HEWLETT PACKARD

HP 8656/57 Series Economical Synthesized Signal Generators Analog and Digital Modulation

Technical Data

HP 8656B, 8657A/B, 8657D, 8657A/B Opt 022

HP 8656/57 Series Synthesized Signal Generators

The HP 8656/57 series is designed to meet the testing needs of the communication industry. Test AM, FM, and pulsed receivers as well as components. Use it in R&D, manufacturing, and support. There are six signal generators in the family, all offering exceptional analog modulation, good spectral purity, and superb output level performance.

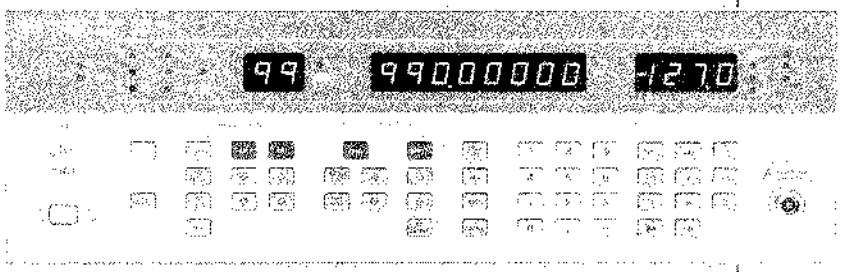
HP 8657D

The HP 8657D adds $\pi/4$ DQPSK modulation. Test radios designed for the North American Digital Cellular Radio System and Japanese Digital Cellular System.

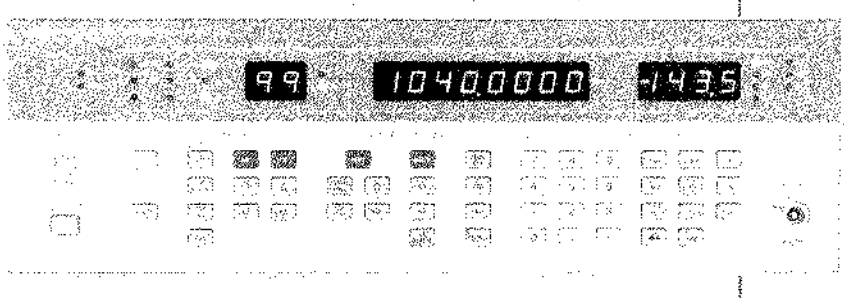
HP 8657A/B Option 022

For European digital communication systems, the HP 8657A/B Option 022 generates 0.3 Gaussian Minimum Shift Keying (0.3 GMSK). Test receivers designed for the GSM Pan-European Digital Cellular Radio System and the PCN European Personal Communications Network.

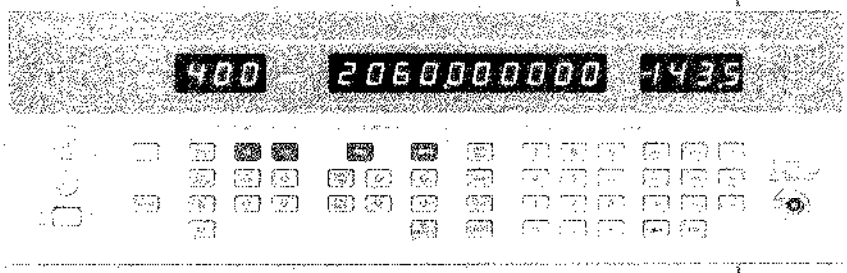
The Choice is Yours



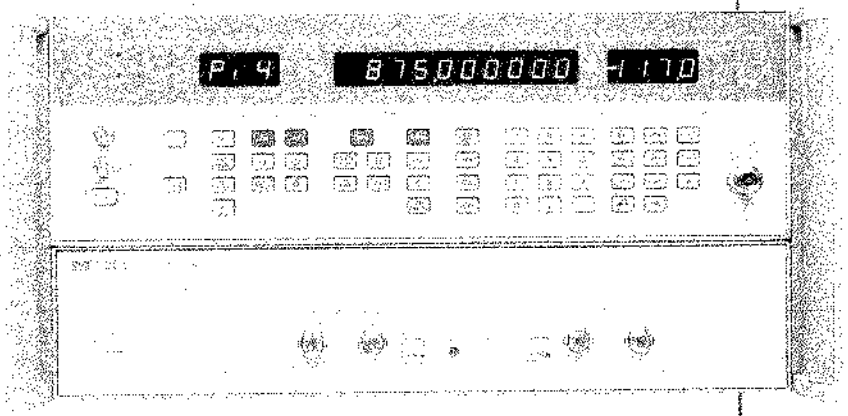
HP 8656B
- 100 kHz to 990 MHz
- AM & FM
- 25 watts RPP
- Lowest cost of family
- In-channel performance



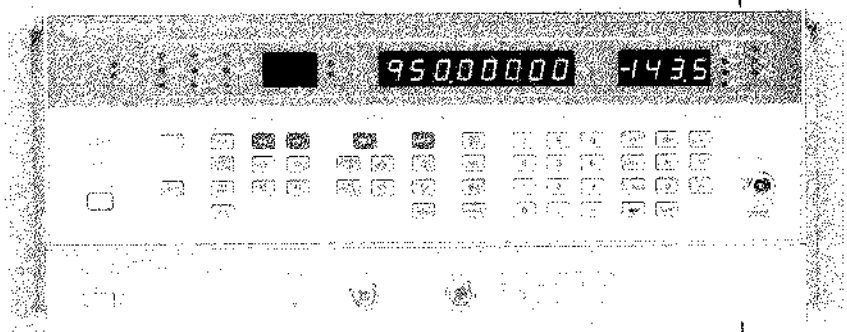
HP 8657A
- 100 kHz to 1040 MHz
- AM & FM
- Low SSB phase noise
- Electronic attenuator for ATE
- Levels to -143.5 dBm
- 50 watts RPP
- In-channel and out-of-channel performance



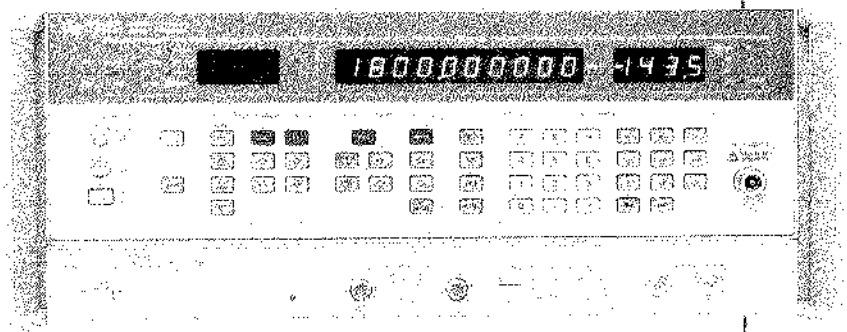
HP 8657B
- 100 kHz to 2060 MHz
- AM, FM, & pulse (option)
- Low SSB Phase Noise
- Levels to -143.5 dBm
- 50 watts RPP
- 1 Hz Frequency resolution
- In-channel and out-of-channel performance



HP 8657D
- 100 kHz to 1030 MHz AM & FM
- π/4 DQPSK for NADC and JDC
  10 to 129.9 MHz
  810 to 965 MHz
  1420 to 1540 MHz data inverted
- Pulse modulation
- <4% error vector magnitude



HP 8657A Option 022
- 100 kHz to 1040 MHz AM & FM
- 0.3 GMSK for GSM
  520 to 1040 MHz
  10 to 130 MHz data inverted
- <3° rms phase error



HP 8657B Option 022
- 100 kHz to 2060 MHz AM & FM
- 0.3 GMSK for GSM and PCN
  520 to 2060 MHz
  10 to 130 MHz data inverted
- Optional pulse modulation
- <3.5° rms phase error
- Baseband I/Q outputs

HP 8656B
specifications

SPECIFICATIONS describe the instruments warranted performance and apply after a 30 minute warm-up. All SPECIFICATIONS are valid over the signal generator's entire Operating/Environmental Range unless otherwise noted.

SUPPLEMENTAL CHARACTERISTICS (shown in italics) are intended to provide additional information useful in applying the instrument by giving typical (expected), but not warranted performance.

FREQUENCY

Range (8-digit LED display): 100 kHz to 990 MHz.
Resolution: 10 Hz.
Switching Speed (to be within 100 Hz of carrier frequency): <35 ms. *(25ms typical at 25°C)*
Accuracy and Stability: Same as timebase used.

