Offset Frequency (cont'd)

Comments

When using the Signal Generator as the local oscillator in a downconverter process, the frequency offset can be set to the intermediate frequency (IF). Once the offset is set, setting both the RF and the local oscillator to the same frequency will produce an IF frequency that is equal to the entered offset.

Using the frequency offset in conjunction with the multiplier mode is useful for harmonic mixing applications. In harmonic mixing, a harmonic of the local oscillator is used to downconvert a signal near the harmonic frequency. Setting the multiplier equal to the harmonic and then entering a frequency offset equal to the desired offset enables the local oscillator to be set to the frequency of the signal to be downconverted.

Programming Example

The following program is written in BASIC for HP 9000 Series 200 or 300 controllers. The following program is used to set the frequency offset to the offset specified by the variable called *Expected*. The offset can be positive or negative and must be in units of MHz.

```
10 SUB Offset_freq(Err,Expected)
20 !
30 OUTPUT 719 USING "2A";"MG"                 ! Clear any old messages
40 ENTER 719 USING "2A";Message$
50 !
60 OUTPUT 719 USING "2A,5D.DDD,2A";"FT,"Expected,"MZ"
70 !
80 OUTPUT 719 USING "2A";"MG"                 ! Check for errors
90 ENTER 719 USING "2A";Message$
100 SELECT VAL(Message$)
110 CASE 1
120 Err=1
130 DISP "ERROR: Offset frequency is out of range"
140 CASE ELSE
150 Err=0
160 END SELECT
170 !
180 OUTPUT 719 USING "4A";"FTOA"              ! Read offset back
190 ENTER 719 USING "K";Offset
200 !
210 IF ABS((Offset/1.E+6)-Expected)>.001 THEN ! More than 1 kHz error
220 Err=-1
230 DISP "WARNING: Programmed offset is more than 1 kHz in error"
240 END IF
250 !
260 SUBEND
```

Error Messages

The following message may be displayed when setting the offset frequency. The message is explained as it pertains to setting offset frequency. For a more complete description of the messages, see the MESSAGES detailed operating instructions.

01 The entered frequency is not within the range of the Signal Generator.

Power Meter Automatic Level Control

Description

External ALC enables the Signal Generator to level the signal at a point other than the output of the Signal Generator. The signal level must be detected using a signal splitter or directional coupler with an RF detector or power meter to provide a DC signal that is proportional to power at the remote point. The Signal Generator will adjust the signal level at the RF output connector to maintain a constant level at the point where the signal is detected. External ALC also enables external devices such as amplifiers, mixers and other specialized devices to be inserted into the RF signal path with control of the final output level by the Signal Generator.

In applications where the external signal path has frequency dependent losses (and/or gains), the RF signal at the end of the signal path will no longer be a constant amplitude over the Signal Generator's frequency range. For example, if a cable is used that has a constant 0.5 dB/GHz loss, a level error of 5 dB would occur after a 10 GHz frequency change. The signal at the RF output connector of the Signal Generator has not changed, but an extra 5 dB of attenuation is introduced in the signal path when the output frequency is changed.

The detection of the signal level can be done using a power meter with an appropriate sensor. The power meter must have an output signal that is proportional to the signal level in watts. The recorder output of most power meters provides the feedback signal for power meter leveling.

External ALC using a power meter has the advantages of temperature compensation and wide dynamic range. Using a sensitive power sensor allows ALC at levels as low as the power meter and sensor can measure. The disadvantage of power meter leveling is the longer settling time and the added complexity of a separate instrument.

Local Procedure

To set the Signal Generator for power meter leveling:

1. Connect the power meter to the remote point using a directional coupler or a power splitter. The power meter sensor must have enough dynamic range to measure the level at the coupled port of the directional coupler. For example, to level a signal of −7 to 0 dBm using a 10 dB coupler, the power sensor must be capable of measuring −17 to −10 dBm in a single range.

2. Press the Signal Generator ALC INT key to set automatic leveling control to internal. Adjust the Signal Generator output level to place the power meter in the appropriate range to monitor the coupled port over the required range. Press the range hold key to prevent a range change. A power meter range change will rescale the feedback voltage and cause oscillations in the leveling circuitry.

3. Reset the Signal Generator range to at least 10 dB above the range required for the desired RF output level. The range may have to be adjusted to compensate for losses and gains in the RF signal path. If the RF signal path will have a relatively high loss, a higher Signal Generator range will be required.

4. Connect the recorder output of the power meter to the external ALC input of the Signal Generator. The recorder output signal typically varies from 0 to 2 Vdc for each power meter range corresponding to a 23 dB dynamic range.

5. Press the ALC PWR MTR key to set the Signal Generator to external power meter ALC mode.

Power Meter Automatic Level Control (cont'd)

Local Procedure (cont'd)

6. Adjust the ALC CAL control on the Signal Generator front panel until the UNLEVELED annunciator is extinguished. Set the Signal Generator VERNIER for a 0 dBm indication on the Signal Generator level meter. Continue adjusting the CAL control until the power meter indicates a level that is in the desired leveling range and lower than the VERNIER setting by the coupling factor. For example, for a desired level in the range of −17 to −10 dBm using a 10 dB directional coupler, adjust the CAL control for a power meter reading of −20 dBm.

   A more accurate calibration can be made using another power meter at the output of the directional coupler. This will eliminate a possible error due to the coupling factor and will give greater assurance that the output of the coupler is accurate.

   Once the calibration is complete, the level at the output of the directional coupler can be varied over a +3 to −10 dB range. If turning the CAL control fully clockwise does not have sufficient range to calibrate the output level, set the range higher until the calibration can be completed.

   If the output level cannot be set low enough, step the RANGE down until the calibration can be performed as described in this step. Using the highest range will provide the best compensation for increasing losses (higher power levels at the Signal Generator output). Using a lower range will provide the best compensation for decreasing losses. See the comments section for more information on selecting the optimum range.

Remote Procedure

The equipment setup for remote control of power meter leveling is the same as the local procedure. However, the calibration must be performed manually. The program code for power meter ALC is C3. Once the calibration is complete, the level can be remotely controlled by programming the VERNIER to the appropriate level. Changing the range while using external power meter leveling will have no affect on the level but can force the Signal Generator to lose control of the level due to insufficient attenuation (lack of ALC dynamic range) or too much attenuation (attempted operation beyond maximum power specification).

The VERNIER setting can be read by the controller using the output active program code suffix. To read the VERNIER setting, send the program string VEOA and then read the VERNIER setting using the ENTER command. The Signal Generator will send the VERNIER setting in units of dBm. If the setting is read as a string, the format will be the program code VE followed by the VERNIER setting in dBm and then the units code DM.

Example

To set the Signal Generator to power meter leveling over the range of −10 to 0 dBm using a 10 dB coupler.

Local

1. Connect the directional coupler to the point where the RF power is to be leveled. Connect the power meter sensor to the coupled port of the 10 dB directional coupler.

2. Press the ALC INT key to place the Signal Generator into internal ALC mode.

3. Set the RF output level for a −15 dBm power meter reading on the power meter. Allow the power meter to auto-range to the coupled power (−15 dBm). Once the power meter has stabilized, press the RANGE HOLD key (or set the range manually) to prevent auto-ranging. The power meter should now be set to read power levels of −20 to −10 dBm on the set range.

Power Meter Automatic Level Control (cont'd)

Example (cont'd)

4. Press the ALC PWR MTR key on the Signal Generator and set the Signal Generator range to +10 dB. The UNLEVELED annunciator may come on when the power meter leveling mode is activated. The calibration in the next step will eliminate this indication.

5. Adjust the front panel CAL control until the UNLEVELED annunciator is extinguished. Reset the VERNIER for a 0 dBm indication on the Signal Generator's front panel LVL meter and then adjust the CAL control until the power meter indicates exactly −10 dBm.

6. The output level can now be set by adjusting the VERNIER for the desired output level as read on the level meter. Setting the range to 0 dB will reduce the output level by 10 dB. However, setting the range lower than 0 dB will not change the output level until the ALC goes unleveled due to insufficient output power to overcome the additional loss in the RF path.

Remote

1. Perform the above steps 1 to 5 to calibrate the external ALC circuitry.

2. Set the output level remotely by programming vernier settings between −10 and +3 dBm. Changing the range will have the same affects as described in step 6 above.

Program Codes HP-IB

Program Code	Description
C3	External Power Meter Leveling Mode

Comments

Using external power meter leveling mode has the advantages of high stability, temperature compensation and high sensitivity. The disadvantage of power meter leveling is the longer settling time (0.2 to 6 seconds). 23 dB of dynamic range is typically available using the Signal Generator's 0 and +10 dB ranges. In addition, amplitude modulation up to 90% depth at rates as high as 100 kHz is typically available using external power meter leveling mode since the Signal Generator's internal detector is used to provide the AM detection.

The response time for a level change using power meter leveling mode will vary depending on the type of power meter, the power meter range setting and filter setting (if used) of the power meter. Settling time increases as the sensitivity of the range used increases. In addition, the response to a level change can be underdamped, critically damped or overdamped depending on the type of meter and filter selection.

Typical 99% settling times for the HP 436A, HP 437B, and HP 438A power meters are shown in the following table. The 99% settling time is the time the power meter requires to make a measurement in a given range.

Power Meter Automatic Level Control (cont'd)

Comments (cont'd)

Power Meter Range Settling Times

Power Meter Range	Typ. 99% Settling	
	HP 437B HP 438A	HP 436A
1	600 ms	10s
2	600 ms	1s
3	66 ms	38 ms
4	66 ms	38 ms
5	66 ms	38 ms

The leveling system will have a longer settling time due to the settling time of the Signal Generator ALC circuitry and the response time of the signal path. Typical settling times for leveling using the HP 432A/B, HP 435B, HP 436A, HP 437B, and HP 438A power meters are given in the following table.

ALC Typical Settling Times

Power Meter	Power Meter Range (dBm)	Power Sensor	10 dB Step to Within ± 1 dB	Step Response
HP 432A/B	−20 to +10	HP 478A	400 ms	Overdamped
HP 435B	−10 to +20	HP 8485A	550 ms	Critically Damped
"	−15	"	3s	Underdamped
"	−20	"	5s	Underdamped
"	−25	"	Unstable	—
HP 436A	0 to +20	HP 8485A	150 ms	Critically Damped
	−10	"	4s	Underdamped
	−20	"	4s	Unstable
	−40 to −20	HP 8484A	200 ms	Critically Damped
	−50	"	2.5s	Underdamped
	−70 to −60	"	—	Unstable
HP 437B				
HP 438A	**Filter No.**			
(All Ranges)	0 to 2	HP 8485A	200 ms	Critically Damped
	3 to 9	"	4s	Underdamped
	0 to 2	HP 8484A	200 ms	Critically Damped
	3 to 9	"	4s	Underdamped

The HP 437B and HP 438A auto filter mode will select filters automatically depending on range. Using the manual filter mode can provide faster ALC settling time.

The Signal Generator range selected will have a direct affect on ALC. The range selected depends primarily on the losses and gains in the RF signal path. In most applications, the ALC dynamic range is limited by the maximum RF power available at a given frequency. For example, with 15 dB of loss in the signal path, the Signal Generator must compensate with at least 15 dB of additional RF output power. With no internal attenuation (0 or +10 dB ranges), the Signal Generator would have to

Power Meter Automatic Level Control (cont'd)

Comments (cont'd)

supply +15 dBm for a leveled signal at 0 dBm. Since the maximum RF output power is specified at less than +13 dBm, the Signal Generator may not be able to supply the required power.

Using Signal Generator ranges of −10 to −90 dB add attenuation to the RF signal path. These ranges are useful mainly when attempting to level low amplitude signals. For example, to level a signal with an amplitude of −50 dBm after a signal path with losses of 30 dB, the attenuation can be set to 10 dB (range −10 dB) to place the Signal Generator at an RF output level of −10 dBm.

The internal circuitry generates RF levels of -10 dBm and higher before introducing attenuation to increase the dynamic range of the Signal Generator. When selecting the proper range for external leveling, the lowest and highest gain/loss should be calculated. The range is then set 10 dB higher than the level required to keep the internally generated RF level near −10 dBm.

The external ALC circuitry is used to adjust the Signal Generator's output level until the detected voltage at the external ALC input is correct. If high harmonics or spurious signals are present in the signal that is being detected, they will affect level flatness. This is especially important when using external amplifiers and mixers within the signal path. For example, if the RF signal level is +10 dBm and the second harmonic is at 0 dBm, the actual detected power will be 11 milliwatts instead of 10 milliwatts (10 dBm). For a detected voltage of 1 volt for +10 dBm, the detected signal will be at 1.1 volts for the 11 milliwatt signal. This will cause a leveling error of about 0.83 dB.

Application Examples

Example 1. External ALC over the range of 0 to +10 dBm is required. The RF signal path exhibits an insertion loss of 6 dB that varies ±12 dB over the frequency range. To control the output level over a 0 to +10 dBm range, an amplifier capable of +16 dBm (10 dBm +4 dB +2 dB) is required.

The range selected for this application depends mainly on the gain of the amplifier. If we assume a gain of +10 dB, the optimum Signal Generator range is 0 dB. The overall signal path gain varies from +12 to +16 dBm. To reduce the level to −10 dBm would require 10 dB of attenuation. The range is set 10 dB above this requirement or 0 dB.

Example 2. The IF output of a mixer is to be leveled at −20 dBm. The conversion loss of the mixer is 10 dB and varies ±3 dB over the frequency range. Using the Signal Generator as the RF source for the mixer, the power meter is connected to the IF port of the mixer using a 10 dB directional coupler.

The attenuation of the signal path is 10 dB and varies ±3 dB. For an IF level of −20 dBm, the RF port must be at a level of approximately −10 dBm. The range selected for the Signal Generator would then be +10 since 0 dB attenuation would be required and the +10 dB range is one step above zero attenuation.

Error Messages

The following message may be displayed when programming the RF output level.

24 The programmed RF output (VERNIER, RANGE or both) is outside the Signal Generator's range.

Pulse Modulation

Description

The Signal Generator provides normal and complemented pulse modulation. In normal pulse modulation, a TTL high level (>3 volts) will turn on the carrier while a TTL low level (<0.5 volts) turns the carrier off. Complement pulse modulation uses a TTL low level to turn on the carrier and a TTL high level to turn off the carrier. Having two modes available allows easiest interfacing to positive or negative logic conventions.

Pulse widths more narrow than the specified minimum pulse width will light the UNLEVELED annunciator to indicate that the pulse peak level accuracy is degraded. Pulse overmodulation is indicated by the UNLEVELED annunciator. Pulse overmodulation occurs at narrow pulse widths as mentioned above and at very low duty cycles when the time between pulses exceeds the instrument's ability to retain a leveled pulse.

Local Procedure

To set the Signal Generator for pulse modulation:

1. Connect an external pulse source to the PULSE IN connector and set the frequency of the external pulse source to the desired pulse repetition rate. Set the amplitude of the external pulse source to a TTL compatible pulse (0 to 5 volts).

2. Press the Signal Generator's PULSE NORM key if the TTL high level is to be used to turn on the carrier.

   If the TTL high level is to turn off the carrier, select pulse complement mode by pressing the PULSE COMPL key.

Remote Procedure

Pulse modulation can be programmed to the normal or complement mode using the program codes P2 or P3 respectively. The program codes P0 and P1 turn off pulse modulation.

The pulse mode (NORM or COMPL) cannot be read by the controller. The pulse width and pulse repetition rate are set by the external pulse source. The controller can interrogate the external source to determine pulse width and repetition rate.

Example

To pulse modulate the Signal Generator at 1 MHz with a 100 nanosecond pulse width:

Local

1. Set the external pulse source for a TTL compatible pulse of 100 nanosecond width at a pulse repetition frequency of 1 MHz.

2. Connect the external pulse source to the PULSE IN connector.

3. Press the pulse NORM key to activate pulse modulation.

Remote

The programming string for setting pulse normal mode on the Signal Generator is P2. The modulating signal is set by programming the external modulating signal source. The alpha character (P) can be sent as upper or lower case.

Pulse Modulation (cont'd)

Program Codes

HP-IB

Program Code	Description
P0	Pulse Off
P1	Pulse Off
P2	Pulse Normal Mode
P3	Pulse Complement Mode

Comments

Overmodulation in pulse mode due to peak level accuracy degradation (narrow pulse widths) or an extremely low duty cycle (too long between pulses) are indicated by the UNLEVELED annunciator. The overmodulation condition can be read by the controller using the ALC UNLEVELED bit of the extended status byte.

Major pulse modulation specifications are not warranted unless an Auto Peak operation has been performed. An Auto Peak operation is performed automatically whenever the frequency is changed by more than 50 MHz while Auto Peak is enabled or the output level is changed by more than 0.4 dB while pulse modulation is enabled.

Changes in load impedance can shift the center frequency of internal filters and require an Auto Peak operation to maintain optimum pulse performance. This could occur if highly reactive loads are switched in and out in automatic test systems.

Large frequency changes cause changes in the self-heating of internal Yttrium Iron Garnet (YIG) filters. Most of the filter passband drift occurs in 15 to 20 seconds but complete settling can require up to 15 minutes. Some experimentation may be required to determine when the Auto Peak operation should be performed during measurements that have large frequency changes and extremely long measurement cycles.

To ensure that pulse performance is optimized before making a measurement, execute an Auto Peak operation before each measurement. The status byte may be monitored to determine when the Auto Peak operation is complete. The SOURCE SETTLED bit is set when the Auto Peak operation is finished.

The Signal Generator uses frequency multiplication to generate frequencies above 6.6 GHz. To produce fast rise times when the frequency is multiplied, a pulse injection circuit is used to pre-bias the multiplication circuits. The pulse injection circuit is critical for fastest rise times and minimum overshoot. The Auto Peak operation measures critical parameters for the pulse injection circuit when pulse mode is enabled.

With pulse mode enabled, a frequency change of 50 MHz or a VERNIER change 0.4 dB or more will trigger an Auto Peak operation. During the Auto Peak, the Signal Generator will switch to CW mode for approximately 200 microseconds while the Auto Peak operation is performed. Pulse mode is then re-enabled and the pulse injection circuitry uses the measured parameters to optimize the pulse risetime.

The bursts of CW power due to changes in the VERNIER setting can be eliminated by using an internal "scratch pad" memory. When an Auto Peak is performed, the parameters required for the pulse injection circuitry are stored in the scratch pad memory. Subsequent operation at this VERNIER setting will use the scratch pad data instead of performing another Auto Peak operation. By sweeping the VERNIER over the entire ALC range (−10 to +3 dBm on the 0 and +10 dB ranges), the scratch pad memory will be filled with the required parameters for the pulse injection circuitry. Once the scratch pad memory contains the data for the current frequency, an Auto Peak operation will not occur for any change in RF output level. A frequency change will erase the scratch pad memory so this process must be repeated at the new frequency.

Pulse Modulation (cont'd)

Comments (cont'd)

Pulse modulation uses a sample and hold system to maintain pulse level accuracy. A capacitor is used to hold the automatic level control (ALC) circuit setting between pulses to reduce the time required for output level settling at the next pulse. When pulse and amplitude modulation are used together, the capacitor has the effect of reducing the effective AM bandwidth. The reduction in AM bandwidth is explained under AM detailed operating instructions.

When pulse modulation is selected with no input pulse, the level meter will drift. This is a normal occurrence due to the limitations of the sample and hold circuitry.

Due to the Auto Peak operations performed during pulse modulation, frequency switching time is slowed to approximately 100 milliseconds. Disabling Auto Peak will speed frequency switching time at the expense of degradation of risetime and overshoot. Pulse specifications only apply when Auto Peak is enabled.

Programming Example

The following program is written in BASIC for HP 9000 Series 200 or 300 controllers. The program will set the pulse mode to the mode specified by the variable *Mode$*.

```
10 SUB Pulse_mode(Err,Mode$)
20 !
30 SELECT UPC$(TRIM$(Mode$))
40 CASE "NORM","NORMAL"
50 Code$="P2"                          ! Code for NORMAL mode
60 CASE "COMP","COMPLEMENT"
70 Code$="P3"                          ! Code for COMPLEMENT mode
80 CASE "OFF",""
90 Code$="P0"
100 CASE ELSE
110 Err=-1
120 DISP "Invalid pulse mode specified"
130 END SELECT
140 !
150 OUTPUT 719 USING "2A";Code$
160 !
170 SUBEND
```

Error Messages

The following message number may be displayed when pulse modulating. For a more complete description of the message, see the MESSAGES detailed operating instructions.

90 An error occurred in the Auto Peak operation. Service may be required to correct the problem.

Range (Output Level)

Description

The RF output level of the Signal Generator is set using the RANGE and VERNIER controls. The RANGE controls change the RF output level in 10 dB steps and the VERNIER changes the RF output level continuously over a 13 dB range. The sum of the output level RANGE and VERNIER is the actual RF output level.

The RANGE is set using the RANGE up or down key. The selected RANGE (+10 to −90) is displayed in the RANGE dB display. The display indicates the RANGE whether in remote or local mode. The local to remote and remote to local transitions do not change the output level RANGE. An instrument preset will set the RANGE to −70 dB.

Local Procedure

To set the RF output level using internal ALC:

1. Press the RANGE up or down key until the desired RANGE appears in the RANGE dB display. Holding the key down will continue stepping the RANGE until the key is released. The RANGE setting represents the maximum level available using that range. The VERNIER control will allow setting output levels from −10 dB below to +3 dB above the RANGE.

   There is a slight overlap of output level settings due to the 13 dB range of the VERNIER control. For best results, the VERNIER setting should be within the range of −10 to 0 dBm. VERNIER settings from 0 to +3 dBm are available for observing a continuous range up to +3 dB above the RANGE setting without changing the RANGE setting.

2. Adjust the VERNIER control until the sum of the RANGE and the level meter reading equal the desired RF output level. The VERNIER can be used to vary the output level continuously about the set level or the RANGE up or down key can be used to step the output level in 10 dB steps.

   If the UNLEVELED annunciator lights for high output level settings, the level meter will indicate maximum available output power. This should only occur when output levels above the specified maximum leveled power are set. For example, if the RF output level is set to +13 dBm and the level meter reads −4 dBm with the UNLEVELED annunciator lighted, only +6 dBm of output power is available at that frequency.

Remote Procedure

The Signal Generator accepts any RF output level between −101.9 and +13 dBm. RF output levels above the specified maximum leveled power may not be available at all frequencies. Programming the RF output level can be done in one of two ways.

The RF output level can be programmed directly using the program code LE, AP, or PL. The units terminator for the output level is dBm which corresponds to the program code DM. The Signal Generator will also accept the program code DB as the terminator. When programming the RF output level, the VERNIER is set between 0 and −9.9 dBm and the RANGE is set accordingly.

The RF output level can also be programmed by programming the VERNIER and the RANGE separately. The program code to set the RANGE is RA and the program code to set the VERNIER is VE. The units terminator for both codes can be either DB or DM.

The output active program code suffix can be used to read the current values of the RANGE, VERNIER or the RF output level directly. To read the RANGE setting, send the program codes RAOA and then read the RANGE setting. The Signal Generator will send the RANGE in fundamental (dBm) units. If the RANGE is read as a string, the format will be the program code RA followed by the RANGE in dBm and then the units terminator DM (dBm).

Range (Output Level) (cont'd)

Remote Procedure (cont'd)

In local mode, the Signal Generator keeps track of the VERNIER setting to within .1 dB. When switching to remote mode, the local RF level setting is preserved. This feature also allows the controller to read the local VERNIER setting by briefly switching to remote to read the VERNIER setting and then returning the Signal Generator to local mode. The VERNIER setting is read by sending the program codes VEOA and then reading the setting. The Signal Generator will send the VERNIER setting in fundamental (dBm) units. If the VERNIER setting is read as a string, the format will be the program code VE followed by the VERNIER setting in dBm and then the units terminator DM (dBm).

The RF output level is read directly by sending the program codes LEOA and then reading the RF output level. The Signal Generator will send the RF output level in fundamental (dBm) units. If the RF output level is read as a string, the format will be the program code LE followed by the RF output level in dBm and then the units terminator DM (dBm). The program codes AP or PL can also be used in place of LE but the Signal Generator will always send the program code LE when the RF output level is read as a string.

Example

To set the RF output level to −56 dBm:

Local

1. Press the ALC INT key to place the Signal Generator into internal ALC mode. The process for setting the RF output level for external ALC modes is covered under the appropriate ALC mode.
2. Set the RANGE to the lowest range that is less than 10 dB above the power or −50 dBm in this case.
3. Adjust the VERNIER until the level meter indicates −6 dBm. For the −50 dBm RANGE, the VERNIER can adjust the output level from −60 to −47 dBm.

Remote

The programming string for setting the RF output level is composed of a program code, numeric data and the units terminator. The RF output level may be programmed directly or the RANGE and VERNIER may be programmed separately. To program the Signal Generator to a level of −56 dBm, the possible program strings are:

"LE—56DM" or "RA—50DBVE—6DM"

In addition, the program code could be AP or PL instead of LE. The alpha characters can be sent as upper or lower case (or even mixed upper and lower case). The Signal Generator RF output level is valid once the SOURCE SETTLED bit of the status byte is set (see comments). The units terminator could be DB or DM. The Signal Generator accepts either terminator for all power related settings.

Program Codes HP-IB

Program Code	Description	Units
RA	Output Level Range	
*LE	RF Output Level	DB
AP	RF Output level	*DM
PL	RF Output level	

*Preferred Program Code

Range (Output Level) (cont'd)

Comments

The 0 to −90 dB ranges directly control a 90 dB step attenuator. The 0 and +10 dB ranges correspond to an internal attenuator setting of 0 dB. The −90 dB range corresponds to an attenuation setting of 90 dB. The +10 dB range is used by the automatic level control (ALC) circuitry to enable the VERNIER to directly control the RF output level between 0 dBm up to a maximum possible level of +13 dBm.

Programming Example

The following program is written in BASIC for HP 9000 Series 200 or 300 controllers. The program will set the output level between −100 and +13 dBm. If a level above 0 dBm is set and is not leveled, an error will be reported.

```
10 SUB Rf_level(Err,Expected)                          ! Expected is in dBm
20 !
30 If Expected<-100 OR Expected>+13 THEN
40 Err=-1
50 DISP "ERROR: Requested output level is out of range"
60 SUBEXIT
70 END IF
80 !
90 OUTPUT 719 USING "2A";"MG"                          ! Clear old messages
100 ENTER 719 USING "2A";Message$
110 !
120 OUTPUT 719 USING "4A,4D.D,2A";"CSLE,"Expected,"DM"  ! Set the level
130 !
140 OUTPUT 719 USING "4A";"LEOA"
150 ENTER 719 USING "K";Level
160 !
170 IF ABS(Level-Expected)>.1 THEN                     ! More than .1 dB in error
180 Err=-1
190 DISP "WARNING: Programmed level is more than .1 dB in error"
200 END IF
210 !
220 V=SPOLL(719)                                       ! Get the status byte
230 IF NOT BIT(V,3) THEN GOTO 220                      ! Wait for source to settle
240 !
250 IF Expected>0 THEN                                 ! Check for unleveled
260 OUTPUT 719 USING "2A";"OS"                         ! Get extended status byte
270 ENTER 719 USING "%,B,B";V,Extended
280 IF BIT(Extended,6) THEN
290 Err=-1
300 DISP "WARNING: The Signal Generator RF output is not leveled"
310 END IF
320 END IF
330 !
340 SUBEND
```

Error Messages

The following message may be displayed when setting the RF output level. For a more complete description of the messages, see the MESSAGES detailed operating instructions.

24 The programmed RF output level is not within the range of the Signal Generator.

Recall and Store Registers

Description

The Signal Generator has nine instrument state storage registers. These registers allow the complete instrument state to be saved in non-volatile memory. A subsequent recall of the stored register will set the Signal Generator to the state that was saved. All front panel settings, including sweep and modulation, are stored when one of the nine registers is used for instrument state storage.

Powering down the instrument will not destroy the setting of the nine state registers. The registers may be cleared to the preset state with a special key sequence (see comments). Register 0 is the instrument preset register. Recalling this register will set the instrument to a known state. An alternate preset state is set by another special key sequence.

Local Procedure

To store the current instrument state in one of the nine storage registers:

1. Press the STO key to indicate that the current settings are about to be saved in one of the storage registers. For system compatible instruments, (*2552A, 2634A and above*) the STO key is a shifted RCL key.
2. Press a number corresponding to one of the nine storage registers. Any number between 1 and 9 may be used as a storage register. Once the key is pressed, the instrument state is saved in that register.

To recall the instrument state from one of the storage registers:

1. Press the RCL key to indicate that one of the ten registers is to be recalled. The zero register is the preset conditions for the instrument.
2. Press one of the numeric keys corresponding to the register that is to be recalled. Valid register numbers are 0 through 9.

Register 0, the preset register, cannot be used to save an instrument state. An attempt to store an instrument state in this register will generate an error message. If a different set of preset conditions are required, one of the nine storage registers may be used to store the alternate preset conditions. For system compatible instruments (*2552A, 2634A and above*) pressing RCL and then the backspace key will provide another set of preset conditions (see comments).

Remote Procedure

The nine storage registers can be used in remote applications. If a register is stored in remote mode, recalling the register will recall the remote VERNIER setting. Local VERNIER control will be locked out until the instrument is preset or the Signal Generator is set to remote mode and then local mode.

The format of the program string follows the front panel sequence. The program code for storing an instrument state is ST. Recalling a register is done using the RC program code. The program string is composed of the appropriate program code followed by a number corresponding to the appropriate register.

Example

To store the current instrument settings in register 1:

Local

1. Press the STO key to indicate that the instrument state is about to be saved. For system compatible instruments (*2552A, 2634A and above*), the STO key is accessed by pressing the blue shift key followed by the RCL key.

Recall and Store Registers (cont'd)

Example (cont'd)

2. Press the number 1 on the numeric keypad. The register is now filled with the current instrument state. Subsequent operations (except re-storing the register) will not affect the settings in register 1.

To recall the instrument state stored in register 1:

1. Press the RCL key to indicate that the instrument state will be recalled from one of the ten registers.
2. Press the number 1 on the numeric keypad. The instrument will be set to the state that was stored in register 1. This recall is non-destructive so recalling register 1 later will produce the same results as this step.

If a register is recalled that was originally stored during remote mode, the VERNIER will not affect the output level. This restriction is required to allow the storage and recall of instrument states in remote mode that include the VERNIER setting. A register that is stored in local mode will preserve the local VERNIER setting. Recall of the register in remote mode will use the same local level VERNIER setting.

Remote

The programming string to store the current instrument state in register 1 is "ST1." To recall the register at a later time, the program string "RC1" would be used. Sending the program string "RC0" or "IP" will preset the instrument.

Program Codes HP-IB

Storage Register Codes

Program Code	Description
ST	Store Instrument State
RC	Recall Instrument State
RL	Recall Instrument State

Instrument Preset Codes

Program Code	Description
RC0	Instrument Preset
IP	Instrument Preset
RCBS	Alternate Preset (*2552A, 2634A and above*)

Comments

The nine storage registers can be cleared using a special front panel key sequence. This feature is useful in high security applications to destroy any instrument settings that might compromise the security. To clear the storage registers, press the LVL key near the front panel meter and the FM 3 MHz deviation range keys at the same time. A successful initialization of all of the storage registers can be confirmed by an instrument preset when the two keys are pressed. All of the registers will be initialized to the preset state.

Storing a register in remote mode will store the remote VERNIER setting. If this register is recalled in local mode, the remote VERNIER setting will be selected and local VERNIER control will be disabled. The local VERNIER setting is stored when a register is stored in local mode. Recalling this register in remote mode will use the stored local mode setting as the remote VERNIER setting.

There are two preset states that can be selected in remote mode or from the front panel. The first preset state is selected by recalling register zero in local or remote mode or sending the program code IP in remote mode. The register 0 preset conditions are given below.

Recall and Store Registers (cont'd)

Comments (cont'd)

RF OUTPUT to ON
ALC mode to INT
RANGE to −70 dB (0 dB for Options 001 and 005)
AUTO PEAK to ON
MTR 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
MKRs disabled (initialized to 3, 6, 9, 12, and 15 GHz)
SWEEP MODE to OFF
STEP to 100 steps (20.000 MHz)
DWELL to 20 ms
TUNE knob to ON

For system compatible instruments (*2552A, 2634A and above*), alternate preset provides a different set of conditions more suitable for some applications. The alternate preset conditions (selected with RCL and Backspace) are given below.

RF OUTPUT to ON
OFFSET frequency to 0
MULTIPLIER and ALC mode unchanged
RANGE to −70 dB (0 dB for Options 001 and 005)
AUTO PEAK to ON
MTR scale to LVL
AM, FM and PULSE modulation to OFF
FREQUENCY to 14 000.000 MHz X Multiplier
FREQ INCR to 1.000 MHz X Multiplier
START to 13 000.000 MHz X Multiplier
STOP to 15 000.000 MHz X Multiplier
ΔF to 2000.000 MHz X Multiplier
MKRs disabled (initialized to 3, 6, 9, 12, and 15 GHz X Multiplier)
SWEEP MODE to OFF
STEP to 100 steps (20.000 MHz X Multiplier)
DWELL to 20 ms
TUNE knob to ON

Error Messages

The following errors apply to storing or recalling instrument state registers.

04 Cannot store a state in register 0. This register is reserved for instrument preset conditions.

92 The data stored in the register being recalled has been corrupted. The instrument will be reset.

RF Output On/Off

Description

The RF output of the Signal Generator can be disabled with the RF ON/OFF key on the front panel. The RF output can be disabled when the minimum power level setting is not low enough to prevent interference as when zeroing a power meter using a high sensitivity power sensor.

With the RF output disabled, the UNLEVELED and ϕ UNLOCKED annunciators will turn on to indicate that the microwave signal source is disabled. In addition, if frequency modulation is enabled, the FM OVERMOD annunciator will also light.

Local Procedure

To turn off the RF output:

1. Press the RF ON/OFF key. The indicator on the key will be lighted whenever the RF output is enabled and extinguished when the RF output is disabled. Pressing the key repeatedly will toggle the RF output between the on and off state.

Remote Procedure

The Signal Generator RF output is turned on or off using a single program code. The program code to turn the RF output on is RF1 or R1. The program code to turn the RF output off is RF0 or R0.

Example

To turn off the RF output:

Local

If the indicator in the RF ON/OFF key is not lighted, the RF output is already off. If the indicator is lighted, press the RF ON/OFF key once.

Remote

The programming string for setting the RF output level to off is RF0 or R0. The alpha characters can be sent as upper or lower case (or even mixed upper and lower case).

Program Codes

HP-IB

Program Code	Description
RF0	RF Output Off
R0	RF Output Off
RF1	RF Output On
R1	RF Output On

Comments

Turning on the RF output will start an Auto Peak operation. To determine when the RF output is settled, the source settled bit of the status byte can be monitored. Once the bit is set, the RF output is settled and the application may continue.

Programming Example

The following program is written in BASIC for HP 9000 Series 200 or 300 controllers. The program will enable the RF output if the parameter is set to "ON" or disable the output if the parameter is set to "OFF."

```
10 SUB Rf_output(Err,State$)
20 !
30 SELECT UPC$(TRIM$(State$))          ! Check for action
40 CASE "OFF"
50 OUTPUT 719 USING "3A";"RF0"         ! Turns RF output off
60 CASE "ON"
```

RF Output On/Off (cont'd)

Programming Example (cont'd)

```
70 OUTPUT 719 USING "5A";"CSRF1"               ! Turns RF on and Auto Peaks
80 Wait_settle:                                ! Wait for Auto Peak to finish
90 V=SPOLL(719)                                ! Get the status byte
100 IF NOT BIT(V,3) THEN GOTO Wait_settle
110 CASE ELSE
120 DISP "ERROR: Invalid parameter "&State$&" was passed"
130 Err=-1
140 END SELECT
150 !
160 SUBEND
```

Error Messages

The following message may be displayed when enabling the RF output. The message is displayed as it pertains to enabling the RF output. For a more complete description of the message, see the MESSAGES detailed operating instructions.

90 An Auto Peak error has occurred during the Auto Peak operation. This message indicates that service may be required.

Single Sweep Mode

Description

The Signal Generator performs a digital sweep by stepping the RF output frequency in discrete steps from the start frequency to the stop frequency. The number of steps that the Signal Generator produces between the start and stop frequency is controlled by the number of steps or the sweep step size parameters. The time that the Signal Generator remains at each step after switching frequencies is controlled by the dwell time parameter.

The Signal Generator has three sweep modes to accommodate a variety of applications. Auto sweep mode is used when a repetitive sweep is required. Auto sweep mode will step the RF output frequency from the start frequency to the stop frequency and then repeat the sweep until the sweep is turned off or a band crossing is encountered.

Single sweep mode will step the RF output frequency from the start frequency to the stop frequency once and then stop. This mode is useful when a single sweep is required for a measuring device to store results. Control signals are provided at the rear panel of the Signal Generator for control of X-Y recorders and external displays.

Manual sweep provides a convenient method to limit the tuning range of the frequency tuning controls. In applications requiring a single band of frequencies, the tuning limits can be set to cover the band of interest which allows the user to tune the frequency without having to watch the Signal Generator display to determine when the frequency is outside of the selected band.

There are four rear panel connectors that are used for sweep coordinating signals. SWP OUT provides a signal that is 0 volts at the beginning of a sweep and 10 volts at the end of the sweep regardless of the sweep width. The output impedance is nominally 100 ohms.

The TONE MKR connector provides a 5 kHz signal when an active marker frequency is generated. This signal can be connected to the AM IN connector on the front panel to provide AM markers on the external display. Nominal impedance of the TONE MKR is 600 ohms.

The BLANKING/MARKER output provides a +5 volt signal at the beginning of each frequency change for blanking an external display. The blanking function is used to eliminate the display of switching transients. Once the frequency has settled, the signal returns to 0 volts unless the new frequency is an active marker frequency. If the frequency is an active marker frequency, the signal is set to −5 volts to provide a Z-axis input for intensifying the display at the marker sweep point.

The PENLIFT connector provides control for an external X-Y recorder and is only active during the single sweep mode. A TTL logic high is used to raise the pen and a TTL logic low is used to lower the pen. The pen is only lowered in single sweep and there is a 100 millisecond sweep delay for the pen to raise or lower.

Local Procedure

To set the Signal Generator for a single sweep:

1. Set the desired sweep parameters.
2. Press the SINGLE SWEEP MODE key to arm the single sweep. The key indicator will light and the RF frequency will be set to the start frequency.
3. Press the SINGLE SWEEP MODE key again to begin the single sweep. The sweep will continue to the stop frequency and then reset to the armed state.

