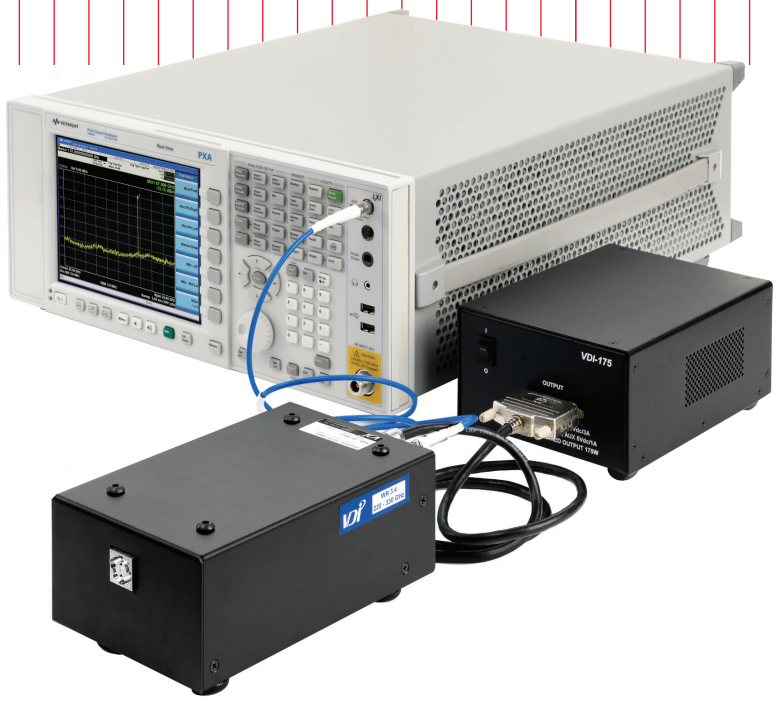
Keysight Technologies

Millimeter Wave Frequency Extenders

From Virginia Diodes Inc. for the
Keysight X-Series Signal Analyzers

Technical Overview



KEYSIGHT TECHNOLOGIES

The Keysight Technologies, Inc. X-series signal analyzers provide outstanding performance across a broad set of characteristics, such as dynamic range, displayed average noise level (DANL), distortion performance, phase noise, and measurement speed for frequencies up to 50 GHz. When paired with a new line of frequency extenders from Virginia Diodes Inc. (VDI), many of these capabilities are available up to 1.1 THz to meet the requirements of both established and emerging millimeter wave applications.

The N9029AVxx signal analyzer frequency extension modules expand the measurement range of microwave signal generators up into the millimeter frequency range. They combine low conversion loss with excellent noise figure to provide the best possible sensitivity for measuring low-level signals.

Figure 1. The N9029AV03 frequency extender covers the WR3.4 band from 220 to 330 GHz.

The N9029AVxx modules can be used in two different operating modes, depending on the type of signals to be measured. In standard mode (see Figure 2), the LO signal comes from the signal analyzer, gets multiplied to a much higher frequency, and is mixed with the incoming millimeter signal entering the module from the waveguide input. The resulting 322.5 MHz IF signal is then routed back into the signal analyzer. A built-in diplexer enables both the LO and IF signals to share the same cable, allowing a single coaxial cable to provide the connection between the signal analyzer and the N9029AVxx frequency extender.

In this mode, the signal identification and image suppression features of the Keysight X-series signal analyzers can be used to correctly identify the actual RF frequency and remove spurious signals. Amplitude readings on the signal analyzer can be corrected with the conversion loss table, which is stored on a USB memory stick included with each N9029AVxx module so that it can be easily downloaded into the signal analyzer's memory.

The standard mode is useful for general spectrum analysis and works best with stable CW or narrowband signals.

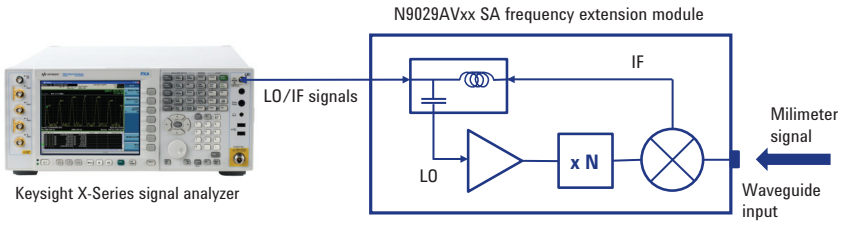


Figure 2. N9029AVxx signal analyzer frequency extension module operating in standard mode.

