User’s Guide

Agilent Technologies
85712D EMC Personality,
84100B/110B EMC Systems

Agilent Technologies

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In This Book . . .

Chapter 1	introduces the HP 85712D EMC auto-measurement personality and the HP 84100B/HP 84110B EMC pre-compliance evaluation systems.
Chapter 2	discusses installing both the HP 85712D EMC auto-measurement personality and the EMC tower/turntable program.
Chapter 3	outlines several tasks designed to help you begin using the HP 85712D EMC auto-measurement personality downloadable program (DLP) as quickly as possible.
Chapter 4	describes, in alphabetical order, each of the HP 85712D EMC auto-measurement personality's front-panel softkeys.
Chapter 5	contains information about the HP 85712D EMC auto-measurement personality's test setup library.
Chapter 6	demonstrates basic spectrum analyzer measurements with examples of typical measurements; each measurement focuses on different functions.

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Introducing the EMC Auto-Measurement Personality

Introducing the EMC Auto-Measurement Personality

This chapter introduces the HP 85712D EMC auto-measurement personality and the HP 84100B/HP 84110B EMC pre-compliance evaluation systems:

- Features of the HP 85712D EMC auto-measurement personality
- Features of the HP 84100B/HP 84110B EMC pre-compliance evaluation system
- System components, options, and accessories
- Front- and rear-panel features
- Screen messages
- Softkey menu map

Start Here

If You Are Familiar with the EMC Auto-Measurement Personality

Read this chapter, then use the manual as a reference. Use the menu maps at the end of this chapter to help you locate the front-panel softkeys.

If You Are Unfamiliar with the EMC Auto-Measurement Personality

Read this chapter, then read chapters 2, 3, and 5. These chapters outline several tasks to help you to learn more about the EMC measurement personality.

- EMC system installation . . . . Chapter 2
- Diagnosing EMI problems using a close-field probe . . . . . Chapter 3
- Making localized susceptibility measurements . . . . Chapter 3
- Conducted EMI evaluations . . . . Chapter 3
- Radiated EMI evaluations using a biconical antenna . . . . Chapter 3
- Making basic spectrum analyzer measurements . . . . Chapter 5

CAUTION

The HP 85712D EMC auto-measurement personality requires a spectrum analyzer firmware version 26.10.90 or higher.

Manual Terms and Conventions

HP 859XE Spectrum Analyzers Series

The HP 859XE series spectrum analyzers invoke the following keys:

Key	A boxed word in this typeface represents a key physically located on the instrument.
Softkey	A word in a shaded box represents a "softkey" that appears on the display of your spectrum analyzer. The softkey label is determined by the EMC personality. Softkeys with the first letter capitalized guide the user to another menu (HP 859XE spectrum analyzer series only).
SOFTKEY	A word in a shaded box represents a "softkey" that appears on the display of your HP 859XE spectrum analyzer. The softkey label is determined by the EMC personality. Softkeys with all letters capitalized perform a specific action and do not lead to another menu.
`DISPLAY`	Text printed in this typeface represents text displayed on the display.

HP 859XA Spectrum Analyzers Series

The HP 859XA series spectrum analyzers invokes the following keys:

(Key)	A boxed word in this typeface represents a key physically located on the instrument.
Softkey	A word in this shaded typeface represents a "softkey" that appears on the display of your spectrum analyzer. The softkey label is determined by the instrument's firmware.
DISPLAY	Text printed in this typeface represents text displayed on the display.

Introducing the EMC Auto-Measurement Personality

The HP 85712D EMC auto-measurement personality adds three EMC analyzer modes (EMC configuration, EMC manual, and EMC automated measurements) to the spectrum analyzer. The HP 85712D can be installed in any of these Hewlett-Packard spectrum analyzers:

- HP 8591E
- HP 8593E
- HP 8594E
- HP 8595E
- HP 8596E
- HP 8591A
- HP 8593A
- HP 8594A
- HP 8595A

NOTE

To take full advantage of all the features implemented in the EMC auto-measurement personality, Option 103 (quasi-peak detector and AM/FM demod) must be installed in the analyzer.

When installed in an HP 8590 Series spectrum analyzer, the HP 85712D provides all the capabilities and functions of the standard spectrum analyzer, with the addition of very specific EMC (electromagnetic compatibility) measurement functions. When used in conjunction with the HP 11945A close-field EMC probe set (Option E51), the combination becomes a powerful EMC analyzer for locating and evaluating potential EMC trouble areas. Add an HP 11966C biconical antenna, an HP 11966D log periodic antenna, or an HP 11967C line impedance stabilizing network (LISN) and use the HP 85712D EMC personality to facilitate precompliance measurements.

NOTE

Included on the HP 85712D EMC auto-measurement personality card are typical transducer factors and common limit lines.

Configuration Menu

The EMC configuration (EMC Config) menu gives you access to configuration functions. EMC Config menu capabilities include the following functions:

- Loading complete setups including: frequency range, bandwidths, detectors, antenna factors, limit lines, and preamp signal loss.
- One of four CISPR (International Special Committee on Radio Interference) frequency ranges with specific bandwidths.
- The appropriate close-field probe transducer factors.
- The appropriate antenna factors.
- The appropriate amplitude offset to account for preamplifier gain or cable loss.
- The desired limit line.

Manual Measurement Test Menu

The manual test (EMC Manual) menu gives you access to special spectral analysis functions particularly suited for EMC troubleshooting. EMC Manual menu capabilities include the following functions:

- Active control of the marker.
- Magnetic-field strength measurements.
- Demodulation of signals at the marker location.*
- Display trace control and manipulation.
- Narrowband and broadband signal discrimination.
- Normalization to a reference trace.
- Average detection measurements.
- Quasi-peak detection measurements. **

Using these functions with the general purpose spectrum analyzer functions will help you evaluate difficult EMC problems.

NOTE

* This function appears only with Option 102 (built-in AM/FM speaker and TV synch trigger) or Option 103 (built-in quasi-peak detection and AM/FM demod).

** This function appears only with Option 103 (built-in quasi-peak detection and AM/FM Demod).

Automated Measurement Test Menu

The Automated (EMC Automatn) Measurement Test menu gives the user access to a group of automated test functions, which perform measurements with a minimum of operator intervention. The user makes the measurements in an environment where all signals can be assumed to be device emissions. Capabilities include:

- Fully automated data taking functions.
- Full measurement setups.
- Selection of limit margins.
- Selection of detection methods.
- Selection of a range of data output options to the display, printer, or plotter.
- Selection of data printing or plotting options.

Introducing the HP 84100B and HP 84110B EMC Systems

The HP 84100B and HP 84110B EMC pre-compliance evaluation systems are powerful, low-cost systems that help you evaluate the electromagnetic compatibility (EMC) performance of your product designs.

Your system consists of a spectrum analyzer (plus accessories) and an HP 85712D EMC auto-measurement personality downloadable program (DLP). The analyzer's front-panel softkeys control the DLP's operations. See Figure 1-1.

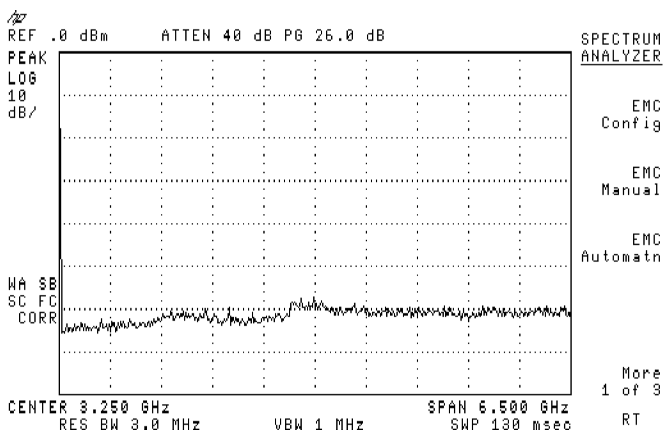


Figure 1-1. Front-Panel Softkeys

While using the EMC auto-measurement personality, you will be making measurements using both softkeys and front-panel keys. It is important to note the manual's designation for a front-panel key is (key). The front-panel softkeys are designated as `softkey`.

NOTE

Refer to the *HP 8591E/8593E Spectrum Analyzer Users Guide* or the *HP 8594E/8595E/8596E Spectrum Analyzer Users Guide* for more specific information about your spectrum analyzer.

What You Received with the HP 84100B EMC System

Standard System

- HP 8591E RF spectrum analyzer (9 kHz to 1.8 GHz) with built-in tracking generator, narrow bandwidths and HP-IB interface.
- HP 85712D EMC auto-measurement personality card.
- *HP 85712D EMC Auto-Measurement Personality Users Guide* (which includes the HP 84100B/84110B quick-start information).
- HP 11945A Option E51 close-field probe set (9 kHz to 1 GHz) with preamplifier, carrying case, cables, and connectors.

Available System Options

- Option 004 adds precision frequency reference to spectrum analyzer.
- Option 020 deletes tracking generator from HP 8591E spectrum analyzer.
- Option 023 replaces the HP-IB interface with an RS-232 interface on the spectrum analyzer.
- Option 040 adds a protective front cover to the spectrum analyzer.
- Option 045 deletes the HP 11945A Option E51 close-field probe set.
- Option 093 replaces the HP 8591E spectrum analyzer with an HP 8593E microwave spectrum analyzer (9 kHz to 22 GHz) with narrow bandwidth and an HP-IB interface.
- Option 094 replaces the HP 8591E spectrum analyzer with an HP 8594E microwave spectrum analyzer (9 kHz to 2.9 GHz) with narrow bandwidth and an HP-IB interface.

- Option 095 replaces the HP 8591E spectrum analyzer with an HP 8595E microwave spectrum analyzer (9 kHz to 6.5 GHz) with narrow bandwidth and an HP-IB interface.
- Option 096 replaces the HP 8591E spectrum analyzer with an HP 8593E microwave spectrum analyzer (9 kHz to 12.8 GHz) with narrow bandwidth and an HP-IB interface.
- Option 103 adds quasi-peak detection and AM/FM demodulation to the HP 8591E or HP 8593E spectrum analyzers.
- Option 193 replaces the HP 8591E RF spectrum analyzer with an HP 8593E RF spectrum analyzer (9 kHz to 22 GHz). Includes an HP-IB interface, quasi-peak detector, tracking generator, and memory card reader.
- Option 194 replaces the HP 8591E RF spectrum analyzer with an HP 8594E RF spectrum analyzer (9 kHz to 2.9 GHz). Includes an HP-IB interface, quasi-peak detector, tracking generator, and memory card reader.
- Option 195 replaces the HP 8591E RF spectrum analyzer with an HP 8595E RF spectrum analyzer (9 kHz to 6.5 GHz). Includes an HP-IB interface, quasi-peak detector, tracking generator, and memory card reader.
- Option 196 replaces the HP 8591E RF spectrum analyzer with an HP 8596E RF spectrum analyzer (9 kHz to 12.8 GHz). Includes an HP-IB interface, quasi-peak detector, tracking generator, and memory card reader.
- Option 915 add component level information and service guide.

Recommended Accessories

- HP 2225A Thinkjet printer with the standard HP-IB interface.
- HP 2225D Thinkjet printer with an RS-232 interface (for use with Option 023).
- HP 7475A six-pen graphics plotter.
  - HP 7475A Option 001 - RS-232 interface.
  - HP 7475A Option 002 - HP-IB interface.
- HP 10833A HP-IB cable, 1 m.
- HP 10833B HP-IB cable, 2 m.
- HP 17255M RS-232 cable, 1.2 m (for use with Option 23).
- HP 85700A blank 32 kilobyte RAM card.
- HP 82215A blank 128 kilobyte RAM card.

What You Received with the HP 84110B EMC System

Standard System

- HP 8591E RF spectrum analyzer (9 kHz to 1.8 GHz) with built-in quasi-peak detector (Option 103), narrow bandwidths (Option 130), and HP-IB interface (Option 021).
- HP 85712D EMC auto-measurement personality card.
- *HP 85712D EMC Auto-Measurement Personality Users Guide* (which includes the HP 84100B/84110B quick-start information).
- HP 11945A Opt. E51 close-field probe set (9 kHz to 1 GHz) with preamplifier, carrying case, cables, and connectors.
- HP 11947A transient limiter.

EMC Accessories Shipped with Your System

- HP 11966C biconical antenna (20 MHz to 300 MHz).
- HP 11966D log periodic antenna (200 MHz to 1 GHz).
- HP 11968C antenna tripod.
- HP 11967C line impedance stabilization network (LISN) (50 to 250 μH/50 Ω).
- HP 11966L 10 meter N-type coaxial cable.

Available System Options

- Option 010 adds a tracking generator to the spectrum analyzer. It is not available with Options 093, 094, 095, 096, 193, 194, 195, or 196.
  - □ To add a tracking generator to the HP 8593E, order Option 193 instead of Option 093.
  - □ To add a tracking generator to the HP 8594E, order Option 194 instead of Option 094.
  - □ To add a tracking generator to the HP 8595E, order Option 195 instead of Option 095.
  - □ To add a tracking generator to the HP 8596E, order Option 196 instead of Option 096.
- Option 023 replaces the HP-IB interface with an RS-232 interface on the spectrum analyzer.
- Option 040 adds a protective front cover to the spectrum analyzer.
- Option 045 deletes the HP 11945A Option E51 close-field probe set.
- Option 66E adds the HP 11966E double-ridged horn antenna.
- Option 66N replaces the HP 11966D log periodic antenna with an HP 11966N high-frequency log periodic antenna.
- Option 093 replaces the HP 8591E RF spectrum analyzer with an HP 8593E RF spectrum analyzer (9 kHz to 22 GHz). It includes an HP-IB interface, quasi-peak detector, narrow bandwidths, and memory card reader.
  - □ Option 093 is not available with Option 010. To add a tracking generator to the HP 8593E, order Option 193 instead of Option 093.
- Option 094 replaces the HP 8591E RF spectrum analyzer with an HP 8594E RF spectrum analyzer (9 kHz to 2.9 GHz). It includes an HP-IB interface, quasi-peak detector, narrow bandwidths, and memory card reader.
  - □ Option 094 is not available with Option 010. To add a tracking generator to the HP 8594E, order Option 194 instead of Option 094.

- Option 095 replaces the HP 8591E RF spectrum analyzer with an HP 8595E RF spectrum analyzer (9 kHz to 6.5 GHz). It includes an HP-IB interface, quasi-peak detector, narrow bandwidths, and memory card reader.
  - □ Option 095 is not available with Option 010. To add a tracking generator to the HP 8595E, order Option 195 instead of Option 095.
- Option 096 replaces the HP 8591E RF spectrum analyzer with an HP 8596E RF spectrum analyzer (9 kHz to 12.8 GHz). It includes an HP-IB interface, quasi-peak detector, narrow bandwidths, and memory card reader.
  - □ Option 096 is not available with Option 010. To add a tracking generator to the HP 8595E, order Option 196 instead of Option 096.
- Option 119 deletes all EMC accessories.
- Option 193 replaces the HP 8591E RF spectrum analyzer with an HP 8593E RF spectrum analyzer (9 kHz to 22 GHz). It includes an HP-IB interface, quasi-peak detector, tracking generator, narrow bandwidths, and memory card reader.
  - □ Option 193 is for an HP 8594E with a tracking generator. Order Option 093 instead of Option 193 to omit the tracking generator.
- Option 194 replaces the HP 8591E RF spectrum analyzer with an HP 8594E RF spectrum analyzer (9 kHz to 2.9 GHz). It includes an HP-IB interface, quasi-peak detector, tracking generator, narrow bandwidths, and memory card reader.
  - □ Option 194 is for an HP 8594E with a tracking generator. Order Option 094 instead of Option 194 to omit the tracking generator.
- Option 195 replaces the HP 8591E RF spectrum analyzer with an HP 8595E RF spectrum analyzer (9 kHz to 6.5 GHz). It includes an HP-IB interface, quasi-peak detector, tracking generator, narrow bandwidths, and memory card reader.
  - □ Option 195 is for an HP 8595E with a tracking generator. Order Option 095 instead of Option 195 to omit the tracking generator.
- Option 196 replaces the HP 8591E RF spectrum analyzer with an HP 8596E RF spectrum analyzer (9 kHz to 12.8 GHz). It includes an HP-IB interface, quasi-peak detector, tracking generator, narrow bandwidths, and memory card reader.
  - □ Option 196 is for an HP 8596E with a tracking generator. Order Option 096 instead of Option 196 to omit the tracking generator.

- Option 251 adds the HP 11951A, Option 12D spectrum analyzer infrared controller.
- Option 252 adds the HP 11952A monitor.
- Option 915 adds spectrum analyzer service documentation.

Recommended Accessories

- HP 2225A Thinkjet printer with the standard HP-IB interface.
- HP 2225D Thinkjet printer with an RS-232 interface (for use with Option 023).
- HP 7475A six-pen graphics plotter.
    - □ Option 001 RS-232 interface.
    - □ Option 002 HP-IB interface.
- HP 10833A HP-IB cable, 1 m.
- HP 10833B HP-IB cable, 2 m.
- HP 17255M RS-232 cable, 1.2 m (for use with Option 023).
- HP 85700A blank 32 kilobyte RAM Card.
- HP 82215A blank 128 kilobyte RAM Card.

Front-Panel Features

This section provides a brief description of front-panel features. Refer to Figure 1-2.

1 **Active function block** is the space on the screen that indicates the active function. Most functions appearing in this block can be changed using the knob, step keys, or data keys.

2 **Message block** is the space on the screen where MEAS UNCAL and the asterisk (*) appear. If the user uncouples one or more functions (sets them manually), and the amplitude or frequency becomes uncalibrated, the message MEAS UNCAL appears. (Use (AUTO COUPLE) and AUTO ALL to recouple functions.) The asterisk indicates that a function is in progress.

3 **Softkey labels** appear on the screen next to the unlabeled keys. Most of the labeled keys on the spectrum analyzer's front panel (also called front-panel keys) access menus of related softkeys.

4 **Softkeys** are the unlabeled keys next to the screen.

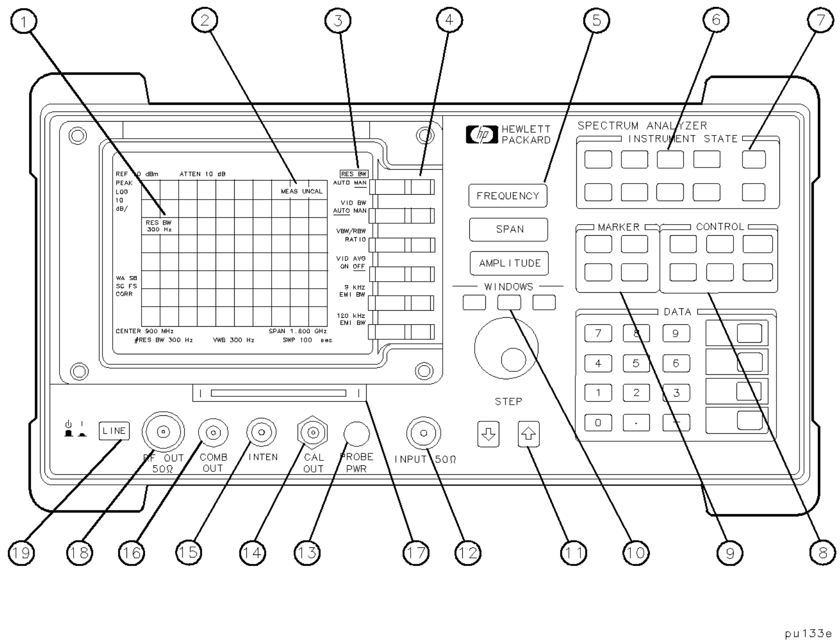


Figure 1-2. Front-Panel Feature Overview

5 (FREQUENCY), (SPAN), and (AMPLITUDE) are the three large dark-gray keys that activate the primary spectrum analyzer functions and access menus of related functions.

6 INSTRUMENT STATE functions affect the state of the entire spectrum analyzer. Self-calibration routines and special-function menus are accessed with these keys. The green (PRESET) key resets the spectrum analyzer to a known state. The (MODE) key accesses the current operating mode of the spectrum analyzer and allows you to change to any operating mode available for your spectrum analyzer. All spectrum analyzers have the spectrum analyzer mode of operation (indicated by SPECTRUM ANALYZER). If an additional softkey label appears in the softkey label area, a program (also called a downloadable program or personality) has been loaded into the spectrum analyzer's memory. This document covers the spectrum analyzer mode of operation only; consult the documentation accompanying the specific measurement personality that you are using for information about other modes

of operation. (For example: the HP 85711A cable television measurements personality, the HP 85713A digital radio measurements personality, or the HP 85715A GSM measurements personality.)

(SAVE) and (RECALL) save and recall traces, states, limit-line tables, amplitude correction factors, and programs to or from a memory card. (SAVE) and (RECALL) also save and recall traces, states, limit-line tables, and amplitude correction factors to or from the spectrum analyzer memory.

NOTE

To reset the spectrum analyzer configuration to the state it was in when it was originally shipped from the factory, use `DEFAULT CONFIG`.

7 (COPY) prints or plots screen data. (This requires Option 021 or 023.) Use (CONFIG), `Plot Config` or `Print Config`, and `COPY DEV PRNT PLT` before using (COPY).

8 CONTROL functions access menus that let you adjust the resolution bandwidth, adjust the sweep time, store and manipulate trace data, and control the instrument display.

9 MARKER functions control the markers, read out frequencies and amplitudes along the spectrum-analyzer trace, automatically locate the signals of highest amplitude, and keep a signal at the marker position in the center of the screen.

10 WINDOWS keys, turn on the windows display mode. They allow switching between windows and control the zone span and location. *For HP 8591E, 8593E, 8594E, 8595E, and 8596E spectrum analyzers only.*

HOLD key. *For the HP 8591E, 8593E, 8594E, 8595E, and 8596E spectrum analyzers, the "hold" function is available as the* `HOLD` *softkey under* (DISPLAY).

11 DATA keys, STEP keys, and knob let you change the numeric value of an active function.

12 INPUT 50Ω is the signal input for the spectrum analyzer. (INPUT 75Ω is the signal input for an Option 001 spectrum analyzer.)

CAUTION

Excessive signal input will damage the spectrum analyzer input attenuator and input mixer. Use extreme caution when using the spectrum analyzer around high-power RF sources and transmitters. The maximum input power that the spectrum analyzer can tolerate appears on the front panel and should not be exceeded.

Excessive dc voltage can also damage the input attenuator. For your particular instrument, note the maximum dc voltage that should not be exceeded on the spectrum analyzer front panel (beneath the INPUT 50Ω connector).

13 PROBE PWR provides power for high-impedance ac probes or other accessories.

14 CAL OUT provides a calibration signal of 300 MHz at −20 dBm (29 dBmV for Option 001 or 011).

15 VOL-INTEN or INTENSITY. *For the HP 8591E, 8593E, 8594E, 8595E, and 8596E spectrum analyzers only.* The VOL-INTEN knob changes the brightness of the display. If Option 102, 103, or 110 is installed, it can also adjust the volume of the internal speaker. If it adjusts both, the inside part of the knob adjusts the intensity while the outside part adjusts the volume.

16 100 MHz COMB OUT supplies a 100 MHz reference signal that has harmonics up to 22 GHz. *For the HP 8593E and 8596E spectrum analyzers only.*

17 **Memory card reader** reads from or writes to a memory card. The memory card reader is standard with an HP 8591E, 8593E, 8594E, 8595E, and 8596E spectrum analyzers.

18 RF OUT 50Ω supplies a source output for the built-in tracking generator. *For Option 010 only. See Table 1-1 below.*

CAUTION

If the tracking generator output power is too high, it may damage the device under test. Do not exceed the maximum power that the device under test can tolerate.

RF OUT 75Ω supplies a source output for the built-in tracking generator. *For Option 011 only. See Table 1-1 below.*

Table 1-1. RF Output Frequency Range

Model Number	Option 010 Frequency Range	Option 011 Frequency Range
HP 8591E	100 kHz to 1.8 GHz	1 MHz to 1.8 GHz
HP 8593E	300 kHz to 2.9 GHz	not available
HP 8594E	300 kHz to 2.9 GHz	not available
HP 8595E	300 kHz to 2.9 GHz	not available
HP 8596E	300 kHz to 2.9 GHz	not available

19 (LINE) turns the instrument on and off. An instrument self-check is performed every time the instrument is turned on. After applying power, allow the temperature of the instrument to stabilize for best measurement results.

NOTE

The instrument continues to draw power when it is plugged into the ac power source even if the line power switch is off.

Rear-Panel Features

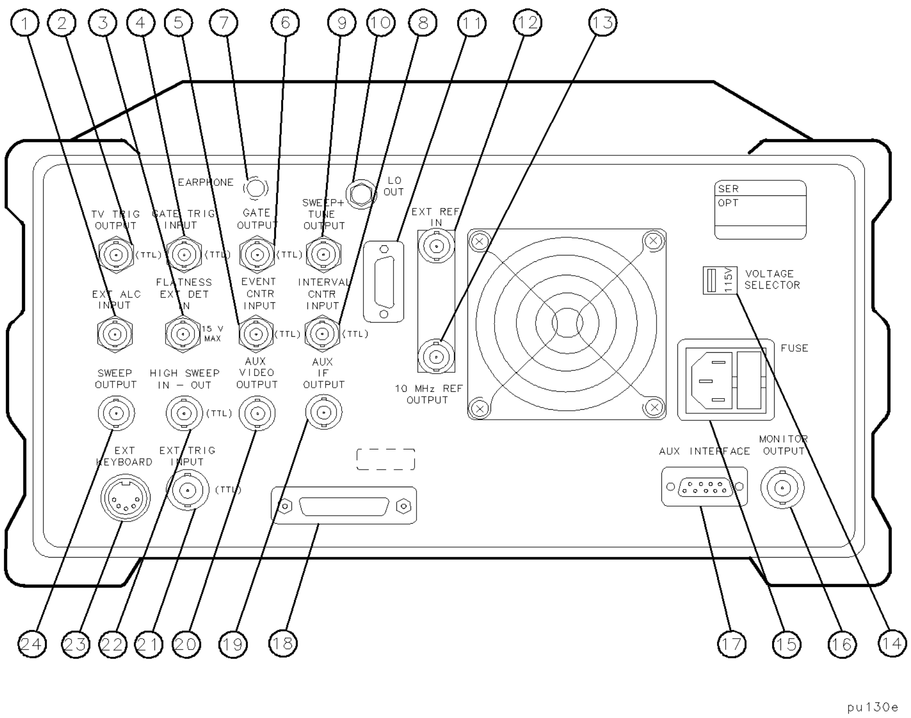


Figure 1-3. Rear-Panel Feature Overview

1 EXT ALC INPUT allows the use of an external detector or power meter for automatic leveling control of the tracking generator. *For an HP 8591E Option 010 or 011 only.* Allows the use of an external detector *for an HP 8593E, HP 8594E, HP 8595E, or HP 8596E Option 010 only.*

2 TV TRIG OUTPUT (TTL) provides TV trigger output using TTL and negative-edge triggering. *For Options 101 and 102 combined, or Option 301 only.*

3 FLATNESS EXT DET IN accepts a signal (16 V maximum) from an external crystal detector. This signal is used to correct the spectrum analyzer response to the detector's flatness. *Option E02 only.* This input is used for digital radio testing in an HP 11758T digital radio test system.

4 GATE TRIGGER INPUT (TTL) accepts a TTL signal that acts as the gate trigger. In edge mode, the trigger event (positive or negative edge) initiates a gate delay. In level mode, the gate trigger input signal opens and closes the gate directly: TTL high sets the gate on; TTL low sets the gate off. When this input is unconnected, TTL is set high. *For Option 105 only.*

5 EVENT CNTR INPUT (TTL) accepts a TTL signal and counts the negative pulses (a falling edge followed by a rising edge) that occur during the gate time interval. *Option E02 only.* This input is used to test for digital radio signal errors when using the HP 11758T digital radio test system.

6 GATE OUTPUT (TTL) provides a TTL signal which indicates gate status when the when the gate is in edge trigger mode. A high TTL signal indicates the gate is on; a low TTL signal indicates the gate is off. GATE OUTPUT is not active in level mode. *For Option 105 only.*

7 EARPHONE connector provides a connection for an earphone jack instead of using the internal speaker. *For Option 102, 103, or 110 only.*

8 INTERVAL CNTR INPUT (TTL) accepts a TTL signal. It identifies negative pulses (a falling edge followed by a rising edge) and measures the accumulated time that a pulse is low during the gate time interval. *Option E02 only.* This input is used to test for digital radio signal errors when using the HP 11758T digital radio test system.

9 SWEEP+TUNE OUTPUT provides a voltage ramp that is proportional to the spectrum analyzer span (0 to 10 V) plus the tuning voltage of the LO. *For Option 009 only.*

10 LO OUT provides the output of the first LO, which is proportional to the frequency that the spectrum analyzer is tuned to. *For Option 009 or 010 only.*

11 DIGITAL DEMOD OUT This output is not currently available.

12 EXT REF IN accepts an external frequency source to provide the 10 MHz, −2 to +10 dBm frequency reference used by the spectrum analyzer. *For an HP 8591E, HP 8593E, HP 8594E, HP 8595E, or HP 8596E only.*

13 10 MHz REF OUTPUT provides a 10 MHz, 0 dBm minimum, time-based reference signal. *For an HP 8591E, HP 8593E, HP 8594E, HP 8595E, or HP 8596E only.*

14 VOLTAGE SELECTOR adapts the unit to the power source: 115 V or 230 V.

15 Power input is the input for the line power source. Make sure that the line-power source outlet has a protective ground contact.

16 MONITOR OUTPUT drives an external monitor with a signal that has a 15.7 kHz horizontal synchronizing rate. It can also be switched to provide an NTSC format output is compatible with VHS video recorders or a PAL format which is compatible with PAL/SECAM video recorders.

17 AUX INTERFACE provides a nine-pin "D" subminiature connector for control of external devices.

CAUTION

- Turn off the spectrum analyzer before connecting the AUX INTERFACE connector to a device. Failure to do so may result in loss of factory-correction constants.
- Do not exceed the current limits for the +5 V supply when using the AUX INTERFACE connector. Exceeding the current limits may result in loss of factory-correction constants.
- Do not use the AUX INTERFACE as a video monitor interface. Damage to the video monitor will result.

18 Interface connectors are optional interfaces for HP-IB (Option 021) and RS-232 (Option 023) interface buses that support remote instrument operation and direct plotting or printing of screen data.

19 AUX IF OUTPUT is a 50Ω, 21.4 MHz IF output that is the down-converted signal of the RF input of the spectrum analyzer. Amplitude-correction factors are not applied to this signal.

20 AUX VIDEO OUTPUT provides detected video output (before the analog-to-digital conversion) proportional to vertical deflection of the

trace. Output is from 0 V to 1 V. Amplitude-correction factors are not applied to this signal.

21 EXT TRIG INPUT (TTL) accepts the positive edge of an external voltage input that triggers the spectrum analyzer's internal sweep source.

22 HIGH SWEEP IN/OUT (TTL) indicates when the spectrum analyzer is sweeping or can be grounded to stop sweeping.

23 EXT KEYBOARD connector is provided with the optional interface connector. The external keyboard is not included with the spectrum analyzer. The external keyboard can be used to enter screen titles, prefixes, remote commands, and writing simple DLPs. *For Options 021 and 023 only.*

CAUTION Turn off the spectrum analyzer before connecting an external keyboard to the spectrum analyzer.

24 SWEEP OUTPUT provides a voltage ramp proportional to the sweep and the spectrum analyzer span (0 V to 10 V).

Data Controls

Data controls are used to change values for functions such as center frequency, start frequency, resolution bandwidth, and marker position.

The data controls will change the active function in a manner prescribed by that function. For example, you can change center frequency in fine steps with the knob, in discrete steps with the step keys, or to an exact value with the number/units keypad. For example, resolution bandwidth, which can be set to discrete values only, is changed to predetermined values with any of the data controls.

Hold Key

Deactivate functions with HOLD, which is found under the (DISPLAY) key. The active function readout is blanked, indicating that no entry will be made inadvertently by using the knob, step keys, or keypad. (Press a function key to reenable the data controls.)

Knob

The knob allows continuous change of functions such as center frequency, reference level, and marker position. It also changes the values of many functions that change in increments only. Clockwise rotation of the knob increases values. For continuous changes, the extent of alteration is determined by the size of the measurement range; the speed at which the knob is turned does not affect the rate at which the values are changed.

The knob lets you change the center frequency, start or stop frequency, or reference level in smooth scrolling action. The smooth scrolling feature is designed to move the trace display to the latest function value as the knob is turned. When either center frequency or reference level is adjusted, the signal will shift right or left or up or down with the rotation of the knob before a new sweep is actually taken. An asterisk is placed in the message block (the upper right-hand corner of the spectrum analyzer display) to indicate that the data on-screen does not reflect data at the current setting.

NOTE

When using the knob to change frequency or amplitude settings, the trace data is shifted. Therefore, when using MAX HOLD A, MAX HOLD B, or MIN HOLD C, moving the center frequency with the knob will not simulate a drifting signal.

Number/Units Keypad

The number/units keypad allows entry of exact values for many of the spectrum analyzer functions. You may include a decimal point in the number portion. If not, the decimal point is placed at the end of the number.

Numeric entries must be terminated with a units key. The units keys change the active function in a manner prescribed by that function. For example, the units keys for frequency span are (GHz), (MHz), (kHz), and (Hz), whereas the units for reference level are (+dBm), (−dBm), (mV), and (μV).

NOTE

If an entry from the number/units keypad does not coincide with an allowed function value (for example, that of a 12 MHz bandwidth), the spectrum analyzer defaults to the nearest allowable value.

Step Keys

The step keys allow discrete increases or decreases of the active function value. The step size depends upon the spectrum analyzer's measurement range or on a preset amount. Each press results in a single step change. For those parameters with fixed values, the next value in a sequence is selected each time a step key is pressed. Changes are predictable and can be set for some functions. Out-of-range values or out-of-sequence values will not occur using these keys.

Fine-Focus Control

The fine-focus control is located on the side of the spectrum analyzer. Use the following procedure to adjust the fine-focus control:

1. Adjust the front-panel intensity control for a comfortable viewing intensity.
2. Use an adjustment tool or small screwdriver to access the fine-focus adjustment. See Figure 1-4. Adjust for a focused display.

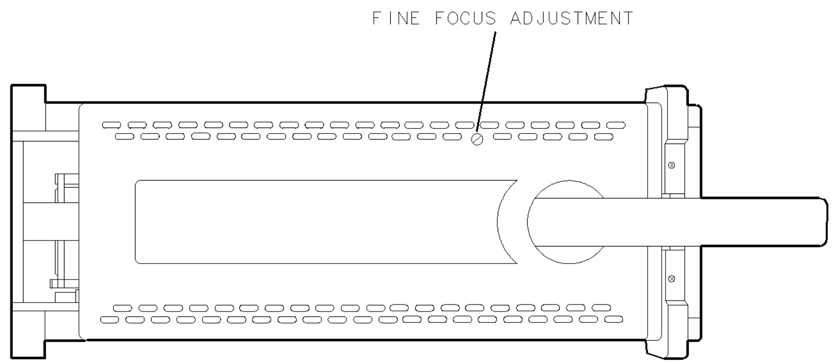


Figure 1-4. Adjusting the Fine Focus

Screen Annotation

Figure 1-5 shows an example of the annotation that may appear on a spectrum analyzer screen. The screen annotation is referenced by numbers and is listed in Table 1-2. The function key column indicates which front-panel key or softkey activates the function related to the screen annotation.

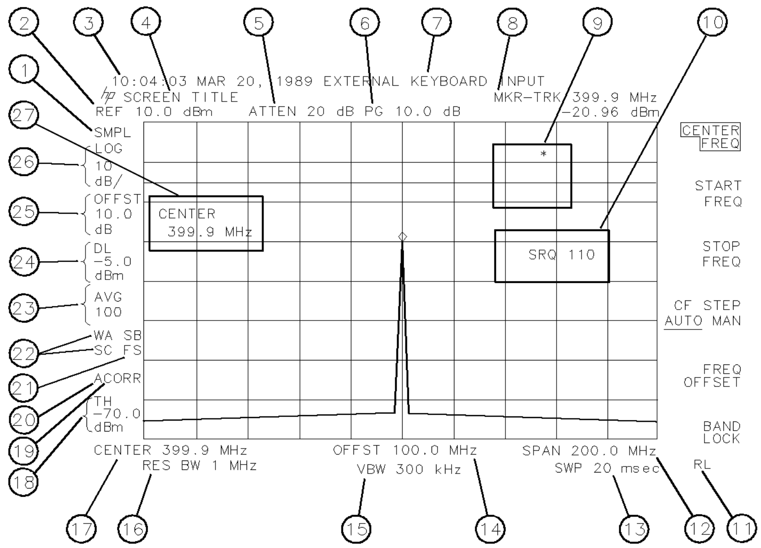


Figure 1-5. Screen Annotation

21 refers to the trigger and sweep modes of the spectrum analyzer. The first letter ("F") indicates the spectrum analyzer is in free-run trigger mode. The second letter ("S") indicates the spectrum analyzer is in single-sweep mode.

22 refers to the trace modes of the spectrum analyzer. The first letter ("W") indicates that the spectrum analyzer is in clear-write mode. The second letter is "A," representing trace A. The trace B trace mode is "SB", indicating trace B ("B") is in the store-blank mode ("S"). The trace mode annotation for trace

C is displayed under the trace mode annotation of trace A. The trace C trace mode is “SC”, indicating trace C (“C”) is in the store blank mode (“S”).

Refer to Table 1-3 for the screen annotation codes for trace, trigger, and sweep modes.

WINDOWS display mode splits the screen into two separate displays. Only one of these displays is active at a time. The currently active window will have a solid line around the graticule rather than a broken line. The complete annotation is not available for each window because of space limitations.

The display will be compressed slightly when using the PAL or NTSC format for the MONITOR OUTPUT, instead of the normal format. The PAL and NTSC formats have less vertical resolution than the spectrum analyzer display. The top and bottom of the spectrum analyzer display are compressed slightly so that all of the information can be fit into the size required by the MONITOR OUTPUT.

Table 1-2. Screen Annotation

Item	Description	Function Key
1	detector mode	DETECTOR SMP PK
2	reference level	REF LVL
3	time and date display	Time Date
4	screen title	Change Title
5	RF attenuation	ATTEN AUTO MAN
6	preamplifier gain	EXTERNAL PREAMPG
7	external keyboard entry	
8	marker readout	(MKR), (MKR ->), (MKR FCTN), or (PEAK SEARCH)
9	measurement uncalibrated or function-in-progress messages	(AUTO COUPLE)
10	service request	See Appendix A
11	remote operation	
12	frequency span or stop frequency	(SPAN), STOP FREQ
13	sweep time	SWP TIME AUTO MAN
14	frequency offset	FREQ OFFSET
15	video bandwidth	VID BW AUTO MAN
16	resolution bandwidth	RES BW AUTO MAN
17	center frequency or start frequency	CENTER FREQ , START FREQ
18	threshold	THRESHLD ON OFF
19	correction factors on	CORRECT ON OFF
20	amplitude correction factors on	
21	trigger	(TRIG)
22	trace mode	(TRACE)
23	video average	VID AVG ON OFF
24	display line	dsP LINE ON OFF
25	amplitude offset	REF LVL OFFSET
26	amplitude scale	SCALE LOG LIN
27	active function block	Refer to the description of the softkey function that was activated.

Table 1-3. Screen Annotation for Trace, Trigger, and Sweep Modes

Trace Mode	Trigger Mode	Sweep Mode
W = clear write (traces A/B/C)	F = free run	C = continuous
M = maximum hold (traces A/B)	L = line	S = single sweep
V = view (traces A/B/C)	V = video	
S = store blank (traces A/B/C)	E = external	
M = minimum hold (trace C)	T = TV (Options 101 and 102 only)	

Softkey Menu Maps

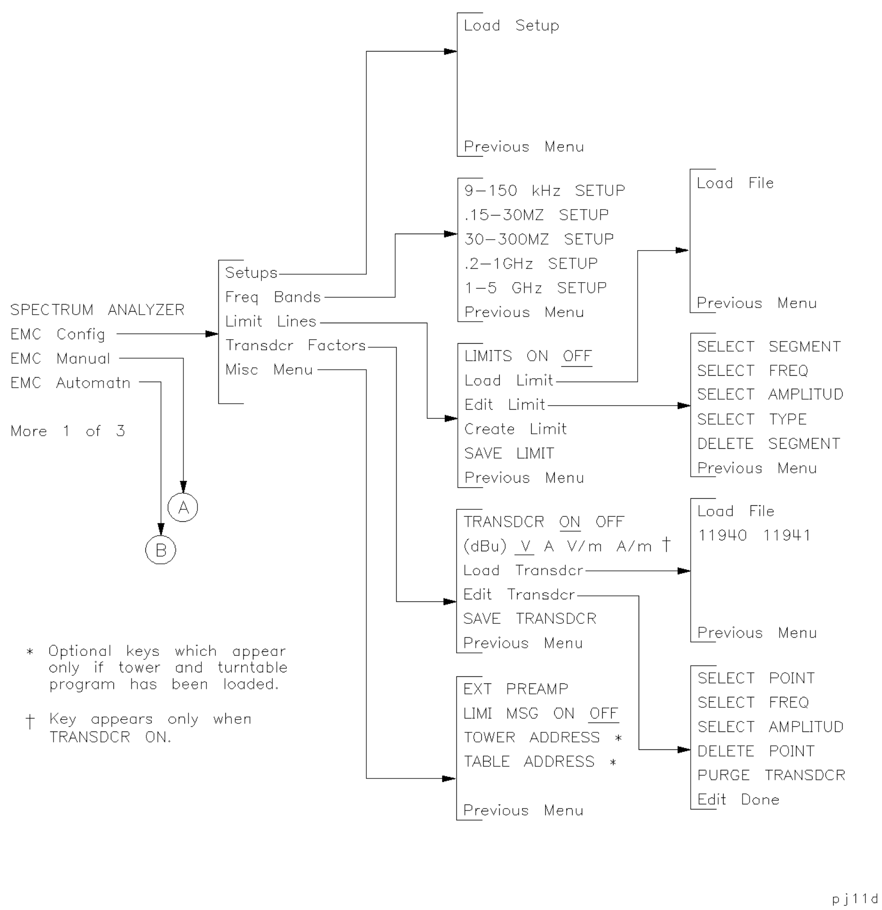


Figure 1-6. EMC Auto-Measurement Personality Menu Map (1 of 3)

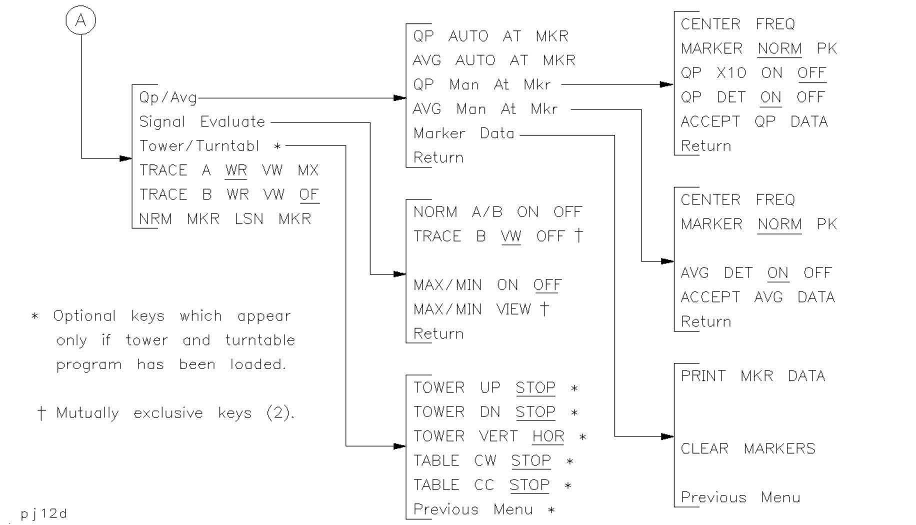


Figure 1-7. EMC Auto-Measurement Personality Menu Map (2 of 3)

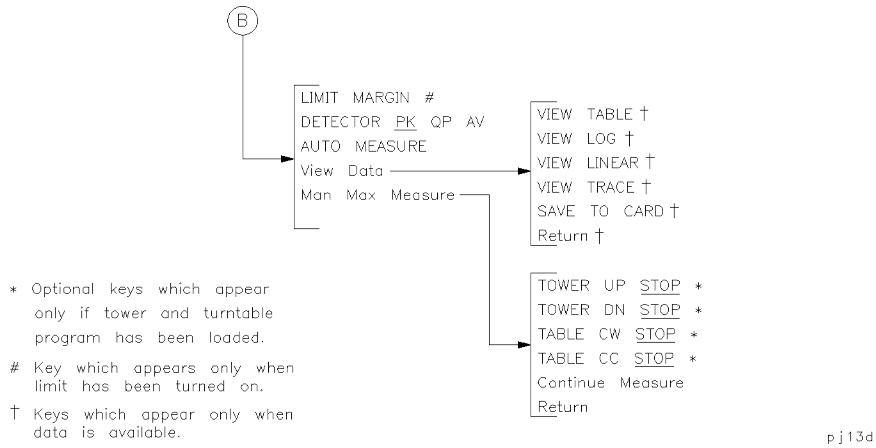


Figure 1-8. EMC Auto-Measurement Personality Menu Map (3 of 3)

2

Installing the EMC Auto-Measurement Personality

Installing the EMC Auto-Measurement Personality

This chapter discusses installing both the HP 85712D EMC auto-measurement personality and the EMC tower/turntable program and includes the following information:

Installing the EMC Auto-Measurement Personality

WARNING

Be sure to clear the analyzer's user memory before you install the EMC auto-measurement personality. Not clearing user memory may result in a SYM TAB OVERFLOW error, which can disrupt analyzer operation. A SYM TAB OVERFLOW error may require using the (CAL) front-panel key to recalibrate your instrument. All user-installed programs will be destroyed during the implementation of the "Clearing the Analyzer's User Memory" procedure described in this chapter. Refer to your analyzer's operation manual for more information about calibrating your instrument.

NOTE

- Internal registers, limit lines, and transducer factors are not cleared when a DISPOSE USER MEM is performed.
- Before using the EMC auto-measurement personality card, perform the spectrum analyzer's amplitude and frequency calibration procedure be followed. These procedures are outlined in your spectrum analyzer's operation manual.

Clearing the Analyzer's User Memory

1. Press (CONFIG).
2. Press MORE 1 of 3.
3. Press DISPOSE USER MEM twice to clear user memory.

Installing the Personality

Use the following information to ensure that the EMC auto-measurement personality card is inserted correctly into the spectrum analyzer. Improper insertion causes error messages to occur, but generally does not damage the card or instrument. Be careful not to force the card into place. The card is easy to insert when installed properly.

1. Locate the arrow printed on the EMC auto-measurement personality card's label.
2. Insert the card into the spectrum analyzer with the card's arrow matching the raised arrow on the bezel around the card-insertion slot. If the card has no arrow, insert the bright-metal end of the card face down into the analyzer's card-insertion slot. See Figure 2-1.

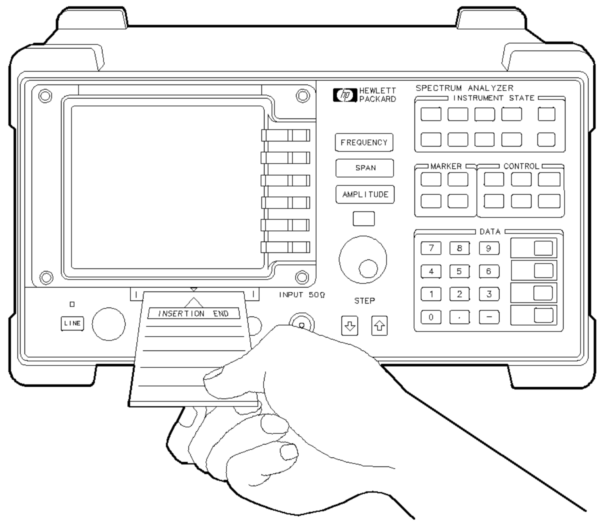


Figure 2-1. Inserting the Memory Card

3. Press the card into the slot. When correctly inserted, about 19 mm (0.75 in) of the card is exposed.

Installing the EMC Auto-Measurement Personality

4. Press (SAVE) or (RECALL). INTRNL CRD will be displayed on the right side of the display. CRD is underlined when the memory card is selected. If INTRNL is underlined, press INTRNL CRD to select CRD.

5. Press CATALOG CARD, CATALOG ALL (dEMC_ANLZ, the EMC personality, will be highlighted, see Figure 2-2), and LOAD FILE. The LOAD FILE key will be highlighted while the EMC personality is being loaded. It takes about 35 seconds for the analyzer to load the EMC personality. Limit lines and transducer factors must be loaded separately from the card. The EMC personality's Load Setup softkey may also be used.

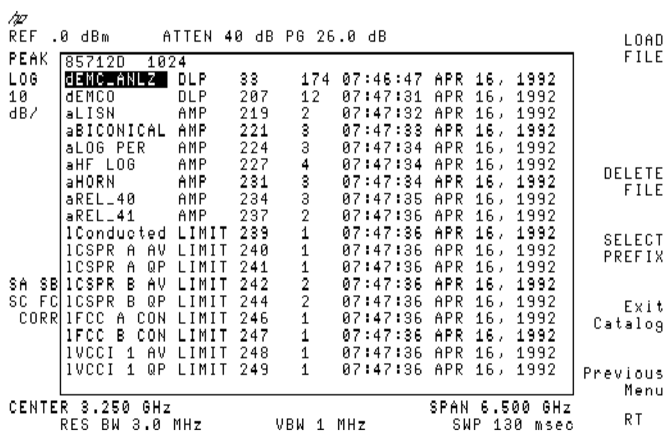


Figure 2-2. Selecting the dEMC_ANLZ File

NOTE

If a SYM TAB OVERFLOW error appears on your display, follow the procedure in "Recovering from a SYM TAB OVERFLOW Error," at the end of this chapter.

6. Press (PRESET). The top level EMC auto-measurement personality softkey menu should be displayed as illustrated in Figure 2-3. The personality is now stored in memory, and the EMC analyzer mode is ready to use.

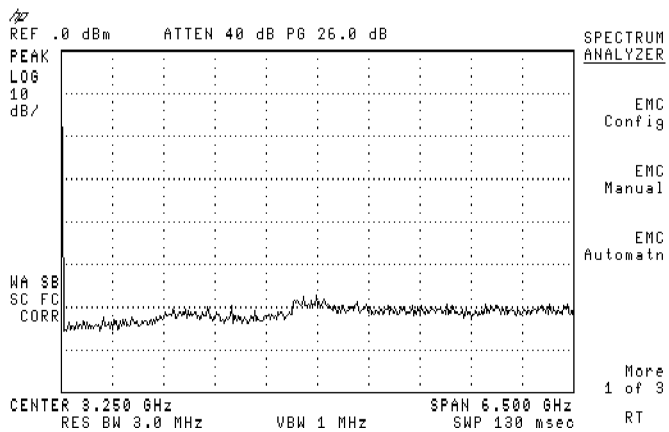


Figure 2-3. EMC Analyzer Available after Pressing (PRESET)

Installing the Tower/Turntable Program

Installing the Program

Install the optional tower/turntable program to control the HP 11968A antenna and HP 11968D turntable positioner. Install the tower/turntable program *after* installing the HP 85712D EMC auto-measurement personality.

NOTE

- Because of memory considerations, the tower/turntable program can only be installed in the HP 859xD or HP 859xE series spectrum analyzers.
- The spectrum analyer must have option 021 (HP-IB) installed.

WARNING

Attempting to install the tower/turntable program in either the HP 859xA or HP 859xB series of spectrum analyzers will result in a `SYM TAB OVERFLOW` error. A `SYM TAB OVERFLOW` error may require the use of the (CAL) front-panel key to recalibrate your instrument. Your analyzer's operation manual has more information about calibrating your instrument. Also, refer to "Recovering from a `SYM TAB OVERFLOW` Error," in this chapter.

Use the following information to ensure that the EMC auto-measurement personality card is inserted correctly into the spectrum analyzer. Improper insertion causes error messages to occur, but generally does not damage the card or instrument. Be careful must be taken, however, not to force the card into place. The card is easy to insert when installed properly.

1. Locate the arrow printed on the EMC auto-measurement personality card's label.
2. Insert the card into the spectrum analyzer with the card's arrow matching the raised arrow on the bezel around the card-insertion slot. If the card has no arrow, insert the bright-metal end of the card face down into the analyzer's card-insertion slot.
3. Press the card into the slot. When correctly inserted, about 19 mm (0.75 in) of the card is exposed.
4. Press (SAVE) or (RECALL). `INTRNL CRD` will be displayed on the right side of the display. CRD is underlined when the memory card is selected. If INTRNL is underlined, press `INTRNL CRD` to select CRD.
5. Press `CATALOG CARD`, `CATALOG ALL`, ⇩ (`dEMCO`, the tower/turntable program, will be highlighted, see Figure 2-4), and `LOAD FILE`. It takes about six seconds for the analyzer to load the tower/turntable program.

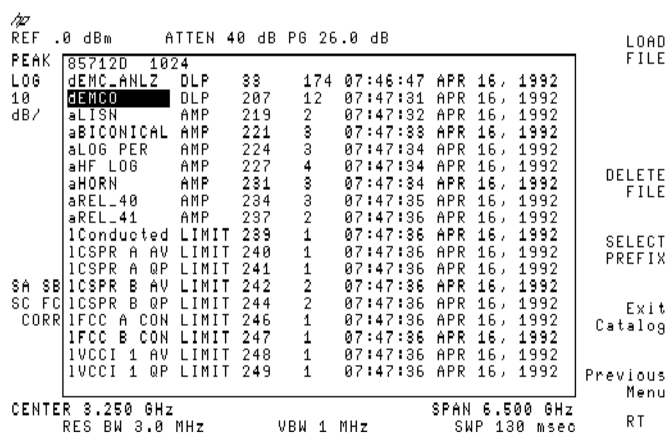


Figure 2-4. Selecting the dEMCO File

NOTE

If a `SYM TAB OVERFLOW` error appears on your display, follow the procedure in "Recovering from a `SYM TAB OVERFLOW` Error," at the end of this chapter.

6. Press (PRESET). The top level EMC auto-measurement personality softkey menu should be displayed. The personality is now stored in memory, and the EMC analyzer mode is ready to use.

Installing the Interconnect Cables

The spectrum analyzer's HP-IB controls the HP 11968A and HP 11968D tower and turntable positioners. See Figure 2-5 for connection information.

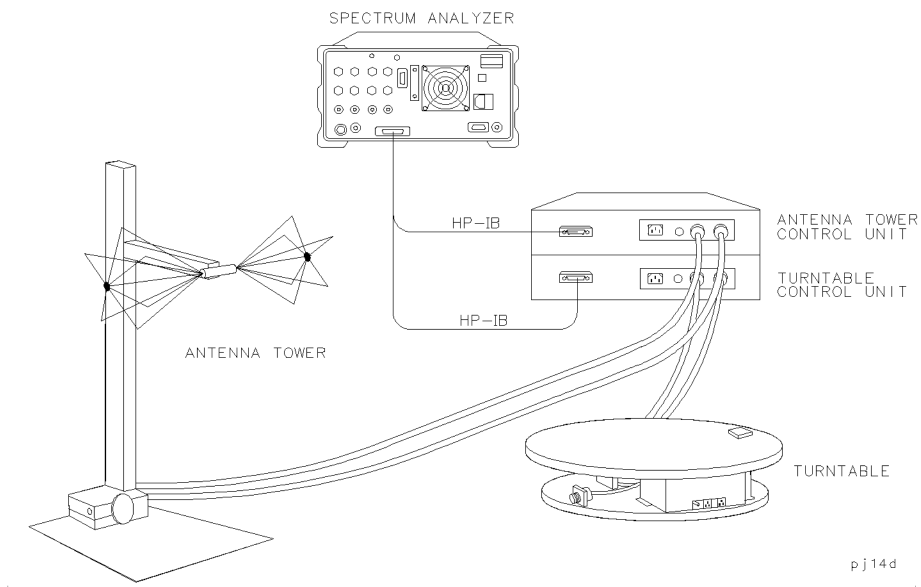


Figure 2-5. Turntable/tower Interconnect Cables

Recovering from a SYM TAB OVERFLOW Error

NOTE

After you use this procedure to recover from a SYM TAB OVERFLOW error, your analyzer may be recalibrated using the (CAL) front-panel key. Your analyzer's operation manual for more information about calibrating your instrument.

