



Signal Generator Extension Modules Operational Manual



979 Second Street SE, Suite 309
Charlottesville, VA 22902-6172 (USA)
Tel: 434.297.3257; Fax: 434.297.3258
www.vadiodes.com

Contents

Section 1 – Introduction	Pages 2-4
Contents	Page 2
SGX General Overview	Page 3
Safety and Operational Guidelines	Page 4
Section 2 – Product Views, Block Diagrams and Specifications	Pages 5-8
Major Components and Accessories	Page 5
Module Details – Front and Rear Panel Connections	Page 6
SGX Configurations	Page 7
General Specifications and Technical Notes	Page 8
Section 3 – Operational Procedures	Page 9
General Operating Procedures	Page 9
Appendix 1 – SGX Test Port Power	Pages 10-17
Test Port Power for WR15 and WR12 (High Power)	Page 10
Test Port Power for WR12 and WR10	Page 11
Test Port Power for WR9.0 and WR8.0	Page 12
Test Port Power for WR6.5 and WR5.1	Page 13
Test Port Power for WR4.3 and WR3.4	Page 14
Test Port Power for WR2.8 and WR2.2	Page 15
Test Port Power for WR1.5 and WR1.0	Page 16
Test Port Power for WR0.65	Page 17
User Controlled Attenuation (UCA) Performance	Page 18
Appendix 2 – Cable Loss Characterization	Page 19
Cable Loss Characterization Data	Page 19
Appendix 3 – SGX Module Drawings	Pages 20
Mechanical Drawing – All SGX Modules with Bias Ports	Page 20
Addendum – Product Updates and Company Contacts	Page 21

SGX General Overview

Signal Generator Extension Modules

Virginia Diodes' Signal Generator Extension (SGX) modules are used to extend the performance of microwave signal generators in the frequency range from 50 GHz through 1.1 THz, in frequency bands from WR15 (50-75 GHz) to WR0.65 (1,100-1,500 GHz). These modules offer high test port power with full waveguide band coverage. Standard features include direct extension include TTL controlled ON/OFF modulation up to ~ kHz and voltage controlled RF attenuation. Additional options include and accessories are available. Options include: RF cables, external micrometer driven variable RF output attenuators, increased amplitude modulation rates (with an added PIN switch), test port extensions, and horn antennas for free-space coupling.




SGX Modules vs. AMC Modules


Some SGX Modules were previously marketed by VDI as AMCs (Amplifier / Multiplier Chains). The term SGX now refers to the full waveguide band standard modules described in this document. The AMC nomenclature is now designated for VDI products that are signal generator extension modules customized for specific customer applications.




Front and Rear Views of SGX Extension Modules

Safety and Operational Guidelines

 Read all instructions and information in this product manual before connecting a module to its power supply or a signal generator. Operational procedures must be followed for proper function. If you have questions, contact VDI before supplying power to or otherwise operating any VDI module.

 VDI assumes the customer is familiar with microwave, millimeter wave and VDI products in general. The user and customer are expected to understand all safety guidelines, health hazards and general advisories that may exist and are associated with the use of this device. VDI is not responsible for any human hazards that may exist or may occur while using this device.

RF Drive Limitations

 Recommended RF input power specifications are noted on the label on the top of every VDI module. See examples on Page 8; these values provide optimal performance. Irreversible damage can result if input power exceeds stated damage threshold.

Virginia Diodes, Inc. (VDI) accepts no liability for damage or injury resulting from or caused by:

- Improper use, disassembly or use for purposes other than those for which the module was designed;
- Use outside common safety, health or general advisories pertaining to microwave, millimeter wave and VDI products;
- Repairs carried out by persons other than VDI or its assigned agents;
- Tampering with or altering power cords or other cabling.

Waveguide Inspection / Test Port Care

- Inspect waveguide flanges prior to making connections.
- Extension module waveguide screws should be torqued in the range 20-50 cNm, greater torque can damage the interface.
- Making a connection with metal debris between the waveguide flanges can damage the waveguide interface and prevent repeatable connections.
- If debris is present, clean the flange with pre-dampened TexWipe wipes or swabs (e.g. Part Number TX1065).
- If these are not available, TexWipe cloths lightly dampened with ethanol may be used (e.g. Part Number TX604).
- Replace dust caps when the system is idle.

RF Cable Care

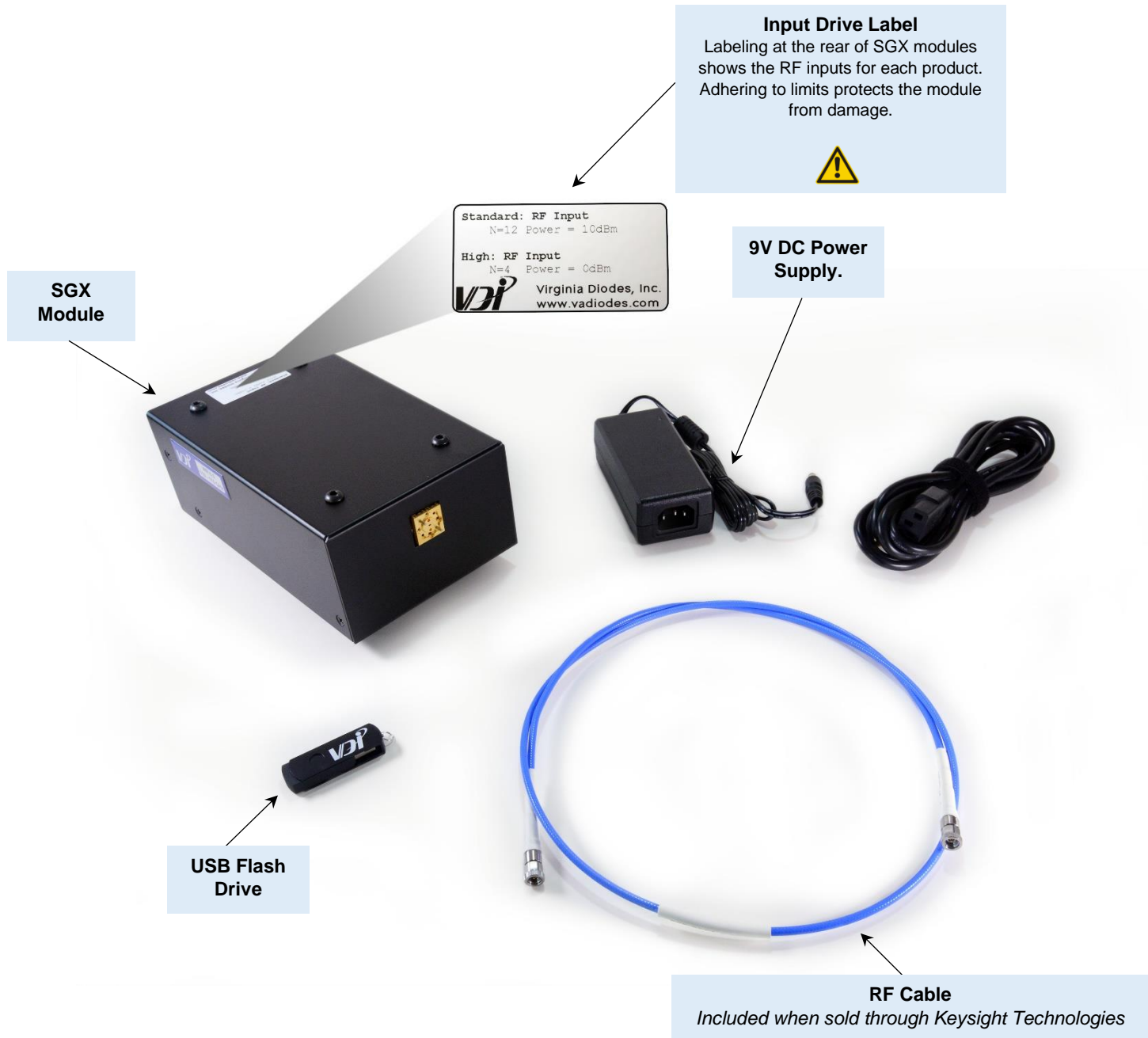
- Use a torque of 90 cNm when making coaxial connections. Avoid sharp bends in cables.

General Operating Practices and Recommendations

- VDI SGX Modules are intended to be used in typical laboratory conditions.
- Use of any attachments and accessories not authorized by VDI or that do not meet VDI's specifications may void a module's limited warranty and could pose a hazard to the operator, or cause lasting damage to the device.
- DC bias cables provided by VDI must be used. Alternative and replacement cables cannot be used unless the DC cables are adequately rated, properly grounded and authorized for use by VDI.
- Each VDI module is intended for use only with its AC/DC converter as supplied by VDI. Use of other power supplies or converters could damage the device or injure the operator.
- Disassembling a module can cause lasting damage to components and pose a hazard to the operator.
- Applying liquids (other than the TexWipe wipes / cloths used for cleaning) can cause lasting damage to the module.
- Check with VDI before any measurement connection is attempted beyond those described in this manual or if it may exceed commonly accepted standards of practice.

