



# AM-FM SIGNAL GENERATORS 0.5 to 512 MHz

models  
8640A  
8640B

TECHNICAL DATA 15 OCT 72

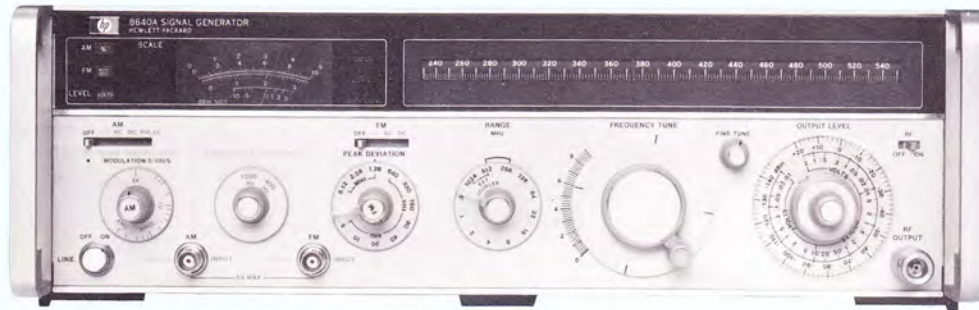
*A New Performance Standard  
for General Purpose  
Signal Generators...*





*...in Two Versions*

## 8640A



This solid-state signal generator features outstanding spectral purity and stability, extremely wide output range along with fully calibrated and metered modulation for the most stringent measurement applications.

## 8640B



This general-purpose signal generator has all the performance features of the 8640A plus synthesizer stability with:

- Internal Phase Lock Synchronizer
- Six-Digit LED Frequency Readout
- External Count Capability to 550 MHz



# Operating Features

Pushbuttons select meter function to read AM, FM, or Output Level.

Modulation selectors for AM, FM, or Pulse; internal or external ac or dc coupled. Independent controls permit simultaneous AM/FM.

Calibrated meter reads AM%, FM peak deviation, or output level in dBm and volts with autoranged scale indication.

Annunciators indicate when output level and modulation settings exceed calibrated limits. Action required to return instrument to fully calibrated operation is displayed.

Single pushbutton will phase lock RF to the internal or external crystal reference.

Counter mode pushbuttons select internal, external, or high resolution operation.

Six-digit LED frequency readout provides RF resolution of 100 Hz or better with X10 and X100 Expand.

AM vernier varies AM depth from 0 to 100%; calibrated AM monitored on front panel meter.

Amplitude control for modulation oscillator output level is independent of modulation setting.

Modulation frequency selector; internal fixed 400 Hz and 1 kHz (variable 20 Hz to 600 kHz shown is available as Option 001).

Input ports for external AM and FM. Output ports for internal modulation oscillator.

FM peak deviation range selector and vernier; calibrated FM monitored on front panel meter.

Built-in counter can measure external signals to 550 MHz.

Range selector allows choice of eleven octave bands. In 512 to 1024 MHz position, the readout displays output frequency from an external doubler.

Frequency tuning control. Eight turns cover one entire frequency band plus liberal over-range.

Dynamic range of +19 to -145 dBm is direct reading using a 10 dB stepped attenuator and concentric vernier. RF output is calibrated and leveled from 450 kHz to 550 MHz. Source impedance is 50  $\Omega$ .

Tuning vernier marks for resettability to 0.1%.

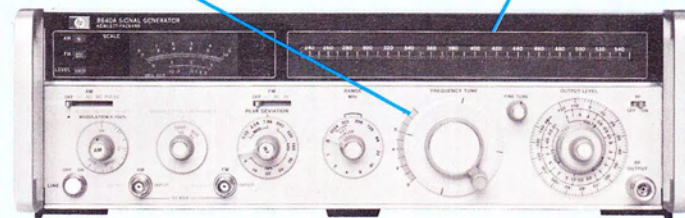
8640A slide-rule frequency indicator features accuracy of  $\pm 0.5\%$ .

Auxiliary RF output  $> -5$  dBm into 50  $\Omega$ .

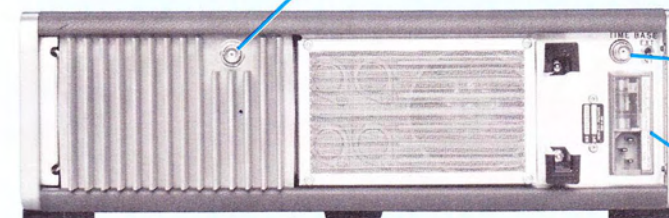
8640A provides all the features of the 8640B except for the frequency counter and internal crystal synchronization.

Input for external 5 MHz standard. Internal reference also available here for external use (8640B).

International line power module allows operation from 100, 120, 220, and 240-volt mains, 48 to 440 Hz.



