

Contents

SECTION 1 - GENERAL INFORMATION	1-1
1.1 INTRODUCTION	1-1
1.2 SPECIFICATIONS	1-1
1.2.1 Generate Mode	1-1
1.2.2 Receive Mode	1-1
1.2.3 Subtone Counter	1-2
1.2.4 Mod Measurements	1-2
1.2.5 Frequency Counter Modes	1-2
1.2.6 Power Meter	1-2
1.2.7 Internal Mod Sources	1-2
1.2.8 Signal Strength (Rec. Level)	1-2
1.2.9 SINAD	1-3
1.2.10 RF Step Size	1-3
1.2.11 Memory	1-3
1.2.12 Voltmeter	1-3
1.2.13 Time Base	1-3
1.2.14 General	1-3
1.2.15 Options	1-3
1.2.16 Standard Accessories	1-4
SECTION 2 - INSTALLATION	2-1
2.1 INTRODUCTION	2-1
2.2 UNPACKING AND INSPECTION	2-1
2.3 WARRANTY INFORMATION	2-1
2.4 POWER REQUIREMENTS	2-1
2.5 ENVIROMENTAL CONSIDERATIONS	2-1
SECTION 3 - OPERATION	3-1
3.1 INTRODUCTION	3-1
3.2 FRONT-PANEL DESCRIPTION	3-1
3.3 APPLICATION NOTES	3-6
3.3.1 Receiver Measurements	3-6
3.3.1a Receiver Audio Distortion Measurement	3-6
3.3.1b Sensitivity-12 dB SINAD	3-7
3.3.1c Modulation Acceptance Bandwidth	3-9
3.3.1d Receiver IF Bandwidth and Symmetry	3-10
3.3.1e Receiver Sensitivity with CTCSS Decoder and Decoder Bandwidth Test	3-11
3.3.1f CTCSS Decoder Sensivity Test	3-13

3.3.2 Transmitter Measurements	3-14
3.3.2a Off the Air Monitoring	3-14
3.3.2b Relative Signal Strength Measurements	3-16
3.3.2c Measuring Transmitter Power and Frequency Error	3-16
3.3.2d Tuning Sub-Audible Transmitter Tones	3-18
3.3.3 Miscellaneous Keyboard Programming.....	3-19
3.3.3a RF Step Size Programming	3-19
3.3.3b Memory and Recall Operation.....	3-19

SECTION 1 GENERAL INFORMATION

1.1 INTRODUCTION

The WAVETEK Model 2100 is a bench-quality and field-portable, microprocessor-controlled Service Monitor. Designed to perform a variety of tests on FM transceivers, the small size and straightforward, front-panel operation make it ideal for production and bench testing. A battery option makes it especially convenient to use in the field.

The Model 2100 will generate and receive from 400 kHz to 999.9999 MHz in 100 Hz steps, but with a usable range from 100 kHz. The RF output level is continuously variable from 0.1 mVRMS to 10 mVRMS in five ranges.

L.E.D. annunciators and two front-panel LCD displays indicate the instrument settings and measurement results.

The Model 2100 contains a 1 kHz modulation source, a 10 Hz to 10 kHz audio synthesizer and an external modulation input. The audio synthesizer output has a second independently variable output on the front-panel. Deviation markers at ± 5 kHz or ± 600 Hz may be superimposed on the demodulated output for viewing on an external oscilloscope.

The Model 2100 measures and displays SINAD in dB or % distortion, volts, FM deviation, signal strength, carrier frequency, demodulated audio frequency, error frequency and sub-tone.

When an RF load is attached to the antenna connector, power may be applied to the RF IN/OUT connector to measure watts. An internal load is available as an option. Twenty memory registers are available for storing and recalling all front-panel keyboard settings. An optional RS-232 interface allows for its use in automated test systems.

1.2 SPECIFICATIONS

1.2.1 Generate Mode

Freq Range*	400 kHz to 999.9999 MHz *Usable range from 100 kHz
Resolution	100 Hz steps
RF Output	0.1 mV to 10 mV in 5 ranges
Accuracy	± 2 dB
Special Purity	<-35 dBc within ± 300 kHz (within all land mobile bands)
FM Deviation	0 to 10 kHz peak
Accuracy	$\pm 5\%$ of FS(Full Scale)
Ext. Modulation	All EIA tones, 10 Hz to 10 kHz
Int. Modulation	10 Hz to 10 kHz
Output Impedance	50 ohms
Reverse Power Protection	Auto switch to external load at inputs greater than 200 mW, on the RF IN/OUT connector, or switch to internal load option if installed.

1.2.2 Receive Mode

Freq Range	400 kHz to 999.9999 MHz
Resolution	100 Hz

Sensitivity	2mV @ 10 dB SINAD, typical
Bandwidth	10 kHz
Image Rejection	-50 dB
RF Step Range	100 Hz

1.2.3 Subtone Counter

Freq Range	60 Hz to 270 Hz
Resolution	0.2 Hz

1.2.4 Modulation Measurements

FM Deviation	0 to ± 10 kHz
Accuracy	$\pm 5\%$ of FS @ 1 kHz from 0 to 7 kHz $\pm 10\%$ of FS @ 1 kHz from 7 kHz to 10 kHz
FM Deviation Markers	± 600 Hz, ± 5 kHz (optional markers available). Accuracy of markers $\pm 5\%$ @ 5 kHz deviation.

1.2.5 Frequency Counter Modes

RF Frequency	30 MHz to 999.9999 MHz
Resolution	1 kHz
Freq Error	10 Hz to 10 kHz @ >10 mV rec. signal
Resolution	10 Hz
Audio Frequency	10 Hz to 20 kHz
Resolution	1 Hz

1.2.6 Power Meter

Range	0 to 100 watts, auto ranging 10 and 100 watts FS
Accuracy	$\pm 10\%$ FS to 600 MHz, $\pm 20\%$ FS 600 MHz to 999.9999 MHz
Display	LCD

NOTE: No internal load standard. External 50 or 100 watt load must be connected at antenna connector. Use coax cables of minimum length. Power applied for 10 sec after 2 minute cool down time.

1.2.7 Internal Modulation Sources

Freq Range	10 Hz to 10 kHz
Resolution	0.1 Hz, 10 Hz to 1999.9 Hz 1.0 Hz, 2 kHz to 10 kHz
Output	0 to 1.0 VRMS
Fixed Frequency	1 kHz
Accuracy	Time Base ± 1 count

1.2.8 Signal Strength (Rec. Level)

Range	40 dB (-50 dBm to -90 dBm)
Accuracy	± 3 dB
Display	LCD

1.2.9 SINAD

Notch	@ 1 kHz
Range	0 to 30 dB
Resolution	1 dB steps
Accuracy	± 1 dB at 12 dB ($\pm 3\%$ @ 25%)
Impedance	10 k ohms
Measurements Units	% Distortion or dB SINAD

1.2.10 RF Step Size

100 Hz to 999.999 MHz steps

1.2.11 Memory

Stores all keyboard settings in each register for system storage.

Memory Size: 20 registers

1.2.12 Voltmeter

Range	± 20 VDC, 20 VAC peak, up to 50 kHz
Input Impedance	100 k ohms
Accuracy	$\pm 5\%$

1.2.13 Time Base

Aging Rate	± 1 ppm/year
Temp (0° to 50° C)	± 0.5 ppm

1.2.14 General

Operating Temp Range	0 to 50°C
Power Requirements	
AC	100/110/220/240 VAC $\pm 10\%$, 50 - 400 cycles
DC	10.5 to 15.2 VDC
Internal Rechargeable Battery	> 12 volt lead acid with > 1 hr run time
Dimensions	26.1 cm (10-3/8 in.) wide (including handle) 16.5 cm (6-1/2 in.) high (including feet) 43.2 cm (17 in.) deep (including rear feet)
Weight w/battery	<15 lbs.

1.2.15 Options

Service Manual

Model 300 Encoder/Decoder with trunking, MTS, IMTS, analog and digital paging, DCS and DTMF formats.

80 Additional Storage Registers

RS-232 Interface Bus

Rechargeable Lead Acid Battery

Protective Soft Cover

Accessories Kit

1.2.16 Standard Accessories

Operation Manual

Antenna

AC Power Cord

Front Dust Cover

SECTION 2 INSTALLATION

2.1 INTRODUCTION

The WAVETEK Model 2100 is a rugged piece of precision test equipment designed for portability and bench use. It is well suited for field use.

2.2 UNPACKING AND INSPECTION

When unpacking the instrument, inspect the shipping container and instrument for shipping damage. If the container is damaged, phone Wavetek immediately. Save the shipping carton and packing materials for possible future use.

FOR CUSTOMER SERVICE call: WAVETEK: (800) 851-1198

2.3 WARRANTY INFORMATION

The Model 2100 is covered by a one year parts and labor warranty.