Single Sweep Mode (cont'd)

Local Procedure (cont'd)

If a new center frequency is entered when single sweep mode is active, the start and stop frequencies will be reset and the single sweep will be set to the armed state in preparation for a sweep. Tuning the frequency will also move the sweep center frequency and reset the single sweep. Pressing the SINGLE SWEEP MODE key during a sweep will reset the sweep to the armed state.

A 100 millisecond wait is executed both at the beginning of a single sweep and at the end of the sweep. This wait is required for the pen of an external recorder to lower at the beginning of a sweep and raise at the end of the sweep.

Remote Procedure

Single sweep is armed with the program code W4 or W5. Once the sweep is armed, it can be executed with the program code W4. A single sweep can be armed and executed with the program code W6.

The controller can monitor the SWEEP DONE bit of the extended status byte to determine when the sweep is finished. The bit will be set when the stop frequency is reached and will not be reset until it is read or the status byte is cleared.

The output couple program code (OC), can be used to read the start frequency, center frequency and dwell time in that order. The three values are not prefixed by program codes and the frequencies are sent in Hz while the dwell time is sent in units of seconds.

Example

To perform a single sweep from 2 to 4 GHz:

Local

1. Set the start frequency to 2 GHz and the stop frequency to 4 GHz.
2. Press the SINGLE SWEEP MODE key to arm the single sweep. The key indicator will light to indicate that single sweep mode has been selected.
3. Press the SINGLE SWEEP MODE key again to execute the sweep. Once the sweep is finished, the single sweep will be rearmed in preparation for another sweep.

Remote

The programming string to perform a single sweep is: "W6"

The alpha character (W) can be sent as upper or lower case. The sweep can be armed and then executed later using the W4 or W5 program codes followed by a W4 program code when the sweep is to be executed. Using the W5 program code alway ensures that a single sweep is armed and does not execute immediately. If the single sweep mode is armed when a W4 program code is received, the sweep will execute.

Program Codes HP-IB

Program Code	Function
W4	Single Sweep Arm or Execute
W5	Single Sweep Arm Only
W6	Single Sweep Arm and Execute

Single Sweep Mode (cont'd)

Comments

The Signal Generator digital sweep is composed of discrete frequencies that are produced sequentially. The minimum step size is limited to the minimum change in frequency that the Signal Generator can produce which is defined as the frequency resolution. The number of steps is dependent on the frequency resolution and the frequency span. For information regarding sweep time, see the DWELL TIME detailed operating instruction.

The actual change in output frequency during a sweep will not be uniform for some frequency bands and may vary up to 2 kHz. This is required to accommodate sweep step sizes that are not exact multiples of the frequency resolution. The sweep steps averaged over several sweep points will be equal to the selected sweep step size. An example of the averaging is defining a sweep step size of 10 kHz at a start frequency of 15 GHz. The minimum tuning increment at 15 GHz is 3 kHz which means that the sweep step size can be 9 kHz or 12 kHz for exact step sizes. To obtain a sweep step size of 10 kHz, the Signal Generator will step by 9 kHz, 9 kHz, 12 kHz and then will repeat the sequence. The average step size is 10 kHz even though the sweep does not execute exactly 10 kHz steps. If the step size is reduced to 1 kHz, the Signal Generator will step by 0 kHz, 0 kHz and then 3 kHz for a 1 kHz average step size in the 3 kHz resolution frequency band.

Sweeps from a higher frequency to a lower frequency can be accomplished by setting the start frequency higher than the stop frequency. This combination results in a negative frequency span as indicated when the frequency span is displayed. Negative frequency spans can only be entered by setting the start frequency higher than the stop frequency.

An Auto Peak operation is performed whenever the RF output frequency is more than 50 MHz from the frequency at which the last Auto Peak operation was performed. The Auto Peak operation optimizes the Signal Generator performance at the current frequency. The Auto Peak operation produces small changes in the RF output level as the peaking is performed. For applications requiring fastest sweeps, Auto Peak may be disabled. However, with Auto Peak disabled, modulation performance and maximum output power may be degraded. The time required for the Auto Peak operation is not included in the dwell time setting.

The automatic level control (ALC) bandwidth is increased when sweep mode is activated. This provides fast response to switching transients when sweeping. In addition, activating sweep mode while amplitude modulating increases the usable AM bandwidth by about 250 times. See the amplitude modulation detailed operating instructions for more information about AM bandwidth while in sweep mode.

The front panel annunciators are filtered in sweep mode to prevent false indications. While sweeping, the frequency changes cause a loss of phase lock and unleveled automatic level control during the frequency change. To prevent constant flashing of the front panel annunciators, the response is damped to indicate only major problems during a sweep. The bits of the extended status byte are also buffered and should not be used to check individual sweep points for phase lock and leveled RF output.

Single Sweep Mode (cont'd)

Programming Example

The following program is written in BASIC for HP 9000 Series 200 or 300 controllers. The program is used to set the Signal Generator to the sweep mode specified by the variable *Mode$*.

```
10 SUB Sweep_set(Err,Mode$)
20 OUTPUT 719 USING "2A";"MG"                      ! Read message from 8673
30 ENTER 719 USING "2A";Message$                   ! to clear any old messages
40 SELECT Mode$
50 CASE "AUTO","AUTOMATIC"
60 Code$="W2"                                      ! Auto sweep mode
70 CASE "MANUAL"
80 Code$="W3"
90 CASE "SINGLE","ONCE"
100 Code$="W6"                                     ! Arm and begin single
110 CASE ELSE
120 DISP "WARNING: Invalid sweep mode specified"
130 Err=-1
140 SUBEXIT
150 END SELECT
160 !
170 OUTPUT 719 USING "2A";Code$
180 !
190 SUBEND                                         ! End of subroutine
```

Error Messages

The following message numbers may be displayed when activating single sweep mode. Each message is explained as it pertains to activating single sweep mode. For a more complete description of the messages, see the MESSAGES detailed operating instructions.

10 The start and stop frequency are set to the same value. No sweep will be generated.

11 The current sweep span is set such that the start frequency would be below the frequency range of the instrument. The sweep will begin at the lowest sweep point that is within the range of the Signal Generator. All sweep points will be allotted, but the frequency will not change until the sweep is within the frequency range of the Signal Generator.

12 The current sweep span is set such that the stop frequency would be above the frequency range of the instrument. The sweep will end at the highest sweep point that is within the frequency range of the Signal Generator. All sweep points will be allotted, but the last sweep points will all be at the highest valid frequency.

16 The k-band amplifier (Option 008 only) crossing occurred during automatic sweep mode. Only one sweep will occur and then the sweep will stop.

90 Auto Peak malfunction. This indicates that the instrument may require service.

Start Frequency (Sweep)

Description

The sweep start frequency determines where the Signal Generator will begin a sweep in each of the three sweep modes. The sweep frequency limits are determined by setting either the start and stop frequency or the center frequency and frequency span. Setting start and stop frequency will begin the sweep at the start frequency and end at the stop frequency. Setting the center frequency and frequency span will start the sweep at one-half the frequency span below the center frequency and end the sweep at one-half the frequency span above the center frequency. Setting the CW frequency when sweep is off will also reset the sweep center frequency to the same value.

Setting the center frequency or frequency span will automatically recalculate the appropriate sweep start and stop frequencies. Resetting the sweep start or stop frequency will reset the sweep center frequency if in sweep mode, or the CW frequency if sweep is off. The frequency span will be recalculated whether sweep is on or off. The sweep center frequency or CW frequency will be reset to be halfway between the start and stop frequencies.

The sweep start frequency can be set to any valid Signal Generator frequency. In addition, if the start frequency is set above the stop frequency, single and auto sweep modes will still sweep from the start to the stop frequency. Manual sweep will start at the lower absolute frequency and move toward the higher absolute frequency.

Local Procedure

To set the Signal Generator to a specific sweep start frequency:

1. Press the SWEEP FREQ START key to indicate that the next entry will be for sweep start frequency.
2. Enter the desired frequency using the numeric keypad. If a mistake is made while entering the frequency, press the backspace key until the incorrect digit disappears. Continue entering the correct digits until the frequency displayed in the FREQUENCY MHz display is correct.
3. Press the appropriate units key. The frequency can be entered in GHz, MHz or kHz. Once the units key is pressed, the displayed frequency will be adjusted to display MHz and the sweep start frequency will be set. The sweep start frequency will continue to be displayed until the units key is released.

The actual frequency displayed after releasing the units key will usually not be the entered frequency. If sweep mode is off, the displayed frequency will indicate the frequency halfway between the new start frequency and the stop frequency. If auto sweep is on, the sweep will be reset and then continue using the new start frequency. If single sweep is on, the sweep will be reset and the sweep will remain armed at the new start frequency. If manual sweep is on, the sweep frequency will be reset to the start frequency.

To check the current sweep start frequency, press and hold the SWEEP FREQ START key. The FREQUENCY MHz display will display the sweep start frequency as long as the key is held. When any sweep mode is turned off, the CW frequency will be set to halfway between the start and stop frequencies (equal to the sweep center frequency).

Remote Procedure

The Signal Generator accepts any sweep start frequency within its specified frequency range. Above 6.6 GHz, the programmed frequency may be rounded by the Signal Generator to be compatible with the 2, 3, or 4 kHz resolution at the programmed frequency (see Comments).

Start Frequency (Sweep) (cont'd)

Remote Procedure (cont'd)

The format of the remote programming follows the front panel key sequence. To program the sweep start frequency, the program code FA is sent followed by the desired frequency and the units (GZ, MZ, KZ, or HZ).

If setting the new start frequency causes a change of the CW frequency (normally the case), the SOURCE SETTLED bit of the status byte can be monitored to determine when the new frequency has settled. Once this bit is set, the NOT ϕ LOCKED bit in the extended status byte may be checked to ensure that the instrument is working correctly. The NOT ϕ LOCKED bit is not valid until after the SOURCE SETTLED bit has been set.

The current sweep start frequency can be read by the controller using the output active program code suffix. To read the start frequency, send the program codes "FAOA" and then read the start frequency. The Signal Generator will send the frequency in fundamental (Hz) units. If the frequency is read as a string, the format will be the program code, FA, followed by the sweep start frequency in Hz and then the units terminator (Hz).

Example

To set the sweep start frequency to 16 232.334 MHz:

Local

1. Press the SWEEP FREQ START key.

2. Key in 16232.334 using the numeric keypad. The FREQUENCY MHz display should show 16232.334 when you have finished keying in the value. Note that the entry is left justified at this point.

3. Press the MHz units key to finish the sequence. The FREQUENCY MHz display should show the entered frequency until the units key is released. The FREQUENCY MHz display should now be right justified.

The frequency could also have been entered as 16.232334 GHz or 16232334 kHz. The only difference is the placement of the decimal point and the units key pressed after the frequency has been entered using the numeric keypad.

Remote

The programming string for setting the sweep start frequency is composed of a program code, numeric data and the units terminator. The frequency may be programmed in units of GHz, MHz, kHz or Hz. To program the Signal Generator start frequency to 16232.334 MHz, the possible program strings are:

"FA16.232334GZ" or "FA16232.334MZ" or "FA16232334KZ" or "FA16232334000HZ"

The alpha characters can be sent as upper or lower case (or even mixed upper and lower case). If the CW frequency changes, the output frequency is valid once the SOURCE SETTLED bit of the status byte is set (see Comments).

Start Frequency (Sweep) (cont'd)

Program Codes

HP-IB

Program Code	Function	Applicable Units
FA	Start Frequency	GZ *MZ KZ HZ

* Preferred Program Code

Comments

Due to the use of frequency multiplication to generate frequencies above 6.6 GHz, the frequency sometimes cannot be set precisely to a desired value. Frequencies below 6.6 GHz can be set to the nearest 1 kHz. All frequencies between 6.6 and 12.3 GHz can be set within 2 kHz of the desired value. Frequencies between 12.3 and 18.6 GHz can be set within 3 kHz of the desired value and frequencies between 18.6 and 26.5 GHz can be set within 4 kHz of the desired frequency. However, with careful selection of frequency, the roundoff error can be reduced to 1 kHz below 18.6 GHz and 2 kHz for frequencies between 18.6 and 26.5 GHz.

When the Signal Generator is programmed to a frequency that cannot be set exactly due to frequency resolution, a random roundoff occurs. To prevent this, the remote program should perform a calculation to determine whether the frequency can be set exactly and adjust the desired frequency accordingly.

To determine whether a frequency can be set to a given value, divide the desired frequency (in kHz) by two if it is between 6.6 and 12.3 GHz, by three if it is between 12.3 and 18.6 GHz or by four if it is above 18.6 GHz. If the result is a whole number (no remainder), the frequency can be set to the desired value. For example, 16 GHz divided by three (it is between 12.3 and 18.6 GHz) is 5 333333.33 kHz. Since the dividend is not a whole number, this frequency cannot be set exactly. The nearest frequencies that can be set are 15.999999 GHz (5.333333X3) and 16.000002 GHz (5.333334X3). Note that the roundoff error is only 1 kHz if 15.999999 GHz is programmed instead of 16 GHz.

For applications that require fastest execution, the SOURCE SETTLED bit of the status byte can be used. Once the bit is set after a frequency has been programmed, the output is valid and the program may continue. If the frequency is programmed and the status byte is not checked, the program should wait at least the frequency switching speed time before assuming the output valid. If the status byte is to be used to monitor settling, the program string that sets the frequency should start with the program code CS. This will clear any previous setting of the SOURCE SETTLED bit to avoid an incorrect indication.

The Signal Generator Option 008 has one frequency where mechanical switches are actuated to change the internal microwave signal path. To avoid excessive mechanical wear on these switches due to repetitive sweeps, only a single sweep is allowed that crosses them in Auto Sweep mode. Single sweep is not affected by this restriction since single sweep will only cross the mechanical switches once. Manual Sweep mode is also not restricted since the operator can hear the switch and react to the number of crossings. The switch point is shown on the following page. See AUTO SWEEP MODE for more information about sweep limitations and ways to expand sweep ranges.

Start Frequency (Sweep) (cont'd)

Comments (cont'd)

Frequency Switch Point	Description
16.0 GHz	The k-band amplifier is switched in to increase output power above 16 GHz (Option 008 only)

Programming Example

The following programs are written in BASIC for HP 9000 Series 200 or 300 controllers. The program below is used to set the Signal Generator to the sweep start frequency specified by the variable called *Expected.* The desired value must be in MHz and should be within the frequency range of the Signal Generator.

```
10 SUB Sweep_start_set(Err,Expected)                 ! Expected frequency in MHz
20 OUTPUT 719 USING "2A";"MG"                        ! Read message from 8673
30 ENTER 719 USING "2A";Message$                     !  to clear any old messages
40 Frequency=INT(Expected*1000)/1000                 ! Round off to nearest kHz
50 OUTPUT 719 USING "4A,5D.DDD,2A";"CSFA";Frequency;"MZ"  ! Update status
60 CALL Settled                                      ! Wait for source to settle
70 OUTPUT 719 USING "2A";"MG"                        ! Check for message from 8673
80 ENTER 719 USING "2A";Message$
90 SELECT VAL(Message$)
100 CASE 1                                           ! Frequency was out of range
110 Err=1
120 DISP "WARNING: Attempt to set sweep start frequency out of range"
130 CASE 10
140 Err=10
150 DISP "WARNING: Sweep start and stop frequency are equal"
160 CASE 90                                          ! Auto Peak Error
170 Err=90
180 DISP "WARNING: Auto Peak error. Service may be required"
190 CASE ELSE
200 Err=0                                            ! Other errors not applicable
210 END SELECT
220 !
230 OUTPUT 719 USING "4A";"FA0A"                     ! Requests current start freq
240 ENTER 719 USING "K";Set_freq                     ! Frequency in Hz
250 Set_freq=INT(Set_freq/1000)/1000                 ! Convert to MHz
260 !
270 IF ABS(Set_freq-Frequency)>.001 AND Err=0 THEN
280 DISP "WARNING: Requested frequency rounded to ";Set_freq
290 END IF
295 SUBEND                                           ! End of subroutine
```

To prevent roundoff errors from occurring, the following subprogram may be used to adjust a frequency so that it is always within 1 or 2 kHz of the desired frequency. Frequencies below 18.6 GHz will be within 1 kHz of the desired frequency and frequencies between 18.6 and 26 GHz will be within 2 kHz of the desired frequency.

Start Frequency (Sweep) (cont'd)

Programming Example (cont'd)

```
300 SUB Round_off(Err,Expected)                          ! Expected frequency in MHz
310 Err=0                                                ! Initialize Err
320 Band=5
330 IF Expected<26500.001 THEN Band=4
340 IF Expected<18600.001 THEN Band=3
350 IF Expected<12300.001 THEN Band=2
360 IF Expected<6600.001 THEN Band=1
370 !
380 Baseband=INT((Expected*1000)/Band)/1000              ! Rounded fundamental
390 Round_down=Baseband*Band
400 IF Round_down<>Expected THEN                         ! Requires rounding
410 Round_up=(Baseband+.001)*Band
420 IF ABS(Round_down-Expected)<ABS(Round_up-Expected) THEN
430 Expected=Round_down                                  ! Minimum error is round down
440 ELSE
450 Expected=Round_up                                    ! Minimum error is round up
460 END IF
470 END IF
480 SUBEND
```

The following program can be called to wait for a source settled indication from the Signal Generator. The program will wait a maximum of 1 second before assuming the SOURCE SETTLED bit is not going to be set. The status byte must be cleared with the CS program code before the frequency is set. If the status byte is not cleared, the SOURCE SETTLED bit may have been set by a previous command (the bit is latched until the status byte is read or cleared).

```
500 SUB Settled
510 T_counter=TIMEDATE                        ! In case no source settled
520 Stat=SPOLL(719)                           ! Serial poll
530 IF TIMEDATE-T_counter>1 THEN Done         ! Default of 1 second
540 IF NOT BIT(Stat,3) THEN GOTO 520          ! Wait for set bit
550 Done: !
560 SUBEND                                    ! Source is settled or 1 second has passed
```

Error Messages

The following message numbers may be displayed when setting the sweep start frequency. Each message is explained as it pertains to setting sweep start frequency. For a more complete description of the messages, see the MESSAGES detailed operating instructions.

01 Entered frequency is not within the range of the Signal Generator.

10 The sweep start frequency has been set equal to the stop frequency. No sweep will occur when a sweep mode is selected.

11 Indicates that the current sweep start frequency is below the range of the Signal Generator. This error may be displayed when the SWEEP FREQ START key is pressed if tuning the instrument placed the sweep start frequency below the frequency range of the Signal Generator.

Start Frequency (Sweep) (cont'd)

Error Messages (cont'd)

12 Indicates that the current sweep stop frequency is above the frequency range of the Signal Generator. This error may be displayed when the SWEEP FREQ STOP key is pressed if tuning the instrument placed the sweep stop frequency above the frequency range of the Signal Generator.

13 Number of steps were adjusted to give even step size. This ensures that the full sweep span is covered by adjusting the number of steps. For example, if the number of steps is set to 100 and the stop frequency is 2000.010 MHz, setting the start frequency to 2 GHz will automatically adjust the number of steps to 10 to accommodate the minimum frequency resolution of 1 kHz.

90 Auto Peak malfunction. This indicates that the instrument may require service.

Status Byte and Polling

Description

The status byte enables a remote controller to determine the instrument's status. There is also an extended status byte which can be read by the controller to determine the state of most of the front panel annunciators.

Status Byte. The status byte contains eight bits which correspond to certain conditions of the instrument. Each bit is defined as follows:

BIT 1 FRONT PANEL KEY PRESSED: This bit is used to indicate that one of the front panel keys has been pressed since the last time the status byte was cleared. The bit is not set if the Signal Generator is in remote mode when a key is pressed. The bit can be used in applications requiring the controller to know when a user changes one of the instrument parameters. For example, the bit can be used to indicate when a user has changed frequency so that measuring equipment (under remote control) can be retuned for another measurement.

Changes of the VERNIER are not indicated by this bit. The RANGE up and down keys and the FREQ INCREMENT up and down keys will have this bit set once for each key press. However, holding the key down will increment or decrement more than one time even though the bit is set only once.

BIT 2 FRONT PANEL ENTRY COMPLETE: This bit is used to detect the completion of a front panel data entry using the numeric keypad, the TUNE knob or the FREQ INCREMENT up or down key. The bit is set once the entry is completed. For example, the bit is set after the units key is pressed when setting the frequency. Since front panel entry is disabled when in remote mode, this bit is not set for entries during remote mode.

When used in conjunction with the FRONT PANEL KEY PRESSED bit, the controller can determine when a user begins entering a front panel value and when the entry is complete. The FRONT ENTRY COMPLETE bit can also be used to detect when the FREQ INCREMENT up or down key is released. The bit will continue to be set until the key is released. The FRONT PANEL KEY PRESSED bit will only be set once for this condition.

BIT 3 CHANGE IN EXTENDED STATUS: The status byte can be read using a serial poll, but the extended status byte requires a program code to be sent to the Signal Generator and then the controller must read both the status byte and the extended status byte from the Signal Generator. The CHANGE IN EXTENDED STATUS bit is used to indicate that the extended status byte has changed from its value the last time was read. This enables the status byte to be monitored using a serial poll until there is a status change in the extended status byte. Once a change has occurred, the controller can read the extended status byte to check the instrument status. For more information regarding the use of this status bit, see the Comments section.

BIT 4 SOURCE SETTLED: The Signal Generator requires a certain length of time to process a command. For example, when setting frequency, the Signal Generator can require anywhere from several milliseconds to 50 milliseconds to change frequency and settle the RF output level. The actual time required depends on the frequency change (see CW Frequency). If the application waits 50 milliseconds (the specified worst case frequency switching time) after

Status Byte and Polling (cont'd)

Description (cont'd)

each frequency change, the RF output will be settled. Note that the wait must start after the Signal Generator has received the frequency programming string. For controllers with buffered output capability, an additional wait is required to allow the buffered output to be received by the Signal Generator. However, for applications requiring faster execution, the source settled bit can be monitored to determine when the RF output has settled. Since most frequency changes will be much faster than the worst case frequency switching time, the application will execute faster if the SOURCE SETTLED bit is monitored.

The SOURCE SETTLED bit is intended to indicate settling after the RF output or AUTO PEAK is turned on and when FM ranges, frequency, output level or pulse modes are changed. The bit will be set after any parameter change except AM, storing a register and changing sweep parameters that do not immediately change the output frequency. However, the bit is not always valid as an indication that the RF output is settled and should only be used to check for settling of the intended parameter changes.

BIT 5 END OF SWEEP: During sweep mode, the END OF SWEEP bit is used to indicate that the current sweep has finished. In AUTO sweep mode the bit will be set once each time the stop frequency is reached. In MANUAL sweep mode, the bit will be set anytime the start or stop frequency is reached. The bit is set when the stop frequency is reached for SINGLE sweep mode. The bit can be used to detect when a single sweep is finished so the controller can spend time computing while the Signal Generator is sweeping.

BIT 6 ENTRY ERROR: The ENTRY ERROR bit is set when an invalid front panel key sequence, HP-IB program code, or parameter value is entered. This bit corresponds to the front panel MESSAGE key. Reading the message after detecting this bit will enable the controller to identify and possibly correct the error.

BIT 7 RQS SERVICE REQUEST BIT: The Signal Generator can generate a service request when one (or more) of the bits in the status byte are set. A request mask must be set to allow one or more of the bits to generate a service request. At power on, the request mask is set to disable any of the bits from generating a service request. A bit is enabled by setting the corresponding bit in the request mask to a logical one (true). The front panel SRQ indicator will be lighted whenever this bit is set in local or remote mode. The HP-IB service request will also be generated in remote or local mode.

BIT 8 CHANGE IN SWEEP PARAMETERS: Changing the CW frequency will reset the start and stop frequencies of the sweep. Any changes to start or stop frequencies, delta frequency, number of steps or step size, dwell time, or center frequency will set this bit.

Extended Status Byte. The extended status byte is read by sending the "0S" program code to the Signal Generator and then reading the status byte and extended status byte. The bits in the extended status byte are set whenever a valid condition exits. The only way to clear a bit that has been set is to clear the status bytes with a CS program code or to read the extended status byte. Once the extended status byte is read, it will be cleared and updated. Note that the bits are not cleared until after the extended status is read. To read the current instrument extended status, the program string "CSOS" should be sent to clear both status bytes and to update the extended status byte. The extended status byte is composed of eight bits with each bit defined as follows:

Status Byte and Polling (cont'd)

Description (cont'd)

BIT 1 SELF TEST FAILED: When the Signal Generator is first turned on, a self-test is performed to check the instrument's Digital Control Unit. If a failure is detected, the SELF TEST FAILED bit is set.

BIT 2 FM OVERMOD: If the FM circuitry is overmodulated by applying more than one volt peak at the input or by exceeding the instrument capability, the FM OVERMOD front panel annunciator and status bit will be set.

BIT 3 This bit is always set to zero.

BIT 4 EXTERNAL REF: When the Signal Generator's rear panel panel FREQ STANDARD INT/EXT switch is set to EXT, the front panel EXT REF annunciator and the EXTERNAL REF status bit will be set.

BIT 5 NOT PHASE LOCKED: If the Signal Generator is not phase locked due to instrument malfunction, is severely FM overmodulated, has the FREQ STANDARD INT/EXT switch in the EXT position with no external frequency reference or has the RF output off, the NOT PHASE LOCKED status bit will be set. This bit is not valid after a frequency change until the SOURCE SETTLED bit is set. The ϕ UNLOCKED annunciator on the front panel corresponds to this bit.

BIT 6 POWER FAILURE/ON: If the mains power to the Signal Generator is interrupted and then returned, this bit will be set. The bit can be used to verify that the line main has not been interrupted since the last time the status byte was checked.

BIT 7 ALC UNLEVELED: If the Signal Generator output level is not calibrated (as indicated by the front panel UNLEVELED annunciator) or the amplitude modulation circuitry is being overmodulated or the RF output is off, the ALC UNLEVELED bit in the extended status byte will be set.

BIT 8 This bit is always set to zero.

Local Procedure

The status byte and the extended status byte can only be read using a controller. All but one of the extended status bits can be read also on the front panel. The POWER FAILURE/ON bit can only be read using a controller. The SELF TEST FAILED will be indicated by a message just after the instrument is turned on. All of the other bits have a status annunciator that is turned on whenever the appropriate conditions exist.

A controller can be used to poll the Signal Generator while in remote mode to determine when a key is pressed or when the extended status byte changes. This is useful in applications requiring retuning of test instruments under remote control while allowing an operator to manually tune the Signal Generator.

Remote Procedure

Serial Poll. When a condition occurs that sets one of the bits of the status byte or the extended status byte, the bit is set and remains set until it is cleared by the controller. When the status byte is cleared, all bits are first cleared and then updated to reflect the current status of the Signal Generator.

A serial poll is used to read the status byte without clearing any of the bits of the status byte. To read the status byte, the command SPOLL is used. The status byte is then read into the controller. The status byte is read as the sum of the weighted values of the bits. See the status byte in the Comments section to determine bit weight value. To clear the status byte, the program code CS must be sent or the status byte and extended status

Status Byte and Polling (cont'd)

Remote Procedure (cont'd)

byte must be read. The clear status command (CS) will clear both the status byte and the extended status byte. If clearing the status changes the extended status byte, the CHANGE IN EXTENDED STATUS bit will be set in the status byte. This enables the controller to monitor the status byte using a serial poll until the extended status byte changes. Reading both status bytes after the output status command (OS) will clear both bytes after they are read.

To read the extended status byte, the program code OS is sent and then the status byte and extended status byte are read into the controller. Since the extended status bits are latched, the extended status byte may indicate that a problem exists that has already been corrected. For example, if the RF output is turned off, the NOT ϕ LOCKED bit and the ALC UNLEVELED bit will be set. If the RF output is then turned on and the extended status byte read, the NOT ϕ LOCKED and ALC UNLEVELED bit will still be set. To read the current instrument status, the status should be cleared (CS) and then the extended status byte will reflect current conditions.

Service Request (SRQ). The Signal Generator can generate a service request whenever one of the bits of the status byte is set. However, the bits must be enabled before a service request will be generated. To enable a bit, the corresponding bit of the Request Mask must be set to a one. For example, to generate a service request when the END OF SWEEP bit is set, bit five of the Request Mask must be set to a logical one (true). The program string required to set bit 5 is "RM16" since bit 5 has a weight of 16 (see the status byte in Comments).

When the Signal Generator is first turned on, the Request Mask is cleared so that a service request will not be generated. The Request Mask value can be read by the controller so bits can be added or cleared from the present values. The Request Mask is cleared by an HP-IB clear but not by an instrument preset.

When a service request is generated (whenever the RQS bit is set true), the status byte is latched so the first cause of the service request can be identified. Reading the stored status byte can only be done using a serial poll. Reading the status byte using the output status program code (OS) will read the current status only. Once the stored status byte is read, the status byte is updated so a subsequent service request is not lost. If more than one bit is enabled to generate a service request and more than one bit is set before the serial poll, the first serial poll will read the status byte associated with the first service request. Once the poll is completed, another service request will be generated due to the one or more other bits that were set after the status byte was stored.

The service request (SRQ) HP-IB bus line is set true whenever the RQS bit of the status byte is set. The front panel SRQ annunciator is also lighted when the RQS bit is set. The service request is cleared when a clear status (CS) is executed or the extended status byte is read (OS). When the controller detects a service request by testing the HP-IB SRQ line, a serial poll must be performed for each instrument on the bus to determine which instrument generated the request. For large systems, the parallel poll can be used to reduce the number of polls required to identify the instrument requiring service.

Parallel Poll. The parallel poll (PPOLL) is used to allow several instruments to respond with the service request status on a single bus line. Since there are eight bus lines, up to eight groups of instruments can be polled at the same time. By testing the data lines after a parallel poll, the group generating a service request can be quickly identified and then the instruments in that group can be serial polled until the instrument(s) requiring service is located. In a system with eight instruments, this reduces the number of polls from eight serial polls to one parallel poll and then a single serial poll.

Status Byte and Polling (cont'd)

Remote Procedure (cont'd)

The controller assigns a data line and the parallel poll sense using a parallel poll configure command. The assigned data line is the line that the Signal Generator will output the SRQ if it is set. The sense determines whether the active (true) value will be a logical zero or a logical one. For example, assigning the Signal Generator parallel poll response to data line five and the sense to false will cause the Signal Generator to output a false signal on data bus line five when the parallel poll occurs (if the SRQ bit is set).

Program Codes

HP-IB

Program Code	Function
CS	Clear status and extended status bytes
OR	Output Request Mask (in binary)
OS	Output status and extended status bytes (in binary)
RM	Prefix to set Request Mask (in binary)
@1	Prefix to set Request Mask (in binary)

Comments

STATUS BYTE								
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								
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 Phase Locked	External Ref	0 (always)	FM Overmodulated	Self-Test Failed

When using the status byte to monitor the results of program strings, care must be taken to avoid incorrect results. When the instrument is preset and the frequency and/or level do not change, the SOURCE SETTLED bit will be set before the extended status byte is set. In addition, some conditions may cause bits in the extended status byte to not be set. For maximum assurance that the instrument is settled and the extended status byte is valid after a preset, the following procedure should be used.

1. Set the Signal Generator to 2 GHz and then preset the instrument with the program string "FR2GZRC0."
2. Monitor the status byte using a serial poll until the SOURCE SETTLED bit is set.
3. Clear the status and prepare the extended status byte with the program string "CSOS."

Status Byte and Polling (cont'd)

Comments (cont'd)

If the above procedure is followed, the extended status byte will be valid and the preset will be complete by the time the extended status is read. If a selected device clear (i.e. CLEAR 719) or a device clear (i.e. CLEAR 7) are used, a settling time of about 2 seconds is required before the extended status byte is valid and the source is settled. Setting the Signal Generator to 2 GHz before the clear will allow the preceding procedure to be followed starting with step 2 after the preset.

The SOURCE SETTLED bit is set once the affected parameter has settled. If a clear status is executed before this bit is set from a previous command, the bit will be set after the status byte has been cleared and before the parameter being programmed has changed. For example, if the instrument is preset and the status cleared as part of a frequency change before the Signal Generator has settled, the SOURCE SETTLED bit will be set by the instrument preset before the frequency change is complete. If the bit is being checked before proceeding, the program will continue before the frequency change has settled.

Status bits are set asynchronously whenever the corresponding condition occurs. If a condition occurs between the time the output extended status program code is received and the time both status bytes are read, the status byte will reflect the changed condition by setting the appropriate bit. Note that once a bit is set, only a clear status or reading the extended status can clear it.

When the ENTRY ERROR bit is enabled to cause a service request, the message must be cleared after the service request. Failure to clear the message will result in additional service requests generated with each program string. To clear the message, output the program code "MG" and then read the message. Once the message is read or the MESSAGE key on the front panel is pressed, the message will be cleared.

The status byte and the extended status byte are both binary values. When entering the status byte and extended status byte into the controller, use a formatted statement to input the values as binary. If a formatted statement is not used, the controller may recognize a value of twelve as a carriage return and terminate the entry. This can occur when the SOURCE SETTLED BIT and the CHANGE IN EXTENDED STATUS bits are the only bits set in the status byte. In addition, the controller should be instructed not to accept the linefeed character (decimal 12) as an early termination of the data transfer. The correct format for the HP 9000 Series 200 and 300 or the HP 85 controllers is:

```
ENTER 719 USING "%,B,B";S1,S2
```

Programming Example

The following programs are written in BASIC for HP 9000 Series 200 or 300 controllers. The program below is used to test for the SOURCE SETTLED bit after a frequency or level change. Since the SOURCE SETTLED bit is not set for some program codes, a timeout is provided to terminate the subroutine.

```
10 SUB Source_settled
20 Time_in=TIMEDATE                          ! Reference for timeout
30 Check_it: !
40 V=SPOLL(719)                              ! Take a serial poll to check the bit
50                                           ! Check for set bit or more than 3 seconds
60 IF NOT BIT(V,3) AND TIMEDATE-Time_in<3 THEN GOTO Check_it
70 SUBEND                                    ! >3 seconds or bit is set
```

Status Byte and Polling (cont'd)

Programming Example (cont'd)

The parallel poll is set up using the Request Mask and the parallel poll commands of the controller. The following program sets up a parallel poll to check for entry errors or changes in the extended status. The parallel poll response will be positive and set for line 1 of the HP-IB bus.

The second subroutine is used to test the HP-IB with a parallel poll and call a user subroutine, Err_8673. The poll indicates an SRQ by the HP 8673.

```
100 SUB Set_8673_poll
110 Mask=4+32                              ! Bits for Entry error (32) and status change (4)
120 PPOLL CONFIGURE 719;1+8                ! Line one with positive sense
130 OUTPUT 719 USING "2A,B";"RM",Mask      ! Enable bits
140 SUBEND

150 SUB Poll_bus
160 Bus=PPOLL(7)
170 IF BIT(Bus,1) THEN CALL Err_8673       ! Routine will serial poll
180 SUBEND

190 SUB Err_8673
200 V=SPOLL(719)
210 IF BIT(V,5) THEN                       ! Entry error occurred
220 DISP "Entry error occurred for HP 8673 (Press MESSAGE key)."
230 PAUSE
240 OUTPUT 719;"MG"                        !Clear message to prevent more requests
250 ENTER 719;Dummy
260 DISP                                   ! Clear display line
270 END IF
280 IF BIT(V,2) THEN                       ! Change in extended status is indicated
290 OUTPUT 719;"OS"
300 ENTER 719 USING "%,B,B";Stat1,Stat2
310 IF BIT(Stat2,0) THEN PRINT "HP 8673 Self Test Failed"
320 IF BIT(Stat2,1) THEN PRINT "HP 8673 FM is overmodulated"
330 IF BIT(Stat2,3) THEN PRINT "HP 8673 is using External Ref"
340 IF BIT(Stat2,4) THEN PRINT "HP 8673 is not phase locked"
350 IF BIT(Stat2,5) THEN PRINT "HP 8673 has had a power failure"
360 IF BIT(Stat2,6) THEN PRINT "HP 8673 is not leveled"
370 END IF
380 SUBEND
```

Error Messages

All messages except NO ERROR will set the ENTRY ERROR bit of the status byte. Errors 95 through 99 are related to the self test performed at power up. If one of these errors is reported and the instrument is still functional, the SELF TEST FAILED bit in the extended status byte will be set.

Steps (Sweep)

Description

The Signal Generator performs a sweep by stepping the RF output frequency in discrete steps between the start and stop frequency of the sweep. The number of steps that the Signal Generator makes between the start and stop frequency is set by the number of steps or the sweep step size.

Setting the number of steps in a sweep will change the sweep step size and setting the sweep step size will change the number of steps. Sweep step size is calculated by dividing the frequency span (VF) by the number of steps when the number of steps is set. The number of steps is set by dividing the frequency span (VF) by the sweep step size when the sweep step size is entered.

The Signal Generator is capable of 1 to 9999 steps within a sweep span as long as the calculated step size is greater than 1 kHz. For a sweep with one step, the Signal Generator will produce the start frequency and the stop frequency.

Sweep step size can be set between 1 kHz and the currently defined sweep span as long as the calculated number of steps is between 1 and 9999 steps. Entering a sweep step size larger than the sweep span will set the step size equal to the span and will cause the Signal Generator to issue a message.

Local Procedure

To set the number of sweep steps:

1. Press the STEP key to indicate that the next entry will be for the sweep step size or the number of steps. The only difference in entering the two parameters is the units terminator.

2. Enter the desired number of steps using the numeric keypad. If a mistake is made while entering the number of steps, press the backspace key until the incorrect digit disappears. Continue entering the correct digits until the number of steps in the FREQUENCY MHz display is correct.

3. Press the STEPS key to indicate that the number of steps rather than the sweep step size has been entered. The sweep step size will be calculated and the sweep step size and the number of steps will be displayed until the STEPS key is released

If the entered value does not produce a sweep step size equal to or greater than the frequency resolution, the number of steps will be reduced until a valid sweep step size is obtained. The number of steps must be between 1 and 9999 steps. If the sweep step size is adjusted, the entered value of number of steps is retained for use when other sweep parameters are changed. This feature enables the sweep parameters to be entered in any order without restrictions due to previous sweep parameters that do not affect the final values. For example, if the number of steps is entered as 200 with the current sweep span defined as 100 kHz, the number of steps will be adjusted to be 100 (1 kHz resolution) and a message will be issued. However, changing the sweep span to 200 kHz will restore the number of steps to 200 without having to re-enter the value.

Remote Procedure

The Signal Generator accepts any number of sweep steps between 1 and 9999 steps. The programmed value may be adjusted as required to be consistent with the remaining sweep parameters and the frequency resolution.