Major Components and Accessories

VDI Signal Generator Extension (SGX) Modules and typical accessories are shown. The exact equipment delivered and especially the input limits (see labels) may vary. Contact VDI with RF input limit or general operational questions before powering-up any module.



Module Details — Front and Rear Panel Connections



SGX Front Panel

*Voltage Bias Ports (+9V) are for use with external VDI components.



SGX – Rear Panel

SGX Configurations

These block diagrams represent the typical configurations of a VDI SGX module.

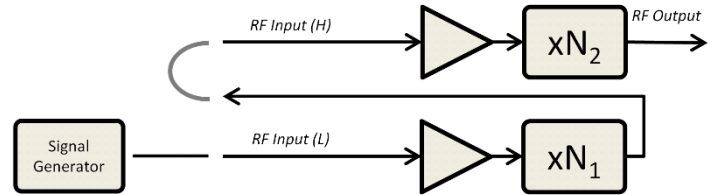


Figure 1: Low Frequency Operation

Proper configuration details for Low Frequency operation are shown. A coaxial jumper connection must be used for Low Frequency operation. N_1N_2 is the multiplication factor this configuration.

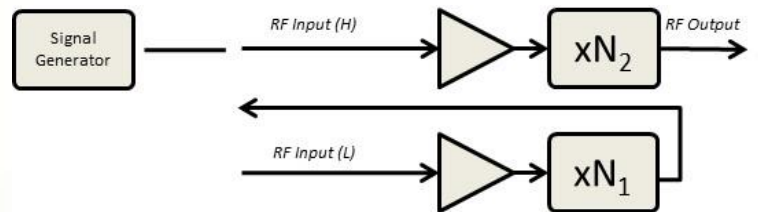


Figure 2: High Frequency Operation

Proper configuration details for High Frequency operation are shown. Coaxial jumper must be removed for High Frequency operation. N_2 is the multiplication factor for this configuration.

General Specifications and Technical Notes

General Specifications Signal Generator Extension Modules

General Specifications Signal Generator Extension Modules			
Description		Specification	Connector
RF Input	Low Freq. (Typical / Damage)	10 dBm ± 3dB / 16 dBm	2.92mm (f)
	High Freq. (Typical / Damage)	0 dBm ± 3dB / 6 dBm	2.4mm (f)
RF Output	VDI Precision Flange	Contact VDI for Details	UG-387/UM
AC Inputs	Single-Volt Power Supply (+9V/4A)	100-240VAC, 3.5A, 50-60Hz	U.S. or E.U.
Amplitude Modulation	TTL / AM Input (ON / OFF)	0 - 5 V, up to ~kHz	BNC (f)
RF Attenuation	User Controlled Attenuation (UCA)	0V-full power, 5V-off	BNC (f).
Voltage Bias Port	--	+9V	LEMO 00
Operating Temperature	Typical / Recommended	25°C / 20-30°C	--
Maximum Weight	--	4.0 Lbs. (1.81 Kg.)	--
Dimensions	Typical (Length x Width x Height)	8" x 5" x 3"	--

Standard: RF Input
N=12 Power = 10dBm

High: RF Input
N=4 Power = 0dBm



Virginia Diodes, Inc.
www.vadiodes.com

RF Drive Labels

Follow the RF input listed on extension module labels to avoid damage. Values shown here are only examples.



Summary of Performance Specifications for Signal Generator Extension Modules

Waveguide Band (GHz)	WR15		WR12†		WR10	WR9.0	WR8.0	WR6.5	WR5.1
Start Frequency (GHz)	50		60		75	82	90	110	140
Stop Frequency (GHz)	75		90		110	125	140	170	220
Output Power (dBm, typ.)	20	19*	19	16	14	14	9	8	4
Output Power (dBm, min.)	17	16*	15	13	10	10	6	3	0
Waveguide Band (GHz)	WR4.3		WR3.4		WM710 (WR2.8)	WM570 (WR2.2)	WM380 (WR1.5)	WM250 (WR1.0)	WM164 (WR0.65)
Start Frequency (GHz)	170		220		260	330	500	750	1100
Stop Frequency (GHz)	260		330		400	500	750	1100	1500
Output Power (dBm, typ.)	2		-2		-6	-10	-21	-23	-25
Output Power (dBm, min.)	-3		-6		-12	-16	-27	-33	-

*Low Power (Part Number: WR15SGX-SE) is available.

†High Power and Standard Power options are available.

Options List:

- External Micrometer Driven Attenuator (~0-30 dB)
- Horn Antenna
- Waveguide Test Port Extensions (1" and 2" available)
- Increased Amplitude Modulation Rate (up to ~300 MHz)
- Voltage Bias Port (on Front Panel) – for external multiplier connections

General Notes:

- VDI SGX modules include a single-volt DC Power Supply.
- Turn-key, sweepable system, includes TTL modulation (ON/OFF up to ~kHz) and User Controlled Attenuation (UCA), 0-5V, both BNC
- Unwanted harmonic content is better than -20dBc typical.
- SGX modules are configured to allow input signals in two bands. Low Frequency Operation: <20 GHz, ~10 dBm, 2.92mm(f). High Frequency Operation: removal of jumper allows higher frequency input, ~0 dBm, 2.4mm(f).
- Higher frequency input reduces unwanted harmonic signals within the band, and is preferred.
- SGX modules can be driven by any signal generator that supplies the required frequency band and power.
- Stability of the input is degraded by the harmonic factor N and phase noise by 20log(N).

The safety and operational guidelines are listed on page 4. VDI recommends the following general operating procedures for using these products with optimal performance.

Turn-On Procedure

- 1) With the RF input power turned 'OFF', make all necessary connections (i.e. RF cable, AC cable, DC cable).
- 2) Set signal generator to desired frequency and appropriate power level.
- 3) Turn 'ON' the RF input power from signal generator.
 - a. For Amplitude Modulation (ON/OFF): use TTL Mod. port (0-5V, up to ~ kHz)
 - b. For RF Attenuation: use UCA port (0V = no attenuation, 5V = full attenuation).

Turn-Off Procedure

- 1) Turn 'OFF' the RF input power from signal generator.
- 2) It is now safe to turn 'OFF' and/or disconnect all other equipment on user test bench.

Operating Procedures for SGX Modules with Voltage Bias Option

VDI multipliers may be purchased to extend frequency coverage up to 1.1THz. SGX modules are shipped with Voltage Bias Ports on the front panel to allow for external multiplier connections. The following guidelines must be followed when using the additional multipliers with these SGX modules.

