Agilent 8648A/B/C/D Signal Generators

Data Sheet

8648A, 100 kHz to 1 GHz
8648B, 9 kHz to 2 GHz
8648C, 9 kHz to 3.2 GHz
8648D, 9 kHz to 4 GHz

Specifications describe warranted instrument performance over the 0°C to 50°C temperature range and after a 30-minute warm-up, unless otherwise noted. All performance below a carrier frequency of 250 kHz is typical. Supplemental characteristics are intended to provide information useful in estimating instrument capability in your application by describing typical, but non-warranted performance.

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Frequency

Range
8648A: 100 kHz to 1000 MHz
8648B: 9 kHz to 2000 MHz
8648C: 9 kHz to 3200 MHz
8648D: 9 kHz to 4000 MHz

Resolution
Settable
8648A/B/C/D: 0.001 Hz

Display
10 Hz

Accuracy[1]
Typically ± $3x10^{-6}$ x carrier frequency (Hz),
±$0.15x10^{-6}$ x carrier frequency (Hz) for Option 1E5

Switching speed (typical)
8648A/B/C/D
<1001 MHz: <75 ms
≥1001 MHz: <100 ms

Internal reference oscillator

Accuracy and stability[1]
(typical, calibration adjustment dependent)
± Aging rate ± temperature effects ± line voltage effects

	Standard timebase (typical)	High stability timebase (Opt 1E5)
Aging	<±2 ppm/year	<±0.1 ppm/year[2] <±0.0005 ppm/day[2]
Temperature	<±1 ppm	<±0.01 ppm[3] (typical)
Line Voltage[4]	<±0.5 ppm	<±0.1 ppm (typical)

Output
10 MHz, typically >0.5 V_{rms} level into 50 Ω

External reference oscillator input
Accepts 2, 5, 10 MHz ±10 ppm typical (±1 ppm typical with option 1E5) and a level range of 0.5 V_{rms} to 2 V_{rms} into 50 Ω

Spectral purity

Harmonics
<–30 dBc (output ≤+4 dBm)

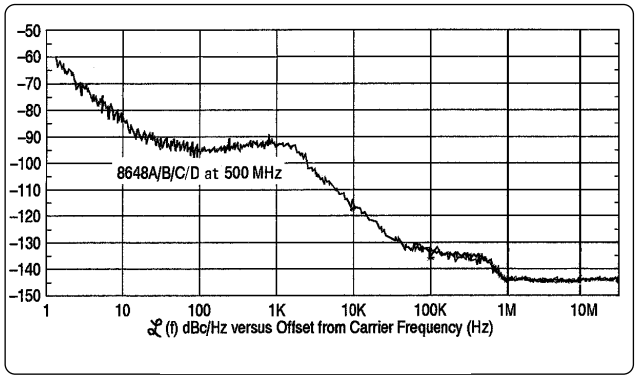
Subharmonics (output ≤+4 dBm)
<1001 MHz: <–60 dBc
≤3200 MHz: <–50 dBc
_4000 MHz: <–40 dBc

Nonharmonics (≥5 kHz offset, output ≤+4 dBm)
8648A/B/C/D
<249 MHz: <–55 dBc
<1001 MHz: <–60 dBc
<2001 MHz: <–54 dBc
≤4000 MHz: <–48 dBc

Residual FM (CCITT, rms)
8648A/B/C/D
<249 MHz: <7 Hz, typically <4 Hz
<501 MHz: <4 Hz, typically <2 Hz
<1001 MHz: <7 Hz, typically <4 Hz
<2001 MHz: <14 Hz, typically <8 Hz
≤4000 MHz: <28 Hz, typically <12 Hz

SSB phase noise (at 20 kHz offset, typical)
8648A/B/C/D
at fc 500 MHz: <–120 dBc/Hz
at fc 1000 MHz: <–116 dBc/Hz
at fc 2000 MHz: <–110 dBc/Hz
at fc 3000 MHz: <–106 dBc/Hz
at fc 4000 MHz: <–104 dBc/Hz

Typical phase noise of the 8648A/B/C/D at 500 MHz



1. After one hour warm-up and within one year of calibration.
2. After four days warm-up and within one year of calibration.
3. Applies over the 25°C ±5°C range.
4. Applies for line voltage change of ±5%.