2.4 POWER REQUIREMENTS

The instrument operation is selectable for 100/120/220/240 VAC, 50/60 Hz primary power sources. The three conductor power cord provides a ground connection when it is connected to the proper outlet.

The instrument can also be operated from 10.5 VDC to 15.2 VDC.

The external DC source should be connected to the "EXT +12 V IN" jack on the rear panel. The plug (not supplied with the unit) should be a 1/8" phone plug (Switchcraft #740 or equivalent) with the positive voltage on the tip of the plug and the negative voltage on the shield.

2.5 ENVIRONMENTAL CONSIDERATIONS

The instrument comes equipped with bottom and rear panel feet. The rear panel feet also serve as cord wraps. It is also equipped with a carrying handle and a stand for the instrument. These features, as well as its small size and light weight, permit easy access in confined working spaces.

The instrument is designed to operate between 0°C and 50°C, and should be used in areas where air flow around the instrument is not restricted. Do not permit the ventilation ports to be blocked or restricted.

NOTE: Exceeding the upper or lower temperature limits for extended period, may not result in damage to the instrument but will cause degraded performance.

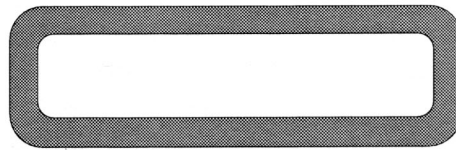
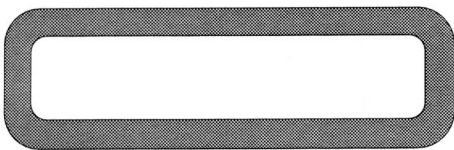
SECTION 3 OPERATION

3.1 INTRODUCTION

This section contains operating instructions for the Model 2100 Communications Service Monitor. Included are descriptions of the front and rear panels (refer to Figure 3-1 on page 3-5), and notes on use of features.

3.2 FRONT-PANEL DESCRIPTION

LED annunciators light to indicate active functions or units. An audible error tone sounds if the user makes an invalid entry. The following descriptions are provided in order to identify the instrument's functions and the corresponding keys.



- MHz
- KHz
- Hz

LEFT and RIGHT LCD displays indicate pertinent instrument settings and measurements. LEDs on right announce proper units during frequency display.

- | |
|----------|
| 1
KHZ |
|----------|

 Activates the 1 kHz modulation source in generate mode.

- | |
|----------------|
| AUDIO
SYNTH |
|----------------|

 Activates audio synthesizer at most recently set frequency and displays frequency on the right LCD in Hz.

- | |
|-----|
| EXT |
|-----|

 Turns on "Modulation in" port. Sounds error tone in receive mode.

- | |
|--------|
| +600Hz |
| +5KHz |

 ●

DEV MARK

 Activates markers at either ± 600 Hz, ± 5 kHz deviation or shuts markers off. Markers are superimposed on DEMOD output for display on external oscilloscope.

- | |
|-------|
| SINAD |
|-------|

 Measures SINAD and displays reading on the left LCD. The SINAD button toggles between dB and % distortion expressions each time it is pressed. Sounds an error tone in receive mode

VOLTS

Activates either DC or AC volts. Measures voltage at SINAD AUDIO IN connector. Displays mode and reading on the left LCD.

WATTS

Measures RF power applied at RF IN/OUT port into a user supplied 50 ohm load connected at the ANTENNA port and displays reading on the left LCD. Sounds an error tone in generate mode.

DEV

Measures FM deviation of the generated or received RF carrier and displays the reading on the left LCD in Hz.

1

2

3

4

5

6

7

8

9

.

0

DATA KEYS: Inputs data when preceded by AUDIO SYNTH, GEN, REC, STORE, RECALL, RF STEP or SHIFT key. Sounds an error tone when not preceded by one of the above keys.

ENTER

Terminates numerical data.

RF
STEP

Displays RF step size on the right LCD. Serves as a prefix for changing RF step size when followed by the data and ENTER key.

↑

When preceded by the RF STEP key, the frequency is stepped up or down (respectively) by the preset step size and the new RF frequency is displayed on the right LCD.

↓

When preceded by the RECALL key, the next front-panel stored setting up or down is implemented and the stored setting address is displayed on the right LCD for a 1/2 second. The display then changes to show the stored setting.

SHIFT

Addresses the following second functions:

Shift 1 - toggles SINAD between dB and % distortion units.

- Shift 6 - identifies software version.
- Shift 9 - verifies lock status of oscillators.
- Shift . - loads storage RAM with present data.
- Shift REC - alternates the receiver LO frequency between high side and low side injection for frequencies above 16 MHz. The SHIFT function may be necessary for some readings if a LO spur interferes with the desired frequency.
- Shift 8 - enables RS-232 mode (not supplied with unit), will disable all front panel controls.
- Shift 0 - displays unit serial # on right LCD.

STORE

Prefix for storing front-panel keyboard settings in memory (must be followed by address code 1 through 20 and then the ENTER key). Displays information on the right LCD.

RE-
CALL

Prefix for recalling front-panel keyboard settings from memory (must be followed by address code 0 through 20 and then the ENTER key). Address 0 contains a non-alterable setting programmed at the factory.

SUB-
TONE

Counts subtone in receive mode and displays on the right LCD.

REC
LEVEL

Measures signal strength in receive mode and displays on the left LCD. The REC LEVEL button toggles between mV and dBm each time it is pressed. Sounds an error tone in generate.

GEN

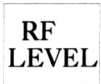
- These two keys select the generate or receive mode. Only one mode is activated at a time. Each key responds by addressing the frequency mode and displaying the RF frequency on the right LCD. When the generate mode is selected, the LED is illuminated. In the receive mode the associated LED illuminates only when the
- squelch is broken by a received signal.

REC

COUNT

- RF
- ERROR
- AF

In the receive mode this selects the counter for RF, ERROR, AF or OFF. In generate the counter monitors the SINAD/AUDIO IN connector and the AF and OFF modes are selectable. The counter also works in the WATTS mode when sufficient power is keyed into the RF IN/OUT port. **The count mode must be de-activated when reprogramming the RF frequency.**



- X 1mV
- X .1mV
- X 10 μ V
- X 1 μ V
- X .1 μ V

Selects one of five level ranges for RF generator. Sounds error tone in receive mode.

LOW BATT



Lights to indicate low battery voltage.

REAR PANEL SWITCH

CHG OPER

Determines function of the front-panel power switch.



Operate - allows front panel-power switch to activate the entire instrument.

Charge - only allows the battery charging circuit to be activated when the front-panel switch is on.

SCOPE TRIG

\pm 15 volt signal for triggering external scope horizontal



NOTE: When the front panel switch is off, no circuitry in the Model 2100, other than the fuse, is active. This means that the battery charging circuit is off.

MICROPROCESSOR RESET



If data entry is not possible because of a system lock-up, the Model 2100 can be returned to factory default condition by performing the following steps:



- (1) Turn unit off
- (2) Wait 5 seconds
- (3) Depress both the Up and Down keys simultaneously and turn the unit on.

