

# Waveguide Amplifiers Operational Manual



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## Contents

<b>Section 1 – Introduction</b> .....	<b>Pages 2-3</b>
Contents .....	Page 2
Safety and Operational Guidelines .....	Page 3
<b>Section 2 – Product Overview and Specifications</b> .....	<b>Pages 4-6</b>
Amplifier Overview .....	Page 4
Product Specifications – Broadband, Medium Power Amplifiers.....	Page 5
Product Specifications – Narrowband, High Power Amplifiers .....	Page 6
<b>Appendix 1 – Amplifier Performance</b> .....	<b>Pages 7-18</b>
Amplifier Performance .....	Pages 7-18
<b>Appendix 2 – Amplifier Drawings</b> .....	<b>Pages 19-22</b>
Mechanical Drawing – WR15 to WR4.3 .....	Page 19
Mechanical Drawing – 130AMPS, 170AMPS Only .....	Page 20
Mechanical Drawing – WR19 .....	Page 21
Mechanical Drawing – Heatsink + Fan Assembly .....	Page 22
<b>Addendum – Product Updates and Company Contacts</b> .....	<b>Page 23</b>

# Amplifier Safety and Operational Guidelines

## Safety and Operational Guidelines



Read all instructions and information in this product manual before connecting the product to external equipment. Operational procedures must be followed for proper function. If you have questions, contact VDI before operating the product.



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.



Disassembly of any VDI components is prohibited and will void the product's warranty. VDI is not responsible for the warranty or guarantee of products that are damaged as a result of improper handling, testing, biasing, or use by the user.

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

- Improper use, disassembly or use for other purposes 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;

## Waveguide Inspection / Test Port Care

- Inspect waveguide flanges prior to making connections.
- 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.

## General Operating Practices and Recommendations

- 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.
- VDI does not recommend the use of liquid or paste for either thermal grounding of VDI components or for locking screws. Liquids/pastes wicking into the VDI components can damage the internal devices and worsen performance.

## Waveguide Amplifiers

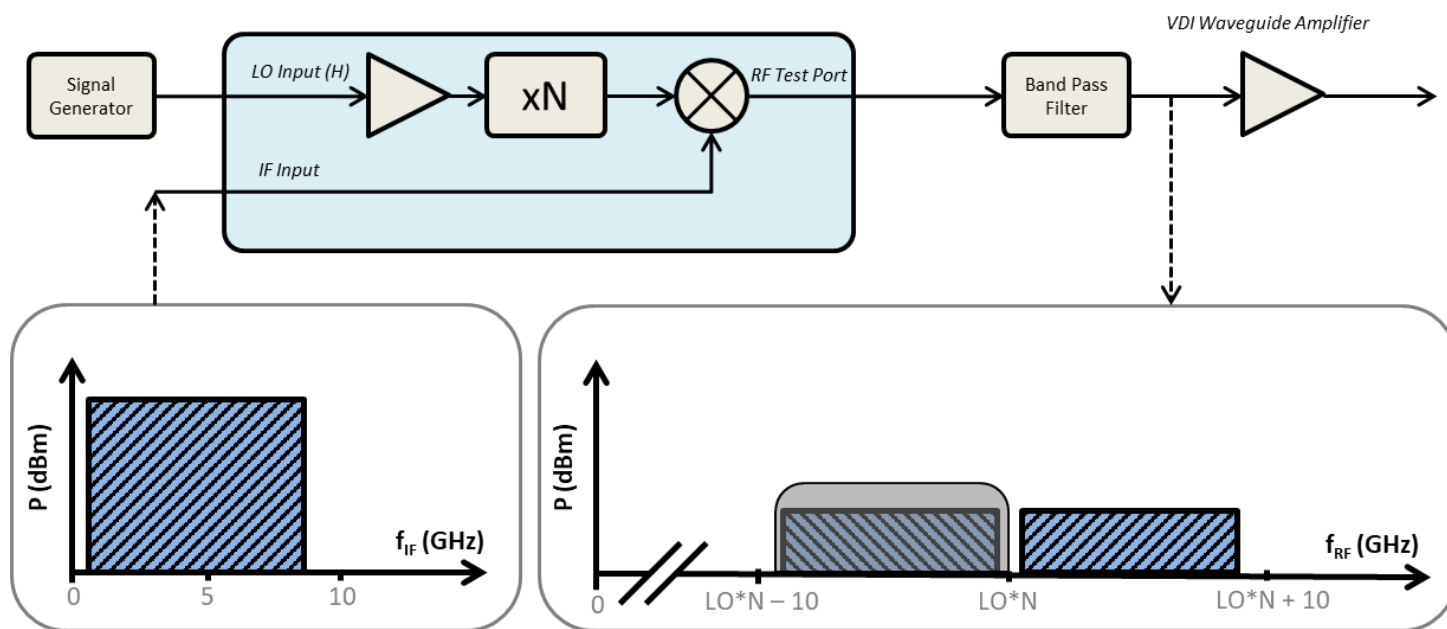
Amplifiers are able to boost a small input RF signal to a large output RF signal. VDI offers amplifiers up to ~260 GHz with additional amplifiers under development. Higher frequency or narrowband higher power amplifiers may be available upon request.



## Amplifiers with VDI SAX and CCU / CCD Modules

VDI amplifiers can be used with VDI Spectrum Analyzer Extension (SAX or SAX-M) Modules and Compact Converter (CC) Modules, configured for block up-conversion mode. In block up-conversion mode, the module up-converts a block of IF signals in the microwave to millimeter-wave frequencies. VDI amplifiers are available to boost the output power and overcome significant conversion and transmission losses.

The figure below shows how an SAX module can be used with a band pass filter and an amplifier to enhance the performance of the module when configured for block up-conversion. Refer to the SAX Operational Manual for details on how to operate an SAX module.



# Product Specifications – Broadband Power Amplifiers

General Specifications for VDI Waveguide Amplifiers	
Description	Specification
DC Bias Voltage (V)	+9 ± 1
Maximum Weight (lbs.)	0.1
Maximum Case Temperature*	< 45°C
Fan Supply Voltage / Current Draw**	+5V / ~20mA



\*Waveguide amplifiers must be connected to thermally grounded waveguide prior to biasing.

\*\*Heatsink + Fan Assembly only included on select amplifiers. Can be removed, but user must provide sufficient heatsinking to stay below the maximum case temperature.

VDI Broadband Power Amplifier Specifications				
VDI Part Number	WR19AMP	WR15AMP	WR12AMP	WR10AMP
Amplifier Band (GHz)	40-60	50-75	60-90	75-110
Waveguide Interface	WR-19	WR-15	WR-12	WR-10
Gain, S21 (dB, typical)	16	20	18	18
Saturated Output Power (dBm, typical)	20	19	20	20
Output P1dB (dBm, typical)†	17	11	16	16
Input Reflection, S11 (dB, typical)	-10	-10	-10	-10
Output Reflection, S22 (dB, typical)	-10	-10	-10	-10
Maximum RF Input Power (dBm)	+10	+10	+10	+10
Bias Connector*	SMP(m)	SMP(m)	SMP(m)	SMP(m)
Current Draw (Typical, Maximum, mA)	400 / 500 (est.)	450 / 1200	150 / 500	150 / 500
VDI Part Number	WR8.0AMP	WR6.5AMP	WR4.3AMP	WR3.4AMP
Amplifier Band (GHz)	90-140	110-170	170-260	220-330
Waveguide Interface	WR-8.0	WR-6.5	WR-4.3	WR-3.4
Gain, S21 (dB, typical)	23	20	24	24
Saturated Output Power (dBm, typical)	19	18	16	5
Output P1dB (dBm, typical)†	13	11	9	-1
Input Reflection, S11 (dB, typical)	-10	-9	-9	-8
Output Reflection, S22 (dB, typical)	-10	-10	-3	-6
Maximum RF Input Power (dBm)	+10	+10	+6	0
Bias Connector*	SMP(m)	SMP(m)	SMP(m)	SMP(m)
Current Draw (Typical, Maximum, mA)	300 / 800	200 / 600	300 / 800	~200 / -

†All amplifiers will meet P1dB specification listed above. P1dB data will not be provided with each amplifier.

\*Amplifiers with SMP(m) bias connectors include SMP(f) to LEMO and SMP(f) to SMA(m) cables. The SMP to LEMO 00 cable is for use with an SAX-UP or CCU module. The SMP to SMA cable is for general use.