The N9029AVxx module can also be used as a wideband downconverter (see Figure 3). In this mode, a separate signal generator is used to provide a fixed LO signal, and a block of RF signals (both the upper and lower sidebands) are downconverted to IF and fed into the signal analyzer RF input. This configuration provides an IF bandwidth of up to 20 GHz.

Block downconversion, in which spectral information is preserved, is very useful for signals that drift or for wideband communication signals. Like the standard mode, conversion loss can be applied to determine RF power. Spurious mixing products can be identified by varying the signal generator frequency slightly to determine the mixing order.

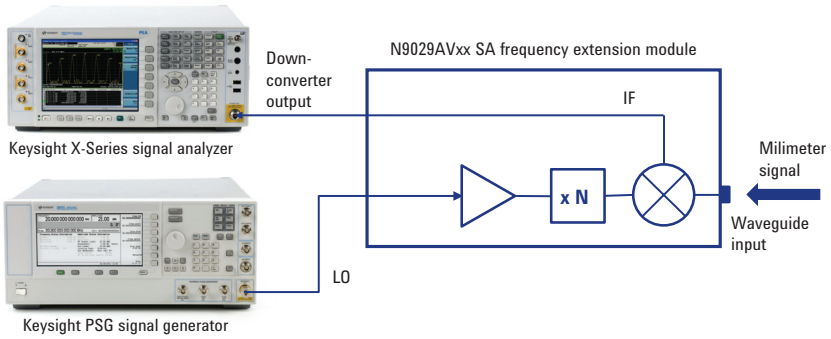


Figure 3. N9029AVxx signal analyzer frequency extension module operating in downconverter mode.

Power supply requirements

Each N9029AVxx frequency extension module requires an N5262VDI-175 external power supply.

Figure 4. The power supply is connected to the frequency extension module with the included DC power cable.

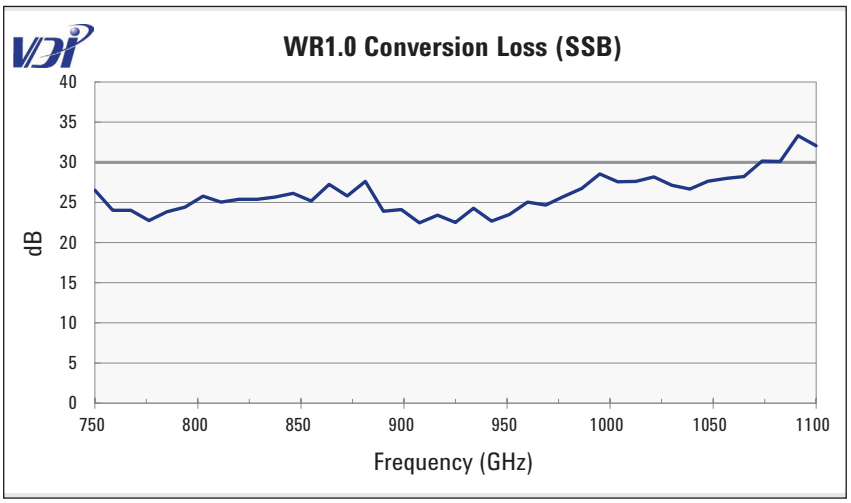


Figure 5. Measured intrinsic mixer conversion loss for the N9029AV01 (750 GHz to 1.1 THz) frequency extension module.