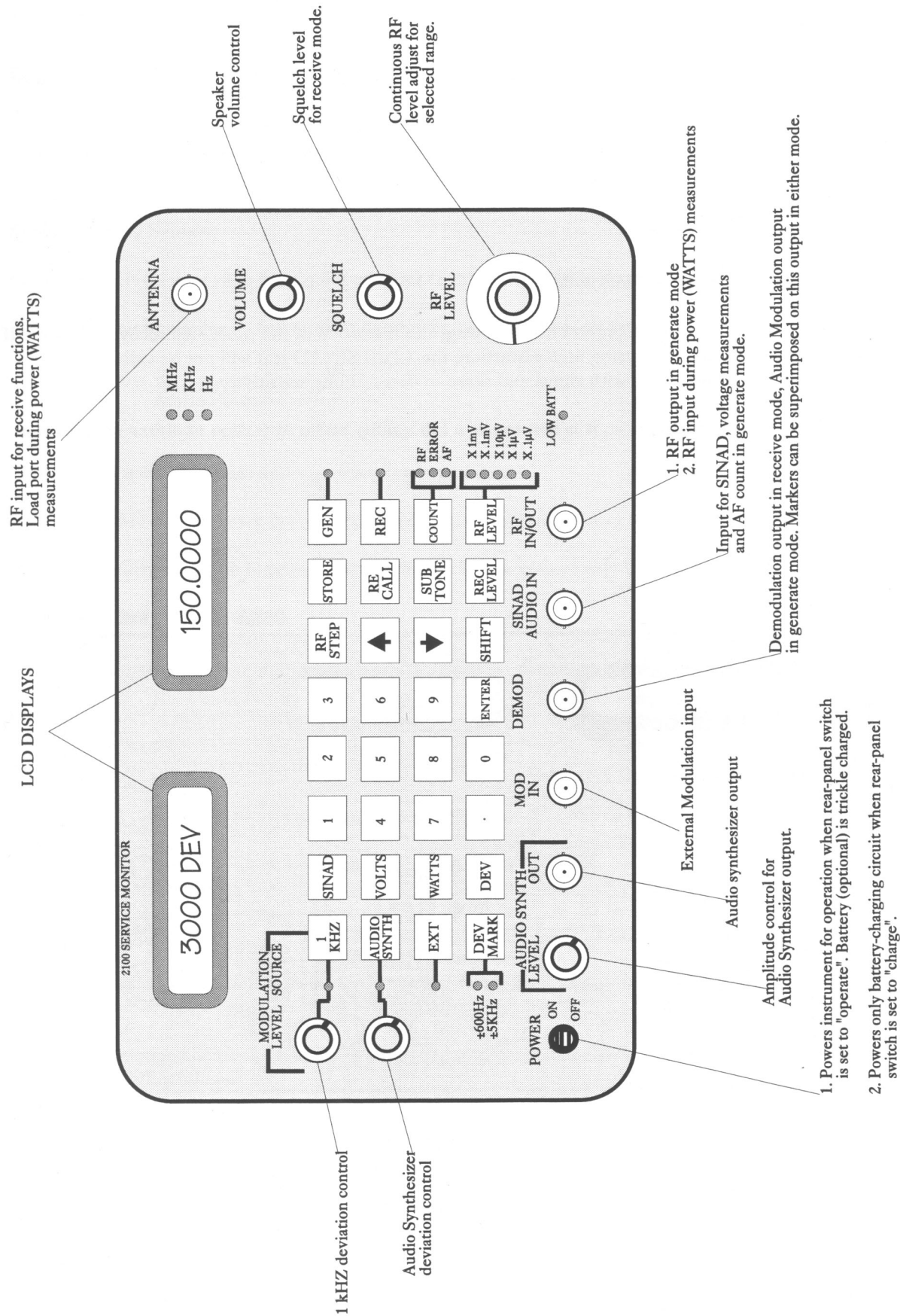


FIGURE 3-1. MODEL 2100 FRONT-PANEL CONTROLS AND PORTS

3.3 APPLICATION NOTES

This section outlines how to use the Model 2100 in some commonly required applications. A brief overview of each test is followed by a description of the steps to take and their related controls.

WARNING: Do not connect RF Power to the Audio Synthesizer, Mod In, Demod, and SINAD/Audio In connectors. Doing so can damage the unit.

3.3.1 Receiver Measurements

3.3.1a Receiver Audio Distortion Measurement

An important factor in proper receiver alignment is knowing the distortion of the processed recovered audio. If problems exist in the audio circuits causing high distortion, the 12 dB SINAD test will not be valid since SINAD combines the distortion factor with signal and noise in determining sensitivity.

NOTE: For % distortion lower than 1%, it is best to use a lab quality audio distortion analyzer with greater resolution.

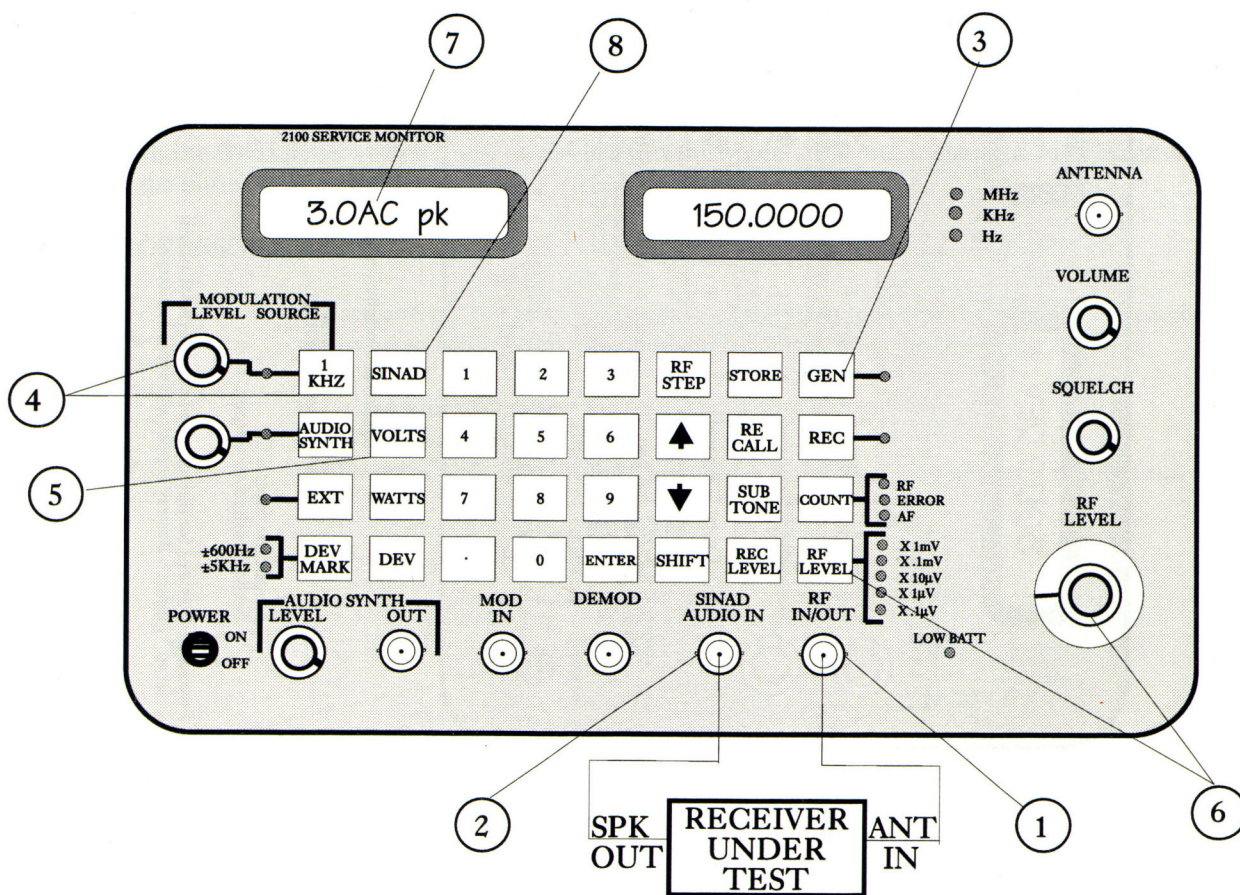


FIGURE 3-2 RECEIVER AUDIO DISTORTION MEASUREMENT

- 1) Cable the antenna port of the receiver under test to the RF IN/OUT port of the Model 2100.
- 2) Cable Audio output or speaker terminals of receiver to SINAD AUDIO IN.
- 3) Select GEN mode.
- 4) Select 1 kHz and adjust 1 kHz level control for 60% of max deviation, i.e. 3 kHz if max allowable is 5 kHz.
- 5) Select VOLTS mode.
- 6) Adjust RF level control to fully quiet receiver (1 mV).
- 7) Adjust receiver volume to full rated audio power, using Volt-Meter feature, and the formula:

$$\text{Audio Power} = \frac{V^2}{2r_{\text{spk}}}$$

where V = speaker voltage and r_{spk} = speaker impedance

- 8) Press SINAD once or twice (as required) to obtain a direct readout of distortion in %.

NOTE: The SINAD button toggles between dB and % expressions each time it is pressed.

3.3.1b Sensitivity - 12 dB SINAD

Sensitivity measurements should reflect signal + noise and distortion if they are to be truly meaningful.

SINAD is a unit of measure that is designed to take these factors into account. An accepted definition of sensitivity is "the amount of RF required to measure 12 dB SINAD from a receiver whose bandpass is challenged" with 60% of the systems maximum deviation.

The RF level for this measurement is typically expressed in mV. SINAD is defined as the voltage ratio:

$$\frac{\text{Signal} + \text{Noise} + \text{Distortion}}{\text{Noise} + \text{Distortion}}$$

and is expressed in dB.

The Model 2100 quickly performs SINAD measurements and displays the results to the nearest dB. This allows the user to rapidly tune receivers for optimum performance.

Causes of distortion such as high noise or audio clipping may be analyzed by connecting an oscilloscope to the Model 2100's DEMOD output.

Refer to Figure 3-3 for the Sensitivity - 12 dB SINAD test procedure.

