# Wideband Distributed Gain Block, DIE, 0.75 to 22 GHz

ENGDA00073

## *Typical Applications*

- Military EW and SIGINT
- Receive or Transmit Circuits
- Telecom Infrastructure
- Space Hybrids
- Test and Measurement Systems

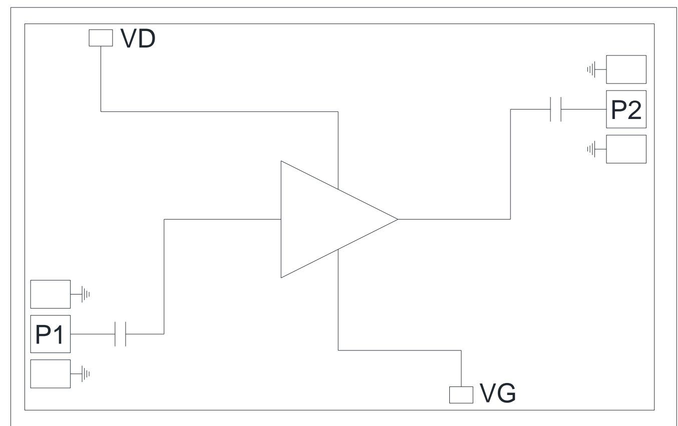
## *Features*

- Wideband performance
- High Linearity
- Positive Gain Slope
- Excellent return loss
    - 20 dB typical
- Size
    - 4.78 x 2.46 x 0.1 mm
    - 0.188 x 0.097 x 0.004 inch

## *Description*

The ENGDA00073 is a wideband GaAs MMIC distributed amplifier die which operates from 0.75 to 22 GHz. The design is 50 ohm matched and includes on board bias circuitry. The amplifier delivers 10 dB gain at 21 GHz with 1 dB of positive gain slope across the full 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*



## Electrical Specifications, T = 25 °C, VD = 8.0 V; VG = -1.1 V

| Parameter | Min | Typ | Max | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| Frequency Range | 0.7 – 10.0 | | | 10.0 – 22.0 | | | GHz |
| Gain | 7 | 9 | | 8.5 | 10 | | dB |
| Noise Figure | | 5.0 | | | 6.0 | | dB |
| Input Return Loss | 15 | 20 | | 15 | 20 | | dB |
| Output Return Loss | 15 | 20 | | 15 | 20 | | dB |
| Output P1dB | 16.5 | 18.0 | | 16.5 | 18.0 | | dBm |
| Output IP3 | 35 | 40 | | 28 | 36 | | dBm |
| Output IP2 | 38 | 48 | | 38 | 46 | | dBm |
| Supply Current | 120 | 152 | 180 | 120 | 152 | 180 | mA |
| Thermal Resistance | | 37 | | | 37 | | °C/W |

## Recommended Operating Conditions

| Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|
| VD | 6.5 | 8 | 10.5 | V |
| ID | | 152 | | mA |
| VG | -0.6 | -1.1 | -1.4 | V |

