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

Printed: AUGUST 1986

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.

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of delivery, or, in the case of certain major components listed in section six of this Operating and Service manual, for the specified period. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

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

LIMITATION OF WARRANTY

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

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

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

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

Manufacturer's Declaration

NOTE

This is to certify that this product meets the radio frequency interference requirements of Directive FTZ 1046/1984. The German Bundespost has been notified that this equipment was put into circulation and has been granted the right to check the product type for compliance with these requirements.

Note: If test and measurement equipment is operated with unshielded cables and/or used for measurements on open set-ups, the user must insure that under these operating conditions, the radio frequency interference limits are met at the border of his premises.

Model **HP 8340B HP 8341B**

NOTE

Hiermit wird bescheinigt, dass dieses Gerät/System in Übereinstimmung mit den Bestimmungen von Postverfügung 1046/84 funkentstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes/Systems angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

Zusatzinformation für Mess- und Testgeräte:

Werden Mess- und Testgeräte mit ungeschirmten Kabeln und/oder in offenen Messaufbauten verwendet, so ist vom Betreiber sicherzustellen, dass die Funk-Entstörbestimmungen unter Betriebsbedingungen an seiner Grundstücksgrenze eingehalten werden.

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SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation. This product has been designed and tested in accordance with international standards.

SAFETY SYMBOLS

⚠ Instruction manual symbol: the product will be marked with his symbol when it is necessary for the user to refer to the instruction manual (refer to Table of Contents).

Indicates hazardous voltages.

⏚ Indicates earth (ground) terminal.

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

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

SAFETY EARTH GROUND

This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring trminals, power, cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and secured against any unintended operation.

BEFORE APPLYING POWER

Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual.

If this product is to be energized via an autotransformer make sure the common terminal is connected to the neutral (grounded side of the mains supply).

SERVICING

WARNING

Any servicing, adjustment, maintenance, or repair of this product must be performed only by qualified personnel.

Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside this product may still be charged even when disconnected from their power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow, time delay, etc.) are to be used for replacement.

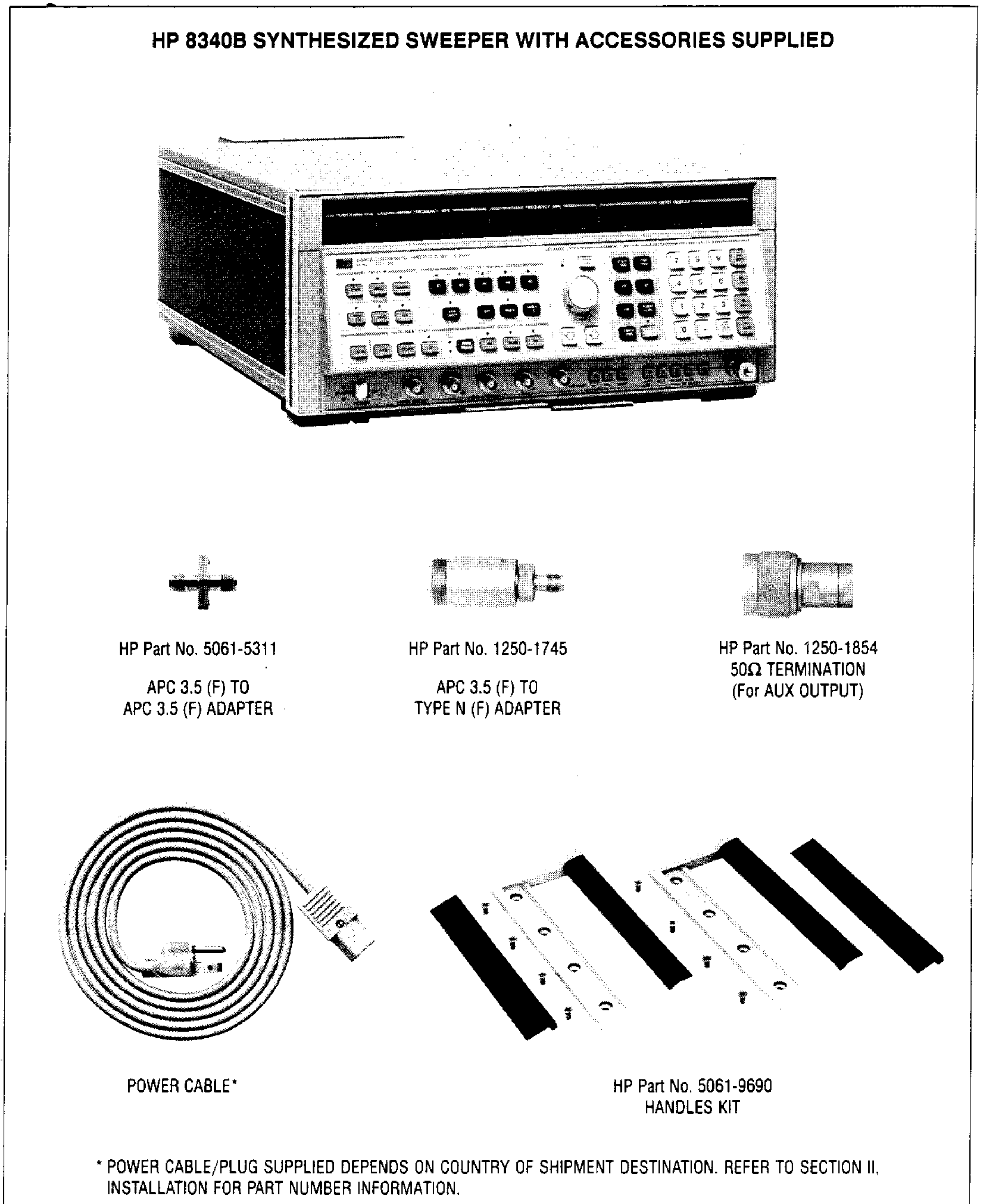


Figure 1-1. HP 8340B with Accessories Supplied

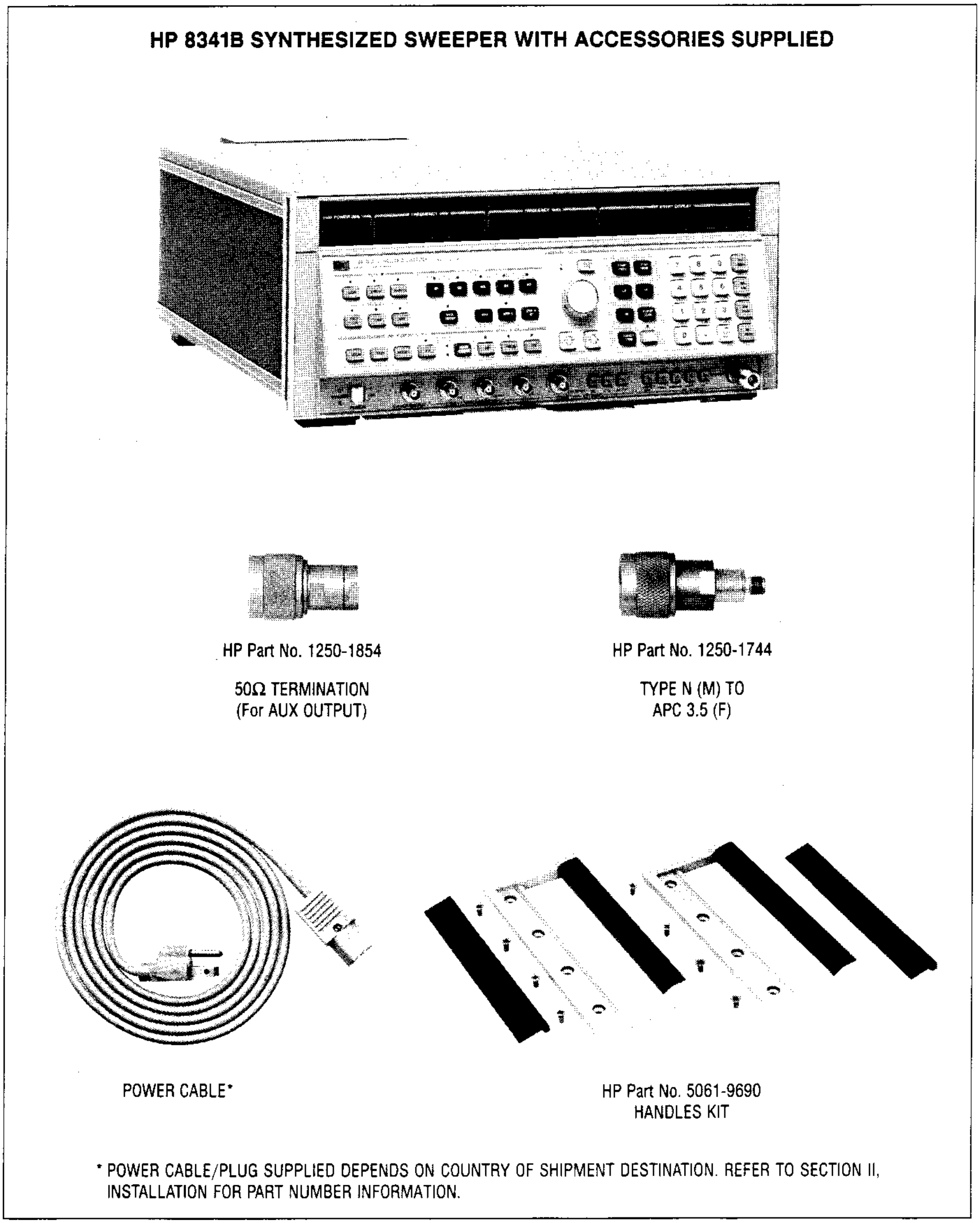


Figure 1-2. HP 8341B with Accessories Supplied

Section I: General Information

OVERVIEW

This Operating Manual contains information required to install and operate (locally and remotely) the HP 8340B and 8341B Synthesized Sweepers. Figures 1-1 and 1-2 show the HP 8340B and 8341B with supplied accessories.

This Operating Manual contains four major sections as well as **IN CASE OF DIFFICULTY**. The following is an overview of the major subjects covered by the manual.

SECTION CONTENT

SAFETY CONSIDERATIONS

This product has been manufactured and tested in accordance with international safety standards. Before operation, examine the product for safety related placards and labels; review the SAFETY CONSIDERATIONS information page which immediately follows the **I GENERAL INFORMATION** tab.

INSTRUMENTS COVERED BY THE MANUAL

A serial number plate is attached to the instrument's rear panel. A typical serial plate is shown in figure 1-3, below. Note that the number is in two parts. The first four numbers with a letter are the serial number prefix. This manual applies to instruments having the same serial number prefix as shown on the title page under **SERIAL NUMBER**. The last five numbers form the numerical suffix that is unique to each instrument.

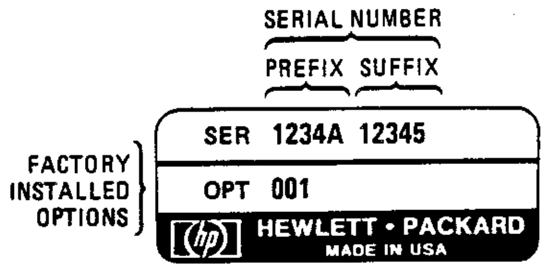


Figure 1-3. Typical Serial Number Plate

An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. An unlisted serial prefix indicates that the instrument is different from those documented in this manual. In such cases, the manual is supplied with a Manual Change Supplement that documents the differences.

The Manual Change Supplement also corrects errors in the manual. To keep your manual as current as possible, Hewlett-Packard recommends that you periodically request the latest Manual Change Supplement. Copies of the Manual Change Supplement are available by ordering HP Part Number 08340-90275, CD3.

For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes Supplement, contact your nearest Hewlett-Packard Sales and Service office. A complete list of these offices is shown at the end of Volume 3.

PRODUCT DESCRIPTION

The HP 8340B/41B Synthesized Sweepers are broadband, analog sweep, frequency synthesizers with versatile modulation and output power control. Major features are given below: (This information may not apply to instruments equipped with Options 001, 003, 004, 005, 006, or 007.)

Frequency Range and CW Resolution

Instrument	Frequency Range	Resolution (CW Mode)
HP 8340B	.01 to 26.5 GHz	≤4 Hz
HP 8341B	.01 to 20.0 GHz	≤3 Hz

Other specifications may be found in the appropriate specifications table.

Modulation Features. Amplitude Modulation, Frequency Modulation, and Pulse Modulation are provided as standard.

Output Power. Refer to the appropriate specification table for maximum output power. The lowest output power available from the HP 8340B/41B is −110 dBm. Displayed Power resolution is 0.05 dBm. The Power Sweep function provides the ability to sweep power up to 40 dB.

Analog Sweeps. The HP 8340B/41B are capable of generating a true analog sweep across their entire frequency range. Additionally, a synthesized sweep mode allows narrow band precision analog sweeps. The bandwidth of precision sweeps can be as narrow as 100 Hz, or as wide as 5 MHz.

Frequency Markers. The HP 8340B/41B are both equipped with five calibrated frequency markers. Sweep modes (**START-STOP** or **CW-ΔF**) can use marker settings for sweep parameters.

Instrument State Save/Recall, Alternate Sweep Function. The HP 8340B/41B have the ability to save and recall up to 9 front panel settings. The Alternate Sweep functions allows the instrument to switch between two completely different front panel states on successive sweeps.

Easy to use controls. The front panel **ENTRY DISPLAY** shows the current active function and its appropriate values. Changing the value of the active function (e.g. Start Frequency, etc) is quickly accomplished through the use of the numeric keyboard, step keys, or rotary knob.

HP-IB Control. All front panel features except the line power switch are fully programmable via HP-IB.

Comprehensive Diagnostics. Many service diagnostic features have been incorporated into the HP 8340B/41B. An internal SELF TEST is run each time the instrument is turned on or when the instrument preset key is pressed. Front panel diagnostic routines are accessible to aid in fault detection and isolation. Detailed information is provided in the IN CASE OF DIFFICULTY section, or in Section 8, Assembly-Level Service Manual (in Volume 3).

NOTE

Option 003 is only available on the HP 8341B. Options 001, 005, 006, and 007 are only available on the HP 8340B. See the option descriptions, below, for a descriptions of all options.

HP 8340B INSTRUMENT CONFIGURATION OPTIONS

Option 001, Front Panel RF Output Without 90 dB Programmable Attenuator. The standard HP 8340B has a front panel RF Output Connector with a 90 dB Programmable Attenuator. HP8340Bs with Option 001 are not equipped with this component. Available RF output power increases slightly when the programmable attenuator is removed. The minimum output power in instruments so equipped is −20 dBm.

Option 004, Rear Panel RF Output With 90 dB Programmable Attenuator. Option 004 instruments have the RF Output connector mounted on the rear panel instead of the front panel. The 90 dB Programmable Attenuator is installed, allowing the output power to be set as low as −110 dBm.

Option 005, Rear Panel RF Output Without 90 dB Programmable Attenuator. Option 005 instruments have the RF Output connector mounted on the rear panel and the 90 dB Programmable Attenuator is deleted. The lower limit of the RF Output power is −20 dBm.

Option 006, Delete Pulse Modulation. Option 006 deletes external pulse modulation capability.

Option 007, Relaxed Phase Noise Specifications. Instruments equipped with this option are warranted to perform within a relaxed phase noise specification.

HP 8341B INSTRUMENT CONFIGURATION OPTIONS

Option 003, Low Harmonics (Available for HP 8341B Only). HP 8341Bs equipped with Option 003 have substantially improved harmonic related spurious signal performance.

Option 004, Rear Panel RF Output With 90 dB Programmable Attenuator. Option 004 instruments have the RF Output connector mounted on the rear panel instead of the front panel. The 90 dB Programmable Attenuator is installed, allowing the output power to be set as low as −110 dBm.

OTHER OPTIONS (APPLICABLE TO BOTH INSTRUMENTS)

CAUTION

The HP 8340B and 8341B instruments require metric threaded screws when any type of hardware is attached to the sides of the front panel (rack flanges, etc.) Rack Flanges or other mounting hardware from english-threaded instruments may be used with HP 8340Bs or 8341Bs, BUT IT IS ESSENTIAL THAT METRIC SCREWS ARE USED INSTEAD OF THE ORIGINAL ENGLISH ONES. FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN STRIPPING THE INSTRUMENT'S THREADS, NECESSITATING COSTLY REPAIR. Refer to Section II, Installation, for metric screw part numbers.

Option 806, Chassis Mount Slide Kit. This kit includes the necessary hardware to mount sliding rack mounts on the instrument. This allows easier access to the instrument when mounted in an equipment rack. It is necessary to remove the instrument side panels in order to install the kit. This is described in detail in Section II: Installation (Figure 7).

Option 908, Rack Flanges without Handles Kit. Option 908 contains a pair of flanges and the necessary hardware to mount the instrument in an equipment rack with 482.6 mm (19 inches) horizontal spacing. Refer to Section II: Installation (Figure 2-8).

Option 910, Extra Operating Manual. Each instrument is supplied with one Operating, Calibration, and Assembly-Level Troubleshooting Manual Set. Each Option 910 ordered provides one additional Operating, Calibration, and Assembly-Level Service Manual set. To obtain additional manuals after receiving the initial instrument shipment, order by manual part number. Refer to EQUIPMENT/ACCESSORIES AVAILABLE, below.

Option 913, Rack Flanges with Handles Kit. Option 913 contains a pair of flanges, a pair of handles, and the necessary mounting hardware to mount the instrument in an equipment rack with 482.6mm (19 inches) horizontal spacing. This kit differs from Option 908 kits in that the flanges accommodate the added handles. This makes it easier to hold and position the instrument when installing or removing the instrument from the rack, or when handling the instrument on the bench. Detailed installation instructions are included in Section II: Installation (figure 2-9).

Option 915, Add Service Documentation. Option 915 adds component-level troubleshooting information. This documentation can also be ordered separately (HP Part Number 08340-90245, CD7) from any Hewlett Packard Sales Office.

Option W03, Warranty Conversion. Option W03, where available, converts the standard one-year return to Hewlett-Packard warranty to a 90-day on-site warranty. W03 can only be ordered at the time of instrument purchase. Instruments ordered with option W03 are identified by a rear panel label. For support after the 90-day warranty expires, Hewlett-Packard recommends HP 8340B or 8341B +02A or +02B on-site service, where available. This extended on-site coverage takes effect the fourth month and continues on a month-to-month basis. Availability of Option W03 is limited by customer location.

Option W30, Extended Service. Option W30 adds two additional years of return-to-HP hardware support, to follow the first year of warranty. Option W30 can be ordered at the time of sale only. Instruments ordered with Option W30 are identified by a rear panel label.

EQUIPMENT AVAILABLE

HP 8756A and HP 8757A Scalar Network Analyzers

These microprocessor-based analyzers allow measurement of scalar (magnitude only) reflection and transmission measurements at RF and microwave frequencies. These network analyzers are fully programmable through HP-IB and can control the HP 8340B/41B (or HP 8350B) and a plotter directly over a private interface bus. In addition to an RF source, a complete network analyzer system requires the use of detectors and/or bridges.

HP 8510 Vector Network Analyzer

This microprocessor-based network analyzer provides highly accurate, real time error corrected vector measurement capability. A complete HP 8510 system includes a source (HP 8350B or 8340B/41B) and an HP 8511, 8512, 8513, 8514, or 8515 test set. The HP 8510 controls the source by means of a private interface bus and can be programmed via HP-IB.

HP 8349B Microwave Amplifier

This product is a general purpose, class A microwave amplifier that delivers a minimum of 100 mW (+20 dBm) of leveled power from 2 to 18.6 GHz, and 50 mW (+17 dBm) from 18.6 to 20.0 GHz.

Millimeter-Wave Source Modules

Millimeter-wave source modules work in conjunction with the HP 8340B/41B and HP 8349B Microwave Amplifier to provide output frequencies in the mm (R, Q, and U) bands. The mm-wave source modules currently available are shown below:

HP 83554A R-Band Millimeter-Wave Source Module. Generates output frequencies from 26.5 to 40 GHz

HP 83555A Q-Band Millimeter-Wave Source Module. Generates output frequencies from 33 to 55 GHz

HP 83556A U-Band Millimeter-Wave Source Module. Generates output frequencies from 40 to 60 GHz

HP 8410C/8411A Network Analyzer

The combination of the HP 8410C Network Analyzer, HP 8411A Frequency Converter, and an appropriate display plug-in forms a phasemeter and a ratiometer for direct phase and amplitude ratio measurements on RF voltages.

Note: The HP 8340B/41B rear panel 0.5V/GHz output must be connected to the HP 8410B/C rear panel FREQ REF INPUT. Two jumpers must be added to the HP 8340B/41B's A28 SYTM Driver assembly (W1 and W2 positions) to change the rear panel 0.5V/GHz output to 1V/GHz. Refer to the RF Section in Section VIII, Assembly-Level Service, in Volume 3 for the procedure for adding jumpers A28W1 and A28W2.

Power Meters and Crystal Detectors

The RF output can be externally leveled using the HP 432, 435, or 436 power meters, or with positive or negative polarity output crystal detectors. Refer to Section III, Operation, for more information.

HP-IB Controllers

To use the HP-IB capabilities of the HP 8340B/41B, a computing controller, such as a Hewlett-Packard 9000 series, 200, or 300 computer is required.

Service Accessories

A Service Kit is available which includes a variety of extender boards, cables, and adapters that will aid in servicing the the instrument. Order HP Part Number 08340-60134, CD0.

SPECIFICATIONS

Listed in Tables 1-1 and 1-2 are the specifications for the HP 8340B and HP 8341B, respectively.

Specifications are the performance standards, or limits, against which the instruments may be tested. Also listed in these tables are the supplemental performance characteristics. Supplemental performance characteristics are not specifications, but are typical characteristics included as additional information for the user. Supplemental performance characteristics are shown in *italic* print.

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, 2.5×10^{-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)

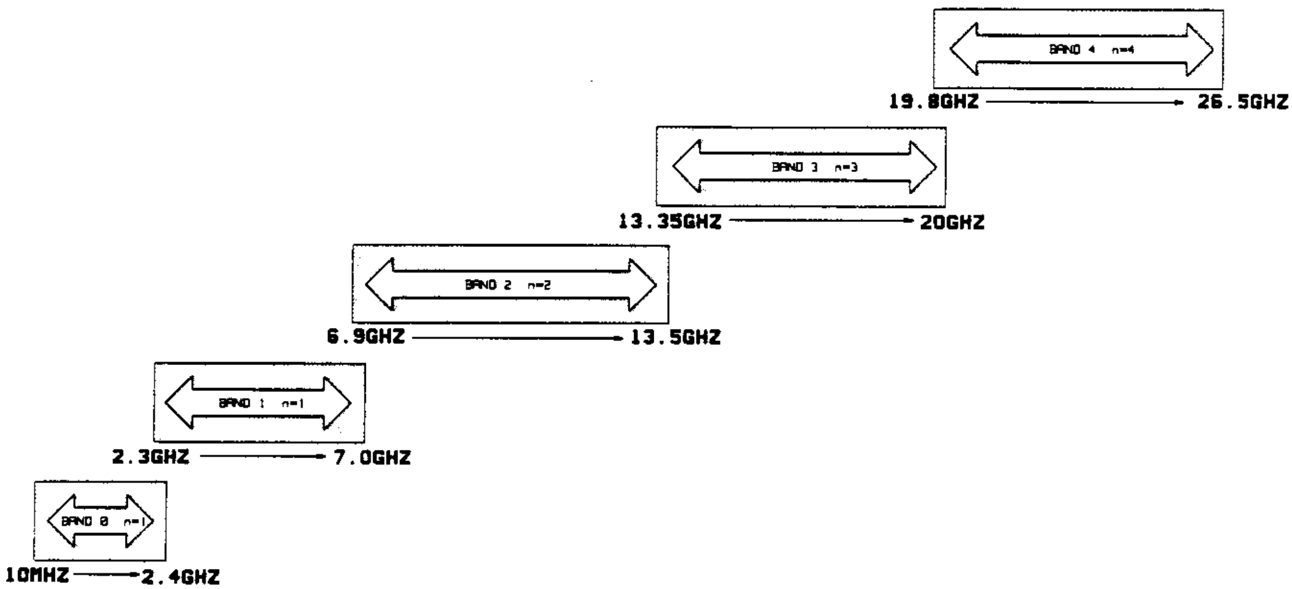


Figure 1. Typical Frequency Ranges and Bandswitch Points in Swept Modes

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) OPTION 001 (Front Panel Output w/o Attenuator)	**Band 0** **0.01 to <2.3**	**Bands 1-3** **2.3 to <20.0**	**Band 4** **20.0 to 26.5**
+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

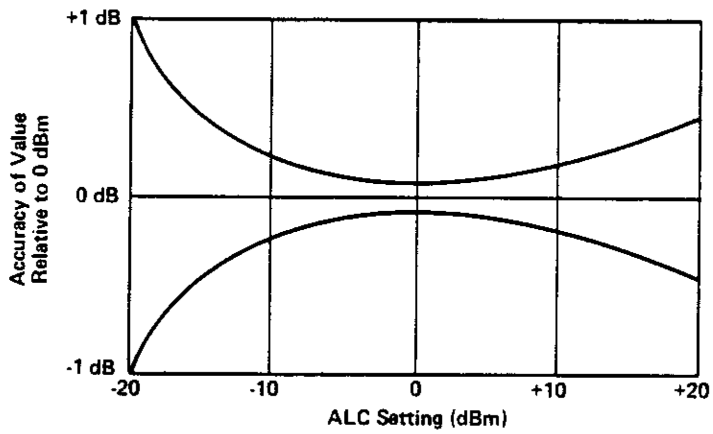


Figure 2. Typical ALC Incremental Accuracy

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)

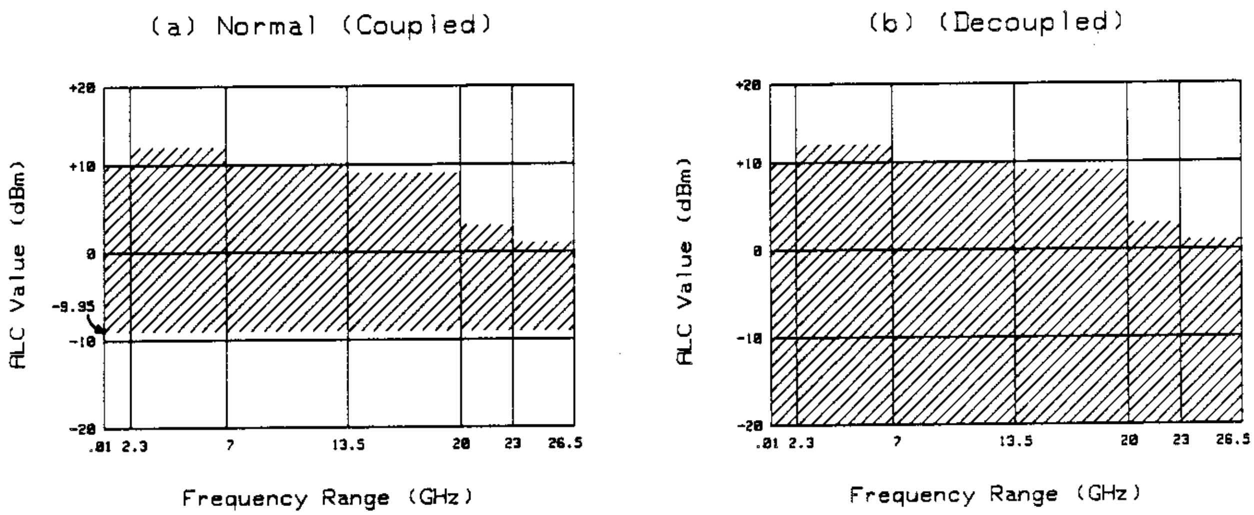


Figure 3. Typical Power Sweep Range

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.)

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

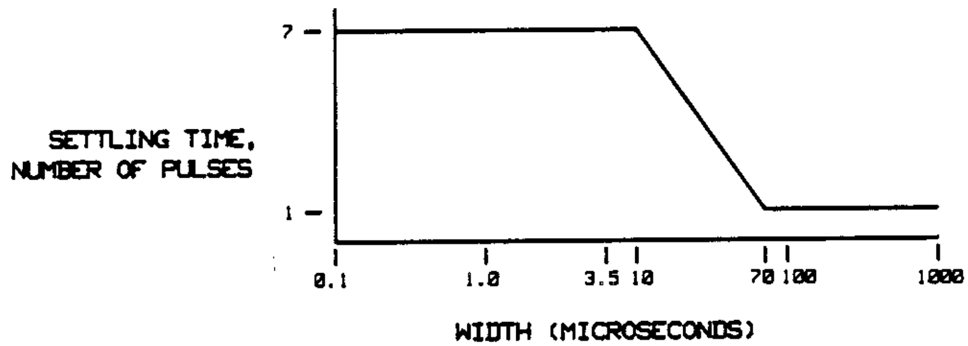
Internally Leveled	Unleveled (Shift Meter)*
PRF/20** to a maximum of 5 kHz	*100 kHz*

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:

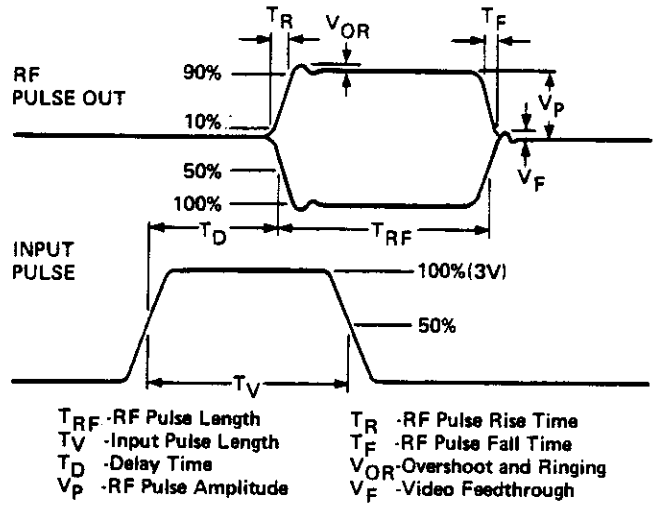


Figure 4. Pulse Definitions

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)

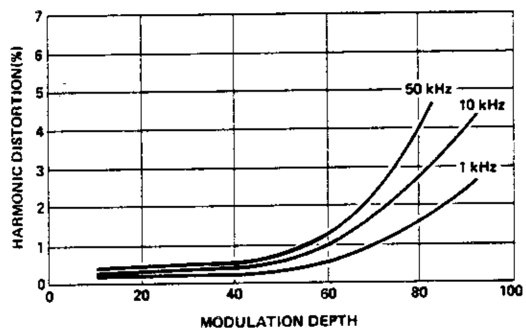


Figure 5. Typical AM Distortion for Various Modulation Rates and Depths

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*.

Table 1-1. Model HP 8340B Specifications and Supplemental Performance Characteristics (13 of 15)

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 HP 8340B 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 RE02 (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

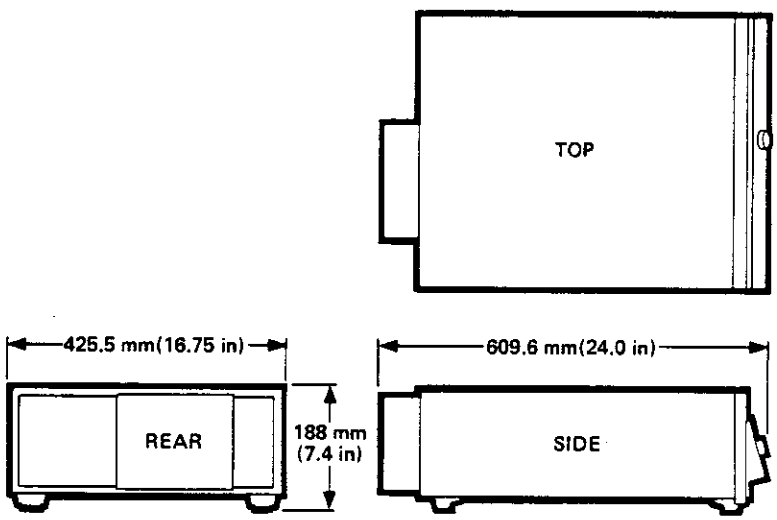


Figure 6. Instrument Dimensions

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)

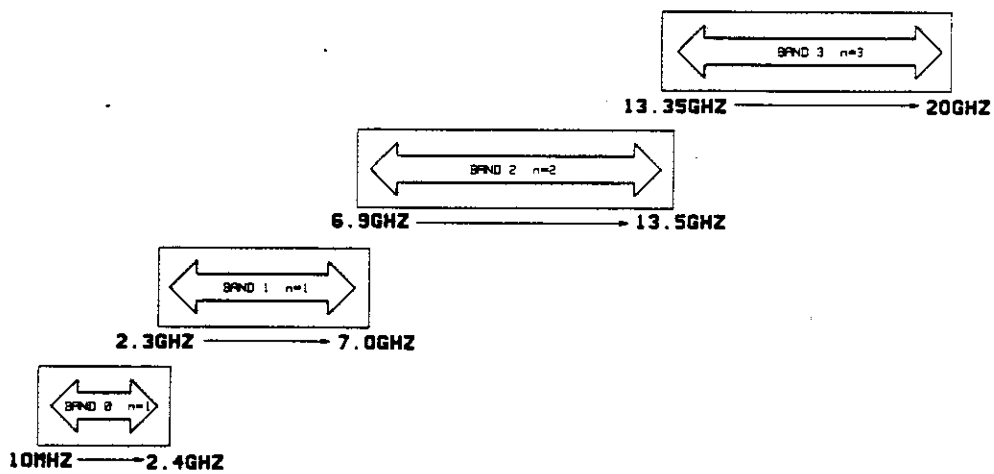


Figure 1. Typical Frequency Ranges and Bandswitch Points in Swept Modes

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*.

