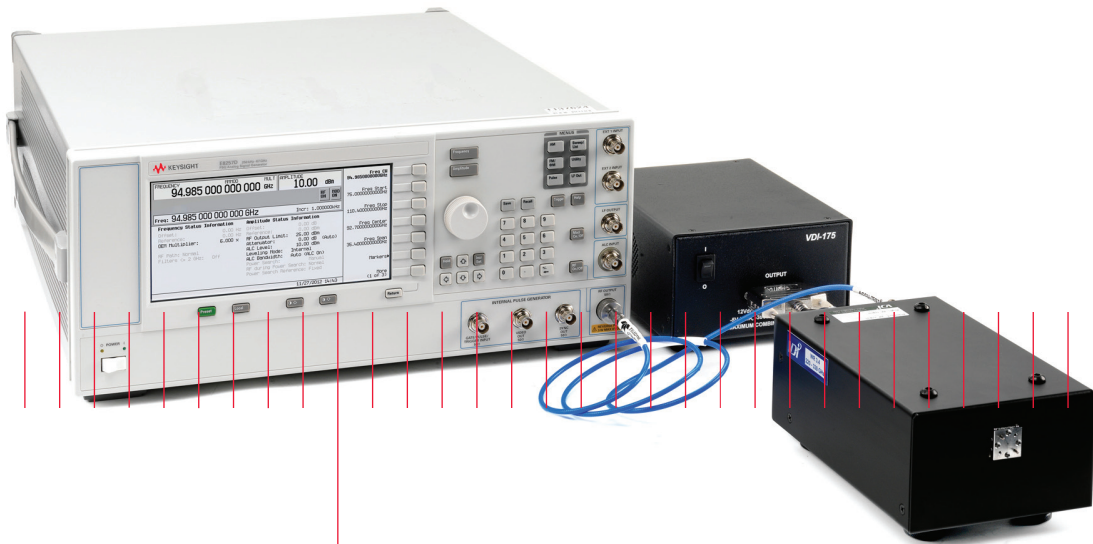


# Keysight Technologies

## Millimeter Wave Frequency Extenders From Virginia Diodes Inc. for the Keysight PSG Signal Generators

### Technical Overview



The Keysight Technologies, Inc. PSG-series signal generators provide outstanding performance across a broad set of characteristics, including output power, phase noise, spurious and harmonic distortion, as well as flexible modulation for frequencies up to 67 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 E8257DVxx signal generator frequency extension modules expand the operating range of microwave signal generators up into the millimeter frequency range. They combine high output power and low phase noise with broad frequency coverage over full waveguide bands. Standard features include TTL-controlled on/off modulation up to approximately 1 kHz and voltage-controlled RF attenuation (UCA). The RF signal from the signal generator gets multiplied in the module to a much higher frequency and the resulting millimeter signal exits through the rectangular waveguide output. A single coaxial cable provides the connection between the signal generator and the E8257DVxx module.



Figure 1. This E8257DV03 frequency extender covers the WR3.4 band from 220 to 330 GHz.

The E8257DVxx modules provide two different RF inputs, depending on the frequency range of the signal generator. The standard RF input is designed for 20 GHz signal generators (see Figure 2), while the high-frequency RF input is optimized for a 40 or 50 GHz signal generator, depending on the waveguide band. The high frequency input bypasses the first multiplication block (i.e. a doubler or tripler) resulting in a cleaner output spectrum.

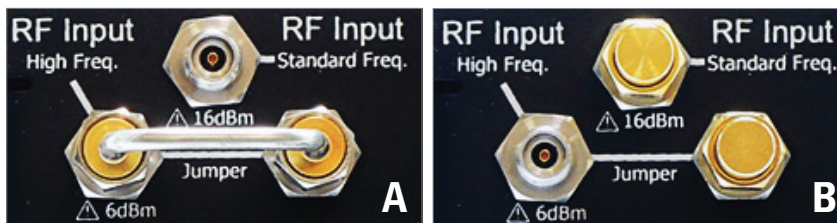


Figure 2. The standard frequency [A] and high frequency [B] RF input modes are shown above. The coaxial jumper connection must be used when using standard frequency operation. With the jumper removed, only the high frequency RF input port is operational.