# Product Specifications – Narrowband Power Amplifiers

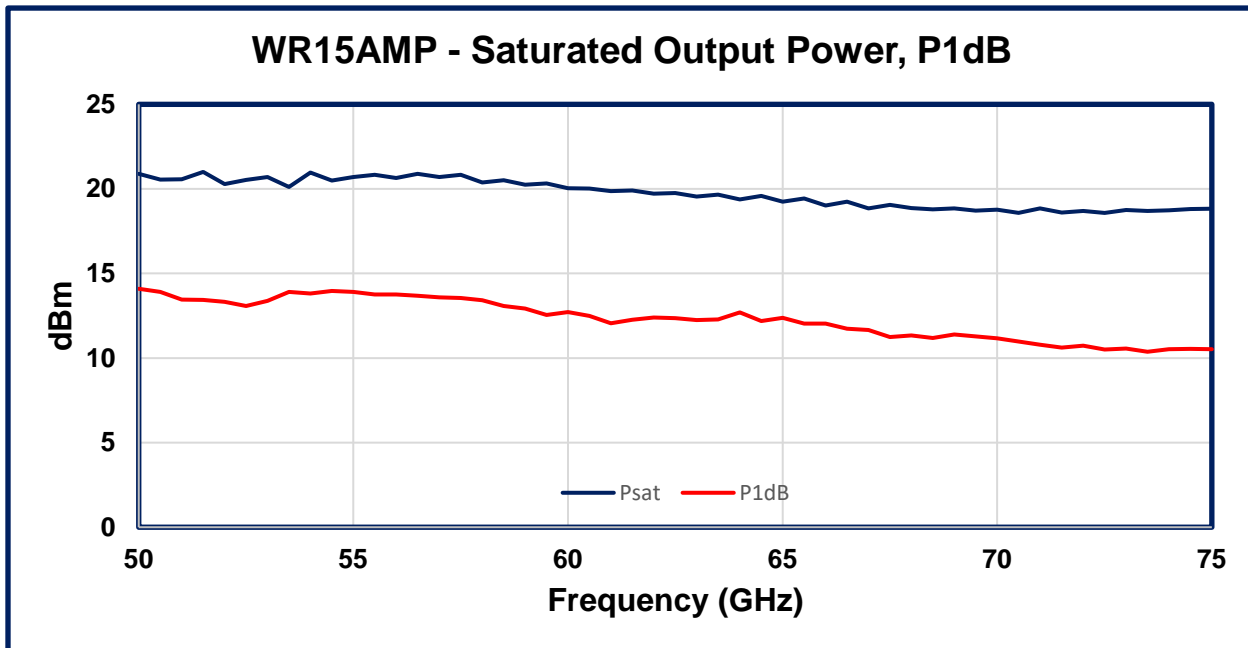
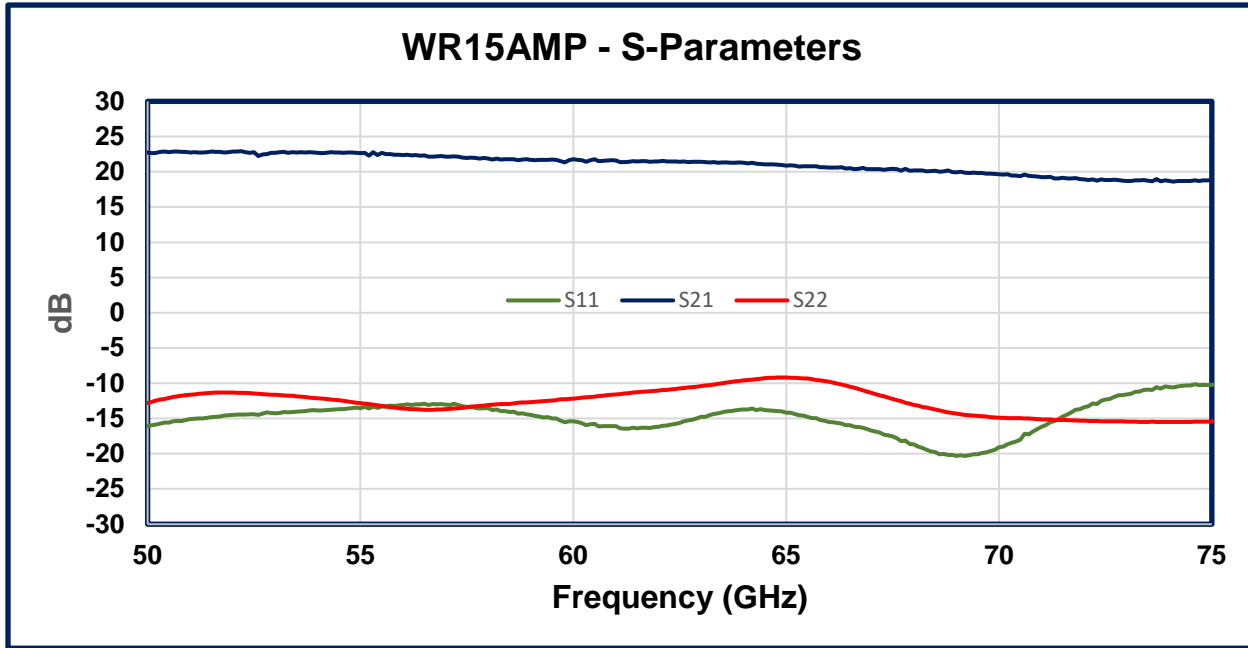
VDI Narrowband Power† Amplifier Specifications					
VDI Part Number	VDI15.0AMP-0055/0067-15-20	VDI12.0AMP-0067/0087-20-20	130AMPS	170AMPS	197AMPS
Amplifier Band (GHz)	55-67	67-87	120-140	160-180	185-205
Waveguide Interface	WR-15	WR-12	WR-6.5	WR-5.1	WR-4.3
Gain, S21 (dB, typical)	17	20	24	17	15
Saturated Output Power (dBm, typical)	20	19	22	21	18
Output P1dB (dBm, typical)††	17	15	15	13	10 (est.)
Input Reflection, S11 (dB, typical)	-7	-10	-10	-10	-10
Output Reflection, S22 (dB, typical)	-10	-10	-10	-10	-10
Bias Connector*	SMP(m)	SMP(m)	SMP(m)	SMP(m)	SMP(m)
Maximum RF Input Power (dBm)	+10	+10	+10	+13	+13
Current Draw (Typical, Maximum, mA)	150 / 500	150 / 500	~500 (typ., est.)	~700 (typ., est.)	~400 (typ., est.)
Heatsink + Fan Assembly	No	No	Yes	Yes	Yes
VDI Part Number	130AMPMP	170AMPMP	197AMPMP		
Amplifier Band (GHz)	120-140	160-180	185-205		
Waveguide Interface	WR-6.5	WR-5.1	WR-4.3		
Gain, S21 (dB, typical)	24	17	15		
Saturated Output Power (dBm, typical)	25	24	20		
Output P1dB (dBm, typical)††	-	-	13 (est.)		
Input Reflection, S11 (dB, typical)	-10	-10	-10		
Output Reflection, S22 (dB, typical)	-10	-10	-10		
Maximum RF Input Power (dBm)	+13	+16	+16		
Bias Connector*	Contact VDI	Contact VDI	Contact VDI		
Current Draw (Typical, Maximum, mA)	~1000 (typ., est.)	~1400 (typ., est.)	~800 (typ., est.)		
Dimensions (L x W x H, inches)	TBD	TBD	TBD		
Heatsink + Fan Assembly	Yes	Yes	Yes		

†Higher Power Narrowband Amplifiers are under development. Contact VDI for more information.

††All amplifiers will meet P1dB specification listed above. Sample P1dB performance as shown in Appendix 1. P1dB data will not be provided with each amplifier.

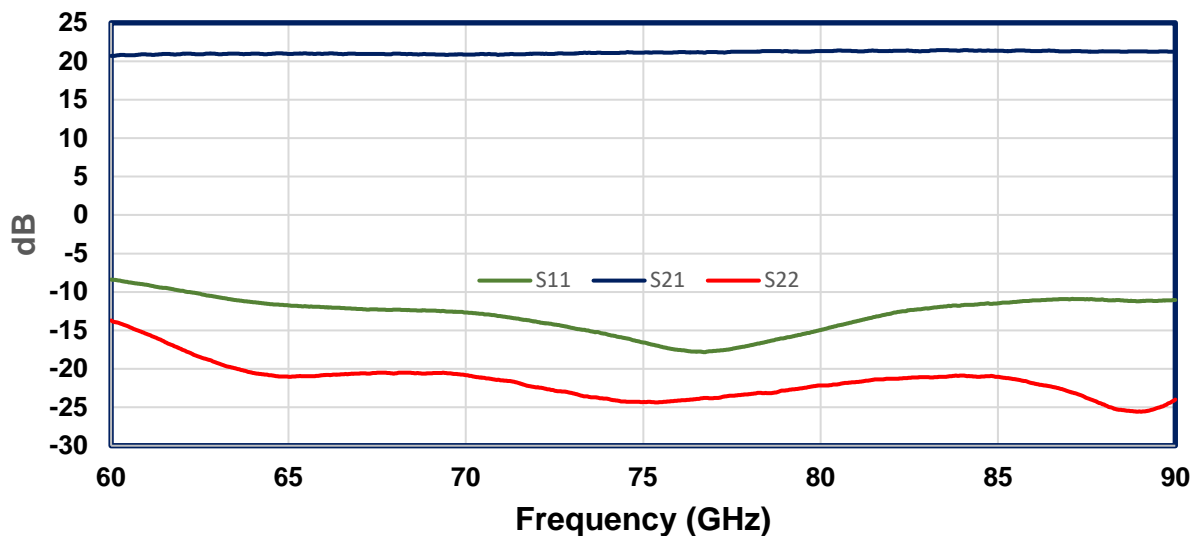
\*Amplifiers with SMP(m) bias connectors include SMP(f) to LEMO and SMP(f) to SMA(m) cables. The SMP to LEMO 00 cable is for use with an SAX-UP or CCU module. The SMP to SMA cable is for general use.

Typical amplifier performance plots are provided below.

