

### Product Overview

The RFGA2054 is a high performance InGaP HBT MMIC amplifier. The RFGA2054's internal active bias circuitry allows the amplifier to operate directly from a 5V supply and provides stable current over temperature and process variations of the Beta. This Darlington amplifier is internally matched to 50Ω making it ideal for applications requiring small footprints and minimal external components.

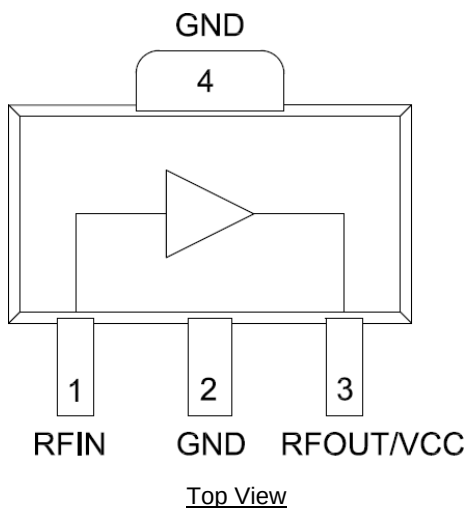


SOT-89 Package

### Key Features

- Low Cost
- Broadband Gain
- Internally Matched
- Internal Active Bias
- No Dropping Resistor Required
- Single Supply 5V Operation
- HBM ESD Level >1000V

### Functional Block Diagram



### Applications

- PA Driver Amplifier
- LO Buffer Amplifier
- Cellular, PCS, GSM, UMTS, LTE, TD\_SCDMA
- Wideband Instrumentation
- Wireless Data, Satellite Terminals

### Ordering Information

| Part No.         | Description                                               |
|------------------|-----------------------------------------------------------|
| RFGA2054TR13     | 2,500 pieces on a 13" reel                                |
| RFGA2054 PCK-410 | 500 – 3000 MHz Evaluation Board with a 5-piece sample bag |

## Absolute Maximum Ratings

| Parameter                              | Rating         |
|----------------------------------------|----------------|
| Storage Temperature                    | -55 to +150 °C |
| Device Voltage (V <sub>CC</sub> )      | +6.0 V         |
| Device Current (I <sub>CC</sub> )      | 130 mA         |
| RF Input Power, CW, 50 Ω Output Load   | +15 dBm        |
| RF Input Power, CW, 10:1 Output VSWR   | +10 dBm        |
| Junction Temperature (T <sub>J</sub> ) | +150 °C        |

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability.

## Recommended Operating Conditions

| Parameter                         | Min | Typ | Max   | Units |
|-----------------------------------|-----|-----|-------|-------|
| Device Voltage (V <sub>CC</sub> ) |     | +5  | +5.25 | V     |
| T <sub>CASE</sub>                 | -40 |     | +85   | °C    |

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

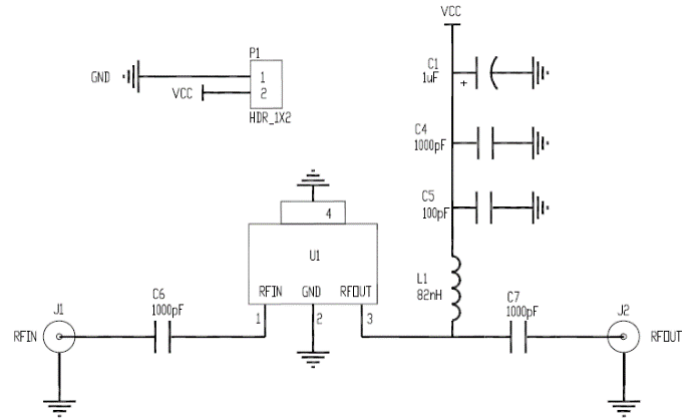
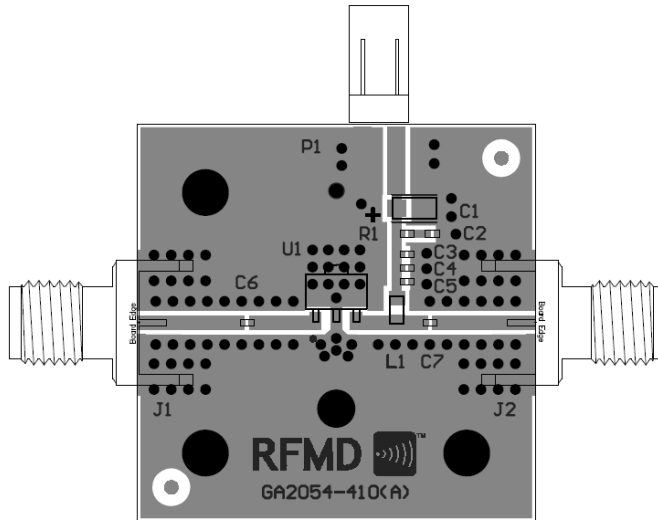
## Electrical Specifications