1. Press (PRESET). If the error does not clear, go on to the next step. If the error clears, go to step 3.
2. Press (PRESET) again. If the error does not clear, repeat this step a minimum of five times, checking each time to see if the error clears. If the error does not clear after five attempts, call your nearest Hewlett-Packard Sales and Service Office for assistance.
   a. Press (CONFIG).
   b. Press (MORE 1 of 3).
   c. Press (DISPOSE USER MEM) to clear user memory.
3. Press (SAVE) or (RECALL). INTRNL CRD will be displayed on the right side of the display. CRD is underlined when the memory card is selected. If INTRNL is underlined, press INTRNL CRD to select CRD.
4. Press CATALOG CARD, CATALOG ALL (dEMC_ANLYZ, the EMC personality, will be highlighted), and LOAD FILE.
5. Optionally, for the HP 859xD and HP 859xE family of analyzers, press CATALOG CARD, CATALOG ALL, (⇩) (dEMC0, the tower/turntable program, will be highlighted), and LOAD FILE.
6. Press (PRESET). The top-level EMC auto-measurement personality softkey menu should be displayed.

3

Making Measurements Using the EMC Auto-Measurement Personality

Making Measurements Using the EMC Auto-Measurement Personality

This chapter describes a series of measurements using the EMC auto-measurement personality and includes the following information:

Making Diagnostic Measurements Using a Close-Field Probe

This test uses a close-field probe to help locate problem emissions in the device under test (DUT) and to characterize those emissions.

In this section . . .

Read This

If you find a reference to a softkey that is not on the display screen, you have probably pressed a front-panel key by mistake. To return to the EMC measurement personality, press the (MODE) front-panel key *two times*.

Helpful Information

The trace information on the display screen presented in this procedure is only for example. It may not reflect what you see on your display.

Setting Up the Test Equipment

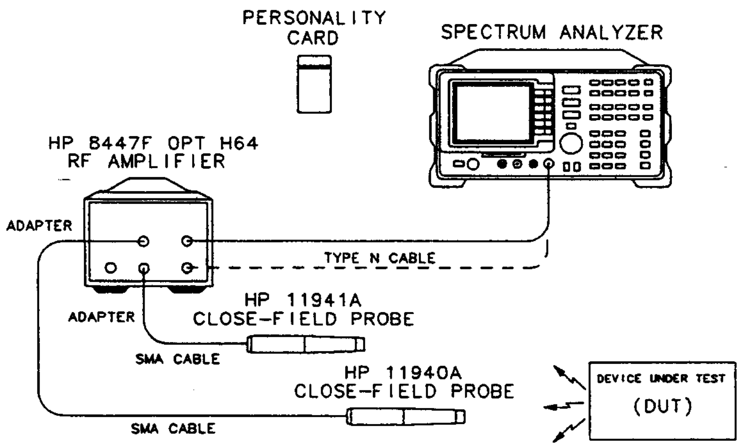


Figure 3-1. Diagnostic (Close-Field Probe) Test Setup

Equipment List

spectrum analyzer	HP 8591E HP 8593E HP 8594E HP 8595E HP 8596E
EMC measurement personality card	HP 85712D
HP 11945A close-field probe set	HP 11940A HP 11941A
preamplifier	HP 8447F Option H64

Making an Automated Diagnostic Measurement

NOTE

For manual setup information, refer to "Making a Manual Diagnostic Measurement" in this chapter.

Configuring the Analyzer for Testing

1. Press (PRESET) to reset the spectrum analyzer to the initial state.
2. Insert the card into the spectrum analyzer with the card's arrow matching the raised arrow on the bezel around the card-insertion slot.
3. Press `EMC Config` to enter the EMC automation top-level menu.

4. Press `Setups`. Scroll down to `PRB D 34` and highlight the setup file. See Figure 3-2.

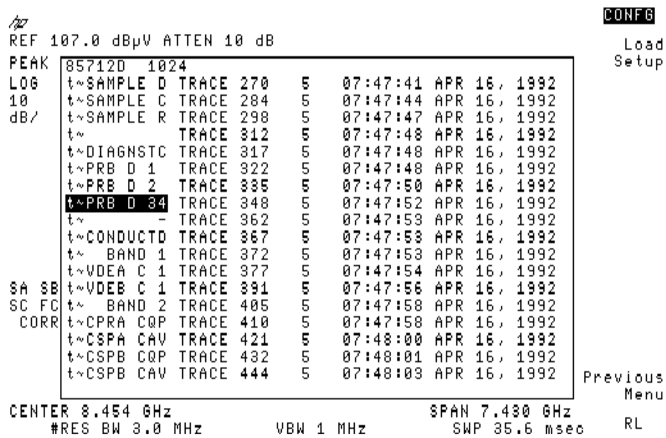


Figure 3-2. `PRB D 34` **Selected**

5. Press `Load Setup` to load the file.
6. Press the (MODE) front-panel key.

Locating the Worst-Case Emissions

7. Press EMC Manual to activate the diagnostic functions.
8. Move the probe around the DUT to find the highest response.
9. Press NRM MKR LSN MKR so that NRM MKR is highlighted.
10. Move the marker using the front-panel knob, the step keys, or (PEAK SEARCH) to the response of interest and record that frequency. See Figure 3-3.

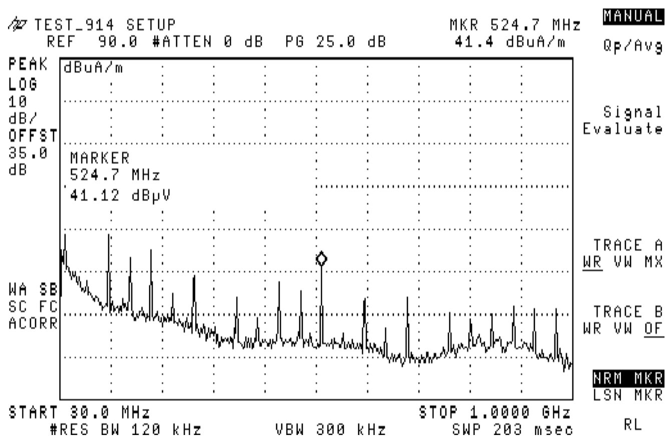


Figure 3-3. Moving the Marker to the Highest Response

11. Press (MKR⇒), MARKER⇒CF to move the marker to center frequency.
12. Press (SPAN) to activate the span.
13. Press 100 (MHz) (or desired span) to reduce the span.

14. Press (MODE), (MODE) to return to the EMC auto-measurement personality. See Figure 3-4.

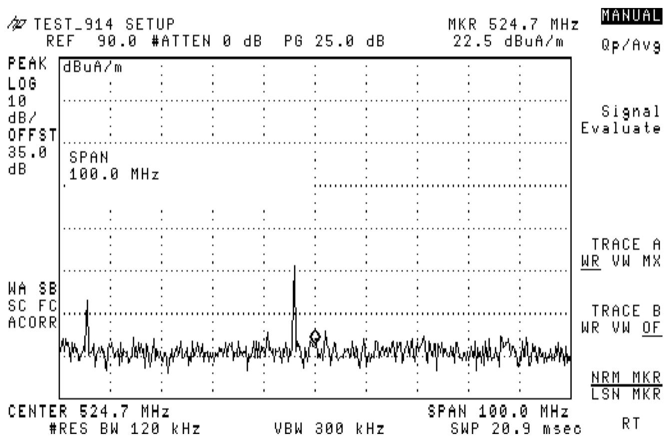


Figure 3-4. Reducing the Span

15. Press TRACE B WR VW OF two times (WR will be underlined).
16. Press TRACE A WR VW MX two times (MX will be underlined), which sets the analyzer to record the worst-case emission level.
17. Move the probe around the DUT to find the worst-case emission. Keep the probe tip close to the source of the emissions.

18. Press TRACE A WR VW MX once again (VW will be underlined) to save the displayed response. See Figure 3-5.

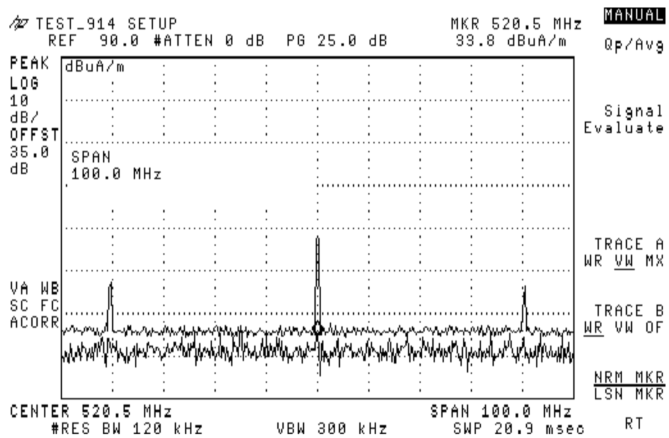


Figure 3-5. Saving the Displayed Response in View Mode

Storing the Data to Internal Memory

19. Press the (SAVE) front-panel key.
20. Press INTERNAL CARD (INTERNAL will be underlined).
21. Press Trace⇒Internal. See Figure 3-6.

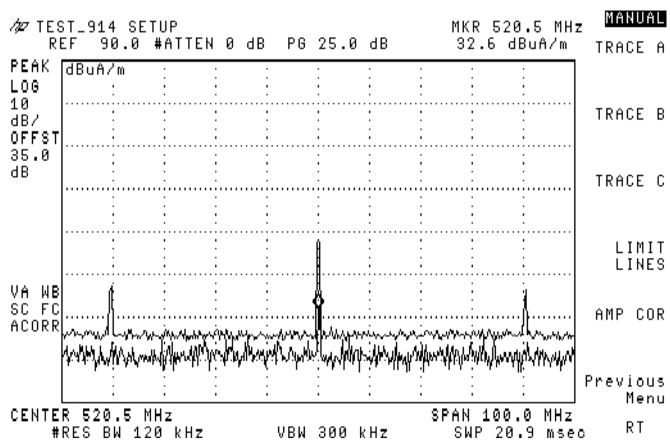


Figure 3-6. Trace to Internal Selected

22. Press TRACE A, 1, (ENTER) ((Hz) key in the lower-right corner of the analyzer) to enter the trace A data into internal register 1.
23. Press (MODE), (MODE) to return to the EMC auto-measurement personality.
24. Press TRACE A WR VW MX once (WR will be underlined) to clear-write trace A.
25. Press TRACE B WR VW OF two times (OF will be underlined) to turn off trace B.

Recalling Previous EMC Data after Modifying the Device Under Test

26. Press the (RECALL) front-panel key.
27. Press **Internal⇒Trace**.
28. Press **TRACE A**, 1, (ENTER) ((Hz) key in the lower-right corner of the analyzer) to recall a previous trace from internal register 1 for comparison.
29. Press (MODE), (MODE) to return to the EMC auto-measurement personality.

Making a Field-Strength Measurement

30. Press the (MKR) front-panel key.
31. Position the marker on the desired signal. Read the field strength value in dBμA/m in the upper-right corner of the CRT. See Figure 3-7. Note the active function area displays only dBμV.
32. Press (MODE), (MODE) to return to the EMC auto-measurement personality.

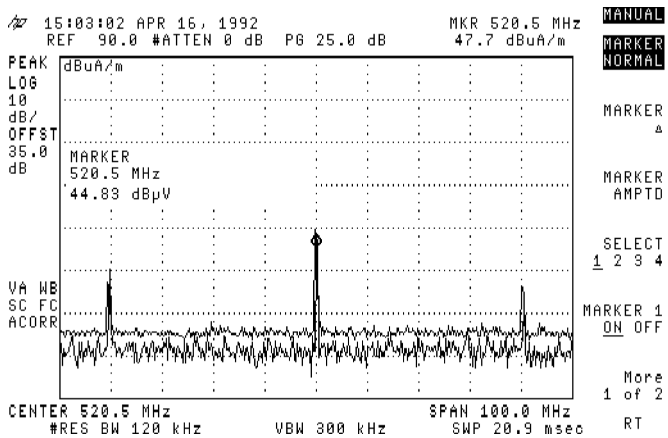


Figure 3-7. Reading the Probe's Output in dBμA/m

Characterizing the Emissions

33. Press SIGNAL EVALUATE .
34. Press MAX/MIN ON OFF (ON will be underlined).
35. Press MAX MIN VIEW until MAX, MIN, and VIEW are all underlined.
36. Toggle MAX MIN VIEW between MAX, MIN, and VIEW to view max-held, min-held, and both signals on the display. See Figure 3-8.
37. Press MAX/MIN ON OFF (OFF will be underlined) to turn off max/min measurements.

NOTE

The signals visible during MIN VIEW are continuous signals. The signals that appear during MAX VIEW and not MIN VIEW are pulsed or broadband signals.

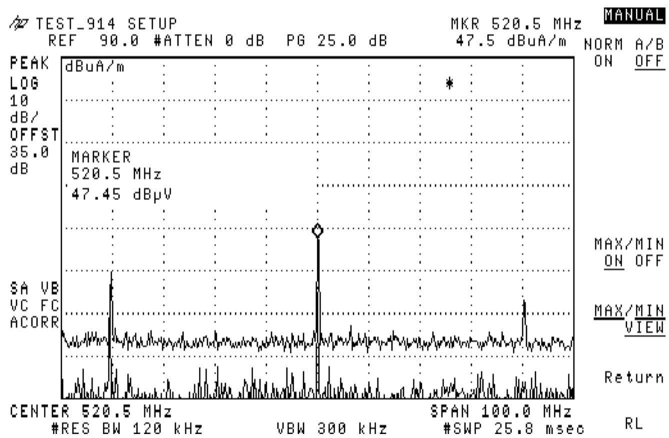


Figure 3-8. Signals Viewed with MAX MIN VIEW

38. Press RETURN .
39. Press the MKR front-panel key.
40. Press MARKER Δ to activate the delta marker.

41. Measure the harmonic interval using the marker delta function and scroll to the next peak of interest. Record the interval. See Figure 3-9.

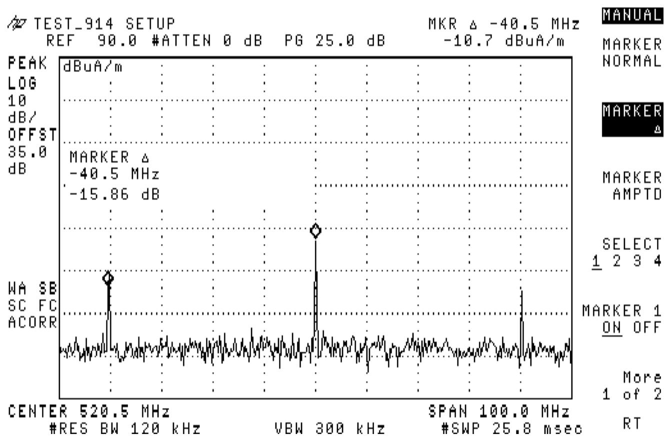


Figure 3-9. Measuring the Harmonic Interval

Printing the Delta Marker Data in Tabular Form

42. Connect the printer to the EMC analyzer (if it has not been previously connected).
43. Press the (COPY) front-panel key.

Clearing the Markers

44. Press the (MKR) front-panel key.
45. Press MORE 1 of 2 and MKRS ALL OFF to clear the markers.
46. Press (PRESET) to clear the analyzer and to return to the top-level EMC measurement personality menu.

Making a Manual Diagnostic Measurement

Important Information

It is important to perform each step in the following procedures. To do otherwise will produce results that are different than expected.

Configuring the EMC Analyzer for Testing

1. Press (PRESET).
2. Press EMC Config .

Setting the EMC Analyzer's Start and Stop Frequencies

NOTE

Measurements can be made outside the close-field probe's frequency range, but the probe will not be calibrated.

3. Press Freq Bands .
4. Press 30-300Mz SETUP when using the HP 11940A close-field probe. See Figure 3-10.

> **NOTE**
>
> The entire 30 MHz to 300 MHz range can be viewed since close-field probes are not susceptible to troublesome ambient signals, such as commercial radio stations.

a. Press .15-30M SETUP when using the HP 11941A close-field probe.

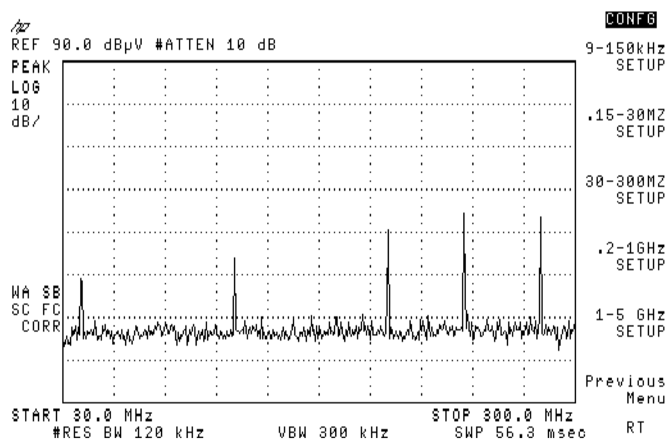


Figure 3-10. 30-300 MHz Setup Selected

5. Press Previous Menu.
6. Press Transdcr Factors.
7. Press Load Transdcr.
8. Press 11940/11941. Toggle to the probe being used. The selected probe will be underlined.

Factoring in the Preamplifier's Gain

9. Press `Previous Menu`.
10. Press `Previous Menu` again.
11. Press `Misc Menu`.
12. Press `EXT PREAMP`
13. Press 25 and `dB` (or a value equal to your preamplifier's gain). The preamplifier's gain appears at the top of the display screen (as `PG 25.0 dB)`. The EMC measurement personality factors in the proper amount of preamplifier gain.

Adjusting the Reference Level and Attenuation

Depending on the amplitude of the signals being measured, the reference level and attenuation may need adjusting.

14. Press (AMPLITUDE).
15. Press 80 (dB).
16. Press ATTEN AUTO MAN to underline MAN.
17. Press 0 (dB). See Figure 3-11.

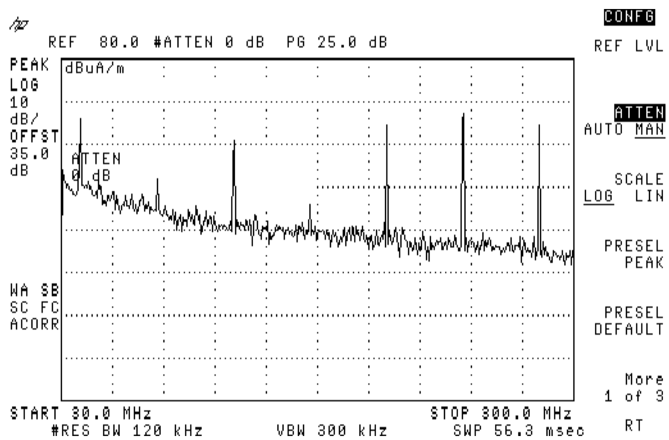


Figure 3-11. Adjusting the Reference Level and Attenuation

18. Press (NEXT) (press (HOLD) on HP 859xA/B) (MODE) to return to the EMC personality.

Making Localized Susceptibility Measurements

Objectives

This test determines if a device under test is susceptible to emissions coming either from the device itself or from some outside source.

In this section . . .

Read This

If you find a reference to a softkey that is not on the display screen, you have probably pressed a front-panel key by mistake. To return to the EMC measurement personality, press the (MODE) key *two times*.

Helpful Information

The trace information on the display screen presented in this procedure is only for example. It may not reflect what you see on your display.

Setting Up the Equipment for Testing

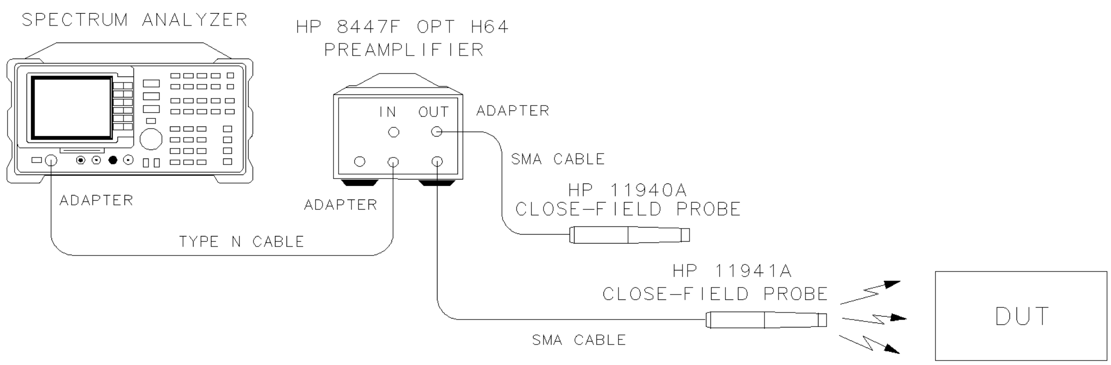


Figure 3-12. Localized Susceptibility Measurements Test Setup

CAUTION

The HP 8447F preamplifier will only accept a 0 dB input, whereas the HP 8591E's tracking generator can output up to 20 dBm. So be sure you know the tracking generator's output before connecting it to the HP 8447F's input. The best (safest) input is about −15 dBm, to prevent the amplifier from going into gain compression. Any higher signal will not improve the amplifier's output above the gain value printed on the amplifier's front panel.

CAUTION

Delete HP 8447F Option H64 preamplifier when using the HP 8593A, HP 8594E, HP 8595E, HP 8596E spectrum analyzers. The HP 8593E, HP 8594E, HP 8595E, HP 8596E tracking generator output will only go to −10 dBm, whereas the HP 8447F requires a minimum of −15 dB to prevent overdriving the preamplifier. When not using the preamplifier with the HP 8593E, HP 8594E, HP 8595E, and HP 8596E spectrum analyzers, set the SCR PWR (source power) to +2.75 dB.

Equipment List

spectrum analyzer (with tracking generator)	HP 8591E with: Opt. 010
	HP 8593E Opt. 010
	HP 8594E Opt. 010
	HP 8595E Opt. 010
	HP 8596E Opt. 010
HP 11945A close-field probe set	HP 11940A
	HP 11941A
preamplifier (use with HP 8591E only)	HP 8447F Opt. H64

CAUTION The maximum safe input power to the HP 11940/41 probes is +30 dBμ (1W).

Localized Susceptibility Measurements Using the HP 8591E

The following steps provide instructions for setting up the tracking generator portion of the EMC analyzer.

1. Press (AUX CTRL).
2. Press Track Gen .
3. Press SRC PWR ON OFF . The source power becomes the active function (SWR PWR in inverse video) however, the source power has not been turned on. See Figure 3-13.

NOTE

The purpose of the previous step is to set the tracking generator to a known level (in dBm) without turning on the tracking generator.

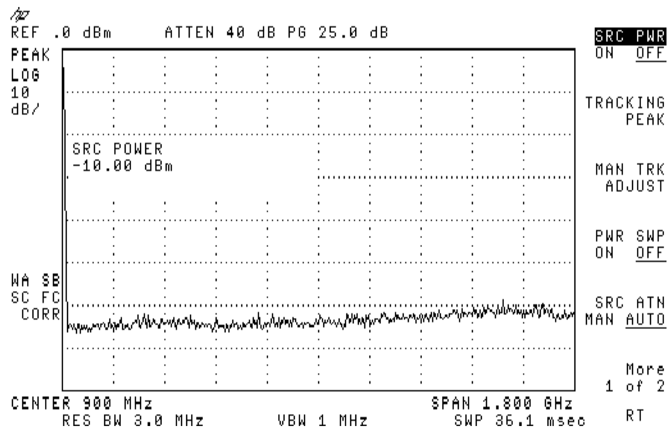


Figure 3-13. Setting Up the Tracking Generator (HP 8591E)

Tuning the Tracking Generator

The next step requires tuning the tracking generator to the frequency of interest. The frequency must be within the frequency range of the probe being used. In the following example we are using an HP 11941A close-field probe (9 kHz to 30 MHz frequency range) to look at a narrow frequency range (about 10 MHz to 30 MHz). To tune the EMC analyzer for that frequency range, do the following:

4. Press (FREQUENCY).
5. Press START FREQ, 10, (MHz).
6. Press STOP FREQ, 30, (MHz). The tracking generator is now sweeping over that range.
7. Press (AUX CTRL).
8. Press Track Gen to return to the tracking generator.
9. Press SCR PWR ON OFF.

CAUTION

In the following step, it is very important to press (- dBm). If you press (+ dBm), it could to overdrive the preamplifier.

Turning On the Tracking Generator

10. Press 15 and (- dBm). The tracking generator is now turned on. Notice that the SCR PWR softkey has toggled to ON. See Figure 3-14.

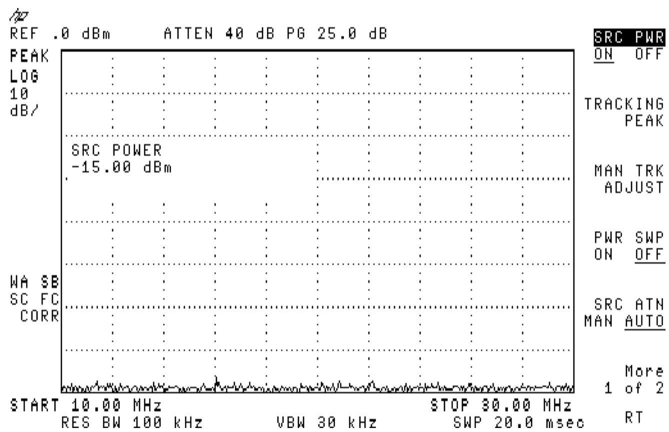


Figure 3-14. Turning On the Tracking Generator (HP 8591E)

> **NOTE**
>
> For more information about specific spectrum analyzer functions, refer to your instrument's operation manual.

11. Move the close-field probe around the circuit under test, looking for any disruption to the DUT's normal operation.

Localized Susceptibility Measurements Using the HP 8593E/94E/95E/96E

The following steps provide instructions for setting up the tracking generator portion of the EMC analyzer.

1. Press (AUX CTRL).
2. Press Track Gen.
3. Press SRC PWR ON OFF. The source power becomes the active function (SWR PWR in inverse video) however, the source power has not been turned on. See Figure 3-15.

NOTE

The purpose of the previous step is to set the tracking generator to a known level (in dBm) without turning on the tracking generator.

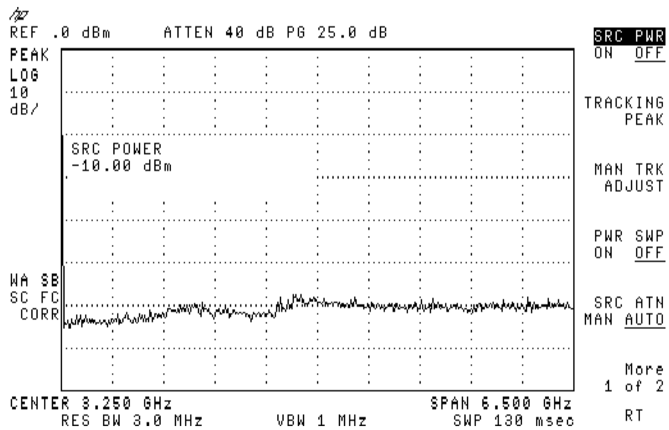


Figure 3-15. Setting Up the Tracking Generator (HP 8593E/94E/95E/96E)

Tuning the Tracking generator

The next step requires tuning the tracking generator to the frequency of interest. The frequency must be within the frequency range of the probe being used. In the following example we are using an HP 11941A close-field probe (9 kHz to 30 MHz frequency range) to look at a narrow frequency range (about 10 MHz to 30 MHz). To tune the EMC analyzer for that frequency range, do the following:

4. Press (FREQUENCY).
5. Press START FREQ, 10, (MHz).
6. Press STOP FREQ, 30, (MHz). The tracking generator is now sweeping over that range.
7. Press (AUX CTRL).
8. Press Track Gen to return to the tracking generator.
9. Press SCR PWR ON OFF.

Turning On the Tracking Generator

10. Press 2.75 and (+ dBm). The tracking generator is now turned on. Notice that the SCR PWR softkey has toggled to ON. See Figure 3-16.

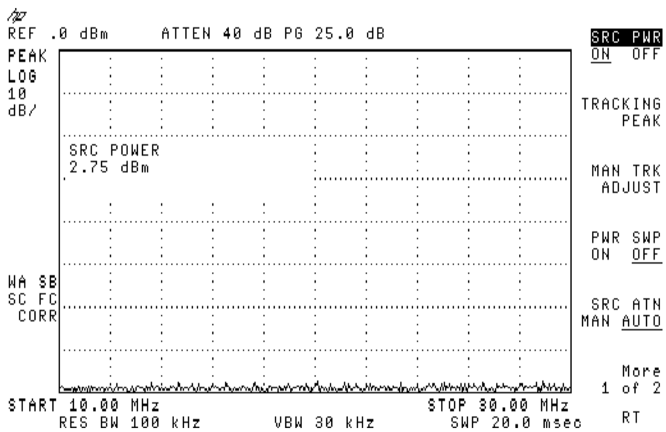


Figure 3-16. Turning On the Tracking Generator

NOTE

For more information about specific spectrum analyzer functions, refer to your instrument's operation manual.

11. Move the close-field probe around the circuit under test, looking for any disruption to the DUT's normal operation.

Making Conducted EMI Evaluations

Objectives

This test finds the highest emissions from the device under test (DUT) and compares those emissions to defined limits.

In this section . . .

Read This

If you find a reference to a softkey that is not on the display screen, you have probably pressed a front-panel key by mistake. To return to the EMC auto-measurement personality, press the (MODE) key *two times*.

Helpful Information

The trace information on the display screen presented in this procedure is only for example. It may not reflect what you see on your display.

Setting Up the Equipment for Testing

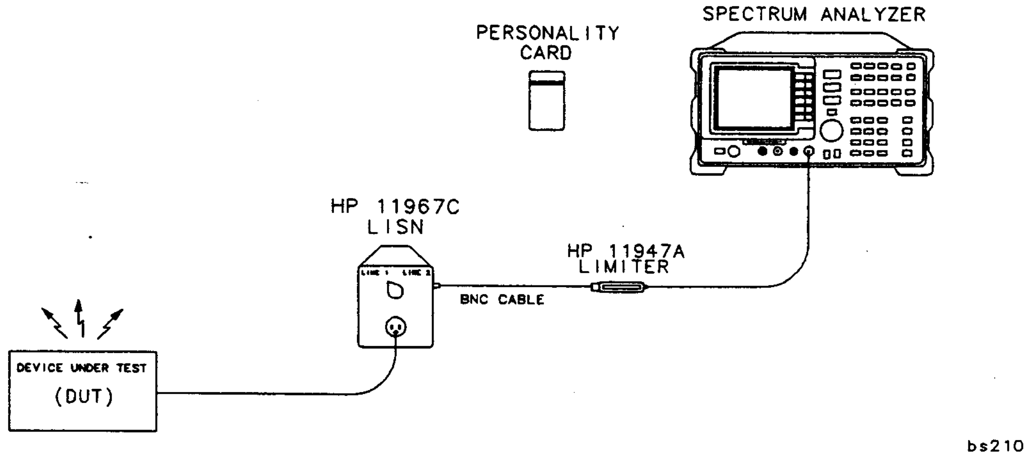


Figure 3-17. Conducted EMI Evaluation Test Setup

CAUTION A transient limiter must be installed for all conducted measurements to protect the spectrum analyzer's input from high-level transients. Such transients may exist on the power mains or result from cycling power to the device under test (DUT).

Equipment List

spectrum analyzer	HP 8591E HP 8593E HP 8594E HP 8595E HP 8596E
EMC measurement personality card	HP 85712D
transient limiter	HP 11947A
line impedance stabilization network (LISN)	HP 11967C
printer	HP 2225A

Making an Automated Conducted Measurement

Configuring the Analyzer for Testing

1. Press (PRESET) to reset the spectrum analyzer to the initial state.
2. Press `EMC Config` to enter the EMC automation top-level menu.
3. Press `Setups`. Scroll down to `VDEA C 2` and highlight the setup file. See Figure 3-18

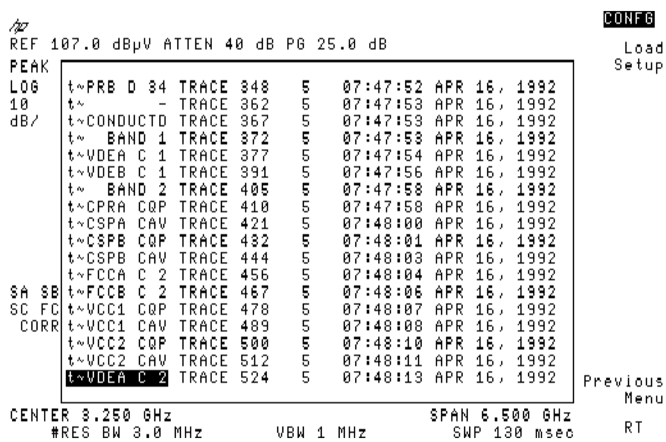


Figure 3-18. `VDEA C 2` **Selected**

4. Press Load Setup to load the file. See Figure 3-19.

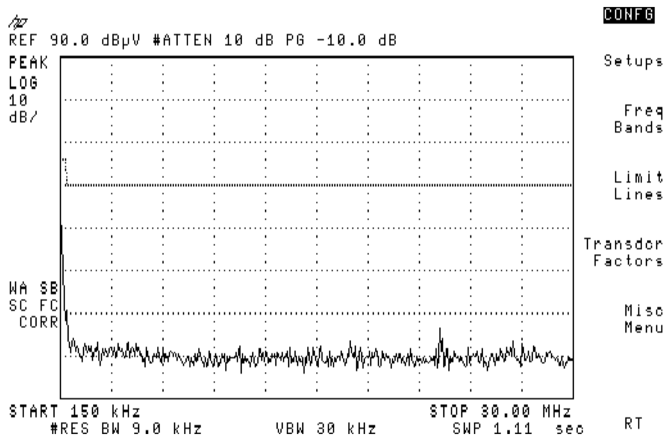


Figure 3-19. VDEA C 2 Loaded into the Analyzer

Setting the Stop Frequency.

5. Press FREQUENCY.
6. Press STOP FREQ, 700, ENTER (kHz key in the lower-right corner of the analyzer). See Figure 3-20.

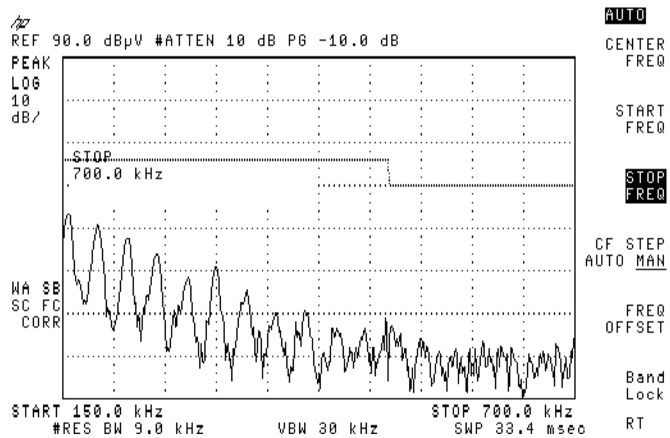


Figure 3-20. Stop Frequency Entered into the Analyzer

7. Press (MODE) to return to the auto-measurement personality.
8. Press EMC Automatn .

Setting the Limit Margin.

9. Press LIMIT MARGIN, 20, (dB) to set the limit margin to 20 dB. See Figure 3-21.

> **NOTE**
>
> The AUTO MEASURE function will only measure signals that exceed the limit margin.

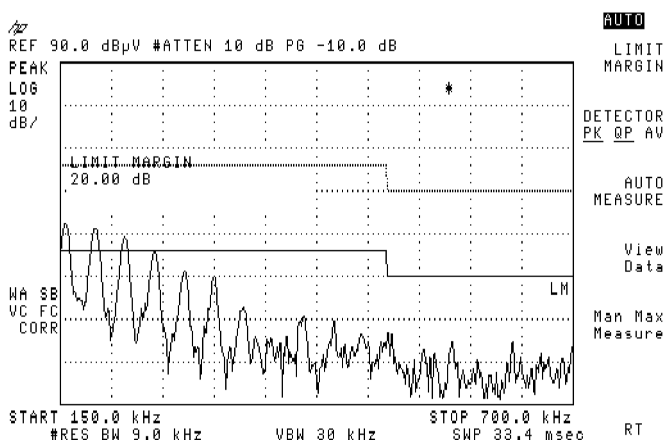


Figure 3-21. Setting the Limit Margin to 20 dB

Making an Automated Measurement

10. Press AUTO MEASURE to invoke the auto measurement routine. The following keys are available to view the data:

    VIEW TABLE — To view the data in tabular format. See Figure 3-22.

    VIEW LOG — To view the data on a log display. See Figure 3-23.

VIEW LINEAR — To view the data on a linear display. See Figure 3-24.

VIEW TRACE — To view the trace data. Note that there is a 5% overscan at each end of the display. See Figure 3-25.

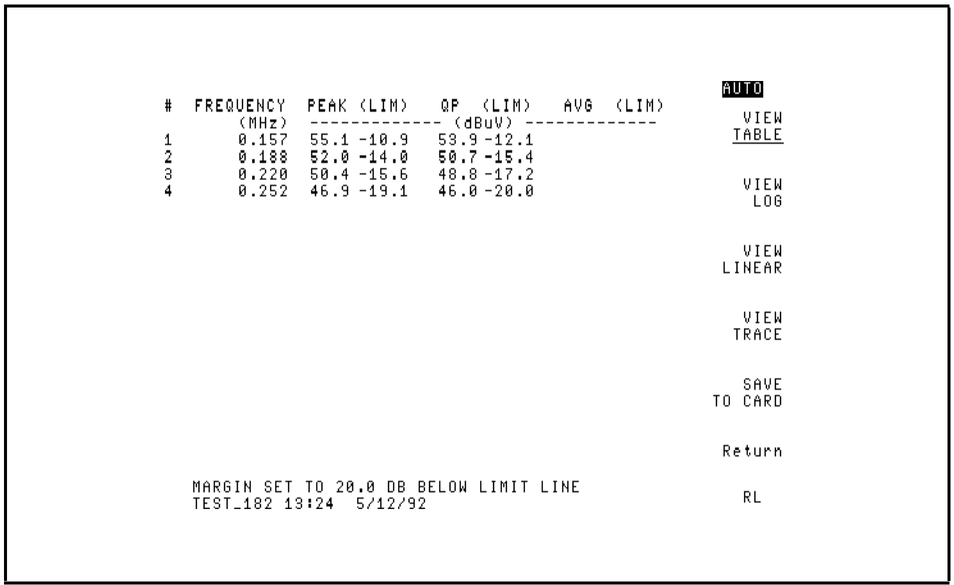


Figure 3-22. View Table Display

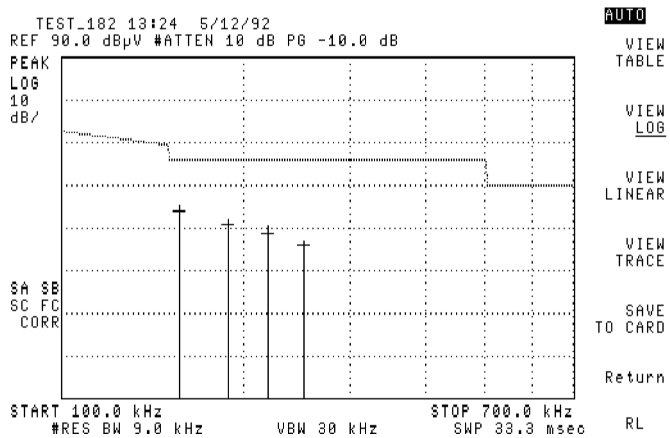


Figure 3-23. View Log Display

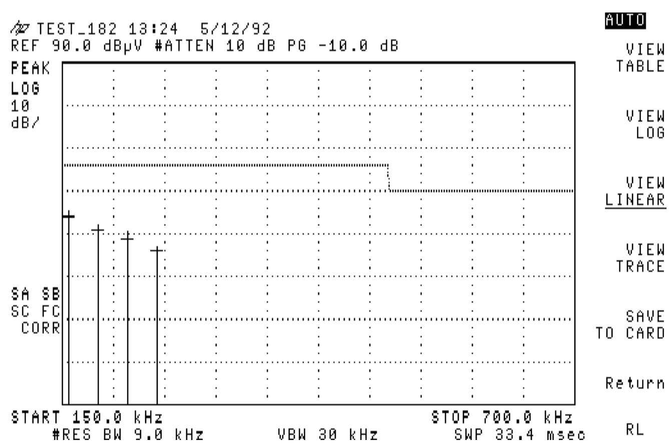


Figure 3-24. View Linear Display

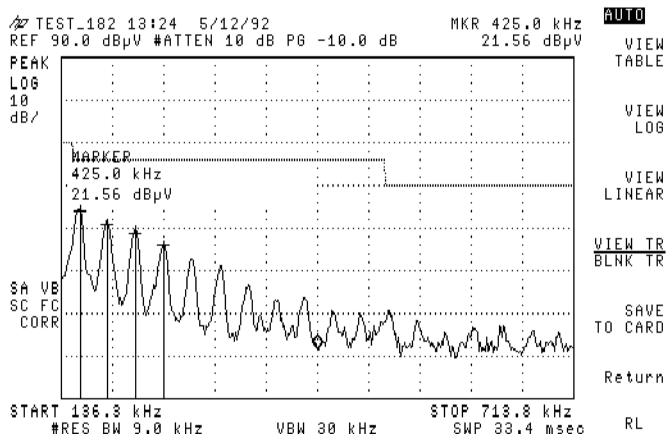


Figure 3-25. View Trace Data

Measuring the Harmonic Interval.

11. Press (PEAK SEARCH) to place the marker on the highest peak.
12. Press DELTA MKR to invoke the delta marker.

13. Press NEXT RIGHT to place the marker on the next harmonic to the right. Note the interval. See Figure 3-26.

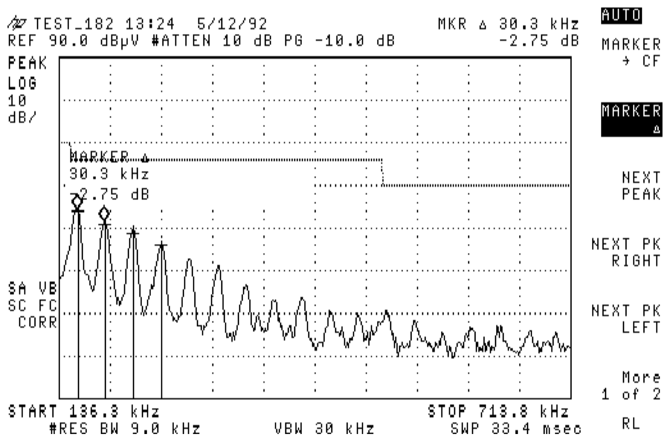


Figure 3-26. Finding the Harmonic Interval

Storing the Data to Internal Memory.

14. Press the (SAVE) front-panel key.
15. Press INTERNAL CARD (INTERNAL will be underlined).
16. Press TRACE ⇒ INTERNAL .
17. Press TRACE B , 2, (ENTER) ((Hz) key in the lower-right corner of the analyzer) to enter the trace B data into internal register 2.
18. Press (MODE), (MODE) to return to the EMC auto-measurement personality.

Recalling Previous EMC Data.

19. Press the (RECALL) front-panel key.
20. Press INTERNAL ⇒ TRACE .

21. Press TRACE B, 2, (ENTER) ((Hz) key in the lower-right corner of the analyzer).
22. Press (MODE), (MODE) to return to the EMC auto-measurement personality.

Making a Manual Conducted Measurement

Important Information

It is important to perform each step in the following procedures. To do otherwise, will produce results that are different than expected.

Configuring the EMC Analyzer and the Downloadable Program for Testing

1. Press (PRESET).
2. Verify that the DUT is connected to the LISN and operational.
3. Press `EMC Config` .
4. Press `Freq Bands` .
5. Press `.15-30MZ SETUP` . See Figure 3-27.

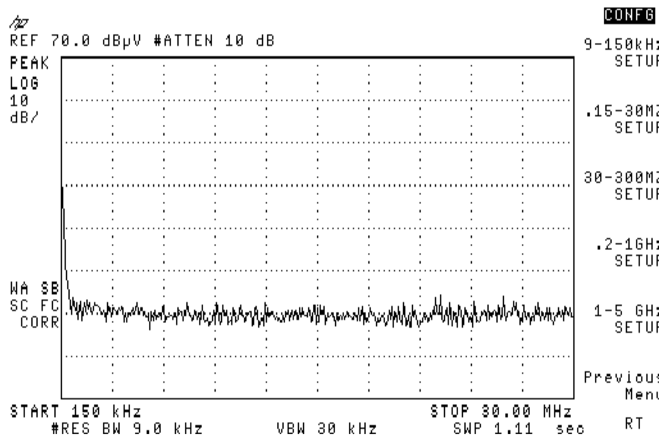


Figure 3-27. 150 kHz to 30 MHz Setup

6. Press `Previous Menu`.

Loading a Limit Line.

7. Press `Limit Lines`.

> **NOTE**
>
> Before loading the limit line, be sure the EMC personality card is installed in the analyzer's front-panel.

8. Press `Load Limit`.

> **NOTE**
>
> If `NO CARD FOUND` is displayed, press `Previous Menu`, insert the EMC personality card into the EMC analyzer, then press `LOAD LIMIT`.

9. Scroll, using the front-panel knob, to the limit line of interest. (In our example we used `lVDE_A_CON`.)

10. Press LOAD FILE . See Figure 3-28.

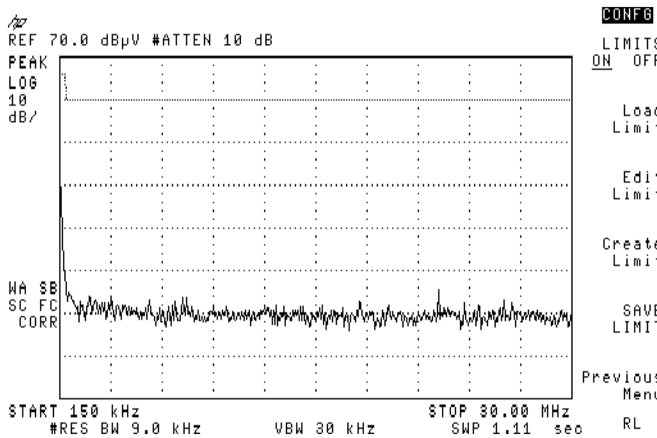


Figure 3-28. Loaded Limit Line

Turning On the Limit-Line Pass/Fail Message.

11. Press Previous Menu .

12. Press Misc Menu .

13. Press LIMI MSG ON OFF. (ON will be underlined.) See Figure 3-29.

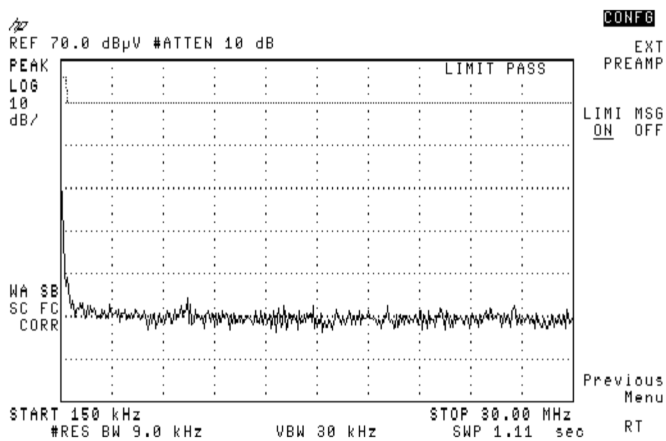


Figure 3-29. Limit-Line Pass/Fail Message

14. Press Previous Menu.

Calibrating Out the Transient Limiter's 10 dB of Loss.

15. Press Misc Menu.

16. Press EXT PREAMP , (-), 10, (dB). See Figure 3-30.

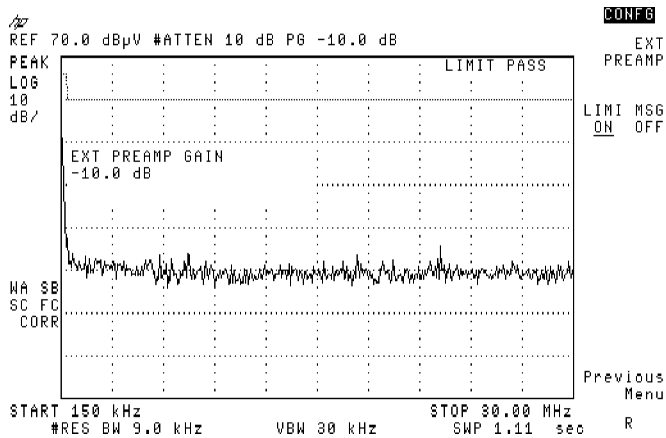


Figure 3-30. External Preamp Gain −10 dB

17. Press (MODE).

Making a Conducted Measurement

18. Press EMC Manual .

Setting the Start and Stop Frequencies.

19. Press (FREQUENCY).
20. Press STOP FREQUENCY , 700, (kHz). Set a frequency just above the area of interest. In our example, we are setting the stop frequency to 700 kHz. If you want to increase the stop frequency, use the front-panel knob to increase the frequency until you get most of the device emissions on screen. See Figure 3-31.

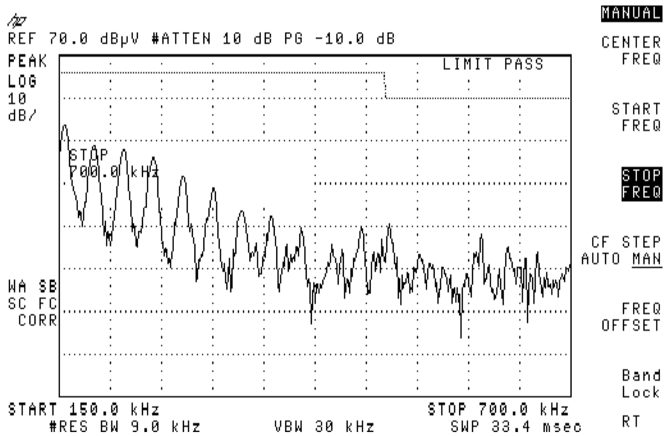


Figure 3-31. Emissions from 150 kHz to 700 kHz

Setting the Amplitude Level.

21. Press (AMPLITUDE).
22. Press 90, (dB). See Figure 3-32.

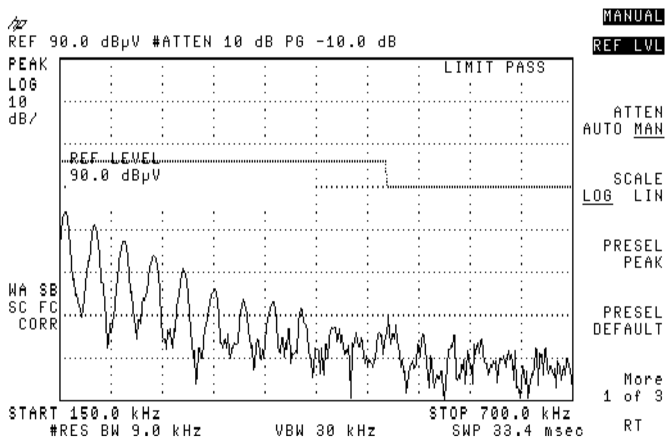


Figure 3-32. Adjusting the Amplitude Level

23. Press (MODE), (MODE) to return to the EMC measurement personality.

24. To verify that the emission is coming from the device under test, disconnect the BNC cable from the transient limiter's input. See Figure 3-33.

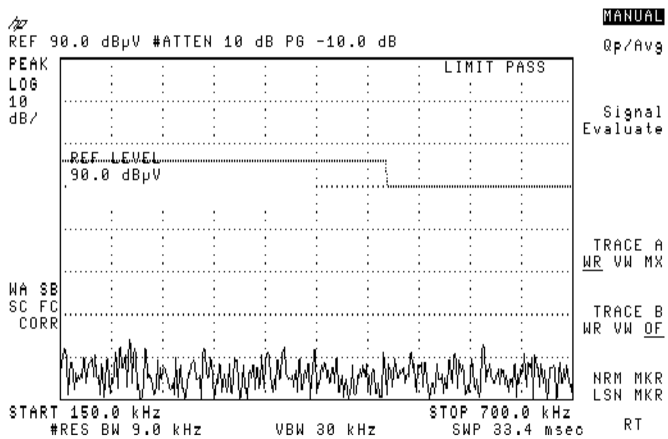


Figure 3-33. Verifying the Emissions

25. Reconnect the BNC cable to the transient limiter's input.

Moving the Marker to the Highest Emission.

26. Press TRACE A WR VW MX, two times (MX will be underlined), to max-hold trace A.
27. Wait for a few sweeps to fill in the worst-case emissions.
28. Press TRACE A WR VW MX (VW will be underlined), to view the trace. See Figure 3-34.

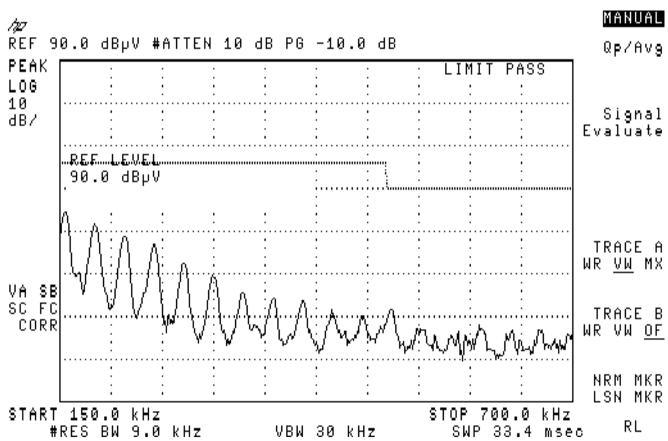


Figure 3-34. Max-Hold Trace in View Mode

29. Press NRM MKR and use the front-panel knob to move the marker to a signal of interest (a signal that appears to be close to or over the limit line). See Figure 3-35.

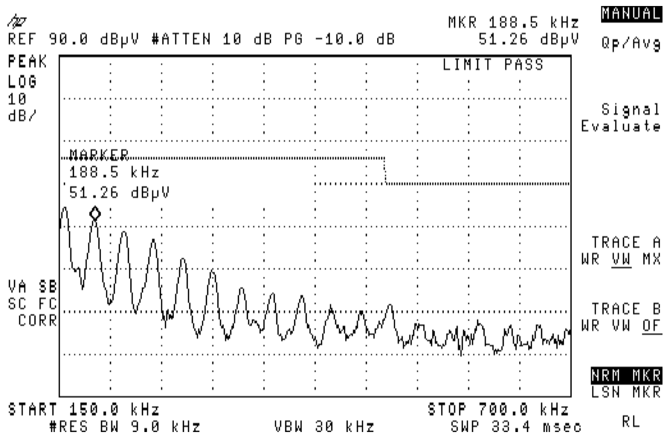


Figure 3-35. Moving the Marker to a Worst-Case Emission

Making a Quasi-Peak Measurement.

NOTE

Although many agencies governing EMI from commercial products require quasi-peak detection, if the emission from the device is within a test limit when measured with peak detection, the device will be considered to have passed the test, even though quasi-peak detection was not used. Quasi-peak detection need be used only when a signal is close to or over the test limit.

