Wideband Distributed Amplifier, DIE
1.5 - 19 GHz

ENGDA00074
Rev. V1

Features

- Wideband Performance
- High Linearity
- Positive Gain Slope: 8 dB
- Excellent Return Loss: 18 dB
- IIP3: 27 dBm, OIP3: 35 dBm @ 9 V
- IIP2: 34 dBm, OIP2: 42 dBm @ 8 V
- Die Size:
  2.40 x 2.48 x 0.1 mm
  0.094 x 0.098 x 0.004 inch
- RoHS* Compliant

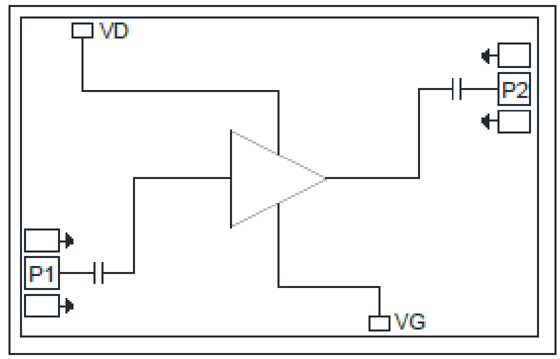
Applications

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

Description

The ENGDA00074 is a wideband GaAs MMIC distributed amplifier die which operates from 1.5 to 19 GHz. The design is 50 ohm matched and includes on board bias circuitry. The amplifier offers 9 dB gain at 19 GHz with 1 dB of positive gain slope across the band. The amplifier is extremely linear with OIP3 near 15 dB better than OP1dB. The MMIC 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
ENGDA00074	Die

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

Electrical Specifications: T_A = +25°C, V_D = 8 - 9 V, V_G = -0.9 - -1.1 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	1.5 - 10 GHz 10 - 19 GHz	dB	6.5 7.0	8.0 8.5	—
Noise Figure	1.5 - 19 GHz	dB	—	6	—
Input Return Loss	1.5 - 10 GHz 10 - 19 GHz	dB	14 15	18 20	—
Output Return Loss	1.5 - 10 GHz 10 - 19 GHz	dB	12 15	16 18	—
Output P1dB	1.5 - 10 GHz 10 - 19 GHz	dBm	13 11 @ 20 GHz	16 16	—
Output IP3	1.5 - 19 GHz, 9 V Bias Max.	dBm	31	35	—
Output IP2	1.5 - 19 GHz, 8 V Bias Max.	dBm	38	42	—
Supply Current	1.5 - 19 GHz	mA	160	195	240
Thermal Resistance	1.5 - 19 GHz	ºC/W	—	40	—

Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Units
Drain Voltage	7.5	8.0 - 9.0	10.5	V
Gate Voltage	-0.8	-1.1	-1.4	V
Drain Current	—	197	—	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.