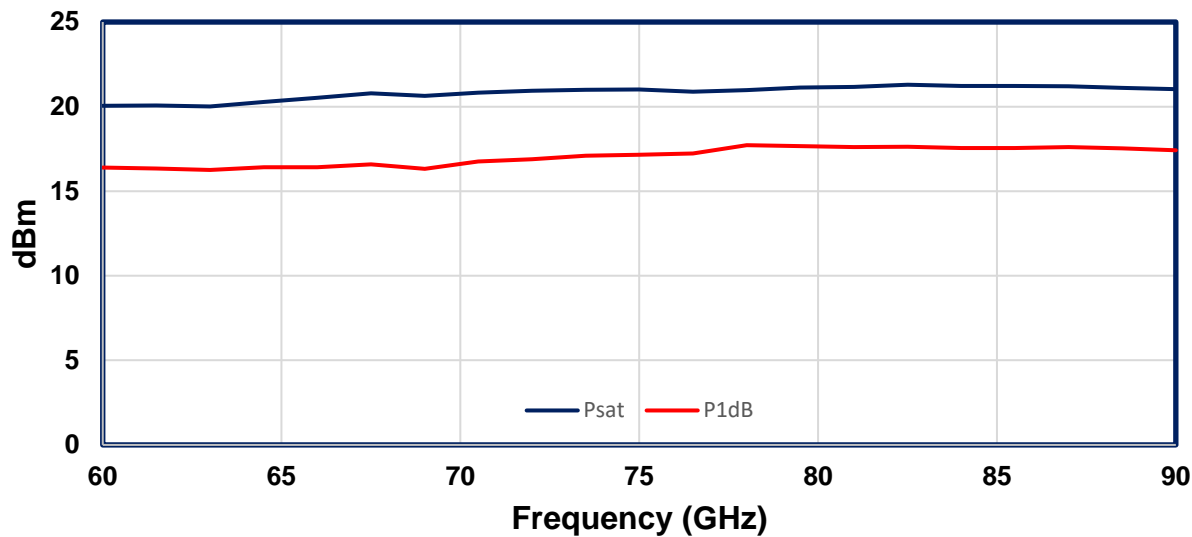


# Amplifier Performance – Continued

## WR12AMP - S-Parameters

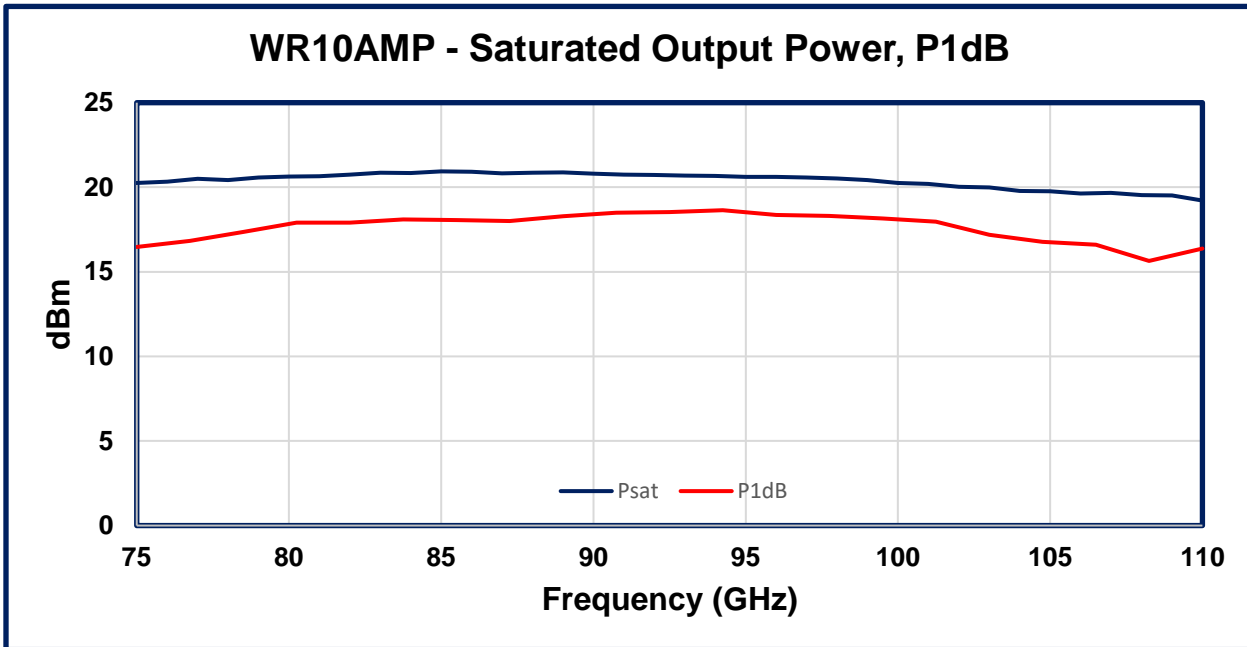
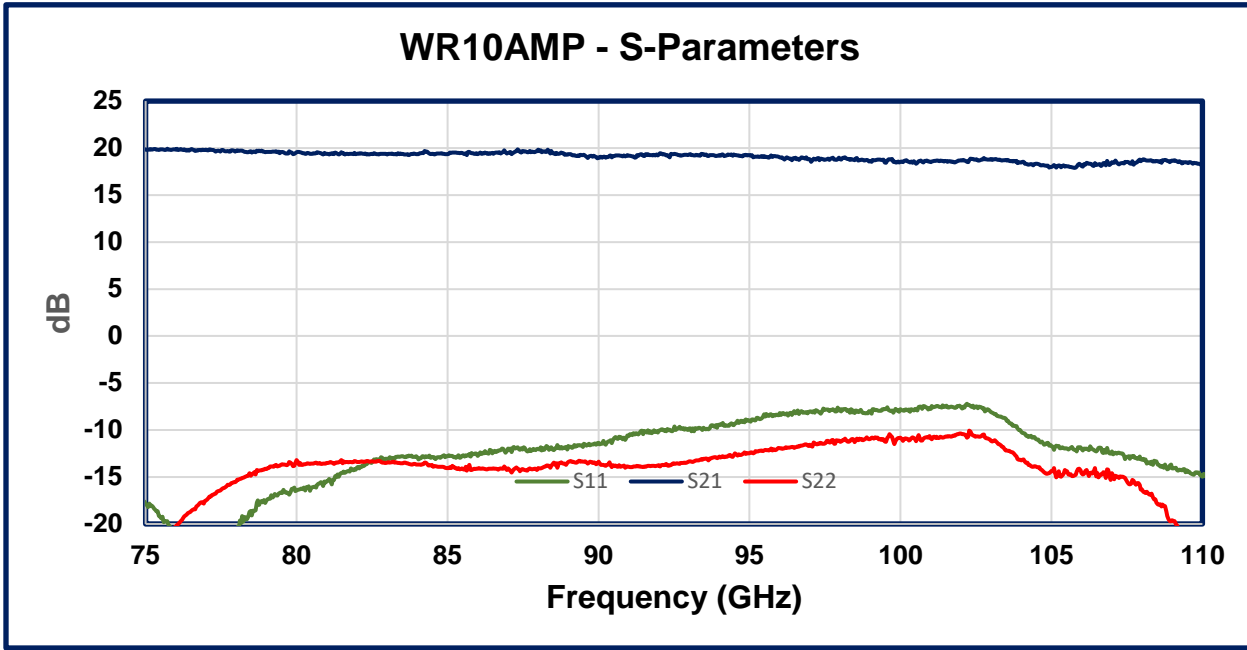


