

# GaN High Power Amplifier, 10 W

## 2 - 20 GHz



MAAP-G0100D

Rev. V1

### Features

- Saturated Power: 10 W
- Power Added Efficiency: 24%
- Large Signal Gain: 18 dB
- Small Signal Gain: 22 dB
- Input Return Loss: <-10 dB
- Output Return Loss: <-10 dB
- CW operation
- Small Footprint

### Applications

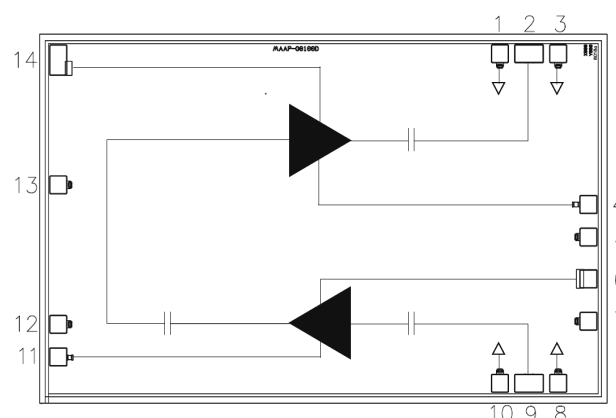
- Electronic Warfare
- Test and Measurement
- Radar
- General Amplification

### Description

The MAAP-G0100D is a 10 W, MMIC HPA utilizing MACOM's high performance, 0.15  $\mu\text{m}$  GaN-on-SiC production process. This amplifier operates from 2 - 20 GHz and can support a variety of applications such as electronic warfare, radar, test and measurement, among others. Under saturation, the MAAP-G0100D achieves 10 W of typical output power with 18 dB of large signal gain and 24% power-added efficiency.

The bare die solution provides peak performance while minimizing required board space.

### Functional Schematic



### Pin Configuration<sup>1</sup>

Pin #	Name
1,3,5,7,8,10,12,13	GND
2	RF Output
4	VG2
6	VD1
9	RF Input
11	VG1
14	VD2

1. The backside of the MMIC must be connected to RF, DC and thermal ground.

### Ordering Information

Part Number	Package
MAAP-G0100D	Gel Pack (10/10)
MAAP-G0100D-AMP	Sample Board (1/1)

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**RF Electrical Specifications:**  $V_D = 28 \text{ V}$ ,  $I_{DQ} = 500 \text{ mA}$ , CW,  $T_C = 25^\circ\text{C}$ ,  $Z_0 = 50 \Omega$

Parameter	Test Conditions	Frequency (GHz)	Units	Min.	Typ.	Max.
Output Power	$P_{IN} = 22 \text{ dBm}$	2 10 20	dBm	39.5 40.5 39.2	40.5 41.5 40.8	—
Power Added Efficiency		2 10 20	%	18 22 22	22 28 29	—
Large Signal Gain		2 10 20	dB	17.5 18.5 17.2	18.5 19.5 19.5	—
Small Signal Gain	$P_{IN} = -20 \text{ dBm}$	2 10 20	dB	—	25 25 20	—
Input Return Loss		2-20	dB	—	-10	—
Output Return Loss		2-20	dB	—	-10	—

### DC Electrical Specifications:

Parameter	Units	Min.	Typ.	Max.
Drain Voltage	V	—	28	—
Gate Voltage	V	—	-1.8	—
Quiescent Drain Current	mA	—	500	—
Saturated Drain Current	mA	—	2000	—

## Recommended Operating Conditions

Parameter	Symbol	Unit	Min.	Typ.	Max.
Input Power	$P_{IN}$	dBm	—	22	—
Drain Voltage	$V_D$	V	—	28	—
Gate Voltage	$V_G$	V	—	-1.8	—
Quiescent Drain Current	$I_{DQ}$	mA	—	500	—
Operating Temperature	$T_C$	°C	-40	—	+85

## Absolute Maximum Ratings<sup>2,3</sup>

Parameter	Symbol	Unit	Min.	Max.
Input Power	$P_{IN}$	dBm	—	24
Drain to Source Breakdown Voltage	$V_{DS}$	V	—	84
Drain Voltage	$V_D$	V	20	28
Gate Voltage	$V_G$	V	-8	+2
Drain Current	$I_D$	A	—	2.5
Gate Current	$I_G$	mA	—	7
Dissipated Power @ +85°	$P_{DISS}$	W	—	49
VSWR	—	Ratio	—	3:1
Junction Temperature (MTTF > 1E6 Hrs)	$T_J$	°C	—	+225°C
Storage Temperature	$T_{STG}$	°C	-65	+150
Mounting Temperature (30 seconds)	$T_M$	°C	—	+320

2. Exceeding any one or combination of these limits may cause permanent damage to this device.

3. MACOM does not recommend sustained operation near these survivability limits.

## Handling Procedures

Please observe the following precautions to avoid damage:

## Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

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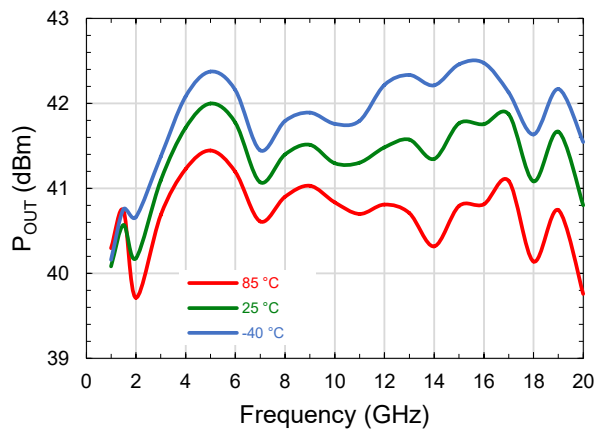
MAAP-G0100D

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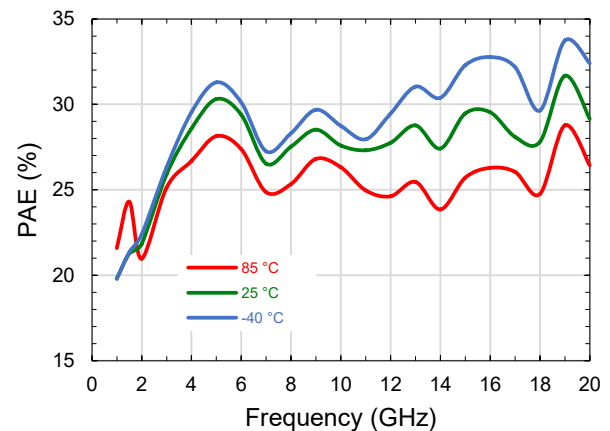
## Typical Performance Curves - Large Signal over Temperature:

$V_D = 28\text{ V}$ ,  $I_{DQ} = 500\text{ mA}$ , CW,  $P_{IN} = 22\text{ dBm}$

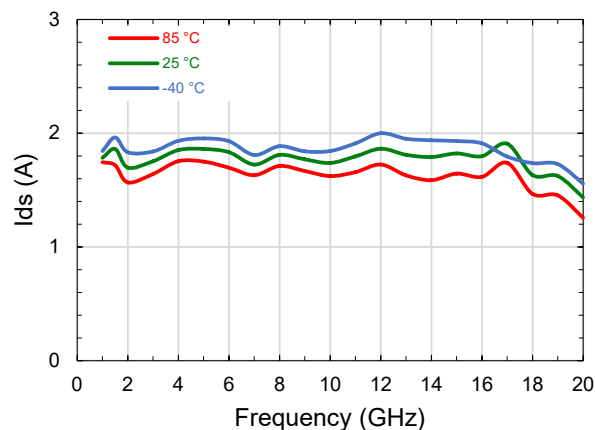
Output Power vs. Frequency



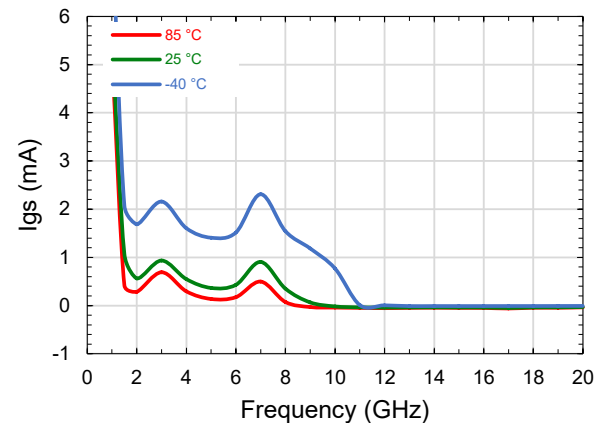
Power Added Efficiency vs. Frequency



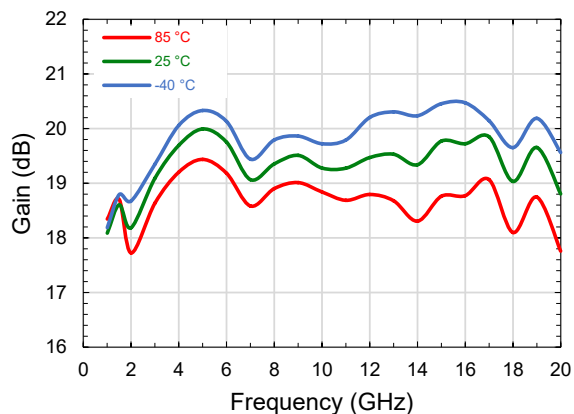
Drain Current vs. Frequency



Gate Current vs. Frequency



Large Signal Gain vs. Frequency



# GaN High Power Amplifier, 10 W 2 - 20 GHz



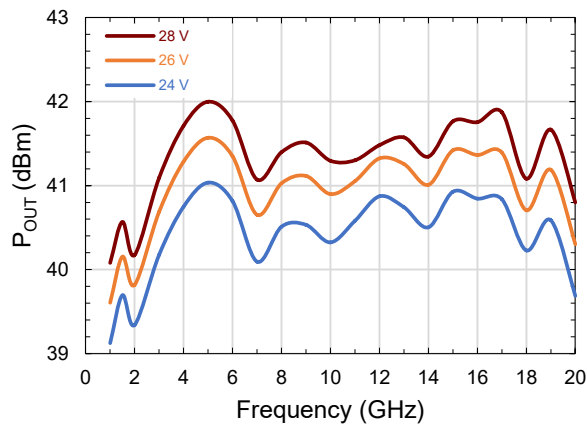
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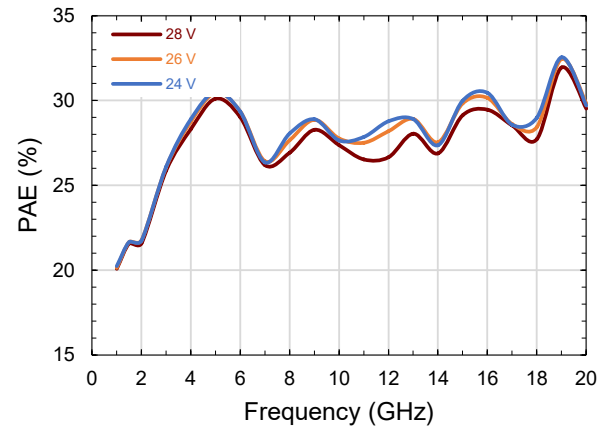
## Typical Performance Curves - Large Signal over $V_D$ :

$I_{DQ} = 500$  mA, CW,  $P_{IN} = 22$  dBm,  $T_C = 25^\circ\text{C}$

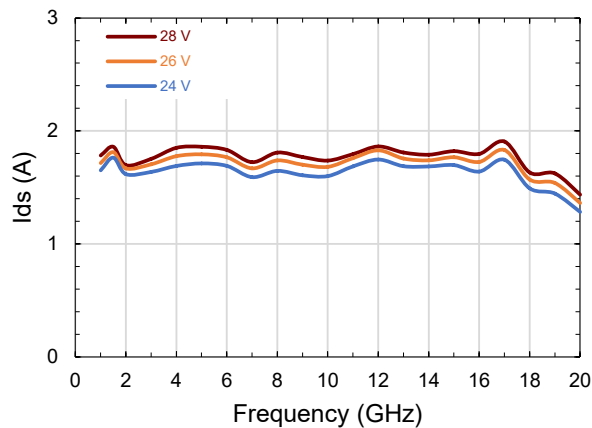
**Output Power vs. Frequency**



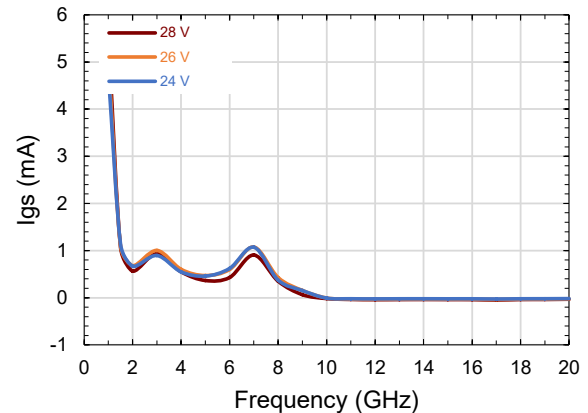
**Power Added Efficiency vs. Frequency**



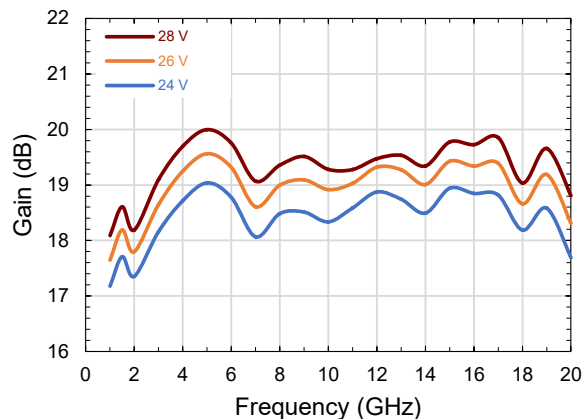
**Drain Current vs. Frequency**



**Gate Current vs. Frequency**



**Large Signal Gain vs. Frequency**



# GaN High Power Amplifier, 10 W 2 - 20 GHz



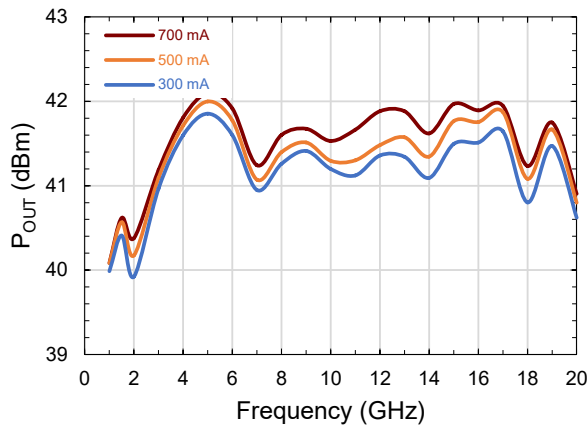
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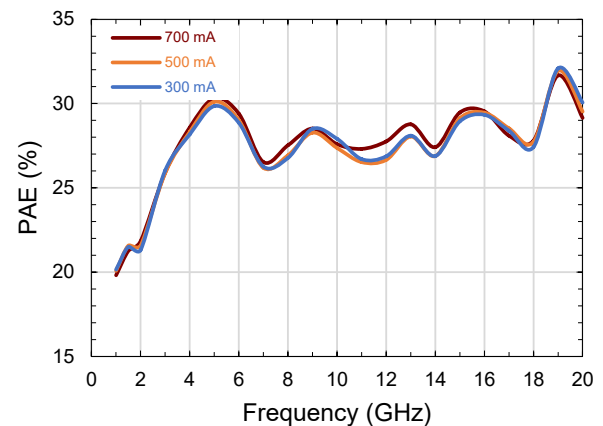
## Typical Performance Curves - Large Signal over $I_{DQ}$ :

$V_D = 28$  V, CW,  $P_{IN} = 22$  dBm,  $T_C = 25^\circ\text{C}$

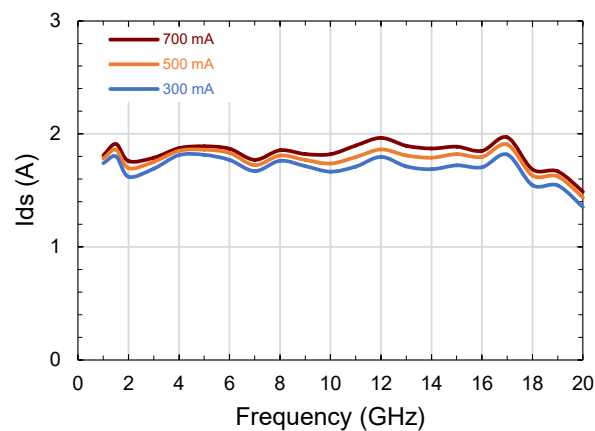
**Output Power vs. Frequency**



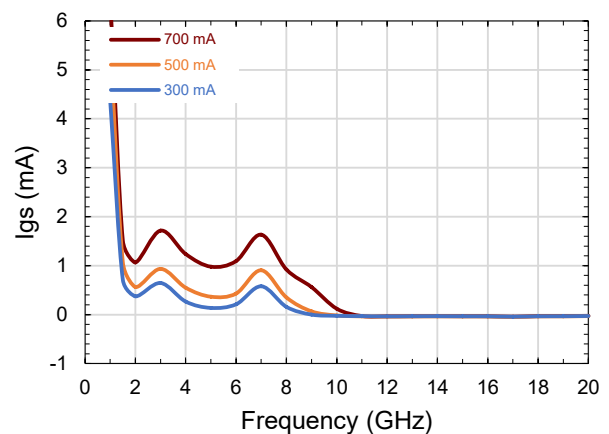
**Power Added Efficiency vs. Frequency**