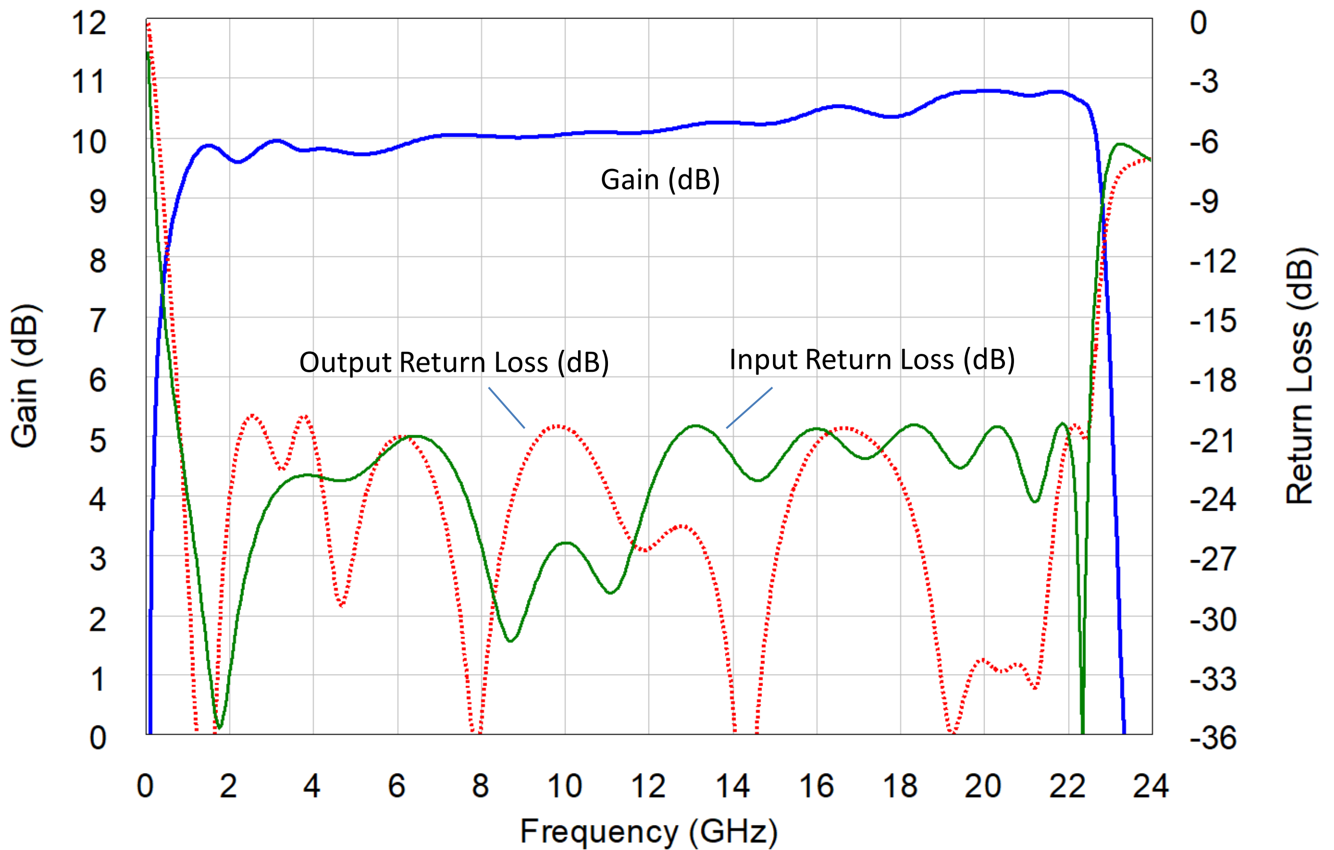
## Absolute Maximum Ratings

| Parameter | Max level |
|---|---|
| Drain Voltage, VD | 12 V |
| Gate Voltage, VG | -6 V |
| RF Input Power | +25 dBm |
| Channel Temperature | +160 °C |
| Operating Temperature | -55 °C to +100 °C |
| Storage Temperature | -65 °C to +150 °C |