## The effects of multiplication on modulated signals

Multiplication works very well for both CW and pulsed signals. Note, however, that the pulse rise and fall times may be altered somewhat compared to the original microwave pulse. The millimeter pulse may sometimes have sharper rise/fall times than the original non-multiplied pulse, particularly if the original pulse had relatively slow rise/fall times.

Millimeter source modules typically provide a fixed amount of output power, since the amplifiers operate in saturated mode. FM and phase modulation are impacted by the frequency extension modules in that the frequency or phase deviation will be multiplied along with the carrier frequency. Using a WR10 band (75 to 110 GHz) module with X6 multiplication in standard mode as an example, an FM modulated microwave signal with 10 MHz max deviation will be multiplied up to 60 MHz deviation at the waveguide output.

Because millimeter frequency extension modules are inherently non-linear devices, they are not suitable for AM modulation or any type of digital modulation that involves amplitude changes, such as QAM, because of the severe clipping that affects signal amplitude.

Through careful design, the unwanted harmonics of the input are typically suppressed by 20 dB or more compared to the desired output.

## Power supply requirements

Each E8257DVxx frequency extension module requires an N5262VDI-175 external power supply.



Figure 3. The power supply is connected to the frequency extension module with the included DC power cable.

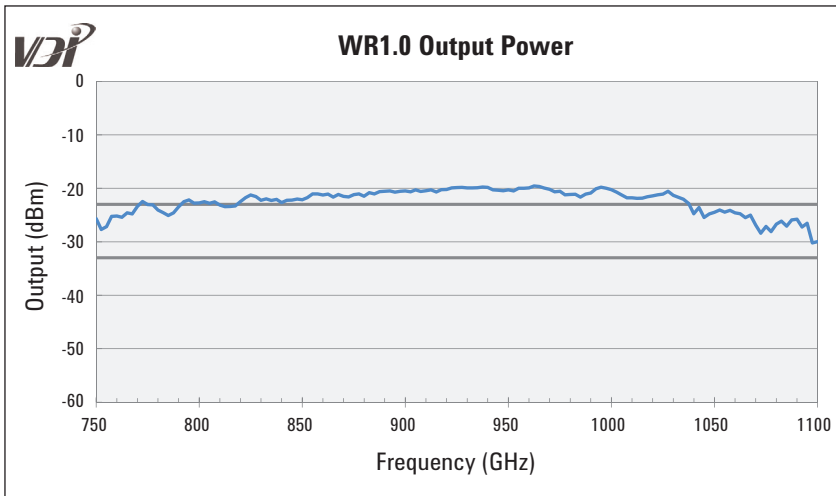


Figure 4. Measured output power for the E8257DV01 (750 GHz to 1.1 THz) frequency extension module.

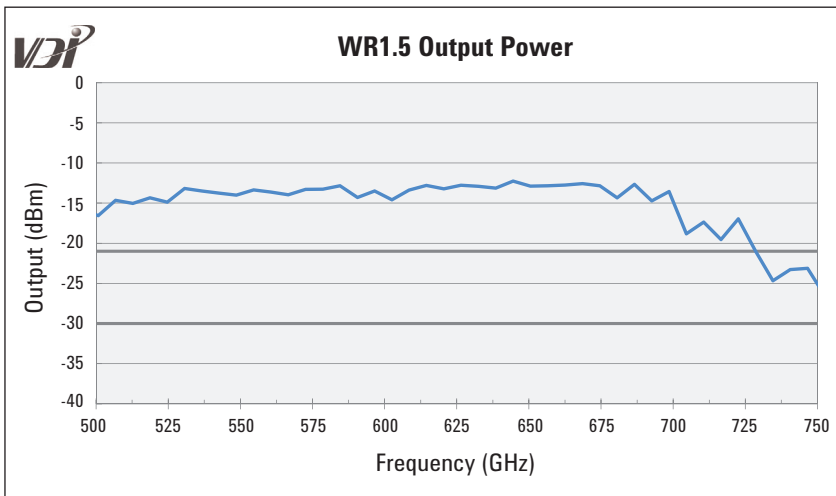


Figure 5. Measured output power for the E8257DV1B (500 to 750 GHz) frequency extension module.