8640A

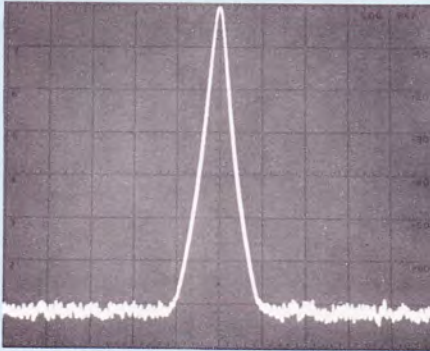


8640B Rear Panel



## for Measurement Applications Requiring:

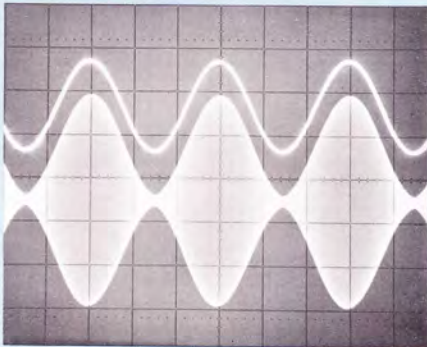
### A Stable CW Source



- Frequency Range: 450 kHz to 550 MHz
- Calibrated, Leveled Output: +19 to -145 dBm (2 V to 0.013  $\mu$ V)
- Stability: <10 ppm/10 min (8640A and 8640B unlocked)
- Internal Phase Lock for Synthesizer Stability: <math>5 \times 10^{-8}</math>/hr (8640B)
- Nonharmonic Spurious: >100 dB down (none detectable on 8640A)
- Residual FM: <5 Hz in a 0.3 to 3 kHz bandwidth
- Wideband Noise: >140 dB/Hz below carrier

The wide power range, high stability, and spectral purity of the 8640 make it ideal for testing high-performance communications receivers.

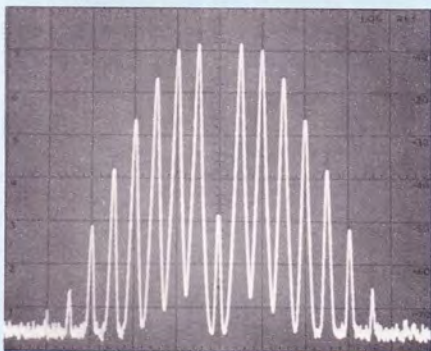
### A High Performance AM Generator



- Calibrated, Metered AM: 0 to 100%
- Envelope Distortion: <1% to 50% AM
- Modulation Rates to 100 kHz; ac or dc coupled
- Incidental PM: <0.3 radians peak
- External Pulse Capability: Pulse width to <1  $\mu$ s

The low incidental modulation and low distortion of the 8640 commend it for AM receiver tests.

### A Precision FM Generator



- Fully calibrated FM deviation; constant with frequency and band change
- Modulation Rates to 250 kHz; ac or dc coupled
- Internal FM, metered, accurate to  $\pm 9\%$  of reading
- Close-in Noise: >130 dB/Hz down at 20 kHz offset
- FM during Internal Phase Lock Operation (8640B only)

The fully calibrated and metered FM makes FM receiver testing with the 8640 fast, simple, and accurate.



## Featuring: ...Low Noise

### General Description

The 8640 signal generator covers the frequency range 500 kHz to 512 MHz (450 kHz to 550 MHz with band over-range) and can be extended to 1100 MHz with an external doubler. An optional built-in audio oscillator is also available to extend the CW output range of the generator down to 20 Hz.

The output level range of the generator is +19 to -145 dBm (2 V to 0.013  $\mu$ V) and is leveled to within  $\pm 0.5$  dB across the full frequency range.

The 8640A/B generators provide AM, FM, and pulse

modulation for a wide range of receiver test applications. AM and FM can be performed independently or simultaneously in either the internal or external modes. This modulation is calibrated and metered for direct readout under all operating conditions.

This broad coverage, together with calibrated output and modulation, provides for complete RF and IF performance tests on virtually any type of HF, VHF, and UHF receivers.

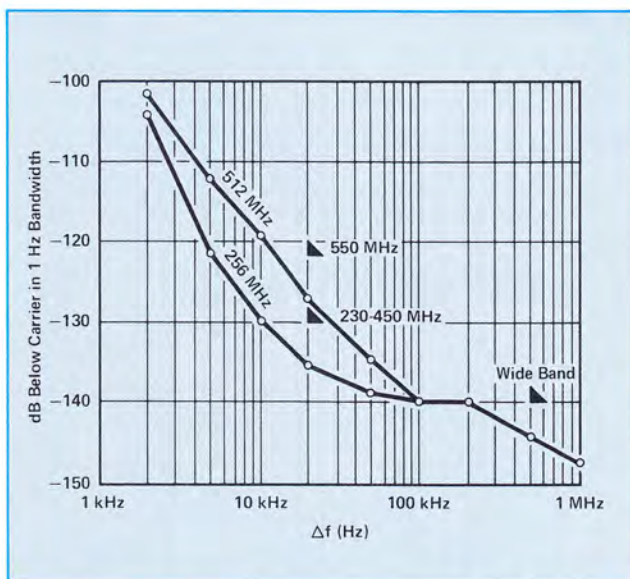
### Spectrally Pure Output Signals

Noise performance of the 8640 is state of the art for a solid-state generator. The high-Q cavity oscillator has been optimized with use of a low noise microwave transistor for spectrally pure output signals. **Figure 1** shows the typical single sideband noise performance stated in a 1 Hz bandwidth for various offsets from a 256 and 512 MHz carrier. The low close-in noise characteristic is ideally suited for the stringent adjacent channel tests that are commonly made on a wide variety of communication receivers.

