OPERATING MANUAL

8673A SYNTHESIZED SIGNAL GENERATOR

2.0 — 26.0 GHz

(Including Options 001, 002, 003, 004, and 005)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 2228A.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I.

HEWLETT PACKARD

1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.

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GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product is a Safety Class I instrument (provided with a protective earth terminal).

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed.

SAFETY EARTH GROUND

An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

WARNINGS

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection.) In addition, verify that a common ground exists between the unit under test and this instrument prior to energizing either unit.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to neutral (that is, the grounded side of the mains supply).

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

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

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

For continued protection against fire hazard, replace the line fuse(s) only with 250V fuse(s) of the same current rating and type (for example, normal blow, time delay, etc.). Do not use repaired fuses or short circuited fuseholders.

SAFETY SYMBOLS

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

ϟ 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.

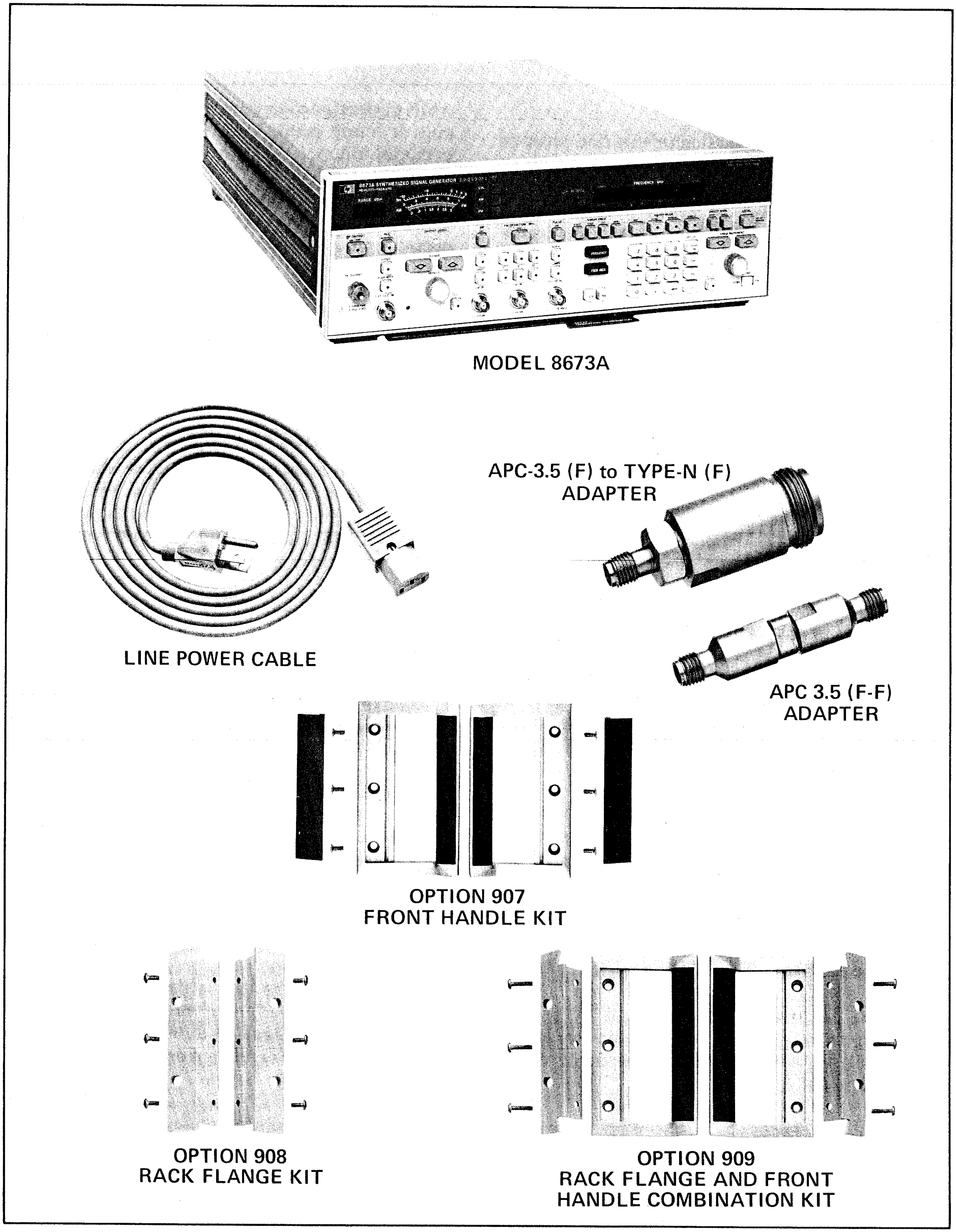


Figure 1-1. HP Model 8673A Accessories Supplied, and Options 907, 908, and 909.

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

This manual contains information required to install, operate, test, adjust and service the Hewlett-Packard 8673A Synthesized Signal Generator. Figure 1-1 shows the Signal Generator with all of its externally supplied accessories.

The 8673A Operating and Service manual has eight sections. The subjects addressed are:

Section I, General Information
Section II, Installation
Section III, Operation
Section IV, Performance Tests
Section V, Adjustments
Section VI, Replaceable Parts
Section VII, Manual Changes
Section VIII, Service

Two copies of the operating information are supplied with the Signal Generator. One copy is in the form of an Operating Manual. The Operating Manual is a copy of the first three sections of the Operating and Service Manual. The Operating Manual should stay with the instrument for use by the operator. Additional copies of the Operating Manual can be ordered separately through your nearest Hewlett-Packard office. The part number is listed on the title page of this manual.

Also listed on the title page of this manual, below the manual part number, is a microfiche part number. This number may be used to order 100 x 150 millimetre (4 x 6 inch) microfilm transparencies of this manual. Each microfiche contains up to 96 photo-duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement, as well as all pertinent Service Notes.

1-2. SPECIFICATIONS

Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument may be tested. Supplemental characteristics are listed in Table 1-2. Supplemental characteristics are not warranted specifications, but are typical characteristics included as additional information for the user.

1-3. SAFETY CONSIDERATIONS

This product is a Safety Class I instrument, that is, one provided with a protective earth terminal. The Signal Generator and all related documentation should be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page found at the beginning of this manual for a summary of the safety information. Safety information for installation, operation, performance testing, adjustment, or service is found in appropriate places throughout this manual.

1-4. INSTRUMENTS COVERED BY THIS MANUAL

Attached to the rear panel of the instrument is a serial number plate. The serial number is in the form: 0000A00000. The first four digits and the letter are the serial number prefix. The last five digits are the suffix. The prefix is the same for identical instruments; it changes only when a configuration change is made to the instrument. The suffix however, is assigned sequentially and is different for each instrument. The contents of this manual apply directly to instruments having the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-5. MANUAL CHANGES SUPPLEMENT

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

In addition to change information, the supplement may contain information for correcting errors in the manual. To keep the manual as current and as accurate as possible, Hewlett-Packard

MANUAL CHANGES SUPPLEMENT (cont'd)

recommends that you periodically request the latest Manual Changes supplement. The supplement is identified with the manual print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

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

1-6. DESCRIPTION

The HP Model 8673A Synthesized Signal Generator has a frequency range of 2.0 to 26.0 GHz (1.95 to 26.5 GHz overrange). The output is leveled and calibrated from +8 dBm to −100 dBm, depending on the frequency. (The output is leveled and calibrated from +10 to −10 dBm for Option 001, from +7 to −100 dBm for Option 004, and from +9 to −10 dBm for Option 005.) AM, FM, and pulse modulation modes can be selected. Frequency, output level, modulation modes, and most other functions can be remotely programmed via HP-IB.

Long-term frequency stability is dependent on the time base, either an internal or external reference oscillator. The internal crystal reference oscillator operates at 10 MHz while an external oscillator may operate at 5 or 10 MHz. The output of the Signal Generator is exceptionally flat due to the action of the internal automatic leveling control (ALC) loop.

External drive signals are required for all modulation modes. AM depth and FM deviation vary linearly with the applied external voltage. Full scale modulation is attained with a 1.0 volt peak signal. Pulse modulation is compatible with TTL levels.

Two ranges of AM depth can be selected: 30% and 100%. The front panel meter can be used to set AM depth. Specified AM rates are from 100 Hz to 100 kHz. However, useable amplitude modulation can be performed at any modulation frequency between 20 Hz and 100 kHz.

Six ranges of FM deviation are selectable: 0.03, 0.1, 0.3, 1, 3, and 10 MHz. FM peak deviation can be set using the front panel meter. At output frequencies below 6.6 GHz, peak deviation is limited to 10 MHz or five times the modulation frequency, whichever is lower. From 6.6 to 12.3 GHz, peak deviation is limited to the lesser of 10 MHz or ten times the modulation frequency; from 12.3 to 18.6 GHz the lesser of 10 MHz or fifteen times the modulation frequency; from 18.6 to 26.0 GHz the lesser of 10 MHz or twenty times the modulation frequency. Usable modulation rates fall between 100 Hz and 10 MHz.

Pulse modulation has two operating modes: NORM (normal mode) and COMPL (complement mode). In normal mode the RF output is On when the drive signal is the TTL high state. In the complement mode the RF output is On when the drive signal is in the TTL low state.

The Signal Generator is compatible with HP-IB to the extent indicated by the following code: SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP1, DC1, DT1, and C0. The Signal Generator interfaces with the bus via three-state TTL circuitry. An explanation of the compatibility code can be found in IEEE Standard 488 (1978), "IEEE Standard Digital Interface for Programmable Instrumentation" or the identical ANSI Standard MC1.1. For more detailed information relating to programmable control of the Signal Generator, refer to Remote Operation, Hewlett-Packard Interface Bus in Section III of this manual.

1-7. OPTIONS

1-8. Electrical Options

Option 001. The internal 10 dB/step attenuator has been deleted. The specified output level is +10 dBm to −10 dBm from 2.0 to 18.0 GHz, +6 dBm to −10 dBm from 18.0 to 22.0 GHz, and +3 dBm to −10 dBm from 22.0 to 26.0 dBm.

Option 002. The internal 10 MHz crystal reference is removed. An external 5 or 10 MHz reference must be used.

Option 003. A special fan allows operation from 400 Hz power mains.

Option 004. The Signal Generator's RF OUTPUT connector is located on the rear panel. Maximum output power is +7 dBm to −100 dBm from 2.0 to 18.0 GHz, +2 dBm to −100 dBm from 18.0 to 22.0 GHz, and −2 dBm to −100 dBm from 22.0 to 26.0 GHz.

Option 005. The Signal Generator's RF OUTPUT connector is located on the rear panel and the attenuator is removed. This combines Options 001 and 004. The specified output level is +9 dBm to

Electrical Options (cont'd)
−10 dBm from 2.0 to 18.0 GHz, +4 dBm to −10 dBm from 18.0 to 22.0 GHz, and +1 dBm to −10 dBm from 22.0 to 26.0 GHz.

1-9. Mechanical Options

The following options may have been ordered and received with the Signal Generator. If they were not ordered with the original shipment and are now desired, they can be ordered from the nearest Hewlett-Packard office using the part numbers included in each of the following paragraphs.

Option 006 (Chassis Slide Mount Kit). This kit is extremely useful when the Signal Generator is rack mounted. Access to the internal circuits and components, or the rear panel is possible without removing the Signal Generator from the rack. The Chassis Slide Mount Kit part number is 1494-0017. An adapter (HP part number 1494-0023) is needed if the instrument rack mounting slides are to be mounted in a standard EIA rack. The slides without the adapter can be directly mounted in the HP system enclosures.

Option 907 (Front Handle Kit). Ease of handling is increased with the front panel handles. The Front Handle Kit part number is 5061-0089.

Option 908 (Rack Flange Kit). The Signal Generator can be solidly mounted to the instrument rack using the flange kit. The Rack Flange Kit part number is 5061-0077.

Option 909 (Rack Flange and Front Handle Combination Kit). This is a unique part which combines both functions. It is not simply a front handle kit and a rack flange kit packaged together. The Rack Flange and Front Panel Combination Kit part number is 5061-0083.

1-10. ACCESSORIES SUPPLIED

The accessories supplied with the Signal Generator are shown in Figure 1-1.

a. The line power cable is supplied in several configurations, depending on the destination of the original shipment. Refer to Power Cables in Section II of this manual.

b. An additional fuse is shipped only with instruments that are factory configured for 100/120 Vac operation. This fuse has a 2A rating and is for reconfiguring the instrument for 220/240 Vac operation.

1-11. EQUIPMENT REQUIRED BUT NOT SUPPLIED

For Option 002 instruments, which lack an internal frequency standard, an external reference must be used. The performance of the external reference should at least match the specifications of the HP Model 10811B Crystal Oscillator. In particular, the frequency should be within ±50 Hz of 10 MHz. When using an external oscillator, microphonically generated or line related spurious signals may increase. SSB phase noise may also be degraded at some offsets from the carrier.

An external signal source is required if amplitude, frequency, or pulse modulation is desired. For AM, the source should have a variable output of 0 to 1 volt peak into 600 ohms, frequency rates up to 100 kHz, and distortion of less than 1%. For FM, the source should have a variable output of 0 to 1 volt peak into 50 ohms, frequency rates up to 10 MHz, and distortion of less than 1%. For pulse modulation, the source should have TTL output levels (>2.4V for a TTL high state and <0.4V for a TTL low state) and 50 ohms nominal impedance. Pulse repetition frequency rates should be 1 Hz to 1 MHz with transition times <10 ns.

1-12. ELECTRICAL EQUIPMENT AVAILABLE

The Signal Generator has an HP-IB interface and can be used with any HP-IB compatible computing controller or computer for automatic systems applications.

The HP-IB Controller and various ROMs are needed to do the automated SRD Bias, YTM Tune, Flatness and ALC, and Pulse adjustment procedures. Specific equipment needed for automated adjustments are:

- Test Cassette HP Part No. 11726-10001
- HP 85F Controller
- 82903A 16K Memory Module
- 00085-15005 Advanced Programming ROM
- 00085-15002 Plotter/Printer ROM
- 00085-15004 Matrix ROM
- HP 3455A Digital Voltmeter
- HP 436A/HP 8455A Power Meter and Sensor

Although the test cassette is part of the HP 11726A Support Kit, it can be ordered separately through the nearest Hewlett-Packard Office. The HP 11726A Support Kit is available for maintaining and servicing the Signal Generator. It consists of cables, adapters, termination, prerecorded programs, extender boards and test extender boards.

The HP 8116A Pulse/Function Generator is adequate for modulating the Signal Generator and meeting stated standards. This remotely programmable signal source is convenient for full remote control of modulation levels and rates.

For pulse modulation requiring pulse delay, the HP 8112A Pulse Generator is recommended.

1-13. RECOMMENDED TEST EQUIPMENT

Table 1-3 lists the test equipment recommended for testing, adjusting and servicing the Signal Generator. Essential requirements for each piece of test equipment are described in the Critical Specifications column. Other equipment can be substituted if it meets or exceeds these critical specifications.

Table 1-1. Specifications (1 of 6)

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Range	2.0—26.0 GHz (1.95—26.5 GHz overrange)	
Resolution	1 kHz 2 kHz 3 kHz 4 kHz	2.0 to 6.6 GHz 6.6 to 12.3 GHz 12.3 to 18.6 GHz 18.6 to 26.0 GHz
Accuracy and Stability	Same as reference oscillator	
Reference Oscillator: Frequency	10 MHz	
Aging Rate	$<5 \times 10^{-10}$/day	After a 10 day warmup (typically 24 hours in a normal operating environment)
Switching Time (for frequency to be within specified resolution and output power to be within 3 dB of set level)	<20 ms	CW and AM modes; AUTO PEAK disabled
SPECTRAL PURITY		
Single-sideband Phase Noise		1 Hz bandwidth; CW mode
2.0—6.6 GHz	−58 dBc −70 dBc −78 dBc −86 dBc −110 dBc	10 Hz offset from carrier 100 Hz offset from carrier 1 kHz offset from carrier 10 kHz offset from carrier 100 kHz offset from carrier
6.6—12.3 GHz	−52 dBc −64 dBc −72 dBc −80 dBc −104 dBc	10 Hz offset from carrier 100 Hz offset from carrier 1 kHz offset from carrier 10 kHz offset from carrier 100 kHz offset from carrier
12.3—18.6 GHz	−48 dBc −60 dBc −68 dBc −76 dBc −100 dBc	10 Hz offset from carrier 100 Hz offset from carrier 1 kHz offset from carrier 10 kHz offset from carrier 100 kHz offset from carrier
18.6—26.0 GHz	−46 dBc −58 dBc −66 dBc −74 dBc −98 dBc	10 Hz offset from carrier 100 Hz offset from carrier 1 kHz offset from carrier 10 kHz offset from carrier 100 kHz offset from carrier

Table 1-1. Specifications (2 of 6)

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY (cont'd)		
Harmonics	<–40 dBc	Up to 26 GHz; output level meter readings ≤ = 0 dB on 0 dBm range and below
Subharmonics and Multiples Thereof	<–25 dBc	2.0 to 18.6 GHz
	<–20 dBc	18.6 to 26.0 GHz
Spurious:		CW and AM modes
Nonharmonically Related	<–70 dBc	2.0 to 6.6 GHz
	<–64 dBc	6.6 to 12.3 GHz
	<–60 dBc	12.3 to 18.6 GHz
	<–58 dBc	18.6 to 26.0 GHz
Power line related and fan rotation related within 5 Hz below line frequencies and multiples thereof		
2.0—6.6 GHz	–50 dBc	<300 Hz offset from carrier
	–60 dBc	300 Hz to 1 kHz offset from carrier
	–65 dBc	>1 kHz offset from carrier
6.6—12.3 GHz	–44 dBc	<300 Hz offset from carrier
	–54 dBc	300 Hz to 1 kHz offset from carrier
	–59 dBc	>1 kHz offset from carrier
12.3—18.6 GHz	–40 dBc	<300 Hz offset from carrier
	–50 dBc	300 Hz to 1 kHz offset from carrier
	–55 dBc	>1 kHz offset from carrier
18.6—26.0 GHz	–38 dBc	<300 Hz offset from carrier
	–48 dBc	300 Hz to 1 kHz offset from carrier
	–53 dBc	>1 kHz offset from carrier
For Opt. 003 only (400 Hz line operation)		
2.0—6.6 GHz	–40 dBc	< 2 kHz offset from carrier
	–50 dBc	2 to 8 kHz offset from carrier
	–65 dBc	> 8 kHz offset from carrier
6.6—12.3 GHz	–34 dBc	< 2 kHz offset from carrier
	–44 dBc	2 to 8 kHz offset from carrier
	–59 dBc	> 8 kHz offset from carrier
12.3—18.6 GHz	–30 dBc	< 2 kHz offset from carrier
	–40 dBc	2 to 8 kHz offset from carrier
	–55 dBc	> 8 kHz offset from carrier
18.6—26 GHz	–28 dBc	< 2 kHz offset from carrier
	–38 dBc	2 to 8 kHz offset from carrier
	–53 dBc	> 8 kHz offset from carrier

Table 1-1. Specifications (3 of 6)

Electrical Characteristics	Performance Limits	Conditions
RF OUTPUT		
Output Level:		+15 to +35°C
Standard Leveled Output	+8 dBm to −100 dBm	2.0 to 18.0 GHz
	+4 dBm to −100 dBm	18.0 to 22.0 GHz
	0 dBm to −100 dBm	22.0 to 26.0 GHz
Option 001 Leveled Output	+10 dBm to −100 dBm	2.0 to 18.0 GHz
	+6 dBm to −100 dBm	18.0 to 22.0 GHz
	+3 dBm to −100 dBm	22.0 to 26.0 GHz
Option 004 Leveled Output	+7 dBm to −100 dBm	2.0 to 18.0 GHz
	+2 dBm to −100 dBm	18.0 to 22.0 GHz
	−2 dBm to −100 dBm	22.0 to 26.0 GHz
Option 005 Leveled Output	+9 dBm to −100 dBm	2.0 to 18.0 GHz
	+4 dBm to −100 dBm	18.0 to 22.0 GHz
	+1 dBm to −100 dBm	22.0 to 26.0 GHz
Remote Programming Absolute Level Accuracy		
2.0 — 6.6 GHz	±1.25 dB	+10 dBm output level range
	±1.00 dB	0 dBm output level range
	±1.50 dB	−10 dBm output level range
	±1.70 dB	−20 dBm output level range
	±2.00 dB	−30 dBm output level range
	±2.00 dB plus ±0.1 dB per 10 dB step below −30 dBm	<−30 dBm output range
6.6 — 12.3 GHz	±1.50 dB	+10 dBm output level range
	±1.25 dB	0 dBm output level range
	±1.75 dB	−10 dBm output level range
	±1.95 dB	−20 dBm output level range
	±2.25 dB	−30 dBm output level range
	±2.25 dB plus ±0.1 dB per 10 dB step below −30 dBm	<−30 dBm output range
12.3 — 18.6 GHz	±1.75 dB	+10 dBm output level range
	±1.50 dB	0 dBm output level range
	±2.10 dB	−10 dBm output level range
	±2.30 dB	−20 dBm output level range
	±2.70 dB	−30 dBm output level range
	±2.70 dB plus ±0.2 dB per 10 dB step below −30 dBm	<−30 dBm output range
18.6 — 26.0 GHz	±2.00 dB	0 dBm output level range
	±2.55 dB	−10 dBm output level range
	±2.85 dB	−20 dBm output level range
	±3.30 dB	−30 dBm output level range
	±3.30 dB plus ±0.2 dB per 10 dB step below −30 dBm	<−30 dBm output range

Table 1-1. Specifications (4 of 6)

Electrical Characteristics	Performance Limits	Conditions
RF OUTPUT (cont'd)		
Manual Absolute Level Accuracy	Add ±0.75 dB to remote programming absolute level accuracy	Absolute level accuracy specifications include allowances for detector linearity, temperature, flatness, attenuator accuracy, meter accuracy, and measurement uncertainty
Remote Programming Output Level Resolution	0.1 dB	
Flatness		0 dBm range; +15 to +35°C
	±0.75 dB	2.0 to 6.6 GHz
	±1.00 dB	2.0 to 12.3 GHz
	±1.25 dB	2.0 to 18.6 GHz
	±1.75 dB	2.0 to 26.0 GHz (Min. to max. variation in power level across specified frequency limits is less than 2 times flatness spec.)
Output Level Switching Time (to be within ±1 dB of final level)	<25 ms	
PULSE MODULATION		
ON/OFF Ratio	>80 dB	
Rise and Fall Times	<35 ns	AUTO PEAK enabled
Minimum Leveled RF Pulse Width	<100 ns	
Pulse Repetition Frequency	dc to 1 MHz	
Minimum Duty Cycle	<0.0001	When internally leveled; no restriction when unleveled
Minimum Pulse Off-Time	<300 ns	
Maximum Peak Power	Same as in CW mode	
Peak Level Accuracy	±1.0 dB	Relative to CW; +15 to +35°C
Overshoot, Ringing	<0.2	2.0 to 6.6 and 6.7 to 26.0 GHz
	<0.25	6.6 to 6.7 GHz
AMPLITUDE MODULATION		
Depth		+15 to +35°C
	0 to 75%	2.0 to 18.0 GHz; 0 dBm maximum carrier level
	0 to 75%	18.0 to 24.0 GHz; −3 dBm maximum carrier level
	0 to 50%	24.0 to 26.0 GHz; −5 dBm maximum carrier level

Table 1-1. Specifications (5 of 6)

Electrical Characteristics	Performance Limits	Conditions
AMPLITUDE MODULATION (cont'd)		
Rates	20 Hz to 100 kHz	3 dB bandwidth, 30% depth
Sensitivity (% AM per Vpk)	30%/V and 100%/V (depending on range)	Maximum input 1 Vpk into 600Ω nominal; AM depth is linearly controlled by varying input level between 0 and 1V peak
Indicated Meter Accuracy	±7% of reading ±3% of range	100 Hz to 10 kHz rates
Accuracy Relative to External AM Input Level	±4% of reading ±2% of range	100 Hz to 10 kHz rates
Incidental Phase Modulation (100 Hz to 10 kHz rates; 30% depth)	<0.4 radians <0.8 radians <1.2 radians <1.6 radians <2.5 radians	2.0 to 6.6 GHz 6.6 to 12.3 GHz >12.3 to 18.6 GHz >18.6 to 24.0 GHz >24.0 to 26.0 GHz
Incidental FM	Incidental phase modulation x f_{mod}	
FREQUENCY MODULATION		
Frequency Response Relative to a 100 kHz Rate	±2 dB ±2 dB	100 Hz to 3 MHz; 30 and 100 kHz/V ranges 3 kHz to 3 MHz 300 kHz/V and 1, 3, and 10 MHz/V ranges
Maximum Peak Deviation	The smaller of 10 MHz or f_{mod} x 5 The smaller of 10 MHz or f_{mod} x 10 The smaller of 10 MHz f_{mod} x 15 The smaller of 10 MHz f_{mod} x 20	2.0 to 6.6 GHz 6.6 to 12.3 GHz 12.3 to 18.6 GHz 18.6 to 26.0 GHz
Sensitivity (peak deviation per Vpk)	Maximum input 1 Vpk into 50 ohms nominal	All ranges; peak deviation is linearly controlled by varying input level between 0 and 1 Vpk
Indicated Meter Accuracy	±12% of reading ±3% of range	100 kHz rate
Accuracy Relative to External FM Input Level	±7% of reading ±3% of range	100 kHz rate
Incidental AM	<5%	Rates <100 kHz; peak deviations ≤1 MHz

Table 1-1. Specifications (6 of 6)

Electrical Characteristics	Performance Limits	Conditions
DIGITAL SWEEP		
Sweep Function	Start/Stop or ΔF (Span) Sweep	
Sweep Modes	Manual, Auto, Single	
Step Size	Maximum of 9999 frequency points per sweep	Minimum step size equals frequency resolution; step size set directly or as number of frequency points per sweep
Dwell Time	Set from 1 to 255 ms per step	
Markers	5 independent, fixed frequency markers set from front panel	Resolution and accuracy are identical to RF output
REAR PANEL AUXILIARY CONTROL CONNECTOR		
14-Pin Connector	Trigger Output Stop Sweep Input End Sweep Output Trigger Sweep Input Negative Z-axis Blanking Service Function Frequency Increment Frequency Decrement Blank Frequency Display Recall Register 1 Sequential Register Recall Ground	
Input Required	Contact closure to ground or 5 μs, negative true TTL pulse	(Internal debounce circuit available to debounce external inputs.)
Outputs	5 μs negative true TTL pulse	
REMOTE PROGRAMMING	All functions HP-IB programmable, except LINE switch	
GENERAL		
Operating Temperature Range	0 to +55°C	
Power Requirements:		
Line Voltage (100, 120, 220, or 240V)	+5, −10%	48—66 Hz
Power Dissipation	400 V · A maximum	
Conducted and Radiated Electromagnetic Interference	MIL-STD 461A-1968	Conducted and radiated interference is within the requirements of methods CE03 and RE02 of MIL-STD 461A, VDE 0871, and CISPR publication 11.
Net Weight	29 kg (64 lb)	
Dimensions: Height Width Depth	146 mm (5.7 in.) 425 mm (16.8 in.) 620 mm (24.4 in.)	For ordering cabinet accessories, module sizes are 5-1/4H, 1MW, 23D.

Table 1-2. Supplemental Characteristics (1 of 2)

Supplemental characteristics are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters.

FREQUENCY

Internal Reference: The internal reference oscillator accuracy is a function of time base calibration ± aging rate, ± temperature effects, and ± line voltage effects. Typical temperature and line voltage effects are $<1 \times 10^{-10}/°C$ and $<5 \times 10^{-10}/+5\%$ to -10% line voltage change. Reference oscillator is kept at operating temperature in STANDBY mode with the instrument connected to mains power. For instruments disconnected from mains power less than 24 hours, the aging rate is $<5 \times 10^{-10}$/day after a 24 hour warmup.

External Reference: 5 or 10 MHz at a level of 0.1 to 1 Vrms into 50 ohms. Stability and spectral purity of the microwave output will be partially determined by characteristics of the external reference frequency.

Reference Outputs: 10 MHz and 100 MHz at a level of 0.2 Vrms nominal into 50 ohms.

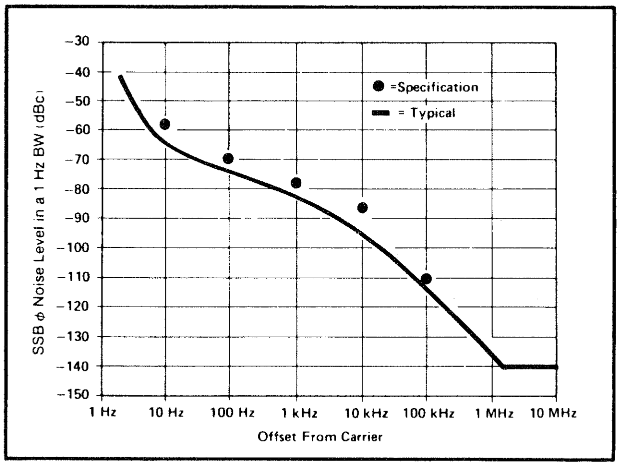
SPECTRAL PURITY

Residual FM in CW and FM Modes, 2.0 to 6.6 GHz* (noise and power line related):

Mode/FM Range	Post-Detection Bandwidth	
	300 Hz—3 kHz	50 Hz—15 kHz
CW, 30, and 100 kHz/V	12 Hz rms	60 Hz rms
300 kHz/V, and 1, 3, and 10 MHz/V	15 Hz rms	75 Hz rms

*Residual FM doubles for 6.6—12.3 GHz, triples for 12.3—18.6 GHz, and quadruples for 18.6—26.0 GHz.

Single-sideband Phase Noise (1 Hz BW, CW mode, 2.0 to 6.6 GHz):*



**Add 6 dB for 6.6 to 12.3 GHz, 10 dB for 12.3 to 18.6 GHz, and 12 dB for 18.6 to 26.0 GHz.*

RF OUTPUT

Output Level Switching Time (to be within ±1 dB of final level with no range change):

Operating Mode	Output Level Switching Time
CW	<15 ms
AM, Pulse, Sweep	<5 ms

For power settings >0 dBm, changes in frequency of several GHz in one step may require additional AUTO PEAK enabling to stabilize power at the desired level. Spurious output oscillations may occur for settings above +8 dBm.

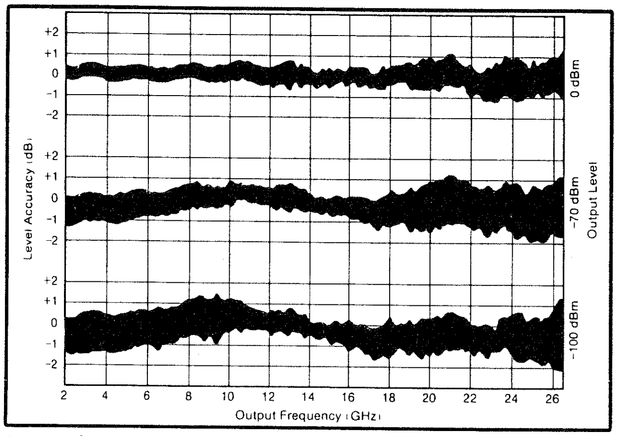
External leveling device characteristics will determine output flatness, absolute level accuracy, and switching time in external leveling modes.

Impedance: 50 ohms.

Source SWR: <2.0.

Table 1-2. Supplemental Characteristics (2 of 2)

Output Level Accuracy:



Typical 8673A output level accuracy at 0, –70, and –100 dBm level settings.

PULSE MODULATION

Pulse Width: Pulse widths less than 100 ns are possible with degraded peak power level accuracy relative to CW.

Pulse Input:

Normal Mode: >3V on, <0.5V off

Complement Mode: <0.5V on, >3V off

Impedance: 50 ohms nominal

Damage Level: more positive +6 Vpk from <50 ohm source or more negative than –0.5 Vpk from ≤50 ohm source.

Pulse Width Compression: <35 ns.

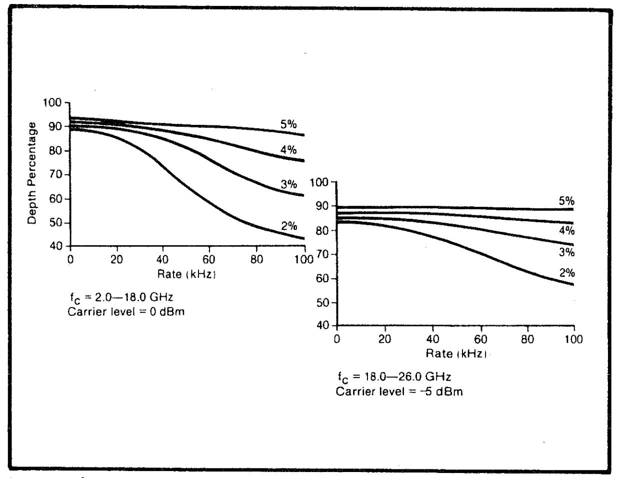
Maximum Delay Time: 150 ns.

Video Feedthrough: <–50 dBc.

AMPLITUDE MODULATION

Frequency Response Relative to a 1 kHz Rate: ±0.25 dB, 100 Hz—10 kHz.

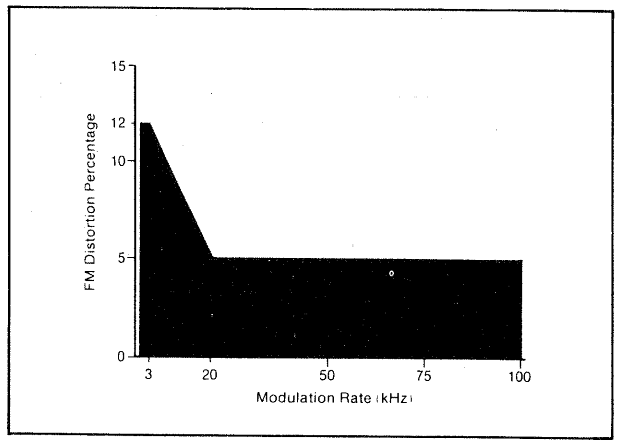
Distortion:



Typical 8673A AM distortion versus modulation rate and depth.

FREQUENCY MODULATION

Rates (3 dB bandwidth): 100 Hz to 10 MHz, 30 and 100 kHz/V ranges; 1 kHz to 10 MHz, 300 kHz/V, and 1, 3, and 10 MHz/V ranges.



Typical 8673A FM distortion versus modulation rate.

DIGITAL SWEEP

Rear Panel BNC Sweep Connections:

Sweep Out: 0 to +10V ramp start to stop (maximum adjustable from +4 to +12V)

Sweep Reference: 1V/GHz ramp (+18V maximum)

Z-Axis Blanking/Markers

Tone Marker Output

Penlift

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

Instrument	Critical Specifications	Recommended Model	Use*
AC Voltmeter	Range: 1 mV to 10V Accuracy: ±1.5% of full scale ±1.5% of reading Frequency Response: 3 kHz to 3 MHz	HP 400E	P, A
Attenuator, Fixed 3 dB	Range: dc to 1 GHz Accuracy: ±0.5 dB SWR: < 1.3	HP 8491A Option 003	P, A
Attenuator, Fixed 6 dB	Range: dc to 26 GHz Accuracy: ±0.6 dB SWR: < 1.6	HP 8493C Option 006	P
Attenuator, Fixed 10 dB	Range: dc to 12.4 GHz Accuracy: ±0.6 dB SWR: < 1.3	HP 8491A Option 010	P
Attenuator, Fixed 20 dB	Range: dc to 26 GHz Accuracy: ±1.0 dB SWR: < 1.6	HP 8493C Option 020	P, A
Attenuator, 10 dB Step	Range: dc to 26 GHz Accuracy: ±7% SWR: < 2.2	HP 8495D Option 004	P
Audio Analyzer[1]	Frequency Range: 20 Hz to 100 kHz Accuracy: ±4% of full scale	HP 8903A	P
Audio Source[1]	Frequency Range: 20 Hz to 100 kHz Output Level: 1 mV to 6V open circuit Flatness: ±2.5%	HP 8903A	P
Cable, Special Interconnect	Special (see Figure 1-2)	Locally Fabricated	A
Controller, HP-IB	HP-IB compatibility as defined by IEEE Standard 488-1978 and the identical ANSI Standard MC1.1: SH1, AH1, T2, TE0, L2, LE0, SR0, RL0, PP0, DC0, DT0, and C1, 2, 3, 4, 5. No substitute available for adjustments.	HP 85F/82903A/ 00085-15005 with 00085-15002/ 00085-15004	C A
Crystal Detector	Frequency Range: 2 to 26 GHz Frequency Response: ±1.5 dB	HP 8473C	P
Current Probe	Frequency Range: 2 to 35 MHz	HP 1110B	A

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

Instrument	Critical Specifications	Recommended Model	Use*
Current Tracer	TTL compatible	HP 547A	T
Digital Voltmeter	Automated adjustment programs require specific test equipment. No substitute is recommended.	HP 3455A	P, A, T
Foam Pads (2 required)	43 × 58 cm (17 × 23 in.), 5 cm (2 in.) thick		P
Frequency Counter	Range: 10 Hz to 500 MHz and 2 to 26 GHz Resolution: 10 Hz to 500 MHz — 1 Hz 2 to 26 GHz — 100 Hz	HP 5343A	P, A
Frequency Standard	Long Term Stability: Better than 10^{-10}/day	HP 5065A	P, A
Local Oscillator	Range: 2 to 26 GHz Level: 2 to 18.6 GHz — +7 dBm 18.6 to 26 GHz — +3 dBm Single Sideband Phase Noise and Spurious Signals: Same as Model 8673A.	HP 8673A	P, A
Logic Pulser	TTL compatible	HP 546A	T
Mixer	Response: 2 to 26 GHz	RHG DMS1—26[2]	P
Modulation Analyzer	Frequency Range: 150 to 990 MHz Input Level: −20 to +13 dBm Amplitude Modulation: Rates — 25 Hz to 25 kHz Depth — to 99% Accuracy — ±2% at 1 kHz Flatness — ±0.5% Demodulated Output Distortion — <0.3% for 50% depth; <0.6% for 90% depth Incidental Phase Modulation — <0.05 radians for 50% depth at 1 kHz rate (50 Hz to 3 kHz bandwidth) Frequency Modulation: Rates — 25 Hz to 25 kHz Deviation — to 99 kHz Accuracy — ±2% at 1 kHz	HP 8901A	P, A
Oscilloscope	Bandwidth: 200 MHz Vertical Sensitivity: 10 mV/div Vertical Input: 50Ω ac or dc coupled Delayed Sweep Mode: 20 ns/dv External Trigger Capability	HP 1715A	C,P, A,T

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

Instrument	Critical Specifications	Recommended Model	Use*
Power Meter	Automated adjustment programs require specific test equipment. Therefore, no substitute is recommended.	HP 436A	P, A
Power Sensor	Frequency Range: 2 to 26 GHz Input Impedance: 50Ω SWR: < 1.25 Must be compatible with power meter	HP 8485A	P, A
Power Source, Variable Frequency AC	Range: 60 Vac to 240 Vac Frequency: 48 to 400 Hz Accuracy ± 2 Hz	California Instruments 501TC/800T3	P P
Preamp – Power Amp	Preamp Frequency: 100 kHz to 1.3 GHz Gain: 26 ± 2 dB Output Power: > 7 dBm Noise Figure: < 8.5 dB Impedance: 50Ω Power Amp Frequency: 100 kHz to 1.3 GHz Gain: 40 ± 3 dB Output Power: > 6 dBm Noise Figure: < 5 dBm Impedance: 50Ω	HP8447F	P
Probe, 10:1	Must be compatible with the oscilloscope.	HP 10017A	P, A
Pulse Generator	Rate: 10 Hz to 4 MHz Rise and Fall Times: < 5 ns Output Impedance: 50Ω Output Level: 0 to 3.5V Pulse Width: 90 ns to 2 μs	HP 8013B	C, P, A
Signal Generator	Output Level: −5 to −20 dBm at 240 MHz	HP 8640B	A
Signature Analyzer	Because the signatures documented are unique to a given signature analyzer, no substitution is recommended.	HP 5004A	T
Spectrum Analyzer	Frequency Range: 20 Hz to 300 kHz Frequency Span/Division: 20 Hz minimum Noise Sidebands: > 90 dB below CW signal, 3 kHz offset, 100 Hz IF bandwidth Input Level Range: −10 to −60 dBm Log Reference Control: 70 dB dynamic range in 10 dB steps Accuracy: ± 0.2 dB	HP 8556A/ 8552B/141T	P

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

Instrument	Critical Specifications	Recommended Model	Use*
Spectrum Analyzer	Frequency Range: 5 Hz to 40 kHz Resolution Bandwidth: 3 Hz minimum Frequency Span/Division: 50 Hz to 500 MHz Amplitude Range: 0 to −70 dB	HP 3580A	P
Spectrum Analyzer System	Frequency Range: 2 to 26 GHz Frequency Span/Division: 1 kHz minimum Amplitude Range: 0 to −70 dB Noise Sideband: > 75 dB down 30 kHz from signal at 1 kHz resolution bandwidth	HP 8569B/ 11517A Option E80 (Note: The HP 11517 Option E80 comprises an external mixer, adapters, waveguide taper section, and necessary cables.)	P, A
Support Kit	Required for servicing and troubleshooting. Includes test cassette with automated adjustment programs.	HP 11726A	A, T
Sweep Oscillator	Center Frequency: 150 to 200 MHz Center Frequency Resolution: 0.1 MHz Sweep Range: 10 and 200 MHz	HP 86222B/ 8620C	A
Termination 50Ω	50Ω BNC	HP 11593A	P, A
Test Oscillator	Level: 0 to 3V into 50Ω or 300Ω Range: 10 kHz to 1 MHz	HP 651B	C, P

* C = Operator's Check, P = Performance Tests, A = Adjustments, T = Troubleshooting

1 The HP 8903A is recommended for the combined use as an analyzer and audio source. A separate audio analyzer and an audio source can be used if critical specifications are met.

2 RHG Electronics Laboratory, Inc., 161 East Industry Court, Deer Park, NY 11729, Tel. (516) 242-1100, TWX 510-227-6083.

3 California Instruments, 5150 Convoy Street, San Diego, CA 92111, Tel. (714) 279-8620.

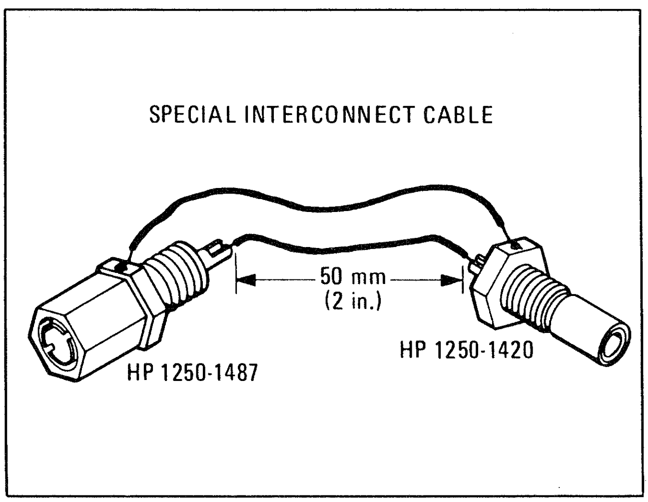
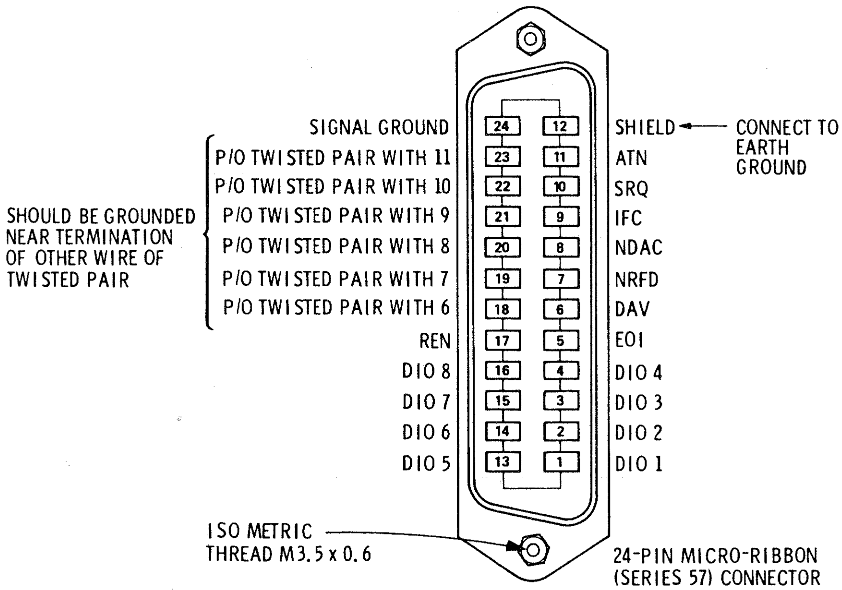


Figure 1-2. Special Interconnect Cable



Logic Levels

The Hewlett-Packard Interface Bus Logic Levels are TTL compatible, i.e., the true (1) state is 0.0 Vdc to +0.4 Vdc and the false (0) state is +2.5 Vdc to +5.0 Vdc.

Programming and Output Data Format

Refer to Section III, Operation.

Mating Connector

HP 1251-0293; Amphenol 57-30240.

Mating Cables Available

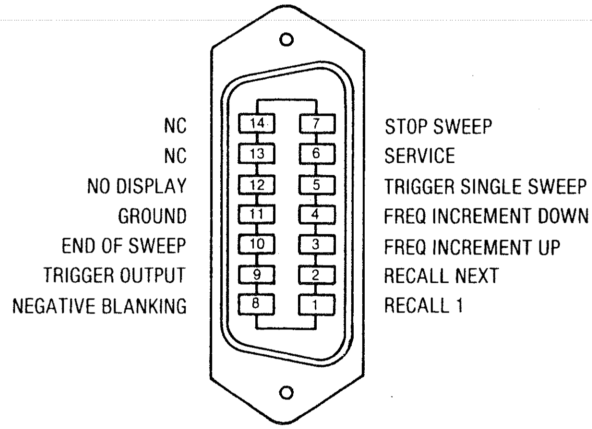
HP 10833A, 1 metre (3.3 ft), HP 10833B, 2 metres (6.6 ft)
HP 10833C 4 metres (13.2 ft), HP 10833D, 0.5 metres (1.6 ft)

Cabling Restrictions

1. A Hewlett-Packard Interface Bus system may contain no more than 2 metres (6.6 ft) of connecting cable per instrument.

2. The maximum accumulative length of connecting cable for any Hewlett-Packard Interface Bus system is 20.0 metres (65.6 ft).

Figure 2-4. Hewlett-Packard Interface Bus Connection



14-Pin Micro-Ribbon (57 Series) Connector

Logic Levels

The rear panel AUX connector logic levels are TTL compatible (5 microseconds negative-true TTL pulse or a contact closure to ground).

Internal Jumper Selection

If the signals to the rear panel AUX connector require contact debouncing (e.g., for mechanical switches), an internal jumper must be changed. The jumper is installed at the factory for electronically clean input signals (i.e., those signals that do not require the use of the debounce circuit). The jumper is located on the A2A2 Key-Code board. To change the jumper position, the top cover of the Signal Generator must be removed.

WARNINGS

This task should be performed by service trained persons who are aware of the potential shock hazard of working on an instrument with protective covers removed.

To avoid hazardous electrical shock, the line (mains) power cable should be disconnected before removing the Signal Generator's cover.

The following procedure describes how to locate and change the jumper position.

a. Set the LINE switch to STBY and disconnect the line power cable.

b. Remove the Signal Generator's top cover by removing the two plastic feet from the rear of the top cover and loosening the screw at the middle of the rear edge of the top cover.

c. Remove the A2A2 Key-Code board by gently lifting the board's extractors (the extractors are color-keyed red and black).

d. The jumper is located on the center of the board.

e. To enable the debounce circuit remove the jumper from W2 and reinstall the jumper at W1.

f. Reinstall the A2A2 Key-Code board and the Signal Generator's top cover.

Figure 2-5. AUX Interface Connector

HP-IB **Table 2-1. Allowable HP-IB Address Codes**

Address Switches					Talk Address Character	Listen Address Character	Decimal Equivalent
MSB				LSB			
0	0	0	0	0	@	SP	0
0	0	0	0	1	A	!	1
0	0	0	1	0	B	"	2
0	0	0	1	1	C	#	3
0	0	1	0	0	D	$	4
0	0	1	0	1	E	%	5
0	0	1	1	0	F	&	6
0	0	1	1	1	G	'	7
0	1	0	0	0	H	(	8
0	1	0	0	1	I	)	9
0	1	0	1	0	J	*	10
0	1	0	1	1	K	+	11
0	1	1	0	0	L	,	12
0	1	1	0	1	M	-	13
0	1	1	1	0	N	.	14
0	1	1	1	1	O	/	15
1	0	0	0	0	P	0	16
1	0	0	0	1	Q	1	17
1	0	0	1	0	R	2	18
1	0	0	1	1	S	3	19
1	0	1	0	0	T	4	20
1	0	1	0	1	U	5	21
1	0	1	1	0	V	6	22
1	0	1	1	1	W	7	23
1	1	0	0	0	X	8	24
1	1	0	0	1	Y	9	25
1	1	0	1	0	Z	:	26
1	1	0	1	1	[	;	27
1	1	1	0	0	\	<	28
1	1	1	0	1	]	=	29
1	1	1	1	0	^	>	30

HP-IB Address Selection (cont'd)

b. Remove the Signal Generator's top cover by removing the two plastic feet from the rear of the top cover and loosening the screw at the middle of the rear edge of the top cover.

c. Remove the A2 Assembly's protective cover.

d. Remove the A2A9 Freq Output HP-IB Assembly. This assembly can be recognized as having one black and one white printed circuit board extractor.

e. Set the switches to the desired HP-IB address (in binary) and the Talk Only or Listen Only condition. The switch is illustrated in Figure 2-3. If both the Talk Only and the Listen Only switches are set to "1", the Talk Only setting overrides the Listen Only setting.

f. Reinstall the A2A9 Assembly.

g. To confirm the setting, press and hold the LOCAL/DISPLAY ADDRESS key on the front panel. The current HP-IB address will be displayed in decimal in the FREQUENCY MHz display.

h. Replace the A2 Assembly's internal cover and the Signal Generator's top cover.

i. Connect the line (mains) power cable to the Line Power Module and set the LINE switch to ON.

The Signal Generator's HP-IB address can also be set from the front panel. However, the FRONT PNL ENABLE switch on the HP-IB address switch must be set to "1". To change the address from the front panel, key in the desired address, press the STO key, then press the LOCAL key. Refer to Remote Operation, HP-IB, in Section III for additional information.

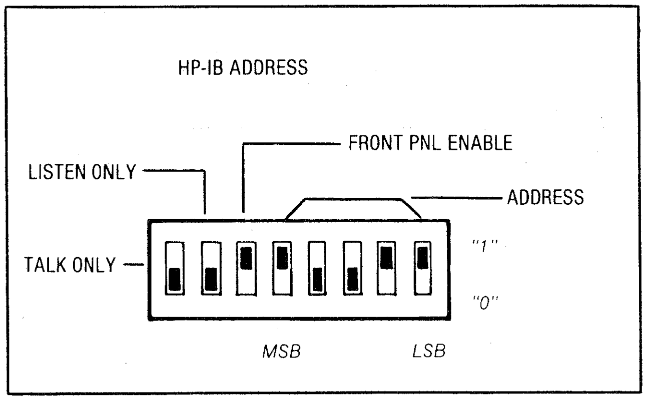


Figure 2-3. HP-IB Address Switch Shown as Set by the Factory

2-8. Interconnections

Interconnection data for the Hewlett-Packard Interface Bus is provided in Figure 2-4.

