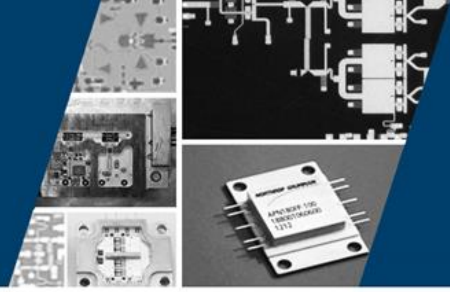
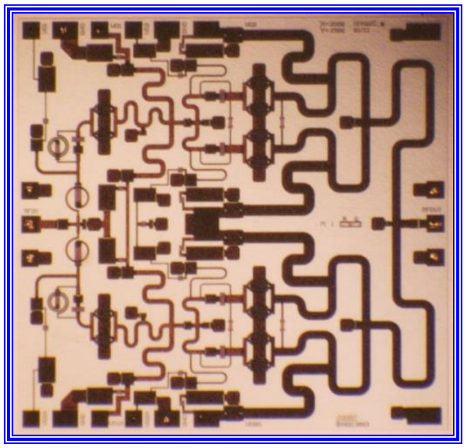
APN226
13.5-15.5 GHz
GaN Power Amplifier



Production Datasheet

Revision: July 2014



X = 2.6mm Y = 2.5mm

Product Features

- RF frequency: 13.5 to 15.5 GHz
- Linear Gain: 20 dB typ.
- Psat: 39.5 dBm typ.
- 0.2um GaN HEMT Process
- 4 mil SiC substrate
- DC Power: 24 VDC @ 880 mA

Applications

- Point-to-Point Digital Radios
- Point-to-Multipoint Digital Radios
- SATCOM Terminals

Product Description

The APN226 monolithic GaN HEMT amplifier is a broadband, two-stage power device, designed for use in SATCOM Terminals and point-to-point digital radios. To ensure rugged and reliable operation, HEMT devices are fully passivated. Both bond pad and backside metallization are Au-based that is compatible with epoxy and eutectic die attach methods.

Performance Characteristics (Ta = 25°C)

Specification	Min	Typ	Max	Unit
Frequency	13.5		15.5	GHz
Linear Gain	19	20		dB
Input Return Loss	9.5	12		dB
Output Return Loss	9.5	12		dB
P1dB (Pulsed)		36.5		dBm
Psat (Pulsed)	38.5	39.5		dBm
PAE @ Psat		27		%
Vd1, Vd2		24		V
Vg1		-3.5		V
Vg2		-3.5		V
Id1		240		mA
Id2		640		mA

Absolute Maximum Ratings (Ta = 25°C)

Parameter	Min	Max	Unit
Vd1, Vd2	20	28	V
Id1		300	mA
Id2		800	mA
Vg1, Vg2	-5	0	V
Input drive level		TBD	dBm
Assy. Temperature (TBD seconds)		300	deg. C

Note: The data contained in this document is for information only. Northrop Grumman reserves the right to change without notice the specifications, designs, prices or conditions of sale, as they apply to this product. The product represented by this datasheet is subject to U.S. Export Law as contained in the Export Administration Regulations (EAR).

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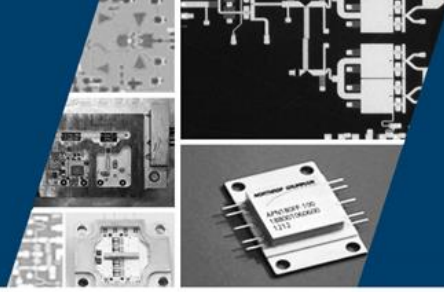
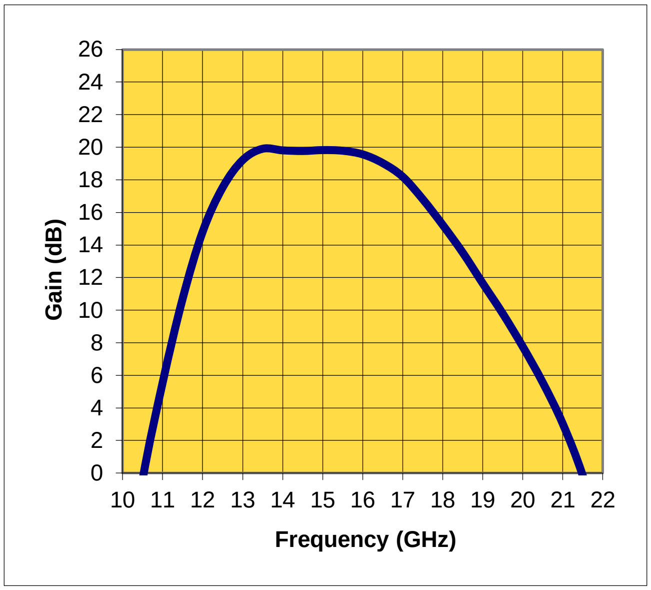
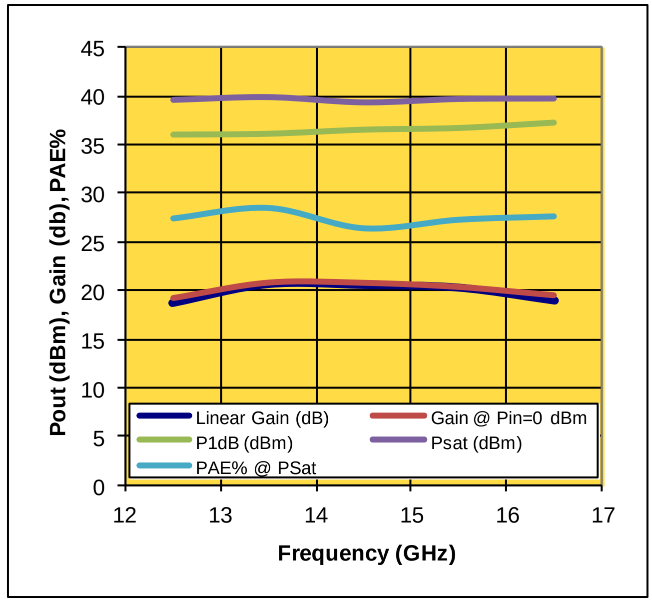