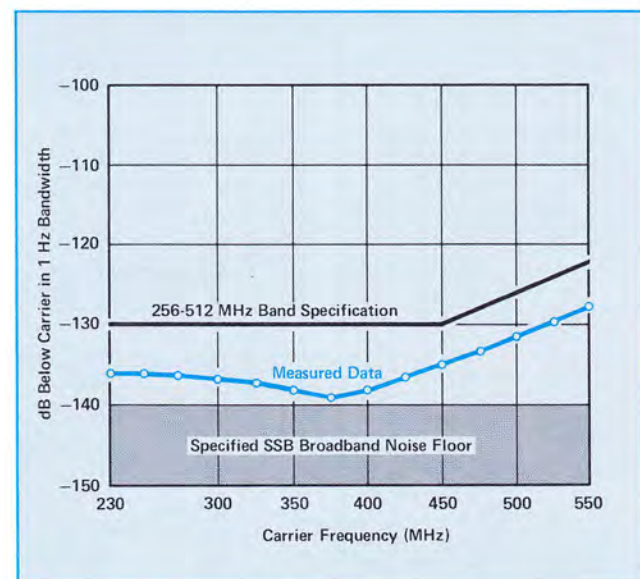
**Figure 2** is a plot of the guaranteed SSB noise performance for a 20 kHz offset from the carrier for any RF output frequency. From 230 to 450 MHz, noise is  $>130$  dB/Hz below the carrier level and rises to 122 dB/Hz at 550 MHz. This signal-to-noise ratio increases

by approximately 6 dB for each division of the output frequency down to the broadband noise floor of better than 140 dB/Hz. This exceptional noise performance is also preserved during FM modulation and in the phase locked mode of the 8640B.

The basic frequency source of the 8640A/B is a mechanically tuned high-Q cavity oscillator that operates over the frequency range 230-550 MHz. This oscillator has an inherent stability of better than 10 ppm/10 min and exceptionally low noise characteristics. The lower 9 frequency ranges are obtained by dividing the basic oscillator frequency and filtering the unwanted harmonics. Using this technique, subharmonic and nonharmonic spurious are virtually eliminated.



**Figure 1.** Measured Single Sideband Noise vs. Offset from Carrier. (256 and 512 MHz Carrier Frequencies on 256-512 MHz Band.) Markers indicate specified limits.



**Figure 2.** Specified Signal-to-Phase Noise Ratio at 20 kHz Offset vs. Carrier Frequency (MHz). For lower frequencies phase noise decreases approximately 6 dB per frequency division down to the broadband noise floor.



## ...High Resolution and Stability

### Mechanical Dial or Built-In Counter

#### 8640A

The 8640A has an easy-to-read slide rule dial with different scales for each of the 10 output frequency ranges. There is an additional scale, to provide direct readout of the output frequency even for the EXTERNAL DOUBLER band, 512 - 1024 MHz.

Frequency accuracy is better than 0.5% and vernier marks are provided on the FREQUENCY TUNE control to allow for frequency resettability of better than 0.1%. The AUX RF OUTPUT on the rear panel can be used for connecting to an external frequency counter.

#### 8640B

The 8640B incorporates a built-in 550 MHz counter for displaying the output frequency. The normal resolution of the 6-digit counter can be increased using the X10 or X100 EXPAND buttons near the display.



Figure 3. 8640A Mechanical Dial Scale.

X100 EXPAND mode, the resolution is 100 Hz at 500 MHz and 0.1 Hz at 500 kHz.

During the expand operation, an OVERFLOW light indicates when significant digits have been shifted off the display. When the EXTERNAL DOUBLER band, 512 to 1024 MHz, is selected, the counter will automatically display the doubled output frequency.

#### External Count Capability

The built-in counter can also be used to count external input signals from 20 Hz to 550 MHz and eliminates the need for a separate frequency counter in many measurement systems. Input sensitivity is <100 mV into 50  $\Omega$ . Using the EXPAND buttons, it is possible to achieve a resolution of 1 Hz in the 0-10 MHz EXTERNAL count mode or 100 Hz in the 0-550 MHz mode.



Figure 4. 8640B Six-Digit Counter.

### Synthesizer Stability in Phase-Locked Mode

Also included in the 8640B is a built-in phase lock synchronizer that locks the RF output frequency to the crystal time base used in the counter. In this locked mode, the output stability is better than  $5 \times 10^{-8}$ /hr and the spectral purity and FM capability of the unlocked mode are preserved. For higher stability, it is possible to lock to an externally applied 5 MHz standard. Two 8640B's can also be locked together for various 2-tone measurements.

#### Pushbutton Operation

Phase locking the 8640B is simple—just push the front panel LOCK button. Lock is established at the frequency shown on the LED display. If lock is broken (for example by tuning to a new output frequency), there is an immediate indication: the LED display flashes. Lock can be re-established with the LOCK pushbutton.

Lock can be achieved in the normal mode of the counter or in the X10 EXPAND mode if the OVERFLOW light is not on. It is not possible to lock in the X100 EXPAND mode or when counting external inputs.

Maximum resolution in the locked mode is 1 kHz at 500 MHz, increasing to 1 Hz at 500 kHz.

#### Phase Lock Fine Tuning

If an output frequency between lock points is required, a TIME BASE VERNIER is provided with a total range of  $\pm 20$  ppm. This fine tunes the internal crystal time base and allows for setting the output frequency between lock points. This gives continuous coverage of all output frequencies even in the phase locked mode. An UNCAL light near the vernier will indicate when this mode has been selected.

