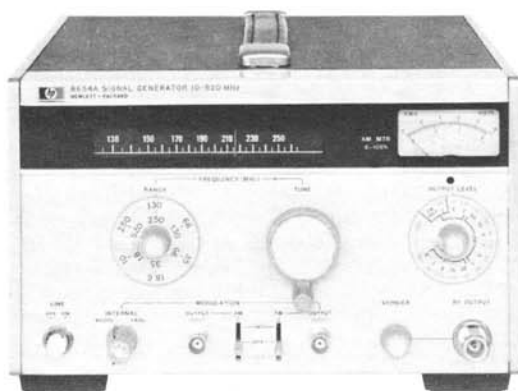


# SIGNAL GENERATORS

Rugged solid-state generator 10 to 520 MHz; synchronizer/counter

Models 8654A, 8654B, 8655A

- Calibrated output power
- Calibrated AM, FM; internal, external, independent
- 25 Watt reverse power protection (optional)



8654A



8654B

## 8654A/B Signal Generators

The HP 8654A/B Signal Generators are portable, low-cost solid-state generators providing calibrated output and versatile modulation capabilities over the 10 to 520 MHz frequency range. The 8654 provides clean RF signals with harmonics  $< -20$  dBc (dB relative to carrier) and subharmonics and spurious  $< -100$  dBc for testing receivers, amplifiers, antennas, and filter networks. The 8654B has calibrated AM and FM while the 8654A has uncalibrated FM.

Its compactness and small size allow the 8654 to fit easily into production, mobile, airborne, and shipboard test locations. Its rugged, lightweight construction is also suitable for field maintenance and service applications.

Internal oscillators provide both amplitude modulation and frequency modulation at 400 Hz and 1000 Hz, or external modulation can be accomplished using standard audio oscillators.

A front-panel meter accurately indicates amplitude modulation depth from 0 to 90% when the meter mode switch is in the AM position. Additionally, the 8654B provides calibrated and metered FM over four deviation ranges: 0 to 3 kHz, 0 to 10 kHz, 0 to 30 kHz, and 0 to 100 kHz.

Reverse power protection is available (Option 003) to protect against accidental triggering of transceivers of up to 25 watts into the signal generator.

Effective RF shielding and output range permit receiver sensitivity measurements to be made down to power levels of 0.1  $\mu$ V.

## 8654A/B Specifications

Specifications apply from 10 to 520 MHz for output power  $\leq +10$  dBm and over the top 10 dB of output level vernier range unless otherwise specified.

### Frequency Characteristics

**Range:** 10 to 520 MHz in 6 ranges.

**8654A ranges (MHz):** 10 to 18.6, 18.6 to 35, 35 to 66, 66 to 130, 130 to 250, 250 to 520.

**8654B ranges (MHz):** 10 to 19, 19 to 35, 35 to 66, 66 to 130, 130 to 270, 270 to 520.

**Accuracy:**  $\pm 3\%$  after 2-hour warm-up.

**Settability:** settle to within 5 ppm of the desired frequency with an external indicator after 1-hour warm-up.

**Stability (after 2-hour warm-up and 15 min. after frequency change):**  $< (1 \text{ kHz plus } 20 \text{ ppm})/5 \text{ min.}$

### Spectral Purity

**Harmonic distortion (output power  $\leq +3$  dBm):**  $< -20$  dBc; with option 003,  $< -15$  dBc.

**Subharmonics and non-harmonic spurious (excluding line related):**  $< -100$  dBc.

**Residual AM (average rms):**  $< -55$  dBc in a 50 Hz to 15 kHz post-detection noise bandwidth.

**Residual FM on CW (averaged rms deviation):**  $< 0.3$  ppm in a 0.3 to 3 kHz post-detection noise bandwidth.  $< 0.5$  ppm in a 50 Hz to 15 kHz post-detection noise bandwidth.

### Output Characteristics

**Range:** 10 dB steps and a 13 dB vernier provide power settings from +10 dBm to  $-130$  dBm (0.7 V to 0.07  $\mu$ V) into 50 $\Omega$ . With Option 003, maximum output power is +8 dBm (0.56 V).

**Impedance:** 50 $\Omega$  ac coupled. SWR  $< 1.3$  on 0.1 V range or lower. With Option 003, SWR  $< 1.5$  on 0.1 V range or lower.

**Level accuracy (total as indicated on level meter):** +10 to  $-7$  dBm,  $\pm 1.5$  dB;  $-7$  to  $-57$  dBm,  $\pm 2.0$  dB;  $-57$  to  $-97$  dBm,  $\pm 2.5$  dB;  $-97$  to  $-127$  dBm,  $\pm 3$  dB.

