Wideband Distributed Amplifier, DIE
1 - 20 GHz

ENGDA00161
Rev. V1

Features

- Wideband Performance
- High Linearity:
  IIP3: 8 dBm @ 6 V;
  IIP3: 10 dBm @ 8 V
- Positive Gain Slope: 10 dB
- Input/Output Return Loss: 16 dB
- Noise Figure: <3 dB, 5 - 18 GHz
- 3 V to 9 V Bias Operation
- Die Size:
  2.93 x 2.00 x 0.1 mm
  0.115 x 0.079 x 0.004 inch
- RoHS* Compliant

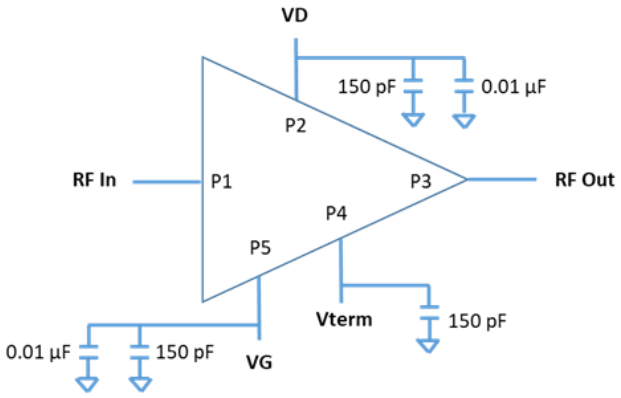
Applications

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

Description

The ENGDA00161 is a wideband, linear GaAs MMIC distributed amplifier die which operates from 1 to 20 GHz. The design is 50 ohm matched and does not require external bias coil inductors. The amplifier delivers 10-dB gain with >1 dB positive gain slope across the band over a wide drain voltage range (3 V to 9 V). Noise figure is <3 dB across 5 - 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.

Functional Block Diagram



Ordering Information

Part Number	Package
ENGDA00161	Die

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

Electrical Specifications:
Freq. = 1 - 20 GHz, T_A = +25°C, V_D = 6 V, 32 mA, V_G = 3 V, 4 mA, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	—	dB	8	10	+ Slope
Noise Figure	5 - 18 GHz	dB	—	<3	—
Input Return Loss	—	dB	14	18	—
Output Return Loss	—	dB	14	19	—
Output P1dB	—	dBm	7	10	—
Output IP3	—	dBm	16	18	—
Supply Current	—	mA	30	30 - 80	100
Thermal Resistance	—	ºC/W	—	180	—

Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Units
Drain Voltage	3	6	9	V
Gate Voltage	-0.2	-0.4	-0.6	V
Drain Current	30	70	100	mA
VTerm	2	3	4	V
ITerm	2	4	6	mA

Absolute Maximum Ratings[1,2]

Parameter	Absolute Maximum
Drain Voltage	10 V
Gate Voltage	-3 V
Active Gate Term, VTerm	5 V
RF Input Power	24 dBm
Junction Temperature	+160°C
Operating Temperature	-55°C to +100°C
Storage Temperature	-65°C to +150°C

1. Exceeding any one or combination of these limits may cause permanent damage to this device.
2. MACOM does not recommend sustained operation near these survivability limits.

