

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

The Keysight Technologies, Inc. microwave 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.

If amplitude modulation (AM) or digital modulation is a requirement, the N9029AVxx frequency extender with Option UDC can perform this function. Please refer to the “Millimeter Wave Frequency Extenders From Virginia Diodes Inc. - Technical Overview”, literature number 5991-3161EN.

Power supply requirements

Each E8257DVxx frequency extension module comes standard with an external 9 V DC power supply.



Figure 3. The power supply is connected to the frequency extension module.

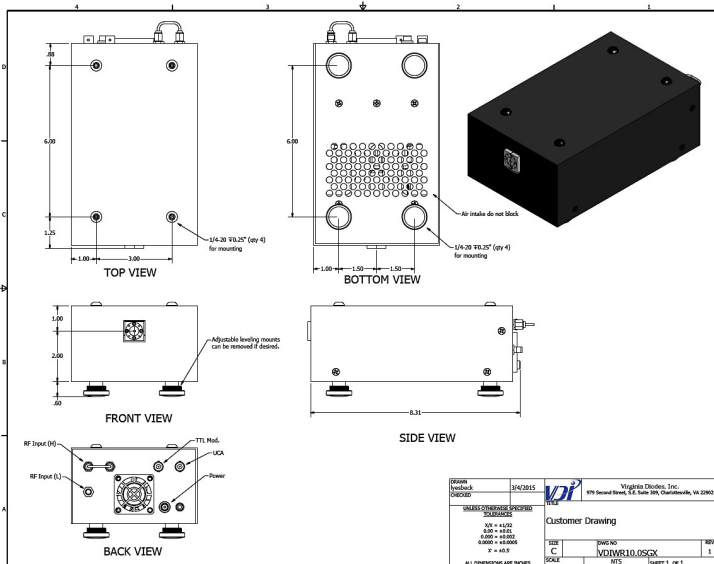


Figure 4. Outline drawing of VDI mm-wave extender.

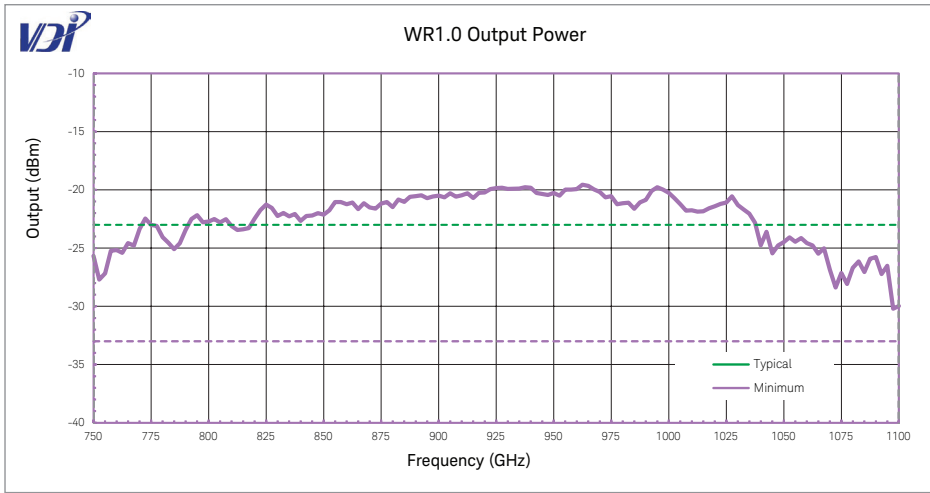


Figure 5. Measured output power for the E8257DV01 (750 GHz to 1.1 THz) frequency extension module.