2-9. Mating Connectors

HP-IB Interface Connector. The HP-IB mating connector is shown in Figure 2-4.

AUX Interface Connector. The rear panel AUX control connector requires a male 14-pin Micro-

Mating Connectors (cont'd)
Ribbon (57 Series) connector. The HP part number is 1251-0142. This connector is also available from Amphenol (Oak Brook, Illinois 60521). Interconnection data for the rear panel AUX control connector is provided in Figure 2-5.

Coaxial Connectors. Coaxial mating connectors used with the Signal Generator should be 50Ω APC 3.5 female connectors.

2-10. Operating Environment

The operating environment should be within the following limitations:

Temperature .... 0 to +55°C
Humidity .... <95% relative
Altitude............... <4570 metres (15 000 feet)

2-11. Bench Operation

The instrument cabinet has plastic feet and fold-away tilt stands for convenience in bench operation. (The plastic feet are shaped to ensure self-aligning of the instruments when stacked.) The tilt stands raise the front of the instrument for easier viewing of the front panel.

2-12. Rack Mounting

WARNING

The Signal Generator weighs 29 kg (64 lbs), therefore care must be exercised when lifting to avoid personal injury. Use equipment slides when rack mounting.

Rack mounting information is provided with the rack mounting kits. If the kits were not ordered with the instrument as options, they may be ordered through the nearest Hewlett-Packard office. Refer to the paragraph entitled Mechanical Options in Section I.

2-13. STORAGE AND SHIPMENT

2-14. Environment

The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

Temperature .... –55 to +75°C
Humidity .... <95% relative
Altitude............. 15 300 metres (50 000 feet)

2-15. Packaging

Tagging for Service. If the instrument is being returned to Hewlett-Packard for service, please complete one of the blue repair tags located at the back of this manual and attach it to the instrument.

Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. 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 re-packaging with commercially available materials:

a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, complete one of the blue tags mentioned above and attach it to the instrument.)

b. Use a strong shipping container. A double-wall carton made of 2.4 MPa (350 psi) test material is adequate.

c. Use enough shock-absorbing material (75 to 100 mm layer; 3 to 4 inches) around all sides of the instrument to provide firm cushion and prevent movement in the container. Protect the front panel with cardboard.

d. Seal the shipping container securely.

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

SECTION II
INSTALLATION

2-1. INTRODUCTION

This section provides the information needed to install the Signal Generator. Included is information pertinent to initial inspection, power requirements, line voltage selection, power cables, interconnection, environment, instrument mounting, storage and shipment.

2-2. INITIAL INSPECTION

WARNING

To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, meters).

Inspect the 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 Figure 1-1. Procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection.

2-3. PREPARATION FOR USE

2-4. Power Requirements

The Signal Generator requires a power source of 100, 120, 220 or 240 Vac, +5% to −10%, 48 to 66 Hz single phase (for Option 003 instruments, 400 Hz single phase and 120 Vac, +5%, −10% only). Power consumption is 400 V·A maximum.

WARNINGS

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

If this instrument is to be energized via an external autotransformer, make sure the autotransformer's common terminal is connected to the neutral (that is, the grounded side of the mains supply).

2-5. Line Voltage and Fuse Selection

CAUTION

BEFORE PLUGGING THIS INSTRUMENT into the mains (line) voltage, be sure the correct voltage and fuse have been selected.

Verify that the line voltage selection card and the fuse are matched to the power source. Refer to Figure 2-1, Line Voltage and Fuse Selection.

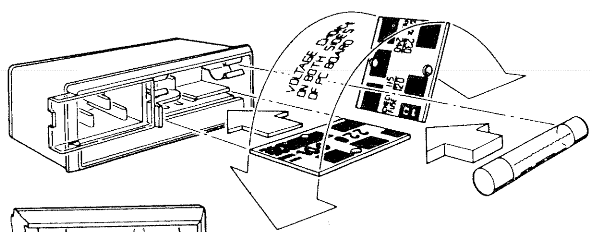
Fuses may be ordered under HP part numbers 2110-0055, 4.0A (250V) for 100/120 Vac operation and 2110-0083, 2.0A (250V) for 220/240 Vac operation.

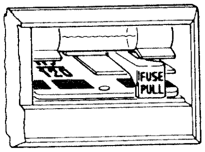
2-6. Power Cables

WARNING

BEFORE CONNECTING THIS INSTRUMENT, the protective earth terminal of this instrument must be connected to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding).

This instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument





Operating voltage is shown in module window.

SELECTION OF OPERATING VOLTAGE

1. Open cover door, pull the FUSE PULL lever and rotate to left. Remove the fuse.
2. Remove the Line Voltage Selection Card. Position the card so the line voltage appears at top-left corner. Push the card firmly into the slot.
3. Rotate the FUSE PULL lever to its normal position. Insert a fuse of the correct value in the holder. Close the cover door.

WARNING

To avoid the possibility of hazardous electrical shock, do not operate this instrument at line voltages greater than 126.5 Vac with line frequencies greater than 66 Hz (leakage currents at these line settings may exceed 3.5 mA).

Figure 2-1. Line Voltage and Fuse Selection

cabinet. The power cable plug shipped with each instrument depends on the country of destination. Refer to Figure 2-2 for the part numbers of power cables available.

2-7. HP-IB Address Selection

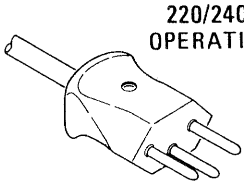
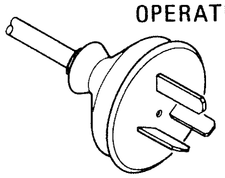
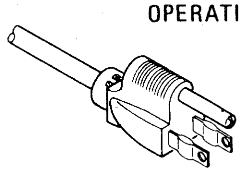
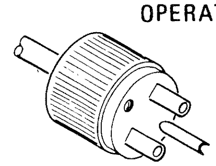
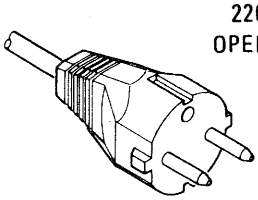
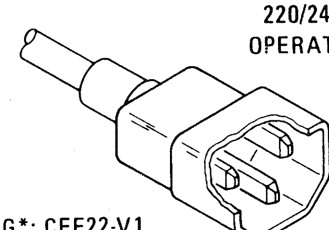
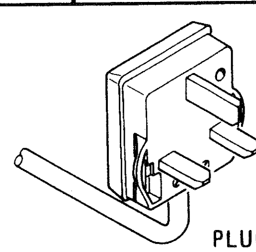
WARNINGS

This task should be performed only by service trained persons who are aware of the potential shock hazard of working on an instrument with protective covers removed.

To avoid hazardous electrical shock, the line (mains) power cable should be disconnected before attempting to change the HP-IB address.

In the Signal Generator, the HP-IB talk and listen addresses can be selected by an internal switch or by a front panel setting. Refer to Table 2-1 for a listing of talk and listen addresses. The address is factory set for a Talk address of "S" and a Listen address of "3". (In binary this is 10011; in decimal this is 19.) The following procedure explains how the switches are to be set.

a. Set the LINE switch to STBY and disconnect the line power cable.

220/240V OPERATION  PLUG*: SEV 1011.1959-24507 TYPE 12 CABLE*: HP 8120-2104	220/240V OPERATION  PLUG*: NZSS 198/AS C112 CABLE*: HP 8120-1369	100/120V OPERATION  PLUG*: NEMA 5-15P CABLE*: 8120-1378	220/240V OPERATION  PLUG*: NEMA 6-15P CABLE*: HP 8120-0698
220/240V OPERATION  PLUG*: CEE7-VII CABLE*: HP 8120-1689	220/240V OPERATION  PLUG*: CEE22-V1 CABLE*: HP 8120-1860	220/240V OPERATION  PLUG*: BS 1363A CABLE: HP 8120-1351	

*The number shown for the plug is the industry identifier for the plug only.
The number shown for the cable is an HP part number for a complete cable including the plug.

Figure 2-2. Power Cable and Mains Plug Part Numbers

SECTION III
OPERATION

3-1. INTRODUCTION

This section provides complete operating information for the Signal Generator. Included in this section are both general and detailed operating instructions, detailed descriptions of the front and rear panel, local and remote operator's checks, and operator's maintenance procedures.

3-2. Operating Characteristics

Table 3-1 briefly summarizes the major operating characteristics of the Signal Generator. This table is not intended to be an in-depth listing of all operations and ranges but gives a rough idea of the instrument's capabilities. For more information on the Signal Generator's capabilities, refer to Table 1-1, Specifications, and Table 1-2, Supplemental Characteristics. For information on HP-IB capabilities, refer to the summary contained in Table 3-4, Message Reference Table.

3-3. Local Operation

Information covering front panel operation of the Signal Generator is given in the sections described below. To rapidly learn the operation of the instrument, begin with Simplified Operation and Operator's Checks. Once familiar with the general operation of the instrument, use the Detailed Operating Instructions for in-depth and complete information about operating the Signal Generator.

Turn-On Information. Instructions relating to the Signal Generator's turn-on procedure are presented to acquaint the user with the general operation of the instrument.

Simplified Operation. The instructions located on the inside of this fold provide a quick introduction to front panel operation of the Signal Generator. These instructions are designed to rapidly acquaint the new user with basic operating procedures and therefore are not an exhaustive listing of all Signal Generator functions. However, an index to the Detailed Operating instructions appears opposite the fold to direct the operator to the more complete discussion of the topic of interest.

Detailed Operating Instructions. The Detailed Operating Instructions provide the complete operating reference for the Signal Generator user. The instructions are organized alphabetically by subject and are placed at the end of this section for easy reference. They are indexed by function in Table 3-2.

Panel Features. Front and rear panel features are described in detail in Figures 3-1 through 3-7.

Operating Information Pull-Out Card. The Operating Information pull-out card is a flexible plastic reference sheet located in a tray below the front panel. It presents general operating instructions. With examples of most of the Signal Generator's features, it is a good learning aid as well as a quick reference.

3-4. Remote Operation

HP-IB. The Signal Generator is capable of remote operation via the Hewlett-Packard Interface Bus (HP-IB). Instructions pertinent to HP-IB operation cover all considerations and instructions specific to remote operation including capabilities, addressing, input and output formats, the status byte, and service requests. At the end of the discussion is a complete summary of all codes.

In addition to the section described above, information concerning remote operation appears in several other locations. General information about HP-IB codes and formats appear on the Operating Information pull-out card. Numerous examples of program strings appear throughout the Detailed Operating Instructions described under Local Operation above.

Auxiliary. The following keyboard functions can be controlled by TTL signals at the rear panel AUX connector:

RECALL 1
FREQ INCREMENT (up and down)
SINGLE Sweep

In addition, several remote-only functions are available. These controls are described in detail in the paragraph titled Auxiliary Control.

ncy	Range: 2.0 to 26.0 GHz Overrange: 1.95 to 26.5 GHz Resolution: 1 kHz 2.0 to 6.6 GHz 2 kHz 6.6 to 12.3 GHz 3 kHz 12.3 to 18.6 GHz 4 kHz 18.6 to 26.0 GHz
Level	Range: –90 to +10 dBm in 10 dB steps (except Options 001 and 005) 0 and +10 dBm (Options 001 and 005 only) Vernier: –10 to +3 dB continuously variable
tion	AM Depth: 30%/V and 100%/V ranges Maximum Input: 1 Vpk into 600 ohms nominal Rates (3 dB bandwidth): 20 Hz to 100 kHz FM Ranges: 30 kHz/V, 100 kHz/V, 300 kHz/V, 1 MHz/V, 3 MHz/V, and 10 MHz/V Maximum Input: 1 Vpk into 50 ohms nominal Maximum Peak Deviation: the smaller of 10 MHz or f_{mod} x 5 2.0 to 6.6 GHz f_{mod} x 10 6.6 to 12.3 GHz f_{mod} x 15 12.3 to 18.6 GHz f_{mod} x 20 18.6 to 26.0 GHz Rates (3 dB bandwidth): 100 Hz to 10 MHz for 30 kHz/V and 100 kHz/V ranges; 1 kHz to 10 MHz for 300 kHz/V, 1 MHz/V, 3 MHz/V, and 10 MHz/V ranges Pulse Pulse Input: Normal Mode: >3V on, <0.5V off Complement Mode: <0.5V on, >3V off Impedance: 50 ohms nominal RF Output: ON/OFF Ratio: >80 dB Rise and Fall Times: <35 ns Minimum Leveled Pulse Width: <100 ns Pulse Repetition Frequency: dc to 1 MHz
	Configuration: Start-Stop Frequencies or Center Frequency ΔF (Span) Modes: Automatic, Single, and Manual Step Size: as large as sweep span to as small as 1 kHz 2.0 to 6.6 GHz 2 kHz 6.6 to 12.3 GHz 3 kHz 12.3 to 18.6 GHz 4 kHz 18.6 to 26.0 GHz Number of Steps: 1 to 9999 Dwell Time: 1 to 255 ms per step Markers: 5 Markers Rear Panel BNC Sweep Connections:

the Signal Generator's main functions. Two procedures are provided as described below.

Basic Functional Checks. This procedure requires a function generator, a microwave frequency counter, a power meter, a power sensor, a crystal detector, and interconnecting cables. It assures that most front panel controlled functions are being properly executed by the Signal Generator.

HP-IB Functional Checks. These procedures require an HP-IB compatible computing controller, an HP-IB interface, and connecting cable. The procedures check all of the applicable bus messages summarized in Table 3-4. The HP-IB Checks assume that front panel operation has been verified by performing the Basic Functional Checks.

3-6. Operator's Maintenance

WARNING

For continued protection against fire hazard, replace the line fuse with a 250V fuse of the same rating only. Do not use repaired fuses or short-circuited fuseholders.

Operator's maintenance consists of replacing defective fuses and adjusting the mechanical zero of the front panel meter.

The primary power fuse is located within the Line Power Module Assembly. Refer to Figure 2-1 for instructions on how to change the fuse.

To mechanically zero the front panel meter, set the LINE switch to the STBY position and place the Signal Generator in its normal operating position. Turn the mechanical zeroing adjustment clockwise to move the needle up scale or counterclockwise to move the needle down scale. The zero point is located at the left end of the 0—1 or the 0—3 scales. DO NOT zero on the left end of the top dB scale at –10 because this is not the proper zeroing point.

If the instrument does not operate properly and is being returned to Hewlett-Packard for service, please complete one of the blue tags located at the end of this manual and attach it to the instrument. Refer to Section II for packaging instructions.

Amplitude, frequency, and pulse modulation of microwave carrier via external modulating signals.

Message key illuminates or flashes to indicate input errors or hardware failures. Depressing the key displays error/malfunction code in frequency display.

Start/stop or Δf sweep is selectable with up to five synthesized markers.

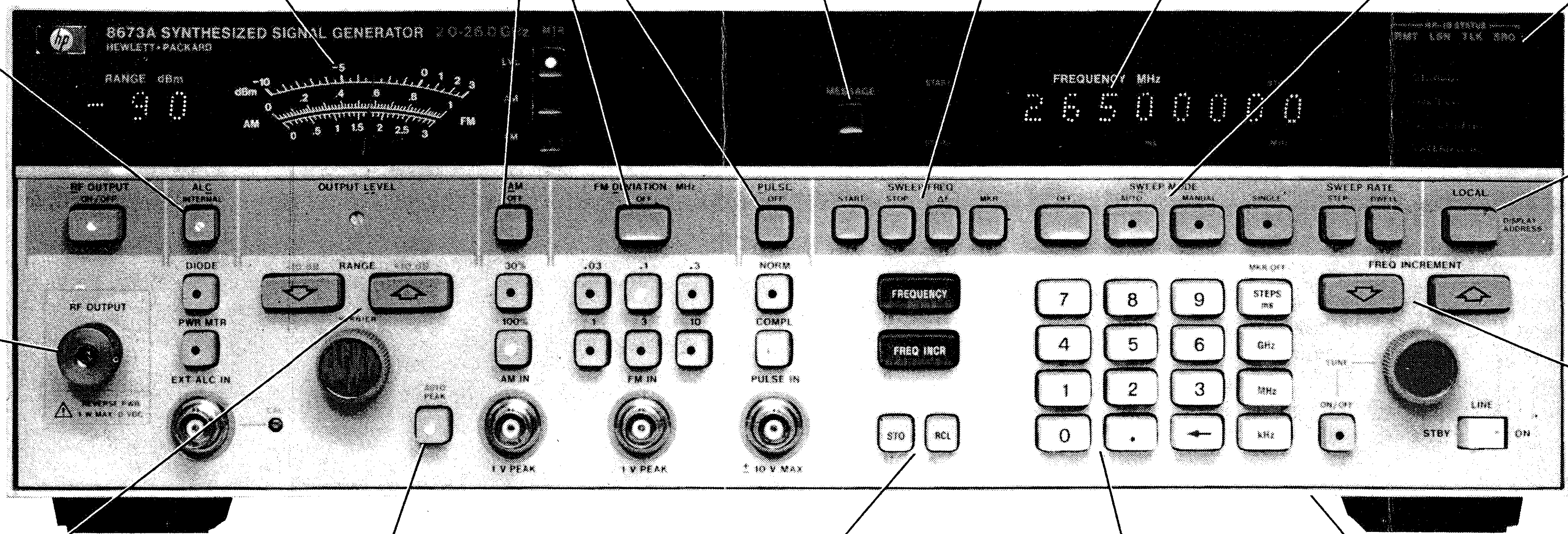
AUTO, MANUAL, and SIN
sweep modes.

power
al
power

Calibrated metering of output level vernier, AM depth, and FM deviation.

11-digit LED display for all frequency related parameters and error/malfunction messages.

Annunciat
modes for
operationa



HP-IB add
front pane

ble from
Resolution
-IB control.

Rotary pul
knob and
keys chang
user-select

ut level controlled in 10 dB
from +10 to –90 dBm with
o +3 dB continuous level
ier.

AUTO PEAK function maximizes available output power at RF connector and optimizes pulse modulation characteristics.

Store and recall up to 9 front panel settings for measurement efficiency.

Frequency entered by function, data, and unit keys.

Pull-out card for convenient op
reference and error code interp

nt panel to the following conditions:

pt Options 001 and 005)
tions 001 and 005 only)

dulation to OFF
) MHz
z

to 5, 10, 15, 20, and 25 GHz)

MHz)

ement values are set in a Function-Data-Units

o 4.5 GHz and frequency increment to 500 MHz:

UNITS

5 GHz
0 MHz

GHz, MHz, or kHz, but are always displayed in

cy by the selected increment value, use:

TUNE
ON/OFF

First press RANGE ⇩ ⇧

to step the output level down or up by increments of 10 dB. The selected range is shown in the RANGE dBm display.

Then, press LVL MTR to select OUTPUT LEVEL VERNIER to be displayed on the meter. Adjust VERNIER between −10 and +3 dB, as read on the meter.

The output level is determined by adding the meter display to the RANGE dBm display.

To maintain output power at a constant level press ALC INTERNAL.

Press AUTO PEAK to maximize power at the output frequency, to minimize power of spurious signals and to optimize pulse shape for pulse modulation.

STORE/RECALL

Up to nine front panel settings can be stored for later use. All Signal Generator front panel functions can be stored, although OUTPUT LEVEL VERNIER is stored in remote mode only.

STO 3 stores a front panel setting in register 3.

RCL 4 recalls a front panel setting stored in register 4 and changes the output of the Signal Generator to the recalled parameters.

MODULATION

Three types of modulation are available: amplitude (AM), frequency (FM), and pulse. Each type requires an external drive signal. Front panel keys select the maximum percent of AM, FM deviation in MHz, and normal (NORM) or complement (COMPL) pulse mode. For AM and FM, a 1 Vpk signal develops full scale modulation. Modulation varies linearly with the input signal. For pulse modulation, a TTL level positive-true pulse turns RF on in normal mode. A TTL level negative-true pulse turns RF on in complement mode.

MESSAGES

Entry errors, hardware malfunctions, and other significant conditions are indicated by the lighted MESSAGE key.

Press MESSAGE to read the two-digit code in the FREQUENCY MHz display. The codes are explained in the

SWEEP

Values for SWEEP FREQ (START, STOP, ΔF, and MKR) and SWEEP RATE (STEP and DWELL) are entered in a Function-Data-Units format.

SWEEP FREQ

The SWEEP FREQ keys set the span of the sweep (that is, the range that the sweep covers). The sweep span can be set with either the START and STOP keys or with the FREQUENCY and ΔF keys.

For example, to set a sweep span of 4 GHz with a start frequency of 2 GHz and a stop frequency of 6 GHz press:

FUNCTION	DATA	UNITS		FUNCTION	DATA	UNITS
START [ ]	[2]	[GHz]	or	[FREQUENCY]	[4]	[GHz]
STOP [ ]	[6]	[GHz]		ΔF [ ]	[4]	[GHz]

SWEEP RATE

During a sweep, the Signal Generator changes frequency in discrete steps. Sweep rate is determined by the number of steps and the dwell time. The number of steps can be set in either of two ways.

To set the number of steps to be used in a sweep press STEP [ ], use the numeric keys to enter the number of steps, then press [STEPS ms].

The sweep span is divided by the number of steps to determine the step size.

To set the step size, press STEP [ ], use the numeric keys to enter the frequency of the step, then press [GHz] or [MHz] or [kHz].

The sweep span is divided by the step size to determine the number of steps.

The dwell time determines how much time elapses before the next frequency step is taken.

To set the dwell time press DWELL [ ], use the numeric keys to enter the time in milliseconds, then press [STEPS ms].

SWEEP MODE

To start a sweep press:

AUTO [○] for a repetitive sweep.

MANUAL [○] for a sweep that is controlled by the TUNE knob or the FREQ INCREMENT Up and Down keys.

SINGLE [○] for one sweep only. Press this key once to tune the Signal Generator to the start frequency. Then, press this key again to actually initiate the sweep.

To stop a sweep, in any mode, press OFF [ ].

3-7. TURN-ON INSTRUCTIONS

WARNINGS

Before the instrument is switched on, all protective earth terminals, extension cords, autotransformers and devices connected to it 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 250V normal blow fuses with the required rated current should be used. Do not use repaired fuses or short circuited fuseholders. To do so could cause a shock or fire hazard.

CAUTIONS

Before the instrument is switched on, it must be set to the voltage of the power source or damage to the instrument may result.

The Signal Generator's RF OUTPUT is protected against reverse power applications up to 1W. However, for greatest protection of expensive internal components, be careful not to apply any reverse power to the RF OUTPUT.

3-8. Turn-On

Turn-On Procedure. The Signal Generator has a standby state and an on state. Whenever the power cable is plugged in, an oven is energized to keep the reference oscillator at a stable operating temperature. If the Signal Generator is already plugged in, set the LINE switch to ON.

If the power cable is not plugged in, follow these instructions.

On the rear panel:

1. Check the line voltage switch for correct voltage selection.
2. Check that the fuse rating is appropriate for the line voltage used (see Figure 2-1). Fuse ratings are printed on the rear panel.
3. Plug in the power cable.

On the front panel, set the LINE switch to ON.

NOTE

The OVEN COLD status annunciator should light to indicate that the Signal Generator requires warming up. The annunciator should turn off within five minutes and the Signal Generator should be ready for general use.

Turn-On Configuration. The Signal Generator turns on to the same control settings it had before it was switched to STBY or even completely off (that is, if line power was removed). The exception to this rule is that it always turns on in local mode.

Turn-On Memory Check. The Signal Generator performs a quick memory check at turn-on. It checks for a failure in ROM (permanent memory) or in RAM (temporary memory), and for the presence of correct data stored in RAM.

NOTE

An internal battery is used to retain data in RAM during standby and off periods. The data restores the last control setup and the nine storage registers.

If a ROM or serious RAM failure occurs, the Signal Generator will attempt to turn on to its last control setup. The Signal Generator might be useable but does require service.

If any, but not all, of the stored data is found to be incorrect, the Signal Generator will turn on to the configuration stored in the first good register. This control setup will then be stored in registers 1 through 9. Incorrect stored data could be caused by even a single bit of data being lost due to line transients, noise or other unpredictable conditions. The Signal Generator should be useable and does not require service unless this situation occurs repeatedly.

If all of the register data has been altered (for example, if the battery failed) the Signal Generator will reinitialize to the front panel preset values stored in register 0 (refer to Simplified Operation for a list of preset values). The initialized control setup will then be stored in all of the registers. The Signal Generator might be useable but does require service.

3-9. Frequency Standard Selection

A FREQ STANDARD INT/EXT switch and two connectors are located on the rear panel. A jumper

Frequency Standard Selection (cont'd)

normally connects the FREQ STANDARD INT connector (A3J9) to the FREQ STANDARD EXT connector (A3J10). The FREQ STANDARD EXT connector can accept a reference signal to be used instead of the Signal Generator's internal frequency standards.

The internal frequency standard is a 10.000 MHz signal at +7 dBm (nominal) with an aging rate of $<5 \times 10^{-10}$/day after warmup (typically 24 hours). When the FREQ STANDARD INT/EXT switch is in the INT position and the jumper is connected between A3J9 and A3J10, the internal reference is enabled.

When the FREQ STANDARD INT/EXT switch is in the EXT position and the jumper is disconnected from the FREQ STANDARD EXT connector, a frequency standard of 5 or 10 MHz at 0 dBm (nominal) can be connected.

NOTE

The EXTERNAL REF status annunciator on the front panel will light when an external reference is being used. Also, the NOT φ LOCKED status annunciator may light if the external reference is not of sufficient accuracy in frequency or has an insufficient power level. The external reference must be within ±200 Hz of 10 MHz or ±100 Hz of 5 MHz for reliable locking to occur. If the external reference level is not within the specified limits (0.1 to 1 Vrms into 50 ohms), its level may be sufficient to turn off the NOT φ LOCKED status annunciator. However, the phase noise of the Signal Generator may be degraded.

Table 3-2. Index of Detailed Operating Instructions

This table is reserved for the final manual.

3-10. ADDITIONAL OPERATING INFORMATION

Performance, from the Signal Generator, can be maximized and optimized by considering the effect of the following controls on the RF output:

a. AUTO PEAK
b. ALC
c. PULSE Modulation Mode
d. SWEEP Mode in a Master/Slave configuration

3-11. AUTO PEAK

Major power and pulse modulation specifications cannot be met unless AUTO PEAK feature is on. Auto Peak, when activated, guarantees that maximum specified power is available at the RF output connector. Unless AUTO PEAK is turned off, it is automatically on whenever the instrument LINE switch is pressed ON. Selecting PULSE MODE also turns on AUTO PEAK. In this mode of operation, changes in frequency of 50 MHz or more result in the instrument re-peaking the output power level. At any one frequency, when the VERNIER is used to change the output power level by more than ≥0.4 dB, a "scratch pad" memory records and stores every 0.4 dB point crossing for the VERNIER's entire range. Subsequent changes in RF output power level, for the frequency setting, will be automatically peaked.

3-12. ALC (Automatic Level Control)

Output power leveling for the instrument's frequency range occurs from three sources selected by the operator. These sources are:

a. INTERNAL
b. DIODE
c. PWR MTR (Power Meter)

INTERNAL. RF power output from the signal generator is automatically leveled.

DIODE. RF output power is leveled externally using a diode detector connected to the instrument's EXT ALC IN connector.

PWR MTR (Power Meter). RF output power is leveled externally using a power meter connected to the instrument EXT ALC IN connector.

CAL Adjustment. Power level at the load is adjusted to agree with the OUTPUT LEVEL Meter when external leveling is used in DIODE or PWR MTR. External leveling techniques are discussed in Hewlett-Packard Application Note 281-5 Microwave Synthesizer Series, May 1981, HP Part Number 5952-8251. Application Note 218-5 specifically applies to the 8672A; however, the main principles of applications also apply to the 8673A. Additionally, the input voltage fed back to the 8673A EXT ALC IN connector should be within a −1V to +1V range. Polarity is of no consequence because an internal circuit in the 8673A performs an absolute value function on the input voltage.

3-13. PULSE Modulation

Guaranteed pulse modulation characteristics and power specifications are met only when Auto Peak is on. Load variations, such as an external attenuator setting change cause reflections that slightly change the RF power output. AUTO PEAK must then be recycled (Off-On) to ensure peaked power output. With a change in output power level of ≥0.4 dB the instrument microprocessor switches to CW for about 200 μsecs. During this time period the injected pulse amplitude is updated. Pulse mode is then re-enabled and the injected pulse amplitude is the correct value to produce fast risetime pulses. Switching speed is slowed to about 100 nsec by this process. The "scratch pad memory", described in paragraph 3-11, again may be used to record and store every 0.4 dB point crossing for the particular frequency in-use.

3-14. SWEEP Mode in MASTER/SLAVE Configuration

In a Master/Slave configuration, two signal generators are interconnected to obtain two swept microwave signals, at a fixed offset from each other. The two instruments are interconnected through the Hewlett-Packard Interface Bus (HP-IB). The MASTER is set to HP-IB address 50 and the SLAVE unit is set to HP-IB address 40. The desired sweep start and stop frequencies are set to identical frequencies on both the master and slave instruments. Desired offsets are then entered on the slave unit using the FREQ INCREMENT control. Swept signals from the instruments will be offset by the FREQ INCREMENT value.

In each sweep mode of operation, the designated Slave Unit will have the MAN and SINGLE pushbutton lamps lit. The designated Master Unit will have only the selectd mode pushbutton lamp lit. A step-by-step example follows:

a. Interconnect two instruments for HP-IB. Designate one instrument as the Master Unit and set its HP-IB Address to 50. Designate the other instrument as the Slave Unit and set its HP-IB Address to 40.

b. On both units, set SWEEP START to 2000 MHz and SWEEP STOP to 12000 MHz. On the Slave Unit set either the number of steps or step size. (As one example: set both master and slave units for 500 steps.)

c. On the Slave Unit select a 50 MHz offset using the FREQ INCR, STEP and the FREQ INCREMENT (⬆) or (⬇).

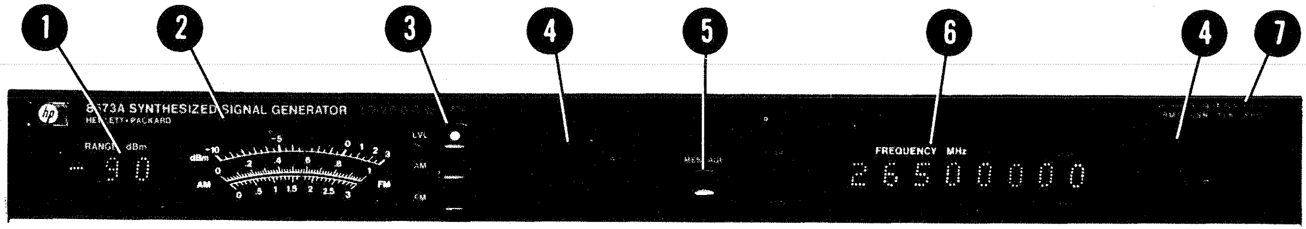
d. Press and hold SWEEP START on the Slave Unit and check for a 50 MHz offset (Display should read 12050 MHz).

e. For AUTO Mode: Press AUTO on Master Unit; Slave Unit will have MAN and SINGLE pushbutton lamps lit.

f. For MANUAL Mode: Press MAN on Master Unit; Slave Unit will have MAN and SINGLE pushbutton lamps lit. On Master Unit enable TUNE ON/OFF. Use the TUNE Knob to tune both Master and Slave Units according to STEP SIZE set on respective units.

g. For SINGLE Mode: On Master Unit, press SINGLE once to enable the sweep. Press it a second time to start one sweep. If SINGLE is pressed during a sweep, the in-progress sweep stops and re-enables.

Disabling Master/Slave Mode. Press SWEEP OFF on both Master and Slave Units. All sweep lamps will be off and only the Master Unit TUNE Knob will cause changes on the Master Unit Display.



1 RANGE dBm Display. Indicates the selected range of the RF output in 10 dB steps from −90 to +10 dBm. Range is set by the RANGE (⬇ and ⬆) keys.

2 Meter. Monitors power level, AM depth, or FM deviation. Meter function is selected by the MTR keys.

3 MTR Keys. Select the meter function.

LVL: selects OUTPUT LEVEL VERNIER for −10 to +3 dB scale indication. Read relative to the RANGE dBm display.

AM: selects 30% (read on the 0 to 3 scale) or 100% (read on the 0 to 1 scale) AM depth, full scale. A 1 volt peak signal applied to the AM IN connector develops full scale modulation.

FM: selects FM deviation. Full scale indication read on the 0 to 3 scale is 30 kHz, 300 kHz, or 3 MHz. Full scale indication read on the 0 to 1 scale is 100 kHz, 1 MHz, or 10 MHz. A 1 volt peak signal applied to the FM IN connector develops full scale modulation.

4 Status Annunciators. Display the internal conditions of the Signal Generator.

ALC UNLEVELED: lights when RF OUTPUT is turned off, more power is requested than is available, no signal is applied to EXT ALC IN when PWR MTR or DIODE is selected, no signal is applied to PULSE IN when NORM pulse mode is selected, overmodulation occurs in AM mode, or pulse width is less than 100 ns.

NOT ϕ LOCKED: lights when one or more of the phase lock loops is unlocked, the RF OUTPUT is OFF, or the INT-EXT switch is in the EXT position with no external reference connected.

FM OVERMOD: lights when the signal applied to the FM IN connector exceeds 1 volt peak or when the modulation index exceeds 5 (2.0 to 6.6 GHz), 10 (6.6 to 12.3 GHz), 15 (12.3 to 18.6 GHz), or 20 (18.6 to 26.0 GHz). The modulation index is equal to the maximum peak deviation divided by f_{mod}. Refer to Table 1-1, Specifications, for additional information.

STANDBY: lights when power is applied but the LINE switch is in the STBY position.

OVEN COLD: lights when the crystal oven is not up to nominal operating temperature.

OUT OF RANGE: lights only in sweep mode when a combination of ΔF and FREQUENCY would cause the sweep frequency to be out of range.

EXTERNAL REF: lights when the rear panel INT-EXT switch is in the EXT position.

5 MESSAGE Key. Lights to indicate entry errors and flashes to indicate hardware malfunctions. A two-digit code appears in the FREQUENCY MHz display when this key is pressed. Refer to the pull-out card or the Messages Detailed Operating Instruction for an explanation of the codes.

6 FREQUENCY MHz Display. Normally indicates output frequency. Message codes and previously set values for FREQ INCR, SWEEP FREQ, and SWEEP RATE functions are displayed for as long as their respective keys are pressed.

7 HP-IB STATUS Annunciators. Indicate the status of the Signal Generator when it is operating via the HP-IB.

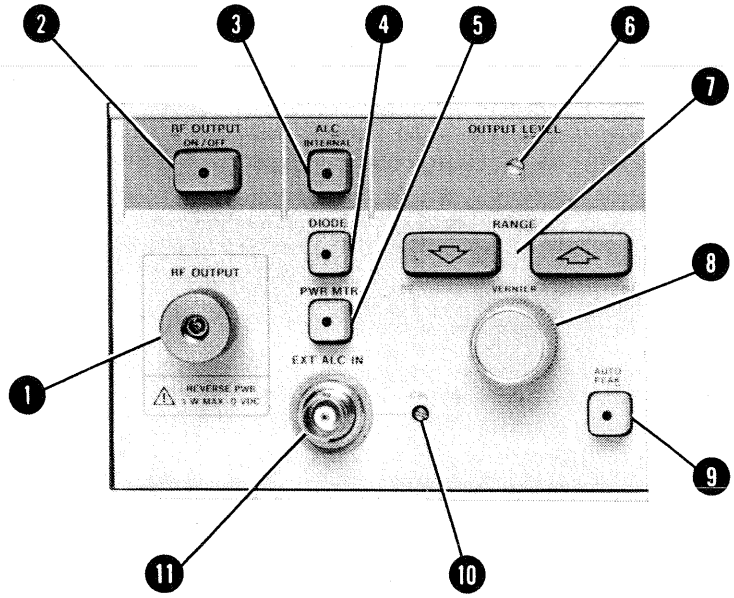
RMT: lights when the Signal Generator is in remote mode.

LSN: lights when the Signal Generator is addressed to listen.

TLK: lights when the Signal Generator is addressed to talk.

SRQ: lights when the Signal Generator is issuing the Require Service message.

Figure 3-2. Displays and Status Annunciators



❶ **RF OUTPUT Connector.** 50 ohm APC 3.5 male connector supplies RF output over the entire frequency range of 2 to 26 GHz.

❷ **RF OUTPUT ON/OFF Key.** Completely turns off the RF output when set to OFF. Setting the RF output to OFF causes the NOT ϕ LOCKED and ALC UNLEVELED status annunciators to light. When the RF OUTPUT is set to ON, the Signal Generator returns to normal operation.

❸ **INTERNAL Key.** Selects internal circuitry for leveling the output power at the front panel RF OUTPUT connector.

❹ **DIODE Key.** Selects external leveling mode for leveling power using an external diode detector. The output of the diode is connected to the EXT ALC IN connector.

❺ **PWR MTR Key.** Selects external leveling mode for leveling power using an external power meter. The output of the power meter is connected to the EXT ALC IN connector.

❻ **Mechanical Meter Zero.** Sets meter suspension so that the meter indicates zero when power is removed from the Signal Generator and the Signal Generator is in its normal operating position.

❼ **OUTPUT LEVEL RANGE Keys (⬇ and ⬆).** Select the RF output level range in 10 dB steps from −90 to +10 dBm. The selected range is displayed in the RANGE dBm display.

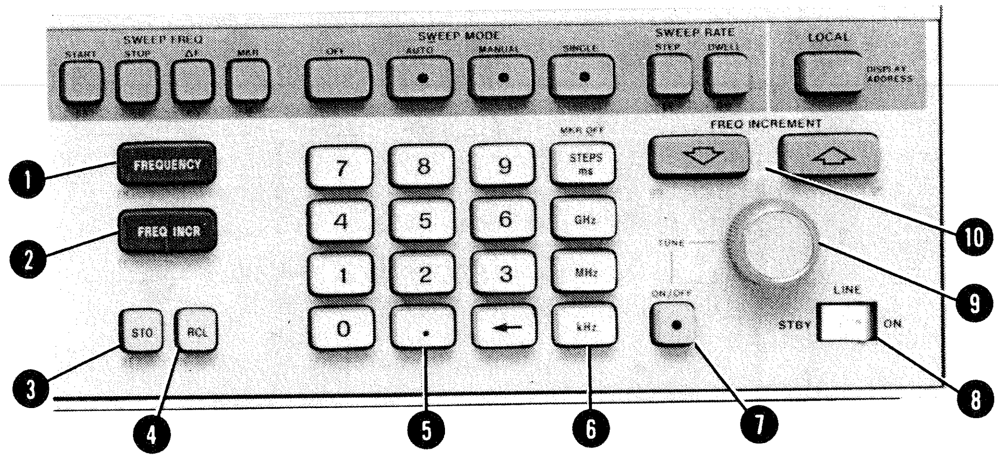
❽ **OUTPUT LEVEL VERNIER.** Adjusts the RF output level over the range of −10 to +3 dB, relative the LVL scale as read on the meter.

❾ **AUTO PEAK Key.** Maximizes power at the output frequency and optimizes pulse shape for pulse modulation.

❿ **CAL Control.** Adjusts the power level at the load when using a diode detector or power meter for external leveling.

⓫ **EXT ALC IN Connector.** BNC female connector with high input impedance (approximately 50 kΩ). Accepts positive or negative leveling signals from either a diode detector or power meter.

Figure 3-3. Output Level Features



1 **FREQUENCY Key.** Used as a prefix to the Data and Units keys to set a continuous wave (CW) frequency or center frequency for a ΔF sweep.

2 **FREQ INCR Key.** Used as a prefix to the Data and Units keys to set the step size for the FREQ INCREMENT ⇩ and ⇧ keys or the TUNE knob. Pressing the FREQ INCR key recalls the current increment value to the FREQUENCY MHz display (for as long as the key is depressed).

3 **STO Key.** Used as a prefix to a numeric key (a single digit 1—9 to identify the storage register) to save the current instrument settings in an internal storage register. All front panel functions can be stored, although OUTPUT LEVEL VERNIER can be stored only in remote mode.

4 **RCL Key.** Used as a prefix to a numeric key (a single digit 0—9 to identify the storage register) to recall the contents saved in that register. The instrument settings change to the recalled parameter values.

RCL 0 is used to preset the front panel. Refer to Simplified Operation in this section for a list of preset conditions.

5 **Data Keys (0-9, ., and ←).** Used with Function keys (that is, FREQUENCY, FREQ INCR, and sweep function keys) and Units keys to set value-selectable parameters. Data keys 1—9 are also used with STO and RCL to identify the storage register.

The backspace key (←) clears one digit at a time starting with the least significant digit. It is used only during data entry and before any Units key is pressed.

6 **Units Keys (MKR OFF/STEPS/ms, GHz, MHz, and kHz).** Used as a suffix to Function and Data keys to set value-selectable parameters. Frequency entries can terminate in GHz, MHz, or kHz but they are always displayed in MHz.

The MKR OFF/STEPS/ms key serves as a terminator for setting the number of steps in a sweep, the dwell time in ms, or as a means of turning off markers. The selected function automatically determines the applicable terminator.

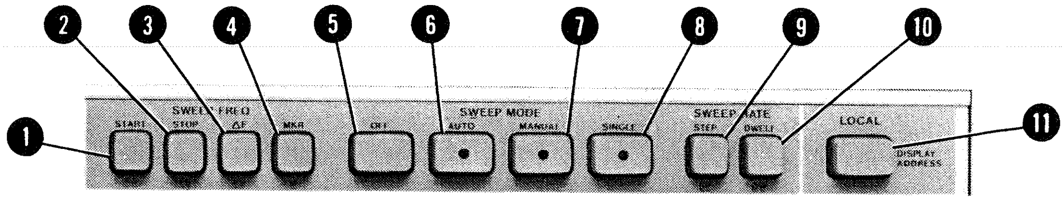
7 **TUNE ON/OFF key.** Enables the TUNE knob when ON; disables the TUNE knob when OFF. The key LED lights when it is ON.

8 **LINE Switch.** Applies power to the Signal Generator when set to the ON position. Power is supplied to the crystal oven and the battery charger circuit in the STBY and ON positions.

9 **TUNE Knob.** Changes the CW frequency by the value set with FREQ INCR. The knob is enabled by the ON/OFF key. The knob also serves as a manual sweep mode control.

10 **FREQ INCREMENT ⇩ and ⇧ Keys.** Decrease or increase the CW frequency in steps; the step size is set with the FREQ INCR key. Holding either key down causes the frequency to continuously change. These keys also serve as a manual sweep mode control.

Figure 3-4. Frequency Control Features and LINE Switch



SWEEP FREQ

❶ **START Key.** Used as a prefix to the Data and Units keys to set the beginning frequency of a sweep. Pressing this key displays the present START value in the FREQUENCY MHz display (for as long as the key is depressed).

❷ **STOP Key.** Used as a prefix to the Data and Units keys to set the ending frequency of a sweep. Pressing this key displays the present STOP value in the FREQUENCY MHz display (for as long as the key is depressed).

❸ **ΔF Key.** Used as a prefix to the Data and Units keys to set sweep span. Pressing this key displays the present span value in the FREQUENCY MHz display (for as long as the key is depressed). Center frequency of the span is set with the FREQUENCY key.

❹ **MKR Key.** Enables previously selected marker frequencies when used as a prefix to Data keys 1 through 5. For example, pressing MKR and 1 enables Marker 1. When used as prefix to the Data and Unit keys, it sets marker frequencies. For example, pressing MKR, 3, 15, and GHz sets the frequency of Marker 3 to 15 GHz. (The first digit pressed after the MKR key is always the marker number.) Pressing the MKR key displays all currently enabled marker numbers within the set sweep range in the FREQUENCY MHz display. Pressing the MKR key and a Data key displays the present frequency of the requested marker.

SWEEP MODE

❺ **OFF Key.** Disables the sweep.

❻ **AUTO Key.** Starts a repetitive sweep (restarting at the end of each sweep).

❼ **MANUAL Key.** Enables the sweep circuitry. It does not start a sweep. The TUNE knob (if enabled) or the FREQ INCREMENT (⬇ and ⬆) keys control the sweep.

❽ **SINGLE Key.** Arms the trigger for single sweep and tunes the Signal Generator to the start frequency. The sweep does not begin until the key is pressed again to trigger the sweep. When pressed during a sweep, the in-progress sweep aborts and rearms the trigger.

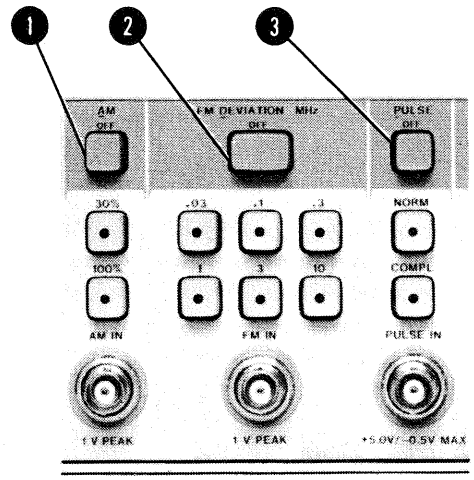
SWEEP RATE

❾ **STEP Key.** Used as a prefix to the Data and Units keys to set the number of steps or the size of each step of a sweep. When the entry is terminated by STEPS, the number of steps is set. When the entry is terminated by GHz, MHz, or kHz, the step size is set. When this key is pressed, the number of steps is displayed on the left side of the FREQUENCY MHz display and the step size is displayed on the right side. The maximum number of steps allowed is 9999.

❿ **DWELL Key.** Used as a prefix to the Data and ms keys to set the time interval between sweep steps. Pressing this key displays the present dwell time value in the FREQUENCY MHz display (for as long as the key is depressed). The allowable values for dwell time range from 1 to 255 ms.

⓫ **LOCAL/DISPLAY ADDRESS Key.** Returns the Signal Generator to local keyboard control from HP-IB (remote) control provided the instrument is not in local lockout. Also displays the current HP-IB address in the FREQUENCY MHz display for as long as the key is depressed.

Figure 3-5. Sweep Features and LOCAL Key



1 AM

AM OFF Key. Disables AM.

AM 30% Key. Enables AM and selects 30% full scale modulation for 1 volt peak applied to the AM IN connector.

AM 100% Key. Enables AM and selects 100% full scale modulation for 1 volt peak applied to the AM IN connector.

AM IN Connector. BNC female connector with an input impedance of 600 ohms. 1 volt peak sets full scale modulation as selected by the AM 30% or 100% key. AM depth varies linearly with the input signal level.

2 FM DEVIATION

FM DEVIATION MHz OFF Key. Disables FM.

FM DEVIATION Keys (.03, .1, .3, 1, 3, and 10). Enables FM and selects the peak deviation sensitivity in MHz obtained when a signal is applied to the FM IN connector. The peak deviation is read on the meter.

FM IN Connector. BNC female connector with an input impedance of 50 ohms. 1 volt peak gives full scale modulation. Deviation varies linearly with the input signal level. Deviation ranges are controlled by the FM DEVIATION keys.

3 PULSE

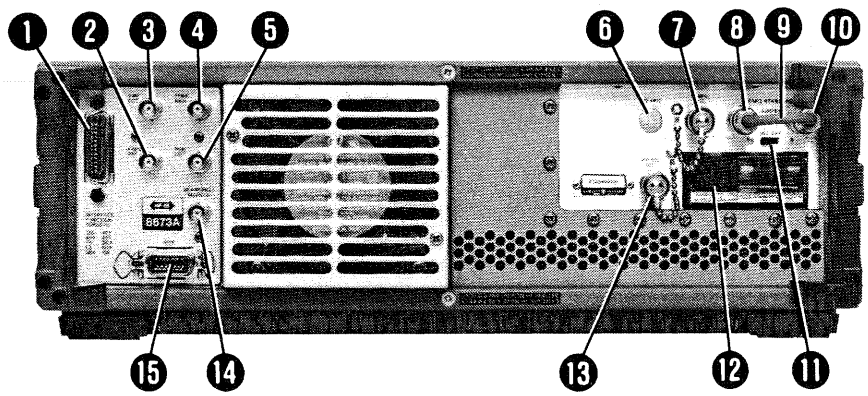
PULSE OFF Key. Disables pulse modulation.

NORM (Normal Mode) Key. Triggers RF output on when the signal to the PULSE IN connector is greater than 2.4 volts.

COMPL (Complement Mode) Key. Triggers RF output on when the signal to the PULSE IN connector is less than 0.4 volts.

PULSE IN Connector. BNC female connector with an input impedance of 50 ohms. Accepts TTL levels.

Figure 3-6. Modulation Features



1. **HP-IB Connector.** Connects the Signal Generator to the Hewlett-Packard Interface Bus for remote operation.

2. **FREQ REF.** BNC female connector. Output impedance is 100Ω nominal. Provides a 1V/GHz ramp (+18V maximum) that is always on, even when sweep is off.

3. **SWP OUT.** BNC female connector. Output impedance is 100Ω nominal. Provides a 0 to +10V ramp from start to stop. An internal adjustment can set the slope of the ramp from 0 to between +4 and +12V.

4. **TONE MKR.** BNC female connector. Output impedance is 600Ω nominal, 5 kHz sine wave. Can be connected to front panel AM IN to provide AM markers.

5. **PEN LIFT.** BNC female connector. TTL-high lifts pen; TTL-low lowers pen. 100 ms delay to lift or lower pen in single sweep mode.

6. **RF OUT (A3J6).** For Options 004 and 005 only. 50Ω APC 3.5 male output connector.

7. **10 MHz OUT (A3J8).** 0 dBm (nominal) into 50Ω, can be used as an external timebase and for troubleshooting.

8. **FREQ STANDARD Output (A3J9).** 10.000 MHz into 50Ω at +7 dBm (nominal) from the internal frequency standard except when INT/EXT switch is in the EXT position.

9. **Jumper (A3W3).** Normally connects the Internal Frequency Standard Output (A3J9) to the External Frequency Standard Input (A3J10).

10. **FREQ STANDARD Input (A3J10).** Normally connected by A3W3 to A3J9. Also used to connect an external frequency standard of 5 or 10 MHz at 0 dBm to the Signal Generator.

11. **FREQ STANDARD INT/EXT Switch.** Normally left in the INT position. Removes power from internal frequency standard when in the EXT position.

12. **Line Power Module.** Permits operation from 100, 120, 220, or 240 Vac. The number visible in the window displays the nominal line (mains) voltage for which the Signal Generator is set (see Figure 2-1). The protective grounding conductor connects to the Signal Generator through this module. The line power fuse is part of this module and is the only part to be changed by the operator.

13. **100 MHz OUT (A3J7).** 0 dBm (nominal) into 50Ω; can be used as an external timebase and for troubleshooting.

14. **BLANKING/MARKER.** BNC female connector. Output impedance is 100Ω nominal. Provides +5V at the beginning of each frequency change for blanking a swept display (to eliminate display of switching transients). Goes to −5V during remainder of frequency step for Z-Axis intensity marker or to 0V for non-marker frequencies.

15. **AUX Connector.** Allows remote control of frequency increment, display blanking, register recall, and start and stop sweep. Refer to Table 3-3, AUX Connector Functions, for additional information.

Figure 3-7. Rear Panel Features

OPERATOR'S CHECKS

3-15. OPERATOR'S CHECKS

3-16. Basic Functional Checks

DESCRIPTION: The purpose of these checks is to give reasonable assurance that the instrument is operating properly.

Each check has been designed to be performed with a minimum of test equipment, and in as short a time as possible. Therefore, although these checks are extremely valuable in locating malfunctions, they are not a substitute for the Performance Tests in Section IV, which verify that the instrument is performing within its published specifications.

Each check is independent from the others and can be performed separately. Simply press RCL 0 to preset the Signal Generator to a known state before beginning an individual check.

