Agilent
8644B, 8664A, 8665B
High Performance RF Signal Generators

Data Sheet

A commitment to value in signal generators

Agilent Technologies

Agilent's high performance RF signal generators – choose one for...

...Best spectral purity

8644B

- 252 kHz to 1030 MHz, 2060 MHz (Option 8644B-002)
- Lowest SSB phase noise and spurious
- Highest output power
- Lowest residual FM
- AM, FM, pulse modulation
- Built-in 2 GHz counter (Option 8644B-011)
- VOR/ILS signal simulation (Option 8644B-009)
- Ultra low leakage (Option 8644B-010)

...High RF frequency coverage

8664A and 8665B

- 100 kHz to 3000 MHz – 8664A, 4200 MHz – 8665B – 6000 MHz
- Low SSB phase noise (Option 8664A-004 or Option 8665B-004)
- AM and wideband FM
- High performance pulse modulation (Option 8664A-008 or Option 8665B-008)
- Ultra low leakage (Option 8664A-010 or Option 8665B-010)

Choose one for your application...

	8644B 1 or 2 GHz	**8664A** 3 GHz	**8665B** 6 GHz
RF communications			
Out-of-channel receiver testing[1]	Ideal for receivers with ≥ 90 dB selectivity and/or spurious immunity of ≥ 85 dB	Ideal for receivers with ≥ 90 dB selectivity with Option 8664A-004, and spurious immunity of < 85 dB to 3 GHz	Same performance as 8664A but up to 6 GHz
General purpose	Lowest possible phase noise and spurious for R&D	Wideband FM with rates to 6 MHz for simulation of many new digital systems	Lowest noise and spurious to 6 GHz
Component test	Highest output power for mixer testing	Ideal clock source with low phase jitter for high speed digital components	Best output level accuracy to 6 GHz for response testing
Radar/EW testing	Full functionality for R&D and manufacturing	Optional pulse modulation with internal delay and width adjust	Same performance as 8664A but up to 6 GHz for coverage of most surveillance radars
Avionics	Option 8644B-009 provides specified VOR/ILS signal simulation	Coverage of most weather and avionics radars. Option 8664A-008 provides pulse modulation capable of generating appropriate pulse width and delay internally	Same performance as 8664A up to 6 GHz

1. For FM receivers with approximately 14 kHz IF BW and 25 kHz channel spacing

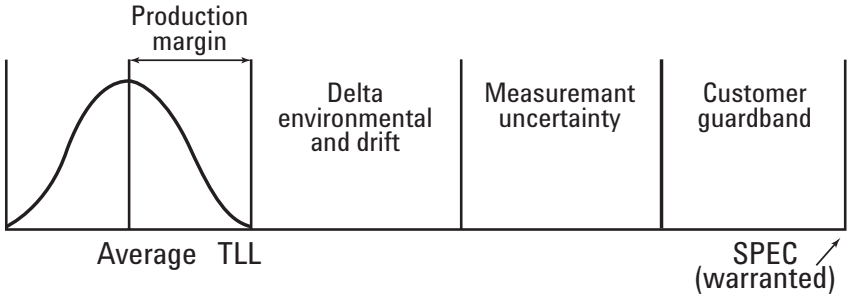
Performance backed by Agilent's reputation and manufacturing experience

Every Agilent Technologies' signal generator meets specifications that would reject most other signal generators

Before any Agilent Technologies' signal generator is introduced, specifications are set to assure that the product will perform consistently for your application. The specification setting process is reflective of the quality that Agilent has always strived to deliver. An explanation of Agilent's specification setting process will show the confidence that you can have when selecting an Agilent Technologies signal generator.

The model used for specification setting is illustrated in the above right figure. The following text defines each element in the figure.

- Production margin is the difference between the average product performance and the test line limit (TLL). This TLL is the pass/fail limit used by the production line at final test under standard environmental conditions.
- Delta environmental represents the possible change in performance over the environmental extremes (e.g., temperature and humidity).



- Drift represents the change in performance over the calibration period.
- Measurement uncertainty accounts for possible measurement errors in the equipment used to characterize the signal generator.
- Customer guardband represents any additional margin necessary to ensure a worst case scenario.