Measured On-Wafer Performance Characteristics (Typical Performance at 25°C)
Vd1 = Vd2 = 24 V, Id1 = 240 mA, Id2 = 640 mA *

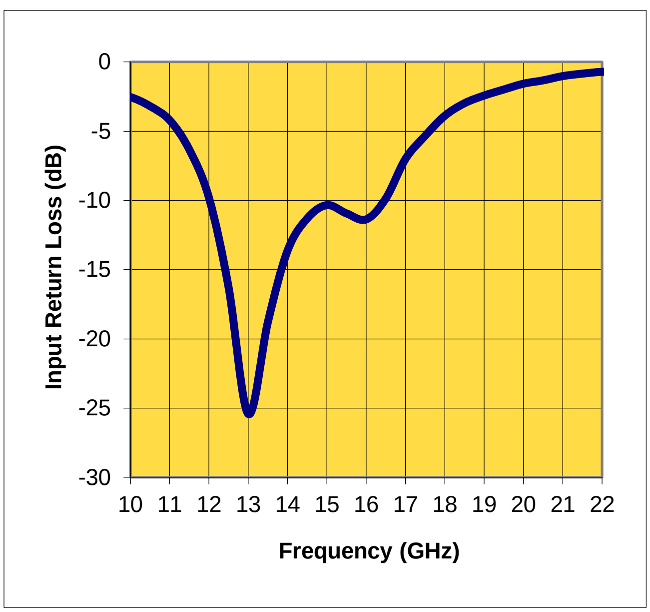
Linear Gain vs. Frequency



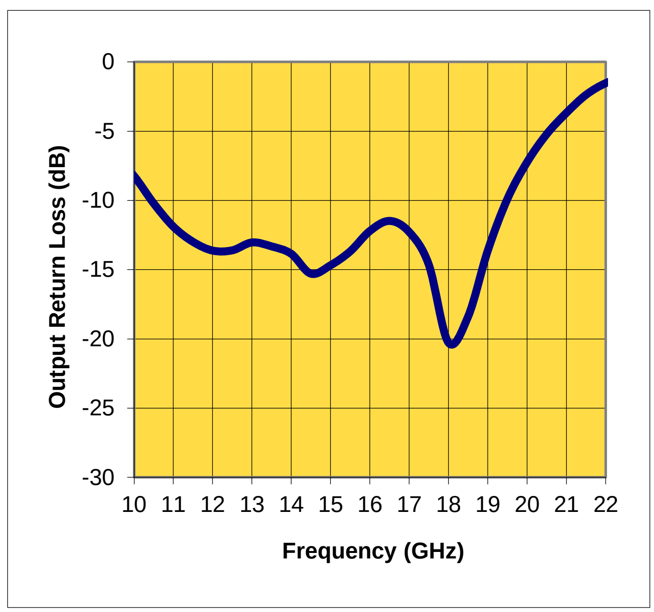
Power, Gain, PAE% vs. Frequency



Input Return Loss vs. Frequency



Output Return Loss vs. Frequency



* Pulsed-Power On-Wafer

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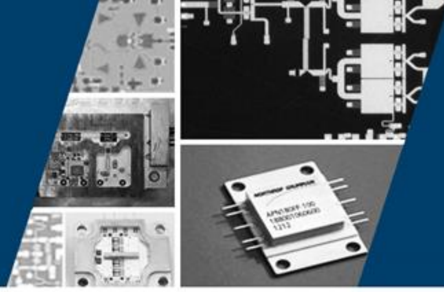
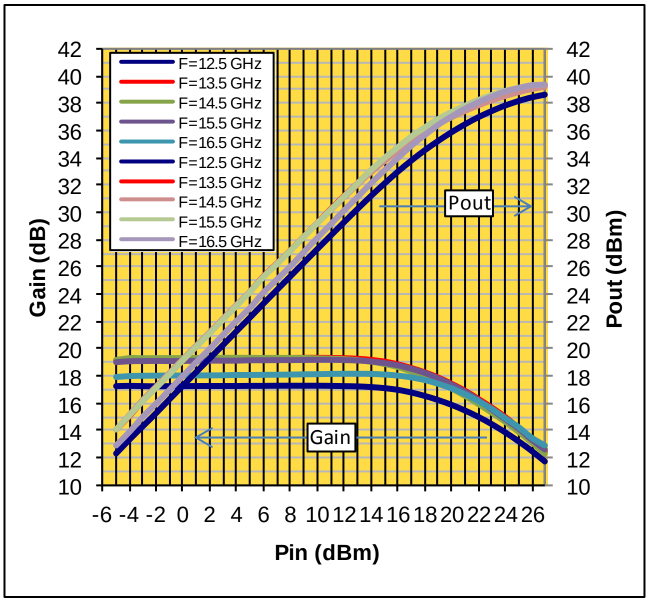
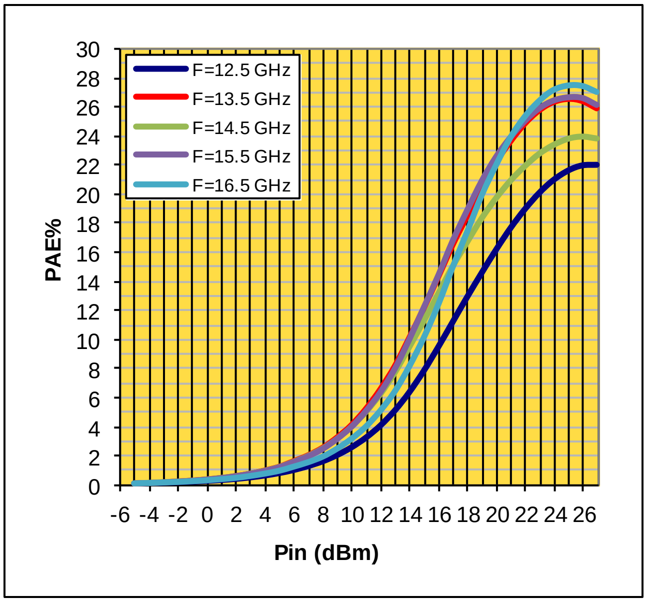


