



**DR 6/11-135A and 135EC
1×N Frequency Diversity
Operation and Maintenance
Digital Radio Test System (DRTS)**

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1 Introduction

Maintenance procedures you perform on DR 6/11 Digital Radio require the use of the Digital Radio Test System (DRTS). Most of the information you will need is included in the maintenance procedures. This section provides additional support information, calibration procedures, and reference material.

An Operating Manual and a video training tape are supplied with each Digital Radio Test System. Refer to that manual for additional test functions and detailed specifications. Contact your Radio Technical Support Group (TSG) for additional instructional material or assistance (1-800-TSG-4545).

1.1 Safety Considerations

Proper grounding of the DRTS is very important for:

- Personal Safety—by eliminating the potential shock hazard
- Equipment Protection—by reducing static electricity
- Test Results—by reducing static and other interference in low-level signals.

The Test Set is grounded through a conductor in the power cord.



WARNING:

Do not operate the test set through a 2-wire extension cord or an ungrounded outlet adapter. Lethal electric shock can result from the use of ungrounded power.

1.2 DRTS Familiarization

The Digital Radio Test System (DRTS) is manufactured by Hewlett-Packard and includes:

- a. An HP* 8593A Spectrum Analyzer
- b. An HP 11758 Digital Radio Test Set
- c. An Accessory Kit.

Within the documentation procedures, they will be identified respectively as the:

- a. SPECTRUM ANALYZER
- b. TEST SET
- c. Accessory Kit.

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1.2.1 Spectrum Analyzer

The Spectrum Analyzer is the top unit when it is mounted on its test stand. Its primary function is to display a portion of the radio-frequency spectrum. You will select the center frequency and span (width) of the spectrum you want to observe.

Several other DRTS Functions (called MODES) are processor-controlled by the internal memory of the Spectrum Analyzer. Those MODES are listed and described later in this section.

On the Spectrum Analyzer, there are KEYS and SOFTKEYS. KEYS are the permanently-labeled keys on the right half of the Spectrum Analyzer. There are six SOFTKEYS along the right edge of the display screen and their labels change as the displayed menus change. Softkeys control the software-based test functions within the Spectrum Analyzer.

1.2.2 Digital Radio Test Set

The Digital Radio Test Set is the lower unit and it contains four units:

- a. Multipath Fading Simulator (MFS), upper left
- b. 3-Tone Source, upper right
- c. Power Meter, lower left
- d. Radio Frequency (RF) Source output, lower right.

Comment: Controls for frequency and level of the RF Source are one of the processor-controlled functions of the Spectrum Analyzer.

1.2.3 Accessory Kit

An Accessory Kit contains:

- a. Adapters, cables, and connectors
- b. A power measurement kit that includes:
 - A power sensor
 - Attenuators to extend the range of the power sensor
 - A reference attenuator for power meter calibration
 - A minimum-loss pad to impedance-match 75-ohm Intermediate Frequency (IF) circuits to the 50-ohm attenuators and power sensor.

Table A lists the items in the accessory kit and Figure 1 shows the location of most of these items.

Table A. Accessory Kit—Items

Location #	Part Description	Part Number	Quantity
1	Adapter, 50-ohm N(M)-N(M)	1250-0778	1
2	Crystal Detector	8470B opt 012	1
3	Adapter, 50-ohm N(F)-N(F)	1250-0777	1
4	Adapter, 75-ohm BNC(F)-BNC(F)	1250-1287	1
5,6	Adapter, 50-ohm N(F)-SMA(M)	1250-2273	2
7,8,9,10	Adapter, 75-ohm BNC(M)-SMB(M)	1250-2278	4
11	Empty		
12	Adapter, SMB(M)-SMB(M)	1250-2279	1
13,14	Transformer, 50-ohm N(M)-75-ohm BNC(F)	9100-4859	2
15,16,17	Adapter, 75-ohm BNC(F)-SMB(F)	1250-2274	3
18	Adapter, right angle N(M)-N(F)	1250-2281	1
19	POWER SENSOR KIT *	11758-60020	1
A	50 MHZ REFERENCE ATTENUATOR 30 dB	11708A	1
B	MIN LOSS PAD (INS. LOSS 5.7 dB)	11852B	1
C	30 dB ATTENUATOR *	8491A opt 030	1
D	30 dB ATTENUATOR, 30 watt, high power *	8498A	1
E	POWER SENSOR *	8481D	1
F	20 dB ATTENUATOR	8491A opt 020	1
20	Wrench, combination 5/16"	8720-0015	1
21,22,23	Empty		
24	Torque Wrench	8710-1932	1
25,26	Adapter, BNC(F)-440(M)	1250-0556	2
27	External Leveling Head	11758-60002	1
28	ROM card and 32K BYTE RAM card		
29,30	Empty		
31,32	Adapter, right angle SMA(M)-SMA(F)	1250-1741	2
33	Cable Rack	11758-00013	1
none	Adapter, N(M)-BNC(F)	1250-0780	1
CA 1	Cable, HP-IB, 10833A	8120-3445	1
CA 2	Cable, 6' N(M)-N(M), 11500A	5060-0200	1
CA 3	Cable, 10' for Power Sensor, 11730B	8120-3385	1
CA 4	Cable, 6' BNC(M)-BNC(M)	11758-60022	2
CA 5	Cable, 10' BNC(M)-BNC(M)	11758-60023	1
CA 6	Cable, 15' BNC(M)-BNC(M)	11758-60024	1
CA 7	Cable, 8' BNC(M)-BNC(M)	11758-60026	4
CA 8	Cable, 10' SMB(F)-SMB(F)	11758-60027	4
CA 9	Cable, 8' N(M)-N(M)	11758-60028	2
CA 10	Cable, for External Leveling Head	11758-60021	1
CA 11	Cable, HP DRTS LO Interconnect	8120-4948	1
CA 12	Cable, HP DRTS Control Interconnect	8120-5343	1
CA 13	Cable, 9 inch, 50Ω, BNC(M)-BNC(M), 10502A	8120-2682	1
CA 14	Cable, 9 inch SMA(M)-N(M)	8120-5148	1

* Serial numbers of both 30 dB Attenuators (8491A opt 30 and 8498A) that were calibrated with the Power Sensor are printed on Sensor label.

