8568A
SPECTRUM ANALYZER
100 Hz to 1.5 GHz

volume 1

Section I
GENERAL INFORMATION

Section II
INSTALLATION
OPERATION VERIFICATION

Section III
OPERATION

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OUT OF PRINT
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CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

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ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

HEWLETT PACKARD

OPERATION AND SERVICE MANUAL

8568A
SPECTRUM ANALYZER
100 Hz to 1.5 GHz
(Including Options 001, 080, 081, 400, 907, 908, 909, and 910)

SERIAL NUMBERS

This manual applies directly to Model 8568A RF Sections with serial numbers prefixed 1839A and IF-Display Sections with serial numbers prefixed 1833A.

With changes described in Section VII (Volume 2), this manual also applies to RF Sections with serial numbers prefixed 1828A, 1824A, 1818A, 1812A, 1806A, 1803A, 1743A, 1740A, and 1721A and to IF-Display Sections with serial numbers prefixed 1826A, 1823A, 1820A, 1811A, 1805A, 1745A, and 1721A.

For additional information about serial number coverage, refer to INSTRUMENTS COVERED BY MANUAL in Section I and MANUAL BACKDATING CHANGES in Section VII.

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MANUAL PART NO. Refer to following page.

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HP 8568A SPECTRUM ANALYZER
SERVICE DOCUMENTATION SUMMARY

The HP 8568A service documentation comprises several individual manuals. These manuals may be ordered individually or in combination as follows:

1)	Operating and Service Manual (includes items 2 and 3)	08568-90012
2)	Operation	08568-90002
3)	Remote Operation	08568-90003
4)	Operation Verification (includes tape cartridge and operation supplement)	08568-90011

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TABLES

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This Operating and Service manual contains information required to install, operate, test, adjust, and service the Hewlett-Packard Model 8568A Spectrum Analyzer. Figure 1-1 shows the instrument and accessories supplied. This section covers instrument indentification, description, options, accessories, specifications, and other basic information.

1-3. This manual is divided into four volumes and nine sections as follows:

Volume 1

SECTION I, GENERAL INFORMATION; contains the instrument description and specifications, explains accessories and options, and lists recommended test equipment.

SECTION II, INSTALLATION AND OPERATION VERIFICATION; contains information concerning initial mechanical inspection, verification of electrical operation, preparation for use, operating environment, and packing and shipping.

SECTION III, OPERATION; contains detailed operating instructions for both manual front-panel and HP-IB remote operation and information.

Volume 2

SECTION IV, PERFORMANCE TESTS; contains the necessary tests to verify that the electrical operation of the instrument is in accordance with published specifications.

SECTION V, ADJUSTMENTS; contains the necessary adjustment procedures to properly adjust the instrument after repair.

SECTION VI, REPLACEABLE PARTS; contains the information necessary to order parts and/or assemblies for the instrument.

SECTION VII, MANUAL BACKDATING CHANGES; contains backdating information to make this manual compatible with earlier equipment configurations.

Volume 3

SECTION VIII, IF-DISPLAY SECTION SERVICE; contains schematic diagrams, block diagrams, component location illustrations, circuit description, repair procedures, and troubleshooting information for the IF-Display Section of the instrument.

Volume 4

SECTION IX, RF SECTION SERVICE; contains schematic diagrams, block diagrams, component location illustrations, circuit descriptions, repair procedures, and troubleshooting information for the RF Section of the instrument.

1-4. SPECIFICATIONS

1-5. Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument is tested. Table 1-2 lists supplemental characteristics. Supplemental characteristics are not specifications but are typical characteristics included as additional information for the user.

1-5a. KNOWN FIRMWARE "BUGS" (STANDARD INSTRUMENT)

1-5b. Manual Operation

1-5b-1. In frequency spans ⩽ 1 MHz (when the analyzer is phase-locked) the YTO UNLOCK Message is displayed on the CRT whenever the center frequency is changed from [X] [X] [ODD] [7] MHz to [X] [X] [ODD] [8] MHz using either the DATA control knob or the step keys. In other words between any frequency ending in 7 where the preceding digit is odd to any frequency ending in 8 where the preceding digit is odd. The first two digits are unimportant. For example, between 1017 MHz and 1018 MHz.

1-5b-2. If [FREQ COUNT] has been selected, counter frequency may be blanked when trace is placed in [VIEW] mode.

1-5b-3. Blanking both Trace A and Trace B when marker is in [FREQ COUNT] mode results in an incorrect counter frequency when either trace is placed in [CLEAR-WRITE] or [MAX HOLD]. This can be corrected by setting MARKER [OFF] then MARKER [NORMAL] then [FREQ COUNT]. Do not select [FREQ COUNT] alone without first turning MARKER OFF then ON again.

1-5b-4. If video averaging is activated when sweep mode is in single, operator must enter desired number of sweeps by pressing [SINGLE] the number of times indicated by the VID AVE #.

1-5b-5. Noise level rises when Center Frequency is "stepped" over 20 MHz boundaries (i.e. 17.5 MHz, 37.5 MHz, etc.).

1-5b-6. CRT frequency readout resolution in zero [FREQUENCY SPAN] is always 1 Hz even though accuracy is dependent on selected [RES BW].

1-5b-7. When [RECALL] [8] is selected with analyzer in LINEAR mode, "LINEAR" label on CRT is not completely erased. Displayed message is "L 1 dB/" and should be just "1 dB/".

1-5b-8. Minimum Reference Level in non-extended mode of 89.9 dB does not allow any range for error correction.

1-5b-9. [SAVE] [7] is allowed but will be written over at entry of next parameter change.

1-5b-10. [RECALL] [8] aborts the error correction function (if selected) but does not turn off the CRT CORR'D message.

1-5b-11. [SAVE] does not save some parameters which have been entered through shift keys, such as VID AVE # and counter resolution. States such as CORR'D, Preamp gains, and View C are not saved.

1-5b-12. HP-IB address can change on Power-On if controller is "talking" on bus before analyzer has completed IP routine. Controller should be held off for 5 sec at analyzer turn-on.

1-5b-13. Autozoom will not operate in single sweep mode.

1-5b-14. [MKR→ CF] causes a sweep, even when sweep is in single mode.

1-5b-15. [FREQ COUNT] and [MAX HOLD] can be selected at the same time. Care must be taken to ensure that the marker is positioned on the current response of the signal.

1-5b-16. [PEAK SEARCH] does not function on negative trace data.

1-5b-17. In [SIGNAL TRACK] mode, if [CENTER FREQUENCY] or Frequency Offset is set to 70.009 MHz, 80.008 MHz, or 90.007 MHz, the analyzer tunes to incorrect frequency.

1-5c. Remote Operation

1-5c-1. With sweep in [CONT] mode and video averaging selected, TS will cause the VID AVE # of sweeps to be taken before executing next command.

1-5c-2. There must be at least a 10 ms wait after an IFC before doing a serial poll.

1-5c-3. When in TALK and in LOCAL, the message KSP (HP-IB Address) and KSr (SRQ 102) will not appear until UNTALKED. The function itself has been executed, only the CRT message is delayed.

1-5c-4. When KSR has been performed, OT does not output the first digit of the first DAC number.

1-5c-5. With KSD selected and reference level in uV or nV units, the HP-IB output data is high by a factor of 10 if output format is 03.

1-5c-6. Outputting trace data (TA or TB) in user units (03) will cause the controller to hang up if any data point is equal to zero.

1-5c-7. When LN KSA LN is performed, the display units returns to dBm on the second LN entry.

1-5d. 8568A KNOWN FIRMWARE "BUGS" (OPTION 001-75Ω INPUT)

1-5e. Firmware Bug Number 1

1-5e-1. Symptoms. When 75Ω SIGNAL INPUT is selected and amplitude units are in voltage, all amplitude readouts (e.g. REF LEVEL, MARKER, etc.) will indicate 5.7 dB lower than actual signal level.

1-5e-2. Cause. Table of correction factors for reference level calculations is missing entry of 5.7 dB for linear units in 75 ohms. This 5.7 dB is to compensate for the minimum-loss pad that matches the 75Ω input to the 50 ohm internal system.

1-5e-3. Operator's "Work Around". Enter –5.7 dB for Preamp Gain on 75Ω input (usually SIGNAL INPUT 1) when in linear units ([SHIFT] D or LIN SCALE). Select 75Ω SIGNAL INPUT. Press [SHIFT] [HOLD] [5] [.] [7] [GHz +dBm dB] . This correction factor must be removed when changing back to log units.

1-5f. Firmware Bug Number 2

1-5f-1. Symptoms. Calibration routine ([SHIFT] W) aborts if 75Ω SIGNAL INPUT is selected.

1-5f-2. Cause. Same as cause for Firmware Bug Number 1 since most of calibration routine is done in LIN SCALE.

1-5f-3. Operator's "Work Around". Since the calibration routine ([SHIFT] W) does not measure anything directly related to 75Ω input, the routine can be done on the 50Ω input and still obtain correct results. After running calibration routine, CAL OUTPUT should be connected to 75Ω SIGNAL INPUT and Manual Calibration Signal Adjustment (Chapter 1 of 8568A Operation, Section III) should be performed.

1-5g. Firmware Bug Number 3

1-5g-1. Symptoms. Selecting linear units ([SHIFT] D or LIN SCALE) when 75Ω SIGNAL INPUT is selected causes the reference level to change by 5.7 dB. Example: With REFERENCE LEVEL set at 0 dBm and 75Ω SIGNAL INPUT selected, pressing LIN SCALE pushbutton will result in a reference level of 142.0 mV, not 273.9 mV (voltage which gives 0 dBm in 75 ohms). This is a difference of 5.7 dB. Note that the amplitude readouts in this condition are still 5.7 dB in error as explained in Firmware Bug Number 1.

1-5g-2. Cause. Same as cause for Firmware Bug Number 1 since selecting 75Ω SIGNAL INPUT in log units adds 5.7 dB gain. Conversion to linear units routine interprets this as a reference level of –5.7 dBm (in above example) due to missing table entry.

1-5g-3. Operator's "Work Around". Operator need only be aware that reference level can be changed by the program in a non-obvious way. Measurement will still be accurate in log units and 5.7 dB in error in linear units.

1-5h. Firmware Bug Number 4.

1-5h-1. Symptoms. Changing SIGNAL INPUT from 75Ω to 50Ω or 50Ω to 75Ω while in dBmV or dBμV units and then changing to dBm units causes a change in reference level of ±1.8 dB.

1-5h-2. Cause. Due to the change from power units to voltage units, two signals which are the same level in dBm are not the same in dBmV or dBμV.

Example:

75Ω → 0 dB ⇒ 48.8 dBmV ⇒ 108.8 dBμV
50Ω → 0 dB ⇒ 47.0 dBmV ⇒ 107.0 dBμV

Since the program is written to maintain the same reference level regardless of units, the gain is changed by 5.7 + 1.8 dB = 7.5 dB.

1-5h-3. Operator's "Work Around". Operator need only be aware that this is the way the program works. No measurement error is introduced.

1-6. SAFETY CONSIDERATIONS

1-7. General

1-8. Before operating this instrument, you should familiarize yourself with the safety markings on the instrument and safety instructions in this manual. This instrument has been manufactured and tested according to international safety standards. However, to ensure safe operation of the instrument and personal safety of the user and service personnel, the cautions and warnings in this manual must be followed. Refer to individual sections of this manual for detailed safety notation concerning the use of the instrument as described in the individual sections.

1-9. Safety Symbols

1-10. The following safety symbols are used throughout this manual and in the instrument. Familiarize yourself with each of the symbols and its meaning before operating this instrument.

⚠ Instruction manual symbol: the apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the apparatus against damage.

⚡ Indicates dangerous voltages.

WARNING The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operation procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the equipment. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

1-11. INSTRUMENTS COVERED BY MANUAL

1-12. Attached to the rear of each section of your instrument is a serial number plate. The serial number is in two parts. The first four digits and letter are the serial number prefix; the last five digits are the suffix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-13. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow Manual Changes supplement. This supplement contains ''change information'' that explains how to adapt the manual to the newer instrument.

1-14. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with this manual's print date and part number, both of which appear on the manual's title page. Complimentary copies of the supplement are available from Hewlett-Packard. Addresses of Hewlett-Packard offices are located at the rear of each volume of this manual.

1-15. For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

ERRATA
10 OCTOBER 1978

1-16. ACCESSORIES SUPPLIED

1-17. Figure 1-1 shows the instrument and the accessories supplied. These accessories are as follows: two power cables (refer to Section II for part number information), instrument bus interconnect cable (HP Part No. 85662-60094), coaxial interconnect cable (HP Part No. 85662-60093), and a Type N Male to BNC Female adapter.

1-18. EQUIPMENT AND ACCESSORIES AVAILABLE

1-19. Service Accessories

1-20. A service accessories package for the instrument is available for convenience in troubleshooting and aligning the instrument. This service accessories package is illustrated in Figure 1-2 including a complete list of contents. The complete package may be obtained from Hewlett-Packard by ordering HP Part Number 08568-60001.

1-21. Desk-Top Computer

1-22. The HP Model 9825A Desk-Top Computer is compatible with the 8568A and can be used for remote operation of the instrument. Remote operation of the instrument using the 9825A as a controller can make testing and adjusting of the instrument much faster than manual operation from the front-panel keyboard. Refer to Table 1-3 for complete list of 9825A accessories and other HP-IB compatible instruments.

1-23. OPTIONS

1-24. Option 001, 75 Ω Input Impedance

1-25. The standard 8568A has a 50Ω input impedance. Option 001 changes the input impedance of SIGNAL INPUT 1 to 75Ω, not fused. SIGNAL INPUT 2 is unchanged.

1-26. Option 080, Information Cards Printed in Japanese

1-27. The Standard 8568A is supplied with two information cards containing operating information printed in English. Option 080 instruments are supplied with similar information cards printed in Japanese.

1-28. Option 081, Information Cards Printed in French

1-29. The standard 8568A is supplied with two information cards containing operating information printed in English. Option 081 instruments are supplied with similar information cards printed in French.

1-30. Option 400, 400 Hz Line Frequency

1-31. The standard 8568A requires that the AC power line frequency be 50 or 60 Hz. Option 400 allows the instrument to also operate with a 400 Hz power line frequency.

1-32. Option 907, Front Handles

1-33. Option 907 instruments are supplied with a front handle kit. Refer to Section II for detailed description of this kit and installation procedure.

1-34. Option 908, Rack Mount Flanges

1-35. Option 908 instruments are supplied with a rack mount flange kit. Refer to Section II for detailed description of this kit and installation procedure.

1-36. Option 909, Front Handles and Rack Mount Flanges

1-37. Option 909 instruments are supplied with a front handle and rack mount flange kit. Refer to Section II for detailed description of this kit and installation procedure.

1-38. Option 910, Extra Manual

1-39. The standard instrument is supplied with one Operating and Service manual. Option 910 instruments are supplied with two Operating and Service manuals.

1-40. RECOMMENDED TEST EQUIPMENT

1-41. Equipment required to test, adjust, and troubleshoot the instrument is listed in Table 1-3. Equipment other than the model number listed may be substituted if it meets the critical specifications indicated in the table.

FREQUENCY

MEASUREMENT RANGE

100 Hz to 1500 MHz through two RF inputs: 100 Hz to 1500 MHz dc coupled and 100 kHz to 1500 MHz ac coupled.

DISPLAYED RANGE

Frequency Span

100 Hz to 1500 MHz over 10 division CRT horizontal axis.

Variable from data knob, or numeric/unit keyboard.

Step keys change span in a 1,2,5 sequence.

In zero span, the instrument is fixed tuned at the center frequency.

Full Span (0 - 1500 MHz) is immediately executed with 0 - 1.5 GHz or INSTR PRESET keys.

Frequency Span Accuracy: For spans >1 MHz, ± (2% of the actual frequency separation between two points +0.5% of span setting); for spans ≤1 MHz, ± (5% of frequency separation +0.5% of span).

Center Frequency

0 Hz to 1500 MHz.

Variable from data knob or numeric/unit keyboard.

Center frequency step size may be set to any value through the numeric keyboard or using the MKR/Δ→STP SIZE key. Center frequency may also be set using MKR→ CF or SIGNAL TRACK keys.

Readout Accuracy:

Span ⩾ 100 Hz: ± (2% of frequency span + frequency reference error x tune frequency + 10 Hz) in AUTO resolution bandwidth after adjusting FREQ ZERO at stabilized temperature, and using the error correction function, SHIFT W and SHIFT X. Add 10% of the resolution bandwidth setting if error correction is not used.

Zero Frequency Span:

Resolution Bandwidth	Accuracy: Frequency Reference Error x Tune Frequency +	Readout Resolution
10—300 Hz	10 Hz	1 Hz
1K—3 kHz	100 Hz	10 Hz
10K—3 MHz	1 kHz	100 Hz

Start-Stop Frequency

Continuously variable from data knob, step keys, or numeric keyboard. Permissible values must be consistent with those for center frequency and frequency span. SHIFT O sets the analyzer start and stop frequencies equal to the frequencies of the two Δ markers.

Readout Accuracy: Center Frequency Readout Accuracy + 1/2 Frequency Span Accuracy. CRT display frequency readouts may be offset from their actual values by the amount entered through the numeric/unit keyboard after executing SHIFT V.

MARKER

Normal

Displays the frequency at the horizontal position of the tunable marker.

Accuracy: Center frequency accuracy + frequency span accuracy between marker and center frequencies.

PEAK SEARCH positions the marker at the center of the largest signal response present on the display to within ±10% of resolution bandwidth.

MKR → CF sets the analyzer center frequency equal to the marker frequency; MKR/Δ→STP SIZE sets the center frequency step size equal to the marker frequency.

Frequency Count

Displays the frequency of the signal on whose response the marker is positioned.
The marker must be positioned at least 20 dB above the noise or the intersection of the signal with an adjacent signal and more than four divisions up from the bottom of the CRT.
Counter resolution is normally a function of frequency span but may be specified directly using SHIFT =.

FREQUENCY (Cont'd)

Accuracy: For span ≤ 100 kHz: frequency reference error x displayed frequency ± 2 counts.

For span > 100 kHz but ≤ 1 MHz: freq. ref. error x displayed frequency ±(10 Hz + 2 counts). For spans > 1 MHz: ± (10 kHz + 1 count).

Frequency Reference Error (see also STABILITY Drift):

Aging Rate	Temperature Stability
$< 1x10^{-9}$/Day ($2x10^{-7}$/Yr)	$< 7x10^{-9}$ 0° to 55° C

Signal Track

Re-tunes the analyzer to place a signal identified by the marker at the center of the CRT and maintain its position. Useful when reducing frequency span to zoom-in on a signal; also keeps a drifting input signal centered.

Δ

Displays the frequency difference between the stationary and tunable markers. Reference frequency need not be displayed.

Accuracy: same as frequency span accuracy; in the FREQ COUNT mode, twice the frequency count uncertainty plus drift during the period of the sweep. (See STABILITY Drift).

MKR/Δ→STP SIZE sets the center frequency step size equal to the frequency difference between the markers. SHIFT O sets the analyzer start and stop frequencies equal to the frequencies of the two markers.

Zoom

Makes it possible to reduce the frequency span about the marker (or signal in the signal track and freq count mode) using the step down key.

RESOLUTION

Resolution Bandwidth

3 dB bandwidths of 10 Hz to 3 MHz in a 1, 3, 10 sequence.

Bandwidth may be selected manually or coupled to frequency span.

Bandwidth Accuracy: Calibrated to:

±20%, 3 MHz to 10 Hz
±10%, 1 MHz to 3 kHz.
30 kHz and 100 kHz bandwidth accuracy figures only applicable ≤90% R.H.

Bandwidth Selectivity

60 dB/3 dB bandwidth ratio:

< 15:1,3 MHz to 100 kHz
< 13:1,30 kHz to 10 kHz
< 11:1,3 kHz to 30 Hz

60 dB points on 10 Hz bandwidth are separated by < 100 Hz.

STABILITY

Residual FM

< 3 Hz peak-to-peak ≤ 10 sec; span < 100 kHz, resolution bandwidth ≤30 Hz, video bandwidth ≤30 Hz.

Drift (After 1 hr. warmup at stabilized temperature):

Frequency Span	Drift (per minute of SWEEPTIME)
≤100 kHz	< 10 Hz
> 100 kHz but < 1 MHz	< 100 Hz
> 1 MHz	< 300 kHz

Because the analyzer is frequency corrected on retrace, drift occurs only during the period of one sweep. This drift is in addition to frequency reference error due to aging.

SPECTRAL PURITY

Noise Sidebands

Offset from Carrier	SSB Phase Noise (1 Hz BW)
300 Hz	90 dBC
3 kHz	100 dBC
30 kHz	107 dBC

Line Related Sidebands

> 85 dB below the peak of a CW signal.

AMPLITUDE

MEASUREMENT RANGE

−135 dBm to +30 dBm.

DISPLAYED RANGE

Scale

Over a 10 division CRT vertical axis with the Reference Level (0 dB) at the top graticule line.

Calibration

Log: 10 dB/div for 90 dB display from Reference Level

5 dB/div for 50 dB display, 2 dB/div for 20 dB display, 1 dB/div for 10 dB display — expanded from Reference Level

Linear: 10% of Reference Level/div when calibrated in voltage.

Fidelity

Log:

Incremental	Cumulative
±0.1 dB/dB over 0 to 80 dB display	≤ ±1.0 dB max over 0 to 80 dB display, 20 − 30°C. ≤ ±1.5 dB max over 0 to 90 dB display

Linear: ±3% of Reference Level.

Reference Level

Range

Log: +30.0 to −99.9 dBm or equivalent in dBmV, dBμV, volts.
Expandable to +60.0 to −119.9 dBm (−139.9 dBm ≤1 kHz resolution bandwidth) using SHIFT I.

Linear: 7.07 volts to 2.2 μvolts full scale.
Expandable to 223.6 volts to 2.2 μvolts (0.22 μvolts <1 kHz resolution bandwidth) using SHIFT I.
(Maximum input must not exceed +30 dBm damage level.)

Continuously variable from data knob or numeric keyboard with 0.1 dB resolution; step keys change level in 10% of full scale increments. Reference level may also be set using the MKR→REF LVL key.

Accuracy

The sum of the following factors determines the accuracy of the reference level readout. Depending upon the measurement technique followed after calibration, various of these sources of uncertainty may not be applicable.

An internal error correction function calibrates and reduces the uncertainty introduced by analyzer control changes from a state defined during the calibration of the instrument when SHIFT W is executed just prior to the signal measurement (i.e. at the same temperature) within the 20°—30°C range.

Calibrator Uncertainty: ±0.2 dB

Frequency Response (Flatness) Uncertainty: ≥10 dB **RF Attenuation**

Input #1:	±1.5 dB, 100 Hz to 1500 MHz. ±1 dB, 100 Hz to 500 MHz.
Input #2:	±1 dB, 100 kHz to 1500 MHz.

Amplitude Temperature Drift:

At −10 dBm reference level with 10 dB input attenuation and 1 MHz resolution bandwidth, ±0.05 dB/°C (eliminated by recalibration)..

Input Attenuation Switching Uncertainty:

±1.0 dB over 10 dB to 70 dB range.

Input Connector Switching UNCERTAINTY:

±0.5 dB, applicable when signals measured using different inputs are compared.

Resolution Bandwidth Switching Uncertainty:

(referenced to 1 MHz bandwidth)
corrected (uncorrected)

Range	20—30°C (After 1 hour warm-up)	0—55°C
3 MHz to 10 Hz	±0.1 dB (±1.0 dB)	(±2.0 dB)
1 MHz to 30 Hz	±0.1 dB (±0.5 dB)	(±1.0 dB)

30 kHz and 100 kHz bandwidth switching uncertainty figures only applicable ≤90% R.H.

Log Scale Switching Uncertainty:

±0.1 dB corrected (±0.5 dB uncorrected).

AMPLITUDE (Cont'd)

IF Gain Uncertainty - corrected (uncorrected):

Assuming the internal calibration signal is used to calibrate the reference level at −10 dBm and the input attenuator is fixed at 10 dB, any changes in reference level in the following ranges will contribute to IF gain uncertainty:

Range	20-30°C	0-55°C
0 dBm to −55.9 dBm	NA	
	(±0.6 dB)	(±1.0 dB)
−56.0 dBm to −129.9 dBm	±1.0 dB	
	(±1.0 dB)	(±1.5 dB)

Corrected uncertainty is covered under Error Correction Accuracy and only applies over 0 dBm to −55.9 dBm range.

Each 10 dB decrease (or increase) in the amount of input attenuation at the time of calibration and measurement will cause a corresponding 10 dB decrease (or increase) in the absolute reference level settings described above.

RF Gain Uncertainty (due to 2nd LO shift):

±0.1 dB corrected (±1.0 dB uncorrected).

Error Correction Accuracy

(applicable when SHIFT W and SHIFT X are used): ±0.4 dB

MARKER

Normal

Displays the amplitude at the vertical position of the tunable marker.

Accuracy: Equals the sum of calibrator uncertainty, reference level uncertainty, and scale fidelity between the reference level and marker position.

PEAK SEARCH positions the marker at the peak of the largest signal present on the display.

MKR→REF LVL sets the analyzer reference level equal to the marker amplitude.

RMS noise density in a 1 Hz bandwidth is read out using SHIFT M, by sampling the displayed trace and arithmetically correcting for the analyzer envelope detector response, log shaping, and measurement bandwidth.

Δ

Displays the amplitude difference between the stationary and tunable markers. Reference frequency need not be displayed.

Accuracy: Equals the sum of scale fidelity and frequency response uncertainty between the two markers.

REFERENCE LINES

Display Line

Movable horizontal line with amplitude readout.

Threshold

Movable horizontal trace threshold with amplitude readout.

Accuracy

Equals the sum of calibrator uncertainty, reference level uncertainty, and scale fidelity between the reference level and reference line.

DYNAMIC RANGE

Spurious Responses

For signal levels ≤ −40 dBm at the input mixer of the analyzer, all image and out-of-band mixing responses, harmonic and intermodulation distortion products are >75 dB below the input signal level; >70 dB down for signals <10 MHz.

Second Harmonic Distortion: For a signal −30 dBm at the mixer and ≥10 MHz, second harmonic distortion >70 dB down; 60 dB down for signals <10 MHz.

Third-Order Intermodulation Distortion: For two signals −30 dBm at the mixer, third-order intermodulation products >70 dB down (+5 dBm T.O.I. for 0 dB input attenuation).

Residual Responses (no signal at input)

<−105 dBm, with 0 dB input attenuation.

AMPLITUDE (Cont'd)

Average Noise Level

Displayed <–135 dBm for frequencies >1 MHz, <–112 dBm for frequencies ≤1 MHz but >500 Hz with 10 Hz resolution bandwidth, 0 dB input attenuation, 1 Hz video filter.

Video Bandwidth: Post detection low pass filter used to average displayed noise; bandwidth variable from 1 Hz to 3 MHz (nominal) in a 1, 3, 10 sequence.

Video bandwidth may be selected manually or coupled to resolution bandwidth.

Digital Video Averaging: Displays the sweep-to-sweep average of the trace over a specifiable number of sweeps with SHIFT G; video averaging is turned off with SHIFT H.

Gain Compression
<0.5 dB for signal levels ≤ – 10 dBm at the input mixer.

SWEEP

TRIGGER

Free Run
Sweep triggered by internal source.

Line
Sweep triggered by power line frequency.

Video
Sweep triggered by detected waveform of input signal at an adjustable level; signal must be ≥0.5 div peak-to-peak. For sweeps of 10 msec and less (zero span) the signal must have >40 Hz rate.
SHIFT y allows any envelope rate, but display will blank between triggers when sweep is <20 msec.

External
Sweep triggered by rising edge of signal input to rear panel BNC connector; trigger source must be >2.4 volt (5 volts max). For sweep of 10 msec and less (zero span) trigger source must have >40 Hz rate.
SHIFT x allows any trigger source rate but display will blank between low rep rate trigger when sweep is <20 msec.

CONTINUOUS
Sequential sweeps initiated by the trigger; 20 msec full span to 1500 sec full span in 1, 1.5, 2, 3, 5, 7.5, 10 sequence.

Accuracy
Sweep time ≤100 sec, ±10%; >100 sec, ±20%.

Zero Frequency Span

1 μsec full sweep (10 divisions) to 10 msec full sweep in 1, 2, 5 sequence; 20 msec full sweep to 1500 sec full sweep in 1, 1.5, 2, 3, 5, 7.5, 10 sequence.
Accuracy: same as continuous
Marker: (sweeps ≥ 20 msec only)
Normal: Displays time from beginning of sweep to marker position.
Accuracy: Sweep time settings ≥20 msec but ≤100 sec, ±10% x (indicated time/sweep time setting); settings >100 sec, ±20% x (indicated time/sweep time setting).
Δ: Displays time difference between stationary and tunable marker.
Accuracy: Same as normal

SINGLE
Single sweep armed on activation and initiated by trigger (sweep ≥ 20 msec only).

DISPLAY

TRACE

A and B are two independent signal response memories each having 1001 horizontal data positions and vertical resolution of 0.1%. Memory contents are displayed on the CRT at a rate independent of the analyzer sweep time.

Clear/Write

Clears memory contents when first activated, then writes the analyzer signal response into the memory each sweep and displays memory.

Max Hold

Retains in memory and displays the largest signal level occuring at each horizontal data position over repetitive sweeps beginning at the time the function is activated.

View

Stops writing into memory and displays memory without changing its contents.

Blank

Stops writing into memory and blanks the trace while retaining the last response in memory.

Arithmetic

A—B→A: Initially subtracts the stored memory contents of B from the current memory contents of A and writes the difference into A; this process continues as the A memory is updated at the sweep rate. To accomplish A+B→A use SHIFT c.

A⇄B: Exchanges A and B display memory contents.

B—DL→B: Subtracts the amplitude of the display line from the memory contents of B and writes the difference into B.

A third signal response memory, C (also with a 1001 data positions), can be used for signal response storage. It is accessed indirectly by transferring memory contents between B and C.

B→C: SHIFT l
B⇆C: SHIFT i
View C: SHIFT j
Blank C: SHIFT k

TRACE DETECTION

A linear envelope detector is used to obtain video information from the IF signal. Positive and negative peak detectors obtain the maximum and minimum signal excursions that occur over time periods corresponding to one or two horizontal data positions on the display. This assures that impulse signals are not missed. When the video signal contains random noise, a detection algorithm is used to selectively choose between the positive and negative peak values to be displayed. In addition, a sample mode with no peak detection is available. The video information before A-D conversion is available at the rear panel RECORDER VIDEO output.

Detection modes may be selected from the front panel:

Normal

SHIFT a: The detection algorithm defined above. (Normal operation.)

Positive Peaks

SHIFT b: Only maximum signal levels are displayed at each data position.

Negative Peaks

SHIFT d: Only minimum signal levels are displayed at each data position.

Sample

SHIFT e: One sample signal level is displayed at each data position.

ANNOTATION

Title

Allows the user to write characters into a specified area on the CRT by pushing SHIFT E and typing the keys next to the blue front panel characters and data numbers desired. Use BACKSPACE for corrections.

Blank

SHIFT o blanks (SHIFT p unblanks) all CRT characters and control setting readouts. SHIFT m blanks (SHIFT n unblanks) the CRT graticule.

DISPLAY (Cont'd)

CATHODE RAY TUBE

Type

Post deflection accelerator, aluminized P31 phosphor, electrostatic focus and deflection.

Viewing Area

Approximately 9.6 cm vertically by 11.9 cm horizontally (3.8 in x 4.7 in.).

The CRT is completely turned off with SHIFT g (and on with SHIFT h) to avoid unnecessary aging of the CRT during long term unattended operation of the analyzer.

INPUTS

Input #1

100 Hz to 1500 MHz, 50Ω, BNC connector (Fused); dc coupled.

Reflection Coefficient: <0.20 (1.5 SWR) to 500 MHz, <0.33 (2.0 SWR) 500 MHz to 1500 MHz; ≥10 dBm input attenuation.

Input #2

100kHz to 1500 MHz, 50Ω, Type N connector; ac coupled.

Reflection Coefficient: <0.20 (1.5 SWR); ≥10 dB input attenuation.

Isolation

>90 dB between inputs.

Also available: Input #1, 100 Hz to 1500 MHz, 75Ω, BNC connector, dc coupled (Option 001).

MAXIMUM INPUT LEVEL

AC

Continuous power, +30 dBm (1 watt); 100 watts, 10 μsec pulse into ≥50 dB attenuation.

DC

Input #1, 0 volts; Input #2, ±50 volts.

INPUT ATTENUATOR

70 dB range in 10 dB steps. Zero dB attenuation accessible only through numeric/unit keyboard.

Attenuation may be selected manually or coupled to reference level.

Accuracy

±1.0 dB over 10—70 dB range.

EXTERNAL SWEEP TRIGGER INPUT (rear panel)

Must be >2.4 volt (5 volt max). 1kΩ nominal input impedance.

EXTERNAL FREQUENCY REFERENCE INPUT (rear panel)

Must equal 10 MHz ±500 Hz, >0 dBm (+15 dBm max). 50 Ω nominal input impedance
Analyzer performance will be degraded unless frequency reference phase noise and spurious signals are <−140 dBc (1 Hz) referred to 10 MHz at a 100 Hz to 10 kHz offset.

OUTPUT

CALIBRATOR
20 MHz ± (20 MHz x frequency reference error [1 x 10^{-9}/day]), −10 dBm ±0.2 dB; 50Ω.

PROBE POWER
+15 V, −12.6 V; 150 mA max.
Powers HP 1121A ac coupled (useable only with input #2) and HP 1120A dc coupled high impedance probes and HP 10855A Preamplifier.

AUXILIARY (rear panel; nominal values)

Display
X, Y and Z outputs for auxiliary CRT displays exhibiting <75 nsec rise times for X, Y and <30 nsec rise time for Z (compatible with HP 1300 series displays).

X, Y: 1 volt full deflection; Z: 0 to 1 V intensity modulation, −1 V blank. BLANK output (TTL level >2.4 V for blanking) compatible with most oscilloscopes.

Recorder
Outputs to drive all current HP X-Y recorders (using positive pencoils or TTL penlift input).

Horizontal Sweep Output (X axis): A voltage proportional to the horizontal sweep of the frequency sweep generator that ranges from 0 V for the left edge to +10 V for the right edge. 1.7 kΩ output impedance.

Video Output (Y axis): Detected video ouput (before A-D conversion) proportional to vertical deflection of the CRT trace. Output increases 100 mV/div from 0 to 1 V. 50 Ω output impedance.

Penlift Output (Z axis): A blanking output, 15 V from 10 kΩ, occurs during frequency sweep generator retrace; during sweep, output is low at 0 V with 10 Ω output impedance for a normal or unblanked trace (pen down).

LOWER LEFT and UPPER RIGHT pushbuttons calibrate the recorder sweep and video outputs with 0,0 and 10,1 volts respectively, for adjusting X-Y recorders.

21.4 MHz IF
A 50 Ω, 21.4 MHz output related to the RF input to the analyzer.

In log scales, the IF output is logarithmically related to the RF input signal; in linear, the output is linearily related. The output is nominally −20 dBm for a signal at the reference level.

Bandwidth is controlled by the analyzer's resolution bandwidth setting; amplitude is controlled by the input attenuator and IF step gain positions.

1st LO
2 - 3.7 GHz, > +4 dBm; 50 Ω output impedance.

Frequency Reference
10.000 MHz, 0 dBm; 50 Ω output impedance.

INSTRUMENT STATE STORAGE

Up to 6 complete sets of user-defined control settings may be stored and recalled by pressing SAVE or RECALL and the desired register number (1 to 6) from the keyboard. Register 0 stores the current state while register 7 stores the instrument state prior to the last function change via the numeric/unit keyboard, step keys or INSTR PRESET.

Save registers are locked using SHIFT (, and unlocked using SHIFT).

Instrument state information stored in registers 0 through 7 is retained in memory indefinitely in STANDBY and approximately 30 days after line power is terminated.

REMOTE OPERATION

The standard 8568A Operates on the Hewlett-Packard Interface Bus (HP-IB). All analyzer control settings (with the exception of VIDEO TRIGGER LEVEL, FOCUS, ALIGN, INTENSITY, FREQ ZERO, AMPTD CAL and LINE) are remotely programmable. Function values, marker frequency/amplitude, and A/B traces may be output; CRT labels and graphics may be input.

LCL

Returns analyzer to local control, if not locked out by controller.

OPTIONS

All specifications are identical to the standard 8568A except as noted.

75Ω INPUT IMPEDANCE (Option 001)

RF Input #1

100 Hz to 1500 MHz, 75 Ω, BNC connector; dc coupled. Not fused.

Average Noise Level

Noise level displayed on RF input #1 < −129 dBM with 10 Hz resolution bandwidth, frequencies >1 MHz; < −106 dB for frequencies ≤1 MHz but >500 Hz. (0 dB input attenuation, 1 Hz video filter).

400 Hz POWER LINE FREQUENCY OPERATION (Option 400)

Line Related Sidebands

>75 below peak of CW signal.

Power Requirements

50, 60 or 400 Hz; 100, 120, 220 or 240 volts (+5%, −10%); approximately 450 VA.

Temperature Range (Operating)

50 - 60 Hz, 0° to 35°C; 400 Hz, 0° to 55°C.

HANDLE/MOUNTING KITS

Front Handle Kit (Option 907)

Recommended for portability and front panel protection.

Rack Flange Kit (Option 908)

Rack Flange and Front Handle Kit (Option 909)

EXTRA MANUAL (Option 910)

GENERAL

ENVIRONMENTAL

Temperature

Operating: 0°C to 55°C; Storage: –40°C to +75°C.

EMI

Conducted and radiated interference is within the requirements of CE03 of MIL STD 461A, VDEE 0871, and CISPR pub'n 1, 2, 4.

WARM-UP TIME

Frequency Reference

Frequency reference aging rate attained after 24 hr. warm-up from cold start at 25°C. Frequency is within 1 x 10^{-8} of final stabilized frequency within 30 minutes.

Operation

Requires 30 minute warm-up from cold start, 0°—55°C.

Internal Temperature Equilibrium

Reached after 2 hr. warm-up at stabilized outside temperature.

POWER REQUIREMENTS

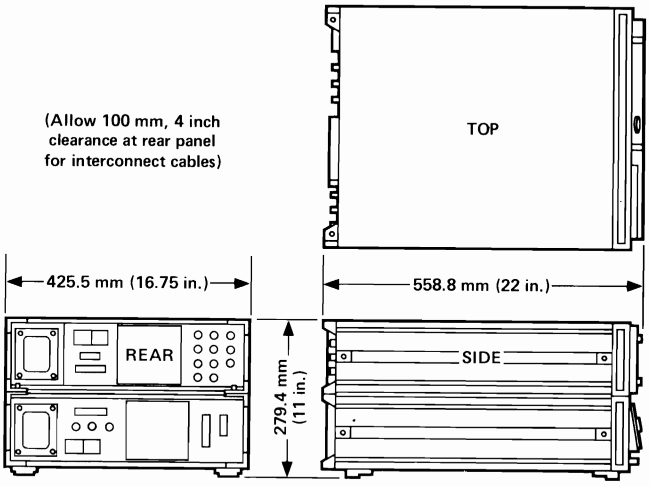
50 to 60 Hz; 100, 120, 220 or 240 volts (+5%, –10%); approximately 450 VA (40 VA in standby).

400 Hz operation is available as Option 400.

WEIGHT

Net: Total, 45 kg (100 lb); IF-Display Section , 21 kg (471 lb); RF Section 24 kg (53 lbs) **Shipping:** IF-Display Section. 31 kg (69 lb); RF Section 34 kg (75 lb).

DIMENSIONS

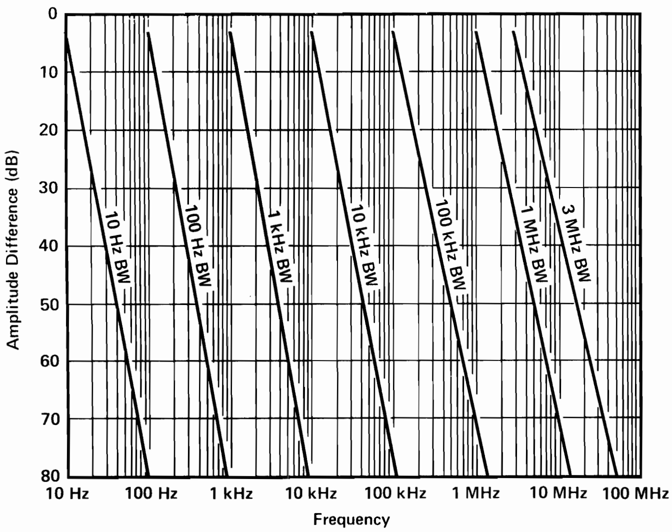


FREQUENCY

Frequency Span: Variable from data knob or from numeric/unit keyboard, in approximately 1% increments.

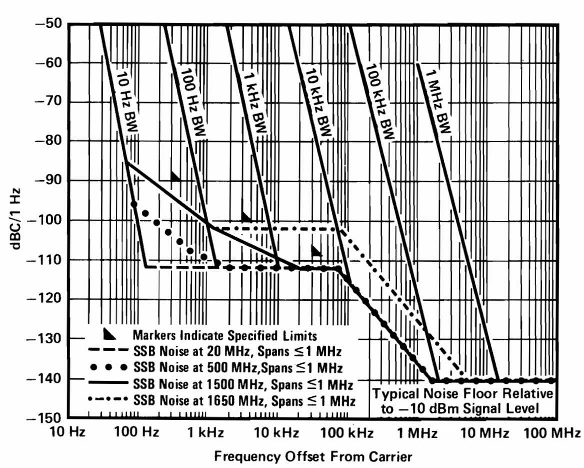
Center Frequency: Variable from data knob or from numeric unit keyboard in approximately 1% increments. Center frequency step size is normally 10% of frequency span.

Resolution



Typical Spectrum Analyzer Resolution

Spectral Purity



Typical SSB Noise vs. Offset from Carrier

AMPLITUDE

Reference Level: Signals at the reference level in log translate to approximately full scale signals in linear typically within ±1 dB at room temperature.

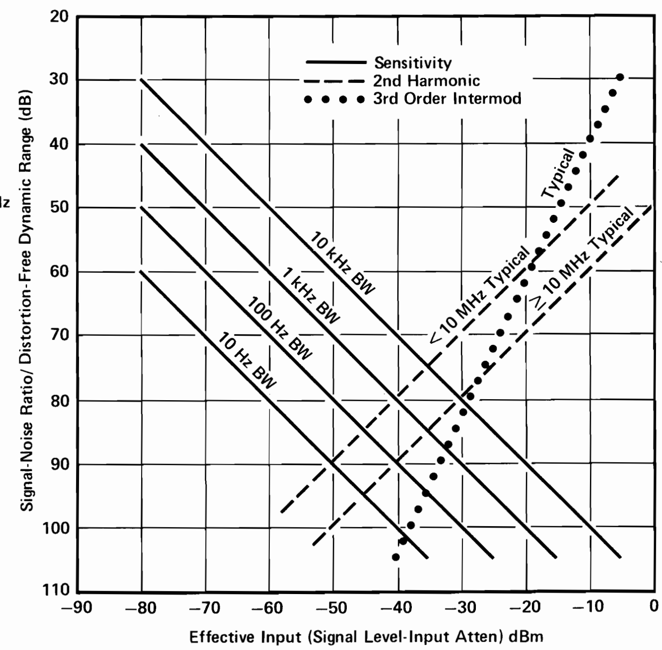
Frequency Response (Flatness) Uncertainty: ≥10 dB RF Attenuation

Input 1: ±0.75 dB 100 Hz to 500 MHz; ±1.0 dB 100 Hz to 1500 MHz; +1, −4 dB 1500 MHz to 1650 MHz.

Input 2: ±0.7 dB 100 kHz to 1500 MHz; +1, −4 dB 1500 MHz to 1650 MHz.

Residual Responses (no signal at input): Typically < −115 dBm with 0 dB input attenuation

Third Order Intermodulation Distortion

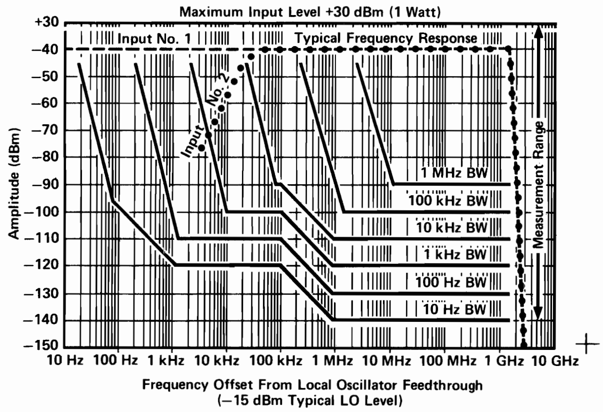


Optimum Dynamic Range

INPUT

LO Emmision is typically < −75 dBm (0 dB RF ATTEN).

Average Noise Level



Typical Sensitivity vs. Input Frequency

REMOTE OPERATION

Typical Programming Times Using HP-9825A

Setting Function Values and Operating Modes:

Center Frequency or Frequency Span	20—3000 msec
Attenuation	40 msec
Marker Peak Search	75 msec
Trace	
Write/store	3—75 msec
Arithmetic	100—500 msec
Most Other Functions	10 msec

Sweep Related Timing Considerations:

Data Acquisition Time	20 msec—1500 sec plus
Set-up Time	20 msec + 3 sec/Center Frequency Resolution (Hz) plus
Frequency Count	0.3—4000 msec
Video Average	150 msec/sweep
Marker Status	15—55 msec

Outputting Data:

Marker Frequency or Amplitude	0.5—15 msec
1001 Trace Points	80—5000 msec
Most Function Values	10 msec

Inputting Data:

1001 Trace Points	400–900 msec

Table 1-3. Recommended Test Equipment (1 of 4)

Instrument	Critical Specifications for Equipment Substitution	Recommended Model	Use***
Oscilloscope	Frequency: 100 MHz. Sensitivity: .005V/Div. Dual Channel; Third Channel Trigger View	HP 1741A	A,T
Probe	10:1 Divider, Compatible with Oscilloscope	HP 10004D	A,T
Function Generator	Output: Sine-wave, 2V p-p Range: 100 Hz to 500 kHz (Sweep Function available)	HP 3312A	A
Signal Generator	Frequency: 20 MHz to 450 MHz SSB Phase Noise: >130 dB below carrier at 20 kHz away Stability: < 10 ppm/10 min.	HP 8640B	A,T,P
Comb Generator	1, 10, and 100 MHz comb teeth up to 1500 MHz, accurate to ±0.01% with external modulation capability	HP 8406A	P
Comb Generator	20 MHz and 100 MHz comb teeth up to 1500 MHz Noise Sidebands: <–90 dBC (1 Hz) at 300 Hz offset <–100 dBC (1 Hz) at 3 kHz offset <–110 dBC (1 Hz) at 30 kHz offset	HP ET8223	P
Frequency Standard	Output: 1, 2, 5, or 10 MHz Accuracy: >± 1×10^{-9}	HP 5061A	P,A
Pulse Generator	Pulse Width: 30 nsec to 250 nsec Rise and Fall Times: 10 nsec Output Level: +2.5V	HP 8002A	A
Sweep Oscillator	Mainframe for RF Plug-In	HP 8620C	A,V,P
RF Plug-In	Frequency: 10 kHz to 1500 MHz Power: 0 dBm Leveling: External Power Meter	HP 86222A	A,V,P
Time Mark Generator	Time Intervals: 10 μsec through 100 msec Accuracy: ±0.005%	HP 226A	P
Spectrum Analyzer	Frequency: 100 MHz to 1500 MHz	HP 8558B/182T	A,T
Spectrum Analyzer	Frequency 100 kHz to 100 MHz Resolution Bandwidth: 10 Hz Frequency Span: 20 Hz	HP 8553B/8552B/141T	A,T

***V - Verification, P = Performance Tests, A = Adjustments, T - Troubleshooting

Table 1-3. Recommended Test Equipment (2 of 4)

Instrument	Critical Specifications for Equipment Substitution	Recommended Model	Use***
Tracking Generator	Frequency: 100 kHz to 100 MHz Output: 0 dBm to –25 dBm Compatible with Spectrum Analyzer	HP 8443A	A
Frequency Response Test Set	Sensitivity: .25 dB/Division Modulation Frequency: 27.8 kHz	HP 8755L	A
Frequency Counter*	Frequency: 20 MHz to 400 MHz Sensitivity: –30 dBm HP-IB Compatible	HP 5340A	A
Electronic Counter	Comb Output: 0.1, 1, 10, and 100 kHz	HP 5245L	P
Tracking Generator	Frequency: 1 MHz to 1500 MHz	HP 8444A, Option H59	V
Digital Voltmeter*	Resolution: ±0.1 mV Range: 0 Vdc to 100 Vdc Input Impedance 100V Range: 10MΩ HP-IB Compatible	HP 3455A	A,T
Power Meter	Range: –20 dBm to +10 dBm Accuracy: ±0.02 dB	HP 432A	A, T, P
Thermistor Mount	Frequency: 100 Hz to 1500 MHz	HP 478A	A, T, P
Power Meter*	Range: –20 dBm to +10 dBm Accuracy: ±0.02 dB HP-IB Compatible	HP 436A, Option 022	V, P
Power Sensor*	Frequency: 100 Hz to 1500 MHz Compatible with HP-IB Power Meter	HP 8482A	V, P
Automatic Synthesizer*	Frequency: 100 kHz to 13 MHz Resolution: ±0.1 Hz Stability: $\pm 1 \times 10^{-8}$ per day Attenuation: Range: 0 dB to –25 dB Accuracy: ±0.2 dB per 10 dB Step HP-IB Compatible	HP 3330B	A, V, P
Desk-Top Computer*	HP-IB Controller capable of verification of HP-IB and performing computer diagnostics	HP 9825A	V

*Needed specifically for Automatic Testing using the 9825A Desk-Top Computer
***V = Verification, P = Performance Tests, A = Adjustments, T = Troubleshooting

Table 1-3. Recommended Test Equipment (3 of 4)

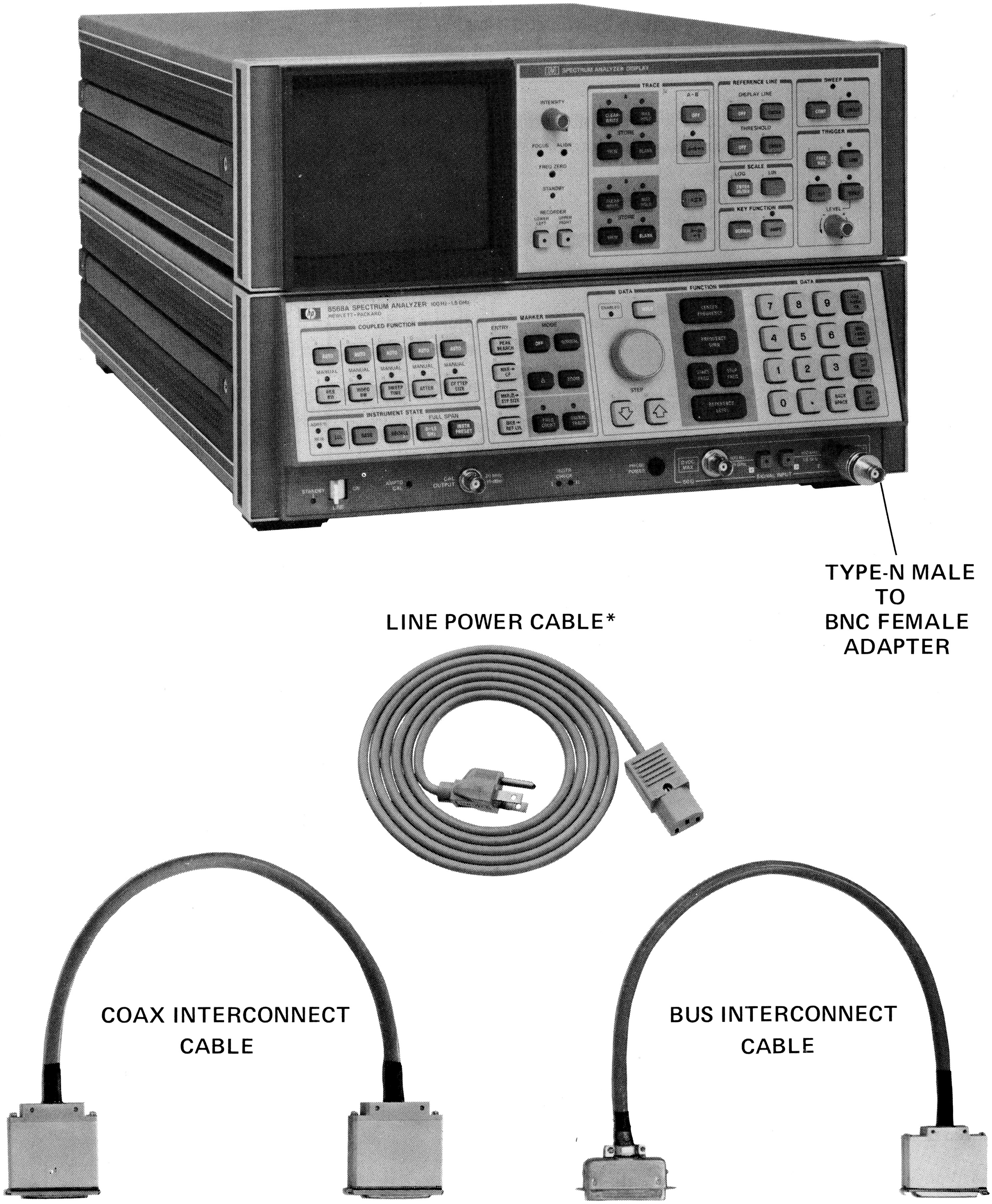
Instrument	Critical Specifications for Equipment Substitution	Recommended Model	Use***
String-Advanced Programming Plug-In*	Compatible with Controller	HP 98210A	V
Plotter-General I/O-Extended I/O Plug-In*	Compatible with Controller	HP 98216A	V
HP-IB Interface*	Compatible with Controller and 8568A HP-IB Connector	HP 98034A	V
Signature Analyzer	No known substitute. Provides preferred method for troubleshooting digital circuitry	HP 5004A	T
DC Power Supply	Output: +2.0 Vdc	HP 721A	A
Step Attenuator	Steps: 10 dB from 0 to 120 dB Frequency: 20 MHz to 1500 MHz Calibrated to uncertainty error of ±(0.02 dB +0.01 dB/10 dB step) at 20 MHz from 0 dB to 120 dB	HP 355D-H89	A, T, P
Step Attenuator	Steps: 1 dB from 0 dB to 12 dB Frequency: 20 MHz to 1500 MHz Calibrated to uncertainty error of ±(0.02 dB + 0.01 dB/10 dB step) at 20 MHz from 0 dB to 12 dB	HP 355C-H25	A, T, P
Power Splitter	Frequency: 1 MHz to 1500 MHz Tracking: <0.2 dB	HP11667A	V
Amplifier	Frequency: 269 MHz Gain: ⩾30 dB	HP 8447F	A
Mixer	Doubled Balanced	HP 10514A	A
Low-Pass Filter	Flatness: ±0.25 dB Cutoff Frequency: <500 MHz Rejection: >40 dB at 1750 MHz	Telonic TLS450-7EE	A
Low-Pass Filter	Cutoff Frequency: 300 MHz	Telonic TLP 300-4AB	P
High-Voltage Probe	1000:1 Divider Impedance: 10MΩ	HP 34111A	A, T

*Needed specifically for Automatic Testing using the 9825A Desk-Top Computer
***V = Verification, P = Performance Tests, A = Adjustments, T = Troubleshooting

Table 1-3. Recommended Test Equipment (4 of 4)

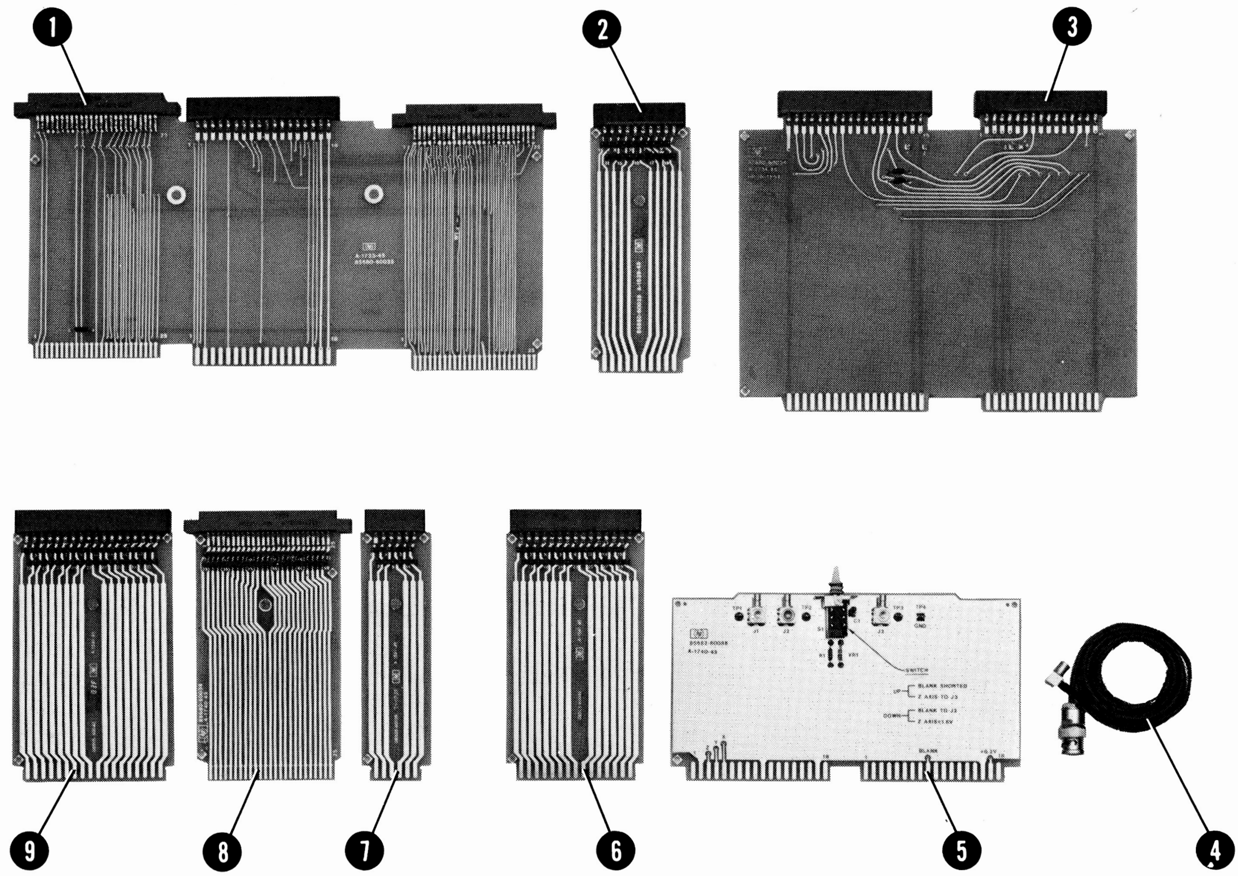
Instrument	Critical Specifications for Equipment Substitution	Recommended Model	Use***
AC Probe	Active probe compatible with probe power connector on Spectrum Analyzer Accessory: 10:1 Divider	HP 1121A	A
Termination	BNC; 50-Ohm	HP 11593A	T, V
Test Cable**	BNC to SMB Snap-On; Two Required	HP 85680-60093	A
Display Adjustment PC Board**	Required for preliminary display adjustments	HP 85662-60088	A
Extender**	A13 HP-IB Interface Extender	HP 85680-60036	T
Extender**	A12 RF Section Interface Extender	HP 85680-60035	T
Extender**	PC Board: 50 Contacts; 2 rows of 25 Two Required	HP 85680-60034	T
Extender**	PC Board: 36 Contacts; 2 rows of 18 Two Required	HP 08505-60042	A, T
Extender**	PC Board: 30 Contacts; 2 rows of 15	HP 08505-60041	A, T
Extender**	PC Board: 20 Contacts; 2 rows of 10	HP 85680-60028	A, T
Extender**	PC Board: 12 Contacts; 2 rows of 6 Two Required	HP 08505-60109	A, T
Test Cable	SMB Snap-on Female both ends	HP 85662-60042	T
Adapter	SMB Snap-on Male to SMB Snap-on Male	1250-0669	T
Tuning Tool	Proper size to fit adjustment slot	HP 8710-0630	A
Tuning Tool	Non-metallic, proper size to fit adjustment slot	HP 8710-0033	A
50Ω/75Ω Minimum Loss Pad	Connectors: 50Ω Type N Female, 75Ω Type N Male Insertion Loss: 5.7 dB Flatness: ⩽0.1 dB from DC to 1.3 GHz Return Loss: ⩾30 dB	HP 11852A	P
Adapter	Type N Female to BNC Male Impedance: 75Ω	HP 1250-1534	P

**Part of Service Accessories
***V = Verification, P = Performance Tests, A = Adjustments, T = Troubleshooting



*Power cable/plug supplied depends on country of destination. Refer to Section II for part number information.

Figure 1-1. Model 8568A Spectrum Analyzer and Accessories Supplied



ITEM	QTY	DESCRIPTION	HP PART NUMBER
1	1	Extender Board: A12 RF Section Interface	85680-60035
2	1	Extender Board: 20 contacts; 2 rows of 10	85680-60028
3	1	Extender Board: A13 HP-IB Interface	85680-60036
4	2	Cable: 4-foot long; BNC to SMB snap-on	85680-60093
5	1	PC Board: Display Adjustment Test	85662-60088
6	1	Extender Board: 30 contacts; 2 rows of 15	08505-60041
7	2	Extender Board: 12 contacts; 2 rows of 6	08505-60109
8	2	Extender Board: 50 contacts; 2 rows of 25	85680-60034
9	2	Extender Board: 36 contacts; 2 rows of 18	08505-60042

Figure 1-2. Service Accessories, HP Part No. 08568-60001

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section includes information on initial inspection, installation, storage/shipment, and electrical operation verification for the HP Model 8568A Spectrum Analyzer.

2-3. INITIAL INSPECTION

2-4. Inspect the shipping containers for damage. If the shipping containers or cushioning material is damaged it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1. If the contents are incomplete, or if there is mechanical damage or defect, notify the nearest Hewlett-Packard office. If either shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for carrier's inspection. The HP office will arrange for repair or replacement without waiting for claim settlement. Refer to Operation Verification portion of this manual section for verification of electrical operation.

2-5. PREPARATION FOR USE

2-6. Operating Environment

2-7. Temperature. The instrument may be operated in temperatures from 0°C to +55°C.

2-8. Humidity. The instrument may be operated in environments with humidity from 5% to 90% at 0° to 40°C. However, the instrument should be protected from temperature extremes which might cause condensation within the instrument.

2-9. Altitude. The instrument may be operated at altitudes up to 4,572 metres (15,000 feet).

2-10. Power Requirements

2-11. The Model 8568A requires a power source of 100, 120, 220, or 240 Vac +5% −10%, 50-60 Hz. Power consumption for each instrument section is less than 250 volt-amperes.

2-12. Line Voltage and Fuse Selection

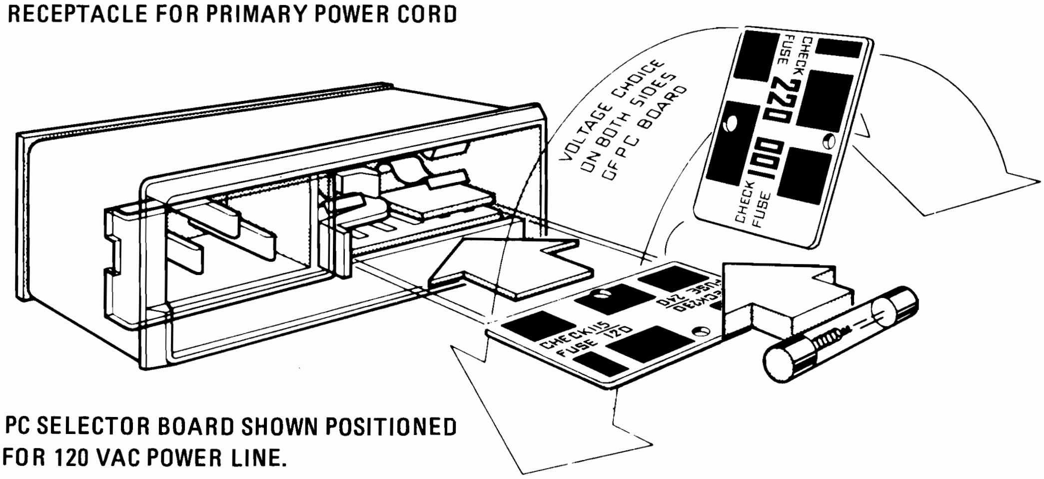
WARNING

BEFORE THIS INSTRUMENT IS SWITCHED ON, its protective earth terminals must be connected through the protective conductors of the AC power cables to socket outlets provided with protective earth contacts. DO NOT negate the earth-grounding protection by using extension cables, power cables, or auto-transformers without protective ground conductors. Failure to ground the instrument can result in personal injury. Refer to Paragraph 2-32.

CAUTION

BEFORE SWITCHING ON THIS INSTRUMENT, make sure it is adapted to the voltage of the ac power source. You must set the voltage selector cards correctly to adapt the 8568A to the power source. Failure to set the ac power input of the instrument for the correct voltage level could cause damage to the instrument when plugged in.

RECEPTACLE FOR PRIMARY POWER CORD



PC SELECTOR BOARD SHOWN POSITIONED FOR 120 VAC POWER LINE.

SELECTION OF OPERATING VOLTAGE

1. SLIDE OPEN POWER MODULE COVER DOOR AND PULL FUSE-PULL LEVER TO LEFT TO REMOVE FUSE.
2. PULL OUT VOLTAGE-SELECTOR PC BOARD. POSITION PC BOARD SO THAT VOLTAGE NEAREST ACTUAL LINE VOLTAGE LEVEL APPEARS IN MODULE WINDOW. PUSH BOARD BACK INTO ITS SLOT.
3. PUSH FUSE-PULL LEVER INTO ITS NORMAL RIGHT-HAND POSITION.
4. CHECK FUSE TO MAKE SURE IT IS OF CORRECT RATING AND TYPE FOR INPUT AC LINE VOLTAGE.
5. INSERT CORRECT FUSE IN FUSEHOLDER.

OPERATING VOLTAGE APPEARS IN MODULE WINDOW.

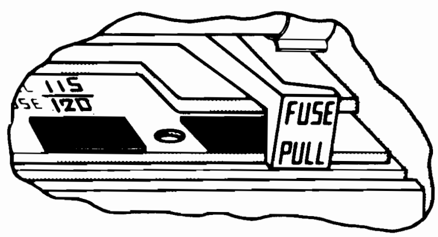


Figure 2-1. Voltage Selection with Power Module PC Board

2-13. Select the line voltages and fuses as follows:

a. Determine the ac line voltage to be used.

b. Position the power line module PC selector board (at the rear panel of each instrument section) shown in Figure 2-1 to select the line voltage (100V, 120V, 220V, 240V) closest to the voltage you measured in step a. Line voltage must be within +5% or −10% of the voltage setting. If it is not, you must use an autotransformer between the ac source and the 8568A.

c. Make sure the correct fuses are installed in the fuse holders. The required fuse rating for each line voltage selection for both instrument sections is as follows:

100/120 - 2 amperes SLOW-BLOW
220/240 - 1 amperes SLOW-BLOW

2-14. HP-IB Address Selection

2-15. The HP-IB address for the HP 8568A is set by means of a 5-segment switch; each of the five segments corresponding to one of the digits of the 5-digit binary equivalent of the address. This switch is preset at the factory for binary 11111. This binary number corresponds to a decimal equivalent of 31. This number is a special instruction which "tells" the Processor to use the HP-IB address stored in the Memory. This stored address is ASCII 2R (decimal 18). Both the ASCII characters and the decimal equivalent of the HP-IB address are displayed on the CRT whenever the instrument goes through its "power-up" routine. Once any key on the instrument front panel is pushed, this information is removed from the CRT display and will not reappear until the instrument again goes through a "power-up" routine.

2-16. The HP-IB address may be changed to any of the addresses listed in Table 2-1 by setting the 5 segments of the HP-IB address switch to correspond to the binary equivalent of the desired ASCII character or decimal value as indicated in the table. The switch is illustrated in Figure 2-2 and is shown in its preset position (decimal 31). The switch is located on the A13 HP-IB Interface in the RF Section of the instrument.

2-17. The HP-IB address may also be changed from the front panel or programmed via a controller by use of a special shift key function. For details on this feature and additional information on the HP-IB address, refer to Remote Operation in Section III (Page 1-4, Addressing the Spectrum Analyzer) of this volume.

2-18. Bench Operation

2-19. The instrument cabinet has plastic feet and foldaway tilt stands for convenience in bench operation. The tilt stands raise the front of the instrument for easier viewing of the control panel. The plastic feet are shaped to make full width modular instruments self-aligning when stacked.

2-20. Front Handles (Option 907)

2-21. Instruments with Option 907 contain a Front Handle Kit. This kit supplies necessary hardware and installation instructions for mounting front Handles on the instrument. Installation instructions are also given in Figure 2-3. See Section VI for part number information.

2-22. Rack Mounting (Option 908)

2-23. Instruments with Option 908 contain a Rack Flange Kit. This kit supplies necessary hardware and installation instructions for preparing the instrument to be mounted on a rack of 482.6 mm (19 inch) spacing. Installation instructions are also given in Figure 2-4. See Section VI for part number information.

Table 2-1. Cross-Reference Between ASCII, Decimal, and Binary Address Codes

ASCII CHARACTER		DECIMAL VALUE	5 BIT BINARY EQUIVALENT
@	SP	00	00000
A	!	01	00001
B	”	02	00010
C	#	03	00011
D	$	04	00100
E	%	05	00101
F	&	06	00110
G	’	07	00111
H	(	08	01000
I	)	09	01001
J	*	10	01010
K	+	11	01011
L	,	12	01100
M	—	13	01101
N	.	14	01110
O	/	15	01111
P	Ø	16	10000
Q	1	17	10001
R	2	18	10010
S	3	19	10011
T	4	20	10100
U	5	21	10101
V	6	22	10110
W	7	23	10111
X	8	24	11000
Y	9	25	11001
Z	:	26	11010
[	;	27	11011
/	<	28	11100
]	=	29	11101
⌢	>	30	11110

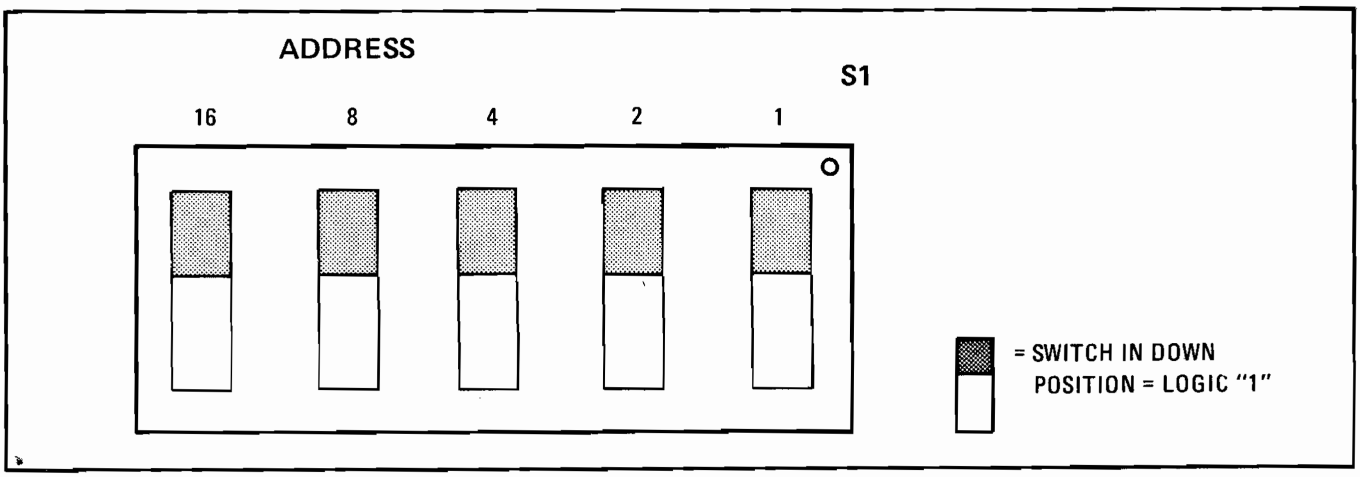
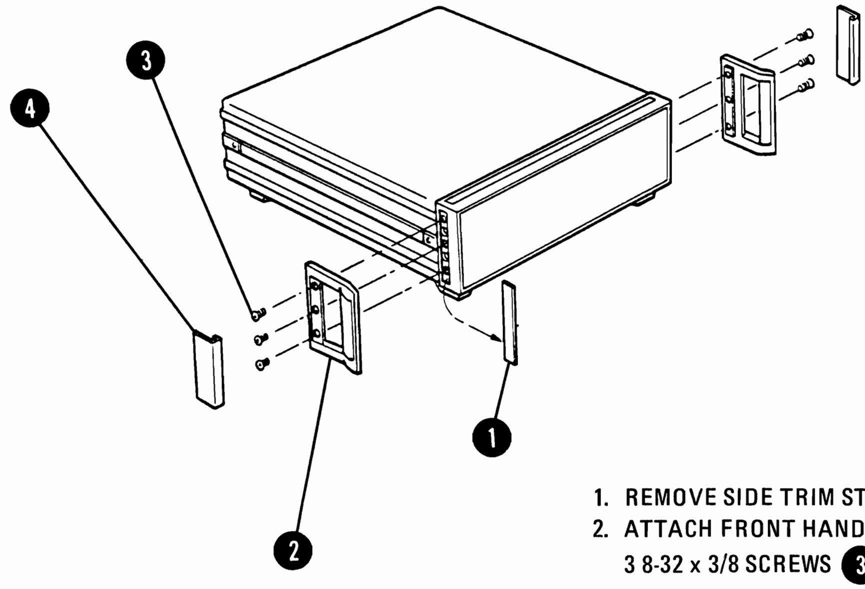
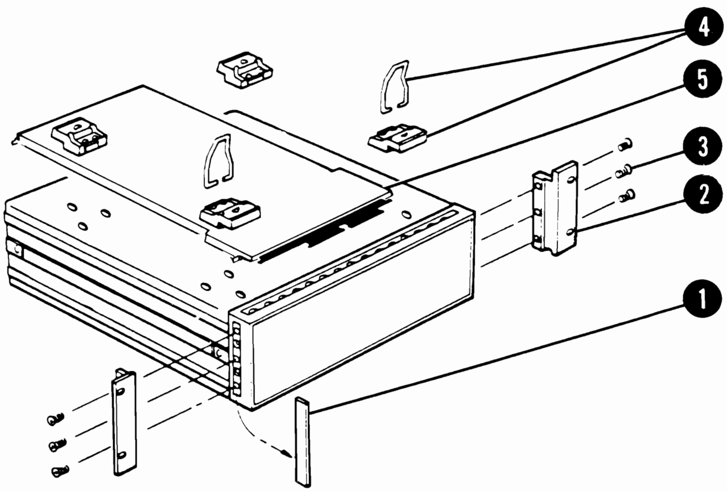


Figure 2-2. HP-IB Address Switch A13S1



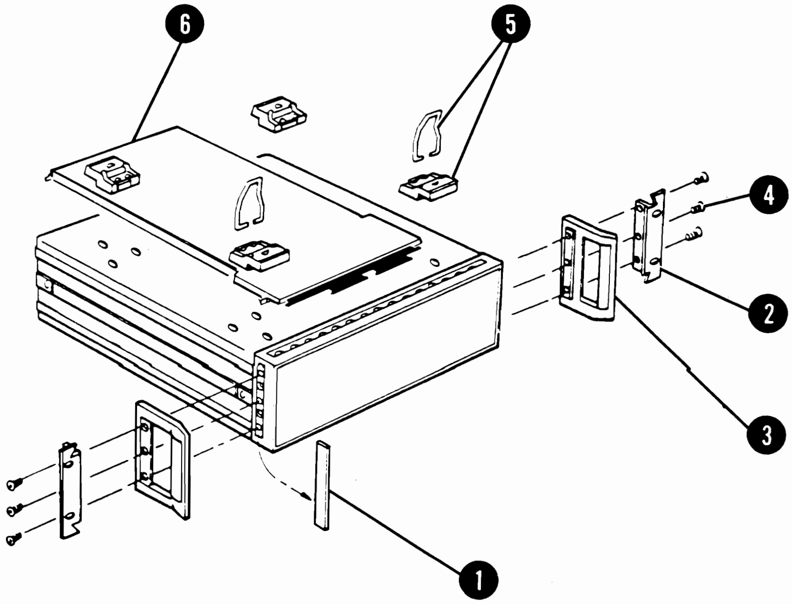
1. REMOVE SIDE TRIM STRIPS (1) .
2. ATTACH FRONT HANDLE ASSEMBLY (2) WITH 3 8-32 x 3/8 SCREWS (3) PER SIDE.
3. PRESS FRONT HANDLE TRIM (4) IN PLACE.

Figure 2-3. Attaching Front Handles



1. REMOVE SIDE TRIM STRIPS (1).
2. ATTACH RACK MOUNT FLANGE (2) WITH 8-32 x 3/8 SCREWS (3) .
3. REMOVE FEET AND TILT STANDS (4) BEFORE RACK MOUNTING. THIS ALSO REMOVES INFORMATION CARD TRAY (5) . TO RETAIN USE OF INFORMATION CARDS, DO NOT REMOVE FEET, AND WHEN RACK MOUNTING, ALLOW APPROXIMATELY 2CM (3/4 INCH) BELOW INSTRUMENT TO ACCOMODATE THE TRAY. (NO FILLER STRIP IS PROVIDED.)

Figure 2-4. Attaching Rack Mount Flanges



1. REMOVE SIDE TRIM STRIPS ❶.
2. ATTACH RACK MOUNT FLANGE ❷ AND FRONT HANDLE ASSEMBLY ❸ WITH 3 8-32 x 5/8 SCREWS ❹ PER SIDE.
3. REMOVE FEET AND TILT STANDS ❺ BEFORE RACK MOUNTING. THIS ALSO REMOVES INFORMATION CARD TRAY ❻. TO RETAIN USE OF INFORMATION CARDS, DO NOT REMOVE FEET, AND WHEN RACK MOUNTING, ALLOW APPROXIMATELY 2CM (3/4 INCH) BELOW INSTRUMENT TO ACCOMODATE THE TRAY. (NO FILLER STRIP IS PROVIDED.)

Figure 2-5. Attaching Rack Mount Flanges with Handles

2-24. Rack Mounting with Front Handles (Option 909)

2-25. Instruments with Option 909 contain a Rack Flange Front Handle Kit. This kit supplies necessary hardware and installation instructions for preparing the instrument, with the addition of front handles, to be mounted on a rack of 482.6 mm (19 inch) spacing. Installation instructions are also given in Figure 2-5. See Section VI for part number information.

2-26. Rack Mounting With Slides (Option C01)

2-27. Instruments with Option C01 contain a Rack Mount Slide Kit. This kit supplies the necessary hardware and installation instructions for preparing the instrument, with the addition of slides, to be mounted on a rack of 482.6mm (19 inch) spacing. The slides provide extra support at the sides of the instrument in the rack. Because of the weight of the 8568A, approximately 45 kg (100

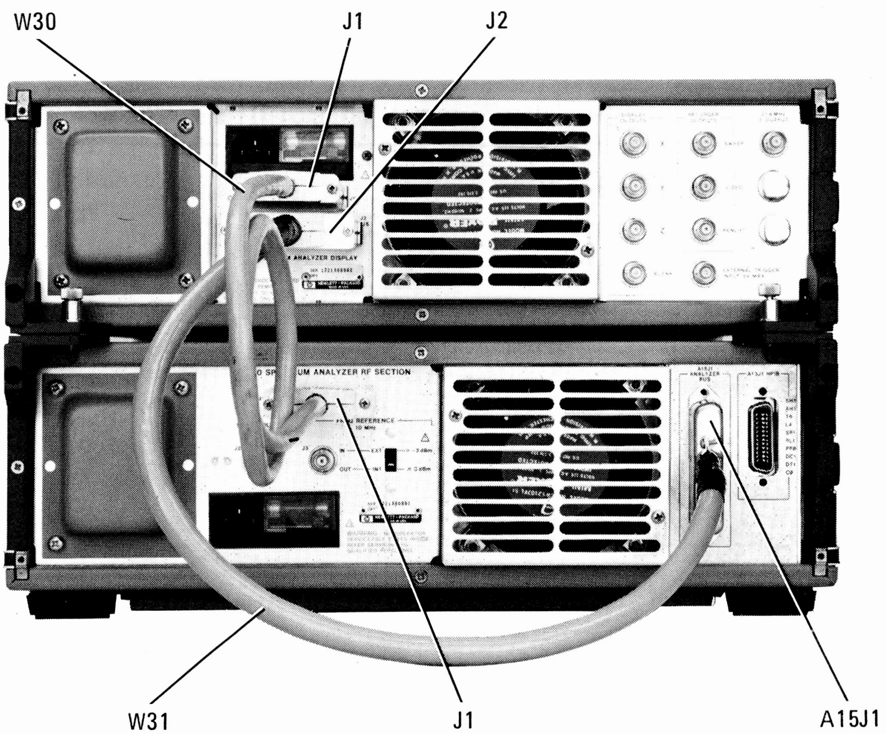


Figure 2-6. 8568A Rear Panel with Interconnect Cables Properly Installed

lbs), the use of this slide kit is recommended. Rack Mount Flanges may be used in conjunction with the Rack Mount Slides but must be ordered separately. Refer to Section VI for part number information.

2-28. Interconnection of Sections

2-29. Place the RF Section right side up on a level work surface. Place the IF-Display Section on top of the RF Section, so that the bottom front of the IF-Display Section is approximately one-half inch (1.3 cm) in front of the top of the RF Section. Slide the IF-Display section back until the hooks on top of the RF Section catch the bottom of the IF-Display Section. At this point the rear panel lock feet should be lined up. Tighten both lock feet thumb screws.

2-30. Cable Connections

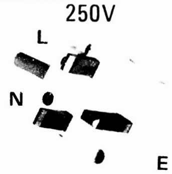
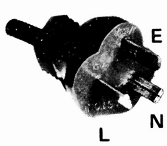
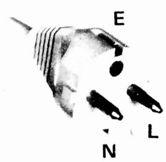
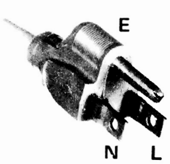
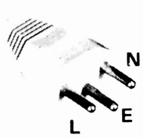
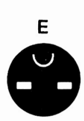
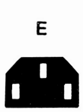
2-31. Interconnect Cables. Connect W31 (Bus Interconnect Cable) to J2 on the IF-Display Section and to A15J1 on the RF Section. Connect W30 (Coaxial Interconnect Cable) to J1 on the IF-Display Section, and to J1 on the RF Section. Figure 2-6 shows the 8568A with the interconnect cables properly installed.

2-32. Power Cables. In accordance with international safety standards, this instrument is equipped with 2 three wire AC power cables. Table 2-2 shows the styles of plugs available on AC power-cables supplied with HP instruments. The numbers for the plugs are part numbers for complete AC power cables. When connected to an appropriate power line outlet, these cables ground the instrument cabinet.

WARNING

If this instrument is to be energized through an autotransformer, make sure the common terminal of the auto transformer is connected to the protective earth contact of the power source outlet socket.

Table 2-2. AC Power Cables Available

Plug Type **	Cable HP Part Number	Plug Description	Cable Length cm (inches)	Cable Color	For Use In Country
250V 	8120-1351 8120-1703	Straight*BS1363A 90°	229 (90) 229 (90)	Mint Gray Mint Gray	Great Britain, Cyprus, Nigeria, Rhodesia, Singapore, So. Africa, India
250V 	8120-1369 8120-0696	Straight*NZSS198/ASC112 90°	201 (79) 221 (87)	Gray Gray	Australia, New Zealand
250V 	8120-1689 8120-1692	Straight*CEE7-Y11 90°	201 (79) 201 (79)	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, United Arab Republic (unpolarized in many nations)
125V 	8120-1348 8120-1398 8120-1754	Straight*NEMA5-15P 90° Straight*NEMA5-15P	203 (80) 203 (80) 91 (36)	Black Black Black	United States, Canada, Japan (100 or 200V), Mexico, Phillippines, Taiwan
	8120-1378 8120-1521 8120-1676	Straight*NEMA5-15P 90° Straight*NEMA5-15P	203 (80) 203 (80) 91 (36)	Jade Gray Jade Gray Jade Gray	
250V 	8120-2104	Straight*SEV1011 1959-24507 Type 12	201 (79)	Gray	Switzerland
250V 	8120-0698	Straight*NEMA6-15P			
250V 	8120-1860	Straight*CEE22-VI			

* Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug.

** E = Earth Ground; L = Line; N = Neutral

WARNING

Any interruption of the protective ground, inside or outside of the 8568A can make this instrument a shock hazard.

2-33. Check to see that the voltage select cards are properly installed and that the proper fuses are installed. (See Paragraph 2-13.) Insert AC power cables into the rear of each instrument section, and plug the AC power cables into AC outlets.

WARNING

Power is still applied to this instrument with the LINE switch in STANDBY. There is no OFF position on the LINE switch. To remove power from the instrument, it is necessary to remove the power cord from the rear of each of the instrument sections.

2-34. Mating Connectors

2-35. A list of connectors on the front and rear panels of the Model 8568A is given in Table 2-3. An industry identification, HP part number, and alternate source for the mating connector is given for each connector on the instrument.

2-36. STORAGE AND SHIPMENT

2-37. Environment

2-38. The instrument may be stored or shipped in environments within the following limits:
Temperature .... −40°C to +75°C
Humidity .... 5% to 90% at 0° to 40°C
Altitude ...... Up to 15,240 metres (50,000 feet)
The instrument should be protected from temperature extremes which might cause condensation within the instrument.

2-39. Packaging

2-40. Original Packaging. It is recommended that the original factory packaging materials be retained for use when shipping the instrument. If original packaging material cannot be retained, packaging materials identical to those used in factory packaging is available through the Hewlett-Packard offices. Part numbers and descriptions of the packaging materials are listed in Figure 2-8. Figure 2-7 illustrates the proper method of packaging the instrument for shipment using original factory packaging materials.

2-41. The combined weight of the two instrument sections is approximately 45 kg (100 lb). Because of the weight involved, do not package the instrument sections fastened together as one unit. The instrument sections must be separated and packaged in separate containers. The quantities of packaging materials in Figure 2-8 are for two cartons; one for the IF—Display Section and one for the RF Section. Instructions for preparing the instrument sections for shipment are contained in Figure 2-7.