If a malfunction is suspected and the Signal Generator is being returned to Hewlett-Packard for service, perform the entire procedure. Document the checks that failed on a blue repair tag located at the rear of this manual and attach the tag to the instrument. This will help ensure that the malfunction has been accurately described to service technicians for the best possible service.

EQUIPMENT:

Test Oscillator .... HP 651B
Pulse Generator .... HP 8013B
Oscilloscope .... HP 1740A or HP 1715A
Termination, 50-ohm .... HP 8493B, Option 010

PROCEDURE:

Turn-On Check

1. Set the LINE switch to STBY. Remove all external cables from the front and rear panels of the Signal Generator, including the power cable connecting the instrument to mains power.

2. Set the rear panel FREQ STANDARD INT/EXT switch to INT and the JUMPER (A3W3) to connect A3J9 and A3J10.

3. After the power cable has been disconnected from the Signal Generator for at least 1 minute, reconnect it to the Signal Generator. Check the front panel of the instrument to verify that the STANDBY and OVEN COLD status annunciators are on.

4. Leave the instrument's LINE switch set to STBY until the OVEN COLD status annunciator turns off. This should occur in 15 minutes or less, depending upon how long the Signal Generator was disconnected from mains power. (The OVEN COLD annunciator may flicker off and on temporarily just as the oven stabilization temperature is reached. This is normal operation.) Once the OVEN COLD status annunciator is off set the LINE switch to ON.

NOTES

If the MESSAGE key light is on or flashing, the instrument self-diagnostics detected a malfunction during turn-on. Press and hold the MESSAGE key to display the message code in the FREQUENCY MHz display. Any code other than 00 represents an error. Refer to the operating information pull-out card for a complete listing of message codes and the malfunctions they represent.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

NOTES (cont'd)

Occasionally, due to line transients or other external conditions, the instrument self-diagnostics may indicate a false error. Pressing the MESSAGE key and repeating the turn-on procedure will usually differentiate between real and false errors. Errors that repeat are usually real.

5. Set the FREQ STANDARD INT/EXT switch to EXT. Verify that the EXT REFERENCE and NOT ϕ LOCKED status annunciators turn on. Set the switch back to INT. The status annunciators should then turn off.

6. Press RCL 0. Verify that the instrument is now preset to the following conditions:
   RF OUTPUT to ON
   ALC INTERNAL to ON
   OUTPUT LEVEL RANGE to −70 dBm
   AUTO PEAK to ON
   Meter scale to LVL
   AM, FM, and Pulse Modulation to OFF
   FREQUENCY to 3000.000 MHz
   FREQ INCR to 1.000 MHz
   START to 2000.000 MHz
   STOP to 4000.000 MHz
   ΔF to 2000.000 MHz
   SWEEP to OFF
   STEP to 100 Steps (20.000 MHz)
   DWELL to 20 ms
   TUNE Knob to ON
   All Status Annunciators off
   MESSAGE key light off

Frequency Check:

The FREQUENCY MHz display and NOT ϕ LOCKED status annunciator are used to check that the internal phase-lock loops remain phase locked across their tuning range. The actual frequency at the RF OUTPUT connector is not checked. However, this connector can be monitored with a microwave frequency counter or spectrum analyzer for greater assurance that the Signal Generator is operating properly.

7. Press RCL 0. Then, set the Signal Generator's frequency to 2 GHz and frequency increment to 1 kHz. Slowly tune from 2000.000 MHz to 2000.010 MHz. Verify that the NOT ϕ LOCKED annunciator remains off at each step.

8. Set FREQ INCR to the values shown in the following table. For each FREQ INCR value, slowly tune from the corresponding start frequency to the stop frequency. Each time, verify that the NOT ϕ LOCKED status annunciator remains off. (Each phase-lock loop is tuned over its entire range.)

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

FREQ INCR	Start Frequency	Stop Frequency
10 kHz	2000.010 MHz	2000.100 MHz
100 kHz	2000.100 MHz	2001.000 MHz
1 MHz	2001.000 MHz	2010.000 MHz
10 MHz	2010.000 MHz	2100.000 MHz
100 MHz	2100.000 MHz	3000.000 MHz
1 GHz	3000.000 MHz	26000.000 MHz

9. Set FREQUENCY to 1.95 GHz and then to 26.5 GHz. (This is the overrange region of operation.) Verify that the NOT ϕ LOCKED annunciator remains off at both frequencies.

Output Level Check:

The Signal Generator's output leveling loop is checked to ensure that it remains locked at all specified power levels. The internal output leveling loop monitors most of the RF output circuitry.

10. Press RCL 0 to set the Signal Generator to a known state.

11. Connect a 50-ohm load or 10 dB attenuator to the Signal Generator's RF OUTPUT connector. (This reduces unwanted power reflections back into the RF OUTPUT connector, thereby preventing a false ALC UNLEVELED annunciator indication.)

12. Set FREQUENCY to 6.6 GHz and Output Level VERNIER to −2 dB. Press the RF OUTPUT key to OFF. Verify that the ALC UNLEVELED and NOT ϕ LOCKED status annunciators turn on and that the meter indicates <−10dB.

13. Press the RF OUTPUT ON/OFF key to ON. Verify that the status annunciators turn off and that the meter indicates −2 dB.

14. Step the output level down in 10 dB steps from −70 to −90 dBm using the RANGE ◀ key. Then, step the output level up in 10 dB steps from −90 to +10 dBm. Verify that the ALC UNLEVELED annunciator remains off.

15. Set Output Level RANGE to 0 dBm and sweep the Output Level VERNIER from −10 dB to +3 dB. Verify that the ALC UNLEVELED annunciator remains off at all VERNIER settings.

16. Set FREQ INCR to 10 MHz. Then, set the output level to the values shown in the following table. Tune from the corresponding start frequency to the stop frequency for each output level. Verify that the indicated power level on the meter remains constant and stable and that the ALC UNLEVELED annunciator remains off. (This ensures that the instrument can generate specified output power and remain leveled.)

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

Output Level		Start Frequency	Stop Frequency
Range	VERNIER		
+10 dBm	−2 dB	2000.000 MHz	18000.000 MHz
+10 dBm	−6 dB	18010.002 MHz	22000.000 MHz
0 dBm	0 dB	22010.000 MHz	26000.000 MHz

Sweep Check:

The FREQUENCY MHz display is used to check the ability of the internal phase-lock loops to remain phase locked while sweeping. A spectrum analyzer can be used to monitor the signal at the RF OUTPUT connector for greater assurance that the Signal Generator is operating properly.

17. Press RCL 0 to set the instrument to a known state. Then, press the AUTO sweep key. Verify that the FREQUENCY MHz display now shows a start frequency of 2000.000 MHz and a stop frequency of 4000.000 MHz. The AUTO key light should flash once each time a new sweep begins.

18. Press SWEEP OFF. Verify that the FREQUENCY MHz display returns to 3000.000 MHz.

19. Press the MANUAL sweep key. The FREQUENCY MHz display should show 2000.000 MHz. Tune the frequency up by turning the TUNE knob clockwise. Verify that the FREQUENCY MHz display changes in 20 MHz increments and stops at 4000.000 MHz.

20. Tune the frequency down to 2000.000 MHz by turning the TUNE knob counter-clockwise. Verify that the FREQUENCY MHz display changes in 20 MHz steps and stops at 2000.000 MHz.

21. Press the SWEEP OFF key and verify that the FREQUENCY MHz returns to 3000.000 MHz.

22. Press the SINGLE sweep key. Verify that the key light turns on and the FREQUENCY display shows 2000.000 MHz.

23. Press the SINGLE sweep key again. A single sweep should now be executed. Verify that the FREQUENCY MHz display changes in 20 MHz steps very rapidly until 4000.000 MHz is reached. The display then returns to the START frequency of 2000.000 MHz.

24. Press the SWEEP OFF key. Verify that the FREQUENCY MHz display returns to 3000.000 MHz.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

AM Check

The front panel meter is used as an indication of AM. The meter monitors input signal level only, rather than actual AM. The ALC UNLEVELED status annunciator is used to verify that overmodulation does not occur.

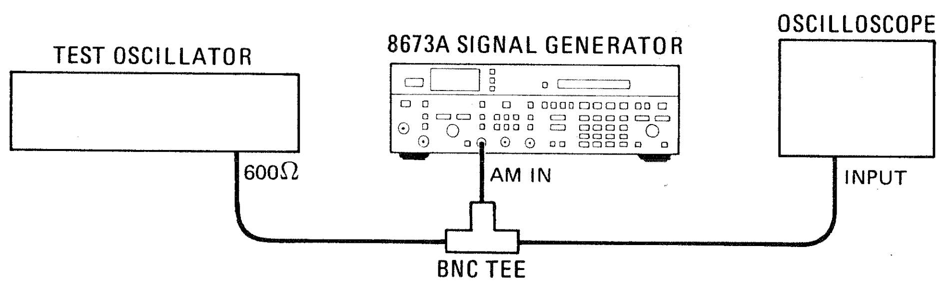


Figure 3-8. AM Functional Check Setup

25. Press RCL 0 to preset the Signal Generator to a known state.

26. Set the test oscillator to 10 kHz at an output level of 0V. Then, connect the test oscillator and oscilloscope to the Signal Generator as shown in Figure 3-8.

27. Set the Signal Generator to each setting shown in the table below. For each setting, slowly increase the test oscillator's output level (starting from 0V) while observing the Signal Generator's meter in AM mode. The meter should indicate a smooth and continuous increase in AM depth. When the meter displays the %AM indicated in the table, verify that the oscilloscope shows the corresponding voltage. The ALC UNLEVELED status annunciator should remain off at all times.

Signal Generator					Oscilloscope
FREQUENCY	RANGE	VERNIER	AM Key	% AM	Display
18 GHz	0 dBm	0 dB	100%	75	0.75V peak
24 GHz	0 dBm	–3 dB	100%	75	0.75V peak
26 GHz	0 dBm	–5 dB	100%	50	0.5V peak
26 GHz	0 dBm	–5 dB	30%	30	1.0V peak

28. Press AM OFF and disconnect the test oscillator and oscilloscope from the Signal Generator.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

FM Check

The front panel meter is used to monitor input signal level, which is proportional to FM deviation. A spectrum analyzer can be used to monitor the signal at the RF OUTPUT connector for greater assurance of FM performance. The FM OVERMOD status annunciator detects a deliberate FM overmodulation condition.

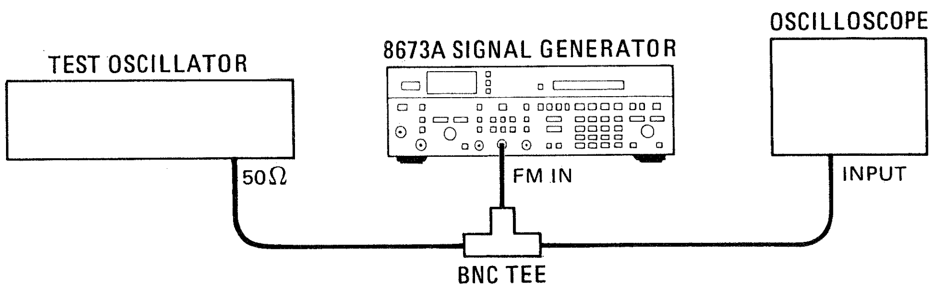


Figure 3-9. FM Functional Check Setup

29. Press RCL 0 to preset the Signal Generator to a known state. Set Output Level RANGE to 0 dBm, Output Level VERNIER to 0 dB, and FM DEVIATION range to .03 MHz. Then, set the meter scale to FM.

30. Set the test oscillator to 10 MHz at an output level of 0V. Then, connect test oscillator and oscilloscope to the Signal Generator as shown in Figure 3-9.

31. Slowly increase the output level of the test oscillator (starting from 0V) until the Signal Generator's meter reads full scale. Verify that the meter increases slowly and continuously and that the FM OVERMOD status annunciator remains off. The oscilloscope display should be approximately 1V peak.

32. Repeat step 31 for each of the following FM deviation ranges: .1, .3, 1, 3, and 10 MHz.

33. Set the Signal Generator's FM DEVIATION range to 10 MHz. Increase the test oscillator output level until a full scale reading is obtained. Decrease the test oscillator frequency slowly until the Signal Generator's FM OVERMOD status annunciator turns on. This should occur at a modulation frequency of 1 to 2 MHz.

34. Press FM DEVIATION MHz OFF and disconnect the test oscillator and oscilloscope from the Signal Generator.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

Pulse Modulation Check:

Pulse modulation is checked using various front panel status annunciators. Although pulse modulation is not monitored at the RF OUTPUT connector, the status annunciators give a high degree of confidence that pulse modulation is functionally working.

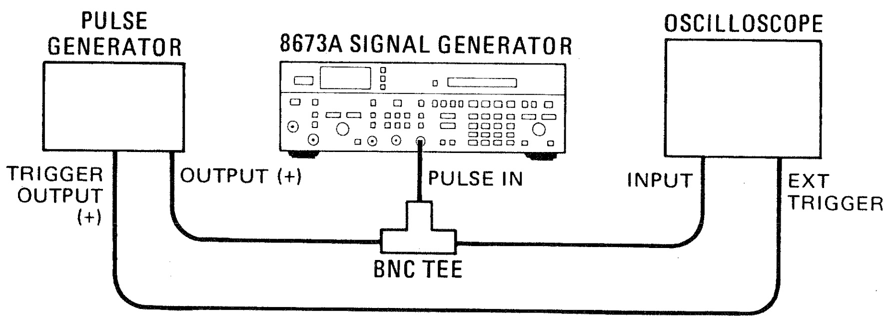


Figure 3-10. Pulse Modulation Functional Check Setup

35. Press the RCL 0. Set Output Level RANGE to 0 dBm and Output Level VERNIER to 0 dB.

36. Press the PULSE COMPL key. The ALC UNLEVELED status annunciator should remain off.

37. Press the PULSE NORM key. Verify that the ALC UNLEVELED status annunciator turns on. Press PULSE OFF and verify that ALC UNLEVELED status annunciator now turns off.

38. Connect the pulse generator and oscilloscope to the Signal Generator as shown in Figure 3-10.

39. Set the oscilloscope to 50 ohm input and external horizontal trigger.

40. Set the pulse generator to the following:

    pulse period range .... 20 ns - 1 μs
    pulse delay range .... 35 ns - 1 μs
    pulse width range .... 10 ns - 1 μs
    amplitude range .... 2 - 5V

    In addition, internal load and normal pulse should be selected.

OPERATOR'S CHECKS

Basic Functional Checks (cont'd)

41. On the pulse generator, adjust the pulse period vernier for an oscilloscope display of 1 pulse per microsecond. Then, adjust the pulse width vernier (and oscilloscope) for an individual pulse width of approximately 150 ns. Adjust the amplitude vernier for a pulse height of approximately 3V peak.

42. Note the indicated power level on the Signal Generator's meter (should be 0 dBm). Press PULSE NORM and PULSE COMPL keys while observing any change in indicated output power level. Indicated level should not vary more than ± 1 dB from the level referenced with pulse off.

43. While in PULSE NORM mode, slowly reduce the pulse width from 150 ns to 50 ns. The ALC UNLEVELED annunciator should come on as 100 ns pulse width is approached. It should remain on down to at least 50 ns. The output level indicated on Signal Generator meter may also vary >1dB as the ALC UNLEVELED annunciator comes on. This is normal instrument operation.

44. Press PULSE OFF and disconnect the oscilloscope and test oscillator from the Signal Generator.

Memory Check

45. Set FREQUENCY to 15 GHz and Output Level RANGE to –20 dBm.

46. Turn the Signal Generator's LINE switch to STBY, wait 30 seconds, then turn the LINE switch to ON. Verify that the FREQUENCY MHz display shows 15000.000 MHz and the RANGE dBm display shows –20 dBm.

Message Check

47. Press RCL 0 to preset the Signal Generator to a known state. Set FREQUENCY to 30 GHz and verify that the MESSAGE key light turns on.

48. Press and hold the MESSAGE key. The FREQUENCY MHz display should show message code 01 (frequency out of range).

49. Release the MESSAGE key. Verify that the key light turns off.

OPERATOR'S CHECKS

3-17. HP-IB Functional Checks

DESCRIPTION: These procedures check the Signal Generator's ability to process or send the HP-IB messages described in Table 3-4. Only the Signal Generator, a controller, and an HP-IB interface are needed to perform these checks.

These procedures do not check if all Signal Generator program codes are being properly interpreted and executed by the instrument. However, if the power-up sequence (including the memory checks) and the front panel operation is good, the program codes, in all likelihood, will be correctly implemented.

The validity of these checks is based on the following assumptions:

a. The Signal Generator performs properly when operated via the front panel keys (that is, in local mode). This can be verified by the Basic Functional Checks.

b. The bus controller properly executes HP-IB operations.

c. The bus controller's HP-IB interface properly executes the HP-IB operations.

If the Signal Generator appears to fail any of these HP-IB checks, the validity of the above assumptions should be confirmed before attempting to service the instrument.

The select code of the controller's HP-IB interface is assumed to be "7". The address of the Signal Generator is assumed to be "19" (its address as set at the factory). This particular select code address combination (that is, 719) is not necessary for these checks to be valid. However, the program lines presented here have to be modified for any other combination.

These checks can be performed together or separately. Any special requirements for a check are described at the beginning of the check.

INITIAL SETUP: The test setup is the same for all of the checks. Connect the Signal Generator to the bus controller via the HP-IB interface.

EQUIPMENT:

HP IB Controller .... HP 9825A/98213A (General and Extended I/O ROM)
—or—
HP 85F/82903A (16K Memory Module)/00085-15005 (Advanced Programming ROM)

HP-IB Interface .... HP 98034A (for HP 9825A)
HP 82937A (for HP 85F)

Remote and Local Messages and the LOCAL Key

NOTE: This check determines if the Signal Generator properly switches from local to remote control, from remote to local control, and if the LOCAL key returns the instrument to local control. If the Signal Generator is in remote mode (that is, the front panel RMT annunciator is on), switch the instrument to STBY, then to ON.

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Description	HP 9825A (HPL)	HP 85F (BASIC)
Send the Remote message (by setting Remote Enable, REN, true and addressing the Signal Generator to listen).	rem 719	REMOTE 719

OPERATOR'S RESPONSE: Check that the Signal Generator's RMT and LSN annunciators are on.

Send the Local message to the Signal Generator.	lcl 719	LOCAL 719

OPERATOR'S RESPONSE: Check that the Signal Generator's RMT annunciator is off but its LSN annunciator is on.

Send the Remote message to the Signal Generator.	rem 719	REMOTE 719

OPERATOR'S RESPONSE: Check that both the Signal Generator's RMT and LSN annunciators are on. Press the LOCAL key on the Signal Generator. Check that the Signal Generator's RMT annunciator is now off, but that its LSN annunciator remains on.

Sending the Data Message

NOTE: This check determines if the Signal Generator properly issues Data messages when addressed to talk. Before beginning this check, turn the Signal Generator's LINE switch to STBY, then to ON. Then key in RCL 0 to preset the front panel.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Address the Signal Generator to talk and store its output in variable V.	red 719, V	ENTER 719; V
Display the value of V.	dsp V	PRINT V

OPERATOR'S RESPONSE: Check that the Signal Generator's TLK annunciator is on. The controller's display should read 3000000000.00 (HP 9825A) or 3000000000 (HP 85F). This corresponds to the data output shown in the FREQUENCY MHz display.

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Receiving the Data Message

NOTE: This check determines if the Signal Generator properly receives Data messages.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Send the first part of the Remote message (enabling the Signal Generator to remote).	rem 7	REMOTE 7
Address the Signal Generator to listen (completing the Remote message), then send a Data message.	wrt 719, "fr15gz"	OUTPUT 719; "FR15GZ"

OPERATOR'S RESPONSE: Check that both the Signal Generator's RMT and LSN annunciators are on and that the FREQUENCY MHz display shows 15000.000 MHz.

Local Lockout and Clear Lockout/Set Local Messages

NOTE: This check determines if the Signal Generator properly receives the Local Lockout message, disabling the LOCAL key. The check also determines if the Clear Lockout/Set Local message is properly received and executed by the Signal Generator. This check assumes that the Signal Generator is in the remote mode.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Send the Local Lockout message.	llo 7	LOCAL LOCKOUT 7

OPERATOR'S RESPONSE: Check that the Signal Generator's RMT annunciator is on. Press the Signal Generator's LOCAL key. The RMT annunciator should remain on.

Send the Clear Lockout/Set Local	lcl 7	LOCAL 7

OPERATOR'S RESPONSE: Check that the Signal Generator's RMT annunciator is off.

Return the Signal Generator to remote mode if the remaining checks in this section are to be performed.	rem 719	REMOTE 719

OPERATOR'S RESPONSE: Check that the Signal Generator's RMT annunciator is on.

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Clear Message

NOTE: This check determines if the Signal Generator properly responds to the Clear message. This check assumes that the Signal Generator is in the remote mode.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Send a Data message that turns AUTO PEAK off.	wrt 719, "k0"	OUTPUT 719; "K0"

OPERATOR'S RESPONSE: Check that the Signal Generator's AUTO PEAK key light is off.

Send the Clear message (turning the Signal Generator's AUTO PEAK function on).	clr 719	CLEAR 719

OPERATOR'S RESPONSE: Check that the Signal Generator's AUTO PEAK key light is on.

Abort Message

NOTE: This check determines if the Signal Generator becomes unaddressed when it receives the Abort message. This check assumes that the Signal Generator is in the remote mode.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Address the Signal Generator to listen.	wrt 719	OUTPUT 719

OPERATOR'S RESPONSE: Check that the Signal Generator's LSN annunciator is on.

Send the Abort message, unaddressing the Signal Generator from listening.	cli 7	ABORTIO 7

OPERATOR'S RESPONSE: Check that the Signal Generator's LSN annunciator is off.

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Status Byte Message

NOTE: This check determines if the Signal Generator sends the Status Byte message. Before beginning this check, turn the Signal Generator's LINE switch to STBY, then to ON.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Place the Signal Generator in serial-poll mode (causing it to send the Status Byte message).	rds (719) →V	V=SPOLL (719)
Display the value of V.	dsp V	PRINT V

OPERATOR'S RESPONSE: The controller's display should read 12.00 (HP 9825A) or 12 (HP 85F).

Require Service Message

NOTE: This check determines if the Signal Generator can issue the Require Service message (set the SRQ bus control line true). This check can be performed in either local or remote mode.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Send a Data message to set the Request Mask to 32.	wtb 719, "@1", 32	OUTPUT 719 USING "2A, B"; "@1", 32
Send a Data message containing an invalid HP-IB code. This causes a Require Service message to be sent.	wrt 719, "fr 35 gz"	OUTPUT 719; "FR 35 GZ"

OPERATOR'S RESPONSE: Check that the SRQ annunciator is on.

Read the binary status of the controller's HP-IB interface and store the data in variable V (in this step, 7 is the interface's select code).	rds (7) →V	STATUS 7, 2;V
Display the value of the SRQ bit (in this step 7 is the SRQ bit for the HP 9825A and 6 is the SRQ bit for the HP 85F, numbered from 0).	dsp"SRQ=", bit(7,V)	PRINT"SRQ="; BIT(V,6)

OPERATOR'S RESPONSE: Check that the SRQ value is 1, indicating the Signal Generator issued the Require Service message.

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Status Bit Message

NOTE: This check determines whether or not the Signal Generator sends the Status Bit message. This check can be performed in either local or remote mode. If the Signal Generator's SRQ annunciator is off, perform the first part of the Require Service Message check before beginning this check.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Configure the Signal Generator to respond to a parallel poll on HP-IB data line DI03.	polc 719, 10	SEND 7; LISTEN 19 CMD 5 SCG 10
Place the Signal Generator in parallel poll mode (causing it to send the Status Bit message) and store the result in variable V.	pol(7) →V	V = PPOLL (7)
Display the value of V.	dsp V	PRINT V

OPERATOR'S RESPONSE: Check that the SRQ annunciator is on and that the response to the parallel poll is 4, indicating that the Signal Generator issued the Status Bit message.

Unconfigure the Signal Generator from responding to a parallel poll.	polu 719	SEND 7; LISTEN 19 CMD 5 SCG 18
Place the Signal Generator in parallel poll mode.	pol(7) →V	V = PPOLL (7)
Display the value of V.	dsp V	PRINT V

OPERATOR'S RESPONSE: Check that the SRQ annunciator is on and that the response to the parallel poll is 0, indicating that the Signal Generator is no longer configured to respond to a parallel poll. Then, turn the LINE switch to STBY, then to ON, to turn the SRQ annunciator off.

OPERATOR'S CHECKS

HP-IB Functional Checks (cont'd)

Trigger Message

NOTE: This check determines if the Signal Generator responds to the Trigger message. This check assumes that the Signal Generator is in remote mode.

Description	HP 9825A (HPL)	HP 85F (BASIC)
Send a Data message to set the Signal Generator's frequency to 9999 MHz.	wrt 719, "fr 9999 mz"	OUTPUT 719; "FR 9999 MZ"
Set the Signal Generator's frequency increment to 1111 MHz.	wrt 719, "fi 1111 mz"	OUTPUT 719; "FI 1111 MZ"

OPERATOR'S RESPONSE: Check that the Signal Generator's frequency is set to 9999 MHz. Then press the Signal Generator's FREQ INCR key to check for an increment of 1111 MHz. This keyboard function is possible in the remote state (even if local lockout is enabled).

Configure the Signal Generator's trigger response to be an INCREMENT (down) function (that is, dn).	wrt 719, "ct dn"	OUTPUT 719; "CT DN"
Send a Trigger message.	trg 719	TRIGGER 719

OPERATOR'S RESPONSE: Check that the Signal Generator's frequency changes to 8888 MHz.

3-18. REMOTE OPERATION, AUXILIARY CONTROL

3-19. AUX Input Lines

A limited number of instrument functions can be controlled through the rear panel AUX connector. These functions are listed in the table below.

The input lines are TTL compatible and negative-edge sensitive. They require a minimum of 5 μs between negative edges. Input signals can be generated by clean TTL drivers or by mechanical switches that require debouncing. The Signal Generator has a built-in debouncing circuit that should be enabled or bypassed depending upon which type of driver is used.

The Signal Generator is shipped from the factory configured for electrically-clean control signals (that is, the internal debouncing circuit is bypassed). One way to determine if the debouncing circuit is bypassed is described below.

- Set FREQ INCR to 1 GHz.

- Ground pin 3 (FREQ INCREMENT Up) several times and observe the change in frequency.

- If the FREQ INCREMENT steps are erratic, the debouncing circuit is still bypassed.

- If the frequency consistently changes in steps of 1 GHz, the debouncing circuit is enabled.

Refer to Section II, Installation, for the procedure for enabling or bypassing the debouncing circuit.

NOTE

Section II, Installation, also shows the pinout configuration of the AUX connector as well as information for a recommended mating connector.

3-20. AUX Output Lines

The AUX connector also has a ground line and three TTL-compatible output lines. The output lines are normally held at the high TTL level. The End of Sweep line produces one 5 μs low-going pulse at the end of each sweep. The Trigger line produces one 5 μs low-going pulse when the Signal Generator has made a large frequency change that may cause loss of phase lock in an instrument tracking the Signal Generator. The Negative Blanking line produces −5V for Z-axis blanking of CRT displays that require a negative blanking voltage.

Table 3-3 AUX Connector Functions

	Pin	Function	Description
INPUTS	1	Recall 1	Recalls the contents of internal storage register 1.
	2	Recall Next	Sequential recall of internal storage registers 2 through 9
	3	FREQ INCREMENT Up	Same as FREQ INCREMENT Up key
	4	FREQ INCREMENT Down	Same as FREQ INCREMENT Down key
	5	Trigger Single Sweep	Same as SINGLE key
	6	Service	Same as internal service switch (on A2A2 Key Code Assembly). Refer to Section VIII, Service
	7	Stop Sweep	Stops sweep. Sweep resumes when this line goes high
	12	No Display	Blanks FREQUENCY MHz display when this pin is grounded and the existing display changes
OUTPUTS	8	Negative Blanking	−5V for blanking
	9	Trigger	One pulse when the Signal Generator has made a frequency change that may cause loss of phase lock to an instrument tracking the Signal Generator
	10	End of Sweep	One pulse at end of each sweep
	11	Ground	

3-21. REMOTE OPERATION, HEWLETT-PACKARD INTERFACE BUS

The Signal Generator can be operated through the Hewlett-Packard Interface Bus (HP-IB). Bus compatibility, programming, and data formats are described in the following paragraphs.

All front panel functions (except that of the LINE switch and the backspace key) and remote-only functions are programmable via HP-IB.

A quick test of the Signal Generator's HP-IB interface is described earlier in this section under Remote Operator's Checks. These checks verify that the Signal Generator can respond to or send each of the applicable bus messages described in Table 3-4.

3-22. HP-IB Compatibility

The Signal Generator has a three-state, TTL, HP-IB interface which can be used with any HP-IB computing controller or computer for automatic system applications. The Signal Generator is programmable via the HP Interface Bus. Its programming capability is described by the twelve HP-IB messages listed in Table 3-4. The Signal Generator's compatibility with HP-IB is further defined by the following list of interface functions: SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP1, DC1, DT1, and C0. A more detailed explanation of these compatibility codes can be found in IEEE Standard 488-1978 (and the identical ANSI Standard MC1.1). For more information about HP-IB, refer to the Hewlett-Packard Electronic Instruments and Systems catalog and the booklet titled "Improving Measurements in Engineering and Manufacturing" (HP part number 5952-0058).

3-23. Remote Mode

Remote Capability. The Signal Generator communicates on the bus in both remote and local modes. In remote, most of the Signal Generator's front panel controls are disabled. Exceptions are the LINE switch, the LOCAL key, the MTR keys, the MESSAGE key, and the FREQUENCY, FREQ INCR, SWEEP FREQ and SWEEP RATE keys for displaying "hidden" parameters. However, front panel displays remain active and valid. In remote, the Signal Generator can be addressed to talk or listen. When addressed to listen, the Signal Generator automatically stops talking and responds to the following messages: Data, Trigger (if configured), Clear (SDC), Remote, Local, Local Lockout, and Abort. When addressed to talk, the Signal Generator automatically stops listening and sends one of the following messages: Data, Require Service, or Status Byte. Whether addressed or not, the Signal Generator responds to the Clear (DCL), Local Lockout, Clear Lockout/Set Local, and Abort messages. In addition, the Signal Generator can issue the Require Service message and the Status Bit message.

Local-to-Remote Mode Changes. The Signal Generator switches to remote operation upon receipt of the Remote message. The Remote message has two parts. They are:

a. Remote enable bus control line (REN) set true.

b. Device listen address received once (while REN is true).

When the Signal Generator switches to remote, the RMT annunciator on the front panel turns on. With the exception of VERNIER, which may change by less than 0.1 dB, the Signal Generator's control settings remain unchanged with the Local-to-Remote transition.

3-24. Local Mode

Local Capability. In local, the Signal Generator's front panel controls are fully operational and the instrument responds to the Remote message. The Signal Generator can send a Require Service message, a Status Byte messsage, and a Status Bit message.

Remote-to-Local Mode Changes. The Signal Generator always switches to local from remote whenever it receives the Local message (GTL) when addressed to listen or the Clear Lockout/Set Local message. (The Clear Lockout/Set Local message sets the Remote Enable control line [REN] false.) The Signal Generator can also be switched to local by pressing the front panel LOCAL key (assuming Local Lockout is not in effect). With the exception of VERNIER, which may change by less than 0.1 dB, the Signal Generator's control settings remain unchanged with the Remote-to-Local transition.

Local Lockout. When a data transmission is interrupted, which can happen by pressing the LOCAL key to return the Signal Generator to local mode, the data could be lost. This would leave the Signal Generator in an unknown state. To prevent this, a local lockout is recommended for purely automatic

Table 3-4. Message Reference Table (1 of 2)

HP-IB Message	Applicable	Response	Related Commands and Controls	Interface Functions*
Data	Yes	All front panel functions (except the LINE switch and the Backspace key) and remote-only functions are bus programmable		AH1 SH1 T5 TE0 L3 LE0
Trigger	Yes	If in remote and addressed to listen, the Signal Generator executes a previously selected program code. It responds equally to the Group Execute Trigger (GET) bus command and program code TR (a Data message).	GET	DT1
Clear	Yes	Sets output to 3000.000 MHz at −70 dBm with sweep and modulation off. Resets many additional parameters as shown in Table 3-6. Responds equally to Device Clear (DCL) and Selected Device Clear (SDC) bus commands.	DCL SDC	DC1
Remote	Yes	Remote mode is enabled when the REN bus control line is true. However, remote mode is not entered until the first time the Signal Generator is addressed to listen. The front panel RMT annunciator lights when the instrument is actually in the remote mode.	REN	RL1
Local	Yes	The Signal Generator returns to local mode (front panel control). It responds equally to the Go To Local (GTL) bus command and the front panel LOCAL key.	GTL	RL1
Local Lockout	Yes	The LOCAL key is disabled. Only the controller can return the Signal Generator to local (front panel control).	LLO	RL1
Clear Lockout/ Set Local	Yes	The Signal Generator returns to local (front panel control) and local lockout is cleared when the REN bus control line goes false.	$\overline{\text{REN}}$	RL1
Pass Control/Take Control	No	The Signal Generator has no controller capability.		C0
Require Service	Yes	The Signal Generator sets the SRQ bus control line true if one of the following conditions exists and it has been enabled by the Request Mask to send the message for that condition: Front Panel Key Pressed, Front Panel Entry Complete, Change in Extended Status, Source Settled, End of Sweep, Entry Error, and Change in Sweep Parameters.	SRQ	SR1
Status Byte	Yes	The Signal Generator responds to a Serial Poll Enable (SPE) bus command by sending an 8-bit byte when addressed to talk. If the instrument is holding the SRQ control line true (issuing the Require Service message) bit 7 (RQS bit) in the Status Byte and the bit representing the condition causing the Require Service message to be issued will both be true. The bits in the Status Byte are latched but can be cleared upon receiving the Clear Status (CS) program code, executing the Output Status function, or executing a serial poll while the SRQ control line is held true.	SPE SPD	T5

Table 3-4. Message Reference Table (2 of 2)

HP-IB Message	Appli-cable	Response	Related Commands and Controls	Interface Functions
Status Bit	Yes	The Signal Generator responds to a Parallel Poll Enable (PPE) bus command by sending a bit on a controller selected HP-IB data line.	PPE PPD PPC PPU	PP1
Abort	Yes	The Signal Generator stops talking and listening.	IFC	T5,TE0 LE,LE0

*Commands, Control lines, and Interface Functions are defined in IEEE Std 488-1978. Knowledge of these may not be necessary if your controller's manual describes programming in terms of the twelve HP-IB Messages shown in the left column.

Complete HP-IB capability as defined in IEEE Std 488 and ANSI Std MC1.1 is: SH1, AH1, T5, TE0, L3, LE0, SR1, RL1, PP1, DC1, DT1, and C0.

Local Mode (cont'd)

applications. Local lockout disables the LOCAL key and allows return-to-local only under program control.

NOTE

Return-to-local can also be accomplished by turning the Signal Generator's LINE switch to STBY, then back to ON. However, this technique has some disadvantages:

a. It defeats the purpose and advantage of local lockout (that is, the system controller loses control of a system element).

b. There are several HP-IB conditions that reset to default states at turn-on.

3-25. Addressing

The Signal Generator interprets the byte on the eight HP-IB data lines as an address or a bus command if the bus is in the command mode. The command mode is defined as attention control line (ATN) true and interface clear control line (IFC) false. Whenever the Signal Generator is addressed (if in local or remote), either the TLK or LSN annunciator on the front panel turns on.

The Signal Generator's Talk and Listen addresses can be set from switches located inside the instrument or from the front panel. The address selection procedure is described in Section II.

The decimal equivalent of the addresses can be displayed in the FREQUENCY MHz display by pressing and holding the LOCAL key. This is the decimal equivalent of the last five bits of both the Talk and Listen ASCII address codes. Refer to Table 2-1 for a comprehensive listing of all valid HP-IB address codes.

Listen Only Mode. If the internal Listen Only switch is set to "1", the Signal Generator is placed in the Listen Only mode. The instrument then responds to all Data messages, and the Trigger, Clear, and Local Lockout messages. It can also respond to a parallel poll with the Status Bit message. However, the Signal Generator cannot send Data messages and cannot respond to a serial poll with the Status Byte message.

The Signal Generator's Listen Only address can also be set from the front panel by keying in 4 0, then pressing the STO key and the LOCAL key. Note that the FRONT PNL ENABLE switch on the internal HP-IB address switch must be set to "1" to allow front panel entries.

Talk Only Mode. If the internal address switches are set to a valid Talk address and the Talk Only switch is set to "1", the Signal Generator is placed in the Talk Only mode. In this mode the instrument is configured to send Data messages whenever the bus is in the data mode. It can also send the Status Byte message in response to a serial poll.

Addressing (cont'd)
The Signal Generator's Talk Only address can also be set from the front panel by keying in 5 0, then pressing the STO key and the LOCAL key. Note that the FRONT PNL ENABLE switch on the internal HP-IB address switch must be set to "1" to allow front panel entries.

3-26. Turn-on Default Conditions

Several HP-IB parameters are reset at turn-on. The parameters and their default conditions are listed below.

- HP-IB Local Mode
- Immediate Execution Mode
- Unaddressed
- Trigger Configuration cleared
- Request Mask cleared
- SRQ cleared

3-27. Displays

The RMT annunciator is on when the Signal Generator is in the remote mode and after it has received its first Data message. The TLK annunciator is on when the Signal Generator is currently addressed to talk; the LSN annunciator is on when the Signal Generator is currently addressed to listen. The SRQ annunciator is on when the Signal Generator is sending the Require Service message.

The MESSAGE key lights for the same conditions in remote as in local. The message can be read in either remote or local when the Signal Generator is under program control. Once the message has been read the key light turns off, whether or not the causing condition has been crorrected.

The FREQUENCY MHz and RANGE dBm displays operate in remote mode just as they do in local. Hidden parameters can still be displayed in the FREQUENCY MHz display by pressing and holding their front panel keys. (This capability is not available to the controller since it cannot hold a program code in the same manner that an operator can hold down a key. However, the Output Active Parameter talk function allows the controller to use its display for showing the current value of hidden parameters.)

3-28. Output Level

Setting output level is the only front panel feature that is not operated in an identical manner in local and remote modes. In local, RANGE is set in steps of 10 dBm and displayed in the RANGE dBm display. The VERNIER knob sets the intermediate values of output power and is read on the meter. In remote, VERNIER is set in 0.1 dB steps. A selection of programming codes allows either combined or independent setting of the RANGE and VERNIER power. The entry format is [Program Code] [Numeric Value] [Units Terminator]. The code LE sets both range and vernier. The code RA sets just the range. The code VE sets just the vernier.

In going from local to remote the output level might change by a fraction of a dB. In going from remote to local the front panel knob takes control. There is no assurance of whether the power will go up, go down, or stay the same.

3-29. Data Messages

The Signal Generator communicates on the interface bus primarily with Data messages. Data messages consist of one or more bytes sent over the bus' data lines when the bus is in the data mode (attention control line [ATN] false). Unless it is set to Talk Only, the Signal Generator receives Data messages when addressed to listen. Unless it is set to Listen Only, the Signal Generator sends Data messages or the Status Byte message when addressed to talk. Virtually all instrument operations available in local mode can be performed in remote mode via Data messages. The major exceptions are changing the LINE switch setting and changing the HP-IB address of the Signal Generator.

3-30. Receiving Data Messages

The Signal Generator responds to Data messages when it is enabled to remote (REN control line true) and it is addressed to listen. The instrument remains addressed to listen until it receives an Abort message or until its talk address or a universal unlisten command is sent by the controller.

Data Message Input Format. The Data message string, or program string, consists of a series of ASCII codes. Each code is typically equivalent to a front panel keystroke in local mode and follows one of three formats:

- [Program Code] [Numeric Value] [Units Terminator] [EOS]
- [Program Code] [Numeric Value] [EOS]
- [Program Code] [EOS]

Receiving Data Messages (cont'd)

Program codes are typically 2 character mnemonics. All codes normally used by the operator to control the Signal Generator are given in Table 3-7, HP-IB Program Codes.

Numeric values are either a single decimal digit, a set of 11 characters or less representing a number, or a string of binary bytes. A string of 11 characters maximum can be expressed in decimal form only. Digits beyond the front panel display capability of a particular parameter are truncated. Therefore, it is best to format the data so that it is rounded to the correct number of digits.

Units terminators are 2 character codes that terminate and scale the associated numeric value. Frequency can be entered in GHz, MHz, kHz, or Hz. Sweep time values are entered in milliseconds. Power values are entered in dB.

End-of-String messages (EOS) can be the ASCII characters Line Feed (LF), semicolon (;), or the bus END message (that is, bus lines EOI true and ATN false). The at sign (@) acts as an EOS when the Signal Generator is in the Deferred Execution mode.

Valid Characters. The ASCII characters used for program strings are: A-Z a-z 0-9 . − + LF , ; @. The alpha program codes can be either upper or lower case since the Signal Generator will accept either type (they can be interchanged). Spaces, unnecessary signs (+, −), leading zeros, and carriage returns (CR) are ignored. However, if a space or other such character were inserted between 2 characters of a program code, the program code would be invalid and any remaining characters in a string might be misinterpreted by the Signal Generator. After receiving an invalid program code, the Signal Generator requires a valid program code before it will respond to numeric entries.

Immediate Execution Mode. ASCII characters can be accepted in the Deferred or Immediate execution modes. Immediate Execution is the default mode at turn-on. It can be set, if necessary, by sending the program code @3. In this mode the Signal Generator produces an End-of-String (EOS) message at the end of each character and does not require one from the controller. The Signal Generator processes each character before accepting the next one. Therefore, the Immediate Execution mode does slow down overall data transfer. However, the Signal Generator can switch faster after the final EOS message than it can in the other mode. This is useful when the system controller is slow enough (data rate <1000 bytes/second) that it cannot take advantage of the Deferred mode's transfer speed or when switching time, independent of message length, is more important than program execution speed.

Deferred Execution Mode. This ASCII mode must be selected by sending the program code @2. In this mode, the Signal Generator accepts strings up to 96 characters at a time, executing the string upon receiving an EOS message. The Signal Generator produces its own EOS message upon receipt of the 96th character in a string. If a block of strings containing more than 96 characters is sent, the first 96 characters are accepted and the Signal Generator holds the bus busy until it executes them. Then the next 96 characters are accepted and so on until the entire block is accepted. If only one string of less than 96 characters is sent, the Signal Generator accepts the strings and frees the bus allowing program execution to continue.

Binary Mode. The Signal Generator's Request Mask is programmed in binary format. Also, learn mode data is sent and received in binary. Binary data is always processed in the Immediate Execution mode.

3-31. Sending the Data Message

The Signal Generator can send Data messages when addressed to talk. It remains configured to talk until it is unaddressed to talk by the controller. To unaddress the Signal Generator, the controller must send the Signal Generator's listen address, an Abort message, a new talk address, or a universal untalk command.

Talk Functions. The types of information that the Signal Generator can send in a Data message are:

- Front Panel Learn Mode
- Special Function Learn Mode
- Messages
- Output Active Parameter
- Output Couple
- Output Lock Frequency
- Test Interface
- Output Status
- Output Request Mask Value (explained later under Sending the Request Mask Value).

Each function is enabled by first addressing the Signal Generator to listen. Then, the Signal Gen-

Sending the Data Message (cont'd)

erator must receive a Data message with the appropriate program code. When the Signal Generator is addressed to talk, it will output data for the selected talk function. If the controller does not repeat the program code or send a new one, the Signal Generator sends data for the last selected talk function when it is addressed to talk. However, it is recommended that a talk function program code be sent each time, prior to addressing the Signal Generator to talk. This will ensure that the Signal Generator sends the appropriate data. Refer to Table 3-5 for a summary of talk functions.

Front Panel Learn Mode. The front panel learn mode uses the controller's memory to learn and store a data string that describes the Signal Generator's current front panel setting. Once an instrument state has been learned, the Signal Generator can be restored to that configuration at a later time. The learn mode requires a controller that can transfer information in binary form.

After receiving an L1 program code (Front Panel Learn Mode) and when addressed to talk, the Signal Generator sends 2 ASCII characters, @ and A, followed by a string of 94 8-bit binary bytes containing information on the front panel configuration. This binary data can then be stored in the controller's memory for future use. In addition, as each configuration goes out onto the bus, it is also stored in the Signal Generator's register 9. The most straight-forward way to program the system controller is to use a loop to read 96 binary characters and store them in an array.

When the Signal Generator is addressed to listen, the binary data can be returned to it in 96-byte strings. When the Signal Generator detects the @A, it will expect the next 94 characters to be in the learn mode string. A checksum is embedded in the string so that possible errors in the storage or transmission of the data will be detected, and the input will be ignored.

Whenever data is being transferred between controller and Signal Generator, it must do so in uninterrupted strings. If a data string is broken or interrupted, the data could be lost or offset, and misinterpreted by the Signal Generator. An offset of data bytes can persist through later data strings until the Signal Generator is eventually switched to standby, then on again.

Special Function Learn Mode. This mode is intended for servicing the Signal Generator. It is similar in operation to the front panel learn mode. After receiving an L2 program code (Special Function Learn Mode) and when addressed to talk, the Signal Generator sends 2 ASCII charcters, @ and 9, followed by a string of 24 8-bit binary bytes. This binary data can then be stored in the controller's memory.

The binary characters are directly related to the digital outputs of the Signal Generator's internal controller. There is no checksum or other error detecting scheme, allowing diagnostic and other special functions that are not normally possible with the Signal Generator. Refer to Section VIII, Service, for additional information.

Messages. This function enables the MESSAGE key to be read under program control. After receiving an MG program code (Message) and when addressed to talk, the Signal Generator sends a two-digit number coded in ASCII followed by a Line Feed (LF) and EOI. The codes represent entry errors and instrument malfunctions. The two-digit codes are explained on the operating information pull-out card and in the Message Detailed Operating Instruction. The Message can always be read by pressing the MESSAGE key, even when the Signal Generator is in remote mode. However, reading the Message once, either in remote or local, clears it to 00 (No Error) whether or not the causing condition has been corrected.

Output Active Parameter. This function allows the user to determine the present value of a specific parameter. After receiving the program code for a value-selectable parameter followed by the program code OA (Output Active) and when addressed to talk, the Signal Generator will output a string over the bus consisting of the following: [Selected Program Code] [Current Numeric Value] [Units Terminator] [LF and EOI]. Any parameter that has a numeric value associated with it can be interrogated. An exception to this output format is Steps. When the controller sends "SPOA", the Signal Generator returns with the string: SP [Step Size] HZ, SP [Number of Steps] SS, [LF and EOI]. The Signal Generator may output a program code that differs from the code sent to it by the controller. For example, the Signal Generator responds with the program code CF (center frequency) when sent FR (frequency) and MK (marker) when sent M1, M2, M3, M4, or M5 (Markers 1 through 5).

Table 3-5. Talk Functions

Function	Program Code	Signal Generator Output Response to Program Code	Comments
Front Panel Learn Mode	L1	96 Binary Bytes [EOI]	
Special Function Learn Mode	L2	26 Binary Bytes [EOI]	See Section VIII, Service
Message	MG	2 Digits [LF and EOI]	
Output Active Parameter	[Progam Code] OA	[Program Code] [Numeric Value] [Units Terminator] [LF and EOI]	Valid Functions: CF, FI, FA, FB, FS, M1-5, DW, LE, VE, RA
	SPOA	SP [Step Size] Hz, SP [# of Steps] SSSP [LF and EOI]	
Output Couple	OC	[START Value], [Center-Frequency Value], [Dwell Value] [LF and EOI]	Frequency is in Hz; dwell is in seconds.
Output Lock Frequency	OK	FR [Numeric Value] Hz [LF and EOI]	
Test Interface	TI [1 Byte]	1 Byte [EOI]	
Output Status	OS	2 Bytes [EOI]	
Output Request Mask	OR	1 Byte [EOI]	

Sending the Data Message (cont'd)

Output Couple. After receiving the program code OC (Output Couple) and when addressed to talk, the Signal Generator sends a data string that gives the current numeric values for the following parameters in the order listed: [START], [Center Frequency], [DWELL] [LF and EOI]. No program codes prefix the numeric values. Hz is the implied terminator for start and center frequency; seconds is the implied terminator for dwell time.

Output Lock Frequency. This function causes the Signal Generator to output the value of its tuned frequency. After receiving the program code OK and when addressed to talk, the Signal Generator sends the value of the frequency at which it is currently phase locked. The data output from the Signal Generator is in the following format: FR [Numeric Value] HZ [LF and EOI].

Test Interface Function. This function allows testing of the HP-IB interface. After receiving the program code TI, followed by an 8-bit byte representing one or more data lines (see table below) and when addressed to talk, the Signal Generator sends the binary byte that it just received. Refer to Section VIII, Service, for additional information.

HP-IB Data Line	DI08	DI07	DI06	DI05	DI04	DI03	DI02	DI01
Weight	128	64	32	16	8	4	2	1

Output Status. After receiving the program code OS (Output Status) and when addressed to talk, the Signal Generator sends two binary bytes, each 8 bits wide. The first byte is identical to the Status Byte of the Serial Poll. The second byte is the Extended Status Byte which provides additional information. See Figure 3-11 for a description of each Status Byte. Bits in the main Status Byte are cleared upon execution of the Output Status function or the Clear Status (CS) program code. Bits on the Extended Status Byte are cleared by removing the causing condition and performing the Output Status function.

3-32. Receiving the Clear Message

The Signal Generator responds to the Clear message by assuming the settings detailed in Table 3-6. The Signal Generator responds equally to the Selected Device Clear (SDC) bus command when addressed to listen, and the Device Clear (DCL) bus command whether addressed or not. The Clear message clears any pending Require Service message.

Table 3-6. Response to a Clear Message

Parameter	Condition
Execution Mode	Immediate
Request Mask	Cleared
Require Service (SRQ)	Cleared
Trigger Configuration	Cleared
MESSAGE	Cleared (set to 00)
RF OUTPUT	ON
ALC	INTERNAL
RANGE	−70 dBm
VERNIER	0.0 dB
AUTO PEAK	ON
MTR	LVL
AM, FM, and Pulse Modulation	OFF
FREQUENCY	3000.000 MHz
FREQ INCR	1.000 MHz
START	2000.000 MHz
STOP	4000.000 MHz
ΔF	2000.000 MHz
MKR	OFF
SWEEP MODE	OFF
STEP	100 steps (20.000 MHz)
DWELL	20 ms
TUNE Knob	ON

3-33. Receiving the Trigger Message

The Signal Generator responds to a Trigger message only if a response has been pre-programmed (see Configure Trigger). Otherwise, it ignores a Trigger message. It responds equally to a Trigger message (with bus command GET) and a Data message with program code TR (Trigger).

Configure Trigger. The Signal Generator's response to a Trigger message is set when it receives a Data message containing the program code CT followed by one valid program code. For example, CTW6 causes a single sweep (W6) when the Trigger message is received.

3-34. Receiving the Remote Message

The Remote message has two parts. First, the remote enable bus control line (REN) is held true; second, the device listen address is sent by the controller. These two actions combine to place the Signal Generator in remote mode. Thus, the Signal Generator is enabled to go into remote when the controller begins the Remote message, but it does not actually switch to remote until addressed to listen the first time. When actually in remote, the Signal Generator's front panel RMT annunciator lights.

3-35. Receiving the Local Message

The Local message is the means by which the controller sends the Go To Local (GTL) bus command. If addressed to listen, the Signal Generator returns to front panel control when it receives the Local message.

When the Signal Generator goes to local mode, the front panel RMT annunciator turns off. However, even when in local, if the Signal Generator is being addressed, its front panel LSN or TLK annunciator turns on.