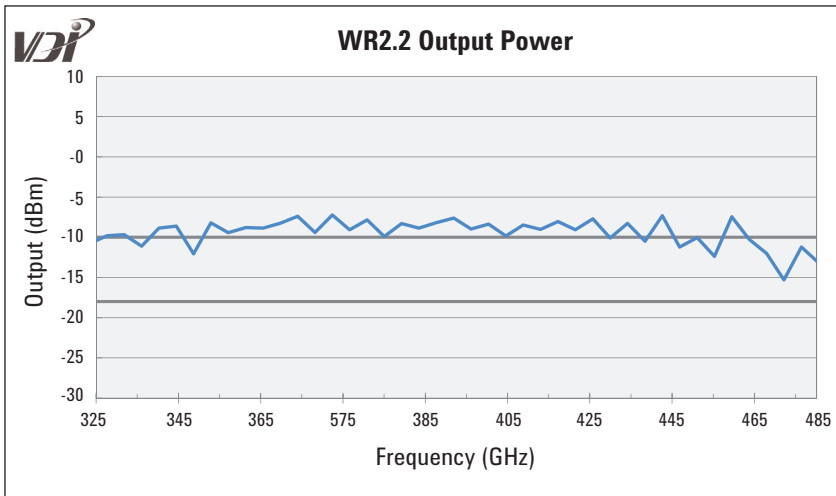


Figure 6. Measured output power for the E8257DV02 (325 to 500 GHz) frequency extension module.

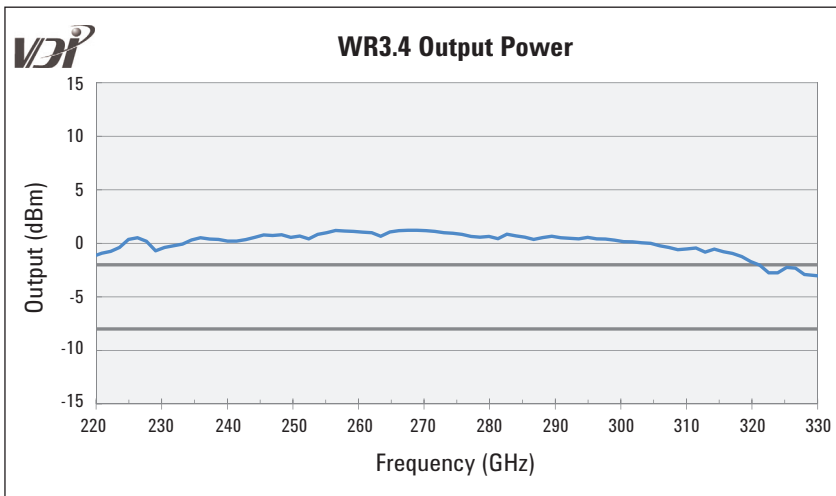


Figure 7. Measured output power for the E8257DV03 (220 to 330 GHz) frequency extension module.

