

**GENERAL DYNAMICS**

*COMMUNICATIONS TEST EQUIPMENT*

R-2590A

Communications System Analyzer

**OPERATOR'S MANUAL**

General Dynamics Decision Systems, Inc  
Communications Test Equipment  
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## Scope of Manual

This manual contains information for using the R-2590 Communications System Analyzer. This Analyzer incorporates many devices and functions, permitting a technician to completely monitor and service radio communications equipment in the shop and in the field.

## Installation

Special package inserts protect the analyzer, which is packed inside a carton. Save the packing carton and packing materials for future use.

### 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.*

1. Place the analyzer on a workbench in the shop, or mobile repair unit.
2. The carry handle can be used as a bale, to adjust the viewing angle. Simultaneously press the buttons located on each swivel point of the carry handle, and rotate it to the desired position. A distinct click will be heard when the handle is locked into a détente position.
3. Attach the female end of the power cord into the appropriate connector on the analyzers rear panel. Connect the other end to the power source. For AC, use a grounded 3-wire 85-265 VAC (50 to 60 Hz) power source. An externally accessible 2A fuse protects this input.
4. Press the power switch ON. The analyzer is now ready for use. Before operating the analyzer, review the operating procedures described in this manual

## Battery Pack Operation

The optional internal battery (RLN5333A), is designed to power the analyzer for up to 2 hours during average use. Containing an internal charger, the analyzer will automatically charge the battery when connected to an AC power source. Battery charging is independent of the main equipment.

When operating under the power of the internal battery, the front LED marked "BATT" will be lit.

## External DC Operation

Use a 2.5 mm plug connected to an appropriate 11-18 VDC power source.

# Getting Started

## Overview

The R2590 is a portable test instrument designed to monitor and service radio communications equipment up to the frequency of 1.0 GHz. 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 (with optional Tracking Generator)
- Duplex Offset Generator
- Signal Strength Meter
- Oscilloscope
- Frequency Counter
- AC/DC Voltmeter
- RF Power Meter
- SINAD Meter
- Signaling Encoder / Decoder

## Operating the R2590

The R2590 has been designed to be intuitive and easy to use. Most commonly used adjustments can be made with one or two simple keystrokes. The primary operating modes of the R2590 are spectrum analyzer, oscilloscope, receive, generate, and duplex. One touch access is provided for these modes via the 'mode selection keys' described below. The F1 through F6 function keys configure themselves dependant on the current mode of the R2590. Each function key has a unique set of parameter keys (F7 through F12) mapped to it.

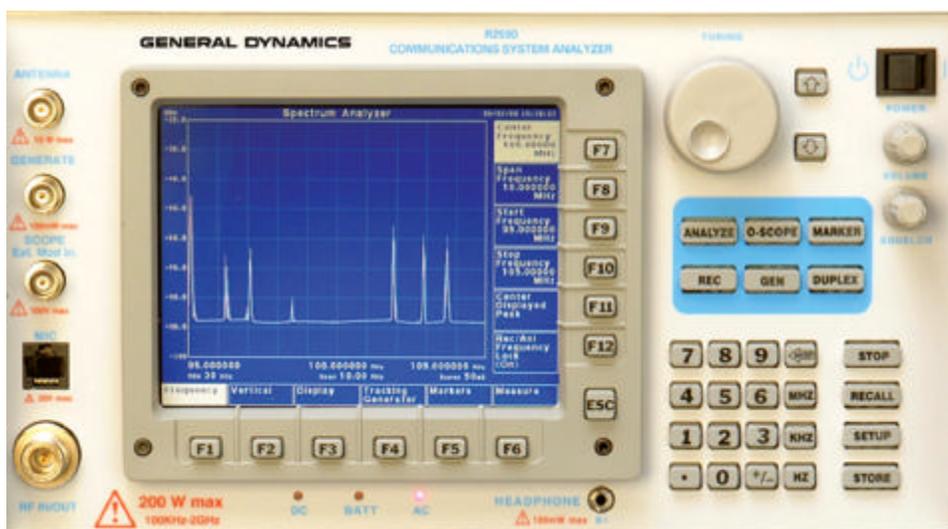


Figure 1 Front Panel

User settings and adjustments are performed through the F7 through F12 parameter keys. Users settings can either be a numeric value such as frequency, or a selection such as ‘on’ or ‘off’. Selecting an available parameter key (designated by a non-blank text field next to it) will make the key active and permit changes to it. Note that a key is active when its label is highlighted.

Certain parameter keys will immediately perform an action, rather than become active for operator input. Such keys, such as ‘Find Peak’ in the spectrum analyzer mode, (F9 parameter key and F5 marker function), will execute the action and maintain the prior active key. This shortens the number of key presses needed during tuning procedures.

There are two methods for entering values depending on the type of input or the users preference; direct entry, and tuning control.

**Direct Entry:** This is usually the most expedient method when the value to enter is already known. With the desired parameter key active, simply enter data using the numeric keypad. Notice that once a direct entry is begun, the parameter keys will change to reflect the available units corresponding to the desired entry. For example, when entering an RF frequency, F7, F8, and F9 will change to “MHz”, “KHz”, and “Hz” respectively. To input a direct entry, you can select the appropriate units, or press the “ENTER” key to choose the default that is always equivalent to the F7 key. Pressing the “ESC” key anytime during a direct entry will terminate the entry without changing the original value.

Note that the numeric keypad also contains “MHz”, “KHz”, and “Hz” keys. These keys will always correspond to what is displayed in the F7, F8, and F9 keys.

**Tuning Control:** The encoder wheel (spin knob) and arrow keys will adjust all active parameter fields. While this is most useful for numeric entries, it can also be used to scroll through individual selections.

Multiple presses of the same key can also change parameters with individual selections, such as “on” or “off”. In these instances, subsequent presses of the same key will rotate the settings through all parameters.

## Front Panel Controls and Indicators

### *Power Switch*

Press ON (1) to energize all circuitry. The unit will automatically select AC power if line power is available.

### *DC, BATT, AC Indicators*

The AC and DC lights indicate what power source is applied. Only the BATT LED will light when the unit is powered to conserve battery life. When the battery options is installed, and AC is applied to the unit, charging voltage will be applied to keep the battery at full operating voltage. External DC input will not charge the battery. Anytime AC is applied the battery will be charging and will provide un-interruptible power to the R2590 is AC or DC is removed during operation. The battery will provide up to 2 hours of operation without any options installed. It takes approximately 24 hours to re-charge a discharged battery to 95% of capacity.

<i>ANALYZE Key</i>	Pressing the 'ANLYZE' button will automatically switch the R2590 in the Spectrum Analyzer mode. Refer to the Spectrum Analyzer section for operational details of this mode.
<i>O-SCOPE Key</i>	Pressing the 'O-SCOPE' button will automatically place the R2590 in the Oscilloscope mode. Refer to Oscilloscope section for operational details of this mode.
<i>MARKER key</i>	Pressing the 'MARKER' button while the R2590 is in either the Analyzer or Oscilloscope mode will change the parameter keys to those associated with the marker function for that mode. The key will have no affect in any other mode.
<i>REC Key</i>	Pressing the 'REC' button will automatically place the R2590 in the Receive mode. Refer to the Receiver section for operational details of this mode.
<i>GEN Key</i>	Pressing the 'GEN' button will automatically place the R2590 in the Generate mode. Refer to the Generator section for operational details of this mode.
<i>DUPLEX Key</i>	Pressing the 'DUPLEX' button will automatically place the R2590 in the Duplex mode. Refer to Duplex section for operational details of this mode.
<i>Function Keys (F1- F6)</i>	The F1 through F6 function keys are used to select the various functions associated with a particular mode. Each function key will provide a unique set of parameter keys.
<i>Parameter Keys (F8 - F12)</i>	The F8 through F12 parameter keys reflect the current function key selection. Each set of parameter keys will correspond to a unique function key selection.
<i>ESC Key</i>	The "ESC" key is used to terminate an action before it is completed. For example, pressing "ESC" during a direct parameter entry via the numeric keypad, will close the direct entry field and leave the parameter unchanged. This key can also be used to return to the previous mode from the "MEMORY" and "SETUP" functions. When used in this manner, multiple presses of the "ESC" key may be necessary to return to the previous mode.
<i>Data Entry Keys (0-9, +/-, ., BKSP, MHz, KHz, Hz)</i>	The data entry keys provide a convenient means for entering specific numeric parameters. The "BKSP", or backspace key, can be used to edit an entry during input.
<i>Squelch Knob</i>	The squelch control knob sets the squelch level for the receiver. Turning the knob completely counter-clockwise fully opens the receiver.
<i>Volume Knob</i>	The volume knob controls the volume of the R2590's internal speaker. Rotating the knob counter-clockwise will minimize the volume level.

#### *Tuning Controls*

The tuning controls consist of the encoder wheel (spin knob), and the up and down pushbuttons. Rotating the wheel will adjust most values, including 'stepping' through non-numeric settings. However, it is especially useful for numeric values that need to be adjusted in very small increments. The up and down arrow keys provide the same function, but with a more precise feel.

#### *STOP Key*

The STOP key will freeze either the Oscilloscope or Spectrum Analyzer displays. This is useful when more detailed examination of the waveform is desired. This key will not affect any other operation of the R2590.

#### *MEMORY Key*

The MEMORY key provides one button access to all stored channel information. Refer to the Memory section for operational details of this function.

#### *SETUP Key*

Many of the operational modes or functions of the R2590 have default settings that can be reconfigured. Pressing the SETUP key while in a particular mode or function, will access the relevant settings. Refer to the Setup section for operational details of this mode.

#### *ENTER Key*

The ENTER key is used to enter direct input entries. It will automatically choose the default units as previously described.

### Front Panel Connectors

#### *ANTENNA*

This RF input port is used for sensitive monitor receiver. Any level above +20dBm will be muted and driven to the internal 10-watt dummy load. Should you exceed this level, the R2590 will sound an alarm to indicate the presence of high power on the Antenna input.