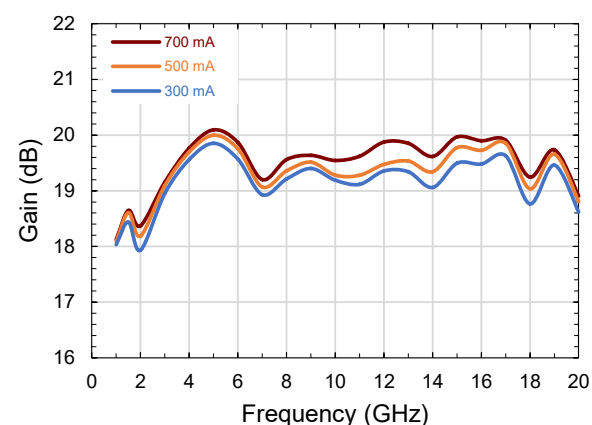
**Drain Current vs. Frequency**



**Gate Current vs. Frequency**



**Large Signal Gain vs. Frequency**



# GaN High Power Amplifier, 10 W 2 - 20 GHz



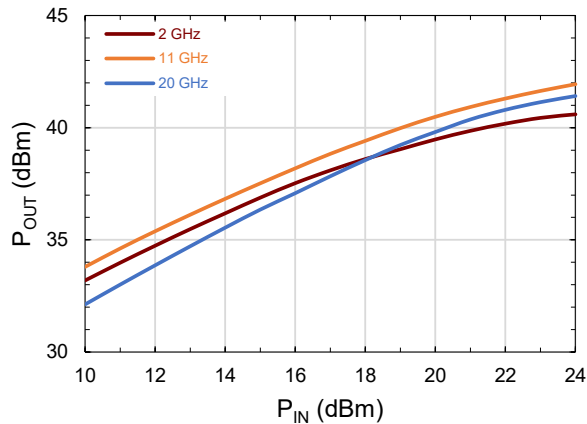
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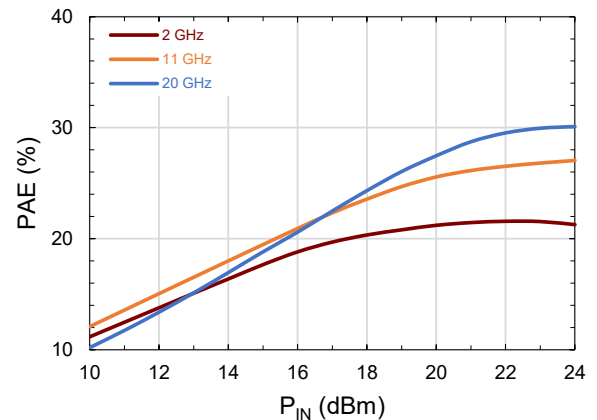
## Typical Performance Curves - Drive-Up over Frequency:

$V_D = 28\text{ V}$ ,  $I_{DQ} = 500\text{ mA}$ , CW,  $T_C = 25^\circ\text{C}$

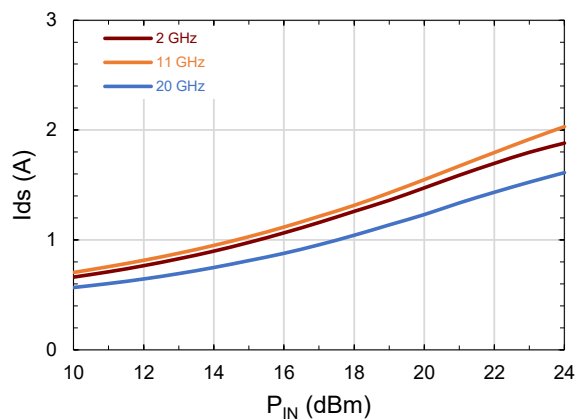
Output Power vs. Input Power



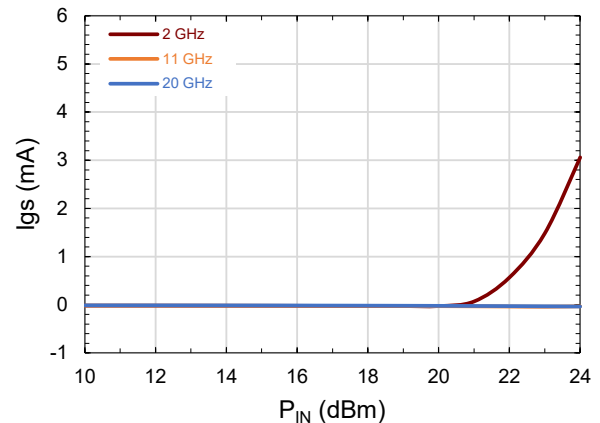
Power Added Efficiency vs. Input Power



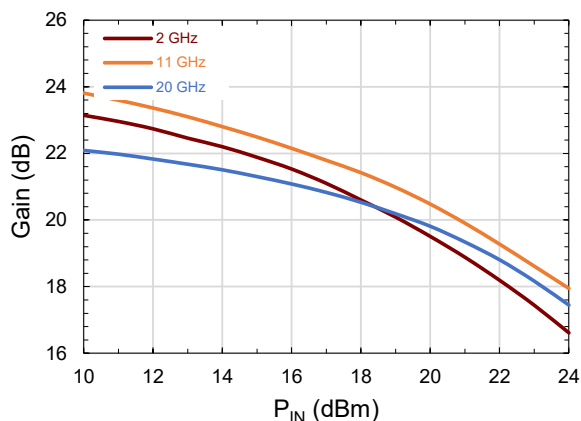
Drain Current vs. Input Power



Gate Current vs. Input Power



Gain vs. Input Power



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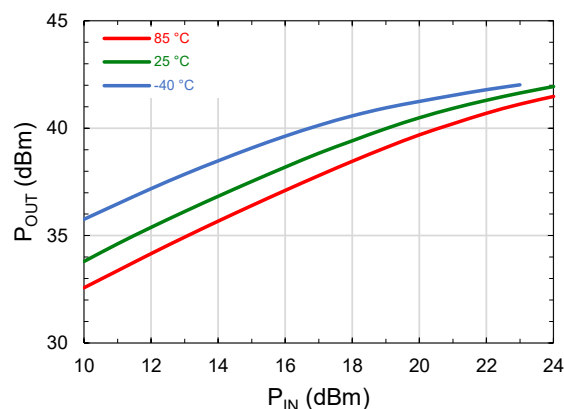
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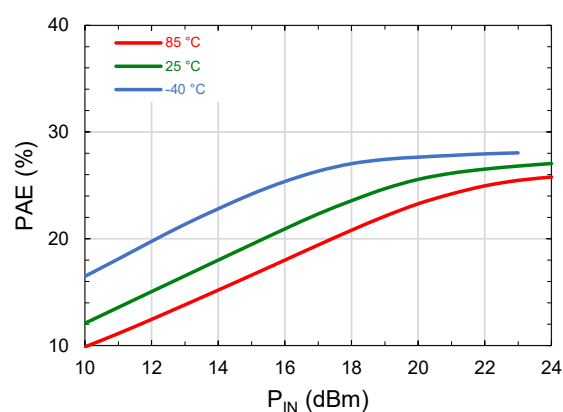
## Typical Performance Curves - Drive-Up over Temperature:

$V_D = 28\text{ V}$ ,  $I_{DQ} = 500\text{ mA}$ , CW, Frequency = 11 GHz

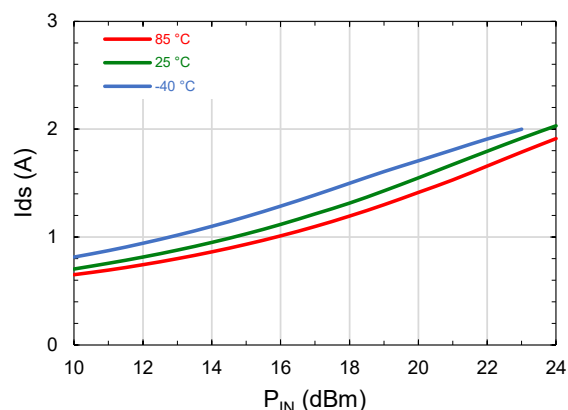
**Output Power vs. Input Power**



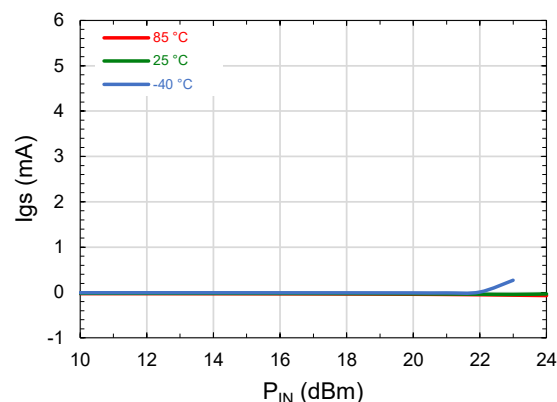
**Power Added Efficiency vs. Input Power**



