Agilent 8657A/8657B Signal Generators

Profile

Spectral performance for general-purpose test

Overview

The Agilent Technologies 8657A and 8657B signal generators are designed to test AM, FM, and pulsed receivers as well as components. With their exceptional analog modulation, good spectral purity, and superb output level performance, these signal generators are ideal for R&D, manufacturing, and support.

In-channel performance

Measurement confidence

The 8657A and B signal generators provide the spectral purity and modulation versatility needed for RF testing of communication and navigation equipment.

Low residual FM ensures wide hum and noise test margins

Hum and noise testing requires a signal generator to have low residual FM to ensure no measurement error. The residual FM of the 8657A and B provides the test margins you need for the most demanding hum and noise tests.

Output level range and accuracy for sensitivity testing

With a dynamic range from +13 to –143.5 dBm, the 8657A and B allow sensitivity measurements to be made on even the most sensitive receivers. The 8657A and B couple this with a level accuracy of ±1 dB (typically 0.5 dB) to –127 dBm across the full temperature range of 0 to 55 degrees C, to give you accurate and repeatable measurements every time.

Low RF leakage eliminates measurement interference

Sensitivity measurements can often be masked by RF leakage (radiated emissions). With the 8657A and B, RF leakage is reduced to a level that assures virtually no measurement interference.

DCFM faithfully reproduces digital signals

For radios with digital squelching, the 8657A and B have extremely stable dc-coupled FM (dcFM). The dc coupling of low-rate tones or digital data eliminates droop, and the exceptional stability and center-frequency accuracy when in dcFM mode eliminates the need to retune the signal generator after dcFM is selected.

Pulse modulation with the 8657B

High-performance pulse modulation (available on the 8657B) will give you confidence in your radar or pulsed carrier measurements. This includes rise/fall times of <35 ns, rates from dc to 30 MHz, and better than 70 dB on/off ratios (fc<1030 MHz).

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Innovating the HP Way

Out-of-channel measurements with the 8657A/B

Low single-sideband phase noise for adjacent channel selectivity testing

A receiver's ability to reject unwanted signals is measured using out-of-channel tests. With its good spectral purity, the 8657A and B make it easy to perform demanding tests such as adjacent channel selectivity measurements.

Adjacent channel selectivity measures a receiver's ability to pick out a desired signal while rejecting a strong signal one channel away. To measure adjacent channel selectivity the out-of-channel signal generator must have low single-sideband (SSB) phase noise and nonharmonic spurious content at channel spacings, otherwise the in-channel signal is masked. The exceptional phase noise performance of the 8657A and B provides a cost-effective solution for many out-of-channel tests.

General purpose and component tests

Output power to drive high-level inputs

For applications requiring high output power, the 8657A and B can overrange beyond the +13 dBm specified output level to >+16 dBm for most frequencies.

DCFM for VCO simulation

State-of-the-art dcFM and wide FM bandwidth make the 8657A and B ideal sources for many VCO simulation applications. For example, the 8657A or B can be used to replace a receiver's VCO during design.

Phase adjust to characterize phase-sensitive devices

The 8657A and B give you the ability to adjust the phase of the output signal in one-degree increments with respect to a source that is locked to the same reference timebase. This feature makes it easy to characterize phase-detector or phase-interferometer receivers during design or manufacturing.

Manual tests

100 nonvolatile store/recall registers save set-up time

The 8657A and B offer as a standard feature the ability to store 100 complete instrument states. This feature decreases set-up time when performing repetitive tests and reduces operator errors.

Register sequencing provides semi-automation

Stepping through the store/recall registers is easy with the front-panel sequence keys or the rear-panel remote-sequence connector. These features allow the user to sequence through the storage registers in any order.

Automated tests

Reliable output attenuators

With production lines requiring ever-faster throughput, test equipment must be more reliable than ever. Output level cycling requires electromechanical relays to switch in and out of different attenuators to produce varying output levels. The 8657A and B enhance system up-time by using a very reliable attenuator technology. The 8657A is especially dependable with its electronic attenuator design. Instead of using mechanical relays for switching the attenuators, the 8657A uses solid-state components for setting output levels. The patented design uses PIN-diode switching elements with 3 million hours mean time between failure rate. This exceptional reliability is backed with a 5-year warranty against attenuator failure.

