GENERAL DYNAMICS

COMMUNICATIONS TEST EQUIPMENT

R2660 Series
Communications System Analyzer

OPERATOR'S MANUAL

GENERAL DYNAMICS DECISION SYSTEMS
Communications Test Equipment
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Scottsdale, Arizona
85257

68-P35270C001 Rev.F

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Section 1

INTRODUCTION

1-1 SCOPE OF MANUAL

This manual contains information for using the R2600 Series Communications System Analyzers. These Analyzers incorporate many devices and functions, permitting a technician to completely monitor and service radio communications equipment in the shop and in the field.

1-2 SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service and repair of this equipment. Failure to comply with these precautions or warnings violates safety standards of design, manufacture, and intended use of the equipment. General Dynamics. assumes no liability for the customer's failure to comply with these requirements.

The safety precautions and warnings listed below represent warnings of certain dangers of which General Dynamics is aware. You as the user of the product, should follow these warnings and all other safety precautions necessary for the safe operation of the equipment in your operating environment.

1-2.1 Grounding the Analyzer

To minimize shock hazard, the Analyzer enclosure must be connected to an electrical ground. This ground connection is provided via a three wire AC power cable. The power cable must be plugged into an approved three-contact electrical outlet. If the unit is not properly grounded while operating from an AC power source, the voltage potential between it and ground may cause an electrical shock.

1-2.2 Unit is Live When Plugged In

Internal circuits are live when the power cable is plugged in, although the front panel switch is in the STANDBY position. The input power plug is the disconnect device.

1-2.3 Keep Away From Live Circuits

Operating personnel must not remove equipment covers. Only Factory Authorized Service Personnel or other qualified maintenance personnel may remove equipment covers for internal subassembly or component replacement or any internal adjustment. Disconnect Analyzer from all voltage sources before removing covers for adjustments, maintenance or repairs. Capacitors inside may still be charged even if the Analyzer is disconnected from the voltage source.

Kapitel 1

EINFÜHRUNG

1-1 VERWENDUNGSZWECK

Dieses Handbuch enthält Informationen über den Umgang mit den Funkmeßplätzen der Serie R2600. Diese Geräte enthalten eine Vielzahl von Bausteinen und Funktionen, mit deren Hilfe der Techniker Kommunikationsgeräte sowohl in der Werkstatt als auch vor Ort vollständig überprüfen und warten kann.

1-2 SICHERHEITSHINWEISE

Die nachfolgenden allgemeinen Sicherheitshinweise sind während aller Phasen der Bedienung, Wartung und Reparatur dieses Gerätes zu befolgen. Die Nichtbeachtung dieser Hinweise bzw. Warnungen stellt ein Verstoß gegen die Sicherheitsstandards der Entwicklung, Herstellung und des bestimmungsgemäßen Gebrauchs des Gerätes dar. General Dynamics lehnt jede Haftung für die Nichtbeachtung dieser Vorschriften seitens des Kunden ab.

Die nachstehenden Sicherheits- und Gefahrenhinweise warnen vor bestimmten von General Dynamics erkannten Gefahren. Sie als der Benutzer des Produktes sollten diese Warnhinweise und sonstige sicherheitstechnische Vorsichtsmaßnahmen beachten, um einen zuverlässigen Betrieb des Gerätes innerhalb einer sicheren Betriebsumgebung zu gewährleisten.

1-2.1 Funkmeßplatz erden

Zur Verringerung der Gefahr eines elektrischen Schlages muß das Gerät elektrisch geerdet werden. Die Sicherheitserdung erfolgt über das dreiadrige Netzkabel. Der Netzstecker muß dazu in eine dreipolige Steckdose eines zugelassenen Typs gesteckt werden. Wird das Gerät beim Betrieb aus einer Wechselstromquelle nicht vorschriftsmäßig geerdet, so kann die Differenzspannung zwischen Gerät und Erde einen elektrischen Schlag hervorrufen.

1-2.2 Das Gerät steht auch in ausgeschaltetem Zustand unter Spannung

Die Schaltungen im Geräteinneren stehen bei gestecktem Netzkabel immer unter Spannung, auch wenn der Schalter auf der Frontplatte sich in Stellung STANDBY befindet. Eine vollständige Trennung vom Netz bewirkt nur das Ziehen des Netzsteckers.

1-2.3 Vorsicht vor spannungsführenden Teilen!

Das Betriebspersonal darf die Gehäuse-Abdeckungen nicht öffnen. Nur vom Werk autorisierte Techniker und sonstiges qualifiziertes Personal dürfen die Geräte-Abdeckungen öffnen, um Teile zusammenzubauen bzw. zu ersetzen oder Einstellungen vorzunehmen. Vor dem Öffnen, muß das Gerät von allen Spannungsquellen getrennt werden, damit Einstell-, Wartungs- und Reparaturarbeiten in spannungslosem Zustand durchgeführt werden. Kondensatoren im Gerät können auch nach der Trennung des Gerätes von der Spannungsquelle noch geladen sein.

1-2.4 Explosive Atmosphere

Do not operate the equipment in the presence of flammable gases or fumes. Operation of any electrical equipment in such an environment constitutes a definite safety hazard.

1-3 WARNINGS AND CAUTIONS

You should observe several precautions when handling this equipment.

WARNING

The Analyzer is designed to be operated with a ground connection to the chassis via a three-wire power connection. If the unit is not properly grounded while operating from an AC power source, the voltage potential between it and ground may cause an electrical shock.

CAUTION

This equipment contains parts that are subject to damage by static electricity. While there is normally no need for operator access to any internal components, take proper precautions in handling should the need arise. Refer to Appendix C for safe handling procedures.

1-3.1 Analyzer Operating Voltage

Before plugging in an AC power cable, verify that the selector switch located on the underside of the unit is set to the correct operating voltage. If using a battery pack, the cover must be removed and the internal voltage selector switch set to the correct position.

1-3.2 DC Power Source

The DC power input is intended to be connected to the Battery Pack accessory, or from a vehicle battery. Connecting the Analyzer DC input to a Power Supply can, in the event of a power supply fault, cause hazardous voltages to be present on the low voltage circuits of the Analyzer.

1-3.3 Maximum DVM Input Voltages

To ensure the safety of the user, the voltages being measured at the DVM input must be kept below Hazardous Live limits. The maximum input levels are: 30 V r.m.s and 42.4 V peak or 60 V d.c.

1-2.4 Betrieb in einer explosionsgefährdeten Umgebung

Das Gerät darf in einer explosionsgefährdeten Umgebung nicht betrieben werden. Brennbare Gase oder Dämpfe in der Nähe des Gerätes stellen ein großes Sicherheitsrisiko dar.

1-3 GEFAHRENHINWEISE

Beim Umgang mit dem Gerät sind folgende Gefahrenhinweise zu beachten.

VORSICHT!

Beim Betrieb des Funkmeßplatzes muß das Chassis über ein dreipoliges Netzkabel geerdet sein. Wird das Gerät bei Speisung aus einer Wechselstromquelle nicht vorschriftsmäßig geerdet, so kann die Differenzspannung zwischen Gerät und Erde einen elektrischen Schlag hervorrufen.

ACHTUNG!

Dieses Gerät enthält Bauteile, die durch statische Elektrizität beschädigt werden können. Normalerweise ist ein Zugriff auf die Bauteile im Inneren des Gerätes zwar nicht erforderlich, jedoch sind im Bedarfsfall die nötigen Vorsichtsmaßnahmen zu beachten. Einzelheiten dazu gehen aus Anhang C hervor.

1-3.1 Betriebsspannung

Vor dem Anschluß des Funkmeßplatzes an das Netz ist sicherzustellen, daß am Spannungswähler auf der Unterseite des Gerätes die richtige Netzspannung eingestellt ist. Bei Verwendung eines Akkusatzes muß die Abdeckung abgenommen und der interne Spannungswähler in die richtige Stellung gebracht werden.

1-3.2 Betrieb mit Gleichspannung

Über den Eingang DC POWER läßt sich der Funkmeßplatz mit Spannung aus dem als Option erhältlichen Akkusatz oder auch aus einem Kfz-Bordnetz speisen. Der Anschluß einer externen Stromversorgung kann im Falle eines Fehlers in dieser Stromversorgung dazu führen, daß die Niederspannungsteile im Funkmeßplatz gefährlich hohe Spannungen annehmen.

1-3.3 Maximale Eingangsspannung des Digitalvoltmeters

Damit die Sicherheit des Benutzers gewährleistet ist, dürfen die Spannungen am Eingang des Digitalvoltmeters bestimmte Werte nicht überschreiten. Die maximal zulässige Werte sind: 30 V eff. und 42,4 V Spitzenspannung oder 60 V Gleichspannung.

1-3.4 Replacement Fuses

For continuous protection against risk of fire, replace only with a fuse of the same type and rating. Part numbers for replacement fuses are shown in Tables 1 and 2.

Other fuses are located inside the Analyzer and should be replaced by Factory Authorized Service Personnel or other qualified maintenance personnel.

Table 1. Operator Replaceable Fuses

LOCATION	OPERATION	FUSE RATING VOLTS	FUSE RATING AMPS	FUSE TYPE	PART NUMBER
Rear Panel	115/230 VAC L	250V	2.5A	F	65-P30222C003
* Rear Panel	115/230 VAC N	250V	2.5A	F	65-P30222C003
Front Panel	ANT	125V	1/16A	F	65-P30277C002
Front Panel	GEN	125V	1/16A	F	65-P30277C002

Table 2. Internal Fuses

LOCATION	OPERATION	FUSE RATING VOLTS	FUSE RATING AMPS	FUSE TYPE	PART NUMBER
* Inside Rear Panel	12 VDC	250V	10A	F	F03A250V10A
Power Supply	115/230 VAC N	250V	1/4A	F	65-P30308C001
Battery Pack	115/230 VAC L	250V	0.5A	F	65-P30222C002
* Battery Pack	115/230 VAC N	250V	0.5A	F	65-P30222C002
Battery Pack	12 VDC	250V	15A	F	65-P26348A004

***Note:** For Analyzers with one AC fuse (F02A250V3A) and one DC fuse (F03A250V10A) on the rear panel, the neutral fuse (N) does not exist.

1-3.4 Ersatz von Sicherungen

Damit ein kontinuierlicher Schutz gegen Feuergefahr gegeben ist, darf eine Sicherung nur gegen eine solche des gleichen Typs und mit dem gleichen Sicherungswert ersetzt werden.

Teilenummern für Ersatzsicherungen gehen aus den Tabellen 1 und 2 hervor. Weitere Sicherungen im Inneren des Gerätes dürfen jedoch nur von autorisiertem bzw. qualifiziertem Personal gewechselt werden.

Tabelle 1. Sicherungen, die vom Benutzer gewechselt werden können

STELLE	BETRIEB	SICHERUNGSWERTE VOLT	AMP	TYP	TEILENUMMER
Rückwand	115/230 VAC L	250V	2,5A	F	65-P30222C003
* Rückwand	115/230 VAC N	250V	2,5A	F	65-P30222C003
Frontplatte	ANT	125V	1/16A	F	65-P30277C002
Frontplatte	GEN	125V	1/16A	F	65-P30277C002

Tabelle 2. Interne Sicherungen

STELLE	BETRIEB	SICHERUNGSWERTE VOLT	AMP	TYP	TEILENUMMER
* i. d. Rückwand	12 VDC	250V	10A	F	F03A250V10A
Netzgerät	115/230 VAC N	250V	1/4A	F	65-P30308C001
Akkusatz	115/230 VAC L	250V	0,5A	F	65-P30222C002
*Akkusatz	115/230 VAC N	250V	0,5A	F	65-P30222C002
Akkusatz	12 VDC	250V	15A	F	65-P26348A004

*** Hinweis:** Bei Geräten mit einer AC-Sicherung (F02A250V3A) und einer DC-Sicherung (F03A250V10A)auf der Rückwand gibt es keine neutrale Sicherung (N).

1-3.5 Other Cautions

Other cautions relating to the operation of the Analyzer are stated in *Italics* throughout this manual.

1-3.6 Replacement and Disposal of Batteries

Should the batteries contained in the Battery pack ever need replacing, this work should be performed by Factory Authorized Service personnel only. Replacement batteries should be of the same type and rating. The batteries contain toxic materials and therefore must be handled with care and transported to a disposal or recycling center.

1-3.7 User Maintenance

Clean only with a damp cloth and a mild detergent. Do not use abrasives, solvents or alcohol. If the Analyzer is used in a relatively dust free environment, no other periodic mainenance should be required.

1-4 SERVICE

The Motorola Test Equipment Service Centers service all R2600 Series Communications System Analyzers. The Centers maintain a stock of original equipment replacements parts and a complete library of service information. A list of worldwide service locations is found at the front of the manual.

1-5 REPLACEMENT PARTS ORDERS

Send orders for replacement parts to the nearest Motorola Test Equipment Service Center. Be sure to include the complete identification number located on the equipment. Also direct inquiries to the Test Equipment Service Center, including requests for part number identification and test equipment calibration or repair.

1-6 INSTALLATION

1-6.1 Packing

Foam pieces protect the Analyzer, which is packed inside a carton. Save the packing container and materials for future use.

1-6.2 Initial Set-up

1. Place the Analyzer on a workbench in the shop or mobile repair unit.
2. Lower the bail underneath to raise the Analyzer for easier viewing.
3. Remove the front cover by pressing in the spring loaded mechanism which snaps into the right front handle of the unit.
4. Before attempting to connect to AC power, set the two-position LINE switch (bottom of unit) to either the 115 or 230 position, as applicable. The factory initially sets the LINE switch for 115 VAC.
5. Take the power cord that is stored in the cover. Attach the cord's female connector to the appropriate connector on the Analyzer's rear panel. Connect the other end of the cord to the power source. For AC, use a grounded 3-wire 100-130 VAC or 200-260 VAC power source.
6. Remove accessories from the cover as needed.

1-3.5 Sonstige Vorsichtsmaßnahmen

Weitere wichtige Hinweise zum Betrieb des Funkmeßplatzes sind in diesem Handbuch durch *Kursivschrift* kenntlich gemacht.

1-3.6 Ersatz und Entsorgung von Akkus

Im Akkusatz enthaltenen Zellen dürfen - falls dies je erforderlich sein sollte - nur von autorisiertem Personal ausgewechselt werden. Ersatzzellen müssen vom gleichen Typ sein und die gleichen Leistungsmerkmale aufweisen. Akkus enthalten giftige Materialien, weshalb sie sorgfältig behandelt und ordnungsgemäß entsorgt werden müssen.

1-3.7 Reinigung

Reinigen Sie das Gerät nur mit einem leicht angefeuchteten Lappen und einem milden Reinigingsmittel. In keinem Fall dürfen Scheuer- oder Lösungsmittel oder Alkohol verwendet werden. Bei Benutzung des Gerätes in einem relativ staubfreiem Raum sollte eine weitere Wartung nicht erforderlich sein.

1-4 KUNDENDIENST

Die Wartung aller R26XX Communications System Analyzer werden vom regionalen Motorola Test Equipment Service Center durchgeführt. Diese Service Center führen ein Lager mit Original-Ersatzteilen und kompletten Serviceinformationen. Eine Liste der regionalen Service Center finden Sie auf der ersten Seite der Bedienungsanleitung.

1-5 ERSATZTEIL BESTELLUNGEN

Bestellungen für Ersatzteile sind unter Angabe der vollständigen Identifikationsnummer des jeweiligen Gerätes an das nächstgelegene Motorola Test Equipment Service Center zu richten. Hier erhalten Sie auch Antwort auf Ihre Fragen bezüglich Teilenummern, Kalibrierung und Reparatur von Testgeräten.

1-6 INSTALLATION

1-6.1 Verpackung

Im Verpackungskarton wird der Funkmeßplatz von Schaumstoffteilen geschützt. Verwahren Sie sämtliche Teile der Verpackung für eine eventuelle spätere Verwendung.

1-6.2 Erste Inbetriebnahme

1. Stellen Sie das Gerät in der Werkstatt oder im Servicewagen auf die Werkbank.
2. Stellen Sie den auf der Unterseite befindlichen Bügel hoch, um das Gerät besser bedienen zu können.
3. Entfernen Sie die Frontplatte durch Eindrücken der Raste, die im rechten Vordergriff des Gerätes einrastet.
4. Vor dem Anschluß an das Netz den Schalter LINE auf der Unterseite je nach der vorhandenen Netzspannung auf entweder 115V oder 230V setzen. Ab Werk ist der Schalter für 115 VAC eingestellt.
5. Das Netzkabel ist im Deckel untergebracht. Stecken Sie die Buchse des Netzkabels in den Kaltgerätestecker auf der Rückseite des Gerätes und verbinden Sie die andere Seite des Netzkabels mit der Stromquelle. Für Netzbetrieb ist ein dreiadriger Anschluß für 100-130 oder 200-260 Volt erforderlich.
6. Entnehmen Sie das benötigte Zubehör aus dem Deckel.

7. Insert the whip antenna into the ANT port, located to the right of the tuning knob on the front panel.
8. Press the power switch ON. The Analyzer is now ready for use. Before operating the Analyzer, review the operating procedures described in this manual.

CAUTION

When installing the Analyzer in a vehicle, fuse the DC supply line close to the vehicle's battery. The DC-10A fuse (located on the Analyzer's rear panel) protects the Analyzer against overload but does not protect the vehicle.

1-6.3 Battery Pack Operation

The optional battery pack (RPN-4000A) is designed to conveniently mount to the back of the Analyzer. Containing an internal battery charger, the battery pack is automatically recharged whenever connected direct to an ac receptacle. Battery charging is independent of the main equipment.

NOTE

The battery pack has an internal switch allowing the user to switch operation of the battery pack to 115 VAC or 230 VAC. Before attempting to plug the battery pack into the ac line for charging, ensure this switch is set to the correct position for your line voltage. This switch is accessible by removing six screws attaching the cover to battery pack chassis as shown in figure 1-1.

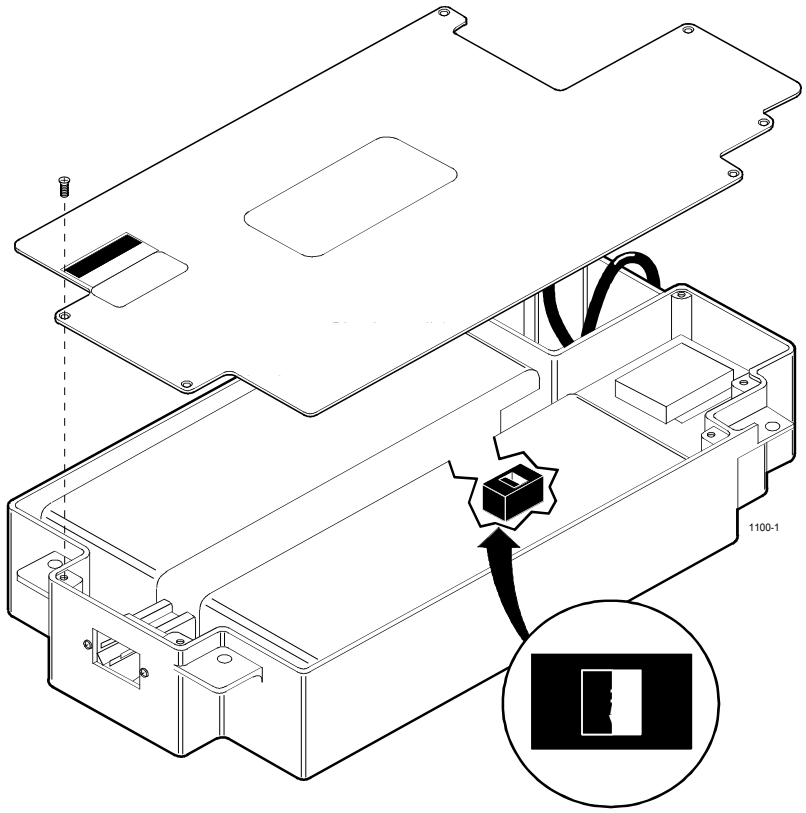


Figure 1-1. 115 VAC/230 VAC Selection Switch

7. Stecken Sie die Stabantenne in die ANT-Buchse rechts neben dem Abstimmknopf auf der Frontplatte.
8. Drücken Sie den Netzschalter auf ON. Der Funkmeßplatz ist jetzt betriebsbereit. Lesen Sie die mitgelieferte Bedienungsanleitung, bevor Sie das Gerät bedienen.

ACHTUNG!

Vor der Installation des Funkmeßplatzes in einem Fahrzeug ist das Speisekabel in unmittelbarer Nähe der Kfz-Batterie abzusichern. Die Sicherung von 10 A (im Inneren des Gerätes oder auf der Rückwand) schützt den Funkmeßplatz zwar gegen Überlastung, nicht jedoch das Fahrzeug.

1-6.3 Betrieb mit Akkusatz

Der als Option erhältliche Akkusatz (RPN-4000A) läßt sich bequem an der Rückseite des Funkmeßplatzes anflanschen. Da der Akkusatz über ein integriertes Ladegerät verfügt, wird er automatisch aufgeladen, sofern er an einer Netzsteckdose angeschlossen ist. Der Ladevorgang verläuft unabhängig vom Hauptgerät.

HINWEIS

Der Akkusatz verfügt über einen eingebauten Spannungswähler für 115 V bzw. 230 V Wechselspannung. Bevor Sie den Akkusatz mit dem Netz verbinden, ist darauf zu achten, daß die Stellung des Spannungswählers der örtlichen Netzspannung entspricht. Zugänglich ist dieser Spannungswähler nach Lösen von 6 Schrauben, mit denen die Abdeckung mit dem Chassis des Akkusatzes verschraubt ist. Siehe dazu Abb. 1-1.

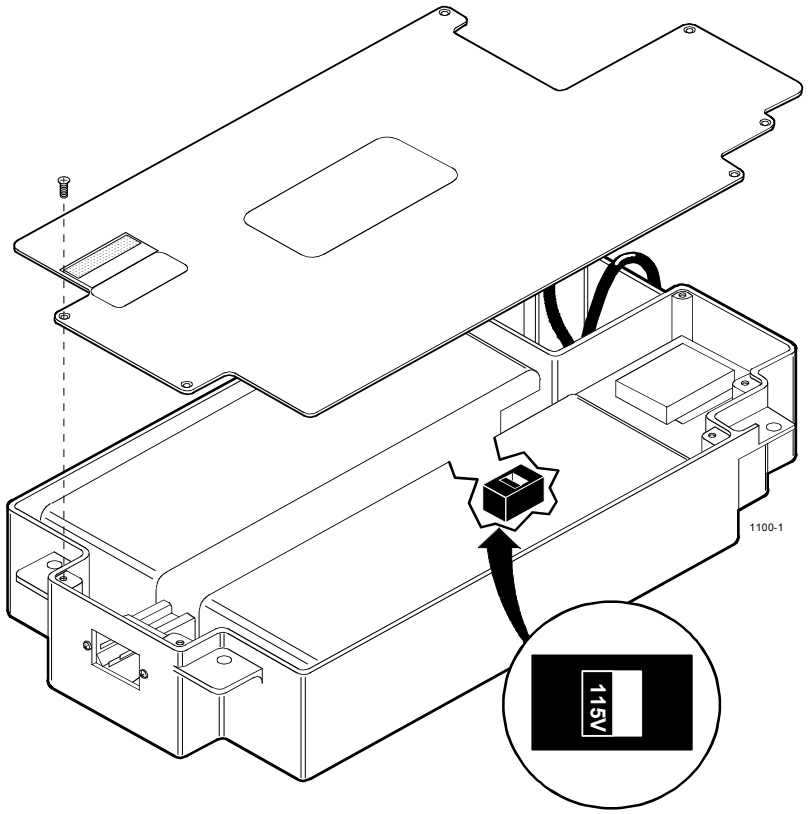


Abb. 1-1. Spannungswähler für 115 / 220 VAC

1-6.4 Battery Pack Installation

1. Set the Analyzer in an inverted vertical position on a table with the back of the unit facing upward.
2. Lay battery pack on the back surface of the Analyzer such that the cut out in the battery, will match the locations of the power plug on the Analyzer. Do not engage the attachment screw yet.
3. Plug four-pin connector from battery pack to four-pin connector on back of Analyzer labeled DC POWER.
4. Plug AC cord from battery pack to AC power plug on back of Analyzer.
5. Dress cabling into retaining area and slide battery into position to align with mounting screws
6. Align and tighten the four slotted mounting screws.

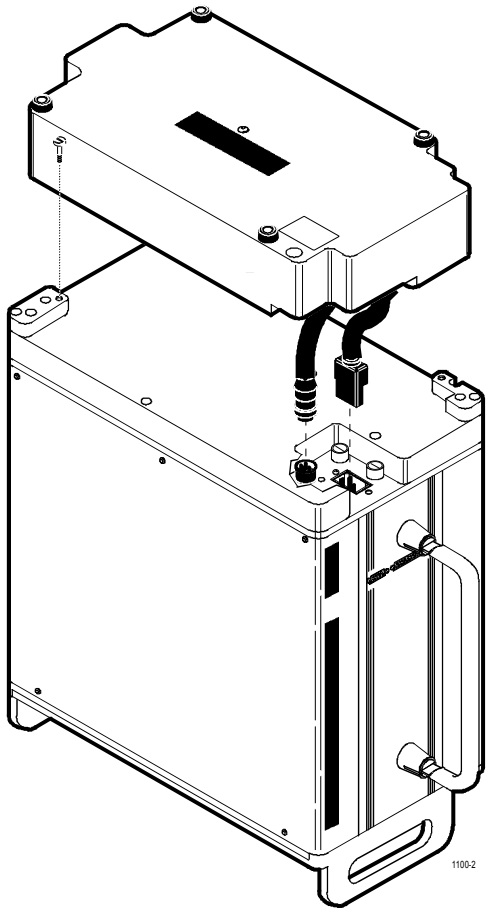


Figure 1-2. Battery Pack Installation

1-6.4 Installation des Akkusatzes

1. Stellen Sie den Funkmeßplatz kopfüber auf einem Tisch mit der Rückseite nach oben.
2. Legen Sie den Akkusatz auf die Rückseite des Gerätes so daß die Bohrung im Akkusatz auf den Netzstecker des Funkmeßplatzes ausgerichtet ist. Befestigungsschraube noch nicht anziehen.
3. Verbinden Sie den vierpoligen Anschlußstecker des Akkusatzes mit dem vierpoligen Anschluß DC POWER auf der Rückseite des Funkmeßplatzes.
4. Stecken Sie das Netzkabel des Akkusatzes in den Netzstecker auf der Rückseite des Funkmeßplatzes.
5. Legen Sie das Kabel in die entsprechende Aussparung und verschieben Sie den Akkusatz so, daß sich die Befestigungsschrauben anziehen lassen.
6. Befestigen Sie den Akkusatz mit den vier Schlitzschrauben.

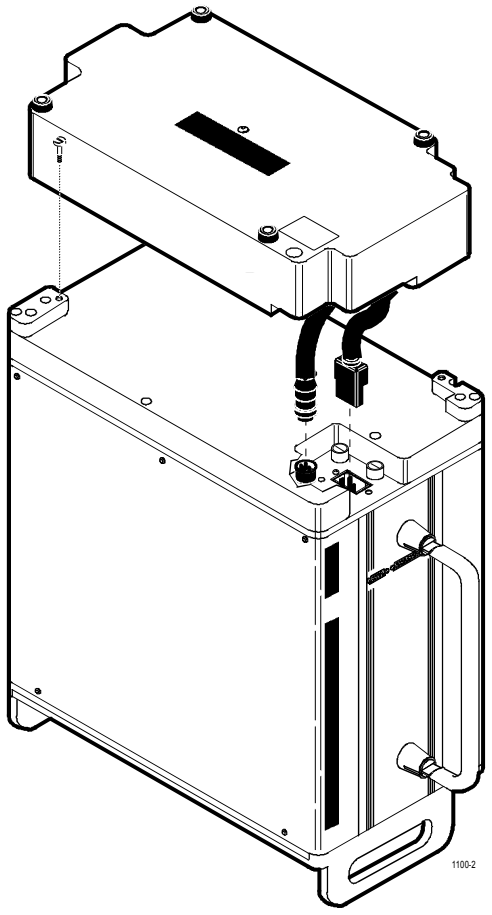


Abb. 1-2. Installation des Akkusatzes

Section 2

DESCRIPTION

2-1 DESCRIPTION

R2600 Series Communication System Analyzers are portable test instruments designed to monitor and service radio communications equipment over the frequency range of 400 Hz to 999.9999 MHz. figures 2-1 and 2-2 show the analyzer's controls, indicators, and connectors, and lists their functions. The analyzer generates signals, measures modulation and frequency, and performs a variety of tests normally associated with the following devices:

- RF Signal Generator
- Sensitive Measurement Receiver
- Spectrum Analyzer
- Duplex Offset Generator
- Oscilloscope
- Frequency Counter
- AC/DC Voltmeter
- RF Wattmeter
- Sweep Generator
- Signaling Encoder/Decoder
- Signal Strength Meter
- SINAD Meter
- Distortion Analyzer

2-2 OPERATOR CONTROLS

2-2.1 Keys & Indicators

Power Switch

Press ON to energize all circuitry. The unit automatically selects AC power if line power is available. Otherwise, the unit looks for a DC source. Switching is automatic upon cycling of the POWER switch.

ON LED

Illuminates when power switch is pressed ON.

DC LED

Illuminates when equipment uses DC power.

Cursor Zone Keys (RF, AUD, & DISP)

Determines the zone of the display that the cursor will be active in. When changing zones, the cursor moves to the same cursor location occupied the previous time it was in that zone.

Cursor Position Keys (Up, Down, Left, Right, TAB)

The five cursor movement keys are used to move the cursor to the left, right, up, down, or tab.

HELP Key

Displays help instructions for the present screen.

MEM Key

Accesses the Memory screen for nonvolatile memory presets.

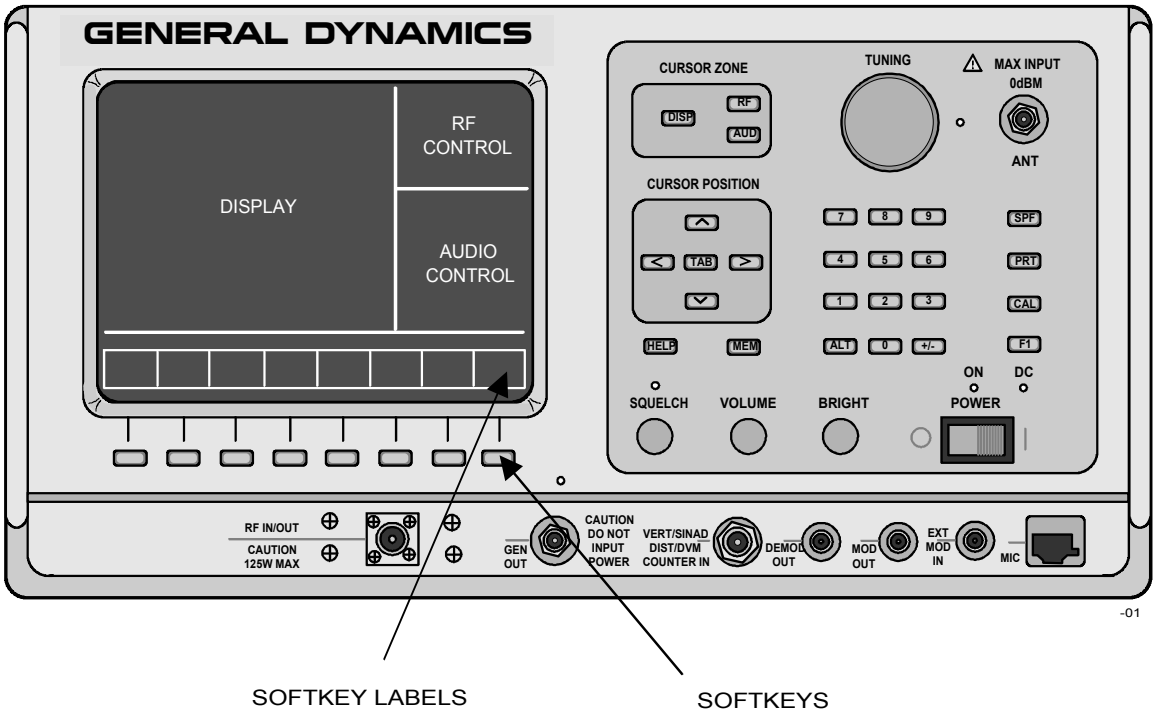


Figure 2-1. Front Panel Controls, Indicators, and Connectors

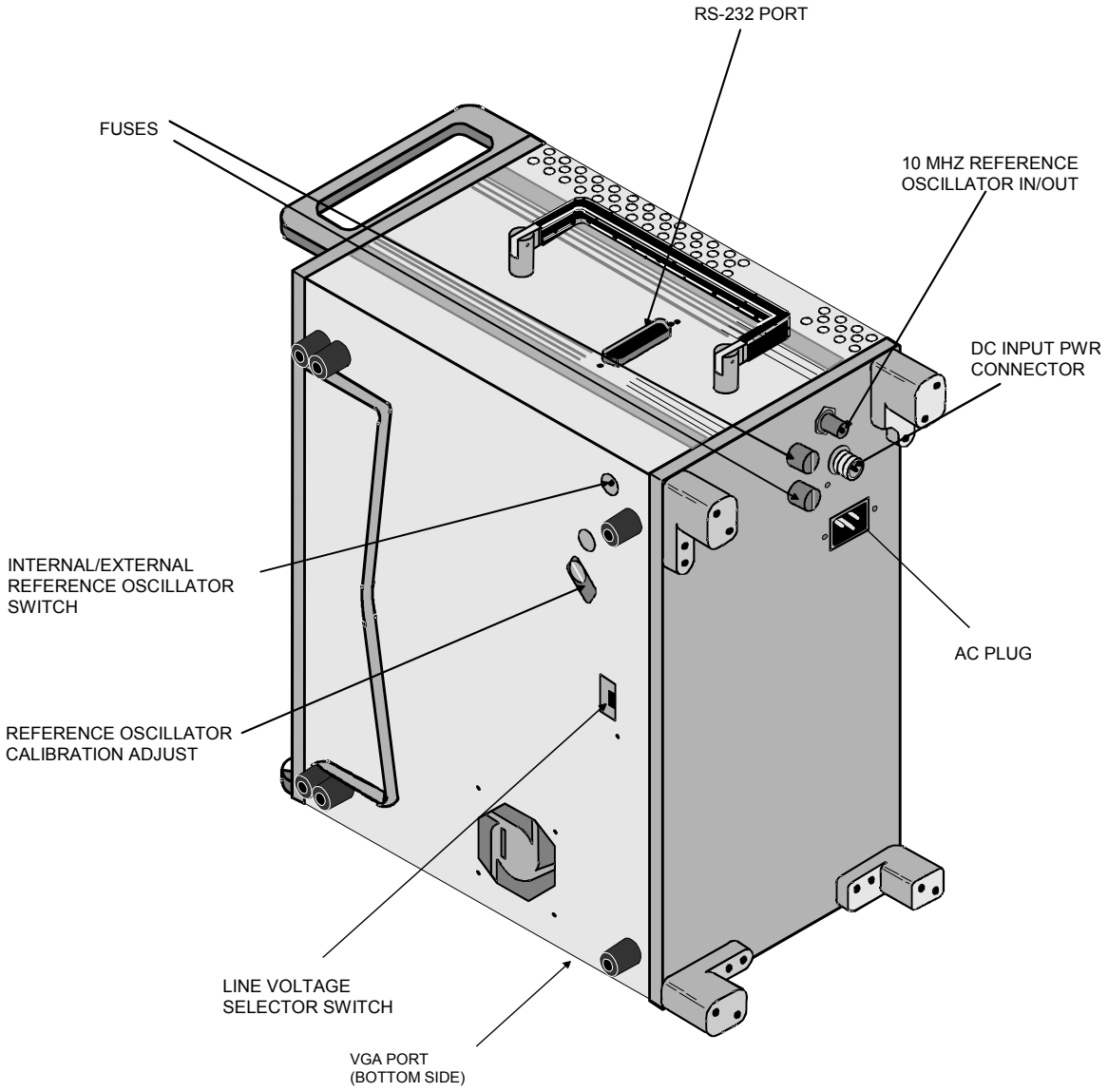


Figure 2-2. Side, Rear, and Bottom Panels

Keys (0-9)

For entering numeric information into the analyzer. When a key is pressed, the existing display numeral (where the cursor is sitting) is replaced with the numeral represented by the keypress. The analyzer then reacts to the new information just entered. When an invalid numeric entry is attempted, the analyzer ignores the keypress and the numeral on the screen remains unchanged.

+/- Key

Toggles the displayed sign from its present value to the negative of its present value.

ALT Key

Enables the alternate functions on the keypad. Upon pressing the ALT key, the message ALT appears on the message line. Pressing any other key following the ALT key will cause the ALT message to disappear.

SPF Key

Displays the special functions menu of the display.

PRT Key

Sends the data contents of the displayed screen to a printer.

CAL Key

Instructs the processor to perform a self calibration on the system.

F1 Key (Optional Function)

Permits access to additional functions. Currently used to return to local mode from remote mode.

Softkeys

Located below the display, the softkeys provide a menu function to indicate all possible values or entries for the current cursor position. If the cursor moves, the softkey functions change.

2-2.2 Knobs

Squelch

Squelch control. Clockwise rotation increases the receiver threshold signal level above which the squelch opens.

Volume

Controls volume of the speaker audio.

Bright

Intensity adjustment of the display. Clockwise rotation results in higher intensity.

Tuning

Incrementally changes the digit over which the cursor is currently sitting. Clockwise rotation of the tuning knob increases the number; counter-clockwise rotation decreases the number. This provides the equivalent of an analog control for numeric cursor entry locations.

2-2.3 DISPLAY

9 cm x 11 cm bit-mapped LCD. Provides data, operating controls, and instructional information. Displays in digital, analog, and bar graph forms.

NOTE

The LCD has a screen saver feature that reduces intensity after approximately 30 minutes of inactivity. Press any key to restore the display.

2-2.4 Connectors

2-2.4.1 Front Panel Connectors

RF IN/OUT

Provides RF input signal to the analyzer's internal monitor or output signal from the analyzer's internal generator. Also provides combined input/output in DUPLEX mode. Contains the RF wattmeter load. This is the only front panel connector to which RF power may be applied.

GEN OUT

Provides a high level generator RF output port isolated from the Monitor input. **DO NOT APPLY RF POWER.**

ANT

Input port for sensitive monitor receiver. Useful for off-the-air measurements. **DO NOT APPLY RF POWER.**

NOTE

The GEN OUT and ANT connectors are protected from overload by an RF fuse installed in the front panel connector. This fuse may be accessed by unscrewing the front portion of the BNC connector from the panel using a 7/16 inch deep socket wrench. Replacement fuse part number is GG-6530277C002.

CAUTION

The RF fuse leads must be trimmed to a length of .48 $\pm$.02 inches and the tips cut to a point to facilitate installation.

VERT/SINAD DIST/DVM COUNTER IN

Combined input port for oscilloscope vertical, SINAD meter, DVM/counter, Distortion meter, DVM, and frequency counter inputs.

DEMOD OUT

Recovered (demodulated) audio output (MONITOR or DUPLEX mode).

MOD OUT

Composite output of internally generated modulation signals.

EXT MOD IN

External modulation input connector. Requires a fixed input level of $1V_{pk}$ for accurate level displays.

MIC

Connector for external accessory microphone.

2-2.4.2 Side Panel Connectors

VGA Port (15 pin)

Provides connection to external VGA format color monitor.

RS-232 PORT (25 pin)

Provides input/output for printer or control interface.

2-2.4.3 Back Panel Connectors

10 MHZ STD

BNC connector provides input/output for 10 MHz reference frequency. Input impedance is 50 ohms. Input level requirement is 70 mV to 1 Vrms. Output level is approximately 250 uVrms.

AC POWER Connector

Primary AC power input port.

DC POWER Connector

Primary DC power input port.

2-3 BOTTOM CONTROLS

Internal/External Oscillator Micro-Switch

Used to switch between input and output configurations for the rear panel 10 MHz reference oscillator BNC connector.

CAUTION

The analyzer will not function properly if this switch is set to external without a 10 MHz reference signal applied to the rear 10 MHz reference BNC connector.

Internal Reference Oscillator Adjustment Access

Provides convenient external access to recalibrate reference oscillator frequency setting.

CAUTION

Use a reliable and accurate frequency standard when making this adjustment.

115/230 VAC Selector Switch

Used to switch the unit's internal power supply for either 115V or 230V operation.

Section 3

OPERATING INSTRUCTIONS

3-1 GENERAL

R2600 Series Communications System Analyzers are designed specifically for the service and monitoring of radio communications equipment. This product represents a breakthrough in simplicity of operation. In place of numerous meters, keys and controls, the analyzer employs an LCD display which simultaneously presents control and data displays. A simplified front panel, utilizing soft keys, cursor movement keys, a numeric key pad, an analog tuning control and other dedicated function keys all combine to make the unit extremely easy to learn and very efficient to use.

Primary operating modes of the unit are MONITOR, GENERATE, DUPLEX and SWEEP GENERATOR. They are accessed through the RF Control display area at the upper right of the screen (figure 3-1). Within these modes of operation, various measurement functions may be selected in order to measure and diagnose many types of radio equipment under test.

RF data display, voltmeters, distortion meter, SINAD meter, frequency counter and modulation decoder functions are available through the Meter display area at the upper left of the screen.

Spectrum analyzer, oscilloscope and bar graph displays are available through the Display area at the lower left of the screen.

Control of the internal modulation synthesizer and level selection for externally applied modulation are provided through the Audio area at the lower right of the screen.

Further explanation of the function of each of these screen areas can be accessed through use of the HELP key to the lower right of the screen.

3-2 BASIC OPERATION

Control of the unit and selection of data to be displayed are done through the use of three main windows which simultaneously appear on this screen.

These three main windows, or cursor zones, are accessed simply through a cluster of three CURSOR ZONE keys at the top center of the unit. The location where the cursor rests within each zone is known as a cursor field. To control the unit and enter data, all operator inputs are made at highlighted cursor field locations (brighter-face type).

For further simplicity, softkeys, with customized on-screen labels interact with the screen to provide a unique menu of entry options for each cursor field. This greatly reduces the number of keys and having to search through unrelated controls to find the one that's needed.

3-2.1 Remote Operation

All R2600 Series Communications System Analyzers are equipped with a standard RS-232 interface. Optionally, the R2600 is equipped with an IEEE 488 interface. Either of these interfaces may be used to remotely control the analyzer using a set of commands, queries, and responses that are defined in the General Dynamics R2600 Series Communications System Analyzer Programming Reference Manual (68-80309E55).

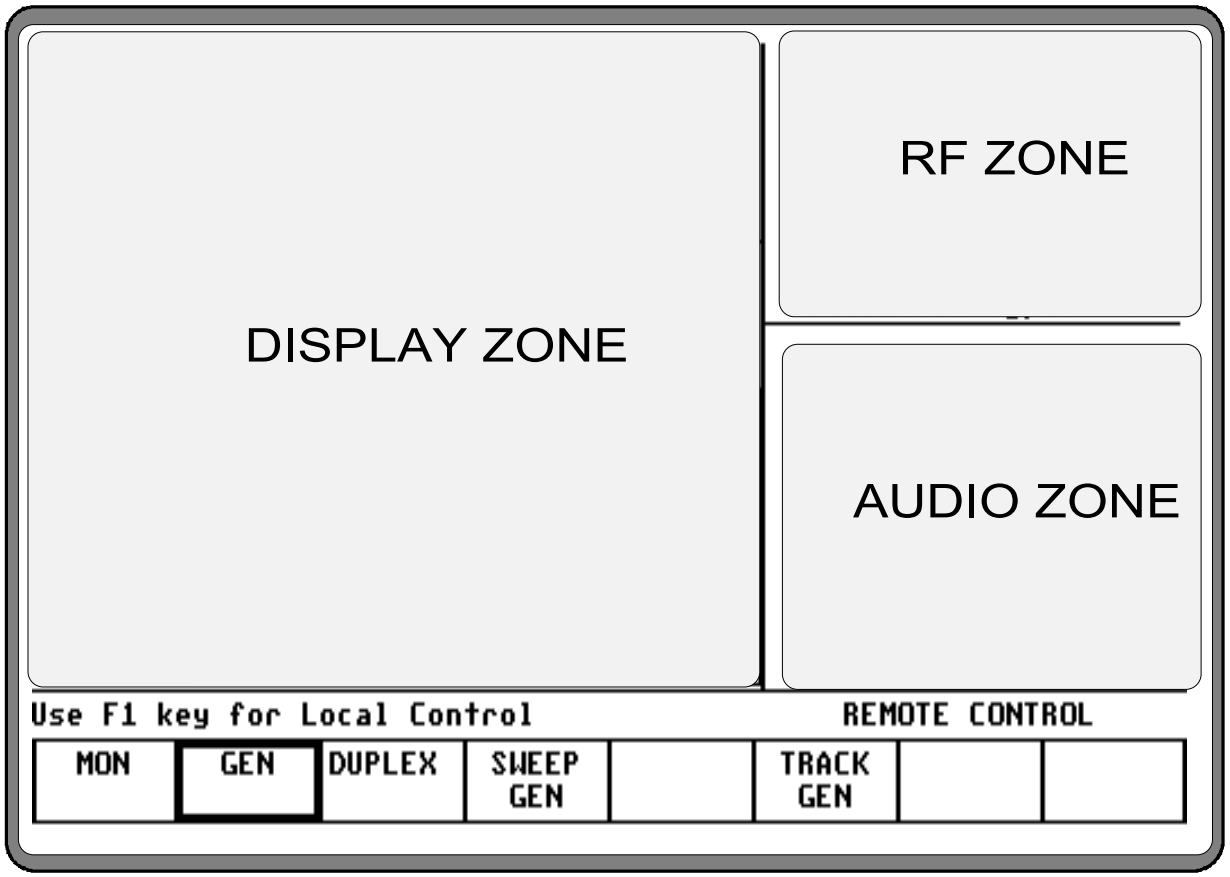


Figure 3-1. Screen Zone Arrangement

To control the cursor location and input information by:

- Use the CURSOR ZONE keys to move the cursor among the three zones.
- Use the CURSOR POSITION keys to move the cursor from field to field within a zone.
- Once at the desired field, use either the TUNING knob or the numeric keys to enter numeric information. Use the soft keys for other menu selections.