Table 1-2. Model HP 8341B 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**
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*.

Table 1-2. Model HP 8341B Specifications and Supplemental Performance Characteristics (5 of 15)

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.*

Table 1-2. Model HP 8341B Specifications and Supplemental Performance Characteristics (6 of 15)

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

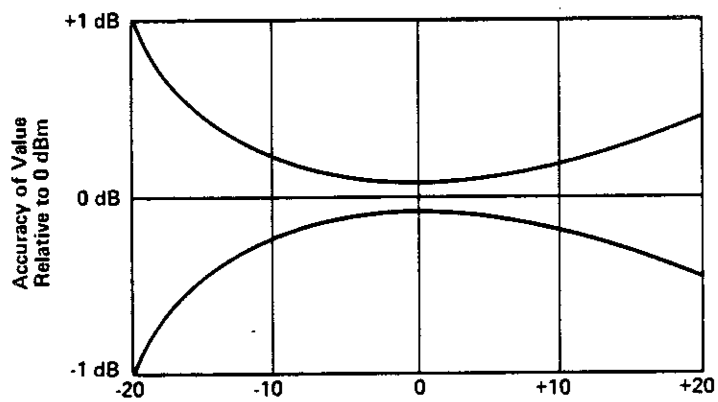


Figure 2. Typical ALC Incremental Accuracy

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

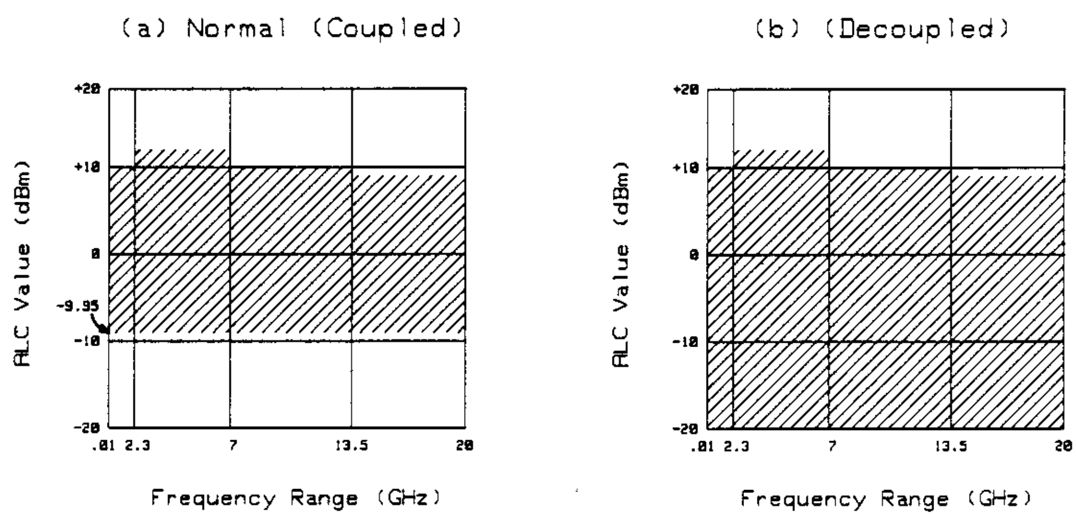


Figure 3. Typical Power Sweep Range

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*.

Table 1-2. Model HP 8341B Specifications and Supplemental Performance Characteristics (8 of 15)

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%

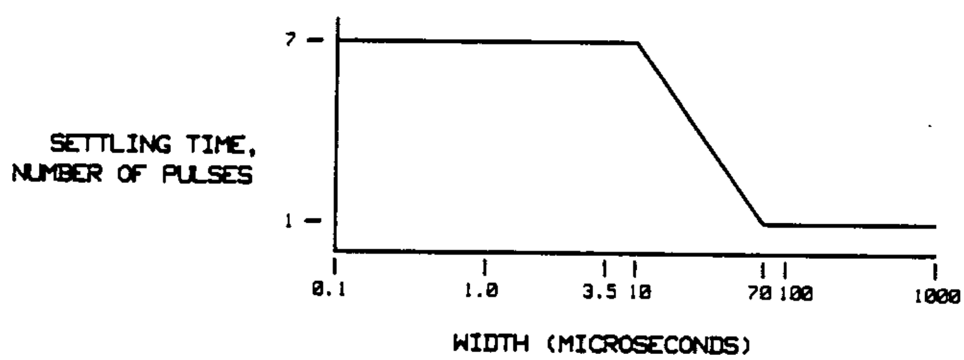
SIMULTANEOUS AM AND PULSE (Parameters shown are typical)

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*

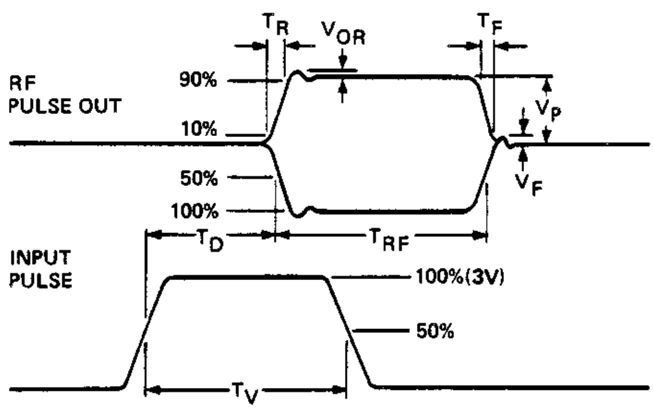
VIDEO FEEDTHROUGH (V_F/V_P):
0.01 to <0.4 GHz (Band 0): *≤5% typically (for output power levels ≤+8 dBm).*
0.4 to <2.3 GHz (Band 0): ≤5% (for output power levels ≤+8 dBm)
2.3 to 20.0 GHz (Bands 1 - 3): ≤0.2%

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:



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. 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.*

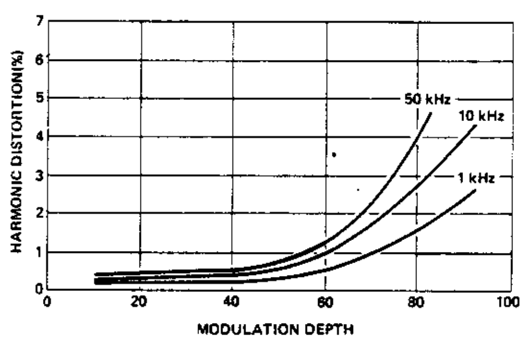


Figure 5. Typical AM Distortion for Various Modulation Rates and Depths

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 RE02 (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

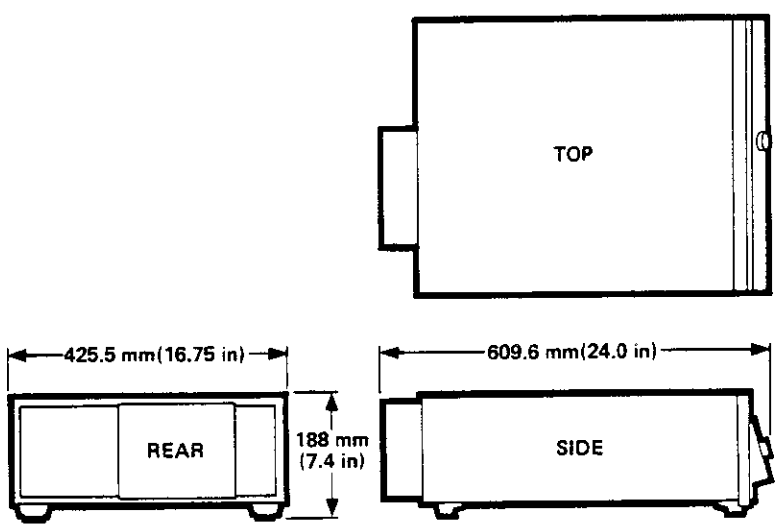


Figure 6. Instrument Dimensions

Supplemental Performance Characteristics are in *italics.*

Table 1-2. Model HP 8341B Specifications and Supplemental Performance Characteristics (15 of 15)

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.

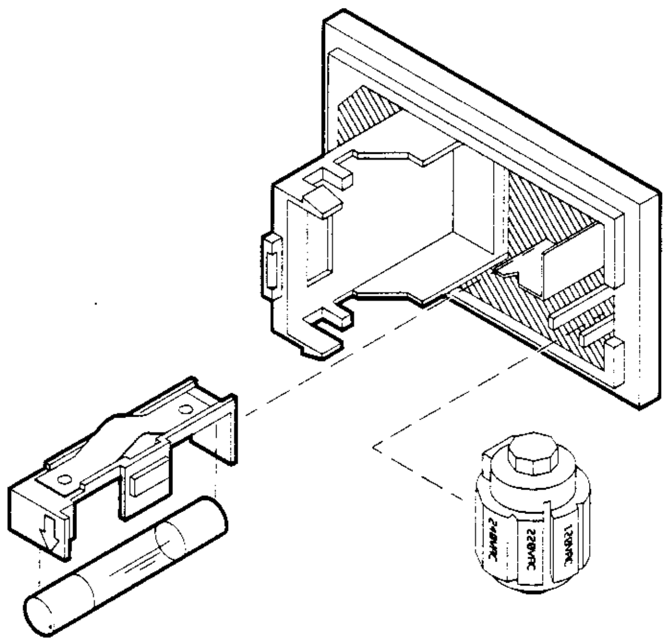
The offset prong of the three-prong connector is the grounding pin. The protective grounding feature may be preserved when operating the HP 8340B/41B from a two-contact outlet by using a three-prong to two-prong adapter and connecting the green wire of the adapter to ground. An adapter is available (for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

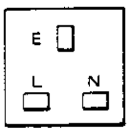
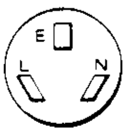
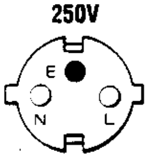
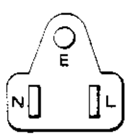
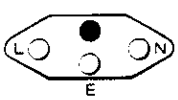
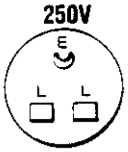
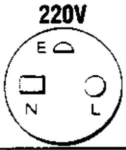
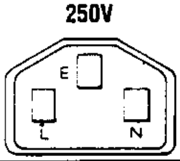
The Interface Function Codes for the HP 8340B/41B are an alphanumerical coded set that describes its operational capabilities on the HP-IB bus. The codes for the instrument are:

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.

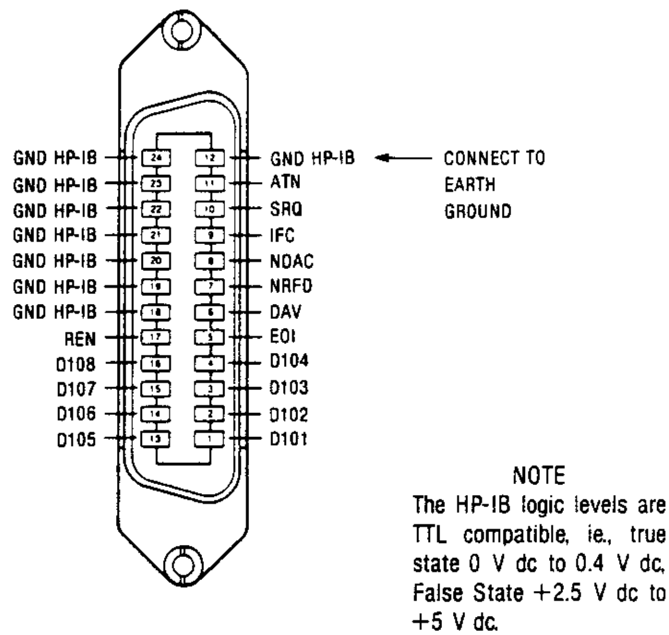
Table 2-3. Model HP 8340B/41B Mating Connectors

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.

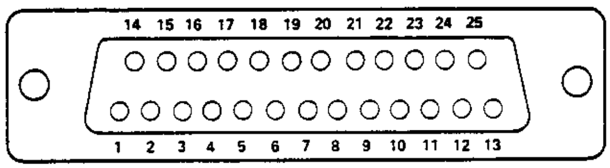
*** HP-IB interface connector J21 signal/pin configuration is shown in Figure 2-2.



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)



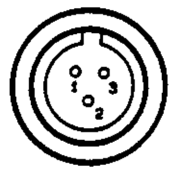
Pin	Mnemonic	Description[1]	In/Out[2]
1		No Connection	
2	Z-AXIS	LOW=Marker Pulse (±5V)	Output
3		No Connection	
4	LALTSEL	Alternate Sweep (LSTTL)	Output
5	LSSP	LOW=Stop Forward Sweep Request	Input/Output[3]
6	+5.2V	+5 Volts (100 mA Max.)	Output
7		No Connection	
8	MUTE	LOW=RF Blank Request (LSTTL)	Input
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

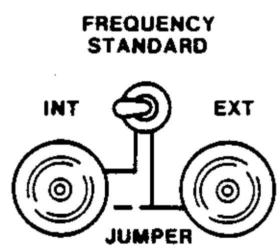


Figure 2-5. Rear Panel FREQUENCY Standard Switch

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 (Pressure)	Up to 15240 meters (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

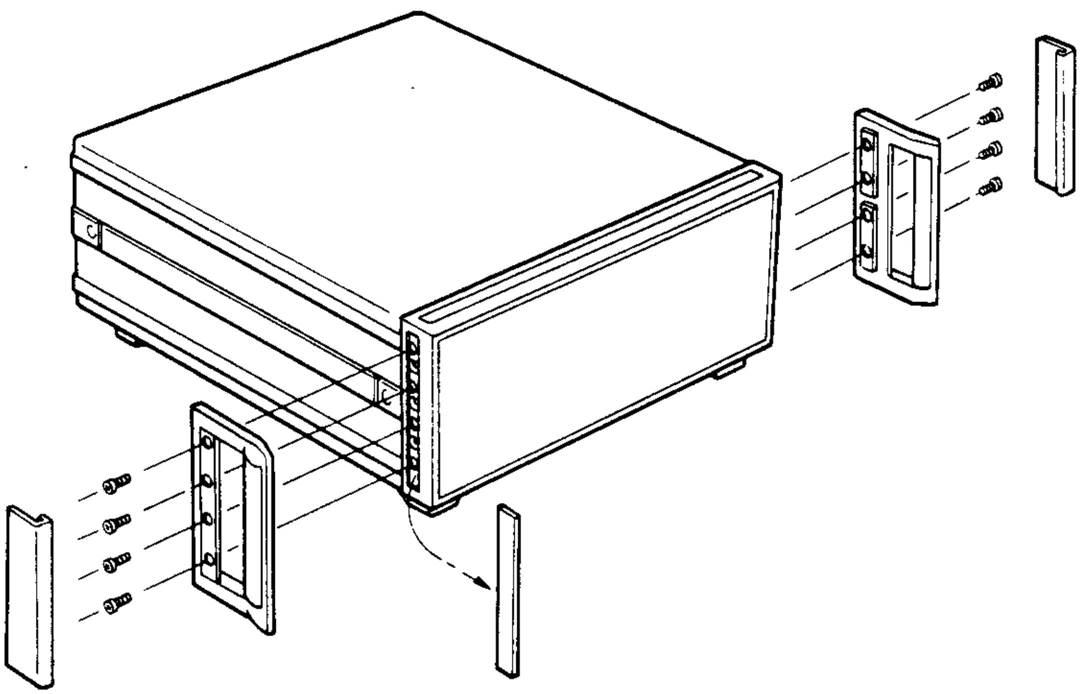
Several forms of an incoming inspection procedure are available in this manual. Section III, Operation, in this volume includes a section on "Getting Acquainted with the HP 8340B/41B" that may be used to quickly verify operational functions when the intstrument is first received. Section IV, Performance 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

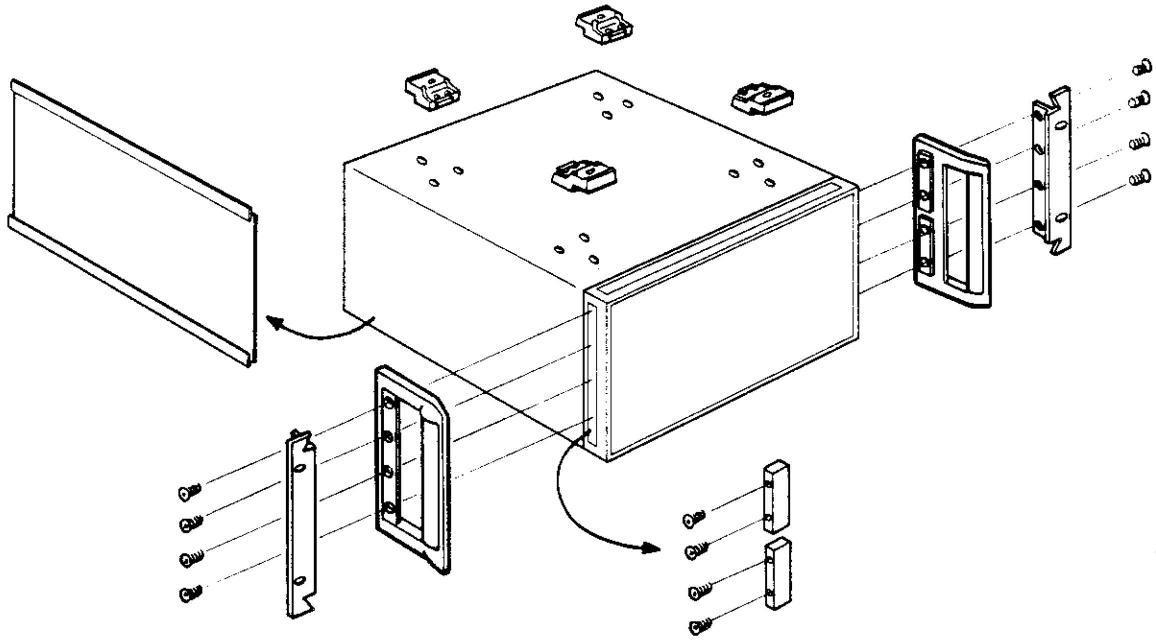
QTY.		PART NO.
2	FRONT HANDLE ASS'Y	5060-9900
2	FRONT HANDLE TRIM	5020-8897
8	M4x0.7x10 FH 90', SCREW (METRIC)	0515-0896



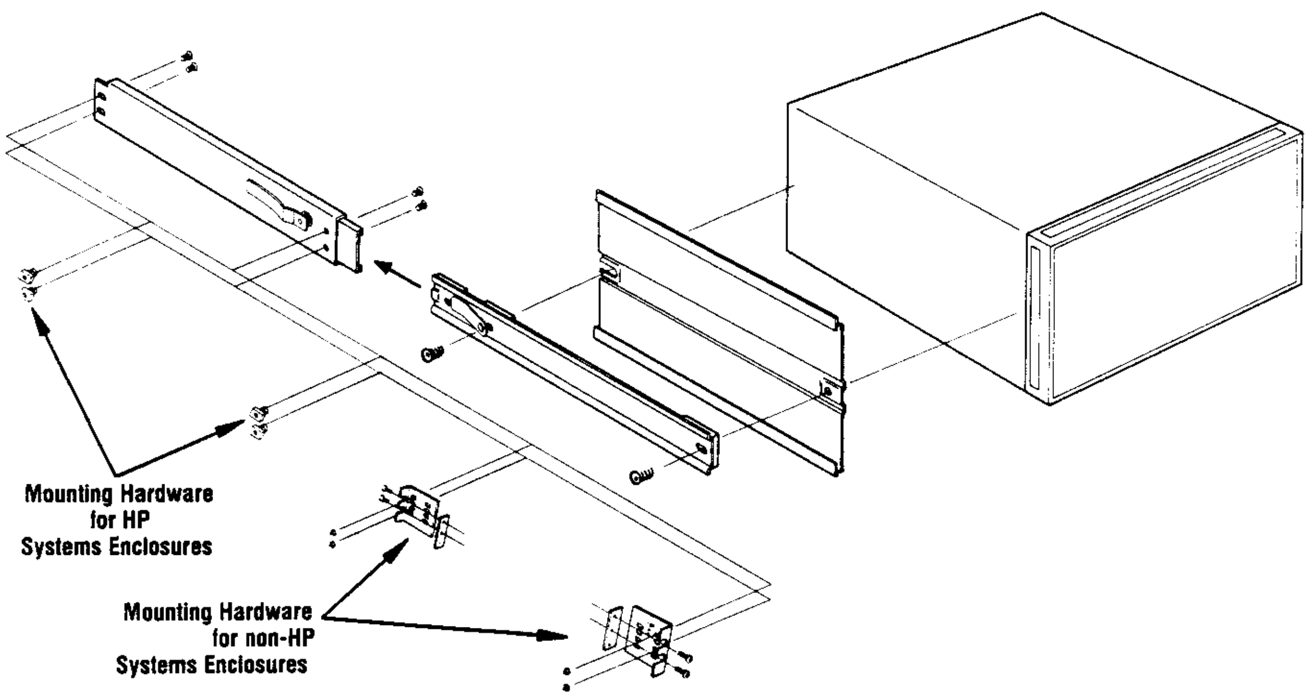
INSTRUCTIONS

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.			

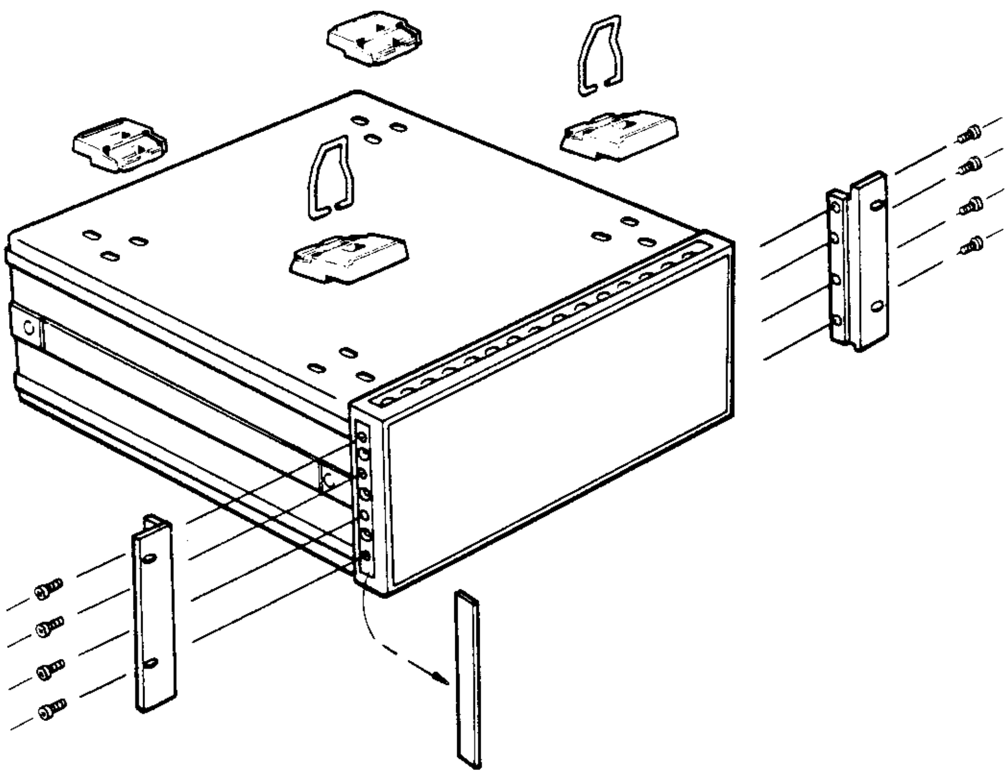
Figure 2-7. Chassis Slide Kit Mounting Instructions (Option 806) (2 of 2)

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.

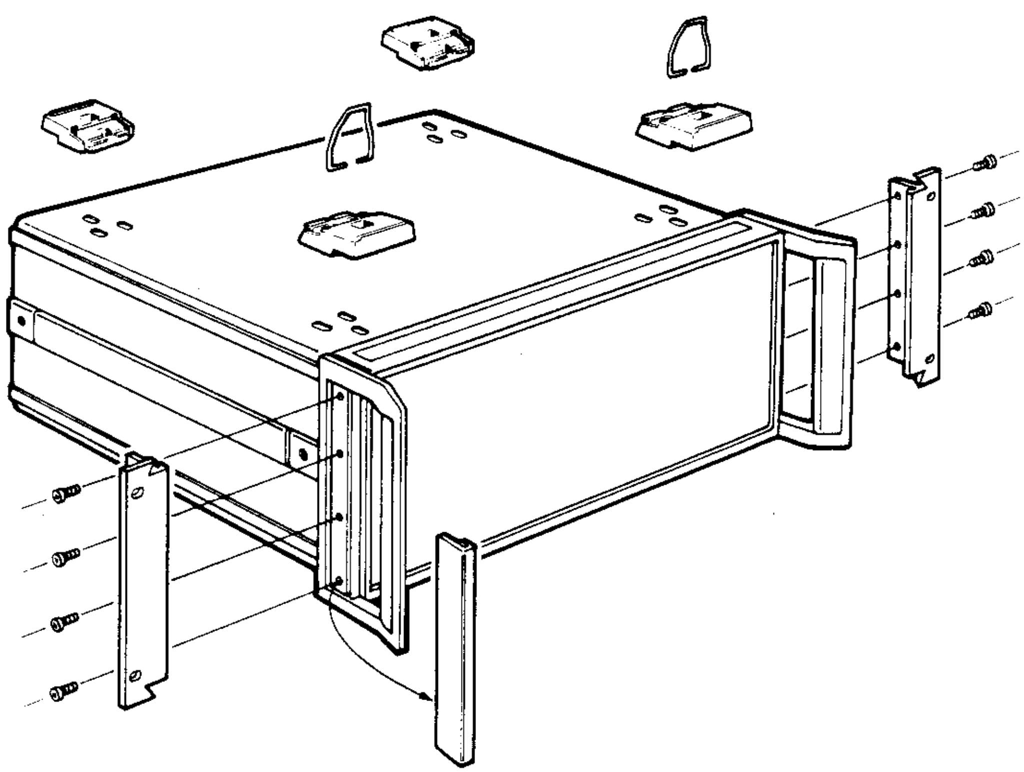
Figure 2-8. Rack Flange Kit Mounting Instructions (Option 908)

METRIC RACK MOUNT KIT FOR CABINETS WITH PREVIOUSLY ATTACHED HANDLES

HP PART NUMBER 5061-9772 (OPTION 913)

CONTENTS

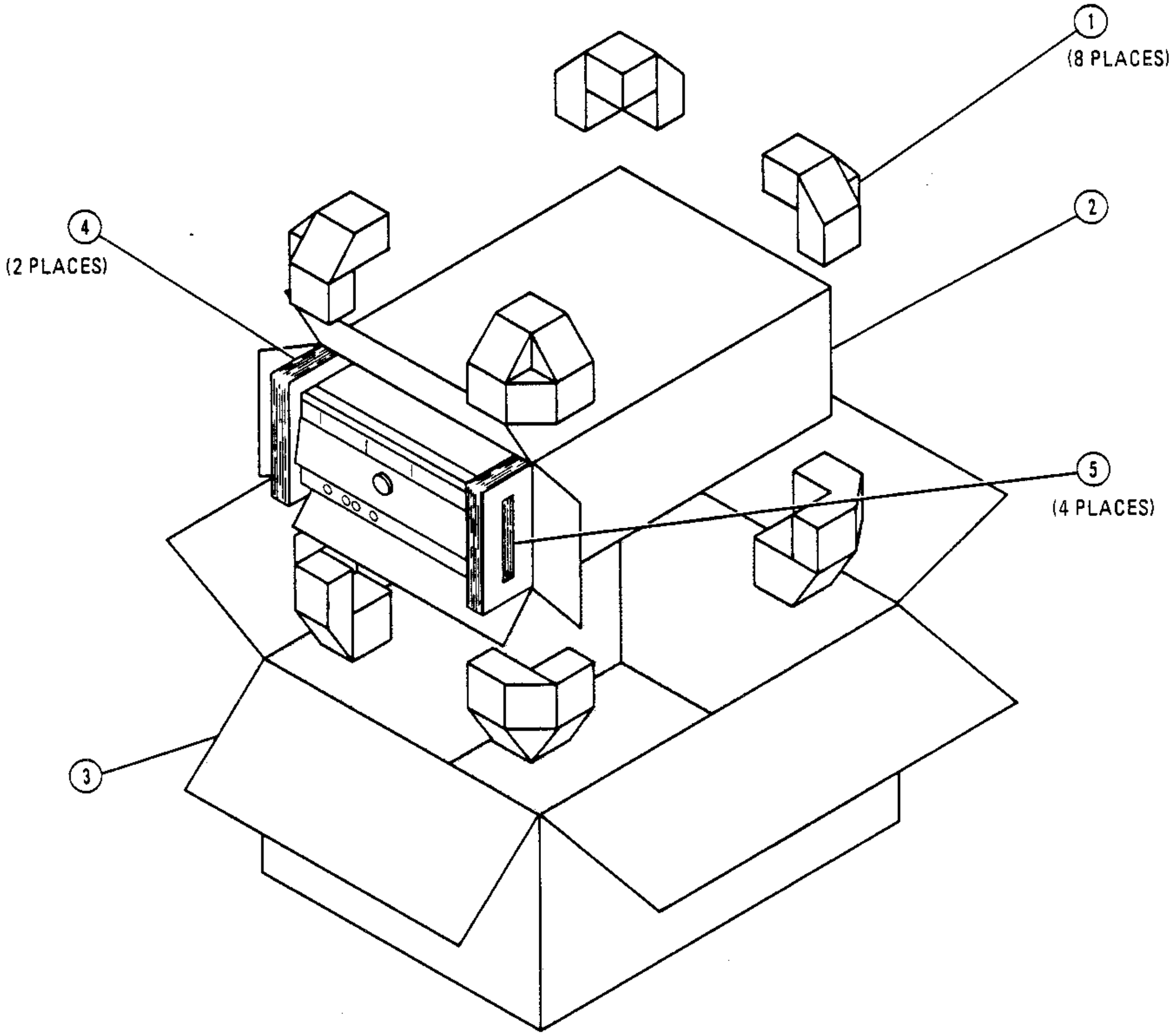
QTY.		PART NO.
2	RACK MOUNT FLANGE	5020-8875
8	M4X0.7X16.H. SCREW (METRIC)	0515-1106



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

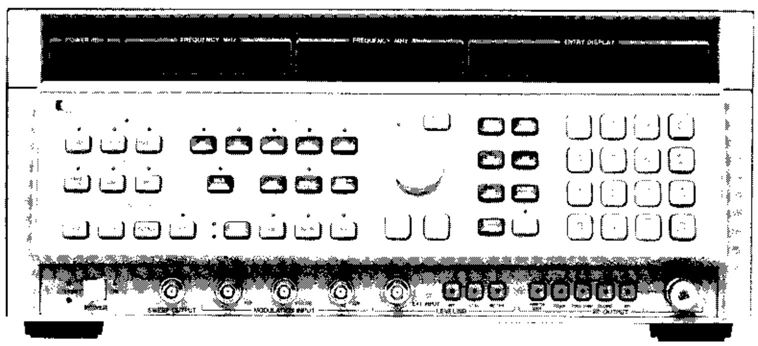
Before the instrument's line power cord is plugged in, the line power module must be set to the voltage of the power source or damage to the instrument may result.

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.

Getting Acquainted with the HP 8340B/41B Synthesized Sweepers



INTRODUCTION

Anyone preparing to use the HP 8340B/41B for the first time should begin by reading this "Getting Acquainted" guide. This guide introduces the basic procedures needed for local (front panel), and remote (computerized) operation of the instrument. An HP 8340B/41B, a computer, and an HP-IB interface cable are all that is required to use this Getting Acquainted guide.

This guide doesn't have any detailed explanations – that is saved for the Operating Information guide of the HP 8340B/41B operating manual. Instead, this guide is designed as a hands-on introduction to the HP 8340B/41B: press the buttons, program the computer, and watch the displays.

Most of the common operations of the HP 8340B/41B are covered in this guide. The in-depth explanations contained in Section III of the HP 8340B/41B Operating Manual will be easier to understand after you have completed this introductory material.

