

## Wideband Distributed Amplifier, DIE, 1 to 19 GHz ENGDA00160

### Typical Applications

- Military EW and SIGINT
- Receiver or Transmitter
- Telecom Infrastructure
- Space Hybrids
- Test and Measurement Systems

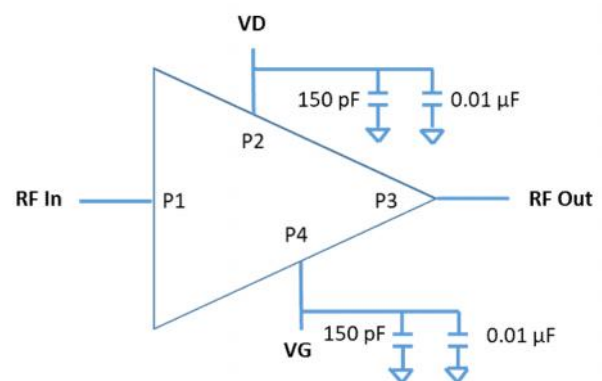
### Description

The ENGDA00160 is a wideband, linear GaAs MMIC distributed amplifier die which operates from 1 to 19 GHz. The design is 50 ohm matched and does not require external bias coil inductors. The amplifier delivers 11-dB gain with > 1 dB positive gain slope across the band over a wide drain voltage range (3 V to 10 V). Noise figure is < 3.5 dB across 4 – 18 GHz for bias voltages between 4 and 8 V. The amplifier has gold backside metallization and is designed to be silver epoxy attached. The RF interconnects are designed to account for wire bonds and external microstrip flares for optimal integrated return loss. No additional ground interconnects are required.

### Features

- Wideband performance
- High linearity, 7-dBm IIP3 at 6 V;  
9-dBm IIP3 at 8 V
- < 3.5 dB noise figure, 4 – 18 GHz
- 11-dB gain, positive gain slope
- 3 V to 10 V bias operation
- In/out return loss > 14 dB typical
- Size
  - 2.93 x 2.00 x 0.1 mm
  - 0.115 x 0.079 x 0.004 inch

### Functional Block Diagram



**Electrical Specifications,  $T = 25\text{ }^{\circ}\text{C}$ ,  $V_D = 8.0\text{ V}$ ,  $40\text{ mA}$** 

Parameter	Min	Typ	Max	Units
Frequency Range	1 – 19			GHz
Gain	9	11	+ slope	dB
Noise Figure		< 3.5 (4-18 GHz)		dB
Input Return Loss	13	15		dB
Output Return Loss	13	15		dB
Output P1dB	7	10		dBm
Output IP3	16	18		dBm
Supply Current	30	30 - 80	100	mA
Thermal Resistance		180		deg C/W

**Recommended Operating Conditions**

Parameter	Min	Typ	Max	Units
$V_D$	3	8	9	V
$I_D$	30	70	100	mA
$V_G$	-0.2	-0.5	-0.7	V