30. Press Qp/Avg .

31. Press `QP AUTO AT MKR`.

32. Read the amplitude level at the bottom of the display screen. In our example, the display shows 50.88 dBμV. See Figure 3-36.

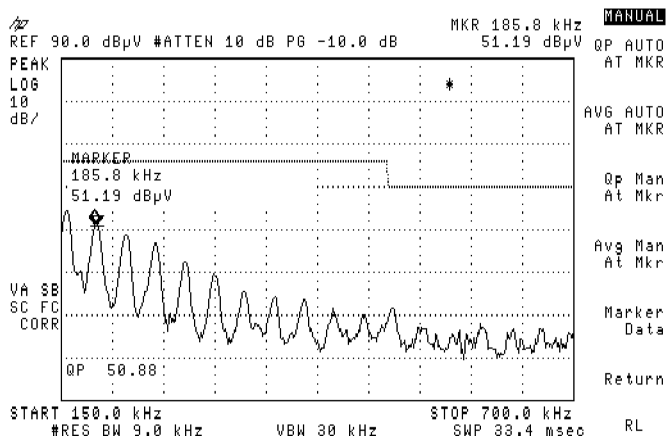


Figure 3-36. Signal after Quasi-Peak Measurement

Printing the Quasi-Peak Marker Data in Tabular Form.

33. Connect the printer to the EMC analyzer.

34. Press `Marker Data`.

35. Press `PRINT MKR DATA`.

36. Press `Previous Menu` to leave the marker data menu.

37. Move the marker (which is still active) to the next signal of interest and repeat the same process by pressing `QP AUTO AT MKR`. The process can be repeated for each signal of interest. Data from any previous quasi-peak measurement will be lost when `QP AUTO AT MKR` or `Qp Man At Mkr` is pressed.

Making an Average Detection Measurement.

38. Move the marker to the signal of interest.
39. Press `AVG AUTO AT MKR`. Notice that the plus symbol (+) is used by average detection. See Figure 3-37.

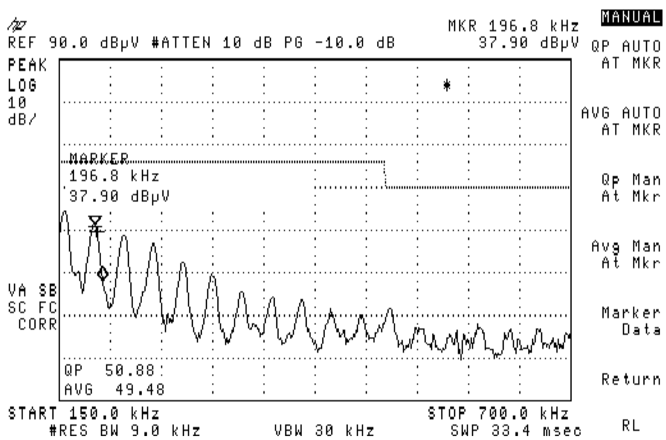


Figure 3-37. Display Showing QP and Average Data

Printing the Average Marker Data in Tabular Form.

40. Connect the printer to the EMC analyzer (if it has not been previously connected).
41. Press `Marker Data`.
42. Press `PRINT MKR DATA`.

Clearing Average and Quasi-Peak Markers.

43. After making the measurement, press CLEAR MARKERS two times to clear the average and quasi-peak markers. Data from any previous average and quasi-peak measurements will be lost.
44. Press (PRESET) to return to the top-level menu.

Making Radiated EMI Measurements Using a Biconical Antenna

Objectives

This test finds the highest emissions from the device under test (DUT) and compares those emissions to known limits.

In this section . . .

Read This

If you find a reference to a softkey that is not on the display screen, you have probably pressed a front-panel key by mistake. To return to the EMC measurement personality, press the (MODE) key *two times*.

Helpful Information

The trace information on the display screen presented in this procedure is only for example. It may not reflect what you see on your display.

Setting Up the Equipment for Testing

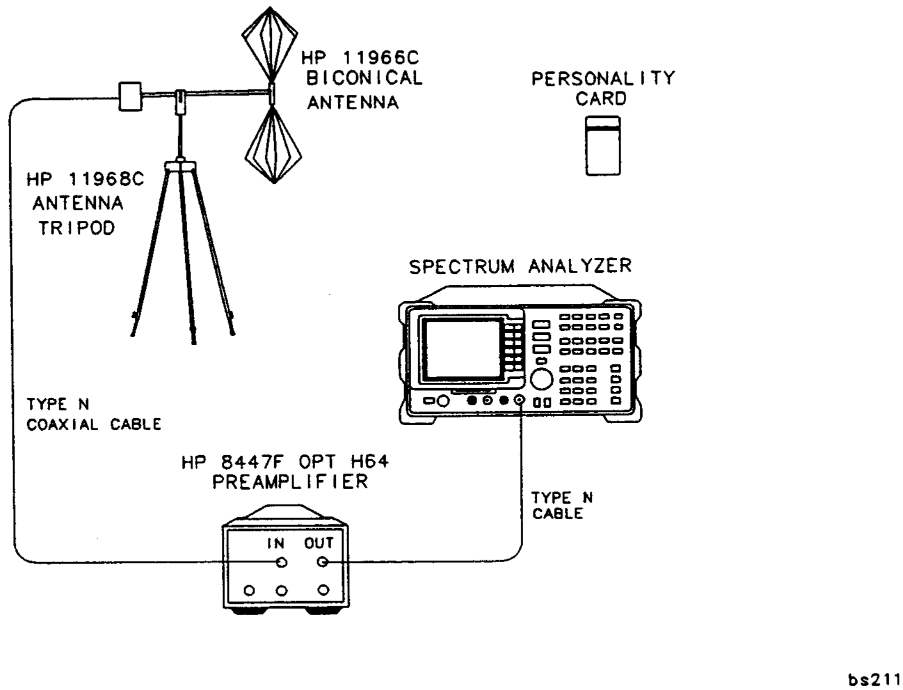


Figure 3-38. Radiated EMI Measurements Test Setup

Equipment List

spectrum analyzer	HP 8591E HP 8593E HP 8594E HP 8595E HP 8596E
EMC measurement personality card	HP 85712D
preamplifier	HP 8447F Option H64
biconical antenna	HP 11966C
antenna tripod	HP 11968C

Making an Automated Radiated Measurement

Configuring the Analyzer for Testing

1. Press the (PRESET) front-panel key to reset the analyzer.
2. Press EMC Config to access the auto-measurement's automatic measurement functions.
3. Press Setups .
4. Scroll to CSPA R 3 using either the front-panel knob or the step keys. See Figure 3-39.

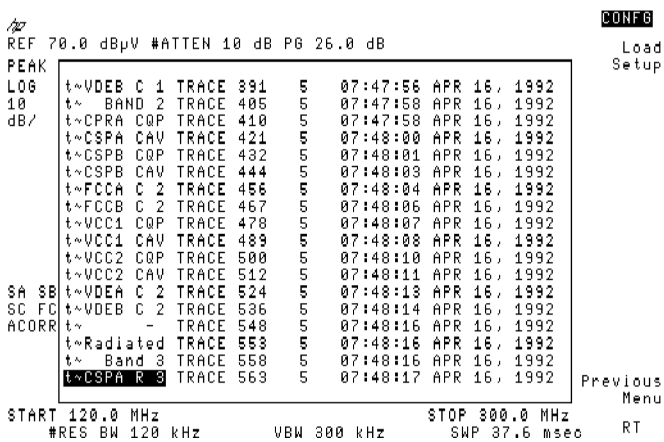


Figure 3-39. CSPA R 3 **Selected**

5. Press Load Setup, which loads the proper frequency range, bandwidths, limit lines, transducer factors, preamp gain, and attenuation into the spectrum analyzer. See Figure 3-40.

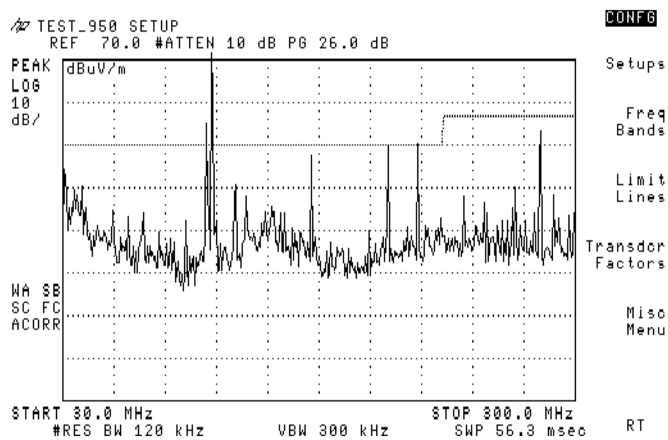


Figure 3-40. CSPA R 3 Loaded into the Analyzer

NOTE

When performing radiated measurements, high ambient signals may be observed in the 88 to 108 MHz range due to commercial FM broadcasting. The frequency range may be modified to move these signals off screen.

Modifying the Frequency to Avoid the FM Band.

6. Press the (FREQUENCY) front-panel key.
7. Press START FREQ , 120, (MHz). See Figure 3-41.

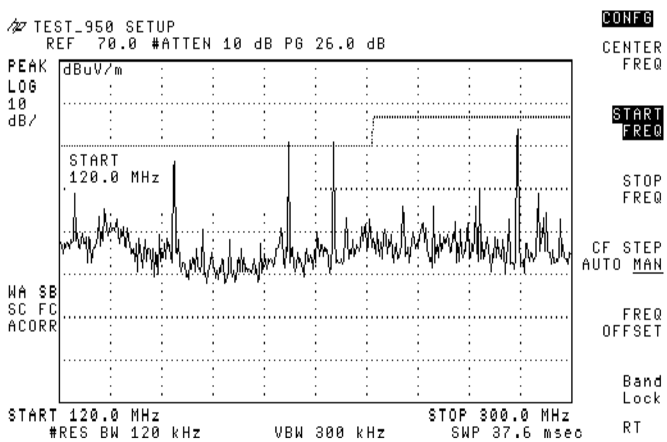


Figure 3-41. Selecting a Start Frequency of 120 MHz

8. Press (MODE), then EMC Automatn to return to the EMC auto-measurement personality.

Comparing the Peak Device Emissions to Limit.

9. Press LIMIT MARGIN , 10, (dB) to measure signals that are within 10 dB of the limit line. The limit line may also be selected using the front-panel knob to position the margin with respect to the limit line. See Figure 3-42 and Figure 3-43.

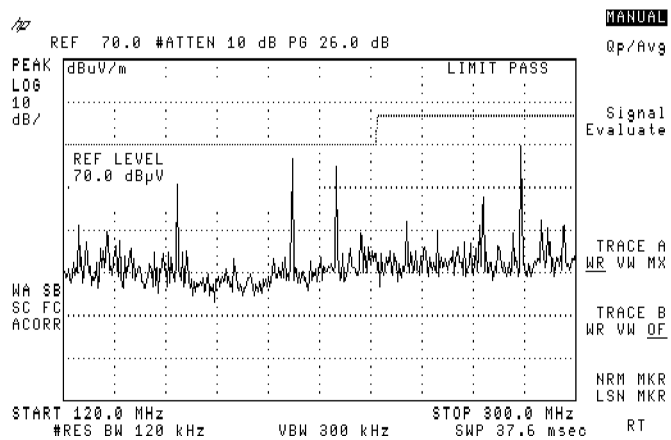


Figure 3-42. Limit Margin with Device under Test Off

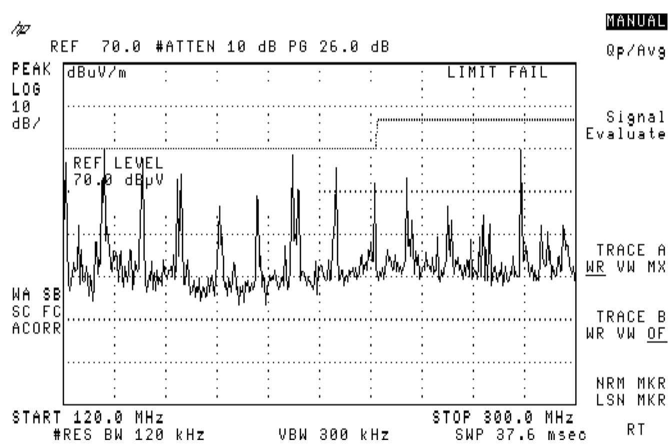


Figure 3-43. Limit Margin with Device under Test On

Making an Ambient Signal List.

10. Turn the device under test (DUT) off.
11. Toggle DETECTOR PK QP AV until only PK is underlined.
12. Press AUTO MEASURE to start the scan sequence and view the results.
13. Press VIEW TABLE to view the data in tabular form. See Figure 3-44.

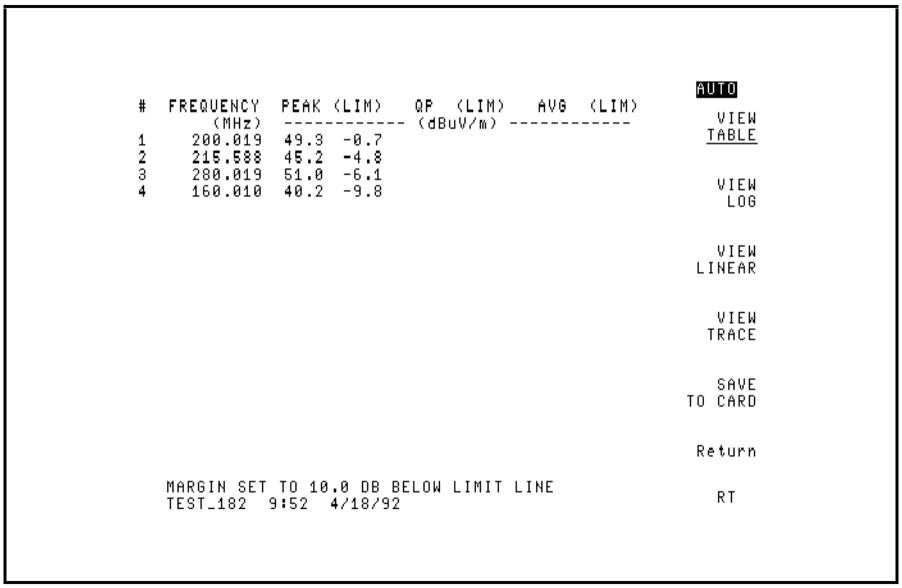


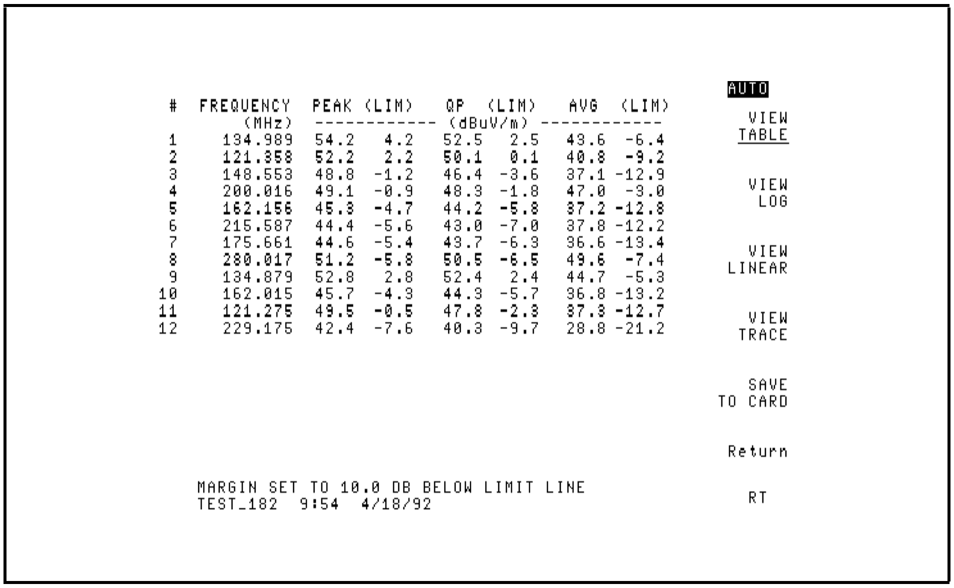
Figure 3-44. Viewing the Data in Tabular Form

14. Press the (COPY) front-panel key to copy the data table to a printer.
15. Turn DUT on.
16. Press RETURN .

Invoking Quasi-Peak and Average Detection.

17. Press DETECTOR PK QP AV until all detection modes are underlined.
18. Press AUTO MEASURE to start the scan sequence and view the results.

19. Press VIEW TABLE to review the list of measured frequencies. Peak, quasi-peak, and average measurements will be listed, along with the delta value that exceeds (or does not exceed) the limit line. See Figure 3-45.



#	FREQUENCY (MHz)	PEAK	(LIM)	QP	(LIM)	AVG	(LIM)
		(dBuV/m)					
1	134.989	54.2	4.2	52.5	2.5	43.6	-6.4
2	121.358	52.2	2.2	50.1	0.1	40.8	-9.2
3	148.553	48.8	-1.2	46.4	-3.6	37.1	-12.9
4	200.016	49.1	-0.9	48.3	-1.8	47.0	-3.0
5	162.156	45.3	-4.7	44.2	-5.8	37.2	-12.8
6	215.587	44.4	-5.6	43.0	-7.0	37.8	-12.2
7	175.661	44.6	-5.4	43.7	-6.3	36.6	-13.4
8	280.017	51.2	-5.8	50.5	-6.5	49.6	-7.4
9	134.879	52.8	2.8	52.4	2.4	44.7	-5.3
10	162.015	45.7	-4.3	44.3	-5.7	36.8	-13.2
11	121.275	49.5	-0.5	47.8	-2.3	37.3	-12.7
12	229.175	42.4	-7.6	40.3	-9.7	28.8	-21.2

MARGIN SET TO 10.0 DB BELOW LIMIT LINE
TEST_182 9:54 4/18/92

Figure 3-45. Viewing the Data in Tabular Form

N O T E

Some ambients are intermittent and may not show up on a data scan, but may appear on the ambient list.

20. Press VIEW TRACE to review the linear data and the captured max-held trace.| The top cross mark represents the quasi-peak value. The lower cross mark represents the average value (if all three detection modes were selected). See Figure 3-46.

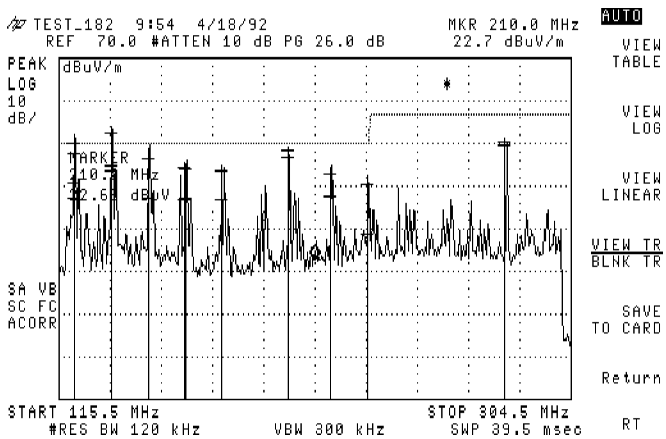


Figure 3-46. Viewing the Linear Data and Max-Held Trace

Measuring the Harmonic Interval.

21. Press (PEAK SEARCH) to place the marker on the highest peak.
22. Press DELTA MKR to invoke the delta marker.
23. Press NEXT PK RIGHT to place the marker on the next harmonic to the right. Note the interval. See Figure 3-47.

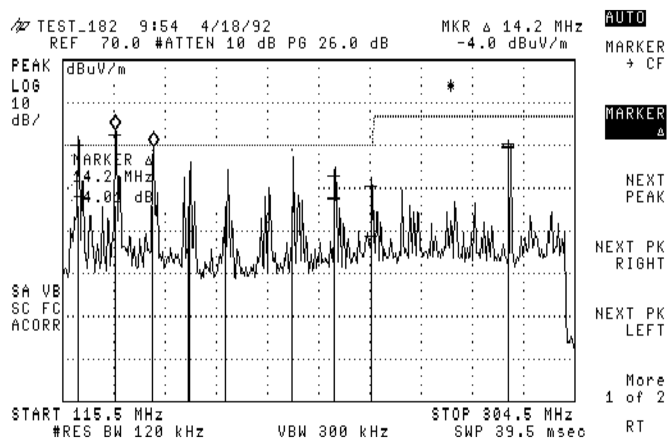


Figure 3-47. Finding the Harmonic Interval

24. Move the marker to the next major peak. See Figure 3-48.

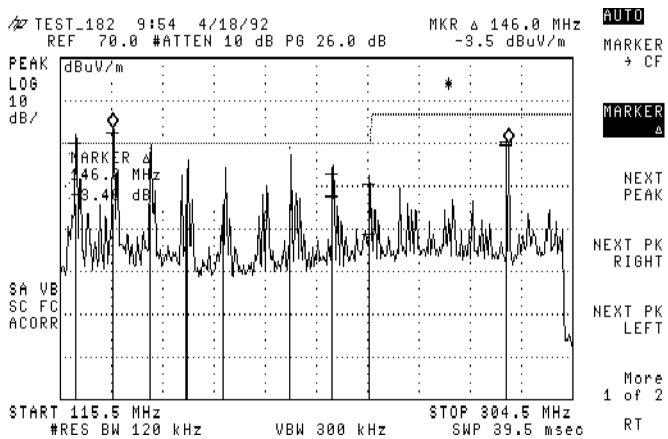


Figure 3-48. Moving the Marker to the Next Peak

25. Press (MODE), (MODE) to return to the auto-measurement personality.
26. Press VIEW TABLE to return to the tabular format on the display.

Printing or Plotting the Results.

27. Press the (COPY) front-panel key to generate a printed or plotted copy of the displayed tabular or graphical information.

NOTE

The information being viewed is stored in the internal registers and is retained even if the power is interrupted. This is useful for setups that are used repeatedly.

28. Press (LINE), (LINE) to turn the analyzer off, then on again.
29. Press EMC Automatn to select the auto-measurements automation functions.
30. Press VIEW DATA to return to the same data screen displayed before the power interruption.

Saving a Custom Setup.

31. Insert a RAM card into the front-panel card slot.
32. Press SAVE TO CARD, 100, (ENTER) ((Hz) front-panel key) to save the custom setup and data to a RAM card.
33. Press (PRESET) to return to the automated measurements top-level menu.

Recalling a Custom Setup.

34. Press EMC Config.
35. Press Setups.
36. Scroll to the desired file (in this case, 100). See Figure 3-49.

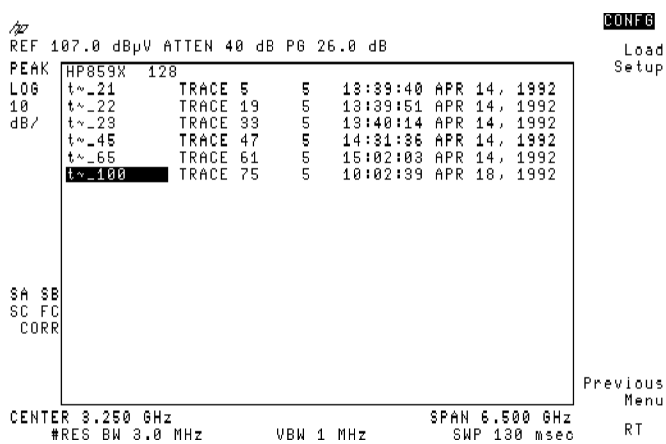


Figure 3-49. Selecting Custom Setup File

37. Press `Load Setup` to retrieve the setup alone and return to the `EMC Config` Menu.

Making a Manual Radiated Measurement

Important Information

It is important to perform each step in the following procedures. To do otherwise will produce results that are different than expected.

Configuring the EMC Analyzer for Testing

1. Press (PRESET).
2. Press EMC Config .
3. Press Freq Bands .
4. Press 30-300Mz SETUP .
5. Press Previous Menu .

Loading a Limit Line.

6. Press Limit Lines .

NOTE

Before loading the limit line, be sure the EMC personality card is installed in the analyzer's front-panel.

7. Press Load Limit .

NOTE

If NO CARD FOUND is displayed, press Previous Menu, insert the EMC personality card into the EMC analyzer, then press Load Limit.

8. Scroll, using the front-panel knob, to the limit line of interest. In our example we used 1CSPR_A_3m.
9. Press LOAD FILE. See Figure 3-50.
10. Press Previous Menu.

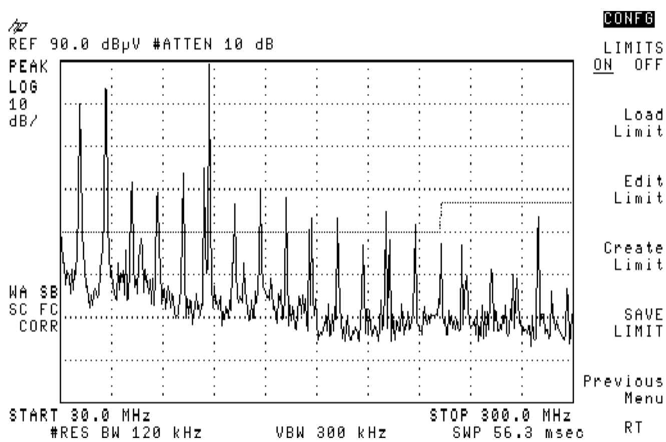


Figure 3-50. Loaded Limit Line

Turning On the Limit-Line Pass/Fail Message..

11. Press `Misc Menu`.
12. Press `LIMI MSG ON OFF` (ON will be underlined). See Figure 3-51.

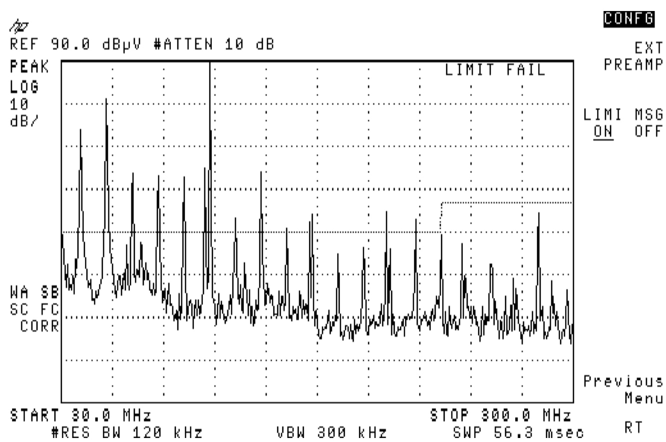


Figure 3-51. Limit-Line Pass/Fail Message

13. Press `Previous Menu`.

NOTE

Before loading the transducer factors, make sure the EMC personality card is installed in the EMC analyzer's front-panel.

Loading Transducer (Antenna) Factors.

14. Press `Transdcr Factors`.
15. Press `Load Transdcr`.

> **NOTE**
>
> If `NO CARD FOUND` is displayed, press `Previous Menu`, insert the EMC personality card into the EMC analyzer, then press `Load Transdcr`.

16. Scroll, using the front-panel knob, to the antenna of interest. In our example we used `aBICONICAL AMP`, which contains the typical transducer (antenna) factors for the HP 11966C biconical antenna.
17. Press `LOAD FILE`.
18. Verify that the transducer factors are loaded by toggling the `TRANSDCR ON OFF` softkey off and on. See Figure 3-52 and Figure 3-53. The displayed trace will shift in amplitude, which will verify that the transducer factors have been loaded into the EMC analyzer.
19. Press `(dBμ) V A V/m A/m` until dBμV/m is selected.

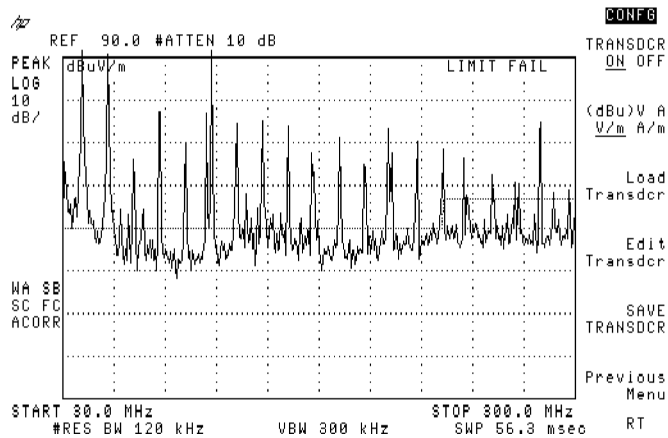


Figure 3-52. Transducer Factors Turned On

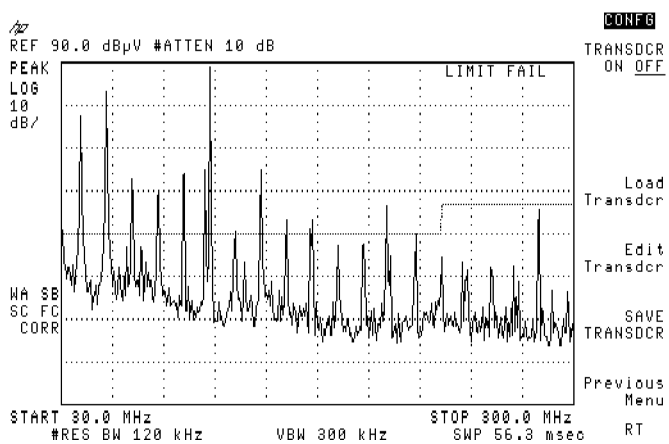


Figure 3-53. Transducer Factors Turned Off

Factoring in the Preamplifier's Gain.

20. Press `Previous Menu`.
21. Press `Misc Menu`.
22. Press `EXT PREAMP`.
23. Press 26, (dB) (or a value equal to your preamplifier's gain). The preamplifier's gain appears at the top of the display screen (as `PG 26.0 dB`). The EMC measurement personality factors in the proper amount of preamp gain. See Figure 3-54.

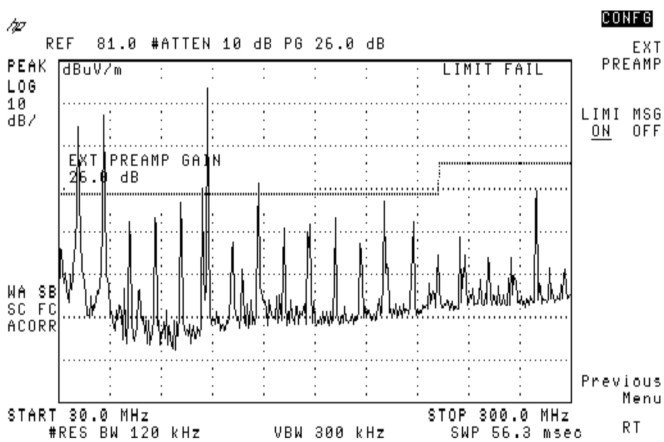


Figure 3-54. Factoring in the Preamplifier's Gain

NOTE

When performing radiated measurements, high ambient signals may be observed in the 88 to 108 MHz range due to commercial FM broadcasting. The frequency range may be modified to move these signals off screen.

Adjusting the Start Frequency.

24. Press the (FREQUENCY) front-panel key.
25. Press 120, (MHz) to enter a start frequency of 120 MHz. See Figure 3-55.

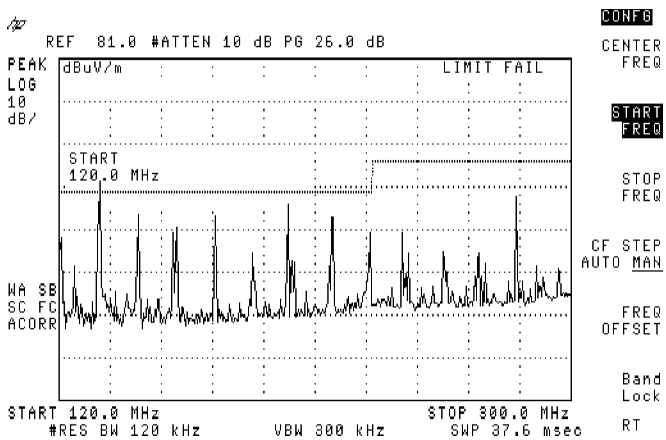


Figure 3-55. Entering a New Start Frequency

Adjusting the EMC Analyzer's Sensitivity.

26. Press the (AMPLITUDE) front-panel key.
27. Press 70, (dB). See Figure 3-56.

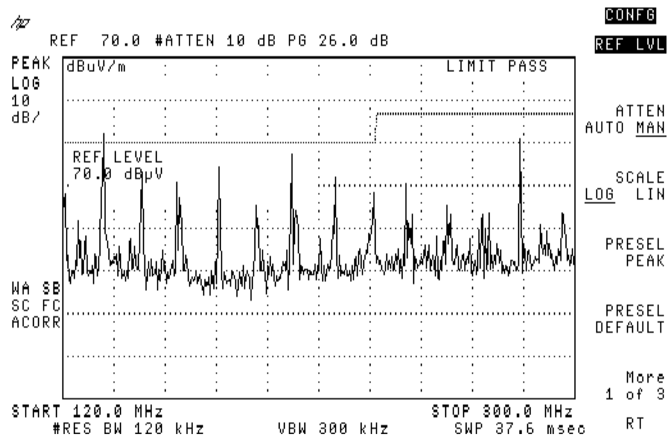


Figure 3-56. Increased EMC Analyzer's Sensitivity

28. Press (MODE) to return to the top-level EMC measurement personality menus.

Making a Radiated Measurement

1. Press EMC Manual .

> **NOTE**
>
> Some signals that appear on the display are device emissions, and some are ambient signals (radio stations, for example). Turning off the device under test will help verify which signals are ambient and which are not.

Identifying Ambient Signals.

2. Once you have identified a problem emission, determine if the signal is ambient by turning off the device under test. Note the ambients. See Figure 3-57 and Figure 3-58.

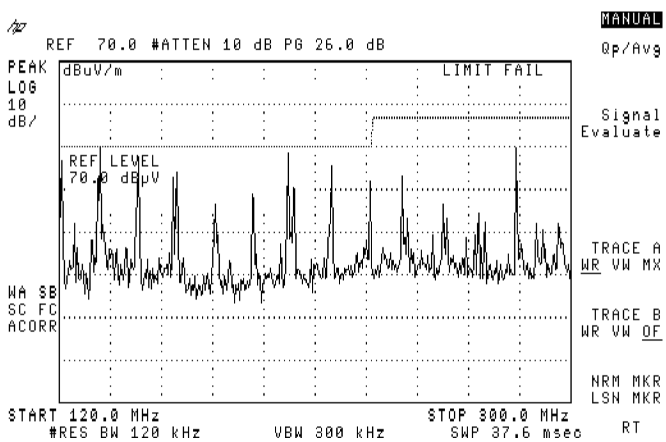


Figure 3-57. Turning the Device under Test On

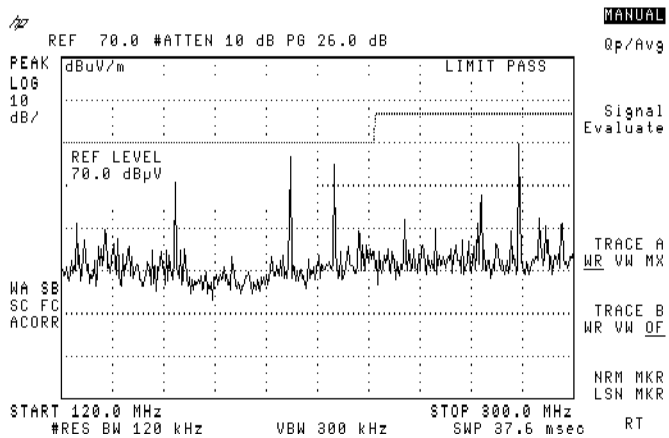


Figure 3-58. Turning the Device under Test Off

Measuring the Highest Emissions..

3. Press the (PEAK SEARCH) front-panel key. See Figure 3-59.

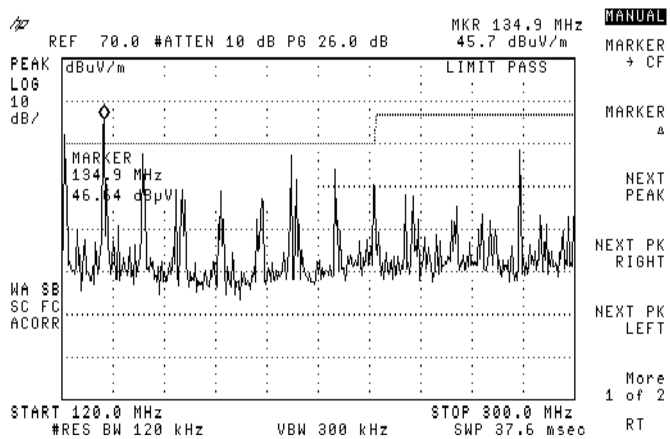


Figure 3-59. Using Peak Search

4. Press MARKER ⇒ CF move the marker to center frequency.
5. Press the (SPAN) front-panel key.
6. Press 5, (MHz). See Figure 3-60.
7. Press (MODE) (MODE) to return to the EMC personality.

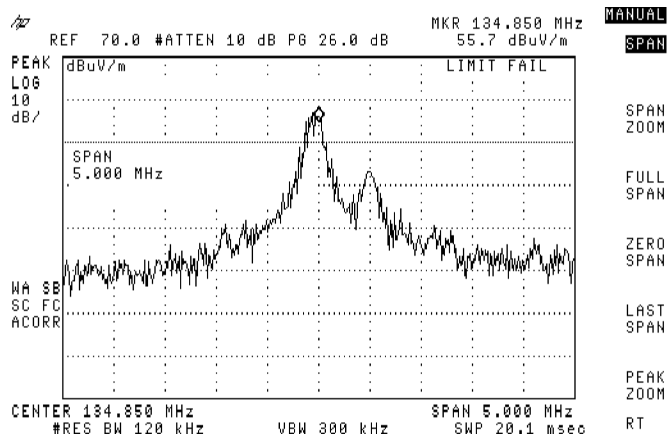


Figure 3-60. Narrowing the Span to Zoom in on a Signal

8. Center the marker on the signal if needed.
9. Press TRACE A WR VW MX , TRACE A WR VW MX (MX will be underlined), to put trace A in max-hold mode. See Figure 3-61.

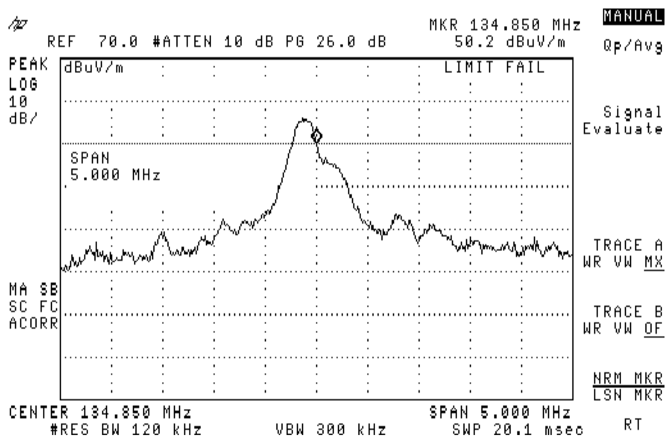


Figure 3-61. Trace A in Max Hold

10. Press TRACE B WR VW OF two times (WR is underlined) to put trace B in write mode.

11. Move the device around and change the polarization of the antenna to get the worst-case emission. See Figure 3-62.
12. If the tower/turntable program is installed:
    a. Press `Tower Turntable`.
    b. Use the position control menu to move the tower/turntable to help find the worst-case emissions.
    c. When done, press `Previous Menu`

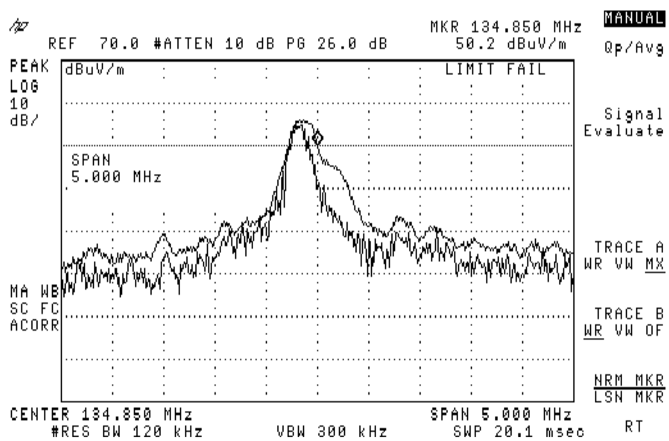


Figure 3-62. Trace A in Max Hold and Trace B in Clear Write

13. Press `TRACE A WR VW MX` (VW will be underlined), to view the worst case emission on trace A.

N O T E

Although many agencies governing EMI from commercial products require quasi-peak detection, if the emission from the device is within a test limit when measured with peak detection, the device will be considered to have passed the test, even though quasi-peak detection was not used. Quasi-peak detection need be used only when a signal is close to or over the test limit.

Making a Quasi-Peak Measurement.

To perform a measurement using average detection, substitute `AVG AUTO AT MKR` for `QP AUTO AT MKR` in the following steps.

14. Press `Qp/Avg`.
15. Press `QP AUTO AT MKR`.
16. Read the amplitude level at the bottom of the display screen. In our example, the display shows `55.15 dB`μ`V/m`. See Figure 3-63.

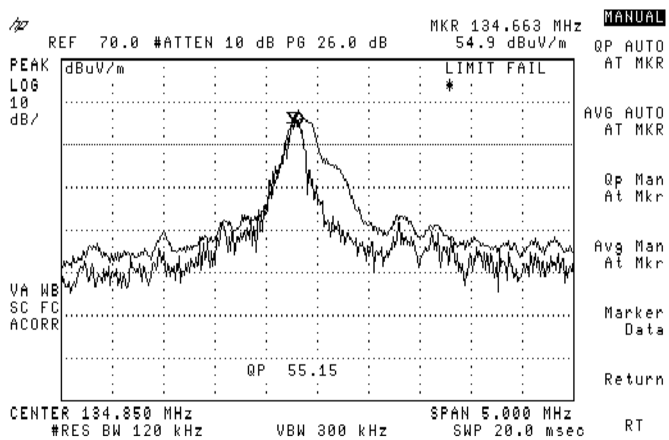


Figure 3-63. Signal after Quasi-Peak Measurement

Printing the Quasi-Peak Marker Data.

17. Connect the printer to the EMC analyzer.
18. Press `Marker Data`.
19. Press `PRINT MKR DATA`.

Clearing the Quasi-Peak Marker Data.

20. Press CLEAR MARKERS, CLEAR MARKERS to clear the quasi-peak marker after making the measurement.
21. Press PRESET to return to the EMC analyzer's top-level menus.

Loading, Editing, Creating, and Storing Limit Lines

Limit lines provide an easy way to compare trace data to a set of amplitude and frequency parameters while the spectrum analyzer is sweeping the measurement range.

In this section . . .

Loading Limit Lines

Limit lines are provided on the card with the HP 85712D EMC auto-measurement personality. These limit lines represent the test limits for the major EMI regulations for CISPR, FCC, VCCI, and VDE conducted and radiated emissions.

Table 3-1. Limit Lines Loaded on the EMC Personality Card

File Name	Description
`1Conducted`	empty file; used as a heading for conducted emissions limit lines
`lCSPR A AV`	CISPR 22, Class A Average Conducted Limit
`lCSPR A QP`	CISPR 22, Class A Quasi-Peak Conducted Limit
`lCSPR B AV`	CISPR 22, Class B Average Conducted Limit
`lCSPR B QP`	CISPR 22, Class B Quasi-Peak Conducted Limit
`lFCC A CON`	FCC Part 15, Class A Conducted Limit
`lFCC B CON`	FCC Part 15, Class B Conducted Limit
`lVCCI 1 AV`	VCCI, Class 1 Average Conducted Limit
`lVCCI 1 QP`	VCCI, Class 1 Quasi-Peak Conducted Limit
`lVCCI 2 AV`	VCCI, Class 2 Average Conducted Limit
`lVCCI 2 QP`	VCCI, Class 2 Quasi-Peak Conducted Limit
`lVDE A CON`	VDE 0871, Class A Conducted Limit
`lVDE B CON`	VDE 0871, Class B Conducted Limit
`l---------`	empty file; used as a spacer between conducted and radiated limit lines
`lRadiated`	empty file: used as a heading for radiated emissions limit lines
`lCSPR A 3m`	CISPR 22, Class A Radiated, 3m limit
`lCSPR B 3m`	CISPR 22, Class B Radiated, 3m limit

Table 3-1. Limit Lines Loaded on the EMC Personality Card (continued)

File Name	Description
lFCC A 3m	FCC Part 15, Class A Radiated, 3m limit
lFCC B 3m	FCC Part 15, Class B Radiated, 3m limit
lVCCI 1 3m	VCCI, Class 1 Radiated, 3m limit
lVCCI 2 3m	VCCI, Class 2 Radiated, 3m limit
lVDE A 3m	VDE 0871, Class A Radiated, 3m limit
lVDE B 3m	VDE 0871, Class B Radiated, 3m limit
lFTZ B 3m	FTZ 1046, Class B Radiated, 3m limit

Loading Limit Lines

1. Press EMC Config.
2. Press Limit Lines.

NOTE

Before proceeding to the next step, be sure to install either the EMC auto-measurement personality card or a RAM card (with a limit line loaded on the card) into the analyzer's memory card slot. Pressing the Load Limit softkey without a card installed will cause the error NO CARD FOUND to appear on the display screen. To recover from the error, press Previous Menu, install the memory card, then press Load Limit.

3. Press Load Limit. The Load Limit softkey catalogs all limit-line files on the memory card.
4. Use the front-panel knob to move the highlighted bar to the limit-line file of interest. For the VDE 0871, Class A, Radiated 3m test limit, the file would be lVDE A 3m. Refer to Table 3-1 for a listing of the limit line files on the HP 85712D EMC auto-measurement personality card. See Figure 3-64.

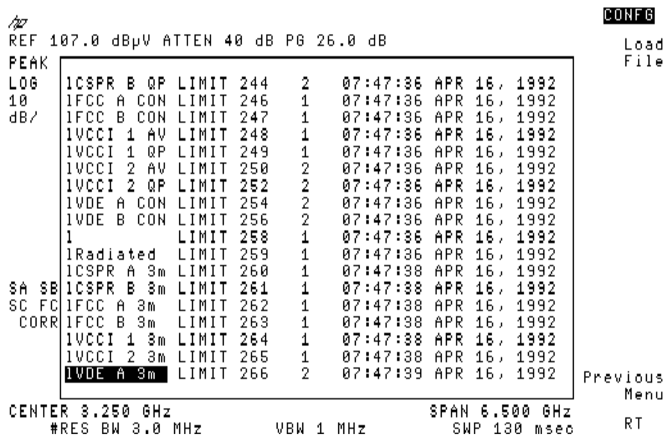


Figure 3-64. Loading a Limit Line

Read This

Use the ⇧ and ⇩ keys or the knob to move the highlighted bar between individual files on a page.

5. Press **Load File**. The limit line from the loaded file is now displayed on the analyzer if the displayed span and reference level corresponds to the limit range selected.

Editing Limit Lines

1. Press EMC Config.
2. Press Limit Lines.
3. Press Edit Limit. See Figure 3-65.

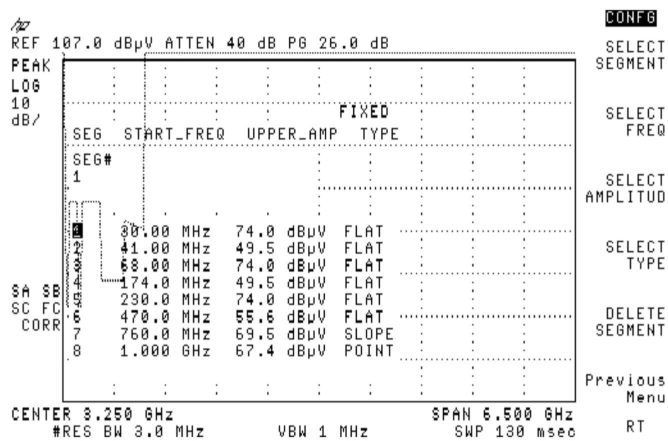


Figure 3-65. Editing a Limit Line

Selecting the Segment Number

Press SELECT SEGMENT. Use the ⇧ ⇩ keys or the knob to highlight the segment to be edited. Limit lines are created by entering frequency and amplitude values, and segment type into a limit-line table. The frequency and amplitude values specify a coordinate point from which a limit-line segment is drawn. Limit lines are constructed from left to right.

Up to 20 segments can be specified for limit-line tables.

Selecting the Frequency Coordinate

Press SELECT FREQ, then enter a frequency value for the segment. A frequency coordinate must be specified. This is the segment's beginning frequency. The segment will not be drawn until the next segment start frequency is defined.

> **NOTE**
>
> There can only be one entry per frequency. Entering two segments with the same frequency in the same limit-line table overwrites the first entry.

Selecting the Amplitude

Press SELECT AMPLITUDE, then enter the amplitude value for the segment. The current amplitude units are used. For example, if the analyzer is in dBμV, the limit-line amplitude values will be in dBμV.

> **NOTE**
>
> When entering a limit-line segment, the frequency and amplitude values will be listed as asterisks (***) until new values are entered. The new segment will be listed last until both the frequency and amplitude values have been entered. Once the frequency and amplitude values are entered, the segment will be sorted into the limit-line table according to frequency.

Selecting the Type

Pressing SELECT TYPE selects the type of limit-line segment. There are three types of limit-line segments:

SLOPE draws a straight line from the current frequency and amplitude point to the next frequency and amplitude point.

FLAT draws a flat line at the current amplitude to the next frequency point.

POINT — sets a limit at a single frequency point. It will not create a limit-line segment. The point should be used to terminate a limit line.

Procedure for Creating a Limit Line

This procedure demonstrates how to create a limit-line (from 30 MHz to 1 GHz) and how to activate testing.

Setting Measurement Conditions

1. Press EMC Config .
2. Press Freq Bands .
3. Press 30-300MZ SETUP .
4. Press (FREQUENCY).
5. Press 10 (MHz) to set the start frequency to 10 MHz.
6. Press STOP FREQ 1.02 (GHz) to set the stop frequency to 1.02 GHz.
7. Press (AMPLITUDE)
8. Press 81 (dB) to set the reference level to 81 dBμV.
9. Press (MODE) to return to the EMC auto-measurement personality.

Creating a Limit Line

10. Press EMC Config .
11. Press Limit Lines .

CAUTION Pressing the Create Limit softkey two times, as directed in the following procedure step, will purge the limit line currently on the display.

12. Press Create Limit two times. See Figure 3-66.

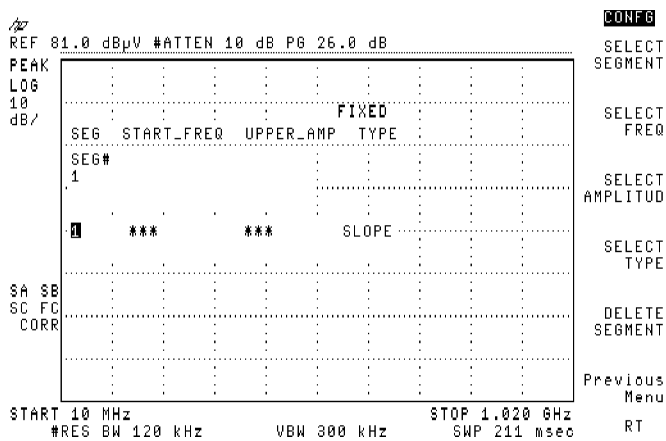


Figure 3-66. CREATE LIMIT Softkey Menu

13. Press SELECT FREQ, 30, and (MHz). See Figure 3-67.

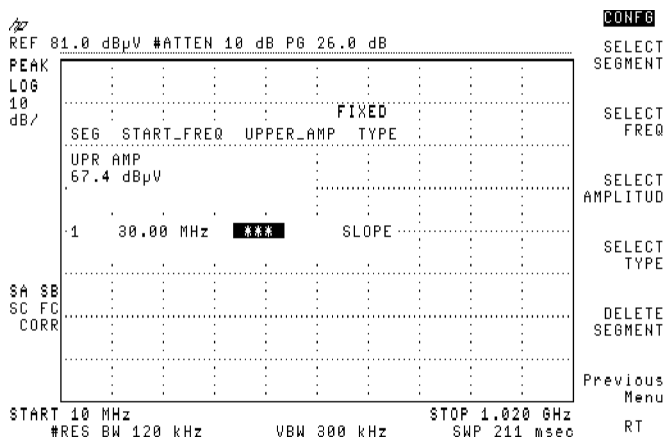


Figure 3-67. Selecting the First Frequency

14. Press SELECT AMPLITUD , 50, and (dB).

15. Press SELECT TYPE , then FLAT . See Figure 3-68.

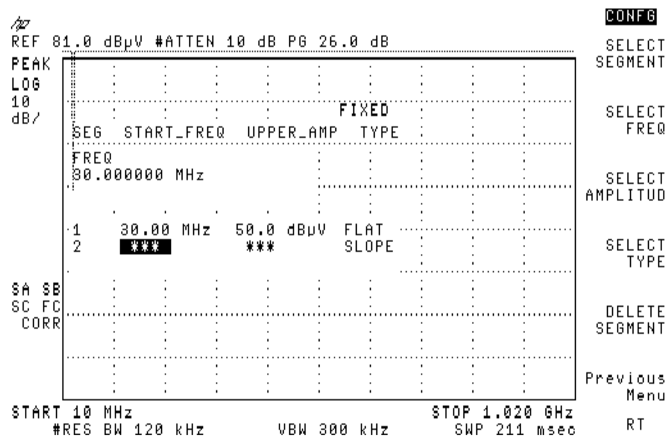


Figure 3-68. Selecting the First Amplitude and Type

Steps 13 through 15 specify the first limit-line point. The first limit-line segment begins at 30 MHz and has an amplitude value of 50 dB.

NOTE

The coordinates for the second point must be entered before the first and second limit-line segments are displayed.

Steps 16 through 18 specify the second limit-line segment. To enter the second limit-line segment:

16. Press SELECT FREQ , 230, and (MHz).
17. Press SELECT AMPLITUD , 57, and (dB).
18. Press SELECT TYPE , then FLAT . See Figure 3-69.

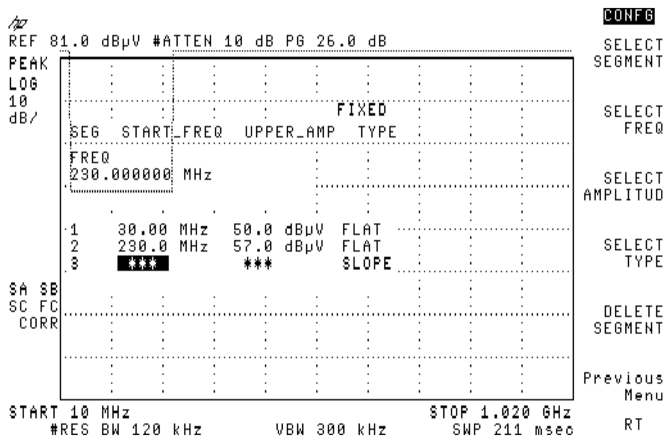


Figure 3-69. Entering the Second Limit-Line Segment

NOTE

The table entries can be edited if you make a mistake. To edit an existing segment, use SELECT SEGMENT to specify the segment, and SELECT FREQ , SELECT AMPLITUD , or SELECT TYPE to specify the column you wish to edit.

Steps 19 through 24 specify the third and fourth limit-line segments.

19. Press SELECT FREQ , 280, and MHz.
20. Press SELECT AMPLITUD , 60, and dB.
21. Press SELECT TYPE , then FLAT . See Figure 3-70.