#### FM While Phase Locked

When phase locked, full FM capability is preserved down to modulation rates of <50 Hz. The narrow bandwidth of the phase lock loop (<5 Hz) provides for FM modulation up to 250 kHz rates and assures no degradation in noise from the unlocked mode. This high stability, coupled with the precision modulation and low noise, makes the 8640B ideal for testing narrowband FM or crystal controlled receivers.



# ...Precision Modulation

## Amplitude Modulation

AM is variable from 0 to 100% with the bandwidth, accuracy, and low incidental FM required for the most stringent AM applications. The front panel meter gives a direct readout of AM percent in either the internal or external mode and autoranges the 0-100% scale at 0-30% for improved settability at low modulation depth.

AM bandwidths up to 100 kHz are available, depending on carrier frequency and modulation depths. Distortion is specified at 400 Hz and 1000 Hz to be <1% up to 50% AM, <3% at 70% AM, and <5% at 90% AM. **Figure 5** shows measured AM distortion characteristics for other modulation frequencies. Note that for 0-50% AM, distortion is <1% to approximately 50 kHz for an output frequency from 8 to 512 MHz.

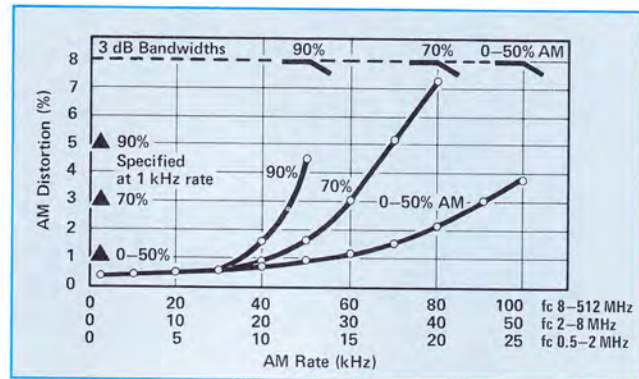


Figure 5. AM distortion vs. AM rate measured at 200 MHz and +13 dBm, representative of all bands.

## Pulse Modulation

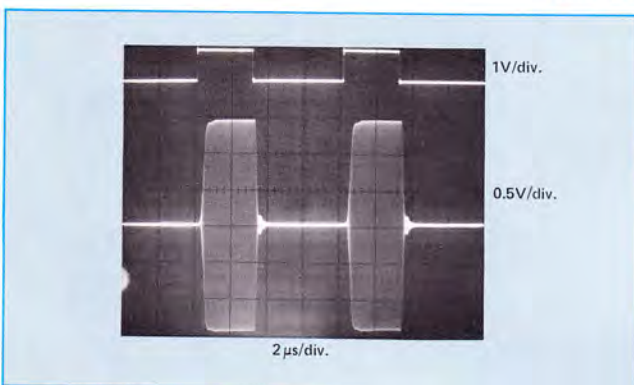


Figure 6. Pulsed RF at 20 MHz Carrier Frequency.

Also included on the AM function switch is a position for external PULSE modulation. In this mode, pulse inputs with repetition rates to 500 kHz and widths down to 1  $\mu$ s can be applied to modulate the RF carrier. Rise and fall times vary with output frequency down to <0.5  $\mu$ s from 32 to 512 MHz.

Pulse inputs turn the RF on. Hence with no pulse input the RF will read approximately zero on the built-in level meter. For pulse inputs within the specified range, the RF output calibration is preserved and the level meter reads the peak pulse power of the RF output. For repetition rates below that specified, the pulsed RF output is still available but the peak pulse level is no longer calibrated or metered.

## Frequency Modulation

FM is calibrated, metered, and the deviation remains constant with frequency and band changes. Peak deviations to at least 0.5% of carrier frequency are available. On the 256-512 MHz band, for example, the maximum deviation is 2.56 MHz **peak** or 5.12 MHz peak-to-peak. With this wide deviation capability, it is possible to sweep the 8640, using the dc coupled FM mode and a sawtooth input to test and align IF filters and discriminators.

For narrowband FM applications, a minimum full scale deviation of 5 kHz is provided on the meter and the PEAK DEVIATION range switch. When switching from the CW to FM mode, there is negligible shift in carrier frequency and no degradation in spectral purity for these narrow deviations. With the 8640B in the phase locked mode it is possible to modulate at rates from 50 Hz to 250 kHz with accurate narrowband FM and the carrier stability of a crystal oscillator. Using

the 8640A or the 8640B in the unlocked mode, it is possible to modulate from dc to 250 kHz with a carrier stability of <10 ppm/10 min.

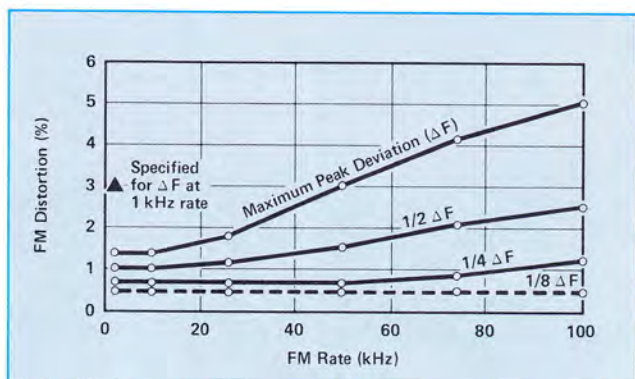


Figure 7. FM distortion vs. FM rate measured in the 8-16 MHz band, representative of all bands.