SUPPLEMENTAL CHARACTERISTICS

Frequency Underrange: *10 kHz with uncalibrated output.*
Phase Offset: *Output phase is adjustable via HP-IB, or from the front panel in 1 degree increments.*
Timebase Characteristics:

	Standard	*Option 001*
Aging Rate	*±2 ppm / year*	*1.5x 10^{-6} / day (after 10 days warm-up) 1.0 x 10^{-9} parts / day (after 180 days warm-up)*
Temperature (0-55°C)	*±10 ppm*	*7 x 10^{-9}*
Line Voltage		*2 x 10^{-9} (+5%, −10%)*
Frequency	*50 MHz*	*10 MHz*
Timebase Reference Signal (Rear Panel)	*Available at a level of > 0.15 V_{rms} into 50 Ω (Output of 10, 5, or 1 MHz is selectable via internal jumper). If the Option 001 or another external reference is used, only that reference frequency is available as an output.*	
External Reference Input (Rear Panel)	*Accepts any 10, 5, or 1 MHz (± 0.002%) frequency standard at a level > 0.15 V_{rms} into 50 Ω*	

SPECTRAL PURITY

Spurious Signals (≤ +7 dBm output levels):
Harmonic: < −30 dBc
Sub-harmonic: None.
Non-Harmonic: < −60 dBc (> 5 kHz from carrier in CW mode)
Residual FM (in CW mode):

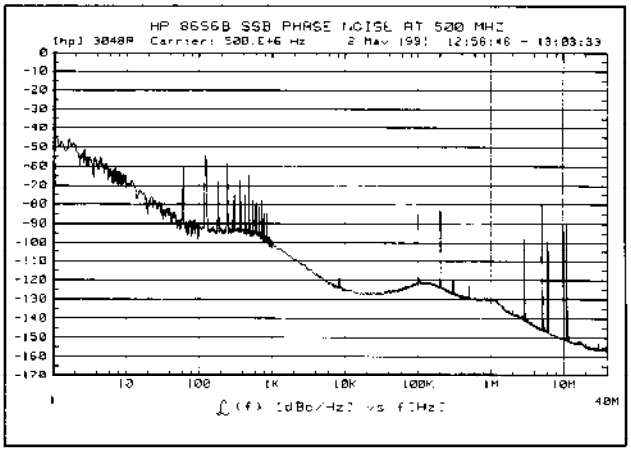
Frequency Range	Post Detection BW (rms detector)	
	300 Hz to 3 kHz	50 Hz to 15 kHz
0.1 - 123.5 MHz	< 7 Hz *(typ <2 Hz)*	< 15 Hz
123.5 - 247 MHz	< 2 Hz *(typ <0.5 Hz)*	< 4 Hz
247 - 494 MHz	< 4 Hz *(typ <1 Hz)*	< 8 Hz
494 - 990 MHz	< 7 Hz *(typ <1 Hz)*	< 15 Hz

Residual AM (50 Hz to 15 kHz post-detection noise bandwidth, in CW mode): < 0.02% AM **SSB Phase Noise (in CW Mode):**

Carrier Frequency	SSB ϕ-Noise 20 kHz offset
0.1 to 123.5 MHz	< −114 dBc/Hz
123.5 to 247 MHz	< −126 dBc/Hz
247to 494 MHz	< −120 dBc/Hz
494 to 990 MHz	< −114 dBc/Hz

SUPPLEMENTAL CHARACTERISTICS

Typical SSB Phase Noise at 500 MHz

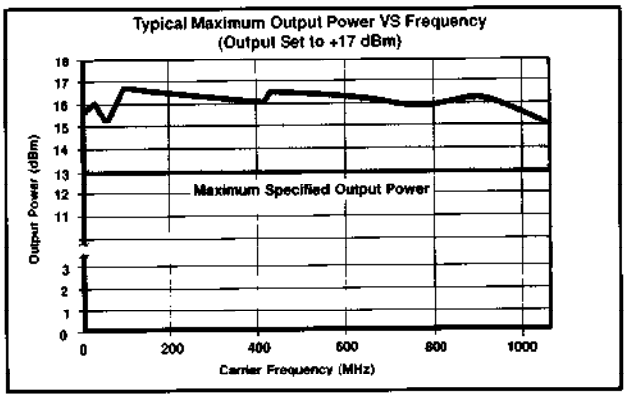


OUTPUT

Level Range (3 1/2-digit LED display): +13 dBm to −127 dBm into 50Ω.
Resolution: 0.1 dB.
Absolute Level Accuracy:[1-pg6]
< ±1.0 dB (123.5 to 990 MHz, +7 to −124 dBm),
< ±1.5 dB (0.1 to 123.5 MHz, and <−124 dBm or > +7 dBm at 0.1 to 990 MHz.
Level Flatness (100 kHz to 990 MHz): ≤ 1.0 dB, output level setting of 0 dBm.
SWR : < 2.0 for levels >−5 dBm.
< 1.5 for levels ≤ −5 dBm.
Reverse-Power Protection: Protects the signal generator from applications of up to 25 watts of RF power (from a 50Ω source) to 990 MHz into generator output; DC voltage cannot exceed 25 V.

SUPPLEMENTAL CHARACTERISTICS

Impedance: *50 Ω Nominal.*
Typical Output Level Overrange:



AMPLITUDE MODULATION

AM Depth(2-digit LED display):[2-pg6]
0 to 99%, levels of < +7 dBm
0 to 30%, levels to < +10 dBm
Resolution: 1%.
AM Rate,
Internal: 400 Hz and 1 kHz, ± 3%.
External: 20 Hz to 40 kHz (1 dB bandwidth, AC coupled)
AM Distortion (internal rates):
0 to 30 % AM < 1.5%.
31 to 70 % AM < 3.0%.
71 to 90 % AM < 4.0% .
Indicator Accuracy (for depths < 90%, and internal rates and levels < +7 dBm)[2-pg6]**:**
< ± (2% ±4% of setting).
Incidental Phase Modulation (at 30% AM depth, internal rates): < 0.3 radians peak.

FREQUENCY MODULATION

Maximum FM Peak Deviation (Δf_{pk}):[3-pg6]

Center Frequency	Maximum Peak Deviation	
	AC Mode (the lesser of)	DC Mode
0.1 to 123.5 MHz	99 kHz or 4000 x rate (Hz)	99 kHz
123.5 to 247 MHz	50 kHz or 1000 x rate (Hz)	50 kHz
247 to 494 MHz	99 kHz or 2000 x rate (Hz)	99 kHz
494 to 990 MHz	99 kHz or 4000 x rate (Hz)	99 kHz
FM not specified for $f_c - (\Delta f_{pk}) < 100$ kHz		

Resolution: 100 Hz for deviations less than 10 kHz; 1 kHz for deviations ≥ 10 kHz.
FM Rate,
Internal: 400 Hz and 1 kHz, ±3%.
External: dc/5 kHz, to 100 kHz,3 dB bandwidth
dc/20 Hz to 50 kHz, 1 dB bandwidth
Center Frequency Accuracy in dc Mode:

Carrier Frequency	Center Frequency Accuracy
0.1 to 123.5 MHz	± 500 Hz
123.5 to 247 MHz	± 125 Hz
247 to 494 MHz	± 250 Hz
494 to 990 MHz	± 500 Hz

Center Frequency Stability in dc Mode:
<10 Hz per hour drift *(typ < 3 Hz per hour).*
FM Distortion (at internal rates and ≥ 3 kHz peak deviations):[4-pg9]
< 0.5% THD plus noise
Indicator Accuracy (internal rates):[3-pg6]
< ±5% of setting.
Incidental AM (peak deviations <20 kHz, internal rates): < 0.1% (f_c > 500 kHz)
< 1% (f_c= 200 to 500 kHz)
< 5% (f_c < 200 kHz)

SUPPLEMENTAL CHARACTERISTICS

External Sensitivity: *1 volt peak for indicated accuracy for ac signals or 1 volt dc when in dc-FM mode.*
External Modulation Input: *Front panel BNC, 600Ω dc-coupled; front panel annunciators indicate application of 1 V peak signal ± 5%.*
Modulating Signal Output: *Internal modulating signal is provided at the front panel BNC connector at nominally 1 volt peak into a 600 Ω resistive load.*
Simultaneous Modulation:
Internal/External: AM/FM, FM/AM, AM/AM, FM/FM,
Internal/Internal, External/External: AM/FM.

HP 8656B
specifications

REMOTE PROGRAMMING

Interface: HP-IB (Hewlett-Packard's implementation of IEEE Standard 488 (and the identical ANSI Standard MC1.1).

