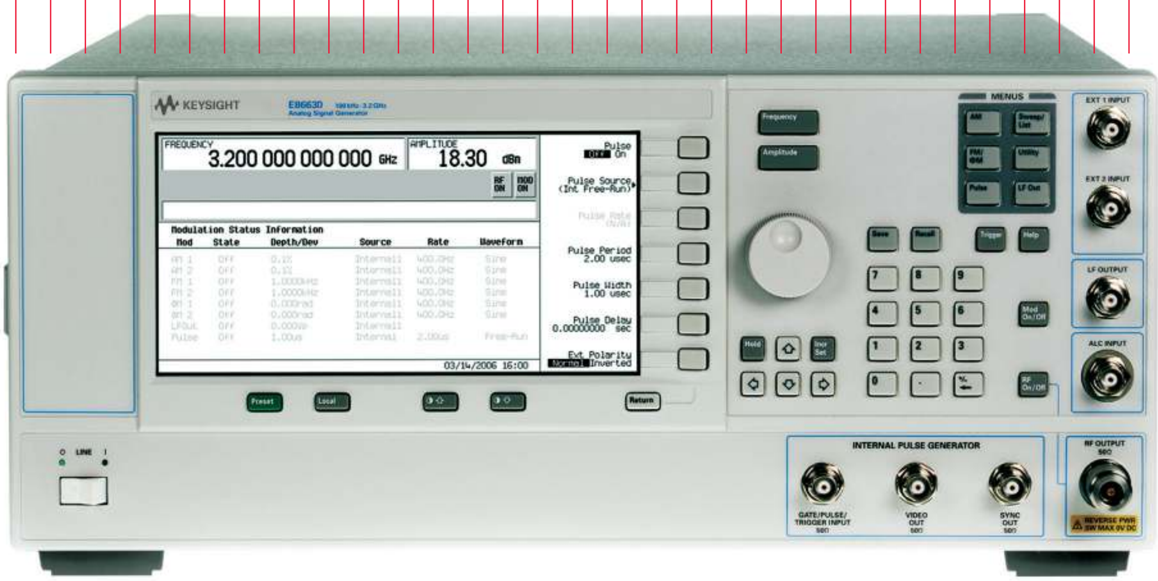
Keysight Technologies
Three Reasons to Migrate From Your 8662A/8663A to the E8663D RF Signal Generator

Application Note



KEYSIGHT
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A New Industry Standard For Low Noise RF Signal Generation

For nearly 30 years, the Keysight Technologies, Inc. 8662A, followed by the 8663A and most recently by the E8663B, have been the industry-standard low noise RF signal generators providing unmatched low close-to-carrier phase noise signals for a variety of demanding RF applications, such as satellite communications, radar and EW, mobile radio and digital communications, and ATE systems. Now obsolete, the legacy 8662A and 8663A have been replaced by the Keysight E8663D – the new industry standard for low noise RF signal generation.

This application note demonstrates the advantages of the E8663D over the 8662A/63A, giving you three compelling reasons to migrate:
1. Superior performance
2. Enhanced usability
3. Modern supportability

Superior Performance

The E8663D provides performance superior to the 8662A/3A in virtually all signal characteristics, from frequency range to typical output power to close-to-carrier phase noise. Following are several measurement graphs that demonstrate this performance. You will find detailed specification comparisons in the Appendix.

Frequency

The E8663D has two frequency range options: 100 kHz to 3.2 GHz and 100 kHz to 9 GHz.[1] The frequency resolution of 0.001 Hz easily surpasses that provided by the 8662A/3A to provide a finer resolution test signal.

Output power

Figures 1 and 2 demonstrate the E8663D has higher typical maximum output power for frequencies greater than 200 MHz and better power flatness over the entire frequency range. In addition, the E8663D has a wider power range, providing power levels as low as –135 dBm over the available frequency ranges.

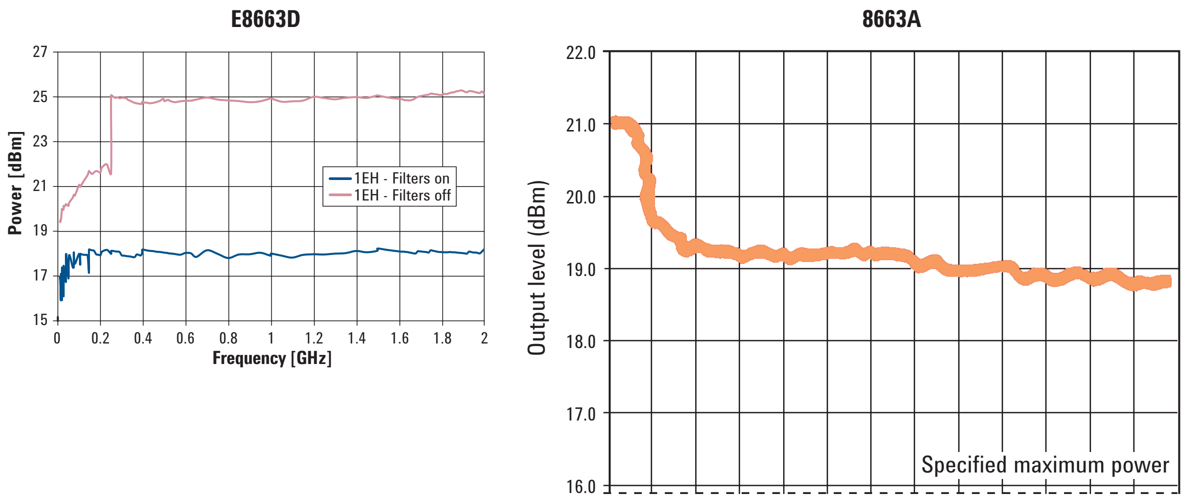

Figure 1. Typical maximum available output power versus frequency.

1. Performance is unspecified below 250 kHz.

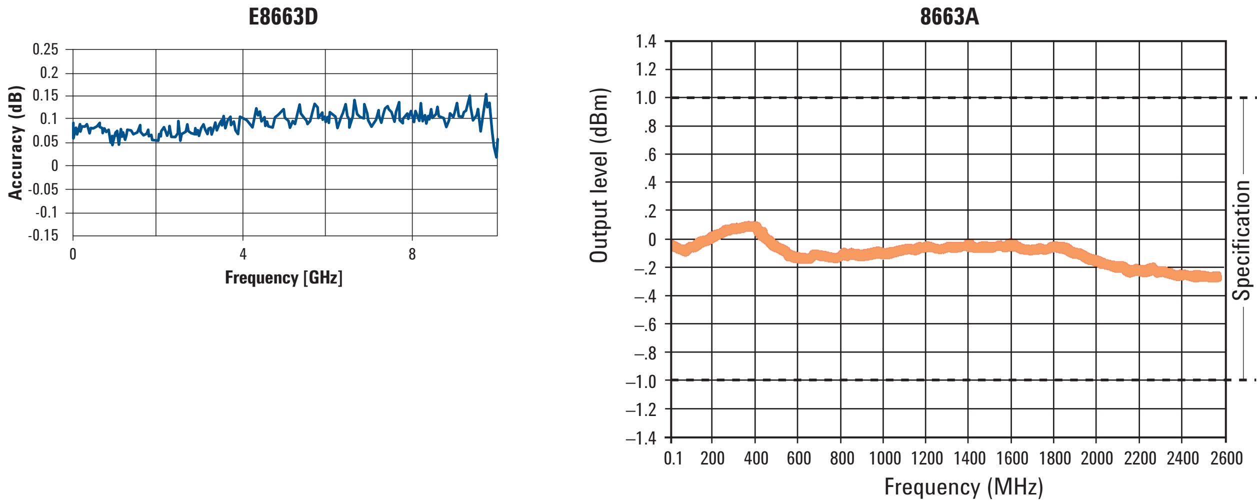

Figure 2. Power level accuracy versus frequency.