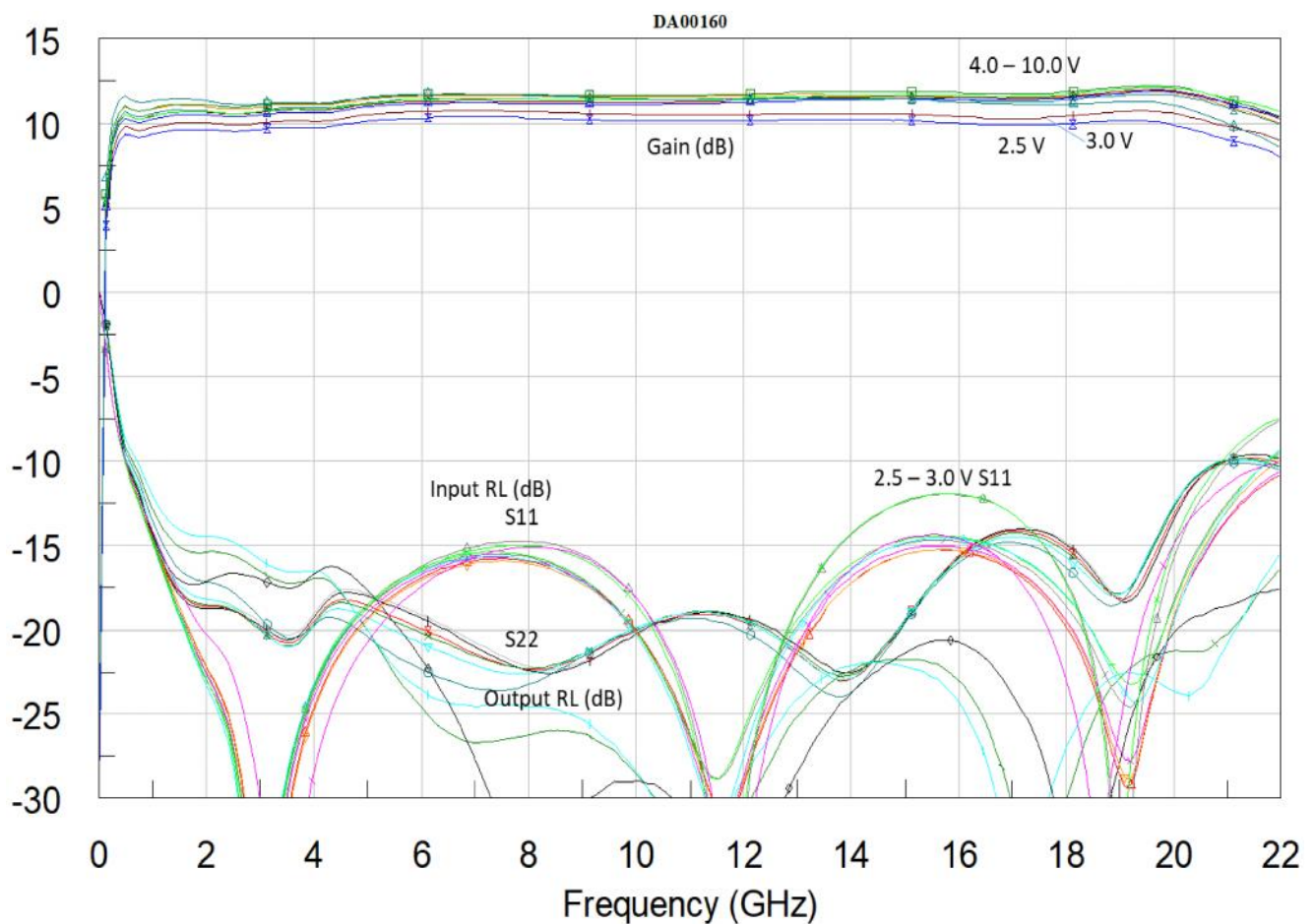
**Absolute Maximum Ratings**

Parameter	Max level
Drain Voltage, $V_D$	11 V
Gate Voltage, $V_G$	-3 V
RF Input Power	+24 dBm
Channel temperature	+160 $^{\circ}\text{C}$
Operating Temperature	-55 $^{\circ}\text{C}$ to +100 $^{\circ}\text{C}$
Storage Temperature	-65 $^{\circ}\text{C}$ to +150 $^{\circ}\text{C}$

