Wideband Distributed Amplifier, DIE
0.8 - 20 GHz

Features

- Wideband Performance
- High Linearity
- Positive Gain Slope: 2.5 dB
- Excellent Return Loss: 18 dB
- Die Size:
  - 4.0 x 2.48 x 0.1 mm
  - 0.157 x 0.098 x 0.004 inch
- RoHS* Compliant

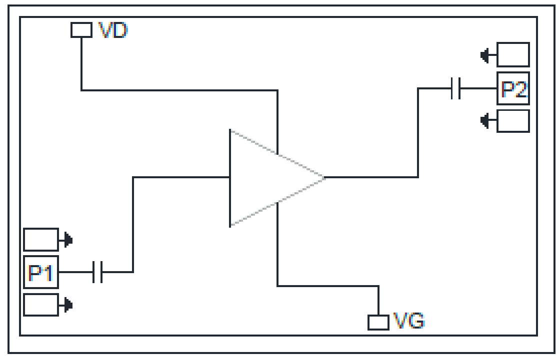
Applications

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

Description

The ENGDA00072 is a wideband GaAs MMIC distributed amplifier (DA) die which operates from 0.8 to 20 GHz. The design is 50 ohm matched and includes all required bias circuitry to function to 0.5 GHz. The DA delivers 9 dB gain at 20 GHz with 2.5 dB of positive gain slope across 2 - 20 GHz. 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
ENGDA00072	Die

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

Electrical Specifications: T_A = +25°C, V_D = 9 - 10 V, V_G = -1.0 - -1.2 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	0.8 - 10 GHz 10 - 20 GHz	dB	5.5 7.0	7.0 8.5	—
Noise Figure	0.8 - 20 GHz	dB	—	5.2	—
Input / Output Return Loss	0.8 - 10 GHz 10 - 20 GHz	dB	15.0 13.5	20.0 18.0	—
Output P1dB	0.8 - 20 GHz	dBm	16	18	—
Output IP3	0.8 - 10 GHz 10 - 20 GHz	dBm	32 30	34 32	—
Output IP2	0.8 - 10 GHz 10 - 20 GHz	dBm	38 40	40 43	—
Supply Current	0.8 - 20 GHz	mA	110	130	150
Thermal Resistance	0.8 - 20 GHz	ºC/W	—	80	—

Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Units
Drain Voltage	9	—	10	V
Gate Voltage	-1.0	-1.1	-1.2	V
Drain Current	—	110	—	mA

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.

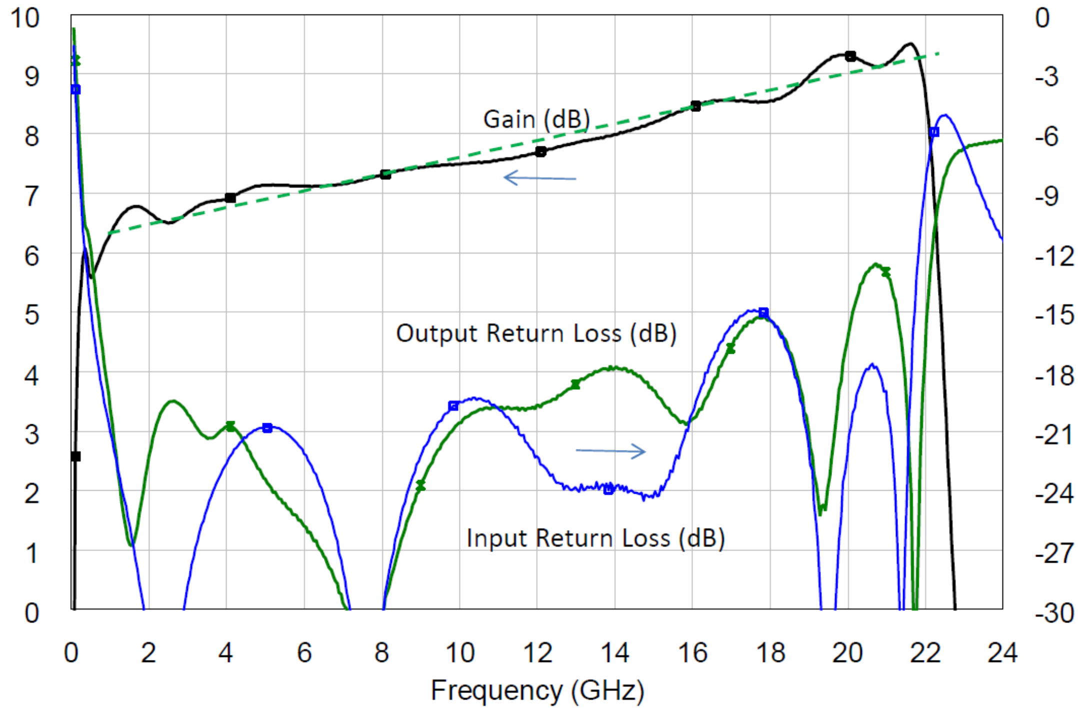
Absolute Maximum Ratings[1,2]