The format of the remote programming follows the front panel key sequence. The program code SS or SP is sent followed by the desired number of steps and the units SS.

Steps (Sweep) (cont'd)

Remote Procedure (cont'd)

The programmed number of steps can be read by the controller using the output active program code suffix. To read the current number of steps, the program string SPOA or SSOA is sent and then the step size and the number of steps must be read. Since step size and the number of steps are directly related, both are sent when the output active program code suffix is used. If read as a string the format is: the program code SP followed by the sweep step size in fundamental units (Hz), the units terminator (Hz), a comma, the program code SP followed by the current number of steps, and the units terminator SS.

Example

To set the number of sweep steps to 350 steps:

Local

1. Press the STEP key.
2. Key in 350 using the numeric keypad. The FREQUENCY MHz display should show 350 when you have finished keying in the value. Note that the entry is left justified at this point.
3. Press the STEP units key to finish the sequence. The FREQUENCY MHz display should show the entered (or adjusted) number of steps on the left half of the display and the calculated sweep step size on the right half of the display. The message key will light if the number of steps are adjusted to indicate the change from the desired value.

Remote

The programming string for setting the number of sweep steps is composed of a program code, numeric data and the units terminator. To program the number of steps to 350 steps, the program string is: "SP350SS"

The program codes SS and SP can be used interchangeably in the above program string. The alpha characters can be sent as upper or lower case (or even mixed upper and lower case).

Program Codes
HP-IB

Program Code	Description	Units
*SP SS	Number of Sweep Steps	*SS SP

* Preferred Program Code

Comments

The Signal Generator digital sweep is composed of discrete frequencies that are produced sequentially. The minimum step size is limited to the frequency resolution which is the minimum change in frequency that the Signal Generator can produce. The number of steps is dependent on the frequency resolution and the sweep span.

The actual change in output frequency will not be uniform for some frequencies and may vary up to 2 kHz. This is required to accommodate sweep step sizes that are not exact multiples of the frequency resolution. The sweep steps averaged over several sweep points will be equal to the selected sweep step size. An example of the averaging is defining a sweep step size of 10 kHz at a start frequency of 15 GHz. The minimum tuning increment at 15 GHz is 3 kHz which means that the sweep step size can be 9 or 12

Steps (Sweep) (cont'd)

Comments (cont'd)

kHz for exact step sizes. To obtain a sweep step size of 10 kHz, the Signal Generator will step by 9 kHz, 9 kHz, 12 kHz, and then repeat the sequence. The average step size is 10 kHz even though the sweep does not execute exactly 10 kHz steps. If the step size is reduced to 1 kHz, the Signal Generator will step by 0 kHz, 0 kHz and then 3 kHz for a 1 kHz average step size.

When the sweep frequency span is changed, the sweep step size is recalculated by dividing the entered span by the current number of steps. Entering the number of sweep steps will recalculate the sweep step size by dividing the sweep frequency span by the entered number of steps. The number of steps will be adjusted until the sweep step size is equal to or larger than the frequency resolution. If the number of steps times the sweep step size does not exactly equal the frequency span, the last sweep point (the stop frequency) will not be included.

The number of steps may be increased automatically by the Signal Generator to offset the effect of frequency resolution on the step size. For example, if the sweep span is set to 1 MHz and 400 steps are selected, the number of steps will be increased to 500 steps. This adjustment is made since 2 kHz steps would yield a span of 800 kHz while 3 kHz steps would provide a span of 1.2 MHz. Since both of the resulting spans are incorrect, the number of steps is increased to 500 to produce a 1 MHz span with 2 kHz steps. The original entry will be retained for recalculation when other sweep parameters are changed.

Programming Example

The following program is written in BASIC for HP 9000 Series 200 or 300 controllers. The program is used to set the number of sweep steps to the number specified by the variable called *Expected*. The desired value must be between 1 and 9999 steps.

```
10 SUB Sweep_steps(Err,Expected)
20 OUTPUT 719 USING "2A";"MG"                            ! Clear message from 8673
30 ENTER 719 USING "2A";Message$                         !  to clear any old messages
40 OUTPUT 719 USING "2A,DDDD,2A";"SP";Expected;"SS"      ! Set size
50 OUTPUT 719 USING "2A";"MG"                            ! Get any error message
60 ENTER 719 USING "2A";Message$
70 SELECT VAL(Message$)
80 CASE 7
90 Err=1
100 DISP "WARNING: The number of steps is out of range"
110 CASE ELSE
120 Err=0
130 END SELECT
140 !
150 SUBEND
```

Error Messages

The following message numbers may be displayed when setting the number of steps. Each message is explained as it pertains to setting the number of steps. For a more complete description of the messages, see the MESSAGES detailed operating instructions.

07 The entered number of steps is less than 1 or greater than 9999.

13 The number of steps was adjusted to achieve a step size that is equal to or greater than the specified resolution. This adjustment also occurs when the selected number of steps would produce a sweep step size that is not a multiple of the 1 kHz minimum frequency resolution. For example, a frequency span of 350 kHz with 140 steps would require a 2.5 kHz step size. The Signal Generator would use 175 steps of 2 kHz to produce a step size that is a multiple of 1 kHz.

Step Size (Sweep)

Description

The Signal Generator performs a sweep by stepping the RF output frequency in discrete steps between the start and stop frequency of the sweep. The number of steps that the Signal Generator makes between the start and stop frequency is set by the number of steps or the sweep step size.

Setting the number of steps in a sweep will change the sweep step size and setting the sweep step size will change the number of steps. Sweep step size is calculated by dividing the frequency span (ΔF) by the number of steps when the number of steps is set. The number of steps is set by dividing the frequency span (ΔF) by the sweep step size when the sweep step size is entered.

The Signal Generator is capable of 1 to 9999 steps within a sweep span as long as the calculated step size is greater than 1 kHz. For a sweep with one step, the Signal Generator will produce the start frequency and the stop frequency.

Sweep step size can be set between 1 kHz and the currently defined sweep span as long as the calculated number of steps is between 1 and 9999 steps. Entering a sweep step size larger than the sweep span will set the step size equal to the span and will cause the Signal Generator to issue a message.

Local Procedure

To set the sweep step size:

1. Press the STEP key to indicate that the next entry will be for the sweep step size or the number of steps. The only difference in entering the two is the units terminator.

2. Enter the desired sweep step size using the numeric keypad. If a mistake is made while entering the frequency, press the backspace key until the incorrect digit disappears. Continue entering the correct digits until the sweep step size in the FREQUENCY MHz display is correct.

3. Press the appropriate units key. You may enter the sweep step size in GHz, MHz or kHz. Once the units key is pressed, the sweep step size will be adjusted to read in MHz and the sweep step size will continue to be displayed until the units key is released.

If the entered value does not result in at least one step and less than 9999 steps, the step size will be adjusted until the Signal Generator is capable of performing the sweep. The entered value is retained for use when other sweep parameters are changed. This feature enables the sweep parameters to be entered in any order with restrictions due to previous sweep parameters not affecting the final values. For example, if the sweep step size is entered as 1 GHz with the current sweep span defined as 100 kHz, the sweep step size will be adjusted to be 100 kHz and a message will be issued. However, changing the sweep span to 10 GHz will restore the sweep step size to 1 GHz without having to re-enter the value.

Remote Procedure

The Signal Generator accepts any sweep step size within the range of 1 kHz and the maximum frequency of the Signal Generator. Any digits below 1 kHz will be truncated and the entered value may be adjusted to be consistent with the remaining sweep parameters.

The format of the remote programming follows the front panel key sequence. The program code SS or SP is sent followed by the desired sweep step size and the units (GHz, MHz, kHz, or Hz).

Step Size (Sweep) (cont'd)

Remote Procedure (cont'd)

The actual step size can be read by the controller using the output active program code suffix. To read the current step size, the program string SPOA or SSOA is sent and then the step size and the number of steps must be read. Since step size and the number of steps are directly related, both are sent when the output active program code suffix is used. If read as a string, the format is the program code SP followed by the sweep step size in fundamental units (Hz) and the units terminator (Hz), a comma, and the program code SP followed by the current number of steps and the units terminator SS.

Example

To set the sweep step size to 455 kHz:

Local

1. Press the STEP key.
2. Key in 455 using the numeric keypad. The FREQUENCY MHz display should show 455 when you have finished keying in the value. Note that the entry is left justified at this point.
3. Press the kHz units key to finish the sequence. The FREQUENCY MHz display should show the calculated number of steps on the left half of the display and the entered (or adjusted) sweep step size on the right half of the display. The message key will light if the sweep step size is adjusted to indicate the change from the desired value.

The sweep step size could also have been entered as .455 MHz or .000455 GHz. The only difference is the placement of the decimal point and the units key pressed after the sweep step size has been entered using the numeric keypad.

Remote

The programming string for setting the sweep start frequency is composed of a program code, numeric data and the units terminator. The frequency may be programmed in units of GHz, MHz, kHz or Hz. To program the sweep step size to 455 kHz, the possible program strings are:

"SP.000455GZ" or "SP.455MZ" or "SP455KZ" or "SP455000HZ"

In addition, the program code SS can be used in place of SP in the above program strings. The alpha characters can be sent as upper or lower case (or even mixed upper and lower case).

Program Codes HP-IB

Program Code	Function	Units
*SP SS	Sweep step size	GZ *MZ KZ HZ

* Preferred Program Code

Comments

The Signal Generator digital sweep is composed of discrete frequencies that are produced sequentially. The minimum step size is limited to the minimum change in frequency that the Signal Generator can produce which is defined as the frequency resolution. The sweep step size can change depending on the current frequency and the next frequency in the sweep.

Step Size (Sweep) (cont'd)

Comments (cont'd)

The actual change in output frequency will not be uniform for some frequencies and may vary up to 2 kHz. This is required to accommodate sweep step sizes that are not exact multiples of the frequency resolution. The sweep steps averaged over several sweep points will be equal to the selected sweep step size. An example of the averaging is defining a sweep step size of 10 kHz at a start frequency of 15 GHz. The minimum tuning increment at 15 GHz is 3 kHz which means that the sweep step size can be 9 or 12 kHz for exact step sizes. To obtain a sweep step size of 10 kHz, the Signal Generator will step by 9 kHz, 9 kHz, 12 kHz, and then will repeat the sequence. The average step size is 10 kHz even though the sweep does not execute exactly 10 kHz steps. If the step size is reduced to 1 kHz, the Signal Generator will step by 0 kHz, 0 kHz and then 3 kHz for a 1 kHz average step size.

When the sweep frequency span is changed, the sweep step size is recalculated by dividing the entered span by the current number of steps. Entering a sweep step size will recalculate the number of steps by dividing the sweep frequency span by the entered sweep step size. The sweep step size will be adjusted until the number of steps is an integer number between 1 and 9999 steps.

Programming Example

The following program is written in BASIC for HP 9000 Series 200 or 300 controllers. The program is used to set the Signal Generator sweep step size to the frequency specified by the variable *Expected.* The desired value must be in MHz and should be between 1 kHz and the maximum frequency of the Signal Generator.

```
10 SUB Step_size(Err,Expected)
20 OUTPUT 719 USING "2A";"MG"                                    ! Clear message from 8673
30 ENTER 719 USING "2A";Message$                                  ! to clear any old messages
40 OUTPUT 719 USING "2A,5D.DDD,2A";"SP";Expected;"MZ"             ! Set size
50 OUTPUT 719 USING "2A";"MG"                                     ! Get any error message
60 ENTER 719 USING "2A";Message$
70 SELECT VAL(Message$)
80 CASE 1
90 Err=1
100 DISP "WARNING: Sweep step size is out of range"
110 CASE ELSE
120 Err=0
130 END SELECT
140 !
150 SUBEND
```

Error Messages

The following message numbers may be displayed when setting the sweep step size. Each message is explained as it pertains to setting sweep step size. For a more complete description of the messages, see the MESSAGES detailed operating instructions.

05 The entered sweep step size is not within the capability of the Signal Generator.

14 The step size is too small for the current frequency span. The entry is saved in anticipation that a new frequency span is going to be entered. The frequency span divided by the entered frequency step size must be less than 9999. If the span is not changed, the step size will be adjusted to produce an integer number of steps between 1 and 9999.

15 The entered step size is larger than the currently defined frequency span. The entry is saved in anticipation that the frequency span will be changed. If the span is not changed, the step size is set to equal to the span (1 step).

Stop Frequency (Sweep)

Description

The sweep stop frequency determines where the Signal Generator will end a sweep in each of the three sweep modes. The sweep frequency limits are determined by setting either the start and stop frequency or the center frequency and frequency span. Setting start and stop frequency will begin the sweep at the start frequency and end at the stop frequency. Setting the center frequency and frequency span will start the sweep at one-half the frequency span below the center frequency and end the sweep at one-half the frequency span above the center frequency. Setting the CW frequency when sweep is off will also reset the sweep center frequency to the same value.

Setting the center frequency or frequency span will automatically recalculate the appropriate sweep start and stop frequencies. Resetting the sweep start or stop frequency will reset the sweep center frequency if in sweep mode, or the CW frequency if sweep is off. The frequency span will be recalculated whether sweep is on or off. The sweep center frequency or CW frequency will be reset to be halfway between the start and stop frequencies.

The sweep stop frequency can be set to any valid Signal Generator frequency. In addition, if the start frequency is set above the stop frequency, single and auto sweep modes will still sweep from the start to the stop frequency. Manual sweep will start at the lower absolute frequency and move toward the higher absolute frequency.

Local Procedure

To set the Signal Generator to a specific sweep stop frequency:

1. Press the SWEEP FREQ STOP key to indicate that the next entry will be for sweep stop frequency.
2. Enter the desired frequency using the numeric keypad. If a mistake is made while entering the frequency, press the backspace key until the incorrect digit disappears. Continue entering the correct digits until the frequency displayed in the FREQUENCY MHz display is correct.
3. Press the appropriate units key. The frequency can be entered in GHz, MHz or kHz. Once the units key is pressed, the displayed frequency will be adjusted to display MHz and the sweep stop frequency will be set. The sweep stop frequency will continue to be displayed until the units key is released.

The actual frequency displayed after releasing the units key will usually not be the entered frequency. If sweep mode is off, the displayed frequency will indicate the frequency halfway between the start frequency and the new stop frequency. If auto sweep is on, the sweep will be reset and then continue using the new stop frequency. If single sweep is on, the sweep will be reset and the sweep will remain armed at the start frequency. If manual sweep is on, the sweep frequency will be reset to the start frequency.

To check the current sweep stop frequency, press and hold the SWEEP FREQ STOP key. The FREQUENCY MHz display will display the sweep stop frequency as long as the key is held. When any sweep mode is turned off, the CW frequency will be set to halfway between the start and stop frequencies (equal to the sweep center frequency).

Remote Procedure

The Signal Generator accepts any sweep stop frequency within its specified frequency range. Above 6.6 GHz, the programmed frequency may be rounded by the Signal Generator to be compatible with the 2, 3, or 4 kHz resolution at the programmed frequency (see comments).

Stop Frequency (Sweep) (cont'd)

Remote Procedure (cont'd)

The format of the remote programming follows the front panel key sequence. To program the sweep stop frequency, the program code FB is sent followed by the desired frequency and the units (GZ, MZ, KZ, or HZ).

If setting the new start frequency causes a change of the CW frequency (normally the case), the SOURCE SETTLED bit of the status byte can be monitored to determine when the new frequency has settled. Once this bit is set, the NOT PHASE LOCKED bit in the extended status byte may be checked to ensure that the instrument is working correctly. The NOT PHASE LOCKED bit is not valid until after the SOURCE SETTLED bit has been set.

The current sweep stop frequency can be read by the controller using the output active program code suffix. To read the stop frequency, send the program codes "FBOA" and then read the stop frequency. The Signal Generator will send the frequency in fundamental (Hz) units. If the frequency is read as a string, the format will be the program code, FB, followed by the sweep stop frequency in Hz and then the units terminator (Hz).

Example

To set the sweep stop frequency to 16 232.334 MHz:

Local

1. Press the SWEEP FREQ STOP key.
2. Key in 16232.334 using the numeric keypad. The FREQUENCY MHz display should show 16232.334 when you have finished keying in the value. Note that the entry is left justified at this point.
3. Press the MHz units key to finish the sequence. The FREQUENCY MHz display should show the entered frequency until the units key is released. The FREQUENCY MHz display should now be right justified.

The frequency could also have been entered as 16.232334 GHz or 16232334 kHz. The only difference is the placement of the decimal point and the units key pressed after the frequency has been entered using the numeric keypad.

Remote

The programming string for setting the sweep stop frequency is composed of a program code, numeric data and the units terminator. The frequency may be programmed in units of GHz, MHz, kHz or Hz. To program the Signal Generator start frequency to 16232.334 MHz, the possible program strings are:

"FB16.232334GZ" or "FB16232.334MZ" or "FB16232334KZ" or "FB16232334000HZ"

The alpha characters can be sent as upper or lower case (or even mixed upper and lower case). If the CW frequency changes, the output frequency is valid once the SOURCE SETTLED bit of the status byte is set (see Comments).

Stop Frequency (Sweep) (cont'd)

Program Codes

HP-IB

Program Code	Function	Applicable Units
FB	Start Frequency	GZ *MZ KZ HZ

* Preferred Program Code

Comments

Due to the use of frequency multiplication to generate frequencies above 6.6 GHz, the frequency sometimes cannot be set precisely to a desired value. Frequencies below 6.6 GHz can be set to the nearest 1 kHz. All frequencies between 6.6 and 12.3 GHz can be set within 2 kHz of the desired value. Frequencies between 12.3 and 18.6 GHz can be set within 3 kHz of the desired value and frequencies between 18.6 and 26.5 GHz can be set within 4 kHz of the desired frequency. However, with careful selection of frequency, the roundoff error can be reduced to 1 kHz below 18.6 GHz and 2 kHz for frequencies between 18.6 and 26.5 GHz.

When the Signal Generator is programmed to a frequency that cannot be set exactly due to frequency resolution, a random roundoff occurs. To prevent this, the remote program should perform a calculation to determine whether the frequency can be set exactly and adjust the desired frequency accordingly.

To determine whether a frequency can be set to a given value, divide the desired frequency (in kHz) by two if it is between 6.6 and 12.3 GHz, by three if it is between 12.3 and 18.6 GHz or by four if it is above 18.6 GHz. If the result is a whole number (no remainder), the frequency can be set to the desired value. For example, 16 GHz divided by three (it is between 12.3 and 18.6 GHz) is 5 333333.33 kHz. Since the dividend is not a whole number, this frequency cannot be set exactly. The nearest frequencies that can be set are 15.999999 GHz (5.333333X3) and 16.000002 GHz (5.333334X3). Note that the roundoff error is only 1 kHz if 15.999999 GHz is programmed instead of 16 GHz.

For applications that require fastest execution, the SOURCE SETTLED bit of the status byte can be used. Once the bit is set after a frequency has been programmed, the output is valid and the program may continue. If the frequency is programmed and the status byte is not checked, the program should wait at least the frequency switching speed time before assuming the output valid. If the status byte is to be used to monitor settling, the program string that sets the frequency should start with the program code CS. This will clear any previous setting of the SOURCE SETTLED bit to avoid an incorrect indication.

The Signal Generator Option 008 has a frequency where mechanical switches are actuated to change the internal microwave signal path. To avoid excessive mechanical wear on these switches due to repetitive sweeps, only a single sweep is allowed that crosses them in auto sweep mode. Single sweep is not affected by this restriction since single sweep will only cross the mechanical switches once. Manual sweep mode is also not restricted since the operator can hear the switch and react to the number of crossings. The switch point is shown in the following table. See AUTO SWEEP MODE for more information about sweep limitations and ways to expand sweep ranges.

Stop Frequency (Sweep) (cont'd)

Comments (cont'd)

Frequency Switch Point	Description
16.0 GHz	The k-band amplifier is switched in to increase output power above 16 GHz (Option 008 only)

Programming Example

The following programs are written in BASIC for HP 9000 Series 200 or 300 controllers. The following program is used to set the Signal Generator to the sweep start frequency specified by the variable called *Expected*. The desired value must be in MHz and should be within the frequency range of the Signal Generator.

```
10 SUB Sweep_start_set(Err,Expected)                    ! Expected frequency in MHz
20 OUTPUT 719 USING "2A";"MG"                           ! Read message from 8673
30 ENTER 719 USING "2A";Message$                        ! To clear any old messages
40 Frequency=INT(Expected*1000)/1000                    ! Round off to nearest kHz
50 OUTPUT 719 USING "4A,5D.DDD,2A";"CSFB";Frequency;"MZ"  ! Update status
60 CALL Settled                                         ! Wait for source to settle
70 OUTPUT 719 USING "2A";"MG"                           ! Check for message from 8673
80 ENTER 719 USING "2A";Message$
90 SELECT VAL(Message$)
100 CASE 1                                              ! Frequency was out of range
110 Err=1
120 DISP "WARNING: Attempt to set sweep stop frequency out of range"
130 CASE 10
140 Err=10
150 DISP "WARNING: Sweep start and stop frequency are equal"
160 CASE 90                                             ! Auto Peak Error
170 Err=90
180 DISP "WARNING: Auto Peak error. Service may be required"
190 CASE ELSE
200 Err=0                                               ! Other errors not applicable
210 END SELECT
220 !
230 OUTPUT 719 USING "4A";"FBOA"                        ! Requests current stop freq
240 ENTER 719 USING "K";Set_freq                        ! Frequency in Hz
250 Set_freq=INT(Set_freq/1000)/1000                    ! Convert to MHz
260 !
270 IF ABS(Set_freq-Frequency)>.001 AND Err=0 THEN
280 DISP "WARNING: Requested frequency rounded to";Set_freq
290 END IF
295 SUBEND                                              ! End of subroutine
```

To prevent roundoff errors from occurring, the following subprogram may be used to adjust a frequency so that it is always within 1 or 2 kHz of the desired frequency. Frequencies below 18.6 GHz will be within 1 kHz of the desired frequency and frequencies between 18.6 and 26 GHz will be within 2 kHz of the desired frequency.

SECTION 4
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 3 under Operator's Checks.

NOTE

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

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

b. The line voltage must be 100, 120, 220, or 240 Vac +5%, −10%.

c. The ambient temperature must be +15 to +35°C for Harmonically Related Spurious signals, RF Output Level, Pulse Peak Level Accuracy, and Amplitude Modulation tests; 0 to 55°C for all other tests.

4-2. ABBREVIATED PERFORMANCE TEST

In most cases, it is not necessary to perform all of the tests in this section. Paragraph 4-7 contains the abbreviated performance tests. These tests can be used for operation verification. Results of these tests may be recorded in Table 4-1, Abbreviated Performance Test Record.

These tests can also be used for incoming inspections and preventive maintenance. They are not intended to be a complete check of specifications, but will provide 90% confidence that the Signal Generator is meeting its major performance specifications. These tests can be performed with less time and equipment than the full Performance Tests.

4-3. CALIBRATION CYCLE

This instrument requires periodic verification of performance to ensure that it is operating within specified tolerances. The performance tests described 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 5, Adjustments. Annual and biannual cleaning procedures are detailed in Section 8, Service.

4-4. PERFORMANCE TEST RECORD

Results of the performance tests may be tabulated in Table 4-4, 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 sweep time 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 required to complete the test setups illustrated in this section.

ABBREVIATED PERFORMANCE TESTS

4-7. ABBREVIATED PERFORMANCE TESTS

TURN-ON CHECKS

Procedure

1. Set the LINE switch to ON.
2. Ensure that the message key indicator is not flashing. If the message key indicator is flashing, refer to the pull-out card for a list of message codes.
3. Press RCL 0. Verify that the instrument is now preset to the following conditions:

   RF OUTPUT to ON
   ALC to INTERNAL
   OUTPUT LEVEL RANGE to −70 dB (0 dB for Option 001 or 005)
   AUTO PEAK to ON
   MTR 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 mode to OFF
   STEP to 100 Steps (20.000 MHz)
   DWELL to 20 ms
   TUNE Knob to ON
   All Status Annunciators off
   MESSAGE key indicator off

ABBREVIATED PERFORMANCE TESTS

FREQUENCY RANGE AND RESOLUTION TEST

Description This test checks the tuning resolution and phase lock capabilities of the baseband (2.0 to 6.6 GHz) frequency generation circuitry using a frequency counter.

Equipment Frequency Counter .... HP 5343A

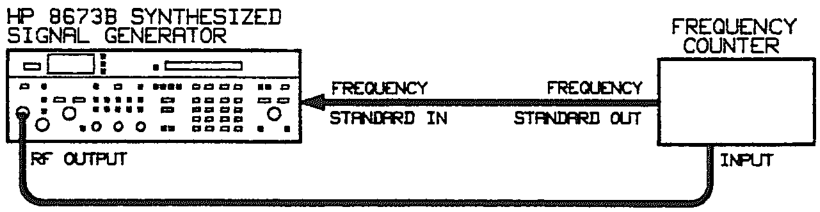

Figure 4-1. Frequency Range and Resolution Test Setup

Procedure

1. Connect the equipment as shown in Figure 4-1. Set the Signal Generator rear panel FREQ STANDARD INT/EXT switch to EXT. Remove the FREQ STANDARD jumper and connect A3J10 to the 10 MHz frequency standard output of the frequency counter. With the Signal Generator and the frequency counter sharing a common timebase, the frequency counter should agree with the Signal Generator FREQUENCY MHz display ±1 count with any selected frequency counter resolution.

2. Select 1 kHz display resolution on the frequency counter.

3. Press RCL 0 on the Signal Generator. Tune the Signal Generator to 2000 MHz at an output level of 0 dBm.

4. Verify that the frequency counter reads 2000.000 MHz ±1 count (due to the accuracy of the frequency counter).

   1999.999 MHz ______ 2000.001 MHz

5. Tune the Signal Generator to each of the frequencies listed in the following table. Verify that the ϕ UNLOCKED annunciator remains off at each frequency and that the frequency counter agrees with the Signal Generator FREQUENCY MHz display ±1 count. Record the readings.

NOTE

Fast tuning of the frequency may cause the ϕ UNLOCKED annunciator to flash on momentarily. This is normal and does not indicate a malfunction.

ABBREVIATED PERFORMANCE TESTS

FREQUENCY RANGE AND RESOLUTION TEST (cont'd)

Procedure (cont'd)

Frequency (MHz)	Minimum Frequency (MHz)	Actual Frequency (MHz)	Maximum Frequency (MHz)
2 090.000	2 089.999	________	2 090.001
2 280.001	2 280.000	________	2 280.002
2 471.112	2 471.111	________	2 471.113
2 662.223	2 662.222	________	2 662.224
2 853.334	2 853.333	________	2 853.335
3 044.445	3 044.444	________	3 044.446
3 235.556	3 235.555	________	3 235.557
3 426.667	3 426.666	________	3 426.668
3 617.778	3 617.777	________	3 617.779
3 808.889	3 808.888	________	3 808.890
3 999.999	3 999.998	________	4 000.000
4 180.000	4 179.999	________	4 180.001
4 370.000	4 369.999	________	4 370.001
4 560.000	4 559.999	________	4 560.001
4 750.000	4 749.999	________	4 750.001
4 940.000	4 939.999	________	4 940.001
5 130.000	5 129.999	________	5 130.001
5 320.000	5 319.999	________	5 320.001
5 510.000	5 509.999	________	5 510.001
5 700.000	5 699.999	________	5 700.001
5 900.000	5 899.999	________	5 900.001
6 100.000	6 099.999	________	6 100.001
6 600.000	5 999.999	________	6 600.001

ABBREVIATED PERFORMANCE TESTS

OUTPUT LEVEL AND FLATNESS TESTS

Description

This test checks output level (maximum leveled power) and output level flatness. The output level test uses a power meter to verify that the specified maximum leveled output power can be generated over the full frequency range. Level flatness measures the variation in output power level as the frequency is changed.

Equipment

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

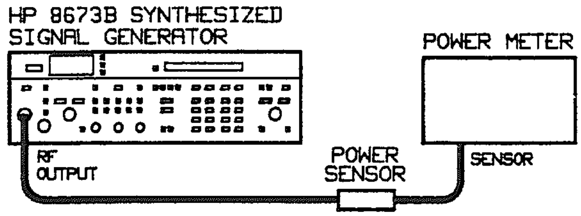

Figure 4-2. Output Level and Flatness Test Setup

Procedure

Output Level Test

1. Connect the equipment as shown in Figure 4-2.
2. Zero and calibrate the power meter.
3. Tune the Signal Generator frequency to 2000.00 MHz.
4. Set the OUTPUT LEVEL RANGE to +10 dB.
5. For a standard Signal Generator, adjust the VERNIER for a power meter reading of +8 dBm or, for a Signal Generator with an option, for one of the following power levels:

   Option 001 .... +10 dBm
   Option 004 ....+7 dBm
   Option 005 ....+9 dBm
   Option 008 ....+8 dBm

6. Activate the AUTO PEAK key. (The AUTO PEAK key indicator should be lighted.)
7. Tune the Signal Generator in 100 MHz steps from 2.0 GHz to 18.0 GHz while observing the power meter reading. Record the frequency at which minimum power occurs.

   Frequency ________

8. Tune the Signal Generator to the recorded frequency. Re-adjust the VERNIER for the same power meter reading used in Step 5.

ABBREVIATED PERFORMANCE TESTS

OUTPUT LEVEL AND FLATNESS TESTS (cont'd)

Procedure (cont'd)

9. Re-tune the Signal Generator from 2.0 GHz to 18.0 GHz in 100 MHz steps while observing the power meter readings. Ensure that the specified maximum leveled output power level is met.

10. For a standard Signal Generator, adjust the VERNIER for a power meter reading of +4 dBm or, for a Signal Generator with an option, for one of the following power levels:

    Option 001 ....+6 dBm
    Option 004 ....+2 dBm
    Option 005 ....+4 dBm
    Option 008 ....+7 dBm

11. Verify that the AUTO PEAK key indicator is lighted.

12. Tune the Signal Generator in 100 MHz steps from 18.0 GHz to 22.0 GHz while observing the power meter reading. Record the frequency at which minimum power occurs.

    Frequency ________

13. Tune the Signal Generator to the recorded frequency. Re-adjust the VERNIER for the same power meter reading used in step 10.

14. Re-tune the Signal Generator from 18.0 GHz to 22.0 GHz in 100 MHz steps while observing the power meter readings. Ensure that the specified maximum leveled output power level is met.

15. For a standard Signal Generator, adjust the VERNIER for a power meter reading of 0 dBm or, for a Signal Generator with an option, for one of the following power levels:

    Option 001 ....+3 dBm
    Option 004 ....−2 dBm
    Option 005 ....+1 dBm
    Option 008 ....+7 dBm

16. Verify that the AUTO PEAK key indicator is lighted.

17. Tune the Signal Generator in 100 MHz steps from 22.0 GHz to 26.0 GHz while observing the power meter reading. Record the frequency at which minimum power occurs.

    Frequency ________

18. Tune the Signal Generator to the recorded frequency. Re-adjust the VERNIER for the same power meter reading used in step 15.

19. Re-tune the Signal Generator from 22.0 GHz to 26.0 GHz in 100 MHz steps while observing the power meter readings. Ensure that the specified maximum leveled output power level is met.

ABBREVIATED PERFORMANCE TESTS

OUTPUT LEVEL AND FLATNESS TESTS (cont'd)

Procedure (cont'd)

Level Flatness Test

NOTE

The flatness specification for power output is not referenced to a particular frequency. The specification represents the total power variation over the entire frequency range.

20. Tune the Signal Generator to 2.0 GHz. Set the OUTPUT LEVEL RANGE to 0 dB. Set the VERNIER for a power meter reading of −5 dBm.

21. Set the power meter mode to dB Relative.

22. Tune the Signal Generator from 2.0 GHz to 6.6 GHz in 100 MHz steps while observing the power meter readings. Record the minimum and maximum output power levels in the following table. Maximum power variation must be within 1.5 dB (highest point to lowest point).

23. Continue tuning the Signal Generator to 12.3 GHz in 100 MHz steps while observing the power meter readings. Maximum power variation must be within 2.0 dB. Record the minimum and maximum output power levels in the following table.

24. Continue tuning the Signal Generator to 18.6 GHz in 100 MHz steps while observing the power meter readings. Maximum power variation must be within 2.5 dB. Record the minimum and maximum output power levels in the following table.

25. Continue tuning the Signal Generator to 26.0 GHz in 100 MHz steps while observing the power meter readings. Maximum power variation must be within 3.5 dB. Record the minimum and maximum output power levels in the following table.

Frequency Range	Power Variation
2.0 — 6.6 GHz	Maximum ________ Minimum ________ Total Variation ________ 1.50 dB
2.0 — 12.3 GHz	Maximum ________ Minimum ________ Total Variation ________ 2.00 dB
2.0 — 18.6 GHz	Maximum ________ Minimum ________ Total Variation ________ 2.5 dB
2.0 — 26.0 GHz	Maximum ________ Minimum ________ Total Variation ________ 3.5 dB

ABBREVIATED PERFORMANCE TESTS

LEVEL ACCURACY TESTS

Description

This test checks level accuracy of the RF output signal. The first test uses a power meter to verify that power levels between 0 dBm and −20 dBm are within specification. Power levels of −30 dBm and below are checked using a spectrum analyzer. The output level of the Signal Generator is adjusted to −20 dBm using the power meter. The Signal Generator output is then mixed with a local oscillator to produce an IF frequency. The IF frequency is displayed on the spectrum analyzer. A reference level corresponding to the −20 dBm output is set on the spectrum analyzer and each 10 dB decrease in range is checked for a 10 dB decrease on the spectrum analyzer display.

Equipment

Power Meter .... HP 436A
Power Sensor .... HP 8485A
Local Oscillator .... HP 8340A
Mixer .... RHG DMS1-26
Spectrum Analyzer .... HP 8566B
40 dB Amplifier .... HP 8447F
20 dB Attenuator .... HP 8493C Option 020

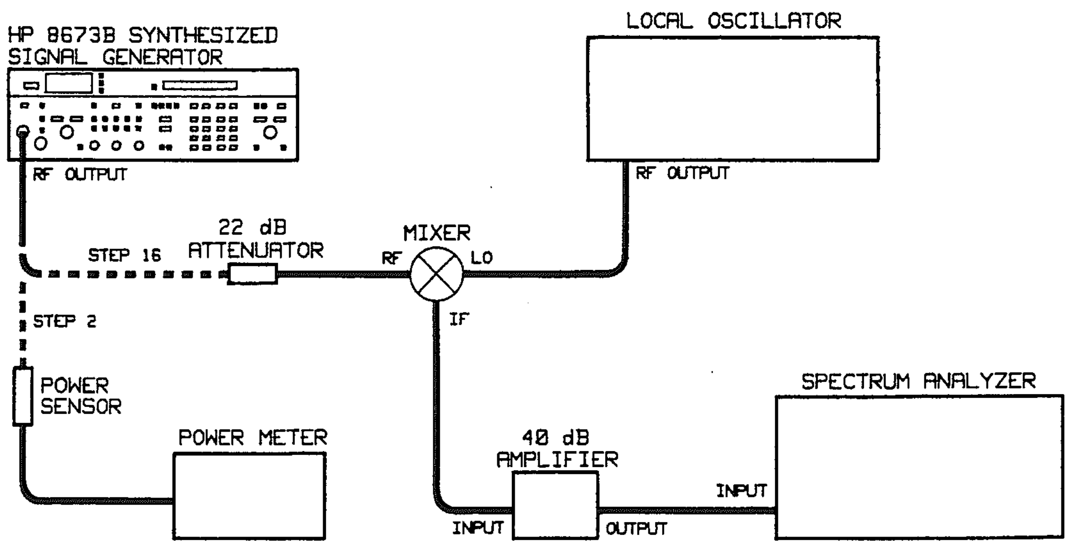

Figure 4-3. Level Accuracy Test Setup

Procedure

High Level Accuracy Test

1. Zero and calibrate the power meter. Set the power meter to dBm mode.
2. Connect the Signal Generator to the power meter as shown in Figure 4-3.
3. Tune the Signal Generator to 2.0 GHz.
4. Set the OUTPUT LEVEL RANGE to 0 dB. Adjust the VERNIER for a front panel meter reading of 0 dBm.
5. Peak the Signal Generator output with the AUTO PEAK key.

ABBREVIATED PERFORMANCE TESTS

LEVEL ACCURACY TESTS (cont'd)

Procedure (cont'd)

High Level Accuracy Test (cont'd)

6. Observe the power meter reading. The reading should be within the limits specified. Record the reading.

   (2.0 GHz, 0 dBm) −1.75 dBm ________ +1.75 dBm

7. Adjust the Signal Generator's VERNIER for a front panel meter reading of −10 dBm (leave RANGE set to 0 dB).

8. Observe the power meter reading. The reading should be within the limits specified. Record the reading.

   (2.0 GHz, −10 dBm) −11.75 dBm ________ −8.25 dBm

9. Tune the Signal Generator to 18.6 GHz.

10. Adjust the VERNIER for a front panel meter reading of 0 dBm.

11. Observe the power meter reading. The reading should be within the specified limits. Record the reading.

    (18.6 GHz, 0 dBm) −2.25 dBm ________ +2.25 dBm

12. Adjust the Signal Generator's RANGE to −10 dB.

13. Observe the power meter reading. The reading should be within the limits specified. Record the reading.

    (18.6 GHz, −10 dBm) −12.85 dBm ________ −7.15 dBm

14. Adjust the RANGE to −20 dB.

15. Observe the power meter reading. The reading should be within the limits specified. Record the reading.

    (18.6 GHz, −20 dBm) −23.05 dBm ________ −16.95 dBm

Low Level Accuracy Test

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

    NOTE

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

17. Tune the local oscillator to 18.7 GHz. Set the output power to +7 dBm.

18. Set the resolution bandwidth on the spectrum analyzer to 300 Hz or less. Adjust the vertical sensitivity to place the peak of the 100 kHz IF signal on the center horizontal graticule line. This calibrates the center graticule line for an absolute reference power level of −20 dBm.

ABBREVIATED PERFORMANCE TESTS

LEVEL ACCURACY TESTS (cont'd)

Procedure (cont'd)

Low Level Accuracy Test (cont'd)

19. Set the RANGE of the Signal Generator 10 dB lower and adjust the VERNIER for a front panel meter reading of 0 dBm.

20. Set the spectrum analyzer reference level 10 dB lower to bring the signal level near the reference graticule line.

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

NOTE

The difference is positive if the signal is above the reference graticule; negative if below.

__________ Output level set in step 18.

\+ __________ Difference measured in step 21.