**RF Data with wire bonds and external microstrip flare pads**

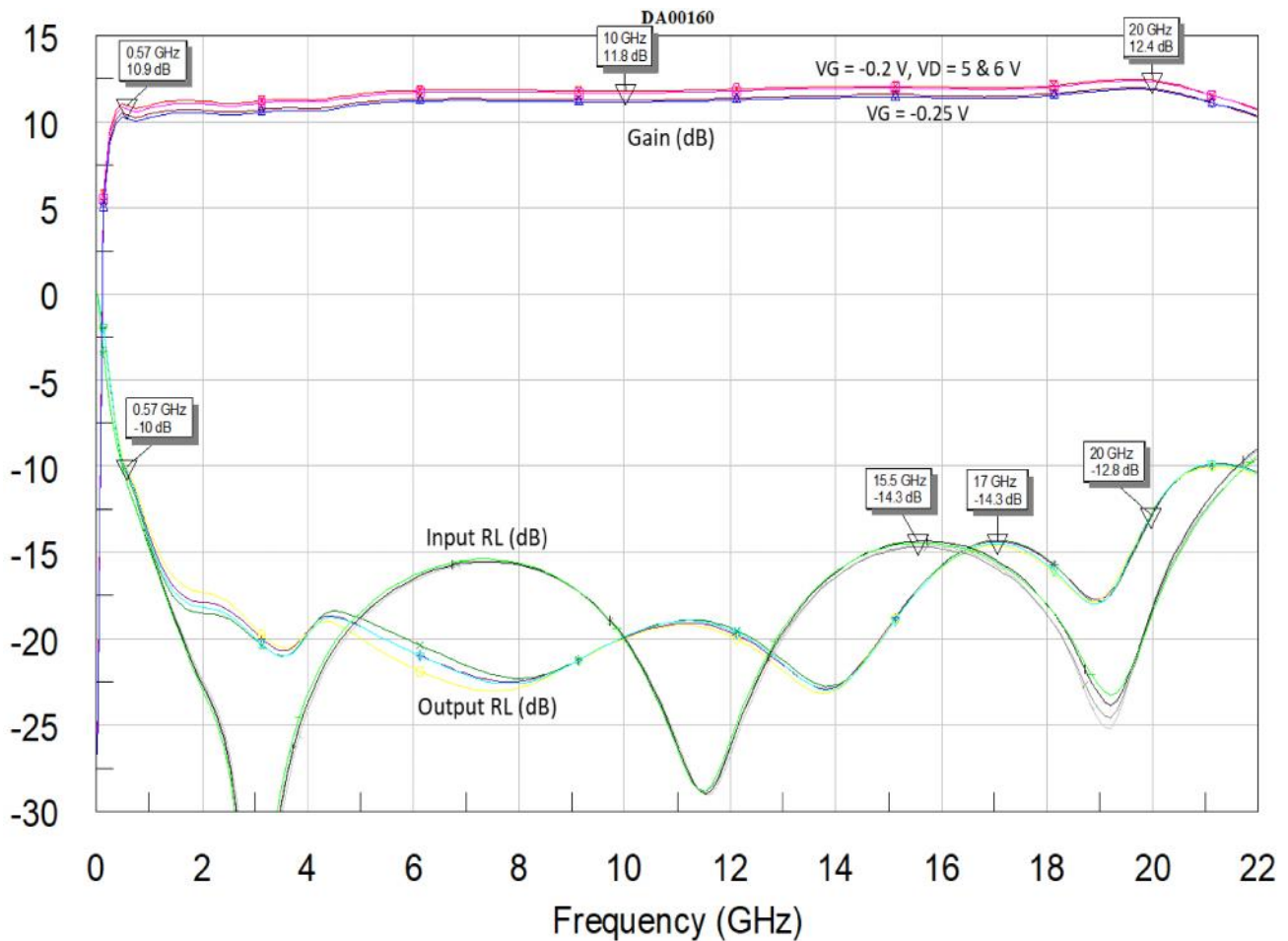
**Gain and Input / Output Return Loss (dB); 2.5, 3, 4, 5, 6, 7, 8, 9, & 10 V drain voltages; -0.25 V gate voltage; no bond wires & external flares**