3-36. Receiving the Local Lockout Message

The Local Lockout message is the means by which the controller sends the Local Lockout (LLO) bus command. If in remote, the Signal Generator responds to the Local Lockout Message by disabling the front panel LOCAL key. The local lockout mode prevents loss of data or system control due to someone accidentally pressing front panel keys. If, while in local, the Signal Generator is enabled to remote (that is, REN is set true) and it receives the Local Lockout message, it will switch to remote mode with local lockout the first time it is addressed to listen. When in local lockout, the Signal Generator can be returned to local only by the controller (using the Local or Clear Lockout/Set Local messages), by setting the LINE switch to STBY and back to ON, or by removing the bus cable.

3-37. Receiving the Clear Lockout/Set Local Message

The Clear Lockout/Set Local message is the means by which the controller sets the Remote Enable (REN) bus control line false. The Signal Generator returns to local mode (full front panel control) when it receives the Clear Lockout/Set Local message. When the Signal Generator goes to local mode, the front panel RMT annunciator turns off.

3-31. Receiving the Pass Control Message

The Signal Generator does not respond to the Pass Control message because it does not have this controller capability.

3-32. Sending the Require Service Message

The Signal Generator sends a Require Service message if one or more of the following conditions exist and if it has been pre-programmed to send the message by the Request Mask.

- Front Panel Key Pressed: when the Signal Generator is in local mode and one of the front panel keys is pressed.
- Front Panel Entry Complete: when the Signal Generator is in local mode and is finished processing a front panel entry.
- Change in Extended Status: when one of the bits on the Extended Status Byte changes.
- Source Settled: when the Signal Generator is settled. Switching transients occur when RF and AUTO PEAK are turned on, and when FM ranges and frequency are changed. If the controller responds to the Signal Generator as soon as the source is settled, instead of waiting a specified time, program speed is increased.
- Entry Error: When an invalid keystroke or program command occurs.
- New Sweep Parameters: when the value of START, STOP, ΔF, DWELL, STEP, or any Marker changes.

The Signal Generator can send a Require Service message in either the local or remote mode.

The Signal Generator sends a Require Service message by setting the Service Request (SRQ) bus line true. The SRQ annunciator on the front panel turns on when the Require Service message is being sent. The Require Service message is cleared after the Output Status function or the Clear Status (CS) program code has been executed by the controller.

Request Mask. The Request Mask functions within the Status Byte. It determines which bits can set the RQS bit true (see Figure 3-11) and consequently set the SRQ bus line true.

The Request Mask is set by the program code @1 followed by an 8-bit byte (a Data Message). The value of the byte is determined by summing the weight of each bit to be checked. Each bit, if true, enables a corresponding conditon to set the RQS bit true. This message is executed immediately and does not require an End-of-String message to be sent. At turn-on, the Request Mask is cleared (that is, set to 0).

Sending the Request Mask Value (a Data Message). After receiving an OR program code (Output Request Mask) and when addressed to talk, the Signal Generator will send a single binary word (8 bits) that describes the present state of the mask. The bit pattern can be interpreted with the information in Figure 3-11.

NOTE

This byte is sent with the bus EO1 line true, thus terminating the message.

3-33. Sending the Status Byte Message

After receiving a Serial Poll Enable bus command (SPE) and when addressed to talk, the Signal Generator sends a Status Byte message. The message consists of one 8-bit byte of which 7 bits correspond to the pattern and descriptions for the Request Mask. The remaining bit, bit 7, is the RQS Request Service bit (see Figure 3-11).

The RQS bit is set when one of the other seven conditions exists and that condition has been enabled by the Request Mask. Bits 1—6 and 8 might be true regardless of conditioning by the Request Mask. However, if a condition has not been selected by the mask, it cannot cause the RQS bit to be set true.

Extended Status Byte. A second status byte is available but can only be accessed via the Output Status function (see explanation under Sending the Data Message). Bit 3 of the Status Byte indicates whether a change has occurred in the Extended Status Byte. If Bit 3 is true, the second status byte should be accessed via the Output Status function to determine the cause of the status change. The bit pattern can be interpreted with the information in Figure 3-11.

3-34. Clearing the Status Byte

Once the Signal Generator sets the SRQ bus line true, it is no longer allowed to alter the Status Byte. If a bit has been enabled and the condition occurs after the SRQ bus line has been set true, the

STATUS BYTE (#1)								
BIT	8	7	6	5	4	3	2	1
WEIGHT	128	64	32	16	8	4	2	1
Condition	Change in Sweep Parameters	RQS Bit Request Service	Entry Error	End of Sweep	Source Settled	Change in Extended Status	Front Panel Entry Complete	Front Panel Key Pressed

EXTENDED STATUS BYTE (#2)								
BIT	8	7	6	5	4	3	2	1
WEIGHT	128	64	32	16	8	4	2	1
Condition	0 (always)	ALC Unleveled	Power Failure/On	Not Locked	External Ref	0 (always)	FM Overmod	Self-Test Failed

Figure 3-11. Status Byte Information

Clearing the Status Byte (cont'd)

bit is stored in a buffer and is read the next time the Signal Generator receives the Serial Poll Enable (SPE) bus command. When addressed to talk (following SPE), the Signal Generator sends the Status Byte message.

After the Status Byte message has been sent it will be cleared if the Serial Poll Disable (SPD) bus command is received, if the Abort message is received, or if the Signal Generator is unaddressed to talk. However, bits stored in the buffer waiting to be read are not cleared. Regardless of whether or not the Status Byte message has been sent, the Status Byte and any Require Service message pending will be cleared if a Clear Status (CS) program code is received or the Output Status function is executed.

NOTE

The Signal Generator must receive a universal untalk command after sending the Status Byte message. Most system controllers send this automatically. However, if a universal untalk command is not sent, the SRQ bus line may not be re-initialized and pending Service Requests may get lost.

3-42. Sending the Status Bit Message

The Signal Generator sends the Status Bit message (if configured) as part of the interface's response byte to the Parallel Poll Enable (PPE) bus command. In order for the Signal Generator to respond to a Parallel Poll Enable bus command it must be assigned a single HP-IB data line by the controller. The controller also assigns the logic level of the bit. Both tasks can be accomplished by the Parallel Poll Configure (PPC) bus command. If the Signal Generator is sending the Require Service message, it will set its assigned status bit true. The Signal Generator can send the Status Bit message without being addressed to talk.

The data line that the Signal Generator is assigned to respond on can be cleared by turning the instrument to STBY or by sending the Parallel Poll Unconfigure (PPU) bus command.

3-43. Receiving the Abort Message

The Abort message is the means by which the controller sets the Interface Clear (IFC) bus control line true. When the Abort message is received, the Signal Generator becomes unaddressed and stops talking or listening.

Table 3-7. HP-IB Program Codes

Program Code	Parameter
AO	AM OFF
AP	Level (RANGE and VERNIER)
A0	AM OFF
A1	AM OFF
A2	AM 30%
A3	AM 100%
CF	Center Frequency
CS	Clear Status
CT	Configure Trigger
CW	CW Frequency
C1	ALC INTERNAL
C2	ALC DIODE
C3	ALC PWR MTR
DB	dB
DF	ΔF
DM	dB
DN	FREQ INCREMENT (Down)
DO	FM DEVIATION OFF
DW	DWELL
D0	FM DEVIATION OFF
D1	FM DEVIATION OFF
D2	FM DEVIATION .03 MHz
D3	FM DEVIATION .1 MHz
D4	FM DEVIATION .3 MHz
D5	FM DEVIATION 1 MHz
D6	FM DEVIATION 3 MHz
D7	FM DEVIATION 10 MHz
FA	START Sweep Frequency
FB	STOP Sweep Frequency
FI	FREQ INCR
FN	FREQ INCR
FR	FREQUENCY
FS	ΔF
F1	FREQ INCR
GZ	GHz
HZ	Hz
IF	FREQ INCREMENT (Up)
IP	Instrument Preset
KZ	kHz
K0	AUTO PEAK OFF
K1	AUTO PEAK ON
K2	AUTO PEAK without extra settling time
LE	Level (RANGE and VERNIER)
L1	Front Panel Learn Mode
L2	Special Function Learn Mode
MG	MESSAGE
MO	Marker(s) OFF
MS	milliseconds
MZ	MHz
M0	Marker(s) OFF
M1	Marker 1
M2	Marker 2
M3	Marker 3
M4	Marker 4
M5	Marker 5
NO	TUNE Knob OFF
N0	TUNE Knob OFF
N1	TUNE Knob ON
OA	Output Active Parameter

Program Code	Parameter
OC	Output Couple
OK	Output Lock Frequency
OL	Front Panel Learn Mode
OR	Output Request Mask
OS	Output Status
PL	Power Level (RANGE and VERNIER)
PO	PULSE OFF
P0	PULSE OFF
P1	PULSE OFF
P2	PULSE NORM
P3	PULSE COMP
RA	RANGE
RC	Recall (RCL)
RD	RANGE Down 10 dB
RF0	RF OFF
RF1	RF ON
RL	Recall (RCL)
RM	RQS Mask
RO	RF OFF
RS	Reset Sweep
RU	RANGE Up 10 dB
R0	RF OFF
R1	RF ON
SD	Slave Down
SF	STEP
SM	MANUAL Sweep
SP	STEP
SS	Steps (suffix)
ST	Store (STO)
SU	Slave Up
SV	Service Function
TI	Test Interface
TR	Execute Trigger
T1	Meter LVL
T2	Meter AM
T3	Meter FM
UP	FREQ INCREMENT (Up)
VE	VERNIER
WO	SWEEP MODE OFF
W0	SWEEP MODE OFF
W1	SWEEP MODE OFF
W2	AUTO Sweep
W3	MANUAL Sweep
W4	SINGLE Sweep
W5	SINGLE Sweep: Arm Only
W6	SINGLE Sweep: Arm and Begin
W7	Master Sweep
W8	Slave Sweep
X0	Marker(s) OFF
X1	Marker 1
X2	Marker 2
X3	Marker 3
X4	Marker 4
x5	Marker 5
@A	Start of Front Panel Learn Mode
@1	Prefix for Request Mask
@2	Deferred Execution Mode
@3	Immediate Execution Mode
@9	Start of Special Function Learn Mode

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

The procedures in this section test the instrument's electrical performance using the specifications of Table 1-1 as the performance standards. These tests are suitable for incoming inspection, troubleshooting, and preventive maintenance. All tests can be performed without accessing the interior of the instrument. A simpler operational test is included in Section III under Operator's Checks.

4-2. ABBREVIATED PERFORMANCE TEST

In most cases, it is not necessary to perform all of the tests in this section. Table 4-1, Operation Verification, lists the tests that are recommended for various conditions. The Operator's Checks in Section III should always be the first step.

NOTE

To consider the performance tests valid, the following conditions must be met:

a. The Signal Generator must have a 1-hour warm-up for all specifications.

b. The line voltage for all instruments except those with Option 003 must be 100, 120, 220, or 240 Vac +5%, −10%; the line frequency must be 48 to 66 Hz. Instruments with Option 003 have the additional capability of operating on line frequencies of 48 to 440 Hz, but the line voltage is limited to a nominal 100 or 120 Vac if the line frequency is >66 Hz.

c. The ambient temperature must be 0°C to 55°C.

4-3. CALIBRATION CYCLE

This instrument requires periodic verification of performance to ensure that it is operating within specified tolerances. The performance tests decribed in this section should be performed at least once each year; under conditions of heavy usage or severe operating environments, the tests should be more frequent. Adjustments that may be required are described in Section V, Adjustments.

4-4. PERFORMANCE TEST RECORD

Results of the performance tests may be tabulated in Table 4-2, Performance Test Record. The Performance Test Record lists all of the performance test specifications and the acceptable limits for each specification. If performance test results are recorded during an incoming inspection of the instrument, they can be used for comparison during periodic maintenance or troubleshooting. The test results may also prove useful in verifying proper adjustments after repairs are made.

4-5. EQUIPMENT REQUIRED

Equipment required for the performance tests is listed in Table 1-3, Recommended Test Equipment. Any equipment that satisfies the critical specifications given in the table may be substituted.

4-6. TEST PROCEDURES

It is assumed that the person performing the following tests understands how to operate the specified test equipment. Equipment settings, other than those for the Signal Generator, are stated in general terms. For example, a test might require that a spectrum analyzer's resolution bandwidth be set to 100 Hz; however, the time per division would not be specified and the operator would be expected to set that control and other controls as required to obtain an optimum display. It is also assumed that the technician will select the cables, adapters, and probes (listed in Table 1-3) required to complete the test setups illustrated in this section.

Table 4-1. Operation Verification

NOTE

The following table of abbreviated performance tests lists tests done after instrument repair. Doing these tests verifies that the instrument meets all major specifications to a 90% confidence level. If a higher level of confidence or a more thorough check is needed, do the entire performance tests with no omissions.

Para. No.	Performance Test	Alteration	Remark
4-7	Frequency Range and Resolution Tests	Omit steps 1-7.	Resolution is of secondary importance if all frequencies remain phase-locked
4-8	Output Level, High Level Accuracy and Flatness Tests	Do steps 14–17 at 4 GHz only. Omit step 18.	
4-9	Low Level Accuracy Tests	Omit test.	Of secondary importance compared to difficulty of doing test
4-10	Harmonics, Subharmonics and Multiples Tests	Omit step 7.	If within specifications at <22 GHz, frequencies >22 GHz normally will be within specifications
4-11	Non-Harmonically Related Spurious Signals (CW and AM Modes) Tests	Omit test.	Normally within specification
4-12	Power Line Related Spurious Signals Tests	Omit test.	Normally within specification
4-13	Single-Sideband Phase Noise Tests	Do all testing only at 6.6 GHz, but at all specified offsets	If within specifications at 6.6 GHz, frequencies in other bands are normally within specifications
4-14	Amplitude Modulation Tests	Omit step 9. Omit tests 11–14.	If in specification for step 8, normally within specification Secondary importance
4-15	FM Frequency Response Tests	Omit step 6.	If in specifications at 4 GHz, normally within specification
4-16	FM Input and Meter Accuracy Tests	No change.	
4-17	Incidental AM Tests	Omit test.	Secondary importance
4-18	Pulse Tests	Omit steps 32-37.	Secondary importance
4-19	Internal Time Base Aging Rate	Omit test.	Secondary importance

PERFORMANCE TESTS

4-7. FREQUENCY RANGE AND RESOLUTION TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Range	2.0 — 26.0 GHz	
Resolution	1 kHz	2.0 to 6.6 GHz
	2 kHz	6.6 to 12.3 GHz
	3 kHz	12.3 to 18.6 GHz
	4 kHz	18.6 to 26.0 GHz

Description This test checks the output frequency range and minimum resolution in each frequency band using a frequency counter. The full frequency range is further checked by tuning each frequency digit from 0 to 9 in succession.

Equipment Frequency Counter .... HP 5343A

Procedure

1. Connect the equipment as shown in Figure 4-1.

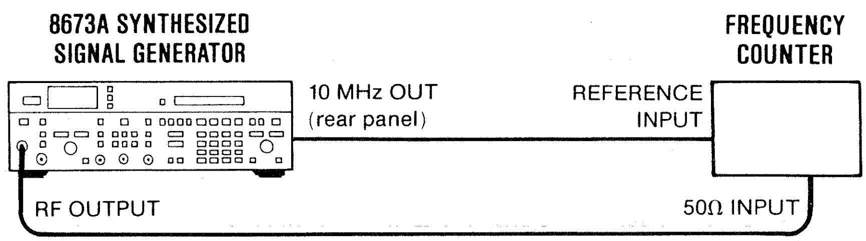


Figure 4-1. Frequency Range and Resolution Test Setup

2. Select 1 kHz display resolution and external reference on the counter.
3. Set Signal Generator to 2.0 GHz and the output power to 0 dBm. The counter should read 2.000 000 GHz within one count.
4. Set Signal Generator to 26.0 GHz. The counter should read 26.000 000 GHz within one count.
5. Set Signal Generator to any other frequency of interest and check counter reading. All readings should be within one count of the Signal Generator setting.
6. Set the Signal Generator to 2.0 GHz and FREQ INCR to 1 kHz. Step frequency up 1 kHz, then step it down 1 kHz while observing the counter. Ensure that the Signal Generator output frequency is accurate within one count on the counter.
7. Repeat step 6 using frequencies of 8 GHz, 14 GHz, and 20 GHz, with the resolutions of 2 kHz, 3 kHz, and 4 kHz, respectively.

PERFORMANCE TESTS

4-7. FREQUENCY RANGE AND RESOLUTION TESTS (cont'd)

Procedure (cont'd)

8. Set the Signal Generator frequency to 2.0 GHz. Starting with a frequency increment of 1 kHz, step the 1 kHz digit from 0 to 9, ensuring that the frequency is accurate within one count on the counter, and the Signal Generator NOT ϕ LOCKED front panel LED remains off at all frequency settings.

NOTE

Fast tuning of frequency with the TUNE knob may cause the NOT ϕ LOCKED LED to momentarily flash on. This is normal, and does not indicate a malfunction.

9. Repeat step 8 with a frequency increment of 10 kHz stepping the next frequency digit from 0 to 9 and checking the frequency accuracy at each step.

10. Repeat step 8, increasing the frequency increment by a factor of 10 each time, until the frequency is 2.999 999 GHz, checking the frequency at each step for accuracy of ±1 kHz at each step.

11. Set the frequency increment to 1 GHz and step the GHz frequency digits from 2 to 25, ending at 25.999 999 GHz, checking the frequency at each step for accuracy of ±1 kHz.

PERFORMANCE TESTS

4-8. OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
RF OUTPUT		
Output Level:		+15 to +35°C
Leveled Output	+8 dBm to −100 dBm	2.0 to 18.0 GHz
	+4 dBm to −100 dBm	18.0 to 22.0 GHz
	0 dBm to −100 dBm	22.0 to 26.0 GHz
Option 001 Leveled Output	+10 dBm to −10 dBm	2.0 to 18.0 GHz
	+6 dBm to −10 dBm	18.0 to 22.0 GHz
	+3 dBm to −10 dBm	22.0 to 26.0 GHz
Option 004 Leveled Output	+7 dBm to −100 dBm	2.0 to 18.0 GHz
	+2 dBm to −100 dBm	18.0 to 22.0 GHz
	−2 dBm to −100 dBm	22.0 to 26.0 GHz
Option 005 Leveled Output	+9 dBm to −10 dBm	2.0 to 18.0 GHz
	+4 dBm to −10 dBm	2.0 to 18.0 GHz
	+1 dBm to −10 dBm	22.0 to 26.0 GHz
Remote Programming Absolute Level Accuracy (+15°C to +35°C)		**2.0—6.6 GHz**
	±1.25 dB	+10 dBm output level range
	±1.00 dB	0 dBm output level range
	±1.50 dB	−10 dBm output level range
	±1.70 dB	−20 dBm output level range
		6.6—12.3 GHz
	±1.50 dB	+10 dBm output level range
	±1.25 dB	0 dBm output level range
	±1.75 dB	−10 dBm output level range
	±1.95 dB	−20 dBm output level range
		12.3—18.6 GHz
	±1.75 dB	+10 dBm output level range
	±1.50 dB	0 dBm output level range
	±2.10 dB	−10 dBm output level range
	±2.30 dB	−20 dBm output level range
		18.6—26.0 GHz
	±2.00 dB	0 dBm output level range
	±2.55 dB	−10 dBm output level range
	±2.85 dB	−20 dBm output level range
Manual Absolute Level Accuracy	Add ±0.75 dB to remote programming absolute level accuracy	Absolute level accuracy specifications include allowances for detector linearity, temperature, flatness, attenuator accuracy, and measurement uncertainty
Flatness (0 dBm range; +15 to +35°C)	±0.75 dB	2.0 to 6.6 GHz
	±1.00 dB	2.0 to 12.3 GHz
	±1.25 dB	2.0 to 18.6 GHz
	±1.75 dB	2.0 to 26.0 GHz

PERFORMANCE TESTS

4-8. OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TESTS (cont'd)

Description High level accuracy (+13 dBm to −20 dBm) and flatness are verified using a power meter and sensor.

Equipment

Power Meter .... HP 436A
Power Sensor .... HP 8485A

Procedure

Output Level Test

1. Connect the power sensor to the power meter. Calibrate and zero the power meter.

2. Connect the power sensor to the RF OUTPUT connector of the Signal Generator as shown in Figure 4-2.

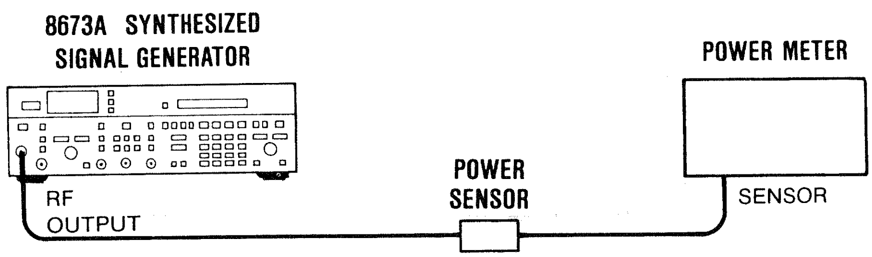


Figure 4-2. High Level Accuracy and Flatness Test Setup

3. Set the Signal Generator frequency to 2.0 GHz and the output level range to +10 dBm.

4. Adjust the VERNIER control to give a power meter reading of +8 dBm.

5. Peak the Signal Generator output with the AUTO PEAK key.

6. Tune the Signal Generator in 100 MHz steps from 2 to 18 GHz, adjusting the power meter's calibration factor and recording the frequency at which minimum power occurs. Reset VERNIER to +8 dBm at the recorded frequency to ensure that the minimum specified power level can be met.

   Frequency ________

7. Set the Signal Generator power to +4 dBm at 18.100 002 GHz. Step the frequency in 100 MHz steps from 18.100 002 to 22 GHz, adjusting the power meter's calibration factor and recording the frequency at which minimum power occurs. Reset VERNIER to +4 dBm at the recorded frequency to ensure that the specified minimum power level can be met.

   Frequency ________

8. Set the Signal Generator power to 0 dBm at 22.1 GHz and step the frequency in 100 MHz steps from 22.1 to 26 GHz, adjusting the power meter's calibration factor and recording the frequency at which minimum power occurs. Reset VERNIER to 0 dBm at the recorded frequency to ensure that the minimum specified power level can be met.

   Frequency ________

PERFORMANCE TESTS

4-8. OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TESTS (cont'd)

Procedure (cont'd)

Level Flatness

9. Set frequency to 2 GHz, output level to –5 dBm, and power meter to dB Relative. Tune to 6.6 GHz in 100 MHz steps and record the minimum and maximum power outputs. Maximum variation should be within 1.5 dB (highest point to lowest point). Continue to tune to 12.3 GHz. Maximum variation should be within 2 dB. Continue on and tune to 18.6 GHz and note level variation. Maximum should be within 2.5 dB. Continue and tune to 26 GHz where maximum variation should be within 3.5 dB.

NOTE

The plus and minus specification for power output is not referenced to a particular frequency. The specification, rather, represents the total power variation over the entire frequency range.

2.0 — 6.6 GHz ±0.75 dB	Minimum	______	
	Maximum	______	
	Total Variation	______	1.50 dB
2.0 — 12.3 GHz ±1.00 dB	Minimum	______	
	Maximum	______	
	Total Variation	______	2.00 dB
2.0 — 18.6 GHz ±1.25 dB	Minimum	______	
	Maximum	______	
	Total Variation	______	2.50 dB
2.0 — 26.0 GHz ±1.75 dB	Minimum	______	
	Maximum	______	
	Total Variation	______	3.50 dB

High Level Accuracy Test

10. Connect the power sensor to the power meter. Calibrate and zero the power meter in the dBm mode.

11. Connect the power sensor to the RF OUTPUT connector of the Signal Generator.

12. Set the Signal Generator frequency to 2.0 GHz and adjust the VERNIER control to give a reading of +8 dBm on the instrument's OUTPUT LEVEL meter.

13. Peak the Signal Generator output with the AUTO PEAK key.

14. Tune the Signal Generator in 2 GHz steps from 2 to 18 GHz. Set the power meter's calibration factor appropriately and record the power output at each frequency. The power meter readings should be within the limits specified in Table 4-2, Performance Test Record.

15. Set the Signal Generator frequency to 2.0 GHz and adjust the VERNIER control to give a reading of +3 dBm on the instrument's OUTPUT LEVEL meter.

PERFORMANCE TESTS

4-8. OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS TESTS (cont'd)

Procedure (cont'd)

16. Tune the Signal Generator in 2 GHz steps from 2 to 22 GHz. Set the power meter's calibration factor appropriately and record the power output at each frequency. The power meter readings should be within the limits specified in Table 4-2, Performance Test Record.

17. Repeat steps 15 and 16 for power levels of 0, −5 and −10 dBm in the 0 dBm range, stepping from 2 to 26 GHz in 2 GHz steps.

18. Repeat steps 15 and 16 for power levels of −10 dBm and −20 dBm in the −10 dBm and −20 dBm ranges respectively.

PERFORMANCE TESTS

4-9. LOW LEVEL ACCURACY TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
RF OUTPUT Remote Programming Absolute Level Accuracy (+15 to +35°C)		**2.0—6.6 GHz**
	±2.00 dB	–30 dBm output level range
	±0.1 dB per 10 dB step	<–30 dBm output level range
		6.6—12.3 GHz
	±2.25 dB	–30 dBm output level range
	±0.1 dB per 10 dB step	<–30 dBm output level range
		12.3—18.6 GHz
	±2.70 dB	–30 dBm output level range
	±0.2 dB per 10 dB step	<–30 dBm output level range
		18.6—26.0 GHz
	±3.30 dB	–30 dBm output level range
	±0.2 dB per 10 dB step	<–30 dBm output level range
Manual Absolute Level Accuracy	Add ±0.75 dB to remote programming absolute level accuracy	Absolute level accuracy specifications include allowances for detector linearity, temperature, flatness, attenuator accuracy, and measurement uncertainty

Description

Low level accuracy (–30 dBm and below) is verified using a local oscillator and mixer to produce a 100 kHz IF signal. The IF signal is then amplified and its level read on a spectrum analyzer.

Equipment

Power Meter .... HP 436A
Power Sensor .... HP 8485A
Local Oscillator .... HP 8673A
Mixer .... RHG DMS1-26
Spectrum Analyzer .... HP 8556A/8552B/141T
40 dB Amplifier .... HP 8447F
20 dB Attenuator .... HP 8493C Option 020

Procedure

1. Calibrate and zero the power meter in the dBm mode.

2. Connect the equipment as shown in Figure 4-3.

NOTE

Connect the mixer directly to the local oscillator to avoid any power loss.

PERFORMANCE TESTS

4-9. LOW LEVEL ACCURACY TESTS (cont'd)

Procedure (cont'd)

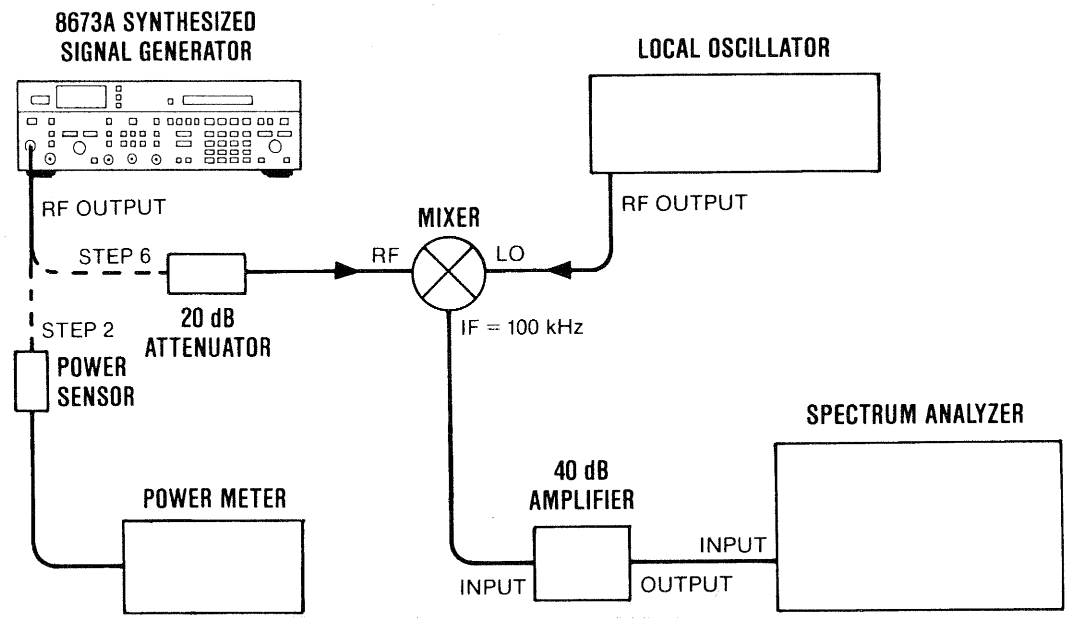


Figure 4-3. Low Level Accuracy Test Setup

3. Set the Signal Generator frequency to 2.0 GHz, RANGE to −20 dBm, and set the VERNIER for 0 dB.

4. Peak the Signal Generator power with the AUTO PEAK key.

5. Adjust the VERNIER for a power meter reading of −20 dBm ±0.01 dB.

6. Disconnect the power meter and connect the Signal Generator to the mixer as shown in Figure 4-3.

7. Set the local oscillator to a frequency 100 kHz ±1 kHz higher than the Signal Generator setting in step 3. Set the local oscillator output power to maximum but not greater than +8 dBm.

8. Set the resolution bandwidth on the spectrum analyzer to 300 kHz or less. Set the vertical sensitivity so that the amplitude of the 100 kHz IF signal is set to the center horizontal graticule as a reference. This calibrates the center graticule line for an absolute reference power level of −20 dBm.

9. Set the range of the Signal Generator 10 dB lower and adjust the Signal Generator's VERNIER for a meter reading of 0 dB.

10. Set the spectrum analyzer reference level 10 dB lower with the IF sensitivity control. This should bring the signal level back up near the center graticule line.

4-9. LOW LEVEL ACCURACY TESTS (cont'd)

Procedure (cont'd)

11. Read the difference between the new signal level and the center reference graticule line. Calculate the actual power as follows:

    ______________ Level set in step 9.
    \+ ______________ Difference measured in step 11.
    ______________ Actual level.

    The actual level calculated should be within the limits listed in Table 4-2, Performance Test Record.

12. Repeat steps 9 through 11, with Signal Generator settings of –30 dBm through –50 dBm in step 3.

13. Note the Signal Generator's signal level (at –50 dBm) on the spectrum analyzer display. This will be a reference for step 14. Remove the 20 dB attenuator, set the spectrum analyzer IF sensitivity 20 dB higher, and set the vertical sensitivity to the same reference level.

14. Repeat steps 9 through 11 with Signal Generator settings of –60 dBm through –90 dBm.

15. Repeat steps 3 through 14 for Signal Generator frequencies of 10 GHz, 14 GHz, and 20 GHz, or select a frequency of interest in each of the following ranges: 6.6 to 12.3 GHz, 12.3 to 18.6 GHz, and 18.6 to 26.0 GHz.

PERFORMANCE TESTS

4-10. HARMONICS, SUBHARMONICS, & MULTIPLES TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY Harmonics	<−40 dBc	Up to 26 GHz; output level meter readings ≤0 dB on 0 dBm range and below
Subharmonics and and Multiples Thereof	<−25 dBc <−20 dBc	2.0 to 18.6 GHz 18.6 to 26.0 GHz

Description

In this test a spectrum analyzer is used to observe the amplitude of various harmonics of the Signal Generator. In the multiplied bands, subharmonics and multiples (harmonics of the unmultiplied signal) are checked. Reasonable care must be taken to ensure that the harmonics being measured are not generated in the spectrum analyzer or external mixer.

Measurements are made directly, except for harmonics above 22 GHz, where an external mixer is used.

Equipment

Spectrum Analyzer .... HP 8569B/11517A Option E80

Procedure

1. Connect the Signal Generator RF OUTPUT to the input of the spectrum analyzer as shown in Figure 4-4.

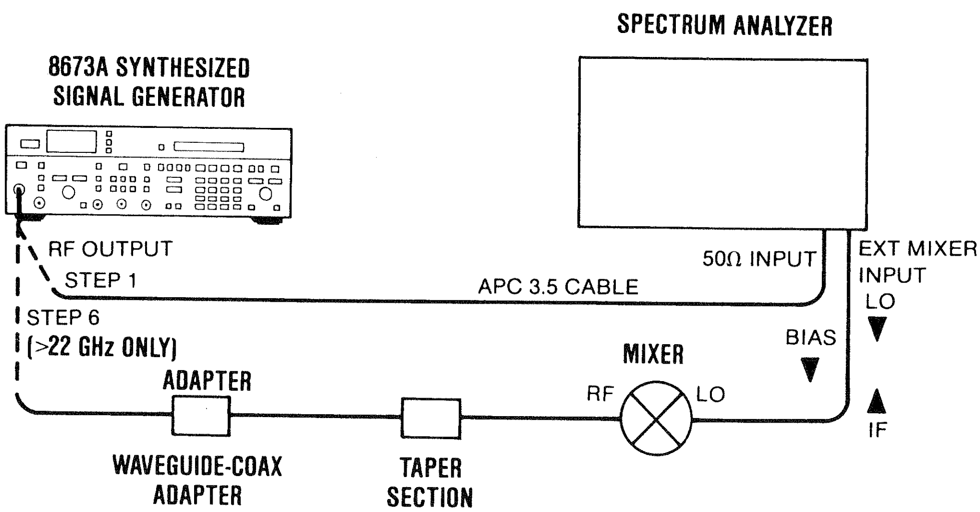


Figure 4-4. Harmonics, Subharmonics, and Multiples Test Setup

2. Set the Signal Generator to 4.000 GHz, RANGE to 0 dBm, and VERNIER to 0 dB.

PERFORMANCE TESTS

4-10. HARMONICS, SUBHARMONICS, & MULTIPLES TESTS (cont'd)

Procedure (cont'd)

3. Set the spectrum analyzer controls to display the fundamental signal. Set the resolution bandwidth to 10 kHz and the input attenuation to 40 dB. Adjust the log reference level to set the signal to the top graticule line of the display.

4. Tune the Signal Generator to 2.000 GHz. The second harmonic, now at 4.000 GHz, viewed on the analyzer display, should be greater than 40 dB below the reference.

5. Repeat steps 2 through 4, at the other Signal Generator frequencies listed, to check each harmonic, subharmonic, and multiple listed in the table below, except for harmonics that are above 22 GHz.

NOTE

This procedure may be repeated for any fundamental frequency of interest within the Signal Generator frequency range.

6. Connect the equipment as shown in Figure 4-4 using the external mixer and adapter. Select the 14.5 to 26.6 GHz band on the spectrum analyzer, and adjust the bias current for optimum signal on the display.

7. Repeat steps 2 through 4, with the Signal Generator set to 12 GHz, to check harmonics at 24 GHz.

Harmonics, Subharmonics, and Multiples

Set Signal Generator to	Check Harmonic Levels at:					
FUNDAMENTAL	HARMONIC	SUBHARMONIC			MULTIPLES	
(GHz)	(GHz)	1/4	1/3	1/2	2/3	3/4
2.0000	4.0000					
4.0000	8.0000					
6.0000	12.0000					
8.0000	16.0000			4.0000		
10.0000	20.0000			5.0000		
12.0000	24.0000			6.0000		
14.0000			4.6667		9.3333	
16.0000			5.3333		10.6667	
18.0000			6.0000		12.0000	
20.0000		5.0000		10.0000		15.0000
22.0000		5.5000		11.0000		16.5000
24.0000		6.0000		12.0000		18.0000
26.0000		6.5000		13.0000		19.5000
LIMITS	<−40 dBc	<−25 dBc 2.0 to 18.6 GHz <−20 dBc above 18.6 GHz				

PERFORMANCE TESTS

4-11. NON-HARMONICALLY RELATED SPURIOUS SIGNALS (CW AND AM MODES) TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY Spurious: Non-Harmonically Related	 <−70 dBc <−64 dBc <−60 dBc <−58 dBc	 CW and AM modes 2.0 to 6.6 GHz 6.6 to 12.3 GHz 12.3 to 18.6 GHz 18.6 to 26.0 GHz

Description A spectrum analyzer, calibrated for −50 dBc, is tuned to any frequency from 2 to 26 GHz in search of spurious signals.

NOTE

The non-harmonically related spurious signals will always increase in amplitude above 6.6 GHz, due to multiplication in the internal YIG tuned multiplier. The increase is determined by a strict mathematical relationship. Therefore, satisfactory performance in the 2 to 6.6 GHz range will always ensure meeting the less stringent specification in the multiplied ranges, that is, from 6.6 to 26.0 GHz.

Equipment Spectrum Analyzer .... HP 8569B

Procedure

1. Connect the Signal Generator RF OUTPUT to the input of the spectrum analyzer as shown in Figure 4-5.

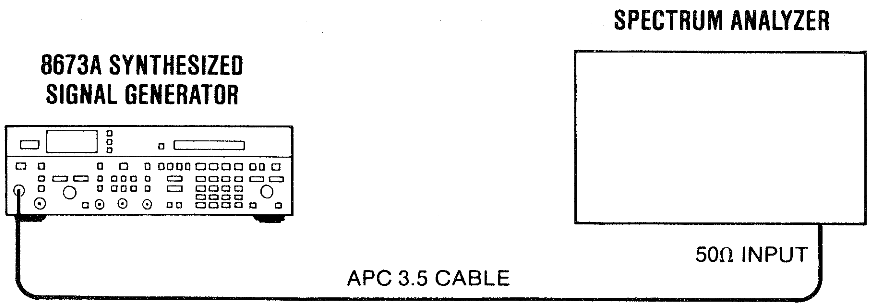


Figure 4-5. Non-Harmonically Related Spurious (CW and AM Modes) Test Setup

2. Set the Signal Generator to 3.000 GHz, RANGE to −50 dBm, and VERNIER to +3 dB.
3. Set the spectrum analyzer controls to display the fundamental signal. Set the resolution bandwidth to 1 kHz and the frequency span per division to 10 kHz.
4. Set the spectrum analyzer controls so that the carrier signal is at the top graticule line.
5. Increase the Signal Generator output to +3 dBm. Do not adjust the spectrum analyzer amplitude calibration. The top graticule line now represents −50 dBc.

PERFORMANCE TESTS

4-11. NON-HARMONICALLY RELATED SPURIOUS SIGNALS (CW AND AM MODES) TESTS (cont'd)

Procedure (cont'd)

6. Tune the spectrum analyzer to any desired frequency in search of non-harmonically related spurious signals. Verify that any signals found are non-harmonically related and are not generated by the spectrum analyzer. Verify that the spurious signals are below the specified limits. Record the results.

Carrier Frequency	Spurious Signal Frequency	Spurious Signal Frequency
______	______	______
______	______	______
______	______	______
______	______	______

7. Repeat step 2 through 6 for any desired carrier frequency from 2 to 6.6 GHz. Record the results. (Checking non-harmonically related spurious signals from 2.0 to 6.6 GHz provides a high level of confidence that the instrument meets its published specifications from 2 to 26 GHz.)

Carrier Frequency	Spurious Signal Frequency	Spurious Signal Frequency
______	______	______
______	______	______
______	______	______
______	______	______

PERFORMANCE TESTS

4-12. POWER LINE RELATED SPURIOUS SIGNALS TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY Power line related and fan rotation related within 5 Hz below line frequencies and multiples therof		**2.0—6.6 GHz**
	-50 dBc	<300 Hz offset from carrier
	-60 dBc	300 Hz to 1 kHz offset from carrier
	-65 dBc	>1 kHz offset from carrier
		6.6—12.3 GHz
	-44 dBc	<300 Hz offset from carrier
	-54 dBc	300 Hz to 1 kHz offset from carrier
	-59 dBc	>1 kHz offset from carrier
		12.3—18.6 GHz
	-40 dBc	<300 Hz offset from carrier
	-50 dBc	300 Hz to 1 kHz offset from carrier
	-55 dBc	>1 kHz offset from carrier
		18.6—26.0 GHz
	-38 dBc	<300 Hz offset from carrier
	-48 dBc	300 Hz to 1 kHz offset from carrier
	-53 dBc	>1 kHz offset from carrier

Description

The RF output of the Signal Generator is mixed with a local oscillator to obtain a 20 kHz IF signal. The line related sidebands are observed on a spectrum analyzer.

NOTE

The Signal Generator and local oscillator are isolated from vibration on a two-inch thick foam pad. The Signal Generator must be operated from a separate power line source (52 to 58 Hz) in order to differentiate its spurious signals from other line related spurious signals.

Equipment

Local Oscillator .... HP 8673A
Spectrum Analyzer (5 Hz—50 kHz) .... HP 3580A
Mixer .... RHG DMS1-26
Variable Frequency AC Power Source .... 501TC/800T, California Instruments

Procedure

1. Place the Signal Generator on a 2-inch foam pad. Connect the equipment as shown in Figure 4-6.

NOTE

Connect the mixer directly to the local oscillator to avoid any power loss.

PERFORMANCE TESTS

4-12. POWER LINE RELATED SPURIOUS SIGNALS TESTS (cont'd)

Procedure (cont'd)

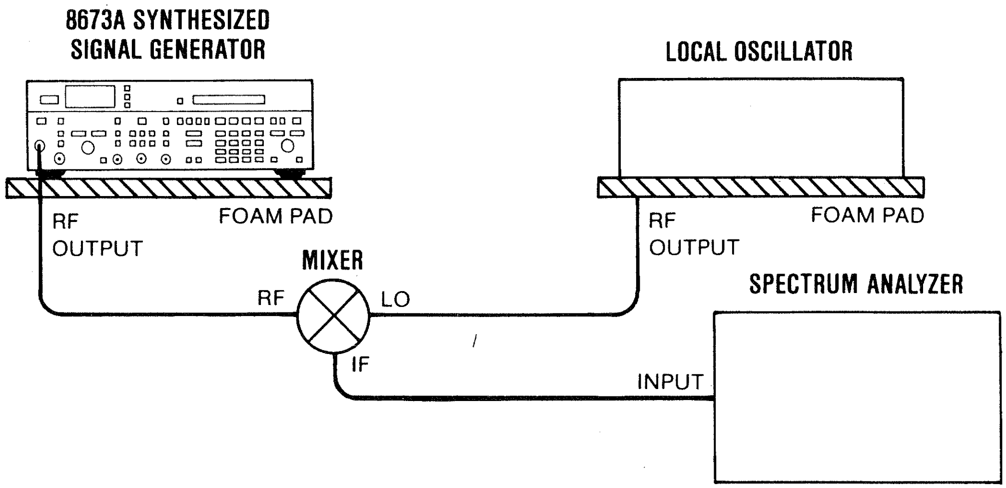


Figure 4-6. Power Line Related Spurious Signals Test Setup

2. Set the Signal Generator to 3000 MHz at −20 dBm with all modulation off.

3. Set the local oscillator to 3000.020 MHz at +7 dBm.

4. Set the spectrum analyzer start frequency to 20 kHz, resolution bandwidth to 3 Hz.

5. Set the spectrum analyzer frequency span per division to 50 Hz. Set the spectrum analyzer controls so the peak of the 20 kHz signal is at the top graticule line. Verify that the line related harmonics of the Signal Generator do not exceed the values shown below. Record the highest spurious signal level in each offset band.

   2.0 — 6.6 GHz <300 Hz offset ________ −50 dBc

   300 Hz — 1 kHz offset ________ −60 dBc

6. Set the spectrum analyzer frequency span per division to 500 Hz. Measure and record the highest spurious signal level.

   2.0 — 6.6 GHz >1 kHz offset ________ −65 dBc

7. Set the Signal Generator and the local oscillator to 7000 MHz and 7000.020 MHz respectively.

PERFORMANCE TESTS

4-12. POWER LINE RELATED SPURIOUS SIGNALS TESTS (cont'd)

Procedure (cont'd)

8. Set the spectrum analyzer frequency span per division to 50 Hz. Set the spectrum analyzer controls so that the peak of the 20 kHz signal is at the top graticule line. Verify that the line related harmonics of the Signal Generator do not exceed the values shown in the table. Record the highest spurious signal level in each offset band.

   6.6 — 12.3 GHz <300 Hz offset frequency________ Level ________ −44 dBc

   300 Hz — 1 kHz offset frequency________ Level ________ −54 dBc

9. Set the spectrum analyzer frequency span per division to 500 Hz. Measure and record the spurious signal levels.

   6.6 — 12.3 GHz >1 kHz offset frequency ________ Level ________ −59 dBc

10. Set the Signal Generator and the local oscillator to 16 000 MHz and 16 000.020 MHz respectively.

11. Set the spectrum analyzer frequency span per division to 50 Hz. Set the spectrum analyzer controls so that the 20 kHz signal is at the top graticule line. Verify that the line related harmonics of the Signal Generator do not exceed the values shown in the table. Record the highest spurious signal level in each offset band.

    12.3 — 18.6 GHz <300 Hz offset frequency ________ Level ________ −40 dBc

    300 Hz — 1 kHz offset frequency ________ Level ________ −50 dBc

12. Set the spectrum analyzer frequency span per division to 500 Hz. Measure and record the spurious signal levels.

    12.3 — 18.6 GHz >1 kHz offset frequency ________ Level ________ −55 dBc

13. Set the Signal Generator and the local oscillator to 20 000 MHz and 20 000.020 MHz respectively.

14. Set the spectrum analyzer frequency span per division to 50 Hz. Set the spectrum analyzer controls so that the 20 kHz signal is at the top graticule line. Verify that the line related harmonics of the Signal Generator do not exceed the values shown in the table. Record the highest spurious signal level in each offset band.

    18.6 — 26.0 GHz <300 Hz offset frequency ________ Level ________ −38 dBc

    300 Hz — 1 kHz offset frequency ________ Level ________ −48 dBc

15. Set the spectrum analyzer frequency span per division to 500 Hz. Measure and record the spurious signal levels.

    18.6 — 26.0 GHz >1 kHz offset frequency________ Level ________ −53 dBc

PERFORMANCE TESTS

4-13. SINGLE-SIDEBAND PHASE NOISE TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY		
Single-sideband Phase Noise (1 Hz bandwidth; CW mode)		**2.0 — 6.6 GHz**
	−58 dBc	10 Hz offset from carrier
	−70 dBc	100 Hz offset from carrier
	−78 dBc	1 kHz offset from carrier
	−86 dBc	10 kHz offset from carrier
	−110 dBc	100 kHz offset from carrier
		6.6 — 12.3 GHz
	−52 dBc	10 Hz offset from carrier
	−64 dBc	100 Hz offset from carrier
	−72 dBc	1 kHz offset from carrier
	−80 dBc	10 kHz offset from carrier
	−104 dBc	100 kHz offset from carrier
		12.3 — 18.6 GHz
	−48 dBc	10 Hz offset from carrier
	−60 dBc	100 Hz offset from carrier
	−68 dBc	1 kHz offset from carrier
	−76 dBc	10 kHz offset from carrier
	−100 dBc	100 kHz offset from carrier
		18.6 — 26.0 GHz
	−46 dBc	10 Hz offset from carrier
	−58 dBc	100 Hz offset from carrier
	−66 dBc	1 kHz offset from carrier
	−74 dBc	10 kHz offset from carrier
	−98 dBc	100 kHz offset from carrier

Description

The RF output of the Signal Generator is mixed with a local oscillator to obtain a 40 kHz or 200 kHz IF signal. The noise sidebands are observed on a spectrum analyzer. Correction factors are applied to compensate for using the spectrum analyzer in the log mode, for local oscillator noise contributions, and for using bandwidths wider than 1 Hz.

NOTE

Normally, phase quadrature needs to be maintained between the Signal Generator and the local oscillator for true phase noise measurement. However, the additional amplitude noise components are so small that they are not significant in these tests.

Equipment

Local Oscillator .... HP 8673A
Spectrum Analyzer (5 Hz — 50 kHz) ...... HP 3580A
Spectrum Analyzer (20 Hz — 300 kHz) .... HP 8556A/8552B/141T
Mixer .... RHG DMS1-26

4-13. SINGLE-SIDEBAND PHASE NOISE TESTS (cont'd)

NOTE

The signal-to-phase noise ratio as measured must be corrected to compensate for 3 errors contributed by the measurement system. These are

a. Using the spectrum analyzer in the log mode requries a +2.5 dB correction.

b. Equal noise contributed by the local oscillator requires a −3 dB correction.

c. The spectrum analyzer noise measurement must be normalized to a 1 Hz noise equivalent bandwidth. The noise equivalent bandwidth for HP spectrum analyzers is 1.2 times the 3 dB bandwidth.

For a 3 Hz bandwidth, the correction factor for the normalized measurement bandwidth would be:

$$\text{Normalizing Factor dB} = 10 \log (1.2 \times 3\ \text{Hz}/1\text{Hz}) = 5.56\ \text{dB.}$$

The total correction for 3 Hz bandwidth would be:

True measurement (dBc) = Reading (dBc) − 5.56 + 2.5 − 3 = −6.06 dB.

Procedure

1. Set the 5 Hz — 50 kHz spectrum analyzer's display to 40 kHz, bandwidth to 1 kHz, and frequency span per division to 5 Hz.

2. Connect the equipment as shown in Figure 4-7.

NOTE

Connect the mixer directly to the local oscillator to avoid any power loss.

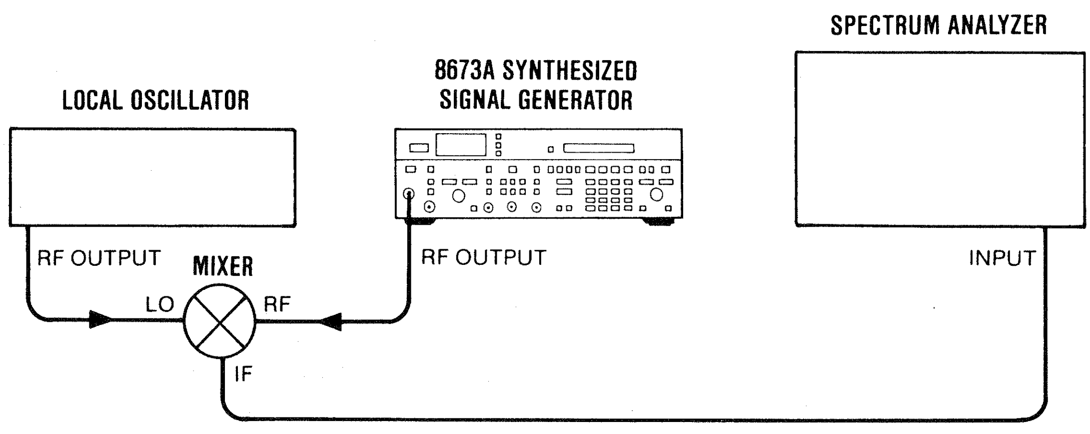


Figure 4-7. Single-Sideband Phase Noise Test Setup

3. Set the Signal Generator to 6600 MHz at −20 dBm.

4. Set the local oscillator to 6599.960 MHz at +8 dBm.

PERFORMANCE TESTS

4-13. SINGLE-SIDEBAND PHASE NOISE TESTS (cont'd)

Procedure (cont'd)

5. Set the spectrum analyzer controls so that the peak of the 40 kHz signal is at the top graticule line.

6. Observe the noise level 10 Hz from the carrier. It should be greater than 58 dB below the carrier. Record the measured level.

   Measured _______________
   Correction −1.30 dB
   Actual level _______________

7. Set the Signal Generator and the local oscillator to 12 300 MHz and 12 299.960 MHz respectively.

8. Observe the noise level 10 Hz from the carrier. It should be greater than 52 dB below the carrier. Record the measured level.

   Measured _______________
   Correction −1.30 dB
   Actual level _______________

9. Set the Signal Generator and the local oscillator to 18 600 MHz and 18 599.960 MHz respectively.

10. Observe the noise level 10 Hz from the carrier. It should be greater than 48 dB below the carrier. Record the measured level.