3-2.2 Expanded Display

Some fields have the ability to expand their contents and overwrite other display areas. These consist of the following:

- Spectrum analyzer, scope waveforms, bargraph displays
- Decode tables
- Encode tables
- Dedicated keys

3-2.2.1 Spectrum Analyzer, Scope Waveforms or Bargraph Display

By pressing the expand softkey within these displays, the entire screen (with the exception of the message line and softkey area) is overwritten and replaced by an enlarged version of the display section to enable a more detailed analysis of displayed data. A return softkey causes the screen to be restored to its original size.

3-2.2.2 Display Tables

Decode Tables are selected from the "Meter:" field. Selection of General Sequence, 5/6 Tone, or Select V decode modes causes the system to overwrite the meter and display zones with the display tables.

NOTE

To escape from a decode display table, return the cursor to the "Meter:" field and make an alternate selection.

Encode Tables are selected from the "Audio Mod Sum:/Mod Sum:" field. Selection of General Sequence or A/B Sequence encode modes and pressing the display table softkey causes the system to overwrite the meter and display zones with the display tables. Use the return softkey to exit to previous screen.

3-2.2.3 Dedicated Keys

Refer to the Other Functions portion of this manual (paragraph 3-8) for an explanation of expanded screens in the HELP, MEM, SPF, and CAL modes.

3-3 HELP

The analyzer provides on-screen operating instructions via the dedicated HELP key. Help screens are organized such that each display area has an associated help screen pertaining to that area of the screen. System help (figure 3-2) is available via a softkey within each help screen. Use the return softkey to return to the function in progress.

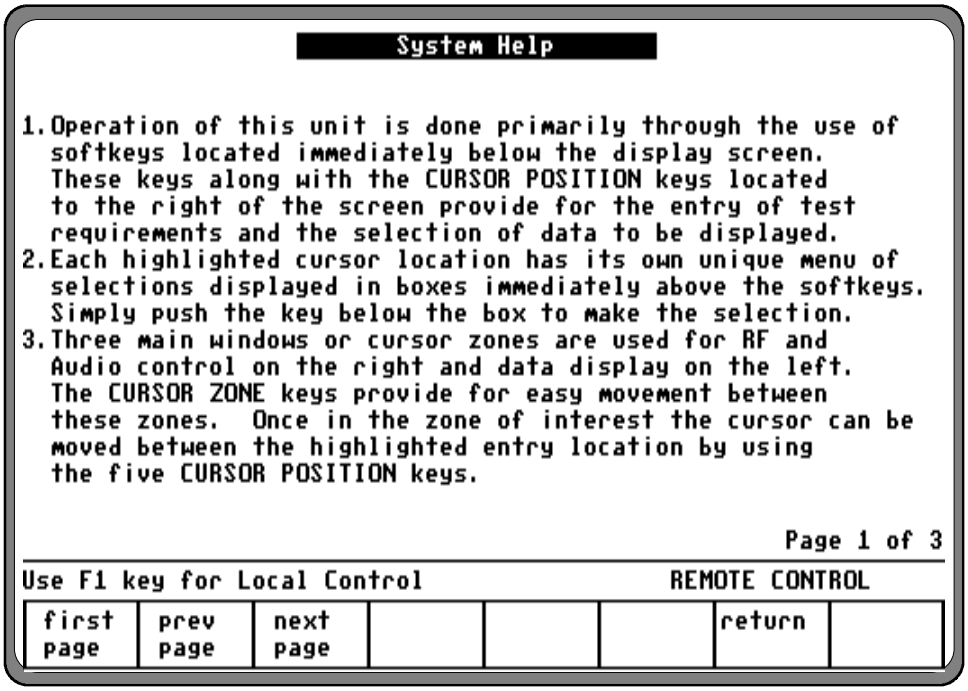


Figure 3-2. System Help

3-4 WARNINGS

The system provides warnings for the following operating conditions, which are considered detrimental to the proper functioning of the analyzer:

- RF Overload

  (Input level to monitor too great for accurate measurement)

- Recalibrate

  (Indicates that the unit's internal temperature has changed more than 10º C from where it was last self-calibrated. This may affect the accuracy of the generator output level, monitor input level below +20 dBm, and modulation level. Refer to paragraph 3-8.3 for further information.

- RF Overtemperature

  (Excessive power to RF load)

- Optional Battery Pack Voltage Low

If any of these conditions exist:

- A warning will be displayed on the warning line of the LCD for RF overload, recalibrate, and low battery voltage.
- A continuous audible warning tone along with an overwrite of the screen with a warning message will be presented for RF overtemperature (figure 3-3). This condition may occur when the intermittent power rating of the 125 watt internal load is exceeded. Both the display and the warning tone remain on and all operator input is ignored until the condition is corrected. The Analyzer then resumes normal operation.

CAUTION

Remove RF power immediately to correct the RF overtemperature condition. Otherwise damage to the unit may occur.

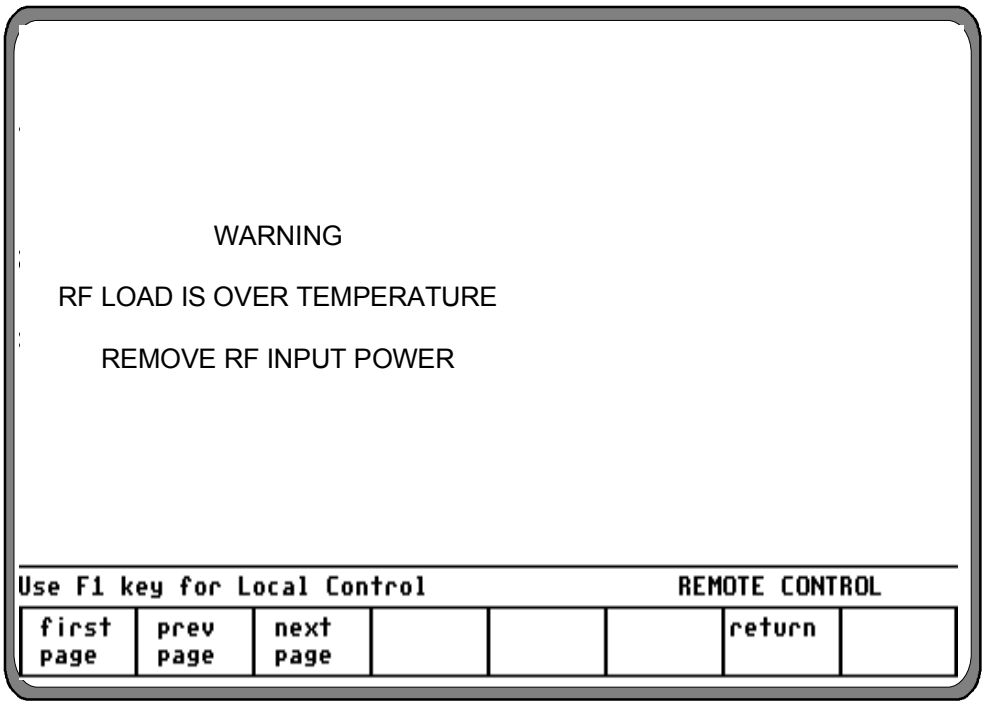


Figure 3-3. RF Overtemperature Warning Message

3-5 PRIMARY OPERATING MODES

Select the operating mode by placing the cursor in the "RF Control:" field in the RF zone. Use the desired softkey to make selection. Primary operating modes are:

- MONITOR
- GENERATE
- DUPLEX
- SWEEP GENERATE

3-5.1 MONITOR Mode

The Monitor mode (figure 3-4) provides the analyzer's test receiver function which is used in the testing of radio transmitters. It is capable of monitoring RF input through it's antenna or a direct connection to the transmitter to accurately determine the frequency, power level, and modulation characteristics. It monitors signals from 400 kHz to 999.9999 MHz. Center frequency is set in 100 Hz increments.

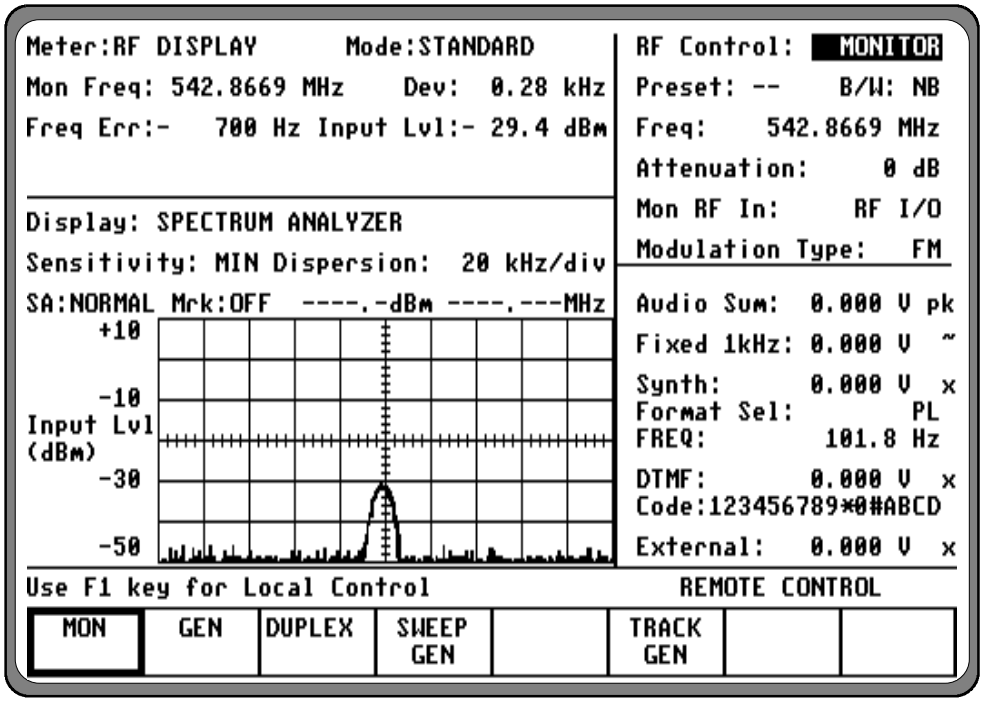


Figure 3-4. Monitor Mode

Specific controls which further configure the MONITOR mode are located within the RF zone when MONITOR is first selected. The specific entry fields are as follows.

Preset

The preset entry field provides a convenient way to enter a bandwidth, frequency, modulation type, and code synthesizer format for the unit by recalling preset data from non-volatile memory. If a preset is not to be used, enter the desired information at each of the fields.

NOTE

If a preset had been selected and changes are made to any of the preset values, the "Preset:" field will have dashes through it, indicating the preset is no longer selected.

B/W

Selects either wide or narrow IF bandwidth of the unit via softkey selection.

Freq

Enter the desired monitor frequency using keypad or tuning knob.

Attenuation

Selects the amount of attenuation at the RF input to the monitor receiver using softkeys. Selectable input attenuation is useful in adjusting displays for a wide range of input levels, as well as for use in high RF field environments where intermodulation may cause desensitization of the receiver.

Mon RF In

Selects the RF input port via softkeys. The RF I/O port contains an RF load and should be used for direct connection to the radio under test. The ANT port accesses the unit's sensitive receiver and should be used with an antenna for "off-the-air" reception. Selection of the ANT port is indicated by a red LED adjacent to the ANT connector.

CAUTION

Do not apply input power to the ANT input port. In the event RF power is inadvertently applied, the port is protected by an in-line RF fuse. This fuse may be accessed by unscrewing the front of the BNC connector out of the front panel. Refer to paragraph 2-2.4.1 for additional detail.

Modulation Type

Selects the type of modulation via softkeys. AM and FM are standard selections. Phase modulation (option) is selected by pressing the sofkey labeled PM, and provides the cpability to generate and monitor PM signals.

3-5.1.1 Phase Modulation

Phase Modulation provides the capability to generate and monitor PM signals. This is an additional softkey selection in the RF Control zone for the modulation type (figure 3-5).

In Generate mode, narrow-band operation provides user control of the audio signal deviation from 0.50 to 2.00 radians in 0.01 radian steps. In wideband operation, the audio signal deviation ranges from 2.0 to 10.0 radians in 0.a radian steps. Tones generated from the Audio zone are limited in frequency from 300 Hz to 3000 Hz for phase modulation

NOTE

Phase Modulation is a hardware option that is installed at the factory. To determine if Phase Modulation is available in the Analyzer, examine the Standard Options display screen (accessed via SPF/Version

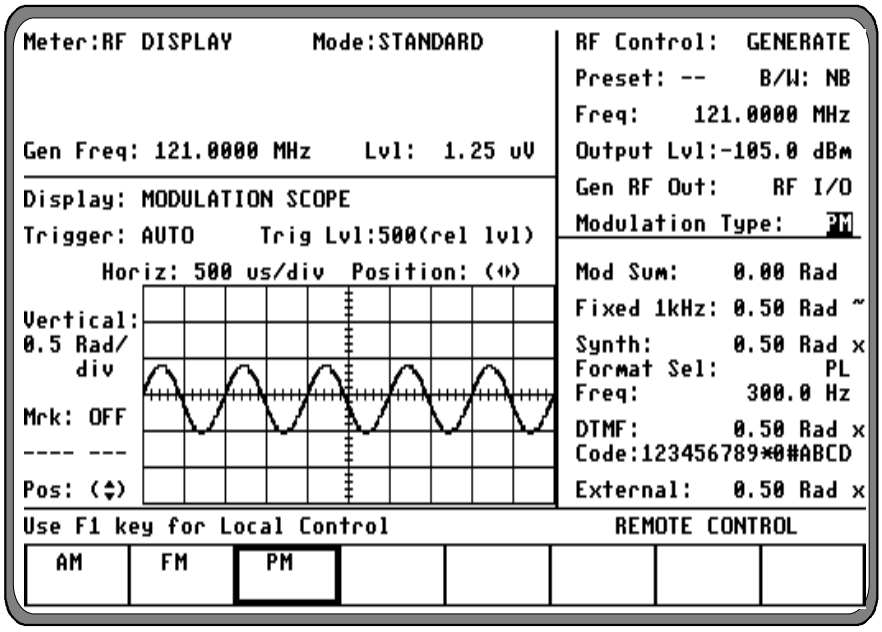


Figure 3-5. Phase Modulation

3-5.2 GENERATE Mode

The GENERATE mode (figure 3-6) configures the Analyzer to generate an RF signal at a controllable output level to provide for a wide range of receiver testing. Multiple internal andexternal modulation signals can be simultaneously impressed on the carrier frequency to generate composite signals for servicing. Signals from 400 kHz to 999.9999 MHz may be generated. Center frequency is set in 100 Hz increments.

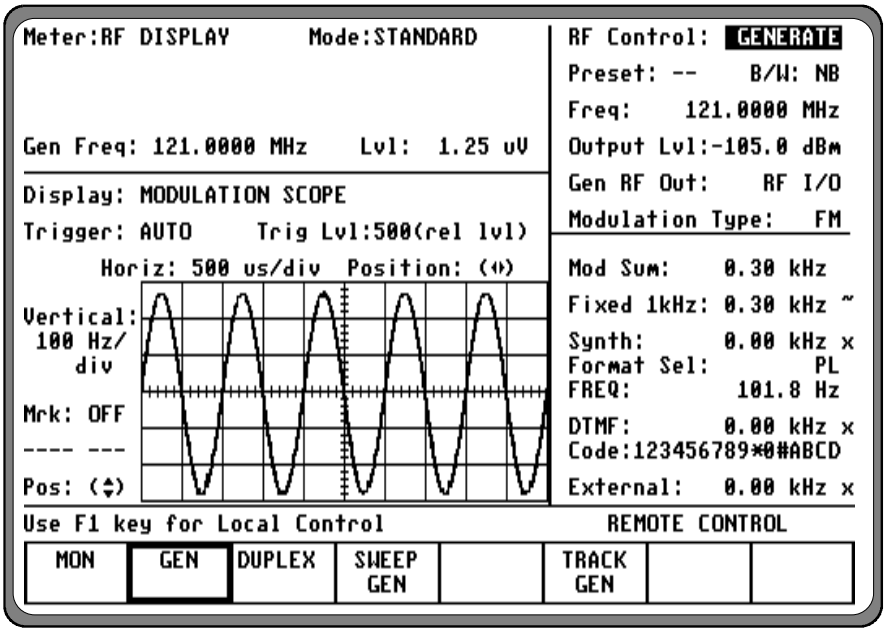


Figure 3-6. Generate Mode

Specific controls which further configure the GENERATE mode are located within the RF Control zone when GENERATE is first selected.

The specific entry fields are as follows:

Preset

The preset function is the same as in the MONITOR mode.

B/W

Selects either wide or narrow bandwidth of the unit via softkey selection.

Freq

Enter the desired generate RF frequency using keypad or tuning knob.

Output Lvl

Selects generator output level in 0.1 dBm steps over the range of -130 dBm to 0 dBm. An alternate display of generate level in microvolts is available in the "Meter:" area of the display zone. Output level is available in two ranges depending upon which output port is selected:

- The range of -80 dBm to 0 dBm is available when the high level GEN output port is selected.
- The range of -130 dBm to -50 dBm is available when the RF I/O output port is selected.

NOTE

If AM modulation is selected, the maximum output at the GEN port is reduced to -6 dBm; the maximum output at the RF I/O port is reduced to -56 dBm.

Gen RF Out

Selects the RF output port via softkeys. The RF I/O port is recommended for most applications where GEN and MON ports are combined for a single connection to the radio under test. The GEN port is recommended where higher levels are needed. Selection of the GEN port is indicated by a red LED adjacent to the GEN OUT connector.

CAUTION

Do not apply input power to the GEN output port. In the event RF power is inadvertently applied, the port is protected by an in-line RF fuse. This fuse may be accessed by unscrewing the front of the BNC connector out of the front panel.

Modulation Type

Selects the type of modulation via softkeys.

3-5.3 DUPLEX Mode

The DUPLEX Mode (figure 3-7) provides a simultaneous RF generator output that is offset in frequency from the monitor center frequency and fully adjustable in output level.

This capability provides for servicing full duplex radio equipment as well as repeaters and radios operating with offset transmit and receive frequencies.

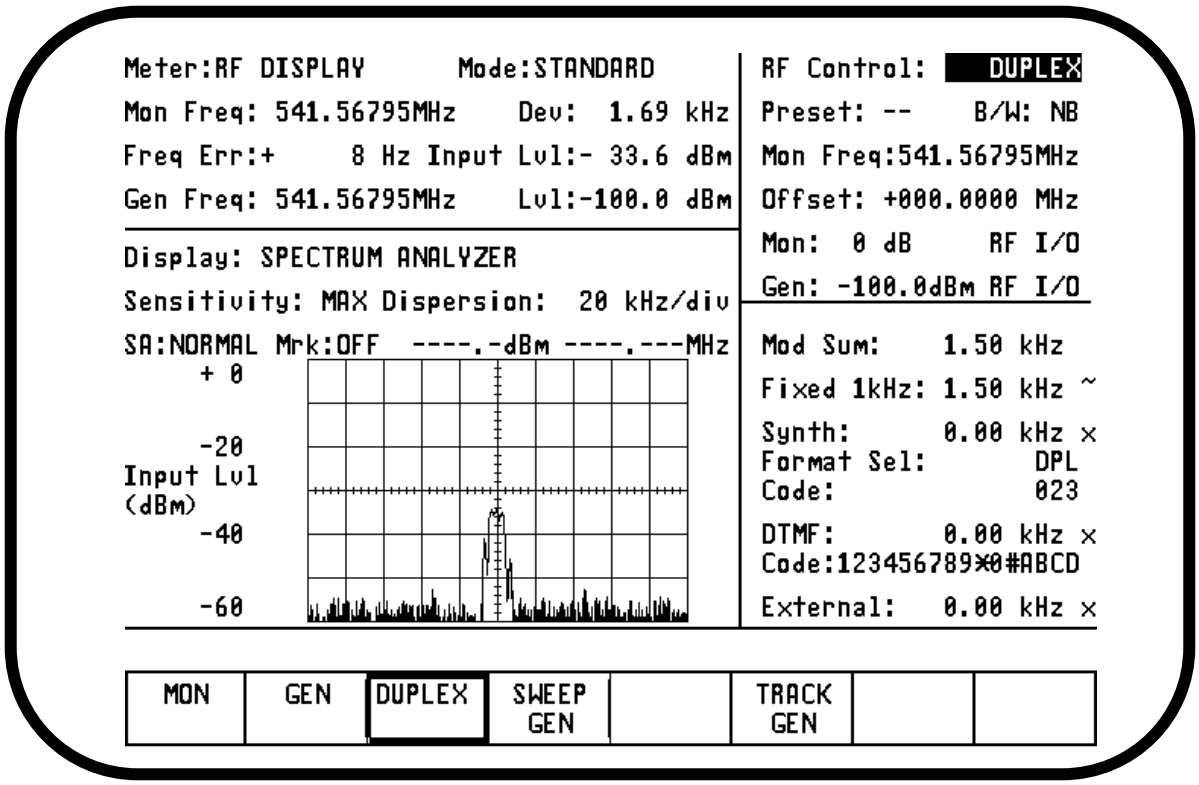


Figure 3-7. Duplex Mode

Specific controls which further configure the DUPLEX mode are located within the RF Control zone when DUPLEX is first selected.

The specific entry fields are as follows:

Preset

The preset function is the same as in the MONITOR mode.

B/W

Selects either wide or narrow bandwidth of the unit via softkey selection.

Mon Freq

Enter the desired monitor frequency using keypad or tuning knob

Wide Offset

Enter the generator frequency offset relative to the monitor frequency entered. Offset frequencies of –999.99975 to +999.99975 MHz are allowed, but the final generate frequency will be constrained to 000.40000 MHz through 999.99995 MHz. The offset frequency is set in 2.5 kHz steps.

Mon

This field actually contains two separate fields, one for monitor input attenuation and one for monitor port selection. Refer to the MONITOR description for further details.

Gen

This field actually contains two separate fields, one for generate output level and one for generate output port selection. Refer to the GENERATE description for further details.

NOTE

Only FM modulation is provided for the duplex generator. Either FM or AM demodulation may be selected. Selection must be done in MONITOR Mode within the RF control zone. The RF I/O port combines monitor and generate signals for the duplex function. However, either the ANT or GEN ports may be independently selected.

3-5.4 SWEEP GENERATE Mode

The SWEEP GENERATE Mode (figure 3-8) provides a sweep generator function with variable level, rate, and bandwidth. A sweep generator is invaluable when measuring and troubleshooting many types of RF filters and frequency variable networks such as IF filters, RF preselectors, duplexers and cavity resonators.

To sweep test connect the GEN output port to the input of the network under test.

To facilitate display of swept responses of networks under test, the units built-in scope display can be accessed by selecting SWEEP GENERATE within the "Display:" field. A suitable RF detector probe should be used to connect from the output of the circuit under test to the VERT/SINAD/DIST input port (refer to ordering instructions provided in the front portion of this manual for recommended accessory RF detectors). The scope's horizontal sweep tracks the sweep of the RF Generator, thus allowing a frequency domain analysis of filterfilters, RF front ends, duplexers, etc.

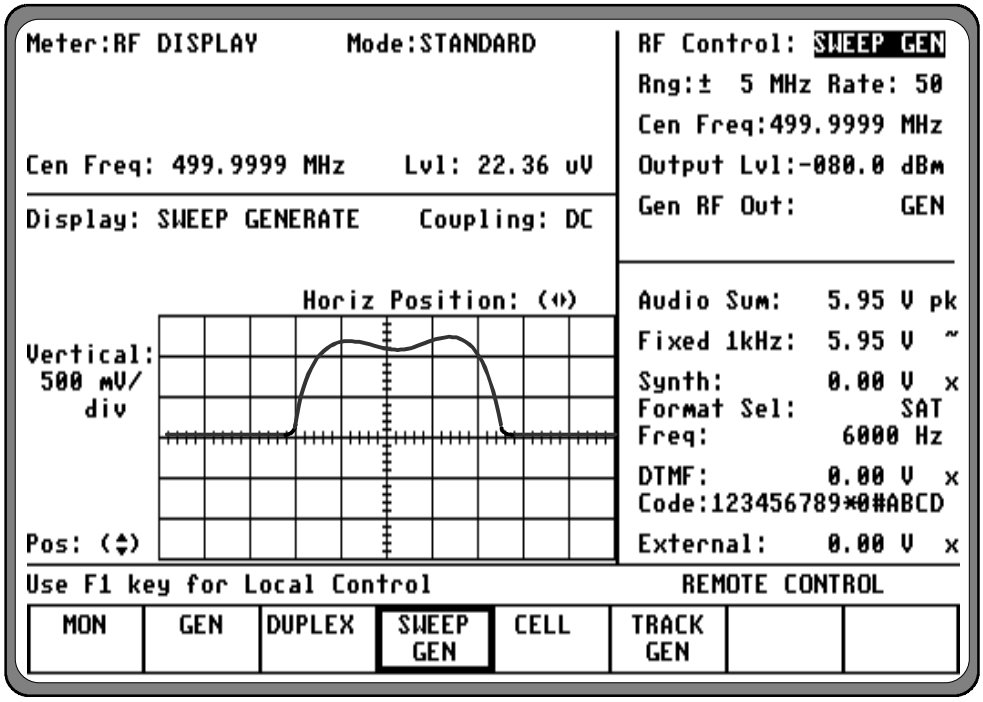


Figure 3-8. Sweep Generator Mode

Specific controls which further configure the SWEEP GENERATE mode are located within the RF Control zone when SWEEP GENERATE is first selected. The specific entry fields are as follows:

Rng

Selects the RF frequency range over which the generator will sweep. Specific ranges are selectable via softkeys.

Rate

Selects the sweep rate for the generator and corresponding scope display. Sweep rate is selectable using softkeys.

Cen Freq

Refer to the GENERATE mode, "Freq:" field.

Output Lvl

Refer to the GENERATE mode.

Gen RF Out

Refer to the GENERATE Mode.

3-5.5 TRACKING GENERATOR Mode (if equipped)

The TRACK GENERATOR mode (figure 3-9) sets up the units signal generator in a sweeping mode for use with the optional Tracking Generator display. This provides a valuable capability for measuring and servicing a wide variety of RF filtering and combining networks.

To operate the Tracking Generator simply select TRACK GEN via softkey in the "RF Control:" field in the RF Control zone. Connect the GEN OUT port to the input of the network under test.

Connect the output of the network under test to the ANT port. Be sure to activate the ANT port thru the "Mon:" field in the RF Control zone. If input attenuation is needed as part of the measurement procedure, 20 or 40 dB attenuation may similarly be selected thru the "Mon:" field in the RF Control zone.

The Tracker display is selected through softkeys at the "Display:" field of the DISP zone at the left center of the screen. The display is a 10 dB/div scale. By adjusting the generator level and selecting 20 or 40 dB of input attenuation, the usable measurement range is approximately 100 dB at frequencies below 500 MHz and 80 dB above 500 MHz.

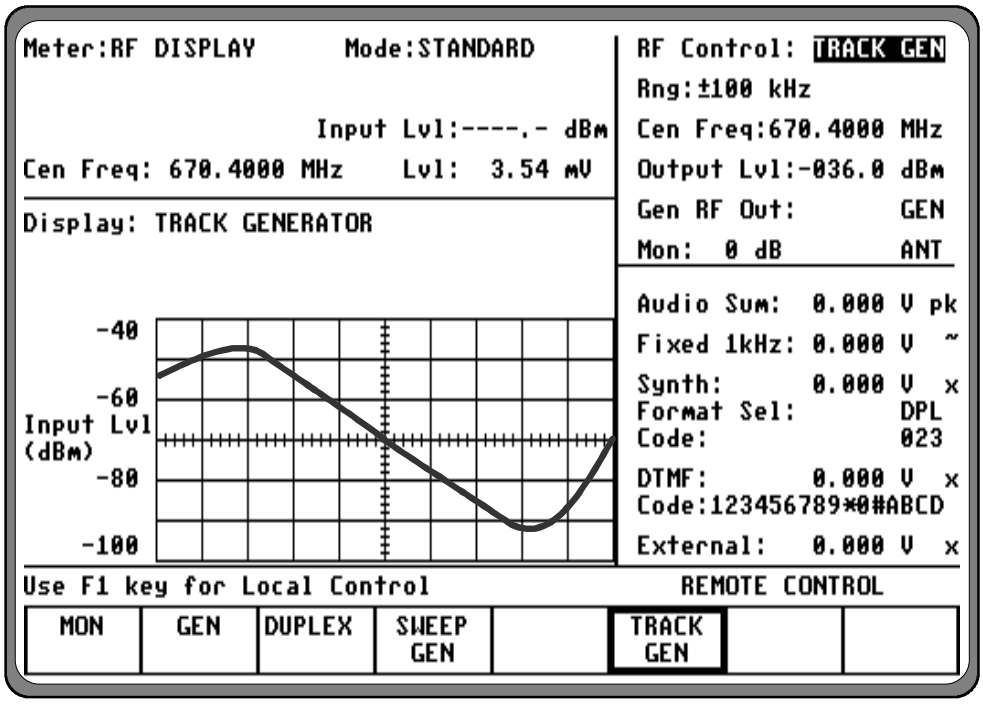


Figure 3-9. Tracking Generator Mode

All adjustments of center frequency, frequency range and generator level are made thru the RF zone at the upper right of the screen. The TUNING control is especially useful in tuning center frequency and generator level. These may all be adjusted as follows, thru softkeys or numeric entry, for the desired display, depending on the type of network being tested.

Rng

Selects the RF frequency range over which the generator will sweep. These are expressed in ± full screen deflection ranges that are selectable via softkeys. The sweep rate of the tracking generator is fixed at approximately 50 ms/sweep.

Cen Freq

Selects the center frequency of the Tracking Generator display. Refer to the GENERATE mode for more detail on frequency entry.

Output Lvl

Refer to GENERATE mode.

Gen RF Out

Refer to GENERATE mode.

3-6 AUDIO/MODULATION SYNTHESIZER

The Audio zone located at the lower right of the screen is used to control the multi-purpose audio synthesizer section of the unit. Signals generated by the audio synthesizer are coupled internally to the generator modulation input as well as to the MOD OUT front panel connector.

In the GENERATE and DUPLEX modes, levels entered in the Audio zone are shown as modulation (either deviation or % AM). The composite sum of modulation, only for those modulation sources enabled, is displayed at the top of the zone at the "Mod Sum:" location.

In the MONITOR and SWEEP GENERATE modes, levels entered in the Audio zone are shown as peak voltage values. The composite sum of the voltage value (only for those modulation sources enabled) is displayed at the top of the zone at the "Audio Sum:" location.

Each of the following modulation signals has a cursor field for entering it's desired level. Use the keypad or TUNING knob to enter the desired level.

An additional cursor field, adjacent to each level entry, is used to enable or switch each selection on and off using softkeys. This field is located at the extreme right side of the zone. There are three possible conditions for this softkey selection.

- CONT activates continuous ON condition, or continuous cycling if a sequence has been selected. A ~ symbol is indicated at the extreme right, adjacent to the level to indicate continuous ON.

- OFF switches off the modulation source. Off is indicated by an "X" at the extreme right, adjacent to the level.

- BURST provides a single timed sequence of modulation only for DTMF, TONE A, TONE B, 5/6 TONE, A/B SEQUENCE, GENERAL SEQUENCE, and TONE REMOTE. A single burst sequence is shown by the "*" symbol.

For DPL, select the START DISC TN (*) softkey to produce a continuous disconnect tone. (Select CONT then "*" softkeys to simulate a complete DPL transmission with disconnect tone.)

The composite sum at the top of the zone will not indicate the burst condition. To set the composite level to include bursts of signaling, temporarily select CONT for those modulation sources which will be "burst" enabled.

3-6.1 Fixed 1 kHz

The analyzer has a fixed 1 kHz modulation source, which can be selected independently from the other audio synthesizers. Level control and on-off selection previously described.

3-6.2 Synth

Level control and on-off selection are selectable via softkey selection. The synthesizer function encodes a broad selection of signaling formats, which are softkey selected through the "Format Sel:" field adjacent to "Syth:" level field. Use of the more softkey accesses three different menu levels for the following signaling formats.

PL

This softkey selects Motorola Private-Line tone coded squelch signaling. This selection produces two additional fields on the line below the "Format Sel:" field (figure 3-10). The first allows for softkey selection of either frequency or code entry. The second is the value corresponding to the frequency or code. Valid PL codes are found in Appendix B. All frequency entries are accepted, but only valid codes can be entered.

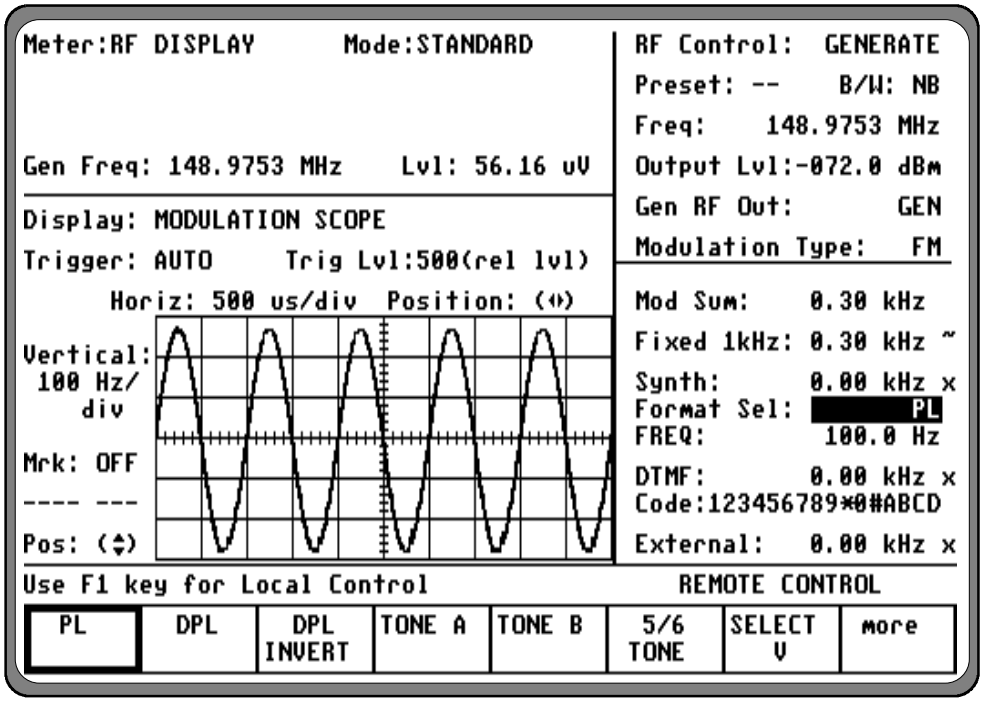


Figure 3-10. PL Format Selection

DPL/DPL Invert

This softkey selects standard or inverted Motorola Digital Private-Line coded squelch. A single cursor field is located below the "Format Sel:" field for entry of code. Only valid DPL codes should be entered per Appendix B.

Tone A/Tone B

This softkey selects either of two continuous audio tones. Tone frequencies may be entered either from the "Freq:" field or from the A/B Sequence tables.

5/6 Tone

This softkey selects 5/6 tone sequences for high-capacity tone paging systems. Only code entry is required in the "Code:" field.

Select V

This softkey selects a number of international formats for five-tone sequential signaling. This selection produces two additional fields on the "Code:" line below the "Format Sel:" field. The first allows a choice of format, selectable by soft-keys. The second selects the numeric code entered by keypad or softkeys.

A/B SEQ

Selects the two-tone sequential paging format, with a choice of four timing sequences selectable through the "Sequence:" field on the line below. An expanded display table can be selected from softkeys to allow entry of A and B frequencies, select a sequence number, and view the tone and delay timing for each sequence. Sequences 1 and 2 are fixed timing for standard "tone" and "tone/voice" pagers, while sequences 3 and 4 may be customized through numeric entries by the user.

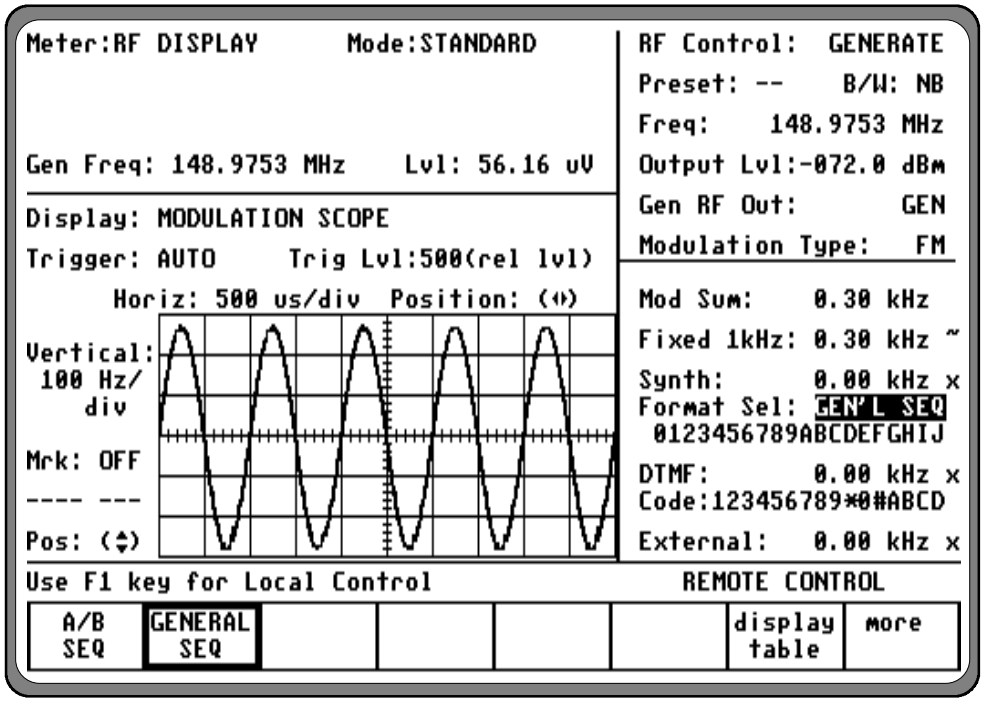
General SEQ

Selects a free-form 20-tone sequence encoding which has full flexibility to enter unique frequency and time duration for each of the 20 tone slots. The single field below the "Format Sel:" field is used to enter the frequency code sequence. An expandable display table is selectable by softkey to allow entry of frequency and time duration data (figure 3-11). Frequencies and durations are tabulated corresponding to a given "code number" (i.e. 1], 2], 3], etc.).

Frequency and times are each selected independently. This is done through entry of independent "Code Sequence:" and "Dur Sequence:" (for example, Code 1] may be selected along with Dur 8] for the first tone slot in the sequence).

Tone Remote

Selects the specialized tone sequence used in control of tone remote equipment. The frequencies used are the same as those for the A/B sequence with timing predetermined per Motorola Tone Remote specifications. Changes to the A and B frequencies can be made from the A/B Sequence table or directly from the Tone A and Tone B "Freq:" fields.



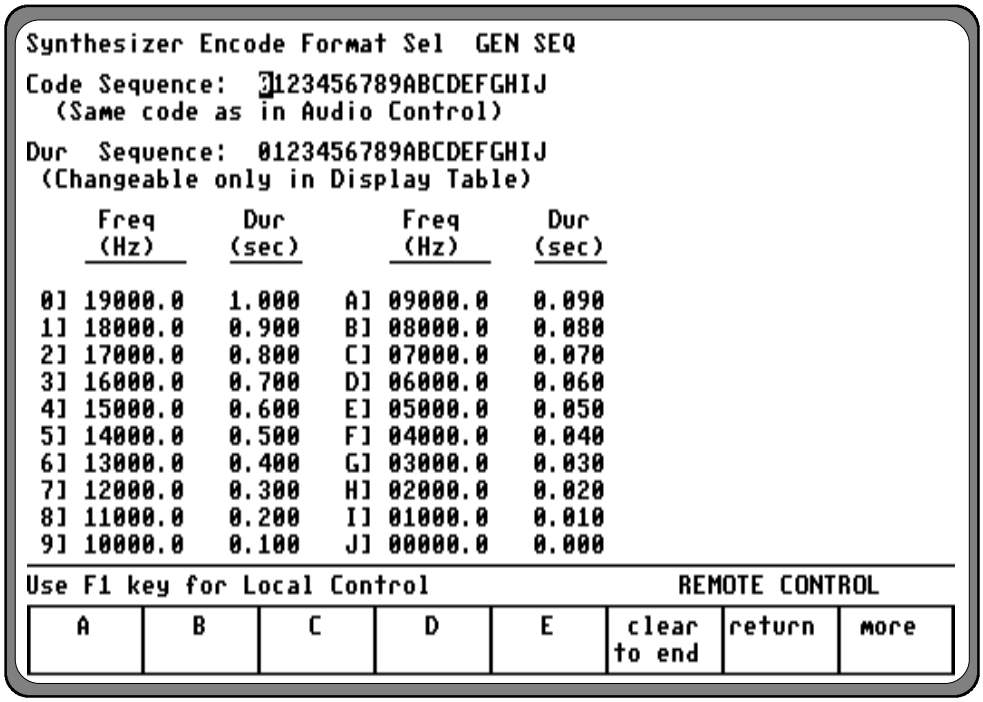


Figure 3-11. General Sequence Mode Select

3-6.3 DTMF

Provides a means for encoding DTMF (Dual-Tone Multi-Frequency) signaling for testing telephone interface systems. Enter level as previously described and enter "Code:" in the field immediately below the "DTMF:" field.

3-6.4 External

Used to set the level and enable externally applied signals from both the MIC and the EXT MOD IN front panel connectors.

NOTE

In the case of external signals applied to the EXT MOD connector, the accuracy of this level displayed is dependent on applying a fixed signal level of 1 Vpk (2 Vpkpk) to the EXT MOD IN connector.

3-7 METER AND DISPLAY

The display of metered data is presented both digitally and graphically within the Display zone in the left portion of the screen (figure 3-12). This zone is divided into two separate display areas: Meter area and Display area.

3-7.1 Meter

Select a measurement display from the following, using softkeys from the "Meter:" cursor field.

3-7.1.1 RF Display

This area displays the RF test data for the radio under test, subject to the mode selected (MONITOR, GENERATE, DUPLEX, TRACK GENERATE, or SWEEP GENERATE).

When the GENERATE mode is selected, the RF Display area shows generator center frequency as well as generate level per the RF Control zone entry. A single cursor field at this location allows selection by softkey of either millivolts/ microvolts (mV/uV), dBu, or dBm units of display.

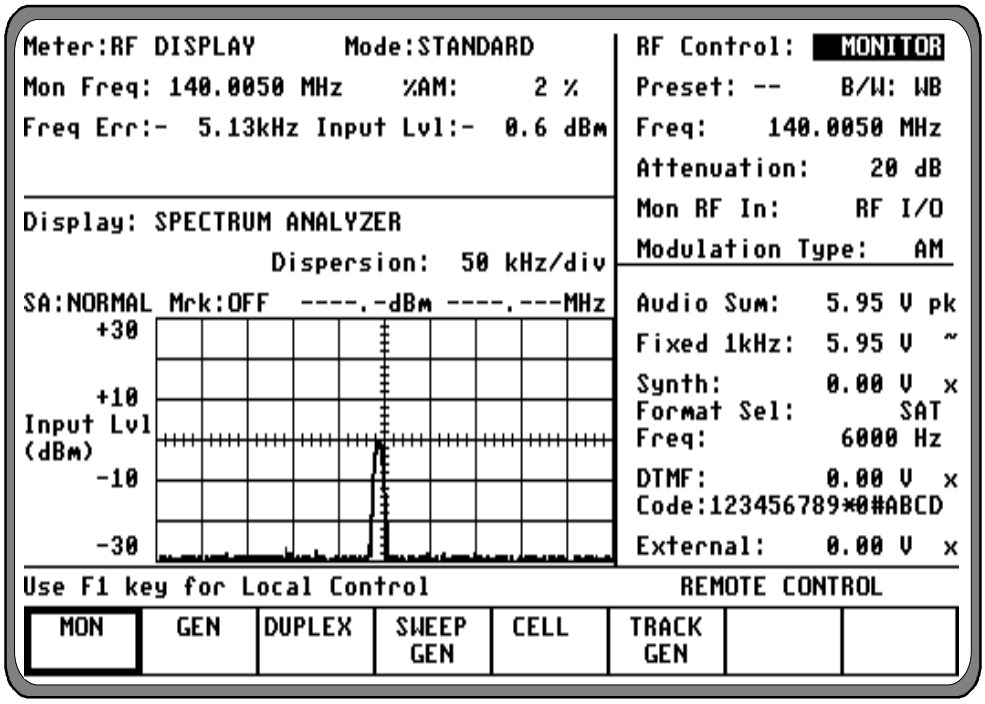


Figure 3-12. RF Display Zone

When DUPLEX mode is selected, the RF Display area reflects a combination of the monitor and generator data, as previously described.

When SWEEP GENERATE mode is selected, the RF Display area reflects the same data as in GENERATE mode. Refer to the previous discussion.

In the MONITOR Mode, the following data is displayed in the RF Display area.

Mon Freq

Center frequency of the radio under test as entered in the RF Control zone.

Freq Err

This area displays the plus or minus frequency offset (error) of the received carrier relative to the center frequency entered above. If the receive phase modulation option is installed and selected in the RF Control zone, this location will display in radians.

Dev/%AM

Indicates the modulation level of the received carrier, dependent upon the modulation type selected in the RF Control zone. If the receive phase modulation option is installed and selected in the RF Control zone, this location will display in radians.

Input Lvl

Displays the signal level received at the selected front panel connector. This area displays transmitter power for high levels of input as well as lower levels of field strength.

Data is displayed only for "on channel" carrier frequencies. A single cursor field at this location allows selection by softkey of either microvolts/watt or dBm units of display.

3-7.1.2 RF Scan

The "Meter:" RF SCAN display (figure 3-13) provides an alternate form of monitor frequency display from the main RF display.