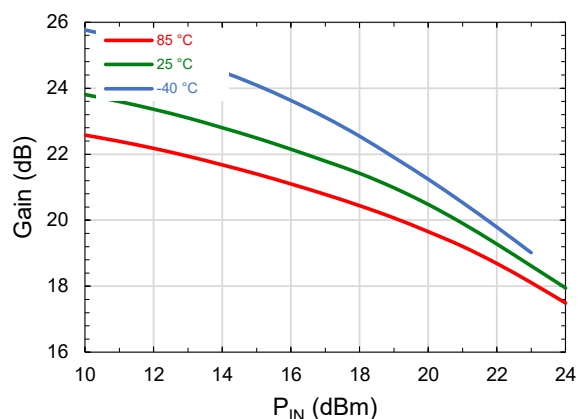
**Drain Current vs. Input Power**



**Gate Current vs. Input Power**



**Gain vs. Input Power**





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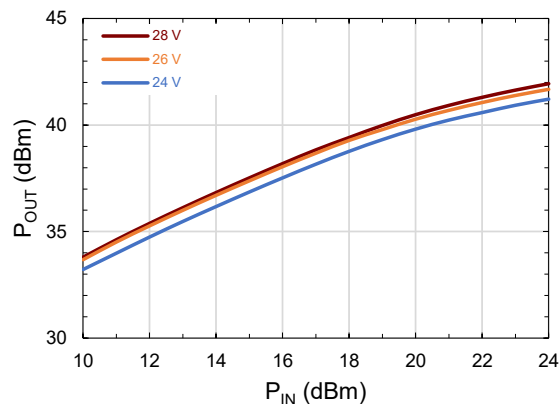
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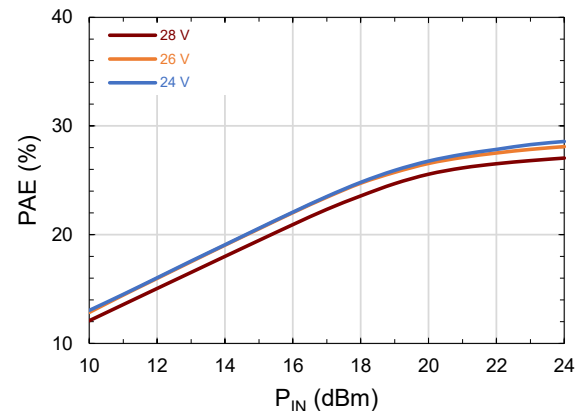
## Typical Performance Curves - Drive-Up over $V_D$ :

$I_{DQ} = 500$  mA, CW, Frequency = 11 GHz,  $T_C = 25^\circ\text{C}$

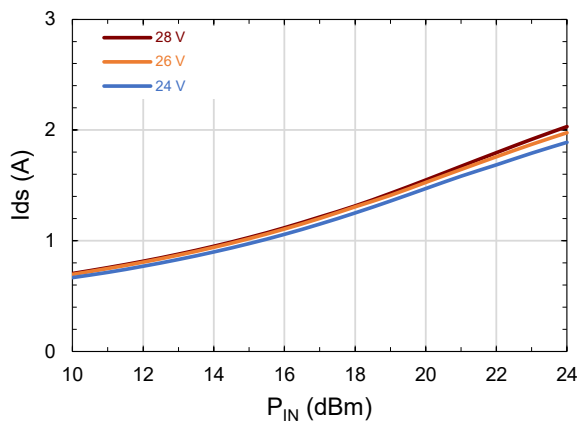
**Output Power vs. Input Power**



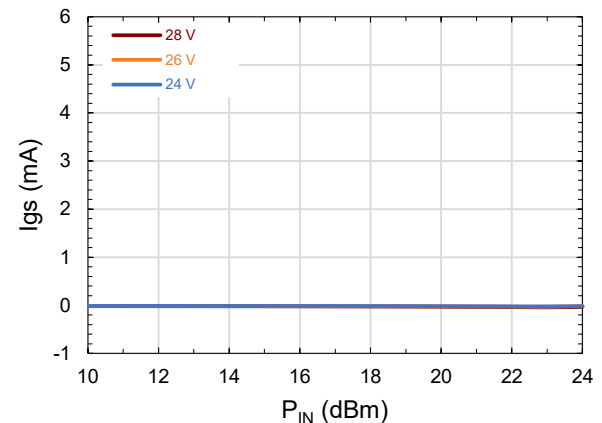
**Power Added Efficiency vs. Input Power**



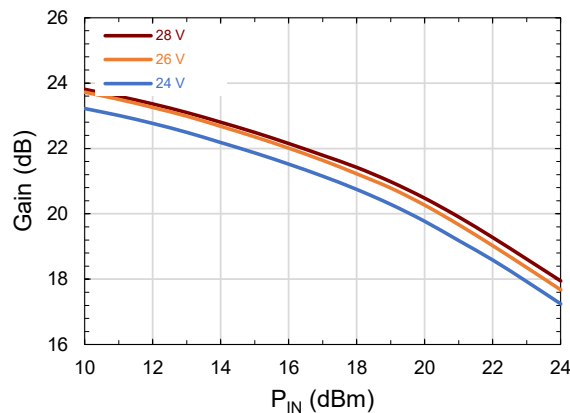
**Drain Current vs. Input Power**



**Gate Current vs. Input Power**



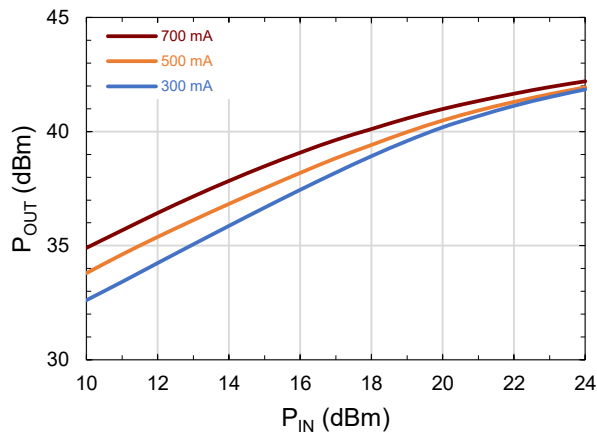
**Gain vs. Input Power**



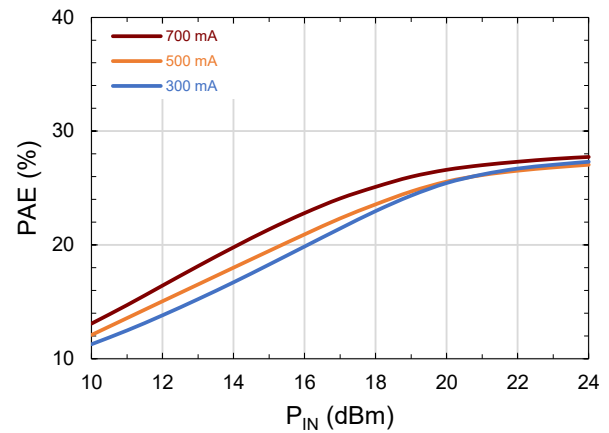
### Typical Performance Curves - Drive-Up over $I_{DQ}$ :

$V_D = 28$  V, CW, Frequency = 11 GHz,  $T_C = 25^\circ\text{C}$

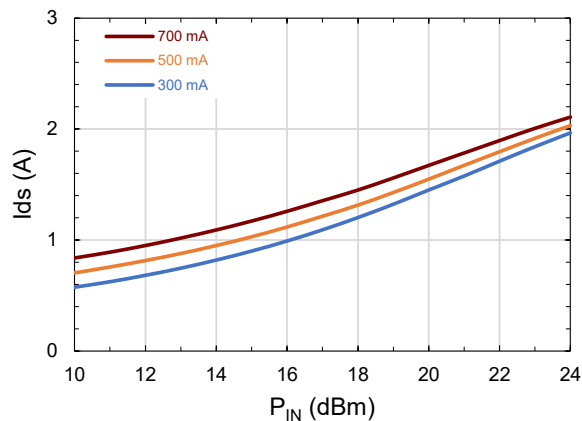
**Output Power vs. Input Power**



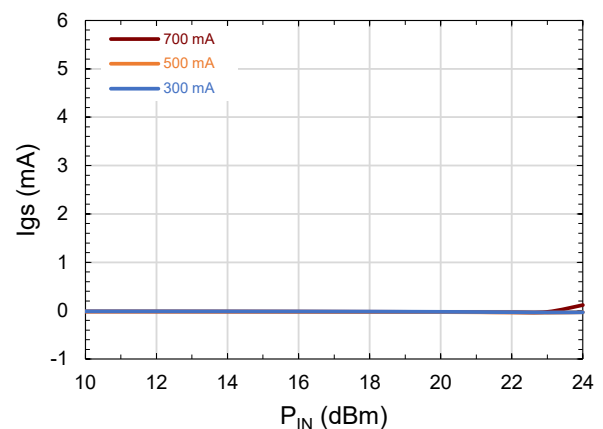
**Power Added Efficiency vs. Input Power**