Measured Fixtured Performance Characteristics (Typical Performance at 25°C)
Vd1 = Vd2 = 24 V Id1 = 240 mA, Id2 + Id2a = 640 mA **

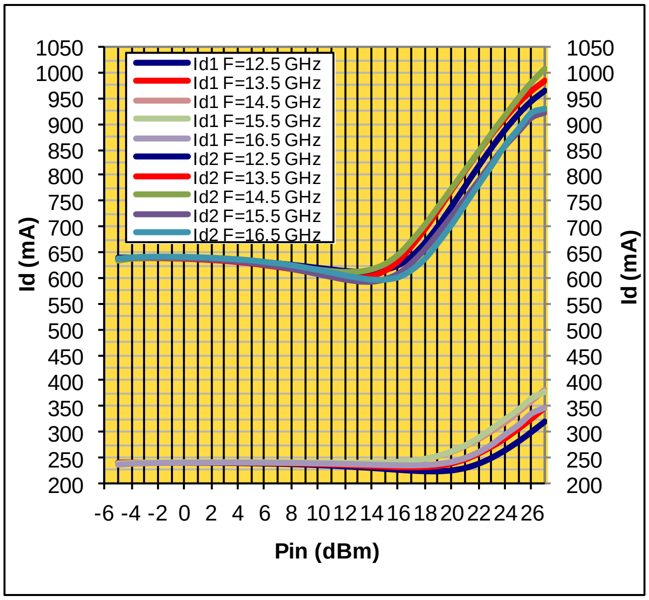
Pout vs. Pin



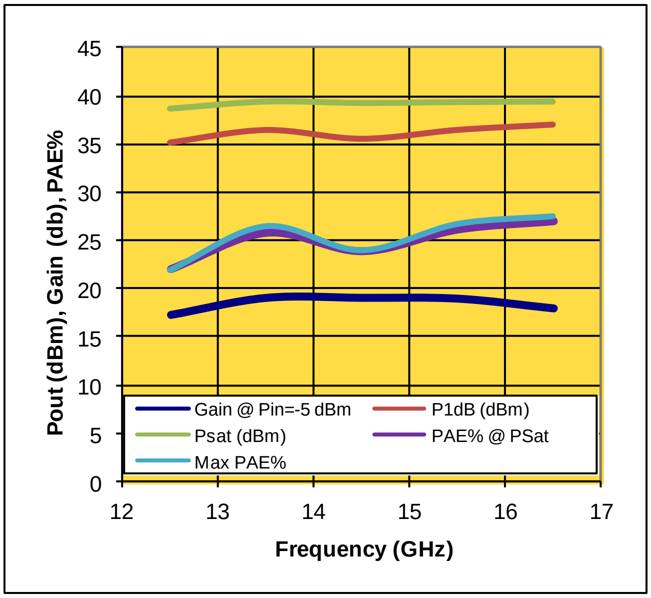
PAE% vs. Pin



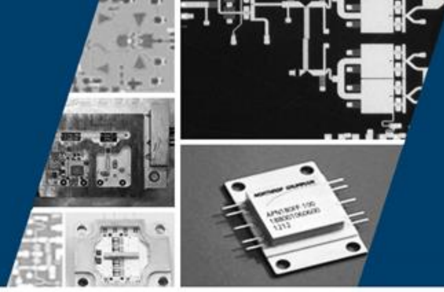
Gain vs. Pin



Pout, Gain & PAE% vs. Frequency



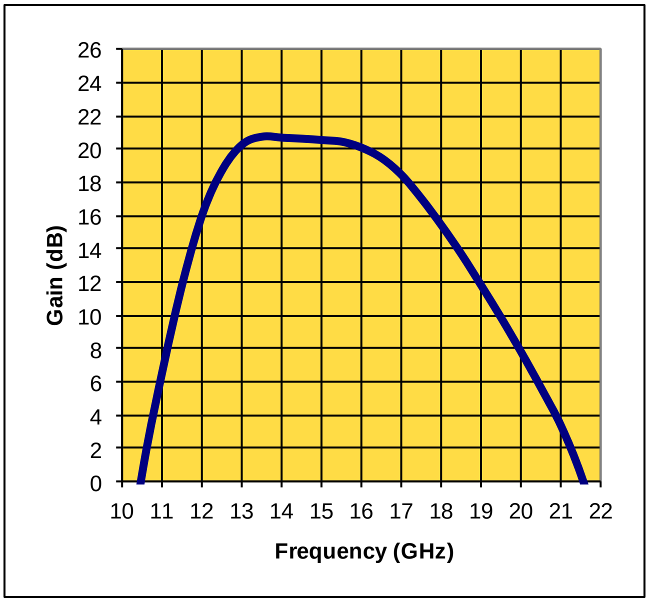
** CW Fixtured



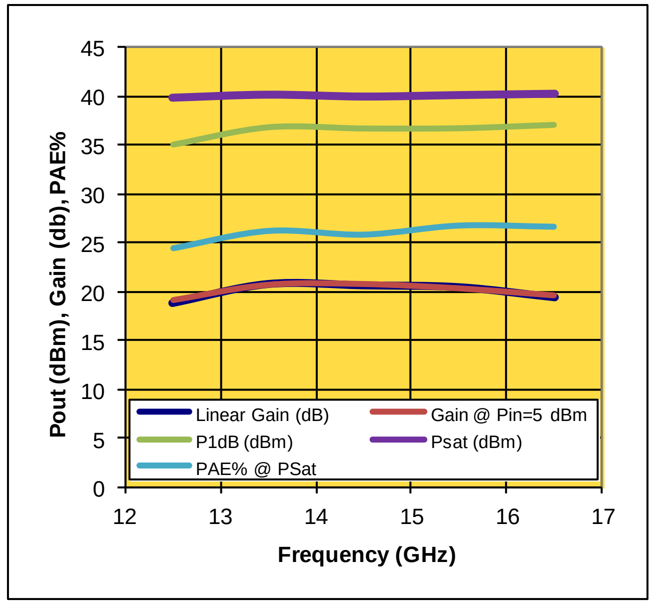
Measured On-Wafer Performance Characteristics (Typical Performance at 25°C)