| Parameter                                  | Conditions <sup>(1)</sup>                                                                      | Min  | Typ  | Max  | Units |
|--------------------------------------------|------------------------------------------------------------------------------------------------|------|------|------|-------|
| <b>Linear Operation</b>                    |                                                                                                |      |      |      |       |
| Input Power                                | Standard EVB circuit without R2<br>V <sub>CC</sub> < 5.0V, Load VSWR < 2:1, R2 Open            |      |      | 3.0  | dBm   |
| Gain, Small Signal                         | 850 MHz                                                                                        |      | 20.3 |      | dB    |
|                                            | 2140 MHz                                                                                       | 17.3 | 18.8 | 20.3 | dB    |
|                                            | 2650 MHz                                                                                       |      | 18.4 |      | dB    |
| Input Return Loss                          | 2140 MHz                                                                                       |      | 13.0 |      | dB    |
| Output Return Loss                         |                                                                                                |      | 13.5 |      | dB    |
| Output P1dB                                | 850 MHz                                                                                        |      | 20.3 |      | dBm   |
|                                            | 2140 MHz                                                                                       | 18.5 | 20.0 |      | dBm   |
|                                            | 2650 MHz                                                                                       |      | 19.5 |      | dBm   |
| Output IP3 <sup>(2)</sup>                  | 850 MHz                                                                                        |      | 33.5 |      | dBm   |
|                                            | 2140 MHz                                                                                       | 28.0 | 30.5 |      | dBm   |
|                                            | 2650 MHz                                                                                       |      | 29.0 |      | dBm   |
| Bandwidth                                  | Minimum 10 dB typical return loss                                                              |      | 3000 |      | MHz   |
| Reverse Isolation                          | 2140 MHz                                                                                       |      | 23.0 |      | dB    |
| Noise Figure                               |                                                                                                |      | 3.6  |      | dB    |
| Device Quiescent Current, I <sub>CCQ</sub> | Pin 3                                                                                          |      | 68   | 78   | mA    |
| Thermal Resistance, θ <sub>JC</sub>        | Junction to case at quiescent state no RF                                                      |      | 135  |      | °C/W  |
| <b>Saturated Operation</b>                 |                                                                                                |      |      |      |       |
| Input Power                                | With R2 5.1KΩ Pin 1 and GND lowering ICQ<br>V <sub>CC</sub> < 5.0V, Load VSWR < 2:1, R2=5.1 KΩ |      |      | 10   | dBm   |
| Saturated Output Power                     | 850 MHz                                                                                        |      | 20.0 |      | dBm   |
|                                            | 2140 MHz                                                                                       |      | 20.5 |      | dBm   |
|                                            | 2650 MHz                                                                                       |      | 20.7 |      | dBm   |
| Operating Current, I <sub>CC</sub>         |                                                                                                |      |      | 90   | mA    |

Notes:

1. Test conditions unless otherwise noted: V<sub>CC</sub> = +5.0V, Temp = +25 °C, 50 Ω test system
2. P<sub>OUT</sub> = 0 dBm/100Hz, Δf = 1 MHz