**Measured Gain varies by 1 dB for VD bias of 4 to 10 V**



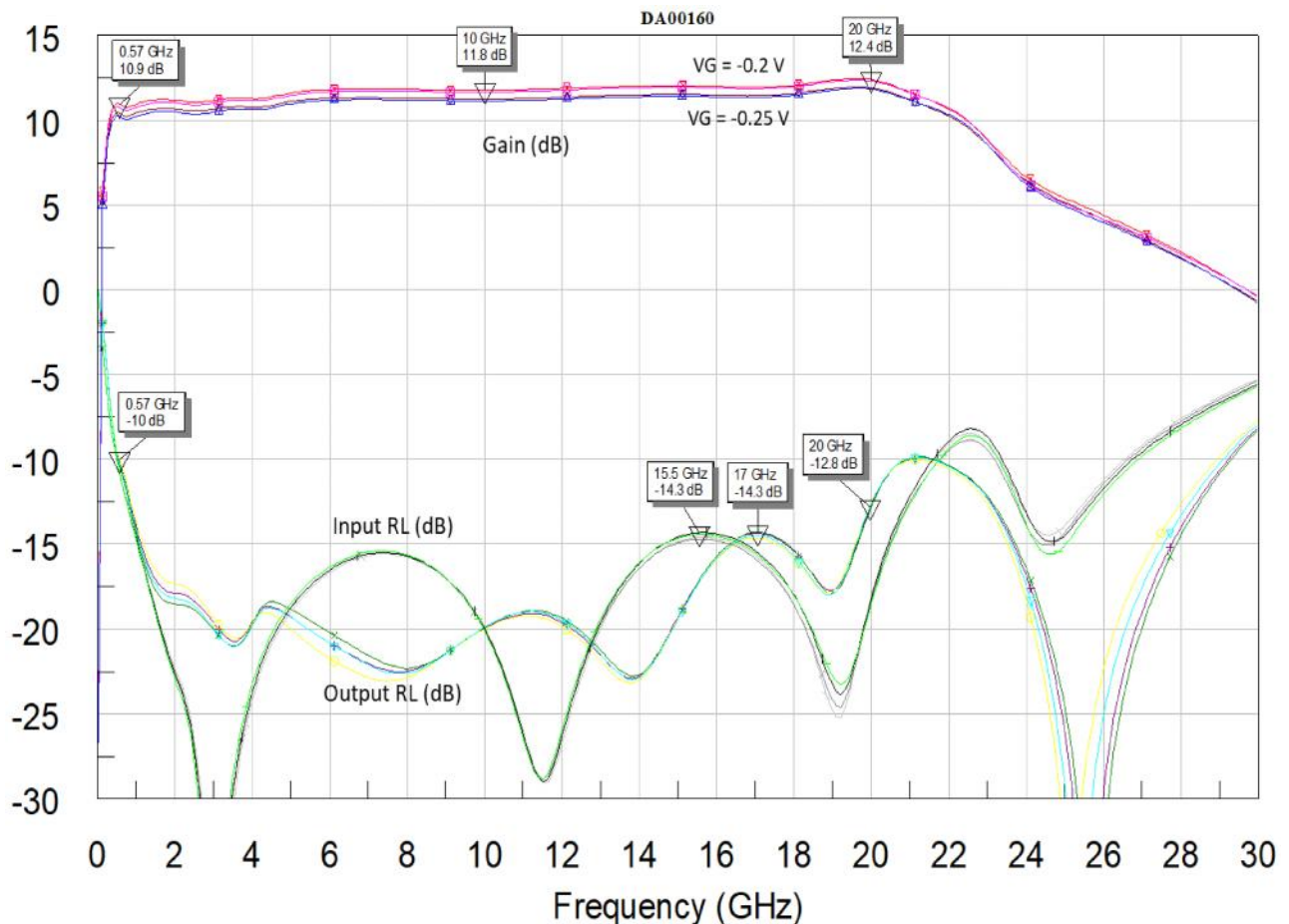
## RF Data with wire bonds and external microstrip flare pads

**Gain and Input / Output Return Loss (dB); 5 & 6 V drain voltages; -0.25 and -0.20 V gate voltages; no bond wires & external flares**



