’) or fails (‘1’) when compared with the limit at the specified point.

Example: `:FETC:IMOD:USER:ATT:FAIL? 14` `1`

:FETCh:IMOD:USER:FAIL?

Parameters: None.

Response: <NR1>

Returned values: 0 | to | 32767 – for bit significance see Table 4-4.

Description: Returns the intermodulation status word. 0 signifies a pass, any other result signifies a failure: for example, 1024 denotes an input-level overload.

Example: `:FETC:IMOD:USER:FAIL?` `512`

:FETCh:IMOD:USER:FONe?

Parameters: None.

Response: <NR2>

Returned values: (Hz)

Description: Returns the actual measured frequency at F1.

Example: `:FETC:IMOD:USER:FON?` `379993415`

:FETCh:IMOD:USER:FONe:TPOWer?

Parameters: None.

Response: <NR2>

Returned values: (dBm)

Description: Returns the tone power at F1 during the intermodulation measurement.

Example: `:FETC:IMOD:USER:FON:TPOW?` `–41.5`

:FETCh:IMOD:USER:LIMit?

Parameters: <NRf>
<point no.>

<point no.> is in the range 1–50.

Response: <NR2> (format dependent on command `:IMOD:DISP:LEV:ABS`)

Returned values: (dBc)

Description: Returns the limit used at the specified point.

Example: `:FETC:IMOD:USER:LIM? 12` `–35.00`

:FETCh:IMOD:USER:TRACe:ASCii?

Parameters: None.

Response: Array of 501 <NR2> comma-separated values (dBm).

Returned values: (dBc) (ASCII)

Description: Returns the Spectrum at Offset trace data in ASCII format.

Example: `:FETC:IMOD:USER:TRAC:ASC?`

:FETCh:IMOD:USER:TRACe:BINary?

Parameters: None.

Response: <nnn-form> (in dBm) – see page 4-125.

Returned values: (mBc, equivalent to 0.01 dBc) 16-bit signed 2's-complement binary values.

Description: Returns the Spectrum at Offset trace data in binary format.

Example: `:FETC:IMOD:USER:TRAC:BIN?`

:FETCh:SPECtrum:FAIL?

Parameters: None.

Response: <NR1>

Returned values: 0 | to | 32767 – for bit significance see Table 4-4.

Description: Returns the spectrum status word. 0 signifies a pass, any other result signifies a failure: for example, 1024 denotes an input-level overload.

Example: `:FETC:SPEC:FAIL?` `0`

:FETCh:SPECtrum:FREQuency?

Parameters: None.

Response: <NR2>

Returned values: (Hz)

Description: Returns the frequency of the marker.

Example: `:FETC:SPEC:FREQ?`

:FETCh:SPECtrum:LEVel?

Parameters: None.

Response: <NR2>

Returned values: (dBm)

Description: Returns the level at the marker.

Example: `:FETC:SPEC:LEV?`

:FETCh:SPECtrum:TRACe:ASCii?

Parameters: None.

Response: <NR2>

Returned values: Array of 501*<NR2>, separated by commas.

Description: Returns the entire trace.

Example: `:FETC:SPEC:TRAC:ASC?`

:FETCh:SPECtrum:TRACe:BINary?

Parameters: None.

Response: Array of 501*<bin>, MS byte first. See Table 4-7.

Returned values: (mBc, equivalent to 0.01 dBc) 16-bit signed 2's-complement binary values.

Description: Returns the entire trace.

Example: `:FETC:SPEC:TRAC:BIN?`

FREQuency SUBSYSTEM

The FREQuency subsystem controls the frequency characteristics of the instrument.

:FREQuency
- **:CENTre\?**
- **:REFerence\?**
- **:ROSCillator**
- **:SPAN\?**

:FREQuency:CENTre or :CENTer

Synonym for :FREQ:REF

Parameters: <NRf_fs>
The frequency to be analyzed.

Valid values: Frequency (Hz).

*RST/startup default: 380 MHz

Description: Sets the center frequency. The actual LO frequency of the instrument is set 10.71 MHz higher than the value specified.

Example: `:FREQ:CENT 124E6`

Sets center frequency to 124 MHz.

:FREQuency:CENTre or :CENTer?

Synonym for :FREQ:REF?

Parameters: None.

Response: <NR2>

Returned values: (Hz)

Description: Reads the center frequency value.

Example: `:FREQ:CENT?` `124600000`

:FREQuency:REFerence

Parameters: <NRf_fs>
The frequency to be analyzed.

Valid values: Frequency (Hz).

*RST/startup default: 380 MHz

Description: Sets the center frequency. The actual LO frequency of the instrument is set 10.71 MHz higher than the value specified.

Example: `:FREQ:REF 124E6`

Sets center frequency to 124 MHz.

:FREQuency:REFerence?

Parameters: None.

Response: <NR2>

Returned values: (Hz)

Description: Reads the center frequency value.

Example: `:FREQ:REF?` `124600000`

:FREQuency:ROSCillator

Parameters: <CPD>
Reference oscillator selection.

Valid values: INT | INT10OUT | EXT1IND | EXT10IND

*RST/startup default: INT10OUT

Description: Selects reference oscillator between internal 10 MHz or external 1 or 10 MHz. For internal, selects between enabling and disabling output from INT STD O/P socket.

INT	internal 10 MHz oscillator, no output.
INT10OUT	internal 10 MHz oscillator with 10 MHz output.
EXT1IND	external 1 MHz indirect via internal PLL.
EXT10IND	external 10 MHz indirect via internal PLL.

Example: `:FREQ:ROSC INT10OUT`

:FREQuency:SPAN

Parameters: <NRf_fs>
The frequency span to be analyzed in spectrum mode.

Valid values: Frequency (Hz).

*RST/startup default: 100 kHz

Description: Sets the span for spectrum analyzer mode.

Example: `:FREQ:SPAN 124E3`

Sets frequency span to 124 kHz.

:FREQuency:SPAN?

Parameters: None.

Response: <NR2>

Returned values: (Hz)

Description: Reads the frequency span value.

Example: `:FREQ:SPAN?` `124000`

HARDcopy SUBSYSTEM

The HARDcopy subsystem controls the printing of measurement data.

:HARDcopy
:PLOT
:ALL
:NAME

:HARDcopy[:PLOT[:ALL]]

Parameters: None.

Description: Outputs over the parallel port connector an A4 hard print of all available information for the current measurement. If limits are turned on, limit lines are printed and annotated.

Example: `:HARD:PLOT:ALL`

:HARDcopy:PLOT:NAME

Parameters: <STRING PROGRAM DATA>

Valid values: Up to 50 characters.

Description: Inserts a string in the heading of all printouts. The string is preceded by the words 'Analysis by:'.

Example: `:HARD:PLOT:NAME "Our mobile unit serial 12345-67"`

IMOD SUBSYSTEM

The IMOD subsystem is used to control the intermodulation measurement process.

```
:IMOD
    :ABORt
    :AVERage\?
    :AVERage
        :STATe\?
    :DISPlay\?
    :DISPlay
        :FREQuency
            :ABSolute\?
        :LEVel
            :ABSolute\?
        :NORMal
            :PRODuct\?
            :EXPanded\?
            :ORDer\?
        :SPAN?
        :TOP\?
        :USER
            :POINt\?
        :VRESolution\?
    :EDIT
        :USER
            :POINts?
            :INSert
                :TONe
                :PRODuct
            :OFFSet?
            :OFFSet
                :STATe\?
                :REMove
:IMOD
    :FREQuency
        :COUPled\?
        :FONe\?
        :FONe
            :LO\?
        :FTWo\?
        :FTWo
            :OFFSet\?
        :ULO\?
        :ULO
            STATe\?
    :INPut
        :SLEVel\?
        :ATTenuation\?
        :OPTimisation\?
        :PREFilter
            [:STATe]\?
        :TONe\?
    :LIMits
        [:STATe]\?
    :MODE\?
    :NBANdwidth\?
    :NORMal
        :LIMit\?
    :USER
        :LIMit\?
    :WINDow\?
```

:IMOD:ABORt

Parameters: None.

Description: This command aborts the current intermodulation measurement.

Example: `:IMOD:ABOR`

:IMOD:AVERage

Parameters: <NRf>

Valid values: 1 – 200

*RST/startup default: 10

Description: Sets the number of averages to be used.

Example: `:IMOD:AVER 20`

:IMOD:AVERage?

Parameters: None.

Response: <NR1>

Returned values: 1 – 200

Description: Returns the number of averages used.

Example: `:IMOD:AVER?` `20`

:IMOD:AVERage:STATe

Parameters: <bool>

Valid values: 0 | 1 | OFF | ON

*RST/startup default: 1

Description: Sets whether averaging is enabled.

Example: `:IMOD:AVER:STAT 0`

:IMOD:AVERage:STATe?

Parameters: None.

Response: <bool>

Returned values: 0 | 1

Description: Returns whether averaging is enabled.

Example: `:IMOD:AVER:STAT?` `0`

:IMOD:DISPlay

Parameters: <CPD>

Valid values: NUMeric | SPECtrum

*RST/startup default: NUMeric

Description: Sets the intermodulation display type.

Example: `:IMOD:DISP NUM`

:IMOD:DISPlay?

Parameters: None.

Response: <CRD>

Returned values: NUM | SPEC

Description: Returns the intermodulation display type.

Example: `:IMOD:DISP?` `NUM`

:IMOD:DISPlay:FREQuency:ABSolute

Parameters: <bool>

Valid values: 0 | 1 | OFF | ON

*RST/startup default: 0

Description: Sets whether frequencies are displayed as:

absolute values (1) or in product form (0)	Normal mode
relative offset values from F1 (0)	User mode.

Example: `:IMOD:DISP:FREQ:ABS OFF`

:IMOD:DISPlay:FREQuency:ABSolute?

Parameters: None.

Response: <bool>

Returned values: 0 | 1 | OFF | ON

Description: Returns whether frequencies are displayed as:

absolute values (1) or in product form (0)	Normal mode
relative offset values from F1 (0)	User mode.

Example: `:IMOD:DISP:FREQ:ABS?` `0`

:IMOD:DISPlay:LEVel:ABSolute

Parameters: <bool>

Valid values: 0 | 1 | OFF | ON

*RST/startup default: 0

Description: Sets whether levels are displayed as absolute values (1) or relative to F1 (0).

Example: `:IMOD:DISP:LEV:ABS OFF`

:IMOD:DISPlay:LEVel:ABSolute?

Parameters: None.

Response: <bool>

Returned values: 0 | 1 | OFF | ON

Description: Returns whether levels are displayed as absolute values (1) or relative to F1 (0).

Example: `:IMOD:DISP:LEV:ABS?` `0`

:IMOD:DISPlay:NORMal:PRODuct

Parameters: <NRf>

Valid values: <product no.>: in the range 1–60; see Table 4-3.

*RST/startup default: 4

Description: Sets which product in the table is currently selected.

Example: `:IMOD:DISP:NORM:PROD 4`

:IMOD:DISPlay:NORMal:PRODuct?

Parameters: None.

Response: <product no.>

Returned values: In the range 1–60; see Table 4-3.

Description: Queries which product in the table is currently selected.

Example: `:IMOD:DISP:NORM:PROD?` `3`

:IMOD:DISPlay:NORMal:EXPanded

Parameters: <bool>

Valid values: 0 | 1 | OFF | ON

*RST/startup default: 0

Description: Sets whether the Expanded list of intermodulation products is displayed.

Example: `:IMOD:DISP:NORM:EXP OFF`

:IMOD:DISPlay:NORmal:EXPanded?

Parameters: None.

Response: <bool>

Returned values: 0 | 1 | OFF | ON

Description: Returns whether the Expanded list of intermodulation products is displayed.

Example: `:IMOD:DISP:NORM:EXP?` `0`

:IMOD:DISPlay:NORMal:ORDer

Parameters: <NRf>

Valid values: 0 to 15; see Table 4-5.

*RST/startup default: 15

Description: Sets which intermodulation orders are measured and displayed.

Example: `:IMOD:DISP:NORM:ORD 3`

:IMOD:DISPlay:NORmal:ORDer?

Parameters: None.

Response: <NR1>

Returned values: 0 to 15; see Table 4-5.

Description: Returns which intermodulation orders are measured and displayed.

Example: `:IMOD:DISP:NORM:ORD?` `0`

:IMOD:DISPlay:SPAN?

Parameters: None.

Response: <NR2>

Returned values: 10 Hz to 300 kHz.

Description: Returns the current span setting (fixed multiple of noise bandwidth up to 300 kHz).

Example: `:IMOD:DISP:SPAN?` `300.00`

:IMOD:DISPlay:TOP

Parameters: <NRf>

Valid values: –150 to 150 (dBc)

*RST/startup default: –10.00

Description: Sets the reference level for the Spectrum at Offset display.

Example: `:IMOD:DISP:TOP –20.00`

:IMOD:DISPlay:TOP?

Parameters: None.

Response: <NR2>

Returned values: –150 to 150 (dBc)

Description: Returns the reference level for the Spectrum at Offset display.

Example: `:IMOD:DISP:TOP?` `–10.00`

:IMOD:DISPlay:USER:POINt

Parameters: <NRf>

Valid values: <point no.>: in the range 1–50.

*RST/startup default: 1

Description: Sets which point in the table is currently selected.

Example: `:IMOD:DISP:USER:POIN 16`

:IMOD:DISPlay:USER:POInt?

Parameters: None.

Response: <NR1>

Returned values: 1–50

Description: Returns which point in the table is currently selected.

Example: `:IMOD:DISP:USER:POIN?` `8`

:IMOD:DISPlay:VRESolution

Parameters: <NRf>

Valid values: 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20 dB/div.

*RST/startup default: 10

Description: Sets the vertical resolution of the Spectrum at Offset display.

Example: `:IMOD:DISP:VRES 5`

:IMOD:DISPlay:VRESolution?

Parameters: None.

Response: <NR1>

Returned values: dB/div.

Description: Returns the vertical resolution of the Spectrum at Offset display.

Example: `:IMOD:DISP:VRES?` `10`

:IMOD:EDIT:USER:POInts?

Parameters: None.

Response: <NR1>

Returned values: 1 to 50

Description: Returns the number of points currently defined in the User mode table.

Example: `:IMOD:EDIT:USER:POIN?`

:IMOD:EDIT:USER:INSert:TONe

Parameters: <NRf>

Valid values: $|F_{offset} + F1| \leq 2.4$ GHz

*RST/startup default: 5.000000 MHz

Description: Adds a frequency offset, relative to F1, to the table.

Example: `:IMOD:EDIT:USER:INS:TON 50000`

:IMOD:EDIT:USER:INSert:PRODuct

Parameters: <NRf>

Valid values: 100 kHz to 2.4 GHz

*RST/startup default: 5.000000 MHz

Description: Adds a product frequency to the table.

Example: `:IMOD:EDIT:USER:INS:PROD 40000`

:IMOD:EDIT:USER:OFFSet?

Parameters: <NRf>
<point no.>

<point no.> is in the range 1–50.

Response: <NR2>

Returned values: (Hz)

Description: Returns the frequency offset at the specified point.

Example: `:IMOD:EDIT:USER:OFFS?` `4500000`

:IMOD:EDIT:USER:OFFSet:STATe

Parameters: <NRf>,<CPD>
<point no.>,<state>

Valid values: <point no.>; in the range 1–50
<state>; TONe | PRODuct | DISabled

Description: Sets the state of the frequency offset at the specified point.

Example: `:IMOD:EDIT:USER:OFFS:STAT 24,DIS`

:IMOD:EDIT:USER:OFFSet:STATe?

Parameters: <NRf>
<point no.>

<point no.> is in the range 1–50.

Response: <CRD>

Returned values: TON | PROD | DIS

Description: Returns the state of the frequency offset at the specified point.

Example: `:IMOD:EDIT:USER:OFFS:STAT? 10` `PROD`

:IMOD:EDIT:USER:REMove

Parameters: <NRf>
<point no.>

Valid values: 1–50

Description: Removes the frequency offset at the specified point from the table.

Example: `:IMOD:EDIT:USER:REM 14`

:IMOD:FREQuency:COUPled

Parameters: <bool>

Valid values: 0 | 1 | OFF | ON

*RST/startup default: 0

Description: Sets whether F1 and F2 are coupled (1) or uncoupled (0).

Example: `:IMOD:FREQ:COUP 1`

:IMOD:FREQuency:COUPled?