Interface Functions Implemented: SH0, AH1, T0, L2, SR0, RL1, PP0, DC1, DT0, C0, E1.

Functions Controlled: All functions controlled from the front panel with the exception of DISPLAY, DISPLAY in conjunction with SEQ, display Amplitude Offset, Backspace, COARSE TUNE, FINE TUNE, and display HP-IB ADRS are programmable with the same accuracy and resolution as in local operation.

GENERAL

Operating Temperature Range: 0 to +55°C.

Storage Temperature Range: –40 to +71°C.

Leakage: Conducted and radiated interference is within the requirements of RE02 of MIL STD 461B and FTZ 1115. Furthermore, RF leakage of less than 1.0 μV is induced in a two-turn loop, 2.5 cm in diameter, held 2.5 cm away from the front surface.

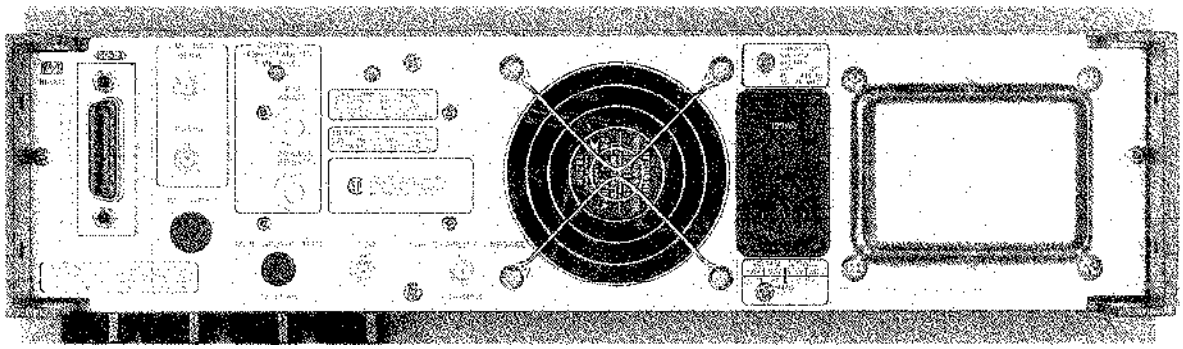
Save/Recall/Sequence Storage Registers: 100 non-volatile registers are available to save front panel settings.

Power Requirements: 100 or 120 or 220 or 240 volts (+5%, –10%) from 48 to 440 Hz; 125 VA maximum.

Weight: Net 18.1 kg (40 lb); shipping 23.6 kg (52 lb).

Dimensions: 133H x 425W x 520D mm (5.25 x 16.75 x 20.5 inches.)

HP System II module size: 5 1/4H x 1MW x 17 D.



[1] Absolute level accuracy includes allowances for detector linearity, temperature, flatness, attenuator accuracy and measurement uncertainty.

[2] AM depth is further limited by Indicator Accuracy specification.

[3] FM depth is further limited by Indicator Accuracy specifications.

[4] FM distortion only applies for deviations up to 25 kHz for 123.5 < f_c <247 MHz, and 50 kHz for 247 < f_c <494 MHz. Typical total FM distortion (harmonic and non-harmonic) is less than 1.5% for all specified deviations and external rates from dc to 100 kHz.

[5] Typically < 0.5% THD for peak deviations > 1 kHz and at normal rates.

SPECIFICATIONS describe the instruments warranted performance and apply after a 30 minute warm-up. All SPECIFICATIONS are valid over the signal generator's entire Operating/Environmental Range unless otherwise noted.

SUPPLEMENTAL CHARACTERISTICS (shown in italics) are intended to provide additional information useful in applying the instrument by giving typical (expected), but not warranted performance.

FREQUENCY

Range (8-digit LED display): 100 kHz to 1040 MHz.
Resolution: 10 Hz.
Display Resolution:
10 Hz for frequencies < 1000 MHz
100 Hz for frequencies ≥ 1000 MHz
Switching Speed (to be within 100 Hz of carrier frequency): <35 ms. *(30 ms typical at 25°C)*
Accuracy and Stability: Same as time base used.

SUPPLEMENTAL CHARACTERISTICS

Frequency Underrange: *To 10 kHz with uncalibrated output and modulation.*
Phase Offset: *Output signal phase is adjustable in 1 degree nominal increments.*
Timebase Characteristics:

	Standard	*Option 001*
Aging Rate	*±2 ppm / year*	*1.5 x 10^{-9} parts / day (after 10 days warm-up) 1.0 x 10^{-9} parts / day (after 180 days warm-up)*
Temperature (0-55°C)	*±10 ppm*	*7 x 10^{-9}*
Line Voltage	—	*2 x 10^{-9} (+5%, -10%)*
Frequency	*50 MHz*	*10 MHz*
Timebase Reference Signal (Rear Panel)	*Available at a level of >0.15 V_{rms} into 50 Ω (Output of 10, 5, or 1 MHz is selectable via internal jumper). If external reference is used, output will be the same frequency.*	
External Reference Input (Rear Panel)	*Accepts any 10, 5, or 1 MHz (±0.002%) frequency standard at a level >0.15 V_{rms} into 50 Ω.*	

SPECTRAL PURITY

Spurious Signals (≤+7 dBm output levels):
Harmonic: <– 30 dBc.
Sub-harmonic: None.

Non-Harmonic (CW mode):

Frequency Range	Offset from Carrier	
	5 kHz to 2 MHz	> 2 MHz
0.1 - 130 MHz	<–60 dBc	<–60 dBc
130 - 260 MHz	<–72 dBc	<–60 dBc
260 - 520 MHz	<–66 dBc	<–60 dBc
520 - 1040 MHz	<–60 dBc	<–60 dBc

Residual FM (in CW mode):

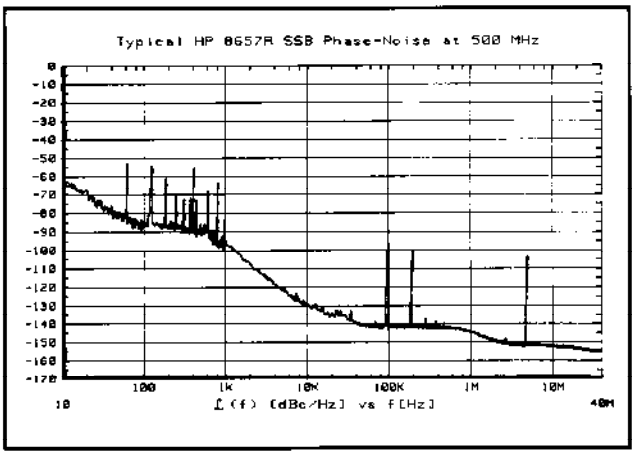
Frequency Range	Post Detection BW (rms detector)	
	300 Hz to 3kHz	50 Hz to 15 kHz
0.1 - 130 MHz	< 4 Hz *(typ < 2 Hz)*	< 6 Hz
130 - 260 MHz	< 1 Hz *(typ < 0.5 Hz)*	< 1.5 Hz
260 - 520 MHz	< 2 Hz *(typ < 1 Hz)*	< 3 Hz
520 - 1040 MHz	< 4 Hz *(typ < 1 Hz)*	< 6 Hz

Residual AM (50 Hz to 15 kHz post-detection noise bandwidth, in CW mode): <0.04% AM.
SSB Phase Noise (in CW Mode):

Carrier Frequency	SSB ϕ-Noise 20 kHz offset
0.1 to 130 MHz	< –124 dBc/Hz
130 to 260 MHz	< –136 dBc/Hz
260 to 520 MHz	< –130 dBc/Hz
520 to 1040 MHz	< –124 dBc/Hz

SUPPLEMENTAL CHARACTERISTICS

Typical SSB Phase Noise at 500 MHz



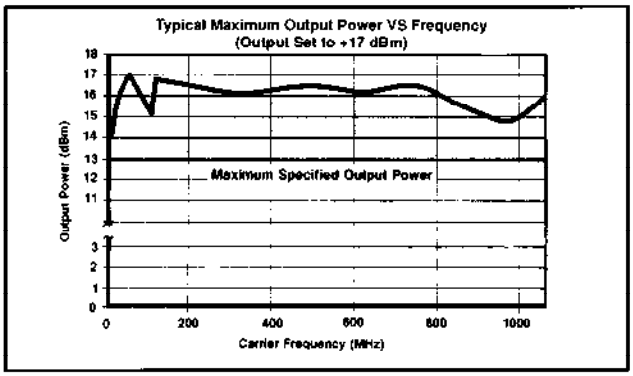
HP 8657A
specifications

OUTPUT

Level Range (3 1/2-digit LED display): +13 dBm to −143.5 dBm into 50Ω, +10 dBm to −143.5 dBm for frequencies from 100 kHz to 1 MHz.
Resolution: 0.1 dB.
Absolute Level Accuracy:[1-pg9]
< ±1.0 dB (+7 to −127 dBm),
< ±1.5 dB (>+7 dBm).
Level Flatness (100 kHz to 1040 MHz): ±0.5 dB, output level setting of 0 dBm.
SWR ($f_c \geq 400$ kHz): <1.5 for levels <− 3.5 dBm.
<2.0 for levels ≤+13 dBm.
Reverse-Power Protection: Protects the signal generator from applications of up to 50 watts of RF power (from a 50Ω source) to 1040 MHz into generator output; DC voltage cannot exceed 50 V.