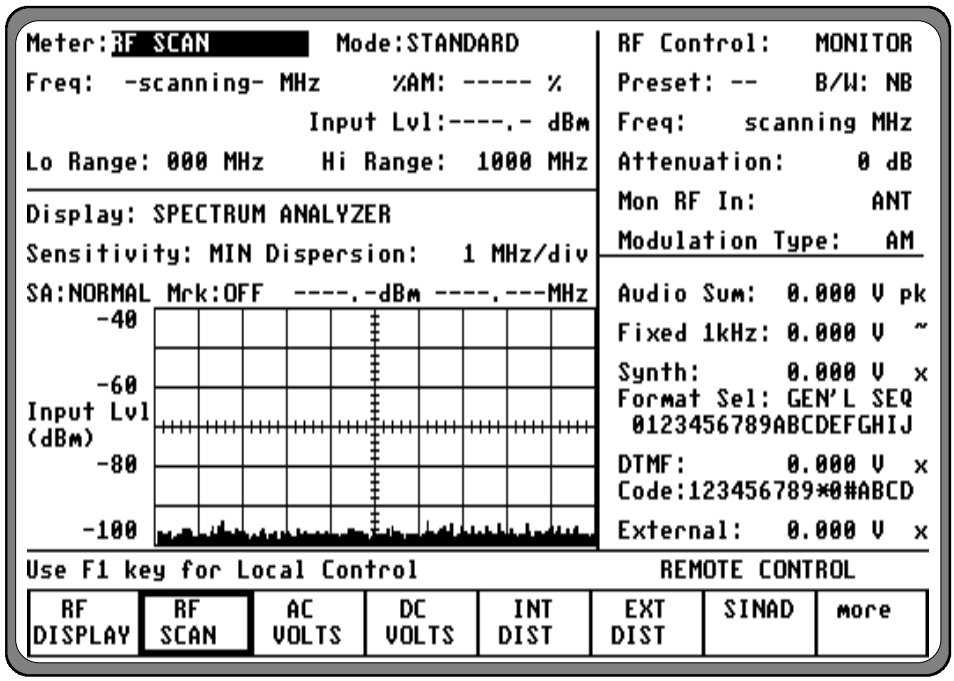


Figure 3-13. RF Control Zone; Scan Mode

It provides an RF frequency counter function where the monitor scans over a selected frequency range and locks on to the carrier that is applied to its input. The direct frequency is then displayed, eliminating the need to first enter the carrier frequency and read its error. The acquired signal is measured to a frequency resolution of 1 Hz.

The RF signal input, either from the ANT or from the RF I/O port, may be displayed. The analyzer scans a specified frequency range to automatically acquire and tune to an input signal from 20 MHz to 999.9999 MHz.

Tuning typically occurs within 5 seconds. For faster acquisition, limit the scan range to 100 MHz increments. This is done by setting the High and Low range limits to narrow the scan range. Move the cursor to the desired Hi or Lo range field in the Meter portion of the screen. Select the range desired either by using the numeric keypad or the optical TUNING knob.

NOTE

The range of values for the low range setting is from 0 to 9 (x 100 MHz). The range of values for the high range setting can be from 0 to 10 (x 100 MHz), with the 10 implying maximum frequency range, or 999.9999 MHz.

Minimum input signal level for automatic frequency acquisition is -30 dBm at the antenna port and +20 dBm at the transceiver port. When the input signal is removed, the scanning operation will resume.

When scanning, the "Freq:" field within the RF Control zone indicates **scanning**. When a carrier is acquired, this changes to **metering**. The actual measured frequency is displayed in the Meter zone along with modulation and level data as described above for RF Display.

3-7.1.3 AC/DC Voltmeter

The analyzer provides a general purpose AC/DC digital voltmeter (figure 3-14). The voltmeter input is the same front panel BNC port that also serves as the input for the SINAD/DIST meter, the VERT oscilloscope input, and the frequency COUNTER IN.

Move the cursor to the "Range:" field. Select either auto-ranging or a specific voltage range (AUTO, 1V, 10V, or 100V DC) by pressing the applicable softkey. Maximum AC range is 70 VAC. If the optional battery pack is installed, an additional selection is available to read the battery voltage.

CAUTION

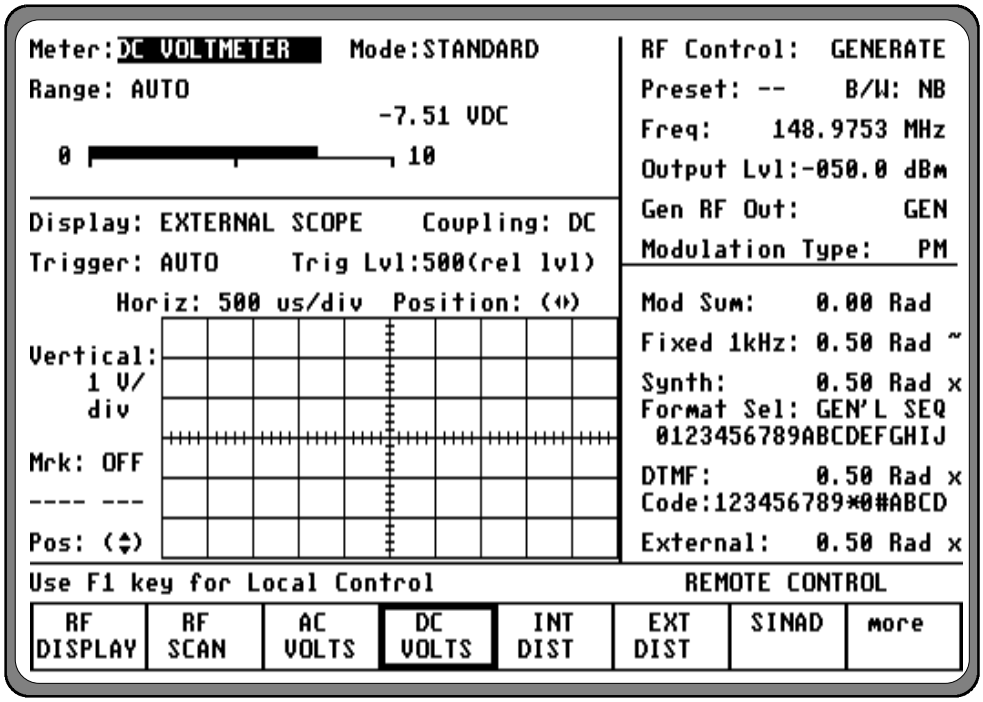
The maximum analyzer input voltage is 42.4 volts peak AC or 60 volts DC.

The data portion of this screen will show a horizontally oriented bar graph for an analog indication along with a digital readout of the measured voltage (up to 4 digits resolution).

In the AC mode, the measured input is also displayed in dBm, referenced to 1mW into 600 ohms.

NOTE

Optional "C" message or CCITT filters, along with a 600 ohm load, are available for selection at the ACVM, SINAD, and Distortion meter inputs. If your unit is equipped with one of these, they are selectable through the Special Function screen (refer to section 3-8.5). If one of these is selected an appropriate message will appear on the message line just above the softkey labels. ***CAUTION: Selection of either filters or load can affect readings within these meter functions.***



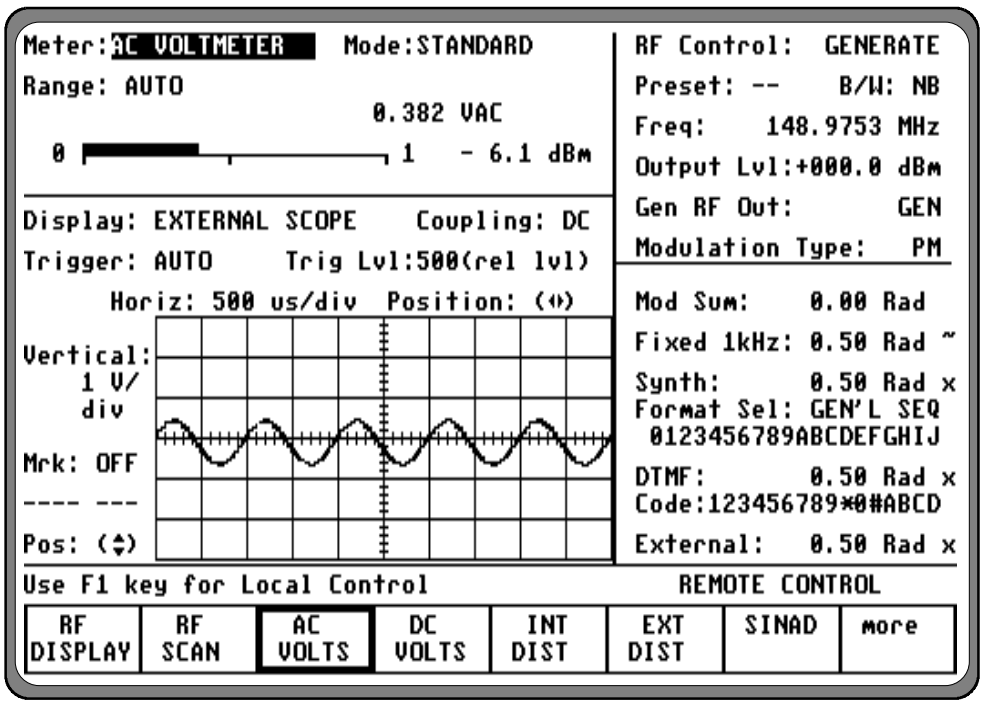


Figure 3-14. Digital Voltmeter Screens

3-7.1.4 INT DIST/EXT DIST Meter

The internal and external distortion meter are selectable via softkeys located within the "Meter:" field in the Display zone. Display consists of a digital readout and bar graph. Distortion is used to measure the audio quality of the transmitter and receiver modulation. The distortion meter is selectable via softkey between internal (coupled from the monitor demodulated signal) and external (through the DIST input on the front panel).

The distortion meter operates only at the fixed frequency of 1 kHz.

3-7.1.5 SINAD Meter

The SINAD meter is selected within the "Meter:" field in the Display zone. Display consists of a digital readout and bar graph. SINAD is used in making receiver sensitivity measurements per EIA specifications using a fixed 1 kHz modulation frequency.

Internal coupling for SINAD is not provided; input is always via the external BNC port on the front panel.

NOTE

Optional "C" message or CCITT filters, along with a 600 ohm load, are available for selection at the ACVM, SINAD, and Distortion meter inputs. If your unit is equipped with one of these, they are selectable thru the Special Function screen (refer to section 3-8.5). If one of these is selected an appropriate message will appear on the message line just above the softkey labels. ***CAUTION: Selection of either filters or load can affect readings within these meter functions.***

3-7.1.6 Counter and Decoding Functions

The following are all accessed via softkey through the "Meter:" field within the Display zone. Their inputs are all normally internally coupled to the monitor demodulated signal for either direct or "off-the-air" testing. If use of these functions is needed for an externally applied signal, the Special Functions screen, under SYSTEM FUNCTIONS, provides a means of switching the input of the Counter/decoder from Internal to External.

These screens contain a "Sensitivity:" field where MIN or MAX may be selected via softkey. This provides a means to desensitize the counter/decoder circuits, if needed to properly measure very high level signals. Under normal operation, this field should be set to MAX.

Cursor fields are provided to access the units low-pass and high-pass baseband filter sections. Filters may be used to remove unwanted voice modulation, etc. which may interfere with decoding the PL signals. Baseband filters apply only to internal coupling.

CAUTION

Entries into the high and low pass areas of this screen write information into the Special Functions screen and memory. To avoid problems with other modulation measurements, make sure settings are set to original values before leaving these screen areas.

The display exhibits a digital frequency and equivalent PL code if applicable. Refer to Appendix B for valid codes.

PL/PER Counter

This softkey provides a convenient means of measuring the frequency of Motorola Private-Line (PL) or any other low frequency audio tones with 3 digit resolution. Period measurement makes it possible to measure low frequencies down to high resolution without the need for the long gate times associated with frequency counting.

CAUTION

Do not input frequencies above 400 kHz to the period counter. Slow down of system operations will result.

DPL Decode

This softkey provides decoding for valid Motorola Digital Private-Line (DPL) codes. Refer to Appendix B for applicable codes. Selection of high and low pass filters may be made from this screen as previously described.

DTMF Decode

This softkey provides a means of decoding DTMF (Dual Tone Multi Freq) signaling for testing telephone interfaced systems. A "reset" softkey clears the display.

FREQ CNTR

This softkey provides a general purpose frequency counter (figure 3-15) for Audio and IF frequency measurements up to 500 kHz. For RF frequency measurements, use the MON function.

The "Resolution:" field provides selection of auto ranging or selectable gate times which provides up to 0.1 Hz resolution (0.1 Hz resolution requires 20 sec gate time). The symbol to the right of the display is an indication of when gating occurs.

NOTE

Selection of any of the General Sequence, 5/6 or Select V decoding functions produces an overwrite display table. To exit this display an alternate selection must be made from the "Meter:" field of the Display zone.

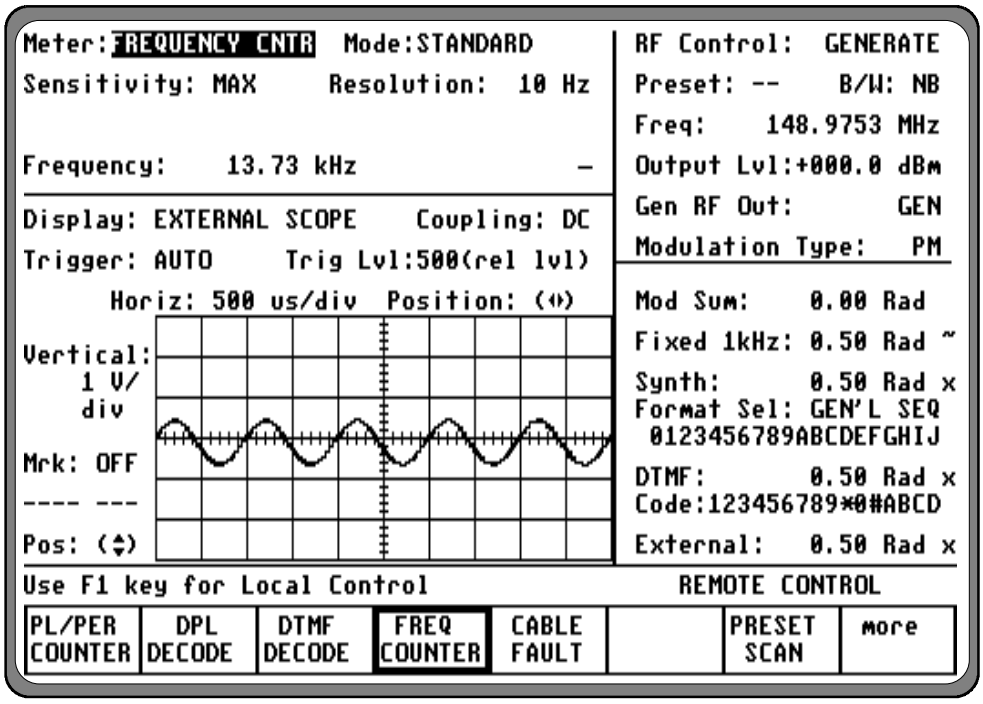


Figure 3-15. Frequency Counter

3-7.1.7 CABLE FAULT (if equipped)

This feature provides the capability to test 50 ohm RF cables for damage or mis-terminations through a simple connection to the input of the cable. It employs the analyzer's Sweep Generator capability to sweep the cable under test and observe any standing wave pattern caused by mis-termination. Analysis of this standing wave pattern on the scope display and the marking of two adjacent nulls in this pattern allows the analyzer to compute the distance to a fault or mis-termination. The cable fault feature is accessed by softkey from the "Meter:" field location in the Display zone as shown in figure 3-16. This automatically selects the appropriate displays in the RF Control and Display zone. The main operation of this feature is controlled thru the "Meter:" field, but the "Rng:", "Output Lvl:" and "Vertical:" fields from the other zones must be adjusted for a proper sized screen display depending on the test frequency and type of fault under test. When these have been adjusted, the test is run from the "Cen Freq:" field in the "Meter:" zone. Refer to section 4-3 in the applications section for a more detailed description of running the test.

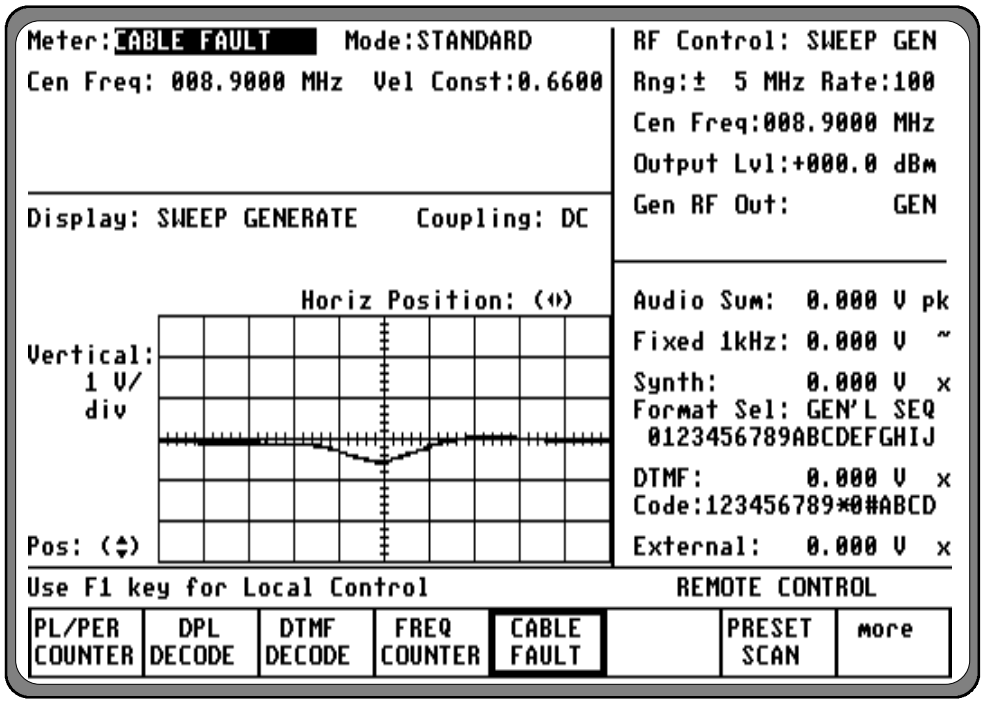


Figure 3-16. Cable Fault Screen

3-7.1.8 GENERAL SEQ DECODE

This softkey provides a free-form decoding function for individual frequency and time duration of tone sequences up to 20 tones. Selection of this mode overwrites the entire display section of the screen and provides a detailed display of data. Start and stop softkeys are used to control the decoding function.

5/6 Decode

This softkey provides a decoding function for 5/6 tone high capacity tone paging systems. Selection of this mode overwrites the entire display section of the screen and provides a detailed display of data. Start and stop softkeys are used to control the decoding function.

SEL V Decode

This softkey provides a decoding function for a number of standard international Select V sequential tone signalling formats. Selection of this mode overwrites the entire display section of the screen and provides a detailed display of data. A "Sequence Select:" field is provided within formats (ZVEI, ZVEI MOD, ZVEI FRENCH, CCIR STD, CCIR 70ms, EEA) which are selected by softkey. Start and stop softkeys are used to control the decoding function.

Handshake

Handshake testing is also provided through an additional start HANDSHK softkey. This links the SELECT V encode sequence selected in the Audio zone to the decode screen. Pressing the start HANDSHK key will send a SELECT V tone burst from the decode screen which will then decode the resulting response from the radio.

3-7.1.9 Preset Scan (if equipped)

The analyzer provides a preset scan function in which the preset monitor frequencies stored in the RF memory are continually scanned. The analyzer scans through the preset frequencies, stopping and dwelling on a channel whenever the receiver squelch is broken. When the receiver becomes squelched again, scanning resumes. All 30 preset monitor frequencies, or a subset consisting of a continuous block of frequencies, can be scanned. When no signals are detected, the analyzer scans through all 30 preset frequencies in less than 1/2 second. If the number of frequencies is reduced, the scanning process is faster. RF signals to be scanned can be input from either the ANT or RF I/O ports.

To activate the Preset Scan function, press the **PRESET SCAN** softkey (figure 3-17). This key not only begins the preset scanning but also serves as a "continue key" to temporarily skip past a channel with heavy radio traffic. When the analyzer is locked on a preset frequency and you wish to continue scanning, although the signal is preset, press the **PRESET SCAN** softkey again. This continues the scanning with the next preset frequency in the memory table. Pressing the **PRESET SCAN** softkey only skips over the frequency once; if radio traffic is still present on that frequency the next time that it is scanned, the analyzer will stop and dwell once again.

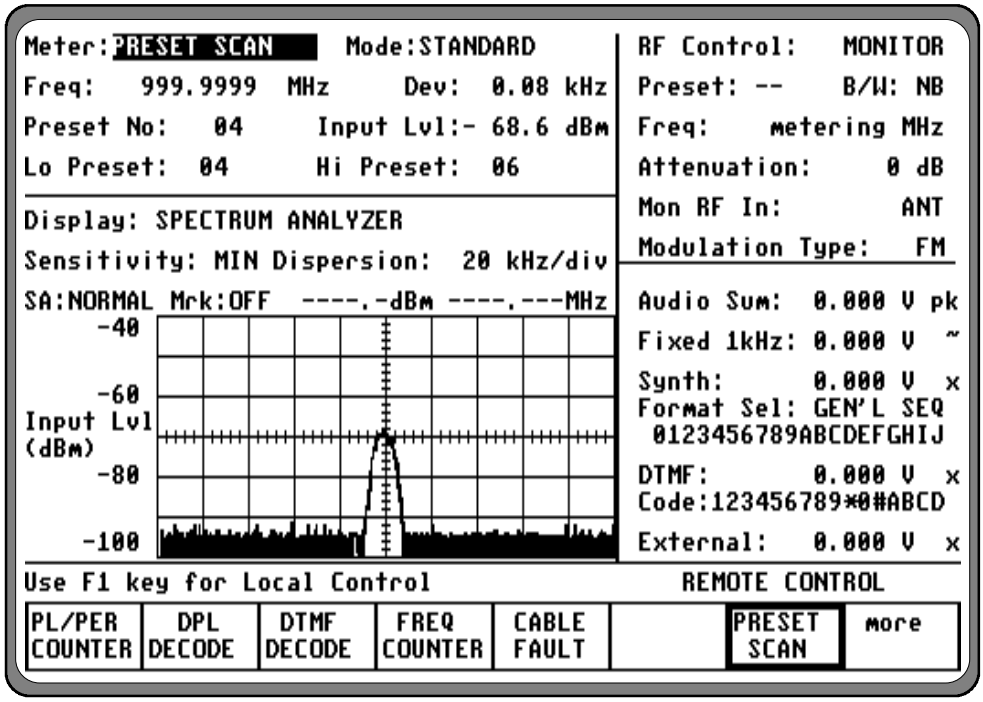


Figure 3-17. Preset Scan

The number of preset frequencies to be scanned can be limited by using the Low Preset and High Preset fields in the meter zone. Entries in these fields will cause the analyzer to only scan from the low preset number to the high preset number. By carefully arranging the preset frequencies in the RF memory into related groups, you can make maximum use of the Low Preset and High Preset scan limiters. For example, a particularly busy preset frequency which is causing the analyzer to stop scanning and dwell for long periods of time can be removed from the scan list

by moving it within the RF memory table to a location just above or below the preset numbers being scanned.

It is recommended that frequencies in the RF memory table be grouped according to their modulation type and bandwidth because these parameters must be manually changed in the analyzer's RF Control zone. If an AM frequency (e.g. aircraft band) is intermixed with FM frequencies (e.g. public service band) in the scan list and the analyzer is set to FM mode, radio traffic on the AM frequency will cause the scanner to lock, but the received audio will be unintelligible and the modulation measurement meaningless.

Because breaking the receiver squelch causes the analyzer to stop scanning, it is important to properly adjust the squelch control. If the squelch is adjusted too loosely (counterclockwise rotation of the squelch knob), it is possible that desired signals will not be strong enough to break the squelch and the analyzer will not stop and dwell on the channel. To adjust the squelch control for proper scanning operation, turn the squelch control fully counterclockwise and activate the Preset Scan mode. The analyzer will not scan because it will lock on the first frequency due to the squelch being open. Now slowly rotate the squelch control clockwise, just until the squelch light goes out, the noise in the speaker stops and the unit begins to scan. If an actual signal is received while the squelch is being adjusted, wait until it ends before resuming the adjustment. For maximum sensitivity, the squelch level should be adjusted as loose as possible (counterclockwise) without being broken by receiver noise.

To halt the scanning operation at any time, press the **RF DISPLAY** softkey. This stops the scanning process and leaves the analyzer locked onto the last scanned frequency prior to the key press.

NOTE

When the unit is in the Preset Scan mode, the response time to key presses will be somewhat slower than normal. For best results, it is recommended that you do not leave Preset Scan active when it is not being used.

3-7.2 Display

Any of the following graphic data displays can be selected for simultaneous display along with the previously discussed meter displays. Select using softkeys from the "Display:" field in the Display zone.

3-7.2.1 Spectrum Analyzer

The Spectrum Analyzer (figure 3-18) is active in the MONITOR or DUPLEX modes. Move the cursor to the "Display:" field within the Display zone.

Select SPECTRUM ANALYZER by pressing the softkey. The input frequency spectrum is displayed in a frequency-versus-amplitude (dBm) graph. Either the ANT or RF I/O port may be selected for input from the "RF Control:" zone. The amount of input attenuation may also be selected within the zone to vary the sensitivity of the Spectrum Analyzer.

If a larger display area is desired, press the expand softkey. (A return softkey is available in the expanded mode allowing return to the normal display).

NOTE

If SPECTRUM ANALYZER is selected while "RF Control:" is in the GENERATE mode, the spectrum analyzer will be disabled and the background will show the message Spectrum Analyzer Disabled in Generate Mode. If SPECTRUM ANALYZER is selected while RF CONTROL is in the SCAN mode, the spectrum analyzer will be disabled and the background will show the message scanning.

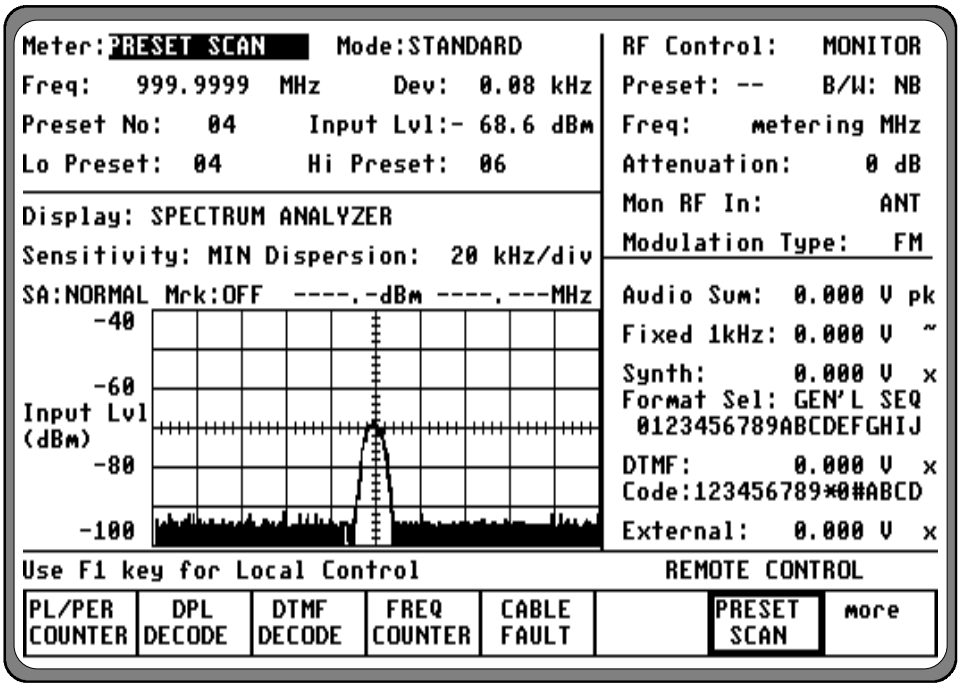


Figure 3-18. Spectrum Analyzer

Sensitivity

The SA "Sensitivity: MIN/MAX" field shifts the baseline reference of the display by 10 db. This is valid only for 0 db input attenuation. Changing the input attenuation or changing from ANT to RF I/O port in the RF Control zone will change the vertical scale of the Spectrum Analyzer display. Calibration is maintained between the display and the signal level present at the input port so there is no need to compensate for added attenuation.

Dispersion

Select the band width (20 kHz, 50 kHz, 100 kHz, 200 kHz, 500 kHz, 1 MHz, 2 MHz [optional], 5 MHz [optional], or 10 MHz [optional] per division) by first moving the cursor to the dispersion field, then pressing the desired softkey. When operating in the optional wider dispersion settings, it is normal for the response time of the analyzer to slow down somewhat. Center frequency is entered from the RF Control zone and may be conveniently varied with the TUNING knob.

NOTE

When operating in dispersions greater than 1 MHz/div, the normal monitor metering functions including "see and hear" audio monitoring are disabled.

Storage (if equipped)

Optional Storage modes (FREEZE, MAX HOLD, and PEAK HOLD) are selected by moving the cursor to the "SA:" field, then pressing the desired softkey.

Freeze -

Pressing this softkey provides immediate storage of a spectrum display. This allows capture of intermittent transmissions etc. for more detailed analysis. To return to normal "real time" analysis, simply press the NORMAL softkey.

Max Hold -

This softkey provides a cumulative storage of peak levels displayed over time. The time duration is indefinite subject to reset by pressing the NORMAL softkey.

The Max-Hold display can be frozen by switching to the Freeze mode. To re-start the max-hold operation, re-select the Max-Hold mode. In any case, this causes the Max-Hold feature to re-initialize and begin collecting input samples.

Peak Hold -

This key provides a cumulative storage capability similar to MAX HOLD. It differs in that in addition to peak responses, the lower portions of the display are also shown to permit observation of "real time" activity.

Average Mode -

Operation in the Average mode continuously averages the previous 100 spectrum analyzer measurements and displays the averaged value. After averaging has been selected, the number of frames used in the averaging calculation will be displayed in the "Cnt:" field.

Markers (if equipped)

Select marker operation by moving the cursor to the "Mrk:" field, then pressing the desired softkey (OFF, DELTA, or ABS). Selection of DELTA (Δ) provides two markers on the SA screen (refer to figure 7-19). These permit relative measurement, between selected points on the display, of both level and frequency. The

dotted marker line represents one that is movable using the Tuning Knob. Set this marker to a point of interest on the display and then press the "toggle marker" softkey to make the other marker movable for similar positioning with the Tuning Knob. Digital displays adjacent to "Mrkr:" continuously show the relative level and frequency difference between the two points selected. Selection of ABS (absolute) mode provides one marker set using the TUNING knob. Absolute frequency and power level of the marker location is displayed.

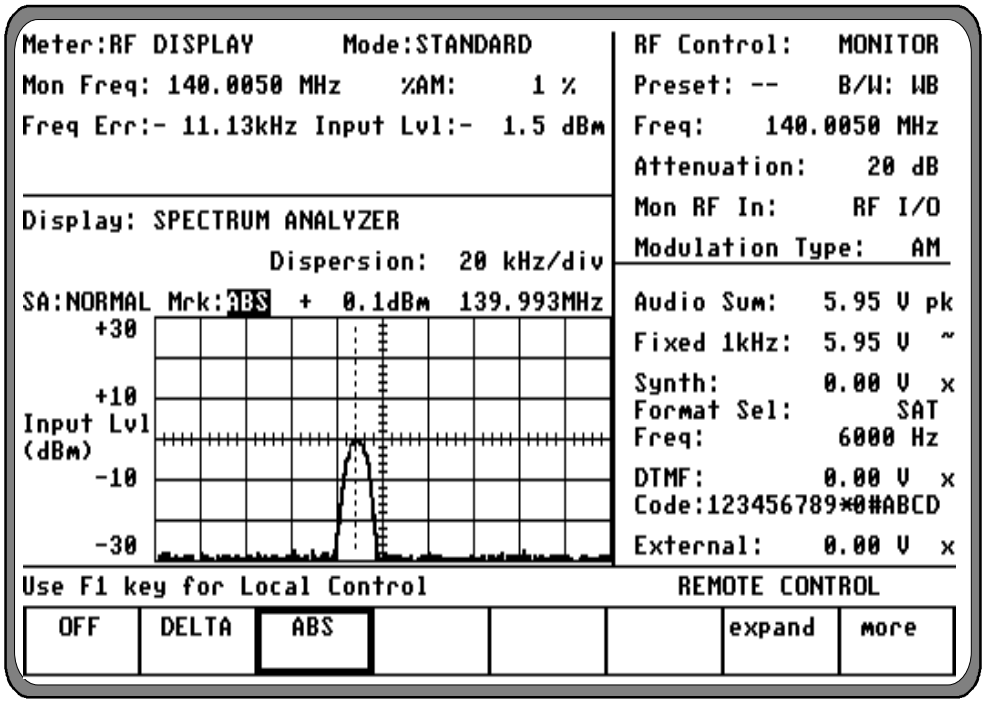


Figure 3-19. Spectrum Analyzer Markers (Option)

In conjunction with the markers are a set of softkey controls that allow the dashed marker to be moved depending upon the information displayed on the graph. These controls are available for both the DELTAT and ABS marker selections by pressing the more softkey.

The spectrum analyzer mode and marker functions are available in the expanded display graph. The provided functions are identical to those found in the normal size display. Normal to expanded screen selections may require readjustment of the markers positions.

left peak

Finds the next highest peak to the left of the current position of the dashed marker.

max peak

Find the maximum peak on the graph.

right peak

Find the next highest peak to the right of the current position of the dashed marker.

next peak

Find the next highest peak to the left or right of the current position of the dashed marker.

center freq

Move to the center frequency of the spectrum analyzer. This is equivalent to centering the dashed marker on the monitor frequency.

3-7.2.2 Modulation Scope

The Modulation Scope (figure 3-20) displays the internal modulation waveforms. It automatically switches between generator or monitor modulation depending on which mode is selected.

In DUPLEX mode, select either generate or monitor modulation displays by first moving the cursor to the "Select:" field within the Display area, then pressing the desired softkey.

The Display area of the screen will indicate MODULATION SCOPE with the input signal displayed in a time-versus-frequency graph.

NOTE

Because the analyzer has a fully digital oscilloscope (storage scope), it inherently has some characteristics which are different from the "real-time" analog scopes familiar to most users. For best overall results, it is recommended that the trigger level be set to 500 and the triggering be set to AUTO.

To change triggering, horizontal position, horizontal range, vertical position, or vertical range, use the cursor control keys to highlight the appropriate cursor fields as follows:

Trigger

Press the AUTO, NORMAL, or SINGLE SWEEP softkey to select the type of triggering desired. The trigger level synchronizes the horizontal time base to the vertical input signal.

In AUTO mode, the scope will trigger continuously. In this mode, the analyzer will always re-sweep the display even if there is no signal present. The rate will be about 1 per second with no signal present and about 10 per second with signal present.

In NORMAL mode, the scope will trigger when the vertical signal exceeds the trigger level set. In NORMAL mode the analyzer will re-sweep at a rate of 10 per second, with the last screen display remaining after removal of the signal.

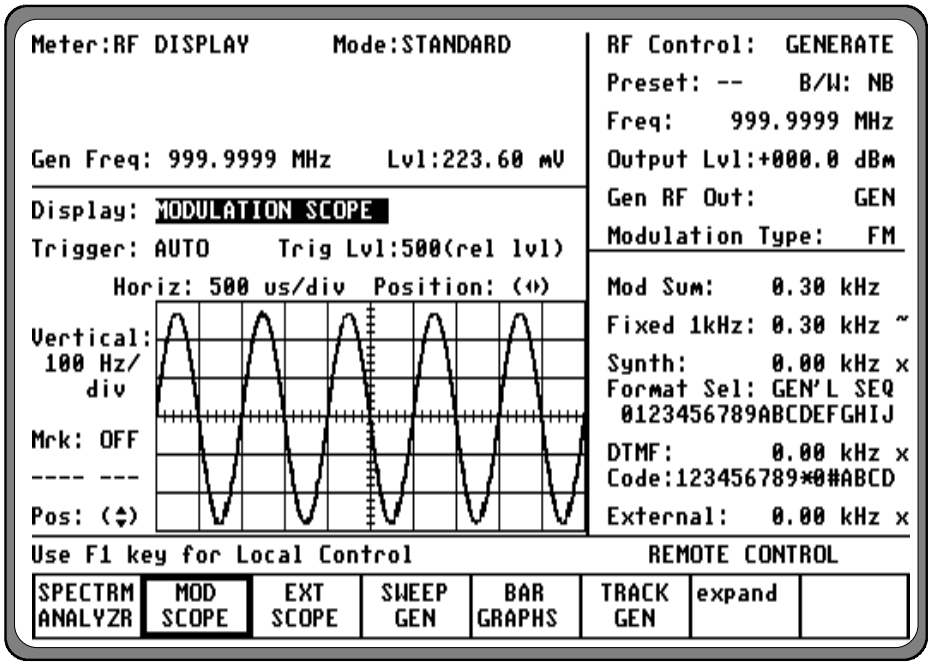


Figure 3-20. Modulation Scope

In SINGLE SWEEP mode, the scope will trigger one time for each softkey press, subject to the trigger level setting (triggering always occurs on the rising portion of the applied waveform). Messages on the line just above the softkeys indicate the status of the single sweep. The single sweep is useful in measuring one-time events, such as a tone burst at the beginning of a transmission. Such bursts may be followed by other modulation which would over-write the screen if measured in the NORMAL trigger mode.

Level

Adjust the TUNING knob to select the desired trigger level. The trigger level is a relative level setting between the values of 0 and 999 (full scale) where 0 is the most negative and 999 is the most positive voltage.

NOTE

To achieve the fastest update rate of the display a trigger level setting of 500 is recommended for most applications.

Horiz

Press the desired softkey to select the Horizontal Sweep rate (20 us to 1 sec/div). Since all ranges cannot be shown on one screen, press the **more** softkey for additional selections.

NOTE

If horizontal sweep rates of greater than 10 msec/div are selected, the update rate will slow down. A good overall setting for most applications is 200 usec per division.

Horizontal Position

Adjust the horizontal position through the (◀▶) cursor field either by using the desired softkey (MOVE LEFT, MOVE RIGHT) or by using the rotary TUNING knob.

Vertical Sensitivity

Press the desired softkey to select the Vertical Sensitivity (AM: 1%, to 50% per division, FM: 100 Hz to 50 kHz per division, dependent on bandwidth selected). When all ranges cannot be shown on one screen, press the more softkey for additional selections.

NOTE

The vertical scales and softkeys for FM deviation will change automatically between wideband and narrowband.

Vertical Position

Adjust the vertical position through the (▲▼) cursor field either by using the desired softkey (MOVE UP, MOVE DOWN) or by using the rotary TUNING knob.

Press the expand softkey from any field in the scope display window to enlarge the display for more detailed analysis. Use the return softkey to get back to the normal size display.

NOTE

Scale and positioning adjustments are not possible for stored waveforms that are displayed through the use of single sweep or triggering on single non-periodic signals.

Marker (if equipped)

Select marker operation by moving the cursor to the "Mrk:" field, then pressing the desired softkey (ΔV, ΔT, or 1/ΔT). Selection provides two markers on the Modulation Scope screen (refer to figure 3-21). Function of the "toggle marker" softkey and Tuning Knob for positioning of markers is similar to that described in section 3-7.2.1.

ΔV -

This softkey selection provides markers that are horizontally located to permit relative readings along the scope vertical axis. The display adjacent to the "Mrk:" field shows the relative vertical deflection between the two marker positions.

ΔT -

This key selection provides markers that are horizontally located to permit relative readings along the scope vertical axis. The display adjacent to the "Mrk:" field shows the relative horizontal deflection between the two marker positions in units of time.

1/ΔT -

This softkey selection provides markers that are also vertically located to permit relative readings along the scope horizontal axis. This selection however inverts the time reading to display the relative difference in terms of frequency.

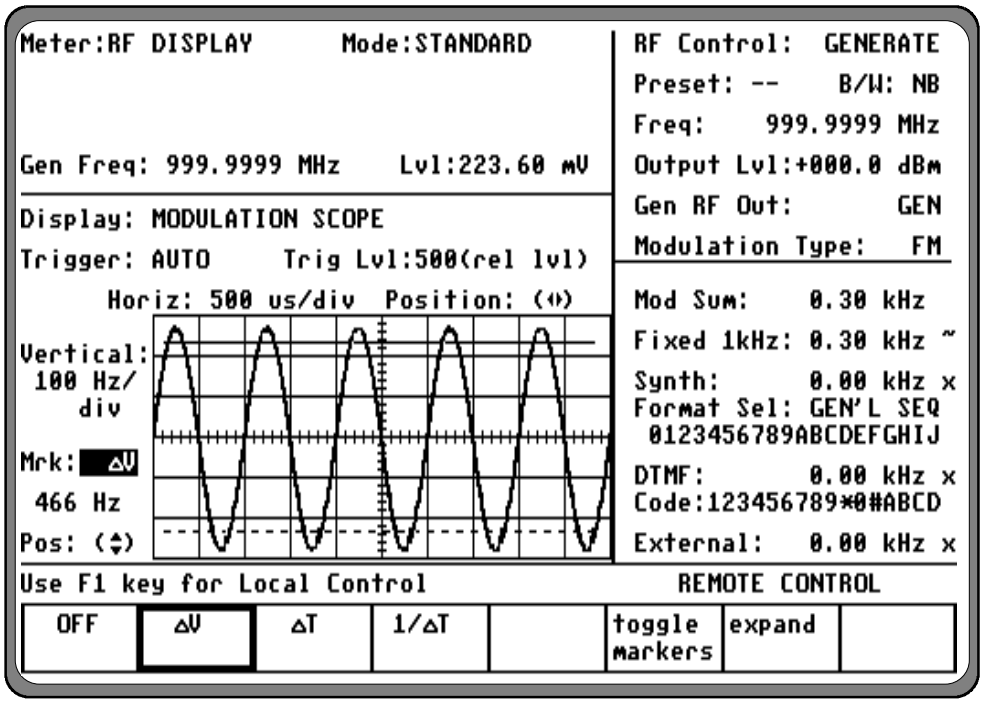


Figure 3-21. Modulation Scope Markers (Option)

3-7.2.3 EXT'L SCOPE

The analyzer provides a general purpose oscilloscope with calibrated vertical input sensitivities and automatic or triggered horizontal sweep rates. Use the scope to analyze waveforms, detect asymmetric modulation or audio distortion, trace signals, and troubleshoot.

The vertical (VERT) input is the same BNC port that also serves as the input for DVM, SINAD/DIST meter, and COUNTER IN.

The EXT'L SCOPE mode has an additional cursor field to select "Coupling:" AC or DC via softkey selection. Operation of triggering, ranges, trace positioning and optional markers are the same as described in MODULATION SCOPE above. Vertical ranges will always display in voltage per division in the EXT'L SCOPE mode.

3-7.2.4 SWEEP GENERATE

This display provides a graphic display in conjunction with the SWEEP GENERATE mode of the unit which is selected in the RF Control zone or selection of the optional cable fault test feature.

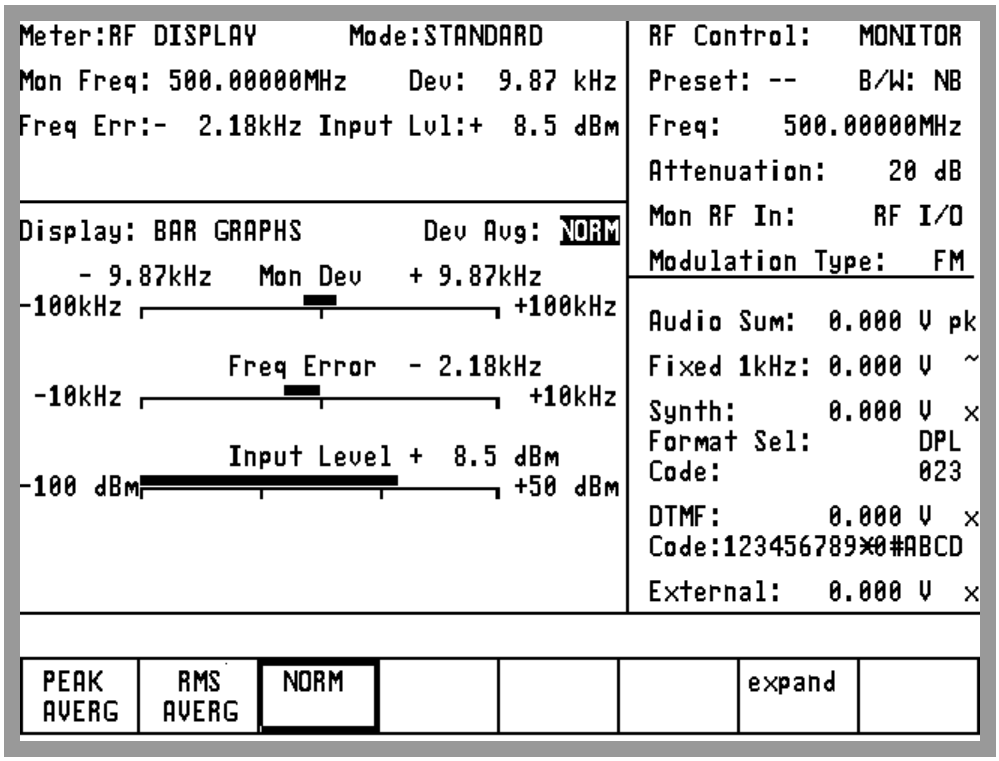
Refer to Sweep Generator description under Primary Operating Modes (paragraph 3-5.4).

To change coupling from AC to DC, or vary horizontal position, vertical position, or vertical sensitivity, move the cursor to highlight that selection. Use the softkeys or TUNING knob, as applicable to each selection.

3-7.2.5 Bar Graphs

The bar graphs (figure 3-22) provide a graphical display of the RF Display data from the Meter area of the screen.

Press the expand softkey to expand the bar graphs to the full display area of the LCD (figure 3-22). If the modulation type is FM, the BAR GRAPHS mode has an additional cursor field to select “Dev Avg:” PEAK AVERG, RMS AVERG or NORM via softkey selection. The setting activates either the Peak averaging or RMS meter or normal peak detection on the deviation measurements. The PEAK AVERG computes a numerical average of peak detection measurements, the RMS AVERG uses a RMS meter to compute the deviation, the NORM use a instaneous peak detection measurement. Note the “Dev Avg:” cursor is not available in modulation types, AM or PM.