Modulation

The standard E8663D is capable of generating CW and pulse modulated signals with pulse widths as narrow as 150 ns. The internal pulse generator provides pulse repetition intervals (PRI) from 70 ns to 42 s (pulse repetition frequencies from 0.024 Hz to 14.28 MHz).

If more extensive modulation capability is needed, Option UNT adds amplitude modulation (AM), frequency modulation (FM), and phase modulation (ΦM) to the instrument. AM bandwidth for the E8663D is specified to 100 kHz and is useable to 1 MHz. FM bandwidth is specified at a 1 dB bandwidth up to 100 kHz and a typical 3 dB bandwidth up to 10 MHz for deviations up to 8 or 16 MHz (for the 3.2 or 9 GHz models, respectively). ΦM provides deviations up to 80 radians (~ 4584° for the 3.2 GHz model) or 160 radians (~ 9167° for the 9 GHz model) with a typical 3 dB bandwidth of up to 4 MHz. The Option UNT internal modulation generator provides a frequency range up to 1 MHz with 0.5 Hz resolution.

The E8663D also offers narrow pulse modulation (Option UNW) capable of generating pulse widths of 20 ns (with 10 ns rise and fall times) to 42 s.

Spectral purity

The standard E8663D provides excellent phase noise performance. At a 20 kHz offset, a 1 GHz signal has -124 dBc/Hz specified and -128 dBc/Hz typical phase noise. Option UNX offers even better close-to-carrier phase noise performance that outperforms the 8662A/8663A signal generators. For carriers in the 1 to 250 MHz range, Option UNX provides a special low phase noise mode that uses internal frequency dividers to further reduce phase noise. Figures 3 through 26 show direct residual and absolute single-sideband (SSB) phase noise measurement comparisons of the E8663D versus the 8663A using a pair of each instrument. For carriers less than 250 MHz, the performance comparison uses the low phase noise mode provided by Option UNX.

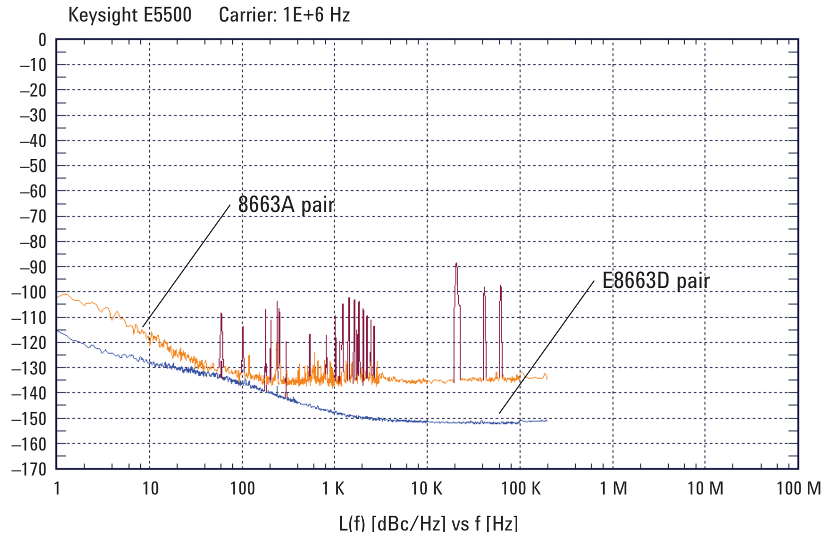

Figure 3. Absolute phase noise comparison for a 1 MHz carrier.

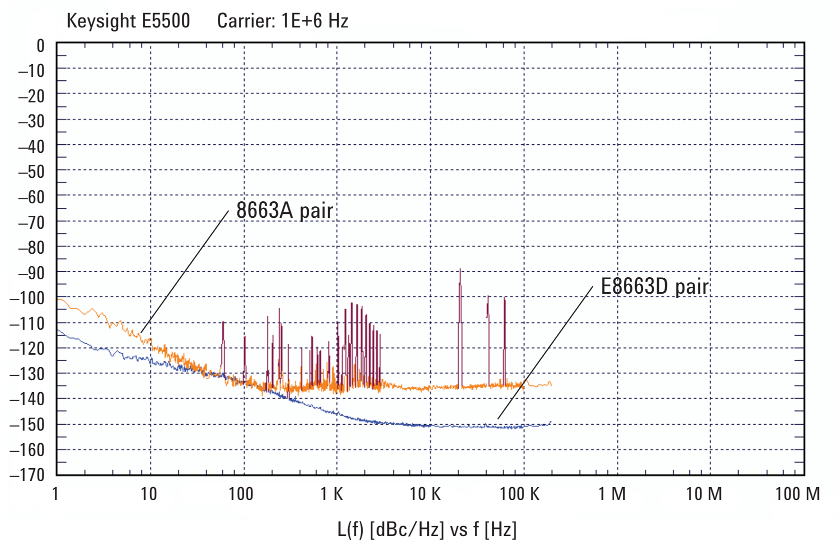

Figure 4. Residual phase noise comparison for a 1 MHz carrier.

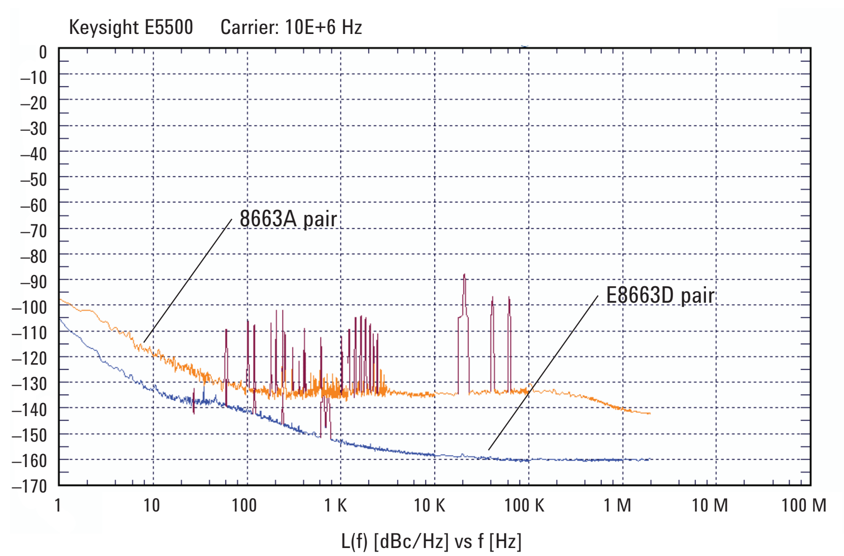

Figure 5. Absolute phase noise comparison for a 10 MHz carrier.

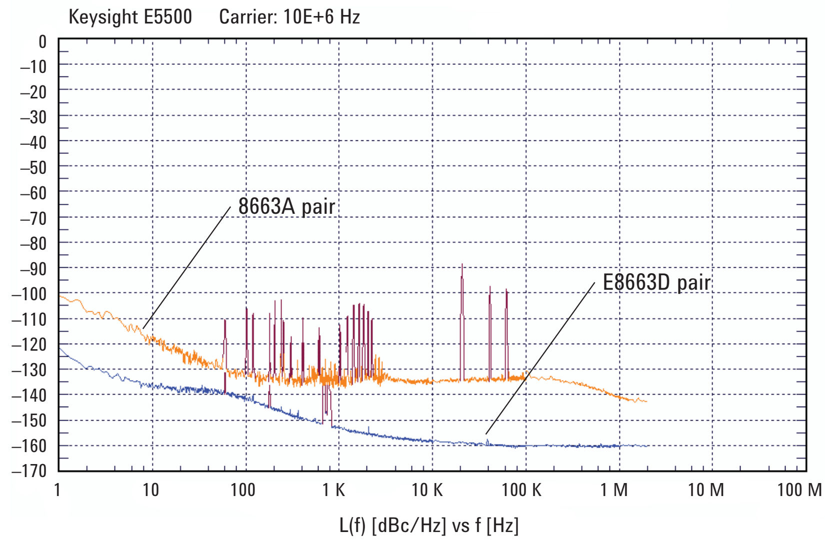

Figure 6. Residual phase noise comparison for a 10 MHz carrier.