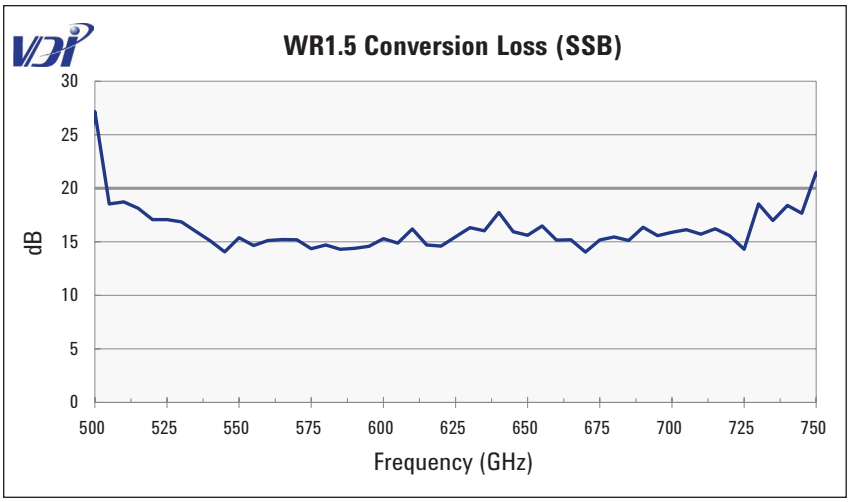


Figure 6. Measured intrinsic mixer conversion loss for the N9029AV1B (500 to 750 GHz) frequency extension module.

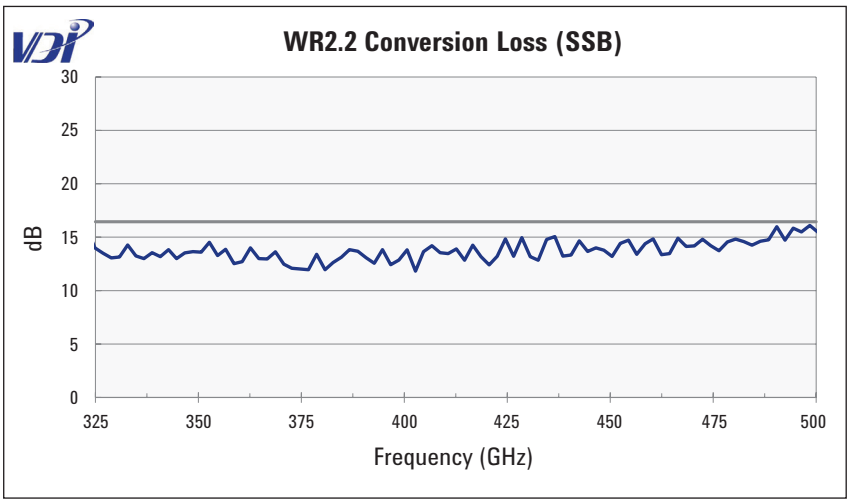


Figure 7. Measured intrinsic mixer conversion loss for the N9029AV02 (325 to 500 GHz) frequency extension module.

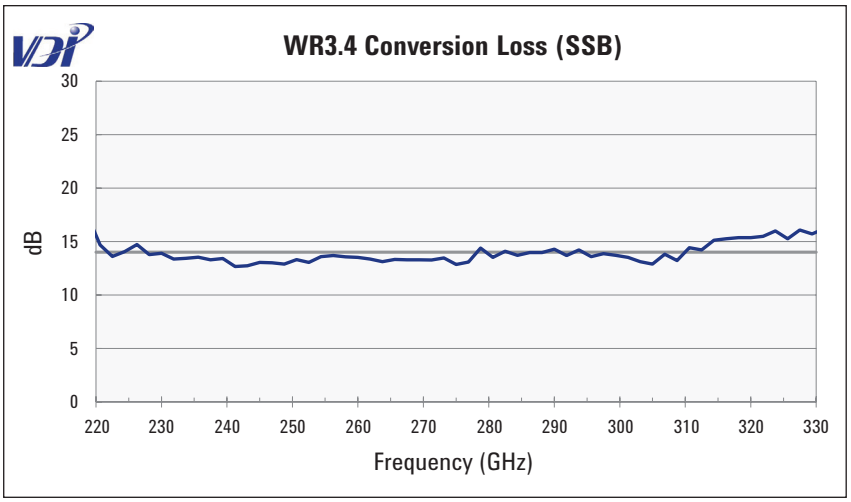


Figure 8. Measured intrinsic mixer conversion loss for the N9029AV03 (220 to 330 GHz) frequency extension module.