2-42. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag to each carton indicating the type of service required, return address, model number and full serial number. Also, mark each container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-43. Other Packaging. If it is necessary to use packaging materials other than the type used in original factory packaging, the following general instructions should be followed.

a. Separate the two instrument sections and wrap each in heavy paper or plastic.

b. Place the instrument sections in separate containers with 8 to 10 cm (3 to 4 inches) of shock-absorbing material around all sides to

Table 2-3. Model 8568A Mating Connectors

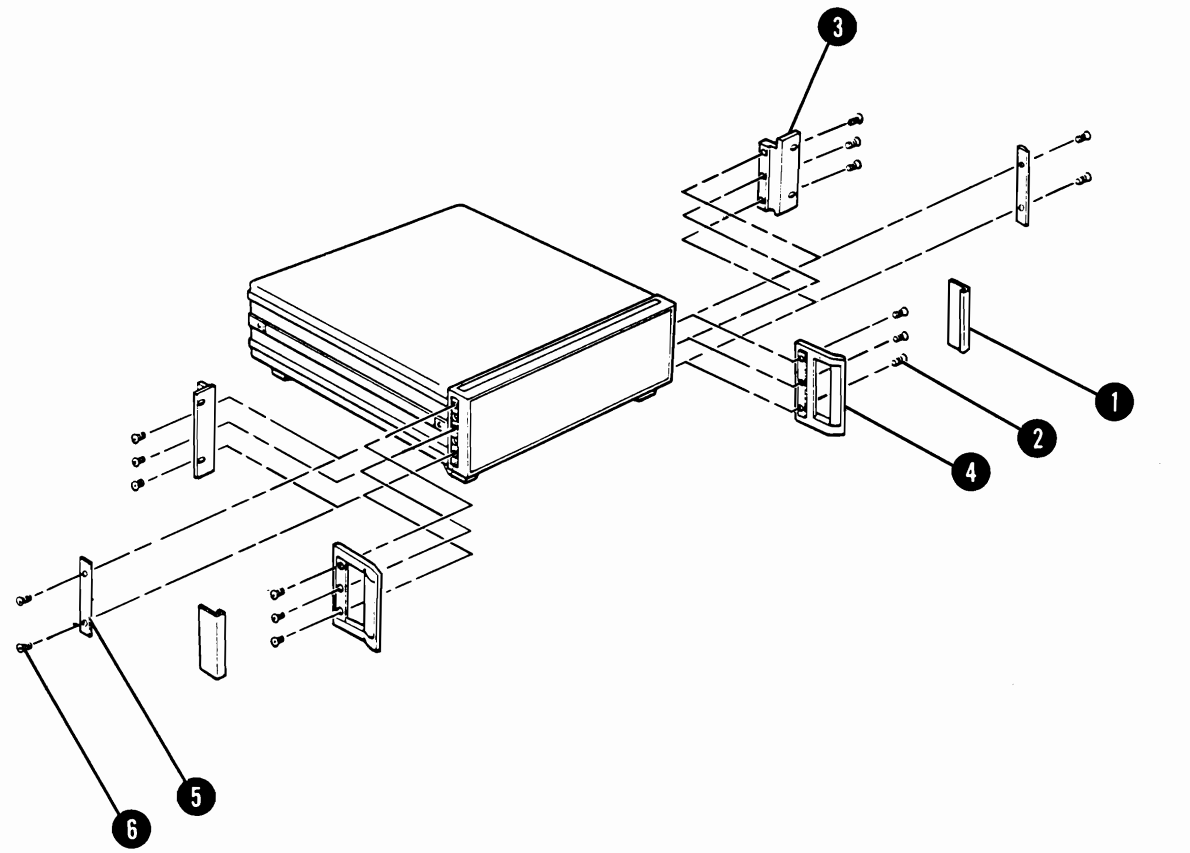
Connector on RF Section	Mating Connector		
	Industry Identification	**HP Part Number**	**Alternate Source**
A5J1 CAL OUTPUT	Type BNC, male connector UG-88/U	1250-0256	Specialty connector 28 P118-1
A5J3 INPUT 1	Type BNC, male connector UG-88/U	1250-0256	Specialty connector 28 P118-1
A5J4 INPUT 2	Type N, male connector UG-21G/U	1250-0882	Specialty connector 25 P117-2
J1	Series D, male connector	1251-4955	ITT Cannon DBM 5W5D
J2	Type BNC, male connector UG-88/U	1250-0256	Specialty connector 28 P118-1
J3	Type BNC, male connector UG-88/U	1250-0256	Specialty connector 28-P118-1
A15J1 Analyzer Bus	Series D, male connector 50 contact, 2 rows	1251-4400	Amphenol 57-30500-15
A13J1 HP-IB	Series D, male connector 24 contact, 2 rows	10631A/B/C (Cables)	None

Connector on IF-Display Section	Mating Connector		
	Industry Identification	**HP Part Number**	**Alternate Source**
J1	Series D, male connector	1251-4955	ITT Cannon DBM 5W5D
J2	Series D, male connector	1251-2245	TRW DDM-50P
J3-J11	Type BNC, male connector UG-88/U	1250-0256	Specialty connector 28 P118-1

provide firm cushioning and prevent movement inside the container. Protect front panels with cardboard. Double-wall corrugated cartons of 125 kg (275 lb) bursting strength are sufficient for shipping containers.

c. Seal each container securely and, if shipping to a Hewlett-Packard office or service center, attach a tag to each container indicating type of service required, return address, model number, and full serial number.

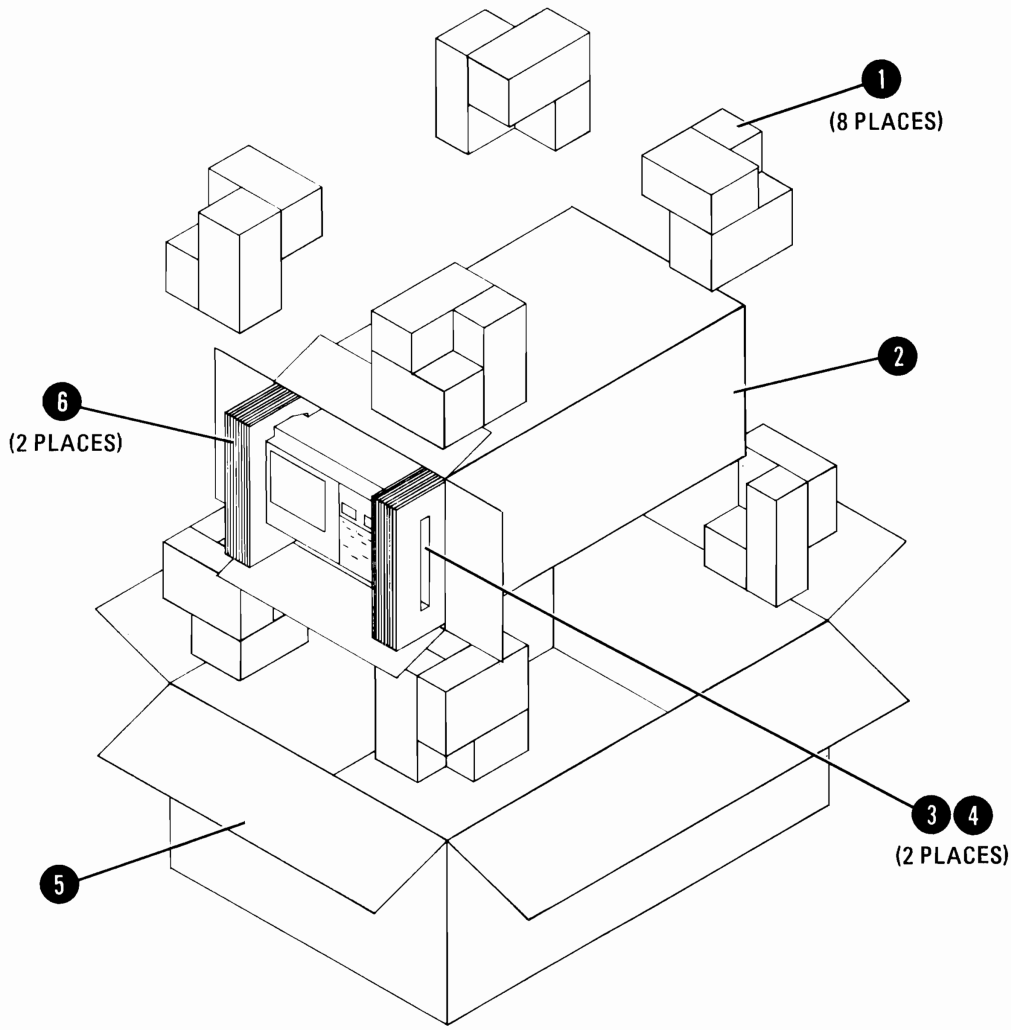
d. Mark each container FRAGILE to assure careful handling.



1. IF FRONT HANDLES ARE INSTALLED, REMOVE TRIM 1 .
2. REMOVE SCREWS 2 THUS REMOVING RACK MOUNT FLANGES 3 OR FRONT HANDLES 4 .
3. ATTACH SHIPPING BARS* 5 USING SCREWS* 6 .

*Refer to Figure 2-8 for Part Numbers of Shipping Bars and Screws.

Figure 2-7. Preparing Instrument Section for Shipment



Item	Qty	HP Part No.	Description
1	16	9220-2732	FOAM PADS–TOP, CORNER; BOTTOM CORNER
2	2	9211-2729	CARTON–INNER
3	4	5021-1722	BARS–SHIPPING, ALUMINUM
4	8	2510-0061	SCREW–FOR ATTACHING SHIPPING BARS
5	2	9211-2730	CARTON–OUTER
6	4	9220-2775	SIDE PADS, CORRUGATED CARDBOARD

NOTE: Quantities given are for two containers; one for the RF Section and one for the IF-Display Section.

Figure 2-8. Packaging for Shipment using Factory Packaging Materials

8568A
SPECTRUM ANALYZER
OPERATION VERIFICATION
REV D

HEWLETT PACKARD

JANUARY 1983

1424 FOUNTAIN GROVE PARKWAY, SANTA ROSA, CALIFORNIA, 95404, U.S.A.

Definition of
OPERATION VERIFICATION

This test procedure is intended to check operation of the instrument's main functions. Its purpose is to provide a reasonable assurance that the instrument operates correctly by semi-automatically performing 16 of the 18 Performance Tests contained in Section IV, Volume 2, of the Operating and Service Manual. A complete list of functions checked is contained in Table 1 along with the equipment required to perform each of the tests. Approximate time to perform all tests (Test Number 0) is 40 minutes. A more detailed test of instrument specifications may be performed by referring to the Performance Tests in Section IV of the Operating and Service Manual.

If the printed test results indicate an **out of tolerance** condition for any test performed by the Operation Verification Program, the instrument under test may be either in or out of specification. Measurement uncertainties may cause the Operation Verification Program to indicate an instrument specification is out of tolerance even though the Performance Test in Section IV indicates it to be within tolerance. In this event, the Performance Test data is to be considered valid. Such measurement uncertainties will particularly affect the Frequency Response, Line Related Sidebands and Residual FM Tests.

Refer to the Performance Tests in Section IV, Volume 2, of the Operating and Service Manual. Perform the Performance Test with the same title as the Operation Verification test. If the instrument does not pass the Performance Test, refer to Adjustments in Section V. Perform all Adjustment procedures related to the function which did not pass, then perform the Performance Test again. If the instrument still does not pass, refer to Section VIII and Section IX, Volumes 3 and 4, of the Operating and Service Manual for troubleshooting information to correct the malfunction.

CONTENTS

8568A SPECTRUM ANALYZER OPERATION VERIFICATION

1. INTRODUCTION

2. Electrical operation of the HP 8568A Spectrum Analyzer is checked using a semi-automatic test procedure contained on a magnetic tape cartridge. Additional tapes may be ordered through your nearest HP office by ordering HP Part No. 08568-60002, which includes this Operation and Information manual.

3. This test procedure is intended to check operation of the instrument's main functions. It is not intended to check all of the specifications of the instrument. A complete list of functions checked is contained in Table 1 along with the equipment required to perform each of the tests. Approximate time to perform all tests (Test Number 0) is 40 minutes. A more detailed test of instrument specifications may be performed by referring to the Performance Tests in Section IV of the Operating and Service Manual.

4. Annotated program listings for the individual tests contained in the program are shown on pages 8 through 61. At the end of each of the listings is a check sum number. This number is a code representing the sum of the key strokes involved in each file of the program. If, after listing your program, the check sum numbers on your listing differ from those contained in this listing, you have a different Operation Verification Program than the one illustrated here. Table 2 is a listing of the program contents indicating where on the tape each portion of the program is located.

5. EQUIPMENT REQUIRED

6. In addition to the test equipment listed in Table 1, an HP 9825B Desktop Computer[1] and an HP 98034A HP-IB Interface are needed to perform the Operation Verification Program. Either HP 9866B Printer and HP 98032A 16-Bit Interface, or an HP-IB Printer, such as the HP 9876A, is optional for added convenience.

7. A permanent record of test results may be obtained by use of an external printer. Test results are printed during the test thus providing a permanent record for comparison in future testing. As a convenience, the HP 8568A CRT display may be selected as the external printer, if a permanent record is not desired. It must be noted, however, that a change in data values for each test is to be expected over a period of time and that Hewlett-Packard warrants the specification range and not the repeatability of the data for any given specification.

8. If an external printer is not used, either "PASSED" or "Out Of Tolerance" is printed on the HP 9825B Internal Strip Printer. Refer to Paragraph 42 for instructions concerning action to be taken if printed results indicate "Out Of Tolerance".

9. PROCEDURE

10. Equipment Connections

11. Install the HP 98034A HP-IB Interface in the HP 9825B Desktop Computer and connect the cable on the HP-IB Interface to the HP 8568A rear-panel HP-IB connector, A13J1. If using an HP 9866B Printer, connect it to the HP 9825B through the HP 98032A 16-Bit Interface. If using an HP-IB Printer, connect an HP-IB cable from its HP-IB connector to A13J1 on the HP 8568A. Do not connect any other instruments to the HP-IB cable at this time.

NOTE

If any instrument connected to the HP-IB cable is not energized, the Bus is held LOW and no data transfer can take place on the Bus.

12. Equipment Warm-Up

13. Turn the HP 8568A and the external printer LINE power ON and allow for a 1-hour warm-up. Also turn on all other equipment to be used and allow sufficient warm-up time as indicated in the Operating and Service manuals for that equipment. After specified warm-up time, turn HP 9825B power OFF.

[1]This is equivalent to the HP 9825A Option 003 with the HP 98210A String-Advanced Programming Plug-In and HP 98216A Plotter-General I/O-Extended I/O Plug-In installed.

Table 1. Tests Performed with Equipment Required and HP-IB Addresses

Test No.	Test Title	Equipment Required	Address*
0	All Tests	All equipment listed	
1	Input Attenuator Switching Uncertainty	HP 3330B**/HP 3335A	04
2	Amplitude Fidelity (linear)	HP 3330B**/HP 3335A	04
3	Amplitude Fidelity (log)	HP 3330B**/HP 3335A	04
4	Log Scale Switching	HP 3330B**/HP 3335A	04
5	IF Gain Uncertainty	HP 3330B**/HP 3335A	04
6	Frequency Span Accuracy	HP 3330B**/HP 3335A	04
7	Sweep Time Accuracy	None	
8	Resolution Bandwidths	None	
9	Residual FM	None	
10	Line Related Sidebands	None	
11	RF Gain Uncertainty	None	
12	Average Noise Level	HP 11593A	None
13	Residual Response	HP 11593A	None
14	Frequency Response	HP 8444A, Opt. 059	None
		HP 436A, Opt. 022	13
		HP 11667A	None
		HP 8482A	None

*If use of different addresses is desired, refer to Paragraph 21.
**HP 3330B Option 005 can be used if an HP 8491A 10 dB Fixed Attenuator is connected to its output.

14. Tape Cartridge Loading

15. Insert the Operation Verification Program tape cartridge into the HP 9825B Desktop Computer. Refer to the HP 9825B Operating and Programming manual for instructions on loading the cartridge. Turn the HP 9825B LINE switch ON. No further operation of the controller is necessary; all further inputs are made from the front panel of the HP 8568A Spectrum Analyzer. All instructions for proper operation of the program are indicated on the HP 8568A CRT display.

16. PROGRAM OPERATION

17. Instructions

18. If an external printer is used, the first display on the HP 8568A CRT asks the operator if instructions are desired. These instructions include general information for the program, required test equipment and a list of the tests which may be performed. If a YES response is entered, these instructions are printed on the external printer. If an external printer is not used, the first CRT display refers the operator to the Operating and Service Manual for instructions.

19. Equipment Required

20. The next display lists the model numbers and HP-IB addresses of the test equipment required to perform all of the tests contained in the program.

21. HP-IB Addresses

22. If HP-IB addresses other than those specified are to be used, it is necessary to change the program to accomodate the different addresses. The program may be changed at this time by keying in, on the HP 9825B, (STOP) (FETCH) (3) (EXECUTE). Line 3 of the program (FILE 0) is now visible on the HP 9825B display. This line reads as follows:

3: dev "sa", 718→Z, "osc", 704, "mtr", 713;
dim A [10]; cfg

The address for the HP 8568A is 18, for the synthesizer is 04, and for the HP 436A is 13. The 7 preceding each of the instrument addresses is the address for the HP 98034A HP-IB Interface. Refer to Remote Operation in Section III (Page 1.4, Addressing the Spectrum Analyzer) for more detailed explanation of HP-IB addressing.

23. Refer to Table 2-1 in the Operating and Service Manual for a list of available HP-IB addresses. Paragraph 2-14 provides instructions for changing the HP-IB address of the HP 8568A. Refer to Operating and Service Manuals for the HP 3330B or HP 3335A and HP 436A for instructions on selecting or changing the HP-IB addresses of those instruments. It is important to note that each instrument connected on the HP-IB bus must have a different HP-IB address.

24. Once the desired HP-IB address has been selected on each of the instruments, these numbers can be entered into the Operation Verification Program, replacing those presently there. Locate the decimal equivalent of the selected HP-IB address in Table 2-1; this is the number to be entered into the program.

25. To change the addresses in the program, press the CHARACTER (BACK) key on the HP 9825B and hold it down until the cursor on the HP 9825B display is directly over the character to be replaced. (Refer to HP 9825B Operating and Programming manual for details on use of the editing keys.) Press the number keys corresponding to the HP-IB address selected. If more than one of the addresses is to be changed, press (FWD) or (BACK) to place the cursor over the next characters to be replaced.

26. After all desired changes have been made, press (STORE). The new addresses are now entered into the program stored in the HP 9825B memory and will remain until the HP 9825B is turned OFF or (ERASE) is pressed. The tape cartridge itself has not been changed, and should not be, therefore, it is necessary to perform this change each time the Operation Verification Program is used. To continue with the Operation Verification Program, press (RUN) on the HP 9825B.

27. AC Mains Frequency

28. The next display asks the operator to enter the AC Mains (line) frequency. This data is used in the Line Related Sidebands Test.

29. Test Record

30. The next display asks the operator to enter the address of the printer to be used for printing the test results. The choice of printers includes the HP 9866B, any HP-IB printer, the HP 9825B Strip Printer, or the CRT of the HP 8568A.

31. If a hard copy printer is selected, the next display asks the operator if serial number and data information of the instrument to be tested is desired as part of the test record to be printed on an external printer or the HP 9825B Strip Printer. If a NO response is entered, the instructions for the entry of this information are not displayed. If a YES response is entered, the next five displays ask the operator to enter the serial number data for each of the instrument sections and the current date for the test record.

32. Pre-Adjustment Routine

33. The next two displays are equipment setup diagrams for amplitude and frequency calibration of the HP 8568A. These adjustment routines are contained in the internal firmware of the instrument and can also be accessed by keying in (RECALL) 8 for amplitude calibration and (RECALL) 9 for frequency calibration. These routines are described in more detail in Section III. The next two displays ask the operator to perform the adjustments by adjusting the front panel AMPD CAL and FREQ ZERO controls to set the CRT trace to designated levels on the CRT. Amplitude and frequency calibration must be within specified limits before program will advance.

34. Test Listing

35. The next display is a complete listing ("menu") of the tests contained in the Operation Verification Program. This list is also contained in Table 1 along with the equipment required for each test.

36. Test Selection

37. All Tests. All tests can be performed as one continuous test by entering (0) (Hz μV μsec) on the HP 8568A keyboard as indicated by the instructions on the CRT display. This test requires approximately 40 minutes to complete. In the All Tests mode the first 13 tests use a single test setup shown in Figure 2. These tests require approximately 35 minutes. No operator interaction should be necessary. If an error is discovered, such as loss of the signal, the operator is alerted by a series of beeps from the HP 9825B. A series of beeps also alerts the operator when the equipment connections must be changed for the Frequency Response Test.

38. Single Tests. Individual functions may be checked by entering the indicated test number. These tests may be performed once or repetitively as desired, by terminating the entry with the proper key as stated in the instructions on the CRT display. The (Hz μV μsec) key is used to perform a test once. When the test is completed, the external printer (if used) prints the specifications of the function tested and the test results obtained. If the results obtained are out of tolerance, a double asterisk (**) is placed next to the recorded data which is out of tolerance. If not using an external printer, either "PASSED" or "Out Of Tolerance" is printed on the HP 9825B Strip Printer. The CRT display returns to the test listing and a YES or NO indication is displayed adjacent to the test performed indicating that the instrument either "PASSED" the test or part of the data obtained was "Out Of Tolerance".

39. Repetitive Testing. Any test may be performed repetitively by terminating the test number entry with the (kHz mV msec) key. When the test is completed, the external printer (if used) prints the data the same as for a single test, and then the test is immediately performed again. Each time the test is completed, the test results are printed. To stop (abort) this repetitive test loop, it is necessary to press the (MHz -dBm sec) key. The test loop is stopped and, at the end of the next sweep, the CRT display returns to the test listing. If an external printer is not used, "PASSED" or "Out Of Tolerance" is printed on the HP 9825B Strip Printer at the end of each test.

40. Equipment Connections

41. At the beginning of each test being performed, the CRT display indicates the equipment connections necessary for the performance of the test. After the equipment is connected as shown and the test continued as instructed, no further operator assistance is required. The test or tests are performed automatically and results printed until testing is complete or aborted by operator.

42. Test Results

43. If the printed test results indicate an out of tolerance indication for any test performed by the Operation Verification Program, refer to Section IV in Volume 2 of the Operating and Service Manual. Perform the Performance Test in Section IV with the same title as the Operation Verification test. If the instrument does not pass the Performance Test, refer to Adjustments in Section V. Perform all Adjustments related to the function which did not pass, then perform the Performance Test again. If the instrument still does not pass, refer to Section VIII and Section IX for troubleshooting information to correct the malfunction.

NOTE

The validity of the measurements in the Operation Verification program is based in part on the accuracy of the test equipment used to perform the test. Therefore, proper calibration of the test equipment must be verified before instrument operation can be checked using the Operation Verification Program.

NOTE

Measurement uncertainties may cause the Operation Verification program to indicate an instrument specification is out of tolerance even though the Performance Test in Section IV indicates it to be within tolerance. In this event, the Performance Test data is to be considered more valid.

NOTE

It is recommended that a working copy of this tape be made and the master stored in a safe location. This can be done by loading and running the tape copy program located on Track 0, File 17, of this tape.

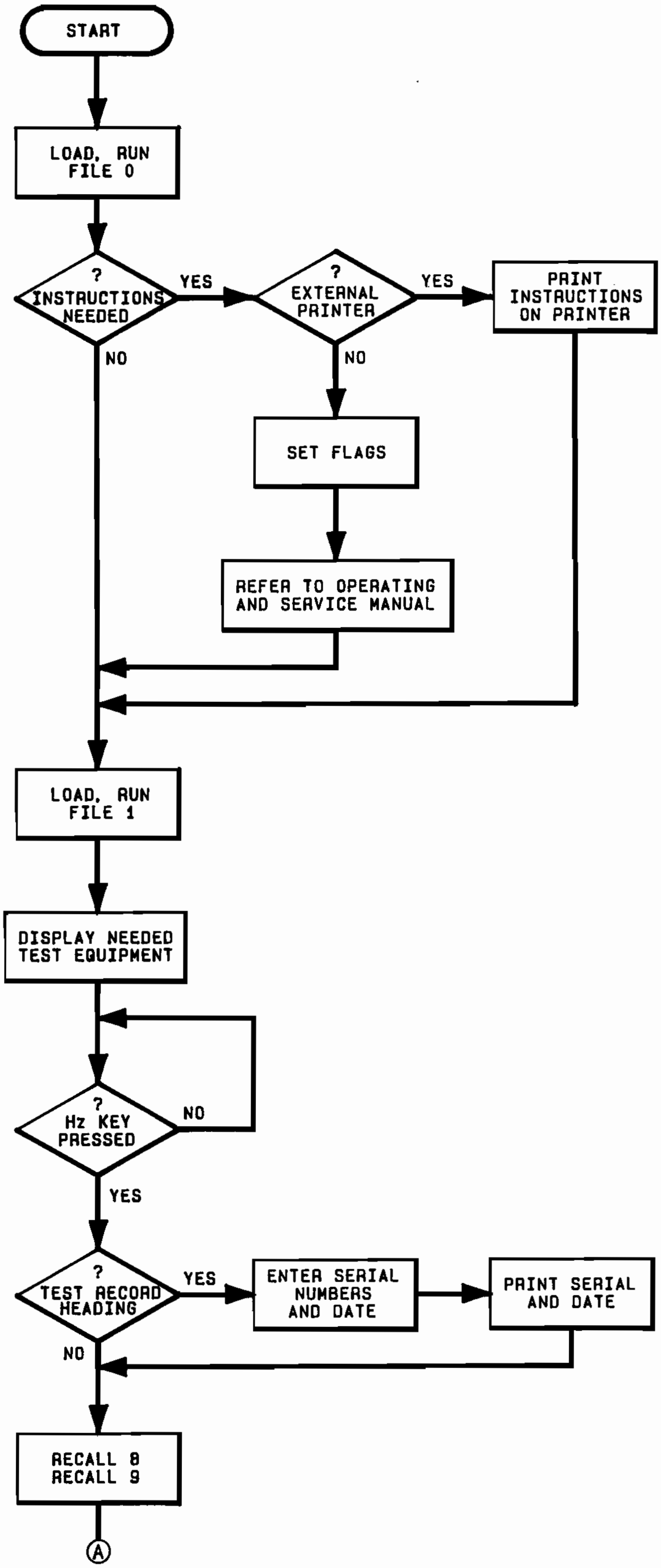


Figure 1. Simplified Flow Chart of Operation Verification Program (1 of 2)

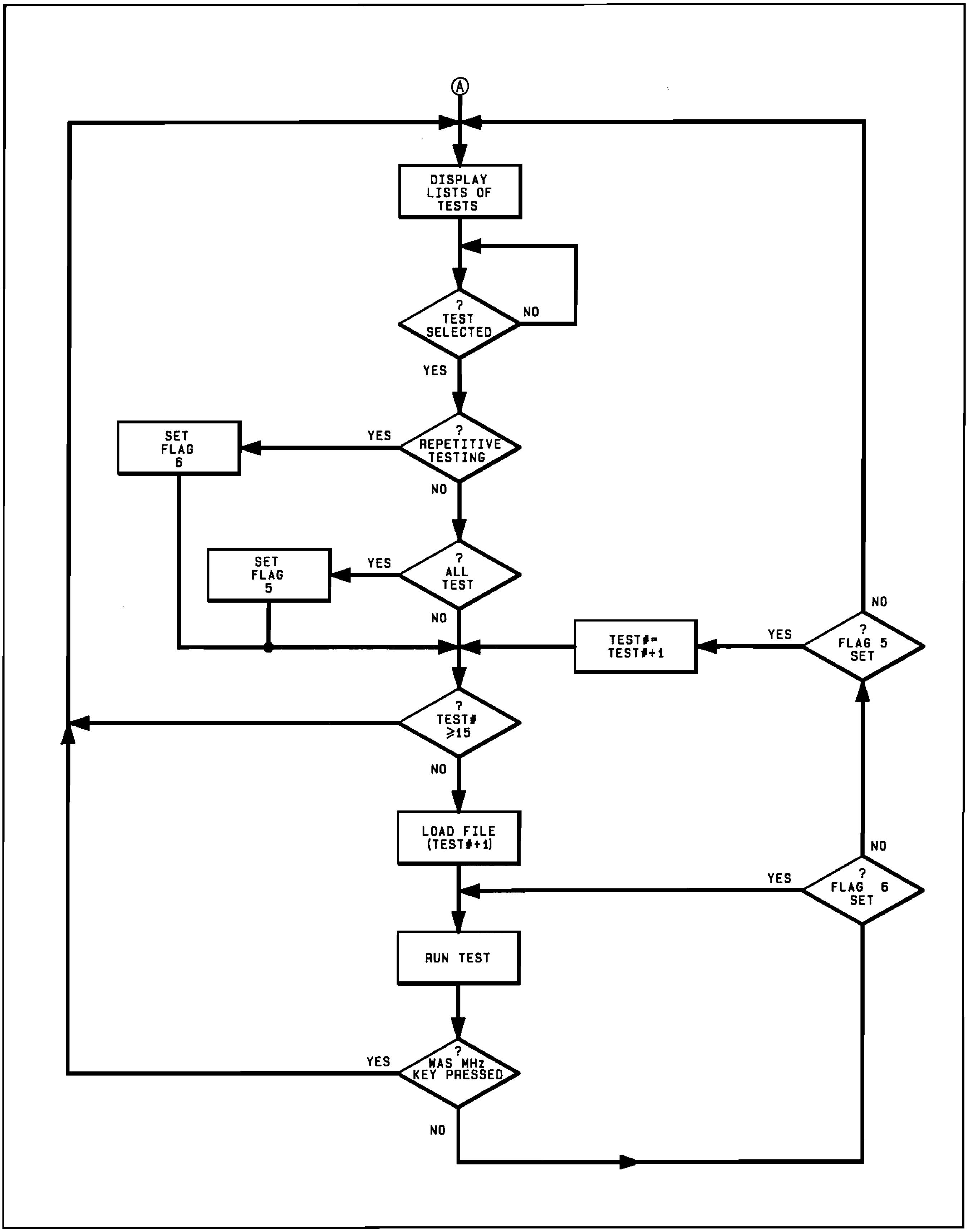
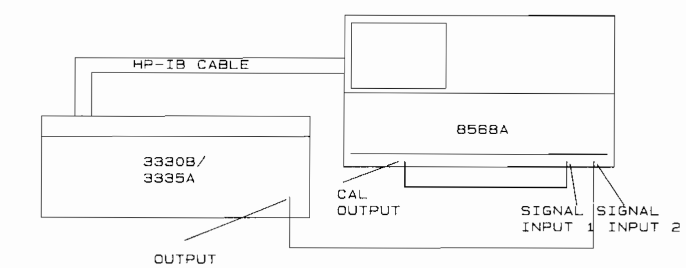


Figure 1. Simplified Flow Chart of Operation Verification Program (2 of 2)

Table 2. Program Tape Organization

Test No.	File No.	Description	Program Size
--	0	Operating Instructions	4438
–	1	Program Driver (Subroutines)	8554
1	2	Input Attenuator Switching Uncertainty	1578
2	3	Amplitude Fidelity (linear)	1406
3	4	Amplitude Fidelity (log)	2538
4	5	Log Scale Switching	1420
5	6	IF Gain Uncertainty	3012
6	7	Frequency Span Accuracy	2374
7	8	Sweep Time Accuracy	1936
8	9	Resolution Bandwidths	4944
9	10	Residual FM	1834
10	11	Line Related Sidebands	1666
11	12	RF Gain Uncertainty	1158
12	13	Average Noise Level	1776
13	14	Residual Response	3058
14	15	Frequency Response	3776
–	16	Pre-cal Routine	1258
--	17	Tape Copy Program	944




```
1. CONNECT SYNTHESIZER TO 8568A AS SHOWN
2. CONNECT BNC CABLE FROM CAL OUTPUT TO
     SIGNAL INPUT 1

    To CONTINUE, push Hz
    To SELECT ANOTHER TEST, push MHz
```

Figure 2. Equipment Connections for "All Tests"

FILE 0

VARIABLES

- D Keyboard entry
- I Loop counter
- J Loop counter
- K Counter
- P "prt" device code
- Z "sa" device code
- A[*] Data
- A$ Instructions

FLAGS

1. Pass/fail indicator
2. HP 9866B Printer
3. HP 9825B Strip Printer
4. Not used
5. All tests mode
6. Repetitive testing mode
7. Abort current test
8. HP 3335A Synthesizer
9. HP 8568A Option 001
10. Not used
11. HP 3330B Option 005 Synthesizer

File 0 Annotated Listing

```
0: "   8568A OPERATION VERIFICATION PROGRAM":
1: "HP 08568-10001,REV.D:   t0f0:  820429":
2: "       Copyright by Hewlett-Packard   APRIL 1978":
3: dev "sa",718)Z,"osc",704,"mtr",713;dim A[10];cfg
4:
5: "8568A OPERATION VERIFICATION INSTRUCTIONS   18 AUGUST 1980":
6: dsp "Operation is through the 8568A."
7: wrt "sa","IP A4 KSm KSo D3 DT@"
8: wrt "sa","PUPA100,350LBDO YOU NEED INSTRUCTIONS ?"
9: wrt "sa","";wrt "sa",""
10: wrt "sa","       YES    PUSH GHz KEY ON 8568A"
11: wrt "sa",""
12: wrt "sa","       NO     PUSH  Hz KEY ON 8568A@"
13: gsb "wait"
14: wrt "sa","EM"
15: if D<1e9;gto -7;if D=1;gto "start"
16: gsb "printer"
17: if flg3;gto +12
18: dim A$[43,72]
19: wrt "sa","EMPUPA96,320LBINSTRUCTIONS ARE BEING PRINTED"
20: wrt "sa","      ON EXTERNAL PRINTER@"
21: for J=0 to 2;0)K;trk 1;ldf J,A$
22: for I=1 to 43
23: if not flg2;if A$[I]=" ";wrt "prt";wait 2000;sfg 2;next I
24: fmt 1,6x,c;wrt "prt.1",A$[I];if A$[I]#" ";cfg 2;0)K
25: if flg2 and A$[I]=" ";1+K)K;if K>6;gto +2
26: next I
27: next J;cfg 2
28: fmt 1,/,80"_",/;wrt "prt.1"
29: wtb "sa","EM D3PUPA100,350LBTo CONTINUE, push Hz",3
30: if flg3;wrt "sa","PUPA100,450LBFOR OPERATING INSTRUCTIONS SEE"
31: if flg3;wrt "sa","SECTION II OF OPERATING AND SERVICE MANUAL@"
32: gsb "wait"
33:
```

"8568A OPERATION VERIFICATION INSTRUCTIONS"

Asks operator if instructions on using the Operation Verification Program are needed. The instructions are then printed on either the HP 9866B or an HP-IB Printer, if available.

```
34: "start":trk 0;fdf 1
35: wrt "sa","EM D3PUPA0,670LB        REQUIRED TEST EQUIPMENT"
36: wrt "sa","";wrt "sa",""
37: wrt "sa"," SYNTHESIZER ............... HP3330B/3335A"
38: wrt "sa",""
39: wrt "sa","     (HP-IB address -- 04)"
40: wrt "sa",""
41: wrt "sa"," TRACKING GENERATOR ...... HP8444A opt.059"
42: wrt "sa",""
43: wrt "sa"," POWER METER .............. HP436A opt.022"
44: wrt "sa",""
45: wrt "sa","     (HP-IB address -- 13)"
46: wrt "sa",""
47: wrt "sa"," POWER SENSOR ..................... HP8482A"
48: wrt "sa",""
49: wrt "sa"," POWER SPLITTER ................. HP11667A"
50: wrt "sa",""
51: wrt "sa"," 50 OHM LOAD ..................... HP11593A@"
52: wrt "sa","PUPA100,50PDLBTo CONTINUE, push Hz@"
53: gsb "wait"
54: ldp 1,4,0
55:
56: "getdata":wrt "sa","EM D3PUPA100,550LBenter 8568 serial number?@"
57: wtb "sa","PUPA100,520LB",17," (IF-DISPLAY SECTION)",18,3
58: wrt "sa","PUPA100,480LB  (enter last 5 digits only)@"
59: wrt "sa","PUPA100,450LB  (for example:  enter) 00123Hz)@"
60: wrt "sa","D3PUPA100,100LBTo CONTINUE, push Hz@"
61: gsb "entry"
62: D→A[1];if D>99999;gto -6
63: wrt "sa","EM PUPA100,550LBenter 8568 serial number?@"
64: wtb "sa","PUPA100,520LB",17," (RF SECTION)",18,3
65: wrt "sa","PUPA100,480LB  (enter last 5 digits only)@"
66: wrt "sa","PUPA100,450LB  (for example:  enter) 00456Hz)@"
67: wrt "sa","PUPA100,100LBTo CONTINUE, push Hz@"
68: gsb "entry"
69: D→A[2];if D>99999;gto -6
70: wtb "sa","EM PUPA100,500PDLBenter month ",17,"(number)     ",18,3
71: wrt "sa","PUPA100,100LBTo CONTINUE, push Hz@"
72: gsb "entry"
73: D→A[3];if D>12 or D<1;gto -3
74: wtb "sa","EM PUPA100,500PDLBenter ",17,"day ",18,"of the month",3
75: wrt "sa","PUPA100,100LBTo CONTINUE, push Hz@"
76: gsb "entry"
77: D→A[4];if D>31 or D<1;gto -3
78: wtb "sa","EM PUPA100,500PDLBenter ",17,"year",18," (19XX)    ",3
79: wrt "sa","PUPA100,100LBTo CONTINUE, push Hz@"
80: gsb "entry"
81: D→A[5];if D<100;D+1900→A[5]
82: if D>3e3;gto -4
83: if not flg3;gto +6
84: prt "     8568A","  OPERATION","  VERIFICATION"
85: fmt 1,/,"Date:",fz2.0,"/",fz2.0,"/",f4.0,/;wrt 16.1,A[3],A[4],A[5]
86: fmt 1,c,fz5.0;wrt 16.1,"I.F.-Display";wrt 16.1," serial no.",A[1]
87: wrt 16.1,"R.F. Section";wrt 16.1," serial no.",A[2]
88: fmt 6,16"-",/;wrt 16.6;gto "pre-cal"
89: fmt 2,2/,18x,5"*"," 8568A OPERATION VERIFICATION DATA ",5"*"
90: wrt "prt.2"
91: fmt 3,2/,7x,"Serial #'s",47x,"Date :";wrt "prt.3"
92: fmt 1,9x,fz5.0,c,30x,2fz2.0,f4.0
93: wrt "prt.1",A[1],"(IF-DISPLAY SECTION)",A[3],"/",A[4],"/",A[5]
94: fmt 7,9x,fz5.0,c;fmt 8,5/,10x,60"-",2/
95: wrt "prt.7",A[2],"(RF SECTION)";wrt "prt.8"
96: gto "pre-cal"
97:
98: "wait":wrt "sa","R1R4EE"
99: if bit(1,rds("sa"))≠1;jmp 0
100: wrt "sa","OA";red "sa",D;wrt "sa","EM KSi EM";ret
101:
```

"start"

Lists required test equipment for Operation Verification.

"get data"

The "get data" routine is used by the "Driver Program" (file 1) for printing serial number and date information on the test record, if desired.

"wait"

The "wait" subroutine is called when a keyboard entry is needed to continue the program. It returns the value of the keyboard entry in variable D.

```
102: "printer":
103: 6→P;cfg 2
104: if rds(P)≠0;sfg 2
105: wrt "sa","IP A4 KSm KSo D3 DT@"
106: wrt "sa","PUPA80,600LBENTER ADDRESS OF PRINTER"
107: wrt "sa","     TO PRINT INSTRUCTIONS ON."
108: wrt "sa","";wrt "sa","";wrt "sa",""
109: if flg2;wrt "sa"," TO USE THE 9866 PRINTER PUSH KHz."
110: if not flg2;wrt "sa"," THE 9866 PRINTER IS NOT AVAILIBLE."
111: wrt "sa","";wrt "sa",""
112: wrt "sa"," TO USE AN HP-IB PRINTER ENTER THE"
113: wrt "sa"," ADDRESS (7XX) ON THE 8568A THEN PUSH Hz.";wrt "sa",""
114: wrt "sa","";wrt "sa"," FOR NO EXTERNAL PRINTER PUSH GHz.@"
115: gsb "wait"
116: if D=1e9;wrt "sa","EMPUPA80,350LBINSTRUCTIONS CAN NOT BE PRINTED"
117: if D=1e9;wrt "sa","     ON THE INTERNAL PRINTER.@";wait 4000
118: if D=1e9;0→P;sfg 3;ret
119: if D=1e3 and flg2;dev "prt",P;ret
120: if D>731 or D<700 and D>31;gto "printer"
121: 100frc(D/100)+700→P
122: if P=Z;sfg 3;ret
123: dev "prt",P;ret
*9195
```

"printer"

Asks operator to indicate what printer is to be used for printing the operating instructions. Flag 3 is set when either the internal HP 9825B Printer or the HP 8568A CRT display is selected. Flag 2 is set when the HP 9866B Printer is selected.

FILE 1

VARIABLES

A Marker amplitude, ASCII character

B Linear reference level, ASCII character

C ASCII character

D Keyboard entry, line length

F Marker amplitude or frequency

I Loop counter

J Loop counter

L HP 8568A Option 001 (75Ω) bit

M ASCII character

N Loop counter, ASCII character

O ASCII character

P "prt" device code

R Log Reference level

V Synthesizer amplitude

Y HP 8568A Interrupt status

Z "sa" device code

B[*] Dimensioned for other files

C[*] Dimensioned for other files

D[*] Dimensioned for other files

X[*] Pass/fail indicator

r4 Test number

r17 AC mains frequency

FLAGS

1 Pass/fail indicator

2 Counter

3 HP 9825B Strip Printer

4 Not used

5 All tests mode

6 Repetitive testing mode

7 Abort current test

8 HP 33335A Synthesizer

9 HP 8568A Option 001

10 Not used

11 HP 3330B Option 005 Synthesizer

Driver Program Annotated Listing

```
0: "8568A OPERATION VERIFICATION DRIVER PROGRAM ":
1: "t0f1:  821122":
2: dim B[5,12],C[2,0:81],D[2,34],X[16],L$[80]
3:
4: "begin":
5: wrt "sa","I1 OL"
6: for N=1 to 80
7: char(rdb("sa"))→L$[N,N]
8: next N
9: mdec;band(16,num(L$[72,72]))→L;if L=16;sfg 9
10: wrt "sa","IP A4 KSo KSm DT@"
11: wrt "sa","D3PUPA16,475LBENTER AC MAINS(LINE) FREQUENCY IN Hz@"
12: gsb "entry"
13: D→r17;if D>500;gto -2
14: gsb "printer$"
15: if P=Z;gto "pre-cal"
16: wrt "sa","EM PUPA32,320LBDO YOU WANT SERIAL NUMBER AND DATE "
17: wrt "sa","  INFORMATION PRINTED ON TEST RECORD?";wrt "sa",""
18: wrt "sa","";wrt "sa","   YES    push GHz KEY"
19: wrt "sa","";wrt "sa","   NO     push Hz KEY@";gsb "wait"
20: if D<1e9;gto -4;if D=1;gto "pre-cal"
21: ldf 0,249,26
22: fdf 16;gto "getdata"
23:
```

"begin"

Calls "printer$" to select printer for tests results. Determines if HP 8568A has Option 001 installed. Asks operator to enter AC mains (line) frequency which is stored in r17. Prints serial numbers and date on test record, if desired.

```
24: "pre-cal":ldf 16,249,249
25:
```

"pre-cal"

Loads and runs file 16 which performs the Recall 8 and 9 spectrum analyzer calibration routines.

```
26: "test select":
27: if flg5 and not flg7;r4+1→r4;gto +10
28: if flg6 and not flg7;gto "test"
29: wrt "sa","KSk EM KSi EM KSm KSo A4 L0";wait 50
30: cll 'menu'
31: wrt "sa","DA1024,DW1090";eir 7,0
32: wrt "sa","R1R4EE"
33: if bit(1,rds("sa"))≠1;jmp 0
34: wrt "sa","DA";red "sa",r4
35: wtb "sa","DA1701LB",17,"LOADING TEST",18,3,"HD"
36: if r4>999;sfg 6;r4/1e3→r4
37: if r4>14;cfg 5,6;gto -8
38: 0→X[r4+1];if r4=0;sfg 5;1→r4
39: ldf r4+1,249,249
40:
```

"test select"

Allows the operator to select tests from "menu". In the all test mode (flag 5 set) loads next test file. In the repetitive testing mode (flag 6 set), execution jumps to "test", which is in the current test file. If a current test has been ABORTed (flag 7 set), execution passes to "menu".

```
41: "menu":
42: wrt "sa","DA1024,PS,D3PUPA160,640,LB8568A Test Listing   "
43: wrt "sa"," "
44: wtb "sa"," OK  No.   TEST        OK  No.   TEST      ",17,10,13,32
45: wtb "sa","     ",18,"0. All Tests          8. Bandwidth     ",10,13
46: wrt "sa","     1. Input Atten.      9. Residual FM   "
47: wrt "sa","     2. Linear Fidel.    10. Line Related  "
48: wrt "sa","     3. Log Fidel.       11. RF Gain       "
49: wrt "sa","     4. Log Switch.      12. Noise Level   "
50: wrt "sa","     5. IF Gain          13. Residuals     "
51: wrt "sa","     6. Freq.Span        14. Freq. Resp.   "
52: wrt "sa","     7. Sweep Time                         "
53: wrt "sa","                                           "
54: wrt "sa",""
55: wtb "sa"," Enter Test Number on 8568A DATA KEYBOARD",10,13
56: wrt "sa",""
57: wrt "sa"," To run Test once,          PUSH  Hz KEY"
58: wrt "sa"," To run Test repetitively,  PUSH KHz KEY"
59: wrt "sa",""
60: wtb "sa"," To ABORT a Test,           PUSH MHz KEY",3
61: wtb "sa","PUPA224,0LB                  ",3
62: wtb "sa","DW1035,3008,DA3008,D3PUPA16,32LB",3
63: 1→X[1];for I=2 to 15;if X[I]≠1;0→X[1]
64: next I
65: for I=0 to 7
66: 121→M;101→O;115→N;if X[I+1]>1;110→M;111→O;32→N
67: if X[I+1]>0;wrt "sa","DA",1103+47I-(I=0),"DW",M,O,N
68: 121→M;101→O;115→N;if X[I+9]>1;110→M;111→O;32→N
69: if X[I+9]>0;wrt "sa","DA",1125+47I,"DW",M,O,N
70: next I;ret
71:
```

"menu"

Displays test menu selection on CRT. Variable X[*] contains pass/fail information which is displayed next to test selection.

```
72: "SET-UP":
73: wrt "sa","KSk EM KSi EM A4 KSo KSm L0 DT@"
74: fmt 1,c,b,c,f2.0,b,c
75: if r4≠0;wrt "sa.1","D3PUPA224,32LB",17,"Test Number ",r4,18,"@"
76: if r4≠0;wrt "sa","PUPA100,64LBTo SELECT ANOTHER TEST, push MHz@"
77: wrt "sa","D3PUPA100,100LBTo CONTINUE, push Hz@"
78: wrt "sa","D2PUPA700,730LB8568A@PUPA520,650"
79: wrt "sa","PDPR 0,300,400,0,0,-300,-400,0"
80: wrt "sa","PU10,155 PD0,130,140,0,0,-130,-140,0"
81: wrt "sa","PU-10,-10PD400,0"
82: wrt "sa","PUPA530,675PDPR380,0PU-20,-15PD0,0PU-40,0PD0,0PU-240,0"
83: wrt "sa","PD0,0,PU-90,-10";ret
84:
85: "RSBW":fxd 0;32→A→B;49+flg9→C;0→D;if flg9;40→D
86: if flg5 and r4=1;gto +4
87: wtb "sa","IP I",C," RC8 TS MA";red "sa",F;if F>-17;1→D;ret
88: gsb "SET-UP";if flg5 and not flg9;gto +24
89: fxd 0;32→A→B;49+flg9→C;0→D;if flg9;40→D
90: wrt "sa","D2PUPA520,650,PUPR90,10PD0,-50",240+D,",0,0,50PU5,-5"
91: wrt "sa","DT@PD10,-80PU",-80+D,"-30PDLBSIGNAL@"
92: wtb "sa","PUPR-90,-30LBINPUT ",C,"@"
93: wrt "sa","PUPA600,660PDPR-80,-40PU-5,-20PDLBCAL@"
94: wrt "sa","PUPR-40,-40PDLBOUTPUT@";if flg5 and not flg9;50→A;46→B
95: wtb "sa","D3PUPA20,200LB",A,B," CONNECT BNC CABLE FROM CAL OUTPUT TO@"
96: wtb "sa","PUPA125,160LBSIGNAL INPUT ",C,"@PS";gsb "wait"
97: if D>1;ret
98: if flg5 and not flg9;gsb "syn 2"
99: gto -12
100:
101: "LOAD":
102: gsb "SET-UP"
103: wrt "sa","D2PUPR360,10PD20,0,0,-10,-5,0,0,-15,5,0,0,-20,-20,0"
104: wrt "sa","0,20,5,0,0,15,-5,0,0,10"
105: wtb "sa","PU20,-45PD-80,-40PU-30,-30PDLB50",250,"@"
106: wrt "sa","PUPR-40,-30LB Load@"
107: wrt "sa","D3PUPA96,300LBCONNECT 50 ohm LOAD TO SIGNAL INPUT 2@"
108: wrt "sa","PS";gsb "wait"
109: ret
110:
111: "syn":gto "syn 2";if flg5 and r4=1;gto +1
112: 32→A→B;gsb "SET-UP"
113: wrt "sa","PUPR-50,-100PD0,200,-400,0,0,-200,400,0PU-400,160PD400,0"
114: if flg11;wrt "sa","PU-280,-60LB3330B opt 005@PUPA440,590";gto +2
115: wrt "sa","PUPA230,650LB3330B/@PUPA230,618LB3335A@PUPA440,590"
116: wrt "sa","PDPR0,0PU-5,-5PD-150-80PU-40,-30LBOUTPUT@,PUPA440,590"
117: if not flg11;wrt "sa","PDPR0,-100,450,0,0,170";gto +2
118: wrt "sa","PDPR230,0,0,10,40,0,0,-20,-40,0,0,10,PU40,0PD180,0,0,70"
119: wrt "sa","PU5,-5PD40,-80PU-30,-30LBSIGNAL@PUPR-80,-30LBINPUT 2@"
120: wrt "sa","PUPA520,865PDPR-400,0,0,-115PU25,0PD0,85,375,0PU-300,15"
121: wrt "sa","LBHP-IB CABLE@";if flg11;wrt "sa","PR250,-330LB10dB PAD@"
122: if flg5 and not flg9;49→A;46→B
123: wtb "sa","D3PUPA20,250LB",A,B," CONNECT SYNTHESIZER TO 8568A AS SHOWN@"
124: if flg5 and not flg9;gto -35
125: if flg9 or not flg5;wrt "sa","PS";gsb "wait"
126: if D=1e6;ret
127:
128: "syn 2":1→D;cfg 8;cfg 11
129: wrt "osc","^L10:00?N0:0;N15:0;";wrt "osc","F30.0MA5M";wait 1000
130: wrt "sa","IP SP30MZ CF20MZ LG5DB RL15DM TS E1 MF";red "sa",F
131: if int(F/1e6+.5)=30;sfg 8;ret
132: if int(F/1e6+.5)≠10;gto -20
133: wrt "sa","MA";red "sa",A;if A>14 or abs(A-5)<2;sfg 11
134: gto -22;if not (flg11 and A>14);ret
135:
136: "entry":wtb "sa","DW1035,3008,DA3008,D3PUPA16,400LB   ",3
137:
138: "wait":eir 7,0;wrt "sa","R1R4EE";if flg5;beep;wait 500;beep
139: if bit(1,rds("sa"))≠1;gto +0;if flg5 or flg6;beep;wait 1000
140: wrt "sa","OA";red "sa",D;wrt "sa","KSkEMKSiEM";ret
141:
```

"SET-UP"

Draws HP 8568A and labels on CRT.

"RSBW"

Draws cable from CAL OUTPUT to signal input 1 or 2 as appropriate. This routine also checks for presence of an on-screen signal as an indication that connections have been properly made. In the "all test" mode, the "syn" subroutine is called.

"LOAD"

Labels CRT and draws 50 ohm load on signal input 2.

"syn"

Labels CRT and draws synthesizer. If HP 3330B Option 005 (flag 11 set) is present, a 10 dB pad is drawn on the synthesizer output. In the "all test" mode, the "RSBW" subroutine is called.

"syn 2"

This routine determines what synthesizer is connected to the spectrum analyzer. Flag 8 is set when an HP 3335A is used. Flag 11 is set when an HP 3330B Option 005 is used. This routine is also used to determine if the synthesizer has been connected properly.

"entry"

Displays keyboard entry on CRT.

"wait"

This routine is called to alert the operator of a test setup change or that a keyboard entry is expected.

```
142: "cont":if flg5 or flg6 or flg7;wrt "prt","@PS";wait 3000;ret
143: wtb "prt",17,"  To CONTINUE, push Hz",18,"@PS";gto "wait"
144:
145: "synthesizer":
146: if flg8;gto +8
147: if flg11;p2+10→p2
148: conv 46,58
149: fmt 2,fz6.2,c,fz6.2;fmt 3,fz6.2
150: if p2<0;wrt "osc.2","^L",p1,"?N",abs(p2),"<"
151: if p2>=0;wrt "osc.2","^L",p1,"?N",p2,";"
152: if p3#0;wrt "osc.3","O",abs(p3),"<"
153: wait 200;conv ;ret
154: fmt 2,fz6.2,c,fz6.2;fmt 3,fz6.2;if flg11;p2+10→p2
155: if p2<0;wrt "osc.2","F",p1,"MA",abs(p2),"M"
156: if p2>=0;wrt "osc.2","F",p1,"MA",p2,"K"
157: if p3#0;wrt "osc.3","AI",abs(p3),"M"
158: wait 200;ret
159:
160: "syn up/down":
161: if flg8;gto +4
162: if p1=1;wrt "osc",">"
163: if p1=0;wrt "osc","<"
164: wait 500;ret
165: if p1=1;wrt "osc","U"
166: if p1=0;wrt "osc","D"
167: wait 500;ret
168:
169: "top lin":
170: wrt "sa","LG TS RLOA";red "sa",V
171: wrt "sa","LN TS RLOA";red "sa",B
172: cll 'synthesizer'(7.6,V)
173: wrt "sa","M2 TS MA";red "sa",A
174: if A>B/1.001 and A<1.001B;ret
175: if A>0;V-20log(A/B)→V;gto -3
176: gsb "top log"
177: gto -8
178:
179: "top log":
180: wrt "sa","M1 LG TS RLOA";red "sa",V;V→R
181: cll 'synthesizer'(7.6,V)
182: wrt "sa","M2 TS MA";red "sa",A
183: if abs(A-R)<.1;ret
184: V-(A-R)→V;if V>13;-10→V
185: gto -4
186:
187: "on interrupt":cfg 7
188: oni 7,"interrupt";wrt "sa","DT@R1R4";eir 7
189: wrt "sa","D3PUPA50,150LBTO ABORT a TEST, push MHz@";ret
190: "interrupt":rds("sa")→Y;if flg6;cfg 6;sfg 7;iret
191: cfg 5;sfg 7;0→X[r4+1];iret
192:
```

"cont"

Prints label "To CONTINUE, push Hz" on CRT. In "all test", "repetitive testing", or "abort testing" modes control is returned directly to the calling routine without displaying label.

"synthesizer"

Sets the synthesizer output frequency and amplitude. p1 is the frequency in MHz, p2 the amplitude in dBm, and p3 the amplitude step size in dB.

"syn up/down"

Steps synthesizer output amplitude up (p1 = 1) or down (p1 = 0).

"top lin"

This routine sets the synthesizer output amplitude to within 0.1% of the spectrum analyzer reference level in the linear mode.

"top log"

This routine sets the synthesizer output amplitude to within 0.1 dB of the spectrum analyzer reference level in the log mode.

"on interrupt"

The "on interrupt" routine allows a test to be aborted before the test results are printed. Flag 7 is set when a test is to be aborted.

"specs"

If an external printer is available, a listing of tests which failed operation verification is printed.

```
193: "specs ?":
194: if P=Z or flg3;gto "test select"
195: fmt 8,11/,80"_",3/;wrt "prt.8"
196: if max(X[*])>1;gto +4
197: fmt 5,9x,6"*",c,6"*",2/
198: wrt "prt.5"," 8568A HAS PASSED THE OPERATION VERIFICATION TEST "
199: gto "test select"
200: wrt "prt","** THE INSTRUMENT HAS NOT PASSED THE FOLLOWING OPERATION"
201: wrt "prt","  VERIFICATION TEST(S). THE ERROR IS INDICATED BY DOUBLE "
202: wrt "prt","  ASTERISK(**) IN THE TEST RECORD.";wrt "prt"
203: wrt "prt","   REFER TO THE OPERATING AND SERVICE MANUAL SECTION IV "
204: wrt "prt","  PERFORMANCE TEST(S) FOR:";wrt "prt"
205: for I=2 to 15
206: if X[I]<=1;next I;gto "test select"
207: jmp I-1
208: wrt "prt","   1. INPUT ATTENUATOR SWITCHING UNCERTAINTY";gto "end"
209: wrt "prt","   2. AMPLITUDE FIDELITY (linear)";gto "end"
210: wrt "prt","   3. AMPLITUDE FIDELITY (log)";gto "end"
211: wrt "prt","   4. LOG SCALE SWITCHING UNCERTAINTY";gto "end"
212: wrt "prt","   5. IF GAIN UNCERTAINTY";gto "end"
213: wrt "prt","   6. FREQUENCY SPAN ACCURACY";gto "end"
214: wrt "prt","   7. SWEEP TIME ACCURACY";gto "end"
215: wrt "prt","   8. RESOLUTION BANDWIDTH";gto "end"
216: wrt "prt","   9. RESIDUAL FM";gto "end"
217: wrt "prt","  10. LINE RELATED SIDEBANDS";gto "end"
218: wrt "prt","  11. RF GAIN UNCERTAINTY";gto "end"
219: wrt "prt","  12. AVERAGE NOISE LEVEL";gto "end"
220: wrt "prt","  13. RESIDUAL RESPONSES";gto "end"
221: wrt "prt","  14. FREQUENCY RESPONSE"
222: "end":wrt "prt";next I
223: ret
224:
```

"printer$"

Allows the operator to select the printer for listing the test results.

```
225: "printer$":6}P;cfg 2
226: if rds(P)#0;sfg 2
227: wrt "sa","IP A4 KSm KSo D3 DT@"
228: wtb "sa","PUPA80,600LB",17,"ENTER ADDRESS FOR PRINTER",18,"@"
229: wrt "sa","PUPA80,450LBFOR NO PRINTER PUSH GHz@"
230: wrt "sa","PUPA80,350LBTO USE CRT PUSH MHz@"
231: if flg2;wrt "sa","PUPA80,250LBTO USE 9866 PUSH KHZ@"
232: wrt "sa","PUPA80,150LBFOR HP-IB PRINTER ENTER ADDRESS(7XX)"
233: wrt "sa","     THEN PUSH HZ@";gsb "wait"
234: if D=1e9;0}P;sfg 3;ret
235: if D=1e6;Z}P;dev "prt",P;ret
236: if D=1e3 and flg2;dev "prt",P;ret
237: if D>731 or D<700 and D>31;gto "printer$"
238: 100frc(D/100)+700}P;dev "prt",P;ret
239:
```

"LF"

Prints the number of blank lines determined by p1.

```
240: "LF":for J=1 to p1;wrt "prt";next J;ret
241:
242:
243:
244:
*26740
```

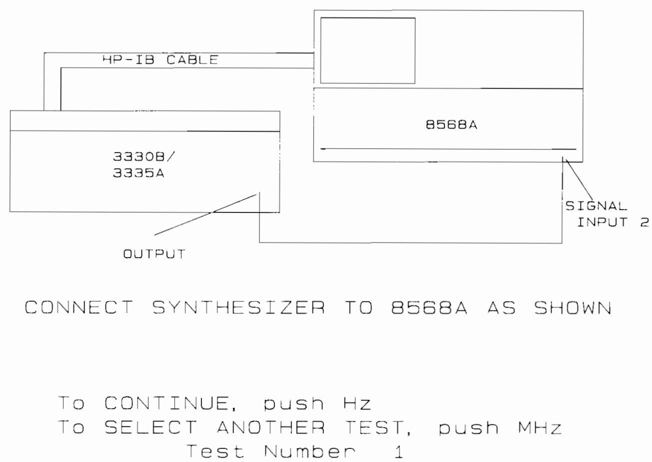
1. INPUT ATTENUATOR SWITCHING UNCERTAINTY

SPECIFICATION:

± 1.0 dB over 10 to 70 dB range

DESCRIPTION:

A signal source of known amplitude is input to the spectrum analyzer and the analyzer adjusted for a reference. The input attenuator is stepped down from 10 dB to 70 dB, the reference level stepped up from − 50 dB to + 10 dB, and the signal source stepped up from − 53 dB to + 7 dB. This maintains the signal peak at the same approximate location on the CRT display. The amplitude of the signal is measured at each step using the marker function on the analyzer.



EQUIPMENT:

Automatic Synthesizer .... HP 3330B/3335A

PROCEDURE:

1. Connect equipment as shown in figure above.
2. Select test no. 1 by keying in 1 [Hz µV µsec] ([kHz mV msec] if continuous testing is desired) on the 8568A keyboard.
3. Follow the instructions as they appear on the 8568A CRT display.
4. The following is an annotated listing of the test procedure.

FILE 2

VARIABLES

A Marker value, ASCII character

D Keyboard entry value

I Loop counter

P "prt" device code

Z "sa" device code

A[*] Measured data

X[*] Pass/fail indicator

FLAGS

1 Pass/fail indicator

2 Counter

3 HP 9825B Strip Printer

4 Not used

5 All tests mode

6 Repetitive testing mode

7 Abort current test

8 HP 3335A Synthesizer

9 HP 8568A Option 001

10 Not used

11 HP 3330B Option 005 Synthesizer

Input Attenuator Switching Uncertainty Test Annotated Listing

```
0: "INPUT ATTENUATOR SWITCHING UNCERTAINTY ":
1: "t0f2:  821102":
2: "input atten":
3:
4: gsb "syn"
5: if D>1;gto -1;if D=1e6;gto "test select";cfg 5,6
6:
7: "test":
8:
9: wtb "sa","IP D3 PUPA176,592LBINPUT ATTENUATOR ACCURACY",3
10: cll 'on interrupt'
11: wrt "sa","CF7.6MZ SP100KZ RB10KZ RL-50DM S2"
12: cll 'synthesizer'(7.6,-53,10)
13: wait 1000;wrt "sa","LN KSA TS E1 E2 TS E1 MA";red "sa",A
14: if A<-56.5 or A>-50;gto -10
15: wrt "sa","M3";if flg7;gto "test select"
16: for I=2 to 7
17: fmt 1,c,f3.0,c;wrt "sa.1","AT",I10,"DB"
18: wrt "sa.1","RL",(I-1)10-50,"DM"
19: cll 'syn up/down'(1);if flg7;gto "test select"
20: wait 1000;wrt "sa","TSE1MA";red "sa",A[I-1];next I
21:
```

"input atten"
Draws equipment setup on CRT and checks for proper keyboard entry to continue or abort test. D is the returned value from keyboard entry.

"test"
Labels test title on CRT and enables interrupt routine. Sets analyzer and synthesizer controls for test. A for-next loop changes the attenuator setting by 10 dB and readjusts reference level by 10 dB so IF gain is constant. A [*] error is from 10 dB attenuation reference setting.

```
22: "print out":
23: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,850LB"
24: if flg3;gto +10
25: wrt "prt";if flg5 and Z≠P;fmt 3,5/;wrt "prt.3"
26: fmt 1,/,10x,"1. INPUT ATTENUATOR SWITCHING UNCERTAINTY",/;wrt "prt.1"
27: fmt 5,24x,c,/;wrt "prt.5","(Referenced to 10dB Attenuation)"
28: fmt 2,10x,c,/
29: wrt "prt.2","SPECIFICATION: +/-1.0dB Maximum (uncorrected)"
30: wrt "prt.2","MEASURED:"
31: fmt 5,20x,c,15x,c;wrt "prt.5","Input Atten","Input Atten"
32: wrt "prt.5","Setting (dB)","Deviation"
33: fmt 5,/,24x,c,23x,c;wrt "prt.5","10","(ref)"
34: for I=1 to 6;32→A
35: if abs(A[I])>1;42→A;sfg 1
36: if flg3;next I;gto +4
37: fmt 2,24x,f2.0,20x,f7.1,b,b
38: wrt "prt.2",(I+1)10,A[I],A,A;next I;wrt "prt"
39: gto +6;if flg5 and Z≠P;fmt 3,4/;wrt "prt.3"
40: prt "   TEST NO. 1   input attenuator"
41: spc ;if not flg1;prt "      PASSED";gto +3
42: prt "out of tolerance";spc
43: prt "REFER TO","OPERATING AND","SERVICE MANUAL  SECTION IV"
44: fmt 6,/,16"-",/;wrt 16.6
45: 1+flg1→X[2];cfg 1
46: if P=Z;gsb "cont"
47: gto "test select"
*20899
```

"print out"

Prints headings, specifications, and test results on printer. The printer may be an external HP-IB printer, the HP 9866B, or the spectrum analyzer CRT display. Out of tolerance conditions are indicated by double asterisks (**) and flag 1 is set. If flag 3 is set indicating no external printer, the HP 9825B Strip Printer is used to print the test title and "PASSED" or "out of tolerance" information.

The value of X[*] is determined for printing "yes" or "no" adjacent to the test title menu on the CRT. Program control is then returned to "test select".

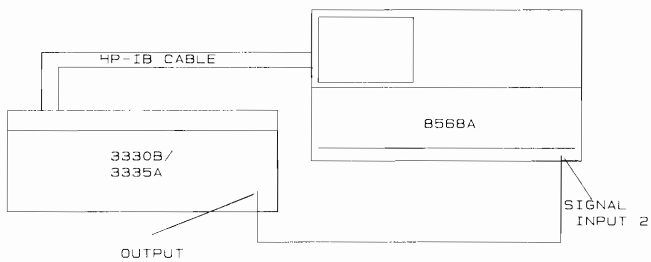
2. AMPLITUDE FIDELITY (Linear)

SPECIFICATION:

±3% of reference level

DESCRIPTION:

A signal source of known amplitude is input to the spectrum analyzer and the analyzer adjusted for a reference. The signal source is stepped down from −10 dB to −30 dB in 10 dB steps and the amplitude of the displayed signal measured using the marker function. This measured value is used to calculate the percent error from the reference level established.



CONNECT SYNTHESIZER TO 8568A AS SHOWN

To CONTINUE, push Hz
To SELECT ANOTHER TEST, push MHz
Test Number 2

EQUIPMENT:

Automatic Synthesizer .... HP 3330B/3335A

PROCEDURE:

1. Connect equipment as shown in figure above.
2. Select test no. 2 by keying in 2 [Hz μV μsec] ([kHz mV msec] if continuous testing is desired) on the 8568A keyboard.
3. Follow the instructions as they appear on the 8568A CRT display.
4. The following is an annotated listing of the test procedure.

FILE 3

VARIABLES

- A Marker amplitude, ASCII character
- B Marker amplitude, ASCII character
- C Marker amplitude
- D Keyboard entry value
- P "prt" device code
- Z "sa" device code
- A[*] Measured data
- X[*] Pass/fail indicator

FLAGS

- 1 Pass/fail indicator
- 2 Counter
- 3 HP 9825B Strip Printer
- 4 Not used
- 5 All tests mode
- 6 Repetitive testing mode
- 7 Abort current test
- 8 HP 3335A Synthesizer
- 9 HP 8568A Option 001
- 10 Not used
- 11 HP 3330B Option 005 Synthesizer

Amplitude Fidelity (Linear) Test Annotated Listing

```
0: "AMPLITUDE FIDELITY (linear)":
1: "t0f3:   821116":
2: "lin check":
3:
4: if flg5;gto "test"
5: gsb "syn"
6: if D>1;gto -1;if D=1e6;gto "test select";cfg 5,6
7:
8: "test":
9:
10: wtb "sa","IP D3PUPA256,592LBLINEAR FIDELITY",3
11: wrt "sa","CF7.6MZ SP0HZ RB3KZ LN AT0DB S2 TS"
12: cll 'synthesizer'(7.6,-10,10)
13: wrt "sa","TS E1 MA";red "sa",A;if A<.02;gto -8
14: gsb "top lin"
15: cll 'on interrupt'
16: wrt "sa","M2 TS MA";red "sa",A
17: cll 'syn up/down'(0)
18: wrt "sa","TS MA";red "sa",B;if flg7;gto "test select"
19: cll 'syn up/down'(0)
20: wrt "sa","TS MA";red "sa",C
21: 100(B/A-.316)}A[1];100(C/A-.1)}A[2]
22:
```

"lin check"

Draws equipment setup on CRT and checks for proper keyboard entry to continue test or abort. D is the returned value from keyboard entry.

"test"

Labels test title.

Sets initial control settings for spectrum analyzer and synthesizer. Verifies that signal is present on CRT.

Linear fidelity is checked over a 20 dB range. With an input signal level of – 10 dBm, signal amplitude is measured and stored in A. Synthesizer output is stepped down 10 dB and the new signal level is measured and stored in B. Synthesizer is stepped down another 10 dB and signal level is measured and stored in C. Percent error for each 10 dB step is calculated and stored in A[1] and A[2].

```
23: "print out":
24:
25: 32}A}B
26: if abs(A[1])>3;42}A;sfg 1
27: if abs(A[2])>3;42}B;sfg 1
28: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,850LB"
29: if flg3;gto +10
30: fmt 1,2/,10x,"2. AMPLITUDE FIDELITY (Linear)",/;wrt "prt.1"
31: fmt 2,10x,"SPECIFICATION:    3.0% of Reference Level",/;wrt "prt.2"
32: fmt 2,10x,"MEASURED:";wrt "prt.2"
33: fmt 5,29x,c;wrt "prt.5","dB Down         Error in %"
34: wrt "prt.5","From Ref        of Reference";wrt "prt"
35: fmt 3,28x,f13.2,b,b
36: wrt "prt.3","   10 dB   ",A[1],A,A
37: wrt "prt.3","   20 dB   ",A[2],B,B;wrt "prt"
38: gto +6;if flg5 and P#Z;cll 'LF'(11)
39: prt "   TEST NO. 2   linear fidelity "
40: spc ;if not flg1;prt "     PASSED     ";gto +3
41: prt "out of tolerance";spc
42: prt "REFER TO","OPERATING AND   SERVICE MANUAL  SECTION IV"
43: fmt 6,/,16"-",/;wrt 16.6
44: 1+flg1}X[3];cfg 1
45: if P=Z;gsb "cont"
46: gto "test select"
*19313
```

"print out"

Prints headings, specifications and test results on printer. The printer may be an external HP-IB printer, the HP 9866B, or the spectrum analyzer CRT display. Out of tolerance conditions are indicated by double asterisks (**) and flag 1 is set. If flag 3 is set indicating no external printer, the HP 9825B Strip Printer is used to print the test title and "PASSED" or "out of tolerance" information.

The value of X[*] is determined for printing "yes" or "no" adjacent to the test title menu on the CRT. Program control is then returned to "test select".

3. AMPLITUDE FIDELITY (Log)

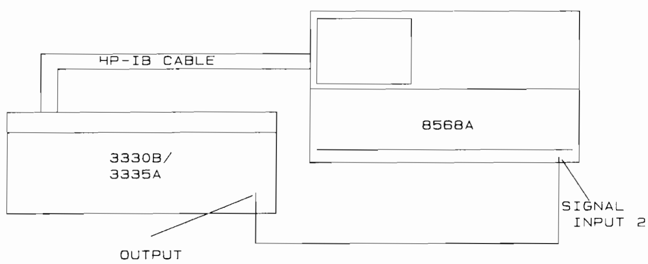
SPECIFICATION:

± 1.0 dB max over 0 to 80 dB display.
± 1.5 dB max over 0 to 90 dB display.

DESCRIPTION:

A signal source of known amplitude is input to the spectrum analyzer and the analyzer adjusted for a reference. The signal source is stepped down in 2 dB steps and the displayed signal amplitude on the analyzer measured at each step. This measurement is performed in both the 3 kHz and 300 kHz bandwidths.

The specification listed is for cumulative error. Only cumulative error is measured in this procedure.



CONNECT SYNTHESIZER TO 8568A AS SHOWN

To CONTINUE, push Hz
To SELECT ANOTHER TEST, push MHz
Test Number 3

EQUIPMENT:

Automatic Synthesizer . . . . HP 3330B/3335B

PROCEDURE:

1. Connect equipment as shown in figure above.
2. Select test no. 3 by keying in 3 [Hz µV µsec] ([kHz mV msec] if continuous testing is desired) on the 8568A keyboard.
3. Follow the instructions as they appear on the 8568A CRT display.
4. The following is an annotated listing of the test procedure.

FILE 4

VARIABLES

A Marker amplitude, ASCII character

B Marker amplitude

D Keyboard entry value

I Loop counter

P "prt" device code

Z "sa" device code

C[*] Measured data

X[*] Pass/fail indicator

r1 Specification limit

FLAGS

1 Pass/fail indicator

2 Counter

3 HP 9825B Strip Printer

4 Not used

5 All tests mode

6 Repetitive testing mode

7 Abort current test

8 HP 3335A Synthesizer

9 HP 8568A Option 001

10 Not used

11 HP 3330B Option 005 Synthesizer

Amplitude Fidelity (Log) Test Annotated Listing

```
0: "AMPLITUDE FIDELITY (log)":
1: "t0f4:   821116":
2: "log fidel":
3:
4: if flg5;gto "test"
5: gsb "syn"
6: if D>1;gto -1;if D=1e6;gto "test select";cfg 5,6
7:
8: "test":
9:
10: wtb "sa","IP D3PUPA272,592LBLOG FIDELITY",3
11: cll 'on interrupt'
12: wrt "sa","CF7.6MZ SP0HZ RB3KZ RL10DM AT30DB S2"
13: cll 'synthesizer'(7.6,10,2);if flg7;gto "test select"
14: wrt "sa","TS E1 MA";red "sa",A;if A<2;gto -9
15: gsb "top log"
16: 0→B;wrt "sa","M3 KSM TS"
17: for I=0 to 45
18: if I=35;wrt "sa","VB30HZ TS"
19: if I=42;wrt "sa","VB3HZ TS"
20: wrt "sa","TS MA";red "sa",A;if I=0;0→A
21: A-B+2*I→C[2,I];2I→C[1,I];if flg7;gto "test select"
22: if I=10;wrt "sa","AT20DB TS MA";red "sa",B;B-A→B
23: cll 'syn up/down'(0)
24: next I
25: wrt "sa","RB300KZ AT30DB TS"
26: cll 'synthesizer'(7.6,10,2)
27: gsb "top log"
28: 0→B;wrt "sa","VB30HZ M3 KSM TS"
29: for I=0 to 35
30: wrt "sa","TS MA";red "sa",A;if I=0;0→A
31: A-B+2*I→C[2,I+46]
32: 2I→C[1,I+46];if flg7;gto "test select"
33: if I=10;wrt "sa","AT20DB TS MA";red "sa",B;B-A→B
34: cll 'syn up/down'(0)
35: next I
36:
```

"log fidel"

Draws equipment setup on CRT and checks for proper keyboard entry to continue test or abort. D is the returned value from keyboard entry.

"test"

Labels test title and enables interrupt routine. Initial control settings of spectrum analyzer and synthesizer are established. Signal is set to reference level and reference set using Marker Delta.

A for/next loop is used to step the synthesizer down in 2 dB steps over a 90 dB range in the 3 kHz resolution bandwidth. The amplitude error is measured and stored in C[2,I], while the input signal level is stored in C[1,I].

The above procedure is repeated over a 70 dB range in the 300 kHz resolution bandwidth. The amplitude error is stored in C[2,I+46], while the input signal level is stored in C[1,I+46].

```
37: "print out":
38:
39: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,900LB"
40: if flg3;gto +9
41: fmt 1,10x,"3. AMPLITUDE FIDELITY (Log)",2/;wrt "prt.1"
42: fmt 6,/,10x,"SPECIFICATION: Cumulative Error  +/-1.0dB",7x,"0-80dB"
43: wrt "prt.6"
44: fmt 7,43x,"+/-1.5dB",7x,"0-90dB",/;wrt "prt.7"
45: fmt 2,10x,"MEASURED:";wrt "prt.2"
46: fmt 5,23x,"3 kHz Bandwidth",/;wrt "prt.5"
47: fmt 5,18x,"dB Down        Cumulative";wrt "prt.5"
48: fmt 5,18x,"From Ref       Error in dB";wrt "prt.5"
49: for I=0 to 4
50: 32→A→B;1→r1
51: if abs(C[2,I])>r1;42→A;sfg 1
52: if flg3;gto +3
53: fmt 3,10x,f15.1,f17.1,b,b,f15.1,b,b
54: wrt "prt.3",C[1,I],C[2,I],A,A
55: next I
56: for I=5 to 45 by 5
57: 32→A→B;1→r1
58: if I>31;1.5→r1
59: if abs(C[2,I])>r1;42→A;sfg 1
60: if flg3;next I;gto +9
61: wrt "prt.3",C[1,I],C[2,I],A,A
62: next I
63: if P=Z;gsb "cont"
64: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,850LB"
65: if P=Z;wrt "prt.6";wrt "prt.7";wrt "prt.2"
66: fmt 5,/,21x,"300 kHz Bandwidth",/;wrt "prt.5"
67: fmt 5,18x,"dB Down        Cmulative";wrt "prt.5"
68: fmt 5,18x,"From Ref       Error in dB";wrt "prt.5"
69: for I=46 to 50
70: 32→A→B;1→r1
71: if abs(C[2,I])>r1;42→A;sfg 1
72: if flg3;gto +2
73: wrt "prt.3",C[1,I],C[2,I],A,A
74: next I
75: for I=51 to 81 by 5
76: 32→A→B;1→r1
77: if abs(C[2,I])>r1;42→A;sfg 1
78: if flg3;next I;gto +3
79: wrt "prt.3",C[1,I],C[2,I],A,A
80: next I;wrt "prt";gto +6
81: prt "   TEST NO. 3     log fidelity  "
82: spc ;if not flg1;prt "     PASSED     ";gto +3
83: prt "out of tolerance";spc
84: prt "REFER TO","OPERATING AND   SERVICE MANUAL  SECTION IV"
85: fmt 6,/,16"-",/;wrt 16.6
86: 1+flg1→X[4];cfg 1
87: if P=Z;gsb "cont"
88: gto "test select"
*15823
```

"print out"

Prints headings, specifications and test results on printer. The printer may be an external HP-IB printer, the HP 9866B, or the spectrum analyzer CRT display. Out of tolerance conditions are indicated by double asterisks (**) and flag 1 is set. If flag 3 is set indicating no external printer, the HP 9825B Strip Printer is used to print the test title and "PASSED" or "out of tolerance" information.

The value of X[*] is determined for printing "yes" or "no" adjacent to the test title menu on the CRT. Program control is then returned to "test select".

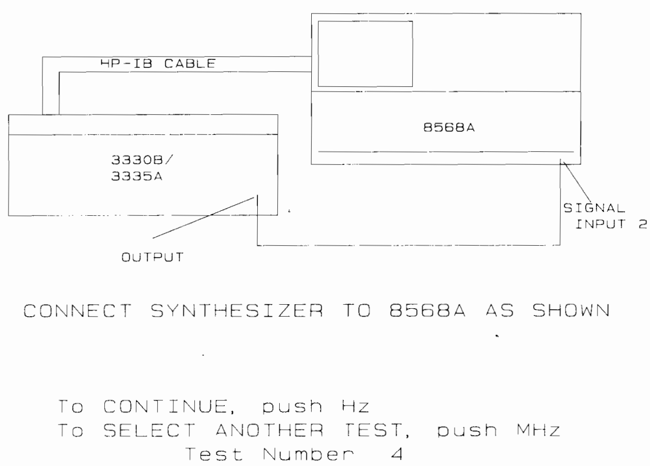
4. LOG SCALE SWITCHING

SPECIFICATION:

±0.5 dB

DESCRIPTION:

A signal source of known amplitude is input to the spectrum analyzer and the analyzer adjusted for a reference in LOG 1 dB/Division. The analyzer is then switched to each of the other LOG scales (2 dB, 5 dB, and 10 dB) and the amplitude of the signal peak is measured at each setting.



EQUIPMENT:

Automatic Synthesizer .... HP 3330B/3335A

PROCEDURE:

1. Connect equipment as shown in figure above.
2. Select test no. 4 by keying in 4 [Hz µV µsec] ([kHz mV msec] if continuous testing is desired) on the 8568A keyboard.
3. Follow the instructions as they appear on the 8568A CRT display.
4. The following is an annotated listing of the test procedure.

FILE 5

VARIABLES

A Marker amplitude, ASCII character

B ASCII character

C ASCII character

D Keyboard entry value

F Synthesizer amplitude (1 dB ref value)

P "prt" device code

V Synthesizer amplitude

Z "sa" device code

A[*] Measured data

X[*] Pass/fail indicator

FLAGS

1 Pass/fail indicator

2 Counter

3 HP 9825B Strip Printer

4 Not used

5 All tests mode

6 Repetitive testing mode

7 Abort current test

8 HP 3335A Synthesizer

9 HP 8568A Option 001

10 Not used

11 HP 3330B Option 005 Synthesizer

Log Scale Switching Test Annotated Listing

```
0: "LOG SCALE SWITCHING UNCERTAINTY ":
1: "t0f5:   821116":
2: "offsets":
3:
4: if flg5;gto "test"
5: gsb "spn"
6: if D>1;gto -1;if D=1e6;gto "test select";cfg 5,6
7:
8: "test":
9:
10: wtb "sa","IP D3PUPA256,592LBLOG SWITCHING",3
11: wrt "sa","CF7.6MZ SP0HZ RB3KZ LG1DB RL-5DM S2 TS"
12: cll 'synthesizer'(7.6,-7,0)
13: wrt "sa","TS E1 MA";red "sa",A;if A<-13;gto -8
14: cll 'on interrupt'
15: gsb "top log"
16: V}F;if flg7;gto "test select"
17: wrt "sa","LG2DB TS";gsb "top log"
18: V-F}A[1]
19: wrt "sa","LG5DB TS";gsb "top log"
20: V-F}A[2]
21: wrt "sa","LG10DB TS";gsb "top log"
22: V-F}A[3]
23:
```

"offsets"

Draws equipment setup on CRT and checks for proper keyboard entry to continue test or abort. D is the returned value from keyboard entry.

"test"

Labels test title and enables interrupt routine. Sets initial spectrum analyzer and synthesizer control settings. Verifies that signal is present.

Signal level is set to top of display in 1 dB/div and reference value is stored in F. Log scale is then switched in 2, 5, 10 dB/div sequence and error is stored in A[*].

```
24: "print out":
25:
26: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,850LB"
27: if flg3;gto +5
28: fmt 1,2/,10x,"4. LOG SCALE SWITCHING UNCERTAINTY",/;wrt "prt.1"
29: fmt 2,/,10x,"SPECIFICATION: +/-0.5dB (uncorrected)";wrt "prt.2"
30: fmt 2,2/,10x,"MEASURED:  (Ref to 1dB/div)";wrt "prt.2"
31: fmt 5,14x,c,14x,c;wrt "prt.5","Log Scale","Error in dB"
32: 32→A→B→C
33: if abs(A[1])>.5;42→A;sfg 1
34: if abs(A[2])>.5;42→B;sfg 1
35: if abs(A[3])>.5;42→C;sfg 1
36: if flg3;gto +6
37: fmt 3,14x,c,f22.2,b,b
38: wrt "prt.3"," 2dB/div",A[1],A,A
39: wrt "prt.3"," 5dB/div",A[2],B,B
40: wrt "prt.3","10dB/div",A[3],C,C;wrt "prt"
41: gto +6;if flg5 and P≠Z;cll 'LF'(6)
42: prt "   TEST NO. 4    log switching   "
43: spc ;if not flg1;prt "    PASSED";gto +3
44: prt "out of tolerance";spc
45: prt "REFER TO","OPERATING AND   SERVICE MANUAL  SECTION IV"
46: fmt 6,/,16"-",/;wrt 16.6
47: 1+flg1→X[5];cfg 1
48: if P=Z;gsb "cont"
49: gto "test select"
*276
```

"print out"

Prints headings, specifications and test results on printer. The printer may be an external HP-IB printer, the HP 9866B, or the spectrum analyzer CRT display. Out of tolerance conditions are indicated by double asterisks (**) and flag 1 is set. If flag 3 is set indicating no external printer, the HP 9825B Strip Printer is used to print the test title and "PASSED" or "out of tolerance" information.

The value of X[*] is determined for printing "yes" or "no" adjacent to the test title menu on the CRT. Program control is then returned to "test select".

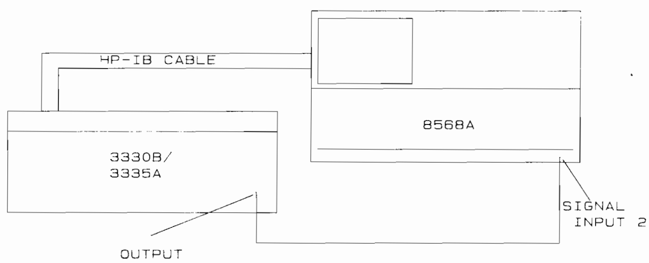
5. IF GAIN UNCERTAINTY

SPECIFICATION:

0.0 dBm to −55.9 dBm; ±0.6 dB
−56.0 dBm to −129.9 dBm; ±1.0 dB

DESCRIPTION:

A signal source of known amplitude is input to the spectrum analyzer and the analyzer is adjusted for a reference level. The amplitude of the signal peak is measured in .1 dB steps from −0.1 dBm to −1.8 dBm, in 1 dB steps from −2.0 dBm to −9.0 dBm, in 10 dB steps from −10 dBm to −50 dBm, and also in 10 dB steps from −10 dBm to −70 dBm. Next, the log offset amplifiers (LG10, LG20-1, and LG20-2) are checked.



CONNECT SYNTHESIZER TO 8568A AS SHOWN

To CONTINUE, push Hz
To SELECT ANOTHER TEST, push MHz
Test Number 5

EQUIPMENT:

Automatic Synthesizer . . . . HP 3330B/3335A

PROCEDURE:

1. Connect equipment as shown in figure above.
2. Select test no. 5 by keying in 5 [Hz µV µsec] ([kHz mV msec] if continuous testing is desired) on the 8568A keyboard.
3. Follow the instructions as they appear on the 8568A CRT display.
4. The following is an annotated listing of the test procedure.

FILE 6

VARIABLES

A Marker amplitude, ASCII character

B Marker amplitude

D Keyboard entry, amplitude step size

I Loop counter

L Reference level

P "prt" device code

R Reference level error

Z "sa" device code

D[*] Measured data

X[*] Pass/fail indicator

r1 Specification limits

FLAGS

1 Pass/fail indicator

2 Counter

3 HP 9825B Strip Printer

4 Not used

5 All tests mode

6 Repetitive testing mode

7 Abort current test

8 HP 3335A Synthesizer

9 HP 8568A Option 001

10 Not used

11 HP 3330B Option 005 Synthesizer

IF Gain Uncertainty Test Annotated Listing

```
0: "IF GAIN UNCERTAINTY ":
1: "t0f6:   821116":
2: "IF Gain":
3:
4: if flg5;gto "test"
5: gsb "syn"
6: if D)1;gto -1;if D=1e6;gto "test select";cfg 5,6
7:
8: "test":
9:
10: wtb "sa","IP D3PUPA224,592LBIF GAIN UNCERTAINTY",3
11: wrt "sa","CF7.6MZ AT10DB RB3KZ RL0DM"
12: wrt "sa","SP1KZ VB300HZ LN KSA TS S2"
13: cll 'synthesizer'(7.6,-3,0)
14: wrt "sa","KSI TS E1E2 TS MA";red "sa",A
15: if A(-9 or A)0;gto -10
16: cll 'on interrupt'
17: gto +7
18: "measure step":L-D}L
19: cll 'synthesizer'(7.6,L-3)
20: wrt "sa","RL",L,"DM"
21: wtb "sa","TS MA";red "sa",A;if I=1 or I=28;A-L}R;ret
22: A-R-L}D[2,I-1];L}D[1,I-1];ret
23: ".1dB step":
24: .1}L;.1}D
25: for I=1 to 11
26: if I=4;.2}D
27: gsb "measure step";if flg7;gto "test select"
28: next I
```

"IF Gain"

Draws equipment setup on CRT and checks for proper keyboard entry to continue test or abort. D is the returned value from keyboard entry.

"test"

Labels test title and enables interrupt routine. Initial control settings for spectrum analyzer and synthesizer are made. Verifies that signal is present.

"measure step"

Reference level of spectrum analyzer is set to L and synthesizer output level is set 3 dB below this value. The first time "measure step" is called in the 3 kHz resolution bandwith (I = 1) and the 1 kHz resolution bandwidth (I = 28) a reference value is stored in R. The reference level is stored in D [1,*] and the corresponding error in D [2,*].