## WR12AMP - Saturated Output Power, P1dB



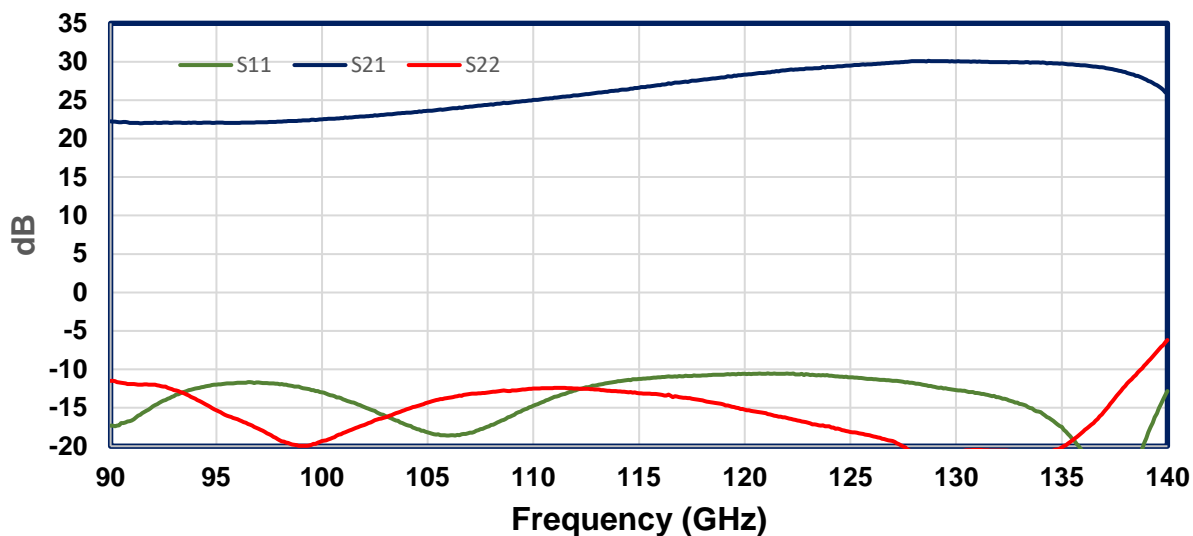


# Amplifier Performance – Continued

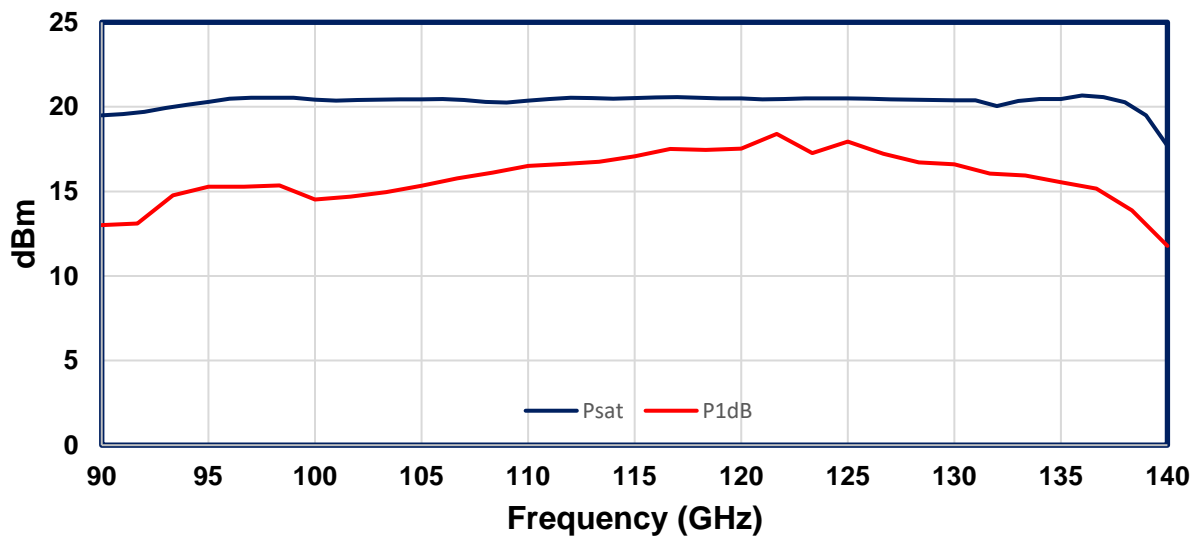


# Amplifier Performance – Continued

## WR8.0AMP - S-Parameters

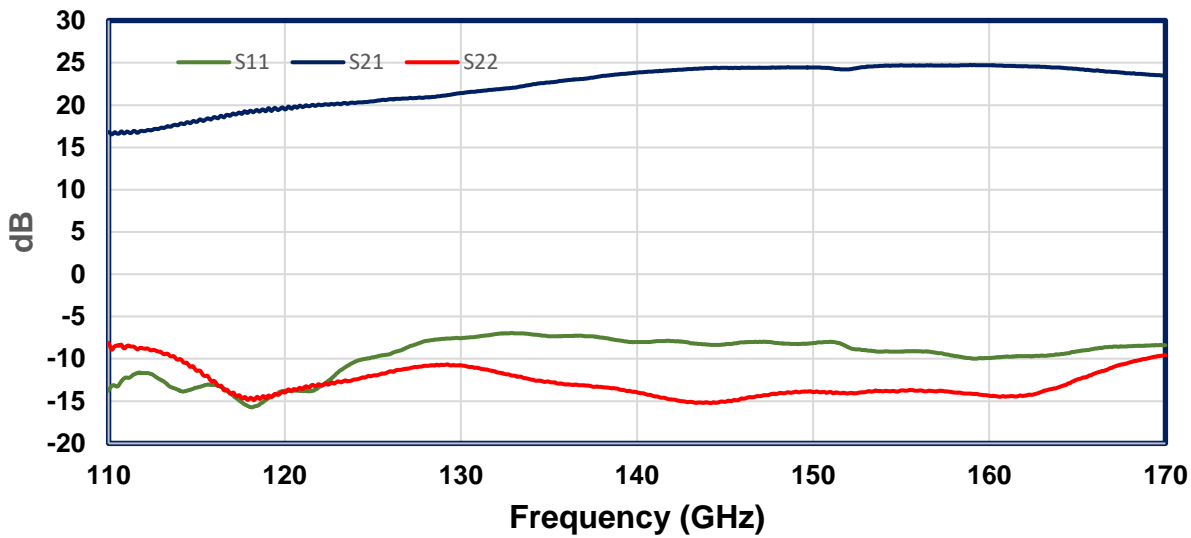


## WR8.0AMP - Saturated Output Power, P1dB

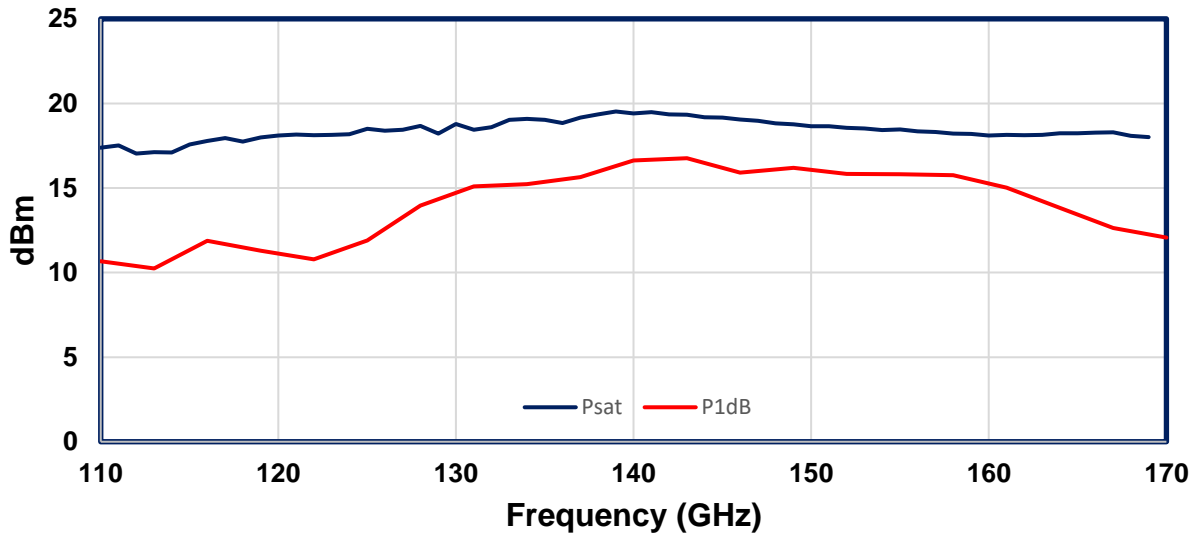


# Amplifier Performance – Continued

## WR6.5AMP - S-Parameters

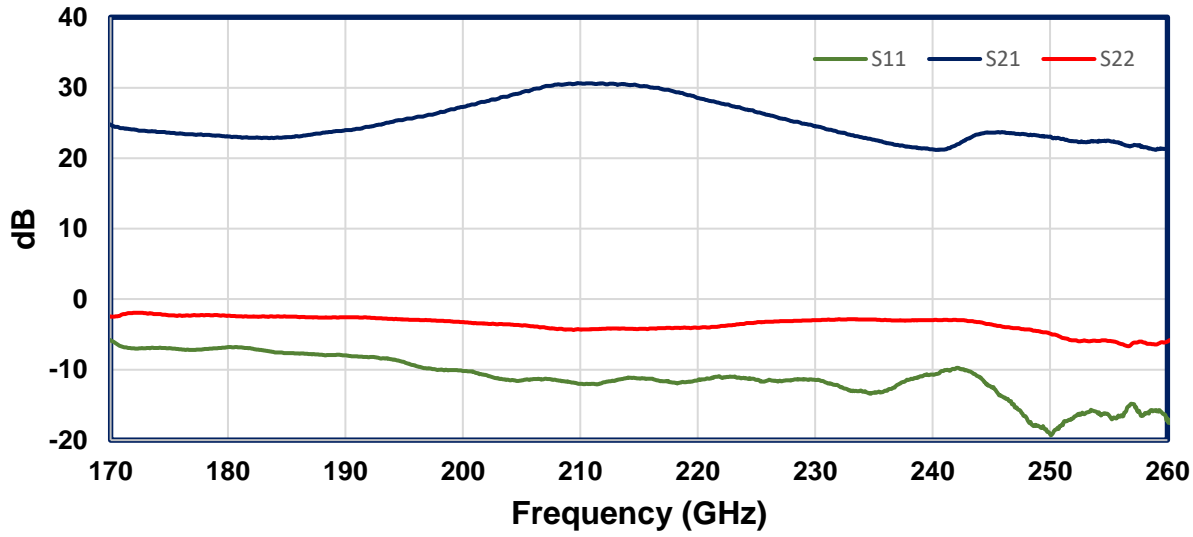