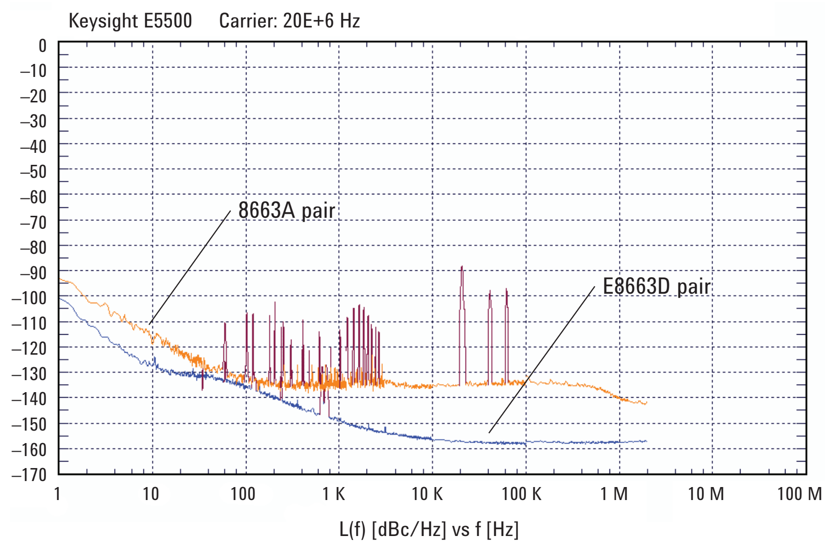

Figure 7. Absolute phase noise comparison for a 20 MHz carrier.

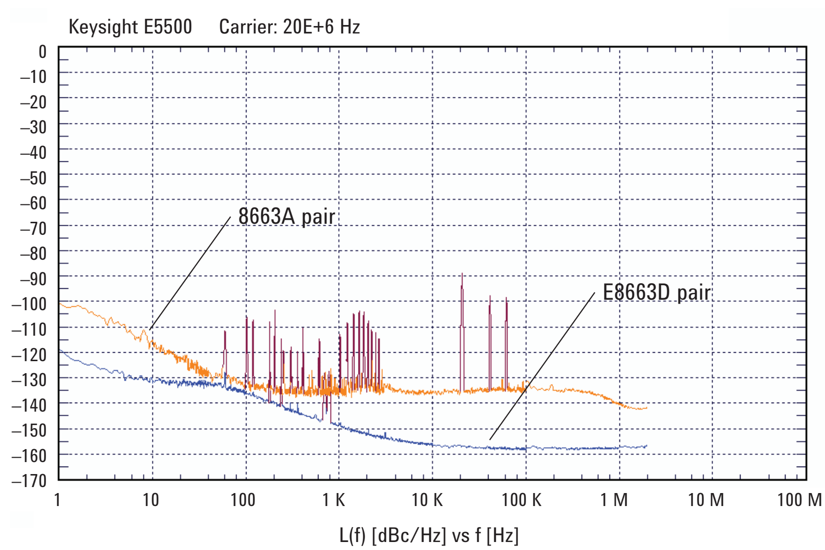

Figure 8. Residual phase noise comparison for a 20 MHz carrier.

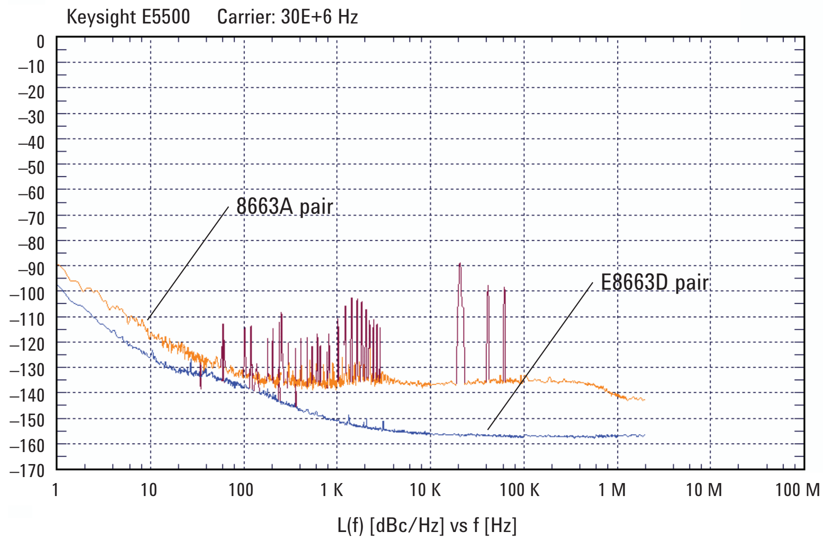

Figure 9. Absolute phase noise comparison for a 30 MHz carrier.

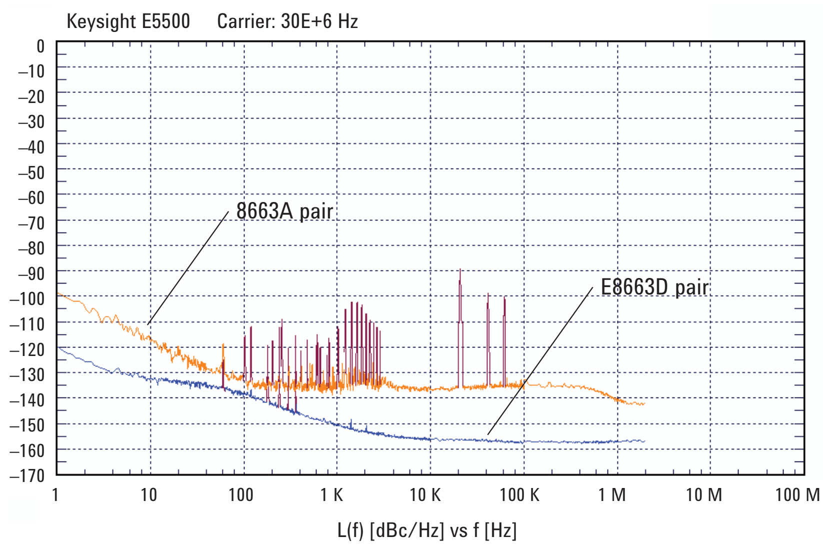

Figure 10. Residual phase noise comparison for a 30 MHz carrier.

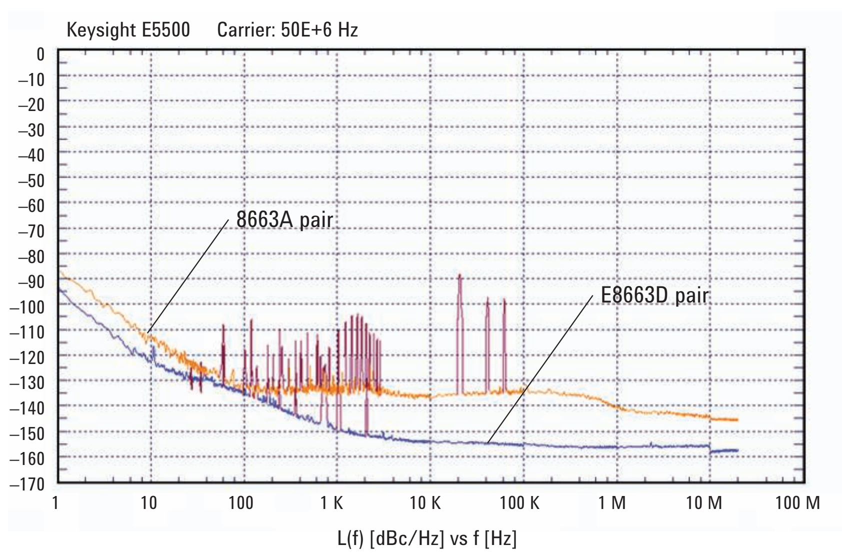

Figure 11. Absolute phase noise comparison for a 50 MHz carrier.