".1 dB step"

A for/next loop steps the reference level in 0.1 or 0.2 dB steps from the −0.1 to −1.8 dBm to measure the 0.1 dB step gains.

```
29: "1dB step":
30: -1}L;1}D
31: for I=12 to 19
32: gsb "measure step";if flg7;gto "test select"
33: next I
34: "10dB step":
35: 0}L;10}D
36: wrt "sa","VB30HZ"
37: for I=20 to 24
38: gsb "measure step";if flg7;gto "test select"
39: next I
40: "1kHz step gain":
41: 10}L;10}D;wrt "sa","RB1KZ TS E1 E2 TS E1"
42: for I=28 to 35
43: if I=35;wrt "sa","VB10HZ TS E1"
44: gsb "measure step";if flg7;gto "test select"
45: next I
46: "log offset amps":
47: -50}L;cll 'synthesizer'(7.6,-48,0)
48: wrt "sa","KSq SP50KZ RB3KZ AT10DB LG10DB RL-50DM VB30HZ"
49: wrt "sa","S2 CT TS E1E2 SP3KZ TS E1 MA";red "sa",B
50: for I=25 to 27
51: wrt "sa","RLDN";L-10}L;if I=27;wrt "sa","RLDN";L-10}L
52: wrt "sa","TS MA";red "sa",A;A-B+D[2,23]}D[2,I-1]
53: L}D[1,I-1]
54: next I
55:
56: "print out":
57:
58: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,950LB"
59: if flg3;gto +12
60: fmt 1,10x,"5. IF GAIN UNCERTAINTY";wrt "prt.1"
61: fmt 5,2/,10x,c
62: wrt "prt.5","SPECIFICATION: Reference Level (uncorrected)"
63: fmt 5,/,25x,"Range",11x,"Error";wrt "prt.5"
64: fmt 5,19x,"0.0 to  -55.9dBm       +/-0.6dB";wrt "prt.5"
65: fmt 5,19x,"-56 to -129.9dBm       +/-1.0dB",/;wrt "prt.5"
66: fmt 2,10x,"MEASURED:  (attenuator set at 10dB)";wrt "prt.2"
67: fmt 4,/,23x,"3kHz Bandwidth",/;wrt "prt.4"
68: fmt 6,15x,"Reference",12x,"Error in dB",/;wrt "prt.6"
69: fmt 8,17x,"Level",15x,"(Ref to",/,17x,"(dBm)",13x,f7.2,"dBm)",/
70: wrt "prt.8",0;.6}r1
71: for I=1 to 26;32}A
72: if I>22;1}r1
73: if abs(D[2,I])>r1;42}A;sfg 1
74: if flg3;next I;gto +14
75: if I=24;fmt 5,/,24x,"Log Offsets",/;wrt "prt.5"
76: fmt 3,10x,f12.1,f20.2,b,b
77: wrt "prt.3",D[1,I],D[2,I],A,A
78: if I#10 and I#23;gto +4
79: if P=Z;gsb "cont"
80: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,950LB"
81: wrt "prt.2";wrt "prt.4";wrt "prt.6";wrt "prt.8",0
82: next I
83: if P=Z;gsb "cont"
84: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,850LB"
85: fmt 5,/,23x,"1kHz Bandwidth";wrt "prt.5"
86: fmt 5,15x,"Reference",19x,"Error in dB",/;wrt "prt.5"
87: wrt "prt.2",0;.6}r1
88: for I=28 to 34;32}A
89: if I>30;1}r1
90: if abs(D[2,I])>r1;42}A;sfg 1
91: if flg3;next I;gto +4
92: wrt "prt.3",D[1,I],D[2,I],A,A
93: next I;wrt "prt"
94: gto +6;if flg5 and P#Z;cll 'LF'(4)
95: prt "   TEST NO. 5       I.F. gains    "
96: spc ;if not flg1;prt "      PASSED";gto +3
97: prt "out of tolerance";spc
98: prt "REFER TO        OPERATING AND   SERVICE MANUAL  SECTION IV"
99: fmt 6,/,16"-",/;wrt 16.6
100: 1+flg1}X[6];cfg 1
101: if P=Z;gsb "cont"
102: gto "test select"
*24283
```

"1 dB step"

A for/next loop steps the reference level in 2 dB steps from −2.0 to −9.0 dBm to measure the 1 and 2 dB step gains.

"10 dB step"

A for/next loop steps the reference level in 10 dB steps from −10.0 to −50.0 dBm to measure the 10 dB step gains.

"1 kHz step gain"

Resolution bandwidth is set to 1 kHz and all step gains are re-measured. A new reference value is established the first time through the for/next loop.

"log offset amps"

A for/next loop steps the reference level in 10 dB steps from −60 to −90 dBm to measure the log offset gains.

"print out"

Prints headings, specifications and test results on printer. The printer may be an external HP-IB printer, the HP 9866B, or the spectrum analyzer CRT display. Out of tolerance conditions are indicated by double asterisks (**) and flag 1 is set. If flag 3 is set indicating no external printer, the HP 9825B Strip Printer is used to print the test title and "PASSED" or "out of tolerance" information.

The value of X[*] is determined for printing "yes" or "no" adjacent to the test title menu on the CRT. Program control is then returned to "test select".

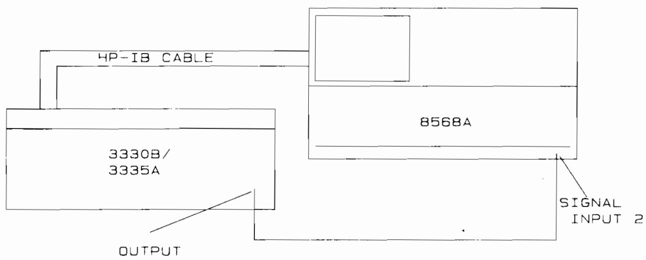
6. FREQUENCY SPAN ACCURACY

SPECIFICATION:

For spans >1 MHz; ±(2% of the actual frequency separation, +0.5% of span setting).
For spans ≤1 MHz; ±(5% of the actual frequency separation, +0.5% of span setting).

DESCRIPTION:

A stable signal source is input to the spectrum analyzer and the analyzer center frequency and span set to measure spans of 10 MHz, 1 MHz, and 100 kHz.



CONNECT SYNTHESIZER TO 8568A AS SHOWN

To CONTINUE, push Hz
To SELECT ANOTHER TEST, push MHz
Test Number 6

EQUIPMENT:

Automatic Synthesizer . . . . HP 3330B/3335A

PROCEDURE:

1. Connect equipment as shown in figure above.
2. Select test no. 6 by keying in 6 [Hz µV µsec] ([kHz mV msec] if continuous testing is desired) on the 8568A keyboard.
3. Follow the instructions as they appear on the 8568A CRT display.
4. The following is an annotated listing of the test procedure.

FILE 7

VARIABLES

A ASCII character

B ASCII character

C ASCII character

D Keyboard entry

F Synthesizer frequency

I Loop counter

J Loop counter

M Marker amplitude

P "prt" device code

Z "sa" device code

A[*] Maximum error in measured data

X[*] Pass/fail indicator

r5-13 Measured data

r14-16 Specification limits

p1 Center frequency

p2 Frequency span

p3 Maximum error in measurement

FLAGS

1 Pass/fail indicator

2 Counter

3 HP 9825B Strip Printer

4 Not used

5 All tests mode

6 Repetitive testing mode

7 Abort current test

8 HP 3335A Synthesizer

9 HP 8568A Option 001

10 Not used

11 HP 3330B Option 005 Synthesizer

Frequency Span Accuracy Test Annotated Listing

```
0: "FREQUENCY SPAN ACCURACY":
1: "t0f7:   821116":
2: "span accuracy":
3:
4: if flg5;gto "test"
5: gsb "syn"
6: if D)1;gto -1;if D=1e6;gto "test select";cfg 5,6
7:
8: "test":
9:
10: wtb "sa","IP D3PUPA192,592LBFREQUENCY SPAN ACCURACY",3
11: cll 'on interrupt'
12: 32}A}B}C
```

"span accuracy"

Draws equipment setup on CRT and checks for proper keyboard entry to continue test or abort. D is the returned value from keyboard entry.

"test"

Labels test title on CRT and enables interrupt routine.

```
13: "10 MHz span":'span'(6,10)→A[1];if flg1;42→A
14: if flg7;gto "test select"
15: "1 MHz span":'span'(10,1)→A[2];if flg1;42→B
16: if flg7;gto "test select"
17: "100 KHz span":'span'(10,.1)→A[3];if flg1;42→C
18: if max(A,B,C)=42;sfg 1
19: if max(A[1],A[2],A[3])=0;gto -14
20: gto "print out"
21:
22: "span":
23: fmt 9,c,f.0,c,f.1,c;cfg 1
24: wrt "sa.9","CF",p1,"MZ SP",p2,"MZ"
25: wrt "sa","RBDN";0→I
26: for F=p1-.4p2 to p1+.4p2 by .1p2
27: cll 'synthesizer'(F,-10,0);if flg7;ret p3
28: wrt "sa","TS E1 MF";red "sa",r(5+I);r(5+I)/1e6→r(5+I)
29: if I=0;wrt "sa","MA";red "sa",M;if M<-60;0→p3;ret p3
30: I+1→I;next F;wrt "sa","CR"
31: 0→p3;for I=0 to 7
32: for J=I+1 to 7
33: .1(J-I)p2→p4
34: if p2>1;if abs(r(5+J)-r(5+I)-p4)>p3;.02p4+.005p2→r14
35: if p2=1;if abs(r(5+J)-r(5+I)-p4)>p3;.05p4+.005p2→r15
36: if p2<1;if abs(r(5+J)-r(5+I)-p4)>p3;.05p4+.005p2→r16
37: max(abs(r(5+J)-r(5+I)-p4),p3)→p3
38: cfg 4;next J;next I
39: if p2>1;if p3>r14;sfg 1
40: if p2=1;if p3>r15;sfg 1
41: if p2<1;if p3>r16;sfg 1
42: ret p3*1e3
43:
44: "print out":
45:
46: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,850LB"
47: if flg3;gto +16
48: fmt 1,10x,"6. FREQUENCY SPAN ACCURACY",2/;wrt "prt.1"
49: fmt 2,10x,"SPECIFICATION:",/;wrt "prt.2"
50: fmt 5,17x,c;wrt "prt.5","Spans >1MHz, +-(2% of actual frequency"
51: wrt "prt.5"," separation +0.5% of total span)"
52: wrt "prt";wrt "prt.5","Spans <=1MHz, +/-(5% of actual frequency"
53: wrt "prt.5"," separation +0.5% of total span)";wrt "prt"
54: fmt 2,10x,"MEASURED:";wrt "prt.2"
55: fmt 5,16x,c
56: wrt "prt.5","Frequency Span      Max Freq           Max Freq"
57: wrt "prt.5","   Setting        Error Measured    Error Allowed"
58: wrt "prt.5","    (MHz)              (kHz)              (kHz)"
59: fmt 2,20x,f4.1,11x,f7.1,b,b,10x,f7.1
60: wrt "prt.2",10,A[1],A,A,r14*1e3
61: wrt "prt.2",1,A[2],B,B,r15*1e3
62: wrt "prt.2",.1,A[3],C,C,r16*1e3;wrt "prt";gto +6
63: prt "   TEST NO. 6    frequency span "
64: spc ;if not flg1;prt "    PASSED";gto +3
65: prt "out of tolerance";spc
66: prt "REFER TO","OPERATING AND   SERVICE MANUAL  SECTION IV"
67: fmt 6,/,16"-",/;wrt 16.6
68: 1+flg1→X[7];cfg 1
69: if P=Z;gsb "cont"
70: gto "test select"
*15311
```

"10 MHz span"

The function "span" returns the maximum error measured for a 10 MHz frequency span. The value is stored in A[1].

"1 MHz span"

The function "span" returns the maximum error measured for a 1 MHz frequency span. The value is stored in A[2].

"100 kHz span"

The function "span" returns the maximum error measured for a 100 kHz frequency span. The value is stored in A[3].

"span"

The spectrum analyzer center frequency and span are set according to the calling program. The synthesizer frequency is then incremented in 1/10 span steps and the spectrum analyzer reads the corresponding marker value and stores it in r(*).

The r(*) matrix elements are then compared to find the maximum error between any two elements. The maximum value is stored in p3. p3 is then compared to the specification and flag 1 is set for an out-of-tolerance condition.

"print out"

Prints headings, specifications, and test results on printer. The printer may be an external HP-IB printer, the HP 9866B or the spectrum analyzer CRT display. Out-of-tolerance conditions are indicated by double asterisks (**) and flag 1 is set. If flag 3 is set indicating no external printer, the HP 9825B Strip Printer is used to print the test title and "PASSED" or "out of tolerance" information.

The value of X[*] is determined for printer "yes" or "no" adjacent to the test title menu on the CRT. Program control is then returned to "test select".

7. SWEEP TIME ACCURACY

SPECIFICATION:

Sweep time ≤100 sec; ±10%
Sweep time >100 sec; ±20%

DESCRIPTION:

An internal measurement function is used to measure the sweep time at 20 msec, 100 msec, 750 msec, 5 sec, 30 sec, 200 sec, and 1500 sec. These sweep times were chosen so as to check all of the sweep time multipliers in the Sweep Generator Current Source circuit (A22 Frequency Control). Sweep start-up time (offset) is measured and subtracted from the measured sweep time. The measured sweep time is compared to the selected sweep time and the percent error calculated.

EQUIPMENT:

No equipment required.

PROCEDURE:

1. Select test no. 7 by keying in 7 [Hz µV µsec] ([kHz mV msec] if continuous testing is desired) on the 8568A keyboard.
2. Follow the instructions as they appear on the 8568A CRT display.
3. The following is an annotated listing of the test procedure.

FILE 8

VARIABLES		FLAGS	
A	Sweep Start Reference, ASCII character	1	Pass/fail indicator
B	Measured sweep time, ASCII character	2	Counter
C	ASCII character	3	HP 9825B Strip Printer
D	ASCII character	4	Not used
E	ASCII character	5	All tests mode
I	Loop counter	6	Repetitive testing mode
J	Sweep Time Multiplier	7	Abort current test
P	"prt" device code	8	HP 3335A Synthesizer
Z	"sa" device code	9	HP 8568A Option 001
B[*]	Measured data	10	Not used
X[*]	Pass/fail indicator	11	HP 3330B Option 005 Synthesizer
r1	Specification limits		
r3	Counter		

Sweep Time Accuracy Test Annotated Listing

```
0: "SWEEP TIME ACCURACY ":
1: "t0f8:   811027":
2: "sweep time":
3:
4: "test":
5:
6: wtb "sa","IP D3PUPA224,592LBSWEEP TIME ACCURACY",3
7: cll 'on interrupt';wtb "sa","PUPA350,310LBto ABORT push MHz ",3
8: for I=0 to 30 by 5;0→r3
9: "retry":if I<30;gto +3
10: wtb "sa","PUPA172,352LB",17,"TESTING 1500 sec SWEEP TIME",18,3
11: wtb "sa","PUPA172,320LBMEASUREMENT TIME ",185," 100sec",3
12: wrt "sa","M2 0HZ KSu KSu KSu KSF OA";red "sa",A
13: if I<13;wrt "sa","M2 1500MZ";1→J
14: if I>12 and I<19;wrt "sa","M2 301MZ";5→J
15: if I>18 and I<24;wrt "sa","M2 151MZ";10→J
16: if I>23;wrt "sa","M2 31MZ";50→J
17: if flg7;gto "test select"
18: wrt "sa","ST OA";red "sa",B[1,I/5+1]
19: wrt "sa","KSF OA";red "sa",B;J(B-A)→B[2,I/5+1]
20: 100(J(B-A)-B[1,I/5+1])/B[1,I/5+1]→B[3,I/5+1]
21: if abs(B[3,I/5+1])>20 and r3<2;1+r3→r3;gto "retry"
22: wrt "sa","ST UP UP UP UP";if I>1;wrt "sa","ST UP"
23: next I
```

"test"

Labels test title on CRT and enables interrupt routine. The marker is placed at the left edge of the CRT and a sweep is started. The internal spectrum analyzer counter is used to measure the sweep time (KSF). The first measurement determines the sweep start-up time, which is stored in A. The marker is then moved to a selected position on the CRT display and another sweep is taken. The percent error is determined and stored in B[3*]. If the error is greater than 20%, the procedure is repeated two more times before the next sweep time is selected.

```
24:
25: "print out":
26:
27: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,850LB"
28: if flg3;gto +8
29: fmt 1,2/,10x,"7. SWEEP TIME ACCURACY",3/;wrt "prt.1"
30: fmt 2,10x,"SPECIFICATION: Sweep Time <=100sec, +/-10%";wrt "prt.2"
31: fmt 3,37x,">100sec, +/-20%",/;wrt "prt.3"
32: fmt 2,10x,"MEASURED:",/;wrt "prt.2"
33: fmt 1,16x,c,8x,c,8x,c
34: wrt "prt.1","Sweep Time","Sweep Time","Sweep Time"
35: wrt "prt.1"," setting  "," measured "," % error";wrt "prt"
36: for I=1 to 7;32→A
37: 109→B;115→C;101→D;99→E;if I>3;32→B
38: if I<4;B[2,I]*1e3→B[2,I]
39: if I<4;B[1,I]*1e3→B[1,I]
40: 10→r1;if I>5;20→r1
41: if abs(B[3,I])>r1;42→A;sfg 1
42: if I=1;if B[2,I]<18.5;42→A;sfg 1
43: if flg3;next I;gto +4
44: fmt 2,14x,f8.0,b,b,b,b,4x,f10.2,b,b,b,b,4x,f10.1,"%",b,b
45: wrt "prt.2",B[1,I],B,C,D,E,B[2,I],B,C,D,E,B[3,I],A,A
46: next I;wrt "prt";gto +6
47: prt "   TEST NO. 7       sweep time"
48: spc ;if not flg1;prt "     PASSED";gto +3
49: prt "out of tolerance";spc
50: prt "REFER TO","OPERATING AND   SERVICE MANUAL  SECTION IV"
51: fmt 3,/,16"-",/;wrt 16.3
52: 1+flg1→X[8];cfg 1
53: if P=Z;gsb "cont"
54: gto "test select"
*16546
```

"print out"

Prints headings, specifications, and test results on printer. The printer may be an external HP-IB printer, the HP 9866B, or the spectrum analyzer CRT display. Out-of-tolerance conditions are indicated by double asterisks (**) and flag 1 is set. If flag 3 is set indicating no external printer, the HP 9825B Strip Printer is used to print the test title and "PASSED" or "out of tolerance" information.

The value of X[*] is determined for printer "yes" or "no" adjacent to the test title menu on the CRT. Program control is then returned to "test select".

8. RESOLUTION BANDWIDTHS

SPECIFICATION:

Bandwidth: 3 MHz to 10 Hz; ±20%
1 MHz to 3 kHz; ±10%

Amplitude: (Referenced to 1 MHz amplitude)

3 MHz; ±1.0 dB	30 Hz; ±0.8 dB
1 MHz to 100 Hz; ±0.5 dB	10 Hz; ±2.0 dB

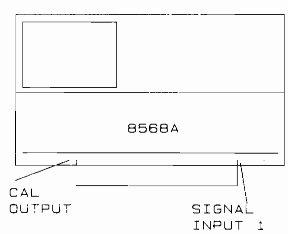
Selectivity: (60 dB/3 dB ratio)
3 MHz to 100 kHz; <15:1
30 kHz to 10 kHz; <13:1
3 kHz to 30 Hz; <11:1
10 Hz: <100 Hz separation of 60 dB points

DESCRIPTION:

The spectrum analyzer CAL OUTPUT signal is connected to the analyzer input. The analyzer steps through the bandwidths from 3 MHz to 10 Hz, centers the signal, sets signal peak to near the reference level, and measures the frequency of the 3-dB points for each bandwidth. The 3-dB bandwidth is then calculated by determining the difference in frequency between the 3-dB points.

Next, the analyzer steps through the bandwidths from 3 MHz to 10 Hz, centers the signal, sets signal peak to near the reference level, and measures the frequency of the 60-dB points of each bandwidth. The 60-dB bandwidth is then calculated by determining the frequency difference between the 60-dB points.

The shape factor is then calculated by dividing the 60-dB bandwidth by the 3-dB bandwidth.




```
CONNECT BNC CABLE FROM CAL OUTPUT TO
   SIGNAL INPUT 1

  To CONTINUE, push Hz
  To SELECT ANOTHER TEST, push MHz
         Test Number  8
```

EQUIPMENT:

No equipment required.

PROCEDURE:

1. Connect cable as shown in figure above.
2. Select test no. 8 by keying in 8 [Hz μV μsec] ([kHz mV msec] if continuous testing is desired) on the 8568A keyboard.
3. Follow the instructions as they appear on the 8568A CRT display.
4. The following is an annotated listing of the test procedure.

FILE 9

VARIABLES

A ASCII character

B ASCII character

C Multiplier

D Keyboard entry, Input selector, 1 MHz BW amplitude

F Recall 8 amplitude, center frequency

G Error limit

I Loop counter

K Counter

N + or − indicator

P "prt" device code

S Frequency Span

Z "sa" device code

A[*] Measured data

B[*] Measured data

X[*] Pass/fail indicator

r1-3 Specification limits

FLAGS

1 Pass/fail indicator

2 Counter

3 HP 9825B Strip Printer

4 Not used

5 All tests mode

6 Repetitive testing mode

7 Abort current test

8 HP 3335A Synthesizer

9 HP 8568A Option 001

10 Not used

11 HP 3330B Option 005 Synthesizer

Resolution Bandwidth Test Annotated Listing

```
0: "RESOLUTION BANDWIDTH ":
1: "t0f9:   821122":
2: "3dB bandwidth ":
3:
4: gsb "RSBW"
5: if D>1;gto -1;if D=1e6;gto "test select";cfg 5,6
6: if abs(F+10)>.2;ldf 16,249,253
7:
```

"3 dB bandwidth"

Draws equipment setup on CRT and checks for proper keyboard entry to continue test or abort. D is the returned value from keyboard entry.

If the signal amplitude is not −10.0 ±0.2 dBm, "pre-test" (file 16) is loaded and run. Program control is then returned to "test-select".

```
8: "test":
9:
10: wtb "sa","IP D3PUPA224,592LBRESOLUTION BANDWIDTH",3
11: 49+flg9→D;wtb "sa","I",D,"CF20MZ LN RL-8DM KSA KST  S2 RB3MZ"
12: cll 'on interrupt'
13: for I=1 to 12;if flg7;gto "test select"
14: wrt "sa","RBOA";red "sa",B[1,I];max(100,2B[1,I])→S
15: wrt "sa","SP",S,"HZ"
16: wrt "sa","TS E1 MA";red "sa",B[3,I];if B[3,I]<-17 or B[3,I]>-8;gto -12
17: wrt "sa","MF";red "sa",B[4,I]
18: wrt "sa","CFOA";red "sa",F
19: if abs(B[4,I]-F)>S/5;wrt "sa","E2";gto -3
20: wrt "sa","E1M3";1→N;-3→A[7];.1→G;.4→C
21: gsb "meas";if S<1000;gsb "search"
22: A[10]-A[8]→B[2,I]
23: wrt "sa","M1 RBDN";next I
24:
25: "shape factor":
26: wtb "sa","IP D3PUPA208,592LBBANDWIDTH SELECTIVITY",3
27: 49+flg9→D;wtb "sa","I",D,"KSI AT0DB RL-8DM RB100KZ KST S2 TS"
28: cll 'on interrupt'
29: for I=1 to 12
30: if I≠4 and I≠5 and I≠7 and I≠12;next I
31: min(2.5e7,B[1,I]*18)→S;if flg7;gto "test select"
32: wrt "sa","CF",B[4,I],"HZ SP",S,"HZ RB",B[1,I],"HZ VB",B[1,I]/10,"HZ TS"
33: wrt "sa","E1MF";red "sa",F
34: if abs(B[4,I]-F)>S/10;wrt "sa","E2TS";gto -1
35: wrt "sa","E1 M3";1→N;-60→A[7];.2→G;5→C
36: gsb "meas";if S<1000;gsb "search"
37: A[10]-A[8]→B[5,I]
38: wrt "sa","M1";next I
39:
```

"test"

Labels test title CRT and enables interrupt routine. Sets initial spectrum analyzer control settings.

For each of the 12 resolution bandwidths, the bandwidth setting is stored in B[1,*]. The Frequency Span is set to the larger of 100 Hz or twice the resolution bandwidth. The peak amplitude of the response is stored in B[3*] and the corresponding frequency in B[4,*]. The center frequency, F, is read and if the peak response is not within two divisions of the center of the display, signal is re-centered and the sweep is retaken. The Marker Delta function is actuated and either "meas" or "search", depending on the frequency span, is called to determine the 3-dB points of the response, which is stored in B[2*].

"shape factor"

Labels test title on CRT and enables interrupt routine. Sets initial spectrum analyzer control settings.

This routine determines the 60-dB points for 4 of the resolution bandwidths. The frequency span, S, is set to 25 MHz or 18 times the resolution bandwidth, B[1*]. The video bandwidth is set to 1/10 of the resolution bandwidth.

The center frequency, F, is read and the signal re-centered if not within 1 division of the center of the display. Marker Delta is enabled and either "meas" or "search" called to determine the 60-dB points of the response, which are stored in B[5*].

```
40: "print out":
41:
42: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,950LB"
43: if flg3;gto +22
44: fmt 1,2/,10x,"8. RESOLUTION BANDWIDTH",2/;wrt "prt.1"
45: fmt 2,10x,"SPECIFICATION:";wrt "prt.2"
46: fmt 5,2/,16x,"Bandwidth     3MHz-10Hz  +/-20%";wrt "prt.5"
47: fmt 5,16x,"Accuracy      1MHz-3kHz  +/-10%";wrt "prt.5"
48: fmt 5,/,16x,"Amplitude    (ref to 1MHz amplitude)";wrt "prt.5"
49: fmt 5,16x,"Switching      3MHz          +/-1.0dB";wrt "prt.5"
50: fmt 5,16x,"Uncertainty    1MHz-100Hz  +/-0.5dB";wrt "prt.5"
51: fmt 5,31x,"30Hz          +/-0.8dB",/;wrt "prt.5"
52: fmt 5,31x,"10Hz          +/-2.0dB",/;wrt "prt.5"
53: fmt 5,15x,"60dB/3dB RATIO  3MHz-100kHz  <15:1";wrt "prt.5"
54: fmt 5,31x,"30kHz-10kHz  <13:1";wrt "prt.5"
55: fmt 5,31x,"3kHz - 30Hz  <11:1";wrt "prt.5"
56: fmt 5,31x,"10Hz  <100Hz between 60dB points",/;wrt "prt.5"
57: if flg5 and P≠Z;cll 'LF'(4)
58: if P=Z;gsb "cont"
59: if P=Z;wrt "sa","EM KSi EM KSo KSm DT@ A4 D2 PUPA50,850LB"
60:
61: fmt 2,10x,"MEASURED:";wrt "prt.2"
62: fmt 5,12x,c,6x,c,6x,c,5x,c
63: wrt "prt.5","Res BW ","Res BW ","Res BW","Amplitude"
64: wrt "prt.5","Setting","Reading","%Error","Deviation";wrt "prt"
65: B[3,2]→D
66: for I=1 to 12
67: 32→A→B
68: if I≠12;B[5,I]/B[2,I]→B[5,I]
69: 100(B[2,I]-B[1,I])/B[1,I]→B[4,I]
70: B[3,I]-D→B[3,I]
71: 10→r1;.5→r2
72: if I=1;20→r1;1→r2
73: if I>7;20→r1
74: if I=11;.8→r2
75: if I=12;2→r2
76: if abs(B[3,I])>r2;42→B;sfg 1
77: if flg3;next I;gto +6
78: fmt 2,10x,f9.0,4x,f9.0,f9.0," %",b,b,f10.2," dB",b,b
79: wrt "prt.2",B[1,I],B[2,I],B[4,I],A,A,B[3,I],B,B
80: next I
81: if P=Z;gsb "cont"
82: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,850LB"
83: 15→r3
84: if not flg3;fmt 2,/,/,13x,c;wrt "prt.2","60dB/3dB RATIO"
85: for I=1 to 12
86: if I≠4 and I≠5 and I≠7 and I≠12;next I
87: 32→A
88: if I>4;13→r3
89: if I>6;11→r3
90: if I=12;100→r3
91: if abs(B[5,I])>=r3;42→A;sfg 1
92: if flg3;gto +8
93: fmt 2,30x,f3.0,c," BW --- ",f5.2,":1",b,b
94: if I<3;wrt "prt.2",B[1,I]/1e6,"MHz",B[5,I],A,A;gto +4
95: if I<9;wrt "prt.2",B[1,I]/1e3,"kHz",B[5,I],A,A;gto +3
96: if I=12;fmt 2,16x,"at 60dB points",f3.0,c," BW --- ",f5.2,"Hz",b,b
97: wrt "prt.2",B[1,I]," Hz",B[5,I],A,A
98: next I
99: wrt "prt";gto +6
100: prt "   TEST NO. 8      bandwidths   "
101: spc ;if not flg1;prt "    PASSED";gto +3
102: prt "out of tolerance";spc
103: prt "REFER TO","OPERATING AND   SERVICE MANUAL  SECTION IV"
104: fmt 6,/,16"-",/;wrt 16.6
105: 1+flg1→X[9];cfg 1
106: if P=Z;gsb "cont"
107: gto "test select"
108:
```

"print out"

Prints headings, specifications, and test results on printer. The printer may be an external HP-IB printer, the HP 9866B or the spectrum analyzer CRT display. Out-of-tolerance conditions are indicated by double asterisks (**) and flag 1 is set. If flag 3 is set indicating no external printer, the HP 9825B Strip Printer is used to print the test title and "PASSED" or "out of tolerance" information.

The value of X[*] is determined for printer "yes" or "no" adjacent to the test title menu on the CRT. Program control is then returned to "test select".

```
109: "meas":0→K;N*B[1,I]*C→A[1];cfg 2
110: if abs(A[1])>S/2;A[1]/2→A[1];jmp 0
111: "read":wrt "sa","MF",A[1],"HZ MA";red "sa",A[2]
112: if abs(A[2]-A[7])<G;gto "hit"
113: A[1]→A[5];A[2]→A[6]
114: K+1→K;if K#1;gto +3
115: A[1]→A[3];A[2]→A[4]
116: N*B[1,I]*(A[4]-A[7])/(40/(5-3(I>10)))+A[3]→A[1];gto "read"
117: if K>20;gto "hit"
118: if A[6]-A[4]=0;A[1]+N→A[1];K+1→K;gto "read"
119: (A[5]-A[3])/(A[6]-A[4])→A[9]
120: int(A[9]*(A[7]-A[6])+A[5])→A[1]
121: if abs(A[1]-A[3])<S/667 and abs(A[1]-A[5])<S/667;gto "hit"
122: if abs(A[6]-A[7])<abs(A[4]-A[7]);A[6]→A[4];A[5]→A[3]
123: if A[1]=A[3];A[1]+N→A[1]
124: if A[9]*N<0;gto "read"
125: if not flg2;0→K;A[3]/2→A[1];sfg 2;gto "read"
126: "hit":A[1]→A[9+N]
127: if N=1;-1→N;gto "meas"
128: ret
129: "search":wrt "sa","O1 DA2051 DR";red "sa",A[5]
130: wrt "sa","DR";red "sa",A[6]
131: A[6]-2048→A[6]
132: if A[7]=-3;A[6]/√2→A[7]
133: if A[7]=-60;A[6]-600→A[7]
134: 200→A[1]
135: wrt "sa","DA",A[5]+A[1]
136: A[6]→A[4]
137: wrt "sa","DR";red "sa",A[2]
138: if A[4]=A[6] and A[2]<A[7];A[1]-10→A[1];gto -3
139: if abs(A[7]-A[2])>abs(A[7]-A[4]) and A[2]<A[7];gto +4
140: if abs(A[7]-A[2])<abs(A[7]-A[4]);A[2]→A[4]
141: A[1]+1→A[1];if A[5]+A[1]=1024;gto +2
142: jmp -5
143: A[1]*S/1000→A[10]
144: max(-A[1],1-A[5])→A[1]
145: wrt "sa","DA",A[5]+A[1]
146: A[6]→A[4]
147: wrt "sa","DR";red "sa",A[2]
148: if A[4]=A[6] and A[2]>A[7];max(1-A[5],A[1]-10)→A[1];gto -3
149: if abs(A[7]-A[2])>abs(A[7]-A[4]) and A[2]>A[7];gto +4
150: if abs(A[7]-A[2])<abs(A[7]-A[4]);A[2]→A[4]
151: A[1]+1→A[1];if A[1]>0;gto +2
152: jmp -5
153: A[1]*S/1000→A[8]
154: wrt "sa","O3"
155: ret
*30221
```

"meas"

The "meas" subprogram is used to find the −3 and −60-dB points of the bandwidth filters. A[7] contains the required point and G the acceptable error limit.

The measurement is made using the Marker Delta function as follows:

An initial frequency offset is calculated based on the resolution bandwidth B[1*] and the variable C. This value is stored in A[1]. A sweep is taken and the marker frequency, A[1], and marker amplitude A[2], are read and stored in A[5] and A[6] respectively. When A[7] and A[2] are within the error limit set by G, execution branches to "hit".

If A[7] and A[2] are not within the error limit, a new offset frequency, A[1] must be determined. The first time this is done, A[2] is placed in A[4] which contains the measured amplitude of the best previous trial. The corresponding frequency is stored in A[3]. A new offset frequency is estimated and another sweep is taken. After two points on the bandwidth filter response are known, the slope, A[9], can be calculated and the next offset frequency, A[1], estimated.

The trials, K, continue until one of 3 conditions is met:

1. The amplitude is within the tolerance set by G
2. The frequency offset is less than 1/667 of the frequency span
3. More than 20 trials have occurred.

Then "hit" stores the Frequency of the 3- or 60-dB point in A[10] and sets N to −1. The above procedure is then repeated to find the frequency of the lower 3- or 60-dB point which is stored in A[8].

"search"

The "search" subprogram is essentially the same as "meas". It provides better accuracy in determining the 3- or 60-dB points as the actual digital display data are used. The A[*] variables are the same.

"search" starts by locating the Marker peak stored in Page 3 of the Digital Storage Memory. The frequency, A[5], and amplitude, A[6], values in display units are then read. The appropriate A[7], 3- or 60-dB point, is then calculated. The upper A[10], and lower, A[8], frequency values are then found by searching through the Trace A (Page 1 of Memory) data. As A[1] is in display units it must be converted to frequency by multiplying the frequency span, S, divided by 1000.

9. RESIDUAL FM

SPECIFICATION:

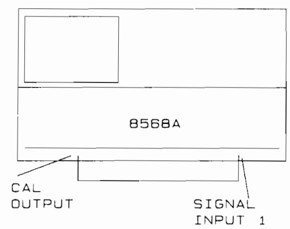
<3 Hz peak-to-peak for sweep time ≤10 sec; span <100 kHz; resolution bandwidth ≤30 Hz, video bandwidth ≤30 Hz.

DESCRIPTION:

The spectrum analyzer CAL OUTPUT signal is connected to the analyzer input and the required front-panel control settings made as stated in the specification.

The slope of the signal is measured to be used in calculating the residual FM.

The signal is adjusted to the center of the display and the peak-to-peak amplitude deviation of the signal measured. This amplitude deviation is converted to frequency deviation by dividing by the slope measured earlier in the test.



CONNECT BNC CABLE FROM CAL OUTPUT TO
SIGNAL INPUT 1

To CONTINUE, push Hz
To SELECT ANOTHER TEST, push MHz
Test Number 9

EQUIPMENT:

No equipment required.

PROCEDURE:

1. Connect cable as shown in figure above.
2. Select test no. 9 by keying in 9 [Hz µV µsec] ([kHz mV msec] if continuous testing is desired) on 8568A keyboard.
3. Follow the instructions as they appear on the 8568A CRT display.
4. The following is an annotated listing of the test procedure.

FILE 10

VARIABLES

- A Marker amplitude, ASCII character
- B Marker Delta amplitude
- C Test limit
- D Keyboard entry, Input selector
- F Recall 8 amplitude
- I Counter
- P “prt” device code
- S Slope
- Z “sa” device code
- A[*] Measured data
- X[*] Pass/fail indicator

FLAGS

1. Pass/fail indicator
2. Counter
3. HP 9825B Strip Printer
4. Not used
5. All tests mode
6. Repetitive testing
7. Abort current test
8. HP 3335A Synthesizer
9. HP 8568A Option 001
10. Not used
11. HP 3330B Option 005 Synthesizer

Residual FM Test Annotated Listing

```
0: "RESIDUAL FM ":
1: "t0f10:   821122":
2: "residual FM":
3:
4: gsb "RSBW"
5: if flg5;gto +2
6: if D>1;gto -2;if D=1e6;gto "test select";cfg 5,6
7: if abs(F+10)>.5;ldf 16,249,253
8:
9: "test":
10:
11: 0→I;3→C;cfg 2
12: wtb "sa","IP D3PUPA288,592LBRESIDUAL FM",3
13: cll 'on interrupt'
14: 49+flg9→D;wtb "sa","I",D,"CF20MZ SP100HZ RB30HZ RL-10DM LG1DB S2 TS"
15: if flg7;gto "test select"
16: wrt "sa","E1 E2 TS E1 M3";if flg7;gto "test select"
17: "calculate filter slope":
18: wrt "sa","MA";red "sa",A;if I>40;gto "adjust"
19: if A+C>.2;I+1→I;fmt 8,f2.0,c;wrt "sa.8",I,"HZ";jmp -1
20: if not flg2;wrt "sa","M3M3";1→I;4→C;sfg 2;jmp -2
```

“residual FM”

Draws equipment setup on CRT and checks for proper keyboard entry to continue test or abort. D is the returned value from keyboard entry.

If the signal amplitude is not within −10.0 ±0.5 dBm, the “pre-test” (file 16) is loaded before the program begins.

“test”

Labels test title on CRT and enables the interrupt routine. The signal is then centered on the CRT.

“calculate filter slope”

The marker is placed approximately 3 dB down from the signal peak and Marker Delta is then turned on. The marker is then moved approximately 3 dB and the slope is measured.

```
21: "measure slope detected residual FM":if flg7;gto "test select"
22: abs(A/I)}S;cfg 2
23: wrt "sa","SS2HZ CF20.00002MZ SP0HZ RL-10DM ST2SC M1 M2 TS"
24: wrt "sa","TS MA";red "sa",A;if A<=-19.5;gto "adjust"
25: if 15+A>1;wrt "sa","CFUP";jmp -1
26: wrt "sa","TS MA";red "sa",A;if flg7;gto "test select"
27: if 15+A<-1;wrt "sa","CFDN";jmp -1
28: wrt "sa","ST10SC TS"
29: wrt "sa","DL0DB B1 BL EX C2 C1 B4"
30: wrt "sa","E1 EX M3 E1 L0 MA"
31: red "sa",B;B/S}A[1]
32: 32}A;if A[1]>3;42}A;sfg 1
33:
34: "print out":
35:
36: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,850LB"
37: if flg3;gto +7
38: fmt 1,2/,10x,"9. RESIDUAL FM",2/;wrt "prt.1"
39: fmt 2,10x,"SPECIFICATION: <3HZ peak-to-peak",/;wrt "prt.2"
40: fmt 2,10x,"MEASURED:";wrt "prt.2"
41: fmt 5,/,20x,f7.1,b,b,/
42: wrt "prt.5",A[1],"Hz peak-to-peak",A,A
43: gto +6
44: prt "  TEST NO.  9    residual F.M.  "
45: spc ;if not flg1;prt "     PASSED";gto +3
46: prt "out of tolerance";spc
47: prt "REFER TO","OPERATING AND   SERVICE MANUAL   SECTION IV"
48: fmt 6,/,16"-",/;wrt 16.6
49: 1+flg1}X[10];cfg 1
50: if P=Z;gsb "cont"
51: gto "test select"
52: "adjust":
53: wrt "sa","S1 RC9"
54: wrt "sa","EMDT@D3PUPA50,400LBADJUST SIGNAL LEVEL FOR A PEAK ON@"
55: wrt "sa","PUPA50,350LBDISPLAY WITH FREQ ZERO ADJUST@"
56: wrt "sa","PUPA100,100LBTo CONTINUE, push Hz@"
57: gsb "wait"
58: gto "test"
*23087
```

"measure slope detected residual FM"

The spectrum analzyer center frequency is then changed in 2 Hz steps until the signal amplitude is -15 ± 1 dBm, which is the same level used to measure the slope, S. If the signal has drifted, "adjust" is called and the FREQ ZERO is readjusted. A sweep is taken and the trace arithmetic functions are used to find the minimum point. Marker Delta and Peak Search are used to find the maximum point and the total variation. This value, B, is divided by S to determine the residual FM.

"print out"

Prints headings, specifications, and test results on printer. The printer may be an external HP-IB printer, the HP 9866B or the spectrum analyzer CRT display. Out-of-tolerance conditions are indicated by double asterisks (**) and flag 1 is set. If flag 3 is set indicating no external printer, the HP 9825B Strip Printer is used to print the test title and "PASSED" or "out of tolerance" information.

The value of X[*] is determined for printer "yes" or "no" adjacent to the test title menu on the CRT. Program control is then returned to "test select".

"adjust"

This routine is called if the signal has drifted since the initial Recall 9 during the "pre-test" routine. The spectrum analyzer is set to continuous sweep and Recall 9. The FREQ ZERO control must be adjusted for a maximum response on the CRT.

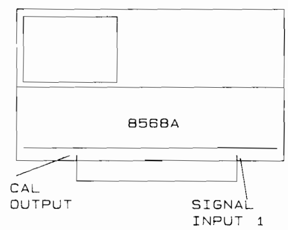
10. LINE RELATED SIDEBANDS

SPECIFICATION:

>85 dB below the peak of a CW signal. (Option 400: >75 dB.)

DESCRIPTION:

The spectrum analyzer CAL OUTPUT signal is connected to the analyzer input and the necessary front-panel control settings made for the test. The harmonics of the line frequency are calculated, and the necessary front-panel control settings made to view the frequencies, and measure the amplitude of the signal at each of the frequencies.




```
CONNECT BNC CABLE FROM CAL OUTPUT TO
   SIGNAL INPUT 1

  To CONTINUE, push Hz
  To SELECT ANOTHER TEST, push MHz
         Test Number 10
```

EQUIPMENT:

No equipment required.

PROCEDURE:

1. Connect cable as shown in figure above.
2. Select test no. 10 by keying in 10 [Hz µV µsec] ([kHz mV msec] if continuous testing is desired) on 8568A keyboard.
3. Follow the instructions as they appear on the 8568A CRT display.
4. The following is an annotated listing of the test procedure.

FILE 11

VARIABLES

A Marker amplitude, ASCII character

B Center frequency, ASCII character

C Marker amplitude, ASCII character

D Keyboard entry, AC mains frequency

E Input selector

F Recall 8 amplitude, AC mains frequency

G Line related sideband harmonic number

I Loop counter

J Loop counter

K + or − indicator

P "prt" device code

Z "sa" device code

A[*] Measured data

X[*] Pass/fail indicator

r1 Specification limit

r17 AC main frequency

FLAGS

1 Pass/fail indicator

2 Counter

3 HP 9825B Strip Printer

4 Not used

5 All tests mode

6 Repetitive testing frequency

7 Abort current test

8 HP 3335A Synthesizer

9 HP 8568A Option 001

10 Not used

11 HP 3330B Option 005 Synthesizer

Line Related Sidebands Test Annotated Listing

```
0: "LINE RELATED SIDEBANDS ":
1: "t0f11:   821122":
2: "line related sidebands":
3:
4: if flg5;gto +4
5: gsb "RSBW"
6: if D>1;gto -1;if D=1e6;gto "test select";cfg 5,6
7: if abs(F+10)>1;ldf 16,249,253
8: r17→D;2D→F;if D>100;D→F
9:
```

"line related sidebands"

Draws equipment setup on CRT and checks for proper keyboard entry to continue test or abort. D is the returned value from keyboard entry.

If the signal amplitude is not within −10 ±1 dBm, the "pre-test routine" (file 16) is loaded and run. Control is then returned to "test select".

```
10: "test":
11:
12: wtb "sa","IP D3PUPA192,592LBLINE RELATED SIDEBANDS",3
13: cll 'on interrupt'
14: wtb "sa","PUPA350,310LBto ABORT push MHz",3
15: 49+flg9→E;wtb "sa","CF20MZ SP100HZ I",E,"S2 TS E1 MA";red "sa",A
16: if A<-16 or A>2;gto -11
17: wrt "sa","E2 E4 M1 CFOA";red "sa",B
18: wrt "sa","A1"
19: for J=2 to 4
20: J→G;if D>100;J-1→G
21: for K=-1 to 1 by 2
22: -120→A[J-1]
23: wrt "sa","CF",B+GKD+40,"HZ VB1HZ"
24: wrt "sa","CT M1 M2",B+GKD+10,"HZ KSu"
25: for I=1 to 20
26: if flg7;gto "test select"
27: wrt "sa","KSM M2",B+GKD+10-I,"HZ MA";red "sa",C
28: max(C+7.8-A,A[J-1])→A[J-1]
29: next I;next K;next J
30:
31: "print out":
32:
33: 32→A→B→C
34: 85→r1;if D>100;75→r1
35: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,850LB"
36: if flg3;gto +6
37: fmt 1,2/,10x,"10. LINE RELATED SIDEBANDS",2/;wrt "prt.1"
38: fmt 2,10x,c,f2.0,c,/
39: wrt "prt.2","SPECIFICATION: Line Related Sidebands >",r1,"dBc"
40: fmt 2,/,10x,"MEASURED:";wrt "prt.2"
41: fmt 5,25x,c,15x,c;wrt "prt.5","Frequency","dBc"
42: if A[1]>-r1;42→A;sfg 1
43: if A[2]>-r1;42→B;sfg 1
44: if A[3]>-r1;42→C;sfg 1
45: if flg3;gto +6
46: fmt 3,26x,f4.0,c,13x,f7.1,b,b
47: wrt "prt.3",F,"Hz",A[1],A,A
48: wrt "prt.3",D+F,"Hz",A[2],B,B
49: wrt "prt.3",2D+F,"Hz",A[3],C,C;wrt "prt";wrt "prt"
50: gto +6
51: prt "  TEST NO. 10    line sidebands "
52: spc ;if not flg1;prt "     PASSED";gto +3
53: prt "out of tolerance";spc
54: prt "REFER TO","OPERATING AND   SERVICE MANUAL  SECTION IV"
55: fmt 6,/,16"-",/;wrt 16.6
56: 1+flg1→X[11];cfg 1
57: if P=Z;gsb "cont"
58: gto "test select"
*8612
```

"test"

Labels test title and enables interrupt routine. The initial control settings for the spectrum analyzer are made.

The J (line frequency harmonic) and K (upper or lower sideband) for/next loops are used to adjust the center frequency so that the line related sideband falls near the left edge of the display. The sweep to marker function (KSu) is used to save measurement time by not having to sweep across the entire display.

The I for/next loop measures the signal amplitude at 1 Hz intervals. The maximum amplitude is stored in A[*].

"print out"

Prints headings, specifications, and test results on printer. The printer may be an external HP-IB printer, the HP 9866B or the spectrum analyzer CRT display. Out-of-tolerance conditions are indicated by double asterisks (**) and flag 1 is set. If flag 3 is set indicating no external printer, the HP 9825B Strip Printer is used to print the test title and "PASSED" or "out of tolerance" information.

The value of X[*] is determined for printer "yes" or "no" adjacent to the test title menu on the CRT. Program control is then returned to "test select".

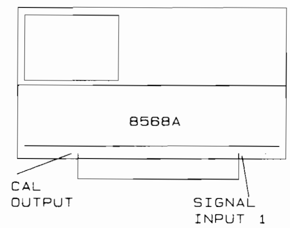
11. RF GAIN UNCERTAINTY

SPECIFICATION:

RF Gain Uncertainty Due to Second LO shift: ± 1.0 dB (uncorrected).

DESCRIPTION:

The CAL OUTPUT signal is connected to the SIGNAL INPUT connector of the analyzer and the analyzer front-panel controls set to view this 20 MHz signal. The 2nd LO is shifted down using the special shift key function. The marker is placed at the signal peak (in Marker Δ) then the 2nd LO is shifted up. The difference in the marker amplitude is measured which corresponds to the difference in the signal level between the 2nd LO shifted up and the 2nd LO shifted down.



CONNECT BNC CABLE FROM CAL OUTPUT TO
SIGNAL INPUT 1

To CONTINUE, push Hz
To SELECT ANOTHER TEST, push MHz
Test Number 11

EQUIPMENT:

No equipment required.

PROCEDURE:

1. Connect cable as shown in figure above.
2. Select test no. 11 by keying in 11 [Hz µV µsec] ([kHz mV msec] if continuous testing is desired) on 8568A keyboard.
3. Follow the instructions as they appear on the 8568A CRT display.
4. The following is an annotated listing of the test procedure.

FILE 12

VARIABLES

A ASCII character

D Keyboard entry, Input selector

F Recall 8 amplitude

P "prt" device code

Z "sa" device code

A[*] Measured data

X[*] Pass/fail indicator

FLAGS

1 Pass/fail indicator

2 Counter

3 HP 9825B Strip Printer

4 Not used

5 All tests mode

6 Repetitive testing

7 Abort current test

8 HP 3335A Synthesizer

9 HP 8568A Option 001

10 Not used

11 HP 3330B Option 005 Synthesizer

RF Gain Uncertainty Test Annotated Listing

```
0: "RF GAIN UNCERTAINTY ":
1: "t0f12:   821122":
2: "RF Gain":
3:
4: if flg5;gto "test"
5: gsb "RSBW"
6: if D>1;gto -1;if D=1e6;gto "test select";cfg 5,6
7: if abs(F+10)>1;ldf 16,249,253
8:
9: "test":
10:
11: 49+flg9}D
12: wtb "sa","IP I",D,"LN KSA CF20MZ SP1MZ RB300KZ VB3KZ RL-7DM"
13: wtb "sa","D3PUPA224,592LBRF GAIN UNCERTAINTY",3
14: cll 'on interrupt'
15: wrt "sa","TS E1 MA";red "sa",A;if A<-17 or A>-7;gto -10
16: wrt "sa","KST TS E1 M3";wait 500
17: wrt "sa","KSU TS E1 MA";red "sa",A[1]
18:
```

"RF Gain"

Draws equipment setup on CRT and checks for proper keyboard entry to continue test or abort. D is the returned value from keyboard entry.

If the signal amplitude is not within -10 ± 1 dBm, the "pre-test routine" (file 16) is loaded and run. Control is then returned to the "test select".

"test"

Labels test title and enables the interrupt routine. After initially setting the spectrum analyzer controls, the shift functions are used to step the second LO in the RF section. The corresponding change in displayed signal amplitude is measured using the Marker Delta function and stored in A[1].

```
19: "print out":
20:
21: 32→A
22: if abs(A[1])>1;42→A;sfg 1
23: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,850LB"
24: if flg3;gto +8
25: fmt 1,2/,10x,"11. RF GAIN UNCERTAINTY",2/;wrt "prt.1"
26: fmt 2,10x,"SPECIFICATION:";wrt "prt.2"
27: fmt 5,20x,"RF Gain Uncertainty (due to 2nd LO shift)";wrt "prt.5"
28: fmt 5,25x,"+/- 1.0dB  (uncorrected)",2/;wrt "prt.5"
29: fmt 5,10x,c,f13.2,c,b,b,/;wrt "prt.5","MEASURED:",A[1],"dB",A,A
30: if flg5 and P#Z;cll 'LF'(10)
31: gto +6
32: prt "  TEST NO. 11        RF gain"
33: spc ;if not flg1;prt "     PASSED";gto +3
34: prt "out of tolerance";spc
35: prt "REFER TO","OPERATING AND   SERVICE MANUAL  SECTION IV"
36: fmt 3,/,16"-",/;wrt 16.3
37: 1+flg1→X[12];cfg 1
38: if P=Z;gsb "cont"
39: gto "test select"
*6406
```

"print out"

Prints headings, specifictions, and test results on printer. The printer may be an external HP-IB printer, the HP 9866B or the spectrum analyzer CRT display. Out-of-tolerance conditions are indicated by double asterisks (**) and flag 1 is set. If flag 3 is set indicating no external printer, the HP 9825B strip printer is used to print the test title and "PASSED" or "out of tolerance" information.

The value of X[*] is determined for printer "yes" or "no" adjacent to the test title menu on the CRT. Program control is then returned to "test select".

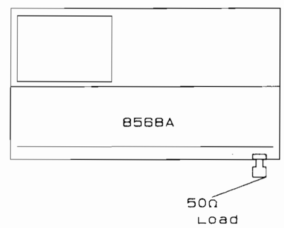
12. AVERAGE NOISE LEVEL

SPECIFICATION:

Displayed: <–135 dBm for frequencies >1 MHz, <–112 dBm for frequencies ≤1 MHz but >500 Hz with 10 Hz resolution bandwidth, 0 dB input attenuation, 1 Hz video filter.

DESCRIPTION:

The signal input of the spectrum analyzer is terminated using a 50-ohm load. The necessary front-panel control settings are made and the average noise level measured at 501 Hz, 1001 MHz, and 1501 MHz.



CONNECT 50 ohm LOAD TO SIGNAL INPUT 2

To CONTINUE, push Hz
To SELECT ANOTHER TEST, push MHz
Test Number 12

EQUIPMENT:

50-Ohm Load . . . . HP 11593A

PROCEDURE:

1. Connect equipment as shown in figure above.
2. Select test no. 12 by keying in 12 (Hz μV μsec) ((kHz mV msec) if continuous testing is desired) on the 8568A keyboard.
3. Follow the instructions as they appear on the 8568A CRT display.
4. The following is an annotated listing of the test procedure.

FILE 13

VARIABLES

A Marker amplitude, ASCII character

B Sum of Trace A data

C ASCII character

D Keyboard entry, Input attenuator setting

I Loop counter

J Loop counter

P "prt" device code

Z "sa" device code

A[*] Measured data

X[*] Pass/fail indicator

FLAGS

1 Pass/fail indicator

2 Counter

3 HP 9825B Strip Printer

4 Not used

5 All tests mode

6 Repetitive testing mode

7 Abort current test

8 HP 3335A Synthesizer

9 HP 8568A Option 001

10 Not used

11 HP 3330B Option 005 Synthesizer

Average Noise Level Test Annotated Listing

```
0: "AVERAGE NOISE LEVEL ":
1: "t0f13:   820412":
2: "noise floor":
3:
4: gsb "LOAD";if flg5 and not flg9;gto "test"
5: if D)1;gto -1;if D=1e6;gto "test select";cfg 5,6
6:
7: "test":
8:
9: 0}D;wtb "sa","IP D3PUPA298,592LB",18,"NOISE LEVEL",18,3,"HD"
10: cll 'on interrupt'
11: if flg5 and not flg9;70}D;cll 'synthesizer'(7.6,-70,0)
12: wrt "sa","SP0HZ AT",D,"DB RB10HZ VB1HZ"
13: wrt "sa","RL",-80+D,"DM ST20SC S2"
14: for I=1 to 3;if flg7;gto "test select"
15: if I=1;wrt "sa","CF1501MZ"
16: if I=2;wrt "sa","CF1001MZ"
17: if I=3;wrt "sa","CF501HZ"
18: 0}B;wrt "sa","TS";wait 10
19: if flg7;gto "test select"
20: wrt "sa","DA3076 DW17 HD 03 TA"
21: for J=1 to 1000;red "sa",A;A+B}B;next J
22: B/1000}A[I];wtb "sa","DA3076 DW18 HD"
23: if flg5 and not flg9;A[I]-70}A[I]
24: next I
25:
```

"noise floor"

Draws equipment setup on CRT and checks for proper keyboard entry to continue test or abort. D is the returned value from keyboard entry.

"test"

Labels test title and enables interrupt routine. The initial control settings for the spectrum analyzer are made. The for/next loop measures the average noise level at 3 frequencies. The 1000 Trace A data values are summed and the average stored in A[*]. During the trace dump the test title flashes.

```
26: "print out":
27:
28: 32}C}B}A
29: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,850LB"
30: if flg3;gto +9
31: fmt 1,2/,10x,"12. AVERAGE NOISE LEVEL";wrt "prt.1"
32: fmt 5,15x,"(Measured in 10 Hz BW)",/;wrt "prt.5"
33: fmt 2,10x,"SPECIFICATION:";wrt "prt.2"
34: fmt 5,20x,c;wrt "prt.5","<-135dBm for frequencies >1MHz"
35: wrt "prt.5","<-112dBm for frequencies <=1MHz but >500Hz"
36: wrt "prt.5","  (with 10Hz resolution bandwidth"
37: wrt "prt.5","         and 0 dB input attenuation)"
38: fmt 2,/,10x,"MEASURED:";wrt "prt.2"
39: if A[1]>-135;42}B;sfg 1
40: if A[2]>-135;42}A;sfg 1
41: if A[3]>-112;42}C;sfg 1
42: if flg3;gto +7
43: fmt 5,20x,"Frequency",5x,"Noise Level",/;wrt "prt.5"
44: fmt 3,20x,c,f12.1,c,b,b
45: wrt "prt.3","1501MHz",A[1]," dBm ",B,B
46: wrt "prt.3","1001MHz",A[2]," dBm ",A,A
47: wrt "prt.3"," 501 Hz",A[3]," dBm ",C,C;wrt "prt"
48: gto +6
49: prt "  TEST NO. 12     noise level   "
50: spc ;if not flg1;prt "    PASSED";gto +3
51: prt "out of tolerance";spc
52: prt "REFER TO","OPERATING AND   SERVICE MANUAL  SECTION IV"
53: fmt 6,/,16"-",/;wrt 16.6
54: 1+flg1}X[13];cfg 1
55: if P=Z;gsb "cont"
56: gto "test select"
*12565
```

"print out"

Prints headings, specifications, and test results on printer. The printer may be an external HP-IB printer, the HP 9866B or the spectrum analyzer CRT display. Out-of-tolerance conditions are indicated by double asterisks (**) and flag 1 is set. If flag 3 is set indicating no external printer, the HP 9825B Strip Printer is used to print the test title and "PASSED" or "out of tolerance" information.

The value of X[*] is determined for printer "yes" or "no" adjacent to the test title menu on the CRT. Program control is then returned to "test select".

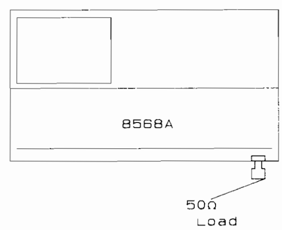
13. RESIDUAL RESPONSES

SPECIFICATION:

<–105 dBm, with 0 dB input attenuation.

DESCRIPTION:

The signal input of the spectrum analyzer is terminated using a 50-ohm load. The peak amplitude of the noise or responses is measured at various frequencies associated with residual responses caused by harmonics and mixing products of the first, second, and third local oscillators, the 10 MHz reference, and the HP-IB and Digital Storage clocks.



CONNECT 50 ohm LOAD TO SIGNAL INPUT 2

To CONTINUE, push Hz
To SELECT ANOTHER TEST, push MHz
Test Number 13

EQUIPMENT:

50-ohm Load .... HP 11593A

PROCEDURE:

1. Connect equipment as shown in figure above.
2. Select test no. 13 by keying in 13 [Hz µV µsec] ([kHz mV msec] if continuous testing is desired) on the 8568A keyboard.
3. Follow the instructions as they appear on the 8568A CRT display.
4. The following is an annotated listing of the test procedure.

FILE 14

VARIABLES

A Marker amplitude, ASCII character

B Marker frequency

C Center frequency

D Keyboard entry, Input attenuator setting

E Frequency Span

F Second IF Frequency

G Frequency offset from nearest 20 MHz comb

H Second LO frequency high/low indicator

I Loop counter

J Loop counter

K Loop counter

L Loop counter

P "prt" select code

Q Second LO frequency

R Loop index

W Measurement counter

Z "sa" device code

A[*] Measured data

X[*] Pass/fail indicator

r1 Residual frequency

FLAGS

1 Pass/fail indicator

2 Counter

3 HP 9825B Strip Printer

4 Not used

5 All tests mode

6 Repetitive testing mode

7 Abort current test

8 HP 3335A Synthesizer

9 HP 8568A Option 001

10 Not used

11 HP 3330B Option 005 Synthesizer

Residual Responses Test Annotated Listing

```
0: "RESIDUAL RESPONSES ":
1: "t0f14:   820412":
2: "residual responses":
3:
4: gsb "LOAD";if flg5;gto "test"
5: if D>1;gto -1;if D=1e6;gto "test select";cfg 5,6
6:
```

"residual responses"

Draws equipment setup on CRT and checks for proper keyboard entry to continue test or abort. D is the returned value from keyboard entry.

```
7: "test":
8:
9: 0→D;if flg5 and not flg9;70→D
10: wrt "sa","IP AT",D,"DB RL",-60+D,"DB DL",-105+D,"DB S2"
11: cll 'on interrupt'
12: wtb "sa","D3PUPA240,592LBRESIDUAL RESPONSES",3
13: wtb "sa","D3PUPA220,550LB",17,"TEST TIME",185,"15 MINUTES",3
14: "initialize":for J=1 to 9 by 2;0→A[J+1];-200→A[J];next J
15:
16: "Harmonics of 1st and 2nd LO":
17: "2nd IF freq":301.4→F
18: "1st LO harmonics":for I=1 to 5
19: "2nd LO harmonics":for J=1 to 10
20: for Q=1748.6 to 1753.6 by 5
21: for L=-1 to 1 by 2
22: if flg7;gto "test select"
23: (LF+JQ)/I-(F+Q)→C
24: if C<15 or C>1520;gto "next"
25: Cmod20→G
26: G<7.5 and G>2.5 or G<17.5 and G>12.5→H
27: if H and Q=1753.6;gto "next"
28: if not H and Q=1748.6;1.01→E;gto +2
29: 1→E
30: 3→W;cll 'meas'
31: "next":next L;next Q;next J;next I
32:
33: "Time Base Harmonics":.1→E
34: for C=5 to 1500 by 5;3→W;cll 'meas'
35: if flg7;gto "test select"
36: next C
37:
38: "8th Harmonic of Divided VTO=21.4":
39: 19.925→C;.1→E;3→W;cll 'meas'
40:
41: "A23A3 Subharmonic":
42: for C=5.5 to 7.5 by 1;1→E;3→W;cll 'meas'
43: if flg7;gto "test select"
44: next C
45:
46: "280MHz Osc":
47: .0889→C;.001→E;3→W;cll 'meas'
48:
49: "HB-IB Harmonics":.65→C;1.01→E;3→W;cll 'meas'
50:
51: "A3A7 Clock Harmonics":
52: 15.824*2→C;.1→E;3→W;cll 'meas'
53: 16*2→C;cll 'meas'
54: for C=.045 to .085 by .01;.01→E;3→W;cll 'meas'
55: if flg7;gto "test select"
56: next C
57: gto "print out"
58:
```

"test"

Labels test title on CRT and enables interrupt routine. Initial 8568A control settings are made. A[*], test results matrix, is initialized.

"Harmonics of 1st and 2nd LO"

This routine determines the center frequency and span necessary to search for residuals caused by harmonics of the first and second LO's mixing to produce a signal at 301.4 MHz, the second IF.

"Time Base Harmonics"

This routine determines the center frequency and span necessary to search for residuals of the internal 10 MHz frequency reference.

"8th Harmonic of Divided VTO = 21.4"

This routine selects the necessary center frequency and span to test for a residual caused when the eighth harmonic of the divided 50 MHz VTO (2.675 MHz) is equal to 21.4 MHz, the third IF.

"A23A3 Subharmonic"

This routine searches for a residual in the 6 to 7 MHz range that can result from subharmonic oscillation of the second LO.

"280 Osc"

This routine tests for a residual at 88.9 kHz.

"HP-IB Harmonics"

This routine searches for residuals in the 150 kHz – 1.01 MHz range during FM coil spans caused by harmonics of the HP-IB processor clock.

"A3A7 Clock Harmonics"

This routine searches the 40 – 90 kHz range for residuals which can result from mixing of the Digital Storage processor clock harmonics and the 10 MHz Frequency Reference harmonics.

```
59: "meas":wrt "sa","CF",C*1e6,"HZ SP",E*1e6,"HZ"
60: "loop":if flg7;ret
61: if W=3 and E<.011;wrt "sa","RB30HZ VB10HZ";gto +6
62: if W=3 and E<.11;wrt "sa","RB1KZ VB1KZ";gto +5
63: if W=3 and C<1000;wrt "sa","RB3KZ VB1KZ";gto +4
64: if W=3;wrt "sa","RB3KZ VB300HZ";gto +3
65: if W=2;wrt "sa","RBDN VBDN";gto +2
66: wrt "sa","RBDN"
67: wrt "sa","TS E1 MA";red "sa",A;wrt "sa","MF";red "sa",B
68: if W#3 and abs(B-r1)>E/5*1e6;ret
69: if A>-107+D;W-1→W;B→r1;if W>0;gto "loop"
70: cll 'sort'(A,B)
71: ret
72:
73: "print out":
74:
75: wrt "sa","LO"
76: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,850LB"
77: if flg3;gto +6
78: fmt 1,/,10x,"13. RESIDUAL RESPONSES",2/;wrt "prt.1"
79: fmt 2,10x,"SPECIFICATION:";wrt "prt.2"
80: fmt 2,25x,"<-105dBm, with 0dB input attenuation";wrt "prt.2"
81: fmt 2,/,10x,"MEASURED:";wrt "prt.2"
82: fmt 5,25x,"Maximum Residual Responses",/;wrt "prt.5"
83: for I=1 to 9 by 2;32→A
84: if flg5 and not flg9;A[I]-70→A[I]
85: if abs(A[I])<105;42→A;sfg 1
86: if flg3;next I;gto +7
87: fmt 5,24x,f7.1,c,b,b,c,f5.0,c
88: if A[I+1]/1e6<1;jmp 2
89: wrt "prt.5",A[I],"dBm",A,A," at",A[I+1]/1e6," MHz";jmp 2
90: wrt "prt.5",A[I],"dBm",A,A," at",A[I+1]/1e3," KHz"
91: next I
92: wrt "prt";gto +6
93: prt "  TEST NO. 13      residuals"
94: spc ;if not flg1;prt "    PASSED";gto +3
95: prt "out of tolerance";spc
96: prt "REFER TO","OPERATING AND   SERVICE MANUAL  SECTION IV"
97: fmt 6,/,16"-",/;wrt 16.6
98: 1+flg1→X[14];cfg 1
99: if P=Z;gsb "cont"
100: gto "test select"
101:
102: "sort":
103:
104: if p1>A[1];6→R;jmp 6
105: if p1>A[3];4→R;jmp 5
106: if p1>A[5];2→R;jmp 4
107: if p1>A[7];0→R;jmp 3
108: if p1>A[9];p1→A[9];p2→A[10];ret
109: ret
110: for K=0 to R by 2
111: A[7-K]→A[9-K]
112: A[8-K]→A[10-K]
113: next K
114: p1→A[7-R];p2→A[8-R];ret
*25153
```

"meas"

This subprogram does the actual search for residual responses. It sets the resolution and video bandwidths based on the span and center frequency of the calling routine. If a suspected residual is found the resolution and video bandwidths are stepped down and another sweep taken. If the suspected residual is still out of specification the resolution bandwidth is stepped down again and another sweep taken. If the difference in frequency of a suspected residual is greater than one fifth of the frequency span on successive sweeps, the "residual" is actually noise and program control is returned to the calling routine. Variable A is used to store the amplitude of the residual and variable B the frequency. Subprogram "sort" is called to determine if the current residual is larger than the previous ones measured.

"print out"

Prints headings, specifications, and test results on printer. The printer may be an external HP-IB printer, the HP 9866B or the spectrum analyzer CRT display. Out-of-tolerance conditions are indicated by double asterisks (**) and flag 1 is set. If flag 3 is set indicating no external printer, the HP 9825B Strip Printer is used to print the test title and "PASSED" or "out of tolerance" information.

The value of X[*] is determined for printer "yes" or "no" adjacent to the test title menu on the CRT. Program control is then returned to "test select".

"sort"

This subprogram determines if the current residual response is larger than the previous one. The five largest residual responses are saved in A[*].

14. FREQUENCY RESPONSE

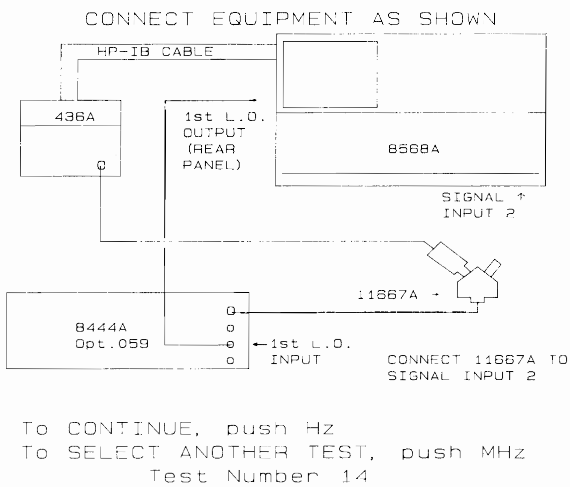
SPECIFICATION;

INPUT #1: ± 1.5 dB, 100 Hz to 1500 MHz with > 10 dB RF Attenuation.
INPUT #2: ± 1.0 dB, 100 kHz to 1500 MHz with > 10 dB RF Attenuation.

DESCRIPTION:

The spectrum analyzer rear-panel 1st LO OUTPUT is connected to a tracking generator which supplies the input signal for the analyzer. A power meter is connected to a power splitter, along with the tracking generator, which in turn is connected directly to the SIGNAL INPUT connector of the analyzer.

The signal amplitude is measured from 1 MHz to 1500 MHz in 20 MHz increments and compared to the measured value of the input signal indicated by the power meter. This procedure is performed for both input connectors. The operator is asked to make the new connection to the other input connector mid-way through the test.



EQUIPMENT:

Tracking Generator .... HP 8444A, Opt. 059
Power Meter .... HP 436A
Power Sensor .... HP 8482A
Power Splitter .... HP 11667A

PROCEDURE:

1. Connect equipment as shown in figure above.
2. Select test no. 14 by keying in 14 [Hz µV µsec] ([kHz mV msec] if continuous testing is desired) on the 8568A keyboard.
3. Follow the instructions as they appear on the 8568A CRT display.
4. The following is an annotated listing of the test procedure.

FILE 15

VARIABLES		FLAGS	
A	Marker amplitude, ASCII character	1	Pass/fail indicator
B	Maximum amplitude	2	Counter
C	Minimum amplitude, ASCII character	3	HP 9825B Strip Printer
D	Keyboard entry	4	Not used
E	Power meter reading	5	All tests mode
F	Center frequency	6	Repetitive testing mode
I	Loop counter, Input selector	7	Abort current test
P	"prt" device code	8	HP 3335A Synthesizer
Z	"sa" device code	9	HP 8568A Option 001
A[*]	Measured data	10	Not used
X[*]	Pass/fail indicator	11	HP 3330B Option 005 Synthesizer

Frequency Responses Test Annotated Listing

```
0: "FREQUENCY RESPONSE ":
1: "t0f15:   820629":
2: "freq response":
3:
4: gsb "8444A"
5: if D)1;gto -1;if D=1e6;gto "test select";cfg 5,6
6: wrt "sa","IP KSk KSi EM LG1DB RB100KZ RL-10DM ST.5SC"
7: wrt "sa","DT@D3PUPA100,350LBADJUST 8444A TRACK ADJUST@"
8: wrt "sa","PUPA100,310LBAND LEVEL ADJUST FOR A@"
9: wrt "sa","PUPA100,270LBPEAK SIGNAL 1 DIVISION@"
10: wrt "sa","PUPA100,230LBBELOW REFERENCE LINE@"
11: wrt "sa","PUPA100,100LBTo CONTINUE, push Hz@"
12: gsb "wait"
13: gto +5
14:
```

"freq response"

Draws equipment setup on CRT and checks for proper keyboard entry to continue test or abort. D is the returned value from keyboard entry.

Instructs operator to adjust controls on HP 8444A as stated.

"test"

Labels test title and enables interrupt routine. Sets initial spectrum analyzer controls for test.

The for/next loop steps the center frequency by 20 MHz. The Marker value, A, is read and compared to the Power Meter reading, E. The maximum, B, and minimum, C, deviation is determined and the peak-to-peak value stored in A[1] for the type N input. If testing of the BNC input is desired, Flag 2 is set and the operator instructed to connect the splitter to input 1. The peak-to-peak deviation is stored in A[2].

```
15: "test":
16:
17: if flg6 and X[15]>0;gto -11
18: cfg 2
19: wrt "sa","KSk EM D3PUPA240,592LBFREQUENCY RESPONSE@"
20: wrt "sa","KST CF1MZ SP100KZ M2 CT S2 TS"
21: cll 'on interrupt'
22: fmt 8,c,f2.0,b
23: 2-flg2}I;wrt "sa.8","PUPA280,560LBSIGNAL INPUT",I,3
24: for I=0 to 75
25: I*20}F;if I=0;1}F
26: if flg7;gto "test select"
27: fmt 9,c,f4.0,c
28: wrt "sa.9","CF",F,"MZ TS MA";red "sa",A
29: if I=0 and A<-14;gto -25;if flg2;gto +8
30: wrt "mtr","DT";red "mtr",E;A-E}A
31: max(A,B)}B;if I=0;A}B
32: min(A,C)}C;if I=0;A}C
33: next I
34: if not flg2;B-C}A[1]
35: if flg2;B-C}A[2]
36: if flg2;gto "print out"
37: wrt "sa","KSk EM A4 KSm KSo";eir 7,0;wait 50
38: wtb "sa","PUPA96,352LBCONNECT POWER SPLITTER TO INPUT 1",3
39: wtb "sa","PUPA96,96LBTo CONTINUE, push Hz",3
40: wtb "sa","PUPA96,64LBTo CANCEL TEST, push MHz",3
41: gsb "wait"
42: if D>1;gto -5;if D=1e6;gto +2
43: wrt "sa","I1 A1 KSp KSn";sfg 2;cll 'on interrupt';gto -24
44:
```

"print out"

Prints headings, specifications and test results on printer. The printer may be an external HP-IB printer, the HP 9866B, or the spectrum analyzer CRT display. Out-of-tolerance conditions are indicated by double asterisks (**) and flag 1 is set. If flag 3 is set indicating no external printer, the HP 9825B Strip Printer is used to print the test title and "PASSED" or "out of tolerance" information.

The value of X[*] is determined for printer "yes" or "no" adjacent to the test title menu on the CRT. Program control is then returned to "test select".

```
45: "print out":
46:
47: if P=Z;wrt "sa","KSk EM KSi EM KSo KSm DT@ A4 D2 PUPA50,850LB"
48: if flg3;gto +13
49: fmt 1,2/,10x,"14. FREQUENCY RESPONSE",2/;wrt "prt.1"
50: fmt 2,10x,"SPECIFICATION:";wrt "prt.2"
51: if P=Z;gto +4
52: fmt 5,21x,c,/
53: wrt "prt.5","INPUT 1, +/-1.5dB(3.0dB pk-pk), 1MHz to 1500MHz"
54: wrt "prt.5","INPUT 2, +/-1.0dB(2.0dB pk-pk), 1MHz to 1500MHz";gto +4
55: fmt 6,15x,c,/
56: wrt "prt.6","INPUT 1, +/-1.5dB(3.0dB pk-pk), 1MHz to 1500MHz"
57: wrt "prt.6","INPUT 2, +/-1.0dB(2.0dB pk-pk), 1MHz to 1500MHz"
58: fmt 2,10x,"MEASURED:";wrt "prt.2"
59: fmt 5,/,24x,c,5x,c,/
60: wrt "prt.5","Signal Input"," Peak-to-peak Amptd"
61: 32}A}C;if abs(A[1])>2;42}A;sfg 1
62: if abs(A[2])>3;42}C;sfg 1
63: if flg3;gto +6
64: fmt 5,27x,c,10x,f7.1,c,b,b
65: fmt 6,27x,c,11x,c
66: if not flg2;wrt "prt.6","INPUT 1","not tested"
67: if flg2;wrt "prt.5","INPUT 1",A[2],"dB",C,C
68: wrt "prt.5","INPUT 2",A[1],"dB",A,A;wrt "prt";gto +7
69: prt "  TEST NO. 14    freq. response "
70: if not flg2;spc ;prt "    input 2"
71: spc ;if not flg1;prt "     PASSED";gto +3
72: prt "out of tolerance";spc
73: prt "REFER TO","OPERATING AND   SERVICE MANUAL  SECTION IV"
74: fmt 6,/,16"-",/;wrt 16.6
75: if not flg2 and (flg6 or flg5);cfg 5,6
76: if not flg2;cfg 1;wrt "prt","@PS";wait 3000;gto "test select"
77: 1+flg1}X[15];cfg 1
78: if P=Z;gsb "cont"
79: if flg5 and not flg3;gto "specs ?"
80: gto "test select"
81:
```

```
82: "8444A":
83: gsb "SET-UP"
84: wrt "sa","D2PUPR-40,-360PD0,150,-360,0,0,-150,360,0"
85: wrt "sa","D2PUPA460,305LBo@PUPA460,335LBo@PUPA460,365LBo@PUPA460,395LBO@"
86: wrt "sa","PUPA290,670PDPR0,150,-150,0,0,-150,150,0"
87: wrt "sa","PU0,100PD-150,0PU130,-70LBO@"
88: wrt "sa","PUPA230,360LB8444A@PUPA200,770LB436A@"
89: wrt "sa","PUPA230,330LBOpt.059@PUPA820,420"
90: wrt "sa","PDPR10,0,0,10,20,0,0,30,-30,30"
91: wrt "sa","PD-30,-30,0,-30,20,0,0,-10,10,0"
92: wrt "sa","PUPA520,930PDPR-320,0,0-110PU25,0PD0,80,295,0"
93: wrt "sa","PU-250,0LBHP-IB CABLE@"
94: wrt "sa","PUPA260,690PDPR0,-150,480,0,15,-15PU-10,-12"
95: wrt "sa","PD40,-38,5,5,10,-10,10,10,-10,12,5,7,-40,40,-20,-26"
96: wrt "sa","PU95,-43PD15,25,-10,10,-15,-25"
97: wrt "sa","PU-375,-80PD365,0,0,20PU-365,-83"
98: wtb "sa","PD-100,0,0,190PU0,20PD0,272,130,0PU0,-10LB",169,3
99: wtb "sa","PUPA480,330LB",168," 1st L.O.@PUPA520,300LBINPUT@"
100: wrt "sa","PUPA390,770LB1st L.O.@PUPA390,740LBOUTPUT@"
101: wrt "sa","PUPA390,710LB(REAR@PUPA390,680LBPANEL)@"
102: wtb "sa","PUPA650,440LB11667A ",169,3
103: wtb "sa","PUPA770,630LBSIGNAL ",94,"@PUPA770,600LBINPUT 2@"
104: wrt "sa","PUPA690,300LBCONNECT 11667A TO@"
105: wrt "sa","PUPA690,270LBSIGNAL INPUT 2@"
106: wrt "sa","D3PUPA170,670LBCONNECT EQUIPMENT AS SHOWN@";gsb "wait"
107: ret
*4398
```

"8444A"

Draws and labels the test equipment setup for the test on the CRT.

FILE 16

VARIABLES

A Marker amplitude

C Input selector

r4 Test number

FLAGS

1 Pass/fail indicator

2 Counter

3 HP 9825B Strip Printer

4 Not used

5 All tests mode

6 Repetitive testing mode

7 Abort current test

8 HP 3335A Synthesizer

9 HP 8568A Option 001

10 Not used

11 HP 3330B Option 005 Synthesizer

Pre-Test and Adjustment Routine Annotated Listing

```
0: "PRE-TEST AND ADJUSTMENT ROUTINE ":
1: "t0f16:   821122":
2: fdf 2
3: gsb "pwr mtr"
4: gsb "RSBW"
5: wrt "sa","DT@"
6: wrt "sa","D3PUPA100,360LBADJUST ""AMPTD CAL"" FOR@"
7: wrt "sa","PUPA100,320LBA MARKER AMPLITUDE READING @"
8: wtb "sa","PUPA100,290LBOF -10.00dBm ",171,"0.01dB@"
9: wrt "sa","PUPA100,100LBTo CONTINUE, push Hz@";gsb "wait"
10: wrt "sa","MA";red "sa",A;if abs(A+10)).1;gto -6
11: 49+flg9}C;wtb "sa","IP RC9 I",C,"DT@"
12: wrt "sa","D3PUPA100,360LBADJUST ""FREQ ZERO"" FOR A@"
13: wrt "sa","PUPA100,320LBMAXIMUM SIGNAL LEVEL ON DISPLAY@"
14: wrt "sa","PUPA100,100LBTo CONTINUE, push Hz@HD";gsb "wait"
15: if flg5 or flg6;ldf r4+1,249,249
16: gto "test select"
17:
18: "pwr mtr":
19:
20: gsb "SET-UP"
21: wrt "sa","PU-180,-20PD0,150,-150,0"
22: wrt "sa","0,-150,150,0PU0,100PD-150,0"
23: wrt "sa","PU120,-70LBO@PUPR-80,80LB436A@"
24: wrt "sa","PUPR35,-80PD0,-220,300,0,0,80"
25: wrt "sa","15,0,0,80,-5,0,0,15,-15,0,0,-15,-5,0,0,-80,15,0"
26: wrt "sa","PU-170,80LBCAL@PUPR-32,-32LBOUTPUT@"
27: wrt "sa","PUPR10,16PD60,60"
28: wrt "sa","PUPR60,-80LBPOWER@PUPR-64,-32LBSENSOR@"
29: wrt "sa","D3PUPA96,224LBCONNECT POWER METER TO CAL OUTPUT"
30: wtb "sa","    AND VERIFY LEVEL IS -10dBm ",171," 0.2dB.",10,13
31: wrt "sa","      IF NOT REFER TO SECTION V OF"
32: wrt "sa","    OPERATING AND SERVICE MANUAL.@";gsb "wait"
33: ret
*4502
```

"PRE-TEST AND ADJUSTMENT ROUTINE"

This file is loaded when the tape is first run and may be called by other files if the signal level is out of prescribed limits.

Via subroutine "pwr mtr" the calibrator output level is checked. The operator is then instructed to adjust the AMPTD CAL and FREQ ZERO controls to calibrate the spectrum analyzer.

"pwr mtr"

Draws the test setup and instructs the operator to verify that the calibrator output level is within the proper limits.

FILE 17

VARIABLES

F File number

I Track number

J Loop counter

N Number of copies

S Current file size

T File type

A$ String data

Copy Program Annotated Listing

```
0: "OPERATION VERIFICATION COPY PROGRAM":
1: "t0f17:  821123":
2: "#1":
3: dim A$[43,72];0→F→I;ent "How many copies ?",N
4: dsp "Write Protect Master Tape";stp
5: "st":fxd 0;trk I;dsp "Insert Master";if I=0 or F#0;stp
6: dsp "Loading FILE",F," Track",I;fdf F;idf F,T,S
7: gto "data";if T=6;ldf F,31,8
8: for J=1 to N;dsp "Insert copy number",J;stp
9: dsp "Recording FILE",F," Track",I;if F=0;rew
10: if F#0;fdf F
11: mrk 1,int(S/1e3+1.5)1e3;rcf F,31
12: next J;F+1→F;gto "st"
```

"#1"

Displays instructions for operator to write-protect and load master tape in controller. A for/next loop is initialized to load and record all files from master to copies. N equals number of copies. Displays operator instructions and records program files on selected number of copies.

```
13: "#2":
14: "data":
15: gto "keys";if T=3;gto +1;ldf F,A$
16: for L=1 to N;dsp "Insert copy number",L;stp
17: dsp "Recording Data FILE",F," Track",I;if F=0;rew
18: if F#0;fdf F
19: mrk 1,int(S/1e3+1.5)1e3;rcf F,A$
20: next L;F+1→F;gto "st"
```

"data"

Displays operator instructions and records data files on selected number of copies.

```
21: "keys":
22: gto "test";if T=5;gto +1;ldk F
23: for L=1 to N;dsp "Insert copy number",L;stp
24: dsp "Recording Key FILE",F,"Track",I;if F=0;rew
25: if F#0;fdf F
26: mrk 1,int(S/1e3+1.5)1e3;rck F
27: next L;F+1→F;gto "st"
```

"keys"

Displays operator instructions and records key files on selected number of copies.

```
28: "test":
29: if T=0;gto +1;if I=0;0→F;1→I;gto "st"
30: dsp "     DONE";beep;wait 200;beep;stp ;gto "#1"
31: "program to be copied is loaded here":
*28190
```

"test"

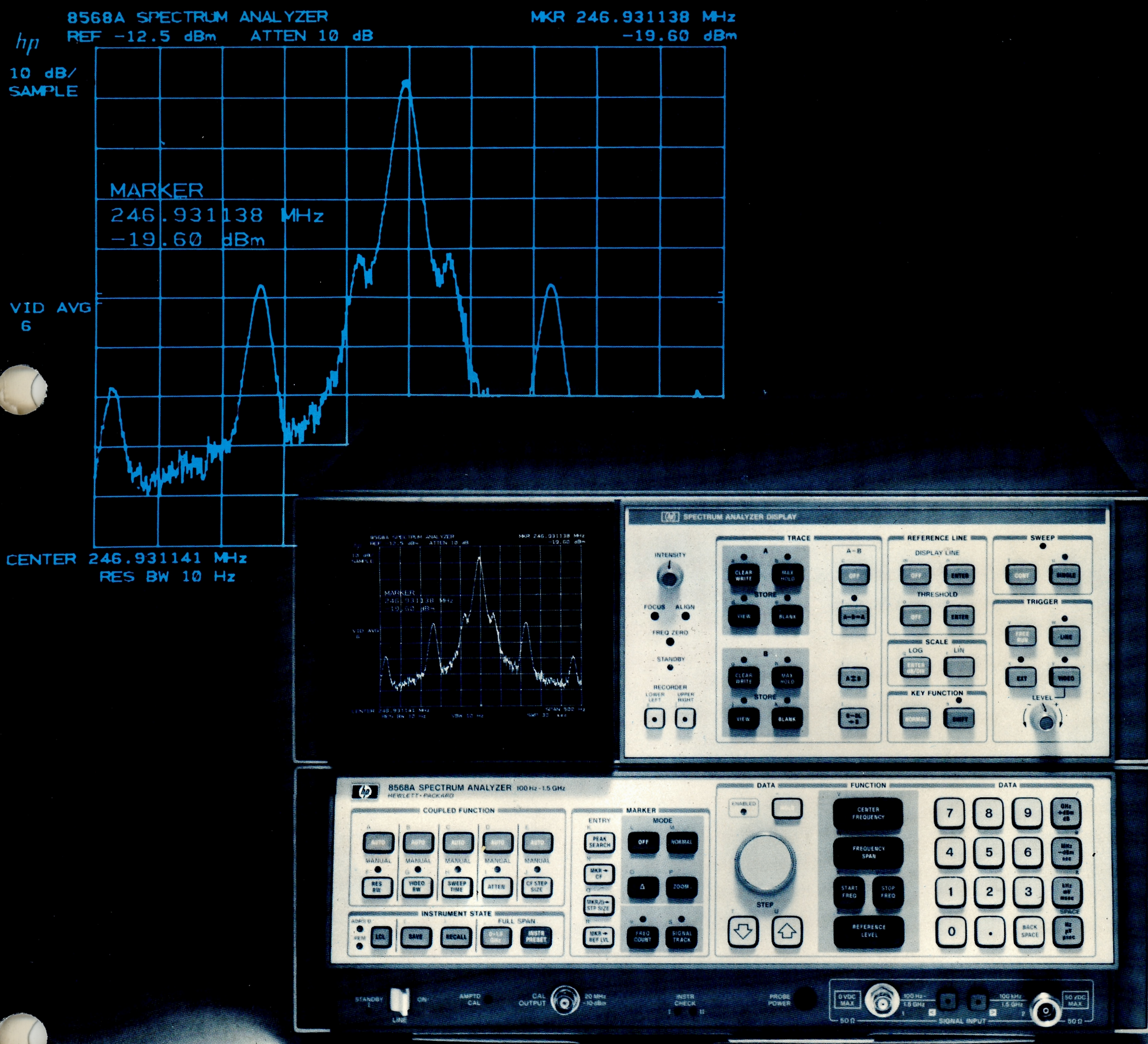
Checks for the null file which indicates all files on the current track have been copied.

HEWLETT PACKARD

HP Part No. 08568-90028

PRINTED IN U.S.A.