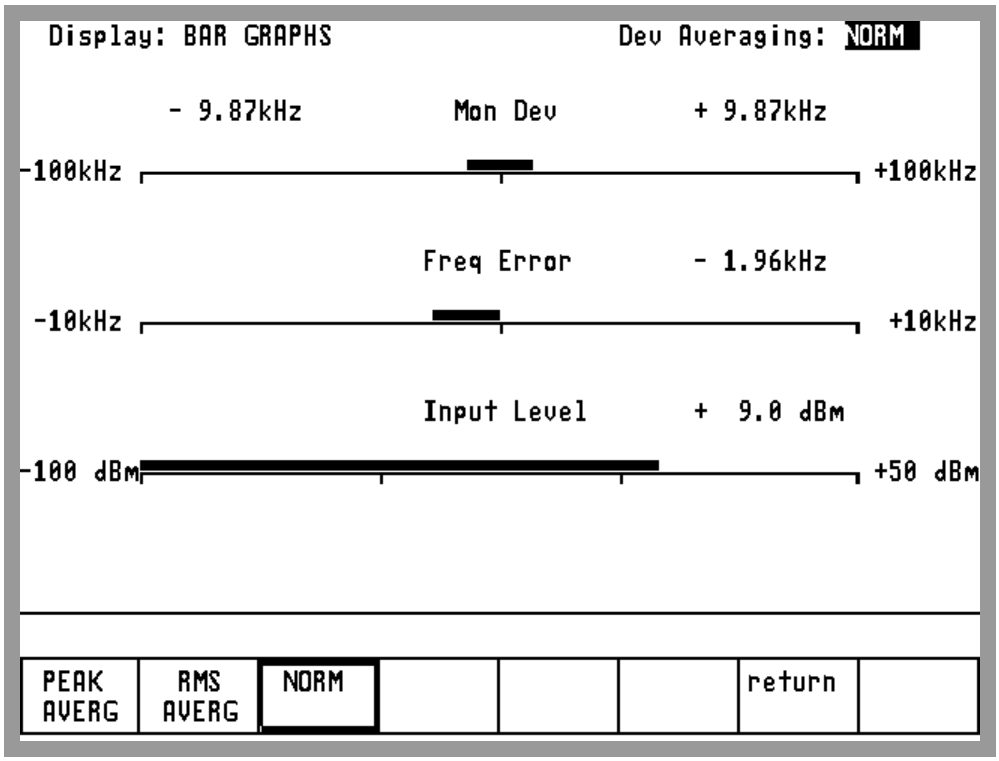


Figure 3-22. Bar Graphs

NOTE

The Freq. Error bar graph is not available if RF SCAN, PL/PER COUNTER, DPL DECODE or FREQ COUNTER are selected in the "Meter:" field area. Selection of the expand key restores the Freq. Error Bar Graph under the above condition.

3-7.2.6 Tracking Generator (if equipped)

This display must work in conjunction with the TRACK GENERATE mode which is selected thru the "RF Control:" field of the RF zone. Refer to section 3-5.5 for a full description of Tracking Generator operation.

3-8 OTHER FUNCTIONS

3-8.1 Audio Monitor

The Analyzer has a speaker for the purpose of audibly monitoring the recovered baseband signal in the MONITOR and DUPLEX modes and the modulating signal in the GENERATE mode. Switching between the two is automatic.

Using the VOLUME control, the input signal to the speaker is adjustable to a maximum level of 0.5 watts rms.

The speaker is also used for audible warnings, such as RF overtemperature.

3-8.2 Calibration

Calibration of the Analyzer is performed by the following steps.

1. Press the CAL key to instruct the processor to perform a self-calibration on the system. The CAL function provides a self calibration of the unit's RF generator output level, the monitor input level and the modulation level. All other parameters are not subject to this self-calibration. This assures the unit's specification accuracy under conditions of ambient temperature extremes and aging. Re-calibration is recommended at weekly intervals or when the re-calibrate warning appears on the screen.

CAUTION

Before starting self-calibration be sure that the 50 ohm load, attached by chain to the front panel, is connected to the GEN OUT port. This provides the termination which is essential to proper calibration. Also ensure all connections to the RF I/O and ANT connectors are removed.

2. Press the START softkey to begin the calibration. While the calibration is active, the message **calibrating** appears.
3. When the calibration has been performed, the message **complete** appears. Press the return softkey or a cursor control key to return to the previous screen.

3-8.3 Print Function

Press the PRT key to send the data contents of the displayed screen to a compatible RS-232 serial format printer or to a compressed graphics file stored on a PC. ASCII character (faster printing), EPSON/IBM printer graphics, or compressed graphics print can be selected.

If ASCII is selected (refer to Special Functions Menu to select REMOTE SETUP and Display Table), all ASCII characters currently on the display are stored in a buffer and serially output to an RS-232 printer. Selection of IBM/EPSON results in a graphic printout of the screen (requires a graphic printer and takes longer to print). If GRAPHIC DUMP is selected, a compressed file of the screen can be generated. This print mode is used with a special print application executing on a PC. Once the compressed file is captured by PC, the file can be printed using the PC's printer resources.

NOTE

Subsequent presses of the PRT key before printing is complete will overwrite the printer buffer.

If using the LX-810S/220 (220 volt operation) serial/parallel printer with the Analyzer, refer to paragraph 4-5 for a special application note.

3-8.4 Special Functions Menu

The Special Function mode (figure 3-23) accessed by pressing the SPF key, provides control over various system conditions as follows:

Version

Accesses a display table which provides the internal software version and checksum for the system and any options present.

Remote Setup

Accesses a display table which allows configuration of the RS-232 and printer interface.

System Functions

Accesses softkeys to select the following:

NVM Clear

This softkey erases the entire RF Preset memory area and front panel CAL memory. The Analyzer must be recalibrated after this key has been pressed.

NVM Reset

This softkey provides a less extensive system reset than NVM Clear. CAL and preset memory are not erased.

Save State

Sets the current condition and settings of the unit as the power up state.

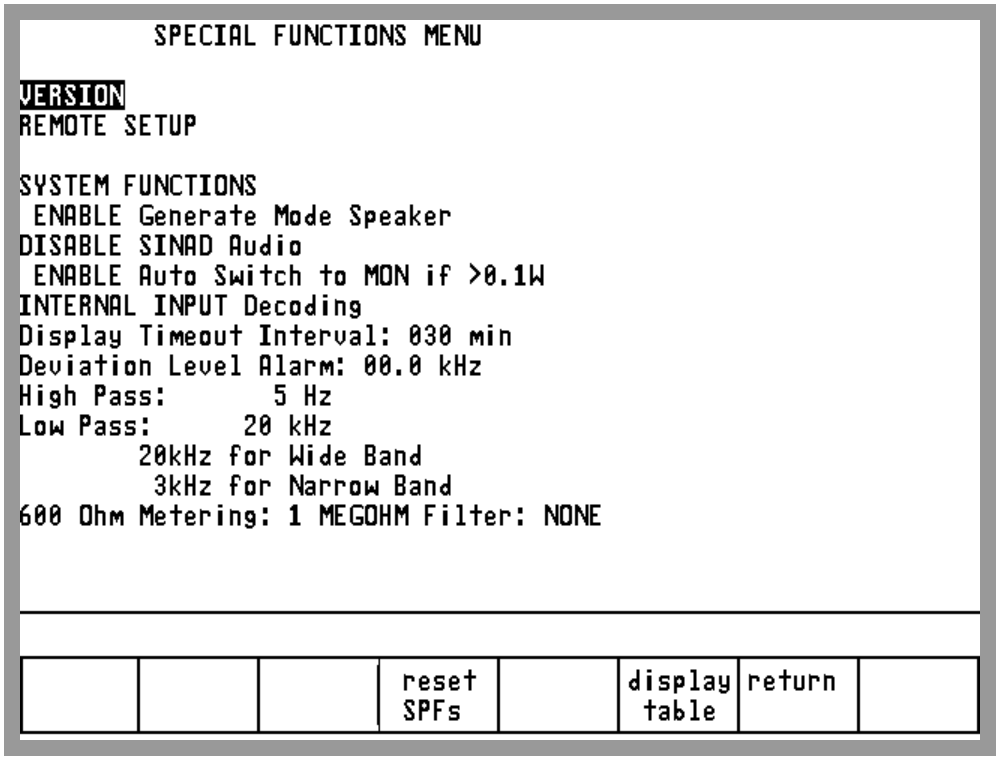


Figure 3-23. Special Functions Menu

NOTE

When any of the following special functions are selected, the normal operating screens will flash a warning SPF Enabled at the lower right of the screen. This serves as a reminder since special functions inadvertently left enabled can adversely effect normal operation of the unit.

SPF Reset

This softkey appears throughout the Special Function screen as a convenience in resetting of all special functions from System Functions through Low Pass Filter to the factory standard state. This will switch all decoding to internal and provide the widest filter bandwidth.

Enable/Disable Generate Mode Speaker

Provides the means to disable the internal speaker during generate mode.

Enable/Disable Sinad Audio

Permits the routing of the signal at the VERT/SINAD connector to the speaker while in sinad metering and generate mode. Note that if both Sinad Audio and Generate Mode Speaker Audio are enabled, the summed audio is routed to the speaker.

Enable/Disable Auto Switch to MON if >0.1 W

Allows the unit to automatically switch to the MONITOR mode when power levels greater than 0.1 watt are applied to the RF IN/OUT front panel connector.

Internal/External Input Decoding

Switches the decoder function between the internal monitor demodulated signal and the signal at the VERT/SINAD front panel connector.

Display Timeout Interval

Permits the entry of the timeout interval to blank the screen after a period of no inputs (key or tuning knob) from the operator.

Deviation Level Alarm

Allows entry of the deviation level for the audible deviation limit alarm in MONITOR mode.

High Pass

Provides softkey selection of monitor baseband high pass filter frequency.

Low Pass

Provides softkey selection of monitor baseband low pass filter frequency.

600 Ohm Metering(Option)

Allows the user to select input impedance (1 megohm or 600 ohm) of the ACVM, SINAD, and Distortion functions.

CAUTION

When the 600 ohm load is selected, the maximum allowable input to these metering functions is reduced to approximately 25 VAC maximum due to power dissipation limits. Overload protection is provided by means of a reset circuit that monitors input leveland switches the 600 ohm load when the maximum input level is exceeded. If this occurs, simply remove the overload and activate the OVERLOAD RESET softkey located at the "600 ohm metering:" field of the Special Function Screen.

Filter (if equipped)

Allows the user to enable/disable internal C-MSG or CCITT filters.

3-8.4.1 Special Function Selection

To select a special function follow the following procedure.

1. Press the SPF key to display the special functions menu on the display.
2. Move the cursor to highlight the field of the function desired. Applicable softkeys
3. Use the softkeys to make selections. Levels may be set using the TUNING knob or keypad.
4. Press the return key to return to the previous screen.

3-8.5 Memory Screens

The Memory screens provide for viewing and entry of preset data into non-volatile memory. The actual selection of a preset number for operation of the system can only be done from the RF Control zone.

Pressing the MEM key accesses the top-level memory display (figure 3-2) which shows the 30 presets (00-29) and the monitor frequency associated with each. A second level screen provides an expanded detail of the settings stored within each preset.

To change the preset memory information, perform the following steps:

1. Press the MEM key to access the special Memory screen.
2. Move the cursor to the desired preset number. When the cursor is over the preset number, press the view preset softkey to display all of the preset's parameters. When a preset has been expanded, the operator may change:
   - The preset number being viewed
   - Monitor frequency
   - Generate frequency
   - Modulation type
   - Bandwidth
   - Duplex offset frequency
   - Audio synthesizer format with applicable frequency, code or sequence
   - DTMF code
3. To clear a particular memory field (except the monitor frequency) press the 'don't care' softkey. The value associated with that cursor location become a "-", and will not affect the current setting when that preset is selected from the RF Control zone.
4. All entries made to the expanded preset table are automatically entered into non-volatile memory. The save to preset soft key provides an added convenience allowing all of the applicable settings entered into the RF Control and Audio Control zones to be copied into the preset number selected. This will erase and overwrite all previously entered settings within that preset.
5. Press the 'return' key to return to the previous screen.

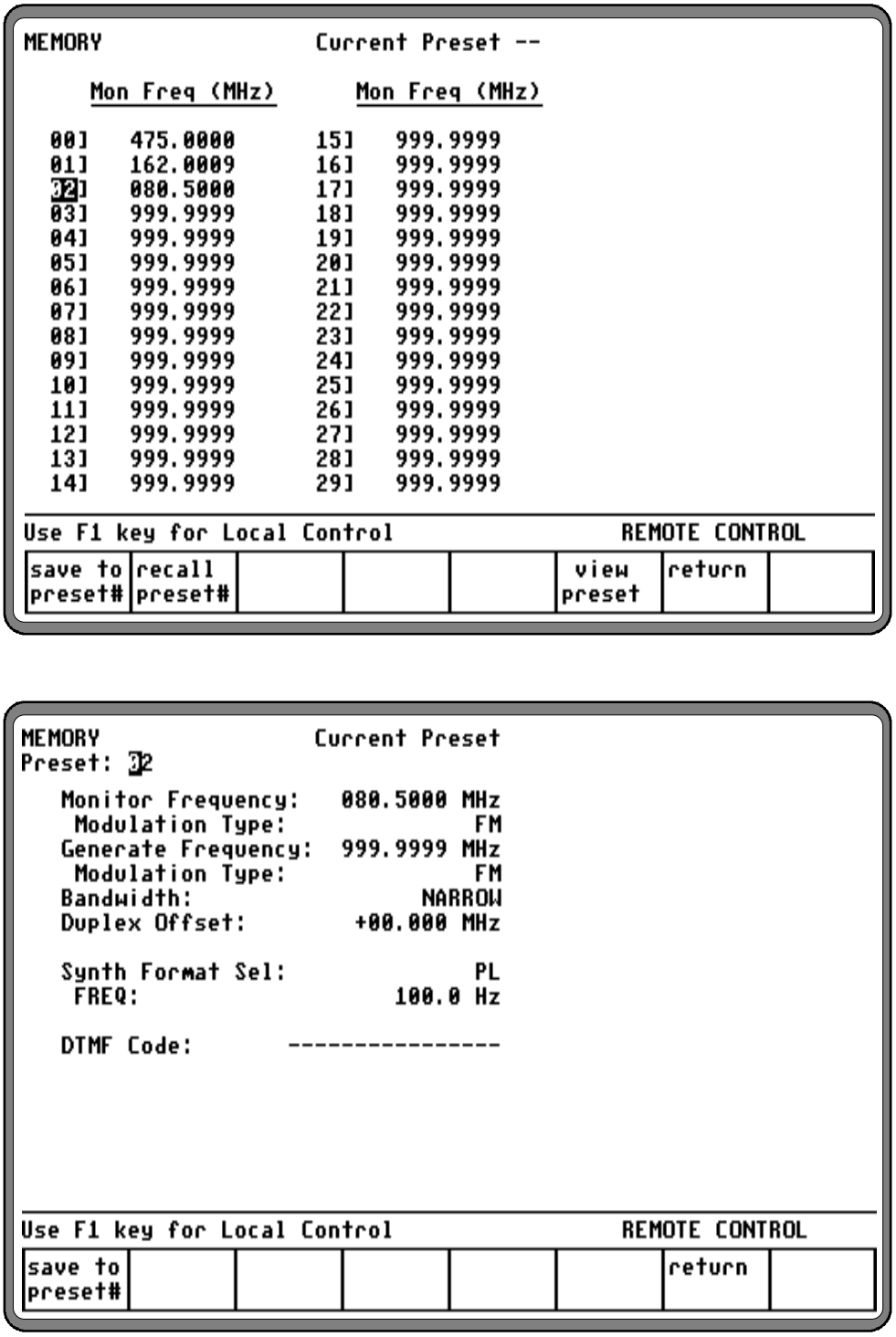


Figure 3-2. Memory Screens

3-8.6 Test Setups (if equipped)

Test Setups provide the capability to save the entire state of the analyzer in a preset. Fifteen additional presets numbered 30 through 44 are available for this purpose. When delivered from the factory, the analyzer is configured with default information in the Test Setups:

NOTE

Test setups are installed at either the factory or in the field using the Field Installation Software. To determine if test setups are available, examine the Standard Options display screen (refer to Special Function Selection paragraph 3-8.5)

TEST SETUP	LABEL	DESCRIPTION
30	Tx Test	"RF Control:" is set to MONITOR and "Display:" is set to SPECTRUM ANALYZER; other parameters are factory default.
31	Rx Test	"RF Control:" is set to GENERATE and "Meter:" is set to SINAD. "Fixed 1kHz:" is switched on with a 3.00 kHz deviation; other parameters are factory default.
32	Dpx Test	"RF Control:" is set to DUPLEX; other parameters are factory default.
33-44	Factory Default	All configuration parameters (except those saved in the standard presets) are set to the factory preset value, which is equivalent to the power-on state of the analyzer from the factory.

NOTE

The default Test Setup values are provided as a convenience and may be overridden at any time.

Each Test Setup also saves the cursor location for later recall. For example, if the analyzer is placed in the generate mode with the cursor on the tens digit of the Output Level and this Test Setup is saved, later recall of this preset will place the cursor back on the tens digit of the Output Level.

The Test Setups work in conjunction with the standard presets (labeled 00 through 29). Each standard preset stores the following information in the non-volatile memory:

- Monitor Frequency
- Monitor Modulation Type
- Generate Frequency
- Generate Modulation Type
- Bandwidth
- Duplex Offset
- Synthesizer Format Selection
- DTMF Code

The Test Setups store all other configuration information in non-volatile memory. This allows a Test Setup to be used for a set of frequencies and audio signals as defined in the separate standard presets.

Full Test Setups are accessed from either the preset cursor location or the MEMORY screen (figure 3-25). To create a test setup, modify the configuration of the analyzer to the test setup to be saved. Press the MEM hardkey to access the MEMORY screen and then move the cursor to one of the 15 Test Setup locations. Use the Save To Preset# softkey to save the analyzer configuration into the Test Setup.

A Test Setup can be recalled from the MEMORY screen using the Recall Preset# softkey or from the preset cursor location in the RF Control Zone.

Each Test Setup has a 15 character label in which alpha-numeric information can be entered to describe that Test Setup. Characters not on the front panel keypad can be entered using the rotary knob.

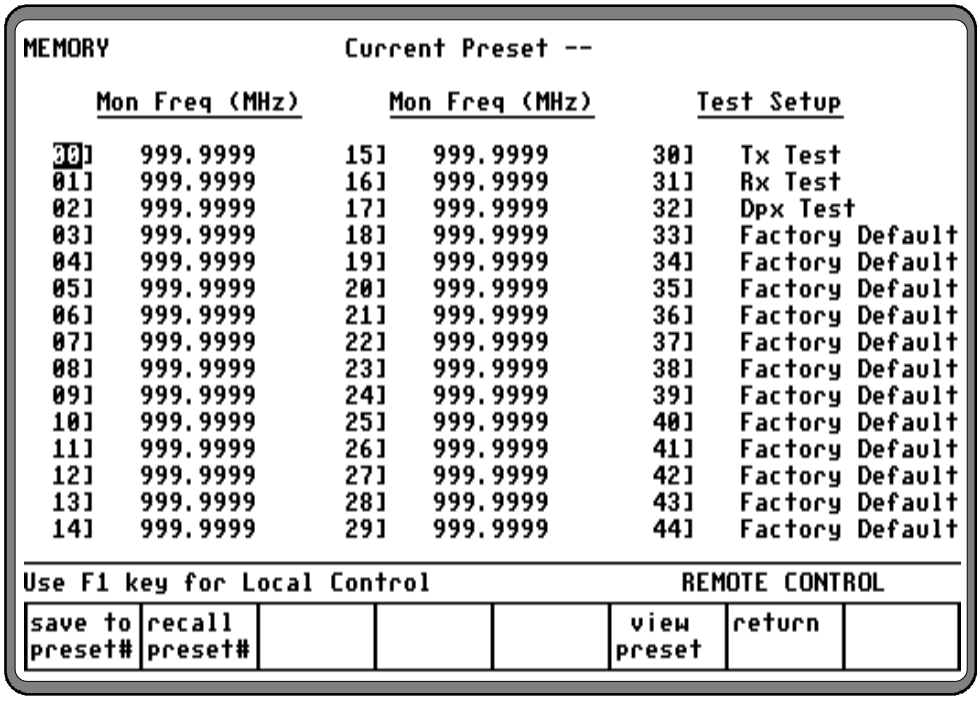


Figure 3-25. Memory Screen with Full Test Setups Option

Section 4

APPLICATIONS

4-1 BASIC FM TRANSMITTE TESTING

This section of the manual contains information on typical test setups to perform some of the more common radio tests using R2600 Series Communications System Analyzers.

General Dynamics takes no responsibility for application accuracy, applicability, or safety. Always refer to your own transceiver's service manual for recommended test methods and specifications

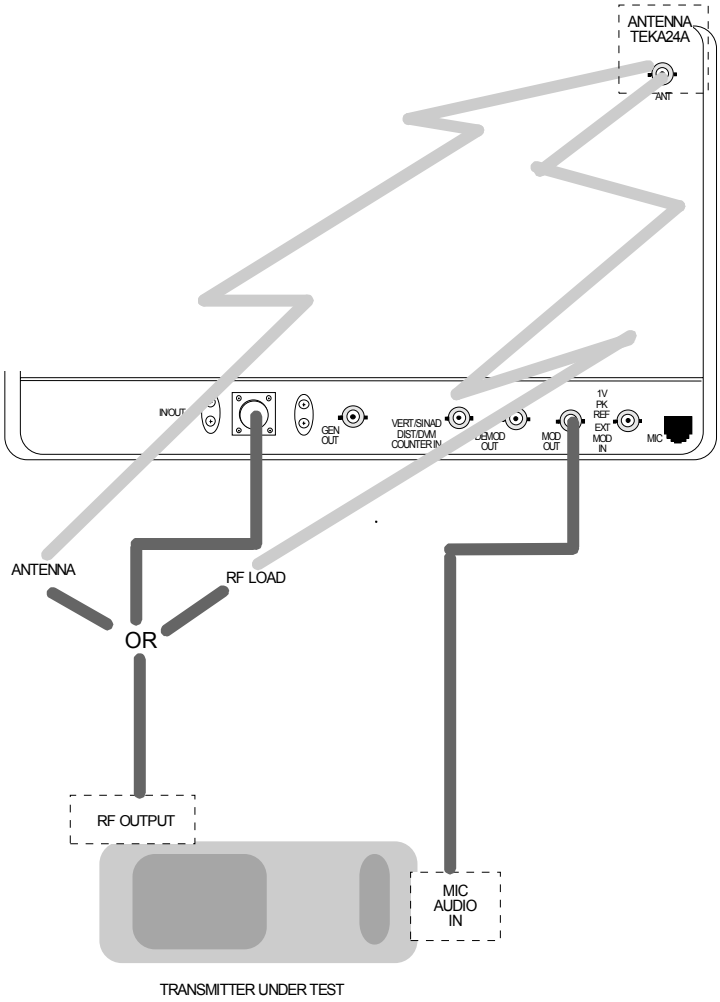


Figure 4-1. Basic FM Transmitter Testing Setup

4-1.1 Basic FM Transmitter Testing Setup

Refer to figure 4-1. Connect the analyzer's RF I/O port to the RF output of the transmitter under test. Connect the analyzer's MOD OUT jack to the mic audio input of the transmitter under test.

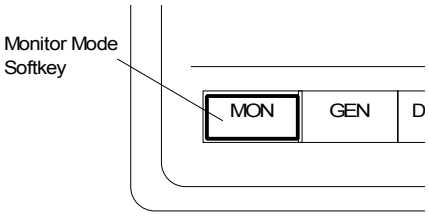
CAUTION

For transmit power output measurements, connect the transmitter under test only to the analyzer's RF I/O port. Do not connect it to the ANT port. The ANT port is used with an antenna for "off-air-" reception.

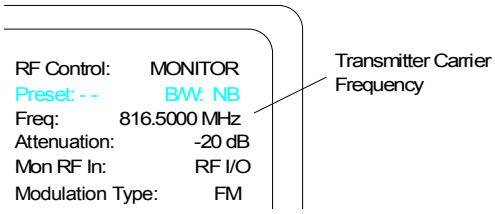
*The built-in RF load dissipates up to 50 W for three minutes and up to 125 W for one minute. If a high-power transmitter is keyed into the analyzer for a time long enough to threaten overheating the power measuring circuitry, the system's audible alarm sounds and the display changes to the **RF LOAD OVERTEMPERATURE** warning, signaling the operator to unkey (refer to paragraph 3-4).*

4-1.2 Transmit Power, Frequency, and Frequency Deviation Measurements

1. With the cursor located within the RF Control zone (refer to paragraph 3-2), press the **MON** softkey to place the analyzer into its Monitor mode of operation.

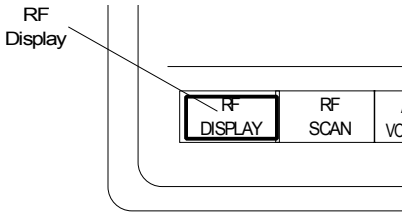


2. Within the RF Control zone, set as follows:

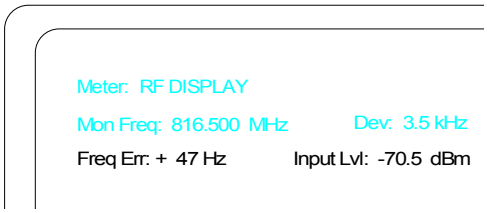


3. Set the SQUELCH control to threshold. For low-power transmitters, may be necessary to use a lower attenuation value in order to unsquelch the monitor (refer to paragraph 3-5.1). Too high of an attenuation setting or too tight a squelch setting inhibits the frequency error reading (refer to paragraph 3-7.1.1). Accurate measurements require sufficient signal level from the radio to fully quiet the analyzer's receiver. Use good quality cable of minimum length to prevent cable-loss which can be a significant factor in RF power measurements, especially at UHF and above.

4. With the cursor located within the Display zone "Meter:" location, press the **RF DISPLAY** softkey:



5. Key the transmitter and read the power (Input Level) and frequency error (Freq Err). Refer to your radio's service manual to determine if power and frequency are within specified limits and determine if any adjustments are required.



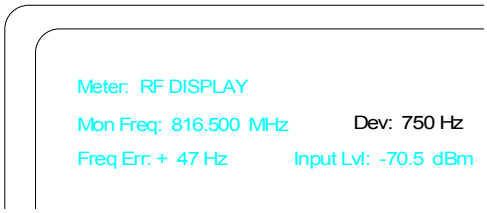
4-1.3 Modulation Measurements

1. Key up the transmitter with appropriate PL (or DPL) enabled.

NOTE

If mic pickup results in deviation errors, install the internal 300 Hz lowpass filter as detailed in paragraph 3-8.5 before making the following measurements and verifications.

2. When monitoring the PL (or DPL) deviation as follows, refer to your radio's service manual to determine if any adjustments are required.



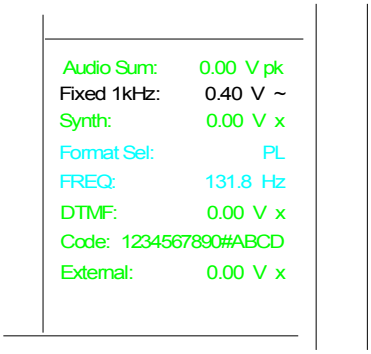
3. Remove the internal 300 Hz lowpass filter if installed.

   Introduce a 1 kHz audio modulating signal from the MOD OUT connector located on the front panel of the analyzer to your radio. Check your radio's service manual to determine the minimum audio signal level required for proper MIC sensitivity as well as the maximum level required to ensure proper IDC (Instantaneous Deviation Control) function.

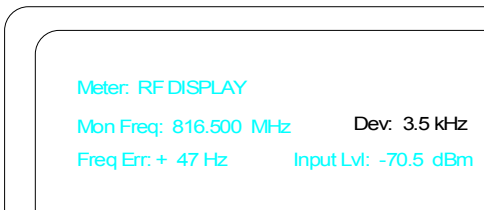
NOTE

The voltage levels displayed in the Audio Control zone are peak open circuit voltages. Source impedance of the MOD OUT port is 100 ohms.

4. Turn the 1kHz signal on, and set for minimum level as determined in step 3.

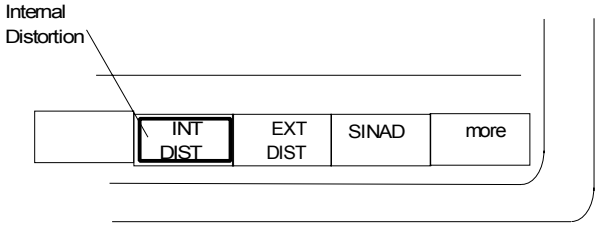


5. Verify proper MIC sensitivity by reading the deviation. Refer to your radio's service manual to determine maximum rated system deviation to determine if any adjustments are required.

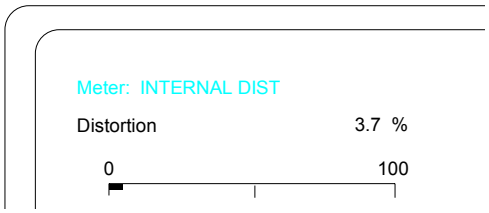


6. Set the 1 kHz audio modulating signal for maximum level as determined in step 3. Repeat steps 4 and 5.

7. To measure the percentage of distortion, locate the cursor within the Display Control zone, at the "meter:" field. Press the **INT DIST** softkey to measure percentage of distortion.

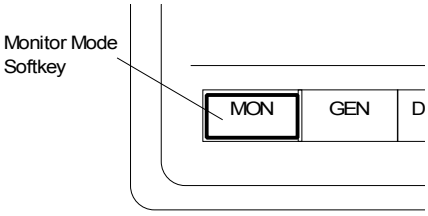


8. Refer to the displayed digital readout and bar graph. Refer to your radio's service manual to determine if any adjustments are required.

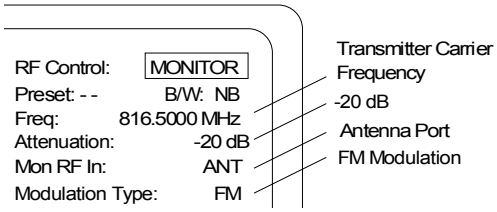


4-1.4 Off-The-Air Measurements

1. Connect the supplied antenna to the analyzer's ANT port. Operate the transmitter under test either into its own antenna or into a dummy RF load.
2. With the cursor located within the RF Control zone, press the **MON** softkey to place the analyzer into its Monitor mode of operation.



3. Set the SQUELCH control to threshold. Within the RF Control zone, set as follows:



4. Check transmitter frequency and modulation as detailed in paragraphs 4-1.2 and 4-1.3.

NOTE

This method may be used to verify frequency and modulation of a remotely located transmitter by reducing the attenuation setting to fully realize the sensitivity of the analyzer "Off-The-Air" monitor function.

4-2 BASIC FM RECEIVER TESTING

This section of the manual contains information on typical test setups to perform some of the more common radio tests using the analyzer.

The analyzer's DVM input is unbalanced (ground referenced). Use an appropriate interface to measure balanced circuits, such as certain receiver audio outputs or telephone lines.

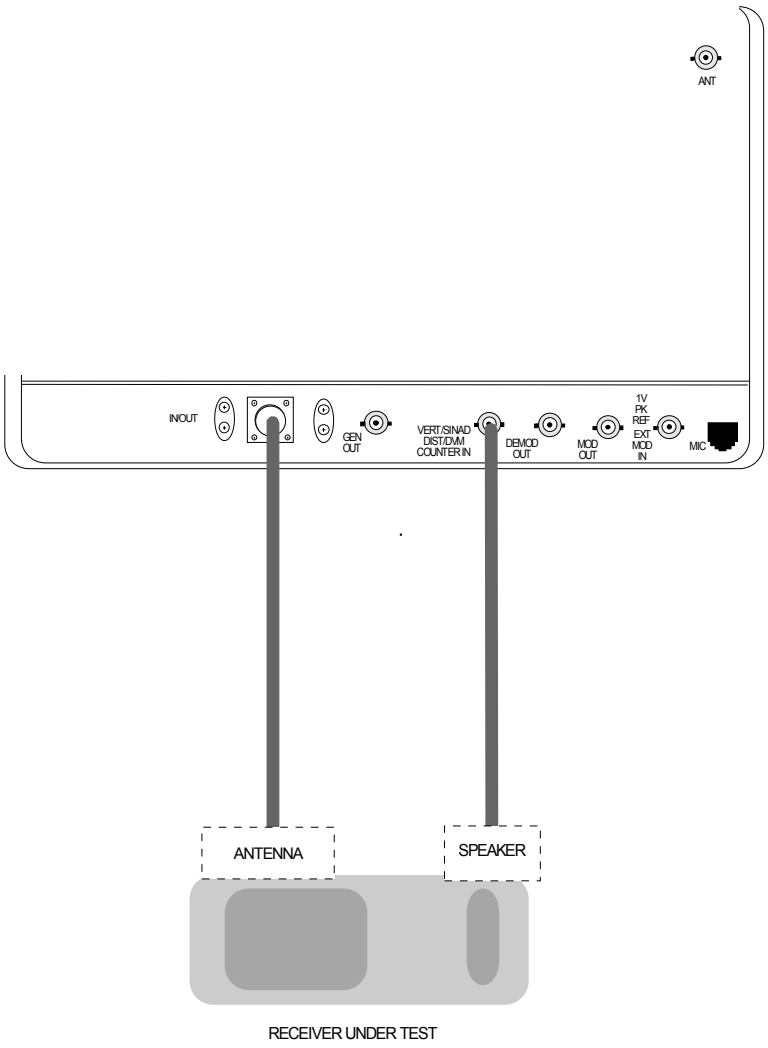


Figure 4-2. Basic FM Receiver Testing Setup

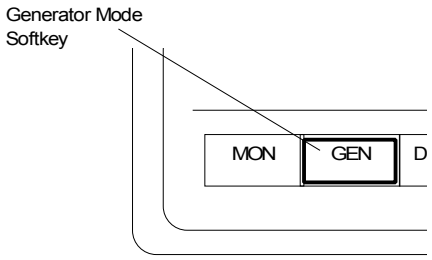
4-2.1 Basic FM Receiver Testing Setup

Refer to figure 4-2. Connect the analyzer's RF I/O port to the radio antenna connector. Connect the radio audio output to VERT/SINAD port of the analyzer.

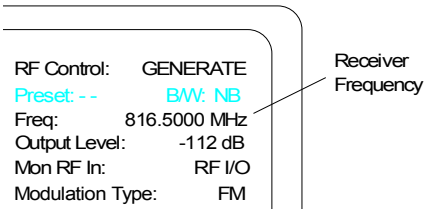
CAUTION

With some radios, grounding the speaker leads will damage the audio circuitry. Use isolation techniques on these radios.

1. With the cursor located within the RF Control zone (refer to paragraph 3-2), press the **GEN** softkey to place the analyzer into its Generator mode of operation.



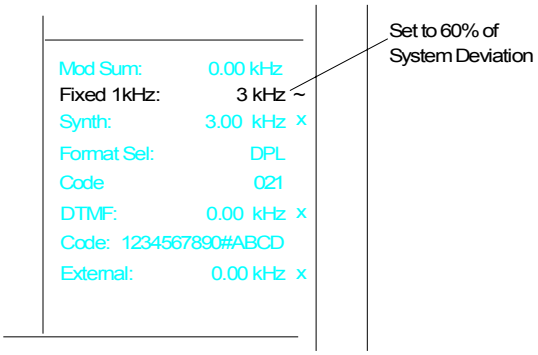
2. Within the RF Control zone, set as follows:



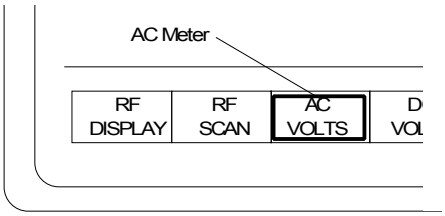
NOTE

For setup and distortion measurements, set output level to at least 30 dB above sensitivity threshold (-80 dBm recommended).

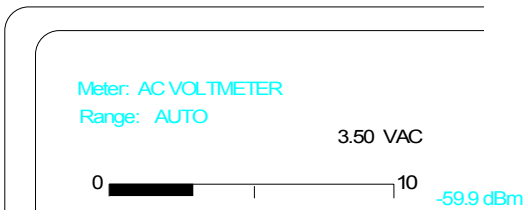
3. Within the Audio Control zone, set as follows:



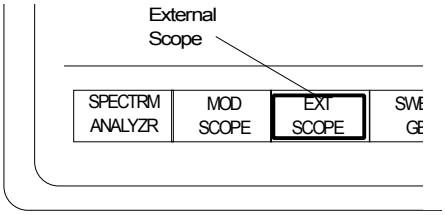
4. With the cursor located within the Display Control zone, press the **AC VOLTS** softkey to display the ac voltmeter:



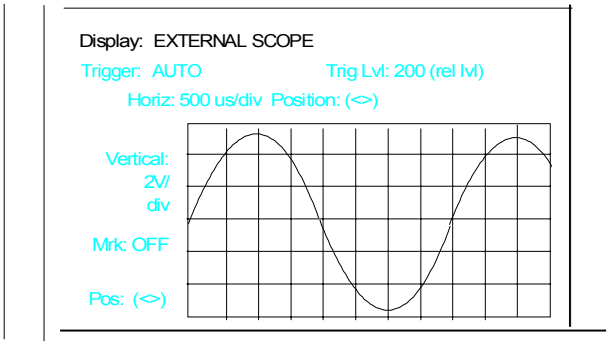
5. Adjust the radio for rated power output by computing voltage needed for rated power with load resistor/speaker in use, and setting the radio volume to produce required voltage.



6. With the cursor located within the Display Control zone (at Display:), press the **EXT SCOPE** softkey.

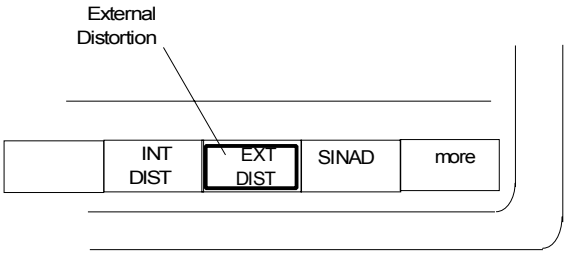


7. Set scope vertical and horizontal deflection to observe sine wave from receiver audio.

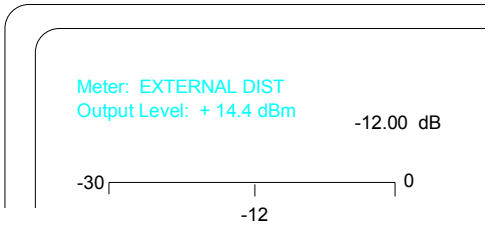


4-2.2 Receiver Distortion Measurement

1. With the cursor located within the Display Control zone, press the **EXT DIST** softkey to measure percentage of distortion.

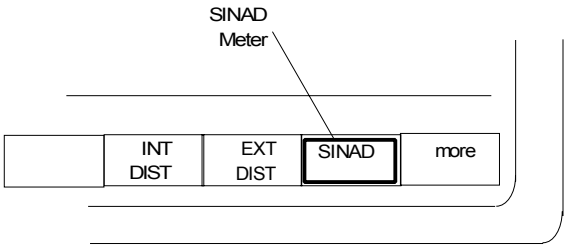


2. Refer to the displayed digital readout and bar graph. Refer to your radio's service manual to determine if any adjustments are required.

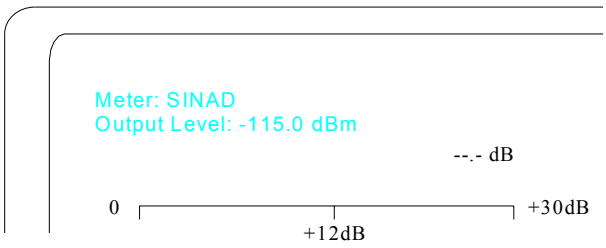


4-2.3 SINAD Measurement

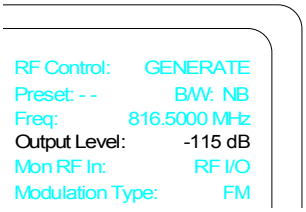
1. With the cursor located within the Display Control zone, press the **SINAD** softkey.



2. Refer to the displayed digital readout and bar graph.



3. Within the RF Control zone, adjust the selected RF level until the SINAD reading on the SINAD meter averages 12 dB (instantaneous reading will vary several dB).



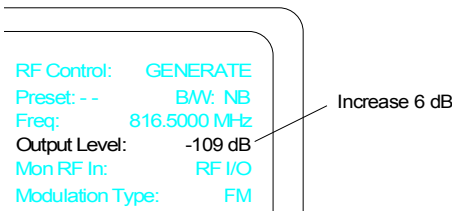
4. Note RF output level required for SINAD reading of 12 dB (-115 dBm typical dependent on manufacturers specifications).

NOTE

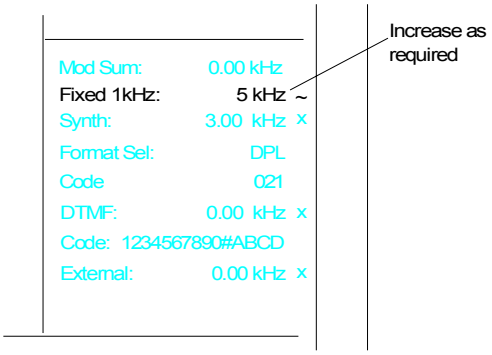
RF output level can be referenced to mV, uV, dBu, or dBm. Selection of units is available within the Display Control zone (Output Level:).

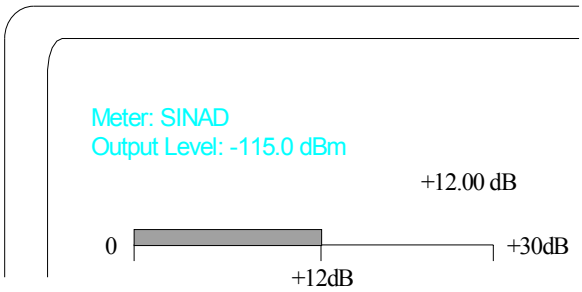
4-2.4 Modulation Acceptance Bandwidth

1. Set the volume control of the radio to 10% of its rated audio output level.
2. Set the RF output level 6 dB (doubles the voltage, i.e. 0.35 uV increased 6dB = 0.7 uV) above the RF output level required in paragraph 4-2.4 to achieve the SINAD reading of 12 dB.

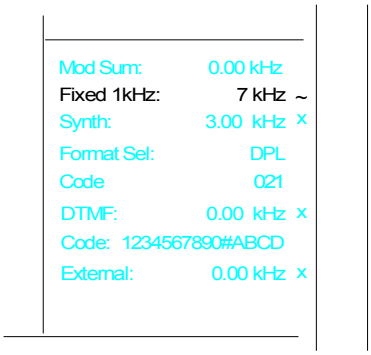


3. Increase the deviation level until the SINAD meter display returns to 12 dB.



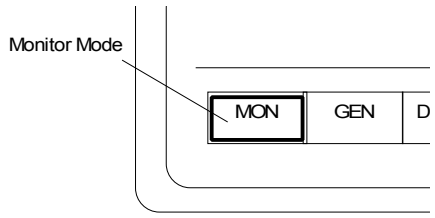


4. Read the deviation level required in step 3. A typical modulation acceptance bandwidth of a 5 kHz receiver is 7 to 8 kHz. Refer to your radio's service manual to determine if any adjustments are required.

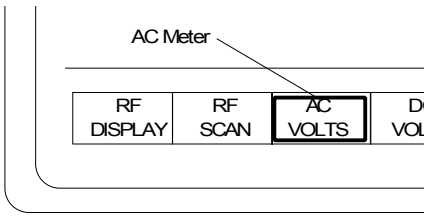


4-2.5 Receiver Sensitivity Testing (20 dB Quieting)

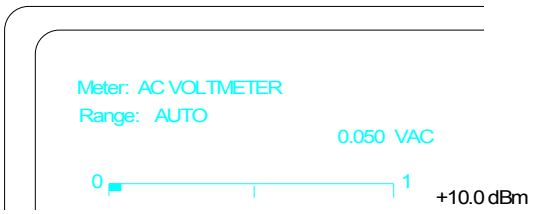
1. With the cursor located within the RF Control zone, press the **MON** softkey to remove input signal from the radio.



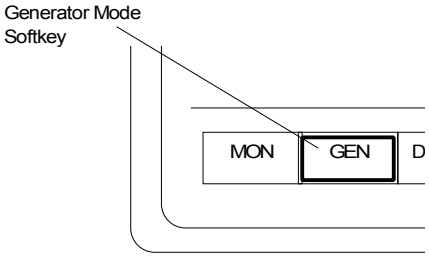
2. With the cursor located within the Display Control zone, press the **AC VOLTS** softkey to display the ac voltmeter:



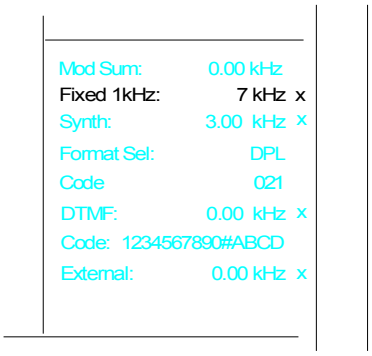
3. Turn on the receiver (unsquelched). Increase the receiver volume control to feed audio noise to the analyzer (at least 1/4 the rated audio power). Record the noise reading in dBm.



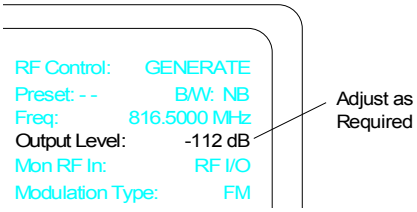
4. With the cursor within the RF Control zone, press the **GEN** softkey.



5. Within the Audio Control zone, set the modulation off.



6. Within the RF Control zone, adjust the RF output level until the noise reading is less than 20 dB from the value recorded in step 3. Refer to your radio's service manual to determine if any adjustments are required.