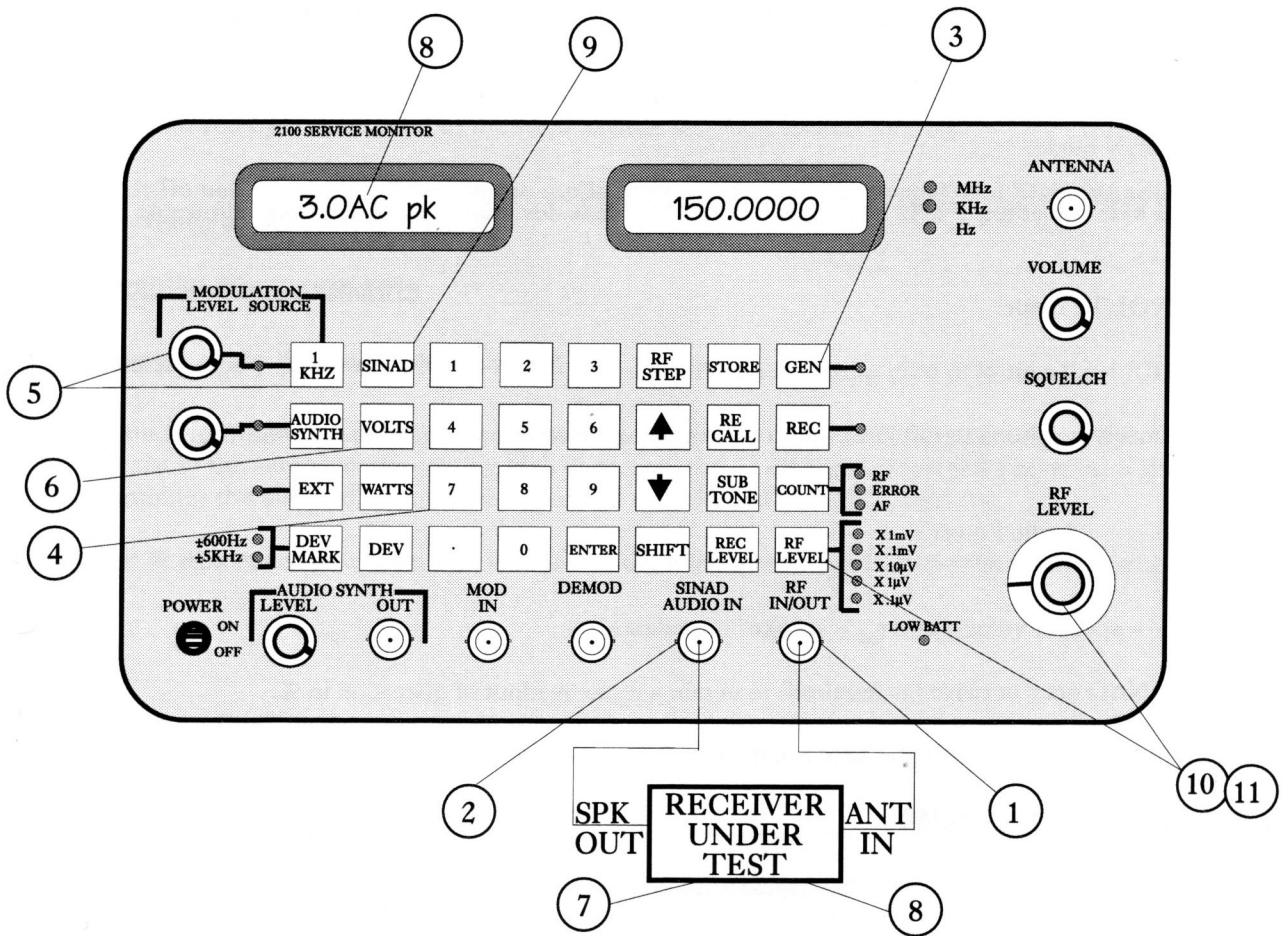


FIGURE 3-3 SENSITIVITY - 12 dB SINAD

- 1) Connect the RF input (antenna port) of the receiver under test to the RF IN/OUT jack on the Model 2100.
- 2) Connect the SINAD AUDIO IN jack of the Model 2100 across the speaker of the receiver. If the external speaker jack is used and it disconnects the internal speaker, a load having the same impedance must be substituted.
- 3) Select the GEN mode.
- 4) Program the receiver frequency in MHz using the numerical keys followed by the ENTER key.
- 5) Select the 1 kHz modulation function and adjust it for 60% of the receivers maximum deviation using the 1 kHz level control. For example, if the maximum deviation of the receiver is specified as 5 kHz then the test deviation would be:

$$5 \text{ kHz} \times .6 = 3000 \text{ Hz}$$

- 6) Select the AC pk VOLTS mode.
- 7) Open the squelch control on the receiver.

8) Adjust the receiver volume to achieve full rated audio power, as specified by the radio manufacturer. Use the internal voltmeter to determine audio power using the formula:

$$\text{Audio Power} = \frac{V^2}{2r_{\text{spk}}} = \frac{V^2(\text{RMS})}{r_{\text{spk}}} \quad (\text{for a sinewave})$$

where V = speaker voltage and r_{spk} = speaker impedance

9) Select the SINAD function for a reading in dB.

10) Adjust the RF level range and vernier for a SINAD reading of 12 dB.

11) The sensitivity of the receiver may now be expressed as the mV setting on the RF level dial.

3.3.1c Modulation Acceptance Bandwidth

In FM voice modulated receivers, the maximum deviation accepted for a certain reduction in SINAD sensitivity is called Modulation Acceptance Bandwidth.

Since poor Modulation Acceptance Bandwidth results in degraded sensitivity with modulation, this test becomes important to fully optimize receiver performance. This operating characteristic is also essential in maintaining a communications system, if the Modulation Acceptance Bandwidth is poor, and exceeded, it will result in degraded receiver sensitivity.

Refer to Figure 3-4 for the Modulation Acceptance Bandwidth test procedure.

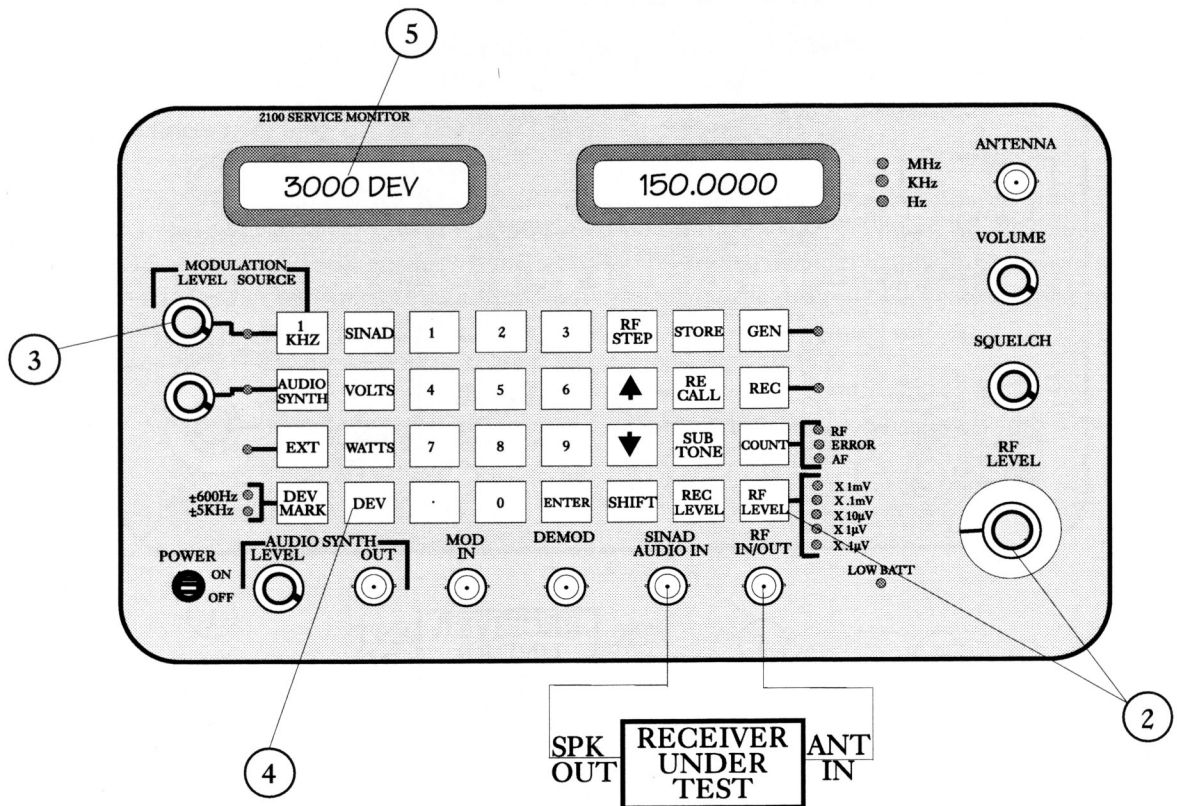


FIGURE 3-4 MODULATION ACCEPTANCE BANDWIDTH

- 1) Perform the 12 dB SINAD test described in the previous section.
- 2) Increase the RF level 6 dB over the 12 dB SINAD sensitivity point (a 6 dB increase is two times the mV setting on the RF output dial).
- 3) Increase the 1 kHz level setting until 12 dB SINAD is read again.
- 4) Activate the DEV mode.
- 5) Multiply the increase in deviation by two to obtain the Modulation Acceptance Bandwidth as shown below:

$$[\text{New deviation} - \text{Previous deviation}] \times 2 = \text{Modulation Acceptance Bandwidth}$$

3.3.1d Receiver IF Bandwidth and Symmetry

This test will determine the IF filter bandwidth and the symmetry (whether or not the high and low cutoff points are correct). A too narrow a bandwidth will cause distortion, and a too wide a bandwidth will cause noise, this test is a good troubleshooting aid in finding causes of high noise and distortion. If the bandwidth of the IF filter is correct, but the offset, (i.e. high cutoff too low or low cutoff too low) the result will be distorted recovered audio in the form of positive peak clipping.