**Level flatness:**  $\pm 1$  dB referenced to the output at 250 MHz for output levels  $> -7$  dBm.

**Auxiliary RF output:**  $> -7$  dBm (100 mV) into 50 $\Omega$ .

**Leakage (with all RF outputs terminated properly):** leakage limits are below those specified in MIL-I-6181D. Furthermore, with an output level  $< 0.01$  V, less than 0.5  $\mu$ V is induced in a 2-turn, 25 mm diameter loop 25 mm away from any surface and measured into a 50 $\Omega$  receiver.

**Reverse power protection (Option 003):** protects signal generator from accidental applications of up to 25 W (+44 dBm) of RF power (between 10 and 520 MHz) into generator output.

### Modulation Characteristics

**Amplitude modulation:** specifications apply for output power  $< +3$  dBm.<sup>1</sup>

**Depth:** 0 to 90%.

**Modulation rate:** internal, 400 and 1000 Hz  $\pm 10\%$ ; external 3 dB bandwidth, dc to  $> 20$  kHz.

**External AM sensitivity:**<sup>2</sup>  $(0.1 \pm 0.01)\%$  AM/mV pk into 600 $\Omega$ .

**Indicated AM accuracy:**<sup>2</sup>  $\pm (5\% \text{ of reading} + 5\% \text{ of full scale})$ .

**Peak incidental frequency deviation (30% AM):**<sup>2</sup>  $< 200$  Hz.

**Envelope distortion:**<sup>2</sup>  $< 3\%$ , 0 to 70% modulation;  $< 5\%$ , 70 to 90% modulation.

### Frequency Modulation

**8654B:** fully calibrated.

**Peak deviation:** 0 to 30 kHz from 10 to 520 MHz.

0 to 100 kHz from 80 to 520 MHz.

**Deviation ranges:** 0 to 3 kHz, 0 to 10 kHz, 0 to 30 kHz, 0 to 100 kHz.

**Modulation rate:** internal, 400 and 1000 Hz  $\pm 10\%$ . External 3 dB bandwidth, dc to  $> 25$  kHz.

**FM distortion:**<sup>2</sup>  $< 2\%$  for deviations up to 30 kHz,  $< 3\%$  for deviations up to 100 kHz.

<sup>1</sup>AM is possible above +3 dBm as long as the combination of the AM depth plus carrier output level does not exceed +9 dBm.

<sup>2</sup>400 and 1000 Hz modulation rates.





- Synchronize 8654A/B, stability 0.1 ppm/hr.
- 500 Hz lock resolution
- Low RFI counter to 520 MHz

**External FM sensitivity (with FM vernier fully clockwise):**<sup>2</sup> 1 volt peak yields maximum deviation indicated on peak deviation meter.

**Sensitivity accuracy (15° to 35°C):**<sup>2</sup>  $\pm 12\%$ . For 100 kHz deviation above 130 MHz, add 3%.

**Indicated FM accuracy (15° to 35°C):**<sup>2</sup>  $\pm (12\% \text{ of reading} + 3\% \text{ of full scale})$ . For 100 kHz deviation above 130 MHz, add 3% of reading.

**Incidental AM:**<sup>2</sup>  $< 1\%$  AM at 30 kHz deviation.

**Frequency modulation, 8654A:** uncalibrated.

**Deviation:**  $> 0.1\%$  of carrier frequency, maximum.

**Modulation rate:** internal, 400 & 1000 Hz  $\pm 10\%$ . External 3 dB bandwidth, dc coupled to  $> 25$  kHz driven from 600 $\Omega$  or less.

**External FM sensitivity:** 10 V<sub>pk</sub> into 600 $\Omega$  yields  $> 0.1\%$  deviation ( $\pm 15$  volts max).

### General Characteristics

**Power:** 100 or 120 volts (+5%, -10%) from 48 to 440 Hz; or 220 to 240 volts (+5%, -10%) from 48 to 66 Hz. Power consumption is 25 VA max. 2.3m (7.5 ft.) power cable furnished with mains plug to match destination requirements.

**Weight:** net, 8.0 kg (17.5 lb). Shipping, 9.5 kg (21 lb).

**Size:** 178 H x 267 W x 306 mm D (7" x 10.5" x 12").

## 8655A Synchronizer/Counter

The HP 8655A Synchronizer/Counter is a phase-lock frequency stabilizer that provides the HP 8654A and 8654B Signal Generators with crystal-oscillator frequency stability. It is also a frequency counter with very low RFI leakage. When used with an 8654 Signal Generator, the frequency can be phase-locked at any frequency from 10 to 520 MHz. In the locked mode the spectral purity and FM capability of the unlocked 8654 are preserved. This performance allows testing of crystal controlled receivers.

Phase locking the 8654 is simple with the 8655A Synchronizer. A push of the LOCK button establishes lock at the frequency shown on the LED display. Maximum lock resolution is 500 Hz. If lock is broken, the LED display flashes. Lock can be re-established by retuning and again pushing the LOCK button.