## ...and Operating Conveniences

### Audio Oscillator Built-In

#### Standard



Standard tones for internal modulation are 400 Hz to 1000 Hz. These tones are available at the front panel and calibrated in output level from 1 V to 10 mV into 600  $\Omega$ . Total harmonic distortion is typically  $<0.25\%$ .

#### Optional

A built-in, variable-frequency oscillator covering the range 20 Hz to 600 kHz is also available on both the 8640A and 8640B. Fixed tones of 400 Hz and 1000 Hz are also provided.

Output from this modulation oscillator is separately available at the front panel and calibrated in level from 3 V to 10 mV into 600  $\Omega$ . When installed, this modulation oscillator, Option 001, extends the usable CW range of the 8640 down to 20 Hz.

### Multifunction Meter and Annunciators

#### Autorangeing Meter

The front panel meter on the 8640 monitors three separate functions. The RF output level, the AM percentage, and the FM peak deviation in kHz or MHz. Pushbuttons are provided to select the meter function, and scale lights indicate the range on which the meter reading should be made. For RF output level and AM%, the scales autorange for maximum resolution. For FM modulation, the appropriate scale is selected automatically with the PEAK DEVIATION range switch.

#### Front Panel Annunciators

Three front panel annunciators are provided to indicate when certain settings of RF level and modulation controls exceed specified limits. Besides giving a warning indication, the annunciators instruct the operator how to return the instrument to proper operation.

The REDUCE PEAK POWER annunciator lights whenever the combined settings of RF output level and AM modulation exceed the maximum specified output level of +19 dBm. Hence for 100% AM, the REDUCE PEAK POWER light will stay on until the RF level is reduced to +13 dBm.

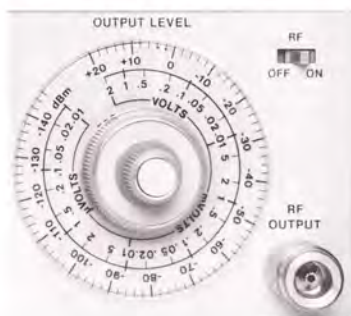
The REDUCE PEAK DEVIATION annunciator lights whenever the PEAK DEVIATION switch has been set to exceed the specified peak deviation limits. The specification on the 8640 provides for a maximum peak deviation of 1% of minimum frequency in each band (e.g., 2.56 MHz on the 256 - 512 MHz band). When this

annunciator lights, the FM is automatically turned off, the FM meter reads zero, and a lower PEAK DEVIATION must be selected.

The REDUCE FM VERNIER annunciator comes on whenever the external FM input and FM vernier setting combine to exceed the maximum deviation indicated on the PEAK DEVIATION range switch. When this occurs, either the FM vernier or the amplitude of the incoming modulation signal should be reduced to obtain specified FM performance.



### Accurate Output Levels



The wide output range of the 8640 is achieved with a 10 dB step attenuator and a 20 dB concentric vernier. Output levels can be read directly on the attenuator dial or using the autoranging meter shown above.

The maximum output level of +19 dBm permits high level tests on receiver IF's, amplifiers, and mixers without additional power amplification. At the same time, extremely low leakage ensures receiver sensitivity measurements down to levels of 0.03 microvolt in a shielded system.

Using a power meter and calibrating the output for one output frequency and vernier setting, it is possible to make sensitivity measurements to better than  $\pm 1$  dB accuracy down to output levels of -127 dBm.



## Complementary Equipment

### External Doubler Operation

The HP 11690A Frequency Doubler is designed to extend the 8640A or 8640B frequency range by doubling the 256 - 512 MHz Frequency Band up to 1024 MHz (to 1100 MHz with band over-range). Its recommended input level for optimum performance with AM modulation is +10 dBm. This doubler comes in a BNC package, has a conversion loss of approximately 12 dB and remains level within  $\pm 1$  dB over its full frequency range.

The 8640A has a dial scale for the 512 to 1024 MHz external doubler band to indicate the correct doubled output frequency. The 8640B also anticipates the use of an external doubler by displaying the correct

doubled output frequency when the 512 to 1024 range is selected. For FM in the doubled range, an additional position on the PEAK DEVIATION RANGE switch allows peak deviation up to 5.12 MHz.

The following specifications describe the 11690A when used with the 8640A or 8640B:

Input Required: +10 to +19 dBm (0.707 V to 2 V)

Conversion Loss: <12 dB

Level Flatness: 2 dB total variation

Suppression of 1st and 3rd harmonic of input: typically >20 dB

### HP 11507A Output Termination



The 11507A Output Termination is a feed-through device having a 50  $\Omega$  input impedance and a three-position rotary switch to control attenuation and output impedance. With a frequency range of 50 kHz to 65 MHz, this multi-purpose termination enhances the usefulness of the 8640A/B in the HF range by providing:

1. A matched 50  $\Omega$  termination for use into high impedance circuits.
2. A 20 dB (10:1) terminated voltage divider which reduces the source impedance to 5  $\Omega$ .
3. A dummy antenna having the IEEE standard characteristics for receiver measurements (driven from a 10:1 divider, frequency range 0.54 to 23 MHz).

### HP 11687A 50 - 75 $\Omega$ Adapter



This 50 - 75  $\Omega$  Adapter with Type N connectors is recommended for use with the 8640A/B for measurements in 75  $\Omega$  systems. The voltage calibration on the output level meter is unaffected by use of the adapter, but a correction of 1.76 dB must be made when using the dB scale.