#### *GENERATE*

This connector provides from -80 dBm up to -10 dBm of RF output and is isolated from the RF IN/OUT port. This output is generally used when sweeping filters and duplexers.. **WARNING - DO NOT APPLY RF POWER TO THIS PORT!**

#### *SCOPE / Ext. Mod In*

This connector is a combined input port for oscilloscope vertical, external modulation, and the SINAD meter. This port is designed to handle up to +/- 100V peak signal levels. Both high sensitivity (+/- 5V max input) and low sensitivity (+/- 100V max input) inputs are user selectable along with AC and DC coupling.

#### *MIC*

This connector is used to externally modulate the generate output using an external microphone. The pin out of the connector conforms to the industry standard RJ-45 connector used on many of the mobile radio microphones. This connector supports both direct modulation and pre-emphasized modulation, under software control.

#### *RF IN/OUT*

This connector provides RF input signal to the analyzer's internal monitor or output signal from the analyzer's internal RF generator. It will also provide combined input/output in "DUPLEX" mode. The RF IN/OUT port has a Type 'N' connector to support wide frequency, 50-ohm inputs and will dissipate up to 200 watts. This connector can provide

from -125dBm to -40dBm of RF output. The receiver path includes 60dB of attenuation through this port.

**HEADPHONE**

The R2590 supports a 1/8" headphone jack. This jack allows the user to monitor the speaker using a mono headphone set. Users can monitor the speaker in noisy environments without missing any information like keyboard beeps, monitor tones and alarm information. The main speaker can also be muted without affecting the headphone output. The headphone jack is not intended to drive an external speaker, only provide low-level outputs to a set of headphones.

**Front Panel Display Screen**

The 6.4" diagonal TFT color LCD provides measurement data, operating controls, and instructional information. The right vertical axis of the display contains the labels for the F7 through F12 parameter keys. The bottom horizontal axis contains the labels for the F1 through F6 function keys. Note that these labels change to reflect the current operating mode of the R2590 analyzer.



Figure 2 Display Screen

The top center of the display screen specifies the current mode. To the right of this is the current time and date. Note that the R2590 can be programmed to blank the display screen after x minutes of inactivity. This is used to conserve power much like a computer monitor. See SETUP for more information.

More specific detail of the information displayed on the LCD is covered in detail in the individual sections of this manual.

## Rear Panel

Figure 3 illustrates the layout of the rear panel of the R2590.

**DC Input** This connector is used when external DC is used to power the analyzer. The DC power source must be able to supply 2.5 Amps at 13.8 volts. The allowable voltage input range is from 11 to 18 volts DC. The DC input is the highest priority power input.

**Tone Output** This connector is used when either receiver demodulation or internal tone generation output. Tone information is controlled under the Generate instrument.

**30 MHz Reference Output** This connector provides a direct tap to the internal reference oscillator. The reference oscillator is a 30 MHz oven controlled design. The standard stability is 0.5ppm but a high stability 0.05ppm oscillator is available.

**VGA Port** This connector provides output to drive an external 640 x 480 VGA monitor. The monitor can operate standalone or be used along with the front panel LCD.

**RS-232 Port** This connector is used to provide updates to the R2590 and to control the instrument with the software simulator. A direct thru DB-9 cable is used to connect the R2590 to the personal computer.

**AC Input** This connector is used to provide the AC voltage input to the R2590. This connector is rated at 2 amps and is protected with an externally accessible 2A fuse. Note that an AC power source is required to charge the optional internal 12-volt battery. The AC voltage requirement is from 90 VAC to 264 VAC, single phase.



Figure 3 Rear Panel

## Spectrum Analyzer

Pressing the 'ANALYZE' mode key accesses the Spectrum Analyzer. The screen will immediately change to the spectrum display recalling the last settings that were used while in this mode. Note that the "STOP" key can be used at any time to freeze the display – the word "STOPPED" will replace the "dBm" designation at the top left of the screen.

**Display Screen** Located on the left side of the screen, the vertical axis indicates the calibrated amplitude of the received signal and is displayed in dBm. Each graticule is 10 dBm in height. With 8 graticules, the spectrum analyzer supplies a total display range of 80 dBm. The scale for the vertical axis is dependant on the reference level and input port selection. 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.

The horizontal axis is the frequency axis of the spectrum analyzer display. The information located directly below this axis of the spectrum screen specifies the span, sweep and resolution bandwidth (RBW) settings of the analyzer. Additional information includes the starting, ending and center frequency. Start, stop, center and span are controlled using the F7 through F10 function keys. The sweep time is controlled automatically and is dependant on the resolution bandwidth and span. Resolution bandwidth can be manually controlled under the Vertical function

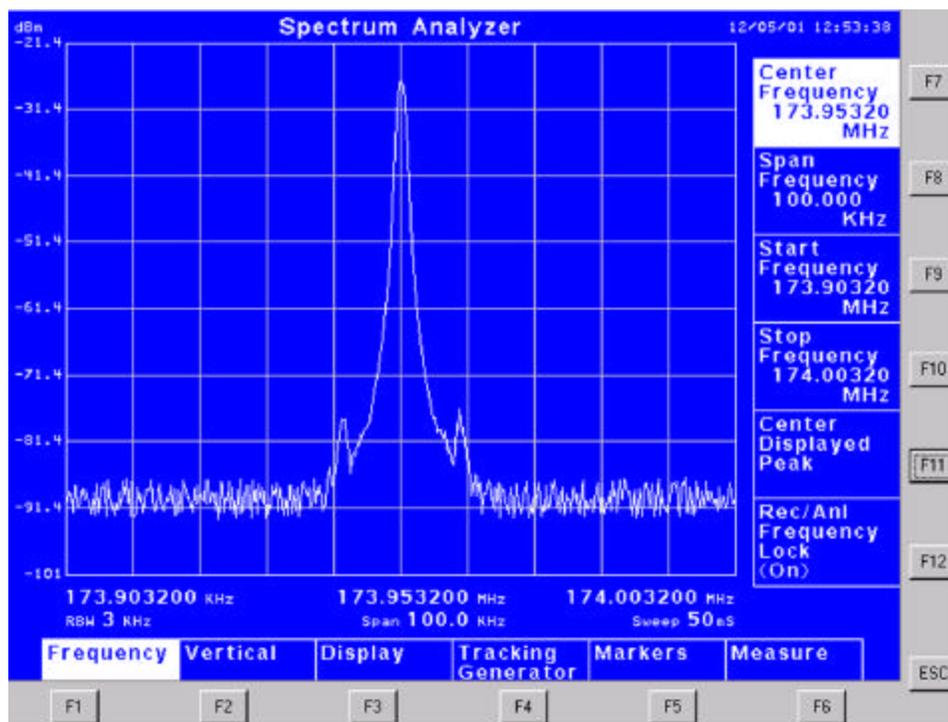


Figure 4 Spectrum Analyzer Display

## Setting frequencies

<b>F1</b>	<b>Frequency</b>
<b>F7</b>	Center Frequency
<b>F8</b>	Span Frequency
<b>F9</b>	Start Frequency
<b>F10</b>	Stop Frequency
<b>F11</b>	Center Displayed Peak
<b>F12</b>	Rec/Anl Frequency Lock (On, Off)

Pressing the F1 function key accesses the Spectrum Analyzer vertical function. The parameter keys are updated as illustrated in Table 1.

F7 adjusts the center frequency of the spectrum display.

F8 adjusts the span width of the spectrum display.

F9 sets the start frequency of the spectrum display.

F10 sets the stop frequency of the spectrum display.

F11 will cause the spectrum analyzer to locate the maximum displayed signal and center it on the display. The center frequency will now be tuned to the peak. The frequency span will remain the same but the start and stop frequencies will change to reflect the new center frequency.

F12 locks the center frequency of the spectrum analyzer display with the frequency setting in the receive mode.

## Vertical settings

<b>F2</b>	<b>Vertical</b>
<b>F7</b>	Reference Level
<b>F8</b>	Input (Antenna, RF I/O)
<b>F9</b>	Amp/Atten Control (Auto, Manual)
<b>F10</b>	Attenuator - Amp/Atten Control Manual
<b>F11</b>	Amp (On, Off) - Amp/Atten Control Manual
<b>F12</b>	Marker Audio (Off, Cont, Toggle)

Pressing the F2 buttons accesses the Spectrum Analyzer vertical function. The parameter keys are updated as illustrated in Table 2.

F7 allows the user to select, and change the analyzers reference level. The reference level is the top of the screen point. If the reference level is changed from the default, the analyzer will automatically

control the -30dB attenuator and +20dB amplifier as needed in order to maintain a calibrated signal. The automatic selection is controlled with the F9 key, which will be described later.

When looking at small signals, it may be necessary to change the reference level to a negative value in order to get the best resolution.

F8 selects between the front panel antenna connector and the high power RF IN/OUT connector for the input source to the analyzer. The antenna input is used when low-level signals are wanted. The RF IN/OUT connector is used to monitor high power inputs. This port is -60dB down with respect to the antenna connector. Typically the analyzer will choose the port best for its input.

F9 toggles between attenuation/amplifier automatic or manual control. Default position is the automatic selection. When the reference level is changed, and F9 is in automatic mode, the analyzer automatically varies the attenuator/amplifier to match the reference level. Under manual control, function keys F10 and F11 are enabled.

F10 adjusts the internal 30dB input attenuator. This attenuator is used to minimize the effects of front-end overload. If you overdrive the antenna input, spurious signals can be generated. By varying the attenuator you can minimize this effect. The attenuator is adjustable in 2dB steps.

F11 controls the +20dB internal amplifier. This amplifier is used to view low-level signals that are near the noise floor of the analyzer. It is important to understand that the amplifier may introduce spurs or increase the noise floor when enabled. It is recommended to only use the amplifier with a narrow resolution bandwidth filter (RBW) to minimize this effect.