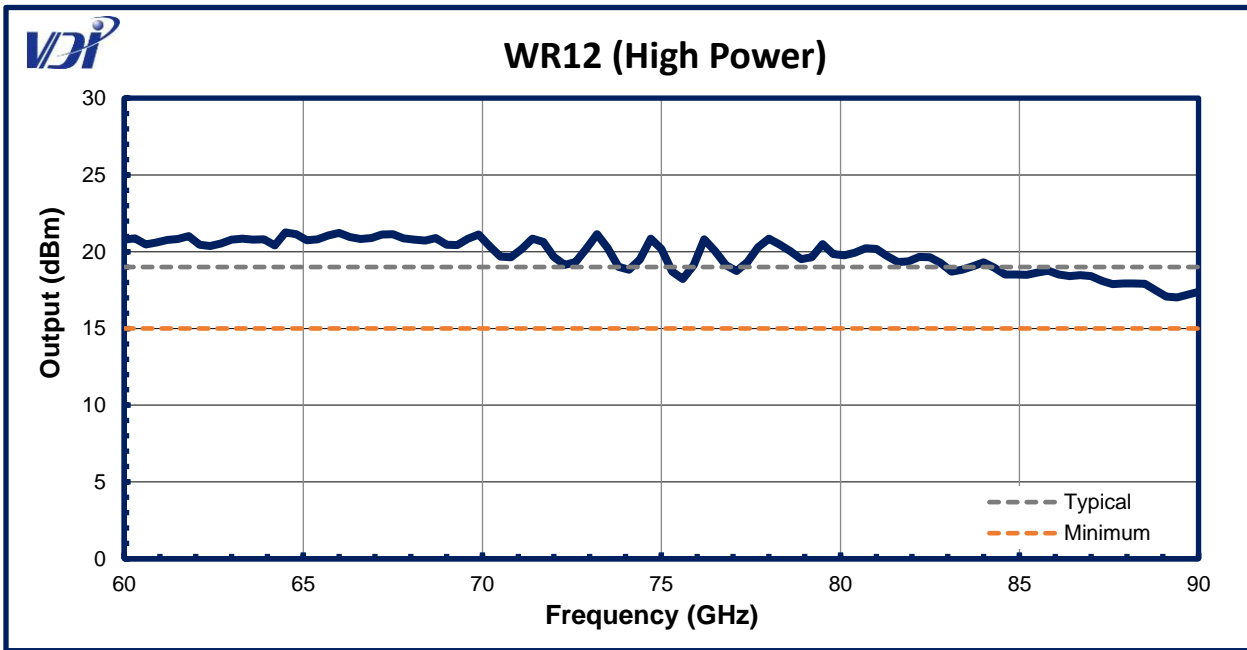
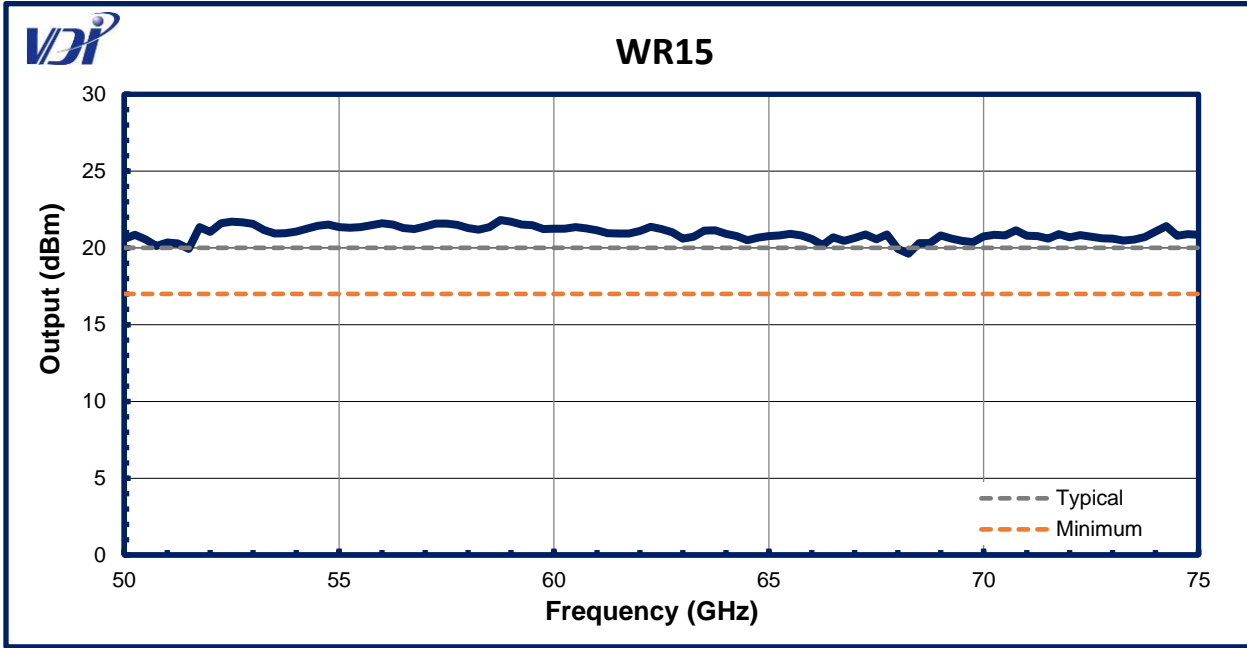
- NEVER disconnect Bias Boxes from external multipliers.
- Turn 'OFF' RF power and disconnect DC power before connecting/disconnecting an external multiplier from the Voltage Bias Port on front panel of the SGX (see panel closer-up, Page 6).
- Cover the Voltage Bias Ports on the front panel of the SGX if not in use.



Front / Rear Views of SGX Module with Voltage Bias Ports and External Multipliers (two with attached Bias Boxes)

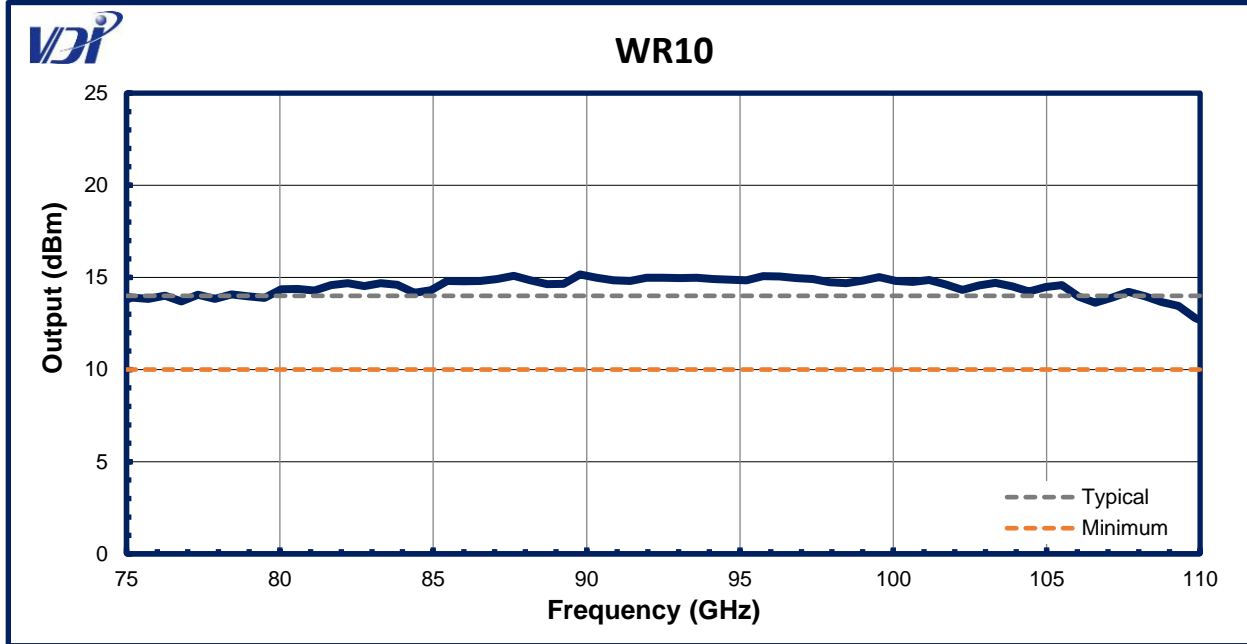
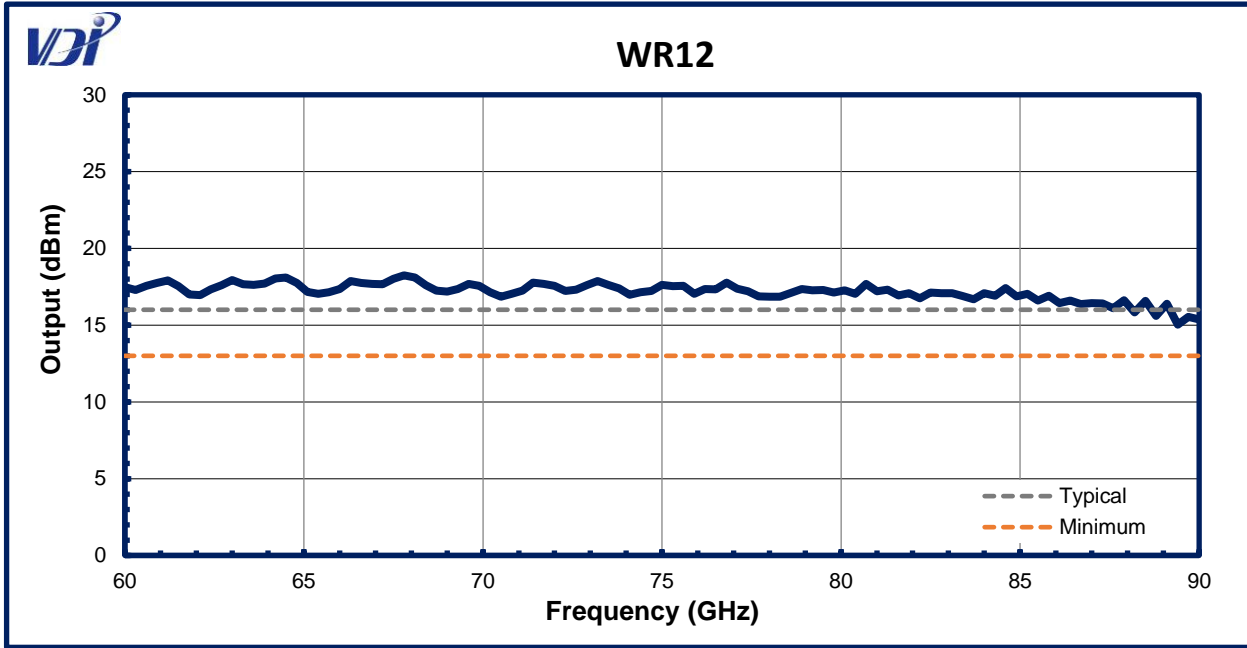
Typical Test Port Power plots are provided on the following pages, starting with WR15 SGX and ending with WR1.0 SGX on Page 17. User Controlled Attenuation (UCA) plots are included on Page 18.