Vd1 = Vd2 = 28 V, Id1 = 240 mA, Id2 = 640 mA *

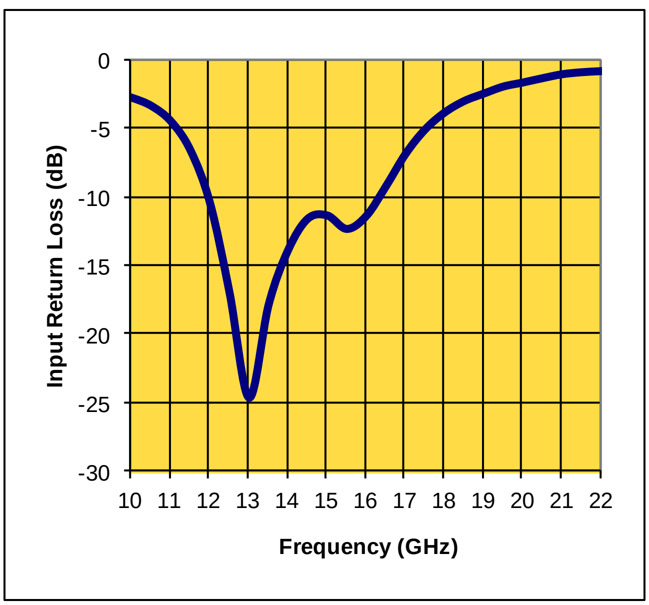
Linear Gain vs. Frequency



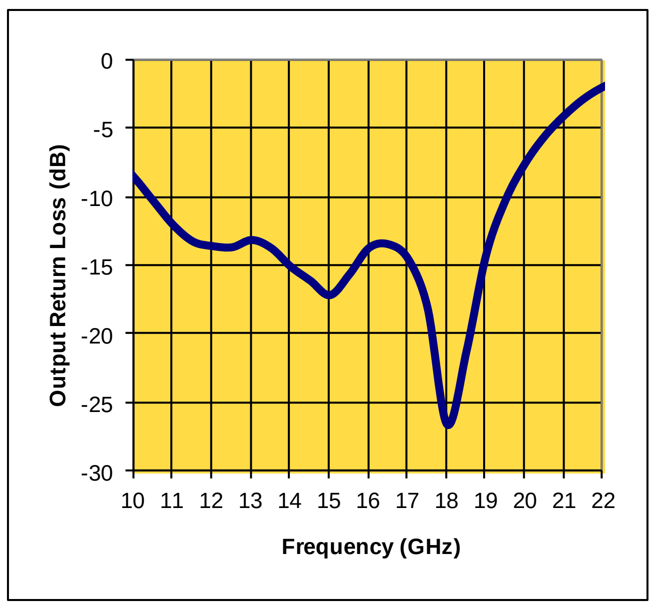
Power, Gain, PAE% vs. Frequency



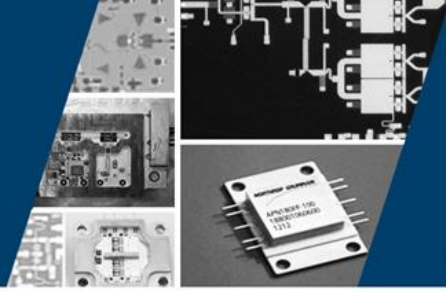
Input Return Loss vs. Frequency



Output Return Loss vs. Frequency

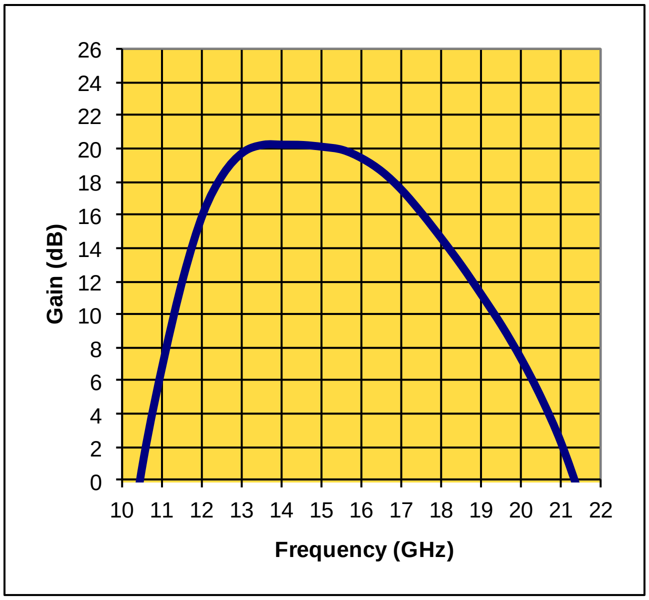


* Pulsed-Power On-Wafer

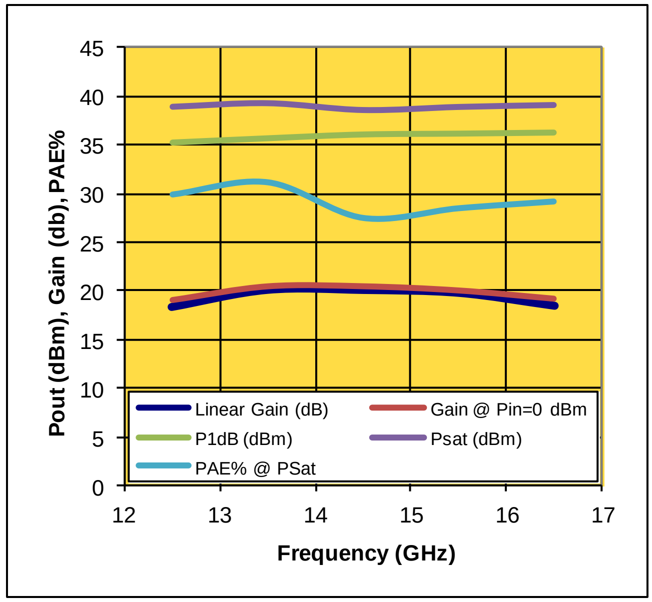


Measured On-Wafer Performance Characteristics (Typical Performance at 25°C) Vd1 = Vd2 = 20 V, Id1 = 240 mA, Id2 = 640 mA *