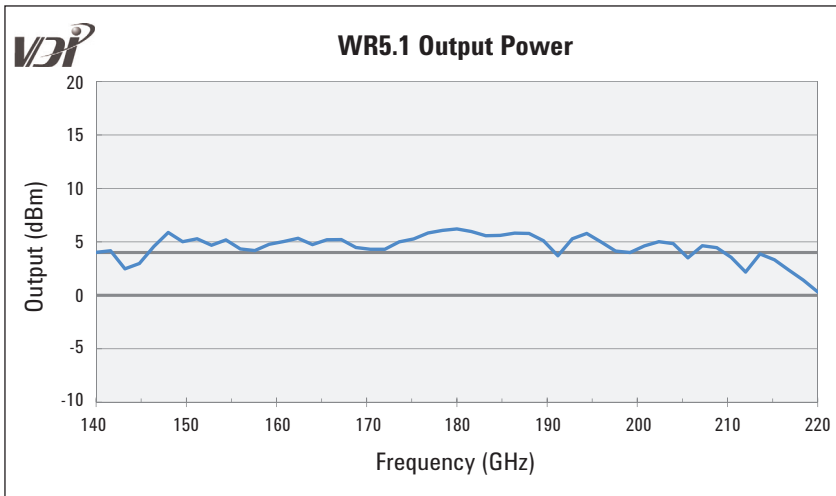


Figure 8. Measured output power for the E8257DV05 (140 to 220 GHz) frequency extension module.

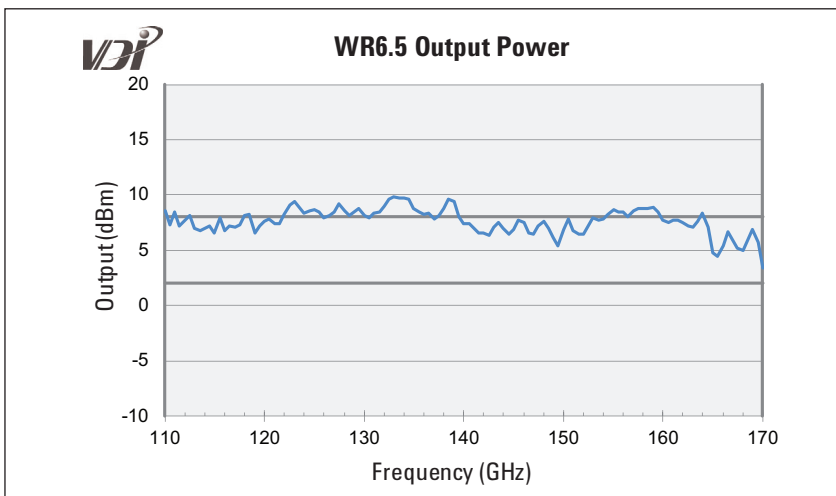


Figure 9. Measured output power for the E8257DV06 (110 to 170 GHz) frequency extension module.

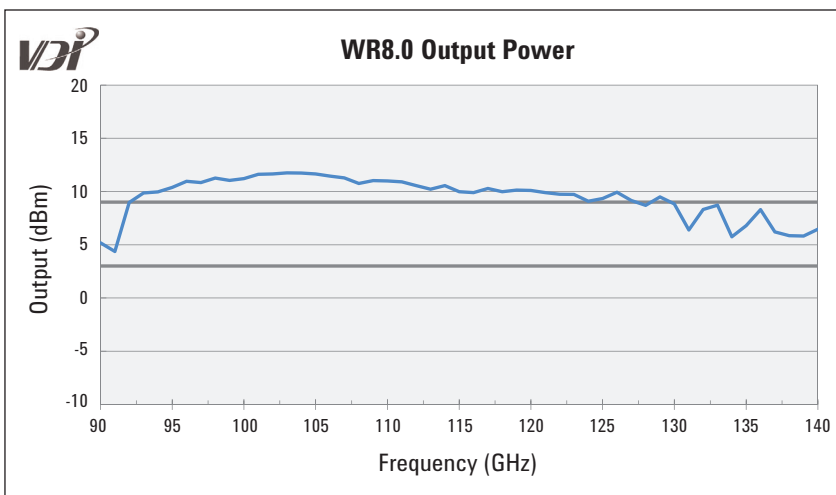


Figure 10. Measured output power for the E8257DV08 (90 to 140 GHz) frequency extension module.