**The optimum level for the reference level is -20dB. Signals above this point may generate front-end overload spurs on the analyzers screen. If large signals near -20dB are present, consider increasing the reference level to 0dB or higher. This will minimize front-end overload effects.**

### Display Functions

F3	Display
F7	Resolution Bandwidth (Auto, Manual)
F8	Sweep Time (Auto, Manual)
F9	Video Average (On, Off)
F10	Peak Hold (On, Off)
F11	Video Bandwidth (1 KHz, 3 KHz, 10 KHz, 30 KHz, 100 KHz, 300 KHz, 1 MHz, 3 MHz)
F12	Return Loss (On, Off)

Pressing the F3 key accesses the Spectrum Analyzer display settings. The display menu controls the resolution bandwidth (RBW), sweep time, video smoothing, video average, peak hold display and hardware bandwidth filters. The parameter keys are updated as illustrated in Table 3.

F7 controls the function of the resolution bandwidth filter selection. When in automatic the analyzer chooses the optimum filter to match the selected frequency span. When in manual the user can select between the following filters: 3 KHz, 30 KHz, 300 KHz, and 3 MHz.

F8 controls the analyzers sweep time. Note that if the sweep is too fast on a narrow filter, the response will be inaccurate.

F9 controls the video averaging function of the analyzer. When averaging is enabled, up to 255 traces can be averaged. The top left of the spectrum analyzer screen will also display the trace count.

F10 turns the peak display feature on and off. This feature tracks and holds the peak on the analyzers display. The normal analyzer trace will continue to operate beneath the peak held trace, and will be depicted in a different color. Note that when used, the markers will operate on the peak held trace.

F11 controls the hardware video bandwidth setting of the spectrum analyzer. In normal operation, the hardware video bandwidth tracks the resolution bandwidth. The user can select from the following video bandwidth settings; 1 KHz, 3 KHz, 10 KHz, 30 KHz, 100 KHz, 300 KHz, 1 MHz, and 3 MHz

## Tracking Generator - Optional

<b>F4</b>	<b>Tracking Generator (Optional Feature)</b>
<b>F7</b>	Generator (On, Off)
<b>F8</b>	Output (Generate, RF I/O)
<b>F9</b>	Source Power
<b>F10</b>	Frequency (Tracking, Fixed)
<b>F11</b>	Resolution/Speed (High/Low, Medium/Medium, Low/High) – Frequency Tracking
<b>F11</b>	Generate Frequency – Frequency Fixed
<b>F12</b>	Modulation (On, Off) - Frequency Fixed

Pressing the F4 key accesses the optional Spectrum Analyzer tracking generator. This screen allows the tracking generator settings to be controlled. The parameter keys are updated as illustrated in Table 4.

F7 toggles the tracking generator function on/off. Once the tracking generator is on, keys F8, F9, F10, and F11 are enabled. Note that when the tracking generator is “ON”, the title of the screen will change to “TRACKING GENERATOR”.

F8 controls the connector the tracking generator RF output port. The two options are ‘Generator’ or ‘RF IN/OUT’.

F9 controls the tracking generator output power level. The selected output port determines the maximum power level setting.

F10 allows the RF generator to be fixed. When in normal ‘Tracking’ setting, the generator will be synchronized to the analyzer’s horizontal sweep. When ‘Fixed’, the RF generator can be set to any frequency across the entire range of the 2590 (see F11 below).

F11 is dependant on the selection of F10. When the RF frequency is ‘Fixed’, this key allows the generators frequency to be set. The frequency can be set anywhere within the range of the RF generator. When in normal tracking mode, F11 allows the user to configure the resolution and speed of the display. A fast sweep speed automatically requires a lower display resolution and visa versa. The resolution / speed selections are ‘High / Low’, ‘Medium / Medium’, or ‘Low / High’ respectively.

F12 is only available when the tracking generator mode is ‘Fixed’. This button allows the generators modulation to be turned on or off. The modulation mode and levels are selected under the generate mode.

## Markers

<b>F5</b>	<b>Markers</b>
<b>F7</b>	Marker 1 (On, Off)
<b>F8</b>	Marker 2 (On, Off)
<b>F9</b>	Find Peak
<b>F10</b>	Next Peak Left
<b>F11</b>	Next Peak Right
<b>F12</b>	Center Marker

Pressing the F5 button accesses the Spectrum Analyzer marker measurement control. The parameter keys are updated as illustrated in Table 5.

F7 controls Marker #1. When the marker is enabled it will depict frequency and amplitude information in a window on the display.

F8 controls Marker #2. When the marker is enabled it will depict frequency and amplitude information in a window on the display.

When both Markers are enabled, an additional window is opened showing the deltas between Marker #1 and Marker #2. Both frequency and amplitude differences are shown.

F9 locates the on-screen peak amplitude of the selected marker. The operation is as follows. Highlight the marker being used and simply press F9 to locate the amplitude. The marker does not have to be enabled before finding a peak. If the marker is off, the analyzer will automatically turn it on and locate the peak amplitude.

F10 takes the current marker location and determines the next peak to its left. Subsequent key presses will continue to move the marker to the next measured peaks.

F11 takes the current marker location and determines the next peak to its right. Subsequent key presses will continue to move the marker to the next measured peaks.

F12 takes the current selected marker and moves it to the center frequency of the analyzer. The information either both markers is not changed, simply the analyzers center frequency is tuned to match the selected marker.

**It is important to note that the marker's frequency is continually tracked, even if the marker goes off screen. Since no amplitude information is available however, it will be arbitrarily be set to 0.0 dBm.**

#### Measurement functions

F6	Measure
F7	Marker 1 Track Peak (On, Off)
F8	NdB Points (On, Off)
F9	NdB Center Marker (On, Off) - NdB Points(On)
F10	Occupied Bandwidth (On, Off)
F11	Occupied Bandwidth % Power - OBW On
F12	Occupied Bandwidth Channel spacing - OBW On

Pressing the F6 key accesses the Spectrum Analyzer measurement tools control. This screen allows specific measurement functions to be controlled. The parameter keys are updated as illustrated in Table 6.

F7 allows marker #1 to track the peak amplitude for on screen signals.

F8 allows the measurement of a signal's width. These additional markers can be set to 'N' dB. Typically the user would measure the -3dB, -20dB and -40dB points. Any values from 0 to -70dB can be entered.

F9 controls the 'N' dB center marker. Control of the 'N' dB level is accessed with button 'F8'. When the 'N' dB center marker is turned on, the calculated center between the 'N' dB points will be displayed. This is useful when the on screen signal is not perfectly gaussian in its response. If the high side of the response does not perfectly match the low side, then the 'N' dB markers are not centered with respect to the on screen signal. The 'N' dB center marker will define where the calculated center of the measured power is located.

F10 toggles the occupied bandwidth measurement function on or off. When the occupied bandwidth is turned on, parameter keys F11, F12 are enabled.

F11 sets the percentage (%) bandwidth to use for the occupied bandwidth calculations. This number typically set at 99% for full channel calculations. Refer to your bandwidth calculation requirements for the needed channel size requirement.

F12 sets the channel spacing size for the occupied bandwidth calculations. Note that the span of the spectrum analyzer is automatically adjusted for 3 times the channel spacing. This is required for an accurate measurement.

## Oscilloscope

Pressing the O-SCOPE mode key accesses the oscilloscope. The screen will immediately change to the oscilloscope display recalling the last settings that were used while in this mode. The Oscilloscope feature provides accurate digital voltage and frequency measurements up to 50 KHz (-3 dB point). 12-bit conversion resolution is used to accurately convert the analog input into the digital display. The user can apply 6 different filters to the incoming signals for more detailed signal analysis. Either an external input (scope probe) or receiver-demodulated audio can be viewed on the oscilloscope. Note that the “STOP” key can be used at any time to freeze the display – the word “STOPPED” will appear at the top left of the screen.

**Display Screen** Located on the left side of the screen, the vertical axis indicates the calibrated amplitude (volts) of the received base-band signal. The scale for the vertical axis is user selectable via the F2 function key.

The horizontal axis is the time axis of the oscilloscope display. The scale for this axis is user selectable via the F3 function key. The information located directly below this axis specifies the current scales for both the horizontal and vertical axis.

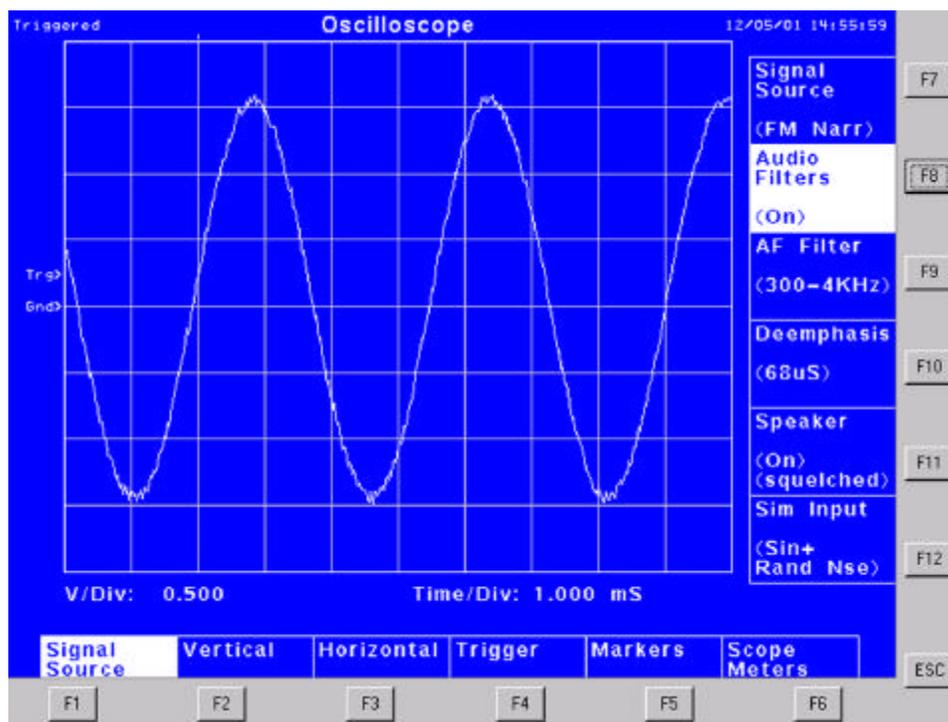


Figure 5 Oscilloscope Display Screen

## Signal Source Selections

F1	Signal Source
F7	Signal Source (Scope/Ext Mod In, Receiver Demod)
F8	Audio Filters (On, Off)
F9	AF Filter (300 Hz LP, 300 Hz HP, 4Khz LP, 4K HP, 20 KHz LP, 300-4Khz BP, 1 KHz Notch, OPTIONAL) – Audio Filters On
F10	De-emphasize (None, 680 $\mu$ S, 470 $\mu$ S, 68 $\mu$ S) – Audio Filters On
F11	Speaker (On, Off) – with squelch indication when On

The F7 key selects the input source for the oscilloscope. Toggling this connector selects between front panels BNC (SCOPE / Ext. Mod In) port or demodulated receiver audio. The default setting is to have access from the front panel BNC connector.