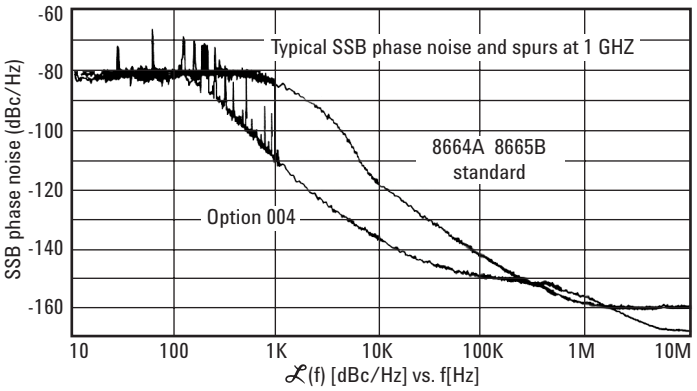
This process means that whether the signal generator is placed in a high temperature environment such as at the top of a rack of equipment or a well controlled environment, the performance stated in our specifications can be relied on for your most exacting applications. This process guarantees that the signal generator is introducing the minimum error possible in the measurements you are performing.

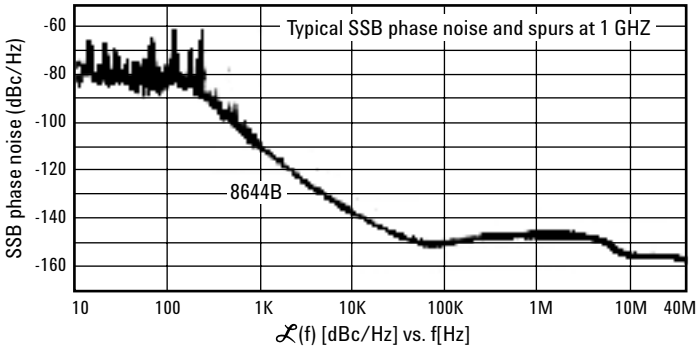
Typical performance
Since some applications push the limits of specifications, Agilent Technologies also provides data that indicates typical performance. This typical performance is generally set at the test line limit (TLL), which is significantly better than the warranted specification. Use the typical data when comparing different products, or when your application pushes the limit on a given specification. The following information highlights typical performance for the most common areas of interest for the 8644B, 8664A and 8665B.

Typical performance, for applications that push specifications

SSB phase noise

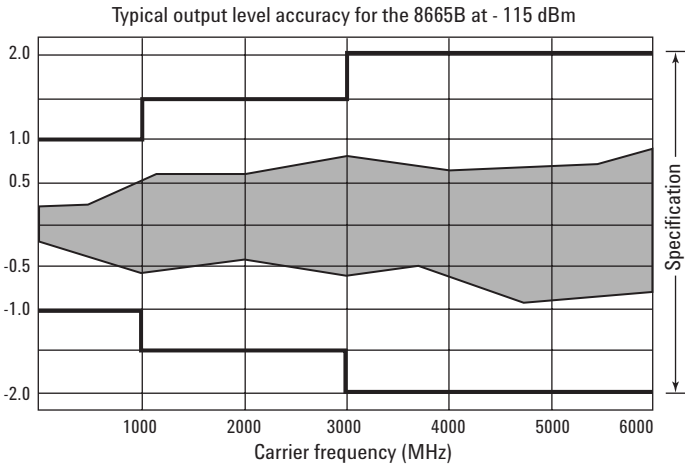
SSB phase noise is an important specification of a signal generator if it is to be used for measuring the adjacent channel selectivity of a receiver. If the phase noise of the signal generator is too high at frequency offsets equal to the channel spacing, the test results might indicate a failure of the receiver when it is actually functioning properly. If the selectivity is ≥ 90 dB, the 8644B (or Option 8664A-004, or Option 8665B-004) is recommended.