## WR6.5AMP - Saturated Output Power, P1dB

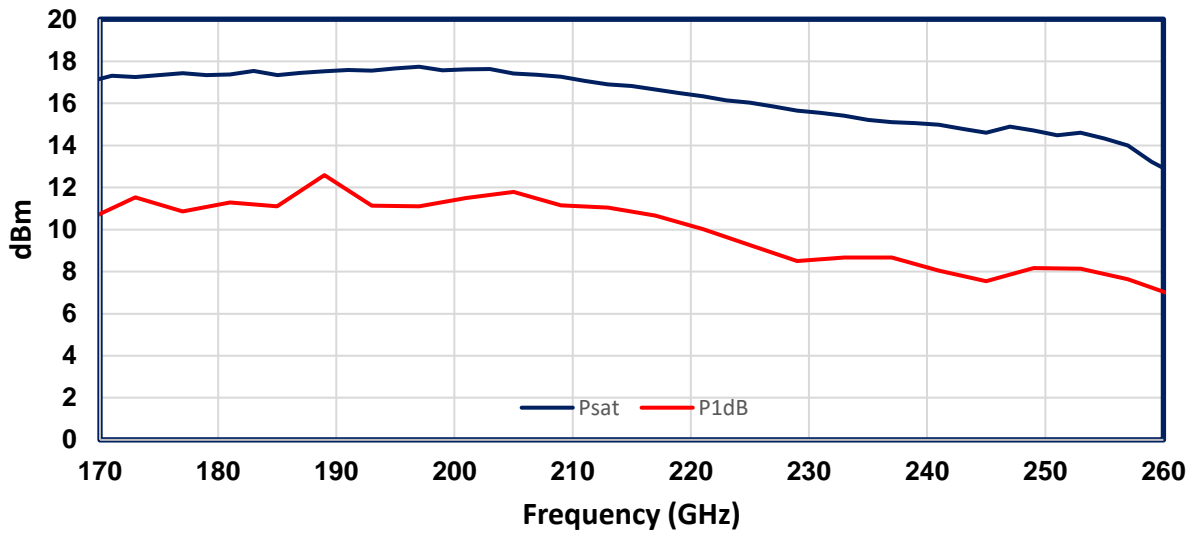


# Amplifier Performance – Continued

## WR4.3AMP - S-Parameters

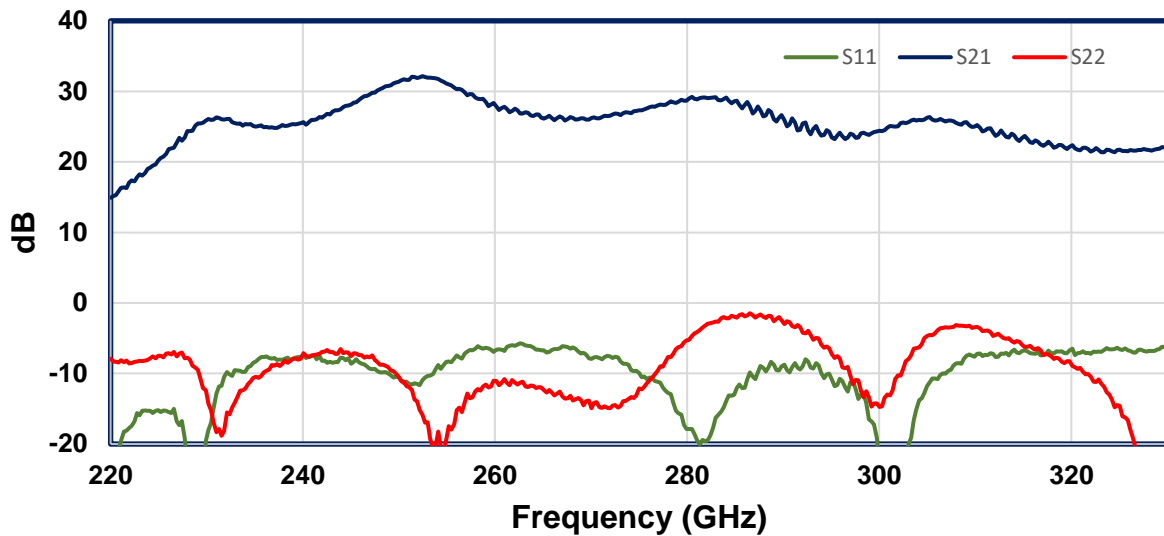


## WR4.3AMP - Saturated Output Power, P1dB

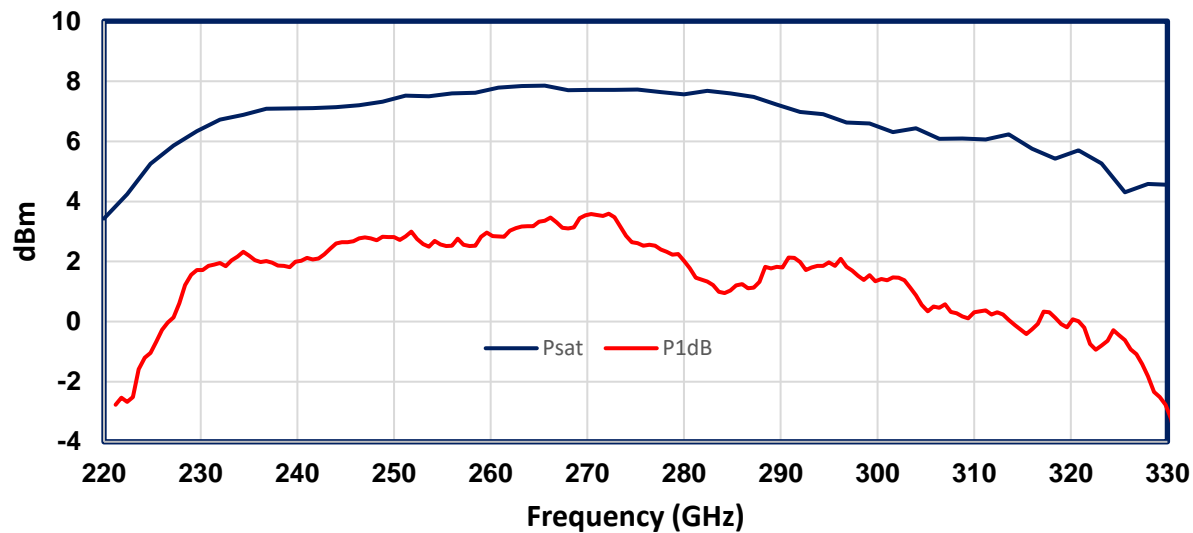


# Amplifier Performance – Continued

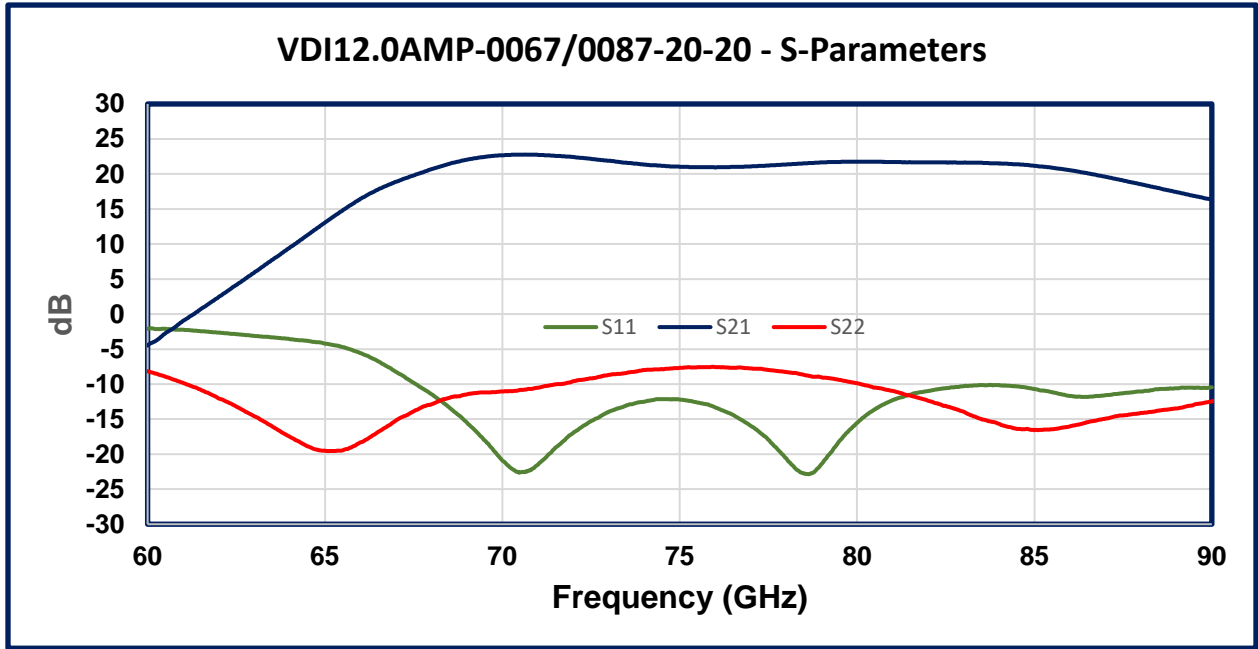
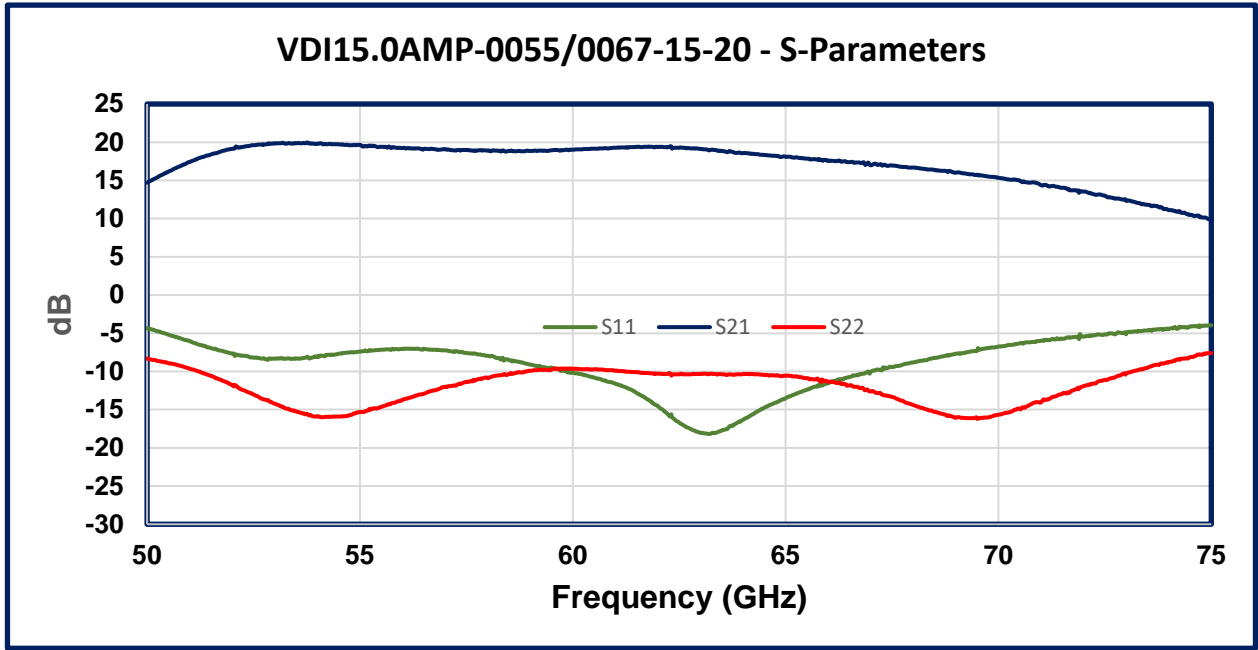
## WR3.4AMP - S-Parameters