Handling Procedures

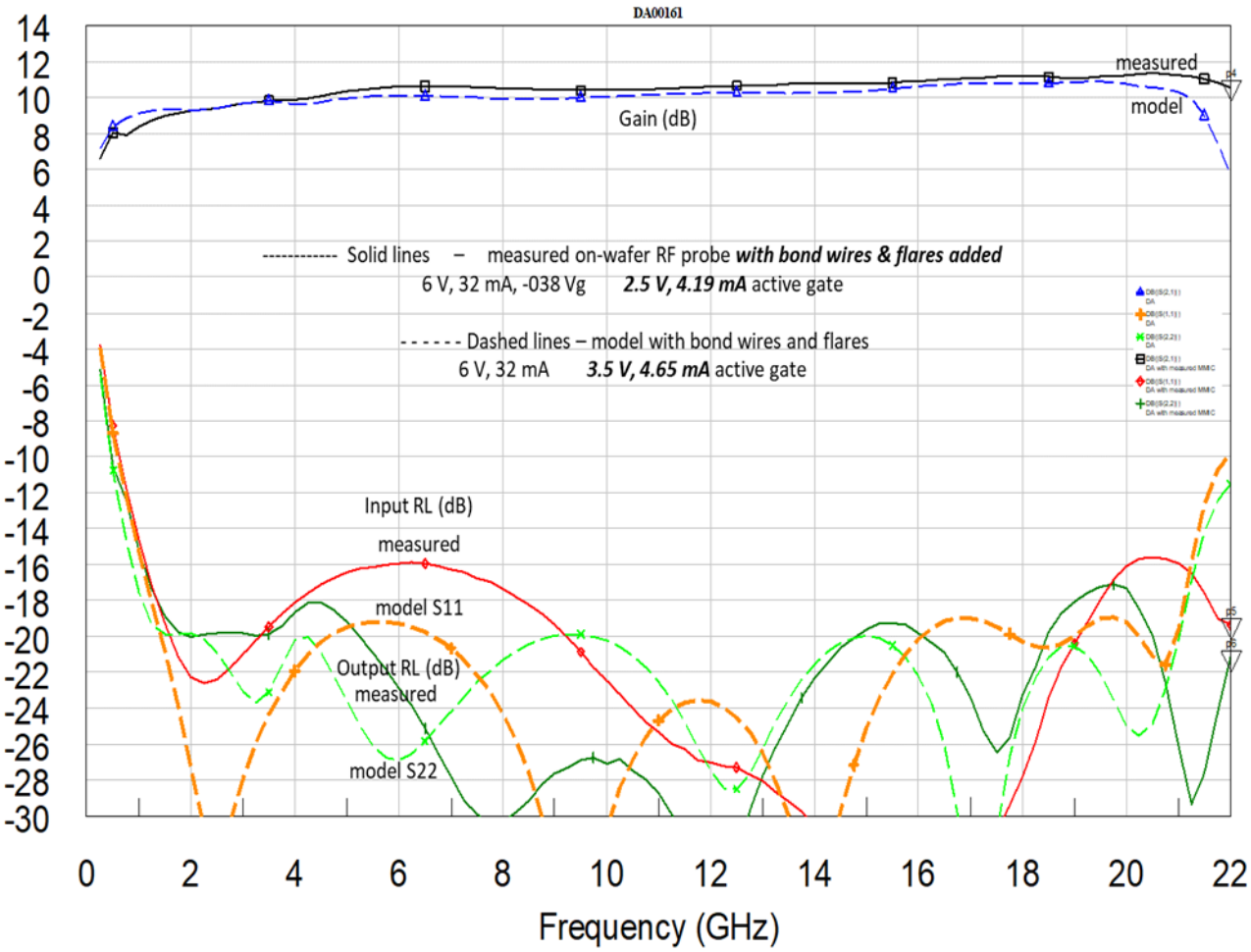
Please observe the following precautions to avoid damage:

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.