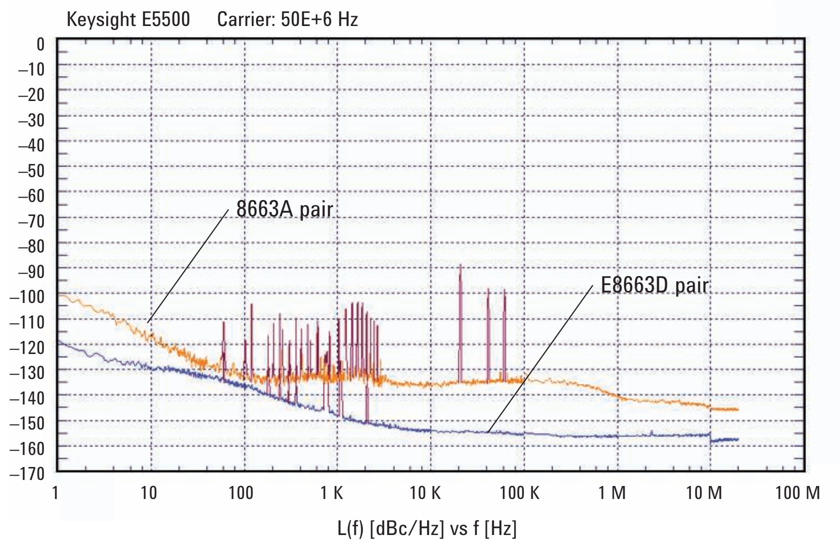

Figure 12. Residual phase noise comparison for a 50 MHz carrier.

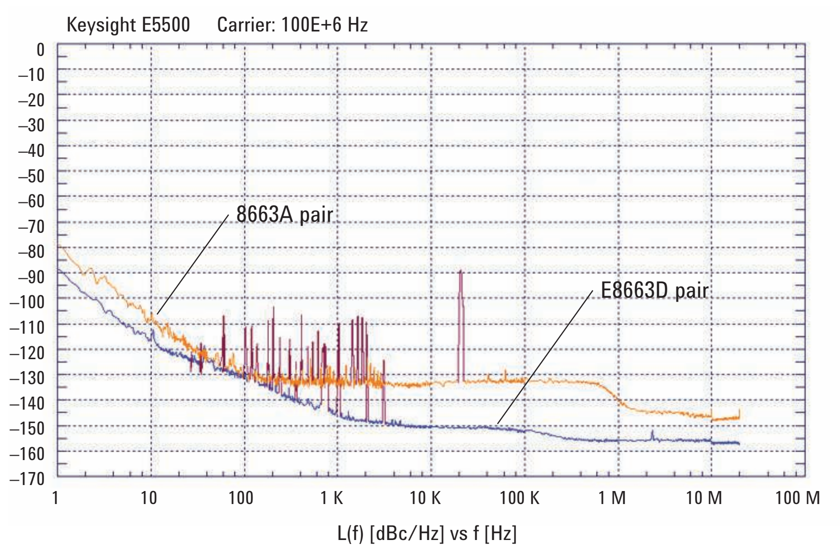

Figure 13. Absolute phase noise comparison for a 100 MHz carrier.

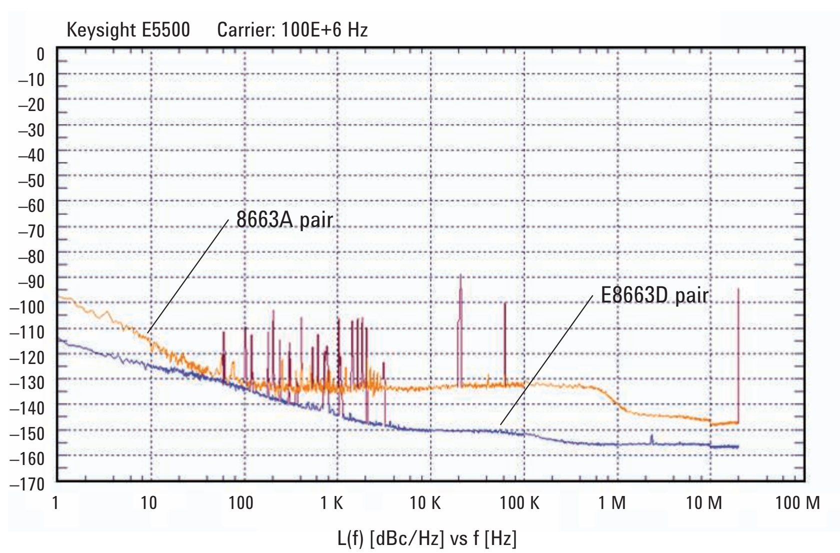

Figure 14. Residual phase noise comparison for a 100 MHz carrier.

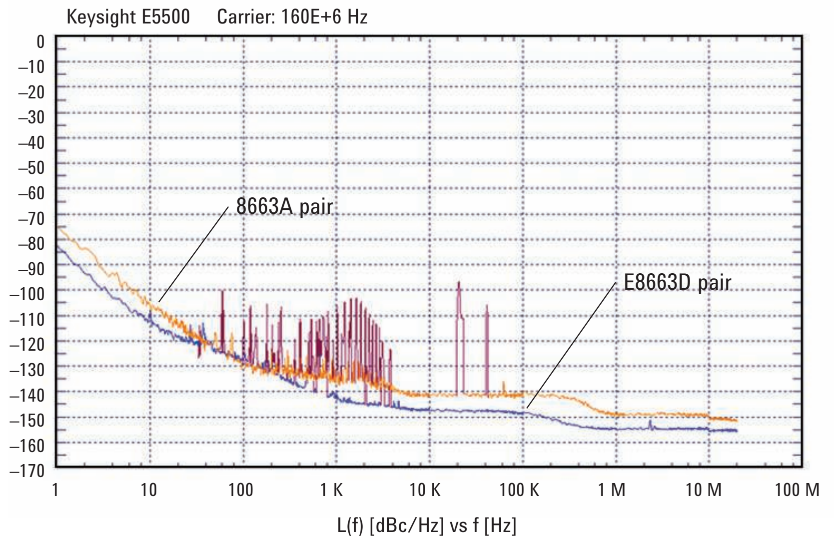

Figure 15. Absolute phase noise comparison for a 160 MHz carrier.

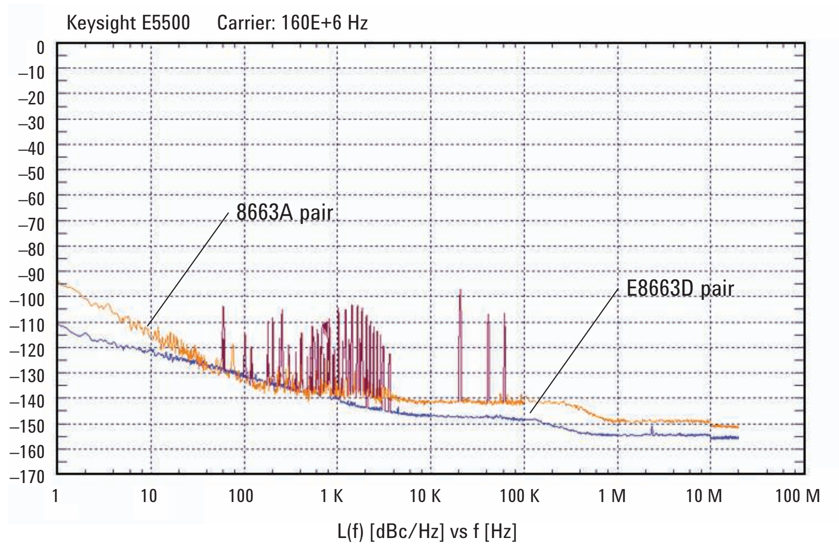

Figure 16. Residual phase noise comparison for a 160 MHz carrier.