## WR3.4AMP - Saturated Output Power, P1dB

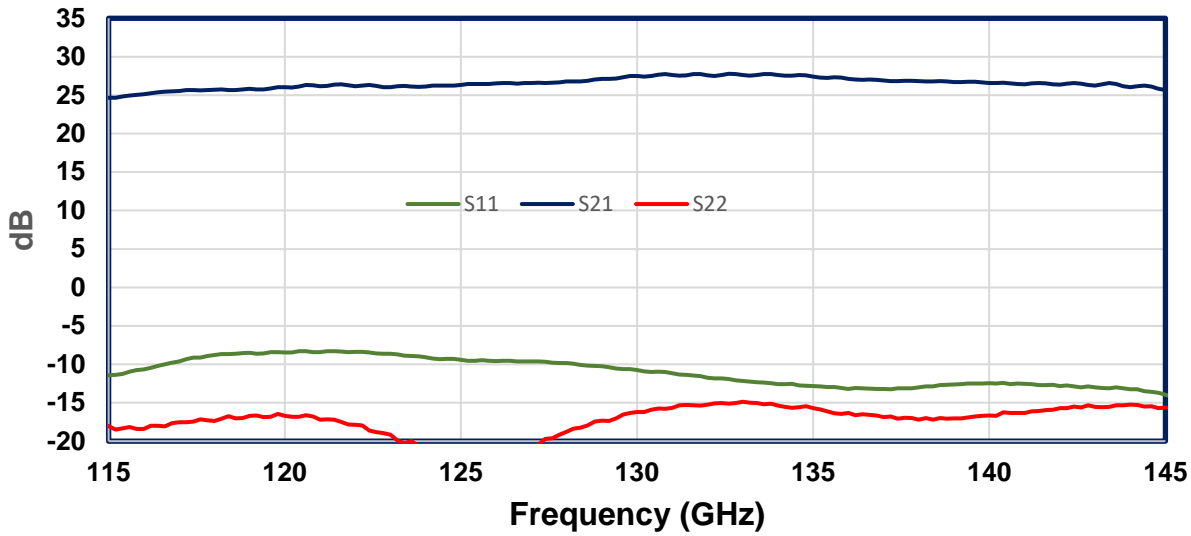


# Amplifier Performance – Continued

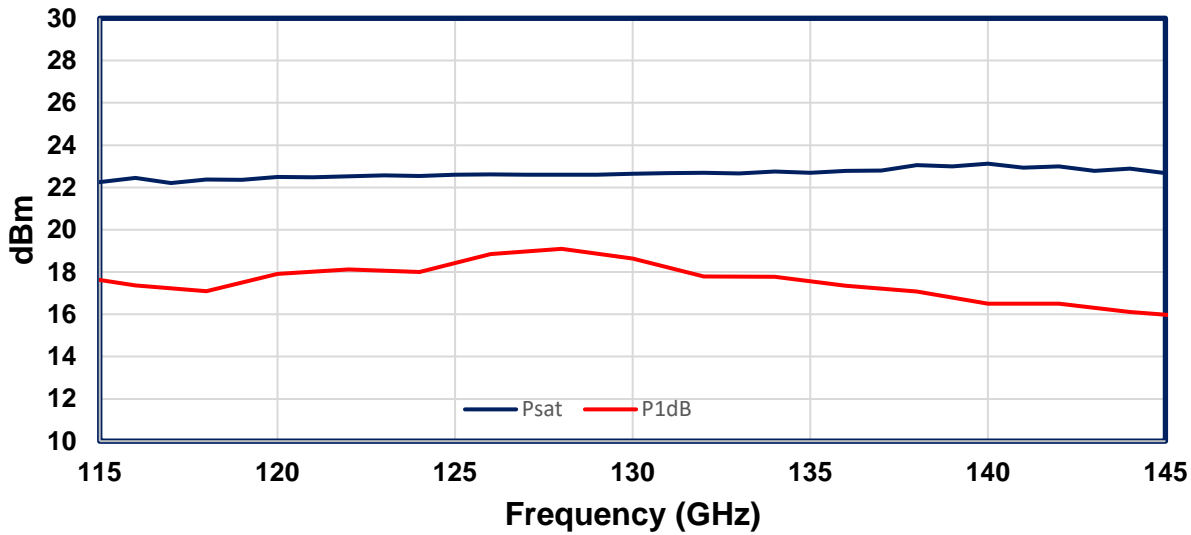


# Amplifier Performance – Continued

## 130AMPS - S-Parameters

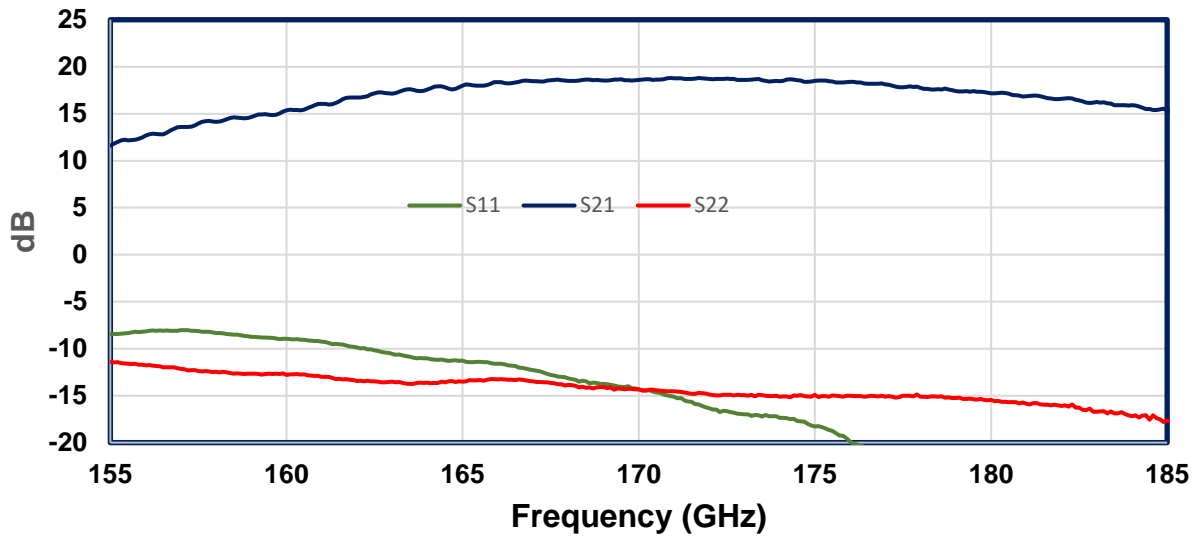


## 130AMPS - Saturated Output Power, P1dB

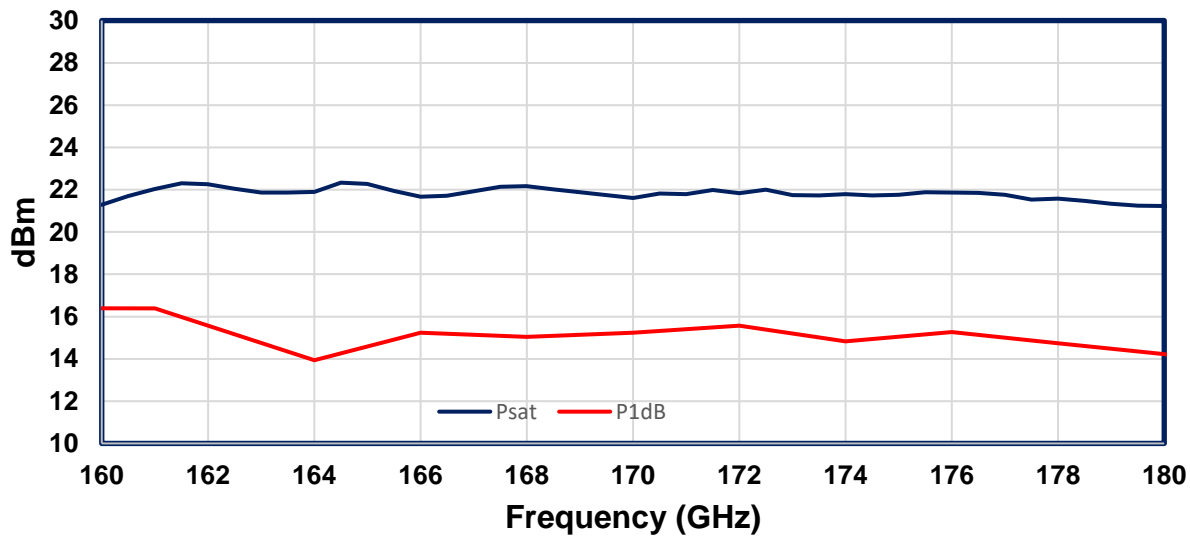


# Amplifier Performance – Continued

## 170AMPS - S-Parameters



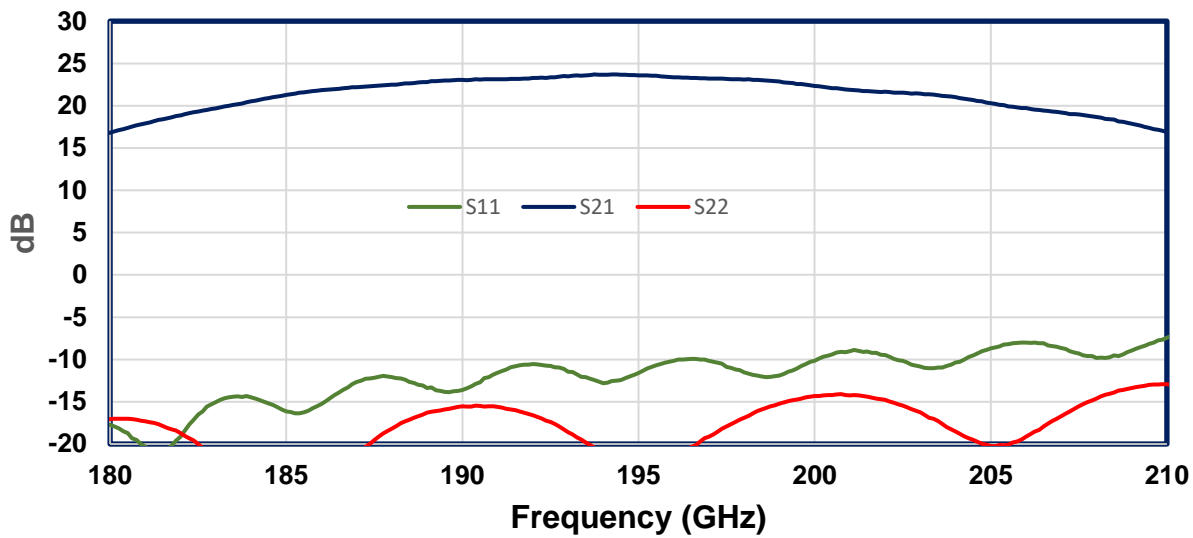
## 170AMPS - Saturated Output Power, P1dB