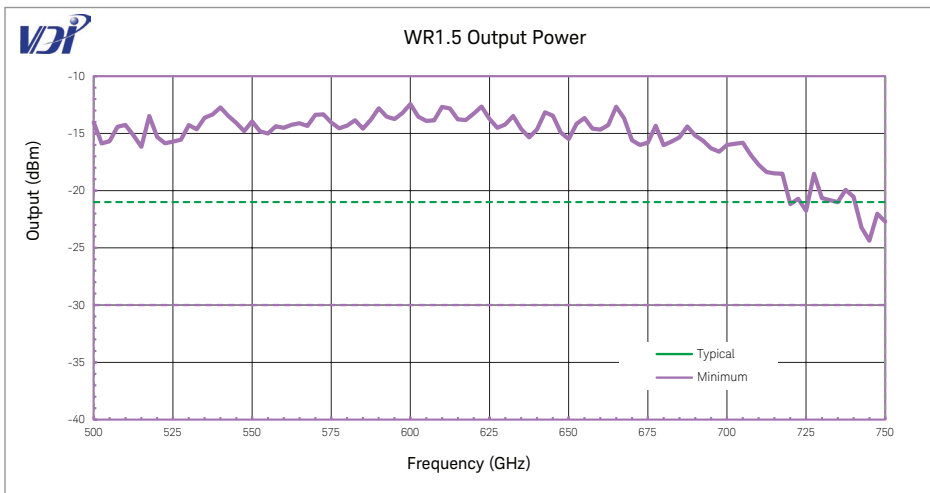


Figure 6. Measured output power for the E8257DV1B (500 to 750 GHz) frequency extension module.

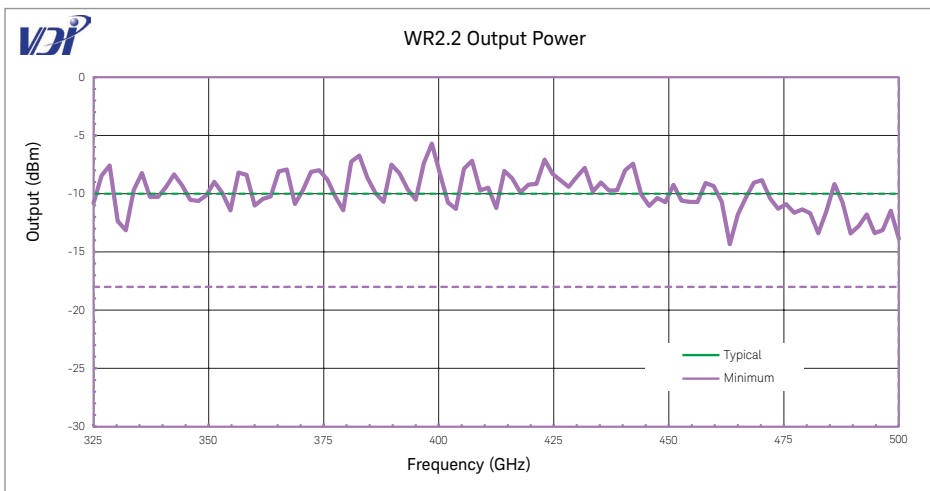


Figure 7. Measured output power for the E8257DV02 (325 to 500 GHz) frequency extension module.

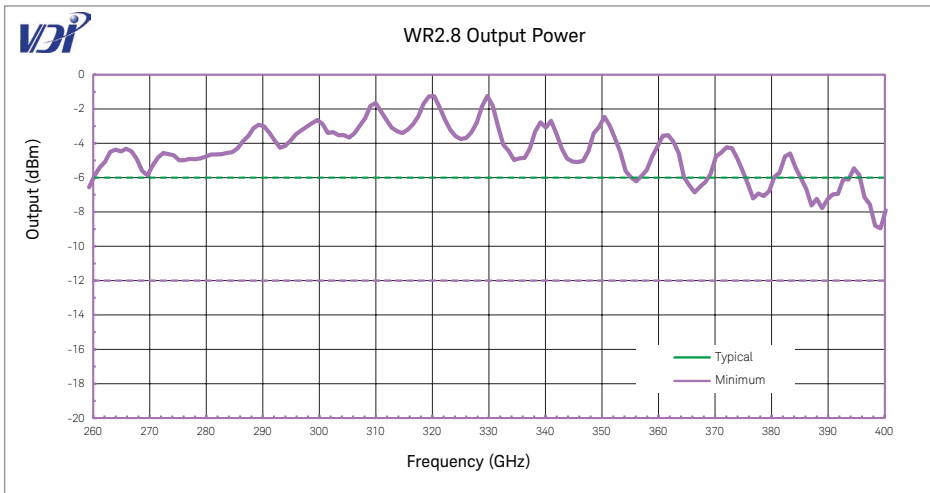


Figure 8. Measured output power for the E8257DV2B (260 to 400 GHz) frequency extension module.