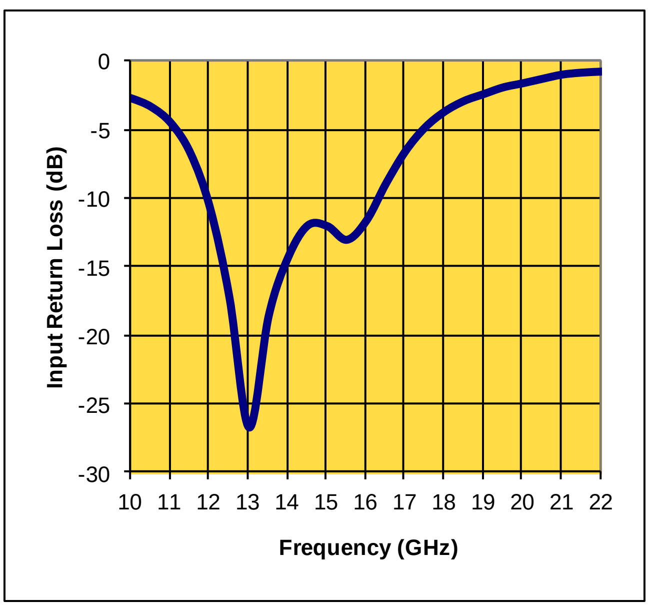
Linear Gain vs. Frequency



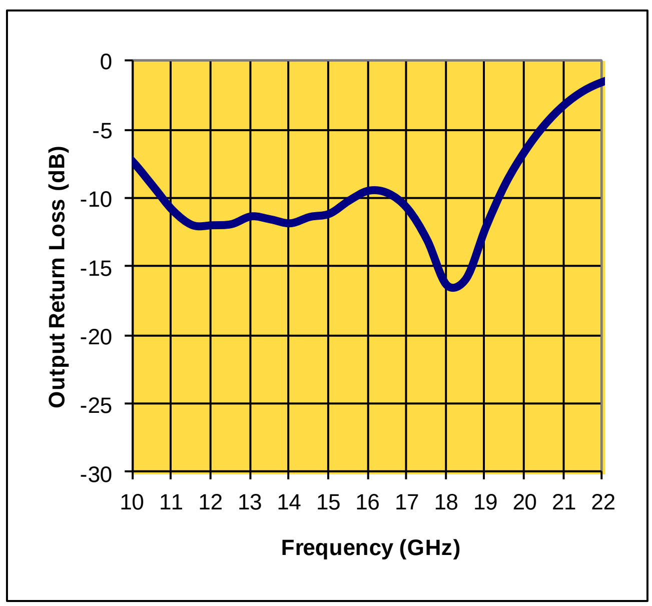
Power, Gain, PAE% vs. Frequency



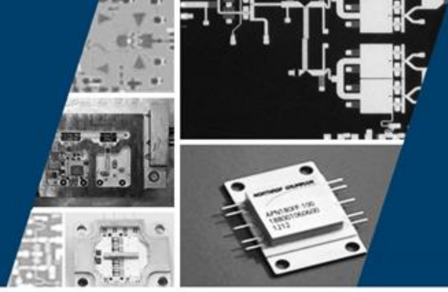
Input Return Loss vs. Frequency



Output Return Loss vs. Frequency

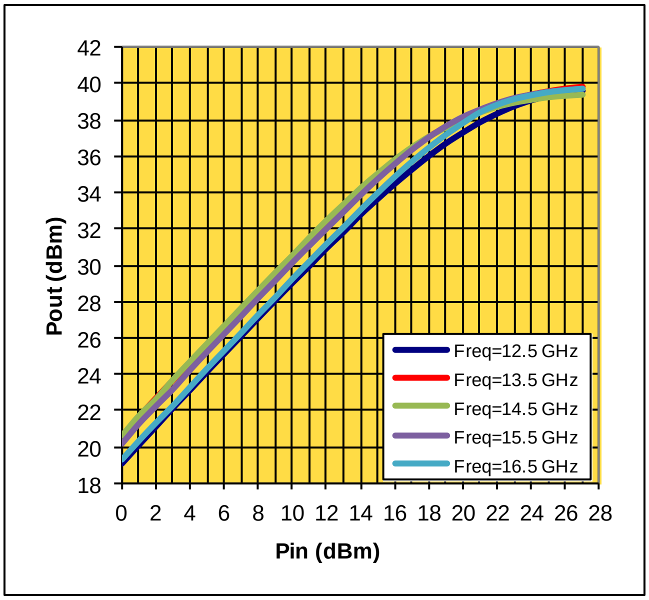


* Pulsed-Power On-Wafer

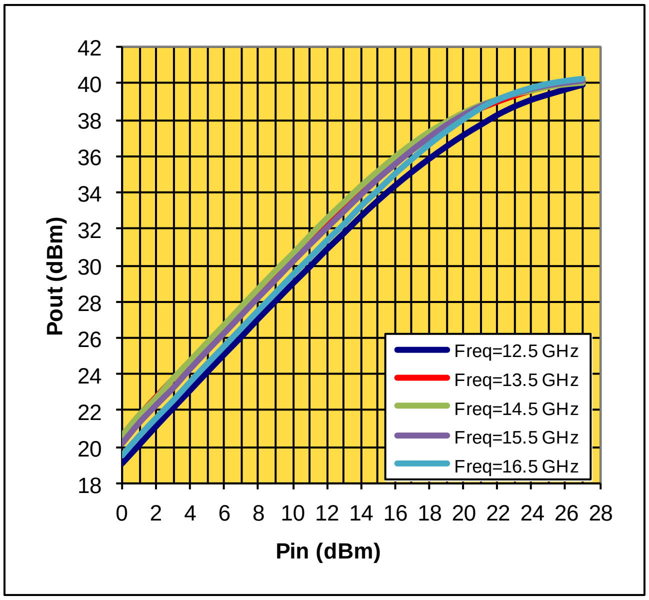


Measured On-Wafer Performance Characteristics (Typical Performance at 25°C)
Id1 = 240 mA, Id2 = 640 mA

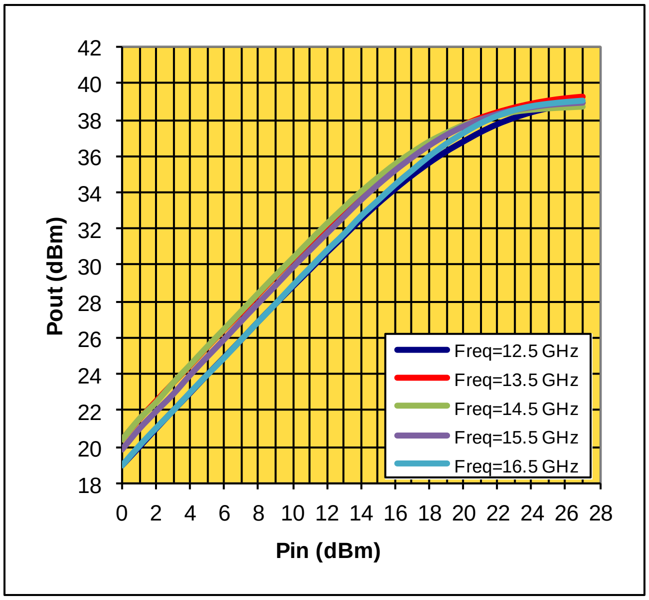
Pout vs. Pin @ Vd1 = Vd2 = 24V *



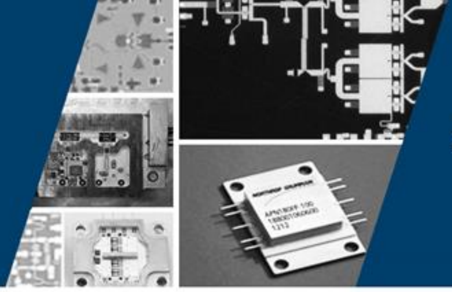
Pout vs. Pin @ Vd1 = Vd2 = 28V *