## 500MHz to 3500 MHz Evaluation Board – RFGA2054PCK-410

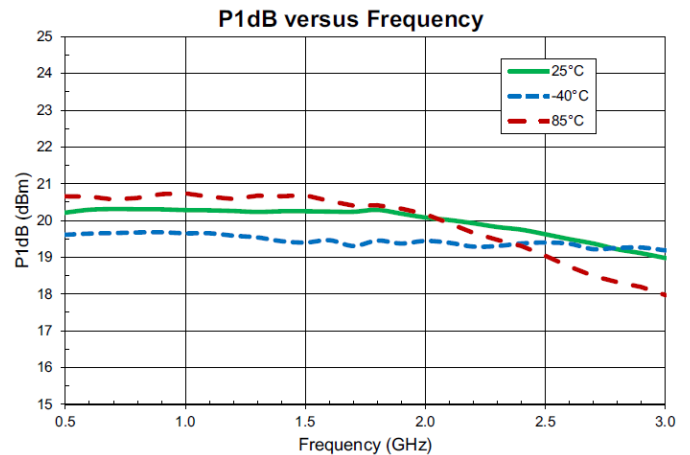
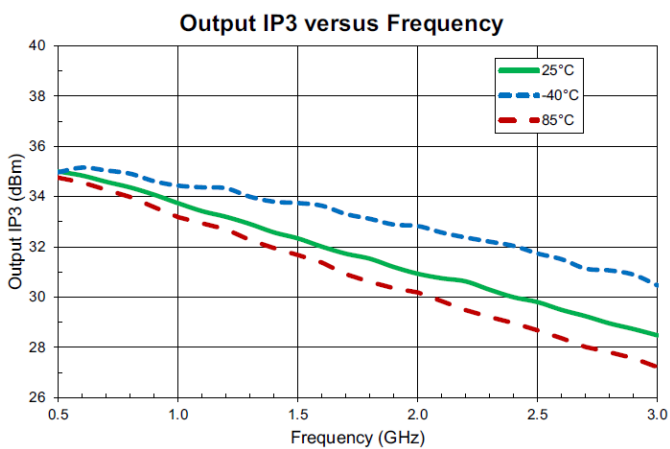
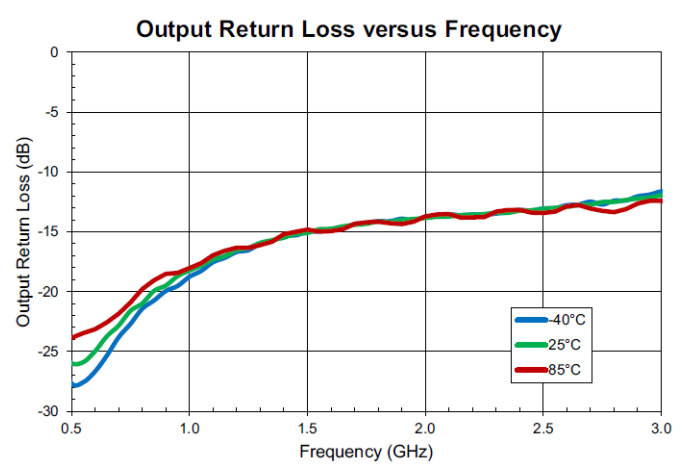
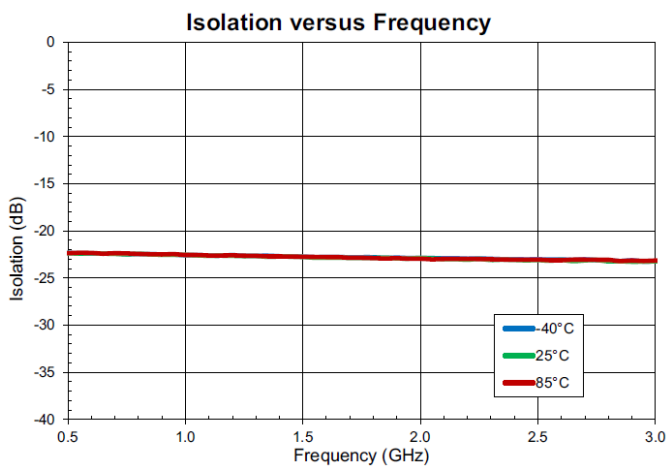
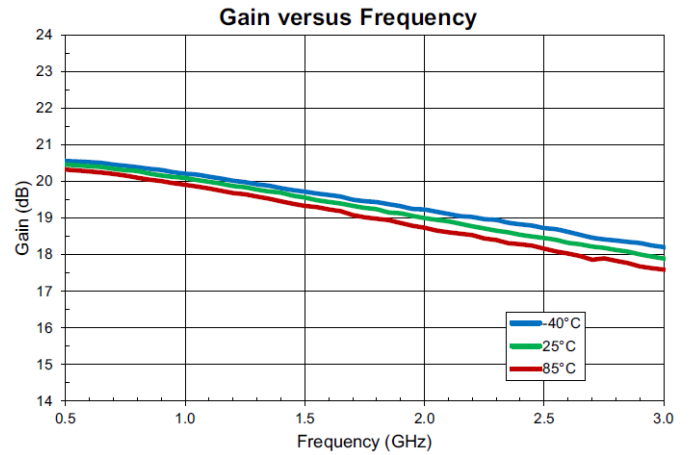
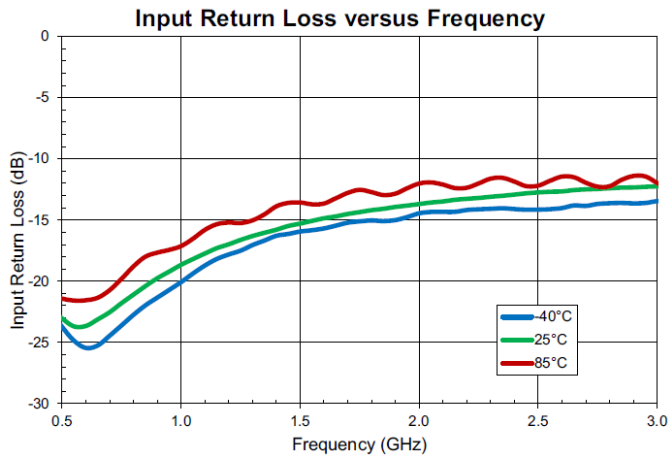


## Bill of Material – RFGA2054PCK-410

| Reference Des. | Value     | Description                         | Manuf.      | Part Number        |
|----------------|-----------|-------------------------------------|-------------|--------------------|
| PCB            | -         | Printed Circuit Board               | Qorvo       | -                  |
| U1             | -         | AMP, InGaP Darlington HBT, SOT-89   | Qorvo       | RFGA2054           |
| C1             | 1 $\mu$ F | CAP, 1 $\mu$ F, 20%, 25V, TANT-A    | AVX         | TAJA105M025        |
| C4, C6, C7     | 1000 pF   | CAP, 1000 pF, 10%, 50V, X7R, 0402   | Taiyo Yuden | RM UMK105BJ102KV-F |
| C5             | 100 pF    | CAP, 100 pF, 5%, 50V, C0G, 0402     | Taiyo Yuden | RM UMK105CG101JV-F |
| L1             | 82 nH     | IND, 82 nH, 10%, W/W, 0805          | Coilcraft   | 0805CS-820XKBC     |
| J1, J2         | -         | CONN, SMA, END LNCH, FLT, 0.062"    | Johnson     | 142-0701-821       |
| P1             | -         | CONN, HDR, ST, PLRZD, 2-Pin, 0.100" | ITW Pancon  | MPSS100-2-C        |