    Measured _______________
    Correction −1.30 dB
    Actual level _______________

11. Set the Signal Generator and the local oscillator to 26 000 MHz and 25 999.960 MHz respectively.

12. Observe the noise level 10 Hz from the carrier. It should be greater than 46 dB below the carrier. Record the measured level.

    Measured _______________
    Correction −1.30 dB
    Actual level _______________

13. Set the spectrum analyzer controls for a bandwidth of 3 Hz and a frequency span per division of 20 Hz. Using a 3 Hz bandwidth requires a 6.06 dB correction factor.

14. Repeat steps 3 through 12 except observe the noise 100 Hz from the carrier. Record the results below.

Frequency	Limit	Measured	Correction	Actual
6600 MHz	−70 dBc	________	−6.06 dB =	________
12 300 MHz	−64 dBc	________	−6.06 dB =	________
18 600 MHz	−60 dBc	________	−6.06 dB =	________
26 000 MHz	−58 dBc	________	−6.06 dB =	________

PERFORMANCE TESTS

4-13. SINGLE-SIDEBAND PHASE NOISE TESTS (cont'd)

Procedure (cont'd)

15. For the remainder of the prcedure, use the 20 Hz — 300 kHz spectrum analyzer. Set the spectrum analyzer bandwidth to 30 Hz and frequency span per division to 200 Hz. The 30 Hz bandwidth requires 16.06 dB correction.

16. Set the Signal Generator and the local oscillator to 6600 MHz and 6599.800 MHz respectively.

17. Tune the spectrum analyzer to place the 200 kHz IF signal at the left edge of the display. Set the spectrum analyzer controls to place the peak of the signal at the top graticule line. Increase the log reference level control to move the peak of the carrier 20 dB above the top graticule line. (The top graticule line is now −20 dBc.)

18. Observe the noise level 1 kHz from the carrier. It should be greater than 78 dB below the carrier. Record the measured level.

    Measured ______________
    Correction −16.06 dB
    Actual Level ______________

19. Set the Signal Generator and the local oscillator to 13 300 MHz and 12 299.800 MHz respectively.

20. Observe the noise level 1 kHz from the carrier. It should be greater than 72 dB below the carrier. Record the measured level.

    Measured ______________
    Correction −16.06 dB
    Actual Level ______________

21. Set the Signal Generator and the local oscillator to 18 000 MHz and 17 999.800 MHz respectively.

22. Observe the noise level 1 kHz from the carrier. It should be greater than 68 dB below the carrier. Record the measured level.

    Measured ______________
    Correction −16.06 dB
    Actual Level ______________

23. Set the Signal Generator and the local oscillator to 26 000 MHz and 25 999.800 MHz respectively.

24. Observe the noise level 1 kHz from the carrier. It should be greater than 66 dB below the carrier. Record the measured level.

    Measured ______________
    Correction −16.06 dB
    Actual Level ______________

PERFORMANCE TESTS

4-13. SINGLE-SIDEBAND PHASE NOISE TESTS (cont'd)

Procedure (cont'd)

25. Set the spectrum analyzer controls for a bandwidth of 300 Hz and a frequency span per division of 2 kHz. Using a 300 Hz bandwidth requires a 26.06 dB correction factor.

26. Repeat steps 16 through 24 except observe the noise 10 kHz from the carrier. Record the results below.

Frequency	Limit	Measured	Correction	Actual
6600 MHz	-86 dBc	________	-26.06 dB =	________
12 300 MHz	-80 dBc	________	-26.06 dB =	________
18 600 MHz	-76 dBc	________	-26.06 dB =	________
26 000 MHz	-74 dBc	________	-26.06 dB =	________

27. Set the spectrum analyzer controls for a bandwidth of 3 kHz and a frequency span per division of 20 kHz. Using a 3 kHz bandwidth requires a 36.06 dB correction factor.

28. Repeat steps 16 through 24 except observe the noise 10 kHz from the carrier. Record the results below.

Frequency	Limit	Measured	Correction	Actual
6600 MHz	-110 dBc	________	-36.06 dB =	________
12 300 MHz	-100 dBc	________	-36.06 dB =	________
18 600 MHz	-100 dBc	________	-36.06 dB =	________
26 000 MHz	- 98 dBc	________	-36.06 dB =	________

PERFORMANCE TESTS

4-14. AMPLITUDE MODULATION TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
AMPLITUDE MODULATION		
Depth (+15°C to +35 °C)	0 to 75%	2.0 to 18.0 GHz; 0 dBm maximum carrier level
	0 to 75%	18.0 to 24.0 GHz; −3 dBm maximum carrier level
	0 to 50%	24.0 to 26.0 GHz; −5 dBm maximum carrier level
Rates	20 Hz to 100 kHz	3 dB bandwidth, 30% depth
Sensitivity (% AM per Vpk)	30%/V and 100%/V ranges	Maximum input 1 Vpk into 600 ohms nominal; AM depth is linearly controlled by varying input level between 0 and 1V peak
Indicated Meter Accuracy	±7% of reading ±3% of range	100 Hz to 10 kHz rates
Accuracy Relative to External AM Input Level	±4% of reading ±2% of range	100 Hz to 10 kHz rates
Incidental Phase Modulation (100 Hz to 10 kHz rates; 30% depth)	<0.4 radians	2.0 to 6.6 GHz
	<0.8 radians	6.6 to 12.3 GHz
	<1.2 radians	12.3 to 18.6 GHz
	<1.6 radians	18.6 to 24.0 GHz
	<2.0 radians	24.0 to 26.0 GHz
Incidental FM	Incidental phase modulation × f_{mod}	

Description

The Signal Generator under test is amplitude modulated with an audio source and mixed down with a local oscillator to produce a modulated 500 MHz IF. The AM depth, accuracy and incidental phase modulation are then measured on the modulation analyzer. The detected audio output from the modulation analyzer is then measured using an audio analyzer. A 0 dB reference is stored at a 1 kHz rate, and the rate stepped from 20 Hz to 100 kHz to measure the AM bandwidth.

Equipment

Local Oscillator .... HP 8673A
Mixer .... RHG DMS1-26
Audio Analyzer (and Source) .... HP 8903A
Modulation Analyzer .... HP 8901A
6 dB Attenuator .... HP 8493C Option 006

PERFORMANCE TESTS

4-14. AMPLITUDE MODULATION TESTS (cont'd)

Procedure

Meter Accuracy

1. Connect equipment as shown in Figure 4-8.

NOTE

Connect the mixer directly to the local oscillator to avoid any power loss.

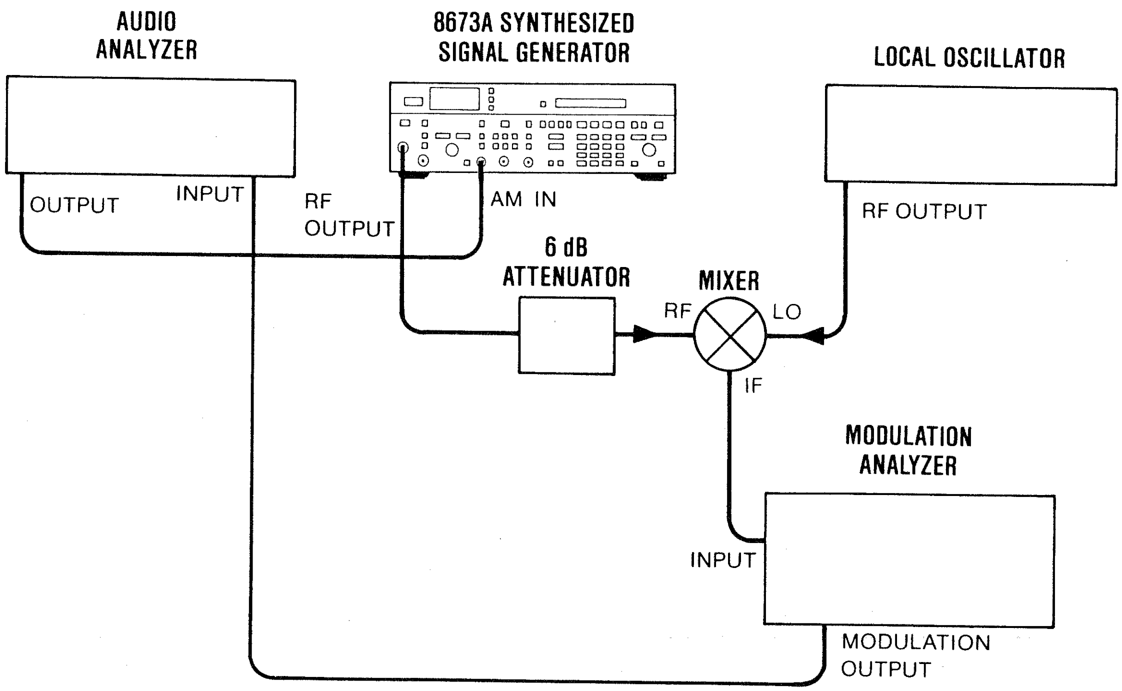


Figure 4-8. AM Modulation Test Setup

2. Set the Signal Generator under test to 0 dBm at 6.6 GHz frequency, internal ALC, AM to 100% range, and FM off.
3. Set the local oscillator to 5.7 GHz at +8 dBm with all modulation off.
4. Select AM mode on modulation analyzer.
5. Set the audio source to 1 kHz, and output level to approximately 0.35 Vrms. Fine tune the level to achieve 50% AM as read on modulation analyzer.
6. The AM meter should indicate 50% AM ±6.5% on the instrument under test.

Accuracy Relative to External AM Input

7. Set the audio source to 10 kHz frequency and 0.530 Vrms. This corresponds to 75% AM depth.
8. Read the actual AM depth on the modulation analyzer. Complete the following table and ensure all measurement data points are within the specified limits.

4-14. AMPLITUDE MODULATION TESTS (cont'd)

Procedure (cont'd)

Signal Generator Frequency	Local Oscillator Frequency	Modulation Rate	AM Depth	Low Limit	Actual Depth	High Limit
6.6 GHz	6.1 GHz	10 kHz	75%	70%	________	80%
6.6 GHz	6.1 GHz	1 kHz	75%	70%	________	80%
6.6 GHz	6.1 GHz	.1 kHz	75%	70%	________	80%
10 GHz	9.5 GHz	10 kHz	75%	70%	________	80%
14 GHz	13.5 GHz	10 kHz	75%	70%	________	80%
18.6 GHz	18.1 GHz	10 kHz	75%	70%	________	80%
22 GHz	21.5 GHz	10 kHz	75%	70%	________	80%

9. Set the audio source level to 0.354 Vrms and perform the measurement below.

26 GHz	25.5 GHz	10 kHz	50%	46%	________	54%

Incidental Phase Modulation

10. Set the Signal Generator under test to 0 dBm at 6.2 GHz, internal ALC, AM to 100% range, and FM off.

11. Set the local oscillator to 5.7 GHz at +8 dBm with all modulation off.

12. Select AM mode on modulation analyzer.

13. Set audio source to 10 kHz and output level to obtain 30% AM.

14. Press the Phase Mod key on the modulation analyzer. The incidental phase modulation should be less than 0.4 radians. Complete the remainder of the measurements in the table below.

Signal Generator		Local Oscillator		Incidental Phase Modulation	
Frequency	Level	Frequency	Level	Limit	Actual
6.2 GHz	0 dBm	5.7 GHz	+8 dBm	<0.4 radians	________
12.3 GHz	0 dBm	11.8 GHz	+8 dBm	<0.8 radians	________
18.0 GHz	0 dBm	17.5 GHz	+8 dBm	<1.2 radians	________
24.0 GHz	−5 dBm	23.5 GHz	0 dBm	<1.6 radians	________
26.0 GHz	−5 dBm	25.5 GHz	0 dBm	<2.0 radians	________

AM Rates

15. Connect the modulation analyzer detected audio output to the input of the audio analyzer.

16. Set the Signal Generator to 0 dBm at 4 GHz, internal ALC, AM to 100% range, and FM off.

17. Set the local oscillator to 3.5 GHz at +8 dBm with all modulation off.

18. Select AM mode on the modulation analyzer.

PERFORMANCE TESTS

4-14. AMPLITUDE MODULATION TESTS (cont'd)

Procedure (cont'd)

19. Set the audio source to 1 kHz rate, at a level of 0.212 Vrms. This corresponds to 30% AM modulation depth.

20. Set audio analyzer to read the amplitude of the input signal.

21. Set the audio analyzer to the dB relative mode using the input signal from the modulation analyzer as a 0 dB reference.

22. Set the audio source to 20 Hz and step the frequency up to 100 kHz. Ensure that the input signal level as read on the audio analyzer does not change more than ±3 dB from the reference at any frequency from 20 Hz to 100 kHz.

23. Repeat steps 5 through 7 for the frequencies and levels listed below.

Signal Generator Frequency	Signal Generator Level	Local Oscillator Frequency	AM Depth	Modulation Level	
				Frequency	Change
4.0 GHz	0 dBm	3.5 GHz	30%	________	________
6.7 GHz	0 dBm	6.2 GHz	30%	________	________
15.0 GHz	0 dBm	14.5 GHz	30%	________	________
24.0 GHz	−3 dBm	23.5 GHz	30%	________	________
26.0 GHz	−3 dBm	25.5 GHz	30%	________	________

PERFORMANCE TESTS

4-15. FM FREQUENCY RESPONSE TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY MODULATION Frequency Response Relative to a 100 kHz Rate	±2 dB	100 Hz to 3 MHz, 30 and 100 kHz/V ranges
	±2 dB	3 kHz to 3 MHz, 0.3, 1, 3, and 10 MHz/V ranges

Description

The test oscillator is tuned to 100 kHz and the output level is adjusted to obtain a Bessel (first carrier) null (2.404). The output level and the 100 kHz rate are the references for later calculations. At other modulation rates, the output level is set and measured for the first carrier null. The measured voltage and the rate are then compared to the established reference to determine frequency response.

Equipment

Spectrum Analyzer .... HP 8569B
Test Oscillator .... HP 651B
Frequency Counter .... HP 5343A
AC Voltmeter .... HP 400E

Procedure

1. Connect the equipment as shown in Figure 4-9.

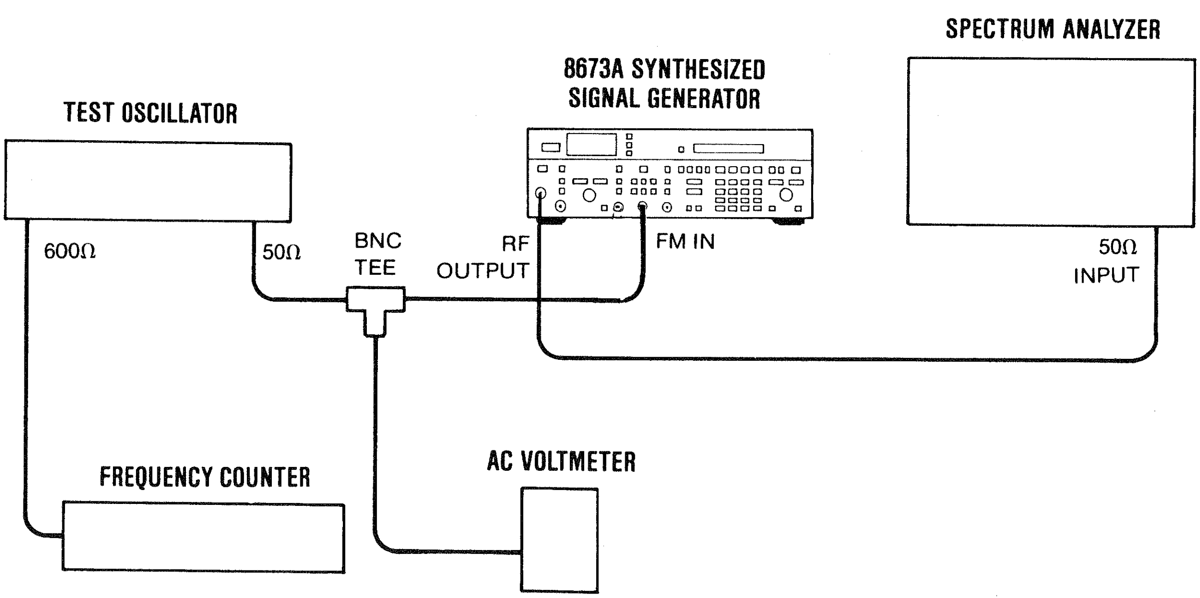


Figure 4-9. FM Frequency Response Test Setup

2. Set the Signal Generator to 4 GHz at 0 dBm. Adjust the spectrum analyzer controls to display the RF signal. Set the frequency span per division to 100 kHz. Set other controls as needed for a calibrated display.

3. Set FM DEVIATION to 10 MHz. Tune the test oscillator to 100 ±1 kHz.

PERFORMANCE TESTS

4-15. FM FREQUENCY RESPONSE TESTS (cont'd)

Procedure (cont'd)

4. Adjust the test oscillator voltage to obtain the first carrier null. The voltage should be about 0.017 Vrms. Record the voltmeter reading in the following table.

5. Tune the test oscillator to 3 kHz and adjust the output voltage to obtain the first carrier null. Record the measured frequency and voltage in the table.

6. Repeat step 5 for each of the remaining frequencies in the table.

FM Rate (in kHz)	Measured Frequency (f_x: in kHz)	Measured Voltage V_x (mVrms)	Calculated Response (in dB)
3	________	________	________
30	________	________	________
100	100.0	________	0
300	________	________	________
1000	________	________	________
3000	________	________	________

7. Use the following equation to calculate FM frequency response:

$$\text{dB} = 20 \log \frac{V_x}{V_{100\ \text{kHz}}} - 20 \log \frac{f_x}{100\ \text{kHz}}$$

where dB = the calculated frequency response

V_x = the voltage measured at f_x

$V_{100\ \text{kHz}}$ = the reference voltage measured at 100 kHz

f_x = the measured frequency.

PERFORMANCE TESTS

4-16. FM INPUT AND METER ACCURACY TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY MODULATION Maximum Peak Deviation	The smaller of 10 MHz or $f_{mod} \times 5$	2.0 to 6.6 GHz
	The smaller of 10 MHz or $f_{mod} \times 10$	6.6 to 12.3 GHz
	The smaller of 10 MHz or $f_{mod} \times 15$	12.3 to 18.6 GHz
	The smaller of 10 MHz or $f_{mod} \times 20$	18.6 to 26.0 GHz
Sensitivity (peak deviation per Vpk)	Maximum input 1 Vpk into 50 ohms nominal	All ranges; peak deviation is linearly controlled by varying input level between 0 and 1 Vpk
Indicated Meter Accuracy	±12% of reading ±3% of range	100 kHz rate
Accuracy Relative to External FM Input Level	±7% of reading ±3% of range	100 kHz rate

Description The output of the Signal Generator is mixed with a local oscillator to produce a 500 MHz IF signal. A modulation analyzer measures the FM characteristics of the IF signal.

Equipment

Modulation Analyzer .... HP 8901A
Test Oscillator .... HP 651B
Mixer .... RHG DMS1-26
Local Oscillator .... HP 8673A
Digital Voltmeter .... HP 3455A
Frequency Counter .... HP 5340A

Procedure

1. Connect the equipment as shown in Figure 4-10.

NOTE

Connect the mixer directly to the local oscillator to avoid any power loss.

PERFORMANCE TESTS

4-16. FM INPUT AND METER ACCURACY TESTS (cont'd)

Procedure (cont'd)

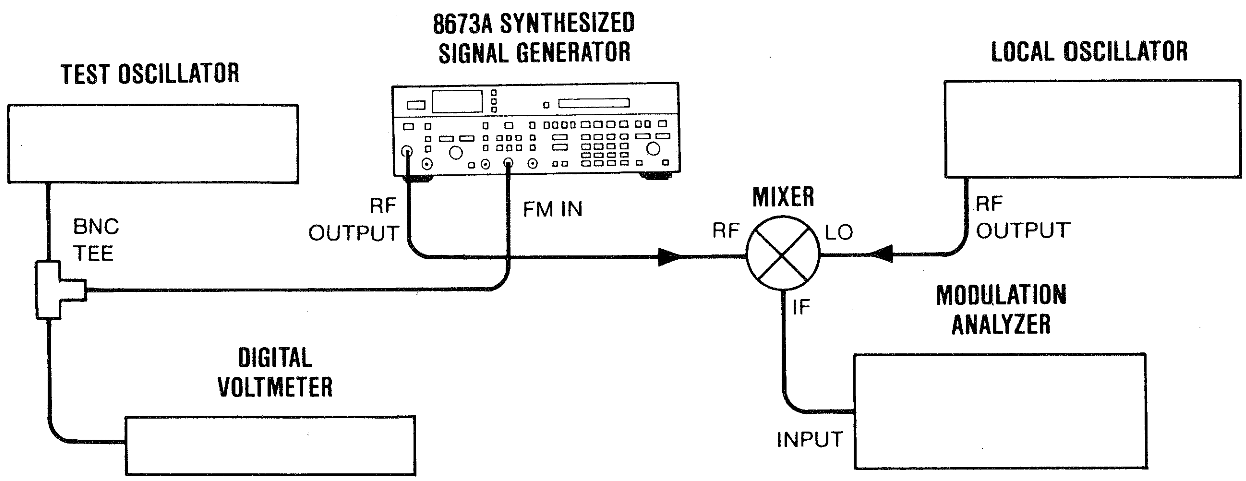


Figure 4-10. FM Input and Meter Accuracy Test Setup

2. Set the instrument under test to −5 dBm at 2 GHz and the local oscillator to +8 dBm at 2.5 GHz. Press the frequency key on the modulation analyzer to verify that the IF is 500 MHz. (The actual IF used is not critical but merely verifies that the setup is working.)

3. Set the test oscillator to 100 kHz rate. Adjust the output level to approximately 0.707 Vrms.

Sensitivity and Meter Accuracy

4. Set the modulation analyzer to measure FM. Set the Signal Generator FM DEVIATION to 0.3 MHz. Adjust the test oscillator level to obtain full scale on the front panel meter. The modulation analyzer should read 300 ±45 kHz deviation.

5. Adjust test oscillator level to obtain 50 kHz deviation as read on the Signal Generator meter.

6. The modulation analyzer should read 50 ±15 kHz deviation.

FM Overmod Test

7. Set the Signal Generator FM DEVIATION to 10 MHz. Set the test oscillator to 2 MHz and 0.707 Vrms. The front panel FM OVERMOD status annunciator should be off.

Accuracy Relative to External FM Input

8. Set the test oscillator to 100 kHz and 0.707 Vrms.

9. Set the Signal Generator FM DEVIATION to 0.3 MHz. The modulation analyzer should indicate deviation within the limits listed in the following table.

PERFORMANCE TESTS

4-16. FM INPUT AND METER ACCURACY TESTS (cont'd)

Procedure (cont'd)

FM Deviation	Test Oscillator Level (Vrms)	Desired Deviation	Low Limit	Measured Deviation	High Limit
.03 MHz	.707 Vrms	30 kHz	27 kHz	________	33 kHz
.1 MHz	.707 Vrms	100 kHz	90 kHz	________	110 kHz
.3 MHz	.707 Vrms	300 kHz	270 kHz	________	330 kHz
1 MHz	.212 Vrms	300 kHz	249 kHz	________	351 kHz

10. Select each FM DEVIATION shown in the table above and set the level of test oscillator to the specified level. Verify that the actual deviation is within the specified limits for each range.

11. Set the Signal Generator FM DEVIATION to 0.3 MHz. Set the Signal Generator to 6.7 GHz and the local oscillator to 7.2 GHz. Verify that the measured deviation is within the limits shown below.

12. Repeat step 11 for the other two Signal Generator and local oscillator frequencies listed below.

Signal Generator Frequency	Local Oscillator Frequency	Low Limit	Actual Deviation	High Limit
6.7 GHz	7.2 GHz	270 kHz	________	330 kHz
12.4 GHz	12.9 GHz	270 kHz	________	330 kHz
18.7 GHz	19.2 GHz	270 kHz	________	330 kHz

PERFORMANCE TESTS

4-17. INCIDENTAL AM TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY MODULATION Incidental AM	<5%	Rates <100 kHz; peak deviations ≤1 MHz

Description

A reference is established by modulating the Signal Generator at 5% AM (the maximum allowable incidental AM). The detected signal is measured with a voltmeter. Then the Signal Generator is frequency modulated and the detected AM level is compared to the reference level.

Equipment

Digital Voltmeter .... HP 3455A
Test Oscillator .... HP 651B
Crystal Detector .... HP 8473C
50 Ohm Termination .... HP 11593A

Procedure

1. Connect the equipment as shown in Figure 4-11.

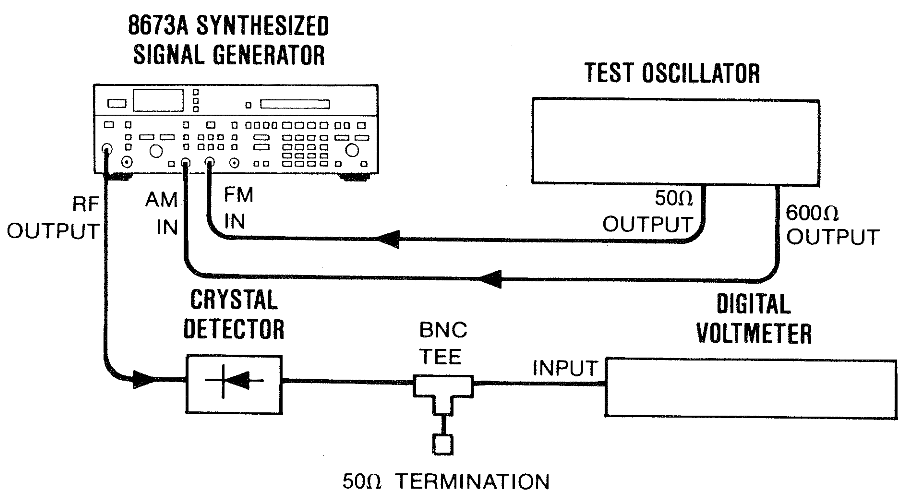


Figure 4-11. Incidental AM Test Setup

2. Set the Signal Generator to 2 GHz at 0 dBm. Select the 30% AM range.

3. Set the test oscillator to 10 kHz, and adjust the output for a 5% AM reading on the Signal Generator.

4. Record the detected level of AM as indicated by the digital voltmeter.

   Reference Level ________ Vrms

5. Set the Signal Generator to AM OFF and set FM DEVIATION to the 1 MHz range.

PERFORMANCE TESTS

4-17. INCIDENTAL AM TESTS (cont'd)

Procedure (cont'd)

6. Set the test oscillator frequency to 100 kHz.
7. Vary the test oscillator amplitude between 0 and 0.5 Vrms. Verify that the voltmeter reading is less than the level recorded in step 4. Record the level.

   2.0 GHz ____________ Vrms

8. Set the Signal Generator to 6.7 GHz at 0 dBm. Vary the test oscillator amplitude between 0 and 0.707 Vrms. Verify that the voltmeter reading does not exceed the level recorded in step 4. Record the maximum level.

   6.7 GHz ____________ Vrms

9. Repeat step 8 for Signal Generator frequencies of 12.4 GHz and 18.7 GHz.

   12.4 GHz ____________ Vrms

   18.7 GHz ____________ Vrms

PERFORMANCE TESTS

4-18. PULSE TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
PULSE MODULATION		
ON/OFF Ratio	>80 dB	
Rise and Fall Times	<35 ns	AUTO PEAK enabled
Minimum Leveled RF Pulse Width	<100 ns	
Pulse Repetition Frequency	dc to 1 MHz	
Minimum Duty-Cycle	<0.0001	When internally leveled; no restriction when unleveled
Minimum Pulse Off-Time	<300 ns	
Maximum Peak Power	Same as in CW mode	
Peak Level Accuracy	±1.0 dB	Relative to CW; +15°C to +35°C
Overshoot, Ringing	<0.2 (<20%) <0.25 (<25%)	2.0 to 6.6 and 6.7 to 26.0 GHz 6.6 to 6.7 GHz

Description

The pulse tests are performed in three parts. The first part tests rise time, fall time, overshoot and ringing. In this test, the pulse modulated output of the Signal Generator is mixed with a local oscillator using a double balanced mixer. The resulting 70 MHz IF signal is amplified and viewed on an oscilloscope to determine pulse performance.

The second part tests peak level accuracy. The output of the Signal Generator is switched between CW and pulse modulation mode using the CW level as a reference. The difference in level between the two modes represents the peak level accuracy error.

The third part tests the on/off ratio. A spectrum analyzer is used to measure the change in power output when the pulse modulator is switched from normal mode to complement mode.

Equipment

Local Oscillator .... HP 8673A
Pulse Generator .... HP 8013B
Oscilloscope .... HP 1715A
Pre Amp-Power Amp .... HP 8447F
Mixer .... RHG DMS1-26
Spectrum Analyzer .... HP 8569B
Variable Step Attenuator .... HP 8495D Option 004
3 dB Attenuator .... HP 8491A Option 003
10 pulse DUT cable .... HP 8491A Option 010
Pulse Mixer Cable .... HP 11726-20007
Pulse DUT Cable .... HP 11726-20006

PERFORMANCE TESTS

4-18. PULSE TESTS (cont'd)

Procedure **Rise Time, Fall Time, Overshoot and Ringing**

1. Connect equipment as shown in Figure 4-12. See Figure 4-13 for the required physical interconnections.

NOTES

The Pulse DUT cable and the Pulse Mixer cable are part of the HP 11726A Support Kit.

Make sure there are no sharp bends in the cable, and that all connections are tight. Connect the LO port of the mixer directly to the output connector of the local oscillator. Connect the 3 dB attenuator directly to the IF port of the mixer. This will minimize distortion of the pulse shape, and thus give more accurate measurements.

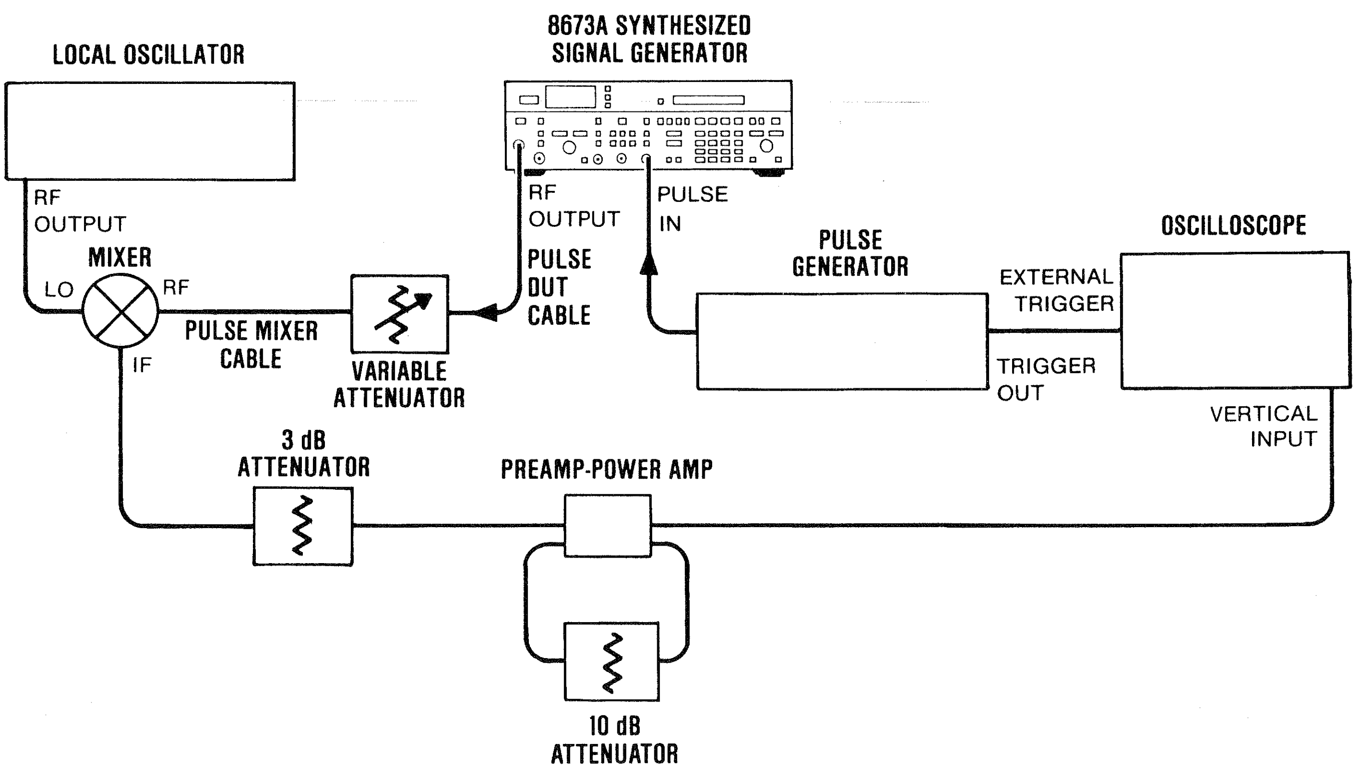


Figure 4-12. Pulse Test Setup

PERFORMANCE TESTS

4-18. PULSE TESTS (cont'd)

Procedure (cont'd)

2. Set the variable step attenuator for 20 dB.

3. Press RCL 0 on the Signal Generator and on the local oscillator. Set equipment controls as follows:

Signal Generator:

OUTPUT LEVEL	+8 dBm
PULSE	NORM
SWEEP FREQ START	2000 MHz
SWEEP FREQ STOP	6600 MHz
FREQ INCR	10 MHz
HP-IB Address	50

Local Oscillator:

Power Level	+8 dBm
Sweep Start Frequency	2070 MHz
Sweep Start Frequency	6670 MHz
Frequency Increment	10 MHz
HP-IB Address	40

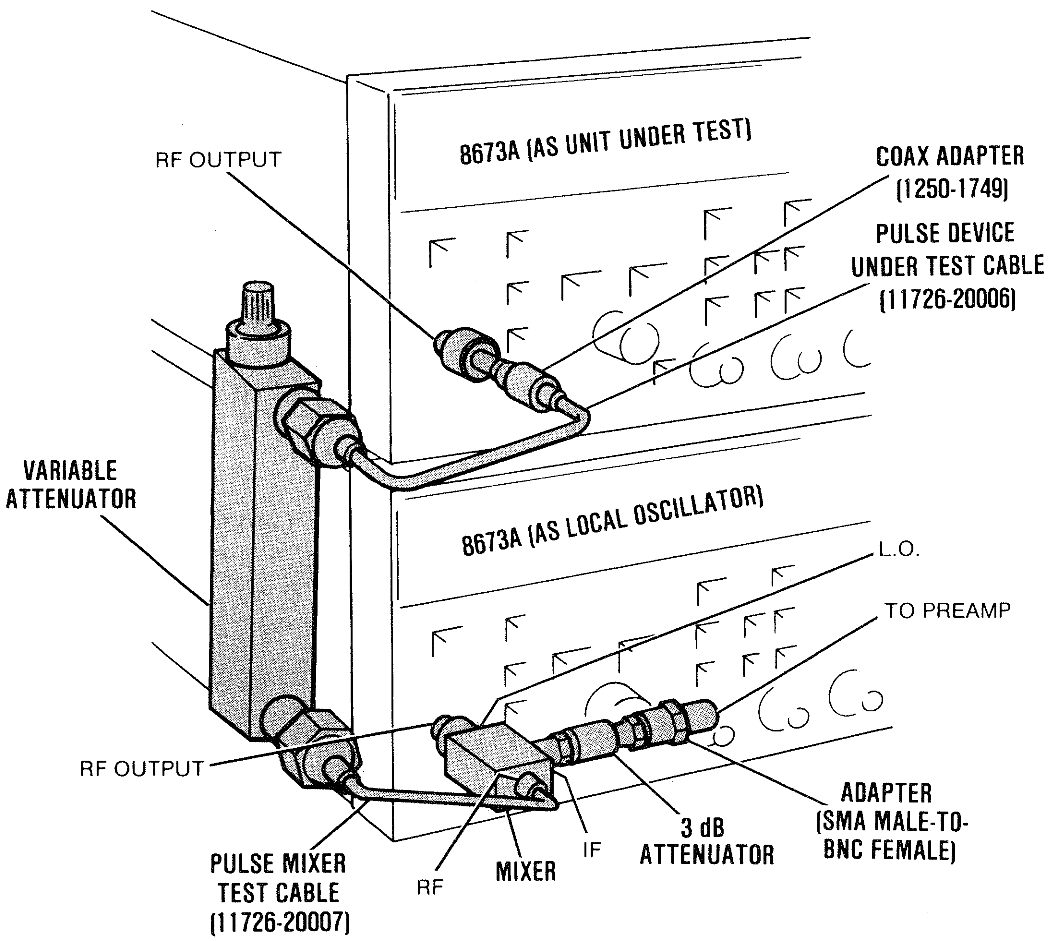


Figure 4-13. Required Equipment Interconnect

PERFORMANCE TESTS

4-18. PULSE TESTS (cont'd)

Procedure (cont'd)

4. The TLK annunciator should be lighted on the Signal Generator, indicating that it will "talk" to, or control, the local oscillator. The LSN annunciator should be lighted on the local oscillator indicating that it will "listen" to, or follow, commands from the Signal Generator. This is referred to as the Master/Slave mode of operation.

5. Set SWEEP MODE to MANUAL on the Signal Generator. Both MANUAL and SINGLE annunciators should be lighted on the Signal Generator. Tuning the frequency of the Signal Generator with the TUNE knob will also cause the local oscillator to change frequency a corresponding amount. Therefore the difference frequency (IF) will remain the same (70 MHz).

6. Set the pulse generator and oscilloscope controls as follows:

Pulse Generator:

Pulse Rate	1 MHz
Pulse Width	120 ns
+ Output	Norm
Int Load	Out
Pulse OUTPUT LEVEL	5V peak
Double/Norm	Norm

Oscilloscope:

Vert Display	Channel A, 50 ohms
Time/Div Main	0.2 μs
Time/Div Delayed	20 ns
Vertical Sensitivity	0.02 V/div.
Trigger	External DC Coupled
Sweep	Mixed

7. Adjust the sweep delay on the oscilloscope to center the modulated 70 MHz RF pulse. Adjust the vertical controls for a 5 division peak pulse display. See Figure 4-14.

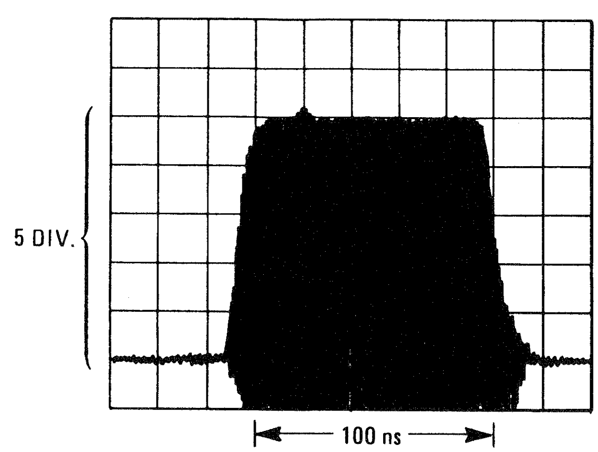


Figure 4-14. Rise Time, Fall Time, Overshoot and Ringing Measurement

PERFORMANCE TESTS

4-18. PULSE TESTS (cont'd)

Procedure (cont'd)

8. Tune the Signal Generator to 2000.000 MHz. The local oscillator should track the Signal Generator frequency with a 70 MHz offset.

9. Measure the pulse rise time, fall time, overshoot and ringing. Record the results.

   Rise Time (10% to 90%) __________ 35 ns
   Fall Time (10% to 90%) __________ 35 ns
   Overshoot and ringing __________ 20%

10. Tune the Signal Generator to 6600.000 MHz. Measure the pulse rise time, fall time, overshoot and ringing. Record the results.

    Rise Time (10% to 90%) __________ 35 ns
    Fall Time (10% to 90%) __________ 35 ns
    Overshoot and ringing __________ 20%

11. Scan the entire frequency band from 2 to 6.6 GHz at output levels of +8 and −10 dBm. Verify that rise and fall times are less than 35 ns and that overshoot and ringing are less than 20%. Record the worst case results.

FREQUENCY (MHz)	OUTPUT LEVEL		Variable Attenuator	Rise (ns)	Fall (ns	Overshoot and Ringing (%)
	Range	Vernier				
________	+10 dBm	-2 dB	20 dB	_____	_____	__________
________	0 dBm	-10 dB	10 dB	_____	_____	__________

NOTE

As the frequency band is scanned using the TUNE knob on the Signal Generator, the peak level of the pulse displayed on the oscilloscope may vary several divisions in amplitude, due to measurement system variations. To compensate for this, adjust the vertical sensitivity controls on the oscilloscope to maintain a constant 5-division peak amplitude while making measurements.

12. Set the SWEEP FREQ START to 6600.002 MHz on the Signal Generator. Set the SWEEP FREQ STOP to 12300.000 MHz.

13. Set the sweep start frequency to 6670.000 MHz on the local oscillator and the sweep stop frequency to 12370.000 MHz.

PERFORMANCE TESTS

4-18. PULSE TESTS (cont'd)

Procedure (cont'd)

14. Tune the Signal Generator to each frequency shown in the table below. Set the OUTPUT LEVEL RANGE and VERNIER as shown for each frequency. Measure rise time, fall time, overshoot and ringing at each frequency. Rise and fall times should be less than 35 ns. Overshoot and ringing should be less than 25% from 6.6 to 6.7 GHz and less than 20% from 6.7 to 12.3 GHz. Record the results.

FREQUENCY (MHz)	OUTPUT LEVEL		Variable Attenuator	Rise (ns)	Fall (ns)	Overshoot and Ringing (%)
	RANGE	VERNIER				
6600.002	+10 dBm	−2 dB	20 dB	________	________	________
6600.002	0 dBm	0 dB	20 dB	________	________	________
6600.002	0 dBm	−10 dB	10 dB	________	________	________
6700.002	+10 dBm	−2 dB	20 dB	________	________	________
6700.002	0 dBm	0 dB	20 dB	________	________	________
6700.002	0 dBm	−10 dB	10 dB	________	________	________
12290.002	+10 dBm	−2 dB	20 dB	________	________	________
12290.002	0 dBm	0 dB	20 dB	________	________	________
12290.002	0 dBm	−10 dB	10 dB	________	________	________

15. Scan the entire band from 6.6 GHz to 12.3 GHz. Ensure that rise time, fall time, overshoot, and ringing are within the limits specified above at power levels of −10 dBm, 0 dBm, and +8 dBm for all frequencies within this range. Record the worst case results.

FREQUENCY (MHz)	OUTPUT LEVEL		Variable Attenuator	Rise (ns)	Fall (ns)	Overshoot and Ringing (%)
	RANGE	VERNIER				
________	+10 dBm	-2 dB	20 dB	________	________	________
________	0 dBm	0 dB	20 dB	________	________	________
________	0 dBm	-10 dB	10 dB	________	________	________

16. Set the SWEEP FREQ START to 12300.003 MHz on the Signal Generator. Set the SWEEP FREQ STOP to 18600.000 MHz.

17. Set the sweep start frequency to 12370.000 MHz on the local oscillator and the sweep stop frequency to 18670.000 MHz.

18. Tune the Signal Generator to each frequency shown in the following table. Set the OUTPUT LEVEL RANGE and VERNIER, and variable step attenuator to the values shown at each frequency. Measure rise time, fall time, overshoot and ringing at each setting. Rise and fall times should be less than 35 ns. Overshoot and ringing should be less than 20 %. Record the measurements.

PERFORMANCE TESTS

4-18. PULSE TESTS (cont'd)

Procedure (cont'd)

FREQUENCY (MHz)	OUTPUT LEVEL RANGE	OUTPUT LEVEL VERNIER	Variable Attenuator	Rise (ns)	Fall (ns)	Overshoot and Ringing (%)
12300.003	+10 dBm	−2 dB	20 dB	______	______	______
12300.003	0 dBm	0 dB	20 dB	______	______	______
12300.003	0 dBm	−10 dB	10 dB	______	______	______
17990.003	+10 dBm	−2 dB	20 dB	______	______	______
17990.003	0 dBm	0 dB	20 dB	______	______	______
17990.003	0 dBm	−10 dB	10 dB	______	______	______
18590.004	+10 dBm	−6 dB	20 dB	______	______	______
18590.004	0 dBm	0 dB	20 dB	______	______	______
18590.004	0 dBm	−10 dB	10 dB	______	______	______

19. Scan the entire band from 12.3 GHz to 18.6 GHz at output levels of −10 dBm, 0 dBm and maximum power. (The maximum power level changes from +8 to +4 dBm at 18 GHz.) Verify that rise and fall times are less than 35 ns and overshoot and ringing are less than 20%. Record the worst case results.

FREQUENCY (MHz)	OUTPUT LEVEL RANGE	OUTPUT LEVEL VERNIER	Variable Attenuator	Rise (ns)	Fall (ns)	Overshoot and Ringing (%)
______	+10 dBm	−2 dB	20 dB	______	______	______
______	+10 dBm	−6 dB	10 dB	______	______	______
______	0 dBm	0 dB	10 dB	______	______	______
______	0 dBm	−10 dB	0 dB	______	______	______

20. Set the SWEEP FREQ START to 18600.004 MHz on the Signal Generator. Set the SWEEP FREQ STOP to 26000.0000 MHz.

21. Set the sweep start frequency to 18530.000 MHz on the local oscillator and the sweep stop frequency to 25930.000 MHz.

22. Tune the Signal Generator to each frequency shown in the table below. Set the OUTPUT LEVEL RANGE and VERNIER, and variable step attenuator to the values shown at each frequency. Measure rise time, fall time, overshoot and ringing at each setting. Rise and fall times should be less than 35 ns. Overshoot and ringing should be less than 20%.

FREQUENCY (MHz)	OUTPUT LEVEL RANGE	OUTPUT LEVEL VERNIER	Variable Attenuator	Rise (ns)	Fall (ns)	Overshoot and Ringing (%)
18600.004	+10 dBm	−6 dB	10 dB	______	______	______
18600.004	0 dBm	0 dB	10 dB	______	______	______
18600.004	0 dBm	−10 dB	0 dB	______	______	______
21990.004	+10 dBm	−6 dB	10 dB	______	______	______
21990.004	0 dBm	0 dB	10 dB	______	______	______
21990.004	0 dBm	−10 dB	0 dB	______	______	______
22000.004	0 dBm	0 dB	10 dB	______	______	______
22000.004	0 dBm	−10 dB	0 dB	______	______	______
25990.004	0 dBm	0 dB	10 dB	______	______	______
25990.004	0 dBm	−10 dB	0 dB	______	______	______

PERFORMANCE TESTS

4-18. PULSE TESTS (cont'd)

Procedure (cont'd)

23. Scan the entire band from 18.6 GHz to 26.0 GHz at output levels of −10 dBm, 0 dBm, and maximum power. (The maximum power level changes from +4 to 0 dBm at 22 GHz.) Verify that rise and fall times are less than 35 ns and that overshoot and ringing are less than 20%. Record the worst case results.

FREQUENCY (MHz)	OUTPUT LEVEL		Variable Attenuator	Rise (ns)	Fall (ns)	Overshoot and Ringing (%)
	RANGE	VERNIER				
________	+10 dBm	−6 dB	10 dB	________	________	________
________	0 dBm	0 dB	10 dB	________	________	________
________	0 dBm	−10 dB	0 dB	________	________	________

Peak Level Accuracy Tests

24. Connect the equipment as shown in Figure 4-12. Set Signal Generator to 6.6 GHz at +8 dBm output level. Set the variable step attenuator to 20 dB.

25. Set the pulse generator to 100 ns pulse width at 1 MHz pulse rate.

26. Set the Signal Generator to PULSE NORM. Adjust the oscilloscope vertical position and sensitivity controls so that the pulse base line is one division from the bottom graticule line and approximately 5 divisions high in peak amplitude.

27. Switch Signal Generator to CW mode.

28. Adjust the oscilloscope vertical sensitivity for a display 5 divisions above the pulse base line. The peak of the CW signal is now the CW peak reference level.

NOTE

Do not touch the vertical position controls after the reference pulse base line has been set.

29. Switch back to PULSE NORM. Without touching the vertical sensitivity controls, measure the difference between the CW peak reference level and the average peak pulse level excluding any over/undershoot. See Figure 4-15.

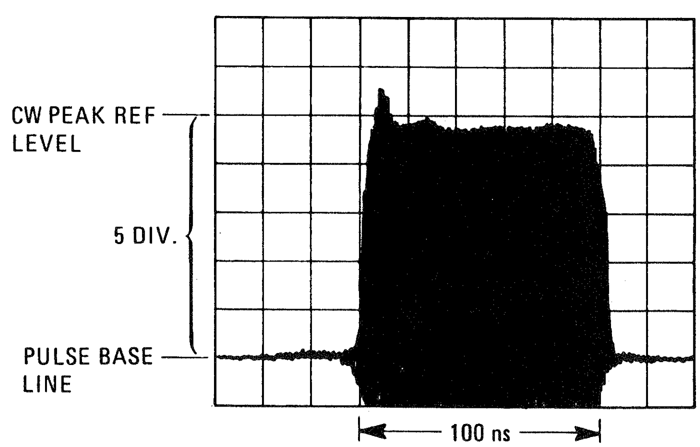


Figure 4-15. Pulse Accuracy Measurement

PERFORMANCE TESTS

4-18. PULSE TESTS (cont'd)

Procedure (cont'd)

30. The error can be read in percent. Using a 5 division peak reference, each division represents 20% of error. Measured error must be within the limits of −8.9% to +12.2%. (−8.9% corresponds to −0.45 divisions on the oscilloscope; +12.2% corresponds to +0.61 divisions.) This is equal to ±1 dB.

Signal Generator		% ERROR
FREQ	LEVEL	
6.6 GHz	+8 dBm	________

31. Repeat steps 24 through 30 for the following frequencies and output levels, keeping a 70 MHz IF between the Signal Generator and local oscillator.

Signal Generator		% ERROR
FREQ	LEVEL	
6.61 GHz	+8 dBm	________
	0 dBm	________
	−10 dBm	________
12.3 GHz	+8 dBm	________
	0 dBm	________
	−10 dBm	________
12.31 GHz	+8 dBm	________
	0 dBm	________
	−10 dBm	________
18.61 GHz	+4 dBm	________
	−10 dBm	________
22.1 GHz	0 dBm	________
	−10 dBm	________

On/Off Ratio Tests

32. Connect the equipment as shown in Figure 4-16.

33. Set the Signal Generator controls as follows:

FREQUENCY	2.0 GHz
OUTPUT LEVEL RANGE	0 dBm
OUTPUT LEVEL VERNIER	−10 dB
PULSE	COMPL
AM	OFF
FM DEVIATION	OFF
SWEEP MODE	OFF

PERFORMANCE TESTS

4-18. PULSE TESTS (cont'd)

Procedure (cont'd)

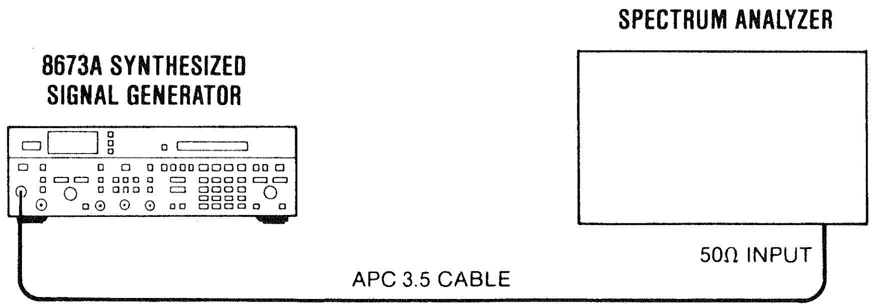


Figure 4-16. On/Off Ratio Test Setup

34. Adjust the spectrum analyzer to establish a reference signal at the top graticule line. Use at least 40 dB of input attenuation and a bandwidth of 1 kHz or less.