## RF Data with wire bonds and external microstrip flare pads

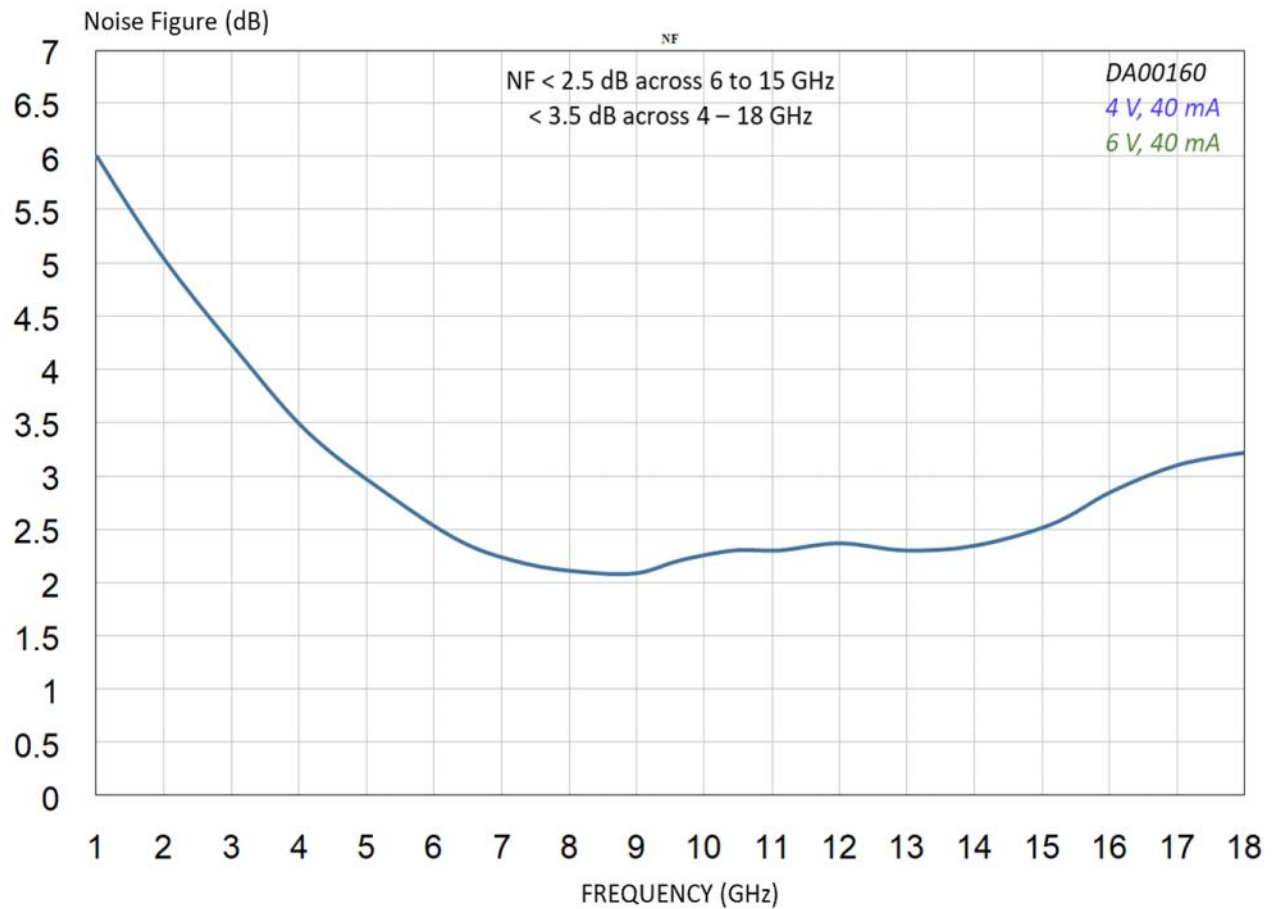
**Gain and Input / Output Return Loss (dB); 5 & 6 V drain voltages; -0.25 and -0.20 V gate voltages; no bond wires & external flares**



**RF Data with wire bonds and external microstrip flare pads**

**Noise Figure (dB);  $V_D = 4.0 - 8.0 V$ ,  $I_{DS} = 40 mA$ ;  $25\text{ }^\circ C$**

**Noise figure varies by only  $\pm 0.1 dB$  for drain voltages between 4 and 8 V; at 3 V bias, noise figure increases slightly in Ku-band**