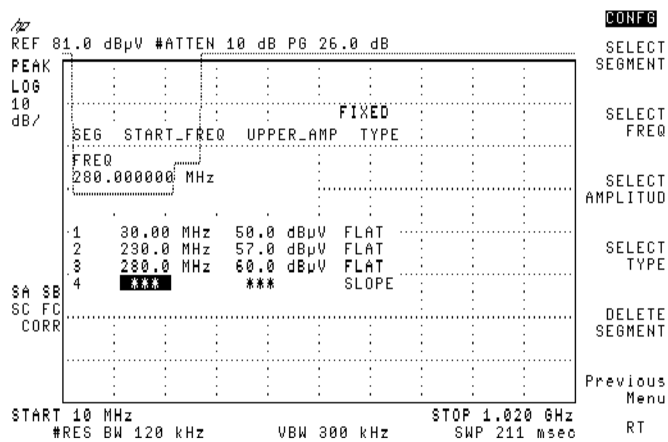


Figure 3-70. Entering the Third Limit-Line Segment

You may notice that the end coordinate of segment three is drawn to a reference point off the top of the analyzer's graticule. Until the next segment is defined, the line will remain drawn to a reference off the top of the graticule.

22. Press SELECT FREQ , 1, and GHz.
23. Press SELECT AMPLITUD , 60, and dB.

24. Press SELECT TYPE, then POINT. See Figure 3-71.

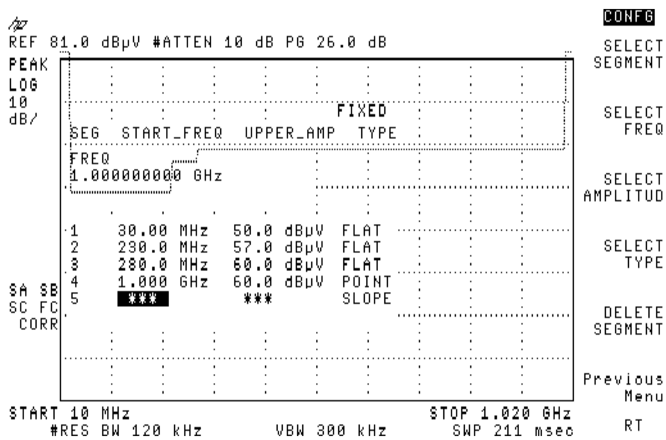


Figure 3-71. The Completed Limit-Line Table

25. After entering all the segments, press Previous Menu to return to the limit-line menu. The limit line can now be saved on a memory card or in the analyzer's memory.

26. Press (MODE), (MODE) to return to the top-level EMC analyzer menu.

Storing and Deleting Limit Lines

This section provides instructions on storing and deleting limit lines. The file name prefix can also be changed using the procedure described in this section.

Storing Limit Lines to a RAM Memory Card

1. Insert a formatted RAM memory card into the card reader slot on the front panel of the analyzer. If your card is already formatted, proceed to step 2; if it is not, perform steps 1a through 1e:
   a. Press the (CONFIG) front-panel key.
   b. Press **More 1 of 3**.
   c. Press **CARD CONFIG**.
   d. Press **FORMAT CARD**.
   e. After the card has formatted, press the (MODE) front-panel key to return the EMC auto-measurement personality.
2. Press **EMC Config**.
3. Press **Limit Lines**.

4. Press SAVE LIMIT. See Figure 3-72.

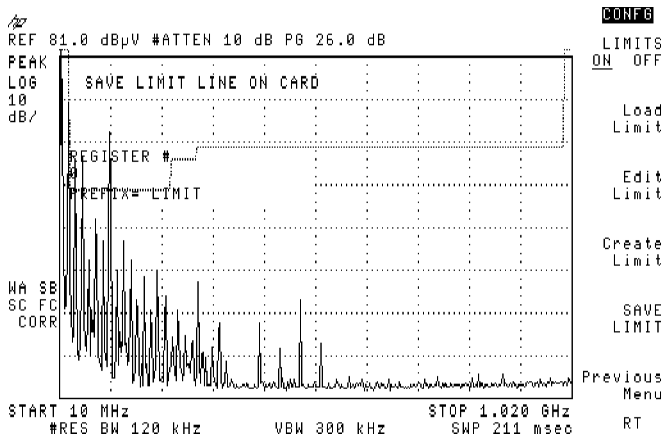


Figure 3-72. Save Limit Screen

5. Press 22, (ENTER) (same as the (Hz) key in the analyzer's lower-right corner), to save the limit line in register 22. Notice that the prefix on the card will be `LIMIT`. See Figure 3-73. The limit line is saved on the card as `lLIMIT_22`. To change the file's prefix, refer to "Changing a File's Prefix," in this section.

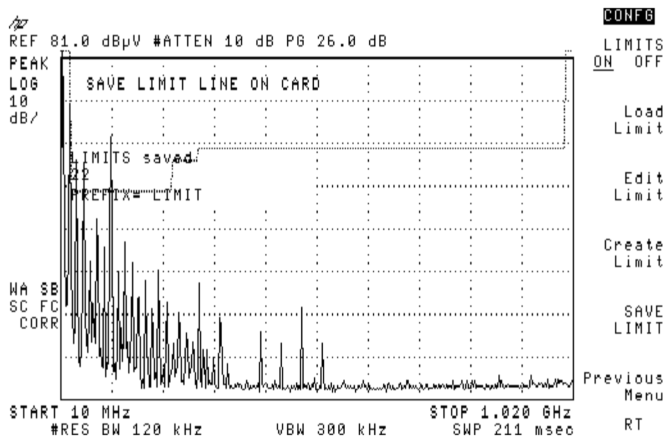


Figure 3-73. Saving Limit Lines in Register 22

Storing Limit Lines to Internal Memory

1. Press (SAVE).
2. Press INTERNAL CRD, INTERNAL will be underlined. See Figure 3-74.

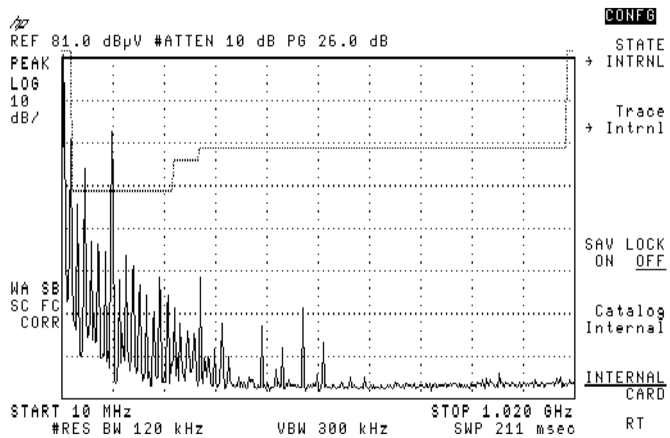


Figure 3-74. INTERNAL Underlined

3. Press Trace → Intrnl.
4. Press Limit Lines.

5. Press 22, (ENTER) (same as the (Hz) key in the analyzer's lower-right corner) to save the limit lines to internal register 22. See Figure 3-75.

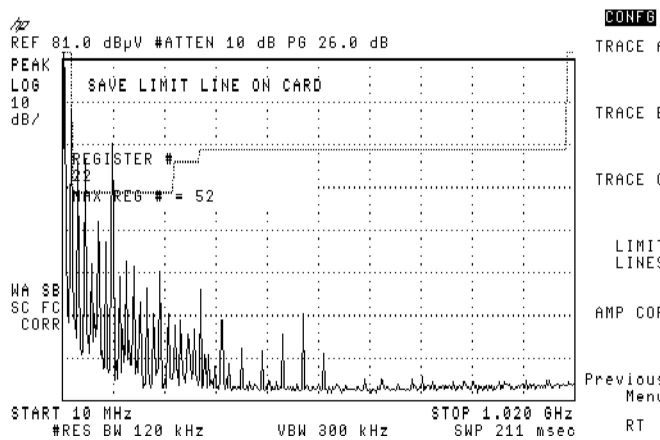


Figure 3-75. INTERNAL TRACE Softkey Screen

6. To return to the LIMIT LINES softkey menu, press (MODE), (MODE).

Changing a File's Prefix (When Storing to a Memory Card)

The following procedure outlines how to designate a prefix for a limit line being stored on a RAM card. This example changes the prefix to GCN.

> **NOTE**
>
> The following illustrations do not necessarily reflect what you may see on your display screen. Their purpose is to illustrate the softkey menus you will see.

1. Press EMC Config .

2. Press LIMIT LINES.
3. Press SAVE LIMIT.
4. Press (CONFIG). See Figure 3-76.

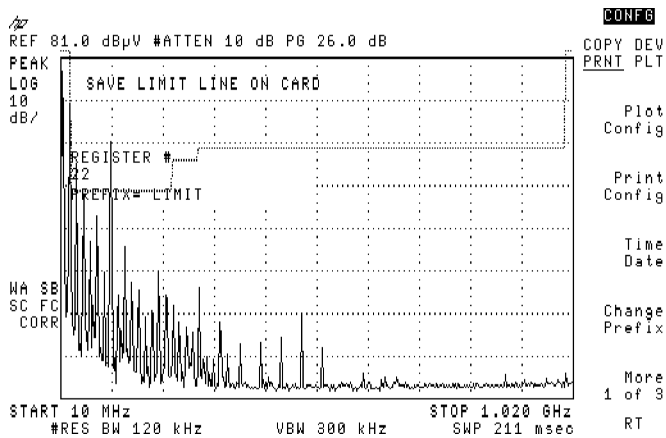


Figure 3-76. (CONFIG) Softkey Screen

5. Press `Change Prefix`. See Figure 3-77.

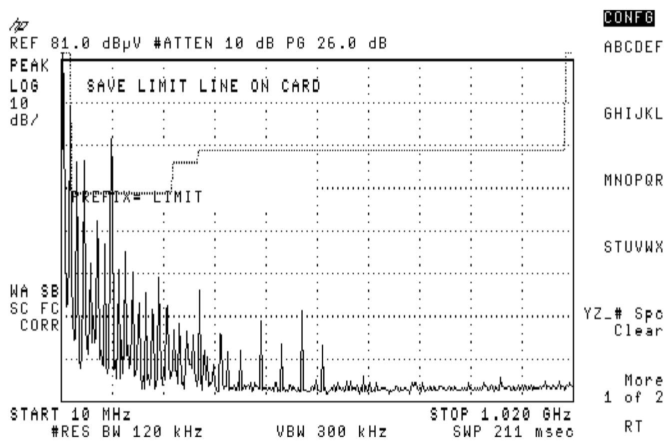


Figure 3-77. Changing the Prefix

6. Press `YZ_# Spc Clear`.

7. Press Clear to clear the previous prefix. See Figure 3-78.

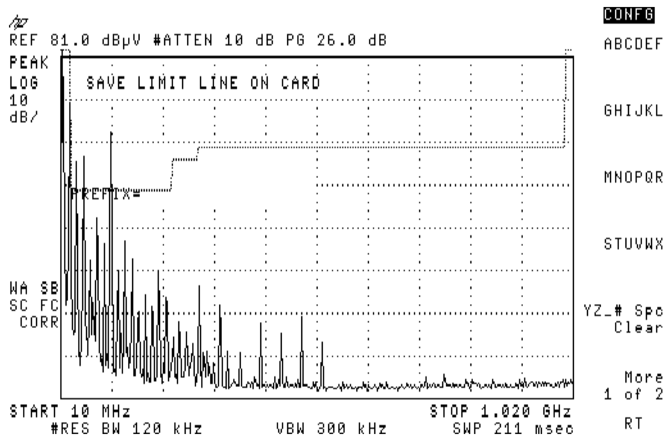


Figure 3-78. Clearing the Prefix

8. Press GHIJKL. See Figure 3-79.

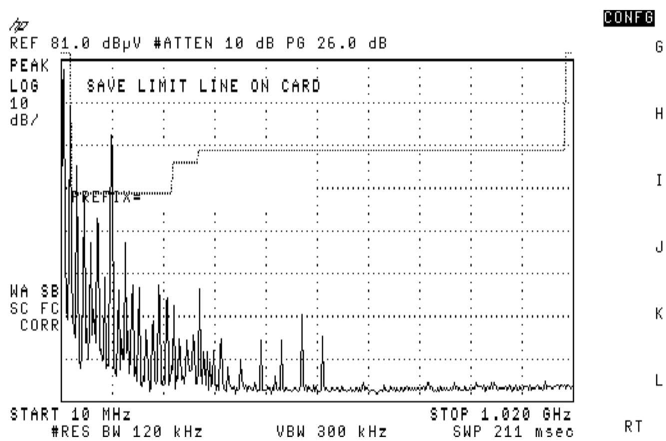


Figure 3-79. Changing the First Letter of the Prefix

9. Press G, which produces the "G."
10. Press ABCDEF.
11. Press C, which produces the second letter.
12. Press MNOPQR.
13. Press N, which produces the third letter.

14. Press (MODE), (MODE), which returns you to the EMC analyzer. See Figure 3-80.

NOTE

If the (MODE), EMC Config , and Limit Lines keys are pressed, the prefix will be reset to LIMIT.

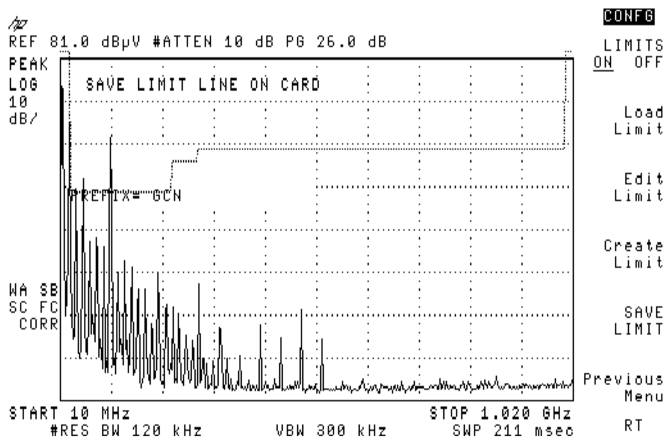


Figure 3-80. The Limit Lines Softkey Menu.

15. Press SAVE LIMIT .

16. Press 10 (ENTER) (same as the (Hz) key in the analyzer's lower-right corner). The limit line will be saved as: lGCN_10.

17. Press LOAD LIMIT to view the file with the prefix change.

Deleting a Limit-Line File

1. Press (RECALL) (or (SAVE)).
2. Press INTERNAL CRD, CRD will be underlined.
3. Press Catalog Card.
4. Press CATALOG ALL (or More 1 of 2 and CATALOG LMT LINE).
5. Scroll, using the front-panel knob, to the limit-line file of interest.
6. Press DELETE FILE two times.
7. Press CATALOG ALL (or CATALOG LMT LINE) to verify that the file has been deleted.

Turning On the Limit Pass/Fail Message

Every measurement sweep of trace A is compared to the limit line. A message can be displayed that indicates whether trace A is within the bounds of the limit line. However, the EMC analyzer normally blanks this message. The `LIMI MSG ON OFF` softkey (in the `MISC MENU`) can be used to turn this message on.

8. Press `EMC Config`.
9. Press `Freq Bands`.
10. Press `.2 - 1 GHz SETUP`.
11. Press `Previous Menu`.
12. Press `Limit Lines`.
13. Press `Load Limit`.

14. Scroll to `1FCC B 3m`. See Figure 3-81.

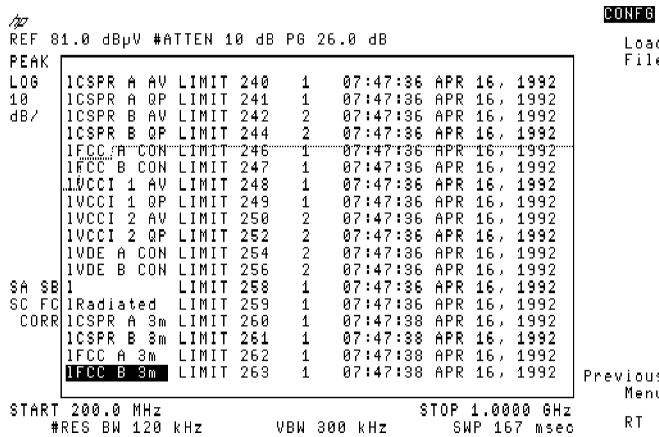


Figure 3-81. `FCC B 3m` **Highlighted**

15. Press `LOAD FILE`.

16. Press `Previous Menu`.

17. Use a BNC cable to connect the analyzer's CAL OUT signal to the analyzer's input.

18. Press `Misc Menu`.

19. Press LIMI MSG ON OFF (ON will be underlined). LIMI MSG ON OFF turns the testing limits on. LIMIT FAIL is displayed because the calibration signal exceeds the limit line. See Figure 3-82.

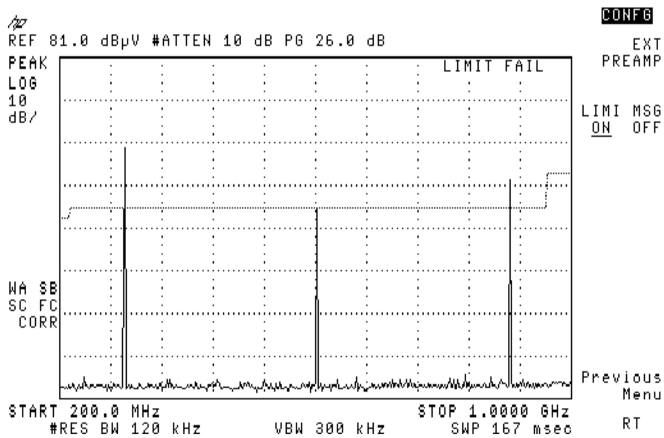


Figure 3-82. Displaying LIMIT FAIL

20. Disconnect CAL OUT from the analyzer input. `LIMIT PASS` is displayed since the signal does not exceeds the limit line. See Figure 3-83.

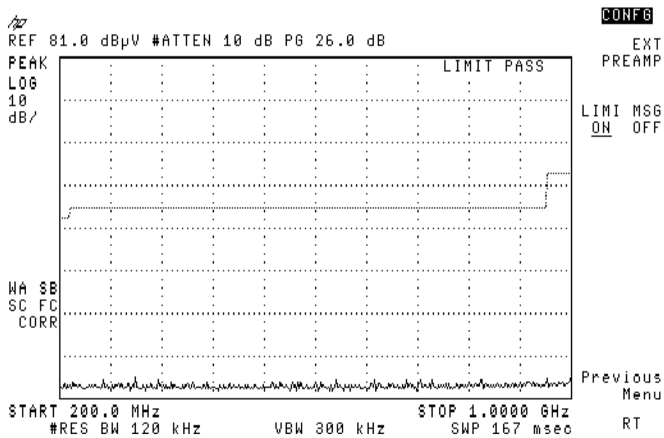


Figure 3-83. Displaying `LIMIT PASS`

Loading, Editing, Creating, and Storing Transducer Factors

Transducer correction factors are used to compensate for frequency-dependent amplitude variations at the input port. Up to 80 pairs of frequency-amplitude correction points can be entered.

In this section . . .

Loading Transducer Correction Factors

1. Press EMC Config .
2. Press Freq Bands .
3. Press 30-300 MZ .
4. Press Previous Menu .
5. Press Transdcr Factors .

> **NOTE**
>
> Before proceeding to the next step, be sure to install either the EMC auto-measurement personality card or a RAM card (with transducer factors loaded on the card) into the analyzer's memory card slot. Pressing the Load Transdcr softkey without a card installed will cause the error NO CARD FOUND to appear on the display screen. To recover from the error, press Previous Menu , install the memory card, then press Load Transdcr .

6. Press Load Transdcr . The Load Transdcr softkey catalogs all transducer factors files (AMP extension) on the memory card.
7. Use the front-panel knob to move the highlighted bar to the transducer correction factors file of interest. For the biconical antenna, the file would be aBICONICAL. Table 3-2 lists the transducer files loaded on the HP 85712D EMC auto-measurement personality card.

Table 3-2. Transducer Factors Loaded on the EMC Personality Card

File Name	Description
aLISN	Transducer factors for the HP 11967C line impedance stabilization network (10 kHz to 105 MHz).
aBICONICAL	Transducer factors for the HP 11966C biconical antenna (30 MHz to 300 MHz) at 3m spacing.
aLOG PRDC	Transducer factors for the HP 11966D log periodic antenna (200 MHz to 1 GHz) at 3m spacing.
aHF LOG	Transducer factors for the HP 11966N HF log periodic antenna (200 MHz to 5 GHz) at 3m spacing.
aHORN	Transducer factors for the HP 11966E double ridged waveguide horn antenna (1 GHz to 18 GHz) at 3m spacing.

Read This

Use the ⇧ ⇩ keys or the knob to move the highlighted bar between individual files on a page.

Press LOAD FILE . The transducer factors (ampcor) from the loaded file are now displayed on the analyzer. See Figure 3-84.

NOTE

To determine if the transducer correction factor data is still loaded into the analyzer, refer to the A indicator next to the CORR indicator on the lower left of the display. See Figure 3-84. The A indicates that the transducer factor data is still loaded into the analyzer. If the transducer correction factors have been purged from the analyzer, the A will not be present on the display screen.

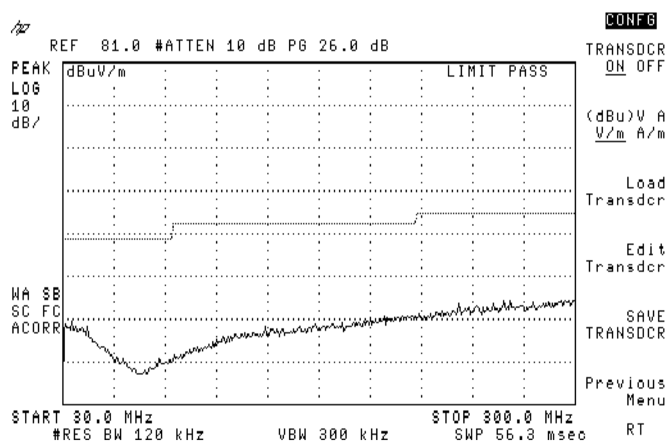


Figure 3-84. Loaded Transducer Factors

Editing Transducer Correction Factors

NOTE

The EMC auto-measurement personality uses the term `TRANSDCR` to mean transducer factors, whereas the analyzer's internal firmware uses the term `AMPCOR`. The terms are interchangeable.

1. Press `EMC Config`.
2. Press `Transdcr Factors`.

3. Press `Edit Transdcr`.

The frequency values must be equal, or in increasing order, or an error condition may result. See Figure 3-85.

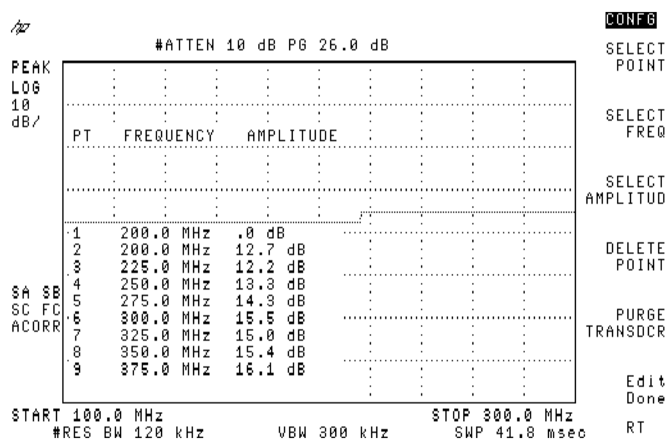


Figure 3-85. Changing Transducer Values

In Figure 3-85, the first amplitude factor's value has an amplitude of 0 dB (displayed as `.0 dB`). If you scrolled to the last amplitude value, you would notice (Figure 3-86) that it also has an amplitude of 0 dB. Loading in 0 dB as the first and last amplitude values defines the start and stop frequencies for the transducer factors. The first two frequency entries must be alike (the same frequency), and the frequency of the last two entries must be alike.

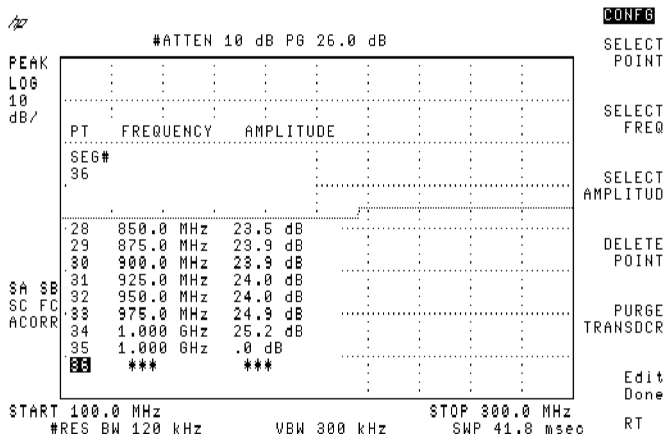


Figure 3-86. Creating a Frequency Range for the Antenna Correction Factors

Creating Transducer Correction Factors

See "Transducer Correction Functions" for descriptions of the functions.

1. Press EMC Config.
2. Press Transdcr Factors.

> **NOTE**
>
> A signal is not used in this procedure for demonstrating how to create amplitude-correction data.

3. Set the start frequency to 300 MHz and the stop frequency to 500 MHz by pressing (FREQUENCY), START FREQ 300 (MHz), and STOP FREQ 500 (MHz).
4. Press (MODE), (MODE) to return to the EMC auto-measurement personality.
5. Press Edit Transdcr to access the editing menus for transducer correction factors.
6. To clear any existing transducer correction data, press PURGE TRANSDCR two times consecutively.

> **NOTE**
>
> After pressing PURGE TRANSDCR the first time, the message IF YOU ARE SURE, PRESS KEY AGAIN TO PURGE DATA will appear. Pressing PURGE TRANSDCR a second time erases the transducer correction data. Select Previous Menu to return to the previous menu without purging the data.

7. To specify the first amplitude-correction point, press:

   SELECT POINT 1 (ENTER).

   SELECT FREQ 1 (Hz).

   SELECT AMPLITUD 0 (dB).

8. To specify the second transducer correction point, press:

   SELECT POINT 2 (ENTER).

   SELECT FREQ 50 (MHz).

   SELECT AMPLITUD 12 (+dBm).

NOTE

Table entries can be edited if you make a mistake. To edit an existing point, use SELECT POINT to specify the point, then SELECT FREQ or SELECT AMPLITUD to specify the entry that you want to edit.

9. To specify the third, fourth, and fifth transducer correction points, press:

   SELECT POINT 3 (ENTER).

   SELECT FREQ 250 (MHz).

   SELECT AMPLITUD 10 (+dBm).

   SELECT POINT 4 (ENTER).

   SELECT FREQ 300 (MHz).

   SELECT AMPLITUD 15 (+dBm).

   SELECT POINT 5 (ENTER).

   SELECT FREQ 350 (MHz).

   SELECT AMPLITUD 22 (+dBm).

10. To specify the last amplitude-correction point, press:

    SELECT POINT 6 (ENTER).

    SELECT FREQ 350 (MHz).

    SELECT AMPLITUD 0 (dB). See Figure 3-87.

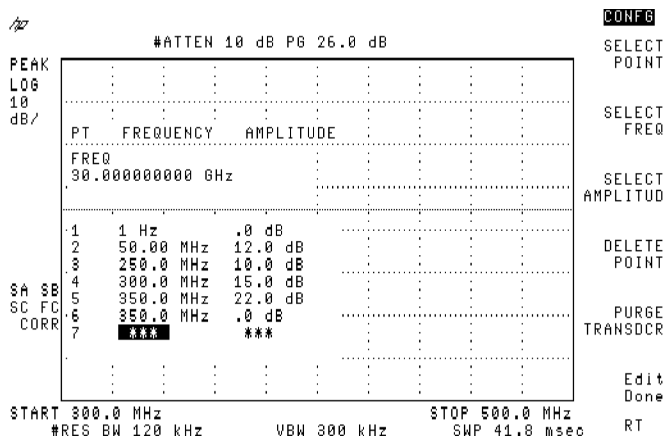


Figure 3-87. Completed Amplitude-Correction Table

11. Press EDIT DONE when all the points have been entered.

Transducer Correction Functions

Transducer correction functions usually are used in the order listed below:

Editing or Viewing the Transducer Correction Tables.

1. Press the (FREQUENCY) front-panel key.
2. Press (START FREQ) 100 (MHz).
3. Press (STOP FREQ) 300 (MHz).
4. Press (MODE).
5. Press EMC Config .

6. Press Transdcr Factors .
7. Press Load Transdcr .
8. Scroll to aLOG PROC.
9. Press LOAD FILE .
10. Press Edit Transdcr to access the softkey menus for creating a transducer correction table.

Press Edit Transdcr to edit an existing transducer correction table or, if no transducer correction table currently exists, to create a transducer correction table.

Selecting the Transducer Correction Factors Point.

Pressing SELECT POINT specifies the transducer correction factor point to be entered or edited. Transducer correction factor data is constructed from left to right and is created by entering frequency and amplitude values into a transducer correction factor table. The frequency and amplitude values specify a coordinate point from which transducer correction factors are interpolated. See Figure 3-88. Up to 80 points can be specified for the transducer correction factors table.

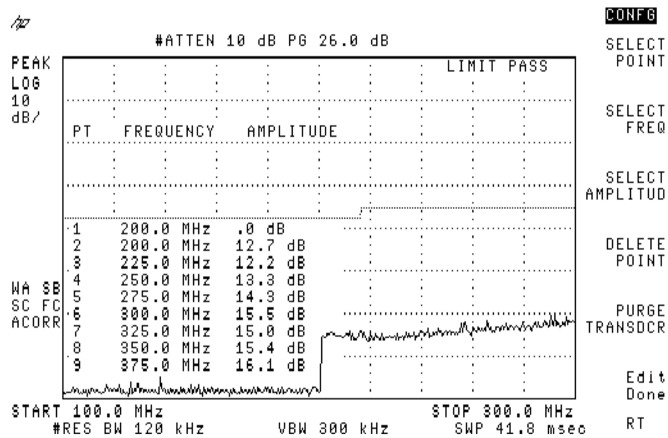


Figure 3-88. Transducer Correction Factor Points

Selecting the Frequency Coordinate.

Press SELECT FREQ, then enter a frequency value for the point.

NOTE

- Only two entries per frequency are used. If more points with the same frequency are entered, only the first and last entries are used. All other amplitude values are ignored.
- When entering transducer correction factor data, the frequency and amplitude values will be listed as asterisks (***) until new values are entered. Once the frequency value is entered, the segment is immediately sorted into the table according to this value.

Selecting the Amplitude Coordinate.

To select the amplitude coordinate for the point, press SELECT AMPLITUD, enter an amplitude value, then press a units key.

Completing Table Entry and Activating Transducer Correction Factors.

Press EDIT DONE to blank the transducer correction table from the screen. Access the menu with TRANSDCR ON OFF.

Press TRANSDCR ON OFF to turn the amplitude corrections on and off.

Storing and Deleting Transducer Correction Factors

Storing Transducer Factors to a RAM Memory Card

1. Insert a formatted RAM memory card into the card reader slot on the front panel of the analyzer. If your card is already formatted, proceed to step 2. If it is not, perform steps 1a through 1e:
   a. Press the (CONFIG) front-panel key.
   b. Press More 1 of 3.
   c. Press CARD Config.
   d. Press FORMAT CARD.
   e. After the card has formatted, press the (MODE) front-panel key to return the EMC auto-measurement personality.
2. Press EMC Config.
3. Press Transdcr Factors.

4. Press `Save Transdcr` . See Figure 3-89.

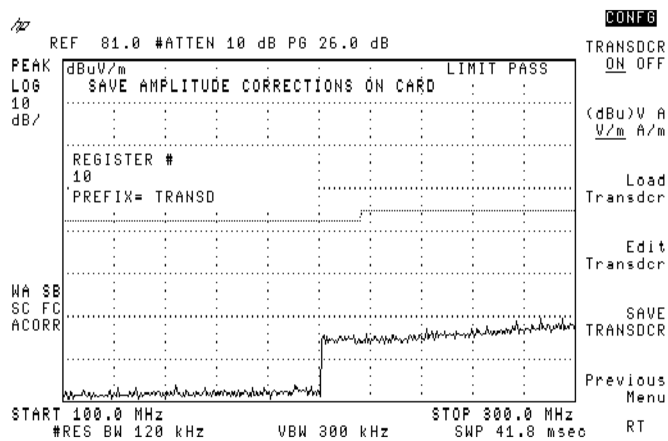


Figure 3-89. Save Transducer Screen

5. Press 47, (ENTER) (same as the (Hz) key in the analyzer's lower-right corner) to save the transducer factors in register 47. Notice that the prefix on the card will be `TRANSD`. To change the file's prefix, refer to "Changing a File's Prefix" later in this section. The transducer factors will be saved on the memory card as `aTRANSD_47`. See Figure 3-90.

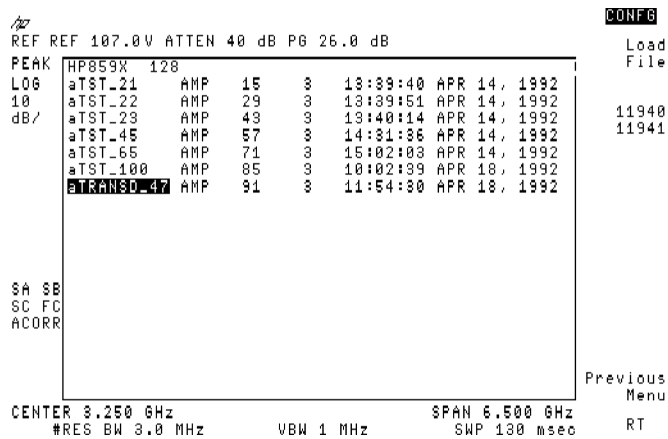


Figure 3-90. Saving Transducer Factors in Register 47

Storing Transducer Factors to Internal Memory.

1. Press SAVE.
2. Press INTERNAL CRD, INTERNAL will be underlined. See Figure 3-91.

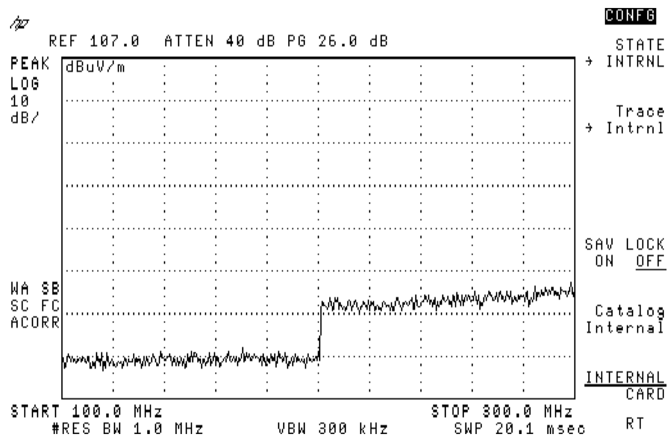


Figure 3-91. INTERNAL Underlined

3. Press Trace → Intrnl.
4. Press AMP COR.

5. Press 10, (ENTER) (same as the (Hz) key in the analyzer's lower-right corner) to save the transducer factors to internal register 10. See Figure 3-92.

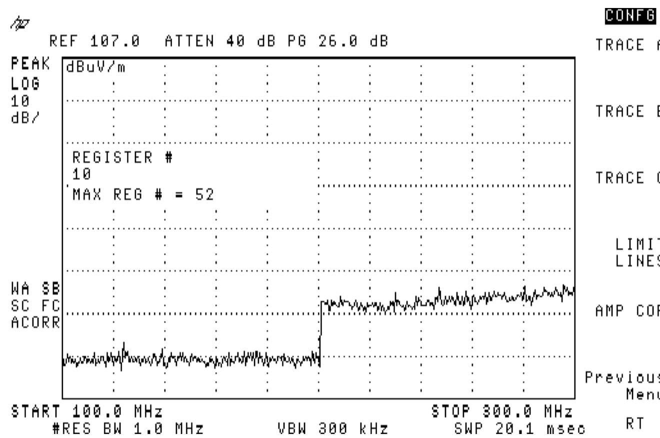


Figure 3-92. INTRNL TRACE Softkey Screen

6. To return to the `Transdcr Factor` softkey menu, press (MODE), (MODE).

Changing a File's Prefix (When Storing to a Memory Card)

NOTE

The following illustrations do not necessarily reflect what you may see on your display screen. Their purpose is to illustrate the softkey menus you will see.

The following procedure outlines how to designate a prefix for a transducer file being stored to a RAM card, for example to change the prefix to DCN, do the following:

1. Press SAVE TRANSDCR .
2. Press (CONFIG). See Figure 3-93.

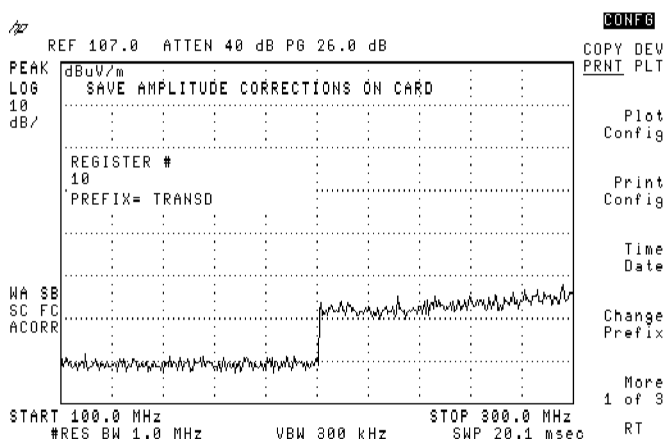


Figure 3-93. (CONFIG) Softkey Screen

3. Press Change Prefix . See Figure 3-94.

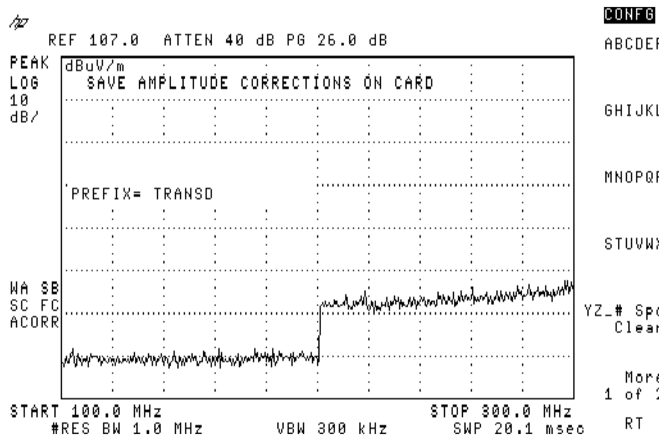


Figure 3-94. Changing the Prefix

4. Press YZ_# Spc Clear .

5. Press `Clear` to clear the previous prefix. See Figure 3-95.

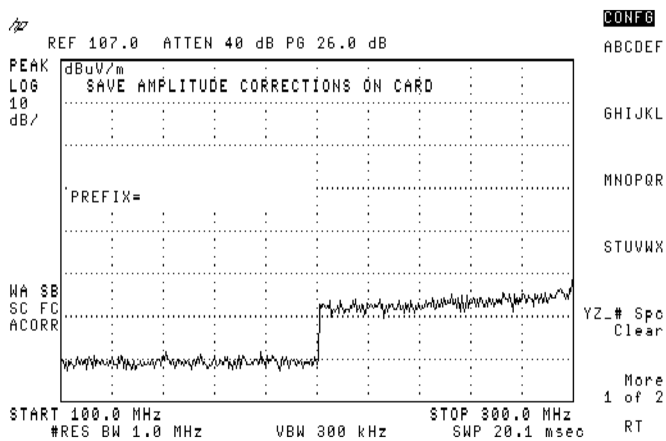


Figure 3-95. Clearing the Prefix

6. Press ABCDEF. See Figure 3-96.

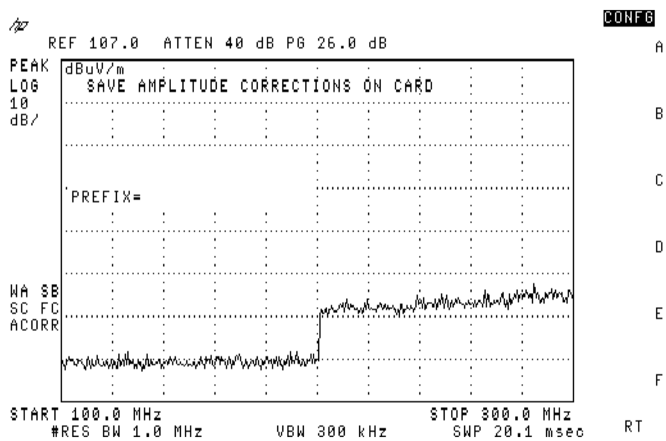


Figure 3-96. Changing the Letter of the First Prefix

7. Press D, which produces the “D.”
8. Press ABCDEF again.
9. Press C, which produces the second letter.
10. Press MNOPQR.
11. Press N, which produces the third letter.

12. Press (MODE), (MODE), which returns you to the EMC analyzer. See Figure 3-97.

NOTE

If (MODE), EMC Config and Transdcr Factors softkeys are pressed, the prefix will reset to TRANSD.

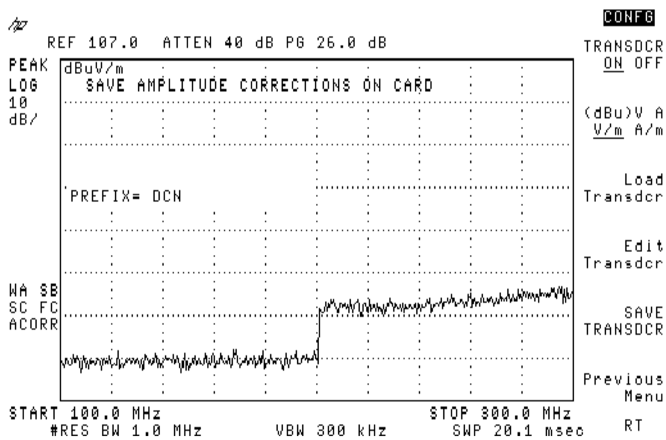


Figure 3-97. The Transdcr Factor Softkey Menu

13. Press Save Transdcr .

14. Press 10, (ENTER) (same as (Hz) key in the analyzer's lower-right corner). The transducer factors will be saved on the memory card as aDCN_10.

15. Press LOAD TRANSDCR to view the file with the prefix change.

Deleting a Transducer Factors File

1. Press (SAVE) or (RECALL).
2. Press INTERNAL CRD , CRD will be underlined.
3. Press Catalog Card .
4. Press CATALOG ALL (or MORE 1 of 2 and CATALOG AMP CORR).
5. Scroll, using the front-panel knob, to the transducer factors file of interest.
6. Press DELETE FILE two times.
7. Press CATALOG ALL or CATALOG AMP CORR to verify that the file has been deleted.

Changing Fundamental Analyzer Functions

You can use the spectrum analyzer's (FREQUENCY) or (SPAN) front-panel keys to change either the center frequency or the span. Often during EMC diagnostic work you need to change the center frequency quickly to look at new signals, or you need to decrease the span to look more closely at signals.

Changing Center Frequency or Span

Press (FREQUENCY), CENTER FREQ to activate the center frequency. Use the numeric keypad, knob, or (⇧) and (⇩) keys to change the value.

Press (FREQUENCY), SPAN to activate the span. Change the value with the numeric keypad, knob, or (⇧) and (⇩) keys.

To return to the EMC auto-measurement personality, press (MODE), (MODE).

Changing the Start and Stop Frequencies

Press (FREQUENCY), START FREQ, or STOP FREQ to change the analyzer's start and stop frequencies. The start and stop frequencies cannot be changed individually from within the EMC auto-measurement personality. Pressing START FREQ sets the frequency for the left side of the graticule. Pressing STOP FREQ sets the frequency for the right side of the graticule. The left and right sides of the graticule correspond to the start and stop frequencies. When these frequencies are activated, their values are displayed below the graticule in place of the center frequency and span.

Changing Reference Level or Bandwidth

You can use (AMPLITUDE) REF LEVEL to change the reference level and (BW) RES BW to chose the bandwidth. Often during EMC diagnostic work you need to change the reference level or resolution bandwidth. Using a narrower resolution bandwidth lets you see signals that are close together. However, as the bandwidth is reduced the analyzer must sweep slower. Therefore, you may want to keep the bandwidth wide until you are viewing closely spaced signals in narrow spans.

Press (AMPLITUDE), then REF LEVEL to activate the reference level. Use the numeric keypad, knob, or (⇑) and (⇓) keys to change the value.

Press (BW), then RES BW to activate the resolution bandwidth. Change the value with the numeric keypad, knob, or (⇑) and (⇓) keys.

To return to the EMC auto-measurement personality, press (MODE), (MODE).

For a more complete description of the spectrum analyzer's functions, refer to "Chapter 5, Making Basic Spectrum Analyzer Measurements"

Measuring a Signal's Field Strength

CAUTION

The marker's amplitude accuracy is maintained only when the user has correctly set the transducer factors, preamp gain, reference offset, and reference level.

During the analysis of signals you may find it useful to use the marker. The marker gives a digital readout of frequency and amplitude. It is from this frequency and amplitude value that the EMC auto-measurement personality calculates the signal's magnetic or electric field strength at the transducer's input. This field-strength reading takes into account the antenna's or probe's amplitude flatness and can be used to compare the absolute amplitudes of different signals.

To activate the marker, press `NRM MKR LSN MKR`. `NRM MKR` will be underlined to indicate that the marker is active. Use the numeric keypad, knob, or ⇧ and ⇩ keys to change the frequency of the marker.

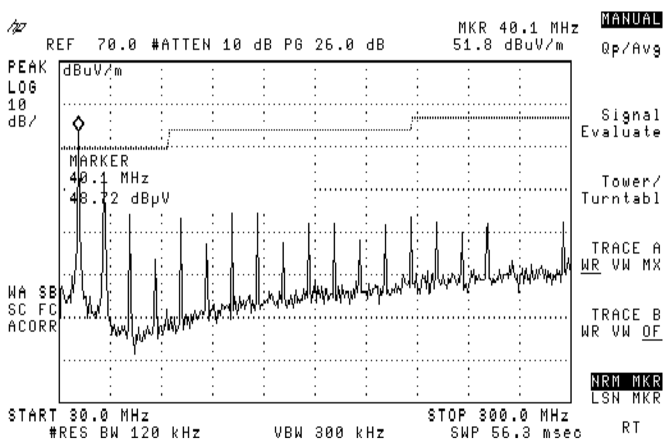


Figure 3-98. Magnetic Field-Strength Measurement

Listening to a Signal's Demodulated Output

A common technique for determining the origin of signals used during EMC troubleshooting is to listen to the demodulated output of the signal of interest. Many types of signals, such as those from video terminals, are distinguishable by sound. The NRM MKR LSN MKR function lets you listen to the demodulated output at the marker frequency.

Press NRM MKR LSN MKR two times (LSN MKR will be underlined) to activate the marker. The sweep pauses briefly at the marker frequency, and the demodulated output can be heard on the analyzer's built-in speaker. If the demodulation options (Options 102 or 103 for the HP 8591E, HP 8593E, HP 8594E, HP 8595E, and HP 8595E spectrum analyzers) are not installed in your spectrum analyzer, you can connect the video output from the analyzer's rear-panel connector to an external amplifier and speaker or headphones.

You can control the volume with the analyzer's front-panel knob. To control the dwell time, press (AUX CTRL) and then DEMOD . Press DWELL TIME and enter the desired value using the (⇧) or (⇩) keys, front-panel knob, or numeric keypad. Press (MODE), (MODE) to return to the EMC manual menu.

Pressing NRM MKR LSN MKR a second time turns off the speaker and causes the sweep to continue without pausing; the marker remains active. Continuing to press NRM MKR LSN MKR causes the LSN function to toggle between ON and OFF.

You can also demodulate a signal by using the controls under (AUX CTRL) if you have an optional demodulation board in your spectrum analyzer. Refer to your spectrum analyzer's user manual for more information.

NOTE

Demodulation is provided in HP 8591E, HP 8593E, HP 8594E, HP 8595E, and HP 8596E spectrum analyzers with Option 102, AM/FM demodulator and TV synch trigger, or Option 103 quasi-peak detection/demodulator.

Using the Analyzer's Trace Capabilities

Under normal spectral analysis you will want to have one trace active on the display. While doing EMC diagnostics, you may want to stop the trace immediately to catch an intermittent or very low repetition signal. While evaluating different product designs you may want to move the probe around the design while having the analyzer remember the highest emissions. These capabilities are available in the EMC manual portion of the EMC auto-measurement personality.

The EMC Manual Test menu gives access to `TRACE A WR VW MX`. When you enter the menu under normal conditions, `WR` will be underlined to indicate that trace A is in the clear-write mode (continuously sweeping). Pressing `TRACE A WR VW MX` displays trace A and stops taking data into trace A (view mode). `VW` will be underlined. Pressing `TRACE A WR VW MX` again will put trace A in max hold. `MX` will be underlined. This capability can be very helpful when trying to catch an intermittent signal.

Pressing `TRACE A WR VW MX` again causes the function to toggle back to the view trace-A mode; `VW` will once again be underlined.

The EMC Manual Test menu gives access to `TRACE B WR VW OF`. When you enter the menu under normal conditions, `OF` will be underlined to indicate that trace B is in store-blank mode (off). Pressing `TRACE B WR VW OF` once places trace B into the view mode; `VW` will be underlined.

Pressing `TRACE B WR VW OF` a second time places trace B into the write mode. This is designated by `WR` being underlined.

Pressing `TRACE B WR VW OF` again causes the function to toggle back to the clear-write trace-B mode. This is designated by `WR` being underlined.

A common technique for evaluating all of the emissions from a product is to put trace A in max hold (remembering the highest emissions) and trace A in clear write (displaying the current emission level). Once the highest emissions are found, you can press `TRACE A MX VW OF` so that `VW` is underlined. Trace B can then be stored into internal memory or to a memory card for archiving. After modifying the device under test, the stored trace can be recalled for comparison to the new emission level.

NOTE

It is important to note that max-hold (MX) does a clear-write on trace A when activated. To accumulate more data after activating max- hold (MX), use the trace functions under the (TRACE) front-panel key.

Trace B can be turned off and stored by pressing TRACE B WR VW OF a third and fourth time. This will return the function to its original state with trace B in the store-blank mode. OF will be underlined.

You can also control trace A and trace B through the (TRACE) key on the front panel. To return to the previously displayed EMC Manual Test menu, simply press (MODE), (MODE).

Discriminating between Narrowband & Broadband Signals

In EMC testing and diagnostics, the test system must be able to differentiate between narrowband and broadband signals. A broadband signal results in a lower measured amplitude when the signal is quasi-peak or average detected. Also, broadband signals can mask narrowband signals which, because they are measured against a lower limit, may cause a product to fail EMI compliance tests.

The EMC auto-measurement personality uses the spectrum analyzer's ability to differentiate between narrowband and broadband signals. Through the `MAX/MIN ON OFF` softkey, the analyzer invokes a routine that helps you locate narrowband signals which might be hidden beneath broadband signals.

Normally, the `MAX/MIN ON OFF` function is off (indicated by **OFF** being underlined). See Figure 3-99.

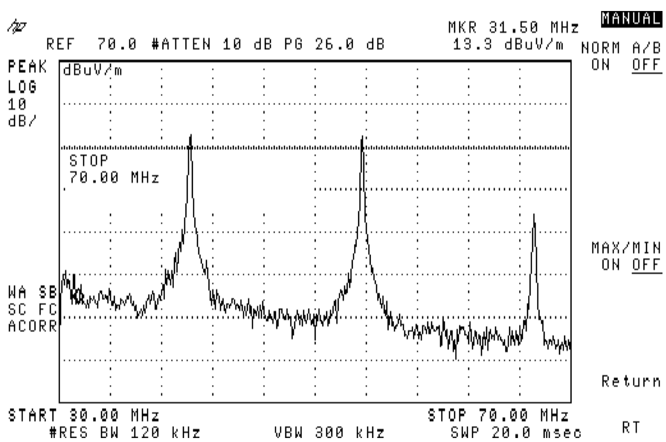


Figure 3-99. `MAX/MIN ON OFF` **Turned Off**

When pressed, MAX/MIN ON OFF causes the analyzer to put trace B into max-hold mode and trace C into min-hold mode (trace A is active). (ON will be underlined to indicate this.) As the analyzer sweeps, the maximum and minimum signal levels are stored in traces B and C. While the maximum and minimum level for narrowband signals remain the same, broadband signals have different maximum and minimum levels. Therefore, if MAX/MIN ON OFF is ON, broadband signals produce two different traces (see Figure 3-100), while narrowband signals produce a single trace. This test requires that the span/resolution bandwidth ratio be less than 200:1.

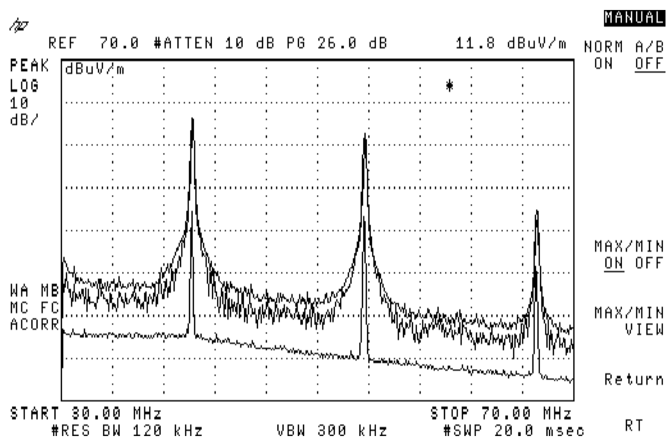


Figure 3-100. Storing Maximum and Minimum Signal Levels

To view the result of the MAX/MIN ON OFF function, press MAX/MIN VIEW. See Figure 3-101. All traces stop sweeping and the maximum and minimum signals are displayed on the CRT. This is denoted by MAX, MIN, and VIEW all being underlined.

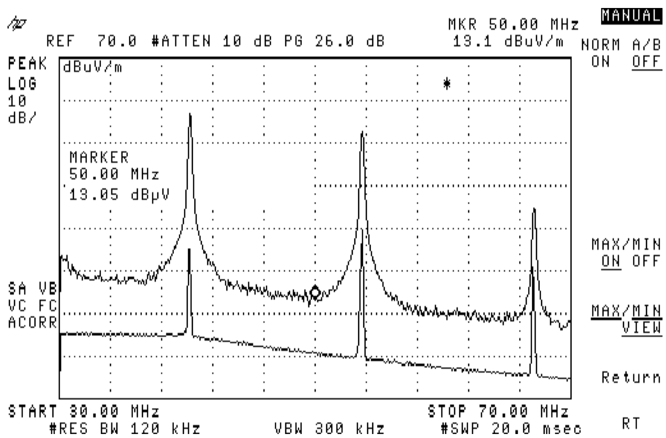


Figure 3-101. Maximum and Minimum Responses Viewed

Pressing MAX/MIN VIEW repeatedly lets you view only the maximum trace, only the minimum trace, or both traces at the same time. See Figure 3-102 and Figure 3-103.