SUPPLEMENTAL CHARACTERISTICS

Impedance: *50 Ω Nominal.*
Absolute level Accuracy:
< ±1.5 dB, output levels <− 127 dBm.
< ± 0.5 dB, 25°C ±10°C, +7 to −127 dBm.
Typical Output Level Overrage:



AMPLITUDE MODULATION

AM Depth (2-digit LED display):[2-pg9]
0 to 99%, level ≤ +7 dBm, $f_c \geq 400$ kHz.[3-pg9]
0 to 30%, level ≤ +10 dBm, $f_c \geq 400$ kHz.[3-pg9]
Resolution: 1%.
AM Rate,
Internal: 400 Hz and 1 kHz, ± 2%.
External: 20 Hz to 40 kHz
(1 dB bandwidth, AC coupled)
AM Distortion (internal rates, level < +7 dBm):
0 to 30 % AM < 1.5% THD plus noise.
31 to 70 % AM < 3.0% THD plus noise.
71 to 90 % AM < 4.0% THD plus noise.
Indicator Accuracy (for depths < 90% and internal rates and levels < +7 dBm):
< ±(2% +6% of setting).
Incidental Phase Modulation (at 30% AM depth, internal rates): < 0.3 radians peak.

FREQUENCY MODULATION

Maximum FM Peak Deviation (2-digit LED display):[2-pg9]

Center Frequency	Maximum Peak Deviation	
	AC Mode (the lesser of)	DCMode
0.1 to 130 MHz	99 kHz or 4000 x rate (Hz)	99 kHz
130 to 260 MHz	50 kHz or 1000 x rate (Hz)	50 kHz
260 to 520 MHz	99 kHz or 2000 x rate (Hz)	99 kHz
520 to 1040 MHz	99 kHz or 4000 x rate (Hz)	99 kHz
FM not specified for $f_c - (\Delta f_{pk}) < 100$ kHz		

Resolution: 100 Hz for deviations less than 10 kHz; 1 kHz for deviations ≥ 10 kHz.
FM Rate,
Internal: 400 Hz and 1 kHz, ±2%.
External:
dc/5 Hz to 100 kHz, 3 dB bandwidth
dc/20 Hz to 50 kHz, 1 dB bandwidth
Center Frequency Accuracy in dc Mode:

Carrier Frequency	Center Frequency Accuracy
0.1 to 130 MHz	± 500 Hz
130 to 260 MHz	± 125 Hz
260 to 520 MHz	± 250 Hz
520 to 1040 MHz	± 500 Hz

Center Frequency Stability in dc Mode: <10 Hz per hour drift *(typ <3 Hz per Hour).*
FM Distortion (at internal rates and ≥ 3 kHz peak deviations):[4-pg9] <0.5% THD plus noise.
Indicator Accuracy (internal rates):
< ±5% of setting.
Incidental AM (peak deviations <20 kHz, internal rates and $f_c \geq 500$ kHz): <0.1% AM

SUPPLEMENTAL CHARACTERISTICS

External Sensitivity: *1 volt peak for indicated accuracy (1 volt dc when in dc-FM mode).*

External Modulation Input: *Front panel BNC, 600 Ω dc-coupled; front panel annunciators indicate application of 1 V peak signal ± 5%.*

Modulating Signal Output: *Internal modulating signal is provided at the front panel BNC connector at nominally 1 volt peak into a 600 Ω resistive load.*

Simultaneous Modulation:

Internal/External: AM/FM, FM/AM, AM/AM, FM/FM

Internal/Internal, External/External: AM/FM.

REMOTE PROGRAMMING

Interface: HP-IB (Hewlett-Packard's implementation of IEEE Standard 488).

Interface Functions Implemented: SH0, AH1, T0, L2, SR0, RL1, PP0, DC1, DT0, C0, E1.

GENERAL

Operating Temperature Range: 0 to +55°C.

Storage Temperature Range: –40 to +71°C.

Leakage: Conducted and radiated interference is within the requirements of RE02 of MIL STD 461B and FTZ 1046. Furthermore, RF leakage of less than 1.0 μV is induced in a two-turn loop, 2.5 cm in diameter, held 2.5 cm away from the front surface.

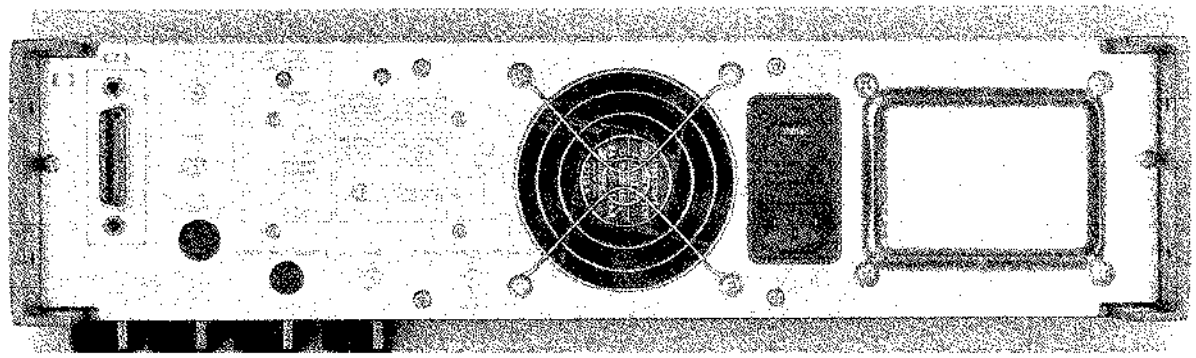
Save/Recall/Sequence Storage Registers: 100 non-volatile registers are available to save front panel settings.

Power Requirements: 100 or 120 or 220 or 240 volts (+5%, –10%) from 48 to 440 Hz; 175 VA maximum.

Weight: Net 18.2 kg (40 lb); shipping 23.6 kg (52 lb).

Dimensions: 133H x 425W x 520D mm (5.25 x 16.75 x 20.5 inches.)

HP System II module size: 5 1/4H x 1MW x 17 D.



[1] Absolute level accuracy includes allowances for detector linearity, temperature, flatness, attenuator accuracy and measurement uncertainty.

[2] AM depth and FM deviation are further limited by Indicator Accuracy specifications.

[3] For f_c < 400 kHz, AM depths of 0 to 30%, levels ≤ +7 dBm.

[4] FM distortion only specified for deviations up to 25 kHz for 130 < f_c <260 MHz, and for 260 < f_c <520 MHz. Typical total FM dist (harmonic and non-harmonic) is less than 1.5% for all deviations and rates from dc to 100 kHz.

HP 8657B
specifications

SPECIFICATIONS describe the instruments warranted performance and apply after a 30 minute warm-up. All SPECIFICATIONS are valid over the signal generator's entire Operating/Environmental Range unless otherwise noted.

SUPPLEMENTAL CHARACTERISTICS (shown in italics) are intended to provide additional information useful in applying the instrument by giving typical (expected), but not warranted performance.

FREQUENCY

Range (10-digit LED display):
100 kHz to 2060 MHz.
Resolution: 1 Hz.
Switching Speed (to be within 1 dB of level and within 100 Hz of carrier frequency):
<35 ms.[1,pg12] *(30 ms typical at 25°C)*
Accuracy and Stability: Same as timebase used.