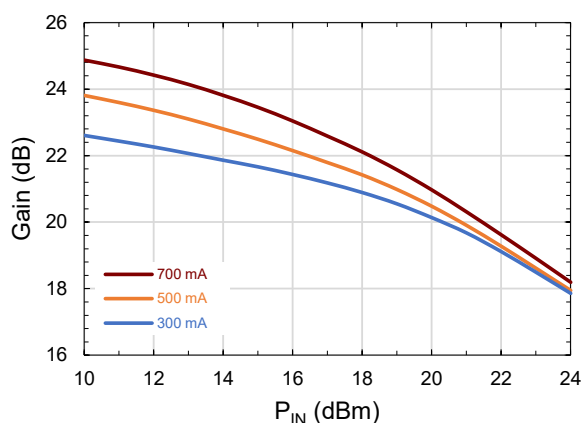
**Drain Current vs. Input Power**



**Gate Current vs. Input Power**



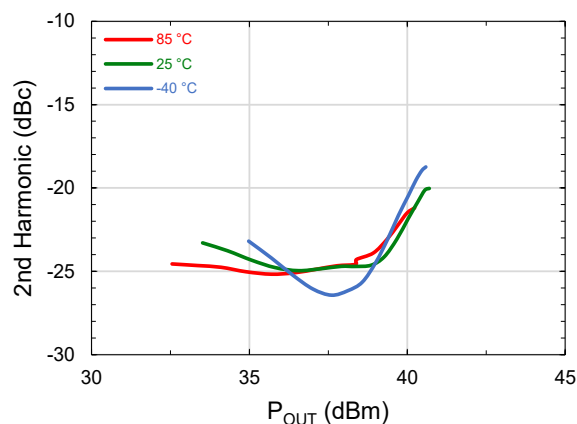
**Gain vs. Input Power**



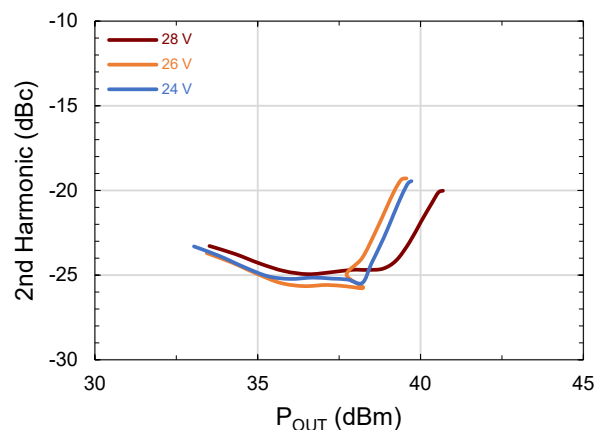
### Typical Performance Curves - Harmonic Levels:

$V_D = 28\text{ V}$ , CW,  $I_{DQ} = 500\text{ mA}$

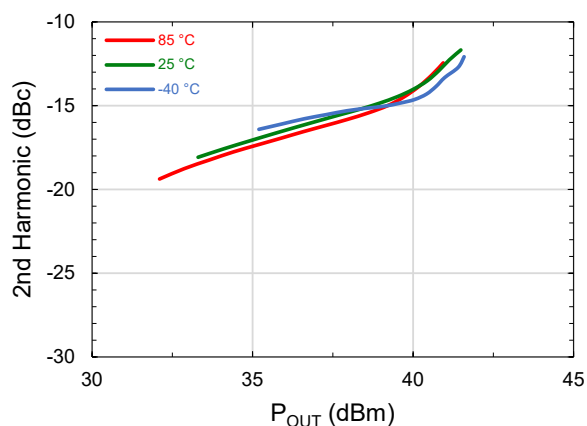
**2nd Harmonic @ 2 GHz over Temperature**



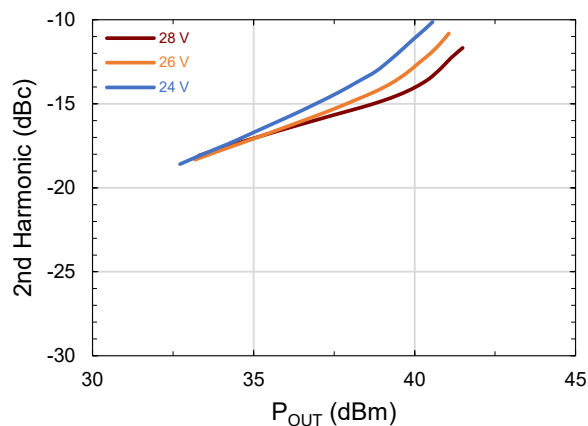
**2nd Harmonic @ 2 GHz over Vd**



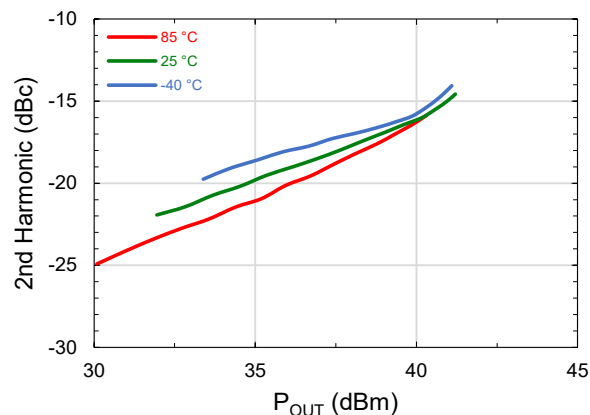
**2nd Harmonic @ 11 GHz over Temperature**



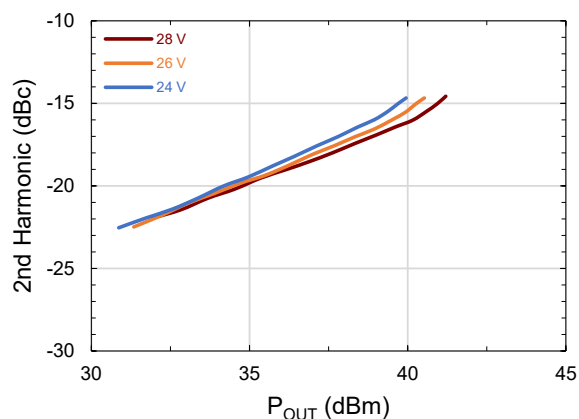
**2nd Harmonic @ 11 GHz over Vd**



**2nd Harmonic @ 20 GHz over Temperature**



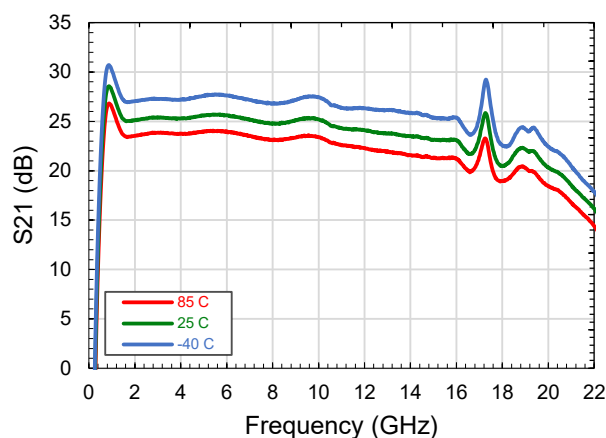
**2nd Harmonic @ 20 GHz over Vd**



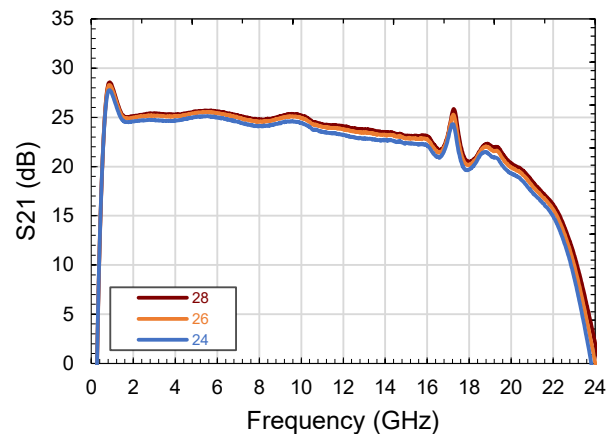
### Typical Performance Curves - Small Signal over Temperature and $V_D$ :

$I_{DQ} = 500$  mA, CW,  $P_{IN} = -30$  dBm

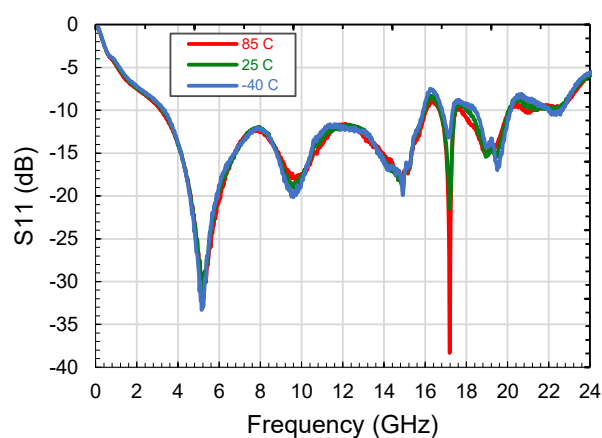
**$S_{21}$  vs. Frequency over Temperature @  $V_D = 28$  V**