Refer to Figure 3-5 for the Receiver IF Bandwidth and Symmetry test procedure.

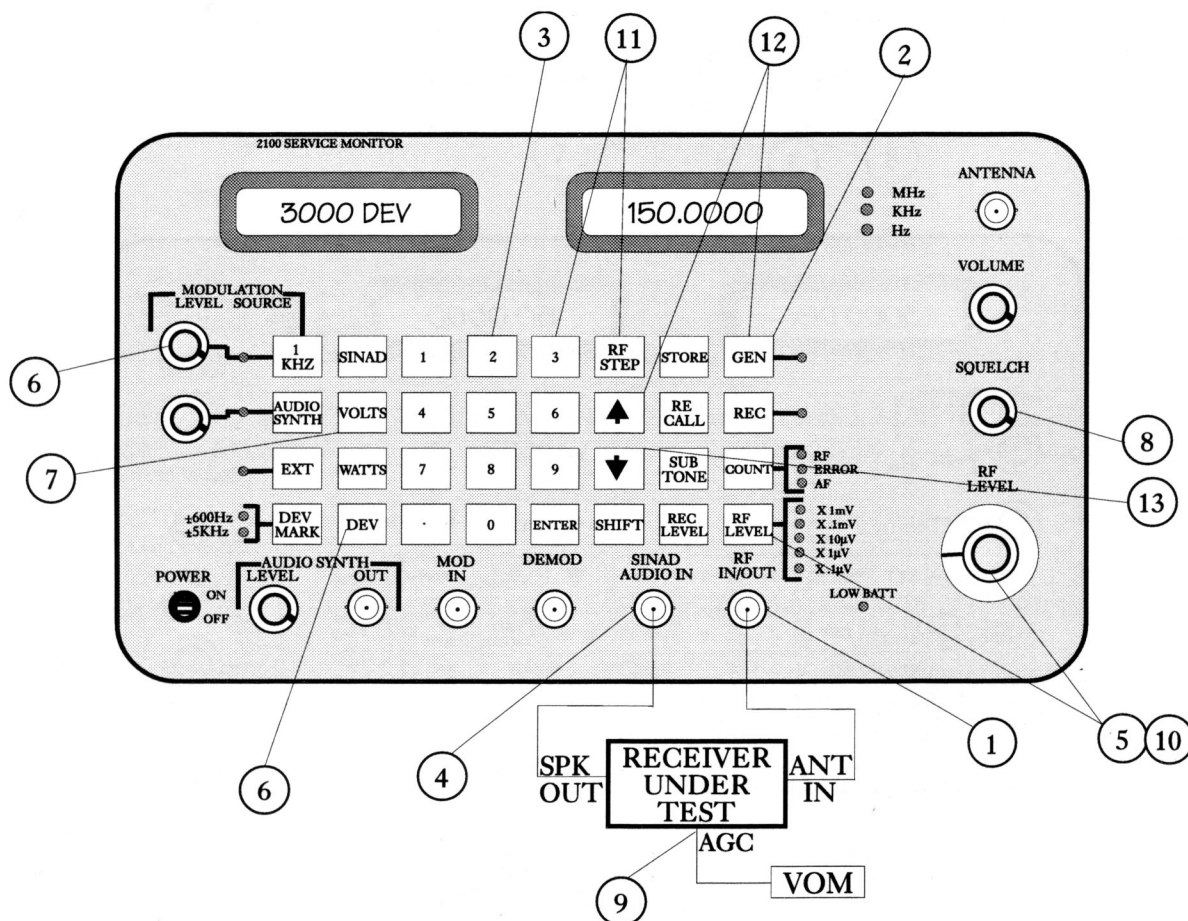


FIGURE 3-5 RECEIVER IF BANDWIDTH AND SYMMETRY

- 1) Connect the RF IN/OUT jack to the RF input (antenna jack) of the receiver under test.
- 2) Select GEN mode.
- 3) Program the receiver frequency in MHz using the numerical keys followed by the ENTER key.
- 4) Connect receiver audio to SINAD AUDIO IN.
- 5) Set RF LEVEL and vernier controls to 1 mV.
- 6) Select DEV, 1 kHz source, and adjust 1 kHz level control for 5 kHz deviation.
- 7) Select the AC pk VOLTS function.
- 8) Adjust receiver squelch to full open position.
- 9) Connect high resolution VOM (in DC mode) to AGC of limiter test point of receiver.
- 10) Reduce RF output by 3 dB. Make note of AGC voltage. Adjust RF output back to 1 mV.
- 11) Select RF step and program for a 100Hz (.0001 MHz) step size using the numerical keys followed by the ENTER key.
- 12) Select GEN and use the UP arrow key to increase the RF frequency until the AGC voltage noted in Step 10 is obtained. Record this as "high" frequency.
- 13) Use the down arrow key to return to the RF center frequency and then continue decreasing the RF frequency until the AGC voltage noted in Step 10 is obtained. Record the "low" frequency. The difference between the high frequency and the low frequency is the 3 dB bandwidth. The symmetry is good if the low frequency is the same amount from center as the high frequency.

3.3.1e Receiver Sensitivity with CTCSS Decoder and Decoder Bandwidth Test

This test determines the amount of RF signal that is required to unsquelch a receiver that uses a CTCSS decoder. The bandwidth part of the test determines the amount the encoder oscillator can drift from the desired CTCSS frequency and still unsquelch the receiver. Too much decoder bandwidth can be a problem if wide enough to allow other transmitters with tone frequencies near the desired to operate the receiver.

This test is often called Tone Squelch Sensitivity.

Refer to Figure 3-6 for the Receiver Sensitivity with CTCSS Decoder and Decoder Bandwidth Test procedure.