The F8 key allows filters to be applied to the incoming signal. The filters can be used on both probe and receiver modes. The filters can be adjusted via the F9 and F10 parameter keys, when F8 enabled.

The F9 key is only enabled when the audio filter parameter key is in the 'On' position. The available analog-processing filter selections are; 300 Hz Low-Pass, 300 Hz High-Pass, 4 KHz Low-Pass, 4 KHz High-Pass, 300 Hz to 4 KHz Band-Pass, 20 KHz Low-Pass, and 1 KHz Notch Filter.

The F10 key is only enabled when the audio filter parameter key is in the 'On' position. The selectable de-emphasis values are, 680  $\mu$ S, 470  $\mu$ S, 68  $\mu$ S, None.

## Vertical Settings

F2	Vertical
F7	Scale
F8	Position
F9	Coupling (AC, DC) – Signal Source Scope/Ext Mod In
F10	Level ( $\pm$ 5V, $\pm$ 100V – Signal Source Scope/Ext Mod In

The Oscilloscope vertical controls are selected and adjusted by pressing the F2 key. Control of the on-screen vertical scaling, offset position, coupling and input level controls are accessed via this key.

F7 controls the vertical per division scaling. The range of this adjustment is from 5 mV/division up to a maximum of 50 V/division.

F8 controls the vertical position. This setting can range from  $-9.97V$  to  $+9.97V$ .

F9 controls the coupling type. When in AC this input is coupled through a large, high voltage capacitor. When in DC mode, the input is referenced to ground. This key is only available when the signal source input is 'Scope/Ext Mod In'.

The F10 key controls the input level. The oscilloscope input can range between  $\pm 5V$  to  $\pm 100V$ . Due to the large voltage span, the expected input can be selected to obtain the highest resolution. To view low voltage inputs, select the  $\pm 5V$  input level for best results. This key is only available when the signal source input is 'Scope/Ext Mod In'. Note that the maximum input is  $\pm 100V$  and damage to the 2590 can occur if this rating is exceeded.

## Horizontal Settings

F3	Horizontal
F7	Scale
F8	Position

The Oscilloscope horizontal controls are enabled and adjusted by pressing the F3 key.

F7 controls the oscilloscope's horizontal scaling. The minimum is 5  $\mu$ S/division and the maximum is 100 mS/division.

F8 controls the position of the oscilloscope trigger. This adjustment ranges from 0% to 100%. Located on the top of the screen is a 'tick' mark that indicates where the trigger is located. With the trigger set to 50%, the tick is in the center of the screen, which allows the user to view information before the trigger occurs and after the trigger occurred. When the trigger mode is set to normal, then screen will freeze when the trigger occurs, thus allowing for a moment in time snap shot of the analog input. For reference, then position reference is as follows. When set to 0% the trigger is located on the far left of the screen. When set to 100%, the trigger is located on the far right of the screen.

### Trigger Settings

F4	Trigger
F7	Level
F8	Mode (Auto, Normal)
F9	Slope (Rising, Falling)
F10	High Freq Reject (On, Off)
F11	Low Freq Reject (On, Off)

The F4 function key controls the Oscilloscope trigger. There are several options that control the trigger functions including high/low noise rejection, level and auto/normal mode. F7 sets the voltage level that the trigger occurs. On AC coupled signals this point is usually set to 0 volts.

On DC coupled signals this point is generally in the middle of the total signal range.

F8 controls the trigger mode. Either Auto or Normal mode can be selected.

F9 controls the slope that activates the trigger. When 'Rising' slope is selected, the trigger will lock on the Low -> High edge of the signal. When the 'Falling' slope is selected, then trigger will lock on the High -> Low edge of the signal.

F10 controls the High Frequency Reject digital filter that is applied to the incoming signal. If an incoming signal has lots of high frequency noise that is impeding trigger lock, turning on the High rejection filter may help.

F11 controls the Low Frequency Reject digital filter that is applied to the incoming data. If an incoming signal has lots of low frequency noise (e.g. 60 Hz interference) that is impeding trigger lock, turning on the Low rejection filter will help.

**Normally only one of the filters is used at a time. But if the signal is located within the two filters (Band-pass) then both of the filters can be used. The filters do not affect the incoming analog signal, only how the trigger lock occurs. For analog input filters, refer to the Signal Source (F1) menu.**

### Marker Functions

F5	Markers
F7	Left (On, Off)
F8	Right (On, Off)
F9	Top (On, Off)
F10	Bottom (On, Off)
F11	Peak to Peak
F12	Frequency

The F5 function key controls the Oscilloscope marker feature. The markers are provided to allow measurement of the incoming analog data. There are 2 markers per axis. When both markers per axis are enabled the oscilloscope will calculate the Delta of the two markers. Horizontal markers will measure amplitude differences in Volts. Vertical markers will measure time differences in  $\mu$ S.

F7 controls and indicates the level of the Left marker. By toggling on the left marker, both left and right will be enabled. The oscilloscope will open 3 windows on the right side of the screen indicating each marker's information.

F8 controls and indicates the level of the Right marker. By toggling on the right marker, both left and right will be enabled. The oscilloscope will open 3 windows on the right side of the screen indicating each marker's information.

F9 controls and indicates the level of the Top marker. By toggling on the top marker, both top and bottom will be enabled. The oscilloscope will open 3 windows on the right side of the scope display indicating individual marker data.

F10 controls and indicates the level of the Bottom marker. By toggling on the bottom marker, both top and bottom will be enabled. The oscilloscope will open 3 windows on the right side of the scope display indicating individual marker data.

F11 is an automatic measurement key to enable a peak-peak measurement. The markers will follow the input signal. This indicates as the analog input changes, the markers will move to give a real time accurate reading. This mode utilizes the top and bottom markers.

F12 is an automatic measurement key to enable frequency measurement. The frequency is calculated utilizing the left and right markers. The top and bottom markers are used to indicate changes in amplitude while measuring the analog signals frequency.

#### Digital Meters / Frequency Counter

<b>F6</b>	<b>Scope Meters</b>
<b>F7</b>	RMS
<b>F8</b>	DC
<b>F9</b>	AC Pk-to-Pk
<b>F10</b>	Period
<b>F11</b>	Frequency

This mode is an Oscilloscope quick calculate function and is accessed by pressing the F6 function key. F7 measurement is the signal's RMS value

F8 measurement is the signal's DC component

F9 measurement is the signal's AC peak-peak component

F10 measurement is the signal's period

F11 measurement is the signal's frequency

## Receiver

Pressing the REC mode key accesses the RF receiver. The screen will immediately change to the receive display recalling the last settings that were used while in this mode.

The receiver's frequency, frequency error, deviation, relative signal level in dBm and uV/mV, any received DTMF and the decoded CTCSS and DCS information. The DTMF window is a 'Ticker

Tape' display that will show 16 received DTMF digits. The screen also indicates what mode the receiver is in (AM, Narrow FM, Wide FM).

As the user changes between the different receiver modes, the audio characteristics will also change. Audio filters for the speaker, demod out and deviation meter are also provided.

**Display Screen** The Receiver screen is divided into 4 individual display zones. The top left portion displays both the RF frequency setting and the frequency error meter. The set RF frequency is added to the measured frequency error and the actual frequency is also displayed. The top right zone displays deviation meter of the R2590. The bottom left zone is the RF input power to the receiver, specified in both dBm and micro volts. The bottom right quadrant shows decoded data if present on the received signal. Decoded data includes DTMF, and CTCSS / DCS sub audible signaling.