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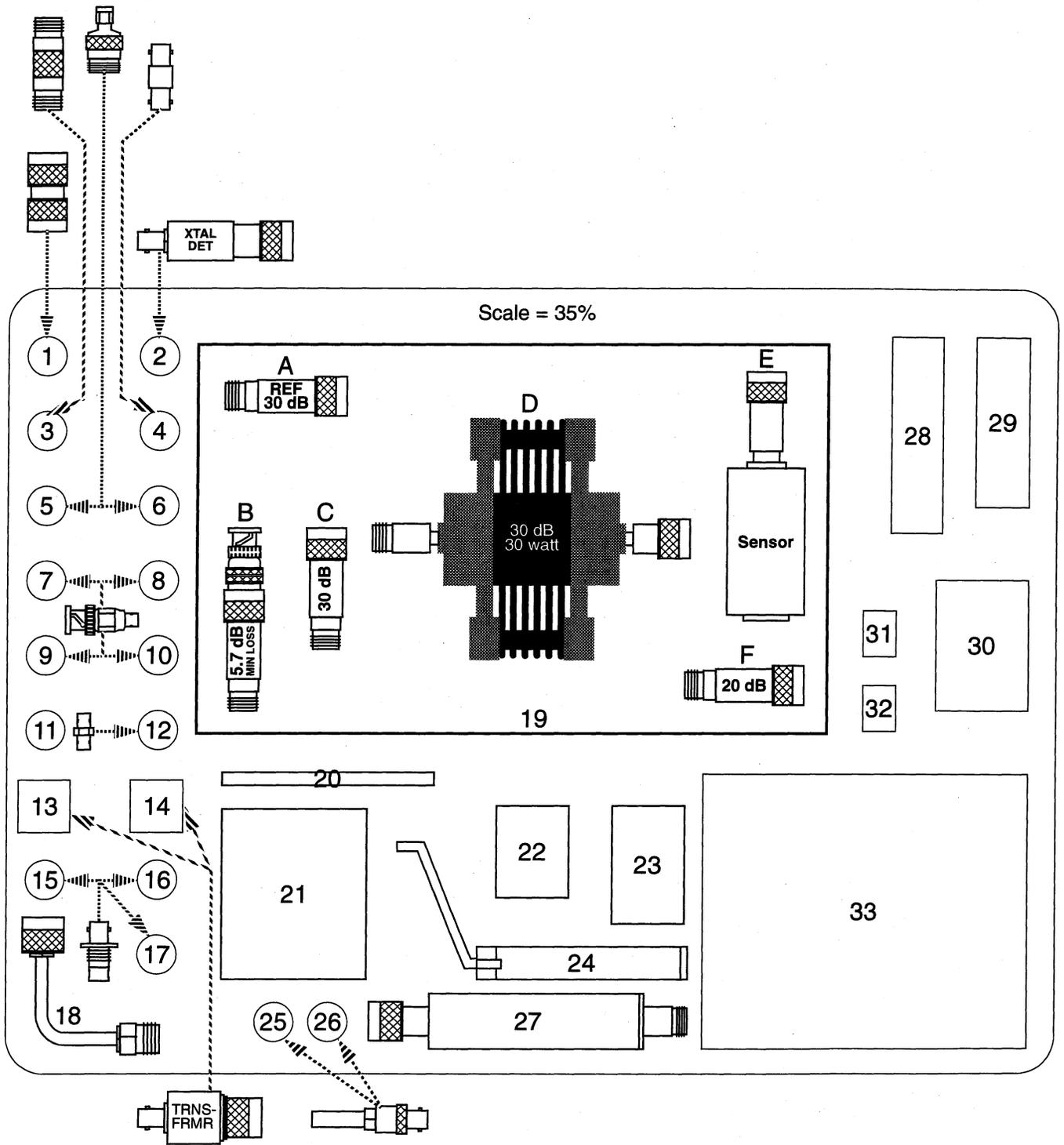


Figure 1. Accessory Kit—Item Location

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1.3 Calibration and Repair

1.3.1 Repair Center

The HP 11758 Digital Radio Test System requires calibration by the Nashville, Tennessee, repair center. The repair center has a special DRTS mobile calibration van which will perform the necessary calibration when it is in your area; the test equipment must be sent to Nashville if repair is needed.

- **HP 8593A Spectrum Analyzer**—Every 24 months.

This unit will be calibrated every 24 months by the DRTS calibration van. The repair center will schedule this with each DRTS location.

- **HP 11758A Power Sensor Kit**—Every 12 months.

During visits by the DRTS calibration van, this kit will be exchanged for a different kit which has been calibrated by the repair center.

On the 12-month interval between DRTS calibration van visits, the kit must be sent to the repair center in Nashville for calibration.

These units can be sent to:

AT&T
Nashville Repair Center
653 Main Stream Drive
Nashville, TN 37228
phone: 1-800-228-1938

Please contact the repair center by phone to make necessary arrangements before shipping.

1.3.2 User

The DRTS user can perform a self-calibration routine on the following units:

- a. Power Meter
- b. Multipath Fading Simulator
- c. Spectrum Analyzer.

For replacement adapters, cables, etc., you should contact the Radio TSG (1-800-TSG-4545). Some of these items are very expensive if ordered directly from Hewlett-Packard in small quantities.

1.4 Interconnection

Each time you transport a DRTS, you will have to remove and reconnect the interconnecting cables.

DRTS Interconnections

Step	Procedure
1	On the rear of the SPECTRUM ANALYZER: <ol style="list-style-type: none">Connect a power cord.On the LO OUTPUT jack, a right-angle adapter should be attached. If not, connect a right-angle adapter [SMA(M) - SMA(F)].
2	On the rear of the TEST SET: <ol style="list-style-type: none">Connect a power cord.On the LO jack, a right-angle adapter should be attached. If not, connect a right-angle adapter [SMA(M) - SMA(F)].Connect one end of the HP DRTS LO Interconnect Cable (HP 8120-4948) to the right-angle adapter on the LO jack and the other end to the right-angle adapter attached to the LO OUTPUT jack on the Spectrum Analyzer.Connect one end of the HP DRTS Control Interconnect Cable (HP 8120-5343) to the AUX INTERFACE jack and the other end to the AUX INTERFACE jack on the Spectrum Analyzer.Tighten all SMA connections with a torque wrench.

Comment: To reduce wear on the jacks, leave the right-angle adapters connected to the jacks and remove only the cable when you dismantle the DRTS for transportation.

End of Procedure

1.5 DRTS Turn-On Sequence


WARNING:

Do NOT apply LINE power in reverse sequence. This may cause the RF source signal to be turned on unintentionally, which could result in RF radiation.

DRTS Turn-On

Step	Procedure
1	On the SPECTRUM ANALYZER, operate the LINE switch to ON.
2	On the TEST SET, operate the LINE switch to ON.
3	Perform this step only if you want to change the displayed time and date. On the SPECTRUM ANALYZER: <ol style="list-style-type: none"> a. Press the CONFIG key (under INSTRUMENT STATE). b. Press TIMEDATE softkey. c. Verify that ON is underlined (selected) on the TIMEDATE ON OFF softkey. If OFF is underlined, press the TIMEDATE ON OFF softkey once to underline ON. d. Press SET TIME softkey. e. Using DATA keys, enter time using HHMMSS format. f. Press any ENTER key. g. Press SET DATE softkey. h. Using DATA keys, enter date using YYMMDD format. i. Press any ENTER key. j. Press the HOLD key to close the active function block.

Comment: For maximum accuracy, allow a 30-minute warm-up before calibration or testing. If necessary, the test set can be used immediately, but at reduced accuracy.

End of Procedure

1.6 Downloading User Programs

Use this procedure to download Group 1 Modes to internal memory in the Spectrum Analyzer.

Comment: All functions within the Spectrum Analyzer are processor-controlled. There are several groups of User Programs (Modes) but there is room in Internal Memory for only one Group. Group 1 Modes provide the necessary test functions for DR 6/11.