# RF Data with wirebonds and external microstrip flare pads

***Gain and In /Out Return Loss (dB)***

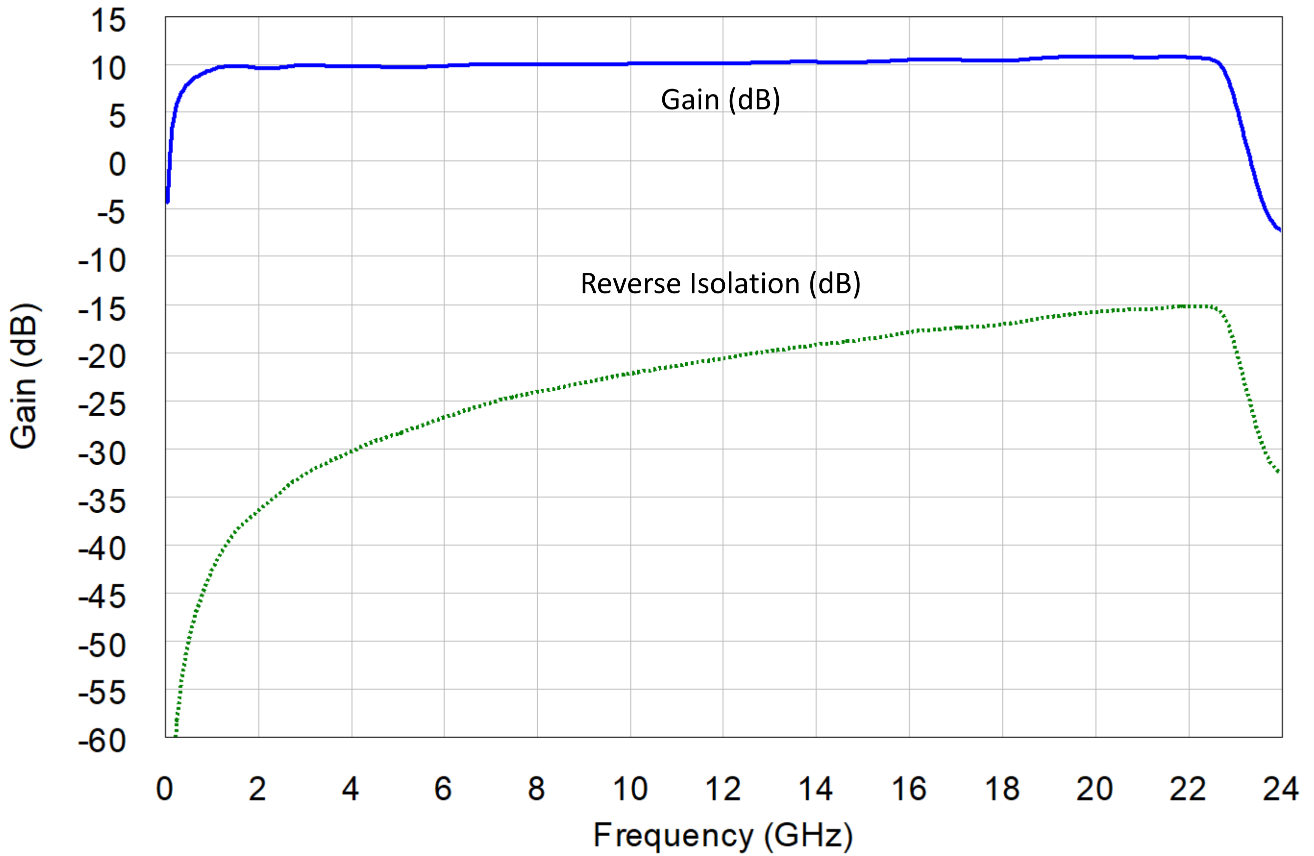
***VD = 8 V;  VG = -1.1 V;  ID = 152 mA***