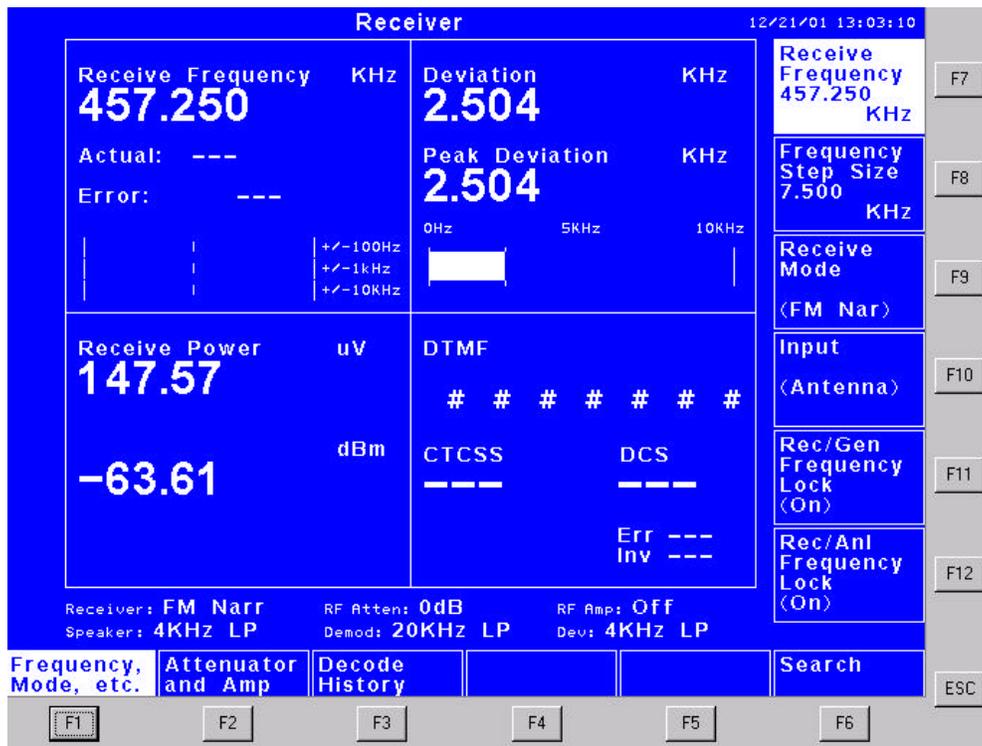


Figure 6 Receive Display Screen

Setting frequency, modulation, and RF inputs

F1	Frequency, Mode, etc
F7	Receive Frequency
F8	Frequency Step Size
F9	Receive Mode (AM, FM Wide, FM Narrow)
F10	Input (RF I/O, Antenna)
F11	Rec/Gen Frequency Lock (On, Off)
F12	Rec/Anl Frequency Lock (On, Off)

The F7 key adjusts the receive frequency of the R2590. The minimum frequency is 250 KHz and the maximum frequency is 1000 MHz. Frequency can be entered from 1 Hz to 1 MHz steps. The user can enter from the numeric keypad, cycle up/down using the arrow keys or rotate up/down using the wheel interface.

F8 selects the frequency step size used with the wheel and up/down arrow keys. This allows quick and easy channel changes using the entered step size. Narrow FM defaults to 5 KHz, Wide FM defaults to

200 KHz and AM defaults to 1 KHz. F9 selects the receiver demodulation mode. The receiver supports AM, Narrowband FM and Wideband FM receiver modes.

F10 controls the input port for the receiver. The two possible inputs are the front panel Antenna port or the RF IN/OUT high power port.

The F11 key will force the generator's frequency to the same frequency as the receiver. This is useful when you need to switch modes and it is known that the frequencies match. When OFF is selected, both the generator and receiver will maintain their independent frequency settings.

The F12 key will force the spectrum analyzer's center frequency to the same frequency as the receiver. This is useful when you need to switch modes and it is known that the frequencies match. When OFF is selected, the spectrum analyzer's center frequency will remain independent.

#### Input attenuator and amplifier

<b>F2</b>	<b>Attenuator and Amp</b>
<b>F7</b>	Attenuator
<b>F8</b>	Amplifier (On, Off)

The F2 function controls the receiver's input attenuator and input amplifier. The amplifier and attenuator are provided to give the user some flexibility in tailoring the quality of the received RF signal. When at a high RF concentration location, it may be needed to incorporate the attenuator to keep the receiver from being overloaded. When pulling a weak signal from the noise the amplifier can be used.

F7 controls the input attenuator. This attenuator is a 30dB attenuator controlled in 2dB steps from 0dB to 30dB. This attenuator is located at the antenna input thus it lowers the actual RF entering the super heterodyne receiver. This allows the user to lower outside effects on the receiver.

F8 controls the +20dB receiver IF amplifier. The amplifier is located at the mixed down 10.7 MHz. point. This allows the amplification of the IF signal without increasing front-end overload.

In some cases it is possible to use both the attenuator and the amplifier to receive the best signal. In the case of receiving a weak signal that is located near a high RF location. The high RF can cause the receiver front end to be overloaded thus limiting the ability for the receiver to convert the weak signal into a form that can be received. In this case the attenuator can be used to protect the front end and the amplifier can be used to boost the weak signal in order to be received.

#### Decoded tone history

<b>F3</b>	<b>Decode History</b>
<b>F7</b>	Clear History

Selecting the F3 key, will access the history of decoded PL, DPL, and DTMF information. Press the F7 key to clear the contents of this screen.

#### RF Signal Search

<b>F6</b>	<b>Search</b>
<b>F7</b>	Jump to Analyzer Frequency
<b>F8</b>	Find Max Signal
<b>F9</b>	Go to Analyzer at RX Frequency

The F6 function key provides easy access to specific frequencies. The user can jump to the currently tuned in analyzer center frequency, find the maximum amplitude signal using the analyzers search mode or jump the analyzer to the receivers frequency.

F7 will tune the receiver's frequency to the current center frequency of the spectrum analyzer. The receiver will automatically round this frequency to the nearest step size.

F8 is used to find the maximum signal within the tuning range of the spectrum analyzer. When the user presses this button the analyzer mode is launched. The analyzer then goes full span, peaking the maximum signal, centering the signal, minimizing the span until the peak signal is accurately located. The receiver is then tuned to the analyzer's center frequency.

F9 provides one-button access to the spectrum analyzer, with the center frequency set to the receiver's frequency.

## Generate

This mode controls the Generate RF power, frequency, tones, DTMF, paging, and sub-audible tone information and is accessed by pressing the GEN mode key. The screen will immediately change to the generator display recalling the last settings that were used while in this mode.

**Display Screen** The Generate screen is divided into 4 specific display zones, with the bottom right quadrant currently blank. The top left portion displays both the RF frequency being generated and the selected output connector. The top right zone displays the settings of the internal modulation sources of the R2590. The bottom left zone is the RF output power of the generator, specified in both dBm and microvolts.



Figure 7 Generate Display

### Power and Frequency

F1	Power and Frequency
F7	Generate Frequency
F8	Modulation Type (AM, FM/PM)
F9	Output Power
F10	Output (RF I/O, Generate)
F11	Rec/Gen Freq Lock (ON, OFF)
F12	SINAD

The F7 key allows the generator frequency to be adjusted. When using the keypad, the resolution can be entered from 1 Hz ..1 MHz. The arrow keys along with the optical wheel changes the frequency in the step size amount.

F8 selects the type of generator modulation (AM or FM/PM). The differentiation between frequency modulation (FM) and phase modulation (PM) is made when setting the modulation level (see F2 Audio tones) below

F9 controls the output generator power. The power ranges from -10dBm to -130dBm depending on the connector used. Higher power levels are available from the “Generate” connector. Lower power levels are available from the “RF IN/OUT” connector. The power can be adjusted in 0.1 dBm steps.

F10 controls which connector the RF generator is available from. Both the front panel GENERATE connector or the high power RF In/Out connector are selectable. The selected connector provides the calibrated power output even though the RF energy can be found on the opposing connector.

The F11 key will force the receiver’s frequency to the same frequency as the generator. This is useful when you need to switch modes and it is known that the frequencies match. When OFF is selected, both the generator and receiver will maintain their independent frequency settings.

The F12 key will provide a SINAD measurement of the signal present at the “SCOPE Ext/Mod In” port. Note that the signal level must be greater than 0.5V (peak-to-peak) for an accurate measurement.

#### Audio Modulation Synthesizer

<b>F2</b>	<b>Audio Tones</b>
<b>F7</b>	1 KHz Tone (ON, OFF)
<b>F9</b>	Modulation - 1 KHz Tone ON
<b>F2</b>	<b>Audio Tones (Optional)</b>
<b>F7</b>	Tone A (ON, OFF)
<b>F8</b>	Audio Frequency - Tone A ON
<b>F9</b>	Modulation - Tone A ON
<b>F10</b>	Tone B (ON, OFF)
<b>F11</b>	Audio Frequency - Tone B ON
<b>F12</b>	Modulation - Tone B ON

This function accesses the internal audio modulation source(s). The standard R2590 includes a 1 KHz fixed tone generator. The optional “Enhanced Modulation Sources” (part number RLN5377A) replaces the single 1 KHz tone with dual independent tone generators (designated as tone A and tone B).

F7 turns the 1 KHz tone on or off.

F9 key is available once the 1 KHz audio tone is enabled. To select the type of modulation (FM or PM), begin a direct numeric entry from the keypad. This action will update the F7 through F10 parameter keys with specific unit selections. Select the F10, “Radians PM Deviation” key to select phase modulation. Keys F7, F8, or F9 will select frequency modulation. The top right quadrant of the generate screen will reflect the selected modulation type (frequency or radians).

F7/F10 (Optional) turns Tone A/Tone B on or off. Keys F8/F11 and F9/F12 are made available when Tone A and/or Tone B are on.

F8/F11 (Optional) is only available when the Tone A is active (ON). The user can enter the tone frequency ranging between 200 Hz to 20.0 KHz in 1 Hz steps.

F9/F12 (Optional) keys are only available when Tone A/Tone B generator(s) are enabled. To select the type of modulation (FM or PM), begin a direct numeric entry from the keypad. This action will update the F7 through F10 parameter keys with specific unit selections. Select the F10, “Radians PM Deviation” key to select phase modulation. Keys F7, F8, or F9 will select frequency modulation. The top right quadrant of the generate screen will reflect the selected modulation type (frequency or radians).

## DTMF Generator

F3	DTMF Tones
F7	Send DTMF A
F8	Send DTMF B
F9	Send DTMF C
F10	Send DTMF D
F11	Send DTMF *
F12	Send DTMF #

This function allows the user to Generate DTMF tone information and is accessed by pressing the F3 function key. Parameter keys or the numeric keypad are then used to enter the special DTMF digits and the numeric keypad is used exclusively to enter numerical (0 – 10) digits.

The F7 key and the BKSP key will generate the DTMF digit 'A'.