SUPPLEMENTAL CHARACTERISTICS

Frequency Underrange: *To 10 kHz with uncalibrated output and modulation.*
Phase Offset: *Output signal phase is adjustable in 1 degree increments.*
Timebase Characteristics:

	Standard	*Option 001*
Aging Rate	*±2 ppm/year*	*1.0×10^{-9}/day after 45 days*
Temperature (0-55°C)	*±10 ppm*	*7×10^{-9}*
Line Voltage	—	*2×10^{-9} (+5%,-10%)*
Frequency	*50 MHz*	*10 MHz*
Timebase Reference Signal (Rear Panel)	*Available at a level of >0.15 V_{rms} into 50 Ω (Output of 10, 5, or 1 MHz is selectable via internal jumper). If an external reference is used, output will be the same frequency.*	
External Reference Input (Rear Panel)	*Accepts any 10, 5, or 1 MHz (±0.002%) frequency standard at a level >0.15 V_{rms} into 50 Ω.*	

SPECTRAL PURITY

Spurious Signals (≤+7 dBm output levels):[1,pg12]

Type of Spurious	Frequency (MHz)		
	0.1-1030	1030-1800	1800-2060
Harmonic	<– 30 dBc	<– 25 dBc	<– 25 dBc
Sub-harmonic	None	<– 40 dBc	<– 35 dBc

Nonharmonic Spurious:

Carrier Frequency	Carrier Offset	
	>5 kHz (Typical)	**>2 MHz**
0.1 to 130	*<– 63 dBc*	<– 60 dBc
130 to 260	*<– 75 dBc*	<– 60 dBc
260 to 520	*<– 66 dBc*	<– 60 dBc
520 to 1030	*<– 63 dBc*	<– 60 dBc
1030 to 2060	*<– 57 dBc*	<– 54 dBc

Residual FM in Hz rms (in CW mode):

Post Detection Bandwidth	Frequency Range (MHz)				
	0.1-130	130-260	260-520	520-1040	1040-2060
0.3 - 3 kHz	<4 Hz	<1 Hz	<2 Hz	<3 Hz	<6 Hz
0.05 - 15 kHz	<6 Hz	<1.5 Hz	<3 Hz	<4 Hz	<8 Hz
Typical Residual FM:					
0.3 - 3 kHz	<2 Hz	<0.5 Hz	<0.5 Hz	<1 Hz	<2 Hz
0.3 - 3 kHz (CCITT)	<1.25 Hz	<0.25 Hz	<0.25 Hz	<0.5 Hz	<1.0 Hz
0.05 - 15 kHz	<3 Hz	<1 Hz	<1 Hz	<1.5 Hz	<3 Hz

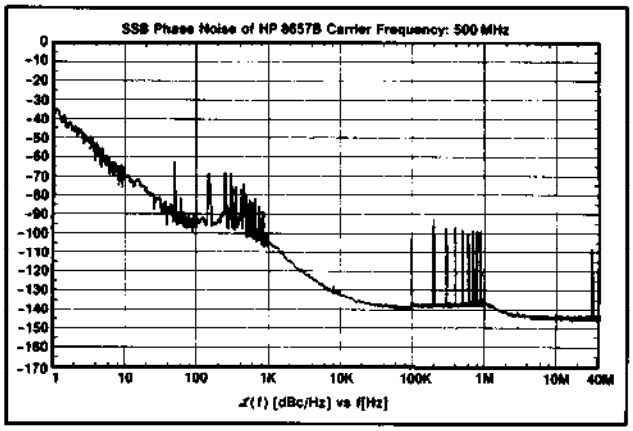
Residual AM (50 Hz to 15 kHz post-detection noise bandwidth, in CW mode): <0.04% AM.

SSB Phase Noise (in CW Mode):

Carrier Frequency	SSB ϕ-Noise 20 kHz offset	*Typical 20 kHz offset*
0.1 to 130 MHz	<–124 dBc/Hz	*<– 130 dBc/Hz*
130 to 260 MHz	<–136 dBc/Hz	*<– 140 dBc/Hz*
260 to 520 MHz	<–130 dBc/Hz	*<– 136 dBc/Hz*
520 to 1040 MHz	<–124 dBc/Hz	*<– 130 dBc/Hz*
1040 to 2060 MHz	<–118 dBc/Hz	*<– 123 dBc/Hz*

SUPPLEMENTAL CHARACTERISTICS

Typical SSB Phase Noise at 500 MHz



OUTPUT

Level Range (3 1/2-digit LED display): +13 dBm to –143.5 dBm into 50Ω.[2-pg12]

Resolution: 0.1 dB.

Absolute Level Accuracy:[3-pg12]

< ±1.0 dB (+3.5 to –127 dBm),
< ±1.5 dB (level >+3.5 dBm).

Level Flatness (100 kHz to 2060 MHz):
±0.5 dB, output level setting of 0 dBm.

Reverse-Power Protection: Protects the signal generator from applications of up to 50 watts of RF power (from a 50Ω source) to 2060 MHz into generator output; DC voltage cannot exceed 25 V.

SUPPLEMENTAL CHARACTERISTICS

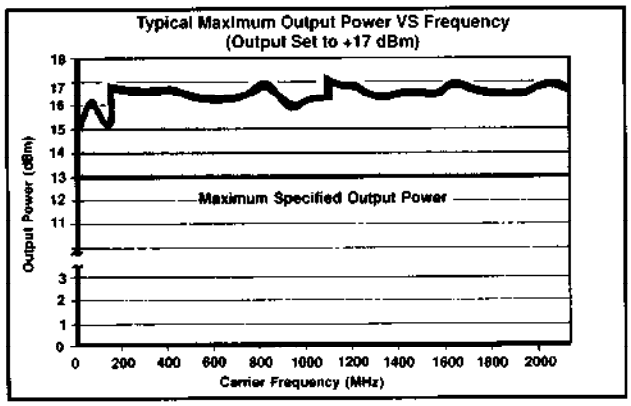
Attenuator Repeatability: *0.01 dB*

Impedance: *50 Ω Nominal.*

Absolute level Accuracy: *1.5 dB, output levels ≤ –127 dBm.*

SWR: *<1.5 for levels ≤ –6.5 dBm.*
<2.0 for levels ≤ +13 dBm.

Typical Output Level Overrange:



AMPLITUDE MODULATION

AM Depth (f_c >400 kHz):[4-pg12]
0 to 100%, level ≤ +7 dBm.
0 to 30%, level ≤ +10 dBm.

Resolution: 1%.

AM Rate,
Internal: 400 Hz and 1 kHz, ± 2%.
External: 20 Hz to 40 kHz (1 dB bandwidth)
20 Hz to 100 kHz (3 dB bandwidth) Typical.

AM Distortion (at 400 Hz and 1 kHz rates, levels ≤ +7 dBm):

AM Depth	f_c<1030	f_c>1030
0 to 30 % AM	1.5%	4%
31 to 70 % AM	3.0%	4%
71 to 90 % AM	4.0%	7%

Indicator Accuracy (for depths < 90%, 400 Hz and 1 kHz rates and levels ≤ +7 dBm):
±(2% + 6% of setting).

Incidental Phase Modulation (at 30% AM depth, internal rates): < 0.3 radians peak.

FREQUENCY MODULATION

Maximum FM Peak Deviation:

Center Frequency	Maximum Peak Deviation	
	AC Mode (the lesser of)	DCMode
0.1 to 130 MHz	200 kHz or 4000 x rate (Hz)	200 kHz
130 to 260 MHz	50 kHz or 1000 x rate (Hz)	50 kHz
260 to 520 MHz	100 kHz or 2000 x rate (Hz)	100 kHz
520 to 1040 MHz	200 kHz or 4000 x rate (Hz)	200 kHz
1040 to 2060 MHz	400 kHz or 8000 x rate (Hz)	400 kHz
FM not specified when peak deviation is > (f_c –100 KHz)		

FM Setting Resolution:

FM Deviation	Carrier Frequency	
	f_c <1040 MHz	f_c >1040 MHz
< 20 kHz	100 Hz	200 Hz
> 20kHz	200 Hz	400 Hz

FM Rate,
Internal: 400 Hz and 1 kHz, ±2%.
External: (referenced to 1 kHz)
dc/5 Hz to 100 kHz, 3 dB bandwidth.
dc/20 Hz to 50 kHz, 1 dB bandwidth.

Center Frequency Accuracy in dc Mode:

Carrier Frequency	Center Frequency Accuracy
0.1 to 130 MHz	± 500 Hz
130 to 260 MHz	± 125 Hz
260 to 520 MHz	± 250 Hz
520 to 1040 MHz	± 500 Hz
1040 to 2060 MHz	± 1000 Hz

Center Frequency Stability in dc Mode:
<10 Hz per hour drift *(typ <3 Hz per hour).*

FM Distortion (at 400 Hz and 1 kHz rates):
<0.5% THD plus noise at deviations shown in the following table.