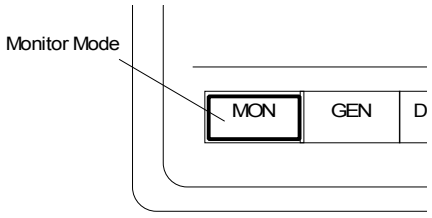


NOTE

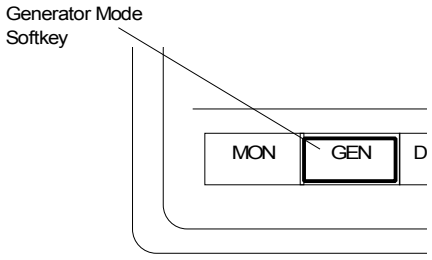
*To convert the RF output level to uV or dBV, locate the cursor within the Display Control zone and press the **RF DISPLAY** softkey. Locate the cursor to units used for Lvl: and select the required unit using the softkeys.*

4-2.6 Squelch Sensitivity Test

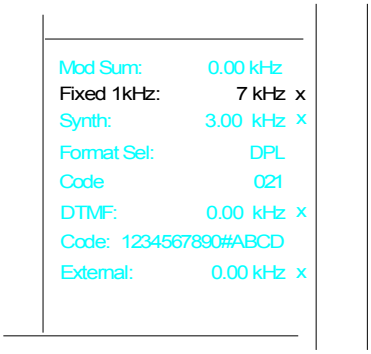
1. With the cursor located within the RF Control zone, press the **MON** softkey.



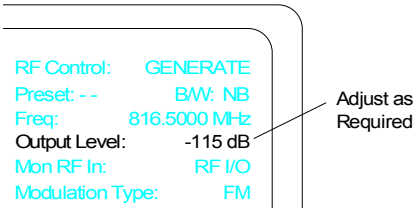
2. Disable the PL/DPL squelch if so equipped. Set the radio's squelch control to the point where the receiver barely quiets.
3. With the cursor located within the RF Control zone, press the **GEN** softkey.



4. Within the Audio Control zone, set the modulation off.



5. Within the RF Control zone, increase the RF output level until the receiver just unsquelches. This is the threshold squelch sensitivity of the radio.

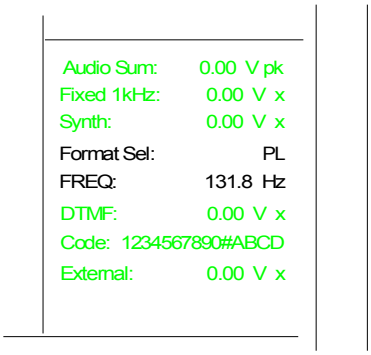


NOTE

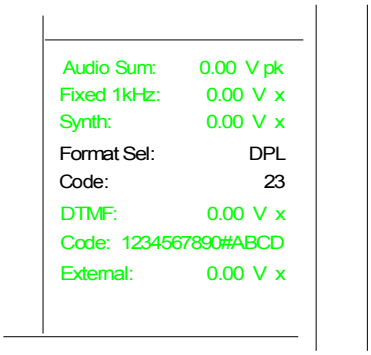
*To convert the RF output level to uV or dBV, locate the cursor within the Display Control zone and press the **RF DISPLAY** softkey.*

6. Repeat step 5 with the radio's squelch level set to maximum tightness to determine the tight squelch sensitivity of the radio.

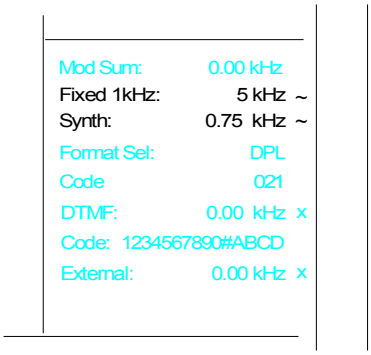
7. To check PL/DPL squelch sensitivity, locate the cursor within the Audio Control zone and enter the proper PL frequency or DPL code per Appendix B.



or

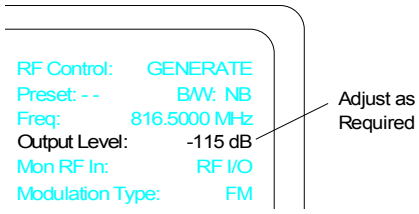


8. With the cursor located within the Audio Control zone, turn on the modulation and set the analyzer synthesizer to provide a nominal 750 Hz (500 - 1 kHz) deviation or to the radio's manufacturer's specifications.



9. Enable the radio's PL/DPL squelch circuit. Fully open the carrier squelch control.

10. Within the RF Control zone, increase the RF output level until the receiver just unsquelches. This is the coded squelch sensitivity.



4-3 CABLE TESTING (if equipped)

4-3.1 Overview

The analyzer cable fault test system can be used to find the distance to a fault in a cable under test such as an open or shorted connector, a damaged (pinched) area of the cable, etc.

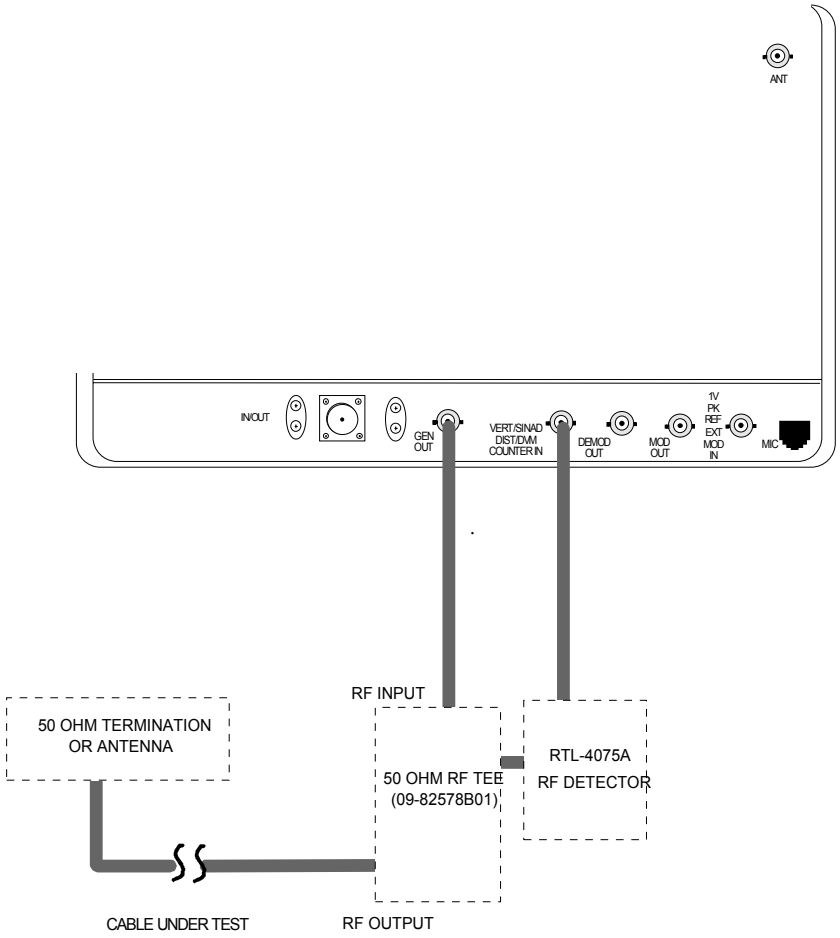


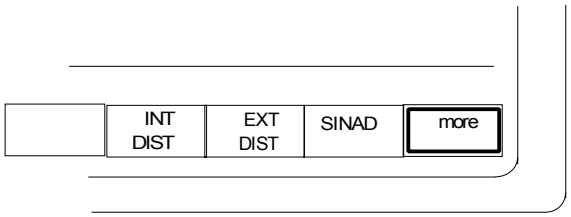
Figure 4-3. Basic Cable Testing Setup

4-3.2 Measuring Fault Distance

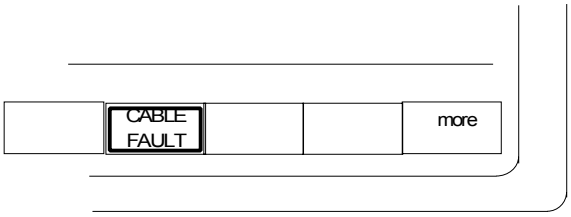
- To measure fault distance, terminate the free end of the cable with a 50 ohm load or the antenna
- To measure cable length, leave the free end of the cable open

Refer to figure 4-3. Connect the output of the RF Detector Probe (RTL-4075A) to the VERT/SINAD connection of the R2600 Analyzer. Attach a 50 ohm Tee (09-82578B01) to the GEN OUT/IN connection of the analyzer, and connect the RF input of the detector probe to the RF Tee. Connect the cable under test to the RF Tee.

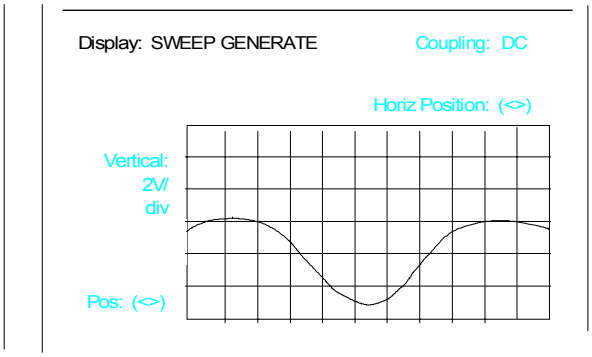
1. With the cursor located within the Display Control zone, press the **more** softkey, then press the **CABLE FAULT** softkey.



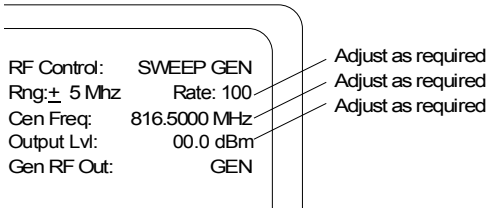
then



2. The sweep generator scope displays the standing wave pattern of the cable.



3. With the cursor located within the RF Control zone, set the range, output level and center frequency for the best display of the standing wave pattern.

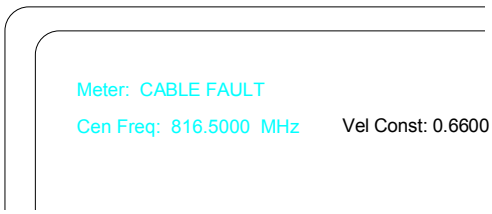


NOTE

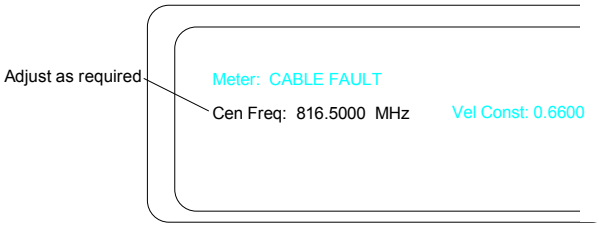
This measurement generally works best with the range set between 10 and 100 MHz. When measuring fault distance, with an antenna attached to the cable, the first and second nul frequencies should be within the operating frequency range of the antenna.

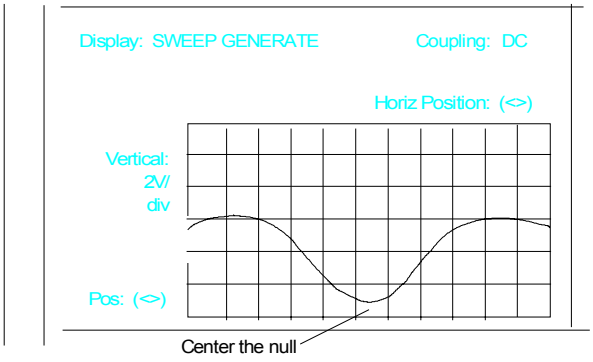
4. Within the Display zone, enter the velocity constant of the cable as required in the "Vel Const: " field.

Polyethylene	0.66
Cellular Polyethylene	0.78
Semi-Solid Polyethylene	0.84

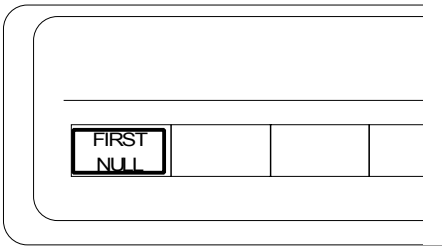


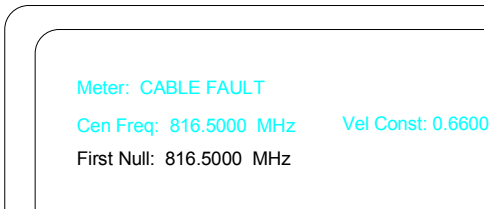
5. With the cursor located within the Display Control zone (Cen Freq:), use the tuning knob to center any null on the sweep generator scope.





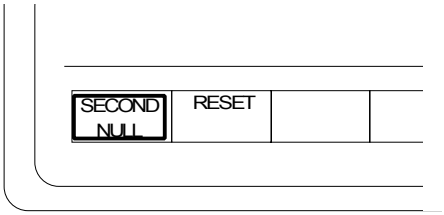
6. With the cursor located within the Display Control zone (Cen Freq:), press the **FIRST NULL** softkey to display the frequency of the first null.

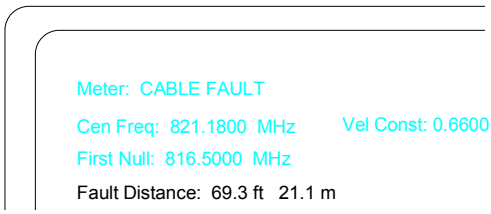




7. With the cursor still located within the Display Control zone (Cen Freq:), use the tuning knob to center an adjacent null to the same location on the sweep generator scope.

8. Press the **SECOND NULL** softkey. The cable fault distance (or cable length) will be displayed.





4-4 TONE REMOTE TESTING

The tone remote function allows the analyzer to generate the required function tones and timing for tone controlled equipment. Specific tones are sent to remote equipment via phone lines that are connected to remotes or control consoles. Base stations and repeaters are examples of equipment using tone control commands. For example, tone commands can command transmitters and receivers to change frequencies or disable PL. The analyzer can simulate the tones and appear to the base station or repeater as a console or desk remote.

The most common use for the tone remote feature is commanding tone remote bases in order to measure all the main transmitter parameters. The main parameters would be power, frequency and system deviation. Without this capability, a technician must rely on personnel at the remote console or carry a tone remote to the base site. This can be impractical and time consuming.

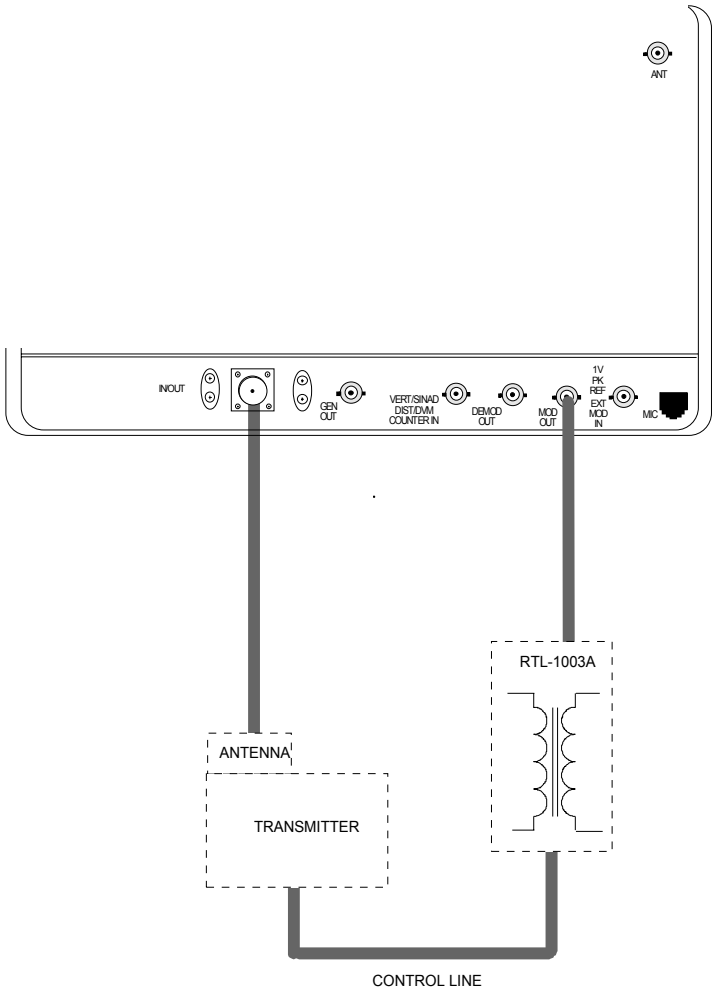


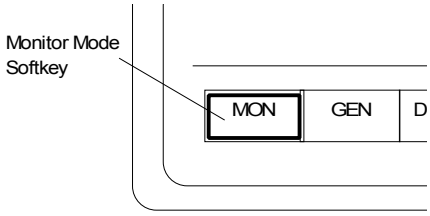
Figure 4-4. Tone Remote Testing Setup

4-4.1 Tone Remote Testing Setup

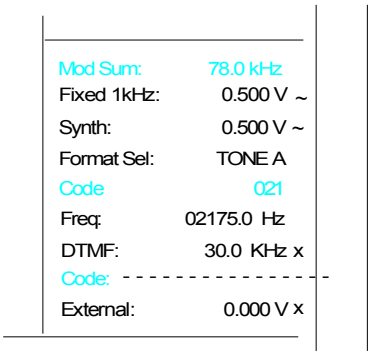
Refer to figure 4-4. Connect the analyzer RF I/O port to the radio antenna connector. Connect the phone lines, using a RTL-1003A matching transformer, to the analyzer's MOD OUT connector.

4-4.2 Checking for Proper Tone Remote Operation

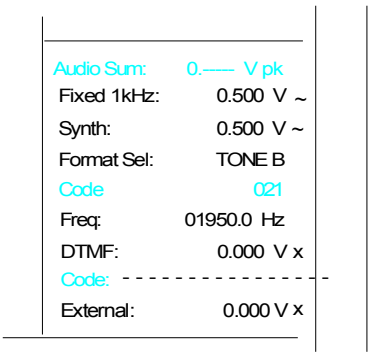
1. With the cursor located within the RF Control zone, press the **MON** softkey to place the analyzer into its Monitor mode of operation.



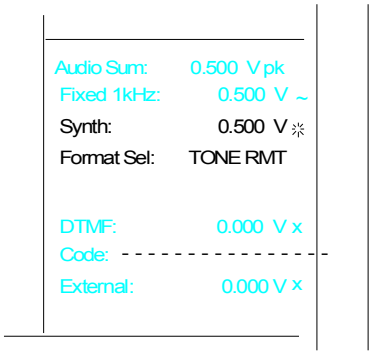
2. Tone Remote frequencies are programmed via the Tone A and Tone B memory. Set up the Audio Control zone, as follows:

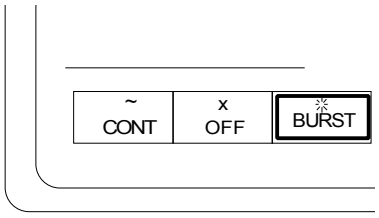


or

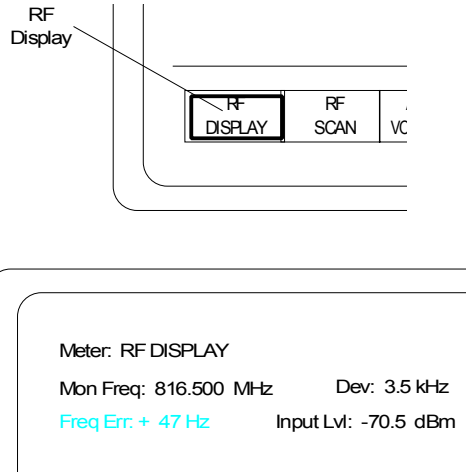


3. Set the "Format Sel:" to **TONE RMT**. The base transmitter is activated when the SYNTH is turned on by pressing the **BURST** key. The level of the fixed 1 kHz tone and "Synth:" field will vary depending on the base specifications.





4. With the cursor located within the Display zone ("Meter:" field), press the RF DISPLAY softkey. Monitor the base frequency, power and deviation.



4-5 Analyzer Setup for Printing

The analyzer must use null modem cable to properly print with any serial printer. **Do not use a standard serial cable; it will not work!**

This is due to the fact that the RS-232 port also is used as a control port to remotely operate the analyzer in computer controlled applications. Different cables are required to activate each function.

To set up the port for printer operation press the **SPF** key. When in this screen, move the high-lighted cursor to **RS232 SETUP** and press the softkey labeled **display table**. This table gives you the ability to configure the RS-232 output from the analyzer. Move the cursor to each field and choose the appropriate softkey entry to match the printer setup.

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Section 5

iDEN INTRODUCTION

5-1 INTRODUCTION

The General Dynamics R2660 iDEN Digital Communications System Analyzer tests the unique requirements of Motorola integrated Dispatch Enhanced Network (iDEN) equipment. All R2600 Series capabilities and features are retained with the test sequences accessed via the LCD display, numeric keypad, screen defined softkeys, cursor movement keys, and the optical tuning knob. R2600 features, as well as the iDEN functions, may also be accessed via the remote control interface port.

The R2660 operates in one of four top-level operating modes. These include:

- ***iDEN BER (Bit Error Rate) Test Mode***

  iDEN BER Test mode supports the testing of iDEN equipment operating in their test mode. The analyzer generates iDEN BER Test 1/6, 6/6 and 4/4 test signals and monitors iDEN BER Test 1/6 signals from mobile transmitters. Test signals contain predefined data patterns that are used to perform BER tests.

  Signal formats DJSMR and DMCA (international formats) are supported in this mode only.

- ***iDEN Base Mode***

  iDEN Base mode supports the testing of iDEN base radios operating in their functional mode. The analyzer provides the capability to monitor signals transmitted by an operational iDEN base radio.

- ***iDEN Mobile Mode***

  iDEN Mobile mode supports the testing of iDEN mobile radios operating in their functional mode. The analyzer simulates iDEN fixed end equipment providing the capability to exercise registration, interconnect and dispatch call operations of the mobile radio under test.

- ***Standard Mode***

  Standard mode supports all the standard test capabilities provided by the R2600 Communication Systems Analyzer Series. Many of the features and functions of this mode are not applicable to iDEN testing due to the unique iDEN modulation and demodulation format. For this reason, they are not included in the iDEN modes of operation, but can be accessed by placing the analyzer into its Standard mode.

5-2 iDEN SYSTEM OVERVIEW

The iDEN system is a high-capacity digital trunked radio system providing integrated voice and data services to the user. The iDEN system uses M16-QAM digital modulation and VSELP (Vector Sum Excited Linear Predictor) speech coding techniques coupled with Time Division Multiple Access (TDMA) channel access methodology to enhance channel capacity and system services. iDEN technology drives the need for new test and measurement functions for use in the service environment. The R2660 provides these features in a manner making servicing of iDEN equipment very similar to testing conventional analog radios.

The following highlights some of the characteristics and definitions of the iDEN digital trunked system. Refer to iDEN System product literature for a more detailed description of the iDEN System and its customer benefits and features. In this manual, fixed end system refers to all infrastructure equipment including Base Radio Repeaters, Site Controllers, and switching equipment. Mobile radio is used as a general term referring to mobile and portable radios.

TDMA / Channel Definition

Conventional trunking systems define a control or traffic channel by specifying a set of inbound and outbound frequencies to a user. The outbound frequency is the transmitter frequency of the Base radio repeater, and the inbound frequency is the mobile radio transmitter frequency. In the iDEN system, the use of a single frequency pair is shared among six users by dividing the frequency into time slots. Each time slot is 15ms in length. For the case of an iDEN voice traffic channel, each mobile radio transmits and receives on one of the six slots as assigned by the iDEN fixed end system. Therefore, the mobile radio transmission is a pulsed RF signal with a 1/6-duty cycle. The base radio transmits and receives on all slots from six different mobile radios. Therefore, each channel is defined by a Carrier Number and time slot definition. The Carrier Number specifies the inbound/outbound frequency pair.

M16-QAM Digital Modulation

The iDEN system uses M16-QAM that is a Motorola Inc. proprietary modulation format. M16-QAM is a digital modulation format containing 16-QAM modulation on four subcarriers. The modulation format contains both amplitude and phase modulation.

Signal Formats

There are multiple formats of iDEN signals: iDEN, DJSMR and DMCA. DJSMR and DMCA are international formats, and are supported only in the analyzer's BER Test mode. Carr # entry of DJSMR and DMCA is not provided.

Carrier Number (Carr #)

The frequency plan of the domestic iDEN system is defined using Carrier Numbers.

Inbound Frequency (Mobile Transmit) =
[0.0125 × Carr # + 806]MHz

Outbound Frequency (Fixed End Transmit) =
[0.0125 × Carr # + 851]MHz

The analyzer provides Carr # entry of test frequency to simplify the test set up effort. Test frequency set up using frequency entry is also provided giving the test operator maximum flexibility. Carr # entry is supported for iDEN systems only, it is not provided for DJSMR and DMCA.

Vocoder

Since the iDEN system utilizes digital modulation, audio must be digitized prior to transmission. Digitized audio is compressed using a VSELP vocoder prior to transmission to make more efficient use of the channel. The analyzer performs the vocoder algorithm on transmitted and received audio providing the capability to support talk and listen testing.

Signal Quality Estimate (SQE)

The SQE is a figure of merit used in the iDEN system indicating the modulation quality of a signal. The analyzer measures this parameter on monitored signals. SQE is expressed in units of dB.

Cellular RF Area Coverage

The iDEN system utilizes a cellular approach for RF area coverage similar to cellular telephone networks.

5-2.1 Mobile Operation On an iDEN System

The following describes key characteristics of the operation of an iDEN Mobile radio on the iDEN system.

Control Channel Acquisition

When powered up, the first activity of an iDEN mobile is to scan selected iDEN frequencies and lock on to a control channel. The control channel contains system information regarding system identification and timing parameters for the mobile radio to use when it operates on the system. The control channel also defines the maximum transmit power that a mobile radio may transmit on the system. The analyzer provides operator selection of a subset of the system information.

Mobile Synchronization

In operational mode, the mobile radio aligns its frequency and transmits timing to the outbound signal from the fixed end system. When testing a mobile radio in operational mode, the radio under test aligns its frequency and timing to the analyzer which simulates the fixed end system. The analyzer does not measure the frequency error of the mobile under test transmitter in operational mode since the mobile is frequency locked to the analyzer outbound signal.

Mobile Registration

In the iDEN system, a mobile radio is identified using an International Mobile Station Identifier (IMSI). The IMSI is assigned to the mobile radio when the radio performs an initial registration with the fixed end system. This assignment occurs when the radio is placed in service. The radio requests to be registered on the system using its International Mobile Equipment Identifier (IMEI). The fixed end system determines that the registration request was made using an IMEI and assigns an IMSI to the subscriber radio.

The assignment of an IMSI and dispatch IDs is an important concept in the test of iDEN mobile radios since a radio that has not been assigned appropriate IDs cannot place a dispatch or interconnect call. A radio that has not yet been placed in service or has been master reset since the time it was in service does not contain IMSI and dispatch ID assignment. The analyzer provides the capability to assign a dummy ID to the radio under test to support operational mode testing. The dummy ID must be removed from the mobile radio when testing is complete. The ID is removed by performing a master reset of the mobile radio under test.

Mobile Assisted Handovers

The mobile radio assists the fixed end system in determining when a handover to another cell should be executed. When the mobile radio is not in the process of transmitting or receiving a signal from the fixed end system, it monitors neighbor cell outbound signals measuring the received power and signal quality. When the mobile reaches the condition that the signal on the current cell is of poor quality and the signal of a neighbor cell is of good quality, the mobile transmits a handover request to the fixed end system. The iDEN infrastructure can also query the mobile radio for a measurement report. The mobile radio then transmits data back to the fixed end system indicating the received signal strength detected by the mobile radio.

The analyzer takes advantage of this system feature when executing an interconnect call scenario. The analyzer queries the radio under test to determine the received signal strength that the mobile radio has detected. The reported data is displayed to the test operator in the interconnect call scenario meter. This process is described in more detail later in this manual.

Call Scenario Description

When a mobile places a call on the iDEN system it goes through a series of system handshakes to establish the call. An example of an interconnect call follows:

1. The mobile is powered up, scans and locks on to a control channel.
2. The mobile registers on the system.
3. When a call is initiated from the mobile radio operator interface, the mobile places a service request on the control channel.
4. The fixed end system assigns the mobile to a dedicated control channel.
5. The mobile uses the dedicated control channel to transmit information required by the fixed end system to complete the call.
6. The fixed end system assigns the mobile to a traffic channel to be used for communication of voice or data.

Mobile Transmit Power Control

The transmitted power of an iDEN mobile is controlled by two methods:

1. The maximum power to be transmitted by a mobile is defined in the control channel system information.
2. However, the mobile radio does not always transmit at the maximum power allowed for a system. The mobile radio detects the signal strength of the received channel and determines the power to be transmitted based on the system Power Control Constant which is defined on the control channel. The mobile then sets its output power level accordingly. The default values of the analyzer's BCCH are set so that a mobile will transmit at its maximum power.

5-3 iDEN TEST OVERVIEW

The following sections provide an overview of analyzer testing of iDEN digital trunked radio equipment:

BER Test Mode Testing

Bit error rate (BER) is a common measurement performed in digital communication systems. BER testing is used to verify the performance of transmitters and receivers. For receiver verification, the test generator generates a signal with a predefined pseudo random bit pattern. The receiver under test demodulates the signal and determines the number of errors by comparing the received signal to the predefined bit pattern. The BER is the number of errors divided by the number of bits over which the measurement is performed. When applied to the land mobile environment, BER is normally expressed in percent. 00.1000% BER indicates one error out of one thousand bits. Receiver sensitivity is often measured based on the detected BER.

Transmitter verification is performed by measuring the transmitted BER using a reference receiver. The reference receiver measures the BER by comparing the received bit pattern to the predefined test pattern.

iDEN equipment provides a BER Test mode in addition to the operational mode of the equipment. In BER Test mode, iDEN equipment transmits and receives iDEN BER test signals. There are several iDEN BER Test signals containing a predefined bit pattern. The analyzer provides the capability to generate and monitor these test signals. With the analyzer in Monitor mode, the analyzer measures the frequency, power, BER and SQE of the transmitted signal to verify transmitter performance. In Generate mode, the analyzer generates test signals to be received by the iDEN equipment under test. This supports sensitivity as well as strong signal testing.

The following test signal set is supported by the analyzer:

- 6/6 and 4/4 test signal generation to test iDEN mobile receivers
- 1/6 test signal generation to test iDEN base receivers
- 1/6 test signal monitor to test iDEN mobile transmitters

Frequency Measurement

Frequency measurement cannot be performed using a standard frequency counter due to the high AM modulation coefficient and the pulsed RF nature of iDEN signals. The analyzer digitizes the monitored signal and utilizes digital signal processing algorithms to measure the frequency error of iDEN signals.

Power Measurement

The AM modulation index and pulsed RF nature of iDEN signals also presents new issues when measuring power. The analyzer provides a long term Averaging Wattmeter with operator selectable measurement period to perform average power measurement of iDEN signals.

Signal Quality Estimate (SQE)

SQE is a modulation quality metric used for iDEN signals. The analyzer performs SQE measurement in both test mode and operational mode to verify transmitter performance. SQE is expressed in units of dB.

Fixed End System Simulation

The analyzer simulates a subset of the iDEN fixed end functions to test an iDEN mobile in operational mode. The analyzer simulates the fixed end to support registration, interconnect and dispatch calls initiated by an iDEN mobile radio. Once the mobile radio under test is on a traffic channel, the analyzer features can be used to verify the performance of the mobile radio under test. Additionally, the analyzer determines radio configuration data for verification during the call scenario tests.

Vocoder

The iDEN system employs a VSELP vocoder to compress voice data. The analyzer performs voice encoding the decoding functions to provide "talk and listen" testing of the mobile radio under test. This supports verification of audio performance prior to returning a radio to service. Analyzer "talk and listen capability" makes the testing of iDEN mobile radios similar to testing performed on conventional analog radios. The 2660B is capable of supporting both 3:1 and 6:1 interconnect call processing. Note that since the iDEN system utilizes a vocoder and digital modulation, the level of audio input to the traffic channel does not affect the transmitted waveform.

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Section 6

iDEN OPTION OPERATING INSTRUCTIONS

6-1 INTRODUCTION

General operation and functions of the R2660 iDEN Digital Communication System Analyzer are similar to the R2600 Series Communications System Analyzers. Refer to the General Operation tab in this manual for general installation instructions, a description of the control functions, and general operational information. The following sections of this manual contain information on how to connect iDEN base or mobile radios to the analyzer for testing, and how to set controls and indicators to obtain the correct screen display.

Error/Warning Messages

Refer to Appendix C for a listing and description of setup and radio error messages. Messages common to all the R2600 Series equipment are detailed in paragraph 7-4 of the General Operation section of this manual.

6-2 iDEN ANALYZER SOFTWARE VERSION SCREEN

To view the software version of the iDEN R2660 Analyzer, press the **SPF** hard key, move the cursor to "VERSION," and select the **display table** softkey. This will configure the analyzer to generate a screen that displays the standard and iDEN software platform versions. Use the cursor to select "SUPERTIER," then press the **view options** softkey. A screen similar to figure 6-1, indicating installed options, will be displayed.

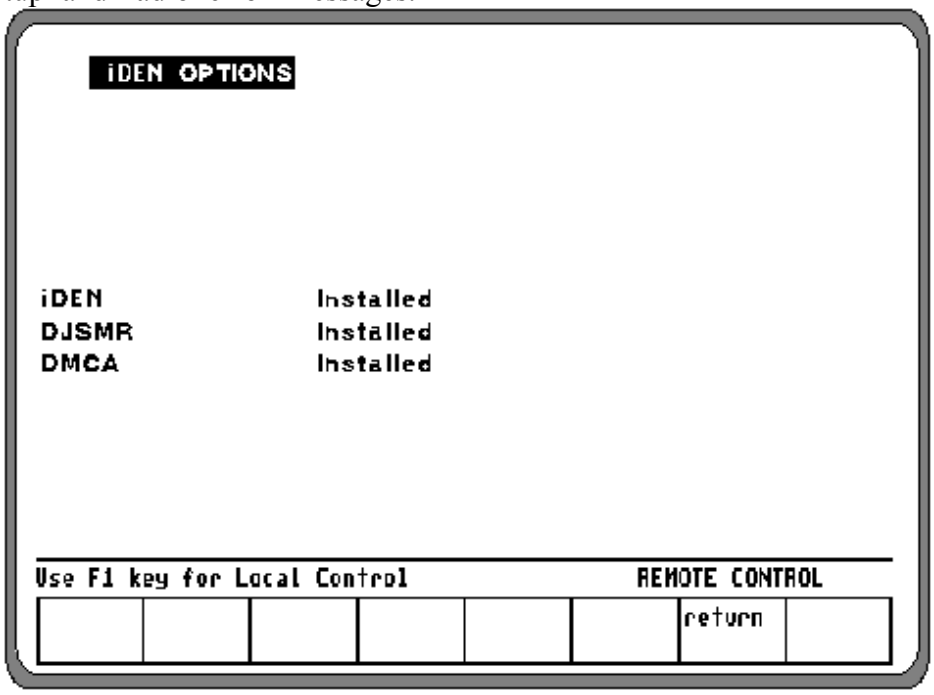


Figure 6-1. iDEN Analyzer Options Screen

6-3 GENERAL OPERATION

To select Standard mode, place the cursor in the "Mode:" field in the Display Zone located at the top of the screen. Press the **STD** softkey. All standard features and functions of the analyzer are accessible by placement of cursor, softkey selection and hardkey selection as described in the General Operation section of this manual.

6-3.1 Connecting a Radio

Use a 50-ohm BNC cable with the supplied BNC to N adapter to connect from the RF I/O port of the analyzer to the antenna port of the radio as shown in figure 6-2.

CAUTION

Observe the input power ratings and warnings of the analyzer to ensure that no damage occurs to the analyzer.

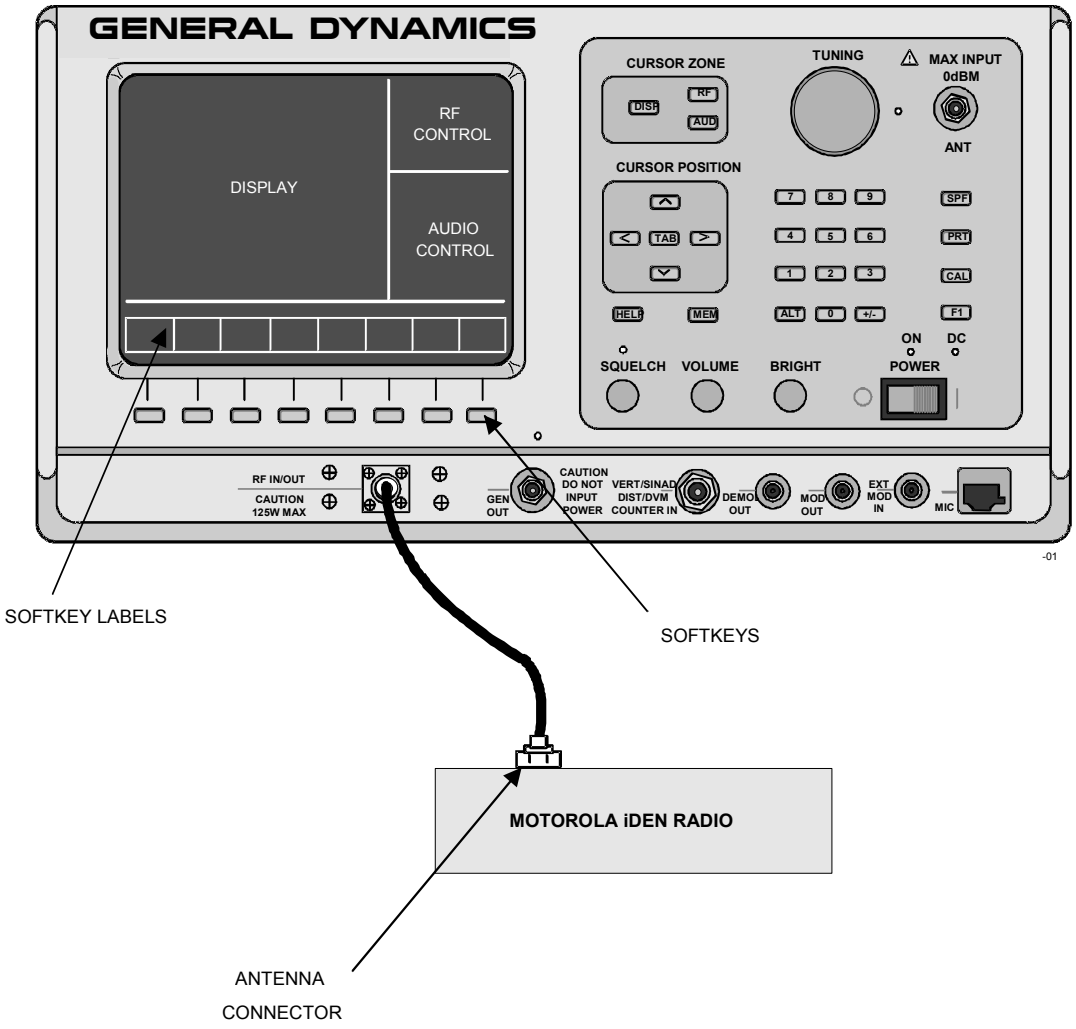


Figure 6-2. iDEN Radio Test Setup

6-4 REMOTE OPERATION

All R2600 Series Communications System Analyzers are equipped with a standard RS-232 interface. Optionally, the R2660 is equipped with an IEEE 488 interface. Either of these interfaces may be used to remotely control the analyzer using a set of commands, queries, and responses that are defined in the General Dynamics R2600 Series Communications System Analyzer Programming Reference Manual (68-P80309E55).

6-5 ACCESSING iDEN MODE

Select the iDEN mode by placing the cursor in the "Mode:" field in the Display Zone located at the top of the screen. Use the **more** softkey to advance the analyzer softkey menu until the iDEN softkey group is available. A screen similar to figure 6-3 appears.

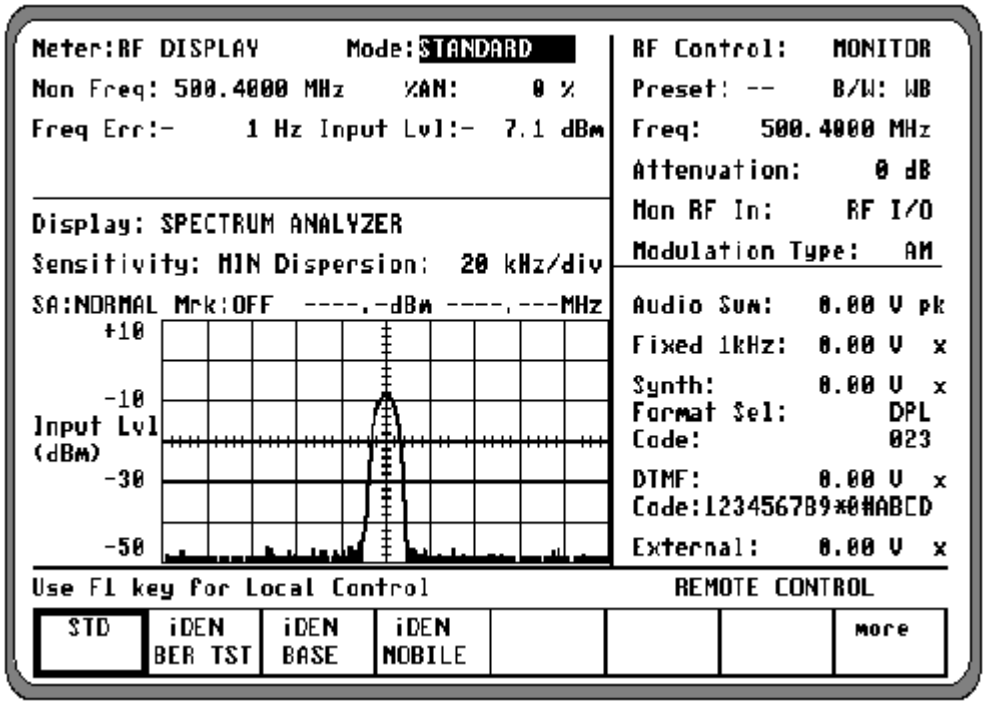


Figure 6-3. iDEN Softkey Group

6-6 iDEN BER TEST MODE

When operating in its iDEN BER (Bit Error Rate) Test mode, the analyzer tests the performance of iDEN equipment by transmitting and/or receiving predefined iDEN BER test signals.

In BER Test mode, the analyzer supports the following test signal set:

- 6/6 and 4/4 test signal generation to test iDEN mobile receivers
- 1/6 test signal generation to test iDEN base receivers
- 1/6 test signal monitor to test iDEN mobile transmitters

Test signals contain predefined data patterns which are used to perform bit error rate (BER) tests on iDEN transmitters and receivers. Frequency error, input power level and SQE (Signal Quality Estimate) are also measured in iDEN BER Test mode.

6-6.1 Accessing iDEN BER Test Mode

Select the iDEN mode by placing the cursor in the "Mode:" field in the Display Zone located at the top of the screen. Use the more softkey to advance the analyzer softkey menu until the iDEN softkey group is available. With the cursor in the "Mode:" field, use the **iDEN BER TST** softkey to place the analyzer into the iDEN BER Test mode. A screen similar to figure 6-4 appears.

NOTE

Upon selection of any of the iDEN modes (iDEN BER TEST, iDEN BASE, or iDEN MOBILE) DSP algorithms are automatically downloaded. This takes 4 seconds or less, ***during which key presses are not recognized.***

6-6.2 iDEN BER Test Primary Operating Modes

Select the operating mode by placing the cursor in the "RF Control:" field in the RF zone. Primary operating modes are:

- MONITOR
- GENERATE
- DUPLEX

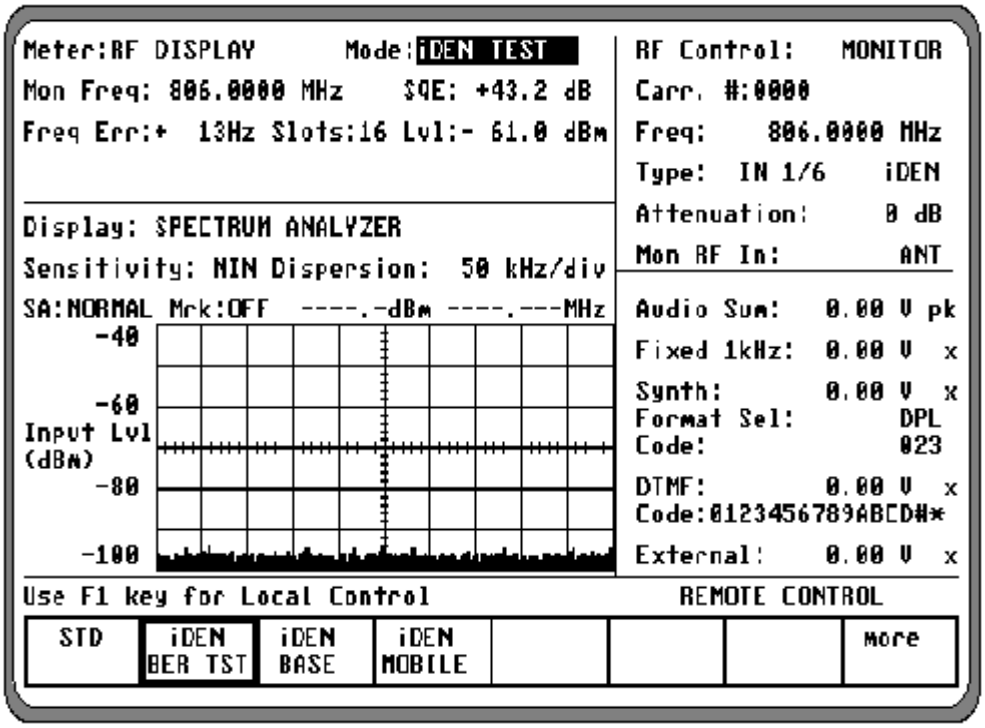


Figure 6-4. iDEN BER Test Mode Screen

6-6.3 iDEN BER Test RF Operation

6-6.3.1 iDEN BER Test Monitor Mode

Selecting the iDEN BER Monitor mode configures the analyzer test receiver functions to monitor iDEN 1/6 BER test signals from a mobile transmitter.