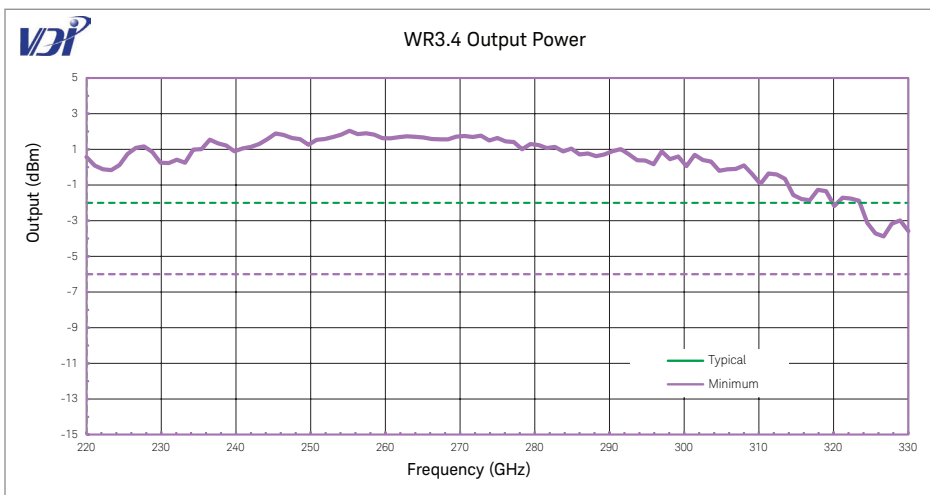


Figure 9. Measured output power for the E8257DV03 (220 to 330 GHz) frequency extension module.

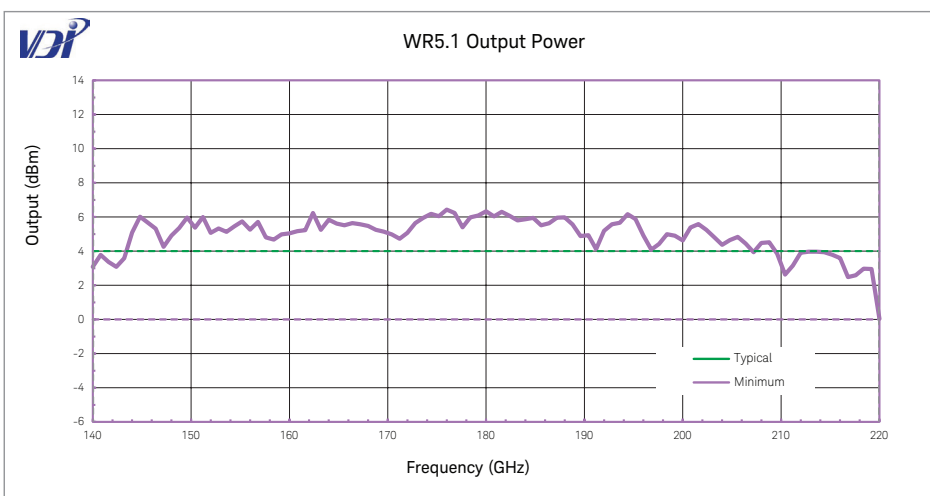


Figure 10. Measured output power for the E8257DV05 (140 to 220 GHz) frequency extension module.

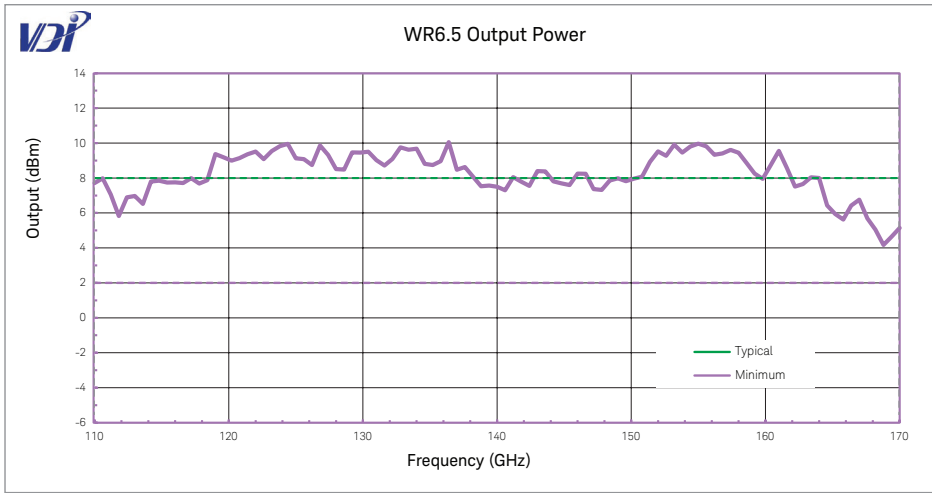


Figure 11. Measured output power for the E8257DV06 (110 to 170 GHz) frequency extension module.