The first step in getting started is to check the line power module, as described in the following section.

Printed: JULY 1986

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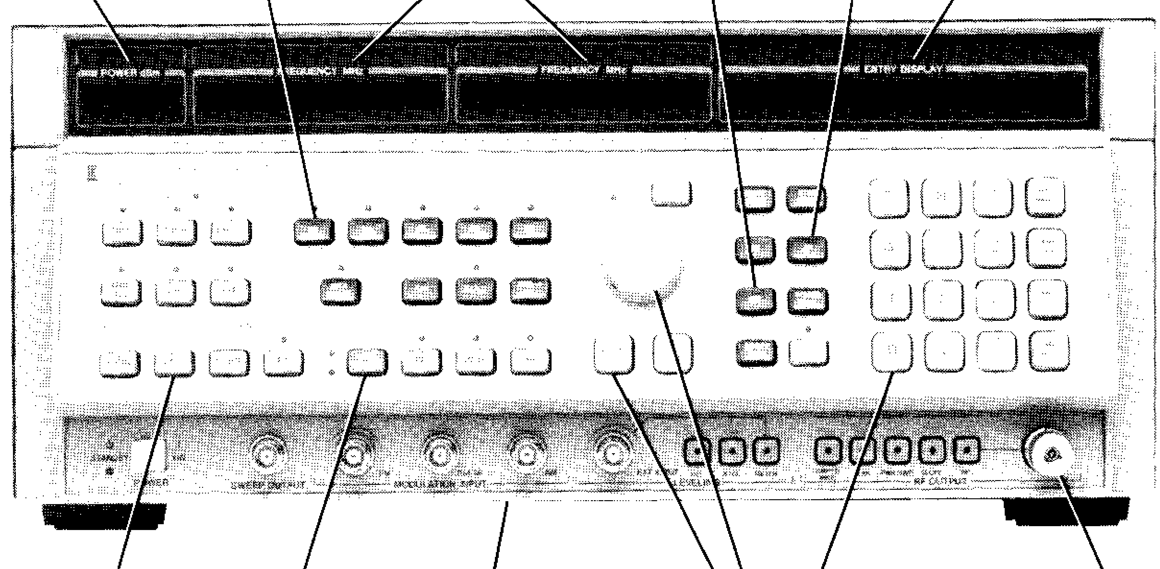


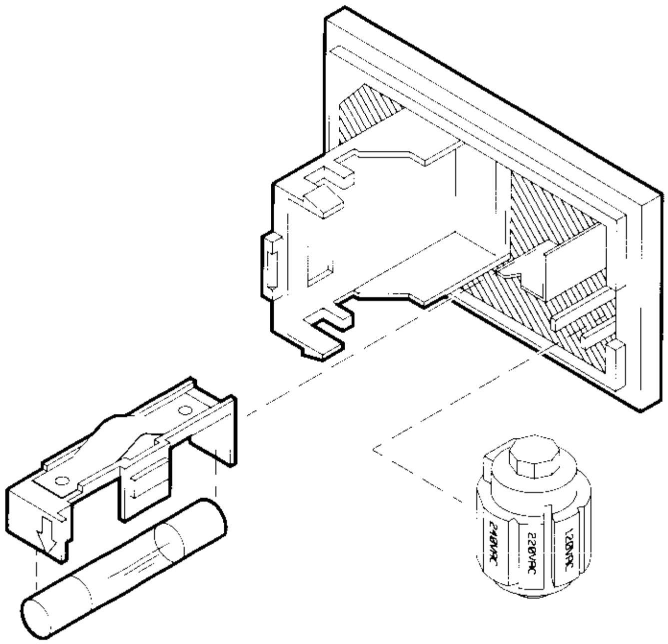
POWER-ON PROCEDURE

If the HP 8340B/41B has just been unpacked, the line-power module located on the rear panel of the instrument must be checked for the proper fuse rating and the correct positioning of the voltage-selector cam, as shown in the accompanying illustration.

After checking the line-power module, attach the ac power cord and apply power to the instrument. Flip the front-panel **[LINE]** switch from STANDBY to ON. Notice that the red OVEN and UNLK (unlocked) annunciators are being displayed in the upper right hand corner of the ENTRY DISPLAY.

One or both of these annunciators will remain on until the crystal oven reaches operating temperature, which will require 5 - 30 minutes from a cold start. When the **[LINE]** switch is in STANDBY, the crystal oven remains at operating temperature; therefore, do not unplug the HP 8340B/41B after it has been installed in its work area.

Although the HP 8340B/41B will not fully meet specifications while the OVEN or UNLK annunciators are on, some preliminary checks are described in the following Local Operation section.



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.

LOCAL OPERATION OF THE HP 8340B/41B SYNTHESIZED SWEEPER

Local operation is also called front-panel operation, because the desired HP 8340B/41B functions are initiated by pressing front-panel keys. The first keys to press are those that cause an internal check of the instrument, as described below.

PRELIMINARY CHECKS

Press and hold the **[INSTR PRESET]** key. Notice the red, green, and amber (yellow) LEDs and annunciators: Amber indicates which keys or functions are presently active; the single green LED indicates when the instrument is sweeping (on when sweeping, off during retrace and band-crossings); and red indicates trouble. If any red LED or annunciator turns on (such as OVEN or UNLK seen at cold power-on), refer to the HP 8340B/41B Operating and Service manual for further instructions.

Release the **[INSTR PRESET]** key, and observe the standard starting conditions: sweeping from 10 MHz to 26.5 GHz (20 GHz for HP 8341B), at 0.0 dBm. Press **[INSTR PRESET]** at any time to achieve this standard condition, including those times you may need a "panic" button to unscramble all of those keystrokes that you experimentally entered.

The displays are blank during the**[INSTR PRESET]** check. To check the displays, press **[SHIFT]**, then the **[FREE RUN]** key, which will cause every segment of every display element to light followed by a marching display of the entire character set.

To return to standard starting conditions, press either **[INSTR PRESET]** or cycle line power, which will turn off this diagnostic function. If you want to keep the previous front panel setup (i.e. start/stop or CW frequency, power level, etc.) cycle the line power. **[INSTR PRESET]** resets all front panel controls to a preselected state. Any other diagnostic function can be deactivated by pressing **[SHIFT]** **[M5]**. A listing of the other diagnostic functions is contained in the HP 8340B/41B Information Cards, see below:

INFORMATION CARDS

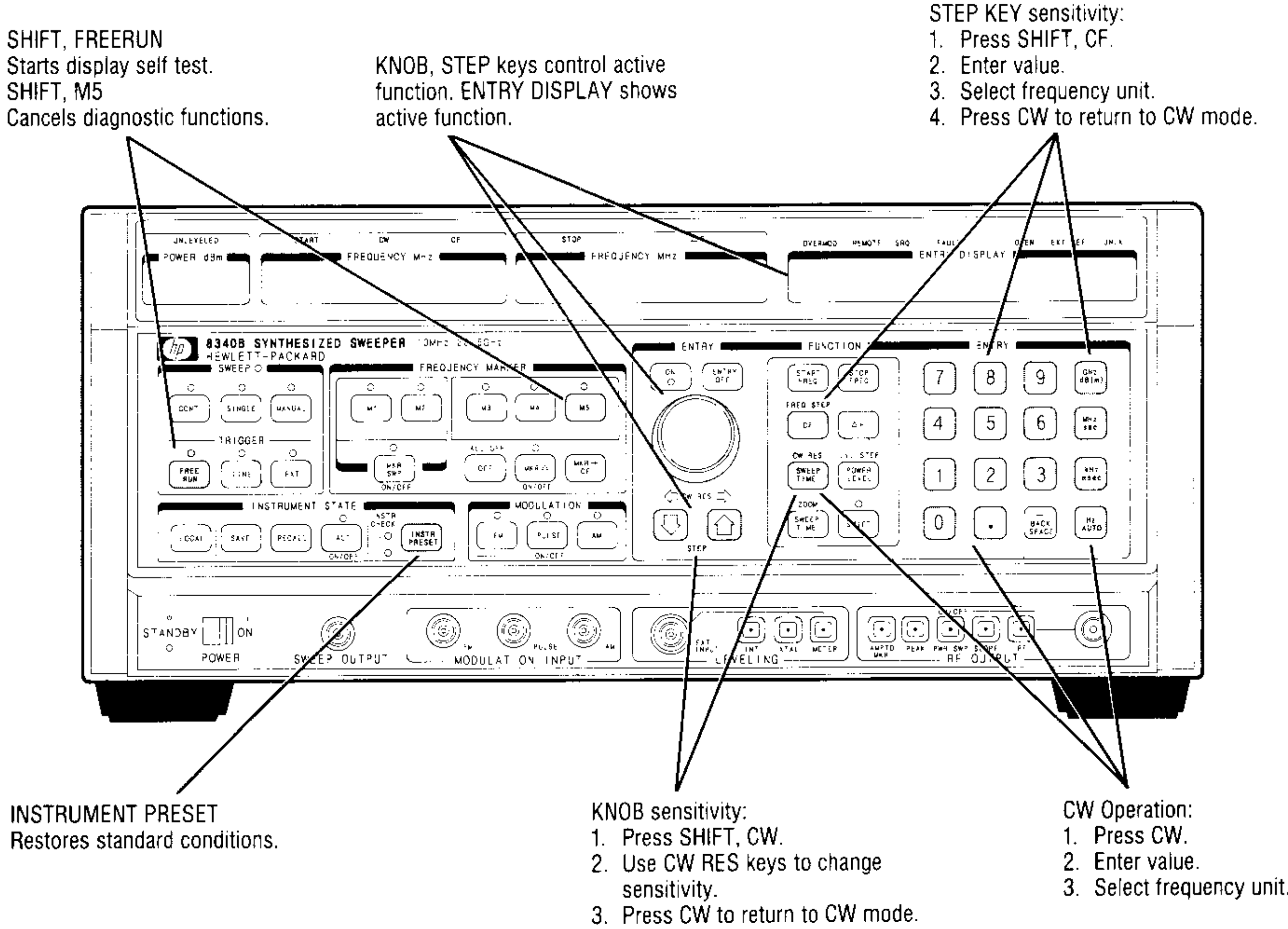
Located below the front panel are information cards that contain a summary of the local and remote commands of the instrument. Slide the cards from their tray, and observe the format of the information: The key-shaped symbols indicate the front-panel keys that are pressed in local operation, the letters and numbers next to the key-shaped symbols are the programming commands used in remote operation, and an explanation of the function follows the symbols and commands.

Under SHIFT KEY FUNCTIONS on the lower information card, find **[SHIFT]** **[FREE RUN]** which is the keystroke sequence you just used to activate the display self test. Notice that there are several other built-in diagnostic functions. For example, press **[SHIFT]**, then **[EXT]** which will display the condition of the internal oscillators (a flashing display indicates an unlocked oscillator; this diagnostic is usually called when the UNLK annunciator is lighted).

Feel free to try any of the functions described on the information cards. The HP 8340B/41B will not be damaged if any keys are pressed in an incorrect sequence. Press **[INSTR PRESET]** at any time to return to standard starting positions.

CW OPERATION

CW operation is one of the major applications of the HP 8340B/41B, and is easy to implement using front-



panel keys. In the CW mode, the instrument outputs a single, low-noise, synthesized frequency. To get the desired CW frequency, press **[CW]**, then use the numeric keypad to enter the desired CW frequency, followed by the frequency unit (GHz, MHz, kHz, Hz). The frequency units (GHz, MHz, kHz, Hz) are on keys located to the right of the numeric keys. Try this example:

[CW] [12.345123456] [GHz]

Check the ENTRY DISPLAY in the upper right hand corner of the instrument, and the left FREQUENCY MHz display, which will both show **CW: 12345.123456 MHz** (the ENTRY DISPLAY always shows the most recently changed function, which in this case is the CW frequency). Notice that this microwave signal has single digit Hz resolution.

Try other CW frequencies in the 10 MHz to 26.5 GHz (20 GHz for HP 8341B) range. As you will see below, the CW frequency can be "tweaked" by using the **[STEP]** keys and the **[KNOB]**, but first save this CW configuration for future recall. Press **[SAVE]**, then **[1]** to save this CW instrument configuration in memory register 1.

STEP KEYS, KNOB

The **[STEP]** keys and the **[KNOB]** affect the function that is currently being displayed in the ENTRY DISPLAY window. When you were entering CW frequencies in the last example, your keystrokes were being displayed in the ENTRY DISPLAY window and you could have used the **[STEP]** keys or **[KNOB]** to control the CW frequency as well.

For example, enter the following:

[CW] [10] [GHz]

The ENTRY DISPLAY will show this value in MHz. Now alternately press the up-arrow and down-arrow **[STEP]** keys while watching the frequency change in the ENTRY DISPLAY window. Press and hold one of the **[STEP]** keys for a repeat action.

Next, alternately rotate the **[KNOB]** clockwise and counter-clockwise while watching the changing CW frequency in the ENTRY DISPLAY. the **[KNOB]** is usually used as a fine-sensitivity adjustment, with the **[STEP]** keys used as a coarse adjustment.

To change the sensitivity of the **[KNOB]**, press **[SHIFT]** then **[CW]**, which will activate the CW RES function. The flashing cursor in the ENTRY DISPLAY indicates the digit affected by the **[KNOB]**. Change the resolution by pressing the **[STEP]** key below the ◀ CW RES ▶ label. After you have positioned the flashing cursor over the desired digit, press **[CW]** to remove the cursor and return to the CW mode. Try the **[KNOB]** to see the effects of your sensitivity adjustment.

To change the sensitivity of the **[STEP]** keys, press **[SHIFT]** then **[CF]**, which will activate the FREQ STEP function (as labeled above the CF key). "STEP" will appear in the ENTRY DISPLAY. Enter the frequency step size you want, using the numerical keys, or the **[KNOB]**, or the **[STEP]** keys (which are in a 1-2-5 sequence), followed by a unit key (GHz, MHz, kHz, Hz). When you are finished, press **[CW]** to return to CW mode, and try the **[STEP]** keys to see the effects of your adjustment.

The **[STEP]** sensitivity you just set will also be the step size for the **[START FREQ]**, **[STOP FREQ]**, **[CF]** frequency keys, as well as markers **[M1]** - **[M5]**. All of these keys are described in this Getting Acquainted guide.

After setting a CW frequency, you will probably want to adjust the power level, which is described below.

POWER LEVEL

The power level, in dBm, is set by a procedure that is very similar to the CW frequency procedure. The HP 8340B/41B can output leveled power for CW or swept frequency operation, or a power sweep. The basic power level adjustment is described here.

To set the power level, press the **[POWER LEVEL]** key, then use the numeric keys to enter any desired power level, followed by the terminator key **[dB(m)]**. The minus (−) sign key is also labeled BACK SPACE; The HP 8340B/41B knows that this key is a minus key when used first in a keystroke sequence, and a back space key at all other times.

The selected power level can range from the minimum level of −110 dBm (−20 dBm for HP 8340Bs equipped with option 001 or 005), to the maximum level allowed, which varies with frequency (see the specifications table in Section I). For practice, enter the following:

[POWER LEVEL] [−20] [dB(m)]

ENTRY DISPLAY will show the selected power level, while the actual power is displayed in the POWER dBm window. If the selected power is beyond the range of the HP 8340B/41B, the closest possible power will be shown in the POWER dBm display.

When the power level is shown in the ENTRY DISPLAY, the power level can be controlled by the **[KNOB]** and **[STEP]** keys. The **[KNOB]** affects the power level at the best possible sensitivity, which is 0.05 dB, while the sensitivity of the **[STEP]** keys can be changed with the LVL STEP function.

To activate the LVL STEP function, press **[SHIFT]** then the **[POWER LEVEL]** key (notice the label LVL STEP above the **[POWER LEVEL]** key). Then use the numerical keypad, or the **[KNOB]**, or the **[STEP]** keys (which have a 1-2-5 sequence) to set your desired power step size, followed by the **[dB(m)]** terminator key. Press the **[POWER] [LEVEL]** key to return to POWER LEVEL mode, then try the **[STEP]** keys to see the effects of your adjustment.

So far, you have set a fixed (CW) frequency and a fixed power level. Now you will set sweep operations, first with a power level sweep, then with frequency sweeps.

POWER SWEEP

NOTE: The POWER SWEEP example shown below does not apply to HP 8340B's equipped with Option 001 or 005, which are not equipped with a 90 dB step attenuator. Such instruments cannot produce power levels below −20 dBm. Power Sweep range with either of these options is −20 dBm to the maximum power available in the given frequency band.

The HP 8340B/41B can sweep the output power over as much as a 40 dB range. To prepare for this power sweep example, enter the following:

[CW] [12] [GHz]

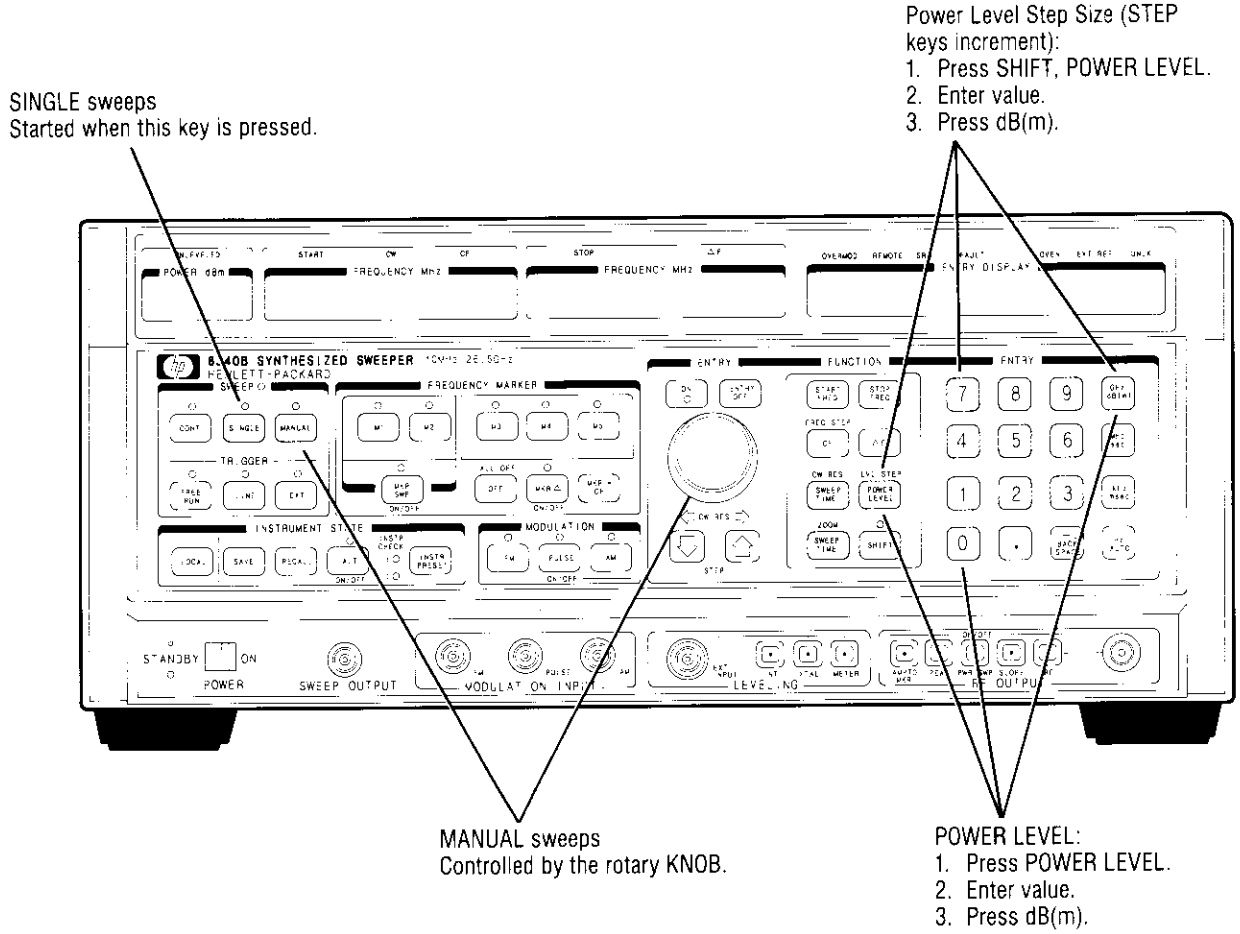
[SWEEP TIME] [10] [sec]

The HP 8340B/41B is outputting a 12 GHz CW frequency, and with further instructions will perform power sweeps having a 10 second period. Next, press **[SHIFT]**, then **[PWR SWP]** which will show the ATN (attenuator) and ALC (automatic leveling control) values in the ENTRY DISPLAY.

The HP 8340B/41B uses the ATN as the coarse adjustment (10 dB steps), and the ALC as the fine adjustment (0.05 dB steps) when you use the **[POWER LEVEL]** key to set a fixed output power. However, for a maximum-range power sweep the ALC must be decoupled from the ATN, which you just did by pressing **[SHIFT] [PWR SWP]**. After decoupling, the ATN and ALC can be set independently.

Use the **[STEP]** keys to change the ATN value (the clicking sould you hear is the attenuator pads being mechanically switched into place). The ATN value can range from 0 dB to −90 dB, in 10 dB steps. Set the ATN to −40 dB for this example.

Next, rotate the **[KNOB]** as you watch the ALC value change. The range is −20 dBm for the lowest value, to an upper value that depends on frequency (see the specifications; the specified upper value is +10 dBm at 12 GHz). The maximum effective upper value is determined by watching the POWER dBm display (which shows the ATN + ALC sum) as you increase the ALC value: The red UNLEVELED annunciator will light when you exceed the maximum value. The maximum range of your power sweep equals the maximum leveled range of the ALC, with the ATN providing a fixed offset.



Set the ALC to −15 dBm for this example, using the **[KNOB]** or the numeric keys (with the **[dB(m)]** terminator key). The POWER dBm display will show −55 (−40 ATN plus −15 ALC), and the power sweep range can be at least 25 dB (ALC range of −15 to +10 dB).

The rest is easy. Press **[PWR SWP]**, and the ENTRY DISPLAY will display 0.00 dB/SWP. Use the**[STEP]** keys, or the **[KNOB]**, or the numerical keys (with the **[dB(m)]** terminator key) to change this to the desired sweep range. For this example, press

[25] [dB(m)]

and the HP 8340B/41B will power sweep from −55 dBm to −30 dBm, in a 10 second period.

Before leaving the power sweep function, there are two more keys you should try. Press **[SINGLE]** to change from CONTinuous sweeps to single sweeps, which start every time you press the **[SINGLE]** key (if you press **[SINGLE]** in the middle of a sweep, the sweep will stop). Next, press **[MANUAL]** which will allow you to use the **[KNOB]** to manually sweep through the −55 to −30 dBm range.

Press **[PWR SWP]** again to turn power sweep off, and press **[POWER LEVEL]** to re-couple the ATN and ALC.

Swept frequency operation is explained in the next section.

SWEPT OPERATION

The HP 8340B/41B can sweep a frequency span as wide as the frequency range of the instrument, or as small as 100 Hz, with 5 frequency markers available to you in the sweep span.

In this Getting Acquainted section, you will be introduced first to establishing swept operation using start/stop frequencies and center/Δ frequencies, followed by marker operations.

START/STOP SWEPT OPERATION

The HP 8340B/41B will sweep from a selected start frequency to a selected stop frequency. To begin, press the **[START FREQ]** key, then enter the numerical value of your desired start frequency, followed by the appropriate frequency unit (GHz, MHz, kHz, Hz); for example:

[START FREQ] [144] [MHz]

Then, press the **[STOP FREQ]** key, enter your desired stop frequency followed by the frequency unit; for example:

[STOP FREQ] [146] [MHz]

The left FREQUENCY MHz display will show your start frequency, while the middle FREQUENCY MHz display (and ENTRY DISPLAY) will show your stop frequency.

Next, adjust the sweep time. In typical applications the sweep time can vary tremendously – from milliseconds in a network analyzer system to more than a minute in thermistor-based power meter systems. However, the sweep time adjustment procedure is the same: Press the **[SWEEP TIME]** key, then a numerical value followed by **[sec]** or **[msec]**. If the fastest possible sweep time is desired, press **[SWEEP TIME]** followed by **[AUTO]**. For example, enter the following:

[SWEEP TIME] [2.5] [sec]

Watch the green LED next to the SWEEP label, which will blink every 2.5 seconds. The LED will blink at each retrace, and at each bandcrossing for wideband sweeps (although you aren't crossing any bands in this example). Next, press **[SWEEP TIME]**, then **[AUTO]** to obtain the fastest possible sweep speed at this frequency span (10.00 msec).

Press **[SAVE]**, then **[2]** to save this start/stop example in storage register 2 for later use.

CENTER FREQUENCY Δ FREQUENCY SWEPT OPERATION

This is another way of establishing swept operation. Start/stop swept operation and center/Δ frequency swept operation are just two different ways of defining the sweep limits.

As an example of CF/Δ F mode, press **[CF]**, a numerical value for the desired center frequency, and the frequency unit (GHz, MHz, kHz, Hz); for practice, try:

[CF] [4] [GHz]

Then press the **[Δ F]** key, a numerical value for the span frequency, and the frequency unit; for example:

[Δ F] [1] [GHz]

The HP 8340B/41B is now sweeping from 3.5 to 4.5 GHz. The left FREQUENCY MHz display shows your center frequency, while the middle FREQUENCY MHz display (and the ENTRY DISPLAY) shows your delta frequency.

While **[Δ F]** is the active function (presently being displalyed in ENTRY DISPLAY), try the **[KNOB]** and **[STEP]** keys and watch the changing **[Δ F]** frequency. This symmetrical expansion of the frequency span about the center frequency is one reason that CF/ΔF swept mode is sometimes used instead of start/stop frequency sweeps. Next, you will add markers to the sweep field.

Press **[SAVE]**, then **[3]** to save this instrument configuration for future recall.

FREQUENCY MARKERS

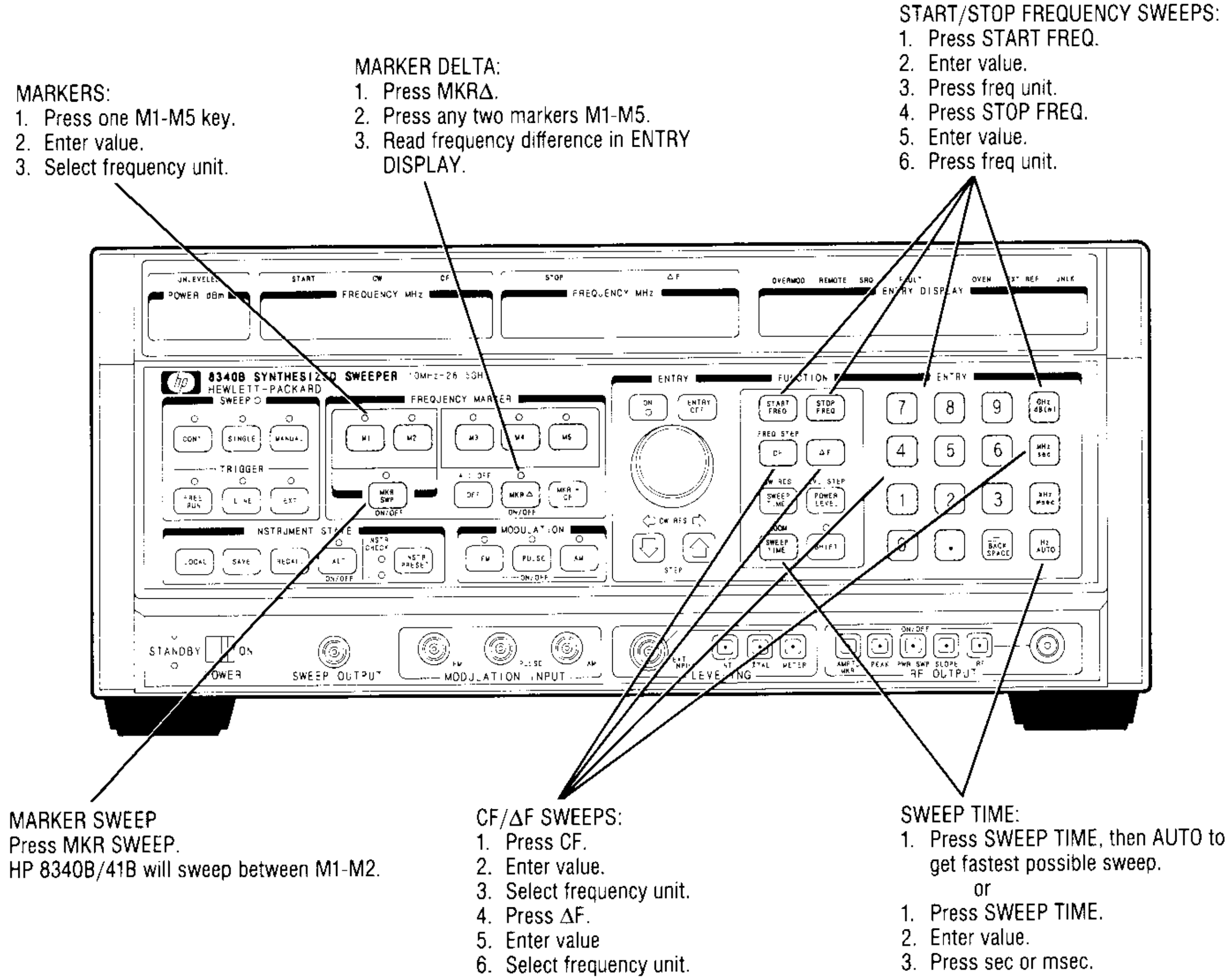
The HP 8340B/41B has 5 frequency markers that can be used as fixed frequency "landmarks," or as variable frequency pointers on a CRT display. Your introduction to frequency markers will be made by continuing with the previous swept frequency examples.

To obtain the instrument configuration used in the start/stop swept frequency example, press **[RECALL]** then **[2]**, which will recall all of the instrument settings that you previously established and SAVEd in storage register 2. The HP 8340B/41B should once again be sweeping from 144 MHz to 146 MHz, with a 10.00 ms sweep speed. Add a marker to this sweep field by pressing **[M1]**, then enter **[144.5] [MHz]**. This causes an intensified dot to appear at that frequency on a CRT display (to obtain a "spike" at that frequency instead of the intensified dot, press **[AMTD] [MKR]**.

For a second marker, press **[M2]**, then enter **[145.5] [MHz]**. This process can be continued for all 5 markers. Note that the marker presently being displayed in the ENTRY DISPLAY window is "active" and as such can be controlled by the numerical keyboard, **[KNOB]**, **[STEP]**, and **[OFF]** keys; pressing any marker key will make that marker the active one.

As an example of the marker delta **[MKR Δ]** function, press **[M3]**, enter **[145.6] [MHz]**, and press **[MKR Δ]**. **[MKR Δ]** causes the frequency difference between any two markers to be displayed in the ENTRY DISPLAY window, and the CRT trace is intensified between the two markers. Select the two markers by pressing any two marker keys. For example, press **[M1] [M2]**, then **[M2] [M3]**, and finally **[M1] [M3]** and watch the ENTRY DISPLAY for the frequency differences. Press **[MKR Δ]** again to turn off the **[MKR Δ]** function. **[MKR Δ]** is a useful aid in examining CRT traces as for example, in measuring the 3 dB bandwidth of a bandpass filter on a network analyzer display.

Once the **[M1]** and **[M2]** markers have been established, the Marker Sweep function will change the start/stop frequencies originally established to the frequencies of these two markers. This can serve as a "magnification" function that you can use to focus in on a selected portion of the CRT trace. As an example, press **[MKR SWEEP]**, which will change the start/stop sweep frequencies to the frequencies of markers **[M1]** and **[M2]** (marker sweep works only with **[M1]** and **[M2]**). Press **[MKR SWEEP]** again to turn off the Marker Sweep function and return the sweep to its previous start/stop limits.



Markers are also used in exactly the same way with CF/ΔF frequency swept mode, so at this point press **[RECALL]**, then **[3]** to recall the CF/ΔF swept mode settings stored in register 3 to continue with the marker examples. The HP 8340B/41B should once again be sweeping around a 4 GHz center frequency.

Markers are very easy to use, especially if you let the **[KNOB]** do the work for you. Try this example: Press **[SHIFT]** and **[OFF]** to turn off all markers (so you are starting with a clean slate), then press **[M1]**. **[M1]** will come up with its most recent frequency; however, at the first turn of the **[KNOB]** the frequency of **[M1]** will jump to the center frequency of the current sweep; that is, if **[M1]** came up at 144.5 MHz it will jump to 4.0 GHz as soon as the **[KNOB]** is turned. The 4 other markers can be brought into the sweep field in the same manner.