### HP 11509A Fuseholder



The 11509A Fuseholder protects the output circuitry of the 8640 against inadvertent transmitter keying when the generator is used in transceiver tests. Burnout occurs whenever the reverse power to the RF output terminal exceeds approximately 0.4 W. When installed, a 1/16A fast fuse element is introduced between the generator and transceiver, and the output characteristics of the generator are virtually unaffected. Insertion loss is <1 dB and output VSWR of the fuseholder is <1.35.

### HP 10514A Double-Balanced Mixer



This mixer is recommended for use with the 8640A/B for a variety of AM, video, and pulse applications. Rise and fall times are better than 1 nsec and the ON-OFF ratio is greater than 35 dB. Careful balancing of the hot-carrier diodes provides excellent suppression of the local oscillator and input frequencies at the output port. The frequency range of the 10514A is 0.2 to 500 MHz, and conversion loss is <9 dB.

### HP 5300A/5303B 525 MHz Counter



For low-cost frequency counting from dc to 525 MHz, the HP 5300A/5303B can be driven from the auxiliary output of the 8640A Signal Generator.



# 8640A/B Specifications

(All specifications apply over the nominal Frequency Bands and over the top 10 dB of the output level vernier range unless otherwise specified.)

## Frequency Characteristics

**Range:** 500 kHz to 512 MHz in 10 Octave Bands (to 1024 MHz with External Frequency Doubler).

**Bands and Band Overlap:** Bands extend 10% below and 7% above the nominal Frequency Bands shown below.

Frequency Bands (MHz)	Frequency Range (MHz) (with overlap)
0.5 - 1	0.45 - 1.07
1 - 2	0.9 - 2.1
2 - 4	1.8 - 4.2
4 - 8	3.6 - 8.5
8 - 16	7.2 - 17.1
16 - 32	14.4 - 34.3
32 - 64	28.8 - 68.7
64 - 128	57.5 - 137.5
128 - 256	115 - 275
256 - 512	230 - 550
External Doubler Band <sup>1</sup> 512 - 1024	460 - 1100

### Internal Counter Resolution (8640B):

Frequency Bands (MHz)	Normal Mode	Expand X10	Expand X100
0.5 - 1	10 Hz	1 Hz	0.1 Hz
1 - 16	100 Hz	10 Hz	1 Hz
16 - 128	1 kHz	100 Hz	10 Hz
128 - 1024	10 kHz	1 kHz	100 Hz

### Accuracy:

8640A, mechanical dial; accuracy better than 0.5%; resettability better than 0.1%.

8640B, 6-digit LED display with X10 and X100 expand; accuracy depends on internal or external reference used.

$$\left[ \begin{array}{c} \text{Total} \\ \text{Count} \\ \text{Accuracy} \end{array} \right] = \left[ \begin{array}{c} \text{Counter} \\ \text{Resolution} \\ (\pm 1 \text{ count}) \end{array} \right] + \left[ \begin{array}{c} \text{Reference} \\ \text{Error} \\ (\text{INT or EXT}) \end{array} \right] + \left[ \begin{array}{c} \text{Reference} \\ \text{Aging} \\ \text{Error} \end{array} \right]$$

Internal Crystal Aging Rate <math>< 2 \text{ ppm/year}</math>  
 Internal Reference Error <math>< \pm 1 \text{ ppm}</math>  
 (when calibrated at 25°C and operating between 15°C and 35°C)

### Fine Tuning:

8640A and 8640B unlocked: >200 ppm total range.

8640B locked mode: >±20 ppm by varying internal time base vernier.

### Stability:

	Normal	Locked (8640B) <sup>2</sup>
<b>Time</b> (after 2-hr. warm-up)	<10 ppm/10 min	<0.05 ppm/hr
<b>Temperature</b> (room ambient 15° to 35°C)	<50 ppm/°C	<2 ppm total variation
<b>Line Voltage</b> (+5% to -10% line voltage change)	<1 ppm	<0.1 ppm
<b>Load</b> (open to short circuit)	<1 ppm	None
<b>Level Change</b> (10 dB on output level vernier)	<1 ppm	
<b>Mode Change</b> (CW to FM)	The greater of 100 Hz or <math>< 0.5 \%</math> of selected peak deviation	

### Restabilization Time:

	Normal Mode	Locked Mode (8640B)
<b>After frequency change</b>	<15 min	None After Relocking
<b>After band change</b>	None	
<b>After 1 min in RF OFF Mode</b>	<10 min	

<sup>1</sup> In the External Doubler Band, the 8640B counter and 8640A dial will display the actual doubled output frequency, and the FM meter indicates the proper peak deviation.

<sup>2</sup> These specifications are given for the 8640B internal reference. When using an external reference, drift in the locked mode will depend on the external reference characteristics.



## Spectral Purity

**Harmonics:** (at 1 volt, +13 dBm output range and below)  
 >35 dB below fundamental of 0.5 to 128 MHz.  
 >30 dB below fundamental of 128 to 512 MHz.

**Subharmonics and Nonharmonic Spurious:** (excluding frequencies within 15 kHz of carrier whose effects are specified in Residual AM and FM)  
 8640A: None detectable.  
 8640B: >100 dB below carrier.

