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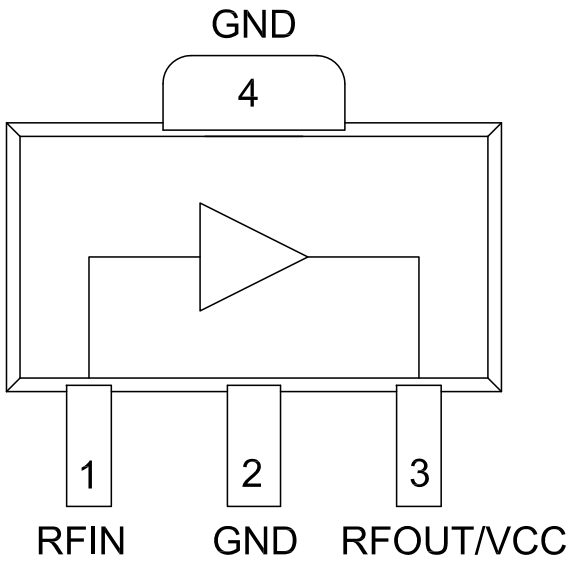
# RFGA2054

## InGaP HBT MMIC AMPLIFIER
## 50MHz TO 3000MHz

**Package: SOT-89**


Functional Block Diagram

## Features

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

## Applications

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

## Product Description

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 Beta variation. This Darlington amplifier is internally matched to 50Ω making it ideal for applications requiring small footprints and minimal external components.

### Ordering Information

| | |
|---|---|
| RFGA2054SR | 7” Sample reel with 100 pieces |
| RFGA2054SQ | Sample bag with 25 pieces |
| RFGA2054TR7 | 7” Reel with 750 pieces |
| RFGA2054TR13 | 13” Reel with 2500 pieces |
| RFGA2054PCK-410 | 500MHz to 3000MHz PCBA with 5-piece sample bag |

### Optimum Technology Matching® Applied

| | | | |
|---|---|---|---|
| ☐ GaAs HBT | ☐ SiGe BiCMOS | ☐ GaAs pHEMT | ☐ GaN HEMT |
| ☐ GaAs MESFET | ☐ Si BiCMOS | ☐ Si CMOS | ☐ BiFET HBT |
| ☑ InGaP HBT | ☐ SiGe HBT | ☐ Si BJT | ☐ LDMOS |





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## Absolute Maximum Ratings

| Parameter | Rating | Unit |
|---|---|---|
| Supply Voltage ($V_{CC}$) | 6.0 | V |
| Device Current ($I_{CC}$) | 130 | mA |
| CW Input Power, 50Ω Output VSWR | 15 | dBm |
| CW Input Power, 10:1 Output VSWR | 10 | dBm |
| Operating Junction Temperature ($T_J$) | 150 | °C |
| Operating Temperature Range ($T_L$) | -40 to +85 | °C |
| Storage Temperature | -55 to +150 | °C |
| ESD Rating - Human Body Model | 1C (1000V) | |
| Moisture Sensitivity Level | MSL-2 | |

NOTES: 1. The maximum rating must all be met simultaneously.
2. $P_{DISS} = P_{DC} + P_{RFIN} - P_{RFOUT}$.
3. $T_J = T_L + P_{DISS} * R_{TH}$.

**Caution!** ESD sensitive device.

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. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.



RFMD Green: RoHS compliant per EU Directive 2002/95/EC, halogen free per IEC 61249-2-21, < 1000ppm each of antimony trioxide in polymeric materials and red phosphorus as a flame retardant, and <2% antimony in solder.