Parameter	Absolute Maximum
Drain Voltage	12 V
Gate Voltage	-6 V
RF Input Power	27 dBm
Junction Temperature	+165°C
Operating Temperature	-55°C to +100°C
Storage Temperature	-65°C to +150°C

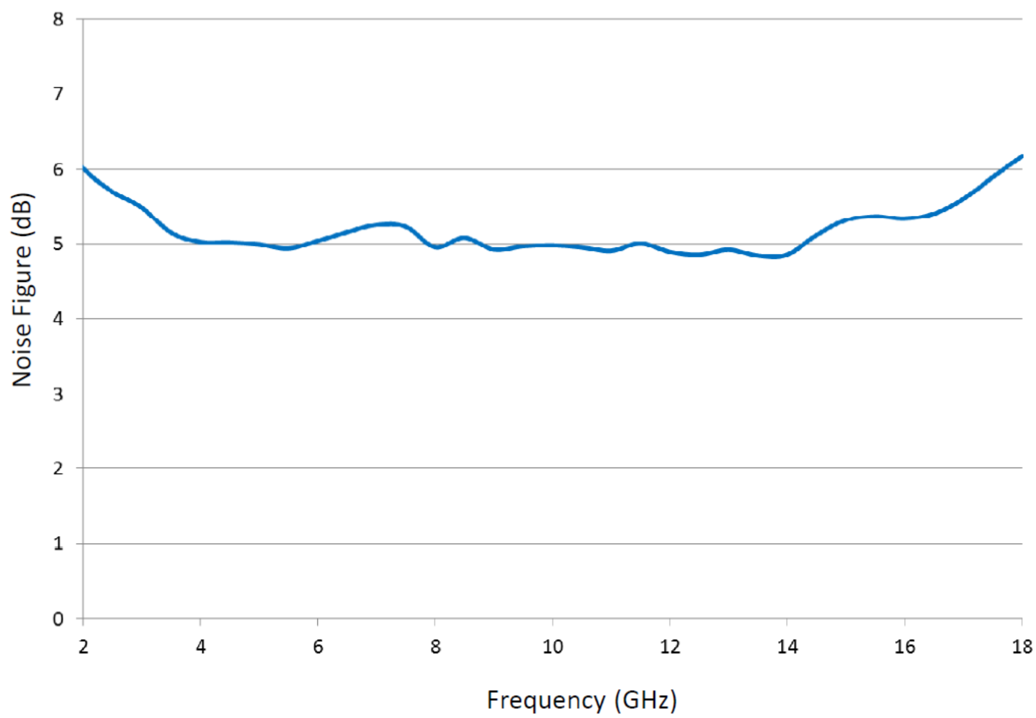
1. Exceeding any one or combination of these limits may cause permanent damage to this device.
2. MACOM does not recommend sustained operation near these survivability limits.