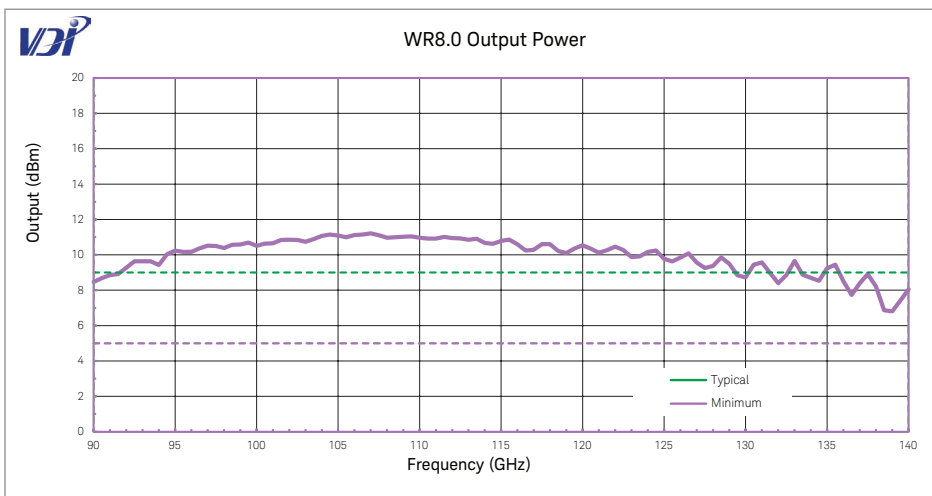


Figure 12. Measured output power for the E8257DV08 (90 to 140 GHz) frequency extension module.

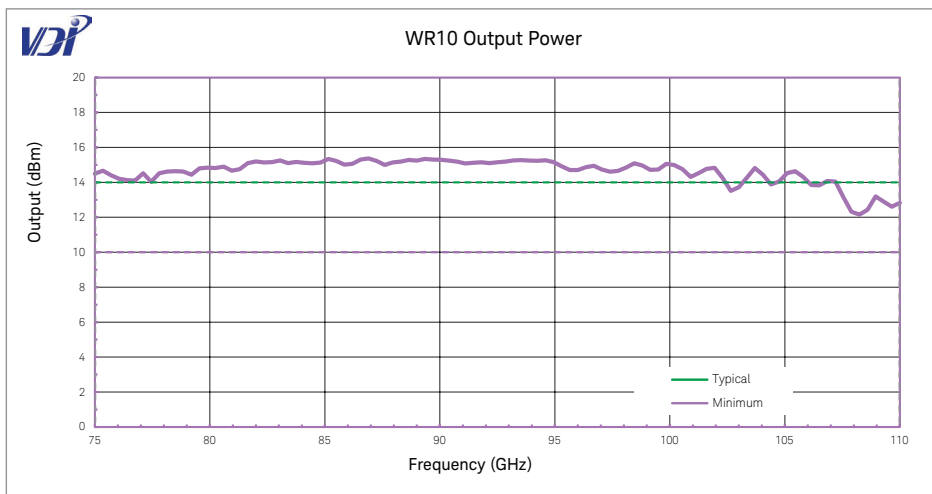


Figure 13. Measured output power for the E8257DV10 (75 to 110 GHz) frequency extension module.