8568A Spectrum Analyzer Operation



HEWLETT PACKARD

8568A Spectrum Analyzer Operation

OCTOBER 1978

HEWLETT PACKARD

1400 Fountain Grove Parkway
Santa Rosa, California, U.S.A.

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08568-90002

CHAPTERS

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CONTENTS

Chapter 1
GENERAL INFORMATION

This chapter describes the 8568A Spectrum Analyzer's general performance characteristics, hardware, and the initial turn on procedure.

Performance Summary

Frequency

Range: 100 Hz to 1500 MHz

Resolution: 10 Hz to 3 MHz bandwidths in 1,3,10 sequence

Spectral Purity: noise sidebands >80 dB below peak of CW signal 300 Hz offset in 10 Hz resolution bandwidth.

Accuracy: internal frequency standard aging $<1 \times 10^{-9}$ parts/day (2×10^{-7}/year) of calibration; center frequency ±(2% of frequency span + frequency standard error x center frequency + 10 Hz)

Amplitude

Range: -137 dBm to +30 dBm

Scaling: dBm, dBmV, dBμV with 10,5,2 or 1 dB per division; or linear voltage scale

Accuracy: ± 3.0 dB with 90 dB displayed range

Description

The 8568A Spectrum Analyzer consists of an 85662A Display Section and an 85680A RF Section.

Accessories supplied	Qty.	HP Part No.
Interconnection cable	1	85662-60071
Interconnection cable	1	85662-60069
Information card	1	7120-6781
Information card	1	7120-6782
Operating and Service Manual	1	08568-90001
8568A Spectrum Analyzer Operation	1	08568-90002
8568A Spectrum Analyzer Remote Operation	1	08568-90003
Power cords	2	See Operating and Service Manual

HP 8568A Spectrum Analyzer

Option Summary

The following options are available:

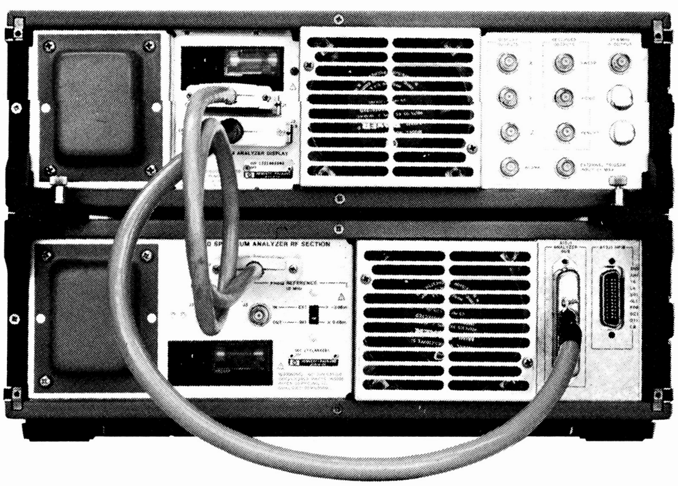
75Ω input impedance, 100 Hz to 1500 MHz, input 1	**Option 001**
400 Hz power line frequency operation	**Option 400**
Front handle kits (one for each section)	**Option 907**

Initial Line Power On and Calibration

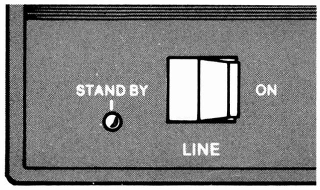
CAUTION

Prior to connecting the line power cords, make sure the proper line voltage and line fuse have been selected for both the RF and Display sections of the analyzer. For complete information on power cords, voltage and fuse selection, see 8568A Operating and Service Manual, section II.

Connect interconnection cables as shown:



Rear Panel Connections



LINE ON and STANDBY

After making the AC power line connections the STANDBY lights of both Display and RF analyzer sections should be on. As long as the instrument is operating (LINE ON) or the STANDBY lights are on (LINE STANDBY), the accuracy specifications of the internal frequency standard will be met. After a cold start up, such as on-receipt operation, the analyzer requires 24 hours to stabilize.

Upon LINE ON, the instrument will perform an automatic internal instrument check, designated by the red INSTR CHECK lights. The HP-IB address will appear in the CRT display. If one or both lights remain on or the HP-IB address fails to appear after several seconds, refer to the Operating and Service Manual, section II.

Manual Calibrator Signal Adjustment

In order to meet specified frequency and amplitude accuracy, this calibration procedure should be used periodically along with the error correction routine below.

1. With LINE power ON, press [INSTR PRESET].
2. Connect CAL OUTPUT to SIGNAL INPUT 2.
3. Press [CENTER FREQUENCY] [2] [0] [MHz −dBm sec]
   [FREQUENCY SPAN] [2] [MHz −dBm sec]
   [RES BW] [1] [MHz −dBm sec]
   [REFERENCE LEVEL] [7] [MHz −dBm sec]
   LOG [ENTER dB/DIV] [1] [GHz +dBm dB] [PEAK SEARCH]
   or press [RECALL] [8]
4. Adjust AMPTD CAL for MKR amplitude of − 10.00 dBm.
5. Press [FREQUENCY SPAN] [0] [Hz μV μsec]
   [RES BW] [3] [0] [Hz μV μsec]
   [SWEEP TIME] [1] [0] [MHz −dBm sec]
   SCALE LOG [ENTER dB/DIV] [1] [GHz +dBm dB]
   or press [RECALL] [9]
6. Maximize response with FREQ ZERO adjustment.

Error Correction Routine

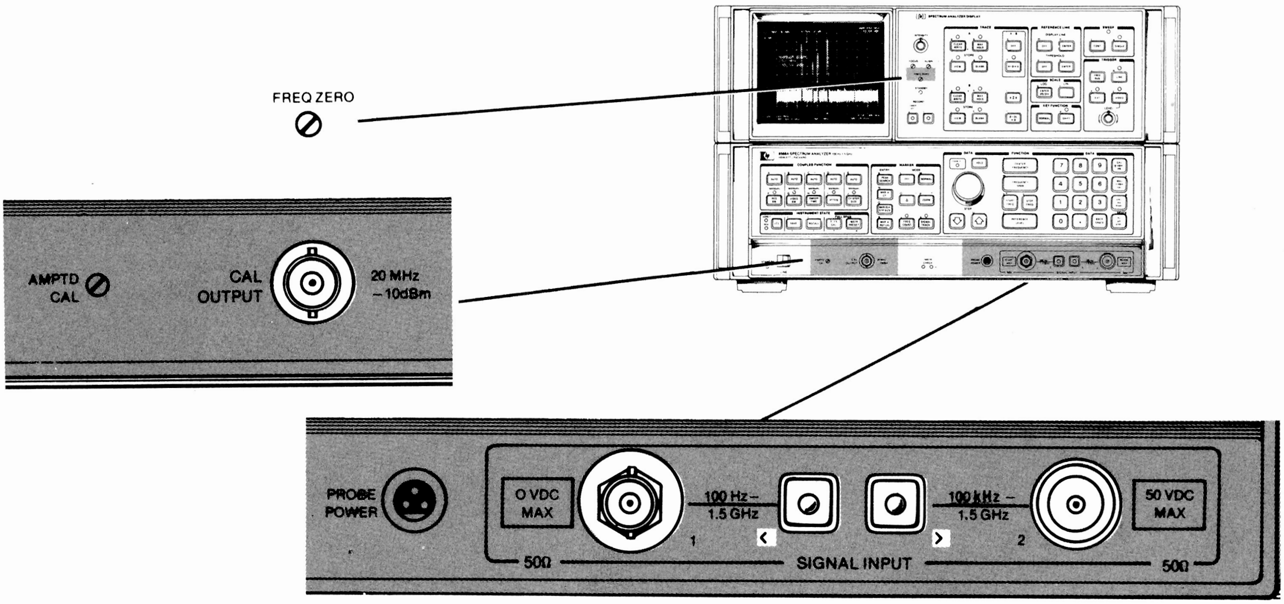
A 1½ minute internal error correction routine minimizes errors due to changes in IF gain, resolution bandwidth, input attenuator or scale changes. To start the routine press KEY FUNCTION [SHIFT] [FREQUENCY SPAN]

A readout "CORR 'D" will appear in the CRT display upon completion of this routine.

If the message "Adjust FREQ ZERO and AMPTD CAL" appears in the display, repeat the manual calibration before running the error correction routine again.

Chapter 12 KEY FUNCTION discusses the details of this error correction routine.

Signal Inputs



Signal Input and Calibration Controls

Either of the RF signal inputs can be selected:

INPUT 1: 100 Hz to 1500 MHz, dc coupled, BNC fused 50Ω.

INPUT 2: 100 kHz to 1500 MHz, ac coupled, Type N 50Ω

Isolation between inputs is >90 dB.

CAUTION

Excessive signal INPUT power will damage the input RF attenuator and the input mixer. The spectrum analyzer total input power must not exceed the values listed:

INPUT	Maximum dc	Maximum RF
1	±0 volts	+30 dBm (1 watt)
2	±50 volts	+30 dBm (1 watt)

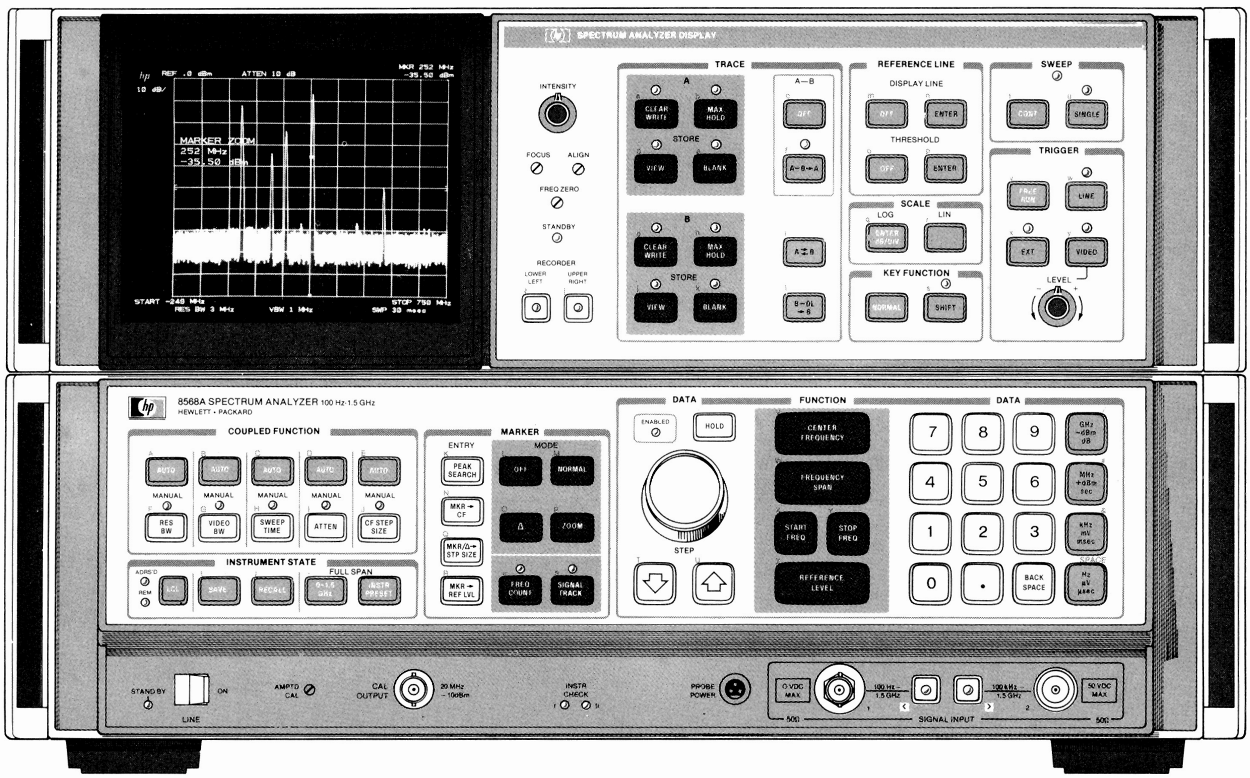
Probe Power

The probe power jack supplies power for high impedance 1:1 active probes, such as the HP 1121A 500 MHz AC Probe; and 50Ω preamplifiers such as the HP 10855A preamplifier. The voltage outputs are +15V, and -12.6V with a maximum current of 150 mA.

CAUTION

Active probes or amplifiers should not be used on RF Input 1, the dc coupled input, unless their output is specified ac only.

Front Panel Overview



CONTROL GROUPS

SIGNAL INPUT: 100 Hz to 1500 MHz

DATA/FUNCTION: Fundamental analyzer control

CAL OUTPUT: Calibration signal

CRT DISPLAY: Signal response and analyzer settings

TRACE: Control of signal response display

MARKER: Movable bright dot markers for direct frequency and amplitude readout

COUPLED FUNCTION: Maintenance of absolute amplitude and frequency calibration by automatically selecting certain analyzer control settings

SWEEP and TRIGGER: Selects amplitude scale and trace update trigger

SCALE: Selects logarithmic or linear amplitude scale.

REFERENCE LINE: Measurement and display aids

INSTRUMENT STATE: Local, remote and preset control settings saving and recalling control settings

KEY FUNCTION: Access to special functions

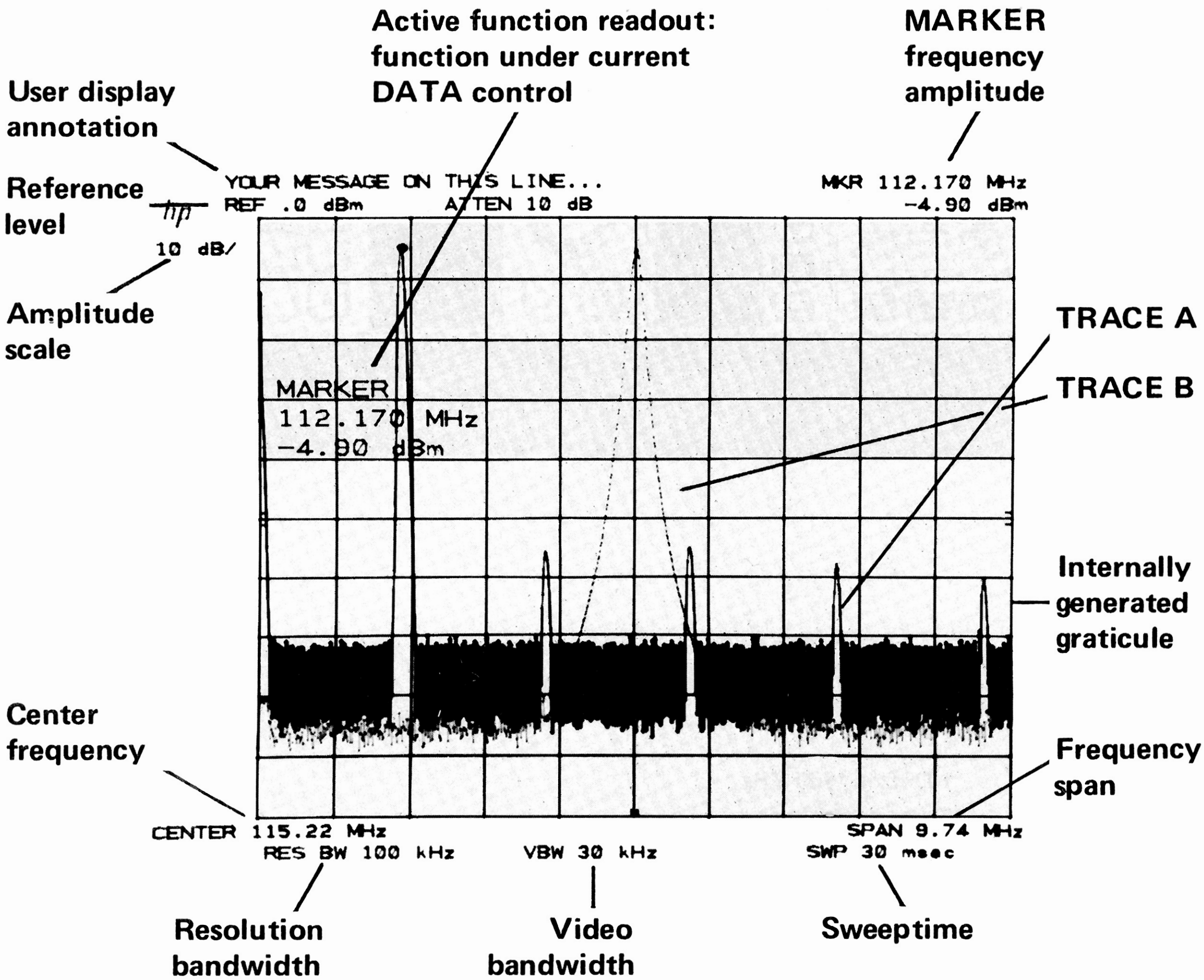
LINE ON/STANDBY Powers instrument and performs instrument check

HP-IB CONNECTOR; AUXILIARY OUTPUTS Rear panel output connectors for full HP-IB and xyz capability

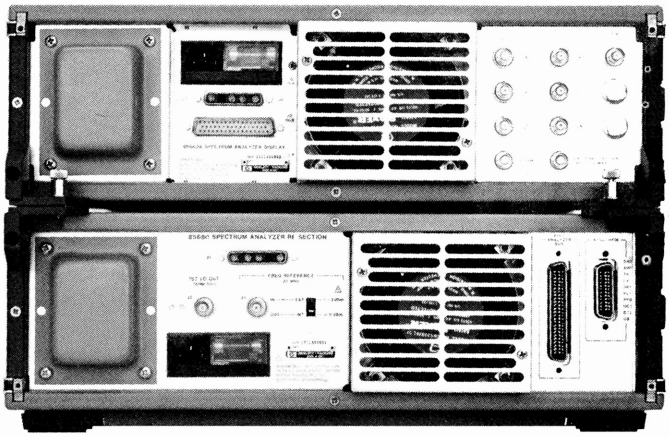
INFORMATION CARDS: Describes the function of each front panel control and [SHIFT] functions; indexes all the HP-IB programming codes; outlines the calibration procedure.

CRT Display

The analyzer's CRT display presents the signal response trace and all pertinent measurement data. The active function area names the function under DATA control and shows the function values as they are changed. All the information necessary to scale and reference the graticule is provided.



Rear Panel Outputs



Display Outputs

Display outputs allow all the CRT information to be displayed on an auxiliary CRT display such as the HP 1310A Large Screen Display.

Display Outputs	Output
X, Y	0 to +1 V
Z	Intensity: -1 V blank, 0 to 1 V intensity modulation

Recorder Outputs

The recorder outputs allow the x-y plot of trace data with x-y plotters using positive penlift coils or TTL penlift input. The front panel keys enable outputs for the calibration of x-y plotter reference points:

Recorder Outputs	RECORDER: LOWER LEFT (Z), UPPER RIGHT	RECORDER Outputs when keys or HP-IB commands are enabled	
		Lower Left	Upper Right
SWEEP	A voltage proportional to the horizontal sweep of the CRT trace that ranges from 0 V for the left edge and to +10 V for the right edge.	0 V left	10 V right
VIDEO	Detected video output (before A-D conversion) proportional to vertical deflection of the CRT trace. Output increases 100 mV/div from 0 to 1 V.	0 V lower	+1 V upper
PENLIFT	A blanking output, 15 V, occurs during CRT retrace; otherwise output is low at 0 V (pen down).	+15 V	+15 V

HP-IB Input Output Connector

The Hewlett Packard Interface Bus allows remote operation of the analyzer as well as input and output of measurement data. See 8568A Spectrum Analyzer Remote Operation, HP part number 08568-90003.

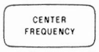
Chapter 2

GETTING STARTED

This chapter is intended to provide you with an overview of the use and capability of the Hewlett Packard 8568A Spectrum Analyzer. The chapters following provide the details on each aspect of operation.

Front Panel Concept

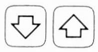
The front panel keys provide convenient control over functions such as center frequency, frequency span, reference level, resolution bandwidth, and sweep time. Any function can be selected by pressing its key and then changed by using the DATA control knob, step keys or number/units keyboard. For example, to specify center frequency

press 

,

then change the value, as read out on the CRT, with *any* or *all* of the DATA controls:

 Continuous coarse and fine tune

 Change in steps

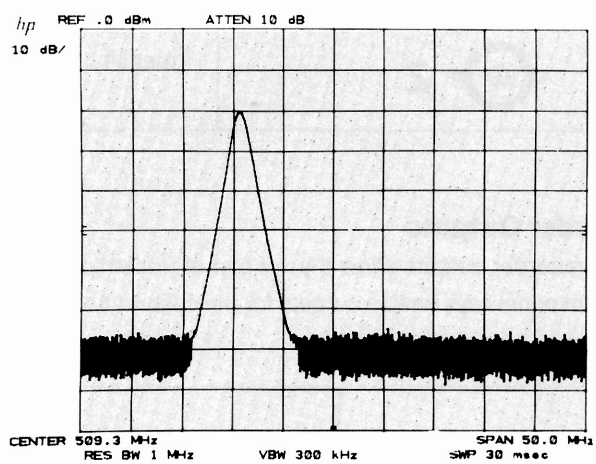
 Set the value exactly

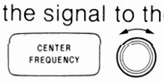
The analyzer's CRT display presents the signal response trace and all pertinent measurement data.

FUNCTION/DATA Controls

The front panel controls are divided into functional groups. Most measurements can be made from the FUNCTION/DATA control group. However, the other groups add to the measurement efficiency, convenience and capability.

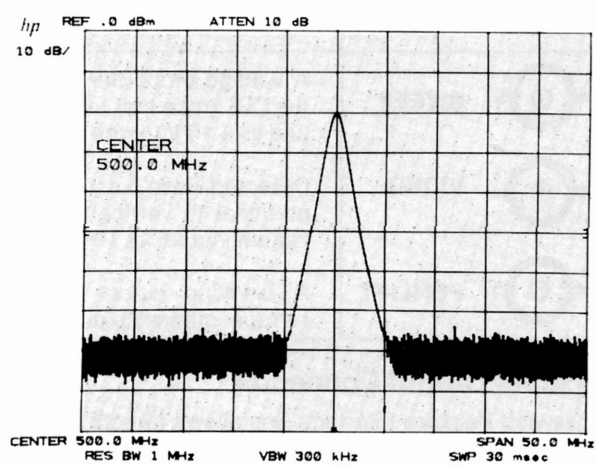
The FUNCTION and DATA controls can be used to measure the frequency and amplitude of a signal such as the one shown.



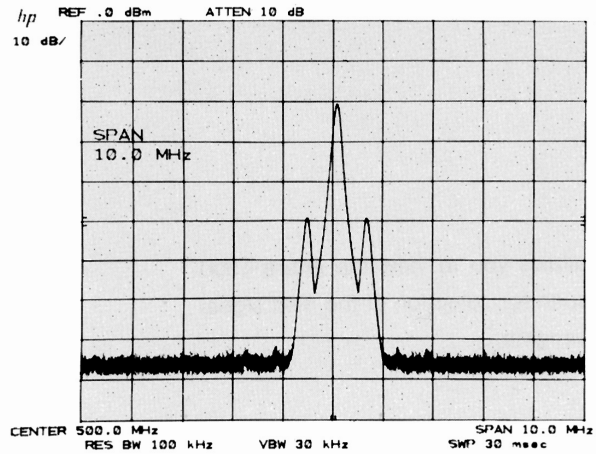
First, move the signal to the center of the display with 

.

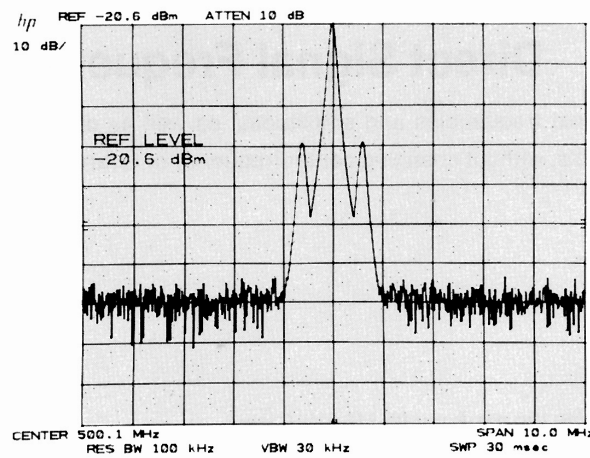
The readout gives the signal frequency. (The DATA step keys or number/units keys could also have been used.



For better frequency resolution narrow the frequency span with [FREQUENCY SPAN] [⇩] [⇩].



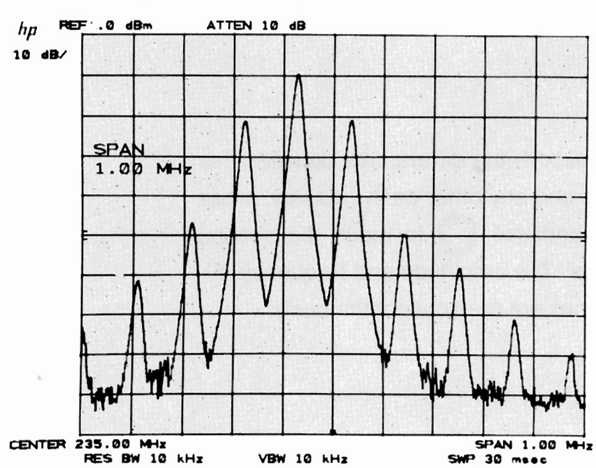
Now bring the signal peak to the reference level with [REFERENCE LEVEL] [⇩] and .
The reference level readout is the signal's power level.



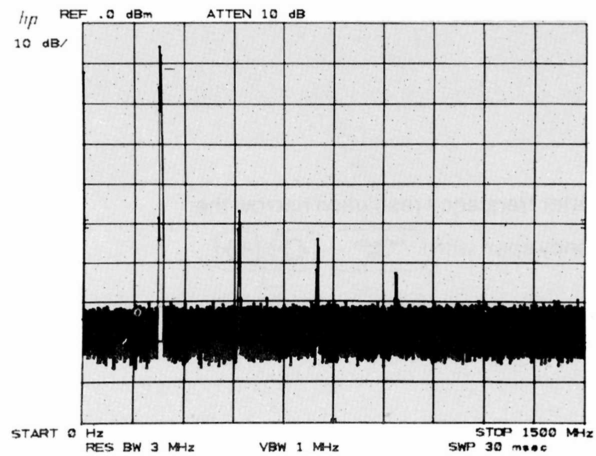
Starting From Full Span

A convenient place to start a new measurement is with a full 1500 MHz frequency span. A single key, [INSTR PRESET] presets all the analyzer functions to give you a 0 Hz to 1500 MHz display with a 0 dBm reference level.

For example, after measurements in a narrow frequency span. . .



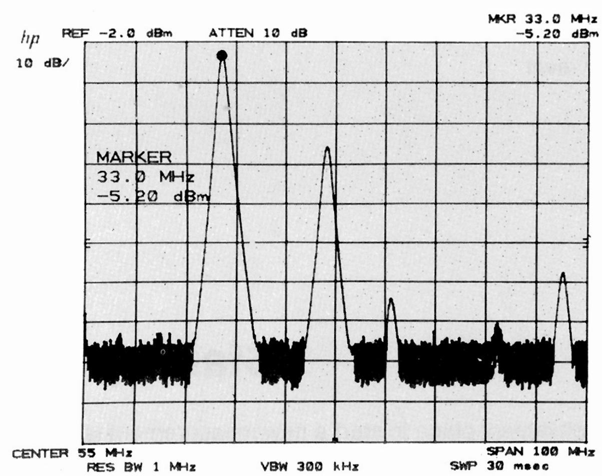
INSTR PRESET allows you to view the entire 1500 MHz span for selection of the next signal to investigate.



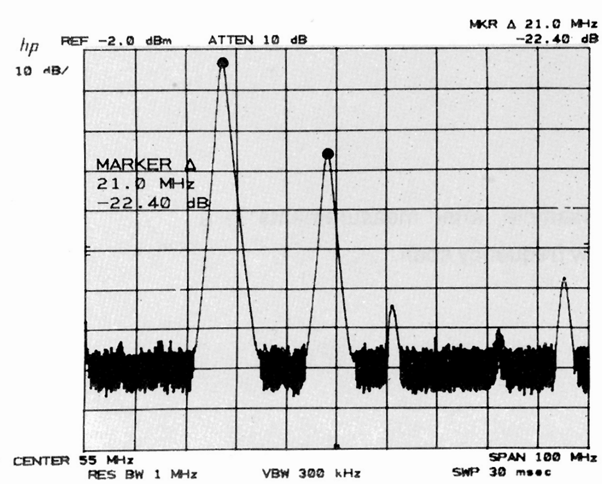
Direct Signal Frequency and Amplitude Readout

Signal frequencies and amplitudes, as well as differences, can be read out directly with the MARKER and DATA controls, without changing center frequency or reference level.

Activate the marker with MARKER NORMAL. Use the DATA knob to position the marker. The amplitude and frequency are read out continuously.



To measure the differences between this signal and any other on the display, press Δ and use the knob to move the second marker. The amplitude and frequency differences are read out continuously.

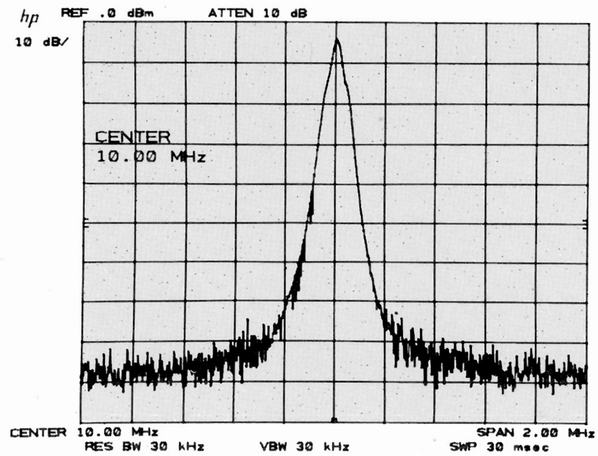


Automatic Display Calibration

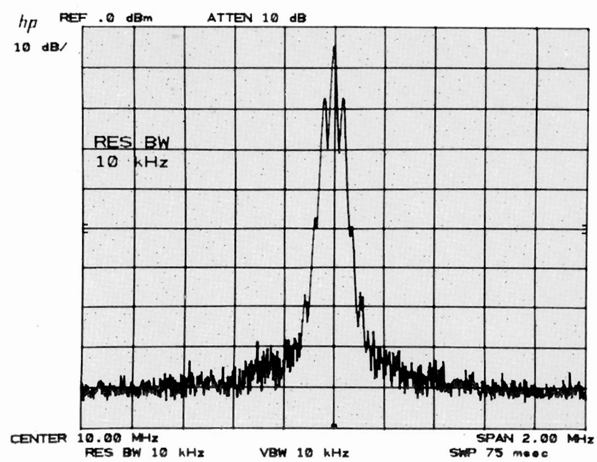
Unless you specifically override the analyzer's COUPLED FUNCTION state, the analyzer will maintain absolute amplitude and frequency calibration during your measurements. Changes of frequency span automatically call for resolution bandwidths, video bandwidths and sweep times that keep the amplitude calibrated while maximizing the trace sweep rate. You can take manual control over any of these functions with the COUPLED FUNCTION and DATA controls.

For example, for higher signal resolving capability the analyzer's resolution bandwidth can be narrowed using the COUPLED FUNCTION [RES BW].

A signal with 40 kHz sidebands is viewed in a 2 MHz span. The sidebands are not visible, because of the 30 kHz resolution bandwidth.

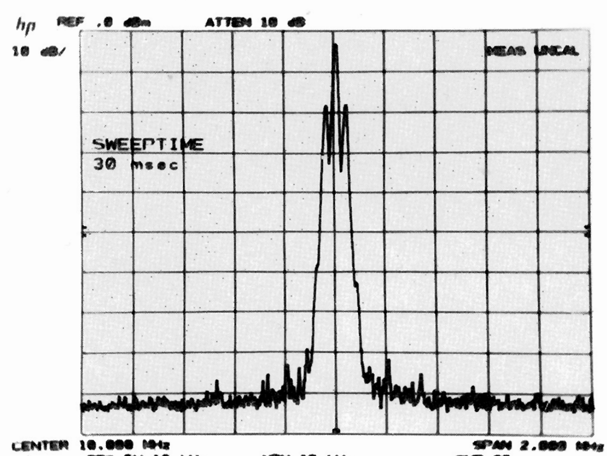


Reduce the resolution bandwidth without changing the span with [RES BW] [⇩]. (The DATA knob ◎ or number/units keyboard could also have been used.)



The sweep time is increased automatically to compensate for the narrower resolution bandwidth. If the sweeptime were in the manual mode, the display could become uncalibrated.

Press [SWEEP TIME] [⇩].
The display uncalibrated message appears in the display.



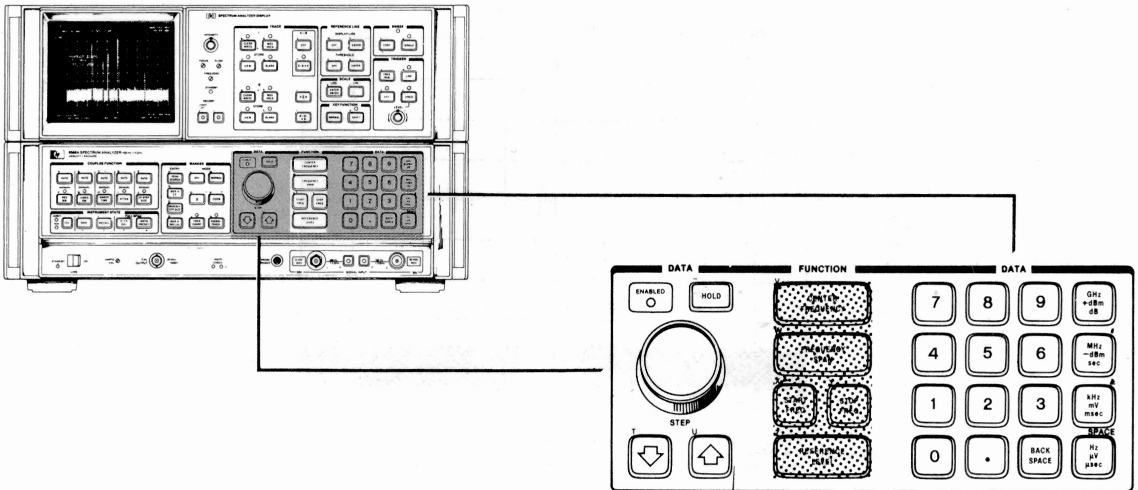
Automatic Measurements

Just as the front panel keys call functions and change their values, simple programming codes from a computing controller can control the spectrum analyzer for automatic measurement through the Hewlett-Packard Interface Bus (HP-IB). HP's implementation of IEEE Standard 488 and identical ANSI Standard MC1.1 "Digital interface for programmable instrumentation".

Detailed information on remote operation is the subject of 8568A Spectrum Analyzer Remote Operation, HP part number 08568-90003.

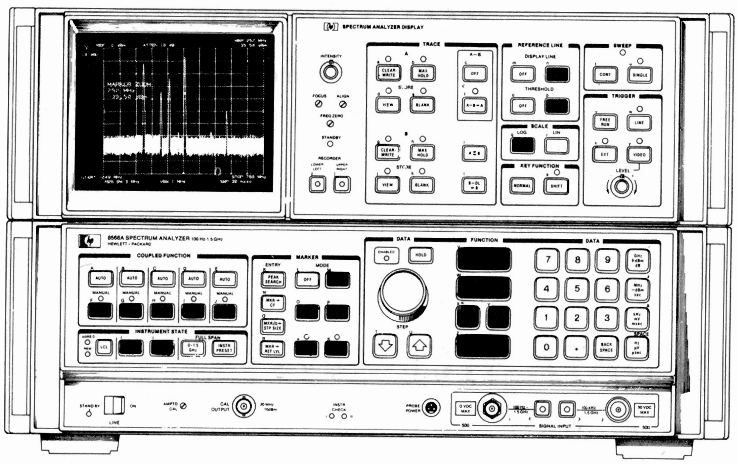
Chapter 3
DATA

DATA controls are used to change function values for functions such as center frequency, start frequency, resolution bandwidth or marker position.



DATA Controls

The DATA controls are clustered about the FUNCTION keys which "call up" or activate the most frequently used spectrum analyzer control functions: center frequency, frequency span (or start/stop frequency) and reference level. The other functions that accept DATA control are shown below:



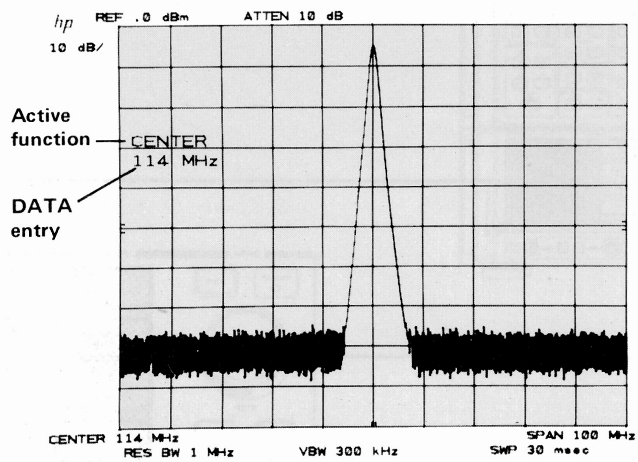
Front Panel Functions Using DATA Controls

To the left of the FUNCTION Keys are the DATA knob and the DATA STEP keys which are used to make incremental changes to the activated function. To the right of the FUNCTION keys is the DATA number/units keyboard which allows changes to an exact value.

The DATA controls will change the activated function in a manner prescribed by that function. For example, center frequency can be changed continuously with the DATA knob, or in steps proportional to the frequency span with the DATA STEP keys, or set exactly with the DATA number/units keyboard. Resolution bandwidth, which can be set only to discrete values, can still be changed with any of the DATA controls. The DATA knob and DATA STEP keys increment the setting from one bandwidth to the next. An entry from the number/units keyboard which may not coincide with an allowable bandwidth will select the nearest bandwidth.

DATA Entry Readout

DATA entries are read from the CRT display as they are changed.



Preventing DATA Entry

A function can be deactivated by pressing [HOLD]. The active function readout is blanked and the ENABLED light goes out, indicating no DATA entry can be made. Pressing a function key re-enables the DATA controls.

DATA Knob ◎

The DATA knob ◎ allows the continuous change of center frequency, frequency span (or start/stop frequencies), reference level, and the positions of the marker, display line and threshold. It can also change the function values which are only incremented.

Clockwise rotation of the DATA knob will increase the function value. For continuous changes, the knob's sensitivity is determined by the measurement range and the speed at which the knob is turned. For example, when the center frequency is activated, ◎ increases the value of the center frequency one horizontal division of span per one quarter turn.

DATA STEP Keys [⇩] [⇧]

The DATA STEP keys allow rapid increase [⇧] or decrease [⇩] of the active function value. The step size is dependent either upon the analyzer's measurements range, on a preset amount or, for those parameters with fixed values, the next value in a sequence. Examples: Activate center frequency and [⇧] will increase the center frequency value by an amount equal to one division of the frequency span (one tenth of the frequency span). If the center frequency step size [CF STEP SIZE] has been preset, [⇧] will increase the center frequency by that preset amount. If frequency span were activated, [⇩] would change the span to the next lower value in predetermined sequence. Activate resolution bandwidth and [⇧] will select the next widest bandwidth.

Each press results in a single step.

DATA Number/Units Keyboard

The DATA number/units keyboard (or DATA keyboard) allows exact value entries to center frequency, frequency span (or start/stop frequency), reference level, log scale and the positions of the markers, display line, threshold and the COUPLED FUNCTIONS.

An activated parameter is changed by entering the number (with the CRT display providing a readout) then selecting the appropriate units key. The value is not changed (entered) until the units key is pressed.

The number portion of the entry may include a decimal, [•]. If not, the decimal is understood at the end of the number. Corrections to number entries are made with [BACK SPACE] which erases the last digit for each press.

Example: With center frequency activated

[1] [•] [2] [6] [5] [BACK SPACE] [BACK SPACE] [5] [GHz +dBm dB]

will set the center frequency to 1.250 GHz.

If the units key were pressed without a number entry, 1 is entered (except in zero frequency span).

Negative DATA Entry

Negative entries from the number units keyboard can be made for power and frequency but not time and voltage.

Negative power entries can be made using [MHz -dBm sec]. The "-dBm" key will enter -dBm, -dBmV or -dBμV. For example in reference level, with the dBmV units, an entry of [5] [0] [MHz -dBm sec] will enter -50 dBmV.

Negative frequency entries can be made using

[SHIFT] [HOLD] (—)

as a prefix to the frequency entry. For example, to enter a negative start frequency, press [FREQUENCY SPAN] [SHIFT] [HOLD] [1] [0] [0] [MHz -dBm sec]. This enters the frequency value as -100 MHz.

Not all functions will accept negative entries (the sign will be ignored).

Multiple DATA Changes

A function, once activated, may be changed as often as necessary without reactivating that function (see Chapter 4, FUNCTION). Any of the DATA controls can be used in any order.*

It is not always necessary to make a DATA entry. For example, start and stop frequency may be activated simply to allow readout of the left and right display reference frequencies as start/stop frequencies.

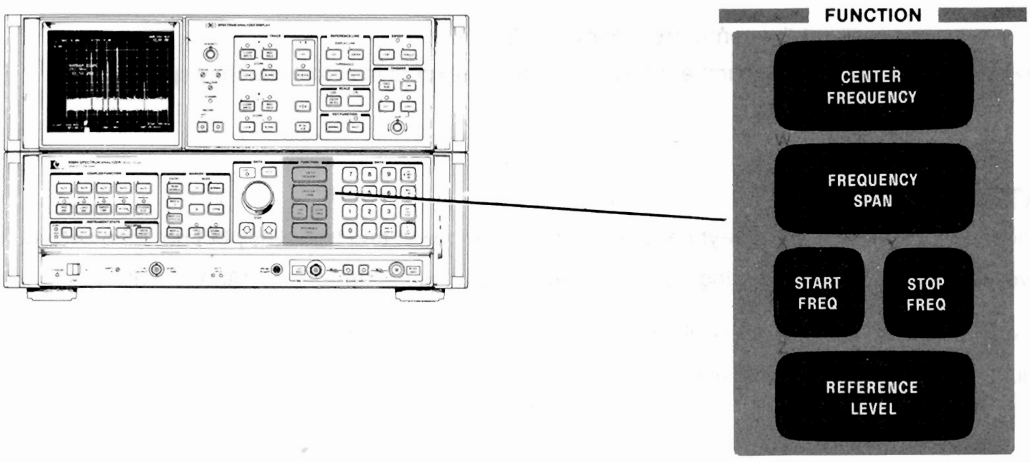
---

*Exceptions are the SHIFT KEY FUNCTIONS which use only DATA number/units keyboard. See Chapter 12.

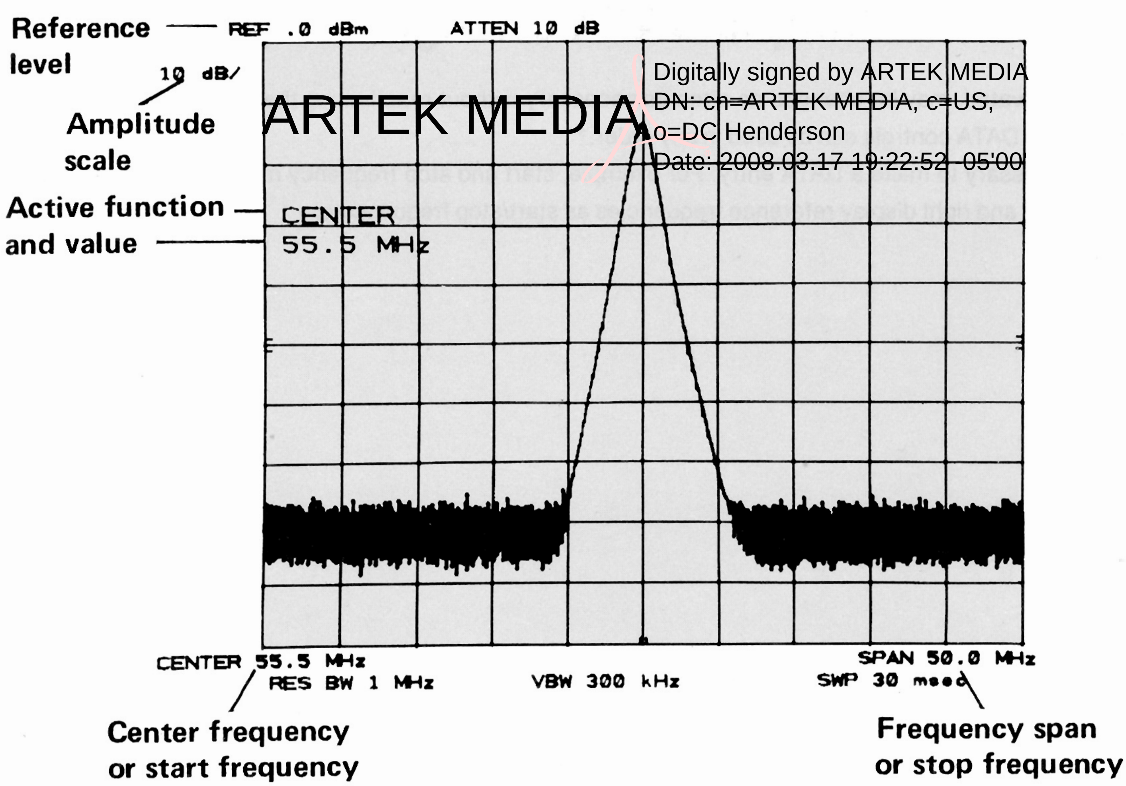
Chapter 4
FUNCTION

This chapter describes the use of FUNCTION and DATA controls for establishing the desired amplitude and frequency display.

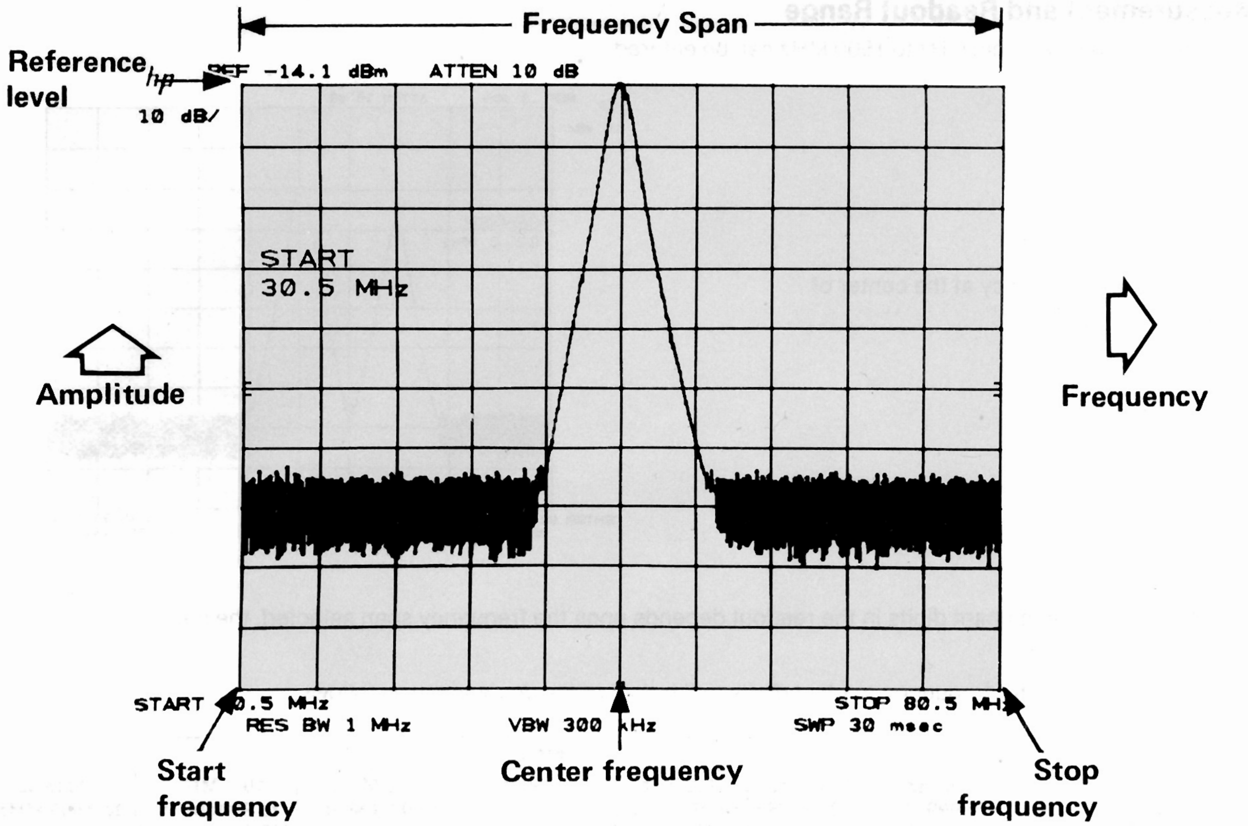
The FUNCTION group allows changes to the most used spectrum analyzer functions: center frequency, frequency span and reference level. An alternate method of setting the frequency scale is provided with the start and stop frequency functions.



The changing value is read out from the display at the active function area and at the display position dedicated to that FUNCTION.



FUNCTION Value Readouts



CRT Graticule Scaling With FUNCTION Readouts

Display Calibration

With changes to the displayed frequency range, the spectrum analyzer changes resolution bandwidth, video bandwidth and sweep time to maintain absolute amplitude and frequency calibration if the COUPLED FUNCTIONs are set to automatic. The examples in this chapter assume this condition. See Chapter 9, COUPLED FUNCTION for additional information on amplitude and frequency calibration.

> **NOTATION CONVENTION**
>
> The instructions explained throughout this manual use the following notation:
>
> (DATA entry) - changing the value of an activated function with any of the appropriate DATA controls.

Frequency Display Range

The frequency range of the horizontal axis can be entered using either of two FUNCTION modes:

[CENTER FREQUENCY] and [FREQUENCY SPAN]

or

[START FREQ] and [STOP FREQ]

When a function from either mode is activated, only the function values of that mode will be displayed. Switching from one mode to the other with no DATA entry makes no change to the displayed frequency spectrum.

Center Frequency

[CENTER FREQUENCY] (DATA entry) changes the center frequency. Center frequency will remain activated (i.e., capable of being changed) until [HOLD], [INSTR PRESET] or another function requiring DATA entry is activated.

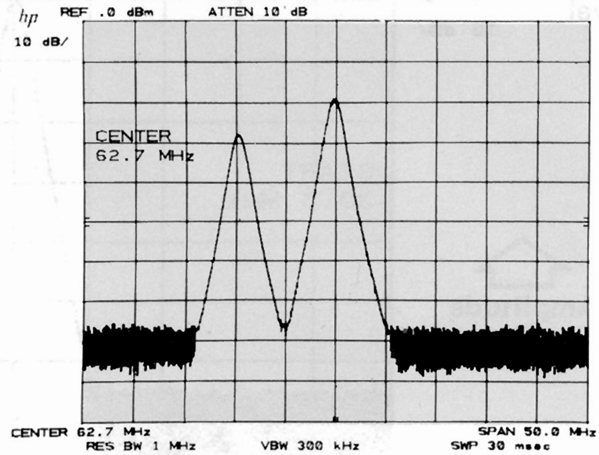
FUNCTION

CENTER FREQUENCY

Measurement and Readout Range

Center frequencies from 0 Hz to 1500 MHz can be entered.

62.7 MHz is the frequency at the center of the display graticule.



The number of significant digits in the readout depends upon the frequency span selected, the narrower the span the more significant digits.

The number of center frequency readout *digits to the right of the decimal* are as follows:

	Frequency Span						
Center Frequency	**100 Hz to 999 Hz**	**1.00 kHz to 9.99 kHz**	**10.0 kHz to 99.9 kHz**	**100 kHz to 999 kHz**	**1.00 MHz to 9.99 MHz**	**10.0 MHz to 99.9 MHz**	**100 MHz to 1500 MHz**
0 Hz to 999 Hz	0	0	0	0	0	0	0
1.000 kHz to 999.999 kHz	3	2	1	0	0	0	0
or 1.000000 MHz to 1499.999999 MHz	6	5	4	3	2	1	0

DATA Entry

CENTER FREQUENCY	Changes the center frequency by about one half the total frequency span each full turn.
CENTER FREQUENCY	Changes the center frequency by one tenth of the frequency span, i.e., by one division. COUPLED FUNCTION CF STEP SIZE can be used to change this step size.
CENTER FREQUENCY	Allows direct center frequency entry. The analyzer will accept a center frequency entry of up to 9 digits for frequencies less than 1000 MHz and 10 digits for frequencies of 1000 MHz to 1500 MHz. Even though the readout may show a fewer number of digits (due to wide frequency span), as the span is narrowed, the full entry will be read out. Abbreviated readouts are not rounded.

Only after a center frequency entry has been made will points along the trace reflect the spectrum change. For example, if the center frequency is changed when a slow sweep is in the middle of the graticule, signal responses on the left-hand side bear no relation to the new center frequency until the sweep passes through them.

Signal Track - Automatic Frequency Control

The center frequency can be locked to a specific signal using the MARKER function [SIGNAL TRACK]. Chapter 7, discusses the procedure and examples.

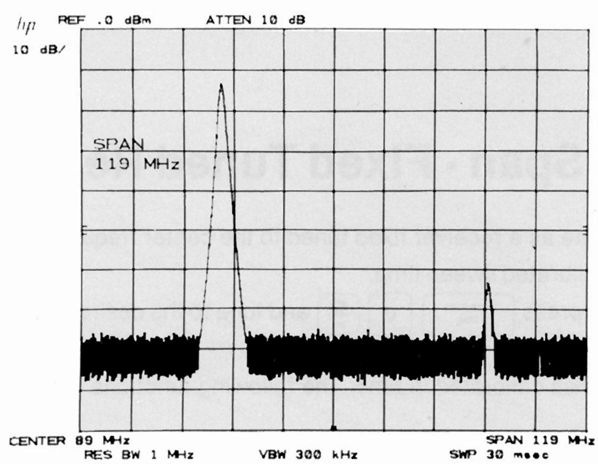
Frequency Span

[FREQUENCY SPAN] (DATA entry) changes the total display frequency range symmetrically about the center frequency. Frequency span is read out from the display.

> **NOTE**
>
> Frequency span readout refers to the total display frequency range. Divide by 10 to determine frequency span per division.

Measurement and Readout Range

Frequency span can be varied from 100 Hz to 1500 MHz. Three significant digits are displayed for frequency spans up to 1000 MHz and four digits from spans of 1000 MHz to 1500 MHz.



DATA Entry

FREQUENCY SPAN (knob)	Changes the frequency span by about a factor of 2 for each half turn.
FREQUENCY SPAN (step keys)	Changes the frequency span to the next value in a 1, 2, 5, 10 sequence.
FREQUENCY SPAN (keypad)	Enters an exact value up to three or four digits, depending on span. Additional digits will be deleted without rounding.

Example of [CENTER FREQUENCY] [FREQUENCY SPAN]

Once a signal response is placed at the center of the display frequency range, the signal's frequency can be read out from center frequency. Reduction of the frequency span will increase the frequency readout resolution.

FUNCTION

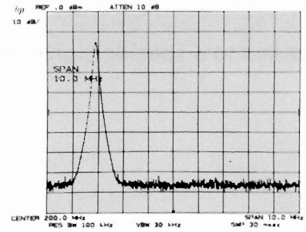
[FREQUENCY SPAN]

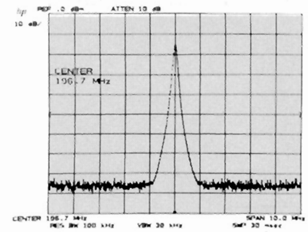
A signal lower than the center frequency can be brought to the center with

[CENTER FREQUENCY] [↓] [↓] [↓]

using [↓] as a coarse tune,

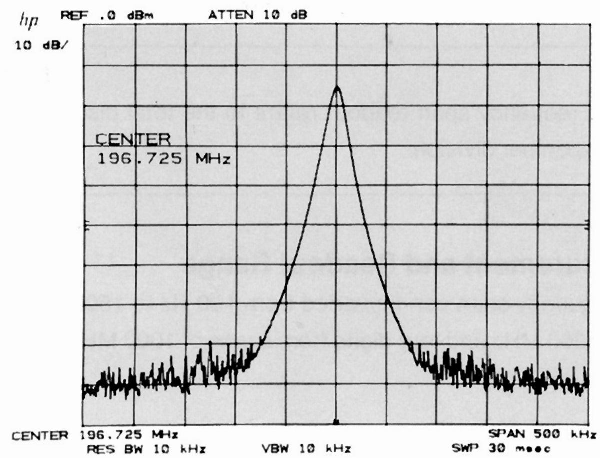
then fine tuning with ◎.





Narrowing the frequency span will increase the center frequency resolution.

[FREQUENCY SPAN] [↓] [↓] [↓] [↓]



Zero Frequency Span - Fixed Tuned Receiver Operation

The spectrum analyzer can operate as a receiver fixed tuned to the center frequency. Modulation waveforms can be displayed in the time domain with calibrated sweep time.

To fix tune the spectrum analyzer press [FREQUENCY SPAN] [0] [MHz −dBm sec] and tune to the desired frequency with [CENTER FREQUENCY] (DATA entry).

The horizontal display axis becomes calibrated in time. The following functions establish a clear display of the video waveform:

TRIGGER/LEVEL [VIDEO] ◎	Stabilizes the waveform trace on the display by triggering on the modulation envelope.
SCALE [LIN]	Voltage amplitude calibration.

COUPLED FUNCTIONS [SWEEP TIME]	Adjusts the full sweep time. Sweep times down to 1 μs full scale are available in zero span. Signal responses for sweep times <20 msec are not digitally stored.
[RES BW] and [VIDEO BW]	Select according to signal bandwidth.

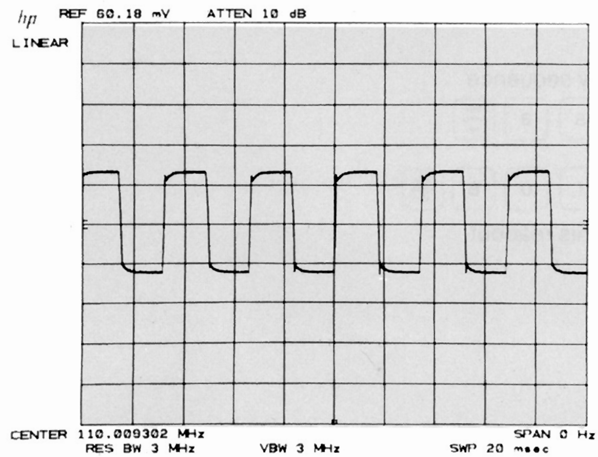
Each of the COUPLED FUNCTION values remain at their current values when zero span is activated.

Measurement and Readout Range

An example shows the readout:

Press [FREQUENCY SPAN] [0] [Hz μV μsec] to activate zero span. Press [CENTER FREQUENCY] [1] [1] [0] [MHz -dBm sec], then fine tune with ◯ for optimum trace.

The analyzer is fixed tuned to 110 MHz. The time domain display shows a modulation waveform at 2 msec/division.



> **NOTE**
>
> The sweep time readout refers to the full 10 division display sweep time. Divide by 10 to determine sweep time per division.

In the time domain, sweep time range is 1 μsec to 10 msec in a 1, 2, 5, 10 sequence and 20 ms to 1500 sec in a 1, 1.5, 2, 3, 5, 7.5, 10 sequence.

The sensitivity of center frequency to the DATA ◯ and [⇧] [⇩] is dependent upon resolution bandwidth:

DATA ENTRY	CENTER FREQUENCY CHANGE
one revolution ◯	6 x (resolution bandwidth)
[⇧] or [⇩]	1 x (resolution bandwidth)

Start and Stop Frequency

A specified frequency range can be displayed by using

[START FREQ] (DATA entry) to set left graticule frequency.

[STOP FREQ] (DATA entry) to set right graticule frequency.

Start and stop are mutually exclusive with the center frequency and frequency span active functions. Activating either start or stop causes both to read out in place of center frequency and frequency span.

Measurement and Readout Range

[START FREQ] can be varied from -850 MHz to 1500 MHz, although entries less than 1700 MHz below stop frequency will effect the [START FREQ] readout.

[STOP FREQ] can be varied from 000 to 2500 MHz although entries 1700 MHz above the start frequency will effect the [STOP FREQ] readout.

The number of readout digits depends upon the frequency span. Narrower frequency ranges add digits to the readout.

FUNCTION

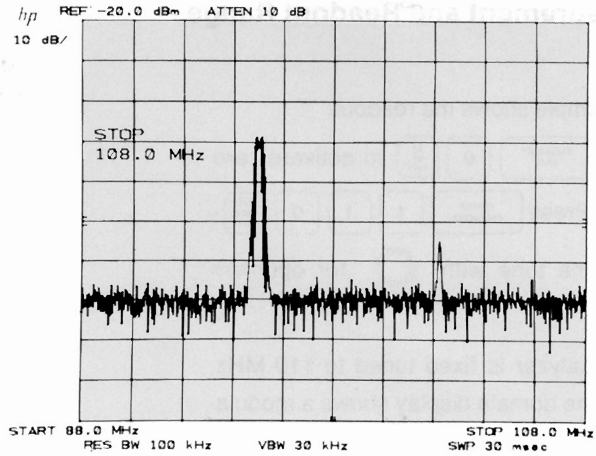
[START FREQ] [STOP FREQ] [REFERENCE LEVEL]

The key sequence

[START FREQ] [8] [8] [MHz −dBm sec]

[STOP FREQ] [1] [0] [8] [MHz −dBm sec]

gives this readout.



The rules governing the number of significant readout digits are the same as for [CENTER FREQUENCY]

DATA Entry

Both start and stop frequencies can be entered from any of the DATA controls.

[START FREQ] or [STOP FREQ]	(knob)	Changes the start or stop frequency. The amount of change per turn is a constant percentage of the frequency span.
[START FREQ] or [STOP FREQ]	[⇩] [⇧]	Changes the frequency by one tenth of the total frequency span.
[START FREQ] or [STOP FREQ]	(keyboard)	Exact start or stop frequencies can be entered. The number of digits readout depends upon the frequency span.

Reference Level

[REFERENCE LEVEL] (DATA entry) changes the absolute amplitude level of the top graticule line. The amplitude scale, that is, the number of amplitude units per division, is entered from the SCALE control group or [INSTR PRESET].

Signal responses below the top graticule are measured by bringing the response to the reference level with [REFERENCE LEVEL] (DATA entry).

NOTE
In logarithmic 10 dB per division scaling, the top 9 divisions are calibrated.

The maximum reference level value is dependent on the input attenuator setting. Levels to the input mixer, which could cause gain compression, will be displayed off the top of the reference level graticule. The maximum reference level limit can be extended with KEY FUNCTION [SHIFT] [ATTEN] allowing a maximum reference level of +60.0 dBm. See Chapter 12 for details concerning reference level ranges.

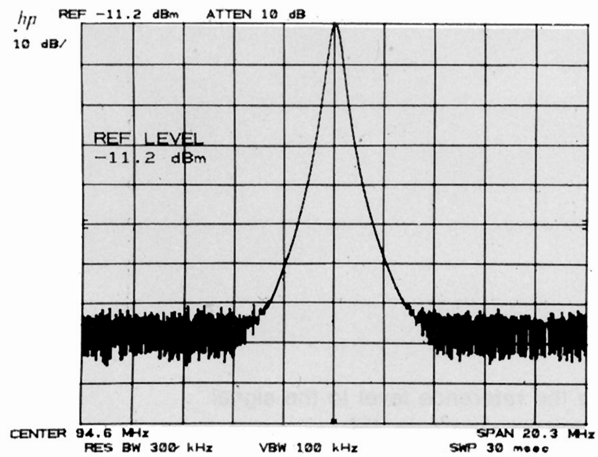
CAUTION

Even with the reference level set to +60 dBm the total input power should not exceed +30 dBm.

Measurement and Readout Range

The reference level can be changed from +30 dBm to -89.9 dBm in 0.1 dB steps. The readout shows one significant digit to the right of the decimal.

RF attenuator: 10 dB
Reference level: -11.2 dBm



Reference level dBm units are selected with [INSTR PRESET]: dBmV, dBμV and volts referred to the analyzer's input impedance can be selected with KEY [SHIFT] FUNCTIONS. The absolute power of the reference level remains constant when units are changed.

Full amplitude readout units information can be found in Chapter 12, KEY FUNCTIONS, page 12.5.

DATA Entry

[REFERENCE LEVEL] [knob]	In logarithmic scale the changes are in 0.1 dB steps: in linear scale the changes are made to the least significant digit.
[REFERENCE LEVEL] [⇩] [⇧]	In logarithmic scale, changes the reference level in steps according to dB/division scale. In linear scale, changes the reference level in 1 dB steps.

[REFERENCE LEVEL] [keypad]	Allows entry of exact reference levels. Digits entered beyond the displayed number of digits are deleted.

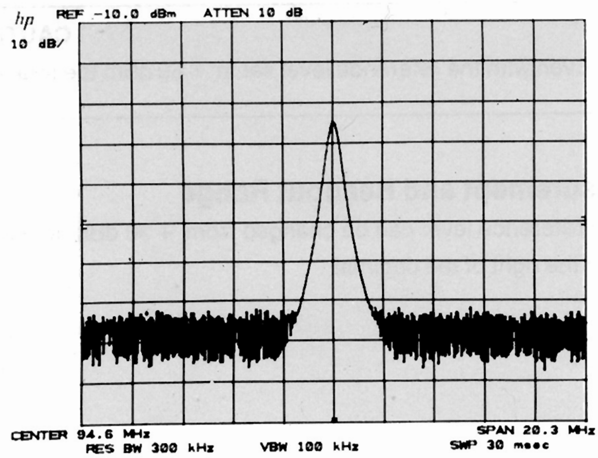
Example

A signal's power level is measured by setting the reference level equal to the signal level.

FUNCTION

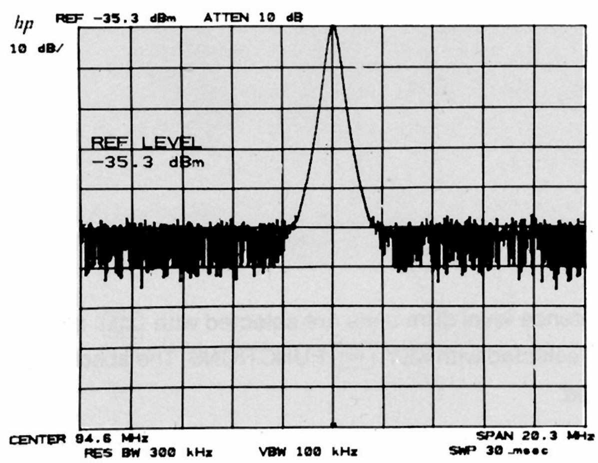
REFERENCE LEVEL

The signal level is roughly -35 dBm.



Change the reference level to the signal with REFERENCE LEVEL ⇩ ⇩ (knob)

The signal level measured is -35.3 dBm.

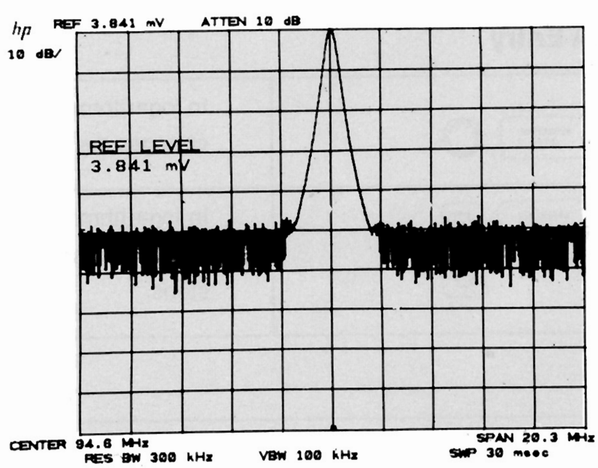


For voltage amplitude units press

D

SHIFT AUTO

The corresponding level is 3.841 mV.



Frequency and Amplitude Offsets

The display readout and (HP-IB readout) of frequency and amplitude can be offset by values entered through [SHIFT] KEY FUNCTIONS. The offset values are read out on the display. Frequency offset is entered with

[SHIFT] [CENTER FREQUENCY] (V) (DATA entry).

Frequency offset may be used, for example, to provide a baseband frequency display scale for a signal which has been converted up or down.

Amplitude offset is entered with

[SHIFT] [REFERENCE LEVEL] (Z) (DATA entry).

Amplitude offset can be used to take into effect external RF attenuation or gain in the reference level reading so that the signal level measured is the level at the input of the amplitude conversion device.

More details and examples are in Chapter 12, KEY FUNCTION, page 12.3.

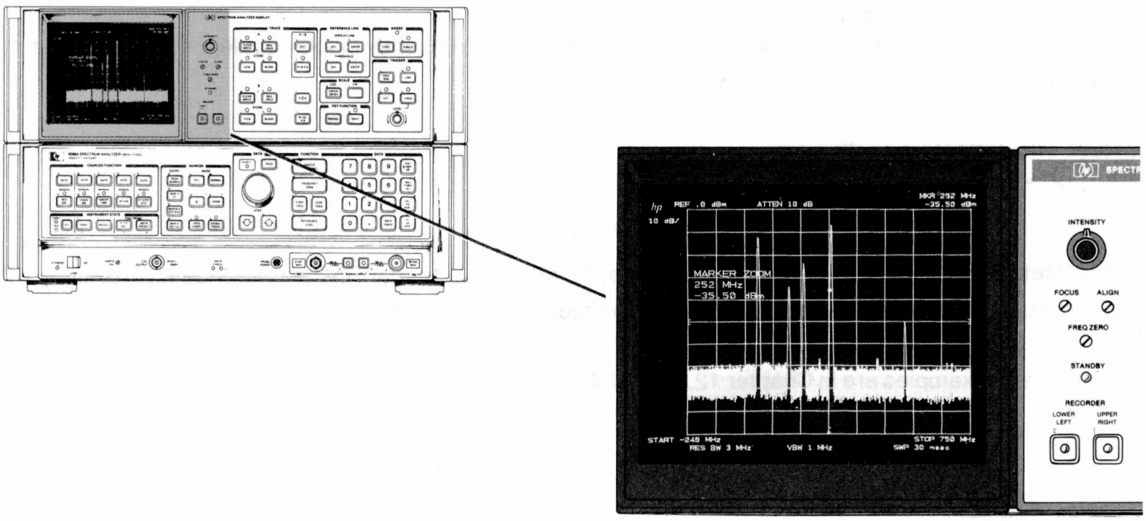
Chapter 5

CRT DISPLAY

This chapter describes the CRT display adjustments, readouts and graphics.

Adjustment of the Display

The adjustments for intensity, focus and alignment simultaneously affect all the lines and characters on the display.



CRT Display and Adjustments

INTENSITY

Controls intensity for all the CRT writing.

FOCUS

A screwdriver adjustment which focuses all the CRT writing. Focusing any one element on the CRT focuses all the writing.

ALIGN

A screwdriver adjustment which tilts all the displayed CRT information.

Display Section Line Power

STANDBY

The light indicates power condition of the Spectrum Analyzer Display section as dictated by the LINE power switch on the 85680A RF section.

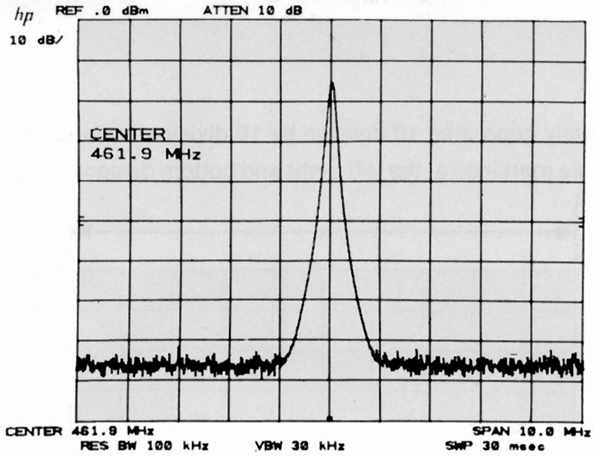
CRT Display Overview

The cathode ray tube of the Spectrum Analyzer Display section displays:

— active function name and value
— graticule
— traces of the signal response
— values that calibrate the frequency, time and amplitude axes.
— values for the spectrum analyzer receiver parameters, that is, COUPLED FUNCTIONS.
— operator originated labels and graphics

Active Function

The function which has been activated for DATA entry is read out in the graticule area shown.



Activating a function immediately writes its name in the active function area along with its present value. The following summarizes the names and readout formats for the front panel designated active functions.

Function	Examples of Active Function Readout
FUNCTION	
CENTER FREQUENCY	CENTER 750 MHz
FREQUENCY SPAN	SPAN 1500 MHz
START FREQ	START 0 Hz
STOP FREQ	STOP 1500 MHz
REFERENCE LEVEL	REF LEVEL .0 dBm
MARKER	
NORMAL	MARKER 550 kHz 19.8 dBm
Δ	MARKER Δ 20.0 MHz -12.4 dB
ZOOM	MARKER ZOOM 20.5 MHz -32.8 dBm
NORMAL FREQ COUNT	COUNTER 19.998 MHz -12.0 dBm
Δ FREQ COUNT	COUNTER Δ 20.000 MHz -.2 dB
ZOOM FREQ COUNT	COUNTER ZOOM 20.000 MHz -.2 dBm
NORMAL SHIFT M	MARKER 16.3 MHz -140.4 dBm (1 Hz)

Function	Examples of Active Function Readout
COUPLED FUNCTION	
RES BW	RES BW 3 MHz
VIDEO BW	VIDEO BW 3 MHz
SWEEP TIME	SWEEP TIME 20 msec
ATTEN	RF ATTEN 10 dB
CF STEP SIZE	CF STEP 150 MHz
REFERENCE LINE	
ENTER	DISPLAY LINE -45.0 dBm
ENTER	THRESHOLD -90.0 dBm
SCALE	
ENTER dB/DIV	LOG 10 dB/

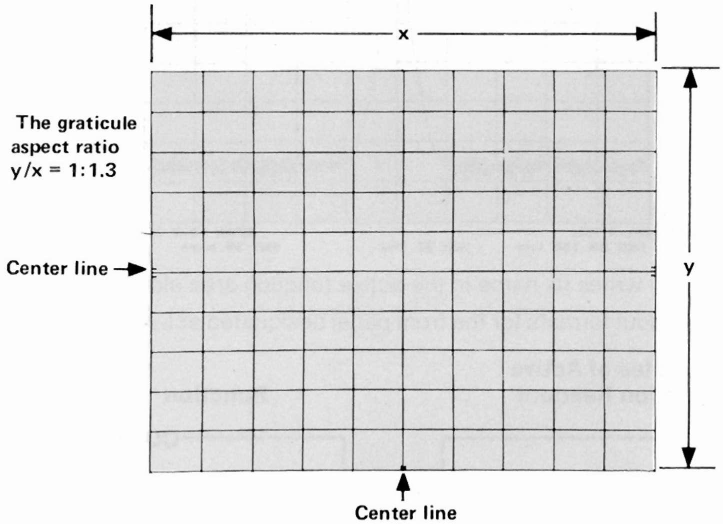
KEY FUNCTION

(See KEY FUNCTION, Chapter 12.)

HOLD **deactivates any active function (except for** SHIFT **E), blanking the active parameter readout.**

Graticule

The display graticule is an internally generated 10 division by 10 division rectangle for referencing frequency, time and amplitude measurements. Double markings at the left, right and bottom designate the center axes.



The graticule may be blanked from the display with KEY FUNCTION [SHIFT] m and restored with [SHIFT] n.

For CRT photography, the graticule may be intensified independent of the annotation and trace by pressing the following sequence:

[SHIFT] z [2] [1] [5] [6] [Hz µV µsec]

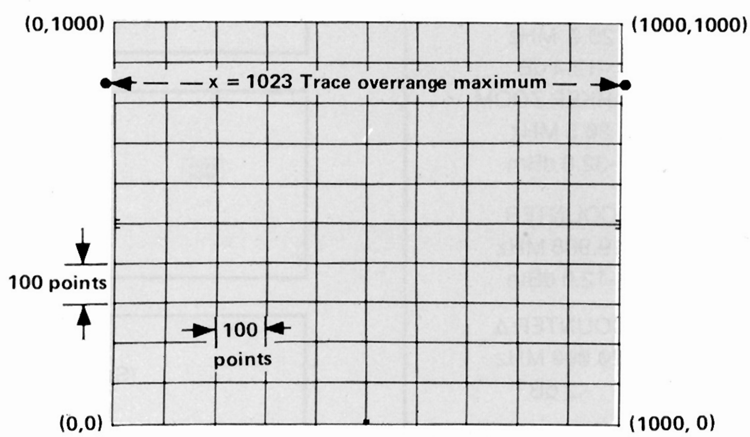
[SHIFT] | [1] [1] [6] [3] [Hz µV µsec]

[2] [1] [1] [5] [Hz µV µsec]

For more intensity, repeat the last two number entries, 1163 Hz and 2115 Hz. [INSTR PRESET] returns the graticule to normal.

Traces

Three separate traces, A, B and C, can be written onto the display. Each trace is generated from 1001 points across the graticule, connected by 1000 point-to-point straight line vectors. The location of each point is designated by an x and y location using the graticule as rectangular coordinates.



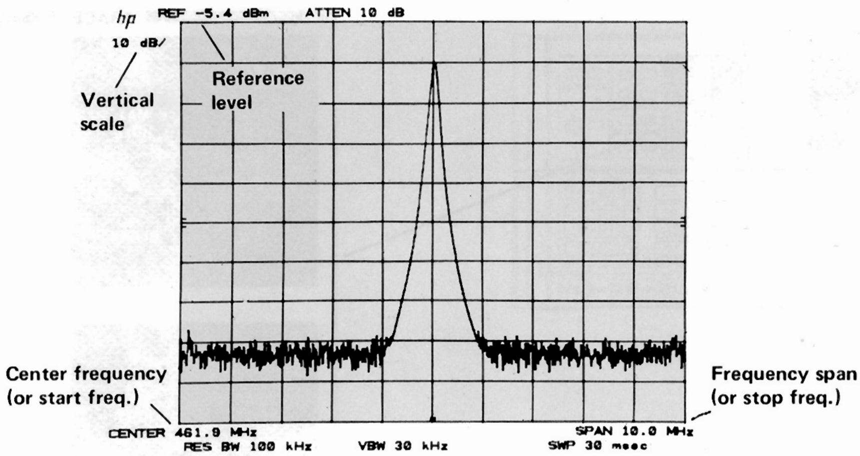
Graticule Referenced in Display Units

Display locations may be referenced in terms of these display units for HP-IB input and output. See Chapter 6 and 8568A Spectrum Analyzer Remote Operation, HP part number 08568-90003.

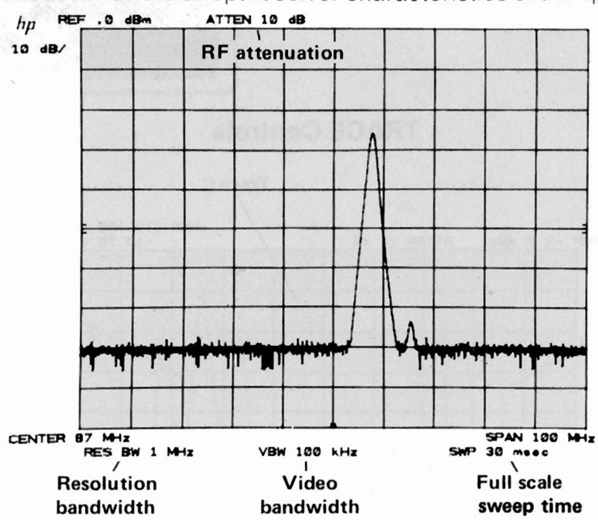
Trace overrange is an additional 23 display units above the top reference level graticule. This display area is not calibrated.

Locations of Permanent Readouts

The vertical and horizontal graticule axes are scaled by these readouts:

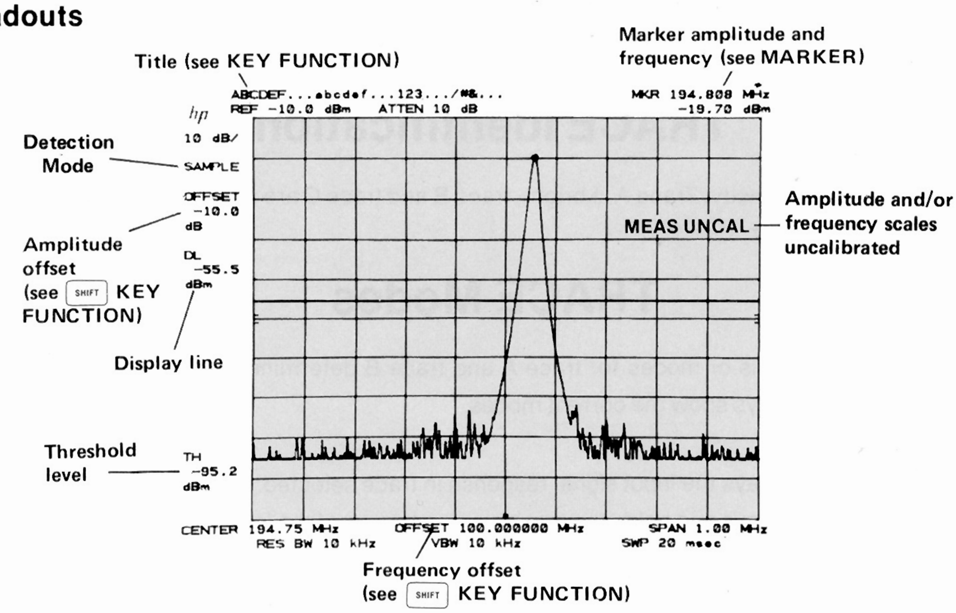


The COUPLED FUNCTIONS that describe the swept receiver characteristics of the spectrum analyzer are:



To blank all the character readouts, press KEY FUNCTION [SHIFT] o. To restore, press [SHIFT] p.

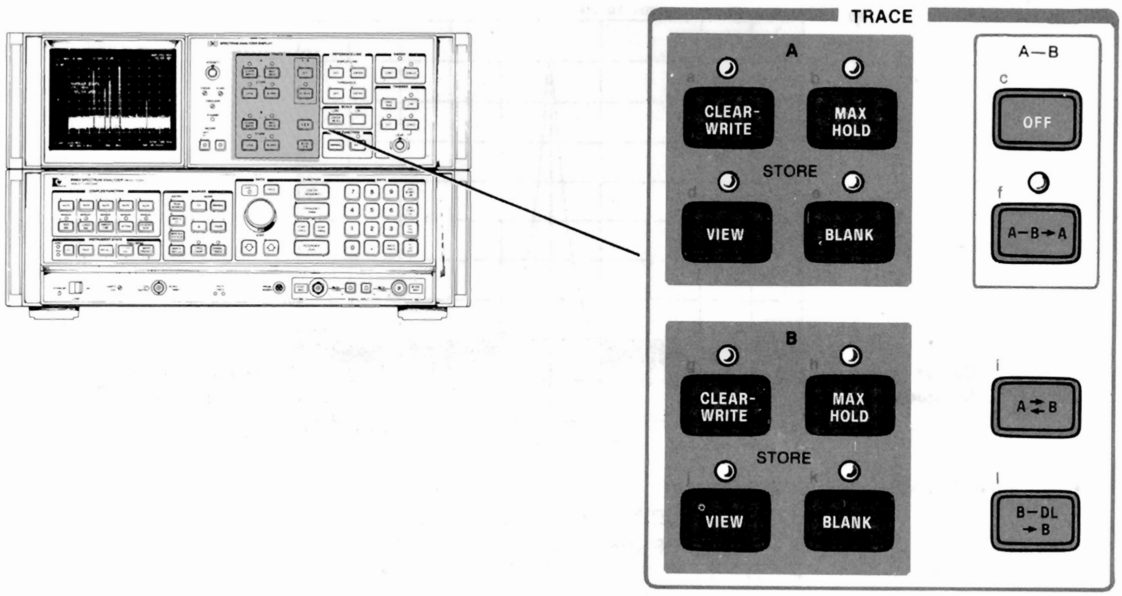
Other Readouts



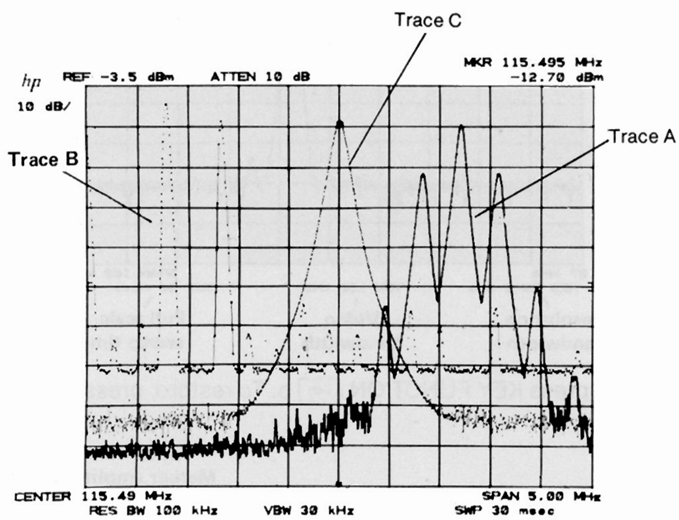
A number of other special function readouts can be activated. These are covered in chapter 12.

Chapter 6
TRACE

This chapter describes the use of the TRACE functions for writing, storing and manipulating trace data.



TRACE Controls



TRACE Identification

Traces are differentiated by intensity. Trace A is bright, trace B and trace C are dim. [VIEW] and [BLANK] allow positive identification.

TRACE Modes

Four mutually exclusive functions or modes for trace A and trace B determine the manner in which the traces are displayed. Indicator lights by the keys show the current modes.

WRITE MODES (sweeping):

[CLEAR-WRITE] Displays the input signal response in trace selected.

[MAX HOLD] Displays and holds the maximum responses of the input signal in trace selected.

STORE MODES (not sweeping):

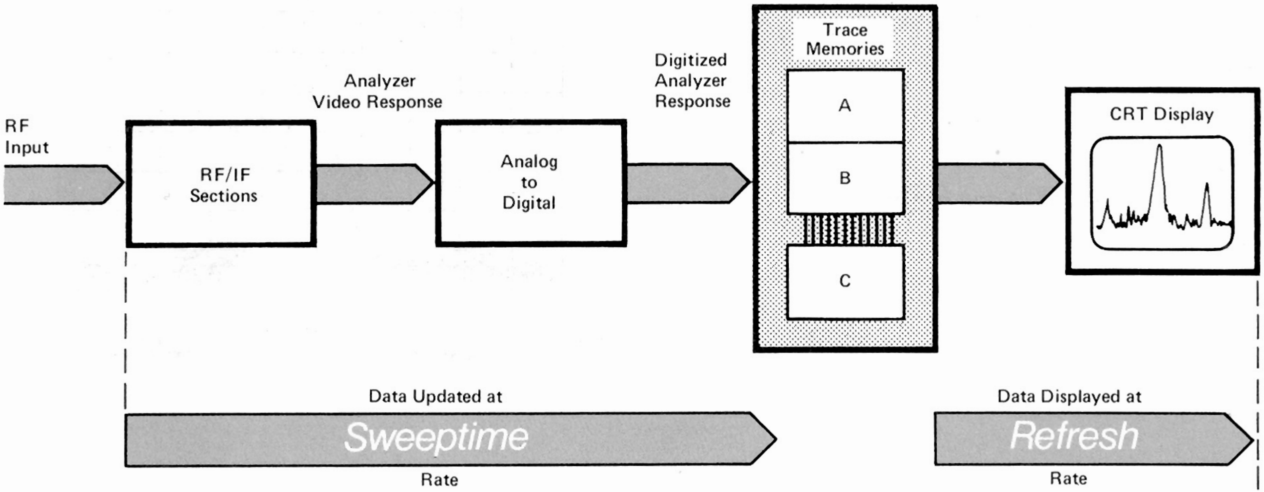
[VIEW] Stores the current trace and displays it on the CRT display.

[BLANK] Stores the current trace and blanks it from the CRT display.