Pout vs. Pin @ Vd1 = Vd2 = 20V *



* Pulsed-Power On-Wafer



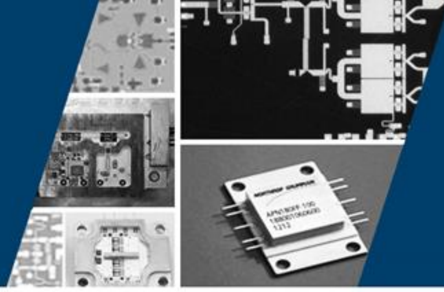
Thermal Properties

Preliminary Thermal Properties with die mounted with 1mil 80/20 AuSn Eutectic to 25mil CuW Shim.

Conditions	Shim Boundary Temperature	Junction Temperature Tjc	Thermal Resistance θjc
Vd = 24V, Id1 = 380 mA * Id2 + Id2a = 1008 mA * Pin=26.9 dBm Pout=39.3 dBm	25 ºC 50 ºC 52.5 ºC	159.3 ºC 196.1 ºC 200.0 ºC **	5.3 ºC/W 5.8 ºC/W 5.83 ºC/W

* Vd = 24.0 V, Idq1 = 240 mA, Id2q = 640 mA
** Max recommended. Pre-qualification reliability testing indicates that MTTF in excess of 10^5 hours can be achieved by ensuring Tjc is kept below 200ºC.