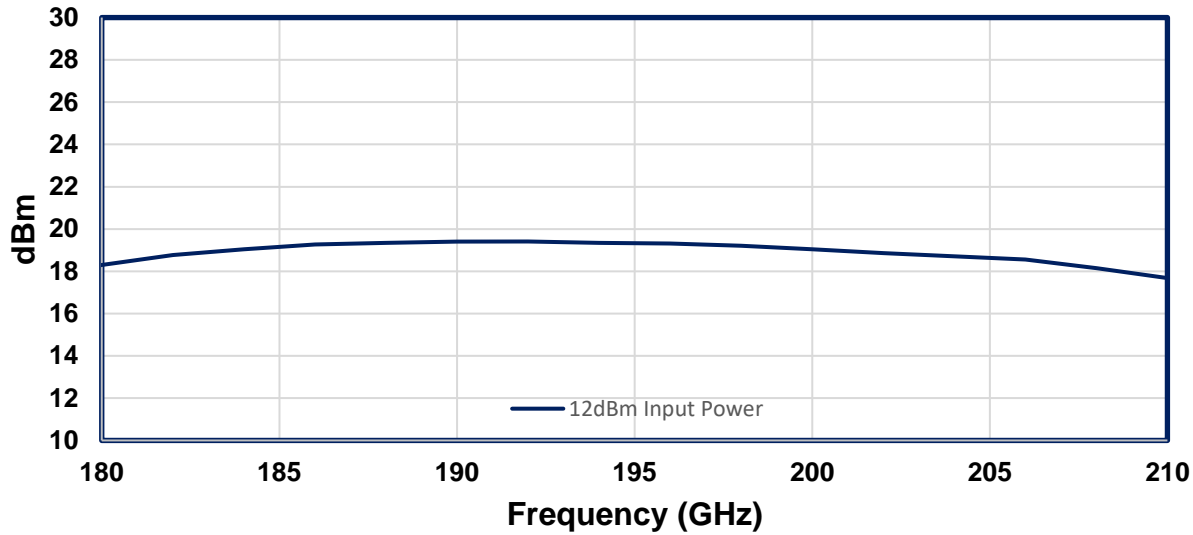


# Amplifier Performance – Continued

## 197AMPS - S-Parameters

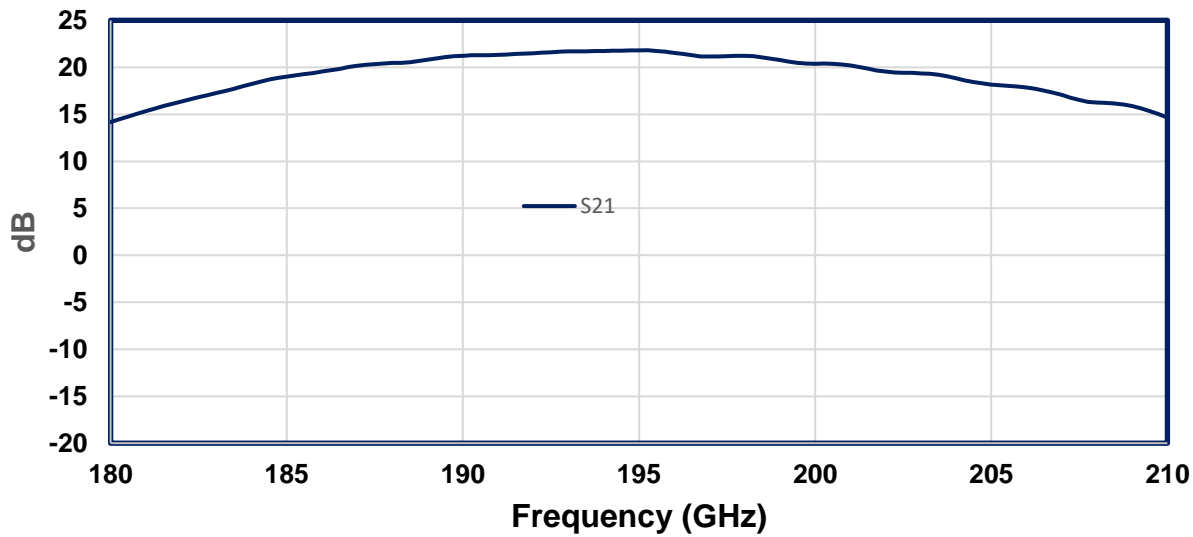


## 197AMPS - Saturated Output Power

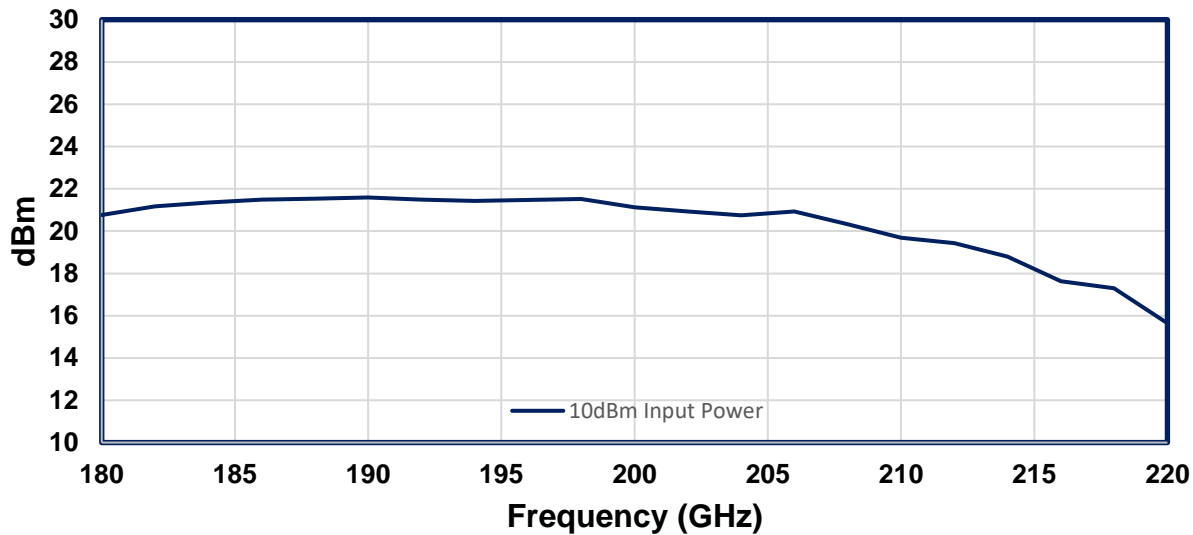


# Amplifier Performance – Continued

## 197AMPMP - S-Parameters



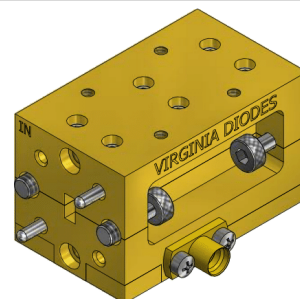
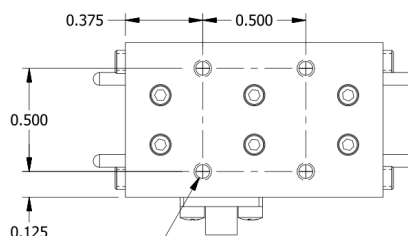
## 197AMPMP - Saturated Output Power



### Mechanical Drawing (WR15, WR12, WR10, WR8.0, WR6.5, WR4.3, 130AMPS and 197AMPS Amplifiers)

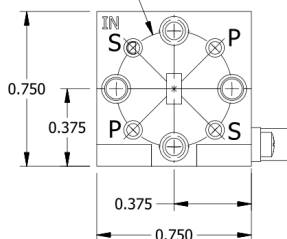
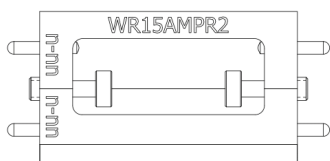
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WAVEGUIDE FLANGES:  
(2) WR-15, UG-387/U-M  
(1) SMP

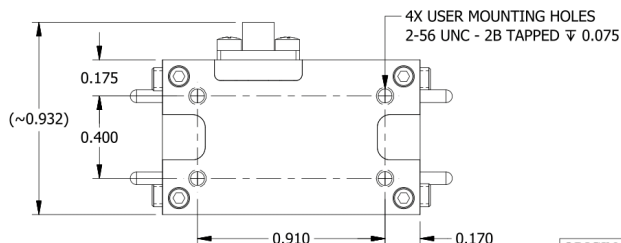
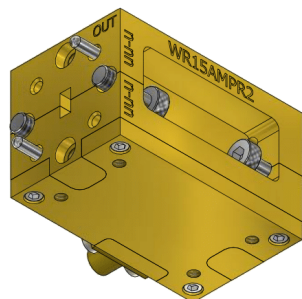
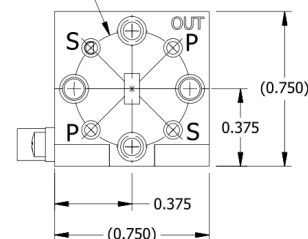
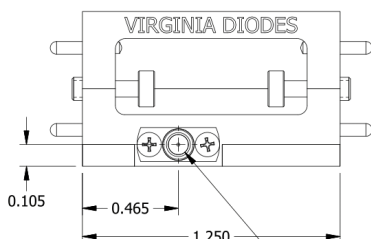


4X USER MOUNTING HOLES  
2-56 UNC - 2B TAPPED  $\nabla$  0.100

WR-15 WAVEGUIDE:  
FLANGE UG-387/U-M



WR-15 WAVEGUIDE:  
FLANGE UG-387/U-M



ORIGINAL DRAWING BY: C. NEFF  
SEGARS ENGINEERING *for*:

**VIRGINIA DIODES, INC.**  
979 2nd ST. SE, SUITE 309  
CHARLOTTESVILLE, VA 22902  
PHONE: 434.297.3257  
FAX: 434-297-3258  
www.virginiadiodes.com

NOTE: SPECIFICATIONS AND CHARACTERISTICS ARE TYPICAL AND SUBJECT TO CHANGE AT ANY TIME.

TITLE:  
**WR-15AMPR2V1**

MATERIAL:  
ALUMINUM ALLOY (MAY BE GOLD PLATED)