Trace Memory

An understanding of the TRACE modes requires a description of the trace memory and trace data transfer within the analyzer.

Display traces are not written onto the CRT directly from the spectrum analyzer's IF section. Instead, the analog signal response is converted to digital information and stored in one trace memory which can then be transferred to the CRT display. The way in which the information is displayed depends upon the TRACE mode selected.



TRACE Modes determine how data is entered into and displayed from trace memories.

The analyzer's response is transferred into the trace memory at the sweep rate of the analyzer; that is, its sweep time. The trace memory is written onto the CRT display at a refresh rate of about 50 Hz, rapid enough to prevent flickering of the trace on the CRT. Trace intensities remain constant as analyzer sweep times are changed.

NOTE

It is important to understand the difference between sweep and refresh.

Sweep - refers to the spectrum analyzer sweeping from a start frequency to a stop frequency and storing measured amplitude data into a trace memory.

Refresh - refers to the transfer of display memory data to the CRT display.

Write Modes

For the write modes, the analyzer signal response is written into trace memory during the sweep and the memory contents are displayed on the CRT.

[CLEAR-WRITE] A(B) — Sets all the values in the trace memory A(B) to zero when first activated (bottom line graticule), then displays the signal response.

[MAX HOLD] A(B) — Latest signal response is written into the trace A(B) memory only at the horizontal positions where the response is greater than the stored response.

When both [CLEAR-WRITE] A and [CLEAR-WRITE] B modes are selected, the analyzer writes into (*sweeps*) A and B alternately.

STORE Modes

In the STORE modes, no updating of the trace memory is made. The current memory data is saved.

[VIEW] A(B) — The trace A(B) data are displayed on the CRT (that is, the refresh is enabled).

[BLANK] A(B) — The trace A(B) data are not displayed on the CRT (that is, the refresh is disabled).

Example

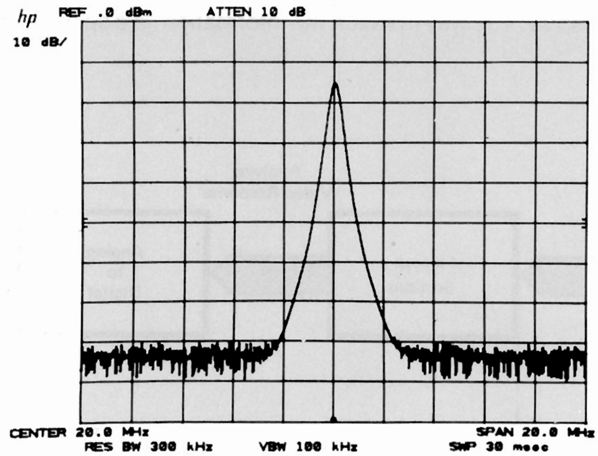
With TRACE modes, signals can be observed as the analyzer sweeps, can be stored for comparison, erased, or monitored for frequency drift.

Center and zoom in on a 20 MHz signal:

Press [CENTER FREQUENCY] [2] [0] [MHz -dBm sec]

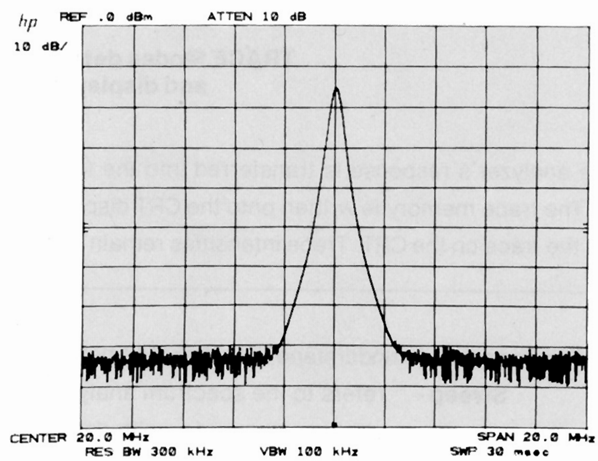
[FREQUENCY SPAN] [2] [0] [MHz -dBm sec]

Since [INSTR PRESET] has set [CLEAR-WRITE] A and [BLANK] B, only A is displayed.



This response can be stored:

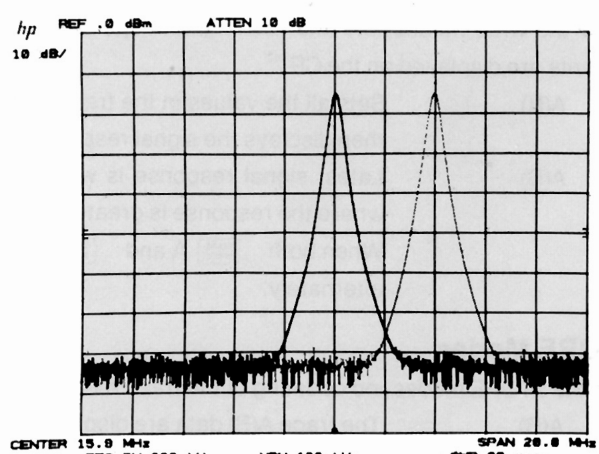
Press [VIEW] A.



Write the same signal with B and change its position relative to trace A:

Press [CLEAR-WRITE] B

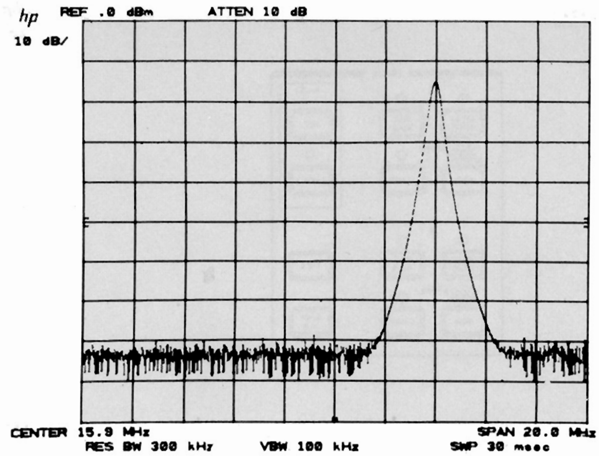
[CENTER FREQUENCY] (knob)



Blank trace A;

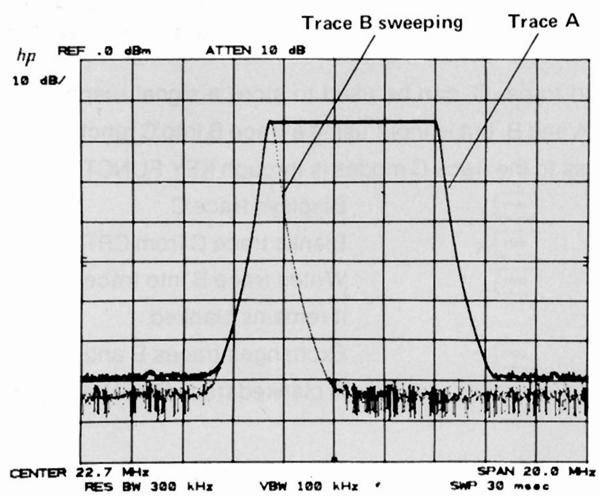
Press [BLANK] A.

This trace can be recalled with [VIEW] A as long as [CLEAR-WRITE] A or [MAX HOLD] A is not used first.



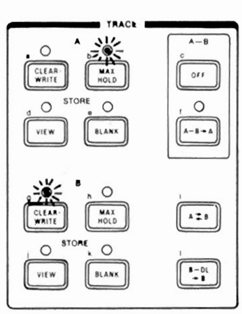
To display the drift of a signal press [MAX HOLD] A.

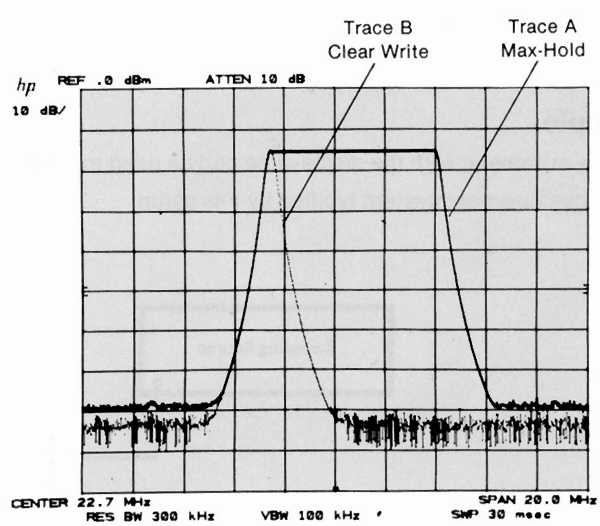
(Simulate frequency drift with [CENTER FREQUENCY] ◯.)



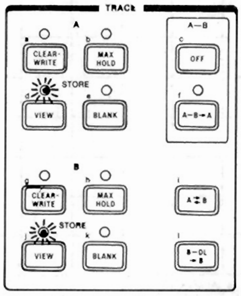
TRACE Exchange

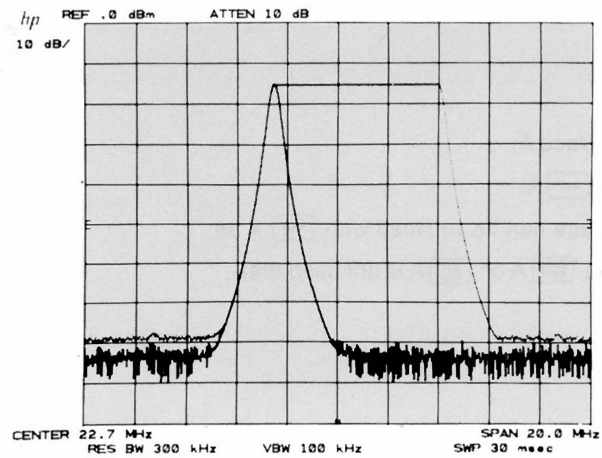
[A⇄B] Exchanges trace A and B, changing their relative intensities and storage memory locations and enables A and B [VIEW]. For example, in the trace display above, the modes and display appear.





Press [A⇄B]





TRACE C Modes

A third trace, C, can be used to store a signal response. Trace C is not swept from the analyzer IF section as are traces A and B, but is input using a trace B into C function (B → C) or a B and C exchange function (B ⇆ C).

Access to the trace C modes is through KEY FUNCTION [SHIFT]. The modes are:

View C:	[SHIFT] j	Displays trace C.
Blank C:	[SHIFT] k	Blanks trace C from CRT display.
B → C:	[SHIFT] l	Writes trace B into trace C. Trace A and B modes are not changed. If trace C was blanked it remains blanked.
B ⇄ C:	[SHIFT] i	Exchanges traces B and C. If trace B is not blanked, trace C will not be blanked. If trace C is blanked trace B will be blanked.

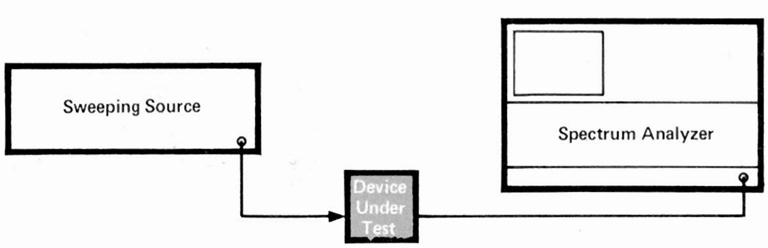
TRACE Arithmetic

TRACE arithmetic allows one trace to be modified by another trace or a display line position.

A-B [A-B→A]	Trace B amplitude (measured in divisions from the bottom graticule) is subtracted from trace A and the result written into trace A from sweep to sweep. Trace B is placed or kept in a STORE mode.
A-B [OFF]	Turns [A-B→A] off.
[B-DL →B]	Subtracts the amplitude of the display line from trace B and writes the result into trace B. Trace B is placed or kept in [VIEW]. Details on display line are in Chapter 8, REFERENCE LINE.

Example

Trace arithmetic with the display line can be used to correct for the frequency response characteristics (flatness) of a swept measurement system typified by this setup:

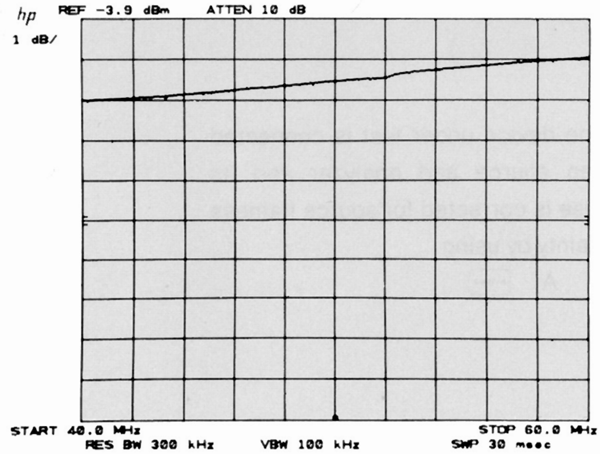


where the device under test is to be characterized for insertion loss over a specific frequency range.

The analyzer and source are set to the proper amplitude level and frequency span with the source output connected directly to the analyzer input.

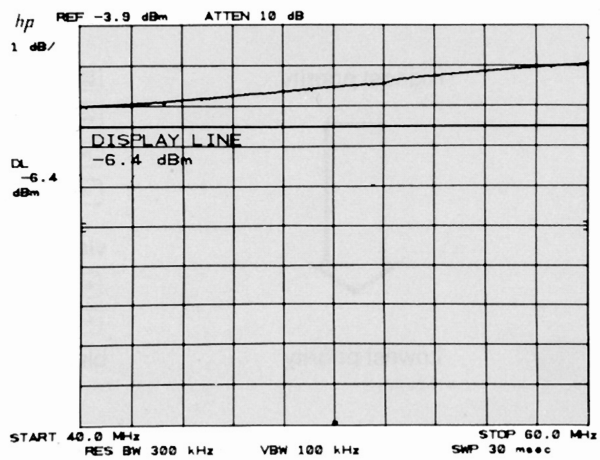
[MAX HOLD] B, sweep source then

[VIEW] B.



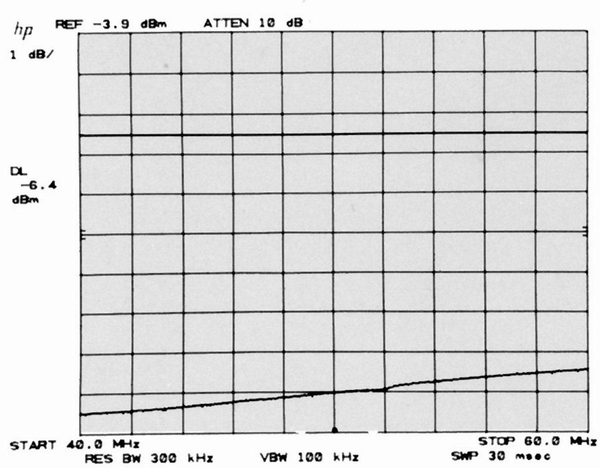
The display line is activated and set below the source/analyzer response.

DL [ENTER]



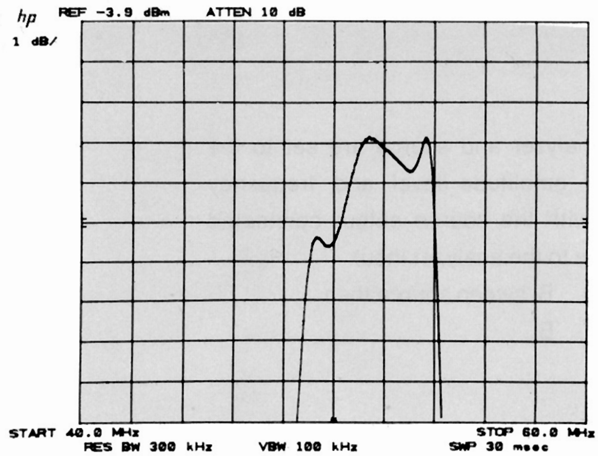
The difference between the display line (in display units) and the source/analyzer response is stored in trace B with [B−DL →B]

Negative values of the [B−DL →B] line would be stored even though not displayed.



Now the device under test is connected between source and analyzer and its response is corrected for source flatness uncertainty by using

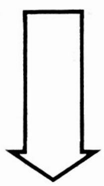
[MAX HOLD] A [A−B→A]



Trace Priority

Functions which act upon a trace always act upon the highest priority trace. Priority is defined by the trace modes as follows:

Highest priority



Lowest priority

[CLEAR-WRITE] A or [MAX HOLD] A
[CLEAR-WRITE] B or [MAX HOLD] B
[VIEW] A
[VIEW] B
view C
[BLANK] A
[BLANK] B
blank C

Marker functions, for example, use trace priority to decide which trace to mark. See chapter 7.

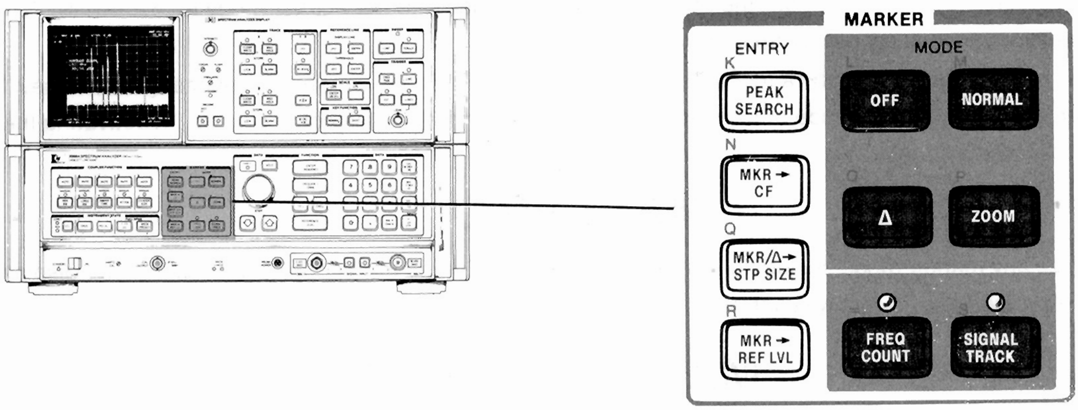
Chapter 7
MARKER

This chapter describes the use of the MARKER and DATA controls for making many measurements faster and with greater accuracy. Markers can be displayed only on TRACE A and TRACE B.

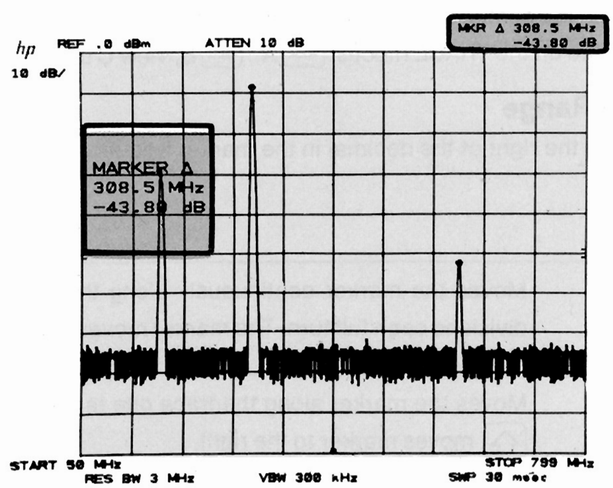
Two types of functions make up the MARKER group: MARKER MODEs, which enable or disable markers and their related functions; and MARKER ENTRY functions which allow the scaling of the display frequency and amplitude using marker information.

Markers are bright spots which lie directly on the display trace. The horizontal position of an activated marker is controlled by the DATA controls. The marker can be positioned at a specific frequency with the DATA number/units keyboard.

Readout of marker amplitude and frequency appears in the upper right of the display outside the graticule. When a MARKER MODE is active, its amplitude and frequency readout also appears in the active function area of the graticule.



MARKER Controls



Marker Readout Locations

MARKER Overview

	FUNCTION
• Direct readout of the amplitude and frequency of a point along the trace	[NORMAL]
• Direct readout of amplitude and frequency differences between points on the trace.	[Δ]
• Expansion of the span about a specific frequency.	[ZOOM]
• Placing a single marker at the highest response.	[PEAK SEARCH]
• Counter accuracy frequency measurements.	[FREQ COUNT]
• Direct noise level readout.	[SHIFT] M
• Analysis of stored traces.	MARKER with [VIEW]
• Amplitude and frequency display scaling.	ENTRY [MKR→ CF] [MKR/Δ→ STP SIZE] [MKR→ REF LVL]

MARKER On But Not Active

An activated marker mode can be deactivated by activating another function, such as display line, or by DATA [HOLD] This does not erase the marker itself nor the upper right display readout. If the marker mode is reactivated, DATA control and active function readout will continue from its last position.

If a marker mode is deactivated by a function, other than MARKER ENTRY, where a value change of the new function results in a rescaling of the amplitude or frequency axes, the marker will not stay on the trace. Reactivating the marker will start it at the display center.

MARKER Off

[OFF] disables any marker mode, including [FREQ COUNT] and [SIGNAL TRACK], and blanks the marker readout from the CRT display. DATA controls are disabled if the marker was active.

MARKER in VIEW

MARKER [NORMAL] and [Δ] may be used on traces A or B in the view mode. This allows detailed analysis of responses which are nonperiodic or unstable.

The markers will be placed on a viewed trace according to the priority defined in Chapter 6, TRACE PRIORITY.

Single Marker - NORMAL

[NORMAL] activates a single marker at the center of the display on the trace of highest priority. Trace priority is defined in Chapter 6. The marker will not activate on the TRACE modes [BLANK] A, [BLANK] B, view C or blank C.

Measurement and Readout Range

The number of significant digits to the right of the decimal in the marker frequency readout is the same as for center frequency readout.

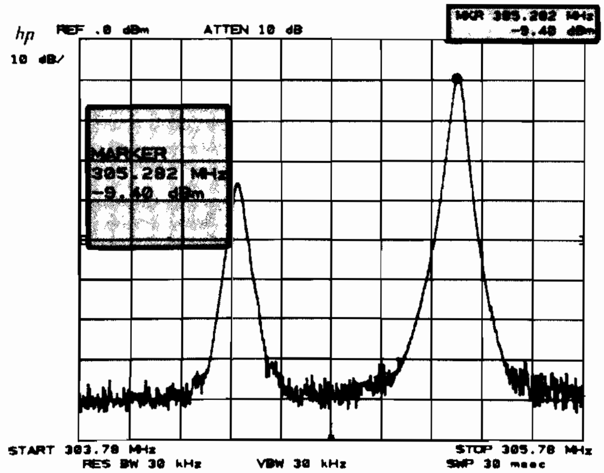
DATA Entry

[NORMAL] (knob)	Moves the marker continuously along the trace at about 5 horizontal divisions each full turn. The marker moves in display unit increments.
[NORMAL] [⇧] [⇩]	Moves the marker along the trace one tenth of the total width per step. [⇧] moves marker to the right.
[NORMAL] (keypad)	Places the marker at the frequency entered. An out-of-range entry results in placement of the marker at a graticule edge.

Example

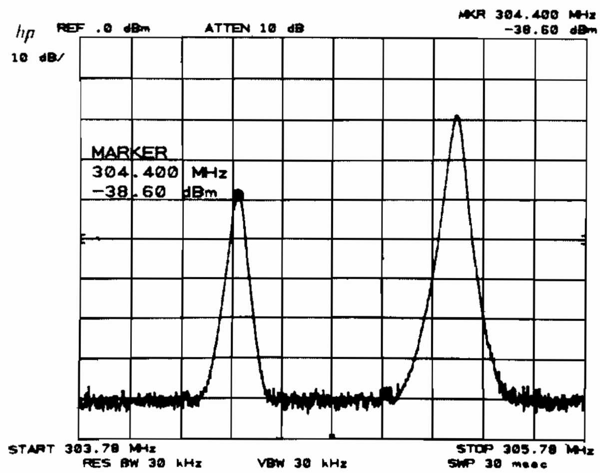
Reading frequencies and amplitudes of signals is greatly simplified using MARKER [NORMAL].

For a given display activate the single marker with [NORMAL] then tune the marker with ◯ to position it at the signal peak. The frequency and amplitude is read out in two display areas.



To read the left-hand signal's parameters move the marker to the signal peak with ◯.

The signal's amplitude and frequency is read out directly.



Differential Markers · Δ

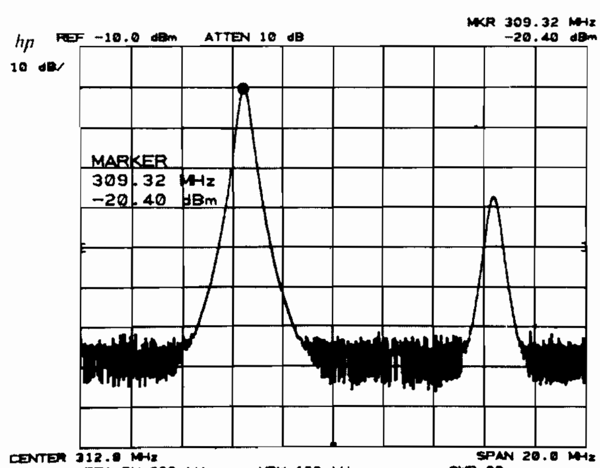
[Δ] activates a second marker at the position of a single marker already on the trace. (If no single marker has been activated, [Δ] places two markers at the center of the display.) The first marker's position is fixed. The second marker's position is under DATA control.

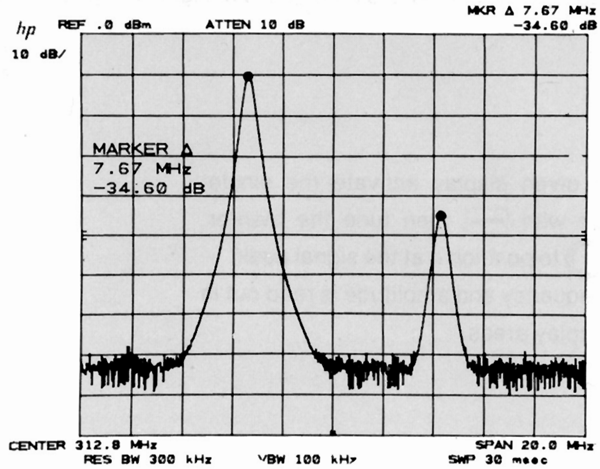
The display readout shows the difference in frequency and amplitude.

Example

Measuring the differences between two signals on the same display.

First set the marker on one of the signal peaks with [NORMAL] ◯.





Activate [Δ] and move the second marker to the other signal peak with the knob and read their differences directly.

Fractional Differences

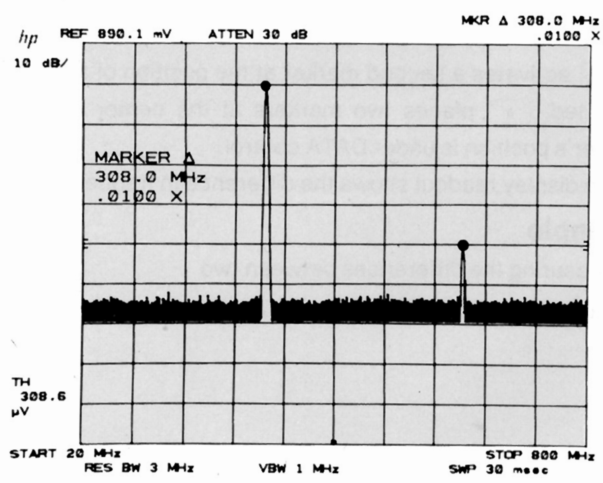
When the reference level is calibrated in voltage, marker [Δ] amplitudes are given as a fraction, the voltage ratio of two levels.

With *logarithmic* amplitude scale and the reference level in voltage, the fraction is based on the equation

$$\text{fraction} = 10^{-\left(\frac{\text{dB difference}}{20}\right)}$$

Since this equation yields the harmonic distortion due to a single harmonic, its distortion contribution can be read directly from the display.

Example



Set up [Δ] on the peaks of a fundamental (left) and its harmonic (right).

With the display referenced and scaled as shown, the readout ".0100X" designates the fractional harmonic content. Percent is calculated as 100X (.0100) = 1.0%.

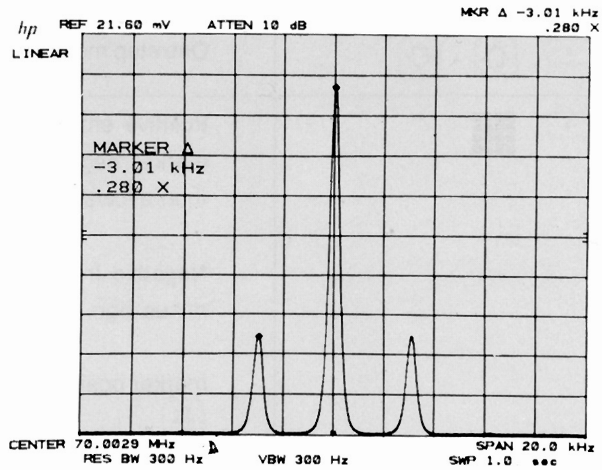
With a *linear* amplitude scale and a reference level calibrated in voltage, the fractional amplitude readout is the simple linear ratio of the two markers.

Example

To measure % AM modulation from a spectral display, calibrate the display with the reference level in voltage and the amplitude scale in voltage.

Place the single marker on the carrier peak, NORMAL ◯, and the second marker on one of the sideband peaks, Δ ◯. The fractional amplitude readout gives one half the modulation index .283.

%AM = 100 x 2 x .28 = 56%



Measurement and Readout Range

The Δ function formats the amplitude readout according to reference level units and scale.

Reference Level Units	SCALE Logarithmic	SCALE Linear
dBm dBmV dBμV	Amplitude in dB	Amplitude in dB
Voltage	Amplitude ratio $10^{-\left(\frac{\text{dB difference}}{20}\right)}$	Ratio of marker amplitudes

Amplitude Readout Format for MARKER Δ

The frequency readout for all MARKER Δ conditions has up to 4 significant digits, depending upon the portion of span measured.

The amplitude readout in dB has a resolution of ±.01 dB for linear scale. The resolution for logarithmic scale depends upon the LOG ENTER dB/DIV value:

LOG SCALE dB PER DIV	RESOLUTION
10	±0.1 dB
5	±0.05 dB
2	±0.02 dB
1	±0.01 dB

MARKER
[Δ] [ZOOM]

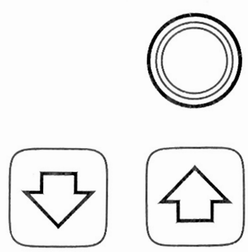
DATA Entry

The minimum incremental change for [Δ] frequency is 0.1% of the frequency span.

[Δ] (DATA knob)	One full turn moves the active marker about one tenth of the horizontal span.
[Δ] [⇧] [⇩]	One step moves the marker one tenth of the horizontal span.
[Δ] (keyboard)	Positive entry places marker higher in frequency than the stationary marker, negative entry places marker lower in frequency. Larger entries than allowable will place the marker on the adjacent graticule border. Negative frequencies can be entered using a [SHIFT] [HOLD] prefix as the minus sign. For example, to set a [Δ] span of 10 MHz with the second marker positioned to the left of the first, press [Δ] [SHIFT] [HOLD] [1] [0] [MHz -dBm sec]

MARKER ZOOM

[ZOOM] activates a single marker on the trace of highest priority (see TRACE PRIORITY, Chapter 6).
In [ZOOM] the DATA knob and STEP keys change the values of *different functions.*

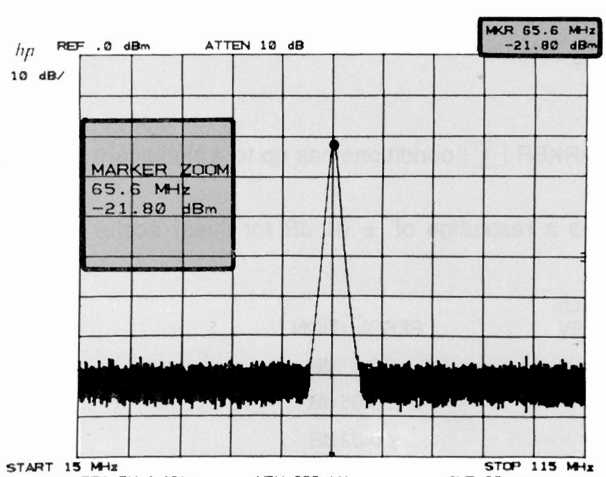


Positions Marker

Changes FREQUENCY SPAN and sets CENTER FREQUENCY equal to MARKER frequency

DATA Control Use for [ZOOM]

The marker can be moved along the trace with the DATA knob (knob), and the frequency span can be changed about the marker with DATA step [⇩] and [⇧]. Each step also sets center frequency equal to the marker frequency.



Measurement and Readout Range

The measurement and readout range for marker zoom is the same as marker [NORMAL].

Better frequency count resolution and automatic recentering of a *signal* are additional zoom features when [FREQ COUNT] is activated.

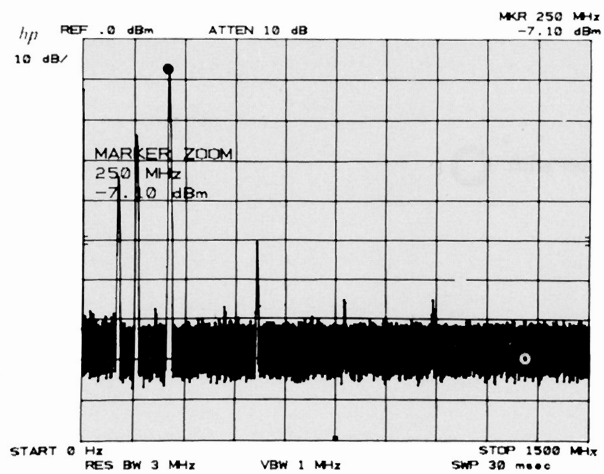
DATA Entry

[ZOOM]	Moves the marker continuously along the trace. Rate dependent on speed of rotation. The marker moves in display unit increments.
[ZOOM] [⇧] [⇩]	Changes the frequency span to the next value in the sequence and sets the center frequency equal to the marker frequency.
[ZOOM]	Places the marker at the frequency entered. An out-of-range entry places the marker at a graticule border.

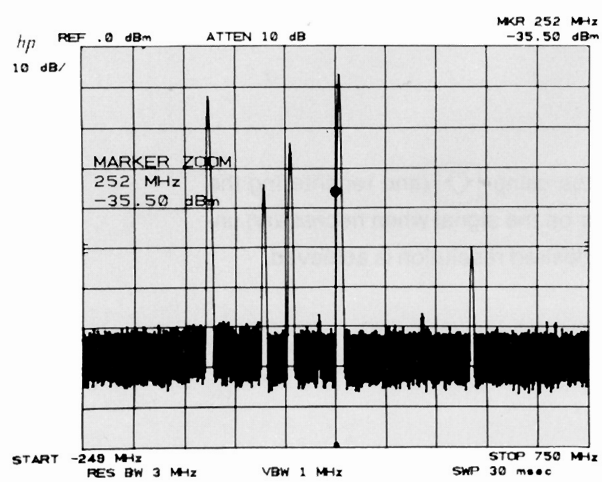
Example

In wide frequency spans it is often necessary to expand a portion of the frequency span about a specific signal in order to resolve modulation sidebands or track frequency drift.

From an [INSTR PRESET] full span, select a signal using the marker with [ZOOM].



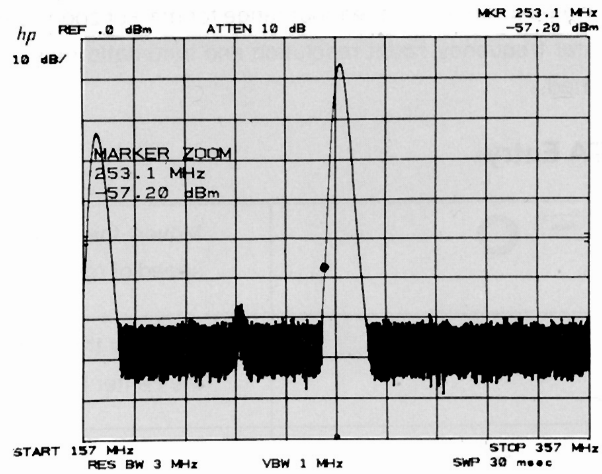
To center the marker and signal *and* expand the frequency span in one step, press [⇩].



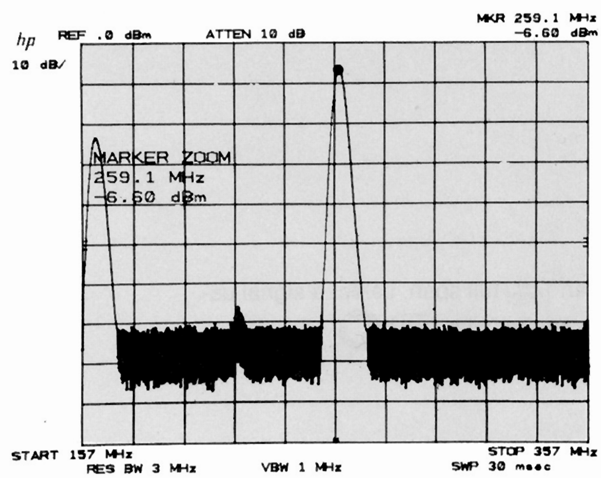
MARKER

ZOOM

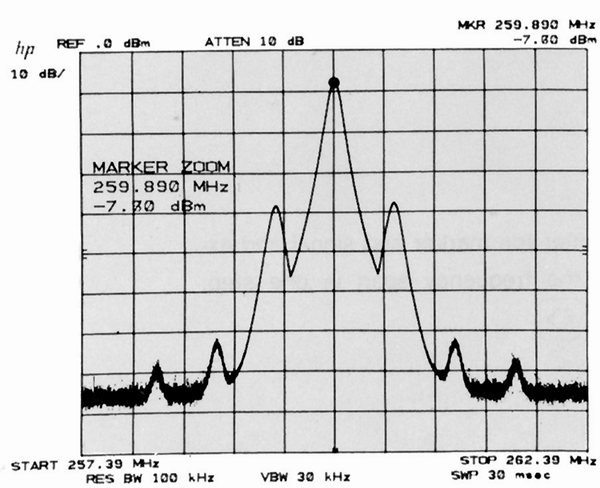
Expanding twice more with [⇩] [⇩] shows the marker requires recentering on the signal.



Recenter with [◯]



Continue using [⇩] (and recentering the marker on the signal when necessary) until the desired resolution is achieved.



Automatic Zoom

The analyzer can automatically zoom in on a signal specified by a marker. The desired frequency span is input from the DATA number/units keyboard.

To use the automatic zoom function

Use [NORMAL] ◯ to identify the signal to be zoomed in on.

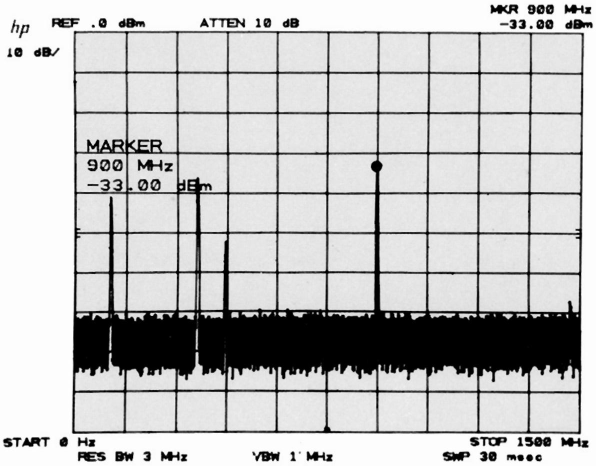
Press [SIGNAL TRACK] [FREQUENCY SPAN] and enter the desired span with the DATA number/units keyboard.

When the units key is pressed the zooming process will begin.

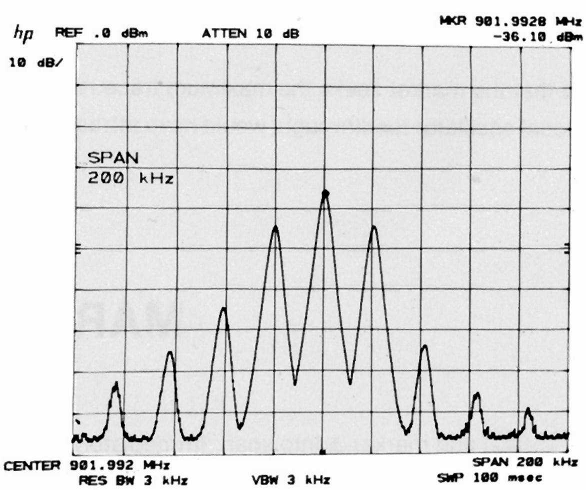
Example

A single carrier needs to be examined in a 200 kHz span to see the sidebands.

Place a marker on the carrier with [NORMAL] ◯
Press [SIGNAL TRACK] [FREQUENCY SPAN]



Enter the span,
Press [2] [0] [0] [kHz mV msec] and auto zoom will be completed.



PEAK SEARCH

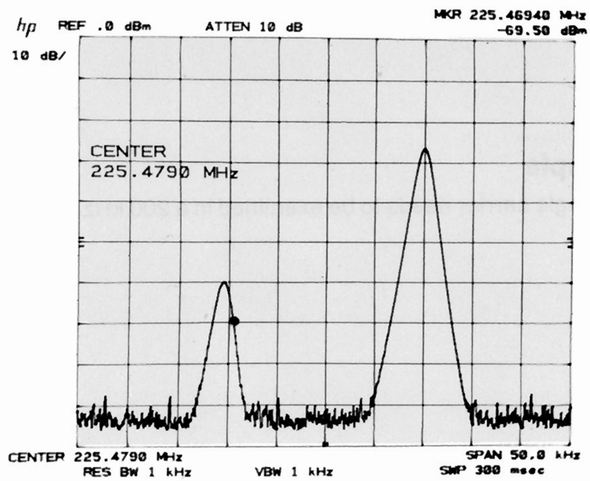
Peak Search

Peak search places a single marker at the highest trace position of the highest priority trace. The active function is not changed.

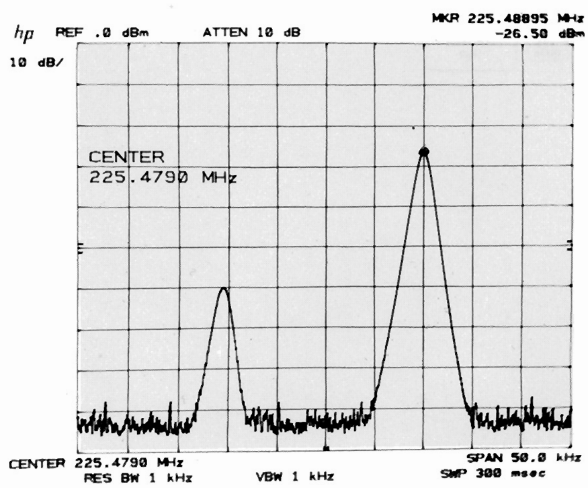
Example

PEAK SEARCH is valuable to position the marker at the peak of the signal response.

In a narrow span the marker may be placed at the signal peak.



Press PEAK SEARCH.



Note that the marker seeks the maximum trace response, no matter what the cause of the response. A larger signal, or the local oscillator feedthrough, would have attracted the marker.

MARKER ENTRY

MKR→ CF, MKR→ REF LVL and marker Δ into span. Immediately set the corresponding FUNCTION value equal to the readout of the active marker or markers:

ENTRY	RESULT
MKR→ CF	marker frequency into CENTER FREQUENCY
SHIFT ∆ (O)	marker ∆ frequency into FREQUENCY SPAN or START FREQ / STOP FREQ,
MKR→ REF LVL	marker amplitude into REFERENCE LEVEL

MKR/∆→ STP SIZE immediately records the single or the differential marker frequency in COUPLED FUNCTION CF STEP SIZE for use with CENTER FREQUENCY DATA ⇧ ⇩.

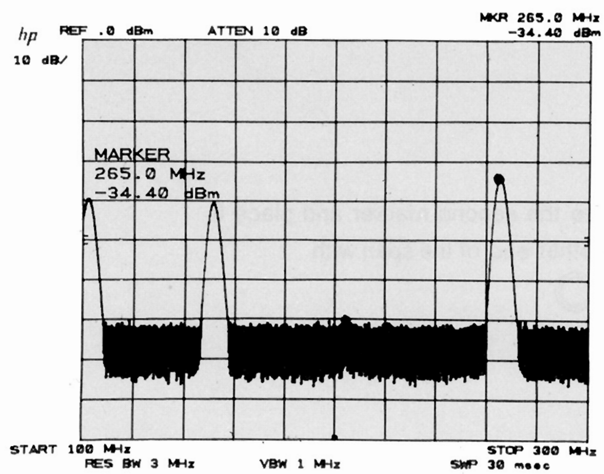
A marker entry can be made any time a marker is on the trace. (SHIFT ∆ (O) with only one marker displayed takes 0 Hz as the lower frequency.) The active function will not be changed.

Example

One of the fastest, most convenient ways to bring a signal to the center of the display is by using MKR→ CF.

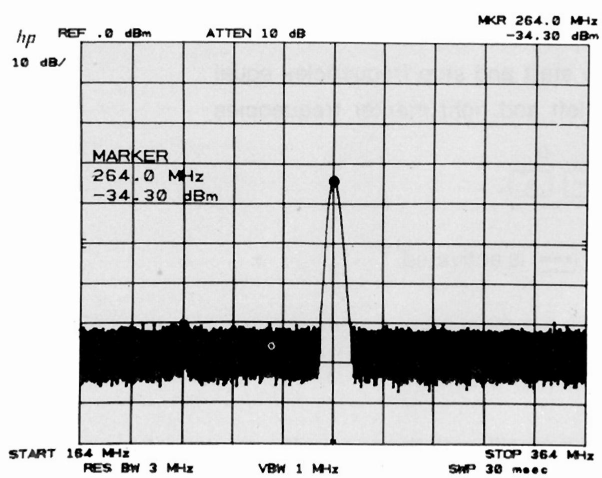
Activate a single marker and bring it to the desired signal:

NORMAL (O)



Change the center frequency to the marker frequency.

MKR→ CF

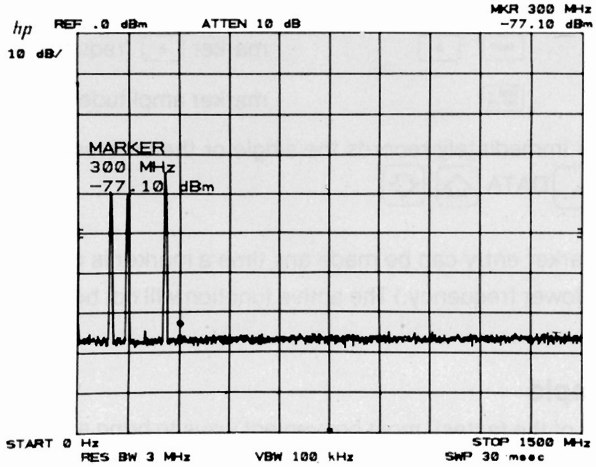


MKR→ CF will also work if start/stop frequencies are read out.

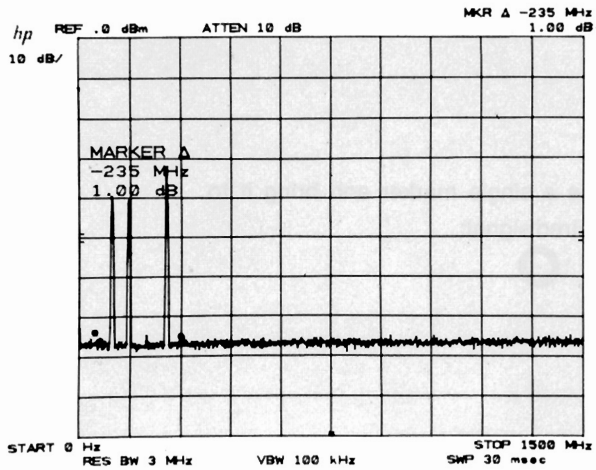
Example

One way to tune to a particular portion of a spectrum being displayed is to use the Δ→ span function.

Activate the single marker and place it at either end of the desired frequency span with [NORMAL] ◯.

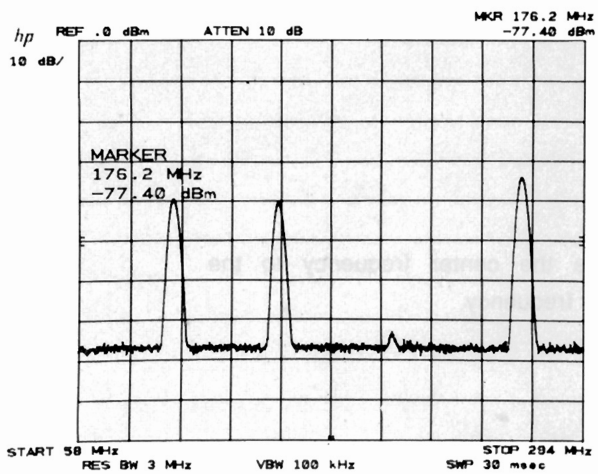


Activate the second marker and place it at the other end of the span with [Δ] ◯.



Set the start and stop frequencies equal to the left and right marker frequencies with [SHIFT] [Δ] (O).

Marker [NORMAL] is activated.



Δ→ span will work the same with start/stop frequency readout. Note that the markers can be placed at either end of the span.

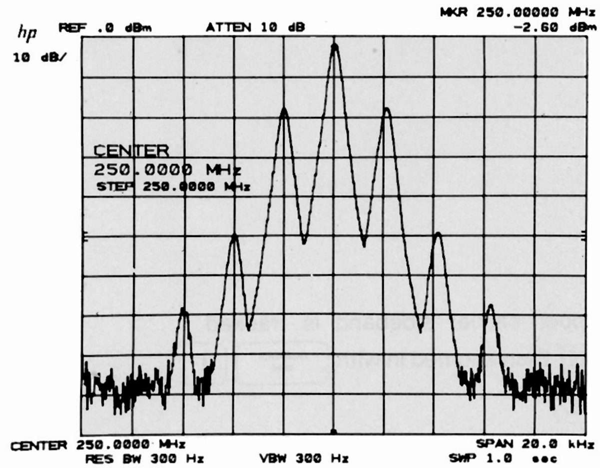
Example

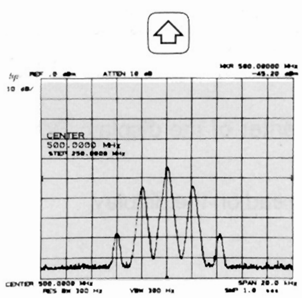
Here is a technique for viewing a fundamental and its harmonics (or any evenly spaced portions of the spectrum) with high resolution..

Narrow the span about the fundamental as necessary with [ZOOM], centering the carrier.

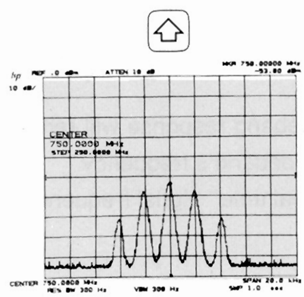
Set the center frequency step size with [MKR/Δ→ STP SIZE].

Now enable center frequency. With each [⇧], successive harmonics will be displayed.

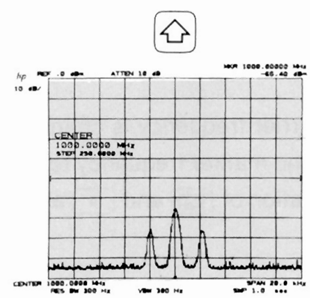




Second Harmonic



Third Harmonic



Fourth Harmonic

Similar stepping can be accomplished using marker [Δ] into step size for intermodulation products or other evenly spaced signals such as communication channels.

SIGNAL TRACK - Automatic Frequency Control

The analyzer is capable of automatically maintaining a drifting signal at the center of the display. To operate signal tracking

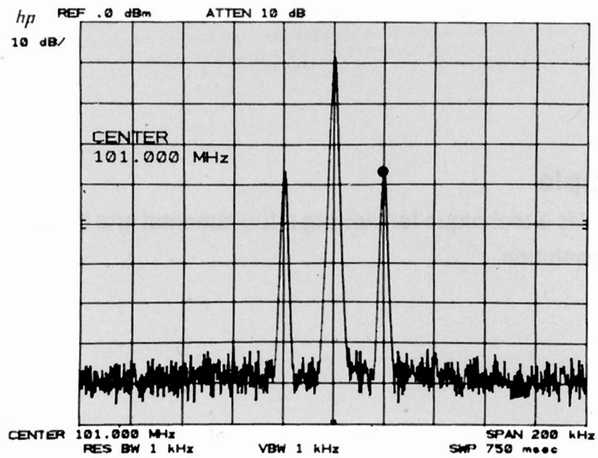
Press [NORMAL], and place the marker on the signal to be tracked with ◯.

Press [SIGNAL TRACK] to initiate the tracking. The light above the key indicates tracking. (Press again to turn off.)

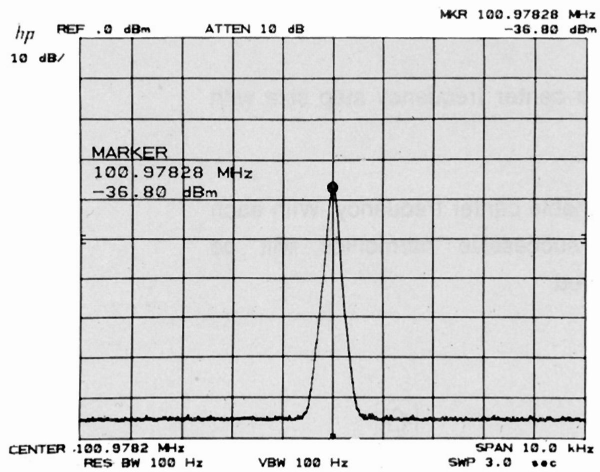
As the signal drifts, the center frequency will automatically change to bring the signal, and marker to the center of the display.

MARKER [OFF], any other MARKER mode or the instrument preset turns the tracking function off.

The upper sideband of a transmitter is to be monitored as the carrier frequency is tuned.
Locate the sideband with [NORMAL] (knob).



The upper carrier sideband is tracked with [SIGNAL TRACK] then zoomed in with [FREQUENCY SPAN] [1] [0] [kHz mV msec]



As the carrier frequency is changed, the sideband response will remain in the center of the display. Both the center frequency and marker frequency read out the sideband's frequency.

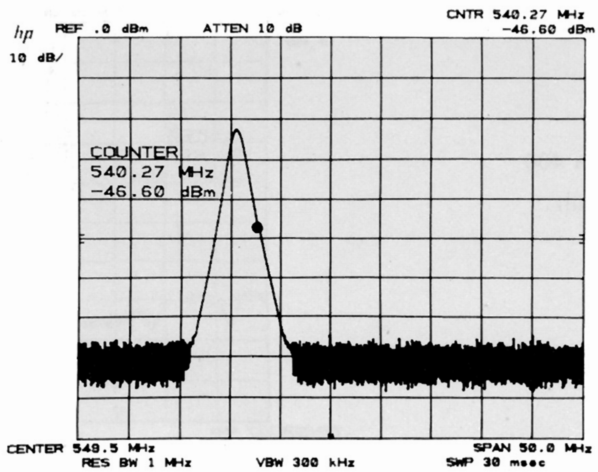
A combination of [SIGNAL TRACK] and [Δ] allows the "real time" signal frequency drift to be read on the display.

FREQUENCY COUNT

Frequency count allows a number of measurements beyond the standard capability of the standard marker modes. Each is used in conjunction with one of the three active marker modes, [NORMAL], [Δ] or [ZOOM] and utilize the DATA controls in the same manner.

[FREQ COUNT] counts the frequency of signals with great precision and accuracy even if the marker is not positioned at the signal peak.

When [FREQ COUNT] is on and the active marker placed on a signal response such that the marker is > 20 dB out of the noise or the intersections of two signal responses and in the top 6 divisions of the graticule, the signal's frequency will be read out directly. [FREQ COUNT] works only for frequency spans of 500 MHz and below.



If the marker is not in the top 6 divisions, the display readout "CNTR" in the top right-hand marker area will blink, indicating the reading may be in error.

NOTE
The amplitude readout is for the absolute marker position and not the signal peak.

The marker mode combinations with FREQ COUNT are:

	Readout
FREQ COUNT + NORMAL	Signal frequency and marker amplitude.
FREQ COUNT + Δ	Frequency between the signal at the first marker, whose frequency has been *stored,* and the second marker's *counted* signal frequency. Amplitude between marker positions.
FREQ COUNT + ZOOM	Signal frequency and marker amplitude. Causes automatic recentering to exact signal frequency upon each successive reduction of span with ⇩.

Measurement and Readout Range

The measurement and readout range for frequency count is the same as the associated marker modes, normal, differential and zoom. Counter resolution to 1 Hz is available using the KEY FUNCTION SHIFT FREQ COUNT. See Chapter 12,page 12.5.

DATA Entry

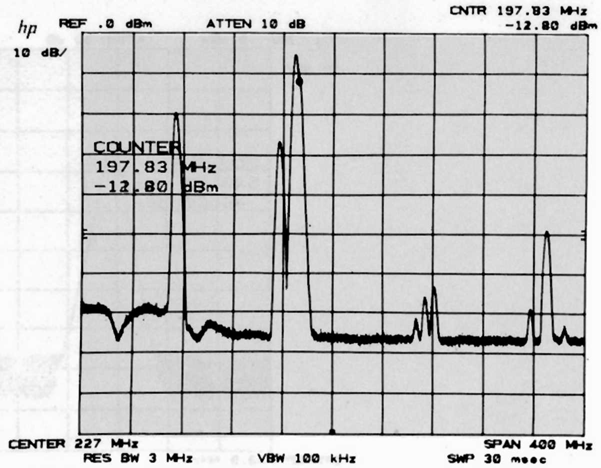
See MARKER NORMAL, Δ and ZOOM.

Example

Counted frequency differences between stable signals can be measured.

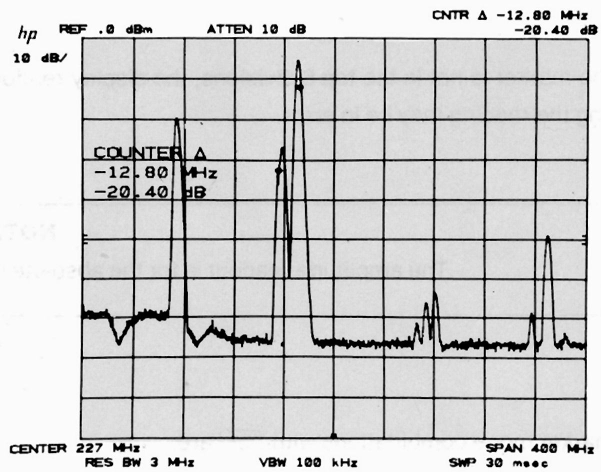
Activate the frequency counter in a 400 MHz span and position the marker with

[FREQ COUNT]  .



To count the difference between the signal and its neighbor place the marker on one signal with  ; then activate marker differential and count the next signal.

Press [Δ]  .



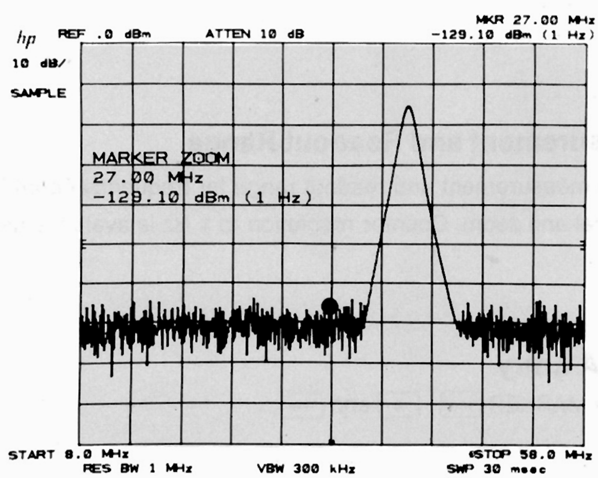
Note that the difference is not the difference of two current counter readings but of one stored counter reading and the current counter reading.

Noise Level Measurement

When noise level is activated and the marker is placed in the noise, the rms noise level is read out normalized to a 1 Hz noise power bandwidth.

Noise level enabled: [SHIFT] [NORMAL] (M)

Noise level disabled: [SHIFT] [OFF] (L)



The noise level measurement readout is corrected for the analyzer's log amplifier response and detector response. The value is also normalized to a 1 Hz bandwidth.

Measurement and Readout Range

Noise level measures noise accurately down to 10 dB above the spectrum analyzer's noise level. The readout resolution is in steps of ± 0.1 dB.

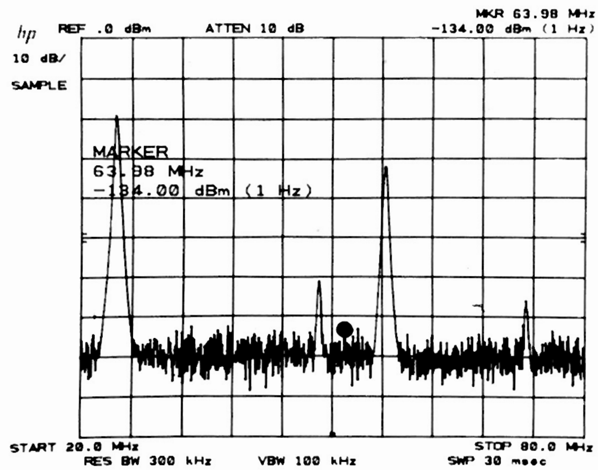
DATA Entry

See MARKER [NORMAL], [Δ] and [ZOOM].

Example

In a communication system the baseband noise level as well as signal to noise ratio measurements are required.

Select a frequency in the baseband spectrum clear of signals with a single marker. Press [NORMAL] ◎.

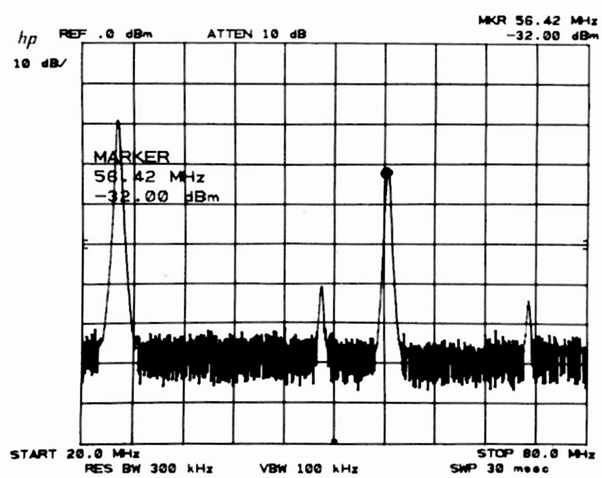


Read the noise at the marker by pressing [SHIFT] [NORMAL] (M).

The noise at 64 MHz is − 134 dBm in a 1 Hz bandwidth. This corresponds to − 134 dBm + 36 dB/4 kHz = − 98 dBm in 4 kHz voice channel bandwidth.

Signal to noise measurements require the measurement of the noise level, as the example above, and the measurement of the absolute signal level. *

Measure the power level of the adjacent signal. To turn the noise level off, press [SHIFT] [OFF] (L) and read the power level.



The signal to noise ratio referenced to 4 kHz bandwidth is − 32 dBm − (− 98 dBm) = 66 dB.

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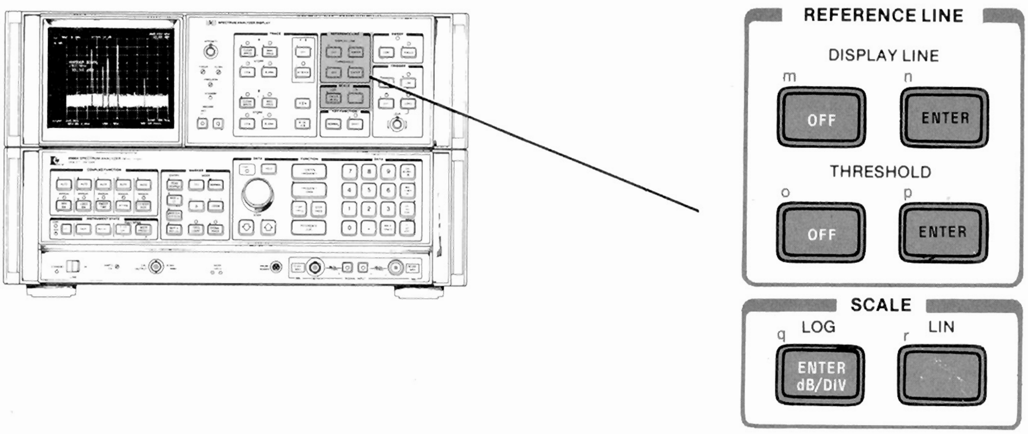
*Normalization to a desired bandwidth uses the equation $10 \log_{10} \left(\frac{\text{desired BW}}{1\ \text{Hz}} \right)$

Chapter 8
SCALE AND REFERENCE LINE

This chapter describes the use of SCALE and REFERENCE LINE control groups for setting the amplitude scale, and for making amplitude level measurements more conveniently.



SCALE

SCALE keys allow the scaling of the vertical graticule divisions in logarithmic or linear units without changing the reference level value.

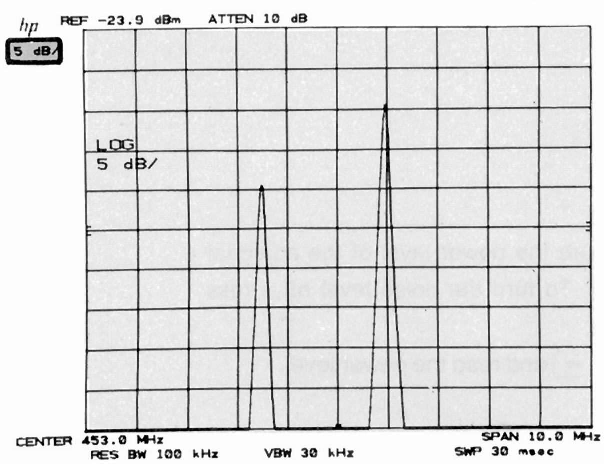
LOG

[ENTER dB/DIV] (DATA entry) scales the amplitude to 1 dB, 2 dB, 5 dB or 10 dB per division.

If [ENTER dB/DIV] is pressed when the scale is linear, 10 dB per division will be automatically entered. The subsequent (DATA), if any, will then replace the automatic 10 dB/div.

LOG

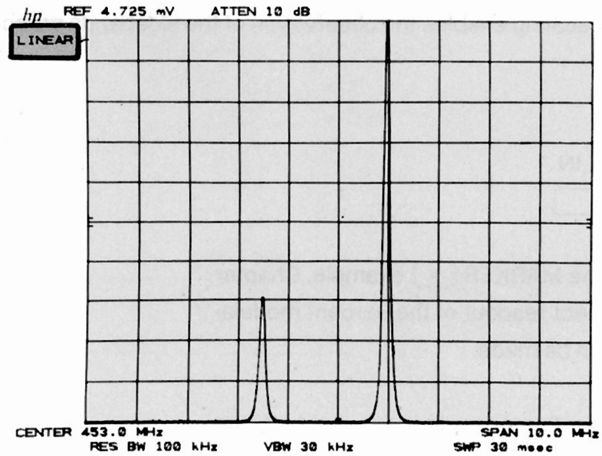
Press [ENTER dB/DIV] [5] [GHz +dBm dB]



LIN

[ ] immediately scales the amplitude proportional to input voltage. The top graticule remains the reference level, the bottom graticule becomes zero voltage. Reference level, and all other amplitudes, are read out in voltage. However, other units may be selected. See Amplitude Units Selection, Chapter 12.

If [ENTER dB/DIV] is pressed when the scale is linear, 10 dB per division will be automatically entered.



LIN
Press [ ]

In LINEAR, a specific voltage per division scale can be set by entering a voltage reference level value. For example, to set the scale to 3 mV/division, key in 30 mV reference level. (Voltage entries are rounded to the nearest 0.1 dB, so the 30 mV entry becomes 30.16 mV, which equals − 17.4 dBm.)

DATA Entry

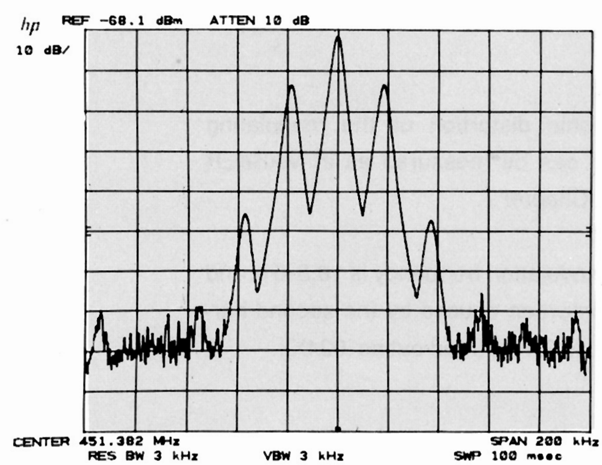
ENTER dB/DIV, knob, ⇩ ⇧	Changes scale in allowable increments (1, 2, 5 or 10 dB per division).
ENTER dB/DIV, keypad	Enables direct scale selection of allowed values. Other entries are rounded to an adjacent value.

No DATA entry will be accepted with the linear SCALE selection key, LIN [ ].

Example

It is convenient to observe AM sidebands in linear as well as logarithmic scales for analysis of both modulation percentages and distortion products.

Modulated AM signal displayed in the 10 dB/division scale shows the carrier, its sidebands and distortion products.

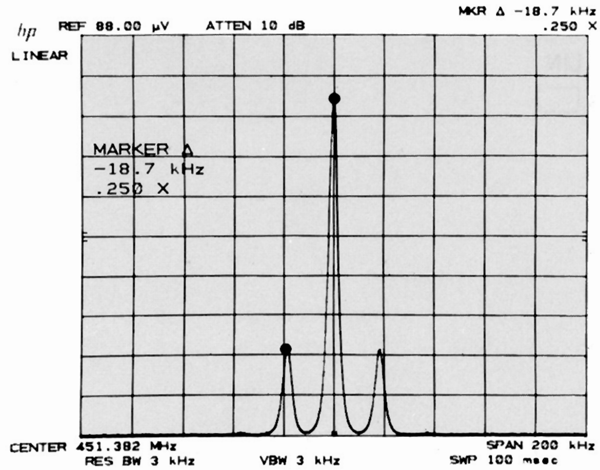


SCALE

Linear scaling enables the observation of the sidebands proportional to the carrier.

LIN

Press [ ] .

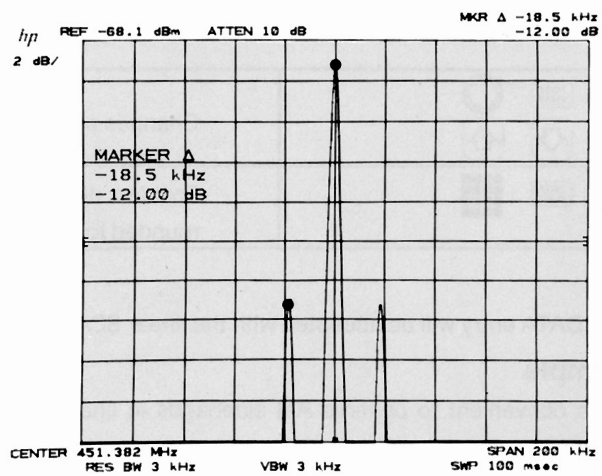


As in the MARKER [Δ] example, Chapter 7, a direct readout of the percent modulation can be made.

The fractional readout is one half the modulation index (only one sideband is measured).

% AM = 2 (.25) X 100 = 50%.

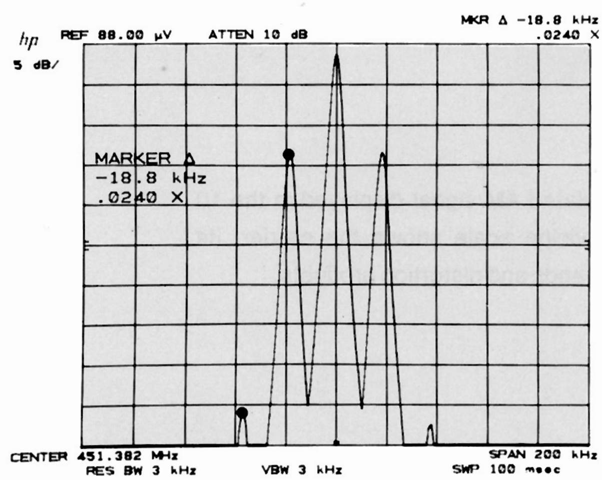
Note that the carrier signal need not be placed at the reference level for an index ratio measurement.



LOG

Change to a logarithmic scale with [ENTER dB/DIV] and change the dB/ with [⇩] [⇩].

The sidebands are 12 dB down from the carrier, verifying the earlier measurement results.



Harmonic distortion of the modulating signal can be measured as in MARKER [Δ], Chapter 7.

The modulation frequency is 18.8 kHz and the distortion caused by the second harmonic is 2.4%, (read out as .024X).

REFERENCE LINE

The reference line functions DISPLAY LINE (DL) and THRESHOLD (TH) place horizontal reference lines on the display. Their levels are read out.

DISPLAY LINE uses:

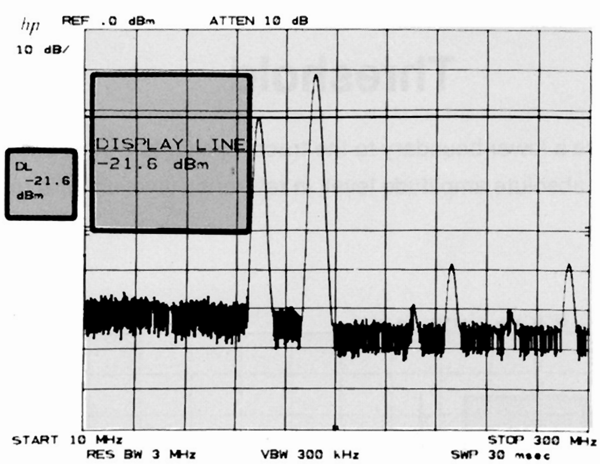
- measure signal levels with direct readout.
- establish a standard for go/no go test comparisons.
- eliminate or reduce amplitude errors due to system frequency response uncertainty in conjunction with TRACE arithmetic.

THRESHOLD provides:

- a base line clipper whose level is read out.

Display Line

Display line [ENTER] (DATA entry) places a horizontal reference line at any level on the graticule. The line's amplitude, in reference level units, is read out on the left-hand side of the CRT display.



The display line can be positioned anywhere within the graticule. When activated after LINE power ON or [INSTR PRESET] the display line is placed 4.5 divisions down from the reference level.

Display line [OFF] erases the line and readout from the CRT display but does not reset the last position. If the display line is activated again before LINE power ON or [INSTR PRESET], it will return to its last position.

Display line position is always accessible for HP-IB and TRACE [B−DL → B], even if never activated. See Chapter 6, TRACE arithmetic.

The display line readout has the same number of significant digits as reference level.

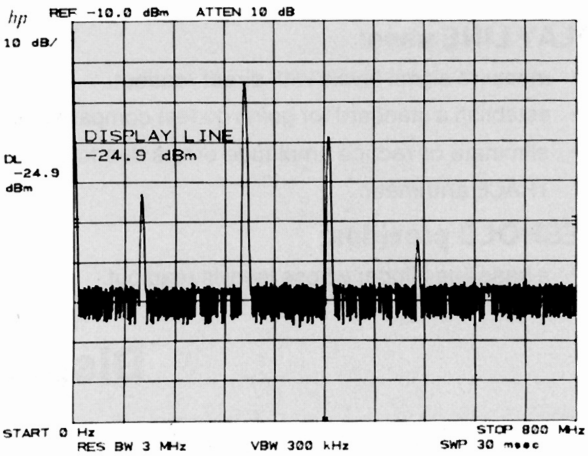
DATA Entry

[ENTER] [knob]	Moves the line about two divisions for each full turn. The line moves in display unit increments.
[ENTER] [⇩] [⇧]	Moves the line one tenth of the total amplitude scale per step.
[ENTER] [keypad]	Positions the line to the exact entry level. Entry may be in mV, μV, ± dBm, ± dBmV, or ± dBμV depending upon which units are selected.

Example

When the amplitude of a number of signals in the same span require a quick readout, the display line can be used.

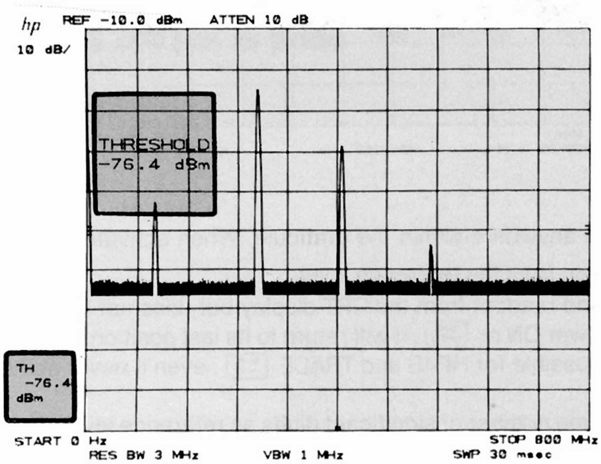
Activate the display line with [ENTER]. With (knob) place the line through the peak of a signal and read out its absolute amplitude level.



Moving the display line to each signal reads out its peak amplitude.

Threshold

Threshold [ENTER] (DATA entry) moves a lower boundary to the trace, similar to a base line clipper on direct writing CRT spectrum analyzers. The boundary's absolute amplitude level, in reference level units, is read out on the lower left-hand side of the CRT display.



The threshold can be positioned anywhere within the graticule. It operates on TRACE [CLEAR-WRITE], [MAX HOLD] or [VIEW] for TRACES A, B and C simultaneously. When activated after LINE power ON or [INSTR PRESET], the threshold is placed 1 division from the bottom graticule.

The threshold level does not influence the trace memory, that is, the threshold level is not a lower boundary for trace information stored and output from the trace memories through the HP-IB. TH [OFF] removes the threshold boundary and readout from the CRT display but does not reset the position. If threshold is activated again before LINE power ON or [INSTR PRESET] it will resume at its last level.

The threshold readout has the same number of significant digits as reference level.

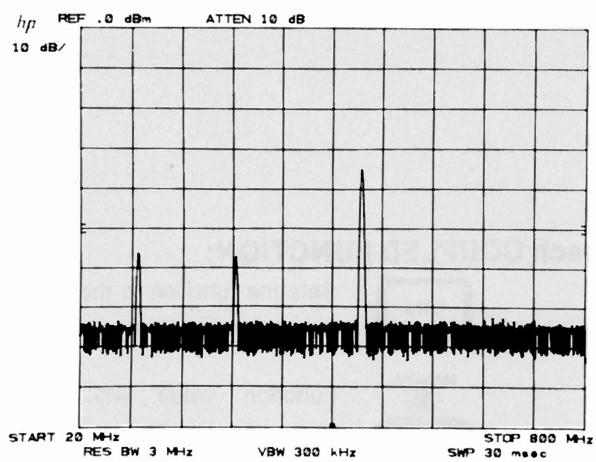
DATA Entry

ENTER ◎	Moves the threshold about two divisions per rotation. The line moves in display unit increments.
ENTER ⇩ ⇧	Moves the threshold one tenth of the total amplitude scale per step.
ENTER (keypad)	Positions the threshold to the exact entry level. Entry may be in mV, μV, ± dBm, ± dBmV, or ± dBμV depending upon units selected.

Example

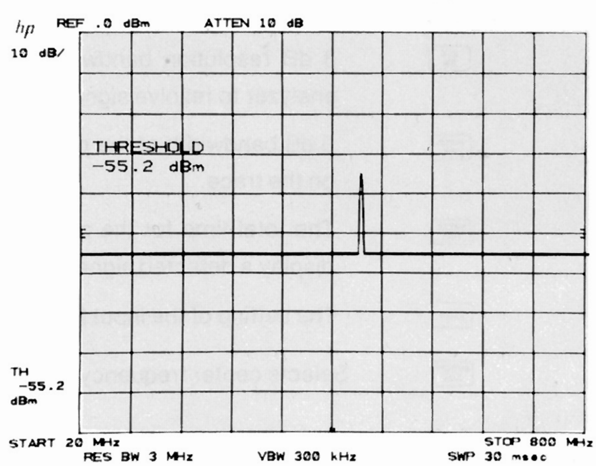
The threshold can be used as a go/no go test limit.

A series of signals can be tested for a specific threshold level by placing the threshold at the test level.



Press THRESHOLD [ENTER] [5] [5] [•] [2] [MHz/−dBm/sec]

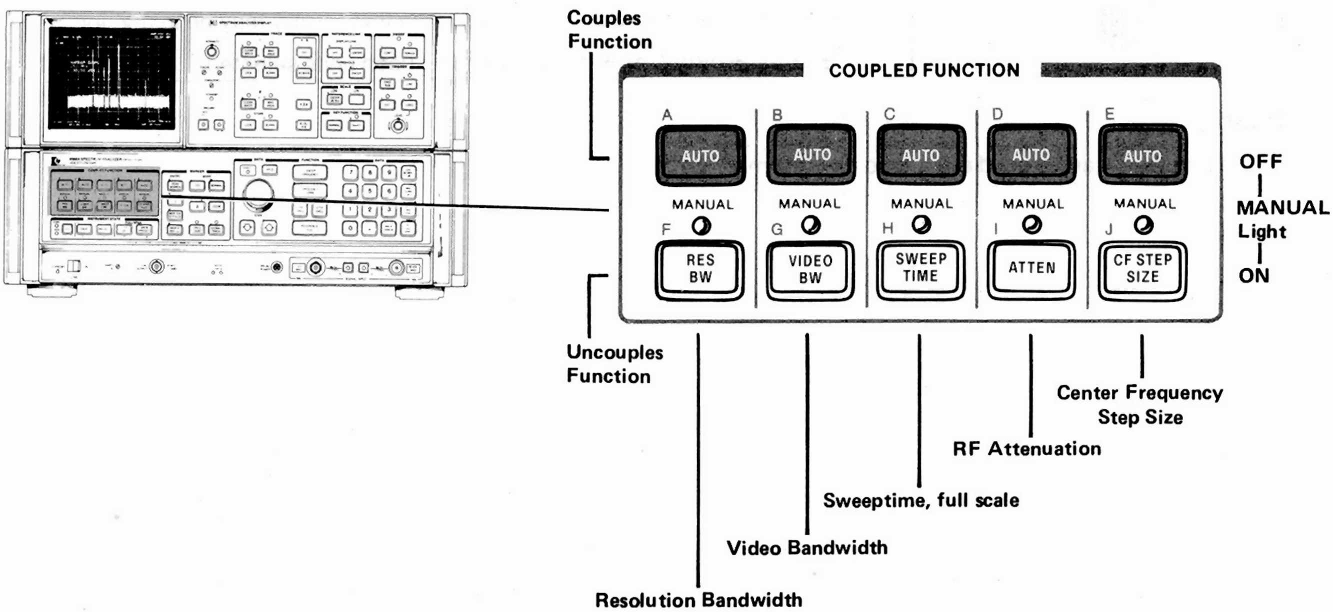
Only those signals > − 55.2 dBm will be displayed



Chapter 9
COUPLED FUNCTION

This chapter describes the COUPLED FUNCTION group and its use in various measurements. The COUPLED FUNCTIONS control the receiver characteristics of the spectrum analyzer.

The values of the COUPLED FUNCTION are automatically selected by the analyzer to keep absolute amplitude and frequency calibration as frequency span and reference level are changed.* The functions are all coupled with LINE power ON, [INSTR PRESET] or when their individual [AUTO] is activated. [0–1.5 GHz] couples all functions but [ATTEN] and [CF STEP SIZE].



For each COUPLED FUNCTION:

[AUTO] Sets the function to the preset value dictated by the analyzer's current state. The function is coupled.

MANUAL [ ] Function value will not change with instrument state. DATA entry changes value. The MANUAL light goes on and stays on until the function is placed in [AUTO] once again.

In most cases the [AUTO] coupled functions will change values to maintain amplitude calibration when one or more of the others are manually set. If the amplitude or frequency becomes uncalibrated, "MEAS UNCAL" appears in the right-hand side of the graticule.

Coupled Function	Selects
[RES BW]	3 dB resolution bandwidth (IF filter) which largely determines the ability of the analyzer to resolve signals close together in frequency.
[VIDEO BW]	3 dB bandwidth of the post detection low pass filter that averages noise appearing on the trace.
[SWEEP TIME]	The total time for the analyzer to sweep through the displayed frequency span or display a detected signal in zero frequency span.
[ATTEN]	The setting of the input RF attenuator which controls signal level at the input mixer.
[CF STEP SIZE]	Selects center frequency change for each DATA [⇧] [⇩] when [CENTER FREQUENCY] is activated.

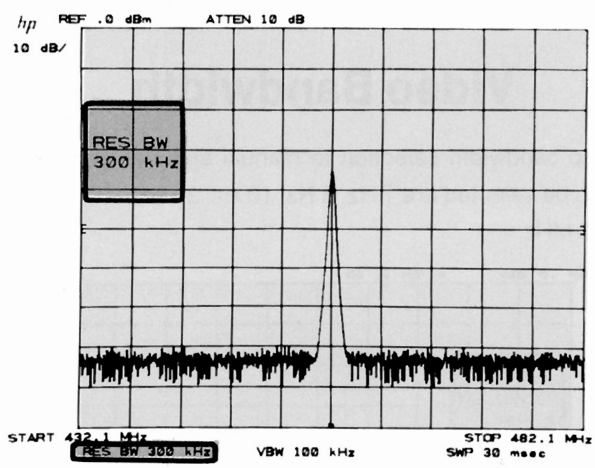
*Center frequency step size does not affect amplitude or frequency calibration.

DATA Entry For COUPLED FUNCTIONS

Discrete values are entered for [RES BW], [VIDEO BW], [SWEEP TIME] and [ATTEN]. The DATA entry from DATA (knob) and [⇧] [⇩] selects these values sequentially from the current value. A DATA entry from the keyboard which is not exactly equal to an allowable value will select an adjacent value. For example, [RES BW] [1] [5] [kHz mV msec] will select 30 kHz bandwidth, the next higher IF bandwidth.

Resolution Bandwidth

[RES BW] (DATA entry) sets bandwidth selection to MANUAL and changes the analyzer's IF bandwidth. The bandwidths that can be selected are 10 Hz, 30 Hz, 100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz and 3 MHz.

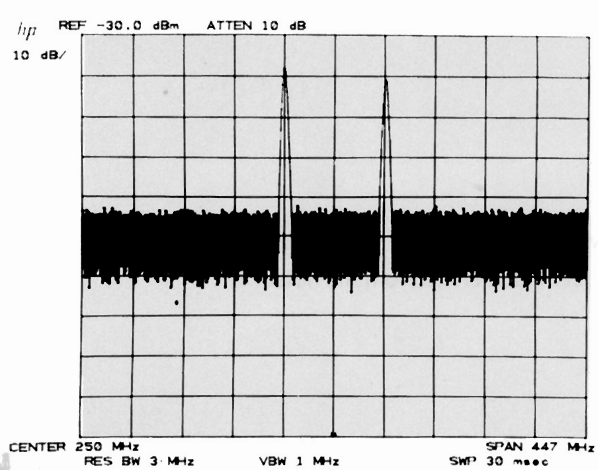


Example

A measurement requiring manual resolution bandwidth selection is the zero span (time domain) observation of modulation waveforms. An example can be found in Chapter 4, Zero Frequency Span - Fixed Tuned Receiver Operation.

Another use of manual resolution bandwidth is for better sensitivity over a given frequency span.

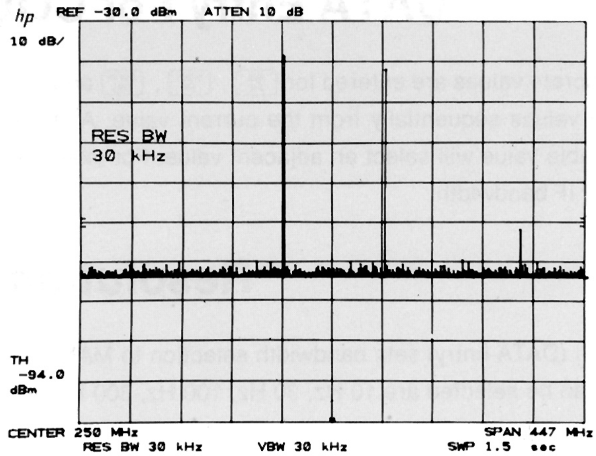
The low level intermodulation products of two signals spaced 100 MHz apart need to be measured. With the functions coupled the analyzer noise may mask these distortion products.