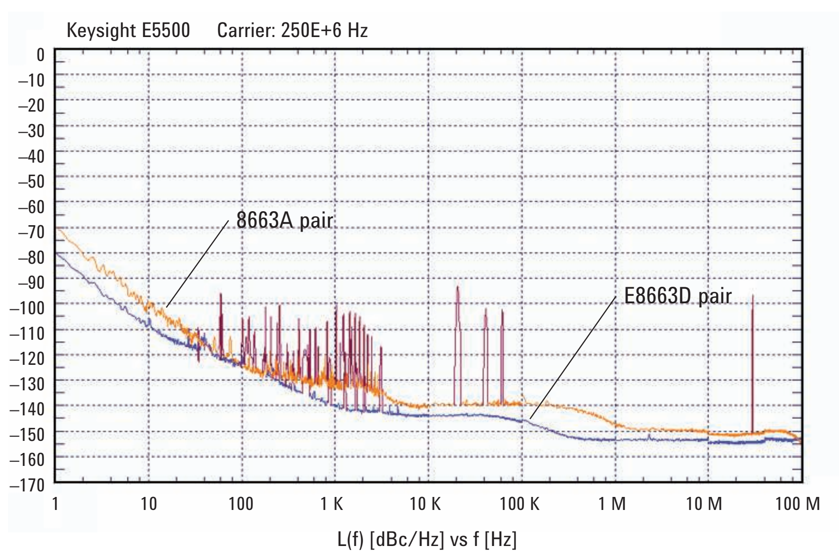

Figure 17. Absolute phase noise comparison for a 250 MHz carrier.

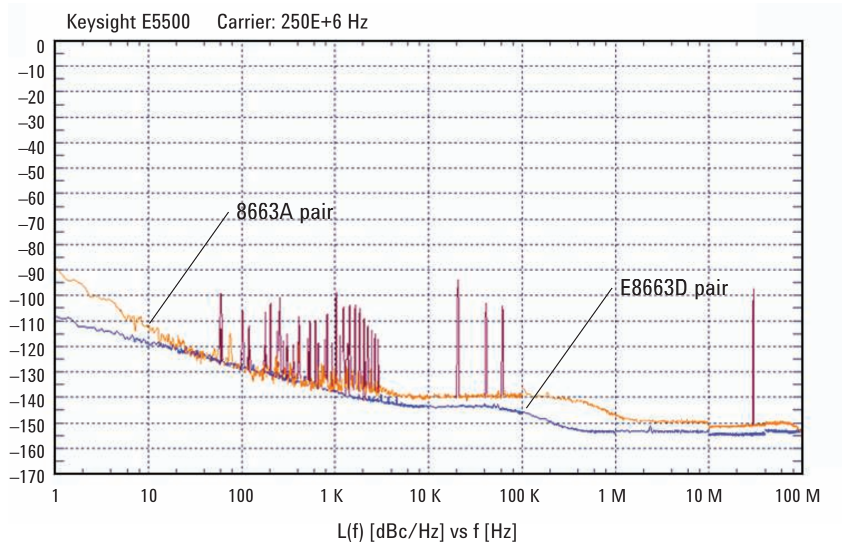

Figure 18. Residual phase noise comparison for a 250 MHz carrier.

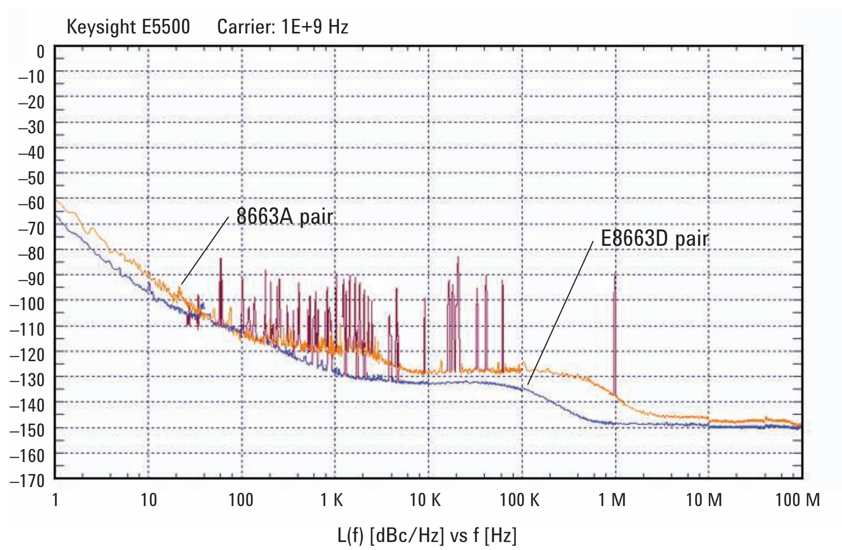

Figure 19. Absolute phase noise comparison for a 1 GHz carrier.

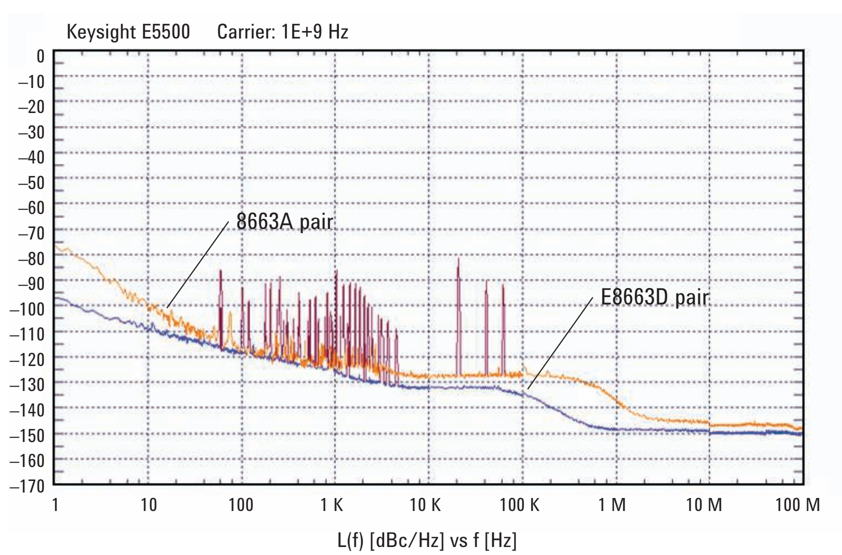

Figure 20. Residual phase noise comparison for a 1 GHz carrier.