Measured RF Data with Wirebonds & External Microstrip Flares

Gain and In / Out Return Loss: V_D = 10 V; V_G = -1.4 V; I_D = 114 mA

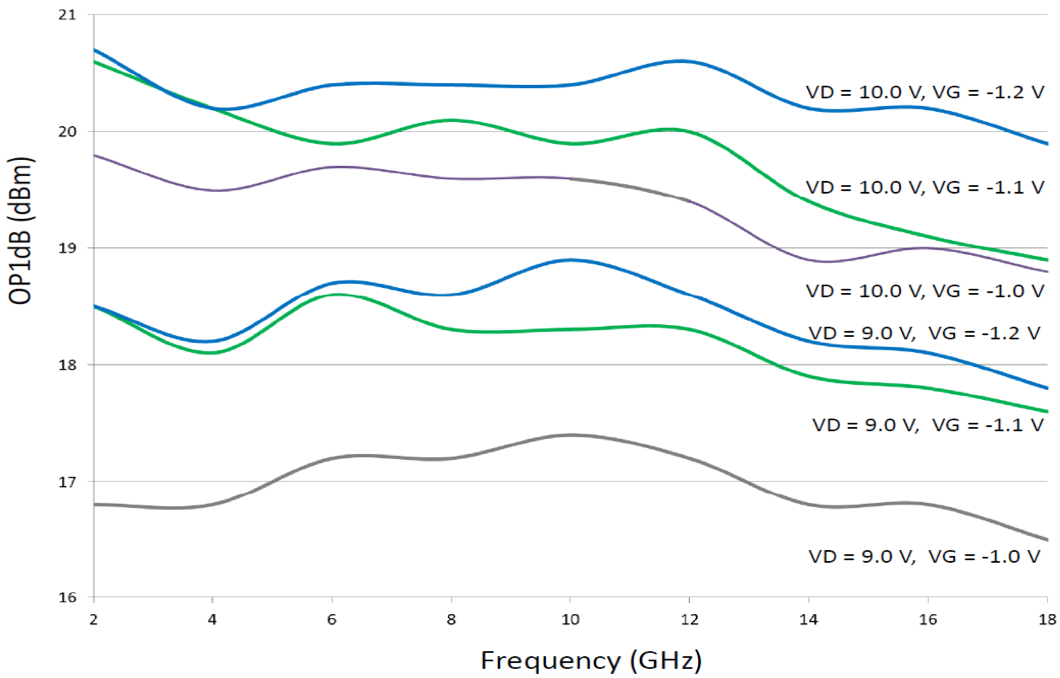


Noise Figure: V_D = 10 V, V_G = -1 V, I_D = 146 mA; T_A = 25°C



Measured RF Data with Wirebonds & External Microstrip Flares

Output Power at 1-dB Gain Compression: V_D = 9 and 10 V, V_G = -1.0, -1.1, and -1.2 V, T_A = 25°C
OP1dB = 20 dBm (10 V, -1.2 Vg); 18 dBm (9 V, -1.2 Vg)



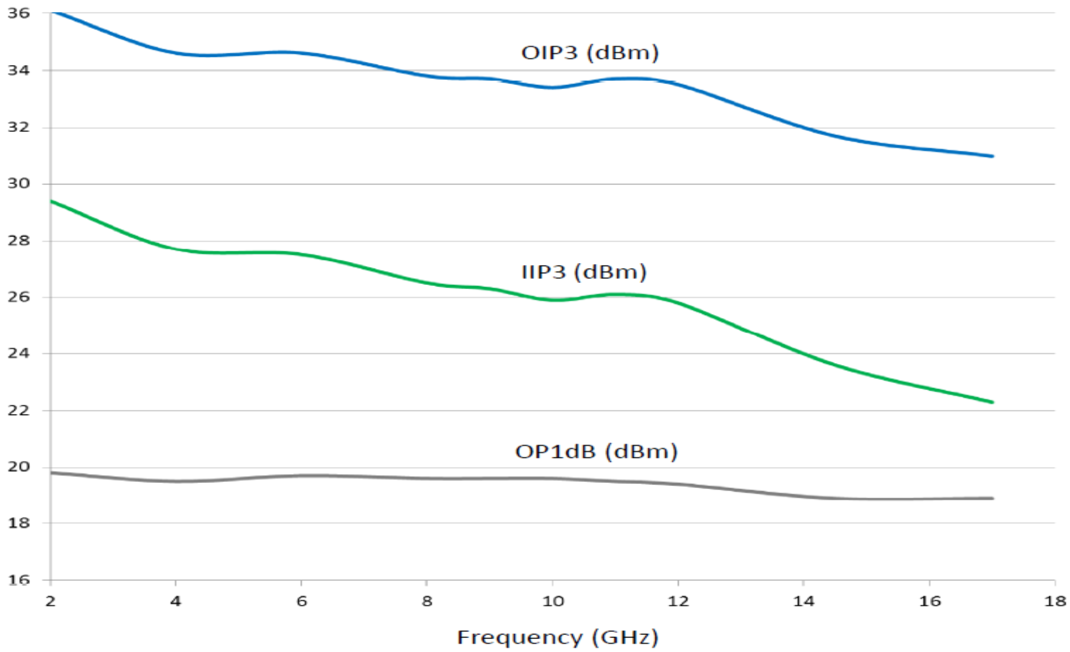
Measured Output Power @ 1-dB Gain Compression (OP1dB) Summary:

0 dBm Input per tone, 2 MHz spacings,
V_D = 9 - 10 V, V_G = -1.0, 1.1, 1.2, T_A = 25°C

Frequency (GHz)	VD = 9 V			VD = 10 V		
	VG = -1.0 V	VG = -1.1 V	VG = -1.2 V	VG = -1.0 V	VG = -1.1 V	VG = -1.2 V
	IDQ = 142 mA	IDQ = 134 mA	IDQ = 123 mA	IDQ = 146 mA	IDQ = 136 mA	IDQ = 126 mA
2	16.8	18.5	18.5	19.8	20.6	20.7
4	16.8	18.1	18.2	19.5	20.2	20.2
6	17.2	18.6	18.7	19.7	19.9	20.4
8	17.2	18.3	18.6	19.6	20.1	20.4
10	17.4	18.3	18.9	19.6	19.9	20.4
12	17.2	18.3	18.6	19.4	20.0	20.6
14	16.8	17.9	18.2	18.9	19.4	20.2
16	16.8	17.8	18.1	19.0	19.1	20.2
18	16.5	17.6	17.8	18.8	18.9	19.9

Measured RF Data with Wirebonds & External Microstrip Flares

IIP3 & OIP3: V_D = 10 V, V_G = -1.0, ID - 146 mA, T_A = 25°C, 0 dBm per tone, 2 MHz Spacing
OIP3 > 31 dBm to 17 GHz; IIP3 > 22 dBm
OP1dB > 18.5 dBm to 18 GHz; OIP3 / OP1dB varies from 12.1 to 16.3 dB



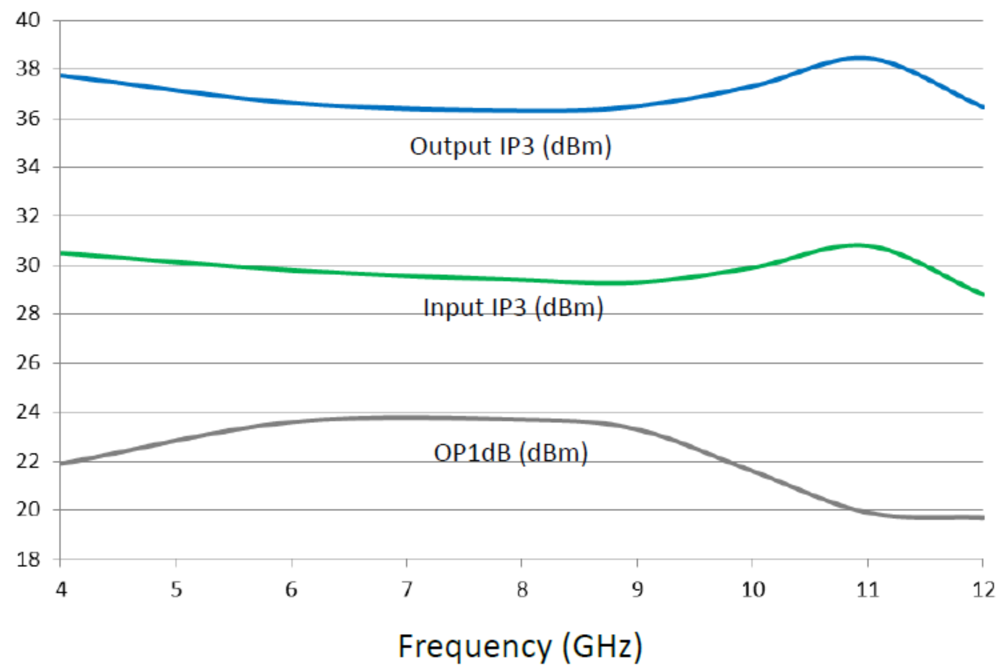
Measured OIP2:

0 dBm Input per tone, 2 MHz spacings, V_D = 10 V, V_G = -1.0, I_D = 146 dBm, OIP2 > 40 dBm, 3 - 18 GHz

F1 (GHz)	F2 (GHz)	IIP2 (dBm)	OIP2 (dBm)
2	2.002	32.5	39.3
5	5.002	33.0	40.1
8	8.002	33.5	40.8
9	9.002	33.5	40.9
10	10.002	32.5	40.0
12	12.002	34.0	41.7
8	10	36.0	43.4
10	12	37.3	44.9
12	14	35.8	43.6
14	16	33.7	41.9
16	18	34.0	42.6

Measured RF Data with Wirebonds & External Microstrip Flare Pads

OIP3, IIP3, OP1dB: V_D = 7 V; V_G = -0.8 V; I_D = 112 mA; 0 dBm per tone, 2 MHz Spacing

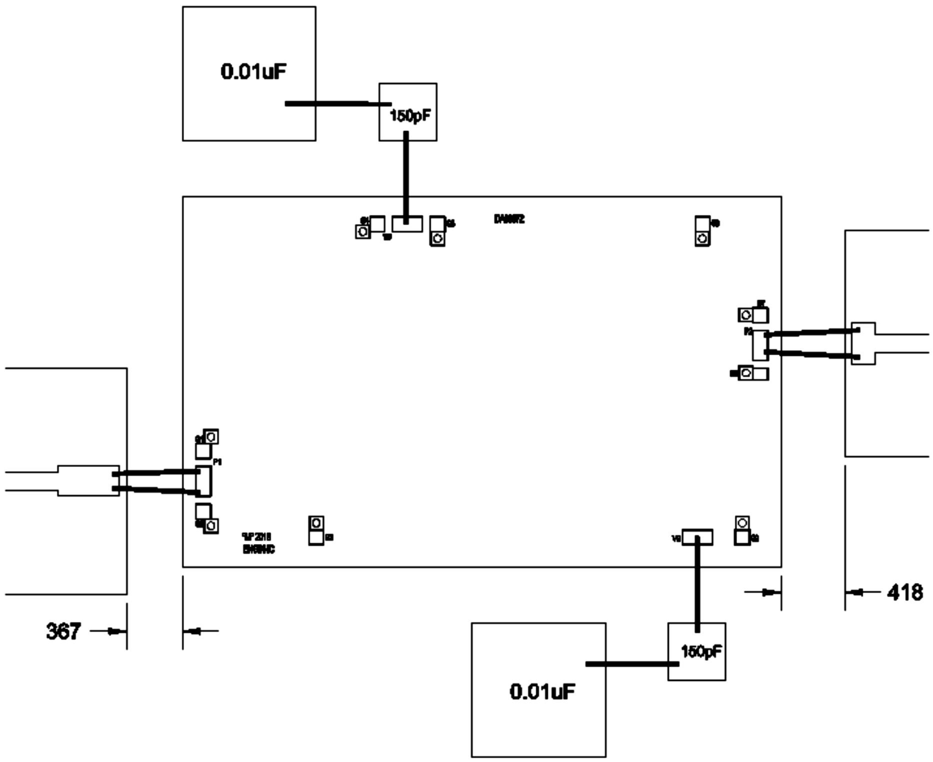


Frequency (GHz)	OP1dB (dBm)	IIP3 (dBm)	OIP3 (dBm)	OIP3/P1dB (dB)
4	21.9	30.5	37.8	15.9
6	23.6	29.8	36.6	13.0
8	23.7	29.4	36.3	12.6
9	23.3	29.3	36.5	13.2
10	21.6	29.9	37.3	15.7
11	19.9	30.8	38.5	18.6
12	19.7	28.8	36.5	16.8