The 8655A can also be used to count external input signals from 1 kHz to 520 MHz. Input sensitivity is better than 100 mV into 50 ohms. Using the EXPAND button it is possible to achieve a resolution of 1 Hz in the 1 kHz—10 MHz EXT COUNT mode or 100 Hz in both the 10—520 MHz EXT COUNT and SYNCHRONIZE COUNT modes.

RF leakage from an 8654B/8655A system is  $< 1.5 \mu\text{V}$  in a 2-turn, 25 mm diameter loop 25 mm away from any surface and measured into a 50 ohm receiver.

## 8655A Specifications

### Counter Characteristics

**Range:** 1 kHz to 520 MHz.

**Sensitivity:**  $< 100$  mV rms ( $-7$  dBm), ac coupled into 50 ohms. (Typically  $< -20$  dBm, 10 kHz to 200 MHz.)

**Maximum input:** AC: 707 mV ( $\pm 10$  dBm) for accurate count. DC:  $\pm 25$  V on EXTERNAL COUNT INPUT, 0 V dc (ac only) on rear panel SYNCHRONIZE COUNT INPUT. Both inputs are protected with common fuse.

**Count resolution:** 6-digit LED display:

Mode	Normal	X10 EXPAND <sup>3</sup>
1 kHz to 10 MHz (EXTERNAL)	10 Hz	1 Hz
10 MHz to 520 MHz (EXTERNAL & SYNCHRONIZE COUNT)	1 kHz	100 Hz

**Accuracy:**  $\pm 1$  count  $\pm$  time base accuracy.

<sup>3</sup>Will continue to accurately count from 1 to 10 MHz and 100 to 520 MHz with loss of most significant digit (indicated by overflow light). Phase lock is not allowed.

<sup>4</sup>Frequency correction error is a function of the unlocked 8654B frequency drift. For optimum FM accuracy, this error may be eliminated by unlocking, returning to the desired frequency, and relocking.



8655A

### Time base characteristics

**Frequency:** 1 MHz temperature-compensated crystal oscillator.

**Aging** (constant operating temperature):  $< 0.1$  ppm/hr,  $< 2$  ppm/90 days.

**Temperature:**  $\pm 5$  ppm from 0° to 50°C. (Referenced to 25°C).

**Typical overall accuracy (after 2 hour warm-up and within 3 months of calibration):** better than  $\pm 2$  ppm from 15° to 35°C. (Optional higher stability time base available.)

**Rear output:** 1 MHz, nominally  $> 0.5$  V peak-to-peak into 500 ohms.

**External reference input:** 1 MHz, nominally  $> 0.5$  V peak-to-peak into 1000 ohms. (Not available with optional high stability time base.)

### 8654A/B-8655A Synchronization Characteristics

**Frequency range:** 10—520 MHz.

**Frequency count resolution:** 1 kHz, or 100 Hz in X10 EXPAND.

**Frequency lock resolution:** 1 kHz. Depressing LOCK +500 Hz button allows a locked resolution of 500 Hz.

**Frequency accuracy:** same as time base accuracy.

**Lock time duration (after 5 minute warm-up, constant ambient):** 45 min. typical.

**FM rate while synchronized:** 50 Hz to  $> 25$  kHz, (with 8654B only).

**FM accuracy (with 8654B only):**

$$\left[ \begin{array}{c} \text{Total FM} \\ \text{Accuracy} \end{array} \right] = \left[ \begin{array}{c} \text{8654B FM} \\ \text{Accuracy} \end{array} \right] \pm \left[ \begin{array}{c} \text{Frequency} \\ \text{Correction Error} \end{array} \right]$$

Frequency correction error<sup>4</sup> is typically  $< \pm 4\%$ .

### General

**RF leakage (when operated with 8654B using furnished interface cables):** less than  $1.5 \mu\text{V}$  in a 2-turn, 25 mm diameter loop 25 mm away from any surface and measured into a 50 ohm receiver.

**Power:** 100, 120, 220, or 240 volts  $\pm 5\%$ ,  $-10\%$ , 48 to 440 Hz, 100 VA maximum. 2.9 m (7.5 ft) power cable.

**Weight:** net, 6 kg (13.0 lb). Shipping 6.5 kg (14 lb).

**Size:** 102 H x 267 W x 318 mm D (4" x 10.5" x 12.5").

### Ordering Information

**8654A AM Signal Generator**

**8654B AM/FM Signal Generator**

**Opt 003:** Reverse power protection (for 8654A/B)

**8655A Synchronizer/Counter**

**Opt 001:** High stability time base (for 8655A)

### Price

\$2400

\$2900

add \$300

\$2200

add \$450