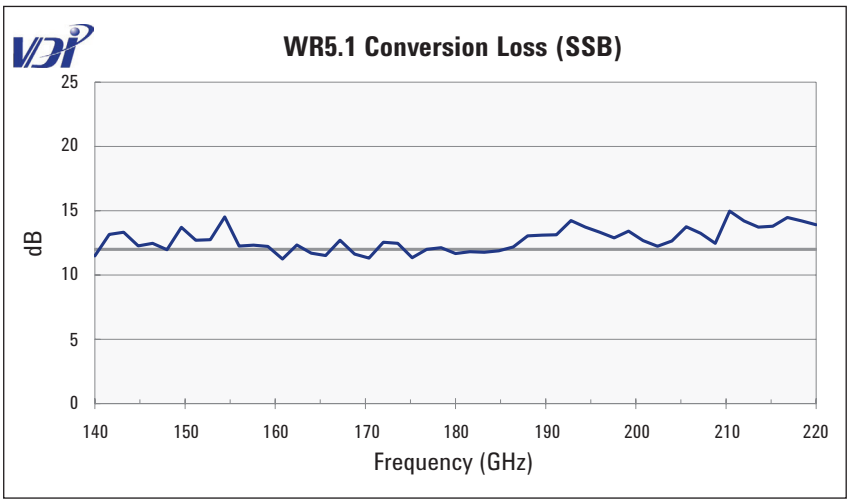


Figure 9. Measured intrinsic mixer conversion loss for the N9029AV05 (140 to 220 GHz) frequency extension module.

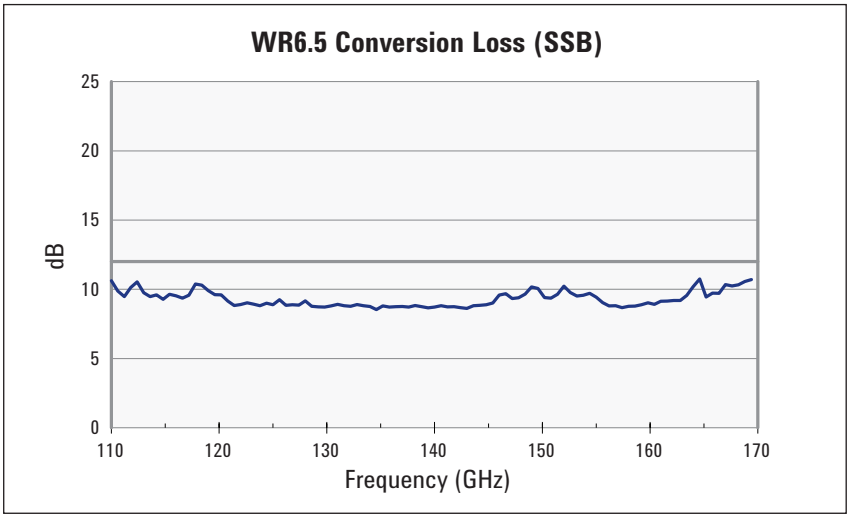


Figure 10. Measured intrinsic mixer conversion loss for the N9029AV06 (110 to 170 GHz) frequency extension module.

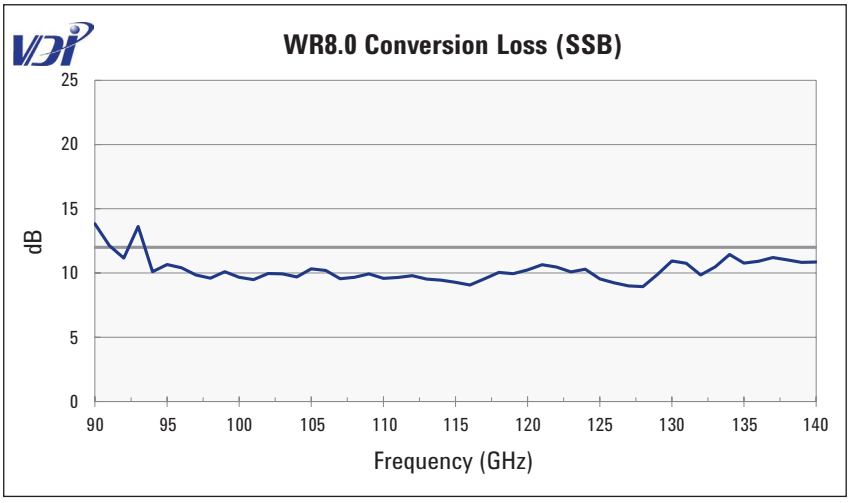


Figure 11. Measured intrinsic mixer conversion loss for the N9029AV08 (90 to 140 GHz) frequency extension module.