**Noise:** Averaged RMS noise level below carrier stated in a 1 Hz bandwidth.

SSB Phase Noise at 20 kHz offset from carrier. (See Figures 1 and 2, page 4.)  
 256 MHz to 512 MHz: >130 dB from 230 to 450 MHz increasing linearly to >122 dB down at 550 MHz.  
 0.5 MHz to 256 MHz: Decreases approx. 6 dB for each divided frequency range until it reaches SSB Broadband noise floor of >140 dB.

SSB Broadband noise floor at maximum vernier. (See Figures 1 and 2, page 4.)  
 0.5 to 512 MHz: >140 dB.

**Residual AM:** (Single Side Band)

Post-detection Bandwidth	
300 Hz to 3 kHz	20 Hz to 15 kHz
>85 dB down	>78 dB down

**Residual FM:**

Post-detection Bandwidth	CW and up to 1/8 maximum allowable peak deviation		Up to maximum allowable peak deviation	
	300 Hz to 3 kHz	20 Hz to 15 kHz	300 Hz to 3 kHz	20 Hz to 15 kHz
<b>230 to 550 MHz</b>	<5 Hz	<15 Hz	<15 Hz	<30 Hz

Note: Residual FM decreases by approximately 1/2 for each divided frequency range until limited by broadband noise floor. This limit for 300 Hz to 3 kHz is about 1 Hz, and for 20 Hz to 15 kHz is about 4 Hz. These are measured values in the 230 to 550 MHz range and calculated for divided ranges, knowing the noise distribution.

## Output Characteristics

**Range:** Continuously selectable from +19 to -145 dBm (2 V to 0.013  $\mu$ V) into 50  $\Omega$ .

**Level Flatness:**  $\leq \pm 0.5$  dB from 0.5 to 512 MHz referred to output at 50 MHz. (Flatness applies to 1 V output range and below and for top 10 dB of vernier range.)

**Impedance:** 50  $\Omega$ , VSWR <2.0 on 2 V and 1 V output ranges; <1.3 on all other ranges.

**Auxiliary Output:** Rear panel BNC output is  $> -5$  dBm into 50  $\Omega$ , source impedance is approximately 500  $\Omega$ .

**Leakage:** (With all unused outputs terminated properly.) Leakage limits are below those specified in MIL-I-6181D. Furthermore, less than 3  $\mu$ V is induced in a 2-turn, 1-inch diameter loop 1 inch away from any surface and measured into a 50  $\Omega$  receiver, and less than 1  $\mu$ V, 2 inches away. This permits receiver sensitivity measurements to at least  $< 0.03$   $\mu$ V in a shielded system.

**Level Accuracy:**

Output Level (dBm)	Using Top 10 dB of Vernier Range			Using Full Vernier Range
	+19 to -7	-7 to -47	-47 to -137	-137 to -145
<b>Total Accuracy as Indicated on Level Meter</b>	$\pm 1.5$ dB	$\pm 2.0$ dB	$\pm 2.5$ dB	$\pm 3$ dB

Note: Level Accuracy error consists of allowances for: meter accuracy, detector linearity, temperature, flatness, attenuator accuracy, and twice the measurement error. All but the attenuator accuracy and the measurement error can be calibrated out with a power meter at a fixed frequency and a fixed vernier setting.



## Modulation Characteristics

### General

**Types:** Internal AM and FM.  
External AM, FM, and PULSE.  
Simultaneous AM and FM or Pulse and FM.

**Internal Modulation Sources:** (independently adjustable output is available at front panel)

**Standard:** 8640A or 8640B.

Frequency: Fixed 400 Hz and 1 kHz,  $\pm 2\%$ .

Output Level: Indicated 10 mV to 1 V rms. Accuracy  $\pm 20\%$  into 600  $\Omega$ .

**Optional:** (Internal Variable Audio Oscillator Option 001, 8640A or 8640B)

Frequency: Variable 20 Hz to 600 kHz,  $\pm 10\%$  in 5-decade continuous bands plus fixed 400 Hz and 1 kHz  $\pm 2\%$ .

Output Level: Indicated 10 mV to 3 V. Accuracy  $\pm 20\%$  into 600  $\Omega$ .

Level Flatness: (referenced to 2 kHz on X100 range)

$\pm 0.25$  dB      200 Hz to 100 kHz

$\pm 0.5$  dB      20 Hz to 600 kHz

Total Harmonic Distortion:

$< 0.25\%$       400 Hz and 1 kHz fixed tones

$< 0.5\%$       20 Hz to 2 kHz

$< 1.0\%$       2 kHz to 600 kHz

### Amplitude Modulation

(AM specifications apply to the top 10 dB of output vernier range unless otherwise specified)

**Depth:** 0 to 100% for output level range of +13 dBm and below and for top 10 dB of vernier range.

**AM Rates:** INT and EXT ac; 20 Hz to AM 3 dB bandwidth below. EXT dc; dc to AM 3 dB bandwidth below.

**AM 3 dB Bandwidth:**

Frequency Bands	0 to 50% AM	70% AM	90% AM
0.5 - 2 MHz	25 kHz	20 kHz	12.5 kHz
2 - 8 MHz	50 kHz	40 kHz	25 kHz
8 - 512 MHz	100 kHz	80 kHz	50 kHz

**AM Distortion:** (at 400 Hz and 1 kHz rates)

Frequency Bands	0 to 50% AM	70% AM	90% AM
0.5 to 512 MHz	$< 1\%$	$< 3\%$	$< 5\%$

**External AM Sensitivity:** 0.1% AM per mV peak into 600  $\Omega$  with AM vernier at full CW position.

**External AM Sensitivity Accuracy:** (400 Hz and 1 kHz rates)  
 $\pm 5\%$  for 0 to 90% AM.

**Indicated AM Accuracy:** (400 Hz and 1 kHz rates using internal meter)

$\pm 8\%$  of reading on 0 - 10 scale.