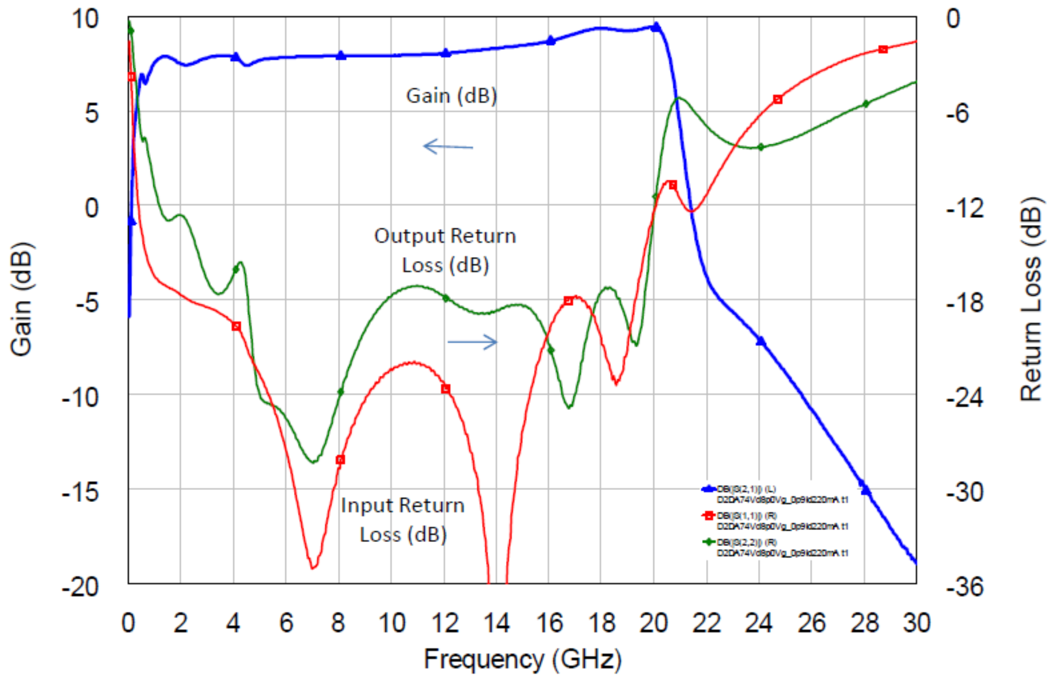
Absolute Maximum Ratings[1,2]

Parameter	Absolute Maximum
Drain Voltage	12 V
Gate Voltage	-6 V
RF Input Power	25 dBm
Junction Temperature	+165°C
Operating Temperature	-55°C to +100°C
Storage Temperature	-65°C to +150°C

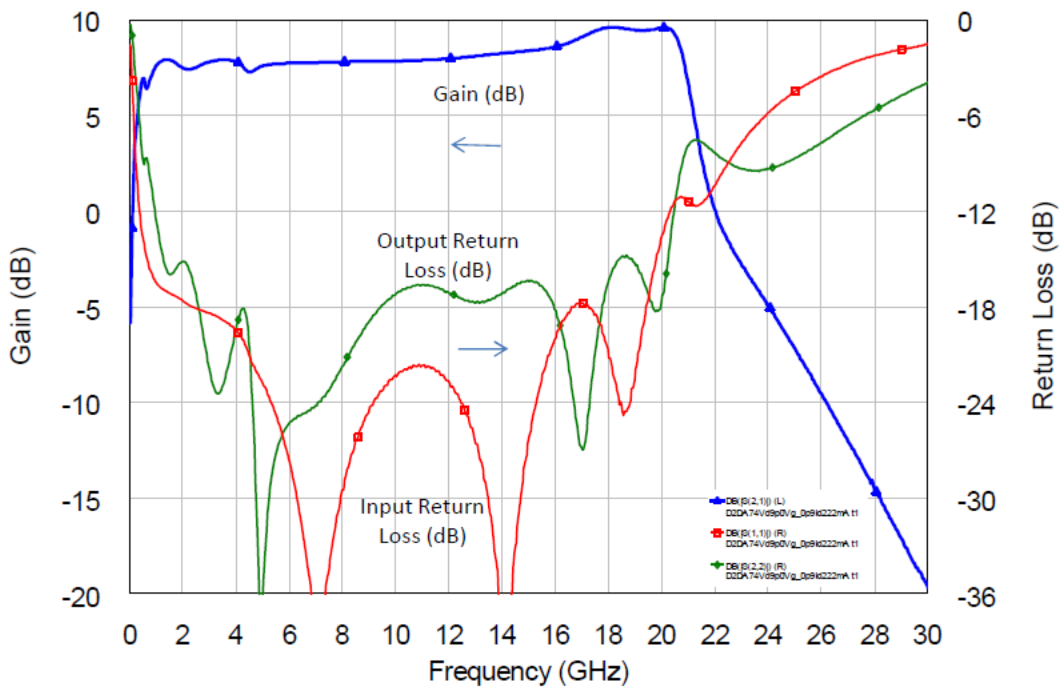
1. Exceeding any one or combination of these limits may cause permanent damage to this device.
2. MACOM does not recommend sustained operation near these survivability limits.