Output

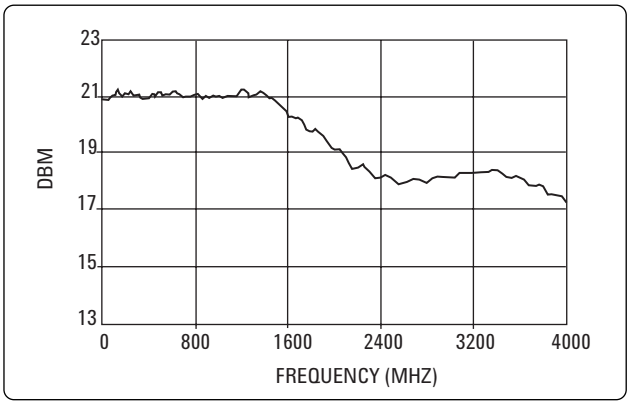
Range
8648A
+10 to –136 dBm

8648B/C/D
≤2500 MHz: +13 to –136 dBm
≤4000 MHz: +10 to –136 dBm

Maximum leveled power
(High power option 1EA)

8648B/C/D only[1]
≤100 kHz: +17 dBm
≤1000 MHz: +20 dBm
≤1500 MHz: +19 dBm
≤2100 MHz: +17 dBm
≤2500 MHz: +15 dBm
≤4000 MHz: +13 dBm

Option 1EA—Typical power versus frequency (GHz)



Display resolution
0.1 dB

Accuracy
8648A/B/C/D[2,3,4]
≤2500 MHz: ±1.0 dB
≤3200 MHz: ±1.5 dB
≤4000 MHz: ±2.0 dB

Reverse power protection (watts into 50 Ω)
≤2000 MHz: 50 watts
≤4000 MHz: 25 watts

SWR (output <–6 dBm, typical)
8648A/B/C/D
<249 kHz: <2.5:1
<2500 MHz: <1.5:1
≤4000 MHz: <2.0:1

Output impedance
Nominally 50 ohms

Amplitude modulation (f_c >1.5 MHz)[5]

Range
0 to 100% (output ≤+4 dBm)

Resolution
0.1%

Accuracy[6] (1 kHz rate)
±5% of setting ±1.5%

Rates
8648A/B/C/D
Internal: 400 Hz or 1 kHz or 10 Hz to 20 kHz with Opt 1E2
External: DC: dc to 25 kHz (typical, 3 dB BW)
AC: 1 Hz to 25 kHz (typical, 3 dB BW)

Distortion (1 kHz rate, THD+N, 0.3 to 3 kHz BW)
(at 30 % AM): <2%
8648A (at 90% AM): <3%
8648B/C/D (at 70% AM): <3%

1. Combining option 1E6 with 1EA reduces maximum output power by 2 dB above 100 MHz. Below 100 MHz, maximum output is +13 dBm (typically+16 dBm for carrier frequencies between 100 kHz and 100 MHz).
2. Accuracy is valid from maximum specified output power to –127 dBm. Below –127 dBm, accuracy is typically ±3 dB in the range 100 kHz to 2500 MHz, and is not specified outside this frequency range
3. Accuracy applies at 25°C ±5°C; and typically degrades up to ±0.5 dB over 0°C to 50°C or at output power levels >13 dBm.
4. Accuracy is ±3 dB for power levels between –100 dBm and –127 dBm for frequencies below 100 kHz or above 2500 MHz.
5. AM is typical above 1001 MHz.
6. AM accuracy applies at 25°C ±5°C and at <70% depth: it is typically ±7% of setting ±1.5% over 0°C to 50°C.

