Errata

Title & Document Type: 8340B/8341B Synthesized Sweeper Getting Started & Quick Ref Guide

Manual Part Number: 08340-90243

Revision Date: 1986-08-01

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

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HP 8340B
SYNTHESIZED SWEEPER
(Including Options 001, 004, 005, 006, and 007)

HP 8341B
SYNTHESIZED SWEEPER
(Including Options 003, 004)

SERIAL NUMBERS

This manual applies directly to the HP 8340B Synthesized Sweeper having a serial number prefix of 2624A and the HP 8341B Synthesized Sweeper prefixed 2624A.

For additional information about serial numbers, refer to INSTRUMENTS COVERED BY THE MANUAL in Section I.

MANUAL PART NO. 08340-90243
Microfiche Part Number 08340-90244
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HEWLETT PACKARD

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.

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NOTE

Specifications are the performance standards, or limits, against which the instrument may be tested. The following Specifications apply for temperatures between 0 and +50°C except were noted. Specifications apply with the PEAK function ON in the CW and MANUAL modes of operation, and with periodic use of AUTO TRACKING CALIBRATION in swept operation.

Supplemental Performance Characterisitcs are in *italics* in this table and are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters. These are denoted as "typical," "nominal," or "approximate."

FREQUENCY

CW MODE

Range: 0 01 to 26 5 GHz

Resolution: n × 1 Hz
Where N = harmonic multiplication (1 to 4). Refer to Frequency ranges and Bandswitch Points description below.

Accuracy: Same as Time Base Accuracy

Time Base

Frequency: 10 MHz

Aging Rate:
1×10^{-9} per day, 2 5 $\times 10^{-7}$ per year after 72 hour warm up if HP 8340B has been disconnected from ac power for less than 24 hours. Aging rate is achieved after 7 to 30 days warm up if HP 8340B has been disconnected from ac power for greater than 24 hours.

Temperature Coefficient: *Typically* $< 1 \times 10^{-10}$ *per °C*

Change due to 10% line voltage change: *Typically* $< 1 \times 10^{-11}$

Accuracy:
Overall accuracy of internal time base is a function of time base calibration ± aging rate ± temperature effects ± line effects.

Switching Time: <50 msec (PEAK function off)
Fast Phase Lock Mode reduces typical switching time to <20 msec.)

CENTER FREQUENCY/SWEEP WIDTH MODE (CF/ΔF)

Range: 10.00005 MHz to 26.49999995 GHz **(center frequency)**
100 Hz to 26.49 GHz **(sweep width)**
Resolution: *Approximately 0.1% of sweep width (ΔF)*

Readout Accuracy with respect to sweep out voltage (sweep time > 100 msec):
$\Delta \leq n \times 5$ MHz: ± 1% of indicated sweep width (ΔF) ± time base accuracy*
$\Delta > n \times 5$ MHz to < 300 MHz: ±2% of indicated sweep width (ΔF)
$\Delta \geq 300$ MHz: ±1% of indicated sweep width (ΔF), or ± 50 MHz, whichever is less

Where n = harmonic multiplication number (1 to 4). Refer to Frequency Ranges and Bandswitch Points description below.

*Time Base effects Center Frequency accuracy only, not sweep width accuracy.

Supplemental Performance Characteristics are in *italics*.

FREQUENCY (Cont'd)

START/STOP MODE

Range
Start: 10 MHz to 26 499.9999 MHz
Stop: 10.0001 MHz to 26.5 GHz

Resolution: *Typically, the same as Center Frequency/Sweep Width mode.*

Readout Accuracy with respect to sweep out voltage (sweep time > 100 msec):
Same as Center Frequency/Sweep Width Mode

FREQUENCY MARKERS

All 5 markers are independently variable and have the same specifications.

Range: 10 MHz to 26.5 GHz

Resolution: *Approximately 0.1% of sweep width (ΔF)*

Readout Accuracy (sweep time >100 msec):
Same as **CENTER FREQUENCY/SWEEP WIDTH MODE (CF/ΔF).**

*Time base accuracy is not a factor in MKRΔ Mode.

FREQUENCY RANGES AND BANDSWITCH POINTS

For bands 0 and 1, the HP 8340B's output is derived from the fundamental frequency of its internal 2.3 to 7.0 GHz YIG-tuned oscillator (n=1). For bands 2, 3, and 4 the output is derived from the 2nd, 3rd, or 4th harmonic of the oscillator (n = 2, 3, or 4)

Bandswitch points in CW Mode (only) always occur at the following points.

Band 0 to 1: 2.3 GHz
Band 1 to 2: 7.0 GHz
Band 2 to 3: 13.5 GHz
Band 3 to 4: 20.0 GHz

Bandswitch points in each of the swept modes (CF/ΔF, START/STOP) and the MANUAL SWEEP mode normally occur at the following points (with the exception listed below):

Band 0 to 1: 2.4 GHz
Band 1 to 2: 7.0 GHz
Band 2 to 3: 13.5 GHz
Band 3 to 4: 20.0 GHz

The swept mode bandswitch points are illustrated in Figure 1.

Supplemental Performance Characteristics are in *italics*.

FREQUENCY (Cont'd)

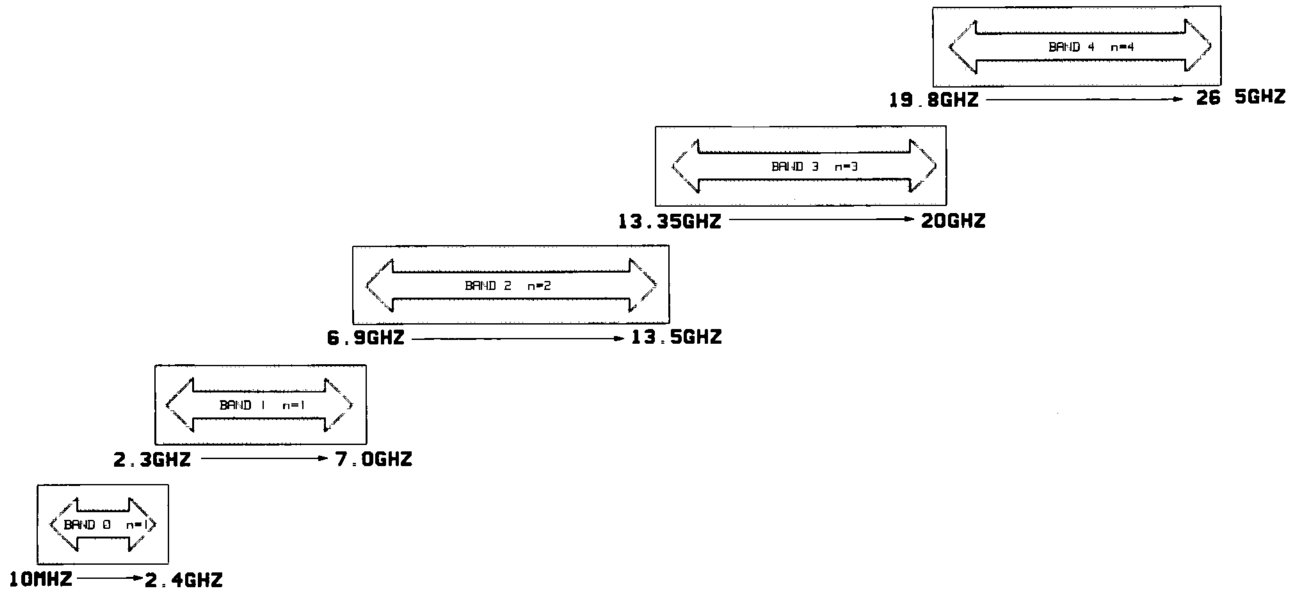


Figure 1. Typical Frequency Ranges and Bandswitch Points in Swept Modes

Note that the bands overlap. However, any sweep will be executed with the minimum number of bandswitch points. If the start frequency is above the lower limit for a given band, the sweep will start in that band and not the next lower one. If the stop frequency exceeds the upper limit of a given band by an amount greater than 0.004 × ΔF, a bandswitch will occur at that band's upper limit.

SPECTRAL PURITY

(Spectral Purity specifications apply for CW mode and all swept modes, unless otherwise stated.)

SPURIOUS SIGNALS (Expressed in dB relative to the carrier level (dBc) at ALC level of 0 dBm)	**Bands and Approximate Frequency Ranges (GHz)** (See Frequency Ranges and Bandswitch Points for complete description)				
	Band 0 0.01 to <2.3	**Band 1 2.3 to <7.0**	**Band 2 7.0 to <13.5**	**Band 3 13.5 to <20.0**	**Band 4 20.0 to 26.5**
Harmonics (only up to 26.5 GHz)	<−35	<−35	<−35	<−35	<−35
Subharmonics and multiples therof (up to 26.5 GHz)	–	–	<−25	<−25	<−20
Non-harmonically related supurious (CW and Manual Sweep mode only)	<−50	<−70	<−64	<−60	<−58

Supplemental Performance Characteristics are in *italics*.

Table 1-1. Model HP 8340B Specifications and Supplemental Performance Characteristics (4 of 15)

SPECTRAL PURITY (Cont'd)

SPURIOUS SIGNALS (Cont'd)

Power line related and spurious due to fan rotation within 5 Hz below line frequency, and multiples thereof

(CW mode only, all power levels)	**Band 0** **0.01 to <2.3**	**Band 1** **2.3 to <7.0**	**Band 2** **7.0 to <13.5**	**Band 3** **13.5 to <20.0**	**Band 4** **20.0 to 26.5**
Offset <300 Hz from carrier	<−50	<−50	<−44	<−40	<−38
Offset 300 Hz to 1 kHz from carrier	<−60	<−60	<−54	<−50	<−48
Offset >1 kHz from carrier	<−65	<−65	<−59	<−55	<−53

SINGLE-SIDEBAND PHASE NOISE (dBc/1 Hz BW, CW Mode, all power levels)

STANDARD INSTRUMENT					
Offset 30 Hz from carrier	<−64	<−64	<−58	<−54	<−52
Offset 100 Hz from carrier	<−70	<−70	<−64	<−60	<−58
Offset 1 kHz from carrier	<−78	<−78	<−72	<−68	<−66
Offset 10 kHz from carrier	<−86	<−86	<−80	<−76	<−74
Offset 100 kHz from carrier	<−107	<−107	<−101	<−97	<−95
OPTION 007, Relaxed Phase Noise Specifications					
Offset 100 Hz from carrier	<−67	<−67	<−61	<−57	<−55
Offset 1 kHz from carrier	<−75	<−75	<−69	<−65	<−63
Offset 10 kHz from carrier	<−83	<−83	<−77	<−73	<−71
Offset 100 kHz from carrier	<−107	<−107	<−101	<−97	<−95

TYPICAL FREQUENCY STABILITY, 50 Hz - 15 kHz post detection bandwidth

Typical Residual FM in CW Mode: *<n × 60 Hz rms*

Typical Residual FM in Swept Mode.
ΔF > n × 5 MHz: *< n × 25 kHz rms*
ΔF ≤ n × 5 MHz: *Same as CW mode*

Where n = harmonic multiplication number (1 to 4). Refer to Frequency Ranges and Bandswitch Points description above

Supplemental Performance Characteristics are in *italics*.

RF OUTPUT

MAXIMUM LEVELED POWER (0°C to +35°C)[1]	Bands and Approximate Frequency Ranges (GHz) (See Frequency Ranges and Bandswitch Points for complete description)					
	Band 0	**Band 1**	**Band 2**	**Band 3**	**Band 4**	
	0.01 to <2.3	**2.3 to <7.0**	**7.0 to <13.5**	**13.5 to <20.0**	**20.0 to <23.0**	**23.0 to 26.5**
STANDARD INSTRUMENT	+10.0 dBm	+12.0 dBm	+10.0 dBm	+9.0 dBm	+3.0 dBm	+1.0 dBm
OPTION 001 (F P Out w/o Atten)	+10 0 dBm	+13.0 dBm	+12.0 dBm	+11.0 dBm	+6.0 dBm	+4.0 dBm
OPTION 004 (R.P. Out w/Atten.)	+10 0 dBm	+11 0 dBm	+9 0 dBm	+7 0 dBm	+1.0 dBm	−1.0 dBm
OPTION 005 (R.P. Out w/o Atten.)	+10.0 dBm	+12.0 dBm	+11.0 dBm	+9 0 dBm	+4 0 dBm	+2 0 dBm

MINIMUM SETTABLE POWER

STANDARD and OPTION 004 (R.P. Out w/Atten): −110 dBm

OPTION 001 (F.P. Out w/o Atten.) and 005 (R.P. Out w/o Atten.): −20 dBm

RF OFF

When the RF key is turned OFF, the POWER dBm display will read OFF and a 0 dBm signal will typically be reduced to a level *<−100 dBm.*

OUTPUT POWER RESOLUTION

"ENTRY DISPLAY": 0.05 dB **"POWER dBm" Display:** 0.1 dB

OUTPUT POWER ACCURACY[2]	Bands and Approximate Frequency Ranges (GHz) (See Frequency Ranges and Bandswitch Points for complete description)		
	Band 0 0.01 to <2.3	**Bands 1 - 3 2.3 to <20.0**	**Band 4 20.0 to 26.5**
STANDARD INSTRUMENT			
+18 to +10 dBm[3]	—	±1.8 dB	±2.3 dB
+10 to −9.95 dBm	±0.9 dB	±1.5 dB	±2.0 dB
−10 to −19.95 dBm	±1.2 dB	±2.0 dB	±2.5 dB
−20 to −49 95 dBm	±1.5 dB	± 2.3 dB	± 2.8 dB
−50 to −79 95 dBm	±1.8 dB	±2.6 dB	±3.1 dB
−80 to −100 dBm	±2 1 dB	±2.9 dB	±3.4 dB
−100 to −110 dBm (typical)	*±2 9 dB*	*±3 7 dB*	*±4.2 dB*
OPTION 004 (Rear Panel Output w/Attenuator)			
+18 to +10 dBm[3]	—	±2.0 dB	±2.5 dB
+10 to −11.95 dBm	±1 0 dB	±1.7 dB	±2.2 dB
−12 to −21.95 dBm	±1 3 dB	±2 2 dB	±2.7 dB
−22 to −51.95 dBm	±1.6 dB	±2 5 dB	±3 0 dB
−52 to −81.95 dBm	±1.9 dB	±2 8 dB	±3 3 dB
−82 to −100 dBm	± 2.2 dB	±3.1 dB	±3 6 dB
−100 to −110 dBm (typical)	*±3.0 dB*	*±3.9 dB*	*±4.4 dB*

Supplemental Performance Characteristics are in *italics.*

RF OUTPUT (Cont'd)

OUTPUT POWER ACCURACY (Cont'd)	**Band 0** **0.01 to <2.3**	**Bands 1-3** **2.3 to <20.0**	**Band 4** **20.0 to 26.5**
OPTION 001 (Front Panel Output w/o Attenuator)			
+18 to +10 dBm[3]	—	±1.6 dB	±2.0 dB
+10 to −10 dBm	±0.9 dB	±1.3 dB	±1.7 dB
−10 to −20 dBm	±1.7 dB	±2.1 dB	±2.5 dB
OPTION 005 (Rear Panel Output w/o Attenuator)			
+18 to +10 dBm[3]	—	±1.8 dB	±2.2 dB
+10 to −10 dBm	±1.0 dB	±1.5 dB	±1.9 dB
−10 to −20 dBm	±1.8 dB	±2.3 dB	±2.7 dB
FLATNESS (Internally leveled)			
STANDARD INSTRUMENT			
+18 to +10 dBm[3]	—	±1.2 dB	±1.7 dB
+10 to −9.95 dBm	±0.6 dB	±1.1 dB	±1.6 dB
−10 to −19.95 dBm	±0.9 dB	±1.6 dB	±2.1 dB
−20 to −49.95 dBm	±1.2 dB	±1.9 dB	±2.4 dB
−50 to −79.95 dBm	±1.4 dB	±2.2 dB	±2.7 dB
−80 to −100 dBm	±1.7 dB	±2.5 dB	±3.0 dB
−100 to −110 dBm (typical)	*±1.9 dB*	*±3.1 dB*	*±3.6 dB*
OPTION 004 (Rear Panel Output w/Attenuator)			
+18 to +10 dBm[3]	—	±1.4 dB	±1.9 dB
+10 to −11.95 dBm	±0.7 dB	±1.3 dB	±1.8 dB
−12 to −21.95 dBm	±1.0 dB	±1.8 dB	±2.3 dB
−22 to −51.95 dBm	±1.3 dB	±2.1 dB	±2.6 dB
−52 to −81.95 dBm	±1.5 dB	±2.4 dB	±2.9 dB
−82 to −100 dBm	±1.8 dB	±2.7 dB	±3.2 dB
−100 to −110 dBm (typical)	*±2.0 dB*	*±3.3 dB*	*±3.8 dB*
OPTION 001 (Front Panel Output w/o Attenuator)			
+18 to +10 dBm[3]	—	±1.0 dB	±1.4 dB
+10 to −10 dBm	±0.6 dB	±0.9 dB	±1.3 dB
−10 to −20 dBm	±0.8 dB	±1.5 dB	±1.9 dB
OPTION 005 (Rear Panel Output w/o Attentuator)			
+18 to +10 dBm[3]	—	±1.2 dB	±1.6 dB
+10 to −10 dBm	±0.7 dB	±1.1 dB	±1.5 dB
−10 to −20 dBm	±0.9 dB	±1.7 dB	±2.1 dB

Supplemental Performance Characteristics are in *italics*.

RF OUTPUT (Cont'd)

TYPICAL ALC INCREMENTAL ACCURACY

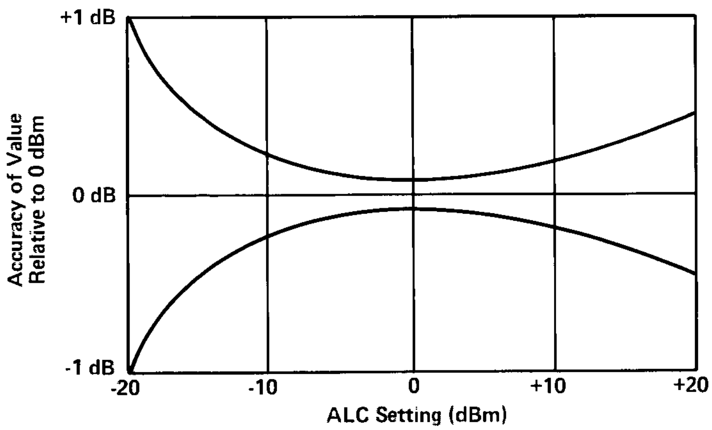


Figure 2. Typical ALC Incremental Accuracy

In normal operation, the ALC does not operate below −9.95 dBm because the 8340B automatically increments the step attenuator at that point. However, when the ALC and step attenuator are independently controlled (DECOUPLED mode), the ALC may be operated over its full +20 dBm to −20 dBm range. Refer to Section III, Operation for a more detailed description. Pressing [SHIFT] [PWR SWP] places the instrument in the decoupled mode. In this mode the data entry keyboard and the rotary knob control the ALC level, and the step up and step down keys control the attenuator.

RF OUTPUT CONNECTOR

Output Impedance: *Nominally 50 Ohms*

Typical Source SWR (Internally leveled only).
0.1 to <2.3 GHz: *Typically <1.3:1*
2.3 to <18.0 GHz: *Typically <1.6:1*
18.0 to 26.5 GHz: *Typically <2.0:1*

STABILITY WITH TEMPERATURE: *Typically ±0.01 dB/°C*

OUTPUT LEVEL SWITCHING TIME:

Typically <10 ms to be within 0.1 dB of final value with no attenuator range change (internally leveled only).

POWER SWEEP

Range:
Displayed: 0 to 40 dB/sweep
Actual: At least 10 dB at any given frequency (at least 20 dB in DECOUPLED mode, see Figure 3 below).

Resolution: 0.05 dB/sweep

Accuracy:
Starting Power Level: Same as Output Power Accuracy
Power Sweep Width and Linearity. See Figure 2

Supplemental Performance Characteristics are in *italics*

RF OUTPUT (Cont'd)

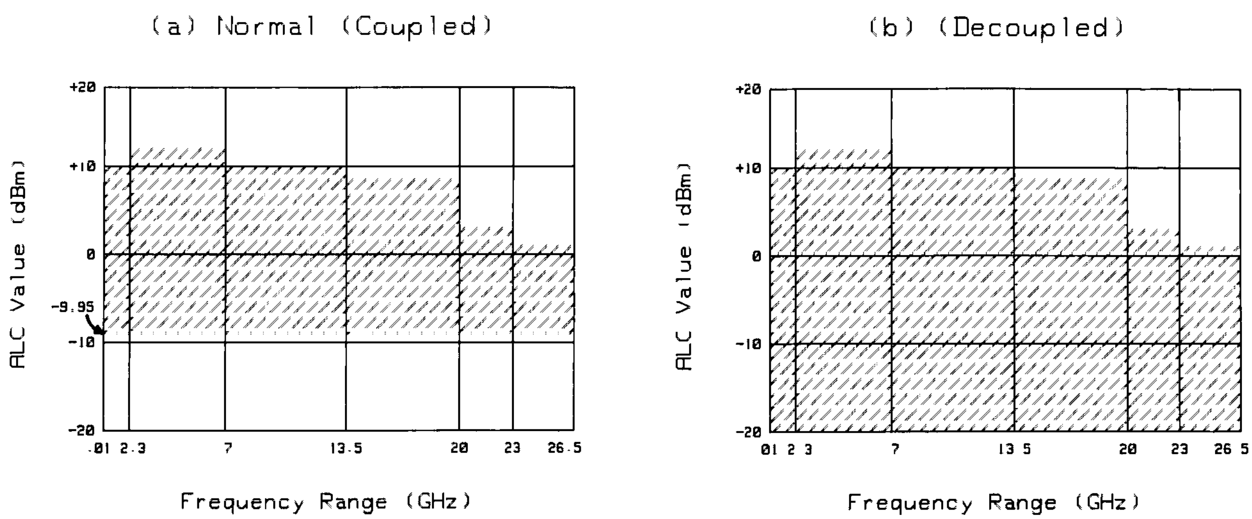


Figure 3. Typical Power Sweep Range

In normal operation (a), the ALC does not operate below −9 95 dBm (unless the instrument is placed in the Decoupled Mode by pressing **[SHIFT] [PWR SWP].** See Figure 3), and so the maximum power sweep range is the difference of −9.95 dBm and the maximum leveled power available at the frequency of interest (specified leveled power shown in the diagram). In the DECOUPLED mode (b), the power sweep range is extended because the ALC can operate down to −20 dBm The maximum power levels shown above do not apply to HP 8340Bs equipped with option 001, 004, or 005

SLOPE COMPENSATION

Calibrated Range: 0 to 1.5 dB/GHz **Resolution:** 0.001 dB/GHz

EXTERNAL LEVELING

XTAL: Allows the HP 8340B to be externally leveled by crystal detectors of positive or negative polarity

METER: Allows power meter leveling with any HP power meter

Range (XTAL or METER): 500 microvolts (−66 dBV) to 2.0 volts (+6 dBV)

Accuracy of voltage at EXT INPUT connector relative to the displayed level (leveling voltage is shown in ENTRY DISPLAY in dBV): *±0.5 dB ±0.2 mV typically.*

Loop Bandwidth:
XTAL Mode. *Nominally 80 kHz* METER Mode. *Nominally 0.7 Hz*

Input Impedance: *Nominally 1 M Ohm.*

Supplemental Performance Characteristics are in italics

PULSE MODULATION

Not Applicable to HP 8340Bs Equipped with Option 006, Delete Pulse Modulation.
(CW mode, and all specifications are typical for frequencies <400 MHz)

ON/OFF RATIO: >80 dB

RISE (T_R) AND FALL (T_F) TIMES: ≤25 nanoseconds

MINIMUM INTERNALLY LEVELED RF PULSE WIDTH (T_{RF}): 100 nanoseconds

MINIMUM UNLEVELED RF PULSE WIDTH: *Typically 25 nanoseconds*

PULSE REPETITION FREQUENCY (PRF)

Non-leveled operation (SHIFT METER): *Typically dc to 20 MHz*

Internally leveled operation: 100 Hz to 5 MHz *(typically 100 Hz to 500 kHz for RF frequencies <400 MHz).*

MAXIMUM PEAK POWER: Same as specified maximum leveled power. (See RF OUTPUT).

ACCURACY OF INTERNALLY LEVELED RF PULSE V_P (relative to CW mode level):

(Note that the ALC attempts to hold pulse amplitude to save level as leveled CW signal.)

Bands and Approximate Frequency Ranges (GHz) (see Frequency Ranges and Bandswitch Points for complete description)			
Pulse Width	**Band 0**		**Bands 1 - 4**
	0.01 to 0.4	**0.4 to <2.3**	**2.3 to 26.5**
100 to <200 ns	—	+3/−0.3 dB*	+1.5/−0.3 dB*
200 to <500 ns	—	+1.5/−0.3 dB*	±0.3 dB
≥500 ns	—	±0.3 dB	±0.3 dB
1 to <2 µs	*+3/−0.3 dB*	—	—
2 to <5 µs	*+1.5/−0.3 dB*	—	—
≥5 µs	*±0.3 dB*	—	—

*+15 to +55°C. Duty Cycle must be ≥0.01%

SIMULTANEOUS AM AND PULSE (Parameters shown are typical)

AM BANDWIDTH AT 30% DEPTH
DC coupled, typical 3 dB point:

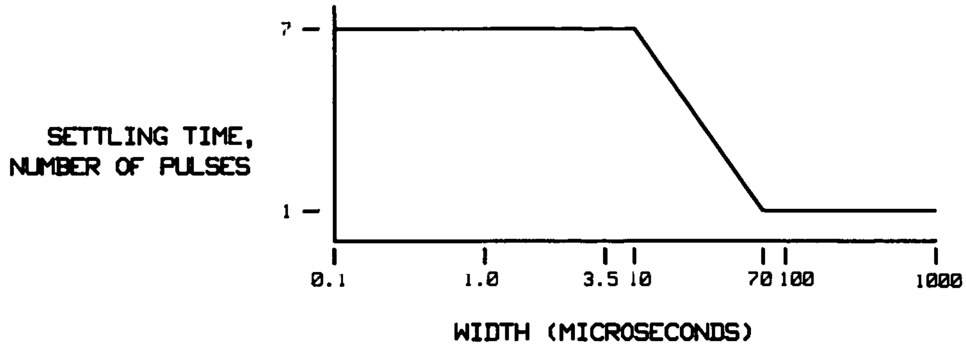
Internally Leveled	Unleveled (Shift Meter)*
PRF/20** to a maximum of 5 kHz	*100 kHz*

SETTLING TIME TO A STEP INPUT, 10%-90%, TYP:

The greater of: 70 µsec, or the time for the number of pulses indicated by the solid line below.	*3.5 µsec*

Supplemental Performance Characteristics are in *italics*.

PULSE MODULATION (Cont'd)



***[SHIFT] [METER]** is an unleveled operating mode, power is controllable, but is not flat over frequency. AM bandwidth in this mode is independent of pulse rate and width. See Section I.

**PRF = PULSE REPETITION FREQUENCY.

OVERSHOOT, RINGING (V_{OR}/V_P): *<15% typically*

PULSE WIDTH COMPRESSION ($T_V - T_{RF}$): *±5 nanoseconds typically*

DELAY TIME (T_D): *50 nanoseconds typically*

VIDEO FEEDTHROUGH (V_F/V_P):
0.01 to <0.4 GHz (Band 0): *≤5% typically (for output power levels ≤+8 dBm)*
0.4 to <2.3 GHz (Band 0): ≤5% (for output power levels ≤+8 dBm)
2.3 to 26.5 GHz (Bands 1 - 4): ≤0.2%

SIDEBANDS (caused by a pulse input when PULSE is OFF):
Typically −50 dBc with a 30 kHz squarewave input from 0.01 to 7.0 GHz.

PULSE INPUT CONNECTOR:

TTL compatible (Open circuit is TTL high level and keeps RF on.) *Damage level is +12 Vdc, −20 Vdc* Refer to Section III, Operation, for input circuit diagram.

Supplemental Performance Characterisitcs are in *italics*.

PULSE MODULATION (Cont'd)

PULSE DEFINITIONS:

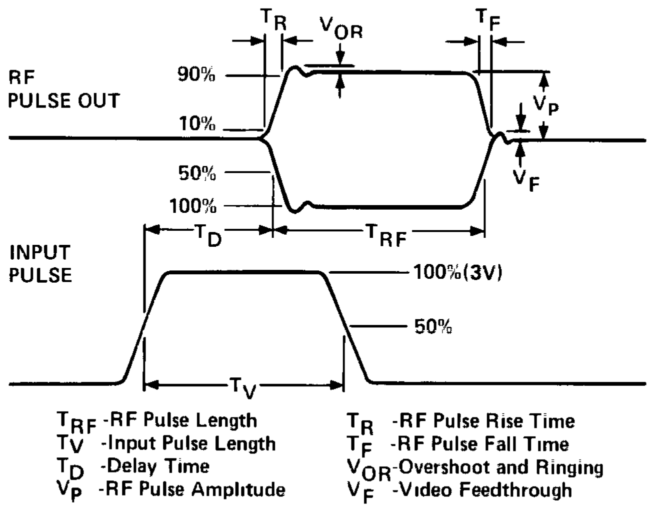


Figure 4. Pulse Definitions

AMPLITUDE MODULATION

(The following specifications apply when the HP 8340B is internally leveled, for waveforms whose envelope peak is at least 1 dB below maximum specified power. Unless noted, pulse modulation must be OFF; however, the HP 8340B is capable of simultaneous amplitude and pulse modulation. See Section III, Operation.)

AM DEPTH: 0 to 90%

AM SENSITIVITY (at 1 kHz rate and 30% Depth):

100%/V ±5% RF amplitude is linearly controlled by varying AM input between 0 and ±1 Volt.

PULSE ON: *100%/Volt typically for rates less than 0.1/Settling Time.*

AM BANDWIDTH (relative to 1 kHz rate at 30% Depth):

DC coupled, 3 dB point ≥100 kHz

PULSE ON: *DC coupled, 3 dB point ≥PRF/20, typically.*
(Refer to Pulse Modulation specs for a more complete description.)

AM FREQUENCY RESPONSE (FLATNESS) (relative to a 1 kHz rate at 30% depth, DC to 10 kHz): ±0.20 dB

DISTORTION: *Typical distortion values are given in Figure 5.*

Supplemental Performance Characteristics are in *italics*.

AMPLITUDE MODULATION (Cont'd)

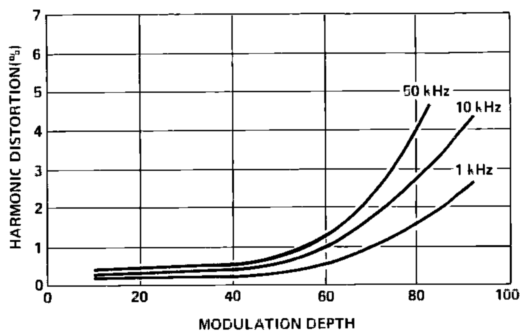


Figure 5. Typical AM Distortion for Various Modulation Rates and Depths

INCIDENTAL PHASE MODULATION (in peak radians) (Rates ≤10 kHz, 30% Depth): *<0.4 typically*

INCIDENTAL FM: *Incidental Phase Modulation × Modulation Frequency*

AM INPUT IMPEDANCE: *Nominally 600 Ohms.*

FREQUENCY MODULATION

MODULATION RATE: 50 kHz to 10 MHz (3 dB bandwidth)

PEAK DEVIATION: The lesser of 10 MHz or:
n × Mod Rate
where n = harmonic multiplication number (1 to 4). Refer to Frequency Ranges and Bandswitch Points Description

DEVIATION ACCURACY: ±10% (at 100 kHz rate)

SENSITIVITY: 1 MHz/Volt or 10 MHz/Volt

INPUT IMPEDANCE: *Nominally 50 Ohms*

SWEEP TIME

RANGE:

10 milliseconds to 200 seconds forward sweep times

Fastest possible sweep typically cycles once every 40 ms; fastest possible full band sweep typically cycles once every 150 ms.

MAXIMUM SPEED: *Nominally 600 MHz/ms*

RESOLUTION: *Approximately 0.1% of current sweep time value.*

ACCURACY: ±5% (sweeptimes ≤50 seconds)

Supplemental Performance Characteristics are in *italics*.

INPUTS

PULSE MODULATION INPUT (Not applicable to HP 8340Bs equipped with Option 006, Delete Pulse Modulation)
Front panel BNC female input connector. TTL compatible (open circuit is TTL high level and keeps RF on). *Damage level is +12 Vdc, −20 Vdc.*

AMPLITUDE MODULATION INPUT
Front panel BNC female input connector. *Nominal input impedance is 600 Ohms.*

FREQUENCY MODULATION INPUT
Front panel BNC female connector. Nominal input impedance is 50 Ohms. Full scale input voltage = ±1 vac. Damage to internal circuitry will result if a signal with a peak voltage of ±8 vac or greater is input

LEVELING EXT INPUT
Front panel BNC female input connector. Used for power meter leveling or crystal detector leveling. Input impedance in XTAL or METER modes is *nominally 1 MOhm.* Refer to EXTERNAL LEVELING specifications.

FREQUENCY STANDARD EXT
Rear panel BNC female connector. Accepts 5 or 10 MHz signal from internal or external timebase. A BNC jumper connects this input to the HP 8340B's FREQUENCY STANDARD INT output for operation from HP 8340B's internal timebase External signal input must be 5 MHz ±50 Hz or 10 MHz ±100 Hz, 0 to +10 dBm. *Nominal input impedance is 50 ohms.*

EXT TRIGGER INPUT
Rear panel BNC female connector. Triggers single sweep. Trigger signal must be >2 Vdc (10 Vdc max) and wider than 0 5 microseconds *Nominal input impedance is 2 kOhms*

STOP SWP IN/OUT:
Rear panel BNC female connector. TTL high while sweeping, stops sweep when grounded externally. TTL low when HP 8340B stops sweep.

HP 8755C INTERFACE
Rear panel. Connects via cable (HP Part No. 8120-3174) to HP 8755C Scalar Network Analyzer to provide Alternate Sweep function.

HP 8410B INTERFACE
Rear panel 25-pin D-type connector. Permits multi-octave operation of HP 8410B/C Network Analyzer with HP8340B via interface cable (HP Part No. 08410-60146). Also provides duplicates of these functions. **Ext Trigger Input, Mute Output, Penlift Output, Neg Blank,** and **Z-Axis Blank/Mkrs.** Also provides an input for a switch closure to execute the UP key function

OUTPUTS

RF OUTPUT
Front panel Type N Female connector. Frequency output range is 10 MHz to 26.5 GHz. *Nominal output impedance is 50 Ohms.* SWR is shown in RF OUTPUT characteristics.

SWEEP OUTPUT
Front and rear panel BNC female connectors. Supplies a voltage proportional to the sweep that ranges from *approximately 0 Vdc* (at start of sweep) to *approximately +10 Vdc* (at end of sweep), regardless of sweep width. In CW mode, the dc voltage is proportional to percentage of full 10 MHz to 26 5 GHz range

0.5V/GHz
Rear panel BNC female connector which outputs a voltage proportional to the instrument's output frequency *(0.5V/GHz).* Nominal load impedance should be greater than or equal to *4 KOhms. Accuracy of this signal is ±1% ±2mV* This signal is intended for use with millimeter-wave source systems This output can be changed to *1.0V/GHz* (for use with the HP 8410C) by adding jumpers W1 and W2 on the A28 SYTM Driver board. The maximum output voltage of this signal is *19 vdc.*

Supplemental Performance Characteristics are in *italics*

OUTPUTS (Cont'd)

10 MHz REF OUTPUT

Rear panel BNC female connector. Output power level is *nominally 0 dBm*, Output impedance is *nominally 50 Ohms*

FREQUENCY STANDARD INT

Rear panel BNC connector. *Output frequency 10 MHz, output power nominally 3 dBm, 50 Ohm nominal output impedance.* Jumpered to **FREQUENCY STANDARD EXT** for operation from HP 8340B's internal timebase

MUTE OUTPUT

Rear panel BNC female connector. Mutes servo motor of X-Y recorder when the HP 8340B crosses a band switchpoint.

PENLIFT OUTPUT J13

For operation with X-Y recorders PENLIFT disables an X-Y recorder's ability to lower its pen during sweep retrace. If **[SHIFT] [LINE]** is pressed on the front panel, PENLIFT will also disable the pen during forward sweep band switchpoints. Because of X-Y recorder limitations PENLIFT will always disable the X-Y recorder's pen at sweep times under 5 seconds.

PENLIFT enables pen operation by providing a current path to ground for the X-Y recorder's pen solenoid. The voltage at the PENLIFT output in this state will be *approximately 0 Vdc* Circuit impedance in this state is *approximately 5 Ohms*

PENLIFT disables pen operation by not providing a current path to ground for the X-Y recorder's pen solenoid The voltage on the PENLIFT output will be equal to the X-Y recorder's pen solenoid supply voltage. Circuit impedance in this state is very high.

NEG BLANK

Rear panel BNC female connector. Supplies negative rectangular pulse *(approximately −5 Vdc into 2 kOhm load)* during the retrace and band switchpoints of the RF output.

Z-AXIS BLANK/MKRS

Rear panel BNC female connector. Supplies positive rectangular pulse *(approximately +5 Vdc into 2 kOhms)* during the retrace and band switchpoints of the RF output Also, supplies a *−5 Vdc* pulse when the RF is coincident with a marker frequency (intensity markers only).

AUX OUT

Rear panel Type-N female connector. Provides a 2.*3 to 7.0* GHz fundamental oscillator output, *nominally 0 dBm and 50 Ohm output impedance*

REMOTE OPERATION

All functions (except line power) may be programmed via the Hewlett-Packard Interface Bus (HP-IB). Detailed Remote operation information is included in Section III, Operation.

GENERAL

ENVIRONMENTAL

Temperature: Operation at 0 to +55°C, except as noted in electrical specifications.

Humidity: Passes 5 day cycling, +40°C, 95% relative humidity.

EMI: Controlled and radiated interference is within the requirements of CE03 and REO2 (relaxed by 10 dB) of MIL STD 461A, and within the requirements of VDE 0871/1978, Level B and CISPR publication 11 (1975)

Supplemental Performance Characteristics are in *italics*.

GENERAL (Cont'd)

WARM-UP TIME

Operation: Requires 30-minute warmup from cold start, 0 to +55°C. Internal temperature equilibrium is reached after 2-hour warmup at stable outside temperature.

Frequency Reference: Reference time base is kept at operating temperature in STANDBY mode with the instrument connected to the ac power. For instruments disconnected from ac power for less than 24 hours, the aging rate is $<1 \times 10^{-9}$/day after a 72-hour warmup.

POWER REQUIREMENTS

47.5 to 66 Hz; 100, 120, 220, or 240 volts (±10%); *Typically, 500 VA maximum (40 VA in* ***STANDBY).***

WEIGHT

Net Weight: 34 kg (75 lb)

Shipping Weight: 52 kg (112 lb)

DIMENSIONS

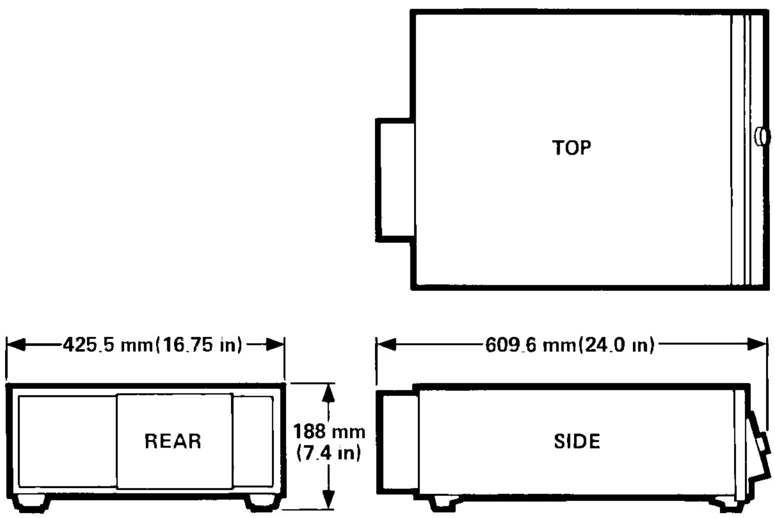


Figure 6. Instrument Dimensions

NOTES

1. Maximum leveled power from 35°C to 55°C will typically be degraded from these specifications by *no more than 2 dB.*
2. Internally leveled, AM off. The POWER dBm display monitors that actual output power, giving accurate readings when unleveled, externally leveled, or when amplitude modulating with a signal that has a dc component. In these modes, the accuracy *typically degrades by ±0.1 dB* over the tabulated values. The ENTRY DISPLAY shows the desired power level, or the desired external detector output voltage, exclusive of modulation.
3. The ALC loop *typically operates up to +20 dBm* to enhance usability at those frequencies where leveled power greater than the maximum specified is available.

Supplemental Performance Characteristics are in *italics.*

NOTE

Specifications are the performance standards, or limits, against which the instrument may be tested. The following Specifications apply for temperatures between 0 and +50°C except were noted. Specifications apply with the PEAK function ON in the CW and MANUAL modes of operation, and with periodic use of AUTO TRACKING CALIBRATION in swept operation.

Supplemental Performance Characterisitcs are in *italics* in this table and are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters. These are denoted as "typical," "nominal," or "approximate."

FREQUENCY

CW MODE

Range: 0.01 to 20.0 GHz

Resolution: n × 1 Hz
Where N = harmonic multiplication (1 to 3). Refer to Frequency ranges and Bandswitch Points description below.

Accuracy: Same as Time Base Accuracy

Time Base

Frequency: 10 MHz

Aging Rate:
1×10^{-9} per day, 2.5×10^{-7} per year after 72 hour warm up if HP 8341B has been disconnected from ac power for less than 24 hours. Aging rate is achieved after 7 to 30 days warm up if HP 8341B has been disconnected from ac power for greater than 24 hours

Temperature Coefficient: *Typically* $< 1 \times 10^{-10}$ *per °C*

Change due to 10% line voltage change: *Typically* $< 1 \times 10^{-11}$

Accuracy:
Overall accuracy of internal time base is a function of time base calibration ± aging rate ± temperature effects ± line effects.

Switching Time: <50 msec (PEAK function off)
Fast Phase Lock Mode reduces typical switching time to <20 msec.)

CENTER FREQUENCY/SWEEP WIDTH MODE (CF/ΔF)

Range: 10.00005 MHz to 19.99999995 GHz **(center frequency)**
100 Hz to 19 99 GHz **(sweep width)**
Resolution: *Approximately 0.1% of sweep width (ΔF)*

Readout Accuracy with respect to sweep out voltage (sweep time > 100 msec).
$\Delta \leq n \times 5$ MHz: ± 1% of indicated sweep width (ΔF) ± time base accuracy*
$\Delta > n \times 5$ MHz to < 300 MHz: ±2% of indicated sweep width (ΔF)
$\Delta \geq 300$ MHz: ±1% of indicated sweep width (ΔF), or ± 50 MHz, whichever is less.

Where n = harmonic multiplication number (1 to 3). Refer to Frequency Ranges and Bandswitch Points description below.

*Time Base effects Center Frequency accuracy only, not sweep width accuracy

Supplemental Performance Characteristics are in *italics*.

FREQUENCY (Cont'd)

START/STOP MODE

Range
Start: 10 MHz to 19.9999999 GHz
Stop: 10.0001 MHz to 20.0 GHz

Resolution: *Typically, the same as Center Frequency/Sweep Width mode:*

Readout Accuracy with respect to sweep out voltage (sweep time > 100 msec).
Same as Center Frequency/Sweep Width Mode.

FREQUENCY MARKERS

All 5 markers are independently variable and have the same specifications.

Range: 10 MHz to 20.0 GHz

Resolution: *Approximately 0.1% of sweep width (ΔF)*

Readout Accuracy (sweep time >100 msec):
Same as **CENTER FREQUENCY/SWEEP WIDTH MODE (CF/ΔF).**

*Time base accuracy is not a factor in MKRΔ Mode

TYPICAL FREQUENCY RANGES AND BANDSWITCH POINTS

For bands 0 and 1, the HP 8341B's output is derived from the fundamental frequency of its internal 2.3 to 7.0 GHz YIG-tuned oscillator (n=1). For bands 2 and 3, the output is derived from the 2nd or 3rd harmonic of the oscillator (n = 2 or 3).

Bandswitch points in CW Mode (only) always occur at the following points:

Band 0 to 1: 2.3 GHz
Band 1 to 2: 7.0 GHz
Band 2 to 3: 13.5 GHz

Bandswitch points in each of the swept modes (CF/ΔF, START/STOP) and the MANUAL SWEEP mode normally occur at the following points (with the exception listed below):

Band 0 to 1: 2.4 GHz
Band 1 to 2: 7.0 GHz
Band 2 to 3: 13.5 GHz

The swept mode bandswitch points are illustrated in Figure 1.

Supplemental Performance Characteristics are in *italics*.

FREQUENCY (Cont'd)

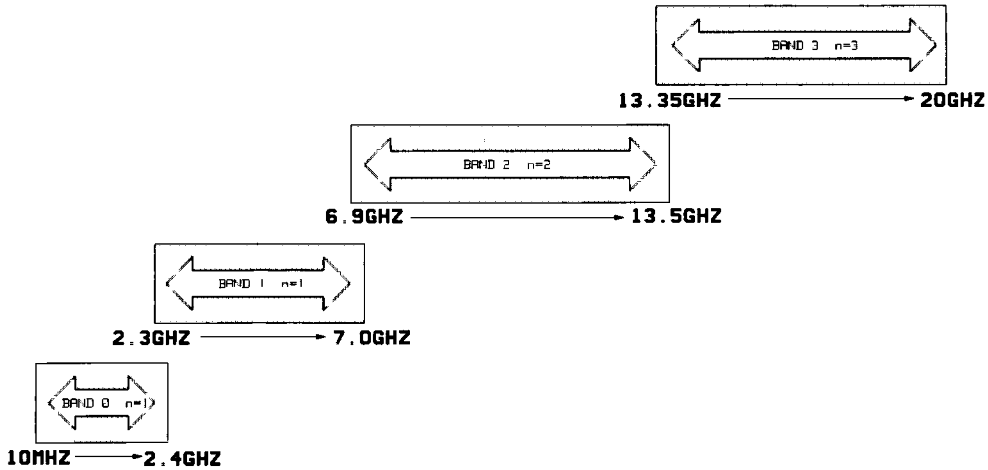


Figure 1. Typical Frequency Ranges and Bandswitch Points in Swept Modes

Note that the bands overlap However, any sweep will be executed with the minimum number of bandswitch points. If the start frequency is above the lower limit for a given band, the sweep will start in that band and not the next lower one. If the stop frequency exceeds the upper limit of a given band by an amount greater than 0.004 × ΔF, a bandswitch will occur at that band's upper limit

SPECTRAL PURITY

(Spectral Purity specifications apply for CW mode and all swept modes, unless otherwise stated.)

SPURIOUS SIGNALS (Expressed in dB relative to the carrier level (dBc) at ALC level of 0 dBm)	**Bands and Approximate Frequency Ranges (GHz)** (See Frequency Ranges and Bandswitch Points for complete description)			
	Band 0 0.01 to <2.3	**Band 1 2.3 to <7.0**	**Band 2 7.0 to <13.5**	**Band 3 13.5 to 20.0**
Harmonics (only up to 20.0 GHz)	<−35	<−35	<−35	<−35
Subharmonics and multiples thereof (up to 20.0 GHz)	–	–	<−25	<−25
Non-harmonically related supurious (CW and Manual Sweep mode only)	<−50	<−70	<−64	<−60

Supplemental Performance Characteristics are in *italics*.

SPECTRAL PURITY (Cont'd)

SPURIOUS SIGNALS (Cont'd)

Power line related and spurious due to fan rotation within 5 Hz below line frequency, and multiples thereof

(CW mode only, all power levels)	**Band 0 0.01 to <2.3**	**Band 1 2.3 to <7.0**	**Band 2 7.0 to <13.5**	**Band 3 13.5 to 20.0**
Offset <300 Hz from carrier	<−50	<−50	<−44	<−40
Offset 300 Hz to 1 kHz from carrier	<−60	<−60	<−54	<−50
Offset >1 kHz from carrier	<−65	<−65	<−59	<−55

SINGLE-SIDEBAND PHASE NOISE (dBc/1 Hz BW, CW Mode, all power levels)

Offset 30 Hz from carrier	<−64	<−64	<−58	<−54
Offset 100 Hz from carrier	<−70	<−70	<−64	<−60
Offset 1 kHz from carrier	<−78	<−78	<−72	<−68
Offset 10 kHz from carrier	<−86	<−86	<−80	<−76
Offset 100 kHz from carrier	<−107	<−107	<−101	<−97

TYPICAL FREQUENCY STABILITY, 50 Hz - 15 kHz post detection bandwidth

Typical Residual FM in CW Mode: *<n × 60 Hz rms*

Typical Residual FM in Swept Mode:
ΔF > n × 5 MHz. *< n × 25 kHz rms*
ΔF ≤ n × 5 MHz: *Same as CW mode*

Where n = harmonic multiplication number (1 to 3). Refer to Frequency Ranges and Bandswitch Points description above.

Supplemental Performance Characteristics are in *italics*

RF OUTPUT

MAXIMUM LEVELED POWER (0°C to +35°C)[1]	Bands and Approximate Frequency Ranges (GHz) (See Frequency Ranges and Bandswitch Points for complete description)			
	Band 0	**Band 1**	**Band 2**	**Band 3**
	0.01 to <2.3	**2.3 to <7.0**	**7.0 to <13.5**	**13.5 to 20.0**
STANDARD INSTRUMENT	+10 0 dBm	+12 0 dBm	+10.0 dBm	+9.0 dBm
OPTION 004 (R.P. Out w/Atten.)	+10.0 dBm	+11 0 dBm	+9 0 dBm	+7.0 dBm

MINIMUM SETTABLE POWER
−110 dBm

RF OFF
When the RF key is turned OFF, the POWER dBm display will read OFF and a 0 dBm signal will typically be reduced to a level *<−100 dBm.*

OUTPUT POWER RESOLUTION
"ENTRY DISPLAY": 0 05 dB **"POWER dBm" Display:** 0.1 dB

OUTPUT POWER ACCURACY[2]	Bands and Approximate Frequency Ranges (GHz) (See Frequency Ranges and Bandswitch Points for complete description)	
	Band 0 0.01 to <2.3	**Bands 1 - 3 2.3 to 20**
STANDARD INSTRUMENT (Front Panel Output w/ Attenuator)		
+18 to +10 dBm[3]	—	±1.8 dB
+10 to −9.95 dBm	±0 9 dB	±1 5 dB
−10 to −19.95 dBm	±1.2 dB	±2 0 dB
−20 to −49.95 dBm	±1.5 dB	± 2 3 dB
−50 to −79.95 dBm	±1.8 dB	±2 6 dB
−80 to −99.95 dBm	±2.1 dB	±2.9 dB
−100 to −110 dBm (typical)	*±2.9 dB*	*±3.7 dB*
OPTION 004 (Rear Panel Output w/Attenuator)		
+18 to +10 dBm[3]	—	±2.0 dB
+10 to −11.95 dBm	±1.0 dB	±1.7 dB
−12 to −21.95 dBm	±1.3 dB	±2.2 dB
−22 to −51.95 dBm	±1.6 dB	±2.5 dB
−52 to −81.95 dBm	±1.9 dB	±2.8 dB
−82 to −99.95 dBm	± 2.2 dB	±3.1 dB
−100 to −110 dBm (typical)	*±3.0 dB*	*±3.9 dB*

Supplemental Performance Characteristics are in *italics*

RF OUTPUT (Cont'd)

FLATNESS (Internally leveled)

STANDARD INSTRUMENT (Front Panel Output w/Attenuator)	**Band 0** **0.01 to <2.3**	**Bands 1 - 3** **2.3 to 20**
+18 to +10 dBm[3]	—	±1.2 dB
+10 to −9.95 dBm	±0.6 dB	±1.1 dB
−10 to −19.95 dBm	±0.9 dB	±1.6 dB
−20 to −49.95 dBm	±1.2 dB	±1.9 dB
−50 to −79.95 dBm	±1.4 dB	±2.2 dB
−80 to −99.95 dBm	±1.7 dB	±2.5 dB
−100 to −110 dBm (typical)	*±1.9 dB*	*±3.1 dB*
OPTION 004 (Rear Panel Output w/Attenuator)		
+18 to +10 dBm[3]	—	±1.4 dB
+10 to −11.95 dBm	±0.7 dB	±1.3 dB
−12 to −21.95 dBm	±1.0 dB	±1.8 dB
−22 to −51.95 dBm	±1.3 dB	±2.1 dB
−52 to −81.95 dBm	±1.5 dB	±2.4 dB
−82 to −99.95 dBm	±1.8 dB	±2.7 dB
−100 to −110 dBm (typical)	*±2.0 dB*	*±3.3 dB*

TYPICAL ALC INCREMENTAL ACCURACY

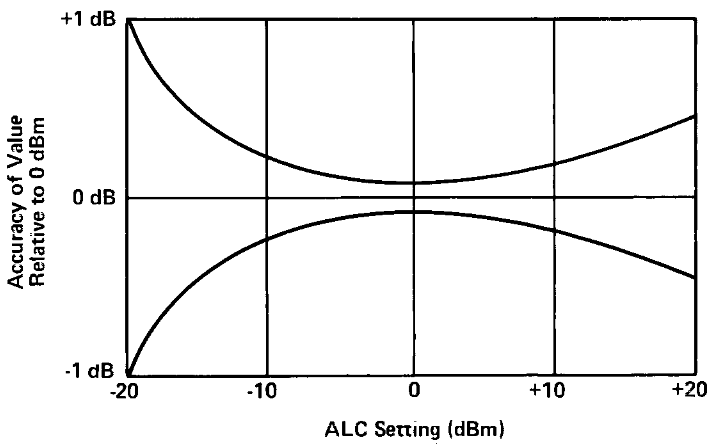


Figure 2. Typical ALC Incremental Accuracy

In normal operation the ALC does not operate below −9.95 dBm because the HP 8341B automatically increments the step attenuator at that point. However, when the ALC and step attenuator are independently controlled (DECOUPLED mode), the ALC may be operated over its full +20 dBm to −20 dBm range. Refer to Section III, Operation for a more detailed description. Pressing **[SHIFT] [POWER SWP]** places the instrument in the Decoupled Mode. In this mode the Data Entry keyboard and the rotary knob control the ALC level, and the step up and step down keys control the attenuator.

Supplemental Performance Characteristics are in *italics*.

RF OUTPUT (Cont'd)

RF OUTPUT CONNECTOR

Output Impedance: *Nominally 50 Ohms*

Typical Source SWR (Internally leveled only):
0.1 to <2.3 GHz: *Typically <1.3:1*
2.3 to <18.0 GHz: *Typically <1.6:1*
18.0 to 20.0 GHz: *Typically <1.8:1*

STABILITY WITH TEMPERATURE: *Typically ±0.01 dB/°C*

OUTPUT LEVEL SWITCHING TIME:

Typically <10 ms to be within 0.1 dB of final value with no attenuator range change (internally leveled only).

POWER SWEEP

Range:
Displayed: 0 to 40 dB/sweep
Actual: At least 10 dB at any given frequency (at least 20 dB in DECOUPLED mode: see Figure 3 below).

Resolution: 0.05 dB/sweep

Accuracy:
Starting Power Level: Same as Output Power Accuracy
Power Sweep Width and Linearity: See Figure 2

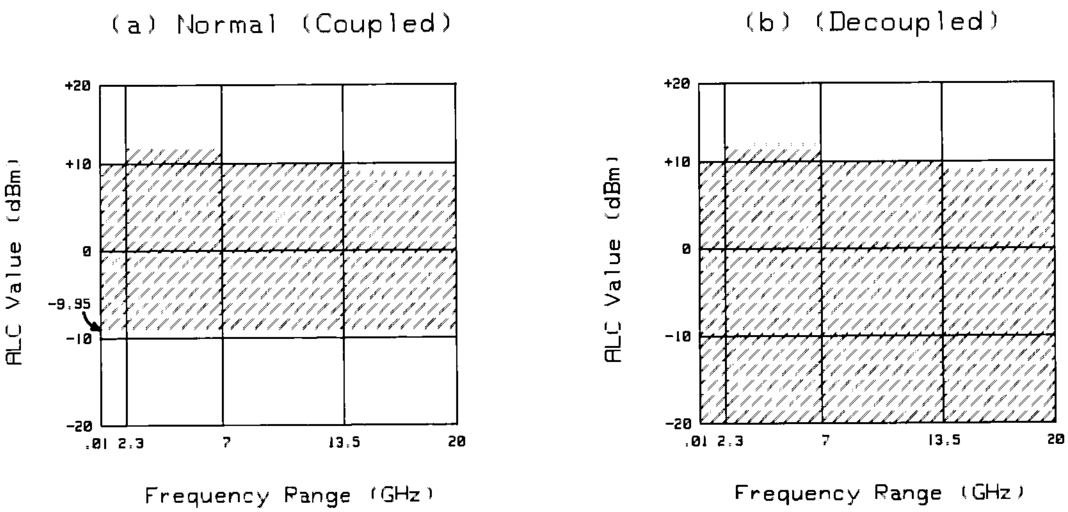


Figure 3. Typical Power Sweep Range

In normal operation (a), the ALC does not operate below −9.95 dBm (unless the instrument is placed in the Decoupled Mode by pressing **[SHIFT] [PWR SWP]**. See Figure 3), and so the maximum power sweep range is the difference of −9.95 dBm and the maximum leveled power available at the frequency of interest (specified leveled power shown in the diagram). In the DECOUPLED mode (b), the power sweep range is extended because the ALC can operate down to −20 dBm. The maximum power levels shown above do not apply to HP 8341Bs equipped with option 004

Supplemental Performance Characteristics are in *italics*.

RF OUTPUT (Cont'd)

SLOPE COMPENSATION

Calibrated Range: 0 to 1.5 dB/GHz **Resolution:** 0.0001 dB/GHz

EXTERNAL LEVELING

XTAL: Allows the HP 8341B to be externally leveled by crystal detectors of positive or negative polarity.

METER: Allows power meter leveling with any HP power meter.

Range (XTAL or METER): 500 microvolts (−66 dBV) to 2.0 volts (+6 dBV)

Accuracy of voltage at EXT INPUT connector relative to the displayed level (leveling voltage is shown in ENTRY DISPLAY in dBV). *±0.5 dB ±0.2 mV*

Loop Bandwidth:
XTAL Mode: *Nominally 80 kHz* METER Mode: *Nominally 0.7 Hz*

Input Impedance: *Nominally 1 M Ohm.*

PULSE MODULATION

(CW mode, and all specifications are typical for frequencies <400 MHz)

ON/OFF RATIO: >80 dB

RISE (T_R) AND FALL (T_F) TIMES: ≤25 nanoseconds

MINIMUM INTERNALLY LEVELED RF PULSE WIDTH (T_{RF}): 100 nanoseconds

MINIMUM UNLEVELED RF PULSE WIDTH: *Typically 25 nanoseconds*

PULSE REPETITION FREQUENCY (PRF)

Non-leveled operation (SHIFT METER): *Typically dc to 20 MHz.*

Internally leveled operation: 100 Hz to 5 MHz *(typically 100 Hz to 500 kHz for RF frequencies <400 MHz).*

MAXIMUM PEAK POWER: Same as specified maximum leveled power. (See RF OUTPUT).

Supplemental Performance Characteristics are in *italics*

PULSE MODULATION (Cont'd)

Bands and Approximate Frequency Ranges (GHz)
(see Frequency Ranges and Bandswitch Points for complete description)

ACCURACY OF INTERNALLY LEVELED RF PULSE V_P (relative to CW mode level):

(Note that the ALC attempts to hold pulse amplitude to save level as leveled CW signal.)

Pulse Width	Band 0		Bands 1 - 3
	0.01 to 0.4	**0.4 to <2.3**	**2.3 to 20.0**
100 to <200 ns	—	+3/−0.3 dB*	+1.5/−0.3 dB*
200 to <500 ns	—	+1.5/−0.3 dB*	±0.3 dB
≥500 ns	—	±0.3 dB	±0.3 dB
1 to <2 μs	*+3/−0.3 dB*	—	—
2 to <5 μs	*+1.5/−0.3 dB*	—	—
≥5 μs	*±0.3 dB*	—	—

*+15 to +55°C. Duty Cycle must be >0.01%

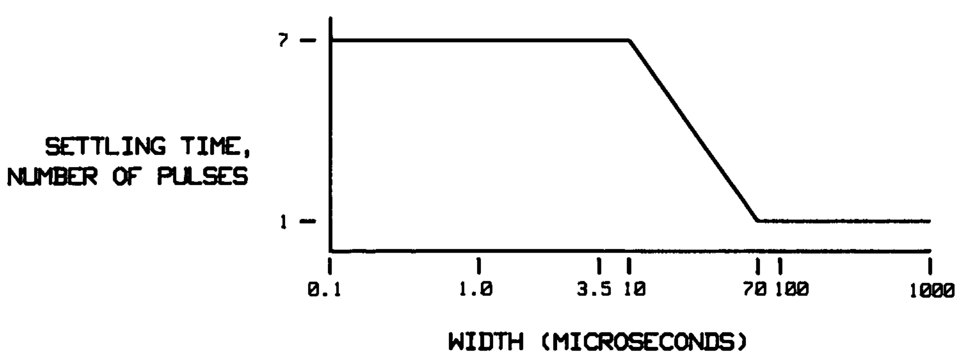
SIMULTANEOUS AM AND PULSE (Parameters shown are typical)

AM BANDWIDTH AT 30% DEPTH
DC coupled, typical 3 dB point:

Internally Leveled	Unleveled (Shift Meter)*
PRF/20** to a maximum of 5 kHz	*100 kHz*

SETTLING TIME TO A STEP INPUT, 10%-90%, TYP:

The greater of: 70 μsec. or the time for the number of pulses indicated by the solid line below.	*3.5 μsec*



*[SHIFT] [METER] is an unleveled operating mode, power is controllable, but is not flat over frequency. AM bandwidth in this mode is independent of pulse rate and width. See Section I.

**PRF = PULSE REPETITION FREQUENCY.

Supplemental Performance Characteristics are in *italics*

PULSE MODULATION (Cont'd)

OVERSHOOT, RINGING (V_{OR}/V_P): *<15% typically*

PULSE WIDTH COMPRESSION ($T_V - T_{RF}$): *±5 nanoseconds typically*

DELAY TIME (T_D): *50 nanoseconds typically*

VIDEO FEEDTHROUGH (V_F/V_P):
0.01 to <0.4 GHz (Band 0): *≤5% typically (for output power levels ≤+8 dBm)*
0.4 to <2.3 GHz (Band 0): ≤5% (for output power levels ≤+8 dBm)
2.3 to 20.0 GHz (Bands 1 - 3): ≤0.2%

SIDEBANDS (caused by a pulse input when PULSE is OFF):
Typically −50 dBc with a 30 kHz squarewave input from 0.01 to 7.0 GHz.

PULSE INPUT CONNECTOR:

TTL compatible. (Open circuit is TTL high level and keeps RF on.) *Damage level is +12 Vdc, −20 Vdc.* Refer to Section III, Operation, for input circuit diagram.

PULSE DEFINITIONS:

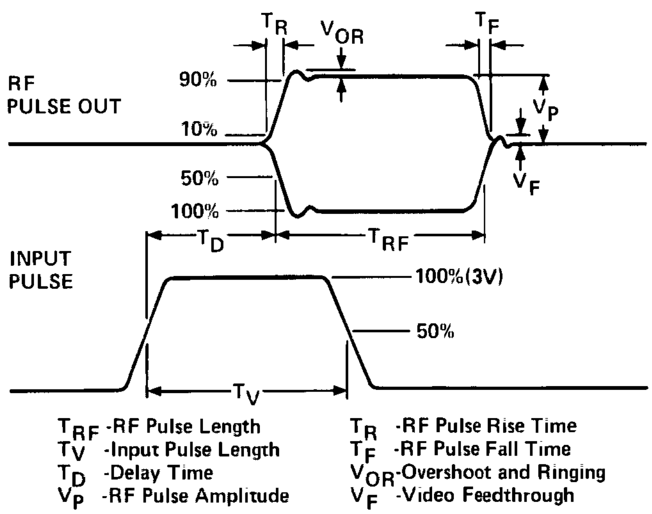


Figure 4. Pulse Definitions

Supplemental Performance Characterisitcs are in *italics.*

AMPLITUDE MODULATION

(The following specifications apply when the HP 8341B is internally leveled, for waveforms whose envelope peak is at least 1 dB below maximum specified power. Unless noted, pulse modulation must be OFF, however, the HP 8341B is capable of simultaneous amplitude and pulse modulation. See Section III, Operation.)

AM DEPTH: 0 to 90%

AM SENSITIVITY (at 1 kHz rate and 30% Depth):

100%/V ±5% RF amplitude is linearly controlled by varying AM input between 0 and ±1 Volt

PULSE ON: *100%/Volt typically for rates less than 0.1/Settling Time.*

AM BANDWIDTH (relative to 1 kHz rate at 30% Depth):

DC coupled, 3 dB point ≥100 kHz

PULSE ON: *DC coupled, 3 dB point ≥PRF/20, typically*
(Refer to Pulse Modulation specs for a more complete description.)

AM FREQUENCY RESPONSE (FLATNESS) (relative to a 1 kHz rate at 30% depth, DC to 10 kHz): ±0.20 dB

DISTORTION: *Typical distortion values are given in Figure 5.*

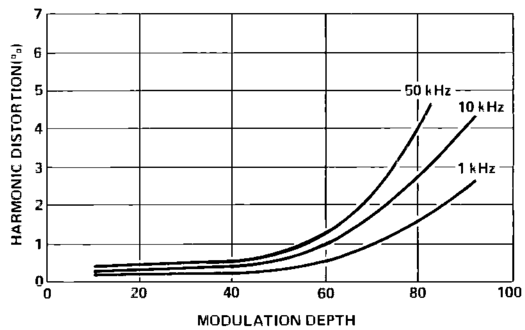


Figure 5. Typical AM Distortion for Various Modulation Rates and Depths

INCIDENTAL PHASE MODULATION (in peak radians) (Rates ≤10 kHz, 30% Depth): *<0.4 typically*

INCIDENTAL FM: *Incidental Phase Modulation × Modulation Frequency*

AM INPUT IMPEDANCE: *Nominally 600 Ohms.*

FREQUENCY MODULATION

MODULATION RATE: 50 kHz to 10 MHz (3 dB bandwidth)

PEAK DEVIATION: The lesser of 10 MHz or:
n × Mod Rate
where n = harmonic multiplication number (1 to 3). Refer to Frequency Ranges and Bandswitch Points Description.

DEVIATION ACCURACY: ±10% (at 100 kHz rate)

SENSITIVITY: 1 MHz/Volt or 10 MHz/Volt

INPUT IMPEDANCE: *Nominally 50 Ohms*

Supplemental Performance Characteristics are in *italics*.

SWEEP TIME

RANGE:

10 milliseconds to 200 seconds forward sweep times

Fastest possible sweep typically cycles once every 40 ms; fastest possible full band sweep typically cycles once every 150 ms.

MAXIMUM SPEED: *Nominally 600 MHz/ms*

RESOLUTION: *Approximately 0.1% of current sweep time value*

ACCURACY: ±5% (sweeptimes ≤50 seconds)

INPUTS

PULSE MODULATION INPUT
Front panel BNC female input connector. TTL compatible (open circuit is TTL high level and keeps RF on). *Damage level is +12 Vdc, −20 Vdc*

AMPLITUDE MODULATION INPUT
Front panel BNC female input connector. *Nominal input impedance is 600 Ohms.*

FREQUENCY MODULATION INPUT
Front panel BNC female connector. Nominal input impedance is 50 Ohms. Full scale input voltage = ±1 vac. Damage to internal circuitry will result if a signal with a peak voltage of ±8 vac or greater is input.

LEVELING EXT INPUT
Front panel BNC female input connector. Used for power meter leveling or crystal detector leveling. Input impedance in XTAL or METER modes is *nominally 1 MOhm*. Refer to EXTERNAL LEVELING specifications.

FREQUENCY STANDARD EXT
Rear panel BNC female connector. Accepts 5 or 10 MHz signal from internal or external timebase. A BNC jumper connects this input to the HP 8341B's FREQUENCY STANDARD INT output for operation form HP 8341B's internal timebase. External signal input must be 5 MHz ±50 Hz or 10 MHz ±100 Hz, 0 to + dBm. *Nominal input impedance is 50 ohms.*

EXT TRIGGER INPUT
Rear panel BNC female connector. Triggers single sweep. Trigger signal must be >2 Vdc (10 Vdc max) and wider than 0.5 microseconds. *Nominal input impedance is 2 kOhms.*

STOP SWP IN/OUT:
Rear panel BNC female connector. TTL high while sweeping, stops sweep when grounded externally. TTL low when HP 8341B stops sweep.

HP 8755C INTERFACE
Rear panel. Connects via cable (HP Part No. 8120-3174) to HP 8755C Scalar Network Analyzer to provide Alternate Sweep function.

HP 8410B INTERFACE
Rear panel 25-pin D-type connector. Permits multi-octave operation of HP 8410B/C Network Analyzer with HP 8341B via interface cable (HP Part No. 08410-60146). Also provides duplicates of these functions: **Ext Trigger Input, Mute Output, Penlift Output, Neg Blank,** and **Z-Axis Blank/Mkrs.** Also provides an input for a switch closure to execute the UP key function.

Supplemental Performance Characteristics are in *italics*.

OUTPUTS

RF OUTPUT

Front panel Type N Female connector. Frequency output range is 10 MHz to 20.0 GHz. *Nominal output impedance is 50 Ohms.* SWR is shown in RF OUTPUT characteristics.

SWEEP OUTPUT

Front and rear panel BNC female connectors. Supplies a voltage proportional to the sweep that ranges from *approximately 0 Vdc* (at start of sweep) to *approximately +10 Vdc* (at end of sweep), regardless of sweep width. In CW mode, the dc voltage is proportional to percentage of full 10 MHz to 20.0 GHz range.

0.5V/GHz

Rear panel BNC female connector which outputs a voltage proportional to the instrument's output frequency *(0.5V/GHz).* Nominal load impedance should be greater than or equal to *4 KOhms. Accuracy of this signal is ±1% ±2mV.* This signal is intended for use with millimeter-wave source systems. This output can be changed to *1.0V/GHz* (for use with the HP 8410C) by adding jumpers W1 and W2 on the A28 SYTM Driver board The maximum output voltage of this signal is *19 vdc.*

10 MHz REF OUTPUT

Rear panel BNC female connector. Output power level is *nominally 0 dBm,* Output impedance is *nominally 50 Ohms.*

FREQUENCY STANDARD INT

Rear panel BNC connector. *Output frequency 10 MHz, output power nominally 3 dBm, 50 Ohm nominal output impedance* Jumpered to **FREQUENCY STANDARD EXT** for operation from HP 8341B's internal timebase

MUTE OUTPUT

Rear panel BNC female connector. Mutes servo motor of X-Y recorder when the HP 8341B crosses a band switchpoint.

PENLIFT OUTPUT J13

For operation with X-Y recorders. PENLIFT disables an X-Y recorder's ability to lower its pen during sweep retrace. If **[SHIFT] [LINE]** is pressed on the front panel, PENLIFT will also disable the pen during forward sweep band switchpoints. Because of X-Y recorder limitations PENLIFT will always disable the X-Y recorder's pen at sweep times under 5 seconds

PENLIFT enables pen operation by providing a current path to ground for the X-Y recorder's pen solenoid The voltage at the PENLIFT output in this state will be *approximately 0 Vdc.* Circuit impedance in this state is *approximately .5 Ohms.*

PENLIFT disables pen operation by not providing a current path to ground for the X-Y recorder's pen solenoid. The voltage on the PENLIFT output will be equal to the X-Y recorder's pen solenoid supply voltage. Circuit impedance in this state is very high.

NEG BLANK

Rear panel BNC female connector. Supplies negative rectangular pulse *(approximately −5 Vdc into 2 kOhm load)* during the retrace and band switchpoints of the RF output.

Z-AXIS BLANK/MKRS

Rear panel BNC female connector Supplies positive rectangular pulse *(approximately +5 Vdc into 2 kOhms)* during the retrace and band switchpoints of the RF output. Also, supplies a *−5 Vdc* pulse when the RF is coincident with a marker frequency (intensity markers only).

AUX OUT

Rear panel Type-N female connector Provides a *2.3 to 7.0* GHz fundamental oscillator output, *nominally 0 dBm and 50 Ohm output impedance.*

Supplemental Performance Characteristics are in *italics*

REMOTE OPERATION

All functions (except line power) may be programmed via the Hewlett-Packard Interface Bus (HP-IB). Detailed Remote operation information is included in Section III, Operation.

GENERAL

ENVIRONMENTAL

Temperature: Operation at 0 to +55°C, except as noted in electrical specifications.

Humidity: Passes 5 day cycling, +40°C, 95% relative humidity.

EMI: Controlled and radiated interference is within the requirements of CE03 and REO2 (relaxed by 10 dB) of MIL STD 461A, and within the requirements of VDE 0871/1978, Level B and CISPR publication 11 (1975)

WARM-UP TIME

Operation: Requires 30-minute warmup from cold start, 0 to +55°C. Internal temperature equilibrium is reached after 2-hour warmup at stable outside temperature.

Frequency Reference: Reference time base is kept at operating temperature in STANDBY mode with the instrument connected to the ac power. For instruments disconnected from ac power for less than 24 hours, the aging rate is $<1 \times 10^{-9}$/day after a 72-hour warmup.

POWER REQUIREMENTS

47.5 to 66 Hz, 100, 120, 220, or 240 volts (±10%), *Typically, 500 VA maximum (40 VA in* ***STANDBY).***

WEIGHT

Net Weight: 34 kg (75 lb)

Shipping Weight: 52 kg (112 lb)

DIMENSIONS

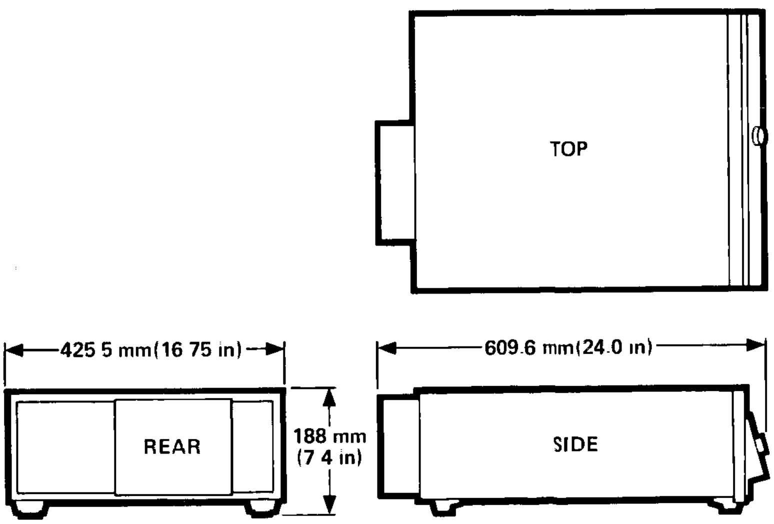


Figure 6. Instrument Dimensions

Supplemental Performance Characteristics are in *italics*.

NOTES
1. Maximum leveled power from 35°C to 55°C will typically be degraded from these specifications by *no more than 2 dB*.   2. Internally leveled, AM off. The POWER dBm display monitors that actual output power, giving accurate readings when unleveled, externally leveled, or when amplitude modulating with a signal that has a dc component. In these modes, the accuracy *typically degrades by ±0.1 dB* over the tabulated values. The ENTRY DISPLAY shows the desired power level, or the desired external detector output voltage, exclusive of modulation.   3. The ALC loop *typically operates up to +20 dBm* to enhance usability at those frequencies where leveled power greater than the maximum specified is available.

Supplemental Performance Characteristics are in *italics*.

Section II: Installation

INTRODUCTION

This section provides installation instructions for the HP 8340B/41B Synthesized Sweepers. This section also includes information about initial inspection, damage claims, preparation for use, packaging, storage and shipment, and Operation Verification.

INITIAL INSPECTION

Inspect shipping container for damage. If the shipping container 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 Figures 1-1 and 1-2. Procedures for checking electrical performance are given in Section IV, Performance Tests. Performance Test limits are also given in Section IV. If an instrument failure is suspected, refer to Appendix A, In Case of Difficulty. If there is any electrical or mechanical defect, or if the shipment is incomplete, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or if 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.

PREPARATION FOR USE

Power Requirements

The HP 8340B/41B Synthesized Sweepers require a power source of 100, 120, 220, or 240 Vac (±10%), 47.5 to 66 Hz, single-phase. Power consumption is approximately 500 VA (40 VA in STANDBY).

Line Voltage and Fuse Selection

CAUTION

To prevent damage to the instrument, make the correct line voltage and fuse selection before connecting line power to the instrument.

Figure 2-1 illustrates the line voltage selection cam and fuse location in the power line module on the rear panel of the HP instrument. Select the line voltage and fuse rating as follows:

a. Measure the ac line voltage available.

b. Refer to Table 2-1 Remove the line voltage selection cam from the line module. Select the correct position of the cam (shown in Figure 2-1) by matching the measured ac line value to the correct range indicated in the table. Note that the line voltage ranges given are within ±10% of the nominal line voltage. If the available line voltage does not fall within this range, you must use an autotransformer between the power source and the HP instrument to bring the line voltage within tolerance.

c. Install the line voltage selector cam in the power line module as shown in Figure 2-1.

d. Select the proper fuse to install. The fuse ratings are indicated in Table 2-1 as well as next to the power line module on the rear panel of the instrument.

Power Cable

In accordance with international safety standards, this instrument is equipped with a three-wire power cable When connected to an appropriate power line outlet, this cable grounds the instrument cabinet. Table 2-2 shows the styles of plugs available on power cables supplied with Hewlett-Packard instruments. The HP Part Numbers indicated are part numbers for the complete power cable/plug set. The specific type of power cable/plug shipped with the instrument depends upon the country of shipment destination.

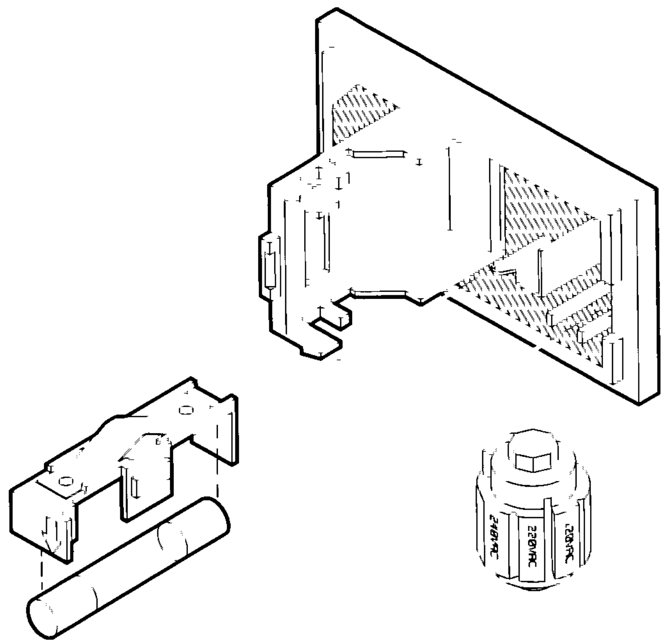
The offset prong of the three-prong connector is the grounding pin The protective grounding feature may be preserved when operating the HP 8340B/41B from a two-contact outlet by using a three-prong to two-prong adapter and connecting the green wire of the adapter to ground. An adapter is available (for US connectors only) as HP Part Number 1251-0048.

Table 2-1. Line Voltage/Fuse Selection

Measured ac Line Voltage	Line Voltage Selection Cam	Fuse/ HP Part Number
90 to 110 volts	100	5.0A 2110-0010
108 to 132 volts	120	4.0A 2110-0005
198 to 242 volts	220	3.0A 2110-0003
216 to 264 volts	240	2.0A 2110-0002

HP-IB Address Selection

The HP 8340A/41B is addressed by an instrument controller on the HP-IB bus by means of a two-digit numerical HP-IB address. This address is set at the factory to 19 but it may be reset by the user to any value between 0 and 31. The HP-IB address is displayed in the ENTRY DISPLAY window upon power up. Pressing **[SHIFT] [LOCAL]** will also cause the current HP-IB address of the HP instrument to be displayed in the ENTRY DISPLAY The HP-IB address may be changed by entering the key sequence: **[SHIFT] [LOCAL]** (new address value; between 0 and 31) **[Hz]** For example, to set the HP-IB Address to 12, press **[SHIFT] [LOCAL] [1] [2] [Hz]**. The HP-IB address is retained in memory when the instrument is in STANDBY as well as when ac line power is removed from the instrument.



CAUTION:

Do not attempt to rotate the voltage selector cam while it is installed in the line module or non-repairable damage will result. The cam must be completely removed from the line module, rotated to the proper position, and reinstalled. Refer to the instructions below.

Replacement of fuse

1. Pry open line module cover door.
2. Pull out fuse carrier.
3. Insert fuse of proper rating.
4. Place carrier back into line module

Selection of Operating Voltage

1. Pry open line module cover door.
2. **REMOVE CAM FROM THE LINE MODULE.**
3. Rotate the cam to the desired voltage. (When the line module cover is closed, the selected voltage will be visible through a small window.)
4. Insert the cam back into the line module.
5. Close the line module cover door

Figure 2-1. Power Line Module

NOTE

An instrument address that is input by the above [SHIFT] [LOCAL] sequence is stored in a memory area referred to as working memory. This address will remain in effect as long as the battery backup circuit is operating properly or until the address is changed with another [SHIFT] [LOCAL] sequence.

Interface Function Codes

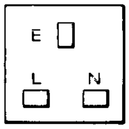
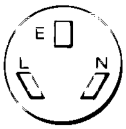
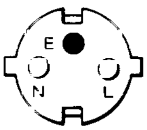
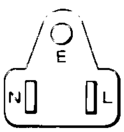
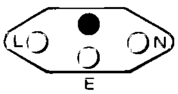
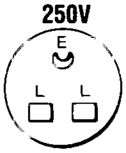
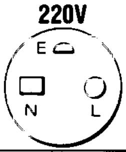
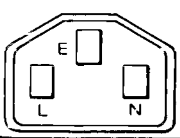
The Interface Function Codes for the HP 8340B/41B are an alphanumerical coded set that describes its operational capabilities on the HP-IB bus. The codes for the instrument are.

SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, C1, C2, C3, C28, E1.

Mating Connectors

All of the externally mounted connectors on this instrument are listed in Table 2-3. Opposite each connector is an industry identification, the HP part number of a mating connector, and the part number of an alternate source for the mating connector.

Table 2-2. AC Power Cables Available

Plug Type[1]	Cable HP Part Number[2]	CD[3]	Plug Description[2]	Cable Length (inches)	Cable Color	For Use in Country
250V 	8120-1351 8120-1703	0 6	Straight BS1363A 90°	90 90	Mint Gray Mint Gray	United Kingdom, Cyprus, Nigeria, Zimbabwe, Singapore
250V 	8120-1369 8120-0696	0 4	Straight ZNSS198/ASC112 90°	79 87	Gray Gray	Australia, New Zealand
250V 	8120-1689 8120-1692	7 2	Straight CEE7-VII 90°	79 79	Mint Gray Mint Gray	East and West Europe, Saudi Arabia, Egypt Republic of So Africa, India (unpolarized in many nations)
125V 	8120-1348 8120-1398 8120-1754 8120-1378 8120-1521 8120-1676	5 5 7 1 6 2	Straight NEMA5-15P 90° Straight NEMA5-15P Straight NEMA5-15P 90° Straight NEMA5-15P	80 80 36 80 80 36	Black Black Black Jade Gray Jade Gray Jade Gray	United States, Canada, Japan (100V or 200V), Mexico, Philippines, Taiwan
250V 	8120-2104	3	Straight SEV1011.1959 24507,Type 12	79	Gray	Switzerland
250V 	8120-0698	6	Straight NEMA6-15P			United States, Canada
220V 	8120-1957 8120-2956	2 3	Straight DHCK 107 90°	79 79	Gray Gray	Denmark
250V 	8120-1860	6	Straight CEE22-VI (System Cabinet Use)			

1. E = Earth Ground; L = Line, N = Neutral
2. Part number shown for plug is industry identifier for plug only. Number shown for cable is HP Part Number for complete cable including plug
3. The Check Digit (CD) is a coded digit that represents the specific combination of numbers used in the HP Part Number. It should be supplied with the HP Part Number when ordering any of the power assemblies listed above, to expedite speedy delivery.

HP-IB, HP 8410, and HP 8755C INTERFACE Connectors

Figure 2-2 shows the signal/pin configuration of the rear panel HP-IB connector. The same information is shown for the HP 8410 INTERFACE connector in Figure 2-3 and for the HP 8755C INTERFACE connector in Figure 2-4.

Internal Oscillator Selection and Warmup Time

The rear panel FREQUENCY STANDARD toggle switch (shown in Figure 2-5) must be in the INT position and the rear panel BNC jumper cable must be connected between the INT and EXT connectors for the instrument to operate properly when using the internal time base standard. By disconnecting the jumper from the INT connector, setting the switch to EXT, and injecting a 10 MHz signal (approximately +3 dBm, 50 Ohm nominal input impedance) from an external source, the HP 8340B/41B can be phase locked to other instruments in a specific test setup. Sharing a common frequency reference will eliminate frequency errors between the instruments due to varying internal oscillator frequencies.

The instrument must be connected to the ac power line in order to keep the internal time base frequency standard oven at operating temperature. The instrument requires approximately 30 minutes to warm up from a cold start before the front panel **OVEN** annunciator goes out. Internal temperature equilibrium is reached after approximately 2 hours with a stable outside temperature. Refer to the instrument specifications in Section I, General Information, in this volume for additional information on warm up times.

Operating Environment

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

Humidity. The instrument may be operated in environments with humidity from 5% to 80% relative at +25°C to +40°C. However, the instrument should also be protected from temperature extremes that could cause condensation within the instrument.

Altitude. The instrument may be operated at pressure altitudes up to 4572 meters (approximately 15,000 feet).

Cooling. The HP 8340B/41B obtain all of their cooling airflow by forced ventilation from the fan mounted on the rear panel. The cooling airflow path is as follows: into the fan from the rear of the instrument, past the internal circuitry, and out the vents in the right side panel and the rear panel heat sink assembly.

CAUTION

Ensure that all airflow passages at the rear and sides of the instrument are clear before installing the instrument in its operating environment. This is especially important when using the instrument in a rack mounted configuration.

Front Handles Kit

All standard instruments are supplied with a front handles kit. This kit must be installed by the user as illustrated in Figure 2-6.

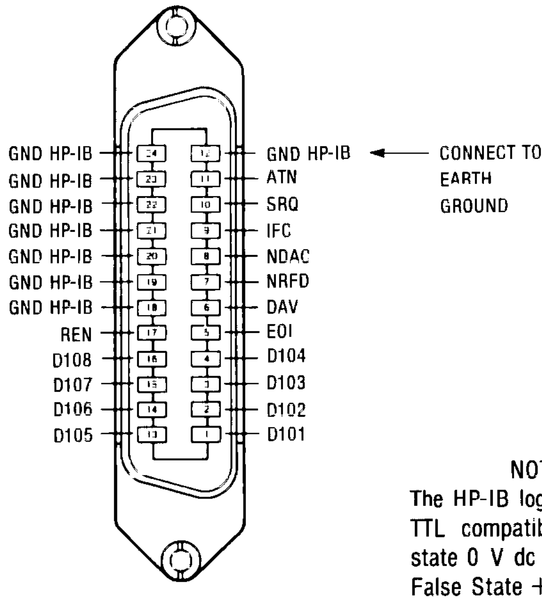
Table 2-3. Model HP 8340B/41B Mating Connectors

HP 8340B/41B Connector		Mating Connector	
Connector Name	**Industry Identification**	**HP Part Number**	**Alternate Source**
J1 SWEEP OUTPUT J2 PULSE J3 AM J4 EXT (Leveling) INPUT	BNC (female)	1251-0256	Specialty Connector 25-P118-1
J5 RF OUTPUT** (HP 8340B)	APC 3 5 (male)	Any precision 3 5mm (female)	N/A
J5 RF OUTPUT** (HP 8341B)	Type N (female)	Any industry standard Type N (male)	N/A
J6 0.5V/GHz J7 SWEEP OUTPUT J8 10 MHz REF OUTPUT J9 INT J10 EXT J11 EXT TRIGGER INPUT J12 MUTE OUTPUT J13 PEN LIFT OUTPUT J14 NEG BLANK J15 Z-AXIS BLANK/MKRS J16 STOP SWP IN/OUT	BNC (female)	1251-0256	Specialty Connector 25-P118-1
J17 8755C INTERFACE*	Audio 3-Pin Connector	N/A	Switchcraft TA-3F
J18 8410 INTERFACE	25-Pin D Series	1251-0063	ITT Cannon DBM-25P
J19 AUX OUTPUT	Type N (female) (50 ohm)	Any industry standard 50 ohm Type N (male)	N/A
J20 RF OUTPUT** (HP 8340B)	APC 3 5 (male)	Any precision 3 5mm (female)	N/A
J20 RF OUTPUT (HP 8341A)	Type N (female)	Any industry standard Type N (male)	N/A
J21 HP-IB***	24-Pin Micro Ribbon	1251-0293	Amphenol 57-30240

* A 1219mm (48 inch) cable assembly with a Switchcraft TA-3F Audio 3-pin connector on each end is supplied with the Model 8755C Swept Amplitude Analyzer as the Alternate Sweep Interface Cable The complete cable may be ordered separately as HP Part Number 8120-3174 The ALT SWP INTERFACE connector J17 signal/pin configuration is shown in Figure 2-4

** Options 004 and 005 only, delete J5, add J20

*** HP-IB interface connector J21 signal/pin configuration is shown in Figure 2-2



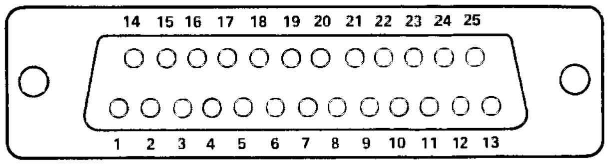
NOTE

The HP-IB logic levels are TTL compatible, ie., true state 0 V dc to 0.4 V dc, False State +2.5 V dc to +5 V dc.

Mnemonic	Description
L ATN	LOW = Attention control line
L DAV	LOW = Data Valid control line
L DIO1 thru 8	LOW = Data Input/Output control lines
L EOI	LOW = End Or Identify control line
L IFC	LOW = Interface Clear control line
L NDAC	LOW = Data Not Accepted control line
L NRFD	LOW = Not Ready For Data control line
L REN	LOW = Remote Enable control line
L SRQ	LOW = Service Request control line

Figure 2-2. HP-IB Connector Signal/Pin Configuration

HP 8410C INTERFACE CONNECTOR J17
(As seen from rear panel)



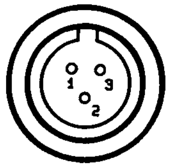
Pin	Mnemonic	Description[1]	In/Out[2]
1		No Connection	
2	Z-AXIS	LOW=Marker Pulse (±5V)	Output
3		No Connection	
4	LALTSEL	Alternate Sweep (LSTTL)	Output
5	LSSP	LOW=Stop Forward Sweep Request	Input/Output[3]
6	+5.2V	+5 Volts (100 mA Max.)	Output
7		No Connection	
8	MUTE	LOW=RF Blank Request (LSTTL)	Input
9	EXT TRIG	HIGH=External Trigger Sweep (LSTTL)	Input
10	PEN LIFT	HIGH=Pen Lift	Output[3]
11		No Connection	
12		No Connection	
13		No Connection	
14	NEG BLANK	LOW=Blanking Pulse (−5V)	Output
15		No Connection	
16	LRETRACE	LOW=Retrace Strobe (LSTTL)	Output
17	LALTEN	LOW=Alternate Sweep Enable (LSTTL)	Output
18		No Connection	
19	GND	Digital Ground/Pen Lift Return	
20		No Connection	
21		No Connection	
22	LSTEPUP	LOW=Step Advance (SW. to GND) (0.4V)	Input
23		No Connection	
24	8410B TRIG	HIGH=Synchronizer Trigger (LSTTL)	Output
25		No Connection	

1. LSTTL Logic Levels INPUTS: Low ≤0.8 Vcd, High ≥2.0 Vdc
   OUTPUTS: Low ≤ 0.4 Vdc, High ≥2.4 Vdc.
2. Control of input lines can be accomplished by contact closure to ground for a logic low level and open circuit for a logic high level
3. Open Collector Output.

Figure 2-3. HP 8410 INTERFACE Connector Signal/Pin Configuration

ALTERNATE SWEEP INTERFACE CONNECTOR J17

HP 8755C
ALT SWP
INTERFACE



(viewed from rear of instrument)

Pin	Mnemonic	Description	Level	Wire Color Code	A62J31 Pin	Source
1	LALTEN	LOW to Externally Enable ALT SWP Mode in HP 8755C	TTL OUTPUT	9 - 1 - 5	23	A57P1-60
2	LALTSEL	Channel Select (HIGH =Channel 1, LOW =Channel 2)	TTL OUTPUT	9 - 1 - 6	24	A57P1-59
3	LRETRACE	LOW During Retrace	TTL OUTPUT	9 - 1 - 7	25	A57P1-58

Figure 2-4. HP 8755C INTERFACE Connector Signal/Pin Configuration

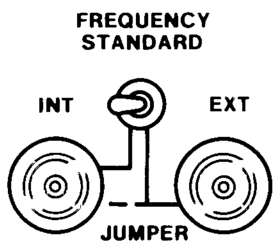


Figure 2-5. Rear Panel FREQUENCY Standard Switch

Chassis Slide Kit (Option 806)

Option 806 instruments are supplied with a Chassis Slide Kit that must be installed by the user. This kit and its mounting instructions are illustrated in Figure 2-7.

Rack Flange Kit (Option 908)

Option 908 instruments are supplied with a Rack Flange Kit. This kit includes only rack flanges; it does not include handles. Mounting instructions are illustrated in Figure 2-8.

Rack Mounting with Handles (Option 913)

Option 913 instruments are supplied with rack mount flanges and front handles. This kit may be installed by the user as illustrated in Figure 2-9.

STORAGE AND SHIPMENT

Environment

The instrument may be stored or shipped in environments within the following limits:

Temperature	−40°C to +75°C
Humidity	5% to 95% relative at 0° to +40°C
Altitude	Up to 15240 meters
(Pressure)	(approximately 50,000 feet)

The instrument should also be protected from sudden temperature fluctuations that could cause condensation in the instrument

Packaging

Original Packaging Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. Original packaging items are shown in Figure 2-10. The instrument front handles must be replaced by the shipping bars when the original packaging materials are used. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number (located on rear panel serial plate). Mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

Other Packaging. The following general instructions should be used for repackaging with commercially available packaging materials:

a. Wrap the instrument in heavy paper or plastic. If shipping to a Hewlett-Packard Office or Service Center, attach a tag indicating the type of service required, return address, model number, and full serial number.

b. Use a strong shipping container.

c. Use enough shock-absorbing material around all sides of the instrument to provide a firm cushion and to prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely.

e. Mark the shipping container FRAGILE to assure careful handling.

f. In any correspondence, refer to the instrument by model number and full serial number

Blue Service Tags

Before sending the instrument back to the HP Service organization, attach a blue service tag, located at the rear of this section, to the instrument. Fill out the tag thoroughly to aid the service technician in isolating the specific fault(s) as quickly as possible.

INCOMING INSPECTION PROCEDURE

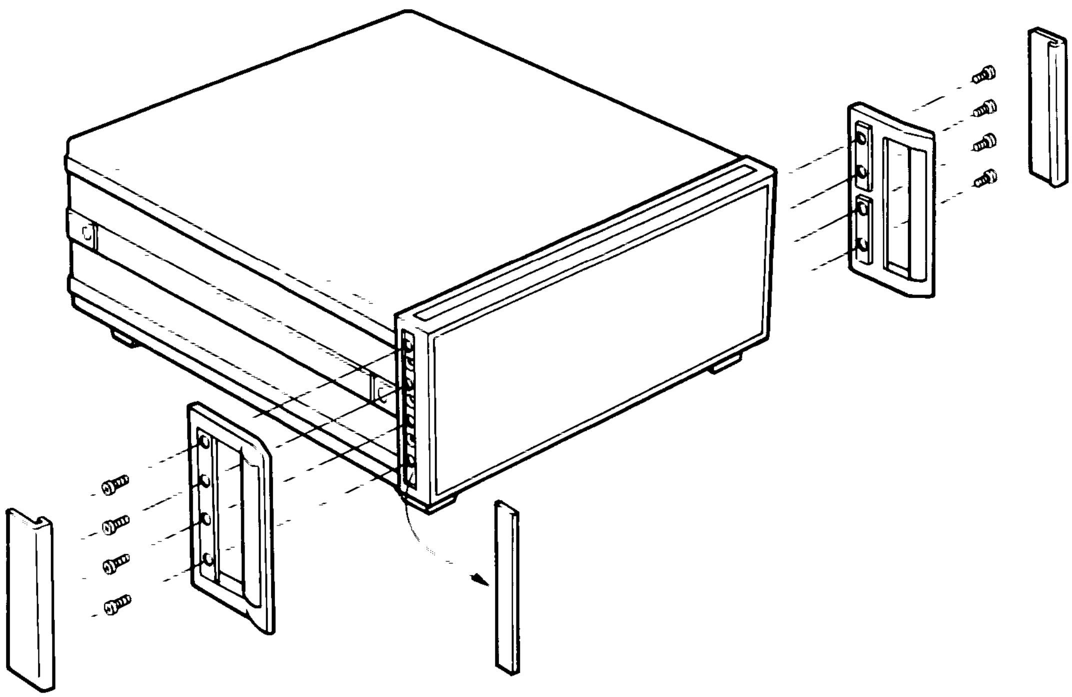
Several forms of an incoming inspection procedure are available in this manual. Section III, Operation, in this volume includes a section on "Getting Acquainted with the HP 8340B/41B" that may be used to quickly verify operational functions when the intstrument is first received. Section IV, Performance Tests, and the HP-IB Operation Verification procedure (also located in Section IV) should be used to verify that the instrument matches its published specifications and performance characteristics.

METRIC FRONT HANDLE KIT

HP PART NUMBER 5061-9690

CONTENTS

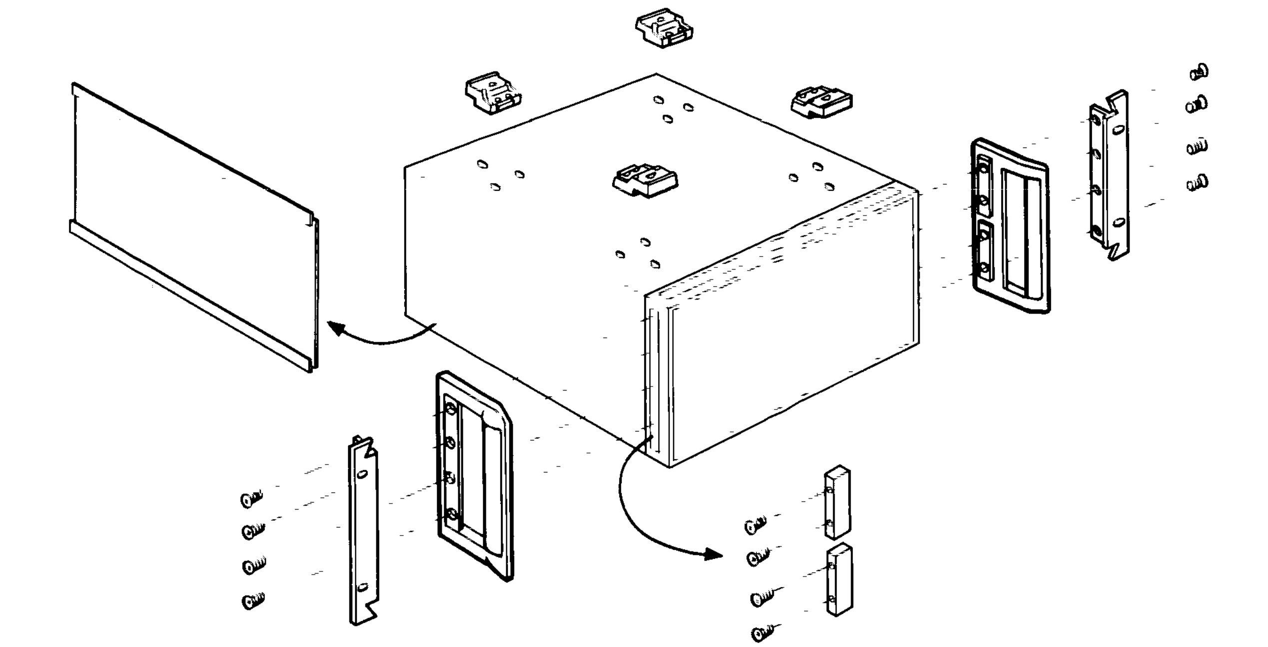
QTY.		PART NO.
2	FRONT HANDLE ASS'Y	5060-9900
2	FRONT HANDLE TRIM	5020-8897
8	M4x0.7x10 FH 90', SCREW (METRIC)	0515-0896



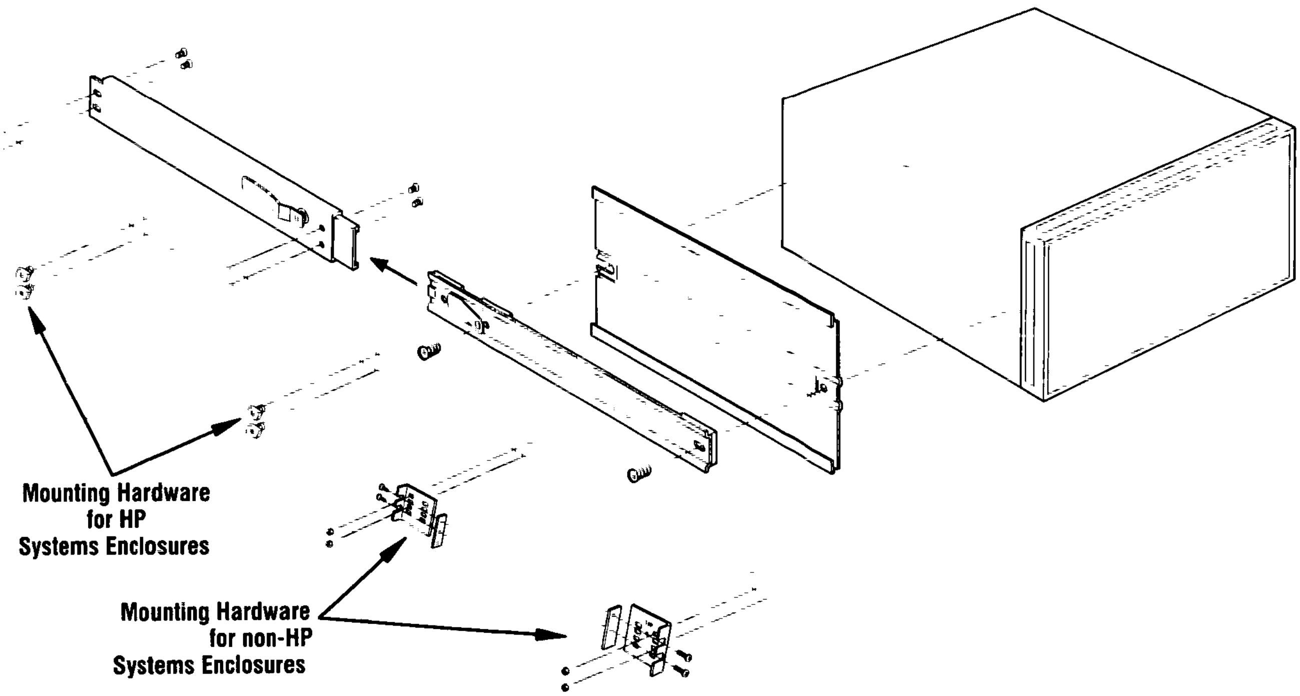
INSTRUCTIONS

1. Remove side trim strips.
2. Attach front handle assembly with 4 screws per side.
3. Press front handle trim in place.

Figure 2-6. Mounting the Front Handles Kit



1. Remove feet assemblies, shipping bars, information card tray (not shown), and side covers.
2. Install new rack flanges and handles. Use screws packaged with rack flange kit.



3. Install new covers (perforated cover is mounted on right side of instrument as seen from front).
4. Remove inner slide assemblies from outer slide assemblies.
5. Secure side covers in place by mounting inner slide assemblies to instrument.
6. Install outer slide assemblies to system enclosure using the appropriate hardware.
7. Lift instrument into position. Align inner and outer slide assemblies. Slide instrument into rack. Realign hardware as needed for smooth operation.

Figure 2-7. Chassis Slide Kit Mounting Instructions (Option 806) (1 of 2)

HP Part Number	Qty	CD	Description
5061-9772	1	6	Rack Mount Kit, Metric (Includes the following parts)
5020-8875	2	2	RACK MOUNT FLANGE
0515-1106	8	2	M4X0.7X16 P.H.
5061-9690	1	7	Handles Kit (Refer to Figure 2-6)
5060-9884	1	9	SIDE COVER – LEFT
5060-9942	1	0	SIDE COVER – RIGHT (PERFORATED)
1494-0059	1	7	Slide Kit, Metric (HP Systems Enclosures) (Includes Inner and Outer Slides)
1494-0061	1	1	Slide Adapter Kit, Metric (NON-HP systems Enclosures) ADAPTER BRACKETS, Metric
All above parts may be ordered as the Chassis Slide Kit, HP Part Number 08340-60136.			

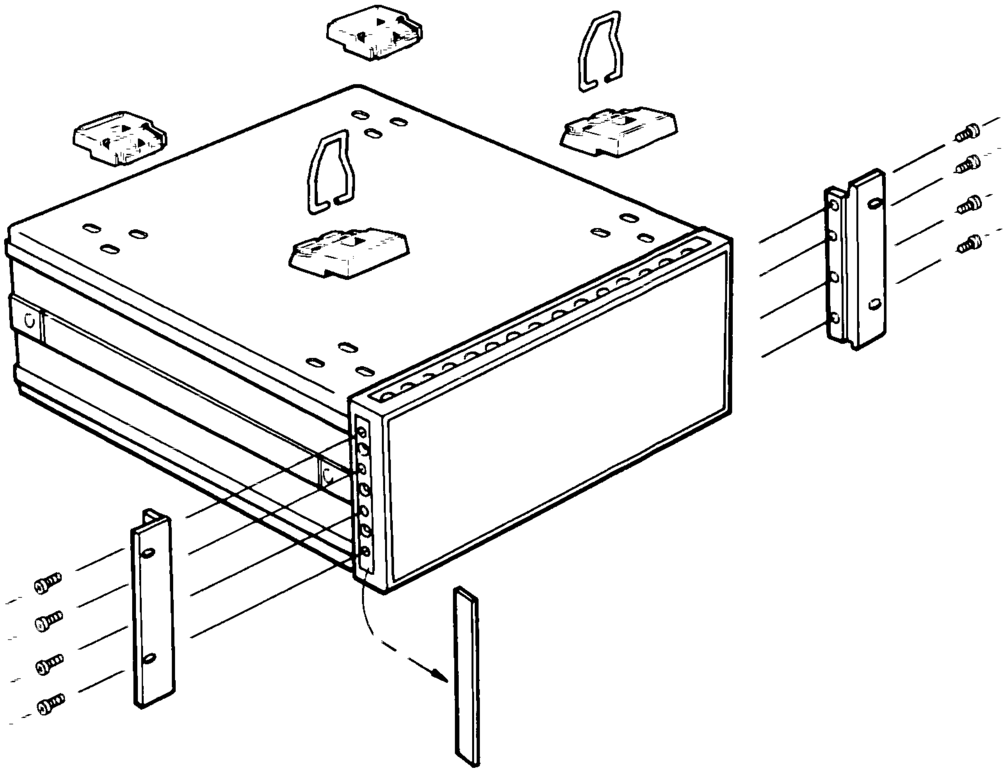
Figure 2-7. Chassis Slide Kit Mounting Instructions (Option 806) (2 of 2)

METRIC RACK MOUNT KIT WITH FRONT HANDLES REMOVED

HP PART NUMBER 5061-9678 (OPTION 908)

CONTENTS

QTY.		PART NO.
2	RACK MOUNT FLANGE	5020-8863
8	M4X0.7X10P.H SCREW (METRIC)	0515-1114



INSTRUCTIONS

1. Remove side trim strips
2. Remove 4 screws and one front handle assembly per side.
3. Attach rack mount flange with 4 screws per side.
4. Remove feet and tilt stands before rack mounting.

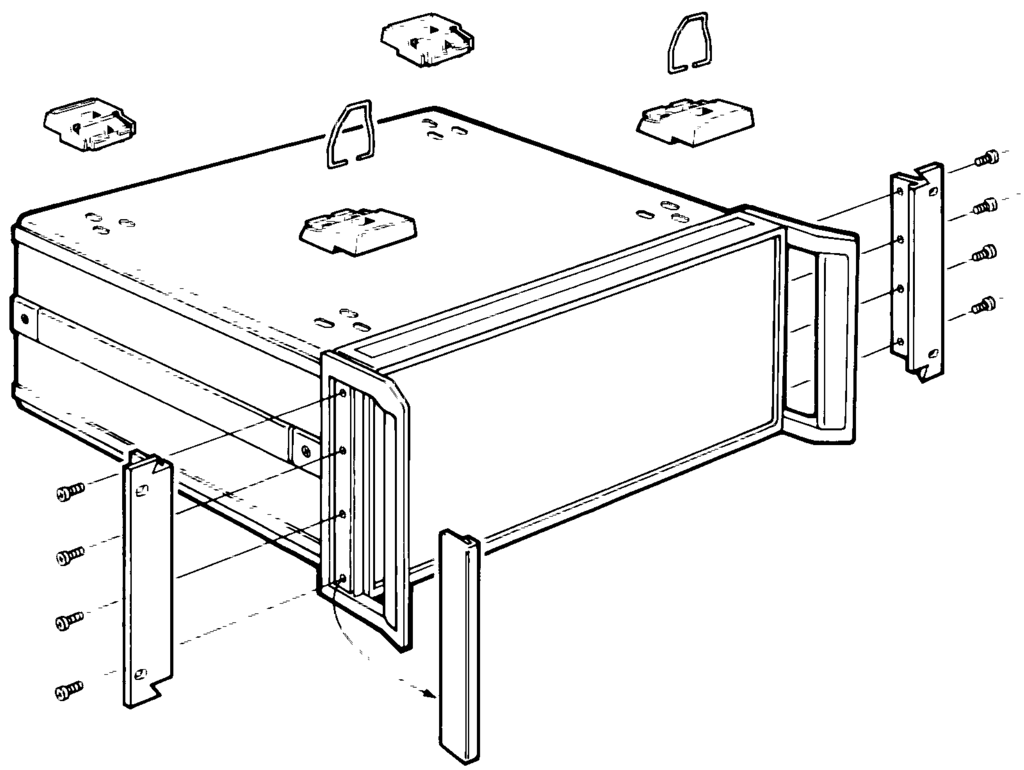
Figure 2-8. Rack Flange Kit Mounting Instructions (Option 908)

METRIC RACK MOUNT KIT FOR CABINETS WITH PREVIOUSLY ATTACHED HANDLES

HP PART NUMBER 5061-9772 (OPTION 913)

CONTENTS

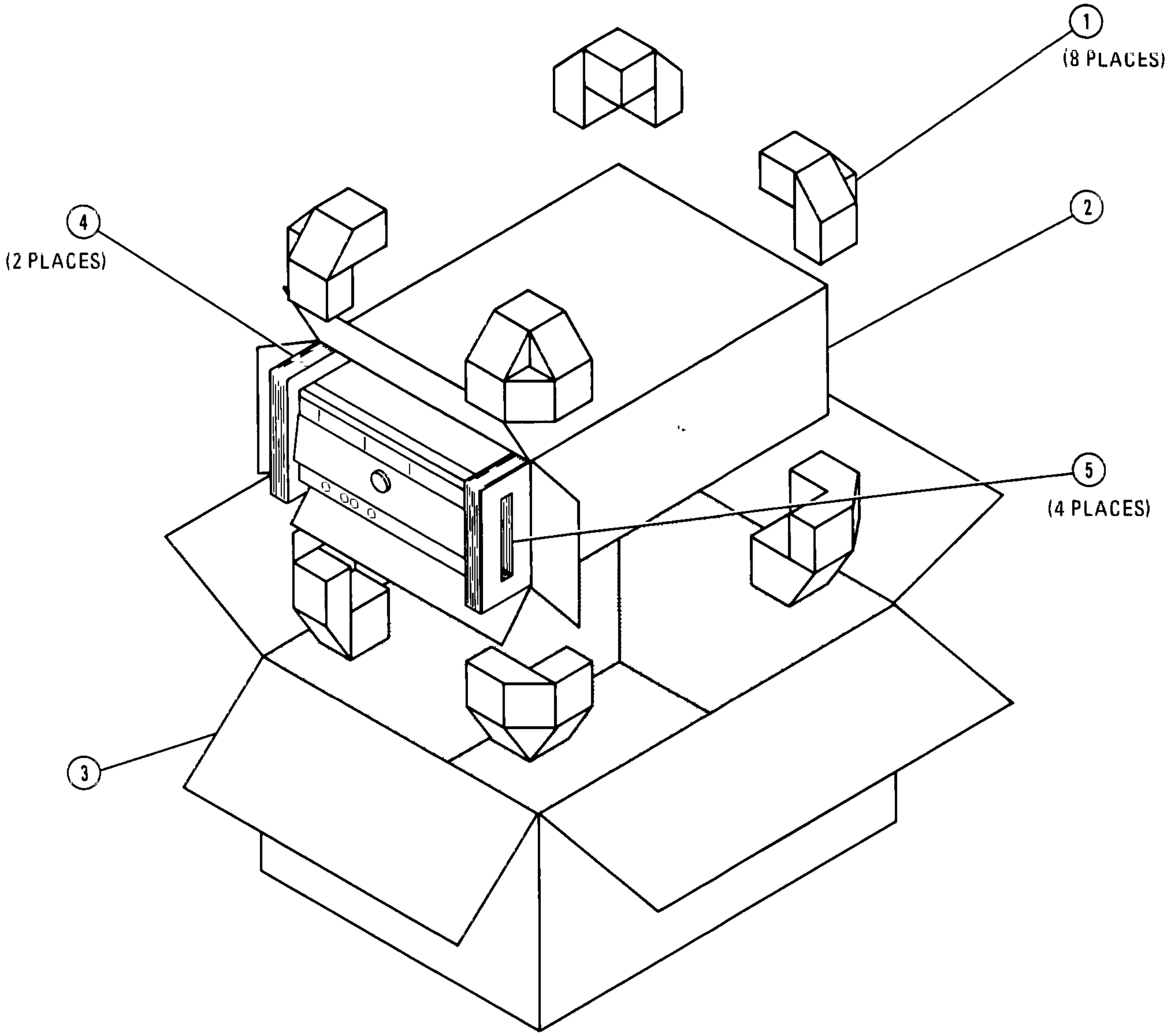
QTY.		PART NO.
2	RACK MOUNT FLANGE	5020-8875
8	M4X0.7X16.H. SCREW (METRIC)	0515-1106



INSTRUCTIONS

1. Remove side trim strips.
2. Remove 4 screws per side.
3. Attach rack mount flange and front handle assembly with 4 new longer screws per side
4. Remove feet and tilt stands before rack mounting.

Figure 2-9. Rack Mounting Kit with Handles (Option 913)



Item	Qty	HP Part No.	C D	Description
1	8	9220-2733	7	FOAM PADS – TOP CORNERS, BOTTOM CORNERS
2	1	9211-4369	2	CARTON – INNER
3	1	9211-4370	3	CARTON – OUTER
3	1	9220-4060	7	SIDE PADS – CORRUGATED CARDBOARD
–	1	9222-0069	2	POLY BAG – TO COVER INSTRUMENT (NOT SHOWN)
5	4	4040-1738	3	SHIPPING BARS
–	8	0515-0896	5	SCREW – M4X0.7X10F.H. (TO MOUNT SHIPPING BARS)

Figure 2-10. Packaging for Shipment using Factory Packaging Materials

Section III. Operation

INTRODUCTION

The Operation section of this manual consists of the following subsections:

GETTING ACQUAINTED GUIDE describes the basic features and essential operating procedures for local (front panel) and remote (HP-IB) operation of the HP 8340B/41B. Personnel using the HP 8340B/41B for the first time should begin with this Guide.

OPERATION: FRONT/REAR PANEL DESCRIPTIONS, HP-IB PROGRAMMING INFORMATION, and POWER CONTROL/MODULATION FEATURES explains the functions of all front and rear panel keys, switches, connectors, indicators and displays, all HP-IB codes and programming procedures, and all the special features associated with power control and modulation. The front/rear panel information is grouped according to the physical layout of the HP 8340B/41B: Figure 3-1 provides a visual index to the front panel functions, Figure 3-2 is an index to the rear panel functions, and Table 3-1 provides a cross reference between functions/modes and the front panel keys. The HP-IB programming information begins with Table 3-2, which lists all code mnemonics, and the codes and procedures are explained in the subsequent text. The power control and modulation information describes the special procedures that can be used to enhance the performance of these functions.

PROGRAMMING NOTES contain supplemental HP-IB programming information. Two Programming Notes are included:

> **Quick Reference Guide for the HP 8340B/41B Synthesized Sweepers** succinctly lists the input programming codes, and was written for the experienced operator.
>
> **Introductory Operating Guide** for use with the HP 9826A or HP 9836A BASIC-language computers provides a detailed explanation of HP-IB programming.

OPERATING GUIDES contain specialized application information. This section contains four Operating Guides (in addition to the Getting Acquainted Guide):

> **Use with X-Y Recorders** explains interfacing of the HP 8340B/41B to HP X-Y recorders.
>
> **External Leveling** of the HP 8340B/41B describes using crystal detectors or power meters.
>
> **Use with the HP 8410B/C Network Analyzer** shows interconnections between the HP 8340B/41B, the Network Analyzer, polar and rectangular displays, and transmission/reflection test sets.
>
> **Use with the HP 8755 Frequency Response Test Set** describes interfacing procedures for the HP 8340B/41B and this scalar network analyzer system.

Contact the nearest HP Sales and Service Office for copies of other Programming Notes and Operating Guides as they become available

SAFETY

Before applying power, refer to SAFETY CONSIDERATIONS in Section I of this manual. The information, cautions, and warnings in this manual must be followed to ensure safe operating conditions for the instrument and the operator.

WARNING

Before the instrument's line power cord is plugged in, all protective earth terminals ("ground" connections), extension cords, auto-transformers and other devices that are connected to the HP 8340B/41B should be connected to a protective earth-grounded socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in personal injury.

Only fuses with the required current rating and specific type should be used. Do not use repaired fuses or short circuit the fuse holder; to do so could cause a shock or fire hazard.

CAUTION

Before the instrument's line power cord is plugged in, the line power module must be set to the voltage of the power source or damage to the instrument may result.

ADDITIONAL OPERATING INFORMATION

Located underneath the HP 8340B/41B Synthesized Sweepers are pullout information cards that summarize the operating procedures and programming codes for the instruments.

If further information is necessary, contact the nearest Hewlett-Packard Sales and Service Office. The world-wide locations of HP offices are listed inside of the back cover of this manual.

Section IV: Performance Tests

INTRODUCTION

The procedures in this section test the HP 8340B and HP 8341B's electrical performance using the specifications given in Section I as the performance standards. These tests are intended for use in incoming inspection, calibration verification, and post-repair performance verification. All tests can be performed without access to the interior of the instrument. An HP-IB Operation Verification procedure is also provided at the end of this section to verify proper HP-IB operation of the instrument.

RECOMMENDED TEST EQUIPMENT

Table 4-2 is a complete list of all required equipment for the tests and adjustments supplied in Section IV, Performance Tests, and Section V, Adjustments. Test equipment other than that noted in the table may be substituted if it meets or exceeds the critical specifications indicated in the table.

TEST RECORD

Results of the Performance Test procedures may be tabulated on the test record card located at the end of this section. Each test lists all of the tested specifications and their acceptable limits. The results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting and after repairs or adjustments have been made.

CALIBRATION CYCLE

This instrument requires periodic verification of performance. The instrument should be checked using the following performance tests at least once every year.

NOTE

The acronym "DUT" (Device Under Test) is used to describe the HP 8340B or 8341B (HP 8340B/41B) under test. The acronym "LO" is used to describe the Local Oscillator.

Options 001, 005, 006, and 007 apply only to HP 8340B's

Table 4-1. List of Manual Performance Tests[1]

Test Number	Performance Test Title	Page
4-1	Internal Time Base Aging Rate	4-9
4-2	Frequency Range and CW Mode Accuracy	4-13
4-3	Sweep Time Accuracy	4-19
4-4	Swept Frequency Accuracy	4-21
4-5	Maximum Leveled Output Power and Power Accuracy	4-25
4-6	External Leveling	4-33
4-7	Spurious Signals Test (10 MHz to 22 GHz - HP 8340B) (10 MHz to 20 GHz - HP 8341B)	4-37
4-8	Spurious Signals Test (22 to 26.5 GHz - HP8340B only)	4-41
4-9	Single Sideband Phase Noise	4-45
4-10	Power Sweep Test	4-53
4-11[1]	Pulse Modulation ON/OFF Ratio Test	4-55
4-12[1]	Pulse Modulation Rise and Fall Time Test	4-57
4-13[1]	Pulse Modulation Accuracy Test	4-63
4-14[1]	Pulse Modulation Video Feedthrough Test	4-67
4-15	Amplitude Modulation Test	4-71
4-16	FM Accuracy and Flatness	4-75
4-17[2]	HP-IB Operation Verification Test	4-83

1. This test is not applicable to instruments equipped with Option 006, Delete Pulse Modulation
2. This is not a Performance Test. It is included as an additional aid to determine that the HP-IB circuitry is operating properly.