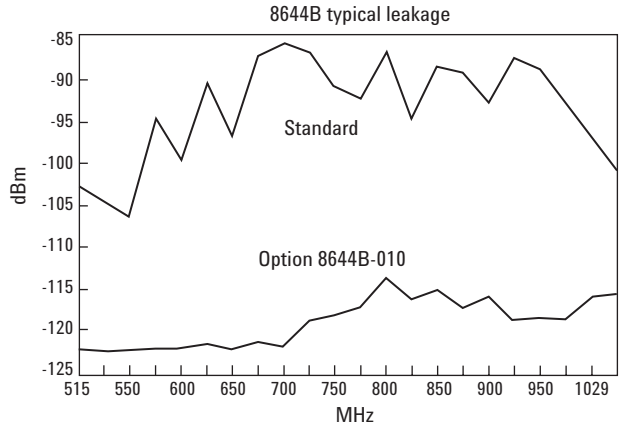
Output level accuracy

Output level accuracy is a combination of temperature variation, flatness over frequency, and the signal generator's internal attenuator and detector accuracies. The graph represents worst case output level accuracy of a sampling of 8665Bs. All of these units fall within the shaded area.



RF leakage

Due to radios becoming more sensitive and operating at higher frequencies, the traditional two-turn loop measurement of RF leakage has become inadequate. To overcome the shortcomings of the two-turn loop, Agilent has developed a new measurement technique using resonant dipole antennas, which is 20 to 25 dB more sensitive than the two-turn loop method. Agilent has been able to reduce the level of radiated emissions in its newer signal generators through innovative design and packaging. Understanding that not all applications require the lowest possible emissions, Option 010 (i.e., 86xxx-010) is available on all of these performance signal generators.



Features that improve the usability of Agilent's 8644B, 8664A and 8665B for your application!

Internal modulation source

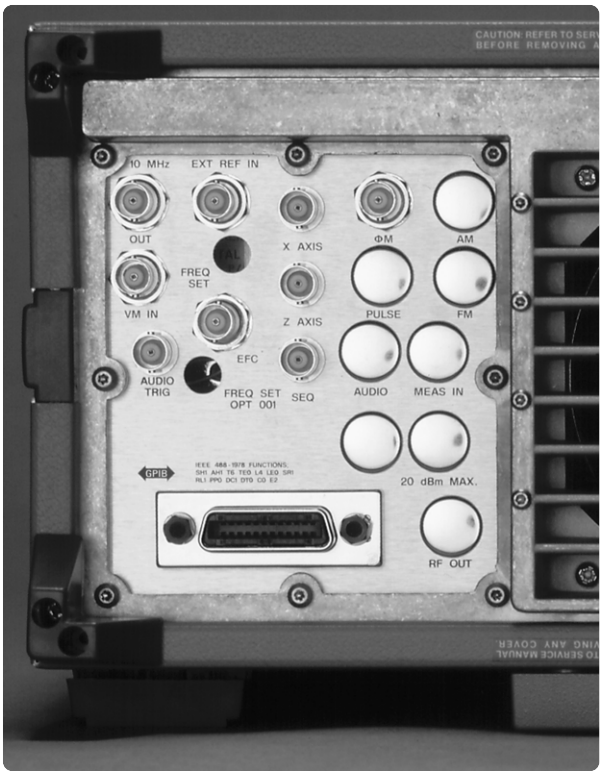
- Low distortion sinewaves to 400 kHz with variable phase and amplitude.
- Triangle, sawtooth and squarewaves to 50 kHz with variable phase and amplitude.
- White Gaussian noise with variable amplitude.
- Two independent sources for two-tone testing.

Optional pulse modulation (Options 8664A-008 and 8665B-008)

- An Agilent designed GaAs pulse modulator provides the exceptional performance that is so critical for pulsed applications.
- < 5 ns rise/fall times, > 80 dB on/off ratio
- Built-in pulse generator features include variable pulse delay and width from 50 ns to 999 ms. This saves purchasing additional equipment.
- Leveled RF output maintains accuracy while in pulse modulation.

High reliability electronic attenuator (optional on 8644B)

For applications up to 1 GHz, the electronic attenuator provides increased reliability. Instead of using mechanical relays, the electronic attenuator uses solid-state components for setting output levels accurate to within ±1.0 dB. The Agilent patented design uses PIN switching elements with three million hours of MTBF, giving the attenuator an estimated 0.2% failure rate.