Center Frequency	Deviation
0.1 to 130 MHz	3 to 100 kHz
130 to 260 MHz	3 to 25 kHz
260 to 520 MHz	3 to 50 kHz
520 to 1040 MHz	3 to 100 kHz
1040 to 2060 MHz	6 to 200 kHz

HP 8657B
specifications

Indicator Accuracy (400 Hz and 1 kHz rates): < 5% of setting

Incidental AM (peak dev. <20 kHz, 400 Hz and 1 kHz rates). <0.5% AM f_c > 1030 MHz
< 0.1% AM, f_c >500 kHz.

SUPPLEMENTAL CHARACTERISTICS

FM Distortion: *Worst case distortion at all specified deviations, rates, and carrier frequencies is 1.5%.*

External Sensitivity:
1 volt peak for indicated accuracy
(1 volt dc when in dc-FM mode).

External Modulation Input:
Front panel BNC, 600 Ω dc-coupled; front panel annunciators indicate 1 V peak signal ± 5%.

Modulating Signal Output: *Internal modulating signal is provided at the front panel BNC connector at nominally 1 volt peak into a 600 Ω resistive load.*

Simultaneous Modulation:
Internal/External: AM/FM, FM/AM, AM/AM, FM/FM, AM/FM/Pulse. [5-pg12]
Internal/Internal, External/External: AM/FM

PULSE MODULATION[5-pg12]

ON/OFF Ratio: >70 dB, $f_c \geq 130$ MHz.
>95 dB, $f_c \geq 1030$ MHz.

Rise/Fall Time: < 35 nanoseconds, $f_c \geq 130$ MHz
< 50 nanoseconds, $f_c \geq 1030$ MHz

HP 8657B OPTION H60

If what you need is pulse modulation to 1 GHz and don't want to pay for 2 GHz coverage the HP 8657B Option H60 provides pulse modulation standard and frequency coverage from 100 kHz to 1040 MHz. All specifications are the same as the HP 8657B with Option 003, up to 1040 MHz.

SUPPLEMENTAL CHARACTERISTICS:

Typical Rise/Fall Time: *10 ns, f_c<1030 MHz;*
18 ns, f_c > 1030 MHz.

Maximum Repetition Rate: *DC - 30 MHz.*

Level Accuracy: *± 1.0dB absolute level accuracy in Pulse Mode.*

Duty Cycle: *0 - 100%. (limited by rise/fall time)*

Pulse Modulation Input: *BNC, high impedance (internally selectable to 50 ohms), can be driven directly by TTL.*

Maximum Input Level: *± 15 V.*

Nominal Input Threshold: *1.6 V.*

Video Feedthrough: *<15%.*

Pulse Time Delay:[6-pg12]
Off to On: 47 nanoseconds
On to Off: 34 nanoseconds

REMOTE PROGRAMMING

Interface: HP-IB (Hewlett-Packard's implementation of IEEE Standard 488).

Interface Functions Implemented: SH0, AH1, T0, L2, SR0, RL1, PP0, DC1, DT0, C0, E1.

GENERAL

Operating Temperature Range: 0 to +55°C.

Storage Temperature Range: -40 to +71°C.

Leakage: Conducted and radiated interference is within the requirements of CE03 (except broadband conducted below 70 kHz) and RE02 of MIL STD 461B, and FTZ 1115. Furthermore, RF leakage of less than 1.0 µV is induced in a two-turn loop, 2.5 cm in diameter, held 2.5 cm away from the front surface. (Typical leakage is <0.05 µV for levels <-40 dBm.)

Save/Recall/Sequence Storage Registers: 100 non-volatile registers are available to save front panel settings.

Rear Panel SEQ Input Level: TTL low to recall next storage register contents.

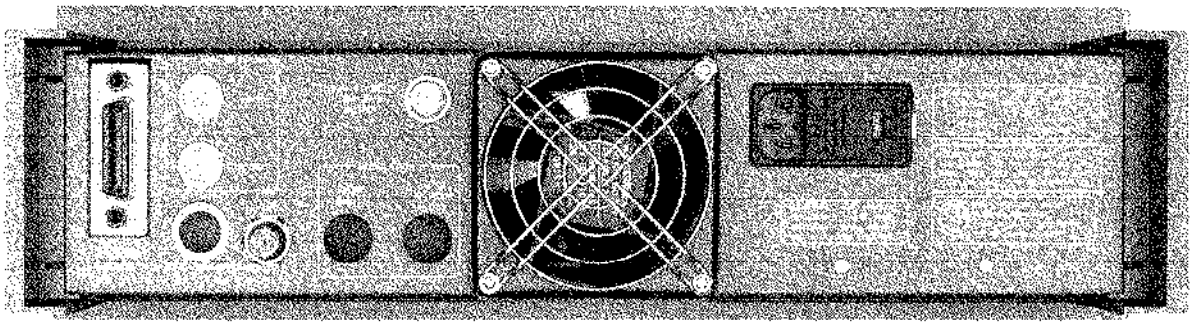
Power Requirements: 100 or 120 or 220 or 240 volts (±10%) from 48 to 440 Hz; 200 VA maximum.

Weight: Net 20.5 kg (45 lb); shipping 26.0 kg (57 lb).

Dimensions: 133H x 425W x 574D mm (5.25 x 16.75 x 22.6 inches.)

HP System II module size: 5 1/4H x 1MW x 17 D.

[1] Spurious specifications apply for output levels ≤+4 dBm and f_c <1030 MHz when pulse modulation is installed.
[2] Maximum output power is +10 dBm with pulse modulation installed at f_c <1030 MHz.
[3] Absolute level accuracy includes allowances for detector linearity, temperature, flatness, attenuator accuracy and measurement uncertainty.
[4] When pulse modulation is installed, maximum specified output level in AM is reduced by 3 dB when f_c <1030 MHz.
[5] Pulse modulation specifications apply for carriers >130 MHz and levels ≤+7 dBm (frequency switching speed typically increases by 30 ms with pulse modulation on). Additionally, AM is unspecified with pulse modulation turned on at $f_c \geq 1030$ MHz.
[6] Time delay between a change in input pulse and carrier response.
[7] Add 5 ms when switching to $f_c \geq 1030$ MHz.



HP 8657D
specifications

SPECIFICATIONS describe the instruments warranted performance and apply after a 30 minute warm-up. All SPECIFICATIONS are valid over the signal generator's entire Operating/Environmental Range unless otherwise noted.

SUPPLEMENTAL CHARACTERISTICS (shown in italics) are intended to provide additional information useful in applying the instrument by giving typical (expected), but not warranted performance.

Analog Modulation Mode

All specifications for the HP 8657D in analog mode are identical to those of the HP 8657B Signal Generator for frequencies from 100 kHz to 1030 MHz (overrange to 1040 MHz). Please refer to the HP 8657B specifications for complete HP 8657D analog mode specifications.

π/4 DQPSK Digital Modulation Mode

FREQUENCY

Range (10-digit LED display):
10 MHz to 129.9 MHz.
810 MHz to 965 MHz.
1420 MHz to 1540 MHz data inverted.
Resolution: 1 Hz.
Switching Speed (to be within 100 Hz of final frequency): <35 ms. (does not apply when switching between frequency ranges listed above)
Accuracy and Stability: Same as timebase used.

SPECTRAL PURITY

SUPPLEMENTAL CHARACTERISTICS

Harmonics: *Typically <–30 dBc.*
Nonharmonic Spurious: *Typically <–50 dBc.*
Residual FM (no data clock):
Typically <6 Hz rms in a 300 Hz to 3 kHz BW.
SSB Phase Noise (no data clock):
Typically <–105 dBc/Hz at a 20 kHz offset.

OUTPUT

Level Range: –143.5 dBm minimum in all ranges.
+3 dBm maximum; 1420 to 1540 MHz
and 10 to 129.9 MHz.
+7 dBm maximum; 810 to 965 MHz.
Resolution: 0.1 dB.
Level Accuracy: ±1.0 dB (–127 dBm to +3 dBm).

π/4 DQPSK MODULATION

Modulation Format: π/4 DQPSK.
Data Rate,
Symbol Clock: 20 kHz to 25 kHz.
Bit Clock: 40 kHz to 50 kHz.
Pre-modulation Filter: Square-root raised cosine.
Filter Shape Factor: α= 0.35 or α= 0.50.
Error Vector Magnitude (+15 to +35° C):
<4%; 10 to 129.9 MHz and 1420 to 1540 MHz, level <+3 dBm.
<3.5%; 810 MHz to 965 MHz, level <+7 dBm.
I/Q Origin Offset (+15 to +35° C):
–35 dB (RF output only).
Inputs: Serial data and clock (bit or symbol).
Outputs: Baseband π /4 DQPSK I and Q signals.