Ordering information

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Option	Description
001	High-stability timebase
002	Rear-panel connections
003	Pulse modulation (8657B only)
1BN	Mil std 45662A calibration certification
1BP	Mil std 45622A calibration with test data
907	Front handle kit
908	Rack flange kit
909	Rack flange kit w/ front handle
910	Adds operation/calibration manual and two service manuals
915	Adds service manual
W30	3-year return repair service
W32	3-year return calibration service
W34	3-year standards compliant calibration service
W50	5-year return repair service
W52	5-year return calibration service
W54	5-year standards compliant calibration service

Technical 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/environment range unless otherwise noted.

Supplemental characteristics *(indicated by italic type)* are intended to provide information useful in estimating instrument capability in your application by describing typical, but not warranted, performance.

Note: The upper frequency range of the 8657A is 1.04 GHz. Specifications above 1.04 GHz apply only to the 8657B.

Frequency

Range	
8657A	100 kHz to 1.04 GHz
8657B	100 kHz to 2.6 GHz
Underrange	*To 10 kHz with uncalibrated output and modulation.*
Resolution	
8657A	10 Hz
8657B	1 Hz
Accuracy and stability	Same as timebase
Switching speed[1]	*<35 ms.[2] (30 ms typical at 25 °C)*
Phase offset	*Output signal phase is adjustable in 1-degree nominal increments.*

Internal reference oscillator

	Std. (typ.)	High-stability Option 001
Aging rate	±2 ppm/yr	8657A, 1.5 x 10^{-8} parts/day after 10 days 1.0 x 10^{-9} parts/day after 180 days 8657B, 1.0 x 10^{-9} parts/day after 45 days
Temperature (0 to 55 °C)	±10 ppm	7 x 10^{-9}
Line voltage		2 x 10^{-9} (+5%, –10%)
Frequency	50 MHz	10 MHz
Timebase reference output (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 Vrms into 50 Ω*

Output

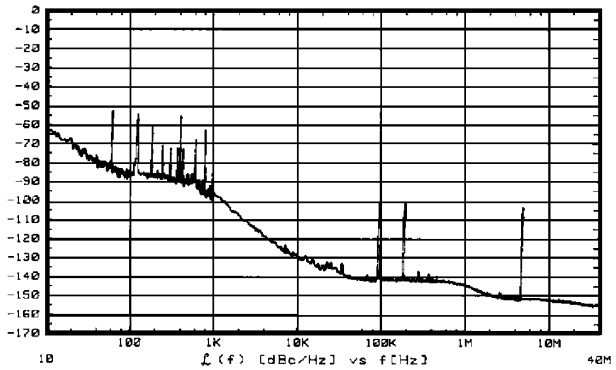
Range (dBm)	
8657A	+13 dBm to –143.5 dBm into 50 Ω, +10 dBm to –143.5 dBm for frequencies from 100 kHz to 1 MHz
8657B	+13 dBm to –143.5 dBm into 50 Ω, +10 dBm to –143.5 dBm with pulse modulation installed at f_c<1.03 GHz
Resolution	0.1 dB
Absolute level accuracy[3]	
8657A	<±1.5 dB (>+7 dBm) <±1.0 dB (+7 to –127 dBm) *<±1.5 dB (<–127 dBm)*
8657B	<±1.5 dB (>+3.5 dBm) <±1.0 dB (+3.5 to –127 dBm) *<±1.5 dB (<–127 dBm)*
Level flatness	
100 kHz to 2.06 GHz	±0.5 dB, output level setting of 0 dBm
Reverse power protection to maximum output frequency)	50 watts (from a 50 Ω source)
Maximum DC voltage	8657A, 50 V 8657B, 25 V
SWR	
8657A (fc(400 kHz)	<1.5 for levels <–3.5 dBm <2.0 for levels ≤ +13 dBm
8657B	*<1.5 for levels ≤ –6.5 dBm* *<2.0 for levels ≤ +13 dBm*
Output impedance	*50 Ω nominal*

1. To be within 100 Hz of carrier frequency.
2. Add 5 ms when switching to fc>1.03 GHz for the 8657B.
3. Absolute level accuracy includes allowances for detector linearity, temperature, flatness, attenuator accuracy and measurement uncertainty.