Parameters: None.

Response: <bool>

Returned values: 0 | 1 | OFF | ON

Description: Returns whether F1 and F2 are coupled (1) or uncoupled (0).

Example: `:IMOD:FREQ:COUP?` `0`

:IMOD:FREQuency:FONe

Parameters: <NRf>

Valid values: 100 MHz to 2.4 GHz

*RST/startup default: 380 MHz

Description: Sets the F1 frequency.

Example: `:IMOD:FREQ:FON 400MHZ`

:IMOD:FREQuency:FONe?

Parameters: None.

Response: <NR2>

Returned values: (Hz)

Description: Returns the F1 frequency.

Example: `:IMOD:FREQ:FON?` `350000021`

:IMOD:FREQuency:FONe:LO

Parameters: <CPD>

Valid values: ABOVe | BELow

*RST/startup default: ABOVe

Description: Sets the mixer's local oscillator to 10.7 MHz above or below the F1 frequency.

Example: `:IMOD:FREQ:FON:LO ABOV`

:IMOD:FREQuency:FONe:LO?

Parameters: None.

Response: <CRD>

Returned values: ABOV | BEL

Description: Returns whether the mixer's local oscillator is set to 10.7 MHz above or below the F1 frequency.

Example: `:IMOD:FREQ:FON:LO?` `BEL`

:IMOD:FREQuency:FTWo

Parameters: <NRf>

Valid values: 100 MHz to 2.4 GHz

*RST/startup default: 385 MHz

Description: Sets the F2 frequency.

Example: `:IMOD:FREQ:FTW 385MHZ`

:IMOD:FREQuency:FTWo?

Parameters: None.

Response: <NR2>

Returned values: (Hz)

Description: Returns the F2 frequency.

Example: `:IMOD:FREQ:FTW?` `385000033`

:IMOD:FREQuency:FTWo:OFFSet

Parameters: <NRf>

Valid values: Range depends on the current F1 frequency.

*RST/startup default: 10 MHz

Description: Sets F2's frequency offset from F1.

Example: `:IMOD:FREQ:FTW:OFFS 30KHZ`

:IMOD:FREQuency:FTWo:OFFSet?

Parameters: None.

Response: <NR2>

Returned values: (Hz)

Description: Returns F2's frequency offset from F1.

Example: `:IMOD:FREQ:FTW:OFFS?` `10000`

:IMOD:FREQuency:ULO

Parameters: <NRf>

Valid values: Range depends on the current F1 frequency.

*RST/startup default: 0 Hz

Description: Sets the user LO value.

Example: `:IMOD:FREQ:ULO 2.5MHZ`

:IMOD:FREQuency:ULO?

Parameters: None.

Response: <NR2>

Returned values: (Hz)

Description: Returns the user LO value.

Example: `:IMOD:FREQ:ULO?` `0`

:IMOD:FREQuency:ULO:STATe

Parameters: <bool>

Valid values: 0 | 1 | OFF | ON

*RST/startup default: 0

Description: Sets the user LO on (1) or off (0).

Example: `:IMOD:FREQ:ULO:STAT ON`

:IMOD:FREQuency:ULO:STATe?

Parameters: None.

Response: <bool>

Returned values: 0 | 1 | OFF | ON

Description: Returns whether the user LO is on (1) or off (0).

Example: `:IMOD:FREQ:ULO:STAT?` `0`

:IMOD:INPut:SLEVel

Parameters: <bool>

Valid values: 0 | 1 | OFF | ON

*RST/startup default: 0

Description: Sets the state of the Self Level on (1) or off (0).

Example: `:IMOD:INP:SLEV ON`

:IMOD:INPut:SLEVel?

Parameters: None.

Response: <bool>

Returned values: 0 | 1 | OFF | ON

Description: Returns the state of the Self Level; on (1) or off (0).

Example: `:IMOD:INP:SLEV?` `0`

:IMOD:INPut:ATTenuation

Parameters: <NRf>

Valid values: 0, 5, 10, …, 55, 60, 65 dB

*RST/startup default: 0

Description: Sets the input attenuation of the instrument.

Example: `:IMOD:INP:ATT 25`

:IMOD:INPut:ATTenuation?

Parameters: None.

Response: <NR1>

Returned values: (dB)

Description: Returns the input attenuation of the instrument.

Example: `:IMOD:INP:ATT?` `30`

:IMOD:INPut:OPTimisation

Parameters: <CPD>

Valid values: NDBalanced | NOISe | DISTortion | MANual

*RST/startup default: NDB

Description: Sets the optimization mode – noise/distortion balanced, low-noise, low-distortion or manual.

Example: `:IMOD:INP:OPT NDB`

:IMOD:INPut:OPTimisation?

Parameters: None.

Response: <CRD>

Returned values: NDB | NOIS | DIST | MAN

Description: Returns the optimization mode – noise/distortion balanced, low-noise, low-distortion or manual.

Example: `:IMOD:INP:OPT?` `NDB`

:IMOD:INPut:PREFilter[:STATe]

Parameters: <NRf>

Valid values: 0 | 1

*RST/startup default: 0

Description: Sets the pre-filter's state:

0 = pre-filter out
1 = pre-filter in

Example: `:IMOD:INP:PREF 1`

:IMOD:INPut:PREFilter[:STATe]?

Parameters: None.

Response: <NR2>

Returned values: 0 | 1

Description: Returns the pre-filter's state:

0 = pre-filter out
1 = pre-filter in

Example: `:IMOD:INP:PREF?` `0`

:IMOD:INPut:TONe

Parameters: <NRf>

Valid values: −137 to +47 dBm

*RST/startup default: 41

Description: Sets the input tone level.

Note that the input tone level is 6 dB lower than the input signal level.

Example: `:IMOD:INP:TON −20.00`

:IMOD:INPut:TONe?

Parameters: None.

Response: <NR2>

Returned values: (dBm)

Description: Returns the input tone level.

Example: `:IMOD:INP:TON?` `−30.5`

:IMOD:LIMits[:STATe]

Parameters: <bool>

Valid values: 0 | 1 | OFF | ON

*RST/startup default: 1

Description: Sets limits on or off.

Example: `:IMOD:LIM:STAT ON`

:IMOD:LIMits:[:STATe]?

Parameters: None.

Response: <bool>

Returned values: 0 | 1 | OFF | ON

Description: Returns whether limits are on or off.

Example: `:IMOD:LIM:STAT?` `0`

:IMOD:MODE

Parameters: <CPD>

Valid values: NORMal | USER

*RST/startup default: NORMal

Description: Sets the mode for intermodulation measurement.

Example: `:IMOD:MODE NORMal`

:IMOD:MODE?

Parameters: None.

Response: <CRD>

Returned values: NORM | USER

Description: Returns the mode selected for intermodulation measurement.

Example: `:IMOD:MODE` `NORM`

:IMOD:NBANdwidth

Parameters: <NRf>

Valid values:

0.1 Hz – 100 kHz	Blackman-Harris
0.1 Hz – 200 kHz	Gaussian

*RST/startup default: 100 Hz

Description: Sets the noise bandwidth for the current window.

Example: `:IMOD:NBAND 10KHZ`

:IMOD:NBANdwidth?

Parameters: None.

Response: <NR2>

Returned values: (Hz)

Description: Returns the noise bandwidth for the current window.

Example: `:IMOD:NBAND?` `1000`

:IMOD:NORMal:LIMit

Parameters: <NRf>, <NRf>
<product no.>, <level>

Valid values: <product no.>; in the range 1–60; see Table 4-3.
<level>; in the range –120 to +150 dBm

*RST/startup default: –120

Description: Sets the limit level at the specified product.

Example: `:IMOD:NORM:LIM 4,–35`

:IMOD:NORMal:LIMit?

Parameters: <NRf>
<product no.>

<product no.> is in the range 1–60; see Table 4-3.

Response: <NR2>

Returned values: (dBm)

Description: Returns the limit level at the specified product.

Example: `:IMOD:NORM:LIM? 4` `–20`

:IMOD:USER:LIMit

Parameters: <NRf>, <NRf>
<point no.>, <level>

Valid values: <point no.>; in the range 1–50.
<level>; in the range –200 to +150 dBm

*RST/startup default: –120

Description: Sets the limit level at the specified point.

Example: `:IMOD:USER:LIM 4,–35`

:IMOD:USER:LIMit?

Parameters: <NRf>
<point no.>

<point no.> is in the range 1–50.

Response: <NR2>

Returned values: (dBm)

Description: Returns the limit level at the specified point.

Example: `:IMOD:USER:LIM? 4` `–20`

:IMOD:WINDow

Parameters: <CPD>

Valid values: BHARris | GAUSsian

*RST/startup default: BHARris

Description: Sets the window type.

Example: `:IMOD:WIND GAUS`

:IMOD:WINDow?

Parameters: None.

Response: <CRD>

Returned values: BHAR | GAUS

Description: Returns the window type.

Example: `:IMOD:WIND?` `BHAR`

INITiate SUBSYSTEM

The INITiate subsystem is used to control the initiation of a measurement process.

:INITiate
:CONTinuous\?
:IMMediate

:INITiate:CONTinuous

Parameters: <bool>

Valid values: ON | OFF | 0 | 1

*RST/startup default: 0

Description: This command is used to select whether the trigger system is continuously initiated or not. With CONTinuous set to OFF the system remains idle until set to ON or INIT:IMMediate is received. When set to OFF, the current measurement process is aborted before returning to idle.
ON = repeat, OFF = single.

Examples:
```
:INIT:CONT ON
:INIT:CONT 1
```

Note: when in CONTinuous trigger mode, pressing SINGLE is equivalent to :INIT:CONT 0; :INIT:IMM

:INITiate:CONTinuous?

Parameters: None.

Response: <bool>

Returned values: 0 | 1

Description: Reads the current trigger initiation state.

Example:
```
:INIT:CONT?                                    1
```

:INITiate:IMMediate

Parameters: None.

Description: Initiates one complete cycle and return to idle (providing CONT is OFF; if CONT is ON, this command will produce an error).

Example:
```
:INIT:IMM
```

INSTrument SUBSYSTEM

The INSTrument subsystem selects the operating mode of the instrument.

:INSTrument
- **:CBPRom**
  - **:PNUMber?**
  - **:VERSion?**
- **:DBPRom**
  - **:PNUMber?**
  - **:VERSion?**
- **:ID?**
- **:SELect\?**
- **:SNUMber?**
- **:SOFTware**
  - **:PNUMber?**
  - **:VERsion?**

:INSTrument:CBPRom:PNUMber?

Parameters: None.

Response: <arbitrary ASCII response data>

Returned values: Part number

Description: Returns the part number of the instrument's CPU boot PROM.

Example: `:INST:CBPR:PNUM?` `44533/471`

:INSTrument:CBPRom:VERSion?

Parameters: None.

Response: <arbitrary ASCII response data>

Returned values: Version number

Description: Returns the version number of the instrument's CPU boot PROM.

Example: `:INST:CBPR:VERS?` `01.06`

:INSTrument:DBPRom:PNUMber?

Parameters: None.

Response: <arbitrary ASCII response data>

Returned values: Part number

Description: Returns the part number of the instrument's DSP boot PROM.

Example: `:INST:DBPR:PNUM?` `44533/465`

:INSTrument:DBPRom:VERSion?

Parameters: None.

Response: <arbitrary ASCII response data>

Returned values: Version number

Description: Returns the version number of the instrument's DSP boot PROM.

Example: `:INST:DBPR:VERS?` `01.20`

:INSTrument:ID?

Parameters: None.

Response: <NR1>

Returned values: Integer

Description: Returns the instrument's identification (ID) number (up to 10 digits maximum).

Example: `:INST:ID?` `1234567890`

:INSTrument:SELect

Parameters: <CPD>
Measurement mode

Valid values: APPLications | SPECtrum

*RST/startup default: SPECtrum

Description: Sets the operating mode of the instrument. When in APPLications mode, spectrum analyzer commands are still accepted and become effective when the mode is changed (and vice versa).

Calibration commands are locked out when not in calibration mode and measurement commands are not accepted whilst in calibration.

Example: `:INST:SEL SPEC`

:INSTrument:SELect?

Parameters: None.

Response: <CRD>

Returned values: APPL | SPEC

Description: Reads the current measurement mode.

Example: `:INST:SEL?` `SPEC`

:INSTrument:SNUMber?

Parameters: None.

Response: <arbitrary ASCII response data>

Returned values: Serial number

Description: Returns the instrument's serial number.

Example: `:INST:SNUM?` `231001/046`

:INSTrument:SOFTware:PNUMber?

Parameters: None.

Response: <arbitrary ASCII response data>

Returned values: Part number

Description: Returns the part number of the instrument's main software.

Example: `:INST:SOFT:PNUM?` `44540/016`

:INSTrument:SOFTware:VERSion?

Parameters: None.

Response: <arbitrary ASCII response data>

Returned values: Version number

Description: Returns the version number of the instrument's main software.

Example: `:INST:SOFT:VERS?` `02.50`

MEASure SUBSYSTEM

The MEASure subsystem has the following command format:

```
:MEASure:<function>? <parameters>
```

The MEASure? query provides, in a single operation, a complete measurement sequence, including configuration and reading of the data. No knowledge of the instrument is required to perform the operation.

<function> defines the measurement operation to be used by MEASure? It is also used in the CONFigure, READ? and FETCh? sub-systems.

<parameters> are optional parameters which describe the essential characteristics of the measurement <function>. For example, in order for a spectrum measurement to be performed, the channel frequency, input level and span characteristics may need to be known by the instrument.

If parameters are omitted, they are assumed to be those currently in use. Parameters may be defaulted from the right by omitting them, or anywhere by substituting the keyword DEFault.

The MEASure? query is identical to performing the following command:

```
:ABORt;
:CONFigure:<function> <parameters>;
:READ:<function>? <parameters>;
```

Note: although the MEASure? query is the most convenient and reliable method of obtaining measurement data, it is not necessarily the most efficient with respect to response time.

:MEASure
- **:IMOD**
  - **:NORMal**
    - **:ATTenuation?**
    - **:ATTenuation**
      - **:FAIL?**
    - **:FAIL?**
    - **:FONe?**
    - **:FONe**
      - **:TPOWer?**
    - **FTWo?**
    - **:FTWo**
      - **:TPOWer?**
    - **:TRACe**
      - **:ASCii?**
      - **:BINary?**
  - **:USER**
    - **:ATTenuation?**
    - **:ATTenuation**
      - **:FAIL?**
    - **:FAIL?**
    - **:FONe?**
    - **:FONe**
      - **:TPOWer?**
    - **:TRACe**
      - **:ASCii?**
      - **:BINary?**

:MEASure
- **:SPECtrum**
  - **:FAIL?**
  - **:FREQ?**
  - **:LEVel?**
  - **:TRACe**
    - **:ASCii?**
    - **:BINary?**

:MEASure:IMOD:NORM:ATTenuation?

Parameters: <NRf> [<NRf> [, <NRf> [, <NRf>]]]
<product no.> [<F1> [, <F2> [, <level>]]]

<product no.> is in the range 1–60; see Table 4-3.

Response: <NR2> (format dependent on command `:IMOD:DISP:LEV:ABS`)

Returned values: (dBc)

Description: Sets up to measure intermodulation attenuation with a numeric display. Performs the measurement for the specified product no., F1, F2 and tone level. Returns the attenuation measurement at the specified intermodulation product.

Example: `:MEAS:IMOD:NORM:ATT? 4` `–32.34`

:MEASure:IMOD:NORM:ATTenuation:FAIL?

Parameters: <NRf> [<NRf> [, <NRf> [, <NRf>]]]
<product no.> [<F1> [, <F2> [, <level>]]]

<product no.> is in the range 1–60; see Table 4-3.

Response: <NR1>

Returned values: 0 | 1

Description: Sets up to measure intermodulation attenuation with a numeric display. Performs the measurement for the specified product no., F1, F2 and tone level. Tests whether the attenuation measurement passes (0) or fails (1) when compared with the limit at the specified intermodulation product.

Example: `:MEAS:IMOD:NORM:ATT:FAIL? 4` `1`

:MEASure:IMOD:NORMal:FAIL?

Parameters: [<NRf> [, <NRf> [, <NRf>]]]
[<F1> [, <F2> [, <level>]]]

Response: <NR1>

Returned values: 0 | to | 32767 – for bit significance see Table 4-4.