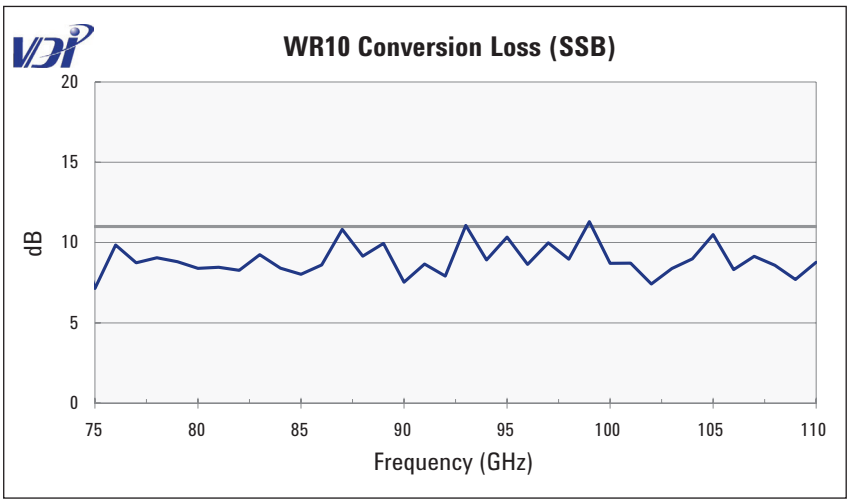


Figure 12. Measured intrinsic mixer conversion loss for the N9029AV10 (75 to 110 GHz) frequency extension module.

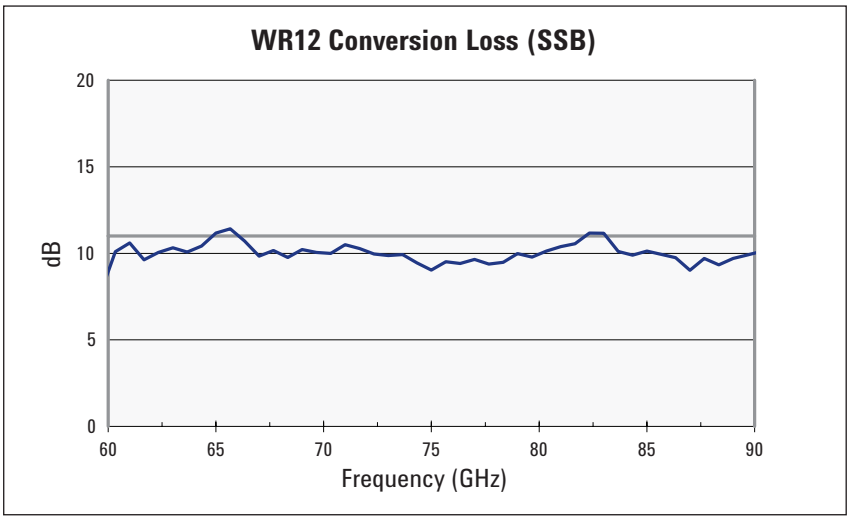


Figure 13. Measured intrinsic mixer conversion loss for the N9029AV12 (60 to 90 GHz) frequency extension.

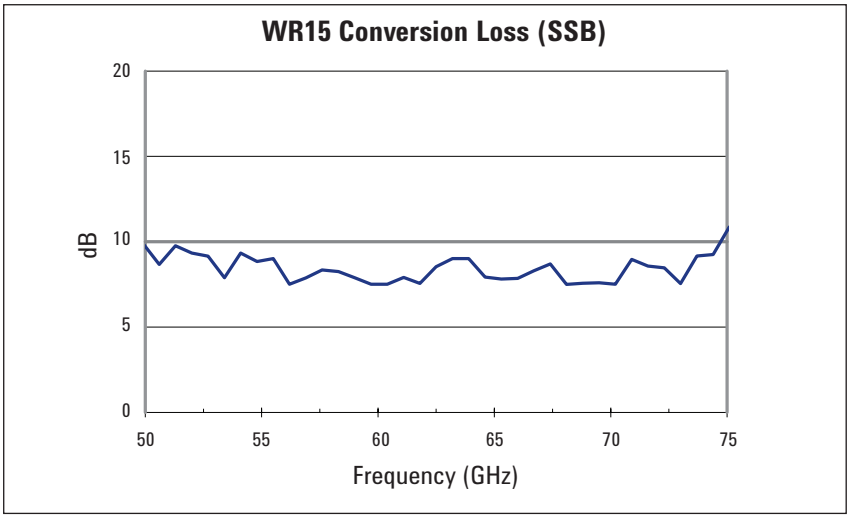


Figure 14. Measured intrinsic mixer conversion loss for the N9029AV15 (50-75 GHz) frequency extension module.