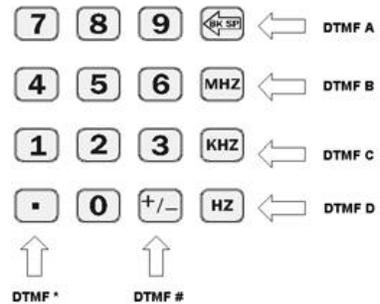
The F8 key and the MHZ key will generate the DTMF digit 'B'.

The F9 key and the KHZ key will generate the DTMF digit 'C'.

The F10 key and the HZ key will generate the DTMF digit 'D'.

The F11 key and the '.' key will generate the DTMF digit '\*'.

The F12 key and the '+/-' key will generate the DTMF digit '#'.



**DTMF Batch Mode** The R2590 can be readily programmed to send a string of up to 20 DTMF digits. With the F3 mode selected, press the STOP key. This will open an input window to permit direct entry of the desired digits. Press the STOP key again to sequentially send the DTMF tones. See SETUP for more information on configuring the DTMF parameters.

**DTMF Setup** You can adjust specific parameters of the DTMF signaling tones by pressing SETUP when F3 is active. The parameter keys will change to reflect the following settings:

F7 – Amplitude, Used to adjust the deviation of the generated tones

F8 – Duration, Specifies the 'on' time of each generated digit. The duration is adjustable from 0 to 5 seconds in 1-millisecond increments.

F9 – Pause, Specifies the pause between digits when sent in batch mode. The pause is adjustable from 0 to 5 seconds in 1-millisecond increments.

F10 – Twist, Twist is an indication of the difference between tone 1 and tone 2 of the DTMF decoder. Default twist is 2dB.

## Paging Encoder - Optional

<b>F4</b>		<b>Paging Tones</b>	
<b>F7</b>	Setup 2-Tone Page	F7	Cap Code
		F8	Type
		F9	Send Page
		F10	Tone Freq Error
		F11	Amplitude
<b>F8</b>	Setup 5/6 Tone Page	F7	Cap Code
		F8	Type
		F9	Send Page
		F10	Tone Freq Error
		F11	Amplitude
<b>F9</b>	Setup Custom Page	F7	Cap Code
		F8	Type
		F9	Send Page
		F10	Tone Freq Error
		F11	Amplitude
<b>F10</b>	Setup POCSAG Page	F7	Cap Code
		F8	Type
		F9	Send Page
		F10	Tone Freq Error
		F11	Amplitude
<b>F12</b>	Send Page		

This mode controls the paging encoder control and is accessed by pressing the F4 key. Please refer to the SETUP section for the parameter criteria for each individual paging format.

F7 selects the analog 2-tone paging sequence. Paging setup variables is accomplished by hitting the 'F12' key (See Setup).

F8 selects the analog 5/6 tone paging sequence. Paging set-up variables is accomplished by hitting the 'F12' key (See Setup).

F9 selects a custom analog-paging format. (See Setup).

F10 selects the POCSAG digital paging format. (See Setup).

## External Modulation

<b>F5</b>		<b>External Modulation</b>	
<b>F7</b>	External Modulation (ON, OFF)		
<b>F8</b>	Coupling (AC, DC)- external modulation ON		
<b>F9</b>	Gain for Modulation- external modulation		
<b>F10</b>	Gain for Tone Out- external modulation ON		
<b>F11</b>	Gain for Speaker- external modulation ON		

The F5 function allows the user to generate external modulation from the signal present at the Oscilloscope connector. There are two function keys used for this operation. One allows you to set the desired output deviation, and the second indicates changes needed to the external modulation source for a calibrated reading.

F7 turns the external modulation ON or OFF.

F8 specifies the coupling at the oscilloscope input. This parameter is only available with External Modulation ON.

F9 specifies the gain of the external signal, prior to being routed to the FM modulator. A gain of 100 produces 5 KHz of modulation with a 1 V input signal. This parameter is only available with External Modulation ON.

F10 specifies the gain of the external signal, prior to being routed to the tone out port. This parameter is only available with External Modulation ON.

F10 specifies the gain of the external signal, prior to being routed to the speaker. This parameter is only available with External Modulation ON.

F12 is available when DC coupling is selected and adjust the amount of DC bias added to the external signal.

## Sub-Audible Tone Generator

<b>F6</b>	<b>Sub audible Tones</b>
<b>F7</b>	Mode (OFF, CTCSS, DCS)
<b>F8</b>	CTCSS or DCS - dependant on mode selection
<b>F10</b>	Deviation
<b>F11</b>	Invert DCS - DCS mode selected

F7 is used to select the sub-audible encoding format. F8 selects the CTCSS frequency, when the CTCSS format is selected. As the frequency is changed, the 'Nrst' (nearest) code will indicate the closest match to an accepted CTCSS

code. This is for reference only; the actual frequency is directly below the CTCSS label.

F8 selects the DCS code, when the DCS format is selected. Only valid DCS codes can be entered.

F10 controls the deviation setting. The deviation can be AM/FM/PM. Refer to the Generator-Audio Tones for adjustment procedure.

F11 controls the DCS invert control. This simply inverts the DCS code and is only available when the DCS format is selected.

## Duplex

This mode controls the Duplex receiver thus allowing full-duplex operation and is accessed by pressing the DUPLEX mode key. The screen will immediately change to the duplex display while maintaining the last settings made in the generate and receive screens.

**Display Screen** The left two quadrants of the duplex display screen are used for the receiver functions. The top left quadrant is fixed and displays the receive frequency setting and the measured frequency error. The bottom left quadrant is user selectable via the F6 Setup function key to display either input power (Power), DTMF and CTCSS / DCS decode (Decode), or transmitter deviation (Deviation).

The right two quadrants of the duplex display screen are used for the generator functions. The top right quadrant is fixed and displays the generator frequency setting and the output connector selected. The bottom right quadrant is user selectable via the F6 Setup function key to display either output level settings (Power), or audio modulation settings (Modulation Sources).

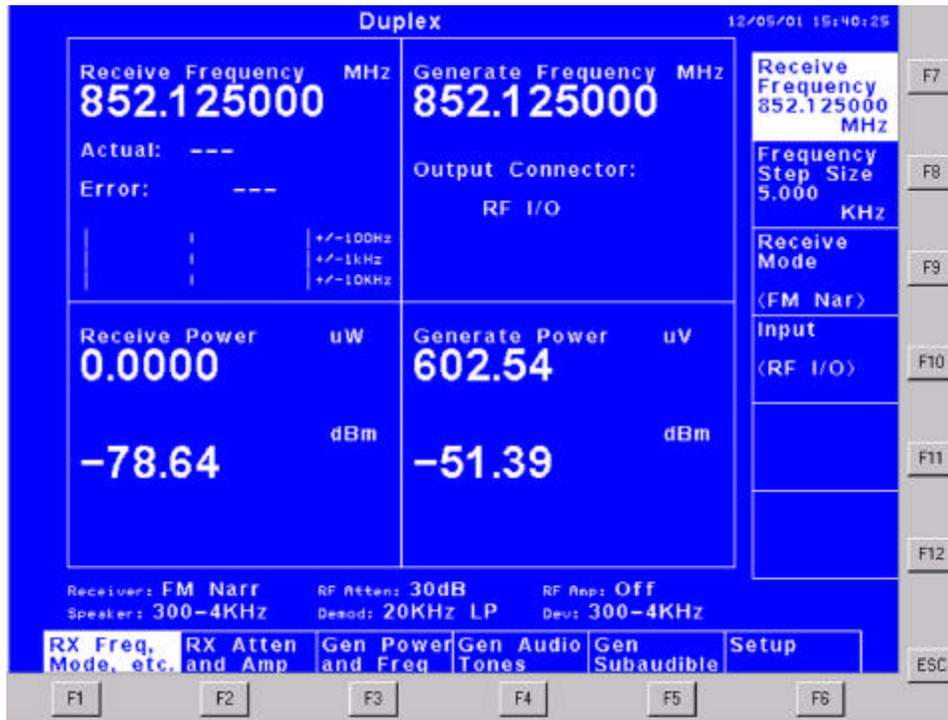


Figure 8 Duplex Display Screen

Setting receive frequency, modulation type, and RF inputs

F1	RX Freq, Mode, etc
F7	Receive Frequency
F8	Frequency Step Size
F9	Receive Mode (AM, FM Wide, FM Narrow)
F10	Input (RF I/O, Antenna)

The F7 function key controls the receiver's frequency. The frequency range is from 250 KHz to 1000 MHz.

F8 programs the frequency step size. This setting determines the

increments made to the receive frequency when adjusted via the up/down arrow keys or the spin knob. Useful when scanning multiple RF channels.

F9 controls the receiver mode. The mode can be AM, Narrow FM or Wide FM.

F10 selects the receiver input connector. The Antenna input is typically used for receiving signals over-the-air, whereas the RF I/O port is used when RF power is being applied.

#### Receiver attenuator and amplifier

<b>F2</b>	<b>Attenuator and Amp</b>
<b>F7</b>	Attenuator
<b>F8</b>	Amplifier (On, Off)

F7 sets the receivers attenuator control. This can be adjusted from 0dB to -30dB in 2dB steps.

F8 controls the +20dB IF amplifier.

#### Setting generator frequency, modulation type, and RF outputs

<b>F3</b>	<b>Gen Power and Freq</b>
<b>F7</b>	Generate Frequency
<b>F8</b>	Modulation Type (AM, FM/PM)
<b>F9</b>	Output Power
<b>F10</b>	Output (RF I/O, Generate)
<b>F11</b>	Generate Offset

The F7 key allows the generator frequency to be adjusted. When using the keypad, the resolution can be entered from 1 Hz.1 MHz. The arrow keys along with the optical wheel changes the frequency in the step size amount.