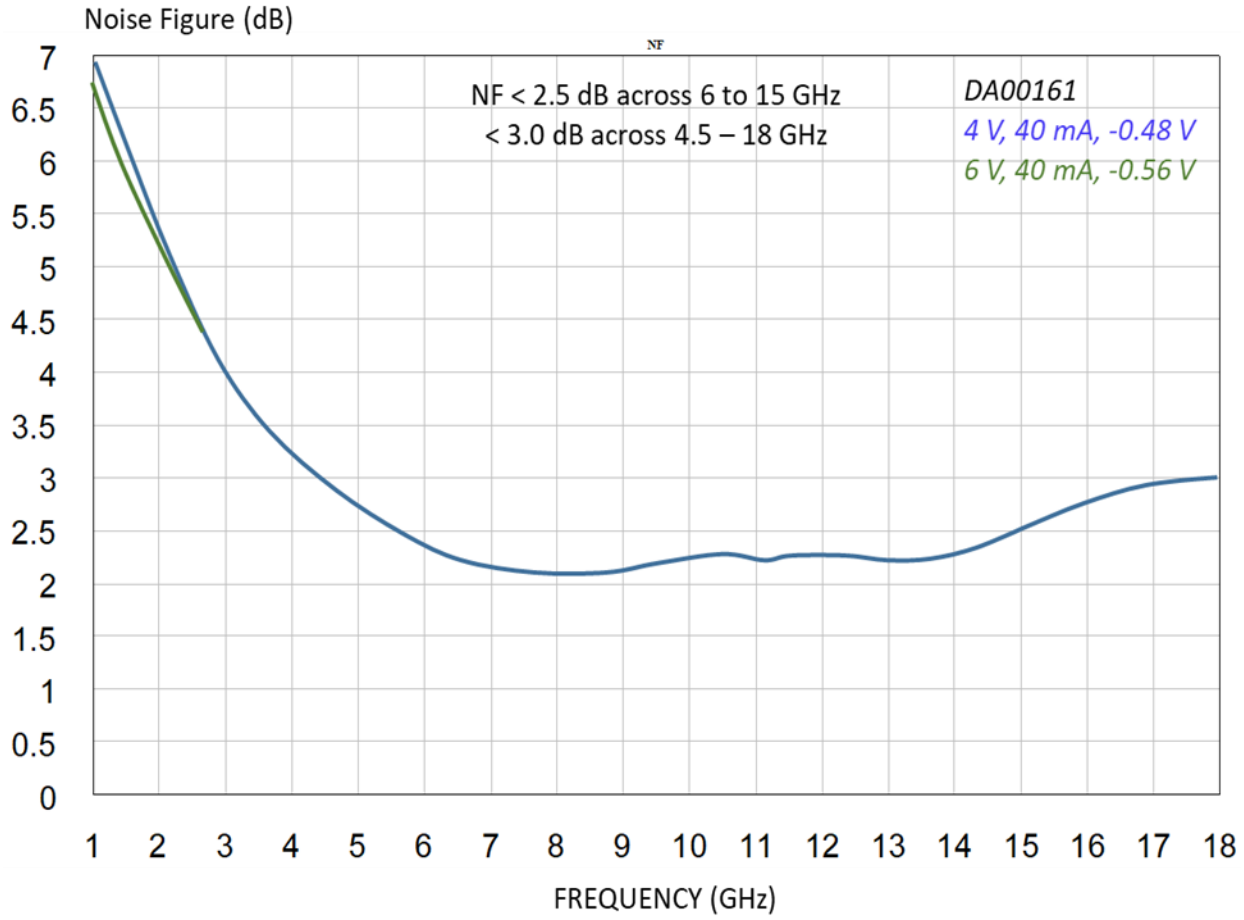
Measured RF Data: With Wirebonds & External Microstrip Flares

Gain and In / Out Return Loss: V_D = 6 V; V_G = -0.38 V, I_D = 32 mA
Active gate termination bias: 2.5 - 3 V, 4 mA; 25 °C
Measured and Modeled Gain are within 0.5 dB across 1 - 20 GHz