Table 4-2. Recommended Test Equipment (1 of 5)

Instrument	Critical Specifications	Recommended Model	Use[1]
Signature Multimeter	Clock Frequency, ≥20 MHz	HP 5005A	T
Oscilloscope	Dual Channel Bandwidth: dc to 100 MHz Vertical Sensitivity: ≤5 mV/Div Horizontal Sensitivity: 50 ns/Div 10 Magnifier External Sweep Capability 50 Ohm Vertical Input	HP 1741A	P, A, T
Oscilloscope Probe	10:1 Divider Probe	HP 10004D	T, A
Digital Voltmeter (DVM)	Range, −50 to +50 Vdc Accuracy, ±0.01% Input Impedance: ≥10 MOhms	HP 3455A or HP 3456A	P, A, T
Power Meter	Power Range: 1µW to 100 mW Accuracy: ±0.02 dB	HP 436A Option 022	P, A, T
Power Sensors	Frequency Range: 10 to 50 MHz Power Range: 1 µW to 100mW	HP 8481A	P, A, T
	Frequency Range: 50 MHz to maximum Frequency of DUT Power Range: 1µW to 100 mW	HP 8485A	P, A, T
Frequency Counter	Frequency Range: Same as DUT Input Impedance: 50 Ohms Frequency Accuracy: time Base Accuracy ± 1 count	HP 5343A Option 011	P, A, T
Universal Counter	Time Interval Range, 100 ns to 200 s	HP 5316A	P, A, T
Spectrum Analyzers	Frequency Range: HP 8340B DUT: 0.01 to 22 GHz HP 8341B DUT: 0.01 to 20 GHz Must have External Time Base Input Center Frequency Accuracy in 0 Hz Span, Same as Time Base Accuracy Minimum Resolution Bandwidth: ≤300 Hz Residual FM: <100 Hz Log Fidelity: ≤1 dB Must have Video Output	HP 8566A or HP 8566B	P, A, T
	Frequency Range: 20 Hz to 40 MHz Resolution Bandwidth, ≤3 Hz	HP 3585A	P, T
Frequency Standard	Frequency: 10 MHz Stability: >1 x 10^{-10}/yr	HP 5061A	P, A
Synthesized Sweeper (used as Local Oscillator in P[1] and A[1], and Sweep Generator in A[1])	Frequency Range: Same as DUT Must have External Time Base Input Frequency Accuracy, Same as Time Base Accuracy RF Power Output: ≥ +4 dBm[3] Phase Noise: Must meet or exceed HP 8340B/41B Line Related Spurious Signals: Must meet or exceed HP 8340B/41B	HP 8340A Opt. 001	P, A

Table 4-2. Recommended Test Equipment (2 of 5)

Instrument	Critical Specifications	Recommended Model	Use[1]
Signal Generator	Frequency. 300 to 400 MHz RF Output Power. ≥0 dBm Settability: to within ±50 kHz	HP 8654A (or HP 8340B/41B)	A
Desktop Computer	HP 236, 226, and 216 are equivalent to the HP 9836, 9826, and 9816 respectively Of the three, the HP 236 (9836) is suggested HP 85F includes HP 83936A ROM Drawer, HP 82937A HP-IB Interface, and I/O ROM HP Part No. 00085-15003.	HP 236 HP 226 HP 216 HP 85F	HP-IB
Plotter/Printer ROM	For HP 85F, no substitute.	HP Part No. 00085-10052	HP-IB
Modulation Analyzer	No Substitute	HP 8901A or HP 8902A	P
Pulse Generator	Pulse Width: ≤100 nS Rise Time: ≤10 ns Frequency: 20 Hz to 50 kHz	HP 8012B	P, A, T
Function Generator	Sinewave Amplitude. ≥1 Vrms Sinewave Frequency. dc to 5 MHz	HP 3325A	P, A, T
Amplifier	Frequency Range: 100 kHz to 1.3 GHz Gain: >20 dB	HP 8447F	P
	Frequency Range. 2 to 20 GHz Gain. 15 dB	HP 8349B	P
Power Supply	0 to 50 Vdc Voltage Drift (in 1 hour): ≤ 0 1% +2 5 mV	HP 6294A	P, A
Mixer	Frequency Range. 1 GHz to maximum frequency of DUT	HP Part Number 0955-0307	P, A
Feedthrough Termination	50 Ohm feedthrough	HP 10100C	P
Attenuators	Frequency Range: same as DUT Maximum Input Power. > +20 dBm Attenuation. 10 dB Connectors: APC-3.5[4]	HP 8493C Opt 010	P, A
	Frequency Range: same as DUT Maximum Input Power: > +20 dBm Attenuation: 20 dB Connectors: APC-3.5	HP 8493C Opt 020	P, A
Step Attenuator	Frequency Range: DC to 100 MHz Maximum Input Power: ≥200 mW avg. Attenuation 0 to 70 dB, settable in 10 dB steps	HP 355D	P
Power Splitter	Frequency Range: 10 MHz to 26.5 GHz Maximum input power. ≥+20 dBm Input SWR. ≤1.3 Output SWR. ≤1.22 Output tracking: ≤0.25 dB	HP 11667B	P

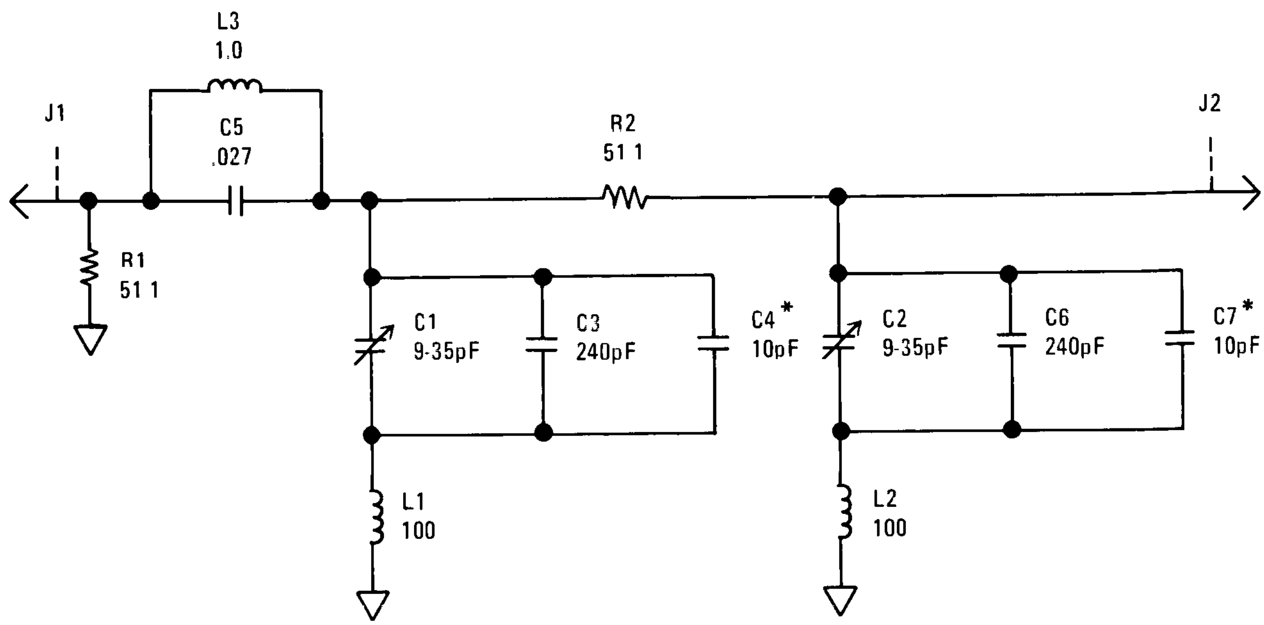
4 Any precision 3.5 mm adapter may be used in lieu of APC 3.5 This is true for any APC 3.5 equipped product mentioned in this manual.

Table 4-2. Recommended Test Equipment (3 of 5)

Instrument	Critical Specifications	Recommended Model	Use[1]
Directional Coupler	Frequency Range: 1.7 to 26.5 GHz Coupling: 16 dB Maximum Input Power: 100mW	HP Part No. 0955-0125	A
Adapters	APC-3.5 (f) to Type N (m) (2 required for HP 8340B/41B) (3 required for HP 8341B with FM)	1250-1744	P, A, T
	APC-3.5 (f) to APC-3.5 (f) (2 required for HP 8340B) (1 required for HP 8341B)	5061-5311	P, A, T
	APC-3.5 (m) to APC-3.5 (m) (Only used in instruments equipped with FM - 2 required)	1250-1748	P, A, T
	APC-3.5 (m) to Type N (m) (1 required for HP 8341B LO)	1250-1743	P, A
	SMC (f) to BNC (f)	1250-0832	P
	SMA Male to BNC Female	1250-1200	P, A
	SMA Female to SMA Female	1250-1159	P
	Type N Male to BNC Female	1250-1476	P
	BNC Female to Dual Banana	1251-2277	P
	SMB (m) to SMB (m)	1250-0069	A
Adapter Tees	BNC Male-Female-Female	1250-0781	P
	SMB Male-Male-Male	1250-0670[2]	T
Active Probe	Input Impedance: 100 KOhms Output Impedance: 50 Ohms	HP 1121A	T, A
Probe Power Supply	For HP 1121A	HP 1122A	T, A
High Pass Filter (1 each required; use only if DUT is HP 8340B)	Frequency Range: 18.0 to 26.5 GHz Connectors: APC-3.5 Female	HP K281C	P
	APC-3.5 Male	HP K281C Opt. 012	P
Low Pass Filter	Pass 100 MHz and below Reject 150 MHz and above	9135-0260	P
Crystal Detector	Negative Frequency Range: Same as DUT	HP 8473C	P, T
Diode (2 required)	Peak Inverse Voltage: 400V Average Forward Current: 750 mA	1901-0028	P
Capacitors	1000 pF (±10%), 100 VDC	0160-4574	P
	0.1 µF (±10%), 200 VDC	0160-0168	A
Resistor	1 MOhm, 1%, 0.5 Watt	0757-0059	A

Table 4-2. Recommended Test Equipment (4 of 5)

Instrument	Critical Specifications	Recommended Model	Use[1]
		HP Part No.	
PC Board Extenders	24-pin	08340-60095[2]	T
	30-pin	08505-60041[2]	T
	36-pin	08505-60042[2]	T
	44-pin	08350-60031[2]	T
	48-pin	08340-60050[2]	T
	62-pin	08340-60096[2]	T
	110-pin	08340-60033[2]	T
IC Test Clip	16-pin	1400-0734[2]	T
	20-pin	1400-0979[2]	T
Adjustment Tool	Fits adjustment slot on components	8830-0024[2]	T
Service Cables	BNC (m) to SMB (f) (2 required)	85680-60093[2]	T
	SMA (m) to SMA (m) Semi-Rigid 61mm (≅2 ft) 2 required	08340-20124[2]	P, A, T
	SMB (f) to SMB (f)	5061-1022[2]	T
	Delay Line — SMA (m) to SMA (m) ≥ 1 meter (3 ft)	08503-20038[2]	P
Nut Driver	9/16-inch, to replace front panel BNC nuts	08340-20099[2]	T
Wrench	5/16-inch slotted box/open end	08555-20097[2]	T
Notch Filter	At least 35 dB rejection at 1 MHz	Locally Fabricate	P
	Construct as shown below. The filter rejection should be: ≥35 dB at 1 MHz <26 dB at 1.01 MHz		



Reference Designator	Description	HP Part No.	Qty.
C1,2	CAPACITOR-VAR CER 9-35PF	0121-0046	2
C3,6	CAPACITOR-MICA 240PF 300V	0140-0199	2
C4,7	CAPACITOR-CERAMIC 10PF 100V	0160-4791	2
C5	CAPACITOR-PE 027 µF 200V	0170-0066	1
J1,2	CONNECTOR RF MALE SMB	1250-0257	2
L1,2	COIL 100µH 5%	9140-0210	2
L3	COIL 1.0µH 5%	9100-3551	1
R1,2	RESISTOR 51.1 1% .125W	0757-0394	2

1 P=Performance Tests, HP-IB=HP-IB Operation Verification Test, A=Adjustments, T=Troubleshooting

2 These parts are included in Service Kit HP Part Number 08340-60134

3 For best accuracy in the Pulse Modulation Rise and Fall Time and the Amplitude Modulation Performance Tests, the Local Oscillator drive to the mixer should be ≥ +4 dBm. The HP 8340A/B Option 001, used as the LO will produce +4 dBm at any frequency. Any HP 8341A/B will provide sufficient power at all frequencies, but may be used only with an HP 8341A/B DUT

4-1. INTERNAL TIME BASE AGING RATE

NOTE

The overall accuracy of the HP 8340B/41B 10 MHz internal time base is a function of time base calibration ± aging rate ± temperature effects ± line effects.

For greatest frequency accuracy, the time base should be allowed to warm up until the output frequency has stabilized (usually 7 to 30 days) before calibrating (adjusting the time base frequency to a known standard). After calibration, the change in time base frequency should remain within the aging rate if: the time base oven is not allowed to cool down, the instrument orientation with respect to the earth's magnetic field is maintained, and the instrument does not sustain any mechanical shock. Frequency changes due to orientation with respect to the earth's magnetic field and altitude changes will usually be nullified when the instrument is returned to its original position. Frequency changes due to mechanical shock will usually appear as a fixed frequency error.

If the instrument is disconnected from ac power allowing the time base oven to cool down, it may be necessary to readjust the time base frequency after a new warmup cycle; however, in most cases, the time base frequency will return to within ± 1 Hz of the original frequency.

Specification

Table 4-3 Internal Time Base Aging Rate Specifications

Aging Rate:

1×10^{-9} per day, 2.5×10^{-7} per year after 72-hour warm up if the instrument has been disconnected from ac power for less than 24 hours. Aging rate is achieved after 7 to 30 days warm-up if the instrument has been disconnected from ac power for greater than 24 hours.

Accuracy:

Overall accuracy of internal time base is a function of time base calibration ± aging rate ± temperature effects ± line effects

Description

A reference signal from the HP 8340B/41B under test is connected to the oscilloscope's vertical input. A frequency standard (with long term stability greater than 1×10^{-10} is connected to the oscilloscope trigger input. The time required for a specific phase change is measured immediately and after a period of time. The aging rate is inversely proportional to the absolute value of the difference in the measured times.

Equipment

Frequency Standard .... HP 5061A
Oscilloscope[1] .... HP 1741A

1 A 50 Ohm Feedthrough Termination (such as the HP 10100C) is required when using an oscilloscope without a 50 Ohm input. It is not required with the HP 1741A.

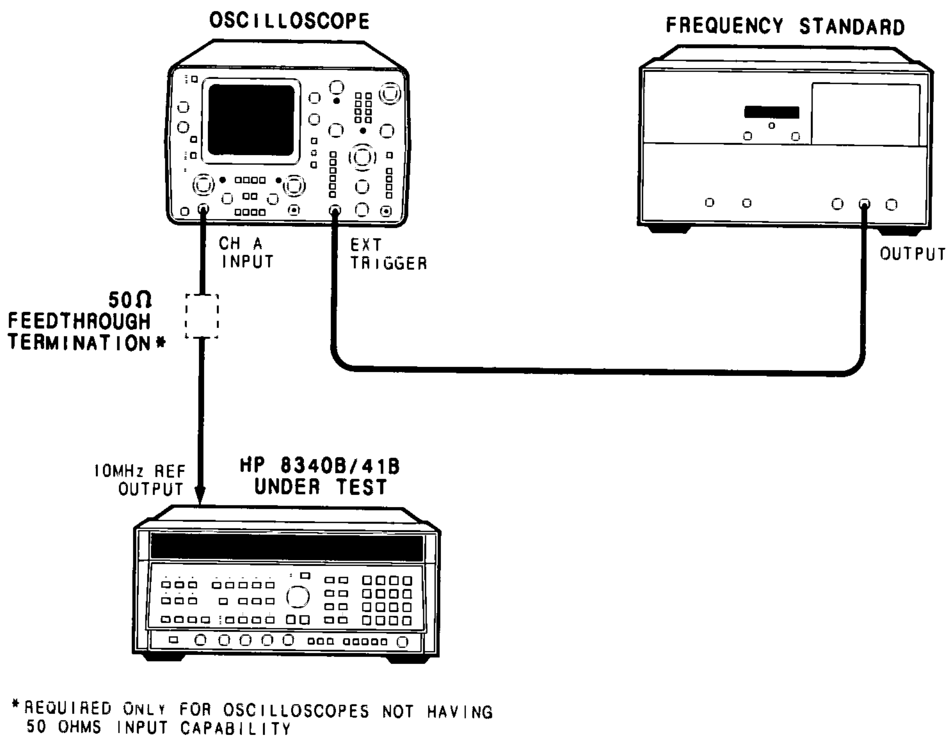


Figure 4-1. Internal Time Base Aging Rate Test Setup

NOTE

Be sure the HP 8340B/41B has been connected to the AC power line for 30 days before beginning this test. If the instrument was disconnected from the ac power line for less than 24 hours, it only has to be connected to AC power for 24 hours before proceeding.

Procedure

1. Connect the equipment as shown in Figure 4-1
2. Adjust the oscilloscope external triggering controls for a stable display of the HP 8340B/41B 10 MHz REF OUTPUT signal.
3. Measure the time required for a phase change of 360 degrees. Record the time (T1) in seconds.

T1 = ____________ second(s)

4-1. INTERNAL TIME BASE AGING RATE (Cont'd)

4. Wait for a period of time (from 3 to 24 hours) and remeasure the phase change time (repeat step 3). Record the period of time between measurements (T2) in hours and the new phase change time (T3) in seconds.

T2 = ____________ hours (h)

T3 = ____________ seconds (s)

5. Calculate the aging rate from the following equation:

Aging Rate = (1 cycle/f) (1/T1 − 1/T3) (T/T2)

Where: 1 cycle = the phase change reference for the time measurement. (In this case, 360 degrees)
f = HP 8340B/41B Time Base output frequency (10 MHz)
T = specified time for aging rate (24 hours)
T1 = initial time measurement (s) for 360 degree (1 cycle change)
T2 = time between measurements (h)
T3 = final time measurement (s) for a 360 degree (1 cycle) change

For example, if:

T1 = 351s
T2 = 3h
T3 = 349s

Then:

Aging Rate = (1 cycle/10 MHz) (1/351s − 1/349s) (24h/3h)

= 1.306×10^{-11} per day

6. Verify that the aging rate is less than $^{-9}$ per day

NOTE

If the absolute frequencies of the frequency standard and the HP 8340B/41B Time Base oscillator are extremely close, the measurement time in steps 3 and 4 (T1 and T3) can be reduced by measuring the time required for a phase change of less than 360 degrees. change "1 cycle" in the equation accordingly (i.e., 180 degrees = 1/2 cycle, or 90 degrees = 1/4 cycle).

7. If the aging rate is not within the required tolerance, be sure sufficient warmup time has been allowed and that the environmental conditions have not changed throughout the test, then check the Time Base heater circuit and, if necessary, replace the Time Base. Refer to service and repair information for the A51 10 MHz Reference Oscillator in the Reference Loop — M/N Loop portion in Section VIII of the Service Manual

4-2. FREQUENCY RANGE AND CW MODE ACCURACY

Specification

Table 4-4. Frequency Range and CW Mode Accuracy Specifications

Range:
HP 8340B: 0.01 to 26.50 GHz
HP 8341B: 0.01 to 20.00 GHz
Resolution: n x 1 Hz
Where N = harmonic multiplication number. Refer to Frequency Ranges and Bandswitch Points description in the specifications portion of Section I.
Accuracy: Same as Time Base Accuracy in the specifications portion of Section I.

Description

The HP 8340B/41B RF output is supplied to a frequency counter. The frequency counter internal time base is used as the reference for the DUT to eliminate time base error from the measurement. The DUT frequency display and the counter display should agree, within the resolution of each instrument. This procedure does not test for CW mode accuracy as a function of the time base accuracy.

NOTE

A fault in the DUT could cause the two displays to be different. Any fault that would cause one of the phase lock loops to be unlocked would be indicated by a front-panel UNLK indication; however, all HP 8340B/41B internal phase lock loops could be locked and the DUT output frequency could be in error (i.e., a phase lock loop frequency divider bit could be bad). If all the dividers work normally, then CW mode frequency accuracy is essentially guaranteed.

In the following procedure, the test frequencies are selected first to test the maximum frequency range and then to exercise each frequency related circuit throughout its CW range while holding all remaining circuits constant. The test frequencies are grouped so that an abnormal indication would point to the circuit most likely causing the problem.

Equipment

Frequency Counter .... HP 5343A Option 011
Adapters
SMA (m) to BNC (f) .... HP P/N 1250-1200
APC 3.5 (f) to APC 3.5 (f) .... HP P/N 5061-5311
(2 required if DUT is HP 8340B)
(1 required if DUT is HP 8341B)
Type N (m) to APC 3.5 (f) .... HP P/N 1250-1744
(1 required if DUT is HP 8341B)
Cable (Semi-Rigid SMA male to SMA male) .... HP P/N 08340-20124

4-2. FREQUENCY RANGE AND CW MODE ACCURACY (Cont'd)

Procedure

1 Connect the equipment as shown in Figure 4-2. Connect the DUT RF Output to the 10 MHz-500 MHz counter input. Allow the equipment to warm up for one hour. The DUT and the Frequency Counter use the same frequency standard to eliminate time base error from the measurement. Set the HP 8340B/41B rear panel FREQUENCY STANDARD switch to EXT.

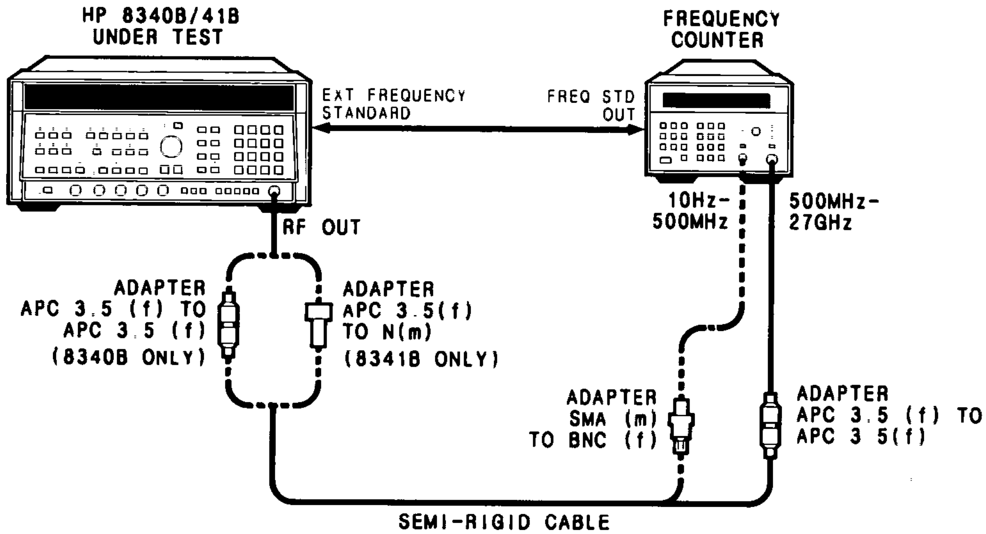


Figure 4-2. Frequency Range Test Setup

2 Press HP 8340B/41B **[INSTR PRESET]**, then **[CW]** and enter **[1] [0] [MHz]**. Press **[POWER LEVEL]** and enter **[+] [1] [0] [dBm]**. the counter should indicate 10 MHz ± 1 Hz ± the resolution of the counter.

3. Check the high frequency endpoint.

FOR HP 8340B

Connect the HP 8340B RF output to the 500 MHz-26.5 GHz counter input. Press the HP 8340B **[CW]** key and enter **[2] [6] [.] [5] [GHz]**. Press **[POWER LEVEL] [0] [dBm]**. The counter should indicate 26.5 GHz ±4 Hz ± the resolution of the counter.

FOR HP 8341B

Connect the HP 8341B RF output to the 500 MHz-26.5 GHz counter input. Press the HP 8341B **[CW]** key and enter **[2] [0] [GHz]**. Press **[POWER LEVEL] [0] [dBm]**. The counter should indicate 20.0 GHz ±3 Hz ± the resolution of the counter.

NOTE

Since the same time base is used for both the HP 8340B/41B and the frequency counter, only the displayed frequency is checked. The actual frequency error is ± (DUT output frequency/10 MHz) X time base error ± 4 Hz (HP 8340B) or 3 Hz (HP 8341B).

4. Check the M/N M Divider frequencies as follows.

NOTE

Pressing [SHIFT] [M1] displays, from left to right, the:
M divide number,
N divide number,
M/N Loop output frequency,
20/30 Loop output frequency.
Press [SHIFT] [M5] to exit this diagnostic mode. The instrument continues to operate normally while in the diagnostic mode.

a Press **[CW]** key and enter **[2] [4] [9] [0] [MHz]** Select a step size of 10 MHz by pressing **[SHIFT] [CF] [1] [0] [MHz]**. Press **[SHIFT] [M1]** to display, from left to right, the M divide number, the N divide number, the M/N Loop output frequency, and the 20/30 Loop output frequency. Press the **[CW]** key to display the CW frequency in the **[ENTRY DISPLAY]**.

b. Using the down arrow key, step down to 2 300.000000 MHz. Check the counter indication at each step The counter should indicate the HP 8340B/41B frequency ± 1 Hz ± the resolution of the counter at each step

NOTE

The above step sets and holds the N Divider to 13 and programs the M Divider through its full range of 8 to 27. Any frequency error as a result of a problem in the M Divider will probably be a multiple of 10 MHz.

c. If a significant frequency error is evident, note the conditions under which the error occurred and continue this procedure to determine if any other conditions produce an error.

5. Check the M/N N Divider frequencies as follows:

a. Select a step size of 200 MHz by pressing **[SHIFT] [CF] [2] [0] [0] [MHz]**. Press **[CW]** to display the CW frequency in the **[ENTRY DISPLAY]**. The CW frequency should be 2 300 000000 MHz

b. Using the up arrow key, step to 6 900.000000 MHz. Check the counter indication at each step. The counter should indicate the HP 8340B/41B frequency ± 1 Hz ± the resolution of the counter.

NOTE

The above step sets and holds the M Divider to 27 and programs the N Divider through its full range of 13 to 36. Any frequency error as a result of a problem in the M Divider will probably be a multiple of 10 MHz.

c. If a significant frequency error is evident, note the conditions under which the error occurred and continue this procedure to determine if any other conditions produce an error.

6 Check the 20/30 MHz N2 loop frequencies as follows:

a. Press **[INSTR PRESET]**. Press**[CF]** key and enter **[2] [3] [1] [0] [.] [5] [MHz]**. Press the **[ΔF]** key and enter **[1] [MHz]**. Select a step size of 1 kHz by pressing **[SHIFT] [CF] [1] [kHz]**.

b. Press **[SINGLE]** sweep key to set the DUT to be phase-locked at the start of sweep (2 310 GHz]. Press **[SHIFT] [M1]** to enter the diagnostic display mode Press **[CF]** to display the center frequency in the **[ENTRY DISPLAY]**. The center frequency should be 2 310500 GHz.

c. Using the up arrow key, step the center frequency up to 2.310510 GHz. Check the counter indication at each step. The counter should indicate the DUT start frequency (CF − 0.0005 GHz) ± 1 Hz ± the resolution of the counter.

NOTE

The above steps set the output of the M/N loop to 180 MHz where M=26 and N=13. The YO start frequency (2310 MHz) is then 20 to 30 MHz below the Nth harmonic (N=13) of 180 MHz (180 x 13 = 2340). The 20/30 MHz output is then 30 MHz. since the ΔF frequency (1 MHz) is between 0.1 to 5 MHz, the 20/30 MHz frequency is derived from the PLL2 75 to 150 MHz VCO output divided by 5 (150 MHz / 5 = 30 MHz). The PLL2 VCO frequency is stepped down in 5 kHz steps which steps the 20/30 frequency from 30 MHz down to 29.990 MHz in 1 kHz steps. Since the M/N frequency remains constant and the HP 8340B/41B output frequency is mixed with a harmonic (13th) of the M/N signal and the resultant output is phase compared to the 20/30 output, the DUT output frequency must increase by 1 kHz/step to satisfy the 20/30 phase lock loop. This checks the least significant (BCD) N2 programming bits.

To observe the N2 PLL2 VCO frequency changes, repeat the N2 loop frequency check (Step 6a through 6c) pressing [SHIFT] [M3] in step 6b rather than [SHIFT] [M1]. [SHIFT] [M3] will display, from left to right, the PLL2 VCO frequency and the PLL3 Up Converter frequency (the PLL3 UP Converter frequency display will be 0 since the PLL3 is not used in the swept mode).

d. Select a step size of 10 kHz by pressing **[SHIFT] [CF] [1] [0] [kHz]**. Press **[CF]** to display the center frequency in the **[ENTRY DISPLAY]**; the display should indicate 2.310510 GHz.

e. Using the up arrow key, step the center frequency up to 2.310600 GHz. Check the counter indication at each step. The counter should indicate the DUT start frequency (CF − 0.0005 GHz) ± 1 Hz ± the resolution of the counter.

NOTE

The above steps program the 20/30 frequency from 29.99 MHz to 29.90 MHz in 0.01 MHz steps and checks additional N2 Divider programming bits.

f. Select a step size of 100 kHz by pressing **[SHIFT] [CF] [1] [0] [0] [kHz]**. Press **[CF]** to display the center frequency in the **[ENTRY DISPLAY]**. The CF should be at 2.310600 GHz.

g. Using the up arrow key, step the center frequency up to 2.311500 GHz. Check the counter indication at each step. The counter should indicate the DUT start frequency (CF − 0.0005 GHz) ± 1 Hz ± the resolution of the counter.

NOTE

The above steps program the 20/30 frequency from 29.9 to 29.0 in 0.1 MHz steps and check additional N2 Divider programming bits.

h. Select a step size of 1 MHz (press **[SHIFT] [CF]** and enter **[1] [MHz]**) Press **[CF]** to display the center frequency in the **[ENTRY DISPLAY]**. The CF should be at 2.311500 GHz.

i. Using the up arrow key, step the center frequency up to 2.320500 GHz. Check the counter indication at each step. The counter should indicate the DUT start frequency (CF − 0.0005 GHz) ± 1 Hz ± the resolution of the counter.

NOTE

The above steps program the 20/30 frequency from 29.0 MHz to 21.0 MHz in 1 MHz steps. The last CF step programs the 20/30 to 30 MHz and the M/N frequency to 180.769231 MHz. This checks the remaining N2 Divider programming bits.

j. If a significant frequency error is evident, note the conditions under which the error occurred and continue this procedure to determine if any other conditions produce an error.

7 Check the 20/30 MHz N1 loop frequencies as follows:

a. Press **[INSTR PRESET]**. Select a step size of 10 kHz by pressing **[SHIFT] [CF] [1] [0] [kHz]**. Press **[CW]** and enter **[2] [3] [1] [9] [.] [9] [7] [MHz]**.

b Press **[SHIFT] [M1]** to display, from left to right, the M divide number, the N divide number, the M/N Output frequency, and the 20/30 Output frequency

c. Using the down arrow key, step the CW frequency down to 2 319.870000 MHz. Check the counter indication at each step. The counter should indicate the DUT CW frequency ± 1 Hz ± the resolution of the counter.

NOTE

The above steps set the output of the M/N loop to 180 MHz where M=26 and N=13. The PLL1 VCO frequency is stepped up in 100 kHz steps. This steps the 20/30 frequency up from 20.03 MHz in 10 kHz steps to 20.13 MHz. The M/N frequency remains constant and the YO frequency is mixed with a harmonic (13th) of the M/N signal. The resultant output is phase compared to the 20/30 output. The DUT output frequency must decrease by 10 kHz/step to satisfy the YO phase lock loop. This checks the least significant N1 programming bits.

d. Select a step size of 100 kHz by pressing **[SHIFT] [CF] [1] [0] [0] [kHz]**. Press the **[CW]** key to view the CW frequency in the **[ENTRY DISPLAY]**. The CW frequency should be at 2 319.870000 MHz.

e. Using the down arrow key, step the CW frequency down to 2 318 970000 MHz Check the counter indication at each step. The counter should indicate the DUT CW frequency ± 1 Hz ± the resolution of the counter.

NOTE

The above steps program the 20/30 frequency from 20.13 up to 21.03 in 0.1 MHz steps and checks additional N1 Divider programming bits.

f. Select a step size of 1 MHz by pressing **[SHIFT] [CF] [1] [MHz]** Press the **[CW]** key to view the CW frequency in the **[ENTRY DISPLAY]**. The CW frequency should be at 2318.97000 MHz.

g Using the down arrow key, step the CW frequency down to 2310 970000 MHz Check the counter indication at each step The counter should indicate the DUT CW frequency ± 1 Hz ± the resolution of the counter.

NOTE

The above steps program the 20/30 frequency from 21.03 MHz to 29.03 MHz in 1 MHz steps and check the remaining N1 Divider programming bits.

8. If frequency errors occurred, the instrument requires service. To troubleshoot the instrument, determine what frequency related circuit is most likely to have caused the symptom (i.e., M/N Loop or 20/30 Loop) then refer to Section VIII of the Service Manual (may be ordered separately).

4-3. SWEEP TIME ACCURACY

Specification

Table 4-5. Sweep Time Accuracy Specifications

Range. 10 milliseconds to 200 seconds forward sweep times.
Accuracy. ±5% (sweeptimes ≤50 seconds)

Description

The HP 8340B/41B is swept from 3 GHz to 7 GHz at 5 different sweep times, ranging from 10 ms to 50 sec The rear panel STOP SWEEP IN/OUT signal of the DUT is used to trigger INPUT A and B on an HP 5316A Universal Counter used in the time interval mode. At the start of a sweep, the STOP SWEEP IN/OUT signal changes from TTL low to TTL high. This pulse triggers INPUT A on the Universal Counter (selected for leading edge triggering) and the count begins. At the end of a sweep, the STOP SWEEP IN/OUT signal changes from TTL high to TTL low At this point, INPUT B is triggered (selected for trailing edge triggering) and the count is complete After the Universal Counter has made several counts, an accurate reading of the DUT sweep time is indicated on its display

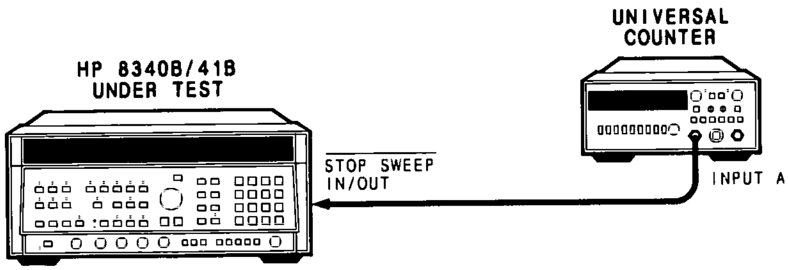


Figure 4-3. Sweep Time Accuracy Test Setup

Equipment

Universal Counter .... HP 5316A

Procedure

1. Connect equipment as shown in Figure 4-3. Switch the HP 8340B/41B POWER to ON. Allow the equipment to warm up for one hour.
2. On the DUT, press **[INSTR PRESET] [START FREQ] [3] [GHz] [STOP FREQ] [7] [GHz] [POWER LEVEL] [0] [dBm]**

4-3. SWEEP TIME ACCURACY (Cont'd)

3. Set up the 5316A as follows:

TI A→B	IN
GATE TIME	MIN
LEVEL/SENSE (CHANNEL A and B)	+MAX
TRIGGER (CHANNEL A and B)	LEVEL
AC/DC (CHANNEL A and B)	DC
ATTN (CHANNEL A and B)	X1
FILTER	NORM
SEP/COM A	COM A
Channel A Triggering	Leading Edge
Channel B Triggering	Trailing Edge

NOTE

To ensure that an accurate sweep time indication is obtained from the HP 5316A in step 4, allow the DUT to complete at least three sweeps.

4. On the HP 8340B/41B, press **[SWEEP TIME] [1] [0] [msec]**. Verify that the sweep time displayed by the HP 5316A is within the limits shown in Table 4-6.

5. Repeat step 4 for values shown in Table 4-6.

Table 4-6. Sweep Time Accuracy Limits

Selected	Lower Limit	Upper Limit
10 ms	9.5 ms	10.5 ms
100 ms	95 ms	105 ms
1 s	.95 s	1 05 s
10 s	9.5 s	10 5 s
50 s	47 5 s	52.5 s

4-4. SWEPT FREQUENCY ACCURACY

Specification

Table 4-7. Swept Frequency Accuracy Specifications

Center Frequency/Sweep Width Mode (CF/ΔF)
Readout Accuracy with respect to sweep out voltage (sweep time > 100 milliseconds):
ΔF ≤ n × 5 MHz: ± 1% of indicated sweep width (ΔF) ± time base accuracy*
ΔF > n × 5 MHz to < 300 MHz: ± 2% of indicated sweep width (ΔF)
ΔF ≥ 300 MHz: ± 1% of indicated sweep width (ΔF), or ± 50 MHz, whichever is less
Where n = harmonic multiplication number Refer to Frequency Ranges and Bandswitch Points description in the specifications table in Section I
* Time Base affects Center Frequency accuracy only, not Sweep Width Accuracy
Start/Stop Mode
Readout Accuracy with respect to sweep out voltage (sweep time > 100 milliseconds):
Same as Center Frequency/Sweep Width Mode.

Description

The HP 8340B/41B (DUT) RF output is connected to the HP 8566B Spectrum Analyzer input The spectrum analyzer is set for zero Hz span at a CW frequency within the DUT swept frequency range The spectrum analyzer VIDEO OUT (applied to the oscilloscope vertical input) will have a response as the DUT output passes through the frequency that the spectrum analyzer is tuned to. The selected spectrum analyzer bandwidth filter will determine the shape of the response.

The HP 8340B/41B SWEEP OUT, in series with a power supply, is applied to an oscilloscope's horizontal input. The input to the oscilloscope is clamped at ±0.7V by two diodes to prevent overdriving the oscilloscope's input. The oscilloscope is calibrated by setting the DUT and the spectrum analyzer to the same CW frequency (e.g., 20% of Band). To set the DUT to have a SWEEP OUT voltage and at the same time a phase locked CW frequency that is proportional to a percentage of a swept frequency band, the START and STOP frequencies are selected, MANUAL SWEEP is selected, and a frequency equivalent to the desired percentage of band is selected (e.g., START 3 GHz, STOP 5 GHz, MANUAL 3.4 GHz, for 20%). The power supply is adjusted for a DVM indication of zero volts and the oscilloscope horizontal position control is used to position the dot to the center graticule line. With the oscilloscope horizontal sensitivity set to 0.05 V/Division, the CRT horizontal axis is now calibrated to approximately 0.5% of the swept frequency range per division. The spectrum analyzer VIDEO OUT voltage to the oscilloscope is then maximum and the scope vertical position is adjusted to place the dot near the top of the CRT.

The HP 8340B/41B can now be set to sweep any frequency range and the oscilloscope center graticule line will represent the calibrated percentage (e.g., 20%) of the sweep range. The spectrum analyzer center frequency is set to a frequency that is the desired percentage (e.g., 20%) of the DUT swept frequency range If the DUT swept frequency accuracy is perfect, the oscilloscope trace will be the response of the spectrum analyzer's bandwidth filter, centered on the CRT. If the trace is not centered, the spectrum analyzer center frequency is adjusted to position the response to the center of the oscilloscope CRT. The amount of spectrum analyzer frequency change is the DUT Swept Frequency Accuracy error.

4-4. SWEPT FREQUENCY ACCURACY (Cont'd)

Since the circuitry that determines swept frequency accuracy is the same for both ΔF Mode and Start/Stop Mode, only Start/Stop Mode swept frequency accuracy is tested.

NOTE

The spectrum analyzer resolution bandwidth and DUT sweep time must be compatible to obtain the desired oscilloscope response.

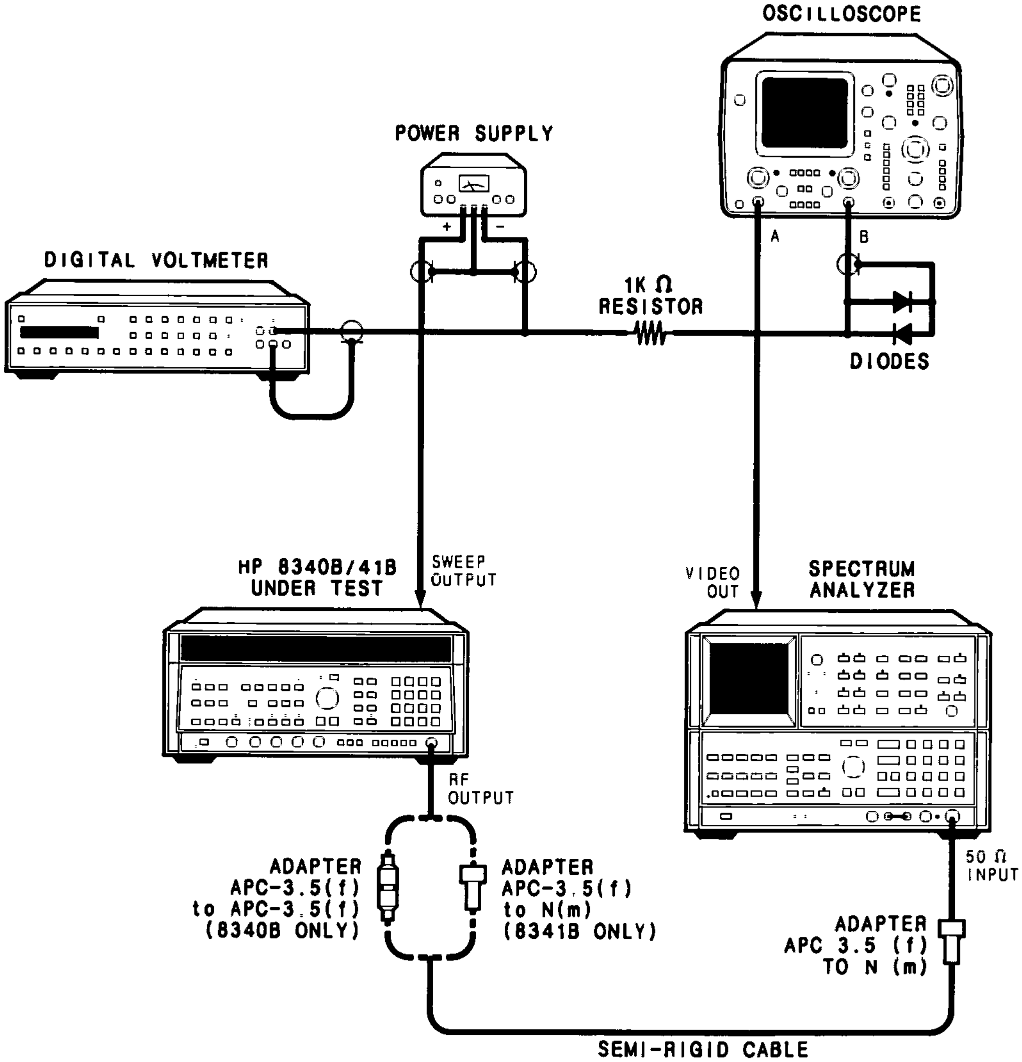


Figure 4-4. Swept Frequency Accuracy Test Setup

Equipment

Spectrum Analyzer	HP 8566B
Oscilloscope	HP 1741A
Power Supply	HP 6294A
Adapters	
Type N (m) to APC 3.5 (f)	HP P/N 1250-1744
(2 required if DUT is HP 8341B)	
(1 required if DUT is HP 8340B)	
APC 3.5 (f) to APC 3.5 (f)	HP P/N 5061-5311
(1 required if DUT is HP 8340B)	
Cable (Semi-Rigid SMA male to SMA male)	HP P/N 08340-20124
Diode (2 required)	HP P/N 1901-0028
Digital Voltmeter	HP 3456A
1 KOhm Resistor	HP P/N 0757-0280

Procedure

1. Connect the equipment as shown in Figure 4-4 (with the power supply output set to 0 Vdc). Allow the equipment to warm up for one hour.
2. Press HP 8340B/41B **[INSTR PRESET]**. Set the oscilloscope to display amplitude versus sweep out voltage (A vs B). Set channel A sensitivity to 0.2V/Div
3. Set the spectrum analyzer REFERENCE LEVEL to 20 dBm. Set CENTER FREQUENCY to 3.4 GHz for 20% (4 GHz for 50%, or 4.6 GHz for 80%). Set FREQUENCY SPAN to zero. Set RES BW (resolution bandwidth) to 3 MHz.
4. Set HP 8340B/41B to have a sweep out voltage and at the same time, a phase locked CW frequency that is proportional to a percentage of band as follows.
   a. Press **[START]** and enter **[3] [GHz]**
   b. Press **[STOP]** and enter **[5] [GHz]**
   c. Press **[MANUAL]** SWEEP and enter **[3] [.] [4] [GHz]** for 20%
   (4 GHz for 50%, or 4.6 GHz for 80%)

CAUTION

Do not adjust the power supply for greater than ±10 Vdc in this procedure.

5. Adjust the oscilloscope's Channel B sensitivity for 0.05 V/DIV and the horizontal position control for midrange. Adjust the power supply voltage for a DVM indication of 0±10 mVdc
6. Adjust oscilloscope horizontal position control to position the dot on the center graticule. Adjust the oscilloscope vertical position to place the dot near the top of the CRT.

NOTE

The oscilloscope is now calibrated for 0.5%/Division and for the desired percentage of band (i.e., 20%, 50%, or 80%). Measurements can now be made at this percentage of band for any Start/Stop frequency and any frequency span.

4-4. SWEPT FREQUENCY ACCURACY (Cont'd)

7. Refer to Table 4-8, press the HP 8340B/41B **[START FREQ]** key and enter the start frequency shown in Table 4-8. Press the **[STOP FREQ]** key and enter the appropriate stop frequency. Press the **[SWEEP TIME]** key and enter the appropriate sweep time. Select the appropriate spectrum analyzer resolution bandwidth. Set the spectrum analyzer center frequency to the appropriate frequency for the percentage of band being tested. Press the HP 8340B/41B **[CONT]** key to return to the swept mode. Stop Frequencies greater than 20.0 GHz only apply to the HP 8340B.

8. Ideally, the oscilloscope response will be at the center graticule line, if not, adjust the spectrum analyzer center frequency to bring the oscilloscope response to the center graticule line. The difference between the original center frequency setting and present center frequency is the HP 8340B/41B swept frequency error. This error should be within the test limit shown in Table 4-8.

9. Repeat steps 3 through 8 to test at 50% and 80% of band.

NOTE

If the swept frequency accuracy error exceeds the test limit, refer to the Sweep Gain and Delay Adjustments, in Section V, Adjustments in the Service Manual.

Table 4-8. Swept Frequency Accuracy Test Frequencies

DUT			Spectrum Analyzer				Test Limit (kHz)
Start Freq (GHz)	Stop Freq (GHz)	Sweep Time (ms)	Center Frequency (GHz)			Res BW (kHz)	
			20% of Band	50% of Band	80% of Band		
2.3	2.300099	3000	2.3000198	2.3000495	2.300792	0.3	±0.99
2.3	2.300101	3000	2.3000202	2.3000505	2.3000808	0.3	±1.01
2.3	2.300499	1000	2.3000998	2.3002495	2.3003992	1.0	±4.99
2.3	2.300501	1000	2.3001002	2.3002505	2.3004008	1.0	±5.01
2.3	2.30499	300	2.300998	2.302495	2.303992	3.0	±49.9
2.3	2.30501	300	2.301002	2.302505	2.304008	3.0	±100.02
2.3	2.31	300	2.302	2.305	2.308	3.0	±200
2.3	2.32	100	2.304	2.310	2.316	10	±400
2.3	2.33	100	2.306	2.315	2.324	10	±600
2.3	2.34	100	2.308	2.320	2.332	30	±800
2.3	2.349	100	2.3098	2.3245	2.3392	30	±998
2.3	2.3501	100	2.31002	2.32505	2.34008	30	±1020
2.3	2.36	100	2.312	2.33	2.348	30	±1200
2.3	2.37	100	2.314	2.335	2.356	30	±1400
2.3	2.38	100	2.316	2.34	2.364	30	±1600
2.3	2.39	100	2.318	2.345	2.372	30	±1800
2.3	2.3999	100	2.31998	2.34995	2.37992	30	±1980
2.3	2.4001	100	2.32002	2.35005	2.38008	100	±2002
2.3	2.799	100	2.3998	2.5495	2.6992	1000	±4990
2.3	2.801	100	2.4002	2.5505	2.7008	1000	±5010
2.3	7.29	100	3.298	4.795	6.292	3000	±49900
2.3	7.31	100	3.302	4.805	6.308	3000	±50000
2.3	8.3	100	3.500	5.300	7.100	3000	±50000
2.3	16.452	100	5.1304	9.376	13.6216	3000	±50000
2.3	20.0	100	5.84	11.15	16.46	3000	±50000
2.3	24.55[1]	100	6.75	13.425	20.1	3000	±50000
2.3	26.5[1]	100	7.14	14.4	21.66	3000	±50000

1 Applies to 8340B only.

4-5. MAXIMUM LEVELED OUTPUT POWER AND POWER ACCURACY TEST

Specification

Table 4-9. Maximum Leveled Output Power and Power Accuracy Specifications (1 of 2)

MAXIMUM LEVELED POWER (0°C to +35°C)	**Bands and Approximate Frequency Ranges (GHz)** (see Frequency Ranges and Bandswitch Points for complete description)					
	Band 0	**Band 1**	**Band 2**	**Band 3**	**Band 4**[1]	
	0.01 to <2.3	**2.3 to <7.0**	**7.0 to <13.5**	**13.5 to <20.0**	**20.0 to <23.0**	**23.0 to 26.5**
STANDARD INSTRUMENT	+10.0 dBm	+12.0 dBm	+10.0 dBm	+9.0 dBm	+3.0 dBm	+1.0 dBm
OPTION 001 (F.P. Out w/o Atten.)	+10.0 dBm	+13.0 dBm	+12.0 dBm	+11.0 dBm	+6.0 dBm	+4.0 dBm
OPTION 004 (R.P. Out w/Atten.)	+10.0 dBm	+11.0 dBm	+9.0 dBm	+7.0 dBm	+1.0 dBm	−1.0 dBm
OPTION 005 (R.P. Out w/o Atten.)	+10.0 dBm	+12.0 dBm	+11.0 dBm	+9.0 dBm	+4.0 dBm	+2.0 dBm

OUTPUT POWER ACCURACY[2]	**Bands and Approximate Frequency Ranges (GHz)** (see Frequency Ranges and Bandswitch Points for complete description)		
	Band 0 **0.01 to <2.3**	**Bands 1-3** **2.3 to <20**	**Band 4**[1] **20 to 26.5**
STANDARD INSTRUMENT			
+18 to +10 dBm[3]	—	± 1.8 dB	± 2.3 dB
+10 to −9.95 dBm	± 0.9 dB	± 1.5 dB	± 2.0 dB
−10 to −19.95 dBm	± 1.2 dB	± 2.0 dB	± 2.5 dB
−20 to −49.95 dbm	± 1.5 dB	± 2.3 dB	± 2.8 dB
−50 to −79.95 dBm	± 1.8 dB	± 2.6 dB	± 3.1 dB
−80 to −100 dBm	± 2.1 dB	± 2.9 dB	± 3.4 dB
OPTION 004 (Rear Panel Output w/Atten.)			
+18 to +10 dBm[3]	—	± 2.0 dB	± 2.5 dB
+10 to −11.95 dBm	± 1.0 dB	± 1.7 dB	± 2.2 dB
−12 to −21.95 dBm	± 1.3 dB	± 2.2 dB	± 2.7 dB
−22 to −51.95 dBm	± 1.6 dB	± 2.5 dB	± 3.0 dB
−52 to −81.95 dBm	± 1.9 dB	± 2.8 dB	± 3.3 dB
−82 to −100 dBm	± 2.2 dB	± 3.1 dB	± 3.6 dB
OPTION 001 (Front Panel Output w/o Atten.)			
+18 to +10 dBm[3]	—	± 1.6 dB	± 2.0 dB
+10 to −10 dBm	± 0.9 dB	± 1.3 dB	± 1.7 dB
−10 to −20 dBm	± 1.7 dB	± 2.1 dB	± 2.5 dB
OPTION 005 (Rear Panel Output w/o Atten.)			
+18 to +10 dBm[3]	—	± 1.8 dB	± 2.2 dB
+10 to −10 dBm	± 1.0 dB	± 1.5 dB	± 1.9 dB
−10 to −20 dBm	± 1.8 dB	± 2.3 dB	± 2.7 dB

Table 4-9. Maximum Leveled Output Power and Power Accuracy Specifications (2 of 2)

FLATNESS (Internally Leveled)			
STANDARD INSTRUMENT (Front Panel Output w/Atten.)	**Band 0** **0.01 to <2.3**	**Bands 1 - 3** **2.3 to <20**	**Band 4**[1] **20 to 26.5**
+18 to +10 dBm[3]	—	±1.2 dB	±1.7 dB
+10 to −9.95 dBm	±0.6 dB	±1.1 dB	±1.6 dB
−10 to −19.95 dBm	±0.9 dB	±1.6 dB	±2.1 dB
−20 to −49.95 dBm	±1.2 dB	±1.9 dB	±2.4 dB
−50 to −79.95 dBm	±1.4 dB	±2.2 dB	±2.7 dB
−80 to −100 dBm	±1.7 dB	±2.5 dB	±3.0 dB
OPTION 004 (Rear Panel Output w/Atten.)			
+18 to +10 dBm[3]	—	±1.4 dB	±1.9 dB
+10 to −11.95 dBm	±0.7 dB	±1.3 dB	±1.8 dB
−12 to −21.95 dBm	±1.0 dB	±1.8 dB	±2.3 dB
−22 to −51.95 dBm	±1.3 dB	±2.1 dB	±2.6 dB
−52 to −81.95 dBm	±1.5 dB	±2.4 dB	±2.9 dB
−82 to −100 dBm	±1.8 dB	±2.7 dB	±3.2 dB
OPTION 001 (Front Panel Output w/o Atten.)			
+18 to +10 dBm[3]	—	±1.0 dB	±1.4 dB
+10 to −10 dBm	±0.6 dB	±0.9 dB	±1.3 dB
−10 to −20 dBm	±0.8 dB	±1.5 dB	±1.9 dB
OPTION 005 (Rear Panel Output w/o Atten.)			
+18 to +10 dBm[3]	—	±1.2 dB	±1.6 dB
+10 to −10 dBm	±0.7 dB	±1.1 dB	±1.5 dB
−10 to −20 dBm	±0.9 dB	±1.7 dB	±2.1 dB

NOTES

1 Applies only to HP 8340B

2 Internally leveled, AM off The POWER dBm display monitors the actual output power, giving accurate readings when unleveled, externally leveled, or when amplitude modulating with a signal that has a dc component The ENTRY DISPLAY shows the desired power level, or the desired external detector output voltage, exclusive of modulation.

3 The ALC loop typically operates up to +20 dB to enhance usability at those frequencies where leveled power greater than the maximum specified is available

4-5. MAXIMUM LEVELED OUTPUT POWER AND POWER ACCURACY TEST (Cont'd)

Description

MAXIMUM LEVELED POWER

For maximum leveled power, a crystal detector and an oscilloscope are used to monitor the swept response. The DUT is set to sweep a given frequency band. The power level is increased until the DUT's UNLEVELED indicator comes on, then decreased until the UNLEVELED indicator just goes out. The maximum leveled power may differ with sweep mode and sweep time. To find the worst case, the maximum leveled power is checked in three modes: single sweep with auto sweep time, single sweep with a two second sweep time, and continuous sweep. The worst case mode is selected, and a frequency marker is positioned at the minimum power point on the swept display. The DUT is set to CW at the marker frequency and the power is measured using a power meter. The power meter indication should be greater than or equal to the maximum leveled power specification. This procedure is repeated for each frequency band.

FLATNESS

Flatness is measured with the RF output level at 0 dBm Flatness is primarily a function of the RF path; therefore, the response will be essentially the same at all ALC levels However, the response will most likely change when the RF Attenuator is stepped to a different attenuation level.

A power meter is used to measure the RF signal level. An oscilloscope, connected to the power meter recorder output, is used to find the frequencies where the maximum and minimum points of the response occur. The DUT is set to a slow sweep to allow the power meter to respond to any power variations. A marker is positioned at the maximum and minimum points on the oscilloscope display. The DUT is then set to CW at each of the marker frequencies and the power indications are recorded. The maximum power level minus the minimum power level should be within the flatness specification

ACCURACY

The absolute power level at the maximum and minimum points should be within the accuracy specification.

Two different Power Sensors may be required to cover the complete frequency range The HP 8481A Power Sensor is used from 10 MHz to 50 MHz and the HP 8485A Power Sensor is used for the other frequency bands covering 50 MHz to maximum output frequency of the DUT The 8485A Power Sensor can be used down to 10 MHz, but if a minimum or maximum that is close to the test limits occurs in this frequency range, the 8481A Power Sensor should be used.

Equipment

Oscilloscope .... HP 1741A
Attenuator .... HP 8493C Opt. 010
Crystal Detector .... HP 8473C
Power Meter .... HP 436A Option 022
Power Sensor .... HP 8481A
Power Sensor .... HP 8485A
Adapters
  APC 3.5 (f) to APC 3.5 (f) .... HP P/N 5061-5311
    (1 required if DUT is HP 8340B)
  TYPE N (m) to APC 3.5 (f) .... HP P/N 1250-1744
    (1 required if DUT is HP 8341B)
  SMC (f) to BNC (f) .... HP P/N 1250-0832

4-5. MAXIMUM LEVELED OUTPUT POWER AND POWER ACCURACY TEST (Cont'd)

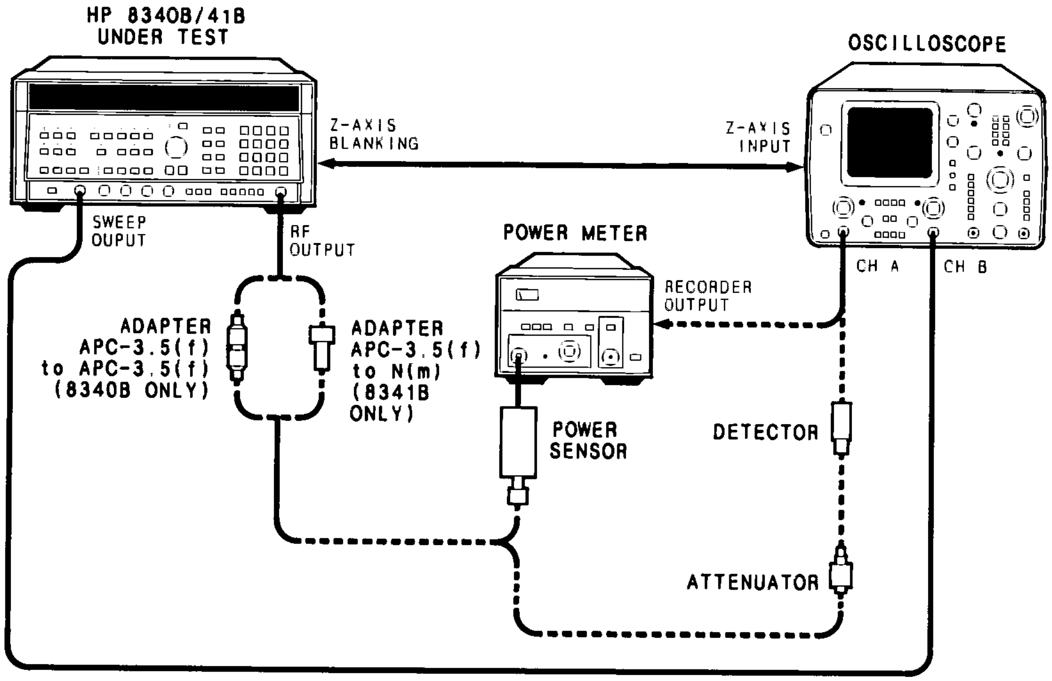


Figure 4-5. Maximum Leveled Output Power and Power Accuracy Test Setup

Procedure

MAXIMUM LEVELED POWER

1. Connect the equipment as shown in Figure 4-5. Connect the 10 dB pad and crystal detector to the DUT RF output and connect the detector output to the oscilloscope channel A input. Allow the equipment to warm up for one hour.

2. Press **[INSTR PRESET]**. Press **[PEAK]** on. Press **[STOP FREQUENCY]** and enter **[2] [.] [3] [GHz]** Adjust the oscilloscope to view the swept output of the crystal detector

   In Band 0 (10 MHz to 2.3 GHz), the crystal detector may pass a portion of the RF signal. This RF feedthrough may be visible on the low frequency portion of the oscilloscope trace.

   Also, as the power in Band 0 is increased toward maximum leveled, the level of the harmonics may increase and cause a perturbation in the swept response. This will cause the maximum power indication on the oscilloscope to increase without causing the UNLEVELED indicator to light Therefore, flatness is only specified at ≤ +10 dBm in Band 0.

3. Press the **[POWER LEVEL]** key and, using the front panel rotary knob, increase the power level until the UNLEVELED indicator comes on. Slowly decrease the power level until the UNLEVELED indicator just goes off. Note the ENTRY DISPLAY power indication.

NOTE

The maximum leveled power indication may differ with sweep mode and sweep time. To find the worst case, the maximum leveled power is checked in continuous sweep with auto sweep time (step 3), single sweep with auto sweep time (step 4), and single sweep with a two second sweep time (step 5).

4. Press **[SINGLE SWEEP]** repeatedly and repeat step 3.

5. Press **[SWEEP TIME]** and enter **[2] [sec]**. Repeat step 3.

6. Select the mode that gave the worst case maximum leveled power indication (lowest ENTRY DISPLAY indication). Press **[M2]** and use the rotary knob to position the marker to the minimum power level point on the oscilloscope trace (for a negative polarity crystal detector, this is the highest point on the display, for a positive polarity detector, this is the lowest point on the display). Using the oscilloscope vertical position control, position the marker on a horizontal graticule line. Note the marker frequency. Press **[MANUAL]** and enter the frequency noted for M2. Due to SYTM tracking, the RF output level at a single frequency may be greater than in a swept mode, therefore, if the oscilloscope now indicates a higher power level than the swept response (for a positive polarity detector, the trace moves down), press **[POWER LEVEL]** and (using the rotary knob) adjust the power level to return the dot on the oscilloscope to the horizontal reference line for the minimum swept power point

7. Disconnect the 10 dB pad and crystal detector and connect the Power Sensor to the DUT RF output. Set the Power Meter's calibration factor switch to include the frequency noted for M2.

   To obtain the most accurate Power Meter reading, zero the Power Meter on the range being used. To zero the Power Meter, press the Power Meter RANGE HOLD, press DUT **[RF]** off, zero the Power Meter, and press **[RF]** on.

   The Power Meter indication should be equal to or greater than the maximum leveled power specification. If the DUT does not meet its maximum leveled power specification, refer to SRD Bias and SYTM Tracking adjustments in Section V

8. Press the**[START FREQ]** key and enter the start frequency for the next band. Press the **[STOP FREQUENCY]** key and enter the stop frequency for the next band. Repeat steps 3 through 7 until all frequency bands have been checked.

FLATNESS

9. Flatness is measured with the RF output level at 0 dBm. Flatness is primarily a function of the RF path; therefore, the response will be essentially the same at all ALC levels. Although the ALC accuracy is not specified separately, the ALC accuracy is typically <0.15 dB for RF output levels from +10 dBm to −9.95 dBm.

   To test ALC accuracy, step the DUT's RF power in 1 dB steps from +10 to −9.95 dBm (note, for instruments with front panel RF output, that as the power steps from −9.95 to −10 dBm, the RF attenuator is set to 10 dB and the ALC is set to 0 dBm). If the power meter indication is >0.15 dB from the ENTRY DISPLAY indication, refer to the ALC adjustments in Section V (in the Service Manual).

4-5. MAXIMUM LEVELED OUTPUT POWER AND POWER ACCURACY TEST (Cont'd)

If the ALC accuracy is tested, frequency response must be considered, therefore, use the 0 dBm power meter indication as a reference.

Also it should be noted that the power level in the ENTRY DISPLAY is the requested power level. In normal ALC modes, the instrument processor duplicates the ENTRY DISPLAY power level in the POWER dBm display with 0.1 dB resolution; however, if AM is selected, the processor reads the ALC level with the A/D converter, calculates the associated power level, and displays the calculated value in the POWER dBm display.

10. Press **[INSTR PRESET]**. Press **[PEAK]** on. Press**[STOP FREQUENCY]** and enter **[2] [.] [3] [GHz]**. Press **[POWER LEVEL]** and enter **[0] [dBm]**.
11. Press the **[SWEEP TIME]** key and enter **[2] [sec]**
12. Adjust the oscilloscope controls to view the Power Meter RECORDER OUTPUT voltage versus the DUT's SWEEP OUTPUT voltage (A versus B). The oscilloscope vertical gain and position must be changed as a function of the power meter range and RECORDER OUTPUT voltage.
13. Press Frequency Marker key **[M2]** and, using the rotary knob, change the marker frequency to position the (intensified) marker on the lowest point on the oscilloscope trace. It may be necessary to adjust the oscilloscope INTENSITY to view the marker dot.
14. Note the marker frequency. Press the **[MANUAL]** key and enter the frequency noted for M2. Reset the power meter calibration factor switch to include this frequency. The power meter indication is the minium power point. Record the power meter indication on the work sheet provided in Table 4-10.

NOTE

For Band 0 (10 MHz to 2.3 GHz), if the minimum or maximum power occurred below 50 MHz, use the HP 8481A Power Sensor to measure the power level.

15. Press the **[CONT]** key to return to the sweep mode. Press **[M1]** and, using the rotary knob, change the marker frequency to position the marker on the highest point on the oscilloscope trace. Note the marker frequency. Press the **[MANUAL]** key and enter the frequency noted for M1. Reset the power meter calibration factor switch to include this frequency. The power meter indication is the maximum power point. Record the power meter indication on the work sheet
16. Press the **[CONT]** key to return to the swept mode. Press the **[START FREQ]** key and enter the start frequency for the next frequency band. Press the **[STOP FREQ]** key and enter the stop frequency for the next frequency band.
17. Repeat steps 12 through 16 to measure the flatness until all frequency bands have been checked.
18. The maximum minus the minimum power meter indications should be within the flatness specifications. If the DUT does not meet its flatness specification, refer to Flatness Adjustments in Section V of the Service Manual

ACCURACY

19. The absolute power level at the maximum and minimum points should be within the accuracy specification. This test may be repeated at other ALC power levels (+10 dBm to −9.95 dBm) to verify flatness and accuracy specifications over the ALC range.

Table 4-10 Maximum Leveled Output Power Test Work Sheet

Frequency Range: 10 MHz to 2.3 GHz

		Power Meter Indication	HP 8340B/41B Entry Display
Step 14	Minimum	______	______
Step 15	Maximum	______	______
Step 18	Flatness: Maximum - Minimum	______	(≤1.2 dB, Standard) (≤1.4 dB, Option 004) (≤1.2 dB, Option 001) (≤1.4 dB, Option 005)

Frequency Range: 2.3 GHz to 7.0 GHz

		Power Meter Indication	HP 8340B/41B Entry Display
Step 14	Minimum	______	______
Step 15	Maximum	______	______
Step 18	Flatness: Maximum - Minimum	______	(≤2.2 dB, Standard) (≤2.6 dB, Option 004) (≤1.8 dB, Option 001) (≤2.2 dB, Option 005)

Frequency Range: 7.0 GHz to 13.5 GHz

		Power Meter Indication	HP 8340B/41B Entry Display
Step 14	Minimum	______	______
Step 15	Maximum	______	______
Step 18	Flatness: Maximum - Minimum	______	(≤2.2 dB, Standard) (≤2.6 dB, Option 004) (≤1.8 dB, Option 001) (≤2.2 dB, Option 005)

Frequency Range: 13.5 GHz to 20.0 GHz

		Power Meter Indication	HP 8340B/41B Entry Display
Step 14	Minimum	______	______
Step 15	Maximum	______	______
Step 18	Flatness: Maximum - Minimum	______	(≤2.2 dB, Standard) (≤2.6 dB, Option 004) (≤1.8 dB, Option 001) (≤2.2 dB, Option 005)

Frequency Range: 20.0 GHz to 26.5 GHz (Applies to the HP 8340B only)

		Power Meter Indication	HP 8340B Entry Display
Step 14	Minimum	______	______
Step 15	Maximum	______	______
Step 18	Flatness: Maximum - Minimum	______	(≤3.2 dB, Standard) (≤3.6 dB, Option 004) (≤2.6 dB, Option 001) (≤3.0 dB, Option 005)

4-6. EXTERNAL LEVELING

Specification

Table 4-11. External Leveling Specifications

XTAL: Allows the HP 8340B/41B to be externally leveled by crystal detectors of positive or negative polarity
METER: Allows power meter leveling with any HP power meter.
Range (XTAL or METER): 500 microvolts (−66 dBV) to 2.0 volts (+6 dBV)
Accuracy of voltage at EXT INPUT connector relative to the displayed level (leveling voltage is shown in ENTRY DISPLAY in dBV): ±0.5 dB ± 200 microvolts.

Description

The HP 8340B/41B external leveling circuit is designed to maintain a constant voltage at the EXT INPUT BNC. This is achieved by first selecting a voltage (in dBV) to which the EXT INPUT will be leveled. This establishes a reference voltage for the ALC. The voltage at the EXT INPUT is then routed through the external leveling circuitry to the ALC and compared to the reference. If a differnce between the two voltages exist, the HP 8340B/41B RF OUTPUT power will be adjusted to compensate for the difference.

The HP 8340B/41B's external leveling circuit allows a positive or negative crystal detector to be used in the external leveling loop. A negative crystal detector (HP 8473C) is used in this test but a crystal detector may be substituted.

The HP 8340B/41B XTAL Leveling mode is selected to verify the instrument's external leveling specification. Nine different dBV values, ranging from +6 dBV to −66 dBV, are selected and the voltage accuracy at the EXT INPUT is checked with a DVM

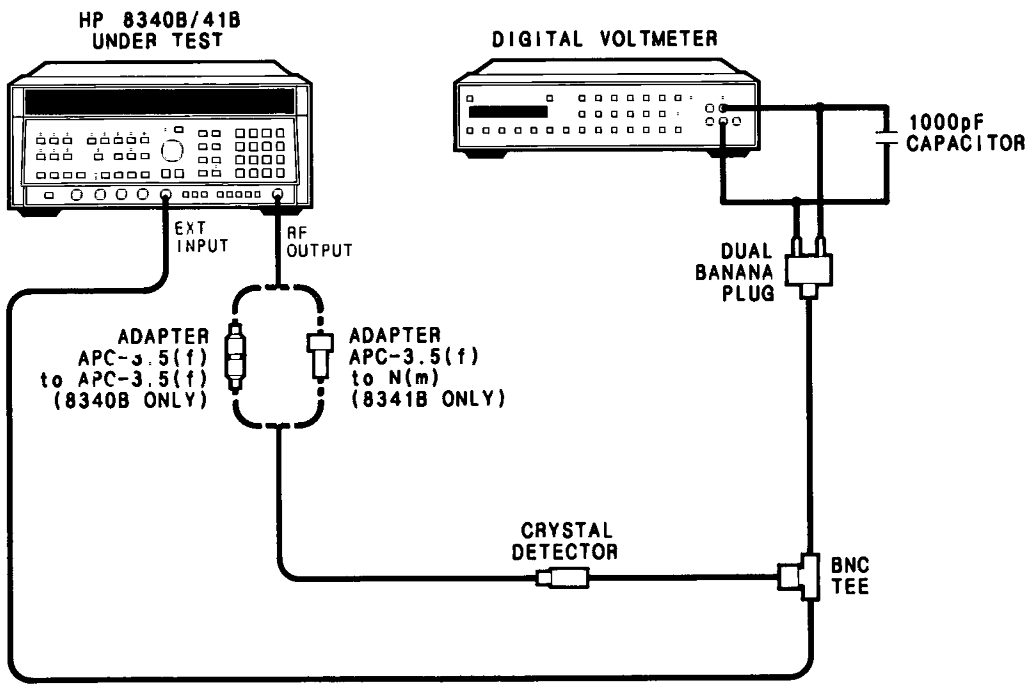


Figure 4-6. External Leveling Test Setup

4-6. EXTERNAL LEVELING (Cont'd)

Equipment

Digital Voltmeter (DVM) .... HP 3456A
Crystal Detector .... HP 8473C
Capacitor (1000 pF) .... HP P/N 0160-4574
Adapters
  APC 3.5 (f) to APC 3.5 (f) .... HP P/N 5061-5311
    (1 required if DUT is HP 8340B)
  TYPE N (m) to APC 3.5 (f) .... HP P/N 1250-1744
    (1 required if DUT is HP 8341B)
  BNC (f) to Dual Banana .... HP P/N 1251-2277
  BNC Tee (m) (f) (f) .... HP P/N 1250-0781
Attenuators (required for Option 001 or Option 005 only)
  10 dB .... HP 8493C Opt. 010
  20 dB .... HP 8493C Opt. 020

Procedure

1. Turn DUTs LINE switch ON. Press **[INSTR PRESET] [CW] [4] [.] [5] [GHz] [POWER LEVEL] [0] [dB(m)]**.

2. Connect equipment as shown in Figure 4-6 (note 1000 pF capacitor shunting DVM input). Allow the equipment to warm up for one hour.

NOTE

In step 3, XTAL mode is selected. In this mode the [dB(m)] terminator key selects dBV. The dBV value selected corresponds to a voltage at which the DUT's EXT INPUT will be leveled (see Table 4-14). The selected dBV is displayed in the ENTRY DISPLAY.

NOTE

If a positive polarity crystal detector is being used for this test, the voltages given in Tables 4-12, 4-13, 4-14, and 4-15 will all be positive.

3. Press **[XTAL] [6] [dB(m)]** DVM reading should be within the values shown on the first line in Table 4-12.

Table 4-12. External Leveling Limits (With No Attenuator)

dBV Selected	DVM Indication (V)		
	Lower Limit	Ideal	Upper Limit
+6	−1.883	−1.995	−2.114
0	−0.944	−1.000	−1.059
−10	−0.2983	−0.3162	−0.3352
−20	−0 0942	−0 01000	−0 1061

4-6. EXTERNAL LEVELING (Cont'd)

4. Repeat Step 3 for the remaining dBV values shown in Table 4-12.
5. Press the down step key to select 10 dB of attenuation (Option 001 and 005 instruments do not include an internal attenuator. For these instruments install a 10 dB attenuator between the RF output and detector).
6. Repeat Step 3 for values shown in Table 4-13
7. Press the down step key to select 20 dB of attenuation (for Option 001 or 005 instruments, remove 10 dB attenuator installed in step 5 and replace it with a 20 dB attenuator).
8. Repeat Step 3 for values shown in Table 4-14.

Table 4-13. External Leveling Limits (With 10 dB Attenuator)

dBV Selected	DVM Indication (mV)		
	Lower Limit	**Ideal**	**Upper Limit**
−30	−29.65	−31.62	−33.70
−40	−9.24	−10.00	−10.79

Table 4-14. External Leveling Limits (With 20 dB Attenuator)

dBV Selected	DVM Indication (mV)		
	Lower Limit	**Ideal**	**Upper Limit**
−50	−2.785	−3.162	−3.550
−60	−0.744	−1.000	−1.259
−66	−0 273	−0.501	−0.731

Table 4-15. dBV vs. Voltage Reference Table

dBV	Voltage	dBV	Voltage
7	−2.239V	−12	−0.2512V
6	−1.995V	−19	−0.1122V
5	−1.778V	−20	−0.1000V
4	−1.585V	−21	−89.13mV
3	−1.413V	−29	−35.48mV
2	−1.259V	−30	−31.62mV
1	−1 122V	−31	−28 18mV
0	−1 000V	−39	−11 22mV
−1	−0 8913V	−40	−10.00mV
−2	−0.7943V	−41	−8.913mV
−3	−0.7079V	−49	−3.548mV
−4	−0.6310V	−50	−3.162mV
−5	−0.5623V	−51	−2.818mV
−6	−0.5012V	−59	−1.122mV
−7	−0.4467V	−60	−1.000mV
−8	−0.3981V	−61	−0.8913mV
−9	−0.3548V	−65	−0.5623mV
−10	−0 3162V	−66	−0.5012mV
−11	−0 2818V	−67	−0 4467mV

4-7. SPURIOUS SIGNALS TEST (10 MHz to 22 GHz - HP 8340B only) (10 MHz to 20 GHz - HP 8341B)

Specification

Table 4-16. Spurious Signals Test Specifications

SPURIOUS SIGNALS (Expressed in dB relative to the carrier level (dBc) at ALC level of 0 dBm)	**Bands and Approximate Frequency Ranges (GHz)** (See Frequency Ranges and Bandswitch Points for complete description)				
	Band 0 **0.01 to <2.3**	**Band 1** **2.3 to <7.0**	**Band 2** **7.0 to <13.5**	**Band 3** **13.5 to <20.0**	**Band 4[1]** **20.0 to 26.5**
Harmonics (up to max. output freq.)	<−35	<−35	<−35	<−35	<−35
Subharmonics and multiples thereof (up to max. output freq.)	—	—	<−25	<−25	<−20
Non-harmonically related spurious (CW and Manual Sweep mode only)	<−50	<−70	<−64	<−60	<−58
Power line related and spurious due to fan rotation within 5 Hz below line frequency, and multiples thereof (CW mode only, all power levels)					
STANDARD INSTRUMENT					
Offset <300 Hz from carrier	<−50	<−50	<−44	<−40	<−38
Offset 300 Hz to 1 kHz from carrier	<−60	<−60	<−54	<−50	<−48
Offset > 1 kHz from carrier	<−65	<−65	<−59	<−55	<−53

1 Band 4 applies to HP 8340B only

Description

The HP 8340B/41B RF output signal is displayed on a spectrum analyzer to verify that the harmonic and non-harmonic spurious signals are at or below the specified level.

Equipment

Spectrum Analyzer .... HP 8566B
Adapters
  TYPE N (m) to APC 3.5 (f) .... HP P/N 1250-1744
    (2 required if DUT is HP 8341B)
    (1 required if DUT is HP 8340B)
  APC 3.5 (f) to APC 3.5 (f) .... HP P/N 5061-5311
    (1 required if DUT is HP 8340B)
Cable (Semi-Rigid SMA male to SMA male) .... HP P/N 08340-20124

4-7. SPURIOUS SIGNALS TEST (10 MHz to 22 GHz - HP 8340B only) (10 MHz to 20 GHz HP 8341B)

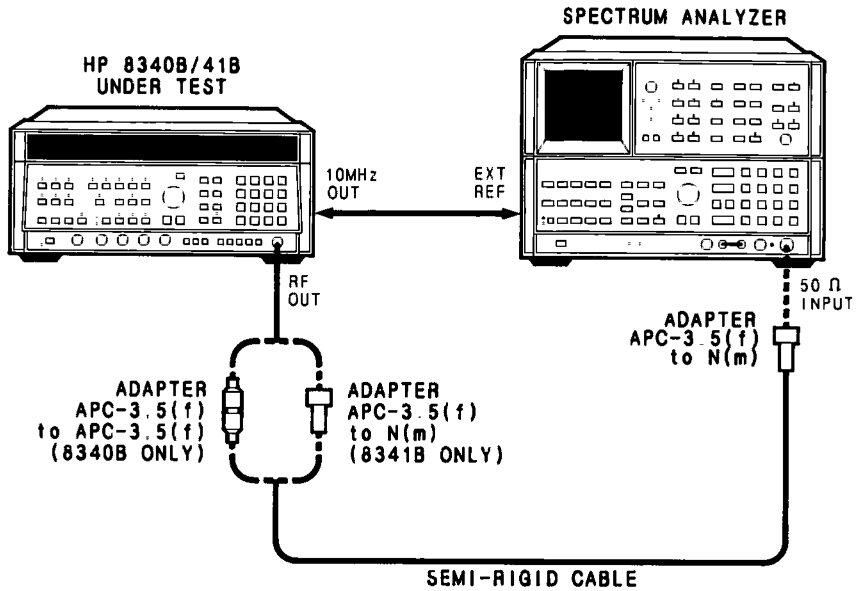


Figure 4-7. Spurious Signals Test Setup (10 MHz to 22 GHz - HP 8340B) (10 MHz to 20 GHz - HP 8341B)

Procedure

1. Connect equipment as shown in Figure 4-7 The position of the DUT can affect spurious responses; therefore, place the DUT in its normal operating position (i.e., flat on its feet) for this test Allow the instruments to warm up for one hour.
2. Press **[INSTR PRESET]** on the DUT. Press the **[STOP FREQ]** key and enter **[2] [.] [3] [GHz]**.
3. Press the DUT's **[POWER LEVEL]** key and enter **[0] [dBm]**.
4. Press the **[CW]** key and enter any frequency of interest within the selected frequency range.
5. Set up the spectrum analyzer to view the DUT's RF output signal. Set the reference level to place the peak of the DUT's RF output signal on the reference level at the top graticule line

4-7. SPURIOUS SIGNALS TEST (10 MHz to 22 GHz - HP 8340B only) (10 MHz to 20 GHz - HP 8341B)

NOTE

When using a spectrum analyzer other than the HP 8566A/B, the spectrum analyzer may generate some mixing products that could appear on the display. If a signal is in question, increase the spectrum analyzer input attenuation by 10 dB, note if signal decreases in amplitude by 10 dB, then return the attenuator to its original position. If the signal in question comes from an external source, it will change by exactly 10 dB. If the signal in question originates in the spectrum analyzer, the level will either change by greater or less than 10 dB or may not change at all.

The DUT's rotary knob circuit may generate some noise spikes when the knob is rotated. These signals should disappear when rotation is stopped.

If a spurious signal is found and it appears out of specification, check the fundamental signal amplitude to ensure it is at 0 dBm. Then check spurious level by substituting a known amplitude signal on the spectrum analyzer.

6 Tune the spectrum analyzer across its full frequency range. Look for any spurious signals. For each spurious response determine what mechanism generated the spurious response and what specification applies

a. Is the spurious response in question an integer multiple of the HP 8340B/41B RF output signal? If it is, the "harmonic" specification applies.

b. Press the DUT's **[SHIFT]** key and then **[M2]** to display, from left to right, the YO harmonic number and the YO frequency. Is the spurious response in question an integer multiple of the YO frequency (and not a harmonic of the RF signal)? If it is the "subharmonic and multiples thereof" specification applies.

NOTE

Press the [CW] key to view the CW frequency in the ENTRY DISPLAY.

c If the spurious response in question does not meet one of the above criteria, the "non-harmonically related" specification applies.

7. Repeat steps 4 through 7 at any frequency of interest within this frequency band.

8. Press the DUT's **[STOP FREQ]** key and enter the stop frequency for the next frequency band Press the **[START FREQ]** key and enter the start frequency for the next frequency band Repeat steps 3 through 8 until all DUT frequency bands have been tested up to 22 GHz (for HP 8340B), or 20 GHz (for HP 8341B).

4-8. SPURIOUS SIGNALS TEST, 22 to 26.5 GHz (Applies only to HP 8340B)

NOTE

Non-harmonically-related spurious responses, resulting from mixing products produced by two or more signals within the HP 8340B, follow a mathematical relationship to the signals that generated them. If the level of all such signals up to 22 GHz are within the specification, then no mixing products will be out of specification above 22 GHz. Therefore, no test is provided for non-harmonically-related spurious signals above 22 GHz.

Specification

Table 4-17. Spurious Signals Test (20 to 26.5 GHz) Specifications

SPURIOUS SIGNALS (Expressed in dB relative to the carrier level (dBc) at ALC level of 0 dBm)	**Bands and Approximate Frequency Ranges** (See Frequency Ranges and Bandswitch Points for complete description)
	Band 4 **20 to 26.5 GHz**
Harmonics (up to maximum output frequency)	<−35
Subharmonics and multiples thereof (up to maximum output frequency)	<−20
Non-harmonically related spurious (CW and Manual Sweep mode only)	<−58
Power line related and spurious due to fan rotation within 5 Hz below line frequency, and multiples (CW mode only, all power levels) STANDARD INSTRUMENT	
Offset <300 Hz from carrier	<−38
Offset 300 Hz to 1 kHz from carrier	<−48
Offset >1 kHz from carrier	<−53

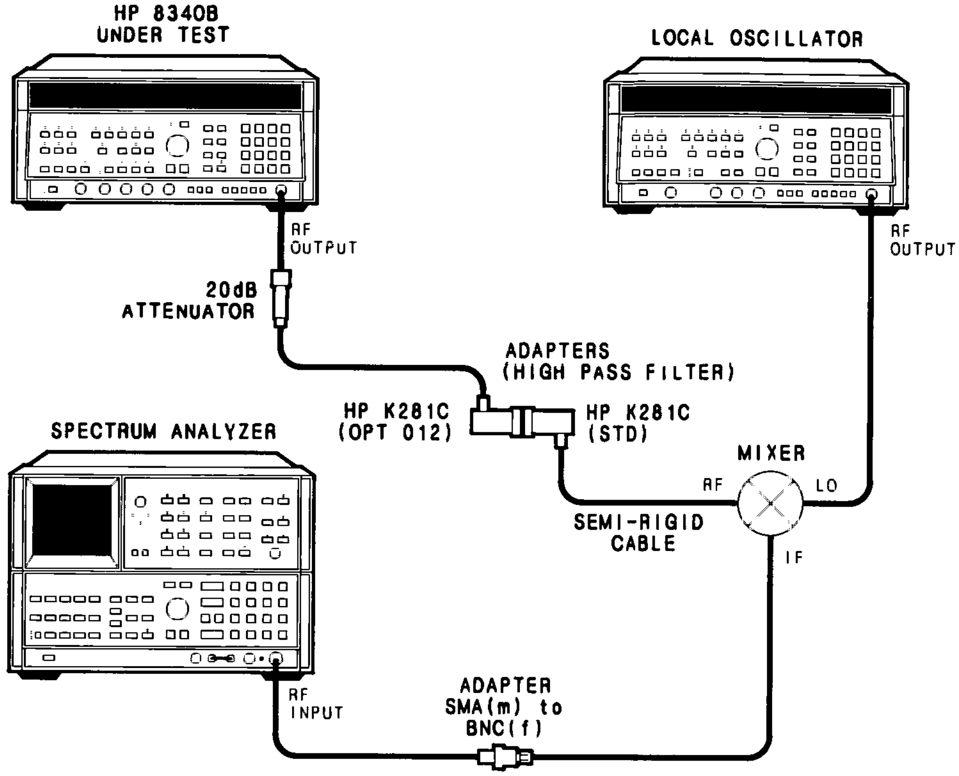


Figure 4-8. Spurious Signals Test Setup (22 to 26.5 GHz)

Description

The HP 8340B Under Test RF output signal is fed through a 20 dB pad and a high pass filter and is then down converted using a mixer and an HP 8340A/B as a Local Oscillator. the mixer output is fed to a low frequency spectrum analyzer.

The DUT is set to a CW frequency. All possible harmonics of the RF signal and harmonics of the YO frequency that could fall within the 22 GHz to 26.5 GHz range are determined.

The LO is set to a CW frequency 50 MHz below each harmonic The specification is in dB below the carrier. To establish the carrier level at the IF, the DUT is temporarily set to the frequency of the harmonic and a reference level is established on the Spectrum Analyzer. The DUT is returned to the original CW frequency The amplitude of the harmonic displayed on the Spectrum Analyzer is used to determine that the harmonic is at or below the specified level.

4-8. SPURIOUS SIGNALS TEST, 22 to 26.5 GHz (Applies only to HP 8340B) (Cont'd)

Equipment

Local Oscillator	HP 8340A/B Opt. 001
20 dB Attenuator	HP 8493C Opt 020
High Pass Filter (Made from the following adapters)[1]	
APC 3 5 (f) to Waveguide	HP K281C
APC 3 5 (m) to Waveguide	HP K281C Option 012
Mixer	HP P/N 0955-0307
Spectrum Analyzer	HP 3585A
Adapters	
SMA (m) to BNC (f)	HP P/N 1250-1200
Cable (Semi-Rigid SMA male to SMA male)	HP P/N 08340-20124

NOTE

It is important that the mixer be connected directly to the LO's RF Output connector. For best results in this test, the local oscillator drive to the mixer should be ≥+4 dBm.

Procedure

1. Connect equipment as shown in Figure 4-8. Allow at least a one hour warm up time On the LO, press **[INSTR PRESET]** and **[PEAK]** (turns PEAK on).

2. Press the DUT's **[INSTR PRESET]** key. Press **[POWER LEVEL]**. If the power level in the ENTRY DISPLAY is not 0 dBm, enter **[0] [dBm]** Press the **[CW]** key and enter any CW frequency in the 10 MHz to 26.5 GHz range

3. Determine all possible harmonic frequencies of the RF signal that could fall within the 22 to 26.5 GHz range. Press **[SHIFT] [M2]** to display from left to right, the band number (in POWER dBm display) and the YO frequency. Determine all possible YO harmonic frequencies that could fall within the 22 to 26 5 GHz range.

4. Press the LO **[CW]** key and enter a frequency 50 MHz below the harmonic frequency to be tested. Press the **[POWER LEVEL]** key and, using the rotary knob, increase the power level until the UNLEVELED indicator light comes **ON**. Slowly decrease the power level until the UNLEVELED light just goes **OFF**.

5. Press **[SAVE] [1]** on the DUT to save the current instrument state. Press **[CW]** and enter the harmonic frequency to be tested. Set the Spectrum Analyzer to view the 50 MHz IF signal with the peak of the signal at the top graticule line.

6. Press **[RECALL] [1]** on the DUT to recall the original instrument state The amplitude of the harmonic displayed on the Spectrum Analyzer should be at or below the specified test.

7. Repeat steps 4 through 6 for each harmonic frequency determined in step 3.

8. Set the DUT to another CW frequency and repeat steps 3 through 7.

---

1. The waveguide portions of these adapters pass high frequencies and attenuate low frequencies

4-9. SINGLE SIDEBAND PHASE NOISE

Specification

Table 4-18. Single-sideband Phase Noise Specifications

SPURIOUS SIGNALS [Expressed in dB relative to the carrier level (dBc)]	**Bands and Approximate Frequency Ranges (GHz)** (see Frequency Ranges and Bandswitch Points for complete description)				
Single-sideband Phase Noise (dBc/1 Hz BW, CW Mode, all power levels)	**Band 0** **0.01 to <2.3**	**Band 1** **2.3 to <7.0**	**Band 2** **7.0 to <13.5**	**Band 3** **13.5 to <20.0**	**Band 4**[1] **20.0 to 26.5**
Offset 30 Hz from carrier	< −64	< −64	< −58	< −54	< −52
Offset 100 Hz from carrier	< −70	< −70	< −64	< −60	< −58
Offset 1 kHz from carrier	< −78	< −78	< −72	< −68	< −66
Offset 10 kHz from carrier	< −86	< −86	< −80	< −76	< −74
Offset 100 kHz from carrier	< −107	< −107	< −101	< −97	< −95
OPTION 007, Relaxed Phase Noise Specifications					
Offset 100 Hz from carrier	< −67	< −67	< −61	< −57	< −55
Offset 1 kHz from carrier	< −75	< −75	< −69	< −65	< −63
Offset 10 kHz from carrier	< −83	< −83	< −77	< −73	< −71
Offset 100 kHz from carrier	< −107	< −107	< −101	< −97	< −95

1 Applies only to HP 8340B

Description

This test is performed in three steps: SYSTEM CALIBRATION, PHASE NOISE MEASUREMENT, and PHASE NOISE CALCULATION. A second HP 8340A/B or HP 8341A/B is used as a local oscillator (LO) to mix down the microwave frequency from the HP 8340B/41B under test (DUT) to a 1 MHz IF. The IF signal is amplified and, for 30 Hz, 100 Hz and 1 kHz offsets, sent directly to a low frequency spectrum analyzer (HP 3585A). For 10 kHz and 100 kHz offsets, a 1 MHz notch filter is inserted between the amplifier and the HP 3585A to attenuate IF signal and obtain increased dynamic range on the HP 3585A. Phase noise is measured using the OFFSET and NOISE LVL functions of the HP 3585A.

SYSTEM CALIBRATION obtains the system's frequency response data (Cal Data (CD) and IF Cal Data (IFCD), measured in dBc). A zero dBm, 1 MHz IF is established and then the LO frequency is reduced to obtain 1.00003, 1.0001, and 1.001 MHz IFs. At each point, the power level at the peak of the IF is recorded as the Cal Data (CD). A 1 MHz notch filter is then inserted between the amplifier and the HP 3585A. The LO frequency is again reduced to obtain 1.01 and 1.1 MHz IFs, and the Cal Data for these points is recorded. The LO frequency is then increased to obtain a 1 MHz IF and the response due to the 1 MHz notch filter is recorded as the IF Cal Data (IFCD). This data is required for calculating the actual phase noise for the 10 kHz and 100 kHz offsets. Since it is not required for the 30 Hz, 100 Hz and 1 kHz offsets, IFCD is defined as zero at these points.

4-9. SINGLE SIDEBAND PHASE NOISE (Cont'd)

PHASE NOISE MEASUREMENT obtains phase noise data for DUT frequencies of 2.202, 6.902, 13.402, 19.502, and, in the case of the HP 8340B, 26.032 GHz. These specific frequencies typically have the worst case phase noise for the HP 8340B/41B. The DUT is adjusted for the test frequency and then the LO frequency is adjusted to obtain a 1 MHz ± 0.9 Hz IF. A signal to noise level (IF to phase noise level at 30 Hz, 100 Hz, 1 kHz, 10 kHz, and 100 kHz offsets from IF) measurement is performed using the OFFSET and NOISE LVL functions of the HP 3585A and the results are recorded as the Measured Noise Level (MNL, measured in dBc).

PHASE NOISE CALCULATION takes the data obtained for MNL and adds and subtracts the calibration data and a 3 dB correction factor to obtain the actual phase noise. The formula that is used is.

$$\text{Actual Phase Noise} = \text{MNL} + \text{IFCD} - \text{CD} - 3\text{ dB}$$

IFCD is the response of the 1 MHz notch filter at 1 MHz. Since the filter is not installed during the 10 Hz, 100 Hz and 1 kHz measurements, IFCD = 0. During the 10 kHz and 100 kHz offset measurements, the notch filter attenuates the IF causing the power difference between the IF and the phase noise to be smaller than it actually is, therefore IFCD must be added to MNL to correct this. The system's frequency response (LCD) causes the difference between the IF level and the phase noise level to be greater than it actually is, therefore CD must be subtracted from MNL. A factor of 3 dB is subtracted from MNL to correct for the LO's phase noise contribution.

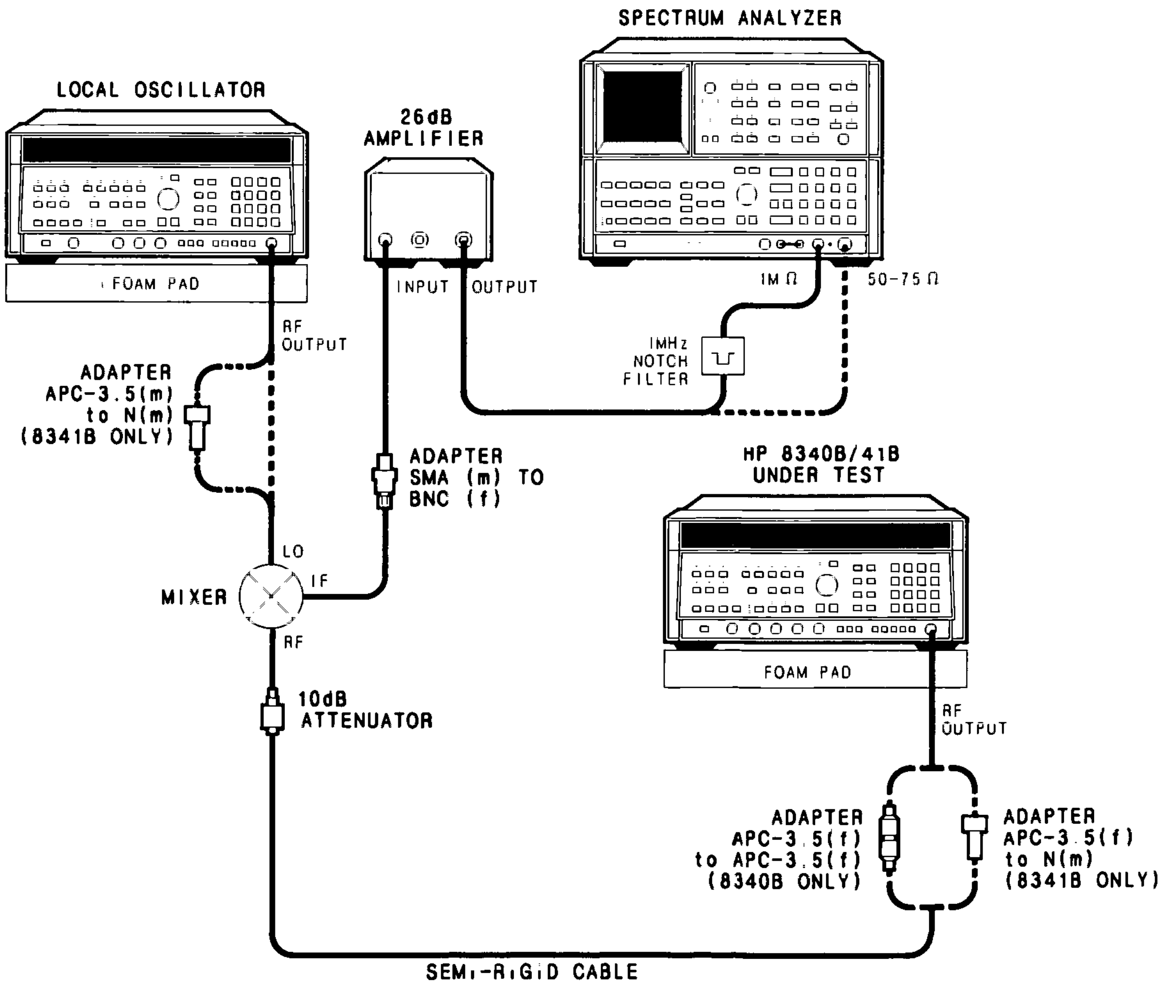


Figure 4-9. Single Sideband Phase Noise Test Setup

4-9. SINGLE SIDEBAND PHASE NOISE (Cont'd)

Equipment

Synthesized Sweeper (Local Oscillator) . . HP 8340A/B Opt. 001 or any HP 8341A/B[2]
Spectrum Analyzer . . . . HP HP 3585A
Power Amplifier . . . . HP 8447F
Attenuator . . . . HP 8493C Opt. 010
Mixer . . . . HP P/N 0955-0307
Adapters
APC 3.5 (f) to APC 3.5 (f) . . . . HP P/N 5061-5311
(1 required if DUT is HP 8340B)
Type N (m) to APC 3.5 (f) . . . . HP P/N 1250-1744
(1 required if DUT is HP 8341B)
Type N (m) to APC 3.5 (m) . . . . HP P/N 1250-1743
(1 required if LO is HP 8341A/B)
SMA (m) to BNC (f) . . . . HP P/N 1250-1200
Cable (Semi-Rigid SMA male to SMA male) . . . . HP P/N 08340-20124
Foam Pads . . . . (Refer to note following step 1)
1 MHz Notch Filter . . . . (See schematic in Recommended Test Equipment list, at the beginning of this section)

NOTE

It is important that the mixer be connected directly to the LO's RF Output connector.

Procedure

1. Connect equipment as shown in Figure 4-9 with the amplifier connected directly to the HP 3585A 50 Ohm input.

NOTE

The foam pads shown in Figure 4-9 are required to isolate the DUT and LO from mechanical vibrations which could induce phase noise.

NOTE

In this procedure, the LO is programmed for +10 dBm. At some points the LO may indicate an unleveled condition. This is to be expected and does not affect the phase noise measurement.

2. On the LO, press **[INSTR PRESET] [CW] [2] [.] [2] [0] [1] [GHz] [POWER LEVEL] [1] [0] [dB(m)] [PEAK]**.

3. On the DUT, press **[INSTR PRESET] [CW][2] [.] [2] [0] [2] [GHz] [POWER LEVEL] [0] [dB(m)] [PEAK]**

4. On the HP 3585A, press INSTR PRESET, CENTER FREQUENCY, 1 MHz, FREQUENCY SPAN, 1 MHz.

5. Switch the HP 3585A AUTO RANGE and REF LVL TRACK off.

6 Allow the equipment to warm up for 1 hour.

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2 usable only with HP 8341B DUT

4-9. SINGLE SIDEBAND PHASE NOISE (Cont'd)

7. Adjust the HP 3585A marker to the peak of the IF

8. On the HP 3585A, press COUNTER.

9. Adjust the frequency of the LO for an HP 3585A COUNTER reading of 1 MHz ±0.9 Hz. This removes any frequency offsets between the DUT and LO.

10. Adjust the output power of the DUT for 0 dBm at the peak of the IF Select a REFERENCE LEVEL of 0 dBm on the HP 3585A.

SYSTEM CALIBRATION

30 Hz Offset Calibration

(not applicable to units equipped with Option 007, Relaxed Phase Noise specifications)

11. On the HP 3585A, press FREQUENCY SPAN, 250 Hz, RES BW, 3 Hz. Allow one sweep to occur. Ensure power at peak if IF is still 0 dBm.

12. Reduce LO frequency by 30 Hz (IF = 1.00003 MHz ±0.9 Hz).

13 Allow one sweep of the HP 3585A to occur Adjust the HP 3585A marker to the peak of the IF Record the marker power level (Cal Data) into Table 4-19

Table 4-19. Phase Noise Calibration Data

Step	Offset (Hz)	Cal Data (dB)
13	30	CD =
14	100	CD =
16	1K	CD =
19	10K	CD =
21	100K	CD =
22	0	IFDC =

100 Hz Offset Calibration

14. Reduce the LO frequency by 70 Hz (IF = 1.0001 MHz ±0.9 Hz) Repeat step 13.

1 kHz Offset Calibration

15. On the HP 3585A, press FREQUENCY SPAN, 2500 Hz, RES BW, 30 Hz.

16. Reduce LO frequency by 900 Hz (IF = 1.001 MHz ±0.9 Hz). Repeat step 13.

10 kHz Offset Calibration

17. Connect 1 MHz Notch Filter as shown in Figure 4-9. Select 1 MOhm input impedance on the HP 3585A.

18. On the HP 3585A, press FREQUENCY SPAN, 25 kHz, RES BW, 100 Hz.

19 Reduce LO frequency by 9 kHz (IF = 1 01 MHz ±0.9 Hz) Repeat step 13

4-9. SINGLE SIDEBAND PHASE NOISE (Cont'd)

100 kHz Offset Calibration

20. On the HP 3585A, press FREQUENCY SPAN, 250 kHz, RES BW, 1 kHz.

21. Reduce LO frequency by 90 kHz (IF = 1.1 MHz ±0.9 Hz). Repeat step 13.

IF Cal Data

22. Increase the LO frequency by 100 kHz (IF = 1 MHz ±0.9 Hz). Repeat step 13.

PHASE NOISE MEASUREMENT

23. Connect equipment as shown in Figure 4-9 with the amplifier connected directly to the HP 3585A 50 Ohm input. Return the HP 3585A to 50 Ohm input impedance.

24. On the DUT, press **[POWER LEVEL] [0] [dB(m)]**. Select the HP 3585A REFERENCE LEVEL to place the peak of the IF at the top graticule of the display. Ensure IF = 1 MHz ±0.9 Hz. If necessary, adjust LO for an HP 3585A COUNTER reading of 1 MHz ±0.9 Hz.

25. On the HP 3585A, press FREQUENCY SPAN, 250 Hz, RES BW, 3 Hz. Step the RANGE until the overload light just turns on and then increment it one step. Allow one sweep to occur.

30 Hz Offset

(not applicable to units equipped with Option 007, Relaxed Phase Noise Specifications)

26. On the HP 3585A, press MANUAL, CLEAR A, MKR → CF, COUNTER

27. On the HP 3585A, press OFFSET, ENTER OFFSET, CF STEP SIZE, 30 Hz, MANUAL, STEP UP (key), NOISE LVL. The noise level measurement takes approximately 30 seconds. For an accurate reading, allow at least 2 measurements to be made before recording value. Record Measured Noise Level (MNL) into Table 4-20

Table 4-20. Phase Noise Measurement Data

Step	Offset	Measured Noise Level [MNL, dBc (1 Hz)]				
		2.202 GHz	6.902 GHz	13.402 GHz	19.502 GHz	26.032 GHz[1]
27	30					
29	100					
31	1K					
34	10K					
36	100K					

1 Applies only to HP 8340B

28. On the HP 3585A, press COUNTER, NOISE LVL, OFFSET, CONT. Return marker to peak of IF and ensure COUNTER reading is 1 MHz ±0.9 Hz. If necessary, adjust LO for a 1 MHz IF. If the IF drifted more than 6 Hz, steps 26 through 28 must be repeated.

4-9. SINGLE SIDEBAND PHASE NOISE (Cont'd)

100 Hz Offset

29 Repeat steps 26 through 28 with a CF STEP SIZE of 100 Hz substituted in step 27.

1 kHz Offset

30. On the HP 3585A, press FREQUENCY SPAN, 2.5 kHz, RES BW, 30 Hz.

31 Repeat steps 26 through 28 with a CF STEP SIZE of 1 kHz substituted in step 27.

10 kHz Offset

32. Connect the equipment in Figure 4-9 with the 1 MHz Notch Filter connected. Select the 1 MOhm input impedance on the HP 3585A.

33 On the HP 3585A, press FREQUENCY SPAN, 25 kHz, RES BW, 100 Hz Decrement the RANGE until the overload light just turns on and then increment it one step.

34. Repeat steps 26 through 28 with a CF STEP SIZE of 10 kHz substituted in step 27.

100 kHz Offset

35 On the HP 3585A, press FREQUENCY SPAN, 250 kHz, RES BW, 1 kHz.

36. Repeat steps 26 through 28 with a CF STEP SIZE of 100 kHz substituted in step 27.

37. Repeat steps 23 through 36 for the CW frequencies shown in Table 4-21.

Table 4-21. Phase Noise Test Frequencies

CW Frequency (GHz)	
DUT	**LO**
6.902	6.901
13.402	13.401
19.502	19.501
26 032[1]	26 031[1]

1. Applies only to HP 8340B

4-9. SINGLE SIDEBAND PHASE NOISE (Cont'd)

PHASE NOISE CALCULATION

38. Using the data obtained in Table 4-19 and Table 4-20, calculate and enter the Actual Phase Noise into Table 4-21

For example: Assume the following data was obtained for the 30 Hz offset at 26.032 GHz

CD = 0 dB (obtained in step 13)
MNL = −50.8 dB (obtained in step 27)
IFCD is defined to be 0 for a 30 Hz offset (also for 100 Hz and 1 kHz)

Therefore

Actual Phase Noise = MNL + IFCD − CD − 3 dB
= −50.8 + 0 − 0 − 3
= −53.8

The value −53.8 would be entered into Table 4-22.

For example: Assume the following data was obtained for the 10 kHz offset at 2.202 GHz

CD = −25.6 dB (obtained in step 19)
IFCD = −44.2 dB (obtained in step 22)
MNL = −66.0 dB (obtained in step 34)

Therefore

Actual Phase Noise = MNL + IFCD − CD − 3 DB
= −66.0 + (−44.2) − (−25.6) −3
= −87 6

The value −87.6 would be entered into Table 4-22

Table 4-22. Phase Noise Test Results

Actual[1] Single Sideband Phase Noise (dBc/1 Hz)					
Offset (Hz)	**2.202 GHz**	**6.902 GHz**	**13.402 GHz**	**19.502 GHz**	**26.032 GHz[2]**
30[3]					
100					
1K					
10K					
100K					

1 Actual = MNL + IFCD − CD − 3dB
where IFCD = 0 for 30 Hz, 100 Hz, and 1 kHz offsets = value measured in step 22 (see Table 4-19) for 10K and 100 kHz offsets

2 Applies only to HP 8340B

3 Not applicable to instruments equipped with Option 007, Relaxed Phase Noise Specifications

4-10. POWER SWEEP TEST

Specification

Table 4-23. Power Sweep Test Specifications

Power Sweep Range Displayed: 0 to 40 dB/sweep Actual: At least 10 dB at any given frequency (at least 20 dB in DECOUPLED mode); see Figure 2 in the HP 8340B/41B specification table. Accuracy Starting Power Level: Same as Output Power Accuracy Power Sweep Width and Linearity: See Figure 2 in the HP 8340B/41B specification table. In normal operation (a), the ALC does not operate below −9.95 dBm (see Figure 3 in the HP 8340B/41B specification table), and so the maximum power sweep range is the difference of −9.95 dBm and the maximum leveled power available at the frequency range of interest (specified leveled power shown in diagram). In the DECOUPLED mode (b), the power sweep range is extended because the ALC can operate down to −20 dBm.

Description

The DUT is set to allow the ALC and the step attenuator to be operated independently (**[SHIFT] [PWR SWP]**). The DUT is then set to do a 20 dB power sweep from −20 dBm to 0 dBm at a CW frequency. The DUT is set to do a manual sweep while its output power is measured at the two end points, −20 dBm and 0 dBm, using a power meter.

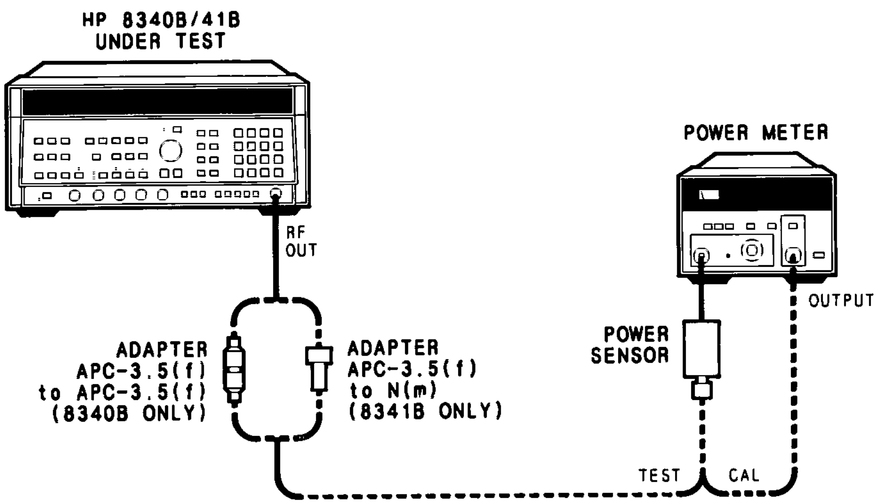


Figure 4-10. Power Sweep Test Setup

4-10. POWER SWEEP TEST (Cont'd)

Equipment

Power Meter .... HP 436A Option 022
Power Sensor .... HP 8485A
Adapters
APC 3.5 (f) to APC 3.5 (f) .... HP P/N 5061-5311
(1 required if DUT is HP 8340B)
Type N (m) to APC 3.5 (f) .... HP P/N 1250-1744
(1 required if DUT is HP 8341B)

Procedure

1. Connect equipment as shown in Figure 4-10. Connect the HP 8485A Power Sensor to the Power Meter. Allow a one hour warm up time. Set the Power Meter's calibration switch to include 1 GHz, then zero and calibrate the Power Meter before connecting the Power Sensor to the DUT.

2. Press the DUT's **[INSTR PRESET]** Press the **[CW]** key and enter **[1] [GHz]**.

3. Press **[SHIFT] [PWR SWP]** to allow the ALC and RF step attenuator to be independently controlled.

NOTE

The step up and step down keys control the RF attenuator. The numeric key pad and rotary knob control the ALC power level.

4. Enter **[−] [2] [0] [dBm]** ALC Power level to set the start of the power sweep at −20 dBm. Press **[PWR SWP]** and enter **[2] [1] [dBm]** to set the power sweep range to >20 dB (The maximum power sweep range is from −20 dBm to maximum power).

5. Press the **[MANUAL]** key. Turn the rotary knob counterclockwise to find the beginning of the power sweep (i e , the power meter indication is at maximum and no longer changing). Record the power meter indication.

NOTE

The POWER dBm display will indicate the approximate output power during a very slow or manual sweep.

6. Rotate the rotary knob clockwise to find the end of the power sweep (i.e., the power meter indication is at maximum and no longer changing). Record the power meter indication

7. The difference between the power meter indications recorded in step 5 and step 6 must be ≥20 dB.

8. Press the **[CW]** key and enter **[5] [GHz]**. Set the power meter's calibration factor switch to include this frequency. Repeat steps 5 through 7 at CW frequencies of 10, 15, and, if the DUT is an HP 8340B, 26 GHz.

4-11. PULSE MODULATION ON/OFF RATIO TEST

NOTE

THIS TEST IS NOT APPLICABLE TO INSTRUMENTS EQUIPPED WITH OPTION 006, DELETE PULSE MODULATION

Specification

Table 4-24. Pulse Modulation ON/OFF Ratio Test Specifications

For CW mode and RF frequencies ≥400 MHz only:
On/Off Ratio: >80 dB

Description

The DUT under test is set to a CW frequency at 0 dBm. The RF output level is viewed on a spectrum analyzer. A reference level is set on the spectrum analyzer display, the PULSE key is pressed (ON)

NOTE

The 50 ohm termination on the DUT's PULSE input simulates the RF OFF state when PULSE is selected (ON).

The difference between the two spectrum analyzer displayed levels is the pulse ON/OFF ratio.

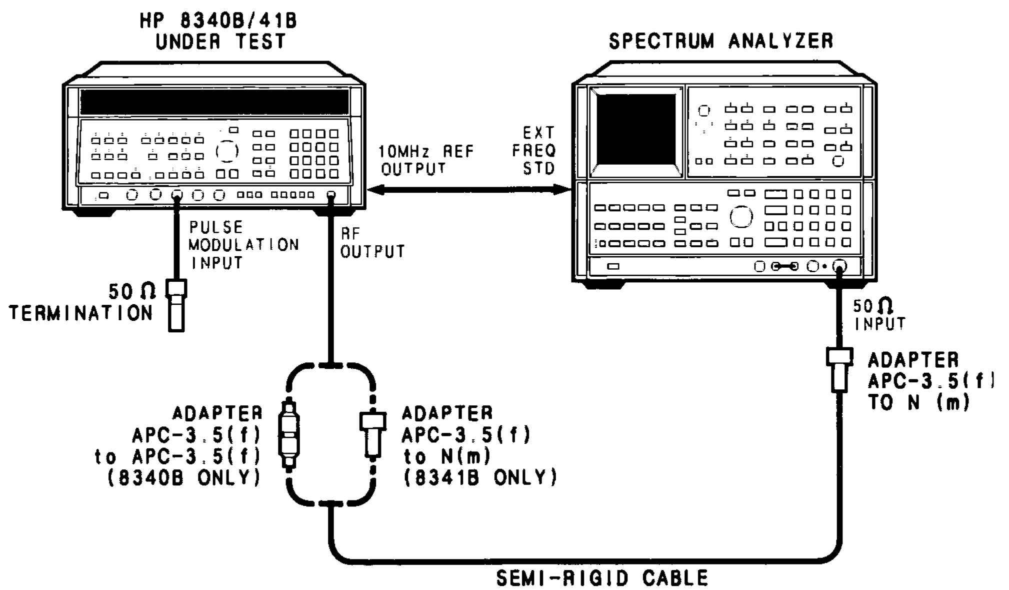


Figure 4-11. Pulse Modulation ON/OFF Ratio Test Setup

4-11. PULSE MODULATION ON / OFF RATIO TEST (Cont'd)

Equipment

Spectrum Analyzer .... HP 8566B
50 Ohm Termination .... HP 10100C
Adapters
  TYPE N (m) to APC 3.5 (f) ... ... HP P/N 1250-1744
    (2 required if DUT is HP 8341B)
    (1 required if DUT is HP 8340B)
  APC 3.5 (f) to APC 3.5 (f) .... HP P/N 5061-5311
    (1 required if DUT is HP 8340B)
Cable SMA (m) to SMA (m) .... HP P/N 08340-20124

Procedure

1. Connect equipment as shown in Figure 4-11. Allow a one hour warm up time.
2. On the DUT, press **[INSTR PRESET]** then **[CW] [1] [GHz]**. The RF power level should be 0 dBm.
3. Set the spectrum analyzer CENTER FREQUENCY to equal the DUT's CW frequency, FREQUENCY SPAN 200 Hz, RES BW 30 Hz, PEAK SEARCH, MKR → CF, MKR → REF LVL, MKRΔ
4. Press the DUT's **[PULSE]** key (ON). The spectrum analyzer marker delta amplitude level should be greater than 80 dB.
5. Repeat steps 2 through 4 at CW frequencies of 3, 9, 15, and, if the DUT is an HP 8340B, 22 GHz.

NOTE

For further verification of the ON/OFF Ratio, steps 2 through 4 may be repeated for other frequencies of interest.

4-12. PULSE MODULATION RISE AND FALL TIME TEST

NOTE

THIS TEST IS NOT APPLICABLE TO INSTRUMENTS EQUIPPED WITH OPTION 006, DELETE PULSE MODULATION.

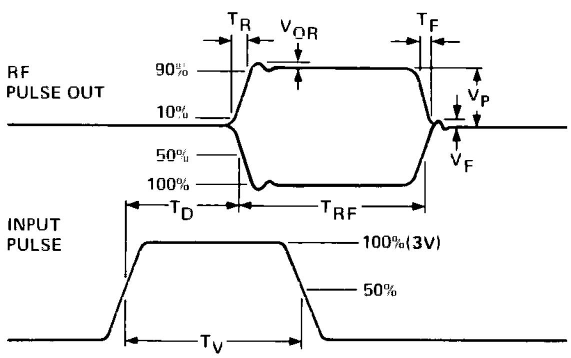
Specification

Table 4-25. Pulse Modulation Rise and Fall Time Test Specification

For CW mode and frequencies ≥400 MHz only.	
Rise (T_R) and Fall (T_F) Times.	<25 nanoseconds

Description

The DUT's RF output frequency is down converted to 50 MHz using a mixer and a local oscillator. The 50 MHz IF signal is amplified and applied to an oscilloscope The DUT is pulsed using a pulse generator. The pulse generator output is also applied to the oscilloscope The oscilloscope is used to measure the pulse envelope rise and fall times Refer to Figure 4-12 Pulse Definitions



T_{RF} -RF Pulse Length
T_V -Input Pulse Length
T_D Delay Time
V_P -RF Pulse Amplitude
T_R -RF Pulse Rise Time
T_F RF Pulse Fall Time
V_{OR} Overshoot and Ringing
V_F Video Feedthrough

Figure 4-12. Pulse Definitions

4-12. PULSE MODULATION RISE AND FALL TIME TEST (Cont'd)

Equipment

Local Oscillator	HP 8340A/B Opt 001 or any HP 8341A/B[1]
Pulse Generator	HP 8012B
Amplifier	HP 8447F
Oscilloscope	HP 1741A
Adapters	
APC 3.5 (f) to APC 3.5 (f) (1 required if DUT is HP 8340B)	HP P/N 5061-5311
Type N (m) to APC 3.5 (f) (1 required if DUT is HP 8341B)	HP P/N 1250-1744
Type N (m) to APC 3.5 (m) (1 required if LO is HP 8341A/B)	HP P/N 1250-1743
SMA (m) to BNC (f)	HP P/N 1250-1200
BNC Tee (m) (f) (f)	HP P/N 1250-0781
Cable (Semi-Rigid SMA male to SMA male)	HP P/N 08340-20124
10 dB Attenuator	HP 8493C Opt 010
Mixer	HP P/N 0955-0307
Low Pass Filter (LPF)	HP P/N 9135-0260

NOTE

It is important that the mixer be connected directly to the LO's RF Output connector.

1 Usable only with HP 8341B DUT

Procedure

1. Connect equipment as shown in Figure 4-13. Connect the mixer directly to the local oscillator RF output to obtain maximum LO drive to the mixer. Connect the BNC tee directly to the HP 8340B/41B PULSE IN connector. Allow a one hour warm up time.