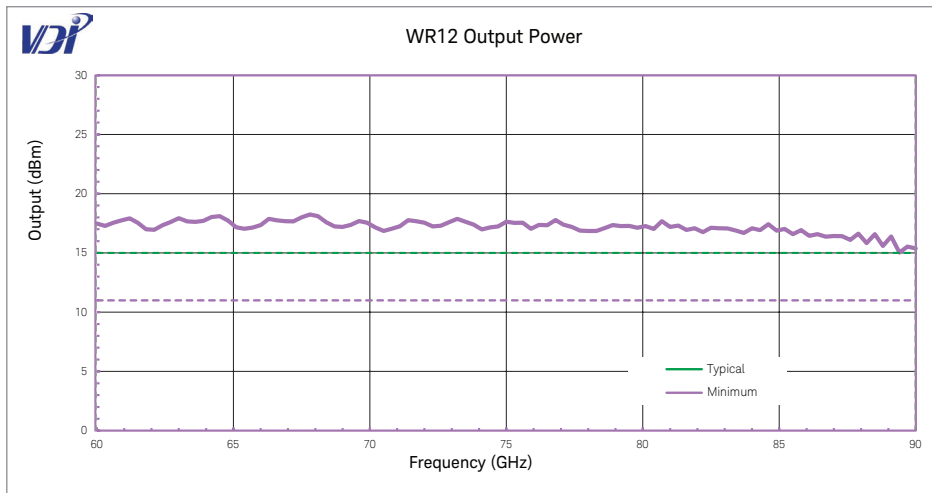


Figure 14. Measured output power for the E8257DV12 (60 to 90 GHz) frequency extension module.

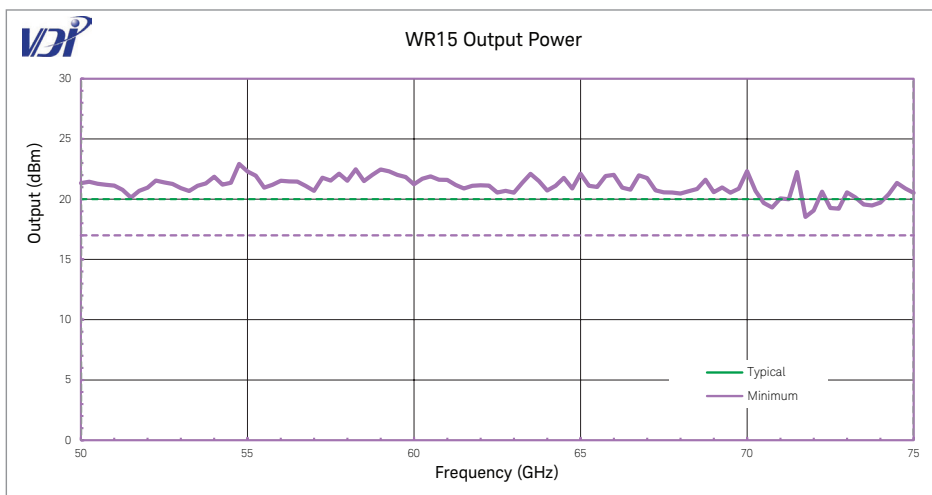


Figure 15. Measured output power for the E8257DV15 (50 to 75 GHz) frequency extension module.

Table 1. Characteristics

Waveguide band	Frequency range (GHz)	RF input mode	Multiplication factors	RF input frequencies (GHz)	Output power (dBm)	
					Typical	Specification
WR1.0	750 to 1,100	Standard	81	9.3 to 13.6	-23	-33
		High	27	27.8 to 40.7		
WR1.5	500 to 750	Standard	54	9.3 to 13.9	-21	-27
		High	18	27.8 to 41.7		
WR2.2	325 to 500	Standard	48	6.8 to 10.4	-10	-16
		High	12	27.1 to 41.7		
WR2.8	260 to 400	Standard	24	10.8 to 16.7	-6	-12
		High	12	21.7 to 33.3		
WR3.4	220 to 330	Standard	18	12.2 to 18.3	-2	-6
		High	9	24.4 to 36.7		
WR5.1	140 to 220	Standard	12	11.7 to 18.3	4	0
		High	6	23.3 to 36.7		
WR6.5	110 to 170	Standard	12	9.2 to 14.2	8	3
		High	4	27.5 to 42.5		
WR8.0	90 to 140	Standard	9	10 to 15.6	9	6
		High	3	30 to 46.7		
WR10	75 to 110	Standard	6	12.5 to 18.3	14	10
		High	3	25.0 to 36.7		
WR12	60 to 90	Standard	6	10.0 to 15.0	16	13
		High	3	20.0 to 30.0		
WR15	50 to 75	Standard	4	12.5 to 18.8	20	17
		High	2	25.0 to 37.5		