__________ Actual level.

Record the actual level calculated in the following table. The level reading should be within the limits specified.

22. Repeat steps 19 through 21 with Signal Generator RANGE settings of −40 dB and −50 dB in step 19. Record the output level readings in the following table.

23. Note the Signal Generator's signal level (at −50 dBm) on the spectrum analyzer display. Remove the 20 dB attenuator, set the spectrum analyzer's IF sensitivity 20 dB higher, and reset the vertical sensitivity to the level noted before removing the 20 dB attenuator.

24. Repeat steps 19 through 21 with Signal Generator RANGE settings of −60 dB through −90 dB. Record the output level readings in the following table.

Test	Results		
	Min	Actual	Max
18.6 GHz			
−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

ABBREVIATED PERFORMANCE TESTS

PULSE MODULATION TEST

Description

On-off ratio is measured at 6.7 GHz with a spectrum analyzer. A local oscillator and mixer is used with an oscilloscope to measure peak level accuracy at 6.7 GHz, and to measure rise time, overshoot and ringing at 6.7, 12, 18 and 19.0 GHz. The IF frequency used is 50 MHz.

Equipment

Spectrum Analyzer	HP 8566B
Pulse Generator	HP 8116A
Oscilloscope	HP 1980B
Local Oscillator	HP 8340A
Preamplifier, 20 dB	HP 8447D
Power Amplifier, 20 dB	HP 8447E
Mixer	RHG DMS1-26
Attenuator, 10 dB (2)	HP 8491A Option 010
Attenuator, 10 dB	HP 8493C Option 010

Procedure

On/Off Ratio at 6.7 GHz

1. Connect equipment as shown in Figure 4-4.
2. Press RCL 0 on the Signal Generator.
3. Set the Signal Generator frequency to 6.7 GHz, RANGE and VERNIER to 0 dBm, PULSE to OFF.
4. Adjust the spectrum analyzer to display the 6.7 GHz CW signal so that the peak of the signal is at the top of the display. The resolution bandwidth should be set for 300 Hz or less, and the span to 20 kHz or less, to reduce broadband noise.

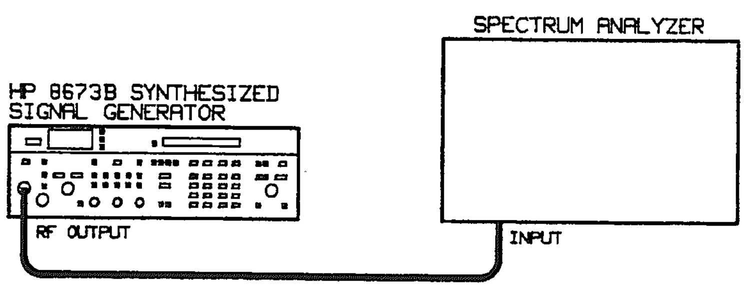

Figure 4-4. On/Off Ratio Test Setup

ABBREVIATED PERFORMANCE TESTS

PULSE MODULATION TEST (cont'd)

Procedure (cont'd)

5. Press the PULSE NORM switch. The signal level should be at least 80 dB below the reference established in PULSE OFF mode.

On/Off Ratio −6.7 GHz ________ >80 dBc

Rise Time, Overshoot and Ringing at 6.7,12,18, and 19 GHz

6. Connect equipment as shown in Figure 4-5.
7. Set Channels 1 and 2 of the oscilloscope to 50 ohm input impedance.
8. Set the pulse generator to 1 MHz PRF, 200 ns width, and 2V peak output level.
9. Set the local oscillator to 6.75 GHz and output level to +7 dBm.
10. Set the Signal Generator to 6.7 GHz. Set RANGE to 0 dBm and the VERNIER to −10 dBm. This will result in a 50 MHz IF pulse modulated signal displayed on the oscilloscope.

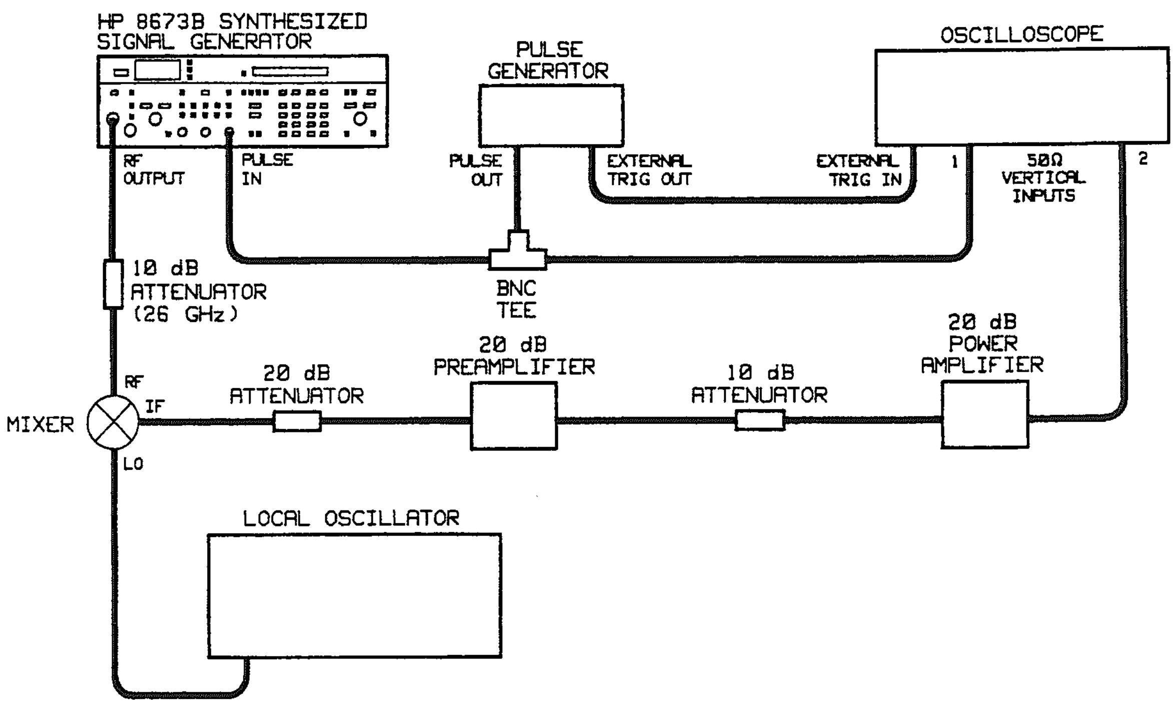

Figure 4-5. Rise Time, Overshoot and Ringing Test Setup

ABBREVIATED PERFORMANCE TESTS

PULSE MODULATION TEST (cont'd)

Procedure (cont'd)

11. Center the 50 MHz waveform on the oscilloscope display. Adjust the oscilloscope vertical position and sensitivity controls so that the pulse base line is one division from the bottom graticule line, and the waveform is 5 divisions in peak amplitude. See Figure 4-6.

12. Measure the pulse rise time, overshoot and ringing. Record the results in the following table.

Signal Generator Frequency	Local Oscillator Frequency	Rise Time	Overshoot and Ringing	Peak Level Accuracy
6.7 GHz	6.75 GHz	___ 35 ns ___ 40 ns (Opt. 008)	___ 30%	−10.8 ________ +18.8%
12 GHz	12.05 GHz	___ 35 ns ___ 40 ns (Opt. 008)	___ 25%	
18 GHz	18.05 GHz	___ 35 ns ___ 40 ns (Opt. 008)	___ 25%	
19 GHz	19.05 GHz	___ 35 ns ___ 40 ns (Opt. 008)	___ 25%	

13. Repeat measurements for rise time and overshoot at 12, 18, and 19 GHz, keeping the local oscillator frequency 50 MHz above the Signal Generator frequency.

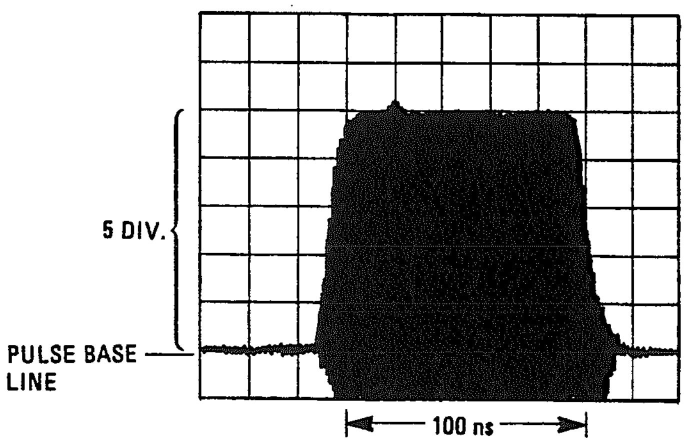

Figure 4-6. Risetime, Overshoot and Ringing Measurement

ABBREVIATED PERFORMANCE TESTS

PULSE MODULATION TEST (cont'd)

Procedure (cont'd)

Peak Level Accuracy at 6.7 GHz

14. Tune the Signal Generator to 6.7 GHz and the local oscillator to 6.75 GHz.

15. Adjust the pulse width on the pulse generator for a 100 ns RF pulse as displayed on the oscilloscope.

16. Switch the Signal Generator to PULSE OFF mode.

17. 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 adjust the vertical position controls after the CW peak reference level and pulse base line have been set.

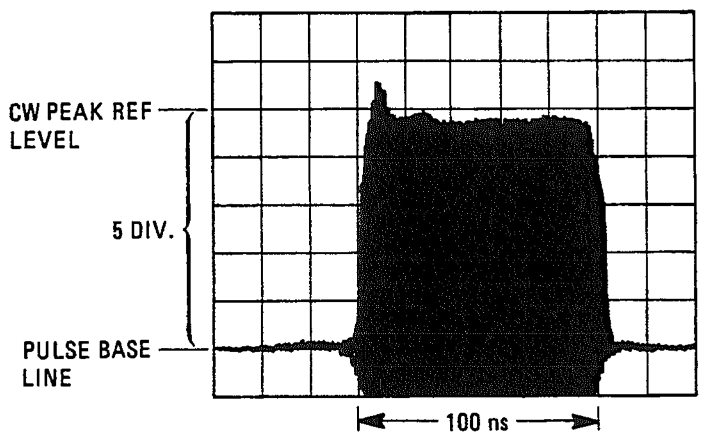

Figure 4-7. Pulse Peak Level Accuracy Measurement

18. Switch back to PULSE NORM. The display should be as shown in Figure 4-7. Measure the difference between the CW peak reference level and the average peak pulse level excluding any over/undershoot. Record the peak level accuracy below.

NOTE

The error can be read in percent. Using 5 divisions for the CW peak reference, each division represents 20% error. Measured error must be within the limits of −10.8% (−0.5 division) and +18.8% (+0.9 division) on the oscilloscope display. This is equal to +1.5/−1.0 dB peak level accuracy.

Peak Level Accuracy −6.7 GHz −10.8%__________ +18.8%

ABBREVIATED PERFORMANCE TESTS

AM ACCURACY TESTS

Description

The Signal Generator is amplitude modulated by an audio source. The modulated signal is mixed with a local oscillator to produce a modulated 100 MHz IF signal. The AM depth, meter accuracy, and accuracy relative to the external AM input are measured using a measuring receiver.

Equipment

Local Oscillator .... HP 8340A
Measuring Receiver .... HP 8902A
Audio Analyzer/Source .... HP 8903B
Digital Voltmeter .... HP 3456A
6 dB Attenuator ....HP 8493C Option 006
Mixer .... RHG DMS1-26

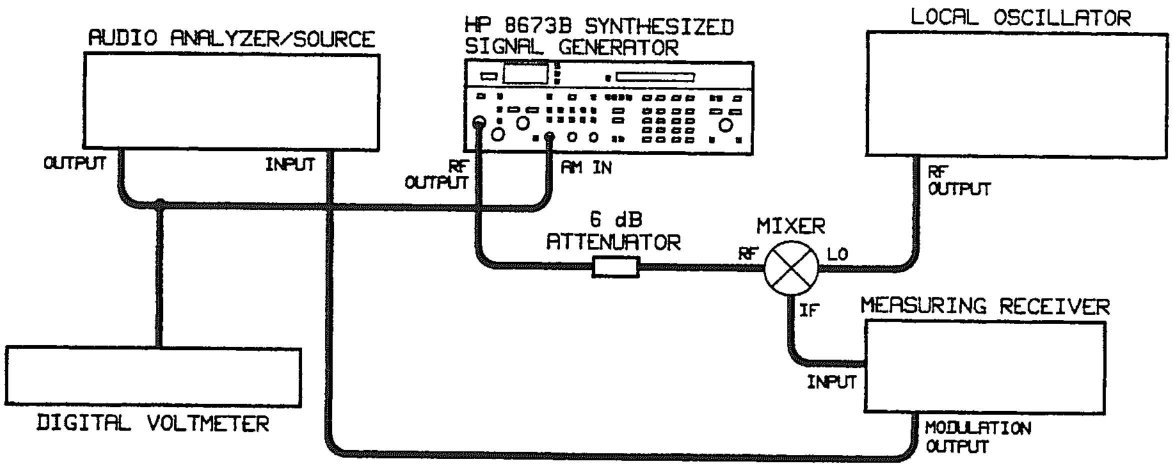

Figure 4-8. AM Accuracy Test Setup

Procedure

Meter Accuracy

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

2. Set the Signal Generator as follows:

   FREQUENCY ....2.0 GHz
   OUTPUT LEVEL RANGE ....0 dB
   OUTPUT LEVEL VERNIER ....0 dBm
   ALC ....INT
   AM ....100% range
   FM ....Off
   PULSE ....Off

3. Tune the local oscillator to 2.05 GHz with an output amplitude of +7 dBm and all modulation off.

4. Select AM mode on the measuring receiver. Set the measurement frequency of the measuring receiver to 50 MHz.

ABBREVIATED PERFORMANCE TESTS

AM ACCURACY TESTS (cont'd)

Procedure (cont'd)

5. Set the modulation source to 1 kHz. Adjust the output level to obtain 50% AM as read on the measuring receiver.

6. The AM meter on the Signal Generator should indicate 50% AM ±6.5%. Record the reading.

43.5% ________ 56.5%

Accuracy Relative to External AM Input

7. Set the audio source frequency to 10 kHz with an output amplitude of 0.530 Vrms as read on the digital voltmeter. This corresponds to 75% AM depth.

8. Read the actual AM depth on the measuring receiver. The reading should be within ±5.0% of 75% AM. Record the reading in the table below.

9. Repeat steps 7 and 8 with the frequencies and modulation rates listed in the table below.

Signal Generator Frequency	Local Oscillator Frequency	Modulation Rate	Low Limit	Actual Depth	High Limit
6.6 GHz	6.5 GHz	10 kHz	70.0%	________	80.0%
6.6 GHz	6.5 GHz	1 kHz	70.0%	________	80.0%
6.6 GHz	6.5 GHz	.1 kHz	70.0%	________	80.0%
10 GHz	9.9 GHz	10 kHz	70.0%	________	80.0%
14 GHz	13.9 GHz	10 kHz	70.0%	________	80.0%
18.6 GHz	18.5 GHz	10 kHz	70.0%	________	80.0%
22 GHz	21.9 GHz	10 kHz	70.0%	________	80.0%

ABBREVIATED PERFORMANCE TESTS

EXTERNAL FM ACCURACY AND METER ACCURACY

Description

The Signal Generator is frequency modulated by an external source. The output of the Signal Generator is then mixed with a local oscillator to produce a modulated 500 MHz IF signal. A measuring receiver measures the FM characteristics of the IF signal.

Equipment

Local Oscillator .... HP 8340A
Measuring Receiver .... HP 8902A
Test Oscillator .... HP 8116A
Digital Voltmeter .... HP 3456A
Frequency Counter .... HP 5343A
Mixer .... RHG DMS1-26

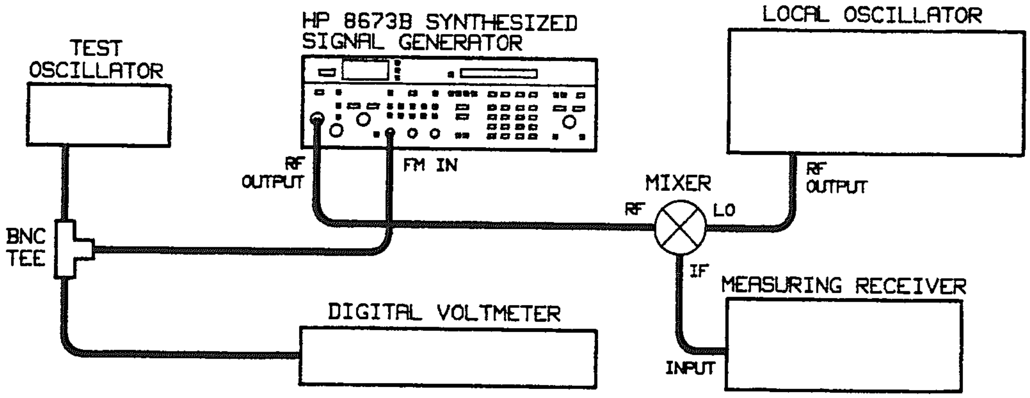

Figure 4-9. External FM Accuracy and Meter Accuracy Test Setup

Procedure

Sensitivity and Meter Accuracy

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

NOTE

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

2. Set the Signal Generator as follows:

   FREQUENCY ....2 GHz
   OUTPUT LEVEL RANGE ....0 dB
   OUTPUT LEVEL VERNIER ....−5 dBm
   FM DEVIATION range ....0.3 MHz
   Meter Scale ....FM

3. Tune the local oscillator to 2.5 GHz with an output amplitude of +8 dBm.

4. Set the measuring receiver to measure FM.

5. Set the test oscillator to a 100 kHz rate. Adjust the test oscillator output level to obtain a full scale reading on the Signal Generator's front panel meter.

6. The measuring receiver should read 300 kHz ±45 kHz deviation. Record the reading.

255 kHz ________ 345 kHz

ABBREVIATED PERFORMANCE TESTS

EXTERNAL FM ACCURACY AND METER ACCURACY (cont'd)

Procedure (cont'd)

7. Adjust the test oscillator level to obtain 50 kHz deviation as read on the Signal Generator's front panel meter.

8. The measuring receiver should read 50 kHz ±15 kHz deviation. Record the reading.

35 kHz ________ 65 kHz

Accuracy Relative to External FM Input

9. Tune the test oscillator to 100 kHz with an output amplitude of 0.707 Vrms as read on the digital voltmeter.

10. Set the Signal Generator FM DEVIATION range to 0.03 MHz. The measuring receiver should indicate FM deviation within the limits listed in the table below. Record the reading in the table.

11. Repeat step 10 using the FM deviation ranges and test oscillator levels listed in the table below. Record the readings in the table.

FM Deviation Range	Test Oscillator Level	Low Limit	Actual Deviation	High Limit
0.03 MHz	0.707 Vrms	27 kHz	________	33 kHz
0.1 MHz	0.707 Vrms	90 kHz	________	110 kHz
0.3 MHz	0.707 Vrms	270 kHz	________	330 kHz
1 MHz	0.212 Vrms	249 kHz	________	351 kHz

12. Tune the Signal Generator to 6.7 GHz. Set the FM DEVIATION range to 0.3 MHz.

13. Tune the local oscillator to 7.2 GHz.

14. Set the test oscillator's output level to .707 Vrms as read on the digital voltmeter.

15. Read the FM deviation on the measuring receiver. Verify that the measured deviation is within the limits shown in the table below. Record the readings.

16. Repeat steps 12 through 15 using the Signal Generator frequencies listed in the table below. Record the readings.

Signal Generator Frequency	Local Oscillator Frequency	Low Limit	Actual Deviation	High Limit
6.7 GHz	7.2 GHz	270 kHz	________	330 kHz
12.3 GHz	12.9 GHz	270 kHz	________	330 kHz
18.6 GHz	19.1 GHz	270 kHz	________	330 kHz

Table 4-1. Abbreviated Performance Test Record (1 of 3)

Test		Results	
	Min.	Actual	Max.
FREQUENCY RANGE AND RESOLUTION			
Baseband Test			
2 000.000 MHz	1 999.999	________	2 000.001
2 090.000 MHz	2 089.999	________	2 090.001
2 280.001 MHz	2 280.000	________	2 280.002
2 471.112 MHz	2 471.111	________	2 471.113
2 662.223 MHz	2 662.222	________	2 662.224
2 853.334 MHz	2 853.333	________	2 853.335
3 044.445 MHz	2 044.444	________	3 044.446
3 235.556 MHz	3 235.555	________	3 235.557
3 426.667 MHz	3 426.666	________	3 426.668
3 617.778 MHz	3 617.777	________	3 617.776
3 808.889 MHz	3 808.888	________	3 808.890
3 999.999 MHz	3 999.998	________	4 000.000
4 180.000 MHz	4 179.999	________	4 180.001
4 370.000 MHz	4 369.999	________	4 370.001
4 560.000 MHz	4 559.999	________	4 560.001
4 750.000 MHz	4 749.999	________	4 750.001
4 940.000 MHz	4 939.999	________	4 940.001
5 130.000 MHz	5 129.999	________	5 130.001
5 320.000 MHz	5 319.999	________	5 320.001
5 510.000 MHz	5 509.999	________	5 510.001
5 700.000 MHz	5 699.999	________	5 700.001
5 900.000 MHz	5 899.999	________	5 900.001
6 100.000 MHz	6 099.999	________	6 100.001
6 600.000 MHz	5 999.999	________	6 600.001
OUTPUT LEVEL AND FLATNESS			
Output Level			
Frequency and Power at Minimum Power Point			
2.0—18.0 GHz			
Frequency ________			
Minimum Power: Standard	+8 dBm	________ (√)	
Option 001	+10 dBm	________ (√)	
Option 004	+7 dBm	________ (√)	
Option 005	+9 dBm	________ (√)	
Option 008	+8 dBm	________ (√)	
18.0—22.0 GHz			
Frequency ________			
Minimum Power: Standard	+4 dBm	________ (√)	
Option 001	+6 dBm	________ (√)	
Option 004	+2 dBm	________ (√)	
Option 005	+4 dBm	________ (√)	
Option 008	+7 dBm	________ (√)	

Table 4-1. Abbreviated Performance Test Record (2 of 3)

Test		Results	
	Min.	Actual	Max.
OUTPUT LEVEL AND FLATNESS (cont'd)			
Output Level (cont'd)			
Frequency and Power at Minimum Power Point			
22.0—26.0 GHz			
Frequency ________			
Minimum Power: Standard	0 dBm	________ (√)	
Option 001	3 dBm	________ (√)	
Option 004	−2 dBm	________ (√)	
Option 005	+1 dBm	________ (√)	
Option 008	+7 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
LEVEL ACCURACY			
High Level Accuracy			
2.0 GHz, 0 dBm	−1.75 dBm	________	+1.75 dBm
2.0 GHz, −10 dBm	−11.75 dBm	________	−8.25 dBm
18.6 GHz, 0 dBm	−2.25 dBm	________	+2.25 dBm
18.6 GHz, −10 dBm	−12.85 dBm	________	−7.15 dBm
18.6 GHz, −20 dBm	−23.05 dBm	________	−16.95 dBm
Low Level Accuracy			
18.6 GHz			
−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
PULSE MODULATION			
On/Off Ratio			
6.7 GHz	80 dBc	________	
Rise Time, Overshoot and Ringing			
6.7 GHz Rise Time		________	35 ns
		________	40 ns (Opt. 008)
Overshoot and Ringing		________	30%
12 GHz Rise Time		________	35 ns
		________	40 ns (Opt. 008)
Overshoot and Ringing		________	25%

Table 4-1. Abbreviated Performance Test Record (3 of 3)

Test		Results		
		Min.	Actual	Max.
PULSE MODULATION (cont'd)				
Rise Time, Overshoot and Ringing (cont'd)				
18 GHz	Rise Time		________	35 ns
			________	40 ns (Opt. 008)
	Overshoot and Ringing		________	25%
19 GHz	Rise Time		________	35 ns
			________	40 ns (Opt. 008)
	Overshoot and Ringing		________	25%
Peak Level Accuracy				
6.7 GHz		−10.8%	________	+18.8%
AM ACCURACY				
Meter Accuracy				
1 kHz rate, 50% AM		43.5%	________	56.5%
Accuracy Relative to External AM Input				
Frequency	Rate			
6.6 GHz	10 kHz	70%	________	80%
6.6 GHz	1 kHz	70%	________	80%
6.6 GHz	0.1 kHz	70%	________	80%
10 GHz	10 kHz	70%	________	80%
14 GHz	10 kHz	70%	________	80%
18.6 GHz	10 kHz	70%	________	80%
22.0 GHz	10 kHz	70%	________	80%
EXTERNAL FM ACCURACY AND METER ACCURACY				
Meter Accuracy				
Full Scale		255 kHz	________	345 kHz
50 kHz		35 kHz	________	65 kHz
Accuracy Relative to External FM Input				
0.03 MHz Range		27 kHz	________	33 kHz
0.1 MHz Range		90 kHz	________	110 kHz
0.3 MHz Range		270 kHz	________	330 kHz
1.0 MHz Range		249 kHz	________	351 kHz
0.3 MHz Range Accuracy				
6.7 GHz		270 kHz	________	330 kHz
12.3 GHz		270 kHz	________	330 kHz
18.6 GHz		270 kHz	________	330 kHz

PERFORMANCE TESTS

4-8. FREQUENCY RANGE AND RESOLUTION TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY		
Range	2.0 to 6.6 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

Description This test checks the tuning resolution in each of four internal frequency bands using a frequency counter. The performance test is divided into a baseband check (2.0 to 6.6 GHz) and a check for bands 2, 3, and 4 (6.6 to 12.3 GHz, 12.3 to 18.6 GHz and 18.6 to 26.0 GHz respectively).

Equipment Frequency Counter .... HP 5343A

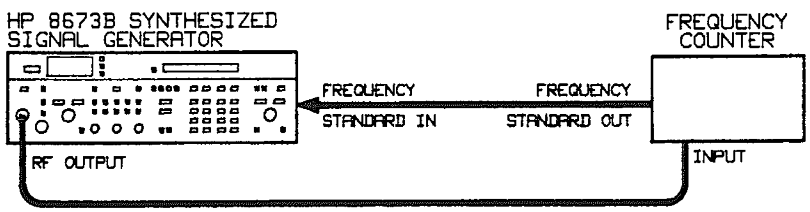

Figure 4-10. Frequency Range and Resolution Test Setup

Procedure

Baseband Test

1. Connect the equipment as shown in Figure 4-10. Set the Signal Generator rear panel FREQ STANDARD INT/EXT switch to EXT. Remove the FREQ STANDARD jumper and connect A3J10 to the 10 MHz frequency standard output of the frequency counter. With the Signal Generator and the frequency counter sharing a common timebase, the frequency counter should agree with the Signal Generator FREQUENCY MHz display ± 1 count with any selected frequency counter resolution.

2. Select 1 kHz display resolution on the frequency counter.

3. Press RCL 0 on the Signal Generator. Set the Signal Generator to 2000.000 MHz at an output level of 0 dBm.

4. Verify that the frequency counter reads 2 000.000 MHz ± 1 count (due to the accuracy of the frequency counter).

   1 999.999 MHz ________ 2 000.001 MHz

PERFORMANCE TESTS

FREQUENCY RANGE AND RESOLUTION TEST (cont'd)

Procedure (cont'd)

5. Set the Signal Generator frequency increment to 1 kHz. Using the TUNE knob, tune the Signal Generator to each of the frequencies listed below. Verify that the ϕ UNLOCKED annunciator remains off at each frequency and that the frequency counter agrees with the Signal Generator FREQUENCY MHz display ± 1 count.

Frequency (MHz)	Minimum Frequency (MHz)	Actual Frequency (MHz)	Maximum Frequency (MHz)
2 000.001	2 000.000	________	2 000.002
2 001.112	2 001.111	________	2 001.113
2 002.223	2 002.222	________	2 002.224
2 003.334	2 003.333	________	2 003.335
2 004.445	2 004.444	________	2 004.446
2 005.556	2 005.555	________	2 005.557
2 006.667	2 006.666	________	2 006.668
2 007.778	2 007.777	________	2 007.779
2 008.889	2 008.888	________	2 008.890
2 009.999	2 009.998	________	2 010.000

6. Set the Signal Generator frequency increment to 10.000 MHz. Using the TUNE knob, tune the Signal Generator to each of the frequencies listed below. Verify that the ϕ UNLOCKED annunciator remains off at each frequency and that the frequency counter agrees with the Signal Generator FREQUENCY MHz display ± 1 count.

Frequency (MHz)	Minimum Frequency (MHz)	Actual Frequency (MHz)	Maximum Frequency (MHz)
2 090.000	2 089.999	________	2 090.001
2 280.000	2 279.999	________	2 280.001
2 470.000	2 469.999	________	2 470.001
2 660.000	2 659.999	________	2 660.001
2 850.000	2 849.999	________	2 850.001
3 040.000	3 039.999	________	3 040.001
3 230.000	3 229.999	________	3 230.001
3 420.000	3 419.999	________	3 420.001
3 610.000	3 609.999	________	3 610.001
3 800.000	3 799.999	________	3 800.001
3 990.000	3 989.999	________	3 990.001
4 180.000	4 179.999	________	4 180.001
4 370.000	4 369.999	________	4 370.001
4 560.000	4 559.999	________	4 560.001
4 750.000	4 749.999	________	4 750.001
4 940.000	4 939.999	________	4 940.001
5 130.000	5 129.999	________	5 130.001
5 320.000	5 319.999	________	5 320.001
5 510.000	5 509.999	________	5 510.001
5 700.000	5 699.999	________	5 700.001
5 900.000	5 899.999	________	5 900.001
6 100.000	6 099.999	________	6 100.001
6 600.000	5 999.999	________	6 600.001

PERFORMANCE TESTS

FREQUENCY RANGE AND RESOLUTION TEST (cont'd)

Procedure (cont'd)

NOTE

Fast tuning of frequency may cause the ϕ UNLOCKED annunciator to flash on momentarily. This is normal and does not indicate a malfunction.

Bands 2 and 3 Test

7. Tune the Signal Generator to 10 000.000 MHz and set the frequency increment (FREQ INCR) to 1 kHz.

8. Tune the frequency down one increment and verify that the Signal Generator frequency display changes to 9 999.998 MHz and the frequency counter reading agrees within ± 1 count.

9. Tune the frequency up two increments and verify that the Signal Generator frequency display changes to 10 000.002 MHz. Verify also that the frequency counter reading agrees within ± 1 count.

10 GHz frequency resolution, 2 kHz ________(√)

10. Tune the Signal Generator to 18 599.997 MHz and set the frequency increment (FREQ INCR) to 1 kHz.

11. Tune the frequency down one increment and verify that the Signal Generator frequency display indicates 18 599.994 MHz and the frequency counter reading agrees within ± 1 count.

12. Tune the frequency up two increments and verify that the Signal Generator frequency display changes to 18 600.000 MHz. Verify also that the frequency counter reading agrees within ± 1 count.

18.599 995 GHz frequency resolution, 3 kHz ________(√)

Band 4 Test

13. Tune the Signal Generator to 25 999.996 MHz and set the frequency increment (FREQ INCR) to 1 kHz.

14. Tune the frequency down one increment and verify that the Signal Generator frequency display indicates 25 999.992 MHz and the frequency counter reading agrees within ± 1 count.

15. Tune the frequency up two increments and verify that the Signal Generator frequency display changes to 26 000.000 MHz. Verify also that the frequency counter reading agrees within ± 1 count.

25.999 996 GHz frequency resolution, 4 kHz ________(√)

16. Disconnect the frequency counter and replace the FREQ STANDARD jumper between A3J9 and A3J10. Set the FREQ STANDARD INT/EXT switch to INT.

PERFORMANCE TESTS

4-9. INTERNAL TIME BASE AGING RATE

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY Reference Oscillator Frequency	10 MHz	After warmup (typically 24 hours in a normal operating environment)
Aging Rate	$< 5 \times 10^{-10}$/day	
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}/day) 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

Oscilloscope .... HP 1980B
Frequency Standard .... HP 5065A

NOTE

The internal 10 MHz reference oscillator will typically take 24 to 48 hours to reach its specified rate after instrument storage or shipment. In some cases, if extreme environmental conditions were encountered during storage, the reference oscillator could take as long as one week to achieve its specified aging rate.

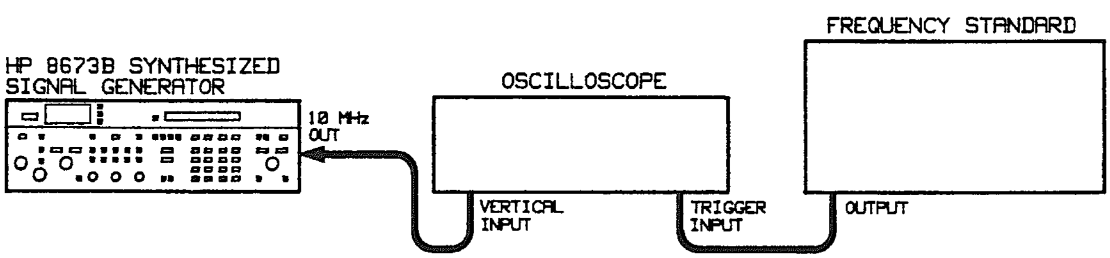

Figure 4-11. Internal Time Base Aging Rate Test Setup

Procedure

1. Connect the equipment as shown in Figure 4-11.

NOTE

This test requires a waiting period of 3 to 24 hours between initial and final measurements.

PERFORMANCE TESTS

INTERNAL TIME BASE AGING RATE (cont'd)

Procedure (cont'd)

2. Set the rear panel FREQ REFERENCE INT/EXT switch to the INT position.

3. Adjust the oscilloscope controls for a stable display of the 10 MHz Signal Generator reference output.

4. Measure the time required for a phase change of 360° (one cycle). 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 for a 360° (1 cycle) change
T_2 = time between measurements
T_3 = final time measurement for a 360° (1 cycle) change

for example:

if T_1 = 351s
T_2 = 3h
T_3 = 349s

then:

$$\text{Aging Rate} = \left| \left(\frac{1\ \text{cycle}}{10\ \text{MHz}}\right)\left(\frac{1}{351\text{s}} - \frac{1}{349\text{s}}\right)\left(\frac{24\text{h}}{3\text{h}}\right) \right|$$

$$= 1.306 \times 10^{-11}/\text{day}$$

7. Verify that the aging rate is less than 5×10^{-10}/day.

NOTE

If the absolute frequencies of the frequency standard and the Signal Generator's reference oscillator are extremely close, the measurement time in steps 4 and 5 (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 (e.g.: 180° = ÷-cycle, 90° = ¼-cycle).

PERFORMANCE TESTS

4-10. FREQUENCY SWITCHING TIME TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
SWITCHING TIME Frequency to be within the specified resolution and amplitude to be within 3 dB of final level.	< 25 ms (2703A and above) < 20 ms (2640A and below)	CW and AM only; AUTO PEAK disabled.

Description

This test measures the frequency switching speed of the Signal Generator. The Signal Generator output is mixed with a local oscillator whose output frequency is set to the frequency resolution specification above (or below) the destination frequency. The difference frequency (IF) is displayed on the oscilloscope.

Frequency switching speed is measured using a digitizing oscilloscope. The oscilloscope is set to trigger the digitizing process at the beginning of the frequency change. Delayed sweep is used to improve the measurement resolution. As the unit under test is switched from the starting frequency to the destination frequency, the IF signal will pass through zero (when the unit under test frequency is equal to the local oscillator frequency). This will generate a phase reversal. The last phase reversal of the IF frequency is the time that the unit under test is within the specified frequency resolution.

The amplitude recovery time is tested using the same measurement setup. The ±3 dB amplitude points of the IF signal are calibrated on the oscilloscope display and the amplitude recovery time is tested to ensure that the IF level is within ±3 dB of the final level.

NOTE

A storage oscilloscope simplifies these tests because it only needs two sweeps to display the switching time. This is especially important for Option 008 where many sweeps cause undue wear on internal relays. If you perform these tests with a non-storage scope, keep the number of sweeps to a minimum.

Equipment

Local Oscillator .... HP 8340A
Mixer .... RHG DMS1-26
Digitizing Oscilloscope .... HP 1980B/19860A

Procedure

1. Set up the equipment as shown in Figure 4-12. The external trigger input of the oscilloscope is connected to the Signal Generator's rear panel Blanking/Marker output. This signal will trigger the oscilloscope at the start of a frequency change when any sweep mode is selected.

FREQUENCY SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

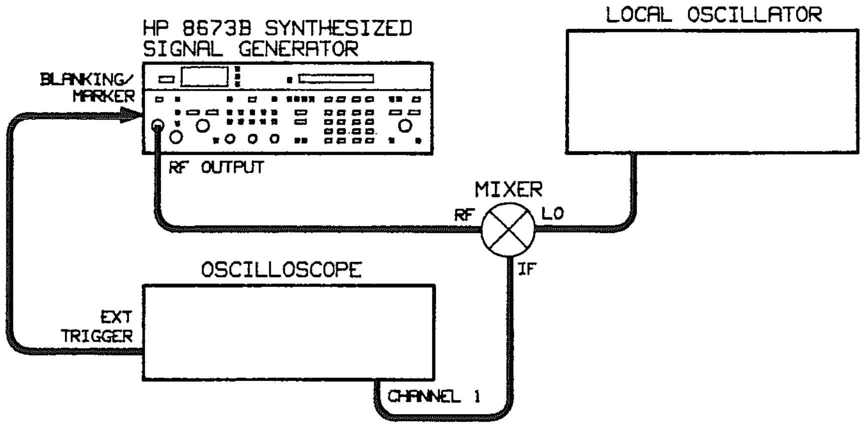

Figure 4-12. Frequency Switching Time Test Setup

2. Set the oscilloscope as follows:

   Channel 1:
   - Vertical Sensitivity to 50 mV/Division
   - Coupling to AC

   Set sweep to delayed

   Main Sweep Parameters:
   - External trigger with DC coupling
   - Positive slope trigger
   - Auto sweep mode

   Set trigger level to E1.00

   Delayed Sweep Parameters:
   - Internal trigger with AC coupling
   - Positive slope trigger
   - Auto sweep mode

   NOTE

   Triggered main sweep must be used to trigger the digitizer at the start of frequency change. If auto trigger mode is selected while digitizing, the oscilloscope will trigger the sweep even without an external trigger signal and the waveform digitized will not be valid for this measurement.

3. Set the oscilloscope's main sweep to 5 ms/per division and delayed sweep to 1 ms/per division. The delayed sweep will be used once the approximate delay required is determined from the main sweep.