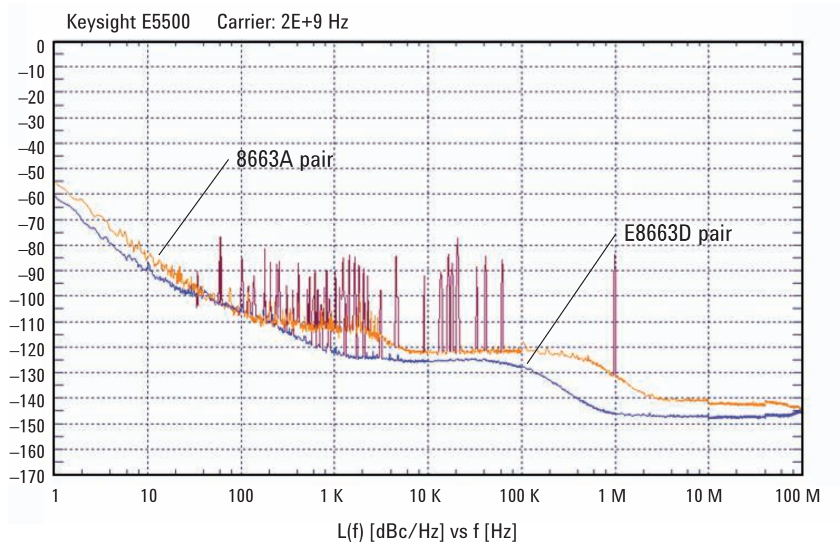

Figure 21. Absolute phase noise comparison for a 2 GHz carrier.

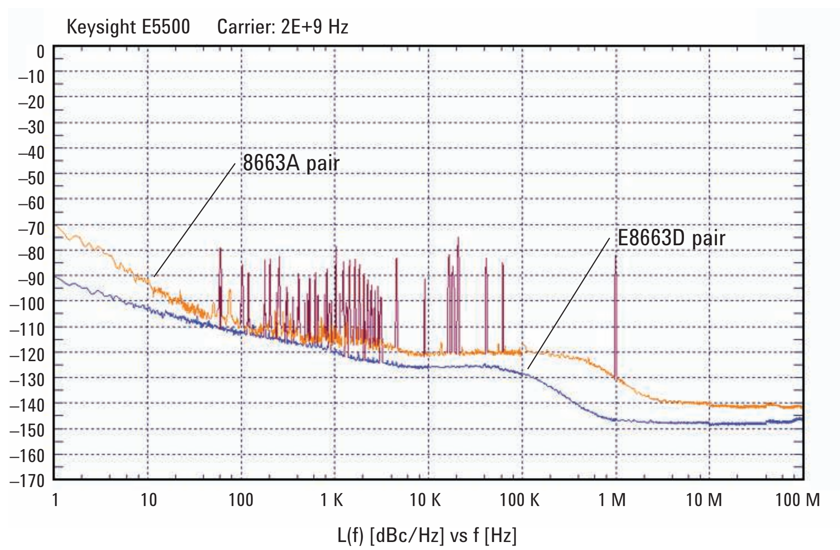

Figure 22. Residual phase noise comparison for a 2 GHz carrier.

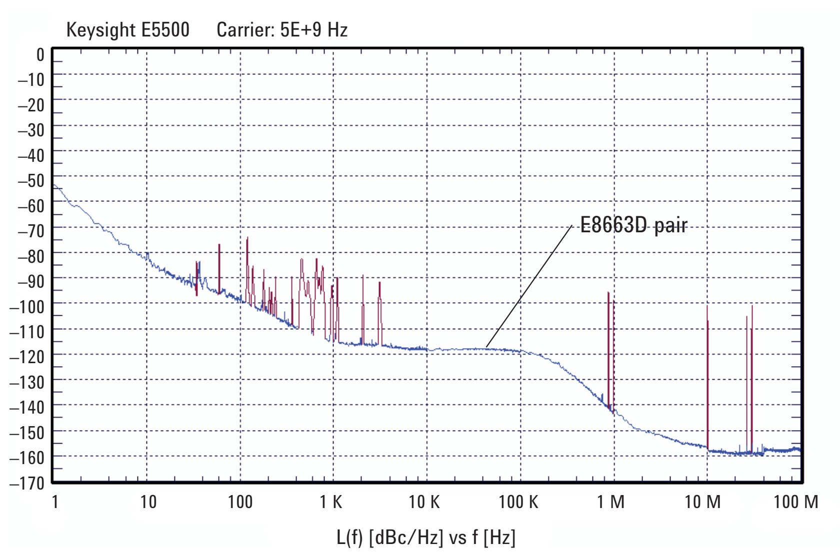

Figure 23. Absolute phase noise comparison for a 5 GHz carrier.

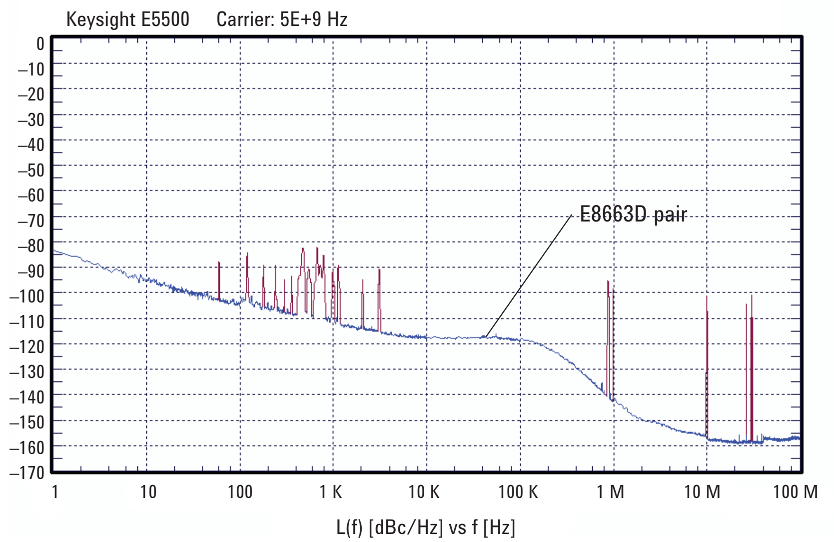

Figure 24. Residual phase noise comparison for a 5 GHz carrier.

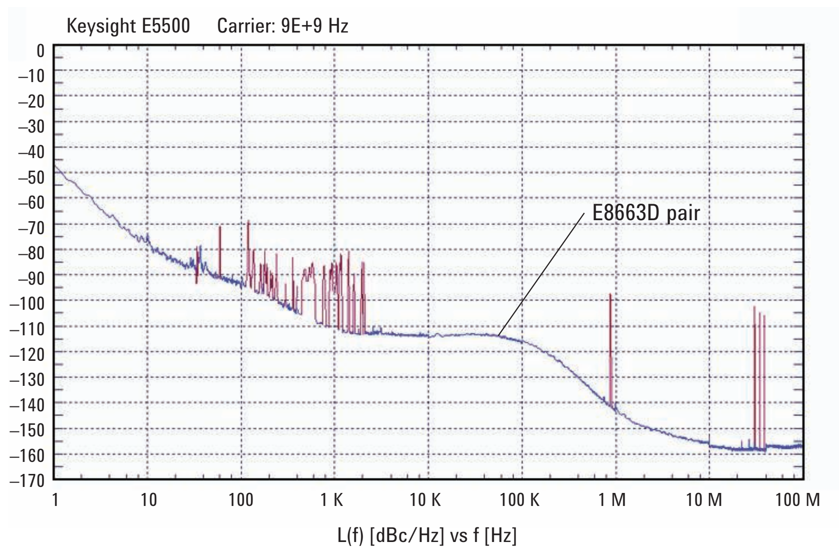

Figure 25. Absolute phase noise comparison for a 9 GHz carrier.