Description: Sets up to measure intermodulation attenuation with a numeric display. Performs the measurement for the specified F1, F2 and tone level. Returns the intermodulation status word. 0 signifies a pass, any other result signifies a failure: for example, 1024 denotes an input-level overload.

Example: `:MEAS:IMOD:NORM:FAIL?` `0`

:MEASure:IMOD:NORMal:FONe?

Parameters: [<NRf> [, <NRf> [, <NRf>]]]
[<F1> [, <F2> [, <level>]]]

Response: <NR2>

Returned values: (Hz)

Description: Sets up to measure intermodulation attenuation with a numeric display. Performs the measurement for the specified F1, F2 and tone level. Returns the actual measured frequency at F1.

Example: `:MEAS:IMOD:NORM:FON?` `379994567`

:MEASure:IMOD:NORMal:FONe:TPOWer?

Parameters: [<NRf> [, <NRf> [, <NRf>]]]
[<F1> [, <F2> [, <level>]]]

Response: <NR2>

Returned values: (dBm)

Description: Sets up to measure intermodulation attenuation with a numeric display. Performs the measurement for the specified F1, F2 and tone level. Returns the tone power at F1 during the intermodulation measurement.

Example: `:MEAS:IMOD:NORM:FON:TPOW?` `−41.5`

:MEASure:IMOD:NORMal:FTWo?

Parameters: [<NRf> [, <NRf> [, <NRf>]]]
[<F1> [, <F2> [, <level>]]]

Response: <NR2>

Returned values: (Hz)

Description: Sets up to measure intermodulation attenuation with a numeric display. Performs the measurement for the specified F1, F2 and tone level. Returns the actual measured frequency at F2.

Example: `:MEAS:IMOD:NORM:FTW?` `389786789`

:MEASure:IMOD:NORMal:FTWo:TPOWer?

Parameters: [<NRf> [, <NRf> [, <NRf>]]]
[<F1> [, <F2> [, <level>]]]

Response: <NR2>

Returned values: (dBm)

Description: Sets up to measure intermodulation attenuation with a numeric display. Performs the measurement for the specified F1, F2 and tone level. Returns the tone power at F2 during the intermodulation measurement.

Example: `:MEAS:IMOD:NORM:FTW:TPOW?` `–43.5`

:MEASure:IMOD:NORM:TRACe:ASCii?

Parameters: <NRf> [<NRf> [, <NRf> [, <NRf>]]]
<product no.> [<F1> [, <F2> [, <level>]]]

<product no.> is in the range 1–50; see Table 4-3.

Response: Array of 501 <NR2> comma-separated values (dBm).

Returned values: (dBc) (ASCII)

Description: Sets up to measure intermodulation attenuation with a numeric display. Performs the measurement for the specified product no., F1, F2 and tone level. Returns the Spectrum at Offset trace data in ASCII format.

Example: `:MEAS:IMOD:NORM:TRAC:ASC?`

:MEASure:IMOD:NORM:TRACe:BINary?

Parameters: <NRf> [<NRf> [, <NRf> [, <NRf>]]]
<product no.> [<F1> [, <F2> [, <level>]]]

Response: <nnn-form> (in dBm) – see page 4-125.

Returned values: (mBc, equivalent to 0.01 dBc) 16-bit signed 2’s-complement binary values.

Description: Sets up to measure intermodulation attenuation with a numeric display. Performs the measurement for the specified product no., F1, F2 and tone level. Returns the Spectrum at Offset trace data in binary format.

Example: `:MEAS:IMOD:NORM:TRAC:BIN?`

:MEASure:IMOD:USER:ATTenuation?

Parameters: <NRf> [<NRf> [, <NRf>]]]
<point no.> [<F1> [, <level>]]]

<point no.> is in the range 1–50.

Response: <NR2> (format dependent on command `:IMOD:DISP:LEV:ABS`)

Returned values: (dBc)

Description: Sets up to measure intermodulation attenuation with a numeric display. Performs the measurement for the specified point no., F1 and tone level. Returns the attenuation measurement at the specified point.

Example: `:MEAS:IMOD:USER:ATT 19?` `–32.34`

:MEASure:IMOD:USER:ATTenuation:FAIL?

Parameters: <NRf> [<NRf> [, <NRf>]]]
<point no.> [<F1> [, <level>]]]

<point no.> is in the range 1–50.

Response: <NR1>

Returned values: 0 | 1

Description: Sets up to measure intermodulation attenuation with a numeric display. Performs the measurement for the specified point no., F1 and tone level. Tests whether the attenuation measurement passes (0) or fails (1) when compared with the limit at the specified point.

Example: `:MEAS:IMOD:USER:ATT:FAIL 14?` `1`

:MEASure:IMOD:USER:FAIL?

Parameters: [<NRf> [, <NRf>]]]
[<F1> [, <level>]]]

Response: <NR1>

Returned values: 0 | to | 32767 – for bit significance see Table 4-4.

Description: Sets up to measure intermodulation attenuation with a numeric display. Performs the measurement for F1 and tone level. Returns the intermodulation status word. 0 signifies a pass, any other result signifies a failure: for example, 1024 denotes an input-level overload.

Example: `:MEAS:IMOD:USER:FAIL?` `512`

:MEASure:IMOD:USER:FONe?

Parameters: [<NRf> [, <NRf>]]]
[<F1> [, <level>]]]

Response: <NR2>

Returned values: (Hz)

Description: Sets up to measure intermodulation attenuation with a numeric display. Performs the measurement for F1 and tone level. Returns the actual measured frequency at F1.

Example: `:MEAS:IMOD:USER:FON?` `379993415`

:MEASure:IMOD:USER:FONe:TPOWer?

Parameters: [<NRf> [, <NRf>]]]
[<F1> [, <level>]]]

Response: <NR2>

Returned values: (dBm)

Description: Sets up to measure intermodulation attenuation with a numeric display. Performs the measurement for F1 and tone level. Returns the tone power at F1 during the intermodulation measurement.

Example: `:MEAS:IMOD:USER:FON:TPOW?` `−41.5`

:MEASure:IMOD:USER:TRACe:ASCii?

Parameters: <NRf> [<NRf> [, <NRf>]]]
<point no.> [<F1> [, <level>]]]

<point no.> is in the range 1–20.

Response: Array of 501 <NR2> comma-separated values (dBm).

Returned values: (dBc) (ASCII)

Description: Sets up to measure intermodulation attenuation with a numeric display. Performs the measurement for the specified point no., F1 and tone level. Returns the Spectrum at Offset trace data in ASCII format.

Example: `:MEAS:IMOD:USER:TRAC:ASC?`

:MEASure:IMOD:USER:TRACe:BINary?

Parameters: <NRf> [<NRf> [, <NRf>]]]
<point no.> [<F1> [, <level>]]]

<point no.> is in the range 1–20.

Response: <nnn-form> (in dBm) – see page 4-125.

Returned values: (mBc, equivalent to 0.01 dBc) 16-bit signed 2's-complement binary values.

Description: Sets up to measure intermodulation attenuation with a numeric display. Performs the measurement for the specified point no., F1 and tone level. Returns the Spectrum at Offset trace data in binary format.

Example:
```
:MEAS:IMOD:USER:TRAC:BIN?
```

:MEASure:SPECtrum:FAIL?

Parameters: None.

Response: <NR1>

Returned values: 0 | to | 32767 – for bit significance, see Table 4-4.

Description: Tests whether there was a known failure with the last spectrum MEASure. 0 signifies a pass, 1024 denotes input level overload.

Example:
```
:MEAS:SPEC:FAIL?
```

:MEASure:SPECtrum:FREQuency?

Parameters: [<NRf> [, <NRf> [, <NRf>]]]
[<frequency> [, <level> [,]]]

Response: <NR2>

Returned values: (Hz)

Description: Sets up to make a spectrum analysis with a numeric display. Performs the measurement for the specified frequency, signal level and span. Returns the frequency of the marker, after performing a peak search on the new data.

Examples:
```
:MEAS:SPEC:FREQ?
:MEAS:SPEC:FREQ? 150MHZ
:MEAS:SPEC:FREQ? 150E6,5DBM
:MEAS:SPEC:FREQ? 150E6,5DBM,10KHZ
```

:MEASure:SPECtrum:LEVel?

Parameters: [<NRf> [, <NRf> [, <NRf>]]]
[<frequency>[, <level> [,]]]

Response: <NR2>

Returned values: (dBm)

Description: Sets up to make a spectrum analysis with a numeric display. Performs the measurement for the specified frequency, signal level and span. Returns the signal level of the marker, after performing a peak search on the new data.

Examples:
```
:MEAS:SPEC:LEV?
:MEAS:SPEC:LEV? 300MHZ
```

:MEASure:SPECtrum:TRACe:ASCii?

Parameters: [<NRf> [, <NRf> [, <NRf>]]]
[<frequency> [, <level> [,]]]

Response: Array of 501* <NR2>, separated by commas.

Returned values: (dBc) (ASCII)

Description: Sets up to make a spectrum analysis with a numeric display. Performs the measurement for the specified frequency, signal level and span. Returns the entire trace.

Example:
```
:MEAS:SPEC:TRAC:ASC? 380MHZ,–10DBM,200KHZ
```

:MEASure:SPECtrum:TRACe:BINary?

Parameters: [<NRf> [, <NRf> [, <NRf>]]]
[<frequency> [, <level> [,]]]

Response: Array of 501* <bin>, MS byte first. See Table 4-7.

Returned values: (mBc, equivalent to 0.01 dBc) 16-bit signed 2’s-complement binary values.

Description: Sets up to make a spectrum analysis with a numeric display. Performs the measurement for the specified frequency, signal level and span. Returns the entire trace.

Example:
```
:MEAS:SPEC:TRAC:BIN? 380MHZ,–10DBM,200KHZ
```

POWer SUBSYSTEM

The POWer subsystem controls the configuration of the RF front-end hardware of the instrument.

:POWer
- **:ATTenuation?**
- **:INPut\?**
- **:OFFSet\?**
- **:OFFSet**
  - **:ATTenuation\?**
  - **:GAIN\?**
  - **:LOSS\?**
- **:PROTection**
  - **:RESet**
  - **:TRIPped?**
- **:REFerence\?**

:POWer:ATTenuation?

Parameters: None.

Response: <NR1>

Returned values: Attenuator setting in steps of 5 dB.

Description: Reads the current input attenuator setting.

Example: `:POW:ATT?`

:POWer:INPut

Parameters: <CPD>
Input selection.

Valid values: Inputs: HIGH | LOW | SENSitive | IF

*RST/startup default: HIGH

Description: Selects which of the two input sockets to use (high-power or low-power), and in the case of the low-power input, a choice of normal or low-power. This always leaves some attenuation in the path so as to ensure that the mixer is protected from overloads or maximum sensitivity, which gives better results with small input signals but leaves the mixer vulnerable to some overloads.

Example: `:POW:INP HIGH`

Selects high-power input.

:POWer:INPut?

Parameters: None.

Response: <CRD>

Returned values: HIGH | LOW | SENS | IF

Description: Reads the current input selection.

Example: `:POW:INP?` `HIGH`

:POWer:OFFSet

Parameters: <bool>

Valid values: 0 | 1

*RST/startup default: 0

Description: Sets level offsets on or off. 0 is OFF, 1 is ON.

Example: `:POW:OFFS`

:POWer:OFFSet?

Parameters: None.

Response: <bool>

Returned values: 0 | 1

Description: Tests whether the level offsets are on or off. 0 signifies OFF, 1 signifies ON.

Example: `:POW:OFFS?` `1`

:POWer:OFFSet:ATTenuation

Parameters: <NRf>
Input level offset.

Valid values: 0.0 to 65.0 (dB)

*RST/startup default: 0.00

Description: Sets input level offset due to external attenuation.

Example: `:POW:OFFS:ATT 30`

:POWer:OFFSet:ATTenuation?

Parameters: None.

Response: <NR2>

Returned values: Input level offset (dB).

Description: Returns the current setting for input level offset due to external attenuation.

Example: `:POW:OFFS:ATT?` `40`

:POWer:OFFSet:GAIN

Parameters: <NRf>
Input level offset.

Valid values: 0.0 to 65.0 (dB)

*RST/startup default: 0.00

Description: Sets input level offset due to external gain.

Example: `:POW:OFFS:GAIN 20`

:POWer:OFFSet:GAIN?

Parameters: None.

Response: <NR2>

Returned values: Input level offset (dB).

Description: Returns the current setting for input level offset due to external gain.

Example: `:POW:OFFS:GAIN?` `30`

:POWer:OFFSet:LOSS

Parameters: <NRf>
Input level offset.

Valid values: 0.0 to 65.0 (dB)

*RST/startup default: 0.00

Description: Sets input level offset due to external system losses.

Example: `:POW:OFFS:LOSS 30`

:POWer:OFFSet:LOSS?

Parameters: None.

Response: <NR2>

Returned values: Input level offset (dB).

Description: Returns the current setting for input level offset due to external system losses.

Example: `:POW:OFFS:LOSS?` `30`

:POWer:PROTection:RESet

Parameters: None.

Description: Attempts to reset the over-power protection circuit.

Example: `:POW:PROT:RES`

:POWer:PROTection:TRIPped?

Parameters: None.

Response: <bool>

Returned values: 0 | 1

Description: Returns '1' if the over-power protection has tripped, otherwise '0'.

Example: `:POW:PROT:TRIP?` `0`

:POWer:REFerence

Parameters: <NRf_os>
The nominal input level.

Valid values: Input level (dBm)

Description: Sets the nominal input level (which is used to determine the hardware settings) in logarithmic units (dBm). Note that power class and step level are **not** supported via GPIB.

Example: `:POW:REF 30.2dBm`

Sets input level to 30.2 dBm.

:POWer:REFerence?

Parameters: None.

Response: <NR2>

Returned values: Input level (dBm).

Description: Returns the current input reference level.

Example: `:POW:REF?` `30.2`

READ SUBSYSTEM

The READ subsystem has the following command format

```
:READ:<function>?<parameters>
```

The READ? query provides a method of performing a FETCh? operation on fresh data. Since the READ? query does not reconfigure the instrument, a common application is to use READ? in conjunction with a CONFigure command; when combined, they provide a MEASure? capability.

<function> defines the measurement operation to be used by READ? It is also used by the CONFigure, MEASure? and FETCH? subsystems.

<parameters> are optional parameters. If parameters are omitted, they are assumed to be those currently in use. Parameters may be defaulted from the right by omitting them, or anywhere by substituting the keyboard DEFault.

The READ? query is identical to performing the following commands:

```
:ABORt;
:INITiate:IMMediate
:FETch:<function>?;<parameters>;
```

:READ
- **:IMOD**
  - **:NORMal**
    - **:ATTenuation?**
    - **:ATTenuation**
      - **:FAIL?**
    - **:FAIL?**
    - **:FONe?**
    - **:FONe**
      - **:TPOWer?**
    - **FTWo?**
    - **:FTWo**
      - **:TPOWer?**
    - **:LIMit?**
    - **:TRACe**
      - **:ASCii?**
      - **:BINary?**
  - **:USER**
    - **:ATTenuation?**
    - **:ATTenuation**
      - **:FAIL?**
    - **:FAIL?**
    - **:FONe?**
    - **:FONe**
      - **:TPOWer?**
    - **:LIMit?**
    - **:TRACe**
      - **:ASCii?**
        - **:BINary?**

:READ
- **:SPECtrum**
  - **:FAIL?**
  - **:FREQ?**
  - **:LEVel?**
  - **:TRACe**
    - **:ASCii?**
    - **:BINary?**

:READ:IMOD:NORM:ATTenuation?

Parameters: <NRf>
<product no.>

<product no.> is in the range 1–60; see Table 4-3.

Response: <NR2> (format dependent on command `:IMOD:DISP:LEV:ABS`)

Returned values: (dBc)

Description: Measures intermodulation at the current settings with a numeric or spectrum display. Returns the attenuation measurement at the specified intermodulation product.

Example: `:READ:IMOD:NORM:ATT? 4` `–32.34`

:READ:IMOD:NORM:ATTenuation:FAIL?

Parameters: <NRf>
<product no.>

<product no.> is in the range 1–60; see Table 4-3.

Response: <NR1>

Returned values: 0 | 1

Description: Measures intermodulation at the current settings with a numeric or spectrum display. Tests whether the attenuation measurement passes (0) or fails (1) when compared with the limit at the specified intermodulation product.