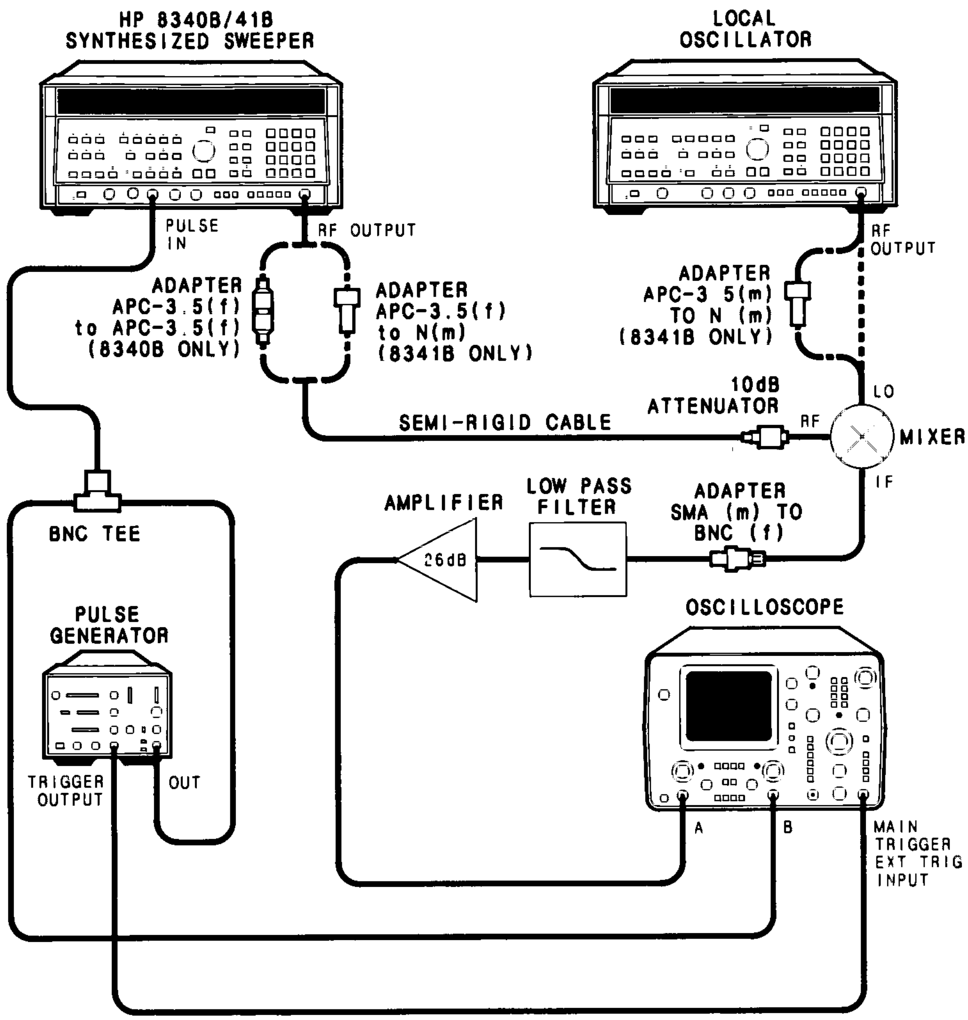


Figure 4-13 Pulse Modulation Rise and Fall Time Test Setup

2. Set up the HP 8012B Pulse Generator as follows.

OFFSET	OFF
POLARITY	+
OUTPUT	NORMAL
INT LOAD	IN
PULSE PERIOD slide switch	1μ − 1m
TRANSITION TIME slide switch	minimum (5n)
AMPLITUDE slide switch	top position (5 0)
PULSE DOUBLE/NORMAL	NORMAL
PULSE DELAY slide switch	minimum
Pulse Delay VERNIER	fully CCW
LEADING EDGE control	fully CCW
PULSE WIDTH slide switch	10n−1μ
TRAILING EDGE control	fully CCW

3. Set both oscilloscope channels A and B for 50 ohm input. Set the oscilloscope to view the pulse generator output waveform. Adjust the HP 8012B pulse width VERNIER for a 100 nanosecond pulse. Adjust the pulse period VERNIER for a 10 microsecond period

   Adjust the amplitude VERNIER for about a 3V pulse amplitude (TTL level). Set the oscilloscope to trigger on this pulse (trigger on channel B).

4. Press **[INSTR PRESET]** on both the DUT and the LO. On the DUT, press **[CW] [1] [GHz]** and the **[PULSE]** modulation key. On the LO, press **[CW] [.] [9] [5] [GHz]**. The IF frequency is then 50 MHz. Set the LO for +10 dBm or maximum leveled output. The DUT's RF power should be 0 dBm.

NOTE

For best accuracy in this test, the Local Oscillator drive to the mixer should be ≥ +4 dBm.

5. Set the oscilloscope horizontal sweep to 50 nanoseconds/division and select channel A input only. Adjust the channel A (pulsed IF input signal) vertical gain and position so that the pulse OFF is at the 0% graticule line and the pulse ON is at 100% graticule line. Select the horizontal MAG X10 The oscilloscope is now calibrated for 5 nanoseconds/division. Adjust the horizontal position control to position the modulation envelope so that the 10% point of the envelope rise time is at the center vertical graticule line similar to Figure 4-14.

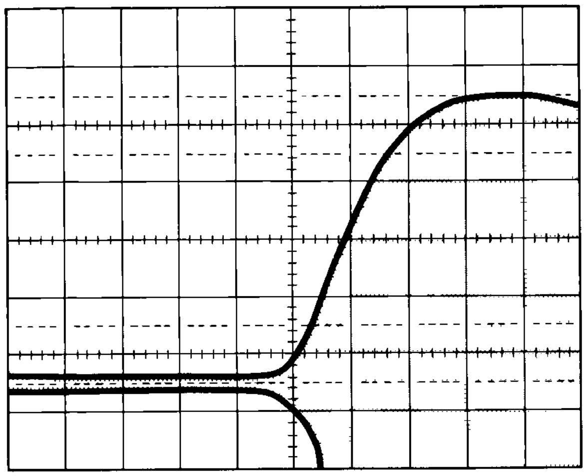


Figure 4-14. Pulse Modulation Rise Time Waveform

6. The 90% point of the envelope rise time should be less than 25 nanoseconds (5 horizontal divisions) from the 10% point

7. Adjust the oscilloscope horizontal position control to view the modulation envelope fall time. Position the waveform so that the modulation envelope crosses the 90% graticule at a vertical graticule line similar to Figure 4-15.

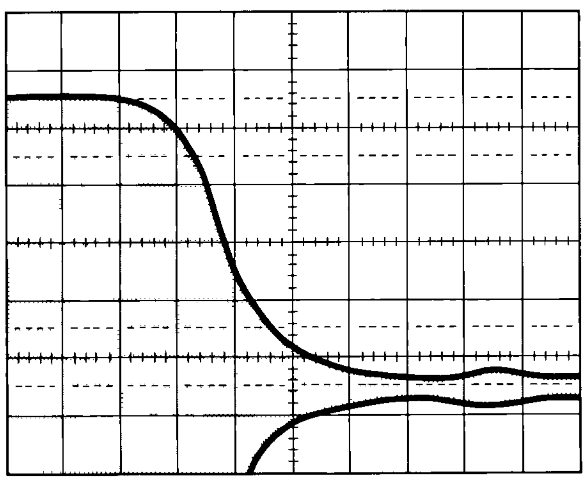


Figure 4-15. Pulse Modulation Fall Time Waveform

8. The 10% point should be <25 nanoseconds (5 divisions) from the 90% point.

9. Repeat steps 5 through 8 at CW frequencies of 3, 9, 15, and, if the DUT is an HP 8340B, 22 GHz. Set the LO CW frequency to be 50 MHz below the DUT's frequency.

4-13. PULSE MODULATION ACCURACY TEST

NOTE

THIS TEST IS NOT APPLICABLE TO INSTRUMENTS EQUIPPED WITH OPTION 006, DELETE PULSE MODULATION.

Specification

Table 4-26. Pulse Modulation Accuracy Test Specifications

For CW mode and frequencies ≥400 MHz only.

Minimum Internally Leveled RF Pulse Width (TI, RFI): 100 nanoseconds

Pulse Repetition Frequency:
Internally leveled: 100 Hz to 5 MHz

Accuracy of Internally Leveled RF Pulse VI, PI (relative to CW mode level):

NOTE

ALC attempts to hold pulse amplitude to same level as leveled CW signal.

Bands and Approximate Frequency Ranges (GHz)
(see Frequency Ranges and Bandswitch Points for complete description)

Pulse Width	Band 0 0.4 to <2.3	Bands 1 - 4[1] 2.3 to 26.5
100 to <200 ns	+3/−0.3 dB[2]	+1.5/−0.3 dB[2]
200 to <500 ns	+1.5/−0.3 dB[2]	±0.3 dB
≥500 ns	±0.3 dB	±0.3 dB

1 Band 4 (≥20.0 to 26.5 GHz) only applies to the HP 8340B

2 +15 to +55°C. Duty Cycle must be >0.01%

Description

The DUT's RF output frequency is down converted to 50 MHz using a mixer and a local oscillator. The 50 MHz IF signal is amplified and applied to an oscilloscope. The DUT is pulsed using a pulse generator. The IF modulation envelope is positioned to convenient horizontal graticule lines. The pulse is turned OFF and the DUT's output power level is adjusted so that the IF carrier is at the horizontal graticule lines established when the DUT was being pulsed. The change in DUT output power level is the accuracy error of the leveled RF pulse.

4-13. PULSE MODULATION ACCURACY TEST (Cont'd)

Equipment

Local Oscillator	HP 8340A/B Opt 001 or any HP 8341A/B[3]
Pulse Generator	HP 8012B
Amplifier	HP 8447F
Oscilloscope	HP 1741A
Adapters	
APC 3.5 (f) to APC 3.5 (f) (1 required if DUT is HP 8340B)	HP P/N 5061-5311
Type N (m) to APC 3.5 (f) (1 required if DUT is HP HP 8341B)	HP P/N 1250-1744
Type N (m) to APC 3.5 (m) (1 required if LO is HP 8341A/B)	HP P/N 1250-1743
SMA (m) to BNC (f)	HP P/N 1250-1200
BNC Tee (m) (f) (f)	HP P/N 1250-0781
Cable (Semi-Rigid SMA male to SMA male)	HP P/N 08340-20124
10 dB Attenuator	HP 8493C Opt 010
Mixer	HP P/N 0955-0307
Low Pass Filter (LPF)	HP P/N 9135-0260

NOTE

It is important that the mixer be connected directly to the LO's RF Output connector. For best accuracy in this test, the local oscillator drive to the mixer should be $\geq$ 4 dBm.

1. Connect equipment as shown in Figure 4-16. Connect the mixer directly to the LO's RF output connector to obtain the maximum mixer LO input level. Connect the BNC tee directly to the DUT's PULSE IN connector. Allow a one hour warm up.

2. Set up the 8012B Pulse Generator as follows:

PULSE PERIOD slide switch	1μ — .1m
TRANSITION TIME slide switch	minimum (5n)
AMPLITUDE slide switch	top position (5.0)
PULSE DOUBLE/NORMAL	NORMAL
PULSE DELAY slide switch	minimum
Pulse Delay VERNIER	fully CCW
LEADING EDGE control	fully CCW
PULSE WIDTH slide switch	10n-1μ
TRAILING EDGE control	fully CCW
OFFSET	OFF
POLARITY	+
OUTPUT	NORMAL
INT LOAD	IN

3. Set both oscilloscope channels (A and B) for 50 Ohm input. Set the oscilloscope to view the pulse generator output waveform. Adjust the 8012B pulse width VERNIER for a 100 nanosecond pulse. Adjust the pulse period VERNIER for a 10 microsecond period. Adjust the amplitude VERNIER for about a 3V pulse amplitude (TTL level).

---

3 Usable only with HP 8341B DUT

4. Press **[INSTR PRESET]** on both the DUT and the LO. On the DUT, press **[CW] [1] [GHz] [POWER LEVEL] [−] [1] [0] [dBm]** On the LO, press **[CW] [.] [9] [5] [GHz]**. The IF frequency is then 50 MHz. Set the LO for +10 dBm or maximum leveled output.

5. Set the oscilloscope horizontal for 50 nanoseconds/division and select channel A input only. Adjust the channel A (IF carrier input signal) vertical sensitivity to view the entire RF envelope.

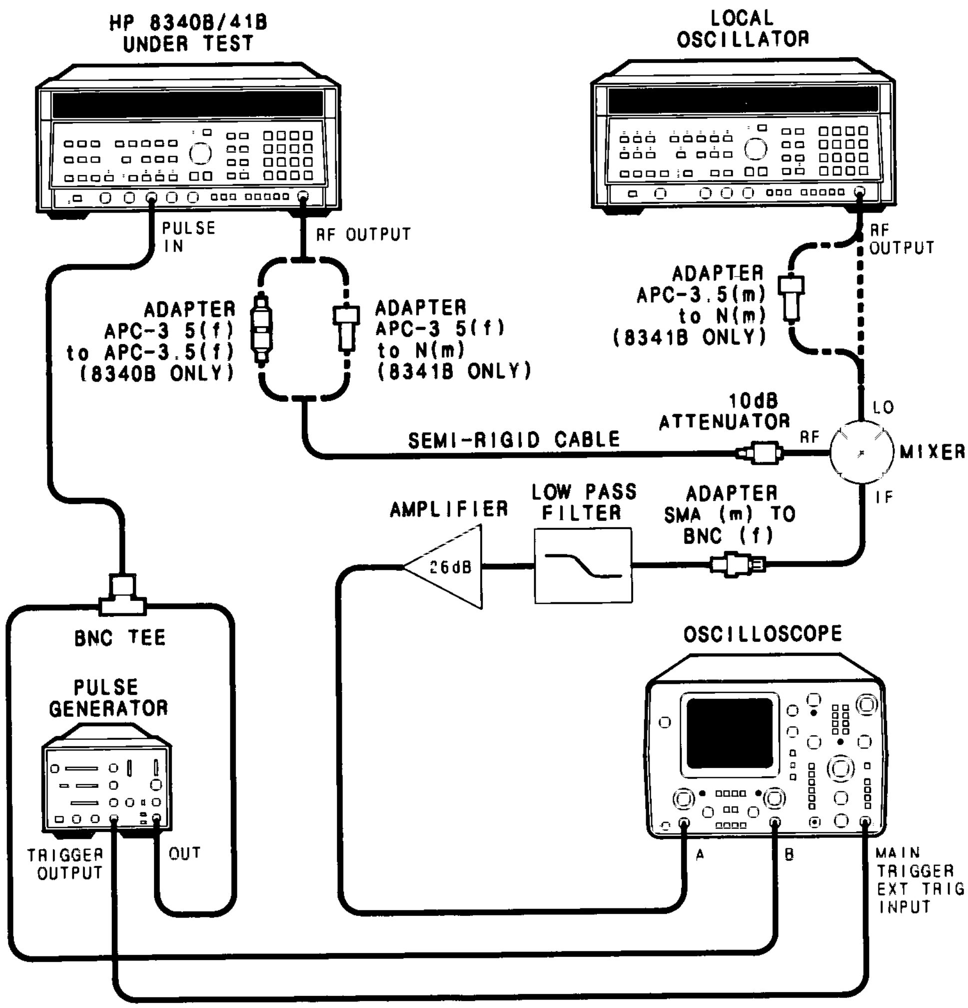


Figure 4-16. Pulse Modulation Accuracy Test

NOTE

It may be necessary to reduce the vertical sensitivity and/or adjust the DUT's RF output level at some frequencies.

4-13. PULSE MODULATION ACCURACY TEST (Cont'd)

6. Press the **[PULSE]** key on the DUT (pulse ON). Adjust the oscilloscope vertical position and sensitivity to place the modulation envelope on convenient horizontal graticule lines. Press the **[PULSE]** key to turn pulse OFF. Press the **[POWER LEVEL]** key on the DUT. Note the power level in the **ENTRY DISPLAY.**

7. Adjust the DUT's power level using the rotary knob so that the IF carrier signal aligns with the horizontal graticule lines established in step 6 for the modulation envelope. Note the **ENTRY DISPLAY** power level.

8. The difference between the power levels noted in step 6 and 7 should be less than the specification for this pulse width and RF frequency.

9. Repeat steps 5 through 8 for pulse widths of 200, 500, and 1000 nanoseconds.

10. To test the Pulse Repetition Frequency range (100 Hz to 5 MHz), set the pulse generator period to 10 milliseconds (100 Hz) and pulse width to 1 microsecond (duty cycle of 0.01%). Repeat steps 5 through 8. Set the pulse generator period to 200 nanoseconds (5 MHz) and pulse width to 100 nanoseconds (minimum specified PW). Repeat steps 5 through 8.

11. Set the pulse generator period to 10 microseconds and pulse width to 100 nanoseconds. Repeat steps 5 through 10 at CW frequencies of 3, 9, 15, and, if the DUT is an HP 8340B, 22 GHz. Set the LO's CW frequency to be 50 MHz below the DUT's frequency. For DUT frequencies of 15 and 22 GHz, press **[PEAK]** to ON.

4-14. PULSE MODULATION VIDEO FEEDTHROUGH TEST

NOTE

THIS TEST IS NOT APPLICABLE TO INSTRUMENTS EQUIPPED WITH OPTION 006, DELETE PULSE MODULATION

Specification

Table 4-27. Pulse Modulation Video Feedthrough Test Specification

For CW mode and frequencies only:
Video Feedthrough (V_F/V_P):
0.4 <2.3 GHz (Band 0): <5% for output power levels ≤+8 dBm
2.3 to 26.5 GHz (Bands 1-4)[1]: ≤0.2%

1. Band 4 (>20.0 to 26.5 GHz) only applies to the HP 8340B.

Description

NOTE

Video feedthrough is any component of the pulse generator signal that appears at the DUT's RF output connector.

The DUT is set to a CW frequency at 0 dBm and is pulsed using a pulse generator. The pulsed RF output signal is fed through a 10 dB attenuator and a low pass filter that will pass only the low frequency (video feedthrough) component of the modulation envelope. The video feedthrough is measured using an oscilloscope. The measured voltage is related to the RF power by:

$P = 10 \log (V^2/R/1\ mW)$

Where:

P = DUT RF output level minus 10 dB, and

R = 50 Ohms.

Equipment

Pulse Generator .... HP 8012B
Oscilloscope .... HP 1741A
Adapters
APC 3.5 (f) to APC 3.5 (f) .... HP/PN 5061-5311
(1 required if DUT is HP 8340B)
Type N (m) to APC 3.5 (f) .... HP P/N 1250-1744
(1 required if DUT is HP 8341B)
SMA (m) to BNC (f) .... HP P/N 1250-1200
BNC Tee (m) (f) (f) .... HP P/N 1250-0781
10 dB Attenuator .... HP 8493C Opt. 010
Low Pass Filter (LPF) .... HP P/N 9135-0260

Procedure

1. Connect equipment as shown in Figure 4-17. Attach the BNC tee directly to the DUT's PULSE input connector. Allow a one hour warm up time.

4-14. PULSE MODULATION VIDEO FEEDTHROUGH TEST (Cont'd)

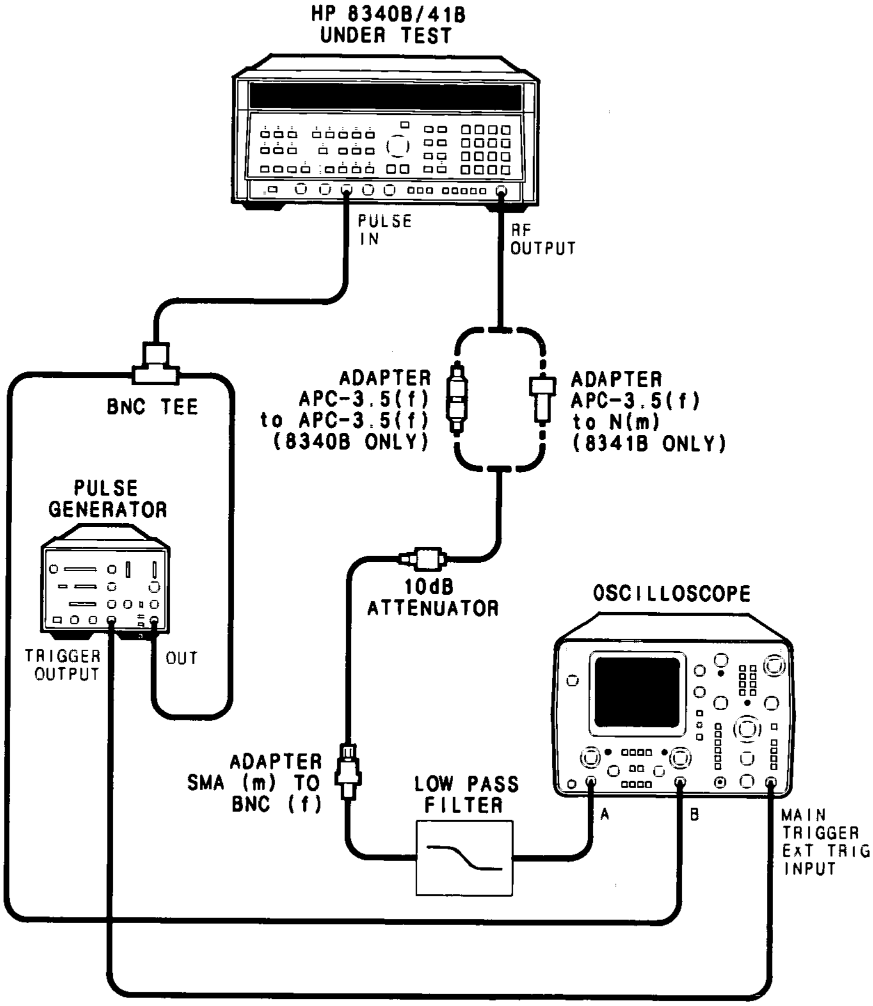


Figure 4-17. Pulse Modulation Video Feedthrough Test Setup

2. Set up the HP 8012B Pulse Generator at follows:

PULSE PERIOD slide switch	1µ — .1m
TRANSITION TIME slide switch	minimum (5n)
AMPLITUDE slide switch	top position (5.0)
PULSE DOUBLE/NORMAL	NORMAL
PULSE DELAY slide switch	minimum
Pulse Delay VERNIER fully	CCW
LEADING EDGE control	fully CCW
PULSE WIDTH slide switch	10n - 1µ
TRAILING EDGE control	fully CCW
OFFSET	OFF
POLARITY	+
OUTPUT	NORMAL
INT LOAD	IN

4-14. PULSE MODULATION VIDEO FEEDTHROUGH TEST (Cont'd)

3. Set both oscilloscope channels (A and B) to 50 Ohm input. Set the oscilloscope to view the pulse generator output waveform Adjust the HP 8012B pulse width VERNIER for a 100 nanosecond pulse Adjust the pulse period VERNIER for a 100 microsecond period. Adjust the amplitude VERNIER for about a 3V pulse amplitude (TTL level) Set the oscilloscope horizontal sweep to 50 nanoseconds/division and select channel A input only.

4. On the DUT, press **[INSTR PRESET]** followed by **[CW] [.] [4] [GHz]**. Press the **[PULSE]** key (pulse ON)

5. Press the **[POWER LEVEL]** key and enter the first power level, **[8] [dBm]**.

6. Adjust the oscilloscope channel A vertical sensitivity and vertical position to view the video feedthrough signal similar to Figure 4-18.

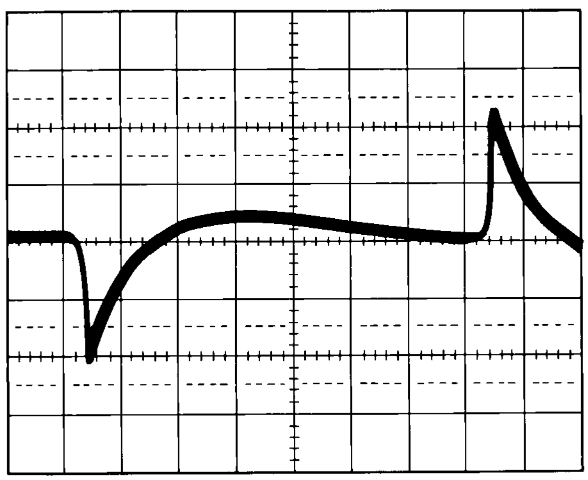


Figure 4-18. Pulse Modulation Video Feedthrough Waveform

7 The test limits for the three power levels are shown in Table 4-28. (Note that the test limit is 5% of Vpk.)

Table 4-28. Pulse Modulation Video Feedthrough Test Limits

HP 8340B/41B RF Output Level (dBm)	P = (dBm)	Vpk	TEST LIMIT (pk voltage)
+8	−2	0.2511	12 mV
0	−10	0.0999	5 mV
−10	−20	0.03162	1.6 mV

The test limits are derived using the following equation:

$P = 10 \log (Vrms^2/R/1\ mW)$

Where:

P = DUT RF output level −10 dBm, and,

R = 50 Ohms.

Example:

For a DUT set to 0 dBm, the output of the 10 dB pad is −10 dBm.

$P = 10 \log (Vrms^2/R/1\ mW)$

$-10 = 10 \log (V^2/50/0.001)$ (divide through by 10)

$-1 = \log (V^2/50/0.001)$ take antilog of both sides

$10^{-1} = 0.1 = (V^2/50/0.001)$ (cross multiply)

$0.0001 = V^2/50$ (cross multiply again)

$\sqrt{0.005} = V = 0.0707$ rms

Test Limit = Vpk × 5% = 0.0707 × 1.414 × 5% = 5 mV

8. Repeat steps 6 and 7 for DUT output power levels of 0 and −10 dBm.

9. Repeat steps 5 through 8 at CW frequencies of 1, 1.5, and 2 GHz.

NOTE

For DUT frequencies above 2.3 GHz the video feedthrough is typically so small that it is difficult to measure. The following steps provide a means to verify that the video feedthrough is negligible.

10. Remove the 10 dB pad between the DUT and the low pass filter. Press the **[CW]** key and enter any frequency from >2.3 GHz to the DUT's maximum frequency. Press the **[POWER LEVEL]** key and enter **[−] [1] [0] [dBm]**.

11. Select the oscilloscope X5 vertical magnifier. The test limit is now 0.2 mV or 1 minor division on the oscilloscope.

12. Select several CW frequencies >2.3 GHz. and verify that the video feedthrough is less than 1 minor division on the oscilloscope.

4-15. AMPLITUDE MODULATION TEST

Specification

Table 4-29. Amplitude Modulation Test Specifications

The following specifications apply when the HP 8340B/41B are internally leveled, for waveforms whose envelope peak is at least 1 dB below maximum specified power. Unless noted, pulse modulation must be OFF, however, the HP 8340B/41B are capable of simultaneous amplitude and pulse modulation. See Section III, Operation.
AM Depth: 0 to 90%
AM Sensitivity at 1 kHz rate and 30% depth: 100%/Volt ± 5%
AM Bandwidth relative to a 1 kHz rate at 30% depth, DC coupled, 3 dB point ≥ 100 kHz
AM Frequency Response (Flatness) Relative to a 1 kHz rate at 30% depth, DC to 10 kHz: ±0.20 dB

Description

AM sensitivity and accuracy is determined by simulating a modulation signal (i.e., setting the function generator to a dc voltage). The unmodulated DUT RF output is measured using a power meter. A dc voltage representing ±30% modulation (±0.3 Vdc) is applied to the DUT's AM input. The power meter indication should change by:

20 log (1 + (dc voltage ± (0.05 times the dc voltage)))

The sensitivity and accuracy is tested at several CW frequencies.

The AM frequency response and bandwidth is measured by down converting the DUT's RF frequency to an IF frequency within the range of the modulation analyzer. The DUT is amplitude modulated using a function generator. The modulation analyzer is set to indicate 0 dB at the reference modulation frequency of 1 kHz. The modulation frequency is varied and the flatness is indicated on the modulation analyzer. The modulating frequency is then set to the bandwidth specification (100 kHz) and the modulation analyzer should indicate > −3 dB. This shows that the actual 3 dB point will occur at a frequency >100 kHz.

Finally, the function generator output level is increased to obtain >90% modulation depth.

Equipment

Local Oscillator	HP 8340A Opt 001 or any HP 8341A/B[1]
Modulation Analyzer	HP 8901A
Function Generator	HP 3325A
Digital Voltmeter	HP 3455A
Amplifier	HP 8447F
Power Meter	HP 436A
Power Sensor	HP 8485A

1 Usable only with HP 8341B DUT.

4-15. AMPLITUDE MODULATION TEST (Cont'd)

Equipment, Cont'd

Adapters	
APC 3.5 (f) to APC 3.5 (f) (1 required if DUT is HP 8340B)	HP P/N 5061-5311
Type N (m) to APC 3.5 (f) (1 required if DUT is HP HP 8341B)	HP P/N 1250-1744
Type N (m) to APC 3.5 (m) (1 required if LO is HP 8341A/B)	HP P/N 1250-1743
Type N (m) to BNC (f)	HP P/N 1250-1476
SMA (m) to BNC (f)	HP P/N 1250-1200
BNC Tee (m) (f) (f)	HP P/N 1250-0781
Cable (Semi-Rigid SMA male to SMA male)	HP P/N 08340-20124
20 dB Attenuator	HP 8493C Opt. 020
Mixer	HP P/N 0955-0307

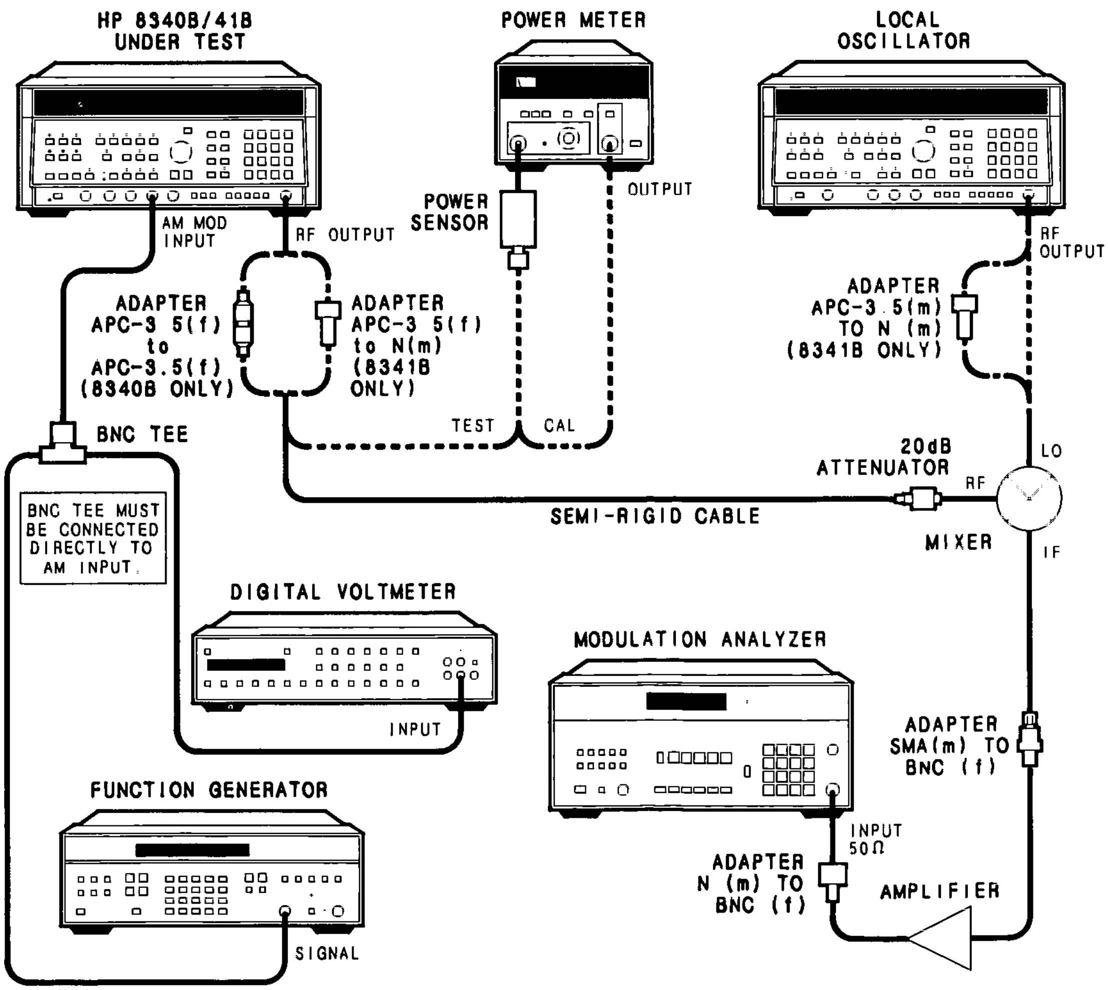


Figure 4-19. Amplitude Modulation Test Setup

NOTE

It is important that the mixer be connected directly to the LO's RF Output connector.

Procedure

AM SENSITIVITY AND ACCURACY

1. Connect equipment as shown in Figure 4-19 Connect the mixer LO port at the LO's RF output Connect the Power Sensor to the power meter. Allow a one hour warm up time. Set the power meter's calibration factor switch to include 1.5 GHz, then zero and calibrate the power meter. Connect the power sensor to the DUT's RF output.

2. On the DUT, press **[INSTR PRESET] [CW] [1] [.] [5] [GHz]** Press the **[POWER LEVEL]** key and enter **[−] [5] [dBm]**.

NOTE

The function generator output impedance is 50 Ohms and its output indication accuracy assumes a 50 Ohm load. The DUT's AM input impedance is 600 Ohms; therefore, a high impedance DVM is used to measure and set the function generator output level.

3. Zero the power meter as follows:

   With power applied to the sensor, press the power meter RANGE HOLD. Press the DUT's **[RF]** key to turn the RF OFF. Zero the power meter. Press the **[RF]** key to turn the RF ON.

4. Using the DVM as an indicator, set the function generator to output 0 Vdc (If the function generator being used does not have this feature, use a dc power supply) Press the DUT's **[AM]** key (AM ON) Note the power meter indication

5. Simulate +30% modulation by setting the function generator output to +0.3 volts dc as indicated on the DVM. The power meter indication should increase by 2.18 to 2.38 dB from the value noted in step 4.

   20 log (1 + (0.3 − (0.05 times 0.3))) = 2.18 dB

   to

   20 log (1 + (0 3 + (0.05 times 0 3))) = 2 38 dB

6. Simulate −30% modulation by setting the function generator output to −0.3 volts dc as indicated on the DVM. The power meter should decrease by 2.91 to 3.29 dB from the value noted in step 4

   20 log (1 + (−0.3 − (0.05 times −0.3))) = −2.91 dB

   to

   20 log (1 + (−0 3 + (0 05 times −0.3))) = −3 29 dB

NOTE

The DUT's test power levels are selected to avoid power meter range changes at the +30 and −30% modulation settings.

7. Press the DUT's **[POWER LEVEL]** key and enter **[+] [5] [dBm]**. Press the **[AM]** key to turn AM OFF. Repeat steps 3 through 6 for this power setting.

8. Press the DUT's **[CW]** key and enter **[4] [.] [5] [GHz]**. Press the **[AM]** key to turn AM OFF. Set the power meter's calibration factor switch to include 4.5 GHz. Repeat steps 3 through 6 for DUT power settings of −5 and +5 dBm.

AM FREQUENCY RESPONSE AND BANDWIDTH

9. Disconnect the power sensor and connect the DUT's RF output to the 20 dB attenuator.

10. On the DUT, press **[CW] [1] [.] [5] [GHz], [POWER LEVEL] [0] [dBm]**. On the LO, press [INSTR PRESET] [CW] [1] [.] [4] [5] [GHz], [POWER LEVEL] [1] [0] [dBm]. Press PEAK (ON). (The output may be unleveled, this will not affect the test.) The IF frequency is now 50 MHz.

NOTE

For best accuracy in the Amplitude Modulation test, the Local Oscillator drive to the mixer should be > +4 dBm.

11. Set the function generator for a sine wave at a reference frequency of 1 kHz at 0 2121 Vrms (0 3 times 0.707) ±0.05 Vrms. For example: 0.25 Vrms, as indicated on the DVM, would fall in this range. Set the modulation analyzer input frequency to 50 MHz (by pressing FREQ 50 MHz), then press AM and AVE. The modulation analyzer should indicate about 21%. Note the DVM indication.

12. Press the dB key. As the modulating frequency is changed, the modulation analyzer will indicate the flatness in dB relative to the 1 kHz reference

13. Set the function generator to 100, 200, 500 Hz, then 1, 2, 5, and 10 kHz. Check the DVM indication and adjust the level of the modulating signal at each frequency to eliminate any flatness error of the function generator Observe the flatness indication on the modulation analyzer. The flatness indication should be ≤ ±0 20 dB

14. Check the AM bandwidth by setting the function generator to 100 kHz. Adjust the function generator output level to the value noted in step 11. The modulation analyzer should indicate ≥ −3 dB.

AM DEPTH

15. Set the function generator to 1 kHz Set the modulation analyzer to indicate percent modulation by setting the controls as follows:

AUTOMATIC OPERATION	ON
AM	ON
RATIO %	OFF
RATIO dB	OFF
PEAK	+

Increase the function generator output amplitude to obtain >90% modulation depth.

16. Repeat steps 11 through 15 at DUT RF frequencies of 3, 9, 15, and, if the DUT is an HP 8340B, 22 GHz. Make sure LO CW frequency is always 50 MHz below the DUT frequency.

4-16. FM ACCURACY AND FLATNESS

Specification

Table 4-30. Frequency Modulation Specifications

FREQUENCY MODULATION

Modulation Rate: 50 kHz to 10 MHz (3 dB Bandwidth)

Peak Deviation:

Bands 0,1:	The lesser of 10 MHz or 5 x modulation rate
Band 2:	The lesser of 10 MHz or 10 x modulation rate
Band 3:	The lesser of 10 MHz or 15 x modulation rate
Band 4[1]:	The lesser of 10 MHz or 20 x modulation rate

Deviation Accuracy (at 100 kHz rate): ±10%

Sensitivity: 1 MHz/V and 10 MHz/V

1. Band 4 only applies to the HP 8340B.

FM Accuracy Description

FM Accuracy is measured by observing the modulated RF carrier on a spectrum analyzer. When the modulation index (Peak Deviation divided by Modulation Rate) is set to exactly 2.404, the power in the carrier will be at zero. This is called a Bessel Null.

Once the carrier has been nulled, the Peak Deviation is known precisely since the Modulation Rate is synthesized. Since the Peak Deviation is known, the FM input voltage can be measured to calculate the FM input sensitivity (1 or 10 MHz/V nominally). The error from nominal is expressed as a percent and is the FM accuracy. This is measured at a 100 kHz rate.

Equipment

Spectrum Analyzer .... HP 8566B
Digital Voltmeter .... HP 3456A
Function Generator .... HP 3325A
Adapters:
  APC 3.5(f) to TYPE N(m) .... HP P/N 1250-1744
    (1 required if DUT is HP 8340B) (2 required if DUT is HP 8341B)
  APC 3.5 (f) to APC 3.5 (f) .... HP P/N 5061-5311
    (1 required if DUT is HP 8340B)
  BNC(f) to dual banana .... HP P/N 1251-2277
  BNC Tee (m) (f) (f) .... HP P/N 1250-0781
Cables:
  Semi-Rigid, (SMA male to SMA male) .... HP P/N 08340-20124
  BNC (m) to BNC (m) (2 required) .... HP P/N 8120-8140

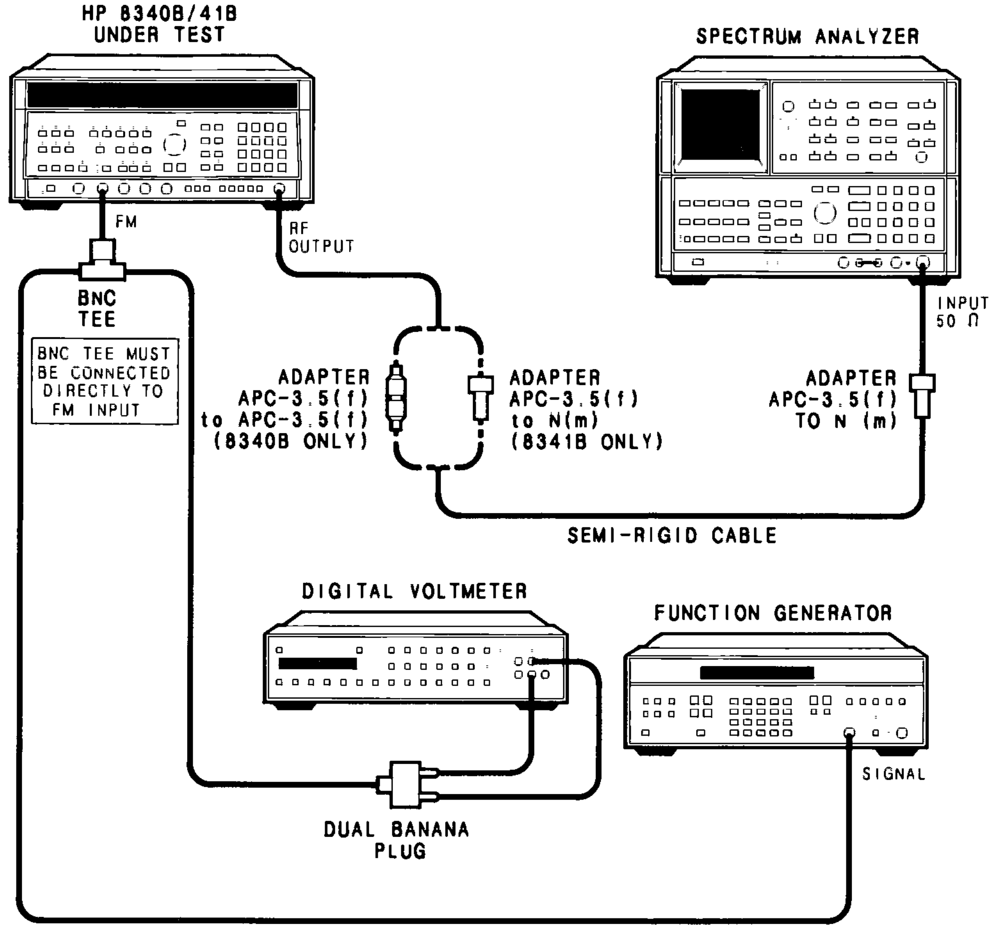


Figure 4-20. FM Accuracy Setup

Procedure

1. Connect the equipment as shown in Figure 4-20, FM Accuracy Setup. The BNC Tee should be connected directly to the DUT's FM input BNC.

2 Set the function generator to a 100 kHz sine wave. Set the DVM to ac volts.

3. Press **[INSTR PRESET]** on the DUT and set up the following conditions.

Sweep Mode:	CW
Frequency out.	2.2 GHz
Leveling:	INT
RF Output:	0 dBm
RF Peaking (PEAK):	ON
FM	ON
FM Sensitivity:	1 MHz/V (default condition)

4. On the function generator, press AMPTD 450 mV (p-p). Then press the **LEFT ARROW** key until the first digit on the left side of the decimal point is flashing

5. Set the spectrum analyzer's center frequency to that of the DUT. Choose a frequency span of 2 MHz. Observe the carrier on the display of the spectrum analyzer while performing step 6.

6. Press the function generator's **UP ARROW** or **DOWN ARROW** keys until the carrier is nulled (minimum amplitude). The function generator's **LEFT ARROW** and **RIGHT ARROW** keys will change the resolution of the **UP ARROW** and **DOWN ARROW** keys for a finer or coarser amplitude adjustment.

7. Measure the rms amplitude of the FM input with the DVM Note this value on the test record card as V_{in}.

   Calculate the actual FM sensitivity and then the percent error Actual deviation is equal to 2.404 times 100 kHz (since the modulation index is at the first Bessel Null) The actual FM sensitivity is then:

   Actual FM Sensitivity = (.2404)/(V_{in} x 1.414)

   % Error = 100 x (Actual FM Sensitivity − Range)/Range
   Where "Range" = 1 (for 1 MHz/V), or 10 (for 10 MHz/V)

8. Set the function generator's amplitude to 45 mV p-p. Press the DUT's the **UP ARROW** key to select an FM sensitivity of 10 MHz/V. Repeat steps 6 and 7.

9. Repeat steps 4 through 8 at CW frequencies of 2.5, 6.9, 13.4, 18 and 20 GHz (20 GHz applies to the 8340B only). After entering a new CW frequency, press the FM key twice to display the FM sensitivity in the DUT's ENTRY DISPLAY and then press the DUT's **DOWN ARROW** key to select an FM sensitivity of 1 MHz/V.

FM Flatness Description

The FM Flatness test uses a delay line discriminator. The discriminator is formed by driving a mixer with a modulated carrier into the LO port, and a delayed carrier into the RF port. The delay is produced with a 3 foot length of cable (the length does not have to be precise). When connected like this, the mixer responds to phase differences between its two inputs. The cable exhibits a constant time delay. As the carrier frequency changes, the cable causes a phase shift at the mixer inputs. This phase shift varies linearly with frequency. The mixer only operates as a phase detector when its inputs are 90° out of phase relative to one another (quadrature). A carrier frequency must chosen such that the cable delay causes a phase shift of 90° (this will be explained in the procedure).

The output of the discriminator is fed to the 50 Ohm input of an HP 3585A spectrum analyzer. By using the tracking generator output to drive the FM input of the DUT, a swept response of FM Flatness will be seen on the spectrum analyzer CRT. The response relative to 100 kHz is verified against the specification.

This test also checks control circuitry on the A23 FM Driver assembly. (That is why FM is checked in bands other than the fundamental band of the YIG oscillator).

Equipment

Spectrum Analyzer . . . . HP 3585A
Mixer . . . . HP P/N 0955-0307
Power Amplifier . . . . HP 8447F
Power Splitter . . . . HP 11667B
Step Attenuator . . . . HP 355D
Delay Line . . . . HP P/N 08503-20038
(> 1 meter in length)
Adapters:
APC 3.5 (m) to APC 3.5 (m) . . . . HP P/N 1250-1748
SMA (m) to BNC (f) . . . . HP P/N 1250-1200
Cables:
Semi-Rigid, SMA (m) to SMA (m) . . . . HP P/N 08340-20124
BNC (m) to BNC (m) . . . . HP P/N 8120-8140
(4 required)

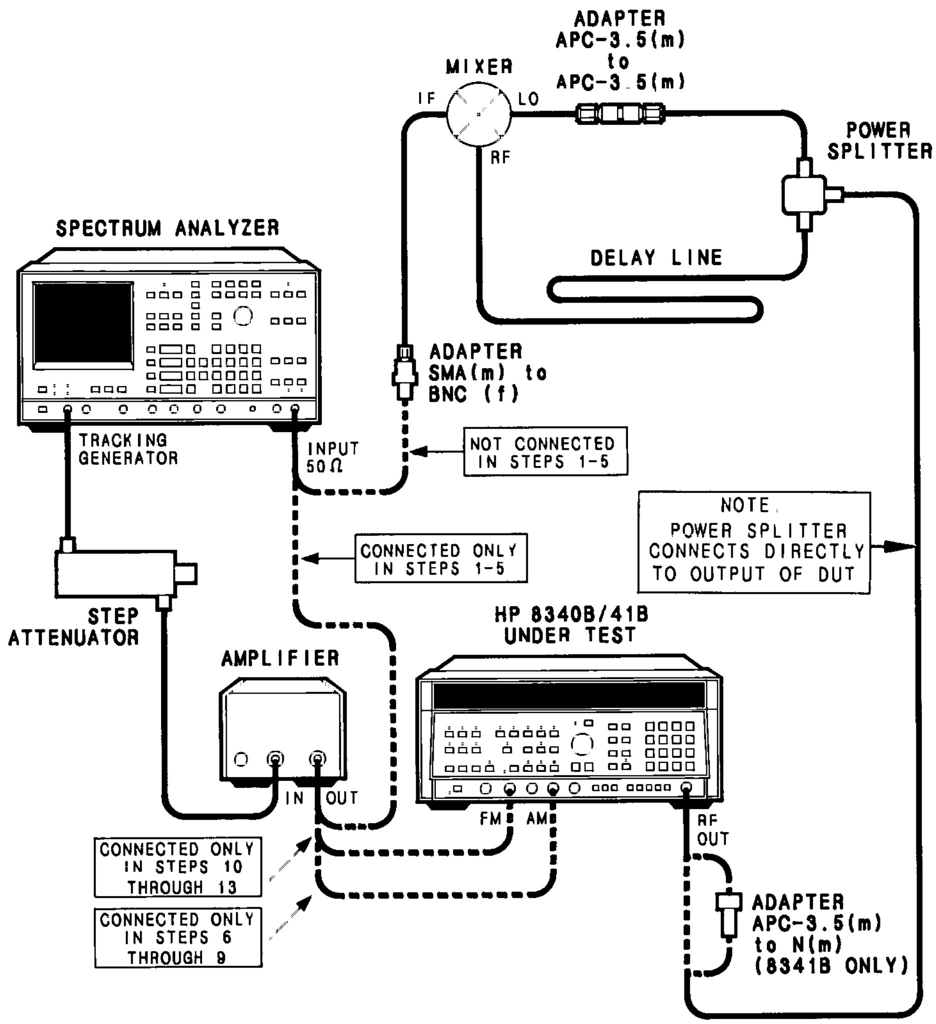


Figure 4-21. FM Flatness Setup

Procedure

1. Refer to Figure 4-21, FM Flatness Setup. Connect the test equipment as shown. Connect the output of the HP 8447F to the 50 Ohm input of the HP 3585A. The HP 3585A should not be connected to the mixer at this time.

2. Press **[INSTR PRESET]** on the DUT and set up as follows:

Sweep Mode:	CW
Frequency:	2.2 GHz
PEAK	ON
Leveling:	INT
Power Out:	+6 dBm

Set the HP 355D step attenuator to 30 dB.

3. Press **[INSTR PRESET]** on the HP 3585A and set up as follows:

Start Frequency:	50 kHz
Stop Frequency:	10 MHz
Resolution BW.	10 kHz (default condition)
Video BW.	1 kHz

Turn the HP 3585A's TRACKING GENERATOR knob fully clockwise.

NOTE

Steps 4 and 5 normalize the frequency response variations due to the HP 3585A's tracking generator, HP 355D step attenuator, HP 8447F amplifier, and cables.

4. Set up the HP 3585A as follows:

NOTE

In the following text, the operator is instructed to press the REF LVL key. This key is actually marked **REF LVL**. Do not press the **REFERENCE LEVEL**, **REF LEVEL VOLT**, or **MKR→REF LVL** keys.

Press **[MANUAL] [1] [MHz] [dB/DIV] [2] [dB].**
Press **[REF LVL].** The **[REF LVL]** key is to the left of the rotary knob, in the MARKER/CONTINUOUS ENTRY section of the front panel
Press **[CLEAR A]** and turn the rotary knob until the marker is 5 divisions up from the bottom horizontal graticule.

Make sure the OVER RANGE message does not come on **Turn off the Autorange function.** Adjust the **RANGE** if the OVER RANGE message comes on

5. Press **[CONT]** sweep to take a swept response of the signal path. When a full sweep is completed, press **[STORE A→B]** and **[A-B]**. Turn **VIEW B** OFF.

A strait line should be displayed across the center of the HP 3585A CRT.

Press **[SAVE] [1]** on the HP 3585A.

NOTE

Steps 6 through 9 find the DUT output frequency that places the mixer inputs in quadrature (90° out of phase).

6. Press **[RECALL] [1]** on the HP 3585A. Make sure the DUT is set to the desired CW frequency. Move the output of the HP 8447F to the DUT's AM input. Connect the output of the mixer to the HP 3585A 50 Ohm input

7. AM is used to find a quadrature frequency that is close to the desired FM flatness test frequency. This is done because at quadrature, AM is rejected and FM response is maximized.

On the DUT, turn **AM** ON. Make sure **FM** is turned OFF.

8. Set up the HP 3585A as follows:

Turn **A-B** OFF. Press **[dB/DIV] [1] [0] [dB] [MANUAL] [1] [0] [0] [kHz]** Press **[CLEAR A]**.

4-16. FM ACCURACY AND FLATNESS (Cont'd)

9. Press **[SHIFT] [CW]** on the DUT. Note the CW frequency shown in the **ENTRY DISPLAY**. This activates the fine tuning feature on the DUT. The CW frequency will be displayed in the DUT's **ENTRY DISPLAY** Take note of the flashing cursor in the **ENTRY DISPLAY**. Press the STEP UP or STEP DOWN keys to place the flashing cursor just to the left of the decimal point. Turn the DUT's rotary knob (changing the CW frequency) until the marker on the HP 3585A's CRT dips. (It is normal for a spurious signal to be displayed below the actual marker Keep turning the DUT's knob until the **marker** dips.)

   Press the STEP UP key twice. Turn the DUT's rotary knob until the marker on the HP 3585A reaches minimum amplitude. This should be possible every 75 MHz or so due to the length of the delay line.

NOTE

> **Step 15 will instruct the operator to set the DUT's FM sensitivity to 10 MHz/V when performing step 10. If the HP 355D step attenuator has not been set to 50 dB, the DUT's OVERMOD light will come on.**

10. Move the output of the HP 8447F to the DUT's FM input. Turn **FM** ON and **AM** OFF Verify that the DUT's FM sensitivity is set to 1 MHz/V (default condition).

11. Set the HP 3585A to 2 dB/DIV and turn **A-B** back ON. Press **[CLEAR A]**. Press **[REF LVL]** and turn the HP 3585A's rotary knob (usually counter-clockwise) until the marker is on the center horizontal graticule. **If the OVER RANGE beep and message occur, turn the rotary knob in the opposite direction.** Don't be concerned if the marker does not move at first, it may take several complete turns of the rotary knob before any change is noticed on the CRT

12. Press **[CONT]** sweep on the HP 3585A. **The spectrum analyzer will now display the FM flatness from 50 kHz to 10 MHz.**

    The HP 3585A's marker offset feature can be used to display a digital readout of the signal power level. The readout will be expressed relative to the power level at 100 kHz. To activate this feature, press the following keys on the HP 3585A.

    [MANUAL] [1] [0] [0] [kHz] [OFFSET] [ENTER OFFSET] [MARKER]

    The power level at any chosen frequency between 50 kHz and 10 MHz (relative to the 100 kHz power level) will be displayed in the upper right hand corner of the CRT. Turn the HP 3585A's rotary knob to change the measurement frequency.

13. Determine the maximum and minimum deviation points from the 100 kHz reference The difference between these points should be $\leq$3 dB. Record the worst case power level on the Test Record Card.

14. Repeat Steps 6 through 13 for frequencies of 2 5, 6 9, 13 4, and 18 GHz. If testing an HP 8341B, proceed to step 15.

    If testing an HP 8340B, also perform the following. Press **[CW] [2] [0] [GHz].** Repeat steps 6 through 13

15. Repeat Steps 6 through 14 with the HP 355D step attenuator set to 50 dB. When repeating step 10, set the FM sensitivity to 10 MHz/V, not 1 MHz/V.

4-17. HP 8340B/41B HP-IB OPERATION VERIFICATION TEST

NOTE

This HP-IB test is an automated test; a Desktop Computer is required.

Two software listings are supplied. Table 4-32 gives a BASIC program listing for the HP 85F; Table 4-33 gives a BASIC program listing for the HP 9826A (HP 226) or 9836A (HP 236). The test procedure applies to either test program used.

Description

The test program given in Table 4-32 is written to verify the HP 8340B/41B HP-IB interface by writing to and reading from the instrument. The program also displays the DUT's status bytes similar to the format shown in Table 4-31, HP 8340B/41B Status Byte Descriptions. Upon running the program the status bits displayed will change initially as the program outputs an IP (INSTR PRESET), S2 (Single sweep), and two TS (Take Sweep) commands. After about two passes through the output loop (program lines 120 to 300 for the HP 85F, program lines 130 to 350 for the HP 9826A/9836A), the status bits should all be zeros and the DUT should be in LOCAL mode. The procedure instructs the operator to press specific HP 8340B/41B front panel keys and perform certain functions which should set specific bits of the status bytes. This procedure will test most of the bits in the two status bytes. However, if the instrument is working properly, the status bit for the Fault Indicator On, the Oven Cold, and the Self Test Failed will not be tested for the set state. By pressing a controller soft key, the program will test the data bits by outputting a series of binary numbers to the DUT and reading back each number that it outputs. If a bit is held HIGH or LOW, the number read will not agree with the number written and the program will display an error message. This procedure does not test all of the HP-IB control lines.

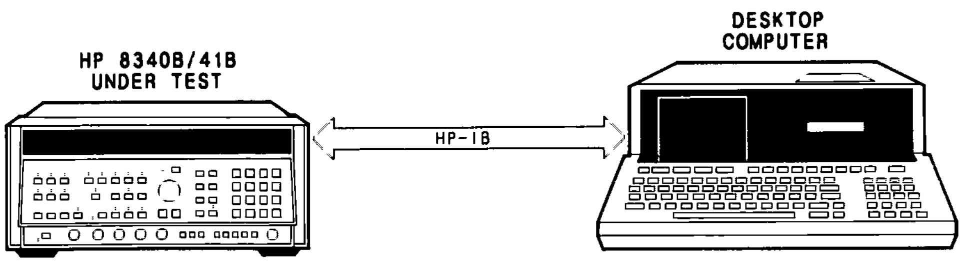


Figure 4-22. HP 8340B/41B HP-IB Operation and Verification Test Setup

Equipment

Desktop Computer .... HP 85F
(Includes HP 82937A HP-IB Interface and
I/O ROM HP P/N 00085-15002 and
HP 82936 ROM Drawer)
Plotter/Printer ROM .... HP P/N 00085-15002

or

Desktop Computer .... HP 9826A(HP 226)/9836A(HP 236)
(With BASIC language and 512K byte memory)

Procedure

1 Connect the equipment as shown in Figure 4-22. Enter the program shown in Table 4-32 if the HP 85F is used, or the program in Table 4-33 if the HP 9826A or 9836A is used. Press the RUN key. The program will display the DUT's status bytes similar to Table 4-31. After the program goes through the output loop routine about two times, all status bits should be "0" and the DUT should be in LOCAL mode (front panel REMOTE indicator not ON).

2 Press the DUT's **[INSTR PRESET]** key. After going through the output loop about three times, status byte 1 decimal value should be 24 (bits 4 and 3 set).

NOTE

After pressing an HP 8340B/41B front panel key, watch the displayed decimal value. When the decimal value changes, press the controller PAUSE key. Note the status bits that are set and press CONT.

3. Press the DUT's **[CW]** key. After the program goes through the output loop about three times all status bits should be "0"; however, status byte 1, bit 1, should have been set during one of the output loop passes Enter **[1] [5] [GHz]** and the byte 1 status bits will change, but after about 2 passes all status bits should be "0"

5. Switch the DUT's rear panel FREQUENCY REFERENCE switch to EXT. Status byte 2 value should be 24 (bits 4 and 3 set). Return the switch to INT.

6. Press the controller softkey K1 (SYNTAX).

NOTE

There will be about a 6 second delay before the status bits change.

The program will output the character string "XYZ" to the DUT. The DUT should not recognize this string and should set status byte 1, bit 5 (SRQ on HP-IB Syntax Error).

7. Press the controller softkey K4 (DATA BIT). The program will test all data bits and display an error message if any bits fail the test, or if all bits pass the test, the program will display "ALL DATA BITS WORKING."

Table 4-31. HP 8340B/41B Status Byte Description

STATUS BYTE (#1)								
BIT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DECIMAL VALUE	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
FUNCTION	SRQ on New frequencies or Sweep Time in Effect	REQUEST SERVICE (RQS)	SRQ on HP-IB Syntax Error	SRQ on End of Sweep	SRQ on RF Settled	SRQ on Changed in Extended Status Byte	SRQ on Numeric Entry Completed (HP-IB or Front Panel)	SRQ on Any Front Panel Key Pressed
EXTENDED STATUS BYTE (#2)								
BIT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DECIMAL VALUE	**128**	**64** (L)	**32** (L)	**16** (L)	**8**	**4**	**2**	**1** (L)
FUNCTION	Fault Indicator On	RF Unleveled	Power Failure	RF Unlocked	External Freq Ref Selected	Oven Cold	Over Mod-ulation	Self Test Failed
(L) See Note 3								

```
10    ! HP 8340B/41B HP-IB OPERATION VERIFICATION
20    !    VERIFICATION TEST
30    !
40    !        15 MARCH 86
50    !
60    I1=719
70    OUTPUT I1 ;"IP S2 TSTS"
80    !
90    ON KEY# 1,"SYNTAX" GOSUB 370
100   ON KEY# 4,DATA BIT GOSUB 400
110   LOCAL 7
120   OUTPUT I1 ;"OS"
130   DISP "HP 8340B/41B STATUS BYTE 1 AND 2"
140   DISP
150   DISP "BYTE_______BIT____________"
160   DISP "# 7 6 5 4 3 2 1 0 VALUE"
170   DISP "_________________________________"
180   DISP
190   ENTER I1 USING "#,B" ; E,F
200   FOR I=1 TO 2
210   DISP I;
220   IF I=1 THEN N=E
230   IF I=2 THEN N=F
240   FOR J=7 TO 0 STEP -1
250   A=BIT(N,J)
260   DISP A;
270   NEXT J
280   DISP N
290   DISP
300   NEXT I
310   DISP USING "4/,A" ; " "
320   KEY LABEL
330   GOTO 120
340   !
350   !  Syntax Test
360   !
370   OUTPUT I1 ; "XYZ"
380   RETURN
390   !
400   !  Test Data Bits
410   !
420   CLEAR
430   DSP USNG "/,K" ; "TEST DATA BITS"
440   FOR C=0 TO 7
450   B=2^C
460   OUTPUT I1 USING "K,B" , "TI",B
470   WAIT 100
480   ENTER I1 USING "#,B" , D
490   IFB#D THEN DISP "  DATA BIT";C;"NOT WORKING"
500   NEXT C
510   DISP "ALL DATA BITS WORKING"
520   DISP "PRESS CONT"
530   PAUSE
540   RETURN
550   END
```

Table 4-33. HP 8340B/41B HP-IB Operation Verification Programming Listing (For Use with HP 9826A/36A)

```
10    ! HP 8340B/41B HP-IB OPERATION
20    !    VERIFICATION TEST
30    !
40            15 MARCH 86
50    !
60    I1=719
70    OUTPUT I1;"IP S2 TSTS"
80    !
90    OFF KEY
100   ON KEY 1 LABEL "SYNTAX" GOTO Syntax
110   ON KEY 4 LABEL "DATA BIT" GOTO Data__bit
120   LOCAL 7
130   OUTPUT 1; CHR$(12);
140   !
150 Read__status: !
160   OUTPUT I1;"OS"
170   !
180   PRINT TABXY(1,1);"HP 8340B/41B STATUS BYTE 1 AND 2"
190   PRINT
200   PRINT "BYTE_______BIT____________"
210   PRINT "# 7 6 5 4 3 2 1 0 VALUE"
220   PRINT "________________________________"
230   PRINT
240   ENTER I1 USING "#,B";E,F
250   FOR I=1 TO 2
260     PRINT I;
270     IF I=1 THEN N=E
280     IF I=2 THEN N=F
290     FOR J=7 TO 0 STEP -1
300       A=BIT(N,J)
310       PRINT A;
320     NEXT J
330     PRINT USING "X,5D";N
340     PRINT
350   NEXT I
360   BEEP 200,.01
370   GOTO Read__status
380   !
390 Syntax: !
400   !
410   OUTPUT I1;"XYZ"
420   GOTO Read__status
430   !
440 Data__bit:!
450   !
460   OUTPUT 1;CHR$(12); ! Clear screen
470   DISP USING "/,K";     TEST DATA BITS"
480   FOR C=0 TO 7
490     B=2^C
500     OUTPUT I1 USING "K,B";"TI",B
510     WAIT .1
520   ENTER I1 USING "#,B";D
530     IFB-D<1 THEN GOTO 550
540   IF B<>D THEN DISP "  DATA BIT  ";C;;NOT WORKING"
550   NEXT C
560   !
570   PRINT "ALL DATA BITS WORKING"
580   DISP "PRESS CONTINUE"
590   PAUSE
600   DISP
610   GOTO Read__status
620   END
```

Hewlett-Packard Model 8340B/41B Synthesized Sweepers

Date: ____________

Model Number: ________

Serial Number: ________

Tested By: ____________

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-1. **Internal Time Base Aging Rate**					
T_1 = Time for 360 degree phase change	3			___ seconds	
T_2 = Time between T_1 and T_3	4			____ hours	
T_3 = Time for 360 degree phase change				___ seconds	
Calculated Aging Rate	5			___ per day	

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-2. Frequency Range and CW Mode Accuracy					
Frequency Range Check					
10 MHz	2	Freq. ±1 Hz ± Counter Resolution		_______ MHz	
20.0 GHz (HP 8341B)	3	Freq ±3 Hz ± Counter Resolution		_______ GHz	
26.5 GHz (HP 8340B)	3	Freq ±4 Hz ± Counter Resolution		_______ GHz	
M/N Divider Check	4b				
(M Divider)		Freq. ±1 Hz ± Counter Resolution			
M = 8 N = 13		2490 MHz		_______ MHz	
9		2480 MHz		_______ MHz	
10		2470 MHz		_______ MHz	
11		2460 MHz		_______ MHz	
12		2450 MHz		_______ MHz	
13		2440 MHz		_______ MHz	
14		2430 MHz		_______ MHz	
15		2420 MHz		_______ MHz	
16		2410 MHz		_______ MHz	
17		2400 MHz		_______ MHz	
18		2390 MHz		_______ MHz	
19		2380 MHz		_______ MHz	
20		2370 MHz		_______ MHz	
21		2360 MHz		_______ MHz	
22		2350 MHz		_______ MHz	
23		2340 MHz		_______ MHz	
24		2330 MHz		_______ MHz	
25		2320 MHz		_______ MHz	
26		2310 MHz		_______ MHz	
27		2300 MHz		_______ MHz	

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-2. Frequency Range and CW Mode Accuracy (Cont'd)					
M/N Divider Check	5b				
(N Divider)		Freq. ±1 Hz ± Counter Resolution			
M = 27 N = 13		2300 MHz		______ MHz	
14		2500 MHz		______ MHz	
15		2700 MHz		______ MHz	
16		2900 MHz		______ MHz	
17		3100 MHz		______ MHz	
18		3300 MHz		______ MHz	
19		3500 MHz		______ MHz	
20		3700 MHz		______ MHz	
21		3900 MHz		______ MHz	
22		4100 MHz		______ MHz	
23		4300 MHz		______ MHz	
24		4500 MHz		______ MHz	
25		4700 MHz		______ MHz	
26		4900 MHz		______ MHz	
27		5100 MHz		______ MHz	
28		5300 MHz		______ MHz	
29		5500 MHz		______ MHz	
30		5700 MHz		______ MHz	
31		5900 MHz		______ MHz	
32		6100 MHz		______ MHz	
33		6300 MHz		______ MHz	
34		6500 MHz		______ MHz	
35		6700 MHz		______ MHz	
36		6900 MHz		______ MHz	

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-2. Frequency Range and CW Mode Accuracy (Cont'd)					
20-30 Loop Check (N2 Divider)					
DUT ENTRY DISPLAY		DUT START Frequency Freq. ±1 Hz ± Counter Resolution			
CF Frequency:					
2.310500 GHz	6b	2.310000 GHz		______ GHz	
2.310501	6c	2.310001		______ GHz	
2.310502		2.310002		______ GHz	
2.310503		2.310003		______ GHz	
2.310504		2.310004		______ GHz	
2.310505		2.310005		______ GHz	
2.310506		2.310006		______ GHz	
2.310507		2.310007		______ GHz	
2.310508		2.310008		______ GHz	
2.310509		2.310009		______ GHz	
2.310510		2.310010		______ GHz	
2.310510	6d	2.310010		______ GHz	
2.310520	6e	2.310020		______ GHz	
2.310530		2.310030		______ GHz	
2.310540		2.310040		______ GHz	
2.310550		2.310050		______ GHz	
2.310560		2.310060		______ GHz	
2.310570		2.310070		______ GHz	
2.310580		2.310080		______ GHz	
2.310590		2.310090		______ GHz	
2.310600		2.310100		______ GHz	
2.310600	6f	2.310100		______ GHz	
2.310700	6g	2.310200		______ GHz	
2.310800		2.310300		______ GHz	
2.310900		2.310400		______ GHz	
2.311000		2.310500		______ GHz	
2.311100		2.310600		______ GHz	
2.311200		2.310700		______ GHz	
2.311300		2.310800		______ GHz	
2.311400		2.310900		______ GHz	
2.311500		2.311000		______ GHz	
2.311500	6h	2.311000		______ GHz	
2.312500	6i	2.312000		______ GHz	
2.313500		2.313000		______ GHz	
2.314500		2.314000		______ GHz	
2.315500		2.315000		______ GHz	
2.316500		2.316000		______ GHz	
2.317500		2.317000		______ GHz	
2.318500		2.318000		______ GHz	
2.319500		2.319000		______ GHz	
2.320500		2.32000		______ GHz	

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-2. Frequency Range and CW Mode Accuracy (Cont'd)					
20-30 Loop Check (N1 Divider)					
DUT ENTRY DISPLAY		Frequency Counter Indicator Freq. ±1 Hz ± Counter Resolution			
CW Frequency.					
2319.97 MHz	7a			_____ MHz	
2319.96	7c			_____ MHz	
2319.95				_____ MHz	
2319 94				_____ MHz	
2319 93				_____ MHz	
2319 92				_____ MHz	
2319.91				_____ MHz	
2319.90				_____ GHz	
2319.89				_____ MHz	
2319.88				_____ MHz	
2319.87				_____ MHz	
2319.87	7d			_____ MHz	
2319.77	7e			_____ MHz	
2319.67				_____ MHz	
2319.57				_____ MHz	
2319.47				_____ MHz	
2319.37				_____ MHz	
2319 27				_____ MHz	
2319 17				_____ MHz	
2319 07				_____ MHz	
2318.97				_____ MHz	
2318.97	7f			_____ MHz	
2317.97	7g			_____ MHz	
2316.97				_____ MHz	
2315.97				_____ MHz	
2314.97				_____ MHz	
2313.97				_____ MHz	
2312.97				_____ MHz	
2311.97				_____ MHz	
2310.97				_____ MHz	

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-3. Sweep Time Accuracy					
10 milliseconds	4		9.5 ms	_______ ms	10.5 ms
100 milliseconds			95 ms	_______ ms	105 ms
1 second			0.95 s	_______ s	1.05 s
10 seconds			9.5 s	_______ s	10.5 s
50 seconds			47.5 s	_______ s	52.5 s

SPECIFICATIONS TESTED Limits		Step	TEST Conditions		Lower Limit	Measured Value	Upper Limit
4-4. Swept Frequency Accuracy 20% of Band Accuracy		8					
DUT Start Freq. (GHz)	**DUT Stop Freq. (GHz)**		**20% of Band**	**Test Limit (kHz)**	**Spectrum Analyzer Center Freq. (GHz)**	**Spectrum Analyzer Center Freq. GHz**	**Spectrum Analyzer Center Freq. (GHz)**
2.3	2.300099		2.3000198	±0.99	2.30001881	________	2 30002079
2.3	2.300101		2.3000202	±1.01	2.30001919	________	2.30002121
2.3	2.300499		2.3000998	±4.99	2.30009481	________	2.30010479
2.3	2.300501		2.3001002	±5.01	2.30009519	________	2.30010521
2.3	2.30499		2.300998	±49.9	2.3009481	________	2.3010479
2.3	2.30501		2.301002	±100.02	2.30090198	________	2.30110202
2.3	2.31		2.302	±200	2.3018	________	2.3022
2.3	2.32		2.304	±400	2.3036	________	2.3044
2.3	2.33		2.306	±600	2.3054	________	2.3066
2 3	2 34		2 308	±800	2.3072	________	2.3088
2 3	2 349		2 3098	±998	2 308802	________	2.310798
2 3	2 3501		2 31002	±1020	2 309	________	2.31104
2.3	2.36		2.312	±1200	2 3108	________	2 3132
2.3	2.37		2.314	±1400	2.3126	________	2 3154
2.3	2.38		2.316	±1600	2.3144	________	2 3176
2.3	2.39		2.318	±1800	2.3162	________	2 3198
2.3	2.3999		2.31998	±1980	2.318	________	2.32196
2.3	2.4001		2.32002	±2002	2.318018	________	2.322022
2.3	2.799		2.3998	±4990	2.39481	________	2.40479
2.3	2.801		2.4002	±5010	2.39519	________	2.40521
2.3	7.29		3.298	±49900	3.2481	________	3.3479
2.3	7.31		3.302	±50000	3.352	________	3.352
2 3	8.3		3.500	±50000	3.45	________	3.55
2 3	16 452		5.1304	±50000	5.0804	________	5.1804
2 3	20 0		5 84	±50000	5.79	________	5.89
2 3	24 55[1]		6 75	±50000	6 70	________	6.80
2.3	26.5[1]		7 14	±50000	7 09	________	7.19

1 Perform this step only when testing an HP 8340B

SPECIFICATIONS TESTED Limits		Step	TEST Conditions		Lower Limit	Measured Value	Upper Limit
4-4. Swept Frequency Accuracy (Cont'd) 50% of Band Accuracy		8					
DUT Start Freq. (GHz)	**DUT Stop Freq. (GHz)**		**50% of Band**	**Test Limit (kHz)**	**Spectrum Analyzer Center Freq. (GHz)**	**Spectrum Analyzer Center Freq. GHz**	**Spectrum Analyzer Center Freq. (GHz)**
2.3	2.300099		2.3000495	±0 99	2 30004851	________	2 30005049
2.3	2.300101		2 3000505	±1 01	2 30004949	________	2.30005151
2 3	2 300499		2 3002495	±4 99	2.30024451	________	2.30025449
2 3	2 300501		2.3002505	±5.01	2.30024549	________	2.30025551
2 3	2.30499		2.302495	±49.9	2.3024451	________	2.3025449
2.3	2.30501		2.302505	±100.02	2.30240498	________	2.30260502
2.3	2.31		2.305	±200	2.3048	________	2.3052
2.3	2.32		2.310	±400	2.3096	________	2.3104
2.3	2.33		2.315	±600	2.3144	________	2.3156
2.3	2.34		2.320	±800	2.3192	________	2.3208
2.3	2.349		2.3245	±998	2.323502	________	2.325498
2.3	2.3501		2.32505	±1020	2.32403	________	2 32607
2.3	2.36		2.33	±1200	2 3288	________	2 3312
2.3	2.37		2 335	±1400	2 3336	________	2 3364
2.3	2 38		2 34	±1600	2 3384	________	2.3416
2 3	2 39		2 345	±1800	2.3432	________	2.3468
2 3	2 3999		2.34995	±1980	2.34797	________	2.35193
2.3	2.4001		2.35005	±2002	2.348048	________	2.352052
2.3	2.799		2.5495	±4990	2.54451	________	2.55449
2.3	2.801		2.5505	±5010	2.54549	________	2.55551
2.3	7.29		4.795	±49900	4.7451	________	4.8449
2.3	7.31		4.805	±50000	4.755	________	4.855
2.3	8.3		5.300	±50000	5.250	________	5.350
2.3	16.452		9.376	±50000	9.326	________	9.426
2.3	20.0		11.15	±50000	11.1	________	11.2
2.3	24.551[1]		13 425	±50000	13 375	________	13 475
2.3	26 5[1]		14 4	±50000	14 35	________	14 45

1 Perform this step only when testing an HP 8340B

SPECIFICATIONS TESTED Limits		Step	TEST Conditions		Lower Limit	Measured Value	Upper Limit
4-4. Swept Frequency Accuracy (Cont'd) 80% of Band Accuracy		8					
DUT Start Freq. (GHz)	**DUT Stop Freq. (GHz)**		**80% of Band**	**Test Limit (kHz)**	**Spectrum Analyzer Center Freq. (GHz)**	**Spectrum Analyzer Center Freq. GHz**	**Spectrum Analyzer Center Freq. (GHz)**
2.3	2.300099		2.3000792	±0.99	2.30007821	________	2.30008019
2.3	2.300101		2.300808	±1.01	2.30007979	________	2.30008181
2.3	2.300499		2.3003992	±4.99	2.30039421	________	2.30040419
2.3	2.300501		2.3004008	±5.01	2.30039579	________	2.30040581
2.3	2.30499		2.303992	±49.9	2.3039421	________	2.3040419
2.3	2.30501		2.304008	±100.02	2.30390798	________	2.3041802
2.3	2.31		2.308	±200	2.3078	________	2.3082
2.3	2.32		2.316	±400	2.3156	________	2.3164
2.3	2.33		2.324	±600	2.3234	________	2.3246
2.3	2.34		2.332	±800	2.3312	________	2.3328
2.3	2.349		2.3392	±998	2.338202	________	2.340198
2.3	2.3501		2.34008	±1020	2.33906	________	2.3411
2.3	2.36		2.348	±1200	2.3468	________	2.3492
2.3	2.37		2.356	±1400	2.3546	________	2.3574
2.3	2.38		2.364	±1600	2.3624	________	2.3656
2.3	2.39		2.372	±1800	2.3702	________	2.3738
2.3	2.3999		2.37992	±1980	2.37794	________	2.3819
2.3	2.4001		2.38008	±2002	2.378078	________	2.382082
2.3	2.799		2.6992	±4990	2.69421	________	2.70419
2.3	2.801		2.7008	±5010	2.69579	________	2.70581
2.3	7.29		6.292	±49900	6.2421	________	6.3419
2.3	7.31		6.308	±50000	6.258	________	6.358
2.3	8.3		7.1	±50000	7.05	________	7.15
2.3	16.452		13.6216	±50000	13.5716	________	13.6716
2.3	20.0		14.16	±50000	14.11	________	14.21
2.3	24.55[1]		20.1	±50000	20.05	________	20.15
2.3	26.5[1]		21.66	±50000	21.61	________	21.71

1 Perform this step only when testing an HP 8340B.

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-5. Maximum Leveled Output Power and Power Accuracy					
Maximum Leveled Power Band 0					
ENTRY DISPLAY Power Indication	3	Continuous Sweep, Auto Sweep Time		______ dBm	
	4	Single Sweep, Auto Sweep Time		______ dBm	
	5	Single Sweep, 2 Second Sweep Time		______ dBm	
Lowest power level recorded in step 3, 4, or 5	6			______ dBm	
Minimum Power Frequency		M2 Frequency		______ GHz	
Power Meter Indication	7	Standard Instrument (F.P. Out with Atten.)	+10 dBm	______ dBm	
		Option 001 (F.P. Out No Atten.)	+10 dBm	______ dBm	
		Option 004 (R.P. Out with Atten.)	+10 dBm	______ dBm	
		Option 005 (R.P. Out No Atten.)	+10 dBm	______ dBm	
Maximum Leveled Power Band 1					
ENTRY DISLAY Power Indication	3	Continuous Sweep, Auto Sweep Time		______ dBm	
	4	Single Sweep, Auto Sweep Time		______ dBm	
	5	Single Sweep, 2 Second Sweep Time		______ dBm	
Lowest power level recorded in step 3, 4, or 5	6			______ dBm	
Minimum Power Frequency		M2 Frequency		______ GHz	
Power Meter Indication	7	Standard Instrument (F.P. Out with Atten.)	+12 dBm	______ dBm	
		Option 001 (F.P. Out No Atten.)	+13 dBm	______ dBm	
		Option 004 (R.P. Out with Atten.)	+11 dBm	______ dBm	
		Option 005 (R.P. Out No Atten.)	+12 dBm	______ dBm	

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-5. Maximum Leveled Output Power and Power Accuracy (Cont'd)					
Maximum Leveled Power Band 2					
ENTRY DISPLAY Power Indication	3	Continuous Sweep, Auto Sweep Time		_____ dBm	
	4	Single Sweep, Auto Sweep Time		_____ dBm	
	5	Single Sweep, 2 Second Sweep Time		_____ dBm	
Lowest power level recorded in step 3, 4, or 5	6			_____ dBm	
Minimum Power Frequency		M2 Frequency		_____ GHz	
Power Meter Indication	7	Standard Instrument (F.P. Out with Atten.)	+10 dBm	_____ dBm	
		Option 001 (F.P. Out No Atten.)	+12 dBm	_____ dBm	
		Option 004 (R.P. Out with Atten.)	+9 dBm	_____ dBm	
		Option 005 (R.P. Out No Atten.)	+11 dBm	_____ dBm	
Maximum Leveled Power Band 3					
ENTRY DISPLAY Power Indication	3	Continuous Sweep, Auto Sweep time		_____ dBm	
	4	Single Sweep, Auto Sweep Time		_____ dBm	
	5	Single Sweep, 2 Second Sweep Time		_____ dBm	
Lowest power level recorded in step 3, 4, or 5	6			_____ dBm	
Minimum Power Frequency		M2 Frequency		_____ GHz	
Power Meter Indication	7	Standard Instrument (F.P. Out with Atten.)	+9 dBm	_____ dBm	
		Option 001 (F.P. Out No Atten.)	+11 dBm	_____ dBm	
		Option 004 (R.P. Out with Atten.)	+7 dBm	_____ dBm	
		Option 005 (R.P. Out No Atten.)	+9 dBm	_____ dBm	

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-5. Maximum Leveled Output Power and Power Accuracy (Cont'd)					
Maximum Leveled Power Band 4 (20-23 GHz)[1] ENTRY DISPLAY Power Indication	3	Continuous Sweep, Auto Sweep Time		_____ dBm	
	4	Single Sweep, Auto Sweep Time		_____ dBm	
	5	Single Sweep, 2 Second Sweep Time		_____ dBm	
Lower power level recorded in step 3, 4, or 5	6			_____ dBm	
Minimum Power Frequency		M2 Frequency		_____ GHz	
Power Meter Indication	7	Standard Instrument (F.P. out with Atten.)	+3 dBm	_____ dBm	
		Option 001 (F.P. Out No Atten.)	+6 dBm	_____ dBm	
		Option 004 (R.P. Out with Atten.)	+1 dBm	_____ dBm	
		Option 005 (R.P. Out No Atten.)	+4 dBm	_____ dBm	
Maximum Leveled Power Band 4 (23-26.5 GHz)[1] ENTRY DISPLAY Power Indication	3	Continuous Sweep, Auto Sweep Time		_____ dBm	
	4	Single Sweep, Auto Sweep Time		_____ dBm	
	5	Single Sweep, 2 Second Sweep Time		_____ dBm	
Lowest power level recorded in step 3, 4, or 5	6			_____ dBm	
Minimum Power Frequency		M2 Frequency		_____ GHz	
Power Meter Indication	7	Standard Instrument (F.P. Out with Atten.)	+1 dBm	_____ dBm	
		Option 001 (F.P. Out No Atten.)	+4 dBm	_____ dBm	
		Option 004 (R.P. Out with Atten.)	−1 dBm	_____ dBm	
		Option 005 (R.P. Out No Atten.)	+2 dBm	_____ dBm	

1 Perform this step only when testing an HP 8340B

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-5. Maximum Leveled Output Power and Power Accuracy (Cont'd)					
Flatness	9				
Band 0 Measurement					
Minimum Power Frequency	13	M2 Frequency		_______ GHz	
Minimum Power Level	14	M2 Power Level		_______ dBm	
Maximum Power Frequency	15	M1 Frequency		_______ GHz	
Maximum Power Level		M1 Power Level		_______ dBm	
Band 1 Measurement					
Minimum Power Frequency	13	M2 Frequency		_______ GHz	
Minimum Power Level	14	M2 Power Level		_______ dBm	
Maximum Power Frequency	15	M1 Frequency		_______ GHz	
Maximum Power Level		M1 Power Level		_______ dBm	
Band 2 Measurement					
Minimum Power Frequency	13	M2 Frequency		_______ GHz	
Minimum Power Level	14	M2 Power Level		_______ dBm	
Maximum Power Frequency	15	M1 Frequency		_______ GHz	
Maximum Power Level		M1 Power Level		_______ dBm	
Band 3 Measurement					
Minimum Power Frequency	13	M2 Frequency		_______ GHz	
Minimum Power Level	14	M2 Power Level		_______ dBm	
Maximum Power Frequency	15	M1 Frequency		_______ GHz	
Maximum Power Level		M1 Power Level		_______ dBm	
Band 4 Measurement[1]					
Minimum Power Frequency	13	M2 Frequency		_______ GHz	
Minimum Power Level	14	M2 Power Level		_______ dBm	
Maximum Power Frequency	15	M1 Frequency		_______ GHz	
Maximum Power Level		M1 Power Level		_______ dBm	

1 Perform this step only when testing an HP 8340B.

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-5 Maximum Leveled Output Power and Power Accuracy (Cont'd)					
Flatness (Maximum minus Minimum Calculations)	18				
Band 0 Calculation		≤1.2 dB (Standard) ≤1.4 dB (Option 004) ≤1.2 dB (Option 001) ≤1.4 dB (Option 005)		_______ dB	
Band 1 Calculation		≤2.2 dB (Standard) ≤2.6 dB (Option 004) ≤1.8 dB (Option 001) ≤2.2 dB (Option 005)		_______ dB	
Band 2 Calculation		≤2.2 dB (Standard) ≤2 6 dB (Option 004) ≤1 8 dB (Option 001) ≤2.2 dB (Option 005)		_______ dB	
Band 3 Calculation		≤2.2 dB (Standard) ≤2.6 dB (Option 004) ≤1.8 dB (Option 001) ≤2.2 dB (Option 005)		_______ dB	
Band 4 Calculation[1]		≤3.2 dB (Standard) ≤3.6 dB (Option 004) ≤2.6 dB (Option 001) ≤3.0 dB (Option 005)		_______ dB	

1 Perform this step only when testing an HP 8340B

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-6. External Leveling		(Using Negative Crystal Detector)			
Leveling Voltage (dBv)					
+6	3		−1.883 V	________ V	−2.114 V
0			−0.944 V	________ V	−1.059 V
−10			−0.2983 V	________ V	−0.3352 V
−20			−0.0942 V	________ V	−0.1061 V
−30			−29.65 mV	________ mV	−33.70 mV
−40			−9.24 mV	________ mV	−10.79 mV
−50			−2 785 mV	________ mV	−3.550 mV
−60			−0 744 mV	________ mV	−1 259 mV
−66			−0 273 mV	________ mV	−0 731 mV

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-7. Spurious Signals (10 MHz to 22 GHz - HP 8340B) (10 MHz to 20 GHz - HP 8341B)					
Frequency of Interest Selected	4				
	6	Refer to Table 4-16 for Specifications			
4-8. Spurious Signals (22 to 26.5 GHz HP 8340B only)					
Frequency of Interest Selected	2				
	6	Refer to Table 4-17 for Specifications			

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-9. Single Sideband Phase Noise from Steps 11 through 38 (Using Tables 4-19, 4-20, and 4-22)	38				
Instruments w/o Opt 007					
2 202 GHz					
Offset = 30 Hz				______ dBc	< −64dBc
100 Hz				______ dBc	< −70 dBc
1 kHz				______ dBc	< −78 dBc
10 kHz				______ dBc	< −86 dBc
100 kHz				______ dBc	< −107 dBc
6.902 GHz					
Offset = 30 Hz				______ dBc	< −64 dBc
100 Hz				______ dBc	< −70 dBc
1 kHz				______ dBc	< −78 dBc
10 kHz				______ dBc	< −86 dBc
100 kHz				______ dBc	< −107 dBc
13 402 GHz					
Offset = 30 Hz				______ dBc	< −58 dBc
100 Hz				______ dBc	< −64 dBc
1 kHz				______ dBc	< −72 dBc
10 kHz				______ dBc	< −80 dBc
100 kHz				______ dBc	< −101 dBc
19.502 GHz					
Offset = 30 Hz				______ dBc	< −54 dBc
100 Hz				______ dBc	< −60 dBc
1 kHz				______ dBc	< −68 dBc
10 kHz				______ dBc	< −76 dBc
100 kHz				______ dBc	< −97 dBc
26 032 GHz[1]					
Offset = 30 Hz				______ dBc	< −52 dBc
100 Hz				______ dBc	< −58 dBc
1 kHz				______ dBc	< −66 dBc
10 kHz				______ dBc	< −74 dBc
100 kHz				______ dBc	< −95 dBc

1 Perform this step only when testing an HP 8340B

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-9 Single Sideband Phase Noise from Steps 11 through 38 (Using Tables 4-19, 4-20, and 4-22) (Cont'd)	38				
Option 007 - Relaxed Phase Noise Specifications					
2.202 GHz					
Offset = 100 Hz				_______ dBc	<−67 dBc
1 kHz				_______ dBc	<−75 dBc
10 kHz				_______ dBc	<−83 dBc
100 kHz				_______ dBc	<−107 dBc
6.902 GHz					
Offset = 100 Hz				_______ dBc	<−67 dBc
1 kHz				_______ dBc	<−75 dBc
10 kHz				_______ dBc	<−83 dBc
100 kHz				_______ dBc	<−107 dBc
13.402 GHz					
Offset = 100 Hz				_______ dBc	<−61 dBc
1 kHz				_______ dBc	<−69 dBc
10 kHz				_______ dBc	<−77 dBc
100 kHz				_______ dBc	<−101 dBc
19.502 GHz					
Offset = 100 Hz				_______ dBc	<−57 dBc
1 kHz				_______ dBc	<−65 dBc
10 kHz				_______ dBc	<−73 dBc
100 kHz				_______ dBc	<−97 dBc
26.032 GHz[1]					
Offset = 100 Hz				_______ dBc	<−55 dBc
1 kHz				_______ dBc	<−63 dBc
10 kHz				_______ dBc	<−71 dBc
100 kHz				_______ dBc	<−95 dBc

1. Perform this step only when testing an HP 8340B.

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-10. Power Sweep					
1 GHz					
Start Level	5			_____ dBm	
End Level	6			_____ dBm	
Power Sweep Range	7	Must be ≥20 dB difference	20 dB	_____ dB	
5 GHz					
Start Level	5			_____ dBm	
End Level	6			_____ dBm	
Power Sweep Range	7	Must be ≥20 dB difference	20 dB	_____ dB	
10 GHz					
Start Level	5			_____ dBm	
End Level	6			_____ dBm	
Power Sweep Range	7	Must be ≥20 dB difference	20 dB	_____ dB	
15 GHz					
Start Level	5			_____ dBm	
End Level	6			_____ dBm	
Power Sweep Range	7	Must be ≥20 dB difference	20 dB	_____ dB	
26 GHz[1]					
Start Level	5			_____ dBm	
End Level	6			_____ dBm	
Power Sweep Range	7	Must be ≥20 dB difference	20 dB	_____ dB	

1. Perform this step only when testing an HP 8340B.

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-11 Pulse Modulation ON/ OFF Ratio					
1 GHz	4	ΔAmplitude must be > 80 dB	80 dB	_______ dB	
3 GHz			80 dB	_______ dB	
9 GHz			80 dB	_______ dB	
15 GHz			80 dB	_______ dB	
22 GHz*			80 dB	_______ dB	
4-12 Pulse Modulation Rise and Fall Time					
1 GHz					
Rise Time	6	Rise Times: 90% point should		_______ nsec	25 nsec
Fall Time	8	be <25 nanoseconds from 10% point		_______ nsec	25 nsec
3 GHz					
Rise Time	6	Fall Times: 10% point should be		_______ nsec	25 nsec
Fall Time	8	<25 nanoseconds from 90% point		_______ nsec	25 nsec
9 GHz					
Rise Time	6			_______ nsec	25 nsec
Fall Time	8			_______ nsec	25nsec
15 GHz					
Rise Time	6			_______ nsec	25 nsec
Fall Time	8			_______ nsec	25 nsec
22 GHz[1]					
Rise Time	6			_______ nsec	25 nsec
Fall Time	8			_______ nsec	25 nsec

1. Perform this step only when testing an HP 8340B

NOTE

Tests 4-11, 4-12, 4-13, and 4-14 do not apply to instruments equipped with Option 006, Delete Pulse Modulation.

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-13. Pulse Modulation Accuracy					
DUT CW Freq. = 1 GHz PRF = 100 kHz					
Pulse Width = 100 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+3 dB
Pulse Width = 200 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+1.5 dB
Pulse Width = 500 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB
Pulse Width = 1000 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB
Pulse Repetition Freq. Range DUT CW Freq. = 1 GHz	10				
Minimum PRF PRF = 100 Hz PW = 1 microsecond	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB
Maximum PRF PRF = 5 MHz PW = 100 nanoseconds	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+3 dB
DUT CW Freq. = 3 GHz PRF = 100 kHz					
Pulse Width = 100 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+1.5 dB
Pulse Width = 200 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB
Pulse Width = 500 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB
Pulse Width = 1000 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+3 dB

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-13 Pulse Modulation Accuracy (Cont'd)					
Pulse Repetition Freq Range	10				
DUT CW Freq = 3 GHz					
Minimum PRF					
PRF = 100 Hz					
PW = 1 microsecond	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB
Maximum PRF					
PRF = 5 MHz					
PW = 100 nanoseconds	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+1.5 dB
DUT CW Freq = 9 GHz					
PRF = 100 kHz					
Pulse Width = 100 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+1.5 dB
Pulse Width = 200 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB
Pulse Width = 500 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB
Pulse Width = 1000 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB
Pulse Repetition Freq. Range	10				
DUT CW Freq. = 9 GHz					
Minimum PRF					
PRF = 100 Hz					
PW = 1 microsecond	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB
Maximum PRF					
PRF = 5 MHz					
PW = 100 nanoseconds	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+1.5 dB

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-13 Pulse Modulation Accuracy (Cont'd)					
DUT CW Freq. = 15 GHz PRF = 100 kHz					
Pulse Width = 100 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+1.5 dB
Pulse Width = 200 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB
Pulse Width = 500 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB
Pulse Width = 1000 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB
Pulse Repetition Freq. Range DUT CW Freq. = 15 GHz	10				
Minimum PRF PRF = 100 Hz PW = 1 microsecond	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB
Maximum PRF PRF = 5 MHz PW = 100 nanoseconds	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+1.5 dB
		NOTE **Perform the following steps only when testing an HP 8340B.**			
HP 8340B CW Freq. = 22 GHz PRF = 100 kHz					
Pulse Width = 100 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+1.5 dB
Pulse Width = 200 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB
Pulse Width = 500 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB
Pulse Width = 1000 ns	6	ENTRY DISPLAY Power Level		______ dBm	
	7	ENTRY DISPLAY Power Level		______ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	______ dB	<+0.3 dB

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-13. Pulse Modulation Accuracy (Cont'd)					
		NOTE Perform the following steps only when testing an HP 8340B.			
Pulse Repetition Freq. Range 8340B CW Freq. = 22 GHz	10				
Minimum PRF PRF = 100 Hz PW = 1 microsecond	6	ENTRY DISPLAY Power Level		_____ dBm	
	7	ENTRY DISPLAY Power Level		_____ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	_____ dB	<+0.3 dB
Maximum PRF PRF = 5 MHz PW = 100 nanoseconds	6	ENTRY DISPLAY Power Level		_____ dBm	
	7	ENTRY DISPLAY Power Level		_____ dBm	
	8	Δ Power between steps 6 and 7	>−0.3 dB	_____ dB	<+1.5 dB

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-14. Pulse Modulation Video Feedthrough					
DUT CW Freq. = 0.4 GHz					
Power Level = +8 dBm	7	Oscilloscope peak voltage		______ mV	< 12 mV
0 dBm				______ mV	<5 mV
−10 dBm				______ mV	<1.6 mV
DUT CW Freq. = 1 GHz	7				
Power Level = +8 dBm				______ mV	<12 mV
0 dBm				______ mV	<5 mV
−10 dBm				______ mV	<1.6 mV
DUT CW Freq = 1.5 GHz	7				
Power Level = +8 dBm				______ mV	<12 mV
0 dBm				______ mV	<5 mV
−10 dBm				______ mV	<1.6 mV
DUT CW Freq. = 2 GHz	7				
Power Level = +8 dBm				______ mV	<12 mV
0 dBm				______ mV	<5 mV
−10 dBm				______ mV	<1.6 mV
DUT CW Freq. = >2.3 GHz	10				
Power Level = −10 dBm (Any Frequency Selected)				______ mV	<0.2 mV

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-15. Amplitude Modulation					
AM Sensitivity					
DUT Freq. = 1.5 GHz	2				
Power = −5 dBm					
	4	Power Meter Indication		______ dB	
+30% Modulation	5	Power Meter Change	>2.18 dB	______ dB	<2.38 dB
−30% Modulation	6	Power Meter Change	>2.91 dB	______ dB	<3.29 dB
DUT Freq. = 1.5 GHz	7				
Power = +5 dBm					
	4	Power Meter Indication		______ dB	
+30% Modulation	5	Power Meter Change	>2.18 dB	______ dB	<2.38 dB
−30% Modulation	6	Power Meter Change	>2.91 dB	______ dB	<3.29 dB
DUT Freq. = 4.5 GHz	8				
Power = −5 dBm					
	4	Power Meter Indication		______ dB	
+30% Modulation	5	Power Meter Change	>2.18 dB	______ dB	<2.38 dB
−30% Modulation	6	Power Meter Change	>2.91 dB	______ dB	<3.29 dB
DUT Freq. = 4.5 GHz	8				
Power = +5 dBm					
	4	Power Meter Indication		______ dB	
+30% Modulation	5	Power Meter Change	>2.18 dB	______ dB	<2.38 dB
−30% Modulation	6	Power Meter Change	>2.91 dB	______ dB	<3.29 dB
DUT Freq. = 1.5 GHz					
AM Frequency Response	11	Note DVM Indication		______ Vrms	
Funct. Gen. = 1 kHz	12	Flatness (read on Modulation		______ dB	≤±0.2 dB
100 Hz	13	Analyzer)		______ dB	≤±0.2 dB
200 Hz				______ dB	≤±0.2 dB
500 Hz				______ dB	≤±0.2 dB
1 kHz				______ dB	≤±0.2 dB
2 kHz				______ dB	≤±0.2 dB
5 kHz				______ dB	≤±0.2 dB
10 kHz				______ dB	≤±0.2 dB
AM Bandwidth	14	Modulation Analyzer	≥−3 dB	______ dB	
Funct. Gen. = 100 kHz		Indication			
Adjust output level to					
that noted in Step 11					
AM Depth					
Funct. Gen. = 1 kHz	15	Maximum Modulation Depth	>90%	______ %	

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-15. Amplitude Modulation (Cont'd)					
DUT Freq. = 3 GHz					
AM Frequency Response	11	Note DVM Indication		_____ Vrms	
Funct Gen = 1 kHz	12	Flatness (read on Modulation		_____ dB	≤±0.2 dB
100 Hz	13	Analyzer)		_____ dB	≤±0.2 dB
200 Hz				_____ dB	≤±0.2 dB
500 Hz				_____ dB	≤±0.2 dB
1 kHz				_____ dB	≤±0 2 dB
2 kHz				_____ dB	≤±0.2 dB
5 kHz				_____ dB	≤±0.2 dB
10 kHz				_____ dB	≤±0.2 dB
AM Bandwidth Funct. Gen. = 100 kHz Adjust output level to that noted in Step 11	14	Modulation Analyzer Indication	≥−3 dB	_____ dB	
AM Depth Funct. Gen. = 1 kHz	15	Maximum Modulation Depth	>90%	_____ %	
DUT Freq. = 9 GHz					
AM Frequency Response	11	Note DVM Indication		_____ Vrms	
Funct Gen = 1 kHz	12	Flatness (read on Modulation		_____ dB	≤±0.2 dB
100 Hz	13	Analyzer)		_____ dB	≤±0.2 dB
200 Hz				_____ dB	≤±0.2 dB
500 Hz				_____ dB	≤±0.2 dB
1 kHz				_____ dB	≤±0 2 dB
2 kHz				_____ dB	≤±0.2 dB
5 kHz				_____ dB	≤±0.2 dB
10 kHz				_____ dB	≤±0.2 dB
AM Bandwidth Funct. Gen. = 100 kHz Adjust output level to that noted in Step 11	14	Modulation Analyzer Indication	≥−3 dB	_____ dB	
AM Depth Funct. Gen. = 1 kHz	15	Maximum Modulation Depth	>90%	_____ %	
DUT Freq. = 15 GHz					
AM Frequency Response	11	Note DVM Indication		_____ Vrms	
Funct. Gen = 1 kHz	12	Flatness (read on Modulation		_____ dB	≤±0.2 dB
100 Hz	13	Analyzer)		_____ dB	≤±0.2 dB
200 Hz				_____ dB	≤±0.2 dB
500 Hz				_____ dB	≤±0.2 dB
1 kHz				_____ dB	≤±0.2 dB
2 kHz				_____ dB	≤±0 2 dB
5 kHz				_____ dB	≤±0.2 dB
10 kHz				_____ dB	≤±0.2 dB
AM Bandwidth Funct. Gen. = 100 kHz Adjust output level to that noted in Step 11	14	Modulation Analyzer Indication	≥−3 dB	_____ dB	
AM Depth Funct. Gen. = 1 kHz	15	Maximum Modulation Depth	>90%	_____ %	

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-15. Amplitude Modulation (Cont'd)					
		NOTE **Perform the following steps only when testing an HP 8340B.**			
8340B Freq. = 22 GHz					
AM Frequency Response	11	Note DVM Indication		_____ Vrms	
Funct. Gen. = 1 kHz	12	Flatness (read on Modulation		_____ dB	≤ ±0 2 dB
100 Hz	13	Analyzer)		_____ dB	≤ ±0.2 dB
200 Hz				_____ dB	≤ ±0.2 dB
500 Hz				_____ dB	≤ ±0.2 dB
2 kHz				_____ dB	≤ ±0.2 dB
5 kHz				_____ dB	≤ ±0.2 dB
10 kHz				_____ dB	≤ ±0.2 dB
AM Bandwidth Funct. Gen. = 100 kHz Adjust output level to that noted in Step 11	14	Modulation Analyzer Indication	≥ −3 dB	_____ dB	
AM Depth Funct. Gen. = 1 kHz	15	Maximum Modulation Depth	>90%	_____ %	

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-16. Frequency Modulation					
ACCURACY					
CW Freq. = 2.2 GHz					
FM Sensitivity = 1 MHz/V	7	V_{in} % Error		_______ V _______ %	 10%
FM Sensitivity = 10 MHz/V	7	V_{in} % Error		_______ V _______ %	 10%
CW Freq. = 2.5 GHz					
FM Sensitivity = 1 MHz/V	7	V_{in} % Error		_______ V _______ %	 10%
FM Sensitivity = 10 MHz/V	7	V_{in} % Error		_______ V _______ %	 10%
CW Freq. = 6.9 GHz					
FM Sensitivity = 1 MHz/V	7	V_{in} % Error		_______ V _______ %	 10%
FM Sensitivity = 10 MHz/V	7	V_{in} % Error		_______ V _______ %	 10%
CW Freq. = 13.4 GHz					
FM Sensitivity = 1 MHz/V	7	V_{in} % Error		_______ V _______ %	 10%
FM Sensitivity = 10 MHz/V	7	V_{in} % Error		_______ V _______ %	 10%
CW Freq. = 18 GHz					
FM Sensitivity = 1 MHz/V	7	V_{in} % Error		_______ V _______ %	 10%
FM Sensitivity = 10 MHz/V	7	V_{in} % Error		_______ V _______ %	 10%
FLATNESS					
FM Sensitivity = 1 MHz/V					
CW Freq. = 2.2 GHz	13	Worst Case Power Level		_______ dB	3 dB
CW Freq. = 2.5 GHz	13	Worst Case Power Level		_______ dB	3 dB
CW Freq. = 6.9 GHz	13	Worst Case Power Level		_______ dB	3 dB
CW Freq. = 13.4 GHz	13	Worst Case Power Level		_______ dB	3 dB
CW Freq. = 18 GHz	13	Worst Case Power Level		_______ dB	3 dB

SPECIFICATIONS TESTED Limits	Step	TEST Conditions	Lower Limit	Measured Value	Upper Limit
4-16. Frequency Modulation (Cont'd)					
FM Sensitivity = 10 MHz/V					
CW Freq. = 2.2 GHz	13	Worst Case Power Level		_______ dB	3 dB
CW Freq. = 2.5 GHz	13	Worst Case Power Level		_______ dB	3 dB
CW Freq. = 6.9 GHz	13	Worst Case Power Level		_______ dB	3 dB
CW Freq. = 13.4 GHz	13	Worst Case Power Level		_______ dB	3 dB
CW Freq. = 18 GHz	13	Worst Case Power Level		_______ dB	3 dB
CW Freq. = 20 GHz[1]	13	Worst Case Power Level		_______ dB	3 dB

1 Perform this step only when testing an HP 8340B

Section V. Adjustments

INTRODUCTION

This section provides adjustment procedures for the HP 8340B/41B Synthesized Sweepers. These procedures should not be performed as routine maintenance but should be used (1) after replacement of a part or component, or (2) when performance tests show that the instrument's specifications cannot be met. Before attempting any adjustment, allow 1 hour warm-up time for the instrument. Table 5-1 lists the adjustment procedures by test number in the order they appear in this Section. Table 5-2 lists all factory selected components. Table 5-3 lists adjustment procedures that interact between assemblies. This table lists the adjustment paragraphs that must be checked when an assembly is adjusted, parts replaced, or the assembly replaced.

SAFETY CONSIDERATIONS

Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to ensure safe operation and to retain the instrument in safe condition. Service and adjustments should be performed only by qualified service personnel.

WARNING

Adjustments in this section are performed with power supplied to the instrument while protective covers are removed. There are voltages at many points in the instrument which can, if contacted, cause personal injury or death. Be extremely careful. Adustments should be performed only by trained service personnel.

Power is still applied to this instrument with the LINE switch set to STANDBY. There is no OFF position on the LINE switch. Before removing or installing any assembly or printed circuit board, remove the power cord from the rear of the instrument.

Capacitors inside the instrument may still be charged, even if the instrument has been disconnected from its source of ac power. Use a non-metallic adjustment tool whenever possible.

EQUIPMENT REQUIRED

Table 4-1 lists the equipment required for the adjustment procedures. If the test equipment recommended is not available, other equipment may be used if its performance meets the "Critical Specifications" listed in the table. The test setup used for an adjustment procedure is referenced in each procedure.

ADJUSTMENT TOOLS

For adjustments requiring a non-metallic tuning tool, use fiber tuning tool, HP Part Number 8710-0033. In situations not requiring non-metallic tuning tools, an ordinary small screwdriver or other suitable tool is sufficient. However, use of a non-metallic adjustment tool whenever possible is recommended. Never try to force any adjustment control in the instrument. This is especially critical when tuning variable slug-tuned inductors and variable capacitors.

FACTORY SELECTED COMPONENTS

Factory selected components are identified with an asterisk on the schematic diagram. The range of their values and functions are listed in Table 5-2. Part Numbers for selected values are located in Table 5-4.

RELATED ADJUSTMENTS

Any adjustments which interact with, or are related to, other adjustments are indicated in the adjustment procedures. It is important that adjustments so noted are performed in the order indicated to ensure the instrument meets its specifications.

LOCATION OF TEST POINTS AND ADJUSTMENTS

Illustrations showing the locations of assemblies containing adjustments and locations of those adjustments within the assemblies are contained within the adjustment procedures where they apply. Also, major assembly and component location illustrations are located in volume 3.

ACCESSING AND STORING CALIBRATION CONSTANTS

Introduction

The HP 8340B/41B contains three memory areas reserved for calibration constants These areas are (1) working, (2) protected, and (3) default. A detailed description of these memory areas is contained in the introduction of Section 8 under the heading "Calibration Constants." When performing adjustments, some calibration constants in the "working memory area" are changed or "adjusted" to optimize performance parameters. Once these calibration constants are set for best instrument performance, the new values should be copied from the "working memory area" to the "protected memory area." The printed copy of the calibration constants (located underneath the top cover of the instrument should also be updated to reflect the new values. Once updated, it should then be returned to its storage location. This calibration data then may be used later in case of loss of valid calibration constants data in the "working memory area."

Procedure to Access Calibration Constants

In the adjustment procedures, calibration constants stored in working memory will be changed (adjusted). A calibration constant can be accessed by pushing the following key sequence:

[SHIFT] [GHz] [number of the Cal. Constant, 1 to 99] [Hz]
[SHIFT] [MHz] [1] [2] [Hz]
[SHIFT] [kHz] [2] [2] [Hz]

The ENTRY DISPLAY will indicate the calibration constant number on the left and the present value on the right Use the STEP keys to select a different calibration constant number. The ENTRY keyboard or the front panel rotary knob can be used to change the value After the new value has been entered, press the **[Hz]** key to retain the new values in "working memory area "

Procedure to Store the Calibration Constants

After adjustments of the calibration constants are completed, the data thus stored in the "working memory area" should be copied to the "protected memory area" by pressing the following key sequence:

[SHIFT] [MHz] [1] [4] [Hz]
[SHIFT] [kHz] [5] [3] [4] [9] [Hz] Wait for "CALIBRATION RESTORED" to be displayed in the ENTRY DISPLAY and then press **[INSTR PRESET]**

Table 5-1. Adjustment Procedures in Paragraph Order

Test	Title	Page
5-1	+22 Vdc Power Supply, A35	5-13
5-2	10 MHz Standard, A51	5-15
5-3	100 MHz Voltage-Controlled Crystal Oscillator (VCXO), A30	5-19
5-4	M/N Loop, A23, A33, and A32A1	5-23
5-5	20/30 Loop Phase Lock, A36, A38, A39, A40, and A43	5-27
5-6	YO Pretune DAC, A54	5-37
5-7	YO Main Driver, A55	5-39
5-8	YO Loop Adjustments	5-43
5-9	FM Accuracy and FM Overmod Adjustment	5-53
5-10	YO Delay Compensation, A54	5-57
5-11	3.7 GHz Oscillator, A8	5-63
5-12	Marker/Bandcross, A57	5-65
5-13	Sweep Generator, A58	5-67
5-14	Unleveled RF Output Adjustments	5-71
5-15	ALC Adjustments	5-89
5-16	Leveled RF Output Adjustments	5-101
5-17	RF Output Power Flatness and Adjustment	5-115
5-18	Pulse Adjustments	5-121
5-19	External Module Leveling Adjustment	5-129

Table 5-2. Factory Selected Components

Reference Designator	Range of Values	Adjustment Paragraph Number	Function of Component
A25C11	Either 0 or 1000 PF	5-14	Selected for optimum Log-Amp speed and stability
A25R36 A25R37	4640 - 9090 Ohms 3830 - 6190 Ohms	5-14 5-14	Adjusts temperature compensation of Band 1-4 detector[1].
A25R109 A25R115	1620 - 3830 Ohms 4640 - 9090 Ohms	5-14 5-14	Adjusts temperature compensation of Band 0 detector.
A30C8	5.6 - 11 PF	5-3	Sets range of C4 so midposition is 100 MHz.
A30L4	0.22 - 0.68 mH	5-3	Centers Oscillator at 100 MHz.
A30R67	110 - 825 Ohms	5-3	Part of attenuator to set 400 MHz output at −10 dBm.
A30R68	6.8 - 61.9 Ohms	5-3	Part of attenuator to set 400 MHz output at −10 dBm.
A30R69	110 - 825 Ohms	5-3	Part of attenuator to set 400 MHz output at −10 dBm.
A39C49	8.2 - 16 PF	5-5	Sets range of C50 so midposition is 160 MHz
A48C22	100 - 160 PF	5-8	Selected to tune RLC network at input of Buffer Amplifier to 25 MHz passband.
A48R22	6.2 - 23.7 Ohms	5-8	Selected to adjust resistance of RLC network at input of Buffer Amplifier for passband bandwidth of 18 to 32 MHz.

[1] The highest Band available with an HP 8341B is Band 3.

Table 5-3 Adjustment Interdependence Between Assemblies (1 of 3)[2]

Assembly Adjusted or Replaced	Associated Adjustments That Must Be Made	Procedure Paragraphs
A1 Alpha Display	None	
A2 Display Driver	None	
A3 Display Processor	None	
A4 Not Assigned		
A5 Keyboard	None	
A6 Keyboard Interface	None	
A7 Lower Keyboard	None	
A8 3.7 GHz Oscillator	Band 0 ALC Loop Gain	5-11; 5-15, steps 15, 18 through 20.
A9 Band 0 Pulse Modulator	None	
A10 Directional Coupler	Flatness Adjustment	5-16, steps 1 through 17
A11 Bands 1-4[1] Detector	A25R36 and A25R37; High Bands and Band 0 ALC Adjustment; Flatness; ADC Adjustment; Pulse	5-15, steps 1 through 9, 15 through 20; 5-17, 5-18
A12 Band 0 Splitter/ Detector	Band 0 ALC, ADC, Flatness, A25R109, and A25R115	5-15, steps 1 through 4, 10 through 20; 5-17, steps 12 through 23
A13 SYTM	SYTM Tracking and SRD Bias Adjustment	5-14 and 5-16
A14 Band 1-4[1] Power Amp.	SRD Bias and ALC Loop Gain.	5-14 and 5-16, A24 and A26 adjustments only.
A15 Band 0 Low-Pass Filter	None	
A16 Band 1-4[1] Modulator/Splitter	SRD Bias and ALC Loop Gain.	5-14 and 5-16, A24 and A26 adjustments only.
A17 Band 0 Mixer	None	
A18 Band 0 Power Ampl	None	
A19 Capacitor Assembly	None	
A20 RF Section Filter	None	
A21 Pulse Modulator Driver	Pulse Adjustment	5-18

1 The highest Band available with an HP 8341B is Band 3
2. Assemblies which are not listed do not require adjustment

Table 5-3. Adjustment Interdependence Between Assemblies (2 of 3)

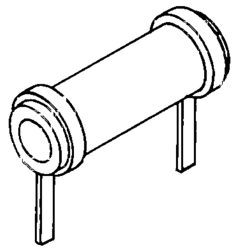
Assembly Adjusted or Replaced	Associated Adjustments That Must Be Made	Procedure Paragraphs
A22 Not Assigned		
A23 FM Driver	FM Gain Adjustment	5-19, steps 1 through 5
A24 Attenuator Driver/SRD Bias	SRD Bias Adjustment	5-14 and 5-16, A24 adjustments only.
A25 ALC Detector	ALC, ADC, Pulse, and External Leveling Adjustment	5-15; 5-17, steps 18 through 23; 5-18.
A26 Linear Modulator	Loop Gain, SRD Bias, Integrator Gate Balance.	5-16; 5-18
A27 Level Control	Flatness, ALC, and ADC Adjustment	5-15 and 5-17.
A28 SYTM Driver	SYTM Tracking and SRD Bias Adjustment	5-14 and 5-16
A29 Reference Phase Detector	None	
A30 100 MHz VCXO	A30C1 thru C4	5-3
A31 M/N Phase Detector	None	
A32 M/N VCO	A32A2C1, A32A2C5	5-4
A33 M/N Output	None	
A34 Reference - M/N Mother Board	None	
A35 Rectifier	+22V Supply	5-1
A36 PLL1 VCO	A36L7, A36L8	5-5, steps 44 thru 61
A37 PLL1 Divider	None	
A38 PLL1 IF	A38L11 thru A38L13.	5-5, steps 62 through 76
A39 PLL3 Upconverter	A39C50, A39L4, L16, L17	5-5 steps 32 through 43
A40 PLL2 VCO	PLL2 Adjustments	5-5, steps 1 through 31
A41 PLL2 Phase Detector	None	
A42 PLL2 Divider	None	
A43 PLL2 Discriminator	PLL2 Adjustments	5-5, steps 1 through 31.

Assembly Adjusted or Replaced	Associated Adjustments That Must Be Made	Procedure Paragraphs
A44 YIG Oscillator	YO Adjustment, Delay Adjustment, and YTM Delay.	5-7; 5-8; 5-9; 5-10; 5-14, steps 32 through 69.
A45 Directional Coupler	Flatness Adjustment	5-17
A46 7 GHz Low-Pass Filter	None	
A47 Sense Resistor Assembly	YO Adjustment and Delay, and YTM Adjustment and Delay.	5-7, 5-10, 5-14, and 5-16.
A48 YO Loop Sampler	Sampler Adjustment	5-8
A49 YO Loop Phase Detector	YO Loop and FM Adjustments	5-8, 5-9
A50 YO Loop Interconnect	None	
A51 Reference Oscillator	10 MHz Standard Adjustment	5-2
A52 Positive Regulator	None	
A53 Negative Regulator	None	
A54 YO Pretune DAC/Delay Compensation	YO Pretune, YO Main Driver, and YO Delay Compensation, SYTM Delay Compensation	5-6, 5-7, 5-10, 5-14 and 5-16
A55 YO Driver	YO Adjustment	5-7.
A56 - 15V Regulator	None	
A57 Marker/Bandcross	Marker Bandcrossing Adjustment	5-12
A58 Sweep Generator	Sweep Generator Adjustment	5-13
A59 Digital Interface	None	
A60 Processor	None	
A61 Not Assigned		
A62 Main Mother Board	None	
A63 90 dB RF Attenuator	Flatness and RF Attenuator Calibration	5-17, steps 1 through 17. For RF Attenuator Calibration, see manual supplement titled "Automated Test Procedures."

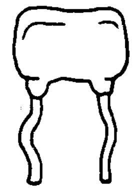
Table 5-4. HP Part Numbers of Standard Value Components (1 of 4)

CAPACITORS

RANGE: 1 to 24 pF
TYPE: Tubular
TOLERANCE:
1 to 9.1 pF = ±.25 pF
10 to 24 pF = ±5%



RANGE: 27 to 680 pF
TYPE: Dipped Mica
TOLERANCE: ±5%



Value (pF)	HP Part Number	CD	Value (pF)	HP Part Number	CD
1.0	0160-2236	8	33	0160-2150	5
1.2	0160-2237	9	36	0160-2308	5
1.5	0150-0091	8	39	0140-0190	7
1.8	0160-2239	1	43	0160-2200	6
2.0	0160-2240	4	47	0160-2307	4
2.2	0160-2241	5	51	0160-2201	7
2.4	0160-2242	6	56	0140-0191	8
2.7	0160-2243	7	62	0140-0205	5
3.0	0160-2244	8	68	0140-0192	9
3.3	0150-0059	8	75	0160-2202	8
3.6	0160-2246	0	82	0140-0193	0
3.9	0160-2247	1	91	0160-2203	9
4.3	0160-2248	2	100	0160-2204	0
4.7	0160-2249	3	110	0140-0194	1
5.1	0160-2250	6	120	0160-2205	1
5.6	0160-2251	7	130	0140-0195	2
6.2	0160-2252	8	150	0140-0196	3
6.8	0160-2253	9	160	0160-2206	2
7.5	0160-2254	0	180	0140-0197	4
8.2	0160-2255	1	200	0140-0198	5
9.1	0160-2256	2	220	0160-0134	1
10.0	0160-2257	3	240	0140-0199	6
11.0	0160-2258	4	270	0140-0210	2
12.0	0160-2259	5	300	0160-2207	3
13.0	0160-2260	8	330	0160-2208	4
15.0	0160-2261	9	360	0160-2209	5
16.0	0160-2262	0	390	0140-0200	0
18.0	0160-2263	1	430	0160-0939	4
20.0	0160-2264	2	470	0160-3533	0
22.0	0160-2265	3	510	0160-3534	1
24.0	0160-2266	4	560	0160-3535	2
27	0160-2306	8	620	0160-3536	3
30	0160-2199	2	680	0160-3537	4

RESISTORS

RANGE: 10 to 464K Ohms
TYPE: Fixed Film
WATTAGE: 125 at 125°C
TOLERANCE: ±1.0%

Value (Ω)	HP Part Number	CD	Value (Ω)	HP Part Number	CD	Value (Ω)	HP Part Number	CD
10.0	0757-0346	2	464	0698-0082	7	21.5K	0757-0199	3
11.0	0757-0378	0	511	0757-0416	7	23.7K	0698-3158	4
12.1	0757-0379	1	562	0757-0417	8	26.1K	0698-3159	5
13.3	0698-3427	0	619	0757-0418	9	28.7K	0698-3449	6
14.7	0698-3428	1	681	0757-0419	0	31.6K	0698-3160	8
16.2	0757-0382	6	750	0757-0420	3	34.8K	0757-0123	3
17.8	0757-0294	9	825	0757-0421	4	38.3K	0698-3161	9
19.6	0698-3429	2	909	0757-0422	5	42.2K	0698-3450	9
21.5	0698-3430	5	1.0K	0757-0280	3	46.4K	0698-3162	0
23.7	0698-3431	6	1.1K	0757-0424	7	51.1K	0757-0458	7
26.1	0698-3432	7	1.2K	0757-0274	5	56.2K	0757-0459	8
28.7	0698-3433	8	1.33K	0757-0317	7	61.9K	0757-0460	1
31.6	0757-0180	2	1.47K	0757-1094	9	68.1K	0757-0461	2
34.8	0698-3434	9	1.62K	0757-0428	1	75.0K	0757-0462	3
38.3	0698-3435	0	1.78K	0757-0278	9	82.5K	0757-0463	4
42.2	0757-0316	6	1.96K	0698-0083	8	90.9K	0757-0464	5
46.4	0698-4037	0	2.15K	0698-0084	9	100K	0757-0465	6
51.1	0757-0394	0	2.37K	0698-3150	6	110K	0757-0466	7
56.2	0757-0395	1	2.61K	0698-0085	0	121K	0757-0467	8
61.9	0757-0276	7	2.87K	0698-3151	7	133K	0698-3451	0
68.1	0757-0397	3	3.16K	0757-0279	0	147K	0698-3452	1
75.0	0757-0398	4	3.48K	0698-3152	8	162K	0757-0470	3
82.5	0757-0399	5	3.83K	0698-3153	9	178K	0698-3243	8
90.0	0757-0400	9	4.22K	0698-3154	0	196K	0698-3453	2
100	0757-0401	0	4.64K	0698-3155	1	215K	0698-3454	3
110	0757-0402	1	5.11K	0757-0438	3	237K	0698-3266	5
121	0757-0403	2	5.62K	0757-0200	7	261K	0698-3455	4
133	0698-3437	2	6.19K	0757-0290	5	287K	0698-3456	5
147	0698-3438	3	6.81K	0757-0439	4	316K	0698-3457	6
162	0757-0405	4	7.50K	0757-0440	7	348K	0698-3458	7
178	0698-3439	4	8.24K	0757-0441	8	383K	0698-3459	8
196	0698-3440	7	9.09K	0757-0288	1	422K	0698-3460	1
215	0698-3441	8	10.0K	0757-0442	9	464K	0698-3260	9
237	0698-3442	9	11.0K	0757-0443	0			
261	0698-3132	4	12.1K	0757-0444	1			
287	0698-3443	0	13.3K	0757-0289	2			
316	0698-3444	1	14.7K	0698-3156	2			
348	0698-3445	2	16.2K	0757-0447	4			
383	0698-3446	3	17.8K	0698-3136	8			
422	0698-3447	4	19.6K	0698-3157	3			

Table 5-4. HP Part Numbers of Standard Value Components (3 of 4)

RESISTORS

RANGE: 10 to 1.47M Ohms
TYPE: Fixed Film
WATTAGE: 5 at 125°C
TOLERANCE: ±1 0%

Value (Ω)	HP Part Number	CD	Value (Ω)	HP Part Number	CD	Value (Ω)	HP Part Number	CD	Value (Ω)	HP Part Number	CD
10.0	0757-0984	4	215	0698-3401	0	4 64K	0698-3348	4	110K	0757-0859	2
11.0	0757-0985	5	237	0698-3102	8	5 11K	0757-0833	2	121K	0757-0860	5
12.1	0757-0986	6	261	0757-1090	5	5 62K	0757-0834	3	133K	0757-0310	0
13.3	0757-0001	6	287	0757-1092	7	6.19K	0757-0196	0	147K	0698-3175	5
14.7	0698-3388	2	316	0698-3402	1	6.81K	0757-0835	4	162K	0757-0130	2
16.2	0757-0989	9	348	0698-3403	2	7.50K	0757-0836	5	178K	0757-0129	9
17.8	0698-3389	3	383	0698-3404	3	8.25K	0757-0837	6	196K	0757-0063	0
19.6	0698-3390	6	422	0698-3405	4	9.09K	0757-0838	7	215K	0757-0127	7
21.5	0698-3391	7	464	0698-0090	7	10.0K	0757-0839	8	237K	0698-3424	7
23.7	0698-3392	8	511	0757-0814	9	12.1K	0757-0841	2	261K	0757-0064	1
26.1	0757-0003	8	562	0757-0815	0	13.3K	0698-3413	4	287K	0757-0154	0
28 7	0698-3393	9	619	0757-0158	4	14.7K	0698-3414	5	316K	0698-3425	8
31 6	0698-3394	0	681	0757-0816	1	16.2K	0757-0844	5	348K	0757-0195	9
34 8	0698-3395	1	750	0757-0817	2	17.8K	0698-0025	8	383K	0757-0133	5
38 3	0698-3396	2	825	0757-0818	3	19 6K	0698-3415	6	422K	0757-0134	6
42.2	0698-3397	3	909	0757-0819	4	21 5K	0698-3416	7	464K	0698-3426	9
46.4	0698-3398	4	1.00K	0757-0159	5	23 7K	0698-3417	8	511K	0757-0135	7
51.1	0757-1000	7	1.10K	0757-0820	7	26 1K	0698-3418	9	562K	0757-0868	3
56.2	0757-1001	8	1.21K	0757-0821	8	28.7K	0698-3103	9	619K	0757-0136	8
61.9	0757-1002	9	1.33K	0698-3406	5	31.6K	0698-3419	0	681K	0757-0869	4
68.1	0757-0794	4	1.47K	0757-1078	9	34.8K	0698-3420	3	750K	0757-0137	9
75.0	0757-0795	5	1.62K	0757-0873	0	38.3K	0698-3421	4	825K	0757-0870	7
82.5	0757-0796	6	1.78K	0698-0089	4	42.2K	0698-3422	5	909K	0757-0138	0
90.0	0757-0797	7	1.96K	0698-3407	6	46.4K	0698-3423	6	1M	0757-0059	4
100	0757-0198	2	2.15K	0698-3408	7	51.1K	0757-0853	6	1.1M	0757-0139	1
110	0757-0798	8	2.37K	0698-3409	8	56.2K	0757-0854	7	1.21M	0757-0871	8
121	0757-0799	9	2.61K	0698-0024	7	61.9K	0757-0309	7	1.33M	0757-0194	8
133	0698-3399	5	2 87K	0698-3101	7	68.1K	0757-0855	8	1.47M	0698-3464	5
147	0698-3400	9	3 16K	0698-3410	1	75.0K	0757-0856	9			
162	0757-0802	5	3 48K	0698-3411	2	82 5K	0757-0857	0			
178	0698-3334	8	3 83K	0698-3412	3	90 9K	0757-0858	1			
196	0757-1060	9	4.22K	0698-3346	2	100K	0757-0367	7			

FIXED COIL					
Tolerance: 10% **Unshielded**					
Value	**HP Part Number**	**CD**	**Value**	**HP Part Number**	**CD**
1 MH	9140-0137	1	390 NH	9100-2254	3
5 MH	9140-0072	3	470 NH	9100-2255	4
10 MH	9140-0131	5	560 NH	9100-2232	7
24 MH	9100-2867	4	680 NH	9140-0141	7
50 NH	9100-2891	4	820 NH	9100-2257	6
51 NH	9135-0073	3	1.2 UH	9100-2258	7
68 NH	9135-0081	3	1.8 UH	9100-2260	1
100 NH	9100-2247	4	2.2 UH	9140-0098	3
120 NH	9100-2248	5	3.3 UH	9140-0111	1
			4.7 UH	9140-0144	0
150 NH	9100-2249	6			
180 NH	9100-2250	9	5 6 UH	9100-1618	1
220 NH	9100-2251	0			
270 NH	9100-2252	1			
330 NH	9100-0368	6			

5-1. +22 VDC POWER SUPPLY, A35

Reference

Performance Test: None
Service Section. Power Supplies

Description

The +22V supply is adjusted for +22 Vdc.