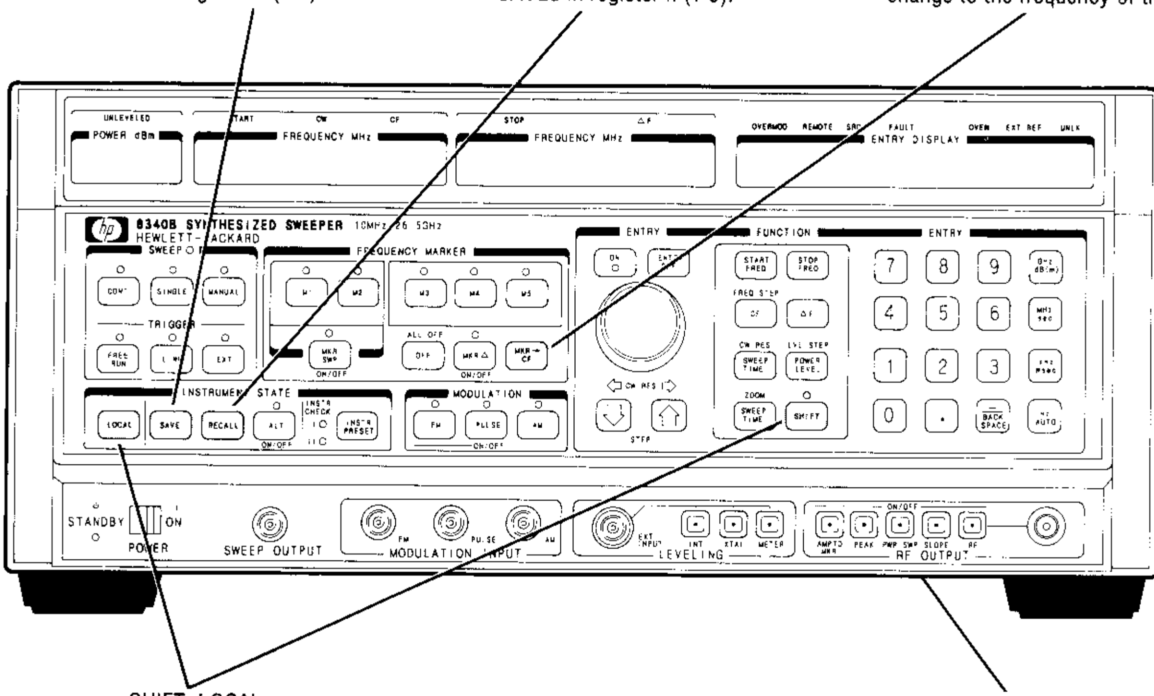
The final example of using markers is **[MKR ➡ CF]**, which changes the center frequency of the sweep to the frequency of one of the maarkers, which is another way of focusing in on a selected portion of the CRT trace. First, press one of the marker keys (the one that you want to become the center frequency) to bring that marker into the ENTRY DISPLAY. Then, press **[MKR ➡ CF]** to change the center frequency to the marker frequency. You can re-use the marker that just became the center frequency.

Markers are indispensable for swept frequency measurements, so practice with them until you are completely comfortable with their many features.

RECALL INSTRUMENT CONFIGURATIONS

For the final Local Operation example, you will recall all of the instrument modes you previously created and saved (with the **[SAVE]** key) by using the **[RECALL]** key.

To recall any previously stored instrument configuration (stored by using the **[SAVE]** key), press **[RECALL]**,



then the number of the storage register (1 to 9). For example:

[RECALL] [1] recalls the CW configuration used in this Getting Acquainted guide.

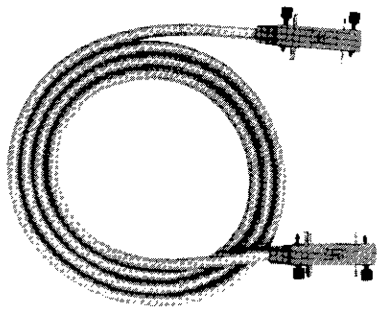
[RECALL] [2] recalls the start/stop sweep example used in this guide.

[RECALL] [3] recalls the center frequency/Δ frequency example.

This completes the basic introduction to local (front panel) operation of the HP 8340B/41B Synthesized Sweepers. At this point, you are ready to study (as needed) the advanced features of Local Operation contained in Section III of the HP 8340B/41B Operating Manual.

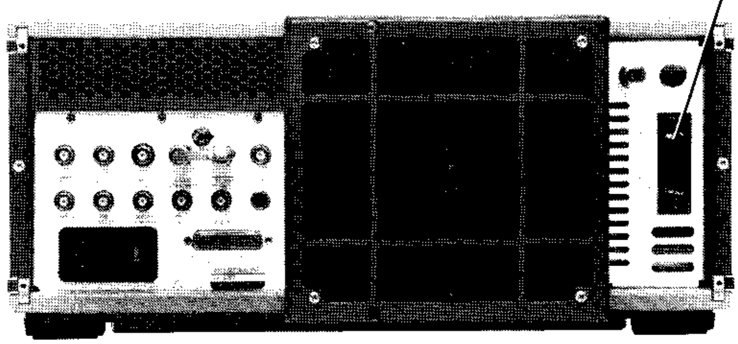
An introduction to remote (computerized) operation of the HP 8340B/41B is provided in the following text.

REMOTE OPERATION OF THE HP 8340B/41B SYNTHESIZED SWEEPERS



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 (13.3 ft.)
HP 10833D	0.5 m (1.6 ft.)



All front panel controls except the **[LINE]** switch can be remotely programmed via an HP-IB (Hewlett-Packard Interface Bus) computer system. Additionally, several special HP 8340B/41B functions are available in an HP-IB system that are not available from the front panel. This section provides an introduction to remove operation of the HP 8340B/41B.

Any HP-IB computer system can control the HP 8340B/41B; however, for simplicity only HP BASIC language commands will be used in this Getting Acquainted section. These BASIC commands are applicable to the HP 9000 series 200 and 300, and HP 80-series of computers. For other computers and other languages, consult the applicable computer manuals.

PREPARATION FOR USE

Prepare the instruments for remote operation by connecting an HP-IB cable between the computer and the HP 8340B/41B, and load the BASIC operating system into the computer (if necessary).

Next, check the HP-IB address of the HP 8340B/41B. If several instruments are connected to an HP-IB cable, each must have a unique address within the range of 00-30. The factory-set address for the HP 8340B/41B is 19, which can be seen in one of two ways: Flip the **[LINE]** switch from STANDBY to ON, and the HP-IB address will appear (momentarily) in the ENTRY DISPLAY; or press **[SHIFT]**, then **[LOCAL]** which will also cause the address to appear in the ENTRY DISPLAY.

To change the HP-IB address, press **[SHIFT]**, **[LOCAL]**, a numerical value (range 00 - 30), and any "terminator" key (GHz, MHz, kHz, Hz). The examples that follow use "19" as the HP 8340B/41B address.

PREPARATORY COMPUTER COMMANDS

HP-IB systems can be very complicated, with several instruments and lots of activity on the bus. Although your simple practice setup (one computer, one instrument) doesn't require any preparatory commands, the following 3 commands are so useful that you should become familiar with them at this time.

The "panic button" for an HP-IB system is the ABORT command. All activity on the bus is halted by this command:

ABORT 7

Enter this statement on the computer, then press the computer's **[EXECUTE]** or **[END LINE]** key. All HP-IB instruments ("7" directs the command to the HP-IB system) have stopped transmitting on the HP-IB and are now listening for a command from the controller (computer).

Now you want to specifically tell the HP 8340B/41B that the computer is in command, not the front panel. To change the HP 8340B/41B from local (front panel) control to remote HP-IB operation, enter this command:

REMOTE 719

followed by pressing the [EXECUTE] or **[END LINE]** key. This command prepares the HP-IB (code "7") instrument located at address 19 for computer control. Notice that the amber REMOTE annunciator above the ENTRY DISPLAY is now lighted. Also notice that the front panel controls on the HP 8340B/41B no longer function, except for the **[LINE]** switch and the **[LOCAL]** key (pressing the **[LOCAL]** key will return front panel control to the HP 8340B/41B).

As the final preparatory command, enter

CLEAR 719

followed by **[EXECUTE]** or **[END LINE]**, as usual. This command clears the internal status byte and extended status byte registers of the HP 8340B/41B, so you start with a "clean slate" before beginning a program. None of the front panel annunciators change when you execute this command. This completes the preparatory commands.

At this point, any front panel function (and several special functions) can be controlled by the computer. However, only a few commands will be presented in this Getting Acquainted guide – just enough to get you started. After this introduction, you will be prepared for the additional material contained in the Programming Notes and Operating Guides contained in Section III of the HP 8340B/41B Operating Manual.

DATA COMMANDS, OUTPUT

Data commands change the operating conditions of the HP 8340B/41B, and are typically the most often used commands in remote applications. All front panel keystroke operations can be replaced by a data command (except for the **[LINE]** switch). The format for outputting data commands is

OUTPUT 719; "CODE"

for the simplest commands, or

OUTPUT 719; "CODE DATA TERMINATOR"

for the commands that require numerical data. In both cases, the statements are followed by **[EXECUTE]** or **[END LINE]**. CODE is the characters that represent a front panel key, or a special function; all codes are listed on the lower Information Card (located below the front panel of the HP 8340B/41B). DATA is the numerical value that is desired, and TERMINATOR is the desired unit (such as GHz, sec, dB(m), etc.). The TERMINATOR abbreviations are also listed on the Information Cards. Try each of the following commands as they are explained to you.

The simplest commands involve no numerical data. For example, Instrument Preset is established by this command:

OUTPUT 719; "IP"

For shifted commands, add **SH**; for example

OUTPUT 719; "SHT1"

starts the display self test, and

OUTPUT 719; "IP"

stops the display test. A complete code-data-terminator command for establishing a 12 GHz CW output is written:

OUTPUT 719; "CW12GZ"

The commands you have tried so far have had one command per statement; however, the commands can be strung back-to-back in the same statement. For example

OUTPUT 719; "CW12GZPL-50DB"

causes the HP 8340B/41B to output a 12 GHz CW signal at a power level of −50 dBm.

The HP 8340B/41B ignores spaces and unassigned characters that are placed in a command string, and automatically upshifts lower-case letters. Therefore, both of the following commands are functionally equivalent (although the statement with spaces requires a longer execution time):

OUTPUT 719; "FA8GHFB12GZPL0DBST500MS"

OUTPUT 719; "FA 8 Gz FB 12 Gz PL 0 dB ST 500 mS"

The second statement is easier to read and check for errors. Looking at the Information Cards, the above statement translates to a start frequency (FA) of 8 GHz, stop frequency (FB) of 12 GHz, power level (PL) of 0 dBm, and a sweep time (ST) of 500 milliseconds (mS).

There is also a command, **EK**, that is added to another code to enable KNOB control of that function on an otherwise remote front panel. For example:

OUTPUT 719: "EKFA" enables KNOB control of the start frequency

OUTPUT 719; "EKFB" enables KNOB control of the stop frequency

OUTPUT 719; "EKPL" enables KNOB control of the power level

This completes the introduction to sending data from the computer to the HP 8340B/41B; but how do you send data from the HP 8340B/41B to the computer (the reverse operation)?

DATA COMMANDS, INPUT

A set of commands allows the computer to read HP 8340B/41B conditions – such conditions as the start frequency, the power level, sweep times and many others. As an example, enter the following program, which will set and read the start frequency of the HP 8340B/41B:

```
10  REMOTE 719
20  OUTPUT 719; "FA 100 Mz FB 200 Mz PL — 50
    dB"
30  OUTPUT 719; "OPFA"
40  ENTER 719; A
50  DISP A; " MHz start frequency"
60  END
```

Press **[RUN]** on the computer. The HP 8340B/41B will start sweeping at 100 MHz (FA 100 Mz), stop sweeping at 200 MHz (FB 200 Mz), at a power level of −50 dBm (PL −50 dB). The command **OPFA** in line 30 translates as "Output Interrogated Parameter" (OP) the "Start Frequency" (FA). The value of the start frequency (the interrogated parameter) is placed in a buffer, and transferred to the computer's variable A in line 40 (A is an arbitrary selection; any floating point variable can be used).

To read the stop frequency and the power level, modify the previous program from line 50 and beyond as follows:

```
50  OUTPUT 719; "OPFB"
60  ENTER 719; B
70  OUTPUT 719; "OPPL"
80  ENTER 719; C
90  DISP A; "MHz start"; B; "MHz stop"; C; "dBm
    power level"
100 END
```

Press **[RUN]** and the start frequency (variable A), stop frequency (variable B), and power level (variable C) will be set by the computer and the values will be displayed on the computer's screen.

This completes the introduction to remote operation of the HP 8340B/41B. Although only a few examples were presented, you will find that most of the other programming commands follow a very similar format, and they will be easy to learn after this introductory practice.

This also completes the Getting Acquainted guide. You should now be ready to study (as needed) the advanced features discussed in Section III of the HP 8340B/41B Operating Manual.

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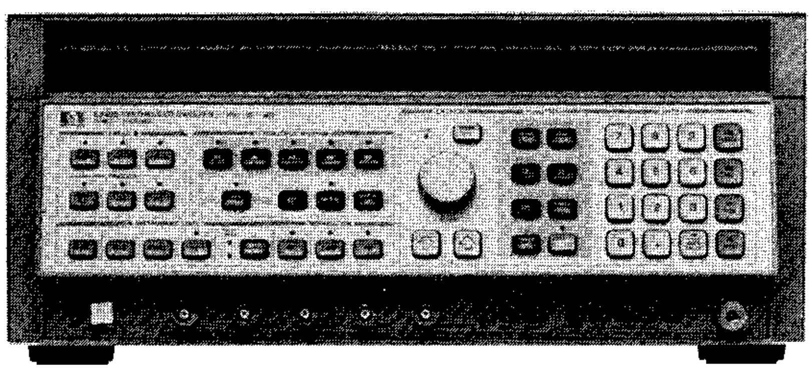
For more information, call your local HP sales office listed in the telephone directory white pages. Ask for the Electronic Instruments Department. Or write to Hewlett-Packard: **U.S.A.** - P. O. Box 10301, Palo Alto, CA 94303-0690. **Europe** - P.O. Box 999, 1180 AZ Amstelveen, The Netherlands. **Canada** - 6877 Goreway Drive, Mississauga L4V 1M8, Ontario. **Japan** - Yokogawa-Hewlett-Packard Ltd., 3-29-21, Takaido-Higashi, Suginami-ku, Tokyo 168. **Elsewhere** in the world, write to Hewlett-Packard Intercontinental, 3495 Deer Creek Road, Palo Alto, CA 94304.

HP Part Number 08340-90283

Printed in U.S.A.

HP 8340B
HP 8341B
SYNTHESIZED SWEEPERS



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HP 8340B/41B
SYNTHESIZED SWEEPERS
Operating Information

1400 FOUNTAINGROVE PARKWAY, SANTA ROSA, CA 95401 U.S.A.

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

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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.

A Table of Contents for this section follows this Introduction.

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.

SECTION III
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SUPPLEMENTAL GUIDES

OPERATING GUIDES

Getting Acquainted with the HP 8340B/41B Synthesized Sweepers

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 8755 Frequency Response Test Set

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

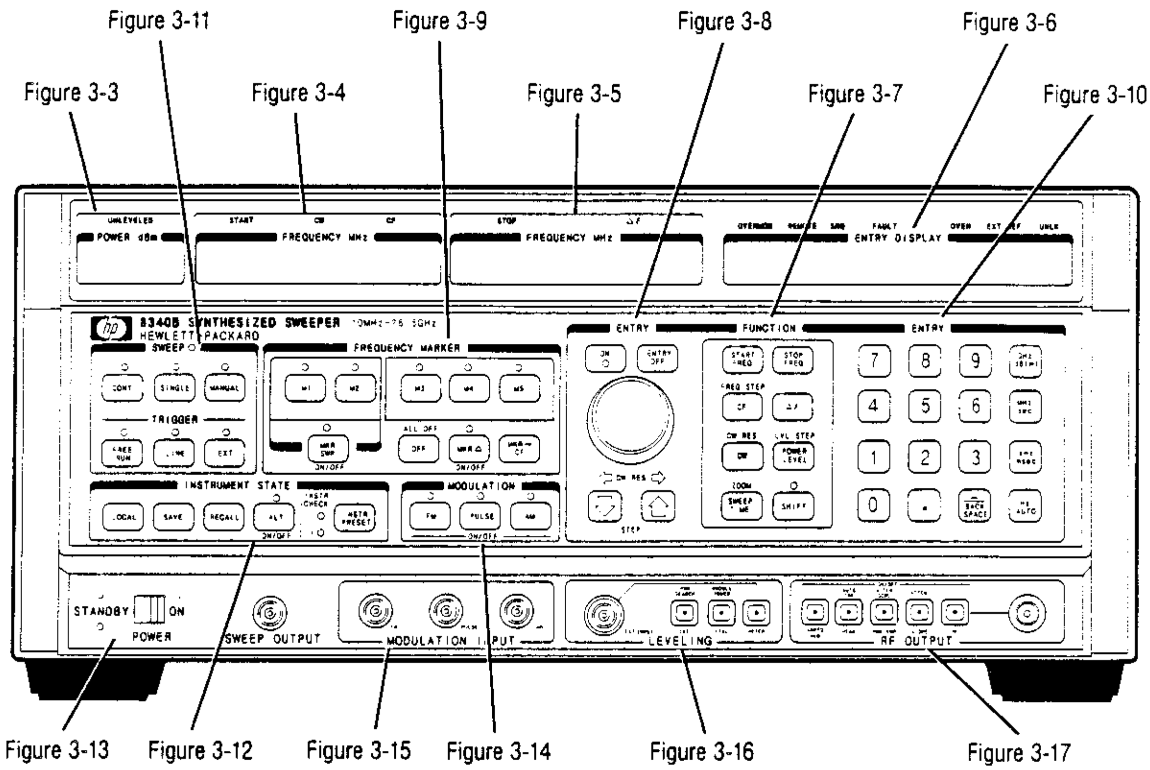


Figure 3-1. Index by front panel keys, display, and connectors

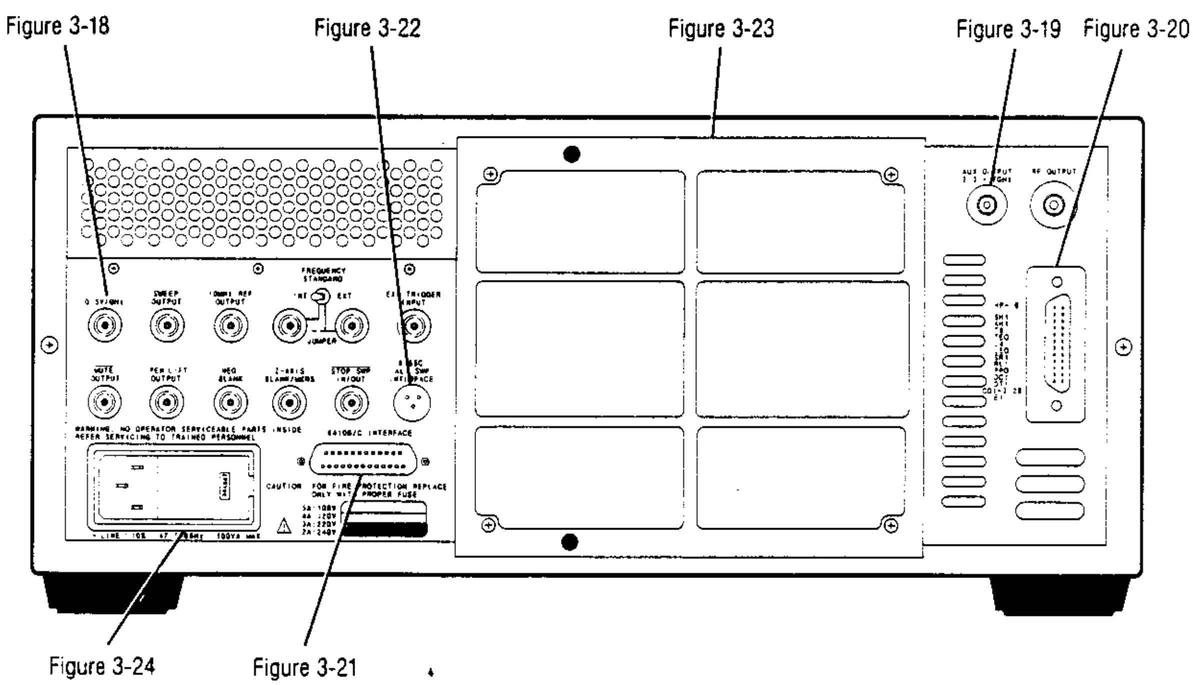


Figure 3-2. Index by rear panel connectors

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	3-12
	ALT OFF		AL0	
Security Memory Erase	ERASE RAM, set all variables and Save/ Recall registers to Instr Preset cond- itions. Working cal- ibration constants overwritten by protected cal constants.	[SHIFT] [MHz] [1] [8] [Hz] [SHIFT] [kHz] [0] [Hz]	SHMZ18HZ SHKZ0HZ	
Power Level and Control				
Set Output Power Level	POWER LEVEL	[POWER LEVEL]	PL	3-7
Power Sweep Mode	POWER SWEEP ON	[PWR SWP]	PS1	3-17
	POWER SWEEP OFF		PS0	
Power Slope Mode	SLOPE ON	[SLOPE]	SL1	
	SLOPE OFF		SL0	
RF Power	RF ON	[RF]	RF1	
	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)

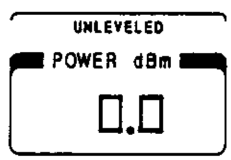
Mode	Function	Keys	HP-IB Code	Reference Figure
HP-IB Functions (Cont'd)				
Control Knob	ENABLE HP 8340B/41B KNOB		EK	
	ENABLE REMOTE KNOB		RB	
Sweep Functions	STEPPED SWEEP		SN	
	INCREMENT FREQUENCY		IF	
	RESET SWEEP		RS	
	TAKE SWEEP		TS	
	TIME LIMIT		TL	
Alternate State Selection	SELECT FOREGROUND		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.

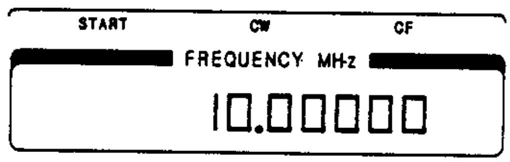
Figure 3-3. Power dBm Display (2 of 2)

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.

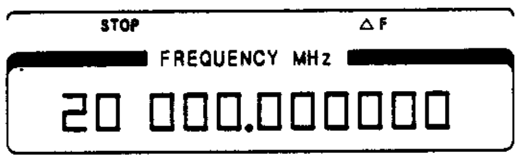
Figure 3-4. START/CW/CF Frequency Display

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.

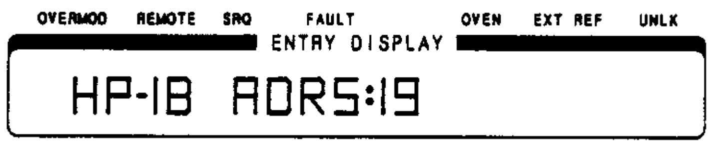
Figure 3-5. Stop/ΔF Frequency Display

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.

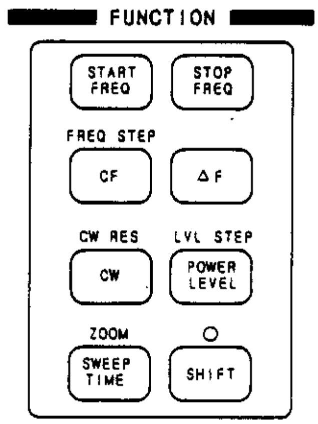
Figure 3-6. Entry Display (2 of 2)

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.

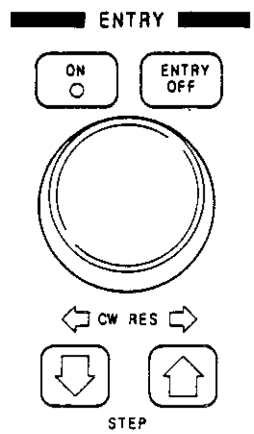
Figure 3-7. Function Keys (3 of 3)

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.

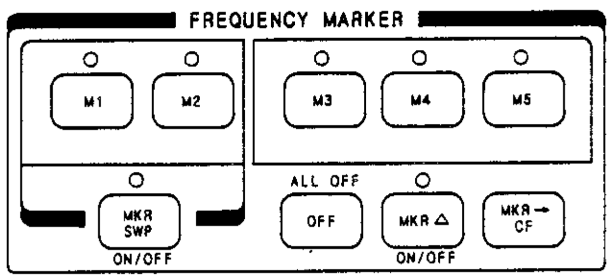
Figure 3-8. KNOB/STEP Entry (2 of 2)

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.

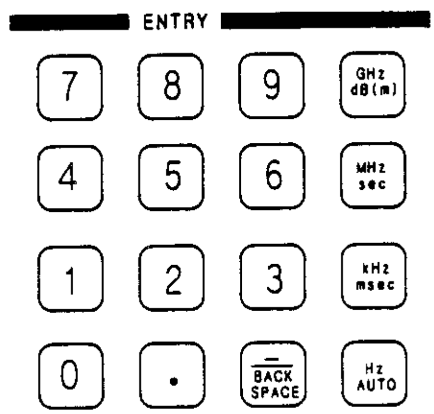
Figure 3-9. Frequency Marker Keys (2 of 2)

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.

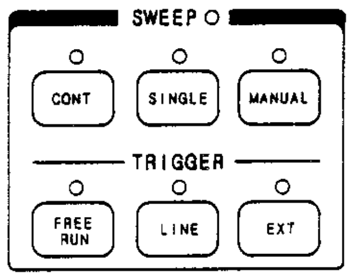
Figure 3-10. Entry Keys (2 of 2)

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"**

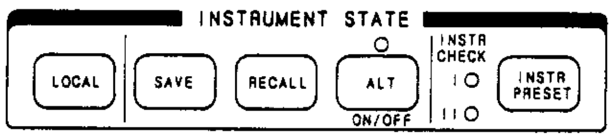
Figure 3-11. Sweep and Trigger Keys (3 of 3)

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.

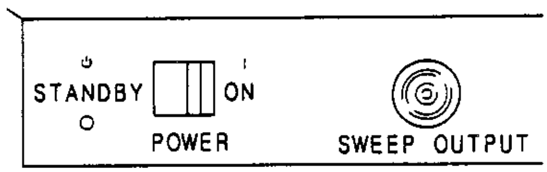
Figure 3-12. Instrument State Keys (3 of 3)

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.

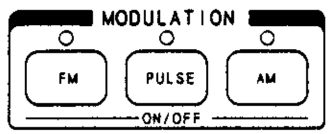
Figure 3-13. Power Switch, Sweep Output

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.

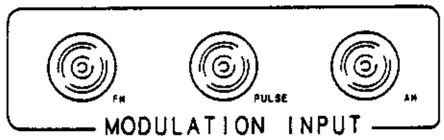
Figure 3-14. Modulation Keys

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.

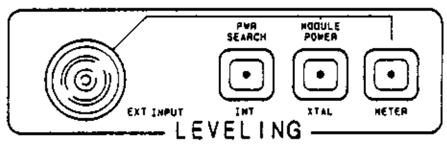
Figure 3-15. Modulation Inputs

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).

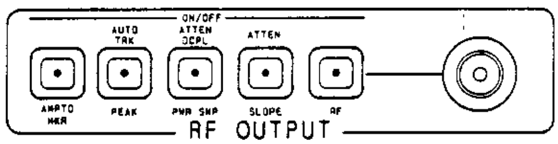
Figure 3-16. Leveling Keys/Input (2 of 2)

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.

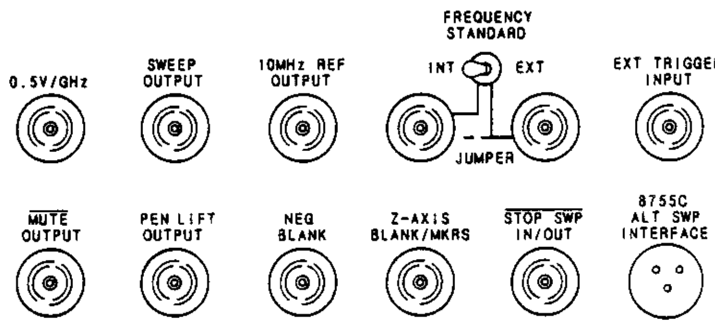
Figure 3-17. RF Keys/Output (3 of 3)

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.

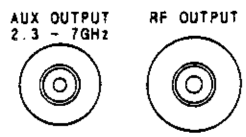
Figure 3-18. Rear Panel BNC Connectors (2 of 2)

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).

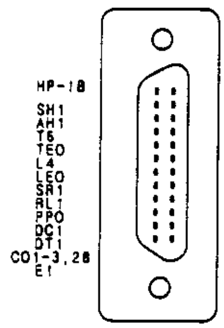
RF OUTPUT is an optional rear panel RF output connector that is functionally equivalent to the standard front panel RF output connector (which is described in Figure 3-17). Option 004 is a rear panel RF output with attenuator, and Option 005 (HP 8340B only) is a rear panel RF output without attenuator. 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

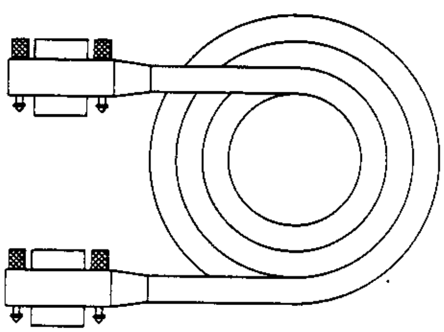
DESCRIPTION

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.

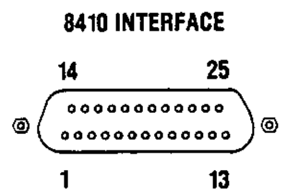
Figure 3-20. HP-IB Connector (2 of 2)

HP 8410B/C Interface/Cable

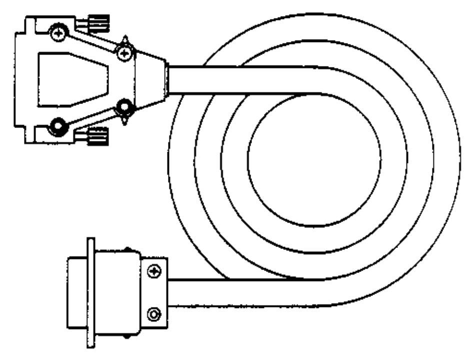
DESCRIPTION

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

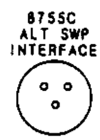
Figure 3-21. HP 8410 Interface (2 of 2)

HP 8755C Interface/Cable

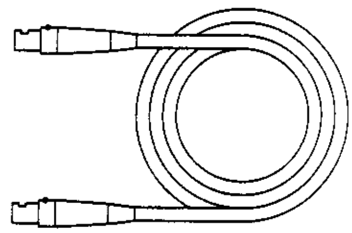
DESCRIPTION

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.

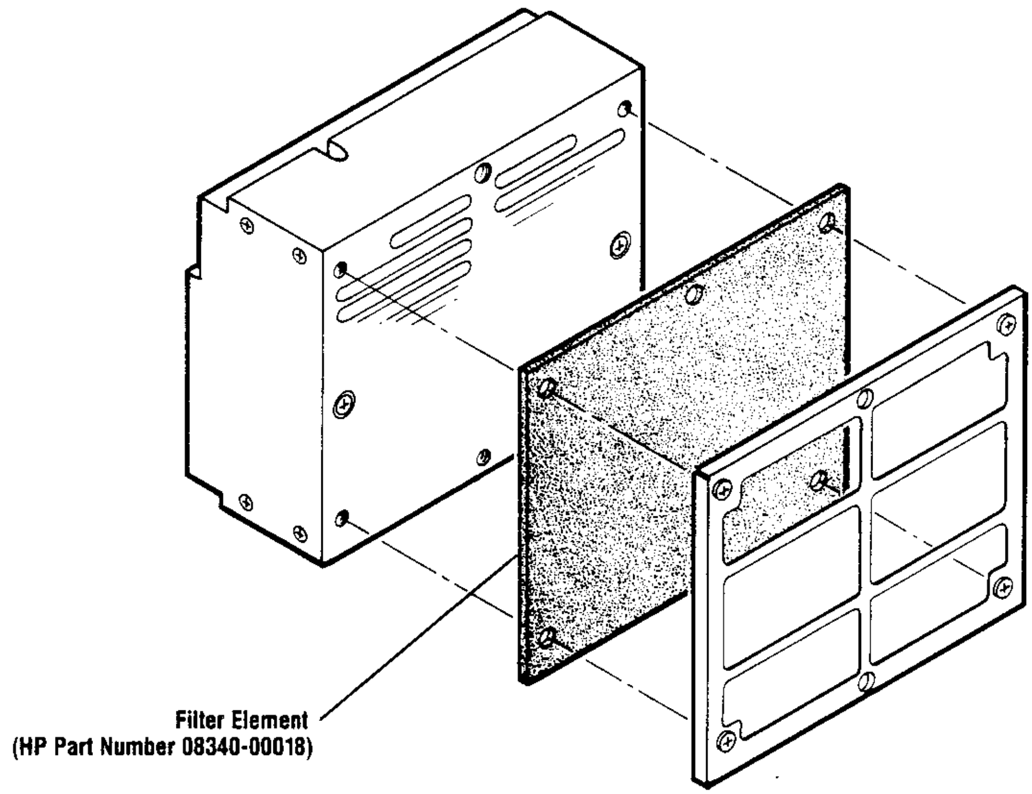
The pin configuration and electrical requirements for this connector are described in Section VIII (Service) of this Manual.