35. Set PULSE MODE to NORM.

36. Reduce the spectrum analyzer reference level as needed to observe the residual signal. It should be >80 dB below the reference established in step 34.

Frequency GHz	Level (dB below reference signal)
2.0	80 ________

37. Repeat steps 33 through 36 for Signal Generator frequencies listed below. Record the results.

Frequency GHz	Level (dB below reference signal)
3.0	80 ________
4.0	80 ________
5.0	80 ________
6.0	80 ________
6.6	80 ________

PERFORMANCE TESTS

4-19. INTERNAL TIME BASE AGING RATE

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY Reference Oscillator Frequency Aging Rate	 10 MHz $<5 \times 10^{-10}$/day	 After a 10 day warmup (typically 24 hours in a normal operating environment)
Accuracy and Stability	Same as reference oscillator	

Description

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

Equipment

Frequency Standard .... HP 5065A
Oscilloscope .... HP 1715A
50Ω Termination .... HP 11593A

NOTE

Be sure the Signal Generator has had 10 days to warm up before beginning this test. If the Signal Generator was disconnected from the power line for less than 24 hours, only a 24 hour warm-up is needed.

Procedure

1. Set the rear panel FREQ REFERENCE INT-EXT switch to the INT position.
2. Connect the equipment as shown in Figure 4-17.

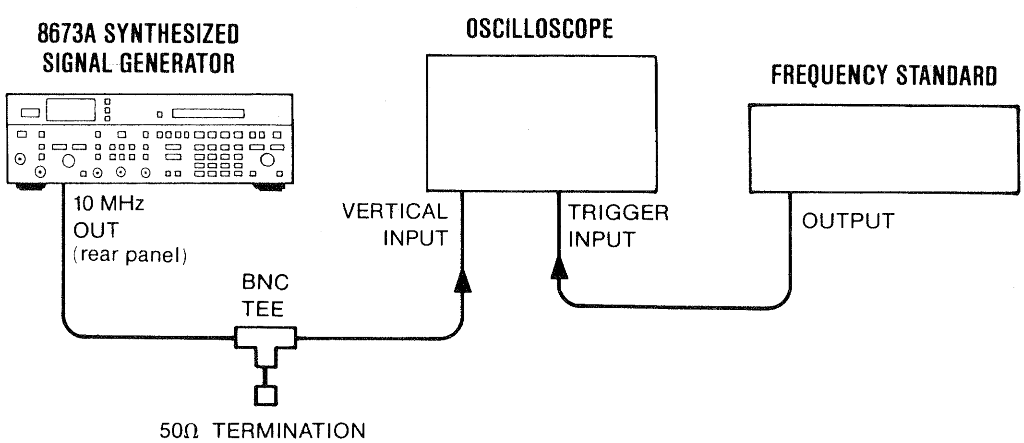


Figure 4-17. Internal Time Base Aging Rate Test Setup

3. Adjust the oscilloscope controls for a stable display of the 10 MHz Signal Generator output.

PERFORMANCE TESTS

4-19. INTERNAL TIME BASE AGING RATE (cont'd)

Procedure (cont'd)

4. Measure the time required for a phase change of 360°. Record the time (T_1) in seconds.

   T_1 = ________ s

5. Wait for a period of time (from 3 to 24 hours) and re-measure the phase change time. Record the period of time between measurements (T_2) in hours and the new phase change time (T_3) in seconds.

   T_2 = ________ h

   T_3 = ________ s

6. Calculate the aging rate from the following equation:

$$\text{Aging Rate} = \left| \left(\frac{1\ \text{cycle}}{f}\right) \left(\frac{1}{T_1} - \frac{1}{T_3}\right) \left(\frac{T}{T_2}\right) \right|$$

where: 1 cycle = the phase change reference for the time measurement (in this case, 360°)

f = Signal Generator's reference output frequency (10 MHz)

T = specified time for aging rate (24h)

T_1 = initial time measurement(s) for a 360° (1 cycle) change

T_2 = time between measurements (h)

T_3 = final time measurement(s) for a 360° (1 cycle) change

for example:

if T_1 = 351s

T_2 = 3h

T_3 = 349s

then:

$$\text{Aging Rate} = \left| \left(\frac{1\ \text{cycle}}{10\ \text{MHz}}\right) \left(\frac{1}{351\text{s}} - \frac{1}{349\text{s}}\right) \left(\frac{24\text{h}}{3\text{h}}\right) \right|$$

$$= 1.306 \times 10^{-11}$$

7. Verify that the aging rate is less than 5×10^{-10}.

NOTE

If the absolute frequencies of the frequency standard and the Signal Generator's reference oscillator are extremely close, the measurement time in steps 5 and 6 (T_1 and T_3) can be reduced by measuring the time required for a phase change of something less than 360°. Change 1 cycle in the formula (i.e., 180° = 1/2 cycle, 90° = 1/4 cycle).

Table 4-2. Performance Test Record (1 of 11)

Hewlett-Packard Company
Model 8673A
Signal Generator

Serial Number ____________________ Tested by ____________________

Date ____________________

Para. No.	Test	Results: Min.	Actual	Max.
4-7.	**FREQUENCY RANGE AND RESOLUTION**			
	Range (GHz)			
	2.000 000	1.999 999	________	2.000 001
	26.000 000	25.999 999	________	26.000 001
	________		________	
	________		________	
	Resolution			
	2.0 GHz, 1 kHz Resolution		______ (√)	
	8.0 GHz, 2 kHz Resolution		______ (√)	
	14.0 GHz, 3 kHz Resolution		______ (√)	
	20.0 GHz, 4 kHz Resolution		______ (√)	
	Accuracy (GHz)			
	All readings within ± one count			
	2.000 000 to 2.000 009		______ (√)	
	2.000 009 to 2.000 099		______ (√)	
	2.000 099 to 2.000 999		______ (√)	
	2.000 999 to 2.009 999		______ (√)	
	2.009 999 to 2.099 999		______ (√)	
	2.099 999 to 2.999 999		______ (√)	
	2.999 999 to 25.999 999		______ (√)	
4-8.	**OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS**			
	Output Level			
	Frequency and Power at Minimum Power Point			
	2.0—18.0 GHz			
	Frequency ________			
	Minimum power	+8 dBm	______ (√)	
	18.0—22.0 GHz			
	Frequency ________			
	Minimum power	+4 dBm	______ (√)	
	22.0—26.0 GHz			
	Frequency ________			
	Minimum power	0 dBm	______ (√)	
	Level Flatness (total variation)			
	2.0—6.6 GHz ±0.75 dB		________	1.50 dB
	2.0—12.3 GHz ±1.00 dB		________	2.00 dB
	2.0—18.6 GHz ±1.25 dB		________	2.50 dB
	2.0—26.0 GHz ±1.75 dB		________	3.50 dB

Table 4-2. Performance Test Record (2 of 11)

Para. No.	Test		Results Min.	Actual	Max.
4-8.	OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS (continued)				
	High Level Accuracy				
	+8 dBm (+10 dBm Range)	2 GHz	+6.00 dBm	________	+10.00 dBm
		4 GHz	+6.00 dBm	________	+10.00 dBm
		6 GHz	+6.00 dBm	________	+10.00 dBm
		8 GHz	+5.75 dBm	________	+10.25 dBm
		10 GHz	+5.75 dBm	________	+10.25 dBm
		12 GHz	+5.75 dBm	________	+10.25 dBm
		14 GHz	+5.50 dBm	________	+10.50 dBm
		16 GHz	+5.50 dBm	________	+10.50 dBm
		18 GHz	+5.50 dBm	________	+10.50 dBm
	+3 dBm (0 dBm Range)	2 GHz	+1.25 dBm	________	+4.75 dBm
		4 GHz	+1.25 dBm	________	+4.75 dBm
		6 GHz	+1.25 dBm	________	+4.75 dBm
		8 GHz	+1.00 dBm	________	+5.00 dBm
		10 GHz	+1.00 dBm	________	+5.00 dBm
		12 GHz	+1.00 dBm	________	+5.00 dBm
		14 GHz	+0.75 dBm	________	+5.25 dBm
		16 GHz	+0.75 dBm	________	+5.25 dBm
		18 GHz	+0.75 dBm	________	+5.25 dBm
		20 GHz	+0.25 dBm	________	+5.75 dBm
		22 GHz	+0.25 dBm	________	+5.75 dBm
	0 dBm (0 dBm Range)	2 GHz	−1.75 dBm	________	+1.75 dBm
		4 GHz	−1.75 dBm	________	+1.75 dBm
		6 GHz	−1.75 dBm	________	+1.75 dBm
		8 GHz	−2.00 dBm	________	+2.00 dBm
		10 GHz	−2.00 dBm	________	+2.00 dBm
		12 GHz	−2.00 dBm	________	+2.00 dBm
		14 GHz	−2.25 dBm	________	+2.25 dBm
		16 GHz	−2.25 dBm	________	+2.25 dBm
		18 GHz	−2.25 dBm	________	+2.25 dBm
		20 GHz	−2.75 dBm	________	+2.75 dBm
		22 GHz	−2.75 dBm	________	+2.75 dBm
		24 GHz	−2.75 dBm	________	+2.75 dBm
		26 GHz	−2.75 dBm	________	+2.75 dBm
	−5 dBm (0 dBm Range)	2 GHz	−6.75 dBm	________	−3.25 dBm
		4 GHz	−6.75 dBm	________	−3.25 dBm
		6 GHz	−6.75 dBm	________	−3.25 dBm
		8 GHz	−7.00 dBm	________	−3.00 dBm
		10 GHz	−7.00 dBm	________	−3.00 dBm
		12 GHz	−7.00 dBm	________	−3.00 dBm
		14 GHz	−7.25 dBm	________	−2.75 dBm
		16 GHz	−7.25 dBm	________	−2.75 dBm
		18 GHz	−7.25 dBm	________	−2.75 dBm
		20 GHz	−7.75 dBm	________	−2.25 dBm
		22 GHz	−7.75 dBm	________	−2.25 dBm
		24 GHz	−7.75 dBm	________	−2.25 dBm
		26 GHz	−7.75 dBm	________	−2.25 dBm

Table 4-2. Performance Test Record (3 of 11)

Para. No.	Test		Results Min.	Results Actual	Results Max.
4-8.	OUTPUT LEVEL, HIGH LEVEL ACCURACY AND FLATNESS (continued)				
	High Level Accuracy (cont')				
	−10 dBm (0 dBm Range)	2 GHz	−11.75 dBm	________	−8.25 dBm
		4 GHz	−11.75 dBm	________	−8.25 dBm
		6 GHz	−11.75 dBm	________	−8.25 dBm
		8 GHz	−12.00 dBm	________	−8.00 dBm
		10 GHz	−12.00 dBm	________	−8.00 dBm
		12 GHz	−12.00 dBm	________	−8.00 dBm
		14 GHz	−12.25 dBm	________	−7.75 dBm
		16 GHz	−12.25 dBm	________	−7.75 dBm
		18 GHz	−12.25 dBm	________	−7.75 dBm
		20 GHz	−12.75 dBm	________	−7.25 dBm
		22 GHz	−12.75 dBm	________	−7.25 dBm
		24 GHz	−12.75 dBm	________	−7.25 dBm
		26 GHz	−12.75 dBm	________	−7.25 dBm
	−10 dBm (−10 dBm Range)	2 GHz	−12.25 dBm	________	−7.75 dBm
		4 GHz	−12.25 dBm	________	−7.75 dBm
		6 GHz	−12.25 dBm	________	−7.75 dBm
		8 GHz	−12.50 dBm	________	−7.50 dBm
		10 GHz	−12.50 dBm	________	−7.50 dBm
		12 GHz	−12.50 dBm	________	−7.50 dBm
		14 GHz	−12.85 dBm	________	−7.15 dBm
		16 GHz	−12.85 dBm	________	−7.15 dBm
		18 GHz	−12.85 dBm	________	−7.15 dBm
		20 GHz	−13.30 dBm	________	−6.70 dBm
		22 GHz	−13.30 dBm	________	−6.70 dBm
		24 GHz	−13.30 dBm	________	−6.70 dBm
		26 GHz	−13.30 dBm	________	−6.70 dBm
	−20 dBm (−20 dBm Range)	2 GHz	−22.45 dBm	________	−17.55 dBm
		4 GHz	−22.45 dBm	________	−17.55 dBm
		6 GHz	−22.45 dBm	________	−17.55 dBm
		8 GHz	−22.70 dBm	________	−17.30 dBm
		10 GHz	−22.70 dBm	________	−17.30 dBm
		12 GHz	−22.70 dBm	________	−17.30 dBm
		14 GHz	−23.05 dBm	________	−16.95 dBm
		16 GHz	−23.05 dBm	________	−16.95 dBm
		18 GHz	−23.05 dBm	________	−16.95 dBm
		20 GHz	−23.60 dBm	________	−16.40 dBm
		22 GHz	−23.60 dBm	________	−16.40 dBm
		24 GHz	−23.60 dBm	________	−16.40 dBm
		26 GHz	−23.60 dBm	________	−16.40 dBm

Table 4-2. Performance Test Record (4 of 11)

Para. No.	Test	Results Min.	Actual	Max.
4-9.	**LOW LEVEL ACCURACY**			
	2.0 GHz to 6.6 GHz			
	Frequency ________			
	−30 dBm	−32.75 dBm	________	−27.25 dBm
	−40 dBm	−42.85 dBm	________	−37.15 dBm
	−50 dBm	−52.95 dBm	________	−47.05 dBm
	−60 dBm	−63.05 dBm	________	−56.95 dBm
	−70 dBm	−73.15 dBm	________	−66.85 dBm
	−80 dBm	−83.25 dBm	________	−76.75 dBm
	−90 dBm	−93.35 dBm	________	−86.65 dBm
	6.6 GHz to 12.3 GHz			
	Frequency ________			
	−30 dBm	−33.00 dBm	________	−27.00 dBm
	−40 dBm	−43.10 dBm	________	−36.90 dBm
	−50 dBm	−53.20 dBm	________	−46.80 dBm
	−60 dBm	−63.30 dBm	________	−56.70 dBm
	−70 dBm	−73.40 dBm	________	−66.60 dBm
	−80 dBm	−83.50 dBm	________	−76.50 dBm
	−90 dBm	−93.60 dBm	________	−86.40 dBm
	12.3 GHz to 18.6 GHz			
	Frequency ________			
	−30 dBm	−33.45 dBm	________	−26.55 dBm
	−40 dBm	−43.65 dBm	________	−36.35 dBm
	−50 dBm	−53.85 dBm	________	−46.15 dBm
	−60 dBm	−64.05 dBm	________	−55.95 dBm
	−70 dBm	−74.25 dBm	________	−65.75 dBm
	−80 dBm	−84.45 dBm	________	−75.55 dBm
	−90 dBm	−94.65 dBm	________	−85.35 dBm
	18.6 GHz to 26.0 GHz			
	Frequency ________			
	−30 dBm	−34.05 dBm	________	−25.95 dBm
	−40 dBm	−44.25 dBm	________	−35.75 dBm
	−50 dBm	−54.45 dBm	________	−45.55 dBm
	−60 dBm	−64.65 dBm	________	−55.35 dBm
	−70 dBm	−74.85 dBm	________	−65.15 dBm
	−80 dBm	−85.05 dBm	________	−74.95 dBm
	−90 dBm	−95.25 dBm	________	−84.75 dBm
4-10.	**HARMONICS, SUBHARMONICS, AND MULTIPLES**			
	Harmonic Subharmonic / Fundamental			
	4.0000 GHz 2f / 2.000 GHz		________	−40 dBc
	4.0000 GHz 1/2f / 8.000 GHz		________	−25 dBc
	4.6667 GHz 1/3f / 14.000 GHz		________	−25 dBc
	5.0000 GHz 1/2f / 10.000 GHz		________	−25 dBc
	5.0000 GHz 1/4f / 20.000 GHz		________	−20 dBc

Table 4-2. Performance Test Record (5 of 11)

Para. No.	Test	Results Min.	Results Actual	Results Max.
4-10.	HARMONICS, SUBHARMONICS, AND MULTIPLES (cont'd)			
	Harmonic or Subharmonic — Fundamental			
	5.3333 GHz 1/3f — 16.000 GHz		________	−25 dBc
	5.5000 GHz 1/4f — 22.000 GHz		________	−20 dBc
	6.0000 GHz 1/2f — 12.000 GHz		________	−25 dBc
	6.0000 GHz 1/3f — 18.000 GHz		________	−25 dBc
	6.0000 GHz 1/4f — 24.000 GHz		________	−20 dBc
	6.5000 GHz 1/4f — 26.000 GHz		________	−20 dBc
	8.0000 GHz 2f — 4.000 GHz		________	−40 dBc
	9.3333 GHz 2/3f — 14.000 GHz		________	−25 dBc
	10.0000 GHz 1/2f — 20.000 GHz		________	−20 dBc
	10.6667 GHz 2/3f — 16.000 GHz		________	−25 dBc
	11.0000 GHz 1/2f — 22.000 GHz		________	−20 dBc
	12.0000 GHz 2f — 6.000 GHz		________	−40 dBc
	12.0000 GHz 2/3f — 18.000 GHz		________	−25 dBc
	12.0000 GHz 1/2f — 24.000 GHz		________	−20 dBc
	13.0000 GHz 1/2f — 26.000 GHz		________	−20 dBc
	15.0000 GHz 3/4f — 20.000 GHz		________	−20 dBc
	16.0000 GHz 2f — 8.000 GHz		________	−40 dBc
	16.5000 GHz 3/4f — 22.000 GHz		________	−20 dBc
	18.0000 GHz 3/4f — 24.000 GHz		________	−20 dBc
	19.5000 GHz 3/4f — 26.000 GHz		________	−20 dBc
	20.0000 GHz 2f — 10.000 GHz		________	−40 dBc
	24.0000 GHz 2f — 12.000 GHz		________	−40 dBc
4-11.	NON-HARMONICALLY RELATED SPURIOUS SIGNALS (CW AND AM MODES)			
	Carrier Frequency — Spurious Signal Frequency		Spurious Signal Level	
	2.0 to 6.6 GHz			
	3 000 MHz — ________		________	−70 dBc
	________ — ________		________	−70 dBc
	________ — ________		________	−70 dBc
	________ — ________		________	−70 dBc
	________ — ________		________	−70 dBc
	________ — ________		________	−70 dBc

Table 4-2. Performance Test Record (6 of 11)

Para. No.	Test	Results Min.	Actual	Max.
4-12.	**POWER LINE RELATED SPURIOUS SIGNALS**			
	Offset Frequency			
	2.0 — 6.6 GHz			
	<300 Hz offset ________		________	-50 dBc
	300 Hz — 1 kHz offset ________		________	-60 dBc
	>1 kHz offset ________		________	-65 dBc
	6.6 — 12.3 GHz			
	<300 Hz offset ________		________	-40 dBc
	300 Hz — 1 kHz offset ________		________	-54 dBc
	>1 kHz offset ________		________	-59 dBc
	12.3 — 18.6 GHz			
	<300 Hz offset ________		________	-40 dBc
	300 Hz — 1 kHz offset ________		________	-50 dBc
	>1 kHz offset ________		________	-55 dBc
	18.6 — 26.0 GHz			
	<300 Hz offset ________		________	-38 dBc
	300 Hz — 1 kHz offset ________		________	-48 dBc
	>1 kHz offset ________		________	-53 dBc
4-13.	**SINGLE-SIDEBAND PHASE NOISE**			
	10 Hz offset from carrier 6600 MHz		________	-58 dBc
	12 300 MHz		________	-52 dBc
	18 600 MHz		________	-48 dBc
	26 000 MHz		________	-46 dBc
	100 Hz offset from carrier 6600 MHz		________	-70 dBc
	12 300 MHz		________	-64 dBc
	18 600 MHz		________	-60 dBc
	26 000 MHz		________	-58 dBc
	1 kHz offset from carrier 6600 MHz		________	-78 dBc
	12 300 MHz		________	-72 dBc
	18 600 MHz		________	-68 dBc
	26 000 MHz		________	-66 dBc
	10 kHz offset from carrier 6600 MHz		________	-86 dBc
	12 300 MHz		________	-80 dBc
	18 600 MHz		________	-76 dBc
	26 000 MHz		________	-74 dBc
	100 kHz offset from carrier 6600 MHz		________	-110 dBc
	12 300 MHz		________	-104 dBc
	18 600 MHz		________	-100 dBc
	26 000 MHz		________	-98 dBc

Table 4-2. Performance Test Record (7 of 11)

Para. No.	Test	Results Min.	Results Actual	Results Max.
4-14.	AMPLITUDE MODULATION			
	Meter Accuracy			
	1 kHz Rate, 50% AM	43.5%	________	56.5%
	Accuracy Relative to External AM Input			
	6.6 GHz 10 kHz	70%	________	80%
	6.6 GHz 1 kHz	70%	________	80%
	6.6 GHz .1 kHz	70%	________	80%
	10 GHz 10 kHz	70%	________	80%
	14 GHz 10 kHz	70%	________	80%
	18.6 GHz 10 kHz	70%	________	80%
	22 GHz 10 kHz	70%	________	80%
	26 GHz 10 kHz	46%	________	54%
	Incidental Phase Modulation			
	6.2 GHz		________	0.4 radians
	12.3 GHz		________	0.8 radians
	18.0 GHz		________	1.2 radians
	24.0 GHz		________	1.6 radians
	26.0 GHz		________	2.0 radians
	AM Rates			
	4.0 GHz ________	−3 dB	________	+3 dB
	6.7 GHz ________	−3 dB	________	+3 dB
	15.0 GHz ________	−3 dB	________	+3 dB
	24.0 GHz ________	−3 dB	________	+3 dB
	26.0 GHz ________	−3 dB	________	+3 dB
4-15.	FM FREQUENCY RESPONSE			
	3 kHz	−2 dB	________	+2 dB
	30 kHz	−2 dB	________	+2 dB
	100 kHz		0 dB	
	300 kHz	−2 dB	________	+2 dB
	1000 kHz	−2 dB	________	+2 dB
	3000 kHz	−2 dB	________	+2 dB
4-16.	FM INPUT AND METER ACCURACY			
	Sensitivity and Meter Accuracy			
	Full Scale	255 kHz	________	345 kHz
	50 kHz	35 kHz	________	65 kHz
	FM OVERMOD		________ (√)	
	Accuracy Relative to External FM Input			
	.03 MHz Range	27 kHz	________	33 kHz
	.1 MHz Range	90 kHz	________	110 kHz
	.3 MHz Range	270 kHz	________	330 kHz
	1 MHz Range	249 kHz	________	351 kHz

Table 4-2. Performance Test Record (8 of 11)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-16.	**FM INPUT AND METER ACCURACY (cont'd)** **Accuracy Relative to External FM Input (cont'd)** 300 kHz Accuracy			
	6.7 GHz	270 kHz	______	330 kHz
	12.4 GHz	270 kHz	______	330 kHz
	18.7 GHz	270 kHz	______	330 kHz
4-17.	**INCIDENTAL AM** 2.0 GHz 5% AM Reference Level ______ Vrms			
	Incidental FM less than reference level		______ Vrms	
	6.7 GHz 5% AM Reference Level ______ Vrms			
	Incidental FM less than reference level		______ Vrms	
	12.4 GHz 5% AM Reference Level ______ Vrms			
	Incidental FM less than reference level		______ Vrms	
	18.7 GHz 5% AM Reference Level ______ Vrms			
	Incidental FM less than reference level		______ Vrms	
4-18.	**PULSE** **Rise Time, Fall Time, Overshoot and Ringing**			
	2000.000 MHz at +8 dBm Rise		______	35 ns
	Fall		______	35 ns
	Overshoot and Ringing		______	20%
	6000.000 MHz at +8 dBm Rise		______	35 ns
	Fall		______	35 ns
	Overshoot and Ringing		______	20%
	6600.002 MHz at +8 dBm Rise		______	35 ns
	Fall		______	35 ns
	Overshoot and Ringing		______	25%
	6600.002 MHz at 0 dBm Rise		______	35 ns
	Fall		______	35 ns
	Overshoot and Ringing		______	25%
	6600.002 MHz at −10 dBm Rise		______	35 ns
	Fall		______	35 ns
	Overshoot and Ringing		______	25%
	6700.002 MHz at +8 dBm Rise		______	35 ns
	Fall		______	35 ns
	Overshoot and Ringing		______	20%

Table 4-2. Performance Test Record (9 of 11)

Para. No.	Test		Results Min.	Results Actual	Results Max.
4-18.	PULSE (cont'd)				
	Rise Time, Fall Time, and Overshoot and Ringing (cont'd)				
	6700.002 MHz at 0 dBm	Rise		________	35 ns
		Fall		________	35 ns
		Overshoot and Ringing		________	20%
	6700.002 MHz at −10 dBm	Rise		________	35 ns
		Fall		________	35 ns
		Overshoot and Ringing		________	20%
	12290.002 MHz at +8 dBm	Rise		________	35 ns
		Fall		________	35 ns
		Overshoot and Ringing		________	20%
	12290.002 MHz at 0 dBm	Rise		________	35 ns
		Fall		________	35 ns
		Overshoot and Ringing		________	20%
	12290.002 MHz at −10 dBm	Rise		________	35 ns
		Fall		________	35 ns
		Overshoot and Ringing		________	20%
	12300.003 MHz at +8 dBm	Rise		________	35 ns
		Fall		________	35 ns
		Overshoot and Ringing		________	20%
	12300.003 MHz at 0 dBm	Rise		________	35 ns
		Fall		________	35 ns
		Overshoot and Ringing		________	20%
	12300.003 MHz at −10 dBm	Rise		________	35 ns
		Fall		________	35 ns
		Overshoot and Ringing		________	20%
	17990.003 MHz at +8 dBm	Rise		________	35 ns
		Fall		________	35 ns
		Overshoot and Ringing		________	20%
	17990.003 MHz at 0 dBm	Rise		________	35 ns
		Fall		________	35 ns
		Overshoot and Ringing		________	20%
	17990.003 MHz at −10 dBm	Rise		________	35 ns
		Fall		________	35 ns
		Overshoot and Ringing		________	20%

Table 4-2. Performance Test Record (10 of 11)

Para. No.	Test	Results Min.	Results Actual	Results Max.
4-18.	PULSE (cont'd)			
	Rise Time, Fall Time, and Overshoot and Ringing (cont'd)			
	18590.004 MHz at −4 dBm Rise		________	35 ns
	Fall		________	35 ns
	Overshoot and Ringing		________	20%
	18590.004 MHz at 0 dBm Rise		________	35 ns
	Fall		________	35 ns
	Overshoot and Ringing		________	20%
	18590.004 MHz at −10 dBm Rise		________	35 ns
	Fall		________	35 ns
	Overshoot and Ringing		________	20%
	18600.004 MHz at +4 dBm Rise		________	35 ns
	Fall		________	35 ns
	Overshoot and Ringing		________	20%
	18600.004 MHz at 0 dBm Rise		________	35 ns
	Fall		________	35 ns
	Overshoot and Ringing		________	20%
	18600.004 MHz at −10 dBm Rise		________	35 ns
	Fall		________	35 ns
	Overshoot and Ringing		________	20%
	21990.004 MHz at +4 dBm Rise		________	35 ns
	Fall		________	35 ns
	Overshoot and Ringing		________	20%
	21990.004 MHz at 0 dBm Rise		________	35 ns
	Fall		________	35 ns
	Overshoot and Ringing		________	20%
	21990.004 MHz at −10 dBm Rise		________	35 ns
	Fall		________	35 ns
	Overshoot and Ringing		________	20%
	22000.004 MHz at 0 dBm Rise		________	35 ns
	Fall		________	35 ns
	Overshoot and Ringing		________	20%
	22000.004 MHz at −10 dBm Rise		________	35 ns
	Fall		________	35 ns
	Overshoot and Ringing		________	20%

Table 4-2. Performance Test Record (11 of 11)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-18.	PULSE (cont'd)			
	Rise Time, Fall Time, and Overshoot and Ringing (cont'd)			
	25990:004 MHz at 0 dBM Rise		______	35 ns
	Fall		______	35 ns
	Overshoot and Ringing		______	20%
	25990.004 MHz at −10 dBm Rise		______	35 ns
	Fall		______	35 ns
	Overshoot and Ringing		______	20%
	Peak Level Accuracy			
	6.61 GHz +8 dBm	−8.9%	______	+12.2%
	0 dBm	−8.9%	______	+12.2%
	−10 dBm	−8.9%	______	+12.2%
	12.3 GHz +8 dBm	−8.9%	______	+12.2%
	0 dBm	−8.9%	______	+12.2%
	−10 dBm	−8.9%	______	+12.2%
	12.31 GHz +8 dBm	−8.9%	______	+12.2%
	0 dBm	−8.9%	______	+12.2%
	−10 dBm	−8.9%	______	+12.2%
	18.61 GHz +4 dBm	−8.9%	______	+12.2%
	−10 dBm	−8.9%	______	+12.2%
	22.1 GHz 0 dBm	−8.9%	______	+12.2%
	−10 dBm	−8.9%	______	+12.2%
	On-Off Ratio (dB below reference signal)			
	2.0 GHz	80	______	
	3.0 GHz	80	______	
	4.0 GHz	80	______	
	5.0 GHz	80	______	
	6.0 GHz	80	______	
	6.6 GHz	80	______	
4-19.	INTERNAL TIME BASE AGING RATE		______	5×10^{-10}/day

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

This section contains adjustments and checks that assure peak performance of the Signal Generator. This instrument should be readjusted after repair to assure performance. Allow a one hour warm-up prior to performing the adjustments. If the mains power cable is removed and reinstalled during an adjustment, be sure that the OVEN COLD status annunciator is off before proceeding with the adjustment.

Most adjustments are performed manually. However, several adjustments are performed with computer assistance using the adjustment software and the HP 85F as a controller.

The order in which the adjustments are made is critical. Prior to making any adjustments, refer to the paragraph titled Related Adjustments.

Determining the adjustments to be performed after a component failure and subsequent repair or a performance test failure is important. This will help keep the adjustment time to a minimum. After the repair and/or adjustment, performance tests are usually required to verify proper performance. Refer to the paragraph titled Related Adjustments.

5-2. SAFETY CONSIDERATIONS

This section contains information, cautions and warnings which must be followed for your protection and to avoid damage to the equipment.

WARNINGS

Maintenance described in this section is performed with power supplied to the instrument and with protective covers removed. Maintenance should be performed only by service trained personnel who are aware of the hazard involved (for example, fire and electrical shock). Where maintenance can be performed without power applied, the power should be removed.

A pin-to-pin voltage difference of 60 Vdc may be found on many of the Signal Generator's circuit board connectors. If a circuit board is placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. The voltage could cause personal injury if contacted.

5-3. EQUIPMENT REQUIRED

Each adjustment procedure contains a list of required test equipment and accessories. The test equipment is identified by callouts in the test setup diagrams included with each procedure.

If substitutions must be made for the specified test equipment, refer to Table 1-2 for the minimum specifications. It is important that the test equipment meet the critical specifications listed in the table if the Signal Generator is to meet its performance requirements.

SRD Bias, YTM Tune, Flatness and ALC, and Pulse Amplitude Control adjustment procedures are automated. Automated adjustment programs are written for specific test equipment; therefore, substitute test equipment cannot be used.

Automated adjustments require a test cassette containing the programs (HP part number 11726-10001) and an HP 85F Controller plus 16K Memory (82903A), the Advanced Programming ROM (00085-15005), the Plotter/Printer ROM (00085-15002), and the Matrix ROM (00085-15004). The test cassette is part of the HP 11726A Support Kit. It can also be ordered separately from your nearest Hewlett-Packard office.

5-4. AUTOMATED ADJUSTMENT PROCEDURES

The adjustment software is a set of menu driven programs written in BASIC language. Adjustment programs are accessed via an executive program named "EXEC". Special function keys, which are enabled by software, select individual adjustment procedures and test routines from the executive program's main menu. Labels for enabled special function keys are displayed on the bottom two lines of the controller's CRT screen.

AUTOMATED ADJUSTMENT PROCEDURES (cont'd)

To load the adjustment software, insert the tape cassette into the controller's tape drive, type the command LOAD "Autost" and then press END LINE. When the tape stops, press RUN. Several system checks are run automatically. For example, the controller is checked for correct ROM configuration and the HP Interface Bus is checked for proper operation. In addition, the Signal Generator is set to RCL 0. After the checks are completed, the main menu of adjustments is displayed (see Figure 5-1).

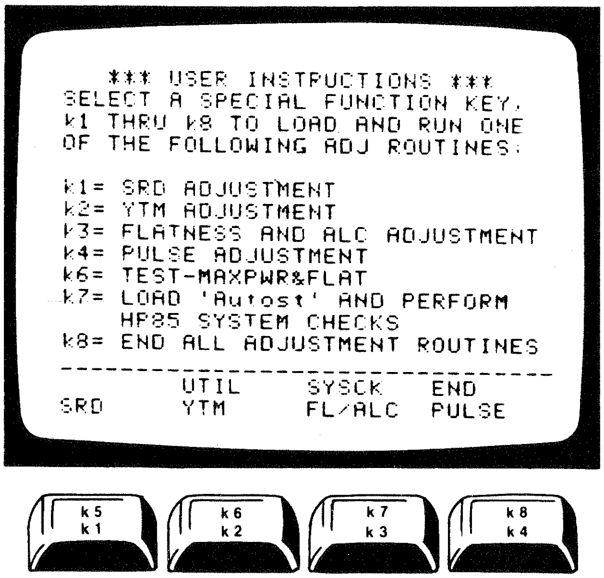


Figure 5-1. Main Menu

Press the special function key (K1 through K8) that corresponds to the adjustment or test that you want to perform. The appropriate program is loaded by the EXEC program and executed.

See Figure 5-2 for a flowchart of the adjustment software. Included in the figure is a brief description of each item in the EXEC program's menu. Detailed descriptions of individual adjustments are included in the appropriate adjustment procedure.

5-5. FACTORY SELECTED COMPONENTS

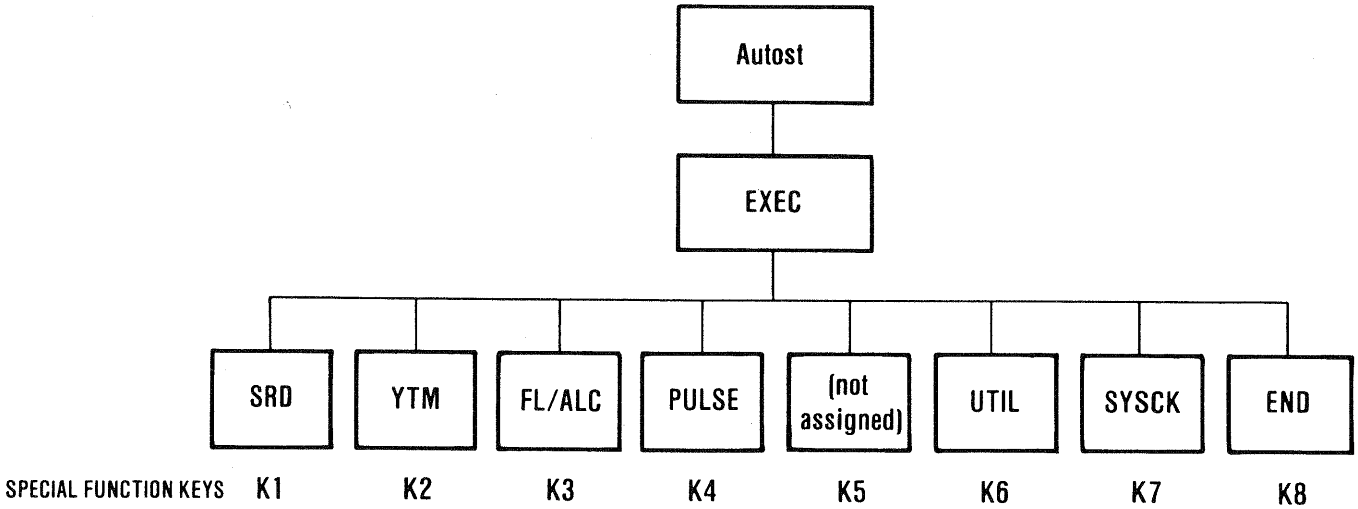
Factory selected components are identified on the schematics and parts list by an asterisk (*) that follows the reference designator. The nominal value of the component is shown. The manual change sheets will provide updated information pertaining to selected components. Table 5-1 lists the reference designator, the service sheet where the component is shown, the normal value range, and the criteria used for selecting a particular value.

5-6. RELATED ADJUSTMENTS

If all the adjustments are to be performed, they should be done in order of appearance in this manual.

In the event of a performance test or component failure, it must be determined if an individual adjustment procedure should be performed or if the instrument should be repaired. Tables 5-2 and 5-3 indicate the required action in either case.

After the instrument is repaired or adjusted, Performance Tests or Operator's Checks must be performed to verify proper operation of the Signal Generator. At a minimum, it is recommended that the Operator's Checks and Operation Verification (refer to Table 4-1) be performed after any instrument repair. Tables 5-2 and 5-3 can be used as a guideline when repairing or adjusting the instrument.



Name	Description
Autost	Autostart program. Contains system hardware checks. Loads and runs EXEC program. Automatically loads and runs if the tape cassette is in the tape drive when power is applied to the controller.
EXEC	Executive program. Allows access to the individual adjustment procedures and test routines via special function keys, as selected by the user.
SRD	SRD Bias Adjustment. Accessed through EXEC.
YTM	YTM Tune Adjustment. Accessed through EXEC.
FL/ALC	Flatness and ALC Adjustment. Accessed through EXEC.
PULSE	Pulse Adjustments. Accessed through EXEC.
UTIL	Utility programs. Tests for maximum power and vernier accuracy. Accessed through EXEC.
SYSCK	Loads and executes Autost.
END	Terminates all adjustment programs or EXEC. Accessed through EXEC.

Figure 5-2. Adjustment Software

Table 5-1. Factory Selected Components (1 of 2)

Reference Designator	Service Sheet	Range of Values	Basis of Selection
A3A1A2C8 and A3A1A2L4	2-A3	0 to 12.0 pF 0.22 to 6.8 μH	100 MHz VCXO Assembly. Centers the frequency adjustment range of A3A1A2C4 around 100 MHz. Refer to the Reference Loop (VCXO) Adjustment procedure.
A3A1A2R67, R68, and R69	2-A3	Refer to Table in VCXO adjustment	100 MHz VCXO Assembly. Required change in attenuation necessary for a −10 dBm output level of the 400 MHz signal. Refer to the Reference Loop (VCXO) Adjustment procedure.
A3A1A5C38, R36, R40, and R41	5-A3	R36: 82.5 or 56.2Ω R41: 100Ω or deleted R40: 51.1Ω or C38 at 27 pF	M/N Loop 5—45 MHz IF Output. If the power output from the IF OUT jack (A3A1A5J2) is less then −5 dBm at any frequency between 5 MHz to 45 MHz, replace R36 82.5Ω with a 56.2Ω resistor, R40 51.1Ω with C38 27 pF capacitor, and remove R41. Proper power output level is 0 ± 5 dBm from 5 to 45 MHz. If this range cannot be met, service may be required.
A3A3R43	12-A3	12 to 14.7 kΩ	Positive Regulator Assembly. Select so that pin 2 of V1 Power Up/Down Detector is 0.1 to 0.2V lower than the +5.2V Power Supply.
A3A7C48	10-A3	3.9 to 5.6 pF	YTO/FM/Coil Driver Assemby. Selected for frequency response on the 100 kHz and lower FM deviation ranges. Use Figure 4-9, FM Frequency Response Test Setup (test oscillator and spectrum analyzer only). Set the test oscillator's controls so the spectrum analyzer's display of the first FM sidebands are 30 dB down from the carrier at 1 MHz. At 3.16 MHz the sidebands should be 40 dB down; at 10 MHz, 50 dB down. If the response is peaking (sidebands are too high), insert a smaller value capacitor. If the response is rolling off (sidebands are too low), insert a larger value capacitor.
A3A7R61, R65, and R75	10-A3	Refer to table.	YTO/FM/Coil Driver Assembly. FM sensitivity is changed by replacing R61, R65 and R75 as a set. Except for the spectrum analyzer, connect equipment as shown in Figure 4-9, FM Frequency Response Test Setup (omit frequency counter). Connect the spectrum analyzer to the junction of A3A9J1 and A3A9J2. Set the Signal Generator to 10 MHz deviation range. Set the test oscillator's output level for the first carrier null (deviation approximately 240 kHz) at a 100 kHz rate. Measure the test oscillator FM drive voltage. The normal value is between 15.42 and 18.86 mV. Change R61, R65 and R75, using the values in the following table, to obtain the normal ac value. Voltage can be raised or lowered by the approximate increments shown in the table below.

Resistor	Nominal Value	Raise Voltmeter Reading		Lower Voltmeter Reading	
		+1 mV	+2.5 mV	−0.75 mV	−1.5 mV
R61	1.96 kΩ	1.78 kΩ	1.62 kΩ	1.96 kΩ	1.96 kΩ
R65	5.11 kΩ	6.19 kΩ	6.19 kΩ	4.64 kΩ	3.83 kΩ
R75	1.82 kΩ	1.78 kΩ	1.78 kΩ	1.96 kΩ	2.15 kΩ

Table 5-1. Factory Selected Components (2 of 2)

Reference Designator	Service Sheet	Range of Values	Basis of Selection
A3A9A5C10	8-A3	20-22 pF	Sampler Assembly. Centers YTO phase detector sampler response. Refer to YTO Loop Sampler Adjustment.
A3A9R20	9-A3	348Ω to 1.21 kΩ	YTO Loop Assembly. Sets YTO Loop gain crossover of 20 ± 2 kHz. Refer to the YTO Loop Phase Detector Adjustment.

Table 5-2. Performance Test Failure and Required Action

Performance Test Failure	Required Action
Frequency Range and Resolution	Check phase lock loops.
Output Level, High Level Accuracy and Flatness	Perform Flatness and ALC adjustment. Check output attenuator and output cable.
Low Level Accuracy	Check attenuator and attenuator driver.
Harmonics, Subharmonics and Multiples	Perform YTM Tune and Flatness and ALC adjustments. Check YTM.
Non-Harmonically Related Spurious Signals (CW and AM Modes)	This problem can occur anywhere in the instrument. Isolate the defective component and make adjustments as required (see Table 5-3). NOTE: If the problem is in Band 1 (2.0 to 6.6 GHz), the output of the A3 RF Source section, W7, should be checked.
Power Line Related Spurious	Refer to Section VIII, Service Sheet 12-A3.
Single-Sideband Phase Noise	Perform 20/30 MHz (LFS) Loop Divider Bias, 160-240 MHz (20/30 MHz or LFS Loop) VCO Pretune, M/N Loop, YTO Driver, YTO Loop Sampler, YTO Loop Offset and FM Overmodulation, and FM Driver adjustments. Check the YTO Loop for phase lock to within 1 Hz resolution. NOTE: An efficient troubleshooting technique is to isolate the problem to one of the phase lock loops, if possible, and then perform the adjustment for that loop.
AM Meter Accuracy Accuracy Relative to External AM Input Incidental Phase Modulation AM Rates (3 dB Bandwidth)	 Perform AM Accuracy and Meter adjustment. troubleshoot the AM and ALC circuits. Repair AM, YTM, or ALC circuits. Perform AM Bandwidth adjustment.
FM Frequency Response	Perform FM Driver and FM Accuracy and Overmodulation adjustments.
FM Input and Meter Accuracy	Perform FM Driver and FM Accuracy and Overmodulation adjustments.
Incidental AM	Repair or adjust the YTM and ALC circuits.
Pulse	Repair or adjust YTM, ALC and pulse circuits.

Table 5-3. Post-Repair Adjustments (1 of 2)

Repaired Assembly	Adjustments
A1A2 — Detector Module Assembly	Flatness and ALC AM Bandwidth AM Accuracy and Meter
A1A3 — Functions Board Assembly	AM Accuracy and Meter FM Accuracy and Overmodulation
A1A4 — Pulse Driver Processing Board Assembly	Flatness and ALC Pulse Modulation Pulse Amplitude Control
A1A5 — DAC and Enable Board Assembly	Pulse Modulation Pulse Amplitude Control
A1A6 — Meter Board Assemby	AM Accuracy and Meter FM Accuracy and Overmodulation
A1A7 — YTM Driver Board Assembly	YTM Tune
A1A8 — SRD Bias Board Assembly	SRD Bias Flatness and ALC Pulse Modulation Pulse Amplitude Control
A1A9 — Preamp Assembly	Flatness and ALC AM Bandwidth AM Accuracy and Meter
A1A10 — YTM Assembly	SRD Bias YTM Tune Flatness and ALC AM Bandwidth AM Accuracy and Meter Pulse Modulation Pulse Amplitude Control
A1A11 — Power Amplifier Assembly	Power Clamp Flatness and ALC Pulse Modulation — Pulse Clamp and ALC Sample Pulse portions only
A1AT2 — Isolator	None
A1AT3 — Pulse Modulator A1CP1 — Bias Tee	Pulse Modulation Pulse Amplitude Control
A1CR1 — Crystal Detector	Flatness and ALC Pulse Modulation — ALC Sample Pulse portion only

Table 5-3. Post-Repair Adjustments (2 of 2)

Repaired Assembly	Adjustments
A1DC1 — Directional Coupler	Flatness and ALC Pulse Modulation — ALC Sample Pulse portion only
A1FL1 — High-Pass Filter	Pulse Modulation Pulse Amplitude Control
A2A3, A2A4, A2A5 — LFS Loop Circuits	20/30 MHz Loop Divider 160—240 MHz (20/30 MHz or LFS Loop) VCO Pretune LFS Loop Filter
A2A7 — I/O Assembly	Sweep Out and Blanking/Marker
A3A1, A3A3, A3A4 — Power Supplies	Power Supply
A3A1A1, A3A1A2 — Reference Loop Circuits	Reference Loop
A3A1A3, A3A1A4, A3A1A5 — M/N Loop Circuits	M/N Loop
A3A5 — DAC Assembly A3A6 — YTO Driver Assembly	YTO Pretune Digital-to-Analog Converter YTO Driver YTO Loop Sampler YTO Offset and FM Overmodulation YTO Loop Phase Detector
A3A7 — YTO FM Coil Driver Assembly	YTO Pretune Digital-to-Analog Converter YTO Driver YTO Loop Sampler YTO Offset and FM Overmodulation YTO Loop Phase Detector FM Driver
A3A8 — 10 MHz Crystal Reference Assembly	10 MHz Reference Oscillator
A3A9A3 — 2.0 to 6.5 GHz YTO Assembly	YTO Pretune Digital-to-Analog Converter YTO Driver YTO Loop Sampler YTO Offset and FM Overmodulation YTO Loop Phase Detector FM Driver FM Accuracy and Overmodulation

ADJUSTMENTS

5-7. POWER SUPPLY ADJUSTMENTS

Reference Service Sheets 11-A3, 12-A3, and 13-A3.

Description Adjust the +22 volt and +20 volt power supplies to their required tolerance. Check the remaining supply voltages referenced to the +20 volt supply (+11V, +5.2V, –5.2V, –10V, and –40V).

Equipment Digital Voltmeter (DVM) .... HP 3455A

Procedure

1. Set the Signal Generator's rear panel FREQ STANDARD INT/EXT switch to INT.
2. Connect the DVM input to A3A1TP1 on the Rectifier Assembly.
3. Adjust +22 ADJ (A3A1R2) for a DVM reading of +22.00 ± 0.02 Vdc.
4. Connect the DVM input to A3A3TP5 on the Positive Regulator Assembly.
5. Set +20 ADJ (A3A3R50) for a DVM reading of +20.000 ± 0.002 Vdc.
6. Check the power supplies shown in the following table. All voltages should be within tolerance. If necessary, refer to troubleshooting information in Section VIII. Repair the defective supply and recheck the voltage.

Power Supply	Test Point	Power Supply Voltage (Vdc)	
		Min.	Max.
+11 Vdc	A3A3TP6	+9.9	+12.1
+5.2 Vdc	A3A3TP2	+5.1	+5.3
–5.2 Vdc	A3A4TP5	–5.1	–5.3
–10 Vdc	A3A4TP4	–9.8	–10.2
–40 Vdc	A3A4TP1	–39.00	–40.60

ADJUSTMENTS

5-8. 10 MHz REFERENCE OSCILLATOR ADJUSTMENT

Reference Service Sheet 1-A3.

Description Connect the reference signal from the Signal Generator (10 MHz OUT) to the oscilloscope's vertical input. A frequency standard (with long term stability greater than 1×10^{-10}) is connected to the trigger input. Adjust the A3A8 Assembly's FREQ adjustment for a minimum drift rate.

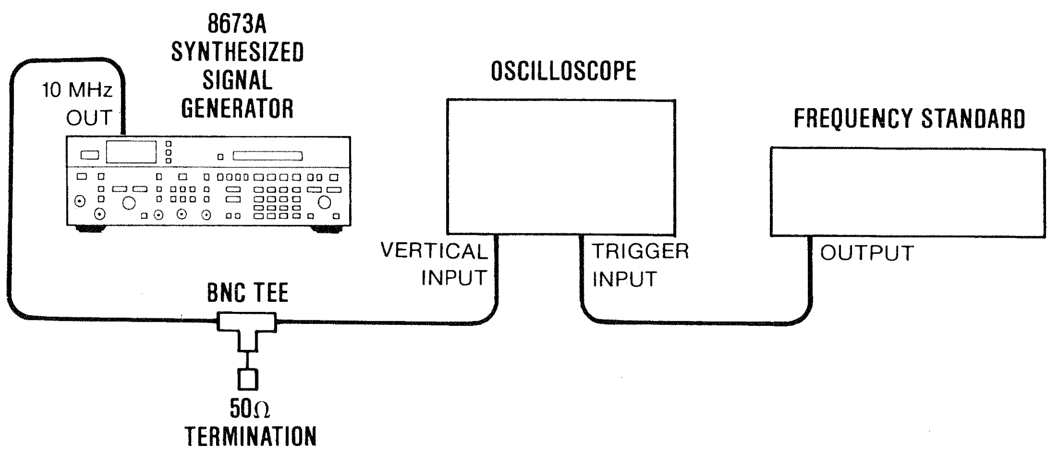


Figure 5-3. 10 MHz Reference Oscillator Adjustment Test Setup

Equipment

Frequency Standard .... HP 5065A
Oscilloscope .... HP 1715A
50Ω Termination .... HP 11539A

NOTE

Be sure the Signal Generator has had 1 hour to warm up before performing the adjustment. Verify that the OVEN COLD and NOT PHASE LOCKED status annunciators are off. If necessary, refer to the troubleshooting information in Section VIII.

Procedure

1. Set the Signal Generator's rear panel FREQ STANDARD INT/EXT switch to the INT position.

2. Connect the equipment as shown in Figure 5-3.

3. Set the FREQ adjustment (on the A3A8 10 MHz Reference Oscillator Assembly) so the signal, as observed on the oscilloscope display, is not drifting.

4. Verify that in 10 seconds the display drifts less than 360° A drift of 360° in 10 seconds corresponds to an adjustment accuracy of 1×10^{-8}. Adjustment accuracy is not specified for this instrument; the numbers shown are what can typically be obtained.

ADJUSTMENTS

5-9. REFERENCE LOOP (VCXO) ADJUSTMENT

Reference Service Sheet 2-A3.

Description The open loop frequency and maximum power output of the 100 MHz VCXO is centered around 100 MHz. The output is set as close as practical to 100 MHz. The 400 MHz signal is adjusted for maximum 400 MHz output and minimum spurious signal output. An attenuator is selected to provide a 400 MHz output of −10 dBm.