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	195	408	0.265	583	2
RF Output	277	157	0.295	630	2

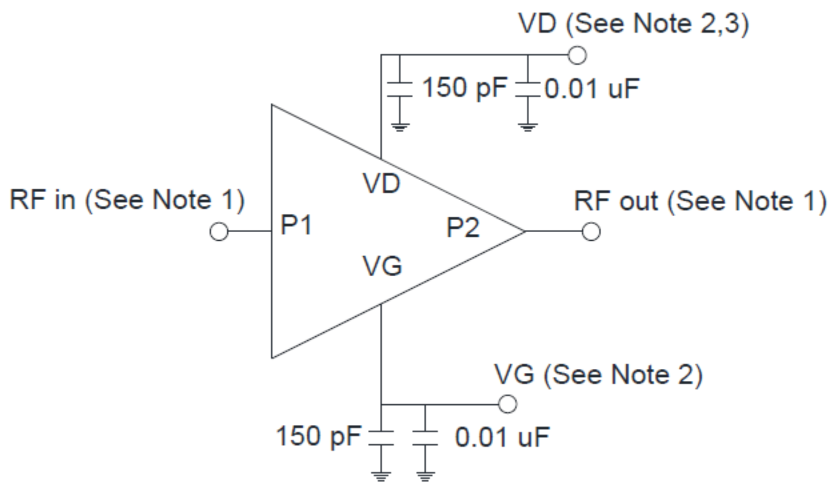


Notes:
1. To achieve bond wire inductance noted, bond the number of wires shown in parallel from each external flare to each associated MMIC RF bond pad as shown above.
2. Gold Wire Details:
   Diameter: 25.4 µm (1 mil)
   Spacing: 4 mils (~ 100 µm) typical
   Height above Ground: 8 mils (~ 200 µm) typical (wedge bonds)
3. Wire Length is total length if the wire were made perfectly straight.

Assembly Guidelines

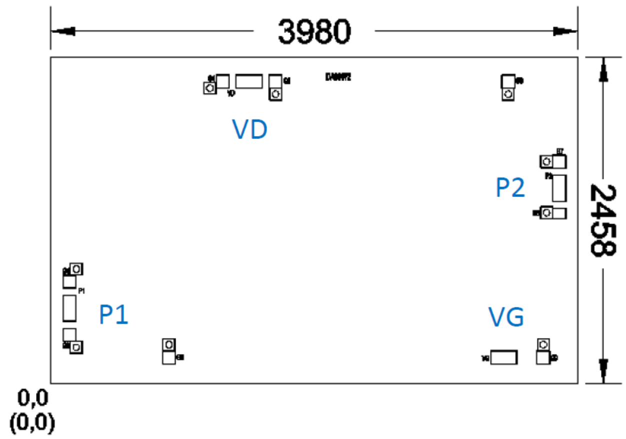
The backside metallization is RF/DC ground. Attachment should be accomplished with electrically and thermally conductive epoxy only. Eutectic Attach is not recommended though product can be made that supports. This device supports high frequency performance. Care should be made to following the wirebond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

Application Circuit and Turn-on Procedure



Notes:
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 to 8 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	3.937	7.874
RF Output	100	200	3.937	7.874
Drain Bias	200	100	7.874	3.937
Gate Bias	200	100	7.874	3.937

Bond Pad Center Point Locations

Pad Location	x-dim, (µm)	y-dim, (µm)	x-dim, (mils)	y-dim, (mils)
RF Input	140	567.5	5.512	22.343
RF Output	3840	1473	151.181	57.99
Drain Bias	1495.5	2278.2	58.878	89.693
Gate Bias	3420	196	134.646	7.717

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.