Table 2. Specifications

Description		Specification	Connector
RF input level	Standard frequency	7 to 13 dBm	2.92 mm (f)
	High frequency	-3 to 3 dBm	2.4 mm (f)
RF output type	VDI precision flange		UG-387/UM
Amplitude modulation	TTL/AM input	0 to 5 V, up to ~1 kHz	BNC (f)
AC input for power supply		100 to 240 VAC, 3.5A	NEMA 5-15P (U.S. and Canada)
		50 to 60 Hz	

Table 3. Ordering information

Keysight model number	VDI part number	Frequency range (GHz)	Description
E8257DV01	WR1.0SGX	750 to 1,100	WR1.0 signal generator frequency extender
E8257DV1B	WR1.5SGX	500 to 750	WR1.5 signal generator frequency extender
E8257DV02 ¹	WR2.2SGX	325 to 500	WR2.2 signal generator frequency extender
E8257DV2B ¹	WR2.8SGX	260 to 400	WR2.8 signal generator frequency extender
E8257DV03 ¹	WR3.4SGX	220 to 330	WR3.4 signal generator frequency extender
E8257DV05 ¹	WR5.1SGX	140 to 220	WR5.1 signal generator frequency extender
E8257DV06 ¹	WR6.5SGX	110 to 170	WR6.5 signal generator frequency extender
E8257DV08 ¹	WR8.0SGX	90 to 140	WR8.0 signal generator frequency extender
E8257DV10 ¹	WR10SGX	75 to 110	WR10 signal generator frequency extender
E8257DV12 ¹	WR12SGX	60 to 90	WR12 signal generator frequency extender
E8257DV15 ¹	WR15SGX	50 to 75	WR15 signal generator frequency extender

1. Option A30 available; 0 to 30 dB variable mechanical attenuator as shown in Figure 16.

Options and accessories

Option A30 Variable mechanical attenuators (0 to 30 dB) are available on most millimeter wave frequency extenders and noted in Table 3.

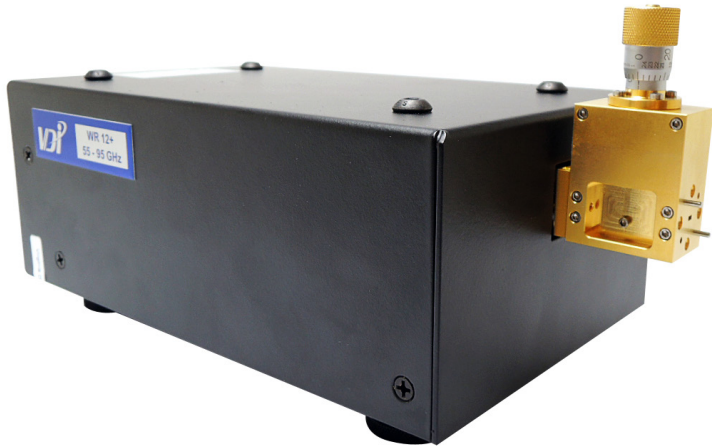


Figure 16. VDI signal generator frequency extender with Option A30 variable mechanical attenuator.

Table 4. Horn antennas options

These rectangular pyramidal horn antennas have a typical midband gain of 24 dBi.

Model number	Frequency range (GHz)
N9029AH15	50 to 75 GHz
N9029AH12	60 to 90 GHz
N9029AH10	75 to 110 GHz
N9029AH08	90 to 140 GHz
N9029AH05	140 to 220 GHz



Figure 17. Waveguide horn antenna.

Accessories included with each E8257DVxx signal generator frequency extender:

- 2.92 mm_(m) to 2.92 mm_(m) coaxial cable, 1.2 m length
- 3.5 mm_(f) to 3.5 mm_(f) adaptor
- USB memory stick with documentation and calibration data
- 9 volt DC power supply

Related web resources

For more information visit:

- www.keysight.com/find/SG_mmwave
- www.keysight.com/find/PSG
- www.keysight.com/find/SA_mmwave
- www.keysight.com/find/MXG
- www.keysight.com/find/EXG

For more information on VDI's signal generator frequency extenders, visit:

www.vadiodes.com

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