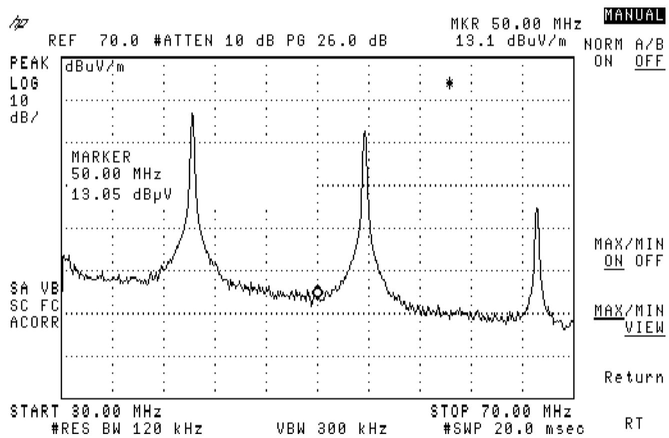


Figure 3-102. Viewing the Maximum Trace

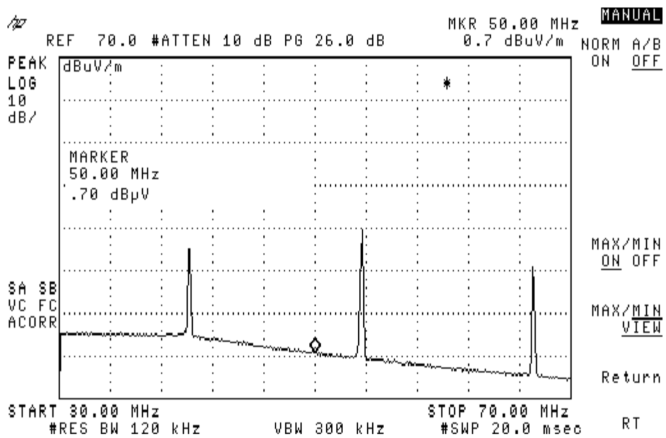


Figure 3-103. Viewing the Minimum Trace

Pressing MAX/MIN ON OFF a second time turns the function off. This will be denoted by OFF being underlined. The MAX/MIN VIEW softkey will no longer be available. Trace A is once again in the clear-write mode.

Measuring Relative Changes in Signal Levels

A common technique in evaluating design changes is to store a product's *worst-case* emissions and later compare these emissions to a modified product design. Using TRACE A WR VW MX can assist in capturing the highest emissions. Refer to, "Using Analyzer Trace Capabilities." Another technique is to normalize the new emissions to trace B using NORM A/B ON OFF.

Figure 3-104 illustrates a signal stored in trace B before initiating normalization. (Trace B is the top trace in the figure; trace A is the bottom trace.) Trace B is in the view mode.

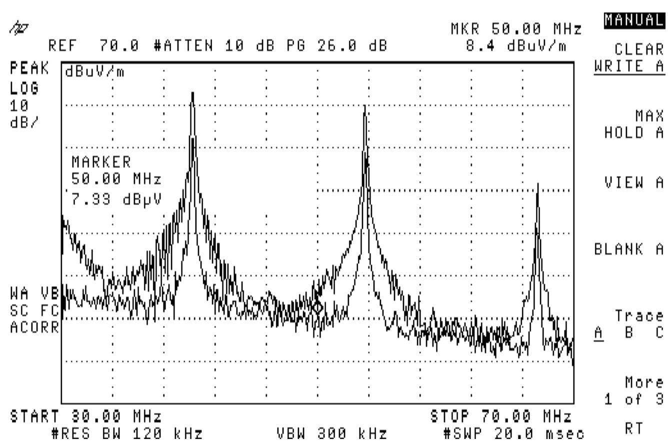


Figure 3-104. Signal before Normalizing

When activated, NORM A/B ON OFF normalizes to trace B any signal at the input. If trace B was left off, then the contents of trace A will be put into trace B's view mode prior to normalization. Any changes in signal level appear relative to the display line located at the third graticule line from the top of the display.

Figure 3-105 illustrates the normalization of the active trace (trace A at the bottom of Figure 3-105) to the stored signal in trace B.

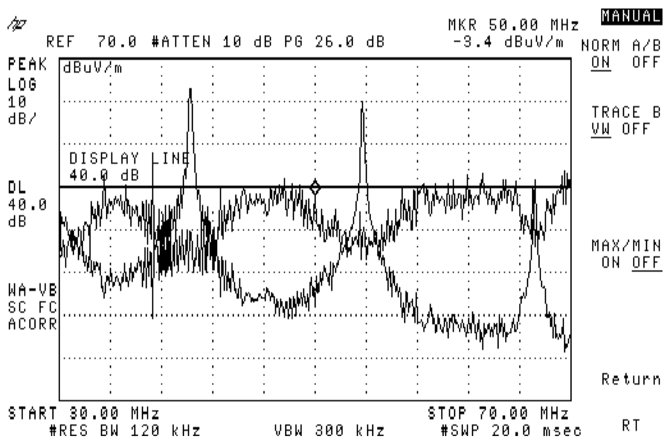


Figure 3-105. Active Trace Normalized

When the display line is the active function, you have the ability to use the numeric keypad, knob, or ⇧ and ⇩ keys to change its position. This is helpful when the contents of trace B make it difficult to measure the relative signal level. See Figure 3-106.

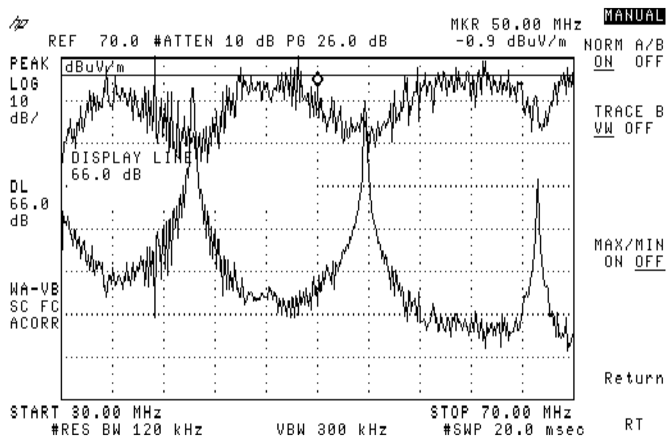


Figure 3-106. Display Line Raised

Trace B may be toggled between view mode and off by pressing TRACE B VW OFF. The state of trace B will be underlined (VW for view or OFF for off). When in the OFF mode, trace B will not be seen on the display. However the contents of trace A will still be normalized to trace B. See Figure 3-107.

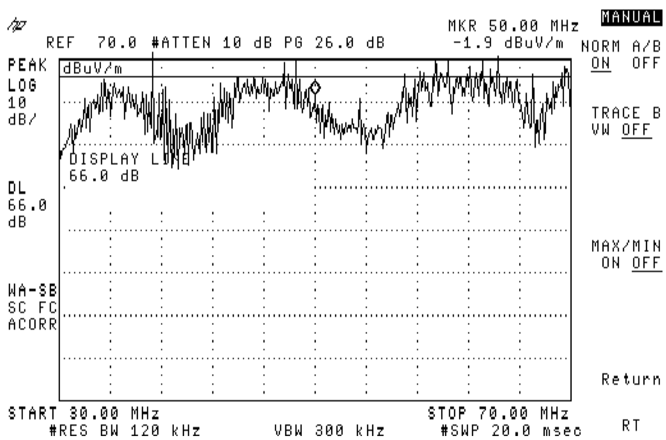


Figure 3-107. Trace B Turned OFF

To turn off the normalization feature, press NORM A/B ON OFF again. OFF will be underlined on the NORM A/B ON OFF softkey and OFF will be underlined on TRACE B VW OFF indicating that both keys have been deactivated.

NOTE

While in the EMC analyzer mode, if you leave any of the EMC menus to use another front-panel key, you can return to that EMC menu by pressing (MODE), (MODE).

Making Quasi-Peak Measurements

Quasi-peak detection weights a signal level based on the repetition frequency of the spectral components making up the signal. That is to say, all three (peak, quasi-peak, and average detection) will yield the same amplitude value for a CW signal. A periodic, broadband, or impulsive signal will yield a quasi-peak level lower than the peak level. The weighting (accounted for through specific charge, discharge and display time constants in the quasi-peak detector circuit) is a function of the repetition frequency of the signal being measured. The lower the repetition frequency, the lower the quasi-peak level.

Although many agencies governing EMI from commercial products require quasi-peak detection, if the emission from the device is within a test limit when measured with peak detection, the device will be considered to have passed the test even though quasi-peak detection was not used. This is because the quasi-peak level of a signal is always equal to or less than the peak level of that signal. Because of the time constants used in the quasi-peak detector, the spectrum analyzer must sweep considerably slower when the quasi-peak detector is on. Therefore, quasi-peak detection need be used only when a signal is close to or over the test limit. All other measurements should be made with peak detection in order to sweep the analyzer faster and save measurement time.

To make a quasi-peak measurement, several spectrum analyzer parameters must be set properly. The spectrum analyzer must be set to one of the three CISPR bandwidths (200 Hz, 9 kHz, or 120 kHz). The sweep time must be slow enough to allow the detector to fully charge and discharge. The spectrum analyzer must be in the linear display mode. All of these parameters are automatically controlled when you press `QP AUTO AT MKR`.

NOTE

The following keys will only be displayed on the spectrum analyzers with Option 103, which adds quasi-peak detection.

Pressing QP AUTO AT MKR causes the spectrum analyzer to run through the following sequence:

1. Records the amplitude of the on-screen marker.
2. Checks that the EMI and video bandwidth is set correctly for the marker frequency. If it is not, a message, the softkey for the correct bandwidth, and the CONTINUE softkey are displayed.
3. Sets the spectrum analyzer center frequency to the marker frequency.
4. Decreases the frequency span to zero, while keeping the marker at center frequency.
5. Sets the spectrum analyzer reference level to bring the marker amplitude close to the top of the display screen.
6. Puts the spectrum analyzer in the linear display mode.
7. Turns on the quasi-peak detector.
8. Sets the spectrum analyzer sweep time to 2 seconds.
9. Turns on QP X10 ON OFF to add 10 times (20 dB) quasi-peak gain if the signal is 20 dB below the reference level.
10. Takes a complete sweep.
11. Puts the marker on the quasi-peak signal and remembers the quasi-peak amplitude level.
12. Returns the analyzer to the settings present when QP AUTO AT MKR is pressed.
13. Displays the measured quasi-peak level with a diode symbol as the marker and displays the quasi-peak level at the bottom of the display screen.

NOTE

If the center frequency, reference level, or sweep time is changed, the quasi-peak markers will no longer be at the correct frequency or amplitude position.

NOTE

Because signals with low repetition rates are more difficult to keep on screen, the quasi-peak detector driver uses a special routine when measuring a pulse signal with a low repetition rate. When decreasing the frequency span, as described in step 4 above, the quasi-peak detector driver does the following:

- The quasi-peak detector driver compares the amplitude value of the marker from step 1 with the marker amplitude of the signal *after* the span has been decreased.
- If the difference between the markers amplitudes is more than 5 dB, the sweep time is increased by a factor of ten, then another measurement sweep and marker amplitude reading is made.
- The quasi-peak detector driver repeats the previous step until the difference between the marker amplitude is less than 5 dB or the sweep time has slowed to 100 seconds.

If the sweep time has slowed to 100 seconds and a signal cannot be found within 5 dB of the marker amplitude, a message is displayed indicating that no signal could be found and the analyzer returns to the settings present when QP AUTO AT MKR or MAN QP AT MKR was pressed. If this happens, place trace A in clear write mode (if it is in view or maximum hold mode) and check that there is a signal to be measured.

Figure 3-108 and Figure 3-109 show a spectrum analyzer display before and immediately following the use of QP AUTO AT MKR .

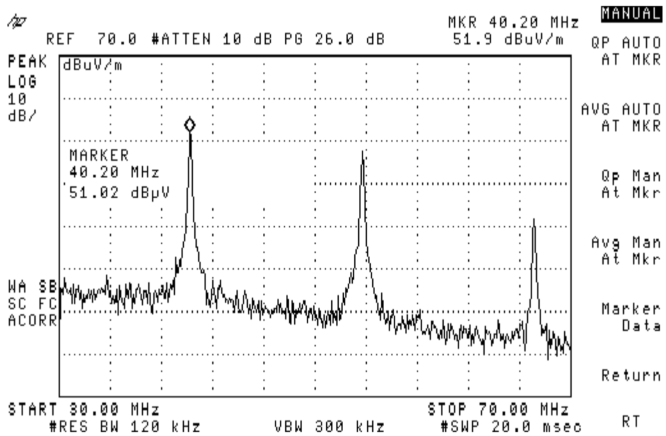


Figure 3-108. Display before an Automatic Quasi-Peak Measurement

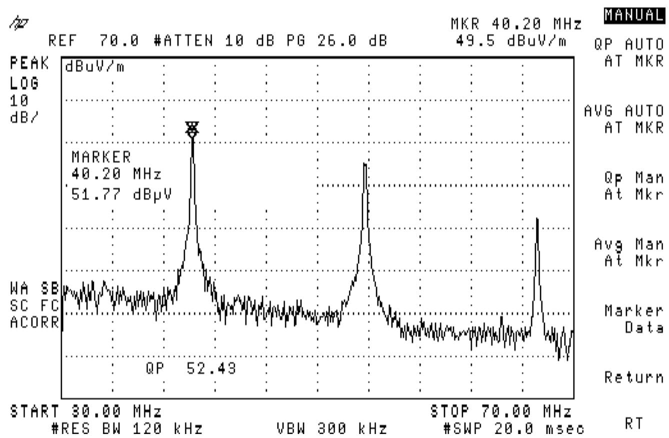


Figure 3-109. Results of an Automatic Quasi-Peak Measurement

The results from the `QP AUTO AT MKR` routine will be displayed on the analyzer CRT. When another quasi-peak measurement is made, the first data marker, and its corresponding data, will be replaced by the new data.

To clear the displayed data from the analyzer CRT, press `Marker Data` in page 2 of the EMC Precompliance Test menu. The Marker Data menu will appear. Select `CLEAR MARKERS` and you will be prompted to press the key again if you really want to clear the markers. Pressing the key again clears all quasi-peak and average data, and quasi-peak and average data markers from the CRT. If after pressing this key the first time you decide that you do not want to erase the data, press any other key to abort.

In specific circumstances you may wish to monitor the quasi-peak level of a signal. This is common when you have signals with very low repetition rates or you want to change the device under test while monitoring the quasi-peak level. Pressing `Qp Man At Mkr` lets you do this by making a manual quasi-peak measurement.

Qp Man At Mkr performs the same routine as QP AUTO AT MKR to get the correct spectrum analyzer settings (steps 1 through 10 above). However, rather than performing steps 11 through 13, the analyzer displays the softkeys shown in Figure 3-110.

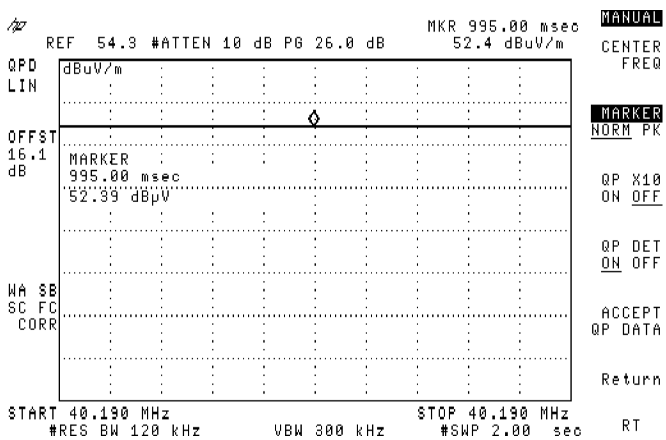


Figure 3-110. Softkeys Available during a Manual Quasi-Peak Measurement

By pressing CENTER FREQ you can change the center frequency of the spectrum analyzer. This lets you look on either side of the signal of interest to make sure you are measuring the true peak.

Select MARKER NORM PK to control the state of the marker. When you first enter this menu the marker is at the center of the CRT. Pressing MARKER NORM PK activates the marker. The span is equal to 0 Hz, so the marker readout is time, not frequency. Pressing MARKER NORM PK again activates peak search and places the marker on the highest peak of the displayed signal at the end of each sweep (PK is underlined).

If the signal has a very low repetition rate that causes the quasi-peak level to be below 7.2 graticule divisions from the top graticule, the quasi-peak gain, QP X10 ON OFF, will be turned on (ON is underlined). If the quasi-peak level is not below 7.2 graticule divisions from the top graticule, the quasi-peak gain will remain off (OFF is underlined). Pressing QP X10 ON OFF toggles the quasi-peak gain between ON and OFF off. If, during a manual measurement, the signal falls below 7.2 graticule divisions from the top graticule, you should turn this gain on before accepting the data. If a signal goes over the top graticule, you will need to turn this gain off before accepting the data.

You can easily compare the peak signal level to the quasi-peak level by turning the quasi-peak detector off and on with QP DET ON OFF. When you enter the Manual Quasi-Peak menu, ON will be underlined. To turn off the quasi-peak detector, press the QP DET ON OFF key. OFF will be underlined. Pressing QP DET ON OFF again will turn the quasi-peak detector back on.

ACCEPT QP DATA tells the spectrum analyzer to remember the frequency and quasi-peak amplitude of the marker. This will be the displayed quasi-peak level when you return to page 2 of the EMC Precompliance Test menu. You may press ACCEPT QP DATA repeatedly, but only the last value will be displayed.

Press Return to return to the analyzer settings that were present when Qp Man At Mkr was pressed and display any quasi-peak values that you choose to accept by pressing ACCEPT QP DATA.

NOTE

Be sure all spectrum analyzer settings are correct during a manual quasi-peak measurement. Guidelines for these settings are given in your spectrum analyzer user's manual.

Table 3-3. Determining the EMI Bandwidth

Marker Frequency	9 kHz to 150 kHz	150 kHz to 30 MHz	30 MHz to 1 GHz
EMI Bandwidth	200 Hz or 1 kHz*	9 kHz	120 kHz
Video Bandwidth	3 kHz	30 kHz	300 kHz

* The 1 kHz bandwidth (for analyzers without option 130) provides an approximate quasi-peak measurement, which will always be higher than or equal to the true quasi-peak value of the signal.

Printing Measurement Results

To get a tabular listing of the measured quasi-peak, average, or peak values, connect a printer to the HP-IB or RS-232 output on your spectrum analyzer and press `Marker Data`. This calls the Marker Data menu. Select `PRINT MKR DATA` to output the data. If the limit line is or was on, the difference (in dB) between the measurement and limit line values will also be printed.

Making Average Measurements

Average detection weights a signal level weighted based on the repetition frequency of the spectral components making up the signal. In other words, both peak and average detection will yield the same amplitude value for a CW signal. A periodic, broadband, or impulsive signal will yield an average level lower than the peak level. The average level is a function of the repetition frequency of the signal being measured. The lower the repetition frequency, the lower the average level.

Average detection is used to recover the dc component of a demodulated signal. The minimum spectrum analyzer video bandwidth (1 Hz in HP 859xE and 30 Hz in HP 859xA spectrum analyzers) is used to accomplish average detection.

If additional averaging is required, use the video bandwidth function available under the (BW) key.

Although many agencies governing EMI from commercial products require average detection, if the emission from the device is within a test limit when measured with peak detection, the device will be considered to have passed the test, even though average detection was not used. This is because the average level of a signal is always equal to or less than the peak level of that signal. Because of the time constants used in the average detector, the spectrum analyzer must sweep considerably slower when the average detector is on. Therefore, average detection need be used only when a signal is close to or over the test limit. All other measurements should be made with peak detection in order to sweep the analyzer faster and save measurement time.

To make an average measurement, several spectrum analyzer parameters must be set properly. The spectrum analyzer must be set to one of the three CISPR bandwidths (200 Hz, 9 kHz, or 120 kHz). The video bandwidth must be lower than the lowest ac component in the signal being measured. The minimum video bandwidth available is used. The spectrum analyzer must be in the linear-display mode. All of these parameters are automatically controlled when you press AVG AUTO AT MKR.

Pressing AVG AUTO AT MKR causes the spectrum analyzer to run through the following sequence:

1. Records the amplitude of the on-screen marker.
2. Checks that the EMI bandwidth is set correctly for the marker frequency. If it is not, a message, the softkey for the correct bandwidth, and the CONTINUE softkey are displayed.
3. Sets the spectrum analyzer center frequency to the marker frequency.
4. Decreases the frequency span to zero, while keeping the marker at center frequency.
5. Sets the spectrum analyzer reference level to bring the marker amplitude close to the top of the display screen.
6. Puts the spectrum analyzer in the linear display mode.
7. Sets the video bandwidth to either 1 Hz (HP 859xE) or 30 Hz (HP 859xA).
8. Sets the spectrum analyzer sweep time to 2 seconds.
9. Takes a complete sweep.
10. Takes the average of the display trace using the video averaging function.
11. Returns the analyzer to the settings present when AVG AUTO AT MKR was pressed.
12. Displays the measured average level with a plus (+) sign as the marker and displays that level at the bottom of the display screen.

NOTE

If the center frequency, reference level, or sweep time are changed, the quasi-peak markers will no longer be at the correct frequency or amplitude position.

Figure 3-111 and Figure 3-112 show a spectrum analyzer display before and immediately following the use of AVG AUTO AT MKR .

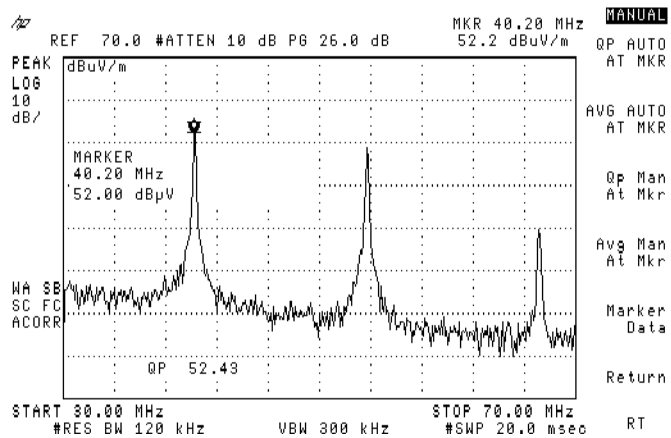


Figure 3-111. Display before an Automatic Average Measurement

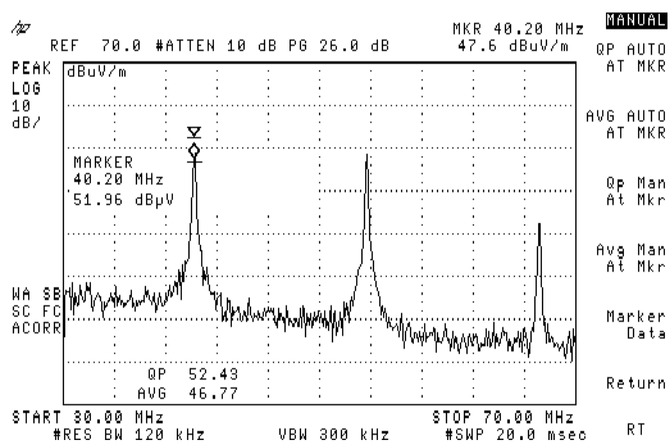


Figure 3-112. The Results of an Automatic Average Measurement

The results from the AVG AUTO AT MKR routine will be displayed on the analyzer CRT. When another measurement is made, the first data marker, and its corresponding data, will be replaced by the new data.

To clear the displayed data from the analyzer CRT, press Marker Data in the Qp/Avg menu. The Marker Data menu will appear. Select CLEAR MARKERS and you will be prompted to press the key again if you really want to clear the markers. Pressing the key again clears all average and quasi-peak data, and average and quasi-peak data markers from the CRT. If after pressing this key the first time you decide that you do not want to erase the data, press any other key to abort.

In specific circumstances you may wish to monitor the average level of a signal. This is common when you have signals with very low repetition rates or you want to change the device under test while monitoring the average level. Pressing Avg Man At Mkr lets you do this by making a manual average measurement.

`Avg Man At Mkr` performs the same routine as `AVG AUTO AT MKR` to get the correct spectrum analyzer settings (steps 1 through 9 above). However, rather than performing steps 10 through 12, the analyzer displays the softkeys shown in Figure 3-113.

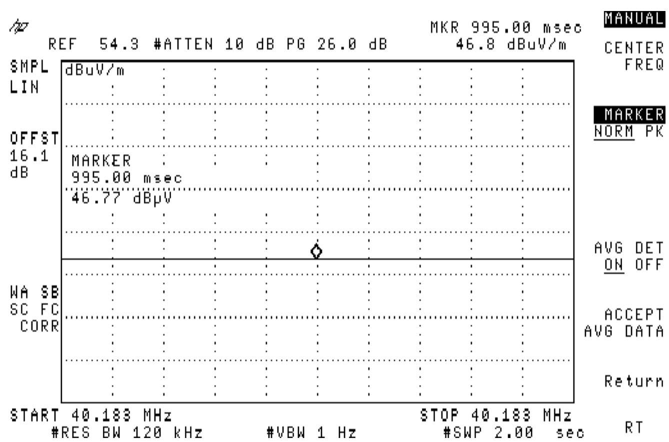


Figure 3-113. Softkeys Available during a Manual Average Measurement

Pressing `CENTER FREQ` lets you change the center frequency of the spectrum analyzer. This lets you look on either side of the signal of interest to make sure you are measuring the true peak.

To select the desired state of the marker, press `MARKER NORM PK`. When you first enter this menu, the marker is at the center of the CRT. Pressing `MARKER NORM PK` activates the marker. Pressing `MARKER NORM PK` again places the marker on the highest point of the displayed signal at the end of each sweep (`PK` is underlined).

You can easily compare the peak signal level to the average signal level by turning the average detector off and on with `AVG DET ON OFF`. When you enter the Manual Average menu `ON` will be underlined. To turn `OFF` the average detector, press `AVG DET ON OFF`. `OFF` will be underlined. Press `AVG DET ON OFF` again to toggle the average detector back on.

NOTE

If additional averaging is required use the video averaging function under the front-panel (BW) key. Press (MODE), (MODE) to return to the EMC auto-measurement personality.

When you are satisfied with the measured value, select ACCEPT AVG DATA; this will tell the spectrum analyzer to remember the frequency and amplitude of the marker. This will be the displayed average level when you return to the EMC Manual Test menu. You may press ACCEPT AVG DATA repeatedly; however, only the last value will be displayed.

Press Return to return to the analyzer settings that were present when Avg Man At Mkr was pressed and display any average values that you choose to accept by pressing ACCEPT AVG DATA.

Printing Measurement Results

To get a tabular listing of the measured quasi-peak, average, or peak values, connect a printer to the HP-IB or RS-232 output on your spectrum analyzer and press `Marker Data`. This calls the Marker Data menu. Select `PRINT MKR DATA` to output the data. If the limit line is or was on, the difference (in dB) between the measurement and limit line values will also be printed.

Making Automated Measurements

The `EMC Automatn` menu gives the user access to a group of automated test functions, which perform measurements with a minimum of operator intervention. Automated testing is ideal for chamber radiated tests or conducted tests with limited ambients. It is assumed that the instrument has been configured using the `EMC Config` softkey. The user is now ready to make some measurements using the automated features of the auto-measurement personality.

The order of the menu keys under the `EMC Automatn` softkey will reflect the order that the user might configure the instrument to make an automatic measurement.

Pressing LIMIT MARGIN selects the test limit that will be used for the automated measurement. The limit margin and limit line provides a window by which the analyzer will look at signals above the limit margin. The limit margin can be changed by using the step keys, the front-panel knob, or the keypad. See Figure 3-114.

NOTE

- If an automatic test is invoked without a limit line on the display (the LIMIT MARGIN softkey will not be present), the analyzer searches for the 20 highest peaks above the noise floor.
- The analyzer will not allow a negative limit margin. If a negative limit margin is entered into the analyzer, the analyzer will return a 0 dB limit margin.

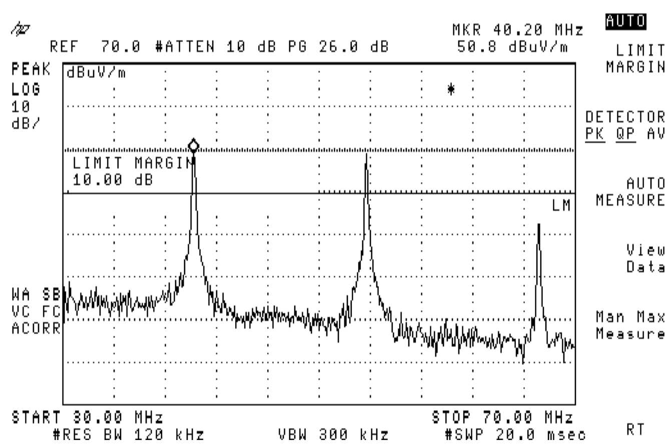


Figure 3-114. Setting Limit Margin and Detectors

Pressing DETECTOR PK QP AV selects the detector which will be used for the automated measurement. Peak is always active. The key can be toggled between PK (peak), PK QP (peak/quasi-peak), PK AV (peak/average), or PK QP AV (peak/quasi-peak/average) detection.

Pressing AUTO MEASURE causes the analyzer to run through the following sequence:

1. The analyzer puts the active trace in max-hold mode.
2. The analyzer waits a prescribed amount of time (worst-case, no more than five seconds). The purpose is to allow the analyzer to detect low rep-rate broadband signals.
3. The analyzer begins a peak search routine identifying signals at or above the limit, minus the margin level. The first signal the analyzer measures is the highest above the limit line, the second signal the second highest and so on until 20 signals are detected. The maximum number of data points the analyzer will take is 20. If the analyzer detects more than 20 data points, it will take the 20 worst peaks. As the measurement proceeds, the peaks being tested and the number left to be tested are displayed at the top of the display. The peak must be 6 dB above the noise floor or adjacent signals to be measured.
4. If QP (quasi-peak) detection was selected as one of the detection mode, the analyzer runs through the following sequence:

NOTE

The analyzer will make the measurement in the selected bandwidth.

   a. Records the amplitude of the on-screen marker.
   b. Sets the analyzer center frequency to the marker frequency.
   c. Decreases the frequency span to zero.
   d. Sets the analyzer reference level to bring the marker amplitude close to the top of the display screen.

e. Puts the analyzer in the linear display mode.

f. Turns on the quasi-peak detector.

g. Sets the analyzer sweep time to two seconds.

h. Adds ten times (20 dB) quasi-peak gain if the signal is 20 dB below the reference level.

i. Takes a complete sweep.

j. Puts the marker on the signal and remembers the quasi-peak amplitude level.

5. If AV (average) detection was selected as one of the detection mode the analyzer runs through the following sequence:

a. Records the amplitude of the on-screen marker.

b. Sets the analyzer center frequency to the marker frequency.

c. Decreases the frequency span to zero, while keeping the marker at center frequency.

d. Sets the analyzer reference level to bring the marker amplitude close to the top of the display screen.

e. Puts the analyzer in the linear display mode.

f. Puts the analyzer in sample mode.

g. Sets the video bandwidth to 1 or 30 Hz.

h. Sets the analyzer sweep time to two seconds.

i. Takes a complete sweep.

j. Takes a mean of the trace and displays that as the average.

k. Puts the marker on the signal and remembers the amplitude level.

6. The results of the measurement will be displayed in tabular form (See Figure 3-115) according the following:

Column 1	Number of detected peaks.
Column 2	Frequency in MHz.
Column 3	Peak (PK) value in selected amplitude units.
Column 4	Peak distance from limit line in selected amplitude units.

Column 5	Quasi-Peak (QP) value in selected amplitude units.
Column 6	Quasi-Peak distance from limit line in selected amplitude units.
Column 7	Average (AV) value in selected amplitude units.
Column 8	Average distance from limit line in selected amplitude units.

NOTE

Data is recorded in the columns of the table for detector modes chosen with the DETECTOR PK QP AV softkey.

NOTE

If (PRESET) (instrument preset) is pressed at any time during the measurement, the data taken up to that point will be retained and may be displayed in tabular form by pressing the EMC AUTOMATN and VIEW DATA softkeys.

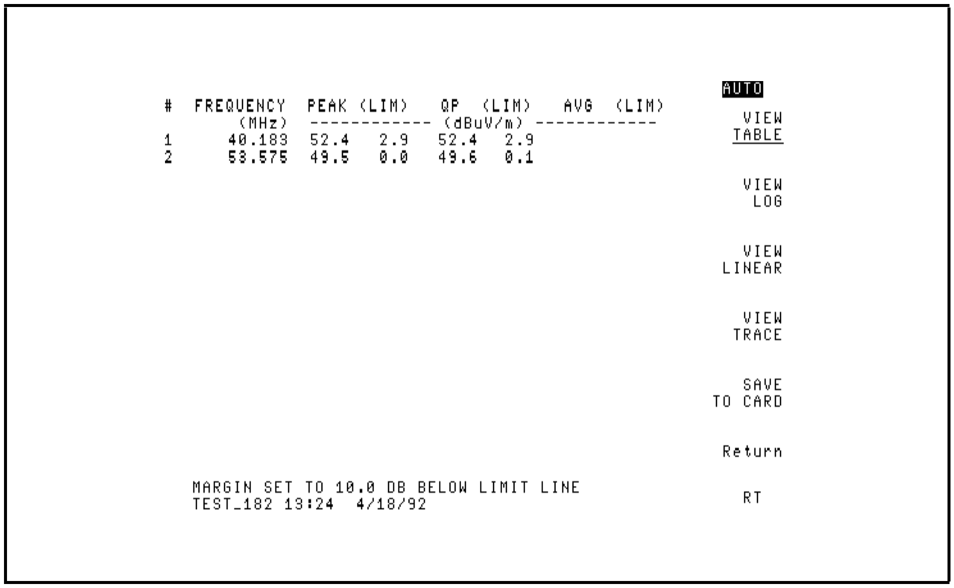


Figure 3-115. Auto Measure Data Table

4

Using the Softkeys

Using the Softkeys

This chapter describes, in alphabetical order, each of the HP 85712D EMC auto-measurement personality's front-panel softkeys.

.15-30MZ SETUP

Path

EMC Config Freq Bands .15-30MZ SETUP

Function

.15-30MZ SETUP selects the 9 kHz bandwidth for frequencies from 0.15 MHz to 30 MHz (CISPR band B). A number sign (#) in the lower left corner of the display indicates that the bandwidth is set to manual. When the bandwidth is set to manual, it will not change when the frequency span is changed. When you select the 9 kHz bandwidth setup softkey, the analyzer automatically sets the spectrum analyzer functions listed below to the indicated values:

Input Attenuation	10 dB
Reference Level	70 dBμV
Resolution Bandwidth	9 kHz
Video Bandwidth (Auto Coupled)	30 kHz
Start Frequency	150 kHz
Stop Frequency	30 MHz
Center Frequency Step Size	1 MHz p

If you wish to set a specific center frequency or center frequency step size, you should do so *after* selecting the .15-30MZ SETUP softkey.

You may also select the 9 kHz bandwidth from the front-panel BW menu.

CISPR recommends using specific bandwidths to make commercial compliance measurements. Using the recommended CISPR bandwidth for a given frequency range helps determine the relevant signal characteristics. For example, broadband signals change in amplitude as the resolution bandwidth changes. Therefore, using the appropriate CISPR bandwidth while evaluating signals will help you predict their behavior during actual compliance testing. Use the 9 kHz bandwidth for measurements from 150 kHz to 30 MHz.

.2-1GHz SETUP

Path

EMC Config Freq Bands .2-1 GHz SETUP

Function

.2-1GHz SETUP selects the 120 kHz bandwidth for frequencies from 200 MHz to 1 GHz (CISPR bands C and D). A number sign (#) in the lower left corner of the display indicates that the bandwidth is set to manual. When the bandwidth is set to manual, it will not change when the frequency span is changed. When you select the 200 MHz to 1 GHz bandwidth softkey, the analyzer automatically sets the spectrum analyzer functions listed below to the indicated values:

Input Attenuation	10 dB
Reference Level	90 dBμV
Resolution Bandwidth	120 kHz
Video Bandwidth (Auto Coupled)	300 kHz
Start Frequency	200 MHz
Stop Frequency	1 GHz
Center Frequency Step Size	10 MHz

If you wish to set a specific center frequency or center frequency step size, you should do so *after* selecting the .2-1GHz SETUP softkey.

CISPR recommends using specific bandwidths to make commercial compliance measurements. Using the recommended CISPR bandwidth for a given frequency range helps determine the relevant signal characteristics. For example, broadband signals change in amplitude as the resolution bandwidth changes. Therefore, using the appropriate CISPR bandwidth while evaluating signals will help you predict their behavior during actual compliance testing. Use the 120 kHz bandwidth for measurements from 30 MHz to 1 GHz.

1-1.8GHz SETUP

Path

`EMC Config` `Freq Bands` `1-1.8 GHz SETUP`

Function

`1-1.8GHz SETUP` selects the 120 kHz bandwidth for frequencies from 1 to 1.8 GHz. A number sign (**#**) in the lower left corner of the display indicates that the bandwidth is set to manual. When the bandwidth is set to manual, it will not change when the frequency span is changed. When you select the 1 to 1.8 GHz bandwidth softkey, the analyzer automatically sets the spectrum analyzer functions listed below to the indicated values:

Input Attenuation	10 dB
Reference Level	90 dBμV
Resolution Bandwidth	120 kHz
Video Bandwidth (Auto Coupled)	300 kHz
Start Frequency	1 GHz
Stop Frequency	1.8 GHz
Center Frequency Step Size	10 MHz

If you wish to set a specific center frequency or center frequency step size, you should do so *after* selecting the `1-1.8GHz SETUP` softkey.

1-2.9GHz SETUP

Path

EMC Config Freq Bands 1-2.9 GHz SETUP

Function

1-2.9GHz SETUP selects the 120 kHz bandwidth for frequencies from 1 to 2.9 GHz. A number sign (#) in the lower left corner of the display indicates that the bandwidth is set to manual. When the bandwidth is set to manual, it will not change when the frequency span is changed. When you select the 1 to 2.9 GHz bandwidth softkey, the analyzer automatically sets the spectrum analyzer functions listed below to the indicated values:

Input Attenuation	10 dB
Reference Level	90 dBμV
Resolution Bandwidth	120 kHz
Video Bandwidth (Auto Coupled)	300 kHz
Start Frequency	1 GHz
Stop Frequency	2.9 GHz
Center Frequency Step Size	10 MHz

If you wish to set a specific center frequency or center frequency step size, you should do so *after* selecting the 1-2.9GHz SETUP softkey.

1-5GHz SETUP

Path

EMC Config Freq Bands 1-5 GHz SETUP

Function

1-5GHz SETUP selects the 120 kHz bandwidth for frequencies from 1 to 5 GHz. A number sign (#) in the lower left corner of the display indicates that the bandwidth is set to manual. When the bandwidth is set to manual, it will not change when the frequency span is changed. When you select the 1 to 5 GHz bandwidth softkey, the analyzer automatically sets the spectrum analyzer functions listed below to the indicated values:

Input Attenuation	10 dB
Reference Level	90 dBμV
Resolution Bandwidth	120 kHz
Video Bandwidth (Auto Coupled)	300 kHz
Start Frequency	1 GHz
Stop Frequency	5 GHz
Center Frequency Step Size	10 MHz

If you wish to set a specific center frequency or center frequency step size, you should do so *after* selecting the 1-5GHz SETUP softkey.

11940/11941

Path
`EMC Config` `Transdcr Factors` `Load Transdcr` `11940/11941`

Function
`11940/11941` selects the close-field probe type used for making field strength measurements. The annotation is underlined to indicate the selected probe. With each press of the key, it is possible to select the following probe sequence: `11940`, `11941`, or neither.

The EMC auto-measurement personality is specifically designed to be used with the HP 11940A and HP 11941A close-field probes. These probes operate from 30 MHz to 1 GHz and 9 kHz to 30 MHz respectively. Both probes are calibrated. The EMC auto-measurement personality lets you measure signal levels in magnetic field-strength units. In order for the analyzer to do this, you must first specify which probe is going to be used. The EMC auto-measurement personality automatically adds the appropriate probe transducer factor to the signal of interest when measuring the field strength at the marker.

Refer to "Measuring a Signal's Field Strength" section in this chapter for more information.

NOTE

- Selecting either the HP 11940A or HP 11941A probes automatically loads the appropriate transducer factors, reference offset, preamp gain, and reference level. Specific measurements may not use a preamp, in which case the preamp gain can be manually set to 0. Reference level may also need adjusting to achieve optimal measurement results.
- The typical HP 11940A and HP 11941A transducer factors are implemented by the EMC auto-measurement personality as both transducer factors and reference offset. The offset of the HP 11940 is 35 dB and the offset of the HP 11941 offset is 45 dB. These offsets, when added to the tabular transducer factors, give the published transducer factors.

30-300MZ SETUP

Path — EMC Config Freq Bands 30-300 MZ SETUP

Function — 30-300MZ SETUP selects the 120 kHz bandwidth for frequencies from 30 MHz to 300 MHz (CISPR band C). A number sign (#) in the lower left corner of the display indicates that the bandwidth is set to manual. When the bandwidth is set to manual, it will not change when the frequency span is changed. When you select the 30 to 300 MHz setup softkey, the analyzer automatically sets the spectrum analyzer functions listed below to the indicated values:

Input Attenuation	10 dB
Reference Level	90 dBμV
Resolution Bandwidth	120 kHz
Video Bandwidth (Auto Coupled)	300 kHz
Start Frequency	30 MHz
Stop Frequency	300 MHz
Center Frequency Step Size	10 MHz

If you wish to set a specific center frequency or center frequency step size, you should do so *after* selecting the `30-300MZ SETUP` softkey.

CISPR recommends using specific bandwidths to make commercial compliance measurements. Using the recommended CISPR bandwidth for a given frequency range helps determine the relevant signal characteristics. For example, broadband signals change in amplitude as the resolution bandwidth changes. Therefore, using the appropriate CISPR bandwidth while evaluating signals will help you predict their behavior during actual compliance testing. Use the 120 kHz bandwidth for measurements from 30 MHz to 300 MHz.

9-150kHz SETUP

Path

EMC Config Freq Bands 9-150 kHz SETUP

Function

9-150kHz SETUP sets the analyzer to CISPR band A (9 to 150 kHz). A number sign (#) in the lower left corner of the display indicates that the bandwidth is set to manual. When the bandwidth is set to manual, it will not change when the frequency span is changed. CISPR recommends using specific bandwidths to make commercial compliance measurements. Using the recommended CISPR bandwidth for a given frequency range helps determine the relevant signal characteristics.

For example, broadband signals change in amplitude as the resolution bandwidth changes. Therefore, using the appropriate CISPR bandwidth while evaluating signals will help you predict their behavior during actual compliance testing. The EMC auto-measurement personality will automatically select the 200 Hz CISPR bandwidth in spectrum analyzers with the narrow bandwidth option (HP 859xD or HP 859xE option 130). Other spectrum analyzers use the 1 kHz bandwidths. In those cases where the 1 kHz bandwidth is being used, the 1 kHz bandwidth most closely resembles the 200 Hz CISPR bandwidth. The 1 kHz bandwidth will always yield a result larger than, or equal to, the CISPR specified 200 Hz resolution bandwidth for CISPR band A (9 kHz to 150 kHz).

NOTE

Any measurement made in the 1 kHz bandwidth that is below the observed limit will also be below the desired limit when measuring in the 200 Hz CISPR bandwidth.

When you select the 9-150kHz SETUP softkey, the analyzer automatically sets the spectrum analyzer functions listed below to the indicated values:

Input Attenuation	10 dB
Reference Level	70 dBμV
Resolution Bandwidth	200 Hz or 1 kHz
Video Bandwidth	3 kHz

> **NOTE**
>
> The start and stop frequencies may be displayed as center = 79.5 kHz and span = 141 kHz.

Start Frequency	9 kHz
Stop Frequency	150 kHz
Center Frequency Step Size	15 kHz

If you wish to set a specific center frequency or center frequency step size, you should do so *after* selecting the 9-150kHz SETUP softkey.

You may also select the either the 200 Hz or 1 kHz bandwidths from the front-panel BW menu.

ACCEPT AVG DATA

Path

EMC Manual Qp/Avg Avg Man At Mkr ACCEPT AVG DATA

Function

ACCEPT AVG DATA accepts the average value at the marker frequency during a manual average measurement and displays the value below the average marker. For more information, refer to "Making Average Measurements" In this chapter .

ACCEPT QP DATA

Path

EMC Manual Qp/Avg Qp Man At Mkr ACCEPT QP DATA

Function

ACCEPT QP DATA accepts the quasi-peak value at the marker frequency during a manual quasi-peak measurement and displays the quasi-peak value below the quasi-peak marker.

For more information, refer to "Making Quasi-Peak Measurements" in this chapter.

AUTO MEASURE

Path

`EMC Automatn` `AUTO MEASURE`

Function

`AUTO MEASURE` starts the data taking sequence for the frequency band selected from the `FREQ BANDS`. If no band has been selected, then the default band is given by the center frequency of the analyzer. First, multiple, fast sweeps are taken in max-hold mode. Next, signals at or above the limit, minus margin level, are identified and measured in the selected detection modes.

CAUTION

`AUTO MEASURE` will overwrite data stored in trace registers 7, 8, 9, and 10. Any trace data previously stored in these registers will be lost.

Finally, the measured signals are displayed in a table, or on a linear or log frequency scale over the selected frequency band as vertical lines with horizontal bars for quasi-peak and average detected amplitudes. The display mode depends on what had been previously selected. The display is static and the appearance of `VIEW DATA` menu indicates the end of this measurement.

The selected frequency bands are overswept for frequency accuracy at the end points consistent with the span accuracy of 5%. The final report range will include data from the requested start frequency minus one bandwidth to the stop frequency plus one bandwidth. Amplitude and frequency data for each measured signal are stored in internal registers 7, 8, 9, and 10 for later printout in tabular format. A maximum of 20 signals per frequency band can be stored.

Data taken can be stopped with instrument `PRESET`. Select `EMC AUTOMATN` from the EMC measurement personality's top-level menu and then press `VIEW DATA` to see the data that has been measured before aborting. Pressing `RETURN` will bring back the complete setup and the live trace from which the data was taken.

AVG AUTO AT MKR

Path

EMC Manual Qp/Avg AVG AUTO AT MKR

Function

AVG AUTO AT MKR performs an average measurement at the marker frequency and displays the results on the CRT.

For more information, refer to "Making Average Measurements" in this chapter.

AVG DET ON OFF

Path

EMC Manual Qp/Avg Avg Man At Mkr AVG DET ON OFF

Function

AVG DET ON OFF lets you turn the average detection on (ON is underlined) or off (OFF is underlined) during a manual average measurement.

For more information, refer to "Making Average Measurements" in this chapter.

Avg Man At Mkr

Path

EMC Manual Qp/Avg Avg Man At Mkr

Function

Avg Man At Mkr lets you control analyzer settings during an average measurement at the marker frequency.

For more information, refer to “Making Average Measurements” in this chapter.

CENTER FREQ

Paths

EMC Manual Qp/Avg Avg Man At Mkr CENTER FREQ
EMC Manual Qp/Avg QP Man at Mkr CENTER FREQ

Function

CENTER FREQ allows changing the center frequency prior to ACCEPT AVG DATA. Sometimes signals drift in frequency so that the analyzer must be manually tuned to assure the signal peak is captured.

CLEAR MARKERS

Path `EMC Manual` `Qp/Avg` `Marker Data` `CLEAR MARKERS`

Function clears the markers and data displayed on the CRT after a quasi-peak or average measurement is made.

For more information about making quasi-peak and average measurements, refer to “Making Quasi-Peak Measurements” and “Making Average Measurements” in Chapter 3.

Continue Measure

Path

`EMC Automatn` `Man Max Measure` `Continue Measure`

Function

`Continue Measure` starts the automated measurement algorithm (See "Auto Measure"). When finished taking data, the measurement personality invokes the `VIEW DATA` menu and the analyzer displays the measured data in the previously selected format.

Create Limit

Path

`EMC Config` `Limit Lines` `Create Limit`

Function

`Create Limit` clears the current limit line and accesses the Limit-Line Editor menu.

For more information about limit lines, refer to "Loading, Editing, Creating, and Storing Limit Lines," in Chapter 3.

(dBμ) V A V/m A/m

Path

EMC Config Transdcr Factors (dBμ) V A V/m A/m

Function

(dBμ) V A V/m A/m selects the desired units to display on the spectrum analyzer's CRT. Either dBμV, dBμA, dBμV/m, or dBμA/m can be chosen. The key is only available when transducer factors are turned on. The transducer factors which are loaded must be appropriate for the units chosen. When transducer factors are turned off, the default dBμV units will appear. The selected units will appear with the reference level annotation and marker annotation, plus after the VIEW TABLE key has been pressed. The HP 859xA/B series of analyzers will only display the selected units after the VIEW TABLE key has been pressed. The units annotation in the active parameter block is always dBμV.

DELETE SEGMENT

Path

EMC Config Limit Lines Edit Limit DELETE SEGMENT

Function

DELETE SEGMENT deletes the highlighted segment of the limit line.

For more information about limit lines, refer to “Loading, Editing, Creating, and Storing Limit Lines,” in Chapter 3.

DELETE POINT

Path

EMC Config Transdcr Factors Edit Transdcr DELETE POINT

Function

DELETE POINT deletes an amplitude-correction factor that was previously selected by SELECT POINT.

NOTE

After deleting a point (while editing the transducer factors) the change will appear in the table, but the transducer must be turned off, then back on again to activate the change.

For more information about transducer factors, refer to "Loading, Editing, Creating, and Storing Transducer Factors," in Chapter 3.

DETECTOR PK QP AV

Path

`EMC Automatn` `DETECTOR PK QP AV`

Function

`DETECTOR PK QP AV` selects the detectors which will be used for the automated measurement (See `Auto Measure` and `MAN MAX MEASURE` for more information). It does not perform an actual measurement. The PK (peak) detector is always on and underlined. The detectors selected are underlined in the following sequence: `PK` (peak), `PK QP` (peak/quasi-peak), `PK AV` (peak/average), or `PK QP AV` (peak/quasi-peak/average).

Edit Transdcr

Path

`EMC Config` `Transdcr Factors` `Edit Transdcr`

Function

`Edit Transdcr` accesses the Transducer Factors Editor menu and displays the segments of the current transducer.

For more information about transducer factors, refer to “Loading, Editing, Creating, and Storing Transducer Factors,” in Chapter 3.

Edit Done

Path

EMC Config Transdcr Factors Edit Transdcr Edit Done

Function

Edit Done erases the transducer factors table from the analyzer's screen.

Use Edit Done when all the transducer factors have been entered.

For more information about transducer factors, refer to "Loading, Editing, Creating, and Storing Transducer Factors," in Chapter 3.

Edit Limit

Path

EMC Config Limit Lines Edit Limit

Function

Edit Limit accesses the Limit-Line Editor menu and displays the segments of the current limit line.

For more information about limit lines, refer to "Loading, Editing, Creating, and Storing Limit Lines," in Chapter 3.

EXT PREAMP

Path

EMC Config Misc Menu EXT PREAMP

Function

EXT PREAMP compensates the displayed signal amplitude to account for preamplifier gain or cable loss. Often a preamplifier is used to increase system sensitivity. For example, use a preamplifier with the close-field probes. The EMC analyzer can automatically compensate the displayed signal amplitude to account for preamplifier gain. This ensures a calibrated display.

To set the amplitude offset, perform the following steps:

1. Press EXT PREAMP. The message `EXT PREAMP GAIN` will be displayed along with the last offset entered. See Figure 4-1.

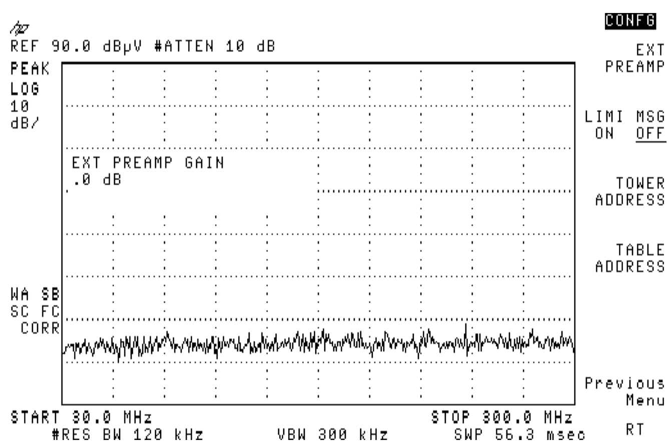


Figure 4-1. Preamplifier Gain Selected as Active Function

2. From the numeric keypad enter the gain of the preamplifier that will be used. Terminate this entry with the (dB) key.

NOTE

Selecting the SPECTRUM ANALYZER mode of operation may remove the offset. Gain must be reset when re-entering the EMC personality.

The offset appears on the top-center of the display. This offset remains until a new value is entered. Preset does not change this value.

A negative value can be entered for EXT PREAMP if you need to calibrate the system for external attenuation, such as a transient limiter or cable loss.

Freq Bands

Path EMC Config Freq Bands

Function Freq Bands gives you access to the frequency band menu.

LIMI MSG ON OFF

Path

EMC Config Misc Menu LIMI MSG ON OFF

Function

LIMI MSG ON OFF toggles the automatic limit-line test message on or off. ON is underlined when the automatic limit testing is activated, in which case either the LIMIT PASS or the LIMIT FAIL message will be displayed on the upper right corner of the display. OFF will be underlined when automatic limit testing is not activated.

Limit Lines

Path

EMC Manual Limit Lines

Function

selects the analyzer's limit-line functionality. During precompliance testing use the LIMIT LINES softkey to load, create, edit, or store limit lines.

Products must comply with different limits issued by the various agencies governing EMC. You can reproduce these limits on the analyzer and compare emission levels to those limits during precompliance testing. For your convenience, the HP 85712D EMC auto-measurement personality card includes most commonly used limit lines.

For more information about limit lines, refer to "Loading, Editing, Creating, and Storing Limit Lines," in Chapter 3.

LIMITS ON OFF

Path

`EMC Manual` `Limit Lines` `LIMITS ON OFF`

Function

`LIMITS ON OFF` turns the current limit line on or off. `ON` will be underlined when the limit line is on. `OFF` will be underlined when the limit line is off.

For more information about limit lines, refer to "Loading, Editing, Creating, and Storing Limit Lines," in Chapter 3.

Load Limit

Path

EMC Manual Limit Lines Load Limit

Function

Load Limit catalogs the memory card for limit lines and displays their file names on the analyzer CRT. If you select the LOAD LIMIT softkey without the memory card inserted into the analyzer, the error CARD NOT FOUND appears on the CRT. To recover from the error, press PREVIOUS MENU, insert a memory card into the memory card slot on the front of the analyzer, then press Load Limit again.

For more information about limit lines, refer to "Loading, Editing, Creating, and Storing Limit Lines," in Chapter 3.

Load File

Paths

EMC Manual Transdcr Factors Load Transdcr Load File

EMC Manual Limit Lines Load Limit Load File

Function

Load File loads the highlighted transducer or limit-line file into the analyzer.

For more information about limit lines, refer to "Loading, Editing, Creating, and Storing Limit Lines," in Chapter 3. Also refer to "Loading, Editing, Creating, and Storing Transducer Factors," Chapter 3, for more information about loading transducer factors files.

Load Transdcr

Path

`EMC Config` `Transdcr Factors` `Load Transdcr`

Function

`Load Transdcr` catalogs the memory card for transducer factors and displays their file names on the analyzer's display. If `Load Transdcr` is selected without the memory card being inserted `CARD NOT FOUND` appears on the CRT. To recover from the error, press `Previous Menu`, insert a memory card into the memory card slot on the front of the analyzer, then press `Load Transdcr` again.

Refer to "Loading, Editing, Creating, and Storing Transducer Factors," Chapter 3, for more information about transducer factors.

Load Setup

Path

EMC Manual Setups Load Setup

Function

Load Setup recalls custom setups from a RAM card or test setups from the HP 85712D ROM card (for example, frequency range, limits, transducer factor, attenuation, bandwidth).

Man Max Measure

Path

EMC Automatn Man Max Measure

Function

Man Max Measure starts sweeping the selected setup band in max-hold mode and changes the key label to CONTINUE MEASURE. The analyzer keeps sweeping in max-hold mode until CONTINUE MEASURE has been pressed. The analyzer then takes data relative to the adjusted limit and with consideration of the max-held amplitudes. The Man Max Measure softkey fills in the spectral envelope for impulsive or intermittent signals so that the automation algorithm knows at which frequencies to measure signals. When finished taking data, the VIEW DATA menu is invoked and the analyzer displays the measured data in the previously selected format.

If Man Max Measure was pressed instead of AUTO MEASURE, the analyzer starts sweeping the selected setup band in max-hold mode and changes the key label to CONTINUE MEASURE. The analyzer keeps sweeping in max-hold until CONTINUE MEASURE is pressed. That is the only significant difference between the two measurement softkeys.