Reduction of the noise level by 10 dB (increased sensitivity) is achieved by decreasing the bandwidth by a factor of 10.

[RES BW] [⇩] [⇩]

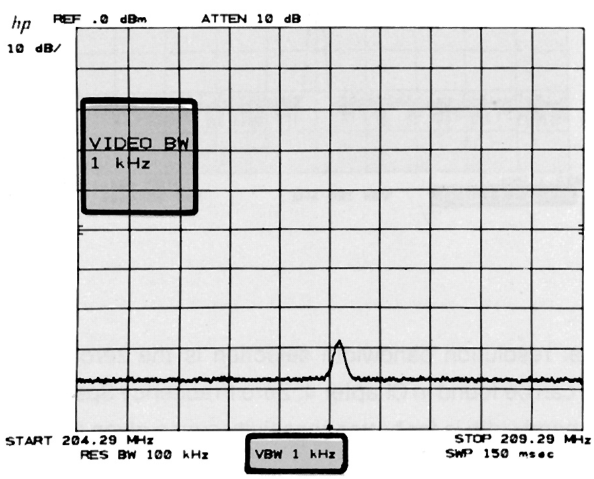
(THRESHOLD has been activated to clarify the display.)



The sweep time automatically slows to maintain absolute amplitude calibration if [SWEEP TIME] is coupled.

Video Bandwidth

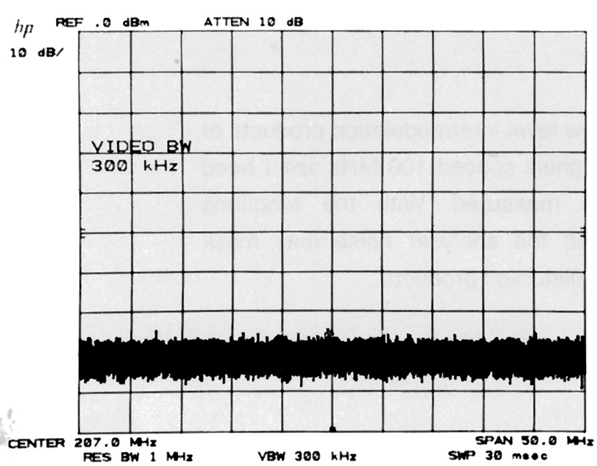
[VIDEO BW] (DATA Entry) sets the video bandwidth selection to manual and changes the analyzer's post detection filter bandwidth. The bandwidths that can be selected are 1 Hz, 3 Hz, 10 Hz, 30 Hz, 100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz and 3 MHz.



Example:

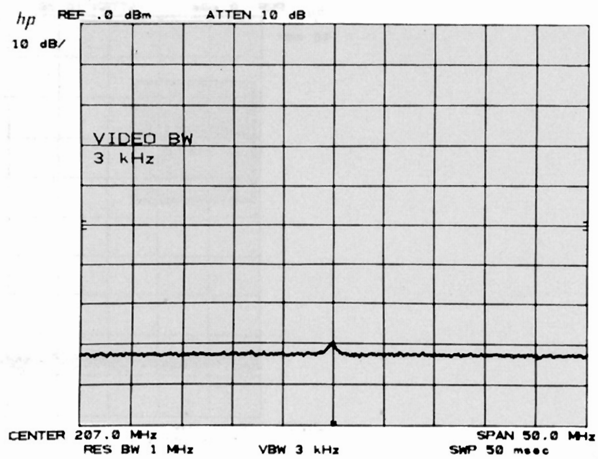
Signal responses near the noise level of the analyzer will be visually masked by the noise. The video filter can be narrowed to smooth this noise.

A low level signal at this center frequency can just be discerned from the noise.



Narrowing the video bandwidth clarifies the signal and allows its amplitude measurement.

Press [VIDEO BW] [⇩] [⇩] [⇩] [⇩]



The sweep time will increase to maintain amplitude calibration.

NOTE

The video bandwidth must be set wider or equal to the resolution bandwidth when measuring impulse noise levels.

Video Averaging

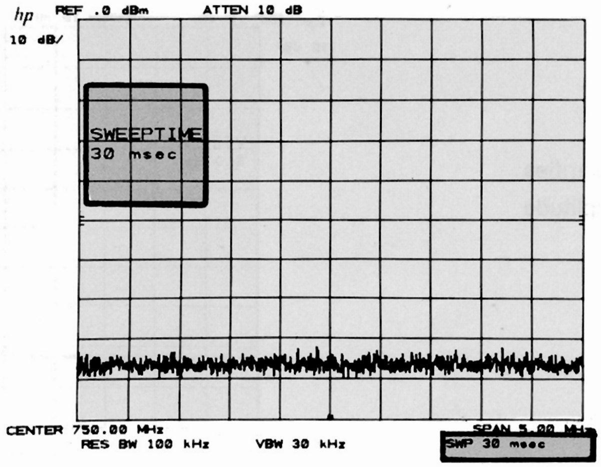
Narrowing the video filter requires a slower sweep time to keep amplitude calibration since the narrower filter must have sufficient time to respond to each signal response. Video averaging is an internal routine which *digitally* averages a number of sweeps, allowing a more instantaneous display of spectral changes due to center frequency, frequency span or reference level changes. See Chapter 12, page 12.11.

Sweep Time

[SWEEP TIME] (DATA entry) sets the sweep time selection to manual and changes the rate at which the analyzer sweeps the displayed frequency or time span.

The sweep times that can be selected are:

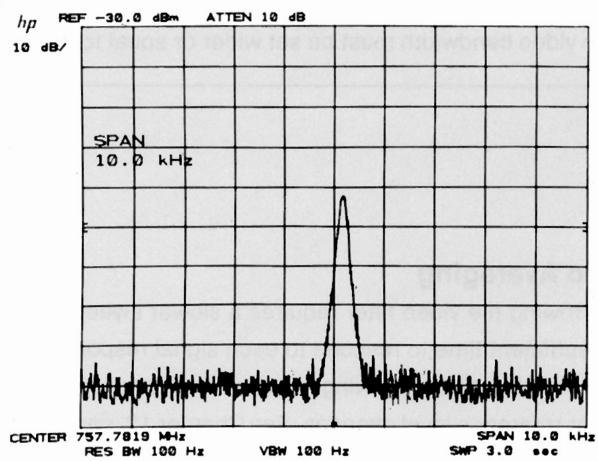
	SWEEP TIME	SEQUENCE
FREQUENCY SPAN ≥ 100	20 ms to 1500 sec	1, 1.5, 2, 3, 5, 7.5 and 10
ZERO FREQUENCY SPAN	1 μs to 10 ms	1, 2, 5 and 10
	20 ms to 1500 sec	1, 1.5, 2, 3, 5, 7.5 and 10



Example

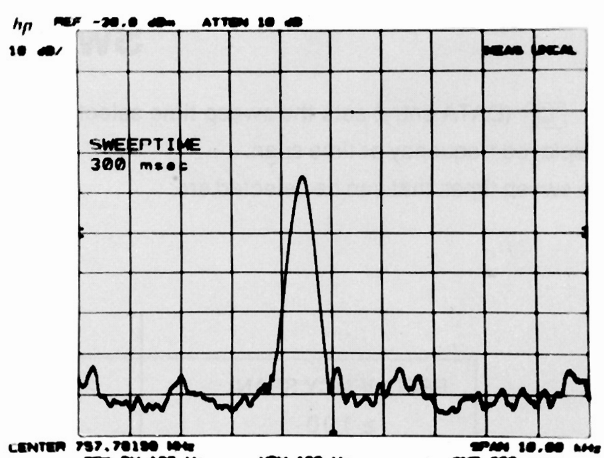
To identify signals quickly in a very narrow frequency span (where the resolution bandwidth would be narrow) the sweep time can be temporarily reduced. (e.g. speed up sweep rate).

A frequency span of 10 kHz will have selected resolutions and video bandwidths of 100 Hz and a sweep time of 3 seconds.



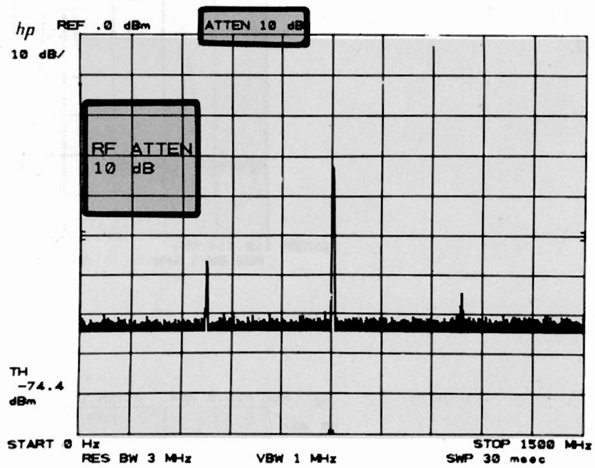
To quickly see signals present in the span press [SWEEP TIME] and [⇩] several times. When the sweep completes its span, couple sweep time again with [AUTO].

Note the DISPL UNCAL message appears automatically, as the faster sweep time causes some distortion of the spectral response.



Input Attenuation

ATTEN (DATA entry) sets the attenuation function to MANUAL and changes the analyzer's RF input attenuation. The levels of attenuation that can be selected are 10 dB to 70 dB in 10 dB steps, or 0 dB under special conditions. Generally the reference level does not change with attenuator settings.



When the RF input attenuator function is coupled (AUTO), the value selected assures that the level at the input mixer is less than −10 dBm (the 1 dB compression point) for on-screen signals. For example, if the reference level is +28 dBm the input attenuator will be set to 40 dB: +28 dBm − 40 dB = −12 dBm at the mixer.

The input mixer level can be changed to assure maximum dynamic range. See Input Mixer Level, Chapter 12.

CAUTION

Greater than +30 dBm total input power will damage the input attenuator. Input powers greater than +13 dBm at the input mixer will be reduced by an internal limiter.

Zero Attenuation

As a precaution to protect the spectrum analyzer's input mixer, 0 dB RF attenuation can only be selected from the number/units keyboard, press ATTEN 0 GHz +dBm dB.

Reference Levels < = −100 dBm and > +30 dBm

Reference levels < = −100 dBm or between +30 dBm and +60 dBm can be called when the reference level extended range is activated. Low reference level limits depend upon resolution bandwidth and scale.

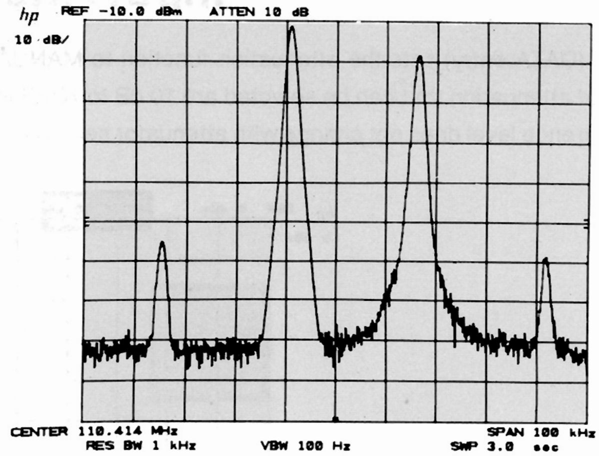
Press SHIFT ATTEN to extend the reference level range.
See Chapter 4, FUNCTION REFERENCE LEVEL, and Chapter 12, KEY FUNCTION, page 12.5.

Determining Distortion Products

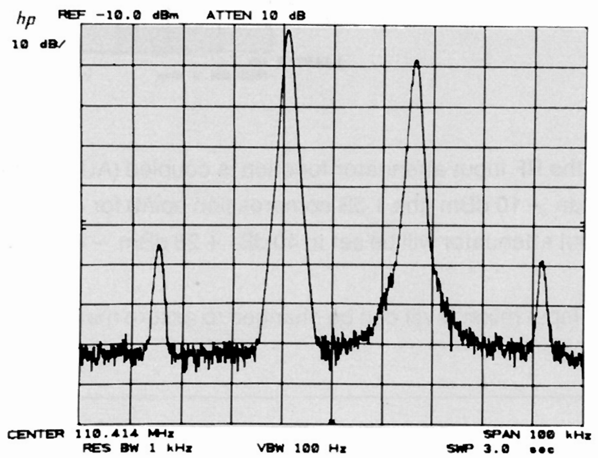
If the total power to the analyzer is overloading the input mixer, distortion products of input signals can be displayed as input signals. The RF attenuator is used to determine which signals, if any, are internally generated distortion products.

Example

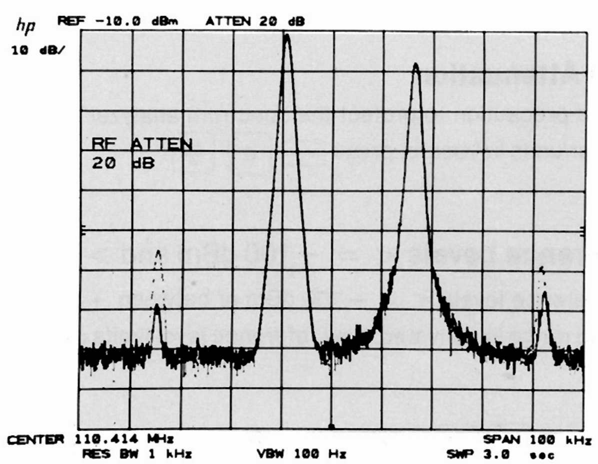
The two main signals shown are producing intermodulation products because the analyzer's input mixer is overloaded.



To determine whether these intermod products are generated by the analyzer, first save the spectrum displayed in B with [CLEAR WRITE] B [VIEW] B



Increase the RF attenuation by 10 dB. Press [ATTEN] [⇧]. (If the reference level changes it will be necessary to return it back to its original value.)



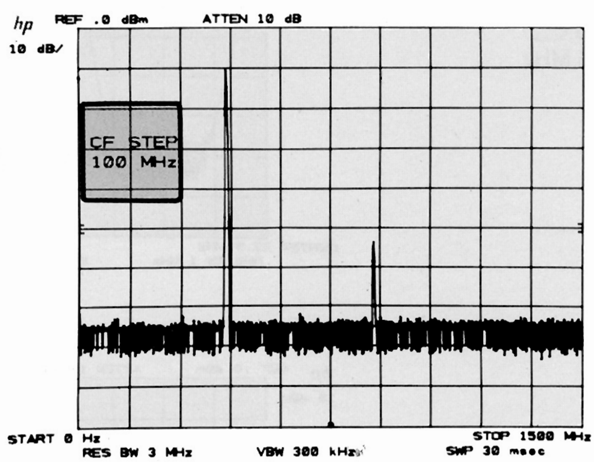
Since some of the signal responses decrease as the attenuation increases (by comparing the response in A with the stored trace in B), distortion products are caused by an overloaded input mixer. The high level signals causing the overload conditions must be attenuated to eliminate this condition.

Center Frequency Step Size

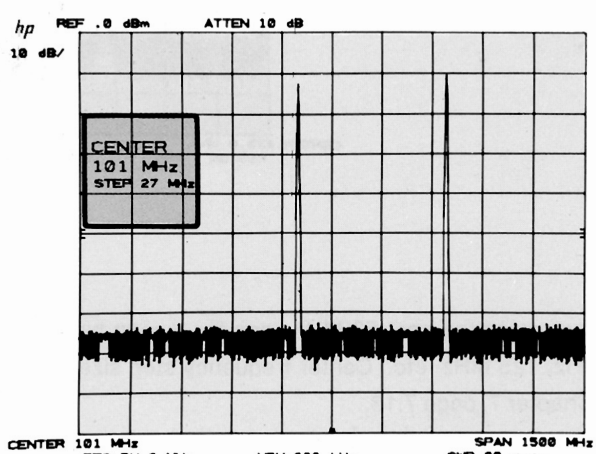
[CF STEP SIZE] (DATA entry) sets step size to MANUAL, changes and stores the step size entered. While [CF STEP SIZE] is in MANUAL, [CENTER FREQUENCY] [⇧] and [⇩] changes center frequency by the step size value stored in the register. Several functions can be used to enter step size value to the register. When a CF step size is AUTO, the center frequency steps will be 10% of the frequency span, even though the CF step size register contains another value.

	Entry Value	[CF STEP SIZE] State
step size [AUTO], [INSTR PRESET] or LINE power ON	100 MHz	coupled (AUTO)
[CF STEP SIZE] (DATA entry)	DATA entry value	uncoupled (MANUAL)
MARKER [MKR/Δ→ STP SIZE]	marker frequency readout	uncoupled (MANUAL)

The step size can be varied from 0 Hz to 1500 MHz to a resolution equal of 1 Hz. It is displayed with the same resolution as center frequency.



When the center frequency is activated with step size in MANUAL, the active function readout includes both the center frequency and the step size value.



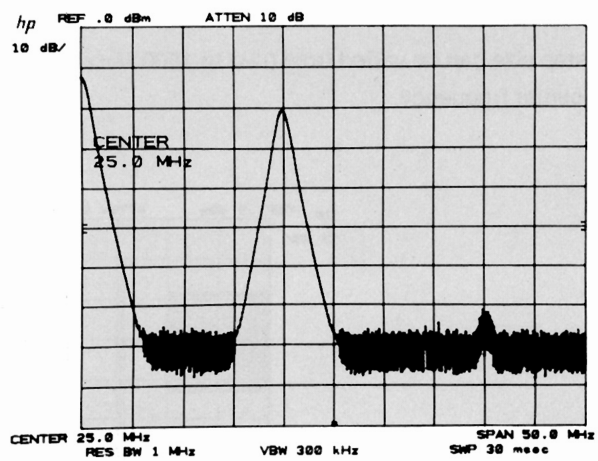
DATA Entry

[CF STEP SIZE] (knob)	Changes the step size in display unit increments.
[CF STEP SIZE] [⇧] [⇩]	Changes the step size in steps equal to one tenth of the frequency span.
[CF STEP SIZE] (keypad)	Selects a specific step size to a resolution equal to the current center frequency readout.

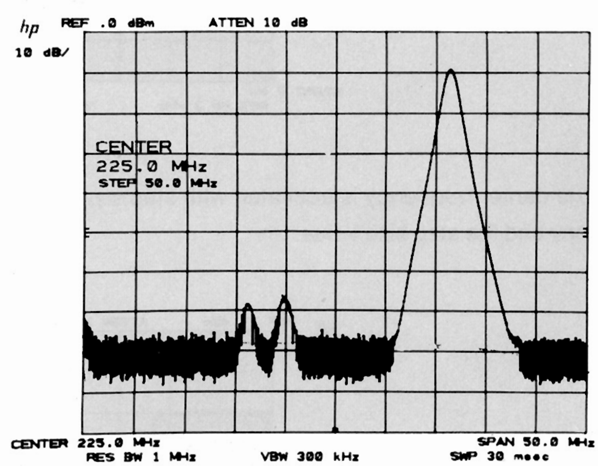
Example

Surveillance of a wide frequency span sometimes requires high resolution. One fast way to achieve this is to take the span in sequential pieces using a tailored center frequency step. This example looks from 0 Hz to 1500 MHz in 50 MHz spans.

First set a span and start frequency. For a span of 50 MHz press [FREQUENCY SPAN] [5] [0] [MHz -dBm sec]. Set the center frequency to 25 MHz with [CENTER FREQUENCY] [2] [5] [MHz -dBm sec].



Set the step size to 50 MHz, [CF STEP SIZE] [5] [0] [MHz -dBm sec], and reactivate center frequency with [CENTER FREQUENCY].



Now each [⇧] sets the center frequency to the next 50 MHz span for a span by span surveillance of the spectrum. (Center frequency = 25 MHz, 75 MHz, 125 MHz, etc.) Center frequency step size can also be defined by the marker, see the MARKER ENTRY portion of Chapter 7, page 7.13.

Chapter 10

SWEEP and TRIGGER

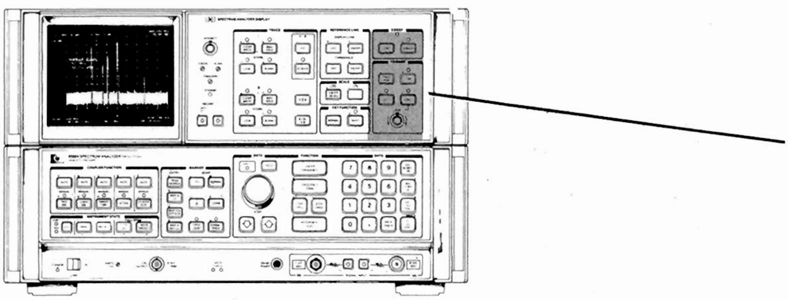
This chapter describes the use of SWEEP and TRIGGER control functions.

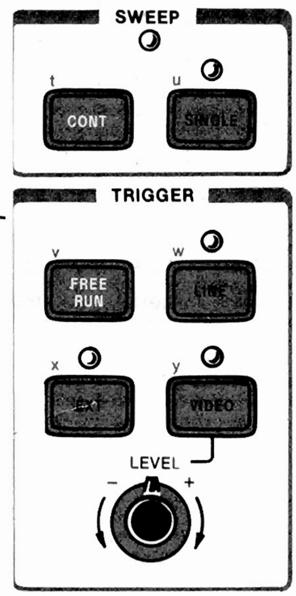
SWEEP controls enable:

[CONT]	continuous, or repetitive sweeping (sweep time ≥ 20 ms).
[SINGLE]	a single sweep which will repeat only on demand (sweep time ≥ 20 ms).

TRIGGER controls select the function which will begin a sweep:

[FREE RUN]	as soon as possible,
[LINE]	line voltage passes through zero on a positive swing,
[EXT]	an external signal voltage passes through ~ 1.5 volts on a positive swing.
[VIDEO]	the level of a detected RF envelope reaches up to the level on the CRT display determined by the LEVEL knob.





SWEEP and TRIGGER Controls

SWEEP

The spectrum analyzer frequency sweep (sweep times ≥ 20 ms), once triggered, continues at a uniform rate from the start frequency to the stop frequency unless new data entries are made to the analyzer from the front panel or the HP-IB. With faster sweeps, changes to center frequency, for example, appear continuous. With long sweep times, a change in center frequency noticeably suspends the sweep while the analyzer updates its state and readout, then the sweep continues from where it was, tracing out the new spectrum.

The SWEEP light indicates that a sweep is in progress. The light is out between sweeps, during data entry and during [FREQ COUNT] gating. (The light is out for sweep times ≤ 10 ms.)

After a sweep, the next sweep will be initiated only if:

- continuous sweep mode is selected or a single sweep demand is made,
- the trigger conditions are met,
- data is not entered continuously from the front panel DATA controls or the HP-IB.

Continuous Sweep

[CONT] enables the continuous sweep mode. Provided the trigger and data entry conditions are met, one sweep will follow another as soon as triggered. Pressing [CONT] initiates a new sweep.

Single Sweep

[SINGLE] enables the single sweep mode. Each time [SINGLE] is pressed, including when the SWEEP mode is changed from continuous, one sweep is initiated provided the trigger and data entry conditions are met. A sweep in progress will be terminated and restarted upon [SINGLE].

Zero Frequency Span Sweep

In zero frequency span, sweep times from 1 μsec to 10 msec are also available. In these sweep times the SWEEP [CONT] and [SINGLE] are disabled. The video signal response is *not* digitally stored (trace modes also disabled), but multiplexed directly onto the display along with the graticule and readouts. The graticule and readouts are refreshed following each fast sweep.

To avoid flicker of the display when external or video triggers are less frequent than 25 msec, the analyzer will trigger internally. If triggers dependent *only* on external or video trigger are required press

[SHIFT] [EXT] x disables "auto" external trigger feature

or [SHIFT] [VIDEO] y disables "auto" video trigger feature

NOTE

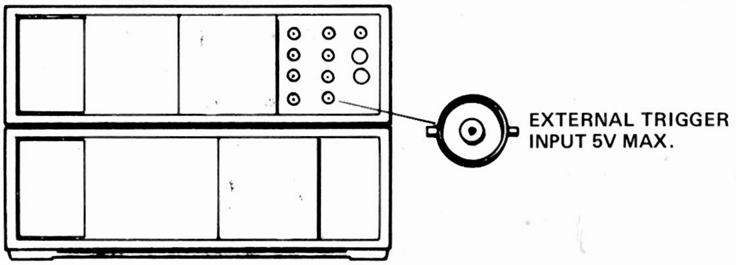
For zero frequency span sweep times ≤ 10 msec and [SHIFT] x or [SHIFT] y the CRT display graticule and readout depend upon triggering. If no trigger is present the CRT display will be blank.

TRIGGER

The analyzer sweep is triggered by one of four modes selected.

- [FREE RUN] allows the next sweep to start as soon as possible after the last sweep.
- [LINE] allows the next sweep to start when the line voltage passes through zero, going positive.
- [EXT] allows the next sweep to start when an external voltage level passes through ≈ 1.5 volts, going positive.

  The external trigger signal level must be between 0 V and + 5 V.



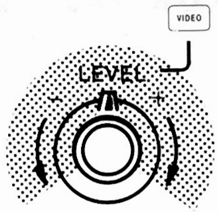
External TRIGGER Input

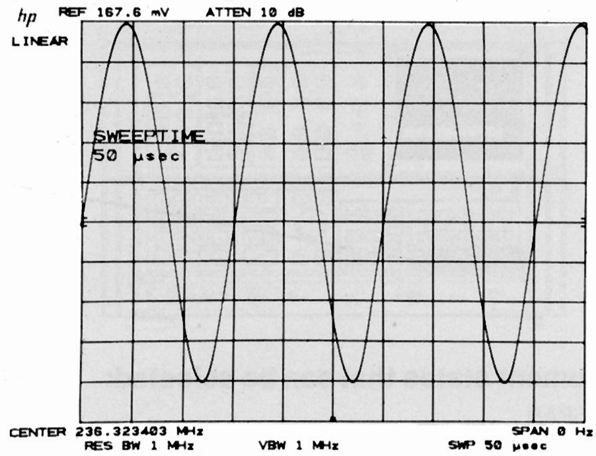
- [VIDEO] allows the next sweep to start if the detected RF envelope voltage rises to a level set by the LEVEL knob. The LEVEL corresponds to detected levels displayed on the CRT between the bottom graticule (full CCW) and the top graticule (full CW).

An RF envelope will trigger the sweep only if it is capable of being traced on the CRT display, that is, the resolution bandwidth and video bandwidth are wide enough to pass the modulation waveform of an input signal.

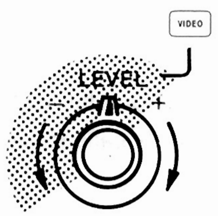
Example

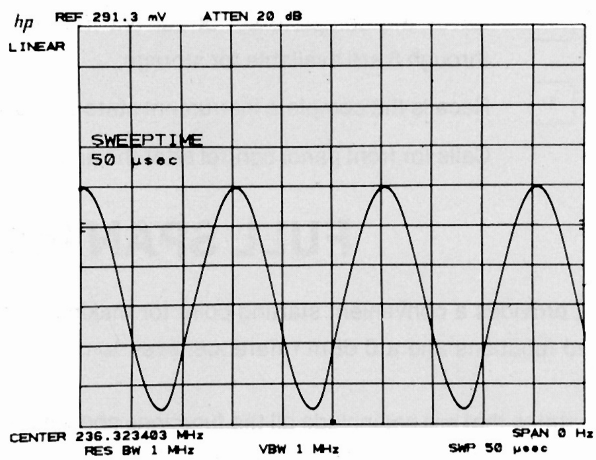
A zero span display of this video waveform will trigger for all LEVEL knob settings.





If the video signal lowers on the display, the LEVEL must be set towards the minus side.

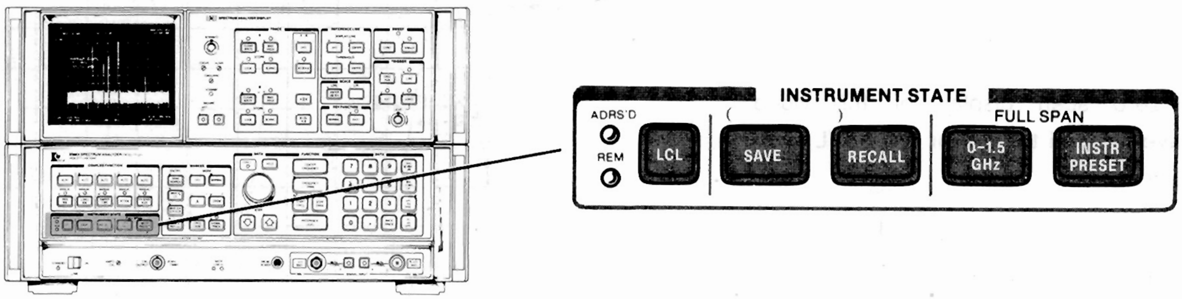




If the level does not cause a trigger within 25 msec, the sweep will be triggered anyway to insure a display. Note that this is true only for sweep times $\leq$10 msec.

Chapter 11
INSTRUMENT STATE

This chapter describes the INSTRUMENT STATE keys. Each key allows access to or activation of a specific set of functions and their values. Some of the sets are built in to the analyzer and some are user defined.



Instrument states that can be selected:

FULL SPAN

[INSTR PRESET] A full 0 Hz to 1500 MHz span with coupled operation and *all* the functions set to known states and values.

FULL SPAN

[0-1.5 GHz] A full 0 Hz to 1500 MHz span with a minimum of other front panel functions changed.

[SAVE] [1] Saves the complete set of current front panel function states and values for later recall. Registers 1 through 6 are available for storage.

[RECALL] [1] Recalls the complete instrument state saved in the register called.

[LCL] Calls for front panel control after the analyzer has been placed in a remote state by an HP-IB controller.

FULL SPAN Instrument Preset

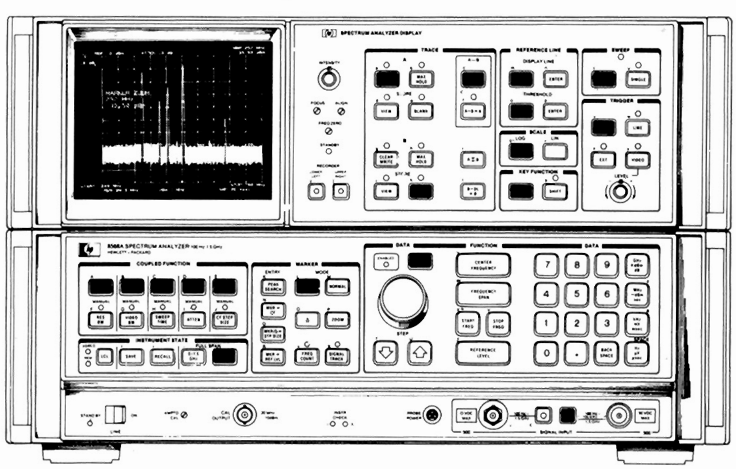
[INSTR PRESET] provides a convenient starting point for making most measurements. That is, it calls for a full 1500 MHz span, coupled functions and a 0 dBm reference level, to name a few. LINE power ON automatically calls for an instrument preset.

The states that are set include all the functions and values of

- front panel functions,
- and [SHIFT] KEY FUNCTIONs,
- and functions accessible only by the HP-IB.

Front Panel Preset

[INSTR PRESET] enables all the front panel functions designated by keys with white lettering. It will save a trace response in TRACE B, but not A or C.



■ **Functions Activated with [INSTR PRESET]**

To be precise:

SIGNAL INPUT:	Input 2 selected	100 kHz - 1.5 GHz
FUNCTION:	Start Frequency	0 Hz
	Stop Frequency	1500 MHz
	Reference Level	0 dBm
DATA:	Hold	
COUPLED FUNCTION:	All set to [AUTO] which corresponds to the following values:	
	Resolution Bandwidth	3 MHz
	Video Bandwidth	1 MHz
	Sweep time	20 msec full scale
	Attenuator	10 dB, coupled to maintain <-10 dBm at input mixer
	Center Frequency Step Size	100 MHz entered in register
TRACE:	A	Clear-Write
	B	Blanked but information in memory saved
	A — B	Off
MARKER:	Off	
INSTRUMENT STATE [SAVE] and [RECALL]:	States are saved including the current state. See [RECALL] [7] below.	
SCALE:	Logarithmic, 10 dB/division	
REFERENCE LINE:	Display line off	5.5 divisions up
	Threshold off	1.0 divisions up
SWEEP:	Continuous	
TRIGGER:	Free run	
INSTR CHECK:	An internal instrument check is made. If the check is false, lights will stay on.	
KEY FUNCTION:	Normal	
[SHIFT] FUNCTIONS:	All [SHIFT] functions are disabled. For example, all titling is erased after an instrument preset. Chapter 12, [SHIFT] KEY FUNCTIONS, discusses the implications of activating instrument preset during [SHIFT] FUNCTION use. If the key is activated (shift light on), [INSTR PRESET] unshifts the key. This is equivalent to pressing [NORMAL].	
HP-IB FUNCTIONS:	"D1"	Display size-normal
	"EM"	Erase trace C memory
	"03"	Output format ASCII absolute
	"PD"	Pen down
	"DA"	Display address set to 3072

Graphic information or control language written into the analyzer memory by HP-IB functions such as graph (GR), plot (PA), label (LB), or display write (DW) will be erased unless stored in trace memory B. Instrument preset also rewrites all the display graticule and character readouts into the appropriate section of the display memory.

See 8568A Spectrum Analyzer Remote Operation (HP part number 08568-90003) for further information.

FULL SPAN 0 - 1.5 GHz

[0-1.5 GHz] immediately sets the COUPLED FUNCTIONs [RES BW], [VIDEO BW] and [SWEEP TIME] to automatic, the start frequency to 0 Hz and the stop frequency to 1500 MHz. The other front panel functions, [SHIFT] KEY FUNCTIONs or HP-IB only states are not changed.

Saving and Recalling Instrument States

[SAVE] (DATA keyboard entry) and [RECALL] (DATA keyboard entry) save and recall complete sets of user defined front panel function values. The DATA entry from the keyboard names the register which stores the instrument state. Six registers, [1] through [6], can be saved and recalled. Only another [SAVE] will erase a saved register. The registers contain their last states even with a loss of line power (power failure). The registers are maintained with an internal battery supply for about a 30 day period after line power failure.

[RECALL] [7] is a special recall function which recalls the instrument state prior to the *last* instrument preset or single function value change, which ever has most recently occurred. It aids in recovering from inadvertent entries.

The current instrument state, if the POWER switch is turned to STANDBY, (or a short term loss of ac line power) can be recovered at POWER ON if [SHIFT] f is activated previous to a power loss.

Some [SHIFT] KEY FUNCTION values or states cannot be saved. Neither can information in the display memories, such as a title or trace.

The [0] register is a buffer for instrument state transfer under remote operation and the [8] and [9] states are used for calibration signal adjustments.

Example

When a test sequence is used over and over, the instrument states can be set up in the registers prior to testing for recall during the procedure.

Keying in a specific state:

[INSTR PRESET]

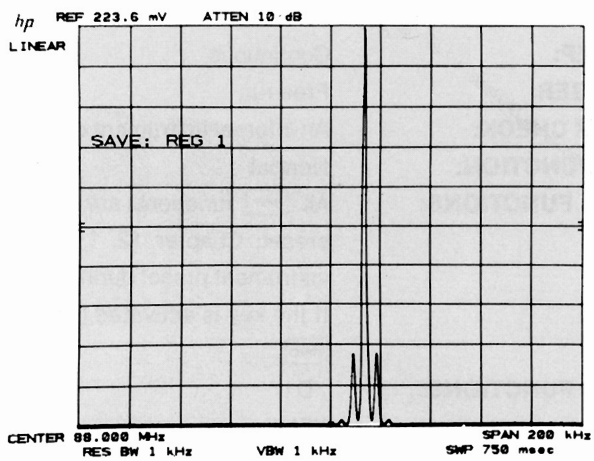
[CENTER FREQUENCY] [8] [8] [MHz -dBm sec]

[FREQUENCY SPAN] [2] [0] [0] [kHz mV msec]

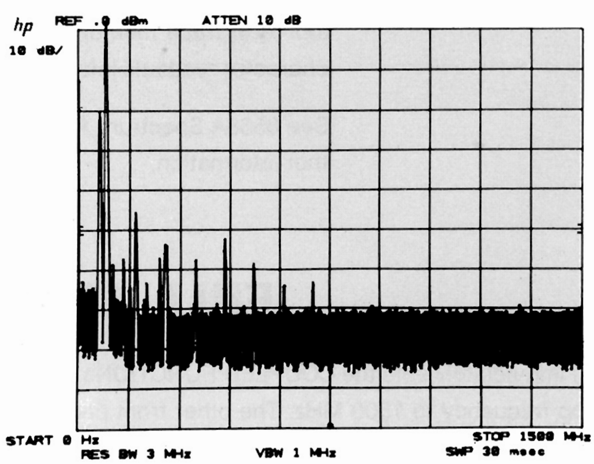
[RES BW] [⇩]

LIN [ ] SCALE

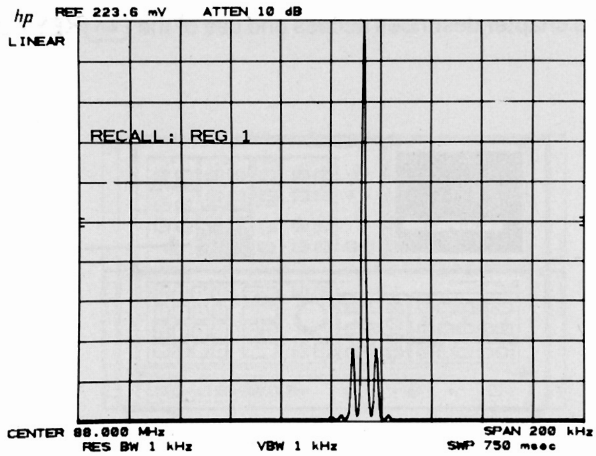
Then save with [SAVE] [1].



Press [INSTR PRESET].



And recall the last state with [RECALL] [1]. Once the state has been recalled, any function can be used for more detailed measurements.
Note that in this case, the state could also have been recalled by [RECALL] [7].

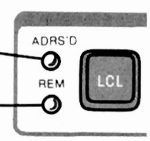


Local Operation

[LCL] enables front panel control after an HP-IB remote LISTEN or TALK command has been executed. An HP-IB local lockout will disable [LCL] until an HP-IB return to local command is executed or the LINE power is turned to STANDBY then ON again.

Indicates instrument has been addressed through HP-IB

Indicates instrument is in remote operation

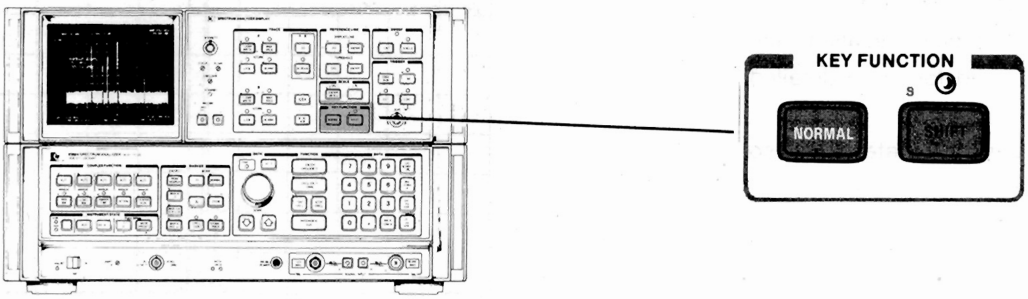


The addressed light remains on until an HP-IB device clear command or any unlisten command is executed.
See 8568A Spectrum Analyzer Remote Operation, HP part number 08568-90003, for more detailed information.

Chapter 12

[SHIFT] KEY FUNCTIONS

This chapter describes access and use of the [SHIFT] KEY FUNCTIONS.



General Description

Shift functions supplement a front panel function or provide unique measurement capabilities. The [SHIFT] functions are not named on the front panel but are coded by the blue characters beside the keys. For example, the frequency offset function is designated by the code V. On the front panel the code V is found in the FUNCTION section:

V
[CENTER FREQUENCY]

The shift functions are activated by pressing [SHIFT] and then the front panel key with the appropriate blue code. A complete summary of shift FUNCTIONS is on the facing page. An index to all shift functions is on page 12.15.

Example

Activate the shift function V (frequency offset) with

press [SHIFT] shift light on

V

press [CENTER FREQUENCY] shift light off and offset function activated

The shift light can always be turned off with [NORMAL], which returns the front panel keys to their designated function. [NORMAL] does not disable the selected shift function (except for title).

DATA Entry

An active shift function value is readout and identified in the active function area of the display the same as any other function using DATA entry. Once the data has been entered, any other function can be activated. The shift function will retain its last value until [INSTR PRESET] or LINE power STANDBY.

DATA entries to shift functions are made only from the number/units keyboard. The ENABLED light remains off even though data may be entered.

Data is entered, that is, changes the instrument state, only when a units key is pressed. If the entry has no units (an address for example), use the [Hz µV µsec] key as the terminator.

FUNCTION SUMMARY

General
- HP-IB Service request — r
- Enter HP-IB address — P
- Power on in last state — f
- Display Address — z
- Display Write — |
- Max mixer input level — ,

Frequency
- Counter Resolution — =
- Frequency offset — V
- Negative entry — -

Amplitude
- Amplitude offset — Z
- Units: dBm — A
  - dBmV — B
  - dBμV — C
  - voltage — D
- Extended reference level range — I
- Negative entry — -
- Preamp gain, input 1 — <
- Preamp gain, input 2 — >

Marker
- Counter resolution — =
- Continue sweep from marker — t
- Enter Δ→ span — O
- Noise level on — M
- Noise level off — L
- Stop single sweep at marker — u

Display
- Annotation blanked — o
- Annotation on — p
- Display correction data — w
- CRT beam off — g
- CRT beam on — h
- Graticule blanked — m
- Graticule on — n
- Title — E

Trace
- A + B → A — c
- Detection:
  - normal — a
  - positive peak — b
  - negative peak — d
  - sampling — e
- Trace C:
  - blank trace C — k
  - B ⇄ C — i
  - B → C — l
  - view trace C — j
- Video averaging on — G
- Video averaging off — H

Trigger · Zero Span
- [EXT] Without 25 msec triggering — x
- [VIDEO] Without 25 msec triggering — y

Instrument State
- Save registers locked — (
- Save registers unlocked —)

Error Correction
- Execute routine — W
- Use correction data — X
- Do not use correction data — Y
- Display data — w

Diagnostics
- Count pilot IF at marker — K
- Count signal IF at marker — Q
- Count VTO at marker — N
- Disable step gain — q
- Frequency diagnostic on — R
- Inhibit phase lock flags — v
- Manual DACS control — J
- Measure sweeptime — F
- Second LO auto — S
- Second LO shift down — T
- Second LO shift up — U

ALPHABETICAL KEY CODE SUMMARY

- A — Amplitude in dBm
- B — Amplitude in dBmV
- C — Amplitude in dBμV
- D — Amplitude in voltage
- E — Title
- F — Measure sweep time
- G — Video averaging on
- H — Video averaging off
- I — Extended reference level range
- J — Manual DACS control
- K — Count pilot IF at marker
- L — Noise level off
- M — Noise level on
- N — Count VTO at marker
- O — Enter Δ→ span
- P — Set HP-IB address
- Q — Count signal IF at marker
- R — Frequency diagnostic on
- S — Second LO auto
- T — Second LO shift down
- U — Second LO shift up
- V — Frequency offset
- W — Execute error correction routine
- X — Use correction data
- Y — Do not use correction data
- Z — Amplitude offset
- a — Normal detection
- b — Positive peak detection
- c — A + B → A
- d — Negative peak detection
- e — Sample detection
- f — Power on in last state
- g — CRT beam off
- h — CRT beam on
- i — B⇄C
- j — View trace C
- k — Blank trace C
- l — B → C
- m — Graticule blanked
- n — Graticule on
- o — Annotation blanked
- p — Annotation on
- q — Disable step gain
- r — HP-IB service request
- t — Continue sweep from marker
- u — Stop single sweep at marker
- v — Inhibit phase lock flags
- w — Display correction data
- x — [EXT] without 25 msec triggering
- y — [VIDEO] without 25 msec triggering
- z — Display address
- \- — Negative entry
- = — Counter resolution
- (— Save registers locked
-) — Save registers, unlocked
- < — Preamp gain, input 1
- > — Preamp gain, input 2
- | — Display write
- , — Max mixer input level

Negative DATA Keyboard Entry

Entering negative data from the DATA keyboard requires the use of a negative symbol prefix on the number entry.

negative entry: [SHIFT] [HOLD]

For example to enter a negative 100 MHz offset frequency:

V

Press [SHIFT] [CENTER FREQUENCY] to activate frequency offset

–

Press [SHIFT] [HOLD] [1] [0] [0] [MHz –dBm sec] to enter a negative frequency.

Not all values can be entered with a negative prefix, for example a negative entry to a voltage reference level will result in entering the positive value.

Negative entries in dB can be made with the -dBm units key or the negative prefix with the +dBm units key. If both negative prefix and [MHz –dBm sec] are used, the value will be entered as positive.

Frequency and Amplitude Offset

The CRT display amplitude and frequency readout can be offset. Entering an offset does not affect the trace.

V

Frequency offset: [SHIFT] [CENTER FREQUENCY] (DATA keyboard entry)

Z

Amplitude offset: [SHIFT] [REFERENCE LEVEL] (DATA keyboard entry)

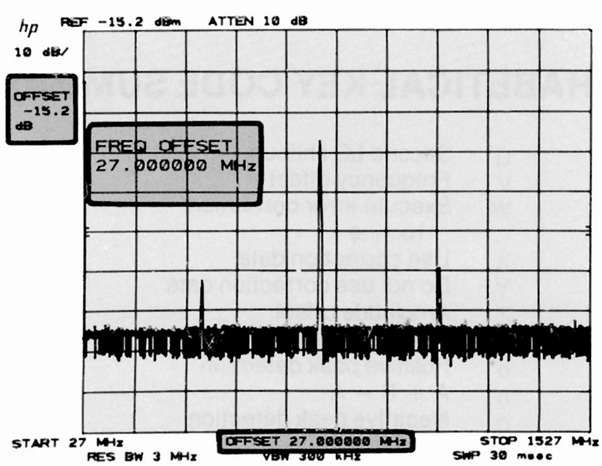
Offset entries are added to all the frequency or amplitude readouts on the CRT display including marker, display line, threshold, start frequency and stop frequency.

FUNCTION

To eliminate an offset, activate the offset and enter zero. [INSTR PRESET] also sets the offsets to zero.

Offsets are stored with the [SAVE] functions for recall with [RECALL].

When an offset is entered its value is displayed on the CRT.



DATA entry from the keyboard can be in Hz, kHz, MHz or GHz for frequency and dB, dBm, mV and μV for amplitude. The amplitude offset readout is always in dB. An entry in voltage can be made and will be converted to dB offset.

The offset range for frequency is -99.999999990 GHz to +99.999999999 GHz in 1 Hz steps. The amplitude offset range is greater than ±100 dB in 0.1 dB steps. Least significant digits will be rounded for frequency and dropped for amplitude offset entries.

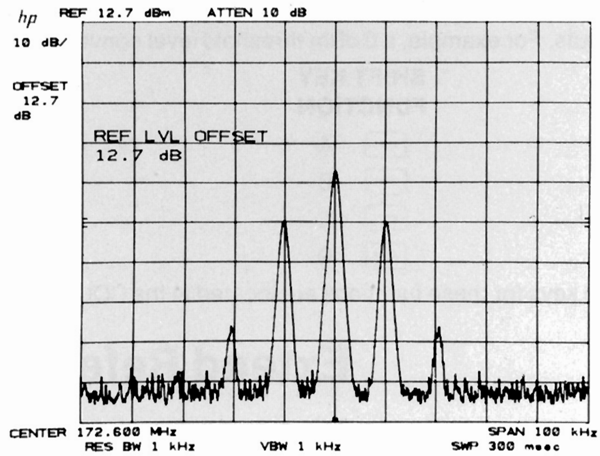
Example

An 102.6 MHz up converter with 12.7 dB attenuation is placed between a signal source and the spectrum analyzer. The offsets can be set so that the CRT display shows the trace referenced to the signal as input to the converter.

Amplitude offset is entered as a positive value to compensate (offset) the loss of the converter.

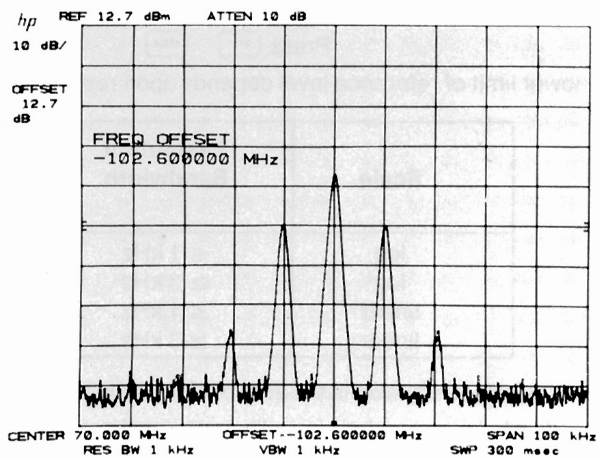
Press [SHIFT] [REFERENCE LEVEL] (Z) [1] [2] [.] [7] [GHz +dBm dB]

Note that the original REF LEVEL of 0 dBm is now changed to 12.7 dBm also.



Frequency offset is entered as a negative value since the input frequency to the converter is lower than the output.

Press [SHIFT] [CENTER FREQUENCY] (V) [SHIFT] [HOLD] (–) [1] [0] [2] [.] [6] [MHz −dBm sec]



Input Mixer Level

As the reference level is changed, the coupled input attenuator is changed to keep the power levels of on-screen signals below − 10 dBm at the input mixer. (The input mixer level is the input signal level minus the attenuator setting.) This input mixer level can be changed in 10 dB steps by pressing

[SHIFT] [0-1.5 GHz] (,) (DATA keyboard entry)

An input mixer level of − 50 dBm ensures that the analyzer has best dynamic range as long as the input signal's total power level is below the analyzer's reference level. Also see Appendix C.

Instrument preset resets the input mixer level to − 10 dBm.

Preamp Gain

Similar to the amplitude offset functions, the preamp gain function allows a positive or negative amplitude offset to all the amplitude readouts. The offsets are *subtracted* from the amplitude readouts so that the displayed amplitudes represent the power levels at the *input* of the preamp. Each signal input can be offset by different amounts.

Preamp gain, input 1: [SHIFT] < (DATA keyboard entry)
Preamp gain, input 2: [SHIFT] > (DATA keyboard entry)

The < *key is beside Input 1, and the* > *key is beside the Input 2.*

The offset is not read out on the CRT. Instrument preset resets the gains to 0 dB.

Amplitude Units Selection

The following shift key codes immediately select the corresponding units for all the amplitude readouts: reference level, marker, display line and threshold.

When a units change is made, all readouts are converted so as to preserve the absolute power levels of all the readouts. For example, a 0 dBm threshold level converts to 47.0 dBmV (50 ohm input) when dBmV units are called.

SHIFT KEY FUNCTION		AMPLITUDE UNITS
[SHIFT] A	or [INSTR PRESET]	dBm
[SHIFT] B		dBmV
[SHIFT] C		dBμV
[SHIFT] D		voltage

The keys for these functions are located in the COUPLED FUNCTION group.

Extend Reference Level Range

Normally the reference level can be set to from -89.9 dBm to + 30.0 dBm in coupled operation. The limits of the range can be extended to a maximum of − 139.9 dBm and + 60.0 dBm.

I

Press [SHIFT] [ATTEN]

The lower limit of reference level depends upon resolution bandwidth, scale and attenuation.

Scale	Resolution Bandwidth	Minimum reference level with extended reference level	
		10 dB attenuation	0 dB attenuation
log	≤ 1 kHz	-129.9 dBm	-139.9 dBm
log	≥ 3 kHz	-109.9 dBm	-119.9 dBm
linear	≤ 1 kHz	-109.9 dBm	-119.9 dBm
linear	≥ 3 kHz	- 89.9 dBm	- 99.9 dBm

When the reference level is set at a minimum, the level may change if either scale or resolution bandwidth is changed. The extended range is disabled with instrument preset.

Counter Resolution

When [FREQ COUNT] is activated, the frequency of the signal marked by the active marker is counted. For more details see MARKER [FREQ COUNT], Chapter 7, page 7.14. In this mode the resolution of the count is the same as the center frequency readout. To increase the resolution

=

press [SHIFT] [FREQ COUNT] (DATA keyboard entry).

For spans ≤2 MHz, the data entry sets the least frequency digit to be counted. For example:

DATA entry	Readout for 100 MHz
100 kHz	100.0 MHz
10 kHz	100.00 MHz
1 kHz	100.000 MHz
100 Hz	100.0000 MHz
10 Hz	100.00000 MHz
1 Hz	100.000000 MHz

Counter resolution can be set between 1 Hz and 100 kHz. The resolution of the counter frequency will remain fixed until changed with a counter resolution data entry or until [INSTR PRESET] is used. The counter resolution cannot be stored with [SAVE].

Values entered other than decade numbers, such as 25 Hz and 326 kHz, will be rounded to the next legal value. For example, a counter resolution data entry of 25 Hz will be entered as 10 Hz, and 326 kHz will become 100 kHz resolution.

Marker Sweeps

When a marker is displayed, the sweep can be made to stop at the active marker and to continue from the active marker. The front panel continuous sweep function is suspended but the sweep trigger and data conditions must still be met. See Chapter 10, SWEEP and TRIGGER.

Stop Sweep at Marker, TALK after Marker

To stop the sweep at the marker,

press MARKER [NORMAL] and
press [SHIFT] u.

A marker must be activated to enter this sweep function.

Each time a sweep is triggered, it will stop at the marker, even if the marker has been moved. A marker being moved when the sweep passes may not stop the sweep.

To disable the stop sweep at marker functions

press MARKER [OFF] or [INSTR PRESET] .

In remote operation, the analyzer will not TALK until the trace sweep stops at the marker. TALK is suspended by keeping the HP-IB Data Valid line not true until the marker is placed.

Continue Sweep from Marker

To start the sweep at the active marker it is first necessary to activate the stop-sweep-at-marker function above. Then

press [SHIFT] t.

Each time [SHIFT] t is pressed the sweep will start at the active marker, continue through a full sweep back to the same marker and stop.

Graticule and Annotation On/Off

The graticule and character readouts can be selectively blanked with key functions. This is valuable when alternative graphics are drawn on the CRT through the HP-IB.

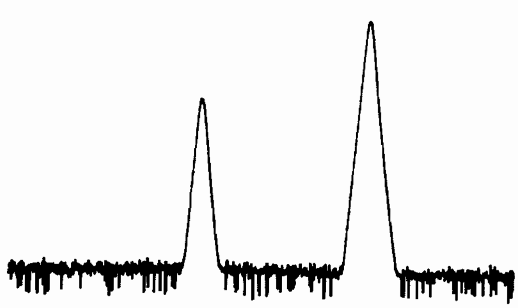
Graticule

Blank: press [SHIFT] m
On: press [SHIFT] n

Annotation

Blank: press [SHIFT] o
On: press [SHIFT] p

Display with annotation (characters) and graticule blanked.



Display blanking does not affect HP-IB input/output of instrument function values or trace information.

CRT Beam On/Off

The CRT beam power supply can be turned off to avoid unneccessary wear of the CRT if the analyzer is operated unattended. *Reducing intensity* or *blanking* the traces does *not* reduce wear.

Beam off: press SHIFT g

Beam on: press SHIFT h

CRT beam power off does not affect HP-IB input/output of instrument function values or trace information.

Display Correction Data and Special Messages

The correction data generated from the error correction routine, can be displayed.

Display correction data: press SHIFT w (lower case)

Do not display correction data: press INSTR PRESET

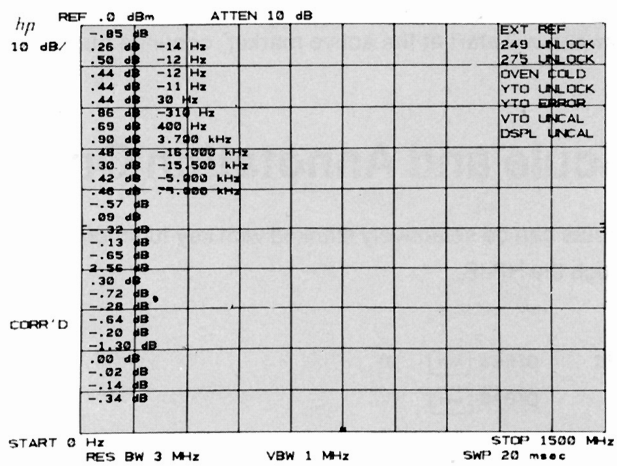
The readout is detailed on page 12.13.

The instrument operating special messages can be displayed by disrupting the analyzers operation.

Display warning messages: press SHIFT v (by inhibiting phase lock flag)

Do not display special messages: press INSTR PRESET

More on the meaning of these messages can be found in the 8568A Operating and Service Manual, Section VIII.



Both Correction Data and Special Messages Displayed

Title

The user can write a message in the top CRT display line. When the title is activated, the front panel blue characters, number keyboard numbers, decimal, backspace and space can be typed onto the top line starting at the left of the display. The full width of the display can be used, however, marker readout may interfere with the last 16 characters of the title.

Activate title: SHIFT E(shift light on)

Enter text: abcdefghijklmnopqrstuvwxyz

ABCDEFGHIJKLMNOPQRSTUVWXYZ

/#&=(),><

0123456789. [space]

To end a title: press NORMAL (shift light off)

A title will remain on the display until the title function is activated again, INSTR PRESET is pressed or an instrument state is recalled with RECALL .

To erase a title without changing the instrument state, end the title function if still active, then

press SHIFT E NORMAL

A + B → A

A + B → A enables the restoration of the original trace A after a A−B→A has been activated. A + B → A is executed with both Trace A and Trace B in VIEW:

press SHIFT c.

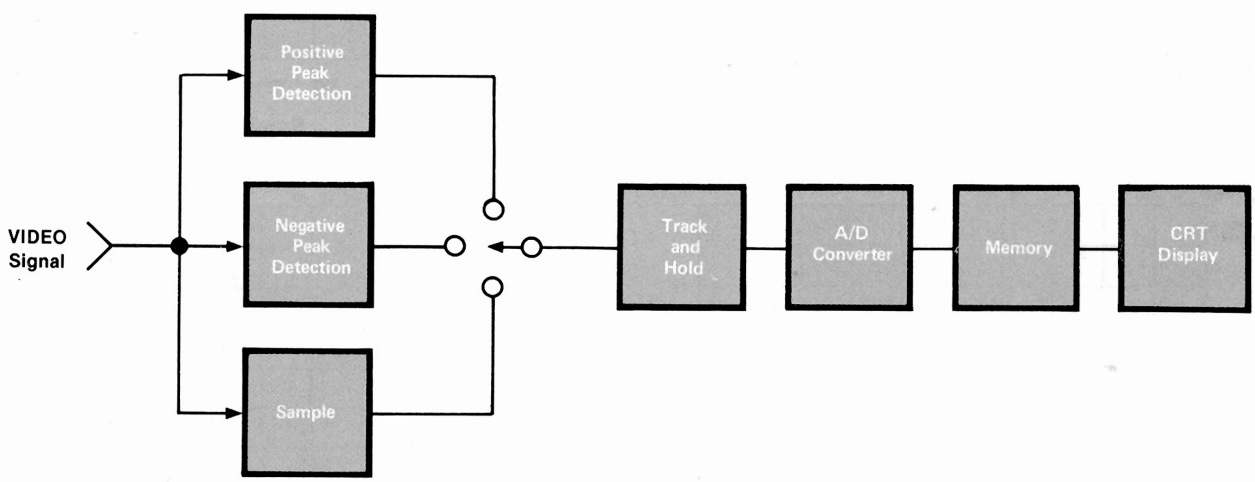
When executed, A−B→A is turned off and the amplitude in trace B is added to the amplitude in trace A (in display units) and the result is written into trace A.

Additional A + B → A executions will each add another trace B response to the cumulative trace A.

Trace Detection Modes

One of four detection techniques can be selected for displaying trace information.

Mode	Access	Use
normal	INSTR PRESET or SHIFT a	• Most measurements.
sample	SHIFT e	• Noise Level Measurements • Zero frequency span waveforms for sweeptimes ≥ 20 msec • Video averaging
positive peak **negative peak**	SHIFT b SHIFT d	• Diagnostic aids for servicing.



During a sweep, only a specified amount of time is available for writing data into each of the 1001 trace memory addresses. In two of these time periods, the positive and negative peak detectors obtain the maximum and minimum IF signal excursions, respectively, and store these values in *alternate* trace memory addresses. This technique allows a graphic presentation of noise on the CRT display.

Normal Mode

In normal mode a detection algorithm selectively chooses between the positive and negative peak values to be displayed. The choice is made dependent upon the type of VIDEO signal present.

Data from the positive peak detector (signal maximums) will always be displayed in the odd addressed trace memories (1,3, . . . 1001). If, within the time period following the storage of a value in an odd address memory, there is no change in VIDEO signal level, the positive peak detector value will also be stored in the even address. In other words, the even adressed memory will also contain positive peak detection data if the signal during that time period is monotonic. Negative peak detector data VIDEO signal minimum) will be stored in the even addressed trace memory if the signal has a point of inflection during the time period.

Normal mode is selected with instrument preset.

Sample Mode

In the sample mode, the *instantaneous* signal value of the final analog-to-digital conversion for the time period is placed in memory. (As sweeptime increases, many analog-to-digital conversions occur in each time period but only the final, single value can be stored.)

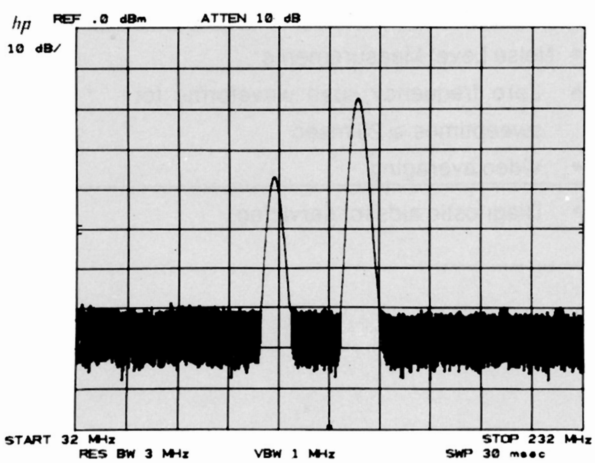
Sample mode is selected automatically for video averaging and noise level.

Positive and Negative Peak Modes

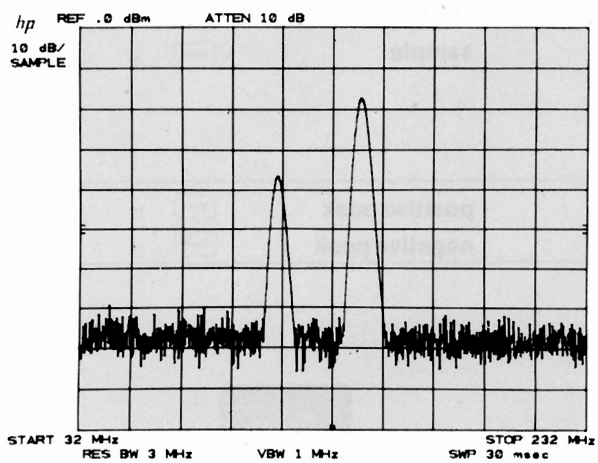
Positive and negative peak modes store signal maximums and minimums respectively, in all trace memories.

Readout

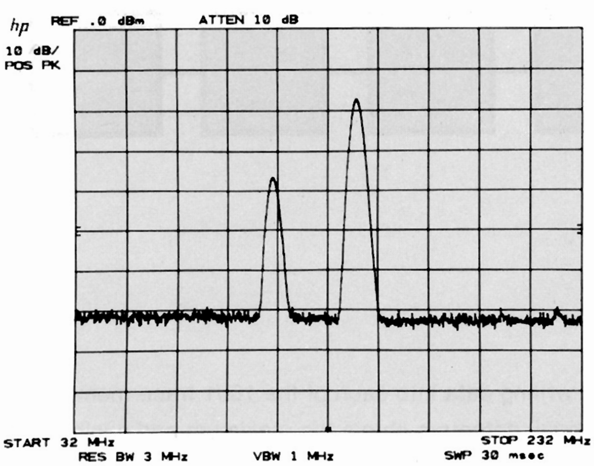
Here, the same signal response is displayed with each trace detection mode.



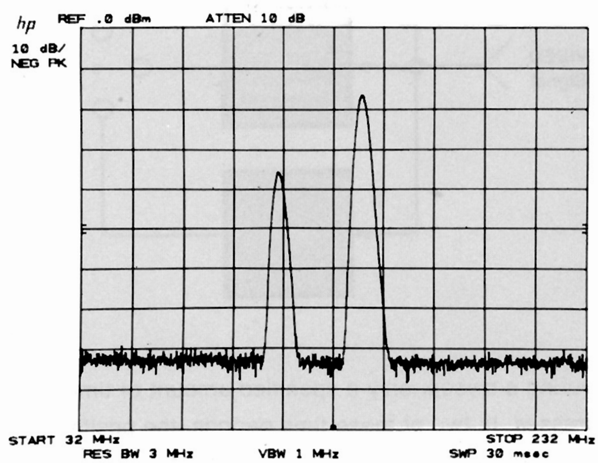
Normal



Sample



Positive Peak



Negative Peak

Trace C

A third trace memory is available for the storage and display of trace information. Only the storage modes (view and blank) can be used.

View C: [SHIFT] j

Blank C: [SHIFT] k

These are analogous to the TRACE A and B modes discussed in Chapter 6.

Trace C cannot be written into directly from the analyzer except when video averaging is used.

Trace information from B can be transferred to C. To transfer from TRACE B to TRACE C, use

B → C: [SHIFT] [B−DL →B]

The sweep will be suspended, the trace in memory B will be read and written into trace C from left to right in about 20 msec. Trace C is viewed. Sweeping will then resume from where suspended. The trace information in B is not changed.

To exchange traces B and C

B ⇄ C: [SHIFT] i

The trace information in B and C is interchanged point for point from left to right in about 20 msec. If TRACE B was blanked, it stays blanked. If trace C was blanked, it stays blanked.

To store TRACE A into trace C, the trace A data must first be transferred into trace B:

press [A⇄B] [SHIFT] l (which also erases last trace C)

or press [A⇄B] [SHIFT] i (which also saves last trace C in B)

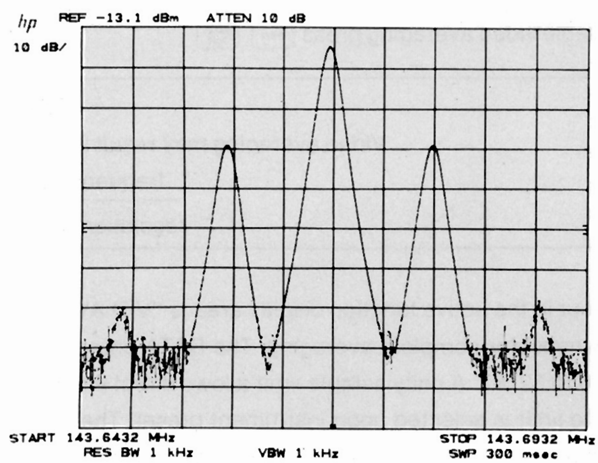
Example

Comparisons of up to three different signal traces can be made simultaneously using traces A, B and C. In this example, the modulation level of a signal will be changed for each trace. To start, clear the display with [BLANK] A, [BLANK] B and [SHIFT] k

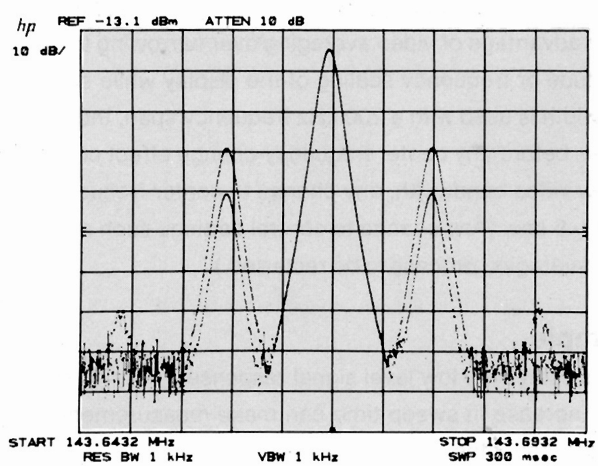
The signal with the desired level of modulation will be stored in trace C:

Press [CLEAR-WRITE] B and allow one sweep.

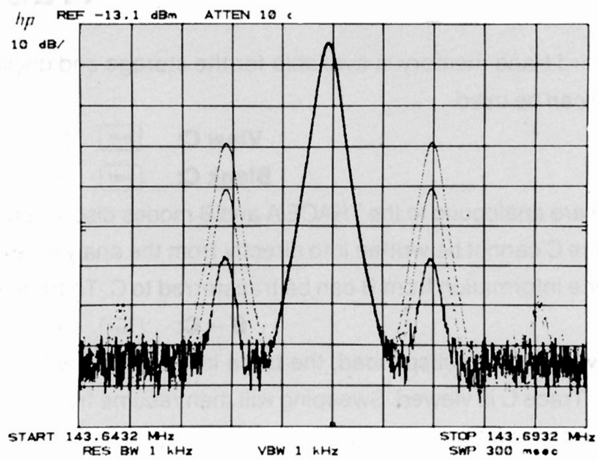
Press [SHIFT] l which writes the trace from B into C.



Change the modulation level, allow one sweep and store in B with [VIEW] B.



Change the modulation level again and store in A, press CLEAR-WRITE A, allow one sweep and press VIEW A. The three traces are differentiated by intensity.



Video Averaging

Video averaging is a trace display routine that averages trace responses from sweep to sweep without requiring a narrow video bandwidth. (Averaging with the video bandwidth is discussed in Chapter 9, COUPLED FUNCTION VIDEO BW .) Both video averaging and reducing video bandwidth are primarily used to improve the analyzer's ability to measure low level signals by smoothing the noise response.

To activate video averaging (and sample detection mode)

press SHIFT G (VIDEO BW) (DATA keyboard entry).

To disable video averaging press SHIFT H (SWEEP TIME)

> **CAUTION**
>
> Video averaging may result in an uncalibrated amplitude display when
>
> $$\frac{\text{frequency span}}{\text{resolution bandwidth}} > 1000$$

Readout in the active function display area is "VID AVG 100". The number represents the maximum number of samples (or sweeps) for complete averaging. The DATA entry can be used to change the maximum sample number in integers from 0 to 32767. A unity sample limit allows direct writing of analyzer response into Trace C (see Trace C below). A 100 sample limit is selected upon instrument preset. The higher the sample limit, the more smoothing possible. Averaging with high sample limits can provide more smoothing than the 1 Hz video bandwidth.

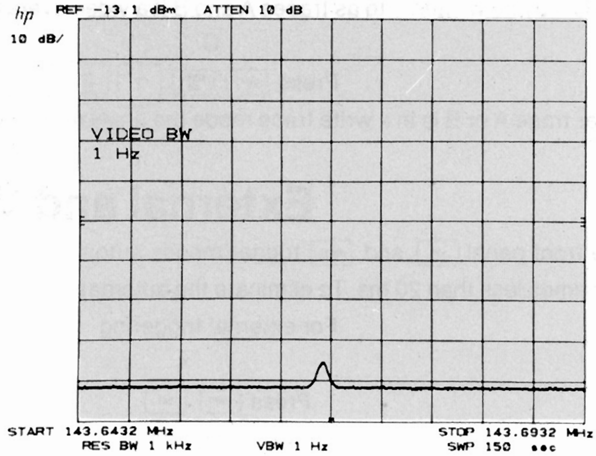
During video averaging the current sample being taken is read out at the left of the display.

The advantage of video averaging over narrowing the video filter is the ability of the user to see changes made to the amplitude or frequency scaling of the display while smoothing the noise response. For example, when a 100 Hz video bandwidth is used with a 200 kHz frequency span, the sweeptime is 2 sec. Almost a full sweeptime duration would have to pass before any center frequency change effect on the trace could be seen. If video averaging is used instead of the narrow video bandwidth, any change to center frequency will be seen immediately, even though full averaging will take roughly 6 sec. (Any change to control settings such as CENTER FREQUENCY, FREQUENCY SPAN, etc., will cause the video averaging process to be restarted.)

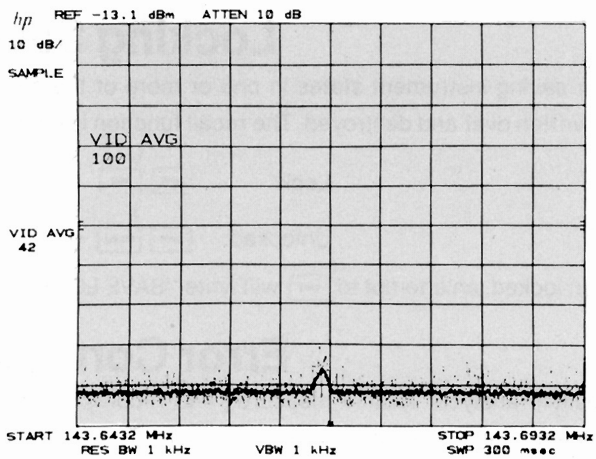
Example

To display very low level signal responses, very narrow resolution and video bandwidths are required. The accompanying increase in sweep time can make measurements cumbersome. Video averaging allows the display of low level signals without the long sweep time.

Viewing a low level signal with a video bandwidth of 1 Hz requires a 150 second sweep.



Take out the narrow resolution and video filters with video bandwidth [AUTO] and start video averaging, press [SHIFT] G [VIDEO].



Now the low level signals begin to show quickly. Changes to the frequency range or amplitude scale will restart the sampling to show the signals quickly, without having to wait 150 seconds. In fact, the video averaging shown took 42 x 300 ms = 12.6 sec., plus the internal computation time, 42 x 100 ms = 4.2 sec., for a total of 16.8 sec.

Video Averaging Algorithm

The averaging of *each* amplitude point depends upon the number of samples already taken and last average amplitude.

$$\overline{y_n} = \frac{n-1}{n} \times \overline{y_{n-1}} + \frac{1}{n} y_n$$

where

$\overline{y_n}$	latest average amplitude value in display units
n	current sample number
$\overline{y_{n-1}}$	last average amplitude in trace memory (TRACE A or B)
y_n	new amplitude entry from analyzer (Trace C)

The new amplitude value, $\overline{y_n}$ is weighted more heavily by the last average amplitude $\overline{y_{n-1}}$ than the new amplitude entry, y_n.

When n equals the limit set (e.g. 100, the preset limit), the last average amplitude is gradually replaced with new data. Thus, the average will follow a slowly changing signal response, particularly if the sample limit is small.

Trace C

Video averaging requires the use of trace memory C. When video averaging is activated, the input signal response is written into trace C, the averaging algorithm is applied to these amplitudes and the results written into TRACE A. Thus two traces are displayed, the input signal in C and the averaged signal in A.

Trace C may be blanked without affecting the operation of video averaging.

Press [SHIFT] k

Trace C may be written into as traces A and B if a video average sample limit of one is selected.

G
Press [SHIFT] [VIDEO BW] [1] [Hz µV µsec]

If either trace A or B is in a write trace mode the analyzer response will also be written into trace C.

External and Video Trigger

The front panel [EXT] and [VIDEO] trigger modes automatically keep the display refreshed in zero frequency spans for sweeptimes less than 20 ms. To eliminate the automatic refresh feature:

For external triggering

X
Press [SHIFT] [EXT]

For video triggering

y
Press [SHIFT] [VIDEO]

Locking Save Registers

After saving instrument states in one or more of the six registers, 1 through 6, the registers can be secured from being written over and destroyed. The recall function is not affected.

Lock: [SHIFT] [SAVE] (

Unlocked: [SHIFT] [RECALL]) or [INSTR PRESET]

When locked, an attempt to [SAVE] will write "SAVE LOCKED" on the CRT and no DATA entry can be made.

Error Correction Routine

A built-in analyzer routine measures and records the amplitude and frequency error factors due to a number of parameters, then corrects the display for them. The routine takes about 1½ minutes to run. When complete, instrument preset will be called and the correction factors applied.

Connect CAL OUT to SIGNAL INPUT 2.

Execute the routine: [SHIFT] W

Use Correction factors: [SHIFT] X

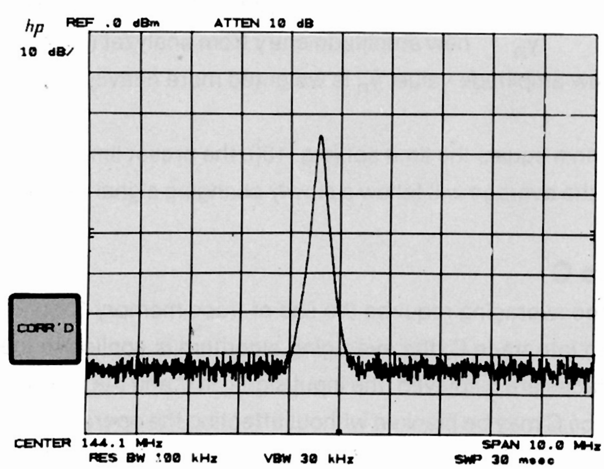
Do not use correction factors: [SHIFT] Y

Display correction factors: [SHIFT] w

If "ADJUST FREQ ZERO" appears on the CRT, manual calibration adjustment is necessary before the routine can be successfully run. See Chapter 1 for the manual calibration procedure.

The correction factors are saved using an internal battery supply for about a 30 day period after line power failure. If the battery supply should be exhausted, all the values will be set to zero.

Indicates that the routine has been run and the display is corrected.



Correction can be turned on or off using [SHIFT] X and [SHIFT] Z after the routine has been successfully completed. Display of the correction factors is discussed on page 12.7.

For more information on accuracy, see the 8568A Spectrum Analyzer Data Sheet.

The readout of the correction factors is as follows:

Line (top to bottom)	Parameter	Correction Values Displayed
1	LOG and LIN scale, BW <100 kHz	Amplitude
2	RES BW = 10 Hz	Both
3	30 Hz	
4	100 Hz	Amplitude (dB)
5	300 Hz	and
6	1 kHz	Frequency (Hz)
7	3 kHz	
8	10 kHz	
9	30 kHz	
10	100 kHz	
11	300 kHz	
12	1 MHz	
13	3 MHz	
14	LOG and LIN scale, BW ≥ 100 kHz	
15	2nd local oscillator frequency shift	
16	30 dB gain (LIN operation only)	
17	20 dB gain (LIN operation only)	
18	10 dB gain (LIN operation only)	
19	50 dB step gain errors	
20	40 dB	
21	30 dB	Amplitude
22	20 dB	
23	10 dB	
24	0 dB	
25	−10 dB	
26	−20 dB	
27	offset error 2 dB/ LOG	
28	offset error 5 dB/ LOG	
29	offset error 10 dB/ LOG	

[SHIFT] FUNCTION Index

All the shift functions are listed below. (DATA) indicates the functions that use a number and unit entry.

	CODE	DISABLE CODE OR KEY	PAGE
GENERAL			
Display Address (DATA)	z		*
Display Write (DATA)	|		*
HP-IB service request	r		*
HP-IB address (DATA)	P		*
Power on in last state	f		11.3
Max. mixer input level	,		12.4
FREQUENCY AND AMPLITUDE			
Amplitude offset	Z		12.3
Amplitude units selection			
dBm	A		12.5
dBmV	B		12.5
dBμV	C		12.5
voltage	D		12.5
Extended reference level range (DATA)	I		12.5
Frequency offset (DATA)	V		12.3
Input mixer level	,		
Negative entry (DATA)	–		12.3
Preamp gain, Input 1 (DATA)	<		12.4
Preamp gain, Input 2(DATA)	>		12.4
MARKER			
Counter resolution (DATA)	=	=	12.5
Continue sweep from marker	t	MARKER [OFF]	12.6
Enter Δ→ Span	O		7.10
Noise Level on	M		7.16
Noise Level off	L		7.16
Stop single sweep at marker, TALK after marker	u	MARKER [OFF]	12.6
DISPLAY			
Annotation blanked	o		12.6
Annotation on	p		12.6
CRT beam off	g		12.7
CRT beam on	h		12.7
Display correction data	w		12.7
Frequency diagnostic on	R		*
Graticule blanked	m		12.6
Graticule on	n		12.6
Title	E	[NORMAL]	12.7
TRACE			
A + B → A	c		12.8
Detection Modes:			
normal	a		12.8
positive peak	b		12.8
negative peak	d		12.8
sample	e		12.8
Trace C			
blank C	k		12.10
B ⇄ C	i		12.10
B → C	l		12.10
view C	j		12.10
Video averaging on	G		12.11
Video averaging off	H		12.11
TRIGGER, ZERO SPAN, SWEEP < 20 msec			
[EXT] without 25 msec trigger	x	[EXT]	12.13
[VIDEO] without 25 msec trigger	y	[VIDEO]	12.13
INSTRUMENT STATE			
Save Registers locked	(		12.13
Save Registers unlocked	)		12.13
ERROR CORRECTION			
Execute Routine	W		12.13
Use data (display corrected)	X		12.13
Do not use data (display not corrected)	Y		12.13
Display correction data on CRT	w		12.13

DIAGNOSTIC AIDS

To aid in servicing the spectrum analyzer, there are a number of diagnostic shift functions. These functions are listed here, their operation and use is covered in the 8568A Operating and Service Manual, Section VIII.

	CODE
Count pilot IF at marker	K
Count signal IF at marker	Q
Count VTO at marker	N
Frequency diagnostic on	R
Inhibit phase lock flags	v
Disable step gain	q
Manual DACS control	J
Scan time measure	F
Second LO auto	S
Second LO shift down	T
Second LO shift up	U

*See 8568A Spectrum Analyzer Remote Operation, HP part number 08568-90003.

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For more information, call your local HP Sales Office or East (301) 948-6370 • Midwest (312) 255-9800 • South (404) 955-1500 • West (213) 877-1282. Or, write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94304. In Europe, Post Office Box, CH-1217 Meyrin 2, Geneva, Switzerland. In Japan, Yokogawa-Hewlett-Packard, 1-59-1, Yoyogi, Shibuya-Ku, Tokyo, 151.

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8568A Spectrum Analyzer Remote Operation

DESIGNED FOR HP-IB SYSTEMS

HEWLETT PACKARD

8568A Spectrum Analyzer Remote Operation

AUGUST 1978

HEWLETT PACKARD

1400 Fountain Grove Parkway
Santa Rosa, California, U.S.A.

Printed in U.S.A.
08568-90003

CHAPTERS

CONTENTS

Appendices **Page**

Chapter 1

INTRODUCTION TO REMOTE OPERATION

This chapter discusses the requirements for remote operation of the spectrum analyzer using an HP-IB* computing controller.

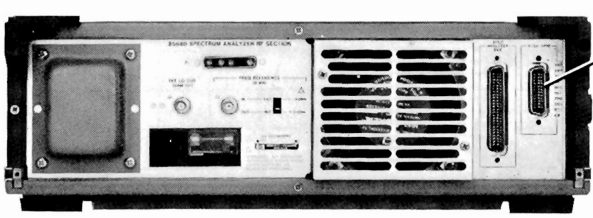
General Description

The standard HP 8568A Spectrum Analyzer is equipped for HP-IB operation. HP-IB hardware includes the HP-IB interface card and the rear panel HP-IB connector. An HP-IB interconnection cable is required to connect the analyzer to the controller HP-IB interface. Programming codes are summarized on the lower pullout information card and in a foldout inside the back cover of this manual. A more detailed syntax summary can be found in Appendix C.

HP 8568A Spectrum Analyzer

HP-IB Interconnection Cable, (supplied with the HP Controller HP-IB interface option)

INFORMATION Cards with Programing Codes



HP-IB Connector (A13J1)

RF Section Rear Panel

* Hewlett Packard Interface Bus, the Hewlett-Packard implementation of instrument interface standard IEEE Std. 488-1975 and ANSI Std. MC1.1, ''Digital interface for programmable instrumentation''

Remote Operation Overview

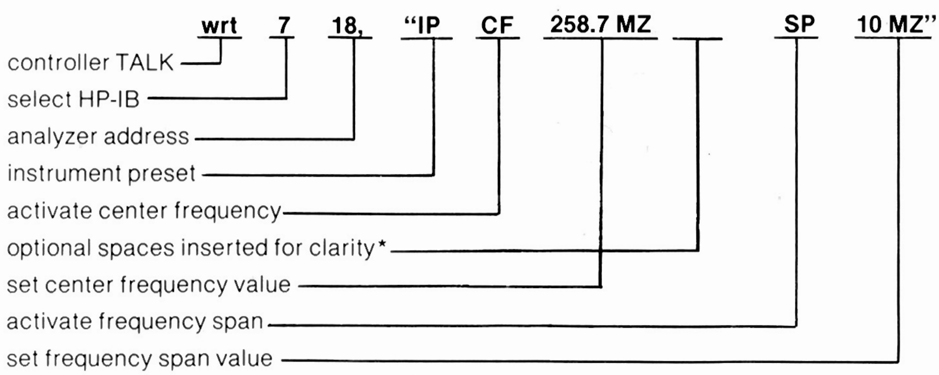
The standard 8568A Spectrum Analyzer with an HP-IB controller allows:

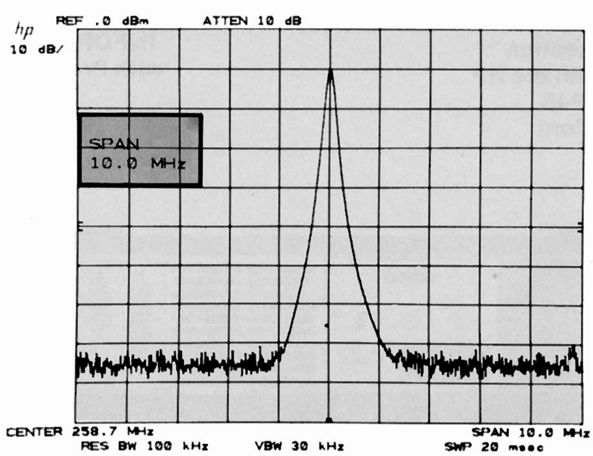
- **Remote operation of the analyzer's front panel functions, including the shift key functions. See Chapter 2.**
- **Output of any analyzer function value or trace amplitude. See Chapter 3.**
- **Input of special CRT display labels and graphics. See Chapter 4.**
- **Interrupt of controller for service or data transfer. See Chapter 5.**

The following illustrate these programming modes:

Change Front Panel Functions

To set the center frequency to 258.7 MHz and the span to 10 MHz with the HP 9825A Computing Controller:

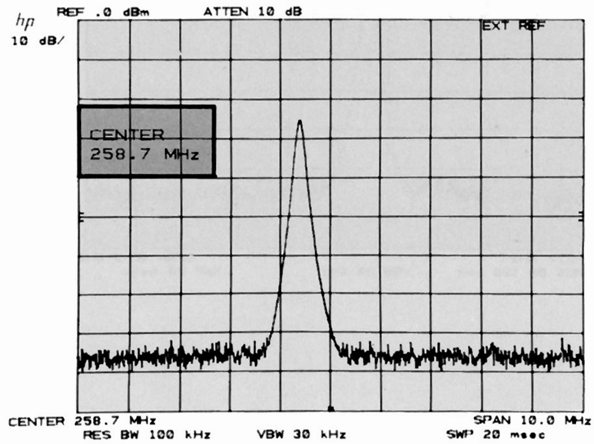




* The spaces' omission will not affect the program.