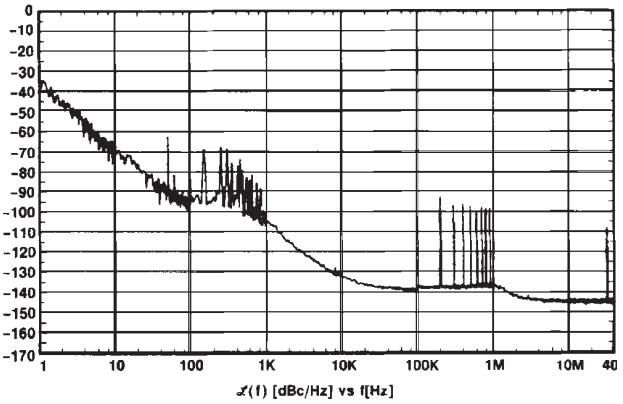
Spectral purity

SSB phase noise (in CW mode, at 20 kHz offset)

0.1 to 130 MHz	<–124 dBc/Hz	*(<–130 dBc/Hz, typical)*
130 to 260 MHz	<–136 dBc/Hz	*(<–140 dBc/Hz, typical)*
260 to 520 MHz	<–130 dBc/Hz	*(<–136 dBc/Hz, typical)*
520 MHz to 1.04 GHz	<–124 dBc/Hz	*(<–130 dBc/Hz, typical)*
1.04 to 2.06 GHz	<–118 dBc/Hz	*(<–123 dBc/Hz, typical)*



Typical Agilent 8657A SSB phase noise at 500 MHz



Typical Agilent 8657B SSB phase noise at 500 MHz

Residual FM (CW mode, rms)

Frequency range	Post detection BW (rms detector) 300 Hz to 3 kHz	50 Hz to 15 kHz[1]
0.1 to 130 MHz	<4 Hz *(typical <2 Hz)*	<6 Hz *(typical <3 Hz)*
130 to 260 MHz	<1 Hz *(typical <0.5 Hz)*	<1.5 Hz *(typical <1 Hz)*
260 to 520 MHz	<2 Hz *(typical <1 Hz)*	<3 Hz *(typical <1 Hz)*
520 MHz to1.04 GHz	8657A, <4 Hz *(typical <1 Hz)*	8657A, <6 Hz
	8657B, <3 Hz *(typical <1 Hz)*	8657B, <4 Hz *(typical <1.5 Hz)*
1.04 to 2.06 GHz	<6 Hz *(typical <2 Hz)*	<8 Hz *(typical <3 Hz)*

1. Typical residual FM specifications for the 50 Hz to 15 kHz post detection bandwidth apply only to the 8657B.

Residual AM (50 Hz to 15 kHz post-detection noise bandwidth, in CW mode)

<0.04% AM

Harmonics (≤+7 dBm output levels)[1]

8657A		<–30 dBc
8657B	0.1 to 1.03 GHz	<–30 dBc
	1.03 to 1.8 GHz	<–25 dBc
	1.8 to 2.06 GHz	<–25 dBc

Subharmonics (≤+7 dBm output levels)

8657A, 8657B	0.1 to 1.03 GHz	None
8657B	1.03 to 1.8 GHz	<–40 dBc
	1.8 to 2.06 GHz	<–35 dBc

Nonharmonics (CW mode)

	Offset from carrier	
Frequency range	**5 kHz to 2 MHz**	**>2 MHz**
0.1 to 130 MHz	8657A, <–60 dBc	<–60 dBc
	8657B, *<–63 dBc (typical)*	
130 to 260 MHz	8657A, <–72 dBc	<–60 dBc
	8657B, *<–75 dBc (typical)*	
260 to 520 MHz	8657A, <–66 dBc	<–60 dBc
	8657B, *<–66 dBc (typical)*	
520 MHz to 1.04 GHz[2]	8657A, <–60 dBc	<–60 dBc
	8657B, *<–63 dBc (typical)*	
1.03 to 2.06 GHz	8657B, *<–57 dBc (typical)*	<–54 dBc

Frequency modulation

Maximum FM peak deviation[3]

Center frequency	AC mode (the lesser of)	DC mode
0.1 to 130 MHz	4000 x rate (Hz) or DC mode max. deviation	8657A, 99 kHz 8657B, 200 kHz
130 to 260 MHz	1000 x rate (Hz) or DC mode max. deviation	8657A, 50 kHz 8657B, 50 kHz
260 to 520 MHz	2000 x rate (Hz) or DC mode max. deviation	8657A, 99 kHz 8657B, 100 kHz
520 MHz to 1.04 GHz	4000 x rate (Hz) or DC mode max. deviation	8657A, 99 kHz 8657B, 200 kHz
1.04 to 2.06 GHz	8000 x rate (Hz) or DC mode max. deviation	8657B, 400 kHz

Resolution

8657A	100 Hz for deviations < 10 kHz; 1 kHz for deviations ≥ 10 kHz
8657B	100 Hz (200 Hz for carrier frequency >1.04 GHz) for deviations <20 kHz; 200 Hz (400 Hz for carrier frequency >1.04 GHz) for deviations >20 kHz

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

1. Spurious specifications apply for output levels ≤+4 dBm and f_c<1.03 GHz when pulse modulation is installed (8657B) only.
2. 520 MHz to 1.03 GHz for 8657B.
3. FM not specified when peak deviation is >(f_c –100 kHz).