4. Set the Signal Generator to the following conditions:

Output Level	0 dBm	Stop Frequency	2 000.000 MHz
ALC	Internal	Step	1 Step
Modulation	Off	Dwell	20 ms
Sweep Mode	Manual	Auto Peak	Off
Start Frequency	3 000.000 MHz		

FREQUENCY SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

5. Set the local oscillator to 2 000.001 MHz CW with an output level of +8 dBm.

6. Using the FREQ INCREMENT keys, set the Signal Generator to the stop frequency (2 000.000 MHz).

7. Set the oscilloscope to main sweep mode and AUTO. Adjust the oscilloscope's channel 1 vertical sensitivity for a 2 division peak-to-peak display of the IF frequency.

8. Set the oscilloscope's main sweep mode to triggered (or NORM). This sweep mode will not trigger the digitizer until the external trigger signal is received.

9. Using the FREQ INCREMENT keys, reset the Signal Generator's frequency to the start frequency (3 000.000 MHz). Press the digitizer (STORE M1) key on the oscilloscope and then use the appropriate FREQ INCREMENT key to step the Signal Generator to the stop frequency (2 000.000 MHz). The oscilloscope should digitize the switching waveform as the frequency changes. The waveform should be similar to the waveform shown in Figure 4-13.

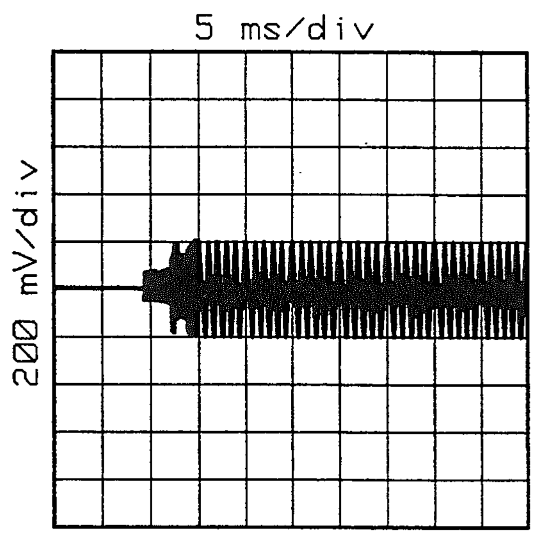

Figure 4-13. Frequency Switching Waveform

10. Set the oscilloscope to delayed sweep mode.

11. Using the digitized signal displayed on the oscilloscope, measure the time to the point at which the IF frequency amplitude suddenly increases and remains more than 1 division peak-to-peak. Set the oscilloscope's delay time to the measured time.

12. Using the FREQ INCREMENT keys, reset the Signal Generator's frequency to the start frequency.

PERFORMANCE TESTS

FREQUENCY SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

13. Press the digitizer (STORE M1) key on the oscilloscope adn step the Signal Generator to the stop frequency with the appropriate FREQ INCREMENT key. The oscilloscope should digitize the switching waveform as the frequency changes. The waveform should now look like that shown in Figure 4-14.

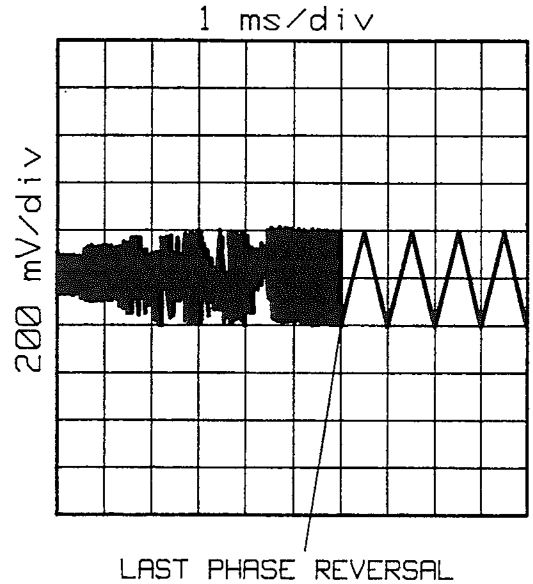

Figure 4-14. Frequency Switching Time Measurement Waveform

14. Measure the frequency switching time by observing the digitized signal on the oscilloscope display. The external trigger is the reference for determining switching speed. The switching time is measured from the display's left graticule to the last phase reversal (as the Signal Generator frequency passes the local oscillator frequency) before the IF signal settles into a steady frequency. Refer to Figure 4-14. Record the frequency switching time.

NOTE

With the oscilloscope in delayed sweep mode, the left graticule of the display corresponds to the delay time. This delay must be added to the time from the left graticule to the last phase reversal to obtain the frequency switching time.

__________ $<$ 25 ms (2703A and above)

__________ $<$ 20 ms (2640A and below)

15. Repeat steps 5 through 12 for each of the start and stop frequencies listed in the following table. Record the switching time for each indicated frequency change.

Amplitude Recovery Time

16. Set the local oscillator to 6 599.999 MHz.

PERFORMANCE TESTS

FREQUENCY SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

Start Frequency (MHz)	Stop Frequeny (MHz)	LO Frequency (MHz)	Measured Switching Time
4 000.000	2 000.000	2 000.001	________ <25 ms*
18 000.000	2 000.000	2 000.001	________ <25 ms*
6 200.000	2 090.000	2 090.001	________ <25 ms*
6 000.000	2 100.000	2 100.001	________ <25 ms*
6 500.000	2 100.000	2 100.001	________ <25 ms*
6 490.000	2 200.000	2 200.001	________ <25 ms*
2 000.000	3 000.000	2 999.999	________ <25 ms*
2 200.000	6 490.000	6 489.999	________ <25 ms*
2 100.000	6 500.000	6 499.999	________ <25 ms*
6 610.000	6 590.000	6 590.001	________ <25 ms*
6 590.000	6 610.000	6 609.998	________ <25 ms*
3 999.000	12 400.000	12 399.998	________ <25 ms
19 500.000	2 100.000	2 100.001	________ <25 ms*
26 000.000	2 100.000	2 100.001	________ <25 ms*
2 100.000	19 500.000	19 499.999	________ <25 ms*
2 000.000	26 000.000	25 999.996	________ <25 ms*
2 100.000	26 000.000	25 999.996	________ <25 ms*

*For 2640A and below, maximum switching time is 20 ms.

17. Set the Signal Generator start frequency to 2 000.000 MHz and stop frequency to 6 600.000 MHz.
18. Set the oscilloscope to main sweep with auto sweep mode. This allows viewing the IF signal without using the external trigger signal.
19. Using the FREQ INCREMENT keys, set the Signal Generator to 6.6 GHz and set the output level to +3 dBm.
20. Adjust the vertical sensitivity and position of the oscilloscope display (main sweep) until a change in output level from +3 dBm to −3 dBm indicates an IF signal amplitude change of exactly 4 divisions peak-to-peak. This calibrates the oscilloscope display to ± 3 dB about 0 dBm. The smaller signal represents −3 dBm and the larger signal represents +3 dBm.
21. Set the top of the displayed signal to a convenient reference near the center of the display. Note the +3 dBm and −3 dBm levels for reference. The measurement will be determined by the time required before the amplitude of the IF signal stays between these two levels. Return the Signal Generator output level to 0 dBm.
22. Set the oscilloscope's sweep mode to triggered (or NORM). This sweep mode will not trigger the digitizer until the external trigger signal is received.
23. Using the FREQ INCREMENT keys, set the Signal Generator to the start frequency (2 000.000 MHz).

PERFORMANCE TESTS

FREQUENCY SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

24. Press the digitizer (STORE M1) key on the oscilloscope and then step the Signal Generator to the stop frequency (6 600.000 MHz). The oscilloscope should digitize the switching waveform as the frequency changes. The waveform should be as shown in Figure 4-15.

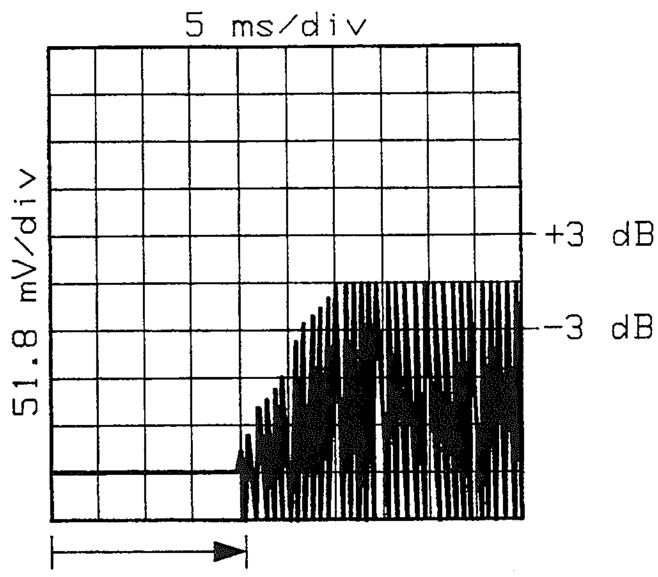

Figure 4-15. Amplitude Recovery Switching Waveform

25. Set the oscilloscope to delayed sweep. Set the oscilloscope's delay time to the time the IF frequency amplitude suddenly increases.
26. Using the FREQ INCREMENT keys, reset the Signal Generator's frequency to the start frequency.
27. Press the digitizer (STORE M1) key on the oscilloscope and step the Signal Generator to the stop frequency with the FREQ INCREMENT key. The oscilloscope should digitize the switching waveform as the frequency changes. The waveform should now look like that shown in Figure 4-16.
28. Measure the amplitude recovery time. The measurement is the time from the left graticule of the display to the last time the IF signal amplitude is outside the reference points established in steps 16 through 21.

NOTE

With the oscilloscope in delayed sweep mode, the left graticule of the display corresponds to the delay time. This delay must be added to the time from the left graticule to the last point the IF amplitude is outside of the references to obtain the amplitude recovery time.

________ <25 ms

PERFORMANCE TESTS

FREQUENCY SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

29. Repeat steps 22 through 28 for each of the start and stop frequencies listed in the following table. Record the amplitude recovery time for each indicated frequency change.

Start Frequency (MHz)	Stop Frequeny (MHz)	LO Frequency (MHz)	Measured Recovery Time
6 601.000	12 300.000	12 299.998	________ <25 ms*
3 000.000	4 000.000	3 999.999	________ <25 ms*
4 000.000	10 000.000	9 999.998	________ <25 ms*
12 301.000	18 600.000	18 599.997	________ <25 ms*
18 601.000	26 000.000	25 999.996	________ <25 ms*
2 000.000	26 000.000	25 999.996	________ <25 ms*
6 601.000	26 000.000	25 999.996	________ <25 ms*
2 000.000	18 600.000	18 599.997	________ <25 ms*

*For 2640A and below, maximum switching time is 20 ms.

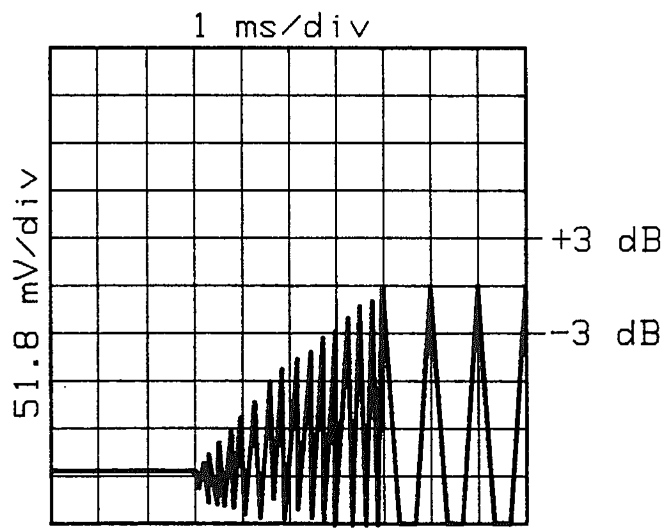

Figure 4-16. Amplitude Recovery Measurement Waveform

PERFORMANCE TESTS

4-11. SINGLE-SIDEBAND PHASE NOISE TEST

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 the readings to compensate for using the spectrum analyzer in the log mode, local oscillator noise contributions, and 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 8340A
Spectrum Analyzer .... HP 3585A
Mixer .... RHG DMS1-26

PERFORMANCE TESTS

SINGLE-SIDEBAND PHASE NOISE TEST (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 requires 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:

Normalizing Factor dB = 10 log (1.2 × 3 Hz/1Hz) = 5.56 dB.

The total correction for 3 Hz bandwidth would be:

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

Procedure

1. Connect the equipment as shown in Figure 4-17.

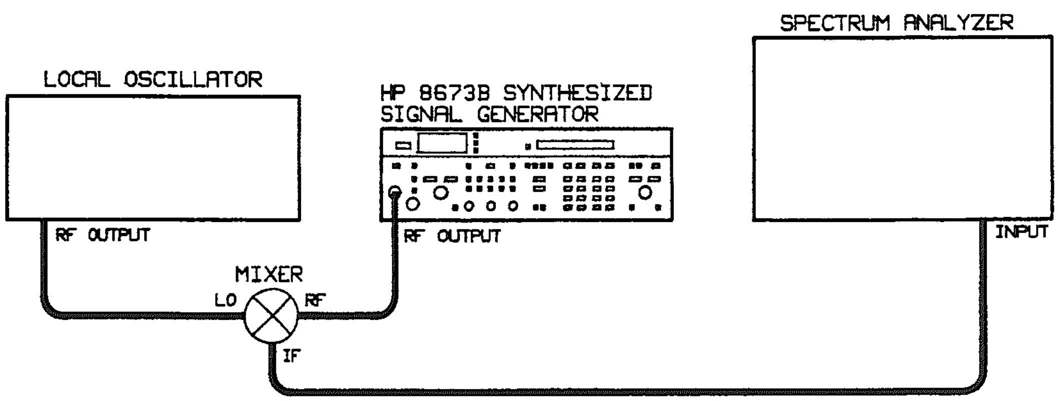

Figure 4-17. Single-Sideband Phase Noise Test Setup

NOTE

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

2. Set the spectrum analyzer's start frequency to 40 kHz, resolution bandwidth to 3 Hz, and stop frequency of 40.05 kHz.

3. Tune the Signal Generator to 6 600 MHz. Set the RANGE to −20 dB. Set the VERNIER to 0 dBm as read on the front panel meter.

4. Tune the local oscillator to 6 599.960 MHz with an output amplitude of +8 dBm.

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

PERFORMANCE TESTS

SINGLE-SIDEBAND PHASE NOISE TEST (cont'd)

Procedure (cont'd)

6. Observe the noise level 10 Hz from the carrier. The displayed level should be greater than 51.94 dB below the carrier (<−51.94 dBc). Record the measured and actual level after correction.

Measured ________ dBc
Correction −6.06 dB
Actual Level ________ dBc

7. Tune the Signal Generator to 12 300 MHz.

8. Tune the local oscillator to 12 299.960 MHz.

9. Observe the noise level 10 Hz from the carrier. The displayed level should be greater than 45.94 dB below the carrier (<−45.94 dBc). Record the measured and actual level.

Measured ________ dBc
Correction −6.06 dB
Actual Level ________ dBc

10. Tune the Signal Generator to 18 600 MHz.

11. Tune the local oscillator to 18 599.960 MHz.

12. Observe the noise level 10 Hz from the carrier. The displayed level should be greater than 41.94 dB below the carrier (<−41.94 dBc). Record the measured and actual level.

Measured ________ dBc
Correction −6.06 dB
Actual Level ________ dBc

13. Tune the Signal Generator to 26 000 MHz.

14. Tune the local oscillator to 25 999.960 MHz.

15. Observe the noise level 10 Hz from the carrier. The displayed level should be greater than 39.94 dB below the carrier (<−39.94 dBc). Record the measured and actual level.

Measured ________ dBc
Correction −6.06 dB
Actual Level ________ dBc

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

17. Repeat steps 3 through 15 while observing the noise 100 Hz from the carrier. Record the results in the following table.

PERFORMANCE TESTS

SINGLE-SIDEBAND PHASE NOISE TEST (cont'd)

Procedure (cont'd)

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

18. Set the spectrum analyzer resolution bandwidth to 30 Hz and frequency span per division to 200 Hz. The 30 Hz bandwidth requires 16.06 dB correction.

19. Tune the Signal Generator to 6 599.800 MHz.

20. Tune the local oscillator to 6 600.000 MHz

21. Adjust 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 IF signal 20 dB above the top graticule line. (The top graticule line is now −20 dBc.)

22. Observe the noise level 1 kHz from the carrier. The displayed level should be greater than 61.94 dB below the carrier (<−61.94 dBc). Record the measured and actual level.

    Measured ________ dBc
    Correction −16.06 dB
    Actual level ________ dBc

23. Tune the Signal Generator to 12 300 MHz.

24. Tune the local oscillator to 12 299.800 MHz.

25. Observe the noise level 1 kHz from the carrier. The displayed level should be greater than 55.94 dB below the carrier (<−55.94 dBc). Record the measured and actual level.

    Measured ________ dBc
    Correction −16.06 dB
    Actual level ________ dBc

26. Tune the Signal Generator to 18 600 MHz.

27. Tune the local oscillator to 18 599.800 MHz.

28. Observe the noise level 1 kHz from the carrier. The displayed level should be greater than 51.94 dB below the carrier (<−51.94 dBc). Record the measured and actual level.

    Measured ________ dBc
    Correction −16.06 dB
    Actual level ________ dBc

PERFORMANCE TESTS

SINGLE-SIDEBAND PHASE NOISE TEST (cont'd)

Procedure (cont'd)

29. Tune the Signal Generator to 26 000 MHz.

30. Tune the local oscillator to 25 999.800 MHz.

31. Observe the noise level 1 kHz from the carrier. The displayed level should be greater than 49.94 dB below the carrier (<−49.94 dBc). Record the measured and actual level.

Measured ________ dBc
Correction −16.06 dB
Actual level ________ dBc

32. Set the spectrum analyzer controls for a resolution 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.

33. Repeat steps 19 through 31 while observing the noise 10 kHz from the carrier. Record the results in the table below.

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

34. Set the spectrum analyzer controls for a resolution 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.

35. Repeat steps 19 through 31 while observing the noise 100 kHz from the carrier. Record the results in the table below.

Frequency	Measured	Correction	Actual	Limit
6600 MHz	________	−36.06 dB =	________	<−110 dBc
12 300 MHz	________	−36.06 dB =	________	<−104 dBc
18 600 MHz	________	−36.06 dB =	________	<−100 dBc
26 000 MHz	________	−36.06 dB =	________	<− 98 dBc

PERFORMANCE TESTS

4-12. HARMONICS, SUBHARMONICS, & MULTIPLES TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY		
Harmonics	<−40 dBc	Up to 26 GHz; output level at or below 0 dBm.
Subharmonics and Multiples Thereof	<−25 dBc <−20 dBc	2.0 to 18.6 GHz 18.6 to 26.0 GHz
For Option 008		
Subharmonics and Multiples Thereof	<−25 dBc <−15 dBc	2.0 to 26.0 GHz 18.6 to 26.0 GHz (1/2 and 3/4 subharmonics only)

Description

This test checks the amplitude of various harmonics of the Signal Generator's output signal. In the multiplied frequency bands (>6.6 GHz), subharmonics and multiples (harmonics of the internal fundamental signal) are also checked for specific levels. Reasonable care must be taken to ensure that the harmonics are not being generated by the spectrum analyzer.

Harmonics are tested at high VERNIER settings (+3 dBm). Subharmonics and multiples are tested at low VERNIER settings (−10 dBm) where the feedthrough of the fundamental signal is largest in relation to the multiplied signal.

Equipment

Spectrum Analyzer .... HP 8566B

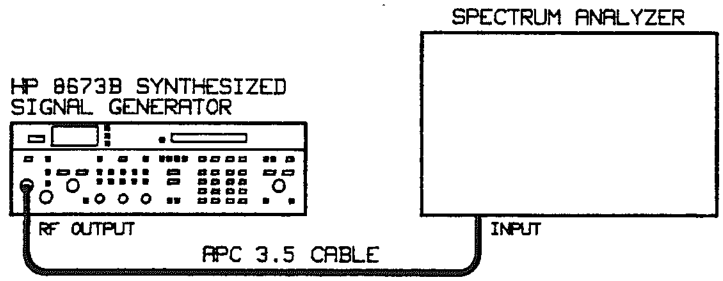

Figure 4-18. Harmonics, Subharmonics, and Multiples Test Setup

Procedure

1. Connect the equipment as shown in Figure 4-18.
2. Tune the Signal Generator to 4 000.000 MHz and set the output level to 0.0 dBm.
3. Set the spectrum analyzer's controls to display the fundamental signal. Set the resolution bandwidth to 10 kHz, the input attenuation to 40 dB, and the sweep span to 100 MHz. Adjust the controls to set the displayed signal to the top graticule line of the display.

HARMONICS, SUBHARMONICS, & MULTIPLES TEST (cont'd)

Procedure (cont'd)

4. Tune the Signal Generator to 2000.000 MHz. The second harmonic, now displayed on the spectrum analyzer at 4000.000 MHz, should be greater than 40 dB below the reference (top graticule line).

__________ <−40 dBc

5. Repeat steps 2 through 4 for each of the frequencies listed below. Use an output level of 0.0 dBm (0 dBm RANGE) to check harmonics and a VERNIER setting of −10 dBm to check subharmonics and multiples. Record the measurements in Table 4-4.

NOTE

This procedure may be repeated for any fundamental frequency of interest within the Signal Generator frequency range. The worst case performance for harmonics is at high VERNIER settings while the worst case performance for subharmonics and multiples is at low VERNIER settings. Use the appropriate VERNIER setting for each test.

Output Frequency (MHz)	Harmonic Frequency (MHz)	Subharmonic			Multiple	
		1/4	1/3	1/2	2/3	3/4
2000.000	4000.000					
4000.000	8000.000					
6000.000	12000.000					
8000.000	16000.000			4000.000		
10000.000	20000.000			5000.000		
11000.000	22000.000			5500.000		
14000.000			4666.667		9333.333	
16000.000			5333.333		10666.667	
18000.000			6000.000		12000.000	
20000.000		5000.000		10000.000		15000.000
22000.000		5500.000		11000.000		16500.000
24000.000		6000.000		12000.000		18000.000
26000.000		6500.000		13000.000		19500.000

PERFORMANCE TESTS

4-13. NON-HARMONICALLY RELATED SPURIOUS SIGNALS TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
Spurious		CW and AM Modes
Non-harmonically 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

Description

A spectrum analyzer is calibrated for −50 dBc and then tuned to any frequency from 12.3 to 18.6 GHz in search of spurious signals.

NOTE

The non-harmonically related spurious signals will always increase in amplitude above 6.6 GHz. This is due to multiplication in the internal YIG-tuned multiplier. The increase is determined by a strict mathematical relationship. Therefore, satisfactory performance in the 2.0 to 6.6 GHz range will always ensure meeting the specification in the other bands.

Equipment

Spectrum Analyzer .... HP 8566B

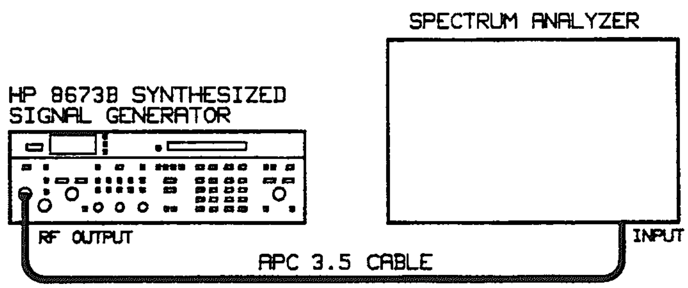

Figure 4-19. Non-harmonically Related Spurious Test Setup

Procedure

1. Connect the equipment as shown in Figure 4-19.
2. Tune the Signal Generator to 3000.000 MHz.
3. Set the OUTPUT LEVEL RANGE to −60 dB. Adjust the VERNIER to 0 dBm.
4. 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.
5. Set the spectrum analyzer controls so that the displayed signal is at the top graticule line.

PERFORMANCE TESTS

NON-HARMONICALLY RELATED SPURIOUS SIGNALS TESTS (cont'd)

Procedure (cont'd)

6. Set the Signal Generator's RANGE to 0 dB. Adjust the VERNIER to −10 dBm. Do not adjust the spectrum analyzer amplitude calibration. The top graticule line now represents −50 dBc.

7. 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 Amplitude
3 000.000 MHz	________	________
3 000.000 MHz	________	________

8. Repeat steps 2 through 7 for any desired carrier frequency from 2.0 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 2.0 to 26 GHz.)

Carrier Frequency	Spurious Signal Frequency	Spurious Signal Amplitude
________	________	________
________	________	________

PERFORMANCE TESTS

4-14. POWER LINE RELATED SPURIOUS SIGNALS TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
SPECTRAL PURITY		CW and AM Modes
Power line related and		2.0 — 6.6 GHz
fan rotation related within	−50 dBc	<300 Hz offset from carrier.
5 Hz below line frequencies	−60 dBc	300 Hz to 1 kHz offset from carrier.
and multiples thereof.	−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 8340A
Spectrum Analyzer .... HP 3585A
Mixer .... RHG DMS1-26
Variable Frequency AC Power Supply ...... 501TC/800T, California Instruments

Procedure

1. Connect the equipment as shown in Figure 4-20.

NOTE

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

2. Place the Signal Generator and the local oscillator on separate two-inch thick foam pads.

3. Tune the Signal Generator to 3 000.000 MHz.

4. Set the OUTPUT LEVEL RANGE to −20 dB. Adjust the VERNIER to 0 dBm.

PERFORMANCE TESTS

POWER LINE RELATED SPURIOUS SIGNALS TESTS (cont'd)

Procedure (cont'd)

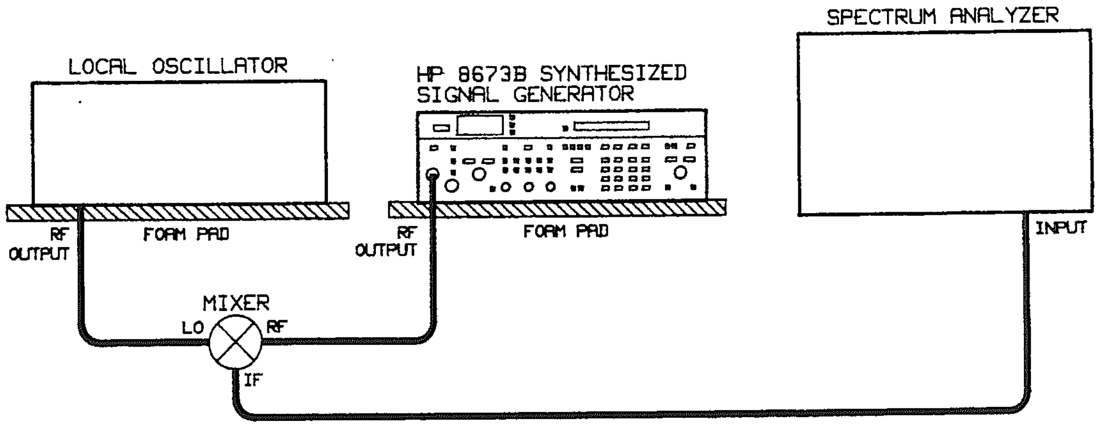

Figure 4-20. Power Line Related Spurious Signals Test Setup

5. Tune the local oscillator to 3 000.020 MHz with an output amplitude of +7 dBm.

6. Set the spectrum analyzer start frequency to 20 kHz, frequency span to 500 Hz, and resolution bandwidth to 3 Hz.

7. Adjust the spectrum analyzer controls to place the peak of the 20 kHz IF signal on 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

8. Set the spectrum analyzer frequency span to 1 kHz. Ensure that the start frequency is 20 kHz. Measure and record the highest spurious signal level.

   300 Hz — 1 kHz offset ________ <−60 dBc

9. Set the spectrum analyzer frequency span to 5 kHz. Ensure that the start frequency is 20 kHz. Measure and record the highest spurious signal level.

   >1 kHz offset ________ <−65 dBc

10. Tune the Signal Generator to 7000 MHz.

11. Tune the local oscillator to 7000.020 MHz.

12. Set the spectrum analyzer frequency span per division to 500 Hz. Adjust the spectrum analyzer controls to place the peak of the 20 kHz IF signal on 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.

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

PERFORMANCE TESTS

POWER LINE RELATED SPURIOUS SIGNALS TESTS (cont'd)

Procedure (cont'd)

13. Set the spectrum analyzer frequency span to 1 kHz. Ensure that the start frequency is 20 kHz. Measure and record the highest spurious signal level.

    300 Hz — 1 kHz offset __________ <−54 dBc

14. Set the spectrum analyzer frequency span to 5 kHz. Ensure that the start frequency is 20 kHz. Measure and record the highest spurious signal level.

    >1 kHz offset __________ <−59 dBc

15. Tune the Signal Generator to 16 000.000 MHz.

16. Tune the local oscillator to 16 000.020 MHz.

17. Set the spectrum analyzer frequency span to 500 Hz. Adjust the spectrum analyzer controls to place the peak of the 20 kHz IF signal on 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.

    12.3 — 18.6 GHz <300 Hz offset __________ <−40 dBc

18. Set the spectrum analyzer frequency span to 1 kHz. Ensure that the start frequency is 20 kHz. Measure and record the highest spurious signal level.

    300 Hz — 1 kHz offset __________ <−50 dBc

19. Set the spectrum analyzer frequency span to 5 kHz. Ensure that the start frequency is 20 kHz. Measure and record the highest spurious signal level.

    >1 kHz offset __________ <−55 dBc

20. Tune the Signal Generator to 20 000.000 MHz.

21. Tune the local oscillator to 20 000.020 MHz.

22. Set the spectrum analyzer frequency span to 500 Hz. Adjust the spectrum analyzer controls to place the peak of the 20 kHz IF signal on 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.

    18.6 — 26.0 GHz <300 Hz offset __________ <−38 dBc

23. Set the spectrum analyzer frequency span to 1 kHz. Ensure that the start frequency is 20 kHz. Measure and record the highest spurious signal level.

    300 Hz — 1 kHz offset __________ <−48 dBc

24. Set the spectrum analyzer frequency span to 5 kHz. Ensure that the start frequency is 20 kHz. Measure and record the highest spurious signal level.

    >1 kHz offset __________ <−53 dBc

PERFORMANCE TESTS

4-15. OUTPUT LEVEL AND FLATNESS TESTS

Specification

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
Option 008 Level Output	+8 dBm to −100 dBm	2.0 to 18.0 GHz
	+7 dBm to −100 dBm	18.0 to 26.0 GHz
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.)

Description

This test checks output level (maximum leveled power) and output level flatness. The output level test uses a power meter to verify that the specified maximum leveled output power can be generated over the full frequency range. Level flatness measures the variation in output power level as the frequency is changed.

Equipment

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

Procedure

Output Level Test

1. Connect the equipment as shown in Figure 4-21.
2. Zero and calibrate the power meter.
3. Tune the Signal Generator frequency to 2 000.0 MHz.
4. Set the OUTPUT LEVEL RANGE to +10 dB.

PERFORMANCE TESTS

OUTPUT LEVEL AND FLATNESS TESTS (cont'd)

Procedure (cont'd)

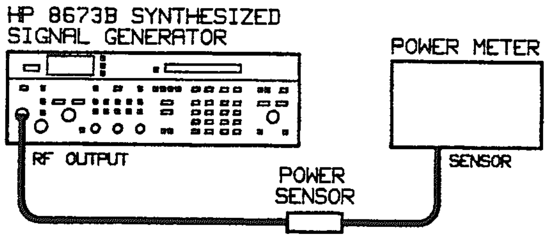

Figure 4-21. Output Level and Flatness Test Setup

5. For a standard Signal Generator, adjust the VERNIER for a power meter reading of +8 dBm or, for a Signal Generator with an option, for one of the following power levels:

   Option 001 .... +10 dBm
   Option 004 ....+7 dBm
   Option 005 ....+9 dBm
   Option 008 ....+8 dBm

6. Activate the AUTO PEAK key. (The AUTO PEAK key indicator should be lighted.)
7. Tune the Signal Generator in 100 MHz steps from 2000.0 MHz to 18 000.0 MHz while observing the power meter reading. Record the frequency at which minimum power occurs.

   Frequency ___________

8. Tune the Signal Generator to the recorded frequency. Re-adjust the VERNIER for the same power meter reading used in Step 5.
9. Re-tune the Signal Generator from 2 000.0 MHz to 18 000.0 MHz in 100 MHz steps while observing the power meter readings. Ensure that the specified maximum leveled output power level is met.
10. For a standard Signal Generator, adjust the VERNIER for a power meter reading of +4 dBm or, for a Signal Generator with an option, for one of the following power levels:

    Option 001 ....+6 dBm
    Option 004 ....+2 dBm
    Option 005 ....+4 dBm
    Option 008 ....+7 dBm

11. Verify that the AUTO PEAK key indicator is lighted.
12. Tune the Signal Generator in 100 MHz steps from 18 000.0 MHz to 22 000.0 MHz while observing the power meter reading. Record the frequency at which minimum power occurs.

    Frequency ___________

PERFORMANCE TESTS

OUTPUT LEVEL AND FLATNESS TESTS (cont'd)

Procedure (cont'd)

13. Tune the Signal Generator to the recorded frequency. Re-adjust the VERNIER for the same power meter reading used in Step 10.

14. Re-tune the Signal Generator from 18 000.0 MHz to 22 000.0 MHz 100 MHz steps while observing the power meter readings. Ensure that the specified maximum leveled output power level is met.

15. For a standard Signal Generator, adjust the VERNIER for a power meter reading of 0 dBm or, for a Signal Generator with an option, for one of the following power levels:

    Option 001 ....+3 dBm
    Option 004 ....−2 dBm
    Option 005 ....+1 dBm
    Option 008 ....+7 dBm

16. Verify that the AUTO PEAK key indicator is lighted.

17. Tune the Signal Generator in 100 MHz steps from 22 000.0 MHz to 26 000.0 MHz while observing the power meter reading. Record the frequency at which minimum power occurs.

    Frequency __________

18. Tune the Signal Generator to the recorded frequency. Re-adjust the VERNIER for the same power meter reading used in Step 15.

19. Re-tune the Signal Generator from 22 000.0 MHz to 26 000.0 MHz in 100 MHz steps while observing the power meter readings. Ensure that the specified maximum leveled output power level is met.

Level Flatness Test

NOTE

The flatness specification for power output is not referenced to a particular frequency. The specification represents the total power variation over the entire frequency range.

20. Tune the Signal Generator to 2 000.0 MHz. Set the OUTPUT LEVEL RANGE to 0 dB. Adjust the VERNIER for a power meter reading of −5 dBm.

21. Set the power meter mode to dB Relative.

22. Tune the Signal Generator from 2 000.0 MHz to 6600.0 MHz in 100 MHz steps while observing the power meter readings. Record the minimum and maximum output power levels in the following table. Maximum power variation must be within 1.5 dB (highest point to lowest point).

23. Continue tuning the Signal Generator to 12 300.0 GHz in 100 MHz steps while observing the power meter readings. Maximum power variation must be within 2.0 dB. Record the minimum and maximum output power levels in the following table.

PERFORMANCE TESTS

OUTPUT LEVEL AND FLATNESS TESTS (cont'd)

Procedure (cont'd)

24. Continue tuning the Signal Generator to 18 600.0 GHz in 100 MHz steps while observing the power meter readings. Maximum power variation must be within 2.5 dB. Record the minimum and maximum output power levels in the table below.

25. Continue tuning the Signal Generator to 26 000.0 GHz in 100 MHz steps while observing the power meter readings. Maximum power variation must be within 3.5 dB. Record the minimum and maximum output power levels in the table below.

Frequency Range	Power Variation
2.0 — 6.6 GHz	Maximum ________ Minimum ________ Total Variation ________ 1.50 dB
2.0 — 12.3 GHz	Maximum ________ Minimum ________ Total Variation ________ 2.00 dB
2.0 — 18.6 GHz	Maximum ________ Minimum ________ Total Variation ________ 2.50 dB
2.0 — 26.0 GHz	Maximum ________ Minimum ________ Total Variation ________ 3.50 dB

PERFORMANCE TESTS

4-16. ABSOLUTE LEVEL ACCURACY TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
RF OUTPUT		
Remote Programming Absolute Level Accuracy (+15 to +35°C)		2.0 to 6.6 GHz
	± 1.25 dB	+10 dB RANGE
	± 1.00 dB	0 dB RANGE
	± 1.50 dB	−10 dB RANGE
	± 1.70 dB	−20 dB RANGE
	± 2.00 dB	−30 dB RANGE
	± 2.00 dB & 0.1 dB / 10 dB step	<−30 dB RANGE
		6.6 to 12.3 GHz
	± 1.50 dB	+10 dB RANGE
	± 1.25 dB	0 dB RANGE
	± 1.75 dB	−10 dB RANGE
	± 1.95 dB	−20 dB RANGE
	± 2.25 dB	−30 dB RANGE
	± 2.25 dB & 0.1 dB / 10 dB step	<−30 dB RANGE
		12.3 to 18.6 GHz
	± 1.75 dB	+10 dB RANGE
	± 1.50 dB	0 dB RANGE
	± 2.10 dB	−10 dB RANGE
	± 2.30 dB	−20 dB RANGE
	± 2.70 dB	−30 dB RANGE
	± 2.70 dB & 0.2 dB / 10 dB step	<−30 dB RANGE
		18.6 to 26.0 GHz
	± 2.25 dB	+10 dB RANGE
	± 2.00 dB	0 dB RANGE
	± 2.55 dB	−10 dB RANGE
	± 2.85 dB	−20 dB RANGE
	± 3.30 dB	−30 dB RANGE
	± 3.30 dB & 0.2 dB / 10 dB step	<−30 dB 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

This test checks absolute level accuracy of the RF output signal using manual settings. The first test uses a power meter to verify that power levels between the maximum leveled power and −20 dBm are within specification. Power levels of −30 dBm and below are checked using a spectrum analyzer. The output level of the Signal Generator is adjusted to −20 dBm using the power meter. The Signal Generator output is mixed

PERFORMANCE TESTS

ABSOLUTE LEVEL ACCURACY TESTS (cont'd)

Description (cont'd)

with a local oscillator to produce an IF frequency. The IF frequency is displayed on the spectrum analyzer. A reference level corresponding to the −20 dBm output is set on the spectrum analyzer and each 10 dB decrease in range is checked for a 10 dB decrease on the spectrum analyzer display.