Output Value or Amplitude

To output the center frequency into controller variable F and display F, first activate center frequency, then execute



wrt 718, "OA"

- "OA" — output active parameter

red 7 18, F; dsp "center frequency = ", F

- red — controller LISTEN
- 7 — select HP-IB
- 18, — analyzer address
- F; — store frequency (Hz) in F
- dsp — display F on desktop controller

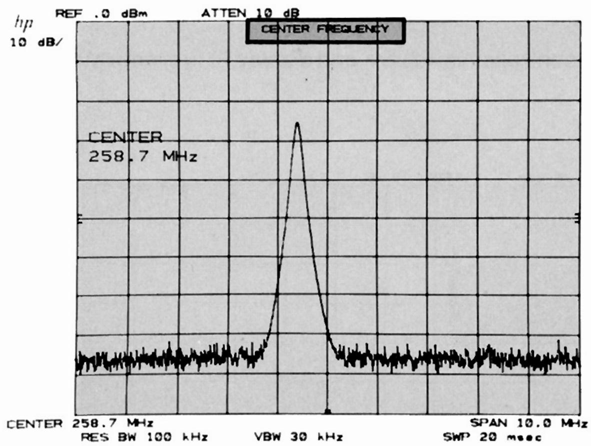
9825 Display reads "center frequency = 258700000.00".

Input CRT Labels and Graphics

To write "Center Frequency" in the top center of the graticule area:

wrt 718, "EM PU PA 448 , 928 LB CENTER FREQUENCY"; wtb 718,3

- "EM — clears trace C memory
- PU — Pen up
- PA — Plot absolute vector to:
- 448 — x position
- , — required delimiter
- 928 — y position
- LB — The following ASCII characters are a label
- CENTER FREQUENCY"; — Text
- wtb 718,3 — Label terminator



HP-IB Controller

Any HP-IB compatible controller can be used to operate the 8568A. The overall system measurement speed and capability depends, to a large extent, on the computing, storage and interrupt capabilities of the controller.

The HP 9825A and HP 9830A/B Desktop Computers are used as the computing controllers in this manual.

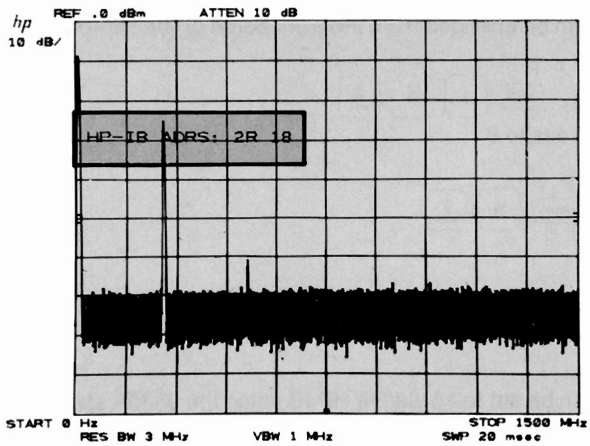
The following summarizes the required accessories for three computing controllers:

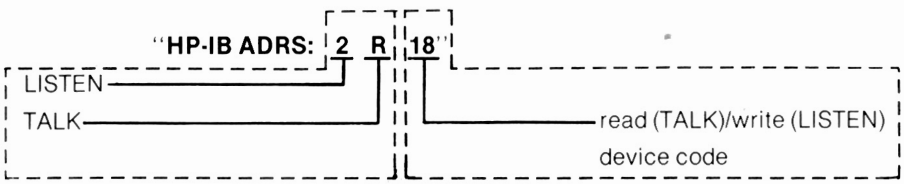
Computing Controller	Required HP-IB Interface	Required ROM Modules	Suggested ROM Modules	Language
9825A	98034A	GENERAL I/O	EXTENDED I/O	HPL
9830A		GENERAL I/O		
9830B	59405A	EXTENDED I/O		BASIC

The HP 8581A Automatic Spectrum Analyzer is an 8568A/9825A based system which includes a HP 9866B Printer, HP 98034A HP-IB Interface Card, computer cradle, system table, sample software programs and all the required accessories.

Addressing the Spectrum Analyzer

Communications between instruments on the HP-IB requires that addresses be assigned. The analyzer's address appears on the CRT display when the LINE power is turned from STANDBY to ON.





Address Readout

Two formats are available for addressing an HP-IB instrument or device. One command format uses separate addresses for TALKING ("R") and LISTEN ("2"). The other uses only a device code ("18") to designate the recipient of the command. The latter format is used when the controller is the HP 9825A Computing Controller with the general I/O ROM.

Examples*

wrt 7 18, "<analyzer command>"
- 18 — 8568A device code, LISTEN
- 7 — HP-IB I/O Select code
- wrt — 9825A TALK

red 7 18, <controller variable>
- 18 — 8568A device code, TALK
- 7 — HP-IB I/O Select code
- red — 9825A LISTEN

CMD "? U 2", "<analyzer command>"
- 2 — 8568A LISTEN
- U — Controller TALK
- ? — unaddress all listeners (UNLISTEN)

CMD "? R 5", <controller variable>
- 5 — Controller LISTEN
- R — 8568A TALK
- ? — unaddress all listeners (UNLISTEN)

* In all examples, the preset addresses of the HP computing controllers are used:
9830A-9830B TALK "U"; LISTEN "5"; DEVICE CODE "21"
9825A HP-IB SELECT CODE "7"

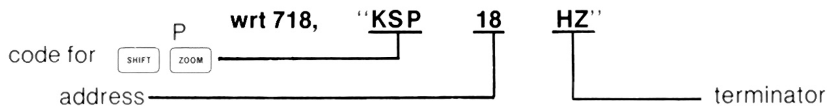
The read/write address of the 8568A can be changed from the front panel or the HP-IB by using the shift function P.

Pressing [SHIFT] [ZOOM] (P) [1] [8] [Hz µV µsec]

sets the address to 18. To set the address to 8

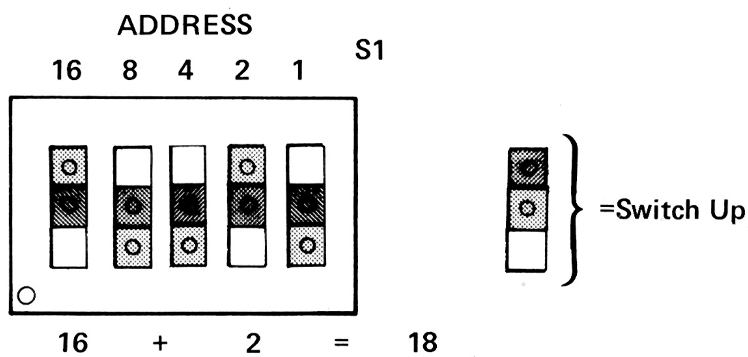
press [SHIFT] [ZOOM] (P) [8] [Hz µV µsec]

From the controller, the address can be set to 18 via the HP-IB using the 9825A statement



The switch on the analyzer's HP-IB interface card (switch S1 of A13) is used to determine what address will be used on line power on. The address is set as the sum of the numbers switched. For example, for the address 18, the 16 and 2 switches are pressed up and all others down.

The switch address 31 is a special code which commands the analyzer to use the last input address (whether from HP-IB or the front panel) upon line power on. If the address is lost*, the default address of 18 will be used.



HP-IB Address Switch on the Interface Card

(8568A Operating and Service Manual, Section II describes the procedure for accessing the address switch.)

* The input address is stored in the analyzer's CMOS memory, which can remember for approximately 30 days with all line power disconnected.

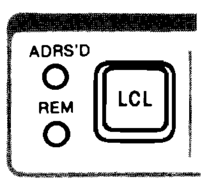
Setting the read/write address also sets the TALK/LISTEN ADDRESS. The following table lists the various combinations.

TALK	LISTEN	GENERAL ADDRESS
@	SP	00
A	!	01
B	"	02
C	#	03
D	$	04
E	%	05
F	&	06
G	'	07
H	(	08
I	)	09
J	*	10
K	+	11
L	,	12
M	–	13
N	.	14
O	/	15

TALK	LISTEN	GENERAL ADDRESS
P	0	16
Q	1	17
R	2	18
S	3	19
T	4	20
U	5	21
V	6	22
W	7	23
X	8	24
Y	9	25
Z	:	26
[	;	27
\	<	28
]	=	29
∧ or ⌢	>	30
Use last entered address at future power ON (set at factory)		31

Remote/Local Operation

If the controller has addressed the analyzer to TALK or LISTEN, the ADRS'D light will be on. When the analyzer is addressed with an HP-IB device command, the analyzer will go to remote, and the REM light will also go on.



Remote operation generally prevents front panel control of the analyzer except by those functions not programmable: LINE power, calibration and display adjustments, video trigger vernier and (LCL). See Chapter 2.

Return to front panel, or local control by

pressing (LCL)

or executing a local device command from the controller such as

lcl 718

CAUTION

An operating HP-IB may be disrupted if the analyzer's LINE power is cycled. An analyzer should be connected to an **operating** HP-IB only with POWER ON.

Similar HP-IB disruption may result from pressing (LCL) when the HP-IB is active, thus a local lockout is recommended during 8568A automatic operation.

Analyzer Response to HP-IB System and Device Commands

HP-IB **system** commands effect all the instruments on the bus. HP-IB **device** commands affect only the device addressed. The spectrum analyzer response to each of the system and device commands is summarized on the next page. The following addresses are used:

	GENERAL ADDRESS	TALK	LISTEN
ANALYZER TALK/LISTEN ADDRESS	18	R	2
9830A/B ADDRESS	21	U	5

OUTPUT COMMANDS

HP-IB Message	Specific Controller Statements		Analyzer Response
	9825A	9830A	
Data Transfer	1:wrt 718,"<command>"*	10 CMD"?U2","<command>"	<listen> <go to remote> executes command
System Trigger	<listen>,<go to remote> 1:trg 7	<listen>,<go to remote> 10 CMD "U" 20 FORMAT 3B 30 OUTPUT (13,20)256,8,512	<go to remote>, new sweep triggered
Device Trigger	1:trg 718	10 CMD "?U2" 20 FORMAT 3B 30 OUTPUT (13,20)256,8,512	
System Clear	<go to remote> 1:clr 7	<go to remote> 10 CMD "?U" 20 FORMAT 3B 30 OUTPUT(13,20)256,20,512	<instrument preset>
Device Clear**	1:clr 718	10 CMD "?U2" 20 FORMAT 3B 30 OUTPUT (13,20)256,4,512	<go to remote> <instrument preset>
System Remote Enable	1:rem 7	10 CMD "?U" 20 FORMAT B 30 OUTPUT (13,20)768	allows <go to remote> by setting HP-IB REN line true
Device Remote	1:rem 718	10 CMD "?U2" 20 FORMAT B 30 OUTPUT(13,20)768 40 CMD "2"	sets REN Line true <go to remote>
System Local	1:lcl 7	10 CMD "?U" 20 FORMAT B 30 OUTPUT(13,20)1024	<remote disabled> REN false, <go to local>
Device Local	1:lcl 718	10 CMD "?U2" 20 FORMAT 3B 30 OUTPUT(13,20)256,1,512	<go to local>
System Local Lockout	<remote enabled> <addressed> 1:llo 7	10 CMD "?U2" 20 FORMAT 3B 30 OUTPUT(13,20)256,17,512	no response to [LCL]
Clear Local Lockout and Set Local	1:lcl 7; rem 7 or press [RESET]	10 CMD "?U2" 20 FORMAT 2B 30 OUTPUT(13,20)1024,768	response to [LCL]
Abort	1:cli 7	Press (STOP) (will not go to local)	<unaddress> but if in local, will remain in local
Read Status Byte	1:rds (7)→A	10 CMD "2U" 20 FORMAT 5B 30 OUTPUT(13,20)256,95,53, 24,512; 40 CMD "R" 50 A = R BYTE 13 60 CMD "?U" 70 FORMAT 3B 80 OUTPUT(13,70)256,25,512;	See Chapter 5, Interrupt and Service Request Capability

* < > indicates an analyzer or controller executed command.

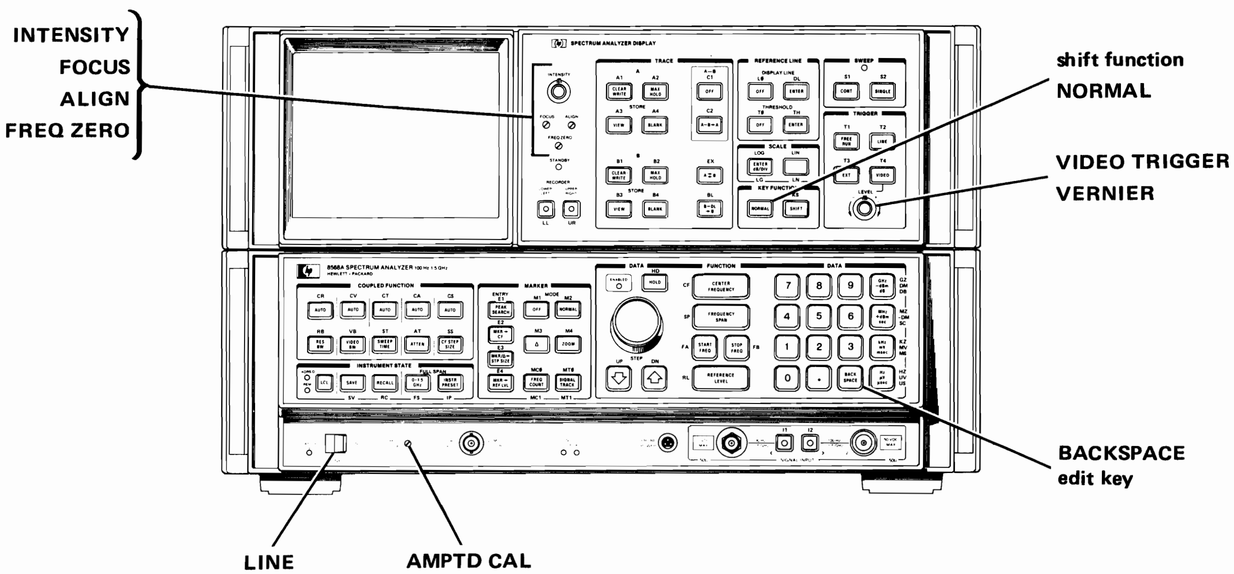
** A device clear can command an instrument preset even if the analyzer is locked in an unexecutable command sequence.

Chapter 2

HP-IB OPERATION OF FRONT PANEL CONTROLS

This chapter describes remote operation of the front panel controls, including the shift functions.

Since most of the controls can be remotely programmed by a controller, it is simpler to describe the controls **not** programmable.



Controls **Not Directly** Programmable

A full listing of those controls that can be remotely operated by a controller can be found with the instrument front panel drawing inside the rear cover.

Front Panel Control Commands

The analyzer responds to a remote front panel command the same way it does to a front panel command. In other words, the analyzer will behave the same whether the control changes come from the system controller with the analyzer in (remote) or the operator (with the analyzer in local).

PROGRAMMING HINT

When writing a program for operation of the analyzer's front panel controls, manually follow the measurement procedure and note the individual steps taken. The same chronological order of these steps can then be used to form the basis of the controller program.

Controller commands follow the same sequence as in manual operation:

1. activate function
2. change function value, if appropriate, with a data entry (including a terminator)

Functions are activated by a two or three character "function code"*. A data entry consists of numbers terminated with a units code. For example, to set the frequency span to 125.3 MHz

wrt 718, "SP 125.3 MZ"

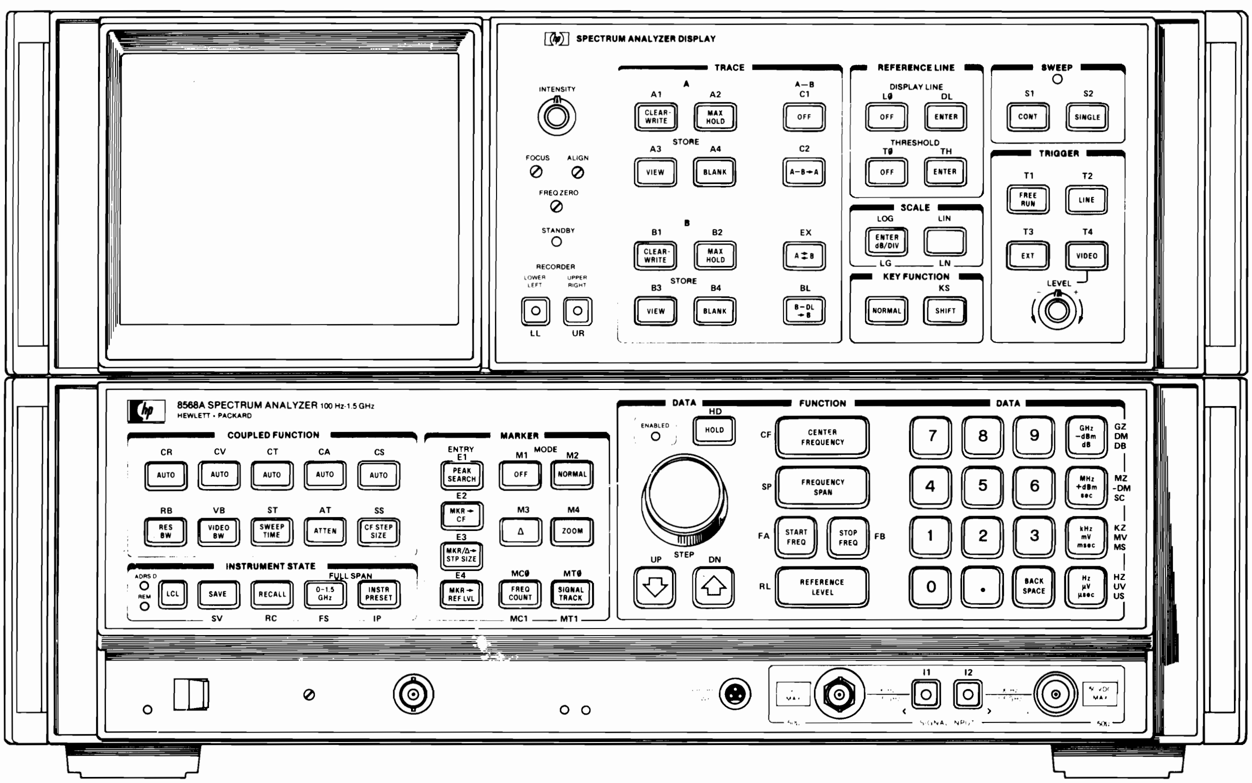
- HP-IB Data Command — **wrt 718,**
- frequency span function code — **SP**
- data value — **125.3**
- entry terminated with MHz unit code — **MZ**

When the line is executed the analyzer responds to MZ just as it would to pressing [MHz -dBm sec] on the front panel.

Function Codes

A front panel function is activated by a two or three character code*. This code generally abbreviates the function name. For example, center frequency CF, reference level RL, and instrument preset IP. Some keys grouped together are numbered by location, such as the marker modes M1, M2, M3 and M4.

A complete summary is in a fold out inside the rear cover. This summary includes the preset conditions with instrument preset, [INSTR PRESET] or IP.



Front Panel Codes
(also see foldout inside rear cover)

* ASCII letters, numbers and symbols.

[SHIFT] KEY FUNCTION Codes

Programming a shift function requires a code sequence similar to the manual procedure for activating a shift function, that is, press [SHIFT], then press the key with the function's code (the front panel blue character).

For example, to select the video averaging shift function, blue code G, execute

```
                                 wrt 718,   "KS   G"
HP-IB Data Command ─────────────────┘         │     │
activates shift ──────────────────────────────┘     │
activates video averaging ──────────────────────────┘
```

About half of the shift key function codes require ASCII lower case letters or symbols.

> **NOTE**
>
> Some controller keyboards do not offer lower case ASCII codes directly. For example, the HP 9830A Computing Controller keyboard outputs the ASCII upper case letters when unshifted. But when shifted the output letters are lower case, even though the 9830A display and companion HP 9866A Printer only show capital letters. To activate the shift function m, graticule off
>
> press 9830A (K) (S) (SHIFT) (M)
>
> The statement line appears as:
>
> 10 CMD "?UR", "KSM"
>
> The code to the analyzer will be sent as KSm. (KSn will turn the graticule on again.)

Data Entry

A data entry through the HP-IB must meet the same requirements as a front panel DATA entry, that is, it must have a number (value) and a message that terminates the entry, signaling the analyzer to assign the function value.

Number

The number code within the quote field must be a string of (ASCII) decimal numbers plus an optional decimal point. It may be preceded by a minus or plus sign. If the decimal is not included in the entry, it will be assumed at the end of the number. Either fixed or floating point notation may be used to make number entries. For example, the entries "12.3E6", "12.3e6" and "12300000" each will enter the same number. Caution should be exercised when using the "E" exponent format, since several marker command mnemonics also begin with E.

The number of significant digits accepted and stored by the analyzer is dependent upon which function is active. For example, an entry of 10 significant digits to center frequency will be stored in the analyzer's center frequency register.

If no number is entered, a "1" will be assumed.

Numbers as Variables

A data entry can be a controller variable as long as the format and individual controller statement syntax rules are followed.

For example, this program changes the center frequency in 100 MHz steps from 100 MHz to 1200 MHz:

```
0: fmt 1,f.0,c,z
1: for F=100 to 1200 by 100
2: wrt 718.1,"CF",F,"MZ";wait 2000  ◄── wait statement is for
3: next F                                viewing convenience
```

The variable F substitutes for the data entry number. The format "f.0,c,z" ensures that all digits of the variable F will be output from the controller with the leading spaces suppressed and no CR/LF's to prematurely terminate the entry. See FORMAT PRECAUTIONS below.

Terminating the Data Entry

The units code is the most common data entry terminator. It sets the value units and enters the function value.

Frequency	Code	Power	Code	Voltage	Code	Time	Code
Hz	HZ	dBm	DM	mV	MV	sec	SC
kHz	KZ	– dBm	– DM*	μV	UV	msec	MS
MHz	MZ					μsec	US
GHz	GZ	dB	DB				

Unit Codes

Other ASCII codes than the units codes can be used to terminate a data entry.

symbol	name	decimal equivalent (ASCII)
,	comma	44
CR	carriage return	13
LF	line feed	10
;	semi colon	59
ETX	end of text	3

ASCII Codes Which Terminate a Numeric Data Entry

These non-unit code terminators originate in the controller's language.

A terminated entry without a units code defaults to the fundamental units for the function activated. The default units of power depend upon the amplitude readout units selected.

Frequency	Hz
Power	± dBm, dBmV, dBμV or dB
Voltage	Volts
Time	seconds

Default Units

For example,

wrt 718, "CF 1200" < CR/LF > * *

results in setting the center frequency to 1200 Hz.

* Either " – 10.0 DM", "10.0 – DM", or – 10.0 – DM" results in a negative entry.

** Execution of the HP 9825A Computing Controller wrt statement calls for a CR/LF as shown. < > indicates a transmitted message that does not appear as program text.

wrt 718, "KSB RL30" < CR/LF >

The reference level will be set to + 30 dBmV since those are the amplitude units selected by the code KSB.

If the unit used as a terminator is not correct for the activated function, the analyzer will select the unit that fits from the chosen unit's group. Unit groups are those written on the DATA keyboard's units keys.

GHz	MHz	kHz	Hz
+ dBm	− dBm	mV	μV
dB	sec	msec	μsec

Unit Groups

For example,

wrt 718, "RL 22 DB"

will enter + 22 dBm to the reference level.

FORMAT PRECAUTIONS

The controller's numeric **output** to the analyzer must be formatted such that the values are

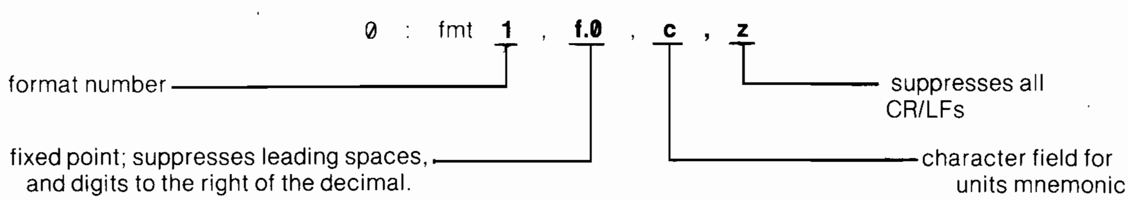
1) not truncated;
2) not terminated by a CR/LF before the units code can be transferred.

Either fixed or floating point formats can be used, although the above conditions are more readily met in fixed point.

Generally the free field formats for computing controllers are sufficient to meet these requirements. However, it is best to retain explicit control of the controller format.

Format is one of the first items to check in a program which locks up the HP-IB or results in erroneous answers. Programs **without** explicit format statements may run or may not run, depending upon the controller's last format condition.

The free field format of the 9825A Computing Controller (equivalent to an output format of 4f18.4) will be sufficient for most single front panel commands. However when four or more commands are issued on one line, the fourth number will be terminated by a CR/LF prior to the units transfer. A better format is



Example:

```
0: fmt 1,f.0,c,z
1: wrt 718.1,"CF",100,"MZSP",200,"KZRB",100,"KZRL",-20,"DM"
```

Line 1: format 1 is referenced in the write select code 718.**1**.

Note that reads (where data is input to the controller) are best transferred in the free field format. This is not the same format as for write. See 9825A General I/O Manual, page 8.

DATA STEPS ⇩, ⇧ Commands

The DATA step key's codes are

⇩ DN step down

⇧ UP step up

These codes can be used in programming just as the step keys are used for front panel data entry.

One useful application of the step key codes is for changing the values in a sequence, such as for center frequency step and frequency span.

For example, to decrease the resolution bandwidth by a factor of 100, four down steps are required (the resolution bandwidth sequence is 1,3,10).

In this example, the step command is used to change the center frequency by a preset step size:

wrt 718, "SS 150 MZ"	set CF step size to 150 MHz
wrt 718, "CF UP UP"	activates center frequency and increases center frequency by 2 steps of 150 MHz

DATA Knob Enable EK

The DATA knob can be activated for use from the front panel allowing the operator to select a specific value while under program control.

The code for activating the DATA knob

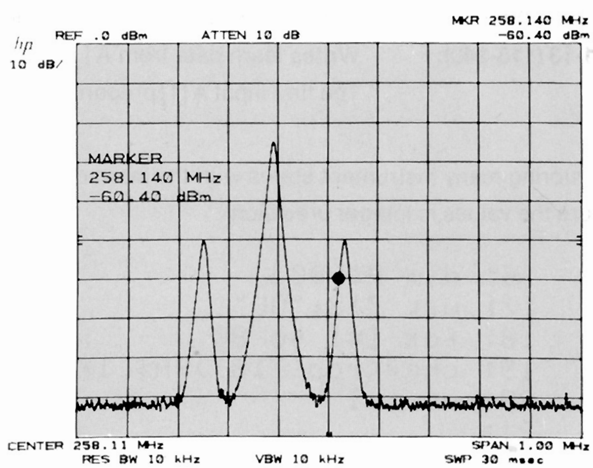
◎ EK enable knob

For example, if the operator is required to set a marker on a signal response for further analysis by the controller, the following statement can be used:

wrt 718, "M2 EK" ; stp

- "M2" — activates single marker (NORMAL mode)
- EK — enable DATA knob
- stp — stops the program

At execution of this program line the operator moves the marker to the signal with ◎ , then continues the program with the 9825A CONTINUE



Only the DATA knob is enabled upon "EK". The other DATA controls and function keys are disabled. Enabled light is on.

DATA Keyboard Enable EE

Entry of data from the keyboard to the controller is possible with the use of the enable entry command "EE". A complete discussion of "EE" is in Chapter 3, Output Commands.

Learn Mode OL

The analyzer is able to output the current instrument state*, 80 bytes, through the HP-IB into controller memory. The controller can reestablish the instrument state by reading the 80 byte "learn string" back into the analyzer. The process is analogous to the front panel [SAVE] and [RECALL].

The command for the learn mode is:

OL output learn bytes

The learn mode requires:

1. uninterrupted transfer of all 80 bytes
2. controller ability to transfer 8 bit binary bytes (wtb and rdb statements in 9825A)

The most convenient form of controller memory for storage and recall of the learn bytes is an array.

To store and recall a single instrument state in an array such as A [ ]:

```
0:
1: dim A[80]
2: wrt 718,"OL"
3: for N=1 to 80
4: rdb(718)→A[N]
5: next N
6: }
7: }  instrument
8: }  state changed
9: }
10:}
11: for N=1 to 80
12: wtb 718,A[N]
13: next N
```

```
10 DIM B[80]
20 FORMAT B
50 CMD "?U2","OL"
60 CMD "?R5"
70 FOR I=1 TO 80
80 B[I]=RBYTE13
90 NEXT I
100 CMD "?U2","IPTS"
110 ←——— instrument state changed
115 CMD "?U2"
120 FOR I=1 TO 80
130 OUTPUT (13,20)WBYTEB[I];
140 NEXT I
150 END
```

Note that the array A [ ] must be transferred with binary read and write statements.

Line 1 (10): Allocates controller memory for a single instrument state.

Line 2 (50): Initiates learn mode.

Lines 3-5 (60-90): Reads learn data from analyzer into controller variable A [ ].

Lines 11-13 (115-140): Writes learn data from A [ ] into the analyzer, reestablishing the original instrument state. The first input A [1] prepares the analyzer to accept the new instrument state.

When storing many instrument states with the learn mode, controller memory can be conserved by using a string array to store the values in integer precision.

```
16: dim A$[80]
17: wrt 718,"OL"
18: for I=1 to 80
19: char(rdb(718))→A$[I,I]
20: next I
21:
22:
23:
24:
25:
26:
27: wrt 718,A$
```

Line 16 to 20: saves the instrument state in the string array A$ [ ].

Line 25: recall the instrument state from the same string.

* Instrument state does not include trace data, the states stored in save registers 1 through 7 or some shift function states.

See the HP 9825A, Computing Controller string variable programming extended I/O and advanced programming manuals for a complete explanation of these statements.

The controller write and read commands are the "binary" form. This suppresses trailing CR/LF, so they are not accepted as part of the learn string by either analyzer or controller. This assures that the correct 8 bits of each of the 80 learn bytes will be transferred.

The shift functions recorded with the learn mode include:

frequency offset
amplitude offset
video averaging (excluding the number of samples)
normal/auto triggering

Several diagnostic aids are also saved.

Take Sweep Command TS

The take sweep command, TS, insures that the analyzer will start and complete one full sweep before the next command is executed. Until a sweep is completed, the analyzer HP-IB will not respond to commands from the bus. One TS is required for each trace in the write mode.

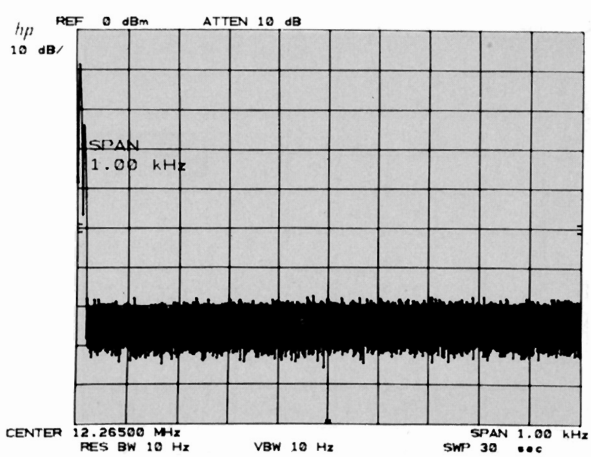
TS triggers a new sweep when the TRIGGER conditions are met.

The FUNCTION, MARKER, TRACE, COUPLED FUNCTION commands and a number of the shift functions require one complete sweep to update the display and trace memory. This is important for the output of measurement data either on the CRT display or through the HP-IB. (See Chapter 3 for output command use of TS.) For example, after a specific set of instructions, a viewed trace A is desired so the following is executed:

wrt 718, "IP CF 12.265 MZ SP 1000 Hz A3"

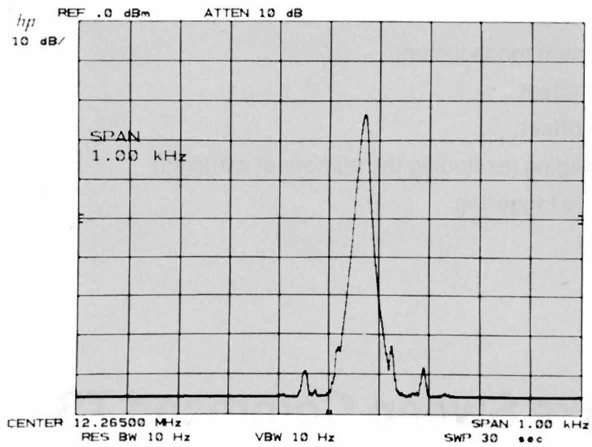
instrument preset — IP
center frequency — CF 12.265 MZ
frequency span — SP 1000 Hz
view in trace A — A3

This command sequence allows insufficient time for a full sweep between setting the span and activating the trace view mode, so only the full span, which was set by the instrument preset, is shown in the viewed trace A.



A take sweep command should be inserted before the view command calling for one complete sweep before execution of A3.

wrt 718, "IP CF 12.265MZ SP 1000 HZ TS A3"



Since the marker is repositioned at the end of each sweep when the marker is on, a TS guarantees that the marker will be on the trace current response before the analyzer TALKS. This is important for outputting the correct marker amplitude and frequency information through the HP-IB.

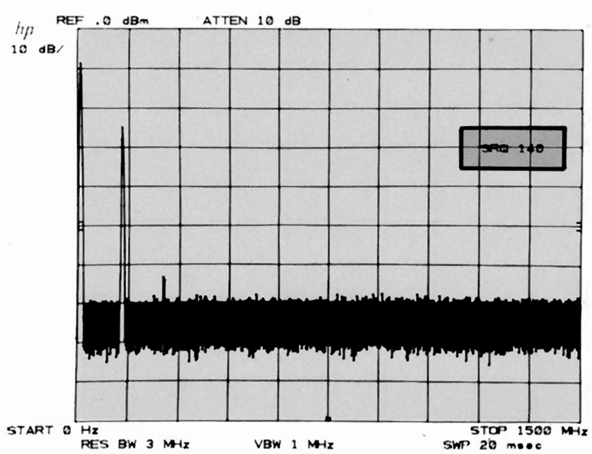
Service Request

When the analyzer is not able to interpret a command, a request for service is made. The CRT display will show "SRQ 140".

Further information on controller service request response (for interrupt) and interpretation (reading status byte) can be found in Chapter 5.

For example, the following statements result in "140" service requests:

wrt 718, "Cf 126 MZ" improper function code, should be "CF 126 MZ"
wrt 718, "CF 126 mZ" improper units code, should be "CF 126 MZ "
wrt 718, "CF, r1, MZ" improper syntax for variable r1, should be "CF," r1, "MZ"



Chapter 3

HP-IB OUTPUT COMMANDS

This chapter describes the commands which make possible the output of information from the analyzer through the HP-IB. See Chapter 1, 8568A Operation HP publication 08568-90002, for a discussion of the other rear panel outputs.

The types of information output through the HP-IB are summarized below:

Output	Output Command Codes	Pages
specific CRT display readout	OA, MF, MA	3.3
total trace information	TA, TB	3.6
specific display memory contents	DR	3. 9 (also see Appendix B)
instrument state learn mode	OL	Chapter 2
operator entered DATA values	EE OA	3.11
all display annotation	OT	3.5
operator enabled service request [SHIFT] r	none	Chapter 5

Command Sequence

An output command tells the analyzer to TALK, and outputs the value on the HP-IB data lines. The controller must then LISTEN and prepare to store the value in memory. The following example illustrates:

```
2:
3:
4:
5: wrt 718,"O1 MA"
6: red 718,A
7:
8:
```

```
10 CMD "?U2","O1 MA"
20 CMD "?R5"
30 ENTER (13,*)A
40 END
```

Line 5 (10): Commands the analyzer to TALK, "wrt 718", and output in decimal, O1, the marker amplitude MA.

Line 6 (20,30): The controller is set to LISTEN and store the marker amplitude level in A.

Output Formats

Outputs to the controller through the HP-IB must be formatted appropriately for the controller and measurement requirements

Analyzer Output	Format Command Code	Output Examples
Decimal value in Hz, dB, volts or seconds	O3	0.52 (volts) 1072367 (Hz) – 10.63 (dBm) .005 (sec)
Decimal values 0 to 4095: Representing trace amplitude CRT positions [1] 0 to 1023 positive and unblanked 2048 to 3071 positive and blanked 3072 to 4095 negative and blanked[2] Representing analyzer machine language words[3] (1024 to 4095)	O1	122 unblanked 1001 unblanked 2050 = +2, blanked 3995 = – 100 blanked 1056 machine language control word
Binary values in two 8 bit bytes, with the 4 most significant bits = 0. The most significant byte is output first.	O2	0000XXXX XXXXXXXX values 0 to 4095
Binary values in one 8 bit binary byte. [4] Amplitudes only.	O4	XXXXXXXX values 0 to 255

The binary formats are used primarily for the rapid transfer of function values which can be expressed in display units.

Value units format, O3 is selected on instrument preset.

1. Decimal values for frequency (x) and amplitude (y) are referenced from the lower left corner of the graticule (0,0). The values represent position in CRT display units. See Chapter 4 and Appendix A.
2. Negative values in the O1 output format are represented by the 12 bit two's complement of the negative number, that is, 4096 – | negative value |. For example, a –300 value would be output as 4096 – | –300 | = 3796.
3. Analyzer machine language programming is discussed in Appendix B.
4. The O4 output byte is composed of bits from the two bytes of the O2 output as follows:

```
0000XXXX  XXXXXXXX     O2
      ||  //////
      XXXXXXXX         O4
```

In O1 and O3 formats, only the exact number of characters to be output is transmitted, that is, a variable length string. Each item is ended by a CR/LF (ASCII 13 and 10). An HP-IB end or identify (EOI) accompanies the last LF.

Controller Formats

It is essential, when reading data from the analyzer, that the format of the controller be compatible with the output format of the analyzer.

Analyzer Format	Controller Format		
	Requirements	Examples	
		9825A	9830A
01	free field	0:fmt f	10 FORMAT
03	field size dependent on function output, use free field format	0:fmt	10 ENTER (13,*)
02	binary, read twice for each value	3:rdb 718,A 4:rdb 718,B	20 RBYTE (13)A 30 RBYTE (13)B
04	binary, read once for each value	0:rdb 718,A	30 RBYTE (13)A

Output of CRT Display Annotation OA MA MF OT

Any value that can 1) be read out on the CRT display and 2) be entered from the DATA controls can be output to the controller.

Three types of commands call for these outputs:

- Output the active function value OA
- Output the marker amplitude MA or the marker frequency MF
- Output the entire CRT readout as strings OT

Output Active Function OA

After a function is activated by either the operator or the controller, its present value can be output.

OA output active function value

The value unit format O3 is automatically selected with an output active function command.

COUPLED FUNCTIONS output using OA are left in MANUAL.

Examples best illustrate the use of OA.

The center frequency is stored in F and printed in the value unit, Hz.

```
0: fmt
1: wrt 718,"IP CF1234MZ"
2: wrt 718,"OA"
3: red 718,F
4: prt F
```

```
10 CMD "?U2","IP CF1234MZ"
20 CMD "?U2","OA"
30 CMD "?R5"
40 ENTER (13,*)F
50 PRINT F
60 END
```
*

When run, the 9825A printer outputs: 1234000000

*The spaces used within the quote field are for clarity and may be omitted. They will be ignored by the analyzer.

The sweep time, in seconds, is stored in T and printed.

```
0: fmt                              10 CMD "?U2";" ST50MS"
1: wrt 718;"ST50MS OA"              20 CMD "?U2";"OA"
2: red 718,T                        30 CMD "?R5"
3: prt T                            40 ENTER (13,*)T
                                    50 PRINT T
                                    60 END
```

The 9825A printer outputs: 0.05

The video averaging sample size is stored in V and printed.

```
0: fmt                              10 CMD "?U2";"IP KSG OA"
1: wrt 718;"IP KSG OA"              20 CMD "?R5"
2: red 718,V                        30 ENTER (13,*)V
3: prt V                            40 PRINT V
                                    50 END
```

The controller printer outputs the 100 sample limit size: 100

Marker Amplitude and Frequency Outputs MA MF

Whenever the markers are displayed, their amplitude and frequency (absolute or differential) can be output.

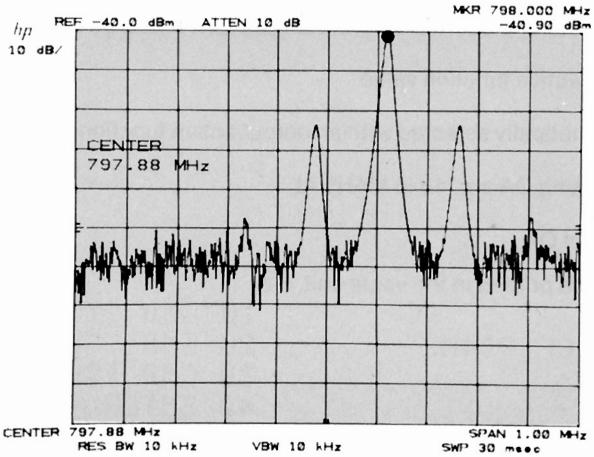
MF marker frequency output

MA marker amplitude output

The outputs can be formatted in amplitude and frequency units O3, decimal display units O1 or a binary output of display units, O2 or O4.

Unlike the OA command, the marker output commands do not require that the marker be activated at the time the output is made, only that the marker is being displayed on the CRT.

Example



Using the analyzer condition shown above, output the marker amplitude and frequency. Note that center frequency is the active function and not the marker.

```
0: fmt
1: wrt 718,"MF"
2: red 718,F
3: wrt 718,"MA"
4: red 718,A
5: prt F,A
```

```
10 CMD "?U2","MF"
20 CMD "?R5"
30 ENTER (13,*)F
40 CMD "?U2","MA"
50 CMD "?R5"
60 ENTER (13,*)A
70 PRINT F,A
80 END
```

```
798000000.00    -40.90
```

```
798000000.00    -40.90
```

A read statement is used for each output command.

Serial **output** commands result in response only to the last command. For example, with

```
0: wrt 718,"MF MA"
1: red 718,F,A
```

reads only the marker amplitude into variable F. Marker frequency will not be read.

In zero span, MF will output the marker position in seconds.

Output All CRT Annotations OT

The output annotations command outputs 32 character strings, up to 64 characters long containing all the CRT readouts except readouts input with the label command LB.

OT Output annotation strings

To complete the command, all 32 strings must be read by the controller. The strings, in order of output, contain the following information:

String	Readout	String	Readout
1	"BATTERY"	17	frequency offset
2	"CORR'D"	18	video averaging
3	resolution bandwidth	19	title
4	video bandwidth	20	"YTO UNLOCK"
5	sweep time	21	"249 UNLOCK"
6	attenuation	22	"275 UNLOCK"
7	reference level	23	"OVEN COLD"
8	scale	24	"EXT REF"
9	trace detection	25	"VTO UNCAL"
10	center frequency or start frequency	26	"YTO ERROR"
11	span or stop frequency	27	"MEAS UNCAL", "*"
12	reference level offset	28	frequency diagnostics
13	display line	29	"2ND LO ↑", 2ND LO ↓"
14	threshold	30	"SRQ"
15	marker frequency	31	center frequency "STEP"
16	marker amplitude	32	active function

The following program stores all the readouts in the A$ string array:

```
1: dim A$[32,64]
2: wrt 718,"OT"
3: for N=1 to 32
4: red 718,A$[N]
5: next N
```

```
10 DIM A$[64]
20 CMD "?U2","OT"
30 CMD "?R5"
40 FOR N=1 TO 32
50 FORMAT B
60 ENTER (13,50)A$
70 NEXT N
```

line 1 (10): dimensions 32 strings each up to 64 characters long.

line 2 (20): the output command

lines 3 to 5 (30 to 70): reads each annotation message and stores it into a string. Strings without messages are null strings

After a LINE power ON, OT and a print routine outputs the following string arrays:

String Number	Contents	String Number	Contents
1		17	
2		18	
3	RES BW 3 MHz	19	
4	VBW 1 MHz	20	
5	SWP 20 msec	21	
6	ATTEN 10 dB	22	
7	REF .0 dBm	23	
8	10 dB/	24	
9		25	
10	START 0 Hz	26	
11	STOP 1500 MHz	27	
12		28	
13		29	
14		30	
15		31	
16		32	HP-IB ADRS: 2R 18

where all blank strings are null (empty).

Output of Trace Data TA TB

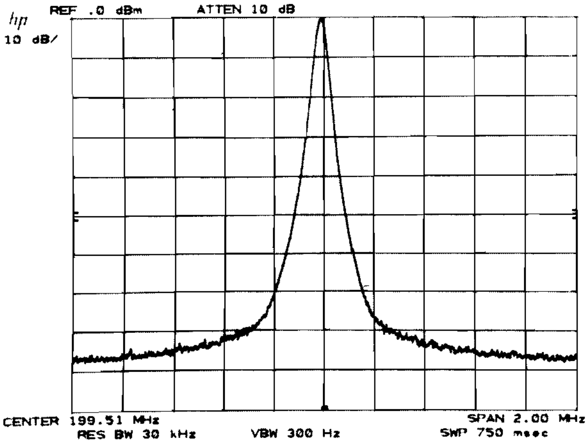
The CRT display traces are stored in digital memory as display unit values. (See Appendix A, Display Memory Structure). These values are output in left to right CRT sequential order by the commands.

TA output trace A

TB output trace B

Even though the trace amplitudes are stored in the display memory as display unit amplitude, they can be output in any of the four output formats.

Example



To store the above trace in the array A[1001] the following program would be run.

```
0: fmt
1: dim A[1001]
2: wrt 718,"O1 TA"
3: for N=1 to 1001
4: red 718,A[N]
5: next N
```

Line 1: set up storage for 1001 trace points
Line 2: sets format and commands trace A output
Lines 3-5: sequentially reads all 1001 trace points into A [N].

A printout of every one hundredth point reads in display units:

```
130.00
128.00
122.00
123.00
138.00
974.00
144.00
115.00
119.00
100.00
127.00
```

} trace amplitude in display units

Changing the output format to O3, and rerunning the same program will change the array to read in units of power:

```
-87.90
-88.10
-88.70
-88.60
-87.10
 -3.50
-86.50
-89.40
-89.00
-90.90
-88.20
```

trace amplitude in dBm

To reduce the controller trace storage requirements only a fraction of the points need be stored. For example:

```
0: fmt
1: dim B[100]
2: fmt
3: wrt 718,"O1 TB"
4: for N=1 to 1001
5: red 718,B
6: if frc(N/10)=0;B→B[N/10]
7: next N
```

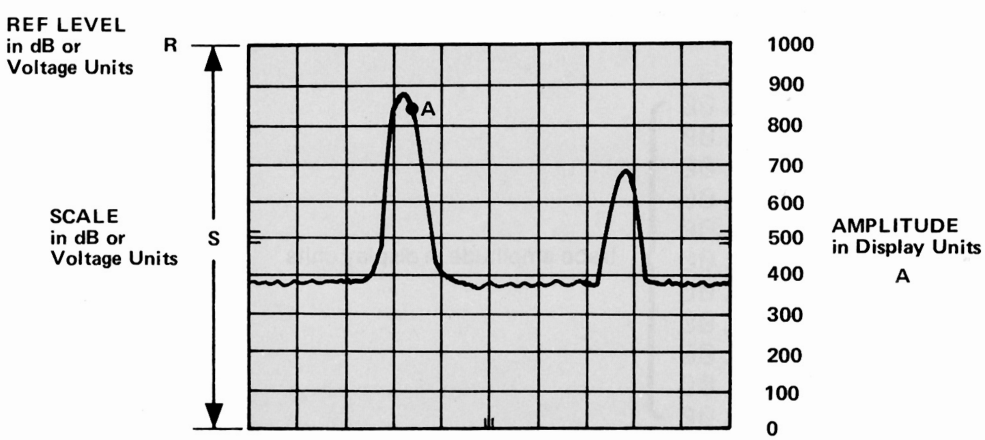
```
10 DIM B[100]
20 CMD "?U2","O1,TB"
25 CMD "?R5"
30 FOR N=1 TO 1001
50 ENTER (13,*)B
60 IF INT(N/10)=N/10 THEN 80
70 GOTO 90
80 B[N/10]=B
90 NEXT N
```

Line 5 (50): reads every point, but stores only every tenth value.

When transferring less than 1001 points of trace data, the output mode is most efficiently terminated with the DATA HOLD command HD.

Output of Trace Arithmetic Values

A – B→A and B – DL→B result in new trace values being placed in memory. When the result of either function lies above the bottom graticule the value is as read out from the display. When the function results in a trace that lies below the bottom graticule the trace will not be displayed. Calculation of the outputs are as follows:



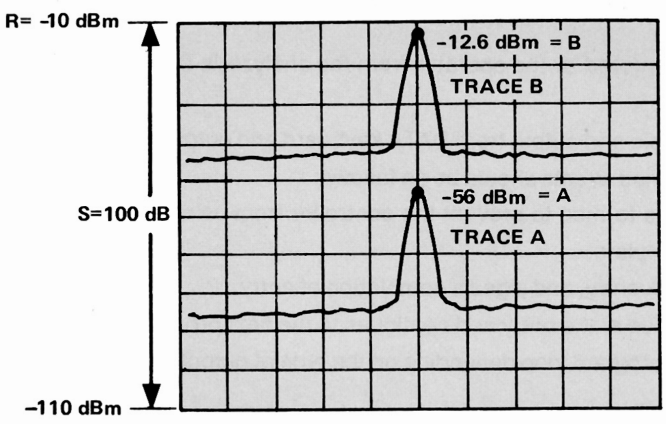
Function	Condition	Output Format		
		01 Display Units	03 LOG SCALE, dB/	03 LINEAR SCALE, Voltage
A – B→A	A > B A < B	A – B 4096 – (B-A)	A – B + (R-S)	A – B
B – DL→A	B > D B < D	B – D 4096 – (D-B)	B – D + (R-S)	B – D

Trace Arithmetic Output Values

where A is trace A position
B is trace B position
D is display line position
(R-S) is the absolute power level of the bottom graticule

Example

The following trace peaks are output:



After A – B→A, trace A blanks. If the peak of trace A is output, the value is

$$A - B + (R\text{-}S) = -56 - (-12.6) + (-10 - 100)$$
$$= -153.4 \text{ dBm in 03 format}$$

Reading Trace Amplitude at a Specific Location DR

The display read command allows the output of individual trace amplitudes, rather than all 1001 points.

DR display read

For output of trace information, the specific trace memory address must first be input to the analyzer with a display address command, DA. Appendix A, Display Memory Structure, explains memory addressing.

These program lines will read out the amplitude at the center frequency of trace A, trace B and trace C into A, B and C respectively.

```
1: fmt
2: wrt 718,"DA501 DR"
3: red 718,A
4: wrt 718,"DA1525 DR"
5: red 718,B
6: wrt 718,"DA3573 DR"
7: red 718,C
```

```
10 CMD "?U2","DA501,DR"
20 CMD "?R5"
30 ENTER (13,*)A
40 CMD "?U2","DA1525,DR"
50 CMD "?R5"
60 ENTER (13,*)B
70 CMD "?U2","DA3573,DR"
80 CMD "?R5"
90 ENTER (13,*)C
```

Learn Mode OL

Learn mode provides one means for saving the analyzer's instrument state, for later recall. A complete discussion of this command is in Chapter 1.

Operator Entered DATA Values EE

The controller can receive values entered by the operator from the analyzer's DATA keyboard using the enable entry command

EE OA enable and output from DATA keyboard and output

The general sequence of programmed events should be as follows:

1. A controller program loop is formed to prevent the controller from using the entered value until the operator signals that the entry is complete.
2. The operator makes a DATA entry, and signals completion of entry.
3. The controller reads the value of the entry and continues to the next program step.

Two methods can be used to exit the program loop depending on the type of output required.

output value	method
a single positive digit from 1 to 9	test the entry for non zero value
a positive integer from 0 to 999999999999	service request

Examples

Single digit entries can be made with the program.

```
1: fmt
2: wrt 718,"EE OA"
3: red 718,N
4: if N=0;gto -2
5: prt N
```

```
10 CMD "?U2","EE"
20 CMD "?U2","OA"
30 CMD "?R5"
40 ENTER (13,*)N
50 IF N=0 THEN 10
60 PRINT N
80 END
```

Line 1 (40): The readout of the entry should be in the free field format for the line 3 read statement.

Lines 2 to 4 (10 to 60): A program loop, exited only when a non-zero entry is made. The loop works this way: The enable entry command sets the entry to zero (default value). OA outputs the value, and the controller reads into N. If N = 0, as it will without a DATA entry, the program continues at line 2.

Line 5 (60): Outputs the entered number on the controller's printer.

The printed outputs from pressing various DATA keys is as follows:

[1]	1.00	[GHz +dBm dB]	1000000000.00
[5]	5.00	[MHz −dBm sec]	1000000.00
[9]	9.00	[kHz mV msec]	1000.00
		[Hz µV µsec]	1.00

There is no response to pressing DATA [0].

Multiple digit entries, and zero, can be made when the service request is used to exit a program loop.

```
1: fmt
2: wrt 718,"R1 R4 EE"
3: rds(718)→A;if bit(1,A)=0;jmp 0
4: wrt 718,"OA"
5: red 718,N
6: prt N
```

Line 1: The readout of the entry should be in the free field format (line 5 read statement).

Line 2: Enable entry command preceded by service request format statements. R1 clears the service request capability of the analyzer. R4 calls for a service request if a unit's key is pressed to signify the completion of an entry. See Chapter 5.

Line 3: A one line program loop which monitors the HP-IB service request status byte. When the unit's key is pressed a service request sets bit 1 of A true and the program continues to line 4. rds (718)→A clears the service request. See Chapter 5.

Line 4 and 5: The active function is output and read.

Line 6: Outputs the entered number on the controller's printer.

Now, positive integer values up to $10^{12}-1$ can be entered. This was illustrated by the following execution of the program.

DATA Entry	Output
[1] [Hz µV µsec]	1.00
[1] [2] [3] [•] [4] [5] [kHz mV msec]	123450.00
[1] [2] [3] [•] [4] [5] [Hz µV µsec]	123.00

Operator Enabled Service Request

When the analyzer is operated from the front panel, an HP-IB controller can be programmed to respond to the service request. [SHIFT] r.

This allows the analyzer operator to call up a controller, and command its attention from the analyzer front panel, even if the analyzer was previously unaddressed in the HP-IB system. Chapter 5 discusses this technique in detail.

Chapter 4

HP-IB INPUT TO THE DISPLAY

This chapter discusses the commands which allow custom CRT display annotation and graphics.

The CRT display memories can store graphic and label data that are input by the HP-IB controller. For example, the display may be used to show the test setup block diagram, test data in a table or graph, instructions, or test limits drawn over the graticule. This data can be displayed on the CRT alone, or with the normal trace and annotation information.

	Command	Command Code
Drawing Vectors	plot absolute plot relative	PA PR
Words, characters and numbers	label	LB
Graphing functions	graph	GR
Inputting a trace	input trace B (in binary)	IB

Normally memory allocated to trace C is used to store and display HP-IB display input data so that trace A and B can be used in a normal manner. However, any part of memory may be used for graphics if required. Appendix B describes the necessary commands.

Clearing the Display

The CRT display can be cleared of annotation and graticule.

"IP A4 KSm KSo" clears display

Instrument preset erases the last graphics in trace C, blanks trace B, and assures that any new labeling or plotting will start in trace C. To erase trace C graphics and prepare the new trace C labeling or plotting without an instrument preset, use the command

"EM A4 B4 KSm KSo L0" clears display without instrument preset

"EM" erases trace C and allows new trace C input

"L0" clears the display line, if enabled.

NOTE

Trace C page is used for the execution of several shift functions. It is not possible to use the trace C page for special graphics *and* use the following shift functions:

KSG video averaging

KSw display error correction data

Sweeping Without a Trace Display

In the above clearing procedure A4, B4 blanks the A and B traces and stops the sweep. In order to continue sweeping and **not** display the trace information the following codes can be written to the display memory.

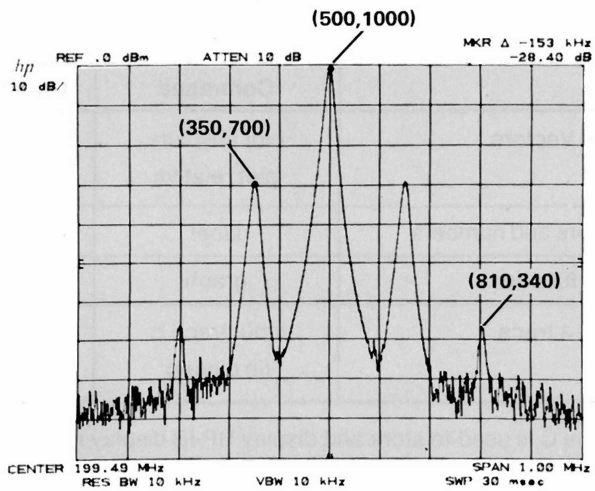
Trace A "DA0 DW 1056" or "DA0PS"

Trace B "DA1024DW1056" or "DA1024PS"

Appendix B discusses the DA, DW and PS commands.

CRT Display Reference Coordinates

Positions on the CRT display are referenced in display units. For example, the coordinates of several points along a trace can be designated as follows:

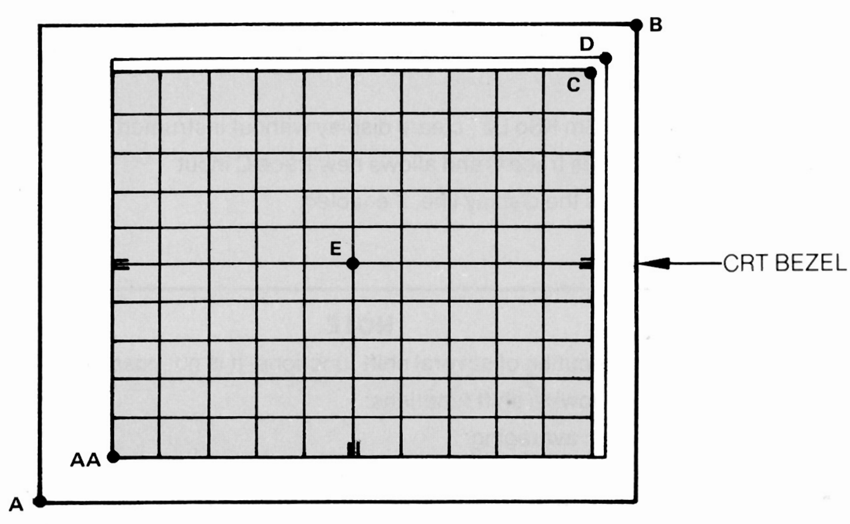


The numbers represent distance from the lower left hand corner of the graticule (X = 0, Y = 0) in display units. The upper right hand graticule corner is the (1000,1000) point. Also see Appendix A.

Three scales referenced to the CRT screen can be used for positioning on the CRT display. Each is initiated by a display size command code D1, D2, or D3. Once a code is selected it remains in effect until changed.

Preset Display Size D1, Full Screen Display Size D2, Expanded Display Size D3

The preset size is used for all graticule trace information. It is automatically called upon instrument preset.



Size	(0,0)	AA	B	C	D	E
D1	AA	(0,0)	*	(1000,1000)	(1023,1023)	(500,500)
D2	A	(120,73)	(1023,1023)	(1005,957)	—	(562,515)
D3	A	(81,49)	(689,689)	(676,645)	—	—

*No writing outside boundary marked by AA, D.

> **NOTE**
> The display size boundaries shown assume the CRT display has been internally adjusted to the standards set in the 8568A Operating and Service Manual.

Aspect Ratio

The aspect ratio of the display, that is, the proportions of x to y that will yield the same length on the CRT, is 1:1.3. For example to create a square figure on the display if the x vector were 100 units, the y vector would have to be 100 x 1.3 = 130 units.

Plot Commands PA PR

Graphics are plotted on the CRT display using vectors: lines whose end points are specified in display units. The vector coordinates can be given in absolute units (plot absolute, PA) or in units relative to the last plotted point (plot relative, PR).

PA plot absolute
PR plot relative

The pen commands, pen up PU and pen down PD, determine whether or not the vector specified is visible on the CRT.

PU pen up, next vectors are not displayed
PD pen down, next vectors are displayed

Notation Conventions

PA	Blue characters are command literals (ASCII code mnemonics).
[ ]	Items within brackets are optional.
. . .	Three dots indicate that the previous item(s) can be duplicated.
< >	Items enclosed in the angular brackets are considered to be elements of the language.
|	Indicates a choice of one element from a list.

Syntax for Plot Absolute

[PU|PD] PA x_1,y_1, [PU|PD] x_2,y_2, [PU|PD] x_3,y_3, . . .

The plot absolute command is followed by sets of x-y pairs. Each pair specifies a location relative to the display origin (0,0) specified in display units. Pen up (PU) and pen down (PD) dictate whether or not the following vector(s) are displayed.

Syntax for Plot Relative

[PU|PD] PR x_1,y_1, [PU|PD] x_2,y_2, [PU|PD] x_3, y_3, . . .

The plot relative command is followed by sets of x-y pairs. Each pair specifies a location relative to the last point specified in display units. Pen commands are used the same as in plot absolute.

> **NOTE**
>
> Each number entry, whether a literal or a variable, requires a delimiter to insure entry. The x and y values in the syntax statements must be delimited by a comma (,), semicolon (;), CR, LF or an ETX. The y value may also be delimited by a following command.

Example

The following programs draw a rectangular figure on the CRT.

```
0: fmt
1: wrt 718,"IP A4 KSm KSo"
2: wrt 718,"D2 PU"
3: wrt 718,"PA 700,500 PD 900,500"
4: wrt 718,"900,300,700,300,700,500"
5: end
```

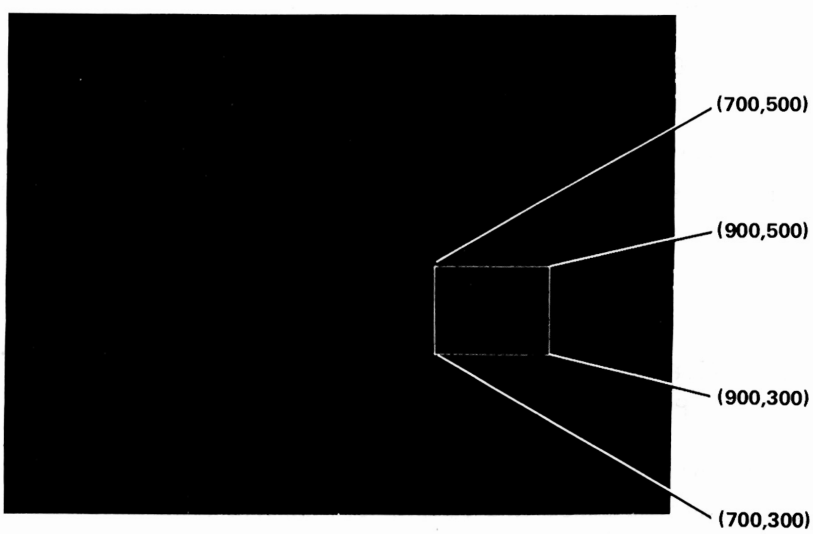
```
10 CMD "?U2","IP;A4,KSM,KSO"
20 OUTPUT (13,*)"D2,PU"
30 OUTPUT (13,*)"PA700,500,PD,900,500"
40 OUTPUT (13,*)"900,300,700,300,700,500"
50 END
```

Line 1(10): Instrument preset and clear the display.

Line 2(20): Specifies the full CRT display size. The pen up command insures that the initial vector to point (700,500) is not drawn.

Line 3(30): Plot absolute command and the starting point of the rectangle. The following pen down command assures that the vector (700,500) to (900,500) will be drawn on the CRT.

Line 4(40): Plots the remainder of the rectangle on the CRT. The pen down condition is still in effect.



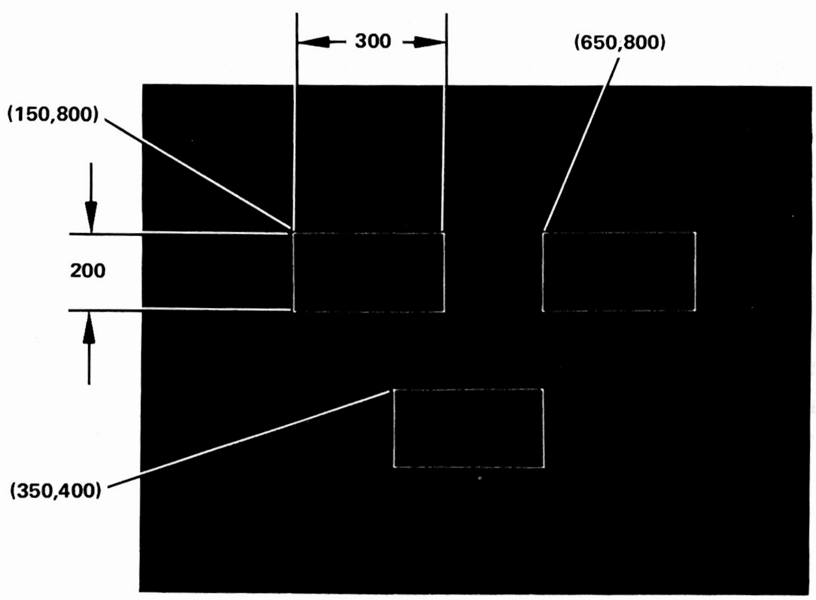
A similar rectangle can be positioned anywhere on the display using the plot relative command. The following programs draw the same figure in the three places on the CRT:

```
0: fmt
1: wrt 718,"IP A4 KSm KSo"
2: wrt 718,"PU PA 150,800"
3: gsb "rectangle"
4: wrt 718,"PU PA 650,800"
5: gsb "rectangle"
6: wrt 718,"PU PA 350,400"
7: gsb "rectangle"
8: end
9: "rectangle":
10: wrt 718,"PD PR 300,0,0,-200,-300,0,0,200"
11: ret
```

```
10 CMD "?U2","IP A4 KSM KSO"
20 CMD "?U2","PU PA 150,800"
30 GOSUB 200
40 CMD "?U2","PU PA 650,800"
50 GOSUB 200
60 CMD "?U2","PU PA 350,400"
70 GOSUB 200
80 END
200 REM RECTANGLE
210 CMD "?U2","PD PR 300,0,0,-200,-300,0,0,200,"
220 RETURN
```

Lines 2,4,6 (20,40,60): Position vector for the drawing of the rectangle. The vector is not displayed.

Line 10 (210): The plot relative command draws a rectangle 200 by 300 display units. Each pair of numbers inputs increments in the x-y pair.



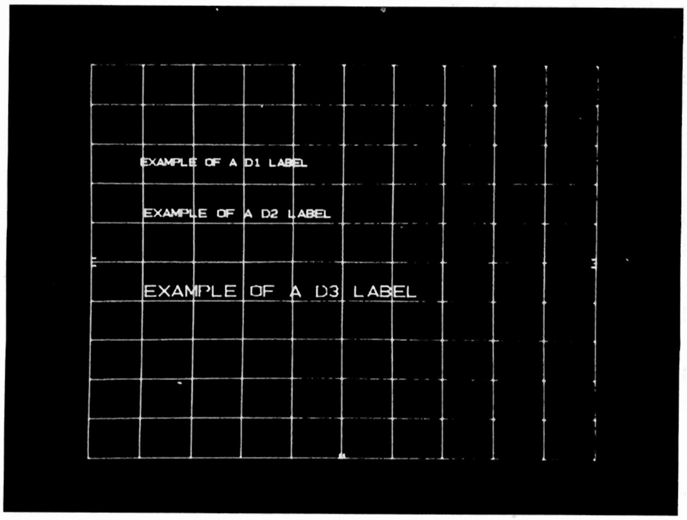
Label Command LB

The label command allows writing text anywhere on the CRT display.

LB label

All HP-IB data messages following a label command will be written on the CRT display. Plot commands are used to position the text on the CRT.

The size of the label characters is determined by the display size.



Syntax for Label

<display size> [plot] LB <text> <label terminator>

LB	enables the label mode
<text>	a string of character codes (see below)
<label terminator>	a message which ends the label mode. The next ASCII character code will not be written on the CRT display.

<label terminator> can be done with either an ASCII ETX, end of text (decimal code 3) or a character code selected by the user with DT label terminator. For example, if the ? symbol is desired to end a label mode, execute the following statement:

wrt 718, "DT?"

An instrument preset will eliminate the special <label terminator> code, ?.

Example

In the following program, line 7 ends the label mode

6:wrt 718, "PU PA 500, 500 LB LABEL"

7:wtb 718, 3

If a ? is to be used to terminate the label mode this line is used before the label statement,

wrt 718 "DT?"

Now line 6 can be written

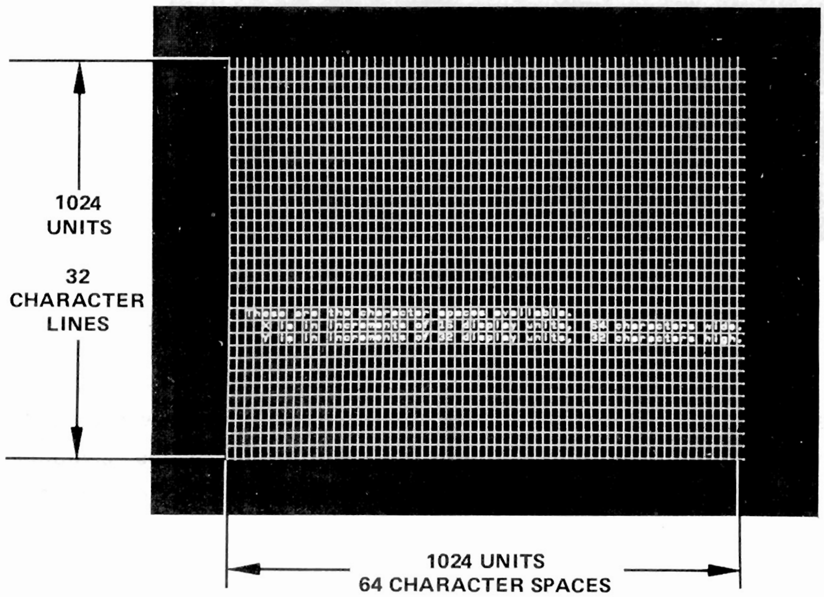
6:wrt 718, "PU PA 500, 500 LB LABEL?"

The ? terminates the label mode, and line 7 can be omitted. The terminator is not displayed, nor is it stored in display memory.

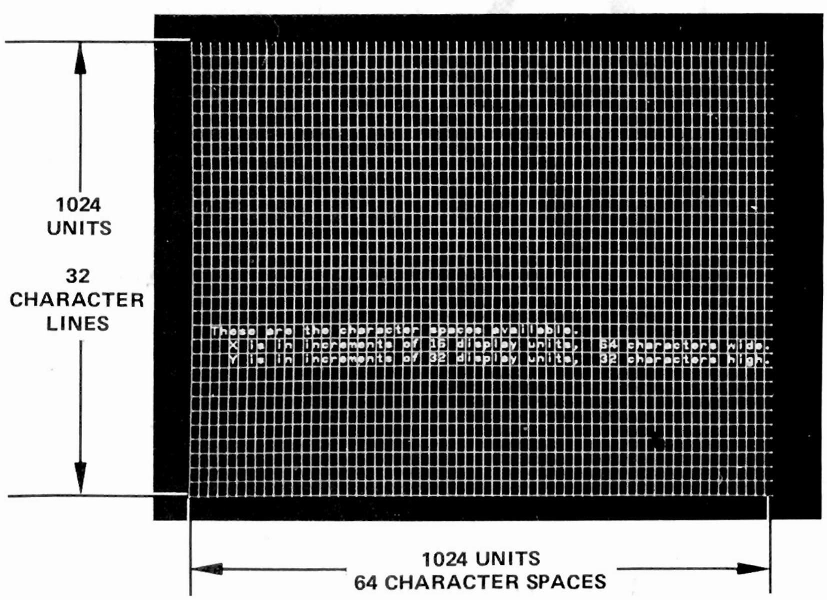
Character Position

Characters generated for the label command are placed on the CRT display in a fixed grid similar to the character positions on a typed page, that is, in rows and columns. This can be an important consideration when labeling graph lines or points. The display size determines position and number of rows and columns.

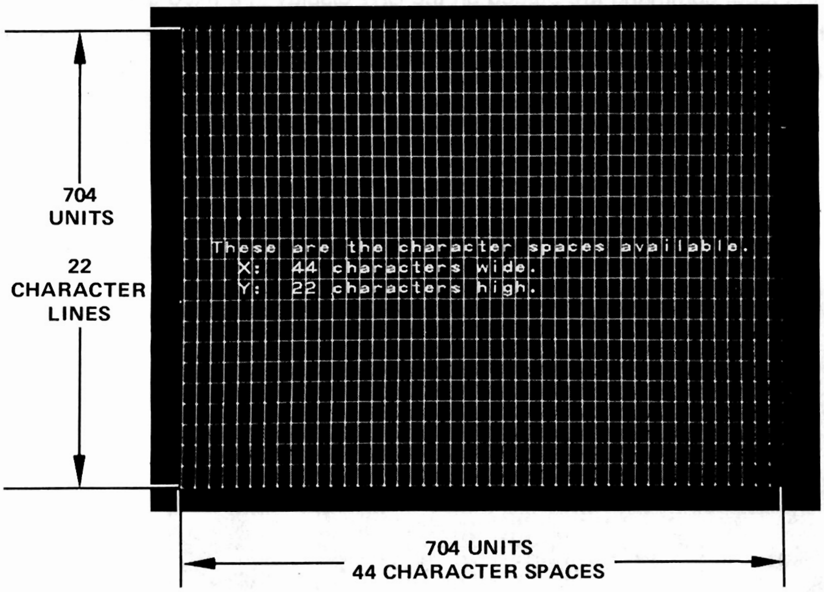
D1:



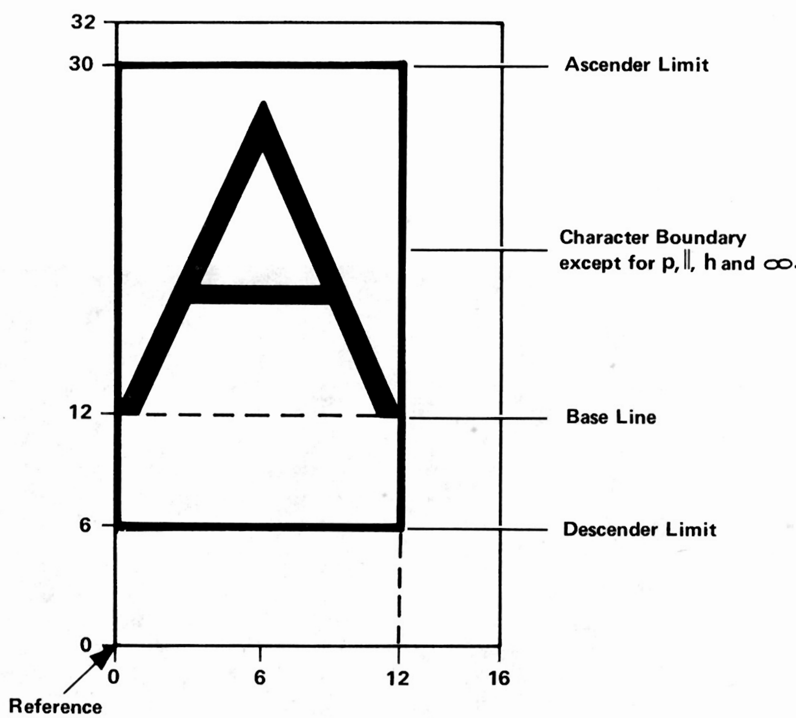
D2:



D3:



The character position is referenced from the lower left corner of the character space shown below. If a plot absolute statement calls a position anywhere within the space, the character will be placed within the "character boundary" in the space. If two characters are labelled into the character space, they will be superimposed over one another.



Single Character Space

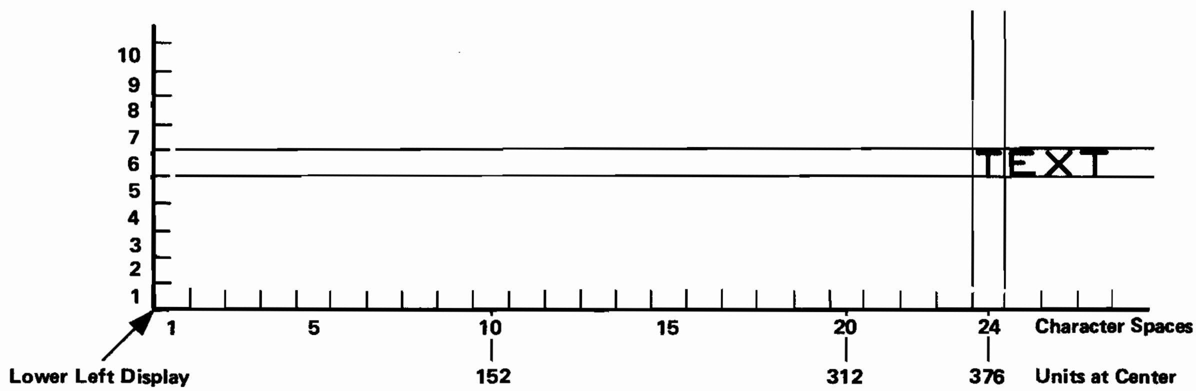
Example

To begin labeling text six characters up from the bottom and 24 characters from the left (in **any** display size), the plot absolute vector values are calculated.

$$x = (\text{character spaces})(16) - 8$$
$$= (24)(16) - 8 = 376$$
$$y = (\text{character spaces})(32) - 16$$
$$= (6)(32) - 16 = 176$$

" PU PA 376, 176 LB <text> "

The first character of text will be positioned as shown:



x may be changed as much as ±7 units and y as much as ±15 units before the text will begin at the next x and y character. In other words, the label positioning statements "PA 376, 176 LB <text>" and "PA383, 191 LB <text>" will place the text in the same character spaces.

Character Set

The character set for the label command is the same as the ASCII set. There are 86 additional characters available.

Code	Char	Code	Char	Code	Char	Code	Char	Code	Char	Code	Char	Code	Char	Code	Char
0	(NULL)	32	SP	64	@	96	`	128		160	∧	192	∠	224	ψ
1		33	!	65	A	97	a	129		161	ˇ	193	ᴬ	225	α
2		34	"	66	B	98	b	130		162	¨	194	∫	226	β
3		35	#	67	C	99	c	131		163	≠	195	¢	227	χ
4		36	$	68	D	100	d	132		164	£	196	∇	228	δ
5		37	%	69	E	101	e	133		165	∝	197		229	ε
6		38	&	70	F	102	f	134		166	⊕	198		230	φ
7		39	'	71	G	103	g	135		167	·	199	g	231	γ
8	(BS)	40	(	72	H	104	h	136		168	←	200	h	232	η
9		41	)	73	I	105	i	137		169	→	201	ı	233	ι
10	(LF)	42	*	74	J	106	j	138		170	§	202		234	ζ
11	(VT)	43	+	75	K	107	k	139		171	±	203		235	κ
12	(FMFD)	44	,	76	L	108	l	140		172	↓	204	L	236	λ
13	(CR)	45	—	77	M	109	m	141		173	‾	205	∩	237	μ
14		46	.	78	N	110	n	142		174	ˣ	206	∩	238	ν
15		47	/	79	O	111	o	143		175	÷	207	o	239	ο
16		48	Ø	80	P	112	p	144		176	o	208	P	240	π
17	(BKON)	49	1	81	Q	113	q	145	(SK16)	177	ı	209	∞	241	θ
18	(BKOF)	50	2	82	R	114	r	146	(SK32)	178	≥	210	r	242	ρ
19		51	3	83	S	115	s	147	(SK64)	179	∃	211	s	243	σ
20		52	4	84	T	116	t	148		180	⊣	212	⊤	244	τ
21		53	5	85	U	117	u	149		181	≥	213	∂	245	υ
22		54	6	86	V	118	v	150		182	∃	214	v	246	ξ
23		55	7	87	W	119	w	151		183	√	215	—	247	ω
24		56	8	88	X	120	x	152		184	~	216	_	248	Γ
25		57	9	89	Y	121	y	153		185	≃	217	ı ı	249	Δ
26		58	:	90	Z	122	z	154		186	‖	218		250	Ω
27		59	;	91	[	123	{	155		187	∴	219	Π	251	Σ
28		60	<	92	\	124	|	156		188	≤	220	Θ	252	Λ
29		61	=	93	]	125	}	157		189	≡	221	Ψ	253	ϒ
30		62	>	94	↑	126	~	158		190	≥	222	Φ	254	Ξ
31		63	?	95	_	127		159		191	^	223		255	

Label Command Character Set

Blank codes are either unassigned or character pieces. ( ) indicates display machine language word see Appendix B.

Examples of Label

In the following program the text is positioned on the CRT by a plot abolute command.

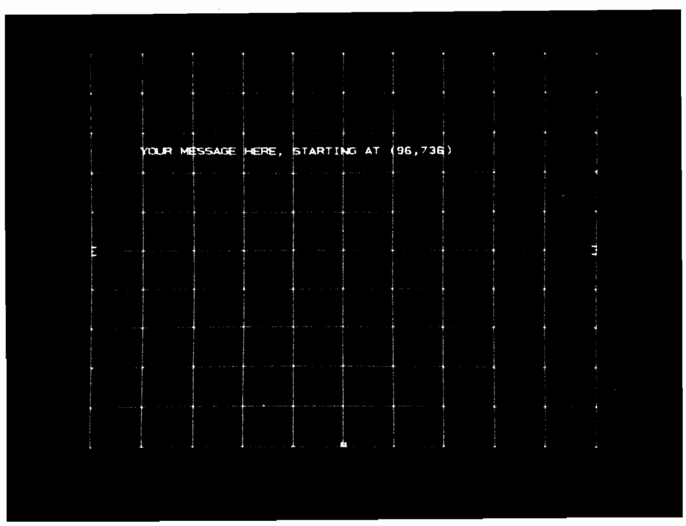
```
0: fmt
1: wrt 718,"IP A4 KSo"
2: wrt 718,"PU PA96,736 LBYOUR MESSAGE HERE,
                                        STARTING AT (96,736)"
3: wtb 718,3

10 CMD "?U2","IP A4 KSO"
20 OUTPUT (13,*)"PU PA 96,736 LBYOUR MESSAGE HERE,
                                             STARTING AT (96,736)"
30 FORMAT B
40 OUTPUT (13,30)3
50 END
```

Line 1(10): Prepares the display and selects display size D1.

Line 2(20): Positions the beginning of the text, enables the label mode and outputs the text.

Line 3(30,40): Ends the label mode.



Here is what happens if the <label terminator> message is omitted:

```
0: fmt
1: wrt 718,"IP,A4,KSo"
2: wrt 718,"PUPA0,500LBThis is the message you want."
3: for N=1 to 10
4: wrt 718,"CF100MZ,SP200KZ,ST50MS"
5: next N
```

Line 2: Since no <label terminator> ends the label mode the following program lines are also written on the CRT.

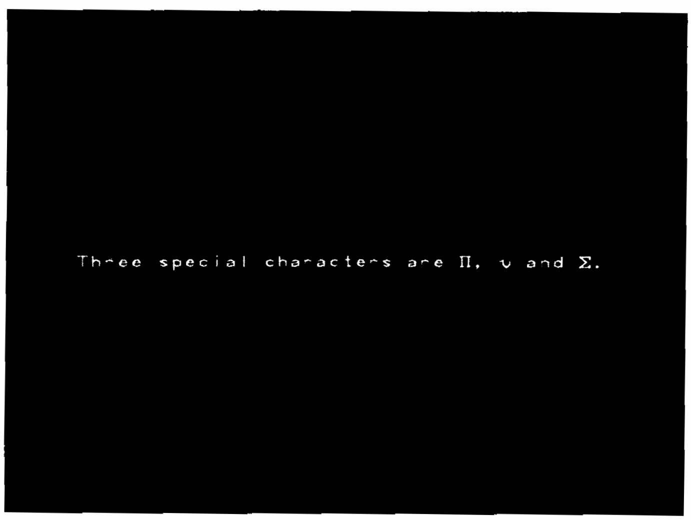
Lines 3 to 5: Any type of program

This final example shows how to use the special character set, and the DT terminator.

```
0: fmt
1: wrt 718,"IP A4 KSm KSo D3 DTz"
2: wrt 718,"PU PA 25,350"
3: wtb 718,"LBThree special characters are "
4: wtb 718,219,44,32,224,32,"and ",251,".z"
```

```
10 CMD "?U2","IP A4 KSM KSO D3 DTZ"
20 OUTPUT (13,*)"PU PA25 350"
30 FORMAT B
35 FORMAT 7B
40 OUTPUT (13,30)"LBTHREE SPECIAL CHARACTERS ARE ";
50 OUTPUT (13,35)219,44,32,224,32,"AND ",251,".Z"
60 END
```

Line 4(35,50): The message in the quote field is followed by the codes of the three special characters 219,224, and 251 with space codes between them. The label mode is ended with "z".



Graph Command GR

The graph command enables HP-IB input to be plotted as a trace. That is, amplitude inputs in display units are input starting at the left of the display. For each y input, x is automatically incremented by one display unit.

Syntax

GR y_1, y_2, y_3, y_4 . . .

The GR command instructs the analyzer to graph the next points input as amplitude coordinates in the trace C display memory. The first point, y_1, will be at the left of the display, and successive points will be plotted left to right in the graticule space (display size D1). Lines are drawn between successive points. Trace C is set to view.

Example

The test limits for an electromagnetic interference test are graphed into trace C using GR. The interference signal is input to trace A. Subsequent B ⇄ C exchange and A – B→A will plot only the out-of-spec interference signals on the CRT. Special annotations are added.

```
0: fmt
1: fmt ;wrt 718,"IP FA200KZ FB5MZ S2 GR"
2: for N=1 to 400
3: wrt 718,400-(3.5/4)N
4: next N
5: for N=401 to 1000
6: wrt 718,300
7: next N
8: wrt 718,"KSi TS KSk B3 C2 TS"
9: fmt f4.0
10: wrt 718,"HD EM KSo DT?"
11: for N=1 to 11 by 2
12: wrt 718,"D2 PU PA 50",90N-20,"LB",10N-10,"?"
13: next N
14: wrt 718,"B4"
15: wtb 718,"PU PA0,600 LB  dB",10,13,"
    Out",10,13,"  of",10,13," Spec?"
16: wrt 718,"D3 PA100,500 LBRADIATED INTERFERENCE,
    200kHz-5MHz?"
```

Line 1: Initiates the graph mode. The IP set DA to 3072 so the graphing starts at the beginning of trace C.

Lines 2 to 7: Writes the test limit values into the trace C memory.

Line 8: Puts the graph data into trace B memory and enables A – B→A .

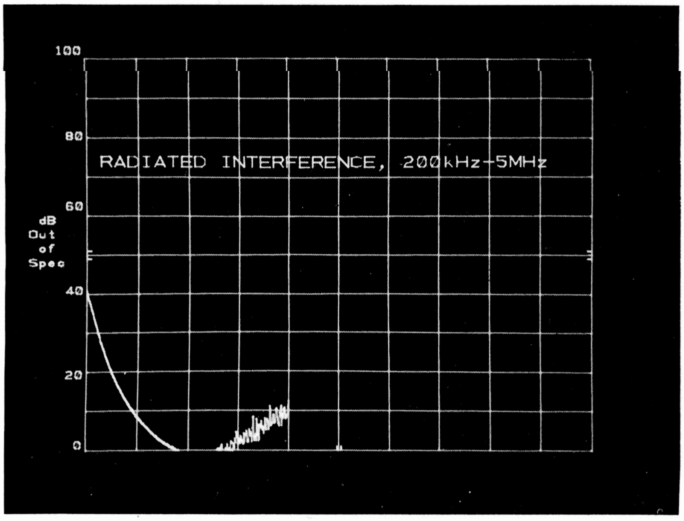
Line 9: Format so that the CRT numbers will not have digits to the right of the decimal.