Table 1. Characteristics

Waveguide band	Frequency range (GHz)	LO input mode	Multiplication factors	LO input frequencies (GHz)	Intrinsic mixer conversion loss (dB) (Not including IF amplifier)	RF power limits: compression/ damage (dBm)	Displayed average noise level (dBc/Hz)
WR1.0	750 – 1,100	Standard	108	6.9 – 10.2	30	–20/–10	–125
		High	36	20.8 – 30.6			
WR1.5	500 – 750	Standard	54	9.3 – 13.9	20	–20/–10	–135
		High	18	27.8 – 41.7			
WR2.2	325 – 500	Standard	36	9.0 – 13.9	17	–20/–10	–145
		High	12	27.1 – 41.7			
WR3.4	220 – 330	Standard	24	9.2 – 13.8	14	–20/–10	–145
		High	12	18.3 – 27.5			
WR5.1	140 – 220	Standard	18	7.8 – 12.2	12	–10/0	–150
		High	6	23.3 – 36.7			
WR6.5	110 – 170	Standard	24	4.6 – 7.1	12	–10/0	–150
		High	6	18.3 – 28.3			
WR8.0	90 – 140	Standard	12	7.5 – 11.7	12	–10/0	–150
		High	4	22.5 – 35.0			
WR10	75 – 110	Standard	12	6.3 – 9.2	11	–10/0	–150
		High	6	12.5 – 18.3			
WR12	60 – 90	Standard	12	5.0 – 7.5	11	–10/0	–150
		High	6	10.0 – 15.0			
WR15	50 – 75	Standard	6	8.3 – 12.5	9	–10/0	–150

Table 2. Specifications

Description		Specification	Connector
LO input level	Standard frequency	7 to 13 dBm	2.92 mm (f)
	High frequency	–3 to 3 dBm	2.92 mm (f)
IF output frequency	Standard frequency	16 kHz to 2.5 GHz	2.92 mm (f)
	High frequency	16 kHz to 20 GHz	2.92 mm (f)
RF input type	VDI precision flange		UG-387/UM
AC input for N5162VDI-175 power supply		100-240 VAC, 3.5A 50-60 Hz	NEMA 5-15P (U.S. & Canada)

Table 3. Ordering information

Keysight model number	VDI part number	Frequency range (GHz)	Description
N9029AV01	WR1.0SAX	750 – 1,100	WR1.0 signal frequency extender
N9029AV1B	WR1.5SAX	500 – 750	WR1.5 signal analyzer frequency extender
N9029AV02	WR2.2SAX	325 – 500	WR2.2 signal analyzer frequency extender
N9029AV03	WR3.4SAX	220 – 330	WR3.4 signal analyzer frequency extender
N9029AV05	WR5.1SAX	140 – 220	WR5.1 signal analyzer frequency extender
N9029AV06	WR6.5SAX	110 – 170	WR6.5 signal analyzer frequency extender
N9029AV08	WR8.0SAX	90 – 140	WR8.0 signal analyzer frequency extender
N9029AV10	WR10SAX	75 – 110	WR10 signal analyzer frequency extender
N9029AV12	WR12SAX	60 – 90	WR12 signal analyzer frequency extender
N9029AV15	WR15SAX	50 – 75	WR15 signal analyzer frequency extender
Option N5262VDI-175	VDI-175	N/A	"Power supply for N9029AVxx SA extender (required for extender operation)"

Accessories included with each N9029AVxx SA frequency extender:

2.92 mm (m) to 2.92 mm (m) coaxial cable, 1.2m length
USB memory stick with documentation and calibration data

Accessories included with each N5262VDI-175 power supply:

DC cable for connection to the N9029AVxx frequency extender

Related Web Resources

For more information visit:
www.keysight.com/find/SA_mmwave
www.keysight.com/find/PXA
www.keysight.com/find/EXA

For more information on VDI's signal analyzer frequency extenders, visit:
www.vadiodes.com

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