Equipment

Power Meter .... HP 436A
Power Sensor .... HP 8485A
Local Oscillator .... HP 8340A
Mixer .... RHG DMS1-26
Spectrum Analyzer .... HP 8566B
40 dB Amplifier .... HP 8447F
20 dB Attenuator .... HP 8493C Option 020

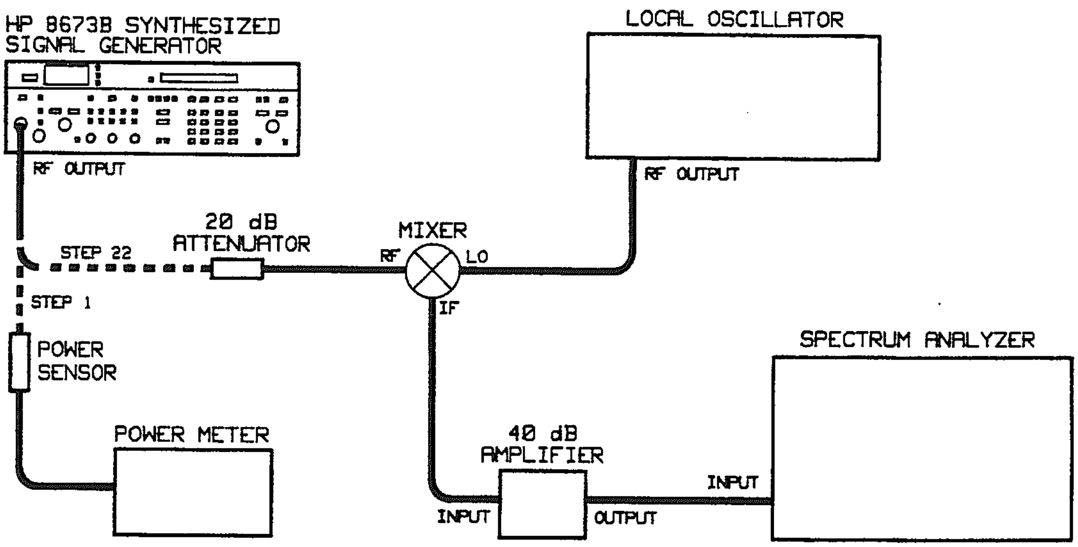

Figure 4-22. Absolute Level Accuracy Test Setup

Procedure

High Level Accuracy Test

1. Connect the equipment as shown in Figure 4-22.

2. Zero and calibrate the power meter. Set the power meter to dBm mode.

3. Tune the Signal Generator to 2.0 GHz.

4. Set the OUTPUT LEVEL RANGE to +10 dB. For a standard Signal Generator, adjust the VERNIER for a power meter reading of +8 dBm or, for a Signal Generator with an option, for one of the following power levels:

   Option 001 .... +10 dBm
   Option 004 ....+7 dBm
   Option 005 ....+9 dBm
   Option 008 ....+8 dBm

PERFORMANCE TESTS

ABSOLUTE LEVEL ACCURACY TESTS (cont'd)

Procedure (cont'd)

5. Peak the Signal Generator output with the AUTO PEAK key.
6. Set the power meter to dB Relative.
7. For a standard Signal Generator, adjust the VERNIER for a front panel indication of +8 dBm or, for a Signal Generator with an option, for one of the following power levels:

   Option 001 .... +10 dBm
   Option 004 ....+7 dBm
   Option 005 ....+9 dBm
   Option 008 ....+8 dBm

8. Tune the Signal Generator from 2.0 to 6.6 GHz in 100 MHz steps while noting the power meter readings at each frequency step. Do not readjust the VERNIER. The power meter readings should be within the limits specified.

   (2.0 — 6.6 GHz) −2.00 dB ________ +2.00 dB

9. Tune the Signal Generator to 2.0 GHz.
10. Set the power meter to dBm mode.
11. Adjust the VERNIER for a power meter reading of +5.0 dBm.
12. Set the power meter mode to dB Relative.
13. Adjust the Signal Generator's VERNIER for an output amplitude of +5 dBm (−5 dBm front panel meter indication).
14. Tune the Signal Generator from 2.0 to 6.6 GHz in 100 MHz steps while noting the power meter readings at each frequency step. Do not readjust the VERNIER. The power meter readings should be within the limits specified.

    (2.0 — 6.6 GHz) −2.00 dB ________ +2.00 dB

15. Tune the Signal Generator from 6.6 to 12.3 GHz in 100 MHz steps while noting the power meter readings at each frequency step. The power meter readings should be within the limits specified.

    (6.6 — 12.3 GHz) −2.25 dB ________ +2.25 dB

16. Tune the Signal Generator from 12.3 to 18.0 GHz in 100 MHz steps while noting the power meter readings at each frequency step. The power meter readings should be within the limits specified.

    (12.3 — 18.0 GHz) −2.50 dB ________ +2.50 dB

17. Repeat steps 9 through 16 using the power levels and frequency ranges listed in Table 4-2.

PERFORMANCE TESTS

ABSOLUTE LEVEL ACCURACY TESTS (cont'd)

Procedure (cont'd)

Table 4-2. High Level Accuracy Test Record

Output Power	Frequency Range	Min.	Actual	Max.
0.0 dBm (+10 dB RANGE)	2.0—6.6 GHz	−2.00 dB	______	+2.00 dB
	6.6—12.3 GHz	−2.25 dB	______	+2.25 dB
	12.3—18.6 GHz	−2.50 dB	______	+2.50 dB
	(Not for Option 004) 18.6—26.0 GHz	−3.00 dB	______	+3.00 dB
−5.0 dBm (0 dB RANGE)	2.0—6.6 GHz	−1.75 dB	______	+1.75 dB
	6.6—12.3 GHz	−2.00 dB	______	+2.00 dB
	12.3—18.6 GHz	−2.25 dB	______	+2.25 dB
	18.6—26.0 GHz	−2.75 dB	______	+2.75 dB
−10 dBm (0 dB RANGE)	2.0—6.6 GHz	−1.75 dB	______	+1.75 dB
	6.6—12.3 GHz	−2.00 dB	______	+2.00 dB
	12.3—18.6 GHz	−2.25 dB	______	+2.25 dB
	18.6—26.0 GHz	−2.75 dB	______	+2.75 dB
−10 dBm (−10 dB RANGE)	2.0—6.6 GHz	−2.25 dB	______	+2.25 dB
	6.6—12.3 GHz	−2.50 dB	______	+2.50 dB
	12.3—18.6 GHz	−2.85 dB	______	+2.85 dB
	18.6—26.0 GHz	−3.30 dB	______	+3.30 dB
−20 dBm (−20 dB RANGE)	2.0—6.6 GHz	−2.45 dB	______	+2.45 dB
	6.6—12.3 GHz	−2.70 dB	______	+2.70 dB
	12.3—18.6 GHz	−3.05 dB	______	+3.05 dB
	18.6—26.0 GHz	−3.60 dB	______	+3.60 dB

Low Level Accuracy Test

18. Tune the Signal Generator to 4.0 GHz.
19. Set the OUTPUT LEVEL RANGE to −20 dB. Adjust the VERNIER for a front panel meter indication of 0 dBm.
20. Peak the Signal Generator with the AUTO PEAK key.
21. Adjust the VERNIER for a power meter reading of −20.0 dBm ±0.1 dB.
22. Disconnect the power meter and connect the Signal Generator to the attenuator and mixer as shown in Figure 4-22.

NOTE

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

PERFORMANCE TESTS

ABSOLUTE LEVEL ACCURACY TESTS (cont'd)

Procedure (cont'd)

23. Tune the local oscillator to a frequency 100 kHz ±1 kHz higher than the Signal Generator setting in step 18.

24. Set the local oscillator output power to +7 dBm.

25. Set the resolution bandwidth on the spectrum analyzer to 300 Hz or less. Adjust the vertical sensitivity to place the peak of the 100 kHz IF signal on the center horizontal graticule line. This calibrates the center graticule line for an absolute reference power level of −20 dBm.

26. Set the RANGE of the Signal Generator 10 dB lower and adjust the VERNIER for a front panel meter reading of 0 dBm.

27. Set the spectrum analyzer reference level 10 dB lower to bring the signal level near the reference graticule line.

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

    NOTE

    The difference is positive if the signal is above the reference graticule; negative if below. Use the spectrum analyzer marker, if available, for best accuracy.

    __________ Output level set in step 25.

    \+ __________ Difference measured in step 28.

    __________ Actual level.

    Record the actual level calculated in Table 4-3. The level reading should be within the limits specified.

29. Repeat steps 26 through 28 with Signal Generator settings of −40 dBm and −50 dBm in step 26. Record the output level readings in Table 4-3.

30. Note the Signal Generator's signal level (at −50 dBm) on the spectrum analyzer display. Remove the 20 dB attenuator, set the spectrum analyzer's reference level 20 dB lower, and reset the vertical sensitivity to the level noted before removing the 20 dB attenuator.

31. Repeat steps 26 through 28 with Signal Generator RANGE settings of −60 dBm through −90 dBm. Record the output level readings in Table 4-3.

32. Repeat steps 18 through 32 with Signal Generator frequencies of 10 GHz, 14 GHz, and 20 GHz.

PERFORMANCE TESTS

ABSOLUTE LEVEL ACCURACY TESTS (cont'd)

Procedure (cont'd)

Table 4-3. Low Level Accuracy Test Record

Test	Results		
	Min	Actual	Max
4.0 GHz			
−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
10 GHz			
−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
14 GHz			
−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
20 GHz			
−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

PERFORMANCE TESTS

4-17. OUTPUT LEVEL SWITCHING TIME TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
SWITCHING TIME Output level to be within ± 1 dB of final output level.	< 25 ms	

Description

This test measures the output level switching speed of the Signal Generator. The Signal Generator output is detected using a crystal detector. The detected amplitude is displayed on the oscilloscope.

Level switching speed is measured using a digitizing oscilloscope. The oscilloscope is set to trigger the digitizing process at the beginning of a small frequency change which produces a trigger signal at the Signal Generator's Blanking/Marker rear panel output. As the unit under test is switched, the RF output signal will be blanked and then rise and settle at a fixed amplitude (the final level). The oscilloscope is calibrated to display the ± 1 dB points about the final level. The switching time is the time required before the IF signal amplitude remains within the reference levels.

NOTE

A storage oscilloscope simplifies these tests because it only needs two sweeps to display the switching time. This is especially important for Option 008 where many sweeps cause undue wear on internal relays. If you perform these tests with a non-storage scope, keep the number of sweeps to a minimum.

Equipment

Crystal Detector .... HP 8473C
Digitizing Oscilloscope .... HP 1980B/19860A
Controller .... HP 85B or HP 9836A

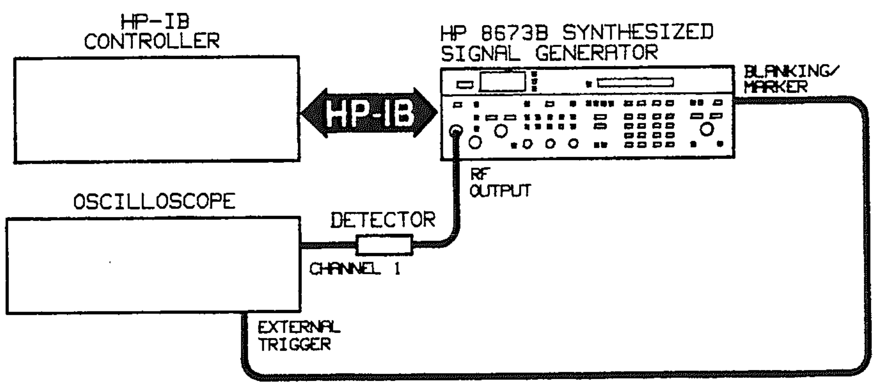

Figure 4-23. Output Level Switching Time Test Setup

PERFORMANCE TESTS

OUTPUT LEVEL SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

1. Set up the equipment as shown in Figure 4-23. The external trigger input of the oscilloscope is connected to the Signal Generator's rear panel Blanking/Marker output. This signal will trigger the oscilloscope at the start of a frequency change when any sweep mode is selected. By making a simultaneous frequency and level change, the oscilloscope can be triggered to view the level switching process.

2. Set the oscilloscope as follows:
   Channel 1:
   - Vertical Sensitivity to 5 mV/Division
   - Coupling to DC

   Set sweep to delayed
   Main Sweep Parameters:
   - External trigger with DC coupling
   - Positive slope trigger
   - Auto sweep mode
   - Set Trigger Level to E 1.00

   Delayed Sweep Parameters:
   - Internal trigger with AC coupling
   - Positive slope trigger
   - Auto sweep mode

   NOTE

   Triggered sweep mode must be used to trigger the digitizer at the start of the simultaneous level and frequency change. If auto sweep mode is selected on the oscilloscope while digitizing, the oscilloscope will trigger the sweep even without an external trigger signal and the waveform digitized will not be valid for this measurement.

3. Set the oscilloscope's main sweep to 5 ms per division and delayed sweep to 1 ms per division. The delayed sweep will be used once the approximate delay required is determined from the main sweep.

4. Set the Signal Generator to the following conditions:
   Output Level .... 0 dBm
   ALC .... Internal
   Modulation .... Off
   Sweep Mode .... Manual
   Start Frequency .... 3 000.000 MHz
   Stop Frequency .... 3 000.010 MHz
   Step .... 10 Steps
   Dwell .... 20 ms

5. Set the oscilloscope to main sweep with auto sweep mode to view the signal without using the external trigger signal.

6. Enter and run the following HP-IB controller program.

PERFORMANCE TESTS

OUTPUT LEVEL SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

```
10 L2+0
20 FOR I+1 TO 20
30 OUTPUT 719;"LE";L2+1;"DB"
40 NEXT I
50 FOR I+1 TO 20
60 OUTPUT 719;"LE";L2-1;"DB"
70 NEXT I
80 GOTO 20
90 ! NEXT PROGRAM
100 L1+-99
110 L2+0
120 OUTPUT 719;"LE";L1;"DB;UP"
130 PRINT "PLEASE PRESS THE DIGITIZER KEY."
140 PRINT "PRESS THE CONTINUE KEY ON THE"
150 PRINT "CONTROLLER WHEN DONE."
160 PAUSE
170 OUTPUT 719;"DN;LE";L2;"DB"
180 END
```

7. While the program is executing, adjust channel 1 vertical controls for an amplitude change of exactly two divisions centered about the middle horizontal graticule. This calibrates the display for a ± 1 dB reference about 0 dBm.

8. Set the oscilloscope's main sweep mode to triggered (or NORM). This sweep mode will not trigger the digitizer until the external trigger signal is received.

9. Press the pause key on the controller to stop the first part of the program. Run the second part of the program by executing the statement "RUN 100." Press the digitizer key on the oscilloscope when instructed to by the program.

   The program will set the output level to the starting value (L1) and step the frequency up. The program will then pause to allow the digitizer key on the oscilloscope to be pressed. After the key is pressed, the program triggers the oscilloscope as the level is switched from the start level (L1) to the stop level (L2). The oscilloscope should digitize the switching waveform as the frequency and level changes. The waveform should be similar to the waveform shown in Figure 4-24.

NOTE

If a negative detector is used, channel 1 should be inverted. If channel 1 is not inverted, the actual waveforms will be the inverse of those shown.

10. Set the oscilloscope to delayed sweep mode. Set the oscilloscope's delay time to the time corresponding to about ½ a division before the digitized signal's amplitude settles into the final value. The measurement will be the time required before the signal stays within ± 1 division of the middle horizontal graticule (the final amplitude). Setting the delay time to begin the sweep at this point will allow more detail to be digitized since the oscilloscope will digitize a smaller portion of the switching waveform.

PERFORMANCE TESTS

OUTPUT LEVEL SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

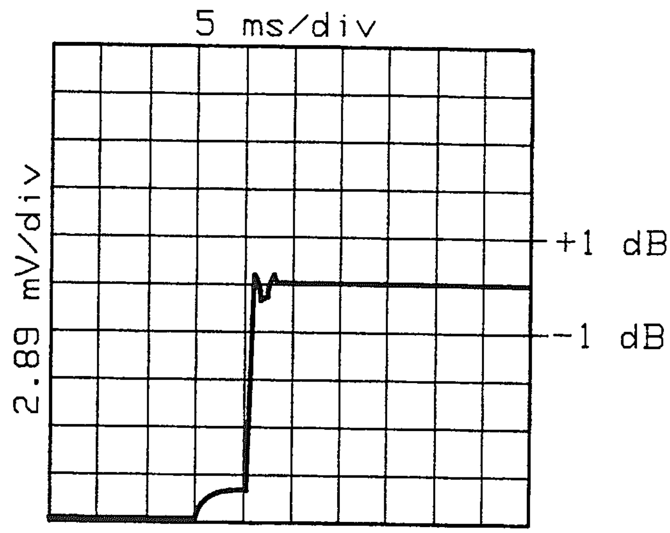

Figure 4-24. Output Level Switching Waveform

11. Rerun the program entered in step 9 by executing the command "RUN 100." Press the digitizer key on the oscilloscope when instructed to by the program. The oscilloscope should digitize the switching waveform with greater detail. The waveform should now look like that shown in Figure 4-25.

12. Measure the level switching time by observing the digitized signal on the oscilloscope display. The external trigger is the reference for determining switching speed. The switching time is measured from the display's left graticule to the last point that the signal is more than ±1 division from the middle horizontal graticule. Refer to Figure 4-25. Record the level switching time.

NOTE

With the oscilloscope in delayed sweep mode, the left graticule of the display corresponds to the delay time. This delay must be added to the time from the left graticule to the last time the signal is more than ±1 division from the middle graticule to obtain the level switching time.

__________ <25 ms

13. Repeat steps 5 through 12 for each of the start and stop levels listed below. Instead of re-entering the program, modify lines 10, 100 and 110 and then run the program as directed. Modify line 10 and 110 of the program by setting L2 to the stop level (i.e. L2=0). Modify line 100 of the program by setting L1 to the start level (i.e. L1=−88). Record the switch time for each indicated level change.

PERFORMANCE TESTS

OUTPUT LEVEL SWITCHING TIME TEST (cont'd)

Procedure (cont'd)

Start Level (dBm)	Stop Level (dBm)	Measured Switching Time
−88.0	0.0	________ <25 ms
−77.0	0.0	________ <25 ms
−66.0	0.0	________ <25 ms
−50.0	−2.0	________ <25 ms
−40.0	0.0	________ <25 ms
−30.0	0.0	________ <25 ms
−20.0	4.0	________ <25 ms
−10.0	2.0	________ <25 ms
− 9.9	7.0	________ <25 ms
− 8.0	6.0	________ <25 ms
− 9.9	0.0	________ <25 ms
− 7.0	3.0	________ <25 ms

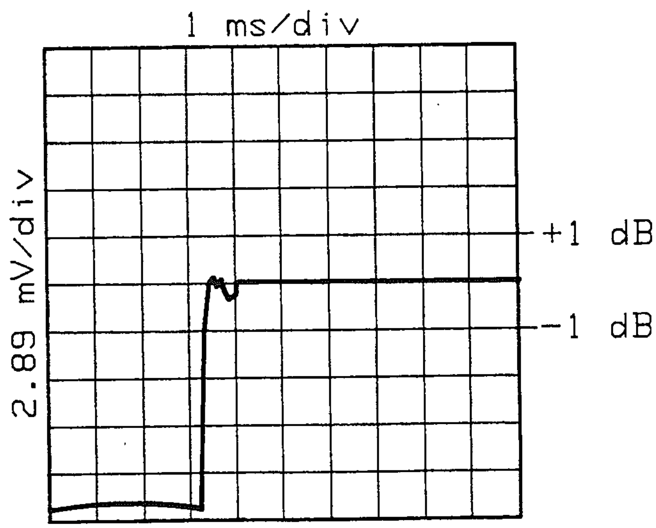

Figure 4-25. Level Switching Time Measurement Waveform

PERFORMANCE TESTS

4-18. PULSE ON/OFF RATIO TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
ON/OFF Ratio	>80 dB	

Description A spectrum analyzer is used to measure the change in output power when the pulse modulator is switched from complement mode to normal mode.

Equipment Spectrum Analyzer .... HP 8566B

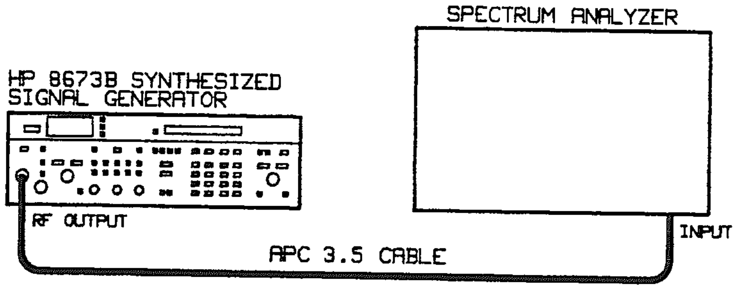

Figure 4-26. Pulse ON/OFF Ratio Test Setup

Procedure

1. Connect the equipment as shown in Figure 4-26.
2. Set the Signal Generator as follows:

   FREQUENCY .... 2 000.0 MHz
   OUTPUT LEVEL RANGE .... 0 dBm
   OUTPUT LEVEL VERNIER .... −10 dBm
   PULSE .... COMPL
   AM .... OFF
   FM DEVIATION .... OFF
   SWEEP MODE .... OFF

3. Set the spectrum analyzer controls as follows:

   Center Frequency .... 2 000.0 MHz
   Frequency Span .... 100 kHz
   Resolution Bandwidth .... 1 kHz
   Video Bandwidth .... 100 Hz
   Sweep Time .... 3 sec

4. Adjust the spectrum analyzer controls to establish a reference at the top graticule line.

PERFORMANCE TESTS

PULSE ON/OFF RATIO TEST (cont'd)

Procedure (cont'd)

NOTE

The spectrum analyzer must not be in the gain compression region for this measurement. If a 3 dB increase in the Signal Generator output level does not produce a 3 dB increase in the level of the displayed signal, the spectrum analyzer is in gain compression. If this happens, increase the spectrum analyzer's input attenuation until a 3 dB increase in the Signal Generator's output level produces a 3 dB change in the displayed signal level.

5. Set PULSE MODE on the Signal Generator to NORM.

6. Reduce the spectrum analyzer reference level as needed to observe the residual signal. It should be >80 dB below the reference established in step 4. Record the reading.

2 000.0 MHz ________ >80 dB

7. Repeat steps 4 through 6 for the Signal Generator frequencies listed below. Record the results in the table below.

Frequency (MHz)	Level (dB below reference)
3 000.0	> 80 ________
4 000.0	> 80 ________
5 000.0	> 80 ________
6 000.0	> 80 ________
6 600.0	> 80 ________

4-19. PULSE RISE/FALL TIME AND OVERSHOOT TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
PULSE MODULATION		
Rise and Fall Times	<35 ns	AUTO PEAK enabled
For Option 008	<40 ns	2.0 to 26.0 GHz AUTO PEAK enabled
Overshoot, Ringing	<20%	2.0 to 6.6 GHz, 6.7 to 26.0 GHz
	<25%	6.6 to 6.7 GHz,
For Option 008	<25%	2.0 to 26.0 GHz

Description

The pulse test uses a mixer to generate an IF signal of 70 MHz. The resulting IF signal is amplified and viewed on an oscilloscope to determine pulse performance.

Equipment

HP-IB Controller .... HP 9836A or HP85B/82903
Local Oscillator .... HP 8340A
Pulse Generator .... HP 8013B
Oscilloscope .... HP 1980B
Pre Amp-Power Amp .... HP 8447F
Mixer .... RHG DMS1-26
20 dB Attenuator .... HP 8493C Option 020
3 dB Attenuator .... HP 8491A Option 003
10 dB Attenuator .... HP 8491A Option 010

Procedure

1. Connect the equipment as shown in Figure 4-27.

NOTE

Make sure there are no sharp bends in the cables, 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.

2. Set the Signal Generator as follows:
   FREQUENCY .... 2 000.0 MHz
   PULSE .... NORM
   OUTPUT LEVEL RANGE .... 10 dB
   OUTPUT LEVEL VERNIER .... Maximum specified power

NOTE

Maximum specified power at 2 000.0 MHz and up to 18 000.0 MHz is as follows:

Standard: .... +8 dBm
Option 001: .... +10 dBm
Option 004: .... +7 dBm
Option 005: .... +9 dBm
Option 008: .... +8 dBm

PERFORMANCE TESTS

PULSE RISE/FALL TIME AND OVERSHOOT TEST (cont'd)

Procedure (cont'd)

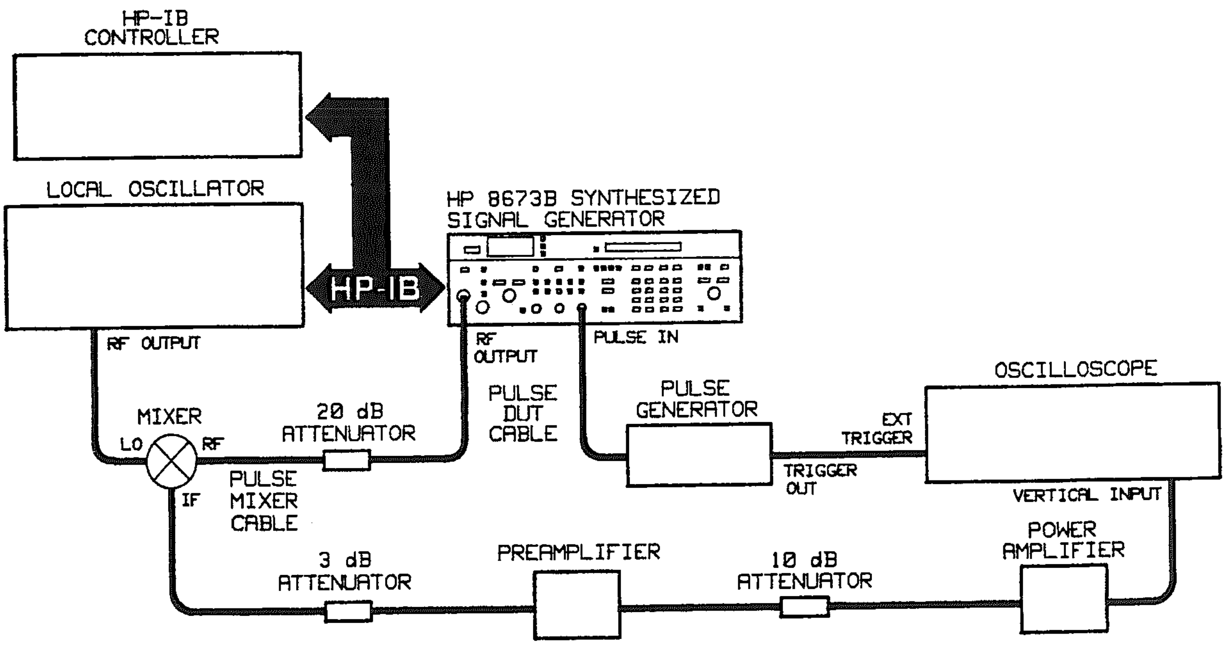

Figure 4-27. Pulse Rise/Fall Time and Overshoot Test Setup

3. Set the pulse generator and oscilloscope controls as follows:

   Pulse Generator:
   - Pulse Rate .... 1 MHz
   - Pulse Width .... 120 ns
   - Pulse Amplitude .... 5V peak

   Oscilloscope:
   - Vertical Display .... Channel 1, DC 50Ω Coupling
   - Time/Div Main .... 20 ns
   - Time/Div Delayed .... 20 ns
   - Vertical Sensitivity .... 20 mV/div.
   - Trigger .... External DC Coupled
   - Sweep .... Triggered

4. Set the local oscillator address to 718. Enter and run the following program.

NOTE

The following program will cause the local oscillator to track the frequency of the Signal Generator with a positive offset of 70 MHz. A change in the Signal Generator's frequency will be detected by the controller and the frequency output of the local oscillator will be automatically changed to maintain the positive offset.

PERFORMANCE TESTS

PULSE RISE/FALL TIME AND OVERSHOOT TEST (cont'd)

Procedure (cont'd)

```
10 F1+0
20 F0+0
30 OUTPUT 719;"FROA"
                                   Read current UUT frequency
40 ENTER 719;F2
45 OUTPUT 719;"CS"
50 LOCAL 719
                                   Convert reading to MHz
55 F2+F2/1000000
60 IF F2<>F1 THEN F1+F2
                                   Calculate 70 MHz offset frequency
70 F3+F1+70
90 IF F0<>F3 THEN GOSUB 500
100 V+SPOLL(719)
110 IF NOT BIT(V,1) THEN GOTO 100
120 V+SPOLL(719)
130 IF NOT BIT(V,1) THEN GOTO 120
140 GOTO 30
500 F0+F3
                                   Local oscillator address
505 OUTPUT 718;"CW";F0;"MZAP7DB"
510 RETURN                         Tune local oscillator to offset frequency
520 END
```

5. Adjust the oscilloscope to center the pulse waveform. Adjust the vertical controls for a 5 division peak pulse display. See Figure 4-28.

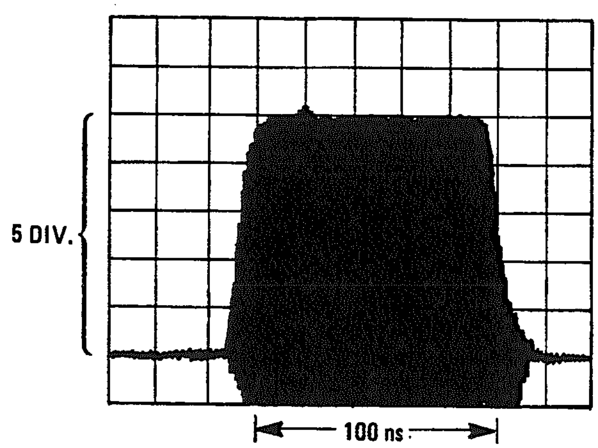

Figure 4-28. Pulse Rise/Fall Time and Overshoot Waveform

PERFORMANCE TESTS

PULSE RISE/FALL TIME AND OVERSHOOT TEST (cont'd)

Procedure (cont'd)

6. Measure the pulse rise time, fall time, overshoot and ringing. Record the results.

Rise Time ________ <35 ns
Fall Time ________ <35 ns
Overshoot and Ringing ________ <20%

For Option 008:
Rise Time ________ <40 ns
Fall Time ________ <40 ns
Overshoot and Ringing ________ <25%

NOTE

For the measurements in this procedure, refer to Figure 4-29, Pulse Definitions, for explanations of the pulse parameters.

Pulse Rise Time = The time required for a pulse to increase from 10% to 90% of peak amplitude (T_R).

Pulse Fall Time = The time required for a pulse to decrease from 90% to 10% of peak amplitude (T_F).

Overshoot and Ringing = The ratio of pulse overshoot (V_{or}) to peak amplitude (V_p). (V_{or}/V_p)

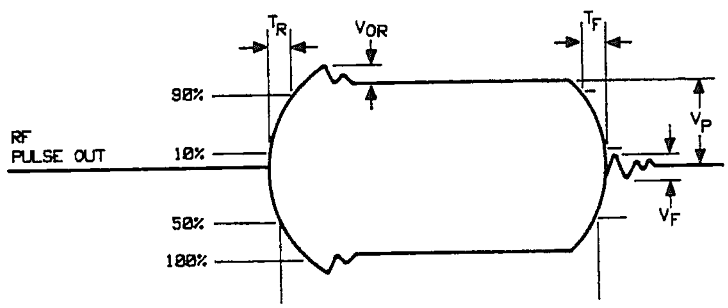

Figure 4-29. Pulse Definitions

7. Tune the Signal Generator to 6600 MHz. Measure the pulse rise time, fall time, overshoot and ringing. Record the results.

Rise Time ________ <35 ns
Fall Time ________ <35 ns
Overshoot and Ringing ________ <20%

For Option 008:
Rise Time ________ <40 ns
Fall Time ________ <40 ns
Overshoot and Ringing ________ <25%

8. Set the Signal Generator to the levels shown in the table below. Tune the Signal Generator's output frequency as shown for each level. The local oscillator should track the Signal Generator with a 70 MHz offset. Measure rise time, fall time, overshoot, and ringing at each frequency. Rise and fall times should be less than 35 ns (40 ns. for Option 008). Overshoot and ringing should be less than 25% from 6600 to

PERFORMANCE TESTS

PULSE RISE/FALL TIME AND OVERSHOOT TEST (cont'd)

Procedure (cont'd)

6700 MHz, less than 20% from 6700 to 26 000 MHz, and less than 25% for Option 008 at all frequencies. Record the results in the following table.

OUTPUT LEVEL		FREQUENCY (MHz)	RISE (ns)	FALL (ns)	Overshoot and Ringing (%)
RANGE	VERNIER				
+10 dB	Max.*	6600.002	______	______	______
+10 dB	Max.*	6700.002	______	______	______
+10 dB	Max.*	12 290.002	______	______	______
0 dB	0 dBm	6600.002	______	______	______
0 dB	0 dBm	6700.002	______	______	______
0 dB	0 dBm	12 290.002	______	______	______
0 dB	−10 dBm	6600.002	______	______	______
0 dB	−10 dBm	6700.002	______	______	______
0 dB	−10 dBm	12 290.002	______	______	______

* Adjust VERNIER for maximum output power as defined in step 2.

9. Tune the Signal Generator from 6.6 to 12.3 GHz. Ensure that rise time, fall time, overshoot, and ringing are within the limits specified at output levels of maximum specified power, 0 dBm, and −10 dBm for all frequencies within this range. Record the worst case results.

FREQUENCY (MHz)	OUTPUT LEVEL		RISE (ns)	FALL (ns)	Overshoot and Ringing (%)
	RANGE	VERNIER			
______	+10 dB	Max.*	______	______	______
______	0 dB	0 dBm	______	______	______
______	0 dB	−10 dBm	______	______	______

* Adjust VERNIER for maximum output power as defined in step 2.

10. Set the Signal Generator to the levels shown in the following table. Tune the Signal Generator's output frequency as shown for each level. Measure rise time, fall time, overshoot, and ringing at each setting. Rise and fall times should be less than 35 ns (40 ns for Option 008). Overshoot and ringing should be less than 20% (25% for Option 008). Record the measurements in the following table.

OUTPUT LEVEL		FREQUENCY (MHz)	RISE (ns)	FALL (ns)	Overshoot and Ringing (%)
RANGE	VERNIER				
+10 dB	Max.*	12 300.003	______	______	______
+10 dB	Max.*	17 990.003	______	______	______
0 dB	0 dBm	12 300.003	______	______	______
0 dB	0 dBm	17 990.003	______	______	______
0 dB	−10 dBm	12 300.003	______	______	______
0 dB	−10 dBm	17 990.003	______	______	______

* Adjust VERNIER for maximum output power as defined in step 2.

PERFORMANCE TESTS

PULSE RISE/FALL TIME AND OVERSHOOT TEST (cont'd)

Procedure (cont'd)

11. Tune the Signal Generator from 12.3 to 18.0 GHz at output levels of −10 dBm, 0 dBm, and maximum power. Verify that the rise and fall times are less than 35 ns (40 ns for Option 008) and overshoot and ringing are less than 20% (25% for Option 008). Record the worst case readings in the following table.

FREQUENCY (MHz)	OUTPUT LEVEL		RISE (ns)	FALL (ns)	Overshoot and Ringing (%)
	RANGE	VERNIER			
________	−10 dB	Max.*	________	________	________
________	0 dB	0 dBm	________	________	________
________	0 dB	−10 dBm	________	________	________

* Adjust VERNIER for maximum output power as defined in step 2.

12. Set the Signal Generator to the levels shown in the following table. Tune the Signal Generator's output frequency as shown for each level. Measure rise time, fall time, overshoot, and ringing at each setting. Rise and fall times should be less than 35 ns (40 ns for Option 008). Overshoot and ringing should be less than 20% (25% for Option 008).

NOTE

Maximum specified power at 18 000 MHz and up to 22 000 MHz is as follows:

Standard: .... +4 dBm
Option 001: .... +6 dBm
Option 004: .... +2 dBm
Option 005: .... +4 dBm
Option 008: .... +7 dBm

OUTPUT LEVEL		FREQUENCY (MHz)	RISE (ns)	FALL (ns)	Overshoot and Ringing (%)
RANGE	VERNIER				
+10 dB	Max.*	18 600.004	________	________	________
+10 dB	Max.*	21 990.004	________	________	________
0 dB	0 dBm	18 600.004	________	________	________
0 dB	0 dBm	21 990.004	________	________	________
0 dB	−10 dBm	18 600.004	________	________	________
0 dB	−10 dBm	21 990.004	________	________	________

* Adjust VERNIER for maximum output power as defined in step 12.

13. Tune the Signal Generator from 18.0 to 22.0 GHz at output levels of −10 dBm, 0 dBm, and maximum. Verify that rise and fall times are less than 35 ns (40 ns for Option 008) and that overshoot and ringing are less than 20% (25% for Option 008). Record the worst case results in the following table.

PERFORMANCE TESTS

PULSE RISE/FALL TIME AND OVERSHOOT TEST (cont'd)

Procedure (cont'd)

FREQUENCY (MHz)	OUTPUT LEVEL		RISE (ns)	FALL (ns)	Overshoot and Ringing (%)
	RANGE	VERNIER			
______	+10 dB	Max.*	______	______	______
______	0 dB	0 dBm	______	______	______
______	0 dB	−10 dBm	______	______	______
* Adjust VERNIER for maximum output power as defined in step 12.					

14. Set the Signal Generator to 25 990.004 MHz and its output to the levels shown in the following table. Measure rise time, fall time, overshoot, and ringing at each setting. Rise and fall times should be less than 35 ns (40 ns for Option 008). Overshoot and ringing should be less than 20% (25% for Option 008).

NOTE

Maximum specified power at 22 000 MHz and up to 26 000 MHz is as follows:

Standard: .... 0 dBm
Option 001: .... +3 dBm
Option 004: .... −2 dBm
Option 005: .... +1 dBm
Option 008: .... +7 dBm

OUTPUT LEVEL		FREQUENCY (MHz)	RISE (ns)	FALL (ns)	Overshoot and Ringing (%)
RANGE	VERNIER				
+10 dB (Not for Opt. 004)	Max.*	25 990.004	______	______	______
0 dB (Not for Opt. 004)	0 dBm	25 990.004	______	______	______
0 dB (For Opt. 004)	−2 dBm	25 990.004	______	______	______
0 dB	−10 dBm	25 990.004	______	______	______
* Adjust VERNIER for maximum output power as defined in step 14.					

15. Tune the Signal Generator from 22.0 to 26.0 GHz at output levels of −10 dBm, 0 dBm, and +6 dBm. Verify that rise and fall times are less than 35 ns (40 ns for Option 008) and that overshoot and ringing are less than 20% (25% for Option 008). Record the worst case results in the table below.