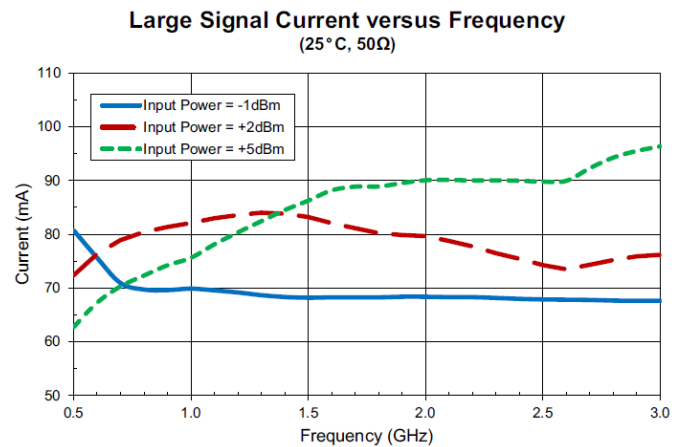
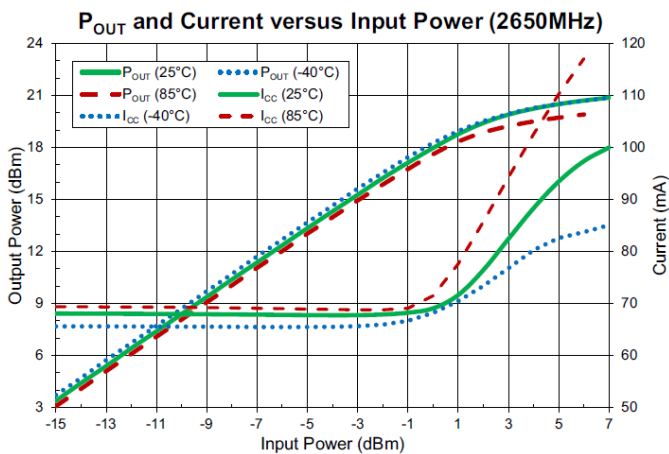
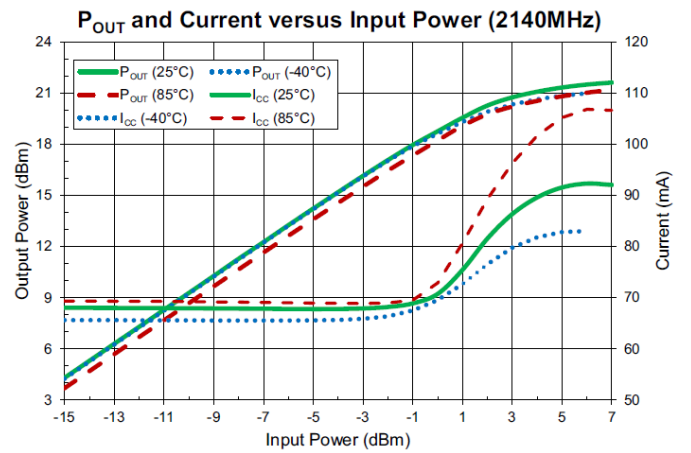
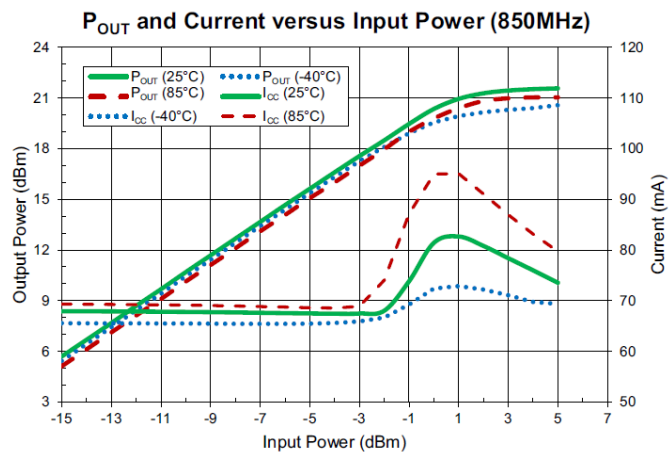
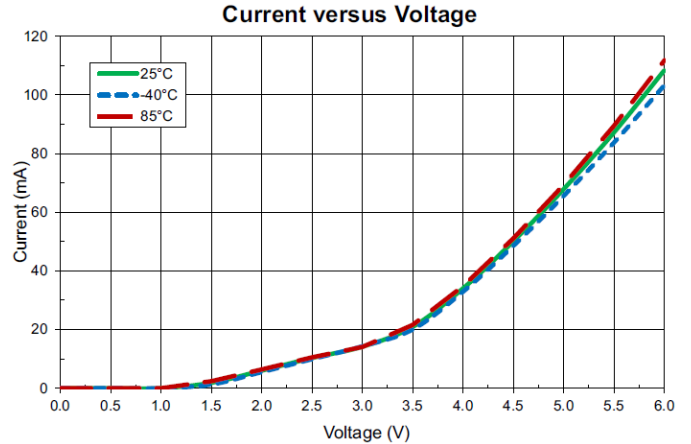
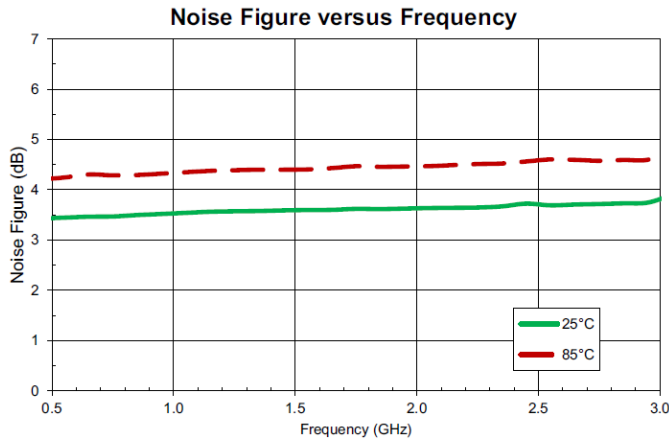
## Linear Operation Performance Plots – RFGA2054PCK-410