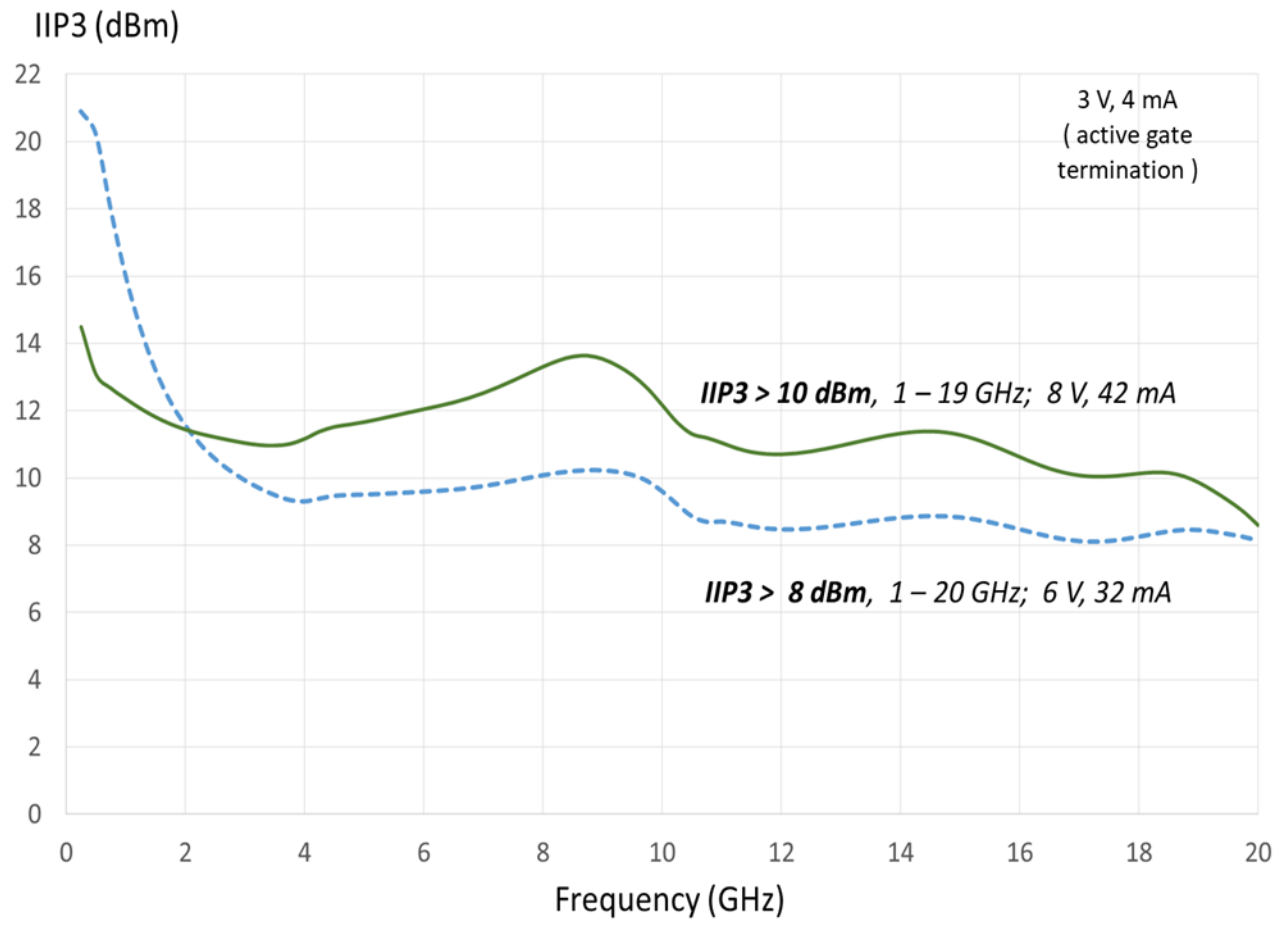
Measured RF Data: With Wirebonds & External Microstrip Flares

Noise Figure: V_D = 4 - 6 V, ID = 40 mA; 25 °C; 3 V, 4 mA
Noise Figure varies by only ± 0.1 dB for drain voltages between 4 and 8 V; at 3 V bias, noise figure increases slightly in Ku-band