Measured RF Data with Wirebonds & External Microstrip Flares

Gain and In / Out Return Loss: V_D = 8 V; V_G = -0.9 V; I_D = 222 mA

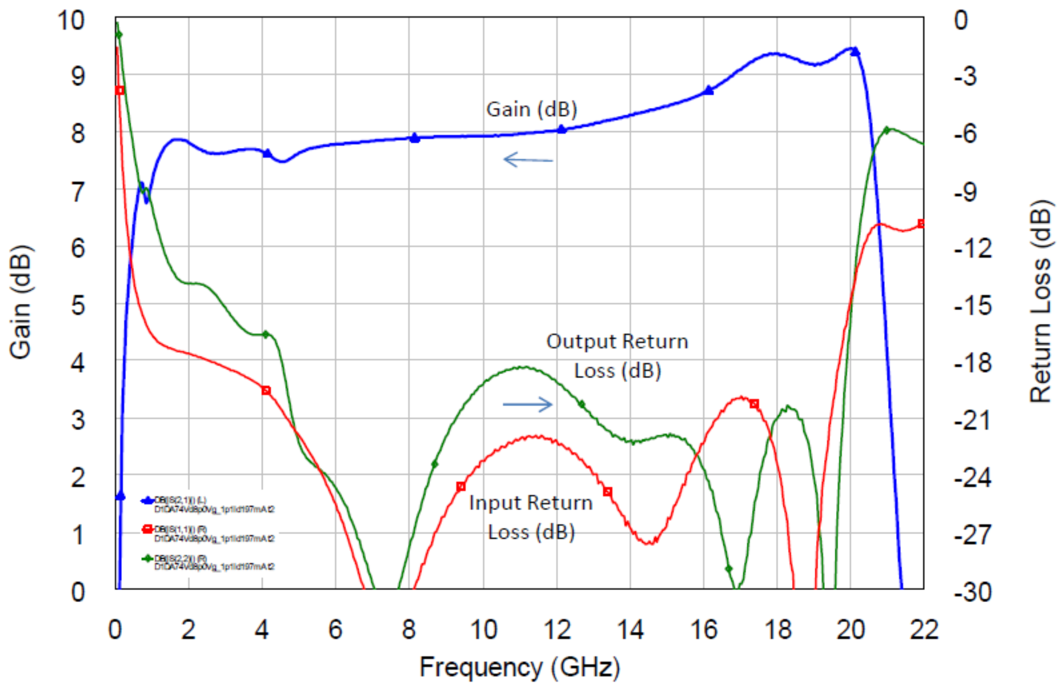


Gain and In / Out Return Loss: V_D = 9 V; V_G = -0.9 V; I_D = 222 mA

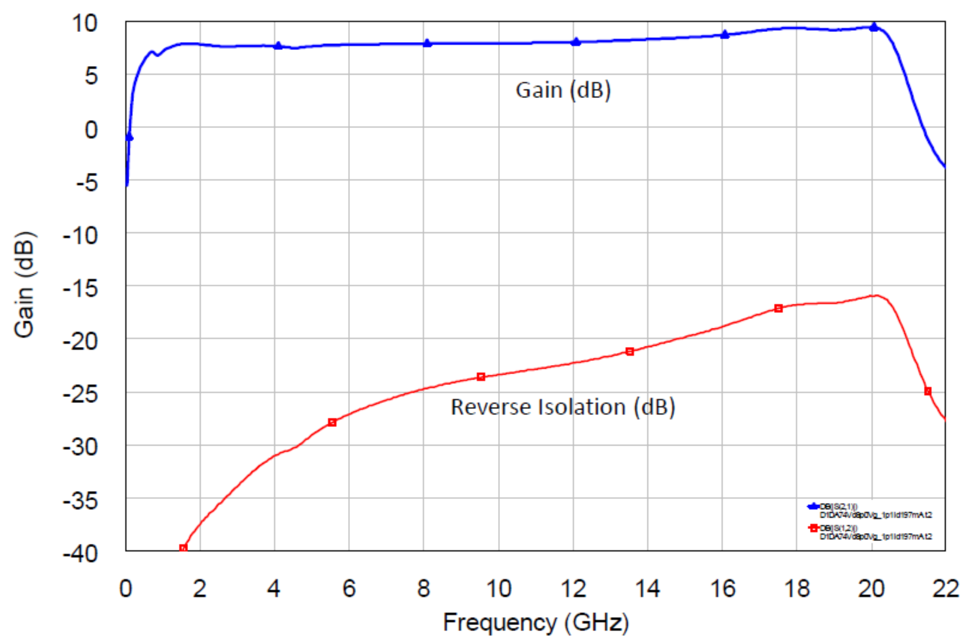