Test conditions unless otherwise noted:  $V_{CC} = +5V$ , 50  $\Omega$  test system, Temp.=+25 °C

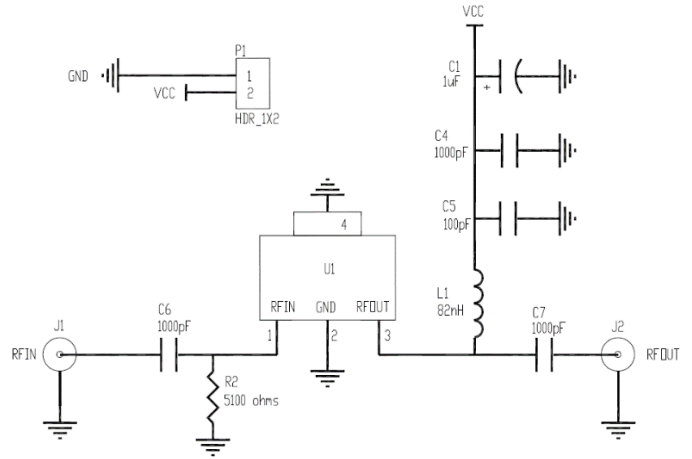
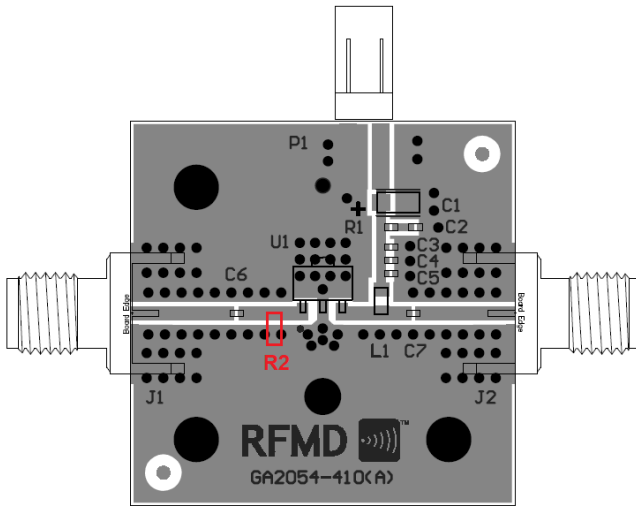


## Linear Operation Performance Plots – RFGA2054PCK-410 (continued)

Test conditions unless otherwise noted:  $V_{CC} = +5V$ , 50  $\Omega$  test system, Temp.=+25 °C



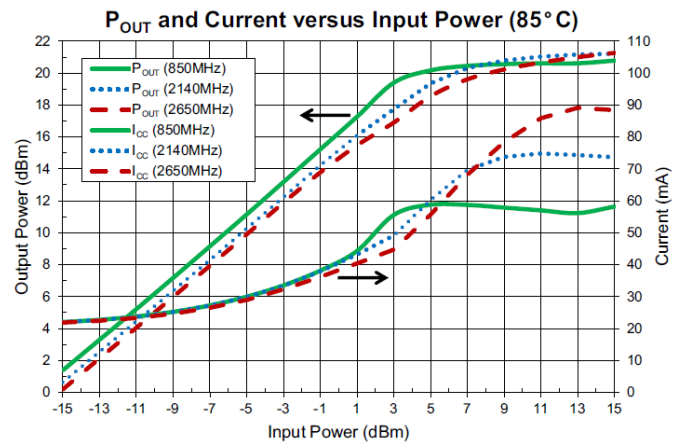
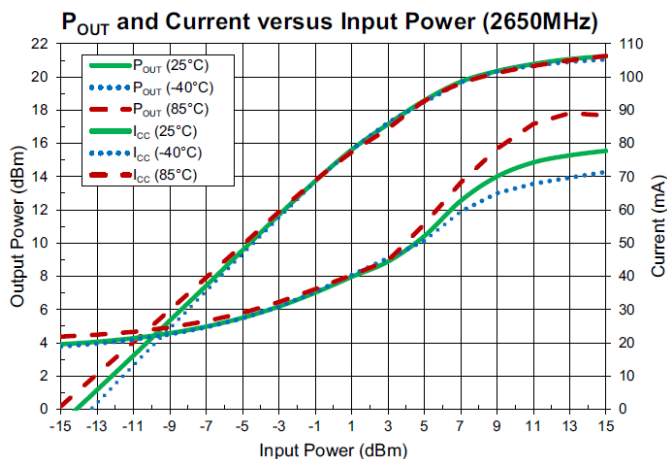
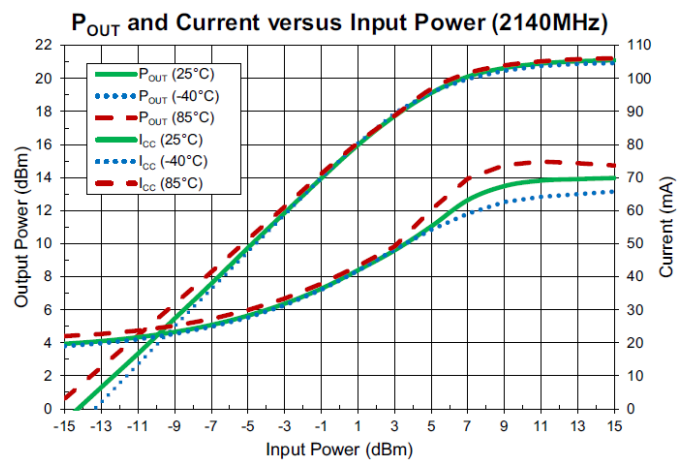
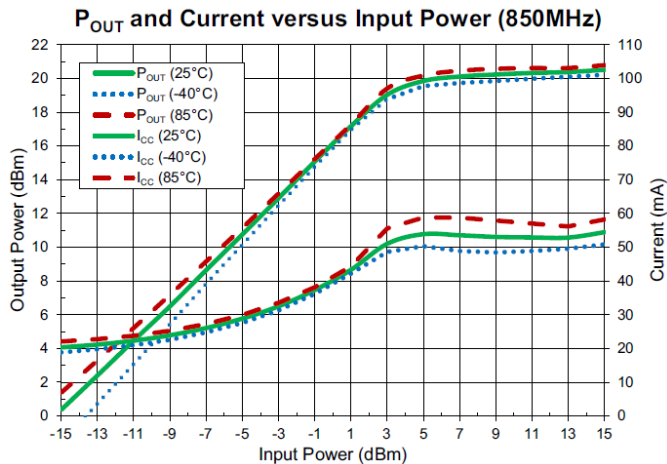
## Saturated Application Board and Schematic