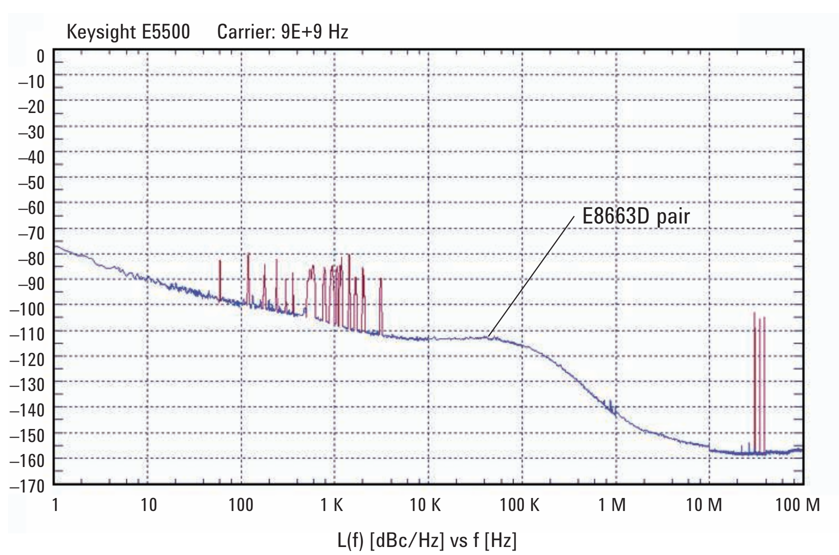

Figure 26. Residual phase noise comparison for a 9 GHz carrier.

Enhanced Usability

The E8663D provides new usability features that increase productivity and utility in your existing and new applications.

LAN connectivity

In addition to the legacy GPIB remote programming interface to support your existing ATE systems, the E8663D also provides the flexibility of LAN and serial (RS232) connectivity for your new or upgraded ATE applications that no longer rely on GPIB
as the method of programming connectivity.

Web-enabled user interface

LAN connectivity also allows you to view and control from your office an E8663D signal generator located in a remote lab. You can activate this Web-enabled graphical user interface from any computer on the same LAN by simply connecting and assigning the E8663D its own IP address.

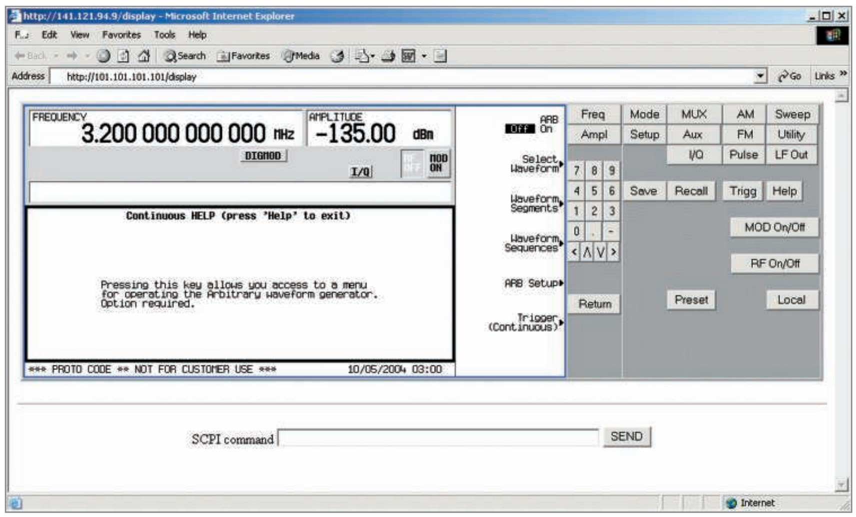

Figure 27. E8663D web-enabled graphical user interface.

Power corrections

Unlike the legacy 8662A/3A, the E8663D can enhance the power accuracy of a signal at the input to a device-under-test (DUT), including cable and connector losses and external amplifier gains. These power corrections use a simple setup with an external GPIB power meter (Figure 28) and can significantly improve the accuracy of your tests.

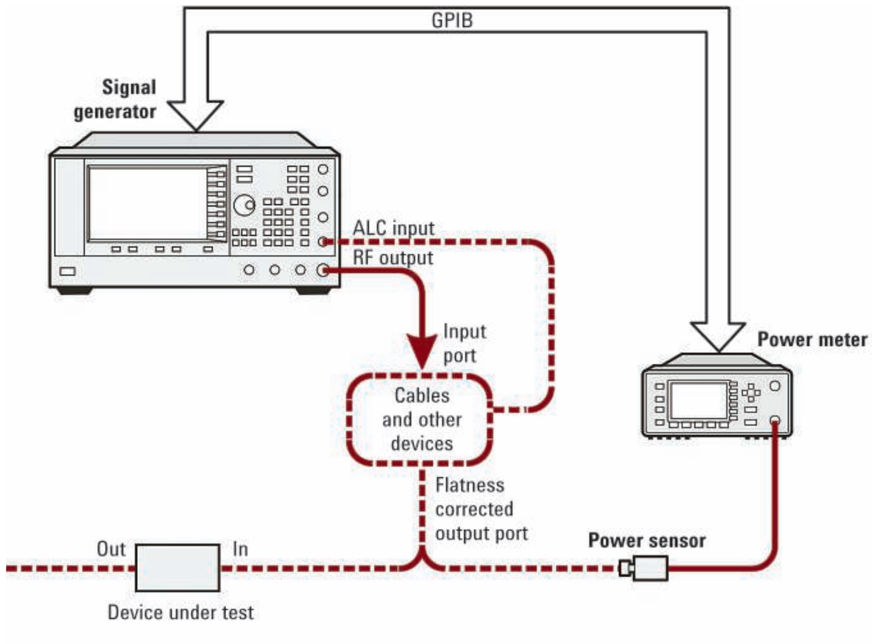

Figure 28. Typical configuration for using the E8663D to correct power at the output of a cable, coupler, or amplifier.

List sweep

In addition to a full digital step sweep capability, you can configure an E8663D with arbitrary frequency and power sweep lists to perform unique sweep configurations. This can increase productivity for your applications in which you currently use an 8662A/3A.

Master/Slave source synchronization

For two-tone intermodulation distortion testing of amplifiers, two 8663As can only provide static CW signals, whereas two E8663Ds can be configured to sweep synchronously with different output frequencies to provide swept two-tone signals with high isolation to a DUT such as an amplifier.

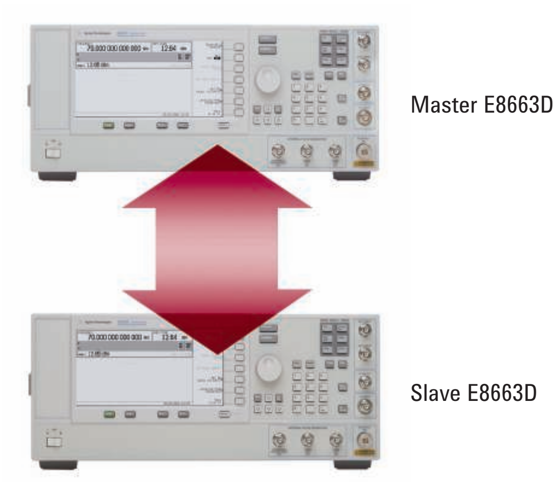

Figure 29. Master/Slave synchronization using the E8663D

Security

The E8663D offers more security features than the 8662A/3A or the E8663B, which allows it to be used in and removed from secure areas. In addition to offering the legacy sanitization of save/recall registers, the E8663D display can be placed in a secure state that blanks out all information and requires an instrument power cycle to restore the display. Option 008 adds an 8 GB removable compact flash memory card accessible through a door on the rear panel. All user-written information is stored in this memory card, which can be removed and stored in a safe location.

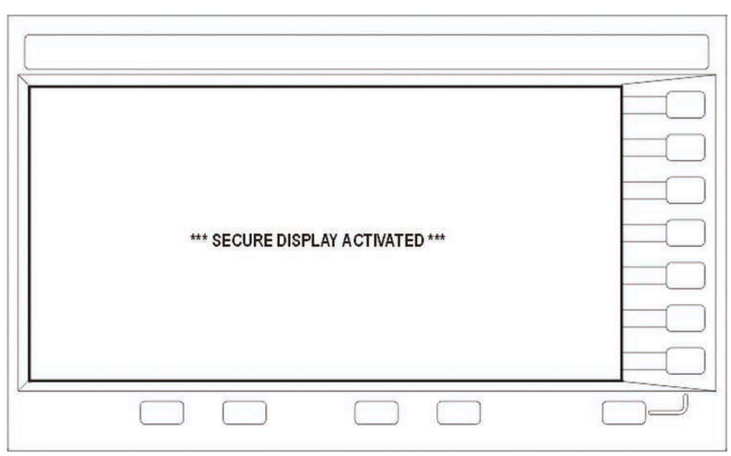

Figure 30. E8663D display in secure state.