Measured RF Data with Wirebonds & External Microstrip Flares

Gain and In / Out Return Loss: V_D = 8 V; V_G = -1.1 V; I_D = 197 mA

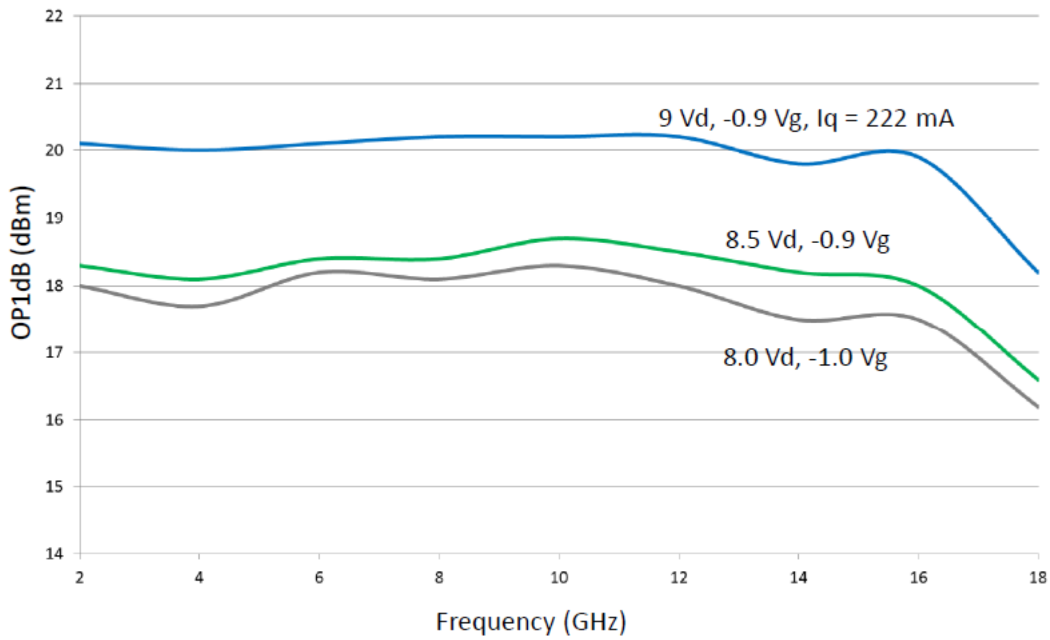


Gain and Reverse Isolation: V_D = 8 V; V_G = -1.1 V; I_D = 197 mA