To begin testing, activate the iDEN BER Test mode per paragraph 6-6.1. Within the RF Control zone, place the cursor in the "RF Control:" field and press the **MON** softkey. A screen similar to figure 6-5 appears.

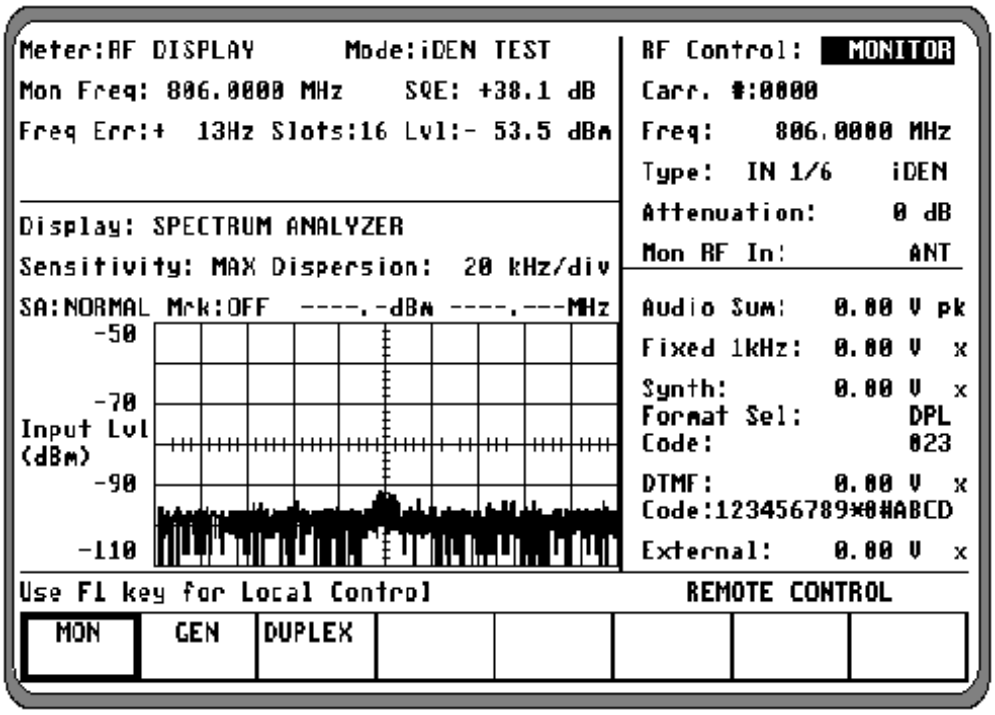


Figure 6-5. iDEN BER Monitor Mode Screen

Use the cursor control keys to position the cursor to select (highlight) the following parameters.

NOTE

Selection of the modulation type and monitor RF bandwidth is not required since the unit is automatically configured for M16-QAM modulation and wideband monitor.

Carr. #

The "Carr. #:" field provides two functions. It provides for selection of the frequency to be monitored using iDEN carrier number assignments numbering 0 to 1199. The carrier number is entered using the numeric keypad or tuning knob. Monitor frequency is a function of both Type and Carr. # selections, the monitored frequency is determined by the following equations.

OUT 1/6: $\text{frequency}_{\text{monitor}}$ (MHz) = 851 + (0.0125 × Carr #)

IN 1/6: $\text{frequency}_{\text{monitor}}$ (MHz) = 806 + (0.0125 × Carr #)

When the frequency to be monitored is entered directly (in the "Freq:" field), the "Carr **#:**" field displays the corresponding iDEN channel. If the selected frequency is not a valid iDEN frequency, the field is filled with dashes.

NOTE

The "Carr #:" field appears only when iDEN signal format is selected. If DJSMR or DMCA signal format is selected, the "Carr #" field is automatically removed from the display.

Freq

The "Freq:" field provides two functions. It provides for display of the frequency to be monitored when "Carr #:" and "Type:" fields are used to select the monitor frequency. The frequency cursor also provides for direct frequency entry. Frequency is entered using the numeric keypad or the tuning knob. This feature provides for monitor capability of frequencies that are not iDEN carriers.

Type

The "Type:" field is used to identify the signal type, the direction of the signal relative to a base radio and the format of the signal to be monitored. Select IN 1/6 to monitor signals transmitted by a subscriber radio. The analyzer uses the OUT/IN selection to determine the monitor frequency for a given carrier number. "IN" corresponds to the lower band, while "OUT" corresponds to the higher band. Select iDEN, DJSMR, or DMCA to select the format of the signal to be monitored.

NOTE

Cursor locations "Attenuation:" and "Mon RF In:" operate as in Standard mode.

6-6.3.2 iDEN BER Test Generate Mode

Selecting the iDEN BER Test Generate mode configures the analyzer to generate iDEN BER test signals.

To begin testing, activate the iDEN BER Test mode per paragraph 6-6.1. Within the RF Control zone, place the cursor in the "RF Control:" field and press the **GEN** softkey. A screen similar to figure 6-6 appears.

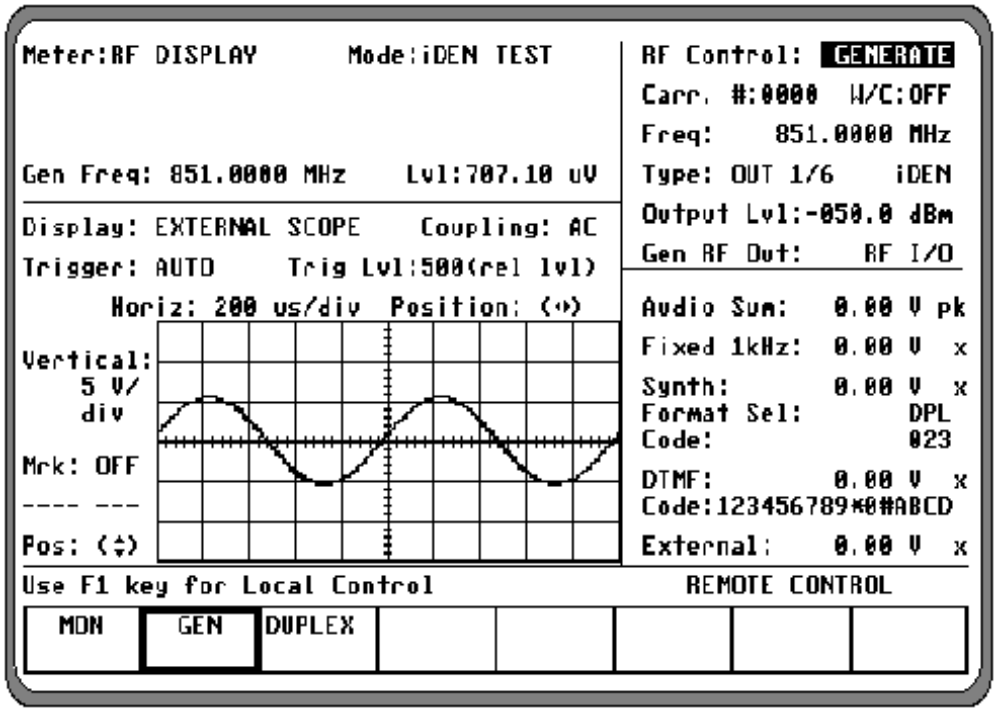


Figure 6-6. iDEN BER Generate Mode Screen

Use the cursor control keys to position the cursor to select (highlight) the following parameters:

CAUTION

The output level is the average power of the generated signal during an active slot. "Off" slots are not included in the average.

NOTE

Selection of the modulation type and bandwidth are not required since the unit is automatically configured for iDEN test signal generation when iDEN BER Test is selected.

Carr. #

The "Carr. #:" field operates as it does for iDEN BER Monitor Test. Generate frequency is determined by the following equations:

OUT 1/6, OUT 6/6, OUT 4/4:
$\text{frequency}_{\text{generate}}$ (MHz) =
851 + (0.0125 × Carr #)

IN 1/6: $\text{frequency}_{\text{generate}}$ (MHz) =
806 + (0.0125 × Carr #)

NOTE

The "Carr #:" field appears only when iDEN signal format is selected. If DJSMR or DMCA signal formats is selected, the "Carr #:" field is automatically removed from the display.

***W/C*:**

W/C provides ON selection to generate signals with window clipping and OFF selection to generate signals without window clipping.

Freq

The "Freq:" field provides two functions. It provides a display of the frequency to be generated when "Carr #:" and "Type:" fields are used to select the generate frequency. The "Freq:" field also provides for direct generate frequency entry for the analyzer. Frequency is entered using the numeric keypad or the tuning knob. This feature provides for generator capability of frequencies that are not iDEN carriers.

Type

The "Type:" field identifies the signal type, the direction of the signal relative to the fixed end system, and the format of the signal to be generated. Select OUT 1/6, OUT 6/6 or OUT 4/4 to generate signals to test mobile radio receivers and IN 1/6 to generate signals to test a base radio receiver. The analyzer uses the OUT/IN selection to determine the generate frequency for a given carrier number. “IN” corresponds to the lower band, while “OUT” corresponds to the higher band. Select iDEN, DJSMR, or DMCA to select the format of the signal to be generated.

6-6.3.3 iDEN BER Test Duplex Mode

Selecting the iDEN BER Test Duplex mode configures the analyzer to simultaneously generate and monitor iDEN test signals.

NOTE

During iDEN BER Duplex testing, the Offset determines the direction (Inbound or Outbound) of the signal to be monitored.

To begin testing, activate the iDEN BER Test mode per paragraph 6-6.1. Within the RF Control zone, place the cursor in the "RF Control:" field and press the **Duplex** softkey. A screen similar to figure 6-7 appears.

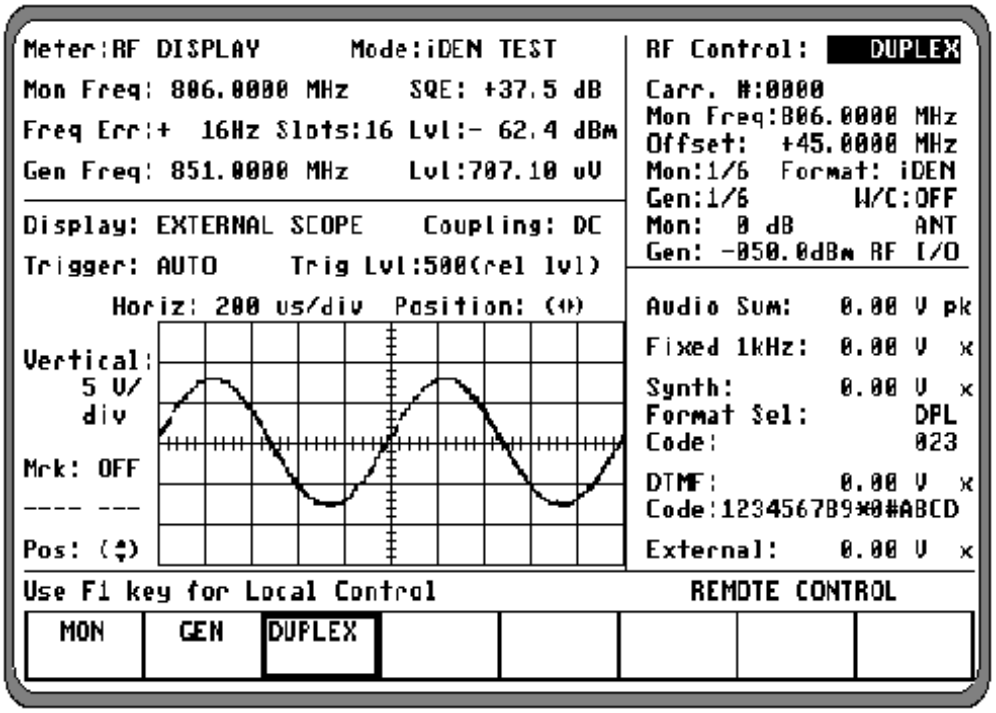


Figure 6-7. iDEN BER Duplex Test Screen

Use cursor control keys to position the cursor to select (highlight) the following parameters:

NOTE

Selection of the modulation type is not required since the unit is automatically configured for iDEN test signal monitoring and generation when iDEN BER Test is selected.

Carr. #

The "Carr. #" field provides two functions. It provides for selection of the frequency to be monitored using iDEN carrier number assignments numbering 0 to 1199. The carrier number is entered using the numeric keypad or tuning knob. Monitor frequency is a function of the "Carr. #" field entry and duplex offset selections, the monitored frequency is determined by the following equations.

Duplex Offset: -45 MHz

$$frequency_{monitor}\,(MHz) = 851 + (0.0125 \times Carr\ \#)$$

Duplex Offset: +45 MHz

$$frequency_{monitor}\,(MHz) = 806 + (0.0125 \times Carr\ \#)$$

When the frequency to be monitored is entered directly using the "Mon Freq:" field, the "Carr #" field provides for display of the corresponding iDEN channel. If the selected frequency is not a valid iDEN frequency, the field is filled with dashes.

NOTE

The "Carr #:" field appears only when iDEN signal format is selected. If DJSMR or DMCA signal formats or duplex offsets are selected, the "Carr #:" field is automatically removed from the display.

Mon Freq

The "Mon Freq:" field provides two functions. It provides a display of the frequency to be monitored when "Carr #:" field is used to select the monitor frequency. The "Mon Freq:" field also provides for direct monitor frequency entry for the analyzer. Frequency is entered using the numeric keypad or the tuning knob. This feature provides for monitor capability of frequencies that are not iDEN channels.

Offset

In iDEN BER Test mode, the offset is limited to +39, +45, and +48 MHz of operation. The duplex offset is selected (Figure 6-7a) using softkeys. +39 MHz should be used for iDEN testing in the 900 MHz frequency band. +45 MHz should be used for iDEN testing in the 800 MHz frequency band. +48 should be used for DJSMR and DMCA testing.

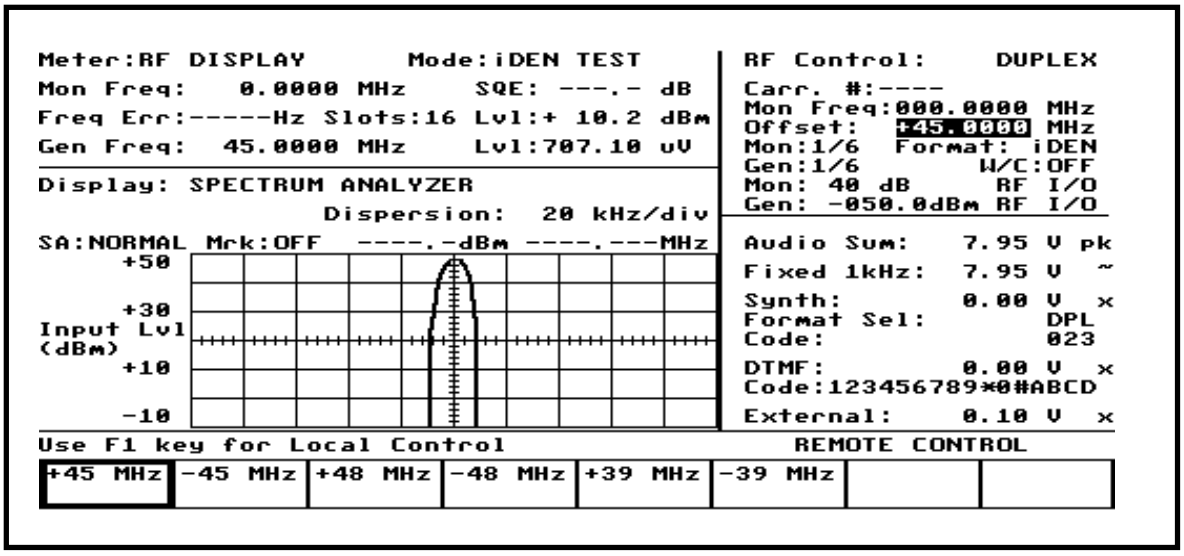


Figure 6-7a. iDEN BER Duplex Offset Screen

Positive duplex offset selection defines the monitor of inbound signals generated by a subscriber radio and the generation of outbound signals.

Negative duplex offset selection defines the monitor of outbound signals generated by a base radio and the generation of inbound signals.

Selection of +48 MHz offset selection also causes the "Carr #:" field to be removed from the display since this duplex offset is not part of the iDEN channel plan.

MON (Type)

The "Mon:" field is used to define the signal type to be monitored. Available signal selection is dependent on the duplex offset selection which defines the direction of the monitored signal. When the duplex offset is positive, IN 1/6, indicating inbound monitor frequency, is available for selection. When the duplex offset is negative, OUT 1/6, indicating outbound monitor frequency, is available for selection.

Format

Select iDEN, DJSMR, or DMCA to define the signal format used for testing.

GEN (Type):

The "Gen (Type):" field is used to define the signal type to be generated. Available signal selection is dependent on the duplex offset selection which defines the direction of the generated signal. When the duplex offset is positive, Out 1/6, Out 6/6 and Out 4/4, indicating outbound frequencies, are available for selection. When the duplex offset is negative, IN 1/6, indicating inbound frequency, is available for selection.

GEN (Level):

The "Gen (Level):" field is used to define the output level of the generated signal during an active slot.

***W/C*:**

W/C provides **ON** selection to generate signals with window clipping and **OFF** selection to generate signals without window clipping.

6-6.4 iDEN BER Test Meters and Displays

The Average Wattmeter, BER Meter and BER Table are new metering functions available in the analyzer for monitoring iDEN signals. The RF Display and Bar Graphs have been slightly modified to accommodate iDEN testing.

6-6.4.1 iDEN BER Test RF Display Measurements

Use the RF Display meter to make measurements of transmitted signal performance. The iDEN RF-Display zone differs from the standard RF-Display zone in that Signal Quality Estimate (SQE) is provided rather than frequency deviation as in the case of FM and percent modulation as in the case of AM modes of operation. Also note that the number of slots for which the measurement is performed is selectable.

RF Display measurements are accessed by placing the cursor in the Display zone's "Meter:" field and pressing the **more** softkey until the **RF Display** softkey is presented. Select the **RF Display** softkey to access the RF Display zone measurements. An example of RF Display zone measurement screen is shown in figure 6-8.

NOTE

The RF Display zone provides a short term average power measurement for iDEN pulsed RF test signals. Use the Average Wattmeter (paragraph 6-9) to make more consistent measurements over a longer measurement period. The Average Wattmeter results will have less measurement variance.

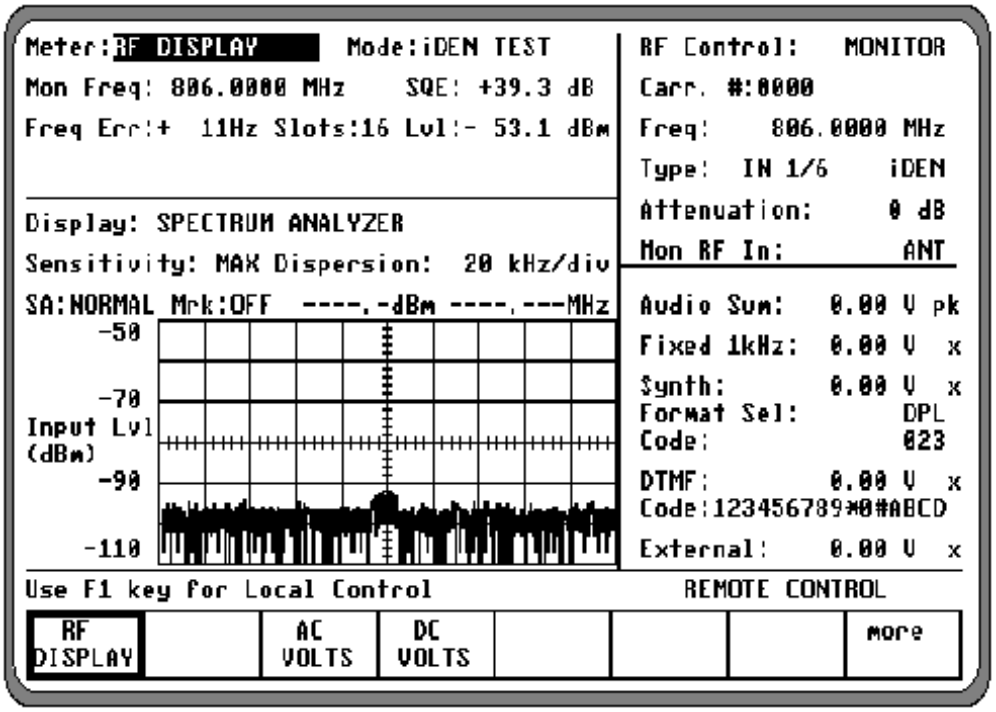


Figure 6-8. iDEN BER RF Display Zone Measurements Screen

Mon Freq

Display of the monitored frequency.

SQE

Display of the SQE in units of dB to provide an indication of modulation quality.

Slots

Measurement results are moving-window-averaged for the number of slots selected. Select the larger values of slots to reduce the variability of measurements. Lower values are useful for obtaining quick results, however the displayed results will have more variation. Average length selections of 4, 16, and 80 slots are provided.

NOTE

Slot selection does not apply to the input level measurement. The input power measurement in the RF Display zone meter is a fixed length short term average.

Freq Error

Display of the frequency error of the received signal relative to the monitor frequency selected. The maximum guaranteed acquisition frequency error is 1500 Hz for iDEN BER Tests.

CAUTION

The monitor frequency setting of the analyzer must be within the range of the frequency error. Therefore, it may be necessary to adjust the monitor frequency to ensure that it is within the frequency error of the equipment under test. The iDEN frequency counter measures the error of iDEN signals only. Use the standard mode RF Display (refer to General Operations section of this manual) to measure the error of continuous signals.

Input Lvl

The input level is a short-term average power measurement of the input signal. Power is averaged over four slots. The displayed measurement is scaled to indicate the average power of an active slot. Therefore when monitoring a 1/6 test signal the average power is scaled by a factor of 6 so that the displayed power is the average power of an active slot.

6-6.4.2 Average Wattmeter

The average wattmeter, used for making long-term input power measurements on consecutive slots of iDEN signals, is available in the "Meter:" field. For information detailing the use of the average wattmeter, refer to paragraph 6-9.

6-6.4.3 iDEN BER Test Meter

The iDEN BER Test meter is available only during iDEN BER Monitor or Duplex Testing. The BER Meter is used to verify the performance of test signals generated by iDEN mobile radios. The meter provides display of BER, SQE, frequency error and input power level. The number of slots used for measurement average and triggering type are operator selectable. Auto and Single triggering modes are provided. In Auto mode, the BER measurements are made repeatedly and the display updated with new results. In Single mode, one BER measurement for the number of slots selected is made and the result is displayed. The displayed results are held until a new measurement is initiated by selecting trigger.

NOTE

BER Meter measurements, with the exception of Input Lvl, are averaged over the number of slots selected by the operator. When one measurement is completed, a new average is started for the next measurement. Measurements ***are not moving window averaged*** *as for the RF Display. The Input Lvl measurement is a short-term average as in the RF Display meter.*

The iDEN BER Meter is accessed by placing the cursor in the Display zone's "Meter:" field and pressing the more softkey until the BER softkey is presented. Select the BER softkey to access the BER Meter. An example of a BER Meter is shown in figure 6-9.

To initiate measurements, selections of trigger type and measurement length are made to set up a BER measurement test. The selections are made as follows:

Trig:

The measurement triggering type is selected from the "Trig:" field. Select **Auto** for automatic triggering and **Single** to perform a single measurement.

Auto – Selecting **Auto** will cause measurements to be made continuously. For slot selections of 4 and 16 the display is updated only at completion of the current measurement since it is a quick measurement. For slot selections of 80 and 960, intermediate results are displayed. The display rolls over to show the next measurement when the current measurement is complete. Completed measurements can be observed using the BER Table. Note that changing the slot selection when a measurement is in progress will cause the measurement to be restarted for the new slot selection. Select the **stop** softkey to terminate a measurement prior to completion. Refer to the BER Table section for a description of its operation.

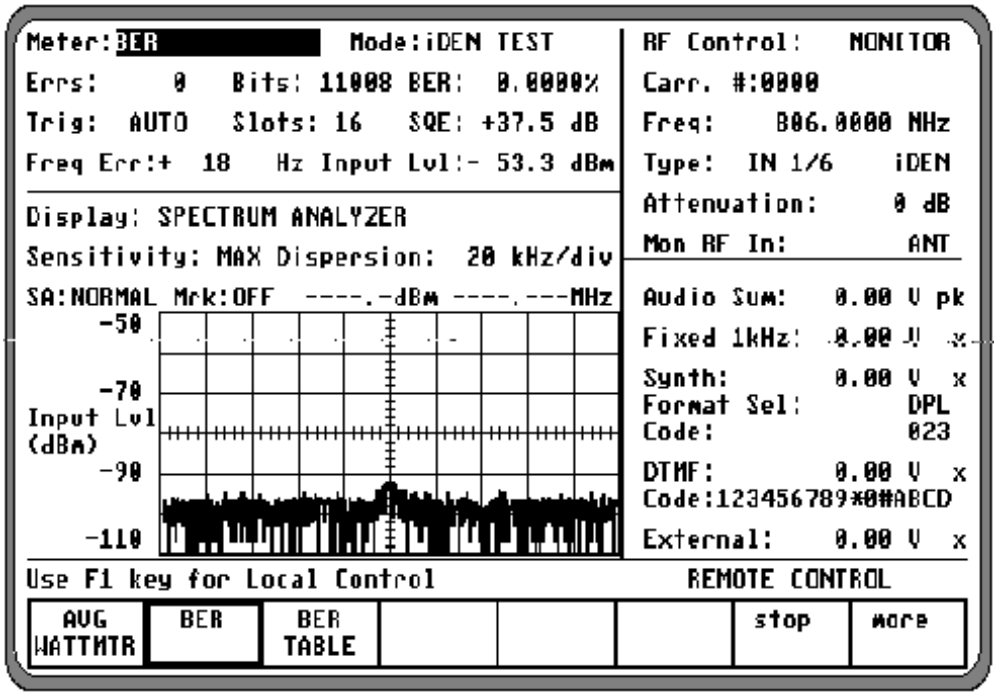


Figure 6-9. iDEN BER Meter

Single – Selecting Single will cause one measurement to be performed. Repeated measurements can be made by reselecting **Single.** When the measurement is started, the Errs, Bits, BER, SQE and Freq Error fields are updated with intermediate results for slot selections of 80 and 960. Upon completion of the measurement, the display is held indicating the completed measurement results. If the measurement length is set for 4 or 16 slots, the display is updated at measurement completion since it is a quick measurement. Note that changing the slot selection when a measurement is in progress will cause the measurement results to reset

and begin a new measurement. Select the **stop** softkey to terminate a measurement prior to completion. If the BER Meter loses signal synchronization due to excessive bit error rate, the meters stops and dashes out the results.

Slots

Measurements are performed for the number of slots selected. Select the larger values of slots to reduce the variability of measurements. Lower values are useful for obtaining quick results, however the displayed results will have more variation. Measurement length selection of 4, 16, 80 and 960 slots are provided.

NOTE

Slot selection does not apply to the Input Level measurement. The input power measurement in the BER meter is a fixed length short term average.

Errs

Display of the bit error count detected during the test. For 80 and 960 slot selections, intermediate error counts are displayed.

Bits

Display of the bit count during the test. For 80 and 960 slot selections, **Bits** is updated during the measurement.

BER

Display of the ratio of bit errors to bit count determined during the test. BER is displayed as a percentage. The BER for one error in one thousand bits is 00.1000%.

Freq Err, SQE, Input Lvl

Display results as previously described for the RF Display meter. Recall that Input Lvl is a short term average not affected by the value selected for **Slots.** The acquisition frequency error range is $\pm$1500 Hz as described for the RF Display.

6-6.4.4 iDEN BER Test Table

The iDEN BER Test table displays a history of the 8 previous measurements made by the BER Meter. The BER Table stores and displays measurements for BER, SQE, FREQ ERR and measurement length (SLOTS) for measurements performed using the BER Meter. Note that the meter zone portion of the BER Table is the same as the BER Meter and the display zone portion is the table indicating previous measurements.

The iDEN BER Table is accessed by placing the cursor in the Display zone's "Meter:" field and pressing the more softkey until the BER TABLE softkey is presented. Select the BER TABLE softkey to access the BER Table. An example of a BER Table is shown in figure 6-10.

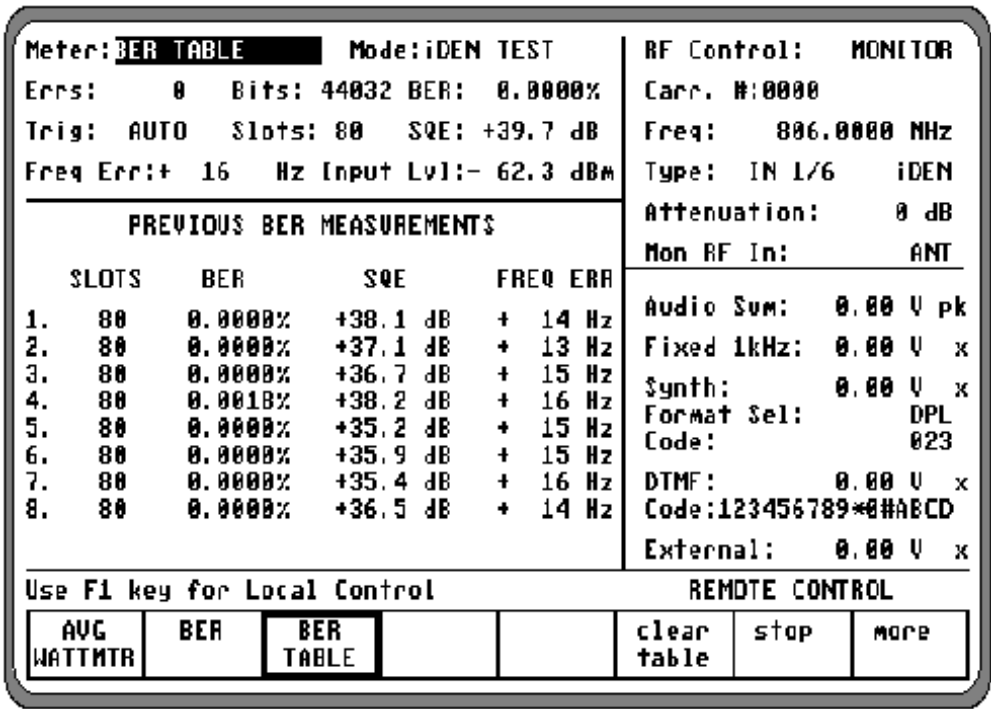


Figure 6-10. BER

Table trigger-type selections and measurement length are made to set up a BER measurement test. The selections are made as follows.

Triggering and slot selection is performed as in the BER Meter. In auto triggering mode, BER measurements are repeatedly performed and the results stored to the BER Table. In single triggering mode, BER measurements are transferred to the BER Table as completed when a measurement is initiated by the operator.

The most recent results are displayed at the top of the table. Previous measurements are shifted down as each new result is added to the table. The oldest measurement is shifted off the bottom of the table, once the table is full.

Two softkey selections are provided to control the BER Table. Selecting **clear table** causes all measurements to be erased from the table. This is a useful feature for beginning with a new table when a new test is begun. Selecting **stop** will terminate BER measurements and freeze the display.

6-6.5 iDEN BER Test Audio Operation

The iDEN BER Test mode Audio zone operates the same as the Audio zone in standard mode (refer to the General Operation section of this

manual). Audio zone configuration does not affect test signal generation. The Audio zone acts as an audio generator with audio output to the front panel Mod Out port.

6-7 iDEN BASE MODE

When operating in its iDEN Base mode, the analyzer tests the performance of iDEN base radios operating in their functional mode. The analyzer provides the capability to monitor signals transmitted by an operational iDEN base radio.

Base radio transmitter measurements include:

- Frequency Error Measurement
- Average Power
- SQE

NOTE

iDEN Base mode supports testing of iDEN signals only. Monitor of live DJSMR or DMCA is not provided.

6-7.1 Accessing Base Mode

Select the iDEN Base mode by placing the cursor in the "Mode:" field in the Display Zone located at the top of the screen. Use the more softkey to advance the analyzer softkey menu until the iDEN softkey group is available. With the cursor in the "Mode:" field, use the iDEN Base softkey to place the analyzer into the iDEN Base mode. A screen similar to figure 6-11 appears.

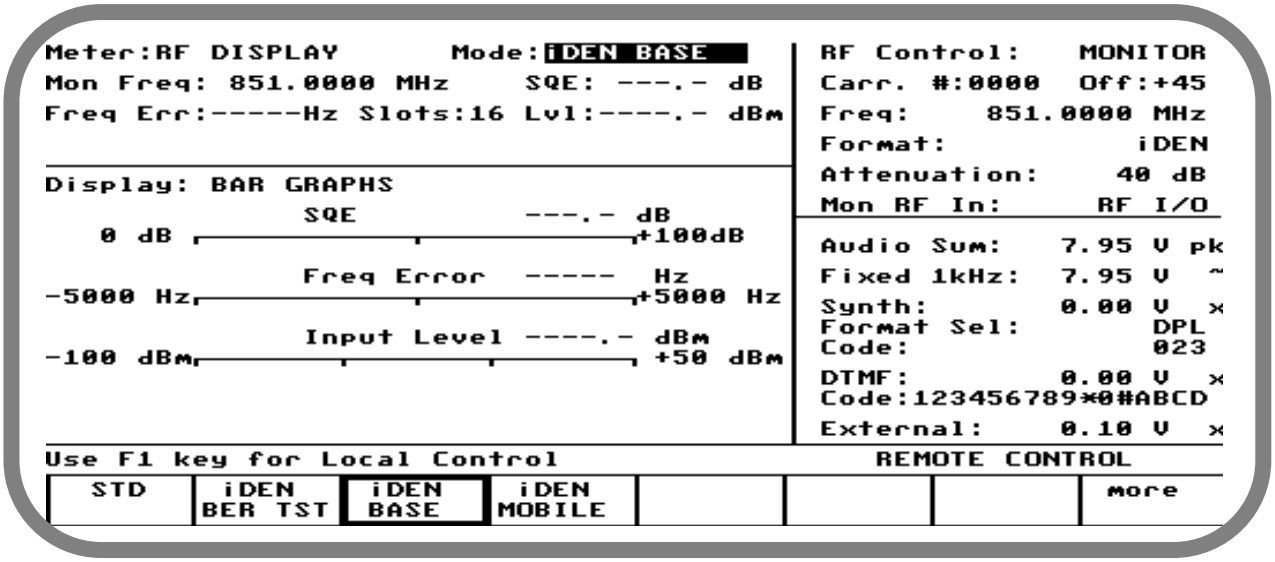


Figure 6-11. iDEN Base Mode Screen

6-7.2 iDEN Base Mode RF Operation

Use the cursor control keys to position the cursor to select (highlight) the following parameters:

RF Control

The analyzer is automatically configured for monitor operation. No other RF modes are provided.

Carr. #

The "Carr. #:" field provides two functions. It provides for selection of the frequency to be monitored using iDEN carrier number assignments numbering 0 to 1199. The carrier number is entered using the numeric keypad or tuning knob. In iDEN Base mode, the analyzer is configured to monitor outbound signals. The monitored frequency is determined by the following equation.

$$\text{frequency}_{\text{monitor}}\ (\text{MHz}) = 851 + (0.0125 \times \text{Carr \#})$$

When the frequency to be monitored is entered directly into the "Freq:" field, the "Carr #:" field displays the corresponding iDEN channel. If the selected frequency is not a valid iDEN frequency, the field is filled with dashes.

Off

Offset is selected by using softkeys (Figure 6-11a). If the 900 MHz option is installed, two softkeys will appear when the cursor is placed on the "OFF" field. Select +39 MHz to perform iDEN testing in the 900 MHz frequency band. Select +45 MHz to perform iDEN testing in the 800 MHz frequency band. If the 900 MHz option is not installed offset is automatically set to +45 MHz when the iDEN Base operational mode is selected.

Freq

The "Freq:" field provides two functions. It provides for display of the frequency to be monitored when "Carr #:" is used to select the monitor frequency. The frequency cursor also provides for direct frequency entry. Frequency is entered using the numeric keypad or the tuning knob. This feature provides for monitor capability of frequencies that are not iDEN channels.

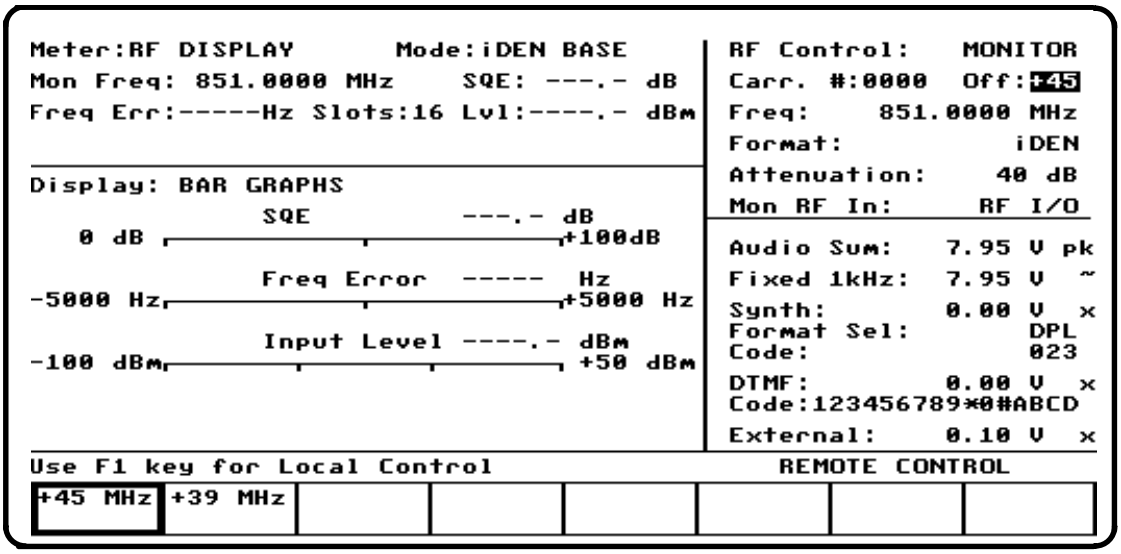


Figure 6-11a. iDEN Base Mode Offset Screen

Format

The format of the monitored signal is automatically set to iDEN when iDEN Base mode is selected. DJSMR and DMCA signal formats are not supported in iDEN Base mode.

NOTE

Cursor locations "Attenuation:" and "Mon RF In:" operate as in Standard mode.

6-7.3 iDEN Base Mode Display Meters and Displays

iDEN Base mode meters and displays operate the same as in Standard mode (refer to the General Operation section of this manual), except that the RF Display meter and bargraphs are modified to display SQE for iDEN mode. In addition, the frequency dispersion of the spectrum analyzer is limited to a maximum of 1 MHz/div.

The average wattmeter, used for making long-term input power measurements on consecutive slots of iDEN signals, is available in the "Meter:" field. For information detailing the use of the average wattmeter, refer to paragraph 6-9.

6-7.4 iDEN Base Mode Audio Operation

The Base Mode Audio zone operates the same as the Audio zone in Standard mode (refer to the General Operation section of this manual). Audio zone configuration does not affect test signal generation. The audio zone acts as an audio generator with audio output to the front panel Mod Out port.

6-8 iDEN MOBILE MODE

CAUTION

Take care to prevent analyzer signals from unintentionally capturing other radios in the area. Observe the following precautions:

- **Do not** use an antenna on the analyzer for over-the-air testing.
- **Use** double-shielded cables on the analyzer to carry signals to and from the radio.
- **Locate** the analyzer at least thirty-five feet from the antenna of a unit that is working in the same system that the analyzer is testing.

When operating in its iDEN Mobile mode, the analyzer tests the performance of iDEN mobile radios by simulating the iDEN fixed end functions. The analyzer operates in duplex mode generating outbound signals, monitoring inbound signals, and performing fixed end control functions supporting the test of iDEN mobile radios in operational mode.

The analyzer simulates the fixed end to support four call scenarios initiated by an iDEN mobile radio.

- Initial Registration
- 6:1 Interconnect Call
- 3:1 Interconnect Call
- Dispatch Call

Additionally, the analyzer determines radio configuration data for verification during the call scenario testing, and measures transmitted signal parameters of the mobile radio under test.

The iDEN system employs a VSELP vocoder to compress voice data. The analyzer performs voice encoding and decoding functions to provide "talk and listen" testing of the mobile radio under test. This "talk and listen" capability makes the testing of iDEN mobile radios similar to testing performed on conventional analog radios. Since the iDEN system utilizes a vocoder and digital modulation, the level of audio input to the traffic channel does not affect the transmitted waveform.

6-8.1 Accessing iDEN Mobile Mode

Select the iDEN Mobile mode by placing the cursor in the "Mode:" field in the Display Zone located at the top of the screen. Use the **more** softkey to advance the analyzer softkey menu until the iDEN softkey group is available. With the cursor in the "Mode:" field, use the **iDEN MOBILE** softkey to place the analyzer into the iDEN Mobile mode. A screen similar to figure 6-12 appears.

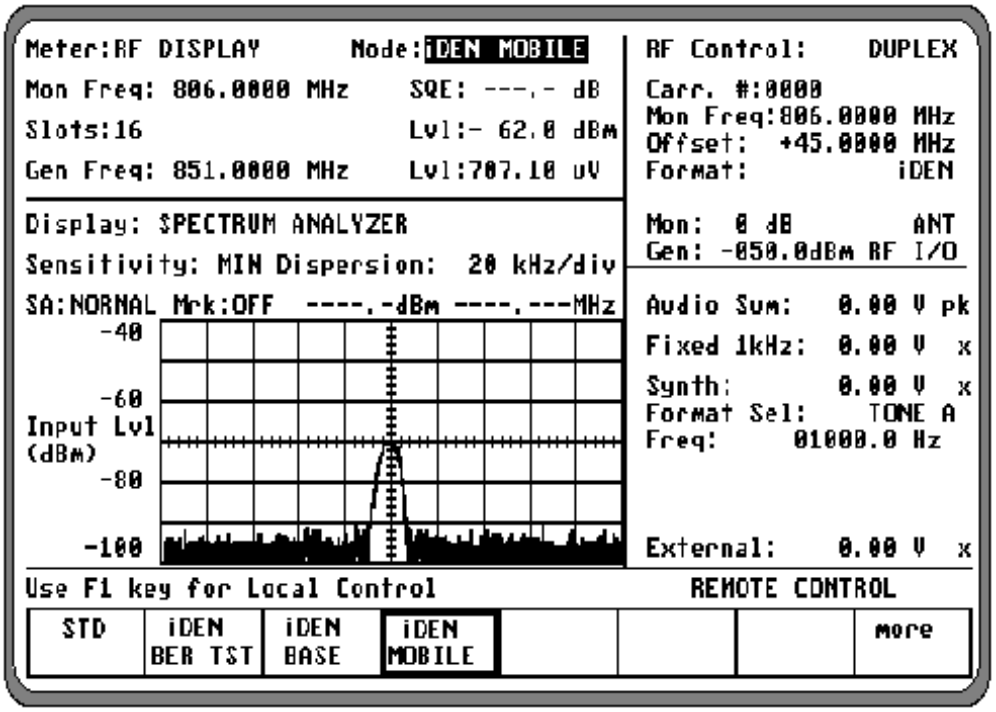


Figure 6-12. iDEN Mobile Mode Screen

6-8.2 iDEN Mobile Mode RF Operation

Selection of iDEN Mobile mode automatically configures the analyzer for duplex operation with +45 MHz duplex offset and window clipping applied to the generated signal.

NOTE

iDEN Mobile mode supports iDEN signal formats only. DJSMR or DMCA is not supported.

Use cursor control keys to position the cursor to select (highlight) the following parameters:

RF Control

The analyzer is automatically configured for duplex when iDEN Mobile mode is selected. No other RF modes are provided.

Carr. #

The "Carr. #:" field provides two functions. It provides for selection of the frequency to be monitored using iDEN carrier number assignments numbering 0 to 1199. The carrier number is entered using the numeric keypad or tuning knob. The monitor signal direction is automatically set to inbound when iDEN Mobile mode is selected. The monitored frequency is determined by the following equation.

$$\text{frequency}_{\text{monitor}}\,(\text{MHz}) = 806 + (0.0125 \times \text{Carr \#})$$

When the frequency to be monitored is entered directly into the "Freq:" field, the "Carr #" field displays the corresponding iDEN channel. If the selected frequency is not a valid iDEN frequency, the field is filled with dashes.

Offset

The frequency offset of the generated signal with respect to the monitor frequency. Offset is selected by using soft keys. If the 900 MHz option is installed, two softkeys will appear when the cursor is placed on the offset field. Select +39 MHz to perform iDEN testing in the 900 MHz frequency band. Select +45 MHz to perform iDEN testing in the 800 MHz frequency band. If the 900 MHz option is not installed, offset is automatically set to +45 MHz when the iDEN mobile operational mode is selected.