Figure 3-22. HP 8755C Interface/Cable

Fan Assembly

DESCRIPTION

Maintenance of the filter element for the fan is described in this Figure.



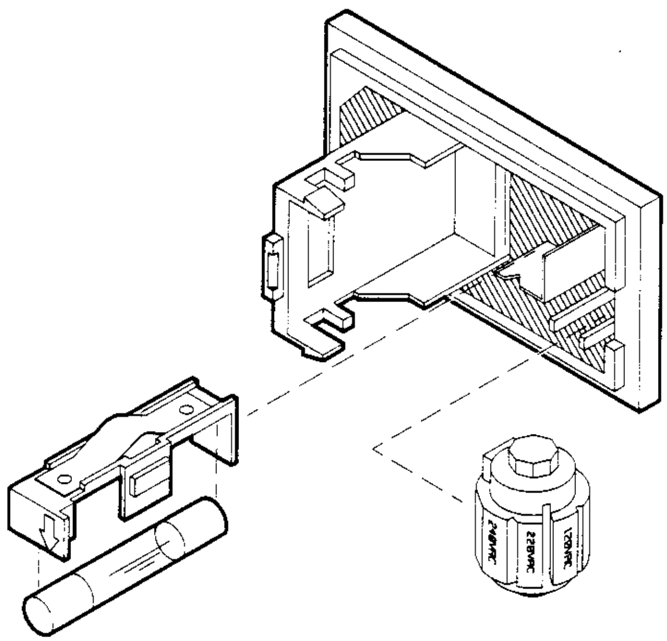
The foam filter element requires regular inspection and cleaning. The cooling fan for the HP 8340B/41B is powerful, and pulls a large amount of air through its filter element; subsequently, the filter element collects dust, smoke, and other contaminants even from environments that seem quite clean. To 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.

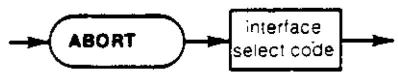
An explanation of the fundamental command statements follows. However, some computers use a slightly different terminology, or support an extended or enhanced version of these commands. Consider the following explanations as a starting point, but for detailed information consult the BASIC language reference 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:

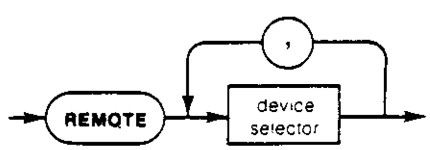
```
10  ABORT 7
100 IF V>20 THEN ABORT 7
```

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
```

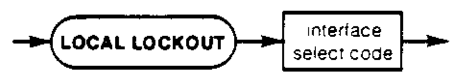
which effects four instruments that have addresses 19, 21, 26, and 15.

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

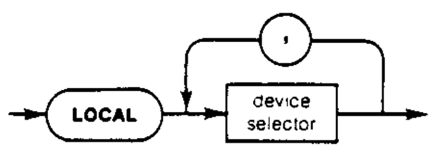


A BASIC example:

```
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:

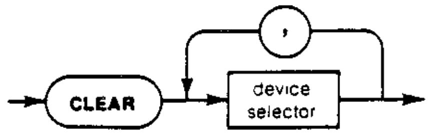
RESUME

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
```

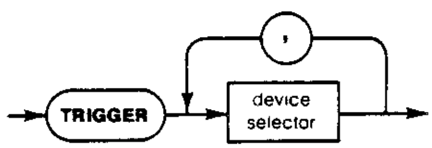
to clear an addressed instrument.

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.

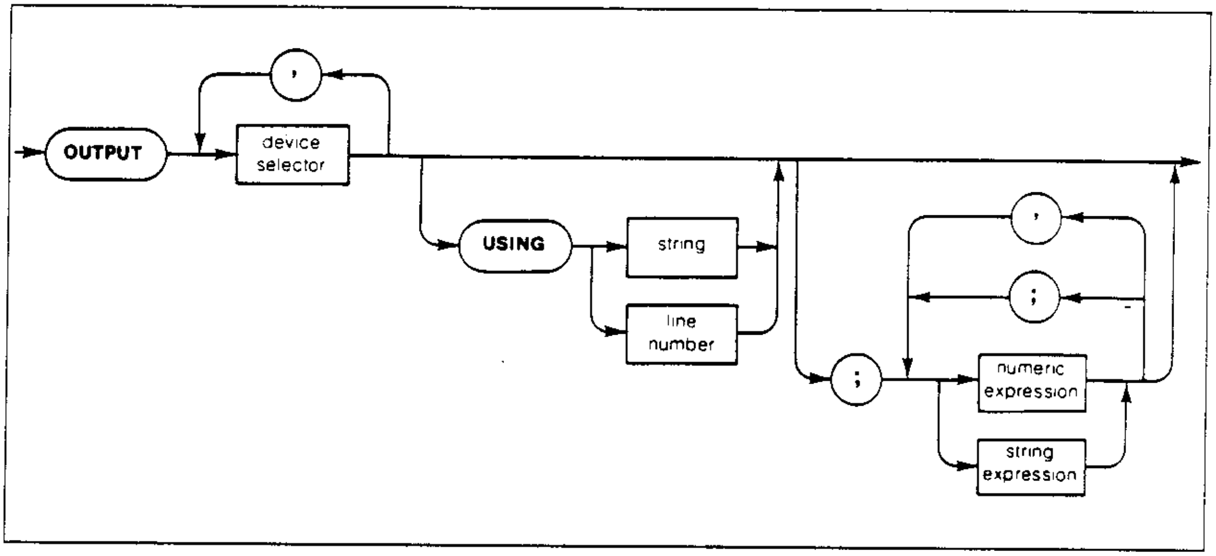
Related statements used by some computers:

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"
```

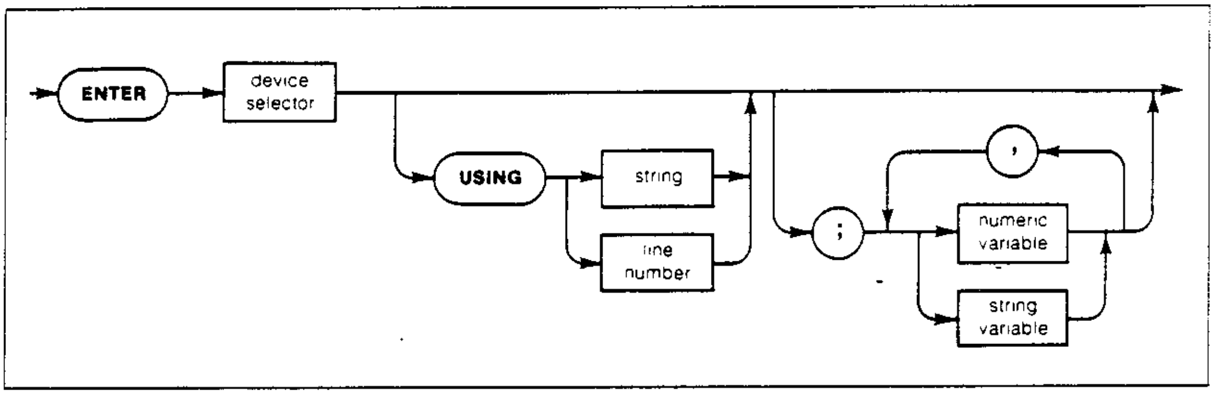
The many programming codes for the HP 8340B/41B are listed in Tables 3-1 and 3-2, and are explained in the Programming Codes subsection.

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 key-strokes. 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.

Table 3-2. HP 8340B/41B Programming Codes (4 of 4)

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]	85	[PULSE]
	used as the back space	86	[AM]
13	[↑]	87	[ENTRY OFF]
14	[↓]		
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]
		105	[GHz/dB(m)]
70	[M3]	106	[MHz/sec]
71	[M4]	107	[kHz/msec]
72	[M5]	108	[Hz/AUTO]
73	[FREE RUN]	109	[INT]
74	[LINE]		
75	[EXT]	110	[XTAL]
76	[MKR SWEEP]	111	[METER]
77	[OFF]	112	[AMTD MKR]
78	[MKRΔ]	113	[PEAK]
79	not used	114	[PWR SWP]
		115	[SLOPE]
80	[LOCAL]	116	[RF]
81	[SAVE]	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]**)
		24	not used
1	SAVE in register n	25	ZOOM frequency function
2	RECALL from register n	26	MANUAL sweep
3	ALTernate with register n	27	Frequency offset (**[SHIFT] [STOP FREQ]**)
4	I/O read (**[SHIFT] [kHz/msec]**)	28	Frequency multiplier (**[SHIFT] [START FREQ]**
5	UNLK indicators (**[SHIFT] [EXT]**)	29	RF SLOPE
6	Power LVL STEP size		
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;"=";BIT(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).

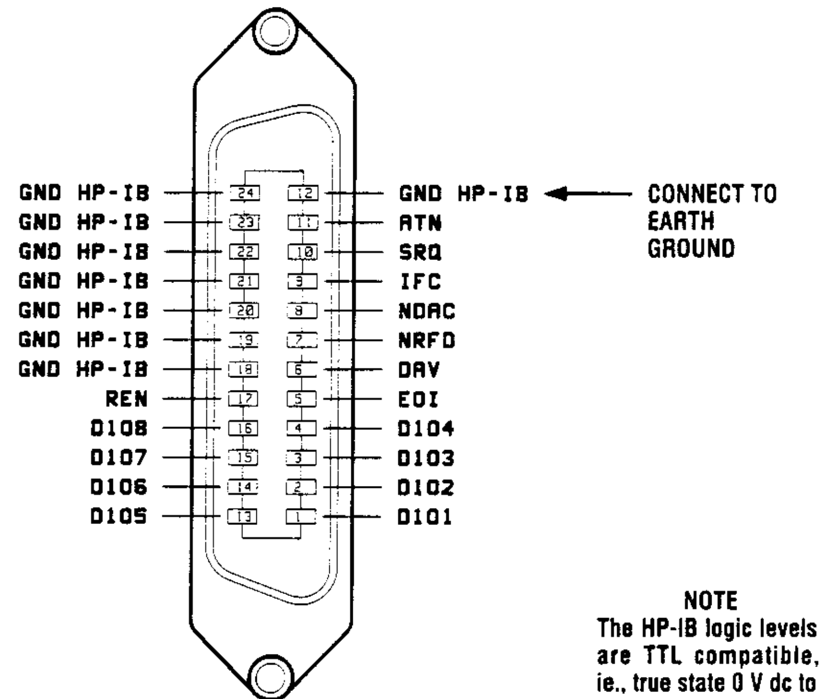


Figure 3-25. HP-IB Pin-Out

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

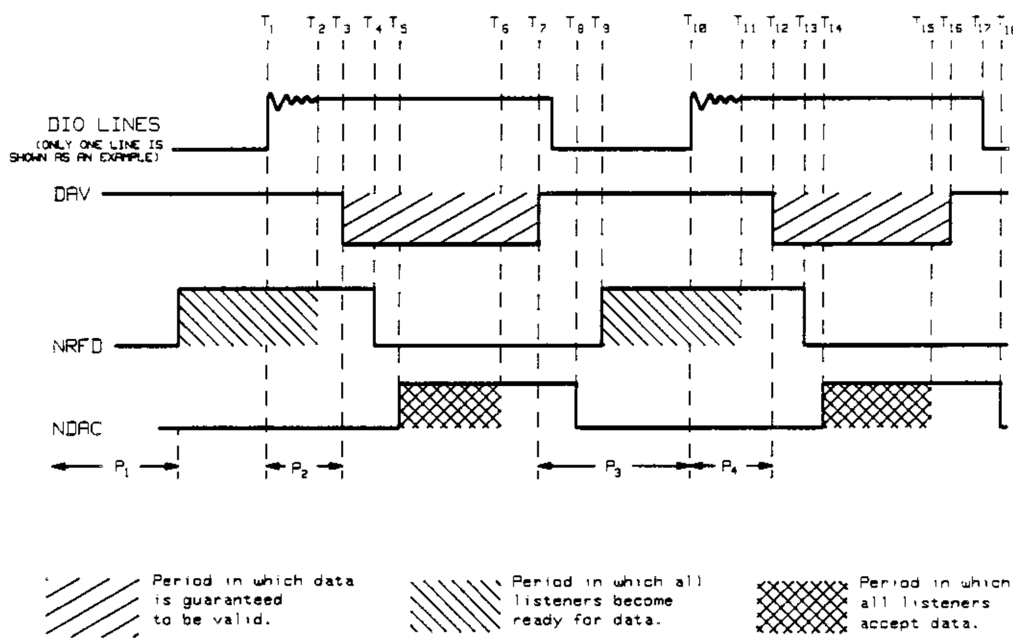
These three lines control the data transfer process.

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:

$\overline{\text{REN}}$

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

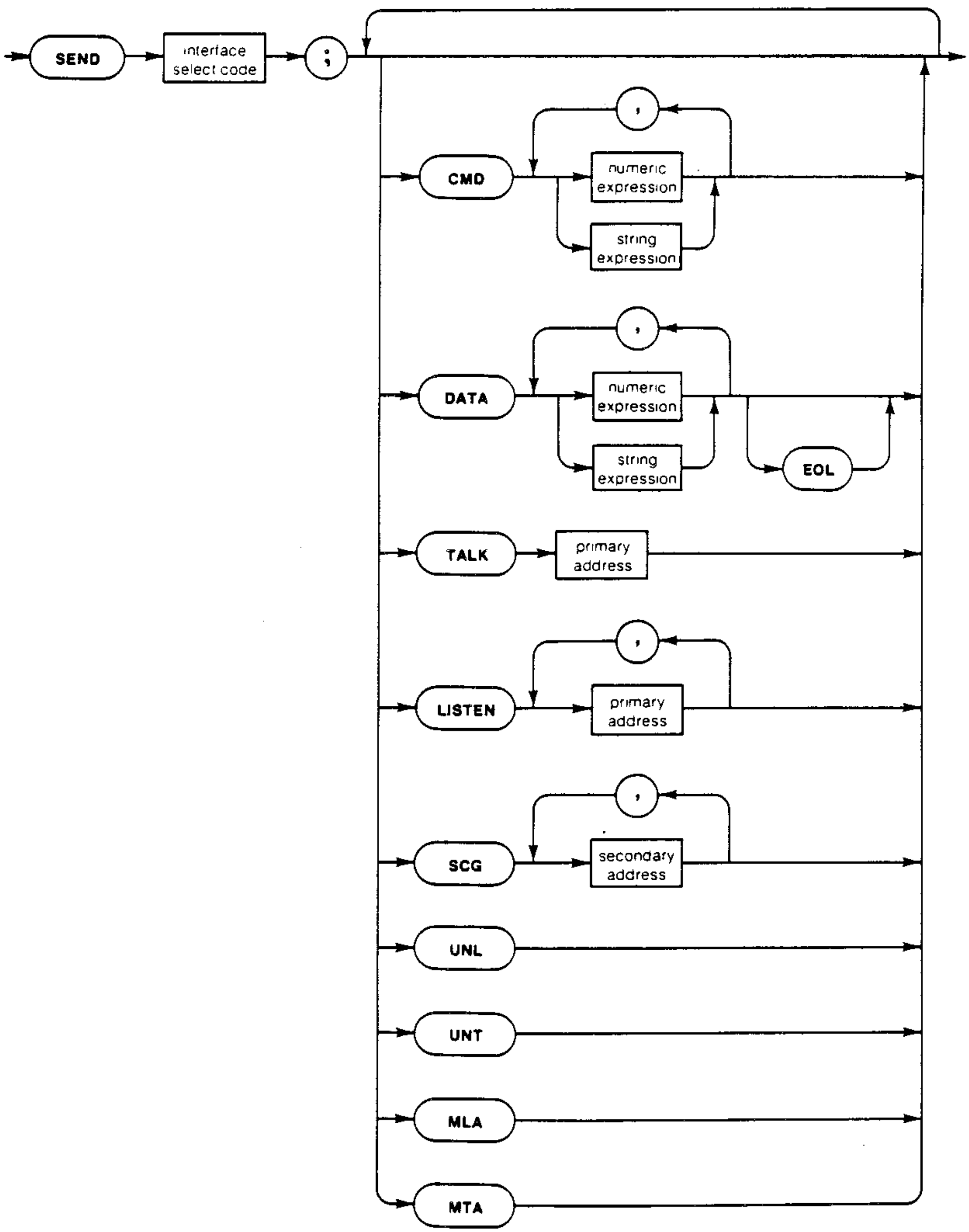
GTL	go to local	**LLO**	local lockout	**LAO-30**	listen address
SDC	selected device clear	**DCL**	device clear	**UNL**	unlisten
PPC	parallel poll configure	**PPU**	parallel poll unconfigure	**TAO-30**	talk address
GET	group execute trigger	**SPE**	serial poll enable	**UNT**	untalk
TCT	take control	**SPD**	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:

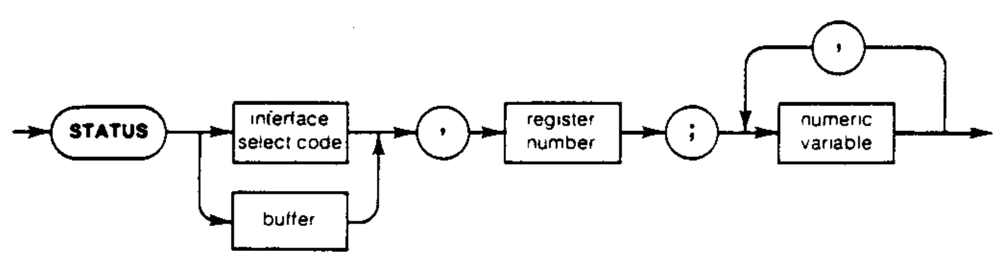
```
100  SEND 7; CMD "?5S"&CHR$(24)
110  ENTER 7 USING "#,B";S
120  SEND 7; CMD CHR$(25)& "_"
```