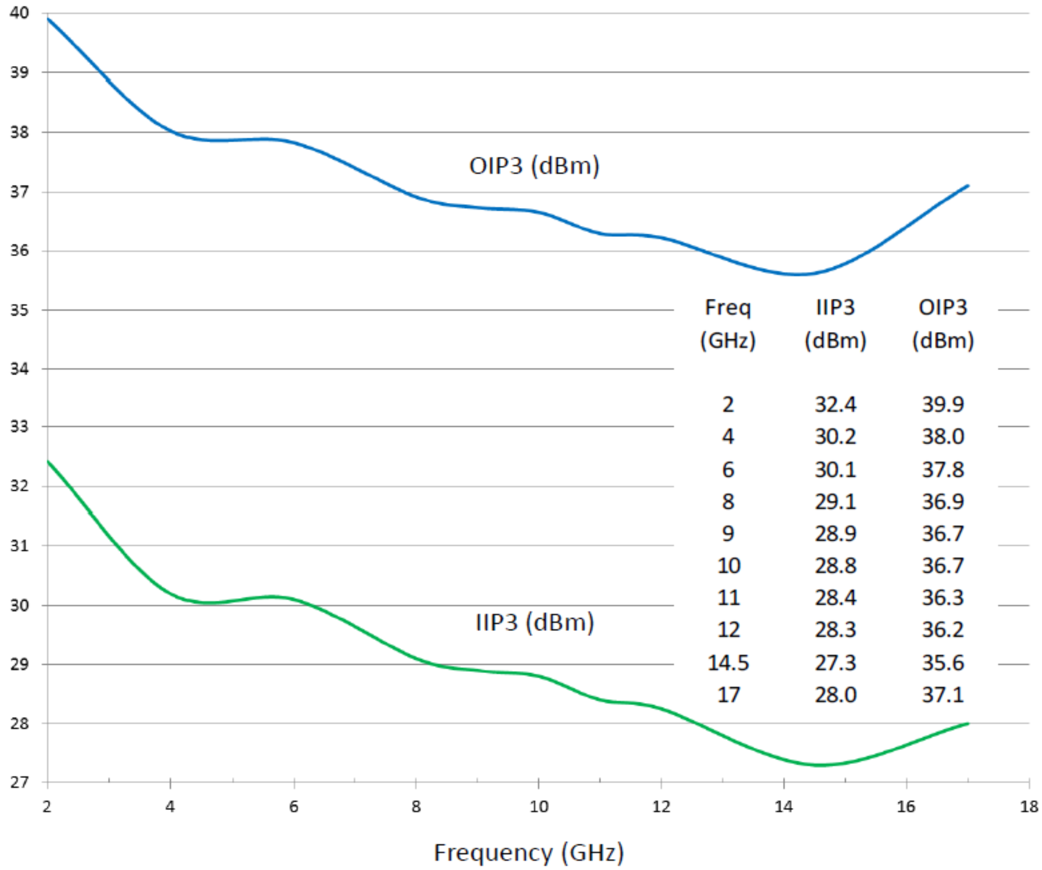
Measured RF Data with Wirebonds & External Microstrip Flares

Output Power at 1-dB Gain Compression: V_D = 8 - 9 V, V_G = -0.9 or 1.0 V, T_A = 25°C
OP1dB @ 2 - 16 GHz = 20 dBm (9.0 V_D, -0.9 V_G); 18 dBm (8.0 to 8.5 V_D, -0.9 to -1.0 V_G)