## *RF Data with wirebonds and external microstrip flare pads*

***Gain and Reverse Isolation (dB)***

***VD = 8 V;  VG = -1.1 V;  ID = 152 mA***

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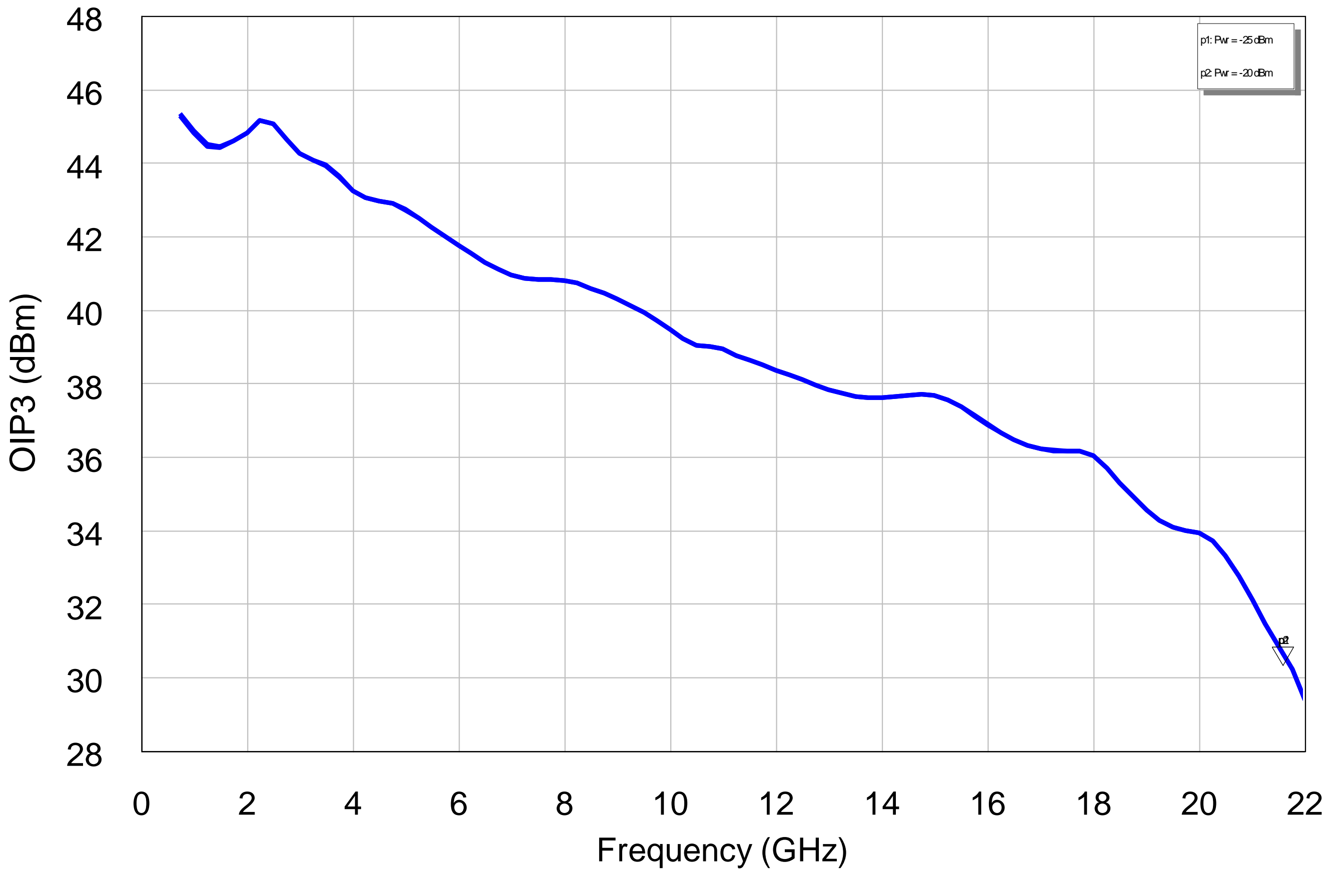
## *RF Data with wirebonds and external microstrip flare pads*