Downloading Programs

Step	Procedure
1	Connect cables per Part 1.4, Interconnection.
2	On the SPECTRUM ANALYZER: <ol style="list-style-type: none"> a. Press the green PRESET key. b. Insert the ROM card into the slot below the display screen. c. Press the RECALL key (under INSTRUMENT STATE). d. Press INTRNL CRD softkey to underline CRD. e. Press CATALOG CARD softkey. f. Press CATALOG ALL softkey. <p style="margin-left: 40px;">Verify dLOADME is highlighted (selected).</p> <p><i>Comment: The data entry KNOB can be used to change the selection.</i></p> <ol style="list-style-type: none"> g. Press LOAD FILE softkey. h. Press MODE LOADER softkey. i. Using the DATA keys: <ol style="list-style-type: none"> 1. Press the number 1 key. 2. Press the ENTER (Hz) key. <p style="margin-left: 40px;">Verify PLEASE WAIT message is displayed in the upper corner of the screen during loading.</p> <p><i>Comment: When the PLEASE WAIT message is gone, Group 1 Modes are loaded.</i></p> j. Remove and store the ROM card.

End of Procedure

2 Power Meter

The power meter is an HP 437B. It is equipped with an HP 8481D Power Sensor which has a range of -20 dBm to -70 dBm. Two 30-dB attenuators are provided to extend the sensor to two other ranges ($+10$ dBm to -40 dBm using one attenuator and $+40$ dBm to $+10$ dBm using both attenuators). The 50-ohm (Ω) impedance of the Power Sensor matches the impedance of RF measurement points. Because IF measurement points are 75Ω , an impedance matching device called a MINIMUM LOSS PAD must be used between the Power Sensor and the IF measurement point. There is 5.7 dB loss in the minimum loss pad. This pad also physically adapts a 50Ω , N-type connector to a 75Ω , BNC-type connector.

A table is provided on the side of each power sensor. For each range of measurement, the table lists the total loss of the attenuators and/or minimum loss pad needed in the test setup. Because of attenuator and power sensor variations, losses shown on the table will vary from the nominal values of 5.7, 30, 35.7, and 60 dB by tenths and hundredths of a dB. This table will be different for each sensor; it was made when the power sensor kit was last calibrated. Values in this table are referred to as OFFSET when a measurement is made. If the power reading is referenced at the far end of the cable, the total OFFSET entered in the power meter will be this value plus some cable loss. The procedures use an additional 0.25 dB loss for an 8-foot BNC(M)-BNC(M) test cable.



WARNING:

RF radiation in excess of 1 milliwatt (0 dBm) may cause bodily harm. Do not open any RF connection with this power level until the IF drive signal has been removed.



CAUTION:

Do not apply a signal level above -20 dBm to the Power Sensor as this will damage the sensor.

2.1 Connecting the Power Sensor

Power Sensor Connection

Step	Procedure
1	On the POWER METER: <ol style="list-style-type: none"> a. Connect the HP 11730B Power Sensor Cable to the Power Meter SENSOR jack. b. Connect the HP 8481D Power Sensor to the free end of the Power Sensor Cable.
End of Procedure	

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2.2 Calibration

Calibrate the POWER METER every time the TEST SET is turned on, before testing is started each day, or if the display flashes a "PLEASE ZERO" message. Do not remove the power sensor cable from the power meter sensor jack after calibration.

Comment: Calibration instructions are also printed on the Power Sensor.

Power Meter Calibration

Step	Procedure
1	The POWER SENSOR must be connected per Part 2.1, Connecting the Power Sensor.
2	<p>On the POWER METER:</p> <ol style="list-style-type: none"> a. Connect the HP 11708A, 50-MHz Reference Attenuator (item A in the Accessory Kit) to the POWER REF jack. b. Connect the Power Sensor (item E) to the Reference Attenuator. c. Press the green PRESET/LOCAL key. d. Press the ENTER key. PLEASE ZERO or UNDER RANGE will be displayed. e. Press the ZERO key. Wait until UNDER RANGE is displayed. f. Press the blue SHIFT key. <p><i>Comment: When you press the blue SHIFT key, the next key you press will select the blue-named function above the key.</i></p> <ol style="list-style-type: none"> g. Press the ZERO key to select CAL (shifted-ZERO). Verify REF CF 100% is displayed. (The arrow keys can be used to change the percentage.) h. Press the ENTER key. <p><i>Comment: When UNDER RANGE is displayed, the Power Meter is calibrated.</i></p> <ol style="list-style-type: none"> i. Remove the Power Sensor from the Reference Attenuator. <p><i>Comment: The Reference Attenuator is used only during calibration. Leave it connected to the POWER REF jack so it cannot be mistaken for the regular 30-dB attenuators.</i></p>

End of Procedure

2.3 Entering Offset

Power Meter OFFSET is the total loss, in dB, of all adapters, attenuators, and test cables between the Power Sensor and the point of power measurement.

A table on the side of the Power Sensor lists offset factors for:

- Four frequency bands; IF and three RF bands (4 GHz, 6 GHz, and 11 GHz)
- Three power ranges; (below -20 dBm, -30 to $+10$ dBm, and 0 to $+40$ dBm).

Comment: An Offset Factors table is accurate only for that Power Sensor when it is used with the two 30-dB attenuators that were calibrated with that sensor. Serial numbers of the calibrated attenuators are printed on a power sensor label.

Offset factors listed on the Power Sensor do not include any cables that may be required between the Power Sensor and the point of measurement.

To ENTER an OFFSET

Step	Procedure
1	On the POWER SENSOR, select the value of OFFSET FACTOR from the table for the frequency band and power range being measured.
2	On the POWER METER: <ol style="list-style-type: none"> a. Press the OFFSET key. Verify that OFS is displayed (OFS is OFFSET). b. Use the arrow keys to change the displayed OFFSET to the value selected in Step 1. c. Is an 8-foot IF test cable loss included in your measurement? Reference: Figure 4. NO - Go to Step 3. YES - Continue. d. Use the arrow keys to increase the displayed OFFSET by 0.25 dB.
3	On the POWER METER, press the ENTER key (enters displayed OFFSET into the meter).

End of Procedure

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2.4 Store, Recall, and Display Offset

Ten storage registers (01-10) are available to store offset factors for different power measurement arrangements. Recalling a stored offset factor puts that value into effect. Contents of these registers are not lost by operation of the PRESET/LOCAL key or by turning the Power Meter off.

To STORE an OFFSET

Step	Procedure
1	<p>On the POWER METER:</p> <ol style="list-style-type: none"> a. Enter the OFFSET. Reference: 2.3 Entering Offset. b. Press the blue SHIFT key. c. Press the ↓ key to select STORE (shifted ↓). d. Use arrow keys to select the storage register (01-10). e. Press the ENTER key.

End of Procedure

To RECALL an OFFSET

Step	Procedure
1	<p>On the POWER METER:</p> <ol style="list-style-type: none"> a. Press the blue SHIFT key. b. Press the ↑ key to select RECALL (shifted ↑). c. Use arrow keys to select the storage register (01-10). d. Press the ENTER key (stored OFFSET becomes current OFFSET).

End of Procedure

To DISPLAY the current OFFSET

Step	Procedure
1	<p>On the POWER METER:</p> <ol style="list-style-type: none"> a. Press the OFFSET key to display OFS value. b. Press the ENTER key (to return to the measurement mode).