Example: `:READ:IMOD:NORM:ATT:FAIL? 4` `1`

:READ:IMOD:NORMal:FAIL?

Parameters: None.

Response: <NR1>

Returned values: 0 | to | 32767 – for bit significance see Table 4-4.

Description: Measures intermodulation at the current settings with a numeric or spectrum display. Returns the intermodulation status word. 0 signifies a pass, any other result signifies a failure: for example, 1024 denotes an input-level overload.

Example: `:READ:IMOD:NORM:FAIL?` `0`

:READ:IMOD:NORMal:FONe?

Parameters: None.

Response: <NR2>

Returned values: (Hz)

Description: Measures intermodulation at the current settings with a numeric or spectrum display. Returns the actual measured frequency at F1.

Example: `:READ:IMOD:NORM:FON?` `379993415`

:READ:IMOD:NORMal:FONe:TPOWer?

Parameters: None.

Response: <NR2>

Returned values: (dBm)

Description: Measures intermodulation at the current settings with a numeric or spectrum display. Returns the tone power at F1 during the intermodulation measurement.

Example: `:READ:IMOD:NORM:FON:TPOW?` `–41.5`

:READ:IMOD:NORMal:FTWo?

Parameters: None.

Response: <NR2>

Returned values: (Hz)

Description: Measures intermodulation at the current settings with a numeric or spectrum display. Returns the actual measured frequency at F2.

Example: `:READ:IMOD:NORM:FTW?` `389313543`

:READ:IMOD:NORMal:FTWo:TPOWer?

Parameters: None.

Response: <NR2>

Returned values: (dBm)

Description: Measures intermodulation at the current settings with a numeric or spectrum display. Returns the tone power at F2 during the intermodulation measurement.

Example: `:READ:IMOD:NORM:FTW:TPOW?` `–43.5`

:READ:IMOD:NORM:TRACe:ASCii?

Parameters: <NRf>
<product no.>

<product no.> is in the range 1–60; see Table 4-3.

Response: Array of 501 <NR2> comma-separated values (dBm).

Returned values: (dBc) (ASCII)

Description: Measures intermodulation at the current settings with a numeric or spectrum display. Returns the Spectrum at Offset trace data for the specified product no. in ASCII format.

Example: `:READ:IMOD:NORM:TRAC:ASC?`

:READ:IMOD:NORM:TRACe:BINary?

Parameters: <NRf>
<product no.>

Response: <nnn-form> (in dBm) – see page 4-125.

Returned values: (mBc, equivalent to 0.01 dBc) 16-bit signed 2's-complement binary values.

Description: Measures intermodulation at the current settings with a numeric or spectrum display. Returns the Spectrum at Offset trace data for the specifed product no. in binary format.

Example: `:READ:IMOD:NORM:TRAC:BIN?`

:READ:IMOD:USER:ATTenuation?

Parameters: <NRf>
<point no.>

<point no.> is in the range 1–50.

Response: <NR2> (format dependent on command `:IMOD:DISP:LEV:ABS`)

Returned values: (dBc)

Description: Measures intermodulation at the current settings with a numeric or spectrum display. Returns the attenuation measurement at the specified point.

Example: `:READ:IMOD:USER:ATT 19?` `–32.34`

:READ:IMOD:USER:ATTenuation:FAIL?

Parameters: <NRf>
<point no.>

<point no.> is in the range 1–50.

Response: <NR1>

Returned values: 0 | 1

Description: Measures intermodulation at the current settings with a numeric or spectrum display. Tests whether the attenuation measurement passes (0) or fails (1) when compared with the limit at the specified point.

Example: `:READ:IMOD:USER:ATT:FAIL 14?` `1`

:READ:IMOD:USER:FAIL?

Parameters: None.

Response: <NR1>

Returned values: 0 | to | 32767 – for bit significance see Table 4-4.

Description: Measures intermodulation at the current settings with a numeric or spectrum display. Returns the intermodulation status word. 0 signifies a pass, any other result signifies a failure: for example, 1024 denotes an input-level overload.

Example: `:READ:IMOD:USER:FAIL?` `512`

:READ:IMOD:USER:FONe?

Parameters: None.

Response: <NR2>

Returned values: (Hz)

Description: Measures intermodulation at the current settings with a numeric or spectrum display. Returns the actual measured frequency at F1.

Example: `:READ:IMOD:USER:FON?` `379993415`

:READ:IMOD:USER:FONe:TPOWer?

Parameters: None.

Response: <NR2>

Returned values: (dBm)

Description: Measures intermodulation at the current settings with a numeric or spectrum display. Returns the tone power at F1 during the intermodulation measurement.

Example: `:READ:IMOD:USER:FON:TPOW?` `–41.5`

:READ:IMOD:USER:TRACe:ASCii?

Parameters: <NRf>
<point no.>

<point no.> is in the range 1–50.

Response: Array of 501 <NR2> comma-separated values (dBm).

Returned values: (dBc) (ASCII)

Description: Measures intermodulation at the current settings with a numeric or spectrum display. Returns the Spectrum at Offset trace data at the specified point no. in ASCII format.

Example: `:READ:IMOD:USER:TRAC:ASC?`

:READ:IMOD:USER:TRACe:BINary?

Parameters: <NRf>
<point no.>

<point no.> is in the range 1–50.

Response: <nnn-form> (in dBm) – see page 4-125.

Returned values: (mBc, equivalent to 0.01 dBc) 16-bit signed 2’s-complement binary values.

Description: Measures intermodulation at the current settings with a numeric or spectrum display. Returns the Spectrum at Offset trace data at the specified point no. in binary format.

Example: `:READ:IMOD:USER:TRAC:BIN?`

:READ:SPECtrum:FAIL?

Parameters: None.

Response: <NR1>

Returned values: 0 to | 32767 – for bit significance see Table 4-4.

Description: Tests whether was a known failure with the last spectrum READ. 0 signifies a pass, 1024 denotes input level overload.

Example: `:READ:SPEC:FAIL?` `0`

:READ:SPECtrum:FREQuency?

Parameters: None.

Response: <NR2>

Returned values: (Hz)

Description: Returns the frequency of the marker, after performing a peak search on the new data.

Example: `:READ:SPEC:FREQ?` `378546342`

:READ:SPECtrum:LEVel?

Parameters: None.

Response: <NR2>

Returned values: (dBm)

Description: Returns the signal level at the marker, after performing a peak search on the new data.

Example: `:READ:SPEC:LEV?` `–27.45`

:READ:SPECtrum:TRACe:ASCii?

Parameters: None.

Response: Array of 501*<NR1>, separated by commas.

Returned values: (dBc) (ASCII)

Description: Measures intermodulation at the current settings with a spectrum display, and returns the entire trace.

Example: `:READ:SPEC:TRAC:ASC?`

:READ:SPECtrum:TRACe:BINary?

Parameters: None.

Response: Array of 501*<bin>, MS byte first. See Table 4-7.

Returned values: (mBc, equivalent to 0.01 dBc) 16-bit signed 2's-complement binary values.

Description: Measures intermodulation at the current settings with a spectrum display, and returns the entire trace.

Example: `:READ:SPEC:TRAC:BIN?`

SPECtrum SUBSYSTEM

The SPECtrum subsystem provides a suite of commands which become enabled when the Spectrum Analyzer mode of operation is chosen.

:SPECtrum
- **:AVERage\?**
- **:DISPlay**
  - **:TOP\?**
  - **:VRESolution\?**
- **:MARKer**
  - **:TOFReq**
  - **:TOPK**
- **:NBANdwidth\?**
- **:WINDow\?**

:SPECtrum:AVERage

Parameters: <NRf>

Valid values: 1 – 200

*RST/startup default: 10

Description: Sets the number of traces to be averaged.

Example: `:SPEC:AVER 200`

:SPECtrum:AVERage?

Parameters: None.

Response: <NR1>

Returned value: 1 – 200. 1 = averaging OFF.

Description: Returns the number of traces to be averaged (if averaging is enabled).

Example: `:SPEC:AVER?` `10`

:SPECtrum:DISPlay:TOP

Parameters: <NRf_os>

Valid values: <noise floor> to <maximum input> (dBm)

*RST/startup default: 10.00

Description: Sets the displayed top-of-screen level of the spectrum analyzer display. Does not alter the settings of the hardware determined from the <input level> (:POW:REF). Used in conjunction with <vertical resolution> (:SPEC:DISP:VRES), allows expansion of part of the measurement range.

Example: `:SPEC:DISP:TOP 23`

Sets top-of-screen level to 23 dBm.

:SPECtrum:DISPlay:TOP?

Parameters: None.

Response: <NR2>

Returned values: <noise floor> to <maximum input>

Description: Reads top-of-screen level.

Example: `:SPEC:DISP:TOP?`

:SPECtrum:DISPlay:VRESolution

Parameters: <NRf_os>

Valid values: 0.01 to 20 (dB/div)

*RST/startup default: 10

Description: Sets the vertical resolution of the spectrum analyzer's display. Does not affect hardware settings.

Example: `:SPEC:DISP:VRES 0.1`

Sets vertical resolution to 0.1 dB/div.

:SPECtrum:DISPlay:VRESolution?

Parameters: None.

Response: <NR2>

Returned values: 0.01 to 20 (dB/div)

Description: Returns the spectrum analyzer's vertical resolution.

Example: `:SPEC:DISP:VRES?` `0.1`

:SPECtrum:MARKer:TOFReq

Parameters: <NRf_fs>

Valid values: Center frequency ±½ x <current span>

Description: Moves the marker to the frequency specified (in preparation for reading the level at the marker). If the frequency is outside the current span it is set to the edge of the current span.

Example: `:SPEC:MARK:TOFR 387.4795MHz`

:SPECtrum:MARKer:TOPK

Parameters: None.

Description: Moves the marker to the peak of the current trace, (in preparation for reading the level and/or frequency at the marker).

Example: `:SPEC:MARK:TOPK`

:SPECtrum:NBANdwidth

Parameters: <NRf_fs>

Valid values: Absolute bandwidth (Hz)

*RST/startup default: 440.00

Description: Sets the noise bandwidth of the Gaussian filter as an absolute frequency (Blackman-Harris is fixed).

Example: `:SPEC:NBAN 50`

Sets Gaussian window bandwidth to 50 Hz.

:SPECtrum:NBANdwidth?

Parameters: None.

Response: <NR2> (Hz)

Returned values: Noise bandwidth.

Description: Returns the current value of the filter bandwidth.

Example: `:SPEC:NBAN?` `50`

:SPECtrum:WINDow

Parameters: <CPD>

Valid values: BHARris | GAUSsian | AUTO-gaussian

*RST/startup default: BHARris

Description: Sets the windowing function used in spectrum analysis mode to Blackman-Harris or Gaussian.
AUTO indicates Gaussian with bandwidth at 1% of span.

Example: `:SPEC:WIND BHAR`

:SPECtrum:WINDow?

Parameters: None.

Response: <CRD>

Returned values: BHAR | GAUS | AUTO

Description: Reads window type.

Example: `:SPEC:WIND?` `BHAR`

STATus SUBSYSTEM

:STATus
- **:CALibration**
  - **:CONDition?**
  - **:ENABle\?**
  - **:EVENt?**
- **:FREQuency**
  - **:CONDition?**
  - **:ENABle\?**
  - **:EVENt?**
- **:OPERation**
  - **:CONDition?**
  - **:ENABle\?**
  - **:EVENt?**
- **:POWer**
  - **:CONDition?**
  - **:ENABle\?**
  - **:EVENt?**
- **:QUEStionable**
  - **:CONDition?**
  - **:ENABle\?**
  - **:EVENt?**

:STATus:CALibration:CONDition?

Parameters: None.

Response: <NR1>
Calibration status register contents.

Returned values: 0 = Calibration successful.
1 = Calibration failed – calibration signal not found.

Description: Reads the contents of the calibration status register.

Example:
```
:STAT:CAL:COND?                                    0
```

:STATus:CALibration:ENABle

Parameters: <NRf>
Mask

Valid values: 0 = Disable calibration failed enable bit.
1 = Enable calibration failed enable bit.

Description: Sets the enable mask which allows true conditions in the calibration status event register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit makes a transition to true, a positive transition will occur in the associated summary bit.

Example:
```
:STAT:CAL:ENAB 1
```

:STATus:CALibration:ENABle?

Parameters: [<NRf>]
[Mask]

Response: <NR1>
Mask

Returned values: Enable mask setting

Description: Reads the enable mask for the calibration status register.

Example:
```
:STAT:CAL:ENAB?
```

:STATus:CALibration:EVENt?

Parameters: None.

Response: <NR1>
Event register contents.

Returned values: 0 = Calibration successful.
1 = Calibration failed – calibration signal not found.

Description: Reads the contents of the event register associated with the calibration status register.

Example: `:STAT:CAL:EVEN?`

Determine what caused the event.

:STATus:FREQuency:CONDition?

Parameters: None.

Response: <NR1>
Frequency status register contents.

Returned values: 0 = Calibration successful. Otherwise integer value, for decode see Table 4-1.

Description: Reads the contents of the frequency status register.

Example response: `:STAT:FREQ:COND?`

`320 (External Standard Failure + External Standard Low)`

:STATus:FREQuency:ENABle

Parameters: <NRf>
Mask

Valid values: For integer value decode see Table 4-1.

Description: Sets the enable mask which allows true conditions in the frequency status event register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit makes a transition to true, a positive transition will occur in the associated summary bit.

Example: `:STAT:FREQ:ENAB`

:STATus:FREQuency:ENABle?

Parameters: [<NRf>]
[Mask]

Response: <NR1>
Mask

Returned values: Enable mask setting

Description: Reads the enable mask for the frequency status register.

Example: `:STAT:FREQ:ENAB?`

:STATus:FREQuency:EVENt?

Parameters: None.

Response: <NR1>
Event register contents.

Returned values: 0 = Calibration successful. Otherwise integer value, for decode see Table 4-1.

Description: Reads the contents of the event register associated with the frequency status register.

Example: `:STAT:FREQ:EVEN?`

Determine what caused the event.

:STATus:OPERation:CONDition?

Parameters: None.

Response: <NR1>
Operation status register contents.

Returned values: 0 = Calibration successful. Otherwise integer value, for decode see Table 4-1.

Description: Reads the contents of the operation status register.

Example:
```
:STAT:OPER:COND?
```

:STATus:OPERation:ENABle

Parameters: <NRf>
Mask

Valid values: For integer value decode see Table 4-1.

Description: Sets the enable mask which allows true conditions in the operation status event register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit makes a transition to true, a positive transition will occur in the associated summary bit.

Example:
```
:STAT:OPER:ENAB 32
```
Program the status register with the mask value 32.

:STATus:OPERation:ENABle?

Parameters: [<NRf>]
[Mask]

Response: <NR1>
Mask

Returned values: Enable mask setting

Description: Reads the enable mask for the operation status register.

Example:
```
:STAT:OPER:ENAB?
```

:STATus:OPERation:EVENt?

Parameters: None.

Response: <NR1>
Event register contents.

Returned values: 0 = Calibration successful. Otherwise integer value, for decode see Table 4-1.

Description: Reads the contents of the event register associated with the operation status register.

Example: `:STAT:OPER?`

Determine what caused the event.

:STATus:POWer:CONDition?

Parameters: None.

Response: <NR1>
Questionable status register contents.

Returned values: 0 = Calibration successful. Otherwise integer value, for decode see Table 4-1.

Description: Reads the contents of the Power Status Register.

Example: `:STAT:POW:COND?`

:STATus:POWer:ENABle

Parameters: <NRf>
Mask

Valid values: For integer value decode see Table 4-1.

Description: Sets the enable mask which allows true conditions in the power status event register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit makes a transition to true, a positive transition will occur in the associated summary bit.

Example:
```
:STAT:POW:ENAB
```

:STATus:POWer:ENABle?

Parameters: [<NRf>]
[Mask]

Response: <NR1>
Mask

Returned values: Enable mask setting

Description: Reads the enable mask for the power status register.

Example:
```
:STAT:POW:ENAB?
```

:STATus:POWer:EVENt?

Parameters: None.

Response: <NR1>
Event register contents.

Returned values: 0 = Calibration successful. Otherwise integer value, for decode see Table 4-1.

Description: Reads the contents of the event register associated with the power status register.

Example:
```
:STAT:POW:EVEN?
```
Determine what caused the event.

:STATus:QUEStionable:CONDition?

Parameters: None.

Response: <NR1>
Questionable status register contents.