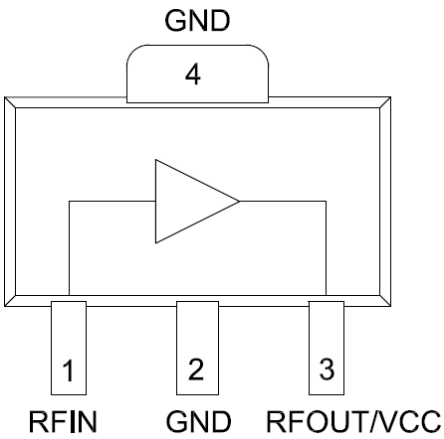
Additional resistor R2, 5.1K $\Omega$ , shunted to ground in between C6 and Pin 1

## Saturated Performance Plots – with R2, 5.1K $\Omega$

Test conditions unless otherwise noted:  $V_{CC} = +5V$ , 50  $\Omega$  test system, Temp. = +25  $^{\circ}C$



Pad Configuration and Description

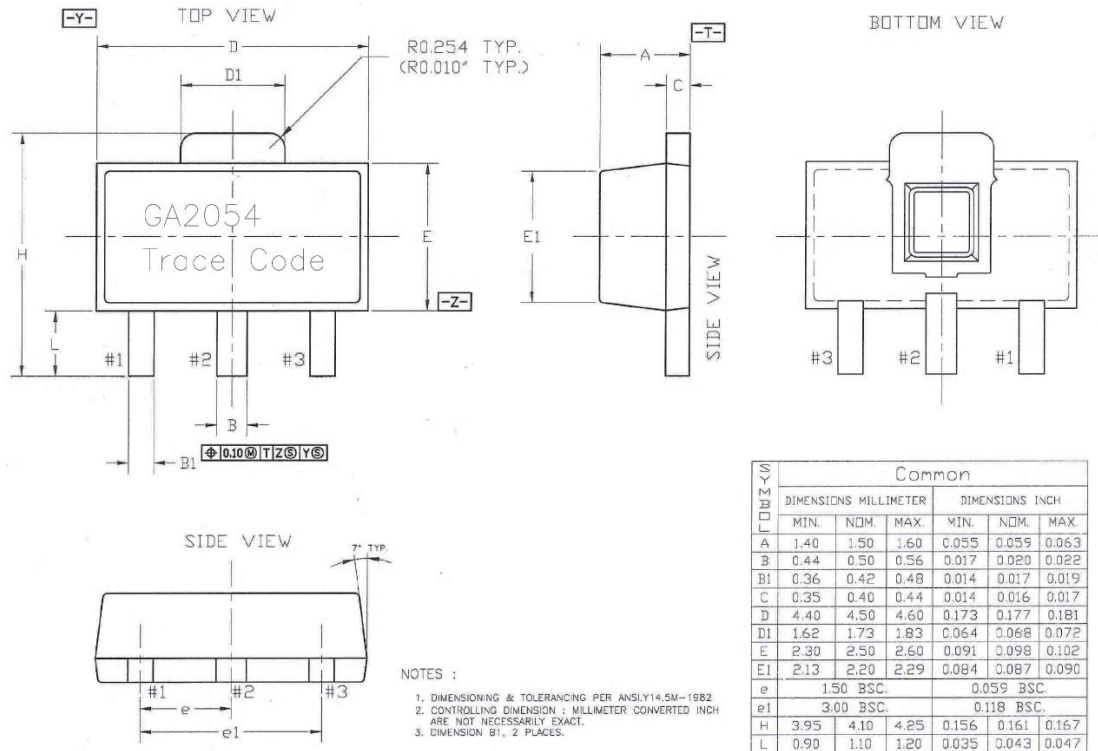


Top View

| Pad No.                 | Label       | Description                                                                                                                                         |
|-------------------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                       | RFIN        | RF input. External DC Block capacitor required.                                                                                                     |
| 3                       | RFOUT / VCC | RF output and DC Supply input. Device Collector, External DC Block capacitor required.                                                              |
| 2, 4<br>Backside Paddle | GND         | RF and DC ground. Use recommended via hole pattern to minimize inductance and thermal resistance. See PCB Mounting Pattern for suggested footprint. |