Marker Data

Path EMC Manual Qp/Avg Marker Data

Function Marker Data lets you print another clear manual quasi-peak and average data.

For more information, refer to “Making Quasi-Peak Measurements,” “Making Average Measurements,” and “Printing Measurement Results” in this chapter.

MARKER NORM PK

Path

`EMC Manual` `Qp/Avg` `QP Man at Mkr` `MARKER NORM PK`

Function

`MARKER NORM PK` lets you turn the marker on (NORM is underlined), or move the marker to the largest displayed signal at the end of each sweep (PK is underlined) during a manual quasi-peak measurement.

For more information, refer to "Making Quasi-Peak Measurements" in this chapter.

MARKER NORM PK

Path

EMC Manual Qp/Avg Avg Man at Mkr MARKER NORM PK

Function

MARKER NORM PK lets you turn the marker on (NORM is underlined), or move the marker to the largest displayed signal at the end of each sweep (PK is underlined) during a manual quasi-peak measurement.

For more information, refer to "Making Average Measurements" in this chapter.

MAX/MIN ON OFF

Path

EMC Manual Signal Evaluate MAX/MIN ON OFF

Function

MAX/MIN ON OFF places trace B in max-hold mode and trace C in min-hold mode. When used with MAX/MIN VIEW, this function lets you discriminate between narrowband and broadband signals. Turning on this function turns off NORM A/B ON OFF.

For more information, refer to "Discriminating between Narrowband and Broadband Signals" in this chapter.

MAX/MIN VIEW

Path

`EMC Manual` `Signal Evaluate` `MAX/MIN VIEW`

Function

`MAX/MIN VIEW` lets you view the results of the `MAX/MIN ON OFF` function. All traces stop sweeping and the maximum or minimum signals are displayed on the CRT. This key only appears when `MAX/MIN ON` is selected.

For more information, refer to "Discriminating between Narrowband and Broadband Signals" in this chapter.

Misc Menu

Path EMC Manual Misc Menu

Function MISC MENU accesses the Miscellaneous menu, which includes EXT PREAMP, and LIMI MSG ON OFF.

NORM A/B ON OFF

Path

EMC Manual Signal Evaluate NORM A/B ON OFF

Function

NORM A/B ON OFF normalizes the input signal to the contents of trace B. Turning on this functions turns off MAX/MIN ON OFF .

For more information, refer to "Measuring Relative Changes in Signal Levels" in this chapter.

NRM MKR LSN MKR

Path

EMC Manual NRM MKR LSN MKR

Function

NRM MKR LSN MKR lets you turn the marker on (NRM MKR is underlined) or pause the analyzer sweep at the marker and listen to the signal (LSN MKR is underlined).

By repeatedly pressing NRM MKR LSN MKR you can toggle between normal marker and listen marker.

For more information, refer to “Listening to a Signal’s Demodulated Output” in this chapter.

PRINT MKR DATA

Path

EMC Manual Qp/Avg Marker Data PRINT MKR DATA

Function

PRINT MKR DATA outputs the measurement data to a printer.

For more information, refer to “Printing Measurement Results” in this chapter.

PURGE TRANSDCR

Path

EMC Config Transdcr Factors Edit Transdcr PURGE TRANSDCR

Function

PURGE TRANSDCR clears the current transducer factors table. Pressing PURGE TRANSDCR displays the message: IF YOU ARE SURE, PRESS KEY AGAIN TO PURGE DATA. Pressing PURGE TRANSDCR a second time clears the transducer factor data.

Refer to "Loading, Editing, Creating, and Storing Transducer Factors," Chapter 3, for more information about transducer factors.

Qp/Avg

Path EMC Manual Qp/Avg

Function Qp/Avg selects the menu which allows quasi-peak and average measurements at the marker frequency.

For more information, refer to “Making Quasi-Peak Measurements” and “Making Average Measurements”in this chapter.

QP AUTO AT MKR

Path

`EMC Manual` `Qp/Avg` `QP AUTO AT MKR`

Function

`QP AUTO AT MKR` performs a quasi-peak measurement at the marker frequency and displays the results on the CRT.

For more information, refer to "Making Quasi-Peak Measurements" in this chapter.

NOTE

This softkey only appears spectrum analyzers with Option 103, which adds quasi-peak detection.

Qp Man At Mkr

Path

EMC Manual Qp/Avg Qp Man At Mkr

Function

Qp Man At Mkr lets you control analyzer settings during a quasi-peak measurement at the marker frequency.

For more information, refer to “Making Quasi-Peak Measurements” in this chapter.

NOTE

This softkey only appears spectrum analyzers with Option 103, which adds quasi-peak detection.

QP X10 ON OFF

Path

EMC Manual Qp/Avg QP Man at Mkr QP X10 ON OFF

Function

QP X10 ON OFF lets you add or remove post-detection gain during a manual quasi-peak measurement. When gain is added, ON will be underlined. OFF is underlined when no post-detection gain is added.

For more information, refer to "Making Quasi-Peak Measurements" in this chapter.

NOTE

This softkey only appears spectrum analyzers with Option 103, which adds quasi-peak detection.

QP DET ON OFF

Path

`EMC Manual` `Qp/Avg` `QP Man at Mkr` `QP DET ON OFF`

Function

`QP DET ON OFF` lets you turn the quasi-peak detector on (ON is underlined) or off (OFF is underlined) during a manual quasi-peak measurement.

For more information, refer to “Making Quasi-Peak Measurements” in this chapter.

NOTE

This softkey only appears spectrum analyzers with Option 103, which adds quasi-peak detection.

RETURN

Paths

EMC Manual Qp/Avg Man Qp At Mkr RETURN

EMC Manual Qp/Avg Man Avg At Mkr RETURN

Function

RETURN returns you to the Qp/Avg menu and resets the analyzer to the settings that were present when either MAN QP AT MKR or MAN AVG AT MKR was pressed. Accepted quasi-peak data will be displayed on the CRT.

For more information, refer to “Making Quasi-Peak Measurements” and “Making Average Measurements” in this chapter.

SAVE LIMIT

Path EMC Manual Limit Lines SAVE LIMIT

Function SAVE LIMIT saves the current limit line to a memory card. You may change the limit-line prefix by using the CONFIG key.

NOTE

When using the SAVE and RECALL front-panel keys to save to a RAM card, the prefix is appended to the file register number. Prefix names can be modified by using the CONFIG front-panel key.

For more information about limit lines, refer to "Loading, Editing, Creating, and Storing Limit Lines," in Chapter 3.

SAVE TO CARD

Path

`EMC Automatn` `View Data` `SAVE TO CARD`

Function

`SAVE TO CARD` will save the current setup and data to a RAM card. Previously selected detection modes and the current data format on the display will also saved as part of the setup file. The user will be asked to ENTER A FILE NUMBER. The file number can be any number from 1 to 899. The user may assign number blocks for specific tests (radiated or conducted, for example).

CAUTION

Data on the card will be overwritten without warning if the file number has already been used. Use only the `SAVE TO CARD` and `LOAD SETUP` softkeys when saving or recalling custom setup and data files, or setup library files.

SAVE TRANSDCR

Path

EMC Config Transdcr Factors SAVE TRANSDCR

Function

SAVE TRANSDCR saves the current transducer correction factors to a memory card. You may change the transducer file prefix by using the CONFIG key and changing the transducer file's prefix.

NOTE

When using the SAVE and RECALL front-panel keys to save to a RAM card, the prefix is appended to the file register number. Prefix names can be modified by using the CONFIG front-panel key.

Refer to "Loading, Editing, Creating, and Storing Transducer Factors," Chapter 3, for more information about transducer factors.

SELECT AMPLITUD

Path

EMC Config Limit Lines Edit Limit SELECT AMPLITUD

Function

SELECT AMPLITUD prompts you for the desired amplitude of the limit-line to be edited.

For more information about limit lines, refer to “Loading, Editing, Creating, and Storing Limit Lines,” in Chapter 3.

SELECT AMPLITUD

Path

EMC Config Transdcr Factors Edit Transdcr SELECT AMPLITUD

Function

SELECT AMPLITUD lets you enter the amplitude value for the current amplitude-correction point. Enter the amplitude value for the frequency by using the data keys. Change an amplitude value by using the step keys or the knob. Press BK SP to correct errors.

Refer to "Loading, Editing, Creating, and Storing Transducer Factors," Chapter 3, for more information about transducer factors.

SELECT SEGMENT

Path: `EMC Config` `Limit Lines` `Edit Limit` `SELECT SEGMENT`

Function: `SELECT SEGMENT` selects the limit-line segment number to be edited.

For more information about limit lines, refer to “Loading, Editing, Creating, and Storing Limit Lines,” in Chapter 3.

SELECT FREQ

Path

EMC Config Limit Lines Edit Limit SELECT FREQ

Function

SELECT FREQ prompts you for the desired frequency of the limit- line segment to be edited.

For more information about limit lines, refer to "Loading, Editing, Creating, and Storing Limit Lines," in Chapter 3.

SELECT TYPE

Path

`EMC Config` `Limit Lines` `Edit Limit` `SELECT TYPE`

Function

`SELECT TYPE` prompts you to enter the segment type (either flat, slope, or point) for the limit-line segment being edited.

For more information about limit lines, refer to “Loading, Editing, Creating, and Storing Limit Lines,” in Chapter 3.

SELECT POINT

Path

EMC Config Transdcr Factors Edit Transdcr SELECT POINT

Function

SELECT POINT lets you create or edit a transducer factors data point. Enter the point number to be created or edited by using the data keys, then press ENTER. Press BK SP to correct errors.

Refer to "Loading, Editing, Creating, and Storing Transducer Factors," Chapter 3, for more information about creating transducer factors.

SELECT FREQ

Path

EMC Config Transdcr Factors Edit Transdcr SELECT FREQ

Function

SELECT FREQ lets you enter the frequency value for a transducer factor point. Enter the frequency value for the frequency by using the data keys. Change the frequency value by using the step keys or the knob. Press BK SP to correct errors.

A frequency coordinate must always be specified for a transducer factor.

NOTE

For transducer factors, only two entries with the same frequency are valid. More points with the same frequency in the same transducer factors table are ignored. Only the first and last points of a series with the same frequency values are used; the middle points are ignored.

Transducer factor data is sorted in the table by frequency. The sorting occurs immediately after you have entered the frequency value via the front-panel.

Refer to “Loading, Editing, Creating, and Storing Transducer Factors,” Chapter 3, for more information about transducer factors.

Setups

Path

`EMC Config` `Setups`

Function

`Setups` catalogs all the setups on a RAM card and selects the menu containing with `Load Setup`.

Signal Evaluate

Path

`EMC Manual` `Signal Evaluate`

Function

`Signal Evaluate` selects the menu which allows normalization (`NORM A/B ON OFF` and `TRACE B VW OFF`) and Min/Max discrimination (`MIN/MAX ON OFF` and `MIN/MAX VIEW`).

TABLE ADDRESS

Path

EMC Config Misc Menu TABLE ADDRESS

Function

TABLE ADDRESS allows setting the HP-IB address for the HP 11968D turntable. The default address is nine.

TABLE CC STOP

Paths

EMC Automatn Man Max Measure TABLE CC STOP

EMC Manual Tower Turntbl TABLE CC STOP

Function

TABLE CC STOP either starts the HP 11968D turntable moving in a counter clockwise direction or stops the turntable from moving.

NOTE

The spectrum analyzer must be controlling the HP-IB bus and an HP 11968D turntable must be present at the TABLE ADDRESS or errors will occur.

TABLE CW STOP

Paths

EMC Automatn Man Max Measure TABLE CW STOP
EMC Manual Tower Turntbl TABLE CW STOP

Function

TABLE CW STOP either starts the HP 11968A turntable moving in a clockwise direction or stops the turntable from moving.

NOTE

The spectrum analyzer must be controlling the HP-IB bus and an HP 11968D turntable must be present at the TABLE ADDRESS or errors will occur.

TOWER ADDRESS

Path

EMC Config Misc Menu TOWER ADDRESS

Function

TOWER ADDRESS allows setting the HP-IB address for the HP 11968D tower. The default address is eight.

TOWER DN STOP

Paths

EMC Automatn Man Max Measure TOWER DN STOP

EMC Manual Tower Turntabl TOWER DN STOP

Function

TOWER DN STOP either starts the HP 11968A tower moving down or stops the tower from moving.

NOTE

The spectrum analyzer must be controlling the HP-IB bus and an HP 11968A tower must be present at the TOWER ADDRESS or errors will occur.

TOWER UP STOP

Paths

`EMC Automatn` `Man Max Measure` `TOWER UP STOP`

`EMC Manual` `Tower Turntabl` `TOWER UP STOP`

Function

`TOWER UP STOP` either starts the HP 11968A tower moving up or stops the tower from moving.

NOTE

The spectrum analyzer must be controlling the HP-IB bus and an HP 11968A tower must be present at the `TOWER ADDRESS` or errors will occur.

TOWER VERT HOR

Path

EMC Manual Tower Turntbl TOWER VERT HOR

Function

> **NOTE**
>
> When first using this feature, toggle this key once or twice to synchronize the spectrum analyzer and tower.

TOWER VERT HORZ positions the HP 11968A tower either horizontally or vertically.

> **NOTE**
>
> The spectrum analyzer must be controlling the HP-IB bus and an HP 11968A tower must be present at the TOWER ADDRESS or errors will occur.

Tower Turntabl

Path

`EMC Manual` `Tower Turntabl`

Function

`Tower Turntabl` is an optional key that invokes the tower and turntable menus.

TRACE A WR VW MX

Path

EMC Manual TRACE A WR VW MX

Function

TRACE A WR VW MX lets you clear write (WR is underlined), view (VW is underlined), or max hold (MX is underlined) trace A.

By repeatedly pressing TRACE B WR VW OF you can toggle back and forth between clear write, view, and max hold of trace A.

For more information, refer to “Using Analyzer Trace Capabilities” in this chapter.

TRACE B VW OFF

Path

EMC Manual Signal Evaluate TRACE B VW OFF

Function

TRACE B VW OFF lets you view (VW is underlined), or turn trace B off (OFF is underlined). This key only appears when NORM A/B ON is selected.

By repeatedly pressing TRACE B VW OFF you can toggle back and forth between view, and trace B off (OFF).

For more information, refer to “Using Analyzer Trace Capabilities” in this chapter.

TRACE B WR VW OF

Path EMC Manual TRACE B WR VW OF

Function TRACE B WR VW OF lets you clear write (WR is underlined), view (VW is underlined), or turn trace B off (OF is underlined).

By repeatedly pressing TRACE A WR VW MX you can toggle back and forth between clear write, view, and trace B off (OF).

For more information, refer to “Using Analyzer Trace Capabilities” in this chapter.

Transdcr Factors

Path

EMC Manual Transdcr Factors

Function

Transdcr Factors enables you to load, edit, create, and store transducer factors. Transducer factors, such as antenna factors, are used to correct the measured signal level for transducer frequency response.

Typical transducer factors for the HP 11966C biconical antenna HP 11966C log periodic antenna, HP 11966N high frequency log periodic antenna, and HP 11966C horn antenna and HP 11967C LISN are included on the HP 85712D EMC auto-measurement personality card for your convenience.

Refer to "Loading, Editing, Creating, and Storing Transducer Factors," Chapter 3, for more information about transducer factors.

TRANSDCR ON OFF

Path

EMC Config Transdcr Factors TRANSDCR ON OFF

Function

TRANSDCR ON OFF turns the current transducer correction factors on or off. ON will be underlined when the transducer correction factors are being applied. OFF is underlined when transducer correction factors are not activated. At any time, you can determine from the display whether the transducer factors are on. If correction is off and ampcor (A) is on, then only an A will be displayed on the lower left of the CRT. See Figure 4-2 and Figure 4-3.

Refer to “Loading, Editing, Creating, and Storing Transducer Factors,” Chapter 3, for more information about transducer factors.

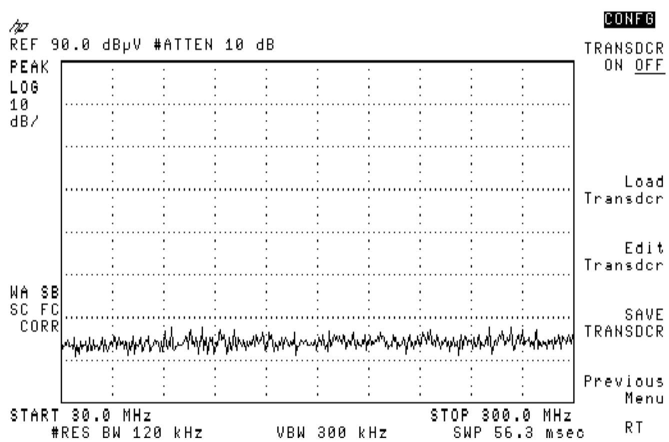


Figure 4-2. Transducer Turned Off (No Input)

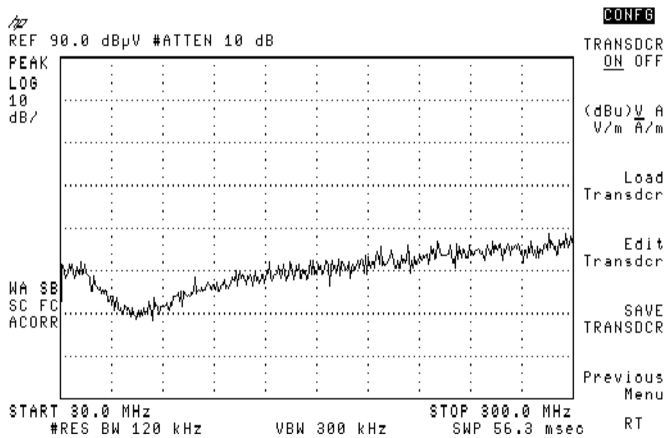


Figure 4-3. Transducer Turned On (No Input)

View Data

Path

EMC Automatn View Data

Function

View Data accesses the view data menu. Recalls previous AUTO MEASURE data and setup to the display.

Press (COPY) at any time to print either the table, log view, or linear view to a local printer.

VIEW LINEAR

Path EMC Automatn View Data VIEW LINEAR

Function VIEW LINEAR displays the data on a linear frequency scale with the start and stop frequencies, plus and minus a bandwidth, that were selected by the user for taking the data. Data points are redistributed appropriately on the linear scale.

Press VIEW LINEAR to view the data and limit line on a linear frequency scale. See Figure 4-4. Again, the quasi-peak and average values are shown by horizontal lines.

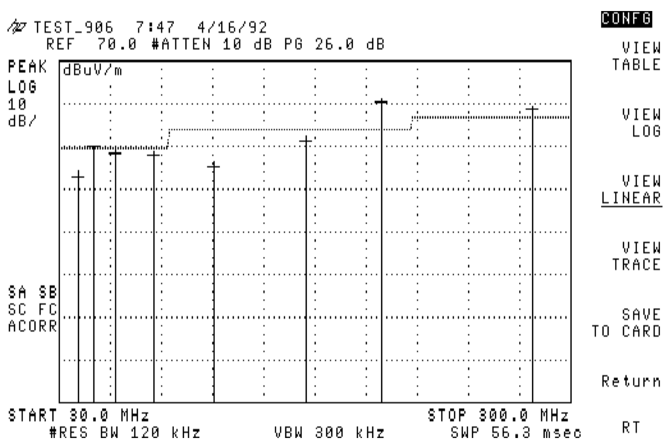


Figure 4-4. Linear Display

Press (COPY) at any time to print either the table, log view, or linear view to a local printer.

VIEW LOG

Path

EMC Automatn View Data VIEW LOG

Function

VIEW LOG displays data on log frequency scale. Data will be within the requested frequency range, plus one bandwidth on each side. The closest integer values of a 1, 2, 3. . . . . .10 sequence are taken for start and stop frequency. See Figure 4-5.

NOTE

Every vertical line represents the next integer value in HP 859xD and HP 859xE series analyzers and represents a multiple of 2 in HP 859xA and HP 859xB series analyzers.

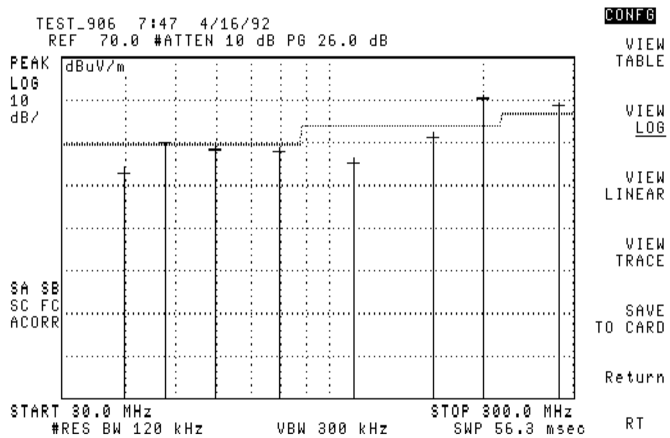


Figure 4-5. Log Display

Press (COPY) at any time to print either the table, log view, or linear view to a local printer.

VIEW TABLE

Path

EMC Automatn View Data VIEW TABLE

Function

VIEW TABLE selects tabular display of data. The table consists of columns for frequency, peak, delta peak from limit, quasi-peak from limit, average, delta average from limit. Press VIEW TABLE to review the data table in tabular form. Both the data and limit margin are displayed.

The results of the measurement will be displayed in tabular form according to the following:

Column 1	Number of detected peaks.
Column 2	Frequency in MHz.
Column 3	Peak (PK) value in dBμV.
Column 4	Peak distance from limit line in dBμV.
Column 5	Quasi-Peak (QP) value in dBμV.
Column 6	Quasi-Peak distance from limit line in dBμV.
Column 7	Average (AV) value in dBμV.
Column 8	Average distance from limit line in dBμV.

NOTE

Data is recorded in the columns of the table for detector modes chosen with the DETECTOR PK QP AV softkey.

Press (COPY) at any time to print either the table, log view, or linear view to a local printer.

VIEW TR/BLANK TR

Path

EMC Automatn View Data VIEW TR/BLANK TR

Function

VIEW TR/BLANK TR allows the user either to view or to blank the max-held trace from which the analyzer interrogates the peaks.

VIEW TRACE

Path

EMC Automatn View Data VIEW TRACE

Function

VIEW TRACE brings up the stored, max-hold trace that was used to identify the peaks and overlays it on the measured data display. The start and stop frequencies are the ones used for the measurement, not the frequencies selected by the user. The measurement personality sets up a wider sweep to find any signals at the band edges that might otherwise be missed because of the 5% span inaccuracy. The linear data points will rescaled for the new range. When the trace is displayed, the marker function is active for measuring amplitude and frequency of other signals of interest. The key label changes to VIEW TR/BLANK TR. The frequency range will remain the same if the trace is blanked.

Press VIEW TRACE to view the max-held trace superimposed on the linear data trace. See Figure 4-6. Press BLNK TR to blank the max-held trace.

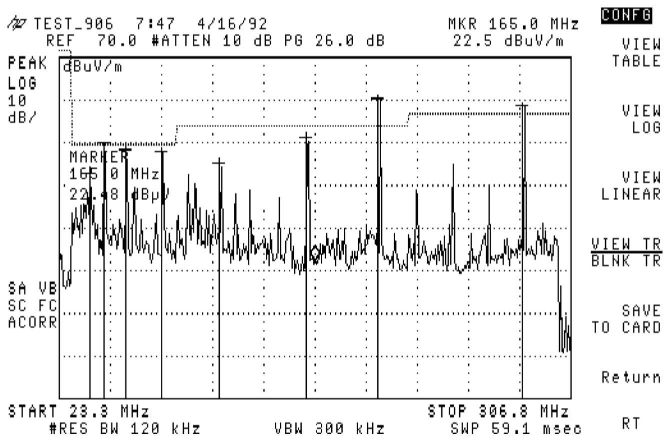


Figure 4-6. Trace View Superimposed on the Linear Trace

Press (COPY) at any time to print either the table, log view, or linear view to a local printer.

5

Using the Test Setup Library

Using the Test Setup Library

This chapter contains information about the HP 85712D EMC auto-measurement personality's test setup library and includes the following information:

Test Setup Library

Supported Measurements

- CISPR 22, Class A & B (QP conducted/average conducted/radiated)
- FCC Vol II, Part 15, Subpart B (conducted/radiated)
- VCCI, Class 1 & 2, ITE (QP conducted/average conducted/radiated)
- VDE 0871, Class A & B (conducted/radiated)
- FTZ 1046, Class B (radiated)
- PRB (close-field diagnostic probe)

User-Created Files

`~001 - 899`	Unique user setups and data files on HP RAM card.
`~900 - 999`	Reserved for System.

Legend

D = diagnostic tests

C = conducted tests

R = radiated tests

QP = quasi to peak detection

AV = average detection

Band 1 = 9 kHz to 150 kHz (diagnostic, conducted)

Band 2 = 150 kHz to 30 MHz (diagnostic, conducted)

Band 3 = 30 MHz to 300 MHz (diagnostic, radiated)

Band 4 = 200 MHz to 1 GHz (diagnostic, radiated)

Band 5 = >1 GHz (radiated)

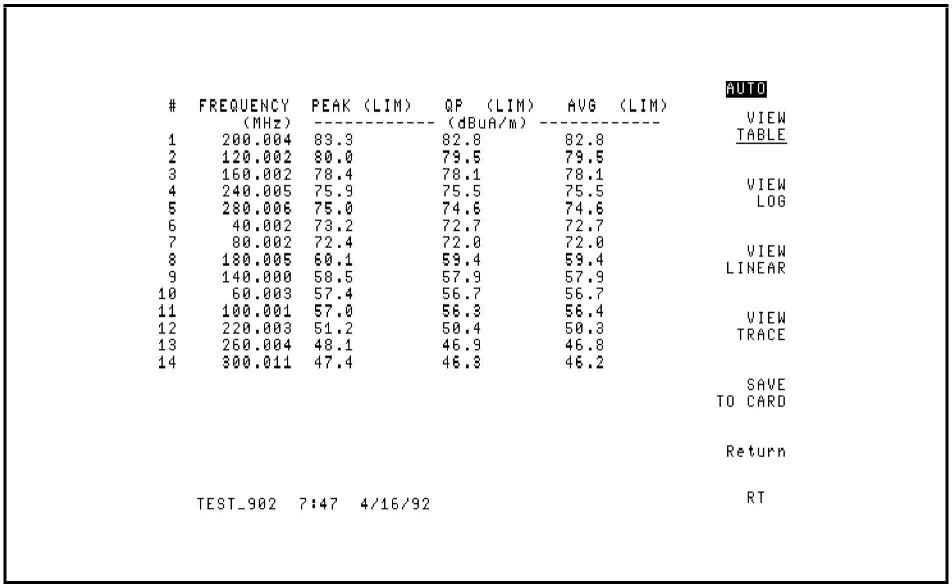
3/10m adj = 10.5 dB adjustment of limit line

3/30m adj = 20 dB adjustment of limit line

Sample Setup and Data Files

Sample Diagnostic Setup and Data

Equipment: HP 11940A Close Field Probe - HP 8447F Opt. H64 Dual Preamp			
Instrument Settings: **120 kHz Resolution Bandwidth, 300 kHz Video Bandwidth, Correction Factor On, +26 dB Preamp, 0 dB RF Attenuation, +70 dBμV/m Reference Level**			
Filename	**Test**	**Frequency Range**	**Limit Line**
˜SAMPLE D	902 - Sample Diagnostic Setup and Data	30 to 300 MHz	OFF



#	FREQUENCY (MHz)	PEAK (LIM)	QP (LIM)	AVG (LIM)
		(dBuA/m)		
1	200.004	83.3	82.8	82.8
2	120.002	80.0	79.5	79.5
3	160.002	78.4	78.1	78.1
4	240.005	75.9	75.5	75.5
5	280.006	75.0	74.6	74.6
6	40.002	73.2	72.7	72.7
7	80.002	72.4	72.0	72.0
8	180.005	60.1	59.4	59.4
9	140.000	58.5	57.9	57.9
10	60.003	57.4	56.7	56.7
11	100.001	57.0	56.3	56.4
12	220.003	51.2	50.4	50.3
13	260.004	48.1	46.9	46.8
14	300.011	47.4	46.3	46.2

Figure 5-1. SAMPLE D **in Tabular Form**

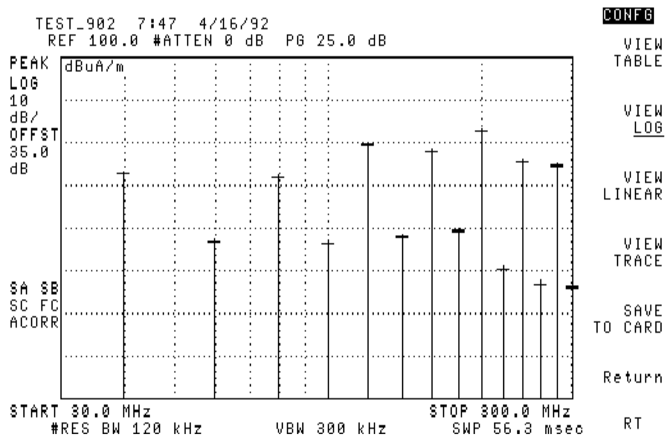


Figure 5-2. `SAMPLE D` **in Log View**

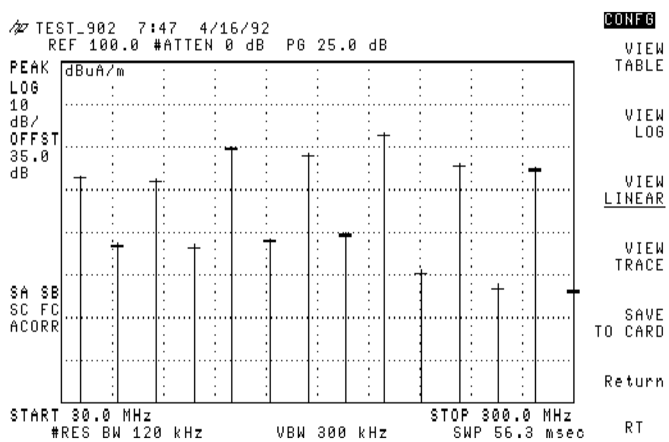


Figure 5-3. `SAMPLE D` **in Linear View**

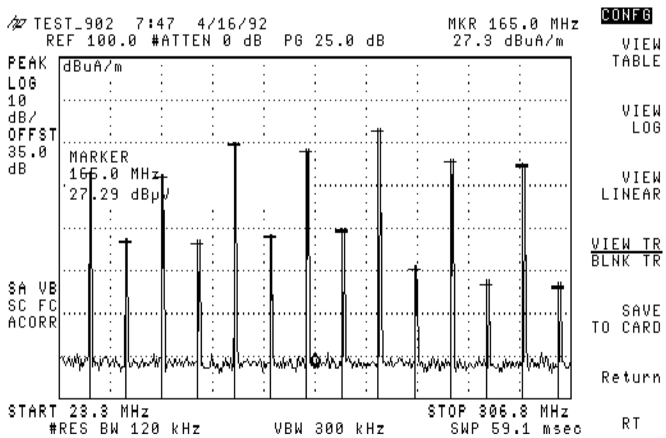


Figure 5-4. `SAMPLE D` **in Linear View with Trace**

Sample Conducted Emissions Test Setup and Data

Equipment: **11967C LISN · HP 11947A Transient Limiter (−10 dB)**			
Instrument Settings: **200 Hz Resolution Bandwidth, 300 kHz Video Bandwidth, LISN Correction Factor, −10 dB Preamp, +10 dB RF Attenuation +85 dB Reference Level**			
Filename	**Test**	**Frequency Range**	**Limit Line**
˜SAMPLE C	904 - Sample Conducted Setup and Data	9 to 150 kHz	VDE B CON

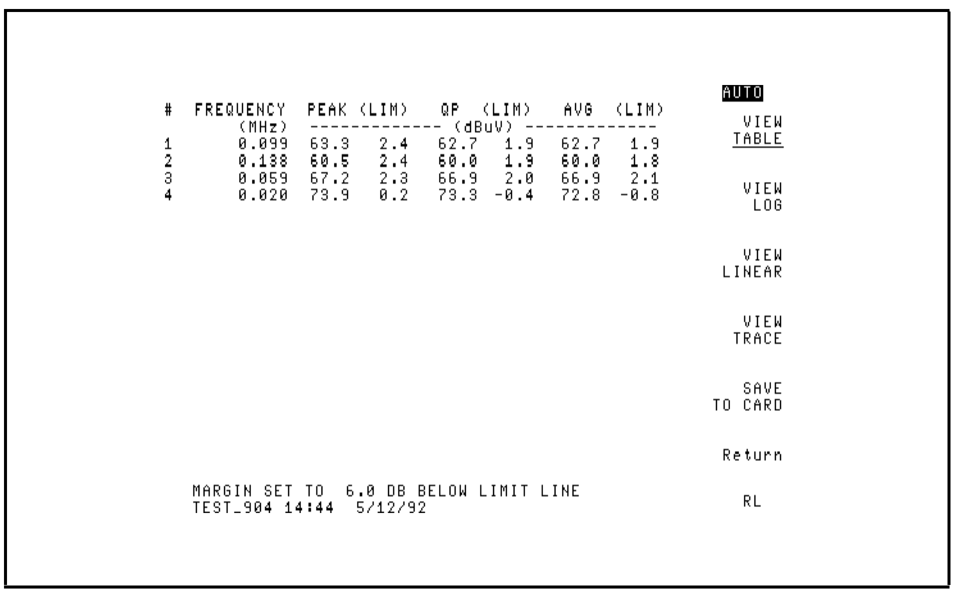


Figure 5-5. SAMPLE C **in Tabular Form**

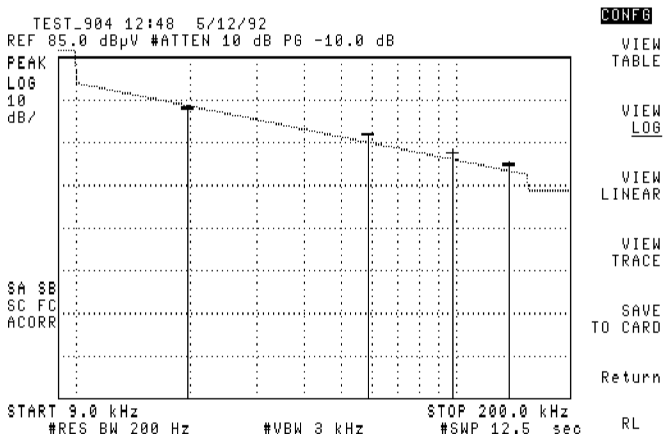


Figure 5-6. `SAMPLE C` **in Log View**

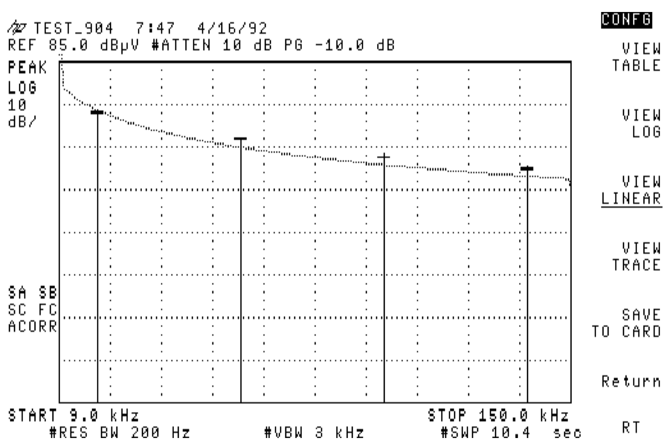


Figure 5-7. `SAMPLE C` **in Linear View**

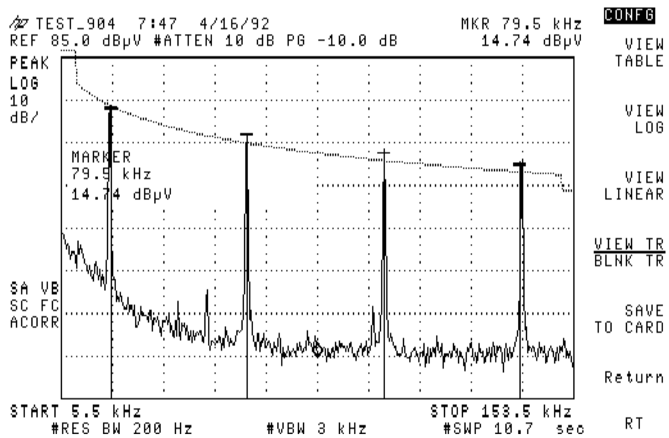
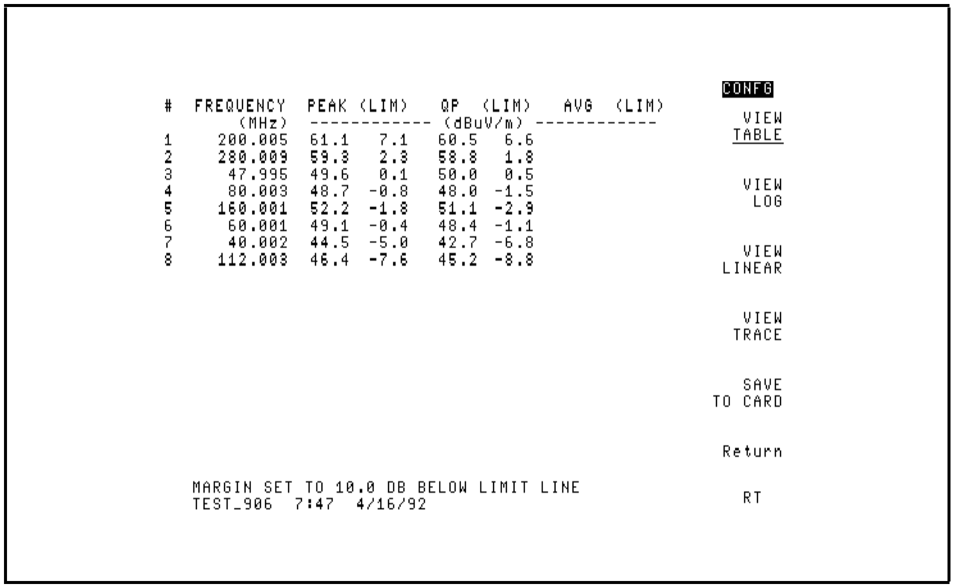


Figure 5-8. SAMPLE C **in Linear View with Trace**

Sample Radiated Emissions Test Setup and Data

Equipment: HP 11966D Log Periodic - HP 8447F Option H64 Dual Preamp			
Instrument Settings: 120 kHz Resolution Bandwidth, 300 kHz Video Bandwidth, BICON Correction Factor, +26 dB Preamp, +10 dB Attenuation, +70 dBμV/m Reference Level			
Filename	**Test**	**Frequency Range**	**Limit Line**
˜SAMPLE R	906 - Sample Radiated Setup and Data	30 to 300 MHz	FCC A 3M



#	FREQUENCY (MHz)	PEAK	(LIM)	QP	(LIM)	AVG	(LIM)
		------------		(dBuV/m)		------------	
1	200.005	61.1	7.1	60.5	6.6		
2	280.009	59.3	2.3	58.8	1.8		
3	47.995	49.6	0.1	50.0	0.5		
4	80.003	48.7	-0.8	48.0	-1.5		
5	160.001	52.2	-1.8	51.1	-2.9		
6	60.001	49.1	-0.4	48.4	-1.1		
7	40.002	44.5	-5.0	42.7	-6.8		
8	112.008	46.4	-7.6	45.2	-8.8		

MARGIN SET TO 10.0 DB BELOW LIMIT LINE
TEST_906 7:47 4/16/92

Figure 5-9. SAMPLE R **in Tabular Form**

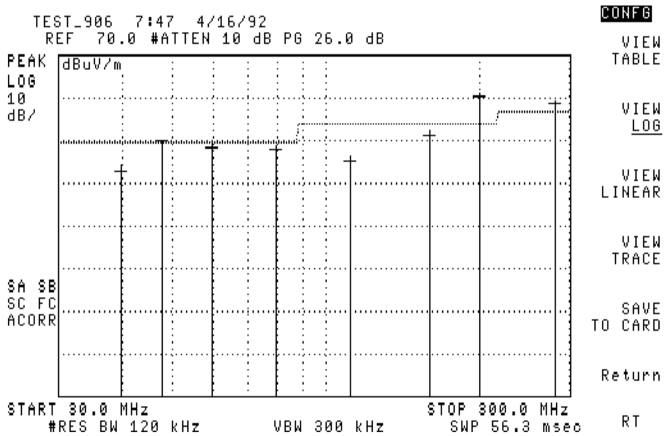


Figure 5-10. `SAMPLE R` **in Log View**

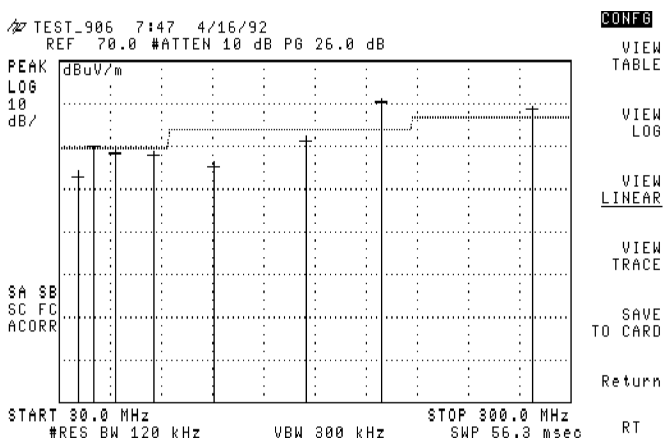


Figure 5-11. `SAMPLE R` **in Linear View**

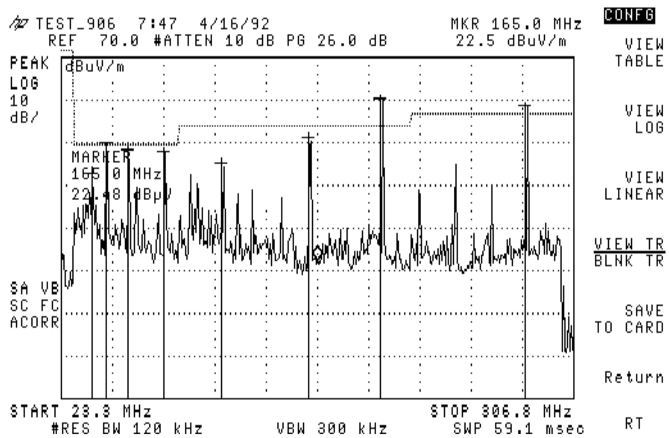


Figure 5-12. `SAMPLE R` **in Linear View with Trace**

Diagnostic Tests

Setup Files: Low Range (9—150 kHz)

Equipment: HP 11941A Close Fld Probe - HP 8447F Opt. H64 Dual Preamp			
Instrument Settings: 200 Hz Resolution Bandwidth, 3 kHz Video Bandwidth; Correction Factor Onf, +28 dB Preamp, 0 dB RF Attenuation; +90 dBμV/m Reference Level			
Filename	**Test**	**Frequency Range**	**Limit Line**
˜PRB D 1	910 - Low Probe (Band 1)	9 kHz to 150 kHz	OFF

Setup Files: Mid Range (.15—30 MHz)

Equipment: HP 11941A Close Field Probe · HP 8447F Opt. H64 Dual Preamp			
Instrument Settings: 9 kHz Resolution Bandwidth, 30 kHz Video Bandwidth; Correction Factor On, +28 dB Preamp, 0 dB RF Attenuation; +80 dBμV/m Reference Level			
Filename	**Test**	**Frequency Range**	**Limit Line**
˜PRB D 2	912 - Low Probe (Band 2)	150 kHz to 30 MHz	OFF

Setup Files: High Range (.030—1 GHz)

Equipment: **HP 11940A Close Field Probe - HP 8447F Opt. H64 Dual Preamp**			
120 kHz Resolution Bandwidth, 300 kHz Video Bandwidth **Correction Factor Off, +25 dB Preamp, 0 dB RF Attenuation** **+90 dBμV/m Reference Level**			
Filename	**Test**	**Frequency Range**	**Limit Line**
˜PRB D 34	914 - High Probe (Bands 3 and 4)	30 MHz to 1 GHz	OFF

Diagnostic Equipment List

spectrum analyzer	HP 8591E
	HP 8593E
	HP 8594E
	HP 8595E
	HP 8596E
EMC measurement personality card	HP 85712D
HP 11945A close-field probe set	HP 11940A
	HP 11941A
preamplifier	HP 8447F Option H64

Diagnostic Test Setup

Diagnostic Test Setup

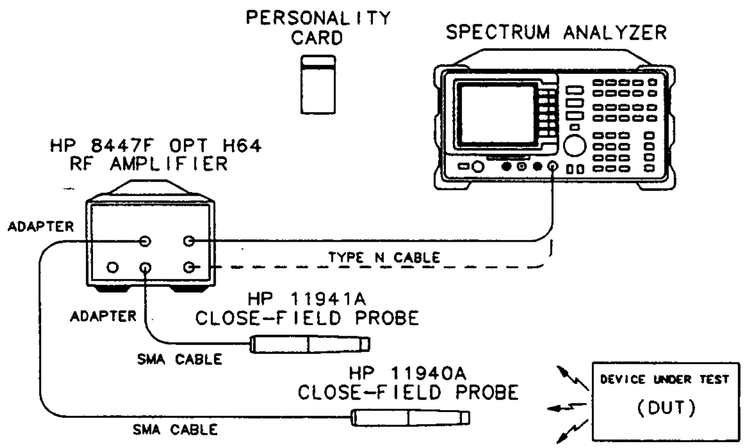


Figure 5-13. Diagnostic Test Setup

Conducted Emissions Tests

Setup Files: Band 1 (9—150 kHz)

Equipment: HP 11967C LISN - HP 11947A Transient Limiter			
Instrument Settings: 200 Hz Resolution Bandwidth, 3 kHz Video Bandwidth; LISN Correction Factor, −10 dB Preamp, +10 dB RF Attenuation; (VDE A ,+95 dB Reference Level), (VDE B +85 dB Reference Level)			
Filename	**Test**	**Frequency Range**	**Limit Line**
˜VDEA C 1	920 - VDE 0871 Class A Conducted	9 kHz to 150 kHz	VDE A CON
˜VDEB C 1	921 - VDE 0871 Class B Conducted	9 kHz to 150 kHz	VDE B CON

Setup Files: Band 2 (.15—30 MHz)

Filename	Test	Frequency Range	Limit Line
Equipment: HP 11967C LISN · HP 11947A Transient Limiter			
Instrument Settings: 9 kHz Resolution Bandwidth, 30 kHz Video Bandwidth; Correction Factor Off, −10 dB Preamp, +10 dB RF Attenuation; +90 dBμV Reference Level			
˜CSPA CQP	940 - CISPR 22, Class A, QP Conducted	150 kHz to 30 MHz	CISPR A QP
˜CSPA CAV	941 - CISPR 22, Class A, AV Conducted	150 kHz to 30 MHz	CISPR A AV
˜CSPB CQP	942 - CISPR 22, Class B, QP Conducted	150 kHz to 30 MHz	CISPR B QP
˜CSPB CAV	943 - CISPR 22, Class B, AV Conducted	150 kHz to 30 MHz	CISPR B AV
˜FCCA C 2	934 - FCC 15J, Class A, Conducted	450 kHz to 30 MHz	FCC A CON
˜FCCB C 2	935 - FCC 15J, Class B, Conducted	450 kHz to 30 MHz	FCC B CON
˜VCC1 CQP	944 - VCCI Class 1, ITE, QP Conducted	150 kHz to 30 MHz	VCCI 1 QP
˜VCC1 CAV	945 - VCCI, Class 1, ITE, AV Conducted	150 kHz to 30 MHz	VCCI 1 AV
˜VCC2 CQP	946 - VCCI, Class 2, ITE, QP Conducted	150 kHz to 30 MHz	VCCI 2 QP
˜VCC2 CAV	947 - VCCI, Class 2, ITE, AV Conducted	150 kHz to 30 MHz	VCCI 2 AV
˜VDEA C 2	930 - VDE 0 871, Class A, Conducted	150 kHz to 30 MHz	VDE A CON
˜VDEB C 2	931 - VDE 0871, Class B, Conducted	150 kHz to 30 MHz	VDE B CON

Conducted Emissions Test Equipment List

spectrum analyzer	HP 8591E
	HP 8593E
	HP 8594E
	HP 8595E
	HP 8596E
EMC measurement personality card	HP 85712D
transient limiter	HP 11947A
line impedance stabilization network (LISN)	HP 11967C
printer	HP 2225A
	HP 2227A

Conducted Emissions Test Setup

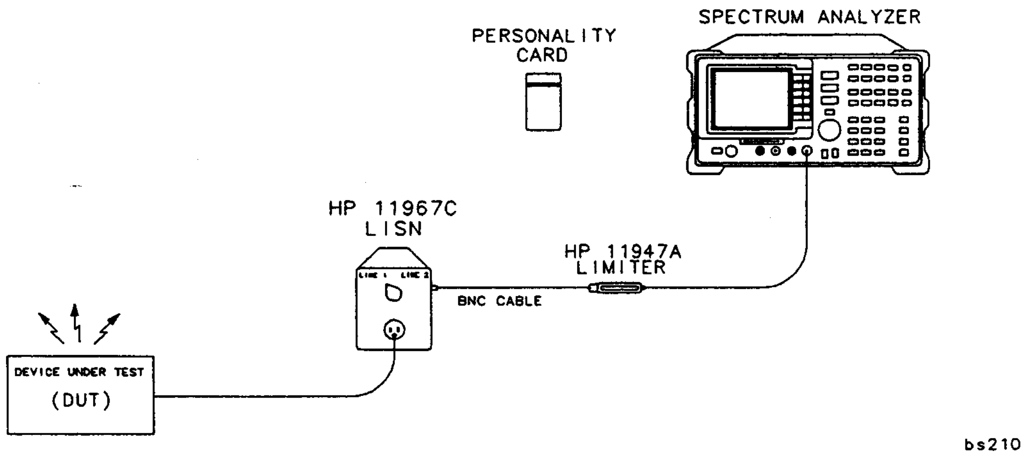


Figure 5-14. Conducted Test Setup

Radiated Emissions Tests

Setup Files: Band 3 (30—300 MHz)

Equipment: HP 11966C Biconical · HP 8447F Opt. H64 Dual Preamp			
Instrument Settings: 120 kHz Resolution Bandwidth, 300 kHz Video Bandwidth; BICON Correction Factor, + 26 dB Preamp, +10 dB RF Attenuation; +70 dBμV Reference Level (VDE_A Radiated, +80 dBμV Reference Level)			
Filename	**Test**	**Frequency Range**	**Limit Line**
˜CSPA R 3	950 - CISPR 22, Class A, Radiated @ 3/30m adj.	30 to 300 MHz	CISPR A 3M
˜CSPB R 3	951 - CISPR 22, Class B, Radiated @ 3m	30 to 300 MHz	CISPR A 3M
˜FCCA R 3	954 - FCC 15B, Class A, Radiated @ 3/10m adj.	30 to 300 MHz	FCC A 3M
˜FCCB R 3	955 - FCC 15B, Class B, Radiated @ 3m	30 to 300 MHz	FCC B 3M
˜VCC1 R 3	962 - VCCI, Class 1, ITE, Radiated @ 3/30m adj.	30 to 300 MHz	VCCI 1 3M
˜VCC2 R 3	963 - VCCI, Class 2, ITE, Radiated @ 3m	30 to 300 MHz	VCCI 2 3M
˜VDEA R 3	964 - VDE 0871, Class A, Radiated @ 3/30m adj.	30 to 300 MHz	VDE A 3M
˜VDEB R 3	965 - VDE 0871, Class B, Radiated @ 3/10m adj.	30 to 300 MHz	VDE B 3M
˜FTZB R 3	966 - FTZ 1046, Class B, Radiated @ 3/10m adj.	30 to 300 MHz	FTZ B 3M

Setup Files: Band 4 (.20—1 GHz)

Equipment:
HP 11966D Log Periodic - HP 8447F Opt. H64 Dual Preamp

Instrument Settings:
120 kHz Resolution Bandwidth, 300 kHz Video Bandwidth
LOGPR Correction Factor, +26 dB Preamp, +10 dB RF Attenuation
+70 dBμV Reference Level (VDEA, +80 dBμV Reference Level)

Filename	Test	Frequency Range	Limit Line
˜CSPA R 4	970 - CISPR 22, Class A, Radiated @ 3/30m adj.	200 MHz to 1 GHz	CISPR A 3M
˜CSPB R 4	971 - CISPR 22, Class B, Radiated @ 3m	200 MHz to 1 GHz	CISPR A 3M
˜FCCA R 4	974 - FCC 15B, Class A, Radiated @ 3/10m adj.	200 MHz to 1 GHz	FCC A 3M
˜FCCB R 4	975 - FCC 15B, Class B, Radiated @ 3m	200 MHz to 1 GHz	FCC B 3M
˜VCC1 R 4	982 - VCCI Class 1, ITE, Radiated @ 3/30m adj.	200 MHz to 1 GHz	VCCI 1 3M
˜VCC2 R 4	983 - VCCI Class 2, ITE, Radiated @ 3m	200 MHz to 1 GHz	VCCI 2 3M
˜VDEA R 4	984 - VDE 0871, Class A, Radiated @ 3 /30m adj.	200 MHz to 1 GHz	VDE A 3M
˜VDEB R 4	985 - VDE 0871, Class B, Radiated @ 3/10m adj.	200 MHz to 1 GHz	VDE B 3M
˜FTZB R 4	986 - FTZ 1046, Class B, Radiated @ 3/10m adj.	200 MHz to 1 GHz	FTZ B 3M

Setup Files: Band 5 (>1 GHz)

Equipment: HP 11966E Horn - HP 8449B Microwave Preamp			
Instrument Settings: 120 kHz Resolution Bandwidth, 300 kHz Video Bandwidth; HORN Correction Factor, +23.5 Preamp, 0 dB RF Attenuation, +70 dBμV Reference Level			
Filename	**Test**	**Frequency Range**	**Limit Line**
˜FCCA R 5	990 - FCC 15B, Class A, Radiated @ 3/10m adj.	1 GHz to 5 GHz	FCC A 3M
˜FCCB R 5	991 - FCC 15B, Class B Radiated @ 3m	1 GHz to 5 GHz	FCC B 3M

Radiated Equipment List

spectrum analyzer	HP 8591E
	HP 8593E
	HP 8594E
	HP 8595E
	HP 8596E
EMC measurement personality card	HP 85712D
preamplifier	HP 8447F Option H64
biconical antenna	HP 11966C
antenna tripod	HP 11968C

Radiated Test Setup

Radiated Test Setup

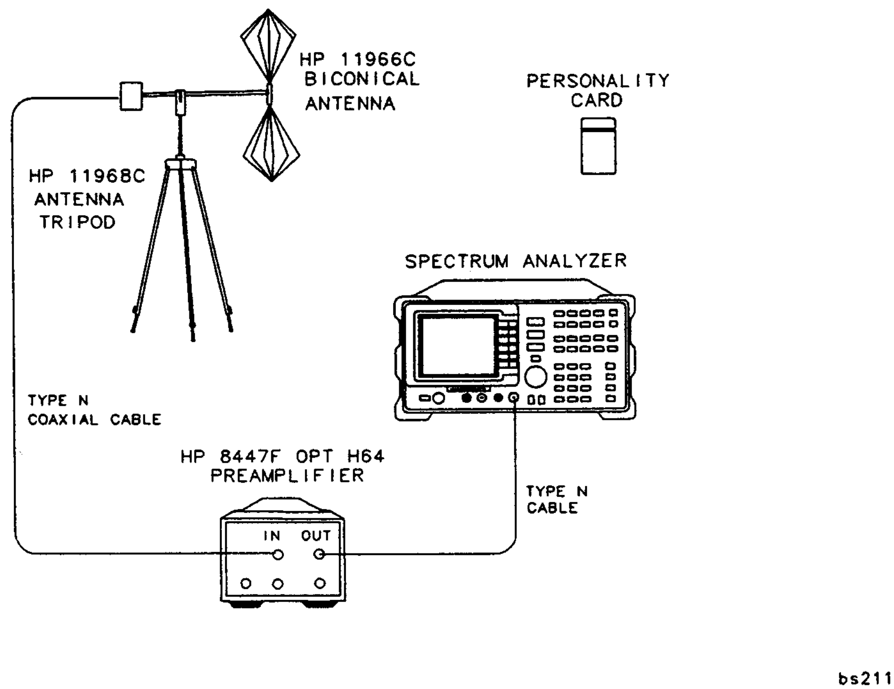


Figure 5-15. Radiated Test Setup

6

Making Basic Measurements using a Spectrum Analyzer

Making Basic Measurements using a Spectrum Analyzer

This chapter demonstrates basic spectrum analyzer measurements with examples of typical measurements; each measurement focuses on different functions.