Wideband FM (8664A and 8665B)

- Typical rates to 5 MHz with 2 MHz of deviation, or rates to 800 kHz with 10 MHz of deviation (f_c > 1500 MHz) allows testing of most wideband receivers.
- Excellent FM linearity is inherent due to YIG oscillator design.
- Stable dc-coupled FM for measurements that require low carrier drift.

Performance signal generator series features

- High stability oven controlled timebase is standard.
- Surface mount construction for improved reliability.
- Three year calibration cycle (MTBC) means less time in the calibration lab.
- Built-in self-diagnostics and calibration saves valuable time by significantly reducing down time.

2 GHz frequency counter (Option 8644B-011)

- 20 Hz to 2 GHz frequency counting via front panel connector.
- Cost and space efficient solution for applications involving audio frequency measurements, local oscillator, IF and transmitter testing.
- Eliminates the need to externally couple the timebase references when using an external counter.

Specifications

	8644B	8664A, 8665B
Frequency		
Range:	0.252 to 1030 MHz	0.1 to 3000 MHz 8664A
	0.252 to 2060 MHz, Option 8644B-002	0.1 to 6000 MHz 8665B
Resolution:	0.01 Hz	0.01 Hz
Accuracy (std. timebase):	0.375 x 10^{-6} times carrier in Hz	0.375 x 10^{-6} times carrier in Hz
< 1 year of calibration		
Switching speed (typical):	< 350 ms	< 50 ms (within 0.33 ppm)
(within 100 Hz)		< 100 ms 8664A-004 or 8665B-004

Spectral purity

SSB phase noise (dBc/Hz):
(at 20 kHz offset)

Carrier (MHz)		**Standard**	**Option 004 (866xx-004)**
4120 to 6000	NA	–105	–116
3000 to 4120	NA	–105	–122
2060 to 3000	NA	–111	–122
1030 to 2060	–130 (Option 8644B-002)	–111	–128
515 to 1030	–136 (–142 typical)	–117	–134
257.5 to 515	–142	–122	–139
128.5 to 257.5	–145	N/A	N/A
0.25 to 128.5	–145	N/A	N/A
8664A, 8665B			
187.5 to 257.5	NA	–128	–144
0.1 to 187.5	NA	–117	–131

Nonharmonics:	< –105 dBc, > 10 kHz offset, 0.252 to 1030 MHz	< –100 dBc, > 10 kHz offset, 187.5 to 2060 MHz
	< –100 dBc, > 10 kHz offset, 1030 to 2060 MHz	< –90 dBc, > 10 kHz offset, 2060 to 6000[1] MHz, 0.1 to 187.5 MHz
Harmonics:	< –25 dBc, output ≤ +10 dBm	< –30 dBc, output ≤ +10 dBm
Subharmonics:	None, 0.252 to 515 MHz	< –75 dBc, 0.1 to 1500 MHz
	< –52 dBc, 515 to 1030 MHz	< –40 dBc, 1500 to 3000 MHz
	< –40 dBc, 1030 to 2060 MHz	< –50 dBc, 3000 to 60001 MHz

Residual FM (Hz rms):	**Standard**		**Standard/Option 004 (866xx-004)**	
Carrier (MHz)	**3 kHz BW**	**15 kHz BW**	**3 kHz BW**	**15 kHz BW**
2060 to 60001	–	–	< 60/< 10	< 80/< 32
1030 to 2060	< 2	< 4	< 15/< 2.5	< 20/< 8
515 to 1030	< 1	< 2	< 7.5/< 1.2	< 10/< 4
257.5 to 515	< 0.5	< 1	< 7.5/< 1.2	< 10/< 4
0.25 to 257.5	< 0.5	< 0.5	–	–
8664A, 8665B				
187.5 to 257.5	–	–	< 7.5/< 1.2	< 10/< 4
0.1 to 187.5	–	–	< 15/< 2.5	< 20/< 8

Residual AM:	< 0.01% AM rms	< 0.04% AM rms
(0.3 to 3 kHz post det. BW)		
SSB AM noise floor (dBc/Hz):	< –157, 10 dBm, < 1030 MHz	< –137, 13 dBm, < 187.5 MHz
(offsets > 100 kHz)	< –150, 10 dBm, < 2060 MHz	< –150, 13 dBm, > 187.5 MHz