SUPPLEMENTAL CHARACTERISTICS

Input Levels: *Nominally TTL.*
Input Impedance: *Nominally 1 kΩ*
Output Levels,
Symbol Clock: *Nominally TTL level.*
N × Symbol Clock: *Nominally TTL level.*
128 × Symbol Clock: *Nominally TTL level.*
Baseband π/4 DQPSK I and Q Output Level:
Typically 0.35 volts into a 50 Ω load.
Simultaneous Modulation: *π/4 DQPSK and pulse (AM and FM are not available in π/4 DQPSK modulation mode).*

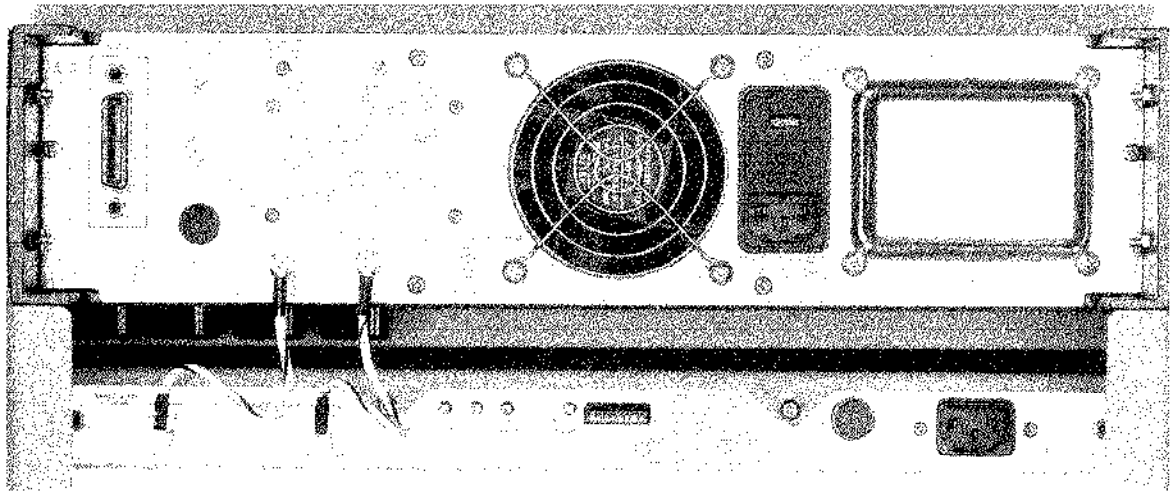
PULSE MODULATION

(standard on HP 8657D, pulse modulation is available in either the analog or π/4 DQPSK modulation mode.)

On/Off Ratio (π /4 DQPSK mode):
>70 dB; $f_c \leq 1030$ MHz.
>50 dB; 1420 MHz $\leq f_c \leq$ 1540 MHz
Rise/Fall Time (10% to 90%):
35 ns, *typically 10 ns.*

GENERAL

Remote Operation: HP-IB. All functions but the line switch, sequence control, digital modulation polarity, and digital filter shape factor are remotely programmable.
Operating Temperature Range: 0 to +55°C.
Storage Temperature Range: –40 to 71°C.
Power Requirements: HP 8657D: 100 or 120 or 200 or 240 volts (±10%) from 48 to 440 Hz; 200 VA maximum. π /4 DQPSK modulator: 90 to 264 volts from 48 to 66 Hz; 75 VA maximum.
Weight: Net 26.4 kg (58 lb); shipping 37.3 kg (82 lb).
Dimensions: 223H × 425W × 575 mm (8.75 × 16.8 × 22.6 inches).



HP 8657A/B Option 022

specifications

SPECIFICATIONS describe the instruments warranted performance and apply after a 30 minute warm-up. All SPECIFICATIONS are valid over the signal generator's entire Operating/Environmental Range unless otherwise noted.

SUPPLEMENTAL CHARACTERISTICS (shown in italics) are intended to provide additional information useful in applying the instrument by giving typical (expected), but not warranted performance.

Analog Modulation Mode

When the 0.3 GMSK modulator is turned off or a clock signal is absent, these instruments perform as standard HP 8657As or HP 8657Bs. Please refer to the HP 8657A or HP 8657B specifications for complete analog mode performance.

0.3 GMSK Digital Modulation Mode

FREQUENCY

Range:
Data Normal:
HP 8657A: 520 MHz to 1040 MHz.
HP 8657B: 520 MHz to 2060 MHz.
Data Inverted: 10 MHz to 130 MHz.

SPECTRAL PURITY

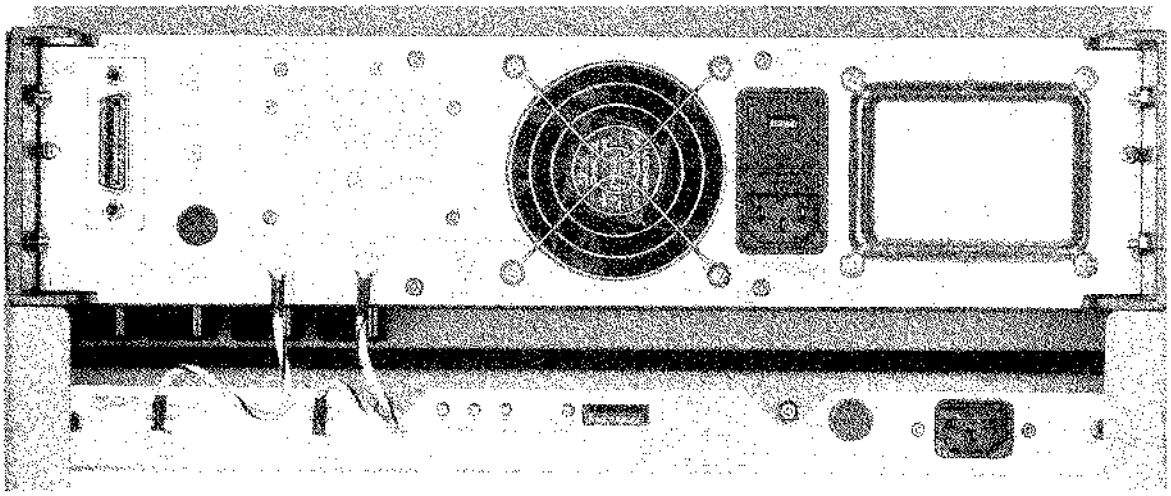
Harmonics: <–30 dBc.
<–25 dBc; fc ≥ 1030 MHz (HP 8657B only).
Nonharmonic Spurious (>150 kHz offsets):
<–50 dBc.
Noise Floor: <–100 dBc.

0.3 GMSK MODULATION

Modulation Format: 0.3 GMSK
Pre-modulation Filter: Gaussian LPF
Bandwidth x Data Rate (BT): 0.3
Data Rate: 270.833 kHz (± 1 kHz).
Modulation Phase Error
890 to 960 MHz and 10 to 130 MHz:
3° rms, *typically 1°.*
8° peak, *typically 5°.*
1030 to 2060 MHz (HP 8657B only):
3.5° rms, *typically 1.5°.*
9° peak, *typically 6°.*
Frequency Error: 10 Hz; fc <1030.
20 Hz; fc ≥ 1030 MHz (HP 8657B only).
Inputs: Serial data and clock.
Outputs (HP 8657B only): Baseband 0.3 GMSK I and Q signals.