Frequency modulation

Peak deviation (rates >25 Hz ac FM)

8648A/B/C/D

<249 MHz: 0 to 200 kHz
<501 MHz: 0 to 100 kHz
<1001 MHz: 0 to 200 kHz
<2001 MHz: 0 to 400 kHz
≤4000 MHz: 0 to 800 kHz

Resolution

For ≤10% peak deviation

<2001 MHz: 10 Hz
≥2001 MHz: 20 Hz

For >10% to maximum peak deviation

<2001 MHz: 100 Hz
≥2001 MHz: 200 Hz

Deviation accuracy (internal 1 kHz rate)

8648A/B/C/D

<1001 MHz: ±3% of FM deviation ±30 Hz
<2001 MHz: ±3% of FM deviation ±60 Hz
≤4000 MHz: ±3% of FM deviation ±120 Hz

Rates

8648A/B/C/D

Internal: 400 Hz or 1 kHz or 10 Hz to 20 kHz with Opt 1E2
External: DC: dc to 150 kHz (typical, 3 dB BW)
AC: 1 Hz to 150 kHz (typical, 3 dB BW)

Distortion (1 kHz rate, THD + N, 0.3 to 3 kHz BW)

<1001 MHz: <1% at deviations >4 kHz
<2001 MHz: <1% at deviations >8 kHz
≤4000 MHz: <1% at deviations >16 kHz
(88 to 108 MHz: <0.5% at deviations ≥75 kHz[1])

Carrier frequency accuracy

(relative to CW in dcFM)[2]

8648 A/B/C/D

<1001 MHz: ±100 (typical 40) Hz, deviations <10 kHz
<2001 MHz: ±200 (typical 80) Hz, deviations <20 kHz
≤4000 MHz: ±400 (typical 160) Hz, deviations <40 kHz

FM + FM

Internal 1 kHz or 400 Hz source plus external. In internal plus external FM mode, the internal source produces the set level of deviation. The external input should be set to ≤±0.5V peak or 0.5 Vdc (one-half the set deviation).

Phase modulation

Peak deviation

<249 MHz: 0 to 10 radians
<501 MHz: 0 to 5 radians
<1001 MHz: 0 to 10 radians
<2001 MHz: 0 to 20 radians
≤4000 MHz: 0 to 40 radians

Resolution

<2001 MHz: 0.01 radians
≥2001 MHz: 0.02 radians

Deviation accuracy (internal 1 kHz rate, typical)

8648A/B/C/D

<1001 MHz: ±3% of deviation ±0.05 radians
<2001 MHz: ±3% of deviation ±0.1 radians
≤4000 MHz: ±3% of deviation ±0.2 radians

Rates:

Internal

400 Hz or 1 kHz or 10 Hz to 20 kHz with Opt 1E2[1]

External

20 Hz to 10 kHz (typical, 3 dB BW)

Distortion (1 kHz rate)

8648 A/B/C/D

<1001 MHz: <1% at deviations ≥3 radians
<2001 MHz: <1% at deviations ≥6 radians
≤4000 MHz: <1% at deviations ≥12 radians

Modulation source

Internal

400 Hz or 1 kHz, front panel BNC connector provided at nominally 1 Vpk into 600 Ω.

External

1 Vpk into 600 Ω (nominal) required for full scale modulation. (High/Low indicator provided for external signals ≤10 kHz.)

1. Only on 8648 series.
2. Specifications apply over the 25°C ±5°C range within one hour of dc FM calibration.

Modulation generator (Option 1E2)[1]

Adds variable frequency modulation source. Functions also included in Option 1EP Pager encoder/signalling option.