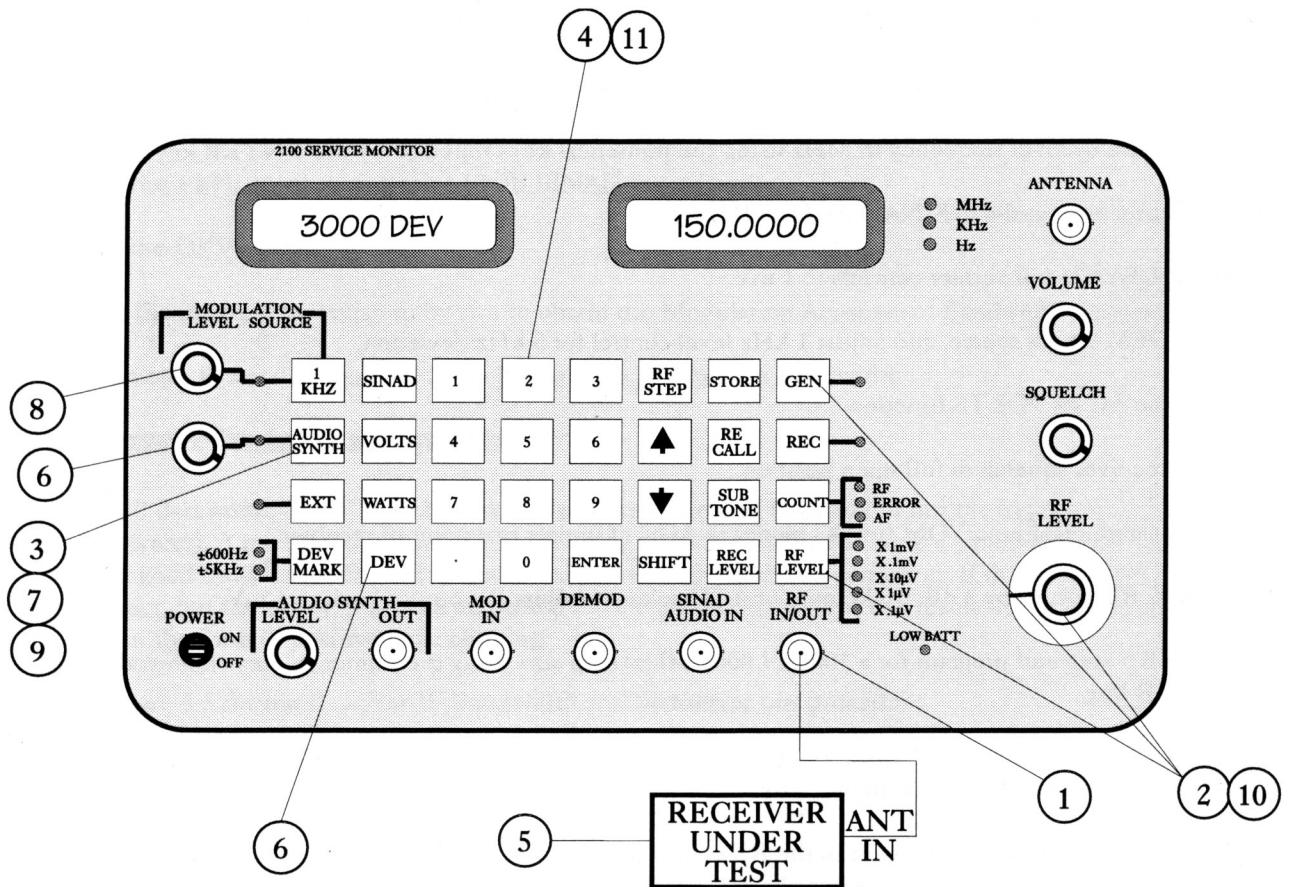


FIGURE 3-6 RECEIVER SENSITIVITY WITH CTCSS DECODER AND DECODER BANDWIDTH TEST

- 1) Connect the RF input (antenna port) of the receiver under test to the RF IN/OUT jack.
- 2) Select GEN mode and set the RF output level to 0.1 mV.
- 3) Select AUDIO SYNTH.
- 4) Set the Audio Synthesizer to the subtone frequency in Hz using the numerical keys followed by the ENTER key.
- 5) Put the receiver under test into Decode Mode and adjust its squelch for threshold.
- 6) Adjust the Audio Synthesizer level control to 600 Hz deviation, or to manufacturers recommended deviation.
- 7) Turn off audio synthesizer by toggling the AUDIO SYNTH key.
- 8) Activate 1 kHz and adjust level to 3 kHz deviation.
- 9) Toggle AUDIO SYNTH on.
- 10) Increase RF LEVEL vernier control until the receiver just becomes unquieted (1 kHz tone is heard + noise). Read the receiver sensitivity from the RF LEVEL dial.

11) Vary the AUDIO SYNTH frequency to either side of selected frequencies in 1 Hz increments using the numerical keys followed by the ENTER key. The difference between the frequencies at which the receiver unsquelched at the last RF level setting is the decoder bandwidth.

3.3.1f CTCSS Decoder Sensitivity Test

This test determines the amount of subtone deviation that is required to unsquelch the CTCSS decoder of a receiver under test.

Refer to Figure 3-7 for the CTCSS Decoder Sensitivity Test procedure.

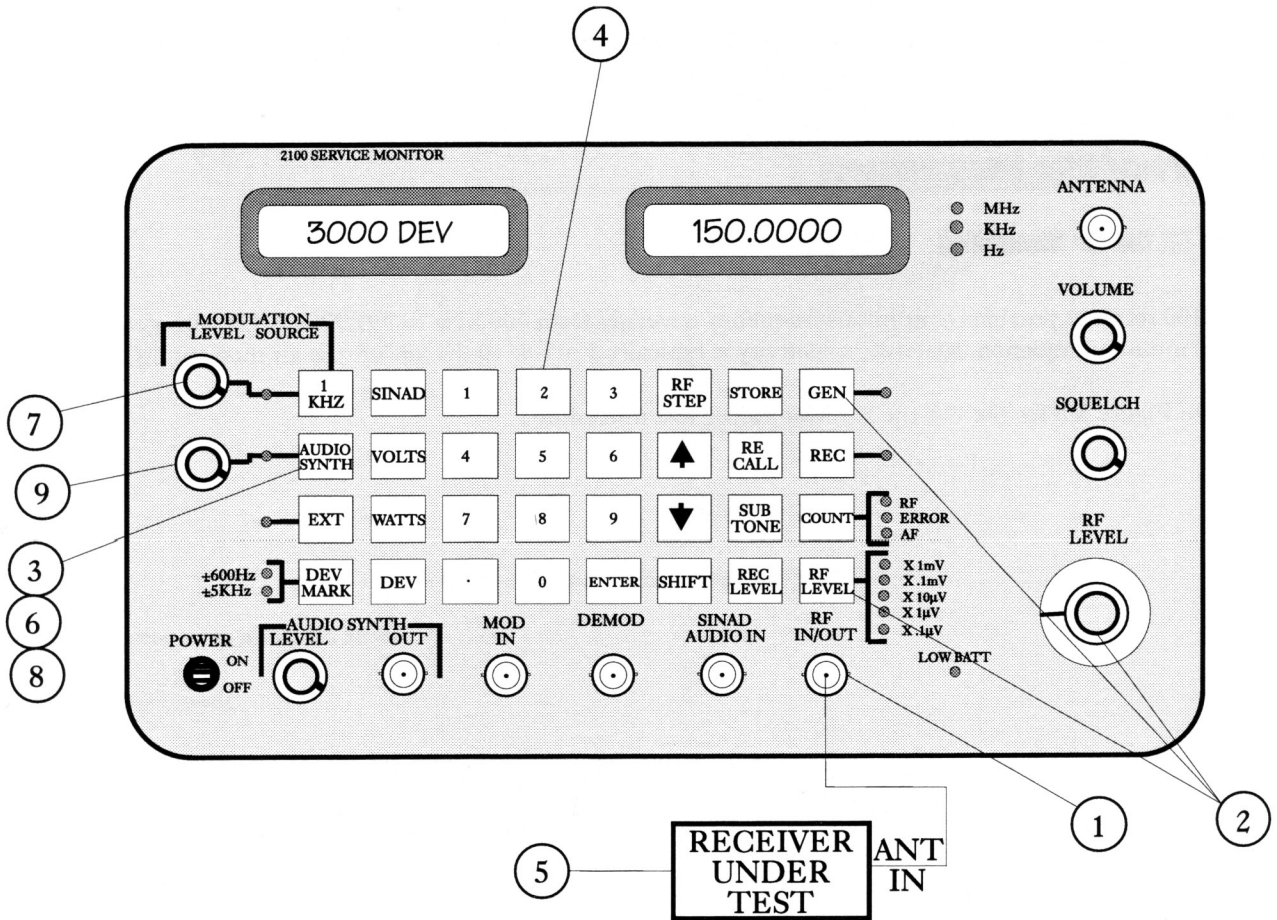


FIGURE 3-7 CTCSS DECODER SENSITIVITY TEST

- 1) Connect the RF input (antenna port) of the receiver under test to the RF IN/OUT jack.
- 2) Select GEN mode and set the RF output level well above the receiver squelch threshold.
- 3) Select AUDIO SYNTH mode.
- 4) Set the audio synthesizer to the subtone frequency in Hz using the numerical keys followed by the ENTER key.

- 5) Put the receiver under test into the decode mode and adjust its squelch for threshold.
- 6) Turn off the audio synthesizer by toggling the AUDIO SYNTH key.
- 7) Activate 1 kHz and adjust level to 3 kHz deviation.
- 8) Toggle AUDIO SYNTH on.
- 9) Starting at minimum audio synthesizer deviation, slowly increase the synthesizer deviation until the decoder unsquelches the receiver.
- 10) The audio synthesizer deviation at this point is the decoder sensitivity.

NOTE: BIRDIES - The receive mode has a broad tuning range and may be subject to interference from internally generated mixer products. At these frequencies, reception may be impaired. Refer to the SHIFT-REC instructions on page 3-3, Section 3.2 Front Panel Description, if this occurs.

3.3.2 Transmitter Measurements

3.3.2a Off the Air Monitoring

The 2100 receiver provides continuous frequency coverage from 400 kHz to 999.9999 MHz with good sensitivity and intermod rejection. Receiver sensitivity is typically 2 mV @ 10 dB for "off the air monitoring".

Refer to Figure 3-8 for the Off the Air Monitoring test procedure.