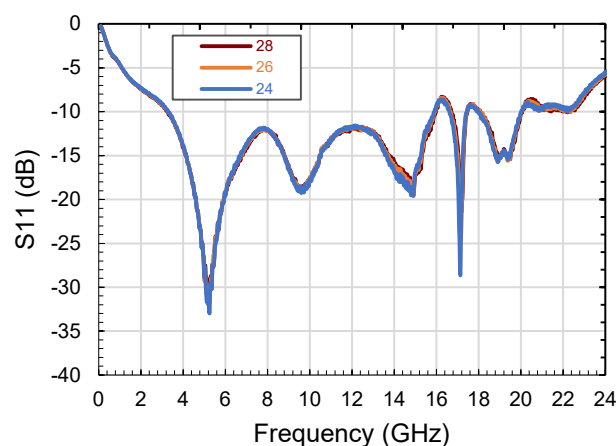
**$S_{21}$  vs. Frequency over  $V_D$  @ 25°C**



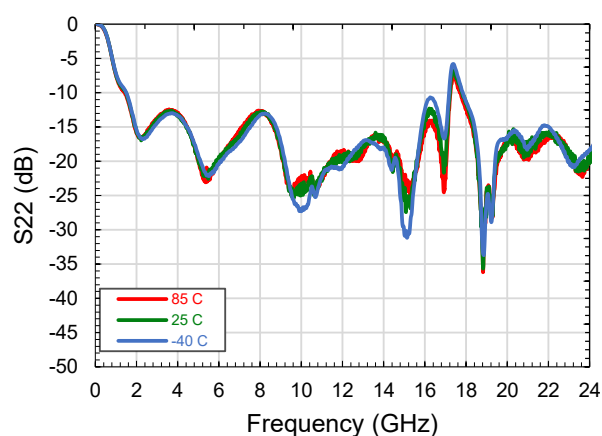
**$S_{11}$  vs. Frequency over Temperature @  $V_D = 28$  V**



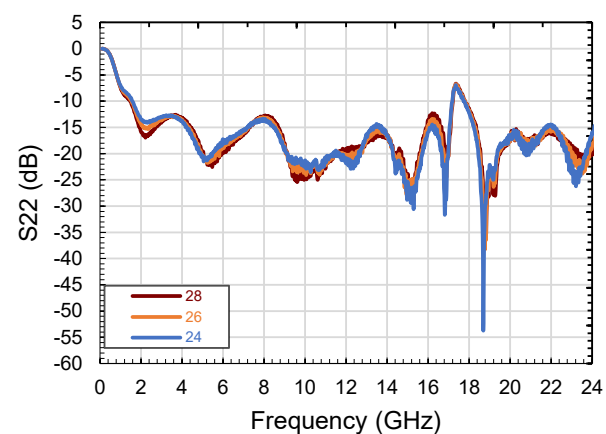
**$S_{11}$  vs. Frequency over  $V_D$  @ 25°C**



**$S_{22}$  vs. Frequency over Temperature @  $V_D = 28$  V**



**$S_{22}$  vs. Frequency over  $V_D$  @ 25°C**



# GaN High Power Amplifier, 10 W

## 2 - 20 GHz



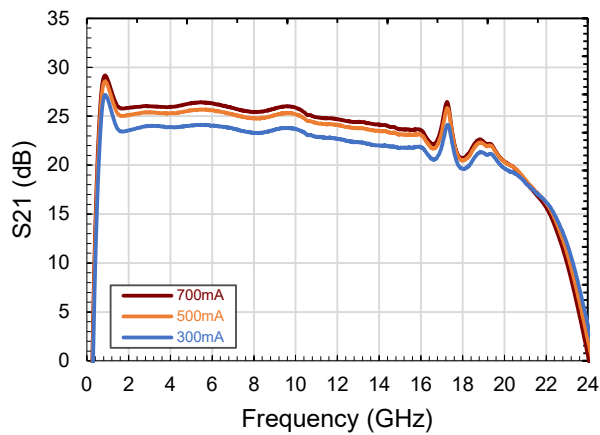
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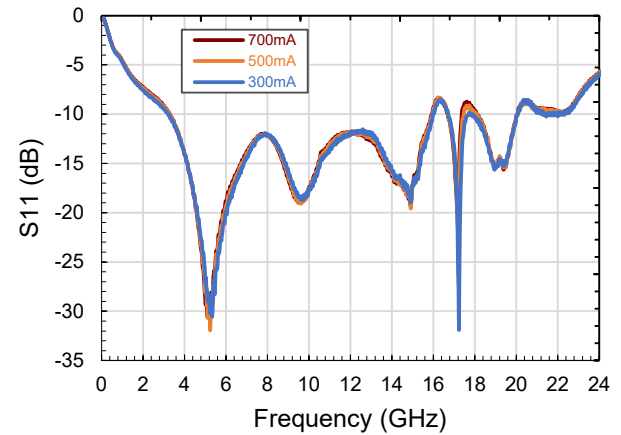
### Typical Performance Curves - Small Signal over $I_{DQ}$ :

$V_D = 28$  V, CW,  $P_{IN} = -20$  dBm

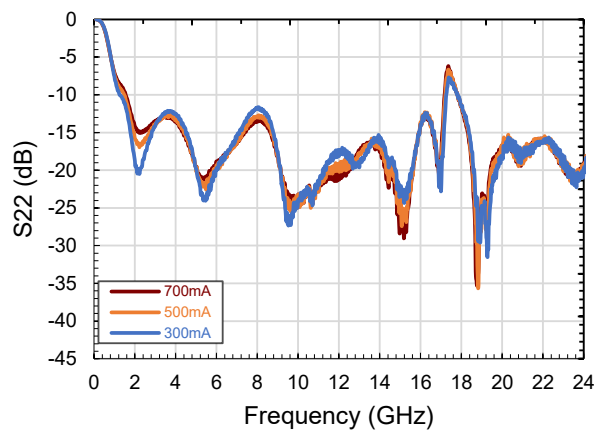
***S<sub>21</sub> vs. Frequency over  $I_{DQ}$***



***S<sub>11</sub> vs. Frequency over  $I_{DQ}$***



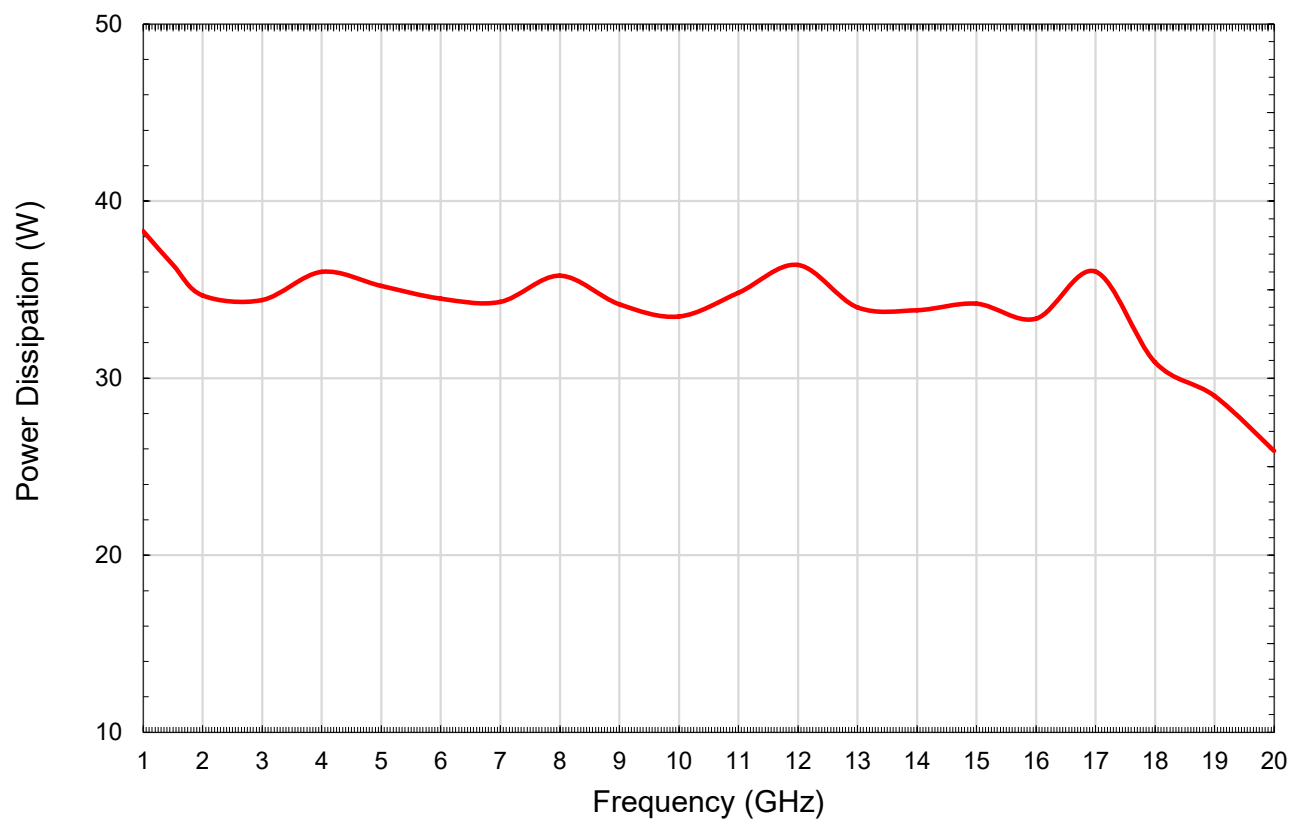
***S<sub>22</sub> vs. Frequency over  $I_{DQ}$***