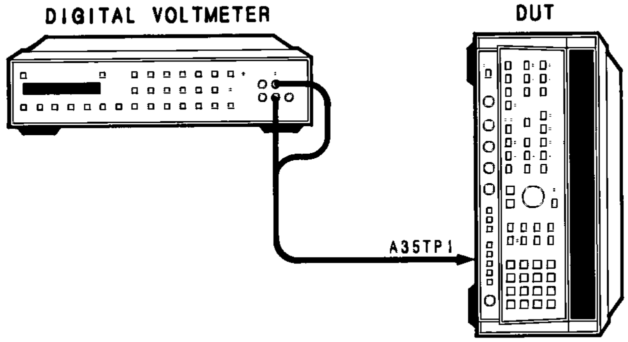


Figure 5-1. +22 Volt Power Supply Adjustments Setup

Equipment

Digital Voltmeter DUM . . . . HP 3456A

Procedure

1. Position DUT in the test position and connect equipment as shown in Figure 5-1.
2. Set LINE switch to ON.
3. The yellow +22V indicator on A35 should be lit.
4. The DVM indication should be +22.000 ±0.010 Vdc. If the indication is out of tolerance, adjust A35R3 +22 ADJ (Figure 5-2) control for the specified voltage.

BOTTOM VIEW

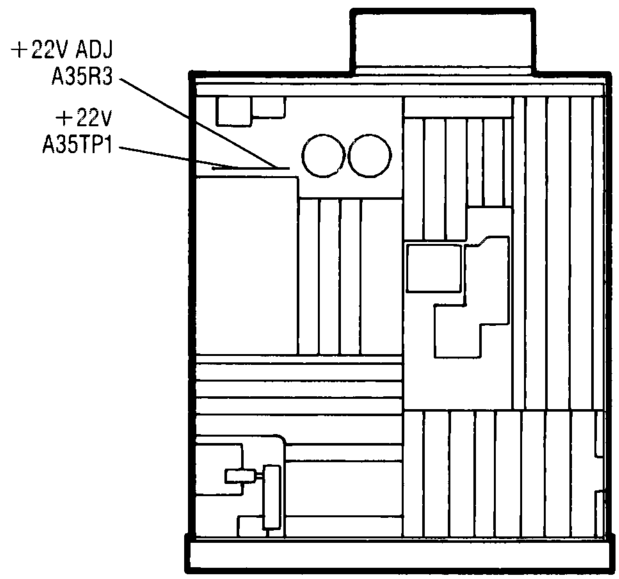


Figure 5-2. +22V Power Supply Adjustment Locations

5-2. 10 MHz STANDARD ADJUSTMENT, A51

Reference

Performance Test: None
Service Section. Reference — M/N Loops

Description

The internal 10 MHz time base is adjusted for frequency accuracy. This procedure does not adjust for long-term drift or aging rate. It adjusts only short-term accuracy. To properly adjust the time base, a frequency standard whose accuracy is known to be better than that of the HP 8340B/41B Time Base is required Refer to Frequency Reference specifications in Section I, Table 1-1 for aging rate specifications for the internal time base (Time base specifications for the HP 8340B and HP 8341B are the same.)

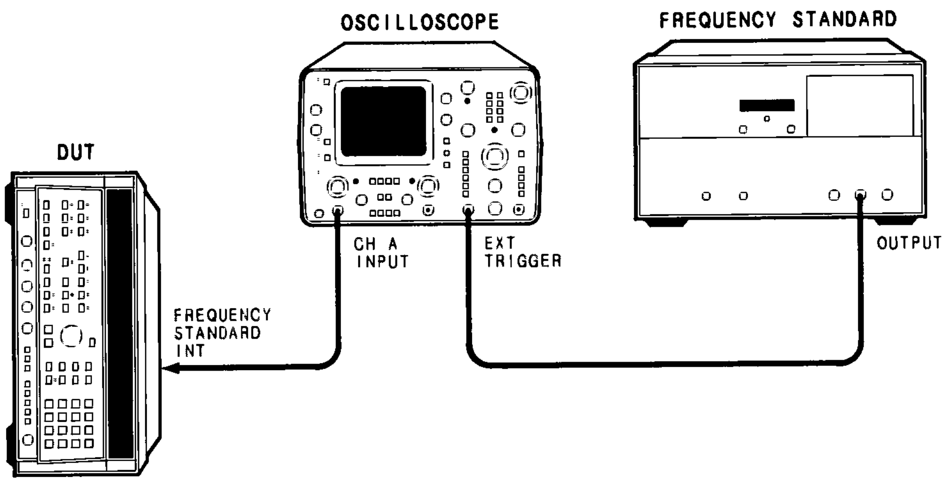


Figure 5-3. 10 MHz Standard Adjustment Setup

Equipment

Oscilloscope .... HP 1741A
Frequency Standard .... any 1, 2, 5, or 10 MHz Frequency Standard
with aging rate of $\pm 1\times10^{-9}$/day or better such as HP 5061A

Procedure

NOTE

Primary power must have been applied to the instrument for at least 30 days before adjusting the internal time base. If the instrument was disconnected from ac power less than 24 hours (after it had its initial 30 day warmup), the warmup time is 24 hours before adjusting internal time base.

NOTE

If front-panel red OVEN annunciator is lighted, do not make internal time base adjustments. This annunciator lights when the oven for the reference crystal oscillator is not at operating temperature; a warm oven that suddenly goes cold has lost power and requires service. Section VIII (Service) describes the action required to repair a faulty oven.

1 Connect equipment as shown in Figure 5-3 as follows:

a. At the DUT, disconnect jumper from rear-panel FREQUENCY STANDARD INT connector.

b. Connect oscilloscope CH A to the DUT's FREQUENCY STANDARD INT connector. (If the oscilloscope being used does not have a 50 Ohm input, connect Channel A through a 50 Ohm feedthrough.)

c. Set switch adjacent to the INT connector to INT position.

d. Connect a frequency standard whose accuracy is known to be better than that of the internal time base, such as an HP 5061A Cesium Beam, to the EXT TRIGGER input of the oscilloscope

e. Set LINE switch to ON.

2. Set oscilloscope controls as follows:

TIME/DIV	0.05 µsec
CHAN A VOLTS/DIV	0.5
MAG x 10 pushbutton	OUT
DISPLAY A pushbutton	IN
TRIGGER COMP A/B	A
INT/EXT trigger pushbutton	IN
EXT Divide By 10	OUT
SWEEP VERNIER control	CAL
TRIGGER HOLDOFF	Fully Counterclockwise
AC/DC trigger pushbutton	OUT (AC)
POS/NEG trigger pushbutton	OUT (POS)
Main TRIGGER LEVEL control	Centered

3. Adjust Main TRIGGER LEVEL control as necessary to display sine wave signal on oscilloscope.

4 Remove dust cap screws used to seal the adjustments from A51 10 MHz Standard. Refer to Figure 5-4 for location of A51 10 MHz Standard.

5. Adjust A51 COARSE frequency adjust for minimum sideways movement of the display signal Adjust A51 FINE frequency adjust for no sideways movement of display signal

6. Observe the sine wave signal on the oscilloscope for 100 seconds. The sine wave trace should move less than 1 cycle or 360 degrees.

7. Disconnect oscilloscope and reinstall dust cover screws over A51 adjustments. Reconnect rear panel cable between FREQUENCY STANDARD INT and EXT connectors.

5-2. 10 MHz STANDARD ADJUSTMENT, A51 (Cont'd)

BOTTOM VIEW

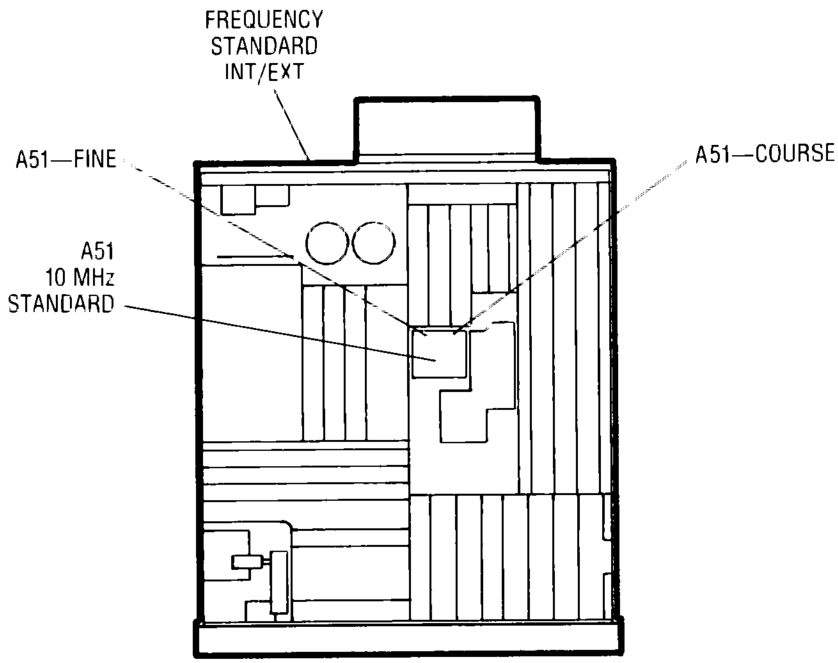


Figure 5-4 10 MHz Standard Adjustments Location

5-3. 100 MHz VOLTAGE-CONTROLLED CRYSTAL OSCILLATOR (VCXO), A30

Reference

Performance Test: None
Service Section: Reference — M/N Loops

Description

The open loop frequency and maximum power output of the 100 MHz VCXO is centered around 100 MHz. The 400 MHz signal is adjusted for maximum 400 MHz output with minimum spurious output. The 400 MHz output is set to −10 dBm by selecting proper resistor values for the attenuator network A30R67, R68, and R69.

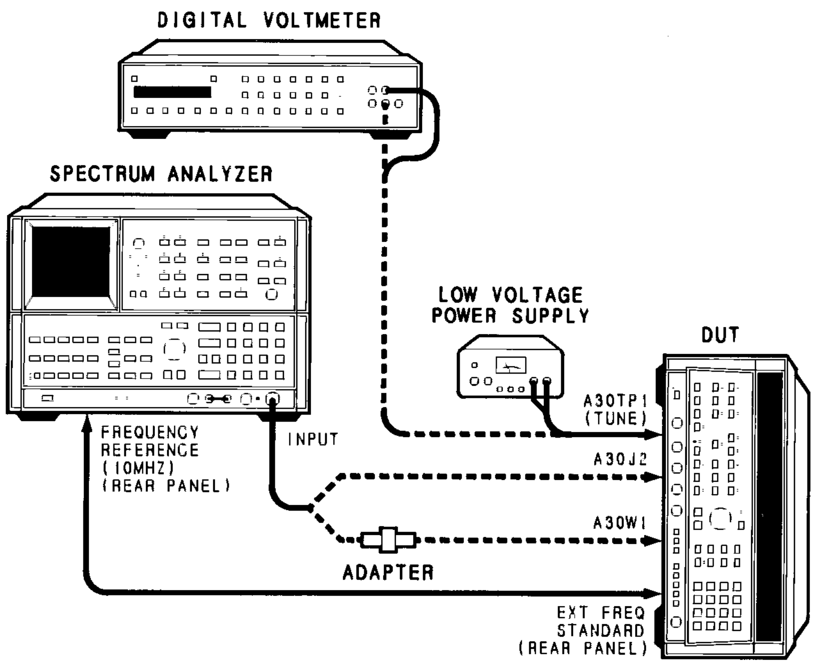


Figure 5-5 100 MHz VCXO Adjustment Setup

Equipment

Spectrum Analyzer	HP 8566B
Digital Voltmeter	HP 3456A
Low-Voltage DC Power Supply	HP 6294A
BNC to SMB Snap-On Test Cable (2 required)	HP P/N 85680-60093
Adapter, SMB Snap-On Male-to-Male	HP P/N 1250-0069

Procedure

1. Position DUT into the Test Position as shown in Figure 5-5 with the bottom cover removed. On the DUT's rear panel, disconnect the BNC cable connected between INT and EXT Frequency Standard connectors, set INT/EXT switch to EXT, then connect a BNC cable from EXT connector to Spectrum Analyzer's Frequency Reference (10 MHz) rear-panel connector. Allow the test equipment to warm up for one-half hour.

2. Set Spectrum Analyzer controls as follows:

CENTER FREQ	100 MHz
REF LEVEL	3 dBm
ATTEN	+20 dB
LOG SCALE	1 dB/DIV
RES BW	300 Hz
VBW	300 Hz
FREQ SPAN	20 kHz
SWEEP TIME	1 SEC.
MARKER ENTRY	Press PEAK SEARCH
MARKER ENTRY	Press MKR → CF
MARKER MODE	Press SIGNAL TRACK

100 MHz OUTPUT ADJUSTMENT

3. On the DUT, set LINE switch to ON and press **[INSTR PRESET]**.
4. At rear panel of the DUT, disconnect the 10 MHz Frequency Standard cable at the EXT FREQUENCY STANDARD connector.
5. Adjust the DC power supply for −8 0V, connect the ground lead to ground and the negative lead to A30TP1 (TUNE). Connect the DVM to A30TP1 (TUNE) and verify that TUNE measures −8 0V Re-adjust the power supply if necessary.

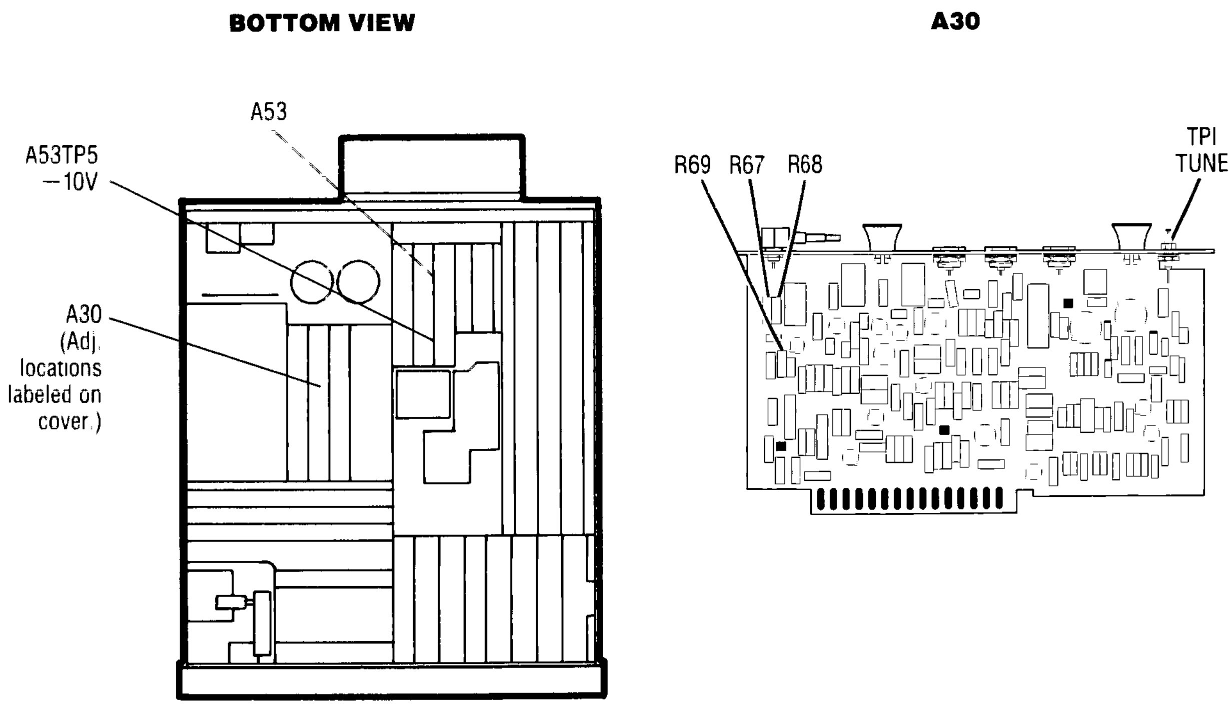


Figure 5-6. Location of A30 100 MHz VCXO Adjustments

6 Disconnect cable W35 from A30J2 100 MHz OUT. Connect Spectrum Analyzer RF Input to A30J2.

7. Adjust A30C4 100 MHz ADJ through its full range while monitoring frequency indication on Spectrum Analyzer. Adjustment should provide a minimum adjustment range of plus and minus 300 Hz centered about 100 MHz. If adjustment does not provide sufficient range, select new values for factory selected components A30C8 and A30L4. A30L4 is used to center the adjustment about 100 MHz and A30C8 is used to adjust the range of A30C4. Refer to Table 5-2 for range of values. Refer to Table 5-4 for HP Part Numbers

8. Adjust A30C4 100 MHz ADJ for Spectrum Analyzer indication of 100.0000 MHz ±0.0001 MHz.

9. Disconnect cable A30W1 at A31J1 400 MHz IN and connect the open end of this cable (A30W1) to the Spectrum Analyzer input using a BNC to SMB Snap-on test cable and SMB male-to-male adapter. Set Spectrum Analyzer controls to view a 400 MHz signal.

10 The 400 MHz output should be −10 dBm ±3 dB.

11. Adjust the DC power supply for 0V at A30TP1 (TUNE). Connect Spectrum Analyzer to A30J2. Adjust Spectrum Analyzer to view 100 MHz.

12. Frequency indication on Spectrum Analyzer should be less than 100 MHz. If not, repeat Steps 2 through 7.

13. Set power supply for an output of −25 Vdc Verify TUNE test point A30TP1 is at −25 Vdc.

14. Frequency indication on Spectrum Analyzer should be greater than 100 MHz. If not, repeat Steps 2 through 7 and verify that the oscillator's range is 100 MHz ±300 Hz. Disconnect power supply from A30TP1. Reconnect 10 MHz signal cable from Spectrum Analyzer to the DUT's rear-panel EXT FREQUENCY STANDARD.

400 MHz OUTPUT ADJUSTMENT

15 Set Spectrum Analyzer to 500 MHz center frequency and 100 MHz frequency span per division.

16. Connect Spectrum Analyzer to A30W1 cable. Adjust A30C3, A30C2, and A30C1 400 MHz adjustments, in that order, to maximize the 400 MHz signal's output power and minimize all harmonics of 100 MHz. The 400 MHz signal should be −10 dBm ±3dB and the harmonics at 100, 300, 500, 600, 700, and 900 MHz must be greater than 40 dB down from the 400 MHz signal. Harmonics at 200 MHz must be greater than 25 dB down from the 400 MHz signal. Harmonics at 800 MHz must be greater than 15 dB down from the 400 MHz signal. It may be necessary to perform the adjustments more than once This should be done in the order stated each time through the adjustments.

17. The amplitude of the 400 MHz signal should be −10 dBm ±3 dB. This amplitude is set by selecting attenuator network resistors A30R67, A30R68, and A30R69.

18. If the amplitude of the 400 MHz signal is not within 3 dB of −10 dBm, note the amplitude and change the values of A30R67, A30R68, and A30R69 as necessary to adjust the amplitude to −10 dBm ±3 dB. Table 5-5 contains a list of attenuations in 1 dB steps and the corresponding values for the attenuator network resistors to adjust the level to −10 dBm. Refer to Figure 5-6 for location of resistors.

19 Check the level of the 100 MHz harmonics as displayed on the Spectrum Analyzer. Harmonics at 100, 300, 500, 600, 700, and 900 MHz must be greater than 40 dB down from the 400 MHz signal. Harmonics at 200 MHz must be greater than 25 dB down from the 400 MHz signal. Harmonics at 800 MHz must be greater than 15 dB down from the 400 MHz signal. If not, repeat step 15.

Table 5-5. Selection Chart for Attenuator Resistors

Attenuation (dB)	Resistors (Ohms)		
	R67	**R68**	**R69**
0	Open	Short	Open
1	825	6.8	825
2	422	12.1	422
3	261	17.8	261
4	215	23.7	215
5	178	31.6	178
6	162	38.3	162
7	133	46.4	133
8	121	51.1	121
9	110	61.9	110

NOTE

HP Part Numbers for resistors may be found in Table 5-5.

20 Set the DUT's LINE switch to STANDBY Disconnect equipment from the DUT and reconnect the two cables Disconnect the 10 MHz Frequency Standard cable at the rear of the DUT, reconnect jumper cabled between INT and EXT, and set switch to INT Set the DUT's LINE switch to ON

5-4. M/N LOOP, A32, A33, and A32A1

Reference

Performance Test. Frequency Range and CW Mode Accuracy
Service Section. Reference — M/N Loops

Description

The M/N VCO tuning range is centered and the output level is set and checked to ensure an adequate RF output level across the band of the M/N output

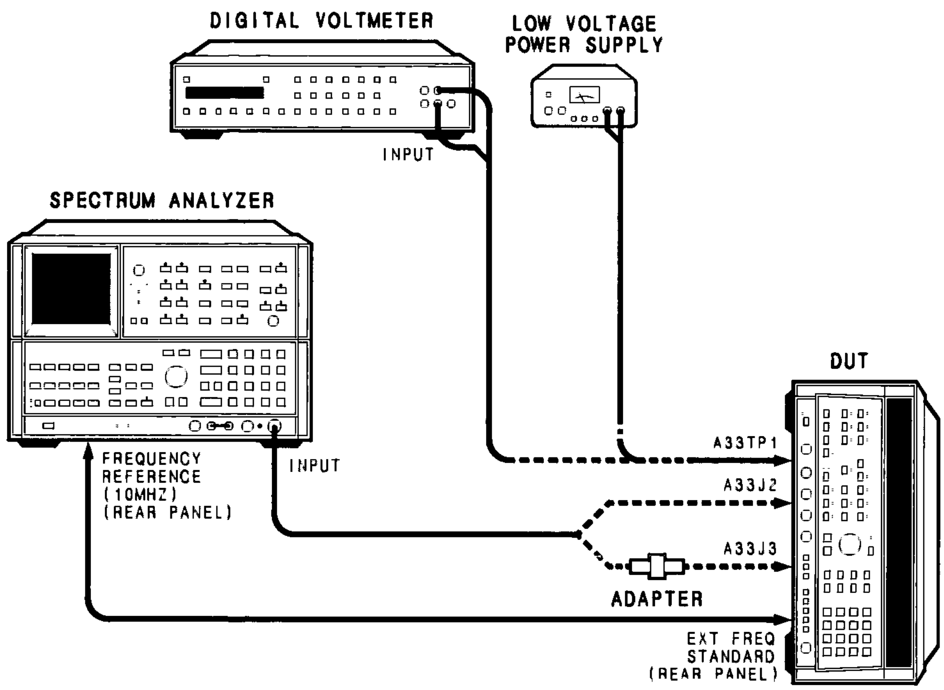


Figure 5-7. M/N Loop Adjustment Setup

Equipment

Spectrum Analyzer	HP 8566B
Digital Voltmeter (DVM)	HP 3456A
Low-Voltage DC Power Supply	HP 6294A
BNC to SMB Snap-On Test Cable	HP P/N 85680-60093
Adapter, SMB Snap-On Male-to-Male	HP P/N 1250-0069

Procedure

1. Position the DUT in the test position as shown in Figure 5-7 with bottom cover removed. On the DUT's rear panel, disconnect the BNC cable connected between INT and EXT Frequency Standard connectors, set INT/EXT switch to EXT, then connect a BNC cable from the DUT's EXT connector to Spectrum Analyzer Frequency Reference (10 MHz) rear-panel connector. Allow one-half hour warm up time.

2. Set LINE switch to ON and press **[INSTR PRESET]**. Connect a jumper between A59TP4 DL1 and A59TP5 +5V to disable the UNLK indicator circuit.

3. Press **[CW]** on the DUT, then enter **[6] [0] [9] [0] [MHz]**.

4. Disconnect the cable from A33J2 M/N OUT and connect this output to Spectrum Analyzer RF INPUT. Set the Spectrum Analyzer as follows:

CENTER FREQ	197.419 MHz
REF LEVEL	3 dBm
ATTEN	+20 dB
LOG SCALE	1 dB/DIV
RES BW	300 Hz
VBW	300 Hz
FREQ SPAN	5 kHz
SWEEP TIME	1 SEC.
MARKER ENTRY	Press PEAK SEARCH
MARKER ENTRY	Press MKR → CF
MARKER MODE	Press SIGNAL TRACK

5. The M/N output frequency indicated on Spectrum Analyzer should be 197.419 MHz ±1 count

NOTE

To display the frequencies that the processor programs, press [SHIFT] [M1] on the DUT. It will display from left to right: the M divide number, the N divide number, the M/N output frequency, and the 20/30 output frequency.

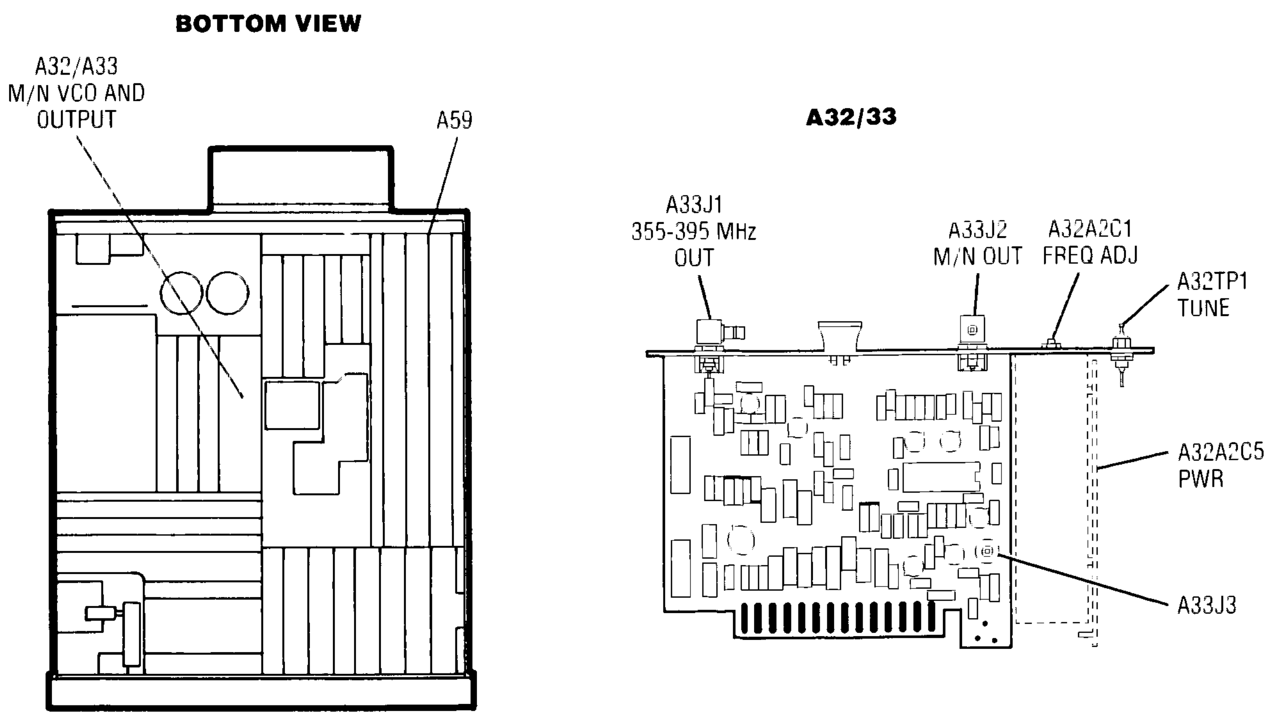


Figure 5-8. Location of M/N Loop Adjustments

5-4. M/N LOOP, A32, A33, AND A32A1 (Cont'd)

6. Connect DVM to A32TP1 TUNE test point. Refer to Figure 5-8 for location of A32 assembly.
7. Loosen locknut on A32A2C1 FREQ ADJ control and adjust A32A2C1 for a DVM reading of −35 0 Vdc ±0.5 Vdc. Retighten A32A2C1 locknut. Verify that DVM reading is still within tolerance.
8. Press **[CW]** on the DUT, then enter **[2] [3] [0] [0] [MHz]**
9. Turn the Spectrum Analyzer's Signal Track off and then set the Spectrum Analyzer for a Center Frequency of 179 230 MHz. Turn the Signal Track on. The frequency indicated on Spectrum Analyzer should be 179 230 MHz ±1 count and the DVM should read −2.8 Vdc ± 1.0 Vdc.
10. Set the DUT's LINE switch to STANDBY.
11. Disconnect the DVM from the A32 assembly. Remove the A32/A33 assembly from the instrument and place it on an extender board.
12. Disconnect the A32 output cable A32A1W1 from A33J3 (Figure 5-8) and connect this cable using SMB male-to-male adapter to the input of the Spectrum Analyzer. Set the DUT's LINE switch to ON and press **[INSTR PRESET]**
13. Turn the Spectrum Analyzer's Signal Track off and then set the Spectrum Analyzer Center Frequency to 375 MHz, the Frequency Span to 100 MHz, Log Scale 5dB/Division, and the Reference Level to +5 dBm.

CAUTION

Do not apply a positive voltage to A32TP1 or damage may occur to the VCO tuning diodes.

14. Connect the low-voltage power supply to the DUT as follows: Positive lead to ground (do this first). Negative lead to A32TP1 TUNE test point. Set the output of the supply for −35.0 Vdc ±0.5 Vdc.
15. Adjust A32A2C5 PWR for a VCO output level of 0 dBm ±2 dB as indicated on Spectrum Analyzer. Refer to Figure 5-8 for location of adjustment.
16. Slowly reduce the voltage output of the external low-voltage power supply connected to A32TP1 TUNE test point while monitoring the VCO output level on the Spectrum Analyzer and voltage level on DVM.
17. The VCO output level should be greater than −2 dBm between 395 MHz (−35 Vdc) and 355 MHz (−2.8 Vdc).
18. Repeat Steps 2 through 9 to check frequency accuracy.
19. Set the DUT's LINE switch to STANDBY Disconnect all the test equipment from the A32/A33 assembly. Reconnect the cable A32A1W1 to A33J3.
20. Reinstall the A32/A33 M/N Output Assembly and remove the jumper from A59TP4 to A59TP5 (UNLK indicator disable).
21. Disconnect the cable from the DUT's rear-panel EXT FREQUENCY STANDARD, reconnect the BNC cable between the INT and EXT connectors, and set the adjacent switch to INT.

5-5. 20/30 LOOP PHASE LOCK, A36, A38, A39, A40, AND A43

Reference

Performance Test: Frequency Range and CW Mode Accuracy
Service Section: 20/30 Loops

Description

hase Lock Loop 2 is adjusted by selecting a very narrow span width and adjusting A40 and A43 for proper voltages at designated test points. If PLL2 will not phase lock (UNLK indicator is lit and **[SHIFT] [EXT]** diagnostic indicates N2 is at fault), the A41 PLL2 Phase Detector must be disabled and a slightly different procedure used to initially set the A40 and A43 adjustments.

Phase Lock Loop 3 is adjusted for maximum multiplier output level at 160 MHz. The VCO is adjusted by setting up proper voltage levels at A39TP3.

Phase Lock Loop 1 40 kHz LPF is properly adjusted using a function generator and spectrum analyzer with an active probe. The response of PLL1 is adjusted for maximum rejection of signals between 160 and 166 MHz using a signal generator and spectrum analyzer.

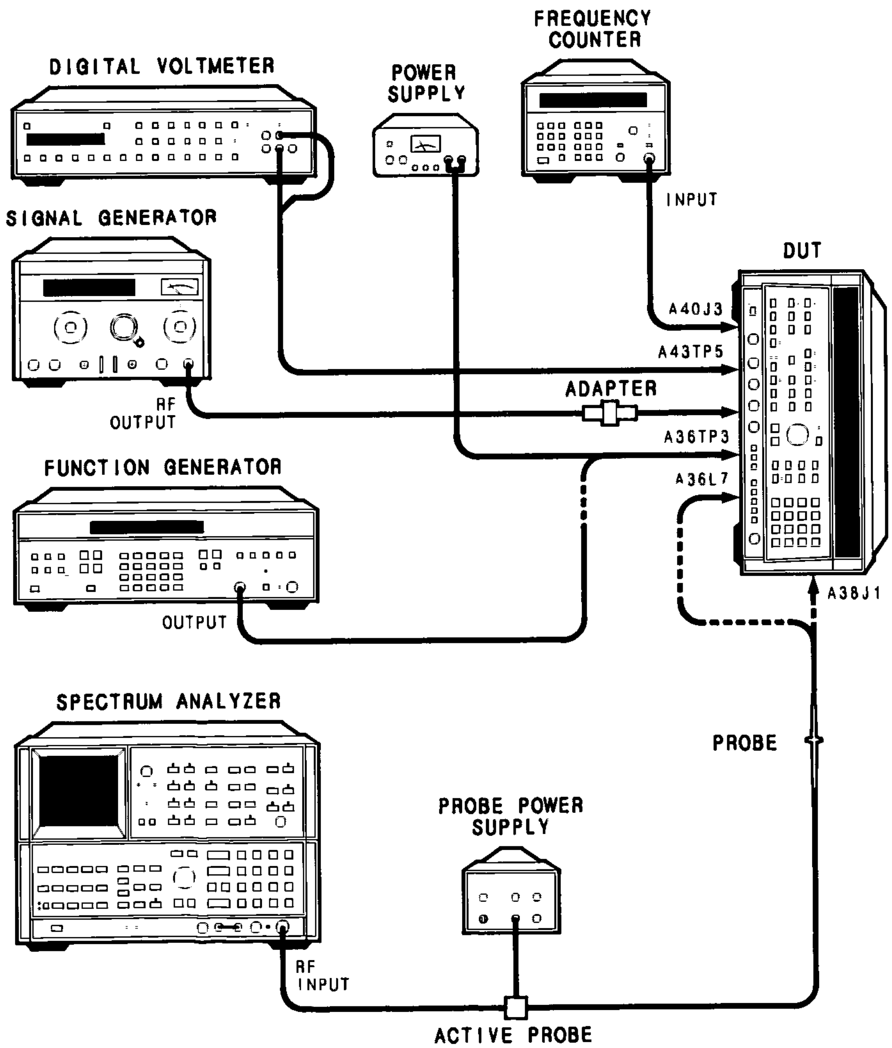


Figure 5-9. 20/30 Loop Phase Lock Adjustments Setup

Equipment

Frequency Counter	HP 5343A
Spectrum Analyzer	HP 8566B
Active Probe	HP 1121A
Probe Power Supply	HP 1122A
Signal Generator	HP 8654A
Low-Voltage DC Power Supply	HP 6294A
Digital Voltmeter (DVM)	HP 3456A
Function Generator	HP 3325A
BNC to SMB Snap-On Test Cable	HP 85680-60093
Adapter, SMB Snap-On Male-to-Male	HP 1250-0069

Procedure

PHASE LOCK LOOP 2

NOTE

If PLL2 is phase locked (UNLK annunciator not lit), proceed to step 12. If the UNLK annunciator is lit, determine if PLL2 (N2) is phase locked as follows: (a) Press [SHIFT] then [EXT], (b). Observe ENTRY display and if N2 is blinking, PLL2 is unlocked. With PLL2 unlocked, proceed to step 1. If some other oscillator circuit caused the UNLK indication, proceed to step 12.

1. Position the DUT in test position as shown in Figure 5-9 with bottom cover removed and allow one-half hour warm up time Set LINE switch to STANDBY Remove A41 PLL2 Phase Detector from its connector on the motherboard. (It is not necessary to completely remove the A41 assembly from the instrument)
2. Set the LINE switch to ON and press **[INSTR PRESET]**.
3. Remove the cable from A40J3 (.15 - 6 MHz OUT FOR $\Delta F \leq .1$ MHz) and connect the Frequency Counter to A40J3 using a BNC to SMB snap-on test cable.
4. Press **[CW]** then enter **[3] [0] [MHz]** to set the N2 oscillator to 150 MHz
5. Connect the DVM to A43TP5 (VCO TUNE) located on top cover of A43.
6. Adjust A40R2 (150 MHz) for a DVM indication of +3.0 Vdc ±0.5 Vdc. Refer to Figure 5-10 for location of adjustments.
7. Adjust A43R9 (.3 MHz) for a DVM indication of 0 300 MHz ±0.001 MHz (N2 frequency divided by 500).
8. Press **[CW]** then enter **[1] [9] [.] [9] [9] [9] [9] [9] [9] [MHz]** to set the N2 oscillator to 100 MHz.
9. Adjust A40R4 (100 MHz) for a DVM indication of +15.0 Vdc ±0.5 Vdc.
10. Adjust A43R41 (.2 MHz) for a frequency Counter indication of 0.200 MHz ±0 001 MHz (N2 frequency divided by 500).

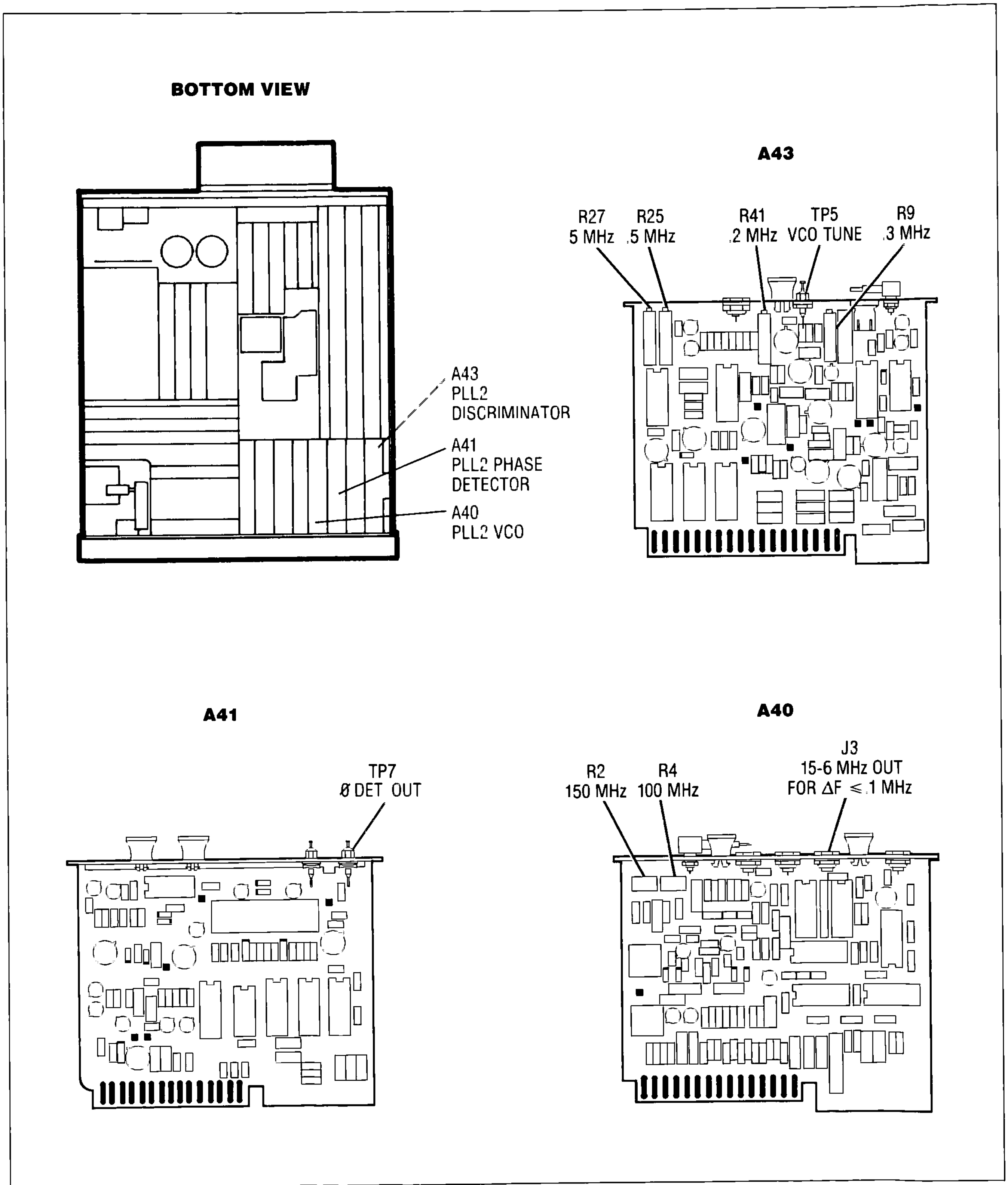


Figure 5-10. Location of PLL2 Adjustments

11. Set the LINE switch to STANDBY. Reinstall A41 (PLL2 Phase Detector). Disconnect the Frequency Counter from A40J3 and reconnect the A39W1 cable to A40J3 (15 - 6 MHz OUT FOR ΔF ≤.1MHz) connector.
12. Set the LINE switch to ON. Press **[INSTR PRESET]**.
13. Press **[CW]** then enter **[3] [0] [MHz]** to set the N2 oscillator to 150 MHz.
14. Connect the DVM to A43TP5 (VCO TUNE) located on the top cover of A43
15. Adjust A40R2 (150 MHz) for a DVM indication of +3.00 Vdc ±0.05 Vdc.
16. Connect the DVM to A41TP7 (ϕ DET OUT) on the top cover of A41.
17. Adjust A43R9 (.3 MHz) for a DVM indication of +3.50 Vdc ± 0.05 Vdc
18. Press **[CW]** then enter **[1] [9] [.] [9] [9] [9] [9] [9] [9] [MHz]** to set the N2 oscillator to 100 MHz.
19. Connect the DVM to A43TP5 (VCO TUNE) located on the top cover of A43.
20. Adjust A40R4 (100 MHz) for a DVM indication of +15.00 Vdc ±0.05 Vdc.
21. Connect the DVM to A41TP7 (ϕ DET OUT) located on the top cover of A41.
22. Adjust A43R41 (.2 MHz)for a DVM indication of 3.50 Vdc ±0.05 Vdc.
23. Repeat Steps 12 through 22 until no further adjustment is required.
24. Set the Spectrum Analyzer as follows:
    a. Press **[INSTR PRESET]**
    b. Set CENTER FREQ to 29.5 MHz
    c. Set SPAN to 200 kHz
25. Connect jumper between A59TP4 (DL1) and A59TP5 (±5V) to disable the UNLK indicator circuit.
26. Set the DUT as follows:
    a. Press **[INSTR PRESET]**
    b. Press **[START FREQ]** then enter **[2] [0] [MHz]**
    c. Press **[STOP FREQ]** then enter **[2] [0] [.] [5] [MHz]**
    d. Press **[SHIFT]**, then **[XTAL]** (This stops the frequency at end of the sweep without a retrace.)
    e. Press **[SINGLE]** Sweep
27. Disconnect the cable W39 from A36J1 (OUT 20-30 MHz) and connect the Spectrum Analyzer (RF INPUT) to A36J1 through an SMB snap-on to BNC cable. Adjust A43R25 (0.5 MHz ΔF) to center the signal on the Spectrum Analyzer screen.
28. Set the Spectrum Analyzer as follows.
    a. Set CENTER FREQ to 25 MHz
    b. Set SPAN to 500 kHz

29. Set the DUT as follows:

    a. Press **INSTR PRESET]**
    b. Press **[START FREQ]** then enter **[2] [0] [MHz]**
    c. Press **[STOP FREQ]** then enter **[2] [5] [MHz]**
    d. Press **[SHIFT]**, then **[XTAL]**
    e. Press **[SINGLE]** Sweep

30. Adjust A43R27 (5 MHz ΔF) to center the signal on the Spectrum Analyzer screen.

31 Disconnect the Spectrum Analyzer from A36J1 and reconnect W39 to A36J1 (OUT 20-30 MHz).

PHASE LOCK LOOP 3

32. Set the LINE switch to STANDBY. Remove A39 (PLL3 Up Converter) and install it on an extender board.

33 Set the LINE switch to ON. Press **[INSTR PRESET]**. Press **[CW]** then enter **[5] [GHz]**. Press **[SHIFT] [M3]** to display the PLL2 and PLL3 frequencies.

34. Connect the Spectrum Analyzer to the Test Connector A39J3 on the P.C. board. Tune the Spectrum Analyzer center frequency to 160 MHz. Set the reference level to −20 dBm and set the scale to 1 dB per division.

35. Adjust A39L16, A39L17, and A39C50 (160 MHz PEAK) for maximum signal level at 160 MHz. Iteration of L16 and L17 adjustment may be necessary. Refer to Figure 5-11 for location of adjustments.

    If A39C50 does not have sufficient range, select the value of A39C49 for proper range. (Refer to Table 5-2.)

36. At the DUT, select the following:

    a. Press **[CF]** then enter **[6] [.] [6] [2] [7] [2] [5] [0] [GHz]**
    b. Press **[ΔF]** then enter **[1] [0] [0] [kHz]**.
    c. Press **[SINGLE]** Sweep

37. Tune the Spectrum Analyzer to a center frequency of 6 MHz. Set the scale to 10 dB per division.

38. The 6 MHz signal displayed should be at least −42 dBm. If not, repeat Steps 33 through 37.

39. Connect the DVM to A39TP3.

40. Adjust A39L11 (PLL3 VCO ADJ) for a DVM indication of −7.5 Vdc ±0.1 Vdc. The voltage may not change with initial adjustment but will change once the phase lock loop locks.

41. Press **[CF]** on the DUT then enter **[5] [GHz]**. Press **[SINGLE]** SWEEP to initiate a sweep.

42. The DVM indication should be −6.7 Vdc ±0.5 Vdc

43. Set the LINE switch to STANDBY. Disconnect the test equipment and reinstall A39 (PLL3 UP Converter) in the instrument.

PHASE LOCK LOOP 1

44. Set the LINE switch to STANDBY. Place A36 (PLL1 VCO) on an extender board. Remove all cables connected to A36.

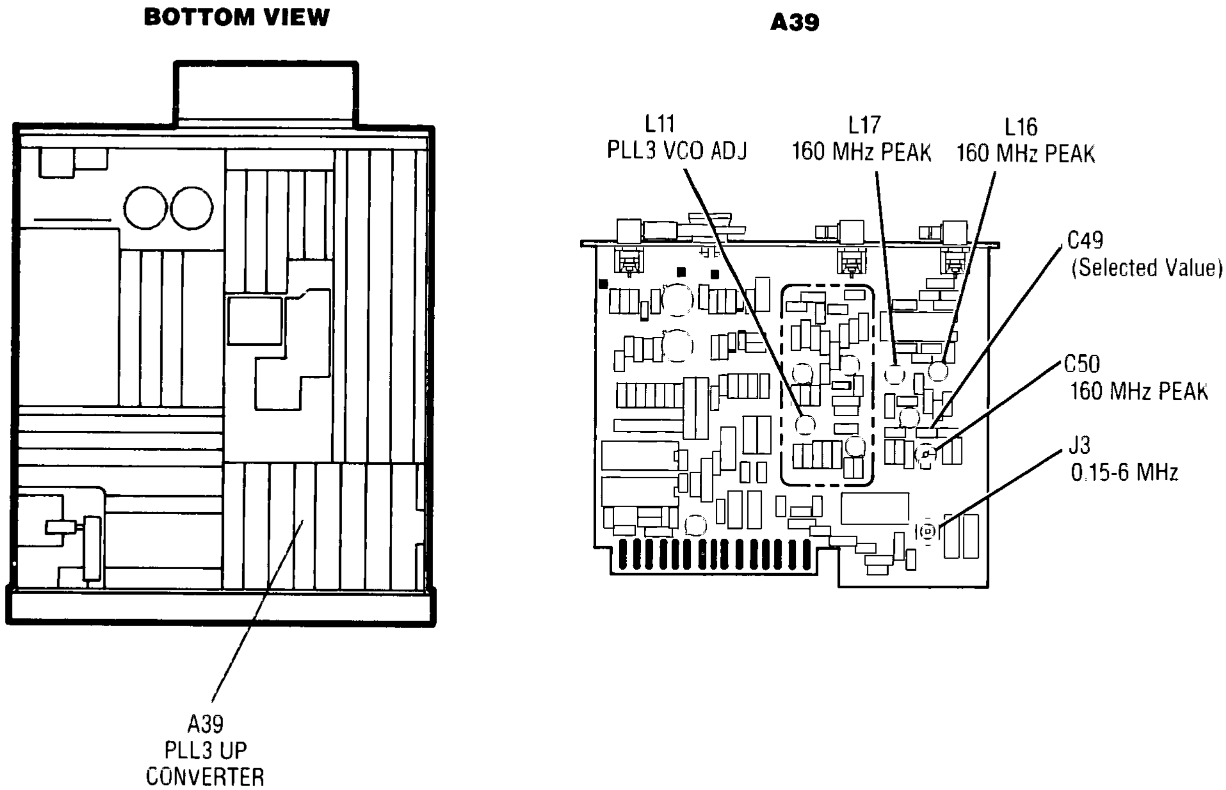


Figure 5-11. Location of PLL3 Adjustments

45. Set the Function Generator controls as follows:

FUNCTION	Sine Wave
FREQ	20 kHz
AMPL	−7.7 dBm

46. Set the Spectrum Analyzer controls as follows.

INSTR PRESET	Press
START FREQ	10 kHz
STOP FREQ	60 kHz
REFERENCE LINE	0 dBm
RES BW	300 Hz
VIDEO BW	1 kHz
SWEEP TIME	1.2 SEC
SCALE	10 dB/DIV
MARKER MODE	NORMAL

47. Set the Spectrum Analyzer Marker to 20 kHz.

48. Connect the active probe to the Spectrum Analyzer input and connect the probe to the output of the 40 kHz LPF on A36 (see Figure 5-13). (This is the terminal on A36L7 next to A36C24.)

49. Connect the Function Generator to A36TP3. Adjust the Function Generator amplitude to place the 20 kHz signal displayed on the Spectrum Analyzer at the 0 dBm reference line.

50. Set the Function Generator to 50 kHz.

51. Set the Spectrum Analyzer Marker at 50 kHz.

52. Adjust A36L7 and A36L8 (50 kHz NULL) to null the 50 kHz signal displayed on the Spectrum Analyzer. Refer to Figure 5-12 for location of adjustments.

53. Note the level of the 50 kHz signal. This level should be at least 65 dB down from the level of the 20 kHz response. Disconnect the test equipment from the A36 assembly.

54. Disconnect the active probe from the Spectrum Analyzer and connect the Spectrum Analyzer input to A36J2 (OUT 200-300 MHz) using a BNC to SMB snap-on test cable. Set the LINE switch to ON

55. Set the Spectrum Analyzer as follows.

INSTR PRESET	Press
START FREQ	150 MHz
STOP FREQ	470 MHz
REF LINE	+10 dBm
MARKER	PEAK SEARCH

56. Connect an external low-voltage dc power supply positive lead to A36TP3 and the negative lead to any convenient chassis ground. Set the external power supply for +16.0 Vdc ± 0.1 Vdc

57. The Oscillator frequency should be 310 MHz ±10 MHz as indicated on the Spectrum Analyzer. If not, remove the metal shield from A36 and increase or decrease the spacing between turns of A36L4 and increase or decrease the area of the single turn of A36L5 to properly tune the oscillator.

58. Change the power supply voltage to +4.0 Vdc ±0.1 Vdc.

59. The Oscillator frequency should drop below 200 MHz with an amplitude greater than −7 dBm.

60. Repeat Steps 56 through 59 if necessary to meet requirements.

61. Set the LINE switch to STANDBY. Reinstall the metal shield on A36 if it was removed, reinstall A36 (PLL1 VCO) in the instrument, and reconnect all cables.

62. Remove A38 (PLL1 IF) from the instrument and install it on an extender board. Connect all the cables to A38.

63. Set the LINE switch to ON and press **[INSTR PRESET]**. Press **[CW]** then enter **[1] [3] [.] [9] [7] [MHz]**

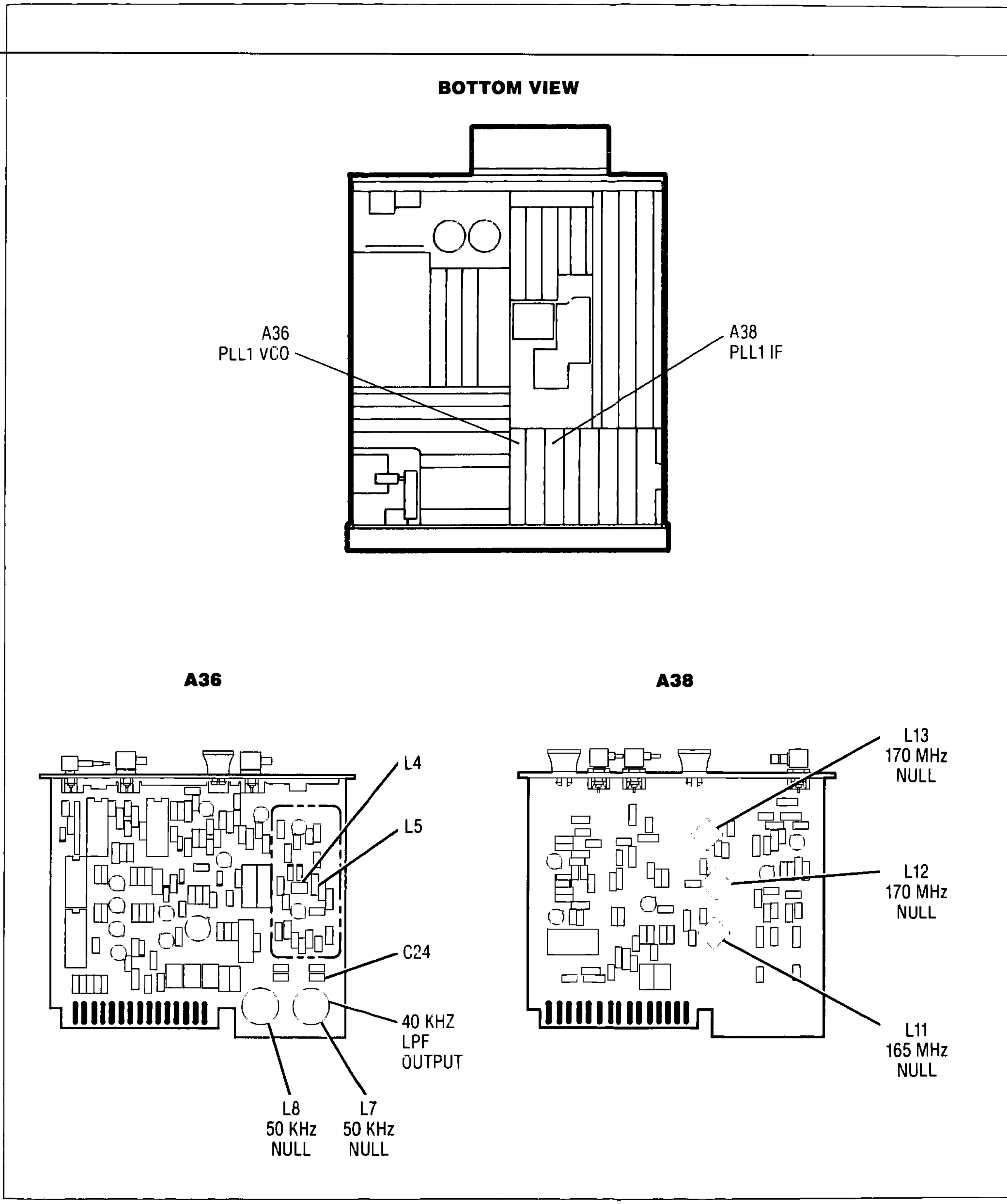


Figure 5-12. Location of PLL1 Adjustments

64. Connect the Spectrum Analyzer to A38J1 (OUT PLL1) IF. Set the Spectrum Analyzer controls as follows:

INSTR PRESET	Press
CENTER FREQ	170 MHz
FREQ SPAN	200 kHz
RES BW	3 kHz
VBW	3 kHz
SWP	100 ms
REF LEVEL	−10 dBm
ATT	0 dB
SCALE/DIV	10 dB/DIV
MARKER	NORMAL

65. Disconnect the cable from A36J2 (OUT 200 - 300 MHz) and connect the cable to the Signal Generator using a BNC to SMB snap-on test cable and adapter.

66. Adjust A38L11 (165 MHz NULL), A38L12 (160 MHz NULL), and A38L13 (170 MHz NULL) fully clockwise.

67. Set the Signal Generator for an output of 330.3 MHz ±0.2 MHz at 0 dBm.

68. Adjust A38L13 (170 MHz NULL) to null the 170 MHz signal on the Spectrum Analyzer.

69. Change the Signal Generator frequency to 325.3 MHz ±0.2 MHz. Set the Spectrum Analyzer CENTER FREQ to 165 MHz.

70. Adjust A38L11 (165 MHz NULL) to null the 165 MHz signal on the Spectrum Analyzer.

71. Change the Signal Generator frequency to 320.3 MHz ± 0.2 MHz. Set the Spectrum Analyzer CENTER FREQ to 160 MHz.

72. Adjust A38L12 (160 MHz NULL) to null the 160 MHZ signal on the Spectrum Analyzer.

73. Set the Spectrum Analyzer CENTER FREQ to 140 MHz. Tune the Signal Generator to 300.3 MHz ±0.2 MHz. Note the amplitude of the 140 MHz response on the Spectrum Analyzer.

74. Set the Spectrum Analyzer as follows:

INSTR PRESET	Press
START FREQ	130 MHz
STOP FREQ	170 MHz
MARKER	NORMAL
MARKER frequency	140 MHz

Slowly tune the Signal Generator from 320.3 to 326.3 MHz while monitoring the display on the Spectrum Analyzer.

75. The amplitude of the signal response between 160 and 166 (Signal Generator frequency of 320.3 to 326.3 MHz) should be at least 60 dB below the response at 140 MHz (Signal Generator frequency of 300.3 MHz) noted in Step 73.

76. Set the LINE switch to STANDBY. Reinstall A38 (PLL1 IF) in the instrument and reconnect all the cables.

5-6. YO PRETUNE DAC, A54

Reference

Performance Test: None
Service Section: Sweep Generator — YO Loop

Description

This procedure makes gain and offset adjustments to the pretune voltage such that the lowest output voltage from the DAC will tune the YO to its lowest frequency (2.3 GHz), and the highest voltage out of the DAC (full scale) will tune the YO to its highest frequency (7 GHz).

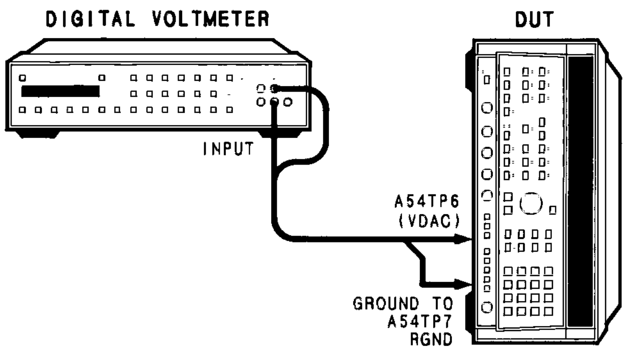


Figure 5-13. YO Pretune DAC Gain Test Setup

Equipment

Digital Voltmeter (DVM) .... HP 3456A

Procedure

1. Position the DUT in the test position as shown in Figure 5-13 with bottom cover removed and turn the LINE switch on. Connect the test equipment as shown in Figure 5-13 and allow one-half hour warm up time. Be sure to connect DVM ground to A54TP7 RGND.

2. Set the DUT as follows:

   a Press **[INSTR PRESET]**
   b. Press **[CW]** then enter **[2] [.] [3] [GHz]** to tune the YO to 2 3 GHz (minimum DAC output).

3. Connect the DVM to A54TP6 (VDAC) and adjust A54R22 (POFF, Figure 5-14) for −5.75 ±0.001 Vdc.

4. Press **[CW]** on the DUT, then enter **[6] [9] [9] [9] [.] [9] [9] [9] [9] [9] [MHz]** to set the YO close to 7 GHz (maximum DAC output).

5. Adjust A54R14 (PGN, Figure 5-14) for −17.5 ±0 001 Vdc

BOTTOM VIEW

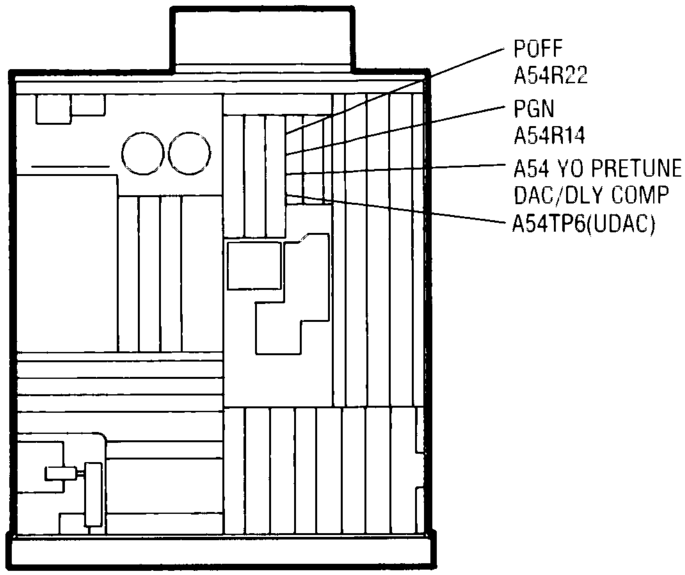


Figure 5-14. YO Pretune DAC Gain Adjustments Location

5-7. YO MAIN DRIVER, A55

Reference

Performance Test: None
Service Section: Sweep Generator — YO Loop

Description

The Main Coil Driver circuit gain and offset are adjusted for the correct output frequency.

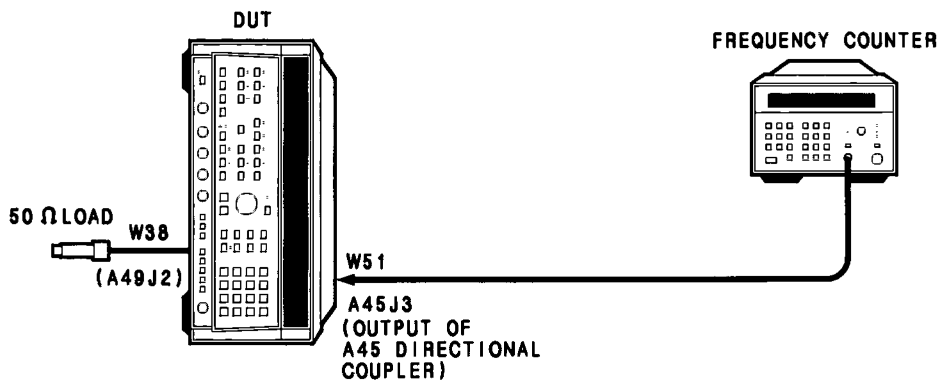


Figure 5-15. YO Main Driver A55 Test Setup

Equipment

Frequency Counter	HP 5343A
50Ω Termination, SMB(f)	HP P/N 1250-0676
Adapter, SMB (m) to SMB (m)	HP P/N 1250-0669

Procedure

1. Position the DUT in the test position as shown in Figure 5-15 with top and bottom covers removed. Remove W3 (Figure 5-17) and connect the frequency counter to W51 as shown in Figure 5-15. Allow one-half hour for warm up time.

2. Remove cable W38 from A49J2 and connect a 50 Ohm load to the end of the cable

3 Set the DUT as follows:

   a. Press **[INSTR PRESET]**
   b. Press **[CW]** then enter **[2] [.] [3] [GHz]**.

4. Adjust A55R47 (OFFSET, Figure 5-16) for an indication of 2.3 GHz ±1 MHz on the Frequency Counter.

5. Press the DUT's **[CW]** key, then enter **[6] [.] [9] [9] [9] [GHz]**.

6. Adjust A55R4 (GAIN, Figure 5-16) for an indication of 6.999 GHz ±1 MHz on the Frequency Counter.

7. Repeat steps 3 through 6 until no further adjustments are necessary.

8. Disconnect the Frequency Counter and reconnect W3 to W51 (Figure 5-17). Remove 50 Ohm load from cable W38 and reconnect the cable to A49J2.

BOTTOM VIEW

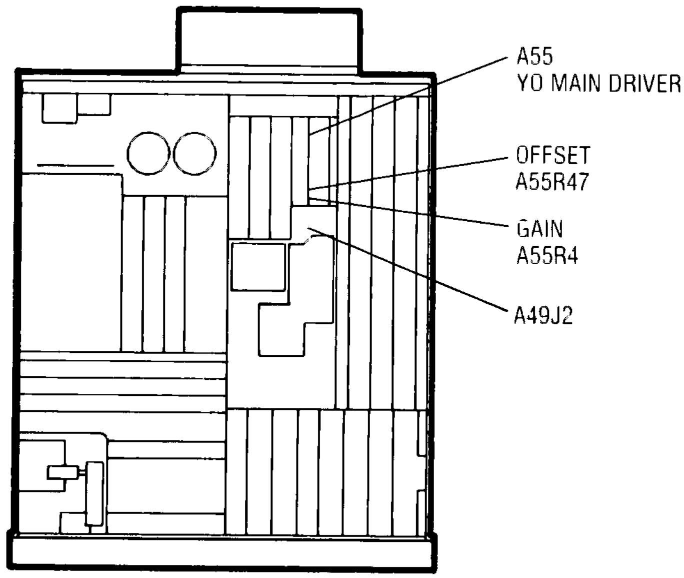


Figure 5-16. YO Main Driver A55 Adjustments Location

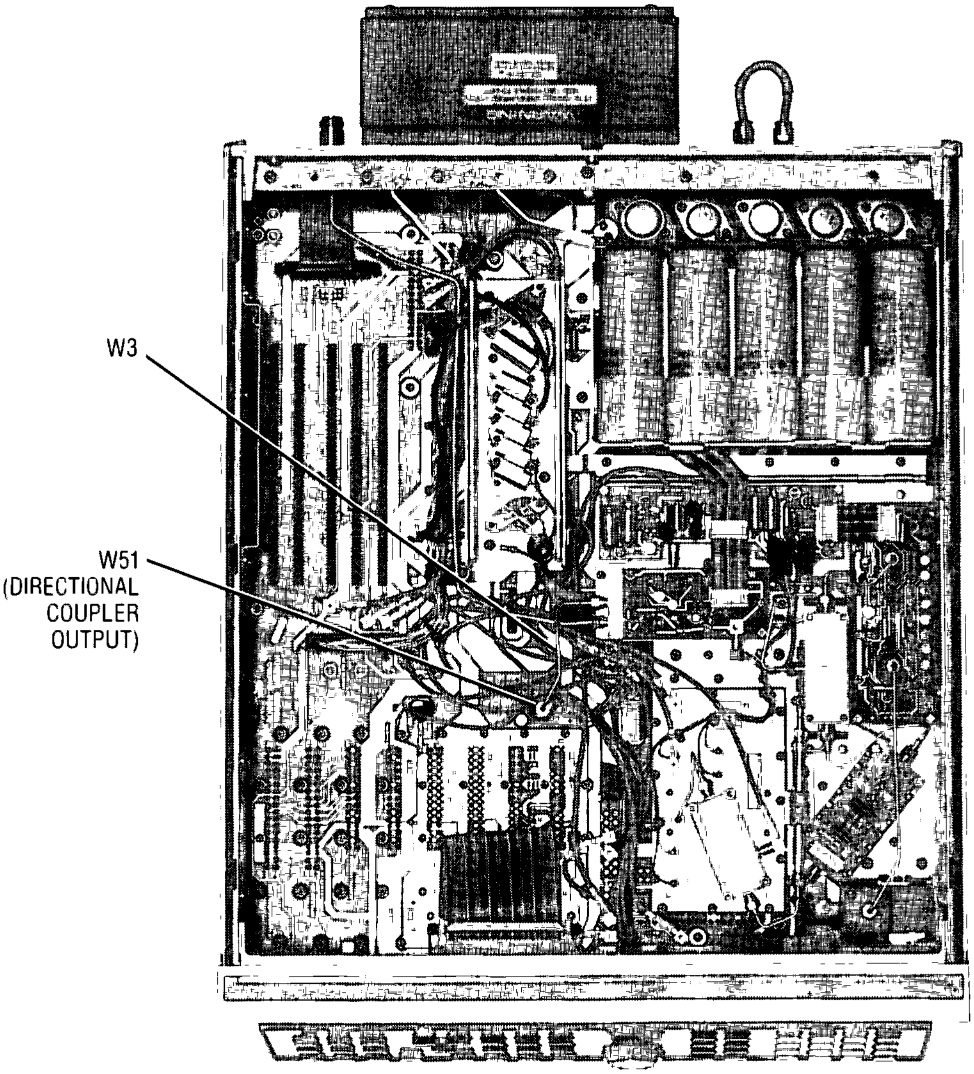


Figure 5-17. Top View, Cable Location

5-8. YO LOOP ADJUSTMENTS

Reference

Performance Test: None
Service Section: Sweep Generator - YO Loop

Description

The YO Loop Adjustment procedure adjusts the sampler drive circuitry and the IF gain.

The YO Loop gain and phase margin adjustment selects the value of resistor A49R18 to place the YO Loop gain and phase within specified limits. This prevents the YO Loop from oscillating while still providing sufficient gain in the YO Loop.

NOTE

The YO frequency adjustment in Paragraph 5-28 must be completed before these adjustments are made.

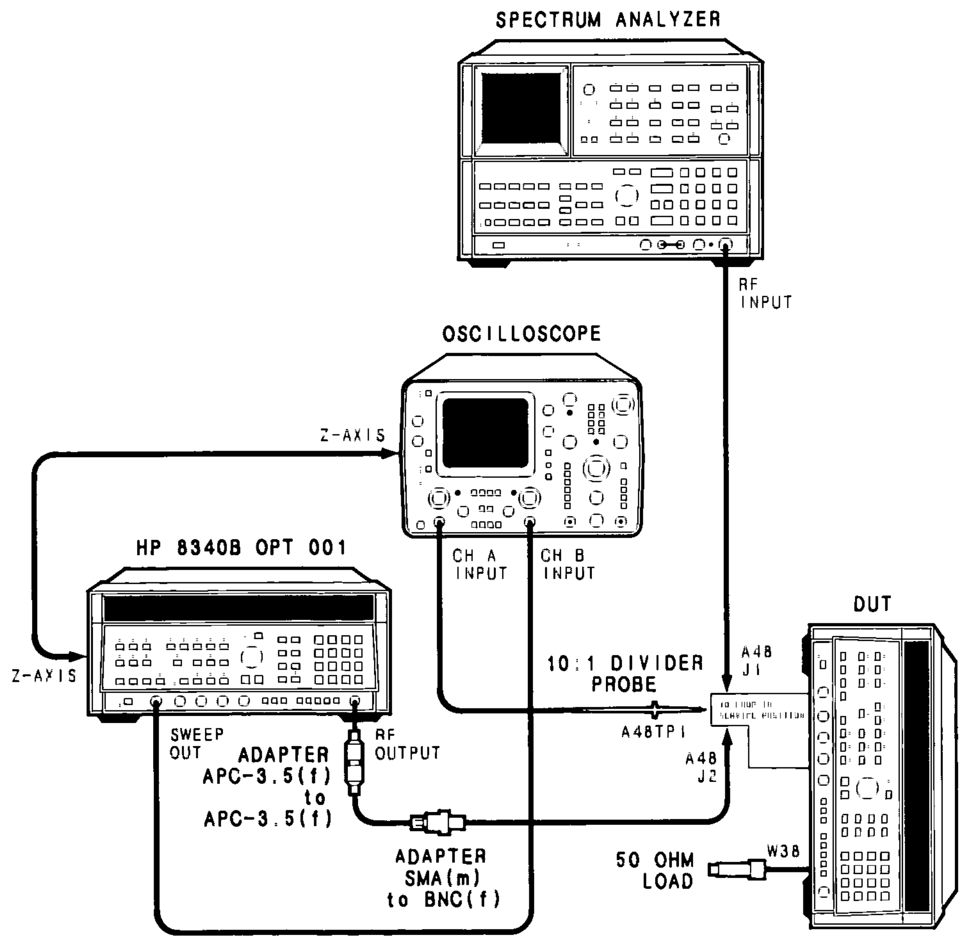


Figure 5-18. YO Loop Adjustment Setup

Equipment

Spectrum Analyzer	HP 8566B
Spectrum Analyzer	HP 3585A
Synthesized Sweeper	HP 8340B Option 001
Oscilloscope	HP 1741A
10:1 Divider Probe	HP 10004D
BNC to SMB Snap-On Test Cable (2 required)	HP P/N 85680-60093
50Ω Termination, SMB (f)	HP P/N 1250-0676
Adapters:	
APC 3.5 (f) to APC 3.5 (f)	HP P/N 5061-5311
SMA (m) to BNC (f)	HP P/N 1250-1200
SMB (m) to SMB (m)	HP P/N 1250-0669
Special Test Fixture	Fabricated Locally

Procedures

YO LOOP RESPONSE ADJUSTMENT

1. Place the DUT in the test position shown in Figure 5-18 and remove the top and bottom covers. Disconnect the rigid cable (W3) going into the A45 Directional Coupler RF Output through a hole in the mother board (top of the DUT). Put the YO Loop section in the Service Position. Disconnect all the cables that connect to A48 and A49 PC boards. Remove the A48 YO Loop Sampler assembly cover. Connect a 50 Ohm load to W38 at the end that connects to A49J2.

2. Connect the test equipment as shown in Figure 5-18 (do not connect the Spectrum Analyzer yet). Set the LINE switch to ON and allow ½ hour warmup.

3. Set the Sweep Generator as follows:

   a. Press **[INSTR PRESET]**.
   b. Press **[CF]** (center frequency) **[1] [8] [7] [MHz]**
   c. Press **[ΔF]** then enter **[2] [0] [0] [MHz]**
   d. Press **[POWER LEVEL]** then enter **[3] [dBm]**
   e. Press **[SWEEP TIME]** then enter **[1] [0] [msec]**.

4. Set the oscilloscope controls as follows.

   a. Select A vs B mode
   b. Set Channel A to 0.05 VOLTS/DIV (with 10:1 Probe)
   c. Set Channel B to 1 VOLT/DIV (typically)
   d. Select DC coupled on both channels.

5. On the oscilloscope, adjust channel B VOLTS/DIV (used as horizontal gain in A vs. B mode) for a trace of 10 horizontal divisions on the screen. Adjust the oscilloscope POSITION control to center the display trace.

6. On the Sweep Generator press **[M1]** and enter **[1] [6] [0] [MHz]** Press **[M2]** and enter **[2] [1] [0] [MHz]**.

7. Adjust A48C1 and A48C2 (Figure 5-19) for a trace on the oscilloscope similar to Figure 5-20. Adjust for the flattest response from 160 MHz to 210 MHz. The amplitude of the response should be at least 0.4 Volts peak-to-peak.

5-8. YO LOOP ADJUSTMENTS (Cont'd)

IF GAIN ADJUSTMENT

8. Verify that the 50 Ohm load is still connected to W38 at the end that was connected to A49J2 Disconnect the oscilloscope probe from A48TP1.
9. Connect the Spectrum Analyzer to A48J1.
10. Set the DUT as follows:
    a. Press **[INSTR PRESET]**
    b. Press **[CW]** then enter **[4] [.] [5] [GHz]**
    c. Connect a jumper between A59TP4 and A59TP5. (This disables the UNLK annunciator circuit.)
11. Set the Sweep Generator as follows:
    a. Press **[INSTR PRESEST]**
    b. Press **[POWER LEVEL]** then enter **[3] [dBm]**
    c. Press **[CW]** then enter **[1] [8] [6] [MHz]**
    d. Press **[SHIFT]** then **[CW]**; press **[STEP]** keys to select 1 kHz resolution.

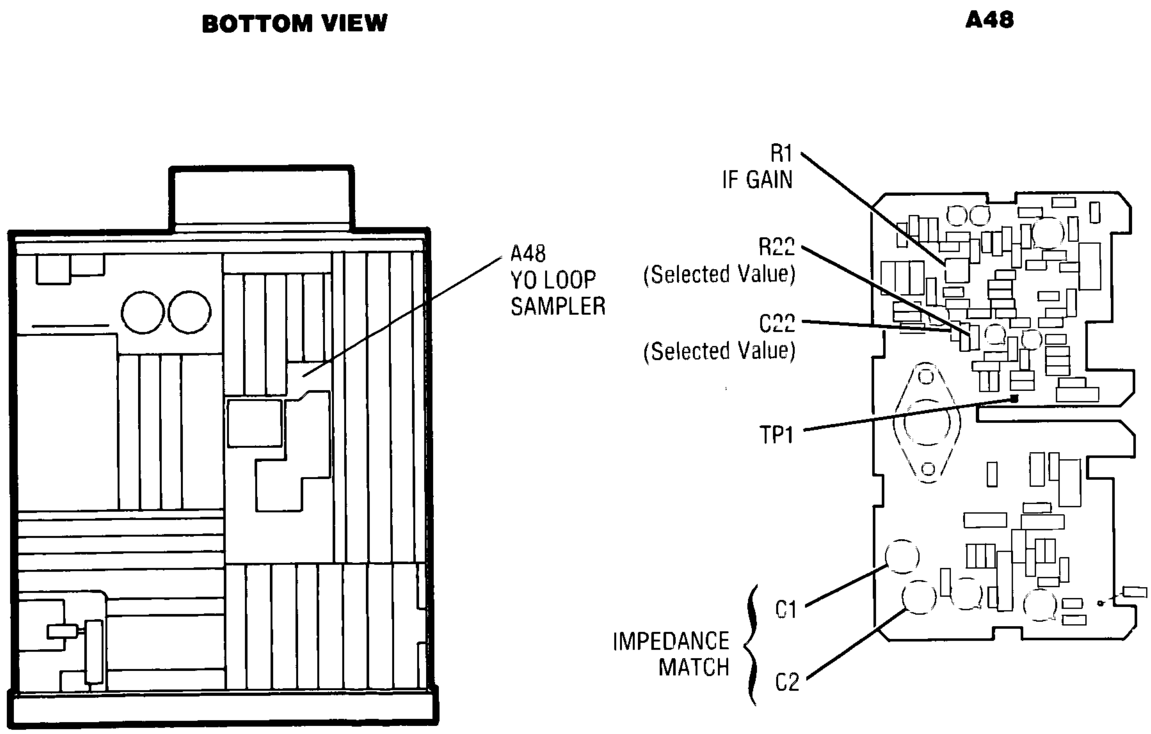


Figure 5-19. Location of YO Loop Adjustments

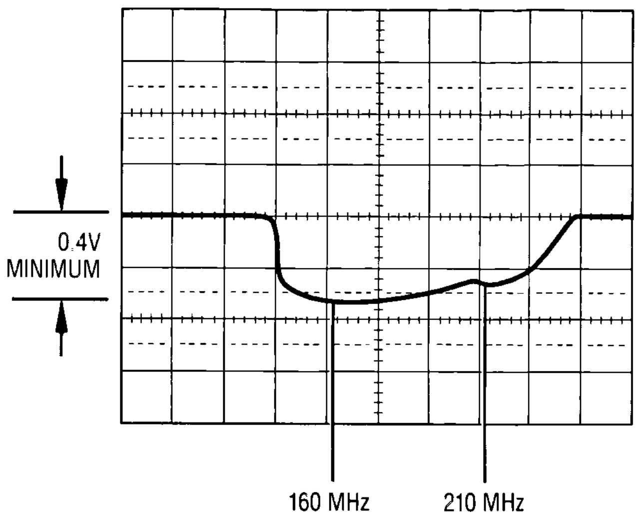


Figure 5-20. Typical Swept Frequency Response at A48TP1

12. Set the Spectrum Analyzer as follows:

   a. Press **[INSTR PRESET]**
   b. Set CENTER FREQ to 30 MHz
   c. Set FREQUENCY SPAN to 60 MHz
   d. Press Marker **[PEAK SERACH]** then **[SIGNAL TRACK]**.
   e. Set REF LEVEL to +10 dBm.

13. On the Sweep Generator press **[CW]** then adjust the rotary knob to set a frequency that will produce a center frequency readout on the Spectrum Analyzer of 25.0 MHz. (See Figure 5-21.) Turn off **[SIGNAL TRACK]** on Spectrum Analyzer.

14. On the DUT, adjust A48R1 (IF GAIN) for a 25 MHz signal displayed on the Spectrum Analyzer of approximately 0 dBm.

15. Set the Spectrum Analyzer as follows:

   a. Press **[INSTR PRESET]**
   b. Set CENTER FREQUENCY to 50 MHz
   c. Set FREQUENCY SPAN to 100 MHz
   d. Set REFERENCE LEVEL to +10 dBm
   e. Select 5 dB/DIV
   f Select MAX HOLD on Trace A

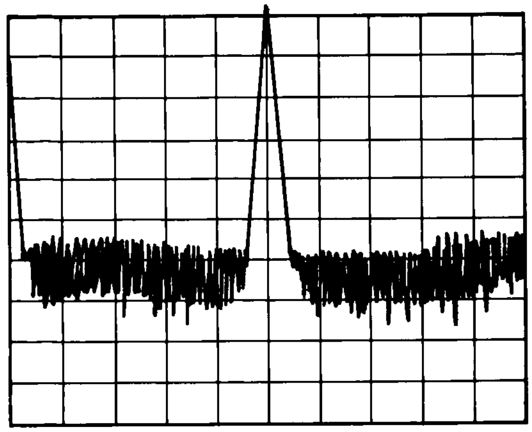


Figure 5-21. YO Loop Gain at A48J1

NOTE

If Sweep Generator frequency is changed too quickly in Step 15, drop outs will occur on the Spectrum Analyzer display. If this happens, slowly adjust the Sweep Generator frequency so that the IF response passes over the drop outs and eliminates them.

16. Slowly tune the Sweep Generator using the rotary knob while monitoring the display on the Spectrum Analyzer. (Maximum hold may be used on the Spectrum Analyzer to trace out the IF response as the frequency is changed.) Verify that the IF frequency response falls within the limits shown in Figure 5-22. If it does not, select new values for A48C22 and A48R22 to adjust the shape of the response (particularly in the 20 to 30 MHz region). Readjust A48R1 IF GAIN control if necessary.
17. Set the DUT's LINE switch to STANDBY. Disconnect all test cables going to the DUT
18. Remove the jumper between A59TP4 and A59TP5.
19. Reinstall the A48 cover and remove the cover from the A49 YO Phase Detector. Removal of the A49 cover will require disassembly of the YO loop. After the cover is removed, reassemble the YO loop. Ensure that all the SMB cables are connected correctly.

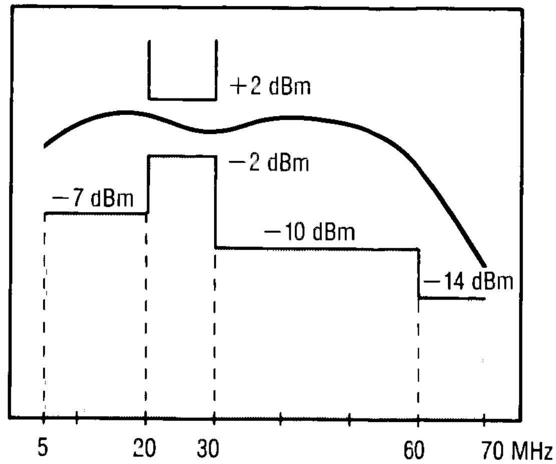


Figure 5-22. IF Frequency Response Limits

GAIN AND PHASE MARGIN ADJUSTMENT

20. Fabricate the special test fixture as shown in Figure 5-23.
21. Place the YO Loop in the Service Position and remove the cover from the A49 Phase Detector board. Remove jumper A49W1 from the Phase Detector board.
22. Connect the Special Test Fixture and the Spectrum Analyzer to the YO Loop as shown in Figure 5-24.
23. On the Special Test Fixture, set S1 to position 1 and set S2 to the J2 position. The YO Loop should now be locked as indicated by A50DS1 (green LED) being lit.
24. On the DUT, press **[INSTR PRESET] [CW] [3] [GHz]**.
25. Set up the Spectrum Analyzer as follows:

INSTR PRESET	Press
TRACKING GENERATOR AMPLITUDE	Fully Clockwise (0 dBm)
INPUT IMPEDANCE	1 Megohm
AUTO RANGE	OFF
REF. LVL. TRK	OFF
START FREQ	0 Hz
STOP FREQ	100 kHz
dB/div	1 dB/div.
REF. LEVEL	−25 dBm
RANGE (use STEP keys)	−15 dBm

26. A trace similar to Figure 5-25, Waveform A should be displayed on the Spectrum Analyzer.
27. On the Spectrum Analyzer, press [STORE A → B] to store the trace from A into Trace B. On the Special Test Fixture, set switch S1 to position 2. The Spectrum Analyzer should display the two traces similar to Figure 5-25, Waveform B.

28. Using the rotary knob on the Spectrum Analyzer, move the marker to the point where the two traces cross Observe the marker frequency on the Spectrum Analyzer. The marker (crossover frequency) should be between 30 and 40 kHz

29. If the crossover frequency is below 30 kHz, the value of A49R18 on the A49 YO Phase Detector board should be decreased in value to increase the crossover frequency. If the crossover frequency is above 40 kHz, the value of A49R18 should be increased to lower the crossover frequency.

30. Disconnect all test equipment from the DUT and reinstall the jumper (W1) on the A49 Phase Detector board.

31 Proceed directly to Adjustment 5-9, FM Accuracy and FM Overmod Adjustment. DO NOT REASSEMBLE THE YO LOOP.

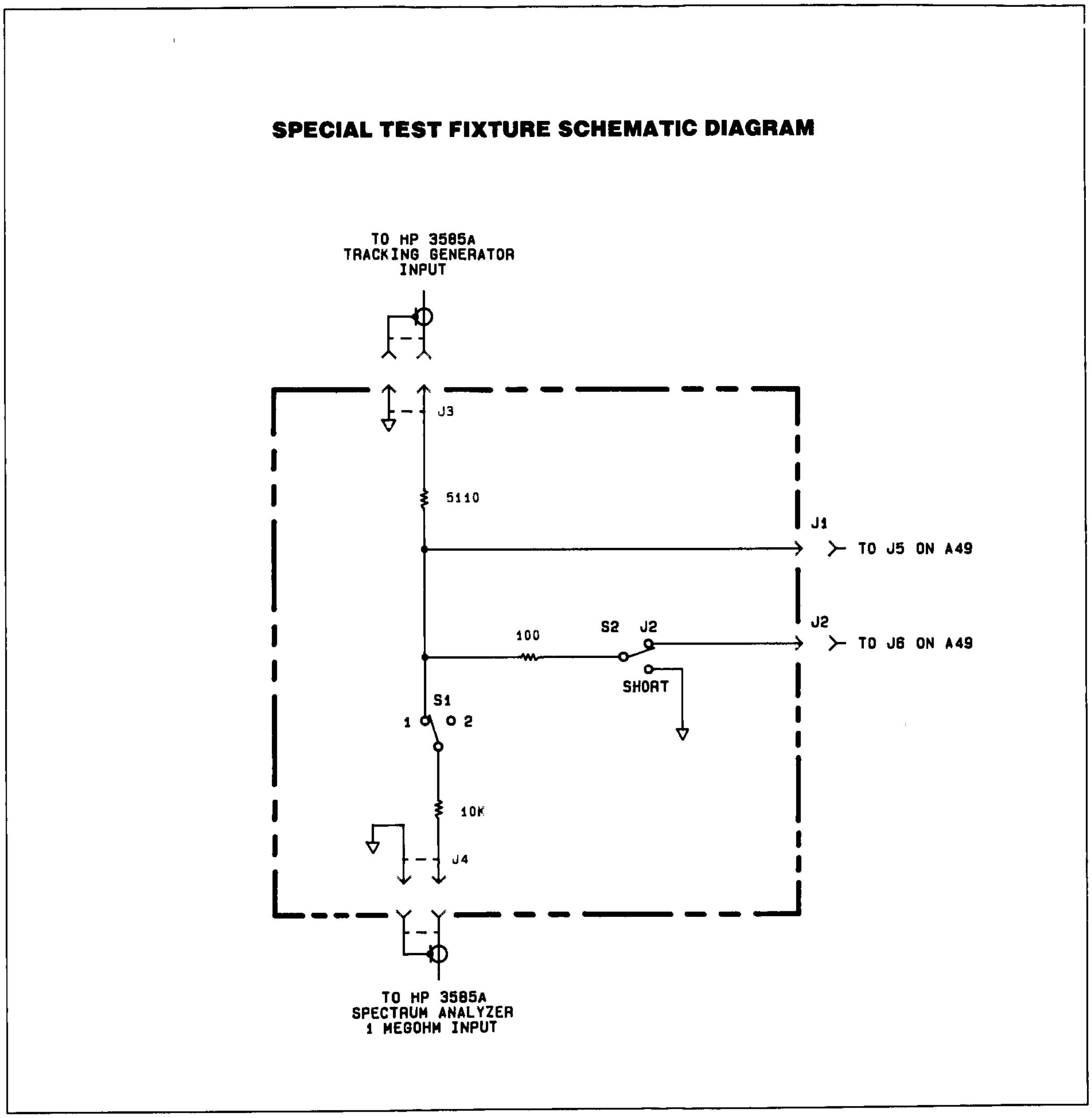
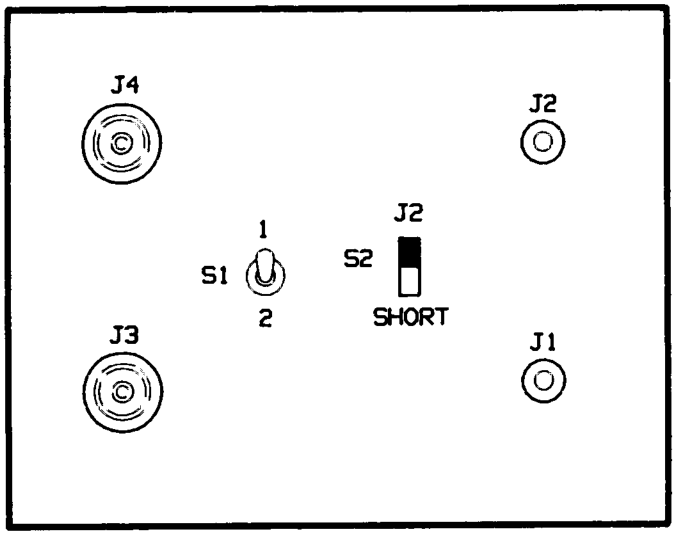
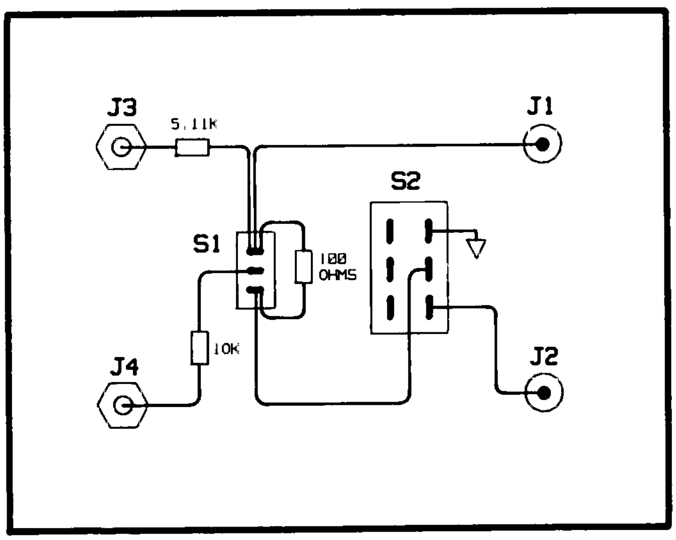


Figure 5-23. Special Test Fixture Fabrication Instructions (1 of 2)

TOP VIEW



BOTTOM VIEW



YO Special Test Fixture Material List

Qty	Description	HP Part Number	Qty	Description	HP Part Number
1	BUD BOX 2.75 × 2.1	7100-1207	2	CHASSIS MOUNT SNAP ON (M)	1250-0691
1	SWITCH SPDT (TOGGLE)	3101-0163	2	LOCK WASHER	2190-0124
1	SWITCH DPDT (SLIDE)	3101-0070 (only requires a SPDT)	2	NUT	2950-0078
2	CHASSIS MOUNT BNC (F)	1250-0212	1	10kΩ ¼W RESISTOR	0757-0442
2	LOCK WASHER	2190-0016	1	100Ω ¼W RESISTOR	0757-0401
2	NUT	2950-0001	1	5.11kΩ ¼W RESISTOR	0757-0438

Figure 5-23. Special Test Fixture Fabrication Instructions (2 of 2)

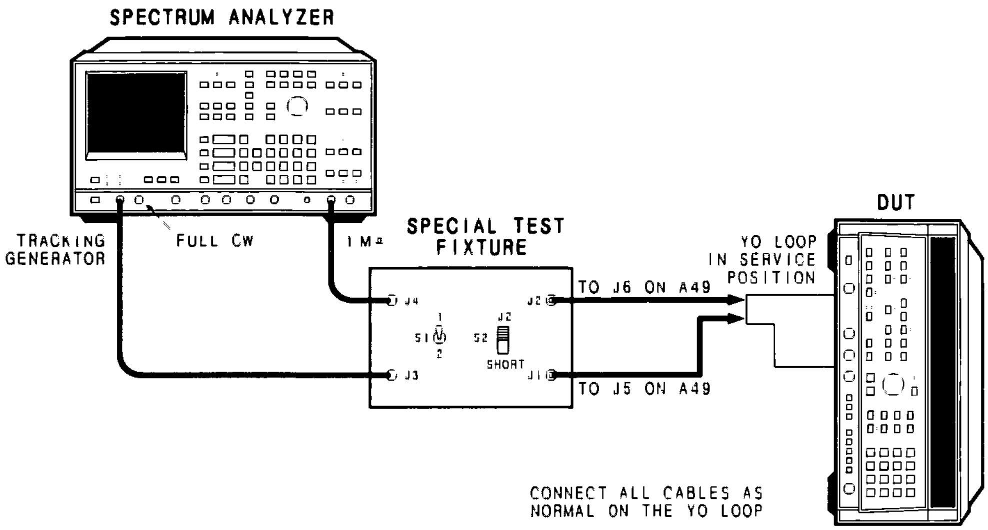


Figure 5-24. YO Loop Gain Test Setup

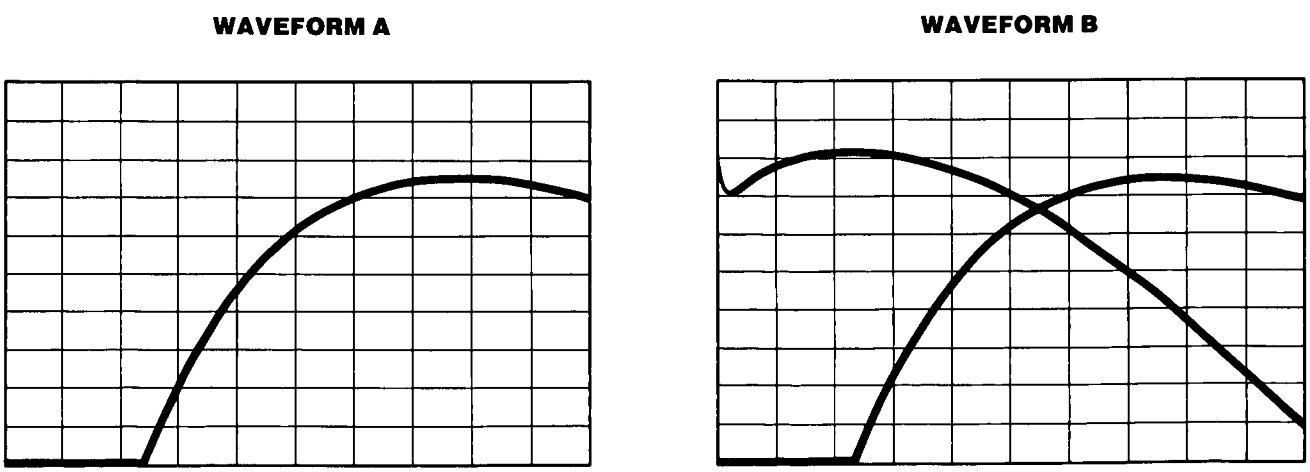


Figure 5-25. Spectrum Analyzer Waveforms of YO Loop Gain

5-9. FM ACCURACY AND FM OVERMOD ADJUSTMENT

Reference

Performance Test: FM
Service Section: Sweep Generator - YO Loop

Description

In the FM accuracy portion of this adjustment procedure, a synthesized function generator and is used to FM the DUT at a fixed modulation rate and frequency deviation. The FM input signal is set such that when the DUT's FM GAIN adjustment (FM accuracy) is adjusted properly, the power of the DUT's carrier frequency will be nulled (minimum power level).

In the FM overmodulation adjustment portion of this adjustment, the DUT is initially set up for its maximum frequency deviation and modulation rate. From this point, the rate is increased until the DUT's FM circuitry reaches its maximum capability. The modulation rate is then decreased until the circuitry stabilizes and the overmod adjustment is set to just turn on the OVERMOD annunciator.

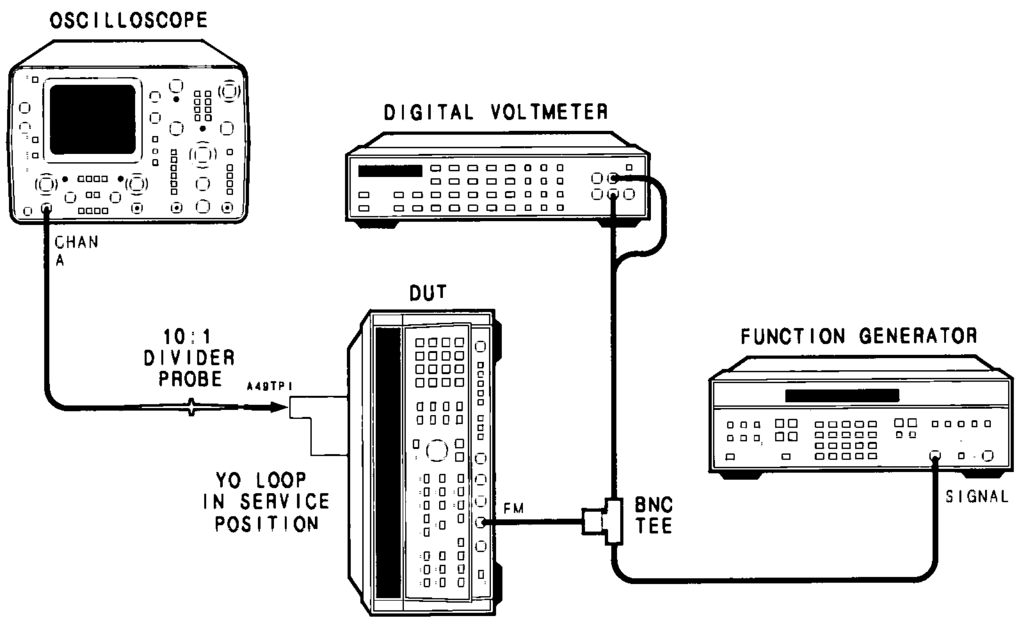


Figure 5-26. FM Accuracy and Overmod Adjustment Setup

Equipment

Spectrum Analyzer	HP 8566B
Digital Voltmeter	HP 3456A
Function Generator	HP 3325A
Oscilloscope	HP 1741A
Adapters:	
APC 3.5(f) to TYPE N(m) (2 required)	HP P/N 1250-1744
APC 3.5 (f) APC 3.5 (f) (8340B only)	HP P/N 5061-5311
BNC(f) to dual banana	HP P/N 1251-2277
BNC Tee	HP P/N 1250-0781
Cables:	
Semi-Rigid, SMA (m) to SMA (m)	HP P/N 08340-20124
BNC (m) to BNC (m) (2 required)	HP P/N 8120-1840

FM GAIN ADJUSTMENT

1. Connect the equipment as shown in Figure 5-26, FM Accuracy and Overmod Adjustment Setup The BNC Tee should be connected directly to the DUT's FM input BNC Switch the DUT to ON and allow the equipment to warm up for 30 minutes

2. On the DUT, press

   [INSTR PRESET]
   [CW] [1] [0] [GHz]
   [POWER LEVEL] [0] [dBm]
   [FM]

   Use the **DOWN ARROW** step key to select an FM sensitivity of 1 MHz/V (default condition).

3. Set the DVM to measure ac volts. Set up the function generator for a 100 kHz sine wave Adjust the function generator's amplitude for 0.16996 Vrms (measured on the DVM). You may not be able to set the function generator's amplitude for this exact voltage so adjust the voltage as close as possible

4. Press **[FM]** on the DUT to turn FM off. Adjust the spectrum analyzer to center the DUT's 10 GHz output (carrier frequency) on the center of the display. Select a frequency span of 500 kHz.

5. Press **[FM]** on the DUT to turn FM on. Adjust A23R28 FM GAIN to null the carrier (i.e., reduce the carrier's power level as much as possible).

FM OVERMOD ADJUSTMENT

6. If the YO Loop is already disassembled, proceed to step 7.

   Remove the YO Loop from the DUT and remove the cover from the A49 YO Phase Detector assembly. In order to remove the cover on the A49 assembly, the YO Loop will need to be disassembled. Reinstall the YO Loop and place it in the service position. Reinstall the ribbon cable and SMB cables which were removed during disassembly.

5-9. FM ACCURACY AND FM OVERMOD ADJUSTMENT (Cont'd)

7. On the DUT, press **[CW] [4] [.] [5] [GHz]**. Press **[FM]** to turn the FM on and use the **UP ARROW** step key to select 10 MHz/V FM sensitivity
8. Set the function generator for a 1.5 MHz sine wave and adjust the amplitude for a 0.707 Vrms reading on the DVM.
9. Connect the oscilloscope's Channel A input to A49TP1. Set the oscilloscope for 0.01 V/div, ac coupled, and 0.5 us/div. The oscilloscope display should look similar to Figure 5-27.
10. Adjust A49R3 until the OVERMOD annunciator on the DUT's front panel turns on, then adjust A49R3 until the OVERMOD annunciator just turns off.
11. Disconnect all of the test equipment from the DUT. Reinstall the cover onto the A49 Phase Detector assembly and reinstall the YO Loop into the DUT.

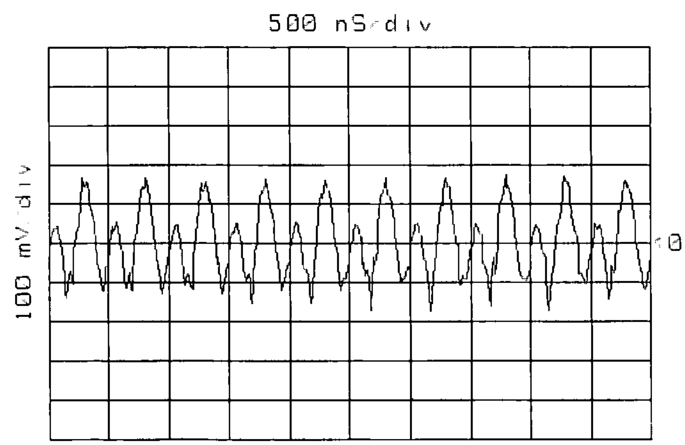


Figure 5-27. Typical Waveform at A49TP1

5-10. YO DELAY COMPENSATION, A54

Reference

Performance Test: Swept Frequency Accuracy
Service Section: Sweep Generator - YO Loop

Description

In this procedure, the programmable width of the YO kick pulse is calibrated. Then the YO delay is adjusted so the marker position tracks from the slowest to the fastest sweep speeds.

Equipment

Spectrum Analyzer .... HP 8566B
Oscilloscope .... HP 1741A
Adapter, APC-3.5 (f) to Type N (m), ... HP P/N 1250-1744
(2 required for HP 8341B, one for HP 8340B)
Cable, SMA (m) to SMA (m) .... HP P/N 08340-20124
Adapter, APC 3.5 (f) to APC 3.5 (f) (required for HP 8340B) ...... HP P/N 5061-5311

NOTE

In the test setup, 2 APC 3.5 (f) to Type N (m) adapters are used with an SMA semi-rigid cable. This setup is used, instead of connecting the DUT to the spectrum analyzer with a Type N cable, to reduce power loss through the cable.

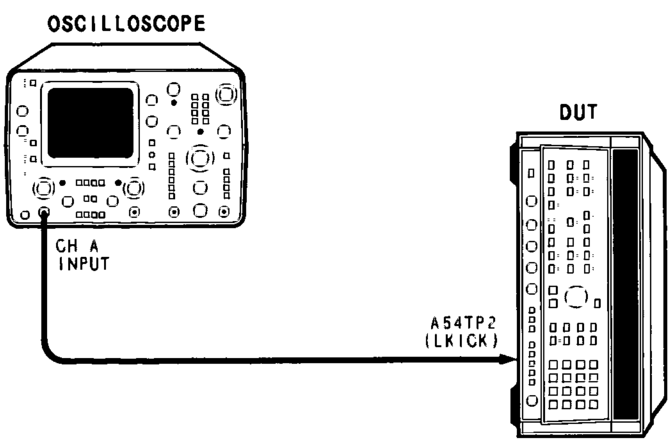


Figure 5-28. YO Kick Pulse Test Setup

Procedure

1. Position the DUT in the Test Position as shown in Figure 5-28 with bottom cover removed. Turn the LINE switch on. Connect equipment as shown in Figure 5-28 and allow one-half hour warm-up time.

YO KICK PULSE ADJUSTMENT

2. On the DUT, make the following settings:

   a. Press **[INSTR PRESET]**
   b. Press **[START FREQ]** then enter **[2] [.] [3] [GHz]**
   c. Press **[STOP FREQ]** then enter **[6] [.] [9] [9] [9] [GHz]**

3. Adjust A54R36 (PW, Figure 5-30) for a 12.5 msec pulse on the oscilloscope.

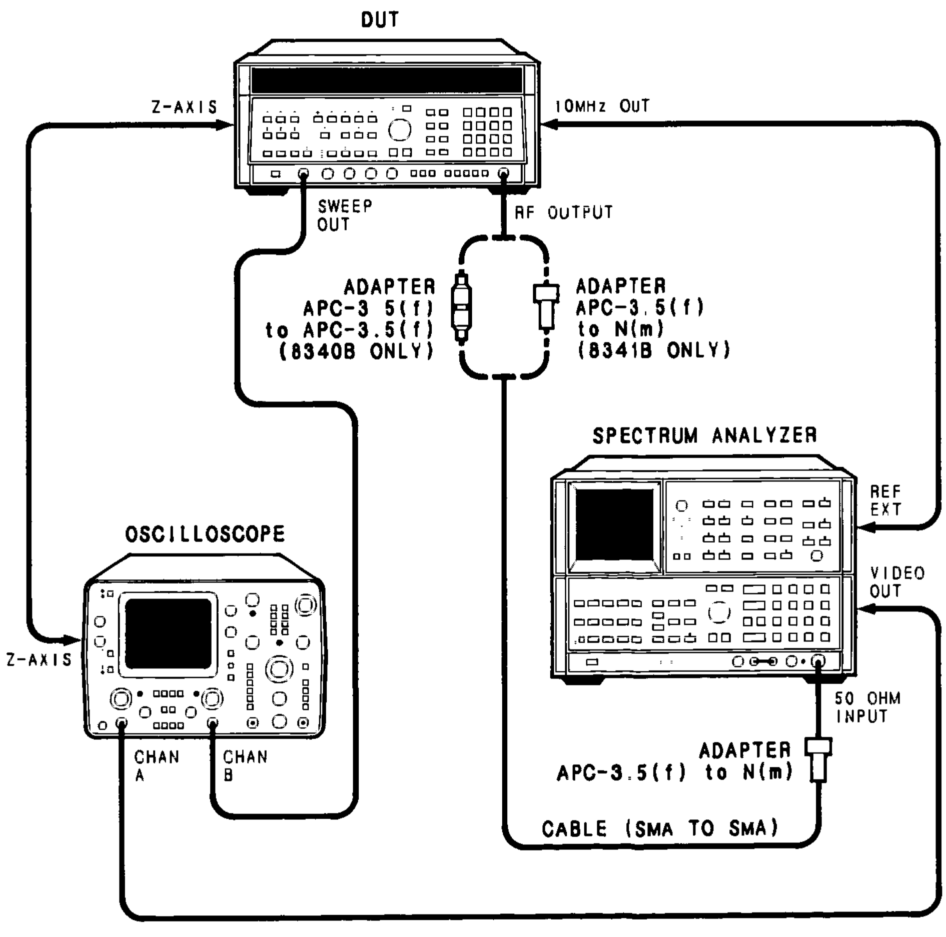


Figure 5-29. YO Delay Compensation Test Setup

5-10. YO DELAY COMPENSATION, A54 (Cont'd)

BOTTOM VIEW

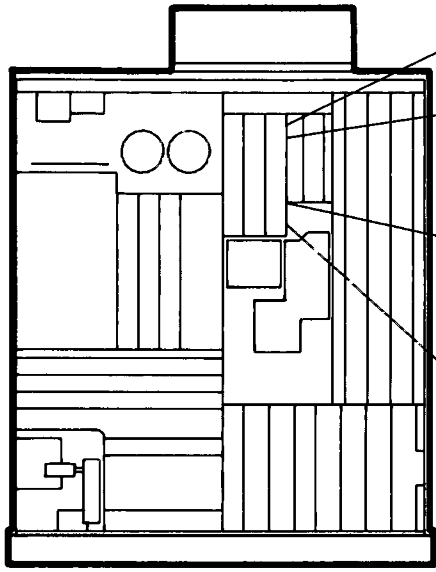


Figure 5-30. YO Delay Compensation Adjustments Location

YO DELAY ADJUSTMENT

4. Connect the test equipment as shown in Figure 5-29.

5. Set the DUT as follows:

   a. Press **[INSTR PRESET]**
   b. Press **[START FREQ]** then enter **[6] [.] [9] [GHz]**
   c. Press **[STOP FREQ]** then enter **[1] [3] [.] [5] [GHz]**
   d. Press **[M1]** then enter **[7] [.] [2] [GHz]**
   e Press **[AMTD MKR]** on.
   f. Press **[SAVE]** then enter **[2]**
   g. Press **[SWEEP TIME]** then enter **[2] [0] [0] [msec]**
   h. Press **[SAVE]** then enter **[1]**
   i. Press Frequency Marker **[OFF]**
   j. Press **[M2]** then enter **[1] [3] [.] [2] [GHz]**
   k. Press **[SAVE]** then enter **[3]**
   l. At ENTRY pad, press **[AUTO]** (sweep time)
   m. Press **[SAVE]** then enter **[4]**
   n. Press **[RECALL]** then enter **[1]**

6. Set the Spectrum Analyzer as follows:
   a. Press **[INSTR PRESET]**
   b. Press **[CENTER FREQUENCY]** then enter 7.2 GHz
   c. Press **[FREQUENCY SPAN]** then enter 0 Hz
   d. Press **[SINGLE]** Sweep
7. Set the Oscilloscope as follows:
   a. Select A vs. B Mode
   b. Set Channel A Volts/Division to 0.5 V/DIV
   c. Set Channel B Volts/Division to 0.1 V/DIV
8. Press **[RF]** on the DUT to turn RF power off.
9. On the oscilloscope, position the marker to center screen with horizontal position control. Press oscilloscope MAG × 10. Reposition the beginning of the marker at center line of screen with the horizontal position control. (See Figure 5-31.)
10. Press **[RF]** on the DUT to turn RF power on.
11. Press the Spectrum Analyzer CENTER FREQUENCY key then use the rotary knob to set Center Frequency so the peak of the signal is at the center line of the oscilloscope screen. (See Figure 5-32.)
12. On the DUT, press **[RECALL]** then enter **[2]**. Press **[RF]** to turn RF power off.
13. Adjust the oscilloscope horizontal position to place the beginning of the marker at the center line of the screen.
14. On the DUT, press **[RF]** key to turn RF power on. Adjust A54R32 (COFF) to set the peak of the signal at the center of the oscilloscope screen.
15. On the DUT, press **[RECALL]** then enter **[3]**.
16. On the Spectrum Analyzer, press CENTER FREQUENCY then enter 13.2 GHz.
17. Set the oscilloscope Channel B Volts/Division switch to 2 V/DIV.
18. On the DUT, press **[RF]** to turn RF power off.
19. Adjust the oscilloscope horizontal position control so the beginning of the marker is at the center line of the screen.
20. On the DUT, press **[RF]** to turn RF power on.
21. Press the Spectrum Analyzer CENTER FREQUENCY and adjust frequency using rotary knob so the peak of the signal is at the center line of the oscilloscope screen.
22. On the DUT, press **[RECALL]**, then enter **[4]**. Press **[RF]** to turn RF power off.
23. Adjust the oscilloscope horizontal position to place beginning of the marker at the center line of the screen.

5-10. YO DELAY COMPENSATION, A54 (Cont'd)

24. Press the DUT's **[RF]** key to turn RF power on. Adjust A54R30 CGN to set the peak of the signal at the center line of the oscilloscope screen.

25. On the DUT, press **[RECALL]**, then enter **[1]**. Repeat steps 7 through 24 until no further adjustment of A54R30 (CGN) and A54R32 (COFF) is necessary.

26. Disconnect all of the test equipment and reconnect the cables.

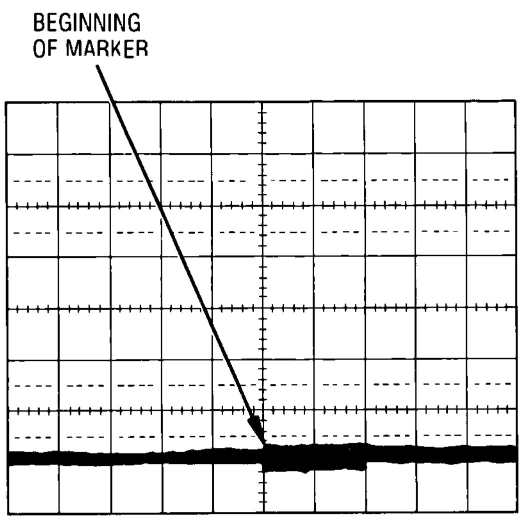


Figure 5-31. Z-Axis Marker Waveform

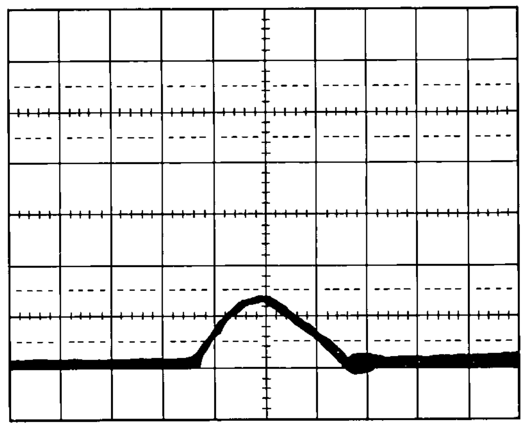


Figure 5-32. Amplitude Marker Waveform

5-11. 3.7 GHz OSCILLATOR, A8

NOTE

This procedure is provided primarily for those cases when the A8A1 circuit board has been repaired or replaced.

Reference

Performance Test: None
Service Section RF Section (Power Level Control)

Description

This procedure monitors the output current of the 100 MHz RF Amplifier that provides the LO signal for the sampler and adjusts for maximum output. The oscillator phase-lock loop is then opened by removing jumper A8E3 and the balance is adjusted at the output of the sampler to obtain a symetrical square wave of approximately 35 Volts peak-to-peak to drive the phase-lock amplifier.