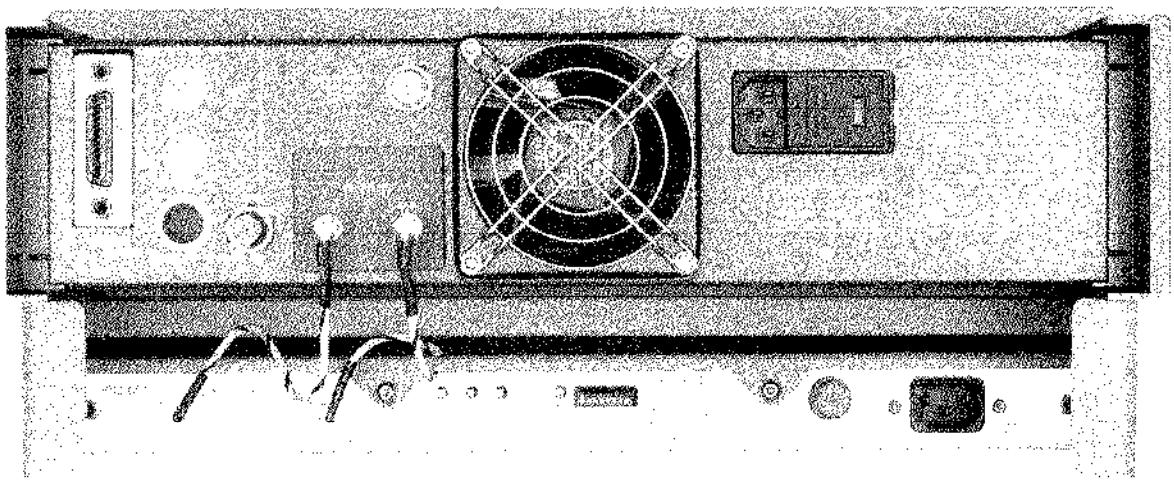
SUPPLEMENTAL CHARACTERISTICS

Inputs:
Data: TTL high represents a "1".
Clock: Data accepted on rising edge.
Input Levels: *Nominally TTL.*
Input Impedance: *Nominally 1 kΩ.*
Time to output modulation after clock input:
25 microseconds.
Time to cease modulation after clock discontinued: *35 microseconds.*
Baseband 0.3 GMSK I and Q Output Level:
Typically 5 volts into a 50Ω load.
Simultaneous Modulation: *AM/FM/pulse/0.3 GMSK.*



GENERAL

Remote Operation: HP-IB. All functions but the line switch, sequence control, >1040 MHz 0.3 GMSK modulator switch (HP 8657B Option 022 only), and modulation data polarity are remotely programmable.
Operating Temperature Range: +15 to +35°C.
Storage Temperature Range: -40 to +71°C.
Power Requirements (0.3 GMSK modulator only): 90 to 264 volts from 48 to 66 Hz; 75 VA maximum.
Weight (0.3 GMSK modulator only): Net 4 kg (9 lb); shipping 9 kg (20 lb).
Dimensions (0.3 GMSK modulator only): 44H X 425W X 422D mm (1.75 X 16.75 X 17 inches).



HP 8657B Option 022

HP 8656B, 57A/B/D
specification

ORDERING INFORMATION

Option	HP 8656B	HP 8657A	HP 8657B	HP 8657D
Standard Instrument	X	X	X	X
001 High Stability Timebase	X	X	X	X
002 Rear Panel Input/Outputs (N/A with Option 022)	X	X	X	N/A
003 Pulse Modulation	N/A	N/A	X	Standard
022 0.3 GMSK Modulation (Includes Option 909, N/A with Option 002)	N/A	X	X	N/A
907 Front Handle Kit	X	X	X	Standard
908 Rack Flange Kit	X	X	X	N/A
909 Rack Flange Kit w/Handles	X	X	X	N/A
913 HP 8657D Rack Flange Kit	N/A	N/A	N/A	X
910 Provides an additional Operation/Calibration Manual and two Service Manuals	X	X	X	X
915 Add Service Manual	X	X	X	X
H60 HP 8657B upper frequency to 1040 MHz, pulse standard	N/A	N/A	X	N/A
+W30 3-year Repair service	X	X	X	X
+W32 3-year Calibration service	X	X	X	X

N/A means NOT Available
X means Available

ACCESSORIES

Retrofit Kits:

To order standard options after shipment, order the following HP part numbers or special option numbers: (Note: These retrofit kits should only be installed by trained service professionals.)

Option	HP 8656B	HP 8657A	HP 8657B	HP 8657D
001	08656-60195	08656-60195	08657-61054	08657-61054
002[1]	Option K16	08657-61037	08657-61055	N/A
003[2]	N/A	N/A	Option G03[2]	N/A
022[3]	N/A	N/A[3]	N/A[3]	N/A

[1]Not available for HP 8657A/B Option 022 or HP 8657D.
[2]Pulse modulation is factory installable only.
[3]Option 022 must be purchased at time of order and cannot be retrofitted.

Manuals

Description	HP 8656B	HP 8657A	HP 8657B	HP 8657D
Operation/Calibration Manual	08657-90115	08657-90115	08657-90115	08657-90107
Service Manual	08656-90205	08657-90004	08657-90007	08657-90131
Option 022 Op/Cal Supplement	N/A	08657-90062	Contact HP	N/A
Option 022 Service Supplement	N/A	08657-90064	Contact HP	N/A

Transit Cases

Description	HP 8656B	HP 8657A	HP 8657B	HP 8657D
Transit Case (mainframe only)	9211-2655	9211-2655[4]	9211-2661[4]	9211-2661[4]
Transit Case for digital modulator	N/A	9211-2648[4]	9211-2648[4]	9211-2654[4]

[4]For instruments fitted with a digital modulator (HP 8657D or HP 8657A/B with Option 022), the digital modulator must be removed and shipped in a separate transit case to avoid instrument damage. The HP 8657A/B Option 022 0.3 GMSK modulator is a non-standard size, but may be shipped in a larger transit case (9211-2648) with additional padding.

Handles and Rack Mount Accessories

Description	HP 8656B, HP 8657A, HP 8657B (except Option 022 instruments - Contact HP)	HP 8657D
Front Handle Kit	5062-3989	5062-3991
Rack Mount Flange Kit	5062-3977	5062-3979
Rack Flange Kit with Handles	5062-3983	5062-3985
Rack Flange Kit for instruments with previously supplied handles	5062-4071	5062-4073

Rack Slide Kit (not available for HP 8657A/B Option 022), 1494-0060.
Slide Adapter Bracket (converts standard rack slides for non-HP rack enclosures), 1494-0061.

Accessories

HP 8347A RF Amplifier, 100 kHz to 3 GHz, leveled +2 to +20 dBm, >25 dB gain.
HP 11721A Frequency Doubler, 50 to 1300 MHz input, <15 dBm conversion loss at +13 dBm.
HP 11687A 50-75Ω Adapter with type N connectors, dc to 1300 MHz.

HEWLETT PACKARD

HP sales office listed in your telephone directory or an HP regional office listed below for the location of your nearest sales office.

United States:
Hewlett-Packard Company
4 Choke Cherry Road
Rockville, MD 20850
(301) 670 4300

Hewlett-Packard Company
5201 Tollview Drive
Rolling Meadows, IL 60008
(708) 255 9800

Hewlett-Packard Company
5161 Lankershim Blvd.
No. Hollywood, CA 91601
(818) 505 5600

Hewlett-Packard Company
2015 South Park Place
Atlanta, GA 30339
(404) 955 1500

Canada:
Hewlett-Packard Ltd.
6877 Goreway Drive
Mississauga, Ontario L4V 1M8
(416) 678 9430

European Headquarters:
Hewlett-Packard S.A.
150, Route du Nant d'Avril
1217 Meyrin 2
Geneva -- Switzerland
41/22 780 8111

Japan:
Yokogawa-Hewlett-Packard Ltd.
15-7, Nishi Shinjuku 4 Chome
Shinjuku-ku
Tokyo 160, Japan
(03) 5371 1315

Latin America:
Hewlett-Packard
Latin American Region Headquarters
Monte Pelvoux No. 111
Lomas de Chapultepec
11000 Mexico, D.F. Mexico
(525) 202 0155

Australia/New Zealand:
Hewlett-Packard Australia Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130
Australia
(03) 895 2895

Far East:
Hewlett-Packard Asia Ltd.
22/F Bond Centre,
West Tower
89 Queensway
Central, Hong Kong
(852) 848 7777

In Europe, please call your local HP sales office or representative:

Austria: (0222) 2500-0

Central Europe, USSR, and Yugoslavia:
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(0222) 2500-0

Belgium and Luxembourg:
(02) 761 31 11

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Finland: (90) 88 721

France: (1) 69 82 60 60

Germany: (06172) 16 0

Greece: (01) 68 28 811

Iceland: (91) 67 10 00

Ireland: (01) 88 33 99

Israel:
Computation and Measurement Systems (CMS) Ltd.
(03) 5380 333

Italy: (02) 95 300 134

Netherlands: (020) 547 6669

Norway: (02) 87 97 00

Portugal: (11) 301 73 30

Spain: 900 123 123

Sweden: (08) 750 20 00

Switzerland:
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(022) 780 41 11 (Suisse Romande)
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Turkey: 175 29 70

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Europe/Africa/Middle East:
Hewlett-Packard S.A.
Marcom Operations Europe
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The Netherlands

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