Test Port Power for WR15 and WR12 (High Power)



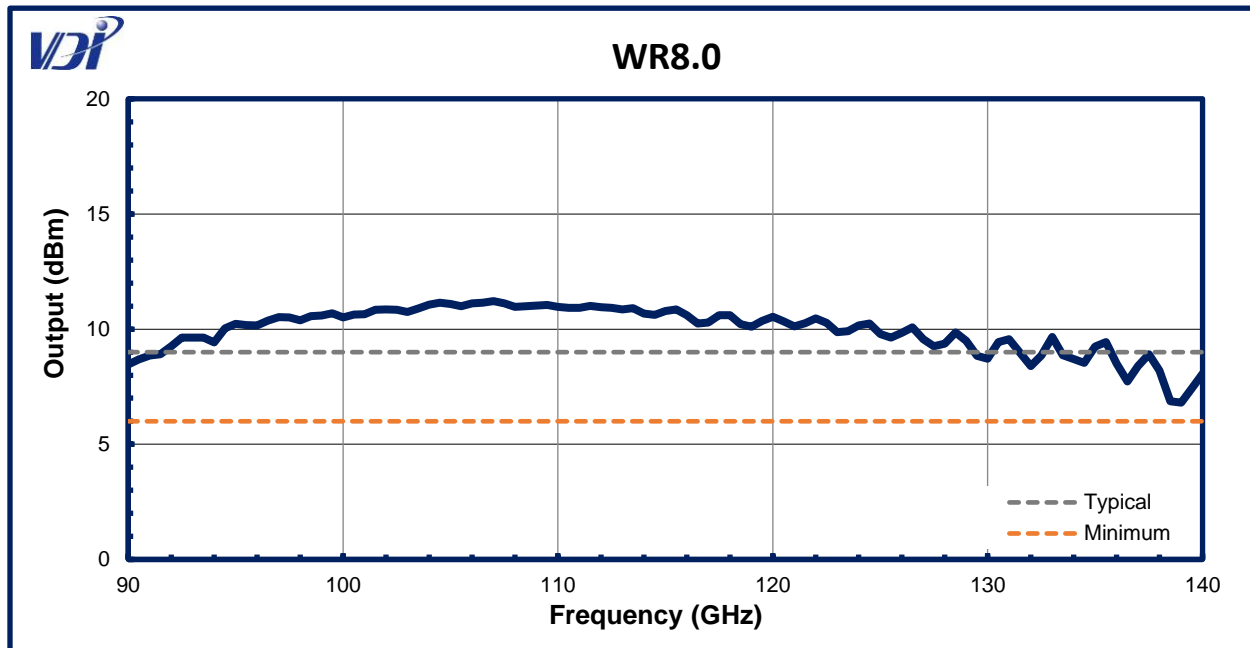
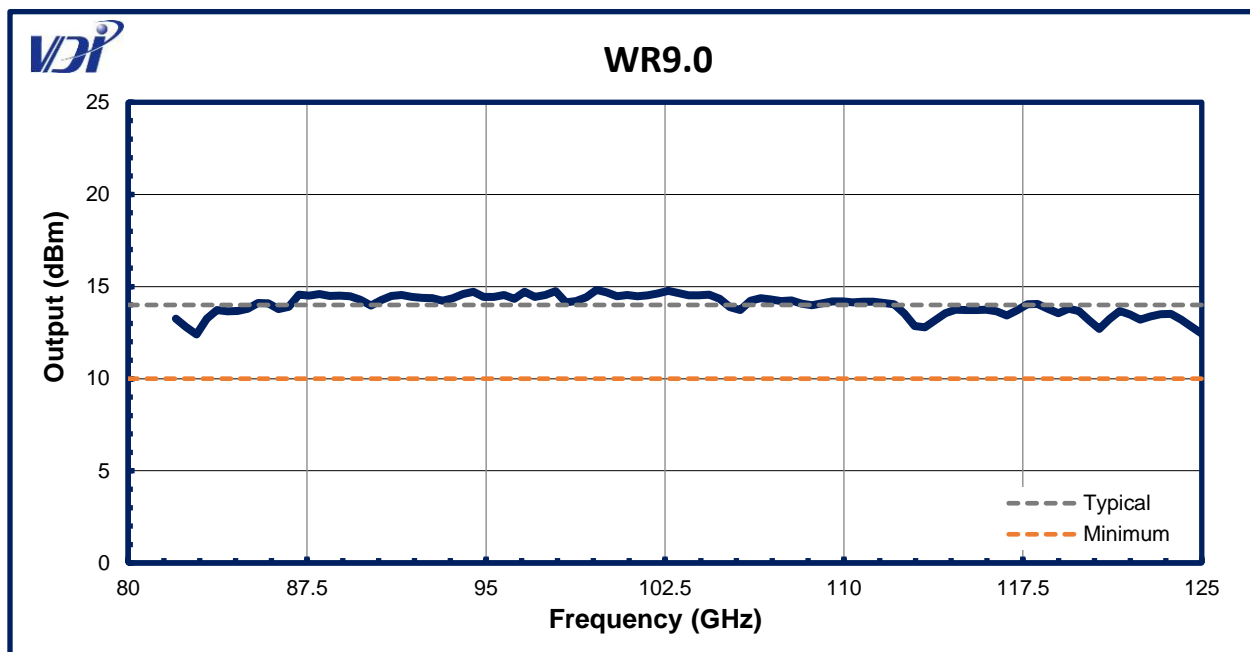
Test Port Power for WR12 and WR10

SGX Performance — Continued



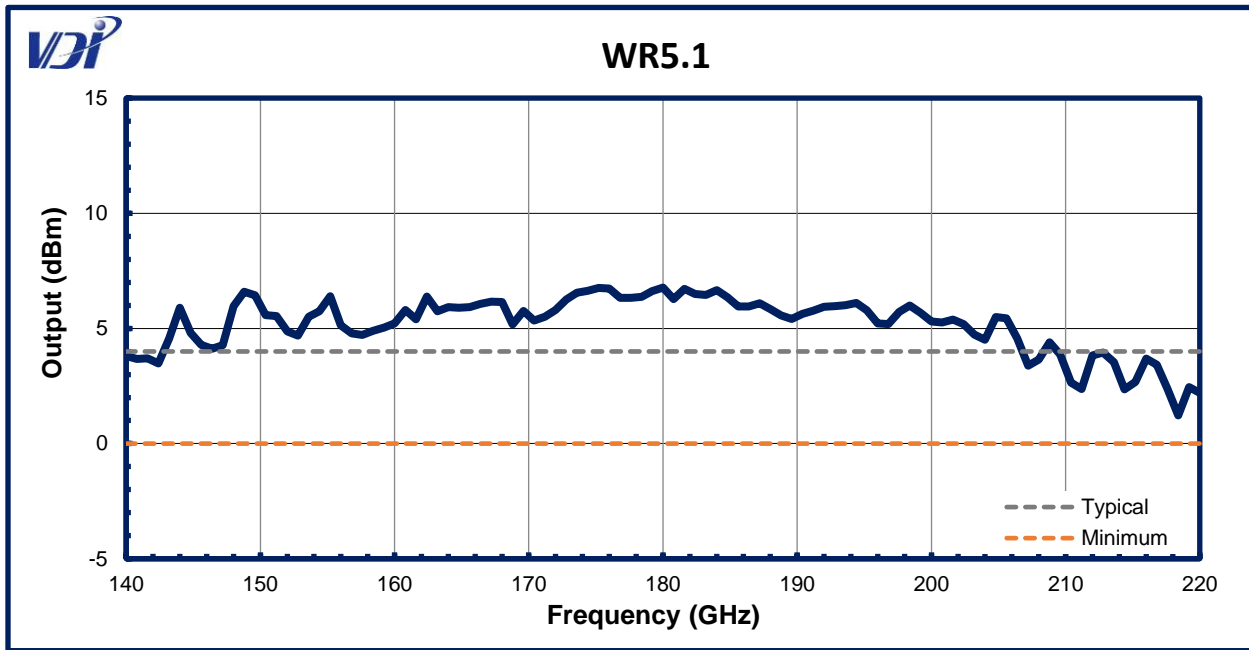
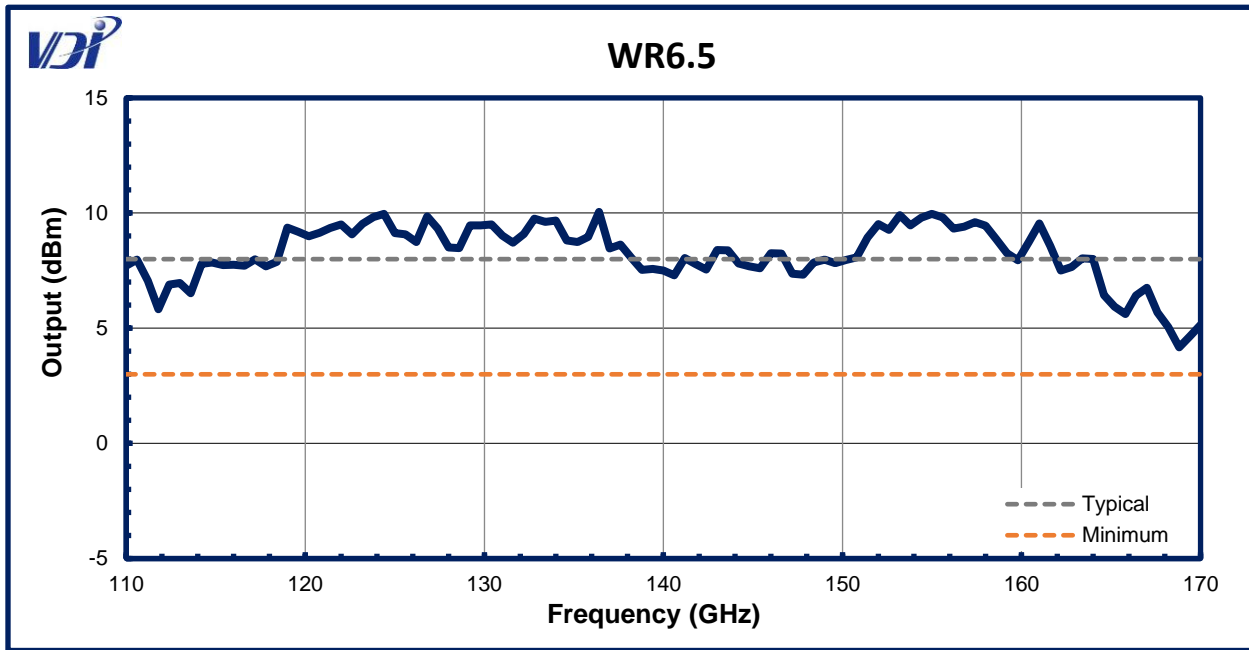
Test Port Power for WR9.0 and WR8.0