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
```

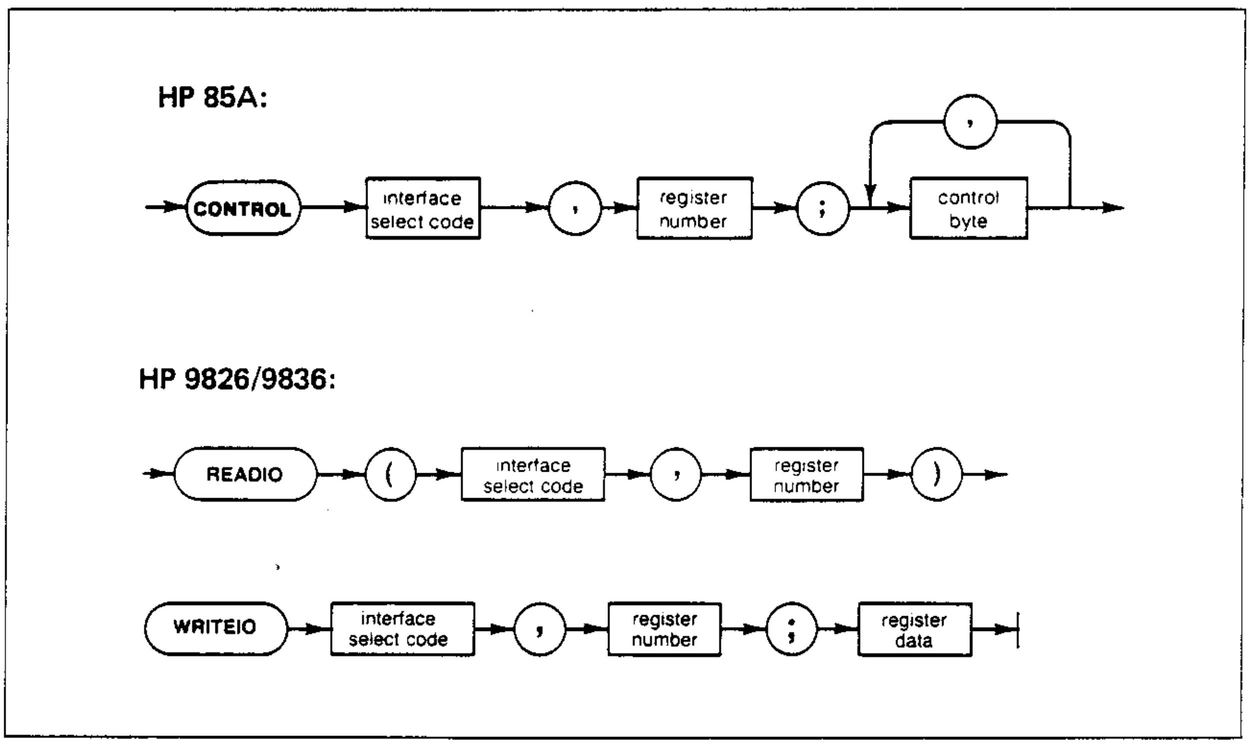
Direct Writing to the HP-IB Lines

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.

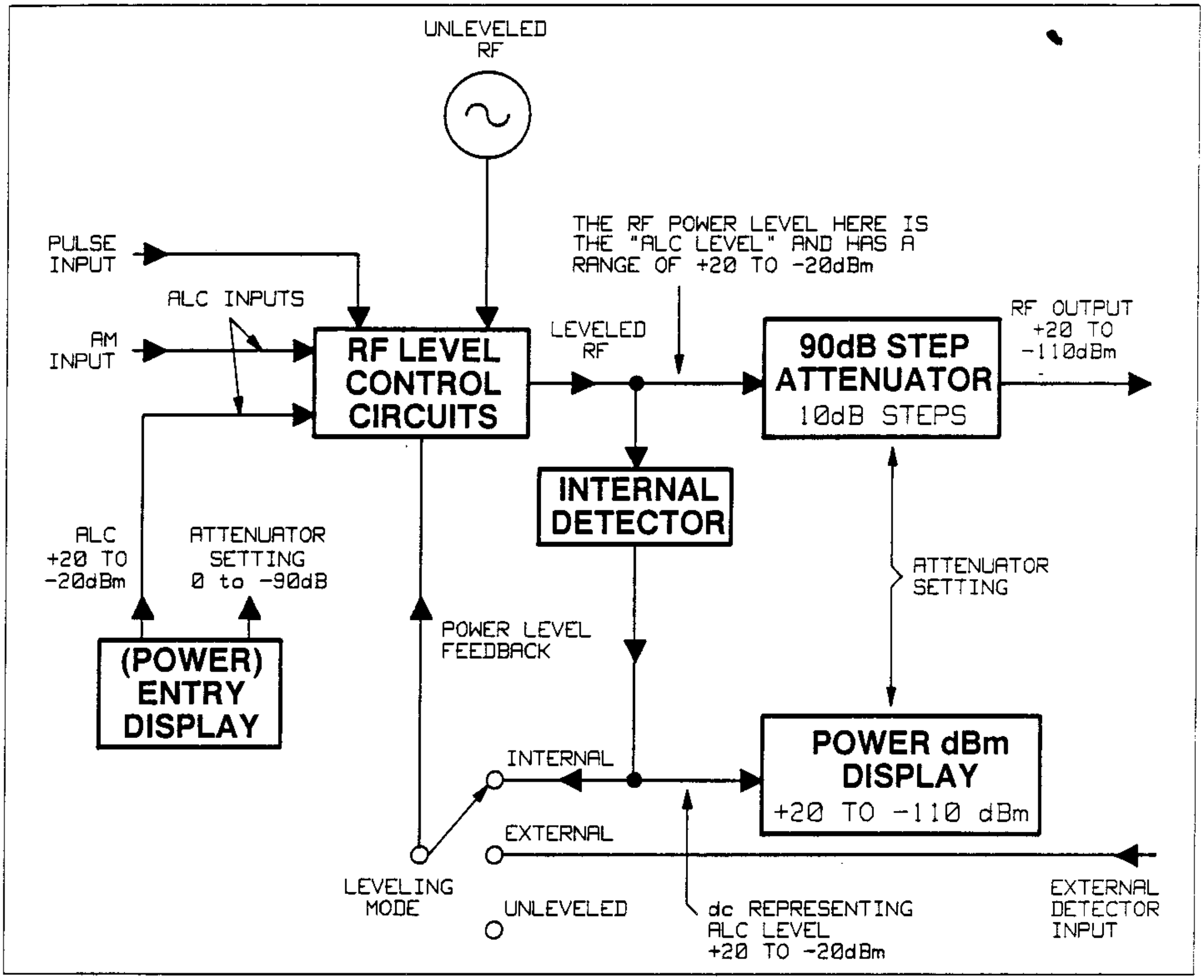


Figure 3-29. ALC Loop Block Diagram

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.

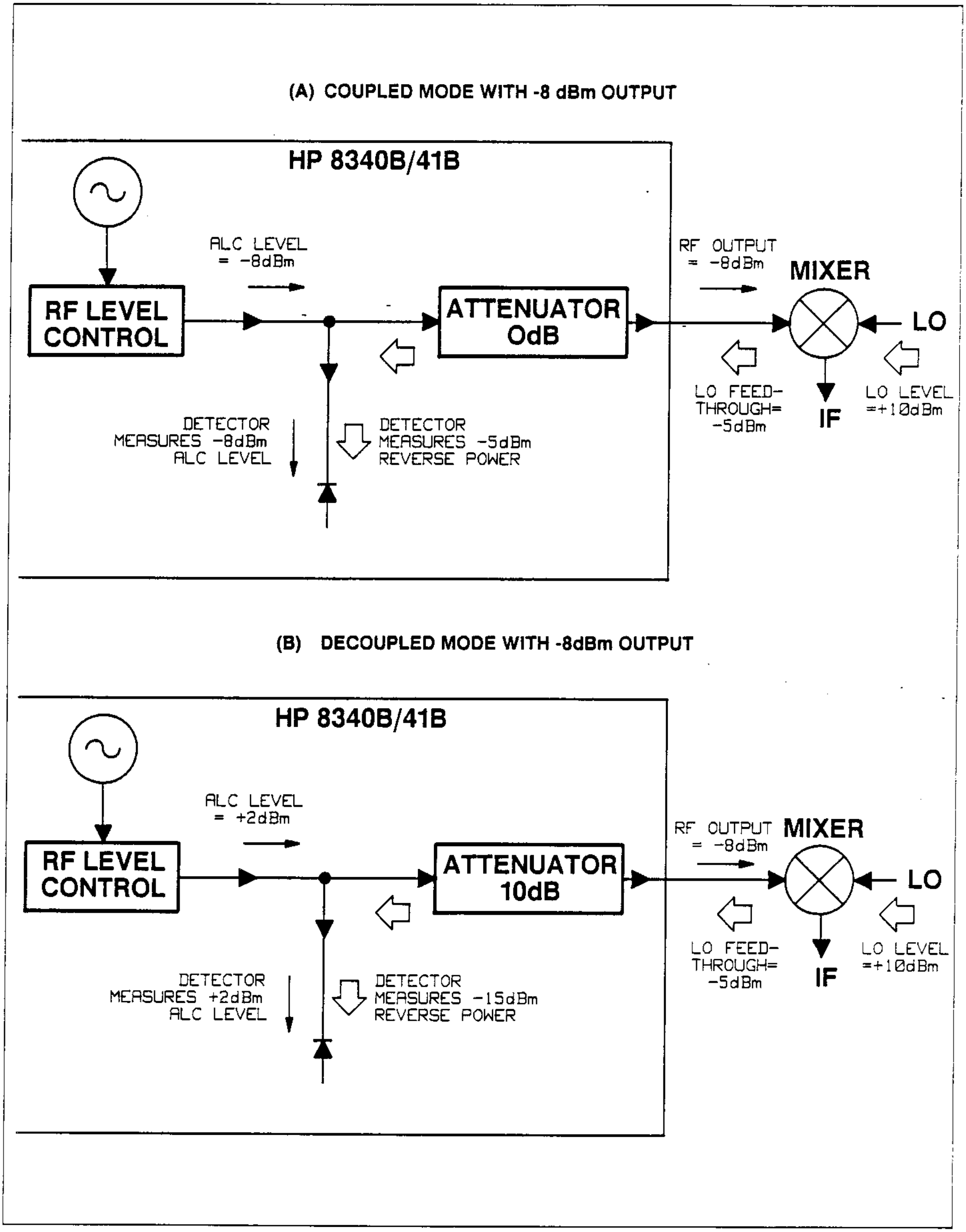


Figure 3-30. Reverse Power Effects

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.

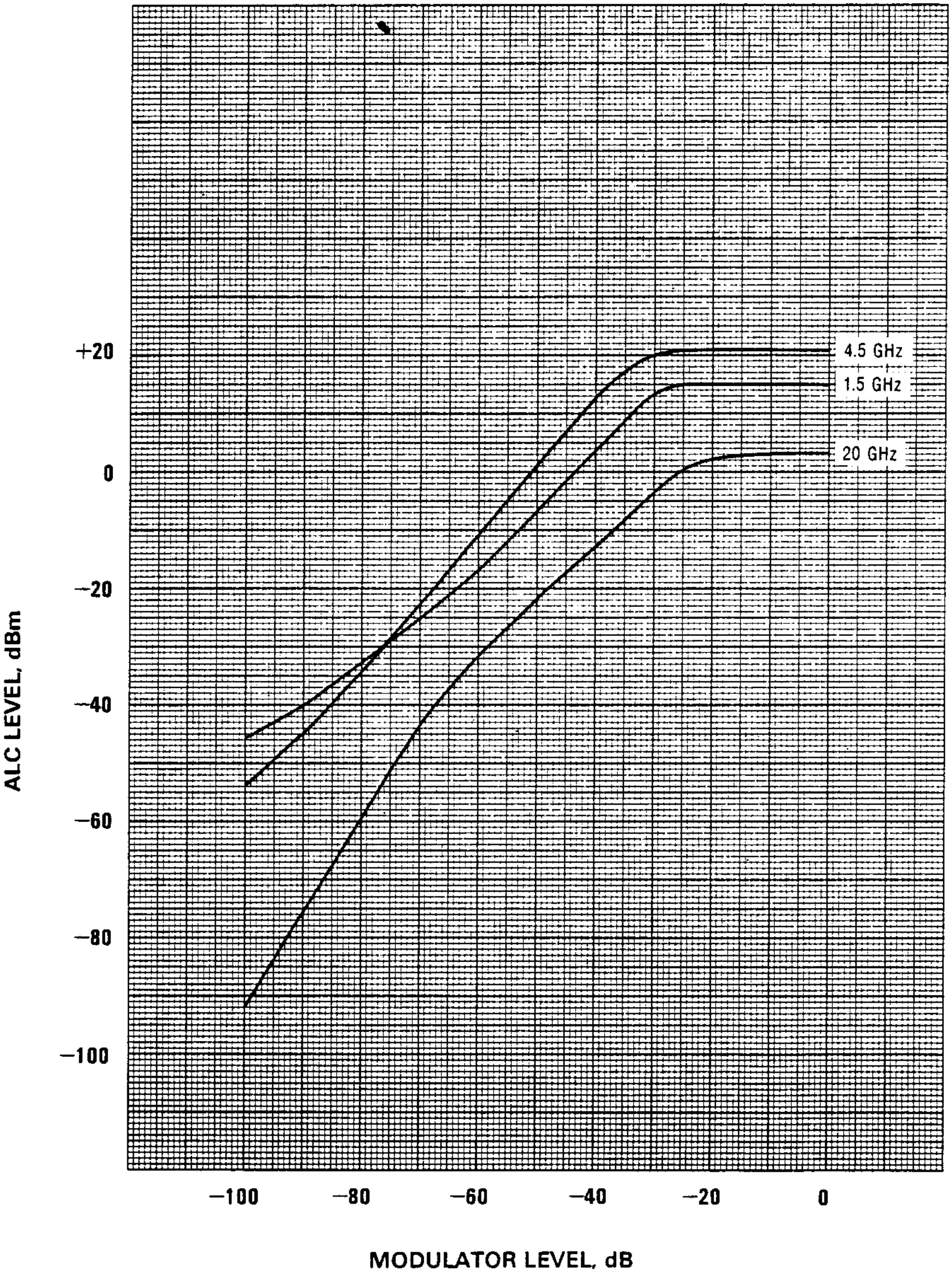


Figure 3-31. Typical Unleveled Modulation Response

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.

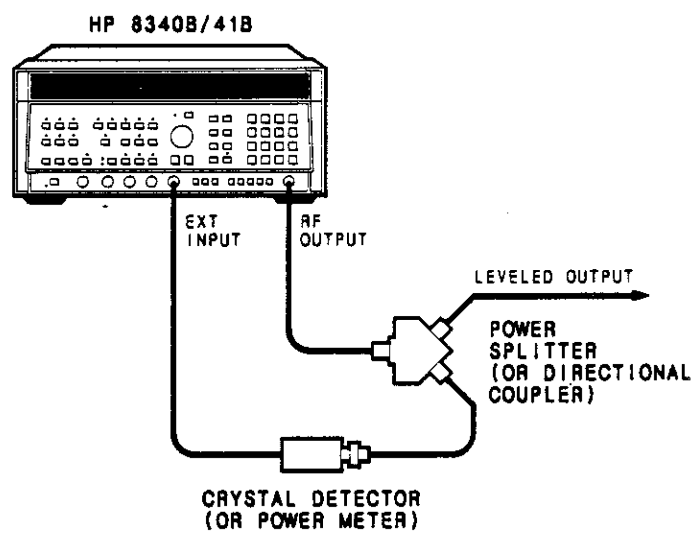


Figure 3-32. Typical External Leveling Hookup

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.

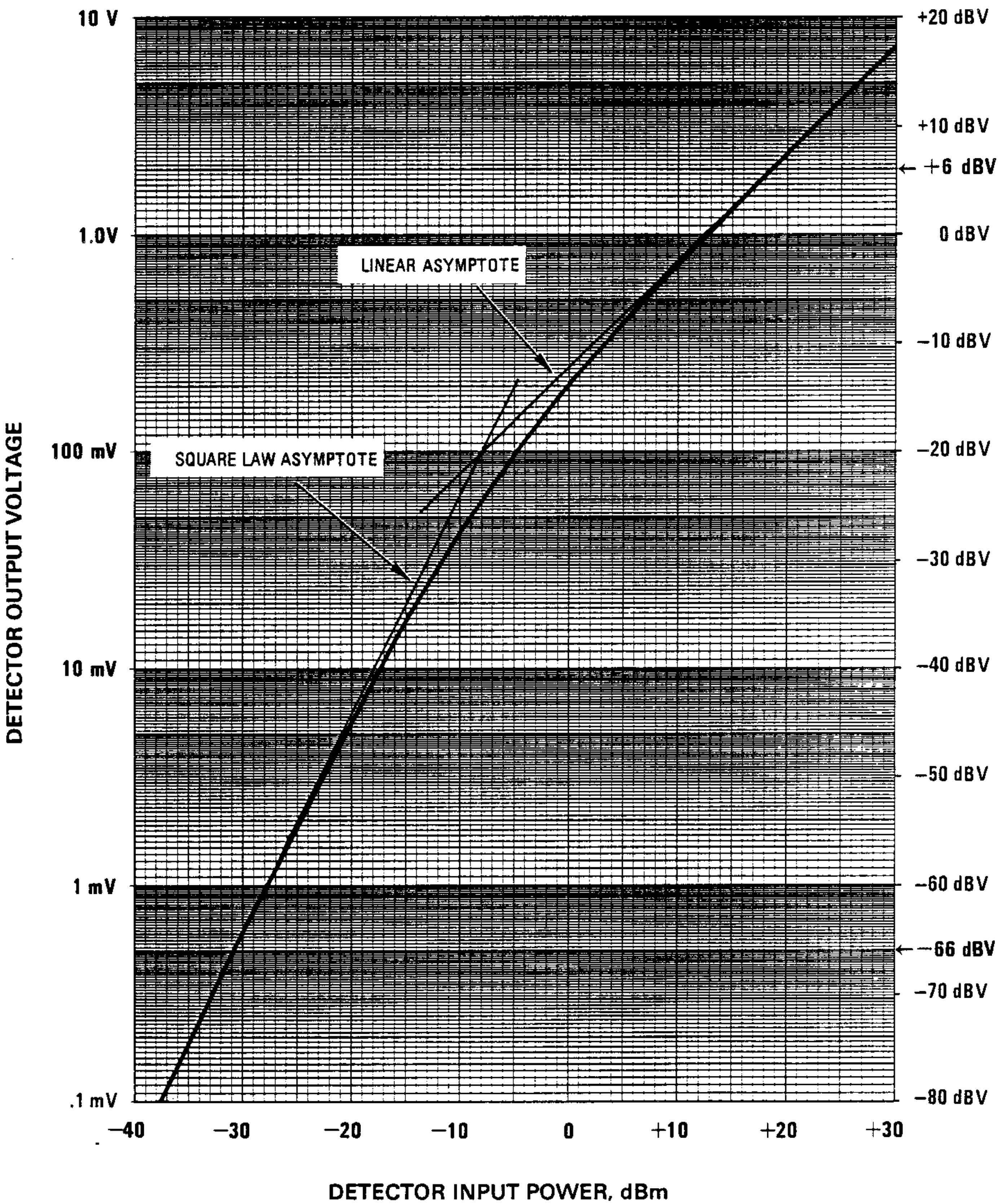


Figure 3-33. Typical Crystal Detector Response at 25°C

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:

$$V_{out} = V_o \times (V_{in} + 1)^2$$

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.

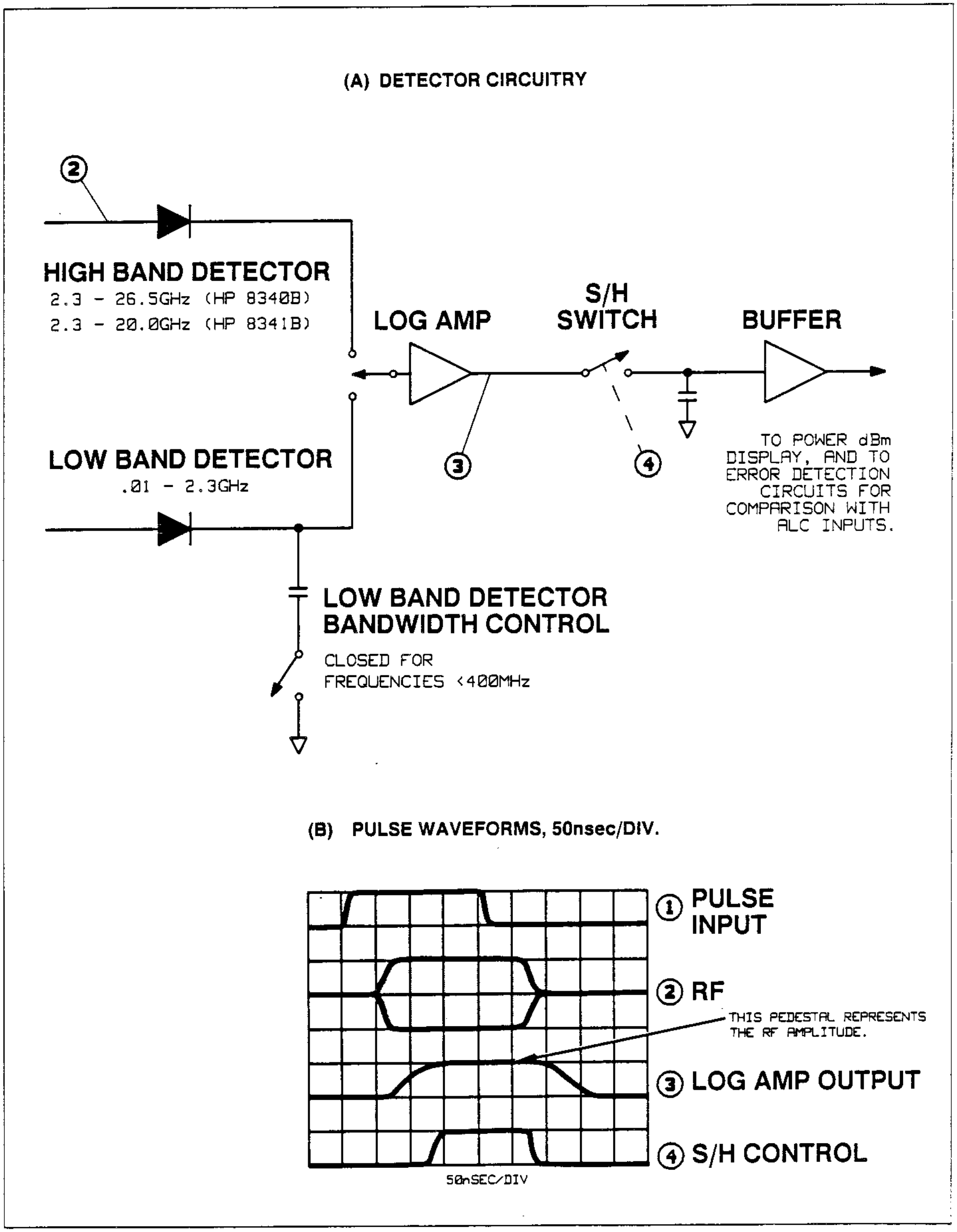


Figure 3-34. Pulse Measuring System

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).

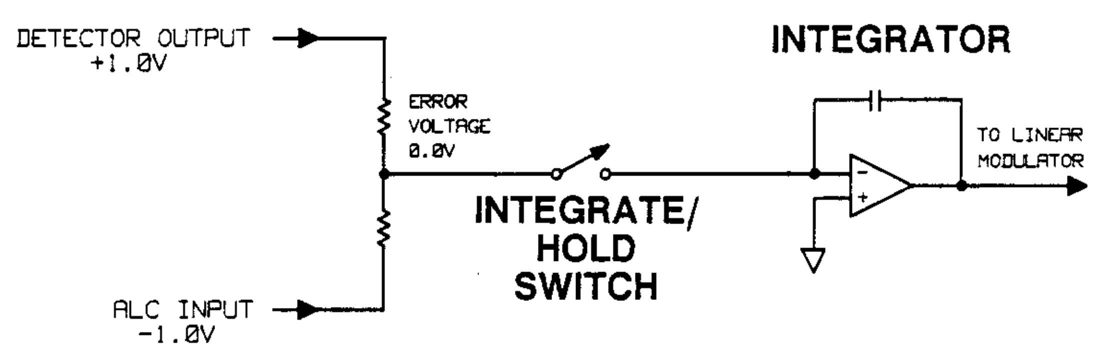


Figure 3-35. Error Detection and Modulator Drive

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.

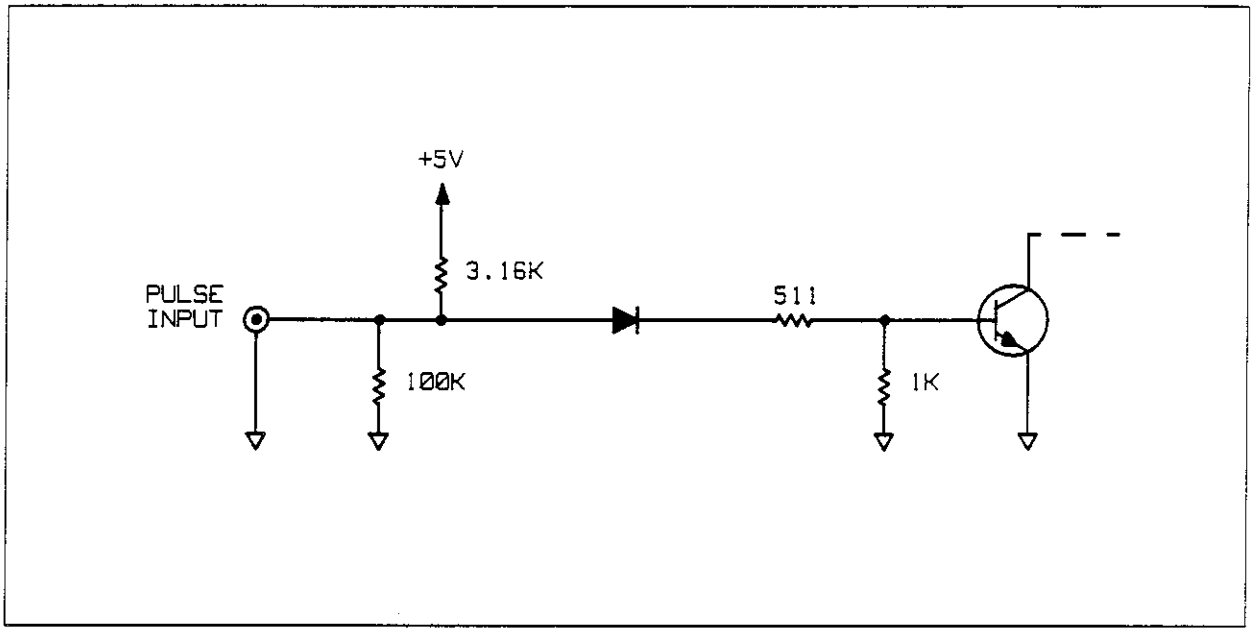


Figure 3-36. Pulse Input Circuit

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.

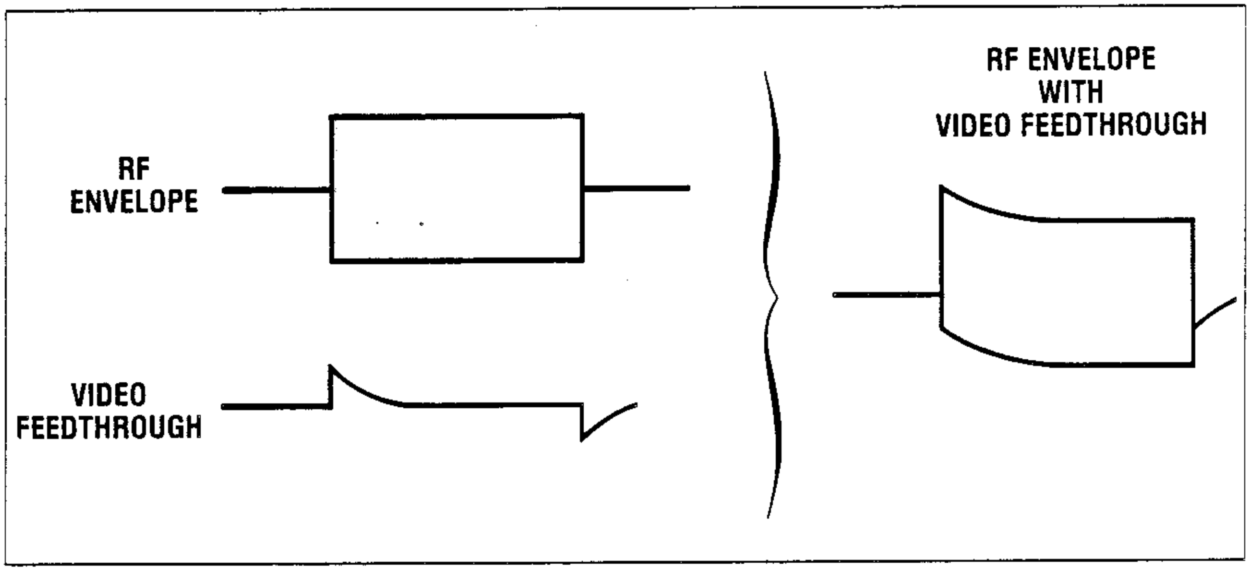


Figure 3-37. Video Feedthrough

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.

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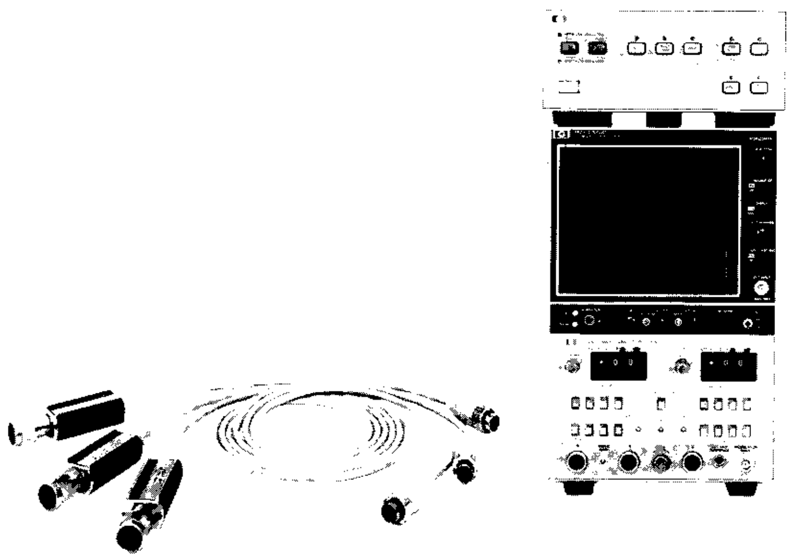
Using the HP 8340A Synthesized Sweeper with the HP 8755 Frequency Response Test Set



8755S FREQUENCY RESPONSE TEST SET

The 8755S consists of:

- 8755C Swept Amplitude Analyzer
- 182T Display
- 11664A Detectors (3 each)
- 8750A Storage-Normalizer

The 8755S is used for scalar transmission and reflection measurements requiring up to 60 dB of dynamic range and for absolute power measurement from −50 dBm to +10 dBm. The 11664A Detectors supplied with the standard 8755S permit operation from 10 MHz to 18 GHz; operation from 10 MHz to 26.5 GHz may be obtained by using the 8755S Option 005, which substitutes for the 11664A Detectors, three 11664B Detectors which have a frequency range of 10 MHz to 26.5 GHz.

The 8340A has the following features to permit maximum utility with the 8755S Frequency Response Test Set:

RF Square-wave Modulation. The 8755C utilizes an AC detection scheme wherein the RF is modulated by a 27.8 KHz square wave. This detection scheme provides excellent stability with time and temperature and allows rejection of unwanted signals that are not modulated. Although the RF can be modulated by an external modulator such as the HP 11665B, this is unnecessary when using the 8340A. All that is required is to connect the MODULATOR DRIVE from the 8755C to the PULSE MODULATION input on the 8340A, and then press PULSE.

"Alternate" Function. The ALT function of the 8340A allows two different front panel settings to be alternated. For example, the front panel setting and the setting stored in a memory register location n (n=1,...,9) can be selected for alternate

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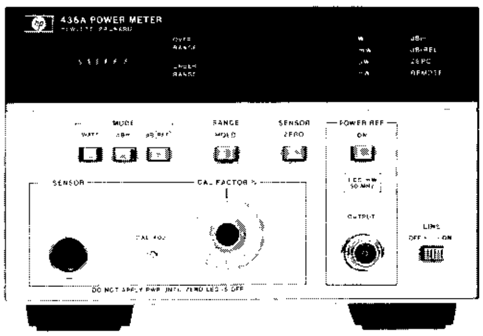
OPERATING GUIDE

Externally Leveling
the HP 8340B/41B Synthesized Sweepers



EXTERNALLY LEVELING THE HP 8340B/41B

The output power of the HP 8340B/41B may be externally leveled. A typical setup for external leveling uses either a power splitter or a directional coupler to sample a portion of the RF output signal. This sampled signal is detected to produce a dc voltage proportional to the RF output level. This voltage is compared to a reference voltage in the ALC circuit inside the HP 8340B/41B to reduce the power level variations over the frequency range. Directional couplers are usually not as broadband as a power splitter which has a flat frequency response over a very wide frequency range. The advantage of a directional coupler is that it does not have as great a main line loss as the 6 dB loss incurred when using the power splitter; therefore, a higher maximum leveled power output may be obtained.

CRYSTAL LEVELING

A listing of crystal detectors, directional detectors, directional couplers, and power splitters that can be used from 10 MHz to 26.5 GHz is shown in Table 1. Connect the equipment as shown in Figure 1. Then perform the following:

1. Press **[INSTR PRESET]** on the HP 8340B/41B and enter the desired functions. (CW or swept mode) and data (desired CW frequency or sweep limits).

2. If a sweep mode is used, set the frequency to the center of the frequency range by pressing the **[CW]** key and then the appropriate frequency value.

3. Press the **[XTAL]** leveling key, then use the knob on the HP 8340B/41B to adjust the REFerence level (shown in the ENTRY DISPLAY) for the desired output power reading on the HP 436A Power Meter. (The power meter is used only for accurate setting of the power level and is not otherwise needed for crystal leveling. If a power meter is not available, the leveled output power may be set by observing the POWER dBm display on the HP 8340B/41B as the REF level is adjusted.

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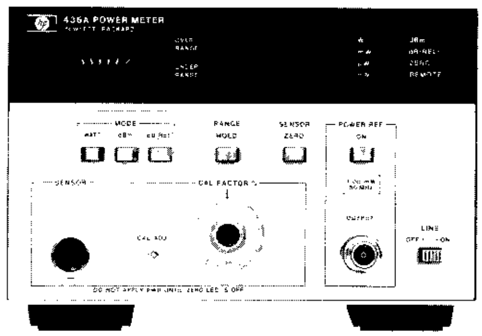
Externally Leveling the HP 8340B/41B Synthesized Sweepers



EXTERNALLY LEVELING THE HP 8340B/41B

The output power of the HP 8340B/41B may be externally leveled. A typical setup for external leveling uses either a power splitter or a directional coupler to sample a portion of the RF output signal. This sampled signal is detected to produce a dc voltage proportional to the RF output level. This voltage is compared to a reference voltage in the ALC circuit inside the HP 8340B/41B to reduce the power level variations over the frequency range. Directional couplers are usually not as broadband as a power splitter which has a flat frequency response over a very wide frequency range. The advantage of a directional coupler is that it does not have as great a main line loss as the 6 dB loss incurred when using the power splitter; therefore, a higher maximum leveled power output may be obtained.

CRYSTAL LEVELING

A listing of crystal detectors, directional detectors, directional couplers, and power splitters that can be used from 10 MHz to 26.5 GHz is shown in Table 1. Connect the equipment as shown in Figure 1. Then perform the following:

1. Press **[INSTR PRESET]** on the HP 8340B/41B and enter the desired functions. (CW or swept mode) and data (desired CW frequency or sweep limits).

2. If a sweep mode is used, set the frequency to the center of the frequency range by pressing the **[CW]** key and then the appropriate frequency value.

3. Press the **[XTAL]** leveling key, then use the knob on the HP 8340B/41B to adjust the REFerence level (shown in the ENTRY DISPLAY) for the desired output power reading on the HP 436A Power Meter. (The power meter is used only for accurate setting of the power level and is not otherwise needed for crystal leveling. If a power meter is not available, the leveled output power may be set by observing the POWER dBm display on the HP 8340B/41B as the REF level is adjusted.

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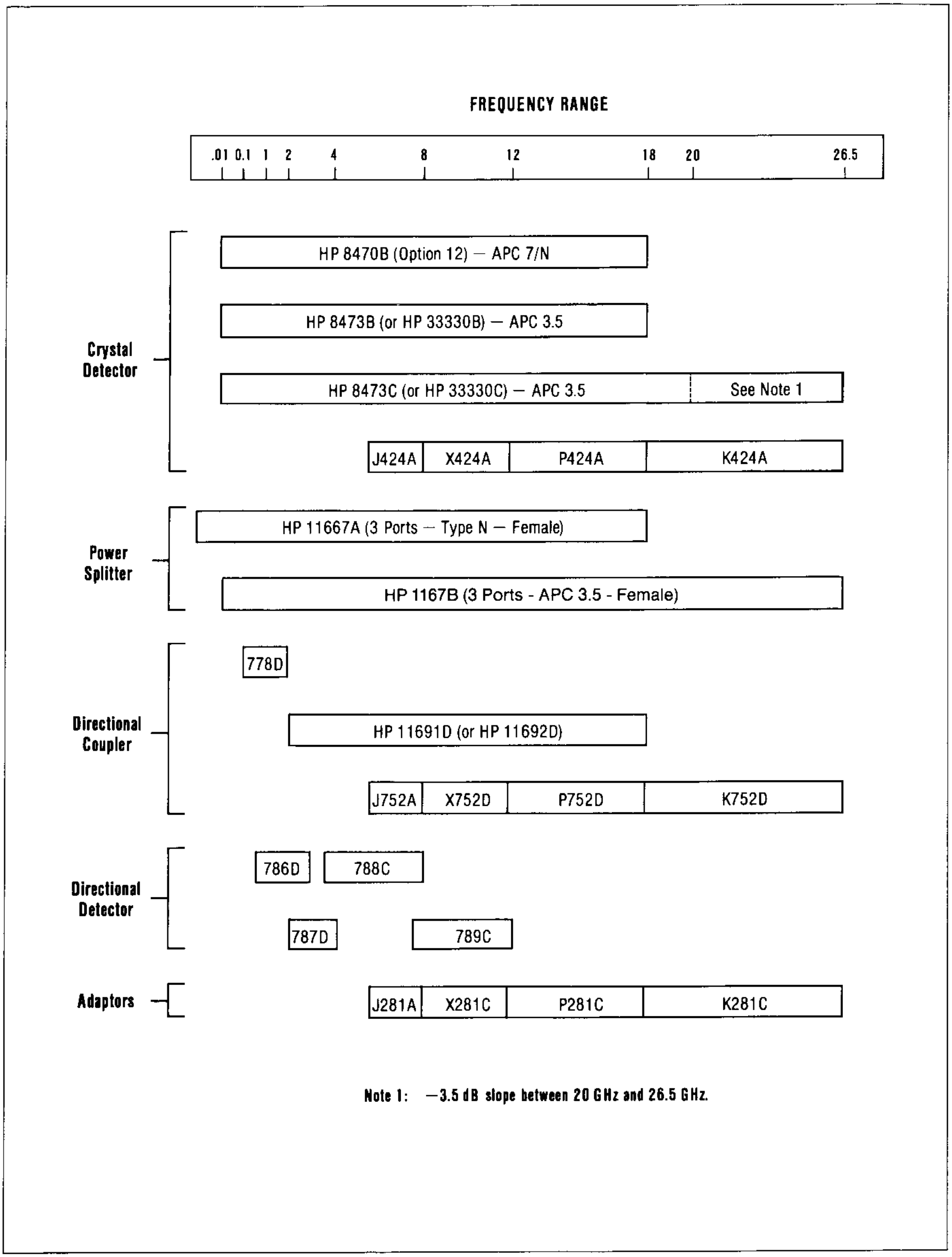
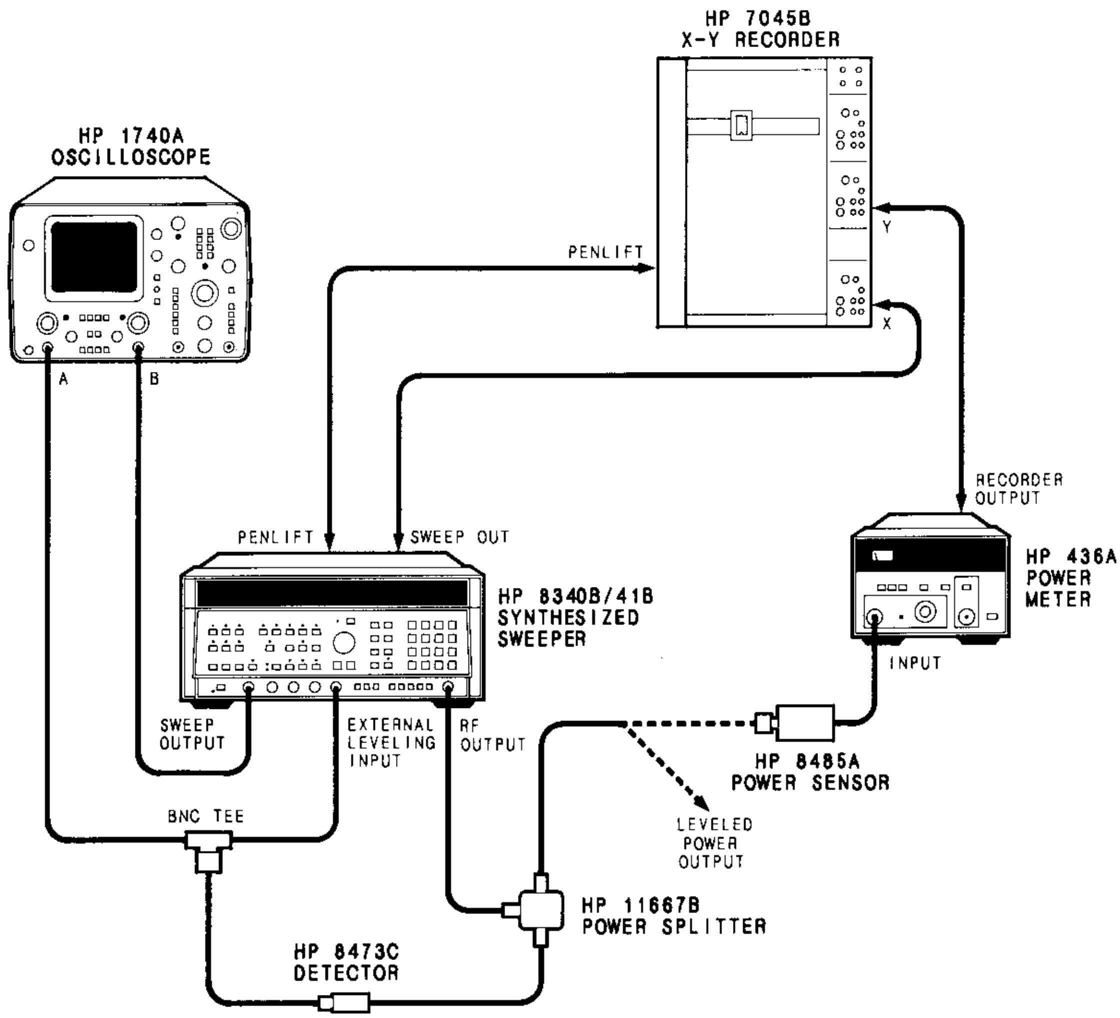
Table 1. Equipment for Crystal Leveling 0.01 to 26.5 GHz





The HP 1740A Oscilloscope is placed in A vs B function.

Figure 1. Typical Equipment Setup for Crystal Leveling

The POWER dBm reading, minus the 6 dB of loss from the power splitter, gives a good approximation of the value of the leveled output power.)

When external leveling a 27.8 kHz square wave modulated signal (such as used with HP 8756A/8757A scalar analyzers) the external power meter will read a 3 dB lower power level than the actual level of the pulsed signal. The power indication on the HP 8340B/41B, however, will read the correct pulse power.

NOTE

The crystal output signal must be between 316 µV and 3.16 V (−70 dBV to + 10 dBV). If desired, the voltage may be checked on an oscilloscope using the setup shown in Figure 1.

4. Then return to the sweep mode.

If a plot is required, an HP X-Y recorder can be used. (Refer to the "Operation with X-Y Recorders" section of this manual). The recorder output of the HP 436A or 438A power meter is used to drive the Y input of the recorder. Due to the slow response of the HP 8485A thermocouple sensor, a slow sweep speed must be selected during the plot. A minimum sweep time of 50 seconds for a full 10 MHz to 26.5 GHz (20 GHz with HP 8341B) sweep is recommended.

NOTE

When the HP 8340B/41B is swept over multiple bands, the RF is momentarily turned off at the band switchpoints. This can create a problem if the HP 436A or 438A is in AUTOSCALE, because the drop in RF power will cause the HP 436A or 438A to switch to a new 10 dB range. Since the RECORDER OUTPUT is 0 to 1 V for each 10 dB range, a range change will cause a spike in the X-Y recorder trace. To avoid this, put the HP 436A or 38A power meter in RANGE HOLD.

POWER METER LEVELING

All of the HP 432A/B/C, 435B, 436A, and 438A power meters and their corresponding sensors, thermistor mounts or thermocouples can be used for external leveling of the HP 8340B/41B. Connect the equipment as shown in Figure 2. Equipment recommended for power meter leveling from 10 MHz to 26.5 GHz (20 GHz with HP 8341B) is shown in Table 2.

Proceed as follows:

1. Press **[INSTR PRESET]** on the HP 8340B/41B, then enter the desired functions (CW or swept mode) and data (desired CW frequency or sweep limits).
2. If a sweep mode is used, set the frequency to the center of the frequency range by pressing the **[CW]** key and then the appropriate frequency value.
3. Turn off RF, then zero power meter with meter connected to leveling setup. Turn RF on.
4. Adjust the HP 8340B/41B power level to within the proper meter range, reading the power level on HP 436A or 438A power meters.
5. Press **[HOLD RANGE]** on both power meters.
6. Press **[METER]** leveling on the HP 8340B/41B.
7. Readjust the power level on the HP 8340B/41B by using the knob to adjust the REF level (shown in the ENTRY DISPLAY).
8. Return the HP 8340B/41B to the sweep mode.

NOTE

This procedure can be shortened by omitting steps 4 and 5 when using either an HP 432A or an HP 435A Analog Display Power Meter. But when an HP 436A Digital Display Power Meter is used, special care is needed to adjust the power level to the desired value. The reason is that the RECORDER OUTPUT signal from the HP 436A used to drive the ALC loop varies from 0 to 1 V for each 10 dB full scale range on the HP 436A. The procedure described above presets the power level in the HP 8340B/41B's INTernal leveling mode. Then [HOLD RANGE] is pressed on the power meters to avoid any large variations of the detected power in the ALC loop when the HP 8340B/41B is set to [METER] leveling.

Due to the fact that power meters are heavily filtered to reduce display jitter, the HP 8340B/41B sweep time must be increased to the following recommended values.

HP 438A, 436A, 435B:
  More than 50 s for full 10 MHz to 26.5 GHz sweep (20 GHz with HP 8341B).
HP 432A:
  Typically 50 s for full 10 MHz to 26.5 GHz sweep (20 GHz with HP 8341B).

If a plot is required, an HP X-Y analog recorder may be used. (Refer to the "Operation with X-Y Recorders" section of this manual). The recorder output of the second power meter is used to drive the Y input of the Recorder. Figure 3 shows a typical output power leveling plot from 10 MHz to 26.5 GHz using a power meter and an HP 8485A power sensor. The output power is 0 dBm at the HP 8340B output connector.

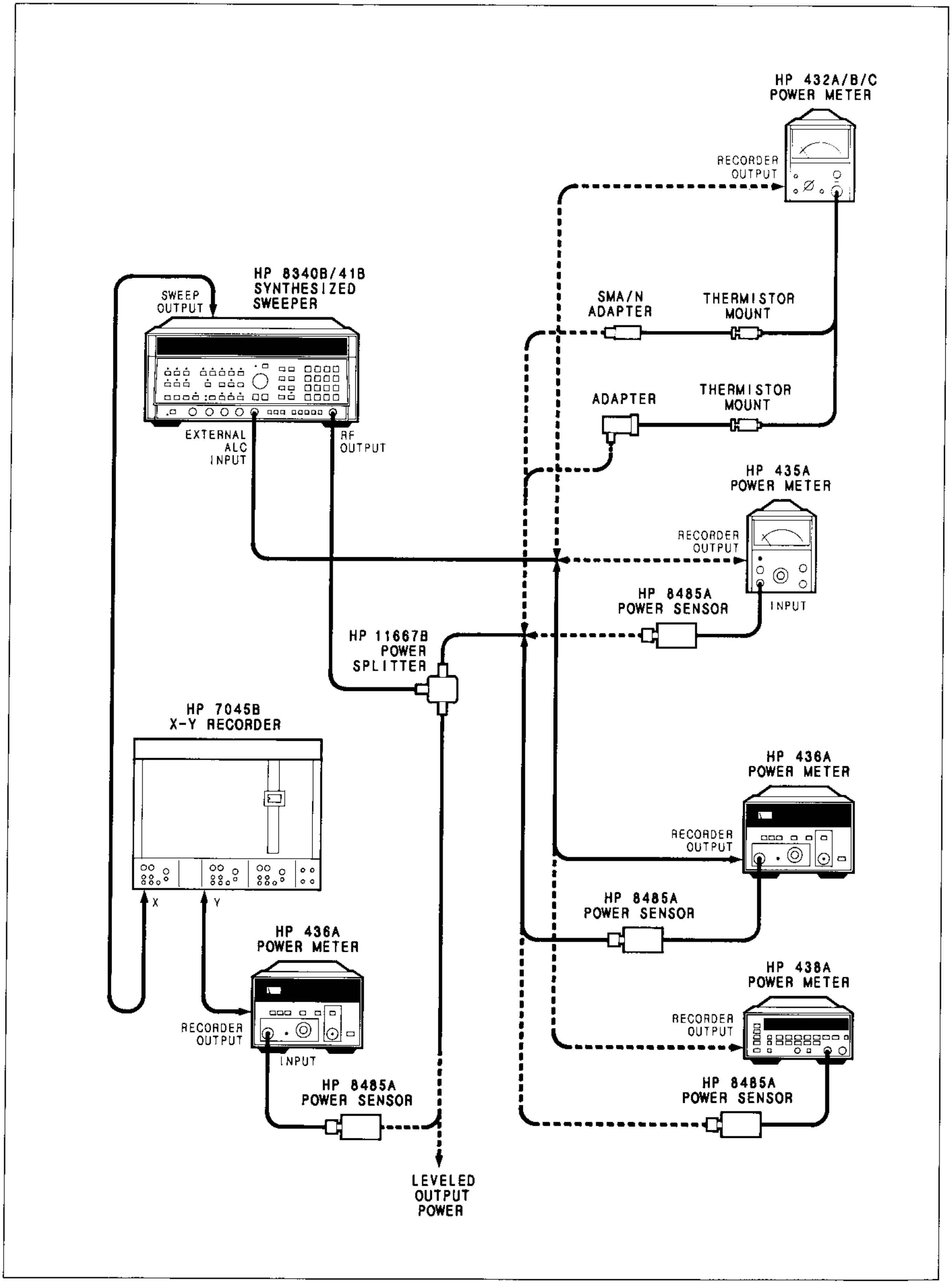
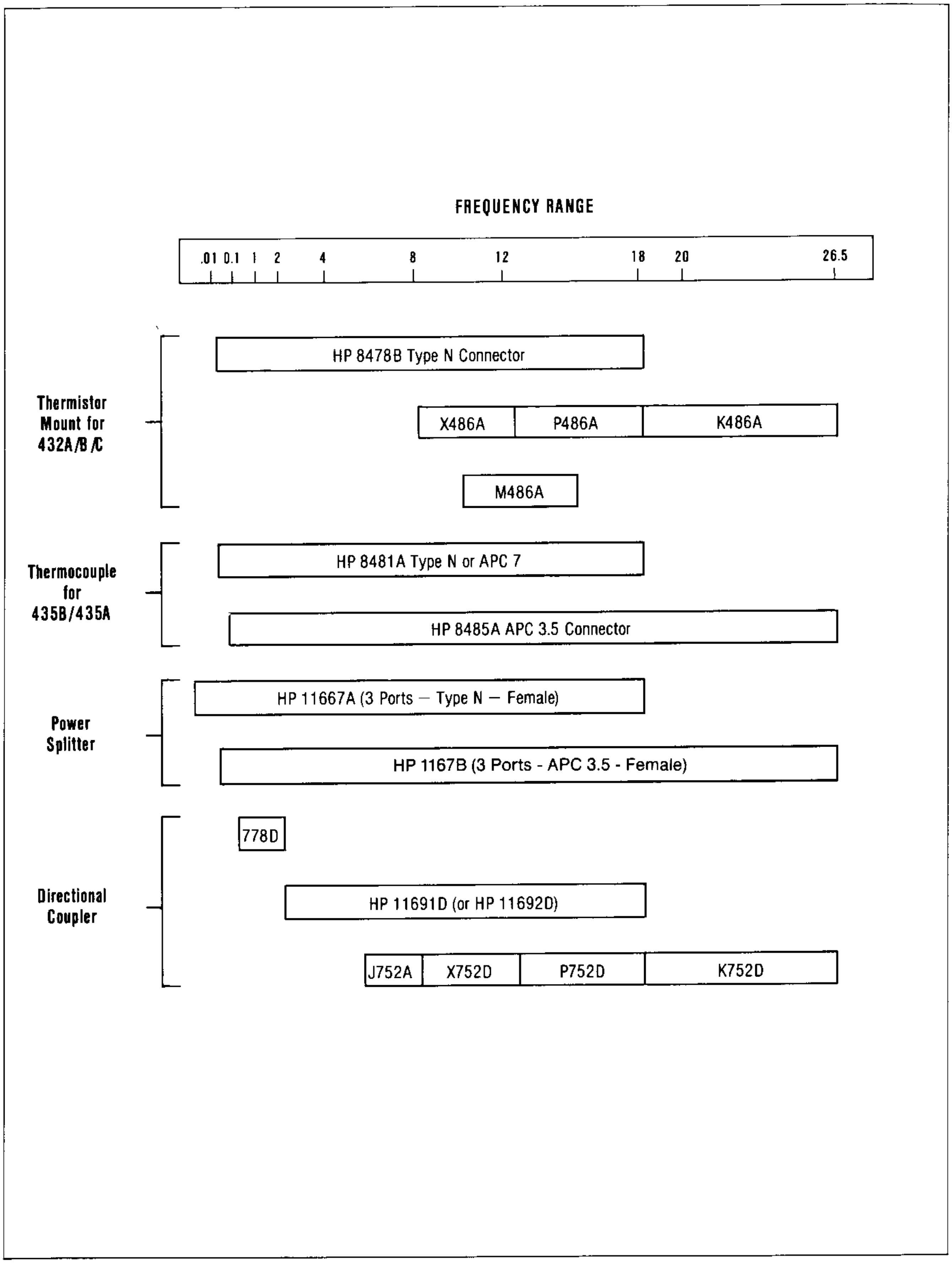


Figure 2. Typical Equipment Setup for Power Meter Leveling

Table 2. Equipment for Power Meter Leveling, 0.01 to 26.5 GHz



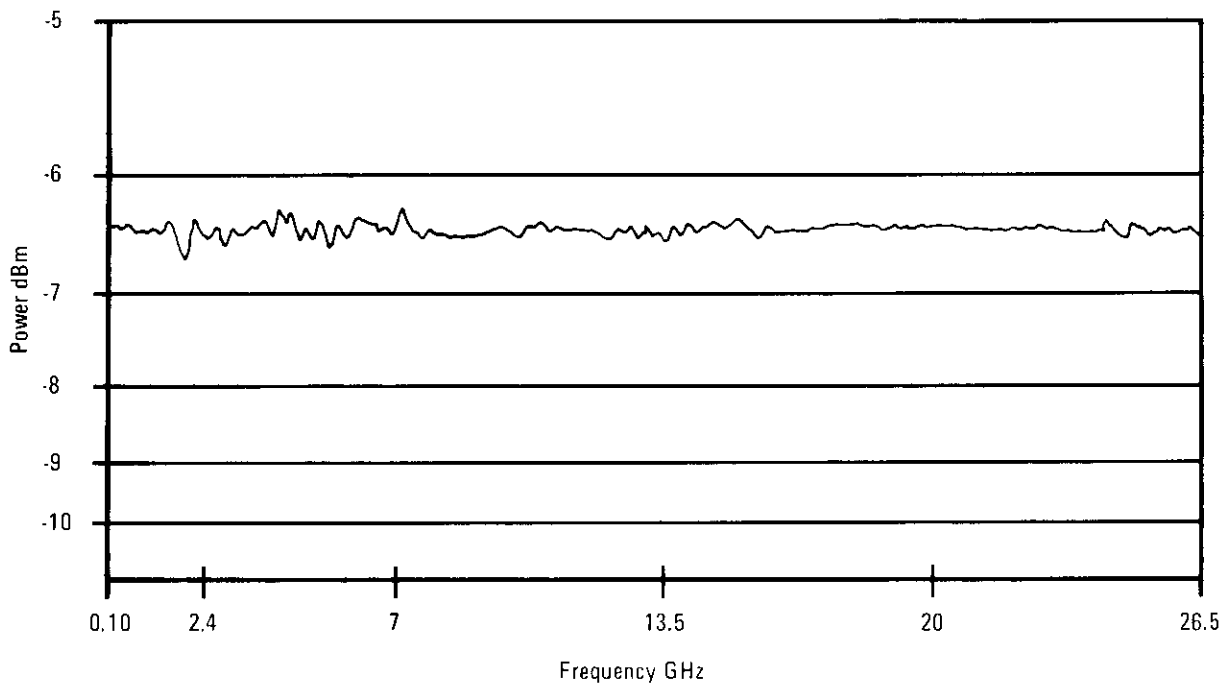


Figure 3. Typical Power Leveling Plot

The POWER dBm display on the HP 8340B/41B is accurate in XTAL or METER modes, whether leveled or not. This is a useful aid in checking for proper operating levels in an external leveling loop. If the POWER dBm display on the HP 8340B/41B goes blank (– – . – –), the ALC loop is reducing its output to a very low level where noise or loop stability may be compromised. Adding fixed attenuation via the step keys will cause the ALC loop to operate at a higher level. The ALC level is the POWER dBm level minus the attenuator setting. For example:

POWER dBm level = −35 dBm,
Attenuator setting = −30 dB

yields,

ALC level = −5 dBm

Operating the ALC above −10 dBm is desirable. If the UNLEVELED light comes on, the ALC level is too high and attenuation should be reduced.

The POWER dBm display will attempt to follow power sweep or slope corrections. Since the display is filtered with a slow time constant, it will display on average value with all but very slow sweeps.

SLOPE and POWER SWEEP entries when externally leveled refer to the reference voltage. With a linear detector, RF level will change 1 dB for each 1 dB change in reference voltage. With a square law detector or power meter, RF level will change 0.5 dB for each 1 dB change in reference voltage.

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HP Part Number 08340-90285

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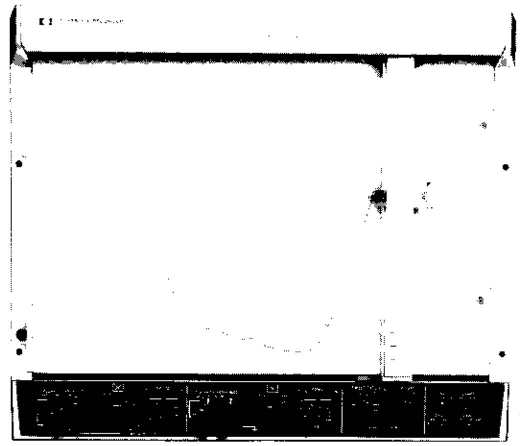
Using the HP 8340A Synthesized Sweeper with X-Y Recorders



X-Y RECORDERS

The HP 8340A is equipped with outputs to control currently existing HP X-Y analog recorders, which are listed below in Table 1. The 8340A must be placed in the SINGLE SWEEP mode when used with an X-Y recorder. Various control lines must also be interconnected; these are described below and a typical setup is also shown in Figure 1.

X-Input: The X-input to the recorder is generally the SWEEP OUTPUT of the 8340A, which is supplied by a BNC connector on both the front and rear panel of the 8340A.

Y-Input: The source of the Y-axis voltage to the recorder depends on the equipment being used in the measurement setup. If the 8755S Frequency Response Test Set is being used, the Y-input would be AUX A for channel 1 and AUX B for channel 2. For 8410B/C systems, the 8412A/B display provides amplitude and phase outputs to the recorder Y-input via the AMPTD and PHASE BNC connectors, respectively. If the HP 436A Power Meter is used, its RECORDER OUTPUT BNC connector should be used.

Care should be taken to allow the recorder enough time to respond to fine-grain variations in the Y-axis voltage. Recommended 8340A sweep times for each X-Y recorder are given in Table 1.

Pen Lift: The PEN LIFT control line is assigned to a pin on the remote control connector of the recorder, as shown in Table 1. (For a complete listing of all pin assignments on the remote control connector, refer to the Operating and Service Manual of the recorder being used.) The PEN LIFT control line is connected to the PEN LIFT OUTPUT BNC connector on the rear panel of the 8340A. PEN LIFT OUTPUT is operable only if the 8340A sweep time has been set to a value greater than 5 sec.

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Table 1. HP X-Y Recorders

XY Recorder	Mute Function	Mute Function Pin Number	PEN LIFT Pin Number	Ground Pin Number	Recommended Sweep Times
7010B	Std.	A2J2 pin 4 A3J2 pin 4	3	A2J2 pin 6 A3J2 pin 6	≥20 sec.
	Option 002	A4J5 pin L A4J5 pin R		A4J5 pin K A4J5 pin P	
7015B	Std.	A4J5 pin L A4J5 pin R	3	A4J5 pin K A4J5 pin P	≥20 sec.
7035B	N/A	N/A	18	6	≥20 sec.
7004B	N/A	N/A	18	6	≥10 sec.
7034A	N/A	N/A	18	6	≥10 sec.
7040A	Std.	Refer to Section III of the Recorder's Operating and Service Manual.			≥10 sec.
7041A	Option 040	X=pin 5 Y=pin 6	1	3	
7044B	Std.	4	1	20	>10 sec.
7045B	Std.	4	1	20	>10 sec.
7046B	Std.	4	34	19	>10 sec.
7047A	Std.	4	1	20	>10 sec.

Recorder (Servo) Mute: When the 8340A is swept over multiple bands, the RF is momentarily turned off at the band switchpoints. To prevent this from causing negative spikes on the X-Y recorder trace, the recorder's servo motor can be muted during the band crossing. The MUTE OUTPUT BNC connector on the rear panel of the 8340A performs this function, and must be connected to both the recorder's X and Y MUTE inputs, the locations of which are shown in Table 1.

As Table 1 also shows, some HP X-Y recorders do not have a MUTE function. When using one of these recorders, the negative spikes at band switchpoints can still be prevented by pressing SHIFT LINE on the 8340A front panel. This activates a function which generates a pen lift signal at each band crossing, thus avoiding the spikes. This function is operable only if the 8340A sweep time has been set to a value greater than 5 sec. Once activated, the function is turned off by pressing SHIFT LINE again. No change in the pen lift connections is required to implement this function.

The SHIFT LINE function may also be remotely programmed via HP-IB. The programming codes are as follows:

SHT21 Enable PEN LIFT during band crossing
SHT20 Disable PEN LIFT during band crossing

As Figure 1 shows, the SHIFT LINE function may be used as a substitute for the MUTE function even on those X-Y recorders that do have MUTE capability.

Figure 2 shows a plot of internally leveled output power from the 8340A vs. frequency. The plot was generated on an HP 7045B X-Y recorder. The output power from the 8340A was monitored with an HP 8485A Power Sensor and HP 436A Power Meter, whose RECORDER OUTPUT provided the Y-axis input to the 7045B.

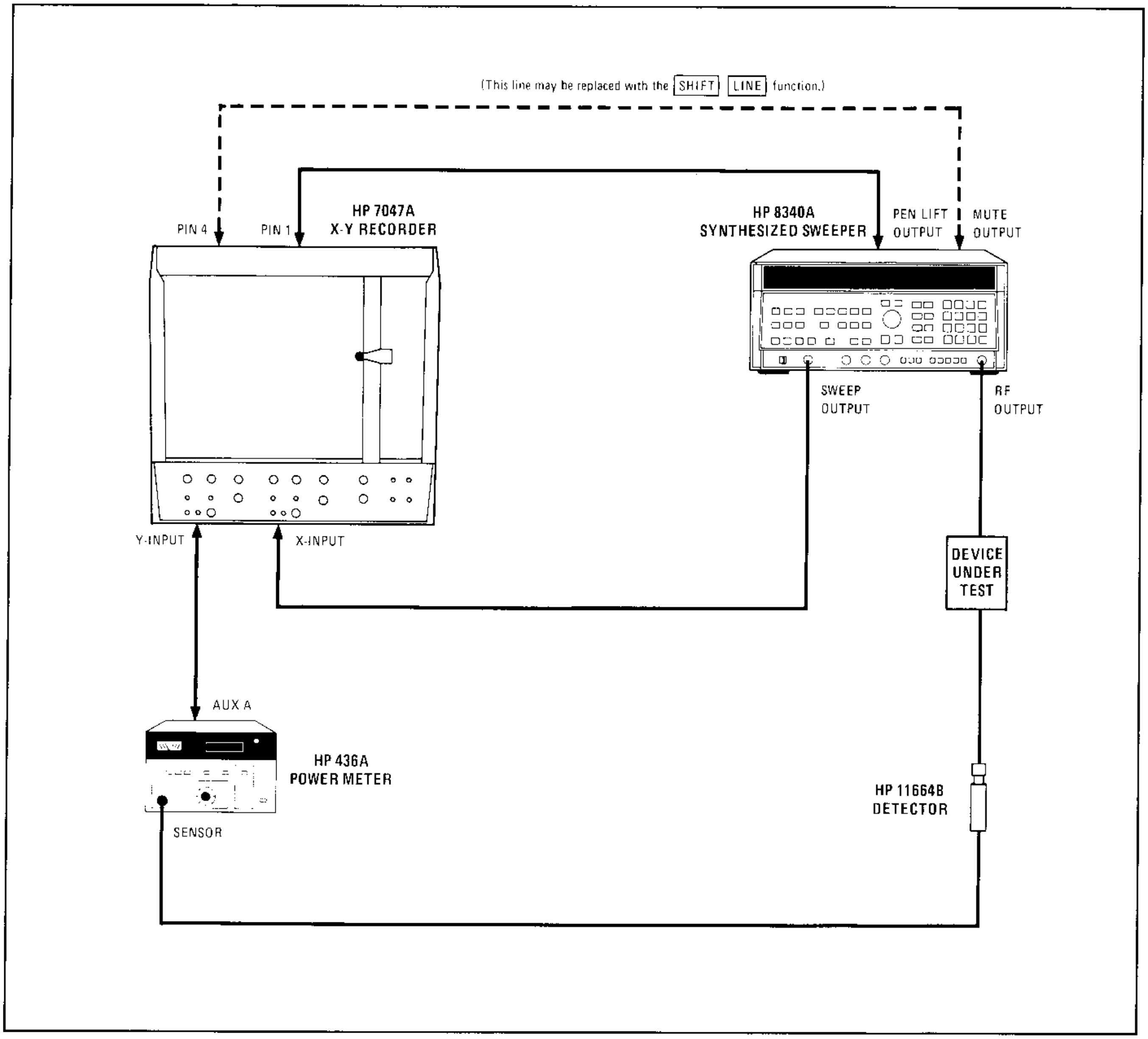

Figure 1. Typical X-Y Recorder Equipment Setup

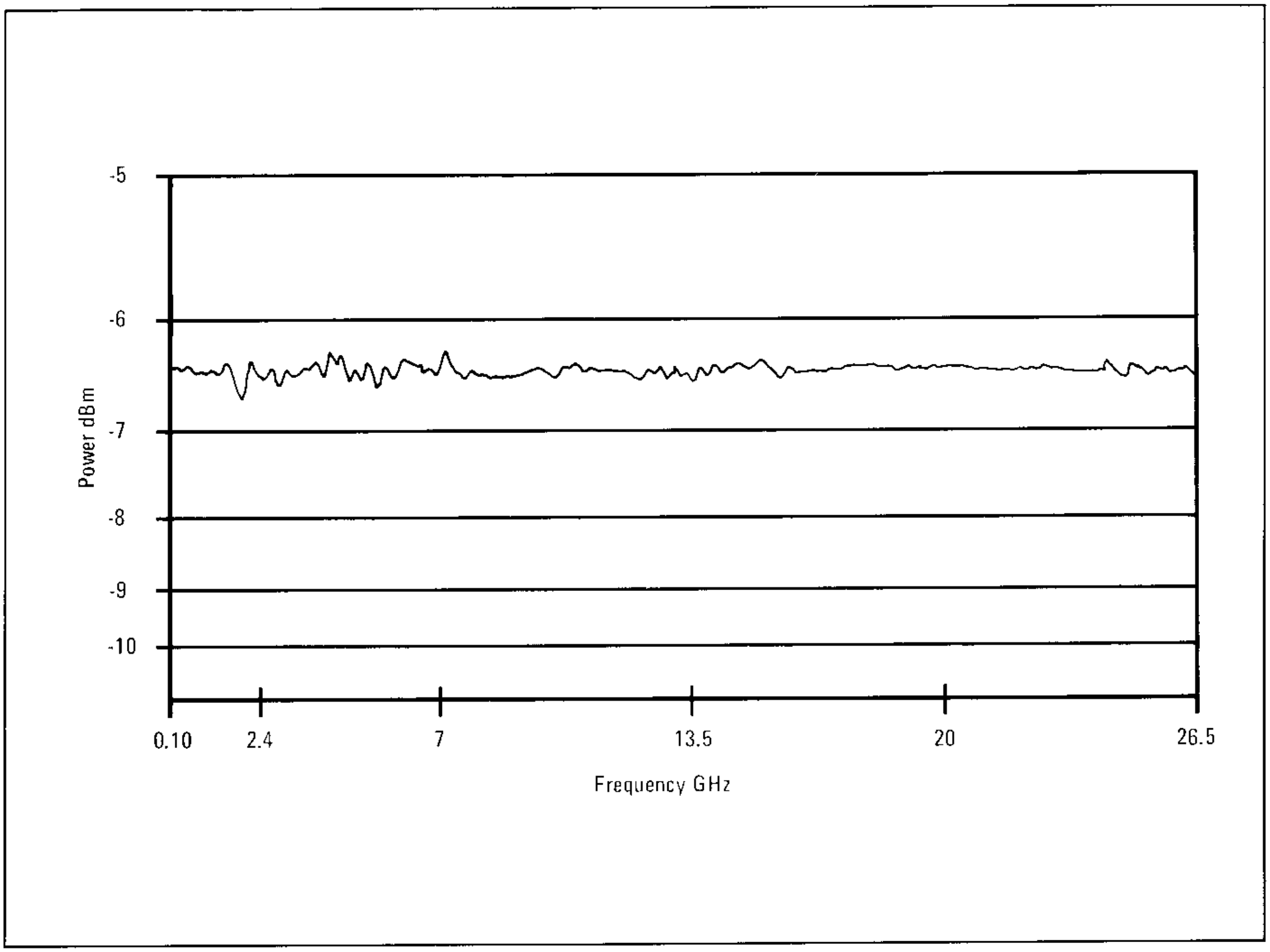

Figure 2. Typical Power Leveling Plot

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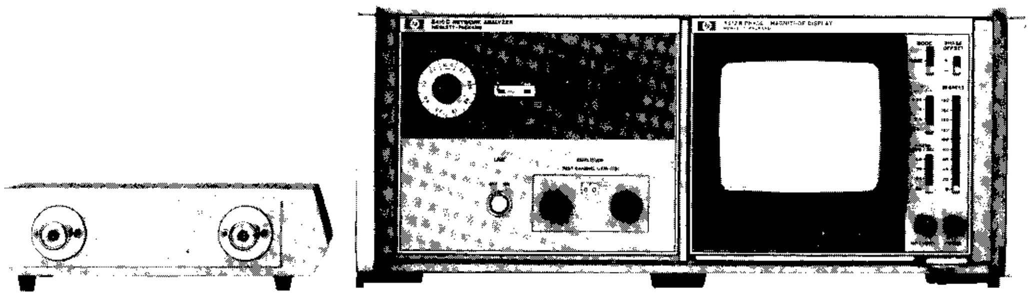
Using the HP 8340A Synthesized Sweeper with the HP 8410B/C Network Analyzer



8410B/C NETWORK ANALYZER

The HP 8340A is compatible with the 8410B/C Network Analyzer systems and accessories. The Source Control Cable (HP P/N 08410-60146) synchronizes the two instruments to provide continuous multi-octave coaxial magnitude and phase measurement capability from 110 MHz to 18 GHz with 65 dB dynamic range. The frequency markers can be displayed in polar format as intensity dots (Z-axis).

Waveguide measurements between 18 and 26.5 GHz can be made with the K8747A Reflection/Transmission Test Unit which is designed for use with the 8410B/C. This test system utilizes two 8340A's, one as a local oscillator and the other to sweep the desired frequency range. If desired, any source covering 18 to 26.5 GHz may be substituted as the L.O.

See Figure 1 for an example measurement setup using the 8410B/C with the 8340A.

The 8410B/C FREQ RANGE should be set to AUTO. In addition, the sweep time on the 8340A should be slow enough and/or sweep range narrow enough to ensure phase locking of the 8410B/C receiver over the entire sweep range.

Notes on connections:

- 1 V/GHz output of the 8340A provides a frequency reference (FREQ REF) to the 8410B/C so that it may synchronize with the sweep.
- The 8410B/C display units (8412B, 8414B) require that the NEG BLANK from the 8340A be used as the blanking signal.
- Z-AXIS BLANK/MKRS (from the 8340A line) contains the Z axis markers. This line connects to the MARKERS input on the 8414B Polar Display and to the Z AXIS input on the 8412B Phase-Magnitude Display.

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- SWEEP OUTPUT outputs a 0 to +10 volt signal in proportion to the swept or CW frequency output. 0 V corresponds to the lower frequency sweep limit; +10 V to the upper. Swept RF output causes a ramp voltage out; CW output causes a dc voltage out. This connection is necessary only when using the 8412B Phase-Magnitude Display.
- 8340A-8410B/C SOURCE CONTROL CABLE. Provides "handshake" lines for synchronization between the 8340A and 8410B/C (HP Part No. 08410-60146).

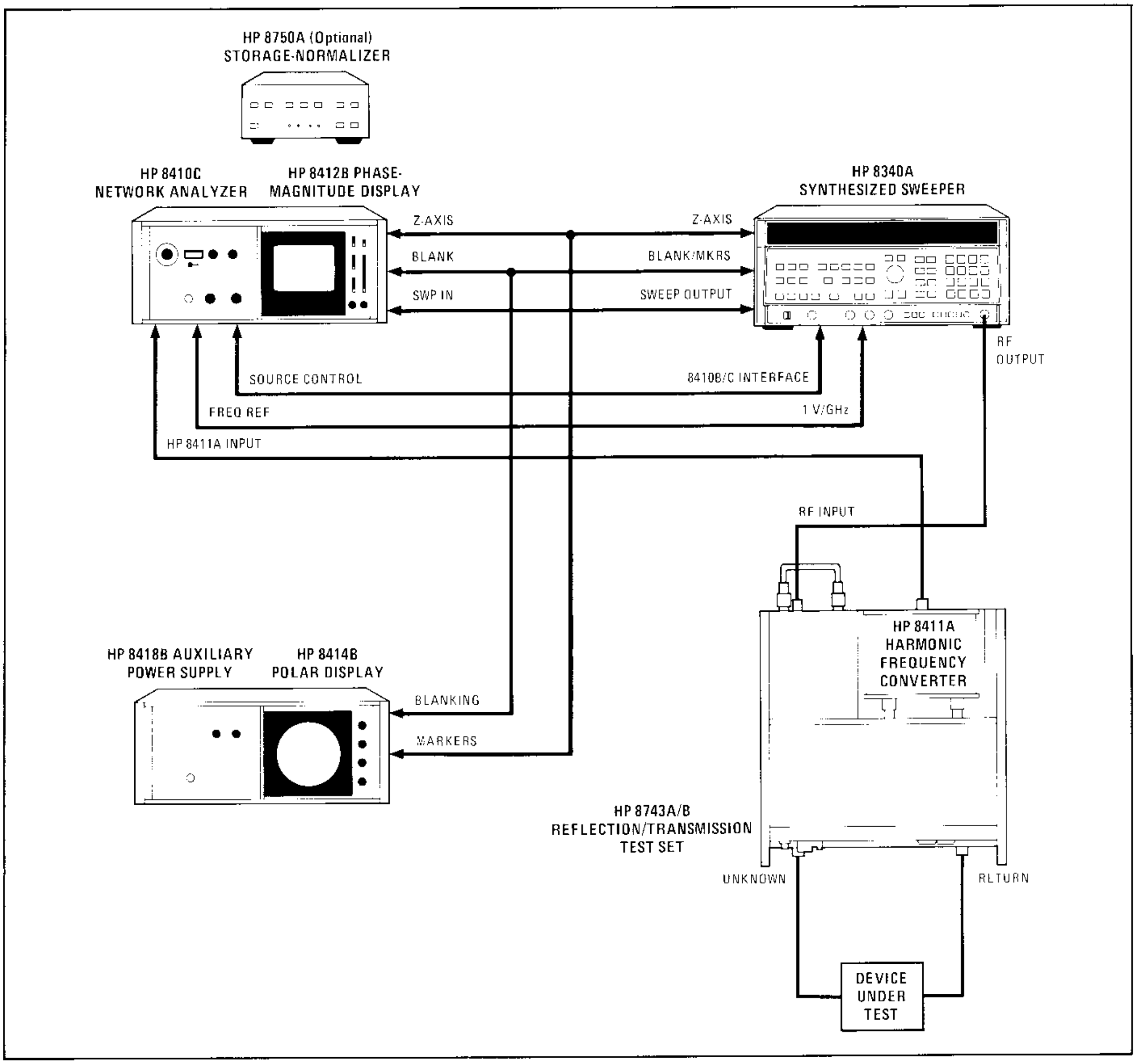

Figure 1. HP 8340A Connections to HP 8410C

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HP Part Number 08340-90043

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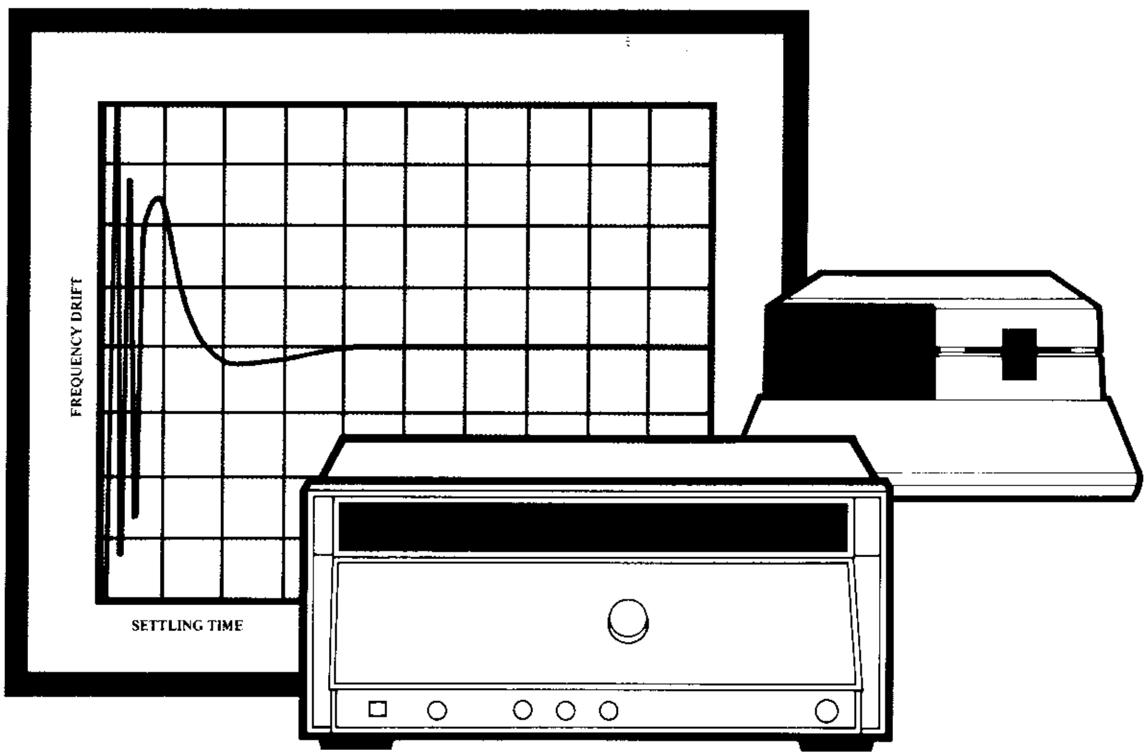
PRODUCT NOTE NO.
8340A-1

[illegible]ASING [illegible]TCHING SPEED [illegible]N THE [illegible] SWEEPER



INTRODUCTION

The increased need in automatic test systems for performance characterization of complex equipment requires fast measurement capability and repeatability. In order to provide dynamic test conditions for these systems, the test source must often settle to a new frequency within a few milliseconds.

The HP 8340A Synthesized Sweeper, for example, specifies its frequency switching time to be less than 50 ms across its broad 10 MHz to 26.5 GHz frequency range. However, if greater switching speed is necessary, one can utilize a few existing HP-IB (Hewlett-Packard Interface Bus) commands and programming techniques to achieve up to four times the specified speed.

This product note addresses the 8340A Synthesized Sweeper's definition of specified switching time, and explains the techniques available to improve its switching time, with sample programs written for the HP 200 series (9816A, 9826A, 9836A) controllers.

WHAT IS SWITCHING TIME?

The HP 8340A Synthesized Sweeper's switching time is defined to be the time between programming two frequencies via HP-IB not including the HP-IB character processing times. The total switching time consists of three overlapping components: processor time, lock time, and settling time. The processor time is the time the 8340A takes to program the hardware to a given frequency. The lock time is defined as the time required for the 8340A to tune and phase lock to the new frequency. Once the lock has occurred, there is still a finite phase error in the phase-locked loops to be settled to a steady state. The time it takes for the 8340A to settle to within a given resolution of the final output frequency is called the settling time. In the 8340A, the processor time and the settling time are constant. However, the lock time depends on the size of the frequency change, and the value of the 8340A output frequency. The specified switching time of the 8340A is the worst case time, and it is measured using the worst case step size and the **UP** and **DN** commands. The 8340A's typical frequency switching time is measured at 45 ms.

For efficient use of system time, one should make sure there are no extraneous carriage returns or line feeds after an instruction so that the interface bus will be released to process other instrument (e.g. HP 8566A Spectrum Analyzer) commands while the 8340A is busy. The use of ";" after an instruction suppresses both the carriage return and the line feed which are normally output to the 8340A after the last terminator.

The following sample program shows the use of **UP** commands and ";":