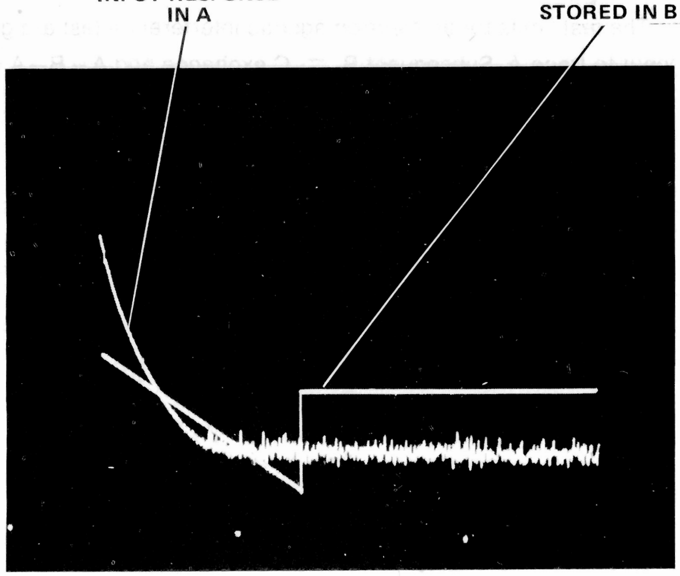
Line 10: Clears the active function readout HD, prepares trace C for input EM, clears the display annotation KSo, and sets the label terminator to ?.

Lines 11 to 16: Labels the graticule.

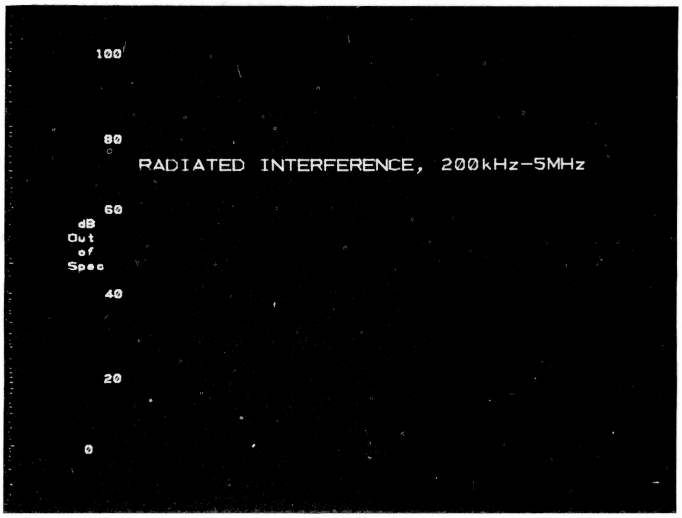
Line 15: CR/LF (ASCII codes 13 and 10) are used to write on the next line. Note the binary write controller statement wtb.

The results of this test show the amount of radiation over the test limit versus frequency.





The original test limits and input can be recalled by the sequence
[LCL] [SHIFT] k [SHIFT] m
A – B [OFF]
[VIEW] A [VIEW] B



Trace C stores the special annotation. (This display can be obtained by [LCL] [BLANK] A [BLANK] B [BLANK] j.)

Input Trace B IB

The input trace B command allows input of all 1001 trace B points in two byte binary format 02. A trace is stored in controller memory using "02TB", the output of trace B in 2 byte binary format, then recalled with IB.

Example

The following program saves a trace in B[1001,2] controller memory array, then restores it to trace B using IB.

```
0:  fmt
1:  dim B[1001,2]
2:  wtb 718,"02TB"
3:  for N=1 to 1001
4:  rdb(718)→B[N,1]
5:  rdb(718)→B[N,2]
6:  next N
7:
8:
9:
10:                          } measurement program
11:
12:
13:
14:  stp
15:  wtb 718,"IB"
16:  for N=1 to 1001
17:  wtb 718,B[N,1],B[N,2]
18:  next N
```

Lines 0 to 6: Stores trace B (in binary) in B [ ].

Lines 15 to 18: Restores trace B.

Line 15: The command IB must not be followed by a CR/LF, thus the use of wtb.

Line 17: Writes two binary numbers for each display point.

Note: Another command, KS 125_{10} can be used to store trace data in a similar manner at any display location. See page C.4.

Chapter 5

SERVICE REQUESTS

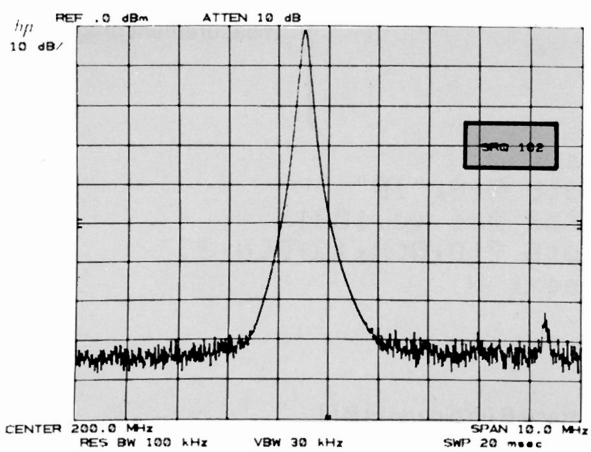
This chapter describes the analyzer's request for service capability and its use for interruptions to obtain service from an HP-IB controller.

A service request is an analyzer output which signifies an occurance at the analyzer, such as a units key pressed, the end of a sweep, or a hardware problem. A service request may trigger the controller to take action, such as changing the instrument state or writing data into the display memory. Service requests place the HP-IB SRQ line true.

When a request for service is being made, the CRT display reads out "SRQ" with a number.

NOTE

If the CRT display annotation has been blanked, the service request notation will **not** appear.



Display During A Service Request

Whether or not the SRQ message is displayed during a request for service, the HP-IB service request line (SRQ) is pulled true, announcing to the HP-IB controller that the analyzer requires attention. The analyzer sends a status byte on the bus which can be interpreted by the controller.

NOTE

HP-IB controller must use a serial polling technique to test for service requests. The analyzer will not respond to HP-IB parallel polling.

Status Byte Definition

Bit	Message	CRT Display Message
0 (LSB)	Unused.	—
1	Units key pressed.	"SRQ 102"
2	End of sweep.	"SRQ 104"
3	Hardware broken.	"SRQ 110"
4	Unused.	—
5	Illegal analyzer command.	"SRQ 140"
6	Universal HP-IB service request. HP-IB RQS Bit.	—
7	Unused.	—

The CRT SRQ number is an octal number based upon the status byte's binary value. For example, the status for an illegal analyzer command is

bit number	7	6	5	4	3	2	1	0
status byte	0	1	1	0	0	0	0	0

What appears on the CRT display is the octal equivalent of the status byte's binary number:*

"SRQ 140"

The octal number will always begin with a "1" since this is translated from bit 6, the universal HP-IB service request bit.

The decimal equivalent is $1 \times (8)^2 + 4 \times (8)^1 + 0 \times (8)^0 = 96$.

More than one service request can be output at the same time. For example, if an illegal analyzer command and an end-of-sweep occurred at the same time "SRQ 144" would appear.

bit number	7	6	5	4	3	2	1	0
status byte	0	1	1	0	0	1	0	0

"SRQ 144"

* The octal equivalent is based upon whole number:

001100000 (binary); $= 1 \times 2^5 + 1 \times 2^6 = 96$ (decimal)

However, one simple way to determine its octal equivalent is to partition the binary number 3 bits at a time from the least significant, and treat each section as a binary number alone. Thus

binary	01	100	000
octal	1	4	0

Service Request Commands R1, R2, R3 and R4

Except for the illegal command service request, SRQ 140, requests for service will not occur unless the appropriate activating command has been given.

SR Command	Allows	Cancelled By
R1	SRQ 140 only (illegal command)	none
R2	SRQ 140 SRQ 104 (end of sweep)	R1 only
R3	SRQ 140 SRQ 110 (hardware broken)	R1 only
R4	SRQ 140 SRQ 102 (units key pressed)	R1 or pressing units key

Commands R2, R3 and R4 may be activated simultaneously, allowing all the SRQ's. R4 must be re-enabled after its use or whenever any SRQ is cleared. R2 and R3 remain enabled until disabled by R1; in other words, R1 is used to disable service request commands except SRQ 140.

An instrument preset enables R3.

R2 also causes an SRQ at the end of the calibration routine and when the specified number of video averages is reached.

Controller Interrupt with Service Request

The HP-IB controller response to a service request depends upon the controller. The operating manual for each controller's HP-IB interface discusses reaction to a pulled SRQ line.

Computing controllers, such as the HP 9825A and HP 9830A, have commands which allow monitoring the SRQ line, then interpreting and clearing the status byte if a request for service occurs.

9825A Computing Controller Statement Review

Bit Functions

bit	bit (N,A)	Returns the value of the Nth bit in A (0 or 1).
	bit ("1010XX",A)	Returns 1 if the mask matches the bit pattern in A, or 0 if the mask does not match. X or other character in the mask indicates bit which is not checked.
dto	dto A	Returns the octal equivalent of the decimal value specified by A.

Interrupt Statements

oni	oni 7, "shutoff"	Establishes the service routine where program execution will branch to interrupt on SRQ from the HP-IB specified by select code 7.
eir	eir 7	Enables the calculator to accept an SRQ interrupt from the HP-IB specified by select code 7.
	eir 7,M	
iret	iret	Signals the end of a service routine. During the interrupt service routine, the interrupt for the peripheral being serviced is automatically disabled to prevent cascading of interrupts.

Examples

This program includes an SRQ interpreter which prints the name of the service request enabled.

```
0: fmt
1: wrt 718,"R1 R3 R4"
2: oni 7,"Interpret SRQ"
3: eir 7
4:
5:
6:
7:                          } any program
8:
9:
10:
11: end
12: "Interpret SRQ":
13: rds(718)→S
14: if bit(3,S);prt "hardware broken"
15: if bit(5,S);prt "illegal command"
16: if bit(1,S);prt "units key pressed"
17: wrt 718,"R4"
18: eir 7
19: iret
```

Line 1:	All but the end of sweep SRQ's are enabled. R1 cleans out former SRQ commands
Line 2:	The "Interpret SRQ" subroutine will be executed when an SRQ occurs.
Line 3:	The controller's interrupt capability is enabled and the program continues.
Lines 12-19:	Interrupt subroutine.
Line 13:	The status byte is read into S and the SRQ line is cleared.
Lines 14-16:	The octal status byte is compared to each analyzer SRQ code. If true the name is printed on the printer.
Line 17:	R4, the units key SRQ is re-enabled.
Line 18-19:	The interrupt capability is re-enabled and the mainline program is continued.

SERVICE REQUESTS

In the following program, data is recorded only when the first sweep ends. This ensures that the test data is complete.

```
0: fmt
1: "Main program":
2: wrt 718,"R2"
3: oni 7,"record data"
4: eir 7
5:
6:                              } any program
7:
8:
9: end
10: "record data":
11: rds(718)→S
12:
13:                             } data output subroutine
14:
15:
16:
17: wrt 718,"R1"
18: iret
```

Line 2:	The end of sweep SRQ is enabled.
Lines 10-18:	Record data subroutine called when the sweep ends.
Line 11:	Reads the status byte and clears the SRQ line.
Line 17:	End of sweep SRQ is cleared by R1; and SRQ will not be called at the next end of sweep.

The same R2 command can be used to ensure the marker is placed before data is output in the program.

The following program uses R4 to allow a data entry into the controller from the analyzer DATA keyboard. Such an entry allows branching to other programs or changes to the instrument state.

```
0: fmt
1: "Main program":
2: oni 7,"key"
3: eir 7
4: wrt 718,"R1 R4"
5: wrt 718,"EE"
6:
7:
8:                             } any program not addressing the analyzer
9:
10:
11: end
12: "key":
13: rds(718)→S
14: wrt 718,"OA"
15: red 718,X
16: dsp X
17:                            } any useful subroutine using variable X.
18:
19: wrt 718,"R4EE"
20: eir 7
21: iret
```

Line 4: Disables previous SRQ commands with R1, then enables the units-key-pressed SRQ command, R4.

Line 5: Enables entry from the DATA keyboard. When an entry is completed by pressing the units key, "key" subroutine is called.

Lines 6-10: Computation or control not involving the analyzer.

Lines 12-21: The SRQ subroutine clears the SRQ line, reads the data entered (OA) and enters the value into variable X.

Service Request From The Front Panel

The operator can call for service from a controller from the front panel when in local by pressing

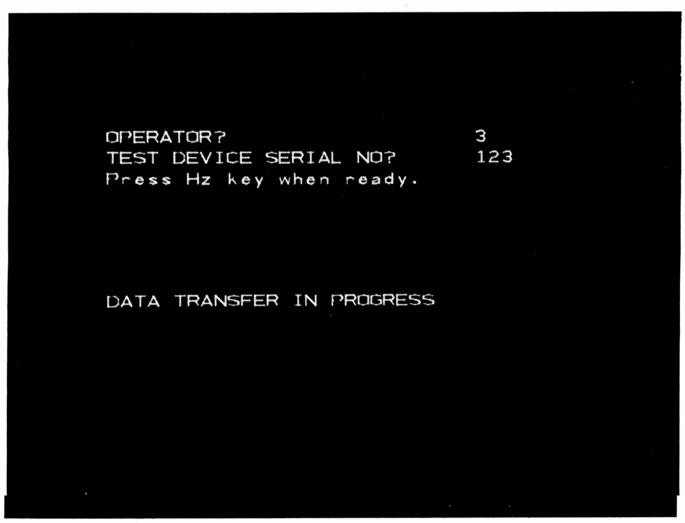
SHIFT r

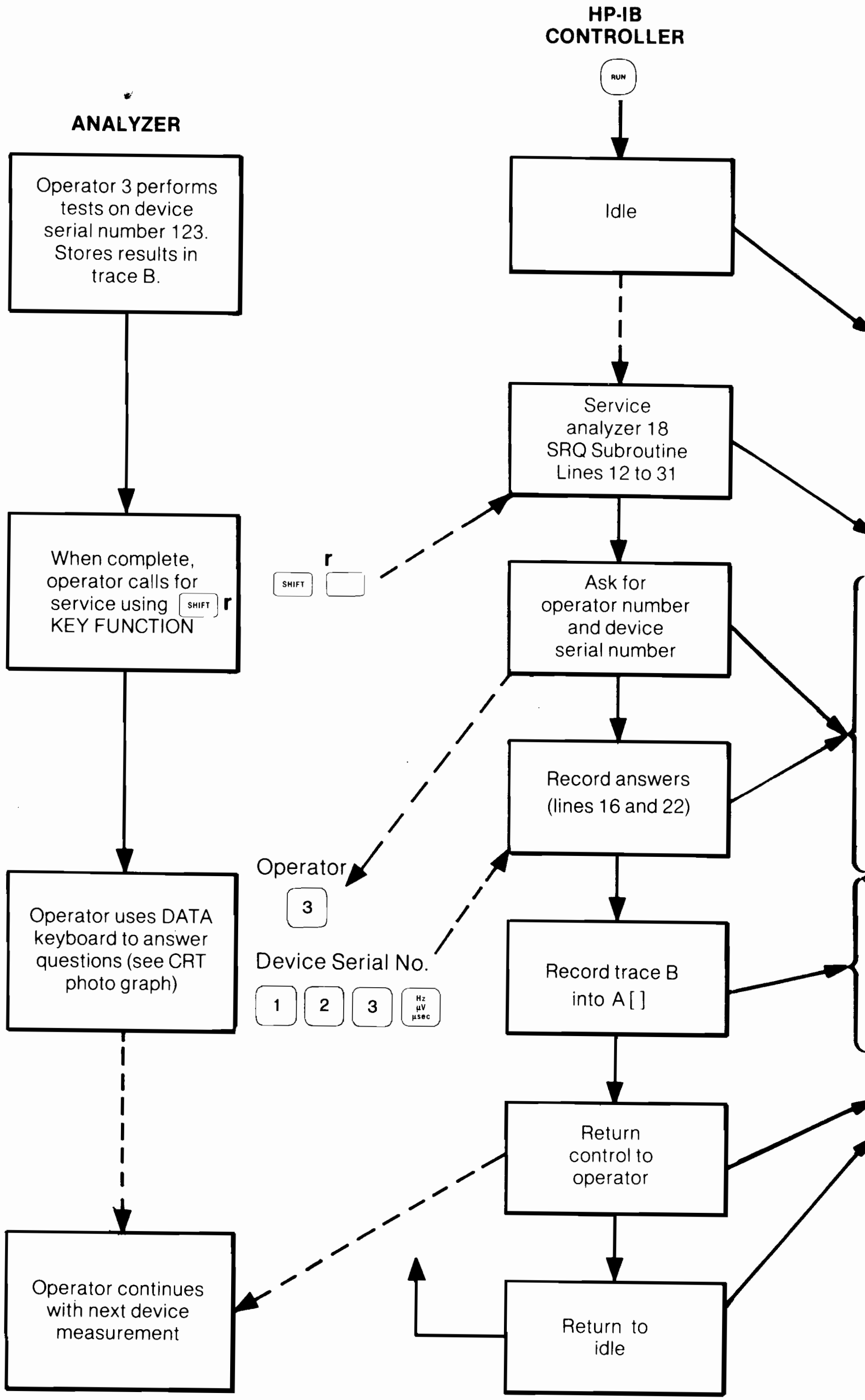
This front panel request for service sends SRQ 102, the units-key-pressed SRQ. It is not necessary for the SRQ command R4 to be enabled to use the front panel service request.

Example

One use for the front panel service request is to summon a remote controller for assistance. Several analyzers, each with a different HP-IB address, can call for a service such as recording trace test data. The following example suggests one possible way to do this for a single analyzer.

During the data transfer, beginning at line 24, the CRT display will appear as follows, with the "DATA TRANSFER" message blinking.






```
 0: fmt
 1: dim A[1001],A$[20]
 2: "  idle  ":
 3: oni 7,"data";eir 7
 4: lcl 718
 5: eir 7;rds(718)→S;if not bit(1,S);jmp 0
 6: gto -1
 7: red 718,A
 8:
 9: end
10:
11:
12: "data":fmt f.0
13: rds(718)→D
14: wrt 718,"SV1 EM 01 KSm KSo A4 DT:"
15: wrt 718,"D3 PUPA64,544 LBTEST STATION?:"
16: wrt 718,"EEOA";red 718,S;if S=0;jmp 0
17: wrt 718,"D3PUPA512,544LB",S,":"
18: wrt 718,"D3 PUPA64,512 LBTEST DEVICE SERIAL NO?:"
19: wrt 718,"D3 PUPA64,490 LBPress Hz key when ready.:"
20: wrt 718,"R1R4EE"
21: rds(718)→D;if bit(1,D)=0;jmp 0
22: wrt 718,"OA";red 718,A;str(A)→A$
23: wrt 718,"PUPA512,512LB",A$[2,len(A$)-3],":"
24: wtb 718,"PUPA 64,312LB",17,"DATA TRANSFER
                                        IN PROGRESS",18,3
25: wrt 718,"TB"
26: for N=1 to 1001
27: red 718,A[N]
28: next N
29: wrt 718,"EM RC1"
30: lcl 718
31: iret
```

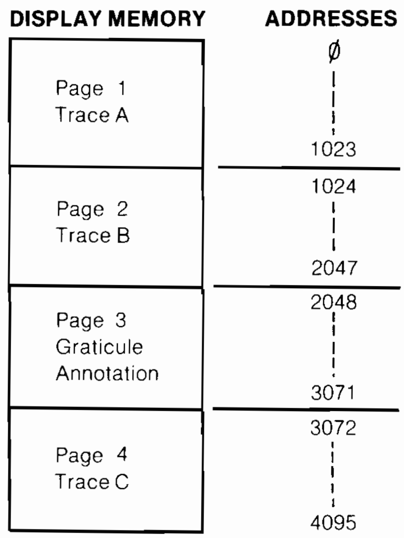
other lines:
- line 13 - reads and clears service request
- line 29 - erases CRT questions

Appendix A

DISPLAY MEMORY STRUCTURE

This appendix discusses the details of the display memory as background for advanced HP-IB display programming (Appendix B). A summary of trace data manipulation by the trace mode functions is also discussed.

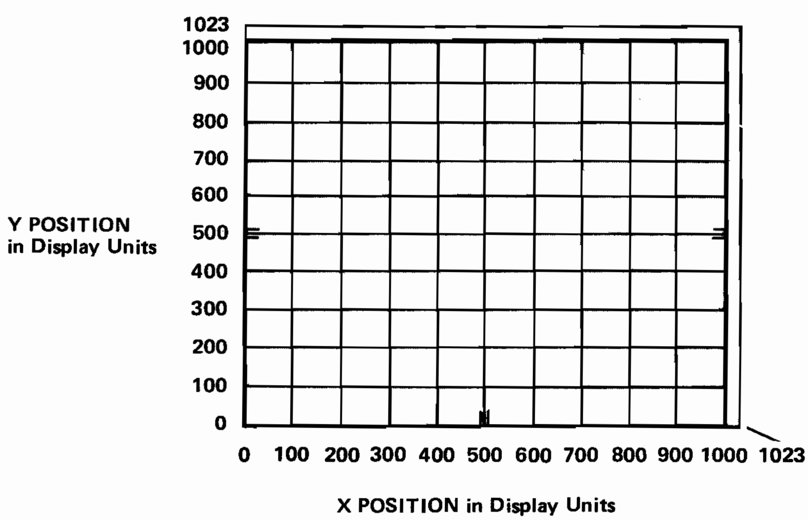
The display memory is defined as the digital storage allocated in the spectrum analyzer for the information which is presented on the CRT display. It is comprised of four different memories: three trace memories and one annotation memory. Addresses are assigned as follows:



Traces

The trace pages are used primarily to store analyzer response data to be displayed. Use is not restricted to the storage of trace data. As Chapter 4 describes, operator defined graphics and annotation can be written into the memory for display on the CRT.

Each trace address may contain an integer from 0 to 4095. When drawing trace values from 0 to 1023 will be plotted on the CRT display as amplitude y position, in display units. Appendix B discusses these values in detail.



For traces A, B and C the horizontal distance on the CRT is determined by the amplitude value's proximity to the first trace address, in the example below, in address 1024.

Trace B (Page 2) 1024 Addresses

Address	Amplitude Value, Y	(x,y) Position on CRT
1024	1040	Display Instruction
1025	622	(0,622)
1026	531	(1,531)
⋮	⋮	⋮
2023	181	(998,181)
2024	162	(999,162)
2025	185	(1000,185)
2026	1072	Overrange Blanked
2027	1072	
⋮		
2046	1072	
2047	1072	
3071		

The addresses 2023 and 2024 describe one trace line, drawn between (998,181) and (999,162). The values in the X-overrange addresses blank those lines.

Annotation and Graticule

Page 3 of the display memory is filled with instructions upon instrument preset. These instructions draw the graticule and annotation on the displays.

The display memory contents for the addresses in page 3 are listed in the table below. The first address given on each line is that of the instruction for the specific readout.

Address	Contents*
2048-2064	controls marker, display line, threshold annotation and graticule on/off functions
2065-2079	center line marks
2085-2099	marker symbols
2100-2114	display line
2115-2167	graticule
2168-2175	"hp"
2176-2192	"BATTERY"
2193-2208	"CORR'D"
2209-2240	"RES BW"
2241-2272	"VBW"
2273-2304	"SWP"
2305-2336	"ATTEN" and "PG" preamp gain number
2337-2368	"REF"
2369-2384	"dB/", "LINEAR"
2385-2400	trace detection mode: "SAMPLE", "POS PK", "NEG PK"
2401-2432	"START" or "CENTER"
2433-2464	"STOP" or"SPAN"
2465-2496	"OFFSET" for amplitude
2497-2528	"DL"
2529-2560	"TH"
2561-2624	"MKR" or "CNTR" or "MKR Δ"
2625-2656	"OFFSET" for frequency
2657-2668	"VID AVG"
2689-2751	title
2753-2768	"YTO UNLOCK"
2769-2784	"249 UNLOCK"
2785-2800	"275 UNLOCK"
2801-2816	"OVEN COLD"
2817-2832	"EXT REF"
2833-2848	"VTO UNCAL"
2849-2864	"YTO ERROR"
2865-2879	"MEAS UNCAL" or "*"
2880-2944	frequency diagnostics
2945-2960	"2ND LO", "↑","↑"
2961-2976	"SRQ" number
2977-3007	center frequency "STEP"
3008-3071	active function readout

*" " indicate the CRT annotation stored, values included where applicable.

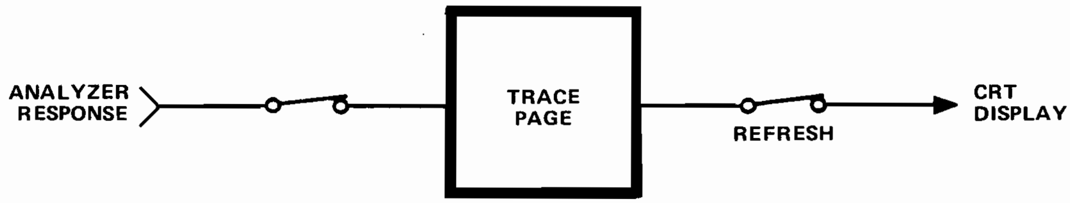
Data Transfer

The trace functions dictate the way in which data is input to and output from the trace page.

This section describes each TRACE function in terms of the interactions of the analyzer response, trace page and CRT display. The events are listed in chronological order, starting from when the trace function is activated. In each case, the analyzer accepts the function command immediately.

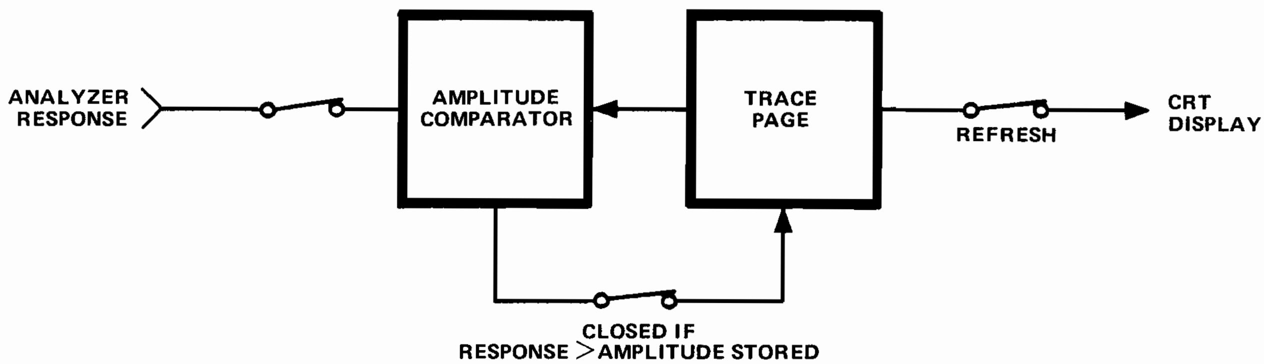
Clear-Write

1. Sweep is stopped.
2. Zero is written into each trace address and displayed on the CRT in one refresh.
3. On the next trigger, the sweep is started from the start frequency (CRT display left), and the amplitudes are written into memory.



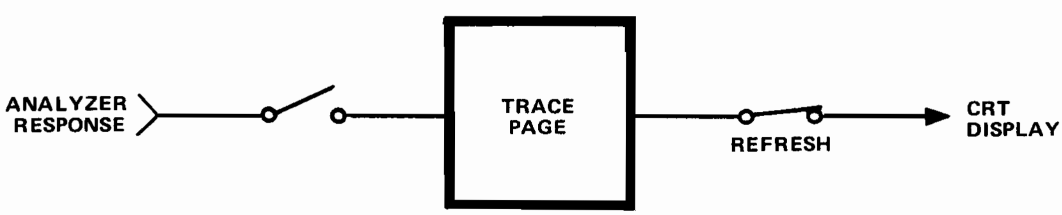
Max Hold

1. Sweep is stopped, but restarts from the left on the next trigger.
2. During each subsequent refresh, the amplitude stored at each trace memory address is compared to the corresponding analyzer response. The largest of the two will be stored at the trace address.



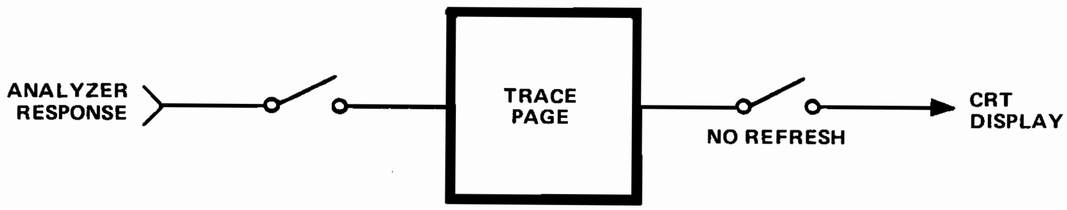
View

1. The sweep is stopped and the trace is displayed on the CRT.



Blank

1. The sweep is stopped and the trace is not displayed.



Exchange A and B

1. The sweep is stopped. If either trace is in a WRITE mode, it is placed in view.
2. The contents of traces A and B are exchanged.

A – B→A On

1. The sweep is stopped and trace B is placed in a STORE mode.
2. A is replaced with A-B.
3. The sweep is continued from where it stopped. Each new analyzer response point is reduced by the amount stored in the corresponding address of trace B, and the result is stored in trace A. This process continues at the sweep rate.
4. Subsequent sweeps will continue the process.

A – B→A Off

1. The analyzer response is written directly into trace A. Trace B and mode are not changed.

B – DL→B

1. Trace B is placed in view. Trace A is not changed.
2. The amplitude stored in the display line register is subtracted from the contents in each trace B address and the result stored at the same trace B address.

Appendix B**

ADVANCED DISPLAY PROGRAMMING

This appendix describes the explicit CRT display programming possible with the analyzer's display language.

A display program allows additional graphics capability on the CRT of the spectrum analyzer beyond those discussed in Chapter 4. Explicit display programming uses less display memory, allowing more efficient use of the 4096 display addresses available.

Appendix A, Display Memory Structure, provides background material for this section.

Display Program

A display program consists of a specific set of display instructions and data words written into the display memory. The **display instructions** dictate the operating mode of the CRT circuitry, such as label, graph or plot. The **data words** direct the CRT beam according to the preceding instruction.

Display instructions and data words are written into memory when the display programming codes are used. For example, the code "PA 500,600" writes into the display memory the instruction code for vector, 1026, followed by the x and y data values 500 and 600. This same "plot absolute" command could just as well been written as a display program by writing "1026, 500, 600" into the display memory. The display program is "executed" over and over to refresh the CRT from memory.

The commands necessary for writing display programs into memory are:

DA <display address> puts the address into the display address register (referred to as the current address). (Display address means display memory address.)

DW <instruction or data write> writes the instruction or data word into the current display address.

DD <binary instruction or data write> writes the two 8 bit binary words into the current address.*

DR <display read> outputs the contents of the current address on to the HP-IB data lines to be read by the HP-IB controller.

Appendix C discusses the syntax of each of these commands in more detail.

Loading and Reading a Display Program

Instructions and data words are loaded directly into the analyzer's display memory by, first, specifying the beginning address of the program, then writing in the instructions and data serially. To write the "1026, 500,600" program beginning at address 1024, which is the first address of trace B, execute

```
0: wrt 718,"DA1024DW1026,500,600" **
```

This display program instructs the display to draw a vector to the position (500,600) on the CRT.

To read and print out the display program, run:

*The first byte contains the four most significant bits, the second contains eight least significant bits of the 12 bit instruction or data word.

**All examples in Appendix B use the 9825A Computing Controller.

```
0: fmt
1: wrt 718,"01DA1024"
2: for I=1 to 3
3: wrt 718,"DAOA"
4: red 718,A
5: wrt 718,"DR"
6: red 718,W
7: wrt 6,A,W
8: next I
9: end
```

Address	Contents
1024.00	1026.00
1025.00	500.00
1026.00	600.00

Line 1: Formats for decimal word values, sets the first address to be read.

Lines 2-8: Read and print three successive display program addresses and their contents. The address is automatically incremented by one for each DR execution.

Line 3: Calls for the output of the display address.

Line 5: Calls for the output of the current display address contents.

The following sections define and outline the instruction and data words. The final section provides detailed examples of display programming and a consolidated coding sheet.

Display Program Word

A display program word can be a value from 0 to 4095. The value is stored as a 12 bit binary word, and several of the bits define the type of word. Graphic representations used in this appendix are defined as follows:

	MSB											LSB	
bit	11	10	9	8	7	6	5	4	3	2	1	0	Decimal total:
	0	1	0	X	X	X	X	X	X	X	1	0	1026 +
decimal value	2048	1024	512	256	128	64	32	16	8	4	2	1	

where x is either a 1 (true) or a 0 (false).

The sample word displayed is 1024 + 2 = 1026, the instruction control word for vector used in the previous examples.

Instruction Words

There are three types of instruction words:

		11	10	9	8	7	6	5	4	3	2	1	0	
1:	**Display control**	0	1	0	X	X	X	X	X	X	0	X	X	1024 +
2:	**Program control**	0	1	0	X	X	X	X	X	X	0	1	1	1027 +
	including end of display	0	1	0	X	X	X	X	X	X	1	X	X	1028 +
3:	**Count/Threshold**	0	1	1	X	X	X	X	X	X	X	X	X	1536 +

Display Control Instructions

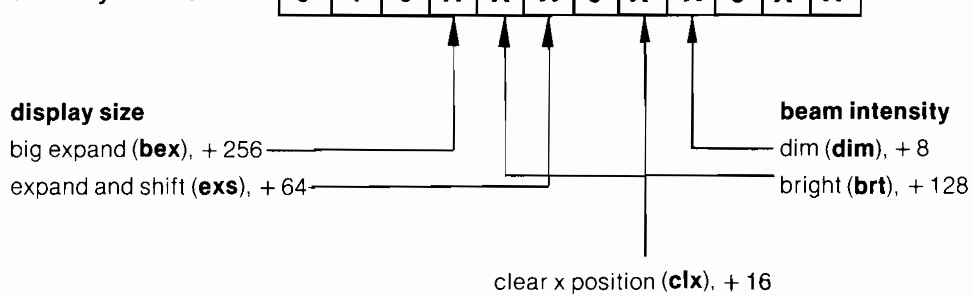
The display control instruction instructs the CRT circuitry on how to use the subsequent data words to direct the CRT beam. The word 1026, vector, is an example. Data values in a display program following 1026 will direct the CRT beam to x,y positions. The two other display control words are label, which writes characters on the CRT, and graph, which displays traces.

	11	10	9	8	7	6	5	4	3	2	1	0	
vector (vtr)*	0	1	0	X	X	X	0	X	X	0	1	0	1026 +
label (lbl)	0	1	0	X	X	X	0	X	X	0	0	1	1025 +
graph (gra)	0	1	0	X	X	X	0	X	X	0	0	0	1024 +

where + indicates that additional bits can be set without changing the primary function.

The syntax of vector, label and graph are similar to their programming code counterparts PA/PR, LB and GR, respectively. Pen up/down, changing display size and beam intensity are controlled by setting various bits along with the control instructions and data word. These functions are called ancillary functions to the instruction.

	11	10	9	8	7	6	5	4	3	2	1	0
ancillary functions	0	1	0	X	X	X	0	X	X	0	X	X



*Abbreviations within the parenthesis are useful as a short hand notation for writing display programs. They are not programming codes.

clear x position (**clx**): The x axis display position is reset to the far left (0,y).

big expand (**bex**): The x and y CRT beam deflection is amplified by a 1.49 factor.[1]

expand and shift (**exs**): The x and y CRT beam deflection is amplified by a 1.13 factor (expand) and the (zero, zero) reference point is shifted to the lower left of the CRT screen (shift).[1]

dim(**dim**): Sets the CRT beam intensity below the normal level.[2]

bright (**brt**): Sets the CRT beam intensity to the maximum level.[2]

Program Control Instructions

The display program will normally execute the contents of memory starting with address 0 and working consecutively to address 4095. Program control instructions are used to alter the normal flow of a program by allowing program execution to be transferred anywhere in memory. These program control words allow jumps to specific display addresses (jmp), jumps to a display program subroutine (jsb), returns (ret), skips to the next control instruction (skc) and a word that simulates a "for . . . next" loop, the decrement and skip on zero (dsz).

	11	10	9	8	7	6	5	4	3	2	1	0	
jump (jmp)	0	1	0	X	0	0	0	X	1	0	1	1	1035
jump to subroutine (jsb)	0	1	0	X	1	0	0	X	1	0	1	1	1163
return (ret)	0	1	0	X	1	1	0	X	1	0	1	1	1227
skip to next control instruction (skc)	0	1	0	X	X	X	0	X	0	0	1	1	1027
skip to next memory page (skp)	0	1	0	X	X	X	1	X	0	0	0	0	1056
decrement and skip on zero (dsz)	0	1	0	X	0	1	0	X	1	0	1	1	1099

The address to be jumped to is the contents of the memory word following the jmp or jsb instruction. For example, "1035, 2048" causes program execution to jump to address 2048. The address given should contain a control instruction, that is, an instruction whose three most significant bits are 0 1 0. (If the address does not contain a control instruction, the program will go to the first control instruction following the specified address.) A return (ret) causes the program execution to return to the first control instruction following the jsb instruction which sent it to the subroutine.

NOTE

Subroutines must not contain label or graph control words. A subroutine may not call another subroutine.

---

(1)The display size commands combine these size instructions as follows:

	instructions	ratio to D1	origin shifted
D1	none	1.00	no
D2	**exs**	1.13	yes
D3	**bex** and **exs**	1.68	yes
—	**bex**	1.49	no

(2)The intensity of the beam is also dependent upon line length. Lines longer than a preset length will be brighter because beam writing rate is slowed.

The skip to next control instruction (skc) causes program execution to go to the next control instruction in memory. The skip to next page (skp) instruction causes program execution to go to the next address which is an integer multiple of 1024. (An instruction which combines skp **and** skc, 1056 + 3 = 1059, will execute as if it were a skp followed by a skc.)

The decrement and skip on zero (dsz) instruction decrements an internal count register then tests the contents for zero. If the contents are not zero, the program goes to the next control instruction. If the contents equal zero, the program will skip the next two addresses then go to the next control instruction. For example, "1099, 1035, 1532, 1026" causes the program to skip to the control word 1026 if the counter register is zero; otherwise it executes the 1035, 1532 which is a jump to address 1532. See Count Register below.

The ancillary control function clear x position (clx) can be added to any of the program control instructions.

Another method of causing skips in program execution is in conjunction with the label mode (either LB or lbl). These are discussed in the Data Word section following.

End of Display

	11	10	9	8	7	6	5	4	3	2	1	0	
end of display (end)	0	1	0	X	X	X	X	X	X	1	X	X	1028 +

When executed, the end of display instruction terminates execution of the display program. The next execution of the program will begin at display address zero upon the next display refresh trigger (note refersh trigger and sweep trigger are not the same).

The end of display instruction bit supercedes all other coding in the instruction except the ancillary function clear x position, clx (bit 4), which may be added. The end instruction will cause a default to graph mode at the beginning of the next program execution if no display control instruction is located at address zero.

Since the fast sweep (direct display of video and sweep) is displayed between program executions, an end instruction is required for the proper operation of the fast sweep display.

An end of display in trace C will be changed to a skip to next memory, 1056, when BC exchange is executed.

Count Register/Threshold

The load counter instruction loads an internal count register with a value determined by bits 0 through 8 of the instruction. The internal register is used in two ways. When in the graph (gra) mode, the display program interprets the register contents as the display THRESHOLD position. The second use is the count register for the decrement and skip on zero (dsz) instruction. The interpretation for these two uses is shown below:

	11	10	9	8	7	6	5	4	3	2	1	0	
load count register (ldc)	0	1	1	0	X	X	X	X	X	X	X	X	1536 + COUNT

Bits 8–0: COUNT (1 to 255)

	11	10	9	8	7	6	5	4	3	2	1	0	
load threshold	0	1	1	0	X	X	X	X	X	X	X	X	1536 +

Bits 7–0: Display threshold position divided by 4.

	11	10	9	8	7	6	5	4	3	2	1	0	
threshold off	0	1	1	1	X	X	X	X	X	X	X	X	1792 +

NOTE

The ldc and dsz instructions use the THRESHOLD level register. Therefore a load THRESHOLD instruction must be executed after all uses of ldc and dsz **and** before the next graph command is executed. Otherwise the threshold may not function correctly.

Data Words

Data words are differentiated by the two most significant bits. The following words are data words:

11	10	9	8	7	6	5	4	3	2	1	0	
0	0	X	X	X	X	X	X	X	X	X	X	0 to 1023
1	0	X	X	X	X	X	X	X	X	X	X	2048 to 3071
1	1	X	X	X	X	X	X	X	X	X	X	3072 to 4095

The use of these data word formats depend entirely upon the type of instruction word preceding.

Graph

Each data word following a graph instruction is interpreted as a y position. Y position values follow the general rule as shown below:

	11	10	9	8	7	6	5	4	3	2	1	0	
positive data, displayed	0	0	X	X	X	X	X	X	X	X	X	X	0 to 1023 = y position
positive data, blanked	1	0	X	X	X	X	X	X	X	X	X	X	2048 + y position
negative data, blanked	1	1	X	X	X	X	X	X	X	X	X	X	4096 - y magnitude (a two's complement value)

With negative data, the CRT beam goes to y = 0. Note that negative data can result from the trace arithmetic functions A − B→A and B − DL→B.

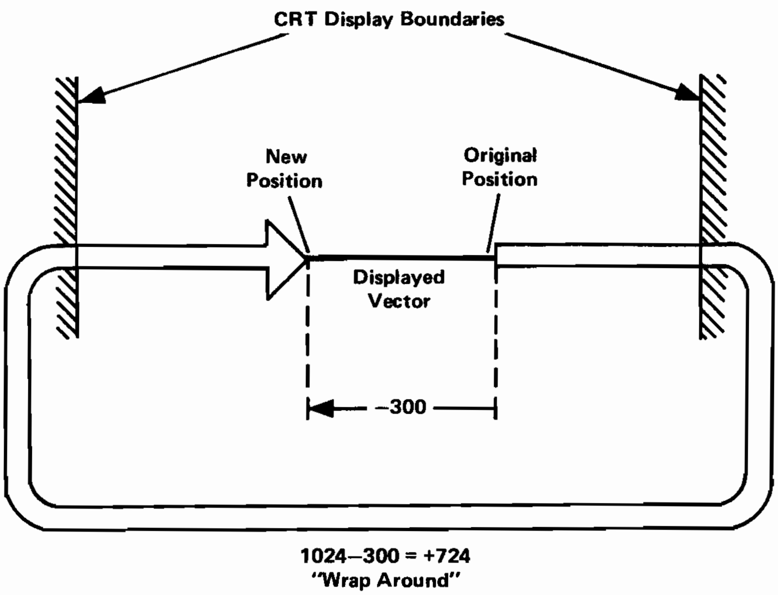
Vector

Data words following a vector (vtr) instruction are interpreted as x, y pairs. The data value determines whether the vector is blanked or displayed, absolute or relative. The x position data sets the absolute/relative ancillary function and the y position data sets the blank/unblank ancillary function.

	11	10	9	8	7	6	5	4	3	2	1	0
x position	R	0	X	X	X	X	X	X	X	X	X	X
y position	B	0	X	X	X	X	X	X	X	X	X	X

when R = 1	(x position + 2048) vector is relative (both x and y are relative)
R = 0	(x position + 0) vector is absolute (both x and y are absolute)
B = 1	(y position + 2048) vector is blanked (pen up)
B = 0	(y position + 0) vector is displayed (pen down)

Negative values for the plot relative x and y positions are entered as complementary values of 1024 to the ten least significant bits of the data word. For example, a plot relative −300 of x position is written in the data word as (1024 − 300) = 724. The actual plot "wraps around" the display to find the −300 position.



	10	9	8	7	6	5	4	3	2	1	0	
x & y negative relative	X	0	X	X	X	X	X	X	X	X	X	0-1023

(bits 10–0: 1024 − \|negative value\|)

Label

Data words following the label instruction are interpreted as character codes.

	11	10	9	8	7	6	5	4	3	2	1	0
character data word	X	X	X	X								

(bits 7–0: 8 bit character code)

The four most significant bits are not used. However, the two most significant bits must not be 0,1 respectively or the word would become a control instruction.

A specific set of character codes provide special label functions:

	Code
null	0
back space (BS)	8
line feed (LF)	10
vertical tab (opposite of line feed) (VT)	11
form feed (move beam to (0,0)) (FMFD)	12
carriage return (CR)	13
blink on (bkon)	17
blink off (bkof)	18
space (SP)	32
skip to next 16 block (sk16)	145
skip to next 32 block (sk32)	146
skip to next 64 block (sk64)	147

A blink on (bkon) will cause blinking of everything drawn on the display until a subsequent blink off (bkof) or an end of display (end) instruction is encountered with program execution.

A skip 16, 32 or 64 will cause program execution to go to the next address which is an integer multiple of 16, 32, or 64 respectively.

Note that these functions will work for both the lbl instruction code (1025 +) or the LB command.

Display Control Instruction Examples

These examples illustrate the use of display control instructions and data words. The loading and reading techniques described at the start of this appendix are used.

Graph (gra)

The graph instruction is used in the trace modes to plot the spectral traces on the CRT display. The graph display instruction along with ancillary functions can be used to visually modify stored trace data.

For example, in a trace stored in trace B memory, the portion between the 5th and 7th graticule line can be highlighted by making the trace brighter. First calculate the addresses where that trace data is stored

5th graticule address = 5(100) + 1024 = 1524
7th graticule address = 7(100) + 1024 = 1724
where 1024 is the first address of trace B.

Next, make up the graph instruction that will brighten the trace from the ancillary function codes:

1024 (gra) + 128 (brt) = 1152
1024 (gra) + 8 (dim) = 1032

With trace B in view the loading program is

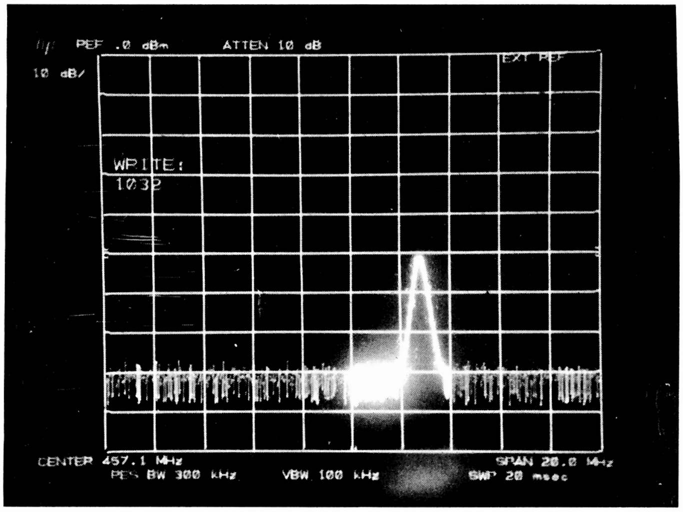
```
0: fmt
1: wrt 718,"DA1524DW1152"
2: wrt 718,"DA1724DW1032"
```

Line 1: Writes a graph/bright instruction so that every data point thereafter is brightened.

Line 2: Returns the beam intensity to dim.

Data points at 1524 and 1724 are lost and all data beyond 1524 is shifted 1 point to the left. All data beyond 1724 is shifted 2 points to the left.

These instructions will be written over when new trace information is written into trace B.



Vector (vtr)

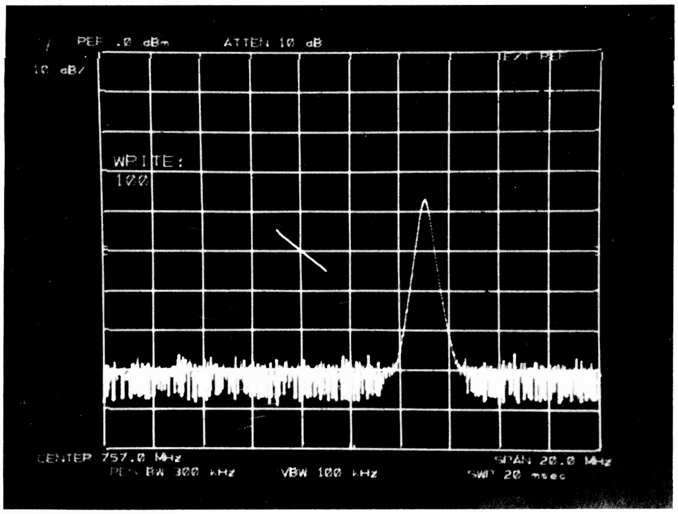
Instructions can be used to draw lines on the CRT display. The data words each determine whether the data is plotted absolute/relative or blanked/unblanked (pen up/pen down). The ancillary functions apply to the vector instructions.

For example, a line is to be plotted on the display with plot relative instructions in trace C memory beginning at address 3072.

address	description	program	word
3072	vector	vtr	1026
3073	x = 450 absolute	450 + 0	450
3074	y = 450 blanked	450 + 2048	2498
3075	x = − 100 relative	(1024-100) + 2048	2972
3076	y = + 100 relative pen down	100 + 0	100

The load program is:

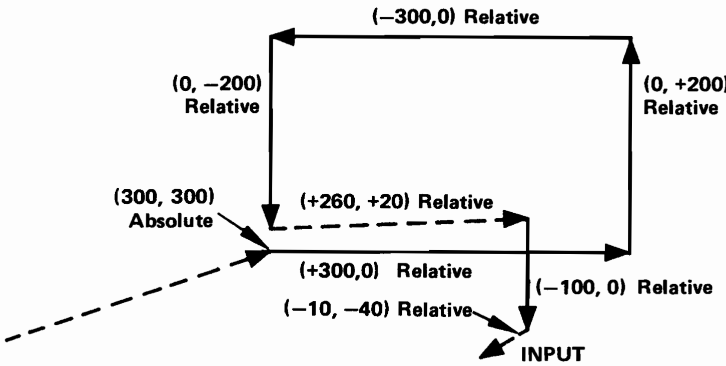
```
0: wrt 718,"DA3072DW1026,450,2498,2972,100"
```



Vector and Label (vtr and lbl)

To demonstrate the display instructions, a simple block diagram will be drawn and labelled. Then the control words will be modified with some of the ancillary functions to demonstrate their use.

First a graphics plan is drawn:



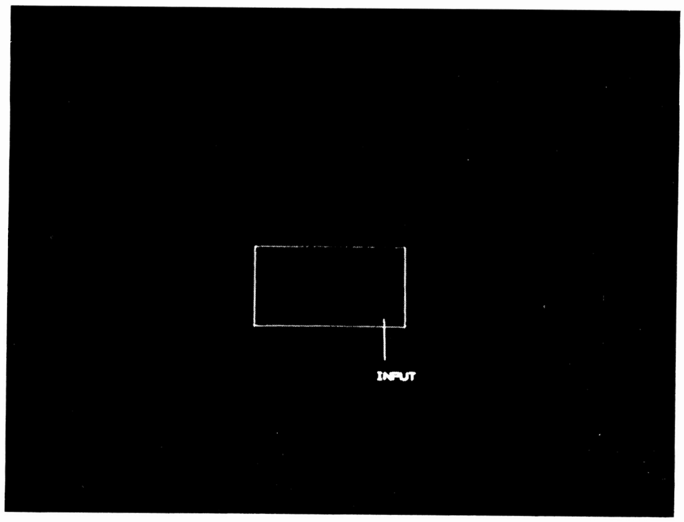
Graphics Plan

The vectors with + and − signs are relative vectors, the others are absolute points. Dashed lines are to be blanked.

address	description	program	word
3072	vector absolute	vtr	1026
3073	x = 300 absolute	300 + 0	300
3074	y = 300 pen up	300 + 2048	2348
3075	x = +300 relative	300 + 2048	2348
3076	y = 0 pen down	0 + 0	0
3077	x = 0 relative	0 + 2048	2048
3078	y = +200 pen down	200 + 0	200
3079	x = −300 relative	(1024-300) + 2048	2772
3080	Y = 0 pen down	0	0
3081	x = 0 relative	0 + 2048	2048
3082	y = −200 pen down	(1024-200) + 0	824
3083	x = +260 relative	260 + 2048	2308
3084	y = +20 pen up	20 + 2048	2068
3085	x = 0 relative	0 + 2048	2048
3086	y = −100 pen down	(1024-100) + 0	924
3087	x = −10 relative	(1024-10) + 2048	3062
3088	y = −40 pen up	(1024-40) + 2048	3032
3089	label	lbl	1025
3090	the word "INPUT"	I	73
3091		N	78
3092		P	80
3093		U	85
3094		T	84
3095	end of display	end	1028

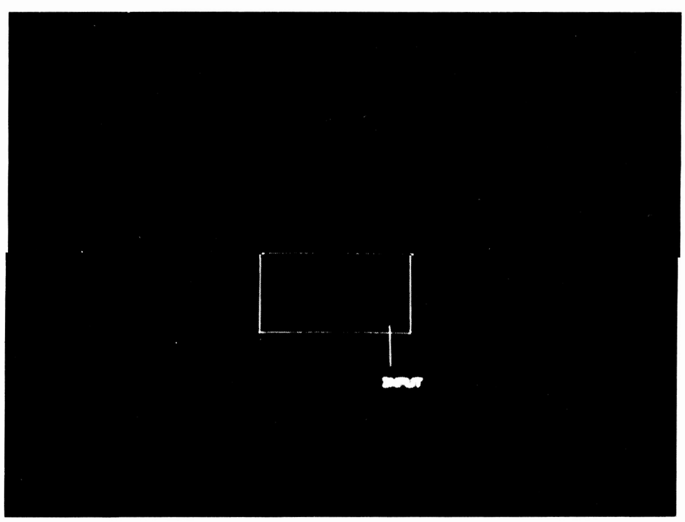
The above plan can then be programmed and run.

```
0: fmt
1: wrt 718,"IPKSoKSmA4"
2: wrt 718,"DA3072DW1026,300,2348,"
3: wrt 718,"2348,0,2048,200,"
4: wrt 718,"2772,0,2048,824,"
5: wrt 718,"2308,2068,2048,924,"
6: wrt 718,"3062,3032,"
7: wrt 718,"1025,73,78,80,85,84,1028,"
```



The display can now be modified by adding various ancillary functions to the existing control words. Brighten the "INPUT" term by adding 128 (brt) to the label address 3089 (1025 + 128 = 1153).

7: wtb 718, "LB",17,"INPUT",18,"1028,"



The label "INPUT" can be made to blink by adding blink on (bk on) and blink off (bk of) words before and after the "INPUT" label.

7: wrt 718, "1025,17,73,78,80,85,84,18,1028"

Alternately line 7 could have been written:

7: wtb 718, "LB", 17, "INPUT", 18, 1028,

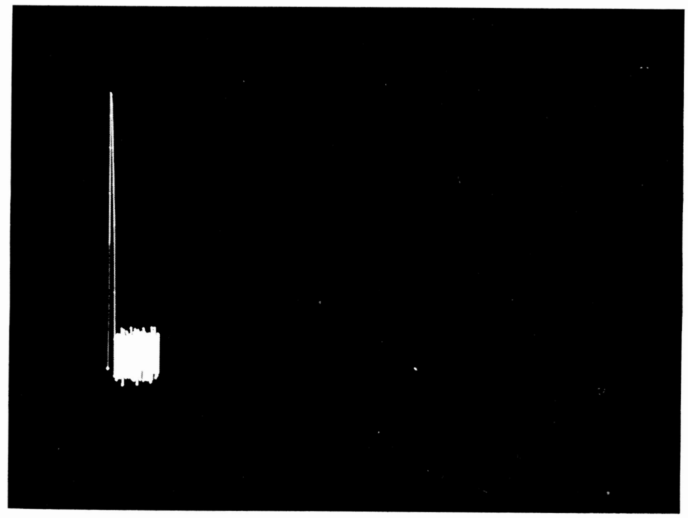
Program Control Instruction Examples

These examples use both program and display control instructions.

End of Display (end) and Skip to Next Memory Page (skp)

To end the display after the first 100 points of trace A write "DW 1028" into address 100.

wrt 718, "S2TSDA100DW1028"



All display memory information beyond the address 100 is ignored, including the annotation. Note that the analyzer sweep has been stopped with S2 to prevent signal response data from writing over the control word.

Skip control words allow certain portions of the display to be omitted from the display. There are two types of skip control words which enable 1) skip over the remainder of the present memory page to the beginning of the next memory, 2) skip to the next control word.

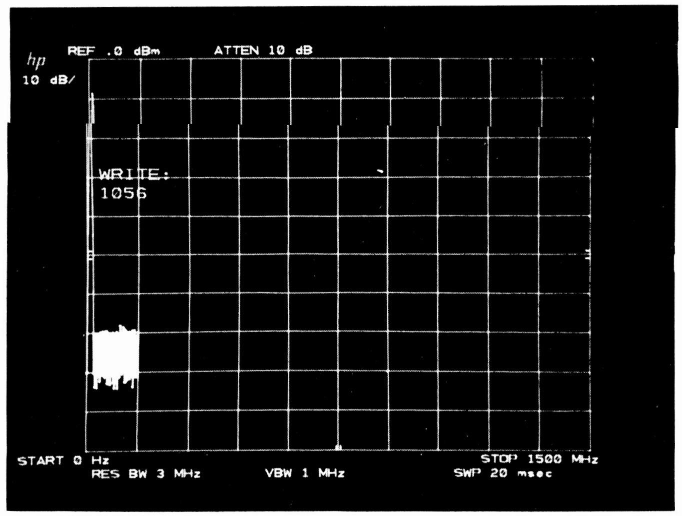
The skip page and skip to next control word have been assigned the two command codes PS and SW, respectively.

In the above example, the annotation was ignored because of the end of display written into address 100. If instead, a skp is written, the rest of the display memory can be displayed while omitting the remainder of trace A.

wrt 718, "S2TSDA100DW1056"

or

wrt 718, "S2TSDA100PS"*



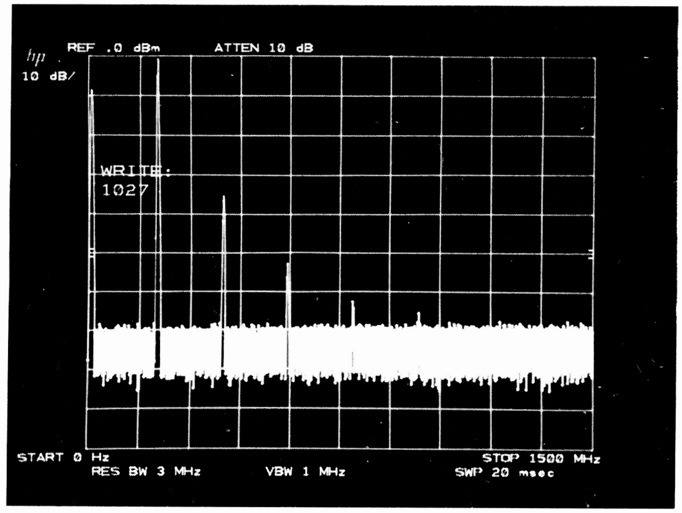
*The programming code PS can be substituted for DW1056.

A skp written into the trace C page will skip the refresh pointer to DA 0 (trace A). This may cause an increase in the trace intensity since the program will not wait for a refresh trigger before beginning the next execution of the program.

Skip to Next Control Instruction (skc)

Program control is transferred to the next control instruction

For example, address 2073 of the annotation memory page contains the label control word which places the center frequency "| |" mark on the CRT. To omit this marker from the display, the label word is replaced by a skc word.



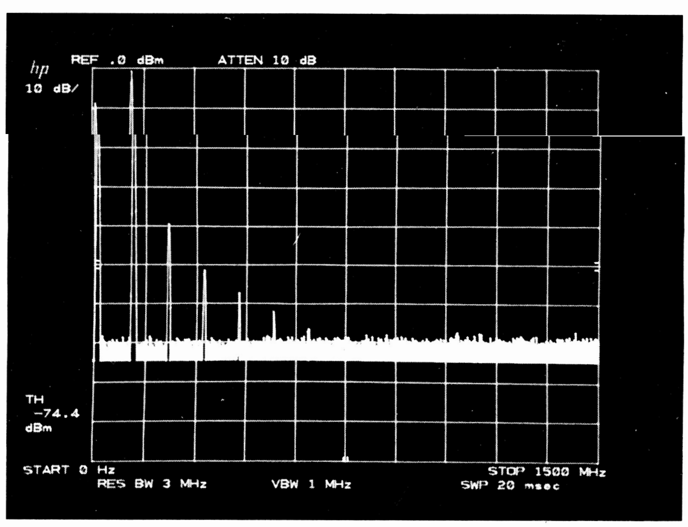
wrt 718, "DA2073DW1027"

or

wrt 718, "DA2073SW"*

Jump (jmp)

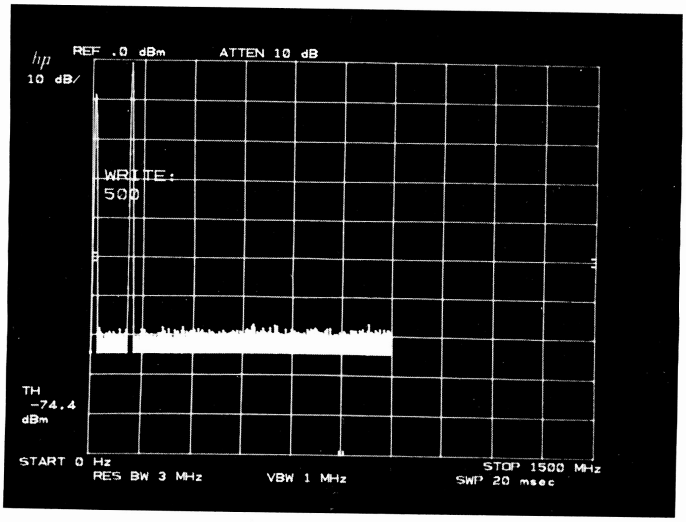
The example demonstrates jmp by jumping over the data in addresses 100 to 500 in trace A. Since the jump should be made to a control word, gra is first written into DA 500.



Before program is loaded.

*The programming code SW can be used for DW 1027.

wrt 718, "S2TSDA500DW1024"
wrt 718, "DA100DW1035,500"

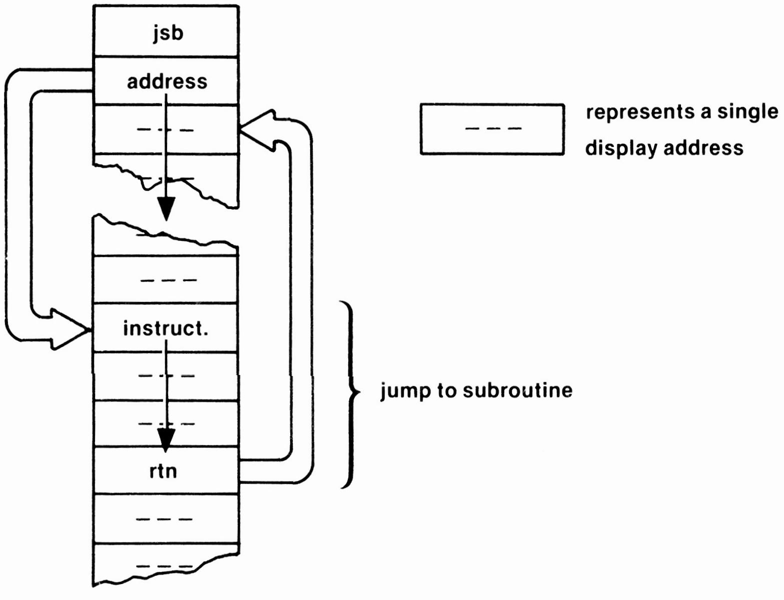


The signal response that would have been shown between display addresses 100 and 500 is omitted and the gap closed.

Jump Subroutine (jsb) and Return (rtn)

The jsb instruction transfers program control to the address specified. If the address does not contain a control word then the program will skip to the next control word after that address. The rtn instruction transfers program control to the first control word following the jsb instruction.

The flow of the program is as follows:



To demonstrate jsb/rtn, this example substitutes a new symbol for the preprogrammed marker symbol.

The marker symbol (a small diamond) is written as a subroutine in the annotation memory at address 2085. Substitution of the diamond symbol can be made by calling for and writing a new jsb routine with this program. The address for the marker subroutine call is located at display address 2054.

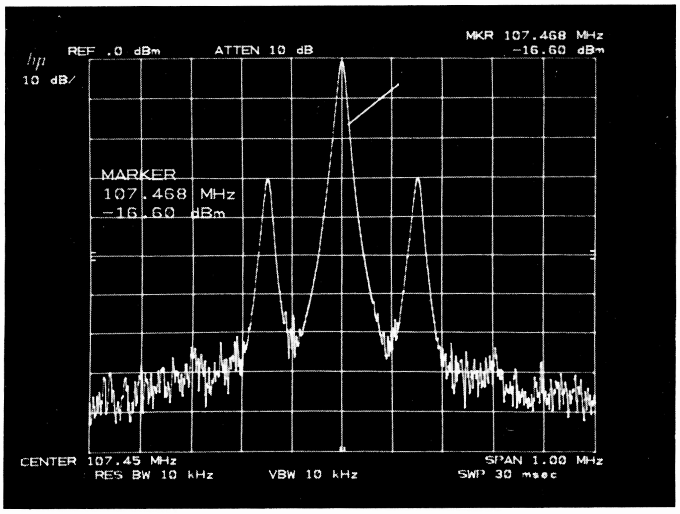
```
0: fmt
1: wrt 718,"DA2054 DW3080"
2: wrt 718,"DA3080 DW1154,2148,100"
3: wrt 718,"1227"
```

Line 1: Rewrites a new subroutine address, 3080, in place of the old one.

Line 2: Writes the new symbol vector subroutine starting at address 3080.

Line 3: Return

After running this program, the display memory contains the following:



Loop Instructions:

Load Counter Register (ldc) and Decrement and Skip on Zero (dsz)

As an example, looping will be used to draw a grid in two places on the CRT display in one refresh. The trace C page will be programmed to contain the graphics.

	address	description	program	word
	3072	plot absolute	vtr	1026
	3073	x = 600 (PA)	600	600
	3074	y = 300 (PU)	300 + 2048	2348
	3075	jump sub	jsb	1163
positioning vector	3076	to subroutine	address	3199
	3077	plot absolute	vtr	1026
	3078	x = 100 (PA)	100	100
	3079	y = 300 (PU)	300 + 2048	2348
	3080	jump sub	jsb	1163
	3081	to	address	3199
	3082	end of display	end	1028
	3199	vector	vtr	1026
	3200	repeat 10 times	ldc + 10	1546
	3201	plot relative	vtr	1026
	3202	x = 0 (PR)	0 + 2048	2048
	3203	y = +25 (PU)	25 + 2048	2073
	3204	x = +300 (PR)	300 + 2048	2348
looping subroutine	3205	y = 0 (PD)	0	0
	3206	x = 0 (PR)	0 + 2048	2048
	3207	y = +25 (PU)	25 + 2048	2073
	3208	x = −300 (PR)	1024-300 + 2048	2772
	3209	y = 0 (PD)	0	0
	3210	decrement	dsz	1099
	3211	jump to	jmp	1035
	3212	start	address	3201
	3213	return	rtn	1227

The program can then be written loading the words sequentially as listed in the above plan.

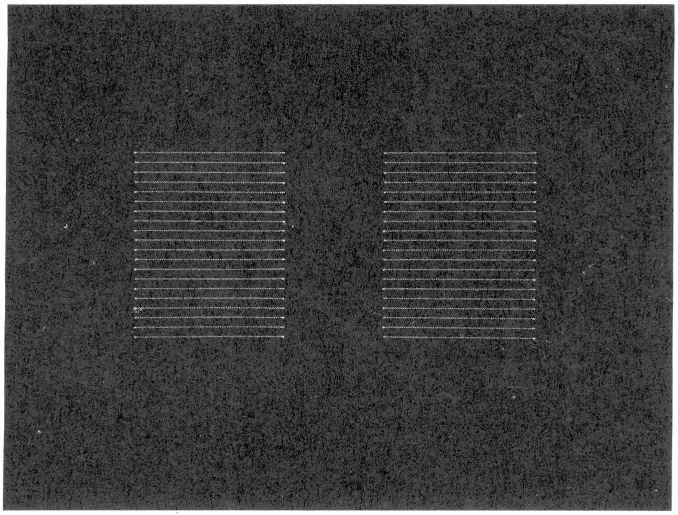
```
0: fmt
1: wrt 718,"IPKSoKSmA4"
2: wrt 718,"DA3072DW1026,600,2348,"
3: wrt 718,"1163,3199,1026,100,2348,1163,3199,"
4: wrt 718,"1028,"
5: wrt 718,"DA3199DW1026,1546,1026,"
6: wrt 718,"2048,2073,2348,0,2048,2073,2772,0,"
7: wrt 718,"1099,"
8: wrt 718,"1035,3201,"
9: wrt 718,"1227 HD"
10: end
```

Line 1: Initializes the analyzer.

Line 2 & 3: The positioning vectors.

Line 4: A skip to next memory insures that the following loop (DA 3199) is not refreshed unless called from addresses 3075 and 3080, the jsb words.

Running the program results in the following display:



INSTRUCTION AND DATA WORD SUMMARY

Display Control Instruction	Data	Word
graph (gra)		1024
	amplitude: position unblanked	y
	position blanked	y + 2048
	negative blanked	4096-|y|
label (lbl)		1025
	character	ASCII or special character code (≤255)
	blink on (bkon)*	17
	blink off (bkof)*	18
	skip to next 16 block (sk16)*	145
	skip to next 32 block (sk32)*	146
	skip to next 64 block (sk64)*	147
vector (vtr)		1026
	x position	data in display units
	y position	data in display units
	absolute vectors	x + 0
	relative vectors	x + 2048
	pen down	y + 0
	pen up (blanked)	y + 2048
Ancillary to gra, lbl and vtr instruction word:		
big expand (bex)		word + 256
expand and shift (exs)		word + 64
bright (brt)		word + 128
dim (dim)		word + 8
clear x position		word + 16
Program Control Instruction	**Data**	**Word**
end of display (end)		1028
skip to next memory page (skp)		1056 or "PS"
skip to next control word[1] (skc)		1027 or "SW"
jump[1](jmp)		1035
	address	0 to 4096
jump to subroutine[1] [3] (jsb)		1163
	address	0 to 4096
return[1] [3] (ret)		1227
decrement and skip two addresses on zero[1] [2] (dsz)		1099
load counter (THRESHOLD position)[2](ldc)		1536 + (count)

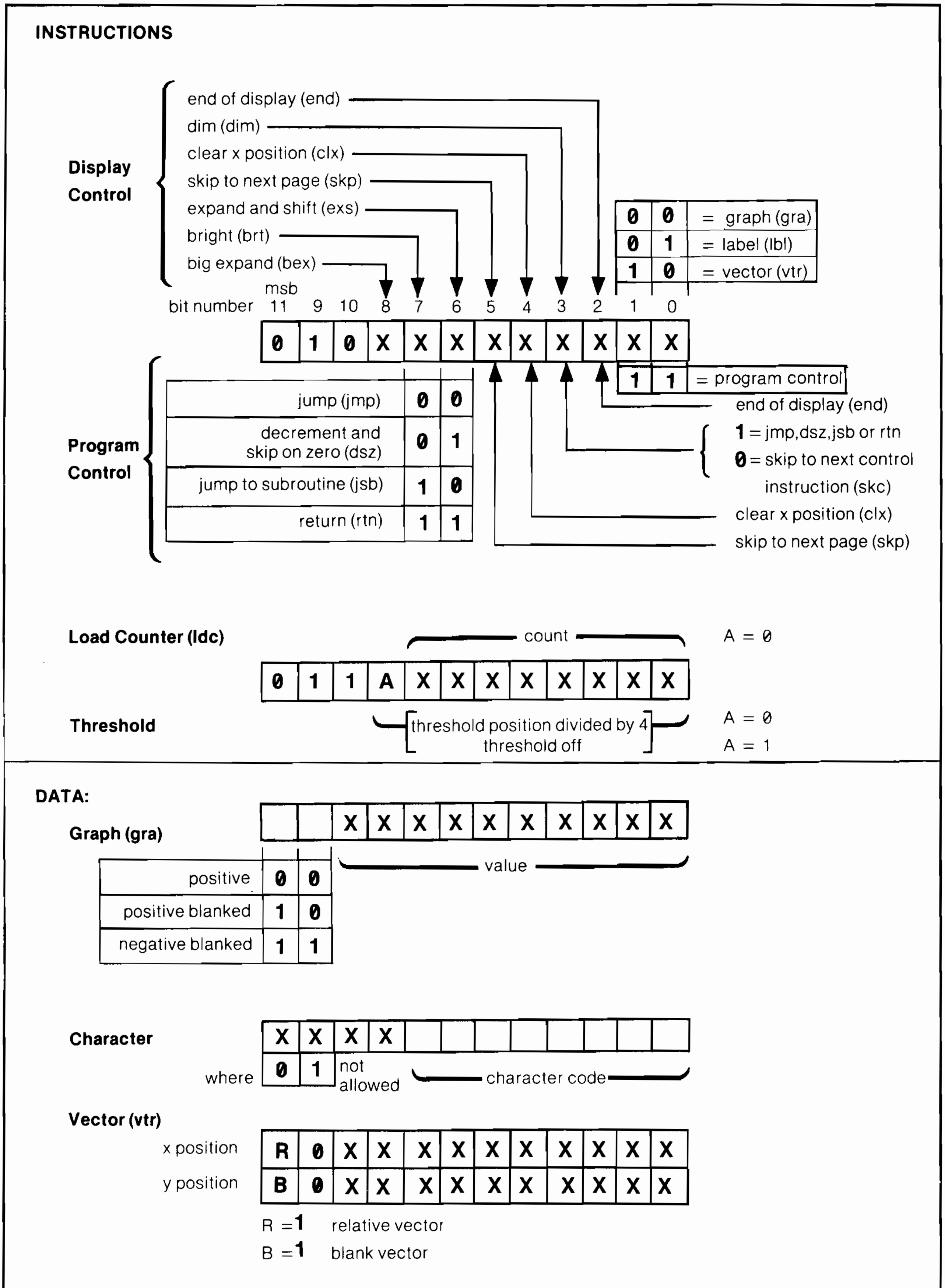
* These can also be accessed using the LB command. These functions can be initiated any time the label mode is active.

(1) Jumps and skips will skip to an address containing a control word.

(2) Loop should use only lbl and vtr control words. ldc is **not** a control word.

(3) Subroutines may use only vtr control words.

CONSOLIDATED CODING



Appendix C

SYNTAX REQUIREMENTS

This appendix summarizes the syntax of the 8568A Spectrum Analyzer programming codes when controlled by an HP-IB Controller. HP-IB is Hewlett Packard's implementation of IEEE Standard 488-1975 and ANSI Standard MC1.1, "Digital Interface for Programmable Instrumentation".

Notation Conventions

< > — Items enclosed within angular brackets are considered to be elements of the language being defined.

: : = — "Is defined as": <A> : : = <B> <C> indicates that <A> can be replaced by the series of elements <B> < C> in any statement which <A> occurs.

[ ] — Square brackets indicate that whatever occurs within the brackets is optional.

| — "or": Indicates a choice of exactly one element from a list. (e.g., <A> | <B> indicates <A> or <B> but not both.

Definitions

<listen> : : = — Controller addresses analyzer to listen.

<talk> : : = — Controller addresses analyzer to talk.

<value> : : = — A number, either fixed or floating point format.

<address> : : = — The next display memory address to be accessed.

<format> : : = — 01 | 02 | 03 | 04, the format of data output from the analyzer.

Data Entry to Analyzer

<entry> : : = <value> <terminator> | <units code> | <entry> <entry>
<terminator> : : = <units code> | <delimiter>
<delimiter> : : = <CR> | <LF> | , | ; | <ETX> (enters Hz, dB, volts or seconds)
<CR> : : = 13_{10} (ASCII carriage return)
<LF> : : = 10_{10} (ASCII line feed)
<ETX> : : = 3_{10}
< unitscode > : : = DM | – DM | DB | HZ | KZ | MZ | GZ | MV | UV | SC | MS | US

units of power:
DM : : = <dBm> | <dBmV> | <dBμV> | DB | GZ
– DM : : = < – dBm> | < – dBmV> | < – dBμV> | SC | MZ

units of voltage:
MV : : = <mV> | KZ | MS
UV : : = < μV> | Hz | US

units of frequency:
HZ : : = <Hz> | UV | US
KZ : : = <kHz> | MV | MS
MZ : : = <MHz> | – DM | SC
GZ : : = <GHz> | DM | DB

units of time:
SC : : = <sec> | MZ | – DM
MS : : = <msec> | KZ | MV
US : : = <μsec> | HZ | UV

<step> : : = UP | DN

Data Output From Analyzer

Output commands can be aborted during the output by addressing the analyzer to listen and issuing any legal command.

The final single character of any output will pull EOI true for data valid condition.

Syntax

Code	Syntax	Function
AT	<listen> AT[<entry> | <step>]	RF input attenuator
A1	<listen> A1	Clear write trace A
A2	<listen> A2	Max hold trace A
A3	<listen> A3	View trace A
A4	<listen> A4	Blank trace A
BL	<listen> BL	B – DL→B
B1	<listen> B1	Clear write trace B
B2	<listen> B2	Max hold trace B
B3	<listen> B3	View trace B
B4	<listen> B4	Blank trace B
CA	<listen> CA	Couples RF input attenuator
CF	<listen> CF[<entry> | <step>]	Center frequency
CR	<listen> CR	Couples resolution bandwidth
CS	<listen> CS	Couples center frequency step size
CT	<listen> CT	Couples sweep time
CV	<listen> CV	Couples video bandwidth
C1	<listen> C1	A – B off
C2	<listen> C2	A – B→A on
DA	<listen> DA[<entry>]	Sets display memory address
DB	see <units code>	
DD	<listen>[<address>] DD <binary value> <binary value> where <address> set by DA.	Writes two 8-bit binary bytes (O4 format) into display address selected.
DL	<listen> DL [<entry> | <step>]	Enables display line and places it at the value level entered.
DM	see <units code>	
DN	<listen> DN (also see <step>)	DATA step down
DR	<listen>[<format>][<address>] DR <talk>	Outputs the contents of designated display address onto the HP-IB data lines. The contents are formatted. Each DR increments display address by 1.
DT	<listen> DT <8 bit binary byte>	Establishes a character, in addition to <ETX>, to terminate a label (LB) entry or a title (KSE) entry. The character will not be stored in display memory when used in a label.
DW	<listen>[<address>] DW[<entry>]	Writes the value into the display address specified. Each value written increments address by one.
D1 D2 D3	<display size> : : = D1 | D2 | D3	Sets the display size for CRT graphics

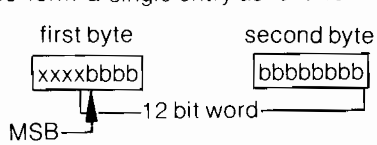
Code	Syntax	Function
EE	<listen> EE	Allows operator to make an entry to the DATA buffer with the DATA number/units keyboard while EE is active.
EK	<listen> EK	Allows operator to change any active function value with the DATA knob while EK is active.
EM	<listen> EM	Replaces trace C addresses (3073-4095) with an end of memory word, 1044. Resets the display address to 3072.
EX	<listen> EX	Exchanges A and B traces.
E1	<listen> E1	Enables peak search.
E2	<listen> E2	Marker into center frequency.
E3	<listen> E3	Marker or Δ into step size.
E4	<listen> E4	Marker into reference level.
FA	<listen> FA [<entry> | <step>]	Start frequency
FB	<listen> FB [<entry> | <step>]	Stop frequency.
FS	<listen> FS	0-1.5 GHz span.
GR	<listen>[<display size>][<address>] GR <y value> where <y value> : : = <value> <delimiter> | <y value> <y value>	Plots successive values as amplitudes on CRT display, incrementing horizontal positions left to right by one for each value. Trace starts at x = 0 position.
GZ	see <units code>	
HD	<listen> HD	Holds or disables DATA entry and blanks active function CRT readout.
HZ	see <units code>	
IB	<listen> IB <exactly 2002, 8 bit binary bytes>	Inputs trace B beginning at address 1025. CR or LF must not occur after IB.
IP	<listen> IP	Instrument preset.
I1	<listen> I1	Selects SIGNAL INPUT 1, left input port.
I2	<listen> I2	Selects SIGNAL INPUT 2, right input port.
KS	<listen> KS	Shift front panel key functions.

Note: Only shift functions which allow entries are listed. All others have the general syntax:
<listen> KS <8 bit binary byte>

Code	Syntax	Function
KSE	<listen> KSE <ASCII or analyzer character string> <title terminator> where <title terminator> : : = <ETX> | <LF> | <character selected by DT command>	Title mode characters called from analyzer character set are displayed on top line of CRT display. Up to 64 characters can be input.
KSG	<listen> KSG [<entry>]	Video averaging on. Maximum sample size set by entry value.

SYNTAX SUMMARY

Code	Syntax	Function
KSJ	<listen> KSJ <value > < delimiter>	
	each entry programs different DACS:	
	<value> HZ	L.S. VTO DAC
	<value> KZ	M.S. VTO DAC
	<value> MZ	YTO DAC
	<value> GZ	SCAN ATTEN/All DACS
	<step>	Steps all DACs by power of 2
KSP	<listen> KSP [<entry>]	Sets HP-IB address.
KSV	<listen> KSV [<entry>]	Frequency offset.
KSZ	<listen> KSZ [<entry>]	Amplitude offset.
KS =	<listen> KS = [<entry>]	Counter resolution.
KS<	<listen> KS< [<entry>]	SIGNAL INPUT 1 preamp gain.
KS>	<listen> KS< [<entry>]	SIGNAL INPUT 2 preamp gain.
KS,	<listen> KS'[<entry>] [<step>]	Input mixer level in 10 dB increments.
KS 123_{10}	<listen> <format> <address> KS 123_{10} <talk> (for HP 9825A, KS 123_{10} is KSπ)	Outputs up to 1001 words of display memory beginning at the address specified. Words are in format specified (use format O2 if KS 125_{10} or IB are to be used). Words separated by LF, last LF sets EOI true. Output may be terminated at any time with a <go to local>.
KS 125_{10}	<listen> <address> KS 125_{10} <up to 2002 eight bit binary bytes> (for HP 9825A, KS 125_{10} is KS→)	Inputs up to 1001 display memory words (two bytes per word), beginning at address specified.
KZ	see <units code>	
LB	<listen>LB<character string> <label terminator> where <label terminator> : : = <ETX>| <character selected by DT command >	Writes specified characters on the CRT display. First character appears at current CRT beam position. See PA and PR.
LG	<listen> LG [<entry>]	Enters LOG SCALE.
LL	<listen> LL	Provides a lower left x-y recorder output voltage at the rear panel for the duration while LL is active. See UR.
LN	<listen> LN	Linear SCALE.
LØ	<listen> LØ	Display line off.
MA	<listen>[<format>] MA <talk>	Outputs the marker amplitude onto the HP-IB DATA lines according to the format.
MCØ	<listen> MCØ	Marker counter measurement off.
MC1	<listen> MC1	Marker counter measurement on.
MF	<listen> [<format>] MF <talk>	Outputs the marker frequency onto the HP-IB DATA lines according to the format.
MS	see <units code>	

Code	Syntax	Function
MTØ	<listen> MTØ	Signal track off.
MT1	<listen> MT1	Signal track on.
MV	see <units code>	
MZ	see <units code>	
M1	<listen> M1	Marker off.
M2	<listen> M2 [<entry> | <step>]	Enables single marker, MARKER normal mode. Marker moves to frequency position of entry value in Hz. Entry must be positive.
M3	<listen> M3 [<entry> | <step>]	Enables second marker. Second marker moves to differential frequency position of entry value in Hz. Entry may be positive or negative.
M4	<listen> M4 [<entry> | <step>]	Enables marker zoom. Marker moves to frequency position of entry value in Hz. Step up or down changes span.
OA	<listen>[<format>] OA <talk>	Outputs the active function value.
OL	saving instrument state: <listen> OL <talk> <80,8 bit binary bytes>	Outputs coded instrument state information into the 80 binary variables.
	recalling instrument states: <listen> <same 80 bytes>	Recalls the instrument state. The first byte transferred to the analyzer establishes the recall mode.
OT	<listen> OT <talk> <32 strings>	Outputs all CRT annotation as strings Strings are from Ø (null) to 64 characters long. Each string terminated with a <CR> <LF>. Last string terminated with an EOI upon <LF>.
		Output Formats:
O1	<listen> O1	ASCII number in display units.
O2	<listen> O2	Two 8 bit binary bytes.
O3	<listen> O3	ASCII number in parameter or instrument units.
O4	<listen> O4	One 8 bit binary byte. The two bytes form a single entry as follows: 
PA	<listen>[<display size>] [<address>] PA<xy pair> where <xy pair> : : = [PU | PD] <value> <delimiter> <value> <delimiter> <xy pair> <xy pair>	Plot absolute draws vectors to x and y entries. PU and PD determine whether vector is displayed or blanked. Entries must be in positive display units.
PD	<listen> PD	Pen down turns beam on.

SYNTAX SUMMARY

<table>
<tr><th>Code</th><th>Syntax</th><th>Function</th></tr>
<tr><td>PR</td><td><listen>[<display size>][<address>]
PR <xy pair> (see PA)</td><td>Plot relative draws vector relative from the last absolute position. Entries can be positive or negative.</td></tr>
<tr><td>PS</td><td><listen> [<address>] PS</td><td>Display program skips to next page of memory from address specified.</td></tr>
<tr><td>PU</td><td><listen> PU</td><td>Pen up turns beam off.</td></tr>
<tr><td>RB</td><td><listen> RB [<entry> | <step>]</td><td>Resolution bandwidth.</td></tr>
<tr><td>RC</td><td><listen> RC Ø|1|2|3|4|5|6|7|8|9</td><td>Recalls instrument states 0 to 9.</td></tr>
<tr><td>RL</td><td><listen> RL [<entry> | <step>]</td><td>Reference level.</td></tr>
<tr><td>R1</td><td><listen> R1</td><td>Resets SRQ to allow only SRQ 140.</td></tr>
<tr><td>R2</td><td><listen> R2</td><td>Allows SRQ 140 and 104</td></tr>
<tr><td>R3</td><td><listen> R3</td><td>Allows SRQ 140 and 110</td></tr>
<tr><td>R4</td><td><listen> R4</td><td>Allows SRQ 140 and 102
R2, R3 and R4 not mutually exclusive</td></tr>
<tr><td>SC</td><td>see <units code></td><td></td></tr>
<tr><td>SP</td><td><listen> SP [<entry> | <step>]</td><td>Frequency span.</td></tr>
<tr><td>SS</td><td><listen> SS [<entry> | <step>]</td><td>Center frequency step size.</td></tr>
<tr><td>ST</td><td><listen> ST [<entry> | <step>]</td><td>Sweep time.</td></tr>
<tr><td>SV</td><td><listen> SV 1|2|3|4|5|6</td><td>Saves instrument states in register 1 through 6.</td></tr>
<tr><td>SW</td><td><listen>[<address>] SW</td><td>Display skips to next control word from address specified.</td></tr>
<tr><td>S1</td><td><listen> S1</td><td>Sweep continuous.</td></tr>
<tr><td>S2</td><td><listen> S2</td><td>Sweep single.</td></tr>
<tr><td>TA</td><td><listen> [<format>] TA
<talk> <1001 Words></td><td>Outputs 1001 trace amplitude values for trace A, beginning with the leftmost trace point.</td></tr>
<tr><td>TB</td><td><listen> [<format>] TB
<talk> <1001 Words></td><td>Outputs 1001 trace amplitude values for trace B, beginning with the leftmost trace point.</td></tr>
<tr><td>TH</td><td><listen> TH [<entry> | <step>]</td><td>Threshold level.</td></tr>
<tr><td>TS</td><td><listen> TS</td><td>Take a sweep. Analyzer does not handshake until sweep is complete, and marker, if on, is placed on trace.</td></tr>
<tr><td>TØ</td><td><listen> TØ</td><td>Threshold level off.</td></tr>
<tr><td>T1
T2
T3
T4</td><td><listen> T1 | T2 | T3 | T4</td><td>Selects trigger mode
T1 free run
T2 line
T3 external
T4 video</td></tr>
<tr><td>UP</td><td><listen> UP</td><td>DATA step up.</td></tr>
<tr><td>UR</td><td><listen> UR
to turn off UR and LL
<listen> UR LL LL</td><td>Provides an upper right x-y recorder output voltage at the rear panel while UR is active.</td></tr>
<tr><td>US</td><td>see <units code></td><td>μsec</td></tr>
<tr><td>UV</td><td>see <units code></td><td>μvolt</td></tr>
<tr><td>VB</td><td><listen> VB [<entry> | <step>]</td><td>Video bandwidth.</td></tr>
</table>

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