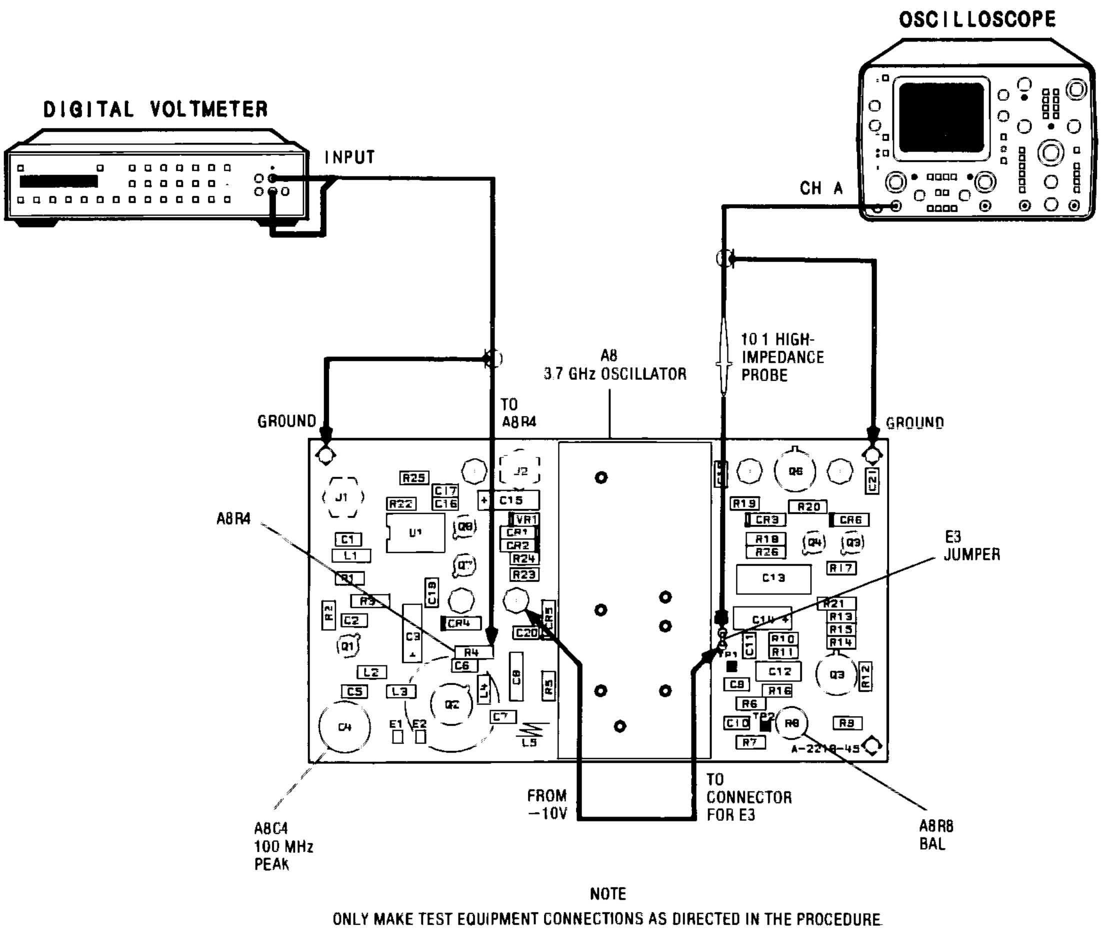


Figure 5-33. A8 3.7 GHz Oscillator Test Setup

Equipment

Digital Voltmeter .... HP 3456A
Oscilloscope .... HP 1741A
10:1 Divider Probe .... HP 10004D

Procedure

1. Connect the DVM to A8R4 as shown in Figure 5-33.
2. Adjust A8C4 (100 MHz Peak) for minimum indication on the DVM (This is maximum current through A8R4 and A8Q2.)
3. Turn the DUT to standby and remove the DVM connections from A8R4.
4. Remove the Jumper A8E3. Connect a jumper from the −10 volt terminal to the lower connection point for E3 as shown in Figure 5-33. (This applies −10 volts to the oscillator.)
5. Connect the Oscilloscope 10:1 high-impedance probe to the upper connection point for E3 as shown in Figure 5-33. Switch the DUT on.
6. Adjust A8R8 (BAL) for a 50% duty cycle square wave with approximately 35 Volts peak-to-peak.
7. Turn the DUT to standby, remove the −10 Volt jumper, oscilloscope probe connections, and reinstall A8E3 in its original position.

5-12. MARKER/BANDCROSS, A57

Reference

Performance Test: None
Service Section: Controller

Description

This procedure adjusts the manual sweep for a range of 0 to 10 Volts and sets the end of sweep at 10 Volts.

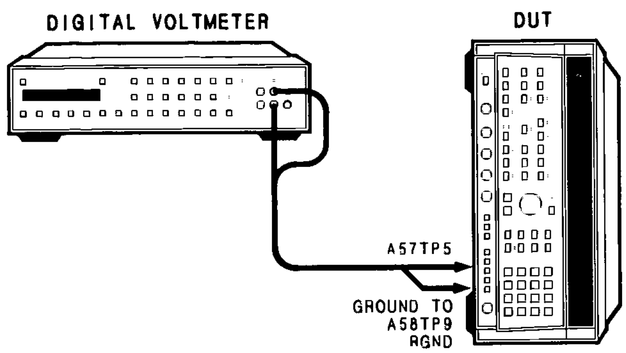


Figure 5-34. Marker Band Crossing Test Setup

Equipment

Digital Voltmeter .... HP 3456A

Procedure

MANUAL SWEEP GAIN

1. Place the DUT in the test position and connect the test equipment as shown in Figure 5-34. Allow one-half hour for warmup.

2. Set the DUT as follows:

   a Press **[INSTR PRESET]**
   b. Press **[START]** then enter **[4] [GHz]**
   c. Press **[STOP]** then enter **[5] [GHz]**
   d. Press **[MANUAL]** Sweep.
   e. Press **[SHIFT] [GHz] [1] [3] [Hz]**, **[SHIFT] [MHz] [2] [Hz]**, and **[SHIFT] [kHz] [1] [0] [0] [0] [Hz]**. (This writes decimal 1,000 to IO address 13, R2)

3. Adjust A57R33 (MAN GAIN, Figure 5-35) for 10.0000 ± 0.0005 Vdc at A57TP5 as indicated on the DVM.

5-12. MARKER/BANDCROSS, A57 (Cont'd)

END OF SWEEP ADJUSTMENT

4 Set the DUT as follows:

   a. Press **[INSTR PRESET]**
   b. Press **[START FREQ]** then enter **[4] [GHz]**
   c. Press **[STOP FREQ]** then enter **[5] [GHz]**
   d. Press **[SHIFT] [MHz] [2] [3] [Hz] [SHIFT] [kHz] [0] [Hz]** to stop the sweep at the end of band (5 GHz).

5. Connect the DVM to A57TP5 (SWEEP OUT), and DVM's ground lead to A58TP9 (RGND).
6. Adjust A57R32 (EOS, Figure 5-35) for an indication on the DVM of 10.000 ±0.0008 Vdc.
7. Press **[CONT]** Sweep key after each adjustment is made for an update of end of sweep indication.
8. Repeat steps 6 and 7 until no further adjustment is needed.

BOTTOM VIEW

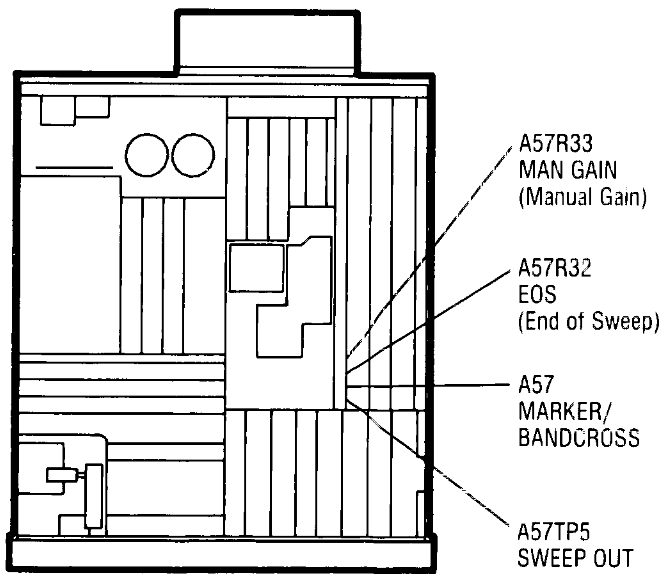


Figure 5-35. Marker Band Crossing Adjustments Location

5-13. SWEEP GENERATOR, A58

Reference

Performance Test. Swept Frequency Accuracy
Service Section. Sweep Generator - YO Loop

Description

The first section adjusts the gain of the sweep ramp amplifier. The next section adjusts the reset error. The last section adjusts the relationship between the VSWP ramp signal and the marker ramp.

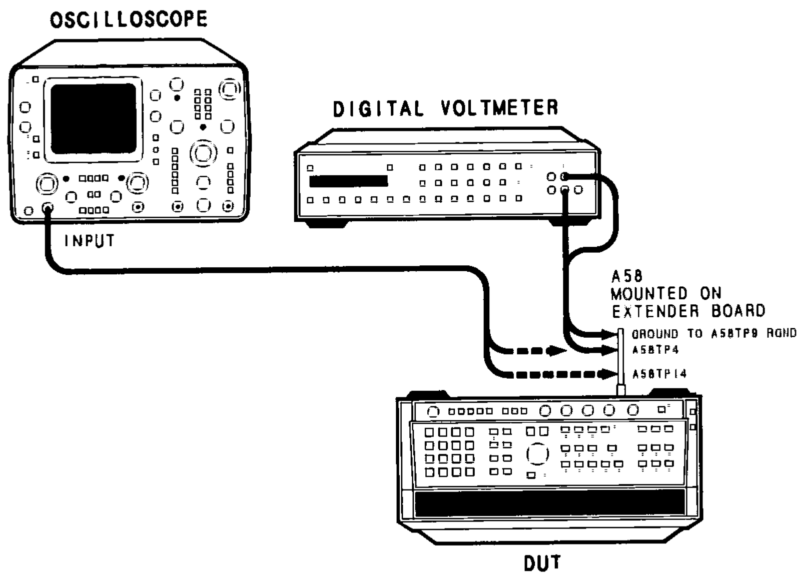


Figure 5-36. Sweep Generator Test Setup

Equipment

Oscilloscope .... HP 1741A
Digital Voltmeter (DVM) .... HP 3456A

Procedure

1. Place the DUT in the test position as shown in Figure 5-36 with bottom cover removed and the A58 Sweep Generator assembly on an extender board. Connect the oscilloscope to A58TP4 (MKR RMP). Turn the DUT's LINE switch ON and allow one-half hour warm up time.

SWEEP RAMP GAIN ADJUSTMENT

2. On the DUT press **[INSTR PRESET]**, **[START FREQ]** and enter **[2] [.] [3] [GHz]**.
3. Press **[STOP FREQ]** then enter **[7] [GHz]**.
4. Press **[SWEEP TIME]** then enter **[1] [0] [msec]**.
5. Adjust A58R4 (SWP TIME, Figure 5-37) for a 10 ms ramp on the oscilloscope (Figure 5-38).

BOTTOM VIEW

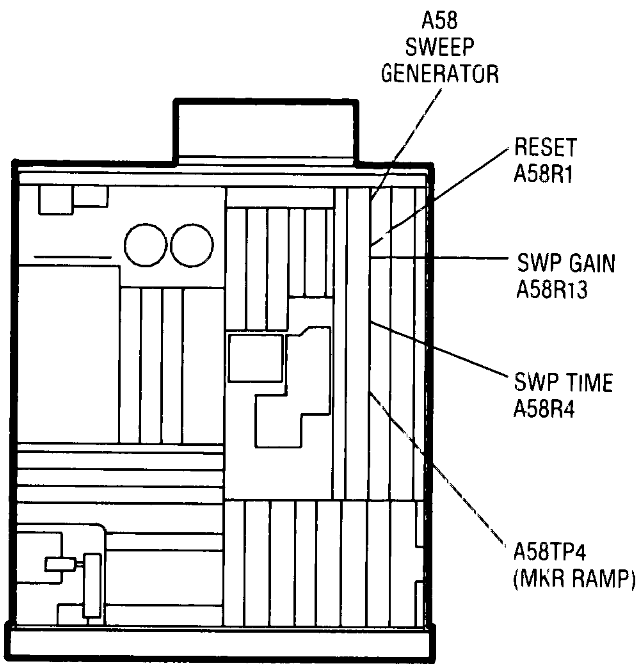


Figure 5-37. Sweep Generator Adjustments Location

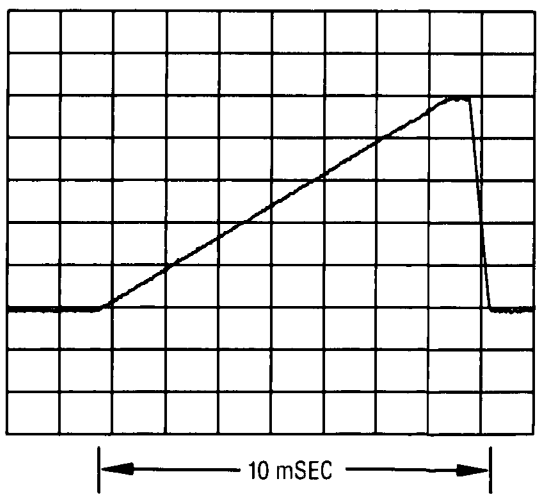


Figure 5-38. Sweep Ramp at A58TP4

5-13. SWEEP GENERATOR, A58 (Cont'd)

RESET ERROR ADJUSTMENT

6. Connect the oscilloscope to A58TP10 (ERROR).
7. Press **[INSTR PRESET]** on the DUT.
8. Adjust A58R1 (RESET, Figure 5-37) for as close as possible to zero Volt average on the oscilloscope. (See Figure 5-39.)

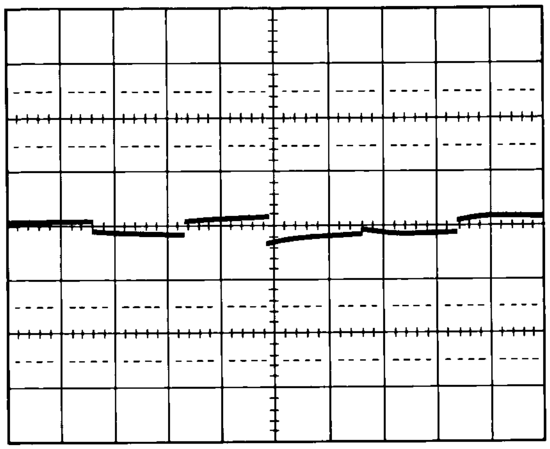


Figure 5-39. Reset Pulse Adjusted to Zero Volt Average

SWEEP GAIN ADJUSTMENT

9. Connect the DVM to A58TP4 (MKR RMP) and connect the DVM ground to A58TP9 (RGND).
10. Set the DUT controls as follows:
    a. Press **[INSTR PRESET]**
    b. Press **[START FREQ]** then enter **[2] [.] [3] [GHz]**
    c. Press **[STOP FREQ]** then enter **[7] [GHz]**
    d. Press **[SHIFT] [MHz] [2] [3] [Hz] [SHIFT] [kHz] [0] [Hz]** to stop the sweep at the end of sweep (7 GHz).
11. Record the reading at on the DVM.
12. Connect the DVM to A58TP10 (VSWP).
13. Adjust A58R13 (SWP GAIN) control so that the DVM reading at A58TP10 = 94% of reading at A58TP4 taken in step 11. EXAMPLE:
    a. DVM reading in step 11 at A58TP4 = 9.9884 Volts
    b. (0.94) (9.9884V) = 9.38909 Volts
    c. Adjust A58R13 for DVM reading at A58TP10 of 9.38909 Volts.
14. Turn the DUT's LINE switch to STANDBY. Remove the extender board from the A58 assembly and re-install A58.

5-14. UNLEVELED RF OUTPUT ADJUSTMENTS

Reference

Performance Test: Maximum Leveled Output Power and Accuracy
Service Section: RF Section

Description

The A28 SYTM Driver assembly is adjusted to cause the SYTM frequency response to track the YO frequency. When the YO frequency is in the center of the SYTM passband, the power loss through the SYTM is minimum; therefore, SYTM tracking is adjusted while viewing power out versus frequency and adjusting the SYTM for maximum power out. In the multiplying bands, Bands 2, 3, and 4, optimum biasing of the step recovery diode (SRD, internal to the SYTM) is also required for maximum power out. Since this the case, the SRD bias adjustments on the A24 and A26 assemblies are also performed in this procedure.

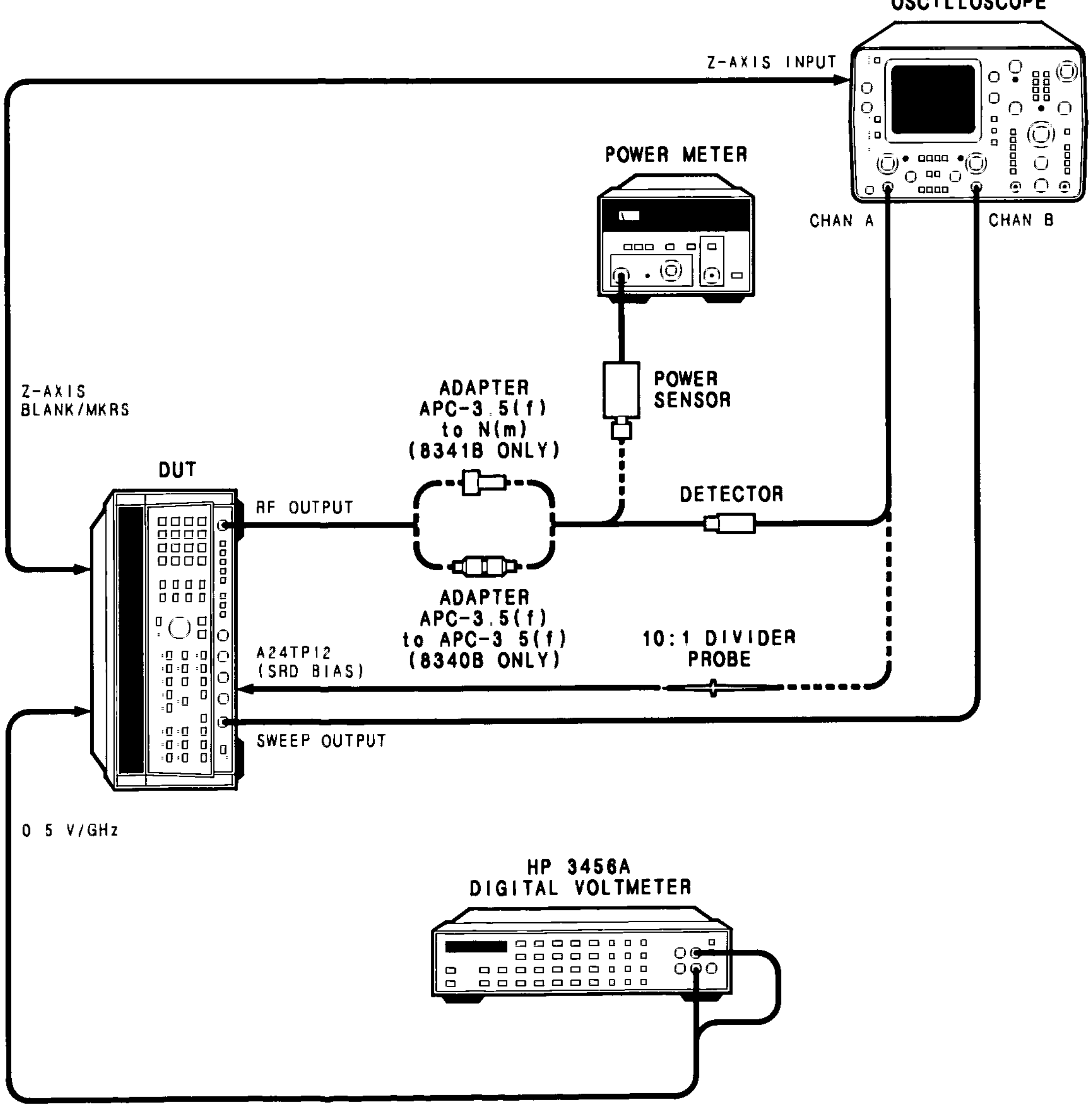


Figure 5-40. Unleveled RF Output Adjustments Setup

5-14. UNLEVELED RF OUTPUT ADJUSTMENTS (Cont'd)

Equipment

Oscilloscope .... HP 1741A
10:1 Divider Probe .... HP 10004D
Digital Voltmeter (DVM) .... HP 3456A
Power Meter .... HP 436A
Power Sensor .... HP 8485A
Detector .... HP 8473C
Adapters:
APC 3.5 (f) to APC 3.5 (f) .... HP P/N 5061-5311
(required if DUT is an HP 8340B)
APC 3.5 (f) – Type N (m) .... HP P/N 1250-1744
(required if DUT is an HP 8341B)
Dual Banana to BNC (f) .... HP P/N 1251-2277

NOTE

The following adjustments should be checked or adjusted before making the adjustments in this procedure: Power Supplies, 20/30 Loop, M/N Loop, Pretune, and Sweep Time.

Procedure

1. Place the DUT in the test position and connect the oscilloscope and detector as shown in Figure 5-40. Connect the DVM to the DUT's rear panel 0.5 V/GHz output BNC. Switch the DUT's LINE switch ON and allow the equipment to warm up for one half hour.

INITIAL SETTINGS

NOTE

Once these initial settings have been made, it will be necessary to complete this procedure and the Leveled RF Output adjustments

2. Access the DUT's Calibration Constants by pressing the following key sequence:

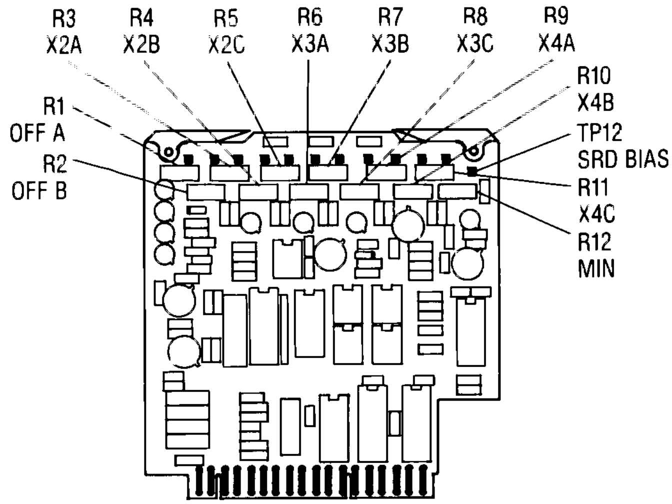
   [INSTR PRESET]
   [SHIFT] [GHz] [2] [Hz]
   [SHIFT] [MHz] [1] [2] [Hz]
   [SHIFT] [kHz] [2] [2] [Hz]

   Preset Cal Constant number 2 to 100 by entering **[1] [0] [0] [Hz].**

NOTE

After initially accessing the Cal Constants, subsequent entry into the Cal Constant mode may be accomplished by pressing; [SHIFT] [GHz] [desired Cal Constant] [Hz] [SHIFT] [ENTRY OFF]. However, after pressing [INSTR PRESET], the full Cal Constant key sequence must be entered (see above).

A24



A26

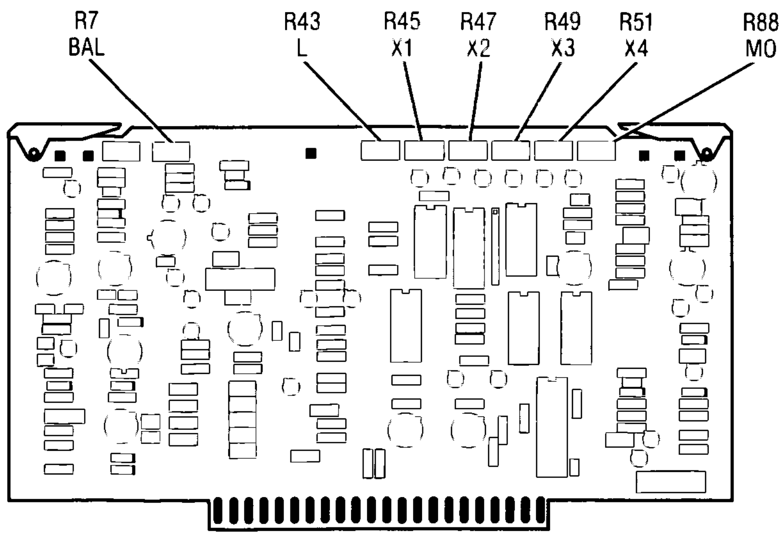


Figure 5-41. Unleveled RF Output Adjustments Location (1 of 2)

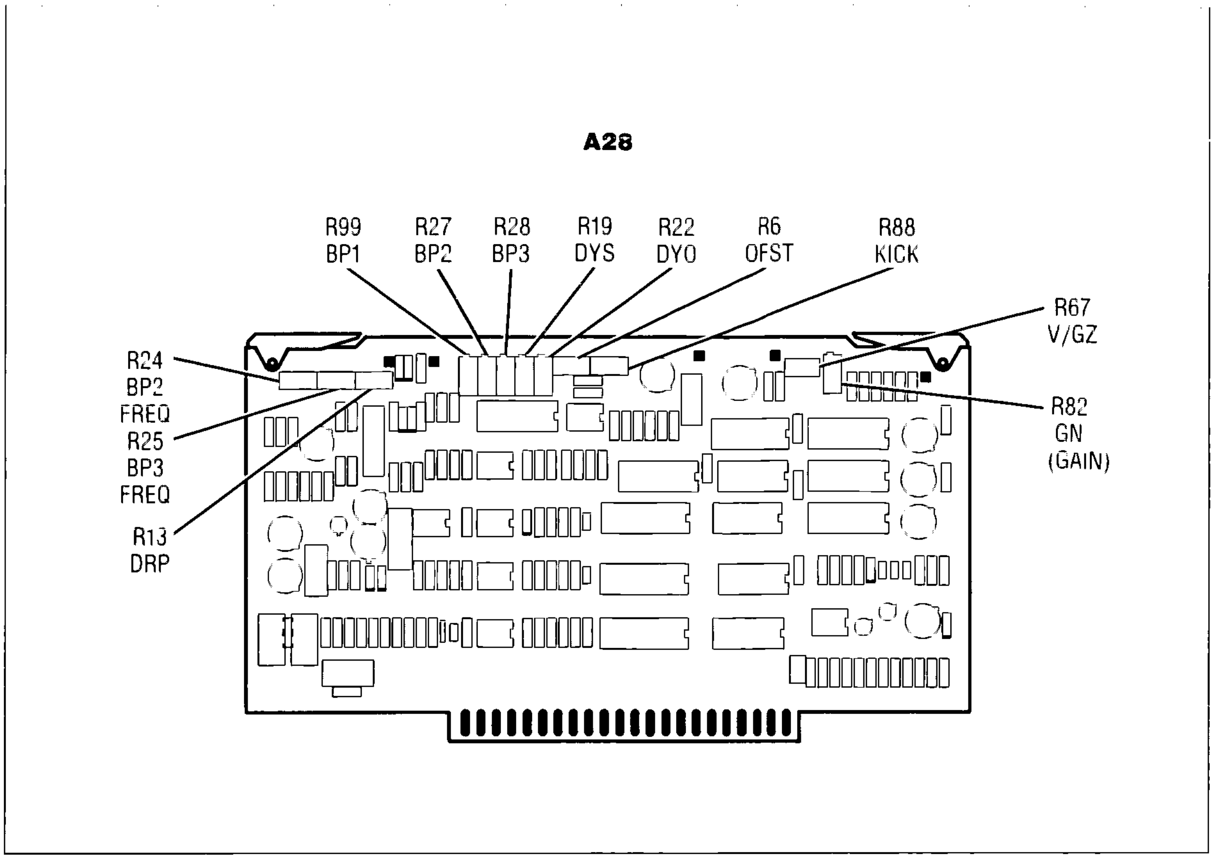


Figure 5-41. Unleveled RF Output Adjustments Location (2 of 2)

5-14. UNLEVELED RF OUTPUT ADJUSTMENTS (Cont'd)

3. Press the **[▲]** step key to access each Cal Constant listed in the table below and preset the Cal Constants to the value provided in the table. Be sure to terminate each entry by pressing **[Hz]**.

Cal Constant	Value	Cal Constant	Value
3	100	52	0
4	100	53	0
5	100	71	1024
6	100	72	1024
7	100	73	1024
8	100	74	1024
9	1024	75	25
10	1024	76	1000
11	1024	77	−25
12	1024	78	25
50	0	80	0
51	0		

4. If the A13 SYTM or the A24 Attenuator Driver/SRD Bias assembly has been replaced, preset the following potentiometers (pots) to the position stated (see Figure 5-41):

   Center the following.

   A24R3 (X2A) A24R6 (X3A) A24R9 X4A) A24R12 (MIN)

   A24R4 (X2B) A24R7 (X3B) A24R10 (X4B)

   Set the following fully counter-clockwise:

   A24R1 (OFF A) A24R2 (OFF B) A24R5 (X2C)

   A24R8 (X3C) A24R11 (X4C)

5. If the A13 SYTM or the A28 SYTM Driver assembly has been replaced, preset the following pots to the position stated (see Figure 5-41):

   Center:

   A28R6 (OFST)

   Set the following fully clockwise:

   A28R13 (DRP) A28R24 (BP2 FREQ) A28R25 (BP3 FREQ) A28R88 (KICK)

   Set the following fully counter-clockwise.

   A28R19 (DYS) A28R22 (DYO) A28R27 (BP2)

   A28R28 (BP3) A28R82 (GAIN) A28R99 (BP1)

5-14. UNLEVELED RF OUTPUT ADJUSTMENTS (Cont'd)

Remove jumpers A28W1 and A28W2 if they are installed on the A28 assembly. These jumpers must be removed to set the V/GHz circuit to 0.5V/GHz.

6. If the A26 assembly has been replaced, preset the following pots to the position stated (see Figure 5-41):

   Set the following fully clockwise:

   A26R88 (MO)

   Center the following:

A26R7 (BAL)	A26R43 (HET)	A26R45 (X1)	A26R47 (X2)
A26R49 (X3)	A26R51 (X4)	A26R91 (GAIN)	

0.5 V/GHZ ADJUSTMENT

7. On the DUT, press **[CW] [1] [0] [MHz].** Adjust A28R67 (V/GHz) for a DVM indication of 5 mV + 0.5 mV

SYTM TRACKING AND UNLEVELED SRD BIAS ADJUSTMENTS

8. On the DUT, press the following key sequence:

   [START FREQ] [6] [.] [9] [GHz]
   [STOP FREQ] [1] [3] [.] [5] [GHz]
   [POWER LEVEL] [0] [dBm]
   [SWEEPTIME] [2] [0] [0] [msec]
   [XTAL]
   [SAVE] [1]

9. Connect the oscilloscope and detector as shown in Figure 5-40 Set the oscilloscope to A vs B mode, horizontal sensitivity (CHAN B) to 1 V/Div dc, and vertical sensitivity (CHAN A) to 0 05 V/Div dc Adjust the horizontal and vertical position controls to view the entire swept RF output response on the oscilloscope. Readjust the vertical sensitivity if necessary so that the trace covers the maximum number of divisions possible.

Band 2 Adjustments

10. Adjust A28R82 (GAIN) to peak the power across the entire band (readjust the scope's vertical position and/or sensitivity if necessary).

NOTE

In the following adjustments, turning the X2A/B, X3A/B, or X4A/B controls clockwise when in the appropriate band will increase the SRD bias and be closer to the squegging region[1]. If squegging occurs, turn the above controls counter-clockwise until the RF output power is reduced ≅ 0.5 dB below the squegging region.

---

1 The squegging region is an area where undesired oscillations of the YIG sphere or Step Recovery Diode (both internal to the SYTM) are produced. Symptoms of squegging are power reversal (actual RF output power decreases as selected RF output power is increased), power holes in the RF output, and spurious responses on the RF output

NOTE

After you have peaked the power in the band you are adjusting, you can determine the approximate power per division on the oscilloscope (for a specific vertical sensitivity) by perform the following. Press [MANUAL] and note the power level in the POWER dBm display. Press [SHIFT] [PWR SWP] and set the ALC level, using the DUT's front panel rotary knob, to the noted power level. Turn the rotary knob counter-clockwise to place the dot on the oscilloscope to a convenient horizontal graticule and note the power level in the POWER dBm display. Turn the rotary knob counter-clockwise to place the dot on the next horizontal graticule and note the power level. The difference between the two readings is the dB/Div sensitivity on the oscilloscope. Repeat this procedure for several horizontal divisions on the scope since the dB/Div will change slightly as the power level is changed (due to the output characteristics of the detector). If you wish to verify the sensitivity at other frequencies, press [MANUAL] and turn the rotary knob for the desired frequency and then repeat this procedure. After completing this procedure, press [RECALL] [1] to return to the instrument state required for the adjustments.

11. If the trace goes off the oscilloscope display in the following adjustments, adjust the vertical position and/or sensitivity controls to view the entire trace on the display

    Adjust A24R3 (X2A) to optimize the power in the first half of the display.

    Adjust A24R4 (X2B) to optimize the power in the second half of the display.

    If the output power begins to decrease while adjusting one of these potentiometers (pots) clockwise (i.e., power reversal, squegging), adjust the pot counter-clockwise until the power is peaked again and then continue turning the pot counter-clockwise until the power is reduced ≅ 0.5 dB.

    It may be desirable to optimize the power in one half of the band (maximum power with no squegging), even though squegging is induced in the other half. One would do this if the side being adjusted is significantly lower in power than the other half. Once the power is optimized, adjust the bias in the other half (using the pot for that half) to eliminate squegging. Iterate between the two adjustments to optimize the power and to ensure that there is no squegging in either half.

    If squegging occurs in the center of the swept display (one division left or right of center), adjust X2A counter-clockwise to eliminate the squegging. Adjusting X2A to eliminate squegging in the center of the band will hopefully force the SRD BIAS test point (A24TP12) into a slight upward slope.

12. Adjust A28R6 (OFST) and A28R82 (GAIN) for optimum power across the entire display.

13. Repeat step 11. After this, disconnect the detector and connect the scope probe to A24TP12 (SRD BIAS) as shown in Figure 5-40. Adjust the scope's vertical sensitivity to view the waveform on TP12. If TP12 exhibits a slight upward slope, as shown in Figure 5-42, proceed to step 14. If TP12 exhibits a flat or downward slope, adjust X2A until a upward slope is displayed on TP12 (do not adjust X2A more than 1/8 of a turn). If adjusting X2A does not provide an upward slope on TP12, adjust X2B until a upward slope is displayed on TP12 (do not adjust X2B more than 1/8 of a turn). If neither of these adjustments provide an upward slope on TP12, repeat steps 9 through 13.

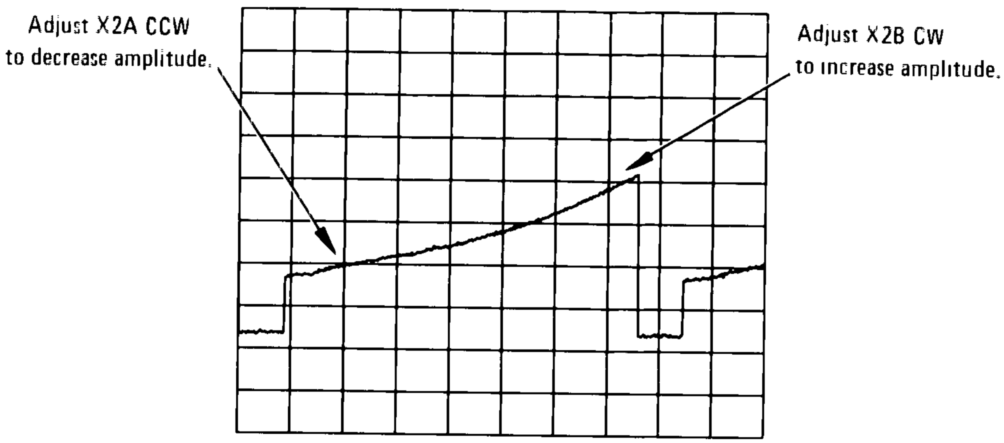


Figure 5-42. Oscilloscope Display of SRD Bias Waveform

14. Disconnect the oscilloscope probe and reconnect the detector as shown in Figure 5-40. Set the oscilloscope's vertical sensitivity (CHAN A) to 0.5 V/Div. Readjust the vertical position and/or sensitivity, if necessary, to view the entire trace on the scope. Note the position of the minimum power point.

15. Press **[MANUAL]** on the DUT. Adjust the front panel rotary knob until the dot on the scope is near the position noted as the minimum power point. Slowly vary the position of the dot around this point while observing the DUT's POWER dBm display. The minimum power displayed should be > 1 dB above the maximum leveled power specification for the DUT in Band 2 (6.9 to 13.5 GHz). If this is not the case, disconnect the detector from the DUT and connect the power meter and power sensor. Again, slowly vary the rotary knob and determine the power level of the minimum power point. If it is still < 1 dB above the maximum leveled power specification, press **[RECALL] [1]** on the DUT and repeat steps 9 through 15.

Band 3 Adjustments

16. On the DUT, press

    [START FREQ] [1] [3] [.] [3] [5] [GHz]
    [STOP FREQ] [2] [0] [GHz]
    [CONT]
    [SAVE] [1]

    Adjust the scope's vertical position and/or sensitivity control to display the swept RF output.

17. Adjust A28R99 (BP1) to peak the power in the second half of the display. This pot may need to be adjusted several turns before any effect is observed.

18. If the trace goes off the oscilloscope display in the following adjustments, adjust the vertical position and/or sensitivity controls to view the entire trace on the display.

    Adjust A24R6 (X3A) to optimize the power in the first half of the display.

    Adjust A24R7 (X3B) to optimize the power in the second half of the display.

If the output power begins to decrease while adjusting one of these potentiometers (pots) clockwise (i.e., power reversal, squegging), adjust the pot counter-clockwise until the power is peaked again and then continue turning the pot counter-clockwise until the power is reduced ≅ 0.5 dB.

It may be desirable to optimize the power in one half of the band (maximum power with no squegging), even though squegging is induced in the other half. One would do this if the side being adjusted is significantly lower in power than the other half. Once the power is optimized, adjust the bias in the other half (using the pot for that half) to eliminate squegging. Iterate between the two adjustments to optimize the power and to ensure that there is no squegging in either half.

19. Adjust A28R99 (BP1) to peak the power in the second half of the display.

20. Access Cal Constant 73 by pressing **[SHIFT] [GHz] [7] [3] [Hz] [SHIFT] [ENTRY OFF]** on the DUT. Using the DUT's rotary knob, adjust Cal Constant 73 to peak the power across the entire band (adjust above and below 1024). Repeat steps 19 and 20

21. Repeat step 18.

22. Note the position of the minimum power point on the scope. On the DUT, press **[MANUAL]**. Adjust the DUT's rotary knob until the dot on the scope is near the position noted as the minimum power point. Slowly vary the position of the dot around this point while observing the DUT's POWER dBm display. The minimum power displayed should be > 1 dB above the maximum leveled power specification for the DUT in Band 3 (13.35 to 20 GHz). If this is not the case, disconnect the detector from the DUT and connect the power meter and power sensor. Again, slowly vary the rotary knob and determine the power level of the minimum power point. If it is still < 1 dB above the maximum leveled power specification, press **[CONT]** on the DUT and repeat steps 17 through 22

Band 4 Adjustments (HP 8340B Only)

If adjusting an HP 8341B, proceed to step 31.

23 On the DUT, press

[START FREQ] [1] [9] [.] [8] [GHz]
[STOP FREQ] [2] [6] [.] [5] [GHz]
[CONT]
[SAVE] [1]

Adjust the scope's vertical position and/or sensitivity to display the swept RF output.

24. Adjust A28R24 (BP2 FREQ) to peak the power across the band. If this adjustment has no effect or reduces the power, return A28R24 to full clockwise and proceed immediately to step 26 (step 25 will not be required).

25 Adjust A28R25 (BP3 FREQ) to peak the power in the second half of the display. If A28R25 has no effect or reduces the power, return the pot to full clockwise. Adjust A28R27 (BP2) to peak the power across the band. If A28R25 (BP3 FREQ) was adjusted from full clockwise, adjust A28R28 (BP3) to optimize the power in the second half of the display.

26. If the trace goes off the oscilloscope display in the following adjustments, adjust the vertical position and/or sensitivity controls to view the entire trace on the display.

Adjust A24R9 (X4A) to optimize the power in the first half of the display

Adjust A24R10 (X4B) to optimize the power in the second half of the display.

If the output power begins to decrease while adjusting one of these potentiometers (pots) clockwise (i.e., power reversal, squegging), adjust the pot counter-clockwise until the power is peaked again and then continue turning the pot counter-clockwise until the power is reduced ≅ 0.5 dB.

It may be desirable to optimize the power in one half of the band (maximum power with no squegging), even though squegging is induced in the other half One would do this if the side being adjusted is significantly lower in power than the other half. Once the power is optimized, adjust the bias in the other half (using the pot for that half) to eliminate squegging. Iterate between the two adjustments to optimize the power and to ensure that there is no squegging in either half.

27. If BP2 FREQ and BP2 have been adjusted, readjust them for maximum power across the band If BP3 FREQ and BP3 have been adjusted, readjust them for maximum power in the second half of the display.

28. Access Cal Constant 74 by pressing **[SHIFT] [GHz] [7] [4] [Hz] [SHIFT] [ENTRY OFF]** on the DUT. Using the DUT's rotary knob, adjust Cal Constant 74 to peak the power across the entire band (adjust above and below 1024).

29. Repeat step 26.

30. Note the position of the minimum power point on the scope. On the DUT, press **[MANUAL]**. Adjust the DUT's rotary knob until the dot on the scope is near the position noted as the minimum power point. Slowly vary the position of the dot around this point while observing the DUT's POWER dBm display. The minimum power displayed should be > 1 dB above the maximum leveled power specifications for the DUT in Band 4 (19.8 to 26.5 GHz). If this is not the case, disconnect the detector from the DUT and connect the power meter and power sensor to the attenuator. Again, slowly vary the rotary knob and determine the power level of the minimum power point. If it is still < 1 dB above the maximum leveled power specification, press **[CONT]** on the DUT and repeat steps 23 through 30.

SYTM Auto Tracking (8340B and 8341B)

31. Press **[SHIFT] [PEAK]** on the DUT. The DUT's ENTRY DISPLAY will display "AUTO TRACKING CALIBRATION". Wait for this display to turn off and then press **[INSTR PRESET].**

SYTM DELAY COMPENSATION ADJUSTMENTS BY BAND

Band 4 Delay Compensation (HP 8340B), Band 3 Delay Compensation (HP 8341B)

32. Connect the scope and detector as shown in Figure 5-40. The scope should be set for A vs B mode.

33. Press the following key sequence on the DUT.

For an HP 8340B

[INSTR PRESET]
[START FREQ] [1] [9] [.] [8] [GHz]
[XTAL]
[SWEEPTIME] [2] [0] [0] [msec]
[SAVE] [1]
[SWEEPTIME] [AUTO]
[SAVE] [2]
[SINGLE]
[SAVE] [3]
[RECALL] [2]

For an HP 8341B

[INSTR PRESET]
[START FREQ] [1] [3] [.] [3] [5] [GHz]
[XTAL]
[SWEEPTIME] [2] [0] [0] [msec] (500 mS if the DUT has Option 003)
[SAVE] [1]
[SWEEPTIME] [AUTO]
[SAVE] [2]
[SINGLE]
[SAVE] [3]
[RECALL] [2]

34. Adjust the scope's vertical and horizontal sensitivity to view the swept display The horizontal gain should be set so the trace covers the full display from left to right

35. Access Calibration Constant 75 by pressing the following key sequence on the DUT.

[SHIFT] [GHz] [7] [5] [Hz]
[SHIFT] [MHz] [1] [2] [Hz]
[SHIFT] [kHz] [2] [2] [Hz]

NOTE

The range for the delay compensation Cal constants, numbers 2 through 8, is 0 to 131. If the Cal Constants do not provide sufficient range for the delay compensation, Cal Constant 8 should be lowered (Cal Constant 7 for the HP 8341B), A28R22 (DYO) and A28R19 (DYS) readjusted, and then the SYTM DELAY COMPENSATION ADJUSTMENTS BY BAND procedure should be repeated.

36. Adjust A28R22 (DYO) for optimum power in the first half of the display Ignore the small power dropout at the beginning of the sweep, this will be eliminated later

37. Adjust A28R19 (DYS) for optimum power in the second half of the display. Iterate between steps 36 and 37 until optimum power is achieved across the band.

38. Using the DUT's rotary knob, adjust Cal Constant 75 (range is 0 to 500) to optimize the power in the first division (left hand side) of the display (i.e., eliminate the small power dropout).

39. Press **[RECALL]** on the DUT and iterate between registers 1 and 2 by pressing **[1]** and then **[2]**. Verify that the fast sweep speed trace (register 2) is no more than ≅ 1 dB below the slow sweep speed trace (register 1) at any point. Also, the minimum power point on the fast sweep speed trace should be > 1 dB above the maximum leveled power specifications for the Band. If either of the above conditions are not met, repeat steps 36 through 40

40. Iterate between registers 1 and 3 and press **[SINGLE]** (initiates the single sweep) after selecting register 3. Verify that the single sweep trace (register 3) is no more than 1 db below the slow sweep trace (register 1) at any point. Also, the minimum power point on the single sweep trace should be > 1 dB above the maximum leveled power specifications for the Band. If either of the above conditions are not met, repeat steps 36 through 40.

    If the DUT is an HP 8341B, proceed to step 51.

Band 3 Delay Compensation, HP 8340B

41. Press the following key sequence on the DUT:

    [CONT] (If not already in continuous sweep mode)
    [START FREQ] [1] [3] [.] [3] [5] [GHz]
    [STOP FREQ] [2] [0] [GHz]
    [SWEEPTIME] [2] [0] [0] [msec]
    [SAVE] [7]
    [SWEEPTIME] [AUTO]
    [SAVE] [8]
    [SINGLE]
    [SAVE] [9]
    [RECALL] [8]

    Adjust the scope's vertical position and/or sensitivity to view the swept display.

42. Access Cal Constant 7 by pressing **[SHIFT] [GHz] [7] [Hz] [SHIFT] [ENTRY OFF]** on the DUT.

43. Using the DUT's rotary knob, adjust Cal Constant 7 (range is 0 to 131) to optimize the power across the entire Band. If Cal Constant 7 is unable to optimize (peak) the majority of Band 3 at the same time (> 60% of the Band should peak at the same time), then proceed with step 44 Otherwise, proceed with step 50.

44. On the DUT, press **[1] [0] [0] [Hz]** to return Cal Constant 7 to 100 Repeat steps 36 and 37.

45. Press **[RECALL]** on the DUT and iterate between registers 7 and 8 by pressing **[7]** and then **[8]**. Verify that the fast sweep speed trace (register 8) is no more than ≅ 1 dB below the slow sweep speed trace (register 7) at any point. Also, the minimum power point on the fast sweep speed trace should be > 1 dB above the maximum leveled power specifications for Band 3. If either of the above conditions are not met, repeat steps 42 through 45

46. Iterate between registers 7 and 9 and verify that the single sweep trace (register 9) is no more than 1 db below the slow sweep trace at any point. After pressing **[9]** on the DUT you need to press **[SINGLE]** to initiate the single sweep. Also, the minimum power point on the single sweep trace should be > 1 dB above the maximum leveled power specifications for Band 3. If either of the above conditions are not met, repeat steps 42 through 46.

47. Press **[RECALL] [2]** on the DUT (recalls the Band 4 fast sweep setup). Adjust the scope's vertical position and/or sensitivity to view the swept display.

5-14. UNLEVELED RF OUTPUT ADJUSTMENTS (Cont'd)

48. Access Cal Constant 8 by pressing **[SHIFT] [GHz] [8] [Hz] [SHIFT] [ENTRY OFF]** on the DUT. Using the DUT's rotary knob, adjust Cal Constant 8 (range is 0 to 131) for optimum power across Band 4

49. Press **[RECALL]** on the DUT and iterate between registers 1 and 2 by pressing **[1]** and then **[2]**. Verify that the fast sweep speed trace (register 2) is no more than ≅ 1 dB below the slow sweep speed trace (register 1) at any point. Also, the minimum power point on the fast sweep speed trace should be > 1 dB above the maximum leveled power specifications for the Band. If either of the above conditions are not met, repeat steps 46 through 49.

    Proceed with step 51.

50. Perform steps 45 and 46.

Band 2 Delay Compensation, HP 8340B and 8341B

51. Press the following key sequence on the DUT:

    [CONT] (If not already in continuous sweep mode)
    [START FREQ] [6] [.] [9] [GHz]
    [STOP FREQ] [1] [3] [.] [5] [GHz]
    [SWEEPTIME] [2] [0] [0] [msec] (500 mS if the DUT is an HP 8341B Option 003)
    [SAVE] [1]
    [SWEEPTIME] [AUTO]
    [SAVE] [2]
    [SINGLE]
    [SAVE] [3]
    [RECALL] [2]

    Adjust the scope's vertical position and/or sensitivity to view the swept display

52. Access Cal Constant 6 by pressing **[SHIFT] [GHz] [6] [Hz] [SHIFT] [ENTRY OFF]** on the DUT. Using the DUT's rotary knob, adjust Cal Constant 6 (range is 0 to 131) to optimize the power across the entire Band

53. Press **[RECALL]** on the DUT and iterate between registers 1 and 2 by pressing **[1]** and then **[2]**. Verify that the fast sweep speed trace (register 2) is no more than ≅ 1 dB below the slow sweep speed trace (register 1) at any point. Also, the minimum power point on the fast sweep speed trace should be > 1 dB above the maximum leveled power specifications for Band 2. If either of the above conditions are not met, repeat steps 52 and 54.

54. Iterate between registers 1 and 3 and verify that the single sweep trace (register 3) is no more than 1 db below the slow sweep trace at any point. After pressing **[3]** on the DUT you need to press **[SINGLE]** to initiate the single sweep. Also, the minimum power point on the single sweep trace should be > 1 dB above the maximum leveled power specifications for Band 2. If either of the above conditions are not met, repeat steps 52 through 54.

Band 1 Delay Compensation

55 Press the following key sequence on the DUT:

[CONT] (If not already in continuous sweep mode)
[SHIFT] [METER] [-] [5] [0] [dBm]
[START FREQ] [2] [.] [3] [GHz]
[STOP FREQ] [7] [.] [0] [GHz]
[SWEEPTIME] [2] [0] [0] [msec] (500 mS if the DUT is an HP 8341B Option 003)
[SAVE] [1]
[SWEEPTIME] [AUTO]
[SAVE] [2]
[SINGLE]
[SAVE] [3]
[RECALL] [2]

Adjust the scope's vertical position and/or sensitivity to view the swept display. The SHIFT METER mode is being implemented to allow the Band 1 delay compensation to be adjusted without any squegging[2] present.

56 Access Cal Constant 5 by pressing **[SHIFT] [GHz] [5] [Hz] [SHIFT] [ENTRY OFF]** on the DUT Using the DUT's rotary knob, adjust Cal Constant 5 (range is 0 to 131) to optimize the power across the entire Band.

57. Press **[RECALL]** on the DUT and iterate between registers 1 and 2 by pressing **[1]** and then **[2]**. Verify that the fast sweep speed trace (register 2) is no more than 2 dB below the slow sweep speed trace (register 1) at any point. If this condition is not met, repeat steps 56 and 57

58. Iterate between registers 1 and 3 and verify that the single sweep trace (register 3) is no more than 2 db below the slow sweep trace at any point. After pressing **[3]** on the DUT you need to press **[SINGLE]** to initiate the single sweep. If this condition is not met, repeat steps 56 through 58.

Multiband Delay Compensation Adjustments

59 Press the following key sequence on the DUT:

[INSTR PRESET]
[START FREQ] [2] [.] [3] [GHz]
[XTAL]
[SWEEPTIME] [1] [sec]
[SAVE] [1]
[SWEEPTIME] [AUTO]
[SAVE] [2]
[SINGLE]
[SAVE] [3]
[RECALL] [2]

Adjust the scope's vertical position and/or sensitivity to view the swept display

---

2 Squegging in Band 1 (2 3 to 7 0 GHz) is seen as large power drop outs and spurious signals on the RF output Band 1 squegging is a function of input power into the SYTM and cannot be adjusted out Band 1 squegging will only occur if maximum available power is requested from the DUT (i e maximum unleveled power) Since this is the case Band 1 squegging will normally not occur when the DUT is set to maximum specified power and below

60. Access Cal Constant 4 by pressing the following key sequence on the DUT.

    [SHIFT] [GHz] [4] [Hz]
    [SHIFT] [MHz] [1] [2] [Hz]
    [SHIFT] [kHz] [2] [2] [Hz].

    If the DUT is an HP 8341B, proceed to step 62

61. Using the DUT's rotary knob, adjust Cal Constant 4 (range is 0 to 131) to optimize the power in Band 4.

62. Access Cal Constant 3 by pressing the **[▼]** step key. Using the DUT's rotary knob, adjust Cal Constant 3 (range is 0 to 131) to optimize the power in Band 3.

63. Access Cal Constant 2 by pressing the **[▼]** step key. Using the DUT's rotary knob, adjust Cal Constant 2 (range is 0 to 131) to optimize the power in Band 2.

64. Access Cal Constant 77 by pressing **[SHIFT] [GHz] [7] [7] [Hz] [SHIFT] [ENTRY OFF]** on the DUT Using the DUT's rotary knob, adjust Cal Constant 77 (range is −25 to +25) for optimum power at the band switch points If this Cal Constant has no effect, reset it to −25.

65. Press the **[▲]** step key to access Cal Constant 78. Using the DUT's rotary knob, adjust Cal Constant 78 (range is −25 to +25) for optimum power at the band switch points. If this Cal Constant has no effect, reset it to +25.

66. Press **[RECALL]** on the DUT and iterate between registers 1 and 2 by pressing **[1]** and then **[2]** Verify that the fast sweep speed trace (register 2) is no more than 1 dB below the slow sweep speed trace (register 1) at any point (ignore squegging which is most likely occurring in Band 1). Also, the minimum power point on the fast sweep speed trace should be > 1 dB above the maximum leveled power specifications for each band (again, ignore squegging in Band 1). If either of the above conditions are not met, repeat steps 59 through 66.

67. Iterate between registers 1 and 3 and verify that the single sweep trace (register 3) is no more than 2 db below the slow sweep trace at any point (ignore squegging which is most likely occurring in Band 1). After pressing **[3]** on the DUT you need to press **[SINGLE]** to initiate the single sweep. Also, the minimum power point on the single sweep trace should be > 1 dB above the maximum leveled power specifications for each band (again, ignore squegging in Band 1). If either of the above conditions are not met, repeat steps 59 through 67.

68. Press the following key sequence on the DUT:

    [RECALL] [2]
    [SHIFT] [GHz] [1] [Hz]
    [SHIFT] [ENTRY OFF] [5] [0] [0] [Hz] (Sets Cal Constant 1 to 500)

    Adjust A28R13 (DRP) for optimum power across the entire frequency range.

69. Press the following key sequence on the DUT:

    [50] [Hz] (Resets Cal Constant 1 to 50)
    [SHIFT] [MHz] [1] [4] [Hz]
    [SHIFT] [kHz] [5] [3] [4] [9] [Hz]

    Wait for "CALIBRATION STORED" to be displayed in the DUT's ENTRY DISPLAY and then press **[INSTR PRESET].**

UNLEVELED SQUEGGING TEST USING THE HP 8566B SPECTRUM ANALYZER

Description

The DUT's RF output signal is down converted using a Local Oscillator and a mixer The IF output of the mixer is fed to a spectrum analyzer. Any squegging of the DUT will appear as a spurious response on the IF signal

This test should be performed after adjusting the SYTM tracking and delay, and the SRD unleveled bias. Since unleveled squegging can be difficult to see using the oscilloscope, this test is performed to determine if additional adjustments are required.

Equipment Required

Synthesized Sweeper .... HP 8340B Option 001
10 dB Attenuator .... HP 8493C Option 010
Mixer .... HP P/N 0955-0307
Spectrum Analyzer .... HP 8566B
Adapters
APC 3.5 (f) To Type N (m) (required if DUT is HP 8341B) ..... HP P/N 1250-1744
APC 3.5 (f) to APC 3.5 (f) .... HP P/N 5061-5311
(1 required if DUT is an HP 8341B; 2 required if DUT is an HP 8340B)

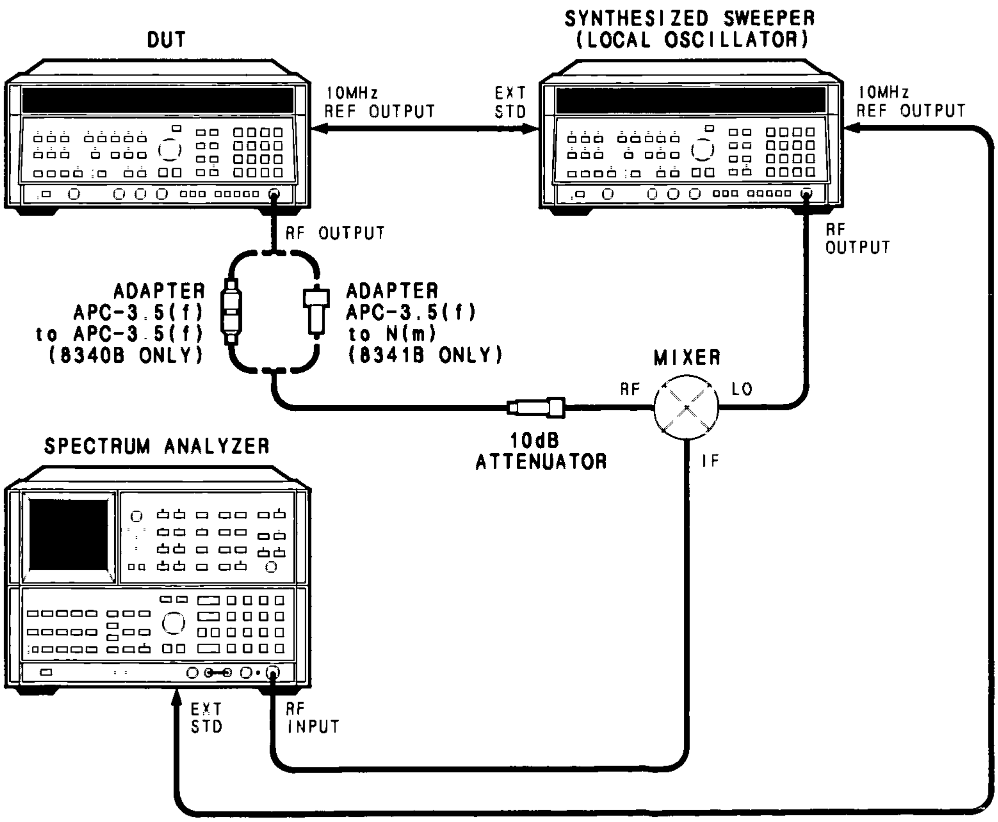


Figure 5-43. Unleveled Squegging Test Setup

5-14. UNLEVELED RF OUTPUT ADJUSTMENTS (Cont'd)

70 Connect equipment as shown in Figure 5-43 Connect the mixer at the Local Oscillator's (LO) RF output connector to obtain maximum mixer LO input level Set the LO and spectrum analyzer to external standard. Allow at least 30 minutes warm up time

71. Press the Local Oscillator **[INSTR PRESET]**. Press **[START FREQ]** and enter **[6] [.] [4] [GHz]**. Press **[STOP FREQ]** and enter **[1] [2] [.] [9] [GHz]**. Press **[POWER LEVEL]** and enter **[1] [0] [dBm]**. Press **[SHIFT] [CF]** and enter **[1] [0] [0] [MHz]** for a step size of 100 MHz. Press **[MANUAL]** SWEEP and enter **[6] [.] [4] [GHz]** to set the Local Oscillator to CW at 6.4 GHz. Press **[PEAK]** to turn on peaking

72. Press **[INSTR PRESET]** on the DUT. Press **[START FREQ]** and enter **[7] [GHz]**. Press **[STOP FREQ]** and enter **[1] [3] [.] [5] [GHz]**. Press **[POWER LEVEL]** and enter **[2] [0] [dBm]**. UNLEVELED indicator should be on. Press **[SHIFT] [CF]** and enter **[1] [0] [0] [MHz]** for a step size of 100 MHz. Press **[MANUAL]** SWEEP and enter **[7] [GHz]**. The mixer IF frequency is now 600 MHz.

73. Set the Spectrum Analyzer as follows:

FULL SPAN	0 - 2.5 GHz
RES BW	300 kHz
VIDEO BW	100 kHz
START FREQ	590 MHz
STOP FREQ	800 MHz
REFERENCE LEVEL	−10 dBm
ATTEN	0 dB

Press HOLD to retain these settings. The 600 MHz IF signal should be near the left side of the Spectrum Analyzer CRT.

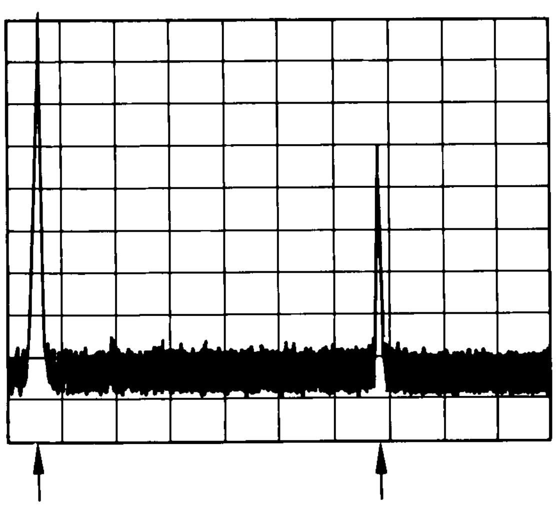


Figure 5-44. Unleveled Squegging Displayed on Spectrum Analyzer

5-14. UNLEVELED RF OUTPUT ADJUSTMENTS (Cont'd)

74. Using the [▲] key on both the DUT and the LO, step through Band 2, observing the Spectrum Analyzer display at each step. There may be responses due to mixing products. These will appear as low level signals. A squegging response will appear as a higher amplitude signal as shown in Figure 5-44. If squegging occurs at DUT frequencies below 10 GHz, adjust A24R3 (X2A) slightly CCW to eliminate squegging. If squegging occurs at frequencies above 10 GHz, adjust A24R4 (X2B) to eliminate the squegging. Note, if the control is adjusted and there is no effect on the response, the response is probably a mixing product

75. For Band 3, press the Local Oscillator **[START FREQ]** and enter **[1] [2] [.] [9] [GHz]**. Press **[STOP FREQ]** and enter **[1] [9] [.] [4] [GHz]**. Press **[MANUAL]** and enter **[1] [2] [.] [9] [GHz]**.

76. On the DUT press **[POWER LEVEL]** and enter **[2] [0] [dBm]**. Press **[START FREQ]** and enter **[1] [3] [.] [5] [GHz]**. Press **[STOP FREQ]** and enter **[2] [0] [GHz]**. Press **[MANUAL]** and enter **[1] [3] [.] [5] [GHz]**.

77 Using the step keys as described in step 26, step through Band 3. If squegging occurs below 15 GHz, adjust A24R6 (X3A) slightly CCW to eliminate the squegging. If squegging occurs above 15 GHz, adjust A24R7 (X3B).

Band 4 Adjustments, HP 8340B only

78. For Band 4, press the Local Oscillator **[START FREQ]** and enter **[1] [9] [.] [4] [GHz]**. Press **[STOP FREQ]** and enter **[2] [5] [.] [9]**. Press **[MANUAL]** and enter **[1] [9] [.] [4] [GHz]**.

79. On the DUT press **[START FREQ]** and enter **[2] [0] [GHz]**. Press **[STOP FREQ]** and enter **[2] [6] [.] [5] [GHz]**. Press **[POWER LEVEL]** and enter **[2] [0] [dBm]** Press **[MANUAL]** and enter **[2] [0] [GHz]**.

80. Using the step keys as described in step 26, step through Band 4. If squegging occurs below 23 GHz, adjust A24R9 (X4A) slightly CCW to eliminate the squegging. If squegging occurs above 23 GHz, adjust A24R10 (X4B).

NOTE

If adjustments of the calibration constants were made in this procedure, the data thus stored in the "working memory area" should be copied to the "protected memory area" by pressing the following key sequence: [SHIFT] [1] [4] [Hz] [SHIFT] [kHz] [5] [3] [4] [9] [Hz] [INSTR PRESET].

5-15. ALC ADJUSTMENTS

Reference

Performance Test: Maximum Leveled Output Power and Accuracy
Service Section: RF Section

LOGGER TEMPERATURE COMPENSATION

Description

NOTE

The following logger temperature compensation procedure should only be done if either A11 or A12 Detector is replaced.

The logger in A25 has temperature compensation in both high and low bands. This procedure calculates the values for the four factory-selected resistors in the temperature compensation circuit.

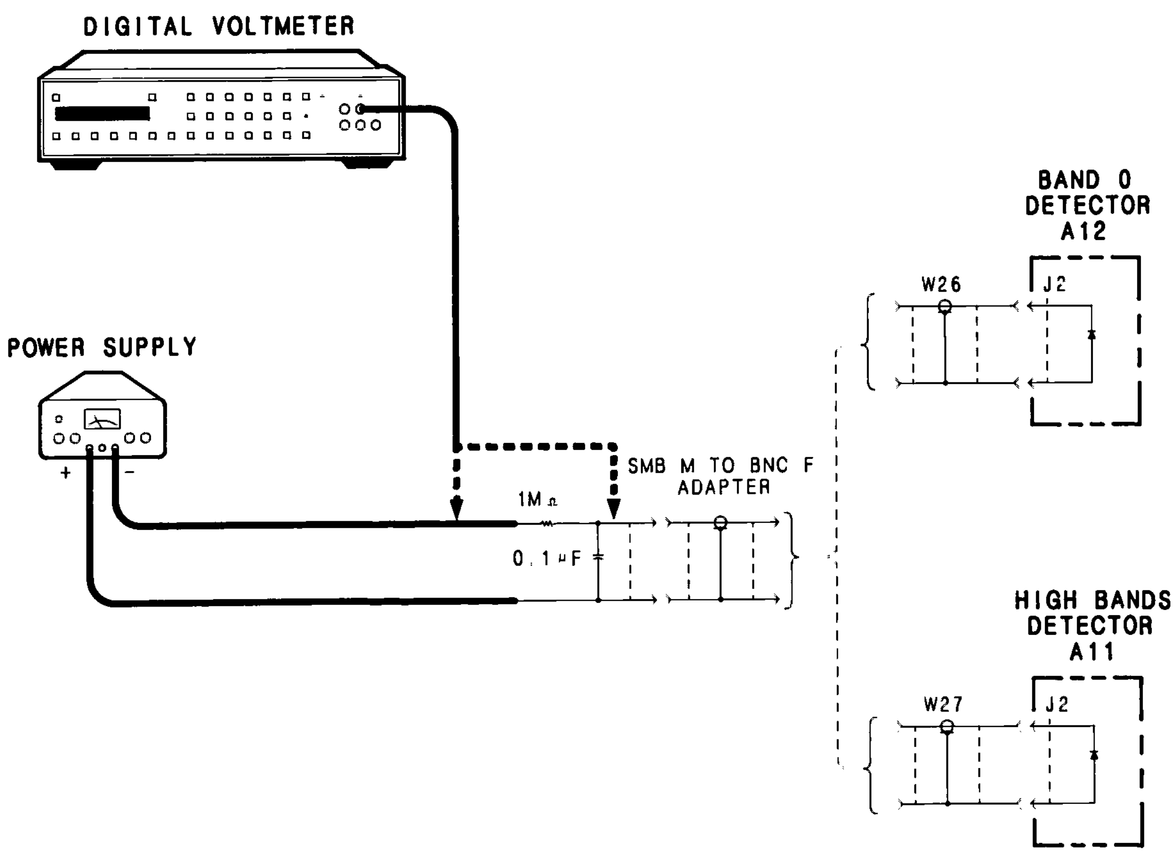


Figure 5-45. Logger Temperature Compensation Test Setup

Equipment

Power Supply .... HP 6294A
Digital Voltmeter (DVM) .... HP 3456A
1 Megohm Resistor .... HP P/N 0757-0059
0.1 UF Capacitor .... HP P/N 0160-0168
Extender Board .... HP P/N 08350-60031

Procedure

1 Disconnect AC power cable from the DUT and allow it to cool for at least two hours

2. Disconnect cables W26 and W27 from A25J2 and A25J1 respectively (Figure 5-46), and remove the A25 PC board from the instrument.

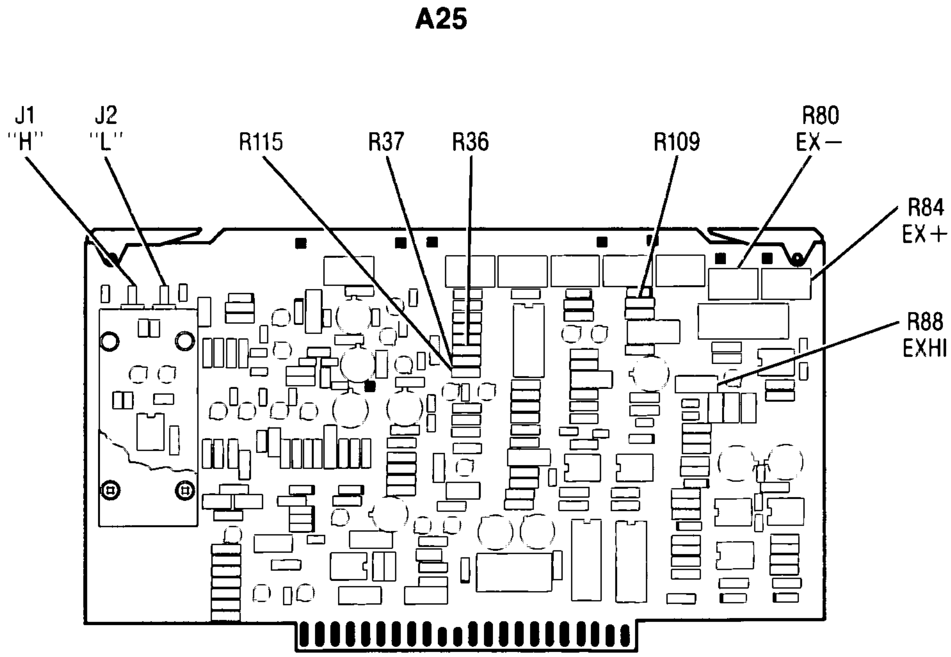


Figure 5-46. ALC Detector A25 Temperature Compensation Adjustments Location

3. Install an Extender Board in place of A25.

4. Set the DVM for Ohms measurement and connect the input between pins 4 and 26 of the extender board. Note the resistance measured. This value is thermistor resistance, R_T, and will be used for calculations in later steps.

5 Connect the test equipment as shown in Figure 5-45 with cable W27 connector connected to an SMB-to-BNC adapter.

6. Connect the DVM across the output terminals of the Power Supply and adjust the power supply output for 5.00 ± 0.01 Vdc. Move the DVM connections back to the SMB-to-BNC adapter as shown in Figure 5-45

7. Note indication on the DVM This value is V_{VM} for high band and will be used for calculations in step 8

8. Calculate "Corrected Video Resistance in Hi Band," R_{VH}, as follows:

$$R_{VH} = (R_{VM} - 100) \times 24000/(R_T + 4000)$$

where:

R_{VH} = Corrected Video Resistance in High Band

R_{VM} = V_{VM} = Value measured in step 7 above.

R_T = Thermistor Resistance measured in step 4 above.

9. Use the Value of R_{VH} found in step 8 above and select the resistance values for A25R36 and A25R37 from Table 5-6

10. Disconnect the high band detector A11 cable W27 from the SMB-to-BNC adapter and connect the low band detector A12 cable W26 to the adapter as shown in Figure 5-45.

11. Connect the DVM at the output of the Power Supply and check that the output is still at 5.00 ± 0 01 Vdc. Move the DVM connections back to the SMB-to-BNC adapter as shown in Figure 5-45.

12. Note indication on the DVM. This value is V_{VM} for low band and will be used for calculations in step 13

13. Calculate "Corrected Video Resistance in Low Band," R_{VL}, as follows.

$$R_{VL} = (R_{VM} - 680) \times 24000/(R_T + 4000)$$

where:

R_{VL} = Corrected Video Resistance in Low Band

R_{VM} = $V_{VM} \times$ 200 Ohms/mV

V_{VM} = Value measured in step 12 above.

R_T = Thermistor Resistance measured in step 4 above

14. Use the value of R_{VL} found in step 13 above and select resistance values for A25R109 and A25R115 from Table 5-7.

Table 5-6. Selected Values of High Band Temperature Compensation Resistors in A25

R_{VH} (Ohms)	A25R36 (Ohms)	A25R37 (Ohms)
800-870	9090	6190
870-950	8250	5620
950-1050	7500	5620
1050-1160	6810	5110
1160-1270	6190	4640
1270-1380	5620	4220
1380-1490	5110	4220
1490-1600	4640	3830

Table 5-7. Selected Values of Low Band Temperature Compensation Resistors in A25

R_{VL} (Ohms)	A25R109 (Ohms)	A25R115 (Ohms)
800-870	3830	9090
870-950	3480	8250
950-1050	3160	7500
1050-1160	2870	6810
1160-1270	2370	6190
1270-1380	2150	5620
1380-1490	1960	5110
1490-1600	1620	4640

ALC ADJUSTMENTS

Description

The ALC detectors have a linear region. Below the linear region the detector response is non-linear. The ALC circuit attempts to compensate for the non-linear regions such that the overall response of the ALC loop is linear over a 40 dB range from −20 dBm to +20 dBm. Since there is a separate detector and modulator for the high bands (Bands 1 - 4) and low band (Band 0), there are separate adjustments for the high bands and low band.

The DUT is set to a CW frequency within the band to be adjusted The RF attenuator and ALC is set for de-coupled operation (controlled separately). The RF output level is set using the ENTRY keys. The power is measured with a power meter and if necessary adjustments are made until the power meter indication is correct at each DUT power level.

Equipment

Power Meter . . . . HP 436A
Power Sensor . . . . HP 8485A
Digital Voltmeter (DVM) . . . . HP 3456A
Power Supply . . . . HP 6294A
Adapters
  APC 3.5 (f) To Type N (m) (8341B only) . . . . HP P/N 1250-1744
  APC 3.5 (f) To APC 3.5 (f) (8340B only) . . . . HP P/N 5061-5311

NOTE

The ALC circuit contains several adjustment controls and the adjustment includes changing calibration constants stored in memory. All of the adjustments in each band interact with each other. In addition, the high band 0 dBm adjustment affects the low band, and the high bands +18 dBm adjustment affects the low band. Before making any adjustments, check the operation of the ALC circuit as described below and make adjustments only if necessary.

NOTE

In the following procedures, do not put P.C. boards on extender boards.

15. Connect the equipment as shown in Figure 5-47. Calibrate and zero the power meter. Allow one hour warmup time. Connect the power sensor to the DUT's RF output. Press **[INSTR PRESET]** on the DUT. Press **[CW]** and enter **[4] [.] [5] [GHz]**. Press the **[RF]** key to turn the RF OFF and zero the power meter. To ensure that the power meter is properly zeroed, select "WATT" mode, and press ZERO until the power meter indicates ≤0.02 on the most sensitive range. Press **[RF]** to turn the RF ON Press **[PEAK]** to turn peaking on. Press **[SHIFT] [PWR SWP]** to decouple the RF attenuator and ALC Enter **[0] [dBm]** If the display does not indicate ATTEN=0 dB, press STEP keys as necessary to select 0 dB attenuation

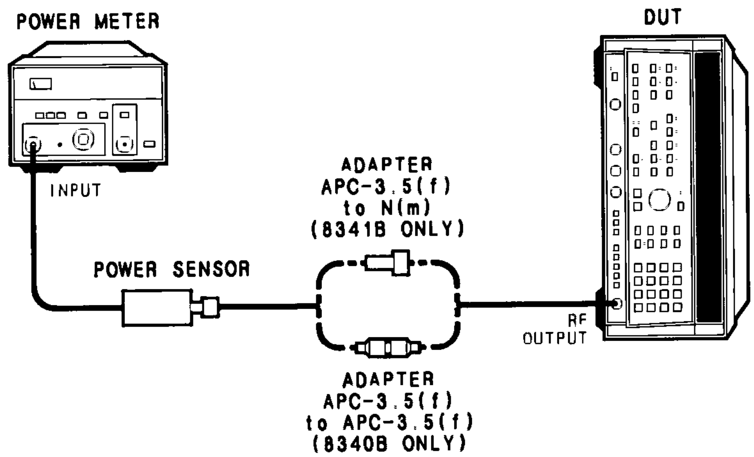


Figure 5-47. ALC Adjustment Test Setup

NOTE

When the power level is changed significantly, it may take as long as one minute for the power meter indication to be accurate. After making a power level change, wait until the power meter indication stabilizes before making any adjustments.

16. Refer to Table 5-8 below, enter the appropriate DUT power level (ALC level) and check the power meter indication. Check the indication at each power level and note the amount of error before making any adjustments. If necessary, adjust the appropriate controls shown in the table to adjust the power level to be within the test limit shown.

    Adjustments are iterative Adjust in the following order:

    0 dBm, −10 dBm, −20 dBm, −10 dBm, 0 dBm, +10 dBm, +18 dBm, and +10 dBm.

    When selecting a new power level, press **[SHIFT] [PWR SWP] [desired power level] [dBm]**

    See Figure 5-48 for more information that may help to reduce the number of iterations required. For example, if the +18 dBm indication is 0.1 dB low (+17.9 dBm), adjust for 0.05 dB high (+18.05 dBm). Then when the +10 is adjusted to +10 dBm, the +18 will move close to the correct level.

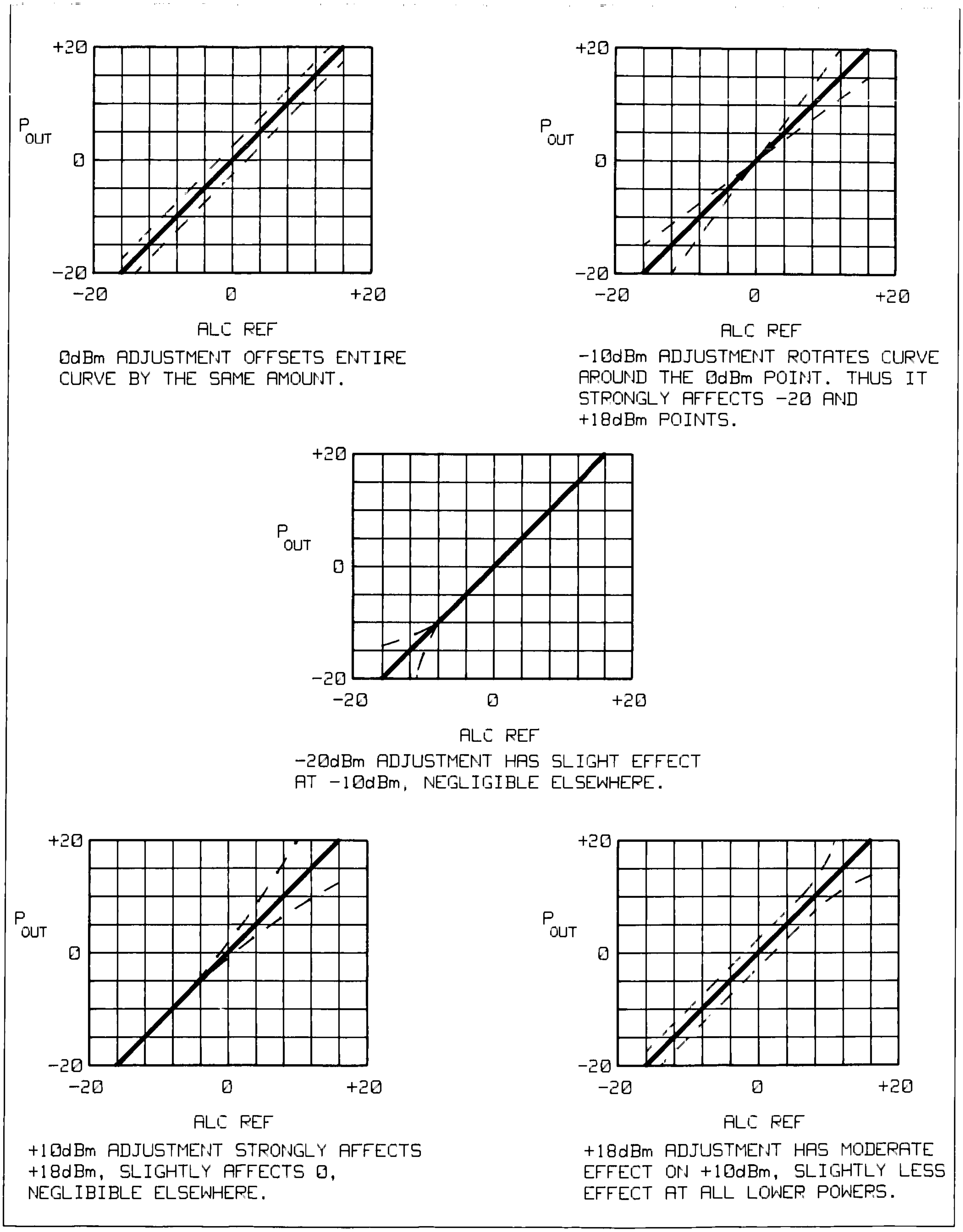


Figure 5-48. Typical ALC Adjustment Response Curves

5-15. ALC ADJUSTMENTS (Cont'd)

Table 5-8. High Band ALC Adjustment

DUT Power Level	Associated Adjustment	Check Limit	Adjustment Limit
−20 dBm	A25R34 (H-20)	0 3 dB	0 2 dB
−10 dBm	Calibration Constant #47*	0 1 dB	0 02 dB
0 dBm	Calibration Constant #44*	0.1 dB	0.02 dB
10 dBm	A25R39 (H+10)	0.1 dB	0.02 dB
18 dBm	A25R24 (+20)	0.2 dB	0.05 dB

* Access Calibration Constant Number 47 by entering the following **[SHIFT] [GHz] [4] [7] [Hz] [SHIFT] [MHz] [1] [2] [Hz] [SHIFT] [kHz] [2] [2] [Hz]** Use **[STEP]** key to change Cal. Constant Number to 44

17. If all power meter indications are within the test limits, check at power levels from −20 dBm to +20 dBm in 5 dB steps.

18. Press **[CW]** and enter **[1] [.] [5] [GHz]**. Press **[SHIFT] [PWR SWP]** to decouple the RF attenuator and ALC. Enter **[0] [dBm]**. Press **[SHIFT] [METER]** and enter**[−] [1] [0] [0] [dBm]**. Dashes should be displayed in the POWER dBm display. If not, rotate the RPG counter-clockwise until the dashes appear (note that the UNLEVELED annunciator will be on at this time). Zero the power meter in "WATT" mode as described in step 15. The low band (Band 0) contains broadband noise. If the power meter is properly zeroed, the broadband noise will be compensated and power measurements will be more accurate. Press **[INT]** (UNLEVELED annunciator off) and then **[SHIFT] [PWR SWP]** (attenuator and ALC should both indicate zero).

19. Refer to Table 5-9 below, enter the appropriate DUT power level (ALC level) and check the power meter indication. Check the indication at each power level and note the amount of error before making any adjustments. If necessary adjust the appropriate controls shown in the table to adjust the power level to be within the test limits.

    Adjustments are iterative. Adjust in the following order:

    0 dBm, −10 dBm, −20 dBm, −10 dBm, 0 dBm, and +10 dBm.

    When selecting a new power level, press **[SHIFT] [PWR SWP] [desired power level] [dBm]**.

Table 5-9. Low Band ALC Adjustment

DUT Power Level	Associated Adjustment	Check Limit	Adjustment Limit
−20 dBm	A25R33 (L-20)	0.3 dB	0.2 dB
−10 dBm	Calibration Constant #46*	0.1 dB	0 02 dB
0 dBm	A25R108 (LOFS)	0 1 dB	0 02 dB
10 dBm	A25R38 (L+10)	0 1 dB	0.02 dB

There is no low band +20 dBm adjustment

* Access Calibration Constant Number 46 by entering the following **[SHIFT] [GHz] [4] [6] [Hz] [SHIFT] [MHz] [1] [2] [Hz] [SHIFT] [kHz] [2] [2] [Hz]**

20. If all power meter indications are within the test limit, check at power levels from −20 dBm to +10 dBm in 5 dB steps.

NOTE

If adjustments of the calibration constants were made in this procedure, the data thus stored in the "working memory area" should be copied to the "protected memory area" by pressing the following key sequence: [SHIFT] [MHz] [1] [4] [Hz] [SHIFT] [kHz] [5] [3] [4] [9] [Hz]. Wait for "CALIBRATION RESTORED" to be displayed in the ENTRY DISPLAY and then press [INSTR PRESET].

EXTERNAL LEVELING ADJUSTMENTS

NOTE

The negative external Xtal leveling adjustments include two variable resistor adjustments (+6 dBV and −60 dBV) and two calibration constant adjustments (−30 dBV and 0 dBV). These adjustments interact similarly to the ALC adjustments. See Figure 5-49 for more information that may help to reduce the number of iterations required. Note that the curve rotates about the −30 dBV level.

21. Connect a negative Xtal detector to the DUT RF output. Connect a BNC Tee at the detector output. Connect a BNC cable from one output of the Tee to the DUT's LEVELING EXT INPUT Connect another BNC cable from the BNC Tee to a DVM. Set the DVM for a floating input and connect a 0.1 UF capacitor across its terminals

    Make adjustments in the following order:

    −30 dBV, 0 dBV, +6 dBV, 0 dBV, −30 dBV, and −60 dBv.

22. Press **[INSTR PRESET]**. Press **[CW]** and enter **[4] [.] [5] [GHz]**. Press **[XTAL]** leveling. The ENTRY DISPLAY should indicate ATN. 0 dB, REF −30.00 dBV. Adjust calibration constant Number 45 for a DVM indication of −31.6 mV ± 0.3 mV. Access Calibration Constant Number 45 by entering the following: **[SHIFT] [GHz] [4] [5] [Hz] [SHIFT] [MHz] [1] [2] [Hz] [SHIFT] [kHz] [2] [2] [Hz].**

23 Press **[POWER LEVEL]** and enter **[0] [dBm]**. Adjust calibration constant Number 48 for a DVM indication of −1.00 volts ±0.01 volts. Access Calibration Constant Number 48 by entering the following: **[SHIFT] [GHz] [4] [8] [Hz] [SHIFT] [ENTRY OFF].**

24. Press **[POWER LEVEL]** and enter **[6] [dBm]**. The ENTRY DISPLAY REF level should be +6 dBV. Adjust A25R88 (EXHI, see Figure 5-46) for a DVM indication of −2.00 volts ±0.02 volts. The +6 dB adjustment will affect the 0 dBV level as well. To minimize the number of iterations, over adjust the +6 dBV level, then when the 0 dBV level is adjusted, the +6 dBV level will be close. For example, if the +6 dBV indication is 0.1V low, adjust for 0.15V high.

25. Press **[XTAL]** and enter **[−] [6] [0] [dBm]**. Adjust A25R80 (EX−) for a DVM indication of −1.000 mV ±0.01 mV. Repeat all negative external leveling adjustments, in the order given, until all DVM indications are within ±1%.

26 Connect a positive Xtal detector in place of the negative Xtal detector. Press [⬇] twice to set the RF attenuator set to 20 dB and the REF set to −60 dBV, adjust A25R84 (EX+) for +1.000 mV ±0.01 mV.

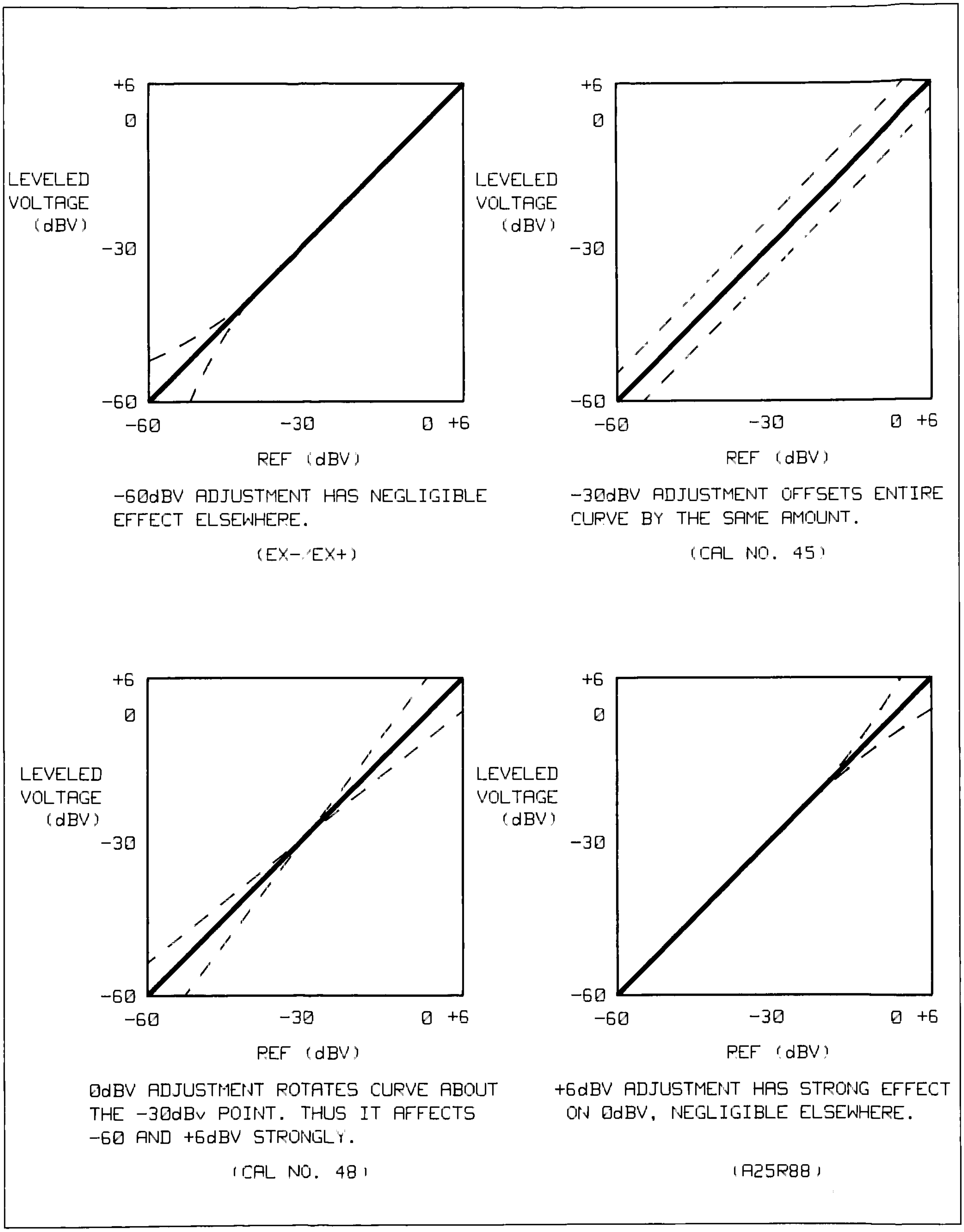


Figure 5-49. Typical External Leveling Response Curves

ADJUST AM OFFSET

27 Connect the Power Sensor to the DUT's RF OUTPUT. Press **[INSTR PRESET]**. Press **[CW]** and enter **[1] [GHz]**. The power level should be 0 dBm. Disconnect any AM inputs. Access Calibration Constant Number 43 by entering the following: **[SHIFT] [GHz] [4] [3] [Hz] [SHIFT] [MHz] [1] [2] [Hz] [SHIFT] [kHz] [2] [2] [Hz]**. Adjust Calibration Constant Number 43 for no more than 0.05 dB change in power meter indication when turning AM on then off.

AM GAIN ADJUSTMENT

28. Set up the following equipment as shown in Figure 5-50 with the power supply set to 0 Vdc Allow the equipment to warm up for at least 30 minutes

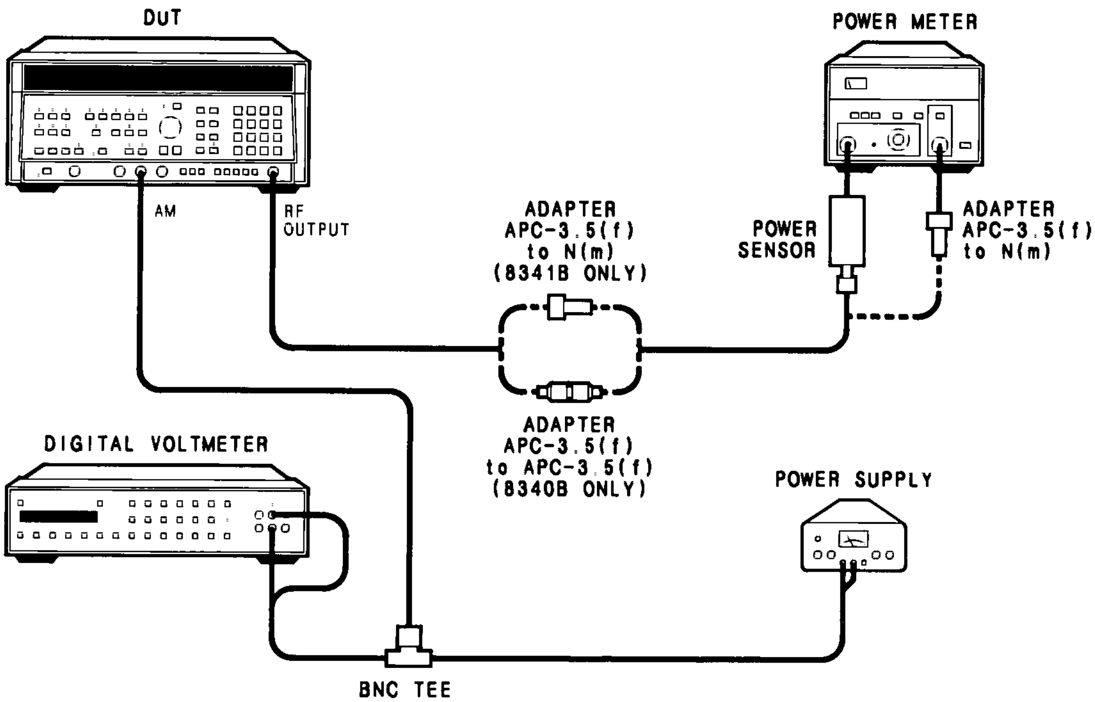


Figure 5-50. AM GAIN Adjustment Test Setup

29 Calibrate the power meter and then set the calibration factor switch for a 1.5 GHz measurement. Connect the power sensor to the DUT's RF output.

30. Press the following key sequence on the DUT:

[INSTR PRESET]
[CW] [1] [.] [5] [GHz]
[POWER LEVEL] [−] [5] [dBm]
[AM].

31. Adjust the power supply for 0 Vdc. Press dB **[REF]** on the power meter (the power meter will now indicate the power level changes from this reference).

5-15. ALC ADJUSTMENTS (Cont'd)

32 Adjust the power supply for +0 3 Vdc The power meter indication should be between 2.18 to 2 38 dB If the indication is not in this range, adjust A26R91 (AM GAIN, Figure 5-51) for a power meter indication within the given range.

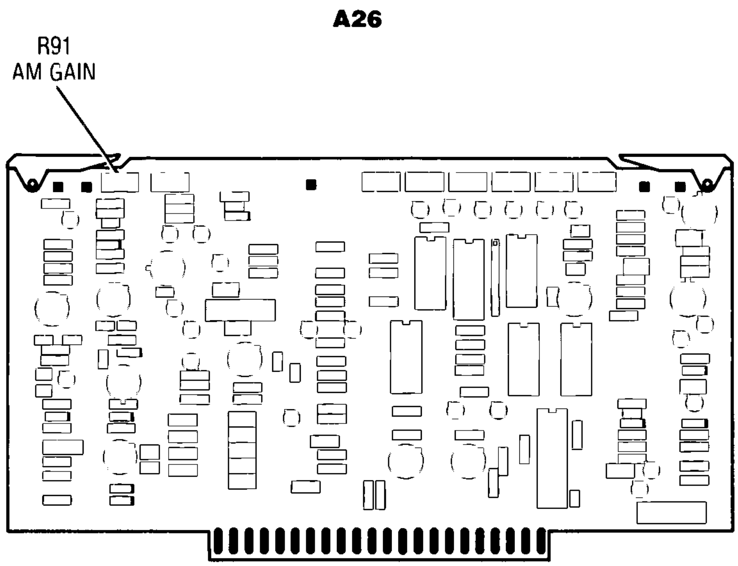


Figure 5-51. A26 Linear Modulator Component Location Diagram

33. Adjust the power supply for −0.3 Vdc. The power meter indication should be between −2.91 and −3.29 dB. If the indication is not in this range, adjust A26R91 (AM GAIN) for a power meter indication within the given range.

34. Repeat steps 32 and 33 until the power level requirements are met for each step

NOTE

If adjustments of the calibration constants were made in this procedure, the data thus stored in the "working memory area" should be copied to the "protected memory area" by pressing the following key sequence: [SHIFT] [MHz] [1] [4] [Hz] [SHIFT] [kHz] [5] [3] [4] [9] [Hz]. Wait for "CALIBRATION RESTORED" to be displayed in the ENTRY DISPLAY and then press [INSTR PRESET].

5-16. LEVELED RF OUTPUT ADJUSTMENTS

Reference

Performance Test: Maximum Leveled Output Power and Accuracy
Service Section: RF Section

Description

In this procedure, the RF output signal is checked in leveled mode. An oscilloscope and detector are used to adjust the Step Recovery Diode (SRD, internal to the SYTM) for optimum bias and to eliminate the possible occurrence of "squegging".

In the next procedure, the ALC loop gain in each band is adjusted for optimum operation.

A final section checks the RF output signal with a Spectrum Analyzer for the appearance of squegging in any of the bands and allows a last fine adjustment to eliminate any squegging that is observed.

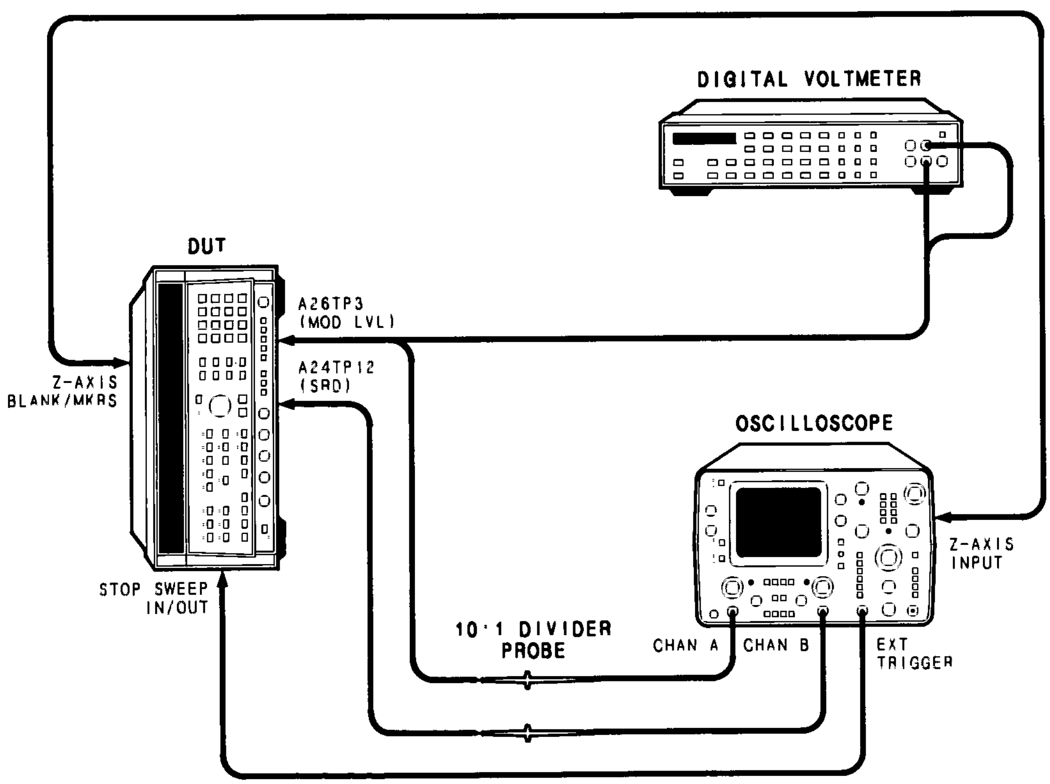


Figure 5-52. Leveled Power SRD Bias Adjustment Test Setup

Equipment

Oscilloscope	HP 1741A
10:1 Divider Probe, 2 Required	HP 10004D
Detector	HP 8473C
Digital Voltmeter (DVM)	HP 3456A
Adapters:	
APC 3.5 (f) to APC 3.5 (f) (HP 8340B only)	HP P/N 5061-5311
APC 3.5 (f) — Type N (m) (HP 8341B only)	HP P/N 1250-1744
Dual Banana to BNC (f)	HP P/N 1251-2277
BNC (f) — Clip Lead	HP P/N 8120-1292

Procedure

MODULATOR OFFSET

1. Connect the DVM to A26TP3 (MOD LVL). Preset A26R88 (MO) fully clockwise (Figure 5-53) Turn the DUT's LINE switch ON and allow 30 minutes warm up.

2. Press **[INSTR PRESET]** on the DUT. Press **[CW] [8] [GHz]**. Press **[SHIFT] [METER]** to bypass the ALC circuit and allow direct control of the linear modulator circuit.

3. Adjust the front panel rotary knob (RPG) for a DVM indication of 0.00 V + 3 mV, then note the indication in the POWER dBm display. Adjust A26R88 (MO) counter-clockwise to decrease the POWER dBm indication by 0.2 dB.

LEVELED BIAS

4. Disconnect the DVM and connect the oscilloscope as shown in Figure 5-52.

5. Set the oscilloscope as follows:

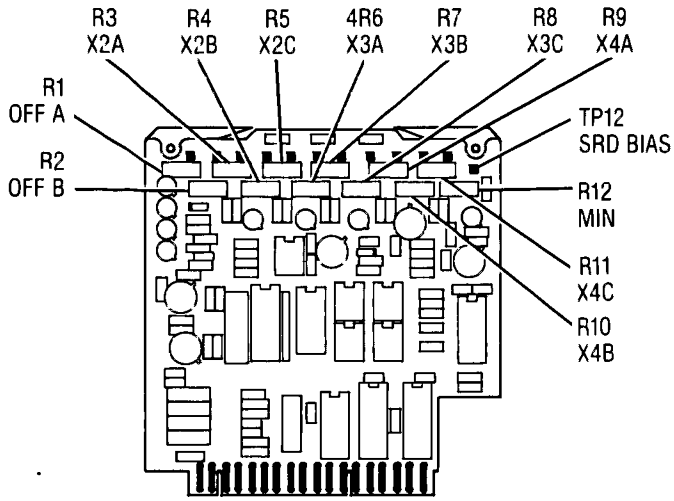
DISPLAY	CHANNEL A
CHAN A	0.02 V/Div DC COUPLED
TRIGGER	EXT. POS
TIME/Div	5 mS

6. On the DUT, press **[INSTR PRESET] [START FREQ] [7] [GHz] [STOP FREQ] [1] [3] [.] [5] [GHz]**. Press **[SHIFT] [PWR SWP] [-] [2] [0] [dBm]**. Press **[SWEEP TIME] [5] [0] [msec]**.

   Save this instrument state by pressing **[SAVE] [2]**.

7. The oscilloscope display should be similar to Figure 5-54. Adjust A24R12 (MIN) so that all points on the trace are reduced to the lowest possible voltage level (i.e., maximum negative voltage).

A24



A26

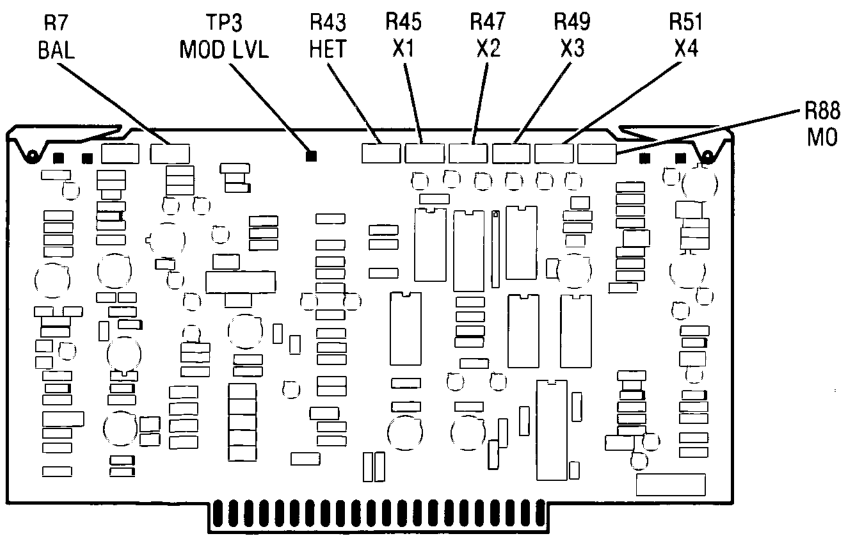


Figure 5-53. SRD Bias Adjustments on A24 and A26

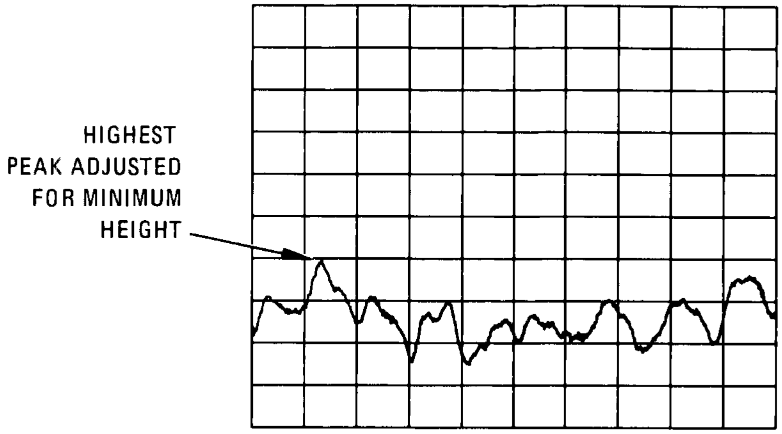


Figure 5-54. Oscilloscope Display at A26TP3 MOD LVL with no Squegging

8. On the DUT, press **[INSTR PRESET] [SHIFT] [CF]** and enter **[2] [0] [0] [MHz]** for a CW step size of 200 MHz. Press **[SWEEP TIME] [5] [0] [msec]** Press **[SHIFT] [PWR SWP]** to decouple the RF attenuator and ALC, and enter **[-] [2] [0] [dBm]**. Press **[PWR SWP] [4] [0] [dBm]** and **[AM]** to turn the AM on. Press **[CW] [8] [GHz]**. This puts the DUT in power sweep from −20 to +20 dB at any frequency selected

   Save this instrument state by pressing **[SAVE] [1]**.

9. Preset A24R1 (OFF A) (Figure 5-53), A24R2 (OFF B), A24R5 (X2C), A24R8 (X3C), and A24R11 (X4C) controls fully counter-clockwise.

10. Set the oscilloscope as follows:

DISPLAY	CHOP
CHAN A	0.05 V/Div DC COUPLED
CHAN B	0.05 V/Div DC COUPLED

   The oscilloscope display should look similar to Figure 5-55.

LEVELED POWER SRD BIAS ADJUSTMENT

11. Adjust A24R1 (OFF A) for optimum display as shown in Figure 5-55, Waveforms A, B, and C.

12. On the DUT, press **[CW] [1] [3] [GHz]**. Adjust A24R2 (OFF B) for optimum trace as shown in Figure 5-55, Waveforms A, B, and C.

13. On the DUT, press **[CW] [1] [0] [GHz]**. Adjust A24R5 (X2C) to minimize the MOD LEVEL voltage (Channel A) at the start of the power sweep and keep the MOD LEVEL power sweep trace straight with no step or bows as it sweep up (see Figure 5-55, Waveforms D and E).

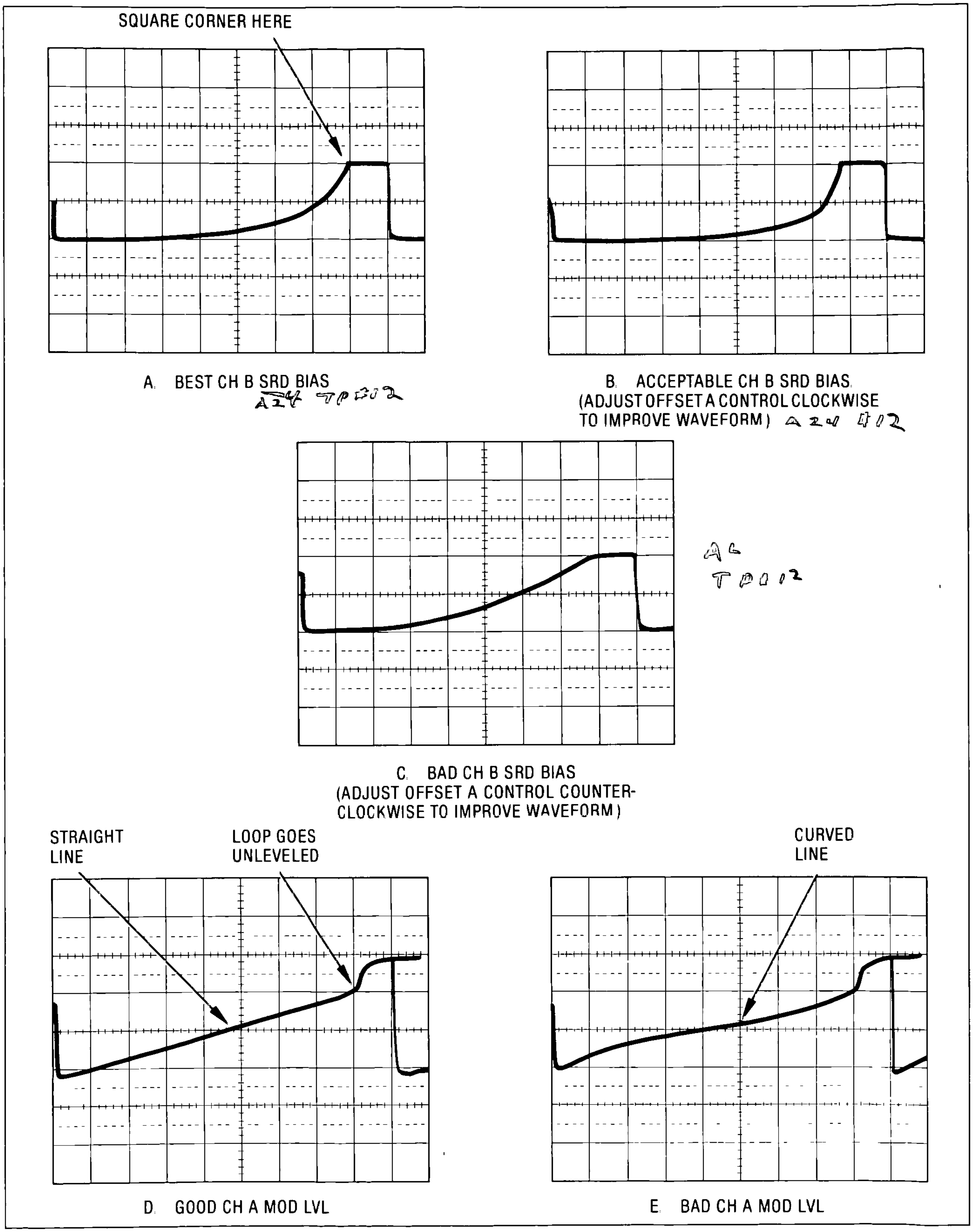


Figure 5-55. Typical MOD LVL and SRD BIAS Waveforms

14. On the DUT, press **[CW] [1] [7] [.] [5] [GHz].** Adjust A24R8 (X3C) for a MOD LEVEL trace as described in step 13.

    If the DUT is an HP 8341B, proceed with step 16.

15. On the DUT, press **[CW] [2] [3] [.] [3] [GHz]** and adjust A24R11 (X4C) for a MOD LEVEL trace as described in step 13.

16. Set the oscilloscope to DISPLAY A and set CHAN A to 0.02 V/Div.

17. Press **[RECALL] [2]** on the DUT. The oscilloscope display should be similar to Figure 5-54. Adjust A24R12 (MIN) so that all points on the trace are reduced to the lowest possible voltage level (i.e., maximum negative voltage).

18. On the DUT, press **[RECALL] [1] [CW] [7] [GHz].** Set the oscilloscope for DISPLAY CHOP, CHAN A to 0.5 V/Div, and CHAN B to 0.5 V/Div.

19. Using the DUT's **[▲]** and **[▼]** step keys, step through Band 2 from 7 to 13.4 GHz and check for an optimum SRD bias trace (Figure 5-55, Waveform A, B, and C) at each step. If not optimum, adjust A24R1 (OFF A) if the frequency is closer to 7 GHz, or adjust A24R2 (OFF B) if the DUT frequency is closer to 13.5 GHz. If an adjustment is made, step through the entire band again, making sure every step is optimized or acceptable if all the steps cannot be optimized.

20. Using the DUT's **[▲]** and **[▼]** step keys, step through Band 2 from 7 to 13.4 GHz and readjust A24R5 (X2C) if necessary to improve the MOD LEVEL trace. Also, adjust A24R1 (OFF A) and A24R2 (OFF B) if necessary to optimize the SRD Bias as in step 19 above. If any adjustments are made, step through Band 2 again until the SRD bias and the MOD LEVEL trace is optimized. It will not be possible to adjust the MOD LEVEL trace for optimum at each step, so adjust for best compromise trace across Band 2 (see Figure 5-55, Waveforms D and E).

NOTE

The SRD bias trace is adjusted in Band 2 with A24R1 (OFF A) and A24R2 (OFF B) set for optimum. It should not require any other adjustments in Bands 3 or 4, unless the SRD bias trace is bad as shown in Figure 5-55. If either the OFF A or OFF B controls are adjusted in Bands 3 or 4, then each band will have to be rechecked, starting with Band 2 at 7 GHz and stepping through each band.

21. On the DUT, press **[CW] [1] [3] [.] [5] [GHz].** Using the DUT's **[▲]** and **[▼]** step keys, step through Band 3 from 13.5 to 19.9 GHz and readjust A24R8 (X3C) if necessary to achieve the best MOD LEVEL trace across Band 3.

    If the DUT is an HP 8341B, proceed to the LINEAR MODULATOR ALC LOOP GAIN ADJUSTMENTS.

22. On the DUT, press **[CW] [2] [0] [.] [1] [GHz]** Using the DUT's step keys, step through Band 4 from 20.1 to 26.5 GHz and readjust A24R11 (X4C) if necessary for the best MOD LEVEL trace across Band 4.

SRD PULSE WILL LOOSE AMPLITUDE WHEN MAX UNLEVELED POWER IS EXCEEDED.

LINEAR MODULATOR ALC LOOP GAIN ADJUSTMENTS

Description

The following adjustments are performed to set the ALC loop gain for each band. The adjustment is done in the power sweep mode, while sweeping the ALC loop from −20 to maximum power.

NOTE

If the A26 Linear Modulator assembly has not been replaced, adjustments may not be necessary.

23. Connect CHAN A of the oscilloscope to A26TP3 (MOD LVL). Connect CHAN B to A25TP2 (DET). Set up the oscilloscope as follows:

DISPLAY	CHOP
CHAN A	0.05V Div DC COUPLED
CHAN B	0.05V/Div DC COUPLED
TRIGGER	EXT. POS.
TIME/Div	5 mS
SWEEP VERNIER	ON

24. On the DUT, press **[INSTR PRESET] [SWEEP TIME] [5] [0] [msec]**. Press **[SHIFT] [PWR SWP] [-] [2] [0] [dBm]**. Press **[PWR SWP] [4] [0] [dBm]**. Press **[SHIFT] [CF] [2] [0] [0] [MHz]** and then **[AM]** to turn AM on. Press **[CW] [1] [0] [MHz]**.

    The oscilloscope display should be similar to Figure 5-56, Waveforms A and B It may be necessary to adjust the SWEEP VERNIER to view the entire sweep

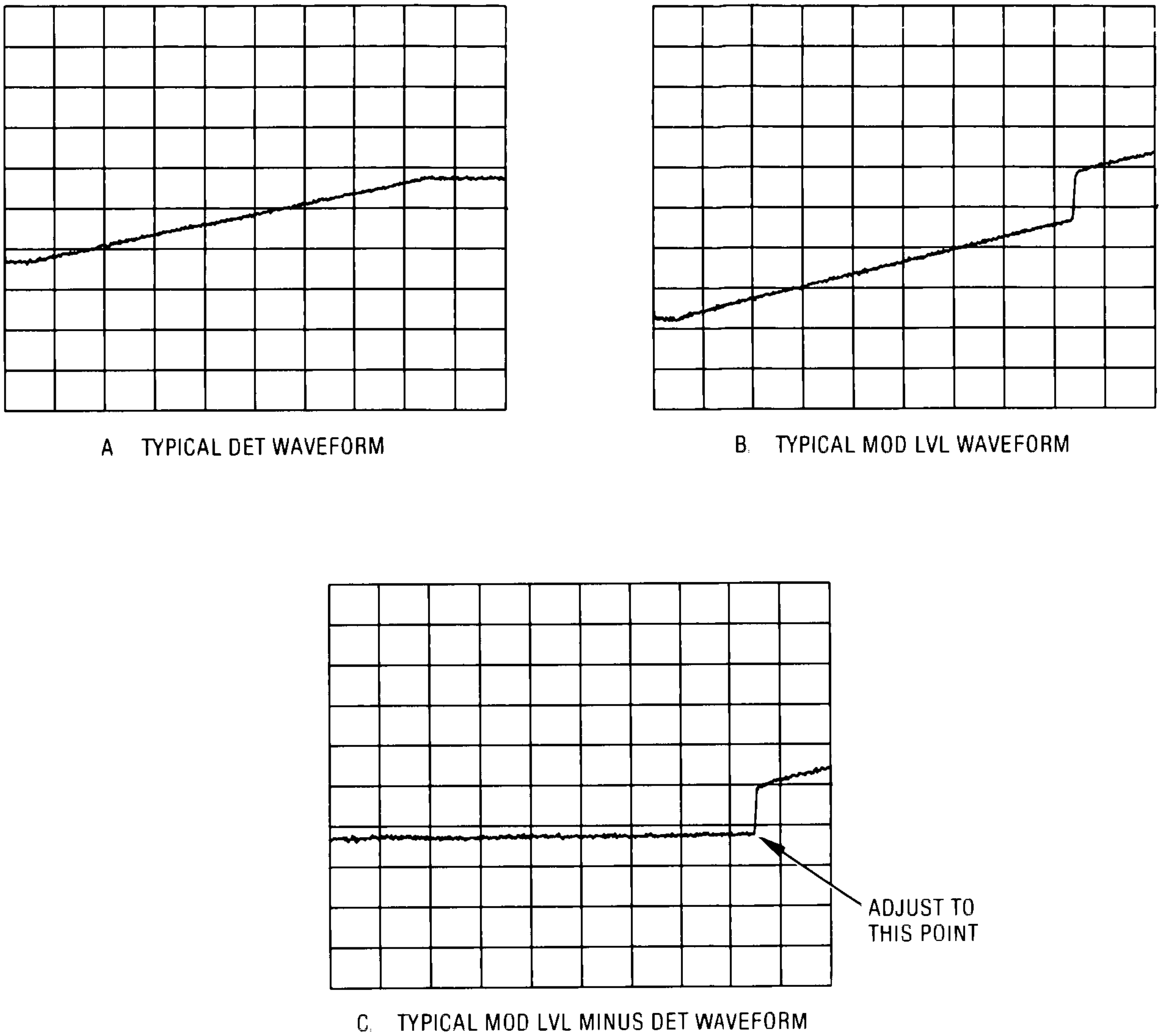


Figure 5-56. Typical MOD LVL and DET Waveforms for ALC Loop Gain Adjustment

NOTE

In steps 25 through 29, the oscilloscope display will be adjusted for the most horizontal line. This adjustment is only concerned with the trace up to where it deviates from a flat line (see Figure 5-56, Waveform C). This point on the display will change position with frequency.

25. On the oscilloscope, invert CHAN B and select DISPLAY A+B mode. Using the DUT's step keys, step the CW frequency through Band 0 from 10 MHz to 2.21 GHz and adjust A26R43 (HET) for the most horizontal line across Band 0.

26. On the DUT, press **[CW] [2] [.] [3] [GHz]**. Using the DUT's step keys, step the CW frequency through Band 1 from 2.3 to 6.9 GHz and adjust A26R45 (X1) for the most horizontal line across Band 1.

27. On the DUT, press **[CW] [7] [GHz].** Using the DUT's step keys, step the CW frequency through Band 2 from 7 0 to 13 4 GHz and adjust A26R47 (X2) for the most horizontal line across Band 2.

28. On the DUT, press **[CW] [1] [3] [.] [5] [GHz].** Using the DUT's step keys, step the CW frequency through Band 3 from 13.5 to 19.9 GHz and adjust A26R49 (X3) for the most horizontal line across Band 3.

    If the DUT is an HP 8341B, proceed to LEVELED BIAS, BANDS 2 THROUGH 4

29. On the DUT, press **[CW] [2] [0] [GHz].** Using the DUT's step keys, step the CW frequency through Band 4 from 20.0 to 26.4 GHz and adjust A26R51 (X4) for the most horizontal line across Band 4.

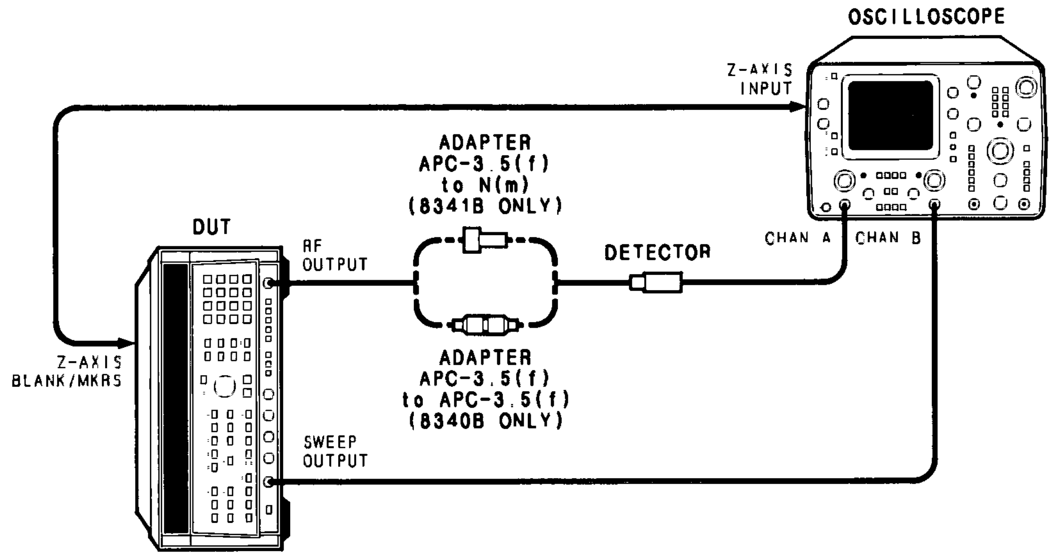


Figure 5-57. Leveled Bias Adjustment Setup, Bands 2 through 4

LEVELED BIAS, BANDS 2 THROUGH 4

30. Remove the oscilloscope probes and connect the detector and oscilloscope as shown in Figure 5-57. On the DUT, press **[INSTR PRESET] [RECALL] [2]** Press **[SWEEP TIME] [AUTO]** Press **[SHIFT] [PWR SWP] [-] [2] [0] [dBm]**.