SGX Performance — Continued



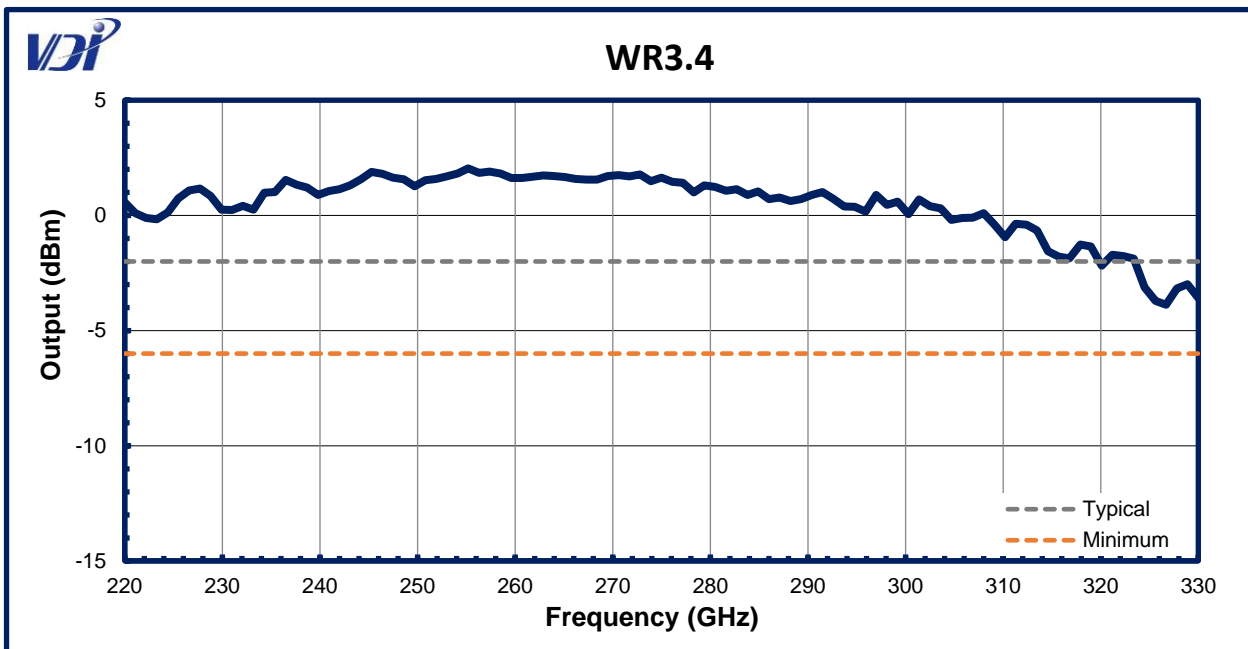
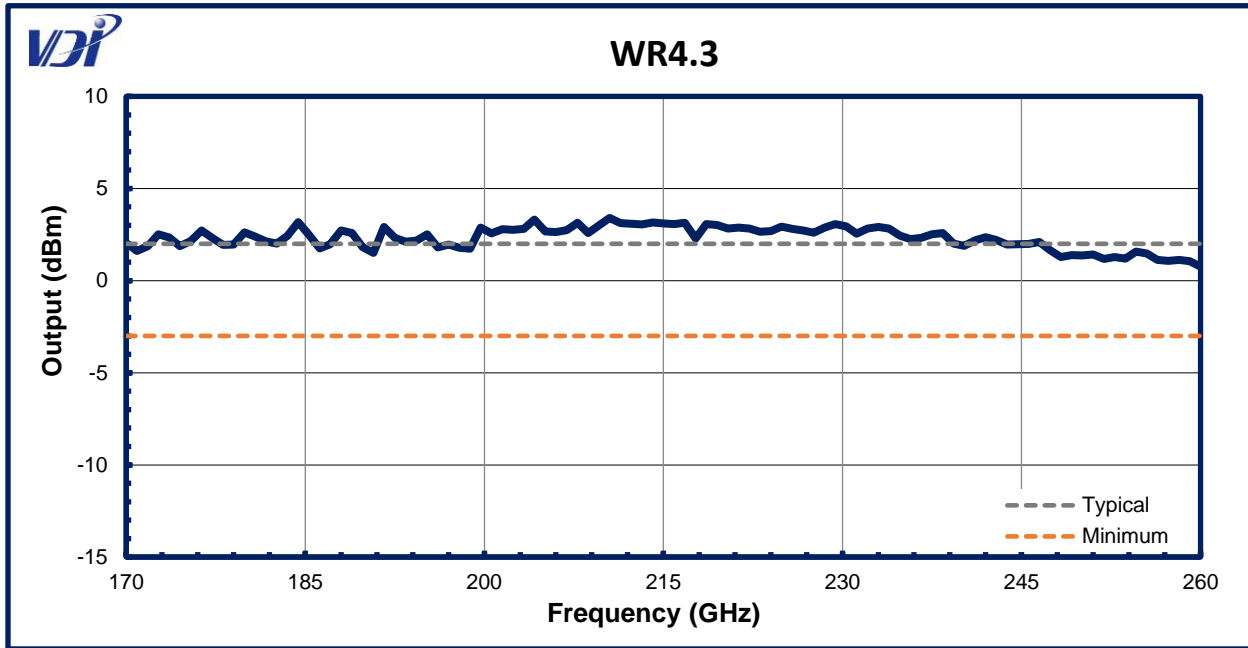
Test Port Power for WR6.5 and WR5.1