| Parameter | Specification | | | Unit | Condition |
|---|---|---|---|---|---|
| | Min. | Typ. | Max. | | |
| **Linear Operation** | | | | | Typical performance at 25 °C using the standard sample EVB with R2 = open. This design is for linear operation only. |
| Input Power ($P_{IN}$) | | | 3.0 | dBm | Max recommended continuous input power, $V_{CC}$ < 5.0V, Load VSWR < 2:1; R2 = open |
| Gain | | 20.3 | | dB | 850MHz |
| | 17.3 | 18.8 | 20.3 | dB | 2140MHz |
| | | 18.4 | | dB | 2650MHz |
| OIP3 | | 33.5 | | dBm | 850MHz (0dBm/Tone, 1MHz spacing) |
| | 28 | 30.5 | | dBm | 2140MHz (0dBm/Tone, 1MHz spacing) |
| | | 29.0 | | dBm | 2650MHz (0dBm/Tone, 1MHz spacing) |
| P1dB | | 20.3 | | dBm | 850MHz |
| | 18.5 | 20.0 | | dBm | 2140MHz |
| | | 19.5 | | dBm | 2650MHz |
| Input Return Loss | | 13 | | dB | 2140MHz |
| Output Return Loss | | 13.5 | | dB | |
| Isolation | | 23 | | dB | |
| Noise Figure | | 3.6 | | dB | |
| Operating Current (Quiescent) | | 68 | 78 | mA | At $V_{CC}$ = 5.0V |
| Operating Voltage ($V_{CC}$) | | 5.0 | 5.25 | V | Max recommended voltage for continuous operation |
| Thermal Resistance ($R_{TH}$) | | 135 | | °C/W | At quiescent current, no RF, $V_{CC}$ = 5.0V |
| **Saturated Operation** | | | | | Typical performance at 25 °C using the input pull-down resistor (R2 = 5.1 KΩ) to lower quiescent current. See schematic following the "saturated operation plots". |
| Input Power ($P_{IN}$) | | | 10 | dBm | Max. recommended continuous input power $V_{CC}$ < 5.0V, Load VSWR < 2:1, R2 = 5.1 KΩ |
| Saturated Output Power | | 20 | | dBm | 850MHz |
| | | 20.5 | | dBm | 2140MHz |
| | | 20.7 | | dBm | 2650MHz |
| Operating Current | | | 90 | mA | Max recommended current for continuous operation |
| Operating Voltage | | 5.0 | 5.25 | V | Max recommended voltage for continuous operation |


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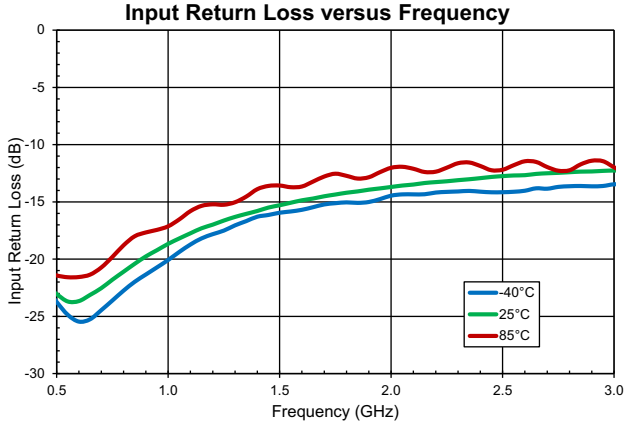
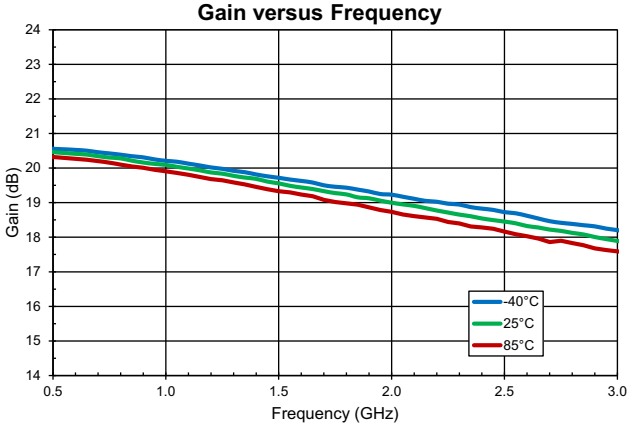
## Typical Performance: 500MHz to 3000MHz Application Circuit

(Linear Operation, R2 = Open)