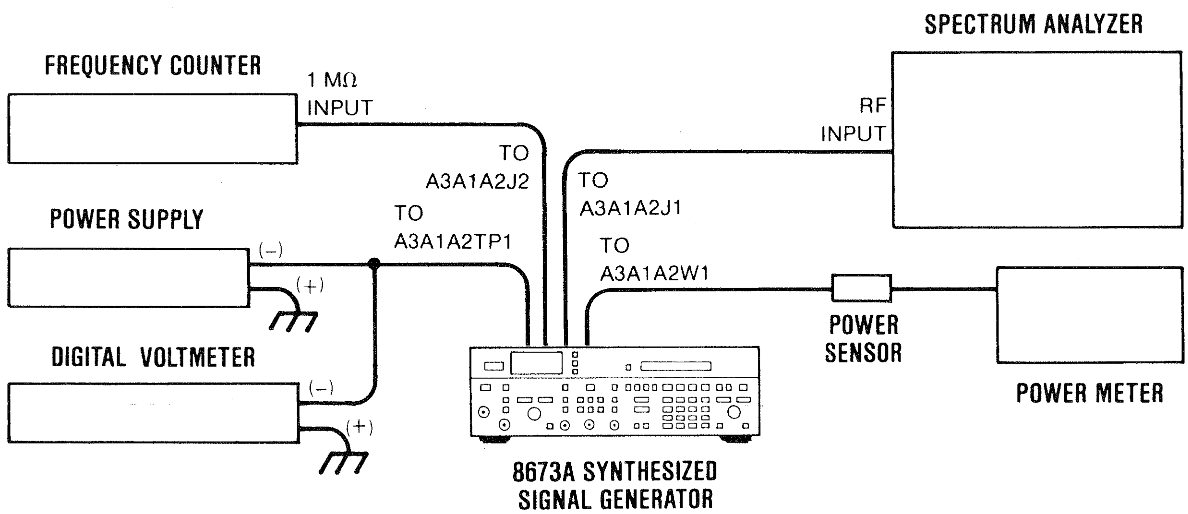


Figure 5-4. Reference Loop (VCXO) Adjustment Test Setup

Equipment

Frequency Counter	HP 5343A
Spectrum Analyzer	HP 8569B
Power Supply	HP 6202B
Power Meter	HP 436A
Power Sensor	HP 8485A
Digital Voltmeter (DVM)	HP 3455A

Procedure

1. Connect the frequency counter to A3A1A2J2 in place of the termination and connect the spectrum analyzer to A3A1A2J1 in place of the gray-orange-white cable.

2. Set the output of a low voltage power supply to −8.00 ± 0.01 Vdc. Connect the positive lead to ground and the negative lead to A3A1A2TP1, 100 MHz TUNE.

3. Tune A3A1A2C4, 100 MHz, for the maximum 100 MHz signal level as viewed on the spectrum analzyer display.

4. Tune A3A1A2C4 to increase the frequency (and decrease the amplitude) until the oscillation stops on the high frequency side; then tune A3A1A2C4 to start the oscillation. Continue to decrease the frequency until the oscillation stops. If the VCXO does not stop oscillating at the high end, decrease the value of A3A1A2C8 by 1 pF from its present value. If it does not stop at the low end, increase the value of A3A1A2C8 by 1 pF. If a change is necessary, repeat this step. If a value of

ADJUSTMENTS

5-9. REFERENCE LOOP (VCXO) ADJUSTMENT (cont'd)

Procedure (cont'd)

A3A1A2C8 cannot be found within the range of 0 to 12 pF, change A3A1A2L4. (The range of values for A3A1A2L4 is listed in step 7.) Then repeat this step.

5. Adjust A3A1A2C4 to obtain the maximum signal level as viewed on the spectrum analyzer display. Slowly tune to a higher frequency until the power drops by 1 dB. Record ΔF_1, that is, how far the 1 dB point is above 100 MHz. Use the frequency counter to make the measurements to 10 Hz resolution.

_______________ ΔF_1

6. Tune to a lower frequency until the power is decreased 1 dB on the other side of the peak. Record ΔF_2, that is, how far the 1 dB point is below 100 MHz.

_______________ ΔF_2

7. The VCXO centering about 100 MHz is correct if $0.5 \leq \frac{\Delta F_1}{\Delta F_2} \leq 2$.

If the ratio is less than 0.5, decrease A3A1A2L4 one value to increase the center frequency. If the ratio is greater than 2, increase A3A1A2L4 one value to decrease center frequency. Refer to the following table for the inductor values.

A3A1A2L4 Inductor Values

Value	HP Part Number
0.68 μH	9140-0141
0.56 μH	9100-2256
0.47 μH	9100-2255
0.39 μH	9100-2254
0.33 μH	9100-0368
0.27 μH	9100-2252
0.22 μH	9100-2251

8. If the inductor value is changed, repeat steps 3 through 7.

9. Adjust A3A1A2C4 to obtain a VCXO output of 100 MHz ±100 Hz.

10. Disconnect the spectrum analyzer from A3A1A2J1 and reconnect the gray-orange-white cable.

11. Disconnect the 400 MHz Output cable (gray-red-white cable) from A3A1A5J1 and connect the cable to the spectrum analyzer. Set the spectrum analyzer's controls for a center frequency of 500 MHz, frequency span per division 100 MHz, and vertical sensitivity per division 10 dB log. Adjust the 400 MHz A3A1A2C3, C2, and C1 adjustments in that order to obtain the maximum 400 MHz signal with the lowest harmonic levels possible.

ADJUSTMENTS

5-9. REFERENCE LOOP (VCXO) ADJUSTMENT (cont'd)

Procedure (cont'd)

12. Check the various harmonics of the 100 MHz signal relative to the 400 MHz signal level. The 200 and 800 MHz harmonics should be greater than 25 dB down; 100, 300, 500, 600, 700, and 900 MHz harmonics should be greater than 35 dB down. If necessary, repeat steps 11 and 12.

13. Disconnect the spectrum analyzer from the gray-red-white cable and connect the cable to the power meter.

14. Check the power meter reading. The power should be −10 to −13 dBm. If the power is incorrect, select the values of A3A1A2R67, R68, and R69 from the Attenuator Resistor Values Table to obtain the proper power level. The attenuation should always be 3 dB or greater.

Attenuator Resistor Values

Attenuation (dB)	Resistors (ohms)		
	R67	R68	R69
3	261	17.8	261
4	215	23.7	215
5	178	31.6	178
6	147	38.3	147
7	133	46.4	133
8	121	51.1	121
9	110	61.9	110

15. If the amount of attenuation is changed, recheck the harmonic levels.

16. Set the Signal Generator's LINE switch to STBY. Disconnect all test equipment except the DVM and reconnect all instrument cables.

17. Set the Signal Generator's LINE switch to ON. Verify that the dc voltage at A3A1A2TP1 is 8 ±1 Vdc. If the voltage is out of tolerance, repeat step 9 or check the 10 MHz Reference Adjustment.

18. Connect the frequency counter to the Signal Generator's RF OUTPUT connector.

19. Verify that the counter reading is within ±1 kHz of the Signal Generator's FREQUENCY MHz display at 2.0 and 6.6 GHz.

ADJUSTMENTS

5-10. M/N LOOP ADJUSTMENTS

Reference Service Sheet 4-A3.

Description The M/N loop frequency is set to track tuning voltage across the frequency range. The output level is set and checked to ensure an adequate RF output level across the band.

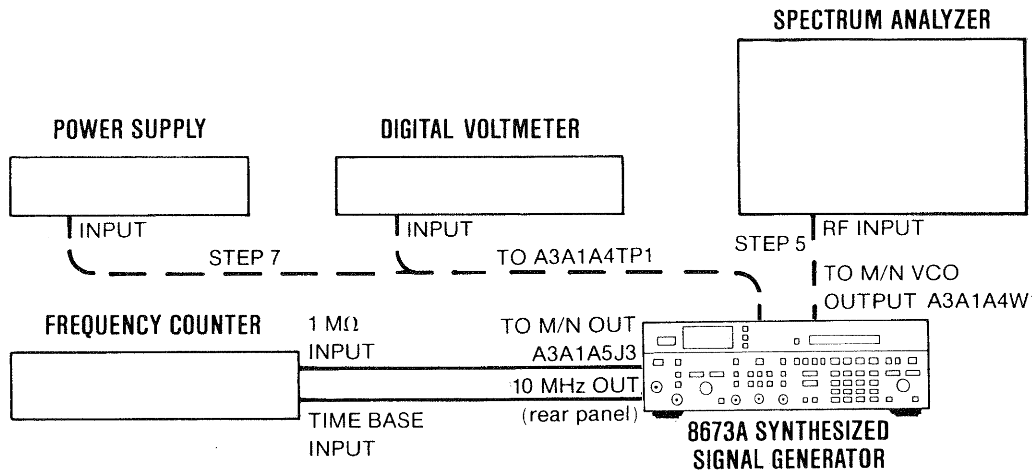


Figure 5-5. M/N Loop Adjustment Test Setup

Equipment

Digital Voltmeter (DVM)	HP 3455A
Frequency Counter	HP 5343A
Spectrum Analyzer	HP 8569B
Power Supply	HP 6202B

Procedure

1. On the Signal Generator, key in RCL 0 and set the frequency to 6090.000 MHz. Set the FREQ STANDARD INT/EXT on the rear panel to INT.
2. Connect the equipment as shown in Figure 5-5.
3. Verify that the M/N output frequency is exactly 197.419 MHz ±1 kHz.

WARNING

Because this circuit board is being placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. The voltage could cause personal injury if contacted.

4. Set the LINE switch to STBY and disconnect the mains power cable. Remove the A3A1A4/A5 Assembly and place it on an extender board.
5. Connect the spectrum analyzer input to the M/N VCO output A3A1A4W1 (white coax).

CAUTION

Do not apply a positive voltage to A3A1A4TP1. A positive voltage will forward bias the VCO tuning diodes and may destroy them.

5-10. M/N LOOP ADJUSTMENTS (cont'd)

Procedure (cont'd)

6. Connect the mains power cable and set the LINE switch to ON.

7. Set the power supply for −35.0 ±0.5 Vdc. Connect the positive output of the power supply to ground and connect the negative output to the A3A1A4TP1 TUNE.

NOTE

The adjustment screws for A3A1A4A1C1 and C5 are held in place by locknuts. After making the adjustment, tighten the locknuts and recheck the frequency and level.

8. Release the locknut for the PWR adjustment, A3A1A4A1C5. Adjust A3A1A4A1C5 for an output level of 0 ±2 dBm. Tighten the locknut.

9. Slowly reduce the dc voltage at A3A1A4TP1, TUNE, while monitoring the VCO output power on the spectrum analyzer. The output power should be greater than −2 dBm between 395 MHz (−35 Vdc) and 355 MHz (−2.3 Vdc).

10. Remove the power supply connection to A3A1A4TP1.

11. Set the LINE switch to STBY and disconnect the mains power cable. Remove A3A1A4/A5 from the extender board and reinstall the assembly in the Signal Generator.

12. Connect the mains power cable and set the LINE switch to ON. Verify that the frequency is still at 6090.000 MHz.

13. Set FREQ ADJ A3A1A4A1C1 for a voltage level of −35.0 ±0.5 Vdc, measured at A3A1A4TP1.

14. Tune the Signal Generator frequency to 2100.000 MHz. Verify that the M/N output frequency is 177.500 MHz and the tuning voltage is −2.4 ±0.7 Vdc.

15. Disconnect all test equipment from the Signal Generator and reconnect all instrument cables.

16. Connect the frequency counter to the Signal Generator's RF OUTPUT connector.

17. Verify that the counter reading is within ±1 kHz of the Signal Generator's FREQUENCY MHz display at 2.0 and 6.6 GHz.

ADJUSTMENTS

5-11. 20/30 MHz (LFS) LOOP DIVIDER BIAS ADJUSTMENT

Reference Service Sheet 1-A2.

Description A substitute VCO feedback signal, derived from an external RF signal source, is monitored with an oscilloscope. The RF signal level is slowly reduced and the CLK BIAS ADJ is set to obtain a stable clock signal. The RF input is reduced to the minimum level that provides a stable signal.

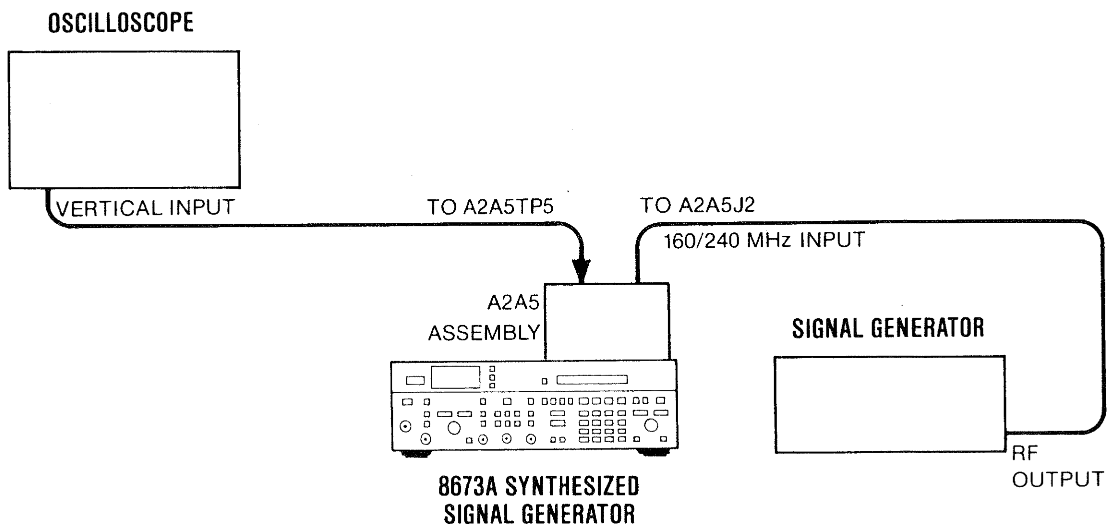


Figure 5-6. 20/30 MHz (LFS) Loop Divider Bias Adjustment Test Setup

Equipment

Oscilloscope .... HP 1715A
Signal Generator .... HP 8640B

Procedure

1. Set the LINE switch to STBY.
2. Remove the screws that hold the A2A5 20/30 MHz Divider Assembly in place.

WARNING

Because this circuit board is being placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. The voltage could cause personal injury is contacted.

3. Remove the A2A5 Assembly, place it on an extender board, and reinstall the assembly.
4. Set the LINE switch to ON.
5. Set the controls of the signal generator in the test setup for continuous wave output of −5 dBm at 240 MHz.

ADJUSTMENTS

5-11. 20/30 MHz (LFS) LOOP DIVIDER BIAS ADJUSTMENT (cont'd)

Procedure (cont'd)

6. Remove the red cable A2W2 from the 160/240 MHz INPUT, A2A5J1.
7. Connect the equipment as shown in Figure 5-6.
8. Center A2A5R4 (CLK BIAS ADJ).
9. Observe the clock signal on the oscilloscope display.
10. Adjust A2A5R4 to obtain a stable clock frequency.
11. Reduce the output level of the signal generator in the test setup while readjusting A2A5R4 to obtain a stable clock at the lowest possible signal.
12. Verify that a stable clock signal is obtained with an input signal of −10 dBm or less.
13. Disconnect the test equipment. Set the Signal Generator to STBY and reinstall A2A5 in its cavity. Reconnect cable A2W2 to A2A5J1.

ADJUSTMENTS

5-12. 160—240 MHz (20/30 MHz OR LFS LOOP) VCO PRETUNE ADJUSTMENT

Reference Service Sheet 3-A2.

Description If any of the 160—240 MHz oscillator components have been replaced, the low and high frequency limits of the oscillator must be checked to ensure proper operation. The oscillator coil is moved closer to or away from the circuit board in order to set the low and high frequency limits.

Equipment Frequency Counter .... HP 5343A

NOTE

This procedure need be performed only if major repair has been done to the oscillator.

Procedure

1. Set the LINE switch to STBY.
2. Remove the screws that hold the A2A3 VCO assembly in place.

WARNING

Because this circuit board is being placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. The voltage could cause personal injury if contacted.

3. Remove the A2A3 assembly, place it on an extender board, and reinstall the assembly.
4. Remove the green cable A3W14 that is connected to the 20/30 MHz OUTPUT A2A3J1. Connect the frequency counter output to A2A3J1.
5. Set the LINE switch to ON.
6. Set A2A3S1 (FREQ TEST SWITCH) to the TEST HIGH FREQ position. The frequency should be greater than 30.5 MHz.
7. If the frequency is less than 30.4 MHz, the oscillator coil must be moved closer to the circuit board. The oscillator cover must be removed before adjusting the coil. Unsolder the four corners of the oscillator cover before removing it. Next, unsolder the oscillator coil leads, move the coil closer to the circuit board, and resolder the coil leads. Clip excess oscillator lead length on the circuit side of board if necessary.

NOTE

The oscillator coil is normally mounted parallel to the circuit board with the bottom threads approximately 1.3 mm (0.050 inch) above the board.

8. Replace the oscillator cover by temporarily soldering one corner of the cover. Then recheck the frequency.

ADJUSTMENTS

5-12. 160—240 MHz (20/30 MHz OR LFS LOOP) VCO PRETUNE ADJUSTMENTS (cont'd)

Procedure (cont'd)

9. Set A2A3S1 to the TEST LOW FREQ position. Verify a frequency reading of less than 19.5 MHz. If necessary, set the LINE switch to STBY, remove the cover, reset the coil, replace the cover, and repeat steps 6 through 9.

10. Set A2A3S1 to the NORMAL position.

11. Replace the oscillator cover permanently by soldering all four corners. Do not solder the entire perimeter of the oscillator cover. The cover is for frequency stability, not for RFI leakage.

12. Set the LINE switch to STBY. Reinstall A2A3 in its cavity and reconnect the green cable to A2A3J1.

ADJUSTMENTS

5-13. LFS LOOP NOTCH FILTER ADJUSTMENT

Reference Service Sheet 2-A2.

Description A 7985 Hz signal is passed through the 8 kHz notch filter. The adjustable components are set for the minimum signal transfer.

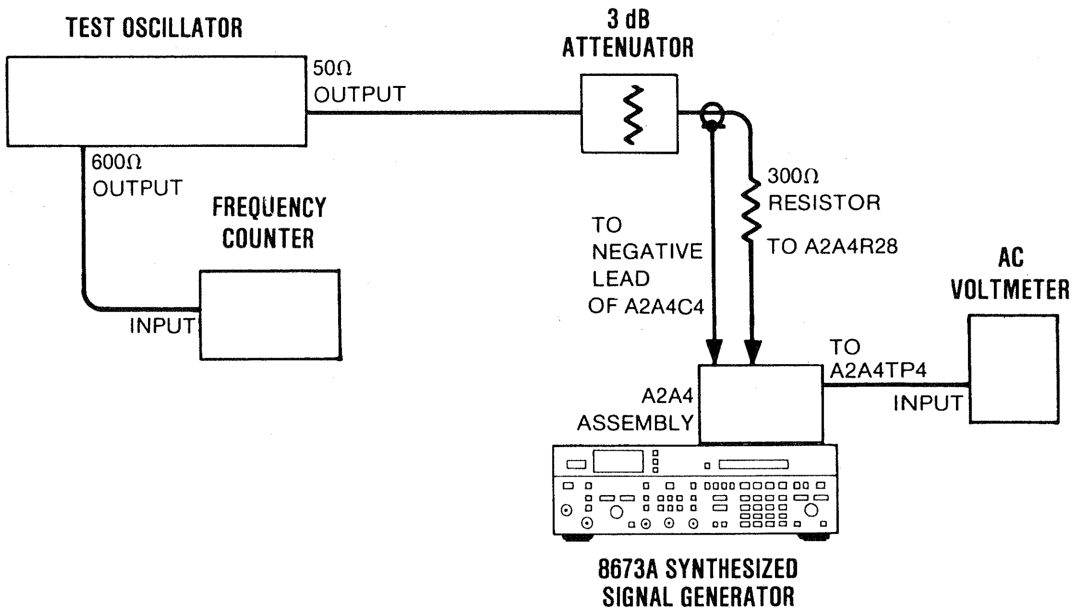


Figure 5-7. LFS Loop Notch Filter Adjustment Test Setup

Equipment

Test Oscillator	HP 651B
Frequency Counter	HP 5343A
AC Voltmeter	HP 400E
3 dB Attenuator	HP 8491A Option 003

Procedure

1. Set the LINE switch to STBY.

WARNING

Because this circuit board is being placed on an extender board, the possibility of coming in contact with 60 Vdc is greatly increased. The voltage could cause personal injury if contacted.

2. Remove the A2A4 20/30 Phase Detector Assembly.
3. Unsolder the input end (top) of A2A4R28 (refer to the component location diagram in Section VIII).
4. Install the circuit board on the extender board.

ADJUSTMENTS

5-13. LFS LOOP NOTCH FILTER ADJUSTMENT (cont'd)

Procedure (cont'd)

5. Connect the equipment as shown in Figure 5-7. The leads from the 3 dB attenuator should be as short as possible. Connect the ground wire to the negative side of A2A4C4.

6. Set the Signal Generator's LINE switch to ON.

7. Set the test oscillator's controls for 1 kHz and an AC voltmeter indication of +10 dBm.

8. Set the test oscillator as close to 7985 Hz as possible.

9. Adjust A2A4L3 and L4 to minimize the meter reading. The indication must be less than −50 dBm.

10. Detune the test oscillator away from 1 kHz while monitoring the AC voltmeter reading. As the oscillator is detuned, the meter indication should increase.

11. Set the Signal Generator's LINE switch to STBY. Resolder A2A4R28 and reinstall the A2A4 assembly.

ADJUSTMENTS

5-14. YTO PRETUNE DIGITAL-TO-ANALOG CONVERTER ADJUSTMENT

Reference Service Sheet 6-A3.

Description This adjustment sets the analog voltages with respect to the digital frequency tuning data. Adjustments are made at selected frequencies. Some of these frequencies are below the low frequency limit of the Signal Generator (2 GHz). These frequencies are selected by shorting test point pair A2A9TP1 and tuning to the specified frequencies.

Equipment Digital Voltmeter (DVM) .... HP 3455A

Procedure

1. Key in RCL 0 on the Signal Generator and set the frequency to 4800.000 MHz.
2. Connect the DVM ground lead to the reference ground, A3A6TP5. (The ground lead remains connected here for the remainder of this procedure.)
3. Attach the DVM test lead to A3A5TP4. Set REF ADJ (Reference Buffer output) A3A5R13 for a DVM reading of −6.50 ±0.04 Vdc.
4. Check the output voltages of the Reference Buffers at A3A5TP1 (+10.75 ±0.25 Vdc) and A3A5TP2 (+10.00 ±0.15 Vdc). Make repairs if necessary.
5. Connect the DVM to the YTO Pretune Output, A3A5TP3.
6. Short test point pair A2A9TP1 with an alligator clip.
7. Adjust 1.6 GHz A3A5R4 (not 1.61) to obtain a DVM reading of −4.80 ±0.01 Vdc.
8. Remove the clip from test point pair A2A9TP1.
9. Adjust 4.8 GHz A3A5R3 to obtain a reading of −14.400 ±0.001 Vdc.
10. Tune to 4900.000 MHz and short the test point pair A2A9TP1.
11. Adjust 1.7 GHz A3A5R29 to obtain −5.100 ±0.001 Vdc.
12. Tune to 4800.000 MHz and repeat steps 7 through 11 until step 7 is within 0.01 Vdc and steps 9 through 11 are within 0.001 Vdc of the specified value.
13. Tune to 4810.000 MHz. Verify that the clip is connected to test point pair A2A9TP1.
14. Adjust 1.61 GHz A3A5R42 (not 1.6) to obtain a DVM reading of −4.830 ±0.001 Vdc.
15. Tune to 5000.000 MHz. Adjust 1.8 GHz A3A5R24 to obtain −5.400 ±0.001 Vdc.
16. Remove the alligator clip. Tune to 2000.000 MHz.
17. Adjust 2.0 GHz A3A5R22 to obtain −6.000 ±0.001 Vdc.
18. Tune to 2400.000 MHz. Adjust 2.4 GHz A3A5R20 to obtain −7.200 ±0.001 Vdc.

ADJUSTMENTS

5-14. YTO PRETUNE DIGITAL-TO-ANALOG CONVERTER ADJUSTMENT (cont'd)

Procedure (cont'd)

19. Tune to 3200.000 MHz. Adjust 3.2 GHz A3A5R18 to obtain -9.600 ±0.001 Vdc.

20. At each frequency listed in the table, check the YTO pretune voltage at A3A5TP3 with the clip attached to the test point pair A2A9TP1.

Signal Generator Frequency (GHz)	Voltage at A3A5TP3 (Vdc)
4.801	−4.803 ±0.001
4.802	−4.806 ±0.001
4.804	−4.812 ±0.001
4.808	−4.824 ±0.001
4.810	−4.830 ±0.001
4.820	−4.860 ±0.001
4.840	−4.920 ±0.001
4.880	−5.040 ±0.001

21. Tune to 4910.000 MHz and measure the voltage at A3A5TP3. The voltage should read −5.130 ±0.002 Vdc with the clip in place.

22. Remove the clip and measure the voltage at A3A5TP3. The voltage should now read −14.730 ±0.002 Vdc. If the voltage tolerances in steps 21 and 22 are not met, repeat this procedure starting from step 5. Then if the voltage tolerances cannot be met, refer to Section VIII for troubleshooting information.

ADJUSTMENTS

5-15. YTO DRIVER ADJUSTMENT

Reference Service Sheet 7-A3.

Description The fundamental output of the Signal Generator is set to the maximum and minimum frequencies and the YTO driver's gain and offset currents are set to give specified YTO output frequencies.

Equipment Frequency Counter .... HP 5343A

NOTE

All boards must be installed in the instrument before these adjustments are made.

Procedure

1. On the Signal Generator, press RCL 0 and set the output level to 0 dBm.
2. Connect the frequency counter to the Signal Generator's RF OUTPUT connector.
3. Connect A3A6TP5 (GND) to A3A7TP2 (TUN VOLT) with a clip-on jumper wire. (This grounds the feedback voltage and opens the YTO phase lock loop.)
4. Tune the Signal Generator to 2000.000 MHz. Adjust A3A6R34, 2 GHz, to obtain 2000.0 ±0.1 MHz on the frequency counter. Wait until the drift is minimal (approximately 30 seconds) before making this adjustment.
5. Tune the Signal Generator to 6599.000 MHz. Adjust A3A6R25, which is labeled 6.199 GHz, to obtain 6599.0 ±0.1 MHz on the frequency counter. Wait until the drift is minimal (approximately 30 seconds) before making this adjustment.
6. Repeat steps 4 and 5 until the required tolerance is obtained at both frequencies.
7. Disconnect A3A6TP5 from A3A7TP2.
8. Verify that the counter reading is within ±1 kHz of the Signal Generator's FREQUENCY MHz display at 2.0 and 6.6 GHz.

ADJUSTMENTS

5-16. YTO LOOP SAMPLER ADJUSTMENTS

Reference Service Sheet 8-A3.

Description The sampler is driven by a sweep oscillator and the dc output is monitored with an oscilloscope. The sampler driver circuit is adjusted for maximum amplitude and flatness over the range of the M/N loop. The sampler's IF preamplifier is adjusted for correct level and the frequency response is checked.

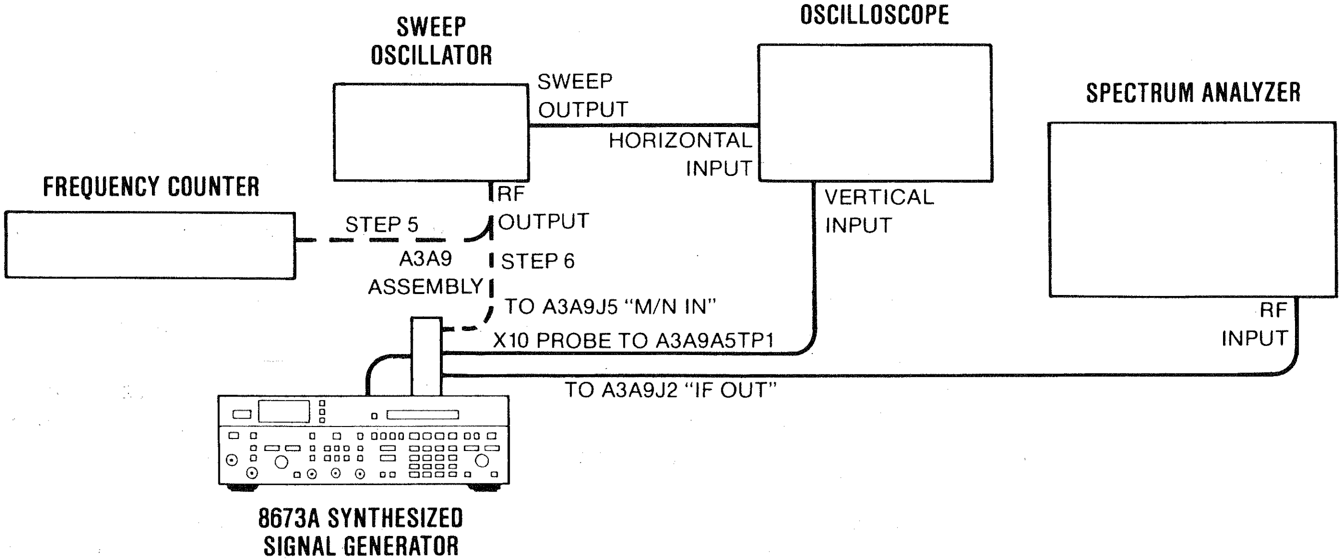


Figure 5-8. YTO Loop Sampler Adjustment Test Setup

Equipment

Oscilloscope	HP 1715A
Divide-by-10 Probe	HP 10017A
Sweep Oscillator	HP 86222B/8620C
Spectrum Analyzer	HP 8569B
Frequency Counter	HP 5343A
50Ω Termination	HP 8493C Option 020

NOTE

An HP 8485A Power Sensor can be used instead of the HP 8493C for the 50Ω termination.

Procedure

1. Set the Signal Generator's LINE switch to STBY and disconnect the mains power cable.

2. Remove the Signal Generator's top and bottom covers and place the A3A9 Assembly into the test position.

3. Remove the right side cover of A3A9.

ADJUSTMENTS

5-16. YTO LOOP SAMPLER ADJUSTMENTS (cont'd)

Procedure (cont'd)

4. Connect a 50Ω termination to the A3A9A1 Directional Coupler output, which normally connects to A1W1.

5. Set the sweep oscillator's controls for a leveled output level of 0 dBm, center frequency range of 187.5 ±1.0 MHz (measured by frequency counter) and a sweep range of 200 MHz ±100 MHz.

6. Connect the equipment as shown in Figure 5-8. Connect the Signal Generator's mains power cord and set the LINE switch to ON.

7. Connect the sweep oscillator's RF output to the M/N LOOP SIGNAL connector, A3A9J5, in place of the white-orange cable.

8. Adjust A3A9A5C1 and C2 (with an insulated adjustment tool) to get an oscilloscope display similar to Figure 5-9. Tune for maximum negative voltage and flatness over the center two divisions. The minimum change from the reference level to the maximum negative voltage should be 0.4 volts. (Troubleshooting Note: If the minimum change is out of tolerance, A3A9A5Q3 and Q8 may have low gain, the YTO feedback signal feeding the RF port of the mixer may be low, or the sampler may be bad.)

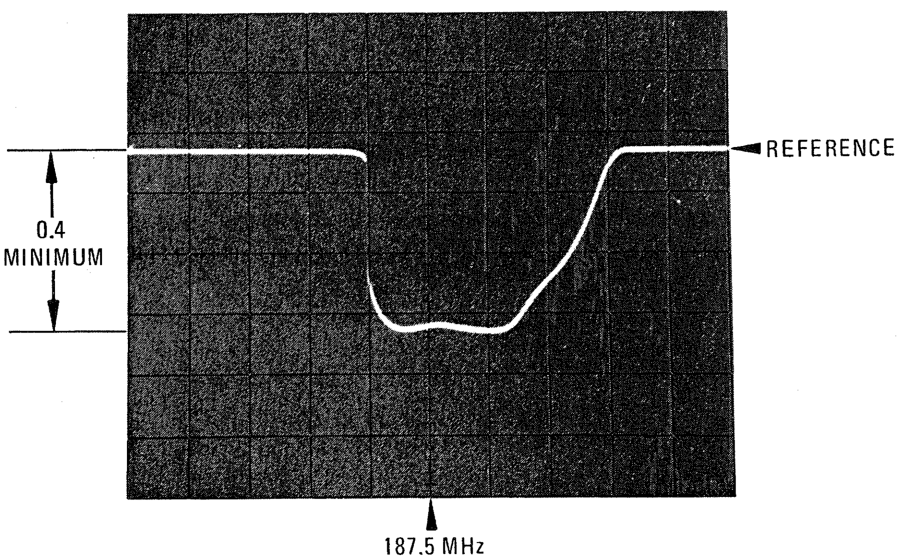


Figure 5-9. Typical Swept Frequency Response at A3A9A5TP1 (frequency span per division 20 MHz)

9. Short A3A7TP2 to ground to open the YTO phase lock loop.

10. Tune to 2100 MHz and disconnect the gray cable from the phase detector output, A3A9J6. Remove the oscilloscope's probe from A3A9A5TP1.

11. Connect the spectrum analyzer's input directly to IF OUT, A3A9J2.

ADJUSTMENTS

5-16. YTO LOOP SAMPLER ADJUSTMENTS (cont'd)

Procedure (cont'd)

12. Set the sweep oscillator's controls for a center frequency of 177.5 ±1.0 MHz and set the sweep width to 10 MHz.

13. Connect the sweep oscillator's output to the M/N LOOP SIGNAL input A3A9J5.

14. Set the spectrum analyzer's controls for a 0 to 100 MHz frequency span. Set the other controls to display the swept IF signal. The fundamental, second and third harmonics should be visible at 30, 60, and 90 MHz. Tune the sweep oscillator slightly to align the signals on the display.

15. Adjust the A3A9A5R1, IF GAIN, so that the displayed IF signal at 30 MHz is +2 ±1 dBm.

16. Slowly tune the sweep oscillator's center frequency from 174 to 181 MHz and observe the fundamental's output level. Verify that the allowable level variation is not exceeded or that the power does not drop below the stated level over the frequency range:
    a. from 6 to 20 MHz, −3 dBm minimum,
    b. from 20 to 30 MHz, +2 to +6 dBm,
    c. from 30 to 70 MHz, −10 dBm minimum.

17. Return the Signal Generator to normal operation as follows:
    a. Disconnect all test equipment.
    b. Reconnect the gray cable to A3A9J6 and the white-orange cable to A3A9J3.
    c. Reverse the instructions in step 4, 3, 2, and 1.

18. Connect the frequency counter to the Signal Generator's RF OUTPUT connector.

19. Verify that the counter reading is within ±1 kHz of the Signal Generator's FREQUENCY MHz display at 2.0 and 6.6 GHz.

ADJUSTMENTS

5-17. YTO LOOP OFFSET AND FM OVERMODULATION ADJUSTMENTS

Reference Service Sheet 9-A3.

Description To operate the YTO loop phase detector in the linear region, the loop offset adjustment is set so that the foldover at the peak of the phase detector output signal just begins. To set the FM overmodulation threshold, the FM overmodulation adjustment is set to a position that just lights the front panel FM OVERMOD status annunciator.

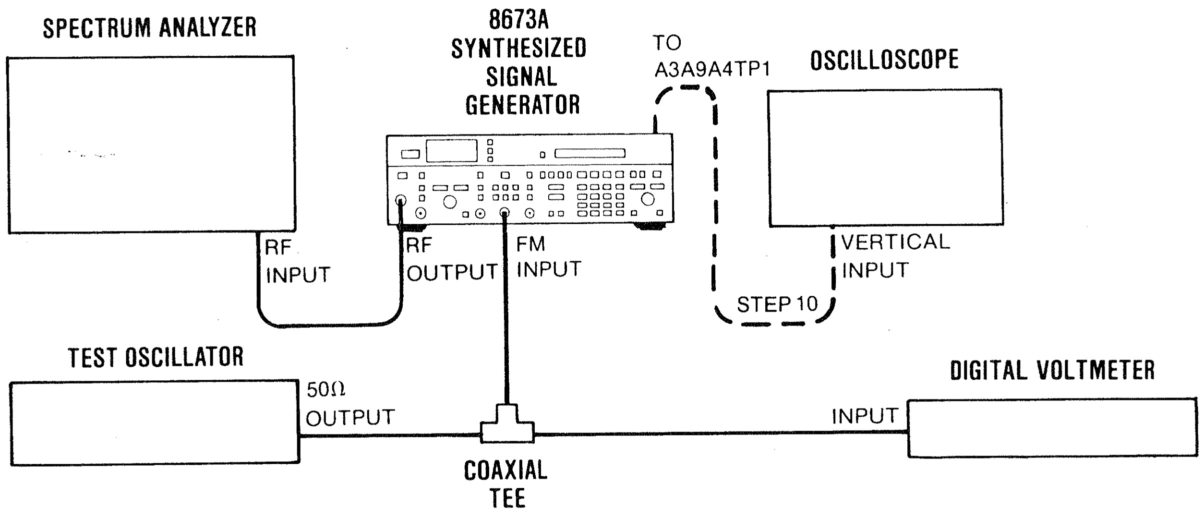


Figure 5-10. YTO Loop Offset and FM Overmodulation Adjustment Test Setup

Equipment

Oscilloscope	HP 1715A
Divide-by-10 Probe	HP 10017A
Spectrum Analyzer	HP 8569B
Test Oscillator	HP 651B
Digital Voltmeter (DVM)	HP 3455A

Procedure

1. Set the Signal Generator's LINE switch to STBY and disconnect the mains power cord.
2. Remove the Signal Generator's top and bottom covers and place the A3A9 Assembly into the test position.
3. Remove the A3A9A4 cover.
4. Connect the equipment as shown in Figure 5-10. Connect the Signal Generator's mains power cord and set the LINE switch to ON.
5. On the Signal Generator, key in RCL 0 and then set FM DEVIATION to 10 MHz.
6. Tune the test oscillator to 100 kHz.
7. Adjust the spectrum analyzer's controls to display the carrier and the 100 kHz sidebands.

ADJUSTMENTS

5-17. YTO LOOP OFFSET AND FM OVERMODULATION ADJUSTMENTS (cont'd)

Procedure (cont'd)

8. Adjust the test oscillator's output level for the first carrier null as observed on the spectrum analyzer's display. Record the test oscillator's output level as measured with the voltmeter.

______________ Vrms (V_1)

9. Divide the measured value by 2.4. Readjust the test oscillator's output level to the computed level, V_2.

$\frac{V_1}{2.4}$ ______________ (V_2)

10. Connect the oscilloscope to A3A9A4TP1 through a divide-by-ten probe. Adjust the oscilloscope's controls to view the 100 kHz signal.

11. Set the YTO loop offset adjustment A3A9A4R53, OFST, so the sinusoidal waveform just begins to fold over. See Figure 5-11.

NOTE

There may be two settings of A3A9A4R53 that give the proper offset. Use the position closer to the center of the adjustment range.

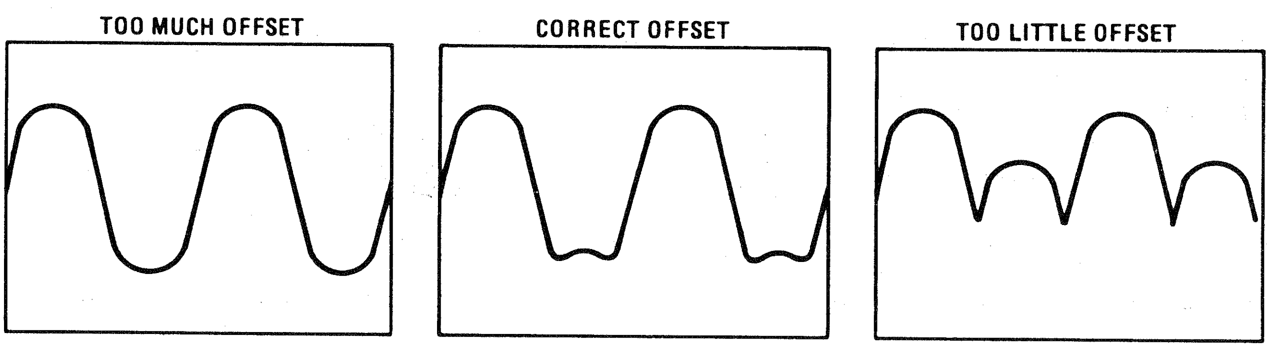


Figure 5-11. YTO Loop Offset Adjustment Waveforms

12. Disconnect the oscilloscope's probe.

13. Adjust the test oscillator's output level for the second carrier null as observed on the spectrum analyzer's display. Record the test oscillator's output level.

______________ Vrms (V_3)

14. Multiply the measured value by 1.18. Readjust the test oscillator's output level to the computed level, V_4.

$V_3 \times 1.18$ ______________ (V_4)

ADJUSTMENTS

5-17. YTO LOOP OFFSET AND FM OVERMODULATION ADJUSTMENTS (cont'd)

Procedure (cont'd)

15. Set the FM overmodulation adjustment A3A9A4R30, OMOD, to the full clockwise position. Slowly rotate the adjustment counterclockwise until the front panel FM OVERMOD status annunciator just turns on.

16. Return the Signal Generator to normal operation by reversing the instructions in steps 4, 3, 2, and 1.

ADJUSTMENTS

5-18. YTO LOOP PHASE DETECTOR ADJUSTMENTS

Reference Service Sheet 9-A3.

Description The gain crossover frequency of the YTO phase lock loop is measured and adjusted using a low frequency spectrum analyzer and tracking generator.

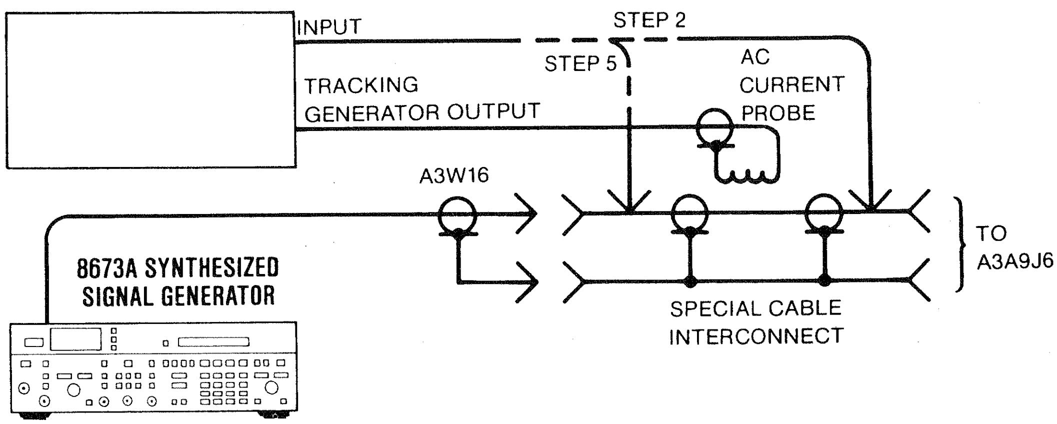


Figure 5-12. YTO Loop Phase Detector Adjustment Test Setup

Equipment

Spectrum Analyzer .... HP 8556A/8552B/141T
(with tracking generator)
AC Current Probe .... HP 1110B
Special Interconnect Cable .... (See Figure 1-2)

Procedure

1. Set the Signal Generator's RF switch to ON.

2. Connect the equipment as shown in Figure 5-12. The special interconnect cable is inserted between A3W16 (gray cable) and A3A9J6 (YTO TUNE 1).

NOTE

When clipping the current probe around the special cable's center conductor, do not allow the metal surface to come in contact with the center conductor connection of the SMA connectors.

3. Set the spectrum analyzer to scan from 0 to 50 kHz, vertical sensitivity per division to 2 dB, scan mode to single, and set the display's variable persistence to maximum.

4. Press the SINGLE sweep key on the Signal Generator.

5. Move the spectrum analyzer's input to the cable side (A3W16) of the special cable.

ADJUSTMENTS

5-18. YTO LOOP PHASE DETECTOR ADJUSTMENTS (cont'd)

Procedure (cont'd)

6. Press the SINGLE sweep key. Check that the gain-crossover frequency is 20 ±2 kHz. If the gain-crossover frequency is not correct, A3A9A4R20 must be changed to set the correct frequency; otherwise, this adjustment is complete. See Figure 5-13.

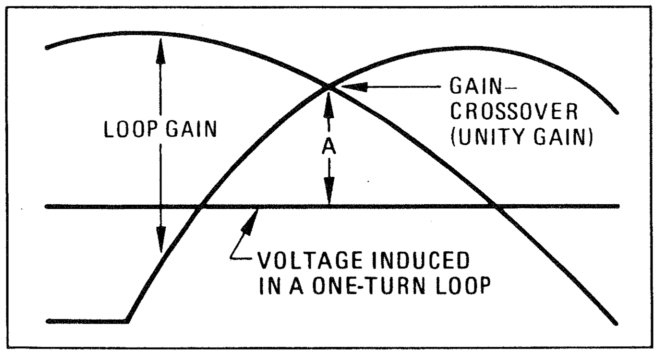


Figure 5-13. Spectrum Analyzer Display of Phase Locked Loop Gain

7. If A3A9A4R20 must be changed, perform the following steps:
   a. Set the LINE switch to STBY.
   b. Disconnect the mains power cord.
   c. Place the A3A9 Assembly in the test position.
   d. Remove the A3A9A4 cover.
   e. Select the value of R20 using the following formula

$$R2 = R1\left(\frac{F1}{20\ \text{kHz}}\right)$$

where R2 = required value for R20
R1 = present value of R20
F1 = measured frequency

for example, if
R1 = 619Ω
and F1 = 25 kHz
then

$$R2 = 619\ \frac{25\ \text{kHz}}{20\ \text{kHz}}$$

R2 = 773Ω or 750Ω (closest value)

8. Install R20, reconnect the mains power cord and set the LINE switch to ON. Recheck the gain-crossover frequency.

ADJUSTMENTS

5-18. YTO LOOP PHASE DETECTOR ADJUSTMENTS (cont'd)

Procedure (cont'd)

NOTE

The other loop parameters, phase margin and loop gain, may be checked if the loop does not operate correctly. Loop gain is checked at 1 kHz and should be approximately 40 dB. Phase margin is checked by disconnecting the input to the ac probe, shorting the input, and pressing the single sweep pushbutton. Phase margin should be approximately 45° and is calculated by the following expression:

$$\theta = \cos^{-1}\left(1 - \frac{10^{\left(\frac{A}{10}\right)}}{2}\right)$$

where θ = phase margin

and A = ratio (in dB) of the induced voltage to the gain-crossover. (Gain-crossover is the reference, therefore the ratio is negative.)

9. Return the Signal Generator to normal operation as follows:
   a. Set the LINE switch to STBY.
   b. Disconnect the mains power cord.
   c. Install the A3A9A4 cover.
   d. Return the A3A9 Assembly to its normal position.
   e. Install the top and bottom covers.

ADJUSTMENTS

5-18. FM DRIVER ADJUSTMENTS

Reference Service Sheet 10-A3.

Description The dc offset of the FM integrator amplifier is set as close to zero volts as possible. Any FM signal present on the error signal line of the YTO phase lock loop is nulled at both high and low FM driver sensitivities.

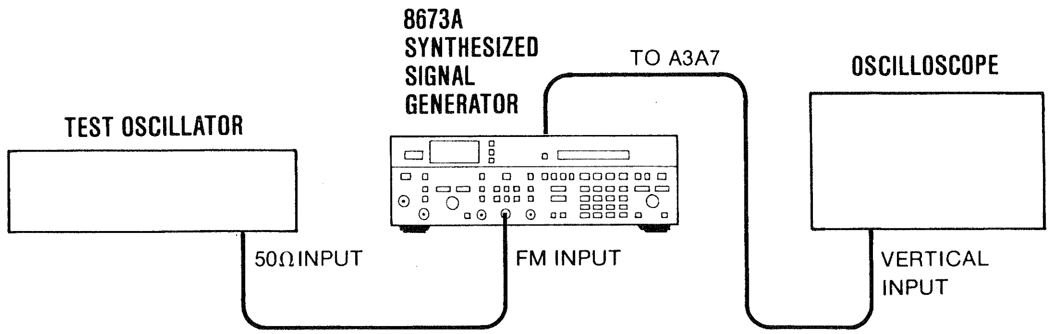


Figure 5-14. FM Driver Adjustment Test Setup

Equipment

Oscilloscope .... HP 1715A
Test Oscillator .... HP 651B

Procedure

1. Set FM DEVIATION to 0.1 MHz.
2. Connect the oscilloscope to A3A7TP3.
3. Set A3A7R28, OFST (offset adjust), for 0.0 ±0.1 Vdc.
4. Set FM DEVIATION to 10 MHz.
5. Verify a voltage level of 0 ±2 Vdc at A3A7TP3.
6. If the RF switch is off, set it to ON.
7. Set the test oscillator controls for an output of 1.5 mVrms at 5 kHz.
8. Connect the oscilloscope to A3A7TP2; connect the test oscillator output to the FM IN connector. The signal displayed by the oscilloscope will generally be less than 20 mV peak-to-peak.
9. Set A3A7R40, GAIN, to null any FM signal present at A3A7TP2.
10. Set FM DEVIATION to 0.1 MHz and test oscillator output level to 0.15 Vrms.
11. Set A3A7R46, −40 GN (−40 Gain), to null any FM signal present at A3A7TP2.

ADJUSTMENTS

5-20. FM ACCURACY AND OVERMODULATION ADJUSTMENTS

Reference Service Sheet 8-A1.

Description The FM gain is set. The modulation drive is set to a level that causes FM deviation to equal a full scale meter reading. The meter drive adjustment is set accordingly. The modulation drive is then set to a level that causes overmodulation. The FM overmodulation adjustment is set to a position that just lights the front panel FM OVERMOD status annunciator.

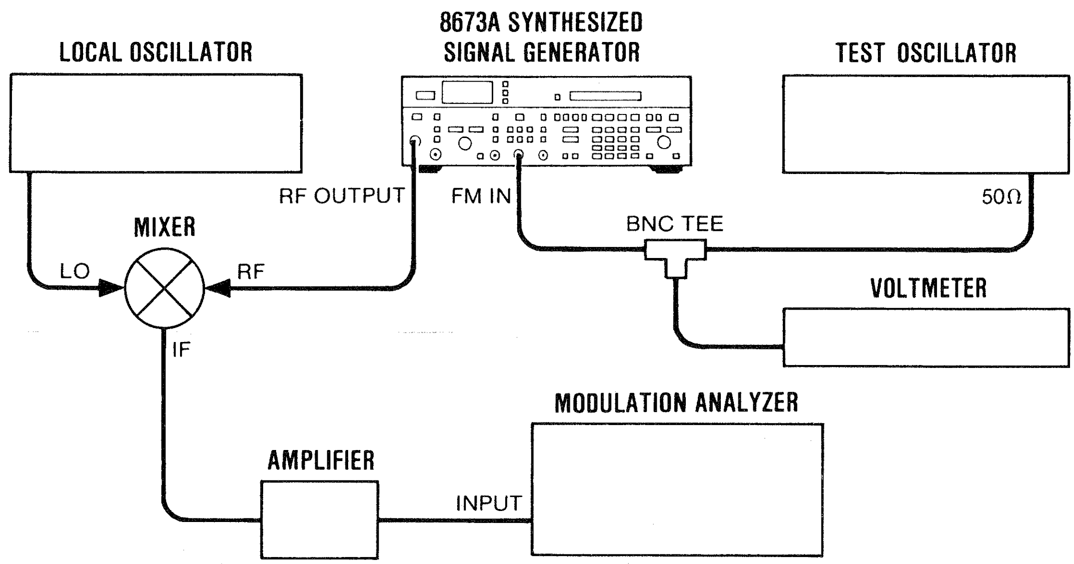


Figure 5-15. FM Accuracy and Overmodulation Adjustment Test Setup

Equipment

Digital Voltmeter	HP 3455A
Modulation Analyzer	HP 8901A
Test Oscillator	HP 651B
Amplifier	HP 8477F (Preamp)
Mixer	RHG DMS1-26
Local Oscillator	HP 8673A

Procedure

1. Connect the equipment as shown in Figure 5-15.

2. On the Signal Generator press RCL 0. Set the instrument to the following conditions:

Frequency	15 GHz
Output Level	−20 dBm
Meter Scale	FM
FM Deviation	0.1 MHz

3. Set the local oscillator's frequency to 15.1 GHz at an output level of +7 dBm, with all modulation off.

ADJUSTMENTS

5-20. FM ACCURACY AND OVERMODULATION ADJUSTMENTS (cont'd)

Procedure (cont'd)

4. Set the test oscillator's amplitude for a voltmeter reading of 0.7071 Vrms.

5. Adjust FM GAIN (A1A6R35) on the A1A6 Meter Assembly for a modulation analyzer reading of 100.0 ±0.1 kHz.

6. Adjust FM MTR (A1A6R70) for a full scale reading of 100 kHz on the Signal Generator's front panel meter.

7. Set the Signal Generator to the 0.03 MHz FM deviation range.

8. Verify that the Signal Generator's front panel meter agrees with the modulation analyzer (approximately 30 kHz) to within 4 kHz.