```
10 OUTPUT 719; "IP PM1 CW"; F; "GZ";...Preset 8340A.  Turn on pulse modulation.  Set the 8340A to CW mode.
20 OUTPUT 719; "SF"; S; "KZ";.........................................................Program the step size.
30 OUTPUT 719; "CW";..................................................................Reactivate CW mode.
40 FOR I=1 TO 100  ┐
50 OUTPUT 719; "UP";│...........................................................Loop to step CW frequency.
60 NEXT I          ┘
70  END
```

COMMANDS THAT IMPROVE SWITCHING TIME

One can improve the 8340A switching time by using a few HP-IB only commands that are implemented in the 8340A.

"IF"

The **IF** command increments the frequency by the specified step size. This command performs the same function as the **UP** command, however, when the 8340A receives an **IF** command it does not update the frequency displayed in the ENTRY DISPLAY (as does the **UP**), thus saving time. This command is functional in the normal mode or the Fixed Points mode (the **SN** command) of the Manual Sweep or in the normal mode of CW operation. (In the Fixed Points mode of Manual Sweep using the **SN** command, one can specify the number of steps desired between the given start and stop frequencies. The minimum and maximum number of these steps are 10 and 1000, respectively.)

The most significant advantage of the **IF** command is that it reduces typical switching time to 25 ms. The disadvantages are that the **IF** command cannot be used to cause random step sizes and that it will not update the ENTRY DISPLAY. However, for most applications, as in automatic test systems, discrete steps are more desirable. In addition, if the 8340A display was active it would be changing too fast to be readable.

The following sample programs show how the **IF** command can be used to increment a frequency by the specified step size in both the Manual Sweep and the CW modes.

The Normal Mode of Manual Sweep:

```
10 OUTPUT 719;"IP PM1 FA";A;"GZ FB";B;"GZ"....Preset 8340A. Turn on pulse modulation. Set start/stop frequency.
20 OUTPUT 719; "SF"; S; "KZ"........................................Program the step size.
30 OUTPUT 719; "S3"; A; "GZ"..................................Set the 8340A in Manual Sweep mode.
40 FOR I=1 TO 100  ┐
50 OUTPUT 719; "IF";│...............................................Loop to step frequency.
60 NEXT I          ┘
70 END
```

The Fixed Points Mode of Manual Sweep:

Delete line 30 and modify lines 20 and 40 to,

```
20 OUTPUT 719; "SN"; N.....Set the 8340A in Fixed Points Manual Sweep mode and specify number of steps desired.
40 FOR I=1 TO  N
```

The Normal Mode of CW:

Modify lines 10-30 to,

```
10 OUTPUT 719; "IP PM1 CW"; F; "GZ"........Preset 8340. Turn on pulse modulation. Set the 8340A in CW mode.
20 OUTPUT 719; "SF"; S; "KZ".............................................Program the Step size.
30 OUTPUT 719; "CW"......................................................Reactivate CW mode.
```

"TRIGGER 719"

The command **TRIGGER 719** (where 719 is the HP-IB address of the 8340A), triggers the 8340A to increment to a new frequency by the specified step size. This command is functional in either the normal or the Fixed Points mode (the **SN** command) of the Manual Sweep, or the normal or Fast Phase-lock mode (the **FP** command) of CW operation (For more information on the **FP** command refer to the the section on **FP** that follows.) The advantages of the **TRIGGER 719** command are typical switching time of 25 ms in the Fixed Points Manual Sweep mode, and less than 25 ms to be within approximately 1 kHz of the final frequency in the Fast Phase Lock mode.

The following sample programs show how the **TRIGGER 719** command is used in both the Fixed Points mode of Manual Sweep and the Fast Phase Lock mode of CW operation.

The Fixed Points Mode of Manual Sweep:

```
10 OUTPUT 719;"IP PM1 FA";A;"GZ FB";B;"GZ"....Preset 8340A. Turn on pulse modulation. Set start/stop frequency.
20 OUTPUT 719; "SN"; N.....Set the 8340A in Fixed Points Manual Sweep mode and specify number of steps desired.
30 FOR I=1 TO N┐
40 TRIGGER 719;│...............................................Loop to step frequency.
50 NEXT I      ┘
60 END
```

The Fast Phase Lock Mode of CW:

```
10 OUTPUT 719; "IP PM1 CW"..................Preset 8340A. Turn on pulse modulation. Activate CW mode.
20 OUTPUT 719; "SF"; S; "KZ".............................................Program the Step size.
30 OUTPUT 719; "FP2.3E9"..................Activate the Fast Phase-lock mode and set the start frequency.
40 WAIT 0.016.........................................................Program a WAIT time of 16 ms.
50 FOR I = 1 TO 100 ┐
60 TRIGGER 719      │..................Loop to step frequency including a WAIT time of 16 ms per step.
70 WAIT 0.016       │
80 NEXT I           ┘
90 END
```

"FP"

The previously mentioned **FP** or Fast Phase-Lock command is functional only in the CW mode. Fast Phase-lock, 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 10 MHz to 26.5 GHz frequency span of the HP 8340A.

FP achieves rapid frequency transition by limiting some of the normal HP 8340A features: the plotter control functions are disabled, the 0-10 volt sweep ramp is frozen, and the HP 8340A 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. Leading spaces and terminations (e.g. **HZ** or "**,**") are ingnored. Avoid using a "**;**" after a numeric entry when using the **FP** command as it suppresses both the Carriage Return and the Line Feed output by a controller. For example, one can program a frequency of 2.3 GHz as follows:

(1) OUTPUT 719; "FP2.3E9"

(2) OUTPUT 719; "FP2300000000"

Variables can be used to represent the frequency after an **FP** command as follows:

(3) OUTPUT 719; "FP";A

However, the same limitations (i.e. frequencies in units of hertz, and 14 characters limitation) as above applys. A format or an image statement in the program may be used to assure the correct representation of the frequency.

When the 8340A receives a **FP** command, it processes the characters and numbers in less than 6 ms and then releases the HP-IB handshake. Thus, the hardware settling time (Lock time + Settling time) will have to be programmed by the user via a **WAIT** statement to guarantee a phase locked frequency. For example, if you program a random step size and cover the total range of the 8340A, a **WAIT** time of 16 ms will typically be sufficient to guarantee phaselocked frequencies. However, if other components of the measurement system (e.t. the HP 8566A Spectrum Analyzer) are programmed in parallel to the 8340A, programming a **WAIT** statement may not be necessary, since the process time of another instrument may allow enough time for the 8340A to reach a synthesized frequency.

The worst-case **WAIT** time of 16 ms covers random step sizes. However, when an application calls for discrete step sizes of less than 1 GHz, the **WAIT** times can be reduced. Some 8340A's were characterized to determine the hardware settling times (**WAIT** times) needed for the frequency to settle within 1 kHz of its final value for various frequency step sizes. The results are shown in TABLE 1 below. For instance, if the user does not cross a band switchpoint and takes 200 MHz steps, the hardware settling time is typically 5 ms, which, when added to the 6 ms of processor time, gives a total typical switching time of 12 ms.

FREQUENCY STEP SIZE	FREQUENCY SPAN	TYPICAL HARDWARE SETTLING TIMES (OR **WAIT** TIMES)	TYPICAL TOTAL SWITCHING TIMES (TO BE WITHIN 1 kHz OF FINAL FREQUENCY)
1 GHz	Within bands[1] (without crossing bandswitch points)	10 ms	16 ms
500 MHz		12 ms	18 ms
200 MHz		6 ms	12 ms
100 MHz		11 ms	17 ms
10 MHz	190 MHz	5 ms	11 ms
5 MHz	and within bands[1]	9 ms	15 ms
2 MHz		8 ms	14 ms
1 MHz		5 ms	11 ms
<1 MHz		<5 ms	<11 ms
Random Step Size	Within the whole range of 8340A 0.01 to 26.5 GHz	16 ms	22 ms

TABLE 1. Typical Step Sizes and Hardware Settling Times or **WAIT** Times.

[1] Bands are:
0.01 to <2.3 GHz
2.3 to <7.0 GHz
7.0 to <13.5 GHz
13.5 to <20.0 GHz
20.0 to <26.5 GHz

SUMMARY

The HP 8340A is both a high performance broadband synthesizer and a broadband sweeper, and is thus a valuable component of automatic test systems. Its broadband analog sweep capability can be used for faster and more thorough characterization than is possible from a digitally stepped sweep. If, however, point to point information is needed, the 8340A's frequency accuracy and programmability, combined with the improved switching speed techniques described in this note, will provide a fast and repeatable stimulus.

For easy reference, the following table (TABLE 2) summarizes the different techniques and resulting switching times.

		CW [1]	
STEP SIZE	COMMANDS	NORMAL MODE (frequency specified in any format)	FAST PHASE-LOCK MODE (frequency specified in exponents or hertz format)
RANDOM STEP SIZE		OUTPUT 719;"CW";F;"GZ" Typically 45 ms	OUTPUT 719;"CW" OUTPUT 719;"**FP**";F;"HZ" WAIT 16[1] Typically **22** ms
SEQUENTIAL STEP SIZE	**UP** **&** **DN**	OUTPUT 719;"CW";F;"GZ" OUTPUT 719;"SF";S;"GZ" OUTPUT 719;"CW" FOR/NEXT loop to increment frequency Typically 45 ms	N/A
	IF	OUTPUT 719;"CW";F;"GZ" OUTPUT 719;"SF";S;"GZ" OUTPUT 719; "CW" FOR/NEXT loop to increment frequency Typically 25 ms	N/A
	TRIGGER **719**	OUTPUT 719;"CW";F;"GZ" OUTPUT 719;"SF";S;"GZ" OUTPUT 719;"CW" FOR/NEXT loop to increment frequency Typically 25 ms	OUTPUT 719;"CW SF";S;"GZ" OUTPUT 719;"**FP**";A WAIT X [1] (where X is time in milliseconds) FOR/NEXT loop to increment frequency including a WAIT time of X milliseconds Typically **<22** ms

TABLE 2. Comparison of Commands and Resulting Switching Times

[1] For complete information on the various commands and programming refer to the respective sections.

MANUAL SWEEP [1]	
NORMAL MODE (frequency specified in any format)	FIXED POINTS MODE (specify number of steps desired)
OUTPUT 719;"S3";F;"GZ" Typically 45 ms	N/A
OUTPUT 719;"FA";A;"GZ" OUTPUT 719;"FB";B;"GZ" OUTPUT 719;"SF";S;"GZ"; Output 719;"S3";A;"GZ" FOR/NEXT loop to increment frequency Typically 35 ms	N/A
OUTPUT 719;"FA";A;"GZ" OUTPUT 719;"FB";B;"GZ" OUTPUT 719;"SF";S;"GZ" OUTPUT 719;"S3";A;"GZ" FOR/NEXT loop to increment frequency Typically 25 ms	OUTPUT 719;"FA";A;"GZ" OUTPUT 719;"FB";B;"GZ" OUTPUT 719;**"SN"**;N (where 10<N<1000) FOR/NEXT loop to implement frequency Typically 25 ms
OUTPUT 719;"FA";A;"GZ" OUTPUT 719;"FB";B;"GZ" OUTPUT 719;"SF";S;"GZ" OUTPUT 719;"S3";A;"GZ" FOR/NEXT loop to increment frequency Typically 25 ms	OUTPUT 719;"FA";A;"GZ" OUTPUT 719;"FB";B;"GZ" OUTPUT 719;**"SN"**;N (where 10<N<1000) FOR/NEXT loop to increment frequency Typically 25 ms

5953-8870 DECEMBER 1983 PRINTED IN U.S.A.

Contact the nearest Hewlett-Packard Sales and Service Office for other Product Notes. A list of available Product Notes is shown below:

Product Note	Title	HP Part Number
8340A-2	Not Assigned	
8340A-3	Not Assigned	
8340A-4	Not Assigned	
8340A-5	*60 GHz FREQUENCY COVERAGE USING THE HP 8340A SYNTHESIZED SWEEPER AND THE WJ 1204-4X FREQUENCY EXTENDER*	5952-9346
8340A-6	*REDUCED HARMONIC DISTORTION USING THE INTEGRA TMF-1800H TRACKING FILTER WITH THE HP 8340A SYNTHESIZED SWEEPER*	5952-9343
8340A-7	*MICROWAVE NOISE FIGURE MEASUREMENTS USING THE HP 8340A SYNTHESIZED SWEEPER WITH THE HP 8970A NOISE FIGURE METER*	5953-8879

ERROR ANNUNCIATORS

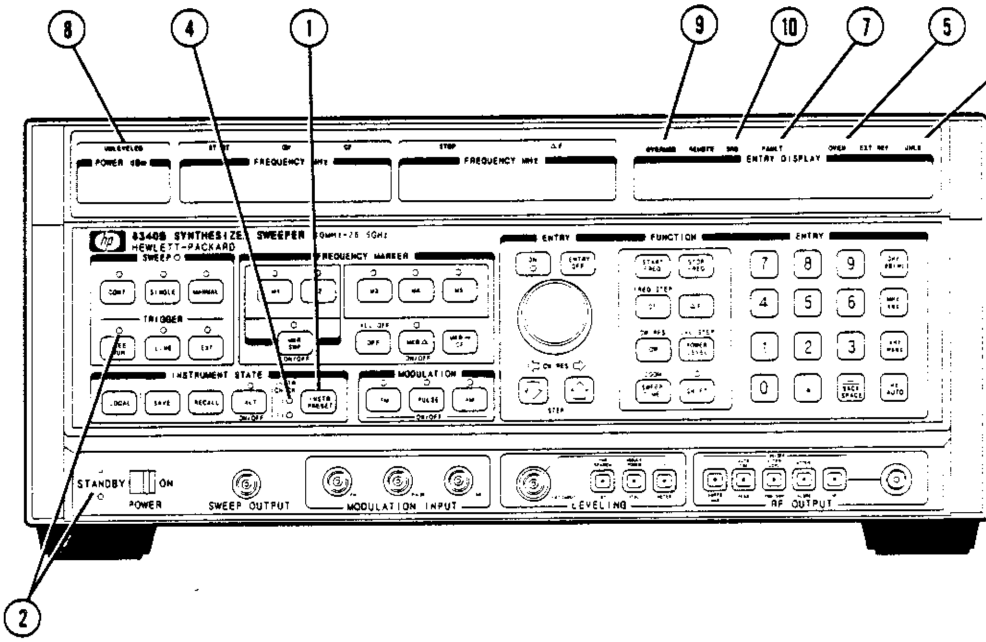
This section allows the operator to differentiate between actual instrument failures and simple procedural errors. The operator is refered to the appropriate portions of the service manual in the case of actual failures.

Assembly-level service information and an Overall Instrument Troubleshooting Guide is available in the Introduction of Section VIII, Assembly-Level Service Manual (Volume 3). Component-level troubleshooting information is provided in an optional manual set. The HP 8340B/41B Component-Level Service Manual set is separately orderable (HP Part Number 08340-90245, CD7).

Figure A-l, on the next page, shows where the front panel annunciators are located.

CONTENTS

FRONT VIEW



REAR VIEW

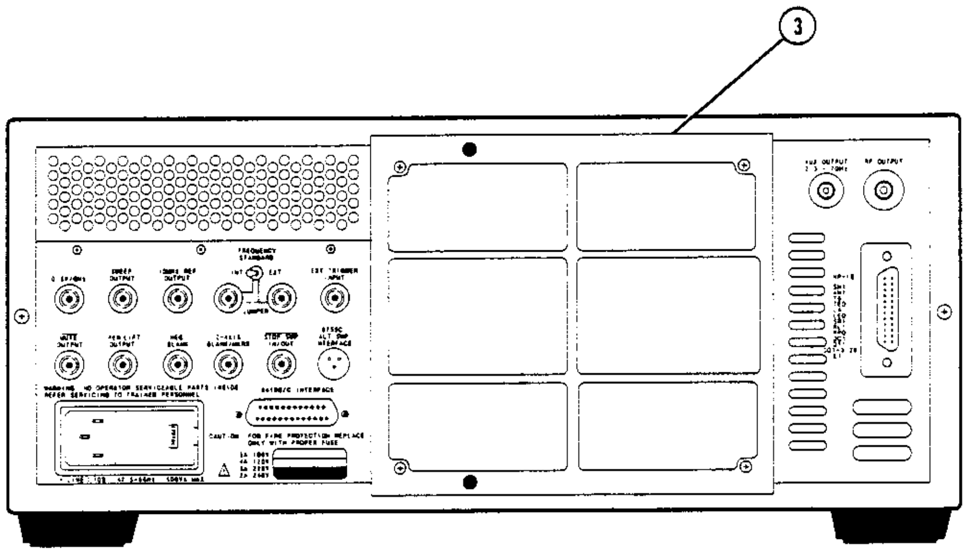


Figure A-1. HP 8340B/41B Error Annunciators

INSTRUMENT APPEARS DEAD

FAN IS NOT OPERATING, LED'S OFF AT POWER ON.

If all instrument LED's are off and the fan is not operating, suspect a problem in the instrument causing complete loss of ac mains, i.e. transformer, wiring, or line filter module related problems. Check the line fuse and line filter module's voltage select cam (Refer to Section II, Installation).

FAN RUNS SLOWLY, ALL LED'S REMAIN ON (But are dim)

Make sure the proper voltage has been selected on the Line Module. See Section II, Installation for detailed information.

PROPER INSTRUMENT STATES – ERROR CONDITIONS

1. INSTRUMENT PRESET CONDITIONS [INSTR PRESET]

Press **[SHIFT] [INSTR PRESET]** and check that the following settings exist. If any instrument condition is not as shown below, the instrument requires service.

(**[SHIFT] [INSTR PRESET]** eliminates any frequency multiplication factor that has been locked into the instrument by earlier use of the **[SHIFT] [ALT]** function, and presets the instrument. Refer to Section III, Operating Information, for details.)

POWER dBm display = 0.0

Factory setting, determined by cal constant #56.

A different power level can be set by changing calibration constant #56. See step 7 of this appendix: Calibration Constant Access Procedure.

FREQUENCY MHz display = 10.000000
START annunciator lit

FREQUENCY MHz display = 26.500000 (HP 8340B) OR 20.000000 (HP 8341B)
STOP annunciator lit. Factory setting. Calibration Constant #54 should always be set to a value of 20000 for the HP 8341B or to a value of 26500 for the HP 8340B. Check this Calibration Constant if the stop frequency is wrong after instrument preset.

ENTRY display = Blank (off)

SWEEP block = Green LED flashing ← **THIS ONE'S IMPORTANT! If the green LED is not flashing when in swept mode, the instrument isn't sweeping and requires service.**

CONT LED on
FREE RUN LED on

FREQUENCY MARKER block = All LED's off

INSTRUMENT STATE block = All LED's off

MODULATION block = All LED's off

ENTRY block = All LED's off

LEVELING block = **INT** LED on

RF OUTPUT block = **RF** LED on

The RF output should be a swept signal, leveled at 0 dBm. This signal should start at 10 MHz and stop at the maximum frequency of the instrument.

EXT REF annunciator = off.

If the rear panel **INT** or **EXT REFERENCE** switch is in the **EXT** position, the **EXT REF** annunciator above the **ENTRY DISPLAY** will be on.

2. INCORRECT FRONT PANEL STATES AFTER [INSTR PRESET]

All LED's Off.

Fan is Operating. If all annunciators and LED's are off (but the instrument's fan is operating), make sure the fan is supplying proper airflow to the interior of the instrument. Make sure the fan filter is not blocked by dust accumulation, a piece of paper, etc. If the instrument's airflow is good, suspect a failure in the instrument's power supply section.

Fan is Not Operating, LED's Come On at Power On, Then Go Out Later. Refer to the **FAN** section, below.

Some LED's Off

If some LED's that should be on are off, the instrument's front panel section is probably the cause.

All LED's On

If all of the LED's and annunciators are on, instrument processor, memory, or power supply is probably the cause.

Character March

If the four display windows have strings of characters marching across them, the instrument processor or memory is probably the cause.

3. FAN

Fan Does Not Turn On

When the **POWER** switch is turned **ON**, the instrument fan should start running. If it does not, the fan, power supply, or K1 Relay (inside the instrument near the rear panel) is probably the cause.

If the instrument has run for some time with the fan not running, the interior temperature may have risen to the point that the A62S1 thermal switch has turned the instrument off. If so, all front panel LED's will have gone off. The switch will reset itself when the instrument cools down.

Fan Does Not Turn Off

When the instrument is in the **STANDBY** mode, the fan should not be running. If it is, the Fan Relay (K1) may be stuck, or the +22V supply has failed. The fan relay solenoid is **energized** when the instrument is in the **STANDBY** mode, turning the fan **off**. If the power to the relay solenoid fails (+22V supply), the solenoid will **de-energize**, turning the fan **on**.

4. INSTR CHECK LED'S REMAIN ON

INSTR CHECK LED's **I and II**, located on the front panel adjacent to the **[INSTR PRESET]** key, indicate the results of Self Test. After switching the power on or pressing **[INSTR PRESET]**, the following will occur:

1. Both LEDs will turn on.
2. LED I will be turned off when the instrument processor determines it is operational, and has verified memory and the peripheral interface timer.
3. LED II will go off when the processor determines that the I/O Address Bus, I/O Data Bus, and the Marker Ram are operating.

If no failure occurs during Self Test, both INSTR CHECK LEDs will go off after about 1 second. If either of these LEDs remain on, the instrument requires service. Refer to the Controller functional group in Volume 3 for troubleshooting information.

NOTE

The instrument Self Test is not able to detect all instrument failures. If a problem is suspected and the Self Test passes, perform the Service Diagnostic Routine, [SHIFT] [M4]. This test performs many other instrument tests and is described at the end of this section.

5. OVEN ANNUNCIATOR

The front panel **OVEN** light is used to indicate the status of the internal frequency standard. When the **OVEN** annunciator is on, the frequency is more than 100 Hz from 10 MHz.

If the internal 10 MHz standard is being used, this will cause the frequency of the RF output to be inaccurate. The **OVEN** annunciator should go out within one half hour after the instrument is connected to ac mains. If the **OVEN** annunciator stays on, the instrument requires service.

If the instrument is using an external 10 MHz standard, this indication will have no effect on instrument performance.

6. UNLK ANNUNCIATOR

The **UNLK** light is used to indicate that that one or more of the six instrument phase lock loops is unlocked. Press **[SHIFT] [EXT]**. The **ENTRY DISPLAY** will show the following:

OSC: REF M/N HET YO N2 N1

The name of the phase lock loop that is unlocked will be flashing. The different loops are listed below along with information about what to do if one of them is unlocked.

REF – If **REF** (reference loop) is flashing, inspect the rear panel, one of two conditions should exist:

a. If the instrument is in internal 10 MHz mode:

   Make sure the **INT STANDARD** BNC and the **EXT STANDARD** BNC are connected together with a jumper cable (make sure the jumper cable is good). Ensure that the rear panel **REFERENCE** switch is in the **INT** position. If this is the case and **REF** is flashing, the instrument requires service. Suspect a problem in the Reference Loop.

b. **If the instrument is in external 10 MHz mode:**

   An external 10 MHz standard should be connected to the **EXT STANDARD** BNC with the rear panel **REFERENCE** switch in the **EXT** position. If this is the case and **REF** is flashing, connect the instrument as described in step A, above. Press **[SHIFT] [EXT]**.

   If REF keeps flashing, the instrument requires service. Suspect a problem in the Reference Loop.

   If REF stops flashing the problem is being caused by the external 10 MHz Reference Standard.

If any of the following indicators are flashing, the instrument requires service.

M/N – Suspect the M/N Loop.

HET – Suspect a problem in the 3.7 GHz Oscillator in the RF section.

YO – Suspect the YO loop.

N1 – Suspect a problem in the PLL1 or PLL3 Loops in the 20-30 Loops.

N2 – Suspect a problem in the PLL2 loop in the 20-30 Loops.

7. FAULT ANNUNCIATOR

The **FAULT** light is used to monitor the status of 5 different internal functions. These functions are described below. If the **FAULT** light is on, press **[SHIFT] [MANUAL]**. The **ENTRY DISPLAY** will show the following:

FAULT: CAL KICK ADC PEAK TRK

The name of the function that has a problem will be flashing.

CAL – This refers to the calibration constants stored in memory (on the A60 Processor board). The calibration constants are checked only when an **[INSTR PRESET]** is done. If **CAL** is flashing the instrument has resorted to default calibration constant data. The major effect of this condition will be RF power output flatness and accuracy degradation. To remedy this situation, the factory-determined calibration constants must be re-entered into the instruments memory. Remove the top cover of the instrument. Get the print-out of the calibration constants from the plastic jacket located on the left-hand side of the instrument. Replace the instrument's top cover. The following procedure must be performed to enter the calibration constants back into memory. When this procedure is complete, place the calibration constant print-out back into the instrument.

CAUTION

The following procedure affects data required for optimum performance of the instrument. Care should be taken when accessing or changing calibration data.

Calibration Constant Access Procedure

1. Press **[SHIFT] [GHz] [1] [Hz]**
   [SHIFT] [MHz] [1] [2] [Hz]
   [SHIFT] [KHz] [2] [2] [HZ]

   The value of calibration Constant #1 will be displayed in the **ENTRY DISPLAY**.

2. Compare the value on the **ENTRY DISPLAY** with the value listed in the print-out. If the values do not match, enter the value from the print-out via the **DATA ENTRY** keyboard and then press **[Hz].** Press the up **STEP** key to view the next calibration constant.

3. Repeat step 2 until all the instrument calibration constants are the same as those shown on the print-out.

4. Store the entered calibration constants into protected memory by pressing the following keys:

   [SHIFT] [MHz] [1] [4] [Hz]
   [SHIFT] [KHz] [5] [3] [4] [9] [Hz]

   The "**CALIBRATION STORED**" message will appear in the **ENTRY DISPLAY**.

   Press **[INSTR PRESET]**, the **FAULT** indicator should be off. If it is still on, suspect a problem with the instrument's memory.

KICK – This refers to the kick pulses used to reset the YO (YIG Oscillator) and SYTM (Switched YIG-Tuned Multiplier). Suspect a problem in the A54 YIG Oscillator Pretune, A55 YIG Oscillator Driver, or the A28 SYTM Driver boards.

ADC – This refers to a check performed on the ADC (analog to digital converter) circuits on the A27 Level Control board. This check is done at **[INSTR PRESET]** or power on. ADC indicates that the **POWER dBm** display may indicate a different power than the instrument is actually producing. Also, an ADC failure will not allow the Peak (**[PEAK]**) and Auto Tracking (**[SHIFT] [PEAK]**) functions to operate properly. If this annunciator is on, suspect a problem on the A27 Level Control board.

PEAK – **This refers to an instrument function that peaks the RF output power at a CW frequency** by fine tuning the SYTM (the SYTM is tuned to the YO frequency). This fault can only come on if the **[PEAK]** button is pushed. If **PEAK** is flashing, something is wrong with the circuitry that peaks the SYTM. **PEAK** indicates that the instrument is not able to optimize its output power. This is an instrument failure which requires service to correct. However, the optimum power may not be adversely affected and may still acceptable to the operator.

TRK – This refers to an instrument function that peaks the RF output power while the instrument is **sweeping.** This fault can only occur if **[SHIFT] [PEAK]** has been pushed. The **TRK** light indicates the same things as if **PEAK** were flashing.

8. UNLEVELED ANNUNCIATOR

The **UNLEVELED** light is used to indicate the status of the RF output power. If the **UNLEVELED** light is off, the output power is leveled and if the light is on, the power is unleveled.

a. Make sure that the correct leveling mode is selected. If internal leveling is desired, the **INT** light should be on. If external leveling is desired, the **XTAL** light should be on. If power meter leveling is desired, the **METER** light should be on. The three lights just mentioned are located on the associated front panel keys.

b. The power level requested should not be greater than the maximum power specification at a given frequency. If the instrument is sweeping, make sure that the power requested does not exceed the maximum power specification for the entire band or bands that are being swept.

NOTE: The **UNLEVELED** light can be lit by AM peaks that exceed maximum available power.

c. If the output power is unleveled at all power levels and all frequencies, suspect an ALC or RF section problem.

d. If the power will level at some frequencies and not others while the instrument is sweeping, the SYTM may not be tracking correctly. Try the AUTO TRACKING feature by pressing **[SHIFT] [PEAK]**.

e. If the power will level at some CW frequencies and not at others, press **[PEAK]** to optimize the SYTM tracking at the frequency of interest.

f. If the power is unleveled in Band 0 (10 MHz to 2.3 GHz) only, suspect a Band 0 ALC or RF section problem.

g. If the power is unleveled in band 1 or above (2.3 GHz to the maximum frequency), suspect a Band 1-4[1] ALC or RF section problem.

NOTE

Refer to the ALC Loop Overview in Section III of this volume.

9. OVERMOD ANNUNCIATOR

OVERMOD can be caused by the operator if FM is being used with a Modulation Deviation that is too high, or by Amplitude Modulation that exceeds the depth capability of the modulators. The only other known causes of OVERMOD are internal instrument failures in the AM, Pulse, or Frequency Modulation circuitry.

The quickest way to determine if the instrument requires service is to disconnect any cables going to the instrument's AM or FM inputs. Press **[INSTR PRESET]**. If the OVERMOD annunciator comes back on, the instrument requires service.

If the OVERMOD annunciator only comes on when a signal is being input to the FM jack, The MODULATION INDEX of the signal is significantly greater than the specified maximum (5), or the peak deviation exceeds 10 MHz. The MOD INDEX (peak deviation in MHz/modulation rate in MHz) should not be greater than 5.

1. The HP 8340B covers bands 1-4, HP 8341A only covers bands 1-3.