Returned values: 0 = Calibration successful. Otherwise integer value, for decode see Table 4-1.

Description: Reads the contents of the questionable status register.

Example: `:STAT:QUES:CON?`

:STATus:QUEStionable:ENABle

Parameters: <NRf>
Mask

Valid values: For integer value decode see Table 4-1.

Description: Sets the enable mask which allows true conditions in the questionable status event register to be reported in the summary bit. If a bit is 1 in the enable register and its associated event bit makes a transition to true, a positive transition will occur in the associated summary bit.

Example: `:STAT:QUES:ENAB 8`

Program the status register with the mask value 8.

:STATus:QUEStionable:ENABle?

Parameters: [<NRf>]
[Mask]

Response: <NR1>
Mask

Returned values: Enable mask setting

Description: Reads the enable mask for the questionable status register.

Example: `:STAT:QUES:ENAB?`

:STATus:QUEStionable:EVENt?

Parameters: None.

Response: <NR1>
Event register contents.

Returned values: 0 = Calibration successful. Otherwise integer value, for decode see Table 4-1.

Description: Reads the contents of the event register associated with the questionable status register.

Example: `:STAT:QUES:EVEN?`

Determine what caused the event.

SYSTem SUBSYSTEM

:SYSTem
- **:DATE\?**
- **:ERRor?**
- **:HOURs\?**
- **:PRESet**
- **:SETTing**
  - **:ERASe**
  - **:RECall**
  - **:SAVE\?**
- **:TIME\?**
- **:TOTal?**
- **:UCAResponse**
  - **[:STATe]\?**

:SYSTem:DATE

Parameters: <NRf>, <NRf>, <NRf>
<year>, <month>, <day>

Valid values: Year: integer.
Month: integer. Valid values are 1 to 12. Values outside range are rejected and an error generated.
Day: integer. Valid values are 1 to 31. Values outside range are rejected and an error generated.

Description: Sets the date of the real-time clock. The year must be entered in full.

Example: `:SYST:DATE 2000,8,20`

Sets the date to 20th August 2000.

:SYSTem:DATE?

Parameters: None.

Response: <NR1>, <NR1>, <NR1>
<year>, <month>, <day>

Returned values: Year: integer.
Month: integer. Values are in the range 1 to 12.
Day: integer. Values are in the range 1 to 31.

Description: Reads the date of the real-time clock.

Example: `:SYST:DATE?` `2000 4 21`

:SYSTem:ERRor?

Parameters: None.

Response: <NR1>,<string response data>
Error number, error message string.

Returned values: Error number: integer.
Error message string: string. Variable length string.

Description: Reads the SCPI 1990.0 error number and error message from the head of the error queue.

Example: `:SYST:ERR?` `-112,'Program mnemonic too long'`

:ERRor?

Synonym for :SYST:ERR?

Parameters: None.

Response: <NR1>,<string response data>
Error number, error message string.

Returned values: Error number: integer.
Error message string: string. Variable length string.

Description: Reads the SCPI 1990.0 error number and error message from the head of the error queue.

Example: `:ERR?` `-112,'Program mnemonic too long'`

:SYSTem:HOURs

Parameters: None.

Description: Resets the elapsed-time counter to zero.

Example: `:SYST:HOUR`

:SYSTem:HOURs?

Parameters: None.

Response: <NR2>

Returned values: Operating (power-on) time (hrs).

Description: Returns the operating time elapsed since the counter was last reset. The time is incremented every 15 minutes (0.25 hrs).

Example: `:SYST:HOUR?` `152.25`

:SYSTem:PRESet

Synonym for *RST

Parameters: None.

Description: Places the instrument in its default state. This preset state is optimized for manual operation. This configuration is given in Chapter 3 (see 'Default settings').

See also *RST in common commands.

Example: `:SYST:PRES`

Presets the instrument.

:SYSTem:SETTing:ERASe

Parameters: <NR1>
<stor_no>

Valid values: 1 to 20

Description: Erases the instrument settings in the selected store.

Example: `:SYST:SETT:ERAS 12`

:SYSTem:SETTing:RECall

Parameters: <NR1>
<stor_no>

Valid values: 1 to 20

Description: Recalls the current settings of the instrument in the selected store.

Example: `:SYST:SETT:REC 4`

:SYSTem:SETTing:SAVE

Parameters: <NRf>, <NRf>
<stor_no>, <name>

Valid values: Store number: 1 to 20; name: up to 20 characters, or none

Description: Saves the current settings of the instrument to the selected store, and names the store with the character string entered.

Example: `:SYST:SETT:SAVE 4,CURRENT`

:SYSTem:SETTing:SAVE?

Parameters: <NR1>
<store_no>

Response: <string>

Returned values: Store name.

Description: Returns the name of the current store.

Example: `:SYST:SETT:SAVE?` `CURRENT`

:SYSTem:TIME

Parameters: <NRf>, <NRf>, <NRf>
<hours>, <minutes>, <seconds>

Valid values: Hours: integer. Valid values are 0 to 23. Values outside range are rejected and an error generated.
Minutes: integer. Valid values are 0 to 59. Values outside range are rejected and an error generated.
Seconds: integer. Valid values are 0 to 59. Values outside range are rejected and an error generated.

Description: Sets the time of the real-time clock. The time is in 24-hour format.

Example: `:SYST:TIME 14,30,0`

Sets the time to 2:30 pm.

:SYSTem:TIME?

Parameters: None.

Response: <NR1>, <NR1>, <NR1>
<hours>, <minutes>, <seconds>

Returned values: Hours: integer. Values are in the range 0 to 23.
Minutes: integer. Values are in the range 0 to 59.
Seconds: integer. Values are in the range 0 to 59.

Description: Reads the time of the real-time clock.

Example: `:SYST:TIME?` `14 30 00`

:SYSTem:TOTal?

Parameters: None.

Response: <NR2>

Returned values: Total operating (power-on) time (hrs).

Description: Returns the total operating time elapsed since the instrument was new. This counter is never reset. The time is incremented every 15 minutes (0.25 hrs).

Example: `:SYST:TOT?` `1192.75`

:SYSTem:UCAResponse[:STATe]

Parameters: <bool>

Valid values: 0 | 1 | OFF | ON

Description: Sets the user calibration auto-response state. 0 is DISABLED, 1 is ENABLED.

Example: `:SYST:UCAR 1`

:SYSTem:UCAResponse[STATe]?

Parameters: None.

Response: <bool>

Returned values: 0 | 1

Description: Reads the current user calibration auto-response state. 0 is DISABLED, 1 is ENABLED.

Example: `:SYST:UCAR?` 1

Remote operation tables

GPIB abbreviations and codes

Abbreviations and codes used in this chapter are summarized in this table.

Table 4-2 GPIB abbreviations and codes

Abbreviation	Full	Standard format
CPD	character program data – a mnemonic used as a command parameter: for example, <burst-type>	[<string>|<string>|...]
CRD	character response data – as CPD but returned from the instrument.	<string>
dBc	Decibel with respect to carrier (Average Tx Power)	
dBm	Decibel with respect to 1 mW reference	
fls	[<frequency(Hz)>[,<level(dB)>[,<span(Hz)>]]]	<NRf>[,<NRf>[,<NRf>]]
flb	[<frequency(Hz)>[,<level(dB)>[,<burst-type>]]]	<NRf>[,<NRf>[,<CPD>]]
h,m	<hour(24)>,<minute>	<NR1>,<NR1>
hh-mm	time: for example, '14–35'	<string>
NRf/_fs/_os	decimal integer or floating point, no suffix/with freq multiplier suffix/with optional suffix	<NR1>|<NR2>/[<units_string>]
NR1	decimal integer	<NR1>
NR2/_os	decimal floating point, no units suffix/with optional units suffix	<NR2>/[units_string>]
y,m,d	<year>,<month>,<day>	<NR1>,<NR1>,<NR1>
yyyy-mm-dd	ISO format date string: for example, '2000-12-16'	<string>

Table 4-3 <product no.> definitions

Intermodulation product	Order	<product no.>	Intermodulation product	Order	<product no.>
F1 + 2F2	3rd	1	6F2– F1	7th (cont.)	31
2F1 + F2		2	**5F2– 2F1**		**32**
F1 – 2F2		3	**4F2– 3F1**		**33**
2F1 – F2		**4**	3F2– 4F1		34
2F2 – F1		**5**	2F2– 5F1		35
F2 – 2F1		6	F2– 6F1		36
F1 + 4F2	5th	7	F1 + 8F2	9th	37
2F1 + 3F2		8	2F1 + 7F2		38
3F1 + 2F2		9	3F1 + 6F2		39
4F1 + F2		10	4F1 + 5F2		40
F1 – 4F2		11	5F1 + 4F2		41
2F1 – 3F2		12	6F1 + 3F2		42
3F1 – 2F2		**13**	7F1 + 2F2		43
4F1 – F2		14	8F1 + F2		44
4F2 – F1		15	F1 – 8F2		45
3F2 – 2F1		**16**	2F1 – 7F2		46
2F2 – 3F1		17	3F1 – 6F2		47
F2 – 4F1	7th	18	4F1 – 5F2		48
F1 + 6F2		19	**5F1 – 4F2**		**49**
2F1 + 5F2		20	**6F1 – 3F2**		**50**
3F1 + 4F2		21	**7F1 – 2F2**		**51**
4F1 + 3F2		22	8F1 – F2		52
5F1 + 2F2		23	8F2 – F1		53
6F1 + F2		24	**7F2 – 2F1**		**54**
F1 – 6F2		25	**6F2 – 3F1**		**55**
2F1 – 5F2		26	**5F2 – 4F1**		**56**
3F1 – 4F2		27	4F2 – 5F1		57
4F1 – 3F2		**28**	3F2 – 6F1		58
5F1 – 2F2		**29**	2F2 – 7F1		59
6F1 – F2		30	F2 – 8F1		60

Note: products in bold type are used as default on power-up.

FAIL? command return bits

The return bits resulting from the FAIL? command query for the FETCh, MEASure and READ subsystems are shown in Table 4-4.

Table 4-4 FAIL? command return bits

Return bit		Command	
Bit	**dec**	**F/M/R:INORM :FAIL?**	**F/M/R:IUSER :FAIL?**
15	32768	0	0
14	16384		
13	8192		
12	4096		
11	2048		
10	1024	Input overload	Input overload
9	512	Data not valid	Data not valid
8	256		
7	128		
6	64		
5	32		
4	16	9^{th} order	
3	8	7^{th} order	
2	4	5^{th} order	
1	2	3^{rd} order	
0	1	Failed	Failed

Return bit value 0 = limits passed.
For failures the integer sum is returned.

Intermodulation order coding bits

The code is used to determine which intermodulation order(s) are displayed in the table and measured.

Table 4-5 Intermodulation order coding

Code	3rd order	5th order	7th order	9th order
0	–	–	–	–
1	√	–	–	–
2	–	√	–	–
3	√	√	–	–
4	–	–	√	–
5	√	–	√	–
6	–	√	√	–
7	√	√	√	–
8	–	–	–	√
9	√	–	–	√
10	–	√	–	√
11	√	√	–	√
12	–	–	√	√
13	√	–	√	√
14	–	√	√	√
15	√	√	√	√

Note: When the code is set to 0, the instrument measures F1 and F2 tone power in Normal mode, and F1 tone power in User mode.

Common commands

Common commands taken from the IEEE 488.2 standard are described in Table 4-6.

Table 4-6 Common commands

Command	Description	Parameter	Comments
*CLS	Clear status		no query
*ESE	Event status enable	0–255	
*ESR?	Standard event status query	0–255	query only
*IDN?	Identification query	<string>	query only
*OPC	Operation complete		
*OPT?	Option identification query		query only
*RST	Reset		no query
*SRE	Service request enable	0–255	
*STB?	Status byte query		query only
*TST?	Self test query		query only
*WAI	Wait to continue		no query

Table 4-7 BINary graphical output command

FETC/READ/MEAS	Returned data	at points	start from	Units	Binary header
:SPEC:TRAC:BIN?	501 Y-values	x-pixel	left	0.01 dBm	#3501

nnn_bin and nnn_bin8

FETC/READ/MEAS:XXX:TRAC:BIN? returns nnn_bin or nnn_bin8.

Format of nnn_bin and nnn_bin8 is a ‘Definite Length Arbitrary Block Response’ to IEEE 488.2 para 8.7.9. #xyyybbbbbb.....bbb

where:

- # is format identifier character ‘#’
- x is <nonzero digit> ASCII digit character ‘1’ to ‘9’, the number of ‘yyy’ digits
- yyy is a number formed from ASCII digits ‘0’ to ‘9’ representing the number of bytes of data, excluding the ‘#xyyy’ header and any ‘Response Message Terminator’
- bbb.. are data bytes

With nnn_bin8, each data item is 8-bit data, represented as one byte (values are 0 to 4). So for 255_bin8, there are 255 bytes of data following the header ‘#3255’.

With nnn_bin, each data item is 16-bit data, represented as two bytes, MS byte first. So for 512_bin, there are 1024 bytes of data following the header ‘#41024’.

Chapter 5
BRIEF TECHNICAL DESCRIPTION

Introduction

The 2309 is a FFT spectrum analyzer which covers the frequency range 100 MHz to 2.4 GHz. A block diagram for the instrument is shown in Fig. 5-1.

Signal path

The instrument has both low-power (0.5 W) and high-power (40 W) inputs. The high-power input can accept 50 W on a 50% duty cycle. This input also has a temperature sensor. The input circuits perform RF level control and feed to a mixer for down-conversion to an intermediate frequency (IF) of 10.71 MHz. The IF level control stages feed via an A-D converter to the digital signal processor (DSP).

Display

This is a 6.5 inch VGA TFT active matrix color LCD. An output for an external color monitor is provided from the MONITOR connector.

Control

The 2309 is a menu-driven instrument. Main menus are displayed by the use of hard keys, and parameters are changed by means of soft keys whose functions change as the menus change. Internal control of the instrument is achieved by a microprocessor which receives data from the various controls and sends instructions via an internal data bus to the signal processing circuits.

The instrument can also be controlled by the built-in General Purpose Interface Bus (GPIB). The interface enables the instrument to be used both as a manually-operated, bench-mounted instrument and as part of a fully-automated test system.

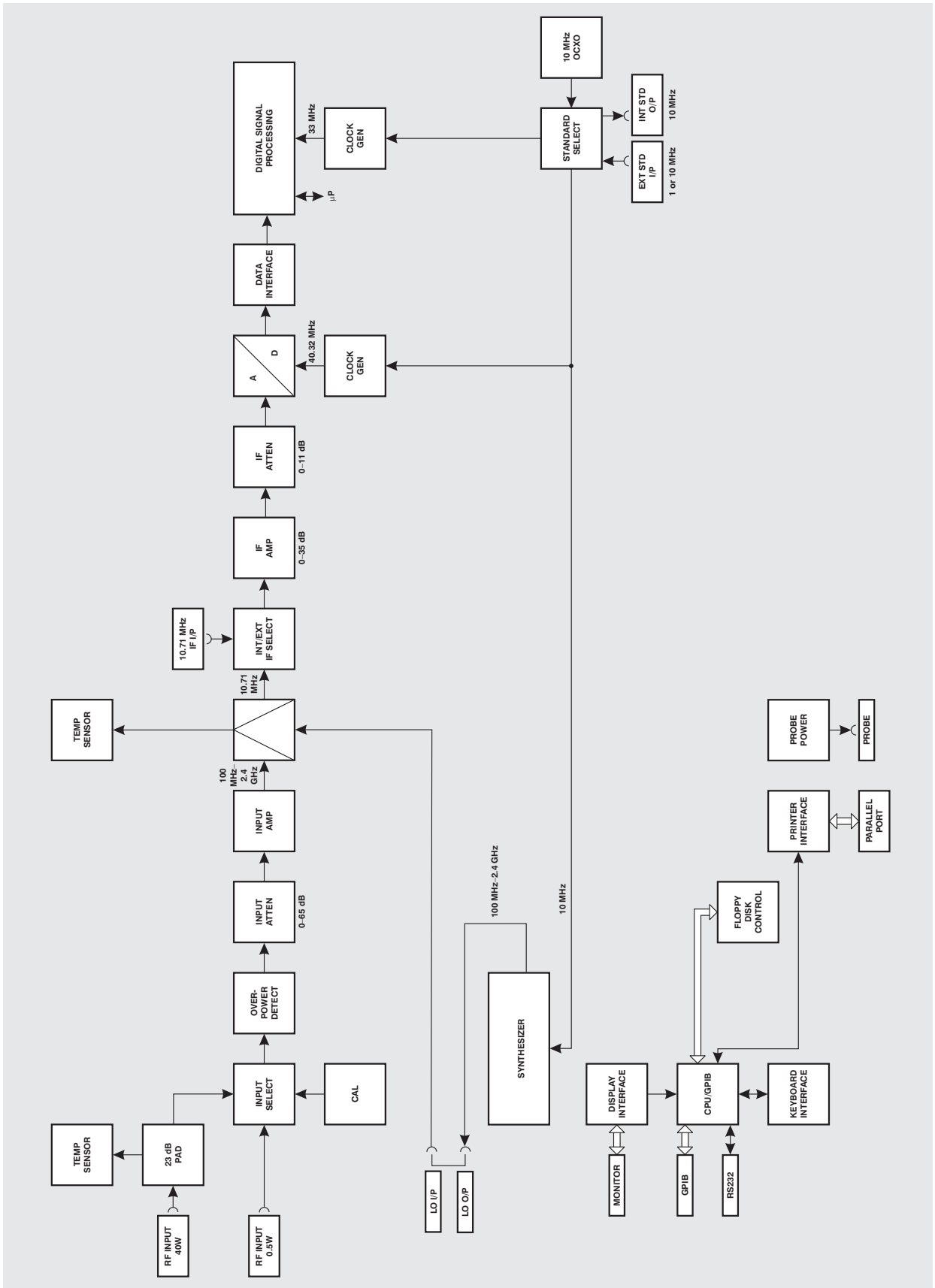


Fig. 5-1 Block schematic diagram

Chapter 6
ACCEPTANCE TESTING

The following procedure is intended as a quick and convenient method for checking the basic functionality of a new instrument. For a full test of instrument performance against the published specification, refer to the 2309/2310 Maintenance Manual, part no. 46882-337.