9. Set the test oscillator's amplitude for a voltmeter reading of 0.7425 Vrms.

10. Set FM OMOD (A1A6R54) to the extreme clockwise position.

NOTE

Adjust FM OMOD as accurately as possible to avoid turning on the front panel FM OVERMOD status annunciator erroneously.

11. Adjust FM OMOD (A1A6R54) in a counterclockwise direction until the FM OVERMOD status annunciator on the Signal Generator's front panel just turns on.

ADJUSTMENTS

5-21. SWEEP OUT AND BLANKING/MARKER ADJUSTMENTS

Reference Service Sheets 6-A2 and 11-A2.

Description The ramp is adjusted for 0 to +10V and is available at the rear panel SWP OUT connector. The Z-axis intensity marker is adjusted to −5V and is available at the rear panel BLANKING/MARKER connector.

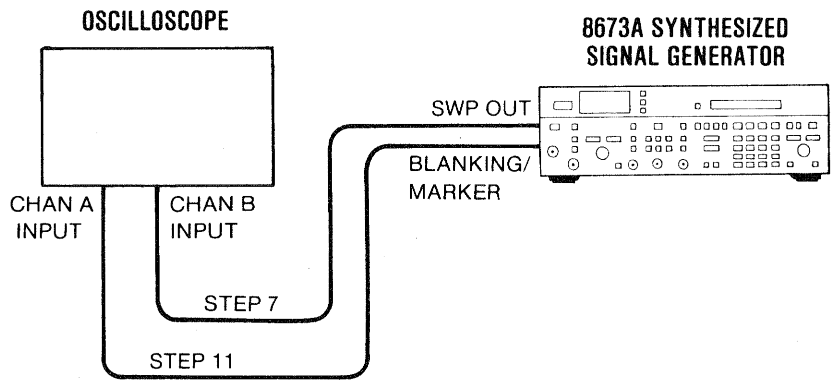


Figure 5-16. Sweep Out and Blanking/Marker Adjustments Test Setup

Equipment

Oscilloscope .... HP 1715A
MPU Test Board .... HP 11726-60001

NOTE

The MPU Test Board is part of the HP 11726A Support Kit.

Procedure

1. Set the Signal Generator's LINE switch to STBY, then remove the top cover.
2. Connect the MPU test board to Microprocessor Assembly A2A8.
3. On the Microprocessor Assembly, short A2A8TP5 to the adjacent GND test point.
4. Set diagnostic switch A2A8S1, on the Microprocessor Assembly, to 4. (Diagnostic mode 4 enables testing of circuits on the A2A7 I/O Assembly.)
5. Set the LINE switch to ON.
6. Verify that the FREQUENCY MHz display shows 04-1, indicating that the diagnostic switch is correctly set to diagnostic mode 4.
7. Connect the Signal Generator to the oscilloscope's channel B input as shown in Figure 5-16.
8. Set the oscilloscope's trigger to channel B and set channel B for dc coupling. Adjust the oscilloscope for the display shown in Figure 5-17.

ADJUSTMENTS

5-21. SWEEP OUT AND BLANKING/MARKER ADJUSTMENTS (cont'd)

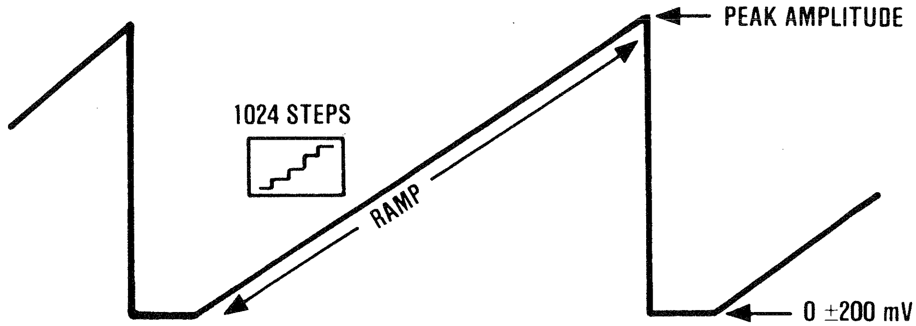
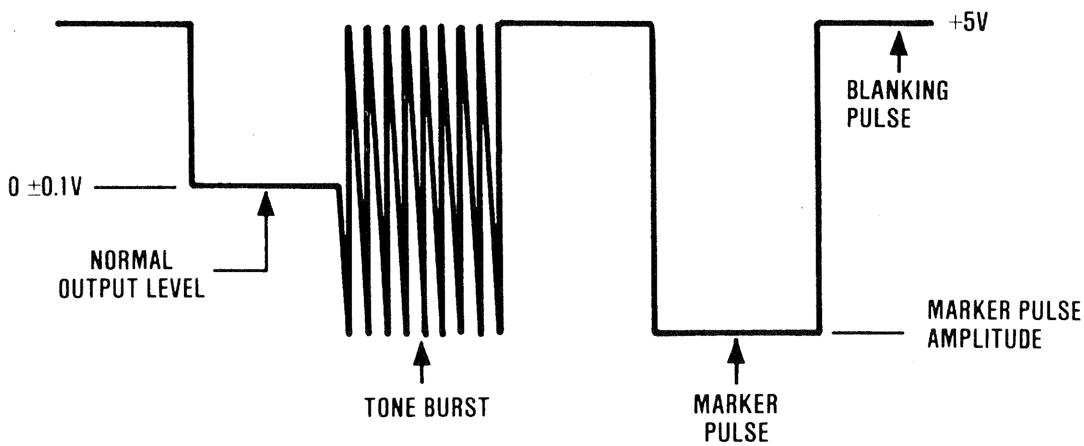


Figure 5-17. Oscilloscope Display for Sweep Out Adjustment

Procedure (cont'd)

9. Set SWP (A2A7R34) for a +10V ramp peak-to-peak. Verify that the ramp contains no discontinuities.

10. Connect the rear panel BLANKING/MARKER BNC connector to channel A of the oscilloscope, leaving the trigger set to channel B.



5-18. Oscilloscope Display for Marker Adjustment

11. Using the GND on channel A of the oscilloscope, set a reference for normal output level (see Figure 5-18).

12. Switch channel A to dc coupling.

13. Adjust MKR (A2A7R50) for a marker pulse −5V below the reference.

ADJUSTMENTS

5-22. SRD BIAS ADJUSTMENT

Reference Service Sheet 6-A1.

Description **Automated adjustment.** The YIG Tuned Multiplier (YTM) multiplies the fundamental frequency of the YIG Tuned Oscillator (2.0 to 6.6 GHz). Multiplication is achieved via the step recovery diode (SRD) inside the YTM. The bias voltages on the SRD control the signal levels of the harmonics generated. Misadjusted bias voltages result in low harmonic levels, and thus low power out in the harmonic frequency bands (6.6 to 26.0 GHz). Extreme misadjustment can cause YTM spurious oscillations and poor pulse shape in pulse modulation mode.

The SRD bias adjustment procedure consists of setting both the source and gate bias voltages of the SRD bias FET. There are four source voltage adjustments; one for each of the four frequency bands. There are six gate voltage adjustments; two for each of the three harmonic bands (bands 2, 3, and 4). The adjustment is performed as follows:

a. Source and gate dc bias voltage values are entered into the controller as shown in Figure 5-19. The bias voltages are listed on the YTM label located inside the Signal Generator near the attenuator. The question mark (?) is used as a prompt to indicate when and where data should be entered.

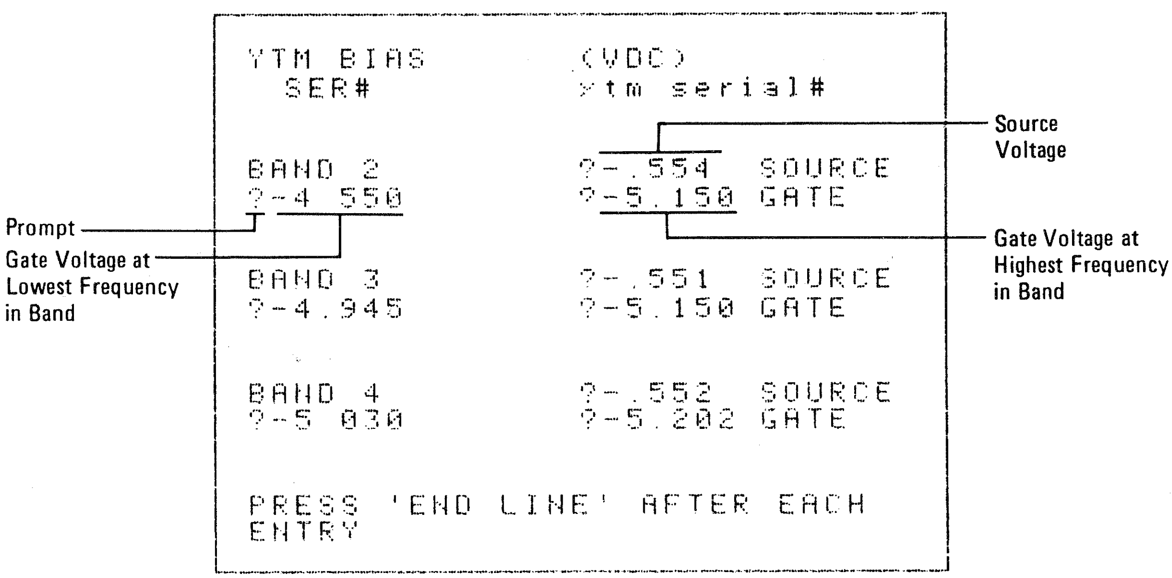


Figure 5-19. Format for Entering SRD Bias Voltages

b. Source voltages for each band are adjusted. Band 1 (2.0 to 6.6 GHz) source voltage is always set to 3.80 ±0.01 Vdc. Band 2 (6.6 to 12.3 GHz), band 3 (12.3 to 18.6 GHz), and band 4 (18.6 to 26.0 GHz) source voltages are set to within ±0.001 Vdc of the voltage listed on the YTM label. After the source voltages are adjusted, the results are displayed.

c. Gate bias voltages are adjusted for bands 2, 3, and 4. Six rectangles are drawn on the controller screen, each one representing an adjustment. The center of the rectangle

ADJUSTMENTS

5-22. SRD BIAS ADJUSTMENT (cont'd)

Description (cont'd)

represents the entered gate voltage. The flashing "X", which represents the error from the entered gate voltage, is adjusted to within one-half division of the rectangle center. See Figure 5-20.

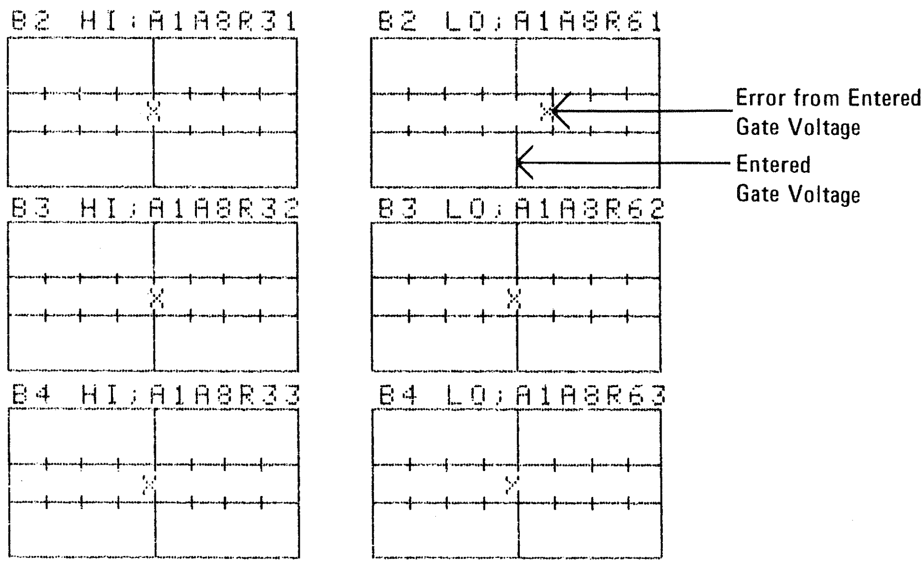


Figure 5-20. Gate Voltage Adjustment

After the gate voltages are adjusted, the results are displayed.

NOTES

If a gate voltage cannot be adjusted, check the controller printout of the entered SRD bias voltages and verify that the gate voltages were entered correctly. The center of the rectangle represents the gate voltage that was entered into the controller.

Gate voltages can be checked manually by measuring dc voltage at the lowest and highest frequency of each band. These voltages should correspond to the voltages on the YTM label.

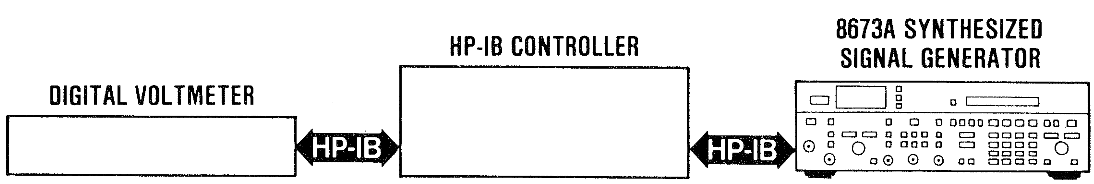


Figure 5-21. SRD Bias Adjustment Test Setup

Equipment

Digital Voltmeter .... HP 3455A
HP-IB Controller .... HP 85F/82903A/00085-15005/00085-15002/00085-15004
Test Cassette .... HP 11726-10001

ADJUSTMENTS

5-22. SRD BIAS ADJUSTMENT (cont'd)

Procedure

1. Connect the Signal Generator and voltmeter to the controller via the HP Interface Bus as shown in Figure 5-21.

2. Set the Signal Generator's HP-IB address to 19 and set the voltmeter's HP-IB address to 22.

3. Load the test program as instructed in the paragraph titled "Automated Adjustment Procedures" in this section.

4. After the program is loaded and the main menu is displayed, press K1 to run the SRD bias adjustment program.

5. Instructions for the remainder of the procedure will be displayed on the controller screen. The program will indicate when the SRD bias adjustment has been completed.

ADJUSTMENTS

5-23. YTM TUNE ADJUSTMENT

Reference Service Sheets 1-A1, 3-A1, 4-A1, 7-A1, and 9-A1.

Description **Automated adjustment.** The YIG Tuned Multiplier (YTM) is swept approximately 200 MHz above and below the Signal Generator's set RF output frequency. The YTM tuning curve is then examined and adjusted until its center frequency equals the set RF output frequency, and tracks the set frequency over the entire 2 to 26 GHz range.

If the YTM tuning is out of adjustment, the bandpass filter either attenuates the YIG Tuned Oscillator (YTO) signal more than normal, resulting in low output power, or insufficiently filters signal harmonics. In addition, a misaligned YTM can cause poor pulse shape in pulse modulation mode. The YTM Tune adjustment should be performed whenever the YTM or associated circuitry has been repaired or whenever low output power or high harmonics exist.

The YTM tune adjustment is performed as follows:

a. Preliminary adjustments are made. These include setting the +12.4 voltage reference, setting the peaker DAC input bits low via the Special Function learn mode, adjusting "INT OS", disabling the power clamp circuit, and setting the front panel CAL control.

b. The oscilloscope display is calibrated to monitor the detected output of the YTM.

c. YTM tuning is adjusted by centering the YTM response peak on the oscilloscope display (see Figure 5-22). Adjustments are made at the highest and lowest frequency in each band. In addition, bands 3 and 4 are adjusted at "breakpoints" to correct for tracking deviation at the higher frequencies.

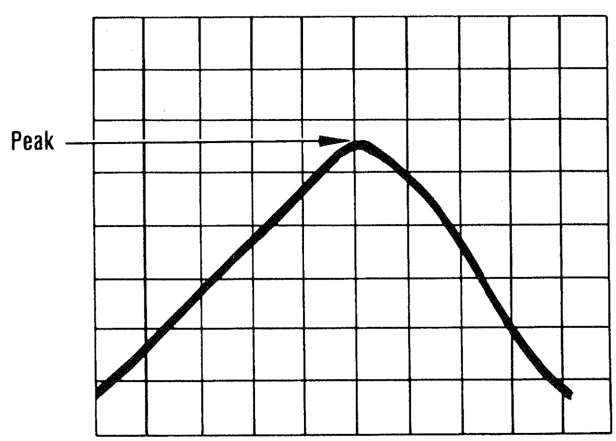


Figure 5-22. Optimum YTM Response

d. Each band is swept to check the YTM tracking response of its passband after adjustment.

ADJUSTMENTS

5-23. YTM TUNE ADJUSTMENT (cont'd)

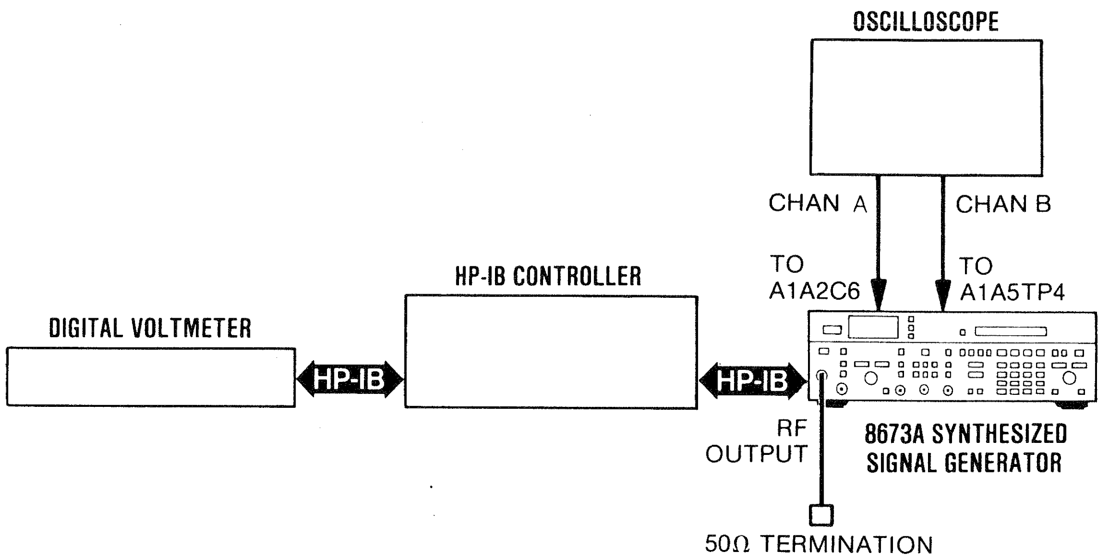


Figure 5-23. YTM Tune Adjustment Test Setup

Equipment

Digital Voltmeter .... HP 3455A
Oscilloscope .... HP 1715A
50Ω Termination .... HP 8485A
HP-IB Controller .... HP 85F/82903A/00085-15005/00085-15002/00085-15004
Test Cassette .... HP 11726-10001

Procedure

1. Set the Signal Generator's HP-IB address to 19 and set the voltmeter's HP-IB address to 22.

2. Load the test program as instructed in the paragraph titled "Automated Adjustment Procedures" in this section.

3. After the program is loaded and the main menu is displayed, press K2 to run the YTM tune adjustment program.

4. Instructions for the remainder of the procedure will be displayed on the controller screen. The program will indicate when the YTM tune adjustment has been completed.

NOTE

Perform the procedure titled "Power Clamp Adjustment" after completing this adjustment.

ADJUSTMENTS

5-25. FLATNESS AND ALC ADJUSTMENTS

Reference Service Sheets 1-A1, 4-A1, 6-A1, 7-A1, and 9-A1.

Description **Automated adjustment.** The flatness adjustments compensate for power variations caused by RF output cables, the attenuator, the crystal detector, and the directional coupler. Misadjusted flatness can cause large variations in power level as frequency changes.

The flatness adjustment procedure is performed as follows:

a. The program runs a flatness plot of the Signal Generator, which is displayed on the controller screen.

b. The program calculates and draws the specification lines and optimum slope for each of the four flatness regions.

c. A copy of the flatness plot is printed.

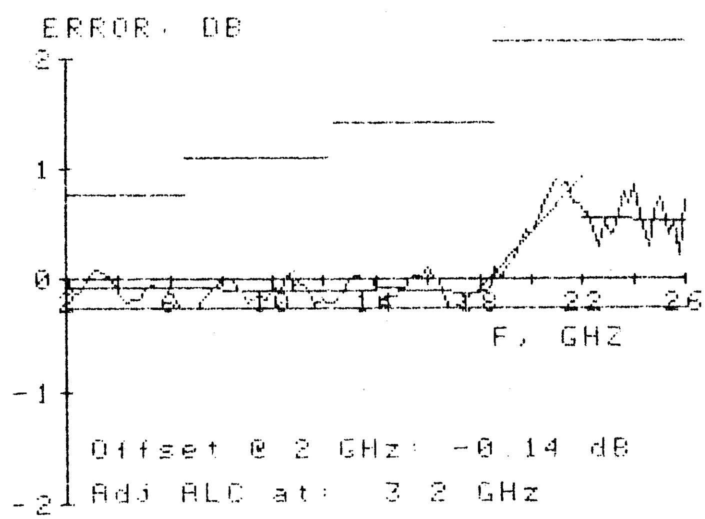


Figure 5-25. Typical Flatness Plot

d. Four axes, representing the slope adjustment for each flatness region, are drawn on the controller screen. The center of each axis represents zero error (the optimum slope for that region). The "X" is adjusted as close as possible for zero error.

e. After the flatness adjustments are made, the controller will print a new flatness plot. Included on the plot is an ALC adjustment frequency that is used in the ALC portion of this adjustment procedure.

The ALC adjustments include centering the ALC loop error voltage within the unleveled detector range, adjusting the AM carrier level, and calibrating the ALC log amp curve. Misadjusted ALC can cause poor AM performance, high level accuracy errors and LVL meter errors.

ADJUSTMENTS

5-25. FLATNESS AND ALC ADJUSTMENTS (cont'd)

Description (cont'd)

The ALC adjustment procedure is performed as follows:

a. The front panel meter's mechanical zero is set for a mechanical indication of exactly zero on the lower scale.

b. The ALC adjustment frequency, provided on the flatness plot printout, is entered into the controller.

c. The ALC loop error voltage is centered within the unleveled detector's window.

d. AM carrier level (with no modulation input) is set to the same power level as the CW level (AM off).

e. Vernier and meter circuits are adjusted.

f. The overrange adjustment is set to obtain the same RF level in and out of the overrange mode.

g. The internal ALC log amp curve is adjusted to produce an output voltage proportional to the log of the detected input power (in Watts) at all levels. This ensures that the proper output power level will be obtained across the full vernier range.

h. The external ALC log amp is adjusted to minimize dc offset and to center the operating range of the external leveling circuitry.

Several utility programs can then be run to check flatness, vernier and maximum power.

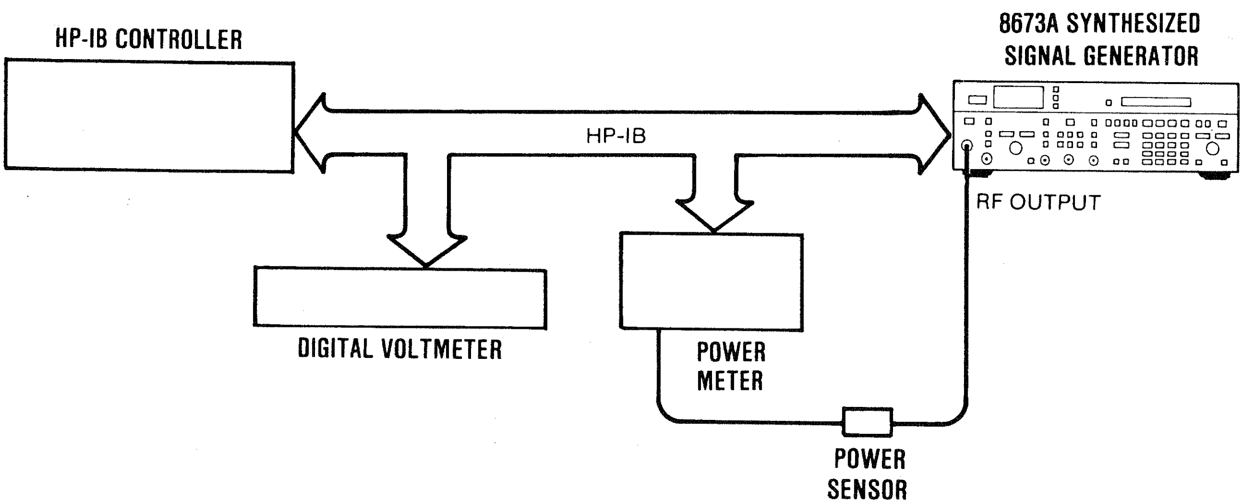


Figure 5-26. Flatness and ALC Adjustments Test Setup

Equipment

Power Meter	HP 436A
Power Sensor	HP 8485A
Digital Voltmeter	HP 3455A
HP-IB Controller	HP 85F/82903A/00085-15005/ 00085-15002/00085-15004
Test Cassette	HP 11726-10001

ADJUSTMENTS

5-24. POWER CLAMP ADJUSTMENT

Reference Service Sheet 7-A1.

Description The power clamp circuit is used to limit power in band 1 (2.0 to 6.6 GHz) below the level where YIG tuned multiplier (YTM) spurious oscillations occur. Spurious oscillations vary with each YTM and with frequency, but generally occur at high power levels (>12 dBm) and at frequencies within band 1. The clamp level is set to prevent spurious oscillations for most operating modes and temperature conditions.

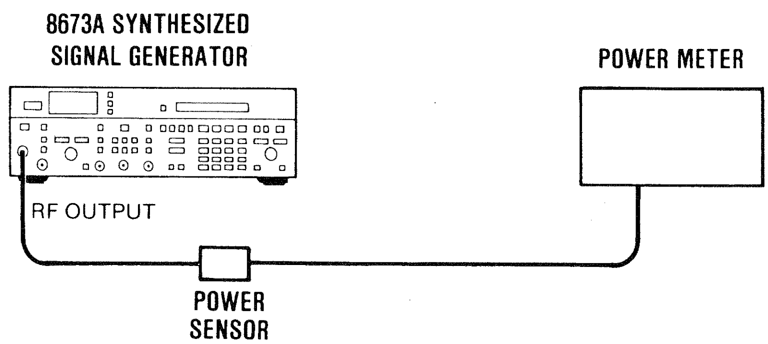


Figure 5-24. Power Clamp Adjustment Test Setup

Equipment

Power Meter .... HP 436A
Power Sensor .... HP 8485A

Procedure

1. Calibrate the power meter to the power sensor.
2. Connect the equipment as shown in Figure 5-24.
3. Set PWR CLAMP (A1A3R51) on the Function Assembly fully clockwise for maximum clamping effect.
4. On the Signal Generator, press RCL 0; set frequency to 5 GHz, RANGE to 0 dBm, and ALC DIODE to on.
5. Set the CAL control on the Signal Generator's front panel fully clockwise.
6. Set the power meter's cal factor for 5 GHz correction.
7. Adjust PWR CLAMP counterclockwise until the power meter reads +14.0 ±0.2 dBm.
8. Set the Signal Generator's frequency increment to 50 MHz. Then, press the FREQ INCREMENT ⇧ key to tune across band 1 (2.0 to 6.6 GHz) while observing the power meter reading. If the power changes suddenly by several dB while changing frequency, the Signal Generator has entered the spurious oscillation (squegging) mode. Decrease the clamp level in 0.5 dB increments at 5 GHz, each time setting the RF key to OFF momentarily and starting the PWR CLAMP adjustment from its fully clockwise position. Repeat this step until no squegging exists.

ADJUSTMENTS

5-24. POWER CLAMP ADJUSTMENT (cont'd)

Procedure (cont'd)

9. When there is no further evidence of squegging, lower the clamp level by another 1 dB to add a stability margin.

NOTE

It should not be necessary to set the clamp level lower then +10 dBm.

10. Record this level for use as a reference in the Flatness and ALC adjustment procedure.

_____________ dBm

ADJUSTMENTS

5-25. FLATNESS AND ALC ADJUSTMENTS (cont'd)

Procedure (cont'd)

NOTE

If either flatness or ALC requires adjustment, both adjustments must be performed. Flatness should be adjusted first because it affects level accuracy at most frequencies.

1. Set the Signal Generator's HP-IB address to 19, set the voltmeter's HP-IB address to 22, and set the power meter's HP-IB address to 13.

2. Calibrate the power meter to the power sensor.

3. Connect the equipment as shown in Figure 5-26.

4. Load the test program as instructed in the paragraph titled "Automated Adjustment Procedures" in this section.

5. After the program is loaded and the main menu is displayed, press K3 to run the flatness and ALC adjustment program.

6. Instructions for the remainder of the procedure will be displayed on the controller's screen. The program will indicate when the flatness and ALC adjustments are completed.

ADJUSTMENTS

5-26. AM BANDWIDTH ADJUSTMENT

Reference Service Sheet 1-A1.

Description ALC loop gain is adjusted separately for each band to optimize ALC loop stability, level switching speed, and AM bandwidth. Each band is scanned in small steps to determine where maximum rolloff and peaking occur in the ALC response. The bandwidth is then adjusted to optimize the above three performance parameters.

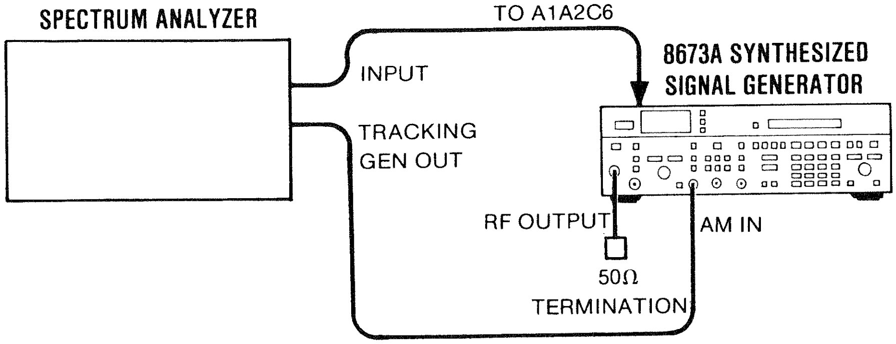


Figure 5-27. AM Bandwidth Adjustment Test Setup

Equipment

Spectrum Analyzer .... HP 8556A/8552B/141T
50Ω Termination .... HP 8485A

Procedure

1. Connect the equipment as shown in Figure 5-27.
2. Key in RCL 0 and then set the Signal Generator to the following conditions:

   Start Frequency .... 2 GHz
   Stop Frequency .... 6.6 GHz
   Step Size .... 10 MHz
   Output Level .... 0 dBm
   AM Mode 100%
   Meter Scale .... AM
   AUTO PEAK .... Off

3. Center the following components: B1 (A1A2A1R61), B2 (A1A2A1R59), B3 (A1A2A1R58), and B4 (A1A2A1R57).
4. Adjust the tracking generator level on the spectrum analyzer so that the Signal Generator's meter reads approximately 30% AM.
5. Change the Signal Generator's meter scale to LVL.
6. Set the spectrum analyzer's vertical sensitivity to 2 dB per division. Adjust the spectrum analyzer's log reference level and linear sensitivity to set the left portion of the displayed signal on a convenient CRT graticule line (two or three divisions from the top of the screen). This represents the reference level for determining AM rolloff.
7. Using the manual sweep mode, tune the Signal Generator from 2000 to 6600 MHz in 10 MHz steps to determine where the sharpest rolloff occurs in the AM response.

ADJUSTMENTS

5-26. AM BANDWIDTH ADJUSTMENT (cont'd)

Procedure (cont'd)

This corresponds to the highest negative difference in level at the far right of the display (200 kHz) as compared to the reference at the left side (0 kHz).

8. When the sharpest rolloff frequency is found, vary the Signal Generator's output level from −10 to +8 dB to determine at what level the sharpest rolloff occurs.

9. At the worst-case rolloff frequency and level, adjust B1 (A1A2A1R61) to set the AM rolloff to −3 dB at 200 kHz as displayed on the spectrum analyzer.

10. Vary the output level from −10 to +8 dB to determine at what level the sharpest peaking occurs.

11. If this peaking level exceeds +2 dB with respect to 0 Hz, readjust B1 to obtain +2 dB.

12. Return to the frequency and level of maximum rolloff and verify that the rolloff does not exceed −3 dB at a 100 kHz rate.

NOTE

The other three bands (B2, B3, and B4) are adjusted in a manner similar to band 1 (B1). Perform steps 13 through 18 for each adjustment listed in the table.

13. For each adjustment, tune the Signal Generator over the corresponding range listed in the Frequency Tuning column of the following table. Determine where the sharpest rolloff occurs in the AM response.

Adj Name	Reference Designation	Frequency Tuning (in 10 MHz steps)	Output Level
B2	A1A2A1R59	6610 to 12300 MHz	−10 to +8 dB
B3	A1A2A1R58	12310 to 17900 MHz 18000 to 18600 MHz	−10 to +8 dB −10 to +4 dB
B4	A1A2A1R57	18610 to 21900 MHz 22000 to 26000 MHz	−10 to +4 dB −10 to 0 dB

14. When the sharpest rolloff frequency is found, vary the Signal Generator's output level over the appropriate range listed in the Output Level column of the table.

15. At the worst-case rolloff frequency and level, set the appropriate adjustment for AM rolloff of −3 dB at 200 kHz as displayed on the spectrum analyzer.

16. Vary the output level over the range used in step 14 to determine at what level the sharpest peaking occurs.

17. If this peak level exceeds +2 dB with respect to 0 Hz, readjust the adjustment for +2 dB.

18. Return to the frequency and level of maximum rolloff and verify that the rolloff does not exceed −3 dB at a 100 kHz rate.

ADJUSTMENTS

5-27. AM ACCURACY AND METER ADJUSTMENT

Reference Service Sheets 7-A1 and 8-A1.

Description The AM log amp is adjusted for calibrated AM depth accuracy and the AM meter circuit is adjusted for accurate indication of AM depth.

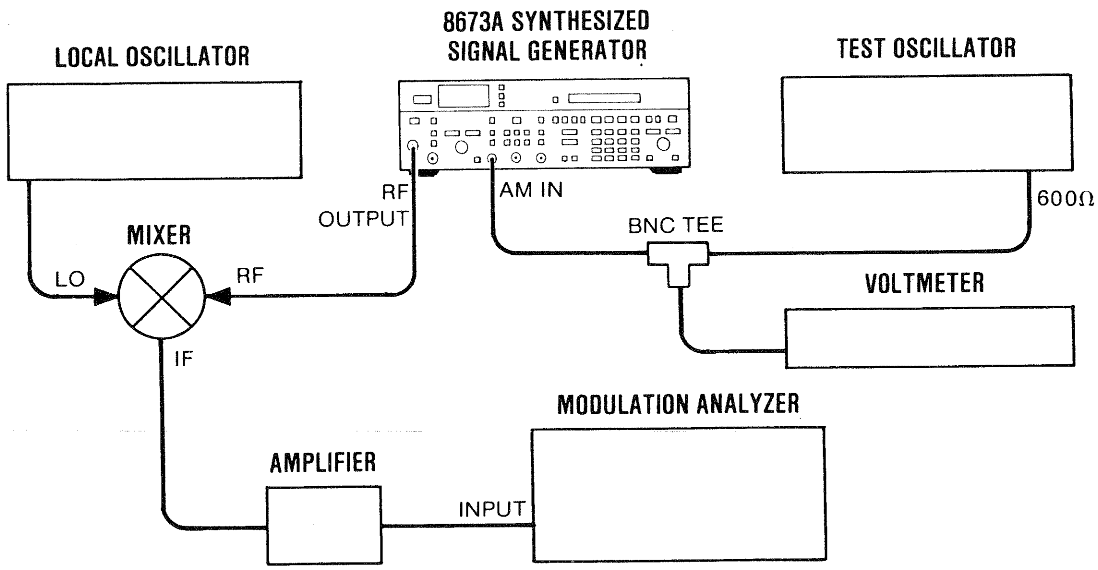


Figure 5-28. AM Accuracy and Meter Adjustment Test Setup

Equipment

Digital Voltmeter	HP 3455A
Modulation Analyzer	HP 8901A
Amplifier	HP 8447F (Preamp)
Test Oscillator	HP 651B
Mixer	RHG DMS1-26
Local Oscillator	HP 8673A

Procedure

1. Connect the equipment as shown in Figure 5-28.

NOTE

Connect the mixer directly to the local oscillator to avoid any power loss.

2. On the Signal Generator press RCL 0. Set the instrument to 2 GHz, −25 dBm output level, 100% AM, and AM meter scale.

3. Set the local oscillator to 2.07 GHz at +5 dBm.

4. Set the test oscillator's amplitude for a voltmeter reading of 0.5303 Vrms at 1 kHz.

5. Adjust AM CAL (A1A3R83) on the Function Assembly for a modulation analyzer reading of 73.00 ±0.01% AM depth.

ADJUSTMENTS

5-27. AM ACCURACY AND METER ADJUSTMENT (cont'd)

Procedure (cont'd)

NOTE

AM CAL is set to 73% AM instead of 75% AM to compensate for internal temperature variations. With the covers installed the actual 75% AM corresponds to the meter reading of 75% AM.

6. Adjust AM MTR (A1A6R84) on the Meter Assembly so that the Signal Generator's meter reads exactly 75% on the middle scale.

ADJUSTMENTS

5-28. PULSE MODULATION ADJUSTMENT

Reference Service Sheets 2-A1, 4-A1, and 9-A1.

Description The pulse clamp circuitry is adjusted to the low level dynamic range of the internal ALC detector circuitry in pulse mode. This prevents excessively long response times at low duty cycles. The maximum output of the Bias-2 DAC is adjusted with all DAC bits set high. This affects the range and resolution of the YTM bias sensing that supplies the input to the pulse amplitude control (PAC) circuit. The YTM injected pulse width is adjusted to provide pre-biasing of the YTM step-recovery diode at the proper time. The series pulse width adjustment is set so as to not conflict with the shunt pulse. The relative timing between the series and shunt pulses is critical for proper modulation performance. The ALC sample pulse timing is adjusted to select the optimum time period for which the ALC loop is activated for pulse purposes. The ALC sample pulse fine adjustments are set to minimize the difference in power between CW (continuous wave) and pulse modes at minimum pulse width. The minimum pulse width indicator circuit is adjusted to turn on the ALC UNLEVELED status annunciator when the pulse width becomes less than 100 ns.

Equipment

Digital Voltmeter	HP 3455A
Oscilloscope	HP 1715A
Divide-by-10 Probe	HP 10017A
Pulse Generator	HP 8013B
HP-IB Controller	HP 85F
Preamplifier	HP 8447F
Crystal Detector	HP 08673-60083

Procedure

Pulse Clamp Adjustment

1. Turn off the Signal Generator's RF and select PULSE NORM mode.
2. Connect the positive lead of the voltmeter to A1A2C6 (the ALC detector buffer output feedthru capacitor) and the ground lead to the Signal Generator chassis ground.
3. Adjust PCP (A1A2A2R21) for a voltmeter reading of −0.56 ±0.03 Vdc.
4. Disconnect the voltmeter from the Signal Generator.

Bias-2 DAC Sensitivity Adjustment

5. Load the following program into the controller's memory.

```
10  ! FILE=SENS
15  DIM I(26),H$[26]
20  OUTPUT 719 ;"L2"
30  FOR J=1 TO 26
40  ENTER 719 USING "#,B" ; I(J)
50  NEXT J
60  I(22)=255
70  I(23)=255
80  H$=""
90  FOR J=1 TO 26
100 H$=H$&CHR$(I(J))
110 NEXT J
120 OUTPUT 719 USING "#,K" ; H$
130 END
```

ADJUSTMENTS

5-28. PULSE MODULATION ADJUSTMENT (cont'd)

Procedure (cont'd)

6. Run the program entered in step 5. This sets all Bias-2 DAC input bits to a high state. Note that the FREQUENCY MHz display indicates all dashes and all the key lights are lit.

7. Connect the voltmeter's positive lead to A1A5TP2 and connect the ground lead to the Signal Generator's chassis ground.

8. Adjust BIAS (A1A5R47) for a voltmeter reading of +2.750 ±0.005 Vdc.

9. Disconnect the voltmeter from the Signal Generator.

10. Reset the Signal Generator by pressing LOCAL, then RCL 0. The FREQUENCY MHz display should now indicate 3000.000 MHz.

YTM Injected Pulse Width Adjustment

NOTE

This adjustment is not critical and is being reserved for future options.

11. Set Y-PW (A1A4R29) to the center of its range.

Series Pulse Width Adjustment

12. Connect the equipment as shown in Figure 5-29.

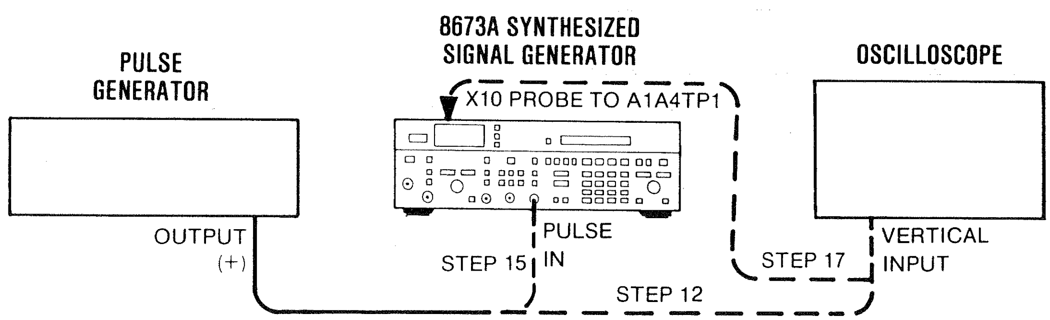


Figure 5-29. Series Pulse Width Test Setup

13. Set the pulse generator to the following settings:

Pulse Period Range	20 ns — 1 μs
Pulse Delay Range	35 ns — 1 μs
Pulse Width Range	10 ns — 1 μs
Pulse Double/Norm	Norm
Output Norm/Compl	Norm
Amplitude Range	4 — 10 Vpk
Offset (+ Output)	Off
Int Load	Out

5-28. PULSE MODULATION ADJUSTMENT (cont'd)

Procedure (cont'd)

14. Set the pulse generator's amplitude for a 5V peak-to-peak signal, the pulse period to 1 μs, and the pulse width to approximately 200 ns using the waveform displayed on the oscilloscope.
15. Connect the output of the pulse generator to the PULSE IN connector on the Signal Generator.
16. Set the oscilloscope's input to AC mode, 1 MΩ impedance.
17. Connect the input of the oscilloscope to A1A4TP1 (SER PUL) using a 10:1 high frequency probe.
18. Set the oscilloscope's vertical sensitivity to 0.2V per division.
19. On the Signal Generator, set the frequency to 6.6 GHz and select PULSE NORM mode.
20. Adjust the pulse generator's pulse delay to center the pulse waveform on the oscilloscope display.
21. Adjust S-PW (A1A4R35) to obtain the waveform shown in Figure 5-30.

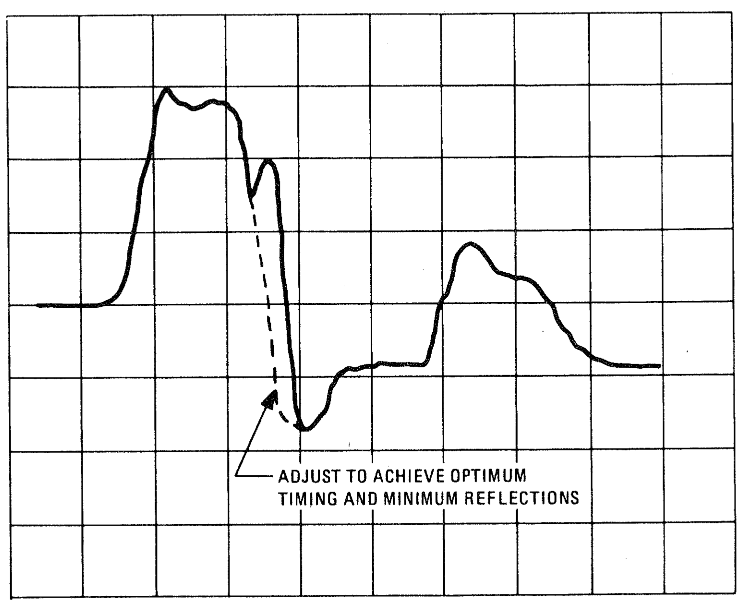


Figure 5-30. Series Pulse Width Waveform

ALC Sample Pulse Adjustment

22. Set PW-S (A1A4R46) fully clockwise.
23. Verify that the pulse generator's pulse period is 1 μs and that the pulse width is 200 ns.

NOTE

It is essential to connect cables of identical length to the oscilloscope; otherwise, timing errors will result (approximately 1 ns per foot of cable).

5-28. PULSE MODULATION ADJUSTMENT (cont'd)

Procedure (cont'd)

24. Connect a 10:1 high frequency probe from the channel B input of the oscilloscope to A1A4TP8 (SMPL).

25. Set the Signal Generator's frequency to 6.6 GHz, output level to −10 dBm, and PULSE NORM mode to on.

26. Set the oscilloscope to the following conditions:

Channel A	Channel B	Display Modes
0.02 V/Div	0.2 V/Div	Vert Disp: Alt
dc coupled	dc coupled	Horiz Disp: Main
(1 MΩ)	(1 MΩ)	Sweep Mode: Auto
		Main Trig: dc, ext
		Time/Div: 0.05 μs

27. Connect channel A of the oscilloscope to the preamplifier output as shown in Figure 5-31.

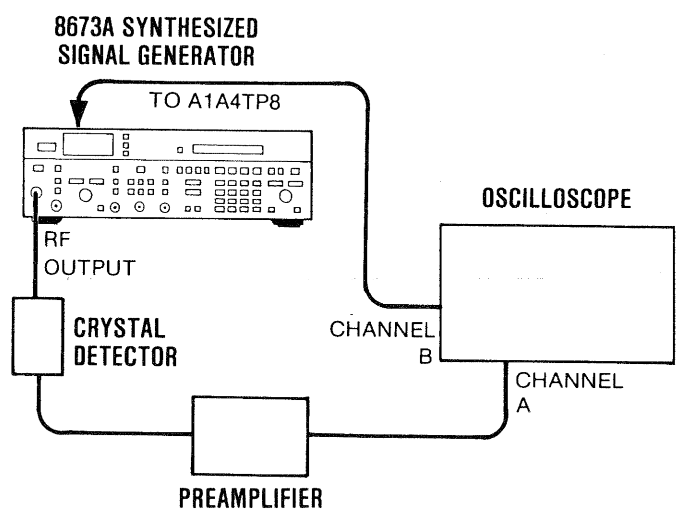


Figure 5-31. ALC Sample Pulse Test Setup

28. Adjust the channel A vertical sensitivity for a waveform display of at least 4 divisions.

29. On the pulse generator, set the pulse period to approximately 1 μs and the pulse width to 100 ±3 ns using the displayed RF detected pulse waveform on the oscilloscope (channel A).

30. Switch the Signal Generator between PULSE NORM and PULSE OFF modes.

31. Adjust L-E (A1A4R24) to minimize the difference between PULSE OFF and PULSE NORM modes. The modes should be within ±1 dB of each other.

ADJUSTMENTS

5-28. PULSE MODULATION ADJUSTMENT (cont'd)

Procedure (cont'd)

32. Set the Signal Generator's output level to +8 dBm.

33. Readjust the oscilloscope's channel A vertical sensitivity for greater than 4 divisions per display.

34. Adjust T-E (A1A4R33) to minimize the difference between PULSE OFF and PULSE NORM modes.

35. Repeat steps 28 through 34 until the error is minimized at both power levels.

NOTE

Try to maintain as wide of a sample pulse as possible while not sacrificing accuracy in order to do so. See Figure 5-32.

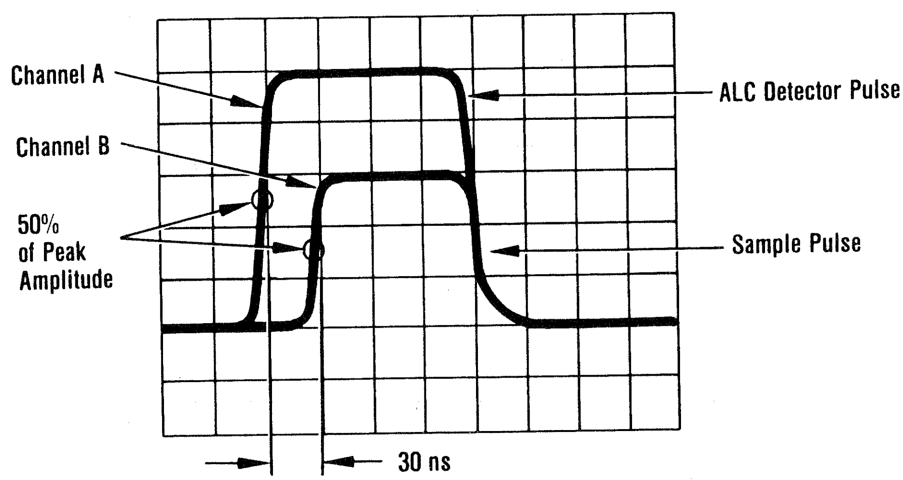


Figure 5-32. ALC Sample Pulse Waveform

36. Reduce the pulse width to 90 ns as displayed on channel A and verify that the pulse level error is less than 9%. (Using a peak pulse level of five divisions, 9% is approximately one-half division.)

37. Recheck the level error at 100 ns.

Minimum Pulse Width Indicator Adjustment

38. Set the Signal Generator to PULSE NORM mode.

39. Set PW-S (A1A4R46) fully clockwise.

40. Set the pulse generator's pulse period to approximately 1 μs and the pulse width to 90 ±3 ns while using the oscilloscope display.

ADJUSTMENTS

5-28. PULSE MODULATION ADJUSTMENT (cont'd)

Procedure (cont'd)

41. Adjust PW-S in a counterclockwise direction until the Signal Generator's front panel ALC UNLEVELED status annunciator just turns off.

42. Set the pulse generator's pulse width vernier fully clockwise, then slowly rotate it counterclockwise. The ALC UNLEVELED status annunciator should turn on shortly after the pulse width narrows to less than 100 ns.