### ***OIP3 (dBm); OP1dB ~ 18 dBm***

*VD = 8.0 V; VG = -1.1 V; ID = 152 mA;* ***OIP3 > 36 dBm to 18 GHz***

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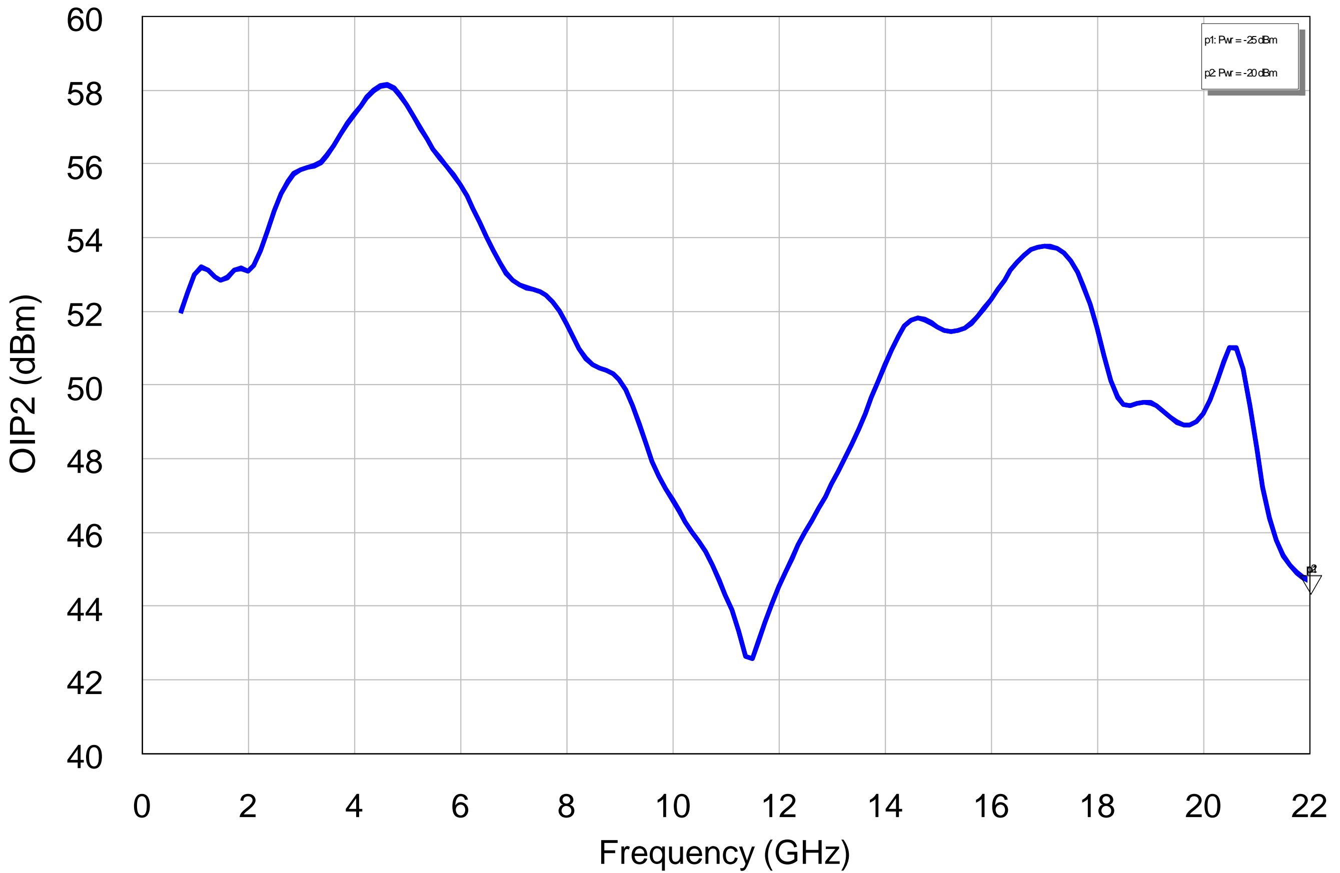
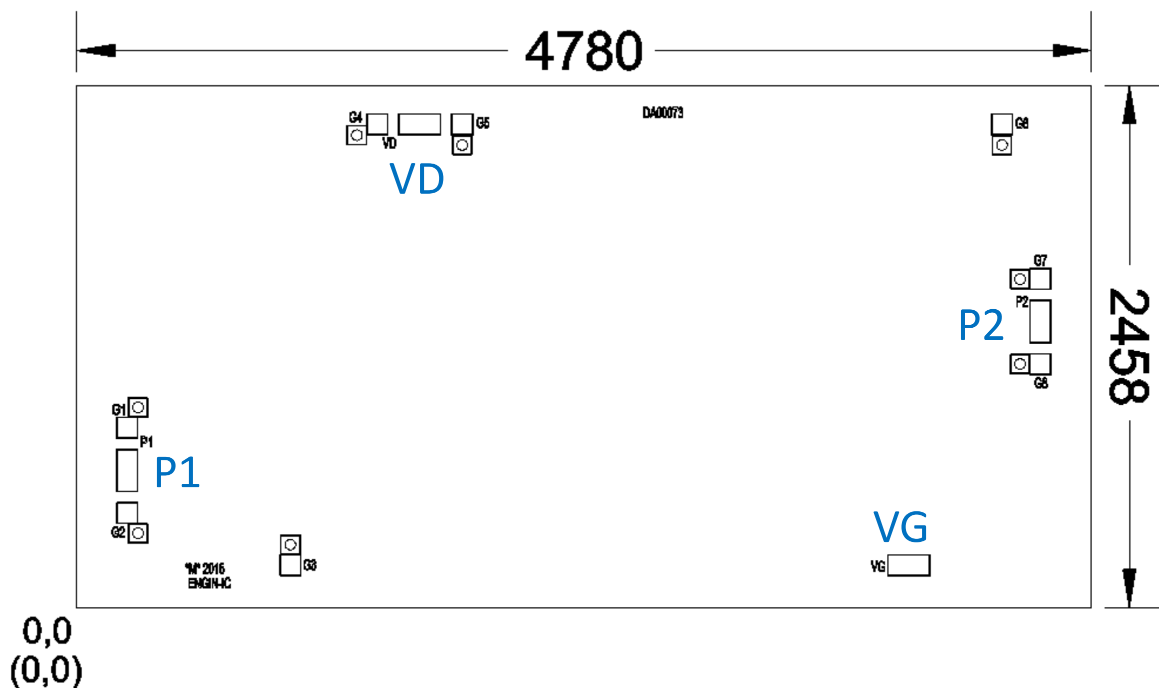
## *RF Data with wirebonds and external microstrip flare pads*