SGX Performance — Continued



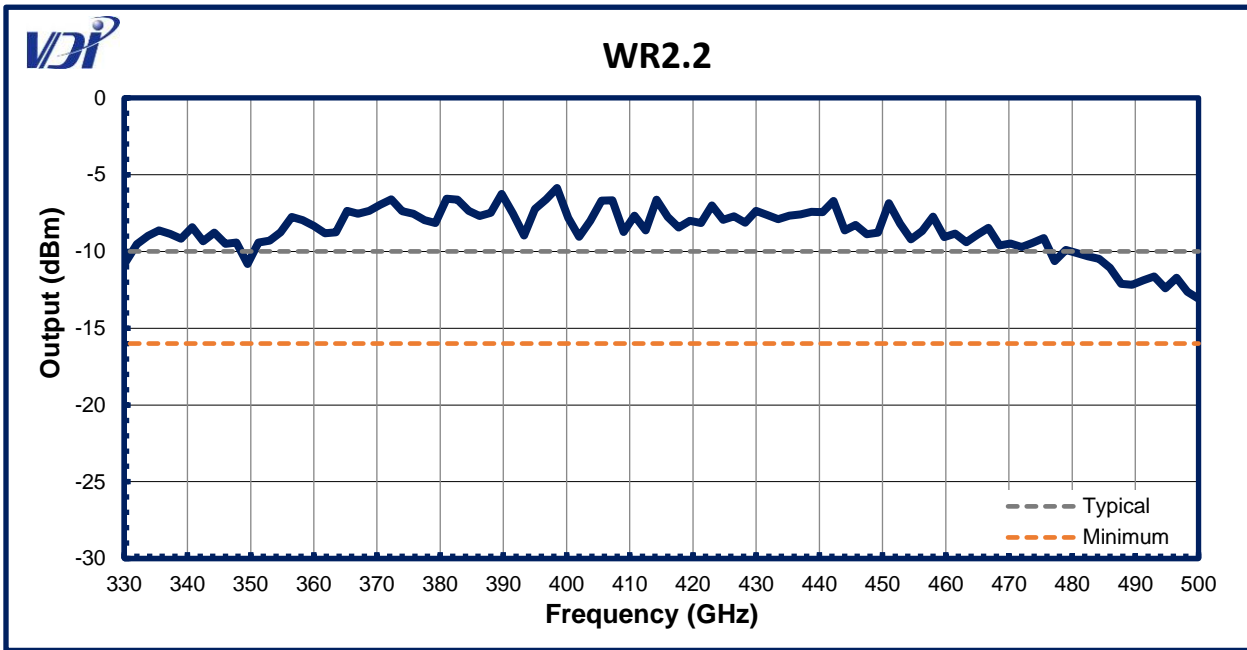
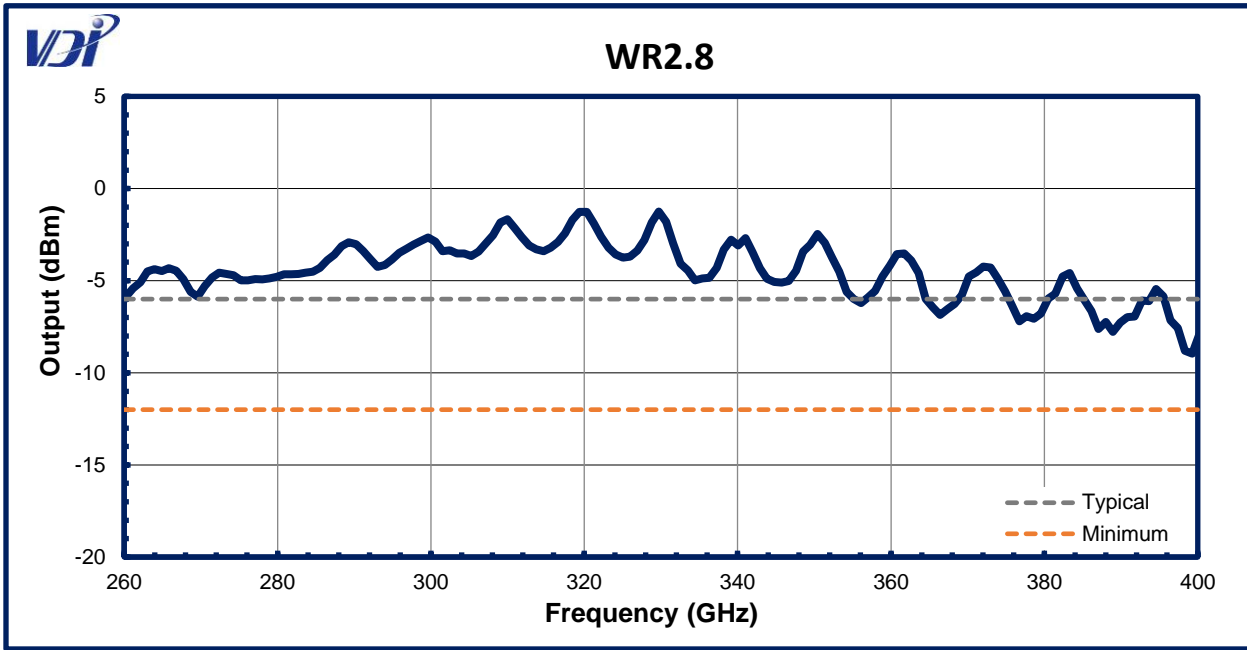
Test Port Power for WR4.3 and WR3.4

SGX Performance — Continued



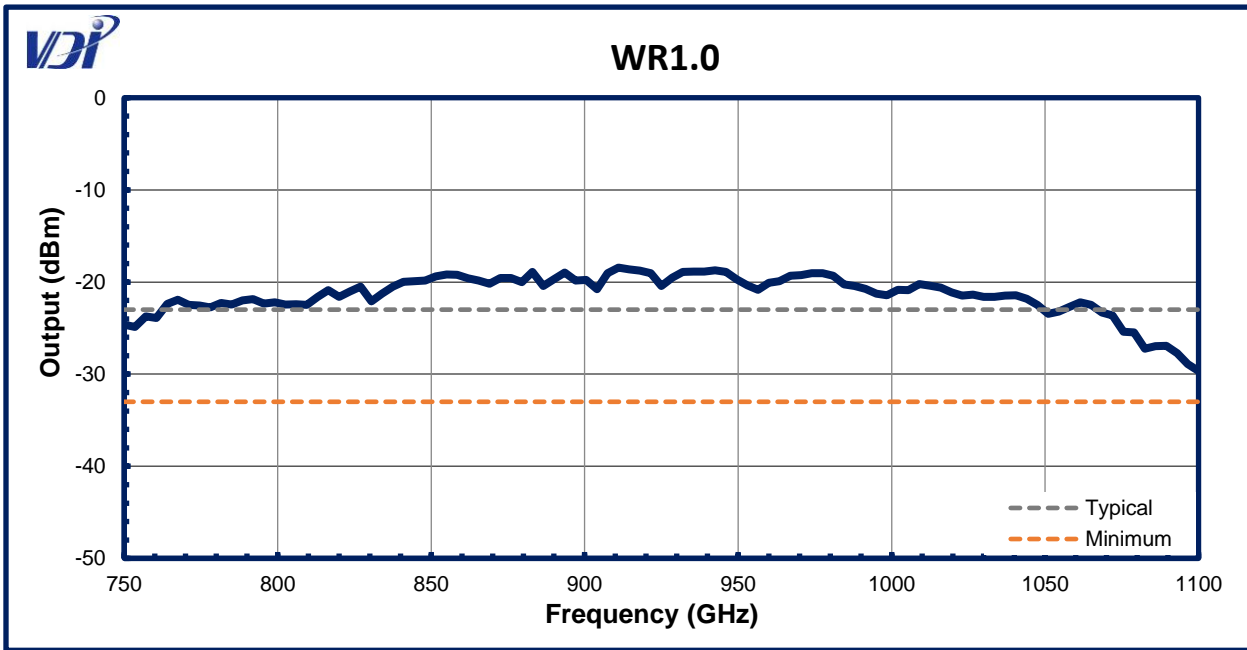
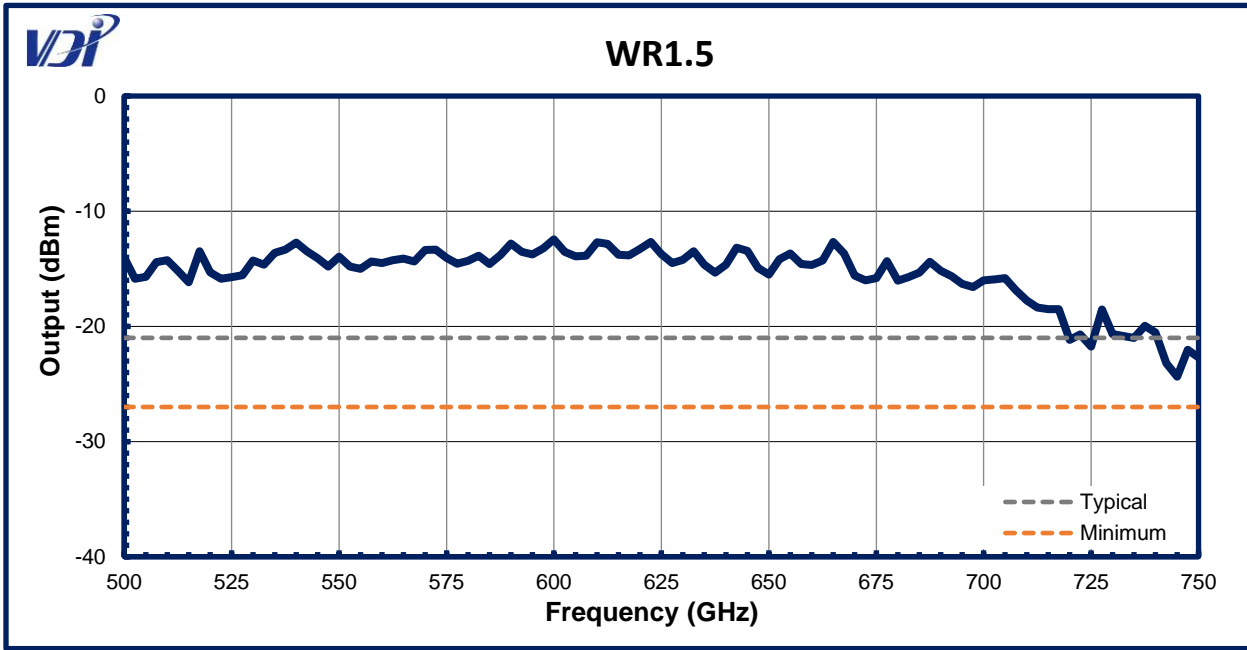
Test Port Power for WR2.8 and WR2.2