31. Set the oscilloscope for A vs B mode and set the oscilloscope's horizontal sensitivity (CHAN B) for 1 V/Div and vertical sensitivity (CHAN A) for 0.005 V/Div. Adjust the oscilloscope's position controls to display the swept RF output

5-16. LEVELED RF OUTPUT ADJUSTMENTS (Cont'd)

32. Using the DUT's front panel rotary knob (RPG), vary the ALC level from −20 dBm to +20 dBm. Look for squegging as shown in Figure 5-58. As the power level is increased, you will need to decrease the vertical sensitivity (CHAN A) and adjust the vertical positions on the oscilloscope. If any squegging occurs, examine the ENTRY DISPLAY to determine the requested ALC level. If the ALC level is at or below the maximum specified leveled power, adjust A24R5 (X2C) counter-clockwise to eliminate the squegging If the ALC level is above maximum leveled power, what you are seeing is probably the RF output going unleveled and cannot be adjusted out

NOTE

Squegging on the oscilloscope display may appear as shown in Figure 5-58 (power spikes and oscillations) or it may appear as power spikes without the oscillations. In either case the appropriate adjustment should be made to eliminate the squegging.

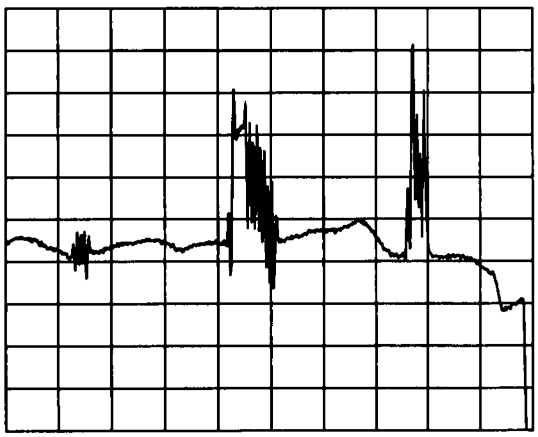


Figure 5-58. Oscilloscope Display with Squegging Present

33 On the DUT, press **[START FREQ] [1] [3] [.] [5] [GHz] [STOP FREQ] [2] [0] [GHz] [SHIFT] [PWR SWP] [-] [2] [0] [dBm]**. Set the oscilloscope's vertical sensitivity to 0 005 V/Div Vary the ALC level as in step 32 and check for squegging. If any squegging occurs, examine the ENTRY DISPLAY to determine the requested ALC level. If the ALC level is at or below the maximum specified leveled power, adjust A24R8 (X3C) counter-clockwise to eliminate the squegging. If the ALC level is above maximum leveled power, what you are seeing is probably the RF output going unleveled and cannot be adjusted out.

If the DUT is an HP 8341B, proceed to step 35.

34. On the DUT, press **[START FREQ] [2] [0] [GHz] [STOP FREQ] [2] [6] [.] [5] [GHz] [SHIFT] [PWR SWP] [-] [2] [0] [dBm]** Set the oscilloscope's vertical sensitivity to 0.005 V/Div. Vary the ALC level as in step 32 and check for squegging. If any squegging occurs, examine the ENTRY DISPLAY to determine the requested ALC level If the ALC level is at or below the maximum specified leveled power, adjust A24R11 (X4C) counter-clockwise to eliminate the squegging If the ALC level is above maximum leveled power, what you are seeing is probably the RF output going unleveled and cannot be adjusted out.

35. On the DUT, press **[SHIFT] [PWR SWP] [0] [dBm]** to set the ALC level at 0 dBm and then press **[START FREQ] [1] [4] [GHz]**. Slowly rotate the DUT's RPG clockwise while watching the oscilloscope display for squegging. If any squegging is seen, stop at the start frequency at which it occurs If the squegging occurs in Band 3 (13.5 to 20 GHz), adjust A24R8 (X3C) counter-clockwise until the squegging is gone If the squegging occurs in Band 4 (20 to 26.5 GHz), adjust A24R11 (X4C) counter-clockwise until the squegging is gone

36. Repeat step 35 for ALC levels of −5 dBm, −10 dBm and −15 dBm.

NOTE

If adjustments of the Cal Constants were made in this procedure, the Cal Constants data stored in the "working memory" should be copied into the "protected memory" by pressing [SHIFT] [MHz] [1] [4] [Hz] [SHIFT] [kHz] [5] [3] [4] [9] [Hz]. Wait for "CALIBRATION RESTORED" to be displayed in the ENTRY DISPLAY, then press [INSTR PRESET].

LEVELED SQUEGGING TEST USING A SPECTRUM ANALYZER

Description

The DUT's RF output signal is down converted using a Local Oscillator (LO) and a mixer. The IF output of the mixer is fed to a spectrum analyzer Any squegging of the DUT will appear as a spurious response on the IF signal.

This test should be performed after SYTM tracking and delay, and SRD unleveled bias adjustments.

Equipment

Synthesized Sweeper .... HP 8340B Option 001
10 dB Attenuator .... HP 8493C Option 010
Mixer .... HP P/N 0955-0307
Spectrum Analyzer .... HP 8566B
Adapters:
APC 3.5 (f) To Type N (m) .... HP P/N 1250-1744
(required if DUT is an HP 8341B)
APC 3.5 (f) to APC 3.5 (f) .... HP P/N 5061-5311
(required if DUT is an HP 8340B)

37. Connect equipment as shown in Figure 5-59 Connect the mixer LO input port directly to the LO RF output connector to obtain maximum mixer LO input level Allow at least 30 minutes warm up time.

38 Press the LO **[INSTR PRESET]**. Press **[START FREQ]** and enter **[6] [.] [4] [GHz]**. Press **[STOP FREQ]** and enter **[1] [2] [.] [9] [GHz]**. Press **[POWER LEVEL]** and enter **[1] [0] [dBm]**. Press **[SHIFT] [CF]** and enter **[1] [0] [0] [MHz]** for a step size of 100 MHz. Press **[MANUAL]** SWEEP and enter **[6] [.] [4] [GHz]** to set the LO to CW at 6 4 GHz.

39. On the DUT, press **[INSTR PRESET]**. Press **[START FREQ]** and enter **[7] [GHz]**. Press **[STOP FREQ]** and enter **[1] [3] [.]] [5] [GHz]**. Press **[POWER LEVEL]** and using the front panel rotary knob, adjust for maximum leveled power (just before the UNLEVELED light comes on). Press **[SHIFT] [CF]** and enter **[1] [0] [0] [MHz]** for a step size of 100 MHz. Press **[MANUAL]** SWEEP and enter **[7] [GHz]** The mixer IF frequency is now 600 MHz.

40. Set the spectrum analyzer for FULL SPAN of 0-2.5 GHz. Set RES BW for 300 kHz. Set VIDEO BW for 100 kHz. Set START FREQ to 590 MHz. Set STOP FREQ to 800 MHz. Set REFERENCE LEVEL to −10 dBm. Set ATTEN to 0 dB. Press HOLD to retain these settings. The 600 MHz IF signal should be near the left side of the spectrum analyzer CRT.

41. Using the [▲] key on both the DUT and the LO, step through Band 2 observing the spectrum analyzer display at each step. There may be signals due to mixing products, and/or squegging. Mixing products will appear as low level signals. Squegging signals will appear as a higher amplitude signal as shown in Figure 5-60. If squegging occurs, adjust A24R5 (X2C) slightly CCW to eliminate the squegging. Note, if the control is adjusted and there is no effect on the signal, the signal is probably a mixing product.

NOTE

Test for squegging at power levels from maximum leveled power to −20 dBm in 5 dB increments.

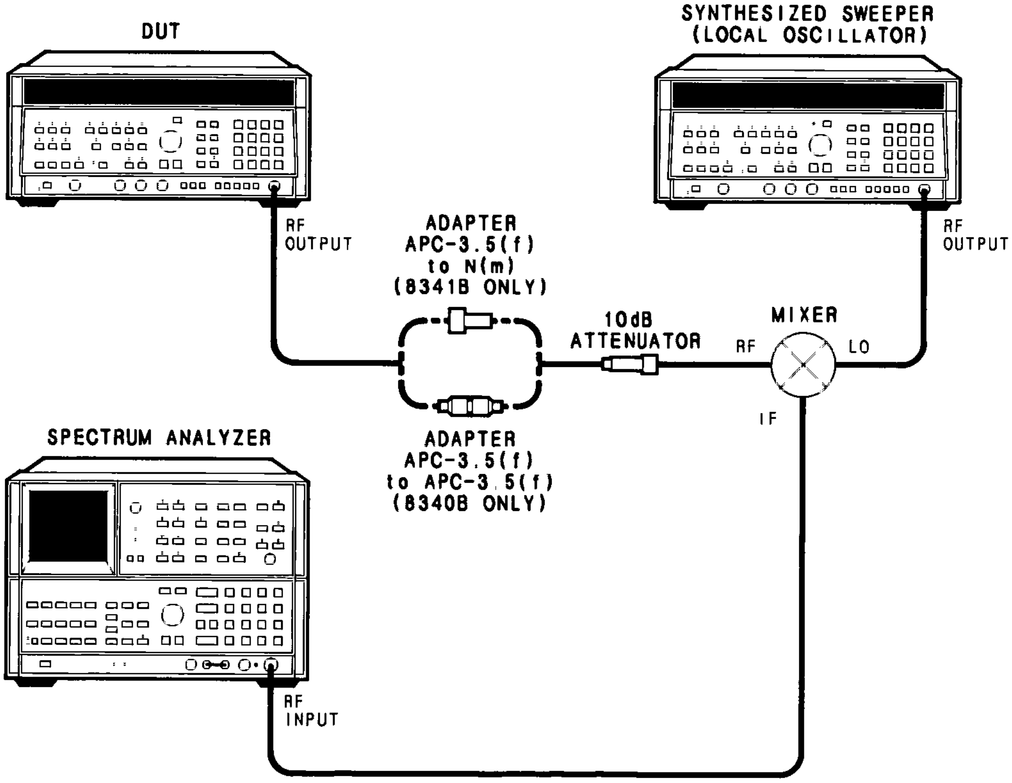


Figure 5-59. Leveled Squegging Test Setup

42. On the DUT, press **[SHIFT] [PWR SWP]** and enter the maximum ALC power level that will be a 5 dB increment below max leveled power (i.e., 15, 10, 5). Repeat step 41 at this power level. Enter the next 5 dB increment and repeat step 41 until the test for squegging has been performed from maximum leveled power to −20 dBm.

43. For Band 3, press the LO **[START FREQ]** and enter **[1] [2] [.] [9] [GHz]**. Press **[STOP FREQ]** and enter **[1] [9] [.] [4] [GHz]**. Press **[MANUAL]** and enter **[1] [2] [.] [9] [GHz]**.

44. On the DUT, press **[START FREQ]** and enter **[1] [3] [.] [5] [GHz]**. Press **[STOP FREQ]** and enter **[2] [0] [GHz]**. Press **[POWER LEVEL]** and using the front panel rotary knob, adjust for maximum leveled power. Press **[MANUAL]** and enter **[1] [3] [.] [5] [GHz]**.

45. Using the step keys as described in step 41, step through Band 3. If squegging occurs, adjust A24R8 (X3C) slightly CCW to eliminate the squegging.

NOTE

Test for squegging at power levels from maximum leveled power to −20 dBm in 5 dB increments.

46. On the DUT, press **[SHIFT] [PWR SWP]** and enter the maximum ALC power level that will be a 5 dB increment below max leveled power (i.e., 10.5). Repeat step 45 at this power level. Enter the next 5 dB increment and repeat step 45 until the test for squegging has been performed from maximum leveled power to −20 dBm. This completes Leveled RF Output Adjustments for an HP 8341B. If testing an HP 8340B, continue with step 47.

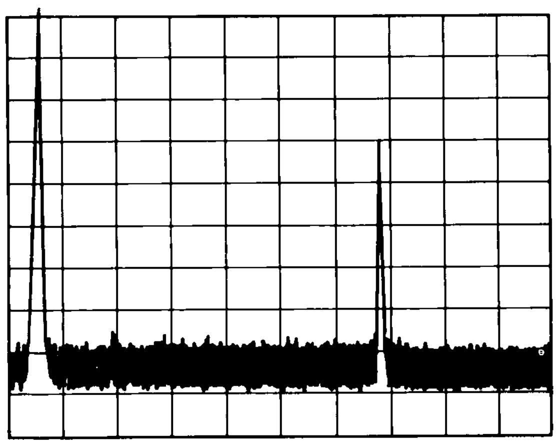


Figure 5-60. Squegging Displayed on Spectrum Analyzer

47. For Band 4, press the LO **[START FREQ]** and enter **[1] [9] [.] [4] [GHz]**. Press **[STOP FREQ]** and enter **[2] [5] [.] [9] [GHz]**. Press **[MANUAL]** and enter **[1] [9] [.] [4] [GHz]**.

48. Press the DUT's **[START FREQ]** and enter **[2] [0] [GHz]**. Press **[STOP FREQ]** and enter **[2] [6] [.] [5] [GHz]**. Press **[CONT]** and **[POWER LEVEL]**. Adjust the DUT front panel rotary knob for maximum leveled power. Press **[MANUAL]** and enter **[2] [0] [GHz]**.

49. Use the step keys to step through Band 4. If squegging occurs, adjust A24R11 (X4C) slightly CCW to eliminate the squegging.

NOTE

Test for squegging at power levels from maximum leveled power to −20 dBm in 5 dB increments.

50 Press the DUT's **[SHIFT] [PWR SWP]** and enter the maximum ALC power level that will be a 5 dB increment below max leveled power (i.e., 5, 0, −5). Repeat step 49 at this power level. Enter the next 5 dB increment and repeat step 49 until the test for squegging has been performed from maximum leveled power to −20 dBm.

5-17. RF OUTPUT POWER FLATNESS ADJUSTMENT

Reference

Performance Test: Maximum Leveled Output Power and Accuracy
Service Section: RF Section

Description

This procedure adjusts the DUT's RF output power flatness across the entire frequency range Flatness is adjusted by using an oscilloscope to view the power meter's recorder output while sweeping. Flatness corrections are made by modifying the appropriate Calibration Constants

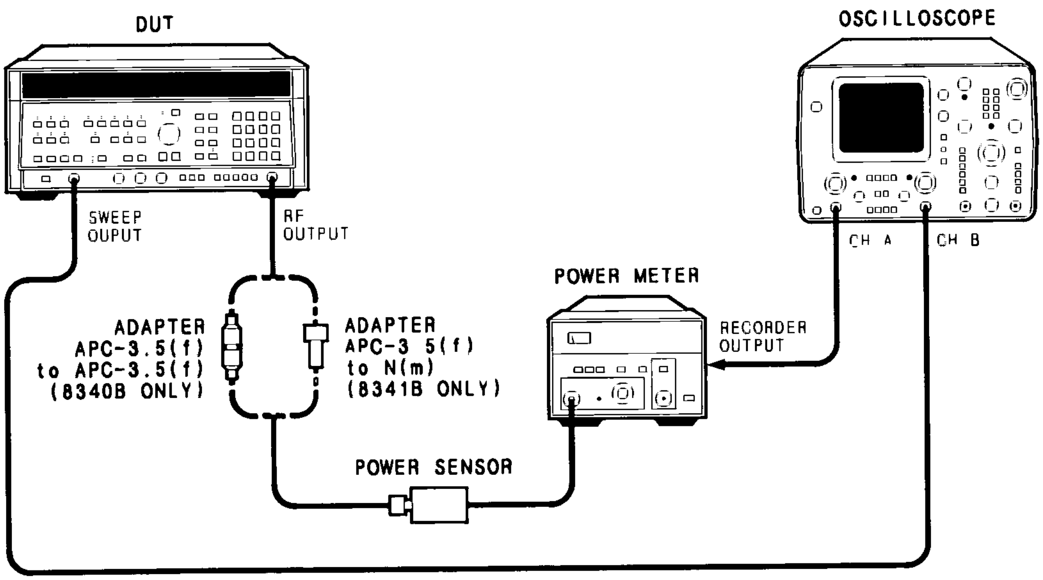


Figure 5-61. RF Output Power Flatness Setup

Equipment

Oscilloscope . . . . HP 1741A
Power Meter . . . . HP 436A
Power Sensor . . . . HP 8485A
Power Sensor . . . . HP 8481A
Adapters:
- APC 3.5 (f) to APC 3.5 (f) . . . . HP P/N 5061-5311
  (required for HP 8340B to HP 8485A connection)
- APC 3.5 (f) — Type N (m) . . . . HP P/N 1250-1744
  (required for HP 8341B to HP 8485A connection)
- APC 3.5 (f) to Type N (f) . . . . HP P/N 1250-1745
  (required for HP 8340B to HP 8481A connection)

Procedure

1. Calculate a correction factor for the HP 8485A Power Sensor as follows:

   Find the CAL FACTOR end points (0.05 GHz and the maximum DUT RF Output frequency) by either using a calculator to find the best straight line approximation to the CAL FACTOR curve in percent or by using a straight edge for the best straight line approximation on the CAL FACTOR curve located on the body of the power sensor.

   Convert both end points to dB using the following equation:

   Endpoint (dB) = −10log(endpoint(%)/100)

   Calculate the slope as follows:

   HP 8340B:

   Slope (dB/GHz) = [26 5 GHz Endpoint (dB) − 0.05 GHz Endpoint (dB)]/26 45

   HP 8341B:

   Slope (dB/GHz) = [20 GHz Endpoint (dB) − 0 05 GHz Endpoint (dB)]/19.95

2. Connect the HP 8485A power sensor to the power meter and then turn the DUT's and the power sensor's LINE switches ON. Connect the oscilloscope as shown in Figure 5-61. Allow 30 minutes for the equipment to warm up.

3. Calibrate and zero the power meter. On the DUT, press **[INSTR PRESET] [CW] [4] [.] [5] [GHz]** and then **[RF]** to turn the RF off Zero the power meter. To ensure that the power meter is properly zeroed, select WATT mode, and press the ZERO button until the power meter indicates < 0.02 on the most sensitive range. Select the dBm MODE on the power meter.

4. On the DUT, press **[INSTR PRESET] [START] [2] [.] [4] [GHz]**. Press **[POWER LEVEL] [0] [dBm] [SWEEP TIME] [5] [sec]**. Press **[SLOPE]**, enter the slope calculated in step 1, and terminate the entry by pressing **[dBm]**. Save this instrument state by pressing **[SAVE] [1]**.

5. Set the oscilloscope to A vs B. Set the horizontal sensitivity (CHAN B) for 1 V/Div and the vertical sensitivity (CHAN A) for 0.1 V/Div. Adjust the oscilloscope's vertical position control to center the trace on the oscilloscope. Adjust the horizontal position control to display the entire trace.

6. On the DUT, press **[INSTR PRESET] [CW] [1] [4] [GHz] [SHIFT] [POWER LEVEL] [.] [0] [5] [dBm] [POWER LEVEL] [-] [1] [dBm]**. Press RANGE HOLD on the power meter and set the CAL FACTOR % dial for the 14 GHz CAL FACTOR indication on the power sensor.

7. Using the DUT's front panel rotary knob (RPG), increase the power level until the power meter indicates 0 dBm. The output power sensitivity on the DUT is 0.05 dBm so adjust the power level for the closest reading to 0 dBm if you cannot adjust for exactly 0 dBm.

8. Adjust the oscilloscope's CHAN A position control to place the dot on the center horizontal graticule. Determine the dB/Div sensitivity of the oscilloscope by rotating the DUT's rotary knob until the dot is 1 major graticule above the center graticule. Determine the sensitivity by reading the power level on the power meter. Repeat this process and determine the sensitivity for the second major graticule above the center graticule and the two major divisions below the center graticule. Once the oscilloscope is calibrated in this manner, you can use the oscilloscope's display to determine the power flatness of the trace. The scope should now be set up for 2.4 GHz/Div (X-Axis) and approximately 0.4 dB/Div (Y-Axis).

9. Set the power meter's CAL FACTOR % dial to 100%. Press **[RECALL] [1]** on the DUT. Set the oscilloscope for maximum PERSISTENCE and minimum BRIGHTNESS. On the DUT, Press **[SHIFT] [GHz] [1] [4] [Hz] [SHIFT] [MHz] [1] [2] [Hz] [SHIFT] [kHz] [2] [2] [Hz]** to access Cal Constant 14.

NOTE

Refer to Figure 5-62 to determine the effect the following adjustments have on the flatness of the RF output.

NOTE

The bandcross points seen on the oscilloscope can be used as a frequency reference for the following adjustments. The frequency of the bandcross points are, from left to right, 7.0, 13.5, and in the case of the HP 8340B, 20.0 GHz. The bandcross points are the points at which the sweep pauses and the power drops to a minimum for an instant.

Adjust Cal Constant 14 for the flattest trace from 2.4 to 9 GHz

Press the DUT's **[▲]** step key to access Cal Constant 15 and adjust Cal Constant 15 and A27R4 (BK PT1) for the flattest trace from 9 to 20 GHz.

If adjusting an HP 8340B, press the DUT's **[▲]** step key to access Cal Constant 16. Adjust Cal Constant 16 and A27R8 (BK PT2) for the flattest trace from 20 to 26.5 GHz.

Repeat these adjustments until the flattest trace is obtained from 2.4 to the maximum DUT RF Output frequency.

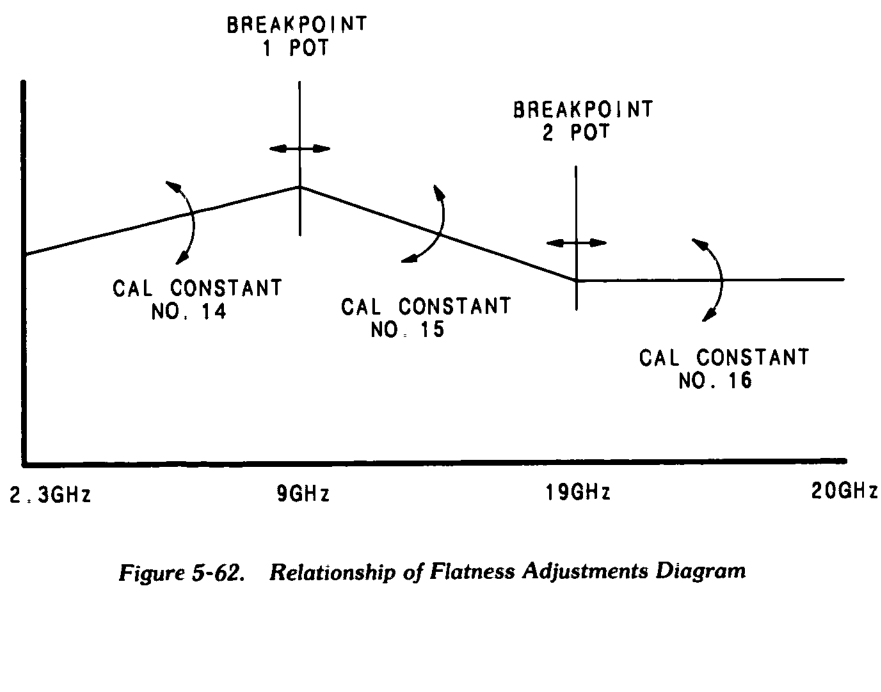


Figure 5-62. Relationship of Flatness Adjustments Diagram

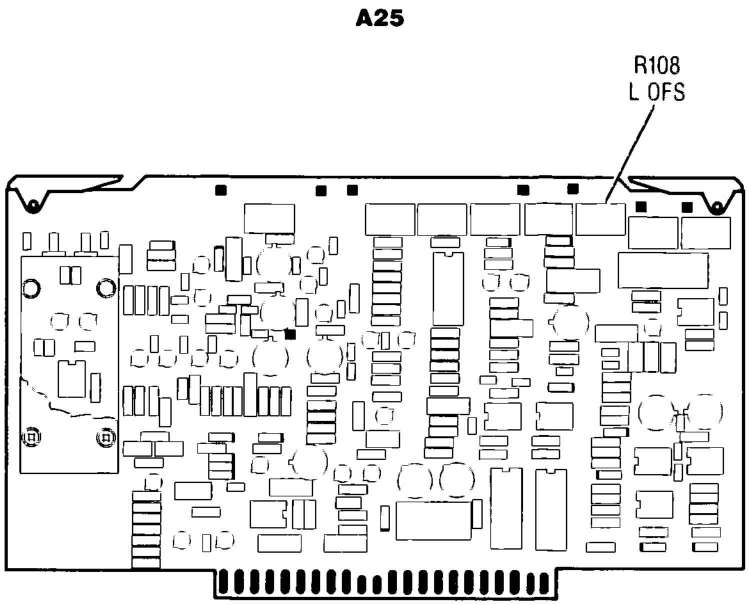


Figure 5-63. Flatness Adjustment Location

10 Set the oscilloscope's PERSISTENCE to minimum On the DUT, press **[MANUAL] [2] [.] [4] [GHz]** and **[SLOPE]** to turn the slope off Adjust the CAL FACTOR % dial on the power meter for the 2.4 GHz CAL FACTOR indication on the power sensor

11. On the DUT, press **[SHIFT] [GHz] [4] [4] [Hz] [SHIFT] [ENTRY OFF]** to access Cal Constant 44. On the power meter, press RANGE HOLD to turn it off. Adjust Cal Constant 44 for a 0 dBm indication on the power meter

12. Turn the power meter off and disconnect the HP 8485A power sensor. Connect the HP 8481A power sensor and turn the power meter on. Allow 15 minutes for the sensor to stabilize and then zero and calibrate the power meter.

13. On the DUT, press **[INSTR PRESET] [START FREQ] [1] [0] [MHz] [STOP FREQ] [2] [.] [4] [GHz] [MANUAL] [1] [0] [0] [MHz] [POWER LEVEL] [0] [dBm]**. Set the power meter's CAL FACTOR % dial for the 100 MHz CAL FACTOR indication on the power sensor.

14. Connect the power sensor to the DUT's RF output and then press **[RF]** on the DUT to turn the RF off. Zero the power meter. To ensure that the power meter is properly zeroed, select WATT mode, and press the ZERO button until the power meter indicates < 0.02 on the most sensitive range. Select the dBm MODE on the power meter.

15. Press **[RF]** on the DUT to turn the RF on Allow a few seconds for the power meter to stabilize and then note the power meter indication. This power level will be P3 in the following equation

16. Press **[MANUAL] [2] [.] [4] [GHz]** on the DUT. Set the power meter's CAL FACTOR % dial for the 2.4 GHz CAL FACTOR indication on the power sensor. Note the power meter indication. This power level will be P4 in the following equation

Calculate the value of P using the following equation.

$$P = (1.044 \times P3) - (0.044 \times P4)$$

5-17. RF OUTPUT POWER FLATNESS ADJUSTMENT (Cont'd)

17. On the DUT, press **[SHIFT] [GHz] [1] [3] [Hz] [SHIFT] [MHz] [1] [2] [Hz] [SHIFT] [kHz] [2] [2] [Hz]** to access Cal Constant 13. Adjust Cal Constant 13 for a power meter indication of P. Adjust A25R108 (LOFS) (Figure 5-63) for a 0 dBm indication on the power meter.

AM OFFSET

18. On the DUT, press **[CW] [4] [.] [5] [GHz] [POWER LEVEL] [0] [dBm].** Set the power meter's CAL FACTOR % dial for the 4.5 GHz CAL FACTOR indication on the power sensor. Adjust the DUT's rotary knob for a 0 dBm indication on the power meter.

19. On the DUT, press **[SHIFT] [GHz] [4] [3] [Hz] [SHIFT] [ENTRY OFF]** to access Cal Constant 43. Adjust Cal Constant 43 for no more than 0.05 dB change in the power meter indication when turning **[AM]** on and off.

ADC CAL CONSTANTS

20. On the DUT, press **[SHIFT] [PWR SWP] [0] [dBm]** to decouple the RF attenuator and the ALC and to set the ALC at 0 dBm. The RF attenuator should also be at 0 dB. If it is not, use the **[▲]** step key to set it to 0. Press **[AM]** to turn the AM on.

21. On the DUT, press **[SHIFT] [GHz] [4] [2] [Hz] [SHIFT] [ENTRY OFF]** to access Cal Constant 42. Adjust Cal Constant 42 so the DUT's POWER dBm display shows 0.00 dBm.

22. On the DUT, press **[SHIFT] [PWR SWP] [-] [2] [0] [dBm]** to set the ALC level to −20 dBm. Press **[SHIFT] [GHz] [4] [0] [Hz] [SHIFT] [ENTRY OFF]** to access Cal Constant 40 and adjust Cal Constant 40 so the DUT's POWER dBm display shows −20.00 dBm.

23. On the DUT, press **[CW] [1] [.] [5] [GHz]**. Press **[SHIFT] [GHz] [3] [9] [Hz]** to access Cal Constant 39 and adjust Cal Constant 39 so the DUT's POWER dBm display shows −20.00 dBm.

NOTE

If adjustments of the Cal Constants were made in this procedure, the Cal Constants data stored in the "working memory" should be copied into the "protected memory" by pressing [SHIFT] [MHz] [1] [4] [Hz] [SHIFT] [kHz] [5] [3] [4] [9] [Hz]. Wait for "CALIBRATION RESTORED" to be displayed in the ENTRY DISPLAY, then press [INSTR PRESET].

5-18. PULSE ADJUSTMENTS

Reference

Performance Test: Pulse Modulation Rise, Fall, and Delta Time, Pulse Modulation Accuracy; and Pulse Modulation Video Feedthrough

Service Section. RF Section

Description

The detector sample-and-hold balance is adjusted for best continuity across the trailing edge of the pulse waveform. The timing is adjusted for maximum negative level.

The integrator gate balance is set for the flattest pulse envelope

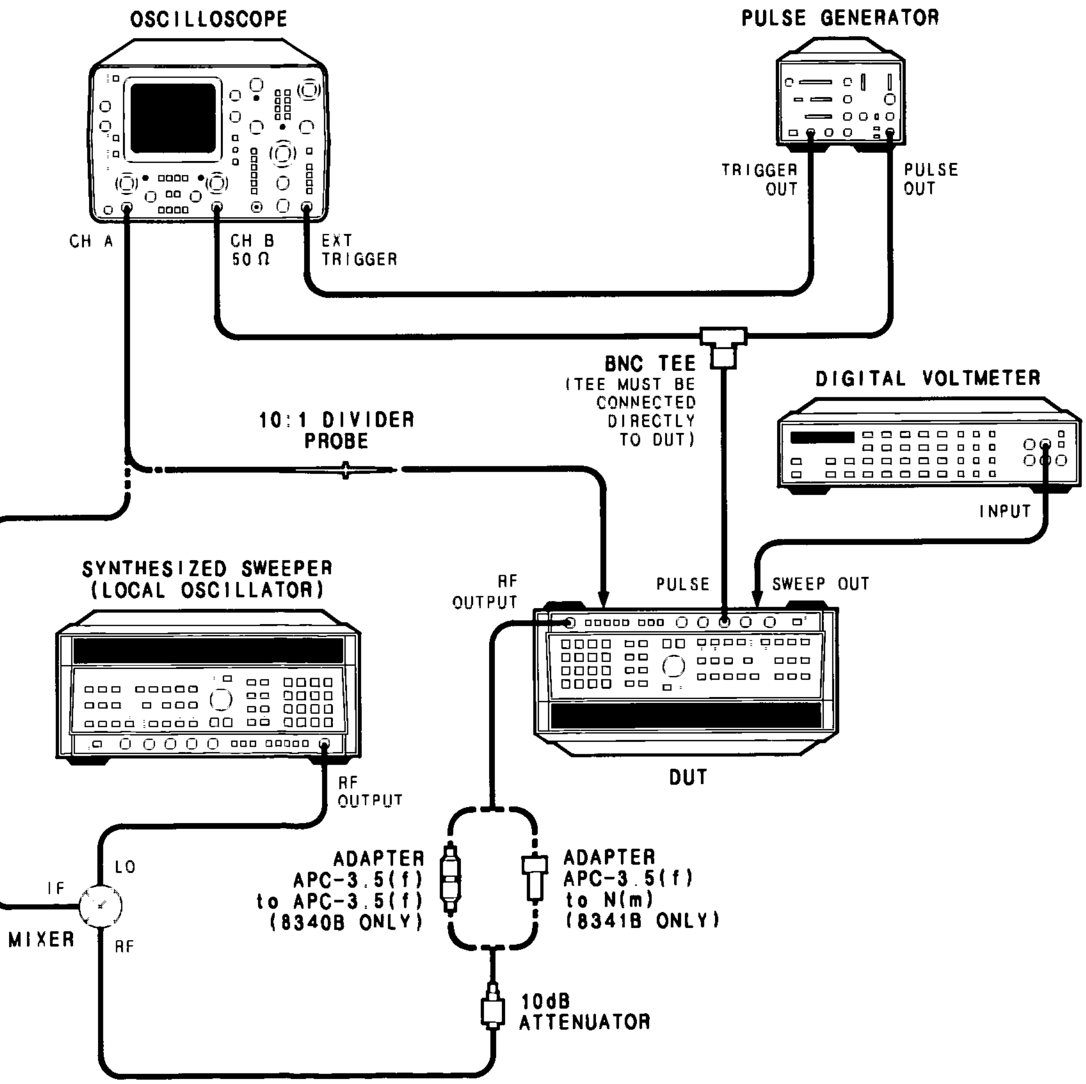


Figure 5-64. Pulse Adjustment Setup

NOTE

The following adjustments are required if any of the following four assemblies have been replaced or if any of the controls listed after each assembly have been adjusted or replaced.

A11 High Band Detector (Bands 1 - 4)
A21 Pulse Modulator Assembly, A21R45 (ON DELAY-INT), A21R47 (OFF DELAY)
A25 ALC Detector Assembly, A25R58 (BAL)
A26 Linear Modulator Assembly, A26R7 (BAL)

Equipment

Synthesized Sweeper	HP 8340B Opt. 001
Pulse Generator	HP 8012B
Oscilloscope	HP 1741A
10:1 Divider Probe	HP 10004D
Mixer	HP P/N 0955-0307
Digital Voltmeter	HP 3456A
Amplifier	HP 8447F
Low Pass Filter	HP P/N 9135-0260
10 dB Attenuator	HP 8493C Option 010
Adapters:	
APC 3.5 (f) to APC 3.5 (f) (required if DUT is an HP 8340B)	HP P/N 5061-5311
APC 3.5 (f) to Type-N (m) (required if DUT is an HP 8341B)	HP P/N 1250-1744
BNC (f) to Dual Banana	HP P/N 1251-2277
BNC Tee	HP P/N 1250-0781

Procedure

If the DUT is equipped with Option 006, Delete Pulse Modulation, proceed directly to step 16.

DETECTOR SAMPLE AND HOLD BALANCE ADJUSTMENT

1. Connect equipment as shown in Figure 5-64. Allow at least 30 minutes warmup.

NOTE

The A21, A25, and A26 PC boards must not be placed on extender boards in this adjustment procedure. Also, the cables connected to detectors A11 and A12 are especially designed for low capacitance and only these cables may be used during adjustment procedures.

2. Set the oscilloscope as follows.

DISPLAY	CHOP
MODE	MAIN
MAG X5	ON
CH A	0.005 V/Div AC COUPLED
CH B	5 V/Div 50 Ohms
TIME/Div	2 μsec

Connect CH A probe to A26TP2 (DET)

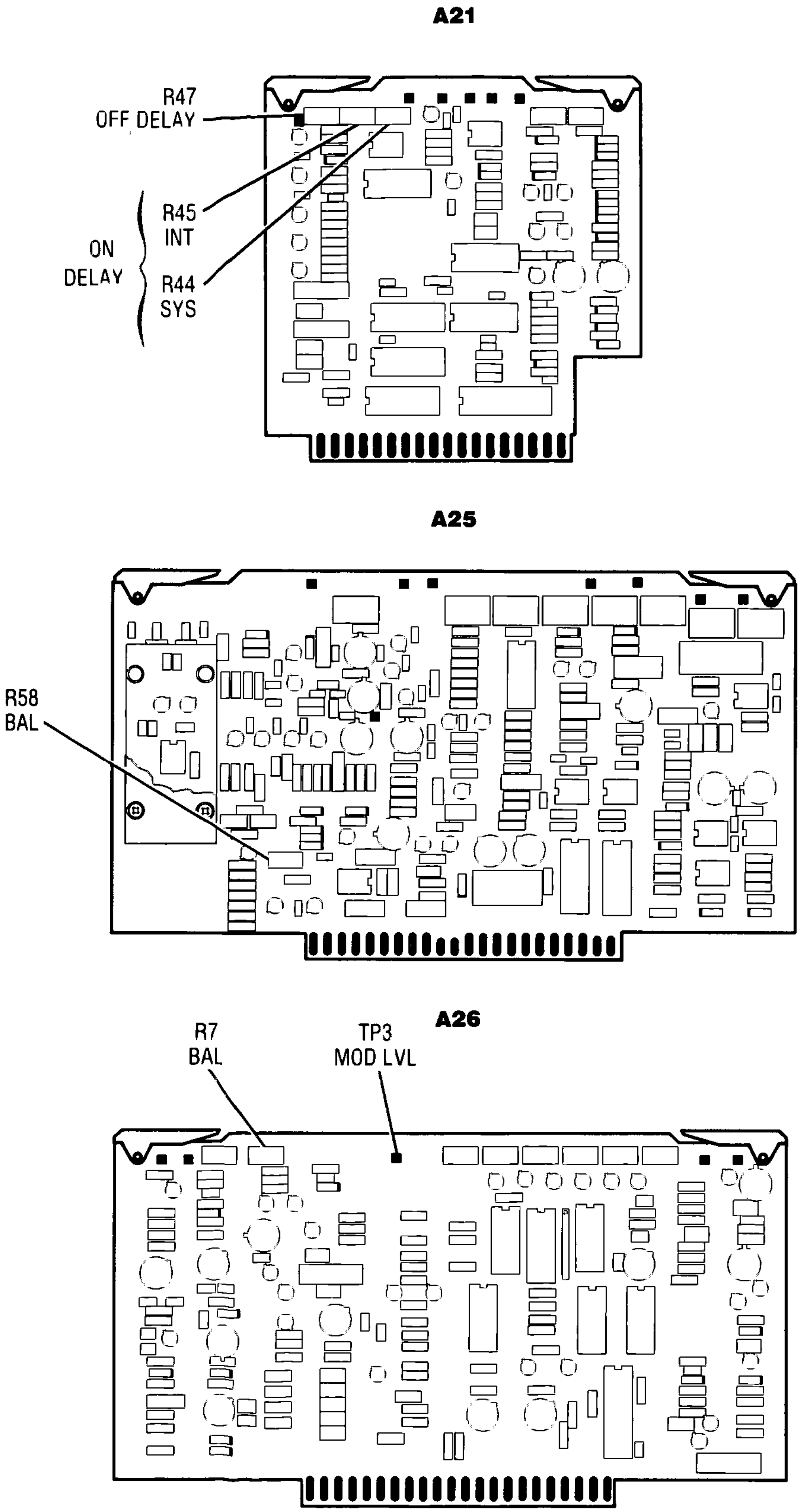


Figure 5-65. Pulse Adjustments Location

5-18. PULSE ADJUSTMENTS (Cont'd)

3. Set the pulse generator for a pulse width of 4 microseconds, a pulse period of 10 microseconds, and amplitude = +3 Volts high and 0 Volts low. Remember that CHAN B is inverted and X5 MAG is on.

4. On the DUT, press **[INSTR PRESET]**. Press **[PULSE]** ON. Press **[CW]** and enter **[5] [GHz]**. Press **[SHIFT] [PWR SWP]** and enter **[0] [dBm]**. Use the step keys to step in 10 dB RF attenuation. If the DUT does not include an RF attenuator, connect a 10 dB pad to the RF output. Set A21R45 (ON DELAY-INT), A21R47 (OFF DELAY), and A21R44 (ON DELAY-SYS) fully counterclockwise. (See Figure 5-65.)

   Check that the DUT is leveled (the UNLEVELED light is not lit).

5. Set the oscilloscope to 1 usec/Div the CH A trace should be similar to Figure 5-66

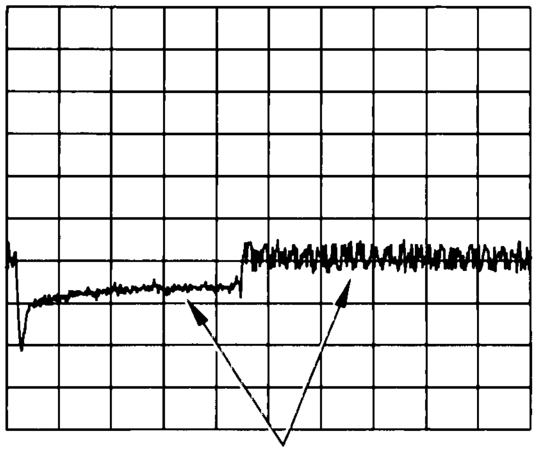


Figure 5-66. Typical A26TP2 (DET) Pulse Waveform

6. Adjust A25R58 (BAL) control for best continuity (flat line) across the pulse trailing edge. (NOTE: A25 must not be on an extender board when viewing trace.).

SAMPLE AND HOLD TIMING ADJUSTMENT

7. Set the pulse generator for a pulse width of 120 nanoseconds. On the DUT, press **[SHIFT] [PWR SWP]** and enter **[−] [1] [0] [dBm]**. Then press **[SHIFT] [SLOPE]** and use the **[STEP]** keys to set attenuator to −10 dB.

8. Connect the DVM to A26TP3 (MOD LVL). Adjust A21R45 (ON DELAY-INT) and A21R47 (OFF DELAY) for the most negative reading.

9. Set the DUT controls as shown below:

   a Press **[SHIFT] [PWR SWP]** and use **[STEP]** keys to set attenuator to −10 dB.
   b Use keys to enter **[0] [dBm]**
   c Press **[CW]** and enter **[5] [GHz]**

10. Set the oscilloscope to 0.2 usec/DIV and adjust the Pulse Generator to a 1 usec pulse.

11. Connect the output IF port of the mixer to CH A of oscilloscope and set oscilloscope to 50 Ohm input and .005 V/DIV.

12 At the Local Oscillator, make settings as follows:

   a. Press **[INSTR PRESET] [CW]** and enter **[4] [.] [9] [5] [GHz]**.
   b. Press **[POWER LEVEL]** and enter **[1] [0] [dBm]**.

13. Turn pulse ON and then OFF alternately by pressing **[PULSE]** pushbutton. Adjust A25R58 BAL control so that the peak-to-peak amplitude of the envelope disiplayed on the oscilloscope is the same value with pulse on and pulse off

INTEGRATOR GATE BALANCE ADJUSTMENT

14. Set the pulse generator for a pulse width of 5 microseconds and a pulse period of 20 microseconds. Set oscilloscope to 1 μsec/Div.

15 On the DUT, press **[PULSE] [SHIFT] [AM]** and adjust A26R7 BAL for the flattest pulse envelope on the CH A display.

   Press **[AM]** OFF and the pulse envelope should be flatter. Proceed to step 23.

SLOW PULSE MODULATION, COURSE ADJUSTMENT

NOTE

Steps 16 through 22 should only be performed for HP 8340Bs that are equipped with 006, Delete Pulse Modulation. Steps 23 through 28 should be performed for all DUTs.

16. Connect the instruments as shown in Figure 5-67

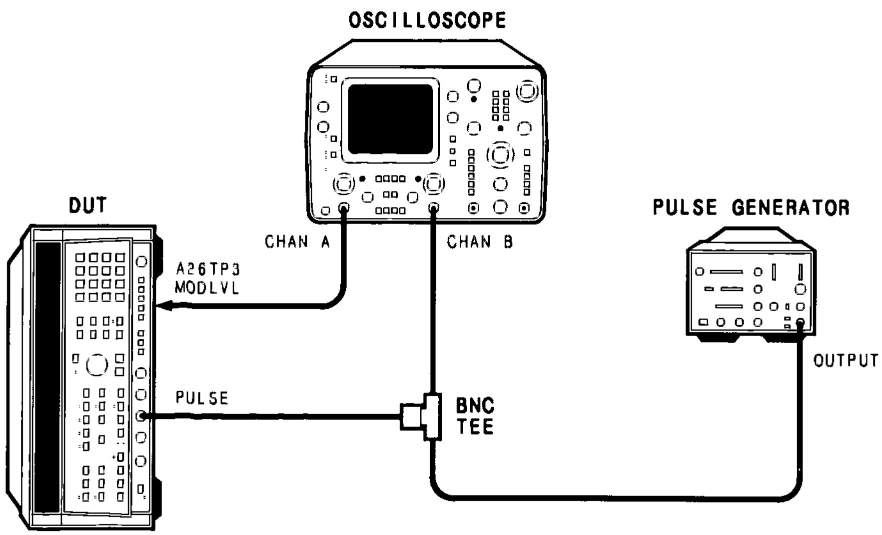


Figure 5-67. Pulse Modulation Rise and Fall Time Test Setup

17. Set up the pulse generator for a 25 kHz, 5 Vpk (10 Vp-p), square wave.

18. Set the oscilloscope as follows:

DISPLAY	CHANNEL A
CHAN A	.005 V/Div (AC)
CHAN B	2.0 V/Div (50 Ohm)
TRIGGER	CHAN B
TIME/Div	5 µsec

19. On the HP 8340B (Option 006), press **[CW] [1] [GHz] [POWER LEVEL] [5] [dBm] [SHIFT] [AM] [SHIFT] [PULSE]**.

20. Adjust A26R7 (BAL) and A25R58 (BAL) full clockwise. The oscilloscope display should look similar to Figure 5-68, waveform a.

21. Adjust A25R58 (BAL) for an oscilloscope display as shown in Figure 5-68, waveform b.

22. Adjust A26R7 (BAL) for an oscilloscope display as shown in Figure 5-68, waveform c

SLOW PULSE MODULATION FINE ADJUSTMENT

23. Connect the equipment as shown in Figure 5-69. Connect the mixer directly to the local oscillator's RF output to obtain the maximum LO drive to the mixer. Connect the BNC tee directly to the DUT's PULSE connector. Allow 30 minutes for the instruments to warm up.

24. Set the oscilloscope as follows:

DISPLAY	CHANNEL B
CHAN A	0.1 V/Div, 50 Ohms
CHAN B	5 V/Div, 50 Ohms
TRIGGER	INT , CHAN B
TIME/Div	5 usec

25. Set up the pulse generator for a 25 kHz (8 divisions on the oscilloscope), 5V peak (10 V p-p) square wave. The damage level for the DUT's PULSE input is +12V −20V so do not overdrive the input.

26. On the DUT, press **[INSTR PRESET] [CW] [2] [GHz] [POWER LEVEL] [0] [dBm] [SHIFT] [PULSE]**.

NOTE

For best accuracy in this test, the LO drive to the mixer should be > +4 dBm.

27. On the LO, press **[INSTR PRESET] [CW] [1] [.] [9] [5] [GHz] [POWER] [LEVEL] [1] [0] [dBm].**

28. Press DISPLAY A on the oscilloscope. Adjust A21R30 (LSYM) so that the 50% points on the pulse envelope cover four vertical graticules on the oscilloscope (50% duty cycle).

29 On the DUT, press **[CW] [3] [GHz].** On the LO, press **[CW] [2] [.] [9] [5] [GHz]**. Adjust A21R29 (HSYM) so that the 50% points on the pulse envelope cover four vertical graticules on the oscilloscope (50% duty cycle).

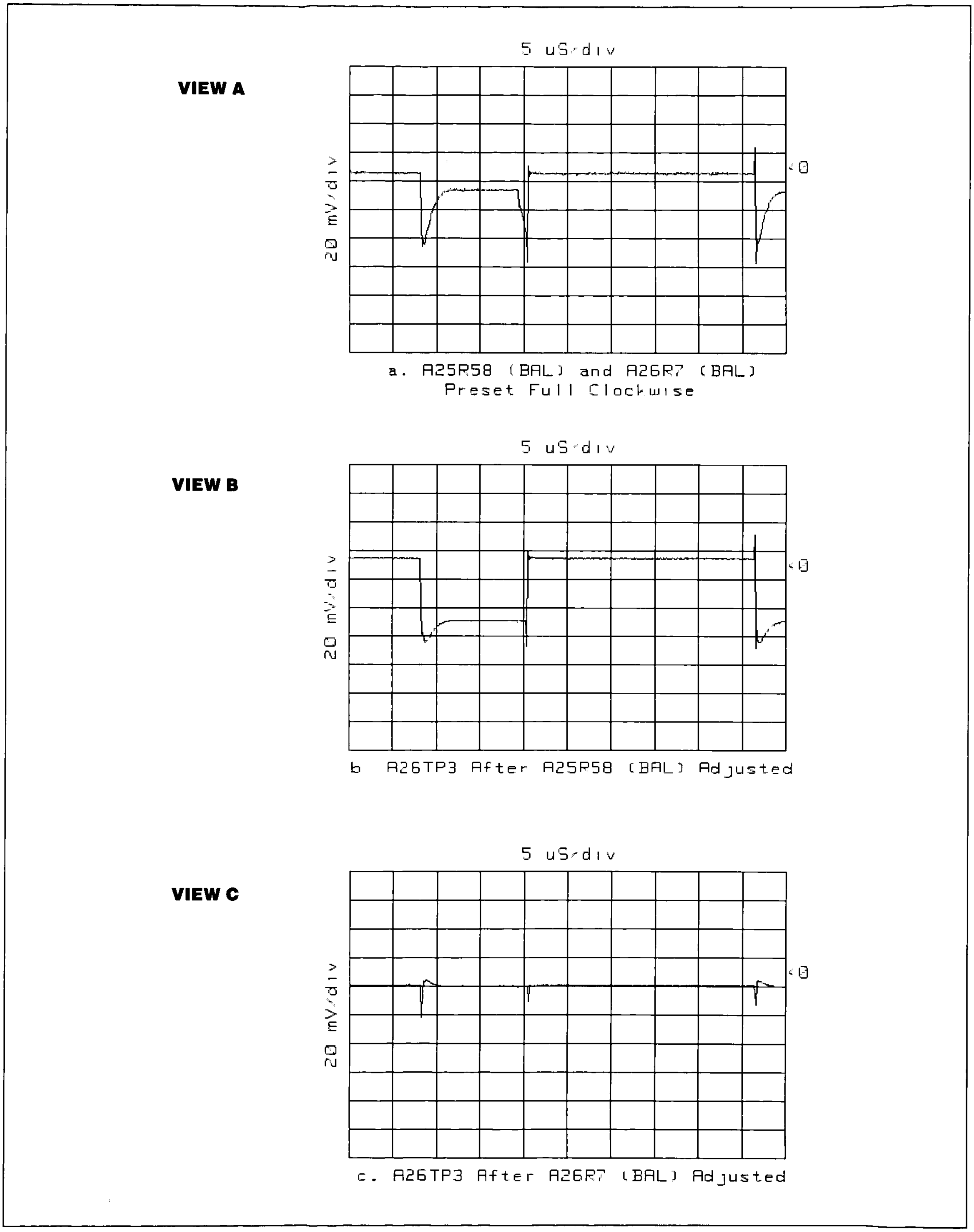


Figure 5-68. A26TP3 Typical Waveforms

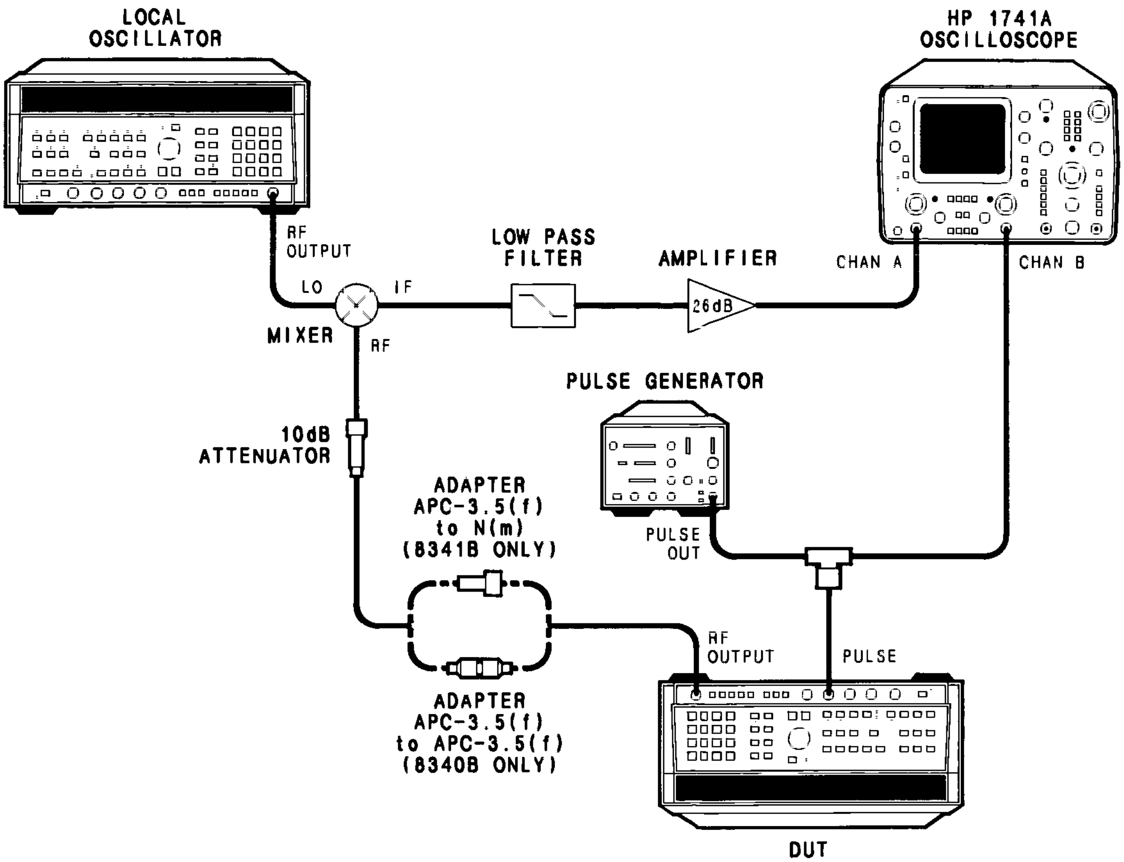


Figure 5-69. Slow Pulse Modulation Fine Adjust Setup

5-19. EXTERNAL MODULE LEVELING ADJUSTMENT

Reference

Performance Test: None
Service Section: RF Section

Description

In this procedure, the DUT's RF output is connected to an external detector and the detector's output is then connected to the DUT's XTAL LEVELING input and a DVM. The DUT is then set to external module leveling, 0 dBm and 10 dBm. At both levels, the DUT's Cal Constants are adjusted for the correct DVM reading and the correct POWER dBm DISPLAY reading.

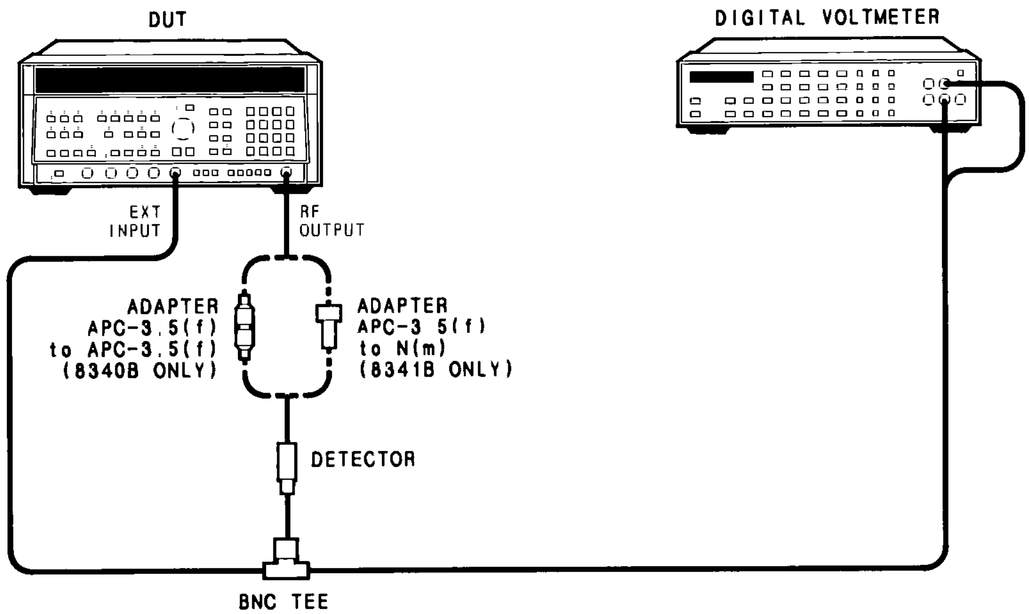


Figure 5-70. External Module Leveling Adjustment Setup

Equipment

Digital Voltmeter (DVM)	HP 3456A
Detector, Positive	HP 8473C Option 003
Adapters:	
APC 3 5 (f) to APC 3 5 (f) (required for HP 8340B only)	HP P/N 5061-5311
APC 3.5 (f) to Type N (m) (required for HP 8341B only)	HP P/N 1250-1744
BNC (f) to Dual Banana	HP P/N 1251-2227
BNC Tee	HP P/N 1250-0781

Procedure

1. Connect the equipment as shown in Figure 5-70. Turn the DUT's LINE switch ON and allow 30 minutes for the equipment to warm up.

2. On the DUT, press **[INSTR PRESET] [CW] [4] [GHz] [AM] [SHIFT] [XTAL] [0] [dBm]** to turn AM on and to set the DUT to external module power leveling of 0 dBm. Press **[SHIFT] [GHz] [3] [5] [Hz] [SHIFT] [MHz] [1] [2] [Hz] [SHIFT] [kHz] [2] [2] [Hz]** to access Cal Constant 35.

NOTE

If, in step 3, Cal Constant 35 is adjusted for a negative voltage reading on the DVM (i.e., −0.002V), it is possible that the DUT's OVERMOD annunciator will turn on. If this occurs, rotate the DUT's rotary knob to turn the OVERMOD annunciator OFF and then adjust the DVM for the proper voltage reading.

3. Using the DUT's front panel rotary knob, adjust Cal Constant 35 (range is −100 to +100) until the DVM reads 0.000 V ± 2 mV.

4. Using the DUT's **[▲]** step key, access Cal Constant 37. Using the DUT's rotary knob, adjust Cal Constant 37 (range is −100 to +100) until the DUT's POWER dBm display indicates 0.0 dBm.

5. On the DUT, press **[SHIFT] [XTAL] [1] [0] [dBm]** to set the external module power to +10 dBm. Press **[SHIFT] [GHz] [3] [6] [Hz] [SHIFT] [ENTRY OFF]** to access Cal Constant 36.

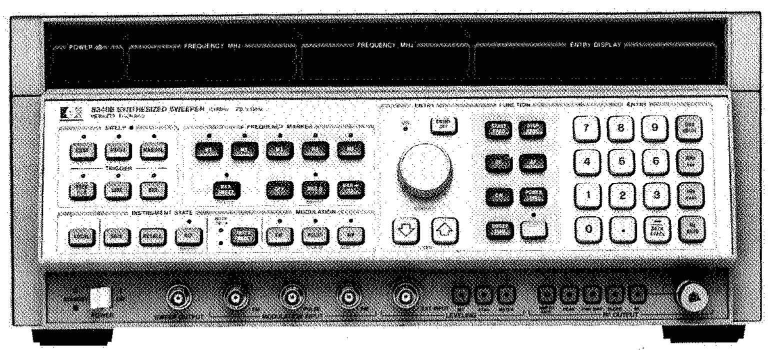
6. Using the DUT's rotary knob, adjust Cal Constant 36 (range is −100 to +100) until the DVM reads 0.3 V ± 2 mV.

7. Using the DUT's **[▲]** step key, access Cal Constant 38. Using the DUT's rotary knob, adjust Cal Constant 38 (range is −100 to +100) until the DUT's POWER dBm display indicates 10.0 dBm.

8. Repeat steps 2 through 8 to ensure that the adjustments are within tolerance.

9. On the DUT, press **[SHIFT] [MHz] [1] [4] [Hz] [SHIFT] [kHz] [5] [3] [4] [9] [Hz].** Wait for "CALIBRATION STORED" to be displayed in the DUT's ENTRY DISPLAY and then press **[INSTR PRESET]**.

HP 8340B
HP 8341B
SYNTHESIZED SWEEPERS



HEWLETT PACKARD

HP 8340B/41B
SYNTHESIZED SWEEPERS
Operating Information

Part of Operating, Calibration, and Assembly Level Service Manual Set
HP Part Number 08340-90243

Printed: AUGUST 1986

HP 8340B/41B Synthesized Sweepers Operating, Calibration, and Assembly Level Service Manual Set

Operating, Calibration, and Assembly Level Service Manual (includes Sections I through P/O VIII)	HP Part Number 08340-90243
Operating, Calibration, and Service Manual Microfiche (includes Sections I through P/O VIII)	HP Part Number 08340-90244
Component Level Service Manual (includes P/O Section VIII)	HP Part Number 08340-90245
Component Level Service Manual Microfiche (includes P/O Section VIII)	HP Part Number 08340-90246

HEWLETT PACKARD

SECTION III
TABLE OF CONTENTS

INTRODUCTION 3-1

LOCAL OPERATING INFORMATION

Figure — Page
3-1. Index by Front Panel Keys, Display and Connectors 3-3
3-2. Index by Rear Panel Connectors 3-4
3-3. Power dBm Display 3-13
3-4. START/CW/CF Frequency Display ... 3-15
3-5. STOP/ΔF Frequency Display 3-16
3-6. Entry Display 3-17
3-7. Function Keys 3-19
3-8. KNOB/STEP Entry 3-22
3-9. Frequency Marker Keys 3-24
3-10. Entry Keys 3-26
3-11. Sweep and Trigger Keys 3-28
3-12. Instrument State Keys 3-31
3-13. Power Switch, Sweep Output 3-34
3-14. Modulation Keys 3-35
3-15. Modulation Input 3-36
3-16. Leveling Keys/Input 3-37
3-17. RF Keys/Output 3-39
3-18. Rear Panel BNC Connectors 3-42
3-19. Rear Panel RF Output 3-44
3-20. HP-IB Connector 3-45
3-21. HP 8410 Interface 3-47
3-22. HP 8755C Interface 3-49
3-23. Fan Assembly 3-50
3-24. Power Line Module 3-51

Table — Page
3-1. Index by Mode and Function 3-5

HP-IB PROGRAMMING INFORMATION

Introduction 3-52
Interconnective Cabling 3-52
Instrument Addresses 3-52
HP-IB Instruments Nomenclature 3-52
Programming the HP 8340B/41B 3-53
HP-IB Command Statements 3-53
HP 8340B/41B Programming Codes 3-59
Programs that Duplicate Front Panel Operations 3-59
Using the Rotary KNOB 3-63
Using Keys that Toggle ON/OFF 3-63
Operator's Programing Check 3-63
Unique HP-IB Programming Codes 3-64
System Timing 3-82
HP-IB Programming Techniques for Special Applications 3-82
HP-IB Pin-Out Description 3-82
The Twelve HP-IB Lines 3-86
Computer Access of HP-IB Lines 3-91
Sending HP-IB Messages 3-92
Reading HP-IB Messages 3-93
Direct Writing to the HP-IB Lines 3-95

Figure — Page
3-25. HP-IB Pin-Out 3-83
3-26. HP-IB Handshake Timing 3-84
3-27. Representative Status Registers 3-94
3-28. Representative Control Registers 3-96

Table — Page
3-2. HP 8340B/41B Programming Codes ... 3-61
3-3. The Standard ASCII Code 3-89

POWER CONTROL AND MODULATION INFORMATION

INTERNAL LEVELING 3-98
Coupled Mode 3-98
Power dBm Display 3-99
Decoupled Mode 3-100
UNLEVELED MODE 3-102
POWER SEARCH 3-104
EXTERNAL LEVELING 3-104
EXTERNAL SOURCE MODULE LEVELING .. 3-105
Detector Characteristics 3-105
POWER dBm Display used with the Attenuator 3-107
Bandwidth 3-107
AMPLITUDE MODULATION 3-108
Power dBm Display used with AM 3-108
Dynamic Range 3-109
Bandwidth for AM Applications 3-109
PULSE MODULATION 3-110
Sample and Hold Leveling 3-110
Response Time 3-114
Unleveled Mode used with Pulse Modulation 3-114
Input Characteristics 3-114
Pulse Envelope 3-115
Source Match 3-115
Video Feedthrough 3-115
SLOW RISE TIME PULSE MODULATION FOR SCALAR NETWORK ANALYZERS 3-116

Figure — Page
3-29. ALC Loop Block Diagram 3-99
3-30. Reverse Power Effects 3-101
3-31. Typical Unleveled Modulation Response 3-103
3-32. Typical External Leveling Hookup 3-104
3-33. Typical Crystal Detector Response at 25°C 3-106
3-34. Pulse Measuring System 3-112
3-35. Error Detection and Modulator Drive .. 3-113
3-36. Pulse Input Circuit 3-115
3-37. Video Feedthrough 3-116

SUPPLEMENTAL GUIDES

OPERATING GUIDES

Getting Acquainted with the HP 8340B/41B Synthesized Sweepers

Using the HP 8340A Synthesized Sweeper with the HP 8755 Frequency Response Test Set

Externally Leveling the HP 8340B/41B Synthesized Sweepers

Using the HP 8340A Synthesized Sweeper with X-Y Recorders.

Using the HP 8340A Synthesized Sweeper with the HP 8410B/C Network Analyzer

PRODUCT NOTES

Increasing the Frequency Switching Speed on the HP 8340A Synthesized Sweeper.

List of other Product Notes

PROGRAMMING NOTES

Introductory Operating Guide (HP-IB) for the HP 8340A/8341A Synthesized Sweepers with the HP 9000 Series 200/300 Desktop Computers (BASIC)

Quick Reference Guide (HP-IB) for the HP 8340B/41B Synthesized Sweepers

IN CASE OF DIFFICULTY

Section III. Operation

INTRODUCTION

This section completely describes all front- and rear-panel keys, connectors, switches, and displays of the HP 8340B/41B Synthesized Sweeper, and explains all code mnemonics and the procedures used for HP-IB programming. Also described are enhancement procedures for the power control and modulation functions.

The descriptive material in the local operation subsection is organized according to the physical layout of the HP 8340B/41B. To find specific information, use as an index either Table 3-1, or Figures 3-1 and 3-2:

> Table 3-1 lists the operation modes and functions of the HP 8340B/41B, shows the keystrokes that initiate those functions, and lists the reference figures that explain the procedures.
>
> Figure 3-1 is a front panel drawing of the HP 8340B, with callouts indicating the reference figures that explain each key connector, switch, and display.
>
> Figure 3-2 is a rear panel drawing of the HP 8340B, with callouts that indicate the appropriate reference figures.

The nucleus for the HP-IB programming material is Table 3-2. Table 3-2 lists all code mnemonics and provides cross referencing to equivalent front panel keys. The codes that do not have an equivalent front panel key, along with the HP-IB programming procedures, are explained following Table 3-2.

The power control and modulation functions have several enhancement provisions. These provisions are mentioned in the relevant parts of the local operation and HP-IB programming subsections, but a collective, detailed explanation is made at the end of this Operation section.

Hewlett-Packard periodically updates the operating information for the HP 8340B/41B, in the form of a Manual Changes Supplement, and publishes a series of Operating Guides and Programming Notes. Contact the nearest HP Sales and Service office (listed inside of the back cover of Volume 3) to obtain this supplemental information as it becomes available.

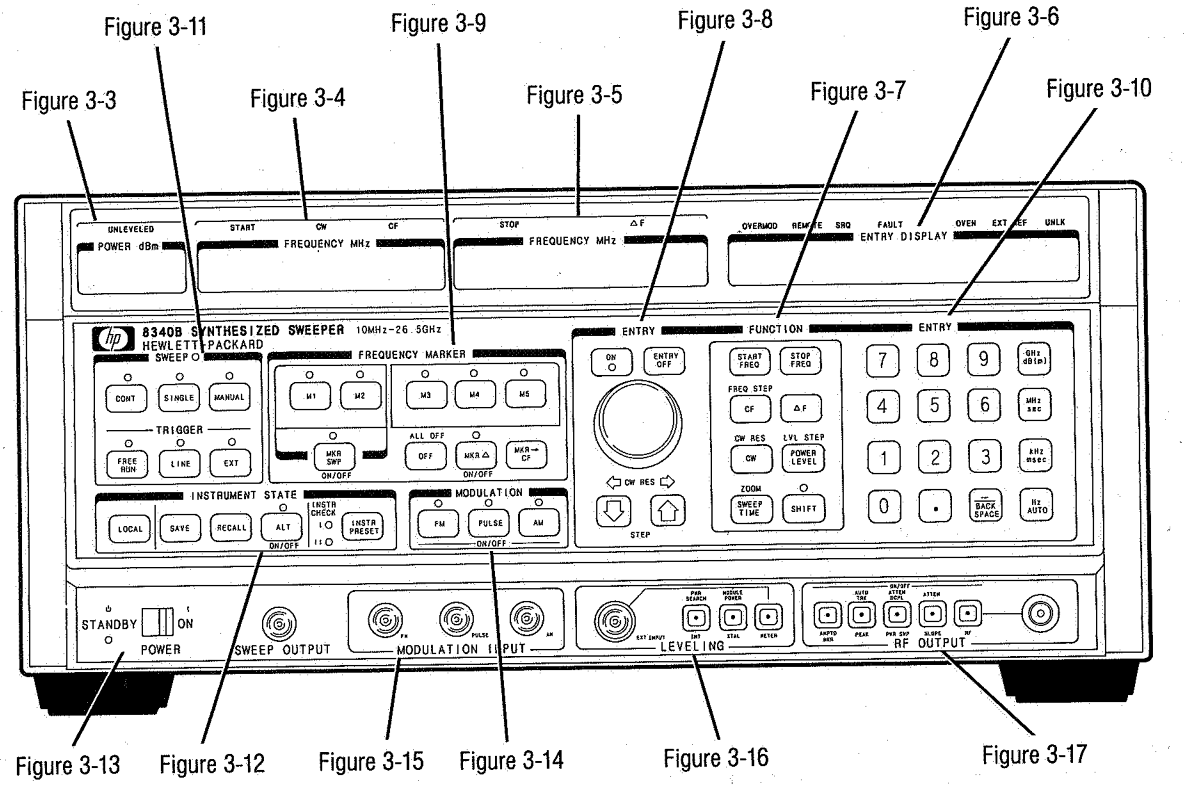


Figure 3-1. Index by front panel keys, display, and connectors

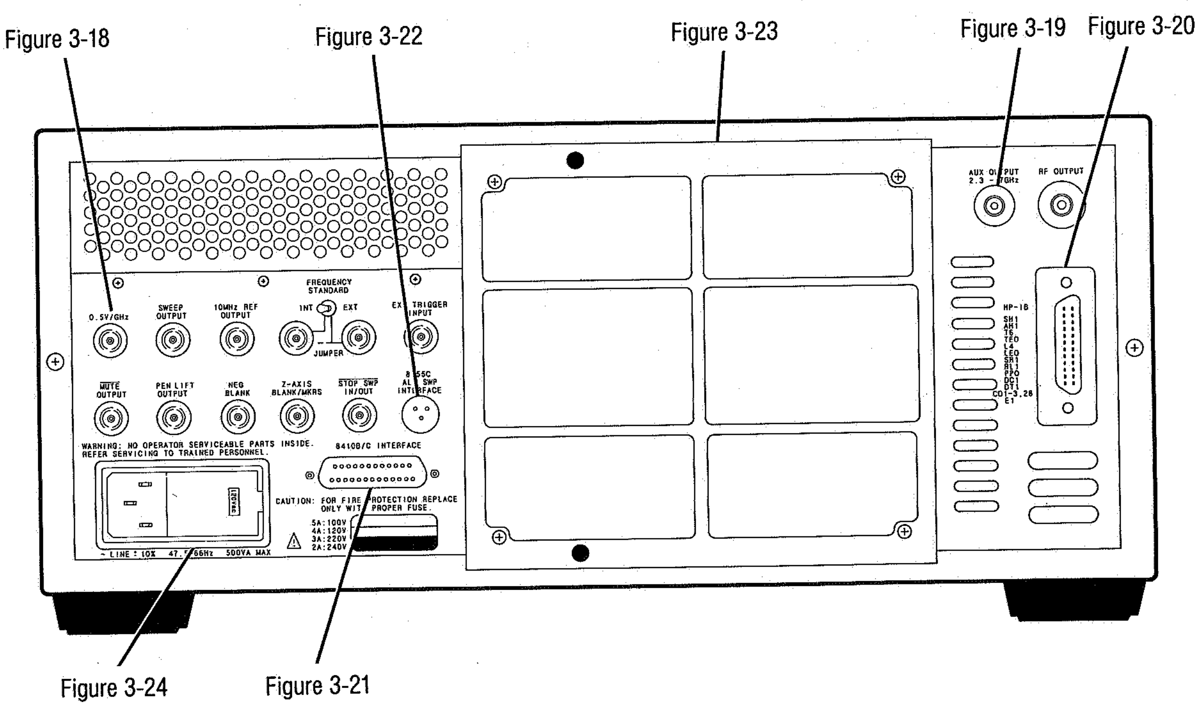


Figure 3-2. Index by rear panel connectors

Table 3-1. Index by Mode and Function (1 of 7)

Mode	Function	Keys	HP-IB Code	Reference Figure
Swept/CW Frequency Selection				
Start/Stop Sweep	START	[START FREQ]	FA	3-7
	STOP	[STOP FREQ]	FB	
Center Frequency/ ΔF Sweep	CF	[CF]	CF	
	ΔF	[ΔF]	DF	
	ZOOM	[SHIFT] [SWEEP TIME]	SHST	
CW Frequency	CW	[CW]	CW	
	CW RESOLUTION	[SHIFT] [CW]	SHCW	
Frequency Markers				
Turn On and Set Marker Frequency	MARKER 1	[M1]	M1	3-9
	MARKER 2	[M2]	M2	
	MARKER 3	[M3]	M3	
	MARKER 4	[M4]	M4	
	MARKER 5	[M5]	M5	
Turn Off a Frequency Marker	M1 OFF	[M1] [OFF]	M1M0	
	M2 OFF	[M2] [OFF]	M2M0	
	M3 OFF	[M3] [OFF]	M3M0	
	M4 OFF	[M4] [OFF]	M4M0	
	M5 OFF	[M5] [OFF]	M5M0	
Turn Off All Markers	ALL OFF	[SHIFT] [OFF]	SHMO	
Turn On And Set Mkr Δ	MKR Δ, Marker "m" Marker "n"	[MKR Δ]	MD1	
Turn Off Mkr Δ Turn Off Mkr Δ	MKR Δ OFF MKR Δ OFF		MD0	
Active Marker To Center Frequency	MKR → CF	[MKR → CF]	MC	3-17
Marker 1-2 Sweep	MKR SWEEP ON	[MKR SWEEP]	MP1	
	MKR SWEEP OFF		MP0	
Marker 1 to Start Marker 2 to Stop	M1 → START M2 → STOP	[SHIFT] [MKR SWEEP]	SHMP	
Amplitude Frequency Markers	AMPTD MKR ON	[AMTD MKR]	AK1	
	AMPTD MKR OFF		AK0	

Table 3-1. Index by Mode and Function (2 of 7)

Mode	Function	Keys	HP-IB Code	Reference Figure
Sweep Mode, Trigger and Time				
Sweep Mode	CONTINUOUS	**[CONT]**	S1	3-11
	SINGLE	**[SINGLE]**	S2 or SG	
	MANUAL FREQUENCY SWEEP	**[MANUAL]**	S3 or SM	
Sweep Trigger	FREE RUN	[FREE RUN]	T1	
	LINE	**[LINE]**	T2	
	EXTERNAL	**[EXT]**	T3	
Sweep Time	SWEEP TIME	**[SWEEP TIME]**	ST	3-7
RF on Dwell	Increases dwell time by 100µs/count entered for "value", up to 12.8 ms	**[SHIFT] [MHz] [1] [7] [Hz]** **[SHIFT] [kHz] [n] [Hz]** where n = "value	SHMZ 17 Hz SHKZ # Hz where # = "value"	3-11
Return Pre-sweep/ Pre-CW step delay time to 400µs	Instrument Preset	**[INSTR PRESET]**	IP	
Modulation				
Amplitude Modulation	AM ON	**[AM]**	AM1	3-14, 3-15
	AM OFF		AM0	
Pulse Modulation	Slow Rise Time Pulse Mod ON	**[SHIFT] [PULSE]**	SHPM	
	NORMAL PULSE MOD. ON	**[PULSE]**	PM1	
	PULSE MOD. OFF		PM0	
Frequency Modulation	FM ON	**[FM]**	FM 1	3-14
	FM OFF		FM 0	
	FM SENSITIVITY 1 MHz/Volt	**[FM] [1] [MHz]**	FM 1 Mz	
	FM SENSITIVITY 10 MHz/Volt	**[FM] [10] [MHz]**	FM 1 10 Mz	
	Disable ALC, Search for Desired Power Level	**[SHIFT] [INT]**	SHRF or SHAI	3-16

Table 3-1. Index by Mode and Function (3 of 7)

Mode	Function	Keys	HP-IB Code	Reference Figure
Step Size, Display, and Entry Control				
Set Frequency Step Size	FREQUENCY STEP SIZE	**[SHIFT] [CF]**	SF or SHCF	3-7
Set Power Step Size	POWER STEP SIZE	**[SHIFT] [POWER LEVEL]**	SP or SHPL	
Increment Active Parameter	STEP UP ↑	**[⏶]** (STEP KEY)	UP	3-8
Decrement Active Parameter	STEP DOWN ↓	**[⏷]** (STEP KEY)	DN	
Numeric Display Update	RE-ENABLE DISPLAY UPDATE	**[SHIFT] [CONT]**	SHS1 or DU1	3-11
X-Y Recorder Interface	ENABLE PENLIFT AT BANDCROSSING	**[SHIFT] [LINE]**	SHT21	
	DISABLE PENLIFT AT BANDCROSSING		SHT20	
Fixed Function To Coupled Mode	AUTO	**[Hz/AUTO]**	AU	3-10
Active Function	DISABLE ACTIVE FUNCTION	**[ENTRY OFF]**	EF	3-8
	Reinstate Calibration Constant Access	**[SHIFT] [ENTRY OFF]**	SHEF	
Frequency Display Scale	MULTIPLICATION FACTOR	**[SHIFT] [START FREQ]**	SHFA	3-7
	RETAIN MULTIPLI-CATION FACTOR AT ON/OFF OR INSTR PRESET	**[SHIFT] [ALT]**	SHAL	3-12
	DISABLES [SHIFT] [ALT], MULTIPLI-CATION FACTOR PRESETS TO 1	**[SHIFT] [INSTR PRESET]**	SHIP	
Display Offset	OFFSET FACTOR	**[SHIFT] [STOP FREQ]**	SHFB	3-7
Instrument State/Registers				
Instrument Preset	INSTR PRESET	**[INSTR PRESET]**	IP	3-12
Save An Instrument State	SAVE n	**[SAVE]**	SV	
Recall An Instrument State	RECALL n	**[RECALL]**	RC	
Lock Registers	SAVE LOCK	**[SHIFT] [SAVE]**	SHSV	
Unlock Registers	SAVE UNLOCK	**[SHIFT] [RECALL]**	SHRC	

Table 3-1. Index by Mode and Function (4 of 7)

Mode	Function	Keys	HP-IB Code	Reference Figure
Instrument State/Registers (Cont'd)				
Alternate Sweep Mode	ALT ON	**[ALT]**	AL1	
	ALT OFF		AL0	
Security Memory Erase	ERASE RAM, set all variables and Save/ Recall registers to Instr Preset conditions. Working calibration constants overwritten by protected cal constants.	**[SHIFT] [MHz] [1] [8] [Hz]** **[SHIFT] [kHz] [0] [Hz]**	SHMZ18HZ SHKZ0HZ	3-12
Power Level and Control				
Set Output Power Level	POWER LEVEL	**[POWER LEVEL]**	PL	3-7
Power Sweep Mode	POWER SWEEP ON	**[PWR SWP]**	PS1	
	POWER SWEEP OFF		PS0	
Power Slope Mode	SLOPE ON	**[SLOPE]**	SL1	
	SLOPE OFF		SL0	
RF Power	RF ON	**[RF]**	RF1	3-17
	RF OFF		RF0	
Peak Output Power (CW Mode or Manual Sweep)	PEAK ON	**[PEAK]**	RP1	
	PEAK OFF		RP0	
Instantaneous Peak	FAST PEAKING	**[SHIFT] [AMTD MKR]**	SHAK	
Tracking Calibration	AUTO TRACKING CALIBRATION	**[SHIFT] [PEAK]**	SHRP	
Leveling Modes	INTERNAL	**[INT]**	A1	3-16
	EXTERNAL CRYSTAL	**[XTAL]**	A2	
	EXTERNAL POWER METER	**[METER]**	A3	
	DISABLE ALC TO CONTROL MODULATOR DRIVE DIRECTLY	**[SHIFT] [METER]**	SHA3	
	ENABLE EXTERNAL SOURCE MODULE LEVELING MODE	**[SHIFT] [XTAL]**	SHA2	

Table 3-1. Index by Mode and Function (5 of 7)

Mode	Function	Keys	HP-IB Code	Reference Figure
Power Level and Control (Cont'd)				
Independent Control of ALC and Attenuator	DECOUPLE ALC AND ATTENUATOR (CONTROL EACH INDEPENDENTLY)	**[SHIFT] [PWR SWP]**	SHPS	3-17
	CONTROL STEP ATTENUATOR INDEPENDENTLY	**[SHIFT] [SLOPE]**	SHSL or AT	
Diagnostic Functions				
Display M/N and 20/30 Loop Frequencies	DISPLAY M,N, M/N FREQ., 20/30 FREQ.	**[SHIFT] [M1]**	SHM1	3-9
Display Band # and Y.O. Loop Frequency	DISPLAY BAND # AND Y.O FREQ.	**[SHIFT] [M2]**	SHM2	
Display VCO1 and VCO2 Frequencies	DISPLAY VC01	**[SHIFT] [M3]**	SHM3	
Diagnostic Tests/ Results	DIAGNOSTIC TESTS/ RESULTS	**[SHIFT] [M4]**	SHM4	
Front Panel Display Test	DISPLAY TEST	**[SHIFT] [FREE RUN]**[1]	SHT1	3-11
Display Unlock	DISPLAY UNLOCK	**[SHIFT] [EXT]**	SHT3	
Display Fault Indicators	DISPLAY FAULT INDICATORS	**[SHIFT] [MANUAL]**	SHS3	
Band Cross Control	DISABLE BAND CROSS	**[SHIFT] [MHz] [2] [3] [Hz]** **[SHIFT] [kHz] [0] [Hz]**	SHMZ23HZ SHKZ0HZ	3-16
	RE-ENABLE BAND CROSS	**[SHIFT] [MHz] [2] [4] [Hz]** **[SHIFT] [kHz] [0] [Hz]**	SHMZ22HZ SHKZ0HZ	
Cause Manual Band Cross	MANUAL BAND CROSS	**[SHIFT] [MHz] [2] [2] [Hz]** **[SHIFT] [kHz] [0] [Hz]**	SHMZ22HZ SHKZ0HZ	
Turn Off Diagnostic Display	DIAGNOSTICS OFF	**[SHIFT] [M5]**[1]	SHM5	3-9
Read/Write to Internal Circuits	SELECT CHANNEL	**[SHIFT] [GHz/dB(m)]**	SHGZ	3-10
	SELECT SUBCHANNEL	**[SHIFT] [MHz/sec]**	SHMZ	
	WRITE DATA	**[SHIFT] [kHz/msec]**	SHKZ	
	READ DATA	**[SHIFT] [Hz/AUTO]**	SHHZ	

1. **[SHIFT] [M5]** will not deactivate the Front Panel Display Test. Instead, press **[INSTR PRESET]** or cycle power off, then on. **[INSTR PRESET]** will restore the instrument to its standard starting condition. Cycling the POWER switch will restore the instrument to its previous state.

Table 3-1. Index by Mode and Function (6 of 7)

Mode	Function	Keys	HP-IB Code	Reference Figure
HP-IB Functions				
Status Bytes and Service Requests	CLEAR BOTH STATUS BYTES		CS	
	OUTPUT BOTH STATUS BYTES		OS	
	MASK STATUS BYTE 1		RM	
	MASK STATUS BYTE 2		RE	
Output Operating Configuring	OUTPUT LEARN STRING		OL	
	INPUT LEARN STRING		IL	
	OUTPUT MODE STRING		OM	
Output Parameters	OUTPUT ACTIVE VALUE		OA	
	OUTPUT NEXT BANDCROSS FREQUENCY		OB	
	OUTPUT COUPLED PARAMETERS		OC	
	OUTPUT DIAGNOSTICS		OD	
	OUTPUT FAULTS		OF	
	OUTPUT FIRMWARE ID		OI	
	OUTPUT LAST LOCK FREQUENCY		OK	
	OUTPUT INTERROGATED PARAMETER		OP	
	OUTPUT POWER LEVEL		OR	
Network Analyzer Function	NETWORK ANALYZER CONFIGURE		NA	
	ADVANCE TO NEXT BANDCROSSING		BC	
	KEYBOARD RELEASE		KR	
	SWAP CHANNELS		SW	

Table 3-1. Index by Mode and Function (7 of 7)

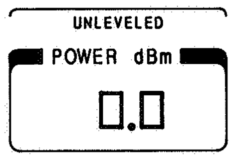
Mode	Function	Keys	HP-IB Code	Reference Figure
HP-IB Functions (Cont'd)				
Control Knob	ENABLE HP 8340B/41B KNOB		EK	
	ENABLE REMOTE KNOB		RB	
Sweep Functions	STEPPED SWEEP		SN	
	INCREMENT FREQUENCY		IF	
	RESET SWEEP		RS	
	TAKE SWEEP		TS	
	TIME LIMIT		TL	
Alternate State Selection	SELECT FOREGROUND		AS0	
	SELECT BACKGROUND		AS1	
Fast Phaselock	FAST PHASELOCK SELECT		FP	
Attenuator Control	INDEPENDENT CONTROL OF ATTENUATOR		AT	
HP-IB Test	TEST HP-IB DATA TRANSMISSION		TI	

Power dBm Display

DESCRIPTION

This display shows the actual power delivered to the RF OUTPUT port of the HP 8340B/41B, and contains the UNLEVELED warning indicator.

PANEL LAYOUT



FUNCTIONS

POWER dBm: The available output power of the HP 8340B/41B is shown in this display, rounded to the nearest 0.1 dB. Depending on the installed attenuator, the available power ranges from a minimum of −110.00 dBm to a maximum that depends on frequency, with a resolution of 0.05 dB (see Table 1-1 for the specified maximum power available for each frequency band). If the user requests a power level that the HP 8340B/41B cannot provide, the instrument will select the closest available power and show that value in the POWER dBm display (to ± 0.1 dB); in this situation the ENTRY DISPLAY, which shows user-selected power level, will not match the POWER dBm display which shows actual power.

The procedures for setting the power level are explained in Figures 3-7 (POWER LEVEL) and 3-17 (POWER SWEEP, PEAKING, and RF OFF).

This display can be blanked (turned off) by pressing **[SHIFT] [CONT].** Although the display is blank, the power functions can be changed by the same local and remote procedures that are used with an active display. Press **[SHIFT] [CONT]** to regain an active display.

INDICATORS

UNLEVELED: The red UNLEVELED annunciator indicates trouble, either from operator error or machine malfunction, with one exception.

Operator error: request for too much power. If the operator requests a power output that is too high for the HP 8340B/41B at that frequency, the UNELEVELED annunciator lights. Typically, the HP 8340B/41B can deliver more power than listed in the specifications (Table 1-1); the UNELEVELED annunciator will light when the true maximum power level has just been exceeded. To remedy an UNLEVELED condition either **[PEAK]** the instrument (for CW or manual modes, as explained in Figure 3-17), or reduce the requested power.

Figure 3-3. Power dBm Display (1 of 2)

Machine malfunction: If the UNLEVELED annunciator lights, and the cause is not a request for excessive power, one or more of the power circuits are malfunctioning. If this happens, press **[INSTR PRESET]** which will restore standard instrument conditions, then re-enter the desired instrument configuration. If the UNLEVELED annunciator remains lighted, shut down the instrument and consult the In Case of Difficulty section in this manual.

Exception: open-loop operation. The ALC can be bypassed by pressing **[SHIFT] [METER]**, as described in Figure 3-16. Under these conditions the UNLEVELED annunciator is lighted, but acts as a reminder in this case instead of a warning.

DIAGNOSTICS

Test this display (and the three other displays) by pressing and holding **[INSTR PRESET]**, which will cause the UNLEVELED annunciator to light, then release **[INSTR PRESET]** and press **[SHIFT] [FREE RUN]** which will light every segment of the LED display ("**88888**"). Press **[INSTR PRESET]** or cycle the POWER switch to cancel this diagnostic test.

NOTE: **[INSTR PRESET]** will restore the instrument to its standard starting condition. Cycling POWER switch will restore the instrument to its previous state.

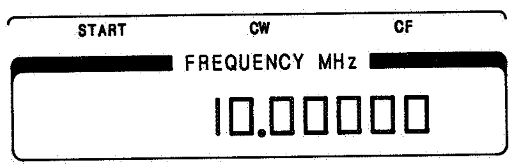
Figure 3-3. Power dBm Display (2 of 2)

START/CW/CF Frequency Display

DESCRIPTION

This display shows (in megahertz) either the start frequency, the CW frequency, or the CF (center frequency) of the HP 8340B/41B depending on its current operating mode.

PANEL LAYOUT



FUNCTIONS

One of three frequencies is shown in this display: Start, CW, or CF. Figure 3-7 explains the implementation of these three functions.

This display can be blanked (turned off) by pressing **[SHIFT] [CONT]**. Although the display is blanked, the Start, CW, or CF values can be changed by the same local or remote procedures that are used when the display is active. Press **[SHIFT] [CONT]** again to turn the display on.

INDICATORS

START, CW, and CF: These three amber annunciators indicate which function value is shown in the display.

DIAGNOSTICS

Press and hold **[INSTR PRESET]** to light the three annunciators, then release **[INSTR PRESET]** and press **[SHIFT] [FREE RUN]** which will light every LED segment ("**8888888888888**"). Press **[INSTR PRESET]** or cycle the POWER switch.

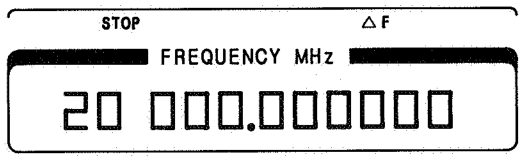
Figure 3-4. START/CW/CF Frequency Display

STOP/ΔF Frequency Display

DESCRIPTION

This display shows, in megahertz, either the Stop frequency or the ΔF frequency span of the HP 8340B/41B.

PANEL LAYOUT



FUNCTIONS

One of two frequencies is shown in this display: Stop, or ΔF. Figure 3-7 explains the implementation of these two functions.

This display can be blanked (turned off) by pressing **[SHIFT] [CONT]**. Although the display is blanked the Stop or ΔF values can be changed by the same local and remote procedures that are used when the display is active. Press **[SHIFT] [CONT]** again to turn the display on.

INDICATORS

STOP, ΔF: These two amber annunciators indicate which function value is shown in the display.

DIAGNOSTICS

Press and hold **[INSTR PRESET]** to light the two annunciators, then release **[INSTR PRESET]** and press **[SHIFT] [FREE RUN]** which will light every LED segment ("**8888888888888**"). Press **[INSTR PRESET]** or cycle the POWER switch to end this diagnostic routine. (This diagnostic also tests the three other displays.)

NOTE: **[INSTR PRESET]** will restore the instrument to its standard starting condition. Cycling the POWER switch will restore the instrument to its previous state.

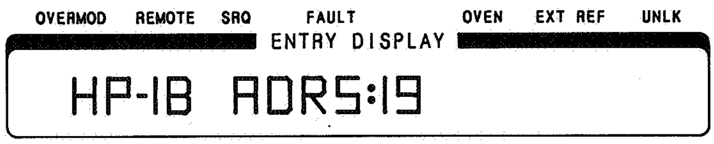
Figure 3-5. Stop/ΔF Frequency Display

Entry Display

DESCRIPTION

This display shows the active function and its present value, and contains the OVERMOD, REMOTE, SRQ, FAULT, OVEN, EXT REF, and UNLK indicators.

PANEL LAYOUT



FUNCTIONS

The most recently activated function and its present value is shown in this display. In local operation, the most recently pressed function key is the active function and will remain active until superseded by the pressing of another function key. The HP 8340B/41B will remember (for approximately three years, or until the battery on the A60 processor board is changed) the activated function even when the power is disconnected, and will display that function in the ENTRY DISPLAY when the power is turned on. The HP-IB address ("HP-IB ADRS=19") is displayed momentarily at power-on, followed by a display of the active function.

In local operation, the active function can be changed by the rotary **[KNOB]**, the **[STEP]** keys, or the numerical keypad. First, press one of the function keys to make that function active and display its present value in the ENTRY DISPLAY. Then, change the value of that function by using either the **[KNOB]**, the **[STEP]** keys, or the numerical keys (with a terminator key).

In remote operation, the ENTRY DISPLAY will show the last function programmed

ENTRY DISPLAY can be blanked (turned off) by pressing **[SHIFT] [CONT]**, which turns off all of the displays. The displays will remain blanked even when the function keys are pressed (although the annunciators will change). To regain a live display, press **[SHIFT] [CONT]** again.

INDICATORS

ENTRY DISPLAY contains two types of indicators: amber identification annunciators, and red warning annunciators.

REMOTE (amber) annunciator lights when the HP 8340B/41B is being remotely controlled by a computer. When REMOTE is lighted all front panel operations are disabled with three exceptions: The POWER switch can only be locally operated, the rotary **[KNOB]** can be enabled by using the EK programming code, and the **[LOCAL]** key will override the computer and restore local control (unless the computer sent a LOCAL LOCKOUT command to the HP 8340B/41B, which disables the **[LOCAL]** key).

Figure 3-6. Entry Display (1 of 2)

FAULT (amber) annunciator lights when one of the internal circuits performs atypically. To identify the affected circuit, press **[SHIFT] [MANUAL]** which will cause "FAULT: CAL KICK ADC PEAK TRK" to appear in the ENTRY DISPLAY. The flashing letters identify the faulty circuit as CAL (calibration constants), KICK (YO or YTM kick pulses), ADC (analog to digital converter), PEAK (power peaking), or TRK (tracking control); at this point the In Case of Difficulty section of this manual should be consulted for further instructions.

EXT REF (amber) annunciator lights when an external frequency source is used as the reference standard instead of the internal crystal oscillator. The internal/external frequency standard is selected by a rear-panel switch; see Figure 3-18 for an explanation of this switch and the associated connectors.

OVERMOD (red) annunciator lights when excessive positive or negative voltage is applied to the front panel FM MODULATION INPUT or when excessive negative voltage is applied to the front panel AM MODULATION INPUT. In the case of AM, this excessive negative voltage causes the HP 8340B/41B to attempt to exceed the maximum modulation depth. This happens at approximately −1 volt AM input. Positive excursions have no limit as long as maximum available power is not exceeded, at which point the UNLEVELED annunciator lights. AM linearity will suffer for inputs above +1 volt. As with the UNLEVELED annunciator, an OVERMOD indication may signify an internal malfunction. The OVERMOD condition can be caused by an FM input signal which significantly exceeds a Modulation Index (peak deviation in MHz/modulation in MHz) of 5.

SRQ (amber) annunciator lights when a remotely controlled HP 8340B/41B initiates a Service Request (SRQ does not apply to local operation). Several conditions can cause a Service Request, including altered parameter values, syntax error, power failure, and unleveled power. The SRQ annunciator remains lighted until the computer sends an acknowledgement signal to the HP 8340B/41B. Service Requests are more fully explained in the HP-IB Programming part of this Operation chapter, and in the In Case of Difficulty section.

OVEN (red) annunciator lights when the oven for the reference crystal oscillator is not at operating temperature. A cold oven typically requires 5-30 minutes to reach operating temperature. The STANDBY position of the POWER switch maintains power to the oven heater, thus keeping the oven warm and the crystal oscillator ready for immediate operation. Although the HP 8340B/41B can be operated with a cold crystal oscillator, the instrument might not fully comply with specifications until the proper operating temperature is achieved.

UNLK (red) annunciator lights when the HP 8340B/41B's output signal is no longer phase-locked to the 10 MHz reference oscillator. Press **[SHIFT] [EXT]**, which will cause "OSC: REF M/N HET YO N2 N1" to appear in the ENTRY DISPLAY. The flashing letters indicate which oscillator is not phase locked. Refer to the In Case of Difficulty Section.

DIAGNOSTICS

Press and hold **[INSTR PRESET]** to light the seven annunciators, then release **[INSTR PRESET]** and press **[SHIFT] [FREE RUN]** which will light every LED segment and show the entire ENTRY DISPLAY character set. Press **[INSTR PRESET]** or cycle the POWER switch to end this diagnostic routine. (This diagnostic also tests the three other displays.)

NOTE: **[INSTR PRESET]** will restore the instrument to its standard starting condition. Cycling the POWER switch will restore the instrument to its previous state.

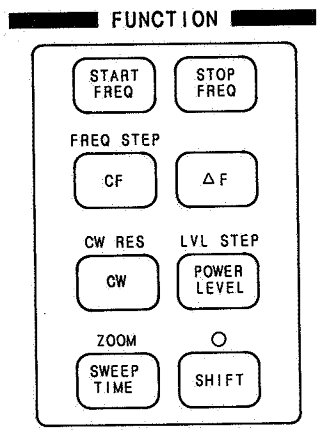
Figure 3-6. Entry Display (2 of 2)

Function Keys

DESCRIPTION

This group of keys selects frequency mode, power level, sweep time, and associated functions.

PANEL LAYOUT



FUNCTIONS

[START FREQ] (HP-IB: FA) selects the start frequency for start/stop swept operation. Press **[START FREQ]**; then use either the rotary **[KNOB]**, the **[STEP]** keys, or the numerical keys with a terminator key to set the desired value. The start frequency must be at least 100 Hz lower than the stop frequency. If there is less than 100 Hz between start/stop, or if the start frequency is greater than the stop frequency, the HP 8340B/41B will change the start or stop frequency to achieve the required separation. The order in which start/stop is entered is not important. If start/stop mode is interchanged with CF/ΔF mode (by pressing either of the start/stop keys and then either of theCF/ΔF keys) the sweep limits are the same. The start frequency appears in the left FREQUENCY MHz display.

[SHIFT] [START FREQ] (HP-IB: SHFA) scales the frequency displays by a multiplication factor of−30 to +30. This is used, for example, when a frequency doubler or tripler is connected to the RF output of the HP 8340B/41B, and the display values are multiplied by a factor of two or three to indicate the system output frequency. Press **[SHIFT] [START FREQ]**, then enter the integer multiplication factor (−30 to +30) followed by any terminator key. The selected multiplication factor effects all frequency functions (start, stop, CF, ΔF, markers and marker functions, and the dB/GHz slope function), but the factor is not stored in the SAVE/RECALL registers (the current factor is used when recalling those registers). Cancel the multiplication factor by pressing **[INSTR PRESET]**, or enter a multiplication factor of 1. **[SHIFT] [ALT]** saves the current multiplication factor as the instrument's default value. In this mode, pressing **[INSTR PRESET]** or turning power off and on will not affect the user-defined multiplication factor. This feature can be disabled by pressing **[SHIFT] [INSTR PRESET]**, which sets the default multiplication factor to 1 and presets the instrument.

Figure 3-7. Function Keys (1 of 3)

[STOP FREQ] (HP-IB: FB) selects the stop frequency for start/stop swept operation. Press **[STOP FREQ]**; then use either the rotary **[KNOB]**, the **[STEP]** keys, or the numerical keys with a terminator key to set the desired value. The restrictions that apply to **[START FREQ]** also apply to **[STOP FREQ]**. The stop frequency appears in the right FREQUENCY MHz display.

[SHIFT] [STOP FREQ] (HP-IB: SHFB) offsets the frequency displays by a fixed amount ranging from −500 GHz to +500 GHz. This is used, for example, when the RF output of the HP 8340B/41B is connected to a mixer, and for convenience the sum or difference frequency is shown in the displays. Press **[SHIFT] [STOP FREQ]**, then enter the desired offset value (−500 GHz to +500 GHz) followed by any terminator key. The offset effects all frequency values (start, stop CF, CW, and markers), but the offset cancels in difference functions such as **[ΔF]**, **[Δ MRK]** and the dB/GHz **[SLOPE]** function. The offset value is not stored in the SAVE/RECALL registers, but the current offset value does change the values of a recalled register. Cancel the offset by pressing **[INSTR PRESET]**, or by entering an offset value of 0.

[CF] (HP-IB: CF) selects the center frequency for center frequency/delta frequency swept operation. Press **[CF]**; then use either the rotary **[KNOB]**, the **[STEP]** keys, or the numerical keys with a terminator key to set the desired value. The order in which CF/ΔF are entered is not important. Start/stop and CF/ΔF modes can be interchanged without changing the actual sweep limits, as described in the **[START FREQ]** paragraph. The CF value appears in the left FREQUENCY MHz display.

[SHIFT] [CF] (HP-IB: SHCF) selects the incremental step size for the STEP keys (the FREQ STEP function). The step size can be as small as 1 Hz, or as large as 10 GHz. Press **[SHIFT] [CF]**, then use either the numerical keys with a terminator key, the rotary **[KNOB]**, or the **[STEP]** keys (which step in a 1-2-5 sequence at this time) to set the desired increment. After setting the step size, "FIXD" appears in the right corner of the ENTRY DISPLAY. An alternative procedure couples the FREQ STEP increment size to the ΔF frequency span: Press **[SHIFT] [CF] [AUTO]** (causing "AUTO" to appear in the ENTRY DISPLAY) and the increment size will become 1/10 of the frequency span. AUTO is the default condition after an **[INSTR PRESET]**. The step size established by the FREQ STEP function is the same for start/stop frequencies, CF/ΔF frequencies, the markers, and manual sweeps. The **[STEP]** keys are explained in Figure 3-8.

[ΔF] (HP-IB: DF) selects the delta frequency (frequency span) for center frequency/delta frequency swept operation. Press **[ΔF]** then use either the **[STEP]** keys, the numerical keys with a terminator key, or the rotary **[KNOB]** to set the desired value. The HP 8340B/41B will sweep from ½ ΔF below to ½ ΔF above the center frequency. The restrictions that apply to **[CF]** also apply to **[ΔF]**. The right FREQUENCY MHz displays shows the **[ΔF]** value.

[SHIFT] [ΔF] has no effect on the HP 8340B/41B.

[CW] (HP-IB: CW) selects a synthesized CW frequency. Press **[CW]**; then use either the rotary **[KNOB]**, the **[STEP]** keys, or the numerical keys with a terminator key to set the desired value. The right side of the ENTRY DISPLAY shows either "AUTO" if the **[STEP]** keys and **[KNOB]** are coupled to the ΔF frequency span, or "FIXD" if they are not coupled (see the **[SHIFT] [CF]** and **[SHIFT- [CW]** paragraphs for an explanation). The left FREQUENCY MHz display shows the CW value.

[SHIFT] [CW] (HP-IB: SHCW) sets the sensitivity of the rotary **[KNOB]** (the CW RES function) for adjusting the CW value. Press **[CW]** to enter CW mode, and set the desired CW value as described in the preceding paragraph. Then, press **[SHIFT] [CW]** and observe the flashing cursor in the ENTRY DISPLAY, which identifies the digit presently affected by the rotary **[KNOB]**. Reposition the cursor by pressing either the left-arrow or right-arrow **[STEP]** key (the arrows are printed in blue above the **[STEP]** keys). When the cursor is positioned over the desired digit, press **[CW]** to return to CW mode. After changing the CW RES, "FIXD" appears in the right corner of the ENTRY DISPLAY. However, the CW RES can be coupled to theΔF frequency span ("AUTO" in the ENTRY DISPLAY) by pressing **[SHIFT] [CW] [AUTO]**, which causes the CW RES to be 1/1000 of the frequency span, reduced to the

Figure 3-7. Function Keys (2 of 3)

next lowest integer power of ten (for example, a frequency span of 16 GHz corresponds to a CW RES of: 16GHz/1000=16 MHz; 16 MHz reduced to the next lowest integer power of ten equals 10 MHz, which is the CW RES). For frequency spans less than 1000 Hz, the AUTO CW RES is 10 Hz. AUTO is the default condition for CW RES after an **[INSTR PRESET]**.

[POWER LEVEL] (HP-IB: PL) controls the output power level of the HP 8340B/41B, when it is internally leveled. Press **[POWER LEVEL]**; then use either the rotary **[KNOB]**, the **[STEP]** keys, or the numerical keys with the **[dB(m)]** terminator key to set the desired value (resolution 0.05 dB). When externally leveled, **[POWER LEVEL]** selects the external detector feedback voltage to which the HP 8340B/41B will attempt to level, with a range of +6 dBV (2.00 V) to −66 dBV (500 μV) and a resolution of 0.1 dB. The EXT INPUT (BNC connector) accepts either positive or negative inputs. When in the **[SHIFT] [METER]** (open-loop) mode the **[POWER LEVEL]** entry controls the linear modulator, as explained in Figure 3-16. In any of these three modes, the POWER dBm display shows the output power to the nearest 0.1 dB (see Figure 3-3 for information on this display, and its UNLEVELED indicator). The output power can range from −110 dBm to a maximum value that depends on frequency (see Table 1-1 for power specifications). Figure 3-17 explains **[PEAK]**, **[PWR SWP]**, and **[SLOPE]** power functions.

[SHIFT] [POWER LEVEL] (HP-IB: SHPL) selects the incremental step size for the **[STEP]** keys when they are used for the power level functions (**[POWER LEVEL]**, **[PWR SWP]**, or **[SLOPE]**). This is the LVL STEP function. Press **[SHIFT] [POWER LEVEL]**; then use either the rotary **[KNOB]**, the **[STEP]** keys (which step in a 1-2-5 sequence in this mode), or the numerical keys with the **[dB(m)]** terminator key to set the desired step size. The step size can range from 0.05 dB to 50.00 dB. Consult Figures 3-3 and 3-17 for further information on power functions.

[SWEEP TIME] (HP-IB: ST) selects the sweep times for frequency sweeps or power sweeps (power sweep is explained in Figure 3-17). Press **[SWEEP TIME]**; then use either the **[STEP]** keys (which increment in a 1-2-5 sequence for sweep time), the rotary **[KNOB]**, or the numeric keys with the **[sec]** or **[msec]** terminator key to set the desired value. Sweep time has an allowable range of 10 msec to 200 seconds, but the fastest sweep time is constrained by the frequency span: The sweep rate cannot exceed 600 MHz/msec (300 MHz/msecfor HP 8341B Option 003) (for example, the full 26.49 GHz frequency span of the HP 8340B can be swept no faster than 26490/600=44.15 msec). The fastest possible sweep can be determined automatically: Press **[SWEEP TIME] [AUTO]** to obtain the fastest possible calibrated sweep time for any sweep span. The right-hand corner of the ENTRY DISPLAY shows "AUTO" when the sweep time is coupled to the frequency span, or "FIXD" when sweep time is independent. AUTO is the default condition after **[INSTR PRESET]**. Also see **TL** in the HP-IB section.

[SHIFT] [SWEEP TIME](HP-IB: SHST) places the HP 8340B/41B into CF/ΔF sweep mode, with ΔF controlled only by the **[STEP]** keys and CF controlled by either the rotary **[KNOB]** or the numerical keys (with a terminator key). This is the ZOOM function, which allows the operator to quickly zoom-in on a frequency band of interest even from very wide sweeps.

[SHIFT] (HP-IB: SH) activates functions that are printed in blue on the front panel, as well as special functions. All **[SHIFT]** functions are described in this Operation chapter, and are summarized on the two information cards located below the HP 8340B/41B.

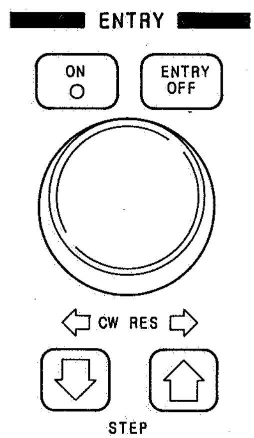
Figure 3-7. Function Keys (3 of 3)

KNOB/STEP Entry

DESCRIPTION

The rotary **[KNOB]** and **[STEP]** keys affect the function that is presently being shown in the ENTRY DISPLAY. **[ENTRY OFF]** blanks the ENTRY DISPLAY.

PANEL LAYOUT



FUNCTIONS

[ENTRY OFF] (HP-IB: EF) blanks (turns off) the ENTRY DISPLAY, and disables the **[STEP]** keys and the rotary **[KNOB]**. When any function key is pressed ENTRY DISPLAY is reactivated, the **ON** indicator next to **[ENTRY OFF]** lights, and the **[KNOB]** and **[STEP]** keys are enabled. To blank the ENTRY DISPLAY without disabling the **[KNOB]** or **[STEP]** keys press **[SHIFT] [CONT]** (as described in Figure 3-6)

[SHIFT] [ENTRY OFF] (HP-IB: SHEF) recalls the Calibration Constant Access Function. This command is used when one wishes to re-enter the calibration constant mode after just exiting it. This saves the trouble of entering the long Cal Constant key sequence again.

ROTARY KNOB (HP-IB: EK) allows analog-type adjustment of the function shown in the ENTRY DISPLAY. Press any function key to activate that function, then turn the rotary **[KNOB]** to obtain the desired value. **[SHIFT] [CW]** in figure 3-7 explains the procedure for adjusting the sensitivity of the rotary Knob. Although the **[KNOB]** has the feel of an analog control, it is actually a digital control that generates 120 pulses per revolution (the **[KNOB]** is frequently referred to as an RPG - rotary pulse generator - in service literature).

[SHIFT] ROTARY KNOB: [SHIFT] does not affect the rotary **[KNOB]**.

Figure 3-8. KNOB/STEP Entry (1 of 2)

STEP KEYS (HP-IB: UP for up-increment, DN for down-increment) change the value of any active function by an incremental step. Press any function key to activate that function, then press either the up-arrow or down-arrow **[STEP]** key to incrementally change the value of that function. Press and hold a **[STEP]** key for a repeat action. The active function is always shown in the ENTRY DISPLAY. **[SHIFT] [CF]** and **[SHIFT] [POWER LEVEL]** in Figure 3-7 explain the procedures for changing the size of the increment step (although for sweep times the increment is a fixed 1-2-5 sequence). After an **[INSTR PRESET]** the step size increments default to 1/10 of the current sweep width (changing as the width changes) for the FREQ STEP, and to 10.00 dB for the LVL STEP.

[SHIFT] STEP KEYS: **[SHIFT]** does not effect the **[STEP]** keys; however, the **[STEP]** keys are used for the shifted CW RES function. CW RES is accomplished by pressing **[SHIFT] [CW]**, then using the **[STEP]** keys to move the cursor left or right in the ENTRY DISPLAY. **[SHIFT] [CW]** in Figure 3-7 explains the CW RES function.

INDICATORS

ON is an LED that is lighted when the **[STEP]** keys and rotary **[KNOB]** are enabled, not lighted when those controls are disabled. The preceding **[ENTRY OFF]** paragraph contains additional information about this indicator.

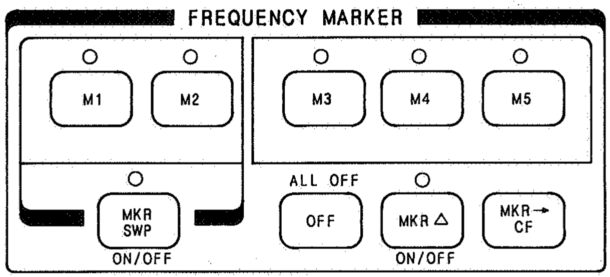
Figure 3-8. KNOB/STEP Entry (2 of 2)

Frequency Marker Keys

DESCRIPTION

This key group selects the five markers, the marker functions (MARKER SWEEP, MARKER DELTA, and MARKER TO CENTER FREQUENCY), and several diagnostic functions that are used during servicing.

PANEL LAYOUT



FUNCTIONS

[M1]...[M5](HP-IB: M1...M5) keys select markers 1-5. Press one **[M1]...[M5]** key, and the present value of that marker will appear in the ENTRY DISPLAY. Use either the rotary **[KNOB]**, the **[STEP]** keys, or the numerical keys with a terminator key to set the desired marker frequency. Repeat this process for the other markers as needed. If the initial marker frequency is outside of the current sweep range, a slight turn of the **[KNOB]** will bring the frequency of that marker to the center frequency of the sweep. markers are normally displayed as z-axis intensity dots but can be changed to amplitude "dips" (an abrupt discontinuity in the sweep trace) by pressing **[AMTD MKR]**, as explained in Figure 3-17. The markers are functional whenever their individual LEDs are lighted; however, only one marker can be "active" at a time (the "active" marker is shown in the ENTRY DISPLAY, and can be changed via **[KNOB]**, **[STEP]** keys, or numerical keys with a terminator key). Press any marker key to make that marker active. After **[INSTR PRESET]** all markers are initialized to 13.255 GHz on the HP 8340B and 9.995 GHz on the HP 8341B; otherwise, the last-used marker values will be remembered by the HP 8340B/41B (for up to three years), even with disconnected ac power.

[SHIFT] [M1] (HP-IB: SHM1) is a service diagnostic that shows (from left to right), the M divisor, N divisor, M/N frequency, and 20/30 loop frequency. Consult the In Case of Difficulty section for additional information.

[SHIFT] [M2] (HP-IB: SHM2) is a service diagnostic that shows (from left to right), the band number and the YIG oscillator (YO) frequency. Consult the In Case of Difficulty section for additional information.

[SHIFT] [M3] (HP-IB: SHM3) is a service diagnostic that shows, from left to right, the PLL #2 VCO frequency and the PLL #3 upconverter frequency. Consult the In Case of Difficulty section for additional information.

Figure 3-9. Frequency Marker Keys (1 of 2)

[SHIFT] [M4] (HP-IB: SHM4) initiates a possible 18 diagnostic tests. These tests are labeled 14 to 31. Other tests are initiated at "power on". These tests are labeled 0 to 13. The results of all of these tests are indicated in the ENTRY DISPLAY, as either a global PASS or FAIL. Each of the test results may be viewed by entering the test number via the **[STEP]** keys, **[NUMERICAL]** keys, or **[KNOB]**. The tests may also be performed over the HP-IB and results read by using the **OD** command (see the HP-IB PROGRAMMING SECTION of this Operating Information manual).

[SHIFT] [M5] (HP-IB: SHM5) turns off all diagnostic routines except the **[SHIFT] [FREE RUN]**display test.

[MKR SWEEP] (HP-IB: MP1 activates the function, MP0 turns off the function) causes the HP 8340B/41B to start sweeping at the frequency of marker **[M1]**, and stop sweeping at the frequency of marker **[M2]** (**[M2]** must have a higher frequency than **[M1]**). If **[MKR SWEEP]** is activated when **[M2]** is at a lower frequency than **[M1]**, the values of **[M1]/[M2]** will be permanently interchanged. Press **[MKR SWEEP]** again to exit from Marker Sweep and return to the previous sweep limits. The LED above the key indicates whether the function is on (lighted), or off (not lighted).

[SHIFT] [MKR SWEEP] (HP-IB: SHMP) causes the sweep limits to permanently change to the frequencies of **[M1]** and **[M2]**. Repeated pressing of **[MKR SWEEP]** alone causes the HP 8340B/41B to toggle between **[M1]/[M2]** sweeps and the previous sweep frequencies; **[SHIFT] [MKR SWEEP]** eradicates the previous sweep values, leaving only the **[M1]/[M2]** frequencies.

[OFF] (HP-IB: M0) turns off (deactivates) any single marker. Press any marker key **[M1]...[M5]**, then press **[OFF]** to deactivate that marker. If **[OFF]** is pressed without first pressing a marker key, the most recently active marker will be turned off. The frequency value of the deactivated marker is retained in memory, and will be recalled when that marker key is pressed once again. A deactivated marker will not affect the **[MKR SWEEP]**, **[MKR Δ]**, or **[MKR → CF]** functions.

[SHIFT] [OFF] (HP-IB: SHM0) turns off (deactivates) all markers, **[M1]** through **[M5]**. However, the frequency values of all markers are retained in memory, and will be recalled when the marker keys are pressed once again. Deactivating the markers will not affect the **[MKR SWEEP]**, **[MKR Δ]**, or **[MKR → CF]** functions.

[MKR Δ] (HP-IB: MD1 turns on the function, MD0 turns off the function) causes the frequency difference between any two markers to appear in the ENTRY DISPLAY. Press any two marker keys **[M1]...[M5]**, then press **[MKRΔ]** and the ENTRY DISPLAY will show the frequency difference. Press any other marker keys **[M1]...[M5]**, and the ENTRY DISPLAY will change to show the frequency difference between the two most recently passed markers. On a CRT display, the trace between the two selected markers is intensified (intensity markers only, not **[AMTD MKR]**). The LED above **[MKRΔ]** shows when the function is on (lighted), or off (not lighted).

[SHIFT] [MKRΔ]: has no effect on the HP 8340B/41B.

[MKR → CF] (HP-IB: MC) sets the center frequency of the sweep to the frequency of the active marker. Press any marker key **[M1]...[M5]**, then press **[MKR → CF]** to change the center frequency of the sweep to that of the marker. The frequency span **[ΔF]** will not change unless the new sweep limits fall outside the frequency range of the HP 8340B/41B; in that case, the HP 8340B/41B will automatically scale down the ΔF to be within the frequency range.

[SHIFT] [MKR → CF] has no effect on the HP 8340B/41B.

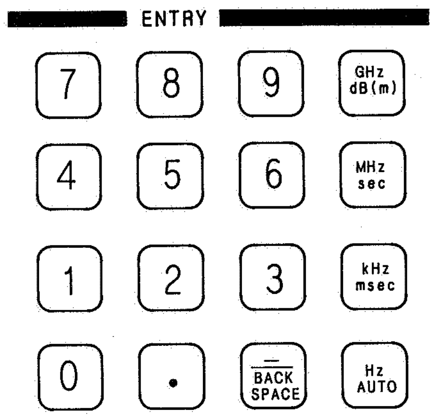
Figure 3-9. Frequency Marker Keys (2 of 2)

Entry Keys

DESCRIPTION

This is the numerical keypad, with the terminator keys, that provides data entry to the HP 8340B/41B.

PANEL LAYOUT



FUNCTIONS

[.] [0]...[9] (HP-IB: decimal numbers 0 through 9, — (minus) sign, and decimal point) are the numerical data entry keys. Press any function key, enter the desired numerical value, then press the appropriate terminator key (GHz, sec, dB(m), etc.). Table 1-1 (Specifications) lists the numerical limits for each function.

[SHIFT] (data entry key) has no effect on the HP 8340B/41B.

[— / BACK SPACE] is a minus sign (—) entry when this key is pressed at the beginning of a data entry sequence, a back space at all other times.

[SHIFT] [— / BACK SPACE] has no effect on the HP 8340B/41B.

[GHz / dB(m)] [MHz / sec] [kHz / msec] [Hz / AUTO] are the terminator keys that must be pressed after a numerical value has been entered. The HP 8340B/41B interprets the terminator key to match the selected function. For example, GHz is selected when a frequency function is active, dB(m) is selected when a power function is active. An explanation of each key follows.

> **[GHz / dB(m)]** (HP-IB: GZ, or DB) selects either gigahertz for a frequency function, decibels or dBm for a power function.
>
> **[MHz / sec]** (HP-IB: MZ, or SC) selects either megahertz for a frequency function, or seconds for a sweep time function.
>
> **[kHZ / msec]** (HP-IB: KZ, or MS) selects either kilohertz for a frequency function, or milliseconds for a sweep time function.

Figure 3-10. Entry Keys (1 of 2)

[HZ / AUTO] (HP-IB: HZ, or AU) selects hertz for a frequency function; AUTO affects **[SWEEP TIME]**, FREQ STOP, and CW RES: Press **[SWEEP TIME]** then **[AUTO]** to obtain the shortest possible sweep time for that frequency span; press **[SHIFT] [CF]** then **[AUTO]** to couple the FREQ STOP increment size to the ΔF frequency span (all of these shifted functions are explaiend in Figure 3-7). When one of the AUTO-coupled functions is active, "AUTO" or its complement "FIXD" (which indicates that AUTO is not active) appears in the ENTRY DISPLAY.

[SHIFT] (terminator key) allows direct electrical access to the internal circuits, registers, and buffers of the HP 8340B/41B. These tremendously powerful functions are comprehensively explained in the optional Component-Level Service Manual; however, a brief explanation follows:

[SHIFT] [GHz / dB(m)] (HP-IB: SHGZ) allows the I/O channel to be specified. The I/O channel, along with the I/O subchannel (explained in the following paragraph) defines the address for a circuit board or memory register that is accessible via the internal I/O bus. The channel values range from 0 to 15. Channel and subchannel addresses are listed in the optional Component-Level Service Manual. Press **[SHIFT] [GHz / dB(m)]**, then enter a numerical value between 0-15, followed by any terminator key.