* Pulsed-Power On-Wafer



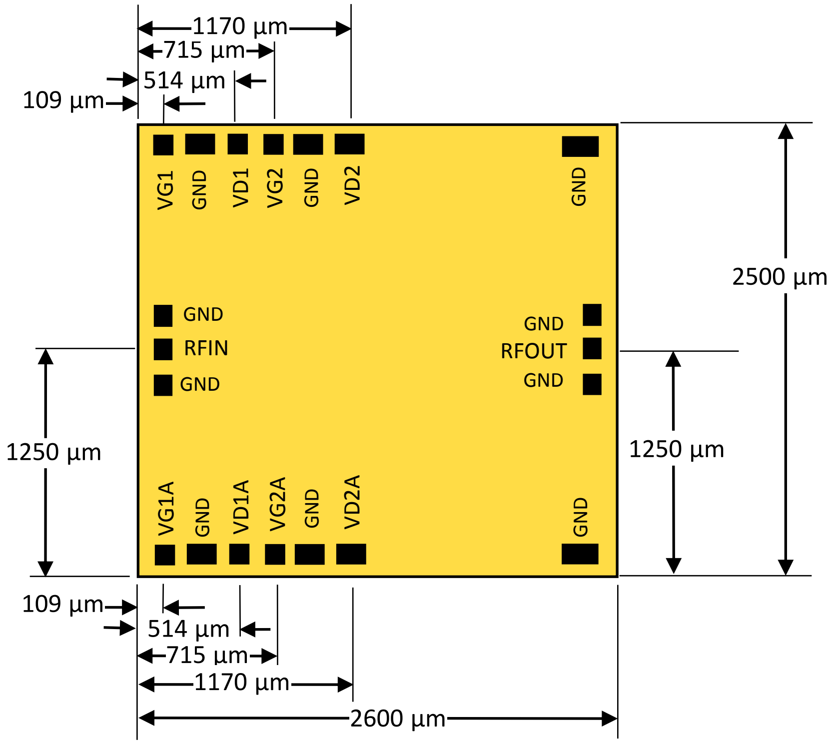
Measured On-Wafer Performance Characteristics (Typical Performance at 25°C)
Vd1 = Vd2 = 24 V, Id1 = 240 mA, Id2 = 640 mA *

Freq GHz	S11 Mag	S11 Ang	S21 Mag	S21 Ang	S12 Mag	S12 Ang	S22 Mag	S22 Ang
8.0	0.788	-175.150	0.056	-69.128	0.002	-149.171	0.624	145.730
8.5	0.792	177.549	0.054	-50.533	0.003	100.724	0.595	126.795
9.0	0.782	169.211	0.081	-26.971	0.005	98.959	0.528	102.406
9.5	0.767	160.468	0.171	-9.116	0.006	84.303	0.455	75.452
10.0	0.743	148.982	0.425	-13.926	0.002	39.443	0.386	43.034
10.5	0.685	136.345	1.041	-37.959	0.004	45.457	0.307	6.553
11.0	0.606	120.640	2.053	-72.411	0.005	78.299	0.252	-24.432
11.5	0.461	101.870	3.697	-111.478	0.004	-19.991	0.229	-50.326
12.0	0.305	82.279	5.877	-156.942	0.006	22.788	0.215	-71.266
12.5	0.140	57.241	7.944	156.616	0.006	-11.884	0.209	-83.304
13.0	0.033	-7.924	9.536	110.075	0.004	-57.805	0.223	-95.152
13.5	0.107	-101.508	10.221	65.248	0.007	-38.639	0.217	-111.473
14.0	0.192	-119.288	10.070	25.403	0.002	-170.834	0.204	-115.664
14.5	0.245	-134.405	10.015	-11.781	0.002	-161.559	0.172	-119.745
15.0	0.273	-143.902	10.061	-47.813	0.002	64.799	0.174	-116.071
15.5	0.254	-141.837	9.979	-83.956	0.004	125.238	0.186	-115.597
16.0	0.259	-133.613	9.615	-121.442	0.004	51.271	0.205	-120.465
16.5	0.348	-122.232	8.968	-159.474	0.005	5.375	0.227	-134.886
17.0	0.477	-126.098	8.065	162.641	0.005	-6.692	0.200	-153.352
17.5	0.569	-132.862	6.836	125.406	0.008	-53.726	0.144	-179.669
18.0	0.662	-139.509	5.673	90.341	0.004	-176.720	0.062	117.915
18.5	0.725	-148.466	4.646	55.355	0.003	-141.496	0.101	25.350
19.0	0.769	-155.321	3.720	20.982	0.007	-102.598	0.209	-8.918
19.5	0.807	-160.898	2.978	-12.195	0.002	-161.597	0.322	-25.318
20.0	0.845	-166.839	2.350	-46.408	0.006	111.398	0.433	-39.840
20.5	0.865	-171.744	1.839	-81.138	0.002	-135.188	0.545	-54.065
21.0	0.895	-176.622	1.404	-118.400	0.005	-152.650	0.647	-65.974
21.5	0.910	178.326	1.002	-159.002	0.005	76.670	0.747	-76.390
22.0	0.925	173.710	0.627	159.607	0.009	87.246	0.832	-89.068
22.5	0.923	169.561	0.341	122.484	0.005	-140.272	0.873	-99.611
23.0	0.931	165.925	0.173	92.298	0.010	115.686	0.903	-108.257
23.5	0.934	162.265	0.087	68.801	0.005	68.757	0.918	-116.042
24.0	0.940	159.140	0.043	52.012	0.007	102.110	0.933	-122.749

* Pulsed-Power On-Wafer

Die Size and Bond Pad Locations (Not to Scale)

X = 2600 ± 25 µm
Y = 2500 ± 25 µm
DC Bond Pad = 100 x 100 ± 0.5 µm
RF Bond Pad = 100 x 100 ± 0.5 µm
Chip Thickness = 101 ± 5 µm



Biasing/De-Biasing Details:
APN226 can be biased from either the top or the bottom of the die.