Waveforms
Sine, Square, Triangle, Sawtooth (Ramp)

Frequency range
Sine: 10 Hz to 20 kHz
Square, Triangle, Sawtooth: 100 Hz to 2 kHz[2]

Frequency accuracy
±0.01% typical

Frequency resolution
1 Hz (3 digits or 10 Hz displayed)

Depth and deviation accuracy (1 kHz sine)
Refer to AM, FM, and Phase Modulation Accuracy specs

Output
Front panel BNC. Nominally 1 Vpk

Pulse modulation (Option 1E6)
(8648B/C/D Only)
Adds high performance pulse modulation capability

On/off ratio
<2000 MHz: >80 dB
≤4000 MHz: >70 dB

Rise/fall times
<10 ns

Maximum repetition rate
10 MHz

Video feedthrough
<30 mV (typical)

Delay
<60 ns (typical)

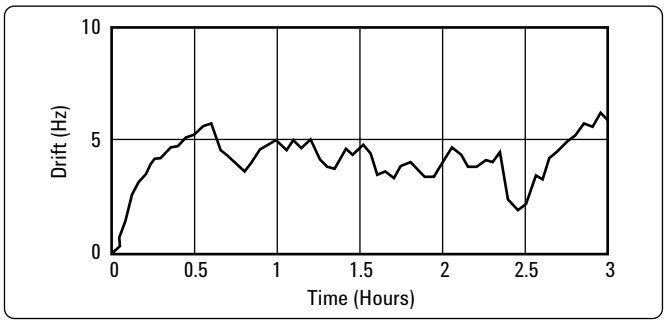
Pulse input
TTL level (±15 V max)

Pager encoder/signaling (Option 1EP)

(8648A only)
Adds functionality for testing POCSAG, FLEX™[3] and FLEX-TD. Also includes Modulation Generator functions of Option 1E2. Instrument characteristics are the same as the 8648A except as noted below.

Frequency
Accuracy with Option 1E5[4] : Typically $\pm 0.15 \times 10^{-6}$ x carrier frequency in Hz or 0.092×10^{-6} x carrier frequency in Hz within 90 days of calibration.

Frequency modulation
FSK Deviation Accuracy with Option 1EP: ±60 Hz[5]



Pager signaling
Supported Pager Protocols: POCSAG, FLEX™, and FLEX-TD

POCSAG
Speed: 512, 1200, and 2400 bps
Message Format: Tone only, Numeric, Alphanumeric

FLEX/FLEX-TD
Speed
- 2 Level FSK: 1600 and 3200 bps
- 4 Level FSK: 3200 and 6400 bps

Message Format: Tone only, Numeric (standard and special), Alphanumeric, HEX/Binary
Address Type: Short, Long

Messaging accessible from front panel or GP-IB
Message Types: Five fixed (built-in), one user-defined
Message Length: 40 characters maximum
Repetition Modes: Single, Burst, Continuous

Messaging accessible only over GP-IB
Message Type: Arbitrary (user-defined)
Batch Length
- FLEX/FLEX-TD: 128 Frames
- POCSAG: 128 Batches

Repetition Mode: Single only
Data Rate Accuracy: ±5 ppm[6]

1. Only on 8648 series.
2. Useable from 10 Hz to 20 kHz; however, bandwidth limitations may result in wave-form degradation. Refer to AM, FM, and Phase ModulationRate specs (External AC mode).
3. FLEX is a Motorola trademark.
4. After one hour warm-up and within one year of calibration.
5. Specifications apply over the 25°C ±5°C range, 4.8 kHz deviation. Meets FLEX requirements at 274 to 288, 322 to 329, 929 to 932 MHz.
6. Specifications apply over the 25°C ±5°C range.

Modulation source
Internal: 400 Hz or 1 kHz, or audio generator (see Option 1E2 for characteristics), front panel BNC connector provided at nominally 1 Vp into 600 Ω.

General
Storage Registers: 70 storage registers with sequence and register number displayed. Up to 10 sequences are available with 30 registers each.