***OIP2 (dBm); OP1dB ~ 18 dBm***

*VD = 8.0 V; VG = -1.1 V; ID = 152 mA;* ***OIP2 > 42 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 Dimension | 100 | 200 | 3.9 | 7.9 |
| P2 RF Output Pad Dimensions | 100 | 200 | 3.9 | 7.9 |
| VD Drain Bias Pad Dimension | 200 | 100 | 7.9 | 3.9 |
| VG Gate Bias Pad Dimension | 200 | 100 | 7.9 | 3.9 |
| | RF Bond Pad Center Point Locations | | | |
| | x-dim, um | y-dim, um | x-dim, mils | y-dim, mils |
| P1 RF Input Pad Location | 240 | 646 | 9.4 | 25.4 |
| P2 RF Output Pad Location | 4540 | 1346 | 178.7 | 53 |
| VD Drain Bias Pad Location | 1617 | 2273 | 63.7 | 89.5 |
| VG Gate Bias Pad Location | 3921 | 201 | 154.4 | 7.9 |

***Notes:***

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

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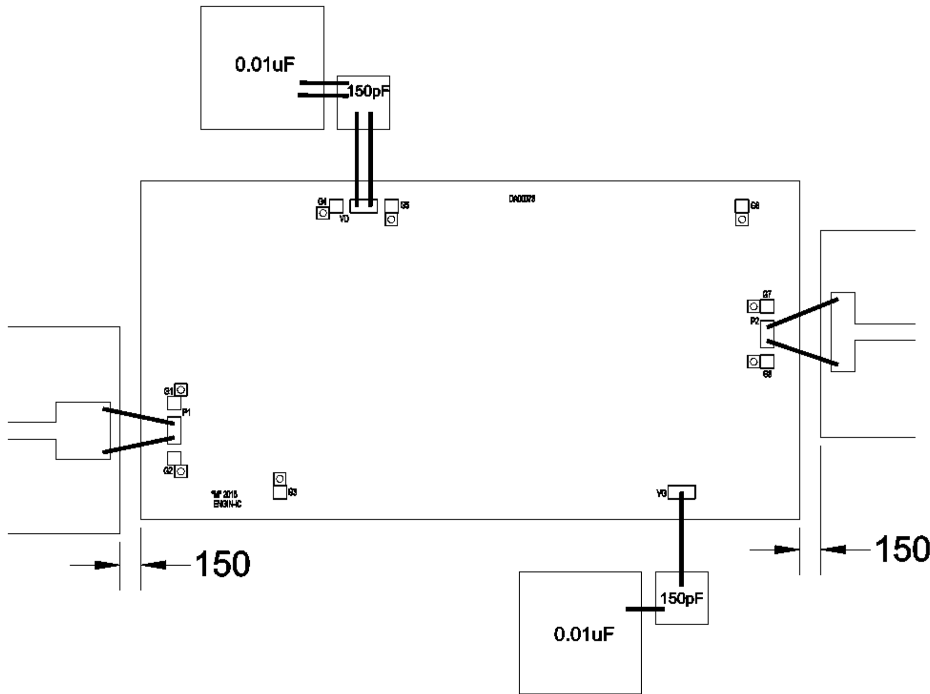
## *External I/O Microstrip Flare Dimensions (on 5-mil Alumina) and I/O Bond Wire Inductances for Optimum Insertion and Return Loss Performance*