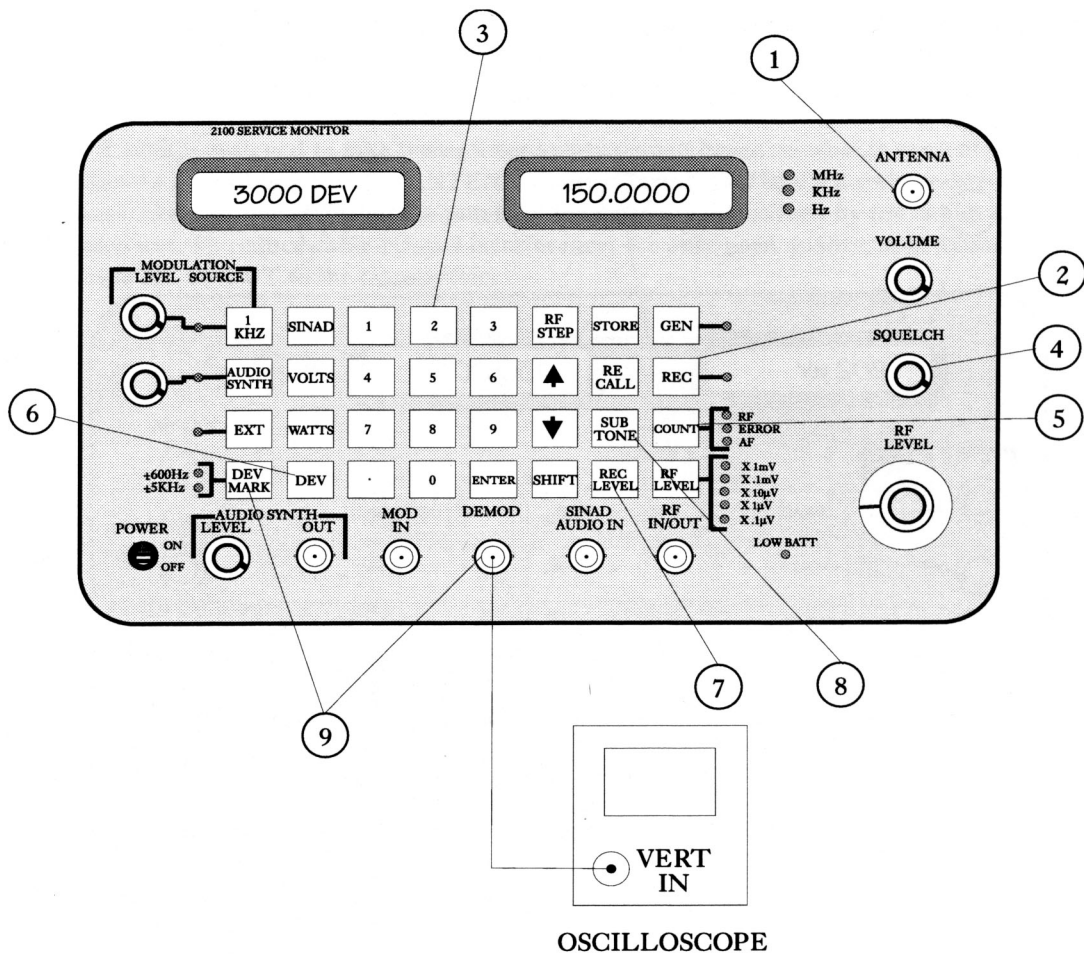


FIGURE 3-8 OFF THE AIR MONITORING

- 1) Attach antenna to antenna input.
- 2) Select REC mode.
- 3) Program the frequency to be monitored in MHz using data entry keys followed by the ENTER key.
- 4) Adjust squelch control for sensitivity required.
- 5) Select COUNT RF to display the actual frequency of received RF signals above 100 mV.
 Select COUNT ERROR to display frequency error of the received signal.
 Select COUNT AF to display the frequency of the audio modulation on the carrier.
- 6) Select DEV to display the FM deviation on the carrier.
- 7) Select REC LEVEL to display the signal strength.
- 8) Select SUBTONE to display CTCSS tone on the right LCD display.
- 9) Select DEV MARK and connect DEMOD connector to an external oscilloscope to calibrate demodulated audio to ± 600 Hz or a ± 5 kHz marker.

3.3.2b Relative Signal Strength Measurements

Refer to Figure 3-9 for the Relative Signal Strength Measurements test procedure.

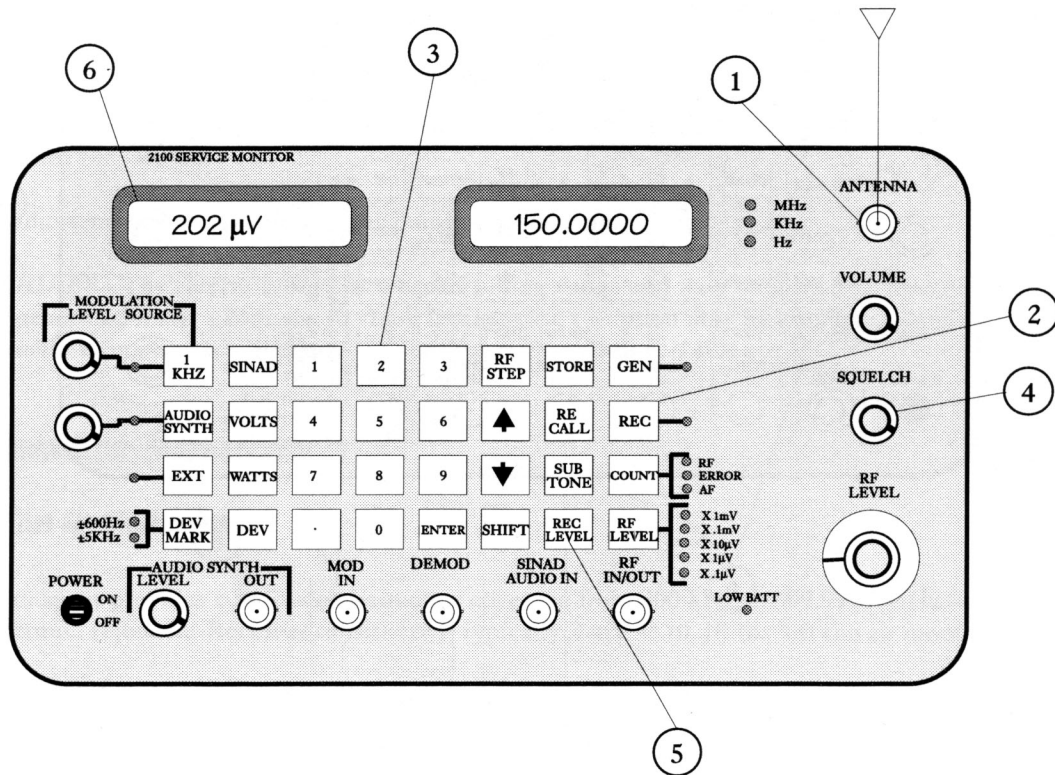


FIGURE 3-9 RELATIVE SIGNAL STRENGTH MEASUREMENTS

- 1) Attach antenna to antenna input. For measuring remote sites, connect to an outside antenna.
- 2) Select RCV mode.
- 3) Program frequency to be monitored in MHz using the numerical keys followed by the ENTER key.
- 4) Open squelch control.
- 5) Select REC LEVEL.
- 6) Compare signal strength reading with last "known good" indication, or use to compare two transmitters of the same output power and approximate location.

NOTE: Several comparisons using the instrument should be made to determine what a reference reading for a local transmitter should be. This may require taking the test readings at the same time of the day as the sample reading due to changing atmospheric conditions.

3.3.2c Measuring Transmitter Power and Frequency Error

The built-in 100 watt power meter automatically switches into a monitor mode if approximately 200 mW or greater is keyed into the RF IN/OUT connector.

This not only protects against circuit damage from accidental keying, it also provides for "hands off" switching into monitor mode for simultaneous display of transmitter power and some other selectable parameter, i.e., frequency error.

NOTE: The Model 2100 is designed to take transmitter measurement based on what is presented at the RF IN/OUT port under the assumption that the ANTENNA port is terminated into a purely resistive 50 ohm load. The user must take into consideration the potential inaccuracies introduced by the cables used to hook up the system under test. To reduce cable-related interference, use only good quality, approximately 6 inch, 50 ohm coax cable from RF IN/OUT to the transmitter.