[SHIFT] [MHz / sec] (HP-IB: SHMZ) allows the I/O subchannel to be specified. Press **[SHIFT] [MHz / sec.]**, then enter a numerical value followed by any terminator key.

[SHIFT] [kHz / msec] (HP-IB: SHKZ) allows a numerical value to be written to the address defined by the channel and subchannel. The appropriate numerical value is explained in the introduction of the optional Component-Level Service Manual. Press **[SHIFT] [kHz / msec]**, enter a numerical value, followed by any terminator key.

[SHIFT] [Hz / AUTO] (HP-IB: SHHZ) allows a numerical value to be read from the address defined by the channel and subchannel. Press **[SHIFT] [Hz / AUTO]**, and the numerical data will appear in the ENTRY DISPLAY. The introduction of the optional Component-Level Service Manual describes the interpretation of this data.

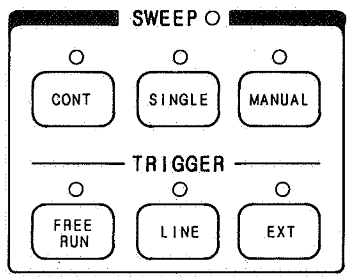
Figure 3-10. Entry Keys (2 of 2)

Sweep and Trigger Keys

DESCRIPTION

Continuous, single, or manual sweeps and internal, external or power line triggering are controlled by these keys. Additionally, display blanking, penlift, and three diagnostic functions are enabled by adding the SHIFT prefix to these keys.

PANEL LAYOUT



FUNCTIONS

[CONT] (HP-IB: S1) allows continuous sweep-retrace-sweep-retrace cycling of the HP 8340B/41B. The sweep is initiated by one of the TRIGGER functions, as explained later in this Figure, while the sweep speed is controlled by the **[SWEEP TIME]** function as explained in Figure 3-7.

[SHIFT] [CONT] (HP-IB: SHS11 disables displays, SHS10 re-enables displays) blanks (turns off) all diplays on the HP 8340B/41B. Although the displays are blanked, the functions that are normally shown in the displays can still be changed in the usual manner, and the changed values will be shown when the displays are reactivated. The displays are reactivated in one of two ways: Press **[SHIFT] [CONT]** again to restore the displays.

[SINGLE] (HP-IB: S2) allows single sweeps of the HP 8340B/41B. Press **[SINGLE]** to start the sweep, which will sweep at a rate determined by the **[SWEEP TIME]** function (explained in Figure 3-7). If **[SINGLE]** is pressed in the middle of a single sweep, the sweep will abruptly stop and the HP 8340B/41B will retrace back to the starting point.

[SHIFT] [SINGLE] has no effect on the HP 8340B/41B.

[MANUAL] (HP-IB: S3) allows manual sweeps. Press **[MANUAL]**, then use the rotary **[KNOB]** to manually sweep between the start/stop limits. In manual mode the HP 8340B/41B will not automatically retrace at the sweep end point (the operator must retrace), and the green LED by the SWEEP label will not light. The resolution of the **[KNOB]** is 0.1% of the sweep span in either start/stop or CF/ΔF mode. Frequencies in manual sweep are synthesized just as they are in CW mode.

Figure 3-11. Sweep and Trigger Keys (1 of 3)

There are two significant differences between **[MANUAL]** sweep and the sweep that can be obtained by having the **[KNOB]** control an active CW function:

1. The sweep output voltage ramp (see Figures 3-13 or 3-18, SWEEP OUTPUT) is 0-10 volts in both modes, but in CW mode 0 volts always corresponds to 10 MHz and 10 volts always corresponds to 26.5 GHz (7.55V at 20 GHz with HP 8341B), while in manual sweep mode 0 volts corresponds to the start frequency and 10 volts corresponds to the stop frequency. In both cases the sweep voltage at intermediate frequencies is a linear interpolation of the frequency span (i.e., a frequency half-way between the start/stop limits has a corresponding sweep voltage of 5 volts).
2. The bandcrossing points in CW mode always occur at precisely 2.3, 7.0, 13.5, and, in the case of the HP 8340B, 20.0 GHz. In manual sweep mode the bandcrossing points have 200 MHz of flexibility, which is automatically used by the HP 8340B/41B for optimum performance (for example, a 2.35 to 7.05 sweep could be accomplished without any band changes in manual sweep mode).

[SHIFT] [MANUAL] (HP-IB: SHS3) activates the FAULT diagnostic routine. When the amber FAULT annunciator appears in the ENTRY DISPLAY, press **[SHIFT] [MANUAL]** to initiate the FAULT diagnostic which will cause "FAULT: CAL KICK ADC PEAK TRK" to appear in the ENTRY DISPLAY. The flashing cursor indicates which circuit (**CAL**ibration constants, **KICK** pulses, **A**nalog to **D**igital **C**onverter, power **PEAK**ing, or **TR**ac**K**ing) is causing the problem. Refer to the In Case of Difficulty section.

[FREE RUN] (HP-IB: T1) allows internal triggering of the any sweep function, and is the fastest possible way to accomplish the sweep-retrace cycle.

[SHIFT] [FREE RUN] (HP-IB: SHT1) activates the display self-test diagnostic function. Press **[SHIFT] [FREE RUN]**, which will cause every segment of every LED in the displays to light, followed by a marching pattern of every character in the display lexicon. Press **[INSTR PRESET]** or cycle the POWER switch to cancel this diagnostic routine. **[INSTR PRESET]** will restore the instrument to its standard starting condition. Cycling the POWER switch will restore the displays to their previous condition. If this marching display ever appears spontaneously, especially at power-on, the main processor circuit has failed and Section VIII (Service) should be consulted for further instructions.

Figure 3-11. Sweep and Trigger Keys (2 of 3)

[LINE] (HP-IB: T2) triggers the sweep functions in synchronization with the ac power line frequency, which is typically 50 or 60 Hz.

[SHIFT] [LINE] (HP-IB: SHT21 enables penlift, SHT20 disables penlift) generates a penlift signal at each band crossing. When an HP 8340B/41B sweep crosses frequency bands, the RF is momentarily turned off at each band crossing which can cause a negative spike on X-Y recorders. To prevent the negative spike, **[SHIFT] [LINE]** activates a rear-panel PENLIFT OUTPUT connector that causes the X-Y recorder's pen to lift at each band crossing. The PENLIFT function works only when the sweep time is >5 seconds. See Figure 3-18 for information on the rear-panel connector, and the X-Y Recorder Operating Guide (at the end of Section III) for specific information on X-Y recorder interconnections.

[EXT] (HP-IB: T3) externally triggers the sweep function. Figure 3-18 explains the rear-panel EXT TRIGGER INPUT connector and the trigger signal requirements.

[SHIFT] [EXT] (HP-IB: SHT3) activates the oscillator function. When the red UNLK annunciator appears in the ENTRY DISPLAY, press **[SHIFT] [EXT]**, which will cause "OSC: REF M/N HET YO N2 N1" to appear in the ENTRY DISPLAY. The flashing cursor indicates which oscillator circuit is not phase locked, with the remedy found in the appropriate part of Section VIII (Service). Press **[SHIFT] [M5]** to cancel this diagnostic function and to return the displays to their previous condition.

INDICATORS

SWEEP green LED lights when the HP 8340B/41B is performing an analog sweep. The LED is off during all of the following: retrace, band crossings (band crossings occur at 2.3 GHz, 7.0 GHz, 13.5 GHz, and, in the case of the HP 8340A, 20.0 GHz), during the phase locking that occurs at the start frequency of each new sweep and each new band, and during manual seeps (since manual sweeps are synthesized).

RF ON DWELL is a time delay from when the instrument turns on its RF output to when the start of sweep occurs. In CW mode, this delay determines how long the instrument will wait (after RF power is activated) before allowing another change in CW frequency. This delay is set at the factor to 400us. If the HP 8340B/41B is used with test equipment that requires a longer delay, perform the following command:

Locally: **[SHIFT] [MHz] [1] [7] [Hz]**

[SHIFT] [kHz] [#] [Hz]

Where # is an integer value from 5 to 128 (500us to 12.8ms). To determine what value to enter for a given delay:

Value = Desired Delay (in microseconds)/100

or

Delay = 100us per count (in the value entry)

Via HP-IB: "**SHMZ17HZ SHKZ#HZ**"

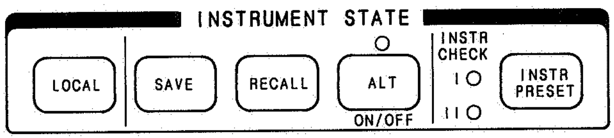
Figure 3-11. Sweep and Trigger Keys (3 of 3)

Instrument State Keys

DESCRIPTION

Instrument check and preset, HP-IB address assignment, storage and recall of operating configurations, alternating operation, and restoration of local control are the functions of this key group.

PANEL LAYOUT



FUNCTIONS

[LOCAL] (HP-IB: LOCAL command). The front panel keys (except **[LOCAL]** and the POWER switch) are inoperative when the HP 8340B/41B is being remotely controlled by a computer. Press **[LOCAL]** to cancel computer control and to reactivate the front panel keys. **[LOCAL]** does not work if the computer executed a LOCAL LOCKOUT command, as explained in the HP-IB section of this chapter.

[SHIFT] [LOCAL] (no HP-IB: code) causes the HP-IB address to appear in the ENTRY DISPLAY. The factory-set address is 19; however, any unique address between 00-30 can be assigned to the HP 8340B/41B by pressing **[SHIFT] [LOCAL]**, entering the address numbers, and pressing any terminator key (GHz, MHz, kHz, Hz). This new address remains in effect until again changed by the operator. The calibration constants (described in Section VIII) can be configured to disable the **[SHIFT] [LOCAL]** function, thus locking the HP 8340B/41B to the address specified in the calibration constants.

[SAVE] (HP-IB: SVn, n=1-9) allows up to 9 different front panel settings to be stored in memory registers 1 through 9. Instrument settings can then be recalled via the **[RECALL]** n (n = 0 through 9, where 0 is the last-used front panel setting) function, or a memory setting can be alternated with the current front panel setting with the **[ALT]** n (n = 1-9) function. Set the front panel controls to any desired configuration, then press **[SAVE]** which will cause "SAVE REGISTER: ?" to appear in the ENTRY DISPLAY. Press any digit 1-9 to select the storage register, and the setting will be saved in that register. The information stored in the memory registers is retained in memory indefinitely when ac line power is constantly available, or for approximately three years without line power.

[SHIFT] [SAVE] (HP-IB: SHSV) is a save-lock that prevents any new front panel settings from being saved. **[SHIFT] [RECALL]** removes the save lock.

[RECALL] (HP-IB: RCn, n=0-9) retrieves a front panel setting that was previously SAVEd in storage registers 1-9 (**[RECALL] [0]** retrieves the last-entered front panel setting). Press **[RECALL]**, which will cause "RECALL REGISTER: ?" to appear in the ENTRY DISPLAY. Then press any digit 0-9, or use the **[STEP]** keys, to select the desired memory register. (The rear panel "8410 CONNECTOR" has a pin that duplicates the step-recall function, as explained in Figure 3-21 and the HP 8340A/HP 8410 Operating Guide).

[SHIFT] [RECALL] (HP-IB: SHRC) cancels the save-lock function, which is described in the previous paragraph.

Figure 3-12. Instrument State Keys (1 of 3)

[ALT] (HP-IB: AL1n, n = 1-9 turns on the function. AL0 turns off the function) causes the instrument state to alternate on successive sweeps between the current front panel setting and the setting stored in memory location 1-9. Press **[ALT]**, which will cause "ALT WITH REGISTER: ?" (? is the last used memory register) to appear in the ENTRY DISPLAY, then press a digit 1-9 to select the desired memory register. Although the HP 8340B/41B is in the alternate mode, the panel displays will only show the current front panel state. The power level of the two alternated functions must have the same attenuator setting,or the attenuator must be decoupled from the ALC (automatic leveling control circuit) which will allow up to 40 dB of power level difference. This restriction is necessary to prevent rapid cycling, and subsequent wear, on the mechanical attentuator. See **[PWR SWP]** in Figure 3-17 for an explanation of the attenuator and ALC relationship. Press **[ALT]** again to cancel the alternate function.

[SHIFT] [ALT] saves the current frequency display multiplication factor as the instrument's default value. In this mode, pressing **[INSTR PRESET]** or turning power off and on will not affect the user-defined frequency display multiplication factor. Refer to the **[SHIFT] [START FREQ]** command in Figure 3-7 for more information. This feature can be disabled by pressing **[SHIFT] [INSTR PRESET]**, which sets the default muliplication factor to 1 and presets the instrument.

[INSTR PRESET] (HP-IB: IP) causes an internal self-test of the HP 8340B/41B, and initializes the instrument to a standard starting configuration:

1. Start sweep at 10 MHz, stop sweep at 26.5 GHz (20 GHz with HP 8341B).
2. Power level set to 0.0 dBm; however, this level can be reset by changing the calibration constants (as described in Section VIII).
3. Sweep time to AUTO (44.15 msec) (33.32 msec on HP 8341B).
4. CONT sweep, FREE RUN trigger.
5. All markers set to 13.255 GHz on the HP 8340B and 9.995 GHz on the HP 8341B (center frequency of the sweep).
6. The checksum of the calibration data is calculated, and if an error is detected then the calibration data in protected memory is used. If the checksum of the protected data is not correct then default values are used, and the FAULT annunciator lights in the ENTRY DISPLAY to indicate a calibration constant error (press **[SHIFT] [MANUAL]** when the FAULT annunciator lights, as described in Figure 3-11).
7. All function values stored in memory registers 1-9 remain in their previous states.
8. A self test is performed, and check LEDs are lighted.

Press **[INSTR PRESET]** at any time to test the instrument and restore the standard starting condition. If either of the two red LEDs that are adjacent to **[INSTR PRESET]** (labeled "INSTR CHECK I/II") remain lighted after a preset, the HP 8340B/41B failed the self-test; refer to Section VIII (Service) for further instructions.

[SHIFT] [INSTR PRESET]: disables the **[SHIFT] [ALT]** function. This command sets the default frequency display multiplication factor to 1 and presets the instrument.

Figure 3-12. Instrument State Keys (2 of 3)

SECURITY MEMORY ERASE is typically used to purge all instrument memory locations and registers after the HP 8340B/41B has been used in highly sensitive or classified applications. This feature completely erases RAM memory, filling RAM locations with zeros and then with ones. It then sets all variables and SAVE/RECALL reigsters to instrument preset values, and downloads protected (ERROM based) Cal Constants into erased RAM (into the Working Cal Constant memory area). The instrument begins operation in the instrument preset mode.

NOTE: Calibration Constants contain no frequency-specific information.

Activating the Security Memory Erase Feature

Locally: Press **[SHIFT] [MHz] [1] [8] [Hz] [SHIFT] [kHz] [0] [Hz]**

Via HP-IB: **SHMZ18HZ SHKZ0HZ"**

INDICATORS

INSTR CHECK I/II red LEDs light if the HP 8340B/41B fails the internal self-test that occurs when **[INSTR PRESET]** is pressed. If this happens, refer to Section VIII (Service) for further instructions.

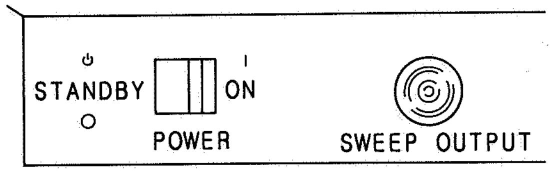
Figure 3-12. Instrument State Keys (3 of 3)

Power Switch, Sweep Output

DESCRIPTION

The POWER switch and the SWEEP OUTPUT front-panel BNC connector are described in this Figure.

PANEL LAYOUT



FUNCTIONS

POWER SWITCH selects either ON, or STANDBY. Once the ac power line has been plugged in, power is always being applied to all or part of the HP 8340B/41B. In STANDBY, power is applied to the crystal oscillator's oven to maintain operating temperature and to the RAM circuits to maintain memory data; in the ON position, power is applied to the entire instrument. When the HP 8340B/41B is connected to ac power for the first time, or after a prolonged period without power, the crystal oscillator's oven requires approximately 30 minutes to reach operating temperature (the red OVEN annunciator in the ENTRY DISPLAY will be lighted during this warm-up period). Power must always be available to the HP 8340B/41B to keep the oven warm; therefore, when the instrument is not in use set the POWER switch to STANDBY, and do not interrupt the ac power.

When the POWER switch is changed from STANDBY to ON, the HP 8340B/41B will automatically initiate an internal circuit check, then momentarily show the HP-IB address in the ENTRY DISPLAY, followed by setting the instrument functions to the last-entered values. If this sequence does not happen, press **[INSTR PRESET]** to initiate an instrument check, as described in Figure 3-12. If a warning annunciator lights at power-on, refer to the display Figures 3-3, 3-4, 3-5, and 3-6 for further instructions.

SWEEP OUTPUT is provided by a front panel BNC connector (and an identical rear panel BNC connector). The output voltage range for this connector is 0 to +10 volts dc. When the HP 8340B/41B is sweeping, the **SWEEP OUTPUT** is 0 Vdc at the beginning of the sweep and +10 Vdc at the end of the sweep, regardless of sweep width. In CW mode, the **SWEEP OUTPUT** ranges from 0 Vdc at the 10 MHz minimum frequency of the HP 8340B/41B, to 10 Vdc at the 26.5 GHz (7.55V at 20 GHz with HP 8341B) maximum frequency, with a proportional voltage for frequencies between 10 MHz-26.5 GHZ (20 GHz with HP 8341B). Pressing **[CW]** then **[MANUAL]** locks the CW frequency but allows a full-range voltage output from the SWEEP OUTPUT, which is controlled by the rotary **[KNOB]** (useful, for example, when scaling an X-Y recorder). The output impedance at this **SWEEP OUTPUT** connector is nominally 1 KΩ.

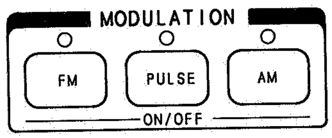
Figure 3-13. Power Switch, Sweep Output

Modulation Keys

DESCRIPTION

These three keys select frequency modulation, pulse modulation, or amplitude modulation of the RF output. These keys are used in conjunction with the front panel FM, PULSE, and AM BNC connectors (shown in Figure 3-15). Table 1-1 lists instrument specifications for the three types of modulation.

PANEL LAYOUT



FUNCTIONS

[PULSE] (HP-IB: PM1 turns on pulse modulation. PM0 turns off the function) activates the pulse modulation function. When pulse modulation is in effect, the RF output of the HP 8340B/41B is turned on (full power selected) and off (>80 dB attenuation) at a rate determined by the pulse modulation input (described in Figure 3-15). Pulse and amplitude modulation can be in effect simultaneously (amplitude modulation is described in a following paragraph). Press **[PULSE]** a second time to turn off the function.

[SHIFT] [PULSE] (HP-IB: SHPM) turns on pulse modulation, allowing proper operation with HP 8755C, 8756A, and 8757A scalar network analyzer. The scalar analyzers' 27.8 Khz square wave modulation output is connected to the HP 8340B/41B **PULSE** input. When the SHIFT PULSE mode is activated, the RF output of the HP 8340B/41B is modulated by the 27.8 kHz square wave. This capability is present on all HP 8340B/41B's regardless of option configuration. Pressing **[PULSE]** (HP-IB: PM0) will turn off this function. This mode may be used for other purposes, providing 2 µsec rise and fall times for pulse widths wider than about 7us.

[AM] (HP-IB: AM1 turns on amplitude modulation, AM0 turns off the function) activates the amplitude modulation function. Amplitude modulation allows the pre-attentuated RF output of the HP 8340B/41B to be continuously and linearly varied between −30 dBm and the maximum power available, at a rate determined by the **AM** input (described in Figure 3-15). Amplitude and pulse modulation can be in effect simultaneously. Press **[AM]** a second time to turn off the function.

[FM] (HP-IB: FM1 turns on frequency modulation, FM0 turns off modulation) activates the frequency modulation function. Frequency deviation is dependent on the magnitude of the input signal. Pressing **[FM]** a second time turns off the function. FM sensitivity is either 1 MHz/volt or 10 MHz/volt and is selected by following the FM1 "on" sequence with either **[1] [MHz]** or **[1] [0] [Mhz]** respecitvely.

[SHIFT] [FM] has no effect on the HP 8340B/41B.

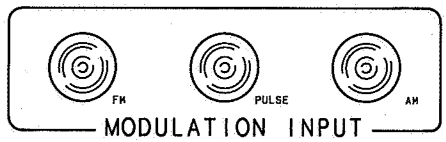
Figure 3-14. Modulation Keys

Modulation Inputs

DESCRIPTION

The external FM, pulse or amplitude modulation signals are applied to the HP 8340B/41B at these three connectors.

PANEL LAYOUT



FUNCTIONS

PULSE MODULATION INPUT is TTL compatible; a TTL high input (>+2 volts) causes maximum selected RF power output, while a TTL low input causes minimum RF output (>80 dB RF on/off ratio). The pulse repetition frequency is dc to 20 MHz in non-leveled applications, 100 Hz to 5MHz when internally leveled. The specifications given in Section I detail the electrical requirements of the **PULSE** modulation input, and explain the subsequent effects on the RF output. The damage levels for this input are ≥+12 volts or ≤−20 volts. This input is also used for the **[SHIFT] [PULSE]** operation.

AM MODULATION INPUT accepts a −1 volt to +1 volt signal, at a frequency of dc to 100 Khz (3 dB bandwidth). With an **AM** input of 0 volts, the RF output level (the reference level) is unaffected; at −1 volts input the RF is shut off, and at +1 volts input the RF output is 100% (6 dB) higher than the reference level (hence there must be ≥6 dB of headroom between the reference power level and the maximum power level available at that frequency). The on (0 volt input) to off (−1 volt input) ratio is a function of power level and frequency, but is always greater than 20 dB. The amplitude of the RF output changes linearly as the **AM** input changes from −1 to +1 volts. The specifications given in Section I list all electrical requirements of the **AM** input, and explain the subsequent effects on the RF output. Damage level for this input is ≥+12 volts or ≤−12 volts.

FM MODULATION INPUT accepts a −8 volt to +8 volt signal when on the 1 MHz/Volt sensitivity, or a −1 volt to +1 volt signal when on the 10 MHz/Volt sensitivity. Any signal greater than these limits will cause distortion. The deviation changes linearly as the FM input changes from 0 to its upper or lower voltage limit. The rate is determined by the frequency of the FM input signal. Table 1-1 lists relevant specifications. Damage level for this input is ≥9 volts or ≤−9 volts.

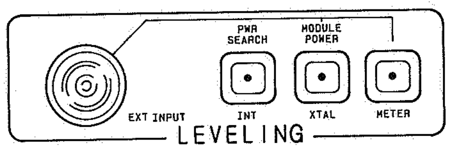
Figure 3-15. Modulation Inputs

Leveling Keys/Input

DESCRIPTION

Internal or external (crystal or power meter) power leveling is selected by these keys, which also select a band crossing diagnostic and allow direct linear modulator access. The external leveling BNC input connector is also described in this Figure.

PANEL LAYOUT



FUNCTIONS

EXT INPUT BNC connector is the input port for an external leveling signal. The signal requirements are listed in the specification tables in Section I. See the Operating Guide "Externally Leveling the HP 8340B/41B Synthesized Sweeper," located at the end of Section III, for detailed information about external leveling procedures.

[INT] (HP-IB: A1) selects internal leveling of the HP 8340B/41B. The specifications tables in Section I list the maximum leveled power for each frequency band, and other power function restraints.

[SHIFT] [INT] (HP-IB: SHA1) bypasses the ALC (automatic leveling control) and allows the user to select a power level to be set in the unleveled mode. The benefit of this function is that an unleveled output power level can be set via HP-IB while allowing; the synthesized sweeper to be pulse modulated with no limit to the minimum pulse reptition frequency, and complete use of the 100 kHz AM bandwidth while simultaneously pulse modulating. Press **[SHIFT] [INT]**, "POWER SEARCH: XXX dBm" will appear in the entry display. The previous internally leveled power will be set automatically. To enter a different power use **[KNOB]**, **[STEP]** keys or numeric keypad terminate with the **[dBm]** key.

[XTAL] (HP-IB: A2) activates external crystal leveling of the HP 8340B/41B. A portion of the RF output (derived from a coupler or a splitter) must be detected, with the detected output being delivered to the **EXT INPUT** BNC connector, thus forming an output-input feedback loop (the loop typically has 80 kHz bandwith). Press **[XTAL]**, and "ATN: −xx dB, REF: −xx.xx dBV" (where x is the last-entered value) will appear in the entry display. Then use the rotary **[KNOB]** or the numerical keys with the **[dB(m)]** terminator key to change the REFerence level, and the **[STEP]** keys to change the ATN while watching either the POWER dBm display (allowing for losses in the coupler or splitter) or an attached power meter. The "Externally Leveling the HP 8340B/41B Synthesized Sweeper" operating guide located at the end of this section fully explains crystal leveling and shows typical equipment interconnections.

[SHIFT] [XTAL] (HP-IB: SHA2) activates the external source module leveling mode. A portion of the mm-wave signal from the HP 83550 series mm-wave Source Module is detected and delivered to the EXT INPUT BNC connector, thus forming an output-input feedback loop. Press **[SHIFT] [XTAL]** and "EXT MODULE POWER: xx.xx dBm" will appear in the entry display. Enter the desired externally leveled module power using either the **[KNOB]**, **[STEP]** keys, or numeric keypad. Terminate with the **[dBm]** key.

Figure 3-16. Leveling Keys/Input (1 of 2)

[METER] (HP-IB: A3) selects external power meter leveling of the HP 8340B/41B. A portion of the RF output must be measured by a power meter, with the power meter also connected to the **EXT INPUT** BNC connector to form an output-input feedback loop (typical bandwidth 0.7 Hz). Press **[METER]**, which will cause (after a brief delay) "ATN: −xx dB, REF: −xx.xx dBV" (where x is the last-entered value) to appear in the ENTRY DISPLAY. Use the rotary **[KNOB]** or the numerical keys with the **[dB(m)]** terminator key to set the REFerence level, and the **[STEP]** keys to set the ATN while watching either the POWER dBm display (allowing for coupler or splitter losses) or the power meter. The "Externally Leveling the HP 8340B/41B Synthesized Sweeper" Operating Guide located at the end of this section fully explains power meter leveling.

[SHIFT] [METER] (HP-IB: SHA3) bypasses the ALC (automatic leveling control) to allow direct control of the linear modulator circuit. This is useful when very narrow pulses are being generated in pulse modulation mode. In this mode there is no limit on the minimum pulse repitition frequency. Press **[SHIFT] [METER]**, and "ATN −xx dB, mod; x.x dB" (where x is the last-entered value) will appear in the ENTRY DISPLAY. To set the power, place the HP 8340B/41B in CW mode, or in pulse modulation mode with pulses wider than 2µsec. Then use the **[STEP]** keys to set the ATN (attenuator), and the rotary **[KNOB]** or numerical keys with **[dB(m)]** terminator key to set the MOD (linear modulator), as follows: Set MOD entry at 0 dB, increment ATN until the POWER dBm display shows a level 5 dB to 15 dB higher than the desired output power, then reduce the power to the desired level by changing the MOD value. The POWER dBm display shows actual power when the HP 8340B/41B is in CW or wide-pulse pulse modulation modes; this actual power changes very little as the pulse width is narrowed, even though the POWER dBm reading drops. Therefore, at this point reduce the pulse width to the desired value and ignore the POWER dBm display. The ATN and MOD values in the ENTRY DISPLAY also have a limitation: Although the ATN displayed value is always accurate, the MOD becomes saturated in the top 10 dB (approximately) of its range at which point no change occurs in the true power, furthermore, the modulation entry is only approximately calibrated. Consequently, rely on the POWER dBm display for the true power level instead of the MOD value. See Figures 3-14 and 3-15 for additional pulse modulation information **[SHIFT] [METER]** can also be used as a diagnostic function for the ALC circuits, as described in Section VIII (Service).

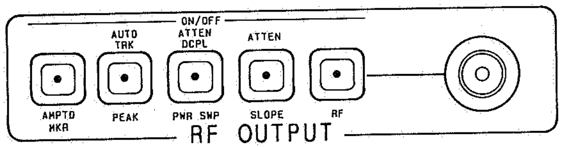
Figure 3-16. Leveling Keys/Input (2 of 2)

RF Keys/Output

DESCRIPTION

All RF power functions, except for power level, are controlled by these keys; and the RF output port is contained in this group.

PANEL LAYOUT



FUNCTIONS

[AMTD MKR] (HP-IB: AK1 turns on amplitude markers, AK0 turns off amplitude markers) on a CRT display. When the markers are activated after an **[INSTR PRESET]**, markers **[M1]...[M5]** appear as intensified dots on a CRT display; press **[AMTD MKR]** to change all of the markers to amplitude spikes. Press **[AMTD MKR]** again to return to intensified-dot markers.

[SHIFT] [AMTD MRK] (HP-IB: SHAK) causes an instantaneous execution of the peaking function, when the HP 8340B/41B is in CW or manual mode. This is one-time implementation of peaking, where the function is quickly turned on then turned off. Peaking is explained in the next paragraph.

[PEAK] (HP-IB: RP1 turns on peaking, RP0 turns off peaking) aligns the output filter (SYTM) so that its passband is centered on the RF output, in CW or manual-sweep mode. Peaking is used to obtain the maximum available power and spectral purity, and best pulse envelopes, at a given frequency. Press **[PEAK]**, and the HP 8340B/41B will automatically peak the present CW frequency, and continue to peak new frequencies as they are entered by the **[KNOB]**, or the **[STEP]** keys, or the numerical keys (with a terminator key). If **[PEAK]** is on for an extended time, the peaking function will automatically re-peak every 7 minutes. Press **[PEAK]** again to cancel this function. When **[PEAK]** is activated, the HP 8340B/41B performs a coarse alignment, and then a fine alignment that begins at the final setting of the coarse search; **[SHIFT] [AMTD MKR]** initiates only a fine alignment which begins at the present instrument setting, **[SHIFT] [AMTD MKR]** is faster, but has less adjustment range than **[PEAK]**. **[SHIFT] [PEAK]**, described in the next paragraph, is a related function.

[SHIFT] [PEAK] (HP-IB: SHRP] is a more extensive version of peaking **[PEAK]** (which requires a fraction of a second to implement), aligns the output filter with a single CW frequency, while **[SHIFT] [PEAK]** aligns all of the YTM tracking calibration constants and requires 5-10 seconds to implement. Use **[SHIFT] [PEAK]** to enhance the power output and spectral purity of swept modes, and to improve tracking performance (especially in harsh environments having wide temperature variations). Press **[SHIFT] [PEAK]**, which will cause "AUTO TRACKING" to appear in the ENTRY DISPLAY. "AUTO TRACKING" will disappear after 5-10 seconds when the calibration has been completed.

Figure 3-17. RF Keys/Output (1 of 3)

[PWR SWEEP] (HP-IB: PS1 turns on power sweep, PS0 turns off the function) allows the power output to be swept when the HP 8340B/41B is in CW mode. This is the procedure:

1. Select a CW frequency, as explained in Figure 3-7.
2. Press **[SHIFT] [PWR SWEEP]**, which decouples the attentuator (ATN) from the automatic leveling control (ALC) and displays the ATN and ALC values in the ENTRY DISPLAY. The ALC range is −20 dBm to an upper value that depends on frequency (see the specifications given in Section I).
3. Use the **[STEP]** keys to set the value of the ATN, and the **[KNOB]** or numerical keys with **[dB(m)]** terminator key to set the ALC for the starting power level, as shown in the POWER dBm display. The ALC value should be as close as possible to −20 dBm to achieve the widest-span power sweep.
4. Set the **[SWEEP TIME]**, as explained in Figure 3-7.
5. Press **[PWR SWEEP]** and "POWER SWEEP: x.xx db/SWP" (where x is the last-entered value) will appear in the ENTRY DISPLAY. Use either the **[KNOB]**, the **[STEP]** keys, or the numerical keys with the **[dB(m)]** terminator key to select the span of the power sweep (positive values only, ranging from 0.0 to 40.00 dB/SWP).
6. Select SWEEP and TRIGGER, as described in Figure 3-11.

If only narrow-span power sweeps are necessary, the ATN does not need to be decoupled from the ALC: Omit steps 2 and 3 in the preceding text using instead the **[POWER LEVEL]** key to set the initial power output. This simplified procedure restricts the range of power sweeps to that of the coupled ALC, which is −9.95 dBm to the maximum power permitted (maximum power depends on frequency, as listed in the Specification Tables.

[SHIFT] [PWR SWEEP] (HP-IB: SHPS) decouples the attenuator (ATN) from the automatic leveling control (ALC), as explained in the preceding function. Recouple the ATN and ALC by pressing **[POWER LEVEL]**.

[SLOPE] (HP-IB: SL1 turns on the slope function, SL0 turns off the function) compensates for system or cable losses at high frequencies by linearly increasing the power output as the frequency increases. Press **[SLOPE]** and "RF SLOPE: xx.xx dB/GHz" (where x is the last-entered value) will appear in the ENTRY DISPLAY. Use either the **[KNOB]**, the **[STEP]** keys, or the numerical keys with the **[dB(m)]** terminator keys to set any positive slope value between 0.000 to 1.500 dB/GHz. Press **[SLOPE]** again to cancel this function. **[SLOPE]** functions in dB/GHz units, but SL (the equivalent HP-IB code) functions in the fundamental units of dB/Hz. Therefore, the SL code should be programmed as SLmdt, where m is 0 (off) or 1 (on), d is the numerical value in dB/Hz, and t is either "DB" or the ASCII LF terminator. For example, to obtain a slope of 1.5 dB/GHz use this procedure:

1. 1.5 dB/GHz = 1.5 dB/1,000,000,000 Hz
2. 1.5 dB/1E9 Hz = 1.5E−9 dB/Hz
3. Programming code is then "SL11.5E−9 DB".

[SHIFT] [SLOPE] (HP-IB: SHSL) allows front panel control of the mechanical attenuator (ATN). Press **[SHIFT] [SLOPE]** and "ATN: x dB" (where x is the last-entered value) will appear in the ENTRY DISPLAY. Use the **[STEP]** keys, or the numerical keys with any terminator key to change the attenuator value within the range 0 dB to−90 dB in 10 dB steps. Keyboard entries are automatically rounded to the nearest 10 dB. The clicking sound heard after each attenuator change is the attenuator pad being mechanically switched into the RF output path.

Figure 3-17. RF Keys/Output (2 of 3)

[RF] (HP-IB: RF1 turns on RF output RF0 turns off RF output) turns the RF output on or off. Press **[RF]**, which will cause "-OFF-" to appear in the POWER dBm display and will cause the output power to be turned off (output <−100 dBm). Press **[RF]** again to turn on the RF output, restoring the last-entered power output.

[SHIFT] [RF] has the same effect on the HP 8340B/41B as **[SHIFT] [INT]**.

RF OUTPUT CONNECTOR. The HP 8340B is equipped with a precision 3.5 male connector. The HP 8341B uses a standard Type-N female connector. The output impedance, SWR, and other electrical characteristics are listed in the specification tables in Section I. When making connections, carefully align the center conductor elements, then rotate the knurled barrel while the mating component remains still. Tighten until a firm contact is obtained.

CARE OF APC AND PRECISION 3.5 CONNECTORS (HP 8340B only). Considerable care must be used when working with APC-3.5 connectors: Do not deform the connector by excessive tightening force, and do not allow the connector to get corroded, scratched, or dirty. If cleaning is necessary, use a firm, lintless brush only; do not use any cleaning solvents, since solvents can chemically damage the plastic bead that supports the center conductor. If this connector is mechanically degraded in any way, high frequency losses will occur.

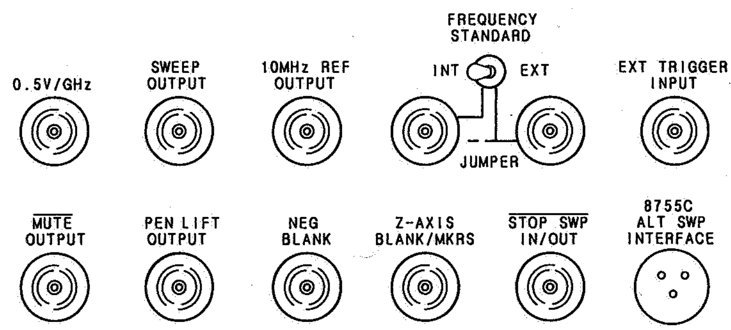
Figure 3-17. RF Keys/Output (3 of 3)

Rear Panel BNC Connectors

DESCRIPTION

The electrical characteristics and requirements of the rear panel BNC connectors are listed in this Figure.

PANEL LAYOUT



FUNCTIONS

0.5V/GHz outputs a voltage that is proportional to the RF output frequency, with a ratio of 0.5 volt output per 1 GHz RF frequency. Load impedance should be ≥4 kΩ. Accuracy is 0.5 V/GHz±1%±2 mV. An output voltage ratio of 1 volts/GHz, to a maximum of 19V, can be achieved by adding two jumpers on the A28 SYTM board (see Section VIII).

SWEEP OUTPUT is provided by a rear panel BNC connector, and an identical front panel BNC connector. The output voltage range for this connector is 0 to + 10 volts dc. When the HP 8340B/41B is sweeping, the **SWEEP OUTPUT** is 0 Vdc at the beginning of the sweep and +10 Vdc at the end of the sweep regardless of sweep width. In CW mode, the **SWEEP OUTPUT** ranges from 0 Vdc at the 10 MHz minimum frequency of the HP 8340B/41B, to 10 Vdc at the 26.5 GHz maximum frequency (20 GHz with HP 8341B), with a proportional voltage for frequencies between 10 MHz - 26.5 GHz (20 GHz with HP 8341B). Pressing **[CW]** then **[MANUAL]** locks the CW frequency but allows a full-range voltage output from the SWEEP OUTPUT, controlled by the rotary **[KNOB]** (useful, for example, when scaling an X-Y recorder). The output impedance at this **SWEEP OUTPUT** connector is nominally 1 kΩ. Figure 3-13 also describes SWEEP OUTPUT.

10 MHz REF OUTPUT provides a 0 dBm, 10 MHz signal derived from the internal frequency standard of the HP 8340B/41B. Test instruments are connected to this 50 Ω BNC connector while the 10 MHz crystal oscillator is being adjusted (as described in Section V, Adjustments, of this Manual), or this can be the master clock reference output for a network of instruments.

Figure 3-18. Rear Panel BNC Connectors (1 of 2)

INT/EXT SWITCH & BNC CONNECTORS select either the internal (INT) 10 MHz crystal oscillator frequency standard, or an external (EXT) frequency standard to be used as the master timebase for the HP 8340B/41B. To select the internal standard, place the switch in the **INT** position and connect a jumper cable between the **INT** and **EXT** BNC connectors (the **INT** BNC is now outputting 10 MHz at +3 dBm). To use an external standard, disconnect the jumper, change the switch to **EXT**, and connect the external source to the **EXT** BNC connector. The external source must be either 5 MHz ±50 Hz or 10 MHz ±100 Hz, and provide 0 to +10 dBm into the 50Ω BNC connector. When the switch is in the **EXT** position the amber **EXT REF** annunciator lights in the ENTRY DISPLAY.

EXT TRIGGER INPUT triggers the start of a sweep. Trigger signal must be >2 volts (10 V maximum), and wider than 0.5 µsec. Nominal input impedance is 2 KΩ. Figure 3-11 describes the front panel procedures that are involved in sweep operations.

MUTE OUTPUT causes the servo motor of an X-Y recorder to pause while the HP 8340B/41B crosses a frequency band switchpoint. The X-Y recorder Operating Guide, located at the end of Section III, explains the interaction of recorders with the HP 8340B/41B.

PENLIFT OUTPUT. For operation with X-Y recorders. PENLIFT disables an X-Y recorder's ability to lower its pen during sweep retrace. If **[SHIFT] [LINE]** is pressed on the front panel, PENLIFT will also disable the pen during forward sweep band switchpoints. Because of X-Y recorder limitations PENLIFT will always disable the X-Y recorder's pen at sweep times under 5 seconds.

PENLIFT enables pen operation by providing a current path to ground for the X-Y recorder's pen solenoid. The voltage at the PENLIFT output in this state will be approximately 0 Vdc. Circuit impedance in this state is approximately .5 Ohms.

PENLIFT disables pen operation by not providing a current path to ground for the X-Y recorder's pen solenoid. The voltage on the PENLIFT output will be equal to the X-Y recorder's pen solenoid supply voltage. Circuit impedance in this state is very high.

NEG BLANKING provides a negative rectangular pulse (approximately −5 volts into 2 KΩ) during retrace and band switchpoints when the HP 8340B/41B is sweeping.

Z-AXIS BLANK/MKRS supplies a positive rectangular pulse (approximately +5 volts into 2 KΩ) during the retrace and switchpoints when the HP 8340B/41B is sweeping. This output also supplies a −5 volt pulse when the RF output is coincident with a marker frequency (intensity markers only, as explained in Figure 3-9).

STOP SWP IN/OUT abruptly stops a sweep when this input is grounded. Retrace does not occur, and the sweep will resume when this input is ungrounded. The open circuit voltage at this connector is TTL High, and is internally pulled low when the HP 8340B/41B stops its sweep. Externally forcing this input High will neither cause damage nor disrupt normal HP 8340B/41B operation.

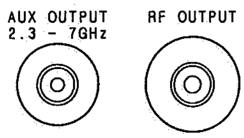
Figure 3-18. Rear Panel BNC Connectors (2 of 2)

Rear Panel RF Outputs

DESCRIPTION

The two rear panel RF Output connectors (one standard, one an option) are described in this Figure.

PANEL LAYOUT



FUNCTIONS

AUX OUTPUT 2.3-7 GHz is a type N female connector that provides a 0 dBm Output from the HP 8340B/41B's fundamental YIG oscillator (the higher frequencies obtainable from the HP 8340B/41B are multiples of this oscillator). Impedance of this connector is 50 Ω (nominal).

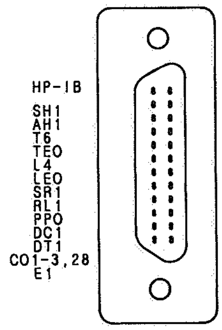
RF OUTPUT is an optional rear panel RF output connector that is functionally equivalent to the standard front panel RF output connector (which is described in Figure 3-17). Option 004 is a rear panel RF output with attenuator, and Option 005 (HP 8340B only) is a rear panel RF output without attenuator. The specifications for each option are listed in Section I of this Manual. Contact the nearest HP Sales and Service office for information about retrofitting an HP 8340B/41B with one of these options.

Figure 3-19. Rear Panel RF Outputs

HP-IB Connector

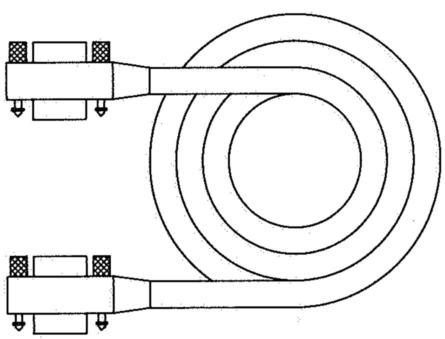
DESCRIPTION

The procedures for connecting the HP 8340B/41B to other HP-IB instruments is explained in this Figure.



The HP-IB interface connector allows the HP 8340B/41B to be connected to any other instrument or device on the HP-IB bus. A complete illustration of pin configuration and signals on the HP-IB interface connector is given in Section II of this Manual.

All HP-IB instruments are interconnected with special HP-IB cables and adapters. These special cables, shown in the accompanying illustration, assure that the proper voltage levels and timing relations are maintained on the HP-IB bus. The adapters are principally extension devices for instruments that have recessed or crowded HP-IB connectors.



HP-IB Interface Cables Available

HP-IB Cable Part Numbers	Lengths
HP 10833A	1 m (3.3 ft.)
HP 10833B	2 m (6.6 ft.)
HP 10833C	4 m (13.2 ft.)
HP 10833D	0.5 m (1.6 ft.)

As many as 14 HP-IB instruments can be connected to the HP 8340B/41B (15 total instruments in the system). The cables can be interconnected in a "star" pattern (one central instrument, with HP-IB cables emanating from that instrument like spokes in a wheel), or in a linear pattern (like boxcars in a train), or in any combination pattern. However, there are certain restrictions:

- Each instrument must have a unique HP-IB address ranging from 0-30 (decimal). Figure 3-12 (**[SHIFT] [LOCAL]**) explains HP-IB addressing for the HP 8340B/41B.

Figure 3-20. HP-IB Connector (1 of 2)

- In a two-instrument system that uses just one HP-IB cable, the cable length must not exceed 4 metres (13 feet).
- When more than two instruments are connected on the bus, the cable length to each instrument must not exceed 2 metres (6.5 feet) per unit.
- The total cable length between all units cannot exceed 20 metres (65 feet).

Hewlett-Packard manufactures HP-IB extender instruments (Models 37201A, 37203A/L) that overcome the range limitations imposed by the cabling rules. These extenders allow twin-pair cable operation up to 1000 metres (3,280 feet), and telephone modem operation over any distance. HP Sales and Service offices can provide additional information on HP-IB extenders.

The codes next to the HP-IB connector describe the HP-IB electrical capabilities of the HP 8340B/41B, using IEEE Std 488-1978 mnemonics (HP-IB, GP-IB, IEEE-488, and IEC-625 are all electrically equivalent). Briefly, the mnemonics translate as follows:

SH1: Source Handshake, complete capability.

AH1: Acceptor Handshake, complete capability.

T6: Talker; capable of basic talker, serial poll, and unaddress if MLA.

TEO: Talker, Extended address; no capability.

L4: Listener, capable of basic listener, and unaddress if MTA.

LEO: Listener, Extended address: no capability.

SR1: Service Request, complete capability.

RL1: Remote Local, complete capability.

PPO: Parallel Poll, no capability.

DC1: Device Clear, complete capability.

DT1: Device Trigger, complete capability.

CO, 1, 2, 3, 28: Controller capability options; CO, no capabilities; C1 system controller, C2, send IFC and take charge; C3, send REN; C28, send I.F. messages.

E1: Electrical specification indicating open collector outputs.

These codes are completely in the **IEEE Std 488-1978** document, published by The Institute of Electrical and Electronic Engineers, Inc., 345 East 47th Street, New York, New York 11017.

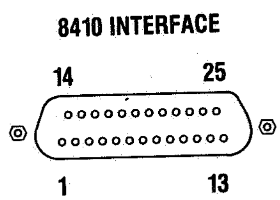
Figure 3-20. HP-IB Connector (2 of 2)

HP 8410B/C Interface/Cable

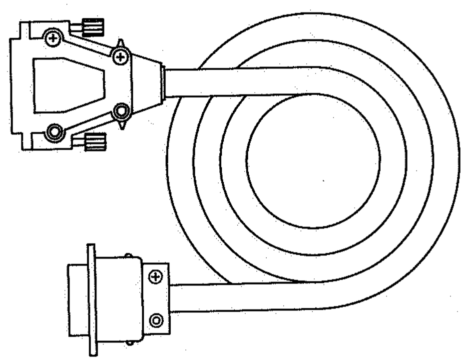
DESCRIPTION

This connector interfaces the HP 8340B/41B to the HP 8410B/C Network Analyzer.

Rear Panel Connector



Interface Cable



Connect the HP 8410B/C Network Analyzer to this port on the HP 8340B/41B, using a Source Control Cable (HP Part Number 08410-60146). An Operating Guide at the end of this Section explains HP 8410B/C to HP 8340B/41B interconnections.

This connector has pins that duplicate several rear panel functions, including EXT TRIGGER INPUT, MUTE OUTPUT, PENLIFT OUTPUT, NEG BLANK, and Z-AXIS BLANK/MKRS. There is also a pin unit input for a switch closure to execute the UP key function, which is used to step through a series of saved instrument states. Additional information is contained in the HP 8410B/C Operating and Service Manual.

Figure 3-21. HP 8410B/C Interface/Cable (1 of 2)

HP 8410C INTERFACE CONNECTOR J18						
J18 Pin	Mnemonic	Levels	Input/Output	Signal Source/ Destination	A62J31 Pin	J18W46 Wire Color Code
1						
2	Z-AXIS BLAND	+5V, −5V*	OUTPUT	A57P1-99	2, 16	2
3						
4	LALTSEL	TTL (LOW TRUE)	OUTPUT	A57P1-59	10,24	0
5	LSSP (LSTOP SWEEP)	TTL (LOW TRUE)	I/O	A57P1-107	5, 19	5
6	+5.2V			A52P1-17, 18, 41, 42	3	3
7						
8						
9	$\overline{\text{MUTE}}$	TTL (LOW TRUE)	INPUT	A57P1-61	8, 22	4
10	EXT TRIG	EXT SOURCE INPUT LEVEL	INPUT	A57P1-106	4, 18	6
11	PEN LIFT	SEE TEXT	OUTPUT	A57P1-108	6, 20	8
12						
13						
14	NEG BLANK	0V, −5V*	OUTPUT	A57P1-41	1, 15	1
15						
16	LRETRACE	TTL (LOW TRUE)	OUTPUT	A57P1-58	11, 25	9 - 0
17	LALTEN	TTL (LOW TRUE)	OUTPUT	A57P1-60	9, 23	9
18						
19	GND			STOP SWEEP BNC GND LUG		9 - 0 - 7
20						
21						
22	LSTEPUP	TTL (LOW TRUE)	INPUT	A62J1-28	14	9 - 0 - 8
23						
24	8410 TRIG	TTL (LOW TRUE)	OUTPUT	A57P1-62	7	7
25						

*See text

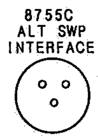
Figure 3-21. HP 8410 Interface (2 of 2)

HP 8755C Interface/Cable

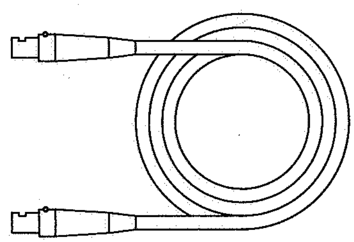
DESCRIPTION

The HP 8755C Scalar Network Analyzer is connected to the HP 8340B/41B at this connector.

Rear Panel Connector



Interface Cable



Connect the HP 8755C Scalar Network Analyzer to the HP 8340B/41B at this connector, using Interface Cable 8120-3174, to provide the alternate sweep function. An Operating Guide at the end of Section III explains the HP 8755C to HP 8340B/41B interconnections.

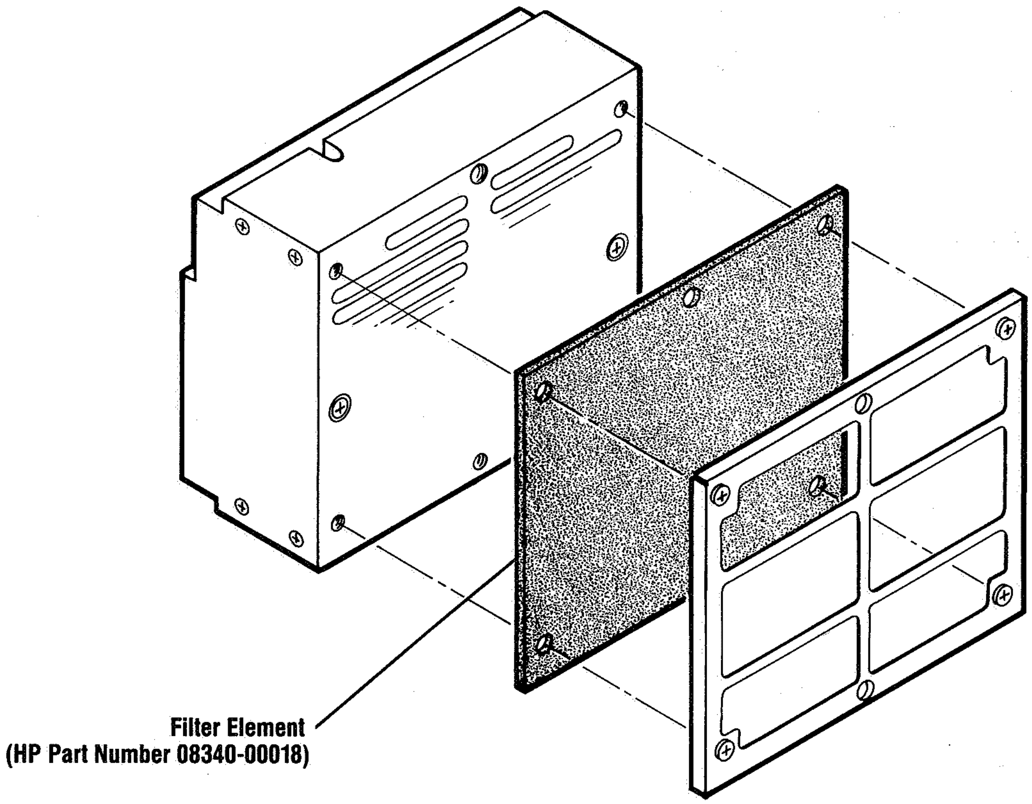
The pin configuration and electrical requirements for this connector are described in Section VIII (Service) of this Manual.

Figure 3-22. HP 8755C Interface/Cable

Fan Assembly

DESCRIPTION

Maintenance of the filter element for the fan is described in this Figure.



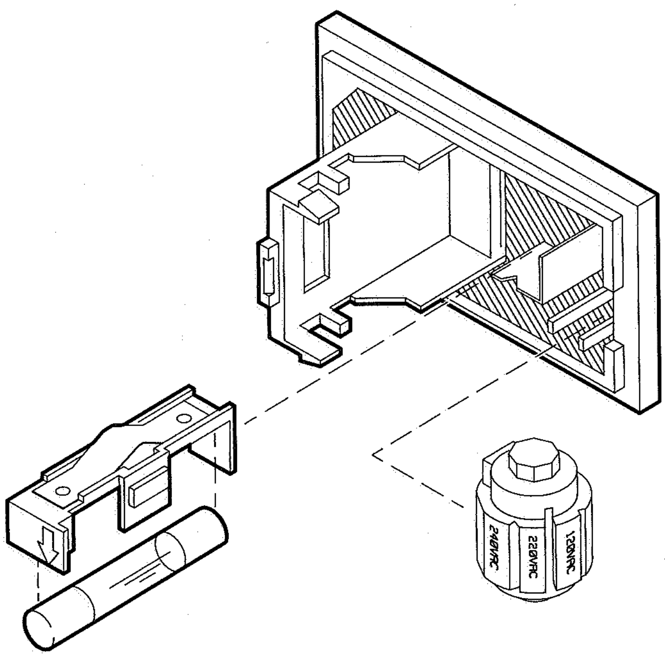
The foam filter element requires regular inspection and cleaning. The cooling fan for the HP 8340B/41B is powerful, and pulls a large amount of air through its filter element; subsequently, the filter element collects dust, smoke, and other contaminants even from environments that seem quite clean. To prevent impaired cooling from a dirt-clogged filter, it is imperative that the filter be inspected regularly, and replaced as needed. (Filter replacement is recommended; cleaning by vacuuming or washing and drying, is recommended only if a replacement filter is not available.) Section VI (Replaceable Parts) contains a complete parts listing for the fan, in the B1 Fan Assembly pictorial.

Figure 3-23. Fan Assembly

Power Line Module

DESCRIPTION

The line power module contains a safety fuse, and a removable cam that is used as a switch to match the HP 8340B/41B's power supply to the locally available ac power.



CAUTION:

Do not attempt to rotate the voltage selector cam while it is installed in the line module or non-repairable damage will result. The cam must be completely removed from the line module, rotated to the proper position, and reinstalled. Refer to the instructions below.

Replacement of fuse

1. Pry open line module cover door.
2. Pull out fuse carrier.
3. Insert fuse of proper rating.
4. Place carrier back into line module

Selection of Operating Voltage

1. Pry open line module cover door.
2. **REMOVE CAM FROM THE LINE MODULE.**
3. Rotate the cam to the desired voltage. (When the line module cover is closed, the selected voltage will be visible through a small window.)
4. Insert the cam back into the line module.
5. Close the line module cover door.

The HP 8340B/41B requires a maximum of 500 VA of electrical power (40 VA in STANDBY) that is delivered to the instrument through the line power module. The module setting must match the locally available voltage, and be fused to provide a measure of safety to the instrument and the operator.

To determine the module's voltage setting, first measure the locally available ac power source. The HP 8340B/41B requires either 100, 120, 200, or 240 volts with a tolerance of ±10%. The HP 8340B/41B also requires an ac frequency of 47.5 Hz to 66 Hz. Some installations may need an autotransformer and/or frequency converters to meet the voltage and frequency requirements. After obtaining suitable voltage and ac frequency, position the selector cam as shown in the accompanying illustration.

The proper fuse rating also corresponds to the voltage selection, and these ratings are printed on the rear panel of the HP 8340B/41B adjacent to the line power module (the fuses are also listed in Section II (Installation) of this Manual).

Appropriate power line cords are listed in Section II (Installation).

Figure 3-24. Power Line Module

HP-IB Programming

INTRODUCTION

HP-IB, the Hewlett-Packard Interface Bus, is the instrument-to-instrument communication system between the HP 8340B/41B and up to 14 other instruments. Any instrument having HP-IB capability can be interfaced to the HP 8340B/41B, including non-HP instruments that have "GPIB," "IEEE-488," "ANSI MC1.1," or "IEC-625" capability (these are common generic terms for HP-IB; all are electrically equivalent although IEC-625 uses a unique connector). This portion of the manual specifically describes interfacing the HP 8340B/41B to one very special type of instrument: a computer.

INTERCONNECTIVE CABLING

Figure 3-20 shows the HP 8340B/41B rear-panel HP-IB connector and suitable cables, and describes the procedures and limitations for interconnecting instruments. Cable length restrictions, also described in Figure 3-20, must be observed to prevent transmission line propogation delays that might disrupt HP-IB timing cycles.

INSTRUMENT ADDRESSES

Each instrument in an HP-IB network must have a unique address, ranging in value from 00-30 (decimal). The default address for the HP 8340B/41B is 19, but this can be changed by the **[SHIFT] [LOCAL]** function as described in Figure 3-12 (the examples in this section use 19 as the address for the HP 8340B/41B). Other instruments use a variety of procedures for setting the address, as described in their operating manuals, but typically either a rear panel switch or a front panel code is used.

HP-IB INSTRUMENTS NOMENCLATURE

HP-IB instruments are categorized as "listeners," "talkers," or "controllers," depending on their current function in the network.

Listener

A listener is a device that is capable of receiving data or commands from other instruments. Any number of instruments in the HP-IB network can simultaneously be listeners.

Talker

A talker is a device that is capable of transmitting data or commands to other instruments. To avoid confusion, an HP-IB system allows only one device at a time to be an active talker.

Controller

A controller is an instrument, typically a computer, that is capable of managing the various HP-IB activities. Only one device at a time can be an active controller.

PROGRAMMING THE HP 8340B/41B

The HP 8340B/41B can be entirely controlled by a computer (although the line POWER switch must be operated manually). All functions that are initiated by front panel keystrokes (local operation) can also be initiated by an HP-IB computer additionally, several functions are possible only by computer (remote) control. Computer programming procedures for the HP 8340B/41B involve selecting an HP-IB command statement, then adding the specific HP 8340B/41B programming codes to that statement to achieve the desired operating conditions. The programming codes can be categorized into two groups: Those that mimic front panel keystrokes, and the unique codes that have no front panel equivalent.

In the programming explanations that follow, specific examples are included that are written in a generic dialect of the BASIC language. BASIC was selected because the majority of HP-IB computers have BASIC language capability; however, other languages can also be used. Hewlett-Packard publishes a series of Programming Notes that contain computer-specific, language-specific information for those wishing to use another language; contact the nearest HP Sales and Service Office (listed inside of the back cover) for a list of HP 8340B/41B Programming Notes.

HP-IB COMMAND STATEMENTS

Command statements form the nucleus of HP-IB programming; they are understood by all instruments in the network and, when combined with instrument-specific codes, they provide all management and data communications instructions for the system.

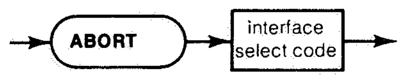
An explanation of the fundamental command statements follows. However, some computers use a slightly different terminology, or support an extended or enhanced version of these commands. Consider the following explanations as a starting point, but for detailed information consult the BASIC language reference manual, the I/O programming guide, and the HP-IB manual for the particular computer being used.

Syntax drawings accompany each statement: All items enclosed by a circle or oval are computer-specific terms that must be enterd exactly as described; items enclosed in a rectangular box are names of parameters used in the statement; and the arrows indicate a path that generates a valid combination of statement elements.

Here are the eight fundamental command statements:

Abort

Abort abruptly terminates all listener/talker activity on the interface bus, and prepares all instruments to receive a new command from the controller. Typically, this is an initialization command used to place the bus in a known starting condition. The syntax is



where the interface select code is the computer's HP-IB I/O port, which is typically port 7. Some BASIC examples:

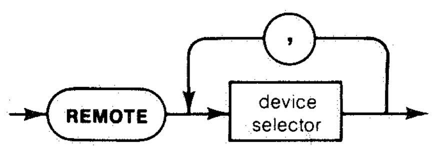
```
10  ABORT 7
100 IF V>20 THEN ABORT 7
```

Related statements used by some computers:

ABORTIO (used by HP-80 series computers)
HALT
RESET

Remote

Remote causes an instrument to change from local control to remote control. In remote control, the front panel keys are disabled (except for the **[LOCAL]** key and the POWER switch), and the amber REMOTE annunciator is lighted in the ENTRY DISPLAY. The syntax is



where the device selector is the address of the instrument appended to the HP-IB port number. Typically, the HP-IB port number is 7, and the default address for the HP 8340B/41B is 19, so the device selector is 719. Some BASIC examples:

```
10  REMOTE 7
```

which prepares all HP-IB instruments for remote operation (although nothing appears to happen to the instruments until they are addresed to talk), or

```
10  REMOTE 719
```

which effects the HP-IB instrument located at addres 19, or

```
10  REMOTE 719, 721, 726, 715
```

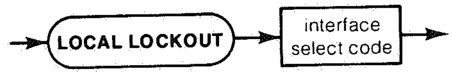
which effects four instruments that have addresses 19, 21, 26, and 15.

Related statements used by some computers:

RESUME

Local Lockout

Local Lockout can be used in conjunction with REMOTE to disable the front panel **[LOCAL]** key. With the **[LOCAL]** key disabled, only the controller (or a hard reset by the POWER switch) can restore local control. The syntax is

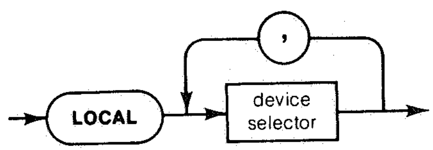


A BASIC example:

```
10  REMOTE 719
20  LOCAL LOCKOUT 7
```

Local

Local is the complement to REMOTE, causing an instrument to return to local control with a fully enabled front panel. LOCAL syntax is



Some BASIC examples:

```
10  LOCAL 7
```

which effects all instruments in the network, or

```
10  LOCAL 719
```

for an addressed instrument (address 19).

Related statements used by some computers:

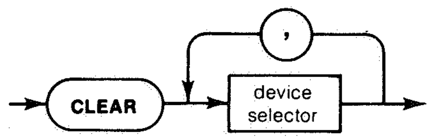
RESUME

Clear

Clear causes all HP-IB instruments, or addressed instruments, to assume a "cleared" condition, with the definition of "cleared" being unique for each device. For the HP 8340B/41B:

1. Both status bytes are reset to zero.
2. All pending output-parameter operations, such as those associated with **OA, OP,** and **OR** codes, are halted.
3. The parser (the software that interprets the programming codes) is reset, and now expects to receive the first character of a programming code.

The syntax is



Some BASIC examples:

```
10  CLEAR 7
```

to clear all HP-IB instruments, or

```
10  CLEAR 719
```

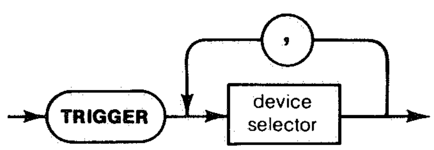
to clear an addressed instrument.

Related statements used by some computers:

RESET
CONTROL
SEND

Trigger

Trigger initiates a single event, such as a single sweep or an instantaneous measurement, from all instruments or an individually addressed instrument. If the HP 8340B/41B is in analog-sweep mode TRIGGER starts the sweep; if in CW, manual sweep, or fast phaselock (code FP) mode TRIGGER increments the frequency. When the upper frequency limit is reached (either the stop frequency for swept modes, or maximum instrument operating frequency for CW mode) the next TRIGGER command will initiate a retrace to the starting frequency. The syntax is



A BASIC example:

```
10   TRIGGER 7
```

to simultaneously trigger all HP-IB instruments, or

```
100  TRIGGER 719
```

to trigger an instrument at address 19, or

```
100  TRIGGER 719, 721, 712
```

to trigger instruments at addresses 19, 21, and 12.

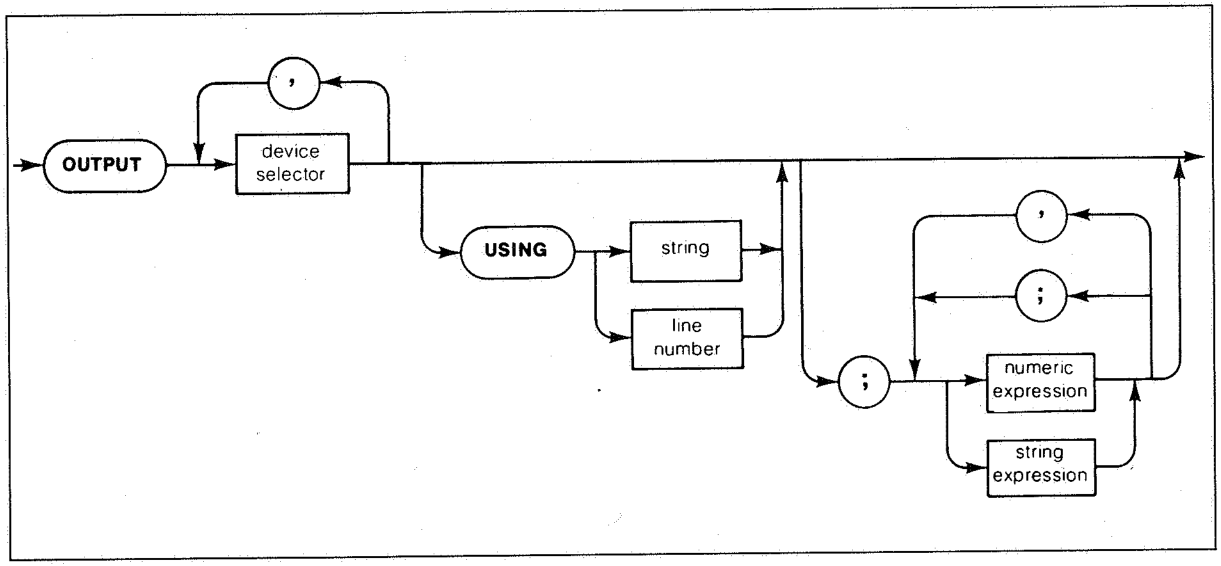
Related statements used by some computers:

RESUME
SEND

The preceding statements are primarily management commands that do not incorporate instrument-specific programming codes. The following two statements do incorporate programming codes, and are used for data communication.

Output

Output is used to send function commands and data commands from the controller to the addressed instrument. The syntax is



where USING is a secondary command that formats the output in a particular way, such as binary or ASCII representation of numbers. The USING command is followed by "image items" that precisely define the format of the output; these image items can be a string of code characters, or a reference to a statement line in the computer program. Image items are explained in the programming codes where they are needed. Notice that this syntax is virtually identical with the syntax for the ENTER statement that follows. A BASIC example:

```
100  OUTPUT 719, "programming codes"
```

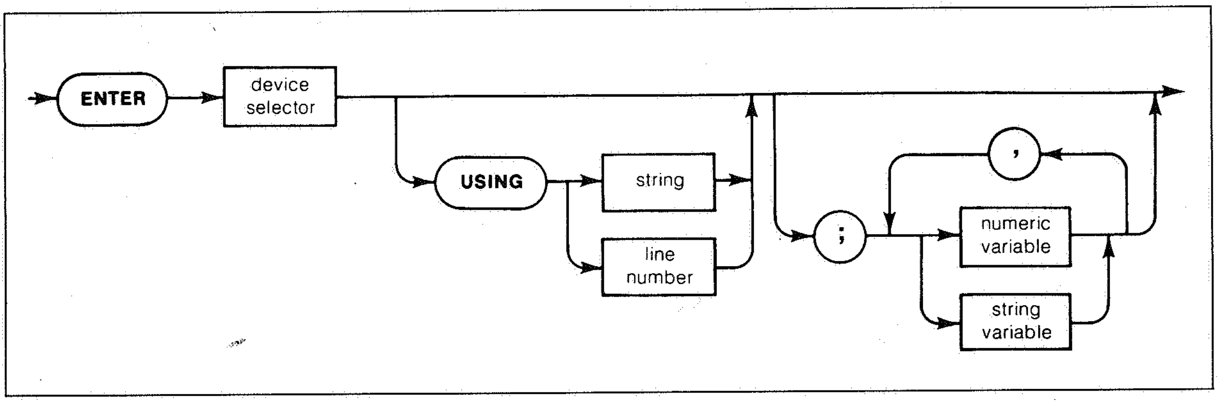
The many programming codes for the HP 8340B/41B are listed in Tables 3-1 and 3-2, and are explained in the Programming Codes subsection.

Related statements used by some computers:

CONTROL
CONVERT
IMAGE
IOBUFFER
TRANSFER

Enter

Enter is the complement to OUTPUT, and is used to transfer data from the addressed instrument to the controller. The syntax is



ENTER is always used in conjunction with OUTPUT, such as:

```
100  OUTPUT 719; "...programming codes..."
110  ENTER 719; "...complementary codes..."
```

ENTER statements are commonly formatted, which requires the secondary command USING and the appropriate image items. The most-used image items involve end-of-line (EOL) suppression, binary inputs, and literal inputs. For example,

```
100  ENTER 719 USING "#, B" A, B, C
```

suppresses the EOL sequence (#), and indicates that variables A, B, and C are to be filled with binary (B) data. As another example,

```
100  ENTER 719 USING "#, 123A"; A$
```

suppresses EOL, and indicates that string variable A$ is to be filled with 123 bytes of literal data (123A). (Note: Be careful when using byte-counting image specifiers, because if the requested number of bytes does not match the actual number available data might be lost, or the program might enter an endless wait state.)

The suppression of the EOL sequence is frequently necessary to prevent a premature termination of the data input. When not specified, the typical EOL termination occurs when an ASCII LF (line feed) is received. However, the LF bit pattern could coincidentally occur randomly in a long string of binary data, where it might cause a false termination. Also, the bit patterns for the ASCII CR (carriage return), comma, or semicolon might cause a false termination. Suppression of the EOL causes the computer to accept all bit patterns as data, not commands, and relies on the HP-IB EOI (end or identify) line for correct end-of-data termination.

The various programming codes that are associated with the ENTER statement are listed in Tables 3-1 and 3-2, and are explained in the Programming Codes subsection.

Related statements used by some computers:

CONVERT
IMAGE
IOBUFFER
ON TIMEOUT
SET TIMEOUT
TRANSFER

This completes the HP-IB Command Statements subsection. The following material explains the HP 8340B/41B programming codes, and shows how they are used with the OUTPUT and ENTER HP-IB command statements.

HP 8340B/41B PROGRAMMING CODES

Table 3-1 lists the HP 8340B/41B programming codes arranged by function, and Table 3-2 lists the codes alphabetically. Notice in the Tables that several codes correspond to keys on the front panel of the HP 8340B/41B. All front panel operations (except the POWER switch) can be duplicated by a remote computer program, and those are the programming codes that are used to replace the keystrokes. There are also several programming codes listed in the Tables that are unique to HP-IB operation. The next two subsections describe all of these codes, first by explaining how front panel operations can be duplicated, and then explaining the unique, HP-IB operations.

Programs that Duplicate Front Panel Operations

Any HP 8340B/41B operation that can be established by pressing keys on the front panel can be duplicated by a computer program, with the exception of the POWER switch function. This is the procedure:

1. Determine the keystroke sequence needed for the desired operation. For example, this sequence establishes a 2.3 GHz CW signal at −30 dBm:

   [INSTR PRESET] [CW] [2] [.] [3] [GHz] [POWER LEVEL] ["] [3] [dB(m)]

2. Use the Information Cards (located beneath the front panel), or Tables 3-1 and 3-2, to find the programming code for each key. Continuing with the example,

Key	Programming Code
[INSTR PRESET]	IP
[CW]	CW
[2]	2
[.]	.
[3]	3
[GHz]	GZ
[POWER LEVEL]	PL
[−]	−
[3]	3
[0]	0
[dB(m)]	DB

3. Combine the programming codes into an OUTPUT command. For an HP 8340B/41B having address 19, this is the complete program:

```
10  ABORT 7
20  CLEAR 7
30  OUTPUT 719; "IPCW2.3GZPL−30DB"
40  END
```

ABORT, CLEAR, and IP are not always required, but it is good programming practice to use them (in this sequence) because they place the HP 8340B/41B in a completely reset, standard operating condition.

The HP 8340B/41B automatically upshifts lower-case characters, and ignores spaces and unassigned characters; therefore, line 30 in the preceding program could be written as follows, resulting in enhanced readability at a slight cost in execution time:

```
30  OUTPUT 719, "IP   CW 2.3 GHz   PL −30 dB"
```

Or the information could be written

```
30 OUTPUT 719, "IP"
40 OUTPUT 719; "CW 2.3 Gz"
50 OUTPUT 719; "PL -30 dB"
60 END
```

For interactive programs, the frequencies, power level, and other numerical data can be placed in the OUTPUT statements as variables. For example:

```
30 OUTPUT 719; "IP"
40 OUTPUT 719; "CW 2.3 Gz"
50 PRINT "ENTER THE POWER LEVEL"
60 INPUT P
70 OUTPUT 719; "PL"; P; "DB"
80 GO TO 50
90 END
```

Table 3-2. HP 8340B/41B Programming Codes (1 of 4)

Code	Operation Performed	Equivalent Key	Ref. Figure
A1	Leveling, internal	[INT]	3-16
A2	Leveling, external	[XTAL]	3-16
A3	Leveling, power meter	[METER]	3-16
AK m	Amplitude marker	[AMTD MKR]	3-17
AL m n	Alternate state	[ALT]	3-12
AM m	Amplitude modulation	[AM]	3-14, 3-15
AS m	Alternate state select		
AT d	Attenuator		
AU	Auto	[Hz/Auto]	3-10
BC	Change frequency band		
CF d t	Center frequency	[CF]	3-7
CS	Clear both status bytes		
CW d t	CW frequency	[CW]	3-7
DB	dB(m) terminator	[GHz/dB(m)]	3-10
DF d t	Delta frequency	[ΔF]	3-7
DN	Down step	[▼]	3-8
DU m	Display updating (=SHS1)		
EF	Entry Display off	[ENTRY OFF]	3-8
EK	Enable rotary knob		
FA d t	Start frequency	[START FREQ]	3-7
FB d t	Stop frequency	[STOP FREQ]	3-7
FM m	Frequency modulation	[FM]	3-14, 3-15
FM1 d	FM sensitivity (d=1 or 10)		3-14, 3-15
FP*	Fast phaselock		
GZ	GHz terminator	[GHz/dB(M)]	3-10
HZ	Hz terminator	[Hz/AUTO]	3-10
IF	Increment frequency		
IL 123b	Input learn data		
IP	Instrument preset	[INSTR PRESET]	3-12
KR	Keyboard release		
KZ	kHz terminator	[kHz/msec]	3-10
M0	Marker off (=MO)	[OFF]	3-9
M1 d t	Marker 1 on	[M1]	3-9
M2 d t	Marker 2 on	[M2]	3-9
M3 d t	Marker 3 on	[M3]	3-9
M4 d t	Marker 4 on	[M4]	3-9
M5 d t	Marker 5 on	[M5]	3-9
MC	Marker to center frequency	[MRK→CF]	3-9
MD m	Marker delta	[MRKΔ]	3-9
MO	Marker off (=M0)	[OFF]	3-9
MP m	Marker sweep, M1-M2	[MKR SWEEP]	3-9
MS	milliseconds terminator	[kHz/msec]	3-10
MZ	MHz terminator	[MHz/sec]	3-10
NA 1 b	Network analyzer configure		
OA (d)	Output active parameter		
OB (d)	Output next band frequency		
OC (3d)	Output coupled parameters		
OD*	Output diagnostic values		
OF (d)	Output fault values		
OI (19a)	Output identification		
OK (d)	Output last lock frequency		

Table 3-2. HP 8340B/41B Programming Codes (2 of 4)

Code	Operation Performed	Equivalent Key	Ref. Figure
OL (123b)	Output learn data		
OM (8b)	Output mode data		
OP (d)	Output interrogated parameter		
OR (d)	Output power level		
OS (2b)	Output status bytes		
PL d t	Power level	**[POWER LEVEL]**	3-7
PM m	Pulse modulation	**[PULSE]**	3-14, 3-15
PS m	Power sweep	**[PWR SWP]**	3-17
RB 1b	Remote rotary knob		
RC n	Recall instrument state	**[RECALL] [0-9]**	3-12
RE 1 b	Extended status byte mask		
RF m	RF output on/off	**[RF]**	3-17
RM 1 b	Status byte mask		
RP m	RF peaking	**[PEAK]**	3-17
RS	Reset sweep		
S1	Sweep, continuous	**[CONT]**	3-11
S2	Sweep, single	**[SINGLE]**	3-11
S3	Sweep, manual	**[MANUAL]**	3-11
SC	Seconds terminator	**[MHz/sec]**	3-10
SF d t	Step frequency size		
SG	Sweep, single		
SH	Shift prefix	**[SHIFT]**	3-7
SHA1	Disable, ALC, set power	**[SHIFT] [INT]**	3-16
SHA2	Enable external source module leveling mode	**[SHIFT] [XTAL]**	3-16
SHA3 d t	Access linear modulator	**[SHIFT] [METER]**	3-17
SHAK	Immediate YTM peak	**[SHIFT] [AMTD MKR]**	3-17
SHAL	Save current freq. mult. factor	**[SHIFT] [ALT]**	3-12
SHAM m	Pulse modulation enhancement	**[SHIFT] [AM]**	3-14
SHCF d t	Set frequency step size	**[SHIFT] [CF]**	3-7
SHCW*	CW increment resolution	**[SHIFT] [CW]**	3-7
SHEF	Restore calibration constant access function	**[SHIFT] [ENTRY OFF]**	3-8
SHFA d t	Display multiplier	**[SHIFT] [START FREQ]**	3-7
SHFB d t	Display offset	**[SHIFT] [STOP FREQ]**	3-7
SHIP	Freq. multiplier defaults to 1	**[SHIFT] [INSTR PRESET]**	3-12
SHM1	Diagnostic: M/N, 20/30 frequency	**[SHIFT] [M1]**	3-9
SHM2	Diagnostic: band, YO	**[SHIFT] [M2]**	3-9
SHM3	Diagnostic: VC01, VC02 frequencies	**[SHIFT] [M3]**	3-9
SHM4	Diagnostic: test/display results	**[SHIFT] [M4]**	3-9
SHM5	Turn off diagnostics	**[SHIFT] [M5]**	3-9
SHMO	Turn off all markers	**[SHIFT] [OFF]**	3-9
SHMP	Marker sweep, M1-M2	**[SHIFT] [MKR SWEEP]**	3-9
SHPL d t	Set power level step	**[SHIFT] [POWER LEVEL]**	3-7
SHPM	Enable HP 8756A/8757A compatability	**[SHIFT] [PULSE]**	3-14, 3-15
SHPS d t	Decouple ATN, ALC	**[SHIFT] [PWR SWP]**	3-17
SHRC	Remove save-lock	**[SHIFT] [RECALL]**	3-12
SHS1 m	Blank displays	**[SHIFT] [CONT]**	3-11
SHS 3	Display fault diagnostic	**[SHIFT] [MANUAL]**	3-11
SHSL d t	Control reference level	**[SHIFT] [SLOPE]**	3-17
SHST d t	ZOOM function	**[SHIFT] [SWEEP TIME]**	3-7

Table 3-2. HP 8340B/41B Programming Codes (3 of 4)

Code	Operation Performed	Equivalent Key	Ref. Figure
SHSV	Lock save/recall	[SHIFT] [SAVE]	3-12
SHRF	Same as SHA1	[SHIFT] [RF]	3-17
SHRP	Tracking calibration	[SHIFT] [PEAK]	3-17
SHT1	Test displays	[SHIFT] [FREE RUN]	3-11
SHT2 m	Bandcrossing penlift	[SHIFT] [LINE]	3-11
SHT3	Display unlock indicators	[SHIFT] [EXT]	3-11
SHGZ d t	IO channel	[SHIFT] [Ghz/dB(m)]	3-10
SHMZ d t	IO subchannel	[SHIFT] [MHz/sec]	3-10
SHKZ d t	Write to IO	[SHIFT] [kHz/msec]	3-10
SHHZ	Read from IO	[SHIFT] [Hz/AUTO]	3-10
SL m d t	Power slope	[SLOPE]	3-17
SM d t	Sweep, manual		
SN d t	Steps, maximum		
SP d t	Set power step size		
ST d t	Sweep time	[SWEEP TIME]	3-7
SV n	Save instrument state	[SAVE] [1-9]	3-12
SW m	Swap network analyzer channels		
T1	Trigger, free run	[FREE RUN]	3-12
T2	Trigger, line	[LINE]	3-12
T3	Trigger, external	[EXT]	3-12
T1 b (b)	Test HP-IB interface		
TL d t	Time line		
TS	Take sweep		
UP	Up step	[▲]	3-8

Note: The HP 8340B/41B automatically upshifts codes entered in lower case, and ignores spaces placed between code groups. The warning message "* * *HP-IB SYNTAX ERROR* * *" appears in the ENTRY DISPLAY if an error is made in the programming format, and the HP 8340B/41B will ignore the unrecognized code characters. (The HP 8340B/41B also clears HP-IB DIO line 8, which sometimes is used as a parity bit; HP-IB lines are explained later in this Section.)

The lower-case letters listed after the codes indicate typical suffix parameters as follows:

If no suffix follows a code in this Table, the code represents either a self-contained, immediate execute function, or one of the terminator codes that scale and define the associated numerical data.

a indicates that alphanumeric ASCII characters are associated with this code.

b indicates binary information consisting of 8-bit bytes. Typically, binary information is transmitted by using either the computer's CHR$ function (which converts a decimal number to a string of binary bytes), such as

```
100  OUTPUT 719; "...code..."&CHR$(decimal)
```

where the "&" concatenates the CHR$ function to the programming code (and prevents an end-of-line terminator from being placed between the code and the data), or for codes that require strings of binary data an image specifier can be used; for example:

```
100  OUTPUT 719; "...programming code...";
110  OUTPUT 719 USING #,B"; byte(s)
```

The final semicolon in line 100 inhibits an end-of-line sequence from the computer (an EOL must not separate code from data). The "#" in line 110 supresses EOL that might occur between data bytes or from a coincidental data bit pattern that mimics an EOL sequence, and the "B" indicates that the subsequent variables represent binary data.

d indicates decimal data, which is allowed in any of these data formats:

single digit:	±d
Integer, decimal:	±d* * *d
Real, decimal:	±d* * *d.d.* * *d
Exponential, decimal:	±d* * *d.d.* * *dE±dd

m indicates a "1" or a "0" must follow the code letters, where the 1 suffix is usually used to turn on the function, and the 0 suffix turns off the function.

n is a single digit, 1-9 for SV and 0-9 for RC, which indicates the desired memory register.

t indicates that a terminator is required. Typically, the programming codes, GZ, MZ, KZ, HZ, DB, SC, and MS are used as terminators because they also serve as units scalars. Alternatively, a comma or an ASCII LF (decimal 10) can be used as a terminator, which will cause the HP 8340B/41B to scale the corresponding function to the fundamental units of Hertz, seconds, or dB(m).

(...) parenthesis indicate codes that cause the HP 8340B/41B to output information for a subsequent input by the computer, with the format of that information being indicated by the parenthetical letters. For example, code listing OC (3d) indicates that 3 decimal values should be read as a result of the OC command:

```
100  OUTPUT 719; "OC"
110  ENTER 719; A,B,C
```

As another example, code listing OM (8b) indicates that 8 binary bytes should be read:

```
100  OUTPUT 719; "OM"
110  ENTER 719 USING "#, B"; B1, B2, B3, B4, B5, B6, B7, B8
```

(The image parameters in line 110 are explained in the preceeding "b-binary data" section.)

* follows the codes that have special suffix requirements; consult the detailed explanation of the code for further information.

Using the Rotary KNOB

The rotary [KNOB] can also be enabled for interactive programs. The **[KNOB]** is normally disabled when the HP 8340B/41B is in REMOTE; however, the "EK" programming code reenables the **[KNOB]**:

```
 80  REM    EK ALLOWS THE KNOB TO CONTROL PL
 90  OUTPUT 719; "EKPL"
100  PAUSE
110  REM  EK ALLOWS THE KNOB TO CONTROL CW
120  OUTPUT 719; "EKCW"
130  END
```

The "EK" can precede or follow the programming code for the function key; that is, "EKCW" and "CWEK" are functionally equivalent. If EK is output by itself, the **[KNOB]** will control the last-activated function:

```
 80  OUTPUT 719; "FA10GZ    FB14GZ    PL -90DB    ST100MS"
 90  OUTPUT 719; "EK"
100  END
```

Line 80 establishes a start frequency of 10 GHz, stop frequency of 14 GHz, power level of −90 dBm, and a sweep time of 100 milliseconds. Line 90 enables the **[KNOB]**, which will control the sweep time since that was the last-activated function.

Using Keys that Toggle ON/OFF

Several keys, such as the MODULATION keys, activate functions that are either ON or OFF. To turn a function ON or OFF, add a "0" (OFF) or "1" (ON) suffix to the key's programming code. For example:

```
200  REM    TURN THE "AMTD MKR" ON
210  OUTPUT 719; "AK1"
220  PAUSE
230  REM    TURN THE "AMTD MRK" OFF
240  OUTPUT 719; "AK0"
```

Operator's Programming Check

To check the various programming codes that duplicate front panel operations, enter this BASIC program (or equivalent):

```
10  DIM A$"60"
20  REMOTE 719
30  PRINT "ENTER PROGRAMMING CODES"
40  INPUT A$
50  OUTPUT 719; A$
60  GOTO 30
70  END
```

RUN the program, and enter any combination of programming codes (60 characters maximum) when prompted; for example:

ENTER PROGRAMMING CODES?

FA12GZ FB18GZ PL −65DB STAU (followed by RETURN or END LINE

The HP 8340B/41B should immediately respond to your commands with, in this example, a 12 GHz start frequency, 18 GHz stop frequency, power level of −65 dBm, and a sweep time set to auto (auto selects the fastest possible sweep rate for a given frequency span).

The preceding applications of the OUTPUT command are sufficient for writing computer programs that duplicate all front panel operations. The next subsection explains programming codes that do not have an equivalent key on the front panel.

Unique HP-IB Programming Codes

Several programming codes are available which do not have an equivalent front panel key; these codes are listed in Table 3-2 and described here, in alphabetical order (the lower case letters that follow each code mnemonic are explained in Table 3-2).

ASm Alternate State Select, is primarily used when the HP 8340B/41B is operating in certain network analyzer systems. AS is always used in conjunction with alternate state mode (**[ALT]**, Figure 3-12) where it causes an abrupt change from one operational state to the other. Use AS when automatic alternation does not occur (for example, when CW mode is used for one or both operational states), or when it might be necessary to interrupt the alternating operation.

First, establish alternating operation between the present operating configuration (called the "foreground" state) and one of the previously SAVEd operating configurations (called the "background" state). For example, code AL13 activates alternating operation between the foreground and background states, with the background state being derived from the contents of memory register 3 (the code parameters are ALnx, where n = 1/0 to activate/deactive alternating operation, and x = 1-9 indicates the memory register that will be transferred to the background register).

With alternating mode in effect, AS is used to abrubptly change the operating state: AS0 causes the present HP 8340B/41B operation (whether that operation is foreground or background) to abruptly halt, retrace to the beginning of the foreground state, and begin operating under the foreground configuration; AS1 causes the present operation to abruptly halt, retrace to the beginning of the background state, and begin operating under the background configuration. After the AS-initiated foreground or background change has been completed, the previously established alternating state operation resumes. A BASIC example:

```
100  REM  PREPARE BACKGROUND STATE, SAVE IN REGISTER 3
110  OUTPUT 719; "...(programming codes)...SV3"
120  REM
130  REM  PREPARE FOREGROUND STATE, AND ALTERNATE
140  OUTPUT 719; "...(programming codes)...AL13"
150  REM
160  REM  ABRUPTLY CHANGE STATUS IF NECESSARY
170  IF X > Y THEN OUTPUT 719; "AS1"
180  IF X < Y THEN OUTPUT 719; "AS0"
```

(X and Y in lines 170 and 180 are arbitrary variables for a hypothetical test.)

ATd Attentuator, allows the attenuator to be set remotely, and is used when the attentuator is decoupled from the ALC (SHSL initiates the decoupling). The standard attenuator (see the attenuator options listed in Section I) has a range of 0 to −90 dB in 10 dB increments; set the attentuator by using the code ATxDB, where x is the numerical value (the HP 8340B/41B will round values to the nearest 10 dB) and DB is the terminator. A BASIC example:

```
100  OUTPUT 719; "AT-40DB"
```

BC Band Change, causes the HP 8340B/41B to advance to the next frequency bandcrossing point. The BC code is used in two situations: 1) It is used when the HP 8340B/41B is in network analyzer mode (the NA programming code), or 2) it is used when automatic bandcrossing has been disabled by the SHA21 code (in this case, the BC code functions identically to the SHA1 code; bandcross disabling and the SHA1/SHA2 functions are described in Figure 3-16).

CS Clear Status bytes, resets to zero the 16 bits in the two status bytes. Any status bit that is in the process of being set, but was deferred pending completion of some function, will also be cleared by CS. Status bytes, along with the CS code, are explained under the OS (Output Status byte) code.

DUm Display Updating, blanks (DU0) or unblanks (DU1) the front panel displays of the HP 8340B/41B, and is identical in function to SHS1m (**[SHIFT] [CONT]**, which is described in Figure 3-11). In automated systems the displays of the HP 8340B/41B might be redundant, and can be blanked to reduce visual distractions for the operation. A BASIC example:

```
100 OUTPUT 719; "DU0"
```

If DU1 is output while the HP 8340B/41B is in the middle of a sweep, the sweep will abruptly stop, retrace, and the resume sweep operations.

EK Enable Knob, activates the rotary **[KNOB]** on an otherwise remote HP 8340B/41B front panel. Once the **[KNOB]** is enabled it is automatically coupled to the presently active function, such as:

```
100 OUTPUT 719; "CWEK"
```

(**[KNOB]** adjusts CW frequency)

```
200 OUTPUT 719; "PLEK"
```

(**[KNOB]** adjusts Power Level)

In the above examples, the CW and PL function codes were output along with EK to explicitly specify the active function; since no data accompanied the function codes, the last-used data values (or the IP default values) will be re-established. EK can also be output alone:

```
300 OUTPUT 719; "EK"
310 OUTPUT 719; "CF70MZ"
320 PAUSE
330 OUTPUT 719; "DF1MZ"
340 PAUSE
350 OUTPUT 719; "ST50MS  PL -25DB"
360 PAUSE
```

EK always controls the active function; hence, at line 320 the **[KNOB]** controls the center frequency (initially at 1 MHz); and at line 340 the **[KNOB]** controls the delta frequency (initially at 1 MHz); and at line 360 the **[KNOB]** controls the power level (initially at −25 dBm). Notice at line 360 that the **[KNOB]** controls PL, not ST, because PL is the last-activated function.

FP Fast Phaselock, is used when the fastest possible frequency transition is necessary between CW frequencies. FP can be used for fast transitions between steps in a stepped CW sweep, or it can be used when the CW frequencies must be rapidly changed to any value in the frequency span of the HP 8340B/41B.

FP achieves rapid frequency transition by limiting some of the normal HP 8340B/41B features: The plotter control functions are disabled, the 0-10 volt sweep ramp is frozen, and the HP 8340B/41B does not wait for a complete locking of the phase lock loop oscillators before releasing the HP-IB handshake. The FP code must have a numerical suffix (14 characters maximum) in Hz units, without any terminator code (ASCII "LF," normally sent by the computer is the only allowable terminator), that sets the starting frequency. A BASIC example of a stepped CW sweep:

```
100 OUTPUT 719; "IP  SF1KZ  CW"
110 OUTPUT 719; "FP1E9"
120   FOR J = 1 TO 100
130   TRIGGER 719
140   NEXT J
150 GOTO 110
```

Line 100 sets the step size (SF) to 1 kHz, and causes the HP 8340B/41B to enter CW mode (the unspecified CW frequency at this point will be the last used CW frequency, or the IP default value). Line 110 initiates fast phaselock mode, and establishes a starting CW frequency of 1E9 Hz (1×10^9 Hz, or 1 GHz). At this point in the program, the HP 8340B/41B is outputting 1 GHz CW but will not increment until line 130 is reached. Line 150 causes a retrace to 1 GHz.

For irregular frequency steps use a variable to represent the numerical data, such as:

```
100  FOR N = 1 TO 4
110 READ A
120  OUTPUT 719; "FP";A
130  NEXT N
140  DATA  1E7, 1E8, 1E9, 1E10
```

Line 140 contains the list of frequencies (in Hz units; hence, 10 MHz, 100 MHz, 1 GHz, and 10 GHz) which are read in line 110. The semicolon beween the "FP" and A (an artibrary variable) in line 120 signifies to the computer that a terminator should not separate the code from the variable.

IF Increment Frequency, is similar to the HP-IB commands TRIGGER and GET (group execute trigger). IF must be used to trigger the SN function, and can be used to increment SM and other CW frequency functions (however, IF cannot be used to trigger FP). For example:

```
100  OUTPUT 719; "SF1GZ  CW1GZ"
110  FOR N = 1 TO 20
120  OUTPUT 719; "IF"
130  NEXT N
```

The step size and the starting CW frequency are both set to 1 GHz in line 100. Lines 110 to 130 cause the CW frequency to increment 20 times (i.e., a 1-21 GHz stepped sweep).

IL123b Input Learn data, is used in conjunction with OL (Output Learn data) to save/recall various operating configurations of the HP 8340B/41B. IL/OL is similar to the SAVE/RECALL functions, except with IL/OL the active function in use prior to OL storage is once again active after the IL restoration (no function is active after a RECALL), and there is virtually no limit to the number of instrument states that can be stored (SAVE/RECALL has a capacity of 9 memory registers, located in the HP 8340B/41B; IL/OL data is stored in the computer's mass storage device). IL is explained under the OL programming code.

KR Keyboard Release, is used with the NA code. If NA bit 1 is set True (=1), the HP 8340B/41B front panel keys are in a lock-and-release mode. In this mode, the keyboard is locked (disabled) after any one key has been pressed, and remains locked until released by the KR code. The typical loop program involves three steps: 1) Determine which key was pressed by using the OM code 2) process the key closure information; 3) use KR to relese the keyboard, and return to step 1.

NAb Network Analyzer configuration, established the operating modules that are used when the HP 8340B/41B is interfaced with certain network analyzers. The modes are established by adding a binary or decimal number to the NA code, where the bits of the number are deciphered as follows:

Bit 0 set true (1);

Enable network analyzer mode with the following features:

1. Enable group-execute trigger (GET) to start a sweep after a mid-sweep update, if in analog sweep mode.
2. Use Stop Frequency to calculate the end of the band.
3. Disable HP 8340B/41B detection of sweep event markers, bandcrossing points, and sweep end point.
4. Do binary search to set sweep reset DAC.
5. Issue end of sweep SRQ for mid-sweep update.
6. Disable automatic alternation when alternating in manual or CW non-swept mode.
7. Ignore BC following mid-sweep updates, until next GET.

Bit 1 set true (1): Enable keyboard hold off, released by KR.

Bit 2 set true (1): Disable "HP-IB SYNTAX ERROR" annunciator that would otherwise appear in the ENTRY DISPLAY.

Bits 3-7: Not used
Bit 0 is set true by decimal "1," bit 1 is set by decimal "2," and bit 2 is set by decimal "4." A BASIC example that sets bits 0, 1, and 2 true:

```
100  OUTPUT 719; "NA"&CHR$(7)
```

In this example, the binary value of decimal 7 (CHR$(7) is concatenated to the NA code (&). Alternatively, a formatted OUTPUT statement could be used to output the same binary information.

```
100  OUTPUT 719 USING "2A, B"; "NA", 7
```

The image specifier "2A, B" indicates that two literal characters will be output, followed by a single binary byte.

Consult the Operating Guide for the specific network analyzer being used for detailed interfacing information.

OA(d) Output Active parameter, allows the computer to read the numerical value of the presently active HP 8340B/41B function. The active function is the last-used function, and appears in an unblanked ENTRY DISPLAY. A BASIC example:

```
100  OUTPUT 719; "FA65MZ FB75MZ PL10DB ST1SC"
110  OUTPUT 719; "OA"
120  ENTER 719;A
130  PRINT "ACTIVE PARAMETER ="; A
```

Sweep time is the active parameter, because it was the last-entered function (line 100). The OA value read by the computer (read in line 120, and assigned to arbitrary variable A) is always in the fundamental units of Hz, dB(m), or seconds.

The Om code (byte 2) can be used to determine the presently active function.

OB(d) Output next Band frequency, indicates the frequency of the next bandcrossing. Bandcrossings occur at 2.4 GHz, 7.0 GHz, 13.5 GHz, and, in the case of the HP 8340B, 20.0 GHz. A BASIC example:

```
100  OUTPUT 719; "CW6GZ"
110  OUTPUT 719; "OB"
120  ENTER 719; A
130  PRINT "NEXT BANDCROSSING"; A/1E9; "GIGAHERTZ"
```

In this example, the HP 8340B/41B is outputting a 6 GHz CW signal, so the next bandcrossing points is 7.0 GHz. The OB frequency is always in Hz; line 130 divides the OB value by 1×10^9 for conversion to GHz units.

OC(3d) Output Coupled parameters, allows the computer to read the values of the start frequency, center frequency, and sweep times (in this order) of the HP 8340B/41B. The values are always read in the fundamental units of Hz and seconds. In BASIC:

```
100  OUTPUT 719; "FA1GZ FB19GZ STAU"
110  OUTPUT 719; "OC"
120  ENTER 719; S,C,T
130  PRINT "START FREQUENCY";S/1E9;"GHZ"
140  PRINT "CENTER FREQUENCY";C/1E9;"GHZ"
150  PRINT "SWEEP TIME";T;"SECONDS"
```

The computer would display, for this example, a start frequency of 1 GHz, a center frequency of 10 GHz, and a sweep time of 0.030 seconds.

OD Output Diagnostic values, allows the computer to read the values that result from the diagnostic functions (always in the fundamental units of Hz, dB(m), or seconds). There are three diagnostic functions that can be used with OD:

1. Oscillator frequencies diagnostic: Programming code SHM1 (keystrokes **[SHIFT] [M1]**; see figure 3-9) activates this diagnostic, which outputs the M value, N value, M/N loop frequency, and the 20/30 loop frequency. In BASIC:

```
100  OUTPUT 719; "SHM1 OD"
110  ENTER 719; M,N,R,L
120  PRINT "M VALUE"; M
130  PRINT "N VALUE"; N
140  PRINT "M/N FREQUENCY"; R; "HZ"
150  PRINT "20/30 LOOP FREQ"; L; "HZ"
```

2. Band number and YIG oscillator diagnostic: Programming code SHM2 (keystrokes **[SHIFT] [M2]**; see Figure 3-9) causes the band number and YIG oscillator frequency to be output, in this order. In BASIC:

```
100  OUTPUT 719; "SHM2 OD"
110  ENTER 719; B, Y
120  PRINT "BAND NUMBER"; B
130  PRINT "YIG OSC FREQUENCY"; Y; "HZ"
```

3. Phase lock loop (PLL) frequencies diagnostic: Programming code SHM3 (keystrokes **[SHIFT] [M3]**; see Figure 3-9) causes the PLL #2 VCO frequency and the PLL #3 upconverter frequency of the 20/30 loop to be output, in this order. In BASIC:

```
100  OUTPUT 719; "SHM3 OD"
110  ENTER 719; F2, F3
120  PRINT "PLL #2"; F2; "HZ"
130  PRINT "PLL #3; F3; "HZ"
```

4. Diagnostic Tests and Results: Programming code SHM4 (keystrokes **[SHIFT] [M4]**; see Figure 3-9) causes a series of up to 18 diagnostic tests. These tests are labeled 14 to 31. Other tests are intiated at "power on". These tests are labeled 0 to 13. Test results are available from the front panel or as a string of 32 characters over the HP-IB. These characters may be either 1 or 0, indicating, respectively, a passed or failed test. In BASIC:

```
100  DIM Test no$(32) [20]
110  OUTPUT 719; "SHM4"
120  FOR I = 1 TO 32
130  READ Test no$(I)
140  DATA "PROCESSOR TST", "ROM 1 CKSUM", "ROM 2 CKSUM", ROM 3
     CKSUM", "ROM 4 CKUSM", "RAM 1 RD/WR", "RAM 2 RD/WR", "EEROM 1
     RD/WR", "EEROM 2 RD/WR"
150  DATA "MRK RAM RD/WR", "PIT (LED REG)", "PIT RESPONDS", "IO ADDR
     BUSS", "IO DATA BUSS", "A-D CONVERTER", "LEVEL REF DAC", "MAN SWP
     DAC" "MARKER RAMP"
160  DATA "RESET DAC", "LEVEL SWP DAC", "BND CROSS DAC", "SWP WIDTH
     DAC", "SWP RANGE ATN", "V/GHz CIRCUIT", "V/GHz BND ATN", "BRK PNT
     1 DAC", "BRK PNT 2 DAC"
170  DATA "ATN SLOPE DAC", "YO PRETUN DAC", "SWEEPTIME DAC", " NOT
,     USED" "A27 INSTALLED"
180  NEXT I
190  DIM Dt$[32]
200  OUTPUT 719; "OD"
210  ENTER 719; Dt$
220  FOR I = 1 TO 32
```

```
230  IF Dt$[I,I] = "1" THEN
240  IMAGE 13A, 10X, "PASS"
250  PRINT USING 240; Test_no$(I)
260  ELSE
270  IMAGE 13A, 10X, "FAIL"
280  PRINT USING 270; Test_no$(I)
290  END IF
300  NEXT I
310  END
```

Consult Section VIII, Service, for a detailed explanation of these diagnostic functions.

OF(d) Output Fault, outputs a decimal value that can be decoded to determine which fault conditions have occurred. These fault conditions are automatically accumulated by the HP 8340B/41B, and are only cleared by an Instrument Preset or when the fault has been output following an OF command. The outputted decimal number is interpreted at the bit level, where the bits are defined as follows:

Bit 0: Not used.
Bit 1: Not used.
Bit 2: N1 oscillator unlocked.
Bit 3: N2 oscillator unlocked.
Bit 4: YIG oscillator unlocked.
Bit 5. HET oscillator unlocked.
Bit 6. M/N oscillator unlocked.
Bit 7. REF oscillator unlocked.
Bit 8. Not used.
Bit 9. Not used.
Bit 10: LVC - preset of level control board failed.
Bit 11: PEAK - peaking algorithm failed.
Bit 12: ADC - ADC time out.
Bit 13: KICK - YO or SYTM kick pulse time out.
Bit 14: CAL - calibration data checksum incorrect.
Bit 15: Not used.

If any of these fault conditions are encountered, consult the In Case of Difficulty section or Section VIII (Service) for further instructions. A BASIC example:

```
100  OUTPUT 719; "OF"
110  ENTER 719; F
120    FOR N = 0 TO 15
130  PRINT "BIT"; N;" =";BIT(F,N)
140  NEXT N
```

Line 130 determines each bit of arbitrary variable F in the BIT(F,N) statement.

OI(19a) Output Identification, outputs the revision date of the firmware presently loaded into the HP 8340B/41B as:

08340BREV day month year
(2 numbers for the day, 3 letters for the month, and 2 numbers for the year)

A BASIC example:

```
10   DIM A$[19]
.
.
.
100  OUTPUT 719; "OI"
110  ENTER 719; A$
120  PRINT "FIRMWARE REVISION"; A$
```

OK(d) Output last locKed frequency, indicates the last phase locked frequency of the HP 8340B/41B, in Hz. A BASIC example:

```
100  OUTPUT 719; "CWEK"
110  PAUSE
120  OUTPUT 719; "OK"
130  ENTER 719; F
140  PRINT "LAST FREQUENCY"; F; "HZ"
```

In line 100, the rotary **[KNOB]** is enabled (EK) and used to adjust the CW frequency. After completing the frequency adjustment, press **[CONTINUE]** on the computer and the last phase lock frequency (the current CW frequency in this example) is read and printed.

OL(123b) Output Learn data, is used on conjunction with IL (Input Learn data) to save and recall specific instrument operating configurations. OL/IL is similar to SAVE/RECALL, except: the function that was active prior to OL storage is once again active after an IL recall; and SAVE/RECALL is restricted to nine instrument configurations and uses the memory of the HP 8340B/41B while OL/IL uses the computer's memory and is restricted only by the size of that memory.

The learn data consists of 123 bytes of information. This information is heavily coded and densely packed for conciseness, so a byte-by-byte deciphering is not recommended (use OP to obtain information about a specific function or state). This is a typical BASIC program using OI and IL:

```
10   DIM A$[123]
.
.
.
100  OUTPUT 719; "...(programming codes..."
110  REM
120  REM  STORE THIS INSTRUMENT STATE
130  OUTPUT 719; "OL"
140  ENTER 719 USING "#,123A"; A$
150  REM
160  REM  RETRIEVE THIS INSTRUMENT STATE
170  OUTPUT 719; "IL" &A$
```

Line 140 is a formatted I/O statement, where the # suppresses the end-of-line sequence (so valid data is not misinterpreted as EOL), and the 123A is an instruction to fill A$ with 123 bytes of literal data. Line 170 concentrates the literal data in A$ (which is an arbitrary variable) with the IL programming code. For additional I/O formatting information, consult the I/O Programming Manual for the specific computer being used.

OM(8b) Output Mode, outputs 8 bytes of information that completely describes the presently active function of the HP 8340B/41B.

Byte 1 records the last-pressed front panel key.

Byte 2 indicates the active function.

Byte 3 records the active and previously active markers.

Byte 4 indicates the marker status.

Byte 5 indicates trigger, sweep, and frequency modes.

Byte 6 indicates the status of various front panel functions.

Byte 7 indicates output power and leveling status.

Byte 8 indicates the status of the modulation and other functions.

A BASIC example:

```
10    DIM B(8)
.
.
.
100   OUTPUT 719; "OM"
110   ENTER 719 USING "#,B"; B(1), B(2), B(3), B(4), B(5), B(6), B(7),
      B(8)
120   FOR J = 1 to 8
130     PRINT "BYTE"; J
140     PRINT "DECIMAL"; B(J)
150         FOR K = 0 TO 7
160         PRINT "BIT";K;"=";BIT(B(J),K)
170         NEXT K
180     PRINT
190   NEXT J
```

Line 110 suppresses the normal end-of-line sequence by using the "#" image specifier (this must be done in case the bit pattern of the data coincidentally duplicates the bit pattern of the EOL, which would cause a false termination), and inputs the 8 bytes of data (image specifier "B" indicates binary data). Lines 120-190 prints the bytes' decimal and bit values. This is how to interpret the byte data:

BYTE 1 indicates the last-pressed front panel key, and the decimal value of this byte corresponds to the keys as follows:

Decimal Value	Key	Decimal Value	Key
0-9	**[0]** - **[9]** numerical keys	82	**[RECALL]**
10	**[.]**	83	**[ALT]**
11	**[−]** minus key	84	not used
12	**[− / BACK SPACE]** used as the back space	85	**[PULSE]**
13	**[▲]**	86	**[AM]**
14	**[▼]**	87	**[ENTRY OFF]**
15	**[MKR→CF]**	88-96	not used
16	**[SHIFT] [MKR SWEEP]**	97	**[START FREQ]**
17	**[INSTR PRESET]**	98	**[STOP FREQ]**
18-64	not used	99	**[CF]**
65	**[CONT]**	100	**[ΔF]**
66	**[SINGLE]**	101	**[CW]**
67	**[MANUAL]**	102	**[POWER LEVEL]**
68	**[M1]**	103	**[SWEEP TIME]**
69	**[M2]**	104	**[SHIFT]**
70	**[M3]**	105	**[GHz/dB(m)]**
71	**[M4]**	106	**[MHz/sec]**
72	**[M5]**	107	**[kHz/msec]**
73	**[FREE RUN]**	108	**[Hz/AUTO]**
74	**[LINE]**	109	**[INT]**
75	**[EXT]**	110	**[XTAL]**
76	**[MKR SWEEP]**	111	**[METER]**
77	**[OFF]**	112	**[AMTD MKR]**
78	**[MKRΔ]**	113	**[PEAK]**
79	not used	114	**[PWR SWP]**
80	**[LOCAL]**	115	**[SLOPE]**
81	**[SAVE]**	116	**[RF]**
		117-128	not used

Decimal Value	Key
(Note: Although all possible shift-key combinations are listed, some of these combinations have no effect on the HP 8340B/41B.)	
129	[SHIFT] [CONT]
130	[SHIFT] [SINGLE]
131	[SHIFT] [MANUAL]
132	[SHIFT] [M1]
133	[SHIFT] [M2]
134	[SHIFT] [M3]
135	[SHIFT] [M4]
136	[SHIFT] [M5]
137	[SHIFT] [FREE RUN]
138	[SHIFT] [LINE]
139	[SHIFT] [EXT]
140	not used
141	[SHIFT] [OFF]
142	not used
143	not used
144	[SHIFT] [LOCAL]
145	[SHIFT] [SAVE]
146	[SHIFT] [RECALL]
147	[SHIFT] [ALT]
148	not used
149	[SHIFT] [PULSE]
150	[SHIFT] [AM]
151	[SHIFT] [ENTRY OFF]
152	[SHIFT] [▼]
153	[SHIFT] [▲]
154-160	not used

Decimal Value	Key
161	[SHIFT] [START FREQ]
162	[SHIFT] [STOP FREQ]
163	[SHIFT] [CF]
164	[SHIFT] [ΔF]
165	[SHIFT] [CW]
166	[SHIFT] [POWER LEVEL]
167	[SHIFT] [SWEEP TIME]
168	[SHIFT] [SHIFT]
169	[SHIFT] [GHz/dB(m)]
170	[SHIFT] [MHz/sec]
171	[SHIFT] [kHz/msec]
172	[SHIFT] [Hz/AUTO]
173	[SHIFT] [INT]
174	[SHIFT] [[SHIFT] [XTAL]
175	[SHIFT] [METER]
176	[SHIFT] [AMTD MKR]
177	[SHIFT] [PEAK]
178	[SHIFT] [PWR SWP]
179	[SHIFT] [SLOPE]
180	[SHIFT] [RF]
181	[SHIFT] [0]
182	[SHIFT] [1]
183	[SHIFT] [2]
184	[SHIFT] [3]
185	[SHIFT] [4]
186	[SHIFT] [5]
187	[SHIFT] [6]
188	[SHIFT] [7]
189	[SHIFT] [8]
190	[SHIFT] [9]
191	not used

BYTE 2 shows the presently active function. Decipher the decimal value of BYTE 2 as follows:

Dec. Value	Active Function	Dec. Value	Active Function
0	non-numerical function (either SAVE LOCK, CLEAR LOCK, or ENTRY OFF)	23	HP-IB address (**[SHIFT] [LOCAL]**)
1	SAVE in register n	24	not used
2	RECALL from register n	25	ZOOM frequency function
3	ALTernate with register n	26	MANUAL sweep
4	I/O read (**[SHIFT] [kHz/msec]**)	27	Frequency offset (**[SHIFT] [STOP FREQ]**)
5	UNLK indicators (**[SHIFT] [EXT]**)	28	Frequency multiplier (**[SHIFT] [START FREQ]**
6	Power LVL STEP size	29	RF SLOPE
7	POWER LEVEL	30	not used
8	SWEEP TIME	31	not used
9	CW RESolution	32	PWR SWEEP
		33	not used
10	CW frequency	34	Power meter leveling (**[METER]**)
11	CF center frequency	35	Decoupled ATN/ALC (**[SHIFT] [PWR SWP]**)
12	ΔF delta frequency	36	Attenuator control (**[SHIFT] [SLOPE]**)
13	START frequency	37	Bypassed ALC (**[SHIFT] [METER]**)
14	STOP frequency	38	not used
15	Marker 1	39	not used
16	Marker 2		
17	Marker 3	40	I/O channel (**[SHIFT] [GHz/dB(m)]**)
18	Marker 4	41	I/O subchannel (**[SHIFT] [MHz/sec]**)
19	Marker 5	42	I/O write (**[SHIFT] [kHz/msec]**)
		43	Sweep time limit (programming code TL)
20	not used	44-245	not used
21	FREQuency STEP size	246	Fault diagnostic (**[SHIFT] [MANUAL]**)
22	Calibration constants accessed	247-256	not used

BYTE 3 shows the presently active and previously active markers. The marker information is coded in bit groups 0-2 (active marker), 3-5 (previously active marker), and 6-7 (not used); the decimal value of those bit groups is the marker number. For example:

BIT NUMBER	7	6	5	4	3	2	1	0
BIT PATTERN	X	X		1	0	0	1	1

is decoded as "active marker is M3 (decimal value of bits 0-2 is 3), and previously active marker is M2 (decimal; value of bits 3-5 is 2)."

BYTE 4 shows the on/off status of the markers and marker functions. If a bit is set True (=1) the marker or function is on, if the bit is False they are off. This is the bit code:

Bit	Marker or Function
0	MKR SWP
1	M1
2	M2
3	M3
4	M4
5	M5
6	not used (always = 0)
7	MRK Δ

BYTE 5 shows the status of the TRIGGER, SWEEP, and FREQUENCY modes. Like byte 3, the mode information is organized by bit groups, and is decoded by using the decimal value of those groups. This is the bit group organization:

Bits	Mode Information
0-1	TRIGGER MODE 0 = FREE RUN 1 = LINE 2 = EXT
2-4	SWEEP MODE 0 = CONT 1 = SINGLE 2 = MANUAL with Hz resolution (code SM) 3 = not used 4 = MANUAL with STEP resolution (code SN)
5-7	FREQUENCY MODE 0 = START/STOP 1 = CF/ΔF 2 = CW, with sweep on 3 = CW, with sweep off

BYTE 6 shows the status of miscellaneous modes and functions, which are ON if the appropriate bit is True (=1), or are OFF if the bit is False.

Bit	Mode or Function
0	AMTD MKR
1	not used (always = 1)
2	not used (always = 1)
3	not used (always = 0)
4	Entry enabled and rotary **[KNOB]** on
5	SAVE lock enabled
6	ALT mode
7	Keyboard **[SHIFT]** on

BYTE 7 shows the status of the power and leveling functions. The decimal value of bit group 0-1 indicates the leveling modes, while the remaining bits indicate whether the function is on (=1) or off (=0).

Bit	Mode or Function
0-1	ALC leveling modes 0 = INT 1 = XTAL 2 = METER
2	not used (always = 0)
3	PWR SWEEP
4	SLOPE
5	RF
6	not used
7	not used

BYTE 8 shows the remaining front panel modes and functions, with the True bits (=1) indicating ON, and the False bits (=0) indicating OFF.

Bits	Mode or Function
0	not used (always = 0)
1	not used (always = 0)
2	not used (always = 1)
3	PULSE
4	not used
5	AM
6	PEAK
7	Penlift enabled (**[SHIFT] [LINE]**)

OP(d) Output interrogated Parameter, instructs the HP 8340B/41B to output the numerical value of any specified function, even if that function is not presently active. The code for any function that has a numerical value associated with it as appended to OP; for example, OPCF for the center frequency (but not CFOP), or OPST for the sweep time (but not STOP). The numerical value is always output in the fundamental units of Hz, dB(m), or seconds. A BASIC example:

```
100  OUTPUT 719; "OPCF"
110  ENTER 719; N
120  PRINT "CENTER FREQUENCY = ";N; "HZ"
```

In this example, N is an arbitrary variable.

OR(d) Output power level, causes the HP 8340B/41B to output the present power level of the instrument. PLOA, OPPL and OR can be used to output power level, but there is a significant difference in the implementation of these codes by the HP 8340B/41B. OR causes the power to be measured by the internal ADC, while PLOA and OPPL reflect the user-requested power that is shown in the ENTRY DISPLAY.

PLOA or OPPL accurately indicate the power output only when the HP 8340B/41B is internally leveled and is not being amplitude modulated (AM) by a modulation signal containing a dc component. Under these conditions the values of PLOA, OPPL, and OR will agree to within the tolerances of the measuring circuits (± 0.1 dB).

OR can always be used to measure power output, and must be used whenever any of these conditions exist: 1)The HP 8340B/41B is unleveled for any reason; 2) the instrument is being amplitude modulated by a modulation signal having a dc component; 3) the HP 8340B/41B is being externally leveled.

A BASIC example:

```
100  OUTPUT 719; "OR"
110  ENER 719; P
120  PRINT "POWER LEVEL = "; P; "DBM"
```

OS(2B) Output Status bytes, is used to read the two 8-bit status bytes from the HP 8340B/41B. The first status byte concerns the cause of an SRQ (Service Request), while the second status byte concerns failures and faults, as follows:

STATUS BYTE (#1)								
BIT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DECIMAL VALUE	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
FUNCTION	SRQ on New fre-quencies or Sweep Time in Effect	REQUEST SERVICE (RQS)	SRQ on HP-IB Syntax Error	SRQ on End of Sweep	SRQ on RF Settled	SRQ on Changed in Extended Status Byte	SRQ on Numeric Entry Completed (HP-IB or Front Panel)	SRQ on Any Front Panel Key Pressed
EXTENDED STATUS BYTE (#2)								
BIT #	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
DECIMAL VALUE	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**
FUNCTION	Fault Indicator On	RF Unleveled	Power Failure	RF Unlocked	External Freq. Ref. Selected	Oven Cold	Over Modulation	Self Test Failed

Status Byte 1

Bit 0: SRQ caused by a key closure on the front panel of the HP 8340B/41B (use the OM code to determine the front panel status).

Bit 1: SRQ caused by the completion of a numeric entry (use the OA code to determine the value of the numerical entry).

Bit 2: SRQ caused by a change in the extended status byte (status byte 2) affected by the RE-coded mask (see the RE code for an explanation of this masking).

Bit 3: SRQ caused by the completion of phase locking and the settling of the RF source (use the OK code to determine the last lock frequency).

Bit 4: SRQ on end-of-sweep or mid-sweep update in NA (network analyzer code) mode.

Bit 5: SRQ caused by HP-IB syntax error.

Bit 6: SERVICE REQUEST; by IEEE-488 convention, the instrument needs service from the controller when this bit is set true.

Bit 7: SRQ caused by a change in the coupled parameters (start frequency, center frequency, and sweep time). Use the OC code to determine the new values of the coupled parameters.

Status Byte 2 (Extended Status Byte)

Bit 0: Self test failed at power on or at Instrument Preset. This bit remains latched until this status byte has been read, or until cleared by the CS or CLEAR 719 commands.

Bit 1: Excessive amplitude modulation input.

Bit 2: Oven for the reference crystal oscillator is not at operating temperature.

Bit 3: External reference frequency was selected by the rear-panel FREQUENCY STANDARD switch.

Bit 4: RF is unlocked (UNLK appears in the ENTRY DISPLAY). Use OF to determine the source of the unlocked output. This bit remains latched until this status byte has been read, or until cleared by the CS or CLEAR 719 commands.

Bit 5: AC line power interruption has occurred since the last Instrument Preset. This bit also remains latched until read or cleared.

Bit 6: RF is unleveled (use OR to determine present power level). This bit also remains latched until read or cleared.

Bit 7: FAULT annunciator is on (seen in the ENTRY DISPLAY of the HP 8340B/41B). Use OF to determine the cause of the fault.

A BASIC example:

```
10    REM CLEAR (RESET TO ZERO) BOTH STATUS BYTES
20    OUTPUT 719; "CS"
.
.
.
100   OUTPUT 719; "OS"
110   ENTER 719 USING "#, B"; S1, S2
120   S = S1
130   FOR K = 1 TO 2
140     PRINT "STATUS BYTE"; K
150       FOR N = 0 TO 7
160       PRINT "BIT";N;"=";BITS(S,N)
170       NEXT N
180     S=S2
190   NEXT K
```

Line 110 is a formatted I/O statement, where # suppresses the end-of-line sequence (to avoid misinterpreting valid data as an EOL sequence), and B indicates that each of the following variables (arbitrary variables S1 and S2) should be filled with one byte of information. Line 160 determines each bit of the status bytes, status byte 1 first (S = S1, N = 0 to 7) then status byte 2 (S = S2, N = 0 to 7).

Programming codes RM and RE explain how the status bytes can be masked.