FREQUENCY (MHz)	OUTPUT LEVEL		RISE (ns)	FALL (ns)	Overshoot and Ringing (%)
	RANGE	VERNIER			
______	+10 dB (Not for Opt. 004)	Max.*	______	______	______
______	0 dB (Not for Opt. 004)	0 dBm	______	______	______
______	0 dB (For Opt. 004)	−2 dBm	______	______	______
______	0 dB	−10 dBm	______	______	______
* Adjust VERNIER for maximum output power as defined in step 14.					

PERFORMANCE TESTS

4-20. PULSE PEAK LEVEL ACCURACY TEST

Specification

Electrical Characteristics	Performance Limits	Conditions
PULSE MODULATION		
Maximum Peak Power	Same as in CW mode	
Peak Level Accuracy	+1.5/−1.0 dB	Relative to CW; +15 to +35°C

Description

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.

Equipment

Local Oscillator .... HP 8340A
Pulse Generator .... HP 8013B
Oscilloscope .... HP 1980B
Pre Amp-Power Amp .... HP 8447F
Mixer .... RHG DMS1-26
20 dB Attenuator .... HP 8493C Option 020
3 dB Attenuator .... HP 8491A Option 003
10 dB Attenuator .... HP 8491A Option 010

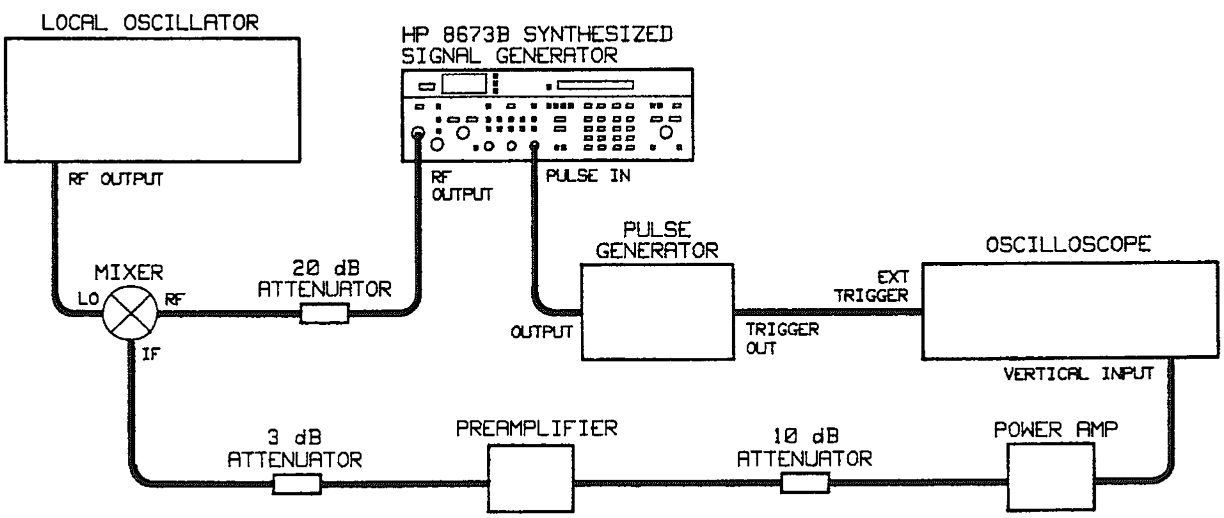

Figure 4-30. Pulse Peak Level Accuracy Test Setup

Procedure

1. Connect the equipment as shown in Figure 4-30.
2. Set the Signal Generator to 6.6 GHz with an output amplitude of +7 dBm.
3. Set the local oscillator to 6.67 GHz with an output amplitude of +8 dBm.
4. Set the pulse generator for a 100 ns pulse width at a 1 MHz pulse rate.

PERFORMANCE TESTS

PULSE PEAK LEVEL ACCURACY TEST (cont'd)

Procedure (cont'd)

5. 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.

6. Adjust the RF pulse width with the pulse generator to obtain a 100 ns RF pulse width as displayed on the oscilloscope.

7. Switch the Signal Generator to CW mode.

8. Adjust the oscilloscope's vertical sensitivity controls to place the peak of the CW signal on the fifth graticule above the pulse base line (refer to Figure 4-31). The peak of the CW signal is now the CW peak reference level.

NOTE

Do not touch the oscilloscope's vertical position controls after the reference pulse base line has been set.

9. Switch the Signal Generator to PULSE NORM. Without adjusting the oscilloscope's vertical sensitivity controls, measure the difference between the CW peak reference level and the average peak pulse level excluding any overshoot. See Figure 4-31.

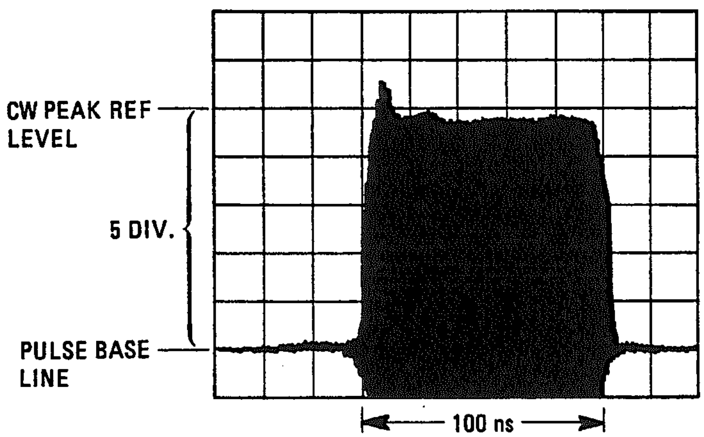

Figure 4-31. Pulse Peak Level Accuracy Measurement

10. Measure the peak level difference in percent. Using a 5 division peak reference, each division represents a 20% difference. Measured difference must be within the limits of −10.8% to +18.8%. (−10.8% corresponds to −0.5 divisions on the oscilloscope; +18.8% corresponds to +0.9 divisions.) This is equal to +1.5 dB, −1 dB. Record the measurement in the following table.

11. Repeat steps 1 through 10 for the frequencies and levels listed in the following table. Record the results.

PERFORMANCE TESTS

PULSE PEAK LEVEL ACCURACY TEST (cont'd)

Procedure (cont'd)

Signal Generator		Local Oscillator		% Difference
FREQ	LEVEL	FREQ	LEVEL	
6.6 GHz	+7 dBm	6.67 GHz	+8 dBm	______
6.61 GHz	+7 dBm	6.68 GHz	+8 dBm	______
	0 dBm			______
	−10 dBm			______
12.3 GHz	+7 dBm	12.37 GHz	+8 dBm	______
	0 dBm			______
	−10 dBm			______
18.61 GHz	+2 dBm	18.68 GHz	+8 dBm	______
	0 dBm			______
	−10 dBm			______
22.1 GHz	−2 dBm	22.17 GHz	+8 dBm	______
	−10 dBm			______

PERFORMANCE TESTS

4-21. AM BANDWIDTH

Specification

Electrical Characteristics	Performance Limits	Conditions
AM Bandwidth	20 Hz to 100 kHz	3 dB bandwidth, 30% depth, Pulse Modulation off
	≤ (Pulsewidth x (PRF) x (4 kHz)	Pulse Modulation On

Description

The Signal Generator is amplitude modulated by an audio source and mixed down with a local oscillator to produce a modulated 100 MHz IF signal. The AM depth is measured with a measuring receiver. The detected audio output from the measuring receiver is input to an audio analyzer. A 0 dB reference level is established on the audio analyzer at a 1 kHz modulation rate. The modulation rate is then stepped from 20 Hz to 100 kHz to verify that the detected audio output remains within ±3 dB (the 3 dB bandwidth).

Equipment

Local Oscillator .... HP 8340A
Measuring Receiver .... HP 8902A
Audio Analyzer/Source .... HP 8903B
Mixer .... RHG DMS1-26
6 dB Attenuator .... HP 8493C Option 006

Procedure

1. Connect the equipment as shown in Figure 4-32.
2. Set the Signal Generator as follows:
   FREQUENCY .... 4.0 GHz
   OUTPUT LEVEL RANGE .... 0 dB
   OUTPUT LEVEL VERNIER .... −2 dBm
   ALC .... INT
   AM .... 100% range
   FM .... OFF
3. Tune the local oscillator to 3.9 GHz with an output amplitude of +8 dBm and all modulation off.
4. Select AM mode on the measuring receiver.
5. Set the audio source to a 1 kHz rate. Adjust the audio source output level for 30% AM depth, as read on the measuring receiver.
6. Set the audio analyzer to read the amplitude of the input signal in dB.
7. Set the audio analyzer to the dB Relative mode using the input signal from the measuring receiver as a 0 dB reference.
8. Tune the audio source from 20 Hz to 100 kHz. The signal level reading on the audio analyzer should not change more than ±3 dB from the reference.

NOTE

The modulation source level may need slight adjustments to hold it at the reference level in step 5.

PERFORMANCE TESTS

AM BANDWIDTH (cont'd)

Procedure (cont'd)

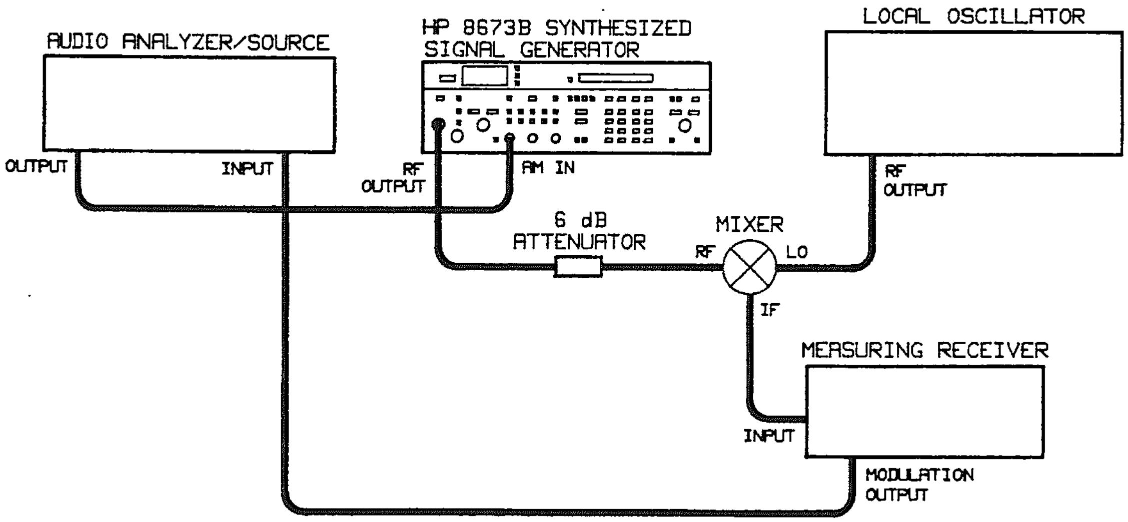

Figure 4-32. AM Bandwidth Test Setup

9. Repeat steps 5 through 8 for the frequencies listed below.

Signal Generator Frequency	Local Oscillator Frequency	AM Depth	Modulation	
			Frequency	Change
4.0 GHz	3.9 GHz	30%	________	________
6.7 GHz	6.6 GHz	30%	________	________
15.0 GHz	14.9 GHz	30%	________	________
24.0 GHz	23.9 GHz	30%	________	________
26.0 GHz	25.9 GHz	30%	________	________

PERFORMANCE TESTS

4-22. AM ACCURACY TESTS

Specification

Electrical Characteristics	Performance Limits	Conditions
AMPLITUDE MODULATION		
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

Description

The Signal Generator is amplitude modulated by an audio source. The modulated signal is mixed with a local oscillator to produce a modulated 100 MHz IF signal. The AM depth, meter accuracy, and accuracy relative to the external AM input are measured on a measuring receiver.

Equipment

Local Oscillator .... HP 8340A
Measuring Receiver .... HP 8902A
Audio Analyzer/Source .... HP 8903B
Digital Voltmeter .... HP 3455A
6 dB Attenuator .... HP 8493C Option 006
Mixer .... RHG DMS1-26

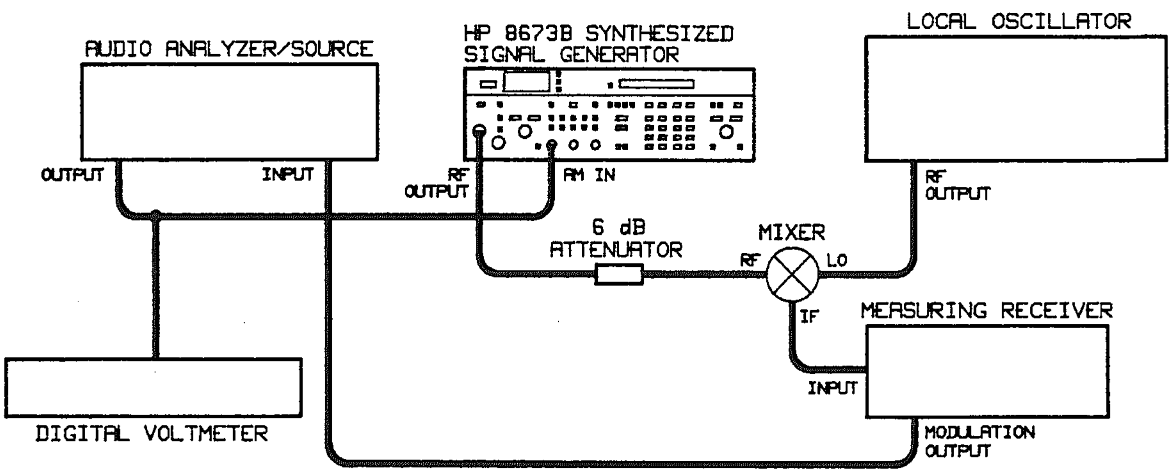

Figure 4-33. AM Accuracy Test Setup

Procedure

Meter Accuracy

1. Connect the equipment as shown in Figure 4-33.

PERFORMANCE TESTS

AM ACCURACY TESTS (cont'd)

Procedure (cont'd)

2. Set the Signal Generator as follows:

FREQUENCY .... 2.0 GHz
OUTPUT LEVEL RANGE .... 0 dB
OUTPUT LEVEL VERNIER .... 0 dBm
ALC .... INT
AM .... 100% range
FM .... OFF

3. Tune the local oscillator to 2.05 GHz at an output amplitude of +8 dBm.
4. Select AM mode on the measuring receiver.
5. Set the modulation source to 1 kHz. Adjust the output level to obtain 50% AM as read on the measuring receiver.
6. The AM meter on the Signal Generator should indicate 50% AM ±6.5%. Record the reading.

AM Meter reading 43.5% ________ 56.5%

Accuracy Relative to External AM Input

7. Set the audio source frequency to 10 kHz with an output amplitude of 0.530 Vrms as read on the digital voltmeter. This corresponds to 75% AM depth.
8. Read the actual AM depth on the measuring receiver. The reading should be within ±5.0% of 75% AM. Record the reading in the table below.
9. Repeat steps 7 and 8 with the frequencies and modulation rates listed in the table below.

Signal Generator Frequency	Local Oscillator Frequency	Modulation Rate	Low Limit	Actual Depth	High Limit
6.6 GHz	6.5 GHz	10 kHz	70.0%	________	80.0%
6.6 GHz	6.5 GHz	1 kHz	70.0%	________	80.0%
6.6 GHz	6.5 GHz	0.1 kHz	70.0%	________	80.0%
10 GHz	9.9 GHz	10 kHz	70.0%	________	80.0%
14 GHz	13.9 GHz	10 kHz	70.0%	________	80.0%

10. Set the Signal Generator OUTPUT LEVEL VERNIER to −3 dBm.
11. Repeat steps 7 and 8 for the frequency listed below.

Signal Generator Frequency	Local Oscillator Frequency	Modulation Rate	Low Limit	Actual Depth	High Limit
18.6 GHz	18.5 GHz	10 kHz	70.0%	________	80.0%

PERFORMANCE TESTS

AM ACCURACY TESTS (cont'd)

Procedure (cont'd)

12. Set the Signal Generator OUTPUT LEVEL VERNIER to −5 dBm.

13. Set the audio source amplitude to 0.354 Vrms as read on the digital voltmeter. This corresponds to 50% AM depth.

14. Read the actual AM depth on the measuring receiver. The reading should be within ±5.0% of 50% AM. Record the reading in the table below.

Signal Generator Frequency	Local Oscillator Frequency	Modulation Rate	Low Limit	Actual Depth	High Limit
22 GHz	21.9 GHz	10 kHz	45.0%	________	55.0%

PERFORMANCE TESTS

4-23. INCIDENTAL FM

Specification

Electrical Characteristics	Performance Limits	Conditions
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
	<2.5 radians	>24.0 to 26.0 GHz
Incidental FM	Incidental phase modulation x f_{mod}	

Description

Incidental FM is measured using a measuring receiver. The output of the Signal Generator is amplitude modulated. An AM reference level is set on the measuring receiver. The modulation analyzer is then set to measure FM. The amount of incidental FM present on the signal is measured and recorded.

NOTE

The specification for incidental FM is derived from incidental phase modulation and the modulation rate (f_{mod}). Thus, worst cases of incidental FM at a 10 kHz maximum modulation rate are as follow:

4 kHz .... 2.0 to 6.6 GHz
8 kHz .... >6.6 to 12.3 GHz
12 kHz .... >12.3 to 18.6 GHz
16 kHz .... >18.6 to 24.0 GHz
25 kHz .... >24.0 to 26.0 GHz

Equipment

Local Oscillator .... HP 8340A
Measuring Receiver .... HP 8902A
Audio Analyzer/Source .... HP 8903B
Mixer .... RHG DMS1-26
6 dB Attenuator .... HP 8493C Option 006

Procedure

1. Connect the equipment as shown in Figure 4-34.

2. Set the Signal Generator as follows:

   FREQUENCY .... 6.2 GHz
   OUTPUT LEVEL RANGE .... 0 dB
   OUTPUT LEVEL VERNIER .... 0 dBm
   ALC .... INT
   AM .... 100% range
   FM .... OFF

3. Tune the local oscillator to 6.1 GHz with an output amplitude of +7 dBm.

4. Select AM mode on the measuring receiver.

PERFORMANCE TESTS

INCIDENTAL FM (cont'd)

Procedure (cont'd)

5. Set the modulation source to 10 kHz. Adjust the output level to obtain 30% AM as read on the measuring receiver.

6. Select FM mode on the measuring receiver. The incidental FM indicated on the measuring receiver should be less than 4 kHz. Record the reading in the following table.

7. Repeat steps 2 through 6 for the frequencies listed in the table below.

Signal Generator		Local Oscillator		Incidental FM	
Frequency	Level	Frequency	Level	Actual	Limit
6.2 GHz	0 dBm	6.1 GHz	+7 dBm	________	<4 kHz
12.3 GHz	0 dBm	12.2 GHz	+7 dBm	________	<8 kHz
18.0 GHz	0 dBm	17.9 GHz	+7 dBm	________	<12 kHz
24.0 GHz	−3 dBm	23.9 GHz	+7 dBm	________	<16 kHz
26.0 GHz	−5 dBm	25.9 GHz	+7 dBm	________	<25 kHz

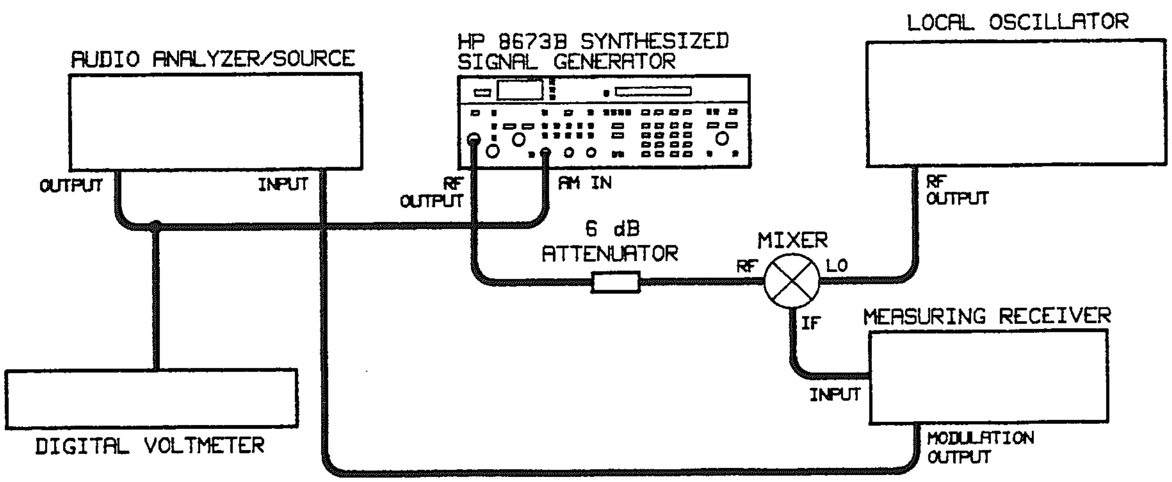

Figure 4-34. Incidental FM Test Setup

PERFORMANCE TESTS

4-24. FM FREQUENCY RESPONSE

Specification

Electrical Characteristics	Performance Limits	Conditions
FM Frequency Response (Relative to 100 kHz rate):		
100 Hz to 3 MHz	±2.0 dB	30 and 100 kHz/V ranges.
3 kHz to 3 MHz	±2.0 dB	300 kHz and 1, 3, and 10 MHz/V ranges.

Description

The test oscillator is tuned to 100 kHz and the output level is adjusted to obtain the first carrier (Bessel) null. This 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

AC Voltmeter .... HP 400E
Frequency Counter .... HP 5343A
Spectrum Analyzer .... HP 8566B
Test Oscillator .... HP 8116A

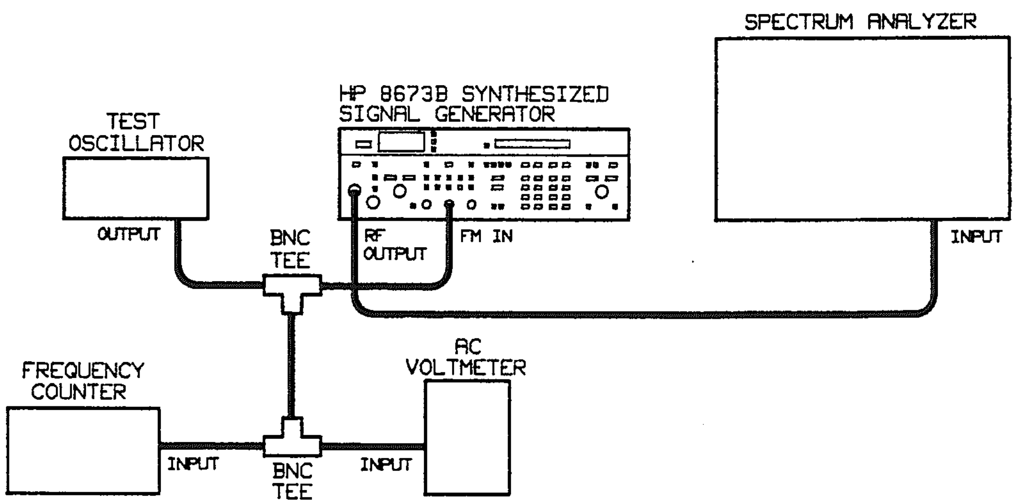

Figure 4-35. FM Frequency Response Test Setup

Procedure

1. Connect the equipment as shown in Figure 4-35.

2. Set the Signal Generator as follows:
   FREQUENCY .... 4000 MHz
   OUTPUT LEVEL RANGE .... 0 dB
   OUTPUT LEVEL VERNIER .... 0 dBm
   FM DEVIATION range .... 10 MHz

PERFORMANCE TESTS

FM FREQUENCY RESPONSE (cont'd)

Procedure (cont'd)

3. Adjust the spectrum analyzer to display the 4 GHz RF signal. Set the spectrum analyzer sweep span to 1 MHz initially. (It will be necessary to change the sweep span for later measurements.) Set the other controls as needed for a calibrated display.

4. Tune the test oscillator to 100 kHz.

5. Adjust the test oscillator's output level to obtain the first carrier (Bessel) null. Record the voltage indicated on the AC voltmeter in the table below. (The voltage should be approximately 0.017 Vrms).

6. Reduce the test oscillator's output level to 0 Vrms.

7. Tune the test oscillator to 3 kHz (f_x). Adjust the test oscillator's output voltage to obtain the first carrier null. Record the measured frequency and voltage in the table below.

8. Repeat steps 6 and 7 for each of the remaining frequencies listed in the table below.

Modulation Frequency (kHz)	Measured Frequency (kHz)	Measured Voltage (Vrms)	Calculated Response (dB)
3	________	________	________
30	________	________	________
100	100.0	________	0
300	________	________	________
1000	________	________	________
3000	________	________	________

9. Use the following equation to calculate the FM frequency response.

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

where dB = the calculated frequency response
V_x = the voltage measured at f_x
$V_{100\ kHz}$ = the reference voltage measured at 100 kHz
f_x = the measured frequency.

PERFORMANCE TESTS

4-25. EXTERNAL FM ACCURACY AND METER ACCURACY

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY MODULATION		
Maximum Peak Deviation	The smaller of 10 MHz or f(mod) x 5.	2.0 to 6.6 GHz
	The smaller of 10 MHz or f(mod) x 10.	>6.6 to 12.3 GHz
	The smaller of 10 MHz or f(mod) x 15.	>12.3 to 18.6 GHz
	The smaller of 10 MHz or f(mod) x 20.	>18.6 to 26.0 GHz
Sensitivity (peak deviation per Vpk)	Maximum input 1 Vpk into 50Ω 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 Signal Generator is frequency modulated by an external source. The output of the Signal Generator is mixed with a local oscillator to produce a modulated 500 MHz IF signal. A measuring receiver measures the FM characteristics of the IF signal.

Equipment

Local Oscillator .... HP 8340A
Measuring Receiver .... HP 8902A
Test Oscillator .... HP 8116A
Digital Voltmeter .... HP 3456A
Mixer .... RHG DMS1-26

Procedure

Sensitivity and Meter Accuracy

1. Connect the equipment as shown in Figure 4-36.

NOTE

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

2. Set the Signal Generator as follows:

FREQUENCY .... 2 GHz
OUTPUT LEVEL RANGE .... 0 dB
OUTPUT LEVEL VERNIER .... −5 dBm
FM DEVIATION range .... 0.3 MHz
Meter Scale .... FM

PERFORMANCE TESTS

EXTERNAL FM ACCURACY AND METER ACCURACY (cont'd)

Procedure (cont'd)

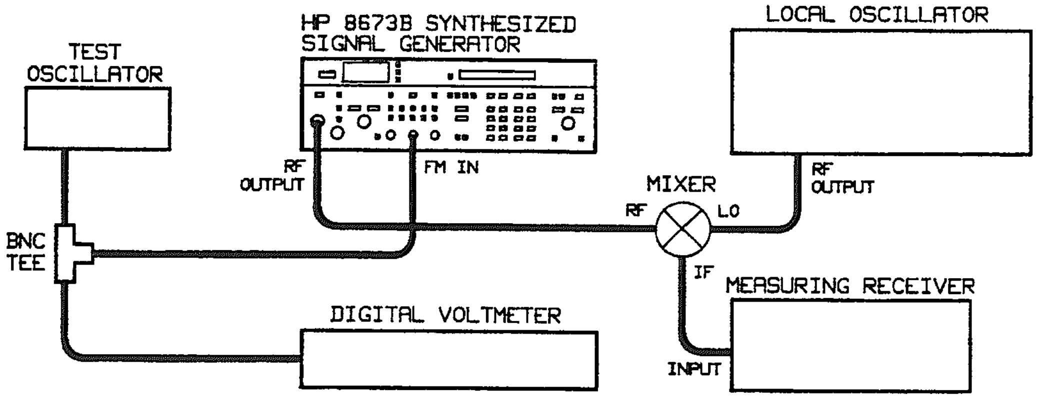

Figure 4-36. External FM Accuracy and Meter Accuracy Test Setup

3. Tune the local oscillator to 2.5 GHz with an output amplitude of +8 dBm.
4. Set the measuring receiver to measure FM.
5. Set the test oscillator to a 100 kHz rate. Adjust the output level to obtain a full scale reading on the Signal Generator's front panel meter.
6. The measuring receiver should read 300 kHz ±45 kHz deviation. Record the reading.

   FM reading 255 kHz ________ 345 kHz

7. Adjust the test oscillator level to obtain 50 kHz deviation as read on the Signal Generator's front panel meter.
8. The measuring receiver should read 50 kHz ±15 kHz deviation. Record the reading.

   FM reading 35 kHz ________ 65 kHz

Accuracy Relative to External FM Input

9. Tune the test oscillator to 100 kHz with an output amplitude of 0.707 Vrms.
10. Set the Signal Generator FM DEVIATION range to 0.3 MHz. The measuring receiver should indicate FM deviation within the limits listed in the following table. Record the reading in the table.
11. Repeat step 10 using the FM deviations and levels listed in the following table. Record the readings in the table.

PERFORMANCE TESTS

EXTERNAL FM ACCURACY AND METER ACCURACY (cont'd)

Procedure (cont'd)

FM Deviation	Test Oscillator Level (Vrms)	Low Limit	Actual Deviation	High Limit
0.03 MHz	0.707	27 kHz	________	33 kHz
0.1 MHz	0.707	90 kHz	________	110 kHz
0.3 MHz	0.707	270 kHz	________	330 kHz
1 MHz	0.212	249 kHz	________	351 kHz

12. Tune the Signal Generator to 6.7 GHz. Set the FM DEVIATION range to 0.3 MHz.

13. Tune the local oscillator to 7.2 GHz.

14. Set the test oscillator's output level to 0.707 Vrms.

15. Read the FM deviation on the measuring analyzer. Verify that the measured deviation is within the limits shown in the following table. Record the readings.

16. Repeat steps 12 through 15 using the frequencies listed in the following table. Record the readings.

Signal Generator Frequency	Local Oscillator Frequency	Low Limit	Actual Deviation	High Limit
6.7 GHz	7.2 GHz	270 kHz	________	330 kHz
12.3 GHz	12.9 GHz	270 kHz	________	330 kHz
18.6 GHz	19.1 GHz	270 kHz	________	330 kHz

PERFORMANCE TESTS

4-26. INCIDENTAL AM

Specification

Electrical Characteristics	Performance Limits	Conditions
FREQUENCY MODULATION Incidental AM	<5%	Rates <100 kHz; peak deviations ≤1 MHz.

Description

The Signal Generator is modulated at 5% AM (the maximum allowable incidental AM). The output signal is detected and measured with a voltmeter. The detected signal is recorded as a reference level. The Signal Generator is then frequency modulated and the detected AM level is compared to the reference level.

Equipment

Test Oscillator .... HP 8116A
Digital Voltmeter .... HP 3456A
Crystal Detector .... HP 8473C
50 Ohm Termination .... HP 11593A

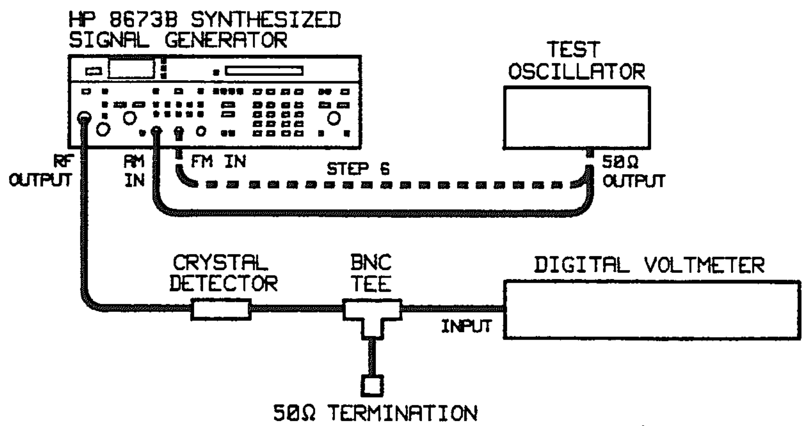

Figure 4-37. Incidental AM Test Setup

Procedure

1. Connect the equipment as shown in Figure 4-37.
2. Set the Signal Generator as follows:

   FREQUENCY .... 2 000.0 MHz
   OUTPUT LEVEL RANGE .... 0 dB
   OUTPUT LEVEL VERNIER .... 0 dBm
   AM switch .... 30% range

3. Set the test oscillator to 10 kHz. Adjust the output level for a 5% AM reading on the Signal Generator.
4. Record the detected AM level indicated on the digital voltmeter.

   Reference Level __________ Vrms

PERFORMANCE TESTS

INCIDENTAL AM (cont'd)

Procedure (cont'd)

5. Set the Signal Generator's AM switch to OFF. Set the FM DEVIATION range to 1 MHz.

6. Connect the test oscillator to the Signal Generator's FM IN connector.

7. Set the test oscillator frequency to 100 kHz.

8. Vary the test oscillator amplitude between 0 and 0.35 Vrms. Verify that the voltmeter reading is less than the level recorded in step 4. Record the maximum level.

2.0 GHz ________ Vrms

9. Repeat step 8 for Signal Generator frequencies of 6.7 GHz, and 12.4 GHz.

NOTE

For frequencies of 6.7 GHz and 12.4 GHz, 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

12.4 GHz ________ Vrms

10. Tune the Signal Generator to 18.7 GHz. 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.

18.7 GHz ________ Vrms

Table 4-4. Performance Test Record (1 of 18)

Hewlett-Packard Company
Model HP 8673B
Signal Generator

Serial Number ____________

Tested by ____________

Date ____________

Para. No.	Test	Results Min.	Results Actual	Results Max.
4-8.	**FREQUENCY RANGE AND RESOLUTION**			
	Baseband Test			
	2 000.000 MHz	1 999.999	______	2 000.001
	2 000.001 MHz	2 000.000	______	2 000.002
	2 001.112 MHz	2 001.111	______	2 001.113
	2 002.223 MHz	2 002.222	______	2 002.224
	2 003.334 MHz	2 003.333	______	2 003.335
	2 004.445 MHz	2 004.444	______	2 004.446
	2 005.556 MHz	2 005.555	______	2 005.557
	2 006.667 MHz	2 006.666	______	2 006.668
	2 007.778 MHz	2 007.777	______	2 007.779
	2 008.889 MHz	2 008.888	______	2 008.890
	2 009.999 MHz	2 009.998	______	2 010.000
	2 090.000 MHz	2 089.999	______	2 090.001
	2 280.000 MHz	2 279.999	______	2 280.001
	2 470.000 MHz	2 469.999	______	2 470.001
	2 660.000 MHz	2 659.999	______	2 660.001
	2 850.000 MHz	2 849.999	______	2 850.001
	3 040.000 MHz	2 039.999	______	3 040.001
	3 230.000 MHz	3 229.999	______	3 230.001
	3 420.000 MHz	3 419.999	______	3 420.001
	3 610.000 MHz	3 609.999	______	3 610.001
	3 800.000 MHz	3 799.999	______	3 800.001
	3 990.000 MHz	3 989.999	______	3 990.001
	4 180.000 MHz	4 179.999	______	4 180.001
	4 370.000 MHz	4 369.999	______	4 370.001
	4 560.000 MHz	4 559.999	______	4 560.001
	4 750.000 MHz	4 749.999	______	4 750.001
	4 940.000 MHz	4 939.999	______	4 940.001
	5 130.000 MHz	5 129.999	______	5 130.001
	5 320.000 MHz	5 319.999	______	5 320.001
	5 510.000 MHz	5 509.999	______	5 510.001
	5 700.000 MHz	5 699.999	______	5 700.001
	5 900.000 MHz	5 899.999	______	5 900.001
	6 100.000 MHz	6 099.999	______	6 100.001
	6 600.000 MHz	5 999.999	______	6 600.001
	Bands 2 and 3 Test			
	10 GHz, 2 kHz Resolution		______(√)	
	18.6 GHz, 3 kHz Resolution		______(√)	
	26 GHz, 4 kHz Resolution		______(√)	

Table 4-4. Performance Test Record (2 of 18)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-9.	INTERNAL TIME BASE AGING RATE		________	$5x10^{-10}$/day
4-10.	FREQUENCY SWITCHING TIME			
	Frequency Switching			
	3.0 to 2.0 GHz		________	25 ms*
	4.0 to 2.0 GHz		________	25 ms*
	18.0 to 2.0 GHz		________	25 ms*
	6.2 to 2.09 GHz		________	25 ms*
	6.0 to 2.1 GHz		________	25 ms*
	6.5 to 2.1 GHz		________	25 ms*
	6.49 to 2.2 GHz		________	25 ms*
	2.0 to 3.0 GHz		________	25 ms*
	2.2 to 6.49 GHz		________	25 ms*
	2.1 to 6.5 GHz		________	25 ms*
	6.61 to 6.59 GHz		________	25 ms*
	6.59 to 6.61 GHz		________	25 ms*
	3.999 to 12.4 GHz		________	25 ms*
	19.5 to 2.1 GHz		________	25 ms*
	26.0 to 2.1 GHz		________	25 ms*
	2.1 to 19.5 GHz		________	25 ms*
	2.0 to 26.0 GHz		________	25 ms*
	2.1 to 26.0 GHz		________	25 ms*
	Amplitude Recovery			
	2.0 to 6.6 GHz		________	25 ms*
	6.601 to 12.3 GHz		________	25 ms*
	3.0 to 4.0 GHz		________	25 ms*
	4.0 to 10.0 GHz		________	25 ms*
	12.301 to 18.6 GHz		________	25 ms*
	18.601 to 26.0 GHz		________	25 ms*
	2.0 to 26.0 GHz		________	25 ms*
	6.601 to 26.0 GHz		________	25 ms*
	2.0 to 18.6 GHz		________	25 ms*
4-11.	SINGLE-SIDEBAND PHASE NOISE			
	10 Hz offset from carrier			
	6600 GHz		________	−58 dBc
	12 300 GHz		________	−52 dBc
	18 600 GHz		________	−48 dBc
	26 000 GHz		________	−46 dBc
	100 Hz offset from carrier			
	6600 GHz		________	−70 dBc
	12 300 GHz		________	−64 dBc
	18 600 GHz		________	−60 dBc
	26 000 GHz		________	−58 dBc

*For 2640A and below, maximum time is 20 ms.