Internal reference oscillator	**Standard high stability**	**Option 001 high stability with EFC**
Aging:	+1.5 x 10^{-8}/day after ten days	±3 x 10^{-10}/day after 10 days
Temperature:	+7 x 10^{-10}, 0 to 55 °C	±6 x 10^{-10}, to 55 °C
Line voltage:	±2 x 10^{-10}, (+5%, -10%)	±1 x 10^{-10}, ±10%
Output:	10 MHz, > 0.15 V_{rms} level into 50 Ω	10 MHz, > 1 V_{rms} level into 50 Ω

External reference input:	Accepts 10 MHz ±5 ppm and a level range of 0.5 V to 2 V_{rms} into 50 Ω
Electronic frequency control (EFC):	Option 001 (86xxx-001) only, +0.01 ppm for ±1 Vdc at rear panel connector, voltage range ±10 Vdc, input impedance 10k Ω

1. 3000 MHz for 8664A, 6000 MHz for 8665B

Specifications (continued)

	8644B	8664A, 8665B	
Output level			
Range:	+16 to –137 dBm, +13 dBm, 8644B-002/005	+13 to -139.9 dBm +9 dBm, Option 8664A-008 or 8665B-008	
Resolution:	0.01 Hz	0.01 Hz	
Absolute accuracy:	±1 dB, output ≥ –127 dBm ±3 dB, output < –127 dBm	±1 dB, output ≥ –119.9 dBm, 1 - 1000 MHz ±1.5 dB, output ≥ –119.9 dBm, 1000 to 3000 MHz ±2 dB, output ≥ –119.9 dBm, 3000 to 6000[1], < 1 MHz ±3 dB, output ≥ –129.9 dBm	
Reverse power protection:	50 watts	25 watts[2], 0.1 to 2060 MHz 1 watt, > 2060 MHz	
Third order intermod: (frequencies < 1300 MHz, two signals at +8 dBm, 25 kHz apart through a resistive combiner)	< –50 dBc	< –47 dBc	
Overrange:	Typically 2 dB	Typically 2 dB	
Switching speed (typical):	< 50 ms	< 50 ms	
SWR:			
Output level		**< 3000 MHz**	**≥ 3000 MHz**
≥ 0 dBm	< 2.2:1	< 1.75:1	< 2.0:1
< 0 dBm	< 1.5:1	< 1.5:1	< 1.75:1
Output impedance:	50 Ω	50 Ω	
Amplitude modulation			
Depth:	0 to 100%, output ≤ +7 dBm	0 to 100%, output ≤ +7 dBm	
Resolution:	0.1%	0.1%	
Bandwidth (3 dB):	dc to > 100 kHz, > 128 MHz	dc to > 10 kHz for > 10 MHz	
Accuracy: 1 kHz rate	±(7% of setting +1%) up to 80% depth	± (6% of setting +1%) up to 90% depth	
Distortion: 30% depth, 1 kHz rate	< 3%; < 4%, 8644B-002	< 4%	
Incidental phase modulation: (at 30% depth, 1 kHz rate)	< 0.2 radians peak	< 0.2 radians peak, ≤ 2000 MHz < 0.2 radians peak, > 2000 MHz	
External input impedance:	600 Ω	600 Ω	
Frequency modulation			
Maximum peak deviation:	20 MHz/200 kHz[3], > 1030 MHz 10 MHz/100 kHz[3], > 515 MHz 5 MHz/50 kHz[3], > 257.5 MHz 2.5 MHz/25 kHz, > 128.5 MHz 1.25 MHz/12.5 kHz[3], > 64 MHz 62.5 kHz/6.25 kHz[3], > 32 MHz Deviation halves per lower octave (> 16, > 8, > 4, > 2, > 1, > 0.5 MHz)	20 MHz, 3000 to 6000[1] MHz 10 MHz, 1500 to 3000 MHz 5 MHz, 750 to 1500 MHz 2.5 MHz, 375 to 750 MHz 1.25 MHz, 187.5 to 375 MHz 5 MHz, < 187.5 MHz	
Resolution:	2.5% of setting	2.5% of setting	
Bandwidth (3 dB):	dc to 100 kHz	dc to 800 kHz	
Carrier accuracy in FM:	±0.5% of setting	±0.6% of setting	
Indicator accuracy:	< 5%, < 30 kHz rates < 10%, < 100 kHz rates	±9%, < 20 kHz rates ±11%, < 20 kHz rates, 8664A-004 or 8665B-004	
Distortion:	< 5%, < 1%[3] 20 Hz to 100 kHz	< 1%, 20 Hz to 20 kHz rates	
Incidental AM:	< 0.5%, deviation ≤ 20 kHz	< 0.3%, deviation ≤ 20 kHz	
External group delay:	< 10 µs, ≤ 100 kHz rates	< 30 µs, ≤ 2 0 kHz rates	
External input impedance:	600 Ω	600 Ω	