Equipment required

Description	Minimum specification
Signal generator	Any one of the IFR 2.4 GHz signal generators: 2025, 2031, 2032, 2041, 2042, 2051(T) or 2052(T)

Initialization self-test

Press the supply switch to power up the 2309. The display will go through a start-up sequence as follows:

The screen displays the following (tests 1 to 15 complete very quickly):

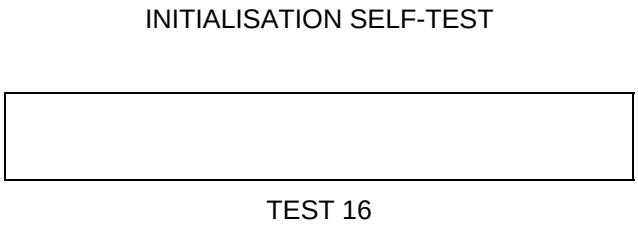


Fig. 6-1 Example of self-test in progress

After the final test, TEST 31, the screen blanks for approximately four seconds, after which the title screen appears. This remains for approximately 20 seconds while the instrument initializes, after which the application screen appears.

The bar display indicates the progress through the initialization self-test; successful completion of the test gives confidence that the following CPU board peripherals are functioning:

- CPU system registers
- Xilinx FPGA boot-up
- Video BIOS
- GPIB controller communication
- Parallel port communication
- Floppy disk controller
- Real time clock
- All serial ports
- DRAM (SIMM)
- NOVRAM
- EEPROM
- FLASH (SIMM)

Front panel tests

This procedure checks that all front panel keys, the rotary control and LEDs are functioning.

(1) On the 2309 select:

[UTIL]
[⇩]
[Front Panel Tests]
[Keyboard/Knob Test]

The screen displays a diagram of the front panel. Systematically depress each of the front panel keys in turn ensuring that a dot appears in the corresponding box on the display. Rotate the rotary control clockwise through one revolution and check for a count of between 60 and 70.

Press 0 four times to exit.

(2) On the 2309 select:

[L.E.D. Test]
[Toggle L.E.D.s] Press this key twice to ensure correct LED operation.
[Return]
[Return]

User self-calibration routine

This routine is run on an occasional basis to correct for changes in operating temperature and environmental conditions. As it exercises most parts of the instrument, namely the internal power reference, input attenuator, input mixer, IF strip and measurement circuits, successful completion will give a high degree of confidence that the instrument meets its specified RF performance. The adjustments performed are as follows:

- Digital IF resonator alignment
- Input attenuator
- IF amplifiers
- Digital IF gain
- IF flatness

Whilst calibration is in progress the screen shown in Fig. 6-2 is displayed. On completion, check that no error messages appear.

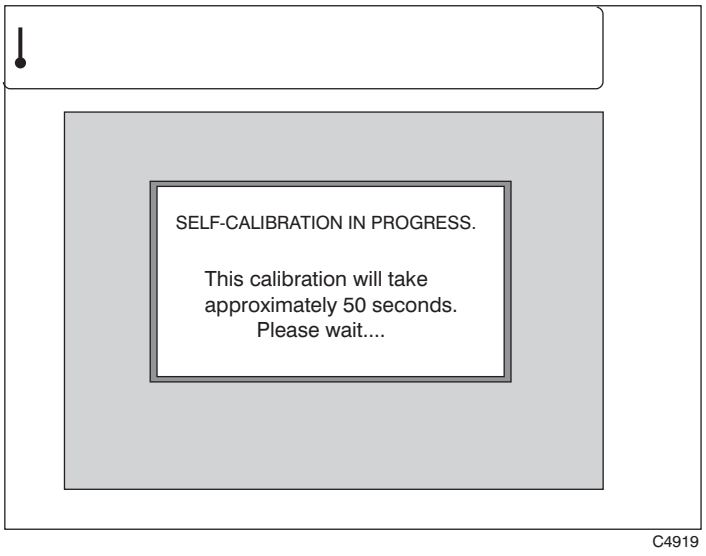


Fig. 6-2 Self-calibration screen

RF input acceptance tests

These tests ensure that an external signal applied to either RF input socket is selected and measured correctly.

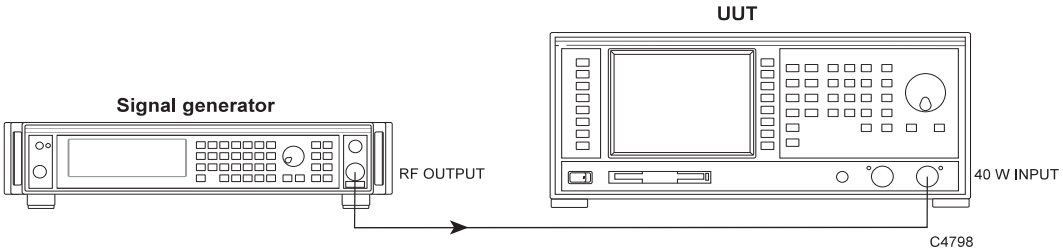


Fig. 6-3 RF input test set-up

(1) Connect the test equipment as shown in Fig. 6-3.

(2) On the 2309 select:

[UTIL] *[Power-On Settings] [Instrument PRESET]*	
[SPECTRUM]	
[FREQ]	2 GHz
[Frequency Span]	10 kHz

(3) Set the signal generator to RF level 0 dBm and carrier frequency 2 GHz.

(4) On the 2309 select:

[MARKERS]
[Markers ON]
[SINGLE]
[Marker → Peak]

(5) Read the Mkr. 1 frequency and level at the bottom of the display. Check that the frequency is nominally 2 GHz and the level is 0 dBm ± 2 dB.

(6) Connect the signal generator to the 0.5 W input of the 2309.

(7) On the 2309 select:

[LEVEL]	
[Low Power Input]	
[Input Level]	0 dBm
[SINGLE]	
[MARKERS]	
[Marker → Peak]	

(8) Read the Mkr. 1 frequency and level at the bottom of the display. Check that the frequency is nominally 2 GHz and the level is 0 dBm ± 2 dB.

Annex A
INTERMODULATION DISTORTION MEASUREMENT

Contents

List of figures

General description

This annex describes how to use the instrument to measure intermodulation distortion. Use these instructions together with the general operating instructions and front- and rear-panel views in Chapter 3.

Default settings

These are the factory default settings for intermodulation operation:

Noise bandwidth	1 kHz
Trigger	Single
Display type	Numeric
Orders displayed	3^{rd}, 5^{th}, 7^{th}, 9^{th}
Expanded list	Off
Window function	Blackman-Harris
RF input selected	High-power
Averaging	On, 10
F1	380 MHz
F2	385 MHz
Input tone level	+41 dBm
dB/div	10 dB
Current function	F1 frequency

Operation

Press [APPS] to select the intermodulation distortion mode of operation. You are given a choice of two modes in which to measure intermodulation distortion.

- In ‘normal’ mode, you specify the frequency of both input tones (F1 and F2) and the orders of intermodulation products that you wish to measure. The instrument searches for the input tones within search windows centered on the frequencies entered. It measures the levels of the input tones and displays them. It calculates the product frequencies, measures the level at these frequencies and displays the results, with a pass/fail entry if you have specified limits.
- In ‘user’ mode, you specify the frequency of only one input tone (F1), and up to 50 tone or product frequencies. Tone and product frequencies can be enabled or disabled individually. The instrument makes the measurements as for normal mode.

Most of the soft-key operations that follow are the same whether you are in normal or user mode. Where they differ, this is shown in the section heading.

(1) Press *[Intermod (Normal)]* to enter the normal mode of operation. A screen similar to that in Fig. A-1 below is displayed. You can make intermodulation measurements at harmonics calculated by the instrument, based on the F1 and F2 frequencies you enter. You can specify which orders of harmonic (3rd, 5th, 7th, 9th) to display (page A-15).

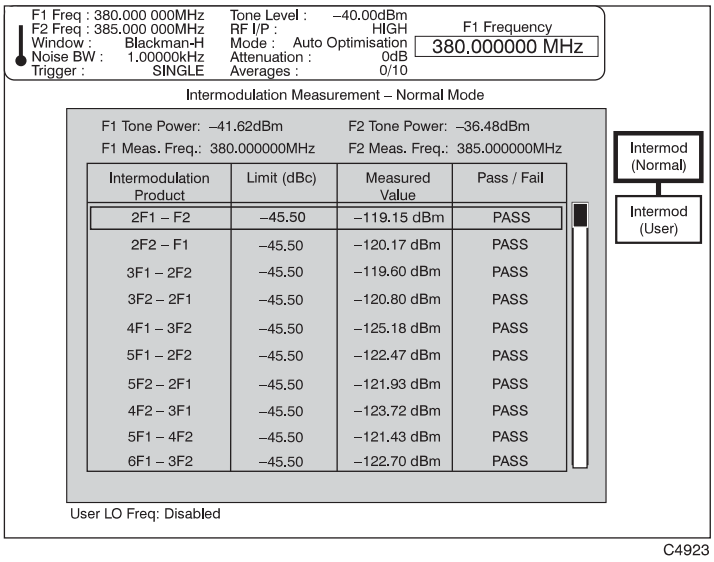


Fig. A-1 Intermodulation:Intermod (Normal) selected

(2) Press *[Intermod (User)]* to enter the user mode of operation. A screen similar to that in Fig. A-2 below is displayed. You can specify frequencies independently of their relationship with F1 and F2. You can make measurements at any chosen frequency offset (positive or negative) from F1. You can enter up to 50 frequency offsets.

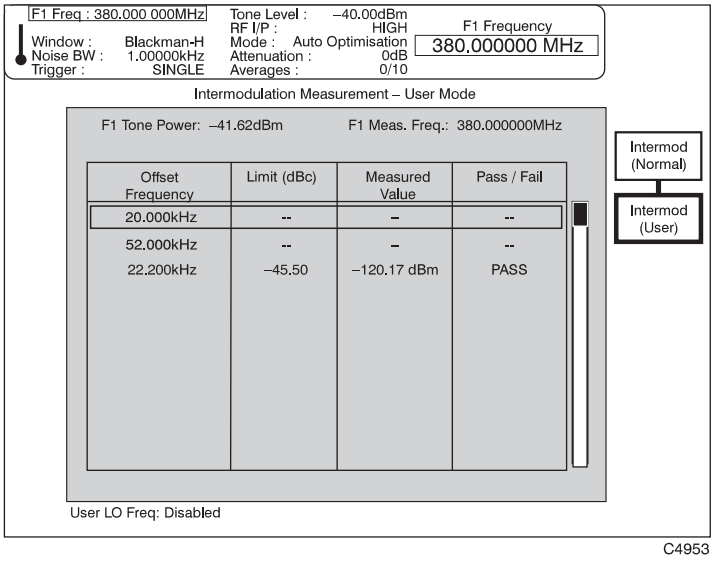
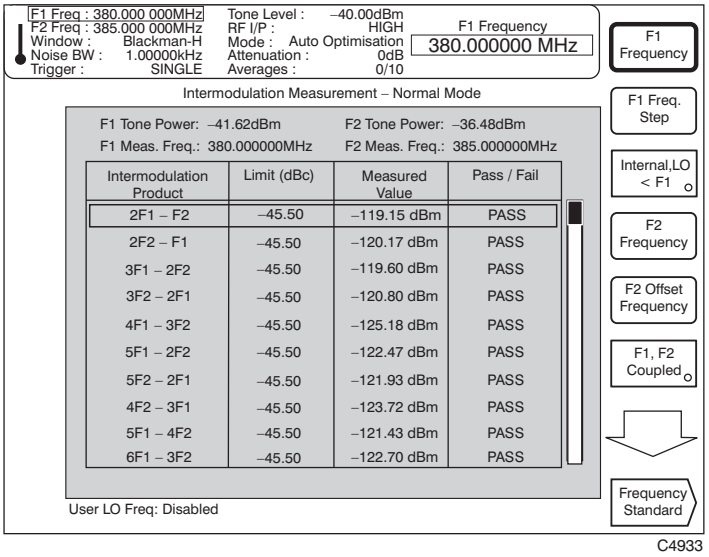


Fig. A-2 Intermodulation: Intermod (User) selected

Note: green entries represent tone frequencies
white entries represent product frequencies
light blue entries are disabled

Frequency (Normal mode)

With the instrument set to normal mode for intermodulation measurement, pressing [FREQ] allows you to change the absolute F1 and F2 frequencies, F1 frequency steps, F2 offset from F1, the external LO's frequency relative to F1, to couple F1 and F2, and to select the type of frequency standard. The 'frequency' soft keys are displayed at the right side of the screen as shown in Fig. A-3.



Intermodulation Product	Limit (dBc)	Measured Value	Pass / Fail
2F1 – F2	–45.50	–119.15 dBm	PASS
2F2 – F1	–45.50	–120.17 dBm	PASS
3F1 – 2F2	–45.50	–119.60 dBm	PASS
3F2 – 2F1	–45.50	–120.80 dBm	PASS
4F1 – 3F2	–45.50	–125.18 dBm	PASS
5F1 – 2F2	–45.50	–122.47 dBm	PASS
5F2 – 2F1	–45.50	–121.93 dBm	PASS
4F2 – 3F1	–45.50	–123.72 dBm	PASS
5F1 – 4F2	–45.50	–121.43 dBm	PASS
6F1 – 3F2	–45.50	–122.70 dBm	PASS

Fig. A-3 Intermodulation: FREQ selected (Normal mode)

(1) Use *[F1 Frequency]* and *[F2 Frequency]* to enter absolute F1 and F2 frequencies, in the range 100 MHz to 2.4 GHz (to 1 Hz resolution), on the keypad. Terminate using the appropriate units key.

(2) Alternatively, use *[F2 Offset Frequency]* to define F2 by its frequency offset from F1. Enter the required offset value, then terminate using the appropriate units key. If F1 changes, the change in offset frequency is shown at the top of the screen.

(3) To change the increment value for F1, press *[F1 Freq. Step]*, which causes the current step value to be displayed at the top of the screen. Enter the required step value, then terminate using the appropriate units key. When the [⇧] [⇩] keys are used, F1 is incremented/decremented by the specified step size. Alternatively, F1 can be adjusted using the rotary control.

(4) Press *[Internal LO < F1]* to change the local oscillator's frequency to 10.71 MHz below F1, instead of 10.71 MHz above F1. When the LO frequency is lower than F1, the key's green 'LED' is lit.

(5) Press *[F1, F2 Coupled]* to lock the relative frequency difference between F1 and F2. A change made to one frequency causes the other to change also, in order to maintain the chosen offset.