F8 selects the type of generator modulation (AM or FM/PM). The differentiation between frequency modulation (FM) and phase modulation (PM) is made is made when setting the modulation level (see F2 Audio tones) below

F9 controls the output generator power. The power ranges from -10dBm to -130dBm depending on the connector used. Higher power levels are available from the “Generate” connector. Lower power levels are available from the “RF IN/OUT” connector. The power can be adjusted in 0.1 dBm steps.

F10 controls which connector the RF generator is available from. Either the front panel GEN connector or the high power RF In/Out connector is selectable. The selected connector provides the calibrated power output even though the RF energy can be found on the opposing connector.

F11 Selects the generate frequency offset. The calculated generator frequency is the receiver frequency plus the offset amount. The offset can be either positive or negative.

#### Audio Modulation Synthesizer

<b>F2</b>	<b>Gen Audio Tones</b>
<b>F7</b>	1 KHz Tone (ON, OFF)
<b>F9</b>	Modulation - 1 KHz Tone ON
<b>F2</b>	<b>Audio Tones (Optional)</b>
<b>F7</b>	Tone A (ON, OFF)
<b>F8</b>	Audio Frequency - Tone A ON
<b>F9</b>	Modulation - Tone A ON
<b>F10</b>	Tone B (ON, OFF)
<b>F11</b>	Audio Frequency - Tone B ON
<b>F12</b>	Modulation - Tone B ON

This mode accesses the internal audio modulation source(s). The standard R2590 includes a 1 KHz fixed tone generator. The optional “Enhanced Modulation Sources” (part number RLN5377A) replaces the single 1 KHz tone with dual independent tone generators (designated as tone A and tone B).

F7 turns the 1 KHz tone on or off.

F9 key is available once the 1 KHz audio tone is enabled. To select the type of modulation (FM or PM), begin a direct numeric entry from the keypad. This action will update the F7 through F10 parameter keys with specific unit selections. Select the F10, "Radians PM Deviation" key to select phase modulation. Keys F7, F8, or F9 will select frequency modulation. The top right quadrant of the generate screen will reflect the selected modulation type (frequency or radians).

F7/F10 (Optional) turns Tone A/Tone B on or off. Keys F8/F11 and F9/F12 are made available when Tone A and/or Tone B are on.

F8/F11 (Optional) is only available when the Tone A is active (ON). The user can enter the tone frequency ranging between 200 Hz to 20.0 KHz in 1 Hz steps.

F9/F12 (Optional) keys are only available when Tone A/Tone B generator(s) are enabled. To select the type of modulation (FM or PM), begin a direct numeric entry from the keypad. This action will update the F7 through F10 parameter keys with specific unit selections. Select the F10, "Radians PM Deviation" key to select phase modulation. Keys F7, F8, or F9 will select frequency modulation. The top right quadrant of the generate screen will reflect the selected modulation type (frequency or radians).

#### Sub-Audible Tone Generator

F5	Gen Sub audible
F7	Mode (Off, CTCSS, DCS)
F8	CTCSS or DCS – dependant on mode selection
F10	Deviation
F11	Invert DCS – DCS mode selected

This button is used to select the encoding type. For this graphic CTCSS was chosen. DCS will be described in the below graphic. This button is used to select the encoding type. For this graphic DCS was chosen. This button selects the CTCSS frequency. As the frequency is changed, the Nrst code will indicate the closest match to an accepted CTCSS code. This is for reference only, the actual frequency is directly below the CTCSS label.

This button selects the DCS code. Only valid DCS codes can be used.

F10 controls the deviation setting. The deviation can be AM/FM/PM. Refer to the Generator-Audio Tones for adjustment procedure.

F11 controls the DCS invert control. This simply inverts the DCS code enter with F8 key.

#### Duplex display setup

F6	Setup
F7	Speaker (Receiver Audio, Generator Audio)
F8	RX Display (Power, Deviation, Decode)
F9	TX Display (Power, Modulation Sources)

The Setup mode key is used to modify the data that is displayed on the screen, according to the users preference. It can also be used to select the audio source that is

present at the R2590's speaker.

F7 is used to select the audio source to the internal speaker. Receiver audio is the demodulated audio from the R2590's receiver, and Generator audio is the output of the internal modulation sources. The F8 key specifies the screen layout for the receiver portion of the display (bottom left screen quadrant).

The F9 key determines the screen layout for the transmitter portion of the display (bottom right screen quadrant).

## Memory

The Memory function is used to store and retrieve channel information from non-volatile memory. This function can be accessed at any time by pressing the MEMORY key. There are 100 individual locations that store receiver and generator frequencies and CTCSS or DCS information. Each location can be assigned a unique 6-digit label for quick and easy recall. Note that the ESC key may be used to exit the memory function and return the R2590 to its previous mode.

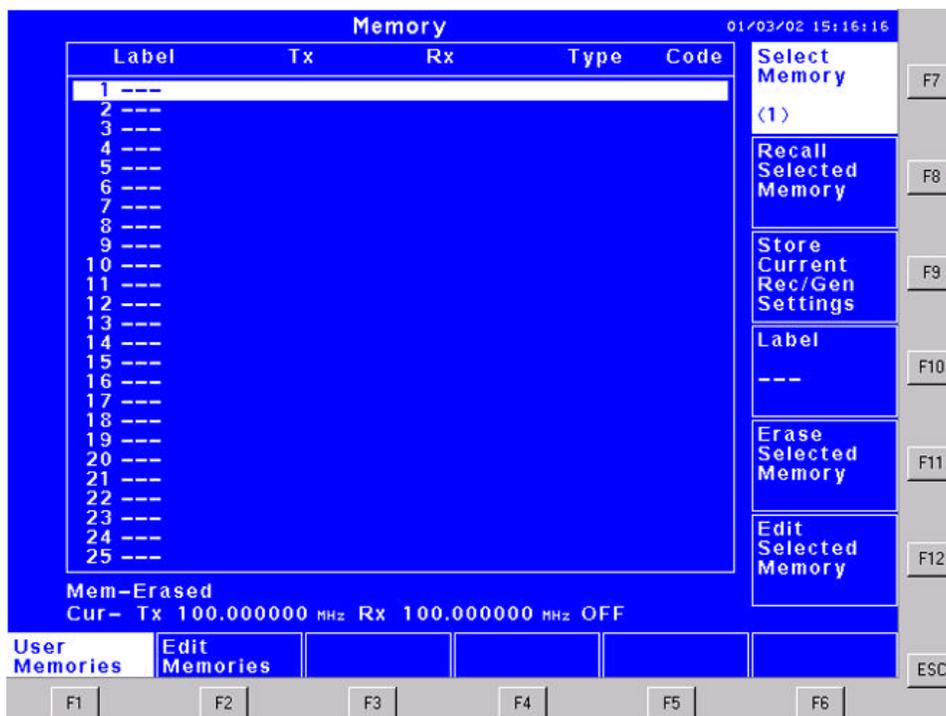


Figure 9 Memory Screen

**Display Screen** Each memory location consists of one line of information that includes the transmit frequency, the receive frequency, the type of sub-audible tone information (CTCSS/DCS) and the applicable code. Each memory location is assigned a number from 1 to 100, with 25 of them being displayed at a time. The bottom of the display screen will show the selected (highlighted) memory location information, in addition to the current settings of the analyzer.

Recall / Store user memories

F1	User Memories
F7	Select Memory (1 - 100)
F8	Recall Selected Memory
F9	Store Current Rec/Gen Settings
F10	Label (-----)
F11	Erase selected Memory

The F1 function key is used to save and retrieve individual channel settings.

F7 selects one out of the 100 memory storage locations. Memory locations may be directly entered, but the spin knob is very useful for quickly scrolling through all 100 locations.

The F8 parameter key is used to retrieve the channel information stored in the memory location displayed in F7. Once selected, the R2590 will return to its previous mode with the updated parameters. Note that the 'Rec/Gen Frequency lock' setting ( F11 of RECEIVE mode), may be forced OFF depending on the frequencies retrieved.

#### Edit memory settings

<b>F1</b>	<b>Edit Memories</b>
<b>F7</b>	Select Memory (1 – 100)
<b>F8</b>	Label (-----)
<b>F9</b>	TX Freq
<b>F10</b>	RX Freq
<b>F11</b>	Type (OFF, CTCSS, DCS)
<b>F12</b>	CTCSS or DCS – dependent on mode selection

The F2 function key is used to modify existing memory entries. Each memory location consists of a alphanumeric label used for identification, individual transmit and receive frequencies, and sub audible tone information.

F7 selects one out of the 100 memory locations. Memory locations may be directly entered, but the spin knob is very useful for quickly scrolling through all 100 locations RF channels. For easy editing, the F7 through F8 parameter keys will continually reflect the information stored in the selected memory location.

F8 contains the current label for the selected memory location. Activating the F8 key will open a window used to enter the information. With this window open, the F1 through F5 function keys will offer groups of alphanumeric characters that will appear in the F7 through F12 parameter keys when selected. To finish a label and store it, select F6 followed by F12.

F9 contains the current transmit frequency for the selected memory location. Changes will automatically be saved.

F10 contains the current receive frequency for the selected memory location. Changes will automatically be saved

F11 contains the current sub audible type selection for the selected memory location. Available settings include OFF, DCS, or CTCSS. When DCS or CTCSS is selected, the applicable code will appear in parameter key F12.

F12 contains the current code for the CTS or CTCSS selection made in F11. Changes will automatically be saved.

## Setup

The SETUP mode is used to configure the R2590 to the users preference and can be accessed by pressing the SETUP key at any time. The SETUP mode is context sensitive, and will initially display those features applicable to the current mode. Pressing the SETUP key a second time will display the screen example shown in figure 10.