Table 4-4. Performance Test Record (3 of 18)

Para. No.	Test		Results		
			Min.	Actual	Max.
4-11.	SINGLE-SIDEBAND PHASE NOISE (cont'd)				
	1 kHz offset from carrier				
	6600 GHz			________	−78 dBc
	12 300 GHz			________	−72 dBc
	18 600 GHz			________	−68 dBc
	26 000 GHz			________	−66 dBc
	10 kHz offset from carrier				
	6600 GHz			________	−86 dBc
	12 300 GHz			________	−80 dBc
	18 600 GHz			________	−76 dBc
	26 000 GHz			________	−74 dBc
	100 kHz offset from carrier				
	6600 GHz			________	−110 dBc
	12 300 GHz			________	−104 dBc
	18 600 GHz			________	−100 dBc
	26 000 GHz			________	−98 dBc
4-12.	HARMONICS, SUBHARMONICS, AND MULTIPLES				
	Fundamental (MHz)	Harmonic or Subharmonic Number			
	2000.000	2		________	−40 dBc
	4000.000	2		________	−40 dBc
	6000.000	2		________	−40 dBc
	8000.000	2		________	−40 dBc
	8000.000	½		________	−25 dBc
	10000.000	2		________	−40 dBc
	10000.000	½		________	−25 dBc
	11000.000	2		________	−40 dBc
	11000.000	½		________	−25 dBc
	14000.000	⅓		________	−40 dBc
	14000.000	⅔		________	−25 dBc
	16000.000	⅓		________	−25 dBc
	16000.000	⅔		________	−25 dBc
	18000.000	⅓		________	−25 dBc
	18000.000	⅔		________	−25 dBc
	20000.000	¼		________	−20 dBc
	20000.000	½		________	−20 dBc*
	20000.000	¾		________	−20 dBc*
	22000.000	¼		________	−20 dBc
	22000.000	½		________	−20 dBc*
	22000.000	¾		________	−20 dBc*

* For Option 008, maximum subharmonic or multiples level is −15 dBc.

Table 4-4. Performance Test Record (4 of 18)

Para. No.	Test		Results		
			Min.	Actual	Max.
4-12.	**HARMONICS, SUBHARMONICS, AND MULTIPLES (cont'd)**				
	Fundamental (MHz)	Harmonic or Subharmonic Number			
	24000.000	¼		______	−20 dBc
	24000.000	½		______	−20 dBc*
	24000.000	¾		______	−20 dBc*
	26000.000	¼		______	−20 dBc
	26000.000	½		______	−20 dBc*
	26000.000	¾		______	−20 dBc*
4-13.	**NON-HARMONICALLY RELATED SPURIOUS SIGNALS**				
	Carrier Frequency	Spurious Signal Frequency			
	3 000.000 MHz	______		______	−70 dBc
	3 000.000 MHz	______		______	−70 dBc
	______ (2.0 — 6.6 GHz)	______		______	−70 dBc
	______ (2.0 — 6.6 GHz)	______		______	−70 dBc
4-14.	**POWER LINE RELATED SPURIOUS SIGNALS**				
	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		______	−44 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
4-15.	**OUTPUT LEVEL AND FLATNESS**				
	Output Level				
	Frequency and power at minimum power point				
	2000.0 — 18 000 MHz				
	Frequency ______				
	Minimum power	(Standard)	+8 dBm	______(√)	
		(Option 001)	+10 dBm	______(√)	
		(Option 004)	+7 dBm	______(√)	
		(Option 005)	+9 dBm	______(√)	
		(Option 008)	+8 dBm	______(√)	

* For Option 008, maximum subharmonic or multiples level is −15 dBc.

Table 4-4. Performance Test Record (5 of 18)

Para. No.	Test		Results		
			Min.	Actual	Max.
4-15.	**OUTPUT LEVEL AND FLATNESS (cont'd)**				
	Output Level (cont'd)				
	18 000—22 000 MHz				
	Frequency ________				
	Minimum power	(Standard)	+4 dBm	________(√)	
		(Option 001)	+6 dBm	________(√)	
		(Option 004)	+2 dBm	________(√)	
		(Option 005)	+4 dBm	________(√)	
		(Option 008)	+7 dBm	________(√)	
	22 000—26 000 MHz				
	Frequency ________				
	Minimum power	(Standard)	+0 dBm	________(√)	
		(Option 001)	+3 dBm	________(√)	
		(Option 004)	−2 dBm	________(√)	
		(Option 005)	+1 dBm	________(√)	
		(Option 008)	+7 dBm	________(√)	
	Level Flatness (total variation)				
	2.0—6.6 GHz, ±0.75 dB			________	1.50 dB
	6.6—12.3 GHz, ±1.00 dB			________	2.00 dB
	12.3—18.6 GHz, ±1.25 dB			________	2.50 dB
	18.6—26.0 GHz, ±1.75 dB			________	3.50 dB
4-16.	**ABSOLUTE LEVEL ACCURACY**				
	High Level Accuracy				
	+8 dBm (Option 001 +10 dBm)				
	(Option 004 +7 dBm)				
	(Option 005 +9 dBm)				
	(Option 008 +8 dBm)				
	2.0—6.6 GHz		−2.00 dB	________	2.00 dB
	+5 dBm				
	2.0—6.6 GHz		−2.00 dB	________	2.00 dB
	6.6—12.3 GHz		−2.25 dB	________	2.25 dB
	12.3—18.0 GHz		−2.50 dB	________	2.50 dB
	0 dBm (+10 dB range)				
	2.0—6.6 GHz		−2.00 dB	________	2.00 dB
	6.6—12.3 GHz		−2.25 dB	________	2.25 dB
	12.3—18.6 GHz		−2.50 dB	________	2.50 dB
	18.6—26.0 GHz	(Not for Opt. 004)	−3.00 dB	________	3.00 dB
	−5.0 dBm (0 dB range)				
	2.0—6.6 GHz		−1.75 dB	________	1.75 dB
	6.6—12.3 GHz		−2.00 dB	________	2.00 dB
	12.3—18.6 GHz		−2.25 dB	________	2.25 dB
	18.6—26.0 GHz		−2.75 dB	________	2.75 dB

Table 4-4. Performance Test Record (6 of 18)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-16.	**ABSOLUTE LEVEL ACCURACY (cont'd)**			
	High Level Accuracy (cont'd)			
	−10 dBm (0 dB range)			
	2.0—6.6 GHz	−1.75 dB	_______	1.75 dB
	6.6—12.3 GHz	−2.00 dB	_______	2.00 dB
	12.3—18.6 GHz	−2.25 dB	_______	2.25 dB
	18.6—26.0 GHz	−2.75 dB	_______	2.75 dB
	−10 dBm (−10 dB range)			
	2.0—6.6 GHz	−2.25 dB	_______	2.25 dB
	6.6—12.3 GHz	−2.50 dB	_______	2.50 dB
	12.3—18.6 GHz	−2.85 dB	_______	2.85 dB
	18.6—26.0 GHz	−3.30 dB	_______	3.30 dB
	−20 dBm (−20 dB range)			
	2.0—6.6 GHz	−2.45 dB	_______	2.45 dB
	6.6—12.3 GHz	−2.70 dB	_______	2.70 dB
	12.3—18.6 GHz	−3.05 dB	_______	3.05 dB
	18.6—26.0 GHz	−3.60 dB	_______	3.60 dB
	Low Level Accuracy			
	2.0 GHz			
	−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
	4.0 GHz			
	−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
	10 GHz			
	−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

Table 4-4. Performance Test Record (7 of 18)

Para. No.	Test	Results Min.	Results Actual	Results Max.
4-16.	**ABSOLUTE LEVEL ACCURACY (cont'd)**			
	Low Level Accuracy (cont'd)			
	14 GHz			
	−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	______	−83.35 dBm
	20 GHz			
	−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	______	−56.70 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
4-17.	**OUTPUT LEVEL SWITCHING TIME**			
	Start Level (dBm) / Stop Level (dBm)			
	−99.0 / 0.0		______	< 25 ms
	−88.0 / 0.0		______	< 25 ms
	−77.0 / 0.0		______	< 25 ms
	−66.0 / 0.0		______	< 25 ms
	−50.0 / −2.0		______	< 25 ms
	−40.0 / 0.0		______	< 25 ms
	−30.0 / 0.0		______	< 25 ms
	−20.0 / 4.0		______	< 25 ms
	−10.0 / 2.0		______	< 25 ms
	−9.9 / 7.0		______	< 25 ms
	−8.0 / 6.0		______	< 25 ms
	−9.9 / 0.0		______	< 25 ms
	−7.0 / 3.0		______	< 25 ms
4-18.	**PULSE ON/OFF RATIO**			
	2.0 GHz	>80 dB	______	
	3.0 GHz	>80 dB	______	
	4.0 GHz	>80 dB	______	
	5.0 GHz	>80 dB	______	
	6.0 GHz	>80 dB	______	
	6.6 GHz	>80 dB	______	

Table 4-4. Performance Test Record (8 of 18)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-19.	**PULSE RISE/FALL TIMES AND OVERSHOOT**			
	2000.000 MHz at: Standard +8 dBm			
	Option 001 +10 dBm			
	Option 004 +7 dBm			
	Option 005 +9 dBm			
	Option 008 +8 dBm			
	Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	6600.000 MHz at: Standard +8 dBm			
	Option 001 +10 dBm			
	Option 004 +7 dBm			
	Option 005 +9 dBm			
	Option 008 +8 dBm			
	Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40%
	Overshoot and Ringing		________	<25%
	6600.002 MHz at: Standard +8 dBm			
	Option 001 +10 dBm			
	Option 004 +7 dBm			
	Option 005 +9 dBm			
	Option 008 +8 dBm			
	Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<25%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40%
	Overshoot and Ringing		________	<25%
	6600.002 MHz at: 0 dBm Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<25%

Table 4-4. Performance Test Record (9 of 18)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-19.	**PULSE RISE/FALL TIMES AND OVERSHOOT (cont'd)**			
	6600.002 MHz at: 0 dBm (cont'd)			
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	6600.002 MHz at: −10 dBm Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<25%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	6700.002 MHz at: Standard +8 dBm			
	Option 001 +10 dBm			
	Option 004 +7 dBm			
	Option 005 +9 dBm			
	Option 008 +8 dBm			
	Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	6700.002 MHz at: 0 dBm Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	6700.002 MHz at: −10 dBm Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%

Table 4-4. Performance Test Record (10 of 18)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-19.	PULSE RISE/FALL TIMES AND OVERSHOOT (cont'd)			
	12290.002 MHz at: Standard +8 dBm			
	Option 001 +10 dBm			
	Option 004 +7 dBm			
	Option 005 +9 dBm			
	Option 008 +8 dBm			
	Rise		______	<35 ns
	Fall		______	<35 ns
	Overshoot and Ringing		______	<20%
	For Option 008:			
	Rise		______	<40 ns
	Fall		______	<40 ns
	Overshoot and Ringing		______	<25%
	12290.002 MHz at: 0 dBm Rise		______	<35 ns
	Fall		______	<35 ns
	Overshoot and Ringing		______	<20%
	For Option 008:			
	Rise		______	<40 ns
	Fall		______	<40 ns
	Overshoot and Ringing		______	<25%
	12290.002 MHz at: −10 dBm Rise		______	<35 ns
	Fall		______	<35 ns
	Overshoot and Ringing		______	<20%
	For Option 008:			
	Rise		______	<40 ns
	Fall		______	<40 ns
	Overshoot and Ringing		______	<25%
	______ at: (6.6 to 6.7 GHz) Standard +8 dBm			
	Option 001 +10 dBm			
	Option 004 +7 dBm			
	Option 005 +9 dBm			
	Rise		______	<35 ns
	Fall		______	<35 ns
	Overshoot and Ringing		______	<25%
	______ at: (6.7 to 12.3 GHz) Standard +8 dBm			
	Option 001 +10 dBm			
	Option 004 +7 dBm			
	Option 005 +9 dBm			
	Rise		______	<35 ns
	Fall		______	<35 ns
	Overshoot and Ringing		______	<20%

Table 4-4. Performance Test Record (11 of 18)

Para. No.	Test	Results Min.	Results Actual	Results Max.
4-19.	PULSE RISE/FALL TIMES AND OVERSHOOT (cont'd)			
	For Option 008:			
	______ at: +8 dBm (6.6 to 12.3 GHz)			
	Rise		______	<40 ns
	Fall		______	<40 ns
	Overshoot and Ringing		______	<25%
	Except Option 008:			
	______ at: 0 dBm (6.6 to 6.7 GHz)			
	Rise		______	<35 ns
	Fall		______	<35 ns
	Overshoot and Ringing		______	<25%
	______ at: 0 dBm (6.7 to 12.3 GHz)			
	Rise		______	<35 ns
	Fall		______	<35 ns
	Overshoot and Ringing		______	<20%
	For Option 008:			
	______ at: 0 dBm (6.6 to 12.3 GHz)			
	Rise		______	<40 ns
	Fall		______	<40 ns
	Overshoot and Ringing		______	<25%
	Except Option 008:			
	______ at: −10 dBm (6.6 to 6.7 GHz)			
	Rise		______	<35 ns
	Fall		______	<35 ns
	Overshoot and Ringing		______	<25%
	______ at: −10 dBm (6.7 to 12.3 GHz)			
	Rise		______	<35 ns
	Fall		______	<35 ns
	Overshoot and Ringing		______	<20%
	For Option 008:			
	______ at: −10 dBm (6.6 to 12.3 GHz)			
	Rise		______	<40 ns
	Fall		______	<40 ns
	Overshoot and Ringing		______	<25%

Table 4-4. Performance Test Record (12 of 18)

Para. No.	Test	Results Min.	Results Actual	Results Max.
4-19.	**PULSE RISE/FALL TIMES AND OVERSHOOT (cont'd)**			
	12300.003 MHz at: Standard +8 dBm; Option 001 +10 dBm; Option 004 +7 dBm; Option 005 +9 dBm; Option 008 +8 dBm			
	Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	12300.003 MHz at: 0 dBm Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	12300.003 MHz at: −10 dBm Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	17990.003 MHz at: Standard +8 dBm; Option 001 +10 dBm; Option 004 +7 dBm; Option 005 +9 dBm; Option 008 +8 dBm			
	Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%

Table 4-4. Performance Test Record (13 of 18)

Para. No.	Test	Results Min.	Results Actual	Results Max.
4-19.	**PULSE RISE/FALL TIMES AND OVERSHOOT (cont'd)**			
	17990.003 MHz at: 0 dBm Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	17990.003 MHz at: −10 dBm Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	________ at: (12.3 to 18.0 GHz) Standard +8 dBm; Option 001 +10 dBm; Option 004 +7 dBm; Option 005 +9 dBm; Option 008 +8 dBm			
	Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	________ at: (12.3 to 18.0 GHz) 0 dBm Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	________ at: (12.3 to 18.0 GHz) −10 dBm Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%

Table 4-4. Performance Test Record (14 of 18)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-19.	PULSE RISE/FALL TIMES AND OVERSHOOT (cont'd)			
	18600.004 MHz at: Standard +4 dBm			
	Option 001 +6 dBm			
	Option 004 +2 dBm			
	Option 005 +4 dBm			
	Option 008 +7 dBm			
	Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	18600.004 MHz at: 0 dBm Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	18600.004 MHz at: −10 dBm Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	21990.004 MHz at: Standard +4 dBm			
	Option 001 +6 dBm			
	Option 004 +2 dBm			
	Option 005 +4 dBm			
	Option 008 +7 dBm			
	Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%

Table 4-4. Performance Test Record (15 of 18)

Para. No.	Test	Results Min.	Results Actual	Results Max.
4-19.	**PULSE RISE/FALL TIMES AND OVERSHOOT (cont'd)**			
	21990.004 MHz at: 0 dBm Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	21990.004 MHz at: −10 dBm Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	________ at: (18.0 to 22.0 GHz) Standard +4 dBm; Option 001 +6 dBm; Option 004 +2 dBm; Option 005 +4 dBm; Option 008 +7 dBm			
	Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	________ at: (18.0 to 22.0 GHz) 0 dBm Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	________ at: (18.0 to 22.0 GHz) −10 dBm Rise		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008:			
	Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%

Table 4-4. Performance Test Record (16 of 18)

Para. No.	Test	Results Min.	Results Actual	Results Max.
4-19.	**PULSE RISE/FALL TIMES AND OVERSHOOT (cont'd)**			
	25990.004 MHz at: Standard 0 dBm			
	Option 001 +3 dBm			
	Option 005 +1 dBm			
	Option 008 +7 dBm			
	Rise		______	<35 ns
	Fall		______	<35 ns
	Overshoot and Ringing		______	<20%
	For Option 008:			
	Rise		______	<40 ns
	Fall		______	<40 ns
	Overshoot and Ringing		______	<25%
	25990.004 MHz at 0 dBm (Except Opt. 004): Rise		______	<35 ns
	Fall		______	<35 ns
	Overshoot and Ringing		______	<20%
	For Option 008:			
	Rise		______	<40 ns
	Fall		______	<40 ns
	Overshoot and Ringing		______	<25%
	25990.004 MHz at −2 dBm (Opt. 004 only): 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%
	For Option 008:			
	Rise		______	<40 ns
	Fall		______	<40 ns
	Overshoot and Ringing		______	<25%
	______ at: Standard 0 dBm			
	(22.0 to 26.0 GHz) Option 001 +3 dBm			
	Option 005 +1 dBm			
	Option 008 +7 dBm			
	Rise		______	<35 ns
	Fall		______	<35 ns
	Overshoot and Ringing		______	<20%
	For Option 008:			
	Rise		______	<40 ns
	Fall		______	<40 ns
	Overshoot and Ringing		______	<25%

Table 4-4. Performance Test Record (17 of 18)

Para. No.	Test	Results Min.	Results Actual	Results Max.
4-19.	PULSE RISE/FALL TIMES AND OVERSHOOT (cont'd)			
	________ at 0 dBm (Opt. 004 at −2 dBm): Rise (22.0 to 26.0 GHz)		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008: Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
	________ at: −10 dBm Rise (22.0 to 26.0 GHz)		________	<35 ns
	Fall		________	<35 ns
	Overshoot and Ringing		________	<20%
	For Option 008: Rise		________	<40 ns
	Fall		________	<40 ns
	Overshoot and Ringing		________	<25%
4-20.	PULSE PEAK LEVEL ACCURACY (Frequency / Level)			
	6.6 GHz +7 dBm	−10.8%	________	+18.8%
	6.61 GHz +7 dBm	−10.8%	________	+18.8%
	0 dBm	−10.8%	________	+18.8%
	−10 dBm	−10.8%	________	+18.8%
	12.3 GHz +7 dBm	−10.8%	________	+18.8%
	0 dBm	−10.8%	________	+18.8%
	−10 dBm	−10.8%	________	+18.8%
	18.61 GHz +2 dBm	−10.8%	________	+18.8%
	0 dBm	−10.8%	________	+18.8%
	−10 dBm	−10.8%	________	+18.8%
	22.1 GHz −2 dBm	−10.8%	________	+18.8%
	−10 dBm	−10.8%	________	+18.8%
4-21.	AM BANDWIDTH (Modulation Frequency)			
	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

Table 4-4. Performance Test Record (18 of 18)

Para. No.	Test		Results		
			Min.	Actual	Max.
4-22.	AM ACCURACY				
	Meter Accuracy				
	1 kHz Rate, 50% AM		43.5%	________	56.5%
	Accuracy Relative to External AM Input				
	6.6 GHz	10 kHz	70.0%	________	80.0%
	6.6 GHz	1 kHz	70.0%	________	80.0%
	6.6 GHz	0.1 kHz	70.0%	________	80.0%
	10 GHz	10 kHz	70.0%	________	80.0%
	14 GHz	10 kHz	70.0%	________	80.0%
	18.6 GHz	10 kHz	70.0%	________	80.0%
	22 GHz	10 kHz	45.0%	________	55.0%
4-23.	INCIDENTAL FM				
		6.2 GHz		________	< 4 kHz
		12.3 GHz		________	< 8 kHz
		18.0 GHz		________	< 12 kHz
		24.0 GHz		________	< 16 kHz
		26.0 GHz		________	< 25 kHz
4-24.	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
4-25.	EXTERNAL FM ACCURACY AND METER ACCURACY				
	Meter Accuracy				
		Full Scale	255 kHz	________	345 kHz
		50 kHz	35 kHz	________	65 kHz
	Accuracy Relative to External FM Input				
		0.03 MHz range	27 kHz	________	33 kHz
		0.1 MHz range	90 kHz	________	110 kHz
		0.3 MHz range	270 kHz	________	330 kHz
		1.0 MHz range	249 kHz	________	351 kHz
	0.3 MHz Range Accuracy				
		6.7 GHz	270 kHz	________	330 kHz
		12.3 GHz	270 kHz	________	330 kHz
		18.6 GHz	270 kHz	________	330 kHz
4-26.	INCIDENTAL AM				
		2.0 GHz		________	< 5%
		6.7 GHz		________	< 5%
		12.4 GHz		________	< 5%
		18.7 GHz		________	< 5%

Stop Frequency (Sweep) (cont'd)

Programming Example (cont'd)

```
300 SUB Round_off(Err,Expected)                    ! Expected frequency in MHz
310 Err=0                                          ! Initialize Err
320 Band=5
330 IF Expected<26500.001 THEN Band=4
340 IF Expected<18600.001 THEN Band=3
350 IF Expected<12300.001 THEN Band=2
360 IF Expected<6600.001 THEN Band=1
370 !
380 Baseband=INT((Expected*1000)/Band)/1000        ! Rounded fundamental
390 Round_down=Baseband*Band
400 IF Round_down<>Expected THEN                   ! Requires rounding
410 Round_up=(Baseband+.001)*Band
420 IF ABS(Round_down-Expected)<ABS(Round_up-Expected) THEN
430 Expected=Round_down                            ! Minimum error is round down
440 ELSE
450 Expected=Round_up                              ! Minimum error is round up
460 END IF
470 END IF
480 SUBEND
```

The following program can be called to wait for a source settled indication from the Signal Generator. The program will wait a maximum of 1 second before assuming the SOURCE SETTLED bit is not going to be set. The status byte must be cleared with the CS program code before the frequency is set. If the status byte is not cleared, the SOURCE SETTLED bit may have been set by a previous command (the bit is latched until the status byte is read or cleared).

```
500 SUB Settled
510 T_counter=TIMEDATE                    ! In case no source settled
520 Stat=SPOLL(719)                       ! Serial poll
530 IF TIMEDATE-T_counter>1 THEN Done     ! Default of 1 second
540 IF NOT BIT(Stat,3) THEN GOTO 520      ! Wait for set bit
550 Done: !
560 SUBEND                                ! Source is settled or 1 second has passed
```

Error Messages

The following message numbers may be displayed when setting the sweep start frequency. Each message is explained as it pertains to setting sweep start frequency. For a more complete description of the messages, see the MESSAGES detailed operating instructions.

01 Entered frequency is not within the range of the Signal Generator.

03 Invalid multiplier entry for system compatible instruments. See paragraph 3-2, System Compatibility, for more information about system compatibility.

Stop Frequency (Sweep) (cont'd)

Error Messages (cont'd)

10 The sweep stop frequency has been set equal to the start frequency. No sweep will occur when a sweep mode is selected.

11 Indicates that the desired sweep start frequency is below the frequency range of the instrument. This error may be displayed when the SWEEP FREQ STOP key is pressed if tuning the instrument placed start frequency below the frequency range of the Signal Generator.

12 Indicates that the desired sweep stop frequency is above the frequency range of the instrument. This error may be displayed when the SWEEP FREQ STOP key is pressed if tuning the instrument placed the stop frequency above the frequency range of the Signal Generator.

13 Number of steps were adjusted to give even step size. This ensures that the full sweep span is covered by adjusting the number of steps. For example, if the number of steps is set to 100 and the stop frequency is 2000.010 MHz, setting the start frequency to 2 GHz will automatically adjust the number of steps to 10 to accommodate the minimum frequency resolution of 1 kHz.

90 Auto Peak malfunction. This indicates that the instrument may require service.

System Automatic Level Control

(2552A, 2634A and above)

Description

External ALC enables the Signal Generator to level the signal at a point other than the output of the Signal Generator. The signal level must be detected using a signal splitter or a directional coupler and a detector to provide a DC signal that is proportional to power at the remote point. The Signal Generator will adjust the signal level at the RF output connector to maintain a constant level at the point where the signal is detected. External ALC also enables external devices such as amplifiers, mixers and other specialized devices to be inserted into the RF signal path with control of the final output level by the Signal Generator.

In applications where the external signal path has frequency dependent losses (and/or gains), the RF signal at the end of the signal path will no longer be a constant amplitude over the Signal Generator's frequency range. For example, if a cable is used that has a constant 0.5 dB/GHz loss, a level error of 5 dB would occur after a 10 GHz frequency change. The signal at the RF output connector of the Signal Generator has not changed, but an extra 5 dB of attenuation is introduced in the signal path when the output frequency is changed.

System leveling mode is available on system compatible Signal Generators only. To determine if a specific Signal Generator is system compatible. (See paragraph 3-2, System Compatibility.) System leveling is used with other system compatible equipment to provide the Signal Generator with the means to control the output level of the system. External mixers, amplifiers and other equipment may be connected in the signal path with feedback from the last component in the signal path generating a system feedback voltage that is 0 volts at 0 dBm and has a sensitivity of 30 millivolts/dB into a 50 ohm load.

The advantages of system leveling are automatic calibration to the Signal Generator's level meter, temperature compensation built into the Signal Generator, and the addition of a +20 dBm range to be used with external amplifiers. When used with a 2 to 20 GHz amplifier, the maximum leveled power of the Signal Generator can be as high as +23 dBm.

Local Procedure

To set the Signal Generator for external system leveling:

1. Connect the external equipment to the Signal Generator with the component generating the system feedback voltage at the end of the signal path.
2. Press the Signal Generator's shift key and then press the SYSTEM key (shifted DIODE key). This sets the Signal Generator to system leveling mode which is indicated by the ALC INT key and the SYSTEM key being lighted. (See paragraph 3-2, System Compatibility.)
3. Reset the Signal Generator range to at least 10 dB above the range required for the desired RF output level. The range may have to be adjusted to compensate for losses and gains in the RF signal path. If the RF signal path will have a relatively high loss, a higher Signal Generator range will be required.
4. Connect the system feedback voltage to the external ALC input of the Signal Generator. No calibration is required on the Signal Generator.
5. If the UNLEVELED annunciator is on, step the range up or down until the UNLEVELED annunciator is extinguished. The UNLEVELED annunciator indicates that the Signal Generator is unable to supply enough power because the signal path has too much attenuation or that the ALC circuitry cannot attenuate the Signal Generator's RF level enough to achieve leveling.

System Automatic Level Control (cont'd)

Local Procedure (cont'd)

6. When the Signal Generator is in the 0, +10 and +20 dB ranges, the system RF output level is equal to the sum of the RANGE and VERNIER settings. Range settings below 0 dB add attenuation to the signal path and do not affect the system level until the ALC goes unleveled.

Remote Procedure

The equipment setup for remote control of system leveling is the same as the local procedure. The program code for system ALC is C4. The system level can be remotely controlled directly for power levels between 0 and +23 dBm. For levels between 0 and −10 dBm, the RANGE should be set to 0 dB and the VERNIER programmed for the appropriate level. Using a range less than 0 dB while using external system leveling will have no effect on the level but can force the Signal Generator to lose control of the level due to insufficient attenuation (lack of ALC dynamic range) or too much attenuation (attempted operation beyond maximum power specification).

The VERNIER and RANGE settings and the RF output level (the sum of the VERNIER and RANGE settings) can be read by the controller using the output active program code suffix. To read the VERNIER setting (−12.0 to +3 dBm), send the program string VEOA and then read the VERNIER setting. The Signal Generator will send the setting in units of dBm. If the setting is read as a string, the format will be the program code VE followed by the setting in dBm and then the units code DM.

The RANGE setting is read by sending the program string RAOA and then reading the RANGE setting. The Signal Generator will send the range in units of dB (−90 to +20 dB). If the RANGE setting is read as a string, the format will be the program code RA followed by the RANGE setting in dB and then the units code DM.

The RF output level is read by sending the program string LEOA and then reading the output level. The Signal Generator will send the range in units of dBm (−102 to +23 dBm). If the RF level is read as a string, the format will be the program code LE followed by the system RF level and then the units code DM. The program code AP or PL can be used instead of LE, but the program code sent by the Signal Generator will always be LE.

Comments

To set the Signal Generator to system leveling using an external system compatible amplifier.

Local

1. Connect the amplifier to the output of the Signal Generator.
2. Connect the system feedback signal from the amplifier to the external ALC input connector on the Signal Generator front panel.
3. Press the shift key and then the SYSTEM key (shifted DIODE). With the Signal Generator range set to 0 dB and above, the output level of the amplifier can be directly controlled using the RANGE and VERNIER.

Remote

1. Perform the above steps 1 to 3 to connect the system.
2. The controller can now directly set and read the output level of the RF amplifier by setting the Signal Generator output level to the desired level.

System Automatic Level Control (cont'd)

Program Codes

HP-IB

Program Code	Function
C4 SHC2	External System Leveling Mode

Comments

Using external system leveling mode has the advantages of no calibration required, built-in temperature compensation, direct control of the leveled RF signal, and an extra range for high power applications. The dynamic range available is dependent only on the signal path gain and losses. Amplitude modulation up to 90% depth at rates as high as 80 kHz is typically available using system leveling mode.

The external ALC circuitry is used to adjust the Signal Generator's output level until the detected voltage at the external ALC input is correct. If high harmonics or spurious signals are present in the signal that is being detected, they will affect level flatness. This is especially important when using external amplifiers and mixers within the signal path. The actual magnitude of the error introduced is dependent on the method used to generate the system feedback signal.

Application Example

Example 1. An RF signal is required to deliver a +20 to +13 dBm signal in the range of 2 to 20 GHz. A system compatible amplifier is available that has a frequency range of 2 to 20 GHz and a maximum output level of +25 dBm.

The amplifier is connected to the Signal Generator and the system feedback signal from the amplifier is connected to the external ALC input connector on the Signal Generator front panel. Pressing the shift key and then the SYSTEM key (shifted DIODE) sets the Signal Generator to system leveling mode. The required output levels can be set directly using the RANGE and VERNIER controls

Example 2. An amplifier and a frequency multiplier are to be connected together to form a frequency multiplier system. The multiplier is system compatible and requires +17 dBm at the input. The RF amplifier is capable of +20 dBm over the 2 to 20 GHz frequency range.

The system is connected by connecting the amplifier to the Signal Generator and the multiplier to the amplifier. The system feedback signal is connected to the external ALC input connector on the Signal Generator front panel. System leveling is set by pressing the shift key and then the SYSTEM key (shifted DIODE). The multiplied frequency can now be set using the RANGE and VERNIER controls.

Error Messages

The following message may be displayed when programming the RF output level.

24 The programmed RF output (VERNIER, RANGE or both) is outside the Signal Generator's range.

Vernier (Output Level)

Description

The RF output level of the Signal Generator is set using the RANGE and VERNIER controls. The RANGE controls change the RF output level in 10 dB steps and the VERNIER changes the RF output level continuously over a 13 dB range. The sum of the output level RANGE and VERNIER is the actual RF output level.

In local mode, the output level meter displays the VERNIER setting. In remote mode, the output level meter displays the remote setting. When going from local to remote mode, the RF output level should not change by more than 0.1 dB. When changing from remote to local mode, the RF output level will return to the front panel setting of the VERNIER which may change the RF output level by as much as 13 dB. The RANGE setting will not change for either transition.

When setting RF output levels above the specified maximum power, an UNLEVELED condition may occur due to insufficient available power. When this occurs, the output level meter will indicate the maximum available power. Increasing the VERNIER setting will not change the displayed level on the output level meter.

Local Procedure

To set the RF output level using internal ALC:

1. Press the RANGE up or down key until the desired RANGE appears in the RANGE dB display. Holding the key down will continue stepping the RANGE until the key is released. The RANGE setting represents the maximum level available using that range. The VERNIER control will allow setting output levels from −10 dB below to +3 dB above the RANGE.

   There is a slight overlap of output level settings due to the 13 dB range of the VERNIER control. For best results, the VERNIER setting should be within the range of −10 to 0 dBm. VERNIER settings from 0 to +3 dBm are available for observing a continuous range up to +3 dB above the RANGE setting without changing the RANGE setting.

2. Adjust the VERNIER control until the sum of the RANGE and the level meter reading equal the desired RF output level. The VERNIER can be used to vary the output level continuously about the set level or the RANGE up or down key can be used to step the output level in 10 dB steps.

   If the UNLEVELED annunciator lights for high output level settings, the level meter will indicate maximum available output power. This should only occur when output levels above the specified maximum leveled power are set. For example, if the RF output level is set to +13 dBm and the level meter reads −4 dBm with the UNLEVELED annunciator lighted, only +19 dBm of output power is available at that frequency.

Remote Procedure

The Signal Generator accepts any RF output level between −101.9 and +13 dBm. RF output levels above the specified maximum leveled power may not be available at all frequencies. Programming the RF output level can be done in one of two ways.

The RF output level can be programmed directly using the program code LE, AP, or PL. The units terminator for the output level is dBm which corresponds to the program code DM. The Signal Generator will also accept the program code DB as the terminator. When programming the RF output level, the VERNIER is set between 0 and −9.9 dBm and the RANGE is set accordingly.

Vernier (Output Level) (cont'd)

Remote Procedure (cont'd)

The RF output level can also be programmed by programming the VERNIER and the RANGE separately. The program code to set the RANGE is RA and the program code to set the VERNIER is VE. The units terminator for both codes can be either DB or DM.

The output active program code suffix can be used to read the current values of the RANGE, VERNIER or the RF output level directly. To read the RANGE setting, send the program codes RAOA and then read the RANGE setting. The Signal Generator will send the RANGE in fundamental (dBm) units. If the RANGE is read as a string, the format will be the program code RA followed by the RANGE in dBm and then the units terminator DM (dBm).

In local mode, the Signal Generator keeps track of the VERNIER setting to within 0.1 dB. When switching to remote mode, the local RF level setting is preserved. This feature also allows the controller to read the local VERNIER setting by briefly switching to remote to read the VERNIER setting and then returning the Signal Generator to local mode. The VERNIER setting is read by sending the program codes VEOA and then reading the setting. The Signal Generator will send the VERNIER setting in fundamental (dBm) units. If the VERNIER setting is read as a string, the format will be the program code VE followed by the VERNIER setting in dBm and then the units terminator DM (dBm).

The RF output level is read directly by sending the program codes LEOA and then reading the RF output level. The Signal Generator will send the RF output level in fundamental (dBm) units. If the RF output level is read as a string, the format will be the program code LE followed by the RF output level in dBm and then the units terminator DM (dBm). The program codes AP or PL can also be used in place of LE but the Signal Generator will always send the program code LE when the RF output level is read as a string.

Example

To set the RF output level to −56 dBm:

Local

1. Press the ALC INT key to place the Signal Generator into internal ALC mode. The process for setting the RF output level for external ALC modes is covered under the appropriate section of the Detailed Operating Instructions.
2. Set the RANGE to the lowest range that is less than 10 dB above the power or −50 dBm in this case.
3. Adjust the VERNIER until the level meter indicates −6 dBm. For the −50 dBm RANGE, the VERNIER can adjust the output level from −60 to −47 dBm.

Remote

The programming string for the setting the RF output level is composed of a program code, numeric data and the units terminator. The RF output level may be programmed directly or the RANGE and VERNIER may be programmed separately. To program the Signal Generator to a level of −56 dBm, the possible program strings are:

"LE—56DM" or "RA—50DBVE—6DM"

In addition, the program code could be AP or PL instead of LE. The alpha characters can be sent as upper or lower case (or even mixed upper and lower case). The Signal Generator RF output level is valid once the SOURCE SETTLED bit of the status byte is set (see Comments). The units terminator could be DB or DM. The Signal Generator accepts either terminator for all power related settings.

Vernier (Output Level) (cont'd)

Program Codes HP-IB

Program Code	Description	Units
VE	Vernier Setting	
*LE	RF Output Level	DB
AP	RF Output Level	*DM
PL	RF Output Level	

*Preferred Program Code

Comments

The VERNIER controls the automatic level control (ALC) circuit directly. The ALC is capable of controlling the RF output level over a −10 to +13 dBm range. Additional dynamic range is provided by a 90 dB step attenuator that is controlled by the RANGE setting.

In remote mode, a Digital to Analog Converter (DAC) is substituted for the front panel VERNIER control. The resolution of the front panel VERNIER is as fine as can be measured while the resolution of the remote mode DAC is 0.1 dB.

Optimum AM performance is achieved for VERNIER settings of 0 dBm and below. Highest harmonic levels occur at high VERNIER settings while subharmonics and spurious signals are highest at low VERNIER settings. Changing ranges below 0 dB will result in approximately the same performance as the 0 dB range at the lower RF output level.

Programming Example

The following program is written in BASIC for HP 9000 Series 200 or 300 controllers. The program will set the output level between −100 and +13 dBm. If a level above 0 dBm is set and the Signal Generator is not leveled, an error will be reported.

```
10 SUB Rf_level(Err,Expected)                               ! Expected is in dBm
20 !
30 If Expected<-100 OR Expected>=13 THEN
40 Err=-1
50 DISP "ERROR: Requested output level is out of range"
60 SUBEXIT
70 END IF
80 !
90 OUTPUT 719 USING "2A";"MG"                               ! Clear old messages
100 ENTER 719 USING "2A";Message$
110 !
120 OUTPUT 719 USING "4A,4D.D,2A";"CSLE,"Expected,"DM"      ! Set the level
130 !
140 OUTPUT 719 USING "4A";"LEOA"
150 ENTER 719 USING "K";Level
160 !
170 IF ABS(Level-Expected)>.1 THEN                          ! More than .1 dB in error
180 Err=-1
190 DISP "WARNING: Programmed level is more than .1 dB in error"
200 END IF
210 !
220 V=SPOLL(719)                                            ! Get the status byte
230 IF NOT BIT(V,3) THEN GOTO 220                           ! Wait for source to settle
240 !
```

Vernier (Output Level) (cont'd)

Programming Example (cont'd)

```
250 IF Expected>0 THEN                                    ! Check for unleveled
260 OUTPUT 719 USING "2A";"OS"                            ! Get extended status byte
270 ENTER 719 USING "%,B,B";V,Extended
280 IF BIT(Extended,6) THEN
290 Err=-1
300 DISP "WARNING: The Signal Generator RF output is not leveled"
310 END IF
320 END IF
330 !
340 SUBEND
```

Error Messages

The following message may be displayed when setting the RF output level. Each message is displayed as it pertains to setting the RF output level. For a more complete description of the messages, see the MESSAGES detailed operating instructions.

24 The programmed RF output level is not within the range of the Signal Generator.