What You'll Learn in This Chapter

The measurement procedures covered in this chapter are listed below.

- Resolving signals of equal amplitude using the resolution bandwidth function.
- Resolving small signals hidden by large signals using the resolution bandwidth function.
- Increasing the frequency readout resolution using the marker counter (HP 8590D Option 013, or HP 8591E, HP 8593E, HP 8594E, HP 8595E, or HP 8596E only).
- Decreasing the frequency span using the marker track function.
- Peaking signal amplitude using preselector peak (HP 8592D, HP 8593E, HP 8595E, or HP 8596E only).
- Tracking unstable signals using marker track and the maximum hold and minimum hold functions.
- Comparing signals using delta markers.
- Measuring low-level signals using attenuation, video bandwidth, and video averaging.
- Identifying distortion products using the RF attenuator and traces.
- Using the spectrum analyzer as a receiver in zero frequency span.
- Measuring signals near band boundaries using harmonic lock (HP 8592D, HP 8593E, HP 8595E, or HP 8596E only).
- Using the comb generator to perform more accurate frequency measurements (HP 8592D only).

Resolving Signals of Equal Amplitude Using the Resolution Bandwidth Function

In responding to a continuous-wave signal, a swept-tuned spectrum analyzer traces out the shape of the spectrum analyzer's intermediate frequency (IF) filters. As we change the filter bandwidth, we change the width of the displayed response. If a wide filter is used and two equal-amplitude input signals are close enough in frequency, then the two signals appear as one. Thus, signal resolution is determined by the IF filters inside the spectrum analyzer.

The resolution bandwidth (RES BW) function selects an IF filter setting for a measurement. Resolution bandwidth is defined as the 3 dB bandwidth of the filter. The 3 dB bandwidth tells us how close together equal amplitude signals can be and still be distinguished from each other.

Generally, to resolve two signals of equal amplitude, the resolution bandwidth must be less than or equal to the frequency separation of the two signals. If the bandwidth is equal to the separation a dip of approximately 3 dB is seen between the peaks of the two equal signals, and it is clear that more than one signal is present. See Figure 6-2.

In order to keep the spectrum analyzer calibrated, sweep time is automatically set to a value that is inversely proportional to the square of the resolution bandwidth. So, if the resolution bandwidth is reduced by a factor of 10, the sweep time is increased by a factor of 100 when sweep time and bandwidth settings are coupled. (Sweep time is proportional to $1/BW^2$.) For fastest measurement times, use the widest resolution bandwidth that still permits discrimination of all desired signals. The spectrum analyzer allows you to select from 30 Hz to 3 MHz resolution bandwidth in a 1, 3, 10 sequence, plus 5 MHz, for maximum measurement flexibility.

Example: Resolve two signals of equal amplitude with a frequency separation of 100 kHz.

1. To obtain two signals with a 100 kHz separation, connect the calibration signal and a signal source to the spectrum analyzer input as shown in Figure 6-1. (If available, two sources can be used.)

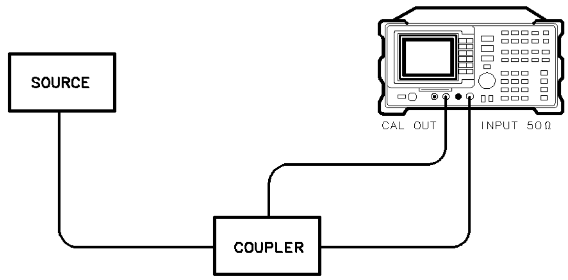


Figure 6-1. Set-Up for Obtaining Two Signals

2. If you are using the 300 MHz calibration signal, set the frequency of the source 100 kHz greater than the calibration signal (that is, 300.1 MHz). The amplitude of both signals should be approximately −20 dBm.
3. On the spectrum analyzer, press (PRESET). Set the center frequency to 300 MHz, the span to 2 MHz, and the resolution bandwidth to 300 kHz by pressing (FREQUENCY) 300 (MHz), (SPAN) 2 (MHz), then (BW) 300 (kHz). A single signal peak is visible.

NOTE

When using an HP 8590D or HP 8592D, if the signal peak cannot be found, increase the span to 20 MHz by pressing (SPAN) 20 (MHz). The signal should be visible. Press (PEAK SEARCH), (MKR FCTN), MK TRACK ON OFF (ON), then (SPAN) 2 (MHz) to bring the signal to center screen. Then press MK TRACK ON OFF so that OFF is underlined to turn the marker track function off.

4. Since the resolution bandwidth must be less than or equal to the frequency separation of the two signals, a resolution bandwidth of 100 kHz must be used. Change the resolution bandwidth to 100 kHz by pressing (BW) 100 (kHz). Two signals are now visible as in Figure 6-2. Use the knob

or step keys to further reduce the resolution bandwidth and better resolve the signals.

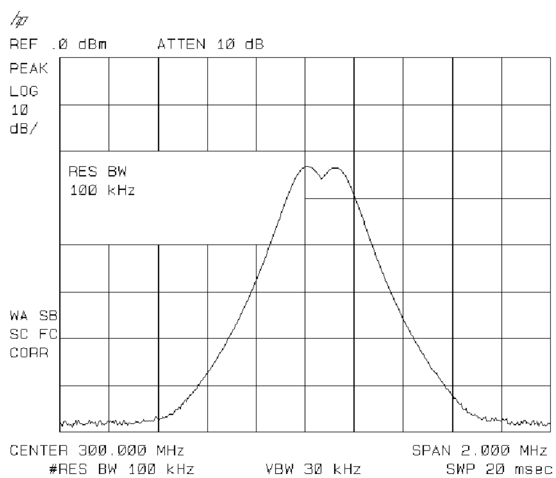


Figure 6-2. Resolving Signals of Equal Amplitude

As the resolution bandwidth is decreased, resolution of the individual signals is improved and the sweep time is increased. For fastest measurement times, use the widest possible resolution bandwidth. Under preset conditions, the resolution bandwidth is “coupled” (or linked) to span.

Since the resolution bandwidth has been changed from the coupled value, a “#” mark appears next to RES BW in the lower left corner of the screen, indicating that the resolution bandwidth is uncoupled.

NOTE

To resolve two signals of equal amplitude with a frequency separation of 200 kHz, the resolution bandwidth must be less than the signal separation, and resolution of 100 kHz must be used. The next larger filter, 300 kHz, would exceed the 200 kHz separation and would not resolve the signals.

Resolving Small Signals Hidden by Large Signals Using the Resolution Bandwidth Function

When dealing with resolution of signals that are not equal in amplitude, you must consider the shape of the IF filter as well as its 3 dB bandwidth. The shape of the filter is defined by the shape factor, which is the ratio of the 60 dB bandwidth to the 3 dB bandwidth. (Generally, the IF filters in this spectrum analyzer have shape factors of 15:1 or less.) If a small signal is too close to a larger signal, the smaller signal can be hidden by the skirt of the larger signal. To view the smaller signal, you must select a resolution bandwidth such that k is less than a. See Figure 6-3.

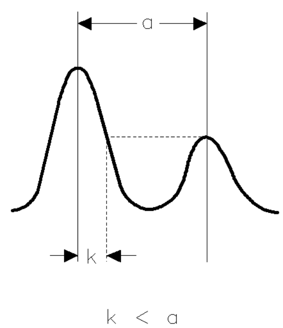


Figure 6-3. Resolution Bandwidth Requirements for Resolving Small Signals

The separation between the two signals must be greater than half the filter width of the larger signal at the amplitude level of the smaller signal.

Example: Resolve two input signals with a frequency separation of 200 kHz and an amplitude separation of 60 dB.

1. To obtain two signals with a 200 kHz separation, connect the equipment as shown in the previous section, "Resolving Signals of Equal Amplitude Using the Resolution Bandwidth Function."
2. Set the center frequency to 300 MHz and the span to 2 MHz: press (FREQUENCY) 300 (MHz), then (SPAN) 2 (MHz).

NOTE

When using an HP 8590D or HP 8592D and the signal peak cannot be found, increase the span to 20 MHz by pressing (SPAN) 20 (MHz). The signal should be visible. Press (PEAK SEARCH), (MKR FCTN), MK TRACK ON OFF so that ON is underlined. Then (SPAN) 2 (MHz) to bring the signal to center screen. Then press MK TRACK ON OFF to OFF to turn the marker track function off.

3. Set the source to 300.2 MHz, so that the signal is 200 kHz higher than the calibration signal. Set the amplitude of the signal to −80 dBm (60 dB below the calibration signal).
4. Set the 300 MHz signal to the reference level by pressing (PEAK SEARCH), (MKR ->), then MARKER ->REF LVL .

   If a 10 kHz filter with a typical shape factor of 15:1 is used, the filter will have a bandwidth of 150 kHz at the 60 dB point. The half-bandwidth (75 kHz) is narrower than the frequency separation, so the input signals will be resolved.

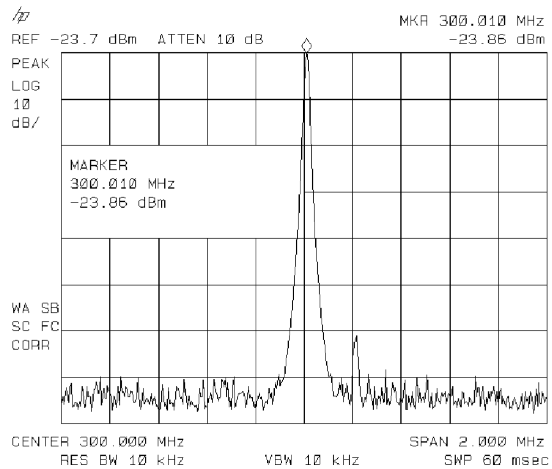


Figure 6-4. Signal Resolution with a 10 kHz Resolution Bandwidth

If a 30 kHz filter is used, the 60 dB bandwidth will be 450 kHz. Since the half-bandwidth (225 kHz) is wider than the frequency separation, the signals most likely will not be resolved. See Figure 6-5. (To determine resolution capability for intermediate values of amplitude level differences, consider the filter skirts between the 3 dB and 60 dB points to be approximately straight. In this case, we simply used the 60 dB value.)

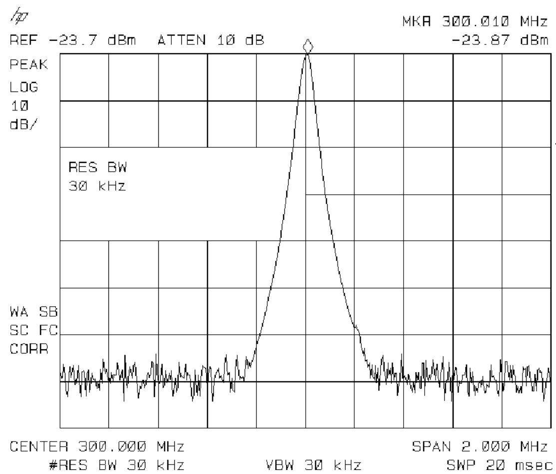


Figure 6-5. Signal Resolution with a 30 kHz Resolution Bandwidth

Increasing the Frequency Readout Resolution Using the Marker Counter

NOTE

This application can only be performed using an HP 8590D with Option 013, or with an HP 8591E, HP 8593E, HP 8594E, HP 8595E, or HP 8596E.

The marker counter increases the resolution and accuracy of frequency readout. When using the marker count function, if the bandwidth to span ratio is too small (less than 0.01), the `Reduce Span` message appears on the display. If `Widen RES BW` is displayed, it indicates that the resolution bandwidth is too narrow. Resolution bandwidths less than 300 Hz are not allowed. If the signal being counted is the largest signal within the 300 Hz bandwidth then the count will be correct. If there is another, larger signal (even off the display), the count will be for the larger signal.

Example: Increase the resolution and accuracy of the frequency readout on the signal of interest.

1. Place a marker on the signal of interest. (If you are using the CAL OUT signal, place the marker on the 300 MHz calibration signal. Press (FREQUENCY) 300 (MHz), (SPAN) 100 (MHz), and (PEAK SEARCH).)
2. Press (MKR FCTN), then `MK COUNT ON OFF` (ON should be underlined) to turn the marker counter on. `COUNTER` and the frequency and amplitude of the marker will appear in the active function area.
3. Increase the counter resolution by pressing `More 1 of 2`, `CNT RES AUTO MAN` and then entering the desired resolution using the step keys or the number/units keypad. For example, press 1 (kHz). The marker counter readout is in the upper right corner of the screen. The resolution can be set from 10 Hz to 100 kHz.
4. The marker counter remains on until turned off. Turn off the marker counter by pressing (MKR FCTN), then `MK COUNT ON OFF` (until OFF is underlined). (`MARKER ALL OFF` also turns the marker counter off.)

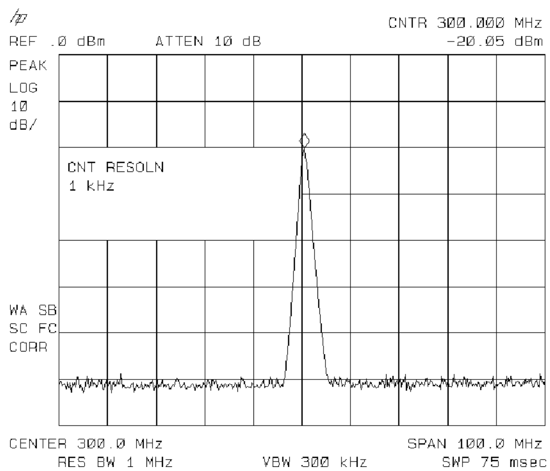


Figure 6-6. Using the Marker Counter

Decreasing the Frequency Span Using the Marker Track Function

Using the spectrum analyzer's marker track function, you can quickly decrease the span while keeping the signal at center frequency.

Example: Examine a carrier signal in a 200 kHz span.

1. Press (PRESET), tune to a carrier signal, and place a marker at the peak. (If you are using the CAL OUT signal, place the marker on the 300 MHz calibration signal. Press (FREQUENCY), 300 (MHz), (SPAN), 200 (MHz), and (PEAK SEARCH).)
2. Press (MKR FCTN), MK TRACK ON OFF (ON) and the signal will move to the center of the screen, if it is not already positioned there (note that the marker must be on the signal). Because the marker track function automatically maintains the signal at the center of the screen, you can reduce the span quickly for a closer look. If the signal drifts off of the screen as you decrease the span, use a wider frequency span.
3. Press (SPAN), 200 (kHz). The span decreases in steps as automatic zoom is completed. See Figure 6-7. You can also use the knob or step keys to decrease the span or use the PEAK ZOOM function under (SPAN).

Press MK TRACK ON OFF again so that (OFF) is underlined to turn off the marker track function.

NOTE

When you are finished with the example, turn off the marker tracking function.

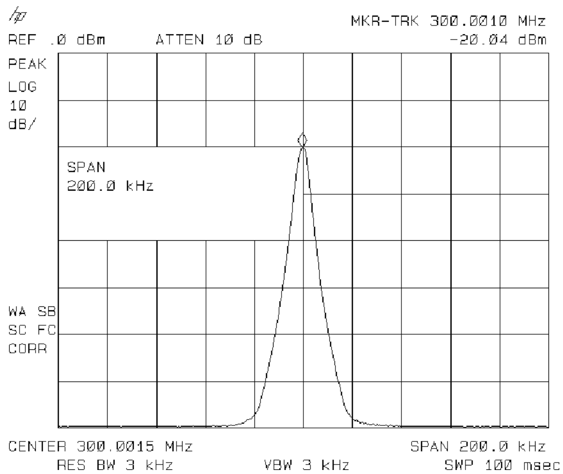


Figure 6-7. After Zooming In on the Signal

Peaking Signal Amplitude with Preselector Peak

NOTE

This application should only be performed using an HP 8592D, HP 8593E, HP 8595E, or HP 8596E.

PRESEL PEAK works above 2.9 GHz only (bands 1 through 4).

The preselector peak function automatically adjusts the preselector tracking to peak the signal at the active marker. Using preselector peak prior to measuring a signal yields the most accurate amplitude reading at the specified frequency. To maximize the peak response of the preselector and adjust the tracking, tune the marker to a signal and press (AMPLITUDE), PRESEL PEAK .

NOTE

PRESEL PEAK maximizes the peak response of the signal of interest, but may degrade the frequency response at other frequencies. Use PRESEL DEFAULT or (PRESET) to clear preselector-peak values before measuring a signal at another frequency.

PRESEL DEFAULT provides the best flatness for a full single-band, for viewing several signals simultaneously.

Example: Use the knob, step keys, or (PEAK SEARCH) to place the marker on your signal and then press (AMPLITUDE) and PRESEL PEAK . The message CAL:PEAKING appears in the active function block while the routine is working.

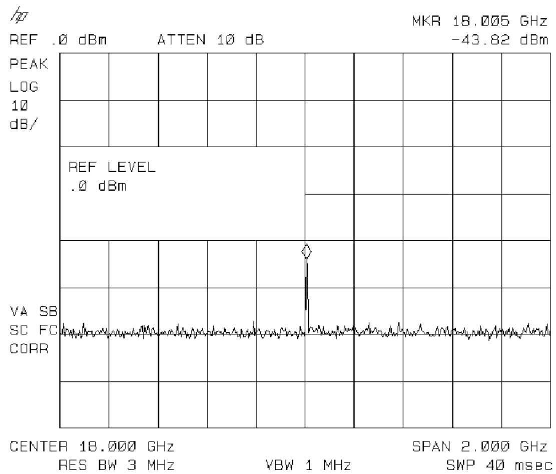


Figure 6-8. Peaking Signal Amplitude Using Preselector Peak

Tracking Unstable Signals Using Marker Track and the Maximum Hold and Minimum Hold Functions

The marker track function is useful for tracking unstable signals that drift with time. The maximum hold and minimum hold functions are useful for displaying modulated signals which appear unstable, but have an envelope that contains the information-bearing portion of the signal.

MK TRACK ON OFF may be used to track these unstable signals. Use (PEAK SEARCH) to place a marker on the highest signal on the display. Pressing MK TRACK ON OFF (ON) will bring that signal to the center frequency of the graticule and adjust the center frequency every sweep to bring the selected signal back to the center. SPAN ZOOM is a quick way to perform the (PEAK SEARCH), (MKR FCTN), MK TRACK ON OFF, (SPAN) key sequence.

Note that the primary function of the marker track function is to track unstable signals, not to track a signal as the center frequency of the spectrum analyzer is changed. If you choose to use the marker track function when changing center frequency, check to ensure that the signal found by the tracking function is the correct signal.

Example: Use the marker track function to keep a drifting signal at the center of the display and monitor its change.

This example requires a modulated signal. An acceptable signal can be easily found by connecting an antenna to the spectrum analyzer input and tuning to the FM broadcast band (88 to 108 MHz). Set the spectrum analyzer center frequency for 100 MHz with a span of 20 MHz, an attenuator setting of 0 dB, and reference level setting of approximately −40 dBm. Your circumstances may be slightly different, depending on building shielding and proximity to transmitters.

1. Connect an antenna to the spectrum analyzer input.
2. Press (PRESET), (FREQUENCY), 100 (MHz), (SPAN), 20 (MHz).

NOTE

Use a different signal frequency if no signal is available at 100 MHz in your area.

3. Press (AMPLITUDE), 40 (−dBm), ATTEN AUTO MAN , 0 (+dBm).
4. Press (SPAN), SPAN ZOOM , 500 (kHz).

   Notice that the signal has been held in the center of the display.

NOTE

If the signal you selected drifts too quickly for the spectrum analyzer to keep up with, use a wider span.

5. The signal frequency drift can be read from the screen if both the marker track and marker delta functions are active. Press (MKR), MARKER Δ , (MKR FCTN), MK TRACK ON OFF ; the marker readout indicates the change in frequency and amplitude as the signal drifts. (See Figure 6-9.)

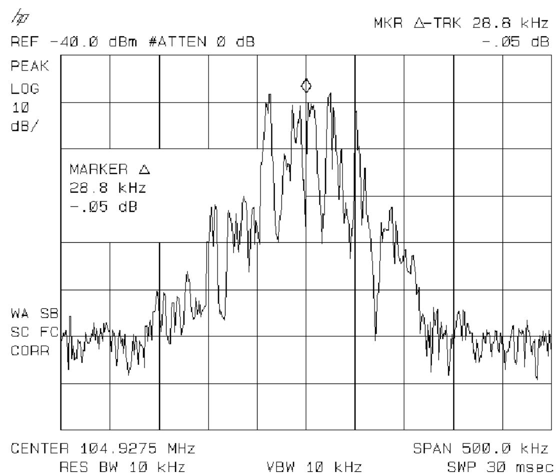


Figure 6-9. Using Marker Tracking to Track an Unstable Signal

The spectrum analyzer can measure the short- and long-term stability of a source. The maximum amplitude level and the frequency drift of an input signal trace can be displayed and held by using the maximum hold function. The minimum amplitude level can be displayed by using minimum hold (available for trace C only).

You can use the maximum hold and minimum hold functions if, for example, you want to determine how much of the frequency spectrum an FM signal occupies.

Example: Using the maximum hold and minimum hold functions, monitor the envelopes of a signal.

1. Connect an antenna to the spectrum analyzer input.
2. Press (PRESET), (FREQUENCY), 100 (MHz), and (SPAN), 20 (MHz).
3. Press (AMPLITUDE), 40 (−dBm), ATTEN AUTO MAN , 0 (+dBm), (SPAN), SPAN ZOOM , 500 (kHz).

   Notice that the signal has been held in the center of the display.
4. Turn off the marker track function by pressing MK TRACK ON OFF (OFF).

5. To measure the excursion of the signal, press (TRACE) then MAX HOLD A. As the signal varies, maximum hold maintains the maximum responses of the input signal, as shown in Figure 6-10.

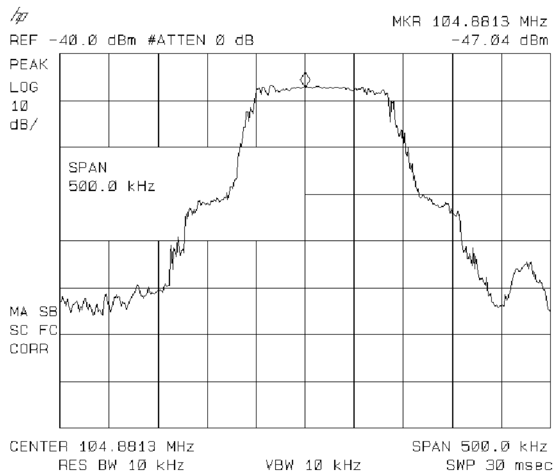


Figure 6-10. Viewing an Unstable Signal Using Max Hold A

Annotation on the left side of the screen indicates the trace mode. For example, MA SB SC indicates trace A is in maximum hold mode, trace B and trace C are in store-blank mode.

6. Press (TRACE), TRACE A B C to select trace B. (Trace B is selected when B is underlined.) Press CLEAR WRITE B to place trace B in clear-write mode, which displays the current measurement results as it sweeps. Trace A remains in maximum hold mode, showing the frequency shift of the signal.

7. Press TRACE A B C to select trace C (C should be underlined). Press MIN HOLD C. Trace C is in the minimum hold mode and displays the minimum amplitude of the frequency drift of the signal.

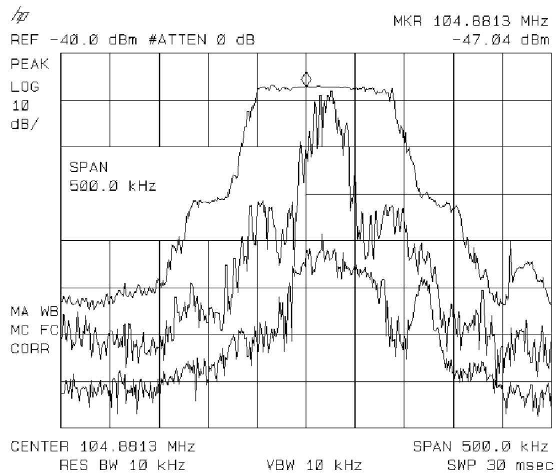


Figure 6-11. Viewing an Unstable Signal With Max Hold, Clear Write, and Min Hold

Comparing Signals Using Delta Markers

Using the spectrum analyzer, you can easily compare frequency and amplitude differences between signals, such as radio or television signal spectra. The spectrum analyzer's delta marker function lets you compare two signals when both appear on the screen at one time or when only one appears on the screen.

Example: Measure the differences between two signals on the same display screen.

1. Connect the spectrum analyzer's CAL OUT to the INPUT 50Ω. Press (PRESET). For the HP 8593E only, set the center frequency to 900 MHz and the span to 1.8 GHz: press (FREQUENCY), 900 (MHz), (SPAN), 1.8 (GHz).

   The calibration signal and its harmonics appear on the display.

2. Press (PEAK SEARCH) to place a marker at the highest peak on the display. The NEXT PK RIGHT and NEXT PK LEFT softkeys move the marker from peak to peak. Press NEXT PK RIGHT to move the marker to the 300 MHz calibration signal. See Figure 6-12.

   The signal that appears at the left edge of the screen is the spectrum analyzer's local oscillator (LO) and represents 0 Hz.

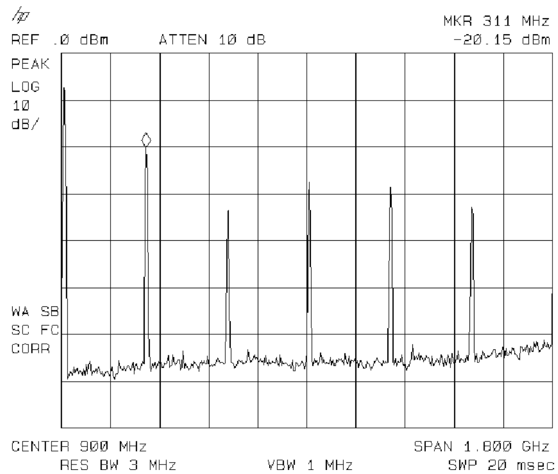


Figure 6-12. Placing a Marker on the CAL OUT Signal

3. Press MARKER Δ to activate a second marker at the position of the first marker. Move the second marker to another signal peak using the NEXT PK RIGHT or NEXT PK LEFT softkeys or the knob.
4. The amplitude and frequency difference between the markers is displayed in the active function block and in the upper right corner of the screen. See Figure 6-13.

   Press (MKR), More 1 of 2, then MARKER ALL OFF to turn the markers off.

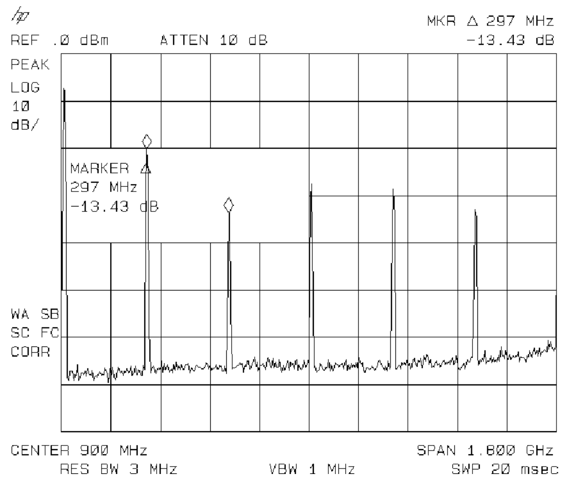


Figure 6-13. Using the Marker Delta Function

5. The `MARKER ->PK-PK` softkey can be used to find and display the frequency and amplitude difference between the highest- and lowest-amplitude signals. To use this automatic function, press (MKR->), `More 1 of 2`, `MARKER ->PK-PK`. See Figure 6-14.

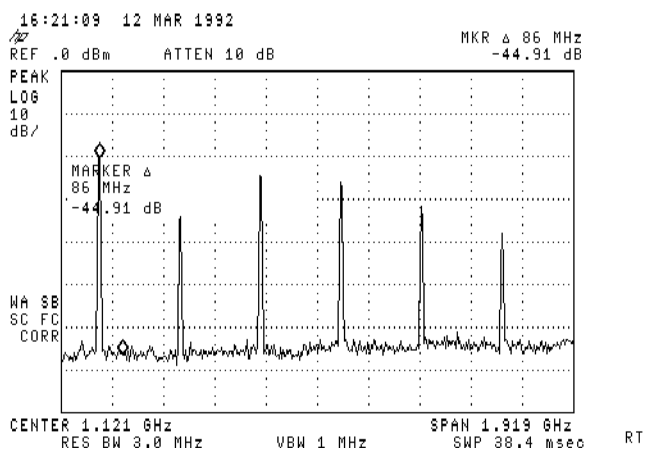


Figure 6-14. Using the Marker to Peak/Peak Function

The frequency and amplitude differences between the signals appear in the active function block. In addition, the softkeys accessed by (MKR->) appear on the screen.

Example: Measure the frequency and amplitude difference between two signals that do not appear on the screen at one time. (This technique is useful for harmonic distortion tests when narrow span and narrow bandwidth are necessary to measure the low-level harmonics.)

1. Connect the spectrum analyzer's CAL OUT to the INPUT 50Ω (if you have not already done so). Press (PRESET), (FREQUENCY), 300 (MHz), (SPAN) and the step down key ((⇓)) to narrow the frequency span until only one signal appears on the screen.
2. Press (PEAK SEARCH) to place a marker on the peak.
3. Press MARKER Δ to identify the position of the first marker.
4. Press (FREQUENCY) to activate center frequency. Turn the knob clockwise slowly to adjust the center frequency until a second signal peak is placed at the position of the second marker. It may be necessary to pause occasionally while turning the knob to allow a sweep to update the trace. The first marker remains on the screen at the amplitude of the first signal peak.

NOTE

Changing the reference level changes the marker delta amplitude readout.

The annotation in the upper right corner of the screen indicates the amplitude and frequency difference between the two markers. See Figure 6-15.

To turn the markers off, press (MKR), More 1 of 2, then MARKER ALL OFF.

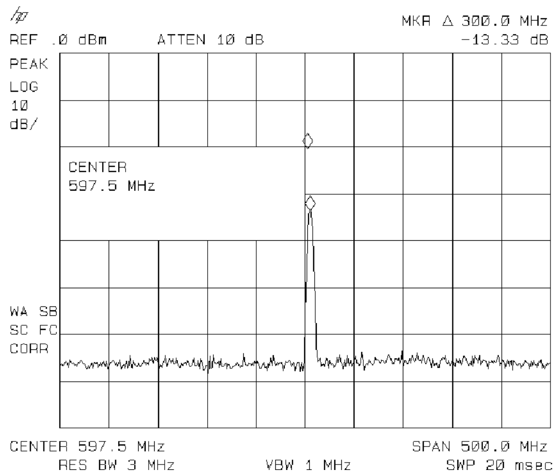


Figure 6-15. Frequency and Amplitude Difference Between Signals

Measuring Low-Level Signals Using Attenuation, Video Bandwidth, and Video Averaging

Spectrum analyzer sensitivity is the ability to measure low-level signals. It is limited by the noise generated inside the spectrum analyzer. The spectrum analyzer input attenuator and bandwidth settings affect the sensitivity by changing the signal-to-noise ratio. The attenuator affects the level of a signal passing through the instrument, whereas the bandwidth affects the level of internal noise without affecting the signal. In the first two examples in this section, the attenuator and bandwidth settings are adjusted to view low-level signals.

If, after adjusting the attenuation and resolution bandwidth, a signal is still near the noise, visibility can be improved by using the video-bandwidth and video-averaging functions, as demonstrated in the third and fourth examples.

Example: If a signal is very close to the noise floor, reducing input attenuation brings the signal out of the noise. Reducing the attenuation to 0 dB maximizes signal power in the spectrum analyzer.

> **NOTE**
>
> The total power of all input signals at the spectrum analyzer input must not exceed the maximum power level for the spectrum analyzer.

1. Connect an antenna to the spectrum analyzer input. Press (PRESET).
2. Reduce the frequency range to view a low-level signal of interest. For example, narrow the frequency span from 88 MHz to 108 MHz by pressing (FREQUENCY), `START FREQ`, 88 (MHz), `STOP FREQ`, 108 (MHz).
3. Place a marker on the low-level signal of interest. Press (MKR) and use the knob to position the marker at the signal's peak.
4. Place the signal at center frequency by pressing (MKR ->) then `MARKER ->CF`.

5. Reduce the span to 10 MHz. Press (SPAN), and then use the step-down key (⇓). See Figure 6-16.

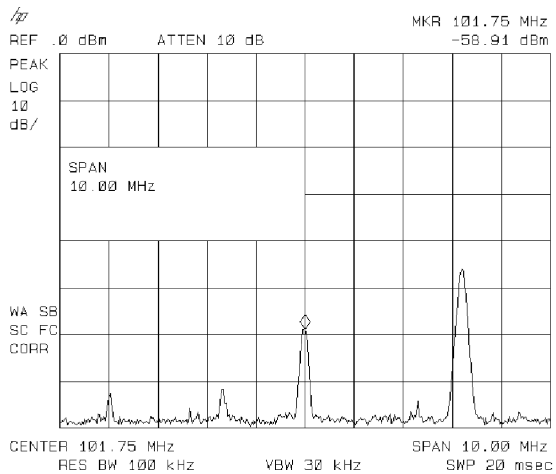


Figure 6-16. Low-Level Signal

6. Press (AMPLITUDE), ATTEN AUTO MAN. Press the step-up key (⇑) once to select 20 dB attenuation. Increasing the attenuation moves the noise floor closer to the signal.

   A "#" mark appears next to the ATTEN annotation at the top of the display, indicating the attenuation is no longer coupled to other spectrum analyzer settings.

7. To see the signal more clearly, press 0 (dBm). Zero attenuation makes the signal more visible. (As a precaution to protect the spectrum analyzer's input mixer, 0 dB RF attenuation can be selected only with the number/units keypad.)

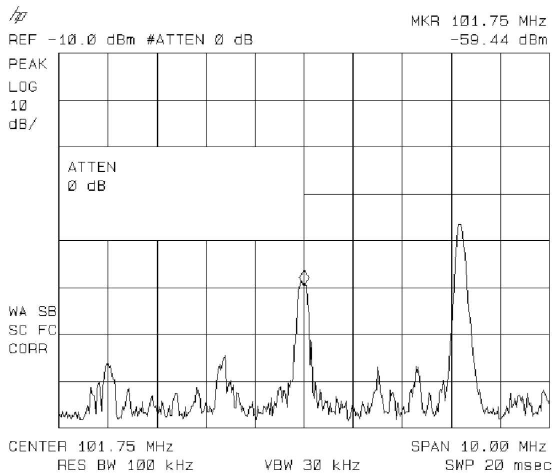


Figure 6-17. Using 0 dB Attenuation

Before connecting other signals to the spectrum analyzer input, increase the RF attenuation to protect the spectrum analyzer's input mixer: press ATTEN AUTO MAN so that AUTO is underlined or press (AUTO COUPLE) and AUTO ALL.

Example: The resolution bandwidth can be decreased to view low-level signals.

1. As in the previous example, connect an antenna to the spectrum analyzer input. Set the spectrum analyzer to view a low-level signal.
2. Press (BW) then (⇓). The low-level signal appears more clearly because the noise level is reduced. See Figure 6-18.

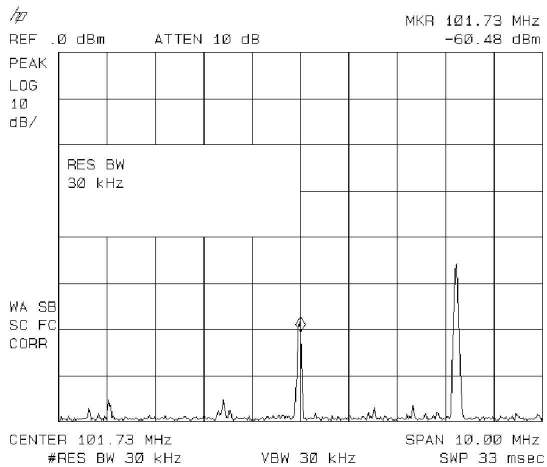


Figure 6-18. Decreasing Resolution Bandwidth

A “#” mark appears next to the `RES BW` annotation at the lower left corner of the screen, indicating that the resolution bandwidth is uncoupled.

As the resolution bandwidth is reduced, the sweep time is increased to maintain calibrated data.

Example: The video-filter control is useful for noise measurements and observation of low-level signals close to the noise floor. The video filter is a post-detection low-pass filter that smooths the displayed trace. When signal responses near the noise level of the spectrum analyzer are visually masked by the noise, the video filter can be narrowed to smooth this noise and improve the visibility of the signal. (Reducing video bandwidths requires slower sweep times to keep the spectrum analyzer calibrated.)

Using the video bandwidth function, measure the amplitude of a low-level signal.

1. As in the first example, connect an antenna to the spectrum analyzer input. Set the spectrum analyzer to view a low-level signal.
2. Narrow the video bandwidth by pressing (BW), `VID BW AUTO MAN`, and the step-down key (⇩). This clarifies the signal by smoothing the noise, which allows better measurement of the signal amplitude.

A "#" mark appears next to the VBW annotation at the bottom of the screen, indicating that the video bandwidth is not coupled to the resolution bandwidth.

Instrument preset conditions couple the video bandwidth to the resolution bandwidth so that the video bandwidth is equal to or narrower than the resolution bandwidth. If the bandwidths are uncoupled when video bandwidth is the active function, pressing VID BW AUTO MAN (so that AUTO is underlined) recouples the bandwidths. See Figure 6-19.

NOTE

The video bandwidth must be set wider than the resolution bandwidth when measuring impulse noise levels.

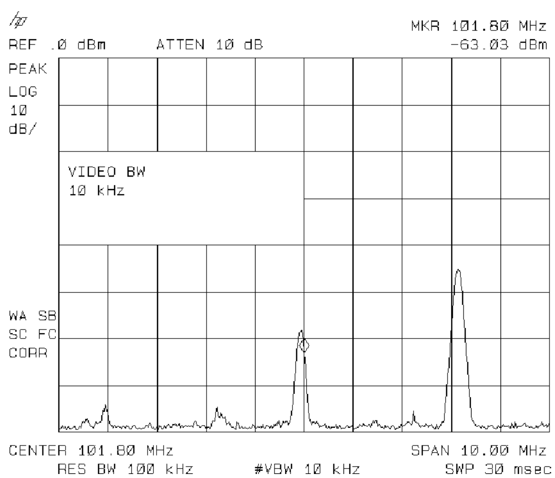


Figure 6-19. Decreasing Video Bandwidth

Example: If a signal level is very close to the noise floor, video averaging is another way to make the signal more visible.

NOTE

The time required to construct a full trace that is averaged to the desired degree is approximately the same when using either the video-bandwidth or the video-averaging technique. The video bandwidth technique completes the averaging as a slow sweep is taken, whereas the video averaging technique takes many sweeps to complete the average. Characteristics of the signal being measured such as drift and duty cycle determine which technique is appropriate.

Video averaging is a digital process in which each trace point is averaged with the previous trace-point average. Selecting video averaging changes the detection mode from peak to sample. The result is a sudden drop in the displayed noise level. The sample mode displays the instantaneous value of the signal at the end of the time or frequency interval represented by each display point, rather than the value of the peak during the interval. Sample mode is not used to measure signal amplitudes accurately because it may not find the true peak of the signal.

Video averaging clarifies low-level signals in wide bandwidths by averaging the signal and the noise. As the spectrum analyzer takes sweeps, you can watch video averaging smooth the trace.

1. Position a low-level signal on the spectrum analyzer screen.
2. Press (TRACE), More 1 of 3, then VID AVG ON OFF. When ON is underlined, the video-averaging routine is initiated. As the averaging routine smooths the trace, low-level signals become more visible. VID AVG 100 appears in the active function block.

   The number represents the number of samples (or sweeps) taken to complete the averaging routine.
3. To set the number of samples, use the number/units keypad. For example, press VID AVG ON OFF (so that ON is underlined), 25 (Hz). Turn video averaging off and on again by pressing VID AVG ON OFF (OFF), VID AVG ON OFF (ON).

   The number of samples equals the number of sweeps in the averaging routine.

During averaging, the current sample appears at the left side of the graticule. Changes in active functions settings, such as the center frequency or reference level, will restart the sampling. The sampling will also restart if video averaging is turned off and then on again.

Once the set number of sweeps has been completed, the spectrum analyzer continues to provide a running average based on this set number.

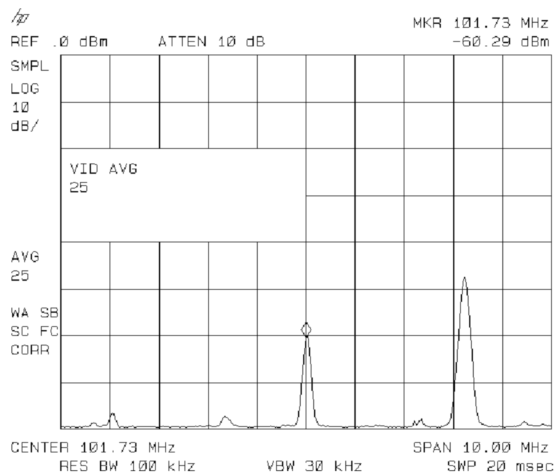


Figure 6-20. Using the Video Averaging Function

Identifying Distortion Products Using the RF Attenuator and Traces

Distortion from the Analyzer

High-level input signals may cause spectrum analyzer distortion products that could mask the real distortion measured on the input signal. Using trace B and the RF attenuator, you can determine which signals, if any, are internally generated distortion products.

Example: Using a signal from a signal generator, determine whether the harmonic distortion products are generated by the spectrum analyzer.

1. Connect a signal generator to the spectrum analyzer's INPUT 50Ω. Set the signal generator frequency to 200 MHz and the amplitude to 0 dBm.

   Set the center frequency of the spectrum analyzer to 400 MHz and the span to 500 MHz: press (FREQUENCY), 400 (MHz), (SPAN) 500 (MHz). The signal shown in Figure 6-21 produces harmonic distortion products in the spectrum analyzer's input mixer.

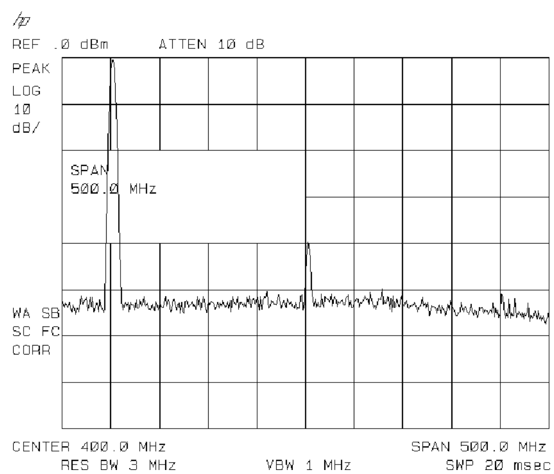


Figure 6-21. Harmonic Distortion

2. Change the span to 200 MHz: press (SPAN), 200 (MHz).
3. Change the attenuation to 0 dB: press (AMPLITUDE), ATTEN AUTO MAN, 0 (dBm).
4. To determine whether the harmonic distortion products are generated by the spectrum analyzer, first save the screen data in trace B.

   Press (TRACE), TRACE A B C (until trace B is underlined), then CLEAR WRITE B. Allow the trace to update (two sweeps) and press VIEW B, (PEAK SEARCH), MARKER Δ. The spectrum analyzer display shows the stored data in trace B and the measured data in trace A.
5. Next, increase the RF attenuation by 10 dB: press (AMPLITUDE), ATTEN AUTO MAN, and the step-up key (⇧) once. (See Figure 6-22.)

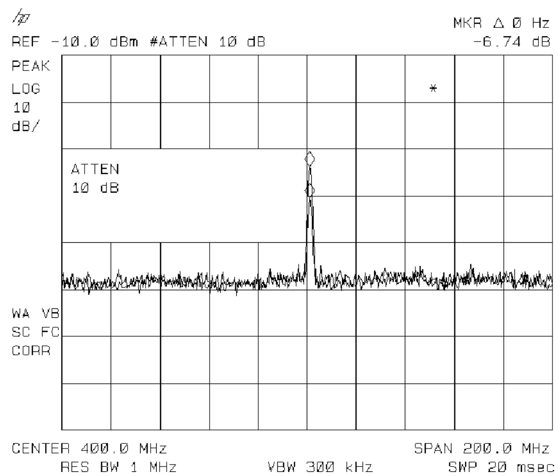


Figure 6-22. RF Attenuation of 10 dB

6. Compare the response in trace A to the response in trace B. If the distortion product decreases as the attenuation increases, distortion products are caused by the spectrum analyzer's input mixer.

   The change in the distortion product is shown by the marker-delta value. The high-level signals causing the overload conditions must be attenuated to eliminate the interference caused by the internal distortion.

If the responses in trace A and trace B differ, as in Figure 6-22, then attenuation is required. If there is no change in the signal level, the distortion is not caused internally. For example, the signal amplitude in Figure 6-23 is not high enough to cause internal distortion in the spectrum analyzer so any distortion that is displayed is present on the input signal.

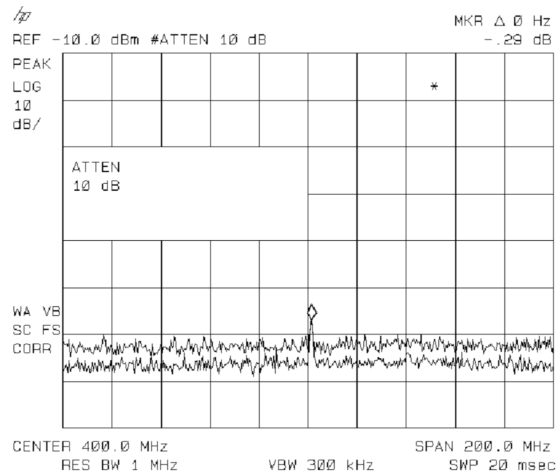


Figure 6-23. No Harmonic Distortion

Third-Order Intermodulation Distortion

Two-tone, third-order intermodulation distortion is a common problem in communication systems. When two signals are present in a system, they can mix with the second harmonics generated and create third-order intermodulation distortion products, which are located close to the original signals. These distortion products are generated by system components such as amplifiers and mixers.

Example: Test a device for third-order intermodulation. This example uses two sources, one set to 300 MHz and the other to approximately 301 MHz. (Other source frequencies may be substituted, but try to maintain a frequency separation of approximately 1 MHz.)

1. Connect the equipment as shown in Figure 6-24.

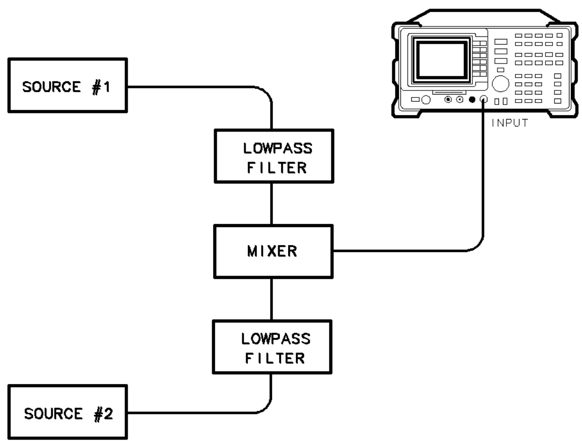


Figure 6-24. Third-Order Intermodulation Equipment Setup

2. Set one source to 300 MHz and the other source to 301 MHz for a frequency separation of 1 MHz. Set the sources equal in amplitude (in this example, the sources are set to −5 dBm).
3. Tune both signals onto the screen by setting the center frequency between 300 and 301 MHz. Then, using the knob, center the two signals on the display. Reduce the frequency span to 5 MHz for a span wide enough to include the distortion products on the screen. To be sure the distortion products are resolved, reduce the resolution bandwidth until the distortion products are visible. Press (BW), RES BW, and then use the step-down key (⇓) to reduce the resolution bandwidth until the distortion products are visible.
4. For best dynamic range, set the mixer input level to −40 dBm and move the signal to the reference level: press (AMPLITUDE), More 1 of 3, MAX MXR LEVEL, 40 (−dBm).

The spectrum analyzer automatically sets the attenuation so that a signal at the reference level will be a maximum of −40 dBm at the input mixer.

5. To measure a distortion product, press (PEAK SEARCH) to place a marker on a source signal. To activate the second marker, press MARKER Δ. Using the knob, adjust the second marker to the peak of the distortion product that is beside the test tone. The difference between the markers is displayed in the active function block.

   To measure the other distortion product, press (PEAK SEARCH), NEXT PEAK. This places a marker on the next highest peak, which, in this case, is the other source signal. To measure the difference between this test tone and the second distortion product, press MARKER Δ and use the knob to adjust the second marker to the peak of the second distortion product. (See Figure 6-25.)

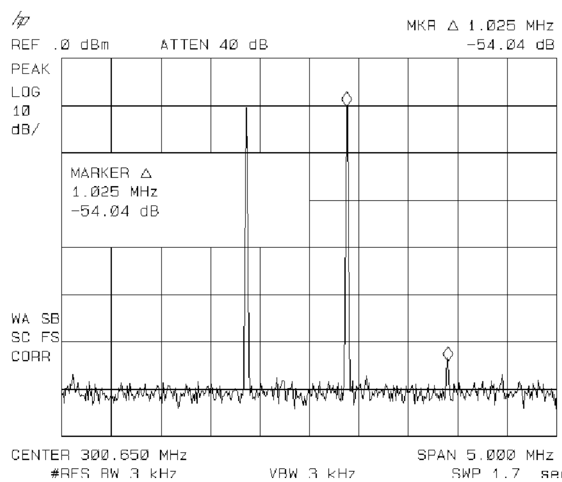


Figure 6-25. Measuring the Distortion Product

Using the Analyzer As a Receiver in Zero Frequency Span

The spectrum analyzer operates as a fixed-tuned receiver in zero span. The zero span mode can be used to recover modulation on a carrier signal.

Center frequency in the swept-tuned mode becomes the tuned frequency in zero span. The horizontal axis of the screen becomes calibrated in time, rather than frequency. Markers display amplitude and time values.

The following functions establish a clear display of the video waveform:

Trigger stabilizes the waveform trace on the display by triggering on the modulation envelope. If the signal's modulation is stable, video trigger synchronizes the sweep with the demodulated waveform.

Linear mode should be used in amplitude modulation (AM) measurements to avoid distortion caused by the logarithmic amplifier when demodulating signals.

Sweep time adjusts the full sweep time from 20 ms (20 μs in zero span with Option 101), to 100 s. The sweep time readout refers to the full 10-division graticule. Divide this value by 10 to determine sweep time per division.

Resolution and video bandwidth are selected according to the signal bandwidth.

Each of the coupled function values remains at its current value when zero span is activated. Video bandwidth is coupled to resolution bandwidth. Sweep time is not coupled to any other function.

NOTE

Capability for measuring AM or FM demodulation is available if Option 102, 103, or 301 is installed in your spectrum analyzer. Refer to "Demodulating and Listening to an AM or FM Signal" in Chapter 4 for more information.

Example: View the modulation waveform of an AM signal in the time domain.

1. To obtain an AM signal, you can either connect an antenna to the spectrum analyzer input and tune to a commercial AM broadcast station or you can connect a source to the spectrum analyzer input and set the percent modulation of the source. (If a headset is used with the VIDEO OUT connector, the spectrum analyzer will operate as a radio.)
2. First, center and zoom in on the signal in the frequency domain. (See "Decreasing the Frequency Span Using the Marker Track Function.") Be sure to turn off the marker track function, since the marker track function must be off for zero span. See Figure 6-26.

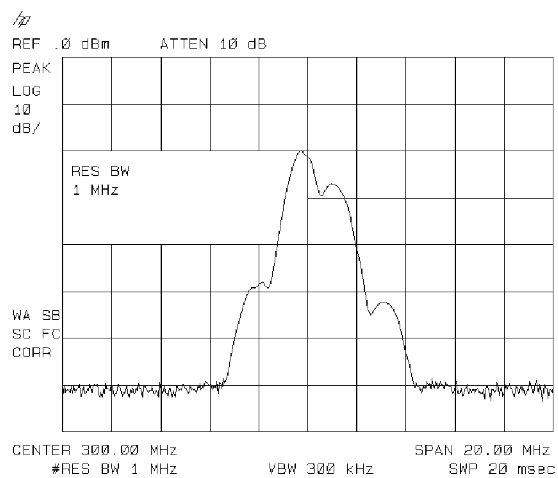


Figure 6-26. Viewing an AM Signal

3. To demodulate the AM, press (BW). Increase the resolution bandwidth to include both sidebands of the signal within the passband of the spectrum analyzer.
4. Next, position the signal peak near the reference level and select a linear voltage display. Press (AMPLITUDE) and change the reference level, then press SCALE LOG LIN to underline LIN.
5. To select zero span, either press (SPAN), 0 (Hz) or press ZERO SPAN. See Figure 6-27. If the modulation is a steady tone (for example, from a signal

generator), use video trigger to trigger on the waveform and stabilize the display. Adjust the sweep time to change the horizontal scale.

Use markers and delta markers to measure time parameters of the waveform.

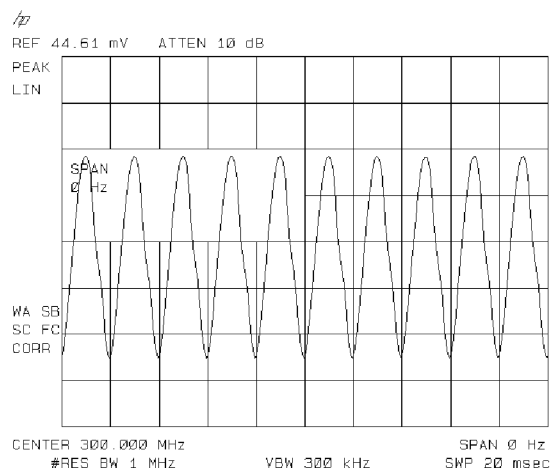


Figure 6-27. Measuring Modulation In Zero Span

Measuring Signals Near Band Boundaries Using Harmonic Lock

NOTE

This application should only be performed using an HP 8592D, HP 8593E, HP 8595E, or HP 8596E.

When measuring signals at or near a band crossing, use the lowest band having a specified upper frequency limit that will include the signal of interest. Using harmonic lock, and choosing the lowest possible band to analyze a signal, ensures the best specified measurement accuracy.

To lock onto a specific harmonic, press (FREQUENCY), `Band Lock`, `BND LOCK ON OFF` (so that ON is underlined), or select a band. After setting the harmonic lock, only center frequencies and spans within the frequency range of the harmonic band may be entered. The span is automatically reduced to accommodate a center frequency specified near the end of the band range.