Listed below are some guidelines for GaN device testing and wire bonding:

a. Limit positive gate bias (G-S or G-D) to < 1V
b. Know your devices' breakdown voltages
c. Use a power supply with both voltage and current limit.
d. With the power supply off and the voltage and current levels at minimum, attach the ground lead to your test fixture.
    i. Apply negative gate voltage (-5 V) to ensure that all devices are off
    ii. Ramp up drain bias to ~10 V
    iii. Gradually increase gate bias voltage while monitoring drain current until 20% of the operating current is achieved
    iv. Ramp up drain to operating bias
    v. Gradually increase gate bias voltage while monitoring drain current until the operating current is achieved
e. To safely de-bias GaN devices, start by debiasing output amplifier stages first (if applicable):
    i. Gradually decrease drain bias to 0 V.
    ii. Gradually decrease gate bias to 0 V.
    iii. Turn off supply voltages
f. Repeat de-bias procedure for each amplifier stage

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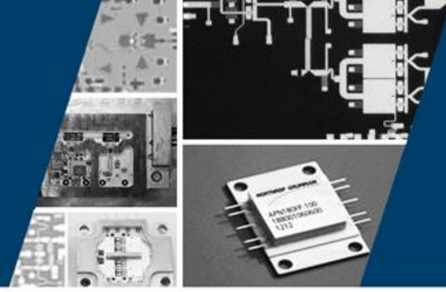
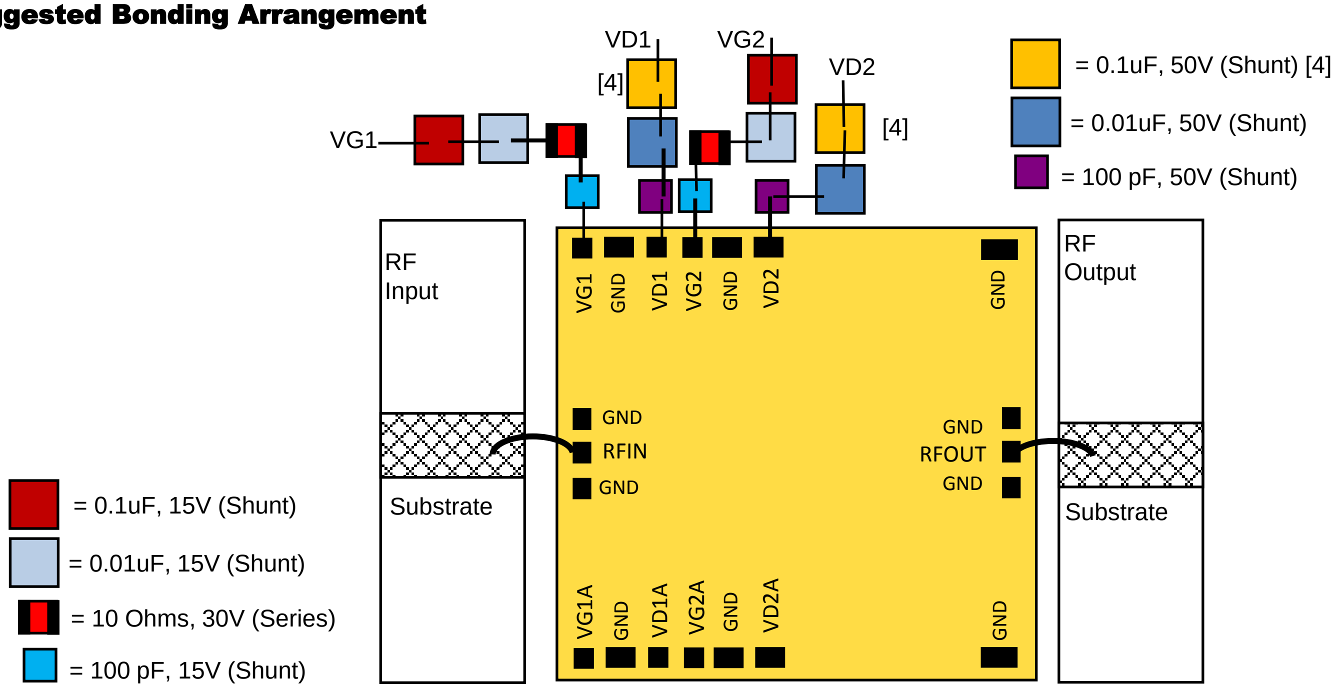


Suggested Bonding Arrangement



Note: APN226 can be biased from either the top or bottom and bias pads VG1A, VD1A, VG2A and VGD2A can be used as an alternative to the configuration shown.

Recommended Assembly Notes

1. Bypass caps should be 100 pF (approximately) ceramic (single-layer) placed no farther than 30 mils from the amplifier.
2. Best performance obtained from use of <10 mil (long) by 3 by 0.5 mil ribbons on input and output.
3. Part must be biased from both sides as indicated.
4. The 0.1uF, 50V capacitors are not needed if the drain supply line is clean. If Drain Pulsing of the device is to be used, do **NOT** use the 0.1uF , 50V Capacitors.

Mounting Processes

Most NGAS GaN IC chips have a gold backing and can be mounted successfully using either a conductive epoxy or AuSn attachment. NGAS recommends the use of AuSn for high power devices to provide a good thermal path and a good RF path to ground. Maximum recommended temp during die attach is 320ºC for 30 seconds.

Note: Many of the NGAS parts do incorporate airbridges, so caution should be used when determining the pick up tool.

CAUTION: THE IMPROPER USE OF AuSn ATTACHMENT CAN CATASTROPHICALLY DAMAGE GaN CHIPS.

PLEASE ALSO REFER TO OUR "GaN Chip Handling Application Note" BEFORE HANDLING, ASSEMBLING OR BIASING THESE MMICS!