(6) Press *[Frequency Standard]* to display the frequency standard selection screen (see 'Frequency standard selection' on page A-8).

(7) Press *[⇩]* to call up a second screen (shown in Fig. A-4), which extends the menu so that you can select the additional function *[User LO Enabled]* (see 'User LO' on page A-9).

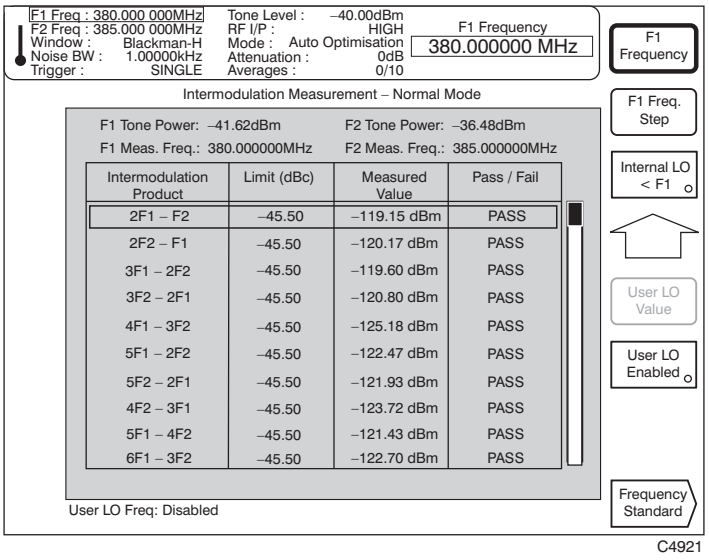


Fig. A-4 Intermodulation: FREQ second screen

(8) Press *[⇧]* to go back to the FREQ screen.

Frequency (User mode)

With the instrument set to user mode for intermodulation measurement, pressing [FREQ] allows you to define the offset and product frequencies, change the absolute F1 frequency, F1 frequency steps, the external LO's frequency relative to F1, to enter an external LO frequency, and to select the type of frequency standard. The 'frequency' soft keys are displayed at the right side of the screen as shown in Fig. A-5.

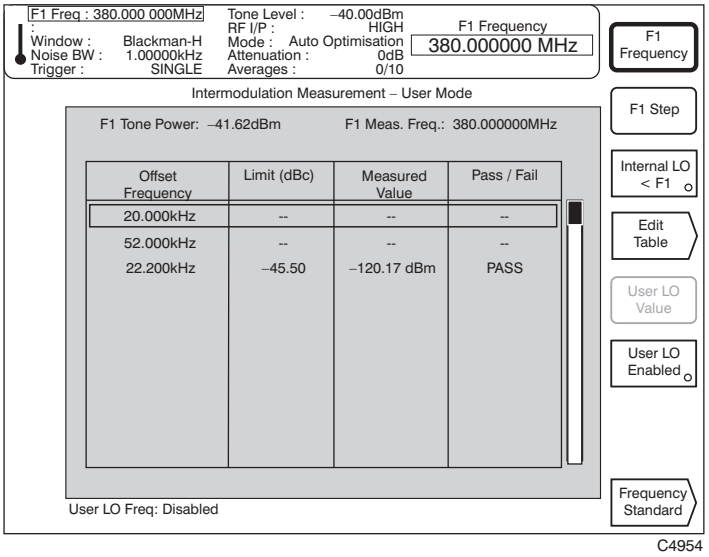


Fig. A-5 Intermodulation: FREQ selected (User mode)

(1) Use *[F1 Frequency]* to enter an absolute F1 frequency, in the range 100 MHz to 2.4 GHz (to 1 Hz resolution), on the keypad. Terminate using the appropriate units key.

(2) To change the increment value for F1, press *[F1 Step]*, which causes the current step value to be displayed at the top of the screen. Enter the required step value, then terminate using the appropriate units key. When the [⇧] [⇩] keys are used, F1 is incremented or decremented by the specified step size. Alternatively, F1 can be adjusted using the rotary control.

(3) Press *[Internal LO < F1]* to change the local oscillator's frequency to 10.71 MHz below F1, instead of 10.71 MHz above F1. When the LO frequency is lower than F1, the key's green 'LED' is lit.

(4) Press *[Edit Table]* to define the offset and product frequencies (see 'Editing the user frequencies' below).

(5) Press *[User LO Enabled]* to allow you to enter the value of an external LO frequency. See 'User LO' on page A-9.

(6) Press *[Frequency Standard]* to display the frequency standard selection screen (see 'Frequency standard selection' on page A-8).

Editing the user tone

To define the frequency offsets from F1, or the product frequency directly, press *[Edit Table]*. The table editing soft keys are displayed at the right side of the screen as shown in Fig. A-6 below.

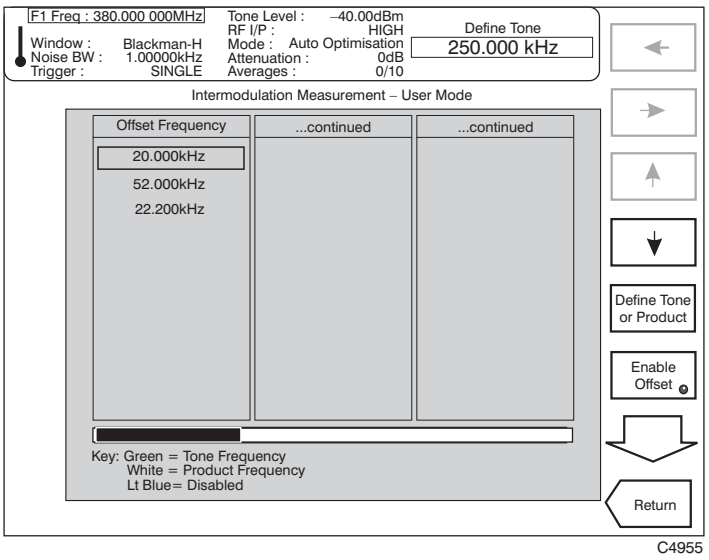


Fig. A-6 Intermodulaton: Edit Table selected

(1) Use the *[←]*, *[→]*, *[↑]* and *[↓]* keys to move the cursor to an offset frequency.

(2) Press *[Define Tone or Product]* to determine whether the selected offset represents a tone frequency or an intermodulation product.

(3) Press *[Enable Offset]* to include the selected offset in the next measurement. The key's green 'LED' is lit when the offset is enabled. Offsets that are disabled appear light blue on the screen.

(4) Press *[⇩]* to call up a second menu (Fig. A-7), which extends the menu so that you can edit the offsets.

(5) Press *[Remove Offset]* to delete the selected offset from the table.

(6) Press *[Restore Offset]* to put back the last offset that you removed.

(7) Press *[⇧]* to go back to the first table-editing menu.

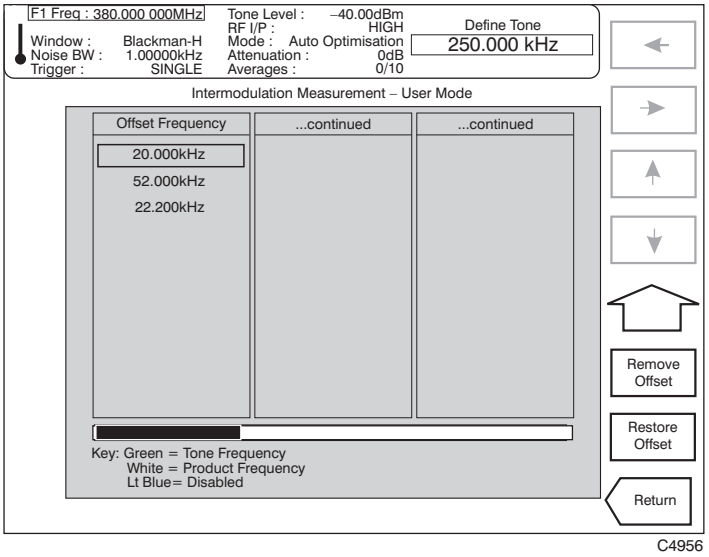


Fig. A-7 Intermodulaton: Edit Table second screen

Frequency standard selection

To change the frequency standard, press *[Frequency Standard]*. The frequency standard selection soft keys are displayed at the right side of the screen as shown in Fig. A-8 below. The soft keys are the same in both normal and user modes, although the screen's contents differ; the normal-mode screen is shown here

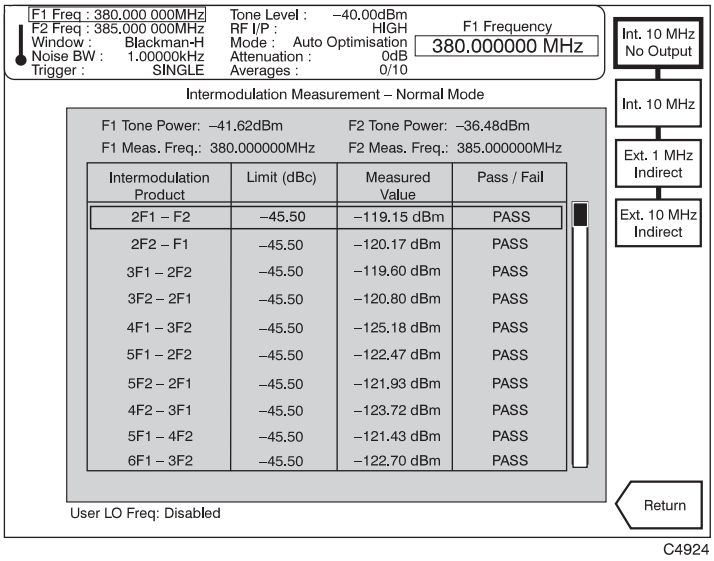


Fig. A-8 Intermodulaton: Frequency Standard selected

(3) To select the instrument's internal standard, press *[Int. 10 MHz]*. When selected, the internally generated 10 MHz standard is also available from the rear panel INT STD O/P socket. To prevent output to the socket, press instead *[Int. 10 MHz No Output]*.

(4) To accept an externally generated 1 or 10 MHz standard for the instrument (for example, if the accuracy of your frequency standard is better than that of the internal standard), connect the signal to the rear panel EXT STD I/P socket, then select between *[Ext. 1 MHz Indirect]* or *[Ext. 10 MHz Indirect]*.

(5) Press *[Return]* to go back to the FREQ screen.

User LO

(1) Press *[User LO Enabled]* to allow you to enter the value of an external LO frequency. You may want to do this, for example, to test the IF intermodulation performance of an external circuit (Fig. A-9). The input to the 2309 is the product of a signal mixed with the external LO.

(2) Press *[User LO Value]* to enter the value that is being used as an external LO frequency. Set F1 and F2 to the frequency of the tones applied to the external mixer. The 2309 uses these frequencies to calculate and display the output frequencies of the external mixer. You can make measurements over a range of LO frequencies simply by re-entering the User LO Value.

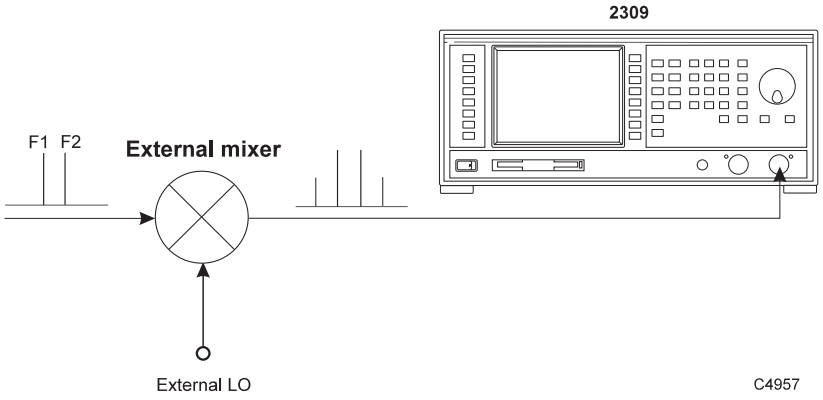


Fig. A-9 Intermodulation: external LO

Level

Press [LEVEL] to control the tone power level, to set the level offset of the device under test and to configure the instrument's hardware to optimize your particular measurement. The 'level' soft keys are displayed at the right side of the screen as shown in Fig. A-10 below. Ensure that the tone level is correctly set since this optimizes the input for maximum intermodulation-free dynamic range.

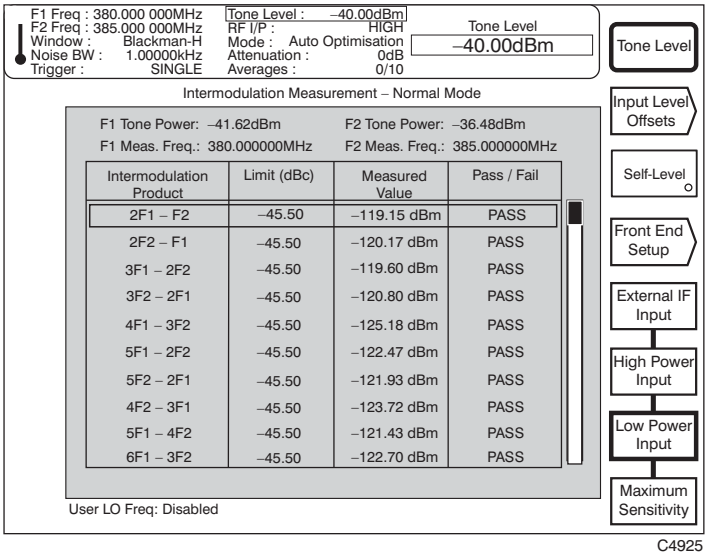


Fig. A-10 Intermodulation: LEVEL selected

(1) Setting the tone level controls the hardware (attenuator, IF gain) settings in order that the A-to-D converter is not overloaded. To set the tone level, press *[Tone Level]*, which displays the level at the top of the screen. Enter your input signal level on the keypad in logarithmic units (dB reference), as follows:

> If the tones are of equal amplitude, enter this level. If they are of differing amplitudes, enter the level of the highest tone.

You can also adjust the tone level by using either the rotary control or the [⇩] [⇧] keys.

(2) Press *[Input Level Offsets]* to compensate for the nominal gain or loss of an external device: see 'Level offsets selection' below.

(3) Press *[Self-Level]* to have the instrument establish optimum levels for a particular measurement. The instrument measures signal levels presented at the input connectors at the F1, F2 frequencies (normal mode), or F1 and tone frequencies (user mode). It then adjusts its input attenuation and sets up the stage gains for optimal dynamic range. Note that if input levels change subsequently, Self-Level needs to be re-applied.

(4) Pressing *[Front End Setup]* gives you the opportunity to configure the instrument's hardware to optimize your measurement: see 'Front-end setup' below.

(5) Pressing *[External IF Input]* allows you to input a 10.71 MHz IF signal at the IF input connector on the rear panel. This allows you to make accurate measurements of relative signal levels at the instrument's IF frequency. Absolute gain accuracy is not guaranteed.

(6) Select between high-power and low-power DC-coupled RF inputs by pressing either *[High Power Input]* or *[Low Power Input]*. When the low-power input is selected a 10 dB attenuator pad is inserted to protect the internal mixer. Press *[Maximum Sensitivity]* to select the low-power input with no mixer protection (0 dB attenuation).

Front-end set-up

You can instruct the instrument to set up its hardware automatically, to favor either low-distortion or high signal-to-noise performance. Low-noise optimization sets the hardware signal chain to its maximum operating level, which gives optimal noise performance at the expense of higher distortion. Low-distortion optimization sets the hardware to its minimum operating level, which gives optimal distortion but degrades signal-to-noise ratio. The *[Noise/Dist Balanced]* soft key balances noise and distortion for a best compromise. Maximum and minimum operating points are set automatically within the instrument.