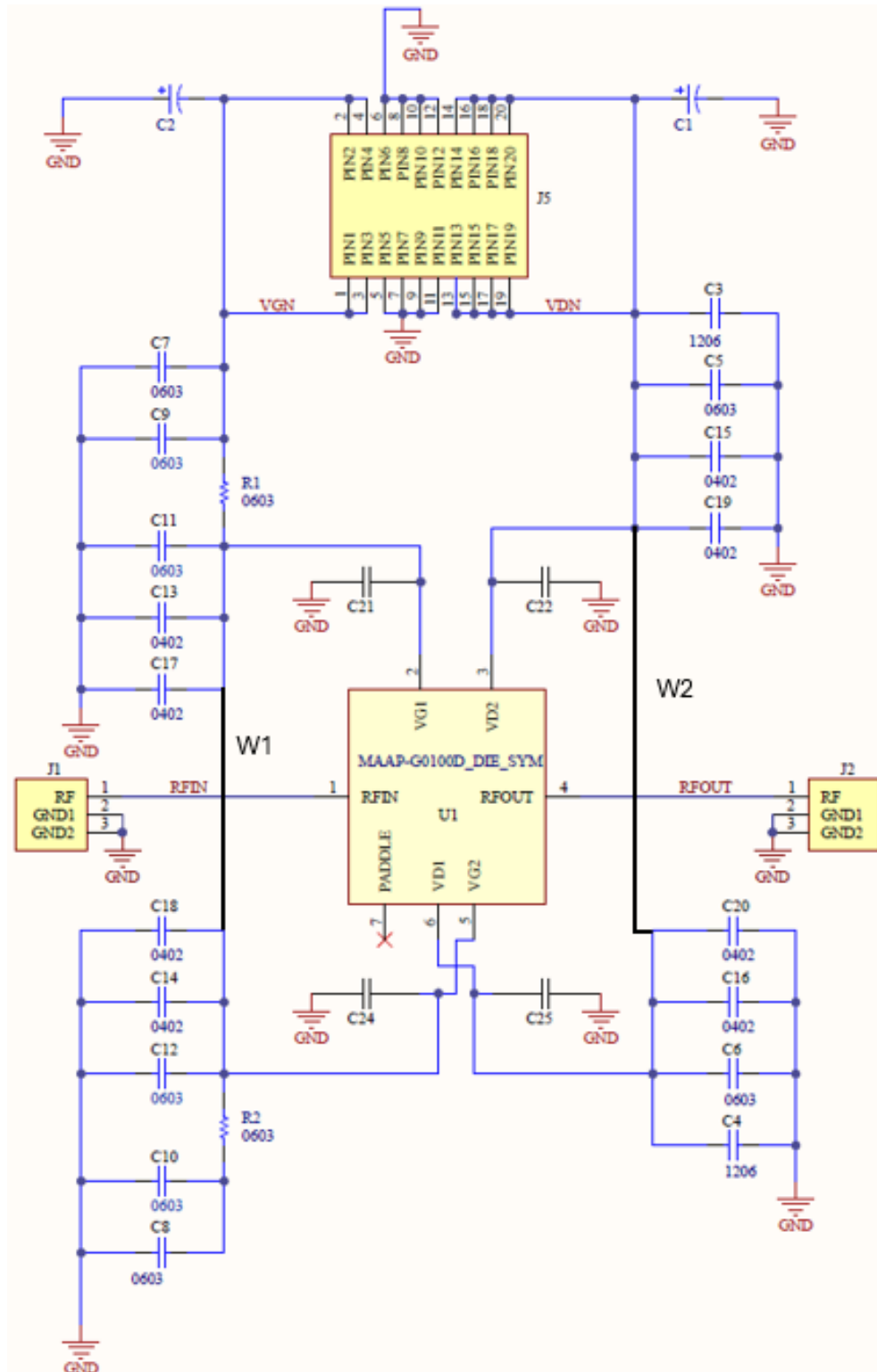
## Thermal Characteristics

Parameter	Operating Conditions	Value
Operating Junction Temperature ( $T_J$ )	Freq = 11 GHz, $V_D = 28$ V, $I_{DQ} = 500$ mA, $I_{DRIVE} = 1.65$ A , $P_{IN} = 22$ dBm, $P_{OUT} = 40.7$ dBm, $P_{DISS} = 35$ W, $T_C = 85^\circ\text{C}$ , CW	185°C
Thermal Resistance, Junction to Case ( $R_{\theta JC}$ )		2.85°C/W

## Power Dissipation vs. Frequency ( $T_C = 85^\circ\text{C}$ )



Evaluation Board Schematic (MAAP-G0100D-AMP)