End of Procedure

2.5 IF Measurement Connections

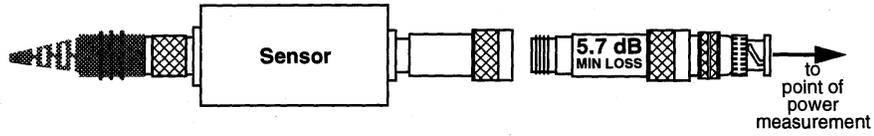


Figure 2. IF Measurement Below -20 dBm (Offset About 5.7 dB)

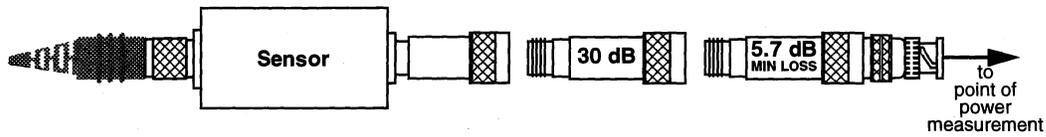


Figure 3. IF Measurement Between -30 dBm to $+10$ dBm (Offset About 35.7 dB)

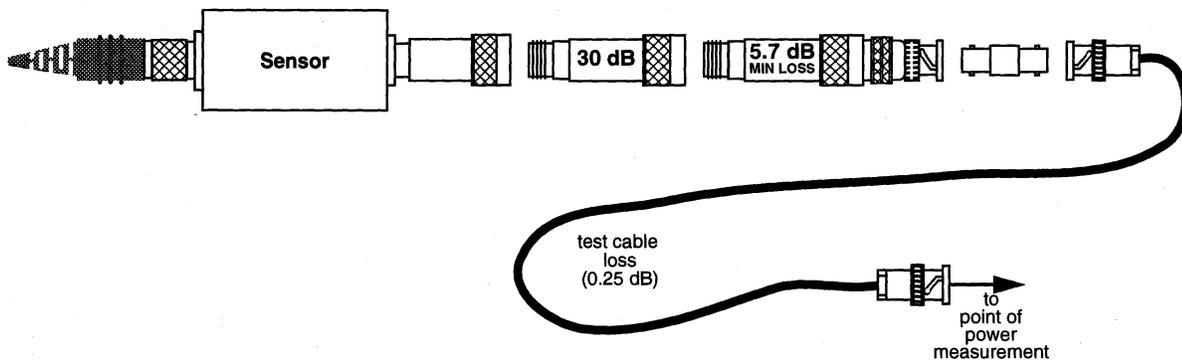


Figure 4. IF Measurement Between -30 dBm to $+10$ dBm with Test Cable (Offset About 35.95 dB)

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2.6 RF Measurement Connections

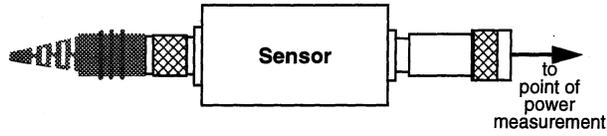


Figure 5. RF Measurement Below -20 dBm
(Offset About 0.0 dB)

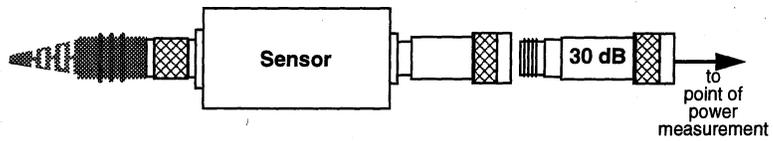


Figure 6. RF Measurement Between -30 dBm to $+10$ dBm
(Offset About 30.0 dB)

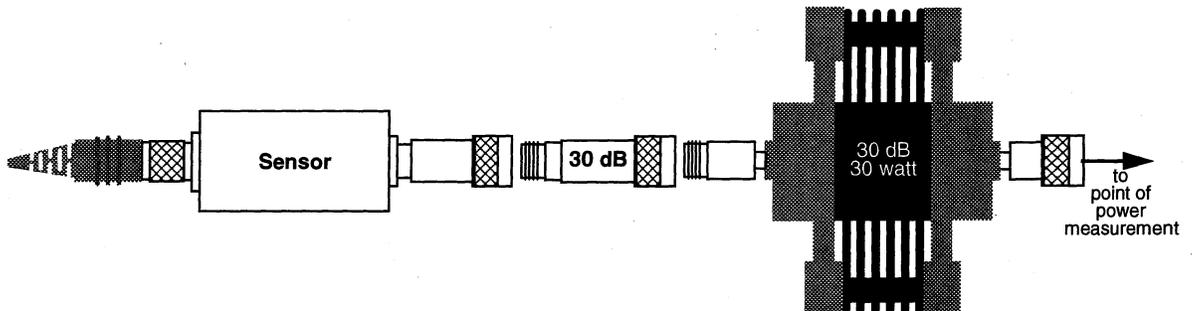


Figure 7. RF Measurement Between 0 dBm to $+40$ dBm
(Offset About 60.0 dB)

3 Spectrum Analyzer

3.1 Calibration

You should perform this calibration procedure annually or if you suspect the HP 8593A Spectrum Analyzer is not meeting its performance specifications.

Spectrum Analyzer Calibration

Step	Procedure
1	Connect cables per Part 1.4, Interconnection.
2	Allow a 30-minute warm-up.
3	On the SPECTRUM ANALYZER: <ol style="list-style-type: none"> a. Press the green PRESET key. b. Connect the CAL OUT jack to the INPUT 50-OHM jack using CA 13 and a BNC(F)-to-N(M) adapter. c. Press the CAL key on the INSTRUMENT STATE panel. d. Press the CAL FREQ & AMPTD softkey. Wait (about 10 minutes). CAL: DONE will appear on the screen. e. Press the CAL STORE softkey. CAL: STORED will appear on the screen. f. Remove the cable previously connected to the INPUT 50-OHM jack. g. Connect the 100-MHZ COMB OUT jack to the INPUT 50-OHM jack using CA 14. h. Press the CAL YTF softkey. Wait (about 5 minutes). CAL: DONE will appear on the screen. i. Press the CAL STORE softkey. CAL: STORED will appear on the screen.

Comment: The Spectrum Analyzer is calibrated.

End of Procedure

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3.2 Spectrum Observation

This function of the Spectrum Analyzer displays signals within a user-selected portion of the frequency spectrum. You will enter the center frequency and the total width (span) of the desired spectrum.

3.2.1 Display

Signal frequencies are displayed horizontally across the ten divisions (centimeters) and signal amplitudes are displayed vertically over eight 1-centimeter divisions.

3.2.2 Active Function Block

When you select a variable, an Active Function Block appears in the left half of the display, third and fourth divisions from the top. The selected variable and its current value will be displayed in the Active Function Block.

Comment: When you change a variable, verify that the change appears in the Active Function Block.

3.2.3 Keys and Softkeys

Keys are the permanently-labeled keys on the right half of the Spectrum Analyzer. There are six softkeys along the right edge of the Display Screen and their labels change as the displayed menus change. Softkeys control the software-based test functions within the Spectrum Analyzer.

3.2.4 Frequency, Span, and Amplitude

Frequency, Span, and Amplitude are three variables that must be defined for Spectrum Analyzation. Setting any or all of them uses the same procedure.