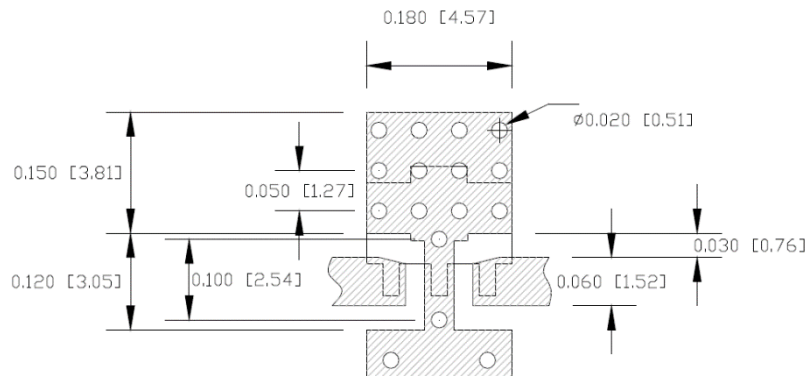
## Package Marking and Dimensions

Marking: Part Number – GA2054  
Trace Code – Assigned by sub-contractor



- Notes:
1. All dimensions are in millimeters. Angles are in degrees.
  2. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

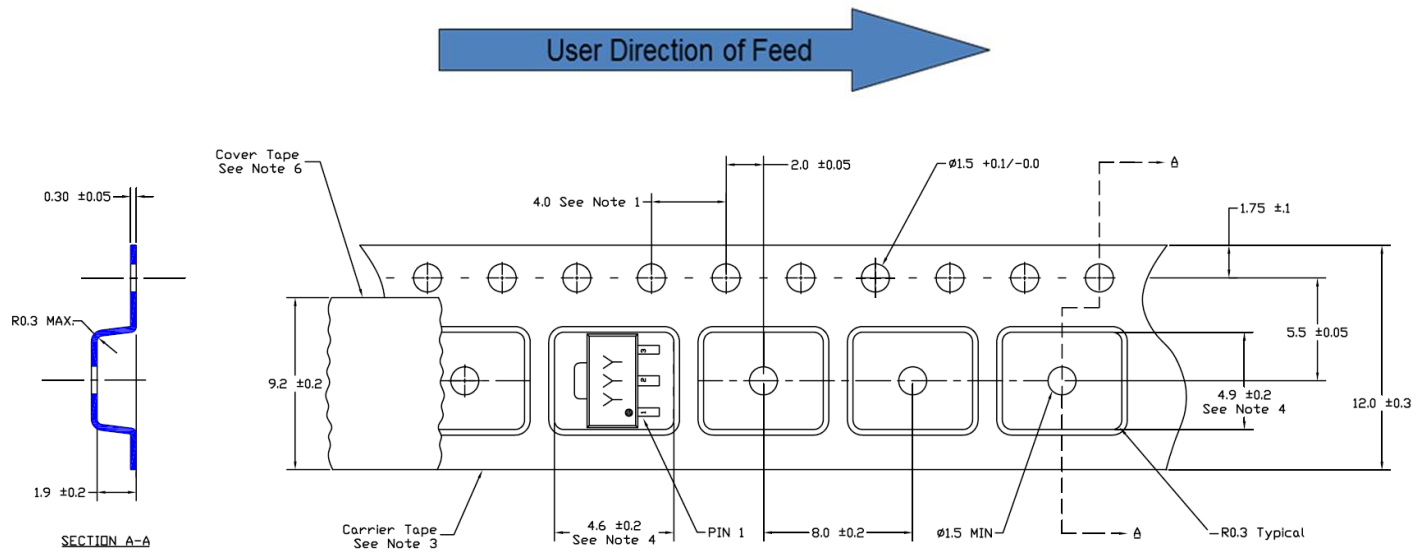
## PCB Mounting Pattern



- Notes:
1. All dimensions are in millimeters. Angles are in degrees.
  2. Use 1 oz. copper minimum for top and bottom layer metal.
  3. Via holes are required under the backside paddle of this device for proper RF/DC grounding and thermal dissipation. We recommend a 0.35mm (#80/.0135") diameter bit for drilling via holes and a final plated thru diameter of 0.25 mm (0.01").
  4. Ensure good package backside paddle solder attach for reliable operation and best electrical performance.



## Tape and Reel Information – Carrier and Cover Tape Dimensions

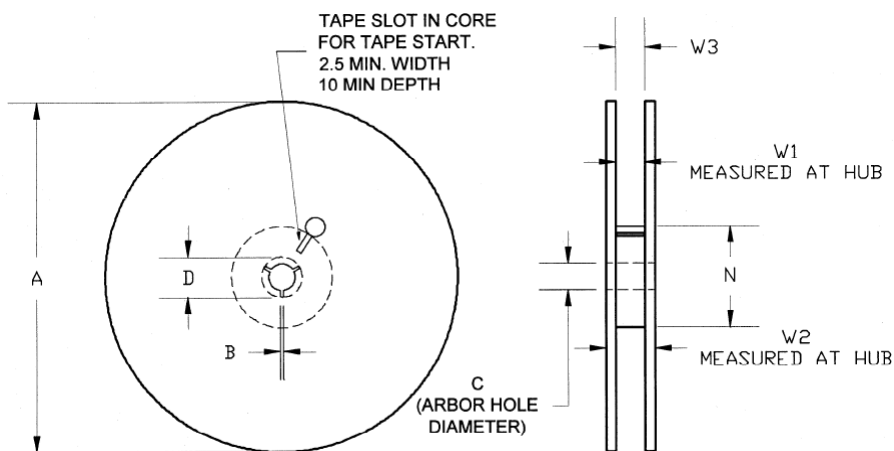


1. 10 sprocket hole pitch cumulative tolerance
2. Camber not to exceed 1mm in 100mm
3. Material: Black Conductive Polystyrene
4. Measured on a plane 0.3mm above the bottom of the pocket.
5. Measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
6. Material: Antistatic Polyester Film