Refer to Figure 3-10 for the Transmitter Power and Frequency Error test procedure

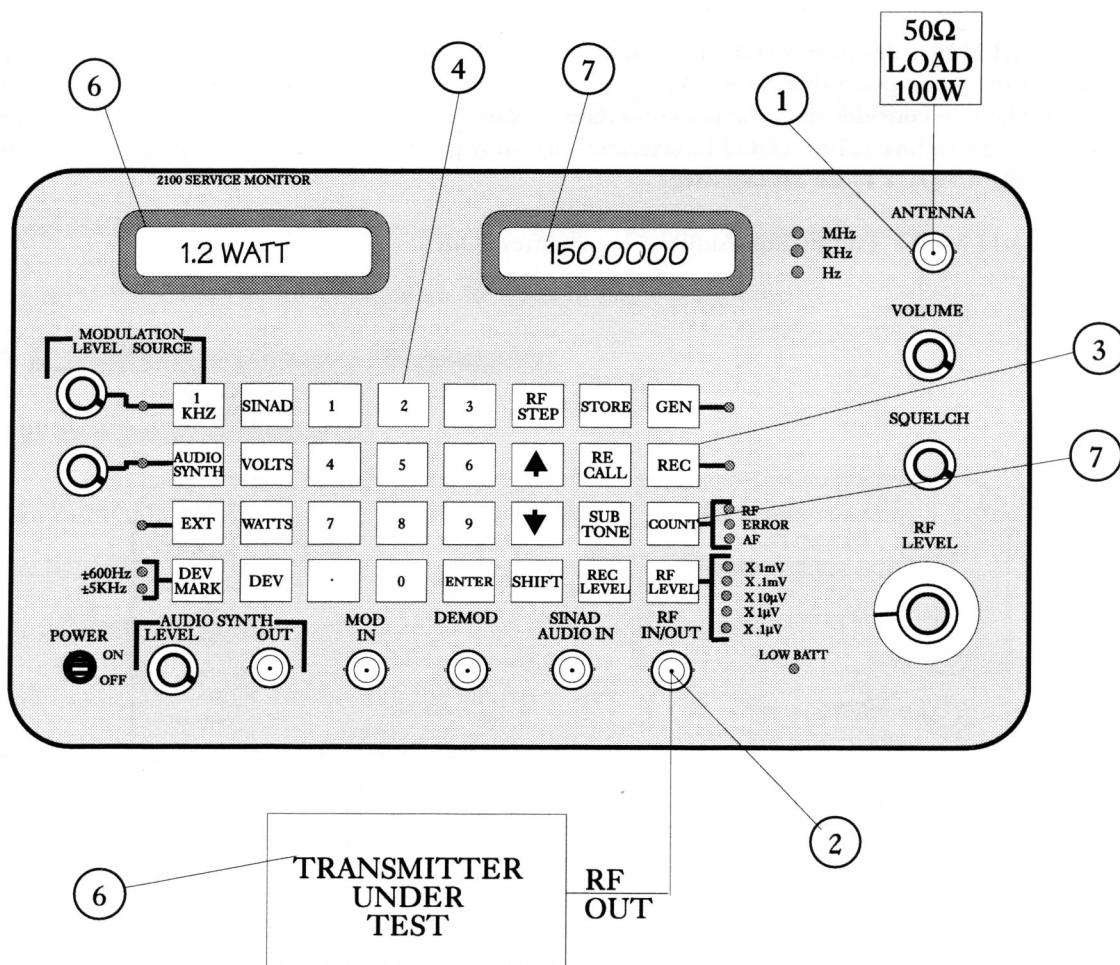


FIGURE 3-10 MEASURING TRANSMITTER POWER AND FREQUENCY ERROR

- 1) Connect a 50 W, 100 watt RF load to the ANTENNA port.
- 2) Connect RF output of the transmitter to RF IN/OUT.
- 3) Select REC mode. (If in GEN mode, unit will automatically switch to REC when power is keyed into unit.)
- 4) Program transmitter frequency on monitor in MHz using numerical keys followed by ENTER key.

5) To prevent overheating the instrument, see the specifications for applying power to the wattmeter.

6) Key the transmitter. Unit will display power in watts (up to 100 watts) on the left LCD.

7) Select COUNT Error and read frequency error on the right LCD.

NOTE: The Model 2100 switches to the watts mode when power is initially keyed in. In order to read frequency error, the COUNT Error mode must therefore be selected after the power is keyed in.

3.3.2d Tuning Sub-Audible Transmitter Tones

CTCSS tones may be identified using the SUBTONE function as in Section 3.3.2a (Off Air Monitoring). This task may also be more rapidly performed by using an oscilloscope to create a lissajous pattern during tuning.

NOTE: The Model 2100 is designed to take transmitter measurement based on what is presented at the RF IN/OUT port under the assumption that the ANTENNA port is terminated into a purely resistive 50 ohm load. The user must take into consideration the potential inaccuracies introduced by the cables used to hook up the system under test. To reduce cable-related interference, use only good quality, approximately 6 inch, 50 ohm coax cable from RF IN/OUT to the transmitter.

Refer to Figure 3-11 for the Tuning Sub-Audible Transmitter Tones

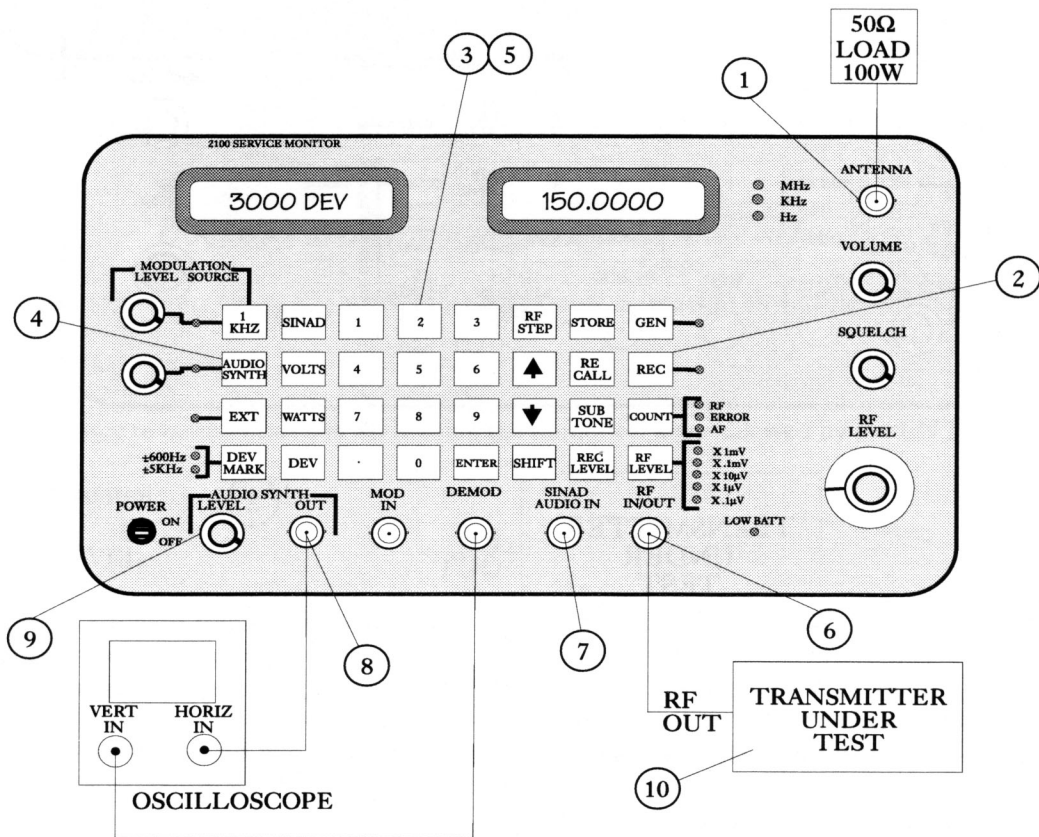


FIGURE 3-11 TUNING SUB-AUDIBLE TRANSMITTER TONES

- 1) Connect a 50 W 100 watt RF load to the antenna port.
- 2) Select REC mode.
- 3) Set frequency for transmitter frequency in MHz using numerical keys followed by ENTER key.
- 4) Select AUDIO SYNTH.
- 5) Use the numerical keys to program the desired subtone in Hz and terminate the data with the ENTER key.
- 6) Cable the Antenna port of the transmitter under test to the RF IN/OUT port.
- 7) Cable the DEMOD out to the oscilloscope vertical input.
- 8) Cable the audio synthesizer output to the oscilloscope horizontal input.
- 9) To prevent overheating the instrument, see the specifications for applying power to the wattmeter.
- 10) Key the transmitter
- 11) Adjust the audio synthesizer level control for a lissajous pattern on the oscilloscope.
- 12) Adjust the transmitter subtone frequency for a stable lissajous pattern.

3.3.3 Miscellaneous Keyboard Programming

3.3.3a RF Step Size Programming

RF step size can be tailored to suit the users specific application by using the RF STEP key.

- 1) Select RF STEP.
- 2) Enter the desired step size in MHz and press ENTER.
- 3) Use the up or down arrow keys to step the RF frequency.

3.3.3b Memory and Recall Operation

Twenty storage registers (1-20) are available for retaining desired front-panel keyboard settings. To store a setup in memory:

- 1) Select STORE.
- 2) Enter a memory location (from 1-20) using the data keys.
- 3) Select ENTER to terminate.

To recall a memory register:

- 1) Select the RECALL key.
- 2) Select the desired memory register (from 1-20) using the data keys.

3) Recall (activate) the register by pressing ENTER.

4) The operator may scroll thru the stored settings by pressing RECALL followed by the up/down arrow keys