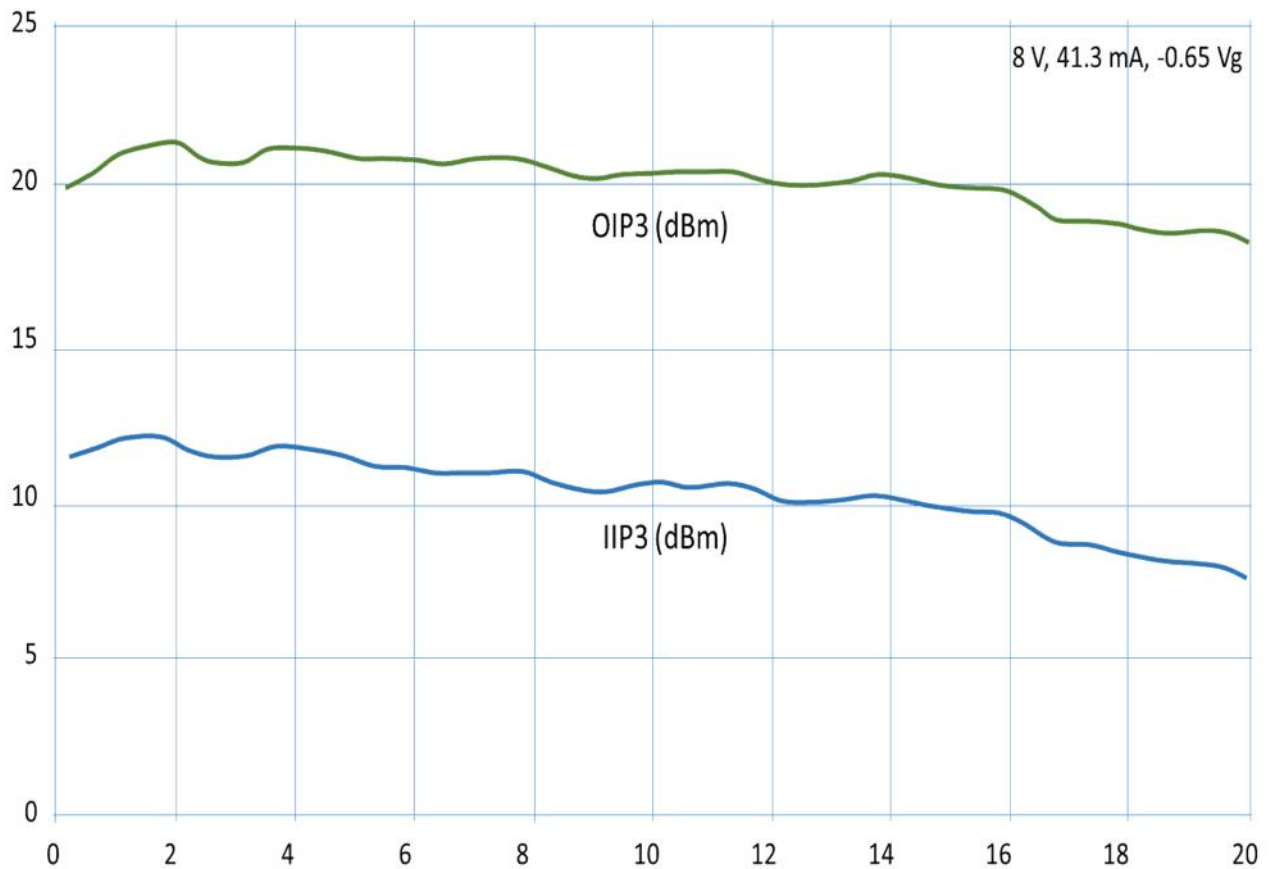


## *RF Data with wire bonds and external microstrip flare pads*

***IIP3 > 8 dBm to 20 GHz (OIP3 > 18 dBm);***

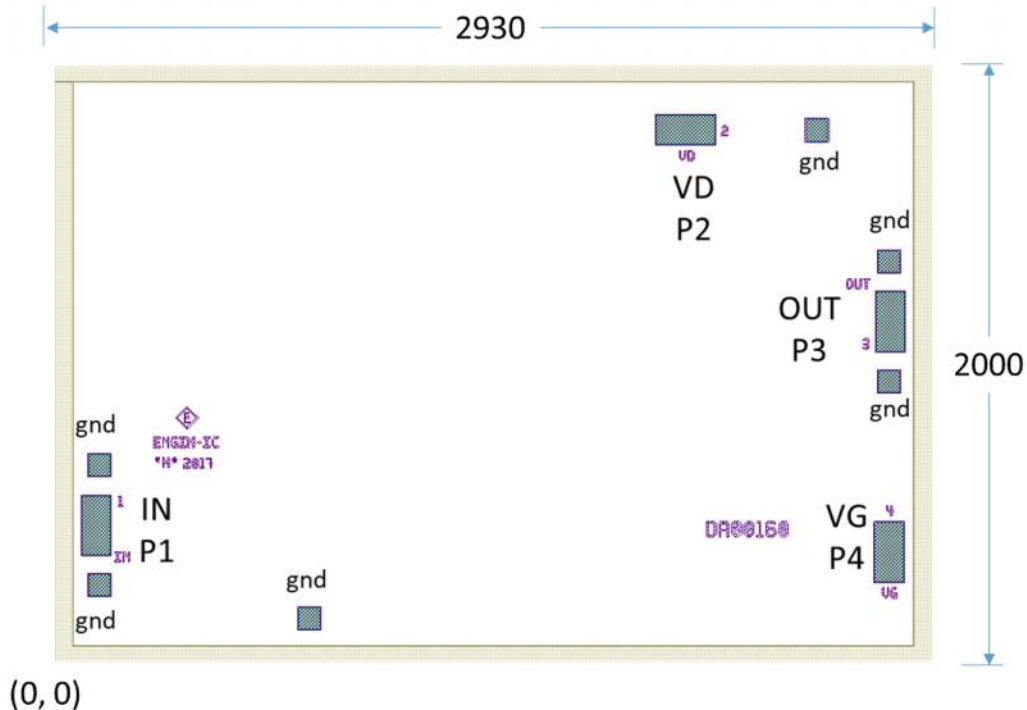
***8 V, 41.3 mA bias; 25 °C (OIP3 increases with current)***