To set Frequency, Span, or Amplitude:

- a. Press the FREQUENCY, SPAN, or AMPLITUDE key.
Verify that the CENTER FREQ, SPAN, or REF LVL softkey is highlighted.
- b. Enter the desired frequency, span, or amplitude criteria by using any one of the three methods of entering data described next.

3.2.5 Entering Data

There are three methods of entering data to the Spectrum Analyzer.

- a. DATA keys in the lower-right corner are 12 numeric and symbol keys for data input.

In the right column are four ENTER keys that select:

Frequency range (GHz, MHz, kHz, and Hz)

Level range (dBm, -dBm, Mv, μ V)

dB/time ranges (dB, sec, ms, μ S)

and initiate the transfer of the selected data to the processor.

- b. The data KNOB to the left of the Data keys performs the same data entry but in an analog manner. Watch the Active Function Block to follow the changes entered. Use the data KNOB to move frequency markers or make amplitude changes.
- c. Below the knob are two data STEP keys. Each press of either key changes and enters the value by a preset amount.

3.2.6 Hold Key

Press the HOLD key to close the Active Function Block and to prevent accidental data entry. The hold releases and a new Active Function Block is displayed when a key or softkey is pressed.

3.2.7 Bandwidth

Bandwidth resolution determines the amount of detail visible on the display trace. For most DR 6/11 measurements, you will use a resolution bandwidth (RES BW) of 100 kHz and a video bandwidth (VID BW) of 3 kHz.

To set or change BANDWIDTH settings:

- a. Press the BW key.
- b. Press RES BW AUTO/MAN softkey to underline MAN.
- c. Use the DATA and ENTER keys (or STEP keys) to select 100 kHz.
Verify that 100 kHz is displayed in the Active Function Block.
- d. Press the VID BW AUTO/MAN softkey to underline MAN.
- e. Use the DATA and ENTER keys (or STEP keys) to select 3 kHz.
Verify that 3 kHz is displayed in the Active Function Block.
- f. Press the HOLD key to close the Active Function Block.

3.2.8 Markers

A marker is a movable, diamond-shaped mark on the display that you can move with the data knob to identify points on the display. The frequency and the amplitude of the marked point are displayed in the upper-right corner. (Several factors affect the accuracy of the amplitude value, so do not use it for more than a reference.)

To place a marker manually:

- a. Press the MKR key.
- b. Press the MARKER NORMAL softkey.
- c. Use the data KNOB to move the marker to the desired location.

To measure the frequency difference between two points (markers):

- a. Press the MARKER DELTA softkey and you will have two markers.
- b. Turn the data KNOB and one marker moves; the other marker stays in the first location.

The frequency difference between the two markers is displayed in the Active Function Block and in the upper-right corner.

To automatically place a marker on the highest-level peak in the display,
press the PEAK SEARCH softkey.

The marker will automatically be placed on the highest peak on the trace and the frequency and amplitude will be displayed.

3.2.9 Modes

Modes are the test functions currently installed in internal memory. Group 1 Modes are the ones you need for DR 6/11 testing.

This is the Group 1 Mode Menu:

- a. SPECTRUM ANALYZER
- b. MODE LOADER
- c. FREQ COUNTER
- d. FLATNESS & SOURCES
- e. EVENT COUNTER.

Each mode has a Main Menu, in some cases followed by a chain of menus. Only one 6-item menu is displayed at a time, and each item name is a softkey designation.

To bring up the Mode Menu of the currently installed modes, press the MODE key once. (The MODE key is located on the INSTRUMENT STATE section of the Spectrum Analyzer front panel.)

To return to the Main Menu you were using, from within any other menu, press the MODE key twice.

3.2.10 Preset

The green PRESET key will also bring up the Mode Menu, but it will wipe out any selections you may have made. It returns the Spectrum Analyzer to predetermined (default) values.

4 Functions (Processor-Controlled by the Spectrum Analyzer)

Three of the Group 1 Modes are "test sets" that exist as processor-controlled software within the Spectrum Analyzer. You will use softkeys to select the Mode, move through the menus, and operate the test functions.

These are the three Group 1 Modes for processor-controlled test set functions.

- a. FREQ COUNTER
- b. FLATNESS & SOURCES
- c. EVENT COUNTER.

To select any of these Modes, press the associated softkey.

Comment: If the Mode menu is not displayed, press the MODE key. If it still is not displayed, Group 1 Modes are not loaded.

4.1 Frequency Counter

You will use this Frequency Counter function to measure any single-tone signal between 10 MHz and 22 GHz. If multiple tones are present, it will measure the highest-level tone.

To Measure Frequency

Step	Procedure																					
1	On the Group 1 Mode Menu, press the FREQ COUNTER softkey to bring up the Main Menu.																					
	<table border="0"> <tr> <td>(Mode Menu)</td> <td>(Main Menu)</td> <td>(Resolution Menu)</td> </tr> <tr> <td></td> <td>PRESET FREQ CNT</td> <td>1 Hz</td> </tr> <tr> <td></td> <td>RESET</td> <td>10 Hz</td> </tr> <tr> <td>FREQ COUNTER</td> <td>FREQ 2.9 22</td> <td>100 Hz</td> </tr> <tr> <td></td> <td>Resoln</td> <td>1 kHz</td> </tr> <tr> <td></td> <td>DSP HOLD ON OFF</td> <td>10 kHz</td> </tr> <tr> <td></td> <td>Misc</td> <td>Main Menu</td> </tr> </table>	(Mode Menu)	(Main Menu)	(Resolution Menu)		PRESET FREQ CNT	1 Hz		RESET	10 Hz	FREQ COUNTER	FREQ 2.9 22	100 Hz		Resoln	1 kHz		DSP HOLD ON OFF	10 kHz		Misc	Main Menu
(Mode Menu)	(Main Menu)	(Resolution Menu)																				
	PRESET FREQ CNT	1 Hz																				
	RESET	10 Hz																				
FREQ COUNTER	FREQ 2.9 22	100 Hz																				
	Resoln	1 kHz																				
	DSP HOLD ON OFF	10 kHz																				
	Misc	Main Menu																				

- 2 On the Main Menu:
 - a. Press softkey **FREQ**, 2.9 22 to underline either 2.9 or 22.
2.9 to measure frequencies between 10 MHz and 2.9 GHz
22 to measure frequencies between 2.75 GHz and 22 GHz
 - b. Press softkey **RESOLN** for the Resolution menu.
- 3 On the Resolution Menu:
 - a. Select the resolution
(lower-frequency resolution is more accurate but takes longer).
 - b. Press **Main Menu** softkey to return to the Main Menu.

End of Procedure

4.2 Flatness and Sources

This mode includes functions that provide test signals (sources) and display Amplitude vs. Frequency Response results (flatness).

On the Mode Menu, press the **FLATNESS & SOURCES** softkey to see the Main Menu. There are three primary functions on the Main Menu:

- a. **SOURCES**
- b. **CALIBRATE**
- c. **MEASURE.**

4.2.1 RF and IF Sources

Press SOURCES softkey to bring up the Sources menu.