SGX Performance — Continued



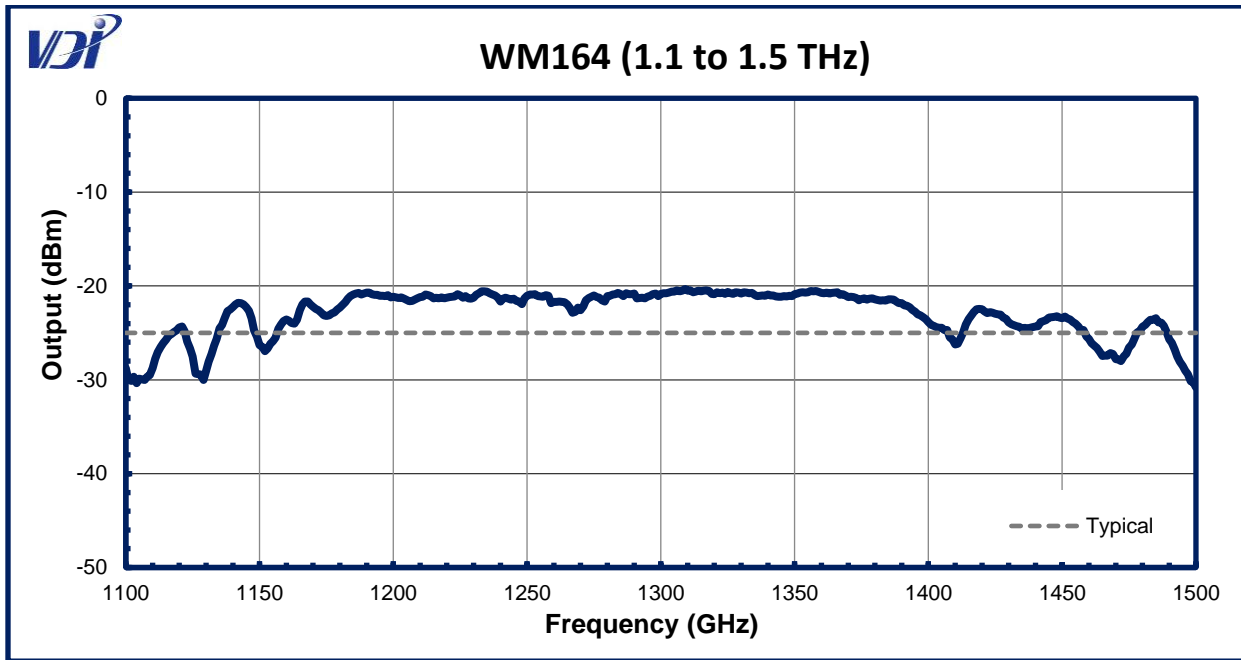
Test Port Power for WR1.5 and WR1.0

SGX Performance — Continued



Test Port Power for WR0.65

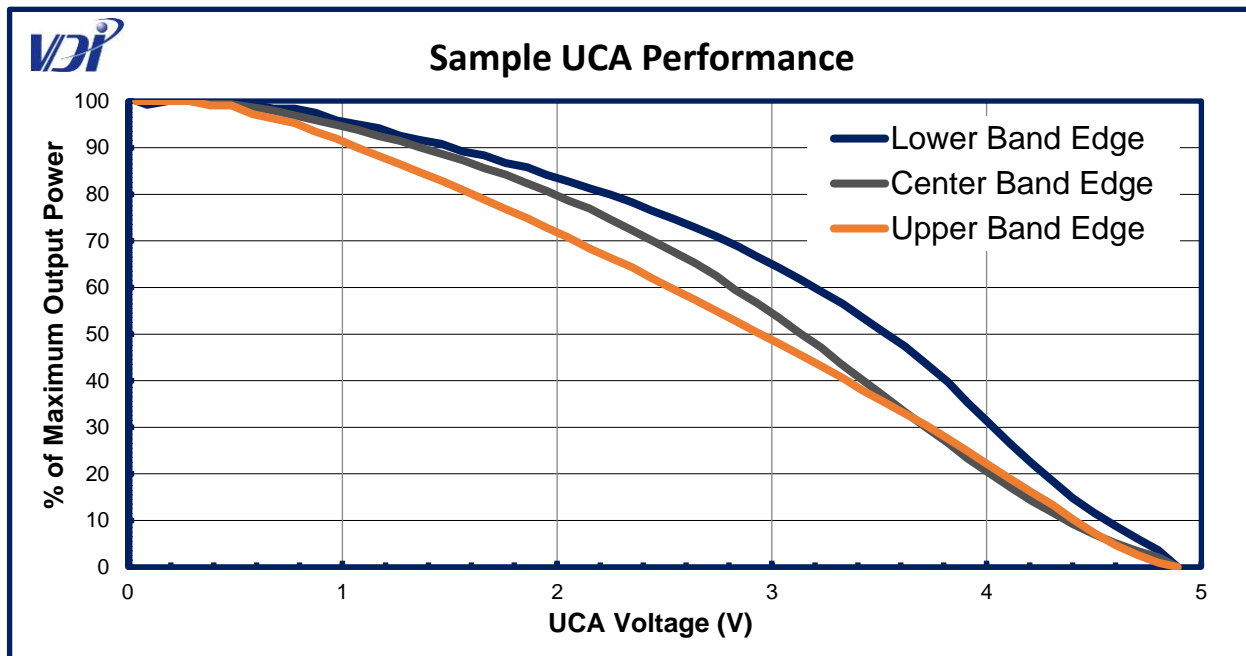
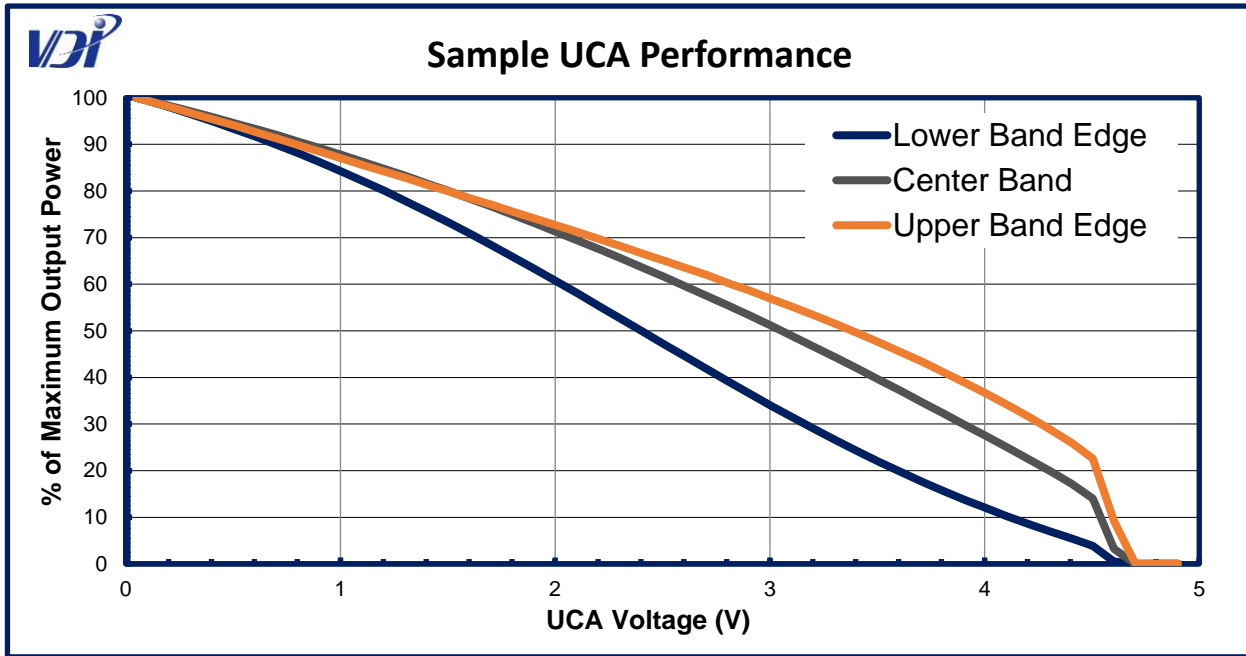
SGX Performance — Continued



User Controlled Attenuation (UCA) Performance

SGX – User Controlled Attenuation (UCA) Performance

Note: The UCA voltage reduces the module's output power. The data presented in these graphs was measured by VDI under specific test conditions. These graphs are intended to be used as examples to show a module's nonlinearity and frequency dependence. The exact shape of the curves will vary significantly depending on the measurement conditions, including operating temperature, modulation rate, duty cycle, and load impedance. The performance is also unique to the frequency band and specific serial number of the module. Finally, it should be noted that for large attenuation values the multipliers can become under-pumped and may generate undesired harmonics at increased levels.