LAST REV. DATE:  
8/24/2016

SHEET:  
1 OF 1

MODEL #:  
WR15AMP

LAST REV.:  
R2V1

UNITS:  
INCH

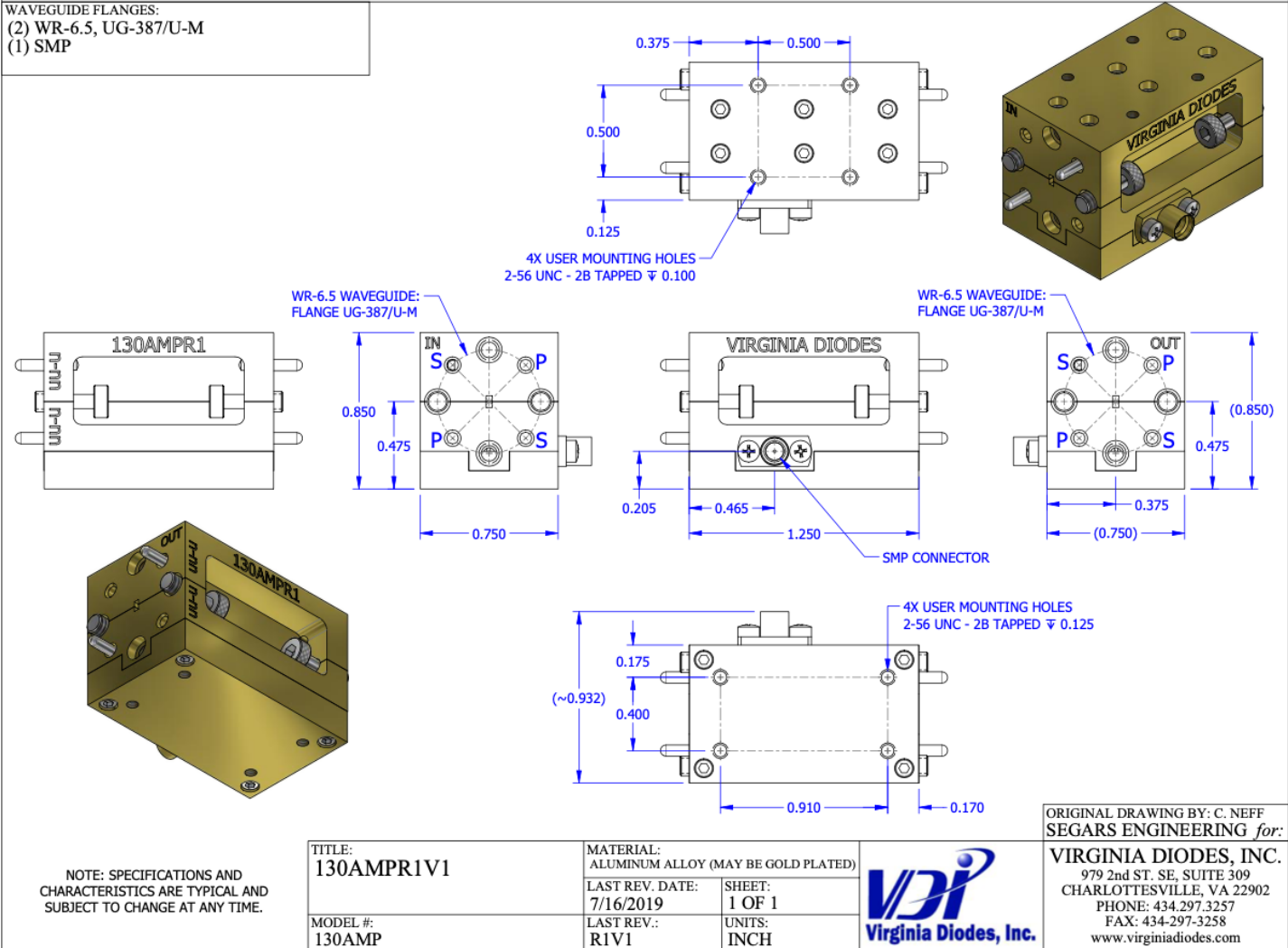


# Mechanical Drawing – Continued

## Mechanical Drawing (170AMPS Only)

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WAVEGUIDE FLANGES:  
 (2) WR-6.5, UG-387/U-M  
 (1) SMP



NOTE: SPECIFICATIONS AND CHARACTERISTICS ARE TYPICAL AND SUBJECT TO CHANGE AT ANY TIME.

TITLE:  
**130AMP R1V1**

MODEL #:  
 130AMP

MATERIAL:  
 ALUMINUM ALLOY (MAY BE GOLD PLATED)

LAST REV. DATE:  
 7/16/2019

LAST REV.:  
 R1V1

SHEET:  
 1 OF 1

UNITS:  
 INCH

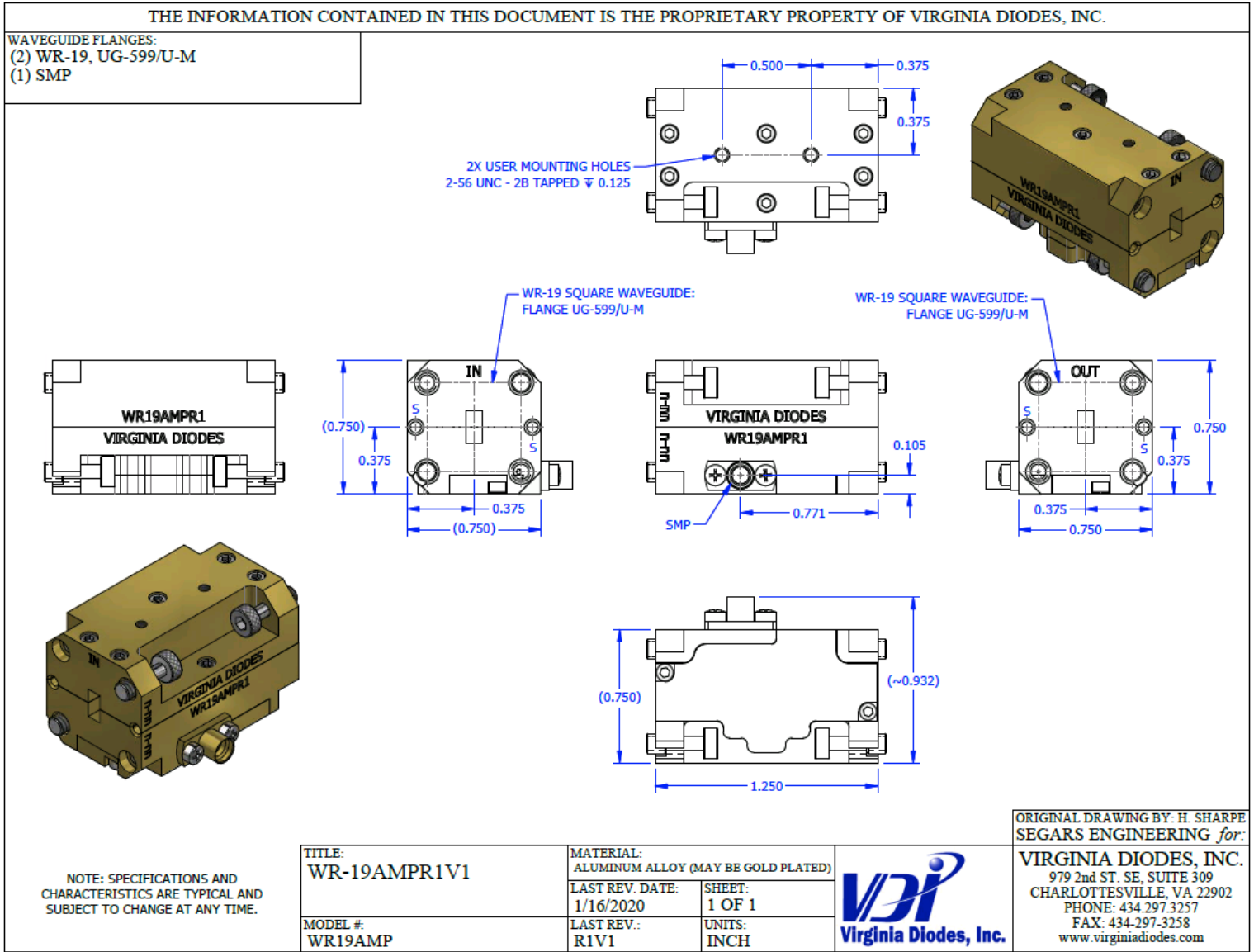


ORIGINAL DRAWING BY: C. NEFF  
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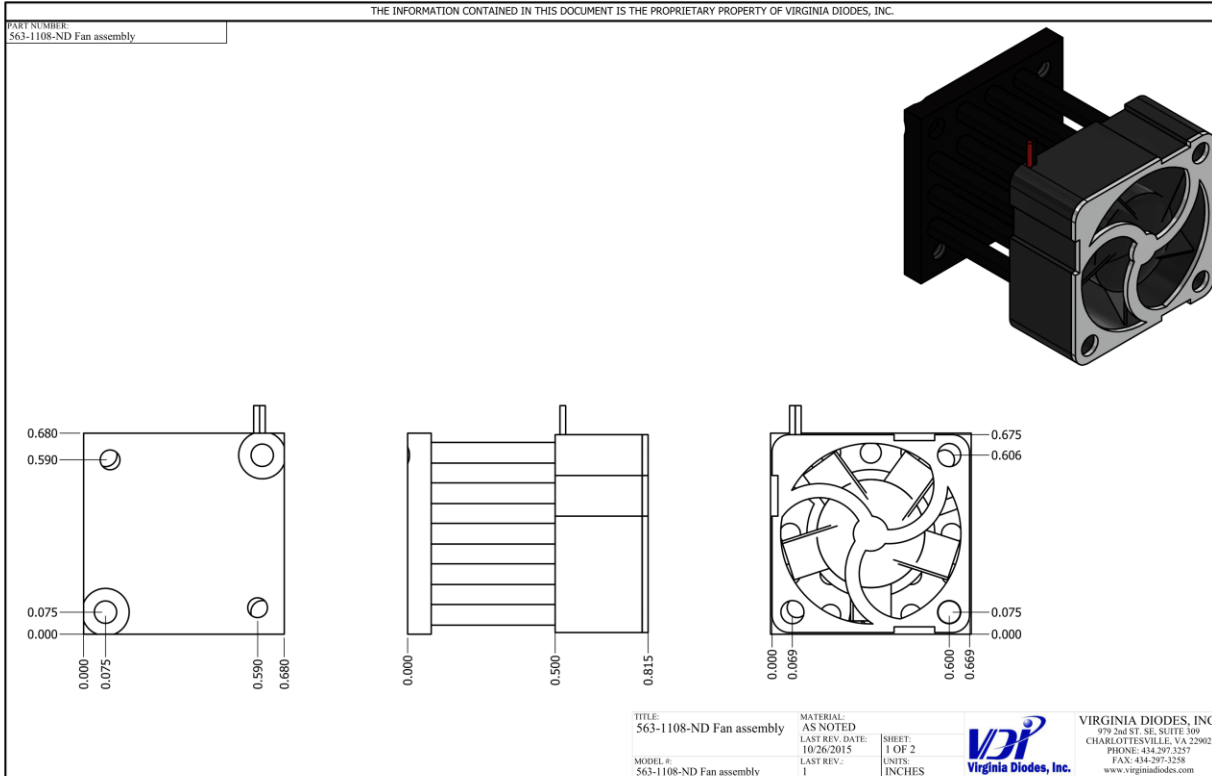
# Mechanical Drawing – Continued

## Mechanical Drawing (WR19AMP Only)



# Mechanical Drawing – Continued

Heatsink + Fan Assembly drawing is shown below. The Heatsink + Fan Assembly is included for select Narrowband Amplifiers.



# Addendum — Product Updates and Company Contacts

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 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](mailto:Technical@vadiodes.com)

Telephone: 434.297.3257