(Mode Menu)	(Main Menu)	(Sources Menu)
	PRESET FLATNESS	SOURCE IF RF
	Sources	CENTER FREQ
FLATNESS & SOURCES	Cal	SPAN
	Meas	SRC PWR ON OFF
		Src Pwr Menu
	Misc	Main Menu

- SOURCE IF RF selects either the RF Source or the IF Tracking Generator.
- CENTER FREQ lets you set the center frequency of the test signal with the DATA keys, data STEP keys, or data KNOB.
- SPAN lets you set sweep width (for a single-frequency tone with no sweep, set SPAN to 0 Hz).

Comment: You can also press the SPAN key to enter span data, then press the MODE key twice to return to the FLATNESS & SOURCES Main Menu.

- SRC PWR ON OFF turns the test signal ON or OFF and allows control of the output level.

The IF signal output is the RF OUT 50 Ω (300 kHz - 2.9 MHz) jack on the front panel of the Spectrum Analyzer. (Yes, the IF signal comes out the RF OUT jack.)

On the Test Set, the RF signal output is the RF OUTPUT 50 Ω jack on the RF SOURCE panel. At that jack, however, the test signal has not been leveled and is not a usable test signal. An External Leveling Head must be attached to the RF OUTPUT jack through a 10-foot double-cable. Leveling takes place within the leveling head to furnish a test signal with a flat response at the output of the leveling head.

4.2.2 Calibration

Press the CAL softkey to bring up the Calibration Menu.

Comment: Pressing the CAL key on the INSTRUMENT panel will also bring up the Calibration Menu.

(Mode Menu)	(Main Menu)	(Calibration Menu)
	PRESET FLATNESS	CAL REFL
	Sources	CAL TRANS
FLATNESS & SOURCES	Cal	NORMALIZE ON OFF
	Meas	SRC PWR ON OFF
	Misc	Main Menu

- a. CAL TRANS begins the calibration process and brings up the message "Connect THRU, Store when ready".
- b. STORE THRU performs the actual transmission calibration.
- c. When calibration is complete, "THRU cal stored, Normalization ON" is displayed.

4.2.3 Measurement

Press the MEAS softkey to display the Measurement Menu.

(Mode Menu)	(Main Menu)	(Measurement Menu)
	PRESET FLATNESS	REFL TRANS
	Sources	AMPL TRK ONOFF
FLATNESS & SOURCES	Cal	SCALE LOG
	Meas	SRC PWR ON OFF
		Meas Fcns
	Misc	Main Menu

- a. REFL TRANS selects reflection or transmission measurements, and you will want TRANS.
- b. AMPL TRK ON OFF switches the amplitude tracking function ON or OFF (ON holds the test trace at a steady vertical position).
- c. SCALE LOG lets you set the vertical sensitivity (dB per division). One division is one centimeter.

4.3 Event Counter and Interval Counter

This Event Counter will count the negative-going pulses that occur during a selected Gate Time interval. Its input connector, EVENT CNTR INPUT, is on the back of the Spectrum Analyzer.

An Interval Counter is also available. It measures the accumulated time that the pulses are negative, but it also counts pulses and, therefore, serves as another Event counter. Its input connector, INTERVAL CNTR INPUT, is also on the back. All criteria set for the Event Counter apply to the Interval Counter.

Press EVENT COUNTER on the Mode Menu to bring up Main Menu.

(Mode Menu)	(Main Menu)	(Gate Time Menu)
	PRESET EVNT CNT	GATE TIME
	RESET CNTRS	100 ms
EVENT COUNTER	STOP CNTRS	1 s
	GATE TIME	10 s
	TOTALIZE ON OFF	
	More 1 of 2	Main Menu

- a. PRESET EVNT CNT resets the counters and conditions them as follows:

GATE TIME - 1 second

TOTALIZE - OFF.

- b. RESET CNTRS resets the counters to zero and starts a new count.
- c. STOP CNTRS turns the counters off and holds the last number. It will also cause the contents of the counters to be displayed if gate time was set to less than 1 second.
- d. GATE TIME accesses the Gate Time menu to select the duration of each count interval. 100 ms, 1 s, or 10 s can be selected with softkeys or a value can be entered with the DATA keys. A gate indicator flashes in the counter displays at the end of each gate time interval.
- e. TOTALIZE ON OFF switches the counters between totalize and gate time count.

TOTALIZE ON conditions the counters to continue counting until they are manually stopped or reset. In TOTALIZE ON, a threshold errored seconds (THLD ERR SEC) count appears in the display. It is a count of the number of seconds the error threshold was exceeded during the measurement time. To change the threshold, press More 1 of 2 on the Main Menu to bring up the EVENT THRESHLD menu.

TOTALIZE OFF conditions the counters to automatically reset at the end of each gate time interval.

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5 3-Tone Source

This test set is located in the Digital Radio Test Set and its function is to supply a 3-tone test signal for transmitter linearization tests. The three tones are 67 MHz, 70 MHz, and 75 MHz. Any of the tones can be turned off independently of the others with the switches on the front panel.

Although the frequency differences between the tones are always the same, the frequencies of all the tones can be offset from nominal with the OFFSET FREQUENCY knob.

The individual tones are always equal in power but total power can be adjusted with the TOTAL POWER OUT knob.

A special function in the Multipath Fading Simulator will display the offset frequency and the total output power of the 3-tone test signal. It is a convenient way to set offset frequency but is not considered accurate enough for setting output power.

Refer to Part 6.5 for more information on the 3-Tone Read function.

6 Multipath Fading Simulator (MFS)

This test set is located in the Digital Radio Test Set and it can be set to change several parameters of an IF signal passing through it, from IF IN to IF OUT. Procedures and functions described in this part are:

- a. Calibration
- b. Attenuation
- c. Fade Event "0"
- d. Notches
- e. 3-Tone Read.

6.1 Calibration

You should perform this calibration procedure annually or if you suspect the MFS is not meeting its performance specifications. It takes about 45 minutes to run.

MFS Calibration

Step	Procedure
1	Connect cables per Part 1.4, Interconnection.
2	On the rear of the SPECTRUM ANALYZER, attach one end of the HP-IB Cable (HP 10833A) to the HP-IB jack.
3	On the rear of the TEST SET, attach the other end of the HP-IB Cable, attached in Step 2, to the HP-IB jack.
4	Allow a 30-minute warm-up.

- 5 Connect the test equipment as shown in Figure 8.
- 6 On the SPECTRUM ANALYZER:
- a. Press the green PRESET key.
 - b. Insert the ROM card.
 - c. Press the MODE LOADER softkey.
 - d. Select 10 with the DATA keys.
 - e. Press the ENTER (Hz) key.
Wait for MULTIPATH FADING SIMULATOR CALIBRATE to load.
 - f. Press the FADER CAL softkey.
 - g. Follow the instructions displayed on the Spectrum Analyzer.

Comment: The remaining steps perform a calibration check.

- 7 On the SPECTRUM ANALYZER:
- a. Press the MKR key.
Verify MARKER 70.00 MHz is displayed in the Active Function block.
Verify the MARKER NORMAL softkey label is highlighted.
 - b. Press the MARKER DELTA softkey.

- 8 On the MFS:
- a. Press the NOTCH DEPTH key.
 - b. Use the arrow keys to set the DEPTH (dB) display to 10.0.

- 9 On the SPECTRUM ANALYZER display:
- a. Read the Marker Δ value to determine notch depth.

Requirement: -10.00 ± 0.30 dB

If the requirement is not met, repeat this procedure. If it fails the second calibration, contact the TSG.