Cable Loss Characterization Data

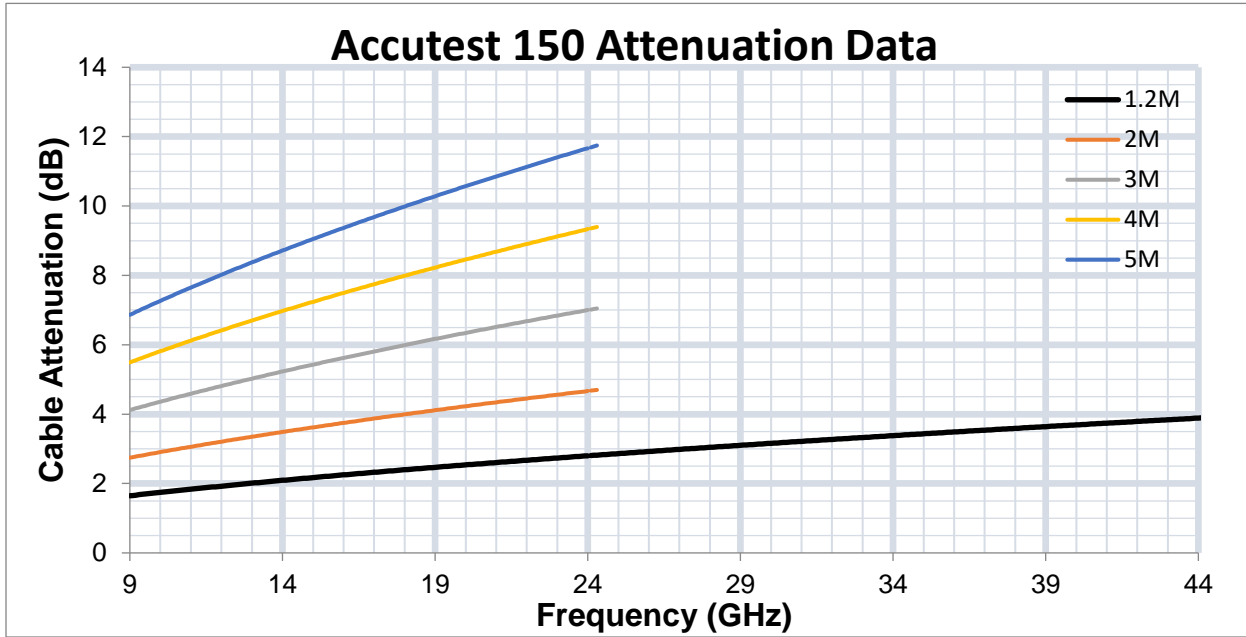
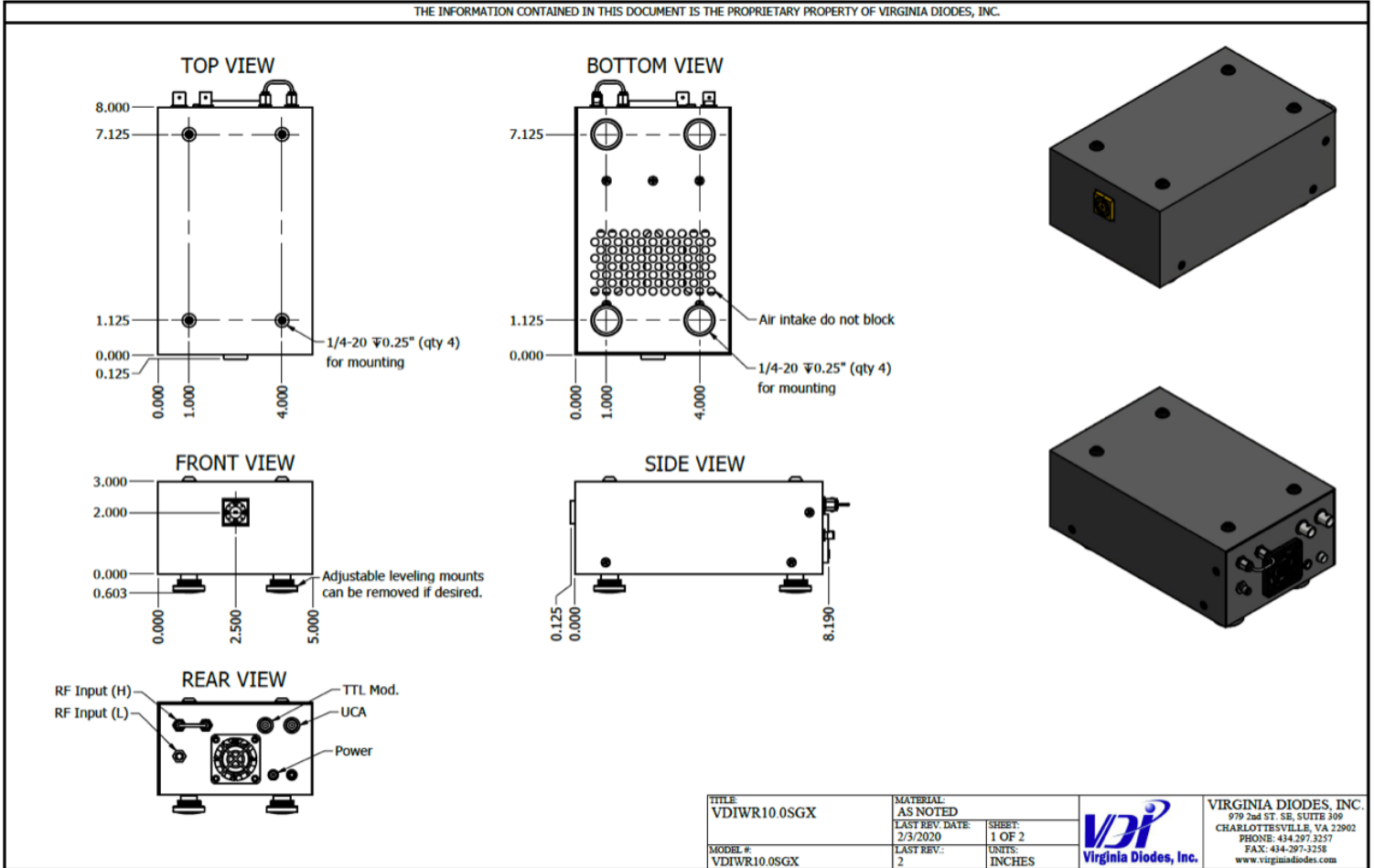


Figure 3:

Typical insertion loss of Accutest 150 (RF Cable) with respect to frequency. This chart can be used to estimate cable losses in your system.

THE INFORMATION CONTAINED IN THIS DOCUMENT IS THE PROPRIETARY PROPERTY OF VIRGINIA DIODES, INC.



Addendum — Product Updates and Company Contacts

Virginia Diodes' Signal Generator Extension (SGX) modules provide high performance frequency extension of microwave signal generators into the THz range. VDI SGX modules offer full waveguide band coverage and are available from WR15 (50-75 GHz) to WR0.65 (1,100-1,500 GHz). Additional bands are under development. VDI modules combine high test port power with low phase noise to offer exceptional performance.

The Virginia Diodes staff of engineering and physical science professionals works to continually improve our products. We also depend upon feedback from colleagues and customers. Ideas to simplify extension module operations, improve performance or add capabilities are always welcome. Be certain that Virginia Diodes has your latest contact details including a phone number and an email address to receive update advisories.



Contact VDI:

Virginia Diodes, Inc.

Web: <http://www.vadiodes.com>

Email: Technical@vadiodes.com

Telephone: 434.297.3257