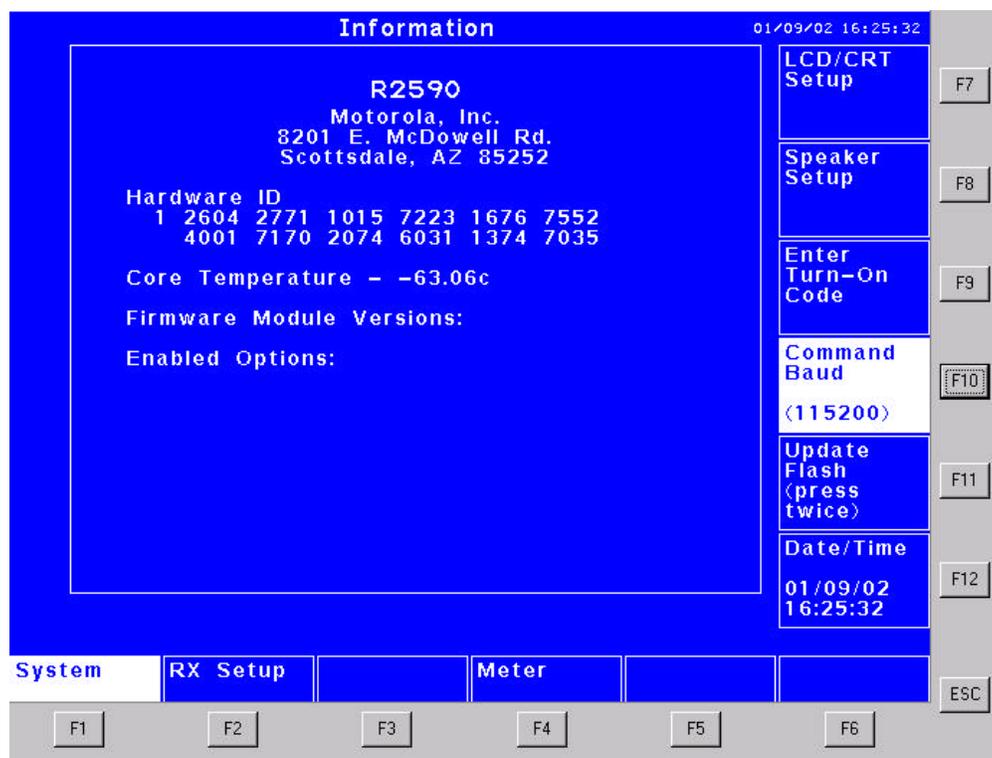


Figure 10 SETUP Screen

**Display Screen** Basic system information is contained in the main display window of the SETUP screen. The 'Hardware ID' is an important identifier as it is used to identify the particular unit to the factory in the event that an upgrade is desired (see Turn-on Code). The 'Firmware Module Version' identifies the individual software loads in the R2590, and is useful when upgrading (see Update Flash). The 'Enabled Options' specify the optional configuration of the unit.

## System Settings

<b>F1</b>	<b>System</b>
<b>F7</b>	LCD/CRT Setup
	<b>F1</b> LCD/CRT
	<b>F7</b> Display Mode
	<b>F8</b> Graticule (%)
	<b>F9</b> Alt Trace (%)
	<b>F2</b> Mike Modulation
	<b>F7</b> Mike Mod (PM/Pre-emphasis, FM Flat)
	<b>F8</b> Gain for FM Mod
	<b>F9</b> Gain for Tone Out
	<b>F10</b> Gain for Speaker
	<b>F11</b> Deviation Hard Limit
<b>F8</b>	Speaker Setup
	<b>F1</b> Speaker
	<b>F7</b> Kbd Volume
	<b>F8</b> Kbd Beep Length
<b>F9</b>	Enter Turn-On Code
<b>F10</b>	Command Baud
<b>F11</b>	Update Flash (Press Twice)
<b>F12</b>	Time/Date
	<b>F1</b> Time Date
	<b>F7</b> Month
	<b>F8</b> Day
	<b>F9</b> Year
	<b>F10</b> Hour
	<b>F11</b> Minute
	<b>F12</b> Second

## Receiver Default Settings

<b>F2</b>	<b>RX Setup</b>
<b>F7</b>	Receive Mode (AM, FM wide, FM Narrow)
<b>F9</b>	Audio Filter (300 Hz LP, 300 Hz HP, 4Khz LP, 4K HP, 20 KHz LP, 300-4Khz BP, 1 KHz Notch, OPTIONAL)
<b>F10</b>	De-emphasis (None, 680 $\mu$ S, 470 $\mu$ S, 68 $\mu$ S)

The receive setup function will configure the default settings of the individual receive mode of the R2590. Specific

## Internal Metering

F4	Meter	
<b>F1</b>	Receiver	
	F11	Squelch
<b>F2</b>	F12	RSSI
	Analyzer	
<b>F3</b>	F7	Log Det
	O-Scope	
<b>F4</b>	F7	RMS
	F8	DC
	F9	AC P-to-P
	F10	Period
	F11	Frequency
<b>F5</b>	Misc Meters 0	
	F7	PS +3.3 V
	F8	PS +5 V
	F9	PS -5 V
	F10	PS +15 V
	F11	PS -15 V
<b>F6</b>	Misc Meters 1	
	F7	PS +3.3 V
	F8	PS +5 V
	F9	PS -5 V
	F10	PS +15 V
	F11	PS -15 V
<b>F7</b>	Misc Meters 2	
	F7	PS +8 V
	F8	PS +8 V
	F9	PS BAT
	F12	PS BAT

This button selects what receiver mode the set-up is being applied to. The user can select between AM, Narrow FM, and Wide FM.

This button selects what RF filter to choose from. The filters available for the receiver is:

- 3 KHz
  - Generally used in AM mode
  
- 30 KHz
  - Generally used in Narrow FM Mode
  
- 300 KHz
  - Generally used in Wide FM Mode
  
- 3 MHz
  - Alternately used in Wide FM Mode

This button selects the audio filter to be use with the speaker. The type of filter used will directly effect the sound of the speakers audio. The available filter values are listed below.

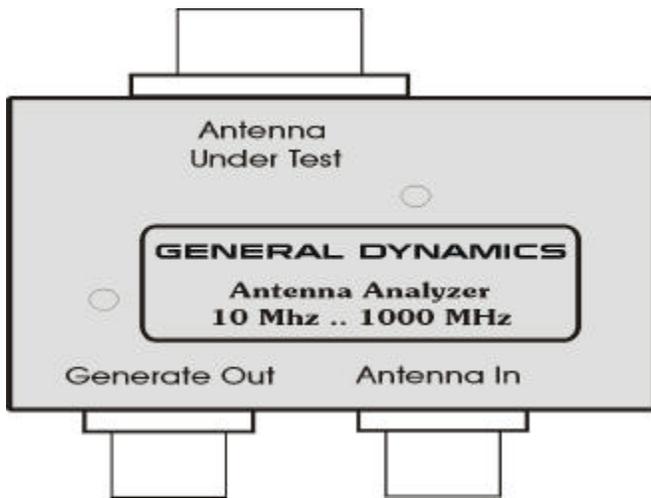
### Available Audio Filters:

- 300 Hz Low Pass
- 300 Hz High Pass
- 4 KHz Low Pass
- 4 KHz High Pass
- 20 KHz Low Pass
- 300Hz ..4K Bandpass

### 1 KHz Notch filter

This button selects the setting of the audio de-emphasis filter. The receiver supports four different audio de-emphasis filters. The available filters are: 680uS, 470uS and 68uS.

## Antenna Analyzer (Optional Feature)



### Overview

The antenna analyzer is a return loss bridge specially designed to interface with the R2590. It allows you to visually determine the frequencies at which an antenna is tuned. In combination with the marker features of the R2590, it also allows you to calculate the SWR at any frequency.

The antenna analyzer works with the tracking generator feature of the R2590. Energy from the tracking generator is sent to the antenna, where it would ideally all be radiated. A special part called a directional coupler inside the antenna analyzer allows it to separate any energy that comes back from the antenna so that it can be displayed on the analyzer screen. Less reflected power indicates a better impedance match (higher return loss, lower SWR).

### Operation

The antenna analyzer is designed to connect directly to the antenna and generate connectors of the R2590 without cables. A single Type-N connector is provided on the antenna analyzer to attach to your antenna.

After making the connections, put the R2590 into spectrum analyzer mode, set the center frequency to the antenna's operating frequency and set the span to 100MHz (you may want to reduce the span later). Turn the tracking generator on and set the source power to -40dBm.

The R2590 will display a graph that shows the amount of power being reflected by the antenna at each frequency. If there is a notch, you may want to adjust the antenna to align that notch with the antenna's operating frequency (lengthen the antenna to lower the notch and vice-versa).

If the notch is deep, you may want to increase the tracking generator power. This can also help minimize the effect of any other power being received by the antenna under test.

Of course you can also adjust the span, vertical position and other analyzer settings to make the graph easier to see.

### Measuring SWR

The R2590 can use the return loss graph to calculate SWR (standing wave ratio). Return loss and SWR are equivalent ways of measuring the same thing, like feet and meters are for distance.

To get an accurate SWR (or return loss) reading, the R2590 needs to calibrate the antenna analyzer. Make sure the analyzer center frequency is set to the antenna's operating frequency, then press the "Setup" button. The label next to the "F12" button should say, "Auto Ret Loss Cal". Disconnect the antenna (leaving the antenna analyzer connected to the R2590), then press the "F12" button twice. The number displayed there will probably change and should be in the range of 15 to 25dB. Connect the antenna again

Next press "F3" and "F12" to turn on a marker and display the SWR at the marker frequency. You can move the marker to another frequency, but note that you may need to repeat the calibration just described to get accurate readings at other frequencies.

# LTR Operation (Optional Feature)



Figure 11 LTR Operation Screen



Figure 12 LTR Generate Message Screen



Figure 13 LTR Generate Setup Screen

## Applications

### Basic FM Transmitter Testing

Setup

Power, Frequency error, Deviation Measurements

Modulation Measurements

### Basic FM Receiver Testing

Setup

SINAD Measurement

Modulation Acceptance Bandwidth

20 dB Quieting

Squelch Sensitivity test

### Spectrum Analysis

Setup

### Sweeping Cavities and Duplexors

Setup