$\pm 9\%$  of reading on 0 - 3 scale (for greater than 10% of full scale).

**Peak Incidental PM** (at 30% AM)

Less than 0.15 radians, 0.5 to 128 MHz.

Less than 0.3 radians, 128 to 512 MHz.

**Peak Incidental FM:** Equals PEAK INCIDENTAL PM x MODULATION FREQUENCY.

### Pulse Modulation

Frequency Bands (MHz)	0.5 - 1	1 - 2	2 - 4	4 - 8	8 - 32	32 - 512
Rise and Fall Times	$< 9 \mu\text{s}$	$< 4 \mu\text{s}$	$< 2 \mu\text{s}$	$< 1.5 \mu\text{s}$	$< 0.5 \mu\text{s}$	$< 0.5 \mu\text{s}$
Pulse Repetition Rate	50 Hz to 50 kHz		50 Hz to 100 kHz		50 Hz to 250 kHz	50 Hz to 500 kHz
Pulse Width Minimum for level accuracy within 1 dB of CW ( $> 0.1\%$ duty cycle)	10 $\mu\text{s}$		5 $\mu\text{s}$		2 $\mu\text{s}$	1 $\mu\text{s}$
Pulse ON/OFF ratio at maximum vernier	$> 40$ dB					
Peak Input Required	$> 1$ V (5 V max.) Sinewave or Pulse return to zero into 50 $\Omega$ .					



### Frequency Modulation

**Deviation:** Maximum allowable deviation equals 1% of lowest frequency in each band as below.

Frequency Band (MHz)	Maximum Peak Deviation (kHz)
0.5 - 1	5
1 - 2	10
2 - 4	20
4 - 8	40
8 - 16	80
16 - 32	160
32 - 64	320
64 - 128	640
128 - 256	1280
256 - 512	2560
512 - 1024	5120

### FM 3 dB Bandwidth:<sup>3</sup>

Internal and External ac; 20 Hz to 250 kHz.  
External dc; dc to 250 kHz.

### FM Distortion: (at 400 and 1 kHz rates)

<1% for deviations up to 1/8 maximum allowable.  
<3% for maximum allowable deviation.

**External FM Sensitivity:** 1 volt peak yields maximum deviation indicated on PEAK DEVIATION switch with FM vernier at full CW position.

**External FM Sensitivity Accuracy:**  $\pm 5\%$  from 15° to 35°C.

**Indicated FM Accuracy:** (using internal meter)  $\pm 9\%$  of meter reading (for greater than 10% of full scale).

### Incidental AM: (at 400 Hz and 1 kHz rates)

<0.5% AM for FM up to 1/8 max. allowable deviation.  
<1% AM for FM at maximum allowable deviation.

<sup>3</sup> With 8640B in LOCKED MODE, external FM is possible only for rates greater than 50 Hz.

## Counter Characteristics (8640B)

### External RF Input:

**Frequency Range:** 20 Hz to 550 MHz.

**Sensitivity:**  $\geq 100$  mV rms into 50  $\Omega$ .

### External Count Resolution: 6-digit LED DISPLAY

Mode	Normal	Expand X10	Expand X100
0 - 10 MHz	100 Hz	10 Hz	1 Hz
0 - 550 MHz	10 kHz	1 kHz	100 Hz

**External Reference Input:** 5 MHz, >0.2 V (5 V maximum) into 1000  $\Omega$ .

### Internal Reference Characteristics: (after 2-hr. warm-up)

**Accuracy:** (after calibration at 25°C)

Better than  $\pm 1$  ppm for 15° to 35°C.

Better than  $\pm 3$  ppm for 0 to 55°C.

**Drift Rate:** (constant temperature and line voltage)

<0.05 ppm over any hour period.

<2 ppm per year.

### Frequency Tuning:

$\geq \pm 20$  ppm using internal time base vernier.

**Rear Output:** >0.5 V pk-pk into 500  $\Omega$ . This will drive another 8640B.

## General Characteristics

**Operating Temperature Range:** 0 to 55°C.

**Power Requirements:** 100, 120, 220, and 240 volts, +5%, -10%, 48 to 440 Hz; 175 VA max. 7 1/2 ft (2,29 m) power cable furnished with mains plug to match destination requirements.

**Weight:** 8640A and 8640B: Net, 45 lb (20,4 kg). Shipping, 53 lb (24,1 kg).

**Price:** 8640A, \$3,100. 8640B, \$4,450.

**Option 001:** (Internal variable audio oscillator, 20 Hz to 600 kHz) available on both 8640A and 8640B, add \$150.

### Dimensions:

NOTES  
DIMENSIONS IN INCHES AND (MILLIMETERS)  
(A) EIA RACK HEIGHT (INCLUDING FILLER STRIP)  
FOR CABINET HEIGHT (INCLUDING FEET) ADD 1/8" (3.18) TO  
EIA RACK HEIGHT  
(B) REAR APRON PROTRUSION