*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).*

| Parameter | RF I/O Port – External Microstrip Flares on 5-mil Alumina | | | | |
|---|---|---|---|---|---|
| | Flare Length x-dim, um | Flare Width y-dim, um | Wire Inductance | Wire Length um | Number of Wires |
| P1 RF Input Pad Flare Dimension | 360 | 416 | 0.28 | 584 | 2 |
| P2 RF Output Pad Flare Dimension | 175 | 576 | 0.31 | 660 | 2 |



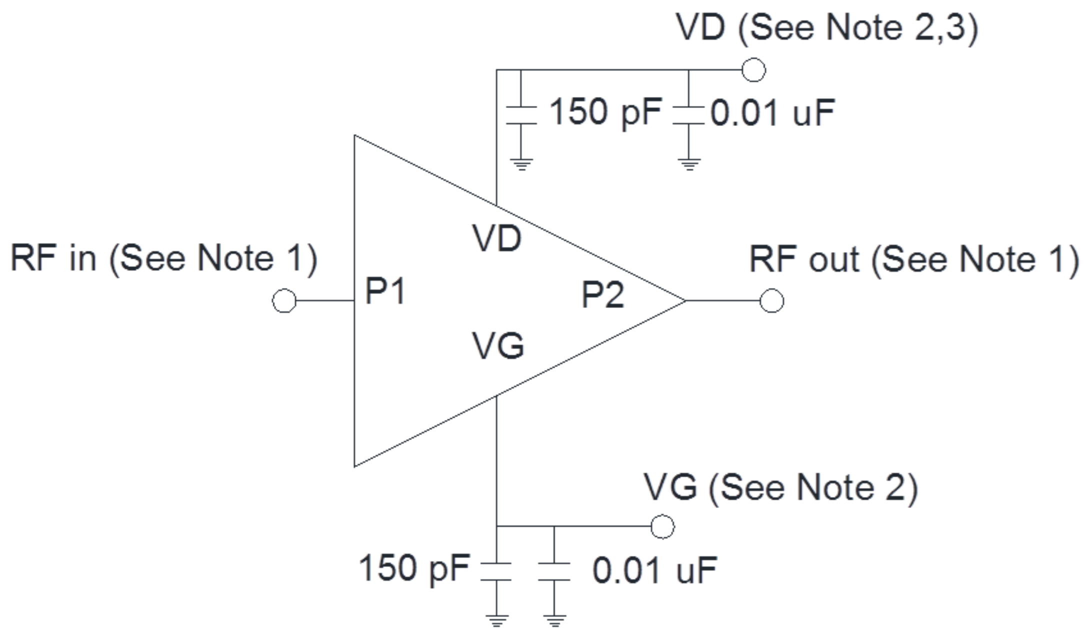

***Notes:***

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:***
   a) ***Diameter: 25.4 µm (1 mil)***
   b) ***Spacing: 4 mils (~ 100 µm) typical***
   c) ***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*




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 to 8.0V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