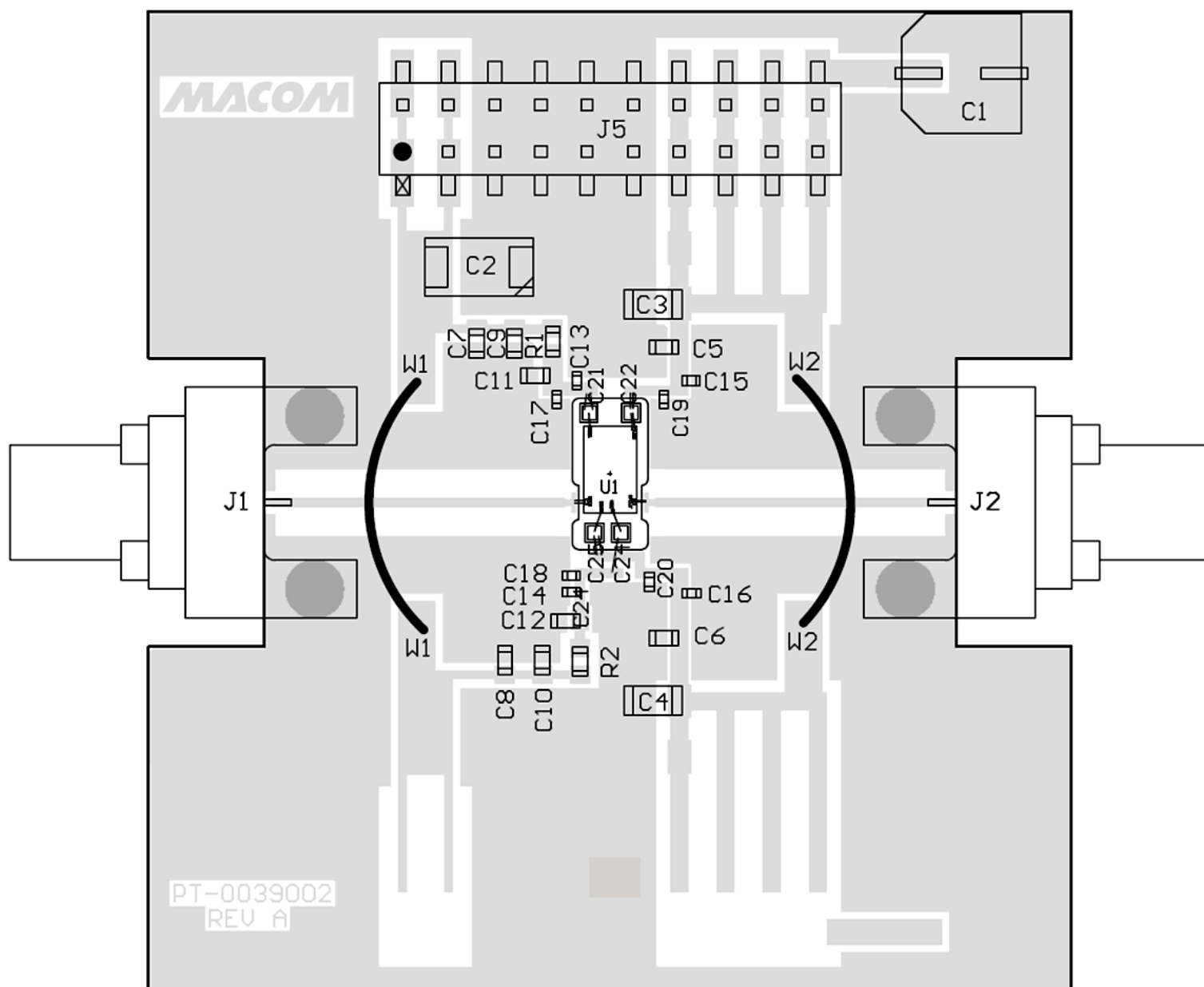


**Evaluation Board Parts List (MAAP-G0100D-AMP)**

Part	Value	Qty.
C1	33 $\mu$ F, Electrolytic Capacitor	1
C2	10 $\mu$ F, Tantalum Capacitor	
C3,C4	10 $\mu$ F, Cap 50V, 1206	2
C5,C6,C7,C8	2.2 $\mu$ F, Cap, 50V, 0603	4
C9,C10	470 pF, Cap, 100V, 0603	2
C11,C12	10 pF, Cap, 250V, 0603	2
C13,C14,C15,C16	0.1 $\mu$ F, Cap, 50V, 0402	4
C18, C18, C19, C20	0.47 pF, Cap, 50V, 0402	4
C21,C22,C24,C25	10 nF, Cap, single layer vertical, 30mil square	4
J1, J2	SMA Female End Launch RF Connector, .005" Pin, .048" Coax	2
J5	20-Pin DC Header, Right Angle	1
R1,R2	0 $\Omega$ , Resistors, 0603	2
W1,W2	Jumper Wire	2
U1	MMIC Die, MAAP-G0100D	1



Evaluation Board Assembly Drawing (MAAP-G0100D-AMP)



**Bias On Sequence**

1. Ensure RF is turned-off
2. Apply pinch-off voltage of -5 V to the gate ( $V_G$ )
3. Apply nominal drain voltage ( $V_D$ )
4. Adjust  $V_G$  to obtain desired quiescent drain current ( $I_{DQ}$ )
5. Apply RF

**Bias Off Sequence**

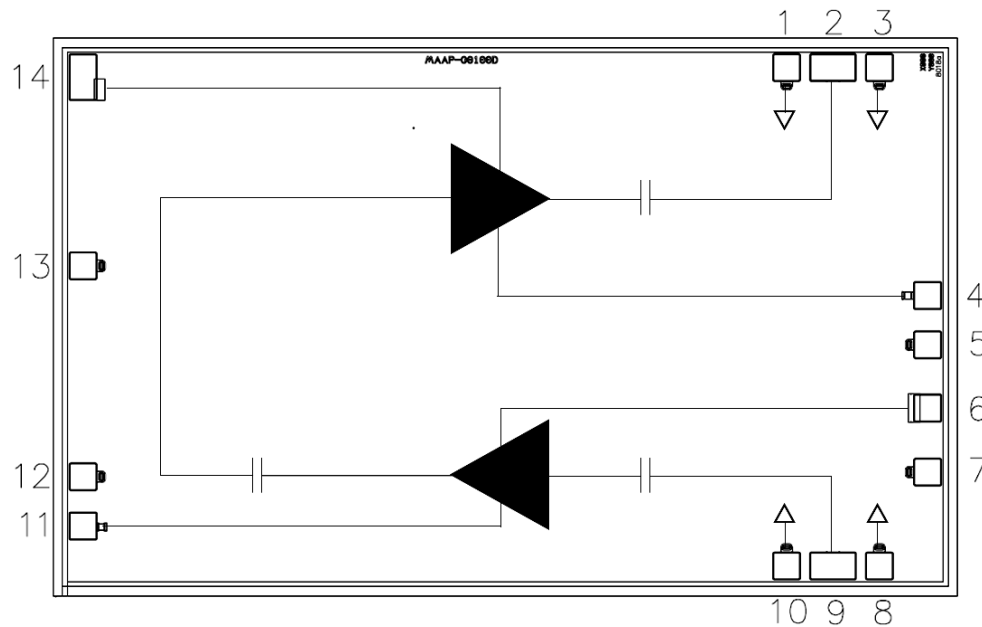
1. Turn RF off
2. Apply pinch-off to the gate ( $V_G = -5$  V)
3. Turn off drain voltage ( $V_D$ )
4. Turn off gate voltage ( $V_G$ )

# GaN High Power Amplifier, 10 W 2 - 20 GHz



MAAP-G0100D

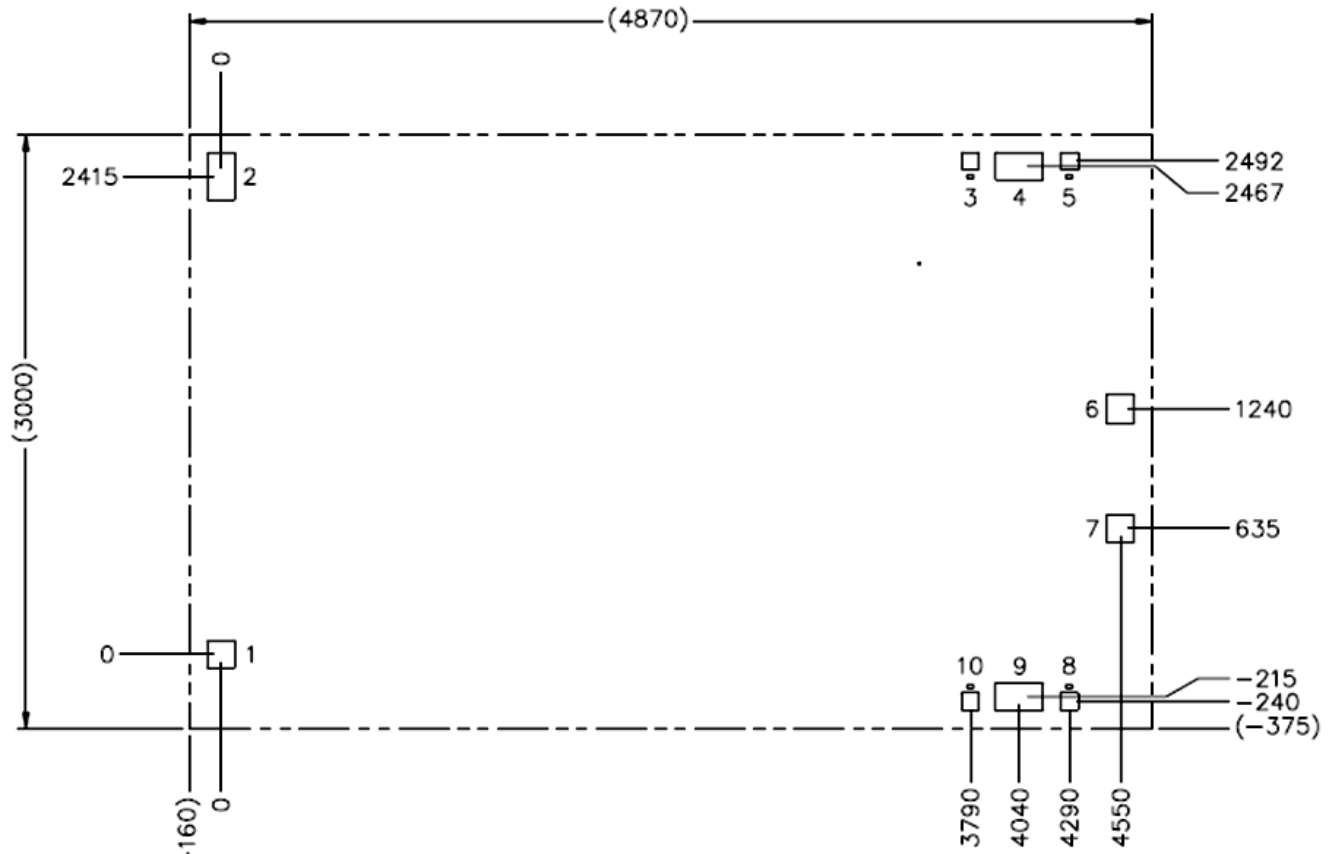
Rev. V1



## Pin Description

Pin #	Name	Description	Pad Size (μm)
1,3,5,7,8,10,12,13	GND	RF and DC ground.	140 x 140
11	VG1	Gate bias for stage 1.	140 x 140
4	VG2	Gate bias for stage 2	140 x 140
6	VD1	Drain bias for stage 1	140 x 140
14	VD2	Drain bias for stage 2	140 x 140
2	RF <sub>OUT</sub>	RF Output. 50-ohm matched. Internally DC blocked.	140 x 250
9	RF <sub>IN</sub>	RF Input. 50-ohm matched. Internally DC blocked.	140 x 250
MMIC backside	GND	RF and DC ground.	NA

## Mechanical Information



### Notes

- 1.) Die size: 1770  $\mu\text{m}$  x 3580  $\mu\text{m}$  (+0/-50  $\mu\text{m}$ )
- 2.) Die thickness: 75  $\mu\text{m}$  (+/- 10  $\mu\text{m}$ )
- 3.) Unless otherwise specified, all dimensions shown are  $\mu\text{m}$  with a tolerance of +/- 5  $\mu\text{m}$ .

## Revision History

Rev	Date	Change Description
V1	09/22/2025	Production release

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