Figure 31. Option 008 removable compact flash memory card.

Enhanced Supportability

The E8663D is not only a superb performance replacement for the 8662A/3A signal generators, it also provides excellent programming code compatibility and provides a lower, long term cost of ownership.

Code compatibility

The E8663D is fully code compatible with the 8662A/3A, providing a remote programming emulation mode that allows the E8663D to be identified as and function like the legacy instruments in most remote programming and ATE applications that currently use the 8662A/3A. For example, the standard E8663D – identified remotely as an 8662A/3A – will work within existing Keysight 3048A or E5500 phase noise measurement systems.

Calibration and repair

The 8662A/3A signal generators were discontinued in April 2002 and are now obsolete instruments for which Keysight does not provide guaranteed support services. Moving forward, it will be increasingly more difficult and more expensive to calibrate and repair your existing 8662A/3A signal generators. As a member of the Keysight PSG family, the new E8663D offers a standard 1-year warranty, extendable to 3-years. The recommended calibration cycle is 2 years, with lower calibration and repair costs as compared to the legacy 8662A/3A. In addition, Keysight also offers an optional extended support life for the E8663D.

Appendix: Detailed Specification Comparisons[1]

Frequency

	8662A	8663A	E8663B	E8663D
Frequency				
Range	10 kHz to 1280 MHz	100 kHz to 2560 MHz	100 kHz to 3 or 9 GHz[2]	100 kHz to 3 or 9 GHz[2]
Resolution	0.2 Hz @ 1280 MHz	0.4 Hz @ 2560 MHz	0.001 Hz	0.001 Hz
CW switching speed	~ 9 ms	~ 9 ms	~ 10 ms	< 11 ms
Accuracy	Time base	Time base	Time base	Time base
Stability	< 5 x 10^{-10} /day	< 5 x 10^{-10} /day	< 2.5 x 10^{-10} /day	< 2.5 x 10^{-10}/day
Digital sweep				
No. of points	100 or 1000	100 or 1000	2 to 1601	2 to 1601
Switching speed	~ 500 µs/pt	~ 500 µs/pt	~ 8 ms/pt	< 9 ms/pt
Start-stop	Yes	Yes	Yes	Yes
Center span	Yes	Yes	No	No
Log sweep	Yes	Yes	Yes	Yes
Agile step sweep	No	No	Yes	Yes

Output power

	8662A	8663A	E8663B	E8663D/with Opt. 1EU
Output power				
Range	+13 to –129.9 dBm	+16 to –129.9 dBm	+15 to –135 dBm	+21 to –135 dBm
Resolution	0.1 dB	0.1 dB	0.01 dB	0.01 dB
Level switching time	< 60 ms	< 60 ms	~ 5 ms (~ 30 ms)	< 6 ms (typ)
Level accuracy	< 1 to –120 dBm	< 1 to –120 dBm	0.8 to –90 dBm	0.8 dB to –90 dBm
Flatness (sweep)	< 1.1 dB	< 1.5 dB	~ < 0.1 dB	< 0.1 dB

Amplitude modulation

	8662A	8663A	E8663B	E8663D/with Opt. UNT
Amplitude modulation				
Depth	0 to 95% < 8 dBm	0 to 95% < 10 dBm	0 to 90%	0 to 90%
Resolution	1%	0.1%	0.1%	0.10%
Rate	dc to 10 kHz max	dc to 10 kHz max	dc to 100 kHz	dc to 100 kHz
Accuracy	5% of setting + 1% AM	6% of setting + 1% AM	6% of setting + 1% AM	6% of setting + 1% AM
Distortion	< 5.5%	< 4%	< 2%	< 2%

Pulse modulation

	8662A	8663A	E8663B/with Opt. UNW	E8663D/with Opt. UNW
Pulse modulation				
On/off ratio	N/A	> 80 dB	80 dB	80 dB
Rise/fall times	N/A	< 100 ns (> 640 MHz)	100 ns/10 ns	10 ns (> 400 MHz)
PRF	N/A	99.9 kHz max	500 kHz/10 MHz	500 kHz / 10 MHz

Frequency modulation

	8662A	8663A	E8663B/with Opt. UNT	E8663D/with Opt. UNT
Frequency modulation				
Rate	dc to 100 kHz	dc to 100 kHz	dc to 100 kHz (10 MHz)	dc to 100 kHz (10 MHz)
Deviation	200 kHz max	400 kHz max	1 to 16 MHz max	1 to 16 MHz max
Accuracy	8% + 10 Hz	7% + 10 Hz	~ 3.5% + 20 Hz	3.5% + 20 Hz
Distortion	< 1.7%	< 1.7%	< 1%	< 1%

1. E8663D specifications are subject to change.
2. Performance is unspecified below 250 kHz.

Phase modulation

	8662A	8663A with Opt. 002	E8663B	E8663D/with Opt. UNT
Phase modulation				
Deviation (> 640)	N/A	400 ° (7 rad)	1 to 160 rad	1 to 160 rad max
Rate (> 640 MHz)	N/A	10 MHz max (50 ohm)	dc to 100 kHz (1 MHz)	dc to 100 kHz (1 MHz)
Resolution	N/A	2 to 4 °	0.1% of set deviation	0.1% of set deviation
BPSK				
Deviation	N/A	90 °	N/A	N/A

Internal modulation and pulse generators

	8662A	8663A	E8663B	E8663D/with Opt. UNT and UNW
Internal modulation generator				
Range	10 Hz to 99 kHz	10 Hz to 99 kHz	0.5 Hz to 1 MHz	0.5 Hz to 1 MHz
Resolution	3 digits	3 digits	0.5 Hz	0.5 Hz
Accuracy	Same as time base	Same as time base	Same as time base	Same as time base
Single or dual	Single	Single	Dual	Dual
Internal pulse generator				
PRF	N/A	N/A	14 MHz max	14 MHz max
Resolution	N/A	N/A	10 ns	10 ns

Harmonics, subharmonics and spurious

	8662A	8663A	E8663B/with Opt. HAR	E8663D
Harmonics (dBc)				
fc < 10 MHz	< –30	< –30	< –28	< –25
10 < fc < 1280 MHz	< –30	< –30	< –30/< –55	< –30 / < –55
1.28 GHz < fc < 2 GHz	< –25	< –25	< –30/< –55	< –30 / < –55
2 GHz < fc < max freq	< –25	< –25	< –55	< –55
Subharmonics (dBc)				
fc < 640 MHz	none	none	none	none
640 MHz < fc < 1280 MHz	–70	–70	none	none
1280 MHz < fc < max freq	N/A	–40	none	none
Spurious (dBc)				
fc < 2 GHz	< –84	< –84	< –74 (–82 typ)	< –74 (–82 typ)
2 GHz < fc < 3.2 GHz	N/A	< –78	< –68 (–76 typ)	< –68 (–76 typ)
3.2 GHz < fc < 9.0 GHz	N/A	N/A	< –62 (–70 typ)	< –62 (–70 typ)

Remote programming

	8662A	8663A	E8663B	E8663D
Remote programming				
IEEE 488 (GPIB)	Yes	Yes	Yes	Yes
RS232	No	No	Yes	Yes
LAN	No	No	Yes	Yes
SCPI	No	No	Yes	Yes

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