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 MHz to 1.04 GHz	±500 Hz
1.04 to 2.06 GHz	±1000 Hz

Center frequency stability in dc mode <10 Hz per hour drift *(typical <3 Hz per hour)*

Distortion (at internal rates)[1] <0.5% THD plus noise *(typical <1.5% for all specified deviations and rates)*

Sensitivity *1 V_{peak} for indicated accuracy, 1 V_{dc} when in dc-FM mode*

Indicator accuracy (internal rates) <±5% of setting

Incidental AM (peak deviations <20 kHz, internal rates)	f_c>500 kHz	<0.1% AM
	f_c>1.03 GHz[2]	<0.5% AM

Amplitude modulation

Range

8657A[3]	0 to 99%, level ≤+7 dBm, f_c ≥400 kHz[4]
	0 to 30%, level ≤+10 dBm, f_c ≥400 kHz[4]
8657B[5]	0 to 100%, level ≤+7 dBm, f_c ≥400 kHz
	0 to 30%, level ≤+10 dBm, f_c ≥400 kHz

Resolution 1%

Rates

Internal	400 Hz and 1 kHz, ±2%
External	20 Hz to 40 kHz (1dB bandwidth); 8657B, *typical, 20 Hz to 100 kHz (3 dB bandwidth)*

Distortion (internal rates, level <+7 dBm)

AM depth	**f_c<1.04 GHz**	**f_c>1.04 GHz**
0 to 30% AM	<1.5%	4%
31 to 70% AM	<3.0%	4%
71 to 90% AM	<4.0%	7%

Sensitivity (typical) 1 V_{peak} for indicated accuracy

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

1. 8657A only. FM distortion only specified for deviations up to 25 kHz for 130<fc<260 MHz, and for 260<fc<520 MHz.
2. 8657B only.
3. AM depth is further limited by indicator accuracy specifications.
4. 8657A only. For fc<400 kHz, AM depths of 0 to 30%, levels ≤+7 dBm.
5. 8657B only. When pulse modulation is installed, maximum specified output level in AM is reduced by 3 dB when fc<1.03 GHz.

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 V peak into a 600 Ω resistive load.

Simultaneous modulation

Internal/External	*AM/FM, FM/AM, AM/AM, FM/FM, AM/FM/(Pulse[1])*
Internal/Internal	*AM/FM*
External/External	*AM/FM*

Pulse modulation (Agilent 8657B only)[1]

On/off ratio

f_c ≥130 MHz	>70 dB
f_c ≥1.03 GHz	>95 dB

Rise/fall times

f_c ≥130 MHz	>35 ns
f_c ≥1.03 GHz	>50 ns

Maximum repetition rate		*dc to 30 MHz, typical*
Level accuracy		*±1.0 dB, typical*
Duty cycle		*0 to 100%, typical (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, typical*
Nominal input threshold		*1.6 V, typical*
Video feedthrough		*<15%, typical*
Pulse time delay[2]	On to off	*34 ns, typical*
	Off to on	*47 ns, typical*

Remote programming

Interface	GPIB (IEEE-488)
IEEE-488 functions	SH0, AH1, T0, L2, SR0, RL1, PP0, DC1, DT0, C0, E1

1. 8657B only. 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 fc≥1.03 GHz.
2. Time delay between a change in input pulse and carrier response.

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 (and CE03 for the 8657B, except broadband conducted below 70 kHz) of MIL STD 461B, and FTZ 1046 (FTZ 1115 for 8657B). 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 for the 8657Bis <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 (+5%, –10% for 8657A; ±10% for 8657B) from 48 to 440 Hz; 160 VA maximum for 8657A (200 VA maximum for 8657B). IEC 1010 compliant.
Weight	8657A, net 18.2 kg (40 lb); shipping 23.6 kg (52 lb) 8657B, net 20.5 kg (45 lb); shipping 26.0 kg (57 lb)
Dimensions	133 mm H x 425 mm W x 574 mm D (5.25 in H x 16.75 in W x 22.6 in D)

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