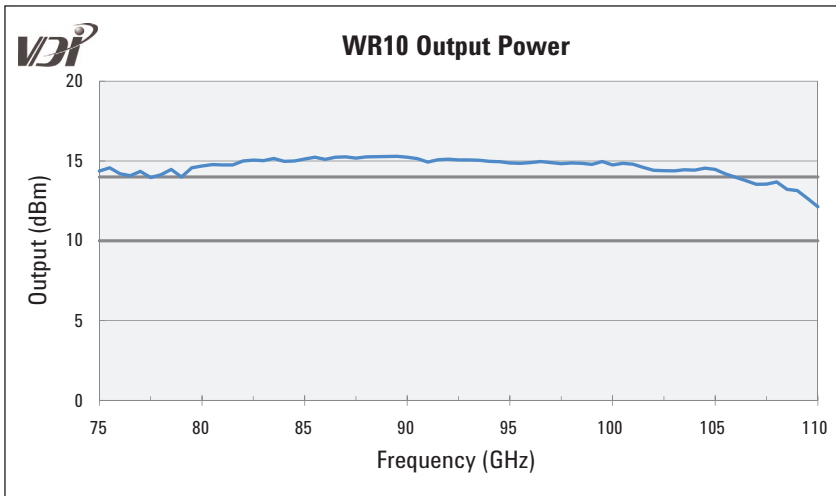


Figure 11. Measured output power for the E8257DV10 (75 to 110 GHz) frequency extension module.

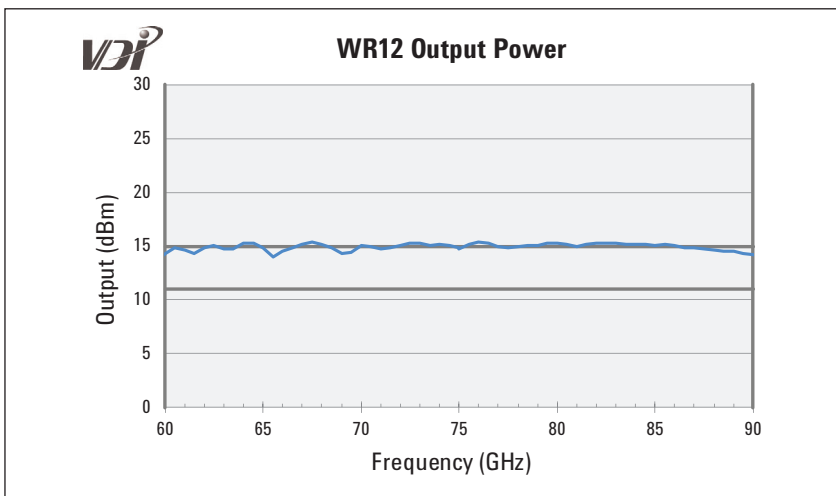


Figure 12. Measured output power for the E8257DV12 (60 to 90 GHz) frequency extension module.

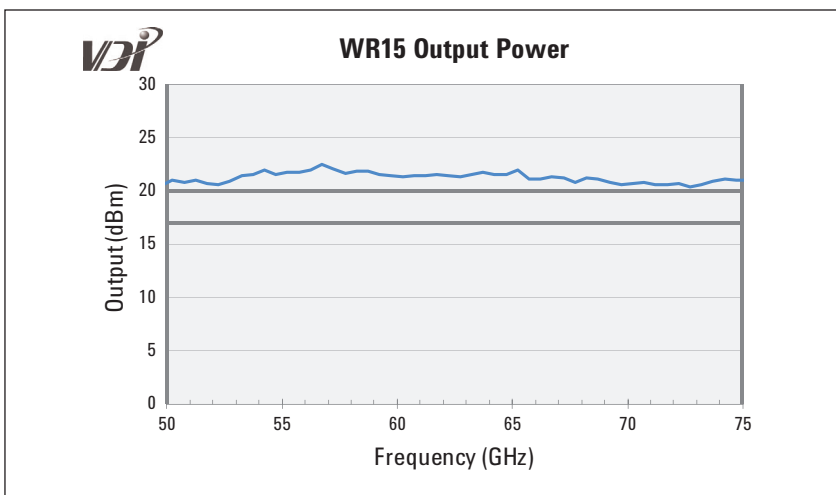


Figure 13. Measured output power for the E8257DV15 (50 to 75 GHz) frequency extension module.