RBb Remote knoB, allows the rotary knob of other instruments (computers, network analyzers) to control the active function of the HP 8340B/41B. The knob is sometimes called an RPG (rotary pulse generator) or cursor wheel in the manual of other instruments. Here is a demonstration program for the HP 9826/9836 (926/936) series of computers:

```
10    REM PRINT TO THE CRT, NOT THE LINE PRINTER
20    PRINTER IS 1

30    OUTPUT 719; "IP CWI GZ"
40    ON KNOB .075 GOSUB 60
50    GOTO 50

60    Count = KNOBX
70    PRINT "KNOB COUNT ="; Count
80    OUTPUT 719; "RB" & CHR$ (Count)
90    RETURN

100   END
```

Line 30 establishes CW as the active function, with an initial value fo 1.0 GHz. ON KNOB in line 40 instructs the computer to detect any rotation of the knob. The computer's knob generates 120 pulses per revolution; when the first pulse is detected, line 40 starts a sampling-time clock (75 milliseconds in this example) and branches to the subroutine located at line 60.

KNOBX in line 60 counts the pulses that occur in the sampling-time interval (the sampling time range is 0.01-2.55 seconds, but the sampling time must be short enough to keep the pulse count in the range of −127 to +128), and assigns the value of that count to arbitrary variable Count. Line 70 displays the pulse counts on the computer's CRT (pulse counts of ±1-30 are typical for this sampling time). Line 80 sends the pulse count information to the HP 8340B/41B, where it affects the active function (CW in this example).

In line 80, the pulse count is converted from decimal to binary by the CHR$ function, and concatenated to the RB code. One byte of numerical data can accompany RB, so the decimal value of Count has an allowable range of −127 to +128. The sampling time is arbitrary; 75 milliseconds was selected for this example because the resultant response of the computer's knob approximates the response from the HP 8340B/41B's knob (the exact effects of the sampling time must be ascertained by experiment).

REb, **RM**b Request mask Extended, and Request Mask, allow masking of the extended status byte (status byte 2) and the service request status byte (status byte 1), respectively. Masking is usually done for interrupt programming, where non-critical bits of the status bytes are masked to prevent them from initiating an unimportant interrupt.

To mask a status byte, the HP 8340B/41B must receive the RE and/or RM code that includes the numerical value of the enabled bits. The numerical value of the bits, in decimal, is:

BIT	7	6	5	4	3	2	1	0
DECIMAL	128	64	32	16	8	4	2	1

For example, to enable bit 2 on status byte 1 while occluding the six other bits, the programming code is **"RM"&CHR#(4)**, where the decimal value of bit 2 is converted to binary by the CHR$ function and concatenated to the RM code.

Masked interrupt programming requires the identification and enabling of the computer's interrupt register, and the transmission of the RM/RE codes to the HP 8340B/41B. Here is a typical BASIC example:

```
100  OUTPUT 719; "CS"
110  OUTPUT 719; "RM"&CHR$(4)
120  OUTPUT 719; "RE"&CHR$(64)
130  ENABLE INTR 7; 8
140  ON INTR 7 GOTO 500
150  OUTPUT 719; "PLEK"
.
.
.
500  PRINT "WARNING:  RF UNLEVELED"
```

Line 110 enables bit 2 (only) of status byte 1, which is the bit that causes an SRQ to be sent when any of the bits in status byte 2 change. Line 120 enables bit 6 (only) of status byte 2, which detects an unleveled RF output. Thus, an unleveled RF is the only condition that will cause the HP 8340B/41B to send an SRQ.

Line 130 enables the computer's interrupt register that is associated with I/O port 7, and instructs the computer to monitor bit 3 (decimal 8) for a true condition. Bit 3, in this example, is the SRQ RECEIVED bit, but the actual bit depends upon the particular computer being used (e.g., bit 2 for the HP 9826A (926), bit 3 for the HP-85A). Line 140 directs the program in the event of a true bit 3, which could occur if the power level is set too high (line 150 allows operator adjustment of the power level via the rotary **[KNOB]**).

Once set, several status byte bits remain latched until cleared by CS or CLEAR (or until after the status bytes are read a second time). The OS explanation describes all status byte bits.

RS Reset Sweep, causes the HP 8340B/41B to retrace to the start frequency. If a sweep is in progress when an RS code is received, the sweep will abruptly terminate and retrace. In BASIC:

```
100  OUTPUT 719; "RS"
```

SFdt Step Frequency size, sets the size of the frequency increment that can be stepped by UP or DN (equivalent to the up/down front-panel **[STEP]** keys). The SF code is equivalent to the SHCF code, and both are equivalent to the **[SHIFT] [CF]** keystroke operation (as described in Figure 3-7).

The SF step size can be as small as 1 Hz, as large as 10 GHz, or it can be coupled to the ΔF frequency span with the AU (auto) code (the coupling is explained in Figure 3-7). A BASIC example:

```
100  OUTPUT 719; "SF 1 MZ"
110  OUTPUT 719; "CW 400 MZ"
120    FOR N = 1 TO 200
130    OUTPUT 719; "UP"
140    NEXT N
150  GOTO 110
```

This program sets the step size to 1 MHz, establishes a starting CW frequency of 400 MHz, then performs a 400-600 MHz discrete sweep.

SG Single sweep, is identical to the S2 code, and both are equivalent to the front-panel **[SINGLE]** key which is described in Figure 3-11. SG causes the HP 8340B/41B to perform single sweeps, and is used in conjunction with the TRIGGER codes (T1, T2, and T3). If trigger code T1 (**[FREE RUN]**) is in effect, the SG code (or the TS code) is output every time a single sweep is needed. If SG is output in the middle of a sweep, the sweep will abruptly terminate and retrace. A BASIC example:

```
100  OUTPUT 719; "IP SG T1"
110  PRINT "PRESS [CONTINUE] TO START THE SWEEP"
120  PAUSE
130  OUTPUT 719; "SG"
140  GOTO 120
```

SMdt Sweep Manual, is identical to the S3 code, and both are equivalent to the front-panel **[MANUAL]** key which is described in Figure 3-11. SM is used by first establishing the start and stop sweep frequencies, then outputting SM to activate manual sweep mode. A BASIC example:

```
100  OUTPUT 719; "IP  FA5GZ  SF1MZ  FB15GZ  EK  SM"
```

This example sets a 5 GHz start frequency, a 1 MHz frequency step size, and a 15 GHz stop frequency. The last two codes in line 100 enable the rotary **[KNOB]** and activate manual sweep mode. In addition to **[KNOB]** control of the sweep, UP and DN can be used and would have a 1 MHz step size.

There are two significant differences between manual sweep and a stepped CW sweep:

1. The sweep voltage ramp (see Figures 3-13 and 3-18, SWEEP OUTPUT) is 0-10 volts for both modes; however, in CW mode 0 volts always corresponds to 10 MHz and 10 volts always corresponds to 26.5 GHz (in the case of the HP 8341B, 7.55v at 20.0 GHz), while in manual sweep mode 0 volts corresponds to the start frequency and 10 volts corresponds to the stop frequency. In both cases the sweep voltage at intermediate frequencies is a linear interpolation of the frequency span (i.e., a frequency half-way between the start/stop limits would have a corresponding sweep voltage of 5 volts).

2. The bandcrossing in CW mode always occur at preciesely 2.4 GHz, 7.0 GHz, 13.5 GHz, and, in the case of the HP 8340B, 20.0 GHz. In manual sweep mode the bandcrossing points have 200 MHz of flexibility and could, for example, accomplish a 13.45-20.05 GHz sweep in a single band instead of the three bands required in stepped CW (8340B). The HP 8340B/41B automatically adjusts the manual sweep bandcrossing point for optimum results.

SNdt   Sweep Number, is used to establish the number of steps for a stepped sweep. The minimum number of steps is 10, while the maximum number is 1000; the frequency sweep span is divided by this SN number to determine the step increment. SN initializes the stepped sweep conditions, but the IF code or the HP-IB statement TRIGGER must be used in conjunction with SN to actually initiate each frequency step. A BASIC example:

```
100  OUTPUT 719; "FA8GZ FB12GZ SN400"
110  FOR N = 1 TO 400
120  OUTPUT 719; "IF"
130  NEXT N
```

This program causes a sweep that starts at 8 GHz and makes 400 steps (19 MHz increments) to the 12 GHz stop frequency. The IF code in line 120 initiates each of the 400 increments; alternatively, line 120 could be:

```
120  TRIGGER 719
```

SPdt   Set Power step size, is identical to the SHPL code, and both are equivalent to the **[SHIFT] [POWER LEVEL]** key which is described in Figure 3-7.

The power step size can be as small as 0.05 dB, or as large as 50.00 dB. Once set, the power level can be incremented by the UP code or decremented by the DN code. Here is a BASIC example of a 120 dB, discrete power sweep at a 12 GHz CW frequency:

```
100  OUTPUT 719; "CW 12 GZ"
110  OUTPUT 719; "SP 0.05 DB"
120  OUTPUT 719; "PL -110 DB"
130    FOR N = 1 TO 2400
140    OUTPUT 719; "UP"
150    NEXT N
160  GOTO 120
```

The power sweep starts at −110 dBm, and increments in 2400 discrete, 0.05 dB steps to an end value of 10 dBm.

SWm   SWap network analyzer channels, is used in conjunction with alternate mode and causes the foreground and background instrument states to be transposed.

Foreground refers to the present operating configuration of the HP 8340B/41B as seen on the front panel displays and indicators, while background is the configuration that is derived from one of the SAVE/RECALL registers 1-9. When the HP 8340B/41B is alternating between the foreground and background configurations only the foreground configuration shows on the front panel displays and indicators, even when the instrument is operating under background conditions. Hence, only the foreground configuration can be changed. SW transposes foreground and background, causing the background to show on the front panel where changes can be made.

Define the foreground configuration as state "B" at the moment that alternating operation begins: At any time thereafter, SW0 causes state "A" to be the front panel state, while SW1 causes state "B" to be the front panel state.

SW does not change any of the values in the SAVE/RECALL register from which the background was derived, even if the background values are changed (when alternate mode is initiated the values in the RECALL register are transferred into the background register; after this transfer, only the background register is involved in alternating operations).

TIb(b)   Test HP-IB Interface, verifies correct data transmission along the HP-IB interface. The procedure involves sending a data byte to the HP 8340B/41B, then having the HP 8340B/41B return the same byte to the computer where the out-going and incoming data is compared. In BASIC:

```
100  FOR N = 0 TO 255
110  OUTPUT 719; "TI"&CHR$(N)
120  ENTER 719 USING "#,B";  A
130  IF A <>N THEN GOSUB 500
140  NEXT N
150  PRINT "TEST COMPLETED"
.
.
.
500  PRINT "TEST FAILED"
510  PRINT "TRANSMITTED";N;"RETURNED";A
520  PRINT
530  RETURN
```

The decimal numbers 0 through 25 cover all possible bit patterns for an 8-bit byte (thus thoroughly exercising all 8 HP-IB data lines), and these numbers are concatenated onto the TI code in line 110. The image items in line 120 specify that EOL should be suppressed (#), and that variable A (an arbitrary variable) should be filled with one byte of binary data (B). In line 130, a returned value that is less than or greater than (i.e., not equal to) the transmitted value signifies an HP-IB test failure.

TLdt Time Limit, constrains the minimum allowable sweep time. The full sweep-time range of the HP 8340B/41B is 10 milliseconds minimum to 200 seconds maximum (although the minimum sweep time is frequency-span dependent, and cannot exceed a sweep rate of 600 MHz / 1 millisecond). This is a non-warranted supplemental performance characteristic. Also, HP 8341B's equipped with Option 003 (Low Harmonics) has a different maximum sweep rate. Refer to the Option 003 supplement for the actual value. TL sets a limit on the minimum sweep time, with that limit ranging from 10 milliseconds to 40 seconds. For example,

```
100  OUTPUT 719; "TL15SC"
```

changes the permissible sweep-time range to 15-200 seconds. STAU is normally used to obtain the fastest possible sweep time for a given frequency span; however, AU will not override a TL restriction.

TS Take Sweep, initiates a single, non-interruptible sweep. All HP-IB commands are deferred until that sweep has been completed. If TS is output while a sweep is in progress, that sweep will abruptly stop, retrace, and begin a new, non-interruptible sweep. The HP 8340B/41B will resume the previous sweep operations at the completion of the TS initiated sweep. A BASIC example:

```
100  OUTPUT 719; "IP SG"
110  PRINT "PRESS [CONTINUE] TO START THE SWEEP"
120  PAUSE
130  OUPUT 719; "TS"
140  GOTO 120
```

This completes the listing of unique HP-IB programming codes.

SYSTEM TIMING

It is sometimes necessary to determine the time required for a sequence of programming codes to be implemented by the HP 8340B/41B. This can be accomplished by the computer's set-time and read-time commands:

```
100  set-time command (computer specific)
.
.
.
200  OUTPUT 719; "...(programming codes)..."
.
.
.
300  C = read-time command (computer specific)
310  PRINT "TIME REQUIRED";C
```

For example, the clock commands for the HP 9826/9836 (926/936) computers are:

```
100  SET TIME 0
.
.
.
300  Clock = TIMEDATE MOD 86400
310  PRINT "TIME REQUIRED"; Clock
```

For the HP-80 series computers the commands are:

```
100  SETTIME 0,0
.
.
.
300  C = TIME
310  PRINT "TIME REQUIRED";C
```

Other computers use similar commands.

HP-IB PROGRAMMING TECHNIQUES FOR SPECIAL APPLICATIONS

Although the preceding programming codes are sufficient for most applications, it is possible to program the HP 8340B/41B at a fundamental level by directly manipulating signals on the HP-IB lines. The following material presents an introductory explanation of these specialized procedures, first by briefly explaining the HP-IB signal lines, followed by the computer codes necessary for direct control of the HP-IB lines.

HP-IB PIN-OUT DESCRIPTION

Figure 3-25 shows a detailed view of the HP-IB connector, with a pin-out description. Notice that HP-IB has 16 dynamic TTL-level signal lines which can be categorized into three groups: data lines, handshake lines, and system control lines. The signal level on these lines is either TTL low (a "True" condition), TTL high (a "False" condition), or floating (electrically disconnected).

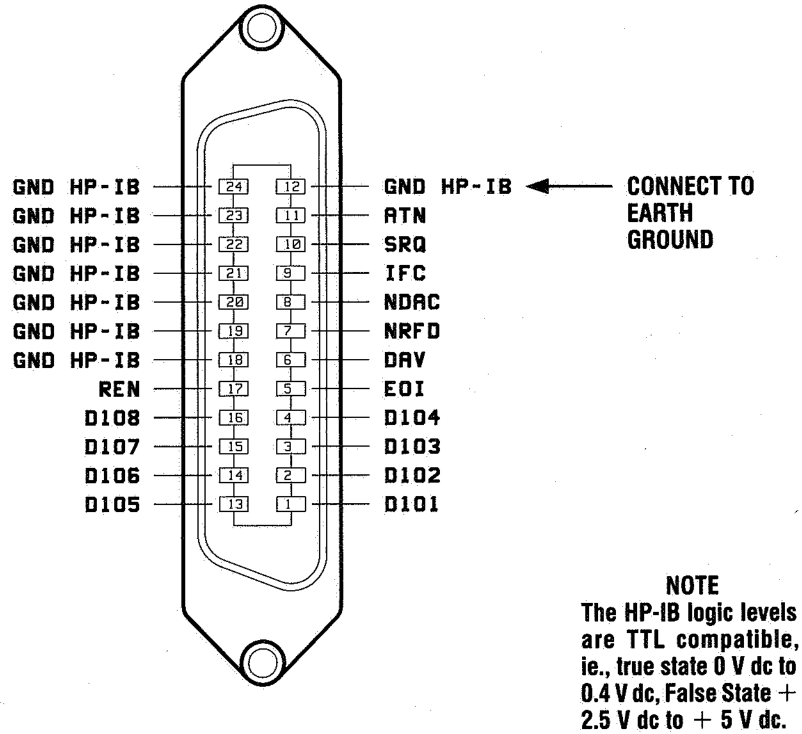


Figure 3-25. HP-IB Pin-Out

Data lines, DIO1-DIO8

These are the eight Data Input/Output lines. Data is transceived on the eight HP-IB data lines as a series of eight-bit bytes, with DIO1 being the least significant bit (LSB) and DIO8 being the most significant (MSB). The meaning of each byte is arbitrary, being different for each type of instrument. The rate of data transfer is controlled by the handshake sequence.

Handshake lines, DAV, NRFD, NDAC

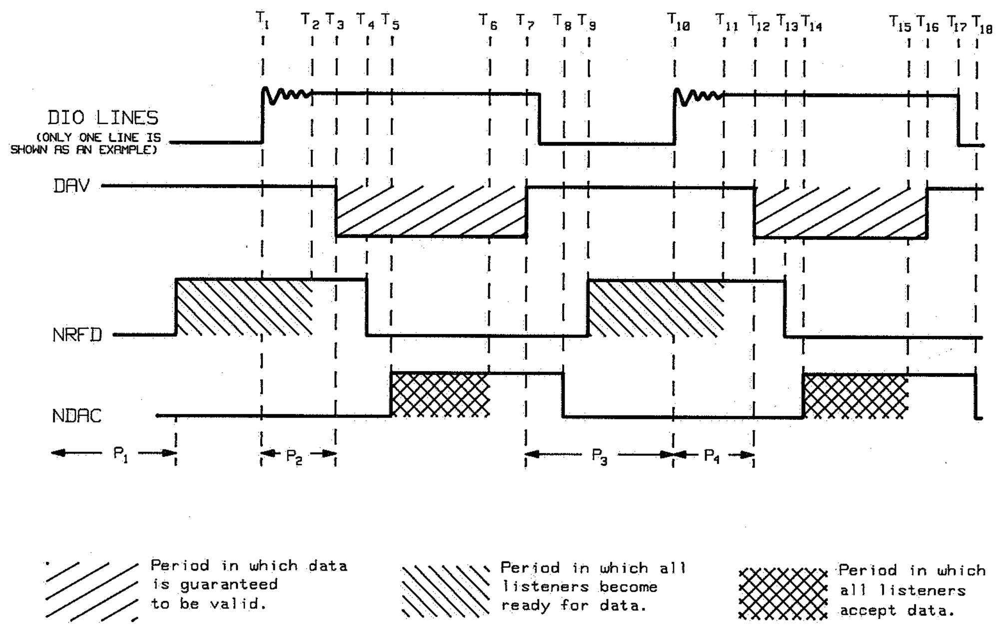
These three lines control the data transfer process.

DAV, Data Valid, line is high (False - data not valid) or low (True - data valid) to indicate the validity of the signals on the DIO lines.

NRFD, Not Ready for Data, line indicates whether the instruments receiving data are prepared to accept that data; NRFD is either low (True - the instruments are not ready for data) or high (False - the instruments are ready for data).

NDAC, Not Data Accepted, line indicates whether the data-receiving instruments have accepted the transmitted data. NDAC is either high (False - the data has been accepted) or low (True - the data has not been accepted).

Figure 3-26 illustrates a representative handshake timing sequence.



This timing diagram illustrates the handshake process by indicating the actual waveforms of the DAV, NRFD, and NDAC lines. The NRFD and NDAC signals each represent composite waveforms resulting from two or more listeners accepting the same data byte at slightly different times, which is usually caused by variations in the transmission path length and individual instrument response rates. Two cycles of the handshake sequence are shown.

The handshake process follows this typical list of events:

P_1 Source initializes DAV to high (False — data not valid). Acceptors initialize NRFD to low (True — none are ready for data), and set NDAC low (True — none have accepted the data).

T_1 Source checks for error condition (both NRFD and NDAC high), then places data byte on DIO lines.

P_2 Source delays to allow data to settle on DIO lines.

T_2 Acceptors have all indicated readiness to accept first data byte; NRFD goes high.

T_3 When the data is settled and valid, and the source has sensed NRFD high, DAV is set low.

T_4 First acceptor sets NRFD low to indicate that it is no longer ready, then accepts the data. Other acceptors follow at their own rates.

T_5 First acceptor sets NDAC high to indicate that it has accepted the data (NDAC remains low due to other acceptors driving NDAC low).

T_6 Last acceptor sets NDAC high to indicate that it has accepted the data; all have now accepted and NDAC goes high.

T_7 Source, having sensed that NDAC is high, sets DAV high. This indicates to the acceptors that data on the DIO lines must now be considered invalid. Upon completion of this step, one byte of data has been transferred.

P_3 (T_7-T_{10}) Source changes data on the DIO lines.

P_4 (T_{10}-T_{12}) Source delays to allow data to settle on the DIO lines.

Figure 3-26. HP-IB Handshake Timing (1 of 2)

T_8	Acceptors, upon sensing DAV high, set NDAC low in preparation for the next cycle. NDAC goes low as the first acceptor sets it low.
T_9	First acceptor indicates that it is ready for the next data byte by setting NRFD high (NRFD remains low due to other acceptors driving it low).
T_{11}	Last acceptor indicates that it is ready for the next data by setting NRFD high; NRFD signal line goes high.
T_{12}	Source, upon sensing NRFD high, sets DAV low to indicate that data on the DIO lines is settled and is valid.
T_{13}	First acceptor sets NRFD low to indicate that it is no longer ready, then accepts the data.
T_{14}	First acceptor sets NDAC high to indicate that it has accepted the data.
T_{15}	Last acceptor sets NDAC high to indicate that it has accepted the data (as at T_6).
T_{16}	Source, having sensed that NDAC is high, sets DAV high (as at T_7).
T_{17}	Source removes data byte from the DIO signal lines after setting DAV high.
T_{18}	Acceptors, upon sensing DAV high, set NDAC low in preparation for the next cycle. All three handshake lines return to their initialized states (as at T_1 and T_2).

Figure 3-26. HP-IB Handshake Timing (2 of 2)

System Control Lines, ATN, IFC, SRQ, REN, EOI

The remaining five lines coordinate communications between the HP-IB LISTENERS, TALKERS, and CONTROLLERS. The system control lines are used as follows:

ATN, Attention, signals Command Mode when low (True), or Data Mode when high (False). All devices must monitor ATN at all times and respond to it within 200 nanoseconds. In Command Mode, the controller is the only talker in the network, while all other devices are listening for instructions.

When a high (False) ATN signifies Data Mode, data may be transferred along the DIO lines. The meaning of each data byte is device dependent, and selected by the instrument designer.

IFC, Interface Clear, when low (True) abruptly terminates all HP-IB communications activity: All talkers and listeners are "unaddressed," and along with the controllers go to an inactive HP-IB state (the instruments' local functions are not impaired). All devices must monitor IFC at all times and respond to it within 100 µsec.

SRQ, Service Request, line is set low (True) by any instrument that needs service from the controller. An SRQ could result, for example, when an instrument is ready to transmit data upon the completion of a measurement, or from an error condition. When the controller detects an SRQ it performs a serial poll of all devices to determine which requested service, and why (polling is explained in the System Commands). The controller can mask the SRQ to prevent any inconvenient interruptions (as explained in the RE/RM programming codes). The HP 8340B/41B lights a red SRQ annunciator in the ENTRY DISPLAY when it initiates an SRQ.

REN, Remote Enable, when low (True) enables HP-IB instruments to respond to commands from the controller or other talkers, when high (False) all devices return to local operation. The HP 8340B/41B lights an amber REMOTE annunciator in the ENTRY DISPLAY when REN is true, and disables front panel control of the instrument (with three exceptions: the POWER switch can only be controlled locally, the **[LOCAL]** key re-enables front panel control unless locked-out by the controller, and the rotary **[KNOB]** can be re-enabled by an EK command from the controller). All devices msut constantly monitor REN and respond to it within 100 µsec.

EOI, End or Identify, is used in conjunction with ATN: When ATN is high (False) EOI goes low (True) to indicate the end of a data transmission sequence; when ATN is low (True) and EOI is low (True) a parallel poll of the HP-IB instruments is performed (the HP 8340B/41B does not respond to parallel polling).

Typically, HP-IB data messages are sent as ASCII characters and are terminated with an ASCII "LF" (line feed, decimal 10). However, when blocks of binary information are being sent LF cannot safely be used as a terminator because the LF bit pattern could unintentionally occur in the middle of a data sequence. To prevent a false termination, the EOI line is used to signify the true end of a data sequence (alternatively, a byte-counting method that explicity defines the number of expected data bytes may be used).

THE TWELVE HP-IB MESSAGES

The HP-IB control, handshake, and data lines interact to transfer information between interconnected instruments. This information transfer process can be organized into 12 distinct categories which are, by convention, referred to as bus messages. These messages will be explained using the following HP-IB mnemonics:

ATN Attention HP-IB line TRUE, indicating Command operating mode.

$\overline{\text{ATN}}$ Attention line FALSE, indicating DATA transfer mode.

CA Controller active state.

CR Carriage Return ASCII decimal 13.

data One or more ASCII data bytes (the HP 8340B/41B accepts lower-case ASCII characters, which it automatically upshifts).

DCL Device Clear, returns all instruments (addressed or not addressed) to an instrument-defined state; DCL is accomplished by ASCII "DC4" (decimal 20).

GET Group Execute Trigger, initiates a simultaneous instrument-defined response from all instruments; accomplished by ASCII "BS" (decimal 8).

GTL Go To Local, returns instruments to local (front panel) control; accomplished by ASCII "SOH" (decimal 1).

LA Listener active state.

LAD Listen Address of a specific Device (see LAG).

LAG Listen Address Group (listen addresses of specified instruments). An HP-IB instrument may have any unique address in the range 00-30 (decimal). The distinction between a listen address and a talk address is made in bits 5 and 6; using address 19 as an example:

BIT	7	6	5	4	3	2	1	0
TALK	X	1	0	1	0	0	1	1
LISTEN	X	0	1	1	0	0	1	1

The corresponding ASCII codes for the available HP-IB addresses are listed in Table 3-3.

LF Line Feed, ASCII decimal 10.

LLO Local Lockout disables the instruments **[LOCAL]**-reset key; LLO is accomplished by ASCII"DCI" (decimal 17).

MLA My Listen Address (listen address of the controller).

MTA My Talk Address (talk address of the controller).

PPC Parallel Poll Configure (not used by the HP 8340B/41B).

PPU Parallel Poll Unconfigure (not used by the HP 8340B/41B).

SC System controller.

SCG Secondary command group (also abbreviated SEC).

SDC Selected Device Clear, causes addressed instruments to clear to an instrument-defined state; accomplished by ASCII "EOT" (decimal 4).

SPD Serial Poll Disable, accomplished by ASCII "EM" (decimal 25).

SPE Serial Poll Enable, accomplished by ASCII "CAN" (decimal 24). A serial polled instrument responds with a byte of information, with each bit corresponding to a specific instrument function.

TA Talker active state.

TAD Talk Address of a specified device (see LAG for related information).

TCT Take Control, transfers active controller responsibility to another instrument; accomplished by ASCII "HT" (decimal 9).

UNL Unlisten, clears bus of all listeners in preparation for assigning new listeners; accomplished by ASCII"?" (decimal 63).

UNT Untalk, unaddresses the current talker so that no talker remains on the bus; accomplished by ASCII "_" (underscore, decimal 95).

These are the 12 bus messages (refer also to the HP-IB Command Statements that have the same names as these messages):

DATA represents the actual transfer of numerical information between instruments. The previous BASIC examples used OUTPUT and ENTER for data messages; the HP-IB bus sequence for a typical OUTPUT statement is:

ATN MTA UNL LAG $\overline{\text{ATN}}$ (ASCII data) CR LF

The HP-IB sequence for a typical ENTER statement:

ATN UNL MLA TAG $\overline{\text{ATN}}$ (ASCII data) CR LF

TRIGGER causes the listening instruments to perform in instrument-defined function, such as starting a sweep. A typical HP-IB sequence:

ATN UNL LAG GET (REN line must be True before executing GET)

CLEAR causes the listening instruments to establish an instrument-specific predefined state. The HP-IB sequence:

ATN DCL (for all bus instruments)

ATN UNL LAD SDC (for an addressed instrument)

REMOTE causes listening instruments to switch from local (front panel) control to remote program control. The HP-IB sequence:

REN ATN UNL LAG

LOCAL clears the REMOTE message and causes the listening instruments to return to local control. The HP-IB sequence:

ATN UNL LAG REN GTL

LOCAL LOCKOUT prevents an instrument over-ride of remote control. The front panel **[LOCAL]** key is inoperative, and only the controller (or a hard reset by the POWER switch) can restore local control. The sequence:

REN ATN LLO

CLEAR LOCKOUT/ LOCAL causes all instruments on the bus to be removed from local lockout and to return to local control. The HP-IB sequence:

$\overline{\textbf{REN}}$

REQUIRE SERVICE (SRQ) can be sent by an instrument at any time to signify that attention is required from the controller. The HP-IB sequence:

SRQ

The SRQ is held true until the instrument no longer needs service, or until a poll is conducted to determine the nature of the SRQ.

STATUS BYTE is an 8-bit byte of information from an addressed instrument, with each bit signifying the status of a specific instrument. The HP-IB sequence:

ATN UNL LAD SPE $\overline{\text{ATN}}$ (data byte) CR LF ATN SPD

STATUS BIT is a parallel poll of the bus instruments. The HP 8340B/41B does not respond to parallel polling.

PASS CONTROL transfers active control of the bus from one controller to another. The HP-IB sequence:

ATN UNL TAD TCT

ABORT terminates all bus transactions, and causes all instruments to listen for a command from the controller. The HP-IB sequence:

IFC REN $\overline{\text{ATN}}$

This completes the 12 HP-IB messages.

Table 3-3. The Standard ASCII Code (1 of 3)

ASCII	HP-IB DIO LINES 8 7 6 5 4 3 2 1	Octal	Decimal	Hexadecimal	HP-IB
NUL	X 0 0 0 0 0 0 0	000	000	00	
SOH	X 0 0 0 0 0 0 1	001	001	01	GTL
STX	X 0 0 0 0 0 1 0	002	002	02	
ETX	X 0 0 0 0 0 1 1	003	003	03	
EOT	X 0 0 0 0 1 0 0	004	004	04	SDC
ENQ	X 0 0 0 0 1 0 1	005	005	05	PPC
ACK	X 0 0 0 0 1 1 0	006	006	06	
BEL	X 0 0 0 0 1 1 1	007	007	07	
BS	X 0 0 0 1 0 0 0	010	008	08	GET
HT	X 0 0 0 1 0 0 1	011	009	09	TCT
LF	X 0 0 0 1 0 1 0	012	010	0A	
VT	X 0 0 0 1 0 1 1	013	011	0B	
FF	X 0 0 0 1 1 0 0	014	012	0C	
CR	X 0 0 0 1 1 0 1	015	013	0D	
S0	X 0 0 0 1 1 1 0	016	014	0E	
SI	X 0 0 0 1 1 1 1	017	015	0F	
DLE	X 0 0 1 0 0 0 0	020	016	10	
DC1	X 0 0 1 0 0 0 1	021	017	11	LLO
DC2	X 0 0 1 0 0 1 0	022	018	12	
DC3	X 0 0 1 0 0 1 1	023	019	13	
DC4	X 0 0 1 0 1 0 0	024	020	14	DCL
NAK	X 0 0 1 0 1 0 1	025	021	15	PPU
SYN	X 0 0 1 0 1 1 0	026	022	16	
ETB	X 0 0 1 0 1 1 1	027	023	17	
CAN	X 0 0 1 1 0 0 0	030	024	18	SPE
EM	X 0 0 1 1 0 0 1	031	025	19	SPD
SUB	X 0 0 1 1 0 1 0	032	026	1A	
ESC	X 0 0 1 1 0 1 1	033	027	1B	
FS	X 0 0 1 1 1 0 0	034	028	1C	
GS	X 0 0 1 1 1 0 1	035	029	1D	
RS	X 0 0 1 1 1 1 0	036	030	1E	
US	X 0 0 1 1 1 1 1	037	031	1F	
space	X 0 1 0 0 0 0 0	040	032	20	LA0
!	X 0 1 0 0 0 0 1	041	033	21	LA1
"	X 0 1 0 0 0 1 0	042	034	22	LA2
#	X 0 1 0 0 0 1 1	043	035	23	LA3
$	X 0 1 0 0 1 0 0	044	036	24	LA4
%	X 0 1 0 0 1 0 1	045	037	25	LA5
&	X 0 1 0 0 1 1 0	046	038	26	LA6
'	X 0 1 0 0 1 1 1	047	039	27	LA7
(	X 0 1 0 1 0 0 0	050	040	28	LA8
)	X 0 1 0 1 0 0 1	051	041	29	LA9
*	X 0 1 0 1 0 1 0	052	042	2A	LA10
+	X 0 1 0 1 0 1 1	053	043	2B	LA11
,	X 0 1 0 1 1 0 0	054	044	2C	LA12
-	X 0 1 0 1 1 0 1	055	045	2D	LA13
.	X 0 1 0 1 1 1 0	056	046	2E	LA14
/	X 0 1 0 1 1 1 1	057	047	2F	LA15
0	X 0 1 1 0 0 0 0	060	048	30	LA16
1	X 0 1 1 0 0 0 1	061	049	31	LA17
2	X 0 1 1 0 0 1 0	062	050	32	LA18
3	X 0 1 1 0 0 1 1	063	051	33	LA19
4	X 0 1 1 0 1 0 0	064	052	34	LA20
5	X 0 1 1 0 1 0 1	065	053	35	LA21
6	X 0 1 1 0 1 1 0	066	054	36	LA22
7	X 0 1 1 0 1 1 1	067	055	37	LA23
8	X 0 1 1 1 0 0 0	070	056	38	LA24
9	X 0 1 1 1 0 0 1	071	057	39	LA25
:	X 0 1 1 1 0 1 0	072	058	3A	LA26

Table 3-3. The Standard ASCII Code (2 of 3)

ASCII	HP-IB DIO LINES 8 7 6 5 4 3 2 1	Octal	Decimal	Hexadecimal	HP-IB
;	X 0 1 1 1 0 1 1	073	059	3B	LA27
<	X 0 1 1 1 1 0 0	074	060	3C	LA28
=	X 0 1 1 1 1 0 1	075	061	3D	LA29
>	X 0 1 1 1 1 1 0	076	062	3E	LA30
?	X 0 1 1 1 1 1 1	077	063	3F	UNL
@	X 1 0 0 0 0 0 0	100	064	40	TA0
A	X 1 0 0 0 0 0 1	101	065	41	TA1
B	X 1 0 0 0 0 1 0	102	066	42	TA2
C	X 1 0 0 0 0 1 1	103	067	43	TA3
D	X 1 0 0 0 1 0 0	104	068	44	TA4
E	X 1 0 0 0 1 0 1	105	069	45	TA5
F	X 1 0 0 0 1 1 0	106	070	46	TA6
G	X 1 0 0 0 1 1 1	107	071	47	TA7
H	X 1 0 0 1 0 0 0	110	072	48	TA8
I	X 1 0 0 1 0 0 1	111	073	49	TA9
J	X 1 0 0 1 0 1 0	112	074	4A	TA10
K	X 1 0 0 1 0 1 1	113	075	4B	TA11
L	X 1 0 0 1 1 0 0	114	076	4C	TA12
M	X 1 0 0 1 1 0 1	115	077	4D	TA13
N	X 1 0 0 1 1 1 0	116	078	4E	TA14
O	X 1 0 0 1 1 1 1	117	079	4F	TA15
P	X 1 0 1 0 0 0 0	120	080	50	TA16
Q	X 1 0 1 0 0 0 1	121	081	51	TA17
R	X 1 0 1 0 0 1 0	122	082	52	TA18
S	X 1 0 1 0 0 1 1	123	083	53	TA19
T	X 1 0 1 0 1 0 0	124	084	54	TA20
U	X 1 0 1 0 1 0 1	125	085	55	TA21
V	X 1 0 1 0 1 1 0	126	086	56	TA22
W	X 1 0 1 0 1 1 1	127	087	57	TA23
X	X 1 0 1 1 0 0 0	130	088	58	TA24
Y	X 1 0 1 1 0 0 1	131	089	59	TA25
Z	X 1 0 1 1 0 1 0	132	090	5A	TA26
[	X 1 0 1 1 0 1 1	133	091	5B	TA27
\	X 1 0 1 1 1 0 0	134	092	5C	TA28
]	X 1 0 1 1 1 0 1	135	093	5D	TA29
^	X 1 0 1 1 1 1 0	136	094	5E	TA30
_	X 1 0 1 1 1 1 1	137	095	5F	UNT
`	X 1 1 0 0 0 0 0	140	096	60	SC0
a	X 1 1 0 0 0 0 1	141	097	61	SC1
b	X 1 1 0 0 0 1 0	142	098	62	SC2
c	X 1 1 0 0 0 1 1	143	099	63	SC3
d	X 1 1 0 0 1 0 0	144	100	64	SC4
e	X 1 1 0 0 1 0 1	145	101	65	SC5
f	X 1 1 0 0 1 1 0	146	102	66	SC6
g	X 1 1 0 0 1 1 1	147	103	67	SC7
h	X 1 1 0 1 0 0 0	150	104	68	SC8
i	X 1 1 0 1 0 0 1	151	105	69	SC9
j	X 1 1 0 1 0 1 0	152	106	6A	SC10
k	X 1 1 0 1 0 1 1	153	107	6B	SC11
l	X 1 1 0 1 1 0 0	154	108	6C	SC12
m	X 1 1 0 1 1 0 1	155	109	6D	SC13
n	X 1 1 0 1 1 1 0	156	110	6E	SC14
o	X 1 1 0 1 1 1 1	157	111	6F	SC15
p	X 1 1 1 0 0 0 0	160	112	70	SC16
q	X 1 1 1 0 0 0 1	161	113	71	SC17
r	X 1 1 1 0 0 1 0	162	114	72	SC18
s	X 1 1 1 0 0 1 1	163	115	73	SC19
t	X 1 1 1 0 1 0 0	164	116	74	SC20

Table 3-3. The Standard ASCII Code (3 of 3)

ASCII	HP-IB DIO LINES 8 7 6 5 4 3 2 1	Octal	Decimal	Hexadecimal	HP-IB
u	X 1 1 1 0 1 0 1	165	117	75	SC21
v	X 1 1 1 0 1 1 0	166	118	76	SC22
w	X 1 1 1 0 1 1 1	167	119	77	SC23
x	X 1 1 1 1 0 0 0	170	120	78	SC24
y	X 1 1 1 1 0 0 1	171	121	79	SC25
z	X 1 1 1 1 0 1 0	172	122	7A	SC26
{	X 1 1 1 1 0 1 1	173	123	7B	SC27
|	X 1 1 1 1 1 0 0	174	124	7C	SC28
}	X 1 1 1 1 1 0 1	175	125	7D	SC29
~	X 1 1 1 1 1 1 0	176	126	7E	SC30
DEL	X 1 1 1 1 1 1 1	177	127	7F	SC31

ASCII Abbreviations

NUL	null	**VT**	vertical tab	**SYN**	synchronous idle
SOH	start of heading	**FF**	form feed	**ETB**	end transmission block
STX	start text	**CR**	carrige return	**CAN**	cancel
ETX	end text	**SO**	shift out	**EM**	end of medium
EOT	end of transmission	**SI**	shift in	**SUB**	substitute
ENQ	enquiry	**DLE**	data link escape	**ESC**	escape
ACK	acknowledge	**DC1**	direct control 1	**FS**	form separator
BEL	bell	**DC2**	direct control 2	**GS**	group separator
BS	backspace	**DC3**	direct control 3	**RS**	record separator
HT	horizontal tab	**DC4**	direct control 4	**US**	unit separator
LF	line feed	**NAK**	negative acknowledge	**DEL**	delete

HP-IB Abbreviations

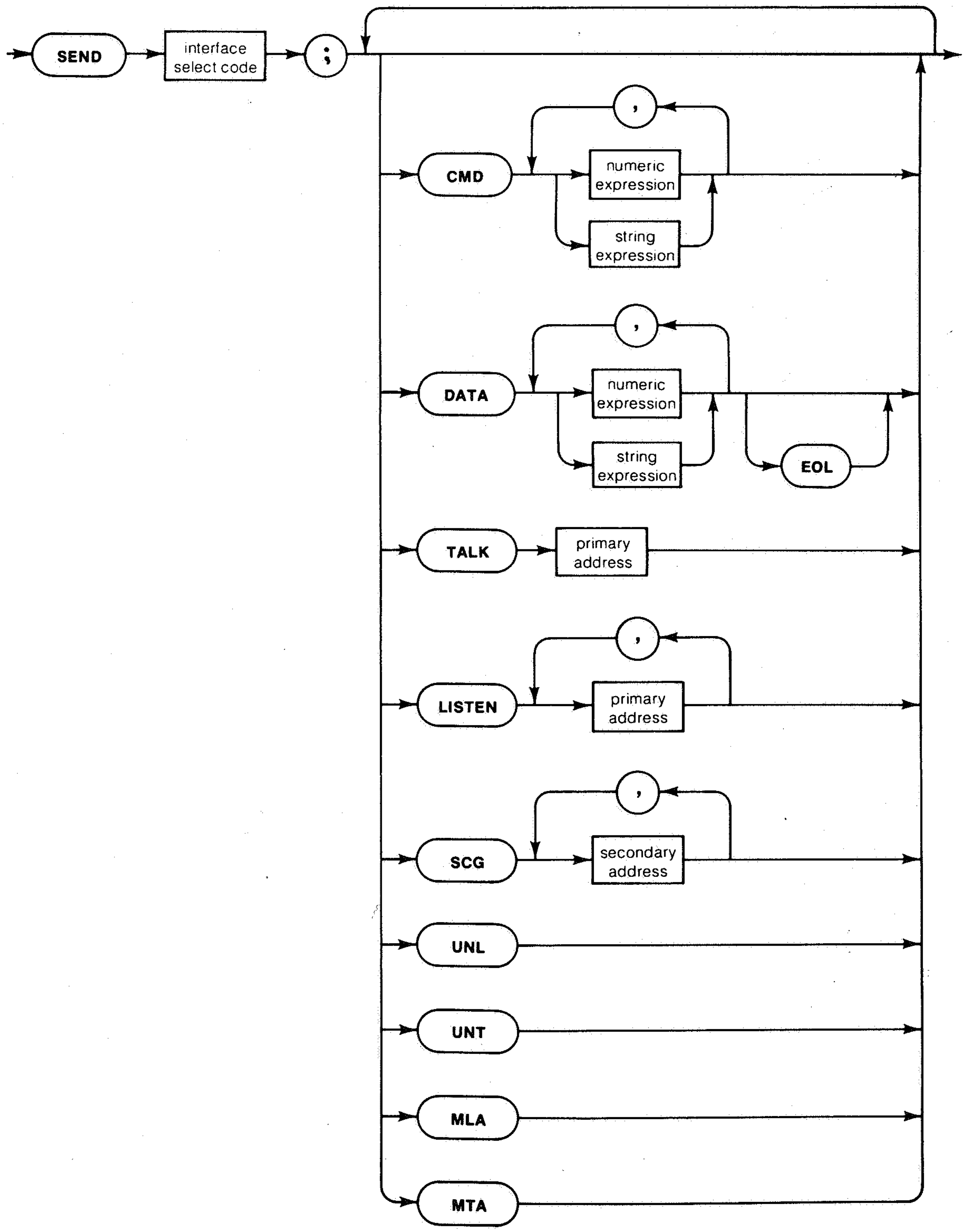
GTL	go to local	**LLO**	local lockout	**LAO-30**	listen address
SDC	selected device clear	**DCL**	device clear	**UNL**	unlisten
PPC	parallel poll configure	**PPU**	parallel poll unconfigure	**TAO-30**	talk address
GET	group execute trigger	**SPE**	serial poll enable	**UNT**	untalk
TCT	take control	**SPD**	serial poll disable	**SCO-31**	secondary command

COMPUTER ACCESS OF HP-IB LINES

The I/O Programming Guide for the specific computer being used must be consulted for detailed information about direct access to the HP-IB lines; however, the intent of the following discussion is to introduce the fundamental procedures involved in this type of programming. After this introduction, the programmer will know what specific information to look for in the computer's I/O Programming Guide.

Sending HP-IB Messages

The BASIC statement used to transmit information directly to the HP-IB lines is the SEND statement, which has this syntax:



The secondary command DATA sets the ATN line False; all other secondary commands (CMD, TALK, LISTEN, UNL, MLA, and MTA) set ATN True. Information accompanying the SEND statement can be either ASCII encoded characters that correspond to the HP-IB functions (see Table 3-3), or computer-recognized mnemonics. For example, to read the status bytes from the HP 8340B/41B, the HP-IB sequence is:

UNL   MLA (the computer's)   TAD (HP 8340B/41B's)   SPE   (data bytes)   SPD   UNT

This sequence is accomplished, in BASIC, by using either computer-recognized mnemonics:

```
100  SEND 7; UNL  MLA  TALK 19  CMD 24
110  ENTER 7 USING "#,B";S
120  SEND 7; CMD 25  UNT
```

where CMB 24 is SPE, and CMD 25 is SPD; or the same sequence can be accomplished using ASCII encoded HP-IB information:

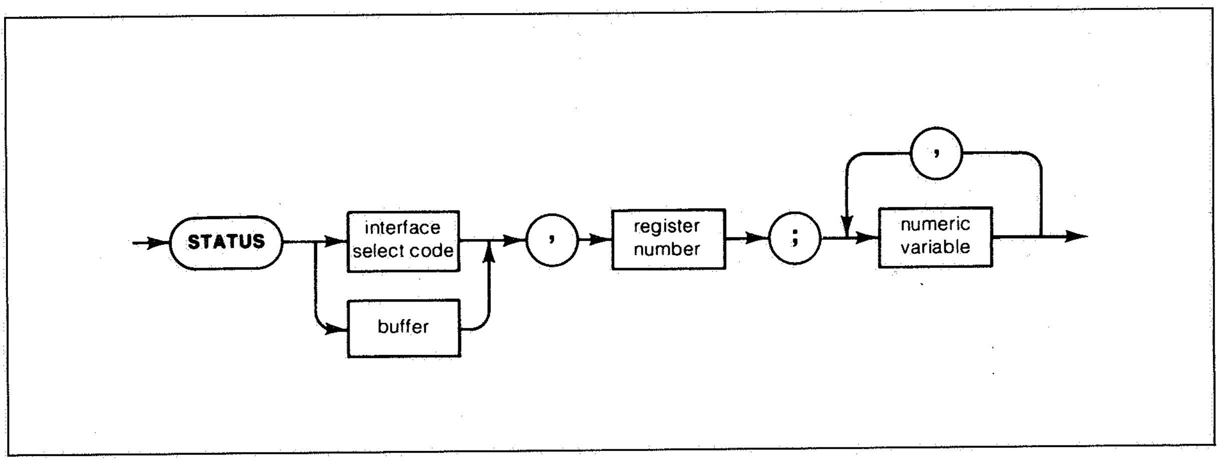
```
100  SEND 7; CMD "?5S"&CHR$(24)
110  ENTER 7 USING "#,B";S
120  SEND 7; CMD CHR$(25)& "_"
```

In line 100, ? is the ASCII code for UNL, 5 is a representative MLA, and S is TA19. In line 120, "_" (underscore) is the ASCII code for UNT. In both examples the ATN line is set True or False by the computer, depending on the context of the mnemonics, and does not require any specific commands.

(This is an illustrative example only; status bytes can be more easily read using a simple OUTPUT "OS" statement.)

Reading HP-IB Messages

The HP-IB lines are read by examining the computer's status registers, using the STATUS statement. The STATUS statement has this syntax:



The function assignment of each status register is computer specific. Figure 3-27 shows representative status register assignments, from the HP 9826 and HP-85A computers.

HP 9826/9836 (926/936) Status Register 7

Most Significant Bit

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
ATN True	DAV True	NDAC* True	NRFD* True	EOI True	SRQ** True	IFC True	REN True
Value = 32 768	Value = 16 384	Value = 8 192	Value = 4 096	Value = 2 048	Value = 1 024	Value = 512	Value = 256

Least Significant Bit

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
DIO8	DIO7	DIO6	DIO5	DIO4	DIO3	DIO2	DIO1
Value = 128	Value = 64	Value = 32	Value = 16	Value = 8	Value = 4	Value = 2	Value = 1

*Only if addressed to TALK, else not valid.
**Only if Active Controller, else not valid.

HP 85A HP-IB Status Registers

Status Register Number	Bit Number 7	6	5	4	3	2	1	0	Default Value	Register Function
SR0	0	0	0	0	0	0	0	1	1	Interface Identification
SR1	IFC	LA	CA	TA	SRQ	DCL or SDC	GET	SCG	0	Interrupt Cause
SR2	0	REN	SRQ	ATN	EOI	DAV	NDAC	NRFD	64	HP-IB Control Lines
SR3	DIO8	DIO7	DIO6	DIO5	DIO4	DIO3	DIO2	DIO1	Not Applicable	HP-IB Data Lines
SR4	0	0	SC	A4	A3	A2	A1	A0	53	HP-IB Address/ System Controller
SR5	SC	LA	CA	TA	SPE	Parity Error	REN	LLO	160	State Register
SR6	0	0	0	SC5	SC4	SC3	SC2	SC1	0	Secondary Commands

Figure 3-27. Representative Status Registers

Here is a BASIC example of reading the status registers:

```
100  FOR N = 0 TO 6
110  STATUS 7,N; S
120  PRINT "STATUS REGISTER"; N
130  PRINT
140    FOR J = 0 TO 7
150    PRINT "BIT";J;"=";BIT; (S,J)
160    NEXT J
170  PRINT
180  NEXT N
```

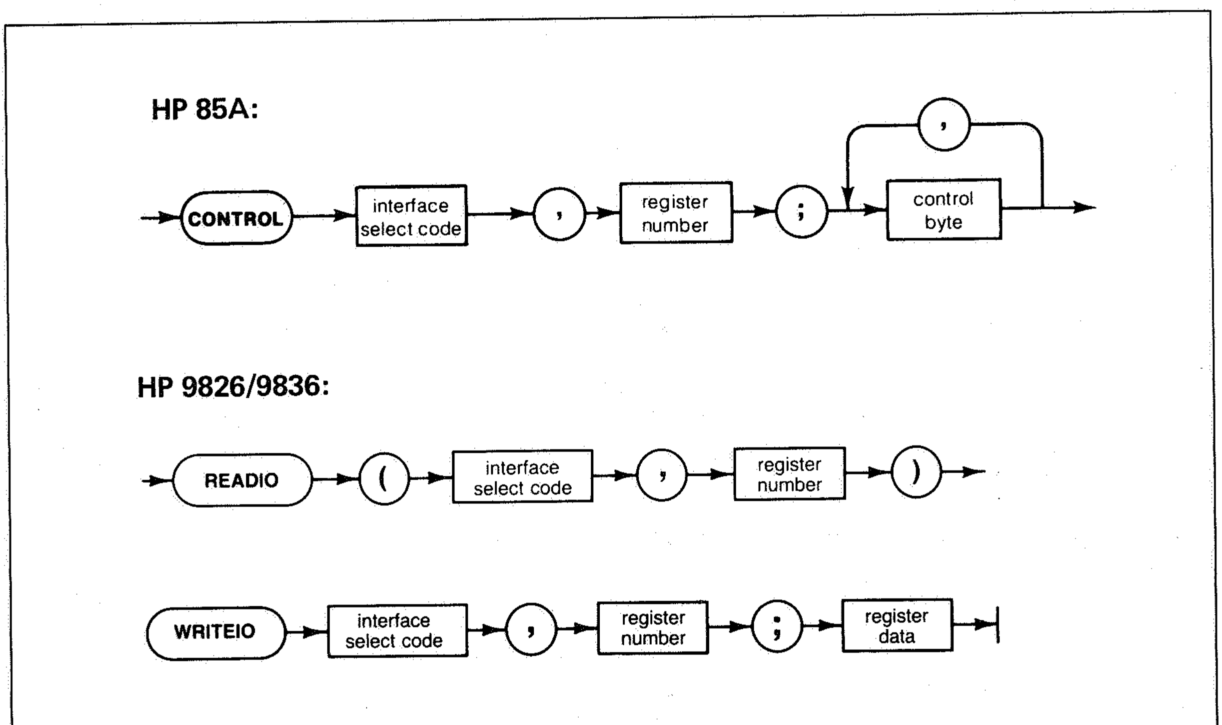
Direct Writing to the HP-IB Lines

The final programming technique covered in this manual involves direct writing to the HP-IB data, handshake, and control lines. This is very advanced programming, and should be attempted only by experienced programmers who are thoroughly familiar with the HP 8340B/41B and HP-IB protocols.

CAUTION

Bus malfunctions or damage can result from errant applications of direct writing to HP-IB lines.

Direct writing to the HP-IB lines is accomplished by the CONTROL statement, which has this syntax:



The CONTROL statement (ASSERT, READIO/WRITEIO are related statements used by some computers) is used to send information to the computer's control registers, which have bit patterns that correspond to the HP-IB lines. The bit pattern of the control registers is computer specific; Figure 3-28 shows representative control registers from the HP 9826 and HP-85A computers.

HP 85A HP-IB Control Registers

Register Number	Bit Number 7	6	5	4	3	2	1	0	Default Value	Register Function
CR0	X	X	X	X	Odd	Even	Always One	Always Zero	0	Parity Control
CR1	IFC	LA	CA	TA	SRQ	DCL or SDC	GET	SCG	0	Interrupt Mask
CR2	X	REN	SRQ	ATN	EOI	DAV	NDAC	NRFD	Not Applicable	HP-IB Control Control Lines
CR3	DIO8	DIO7	DIO6	DIO5	DIO4	DIO3	DIO2	DIO1	Not Applicable	HP-IB Data Lines

HP 9826/9836 (926/936) HP-IB READIO Register 23 — Control-Line Status

Most Significant Bit — Least Significant Bit

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
ATN True	DAV True	NDAC* True	NRFD* True	EOI True	SRQ** True	IFC True	REN True
Value = 128	Value = 64	Value = 32	Value = 16	Value = 8	Value = 4	Value = 2	Value = 1

*Only if addressed to TALK, else not valid.
**Only if Active Controller, else not valid.

HP 9826/9836 (926/936) HP-IB READIO Register 31 — Bus Data Lines

Most Significant Bit — Least Significant Bit

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
DIO8	DIO7	DIO6	DIO5	DIO4	DIO3	DIO2	DIO1
Value = 128	Value = 64	Value = 32	Value = 16	Value = 8	Value = 4	Value = 2	Value = 1

HP 9826/9836 (926/936) HP-IB WRITEIO Register 31 — Data-Out Register

Most Significant Bit — Least Significant Bit

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
DIO8	DIO7	DIO6	DIO5	DIO4	DIO3	DIO2	DIO1
Value = 128	Value = 64	Value = 32	Value = 16	Value = 8	Value = 4	Value = 2	Value = 1

Figure 3-28. Representative Control Registers

The bits in the control registers are set using this statement:

CONTROL 7, (register number); (decimal value of True bits)

To set the bits (and the corresponding HP-IB lines True (=1), use their corresponding decimal values:

BIT	7	6	5	4	3	2	1	0
DECIMAL	128	64	32	16	8	4	2	1

For example,

```
100  CONTROL 7,2; 16
```

sets bit 4 (decimal 16) of control register 2 True, while all other bits in that register are set False. As another example,

```
100  CONTROL 7,3; 63
```

sets bits 0-5 True (decimal 1+2+4+8+16+32 = 63) and bits 6-7 False.

This completes the HP-IB programming information.

USING THE 8340B/41B POWER CONTROL AND MODULATION SYSTEMS.

The preceding explanations of the power control and modulation functions are sufficient for the majority of applications; however, to extract the utmost performance from this instrument the following special information might be helpful.

INTERNAL LEVELING

The RF Output is controlled by the automatic level control (ALC) circuit, otherwise referred to as the leveling loop. Figure 3-29 shows a simplified diagram of this system. The leveling loop is a feedback control system, in which the output power is measured and compared to the desired level. If the two are not equal the loop changes the output until they are equal.

The two inputs labeled "ALC INPUTS" convey the desired power level. One of these is a voltage derived from the power value shown in the ENTRY DISPLAY. In the absence of modulation this voltage is used to set the output power level. The amplitude modulation (AM) input causes the output to increase or decrease relative to this level. (The pulse modulation input is essentially an ON/OFF switch, not an ALC input.)

The RF power level from the level control circuits is referred to as the "ALC level," and is measured by a crystal detector. The DC output from this detector is fed back to the level control circuits for comparison with the ALC inputs. Since crystal detectors lose sensitivity at low power levels, the detector provides an accurate power indication for ALC levels down to −10 dBm, and is acceptable (±1dB) down to −20 dBm. The maximum amount of power available from the level control circuits varies with RF frequency, from +1 dBm specified at 26.5 GHz (HP 8340B only) to typically +21 dBm at 4.5 GHz; therefore, the level control circuits can provide continuous control of ALC levels over a maximum span of approximately −20 dBm to +20 dBm.

Coupled Mode

Since many applications require power levels less than −20 dBm, a step attentuator[1] is provided that has a range of 0 to −90 dB in 10 dB steps. Thus, power levels down to −110 dBm is achieved when the attenuator and ALC work in conjunction. Because of the attenuator, the ALC will normally be used over only a portion of its 40 dB range: Since accuracy suffers below −10dBm and at some (HP 8340B) frequencies only +1 dBm is available, the ALC is normally set between −10 and 0 dBm. To get power less than −100 dBm, the attenuator is left at −90dB, and the ALC used from −10 to −20 dBm; however, the ALC accuracy and noise performance is degraded at this level, and is the reason that some specifications apply only down to −100 dBm. At frequencies where power levels above 0 dBm are desired, the attenuator is left a 0 dB and the ALC used from 0 to +20 dBm (or whatever power is available at the RF frequency in use). The proper combination of ALC and attenuator is decided by the internal microprocessor: the user need only set the desired power in the ENTRY DISPLAY via the **[POWER]** key.

[1] HP 8340B's equipped with Options 001 or 005 are not supplied with the step attenuator.

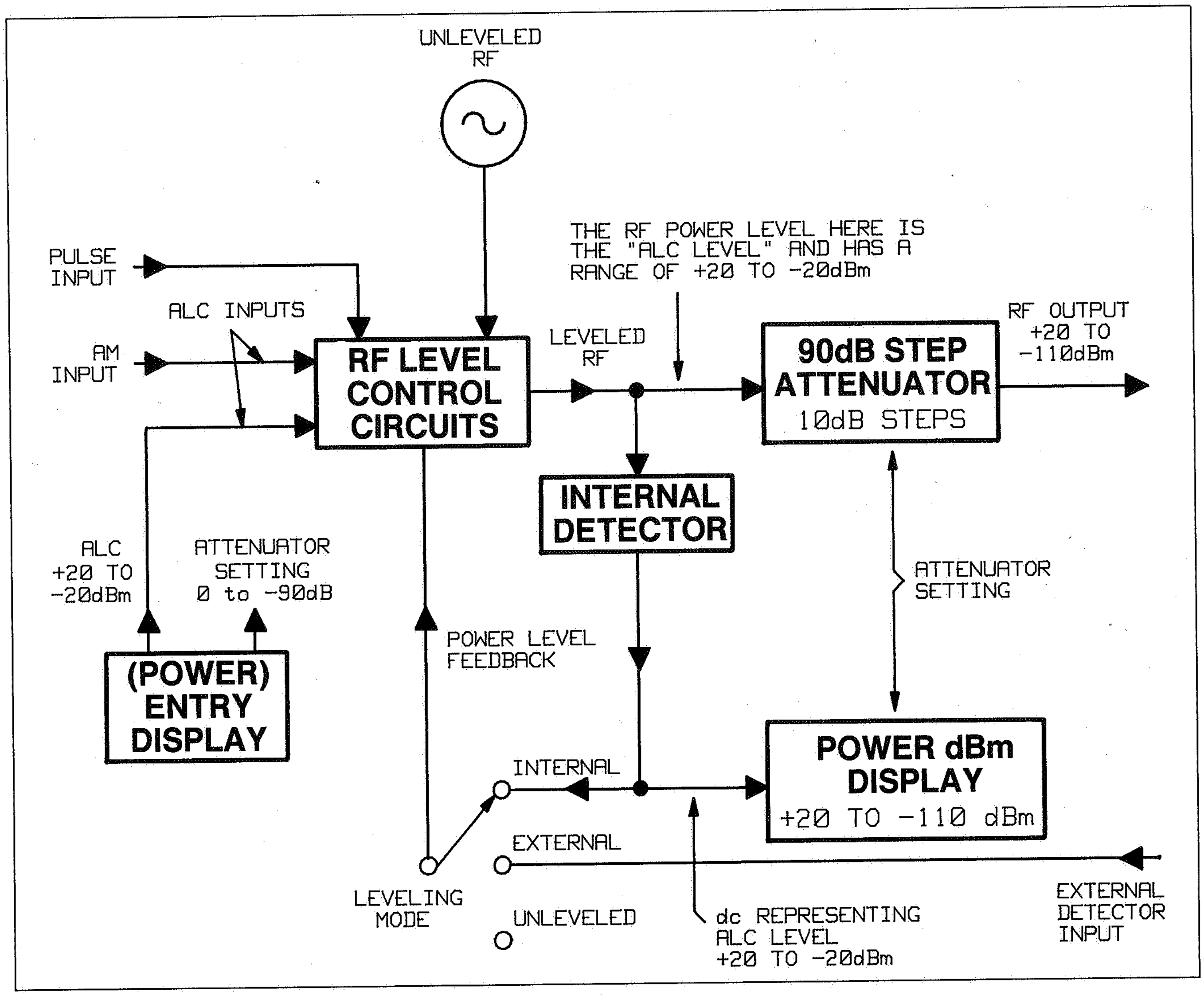


Figure 3-29. ALC Loop Block Diagram

POWER dBm Display

If the requested power is greater than can be provided, the level control loop will provide maximum available power and light the UNLEVELED annunciator. When unleveled, the output power does not equal the value shown in the ENTRY DISPLAY. The internal detector is monitoring the actual power, however, and its output voltage controls the POWER dBm display. The detector voltage is interpreted to give ALC level, and the attenuator setting is subtracted to yield actual output power, even when unleveled.

The AM input is DC coupled, and a DC input will change the output power. This change does not appear in the ENTRY DISPLAY, but the POWER dBm display accurately indicates the real output.

When the instrument is internally leveled, the UNLEVELED annunciator is off, and AM is off, the POWER dBm display simply repeats the value shown in the ENTRY DISPLAY. When externally leveled, or the UNLEVELED annunciator is on, or AM is on, the POWER dBm display indicates the ALC level and reflects the true output power. This might not agree with the ENTRY DISPLAY value, which shows the desired level in the absence of modulation.

The above should be understood when using power sweep. When the POWER dBm display is repeating the ENTRY DISPLAY, it indicates start power. If the POWER dBm display is indicating ALC level, it shows the average power over the sweep. (The circuit is heavily filtered above 5 Hz.) Since the start and stop dwell times are unequal, this averge reading has little meaning.

In a variety of situations it is possible to drive the ALC level below −20 dBm, such as putting DC into the AM input, or when externally leveled. Since the internal detector is inaccurate at these levels, the POWER dBm display would be very misleading. For that reason, and as a warning, the POWER dBm display blanks at ALC levels below −22.0 dBm. This may occur at an output power of −22 dBm, −32 dBm, −42 dBm, etc., depending on the attenuator setting.

Decoupled Mode

In some applications it is advantageous to control the ALC and attenuator separately, achieving combinations of settings which are not available in the coupled mode. Press **[SHIFT] [PWR SWP]** to achieve decoupled mode, which causes "ATTN:_____dB, ALC: _____._____dBM" to show in the ENTRY DISPLAY. The ALC setting is entered via keypad or **[KNOB]**, while the attenuator is incremented with the **[STEP]** keys. As before, the POWER dB display indicates the true, composite output power. (Note: If an entry is made in decoupled mode, and subsequently **[POWER LEVEL]** is pressed, the HP 8340B/41B reverts to coupled mode. It will set itself to the same power level, but the attenuator and ALC settings may be different.)

One use of decoupled operation is power sweep, where the output power linearly tracks the sweep voltage ramp. The HP 8340B/41B can generate power sweeps of up to 40 dB, depending on frequency. The power at the start of the sweep is set via **[POWER LEVEL]** (coupled operation) or **[SHIFT] [PWR SWP]** (decoupled operation), and the sweep range (the amount the power increases during the sweep) is entered by pressing **[PWR SWP]** followed by the desired dB sweep value. If the sweep range entered exceeds the ALC range (stop power greater than maximum available power) the UNLEVELED annunciator will light at the end of sweep. No warning is given at the time of entry. If the start power is entered via the **[POWER LEVEL]** key, the ALC is set no lower than −10 dBm, limiting available power sweep range to 30 dB at 4.5 GHz, or 11 dB at 26.5 GHz (HP 8340B). Using decoupled mode and setting the ALC to −20 dBm gives an additional 10 dB of sweep range (although at −20 dBm, start power uncertainty is degraded by ±1 dB).

Decoupled mode is also useful when working with mixers. Figure 3-30A shows a hypothetical setup where a HP 8340B/41B is providing the small signal to a mixer. The HP 8340B/41B output is −8 dBm, which in coupled mode results in ALC = −8 dBm, ATTN = 0 dB. The mixer is driven with an LO of +10 dBm, and has LO to RF isolation of 15 dB. The resulting LO feedthrough of − 5 dBm enters the HP 8340B/41B's OUTPUT port, goes through the attenuator with no loss, and arrives at the internal detector. Dependng on frequency, it is possible for most of this energy to enter the detector. Since the detector responds to its total input power regardless of frequency, this excess energy causes the leveling circuit to reduce its output. In this example the reverse power is actually larger than the ALC level, which may result in the HP 8340B/41B output being shut off.

Figure 3-30B shows the same setup, with decoupled mode used to give a −8 dBm output: ALC = +2 dBm, ATTN = −10 dB. The ALC is 10 dB higher, and the attenuator reduces the LO feedthrough by 10 dB. Thus the detector sees +2 dBm desired signal versus a possible −15 dBm undesired one. This 17 dB difference results in a maximum 0.1 dB shift in the HP 8340B/41B output level.

Reverse power is a problem with spectrum analyzers that do not have preselection capabability. Some analyzers have as much as +5 dBm LO feedthrough coming out of their RF input, at some frequencies. The effects of reverse power are less in the heterodyne band (.01 to 2.3 GHz) where the power amplifier provides some broadband matching. Similarly, from 2.3 to 26.5 GHz, reverse power that is within 10 MHz of the HP 8340B/41B's frequency may be partially absorbed by the YIG filter. If the frequency difference is small enough to be within the leveling loop bandwidth (typically 10 kHz CW, 200 kHz sweep or AM), the effect of reverse power is amplitude modulation of the HP 8340B/41B's output. The AM rate equals the difference in RF frequencies. Reverse power problems may be treated by using the unleveled mode, as described below.

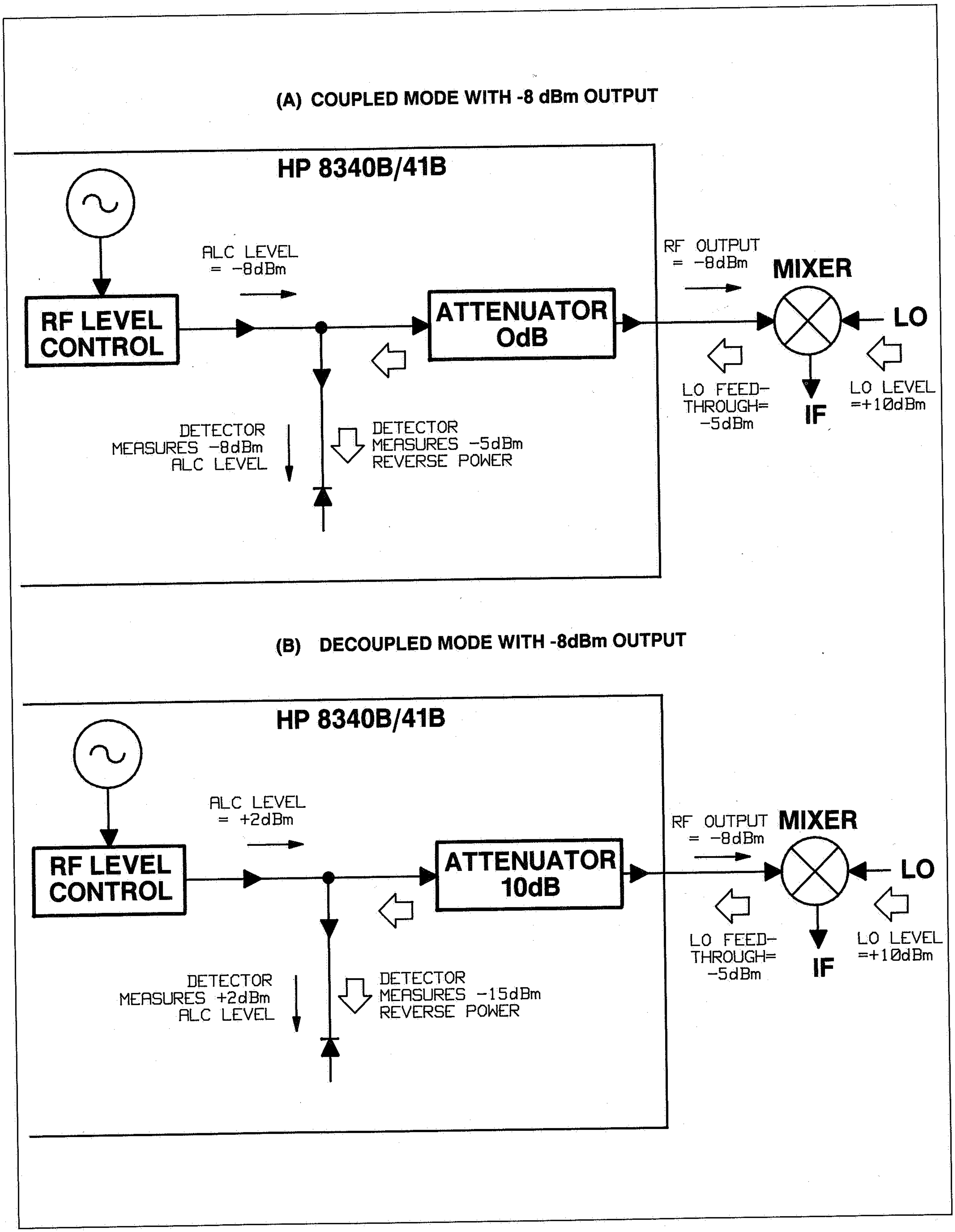


Figure 3-30. Reverse Power Effects

When using decoupled mode to set low ALC levels, some caution is necessary. At ALC = −20 dBm, the amplitude accuracy degrades by ± 1 dB. This results from temperature induced drift in the detection circuitry. Some spurious signals, such as ac power line related sidebands are worse at −20 dBm and may exceed specifications (which do not apply at ALC = −20 dBm). Despite its level uncertainty, the output power at ALC = −20 dBm is more stable than a normal power meter. In checking the output, care must be taken to zero the meter with the HP 8340B/41B's RF turned off. Pressing the "sensor zero" button on a power meter does not assure that it is zeroed, since the display on some meters is blank for inputs below −30 dBm when in the "dBm" mode. Selecting the "WATT" mode keeps the display alive, and the user can then see if the meter is really zeroed (press the zero button several times if necessary).

When the HP 8340B/41B's heterodyne band (.01 to 2.3 GHz) is in use, approximately −30 dBm of broadband noise is generated along with the desired signal. If the desired signal is −20 dBm and the result is measured on a power meter, the reading will be about 0.5 dB high. To accurately measure the signal, the power meter must be zeroed in the presence of the noise: Connect the power meter, then press **[RF]** to shut off any RF output; although the RF is off, the noise is still present and the power meter can now be zeroed. When going to frequencies above 2.3 GHz, the meter must be re-zeroed. The broadband noise is attenuated by the step attenuator, along with the desired signal. Noise makes a 0.05 dB contribution at ALC = −10 dBm.

UNLEVELED MODE

The HP 8340B/41B has a power control mode in which the leveling feedback loop is opened. The ALC inputs are used to directly control the RF modulator. Pressing **[SHIFT] [METER]**activates this mode. The annunciators on the leveling mode keys are extinguished, the UNLEVELED annunciator is lighted, and the ENTRY DISPLAY shows: ATTN:_____dB, MOD:_____._____dB. As with the decoupled mode, the attenuator is set via the **[STEP]** keys, and the modulator entry is made with keypad or **[KNOB]**. The entry range is 0 to −100 dB. The modulator entry is an approximately calibrated relative indication, because the modulator's gain and maximum output change with frequency. See Figure 3-31.

AM works in this mode with unspecified distortion. Pulse modulation works. Power sweep works with linearity as depicted in Figure 3-31. The POWER dBm display still indicates actual output power. As with other leveling modes, it indicates the sum of "ALC level" and attenuation, with useful accuracy down to ALC levels of − 20dBm. Sweeps will, of course, be unleveled. When in the unleveled mode, there is no feedback stabilization of power, and its stability versus time and temperature is unspecified.

This mode is useful for signal tracing while troubleshooting the HP 8340B/41B. It is also useful in some pulse modulation applications, as explained in that section. It can also be used to output in the presence of large reverse power (a problem described under "decoupled mode"). To do so, the reverse power's effect on the POWER dBm display must be eliminated by shutting that power off, or temporarily setting the HP 8340B/41B's attenuator to a high value. Then, in the unleveled mode (SHIFT METER), use the knob to set the desired ALC level via the power dBm display (remember to mentally compensate for any attenuation in use). Then remove attenuation or turn on the reverse power. In the presence of reverse power, the POWER dBm display will change to an incorrect value, but the output power will be as previously set.

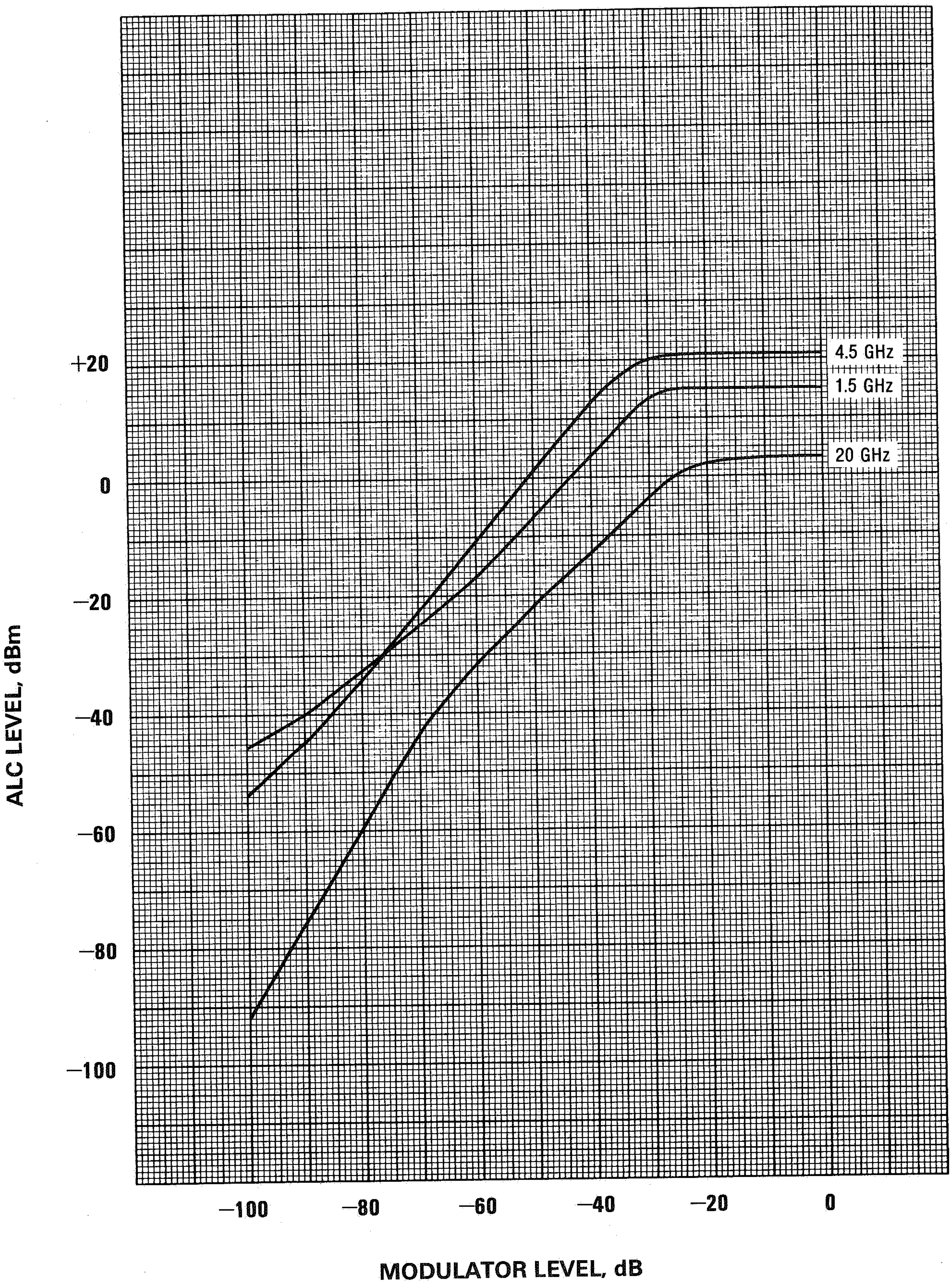


Figure 3-31. Typical Unleveled Modulation Response

POWER SEARCH

Unleveled mode may also be accessed by pressing **[SHIFT] [INT]**. The ENTRY DISPLAY now reads "POWER SEARCH ______dBm" and the "INTERNAL" annunciator comes on. The power reading that appears is the same as the internal leveling power, and it can be changed via keypad, **[KNOB]**, or **[STEP]** keys. In this mode, the instrument is unleveled as in the **[SHIFT] [METER]** mode, but the microprocessor automatically searches out the correct power level. This search occurs with each power entry change or frequency change, and requires about 200 ms. Once the search is completed, the instrument behaves exactly as with **[SHIFT] [METER]**. In this mode the attenuator is set automatically. For decoupled operation while unleveled, the **[SHIFT] [METER]** mode must be used.

EXTERNAL LEVELING

In externally leveled operations, the output power from the HP 8340B/41B is detected by an external sensor. The output of this detector is returned to the HP 8340B/41B's leveling circuits, and the output power is automatically adjusted to keep the power constant at the point of detection. Figure 3-32 shows a basic external leveling arrangement. The output of the detected arm of the splitter or coupler is held constant. if the splitter response is flat, then the output of the other arm will be constant also. This arrangement offers superior flatness over internal leveling, especially if long cables are involved. For best flatness a good resistive splitter with power meter detection should be used.

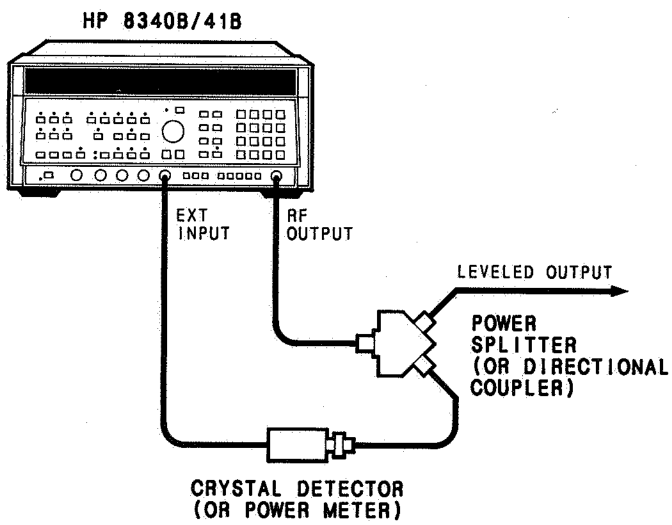


Figure 3-32. Typical External Leveling Hookup

Reference to Figure 3-29 inciates that when externally leveled, the power level feedback is taken from the external detector input rather than the internal detector. This feedback voltage is what the loop is trying to control. For a given ALC input, the loop will adjust its output until the feedback is, for instance, 10 mV. The type of coupler or detector has no influence on this — if the loop is able, it will drive the feedback to the requested level. Since there is no inherent relationship between ALC input and the amount of externally leveled RF power, the power level ENTRY DISPLAY shows the feedback voltage which the loop is seeking. This voltage is called the reference voltage and is displayed alongside the attenuator setting as ATTN: ______dB, REF:______.______dBV. The entry units are dBV (dB relative to 1 volt), where 1.00 V = 0dBV, 0.1 V = −20 dBV, etc. As with the decoupled mode of internal leveling, the REF is set with the keypad or **[KNOB]** while the attenuator is set with the **[STEP]** keys. The attenuator will normally be left at 0 dB. Its use is described below.

The reference voltage may be set over a range of −66 dBV (.0005V) to +6 dBV (2.00V). This wide range accommodates a variety of detectors and leveling situations. The input accepts either positive or negative voltages automatically. For example, with REF = 20 dBV, the loop will level with an input of either +0.1V or −0.1V. The input will accept overloads of ±25 volts with no damage. The input resistance is 1 MΩ. Figure 3-33 shows the input power versus output voltage characteristics for typical HP crystal detectors. From the chart the leveled power at the crystal detector input resulting from any reference setting may be determined. The range of power adjustment is approximately −30 dBm to +18 dBm.

Detector Characteristics

As shown in Figure 3-33, crystal detectors may be characterized by three operating regions. In the square law region (Pin <−20 dBm) the output voltage is proportional to the square of the input voltage, in other words, proportional to input power. In the linear region (Pin >+5 dBm) the output voltage is directly proportional to the input voltage. Because of this, when leveling in the linear region a 1 dB reference change causes a 1 dB power change, while in square law a 1 dB reference change causes a 1/2 dB power change. This should be understood when using power sweep or AM. The power sweep function will sweep the reference by up to 40 dB, but if a square law detector is being used, the power will only sweep 20 dB. The power sweep will only be linear if the operation is entirely in square law or entirely in linear. In the transition region, the power sweep will be non-linear. As may be seen in Figure 3-33 by drawing a line between −10 dBV and −50 dBV, the worst deviation from a straight line is 3 dB of reference voltage, or 2 dB of RF power. The amplitude modulation system is designed to be linear with a square law detector. With a linear detector, the modulation depth will be more than expected, and there will be significant distortion.

HP power meters have a rear panel output ("recorder" output) which responds linearly with power. The output is +1.00V for full scale on whatever range is selected +.50V for 3 dB below full scale, +.10V for 10 dB below full scale. These numbers may be seen directly on the 0 −1 "WATTS" scale on an analog power meter (e.g., HP 432, 435). This response is the same as a square law detector, so all the comments above for such detectors apply to power meters.

Setting the desired power with a non-autoranging meter (HP 432, 435) is straightforward. Assume +3 dBm is desired at the power sensor. Set the power meter on the +5 dBm range, so the desired power is 2 dB below full scale. Since the RF power changes 1/2 dB for each 1 dB reference change, set the reference for −4 dBV.

Auto ranging meters (e.g., HP 436) must be used in their range hold modes to prevent range change during blanking or other RF-off intervals. To lock the meter to the desired range, internal leveling must be used. Adjust the HP 8340B/41B output power until the meter is on the desired power range, then press range hold. As an example, consider the HP 436: The HP 436 changes ranges every 10 dB, so if −8 dBm is desired, the reference must be set for 8 dB below full scale (REF = 16 dBV) with the HP 436 locked on the −10 to 0 dBm range. (Caution: the HP 436 range change circuits have intentional hysteresis. Setting the power to 0 dBm may place the meter on either the −10 to 0 range or the 0 to +10 range. For no ambiguity, force the meter to the middle of the range (−5 dBm, +5 dBm, etc.), then press range hold.)

POWER dBm Display used with the Attenuator

Some external leveling applications require low output power from the HP 8340B/41B, for example, leveling the output of a 30 dB amplifier to a level of −10 dBm. In this application, the output of the HP 8340B/41B is around −40 dBm when leveled. At some frequencies this level is beyond the range of the ALC modulator alone. If so, the OVERMOD annunciator lights. Inserting 40 dB of step attenuation results in an ALC level of 0 dBm, which is well within the range of the ALC. At 26.5 GHz, where only + 1 dBm is available (8340B), 30 dB attenuation is a better choice as it results in an ALC level of − 10dBm. This gives a margin for AM or other functions that vary the power level.

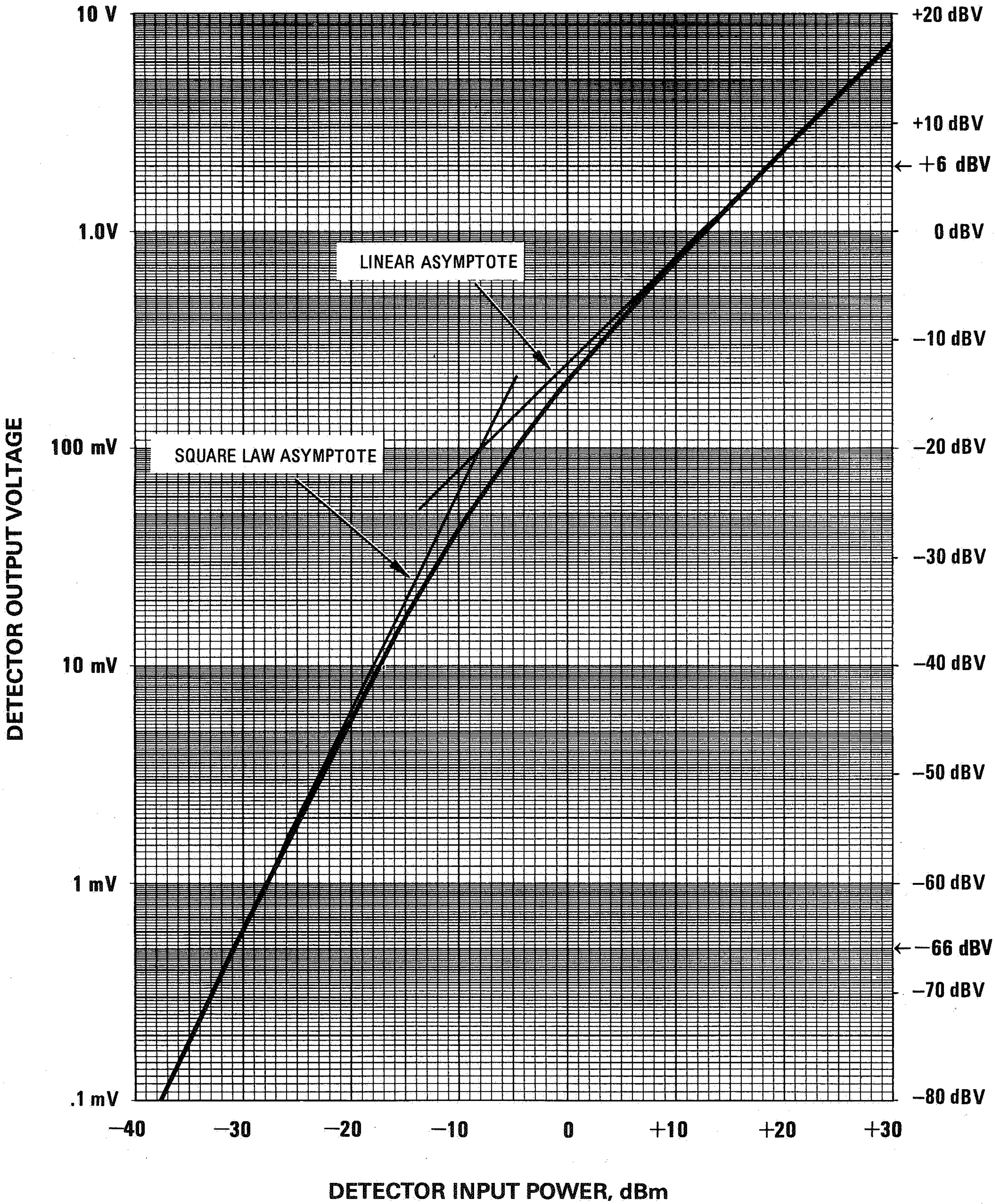


Figure 3-33. Typical Crystal Detector Response at 25°C

Referring to Figure 3-29, it is seen that when externally leveled, the POWER dBm display is still connected to the internal detector of the HP 8340B/41B. Thus, it always tells the true output power, regardless of external leveling setup. This is a useful aid to determining if the external hardware is functioning properly. In the above example, if the POWER dBm display shows −40 dBm when the amplifier ouput is leveled to −10 dBm, the user knows the gain is 30 dB. As explained in the internal leveling section above, the POWER dBm display is only accurate down to ALC levels of about −22 dBm, below which it is intentionally blanked, therefore, that display is only useful if the ALC level is forced to be greater than −22 dBm. This is done by inserting step attenuation until the display lights up again. As still more attenuation is added, the POWER dBm reading remains essentially constant as the external leveling loop holds the output level constant. With each additional 10 dB step of attenuation, the ALC level jumps 10 dB, until finally maximum available ALC level is reached and the UNLEVELED annunciator lights. For best display accuracy and minimum noise, the ALC level should be greater than −10 dBm. This is achieved by using attenuation equal to the tens digit of output power. Example: output power = −43 dBm; use ATTN. = −40 dB, ALC = − 3 dBm.

When sweeping while externally leveled, the output power changes with frequency in order to level at a distant point. The POWER dBm display tries to follow this change. Due to its heavy filtering, at fast sweep speeds the meter displays an average power level.

When using mixers, or in other situations where reverse power may be encountered, caution is necessary. See the decoupled mode and unleveled mode sections above. Reverse power into the HP 8340B/41B when externally leveled makes the POWER dBm display read incorrectly; unwanted RF energy entering the external detector causes the loop to level at the wrong power level.

Bandwidth

When externally leveled, the leveling loop bandwith differs from what it is when internally leveled. If AM is on or when sweeping with sweep time <5 seconds, the nominal loop bandwidth is:

Internal: 150 kHz

External, crystal: 80 kHz with square law detector, 40 kHz with linear detector.

External, power meter: 0.7 Hz

The significance of loop bandwidth is that it generally equals AM bandwith and influences the fastest useable sweep speed. The best way to set sweep time is to increase it until measured flatness no longer changes. For the sake of understanding — observe a plot of unleveled flatness across the band of interest. The number of ripples divided by sweep time gives the number of "ripples per second" which the leveling loop must remove. The loop bandwidth must be several times this number in order to do so. From the above it is apparent that the useable sweep time will depend on frequency range and RF hardware in use. When using long cables there will be many ripples, and their amplitude is dependent on the match at each end of the cable. Inserting 10 dB of step attenuation greatly improves the source match when externally leveled, thereby reducing the ripple amplitude.

For best stability of the leveling loop, the video bandwidth of the external detector should be 100 kHz or more when XTAL leveling is selected. The capacity of coaxial cables reduces the video bandwidth of crystal detectors. A typical point-contact detector (HP 420 series, 423A, 8470A) will work with up to 4 feet of 50Ω coax on its output. Typical HP low barrier schottky detectors (HP 423B, 8470B, 3330 series) will drive up to 40 feet of 50 Ω cable.

The above paragraph applies to square law detectors with no dc offset (Vout = 0 for Pin = 0).

In METER mode, the external leveling bandwidth is reduced to 0.7 Hz in order to allow operation with power meters. Power meters have a very slow response due to thermal delay time and heavy electrical filtering. The 0.7 Hz bandwidth assures proper operation with any HP power meter on any range.

When turning on the RF power, either when unblanking or using the RF key, the slow response of the power meter can cause serious power overshoot in some external leveling systems. This overshoot may damage active devices or some power sensors. To prevent this problem in the HP 8340B/41B, a slow turn on circuit is employed when METER leveling is selected. This circuit raises the power slowly over a period of 2 seconds. The sweep generator automatically waits for this settling time to end before beginning a sweep.

Amplitude modulation is possible when power meter leveled. The system provides linear AM and is dc coupled. For rates below 0.7 Hz, the leveling is done via the power meter sensor and behaves just like internal leveling. Above 0.7 Hz, feedback from the power meter rolls off and is replaced by feedback from the HP 8340B/41B's internal detector. Thus, high frequency envelopes are under control of the internal detector, while the power meter controls the power level. The modulation depth is still accurate and the bandwidth is nominally 80 kHz. The power sensor is not following the modulation; hence, it will average the power. When modulating with a sinusoid symmetric about 0V, the average output power increases (by 50% for 100% AM). The power sensor senses this increase and reduces the HP 8340B/41B's output until the average equals what the power was with no modulation. As long as the modulation depth remains constant across the frequency band (use moderate rates and depths), this system will level the power while providing amplitude modulation.

EXTERNAL SOURCE MODULE LEVELING

The HP 8340B/41B provides an external leveling mode, for use with compatible Hewlett-Packard instruments, which provides leveling at a remote location along with power calibration and flatness compensation. Compatible instruments are the HP 83550 series millimeter-wave source modules when driven by an HP 8349B Microwave Amplifier. The HP 8349B may also be used in a stand-alone amplifier configuration. Refer to an appropriate HP 83550 mm-wave source-system guide for interconnect instructions.

Once the HP 8340B/41B - HP 8349B - HP83550 series instruments are hooked up, press **[SHIFT] [XTAL]** on the HP 8340B/41B. This causes "EXT MODULE POWER: XX.XX dBm" to be displayed in the ENTRY DISPLAY, which will accept power level changes via the **[KNOB] [STEP]** keys or ENTRY keyboard. The HP 8340B/41B will accept power level requests from −20 to +20 dBm, however, this range exceeds the operational range of existing mm-wave source modules. Refer to the mm-wave source module manual for more information.

The SHIFT XTAL mode is unlike external leveling in that the POWER dBm display indicates the output power of the remote module, not the HP 8340B/41B RF output. This mode provides all the modulation features of an internally leveled HP 8340B/41B, with performance limited by the dynamic range and leveling bandwidth of the individual source modules.

AMPLITUDE MODULATION

The HP 8340B/41B provides linear, dc coupled amplitude modulation when internally leveled or externally leveled with a square law detector or power meter. The input resistance is 600Ω whether the AM function is on or off. The sensitivity is 100% per volt ±5%. This means that +1.0 volt doubles the output voltage (+6 dB), while −1.0 volt shuts the output completely off. The input accepts ±15 V dc with no damage, and is resistor-diode clamped to protect against higher voltage transients. Most sine wave generators are calibrated in terms of RMS voltage, so 0.707 V RMS equals 1.00 V peak. The generator's output meter is accurate only if the load impedance equals the source impedance.

POWER dBm Display used with AM

The POWER dBm display on the HP 8340B/41B always tells actual output power. A dc input to the AM jack causes the power level to shift, and the display reflects this: +1.0 volt causes the display to increase 6 dB. If that much power is not available, the UNLEVELED annunciator lights and the display shows the actual output. Inputs which reduce the ALC level below −22 dBm will blank the display. Inputs of −1.0 volt or more negative shut off the output and light the OVERMOD annunciator.

The POWER dBm display is filtered so that it will not flicker for AM rates above 20 Hz. The filtering creates an average of RF voltage, which is then displayed as power in a 50Ω system (dBm, 50Ω).

Therefore, modulation inputs with no dc component do not cause the POWER dBm display to shift, and this displayed number represents the power of the unmodulated carrier. A power meter measurement of output power changes with modulation present, increasing 1.76 dB with 100% deep, sinusoidal, no dc component modulation. Attempted deep modulation at high rates causes the POWER dBm display to shift, because the AM system canot keep up with the input and the resultant high distortion causes a shift in average power.

Dynamic Range

As mentioned previously with reference to Figure 3-29, the AM input is an ALC input which does not differ in its effect from a power entry input. Therefore, the AM system is limited by where it is operating within the ALC range. In the normal "coupled" operating mode, the ALC will likely be set between −10 dBm and 0 dBm (see the preceeding pertinent section). Depending on frequency, the maximum available power is between +1 dBm (HP 8340B) and +21 dBm. The ALC is reasonably accurate down to −20 dBm, and typically is well behaved to about −30 dBm. Expressing the desired modulation depth in dB's will let the user determine the range over which the ALC loop is being exercised. Thirty percent AM creates excursions of +2.3 dB to −3.1 dB, relative to the quiescent level; 50%: +3.5 dB to −6.0 dB; 90%: +5.6 dB to −20.0 dB. (The above assumes a modulation waveform symmetric about 0 V.)

For example: Output power = −19.0 dBm. In coupled mode this results in ATTN = −10 dB, ALC = −9.0 dBm. Ninety percent modulation depth results in an ALC range of −9.0 dBm + 5.6 dB = −3.4 dBm maximum, − 9.0 dBm −20 dB = − 29.0 dBm minimum. This is within the ALC limits at any frequency but the distortion may suffer due to operation below −20 dBm. Using decoupled operation the desired output power may be set with ATTN = −20DB, ALC = +1.0 dBm. Then 90% depth swings the ALC from +6.6 dBm to −19.0 dBm. The distortion will probably be better under these conditions if +6.6 dBm is available at the frequency of interest. At some frequencies +20 dBm is available, and setting ATTN = −30 dB, ALC = +11.0 dBm may give a further improvement, especially if attempting greater than 90% depth. For minimum distortion the ALC should be used between −15 dBm and +15 dBm, but not within 2 dB of maximum available power.

On HP 8340B's operating above 23 GHz the available output power is limited: +1 dBm specified, +3 dbm typical. If the ALC is set close to 0 dBm, the headroom available for modulation is limited. Three dB excess power allows a maximum of 40% peak modulation. The available depth is not affected. Decoupled mode may be used to advantage here. For example, in coupled mode an output power of −10 dBm results in ATTN = 10 dB, ALC = 0.0 dBm. Using decoupled mode, setting ATTN = 0 dB, ALC = −10.0 dBm gives plenty of headroom with enough depth available for 90% symmetric AM. Available power can be maximized at a CW frequency by using the PEAK function.

Bandwidth for AM Applicaitons

The small signal AM bandwidth extends from dc to a −3 dB frequency of at least 100 kHz. The actual upper limit is a direct function of the loop gain of the ALC loop. The primary variable in the loop gain is the gain of the modulator, which varies with both power level and frequency. In general, the modulator gain deviates the most from nominal at power levels just below maximum, although at some frequencies the gain will deviate at lower power levels because of non-optimum YTM bias. The latter is only a problem above 7.0 GHz. The small signal (30% depth) bandwidth may be expected to vary between 100 kHz and 300 kHz as power and/or frequency is changed. The bandwidth for greater depths is less. At 90% depth expect about 1/2 the 30% bandwidth.

The above bandwidths are for internal leveling. When external leveling with a crystal detector in its square law region the bandwidth is 1/2 of the internally leveled bandwidth at the same frequency and output power level. With a crystal detector in its linear region, the bandwidth is 1/4.

The external leveling system is designed to provide linear AM when using a square law detector. The RF output follows this law:

$$V_{out} = V_o \times (V_{in} + 1).$$

This applies also to internal leveling. When externally leveled with a linear detector the relationship is:

$$Vout = Vo \times (Vin + 1)^2$$

A power meter is a square law detector, so AM with power meter leveling is linear. For bandwidth see the external leveling secton.

For simultaneous AM and pulse modulation, see the next section.

PULSE MODULATION

The HP 8340B/41B provides leveled pulse modulation over a wide range of pulse widths and rates. Characteristics such as leveling accuracy and response time vary with pulse width, pulse rate, temperature, power level, and RF frequency. In order to use the pulse leveling system to best advantage it is helpful to understand its operation and limitations.

Sample and Hold Leveling

The basic leveling loop was previously explained with reference to Figure 3-29. Fundamental to its operation is the internal detector which measures the RF amplitude. The leveling performance is limited by the accuracy of this measurement. The most difficult aspect of leveled pulse modulation is measuring the amplitude of a very narrow RF pulse.

Figure 3-34 is a block diagram of the detector circuitry, with waveforms. Trace 1 is the pulse modulation input signal to the HP 8340B/41B. It controls a fast RF modulator which is either full on or full off. The amplitude when on is controlled by the linear modulator used for CW leveling and AM. Trace 2 is the resultant RF pulse, which is the HP 8340B/41B's output. This pulse is detected by the crystal detector. It trails the pulse input by 55 nsec, representing propogation delays in the pulse modulator and its drive circuits.

The output of the crystal detector is amplified by a logarithmic amplifier (log amp). The log amp is used for several reasons, one of which is its high gain for small signals, reducing the effects of sample and hold errors. Trace 3 is the output of the log amp. The delay and relatively slow rise time are caused by the finite bandwidths of the detector and log amp. The pedestal (arrow) represents the RF amplitude. This level is captured for further processing by the sample and hold circuit (S/H), represented by the switch-capacitor combination. Trace 4 shows the signal controlling the switch, which is closed when trace 4 is high.

Trace 4 is timed to coincide with the pedestal of trace 3. This timing is done by circuitry associated with the pulse modulator and is factory adjusted for best coincidence. Since the S/H switch is closed only during trace 3's pedestal, the capacitor charges to a constant dc voltage. This voltage is the same as what comes out of the log amp during CW operation at the same power level. The capacitor is isolated by a buffer to prevent the following circuits from discharging it between pulses. The output of the buffer is compared to the ALC inputs in the same manner as with CW operation.

Figure 3-34 shows a 200 nsec pulse. If the pulse were narrowed to 100 nsec, trace 3 would not quite reach its pedestal before it begins to fall. The result is a dc output from the S/H that is smaller than it would be in CW. The ALC circuits respond by raising the RF output until that voltage is what it should be. This is the reason for poor leveling accuracy with narrow pulses. As the pulses are made narrower, their amplitude grows.

The amount of accuracy degradation as the pulses are narrowed varies with frequency, temperature, and power level. The variation with frequency and temperature is due to detector characteristics and RF envelope shape. The detector has a finite rise time determined by its output resistance and shunt capacitance. At some frequencies there is a slight amount of overshoot on the RF envelope, which tends to charge the shunt capacity faster, resulting in better narrow pulse leveling accuracy. A much more pronounced effect is due to the use of a different detector for frequencies below 2.3 GHz. The low band detector has a higher shunt capacity in order to make it function properly at low frequencies. For operation below 400 MHz, a large amount of additional capacity is switched in, enabling detector operation down to 10 MHz. Trace 3 in Figure 3-34 is representative of operation above 2.3 GHz, where pulse accuracy is within 1.5 dB at 100 nsec. From 0.4 to 2.3 GHz, the slower rise time gives a 1.5 dB specification at 200 nsec width. Operation below 0.4 GHz is not specified, but typically is within 1.5 dB at 2 μsec width.

The detector's rise time depends on its output resistance, which drops with increasing temperature. Therefore, the narrow pulse leveling accuracy improves at higher operating temperatures.

Narrow pulse accuracy is also power level dependent. Very high ALC levels reduce the detector's output resistance, improving rise time and therefore accuracy. The rise time of a log amp is dependent on signal level, degrading with small signals. In low band ($<$2.3 GHz) the log amp is faster than the detector at any ALC level above -10 dBm, so there is no degradation due to the log amp in any coupled mode operation. In high band, the log amp rise time at ALC $= -10$ dBm is slow enough to be comparable to the detector rise time. Therefore, as power is decreased, the leveling accuracy slightly degrades (narrow pulse amplitude grows relative to CW).

The leveling specifications apply to coupled operation, with no AM; in other words, ALC> -10 dBm. Using the decoupled mode or AM, the ALC level can be driven down to -20 dBm or lower. At -20 dBm, the log amp slows down enough that high band accuracy is typically 1.5 dB at 150 nsec, 3.0 dB at 100 nsec. Decoupled mode can also be used to operate the ALC at high levels and achieve better narrow pulse accuracy.

The above discussion applies to internal leveling only. Externally leveled pulse performance will, of course, depend on the detector, but even with a perfect detector the external leveling circuitry is not as fast as internal. It typically will level pulses wider than 2 μsec.

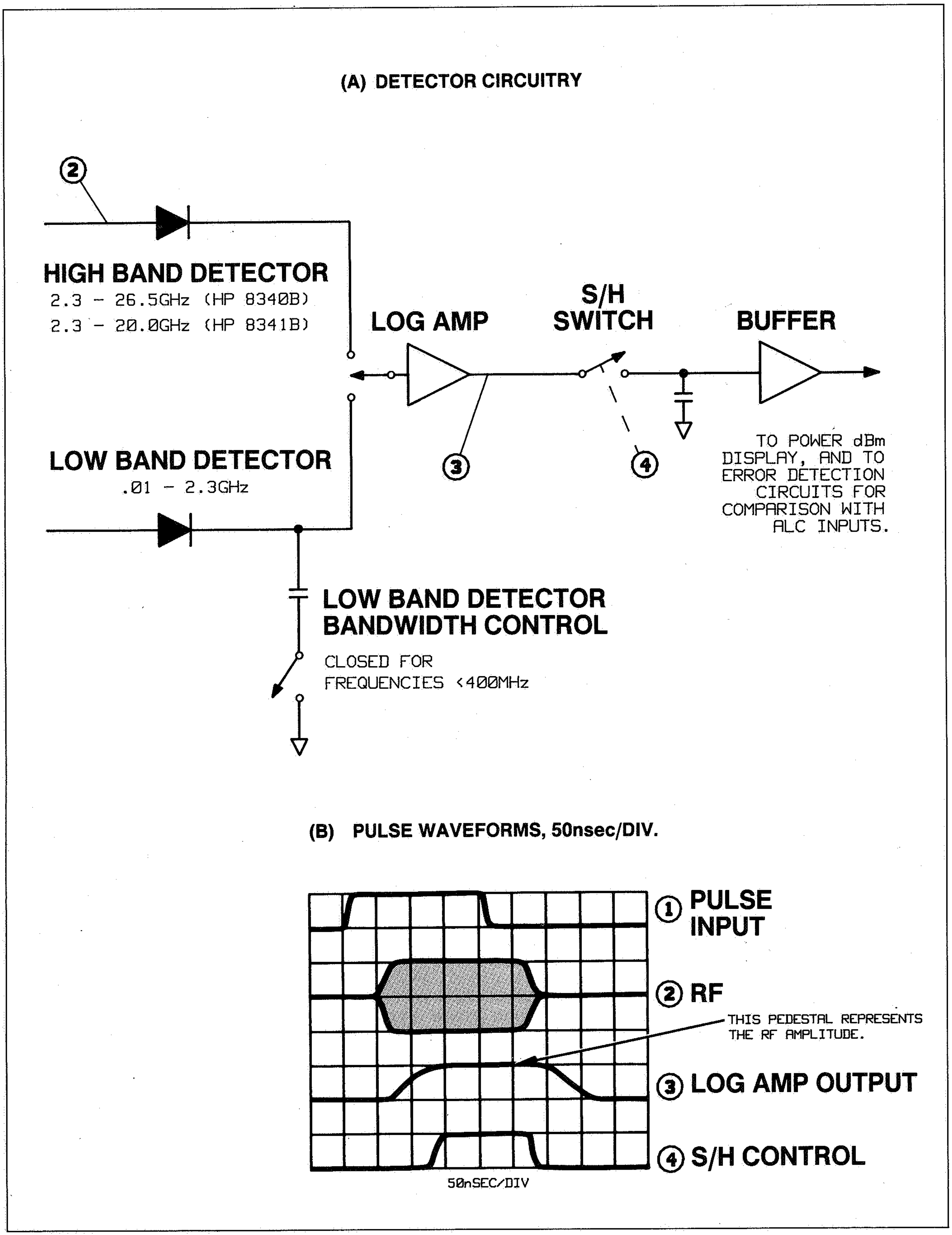


Figure 3-34. Pulse Measuring System

Another type of leveling error arises from long pulse periods (low repetition rates), or more precisely, long off times between pulses. The problem lies in the error detection and modulator drive circuits shown in Figure 3-35. On the left is the comparison point, where the ALC input is compared to the detector output. For this discussion assume the two resistors are equal in value, so if the ALC and detector voltages are equal in magnitude but opposite in polarity, the error signal will be zero. The error is fed to an integrator through the integrate/hold switch. This switch is closed continuously during CW operation. Any error signal causes the integrator output to change at a controlled rate (determined by capacitor C), changing the RF output via the linear modulator. The integrator output continues to change until its input is zero, which means the detector voltage is balancing the ALC input voltage. The time required to cancel an error is about 70 μsec (4 μsec with AM on or when sweeping fast, under which conditions a smaller value of C is switched into the circuit).

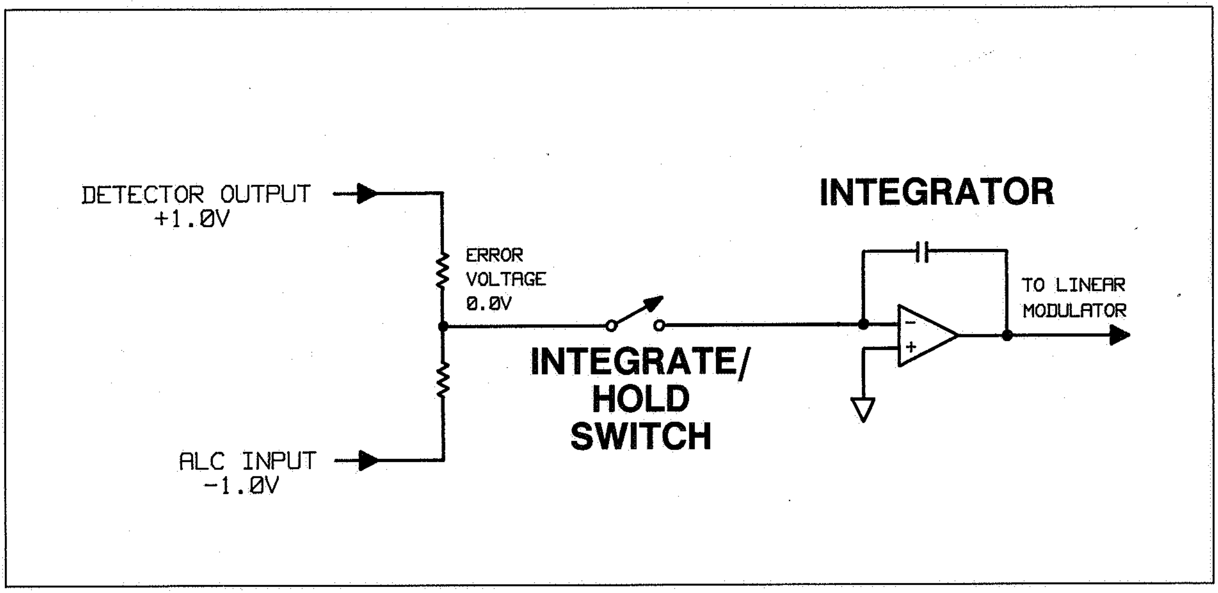


Figure 3-35. Error Detection and Modulator Drive

Consider now pulse operation with a period of 1 msec. The detector S/H measures a pulse and holds its value until the next pulse. Assuming an error is present, the integrator responds to that error, reaching the proper modulator drive in about 40 μsec. Since the detector S/H is still holding the error from the last pulse, the integrator keeps changing until the next pulse, overshooting its mark and causing instability. For this reason the integrate/hold switch is only closed during a pulse. During the period beween pulses, the switch is opened, thus the integrator input is zero so the modulator drive doesn't change. This assures that the amplitude at the beginning of the next pulse is the same as at the end of the previous pulse. Corrections take place only during the pulses, until equilibrium is reached.

Since this may cause very long response times for narrow pulses, the integrate/hold switch is held closed a minimum of 10 μs per pulse, for pulses narrower than that. This is not long enough to cause overcorrections but speeds response time for 100 ns pulses by a factor of 100.

During the period between pulses, the integrate/hold circuit is expected to hold the modulator drive constant. Because of leakage currents, the output will in fact drift, causing the pulse amplitude to be in error. This error will grow with off time and also temperature, as leakage is strongly temperature dependent. The circuit is designed worst case for <0.1 dB droop in 10 msec at an ambient temperature of 55°C. At 25°C, a typical unit drifts about 1 dB per minute. The drift may be in either direction.

Response Time

The response time to a step change in level is a function of pulse width and rate and is detailed in the specifications. The response time is a function of ALC loop bandwidth, which varies with frequency and power as explained in the AM section. The listed response characteristics apply at the minimum expected loop bandwidth. An intuitive feeling for response may be gained by the following: At minimum bandwidth in CW it takes 70 µs to respond to a change and settle to within 10% of the size of the change. In pulse mode, the same degree of settling requires 70 µs of closure of the integrate/hold switch. This may come from one of 70 µs pulse, two 35 µs pulses, etc. Any pulse less than 10 µs wide is treated as a 10 µs pulse. If the pulse *period* is less than 10 µs,the integrate/hold switch is continuously closed, so the system responds in 70 µs regardless of width or period.

Simultaneous AM and pulse modulation is provided by the HP 8340B/41B. The AM is dc coupled and linear, just as with normal CW leveling. If AM is used to exercise the ALC below −10 dBm, the narrow pulse leveling accuracy degrades as explained above. The bandwidth is given by the equation: 3dB BW = 0.35/Tr, where Tr is the resposne time to a step change described above.

Uneleveled Mode Used With Pulse Modulation

Decoupled operation may be used for dynamic range extension or any of the other uses described for CW or AM. Several pulse related problems may be treated with the unleveled **([SHIFT] [METER])** operating mode already described.

Narrow pulse leveling accuracy problems may be treated by simply not attempting to level them. The unleveled mode allows the user to control the linear modulator directly. The setting of this modulator does not change with pulse width, so the pulse amplitude remains constant as the pulse is narrowed. Pulses as narrow as 25 nsec may be produced in this mode. To set the amplitude, go to CW operation (pulse off) and set the desired power via the POWER dBm display.

As the pulses are narrowed, the POWER dBm reading drops since it is measuring the output of the detector S/H system and it is the limitations of this system which cause the narrow pulse leveling problems. The real amplitude remains essentially constant, however. In unleveled mode, the POWER dBm display accuracy is the complement of the corresponding leveled pulse accuracy; that is, −1.5 dB +0.3 dB for width = 100 to 200 ns, frequency ≥2.3 GHz. If operating close to maximum ALC output there is some amplitude drift (a few tenths of a dB) due to component self-heating when going from 100% duty cycle to low duty cycles.

Since unleveled mode does not involve the integrate/hold circuit, there is no leakage induced amplitude drift between pulses. Consequently, very long periods may be employed that are limited only by the long term drift of the modulator drive circuits. This is not negligible and should be characterized by the user at the frequency of interest. Drifts of a few dB should be expected during warmup. Since this mode is not feedback leveled, the power changes markedly with frequency.

In unleveled mode the ALC inputs control the linear modulator directly, so the response time is not dependent on pulse parameters. The response time is 70 µs maximum in CW, sweeps >5 seconds, normal AM; or 4 µs maximum for sweeps < 5 seconds. AM works in unleveled mode, but the linearity and sensitivity varies with power level and frequency. See the pertinent preceding section.

Input Characteristics

When pulse mode is activated, the HP 8340B/41B RF output is controlled by the voltage at the pulse input. The input circuit is shown in Figure 3-36. The output is off for inputs below approximately +1.5V. If the input is left open it pulls itself up to +1.8V, which will turn the output on. The HP 8340B/41B's delay and compression specifications assume an input of 0 to +3.0V, which requires sinking about 1.6 mA and sourcing about 2.7 mA respectively. The input accepts +12 V to −20 V with no damage, which is compatible with the ±6 V modulator drive of certain network analyzers. Aside from small effects on delay and compression, the waveform and amplitude of the input is unimportant, as long as it transitions from +0.5 to +2.5 V in 2 µs or less. This transition is sufficient to generate the fastest rise time. Since the input is not linear, input overshoot will not appear on the output.

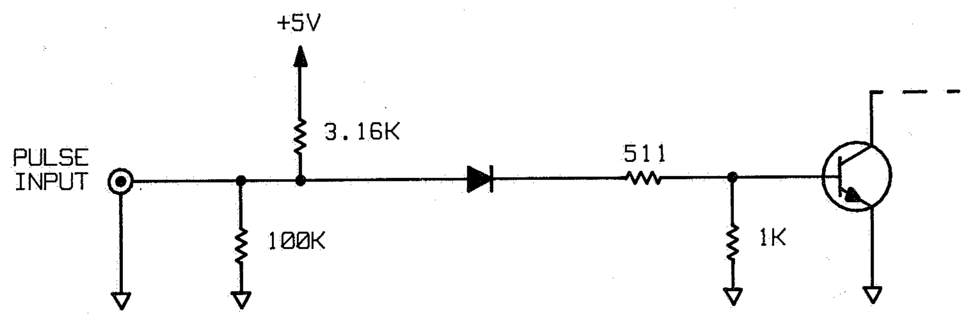


Figure 3-36. Pulse Input Circuit

Pulse Envelope

The pulse envelope produced by the HP 8340B/41B is not a perfect rectangle, rather it has finite rise time, overshoot, and video feedthrough. Below 2.3 GHz the rise time and overshoot are essentially independent of frequency, but above 2.3 GHz they are strongly influenced by the passband shape and centering of the HP 8340B/41B's tracking YIG filter. Best envelopes are normally obtained by using the PEAK function. The envelopes will change with frequency and slightly with power level.

Source Match

In the absence of attenuation with a resistive pad, a leveled microwave source generally provides a 50Ω source match at its operating frequency only. The source match at other frequencies is that of the unleveled RF hardware. In this case this is a YIG filter which is a good reflection for anything more than about 20 MHz off center, and not much better within its passband. The match is good only for signals at the output frequency plus or minus the leveling loop bandwidth. Thus a CW reflection will be absorbed. A time varying reflection, as from a reflective modulator, may contain modulation sidebands outside the leveling loop bandwidth. If so, these sidebands may be re-reflected. When pulse modulating, any reflection of the pulse will contain sidebands far outside the loop bandwidth, so the leading edge of the reflection will be re-reflected. In this manner a poorly matched system can generate very poor envelopes (anywhere in the system, not only at the source). Performance is improved by padding between the reflections. At the source, if output powers above −10 dBm are in use, coupled mode results on 0 dB RF attenuation. If enough power is available, decoupled mode may be used to improve the HP 8340B/41B's source match by inserting 10 dB attenuation and using a 10 dB high ALC level.

Video Feedthrough

Video feedthrough is a low frequency signal, at the modulation rate, which is superimposed on the RF envelope. See Figure 3-37. If large enough, video feedthrough can disturb mixer balance, amplifier bias, crystal detector output, etc. Since it is low frequency energy, it can distrub systems which are not intended to deal with it, especially demodulation systems.

The HP 8340B/41B's high band (>2.3 GHz) employs a tracking YIG filter which essentially eliminates video feedthrough. Attempts to measure it can turn out to be measurements of ground currents in coaxial cables. The HP 8340B/41B's low band (<2.3 GHz) employs a low level mixer followed by a high gain amplifier. At high power levels, the bias levels in the amplifier shift slightly as the RF is turned on or off. The slew of the bias from one level to another couples to the output and produces the video feedthrough waveform. For this reason the 5% specification is only valid for power levels up to +8 dBm. At low ALC levels (−10 dBm), another mechanism predominates. Mixer imbalance produces dc at the output of the mixer, and its magnitude varies with RF amplitude and/or modulator state. This shifting dc level couples through the amplifier, which is AC coupled, and emerges as video feedthrough spikes. In percentage terms this mechanism gets worse at low levels. The lowest percentage video feedthrough is probably found at ALC levels around 0 dBm.

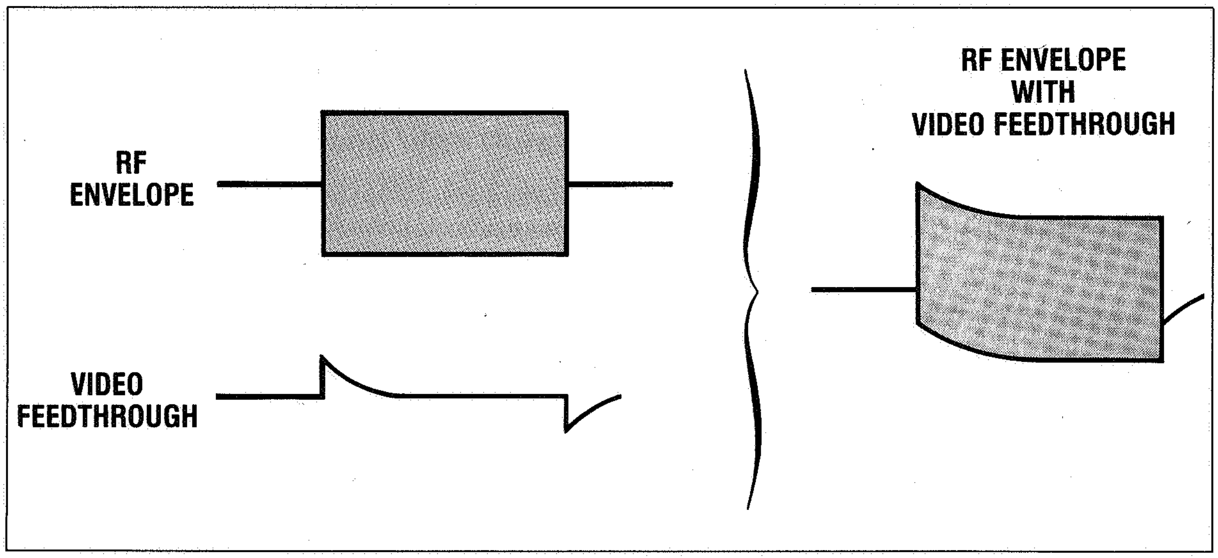


Figure 3-37. Video Feedthrough

SLOW RISE TIME PULSE MODULATION FOR SCALAR NETWORK ANALYZERS

For proper operation of HP 8755C, 8756A, and 8757A scalar analyzers, the HP 8340B/41B offers a pulse modulation mode which provides approximately 2us rise and fall times. Press **[SHIFT] [PULSE]** to enter this mode. The scalar analyzer's modulation output is connected to the HP 8340B/41B **PULSE** input. The slow waveform reduces the spectral width of the output, improving measurements made on filters with steep skirts. This mode may be used for other purposes, and functions properly for pulse widths wider than about 7us.

FURTHER INFORMATION

This completes Section III of the HP 8340B/41B Synthesized Sweepers Operating and Service Manual. For further information, there are several Programming Notes, Operating Guides, and general-reference Application Notes that are applicable to the HP 8340B/41B.

HEWLETT PACKARD

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