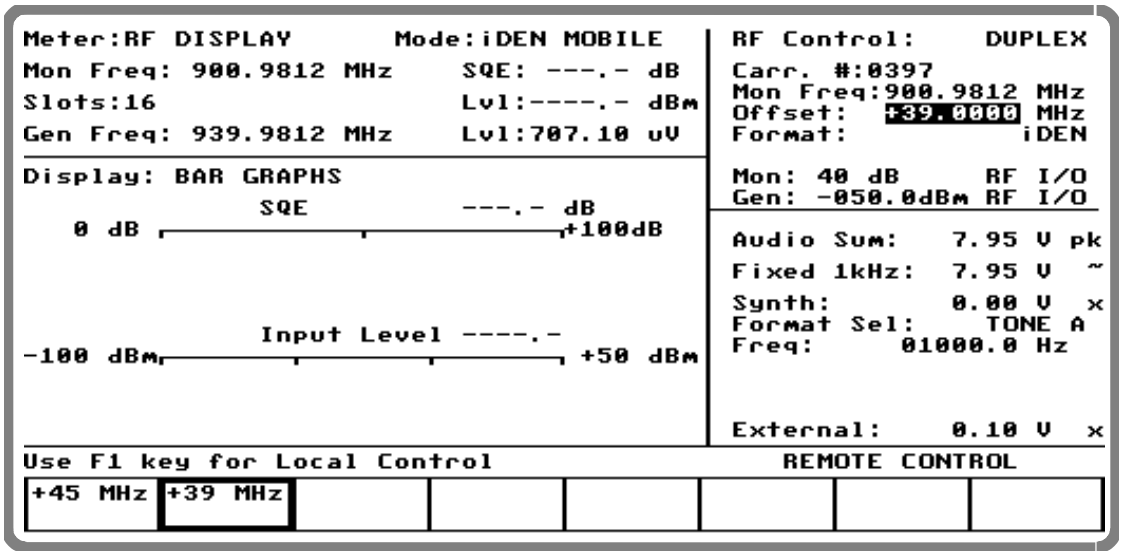


Figure 6-12a. iDEN Mobile Mode Duplex Offset Screen with 900 MHz Option

Format

Format is automatically set to iDEN when iDEN Mobile mode is selected. DJSMR and DMCA signal formats are not supported in this mode.

Mon Freq

The "Mon Freq:" field provides two functions. It provides for display of the frequency to be monitored when "Carr #:" field is used to select the monitor frequency. The "Mon Freq:" field also provides for direct monitor frequency entry using the numeric keypad or tuning knob.

6-8.3 iDEN Initial Registration Test

The iDEN Registration test is used to assign IDs (IMSI; or IMSI and Dispatch ID) to a mobile radio under test.

NOTE

ID assignment is required if the mobile radio under test does not contain IDs. The mobile radio cannot perform Interconnect or Dispatch call testing if it does not contain IDs.

Select the iDEN Mobile mode by placing the cursor in the "Mode:" field in the Display zone located at the top of the screen. Use the more softkey to advance the analyzer softkey menu until the iDEN softkey group is available. With the cursor in the "Meter:" field, use the more softkey to advance the analyzer softkey menu until the INITIAL REG softkey is available. Press the INITIAL REG softkey. A screen similar to figure 6-13 appears.

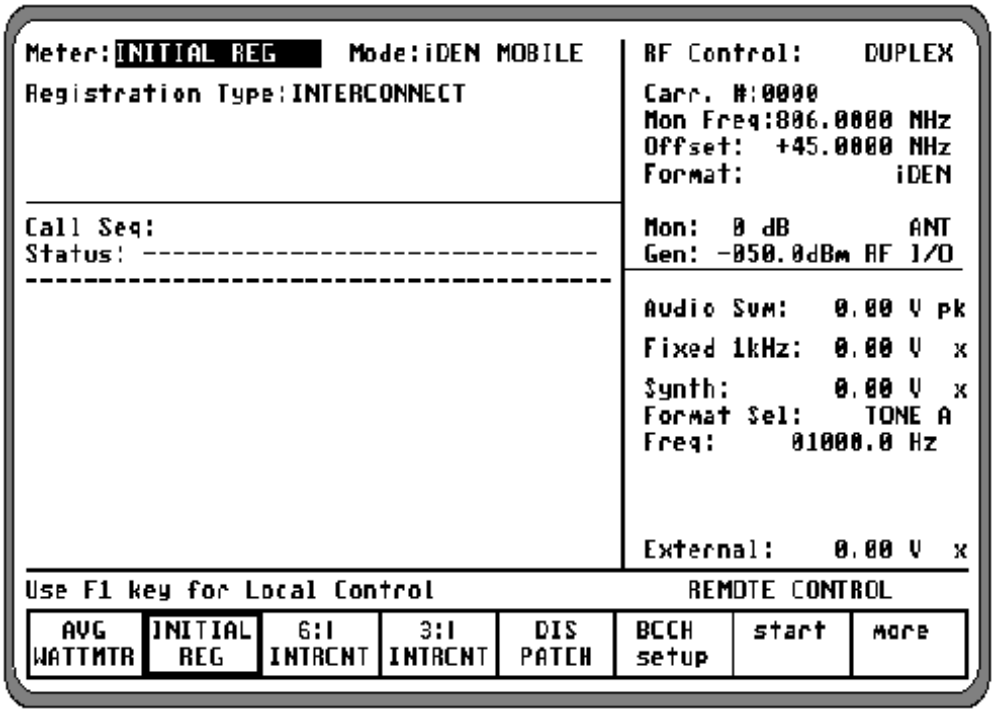


Figure 6-13. iDEN Registration Test Screen with 3:1 Option

Use the cursor control keys to position the cursor, and the softkeys to select (highlight) the following parameter:

Registration Type

Select **DISPATCH** to perform assignment of IMSI and Dispatch IDs. Select **INTERCONNECT** to assign IMSI ID only.

Call Sequence

The call sequence is a thermometer display indicating the progress of the call test. The thermometer is updated as the test is executed. Refer to appendix B for a detailed description of the Initial Registration Test scenario.

Status

The status line provides a brief message indicating the state of the call. The status line is updated as the test is executed.

Error

When error conditions relating to the call test occur, they are identified below the status line. Error conditions are described in Appendix C.

6-8.3.1 BCCH Parameters

With the screen displayed in figure 6-13 (iDEN Registration Test Screen), select the BCCH Setup softkey to set the BCCH parameters. A screen similar to figure 6-14 appears.

This screen provides for customization of the analyzer BCCH prior to beginning a call test. This is necessary if the radio has been in service and dispatch call testing is to be performed. If the radio has been master reset (consult radio user's manual for details), then BCCH customization is optional. The Regional Network Code (RNC) of the analyzer must match the mobile's home system code. If the code does not match, the mobile under test cannot place a dispatch call. Interconnect calls can be placed, even if the RNC does not match, with the radio in its roaming mode.

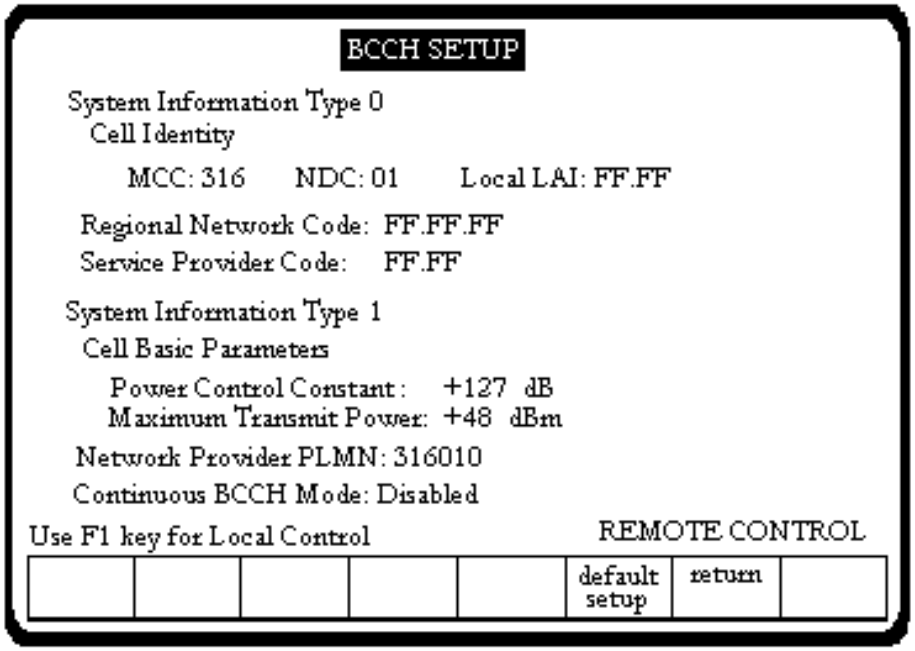


Figure 6-14. BCCH Parameters Setup Screen

Use the cursor control keys to position the cursor, to select (highlight) the following parameters:

Cell Identity

Using the numeric keypad, softkeys, and tuning knob, enter the MCC (Mobile Country Code), NDC (National Domain Code) and Local LAI (Local Location Area Identifier).

Regional Network Code

Using the numeric keypad, softkeys, and tuning knob, enter the Regional Network Code.

Service Provider Code

Using the numeric keypad, softkeys, and tuning knob, enter the Service Provider Code.

Power Control

Using the numeric keypad and tuning knob, enter the Power Control constant.

Maximum Transmit Power

Using softkeys, select the maximum transmit power.

Network Provider PLMN

Using the numeric keypad and tuning knob, enter the Network Provider Public Land Mobile Network (PLMN) code.

Continuous BCCH Mode

Using softkeys, select either Continuous BCCH Mode Enable or Disable.

NOTE

The BCCH parameters can be reset to their default values. Use the cursor to highlight the display screen title "BCCH SETUP" and select the ***default*** *softkey. Refer to Appendix A for a detailed description of the BCCH parameters.*

6-8.3.2 Performing the iDEN Initial Registration Test

Once the BCCH and RF parameters are selected, the test is initiated by placing the cursor in the "Meter:" field and selecting the start softkey. Selecting the start softkey causes the RF output to turn on and generate the BCCH. The mobile radio under test locks onto the BCCH and initiates the registration procedure.

The Call Sequence thermometer and status line is updated during the test indicating the status of the registration procedure. When the thermometer reaches #6 "Test Ended" the test is complete and appropriate IDs are assigned to the mobile radio.

6-8.4 iDEN Interconnect Call Test

The Interconnect Call Test provides for the testing of an interconnect call originated by the mobile radio under test. The analyzer simulates iDEN fixed end equipment generating the outbound signal and monitoring the inbound signal to establish the call originated by the mobile radio. Default values for the BCCH System ID and power control parameters are provided, or operator specified parameters are selectable to customize the test. Default power control parameters are set so that the radio under test transmits with maximum power. Operation of the BCCH Setup screen is detailed in paragraph 6-8.3.1. BCCH parameters and frequency must be selected prior to starting the test. BCCH parameters and test frequency cannot be modified when the test is in progress.

During call establishment, the analyzer determines mobile classmark information IMEI, and called telephone number and displays the values in the Interconnect meter. Once the call is established, the analyzer performs vocoder functions to support full duplex talk and listen capability. Power level and signal quality are measured on the inbound signal. Additionally, the received signal strength detected by the radio under test is determined, using the associated control channel to the mobile radio, and displayed.

Select the iDEN mode by placing the cursor in the "Mode:" field in the Display zone located at the top of the screen. Use the more softkey to advance the analyzer softkey menu until the iDEN softkey group is available. With the cursor in the “Meter” field, use the move softkey to advance the analyzer softkey menu until the 6:1 INTRCNT softkey appears. If the 3:1 option is installed, the 3:1 INTRCNT softkey will also appear. Select either the 6:1 INTRCNT or 3:1 INTRCNT softkey to be compatible with the radio being tested. A screen similar to figure 6-15 appears.

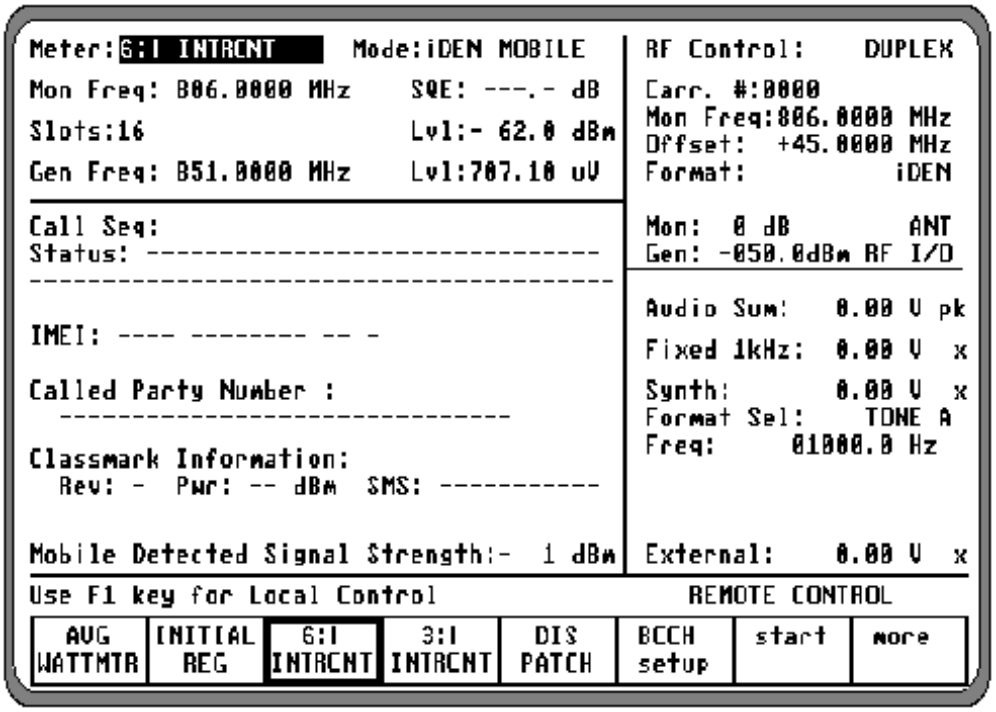


Figure 6-15. iDEN Interconnect Call Test Screen with 3:1 Option Installed

Use the cursor control keys to position the cursor to select (highlight) the following parameters.

Slots

Select 4, 16 or 80 to define the number of slots to average the SQE measurement over. The variance of the SQE measurement is reduced by selecting the larger values of slots.

BCCH Parameters

Select the BCCH Setup softkey to access the BCCH Setup screen described in paragraph 2-8.2.1.

Mon Lvl

The monitor level is the power level of the mobile radio under test, transmitted signal. This value is updated during testing.

SQE

The SQE of the mobile radio under test transmitted signal. This value is updated during testing.

Call Sequence

The call sequence is a thermometer display indicating the progress of the call test. The thermometer is updated as the test is executed. When the call has been established,

measurement and test functions (i.e. spectrum analyzer, ac voltmeter and internal audio scope as described in section 6-8.6.1) can be performed.

Refer to Appendix C for a detailed description of the Interconnect Call Test scenario.

Status

The status line provides a brief message indicating the state of the call. The status line is updated as the test is executed.

Error

When error conditions occur, they are identified below the status line. Error conditions are described in Appendix B.

IMEI

This field displays the International Mobile Equipment Identifier of the mobile radio under test. The IMEI is determined using the signaling channel during the interconnect call scenario.

Called Party Number

This field displays the called telephone number selected on the mobile when the call was initiated.

Classmark Information

Classmark information describes the configuration of the mobile radio under test. The classmark information is determined on the signaling channel during the call test.

REV

This is the revision level of the mobile radio under test.

PWR

This is the maximum transmit power capability of the mobile radio under test.

Mobile Detected Signal Strength

This displays the signal strength detected by the mobile radio under test. The level is detected and updated during the call using the associated control channel.

6-8.4.1 Performing the Interconnect Call Test

NOTE

For optimum troubleshooting capability, it is best to begin with the mobile radio under test in a known state. This is accomplished by cycling the power of the mobile radio OFF, then ON.

Once the BCCH and RF parameters are selected, the test is initiated by placing the cursor in the "Meter:" field and selecting the start softkey. Note that BCCH parameters and the test frequency cannot be changed after the test is started. Selecting the start softkey causes the RF output to turn on and generate the BCCH. The mobile radio under test locks onto the BCCH and will either go into service or perform registration and location update depending on the state of the mobile radio. The mobile radio under test normally provides an "in service" indicator. Consult the operation instructions supplied with your mobile radio.

An interconnect call can now be initiated by the mobile radio. Refer to the operating instructions of the mobile radio for instructions detailing the initiation of an interconnect call.

The analyzer responds to the mobile radio call request and continues through the call scenario. The analyzer determines the mobile radio's configuration data as the call progresses. Measurements can be made when the test sequence reaches #8 Measurement State.

Measurements are performed on the mobile radio's transmitted signal. The SQE and configuration data is determined and displayed. Note the Mobile Detected Signal Strength is updated on the signaling channel throughout the

duration of the call test. Therefore, changing the generator level ("Gen Level:" field) during the call test will result in a change in the Mobile Detected Signal Strength.

CAUTION

Selection of other call tests such as Initial Registration or Dispatch result in the termination of the Interconnect call.

NOTE

See 6-8.6 for a description of meters and displays that can be accessed while a call test is in process.

6-8.5 iDEN Dispatch Call Test

The iDEN Dispatch Call test provides for the test of a group dispatch call originated by the mobile radio under test. The analyzer simulates iDEN fixed end equipment generating the outbound signal and monitoring the inbound signal to establish the call originated by the mobile radio under test.

During call establishment, the analyzer determines the mobile radio's classmark information and IMEI. Once the call is established, the analyzer performs vocoder functions supporting half duplex dispatch talk and listen operation. Power level and signal quality are measured on the inbound signal.

Select the iDEN mode by placing the cursor in the "Mode:" field in the Display zone located at the top of the screen. Use the more softkey to advance the analyzer softkey menu until the iDEN softkey group is available. With the cursor in the "Meter:" field, use the more softkey to advance the analyzer softkey menu until the DISPATCH softkey is available. With the cursor in the "Meter:" field, press the DISPATCH softkey. A screen similar to figure 6-16 appears.

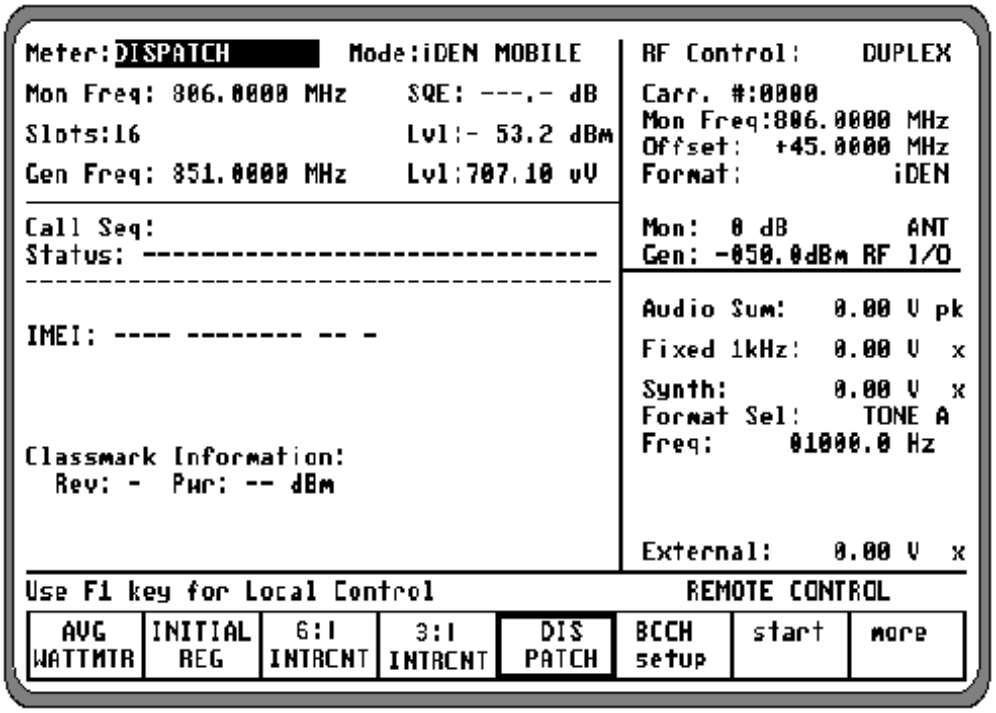


Figure 6-16. iDEN Dispatch Test Screen with 3:1 Option Installed

Use the cursor control keys to position the cursor to select (highlight) the following parameters:

Slots

Select 4, 16 or 80 to define the number of slots to average the SQE measurement over. The variance of the SQE measurement is reduced by selecting the larger values of slots.

Mon Lvl

The monitor level is the power level of the mobile radio under test transmitted signal. This value is updated during testing.

SQE

The SQE of the mobile radio under test transmitted signal. This value is updated during testing.

Call Sequence

The call sequence is a thermometer display indicating the progress of the call test. The thermometer is updated as the test is executed. When the call has been established, measurement and test functions (i.e. spectrum analyzer, ac voltmeter and internal audio scope as described in section 6-8.6.1) can be performed.

Refer to Appendix C for a detailed description of the Dispatch Call Test scenario.

Status

The status line provides a brief message indicating the state of the call. The status line is updated as the test is executed.

Error

When error conditions occur, they are identified below the status line. Error conditions are described in Appendix C.

IMEI

This field displays the International Mobile Equipment Identifier of the mobile radio under test. The IMEI is determined using the signaling channel during the call scenario.

Classmark Information

Classmark information describes the configuration of the mobile radio under test. The classmark information is determined on the signaling channel during the call test.

REV

This is the revision level of the mobile radio under test.

PWR

This is the maximum transmit power capability of the mobile radio under test.

External

Used to set the level and enable externally applied signals from both the MIC and EXT MOD IN front panel connectors. During the Dispatch test a third option is available, “PTT.” This option is also available during Interconnect Call test. This option switches on external each time the Push-To-Talk (PPT) button on the mic is pressed. When the Push-To-Talk button on the mic is released, the external is switched off.

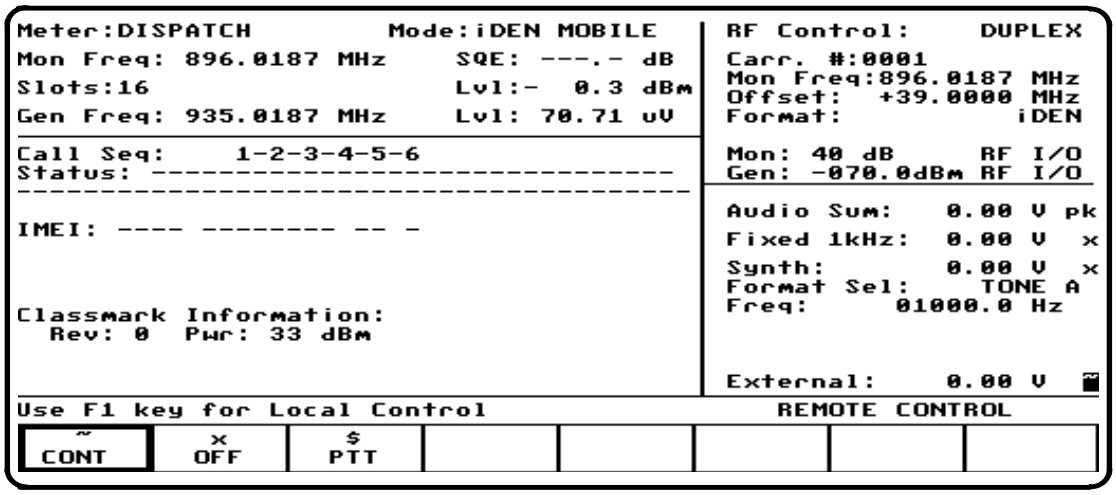


Figure 6-16a. iDEN Dispatch Test with PTT Enable Softkey

6-8.5.1 Performing the Dispatch Call Test

NOTE

For optimum troubleshooting capability, it is best to begin with the mobile radio under test in a known state. This is accomplished by cycling the power of the mobile radio OFF, then ON.

The mobile radio under test must be power cycled, or the LAI changed from the previous setting in the BCCH parameter screen, in order to determine and display Classmark data in a Dispatch call test.

CAUTION

When performing a dispatch call the analyzer BCCH Regional Network Code must match the mobile's home system. If the Regional Network Code is not correct, the mobile cannot place a dispatch call. This problem can be corrected by resetting the mobile and performing the initial registration test.

Once the BCCH and RF parameters are selected, the test is initiated by placing the cursor in the "Meter:" field and selecting the start softkey. Note that BCCH parameters and the test frequency cannot be modified when the test is in progress. Selecting the start softkey causes the RF output to turn on and generate the BCCH. The mobile radio under tests locks onto the BCCH and may initiate registration and location update depending on the state of the mobile when the test begins. The mobile radio under test normally provides an "in service" indicator. When the radio is "in service" the dispatch call can be initiated from the mobile.

Refer to the mobile radio's operating instructions for instructions detailing the initiation of a group dispatch call.

The analyzer determines the configuration and call processing data defined as the call progresses. The call progresses to the #5 MS Talker.

Measurements are performed on the transmitted signal. The analyzer performs voice decode functions to allow monitoring of voice transmitted by the mobile radio. Releasing the PTT of the mobile radio under test causes the call test scenario to enter the state #5 Open.

At this state, the mobile radio can be keyed to perform additional testing on the mobile radio's transmitter or the analyzer's audio sources can be turned on to test the mobile radio receiver. Turning on any one of the analyzer's audio sources, or using the microphone input causes the call test scenario to enter the state #5 R2660 Talker.

Audio can now be monitored on the mobile radio's speaker. The mobile radio and the analyzer can alternate operating as the talker. Select the stop softkey to terminate the test.

NOTE

The test cannot be terminated from the mobile radio.

6-8.6 iDEN Mobile Mode Meters and Displays

The iDEN Mobile Display zone provides dedicated displays dependent on the selected call scenarios (refer to Interconnect and Dispatch Call Tests).

When a call test is in progress, other meter and display measurements can be made by placing the cursor in the "Meter:" field and selecting the more softkey. Available meters/displays include:

- ***Spectrum Analyzer***

  The Max Hold function is well suited for the display of the iDEN mobile radio's pulsed RF transmission. Note that the frequency dispersion is limited to 1 MHz per division when operating in an iDEN mode.

- ***Average Wattmeter***

  Use of the average wattmeter is detailed in paragraph 6-9.

- ***Internal Audio Scope***

  Use of the internal audio scope is detailed in paragraph 6-8.6.1.

- ***AC Voltmeter, DC Voltmeter, Internal Distortion, External Distortion, SINAD***

NOTE

Selection of certain meter displays may result in a full screen meter display. To access the "Display:" field, select a meter function (e.g. RF Display) that results in display of this field.

6-8.6.1 Internal Audio Scope

The internal audio scope is used when audio testing is performed during an Interconnect or Dispatch Call test. A sample of the internal audio scope screen is shown in figure 6-17. The internal audio scope can be used to display decoded audio from the inbound channel transmitted by the mobile radio. It can also be used to display audio generated by the analyzer for input to the outbound voice traffic channel. Control and selections are the same as for the Enhanced External Oscilloscope (as described in the General Operation section of this manul), with the exception that the internal audio scope provides for selection of display of GEN (generated) or MON (monitored) audio.

The internal audio scope can be accessed by placing the cursor in the Display zone's "Meter:" field and pressing the more softkey until the RF DISPLAY softkey is presented. Place the cursor in the Display zone's "Display:" field. Select the INT AUD SCOPE softkey to access the internal audio scope screen.

NOTE

The internal audio scope is useful for observing waveform shape only. The level is not calibrated, and only represents a voltage internal to the analyzer.

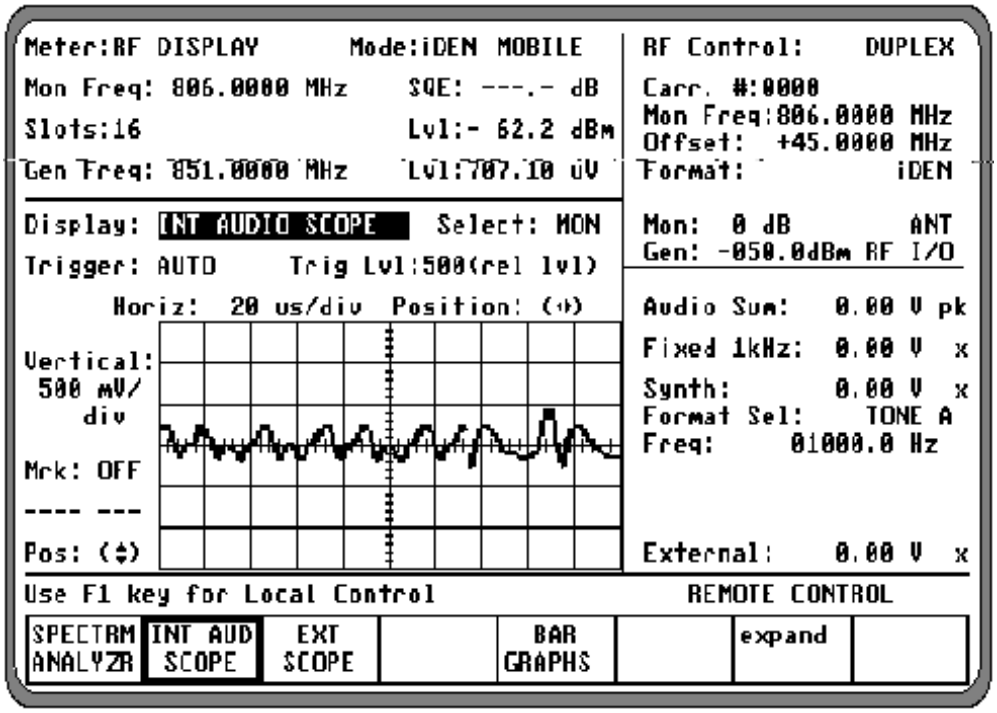


Figure 6-17. Internal Audio Scope Screen

6-8.7 iDEN Mobile Mode Audio Operation

The iDEN Mobile Audio zone is a subset of the audio zone in Standard mode (refer to the General Operation section of this manual).

The zone is modified so that only audio sources applicable to iDEN mobile audio testing are available. DTMF and other signaling tone generation audio sources are not available.

The output level of the audio sources is selectable in units of peak voltage. Each source provides an output range of 0.00 to 7.95 Vpk to the MOD OUT port on the front panel.

NOTE

The level of the audio sources does not impact the modulation parameters of the generated RF signal since iDEN is a digital modulation format.

6-9 AVERAGE WATTMETER

The average wattmeter is used to perform a long-term input power measurement on consecutive slots of iDEN signals. A sample of the average wattmeter screen is shown in figure 6-18. Recall that the RF Display zone meter provides a short-term measurement. The short-term average is not performed on consecutive slots. Additionally, the short-term measurement is susceptible to variability in the measurement due to the pulsed nature and high AM modulation content of iDEN signals.

The average wattmeter addresses these issues by performing a long-term average over consecutive slots. The measurement time is selectable in the range 90 msec to 4.32 sec in increments of 90 ms. In iDEN BER Test and iDEN Mobile modes the measurement is scaled by a factor of 6, presenting the average power during an active slot. In iDEN Base mode, no scaling is performed since the duty cycle of the measured signal is 100%.

The iDEN test signal repeats every 16 slots. Therefore best results can be obtained by selecting measurement periods of 1.44, 2.88 or 4.32 sec.

The average wattmeter is accessed by placing the cursor in the Display zone's "Meter:" field and pressing the more softkey until the AVG WATTMTR softkey is presented. Select the AVG WATTMTR softkey to access the average wattmeter screen.

To initiate measurements, place the cursor in the "Measurement Period:" field and use the tuning knob to set the time length of the measurement. Press the start softkey to begin the measurement. The result will be displayed when the measurement is completed. Measurements will be automatically continued until the stop softkey is selected. The cursor in the "Measurement Period:" field will flash to indicate when each measurement is complete.

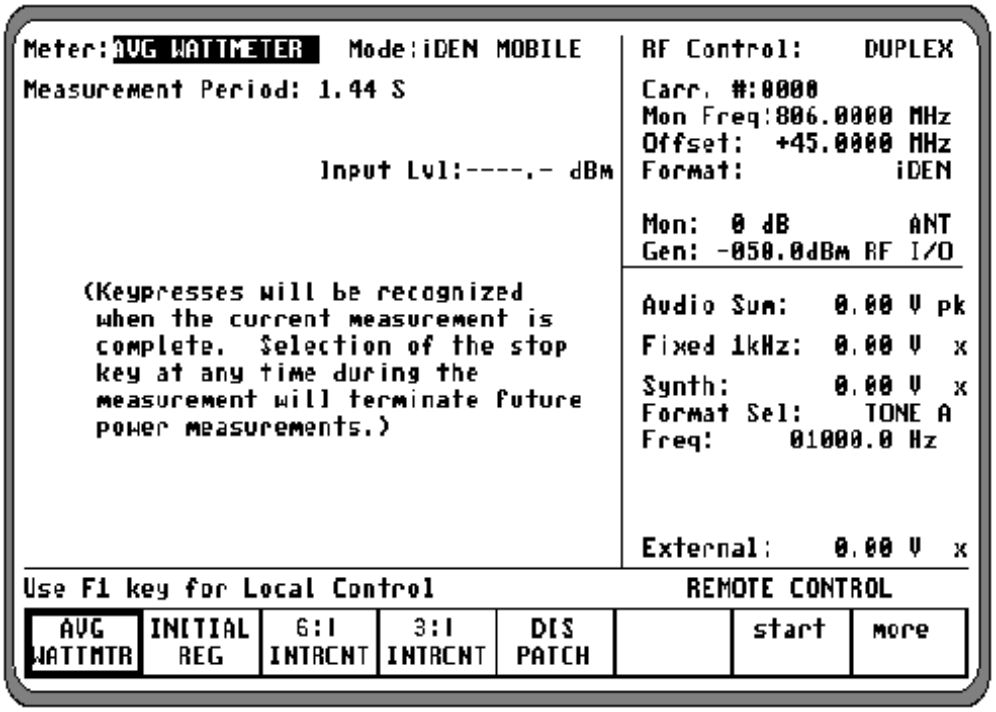


Figure 6-18. Average Wattmeter Screen with 3:1 Option Installed

NOTE

*Selecting the **stop** softkey will cause measurements to be stopped when the current measurement is complete.*

Measured power is displayed in dBm or watts selectable from the Input Lvl units cursor position.

6-10 OUTPUTS

The following iDEN-related outputs are available in addition to the outputs of the standard system.

6-10.1 I and Q Channel Baseband Outputs

The I and Q channel baseband outputs are located on the right side of the housing extender and are labeled I OUT and Q OUT. These baseband signals can be used to drive a complex signal generator providing analog I and Q inputs to generate an M16-QAM signal. This is useful in generating signals out of the frequency range of the analyzer or for laboratory quality spectral purity.

6-10.2 One Pulse Per Three Second (1PP3S) Synchronization Signal

The 1PP3S synchronization signal is also located on the housing extender and is labeled SYNCH. This signal is synchronous with slot timing of test signals generated in iDEN BER Test mode of operation.

NOTE

*In order to activate synchronization, the BER Test signal generator must be initialized at least 10 seconds **after** the analyzer has been placed in iDEN BER Test mode. This is most easily accomplished by toggling the window clipping selection between ON and OFF.*

Section 7

iDEN OPTION APPLICATIONS

7-1 BASIC iDEN TESTING

This section of the manual contains information on typical test setups to perform some of the more common iDEN radio tests using the R2660 iDEN Communications System Analyzer.

CAUTION

For best monitor operation, select the input attenuation (0, 20, or 40 dB) and input port (RF I/O, or Antenna) such that the peak displayed on the spectrum analyzer is 5 dB or more below the top of the display. Overdriving the spectrum analyzer (displayed or not) degrades monitor measurements.

7-2 TESTING iDEN BASE RADIO

7-2.1 Base Radio Receiver BER Test

The base radio receiver performance is verified with the radio operating in test mode.

Performance of this test requires the analyzer to be configured as a test signal generator. The base radio measures the BER of the received signal.

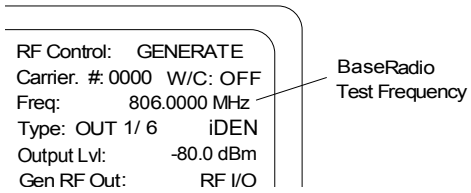
The output level of the analyzer is reduced until the base radio BER threshold is determined. Consult the base radio maintenance manual, as specific frequencies may be specified for BER test of your equipment For this example, the base radio frequency test is 806.0000 MHz.

1. Connect the base radio under test RF output to the RF I/O port of the analyzer as shown in figure 2-2. Consult the base radio maintenance manual to determine the appropriate input test port.

   If testing is to be performed for signals stronger in level than -70 dBm, the Gen port should be used.

2. Select the iDEN mode by placing the cursor in the "Mode:" field in the Display Zone located at the top of the screen. Use the more softkey to advance the analyzer softkey menu until the iDEN softkey group is available. With the cursor in the "Mode:" field, use the **iDEN BER TST** softkey to place the analyzer into the iDEN BER Test mode.

3. Place the cursor within the RF Control zone, and configure the analyzer as follows:



4. Configure the base radio under test to its BER Test Mode. Consult your base radio's maintenance manual for specific instructions.

5. Monitor the base radio's received BER. Reduce the analyzer's output level until the radio measures BER corresponding to sensitivity threshold. Consult your base radio's maintenance manual for the receiver sensitivity specification.

NOTE

*To perform this test with window clipping applied to the generated signal, place the cursor within the RF Control zone at the "W/C:" field and select **ON**.*

7-2.2 Base Radio Operating in Functional Mode

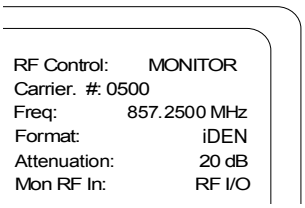
Performance of this test verifies correct operation of an iDEN base radio transmitter operating in its functional mode.

The frequency error, transmitter power and SQE of the base radio output are measured. For this example, the base radio frequency test is 857.2500 MHz and the power into the analyzer exceeds
0 dBm.

1. Connect the base radio under test RF output to the RF I/O port of the analyzer as shown in figure 2-2. Consult the base radio maintenance manual to determine the appropriate output test port and expected power level.

2. Select the iDEN mode by placing the cursor in the "Mode:" field in the Display Zone located at the top of the screen. Use the **more** softkey to advance the analyzer softkey menu until the iDEN softkey group is available. With the cursor in the "Mode:" field, use the **iDEN BASE** softkey to place the analyzer into the iDEN Base mode.

3. Place the cursor within the RF Control zone, and configure the analyzer as follows:



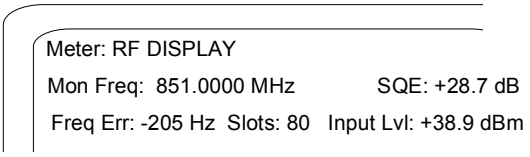
CAUTION

Be sure not to overdrive the analyzer input which is rated for 125 Wpeak and 25 Waverage pwr. Overdriving the analyzer will result in incorrect results. To verify proper power levels, observe the input signal on the spectrum analyzer. If the input goes off the scale, the analyzer is overdriven. If required, use the attenuation selection available in the RF Control zone to increase the input attenuation.

If signals less than -10 dBm are to be measured, use the antenna input port on the analyzer.

4. Place the cursor in the "Meter:" field located in the Display zone and select the **RF DISPLAY** softkey.

   As shown below, the frequency error, power level and SQE of the base radio transmitted signal will be displayed.



5. Use the average wattmeter to measure longer term average power of the base radio transmitter output signal. Access the average wattmeter by placing the cursor in the Display zone "Meter:" field. Press the **more** softkey until the **AVG WATTMTR** is displayed. Press the **AVG WATTMTR** softkey to begin measurements.

NOTE

Increasing the measurement period (using the "Measurement Period:" field) reduces the variability of the readings.

Placing the cursor on the Measurement Period locator allows it to be used as a measurement indicator. It will flash each time a measurement is completed and the display updated.

7.3 TESTING iDEN MOBILE RADIO

7-3.1 Mobile Radio in BER Test Mode

This application example describes the test of a mobile's transmitter and receiver with the radio operating in test mode. Performance of this test requires the analyzer to operate in duplex iDEN BER Test mode generating a 6/6 test signal and monitoring a 1/6 test signal transmitted by the mobile under test.

When testing the mobile's receiver, the radio under test measures the BER of the received signal and displays the result to the test operator on the mobile radio's ergonomic display. The output level of the analyzer is reduced until the mobile radio BER threshold is determined. Consult the mobile radio maintenance manual to determine the BER threshold percentage to be used in testing. When testing the mobile's transmitter, the mobile generates a 1/6 test signal. The analyzer measures the transmitted BER, frequency error, power level and SQE of the signal transmitted by the mobile.

For this example, the test frequency is set using a Carr # of 0005. Consult the mobile radio maintenance manual, as specific test frequencies may be specified for BER test of your equipment.

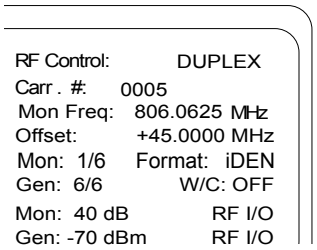
1. Connect the RF input/output of the mobile radio under test to the RF I/O port of the analyzer as shown in Figure 2-2. Consult the mobile radio maintenance manual to determine the appropriate test port.

2. Select the iDEN BER Test mode by placing the cursor in the “Mode:” field in the Display Zone located at the top of the screen, and using the more softkey to advance the analyzer softkey menu until the iDEN softkey group is available. With the cursor in the “Mode:” field, select the iDEN BER TST softkey.

NOTE

Upon selection of any of the iDEN modes (iDEN BER TEST, iDEN BASE, or iDEN MOBILE) DSP algorithms are automatically downloaded. This takes 4 seconds or less, ***during which key presses are not recognized.***

3. Place the cursor within the RF Control zone and configure the analyzer as follows:



4. Configure the mobile under test to BER Test mode. Consult your mobile radio's maintenance manual for specific instructions.

Mobile Receiver Test

5. Monitor the mobile radio's received BER. Reduce the analyzer's output level until the radio measures BER corresponding to sensitivity threshold. Consult your mobile radio's maintenance manual for the receiver sensitivity specification.

NOTE

To perform this test with window clipping applied to the generated signal, place the cursor within the RF Control zone at the "W/C:" field and select ***ON****.*

Mobile Transmitter Test

6. Turn on the transmitter of the mobile radio. Consult your mobile radio maintenance manual for instructions.

7. Access the BER Meter by placing the cursor in the Display zone's "Meter:" field and pressing the **more** softkey until the **BER** softkey is presented. Press the **BER** softkey to display the BER Meter. A screen similar to figure 7-3 appears.

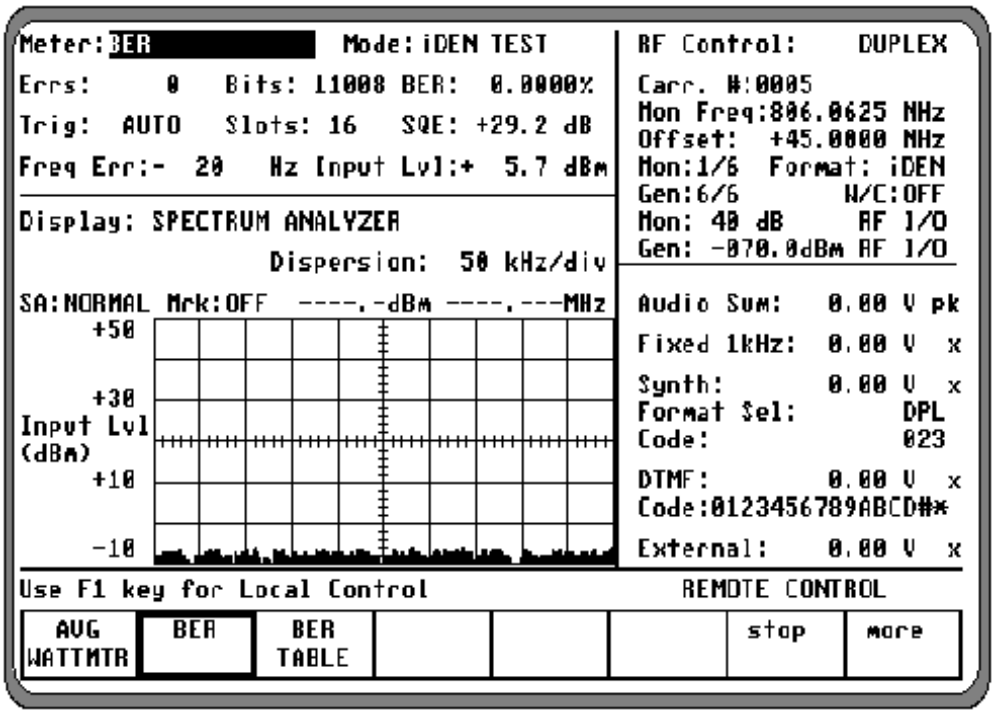


Figure 7-3. Mobile Radio (BER Test Mode) BER Meter Sample

NOTE

The BER meter defaults to measure BER, SQE, and frequency error averaged over 16 slots. The number of slots is operator selectable: 4, 16, 80 or 960. The default trigger is Auto, and the BER meter continuously updates the display with new measurements. In the example above, each measurement is made for 16 time slots. The display is updated with complete measurements only, each measurement takes approximately 1.5 seconds.

When 80 or 960 slots are selected, the display shows intermediate measurements and the displayed values roll over when a new measurement begins. Selecting the single softkey, with the cursor placed in the "Trig:" field, causes the meter to perform a single measurement. The displayed value is held until the trigger is re-selected.

Input Lvl displayed is not dependent on the Slots selection. It is a short-term average power measurement performed over 4 slots. The measurement is not performed on consecutive slots.

8. Access the BER Table by placing the cursor in the Display zone's "Meter:" field and pressing the **more** softkey until the **BER TABLE** softkey is presented. Press the BER TABLE softkey to display the BER Table. A screen similar to figure 7-4 appears.