***IIP3 > 10 dBm to 15 GHz (OIP3 > 20 dBm)***





## Outline Drawing



	Pad Dimensions			
	Length (x-dim, um)	Width (y-dim, um)	Length (x-dim, mils)	Width (y-dim, mils)
P1 RF Input Pad	100	200	3.94	7.87
P2 VD Drain Bias Pad	200	100	7.87	3.94
P3 RF Output Pad	100	200	3.94	7.87
P4 VG Gate Bias Pad	100	200	3.94	7.87

	Bond Pad Center Point Locations			
	(x-dim, um)	(y-dim, um)	(x-dim, mils)	(y-dim, mils)
P1 RF Input Pad	136	462	5.35	18.19
P2 VD Drain Bias Pad	2107	1781	82.95	70.12
P3 RF Output Pad	2791	1142	109.88	44.96
P4 VG Gate Bias Pad	2787	372	109.72	14.65

**Notes:**

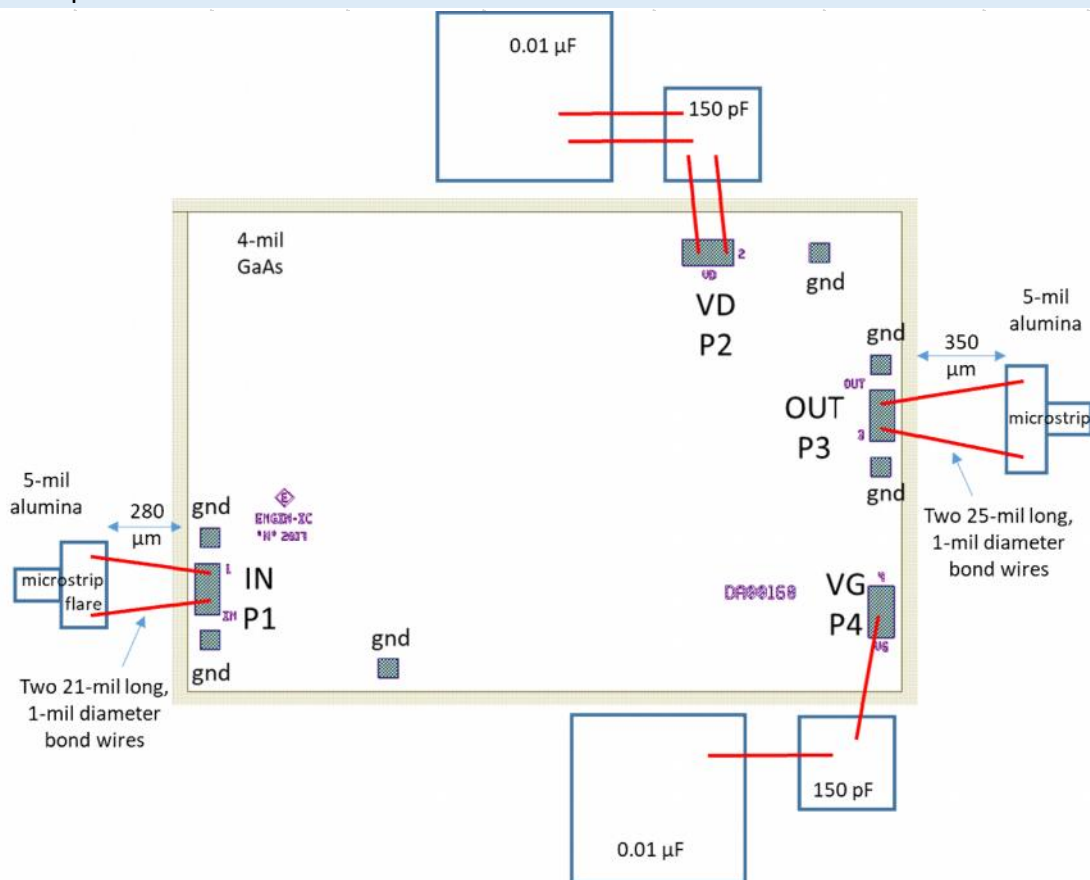
- 1. All dimensions are given in both  $\mu\text{m}$  and mils. Substrate thickness: 100  $\mu\text{m}$  (0.004").**
- 2. Backside metallization is gold.**
- 3. Bond pad metallization is gold.**



## External I/O Microstrip Flare Dimensions (on 5-mil Alumina) and I/O Bond Wire Inductances for Optimum Insertion and Return Loss Performance