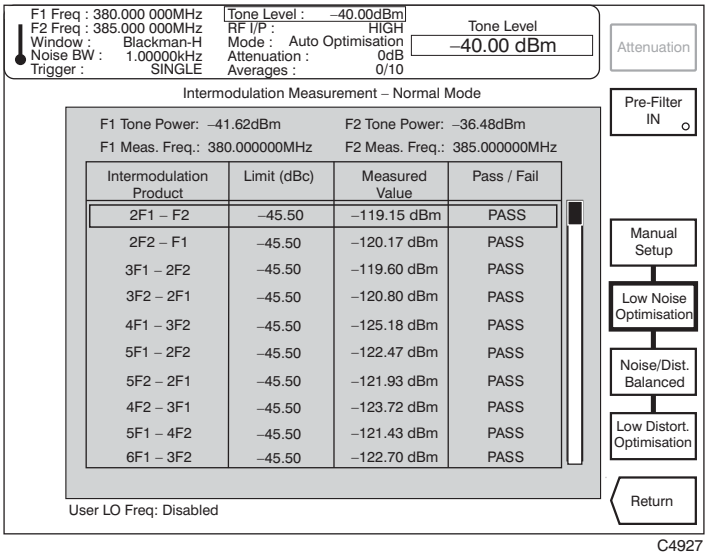


Fig. A-11 Intermodulation: Front End Setup selected

(1) Press *[Pre-Filter IN]* to pass the intermodulation products and reject the main tones. The pre-filter is a 10.7 MHz bandpass filter giving 30 dB of rejection at an offset of 400 kHz from the center of the passband. For tone spacings of 200 kHz or more, one of the main tones is attenuated by the filter by at least 30 dB and distortion performance is improved as the A-to-D converter is not overloaded. The key's green 'LED' is lit when the filter is active.

If the filter is used with a tone spacing of less than 200 kHz, the converter may overload. A warning message appears if this is likely to happen.

(2) Press *[Manual Set-up]* to set the instrument's input attenuation manually, in the range 0 to 65 dB. This controls the gain of the input attenuator only – gains of following stages are not affected. To adjust the gain of all stages in the instrument, use *[Input Level]* on the LEVEL screen.

(3) Press *[Low Noise Optimisation]* to set the instrument's stage gains to provide the best balance of noise and distortion in the measurement.

(4) Press *[Noise/Dist. Balance]* to set the instrument's stage gains to give optimum noise performance, at the expense of an increase in distortion.

(5) Press *[Low Distort. Optimisation]* to set the instrument's stage gains to give minimal distortion, at the expense of a decrease in signal-to-noise ratio.

(6) Press *[Return]* to go back to the LEVEL screen.

Level offsets selection

The RF offset facility enables you to display the true RF power at the output of the device under test when an external device, such as an attenuator or amplifier, is connected between the device under test and the instrument. The displayed input level does not change but the RF front-end hardware is modified to compensate for the nominal gain or loss of the external device. In addition, the facility can be used to compensate for cable loss in a test system.

Press *[Input Level Offsets]* to display the level offset soft keys at the right side of the screen as shown in Fig. A-12 below.

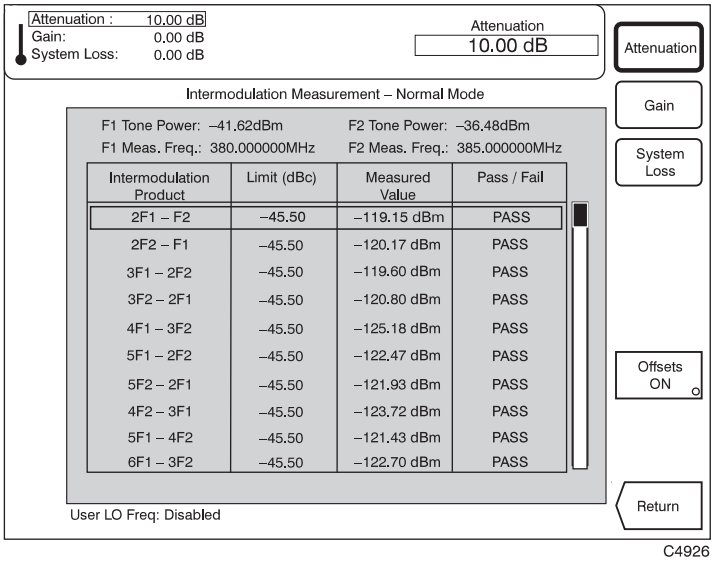


Fig. A-12 Intermodulation: Input Level Offsets selected

(1) To enter the amount of attenuation being applied, press *[Attenuation]*, enter the value using the keypad and terminate with the [dB] key.

When the [⇧] and [⇩] keys are used, the attenuation value is incremented/decremented in 1 dB steps for attenuator values ≥10 dB and 0.1 dB steps for attenuator values <10 dB. Alternatively, fine adjustment of the attenuation setting can be made using the rotary control. One knob click represents a change in value of 0.01 dB.

(2) To enter the amount of gain being applied press *[Gain]*, enter the value using the keypad and terminate with the [dB] key.

When the [⇧] and [⇩] keys are used, the gain value is incremented/decremented in 1 dB steps for gain values ≥10 dB and 0.1 dB steps for gain values <10 dB. Alternatively, fine adjustment of the gain setting can be made using the rotary control. One knob click represents a change in value of 0.01 dB.

(3) To compensate for power loss through cables, press *[System Loss]*. Enter the amount of cable loss occurring in the test configuration and terminate using the [dB] key.

(4) Press *[Offsets ON]* to enable or disable the offsets. When the key's green 'LED' is lit the offsets are being applied.

The average transmitter power displayed is modified by the RF offsets as follows:

Displayed average power = Measured average power + attenuation – gain + system loss.

(5) Press *[Return]* to go back to the LEVEL screen.

Measure

Press [MEASURE] to select the measurement mode. This enables you to control the averaging process as well as to select window function. The 'measure' soft keys are displayed at the right side of the screen as shown in Fig. A-13 below.

Measurements are made in a sequence after [SINGLE] or [REPEAT] is pressed. RMS average power is measured at the entered F1 and F2 frequencies and displayed in the header of the table. This is followed (in the body of the table) by each of the intermodulation products selected for measurement. For each offset frequency, the instrument measures RMS power. It displays the result either as an absolute value, or as a level relative to the measured F1 level.

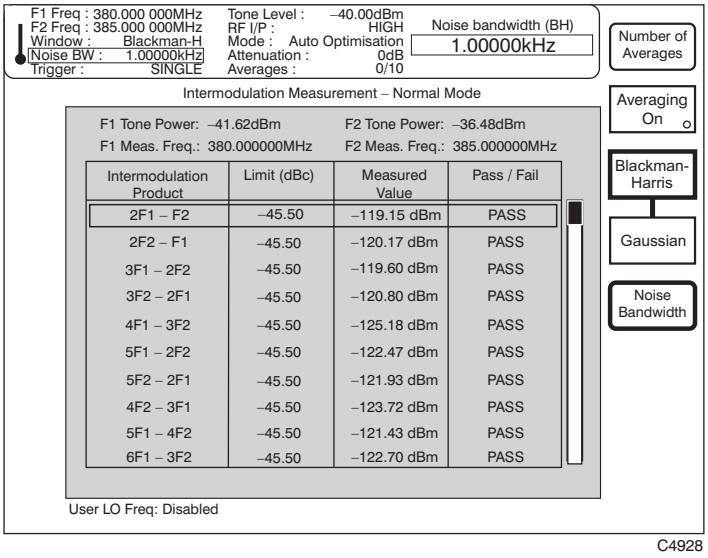


Fig. A-13 Intermodulation: MEASURE selected

(1) You can specify the number of averages being applied to the measurement by pressing *[Number of Averages]* and entering the number on the keypad in the range 1 to 200 (the instrument's default is 10). Terminate using any [ENTER] key.

(2) Press [SINGLE]. The fixed number of bursts is averaged and then the measurement process is halted. The trace is updated only at the end of the averaging process. To initiate a new measurement cycle press [SINGLE] once again.

(3) Press *[Averaging On]* to enable or disable the averaging process. When *On* the key's green 'LED' is lit.

(4) To select the Blackman-Harris (five-term) window function, press *[Blackman-Harris]*. This is usually used when a measurement requires high dynamic range. The noise bandwidth is less than or equal to 0.44% of the set span.

(5) To select the Gaussian window function, press *[Gaussian]*. This is usually used for high amplitude-accuracy measurements. The noise bandwidth is at a fixed percentage (1%) of the set span.

(6) The final soft key shows *[Noise Bandwidth]*. To set the noise bandwidth, press the key and enter the value on the numeric keypad. Terminate using the [Hz] or [kHz] keys.

Display

Press [DISPLAY] to select the display mode. This enables you to select the type of format for the display, display results as absolute or relative, scroll through entries, and select which orders of intermodulation product are displayed. The 'display' soft keys are displayed at the right side of the screen as shown in Fig. A-14 below.

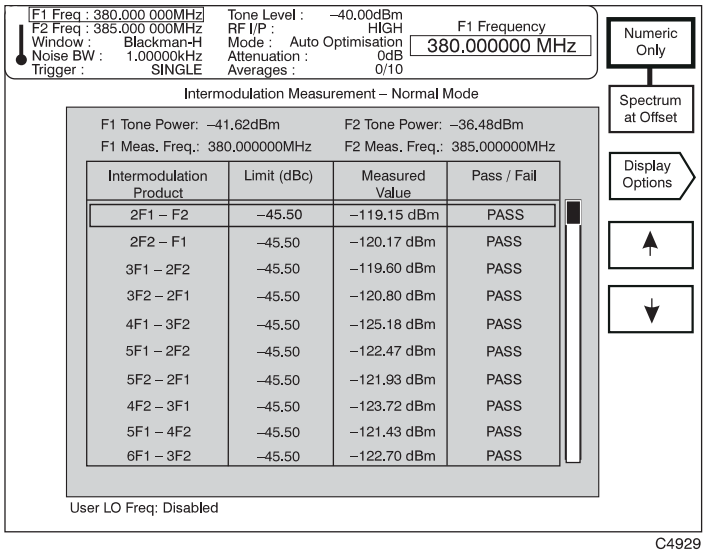


Fig. A-14 Intermodulation: DISPLAY selected

(1) Press *[Numeric Only]* to display the intermodulation results in a tabular form.

(2) Press *[Spectrum at Offset]* to display the spectrum at the frequency highlighted in the list of entries in the table. Use the up/down arrow soft keys to highlight an entry. Press [SINGLE]: a new measurement is made, and the result is displayed graphically (Fig. A-15). The center frequency is taken from the table; frequency span = 30 x noise bandwidth setting.

After performing a *Spectrum at Offset* measurement, upon returning to *Numeric Only* the Pass/Fail field will show '*Old [HH:MM]*' for entries other than the selected product or offset frequency. This is because *Spectrum at Offset* will have remeasured for the selected entry only. *HH:MM* indicates the time at which the measured value was taken.

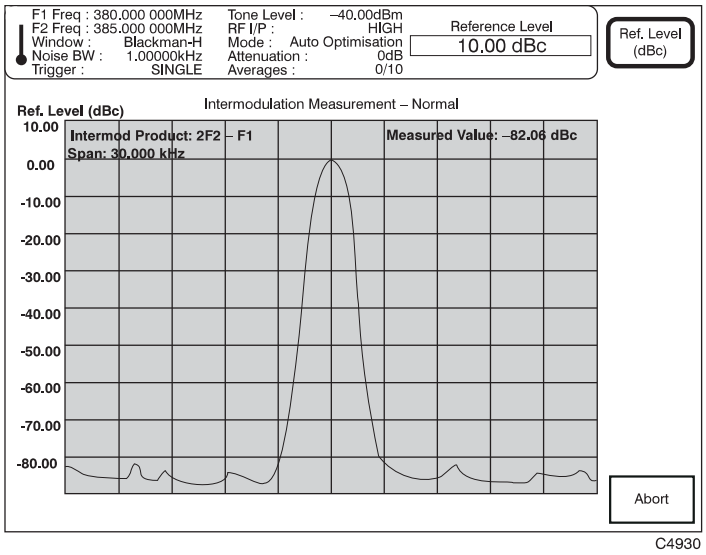


Fig. A-15 Intermodulation: Spectrum at Offset selected

(3) You can select how many intermodulation products to display by pressing *[Display Options]*.

Display options

Press *[Display Options]* to set frequency and level results either as values relative to F1 or absolute values.

You can choose which order of intermodulation products you wish to measure and display. Switching off any of these soft keys simplifies the presentation and speeds up the calculation of results.

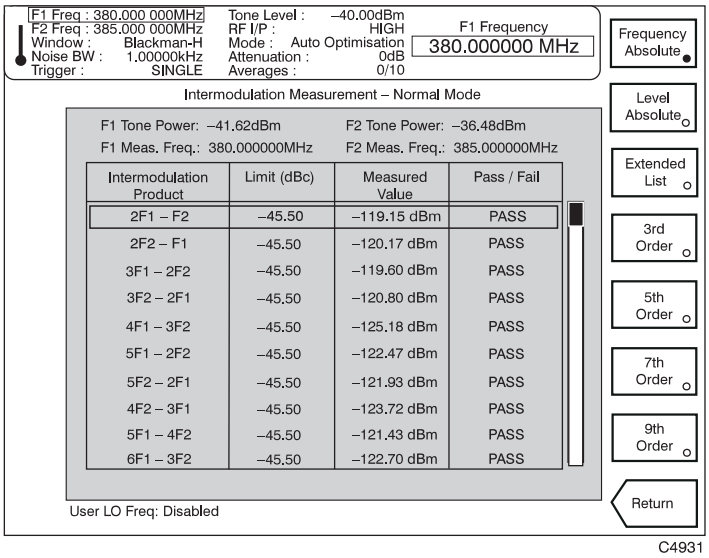


Fig. A-16 Intermodulation: Display Options selected

(1) Press *[Frequency Absolute]* to toggle between displaying the intermodulation products either as absolute frequency values, or as values relative to the value of frequency F1. The screen displays entered values until a valid measurement is made, when it displays the measured values. When absolute frequency is selected, the key's green 'LED' is lit.

Note that in the *Intermodulation Product* column, there is an additional offset for the nearest marker position, so that the figure is not quite exactly 2F1 – F2, 2F2 – F1, and so on.

(2) Press *[Level Absolute]* to toggle between displaying the measured levels of intermodulation products either as absolute values (dBm), or as values relative to the measured level of frequency F1 (dBc). When absolute level is selected, the key's green 'LED' is lit.

(3) Press any of the intermodulation product soft keys shown in Fig. A-16. These allow you to select and deselect the 3rd-, 5th-, 7th- and 9th-order products from both the spectral and tabular displays. The green 'LED' is lit when the relevant order of product is selected.

(4) Press *[Extended List]* to view more intermodulation products, spaced further from the input tones. A grayed-out entry cannot be measured using the current F1 and F2 values.

(5) Press *[Return]* to go back to the DISPLAY screen.

Limits

You can specify values for level limits against which intermodulation measurements are tested to provide a pass or fail result. Press [LIMITS] to display the current limits for the instrument, together with the 'Limits' soft keys displayed at the right side of the screen as shown in Fig. A-17 below.

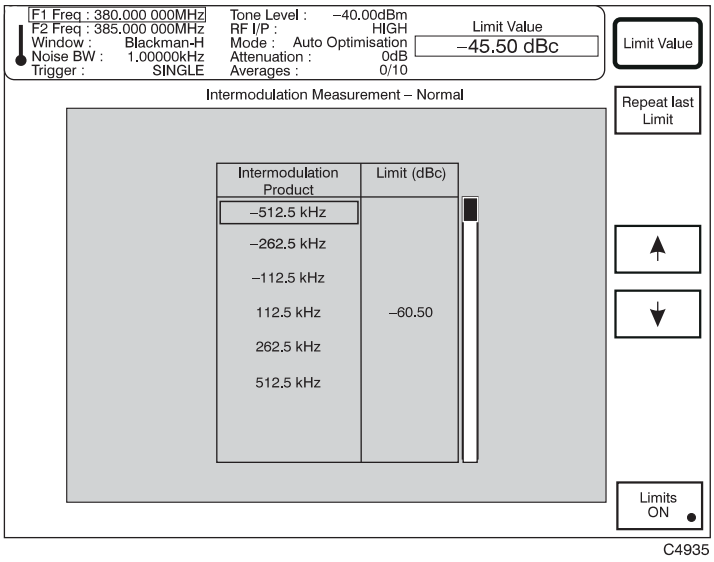


Fig. A-17 Intermodulation: LIMITS selected

(1) Use the *[↑]* and *[↓]* keys to move the cursor to the offset frequency whose value you wish to change

(2) Press *[Limit Value]* and enter the new limit.

(3) Use *[Repeat Last Limit]* to enter the new limit value again at a different location in the table.

(4) Press *[Limits ON]* to enable or disable the displayed limits. When the key's green 'LED' is lit the limits are being applied.

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