- b. Press the MODE key.
- c. Press the MODE LOADER softkey.
- d. Select 1 with the DATA keys.
- e. Press the ENTER (Hz) key (Group 1 Modes are reloaded).
- f. Remove and store the ROM card.
- g. Remove the test connections established in Step 5 (Figure 8).

End of Procedure

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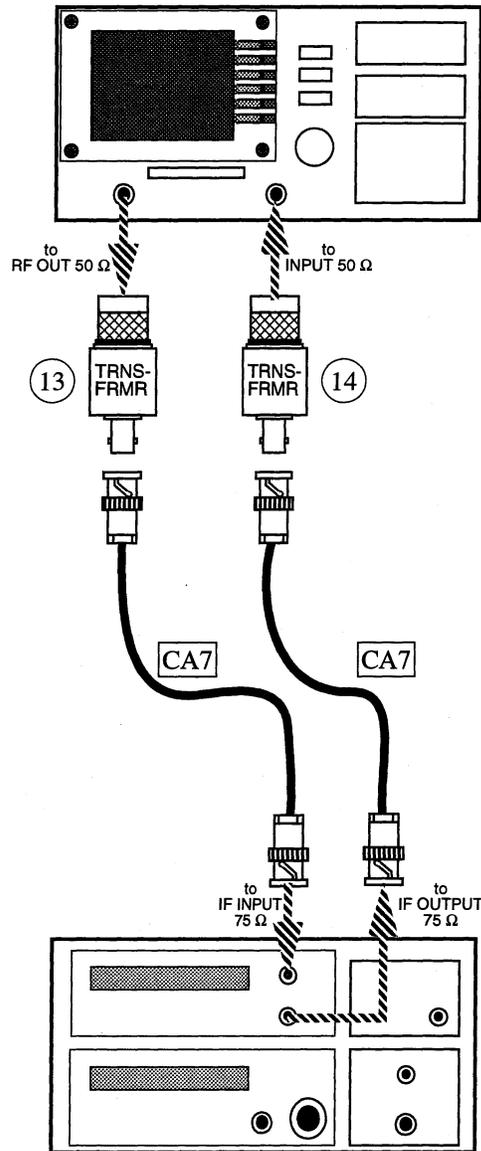


Figure 8. MFS Calibration

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6.2 IF Attenuation

This function provides adjustable loss to an IF signal connected through the MFS.

Setting Variable IF Attenuator

Step	Procedure
1	<p>On the MFS:</p> <ol style="list-style-type: none">Press the green PRESET/LOCAL key.Press the ENTER key. <p><i>Comment: Because the MFS does not automatically preset when it is turned OFF, you must manually preset to eliminate any existing notches, attenuation, or fade conditions.</i></p> <ol style="list-style-type: none">Press the ATTEN key.Use the arrow keys to select the desired attenuation, in dB.Press the ENTER key. <p><i>Comment: In some tests, you will adjust attenuation to a specific level by observing the Power Meter. In those cases, you must watch the Power Meter instead of the ATTEN display on the MFS.</i></p>

**CAUTION:**

The attenuation value indicated in the ATTEN display **must not be a negative number**. Negative loss is gain, so the signal would be amplified instead of attenuated by that amount. Equipment damage could result.

End of Procedure

6.3 Fade Event "0"

In this test, a 10-minute series of internally stored characteristics of severe multipath fades are applied to the IF signal connected through the MFS. It is a dynamic stress-test of radio receiver and digital receiver propagation distortion countermeasures. During the 10-minute test, event counters monitor error performance to determine test results.

For procedures for this test, refer to Part 6.4, Notches.

6.4 Notches

Most of the signal distortion caused by severe multipath fade is some type of a notch, a shape caused by multipath signal cancellation. Notches generated in the MFS can be at a fixed frequency, swept across the band at varying rates, and varied in depth.

You will use fixed-frequency notches to create a slope across much of the bandwidth and centered at 64 MHz, and again at 76 MHz, to test the amplitude-slope correction capability of the Adaptive Slope Equalizer. The same test also checks the Transversal Equalizer.

Any notch test can be performed twice; once in Minimum Phase (Min Phase) and again in Non-Minimum Phase (Non-Min). The difference between minimum and non-minimum phase is whether the delay increases or decreases as the signal amplitude decreases. Because both conditions exist in an actual signal, tests must include both types of distortion.

Procedures for using a notch to create slope and for using Fade Event "0" are in the **TERMINAL/REGENERATOR - TEST PROCEDURES** tab under:

- IF Loopback Propagation Distortion Checks
- Over-the-Air Propagation Distortion Checks.

6.5 3-Tone Read

An internal function of the MFS provides a "readout" of the offset frequency of the 3-Tone Source. Offset is the difference between the actual frequencies of the three tones and the frequencies marked above the tone switches. An OFFSET FREQUENCY knob varies the amount of offset. For linearization tests, we want zero offset.

Comment: Although the output power of the three combined tones is also displayed in the 3-Tone Read function, maintenance procedures use a power meter measurement to more accurately set output power.

Procedures for using the 3-Tone Read function are in the **RADIO TRANSMITTER - TEST PROCEDURES** tab under Linearization.

7 Menus

7.1 Group 1 Mode Menus

Group 1 Modes provide the necessary test functions for DR 6/11 radio systems. These functions are:

- a. FREQUENCY COUNTER
- b. FLATNESS and SOURCES
- c. EVENT COUNTER.

Figures 9, 10, and 11 show the menus and associated softkey labels associated with these functions. Figure 12 is a Special Functions menu which can be accessed from the Flatness and Sources menu.