Measured RF Data with Wirebonds & External Microstrip Flares

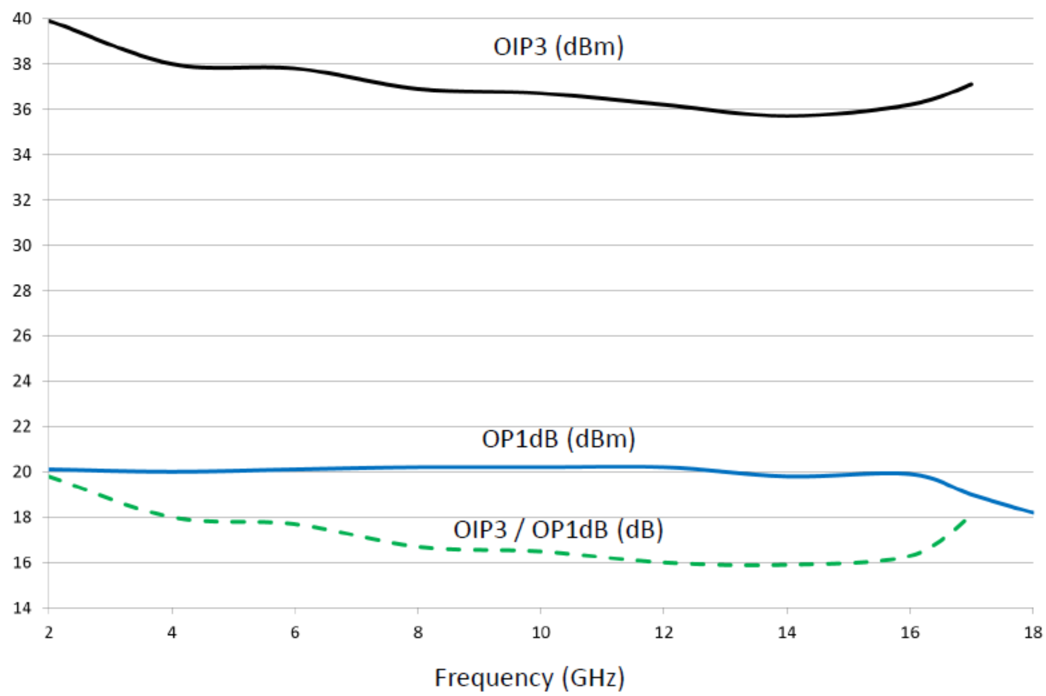
OIP3 > 35 dBm, IIP3 > 27 dBm, 2 - 17 GHz: V_D = 9.0 V (optimum); V_G = -0.9 V; I_D = 222 mA; 0 dBm per tone (also measured same IIP3 and OIP3 performance at -10 and -5 dBm per tone)



Freq (GHz)	IIP3 (dBm)	OIP3 (dBm)
2	32.4	39.9
4	30.2	38.0
6	30.1	37.8
8	29.1	36.9
9	28.9	36.7
10	28.8	36.7
11	28.4	36.3
12	28.3	36.2
14.5	27.3	35.6
17	28.0	37.1

Measured RF Data with Wirebonds & External Microstrip Flares

Output Third-Order Intercept (OIP3, dBm) and Output Power at 1-dB Gain Compression: V_D = 9.0 V (optimum); V_G = -0.9 V; I_D = 222 mA; T_A = 25°C



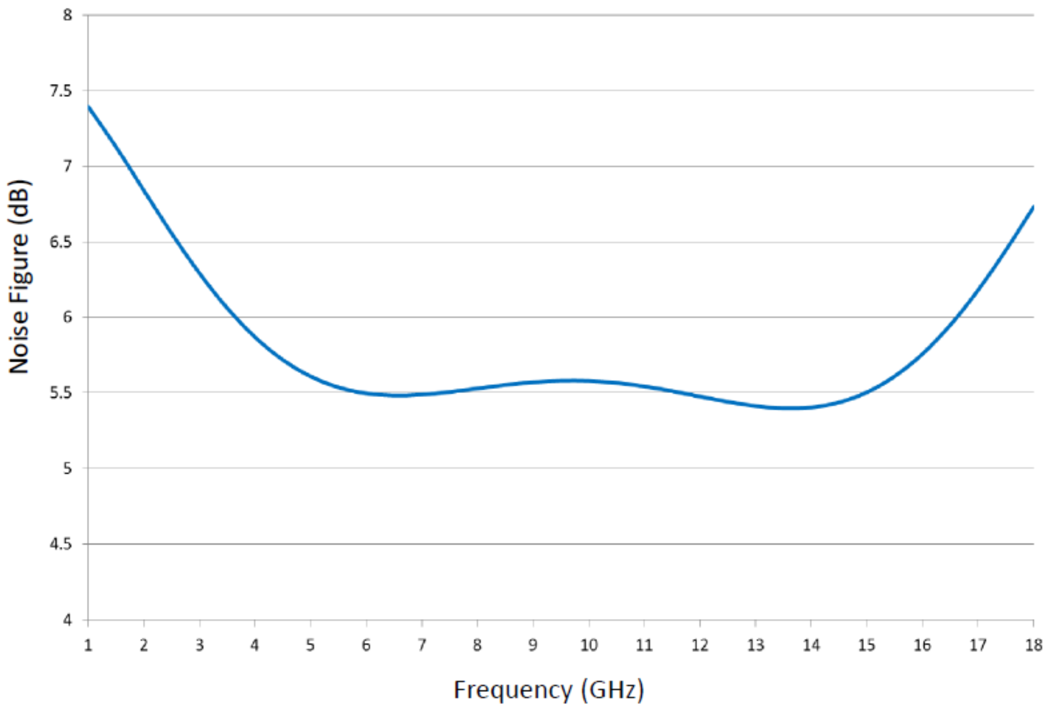
Measured RF Data with Wirebonds & External Microstrip Flares