*S-parameters can be supplied at DIE level such that optimal flare dimensions can be made for the substrate connection medium used (if different from 5-mil Alumina).*

RF I/O Port - External Microstrip Flares on 5-mil Alumina	Length (x-dim, $\mu\text{m}$ )	Width (y-dim, $\mu\text{m}$ )	Wire Inductance (nH)	Wire Length ( $\mu\text{m}$ )	# of Wires
P1 RF Input Pad External Flare Dimension	190	346	0.25	533	2
P3 RF Output Pad Ext. Flare Dimension	137	437	0.28	635	2



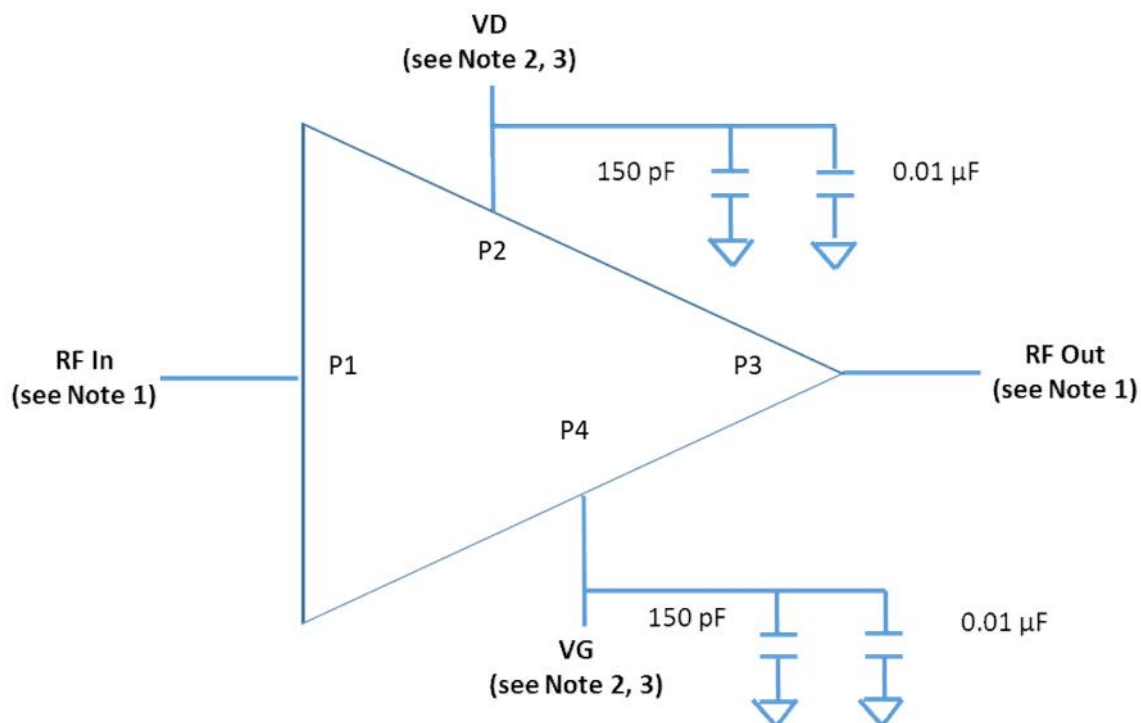
**Notes:**

- To achieve bond wire inductance noted, bond the number of wires shown in parallel from each external flare to each associated MMIC RF bond pad as shown above.
- Gold Wire details:
  - Diameter: 25.4  $\mu\text{m}$  (1 mil)
  - Spacing: 5 mils ( $\sim 127 \mu\text{m}$ ) typical
  - Height above Ground: 8 mils ( $\sim 200 \mu\text{m}$ ) typical (wedge bonds)
- Wire Length is total length if the wire were made perfectly straight.

## Assembly Guidelines

The backside metallization is RF/DC ground. Attachment should be accomplished with electrically and thermally conductive epoxy only. This device supports high frequency performance. Care should be made to following the wire bond dimensions as shown in the flare diagram.

## Application Circuit and Turn-on Procedure



Note 1: Internal blocking capacitors on RF in/out ports (P1 and P2)

Note 2: Gate voltage (VG) must be applied prior to drain voltage (VD)  
 Drain voltage (VD) must be removed prior to gate voltage (VG)

Note 3: Performance is optimized with VD set in the 4 to 8 V range