ISO 9002 compliant

The Agilent 8648A/B/C/D signal generators are manufactured in an ISO 9002 registered facility in concurrence with Agilent Technologies' commitment to quality.

Environmental

Operating temperature range
0°C to 50°C

Shock and vibration
Meets MIL STD 28800E Type III, Class 5

Leakage
Conducted and radiated interference meets MIL STD 461B RE02 Part 2 and CISPR 11. Leakage is typically <1 µV (nominally 0.1 µV with a two-turn loop) at ≤1001 MHz, when measured with a resonant dipole antenna one inch from any surface (except the rear panel) with output level <0 dBm
(all inputs/outputs properly terminated).

Remote programming

Interface
GP-IB (IEEE-488.2-1987) with Listen and Talk.

Control languages
SCPI version 1992.0. 8656B and 8657 code compatibility on 8648A/B/C/D.

Functions controlled
All functions are programmable except the front-panel power key, the knobs, the increment set key, the arrow keys, the reference keys and the rear-panel display contrast control.

IEEE-488 functions
SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, E2.

General

Power requirements
90 to 264 V; 48 to 440 Hz; 170 VA maximum

Internal diagnostics
Automatically executes on instrument power-up.
Assists user in locating instrument errors and locating faulty module.

Storage registers
300 storage registers with sequence and register number displayed. Up to 10 sequences are available with 30 registers each.

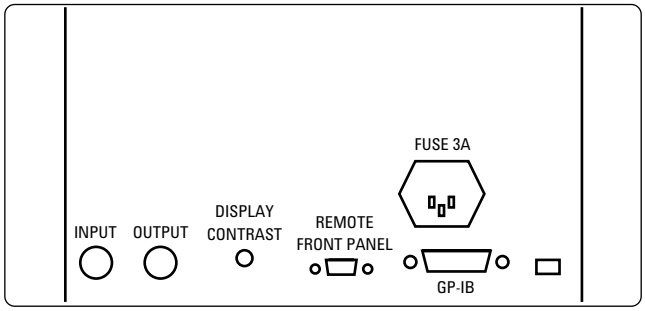
Weight
8648A
7 kg (15 lb.) net, 9 kg (20 lb.) shipping

8648B/C/D
8.5 kg (19 lb.) net, 11 kg (24 lb.) shipping

Dimensions
8648A/B/C/D
165H x 330W x 368D mm (6.5H x 13W x 14.6D inches)

Accessories

Transit case
8648A/B/C/D: P/N 5961-4720



8648 Rear panel

To add options to a model, use the following ordering scheme:

Example

Model #	8648C
Model #-option#	8648C-1EA
Model #-option#	8348C-1E2

Options

Model # -1EA	High output power [1]
Model # -1E2	Modulation generator
Model # -1E5	High stability time base
Model # -1E6	Pulse modulation [1]
Model # -1EP	Pager signaling capability [2]

Documentation

Model # -UK6	Commercial calibration certificate with testdata
08648-90048	English Operation and Service Guide
Model # -AB0	Chinese localization Taiwan
Model # -AB1	Korean localization
Model # -AB2	Chinese localization - China
Model # -ABD	German localization
Model # -ABE	Spanish localization
Model # -ABF	French localization
Model # -ABJ	Japanese localization
Model # -0B0	Delete manuals

Accessories

Model # -1CM	Rack mount kit

Warranty and Service

Standard warranty is 12 months.
For warranty and service of 5 years, specify 60 months (quantity = 60)

R-51B	Return-to-Agilent warranty and service plan (months)

Calibration

For 3 years, specify 36 months of the appropriate calibration plan.
For 5 years, specify 60 months.

R-50C-001	Standard calibration plan (months)
R-50C-002	Standards compliant calibration plan (months)

1. Not available on 8648A
2. Only available on 8648A

Additional resources

For additional information and feature comparisons, refer to the 8648 product overview (literature number 5962-6191E).

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