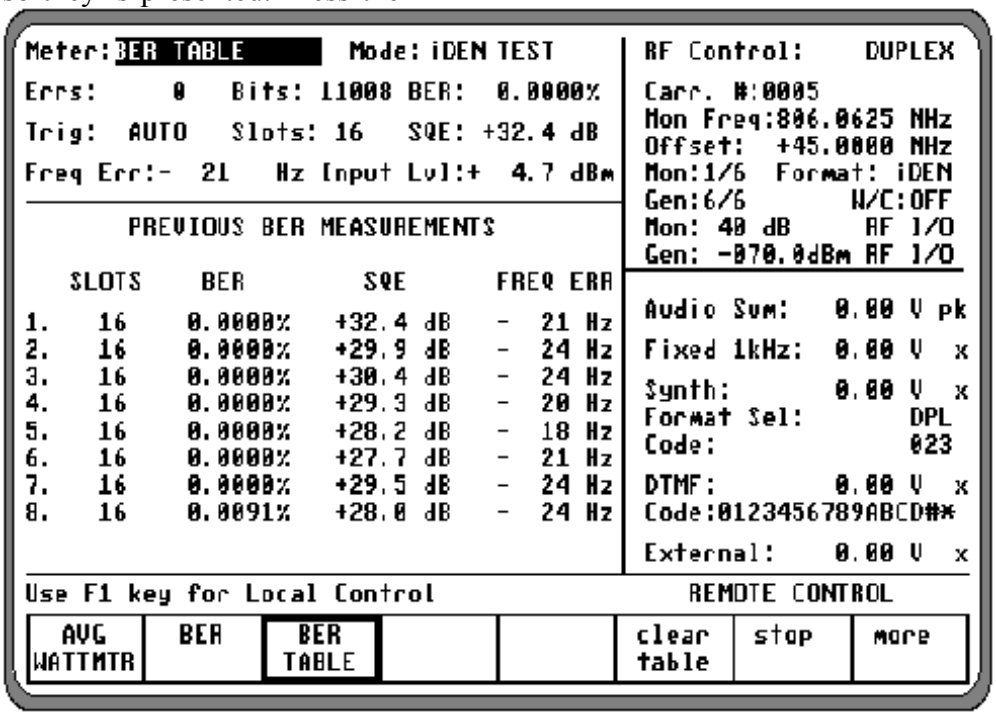


Figure 7-4. Mobile Radio (BER Test Mode) BER Table Sample

Use the BER Table to observe the 8 most recent BER measurements. Completed measurements are displayed in the table. The measurement that is in progress is displayed at the top of the BER Table. This portion of the BER Table is identical to the BER Meter.

9. Access the average wattmeter by placing the cursor in the Display zone "Meter:" field. Press the **more** softkey until the **AVG WATTMTR** is displayed. Press the **AVG WATTMTR** softkey to begin measurements.

   Measure the average power on consecutive slots for operator specified measurement period. This differs from the RF Display measurements and BER Meter measurements which provide a short term average of four slots on nonconsecutive slots.

10. To stop measurements, select the **stop** softkey. Measurements will be terminated when the current measurement is complete. Measurements should be stopped prior to exiting the average wattmeter.

NOTE

Increasing the measurement period (using the "Measurement Period:" field) reduces the variability of the readings.

Placing the cursor on the Measurement Period location allows it to be used as a measurement indicator. It will flash each time a measurement is completed and the display updated.

7-3.2 Mobile Radio Operating in Functional Mode

The following test instructions use the analyzer to simulate iDEN fixed end equipment to test the mobile radio in its functional mode of operation.

7-3.2.1 Interconnect Call Test of a Registered Mobile Radio

Performance of this test verifies correct operation of an iDEN mobile radio operating in its interconnect mode.

"Talk and listen" capability, transmitter performance and mobile configuration data are verified. For this example, the mobile radio monitor frequency is 811.6125 MHz and the generate frequency is 856.6125 MHz (corresponds to carrier assignment number 0449). In addition, the mobile radio has previously been in service and contains a valid IMSI. Make sure to select a test frequency that is included in the channel plan of the mobile radio under test.

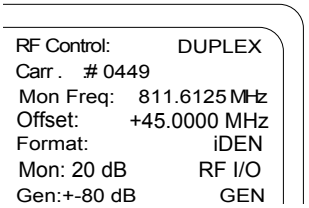
1. Connect the mobile radio under test RF output to the RF I/O port of the analyzer as shown in figure 2-2. Consult the mobile radio maintenance manual to determine the appropriate output test port and expected power level.

2. Select the iDEN Mobile Testing mode by placing the cursor in the "Mode:" field in the Display Zone located at the top of the screen, and using the **more** softkey to advance the analyzer softkey menu until the iDEN softkey group is available. With the cursor in the "Mode:" field, select the **iDEN MOBILE** softkey.

NOTE

Upon selection of any of the iDEN modes (iDEN BER TEST, iDEN BASE, or iDEN MOBILE) DSP algorithms are automatically downloaded. This takes 4 seconds or less, ***during which key presses are not recognized.***

3. Place the cursor within the RF Control zone, and configure the analyzer as follows:



CAUTION

Be sure not to overdrive the analyzer input which is rated for 125 Wpeak and 25 Waverage pwr. Overdriving the analyzer will result in erratic results. To verify proper power levels, observe the input signal on the spectrum analyzer. If the input goes off the scale, the analyzer is overdriven. If required, use the attenuation selection available in the RF Control zone to increase the input attenuation.

If signals lower than -10 dBm are to be measured, use the antenna input port on the analyzer.

4. Access the BCCH parameters setup screen as detailed in paragraph 6-8.2.1. Use this screen to configure the analyzer's BCCH to match the mobile radio under test home system. Consult the service provider for system identifier information. Select the return softkey to return to the interconnect test.

NOTE

The BCCH Setup can be set to default values by pressing the default softkey. BCCH parameters must be set prior to starting the call test. BCCH parameters cannot be modified during the test.

5. Press the **start** softkey to begin testing. Note that the test frequency and BCCH parameters cannot be modified after the test has been started. Start of testing causes the analyzer output to be turned on, and a BCCH to be transmitted to the mobile radio under test. The thermometer display and status message will reach the state:

   #1: BCCH Transmitted

   The thermometer display indicates the progression of the call scenario. The status message provides a description of the current state of the call test.

NOTE

For optimum troubleshooting capability, it is best to begin with the mobile radio under test in a known state. This is accomplished by cycling the power of the mobile radio OFF, then ON.

   The mobile radio will scan and lock on to the analyzer's BCCH. The mobile may automatically perform registration and location update dependent on the state of the radio. The mobile's "in service" indicator shows when a call can be placed.

6. Initiate a telephone call from the mobile radio under test. Consult the mobile radio operator manual for details concerning the placement of a phone call.

7. The analyzer will automatically continue to simulate the fixed end equipment performing signaling functions necessary to establish the call. The thermometer will reach the state:

   #8: Measurement State

   A screen similar to figure 7-5 appears.

   Refer to the Interconnect Call Test screen for power level and SQE measurements of the transmitted signal of the mobile radio. The IMEI and classmark information of the mobile radio is also displayed. The "Mobile Detected Signal Strength:" field indicates the received signal strength detected by the mobile radio. The analyzer updates this value during the test using the control channel associated with the traffic channel.

8. Press the analyzer's PTT and speak into the microphone. Your voice should be audible on the mobile radio's speaker. Speak into the mobile radio's handset; your voice should be audible on the analyzer's speaker. Make sure to turn the analyzer external audio source on to enable the microphone.

9. Within the RF Control zone, place the cursor on the "Gen Lvl:" field and reduce the output level. Observe the "Mobile Detected Signal Strength:" field located within the Display zone. This value should track the changes generated by the analyzer.

10. Monitor the transmitted spectrum of the mobile radio using the analyzer's spectrum analyzer mode as described in the General Operation section of this manual).

NOTE

Use the Max Hold feature of the analyzer's Spectrum Analyzer mode to observe the pulsed RF output of the mobile.

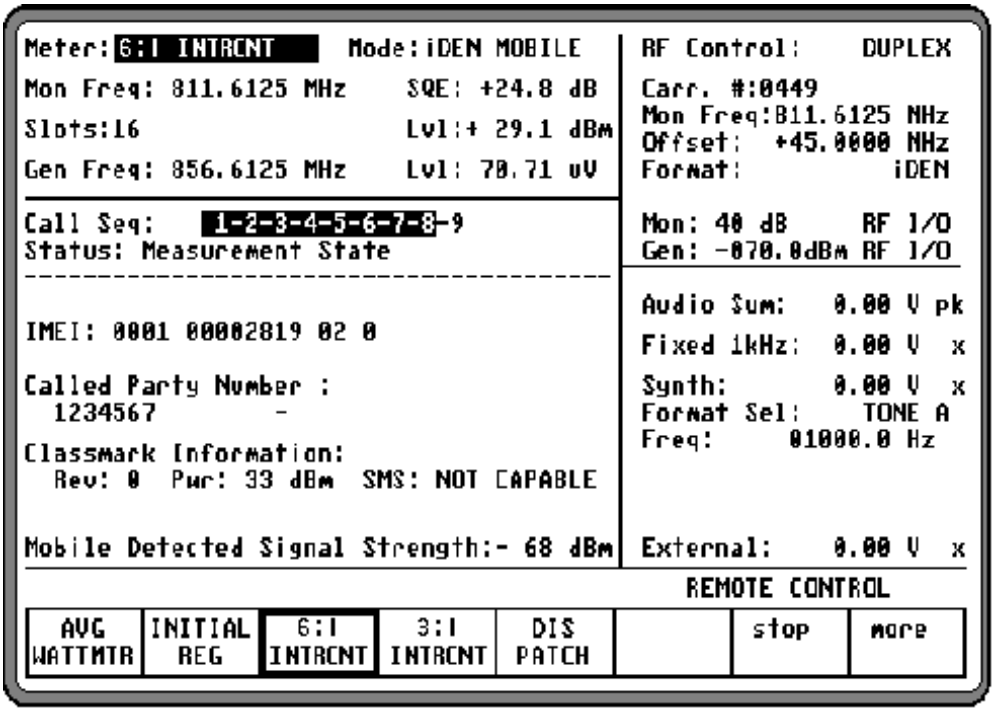


Figure 7-5. iDEN Mobile Interconnect Call – Measurement State with 3:1 Option Installed

11. Monitor the transmitted audio recovered on the inbound channel and the analyzer's generated audio to be transmitted on the outbound channel using the internal audio scope described in paragraph 6-8.6.1.

12. Monitor the long-term power using the average wattmeter as described in paragraph 6-9.

13. Return to the Interconnect Call Test screen (step 2) (Note that selection of Initial Registration or Dispatch will cause the test to terminate) and press the **stop** softkey to terminate testing. If Continuous BCCH is disabled, the mobile radio service indicator will indicate that the mobile radio is not in service since no BCCH is available for acquisition. The thermometer will reach the state:

    #9: Test Ended

    when the test is completed. The analyzer automatically turns off the RF output.

7-3.2.2 Dispatch Call Test of a Mobile Radio

Performance of this test verifies correct operation of an iDEN mobile radio operating in its dispatch mode.

"Talk and listen" capability, transmitter performance and mobile configuration data are verified. *For this example, the mobile radio monitor frequency is 814.7250 MHz and the generate frequency is 859.7250 MHz (corresponds to carrier assignment number 0698). The example also covers Initial Registration for mobile radios that do not contain valid IDs.*

NOTE

The IMSI assigned to the mobile radio during performance of this test is provided for and valid only for testing purposes. The IMSI assigned should be removed from the mobile radio prior to placing the mobile radio into service. Consult the mobile radio's maintenance manual for instructions concerning removal of this IMSI.

1. Connect the mobile radio under test RF output to the RF I/O port of the analyzer as shown in figure 6-2. Consult the mobile radio maintenance manual to determine the appropriate output test port and expected power level.

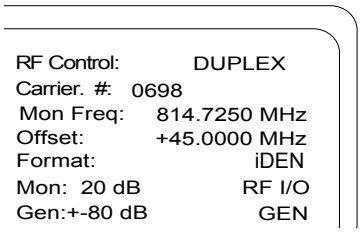
2. Select the iDEN Mobile mode by placing the cursor in the "Mode:" field in the Display Zone located at the top of the screen, and using the **more** softkey to advance the analyzer softkey menu until the iDEN softkey group is available. With the cursor in the "Mode:" field, select the **iDEN MOBILE** softkey.

NOTE

Upon selection of any of the iDEN modes (iDEN BER TEST, iDEN BASE, or iDEN MOBILE) DSP algorithms are automatically downloaded. This takes 4 seconds or less, ***during which key presses are not recognized.***

NOT PREVIOUSLY REGISTERED

3. Place the cursor within the RF Control zone, and configure the analyzer as follows:



CAUTION

Be sure not to overdrive the analyzer input which is rated for 125 W_{peak} and 25 $W_{average\ pwr}$. Overdriving the analyzer will result in incorrect results. To verify proper power levels, observe the input signal on the spectrum analyzer. If the input goes off the scale, the analyzer is overdriven. If required, use the attenuation selection available in the RF Control zone to increase the input attenuation.

NOTE

Both IMSI and dispatch IDs must be assigned since the dispatch operational mode of the mobile radio is being tested. The BCCH could be customized, however, this should not be necessary since the mobile radio has not previously been in service.

4. Place the cursor in the "Meter:" field in the Display zone. Select the **INITIAL REG** softkey.

5. Place the cursor in the "Registration Type:" field and select the **DISPATCH** softkey.

   Use this screen to assign both IMSI and dispatch IDs.

6. Press the start softkey to begin testing. Start of testing causes the analyzer output to be turned on, and a BCCH to be transmitted to the mobile radio under test. The thermometer display and status message will reach the state:

#1: BCCH Transmitted

The thermometer display indicates the progression of the call scenario. The status message provides a description of the current state of the call test.

Turn on the mobile radio, and it will scan and lock onto the analyzer's BCCH. The mobile radio then automatically requests registration.

7. The analyzer will automatically continue to simulate the fixed end equipment performing signaling functions necessary to complete registration. If Continuous BCCH is disabled, the thermometer display and status message will reach the state:

#5: Registration Complete

then

#6: Test Ended

When the test is completed, the analyzer automatically turns off its RF output and the **stop** softkey toggles to **start**.

PREVIOUSLY REGISTERED

If the radio has been previously registered, the Regional Network Code of the analyzer must be customized to match the code of the mobile's home system.

8. Access the iDEN Dispatch Call screen as detailed in paragraph 6-8.3. The thermometer display and status message will reach the state:

#1: BCCH Transmitted

The thermometer display will continue indicating the progression of the call scenario. The accompanying status message provides the description of the current state of the dispatch call test.

The in service indicator on the mobile handset indicates that a call can be placed. Press the PTT of the mobile radio.

9. Initiate a group dispatch call from the mobile radio under test. Consult the mobile radio operator's manual for details of placing a group dispatch call. The thermometer display and status message will reach the state:

#5. MS Talker

10. Select **RF DISPLAY** in the "Meter:" field, and **INT AUD SCOPE** in the "Display:" field. Speak into the mobile radio's handset. Your voice should be audible on the analyzer's speaker, and should appear on the Internal Audio Scope display. A screen similar to figure 7-6 appears.

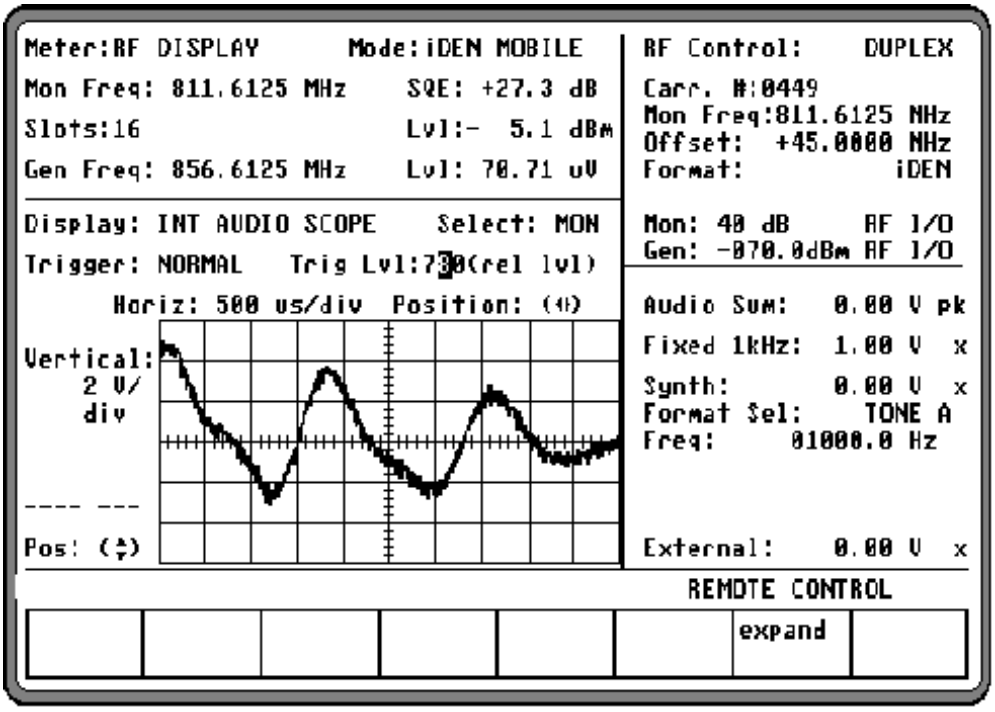


Figure 7-6. iDEN Mobile Dispatch Call – MS Talker/Internal Audio Scope

Return to the **DISPATCH** selection in the "Meter:" field. Release the PTT. The thermometer display and status message will reach the state:

#5. Open

A screen similar to figure 7-7 appears.

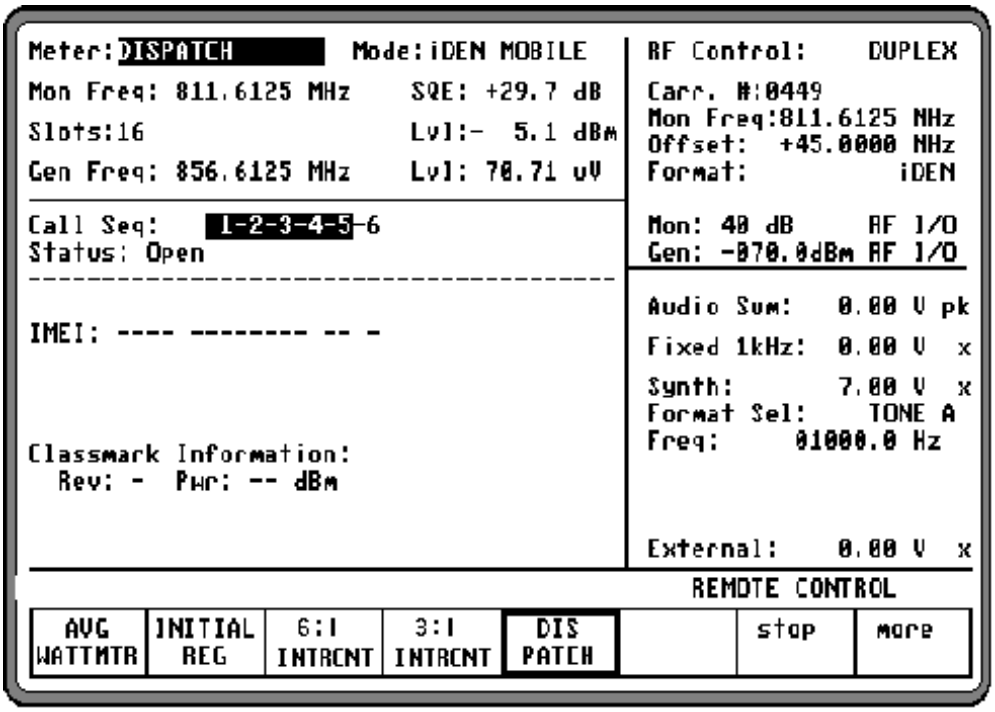


Figure 7-7. iDEN Mobile Dispatch Call – Open with 3:1 Option Installed

NOTE

In this operational state of the test, the traffic channel is open and the analyzer can become the talker or the mobile radio can resume talking.

11. Within the Audio zone, place the cursor in the "Fixed 1kHz:" field. Enable this feature and set the level to 1.00V. The thermometer display and status message will reach the state:

    #5. R2660 Talker

    A screen similar to figure 7-8 appears.

    The analyzer is now the talker and the 1kHz tone should be audible on the mobile radio's speaker. Note that the analyzer microphone is also available for use. Make sure to turn the external audio input on to enable the microphone.

12. Turn off the audio tone generated in step 11. The thermometer display and status message will reach the state:

    #5. Open

    The channel is open and either the mobile radio or the analyzer can resume talking.

13. Press the stop softkey to terminate testing. The analyzer's output is turned off and the mobile radio is no longer in service. If Continuous BCCH is disabled, the thermometer display and status message will reach the state:

#6. Test Ended

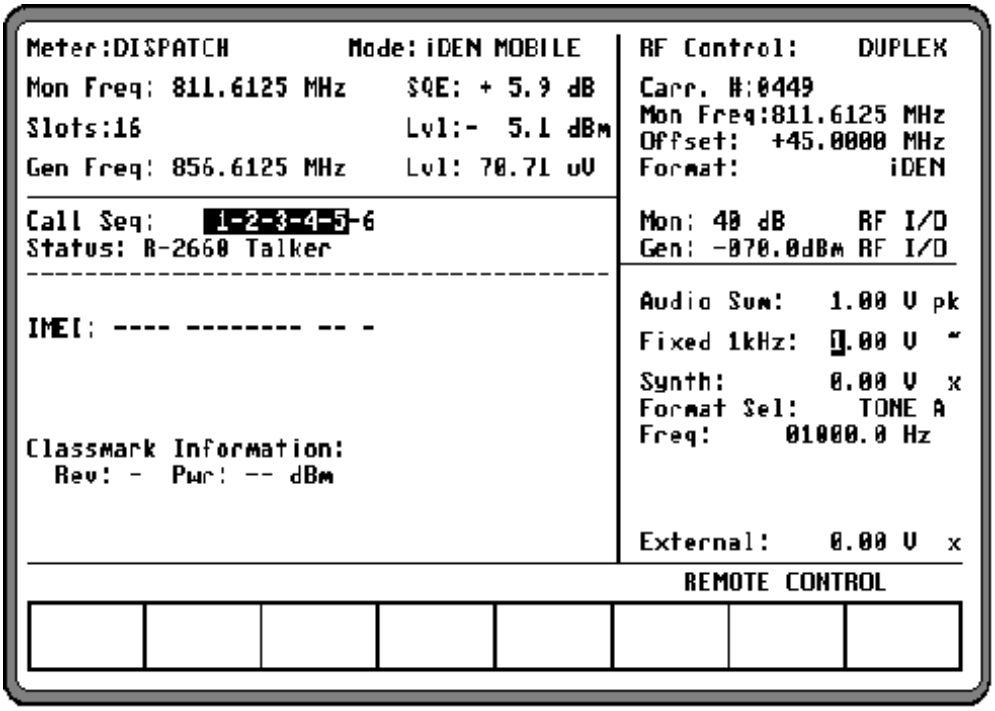


Figure 7-8. iDEN Mobile Dispatch Call – R2660 Talker

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Appendix A

LIST OF ABBREVIATIONS

A	Ampere
AC	Alternating Current
AM	Amplitude Modulation
ATTEN	Attenuation
AUTO	Automatic
BATT	Battery
BNC	Coaxial RF Connector
BW	Bandwidth
C	Celsius
CAL	Calibrate
CCIR	International Radio Consultative Committee
Cm	Centimeters
CMOS	Complementary Metal Oxide Semiconductor
Cntr	Counter
CRLF	Carriage-return-line feed
CW	Continuous Wave
dB	Decibel
dBc	Decibel (referred to carrier)
dBm	Decibel (referred to 1mW into 50 ohms)
DC	Direct Current
Demod	Demodulation
DEV	Deviation
Disp	Dispersion
DIST	Distortion
Div	Division
DPL	Digital Private Line, a Motorola registered trademark
DTMF	Dual-tone multi-frequency
Dur	Duration
DVM	Digital Voltmeter
EEA	Electronic Engineering Association
EIA	Electronics Industry Association
Ext'l	External
FM	Frequency Modulation
FREQ	Frequency
GEN	Generate
GHz	Gigahertz
Horiz	Horizontal
HPF	High Pass Filter
Hz	Hertz
IC	Integrated Circuit
IDC	Instantaneous Deviation Control
IEEE	Institute of Electrical and Electronics Engineers
IF	Intermediate Frequency
IMTS	Improved MobileTelephone System
I/O	Input/Output
Kohm	Kiloohm
kHz	Kilohertz
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
LPF	Low Pass Filter
Lvl	Level
MHz	Megahertz
MIC	Microphone
MIN	Minimum
MOD	Modulation
MON	Monitor
us	Microsecond
ms	Millisecond

LIST OF ABBREVIATIONS-CONTINUED

MSEC	Millisecond
Mtr	Metering
MTS	Mobile Telephone System
MV	Millivolts
uV	Microvolts
mW	Milliwatt
n	Number
N/A	Not Applicable
NB	Narrow Bandwidth
NVM	Non-volatile memory
ORIG	Originated
PCT	Percent
PL	Private Line, a Motorola registered trademark
+/-	Plus or minus
PRT	Print
RF	Radio Frequency
RMS	Root-Mean-Square
Rng	Range
RS	Receiver Specification
SEC	Second
SEQ	Sequence
SINAD	Ratio of (Signal + Noise + Distortion)/(Noise + Distortion)
SPF	Special Function
SSB	Single Sideband
STD	Standard
SW	Switch
SWP	Sweep
Synth	Synthesizer
TN	Tone
Trig	Trigger
TX	Transmitter
UHF	Ultra High Frequency
V	Volts
VAC	Volts Alternating Current
VDC	Volts Direct Current
Vert	Vertical
VRMS	Volts (root-mean-square)
W	Watts
WB	Wide Bandwidth
XCVR	Transceiver
XX	(Select Any Valid Number)
ZVEI	Zentral-Verband der Elektro-Industrie (a German Electronics Industry Association)

Appendix B

TONE AND CODE SPECIFICATIONS

Table B-1. Standard DTMF Tones

Tone Group	Standard Dtmf (Hz)
LOW	697
LOW	770
LOW	852
LOW	941
HIGH	1209
HIGH	1336
HIGH	1477
HIGH	1633

Table B-2. DTMF Frequency Coding*

Key	Low Group Tone (Hz)				High Group Tone (Hz)			
	697	770	852	941	1209	1336	1447	1633
1	•				•			
2	•					•		
3	•						•	
A	•							•
4		•			•			
5		•				•		
6		•					•	
B		•						•
7			•		•			
8			•			•		
9			•				•	
C			•					•
*				•	•			
O				•		•		
#				•			•	
D				•				•

*The analyzer has provisions for encoding and decoding 16 different keys. Each key is assigned two frequencies: one from a low-tone group and one from a high-tone group. Four tones are available from each group, with 16 different combinations of low and high group tones. This table shows the tone assignments of each key.

Table B-3. Private-Line (PL) Codes

Code	Frequency (Hz)
XZ	67.0
WZ	69.3
XA	71.9
WA	74.4
XB	77.0
WB	79.7
YZ	82.5
YA	85.4
YB	88.5
ZZ	91.5
ZA	94.8
ZB	97.0
1Z	100.0
1A	103.5
1B	107.2
2Z	110.9
2A	114.8
2B	118.8
3Z	123.0
3A	127.3
3B	131.8
4Z	136.5
4A	141.3
4B	146.2
5Z	151.4
5A	156.7
5B	162.2
6Z	167.9
6A	173.8
6B	179.9
7Z	186.2
7A	192.8
M1	203.5

Table B-3. Private-Line (PL) Codes (cont)

Code	Frequency (Hz)
8Z	206.5
M2	210.7
M3	218.1
M4	225.7
9Z	229.1
M5	233.6
M6	241.8
M7	250.3

Table B-4. 5/6 Tone Paging Tones

Digit	Frequency
0	600
1	741
2	882
3	1023
4	1164
5	1305
6	1446
7	1587
8	1728
9	1869
R	459
X	2010

Table B-5. DPL Standard Codes

023	174	445
025	205	464
026	223	465
031	226	466
032	243	503
043	244	506
047	245	516
051	251	532
054	261	546
065	263	565
071	265	606
072	271	612
073	306	624
114	311	627
115	315	631
116	331	632
125	343	654
131	351	662
132	364	664
134	365	703
143	371	712
152	411	723
155	412	731
156	413	732
162	423	734
165	431	743
172	432	

Table B-6. Select V Frequencies

Character	ZVEI Std (Hz)	ZVEI Mod (Hz)	ZVEI French (Hz)	CCIR Std (Hz)	CCIR 70ms (Hz)	EEAA (Hz)
0	2400	2200	2400	1981	1981	1981
1	1060	970	1060	1124	1124	1124
2	1160	1060	1160	1197	1197	1197
3	1270	1160	1270	1275	1275	1275
4	1400	1270	1400	1358	1358	1358
5	1530	1400	1530	1446	1446	1446
6	1670	1530	1670	1540	1540	1540
7	1830	1670	1830	1640	1640	1640
8	2000	1830	2000	1747	1747	1747
9	2200	2000	2200	1860	1860	1860
G	2800	885	885	2400	2400	1055
B	810	810	810	930	930	930
C	970	2600	2600	2247	2247	2247
D	885	2800	2800	991	991	991
F	930	930	930	873	873	873
R	2600	2400	970	2110	2110	2110
N_T Tone	0	0	0	0	0	0
Length (msec)	70	70	70	100	70	40

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Appendix C

SAFE HANDLING OF CMOS INTEGRATED CIRCUIT DEVICES

Many of the integrated circuit devices used in communications equipment are of the CMOS (Complementary Metal Oxide Semiconductor) type. Because of their high open circuit impedance, CMOS ICs are vulnerable to damage from static charges. Care must be taken in handling, shipping, and servicing them and the assemblies in which they are used.

Even though protection devices are provided in CMOS IC inputs, the protection is effective only against overvoltage in the hundreds of volts range such as are encountered in an operating system. In a system, circuit elements distribute static charges and load the CMOS circuits, decreasing the chance of damage. However, CMOS circuits can be damaged by improper handling of the modules even in a system.

To avoid damage to circuits, observe the following handling, shipping, and servicing precautions.

1. Prior to and while servicing a circuit module, particularly after moving within the service area, momentarily touch both hands to a bare metal earth grounded surface. This will discharge any static charge which may have accumulated on the person doing the servicing.

NOTE

Wearing Conductive Wrist Strap will minimize static buildup during servicing.

WARNING

When wearing Conductive Wrist Strap, be careful near sources of high voltage. The good ground provided by the wrist strap will also increase the danger of lethal shock from accidentally touching high voltage sources.

2. Whenever possible, avoid touching any electrically conductive parts of the circuit module with your hands.
3. Normally, circuit modules can be inserted or removed with power applied to the unit. However, check the INSTALLATION and MAINTENANCE sections of the manual as well as the module schematic diagram to insure there are no objections to this practice.
4. When servicing a circuit module, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) because they contribute to static buildup.
5. All electrically powered test equipment should be grounded. Apply the ground lead from the test equipment to the circuit module before connecting the test probe. Similarly, disconnect the test probe prior to removing the ground lead.
6. If a circuit module is removed from the system, it is desirable to lay it on a conductive surface (such as a sheet of aluminum foil) which is connected to ground through 100k of resistance.

WARNING

If the aluminum foil is connected directly to ground, be cautious of possible electrical shock from contacting the foil at the same time as other electrical circuits.

7. When soldering, be sure the soldering iron is grounded.

1. Prior to connecting jumpers, replacing circuit components, or touching CMOS pins (if this becomes necessary in the replacement of an integrated circuit device), be sure to discharge any static buildup as described in procedure 1. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch pins on the CMOS device and associated board wiring.

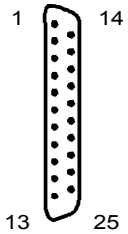
Appendix D

EXTERNAL PORT PIN ASSIGNMENTS

RS-232 PORT

This is a full bidirectional RS-232 port with the capability to respond to a serial input. The port serves a dual purpose in that if an RS-232 is not desired, the port can be used as a printer output. Software determines if the port functions as an RS-232 bidirectional port or as an output-only printer port. 25 pin female "D" connector on Processor Module for RS-232 interface at the side panel. Drawing shows pins as seen from a side view of the Analyzer.

PIN	
1	GND
2	TXD (transmit data)
3	RXD (receive data)
4	RTS (request to send)
5	CTS (clear to send)
6	DSR (data set ready)
7	SIG GND (signal ground)
8	DCD* (data carrier detect)
9-19	not used
20	DTR* (data terminal ready)
21	not used
22	RI (Ring Indicator)
23-25	not used



NOTE

For printer use, pins 5 and 20 of this port should be tied together inside the cable to the printer. 30-80387B58 printer cable provides the required interface.

DCD* (Data Carrier Detect) input is not used in this application.

DSR* (Data Set Ready) is a general purpose input that is used for modem control. This line is not used when a printer is connected.

DTR* (Data Terminal Ready) is a general purpose output to indicate the Analyzer is ready to receive more data on the RXD line.

RTS* and CTS* (Request-To-Send, Clear-To-Send) are handshaking signals used in RS232 communications.

RXD (Receive Data) input signal is the data received. If this connector is used as a printer output, the RXD pin is not used.

TXD (Transmit Data) output signal is the data being transmitted.

REAR PANEL DC INPUT PORT

Drawing shows pins as seen from a rear view of the Analyzer.

Positive DC voltage must be between +11 and +18VDC.

Either "+" pin may be used for the positive DC voltage since these two pins are tied together internally.

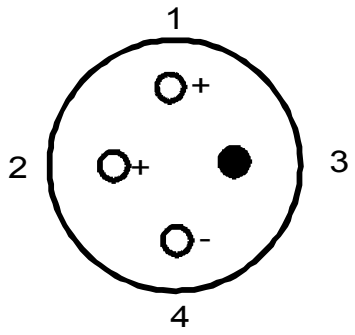


Figure D-1. Rear Panel DC Input Port

APPENDIX E

BCCH PARAMETERS

E-1 INTRODUCTION

This appendix provides a description of selectable BCCH parameters. The parameters selectable in the BCCH Setup screen are a small subset of the BCCH parameters configurable in the iDEN system. Refer to iDEN system documentation for a description of the complete BCCH.

The BCCH Setup screen (paragraph 6-8.2.1) provides the user with the capability to select the following parameters as described below.

E-2 SYSTEM INFORMATION TYPE 0

The Global Location Area Identifier specifies the cell identity in a globally unambiguous manner. The Global Location Area Identifier is made up of the Mobile Country Code (MCC), the National Domain Code (NDC) and the Local Location Area Identifier (Local LAI).

- MCC (Mobile Country Code):
- NDC (National Domain Code):

Local LAI (Local Location Area Identifier):

The Local LAI uniquely defines the Location Area within the national naming domain. The Local LAI is a 2 octet hexadecimal field.

Regional Network Code:

The Regional Network code is transmitted on the BCCH of each cell within a given network. It identifies the network to listening mobile stations. The mobile uses the Regional Network ID to determine if it should seek service on that network. The Regional Network ID is a 3 octet hexadecimal field.

Service Provider Code:

The Service Provider Code is transmitted on the BCCH of each cell within a given network. It identifies the service provider to listening mobile stations. The mobile uses the Service Provider Code to determine if it should seek service on that network. The Service Provider Code is a 2 octet hexadecimal field.

E-3. SYSTEM INFORMATION TYPE 1

Power Control Constant (PCC):

The power control constant is selectable over the range of (-128 to +127) dB in 1 dB steps. The PCC is transmitted on the BCCH. The mobile radio determines its transmitter power setting based on the PCC and the received signal strength measured by the mobile. Appropriate selection of PCC and the analyzer output power will cause the mobile to transmit at less than maximum power.

Maximum Transmit Power:

Maximum Transmit Power is a BCCH parameter specifying the maximum power a mobile is allowed to transmit on a given cell.

E-4. CONTINUOUS BCCH

With continuous BCCH disabled, the BCCH transmission will begin on start of a registration, interconnect, or dispatch test and will stop on selection of a non-mobile mode, on modification of a BCCH parameter or when the registration, interconnect or dispatch test is stopped. With continuous BCCH enabled, the BCCH transmission will begin on start of a registration, interconnect, or dispatch test and will stop only on selection of a non-mobile mode or on modification of a BCCH parameter.

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APPENDIX F

CALL SCENARIO DESCRIPTIONS

Table F-1. Initial Registration/IMSI Assignment Scenario

SIGNALING EVENT		DESCRIPTION
1	BCCH Data Transmission	The R2660 generates an Outbound Primary Control Channel (PCCH) on frequency, port, and output level selected by the operator. Broadcast Control Channel (BCCH) System Information types 0 and 1 are transmitted.
2	Registration Channel Requested	The mobile radio under test establishes a radio resource connection by making a Channel Request on the Random Access Channel (RACH). The Channel Request is indicated on the display.
3	Registration Channel Assigned	The R2660 assigns an unassigned channel as the Dedicated Control Channel (DCCH) and begins transmitting DCCH Slot Descriptor Blocks (SDBs). The R2660 sends an Immediate Assignment command to the mobile radio under test on the Common Control Channel (CCCH). The completion of the Channel Assignment is indicated on the display.
4	Registration Proceeding	The mobile radio under test performs initial registration by issuing a Registration Request message on the DCCH. A "Registration Proceeding" message is displayed. The analyzer receives the inbound signal and transmits an acceptance message assigning a International Mobile Station Identifier (IMSI) to an interconnect radio, or an IMSI, Dispatch Group ID, and Dispatch Individual ID for a dispatch radio as selected prior to beginning the test.
5	Registration Complete	The mobile radio under test sends a completion message to the R2660. Registration Complete is indicated on the display. The R2660 un-assigns the DCCH channel, leaving only the BCCH data being transmitted.
6	Test Ended	The R2660 unassigns the BCCH channel. The test is complete and is indicated on the display.

Table F-2. Mobile Originated Interconnect Call

SIGNALING EVENT		DESCRIPTION
1	BCCH Data Transmission	The R2660 generates an Outbound Primary Control Channel (PCCH) on frequency, port, and output level selected by the operator. Broadcast Control Channel (BCCH) System Information types 0 and 1 are transmitted. Once the test has been started, the BCCH parameters are no longer selectable. The R2660 is in Duplex mode, and monitors the inbound channel for messages from the mobile radio under test on the Random Access Channel (RACH). BCCH data transmission is indicated on the display. The user powers up the mobile radio under test. The radio scans and acquires the outbound signal of the R2660.
2	Registration Update Requested	Registration update. The mobile radio under test may attempt to re-register.
3	Location Update Requested	Location Update: If the location field in the BCCH data is different from the last call that the mobile radio under test operated on, the mobile radio under test will perform a location update.
4	Mobile Originated Interconnect Call	The operator must now initiate a telephone call on the mobile radio under test. The mobile radio under test requests a channel on the RACH. The display indicates that the mobile radio under test has requested a channel for interconnect call.
5	Interconnect Channel Assigned	The R2660 assigns a DCCH on an unassigned channel. The R2660 then sends an Immediate Assignment command to the mobile radio under test on the CCCH. The display indicates that the assignment has been made.
6	Circuit Mode Service Request	The mobile radio under test sends a Circuit Mode (CM) Service Request message on the assigned DCCH. The display indicates that this has occurred, and the R2660 transmits a CM Service Accept message.
7	Call Setup Proceeding	The mobile radio under test transmits a Setup message on the DCCH. The display indicates that the message was sent, along with the Called number address as follows: 7.1 The R2660 transmits a Call Proceeding message on the DCCH in order to confirm the call request. The three optional elements within the message are not supported by the R2660. 7.2 The R2660 transmits the Assignment Command on the DCCH to assign a Temporary Control Channel (TCCH). 7.3 The mobile radio under test responds on new TCCH with an Assignment Access. The R2660 then converts the TCCH SDB to a Traffic Channel (TCH).

Table F-2. Mobile Originated Interconnect Call (cont)

SIGNALING EVENT		DESCRIPTION
7 (cont)	Call Setup Proceeding (cont)	7.4 The R2660, simulating an entire Fixed-End and Base System, transmits an Alerting message as though it was in touch with a called mobile radio under test. There are no supportable options in this message. 7.5 The R2660 transmits a Connect message on the new TCH. There are no supportable options in this message. 7.6 The mobile radio under test responds with a Connect Acknowledge message.
8	Measurement State	8.1 The R2660 transmits a Measurement Inquire message. The display indicates that the system is in the measurement state. This state and the following are repeated on a periodic basis. 8.2 The mobile radio under test responds with a Measurement Report. The R2660 displays the measurement data. 8.3 Voice transmissions are conducted throughout duration of call. 8.4 User ends phone call at mobile radio under test. The mobile radio under test transmits a Disconnect Message, with the cause element set to %0010000, Normal Clearing. 8.5 The R2660 responds by sending a Release Request to the mobile radio under test. The cause element is set to User, Normal Clearing %0000, %0010000. 8.6 The mobile radio under test sends back a Release Complete message.
9	Test Ended	The R2660 un-assigns the channels, ending the test. The display indicates that the Interconnect Call test is complete.

Table F-3. Mobile Originated Dispatch Group Call

SIGNALING EVENT		DESCRIPTION
1	BCCH Data Transmission	The R2660 generates an Outbound Primary Control Channel (PCCH) on frequency, port, and output level selected by the operator. Broadcast Control Channel (BCCH) System Information types 0 and 1 are transmitted. Once the test has been started, the BCCH parameters are no longer available. The R2660 is in Duplex mode, and monitors the inbound channel for messages from the mobile radio under test on the Random Access Channel (RACH). BCCH data transmission is indicated on the display. The user powers up the mobile radio under test. The radio scans and acquires the outbound signal of the R2660. Following this acquisition, one of the following two states is enacted: 1) Registration update; or 2) Location update.
2	Registration Update Requested	Registration Update. The mobile radio under test may also attempt to re-register, dependent on the state of the radio.
3	Location Update Requested	Location Update. If the location field in the BCCH data is different from the last call that the mobile radio under test operated on, the mobile radio under test will perform a location update.
4	Group Call Proceeding	The user must initiate a group call on the mobile radio under test by keying the Push-To-Talk (PTT). The mobile radio under test sends a Group Call Request on the RACH. The display indicates that the mobile radio under test has transmitted a Group Call as the talker.
5	MS Talker	The R2660 begins a cycle of issuing Group Call Grant on the CCCH, and monitoring the inbound voice on the TCH. The Group Call Grant message echoes back the Individual ID and Group IDs of the talker mobile radio under test, and assigns the TCH number for the group call.
	Open	The user de-keys and the mobile radio under test sends a group Call End of Transmission (EOT) message. The R2660 responds re-assigning the TCH to a Temporary Control Channel (TCCH) The user now has the option of enabling audio on the R2660 (by keying the external microphone input, or turning on a tone, for example) and making the R2660 behave as a talker or using the radio as the talker.
	R2660 Talker	Turning on an analyzer audio source causes the analyzer to become the talker. The MS Talker, Open, and R2660 Talker status can be switched back and forth indefinitely.
6	Test Ended	The R2660 displays "TEST ENDED," and unassigns all slots, ending the transmissions.

APPENDIX G

ERROR AND WARNING MESSAGES

This appendix describes errors and warning messages that may occur during a call test. The error messages are posted on the line below the status line in the Initial Registration, Interconnect and Dispatch call test displays. A description of the message and possible causes follow.

G-1 CHANNEL FAILURE

The channel failure error message indicates that the RF traffic channel between the mobile and the analyzer has failed during an interconnect or dispatch call test. The analyzer determines this condition by detecting an absence of traffic channel data packets transmitted from the mobile under test. If the analyzer detects an absence of inbound traffic channel data packets, it stops the test and displays the message ***"Channel Failure."***

Two analyzer set up problems that can cause this error are:

a) The output level of the analyzer is too low and the RF link to the mobile is lost. This will cause the mobile to stop transmitting.

b) The power transmitted by the mobile to the analyzer is too high for the current attenuator setting overloading the analyzer receiver. This may cause the analyzer to incorrectly decode inbound traffic channel data and indicate channel failure.

G-2 EXPECTED MESSAGE NOT RECEIVED

This error occurs if the mobile radio under test does not acknowledge an analyzer outbound message with an appropriate response within the time limit. If the analyzer detects this condition, it stops the test and displays the message ***"Expected Message Not Received."*** The test must be restarted to recover from this error.

G-3 INVALID CHANNEL REQUEST

If the analyzer is not configured for the appropriate call test, the invalid channel request error may be generated when a call is initiated by the mobile radio under test. When the analyzer detects this condition, it stops the test and displays the error message ***"Invalid Channel Request."*** Several examples of conditions that will generate this error follow:

a) Initiating a group dispatch call from the mobile under test with the analyzer configured for the interconnect call test will cause this error to occur.

b) Initiating an interconnect call from the mobile under test with the analyzer configured for the dispatch call test will cause this error to occur.

c) Initiating a group dispatch call or interconnect call from the mobile under test when the analyzer is configured for the initial registration test will cause this error to occur.

All of the above examples are corrected by placing the analyzer in the appropriate call test.

G-4 SUBSCRIBER NOT INITIALIZED

This error occurs in the Interconnect or Dispatch call tests if the mobile radio under test does not contain a valid IMSI at the beginning of the call scenario. If the mobile does not contain an IMSI, it will make a registration request to the analyzer using an IMEI. The analyzer recognizes this condition, stops the test and displays the error message ***"Subscriber Not Initialized."*** To correct the condition, use the Initial Registration test to assign dummy IMSI and dispatch IDs to the radio under test.

G-5 SUBSCRIBER PREVIOUSLY INITIALIZED

This error occurs in the Initial Registration test if the mobile under test already contains a valid IMSI. If the mobile under test contains a valid IMSI, it will make a registration request to the analyzer using its IMSI. The analyzer detects this condition, stops the test and displays the error message ***"Subscriber Previously Initialized."*** Since the mobile already contains a valid IMSI, it is not necessary to perform the Initial Registration test. Testing can be performed using the Dispatch or Interconnect call tests.

G-6 UNEXPECTED MESSAGE RECEIVED

This error occurs if the mobile under test transmits an inbound message to the analyzer that is not supported, unexpected, or not recognized by the analyzer. When the analyzer detects this condition, it stops the test and displays the message ***"Unexpected Message Received."*** Examples of mobile under test operator actions that cause unexpected messages follow:

a) Messages from the mobile under test requesting features not supported by the analyzer will cause the unexpected message error. Examples include:

   – Initiation of a private dispatch call from the radio under test. Recall that the analyzer does not support private dispatch calls.

   – Selection of numeric keys after the call has been established.

   – Selection of the "Hold" option on the mobile under test when an interconnect call is in progress.

The call test must be restarted after this error occurs. The actions described above should not be performed since an unexpected message error will result.

b) An unexpected message is a message transmitted by the mobile that is supported by the analyzer. However, the message has occurred at an inappropriate time with respect to the current call test state.

c) A mobile message transmitted to the analyzer containing unrecognizable data fields (i.e., protocol discriminator or message type) will cause the unexpected message received error to occur.