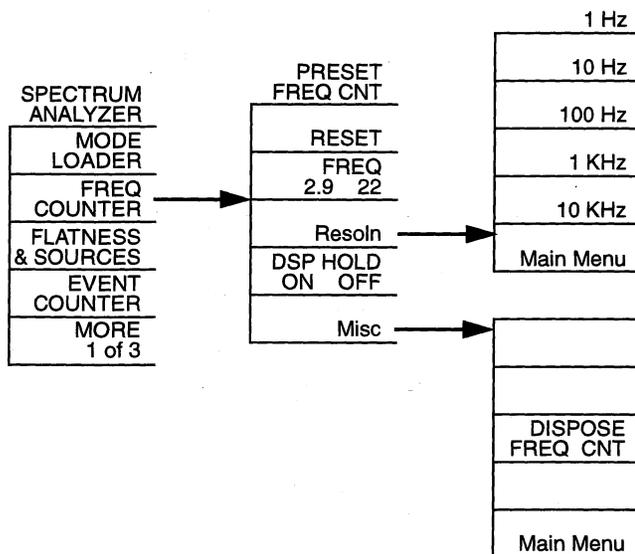


Figure 9. Frequency Counter Menu Tree

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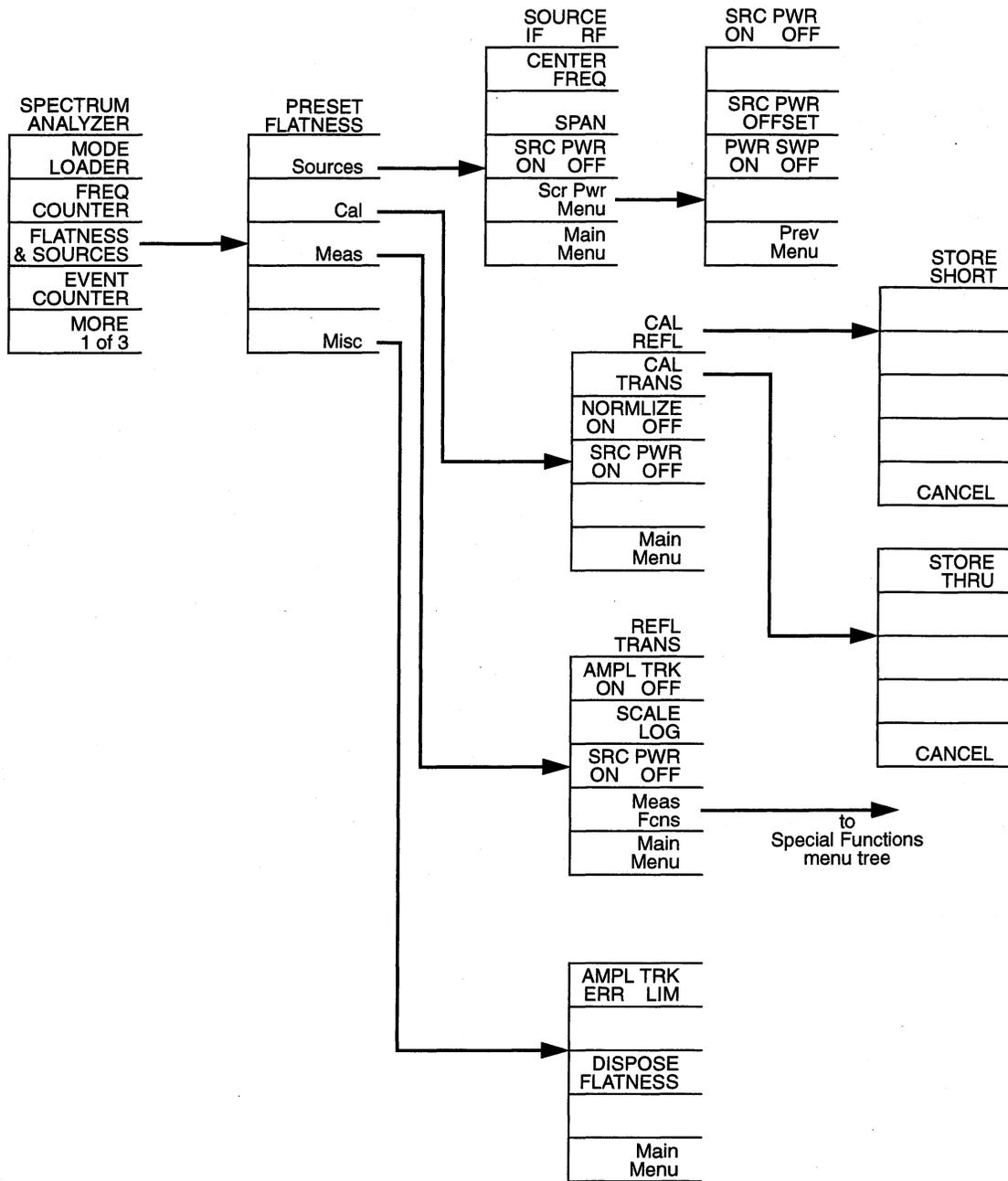


Figure 10. Flatness and Sources Menu Tree

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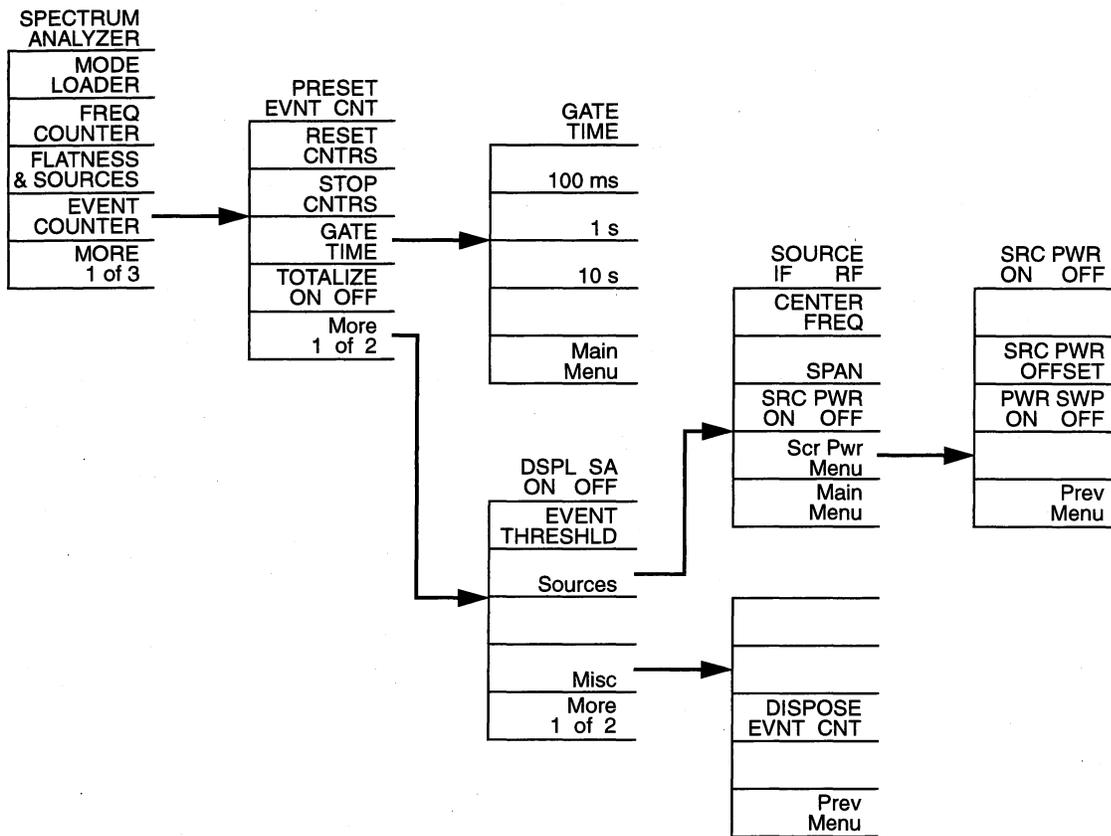


Figure 11. Event Counter Menu Tree

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7.2 Spectrum Analyzer Menus

You can find the menus for the HP 8593A Spectrum Analyzer in the **HP 8591A/8593A Installation, Verification, and Operation Manual**. The menus are located at the back of the manual and labeled HP 8591A/8593A Spectrum Analyzer Mode Menu. One manual was supplied with each DRTS.

Menus with softkey labels are provided for the following keys:

- AMPLITUDE
- AUX CTRL
- AUTO COUPLE
- CAL
- BW
- CONFIG
- DISPLAY
- FREQUENCY
- MEAS/USER
- MKR
- MKR→
- MODE
- PRESET
- PEAK SEARCH
- RECALL
- SAVE
- SIGNAL TRACK
- SPAN
- SWEEP
- TRACE
- TRIG.