Example:

1. Connect 100 MHz COMB OUT to the spectrum analyzer input. The HP 8595E does not have a 100 MHz COMB OUT signal, so it cannot be used for this measurement example. (An external source must be substituted.)
2. Press (PRESET) and then the following keys:

   (AUX CTRL) `COMB GEN ON OFF` (ON)
   (SPAN) 350 (MHz)
   (FREQUENCY) 3 (GHz)
   `Band Lock` `BND LOCK ON OFF` (ON)

3. Place a marker on the farthest peak to the left by using the (PEAK SEARCH) key.
4. Press `MARKER Δ`, `NEXT PK RIGHT`, `NEXT PK RIGHT` to show the frequency and amplitude difference between the two comb teeth.

You will see three comb teeth on your display. The spectrum analyzer is locked in band 1 and will not allow multiband sweeps. See Figure 6-28.

5. To see a multiband sweep, press the following keys:

   (MKR) More 1 of 2 MARKER ALL OFF

   (FREQUENCY) Band Lock BND LOCK ON OFF (OFF)

6. Place a marker on the farthest peak to the left by pressing (PEAK SEARCH).

7. Press MARKER Δ. Use NEXT PK RIGHT to place a marker on the farthest peak to the right. The marker readout displays the frequency and amplitude difference between the two comb teeth. See Figure 6-29.

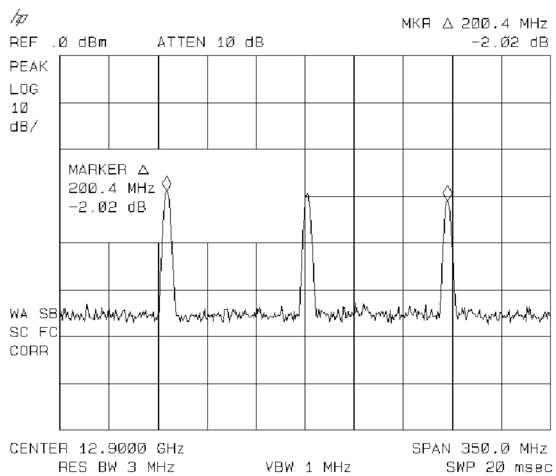


Figure 6-28. Using Harmonic Lock

NOTE

The comb frequencies have a 100 MHz spacing.

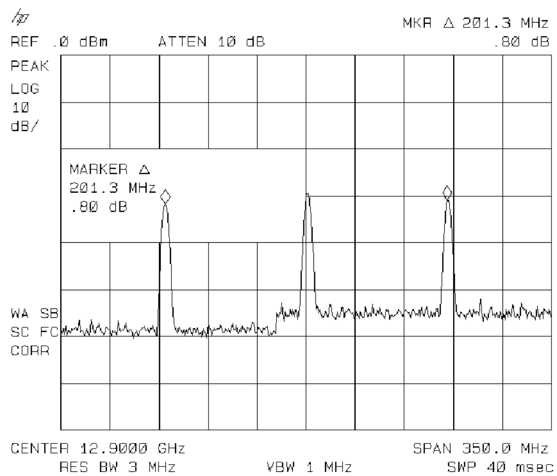


Figure 6-29. Harmonic Locking Off

Using the Comb Generator to Perform More Accurate Frequency Measurements

NOTE

This application can only be performed using an HP 8592D.

The spectrum analyzer has a built-in comb generator that can be connected temporarily to verify frequency accuracy. To identify a signal with the best frequency accuracy provided by the spectrum analyzer, use `Correct To Comb`.

Example:

1. Set the spectrum analyzer to a state where your signal is displayed in a span >17 MHz and ≤400 MHz. The span should be wide enough to include a comb tooth; however, the narrowest span assures the best accuracy.

   In Figure 6-30, the known signal is 4050.0 MHz, and is measured as being 4050.8 MHz.

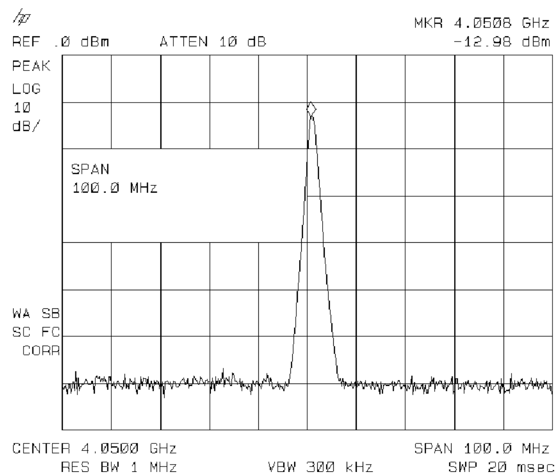


Figure 6-30. Measuring an Input Signal

2. Disconnect the input signal, and connect the 100 MHz COMB OUT to the spectrum analyzer input.
3. Press (AUX CTRL), `COMB GEN ON OFF` (ON), then `CORRECT TO COMB`. The marker is activated and the menu for the correct to comb routine is displayed. The message `Set marker on comb tooth then press CONTINUE softkey to correct freq offst.` is displayed. See Figure 6-31.
4. Use (PEAK SEARCH), `NEXT PK RIGHT` or `NEXT PK LEFT`, or use the knob to place the marker on the comb tooth that is nearest to the location of the input signal.

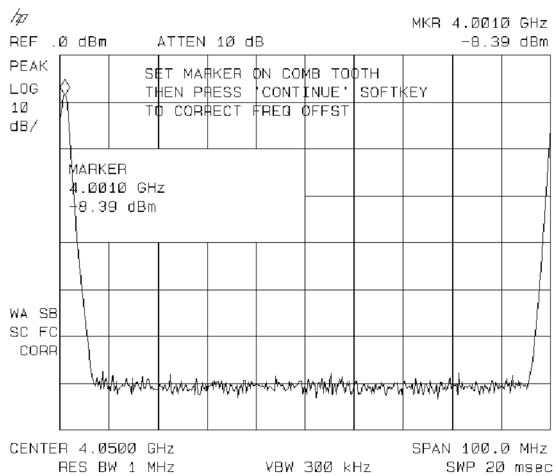


Figure 6-31. Using the Correct to Comb Function

5. Press CONTINUE or you may end the routine at this point by pressing ABORT.
6. If you pressed CONTINUE, the spectrum analyzer automatically calculates and puts in a frequency offset. The frequency offset in the spectrum analyzer is automatically set for the best accuracy available in the current span and center frequency.
7. Reconnect the input signal and use the marker to read the corrected frequency.

The frequency offset is displayed at the bottom center of the screen. The known signal is measured as being 4050.0 MHz. See Figure 6-32.

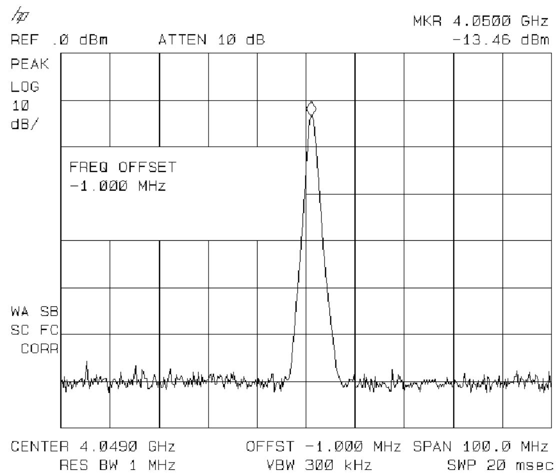


Figure 6-32. Frequency Readout with a Frequency Offset

NOTE

- If you change the center frequency or span, you must recorrect the frequency. Note that the spectrum analyzer's frequency offset has been used to help calibrate the display, and remember to reset the offset before making other measurements. To clear the offset, use `CLEAR OFFSET`, or press the (PRESET) key.
- For center frequencies less than 50 MHz, the local oscillator can be used as a referenced signal rather than a comb tooth to obtain better accuracy.

  The Correct-to-Comb function is recommended for spans 17 to 400 MHz, and is not useable in multiband sweeps.

  When using `Correct To Comb` in band 0, 20 dB of attenuation or greater should be used; otherwise the comb generator's power level overloads the first converter.

A

EMC Regulatory Agencies

EMC Regulatory Agencies

The following is a listing of addresses for obtaining EMC regulation information.

Table A-1. Where to Obtain EMC Regulations

Country Agencies	Addresses
IEC **CISPR**	
Sales Department of the Central Office of the IEC	P.O.Box 131 3, Rue de Varembe 1121 Geneva 20, Switzerland
CCIR	
ITU, General Secretariat Sales Service	Place de Nation 1211 Geneva, Switzerland
AUSTRALIA	
Australia Electrotechnical Committee Standards Association of Australia	P.O Box 458 NORTH SYDNEY N.S.W. 2060 Telephone: + 61 (2) 963 41 11 Telegrams: AUSTANDARD Telex: 26514 astan aa Telefax: + 61 (2) 959 38 96
BELGIUM	
Comité Electrotechnique Belge	3 Galerie Ravenstein, Boite 11, B-1000 BRUXELLES Telephone: + 32 (2) 512 00 28 Telegrams: CEB TF 5120028 BRUXELLES Telefax: + 32 (2) 511 29 38 <<pour CEB>>

Table A-1. Where to Obtain EMC Regulations (continued)

Country Agencies	Addresses
CANADA	
Standards Council of Canada Standards Sales Division	350 Sparks Street, Suite 1200 OTTAWA, Ontario K1P 6N7 Telephone: (613) 238-3222 Telegrams: STANCAN OTTAWA Telex: 053-4403 stancan ott. Telefax: (613) 995 4564
Canadian Standards Association (CSA)	178 Rexdale Boulevard REXDALE (TORONTO), Ontario M9W 1R3 Telephone: (416) 747-4044 Telefax: (416) 747-2475
DENMARK	
Dansk Elektroteknisk Komite	Strandgade 36 st DK-1401 KOBENHAVN K Telephone: + 45 (31) 57 50 50 Telegrams: DANELKOMITE Telex: 16600 fotex dk (Danelkomite Copenhagen) Telefax: + 45 (31) 57 63 50
FRANCE	
Comité Electrotechnique Francais	UTE-CEdex 64 F-92052 PARIS LA DÉFENSE Telephone: + 33 (1) 47 68 50 20 Telex: cefute 620816 f Telefax: + 33 (1) 47 89 47 75
GERMANY	
VDE-VERLAG GmbH	Austieferungsstelle Merianstrasse 29 D-6050 OFFENBACH a.M. Telephone: + 49 (69) 8306-1 Telex: 4152678 vig d Telefax: + 49 (69) 83 10 81

Table A-1. Where to Obtain EMC Regulations (continued)

Country Agencies	Addresses
INDIA	
Burear of Indian Standards Sales Department	Manak Bhavan 9 Bahadur Shah Zafar Marg. NEW DELHI 110002 Telephone: + 91 (11) 331 01 31 Telegrams: MANAKSANSTHA Telex: 031-65870 bis in Telefax: + 91 (11) 331 40 62
ITALY	
Cometato Elettrotecnico Italiano	Viale Monza 259 1-20126 MILANO MI Telephone: + 39 (2) 25 77 31 Telegrams: ELETTROCOMIT MILANO MI Telefax: + 39 (2) 25 773 222
JAPAN	
Japanese Standards Association	1-24 Akasaka 4 Minato-Ku TOKYO 107 Telephone: + 81 (3) 583-8001 Telex: 24 24 245 jsatyo j Cables: JSASTAN Telefax: + 81 (3) 580 14 18
NETHERLANDS	
Nederlands Normalisatie-Instituut Afd. Verdoop en Informatie	Kalfjeslaan 2, P.O. Box 5059 NL 2600 GB Delft Telephone: 31 (15) 69 03 90 Telegrams: NORMALISATIE DELFT Telex: 38144 nni ni Telefax: + 31 15 69 01 90

Table A-1. Where to Obtain EMC Regulations (continued)

Country Agencies	Addresses
NORWAY	
Norsk Elektroteknisk Komite	Harbizalleen 2A Postboks 280, Skoyen N—0212 OSLO 2 Telephone: + 47 (2) 52 69 50 Telegrams: NORWELCOM Telex: 77206 nenek n Telefax: + 47 (2) 52 69 61
SOUTH AFRICA	
Enquiries: South African Bureau of Standards Electronic Engineering Department	Private Bag X191 PRETORIA 0001 Republic of South Africa
Radio Regulations/Government Gazette Publications Department The Government Printer	Private Bag X85 PRETORIA 0001 Republic of South Africa
SPAIN	
Comité Nacional Espanol de la CEI	Francisco Gervas 3. E - 28020 MADRID Telephone: + 34 (1) 270 44 00 Telex: 27 626 unesa e Telefax: + 34 (1) 270 28 55 or 270 49 72
SWEDEN	
Svenka Elecktriska Kommissionen	P.O. Box 1284 S-164 28 KISTA-STOCKHOLM Telephone: + 48 8 750 78 20 Telex: 171 09 elnorm s Telefax: + 46 8 751 84 70

Table A-1. Where to Obtain EMC Regulations (continued)

Country Agencies	Addresses
SWITZERLAND	
Swiss Electrotechnical Committee Swiss Electrotechnical Association	Seefeldstrasse 301 CH-8008 ZURICH Telephone: + 41 (1) 384 91 11 Telegrams: ELEKTROVEREIN ZURICH Telex: 817 431 sev ch Telefax: + 41 (1) 55 14 26
UNITED KINGDOM	:
British Standards Institution BSI Sales Department	Linford Wood MILTON KEYNES MK14 GLE Telephone: + 44 (908) 22 00 22 Telex: 825777 bsi mk g Telefax: + 44 (908) 32 08 56
British Defence Standards DEF STAN Ministry of Defence	Northumberland House Northumberland Avenue LONDON WC2N 5 BP Telephone: 01 218 9000

Table A-1. Where to Obtain EMC Regulations (continued)

Country Agencies	Addresses
UNITED STATES OF AMERICA	
America National Standards Institute Inc. Sales Department	1430 Broadway NEW YORK, N.Y. 10018 Telephone: + 1 (212) 642 49 00 Telegrams: STANDARDS Telex: 023-42 42 96 ansi ui Telefax: + 1 (212) 302 12 86
FCC Rules and Regulations	Superintendent of Documents U.S. Government Printing Office Washington D.C. 20402
U.S. Military Specifications	Naval Publications and Forms Center 5801 Tabor Ave. Philadelphia, PA 19120
IEEE Service Center	445 Hoes Lane P.O. Box 1331 Piscataway, NJ 08855-1331
Radio Technical Commission For Aeronautics	One McPherson Square 1425 K Street NW., Suite 500 Washington, D.C. 20005 Telephone: + 1 (202) 682 02 66

Glossary

Glossary

absolute amplitude accuracy
The degree of correctness or uncertainty of an absolute measurement (expressed in either % or dB power). It includes relative uncertainties plus calibrator uncertainty. Refer also to **relative amplitude accuracy**.

active function readout
An on-screen indicator of the function subject to change by the knob, step keys, or key pad. The active function is the one that was written inside the graticule at the last key press or remote-programming command. The typical physical location of the active function readout information is on the left-hand side of the graticule.

active marker
The marker that can be positioned on a trace by front-panel controls or programming commands.

active trace
The trace (commonly A, B, or C) that is being swept (updated) with incoming signal information.

amplitude accuracy
The general uncertainty of a spectrum analyzer amplitude measurement, whether relative or absolute.

amplitude-left marker
A second or third marker whose position is based upon the amplitude difference relative to a reference marker. The position of the second marker is made relative to the position of the reference marker. The marker readout in this mode represents the frequency and amplitude difference between the original marker and the second marker.

amplitude-right marker
A second or third marker whose position is based upon the amplitude difference relative to a reference marker. The position of the third marker is made relative to the position of the reference marker. The marker readout in this mode represents the frequency and amplitude difference between the original marker and the third marker.

anechoic chamber
An enclosure for making electromagnetic interference and susceptibility measurements. The chamber provides high attenuation of external signals (70 to 100 dB) and is lined with an absorbent material that reduces interior reflections and room resonance.

antenna factor
The ratio of field strength in volts/meter to an antenna's output signal in volts. Generally, the field strength is given in dB above 1 μV per meter (dBμV/m) and the antenna output in dB above 1 μV (dBμV). Antenna factor is commonly expressed in logarithmic terms so that the antenna factor K is expressed as dB/m.

ASCII
The acronym for American Standard Code for Information Interchange. It is an eight-bit code (7 bits plus parity check) used for data (information) interchange. An ASCII value is a specific combination of bits ranging from 0 to 255 that represents characters in machine language that computers and controllers can understand.

attenuation
A general term used to denote a decrease of signal magnitude in transmission from one point to another. Attenuation may be expressed as a scalar ratio of the input to the output magnitude in decibels.

bandwidth selectivity
A measure of an analyzer's ability to resolve signals unequal in amplitude. It is the ratio of the 60-dB bandwidth to the 3-dB bandwidth for a given resolution (IF) filter. Bandwidth selectivity tells us how steep the filter skirts are. Bandwidth selectivity is sometimes called shape factor.

battery-backed RAM
Random access memory (RAM) data retained by a battery. RAM memory cards can contain data that is maintained with a battery. Refer also to nonvolatile memory.

blank mode
This is an analyzer function that stores any active trace in the analyzer's reserved memory and blanks the display. The stored trace may be either A, B, or C. Refer also to reserved memory.

broadband response

That condition in which displayed amplitude results from a signal whose spectrum is wider than the resolution bandwidth of a spectrum analyzer and whose repetition frequency is lower than the bandwidth of the spectrum analyzer. A combination of signal and receiver characteristics determines when a signal is classified as broadband. Refer also to narrowband response. The following checks can help verify a response as broadband:

- Change the resolution bandwidth. The displayed amplitude changes.
- Change the sweep time. The spacing of the responses on the display changes as you change the sweep time.
- Change the span. The spacing of the responses does not change. Spacing should be independent of frequency span.
- Change the video bandwidth. If the video bandwidth is made narrower than the resolution bandwidth, the displayed amplitude of the responses decreases.

card reader

See memory card.

characteristics

Non-guaranteed operating information in the form of typical, nominal, or approximate values for spectrum analyzer performance.

character set

The set of symbols which normally include both alpha and numerics, plus punctuation or any other symbol which may be read, stored, or written and used for organization, control, or representation of data.

CFR

The abbreviation for the Code of Federal Regulations.

CISPR

The acronym for *Comité International Spécial des Perturbations Radio-électriques* (International Special Committee on Radio Interference) or the International Commercial EMC Advisory Committee.

clear-write mode

An analyzer function that zeros specified trace A, B, or C memory, then updates the trace memory with each new sweep. The contents of trace memory are written to the display at a flicker free rate.

conducted emissions
Unwanted signals coupled onto power or signal lines by a particular device.

command
A set of instructions that are translated into instrument actions. The actions are usually made up of individual steps that together can execute an operation. Generally, for spectrum analyzers it is a sequence of code that controls some operation. These codes can be keyed in via a controller or computer. Refer also to **function**.

continuous-sweep mode
The analyzer condition where traces are automatically updated each time trigger conditions are met.

correction factors
Error coefficients stored in memory during the process of self calibration. These coefficients are calculated into other measurements to minimize circuitry errors. This factor is the product of the ratio and phase-angle correction factors for the existing conditions of operation.

current probe
A magnetic-field sensor that is clamped around power lines to sense conducted emissions. It is the transducer for most MIL-STD conducted-emissions testing. The voltage at the output of the probe is proportional to the power-line current and affected by probe characteristics. Probe characteristics are provided by the manufacturer in the form of transfer impedance, Z, which varies as a function of frequency. The equation below illustrates how probe characteristics may be stated:

$$Z(dB\Omega) = V(dB\mu V) - I(dB\mu A)$$

data line
The area on a screen where user-selected characters are displayed. These characters are selected from the front-panel keys or with a remote controller. Refer also to **title area**.

debug mode

A term specific to HP 70000 modular measurement systems. In debug mode, (available only in the local oscillator module) faulty commands are displayed as they are executed. When a faulty command is encountered, operation of the program or user-defined function stops. The last character(s) displayed at the right end of the command line is responsible for the faulty command.

default

The preset conditions, options, or parameters of an instrument. In some instances, the default state may be changed by choosing key selections or writing programming commands to use other conditions.

delta marker

An analyzer mode in which a fixed reference marker is established, and a second marker becomes active and can be placed anywhere along the trace. A readout indicates the relative frequency separation and amplitude difference between the reference and active markers.

digital display

A mode in which trace (analog video) information is digitized and stored in memory, prior to being displayed. The displayed trace is a series of points. The number of points is a function of the particular analyzer. HP analyzers draw vectors between the points to present a continuous looking trace. The number of stored data points is a function of the particular analyzer. The displayed information is refreshed (old data points are replaced with new data points stored in memory) at a flicker-free rate. The data in memory is updated at the sweep rate of the analyzer. Refer also to raster display and vector display.

display detector mode

The manner in which analog video information is processed prior to being digitized and stored in memory. Refer also to negative peak, positive peak, quasi-peak detector, Rosenfell,

and sample.

display dynamic range

The maximum dynamic range over which both a large and small signal can be viewed simultaneously on the display. For most analyzers, the actual dynamic range may be greater than the display dynamic range. Refer also to dynamic range.

display fidelity

The measurement uncertainty of relative differences in amplitude on a spectrum analyzer display. On purely analog analyzers (those analyzers that write the video signal directly onto the screen), these differences are displayed on the screen and the graticule is used to evaluate the measurement. Many analyzers with digital displays (refer to digital display) have markers that can be used to measure the signal. As a result, measurement differences are taken from stored date, and the ambiguity factor of the display is reduced. Refer also to **scale fidelity**.

display range

The calibrated range of the display for a particular display mode or scale factor. Refer also to **linear display**, **log display**, and **scale factor**.

display units

The range of amplitude values that trace memory can take on, and varies from analyzer to analyzer.

displayed average noise level

The noise level viewed on the analyzer's display after narrowing the video bandwidth setting enough to reduce the peak-to-peak noise fluctuations so the trace is often a straight line. Usually this term refers to the analyzer's own internally generated noise as a measure of sensitivity. It is typically specified in dBm under conditions of minimum resolution bandwidth and minimum input attenuation.

DLP

The abbreviation for downloadable program. A single programming command or a sequence of programming commands used to perform specific operations. DLPs can be made up of several functions, variables, and traces defined by the program creator. A DLP is generally created in a computer, then stored (downloaded into) in the spectrum analyzer RAM or EEPROM. Once downloaded, the DLP can be executed without a computer or controller.

DOC

The abbreviation for the Department of Communications.

drift

The slow (relative to sweep time) change of signal position on the display as a result of a change in local-oscillator frequency versus sweep voltage.

While periodic tuning may be needed to correct drift, drift does not impair frequency resolution.

dynamic range

The ratio, in dB, that can be measured with some degree of accuracy between the smallest and largest signals simultaneously present at the input of an analyzer. Absolute statements of dynamic range should be accompanied by which performance parameters were used to calculate the dynamic range. Some of these parameters include spurious responses, gain compression, displayed average noise level, and third order intermodulation distortion (TOI distortion). For example, spurious response-free dynamic range refers to the range of spurious products that can be observed and guaranteed not to have been generated in the analyzer. TOI distortion-free dynamic range is the signal-to-noise ratio of an input signal whose TOI-distortion product level is equal to the displayed average noise level.

electric field strength

The magnitude of an electric field (E), commonly expressed in volts per meter (V/m), or dB above a microvolt per meter (dBμV/m).

EMC

The abbreviation for electromagnetic compatibility. EMC is a condition of equipment tolerance to external electrical and magnetic fields.

EMI

The abbreviation for electromagnetic interference. An EMI measurement determines the degree to which potentially offending, undesirable signals emanate from a device.

envelope

The boundary of the family of curves obtained by varying a parameter (usually amplitude) of an incoming wave. Another wave made up of the instantaneous values of an incoming RF signal. The boundary wave indicates the variation in amplitude of the original family of curves (the RF signal).

envelope detector

A detector circuit whose output follows the envelope, but not the instantaneous variation of its input signal. This detector is sometimes called a peak detector. In superheterodyne spectrum analyzers, the input to the envelope detector comes from the final IF, and the output is a video signal. With the spectrum analyzer in zero span, the envelope detector demodulates the input signal, allowing the modulating signal to be viewed as a function of time on the display.

error message

A message displayed on the screen indicating missing or failed hardware, improper user operation, or other conditions that require additional attention. Generally, the requested action or operation cannot be completed until the condition is resolved.

external mixer

An independent mixer, usually having a waveguide input port, used to extend the frequency range of those spectrum analyzers designed to use them. The analyzer provides the local oscillator signal and mixer bias (if needed), and the mixing products are returned to the analyzer's IF input.

far field

An electromagnetic field at a sufficient distance from an emitter so that the wave front is, for all practical purposes, a plane (that is, has little or no curvature). In the far field, the relationship between the electric and magnetic fields is governed by the transmission medium, not by the source of the radiation. In the far-field, the electric- and magnetic-field strengths are inversely proportional to the radial distance (r) from the source. The boundary between near and far fields is expressed with the following equation:

$$r \geq \lambda/2\pi, D << \lambda$$

$$r \geq D^2/2\lambda, D \geq \lambda$$

r = radial distance from the source to the boundary

D = maximum linear dimension of the radiator

λ = wavelength of radiation

FCC
The abbreviation for the Federal Communications Commission.

FFT
The abbreviation for fast Fourier transform. It is a mathematical operation performed on a time-domain signal to yield the individual spectral components that constitute the signal. Refer also to **spectrum**.

firmkey
Keys displayed on the CRT that remain constant throughout a specific analyzer operation. Refer also to **front-panel key** or **softkey**.

firmware
Instruction code that is integrated with the hardware to form a functional set that cannot be altered during normal operation. The instruction code, permanently installed in the circuitry of the instrument, is classified as ROM (read-only memory). Firmware determines the functional characteristics, as opposed to the electrical characteristics, of the instrument or equipment. Each firmware version is identified by a revision code number, or date code.

firmware date code
Indicates which revision of firmware (instrument software or ROM) resides in memory.

flatness
The displayed amplitude variation over a specified frequency range. Flatness of ±1 dB indicates that maximum and minimum values of the analyzer's amplitude response are at most 2 dB apart. Flatness is also called relative flatness for some analyzers. Refer also to **frequency response**.

frequency accuracy
The uncertainty with which the frequency of a signal or spectral component is indicated, either in an absolute sense or relative to some other signal or spectral component. Absolute and relative frequency accuracies are specified independently.

frequency range
The range of frequencies over which the spectrum analyzer performance is specified. The maximum frequency range of many microwave analyzers can be extended by using external mixers.

frequency resolution

The ability of a spectrum analyzer to separate closely spaced spectral components and display them individually. Resolution of equal amplitude components is determined by resolution bandwidth. Resolution of unequal amplitude signals is determined by resolution bandwidth and bandwidth selectivity. Refer also **resolution bandwidth** and **shape factor**.

frequency response

The peak variation in the displayed signal amplitude over a specified center frequency range. Frequency response is typically specified in terms of ±dB relative to the value midway between the extremes. It also may be specified relative to the calibrator signal. In some analyzers, this term is called absolute frequency response. Refer also to **flatness**.

frequency span

The frequency range represented by the horizontal axis of the display. Generally, frequency span defines the total span across the full display. Some analyzers indicate frequency span (scan width) as a per-division value.

frequency stability

A general phrase that covers both short- and long-term local oscillator instability. The sweep ramp that tunes the local oscillator determines where a signal appears on the display. Any long-term variation in local oscillator frequency (drift) with respect to the sweep ramp causes a signal to shift its horizontal position on the display slowly. Shorter-term local oscillator instability can appear as random FM or phase noise on an otherwise stable signal.

front-panel key

Typically, labeled keys that are located on an instrument's front panel. The key labels identify the function the key activates. Numeric keys and step keys are examples of front-panel keys. Refer also to **softkey** or **firmkey**.

FTZ

The abbreviation for *Fernmeldetechnisches Zentralamt*. This is the part of the German post office that regulates EMI (electromatic interference).

full span

Depends upon the spectrum analyzer. Full span for some analyzers means a frequency span over the entire tuning range of the analyzer. Full span is a mode of operation in which the spectrum analyzer scans the entire frequency band of an analyzer.

function
The action or purpose which a specific item is intended to perform or serve. The spectrum analyzer contains functions that can be executed via front-panel key selections, or through programming commands.

gain compression
The signal level at the input mixer of a spectrum analyzer where the displayed amplitude of the signal is a specific number of dB too low, due only to mixer saturation. The signal level specified is for 1 dB or 0.5 dB compression and usually between −3 dBm and −10 dBm.

hard copy
Information or data printed onto paper rather than being stored on disk or in the instrument's memory.

harmonic distortion
Undesired frequency components added to signals as a result of nonlinear behavior of the device (for example, a mixer or an amplifier) through which signals pass. These unwanted components are harmonically related to the original signal.

harmonic mixing
The utilization of local oscillator harmonics generated in a mixer to extend the tuning range of a spectrum analyzer beyond the range achievable using just the local oscillator fundamental. The mathematical algorithm is:

$$F_{IN} = N \times F_{LO} \pm F_{IF}$$

heterodyne
The process of a high-frequency wave reception into a nonlinear device that mixes the incoming wave with a locally generated wave to provide an output having frequencies equal to the sum and the difference of the combined frequencies.

HP-IB
The abbreviation for Hewlett-Packard Interface Bus. It is Hewlett-Packard's implementation of IEEE-488 (*Standard Digital Interface for Programmable Instrumentation*). Hewlett-Packard uses a parallel

interface that allows you to "daisy-chain" more than one device to a port on a computer or instrument.

IEC
The abbreviation for the International Electrotechnical Commission. IEC is a commission that deals with electromagnetic compatibility as related to television transmission. (The French name is *Commision Electrotechnique Internationale* (CEI)).

IF
The abbreviation for intermediate frequency. A frequency to which a signal wave is shifted locally as an intermediate step in transmission or reception. On spectrum analyzers, this is the frequency resulting from conversion before demodulation.

IF gain/IF attenuation
A control that adjusts the vertical position of displayed signals without affecting the signal level at the input mixer. When changed, the value of the reference level is changed accordingly.

IF feedthrough
A condition that results in a rise in amplitude of the baseline trace. This occurs as a result of an input signal at the intermediate frequency (IF) passing through the input mixer. This a potential problem on nonpreselected spectrum analyzers. The entire baseline trace rises because the signal is always at the IF. (Mixing with the local oscillator is not required.)

image response
A displayed signal that is actually twice the intermediate frequency (IF) away from the frequency indicated by the spectrum analyzer. For each harmonic of the local oscillator there is an image pair. One is below the local oscillator frequency by the IF and the other is above. Images are most obvious on nonpreselected spectrum analyzers. On preselected spectrum analyzers, the image responses are often attenuated.

impedance
The apparent opposition to the flow of current in an electrical path, or the ratio of the applied input voltage to the input current. The specified nominal input impedance of a spectrum analyzer is stated for the input connector. The most common impedance for RF and microwave spectrum analyzers is 50Ω. However, 75Ω is typically used for cable television work.

impulse bandwidth

The width of a rectangular, linear-phase filter that has the same peak-voltage output as the actual analyzer filter. The impulse bandwidth of the synchronously-tuned, Gaussian-like resolution filters in Hewlett-Packard spectrum analyzers is approximately 1.6 times the 3 dB bandwidth.

incidental FM

Undesired frequency modulation on the output of a device (for example a signal source or an amplifier) caused by, or incidental to, some other form of modulation, such as amplitude modulation.

input attenuator

An attenuator between the input connector and the first mixer of a spectrum analyzer (also called an RF attenuator). The input attenuator is used to adjust the signal level incident on the first mixer in order to prevent gain compression due to high-level or broadband signals. It is also used to set the dynamic range by controlling the degree of internally-generated distortion.

input impedance

The terminating impedance that the analyzer presents to the signal source. The nominal impedance for RF and microwave analyzers is usually 50 Ω. For some systems, such as cable TV, 75Ω is standard. The degree of mismatch between the nominal and actual input impedance is specified in terms of VSWR (voltage standing wave ratio). Refer also to **VSWR**.

interface

The place at which independent systems meet and interact. An operator's interaction with an instrument might occur at a keyboard. The keyboard then serves as part of the interface.

intermodulation distortion

Undesired frequency components resulting from the interaction of two or more spectral components passing through a device having nonlinear behavior, such as a mixer or an amplifier. The undesired components are related to the fundamental components by sums and differences of the fundamentals and various harmonics. Distortion products from intermodulation of frequencies f_1 and f_2 can occur at the frequencies derived from the following equation:

$$f_1 \pm f_2, 2 \times f_1 \pm f_2, 2 \times f_2 \pm f_1, 3 \times f_1 \pm 2 \times f_2, \text{ and so on}$$

limit line

A series of line segments, positioned according to frequency and amplitude within the spectrum analyzer's measurement range. Two defined limit lines may be displayed simultaneously. One sets an upper test limit, the other sets a lower test limit. Trace data can be compared with limit lines as the spectrum analyzer sweeps. If the trace data falls outside of the range between the upper and lower limits, the spectrum analyzer displays a message or sounds a warning, indicating that the trace failed the test limits.

limit-line file

The user-memory file that contains the limit-line table entries. Limit lines are composed of frequency and amplitude components that make up a trace array, and this data is stored in the file. Refer also to **limit line**.

limit-line table

A table of frequency and amplitude values that describe a limit line. The table can be stored, recalled, edited and so forth. Refer also to **limit line**.

linear display

The display mode in which vertical deflection on the screen is directly proportional to the voltage of the input signal. The bottom line of the graticule represents 0 V; the top line, the reference level, is a non-zero value. Analyzers with microprocessors allow reference level and marker values to be indicated in dBm, dBmV, dBμV, volts, and in some cases, watts.

linear input level

The maximum input-signal level where gain compression does not occur. Refer also to **gain compression**.

LISN
The acronym for line impedance stabilization network. Also called artificial mains network. This network provides low-pass filtering of the primary (mains) power before directing the power to a device under test (DUT). It capacitively couples power-line emissions from the DUT to the EMI receiver. The input impedance (50Ω) of the receiver determines the load impedance for the emissions signals.

LO
The abbreviation for local oscillator. The local-oscillator output in a superheterodyne system is mixed with the received signal to produce a sum or difference equal to the intermediate frequency (IF) of the receiver. Refer also to IF.

LO feedthrough
The response that occurs on a spectrum analyzer's CRT when the first local-oscillator frequency is equal to the first IF. LO feedthrough occurs when the analyzer is tuned to 0 Hz, thus it is a 0 Hz marker with no error. As a result it can be used to improve the frequency accuracy of spectrum analyzers with nonsynthesized LO systems.

LO emission or feedout
The presence of the local-oscillator signal at the input of a spectrum analyzer. The level can be greater than 0 dBm on nonpreselected spectrum analyzers, but it is usually less than −70 dBm on preselected spectrum analyzers.

log display
The display mode in which vertical deflection is a logarithmic function of the input-signal voltage. The display calibration is set by selecting the value of the top graticule line (reference level) and scale factor in dB per division. On many Hewlett-Packard analyzers, the bottom graticule line represents zero volts for scale factors of 10 dB/division or more. The bottom division, therefore, is not calibrated for those analyzers. Analyzers with microprocessors allow reference level and marker values to be indicated in dBm, dBmV, dBμV, volts, and occasionally in watts. Nonmicroprocessor-based analyzers usually offer only one kind of unit, typically dBm.

magnetic field strength

The magnitude of a magnetic (H) field expressed in amperes per meter (A/m). Under far-field conditions, electric and magnetic fields are related by the impedance (377Ω) of free space:

$$H = \frac{E}{377\Omega}$$

marker

A visual indicator that can be placed anywhere along the displayed trace. A marker readout indicates the absolute value of the trace frequency and amplitude at the marked point. The amplitude value is displayed with the currently selected units. Refer also to **delta marker** and **noise marker**.

mask

A predefined set of frequency and amplitude coordinates used to evaluate whether incoming pulses meet regulatory requirements. Masks can also be created to evaluate spurious or transient signal pulses.

maximum input level

The maximum, safe signal power that can be applied safely to the input of a spectrum analyzer. Typically 1 W (+30 dBm) for Hewlett-Packard spectrum analyzers, depending on the setting of the input attenuator.

measurement bandwidth

The resolution bandwidth required for a specific measurement. For MIL-STD measurements, the resolution bandwidth is often determined by the tester with the approval of the contracting agency.

For commercial EMI testing the measurement bandwidths required usually follow the recommendations of C.I.S.P.R.:

Band A (10 kHz to 150 kHz): 200 Hz

Band B (150 kHz to 30 MHz): 9 kHz

Band C and D (30 MHz to 1 GHz): 120 kHz

measurement range

The ratio, expressed in dB, of the maximum signal level that can be measured (usually the maximum safe input level) to the lowest achievable average noise level. This ratio is almost always much greater than can be realized in a single analyzer setting. Refer also to **dynamic range**.

memory

The capacity of an analyzer to store information that is subject to recall. The memory is the location where such data is stored. See also RAM and ROM.

memory card

A small, credit-card-shaped memory device that can store data or programs. The programs sometimes have measurement personalities, which give additional capabilities to an instrument. Refer also to personality, RAM cards, and ROM cards.

menu

Spectrum-analyzer functions displayed with labels in groups on the display. These functions can be activated by pressing front-panel keys or softkeys. A softkey may select yet another menu. Refer also to softkey or firmkey.

mixing mode

A description of the particular signal combinations that create a given response on a spectrum analyzer. The mixing mode, such as 1^+, indicates the harmonic of the local oscillator used in the mixing process, and whether the input signal is above or below that harmonic.

multiple responses

Two or more responses on a spectrum-analyzer display from a single input signal. Multiple responses occur only when mixing modes overlap and the local oscillator is swept over a wide enough range to allow the input signal to mix on more than one mixing mode. Normally, multiple responses are greatly attenuated in preselected analyzers.

narrowband response

The condition in which the displayed amplitude results from a signal made up of only one spectral component. This condition occurs for continuous wave signals and repetitive signals whose repetition rate is greater than about twice the resolution bandwidth of the analyzer. Note that a signal can have a spread spectrum and still be viewed in the narrowband mode on the spectrum analyzer. The same checks that were listed under **broadband response** are used here but with different results:

- Change the frequency span. The indicated frequency separation of the components remains unchanged.
- Change the resolution bandwidth. The amplitude of the components does not change (as long as the bandwidth remains narrow relative to the separation of the responses).
- Change the sweep time. The separation of the components is independent of sweep time.
- Change the video bandwidth. The amplitude of the components is unaffected.

near field

The electromagnetic field sufficiently close to a radiating source such that the relationship between the electric and magnetic fields is governed by the radiating source. In this area the electric (E) field and magnetic (H) field components vary inversely with r (radial distance from source) and with powers of r. Near field conditions can be expressed with the following equations:

$$point = \frac{r \leq \lambda}{2\pi}$$

$$arrays = \frac{D^2}{2\lambda}$$

negative peak

The minimum value of a video signal which represents the envelope of the signal. On digital displays set to the negative-peak detection mode, each displayed point of the video signal indicates the minimum value of the signal for that part of the frequency span or time interval represented by the point.

noise figure

The amount by which the noise of a device exceeds the theoretical minimum. More exactly, the ratio, usually expressed in dB, of the signal-to-noise ratio at the input of a device (mixer, amplifier, and so on) to the signal-to-noise ratio at the output of the device.

$$noise\ figure\ = S/N_{OUT} - S/N_{IN} - GAIN\ for\ an\ amplifier$$

noise marker

A marker whose readout represents the noise density (or rather the noise level) in a 1 Hz noise power bandwidth. When the noise marker is selected, the sample display detection mode is activated, the values of a number of consecutive trace points about the marker (the number depends on the type of analyzer) are averaged, and this average value is normalized to an equivalent value in a 1 Hz noise power bandwidth. The normalization process accounts for the effects of the detection and bandwidth and often the effect of the log amplifier when we select the log-display mode.

noise sidebands

Modulation sidebands that indicate the short-term instability of the local-oscillator (primarily the first local oscillator) system of a spectrum analyzer. The modulating signal is noise in the local-oscillator circuit itself or in the local-oscillator stabilizing circuit, and the sidebands comprise a noise spectrum. The mixing process transfers any local-oscillator instability to the mixing products, so the noise sidebands appear on any spectral component displayed on the analyzer far enough above the broadband noise floor. Because the sidebands are noise, their level relative to a spectral component is a function of resolution bandwidth. Noise sidebands are typically specified in terms of dBc/Hz (amplitude in a 1 Hz bandwidth relative to the carrier) at a given offset from the carrier, the carrier being a spectral component viewed on the display. The noise sidebands can reduce the analyzer's ability to resolve signals occurring close to larger signals.

nonvolatile memory

Memory that is retained in the absence of an ac power source. This memory is typically retained with a battery. Refer also to battery-backed RAM.

normal detection mode

The default detection mode for most digital-display spectrum analyzers. This mode uses the rosenfell algorithm to simulate analog display noise and signal responses, while allowing the advantages of a digital display. The rosenfell algorithm determines whether a video signal point is noise or signal for that part of the frequency span or time interval. Either the maximum or minimum video signal of that interval is displayed accordingly. Refer also to rosenfell, positive peak, negative peak, and sample mode.

operating system

A group of programs that control the general operation of a computer and its peripherals. The operating system assigns memory space, schedules jobs, and controls input and output.

parameter units

Standard units of measure, which include the following:

Measured Parameter	Unit Name	Unit Abbreviation
frequency	hertz	Hz
power level	decibel (relative to 1 milliwatt)	dBm
power ratio	decibel	dB
voltage	volt	V
time	second	s (sec)
electrical current	ampere	A
impedance (resistance)	ohm	Ω

peak-detection mode

For analyzers with digital displays, the display detection mode in which each displayed point indicates the maximum value of the video signal for that part of the frequency span or time interval represented by the point.

peak detector

A detector that follows the peak of the IF signal applied to it. The standard detector for a spectrum analyzer with only one detection mode is a peak detector (envelope detector). MIL-STD EMI measurements usually call for positive peak detection. Refer also to quasi-peak detector and envelope detector.

personality
Applications software on a memory card or other electronic media that are downloaded into analyzer RAM. The software directs spectrum analyzer operation so that complex measurements are initiated with front-panel selections and completed without connections to an external computer. Personalities can be designed to automate or simplify instrument operation. Examples include digital radio personalities and cable television personalities.

phase lock
The action that causes a local oscillator or periodic generator to operate at a constant phase angle relative to a reference signal source.

phase noise
Refer to noise sidebands.

positive peak
For analyzers with digital displays, the display detection mode in which each displayed point indicates the maximum value of the video signal for that part of the frequency span or the time interval represented by the point.

preamplifier
A low-noise-figure amplifier that improves system (preamplifier/spectrum analyzer) sensitivity over that of the analyzer itself.

predefined trace
One of the multiple (usually two or three) available traces of a spectrum analyzer. Refer also to trace.

preselector
A tunable bandpass filter placed ahead the input mixer of a spectrum analyzer. It tracks the appropriate mixing mode and passes signals of the desired frequency and reduces others. Preselectors are typically used only above 2 to 3 GHz, depending on the spectrum analyzer model. They greatly reduce multiple and image responses and, for certain signal conditions, improve dynamic range.

quasi-peak detector
A detector circuit designed with time constants that give a weighted value to the indicated amplitude of a broadband signal. The displayed signal output is an indication of the degree to which the detected signal would impair the intelligibility of a desired signal. The time constants (rise, fall, average) for EMI purposes are based on the recommendations of CISPR. that are in turn based on subjective tests. Interference limits for commercial EMC tests are often given in quasi-peak values.

query
A spectrum-analyzer programming command having the distinct function of initializing a response. These commands typically end with a question mark (?). Query commands return information to the operator.

radiated emissions
Electromagnetic energy emanating from a device and propagating through space, that is it simulates analog meter movement. This term is frequently used with EMC testing.

RAM cards
A software device used to contain software programs for downloading into a spectrum analyzer. RAM cards provide battery backed memory. If the battery is removed the data is lost. RAM cards can be written to or from. Refer also to personality and ROM cards.

random-access memory
RAM (random-access memory) or read-write memory. A storage area allowing access to any of its storage locations. Data can be written to or retrieved from RAM, but data storage is only temporary. User-generated information appearing on a display is typically RAM data. When source power is completely removed, the information disappears. Battery-backed RAM data is lost if the battery is removed for greater than a specified length of time.

raster display
A video display that sweeps a beam through a fixed pattern, building up an image with a matrix of points. A television-like display in which the image is formed by scanning the electron beam rapidly across and slowly down the CRT face and gating the beam on or off as appropriate. The scanning rates are fast enough to produce a flicker-free display. Refer also to vector display and sweep time.

read-only memory
ROM (read-only-memory) is the area in the analyzer that contains the analyzer's operation instructions (code). This memory cannot be changed. The data can be accessed (read), but not altered by the user.

reference level
The calibrated vertical position on the display used as a reference for amplitude measurement. The reference-level position is normally the top line of the graticule. On some analyzers, it can be set anywhere on the display with front panel keys or remote commands. Refer also to scale factor.

relative amplitude accuracy
The uncertainty of an amplitude measurement in which the amplitude of one signal is compared with the amplitude of another, regardless of the absolute amplitude of either. Distortion measurements are relative measurements. Contributors to uncertainty can include frequency response and scale fidelity and changes of input attenuation, IF gain, scale factor, switching uncertainty, and resolution bandwidth.

relative-marker mode
See delta marker.

reserved memory
An area used to store measurement results (trace A, B, or C), configuration information, correction factors, and selections made with front-panel keys or programming commands. For example, the limit-line table contents are stored in reserved memory as well as the currently active key menu.

residual FM
The inherent short-term frequency instability of an oscillator in the absence of any other modulation. In the case of spectrum analyzers, the definition is usually expanded to include the case where the local oscillator is swept. Residual FM is usually specified in peak-to-peak values, because they are most easily measured on the display, if they are visible at all.

residual responses
Discrete responses seen on a spectrum-analyzer display although no input signal is applied.

resolution

Refer to frequency resolution.

resolution bandwidth

The width of the resolution bandwidth (IF) filter of a spectrum analyzer at some level below the minimum insertion-loss point (maximum deflection point on the display).

RFI

The abbreviation for radio-frequency interference. RFI is the impairment of a desired radio signal by an electromagnetic disturbance.

rosenfell detection mode

For digital displays, this is the display detection technique in which the value displayed at each point on a trace is based upon whether or not the video signal both rose and fell during the frequency or time interval represented by the point. If the video signal only rose or only fell, the video signal is probably not that of noise, and the maximum value is displayed. If the video signal both rose and fell, the video signal is probably a noise signal. Therefore, the maximum value during the interval is displayed by odd-numbered points, and the minimum value by even-numbered points. To prevent the loss of a signal occurring during an even-numbered interval, the maximum value of the signal during this interval is preserved. At the next (odd-numbered) interval, the value displayed is the greater of the value carried over or the maximum that occurs during the current interval. Refer also to normal detection mode.

sample detection mode

For digital displays, the display detection mode in which the value displayed at each point is the instantaneous value of an incoming video signal at the end of the frequency span or time interval represented by the point.

scale factor

The per-division calibration of the vertical axis of the display.

scan (frequency span) accuracy

The uncertainty of the indicated frequency separation of any two signals on the display. The measured accuracy of the horizontal axis of the analyzer display. When two horizontal points are set with analyzer controls, then measured, the linearity is the visually calculated error between the two displayed points compared with the analyzer settings.

sensitivity
The level of the smallest signal that can be observed on a spectrum analyzer, usually under optimized conditions of minimum resolution bandwidth, 0 dB input attenuation, and minimum video bandwidth. Hewlett-Packard defines sensitivity as the displayed average noise level.

serial prefix
Characters appearing on a serial number label that identifies an instrument. The first four characters (usually numbers) of the prefix identify the particular hardware in each model number. The fifth character (usually alpha) identifies the country in which the unit was manufacturered. Refer also to **firmware**.

shape factor
Refer to **bandwidth selectivity**.

signal resolution
The ability of the spectrum analyzer to resolve two separate input signals. Closely-spaced signals are more difficult to resolve than signals spaced far apart. Refer also to **resolution bandwidth** and **shape factor**.

signal identification
A routine, either manual or automatic, that identifies whether or not a particular response on the spectrum analyzer's display is from the mixing mode for which the display is calibrated. If the routine is automatic, the analyzer's tuning may change to show the signal in the correct mixing mode, or the analyzer may indicate the signal's frequency. The analyzer may then allow the option of ignoring the signal or having the analyzer tune itself properly for the signal. This operation is not generally needed for preselected spectrum analyzers.

single-sweep mode
That mode in which the spectrum analyzer sweeps once when trigger conditions are met. Each sweep is enabled (allowed to reoccur when trigger conditions are met) by pressing an appropriate front-panel key, or by sending a programming command.

sinusoid
A wave whose amplitude is proportional to the sine (or cosine) of an angle that is a linear function of time.

softkey
Keys whose labels, and functions, change as the result of key presses. Softkey labels are displayed on the screen or monitor. Softkey selections usually evoke menus that are written into the instrument software. Front-panel key selections determine which menu (set of softkeys) appears on the display.

span
Span equals the stop frequency minus the start frequency. The span setting determines the horizontal-axis scale of the spectrum-analyzer display. Refer also to frequency span.

span accuracy
The uncertainty of the indicated frequency separation of any two signals on the display.

specifications
Warranted operating performance. Spectrum analyzers are guaranteed to meet certain operating conditions. These conditions are typically listed in a table.

spectral purity
Refer to noise sidebands.

spectral component
One of the sine waves comprising a spectrum.

spectrum
An array of sine waves differing in frequency, phase, and amplitude. Such an array completely determines a signal, such that a time-domain signal can be converted (mathematically) to a spectrum, and a spectrum can be converted to a time domain signal. Most spectrum analyzers do not measure the phase of the spectrum, only the amplitude and frequency components. The amplitude spectrum cannot be restored to a time-domain signal without the phase information.

spectrum analyzer

A device that effectively performs a Fourier transform and displays, in the frequency domain, individual spectral components (sine waves) that constitute a time-domain signal. Spectrum analyzers typically display the power distribution of an incoming signal as a function of frequency. The characteristics of electrical waveforms can be analyzed since the frequency range of interest is swept repeatedly allowing the components of the signal to be displayed. Refer also to spectrum.

spurious response

The undesired responses that appear on a spectrum-analyzer display as a result of the input signal. Internally generated distortion products are spurious responses, as are image and multiple responses.

start/stop frequency

The start and stop points of the frequency span range. On microprocessor-controlled analyzers, start and stop frequencies may be set independently.

state-register

The area of user memory in the analyzer where analyzer settings are stored.

step key

A key used to create an increment of change in an active analyzer setting. The front-panel (▲) and (▼) are called step keys.

stimulus-response mode

The operating state that allows a spectrum analyzer to make measurements similar to those of a network-analysis measurement system. Spectrum analyzers with this ability use tracking-generator functions. The tracking generator may be an external instrument (stand-alone tracking generators) or designed into the analyzer hardware. Measurement results are displayed in a relative-amplitude scale resulting from a variation, plus or minus, from a reference (normalized) value stored in a trace.

sweep time
The time it takes the local oscillator to tune across the selected span. Sweep time directly affects how long it takes to complete a measurement. It does not include the dead time between the completion of one sweep and the start of the next. It is the function of frequency span, resolution bandwidth, and video bandwidth.

syntax
The grammar rules that specify how commands must be structured for an operating system, programming language, or application.

test limit
The acceptable results for any given measurement.

title area
Refer to data line.

trace
The displayed measurement results across the selected frequency span. On digital displays, a trace is made up of a series of points. The number of independent traces is specific to a particular analyzer.

trace elements
Describe the location of a point along the horizontal axis of a trace. Position unit values of a trace begin on the left-hand side of the graticule and increase to a predefined value (specific to the spectrum analyzer model) on the right-hand side of the graticule.

transducer
A device that receives a signal in the form of one type of energy and converts it to a signal in another form. An antenna is an example of a transducer.

transfer impedance

Ratio of the voltage output from a current probe to the current through a wire enclosed by the probe. Commonly expressed in decibels referenced to 1Ω (dBΩ). The equation below illustrates how the transfer impedance of a probe can be stated for typical measurement units. Refer also to current probe.

$$Z\,(dB\Omega) = V\,(dB\mu V) - I\,(dB\mu A)$$

I = current through the wire (expressed in decibels, referenced to 1 μV (dBμV))
V = probe output voltage
Z = transfer impedance of the probe

UNCAL

A displayed prompt that indicates an uncalibrated measurement condition exists. It appears when instrument settings affect the accuracy of measurement results to the extent that they no longer meet some specifications.

UNCOR

A displayed prompt that indicates an uncorrected measurement condition exists. It appears when correction factors are not applied to measurement results. Making measurements while UNCOR is displayed could result in measurements not meeting specifications.

units

Dimensions on the measured quantities. Units usually refer to amplitude quantities because they can be changed. In spectrum analyzers with microprocessors, available units are dBm (dB relative to 1 milliwatt, dissipated in the nominal input impedance of the analyzer), dBmV (dB relative to 1 millivolt), dBμV (dB relative to 1 μV), volts, and in some analyzers, watts.

update

To make existing information current; to bring information up to date.

upgrade

To improve the quality or extend the capability of an instrument or product. Enhancements to upgrade a product. These enhancements can then be documented in an update package.

variable persistence
A property of the display that allows the adjustment of the trace-fade rate which is created by the display's electron beam. It is a capability of purely analog displays which provides flicker-free trace display regardless of sweep time.

VDE
The abbreviation for *Verband Deutscher Electrotechniker*, a nongovernment body that prepares standards and performs EMI certification testing. VDE standards are the basis for most FTZ regulations. Refer also to FTZ and EMI.

vector display
A cathode-ray tube that moves the electron beam so that it draws a figure on the screen. The image (consisting of trace, graticule, and annotation) is written directly as a series of lines onto the display screen. It is not created from a series of dots as with the raster display.

video
A term describing the output of a spectrum analyzer's envelope detector. The frequency range extends from 0 Hz to a frequency that is typically well beyond the widest resolution bandwidth available in the analyzer. However, the ultimate bandwidth of the video chain is determined by the setting of the video filter.

video amplifier
A post-detection, dc-coupled amplifier that drives the vertical deflection plates of the display. Refer also to video bandwidth and video filter.

video average
The digital averaging of spectrum-analyzer trace information. It is available only on analyzers with digital displays. Each point on the display is averaged independently, and the average is computed based on the number of sweeps selected by the user. The averaging algorithm applies a factor to the amplitude value of a given point on the current sweep ($1/n$, where n is the number of the current sweep); applies another factor to the previously stored average [$(n - 1)/n$]; and combines the two for a current average. After the designated number of sweeps are completed, the factors remain constant, and the display becomes a running average.

video bandwidth

The cut-off frequency (3 dB point) of an adjustable low-pass filter in the video circuit. When the video bandwidth is equal to or less than the resolution bandwidth, the video circuit cannot fully respond to the more rapid fluctuations of the output of the envelope detector. The result is a smoothing of the trace, or a reduction in the peak-to-peak excursion, of broadband signals such as noise and pulsed RF when viewed in broadband mode. The degree of averaging or smoothing is a function of the ratio of the video bandwidth to the resolution bandwidth.

video filter

A post-detection, low-pass filter that determines the bandwidth of the video amplifier. It is used to average or smooth a trace. Refer also to video bandwidth.

VSWR

The abbreviation for voltage standing wave ratio. This is the ratio of maximum amplitude to the minimum amplitude of corresponding components of the field (or voltage or current) appearing along the transmission path in the direction of propagation. The standing wave ratio in a uniform transmission line is calculated with the following formula:

$$\frac{1+\rho}{1-\rho}(where\ \rho\ is\ the\ reflection\ coefficient)$$

zero span

The case in which a spectrum analyzer's local oscillator remains fixed at a given frequency so that the analyzer becomes a fixed-tuned receiver. In this state, the bandwidth is equal to the resolution bandwidth. Signal-amplitude variations are displayed as a function of time. To avoid loss of signal information, the resolution bandwidth must be as wide as the signal bandwidth. To avoid any smoothing, the video bandwidth must be set wider than the resolution bandwidth.

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