Table 1. Characteristics

Waveguide band	Frequency range (GHz)	RF input mode	Multiplication factors	RF input frequencies (GHz)	Output power (dBm)	
					Typical	Minimum
WR1.0	750 – 1,100	Standard	81	9.3 – 13.6	–23	–33
		High	27	27.8 – 40.7		
WR1.5	500 – 750	Standard	54	9.3 – 13.9	–21	–30
		High	18	27.8 – 41.7		
WR2.2	325 – 500	Standard	36	9.0 – 13.9	–10	–18
		High	12	27.1 – 41.7		
WR3.4	220 – 330	Standard	18	12.2 – 18.3	–2	–8
		High	9	24.4 – 36.7		
WR5.1	140 – 220	Standard	12	11.7 – 18.3	4	0
		High	6	23.3 – 36.7		
WR6.5	110 – 170	Standard	12	9.2 – 14.2	8	2
		High	4	27.5 – 42.5		
WR8.0	90 – 140	Standard	9	10 – 15.6	9	3
		High	3	30 – 46.7		
WR10	75 – 110	Standard	6	12.5 – 18.3	14	10
		High	3	25.0 – 36.7		
WR12	60 – 90	Standard	6	10.0 – 15.0	15	11
		High	3	20.0 – 30.0		
WR15	50 – 75	Standard	4	12.5 – 18.8	20	17
		High	2	25.0 – 37.5		

Table 2. Specifications

Description	Specification	Connector
RF input level	Standard frequency	7 to 13 dBm
	High frequency	–3 to 3 dBm
RF output type	VDI precision flange	UG-387/UM
Amplitude modulation	TTL/AM input	0 – 5 V, up to ~1 kHz
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
E8257DV01	WR1.0SGX	750 – 1,100	WR1.0 signal generator frequency extender
E8257DV1B	WR1.5SGX	500 – 750	WR1.5 signal generator frequency extender
E8257DV02	WR2.2SGX	325 – 500	WR2.2 signal generator frequency extender
E8257DV03	WR3.4SGX	220 – 330	WR3.4 signal generator frequency extender
E8257DV05	WR5.1SGX	140 – 220	WR5.1 signal generator frequency extender
E8257DV06	WR6.5SGX	110 – 170	WR6.5 signal generator frequency extender
E8257DV08	WR8.0SGX	90 – 140	WR8.0 signal generator frequency extender
E8257DV10	WR10SGX	75 – 110	WR10 signal generator frequency extender
E8257DV12	WR12SGX	60 – 90	WR12 signal generator frequency extender
E8257DV15	WR15SGX	50 – 75	WR15 signal generator frequency extender
Option N5262VDI-175	VDI-175	N/A	Power supply for E8257DVxx SG extender (required for extender operation)



## Accessories included with each E8257DVxx SG frequency extender:

2.92 mm<sub>(m)</sub> to 2.92 mm<sub>(m)</sub> coaxial cable, 1.2 m length  
3.5 mm<sub>(f)</sub> to 3.5 mm<sub>(f)</sub> adaptor  
USB memory stick with documentation and calibration data

## Accessories included with each N5262VDI-175 power supply:

DC cable for connection to the E8257DVxx frequency extender

## Related web resources

For more information visit:  
[www.keysight.com/find/SS\\_mmwave](http://www.keysight.com/find/SS_mmwave)  
[www.keysight.com/find/PSG](http://www.keysight.com/find/PSG)

For more information on VDI's signal generator frequency extenders, visit:  
[www.vadiodes.com](http://www.vadiodes.com)

Virginia Diodes Inc. contact info:

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