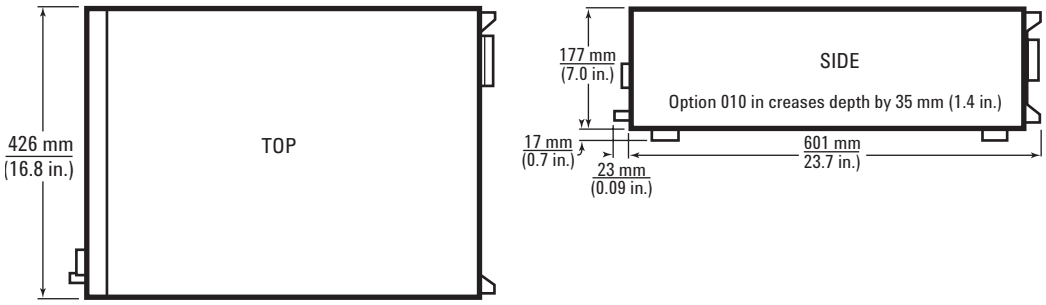
1. 3000 MHz for 8664A, 6000 MHz for 8665B
2. One watt on 8665B
3. Low noise mode three

Specifications (continued)

	8644B	8664A, 8665B
Pulse modulation		**Options 8664A-008 and 8665B-008**
On/off ratio:	> 35 dB, > 80 dB, > 1030 MHz	> 80 dB
Rise/fall time, 10 to 90%:	< 100 ns	< 5 ns
Repetition rate:	dc to 1 MHz	dc to 10 MHz
Internal width/delay:	N/A	Variable from 50 ns to 1 s ±5% accuracy, 0.2% of full scale resolution
Minimum width:	0.5 μs	10 ns
Video feedthrough/overshoot:	< 15%	< 25%
Output level accuracy:	±2 dB	Same as standard
External inputs/outputs:	Input level: on state; > 3.0 V_{peak} (600 Ω input impedance) off state; < 0.8 V_{peak}	Input level: TTL into 50 Ω or Schottky TTL Sync out and video out: TTL into 50 Ω
Internal modulation source		
Number of sources:	Two sources simultaneously available through summation, independently adjustable in frequency, phase, amplitude and waveform. Source one may also be internally modulated with AM, FM, phase modulation and pulse modulation to create a subcarrier waveform.	
Waveforms and rates:	Sine, white Gaussian noise; 0.1 Hz to 400 kHz Triangle, sawtooth, square; 0.1 Hz to 50 kHz	
Frequency accuracy:	Same as timebase	
Output level (into 600 Ω):	1 V_{peak}, 2 V_{peak} for 8644B	
Output resolution:	2 mV_{peak}	
Total harmonic distortion:	< 0.1%, ≤ 20 kHz rates	
Frequency sweep		
Digital sweep:	Digitally stepped sweep over entire frequency range. Linear/log selection. 0.5 to 1000 sec sweeps.	
Markers/Z axis output:	Three markers available /Z axis output nominally +5 V/X axis output nominally 0 to 10 V.	
Phase continuous sweep:	40 MHz of span available at maximum carrier frequency. Twenty ms to ten sec sweep times.	
Remote programming		
Interface:	GPIB (IEEE 488.2-1987).	
Control language:	Hewlett-Packard Systems Language (HP-SL). All functions controlled except power.	
IEEE-488 functions:	SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, C0, E2.	