IIP2 > 36 dBm, 8 V, -1.0 V_G (optimum bias for IIP2), 2 - 12 GHz; >34 dBm, 8 V, -0.9 V_G; >31 dBm, 9 V, -0.9 V_G
OIP2 ~ 8 dB higher than IIP2
Measured 2nd harmonic level (2 * F2) also provided
Tone levels ranging from -5 to 0 dBm per tone; note frequency spacings

VD (V):	8	VG (V):	-0.9		VD (V):	8	VG (V):	-1		VD (V):	9	VG (V):	-0.9
F1	F2	IIP2	2*F2		F1	F2	IIP2	2*F2		F1	F2	IIP2	2*F2
(GHz)	(GHz)	(dBm)	(dBc)		(GHz)	(GHz)	(dBm)	(dBc)		(GHz)	(GHz)	(dBm)	(dBc)
		high side					high side					high side	
2	2.002	45.7	-52		2	2.002	44.5	-51		2	2.002	41.5	-48
4	4.002	38.7	-45		4	4.002	45.2	-51		4	4.002	35.2	-41
5	5.002	38.5	-45		5	5.002	44.8	-51		5	5.002	35.3	-41
8	8.002	34.2	-44		8	8.002	42.0	-48		8	8.002	32.7	-39
9	9.002	34.5	-41		9	9.002	41.2	-47		9	9.002	31.5	-38
10	10.002	38.0	-44		10	10.002	36.0	-42		10	10.002	31.3	-37
11	11.002	37.8	-44		11	11.002	38.0	-44		11	11.002	31.5	-38
12	12.002	43.5	-50		12	12.002	43.8	-50		12	12.002	33.8	-40
		low side					low side					low side	
		(2 GHz)					(2 GHz)					(2 GHz)	
8	10	42.5			8	10	49.2			8	10	47.2	
10	12	42.8			10	12	51.5			10	12	48.7	
12	14	37.5			12	14	45.2			12	14	48.2	
14	16	37.0			14	16	42.3			14	16	45.3	
16	18	33.5			16	18	38.2			16	18	48.2	

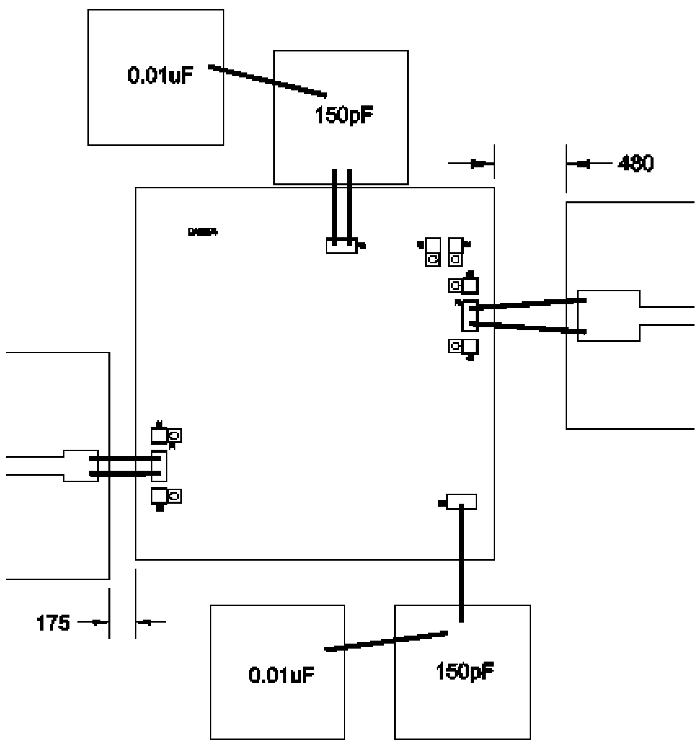
Measured RF Data with Wirebonds & External Microstrip Flares