Measured RF Data: With Wirebonds & External Microstrip Flares

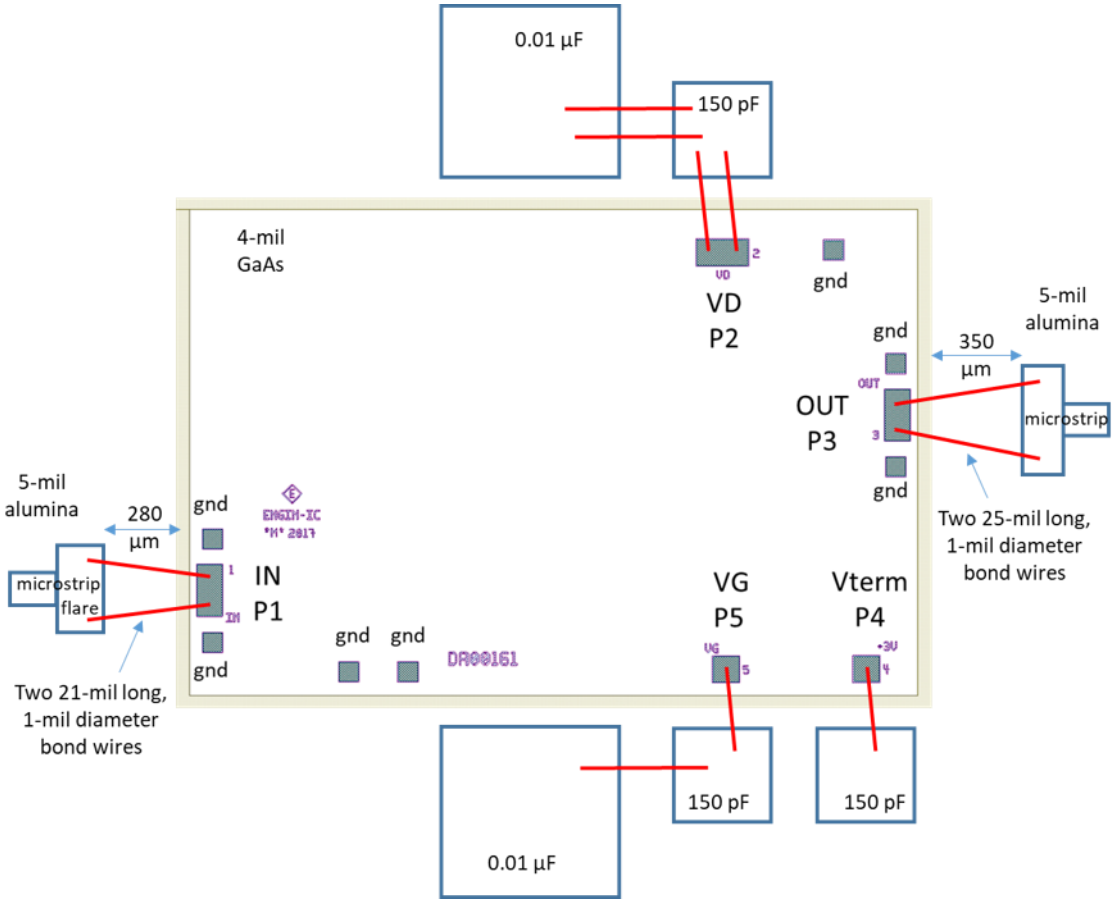
IIP3 > 10 dBm to 19 GHz (OIP3 > 20 dBm); 8 V, 42 mA bias; 3 V, 4 mA active gate term.; 25 °C
IIP3 > 8 dBm to 20 GHz (OIP3 > 18 dBm); 6 V, 32 mA bias



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).

Pad Flare Dimension	Flare Width x-dim, (µm)	Flare Length y-dim, (µm)	Wire Inductance	Wire Length (µm)	# of Wires
RF Input	190	346	0.25	533	2
RF Output	137	437	0.28	635	2



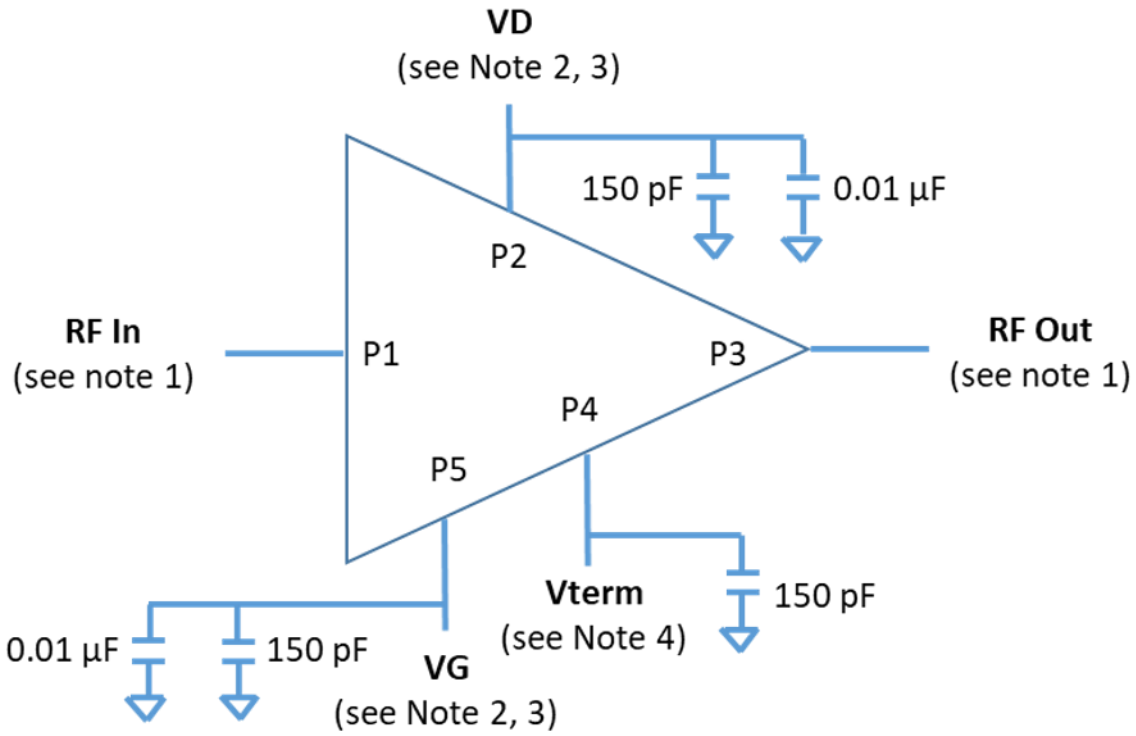
Notes:

1. 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.
2. Gold Wire Details:
   Diameter: 25.4 µm (1 mil)
   Spacing: 4 mils (~ 100 µm) typical
   Height above Ground: 8 mils (~ 200 µm) typical (wedge bonds)
3. Wire Length is total length if the wire were made perfectly straight.

Assembly Guidelines

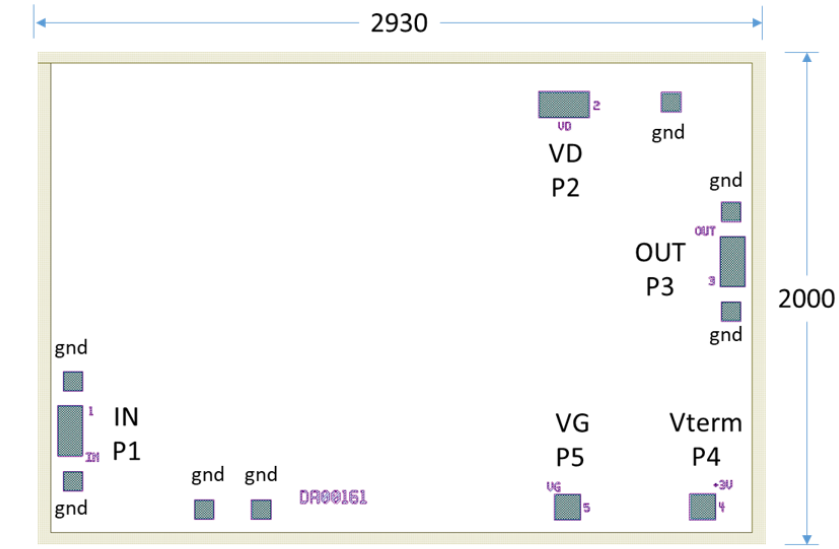
The backside metallization is RF/DC ground. Attachment should be accomplished with electrically and thermally conductive epoxy only. Eutectic Attach is not recommended though product can be made that supports. This device supports high frequency performance. Care should be made to following the wirebond dimensions as shown in the flare diagram.

Application Circuit and Turn-on Procedure



1. Internal blocking capacitors on RF in/out ports (P1 and P2).
2. Gate Voltage (V_G) must be applied prior to Drain Voltage (V_D)
3. Drain Voltage (V_D) must be removed prior to Gate Voltage (V_G).
4. Performance is optimized with V_D set in the 4 - 8 V range.
5. Vterm (active gate termination) voltage should normally be near 3 V

Outline Drawing



Pad Dimensions

Pad Dimension	Length x-dim, (µm)	Width y-dim, (µm)	Length x-dim, (mils)	Width y-dim, (mils)
RF Input	100	200	3.94	7.87
RF Output	100	200	3.94	7.87
Drain Bias	200	100	7.87	3.94
Gate Bias	100	200	3.94	7.87

Bond Pad Center Point Locations

Pad Location	x-dim, (µm)	y-dim, (µm)	x-dim, (mils)	y-dim, (mils)
RF Input	136	462	5.35	18.19
RF Output	2791	1142	109.88	44.96
Drain Bias	2107	1718	82.95	70.12
Gate Bias	2787	372	109.72	14.65

Notes:
All dimensions are given in both µm and mils.
Substrate thickness: 100 µm (0.004”).
Backside metallization is gold.
Bond pad metallization is gold.