Specifications (continued)

	8644B		8664A, 8665B
Avionics Option 8644B-0009	8644B-009 provides the performance needed for testing VOR and ILS (localizer, glide slope and marker beacon) receivers. 8644B-009 provides guaranteed specifications necessary to make these demanding tests.		N/A
VOR (108 to 118 MHz)	Bearing accuracy: 0.1°, frequency accuracy: Same as timebase, AM accuracy (30%): ±5% of setting, AM distortion: 2%, FM accuracy (480 Hz dev.): ±1.5 Hz		
ILS: localizer/glide slope (108 to 112 MHz/329.3 to 335 MHz)	DDM resolution:	Localizer: 0.0002 Glide slope: 0.0004	
	DDM accuracy:	Localizer: ±0.0004 ±5% of DDM Glide slope: ±0.0008 ±5% of DDM	
Marker beacon (75 MHz):	AM accuracy: ±5% of setting AM distortion: 2% AM accuracy (95%): ±5% of setting +1% AM distortion: 5%		
2 GHz counter Option 011			
Frequency range:	20 Hz to 2 GHz in three ranges		N/A
Sensitivity:	25 mV_{rms} (–19 dBm into 50 Ω)		
Maximum input:	2.25 V_{rms} (+20 dBm into 50 Ω)		
Impedance:	50 Ω, 10 MHz to 2 GHz; 1 M Ω shunted by < 65 pf, < 10 MHz		
Coupling:	ac		
Gate times:	0.1s to 1s in 0.1s steps		
Measurement resolution:	Measured frequency (Hz) x 10^{-8}/gate time or 0.01 Hz if greater		
Measurement uncertainty:	(± time base accuracy) plus (± measurement resolution)		
General			
Power requirements:	±10% of 100 V, 120 V, 220 V or 240 V; 48 to 440 Hz; 500 VA except 8644B 400 VA.		
Operating temperature:	0 to 55 °C		
Leakage:	Conducted and radiated interference meets MIL STD 461 B REO2 and FTZ 1046. Leakage is measured into a resonant dipole antenna, one inch from the instrument's surface with output level < 0 dBm (all inputs/outputs properly terminated, f_c < 1 GHz). Leakage is typically < 16 µV or < 2 µV with Option 010, measured at the front panel. The older two-turn loop method of measurement is typically < 1 µV or < 0. 1 µV for Option 010.		
Acoustic noise:	Typically < 5.5 bels		
Storage registers:	Ten full function and 40 frequency/amplitude registers.		
Calibration/diagnostics:	Internal calibration and diagnostics functions are available to the user. Built-in test capability locates circuit malfunctions to allow repair through module replacement.		
Calibration interval:	Recommended three years (MTBC).		
Weight:	8644B; 30 kg (67 lbs). 8664A/8665B; 35 kg (78 lbs)		
Dimensions:	177H x 426W x 601D mm (7 x 16.8 x 23.7 in.). Option 010 adds 35 mm (1.4 in.) to depth.		



Ordering information

Note: To add options to a product, specifiy the model number, followed by the option number. For example:

Models: 8644B, 8664A, 8665B
Option 8644A-005 or Option 8665B-010

		8644B	8664A 8665B
Options:			
001	High stability time base with EFC	✓	✓
002	2 GHz doubled output	✓	✓
003	Rear panel input/output	✓	✓
004	Low noise option	Not applicable	✓
005	Electronic attenuator (N/A with Option 002)	✓	✓
008	Pulse modulation	✓	✓
009	Specified VOR/ILS	✓	✓
010	Reduced leakage configuration	✓	✓
011	2 GHz internal frequency counter	✓	✓
907	Front handle kit (5061-9690)	✓	✓
908	Rack flange kit (5061-9678)	✓	✓
909	Combined front/rack flange kit (5061-9684)	✓	✓
915	Add service manual service kit	08645-61116	08665-61116
R1281A	Additional 3 years of return warranty	✓	✓

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