| Feature             | Measure                                  | Symbol | Size (in) | Size (mm) |
|---------------------|------------------------------------------|--------|-----------|-----------|
| Cavity              | Length                                   | A0     | 0.181     | 4.60      |
|                     | Width                                    | B0     | 0.193     | 4.90      |
|                     | Depth                                    | K0     | 0.075     | 1.90      |
|                     | Pitch                                    | P1     | 0.315     | 8.00      |
| Centerline Distance | Cavity to Perforation - Length Direction | P2     | 0.079     | 2.00      |
|                     | Cavity to Perforation - Width Direction  | F      | 0.217     | 5.50      |
| Cover Tape          | Width                                    | C      | 0.362     | 9.20      |
| Carrier Tape        | Width                                    | W      | 0.472     | 12.0      |

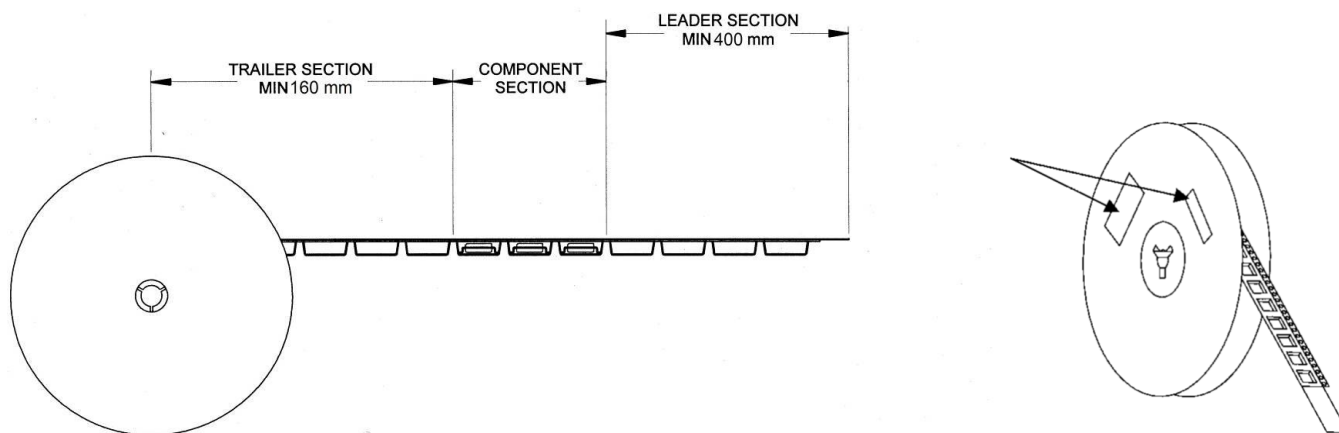
## Tape and Reel Information – Reel Dimensions

Standard T/R size = 2,500 pieces on a 13" reel.



| Feature | Measure              | Symbol | Size (in) | Size (mm) |
|---------|----------------------|--------|-----------|-----------|
| Flange  | Diameter             | A      | 12.992    | 330.0     |
|         | Thickness            | W2     | 0.717     | 18.2      |
|         | Space Between Flange | W1     | 0.504     | 12.8      |
| Hub     | Outer Diameter       | N      | 4.016     | 102.0     |
|         | Arbor Hole Diameter  | C      | 0.512     | 13.0      |
|         | Key Slit Width       | B      | 0.079     | 2.0       |
|         | Key Slit Diameter    | D      | 0.787     | 20.0      |

## Tape and Reel Information – Tape Length and Label Placement



### Notes:

1. Empty part cavities at the trailing and leading ends are sealed with cover tape. See EIA 481-1-A.
2. Labels are placed on the flange opposite the sprockets in the carrier tape.

## Handling Precautions

| Parameter                        | Rating   | Standard                 |
|----------------------------------|----------|--------------------------|
| ESD – Human Body Model (HBM)     | Class 1C | ESDA / JEDEC JS-001-2012 |
| ESD – Charged Device Model (CDM) | Class C3 | ESDA / JEDEC JS-002-2012 |
| MSL – Moisture Sensitivity Level | Level 3  | IPC/JEDEC J-STD-020      |



Caution!  
ESD-Sensitive Device

## Solderability

Compatible with both lead-free (260°C max. reflow temp.) and tin/lead (245°C max. reflow temp.) soldering processes.  
Solder profiles available upon request.

Contact plating: NiPdAu

## RoHS Compliance

This part is compliant with 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment) as amended by Directive 2015/863/EU.

This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) Free
- PFOS Free
- SVHC Free



## Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

**Web:** [www.qorvo.com](http://www.qorvo.com)

**Tel:** 1-844-890-8163

**Email:** [customer.support@qorvo.com](mailto:customer.support@qorvo.com)

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