Noise Figure, 1 to 18 GHz; 25ºC: V_D = 8.0 to 9.0 V, V_G = -0.9 to -1.0 V



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	205	228	0.21	457	2
RF Output	334	409	0.35	762	2

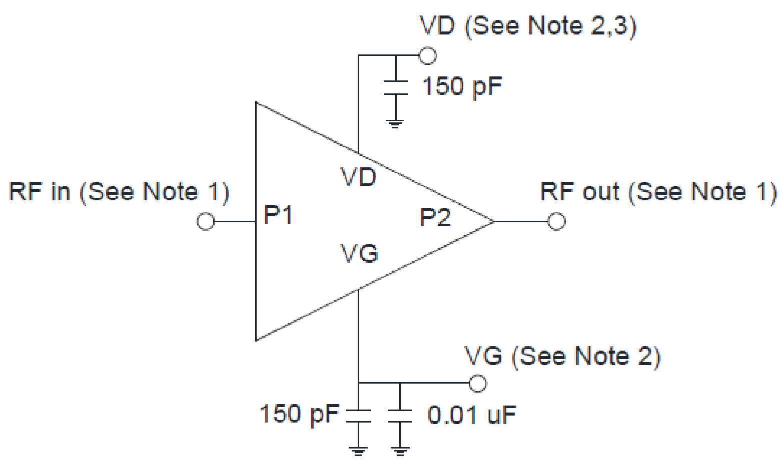


Notes:
1. To achieve bond wire inductance noted, bond the number of wires shown in parallel from each external flare to each associated MMIC RF bond pad as shown above.
2. Gold Wire Details:
   Diameter: 25.4 µm (1 mil)
   Spacing: 4 mils (~ 100 µm) typical
   Height above Ground: 8 mils (~ 200 µm) typical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

Assembly Guidelines

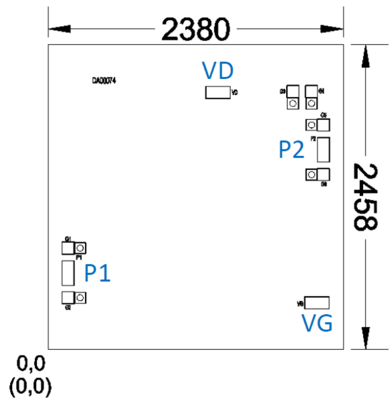
The backside metallization is RF/DC ground. Attachment should be accomplished with electrically and thermally conductive epoxy only. Eutectic Attach is not recommended though product can be made that supports. This device supports high frequency performance. Care should be made to following the wirebond 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 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	3.9	7.9
RF Output	100	200	3.9	7.9
Drain Bias	200	100	7.9	3.9
Gate Bias	200	100	7.9	3.9

Bond Pad Center Point Locations

Pad Location	x-dim, (µm)	y-dim, (µm)	x-dim, (mils)	y-dim, (mils)
RF Input	162	618	6.4	24.3
RF Output	2218	1611	87.3	63.4
Drain Bias	1368	2073	53.9	81.6
Gate Bias	2166	378	85.3	14.9

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.