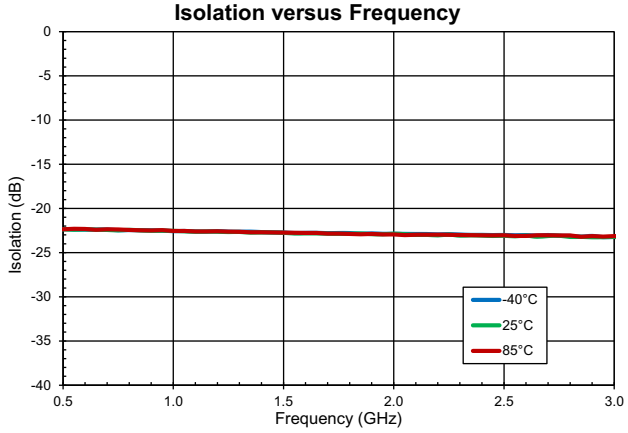
Input Return Loss versus Frequency



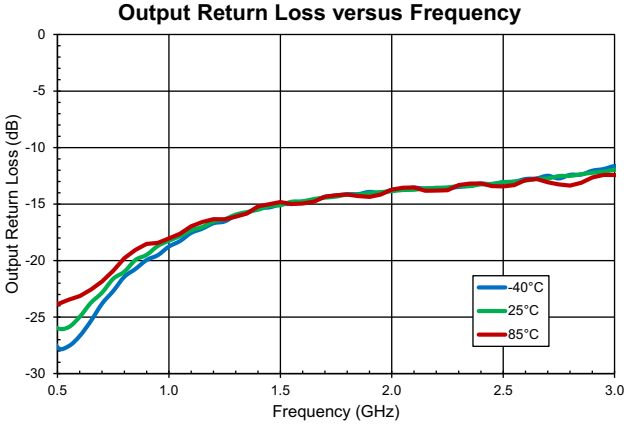

Gain versus Frequency



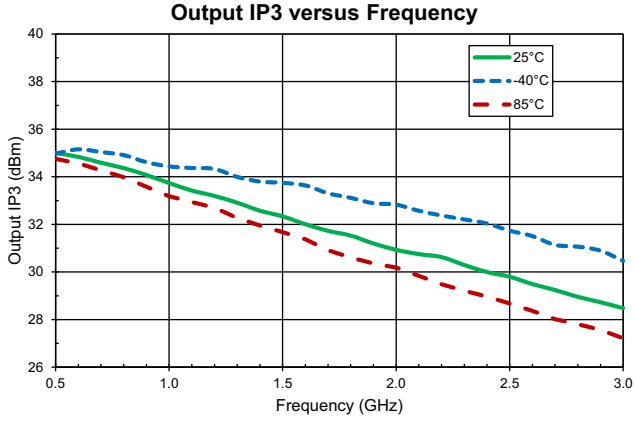

Isolation versus Frequency



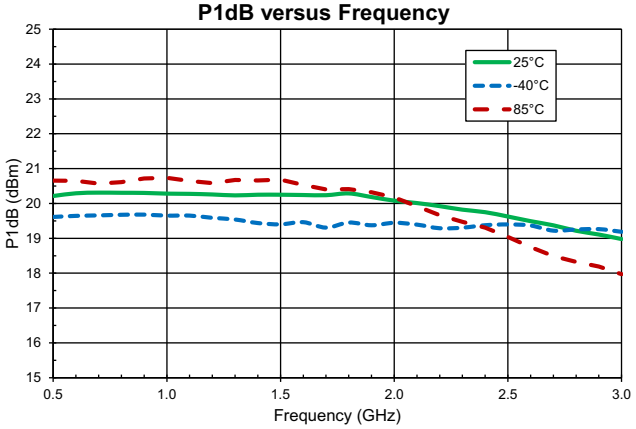

Output Return Loss versus Frequency




Output IP3 versus Frequency



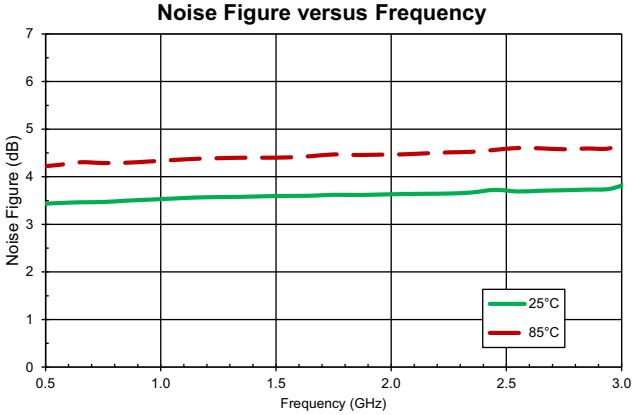

P1dB versus Frequency



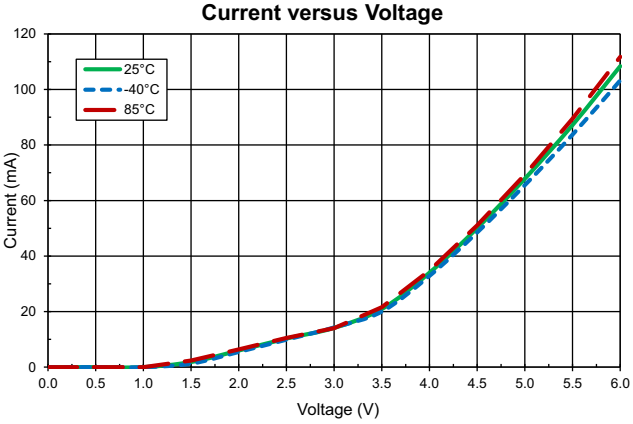
## Typical Performance: 500MHz to 3000MHz Application Circuit

(Linear Operation, R2 = Open)

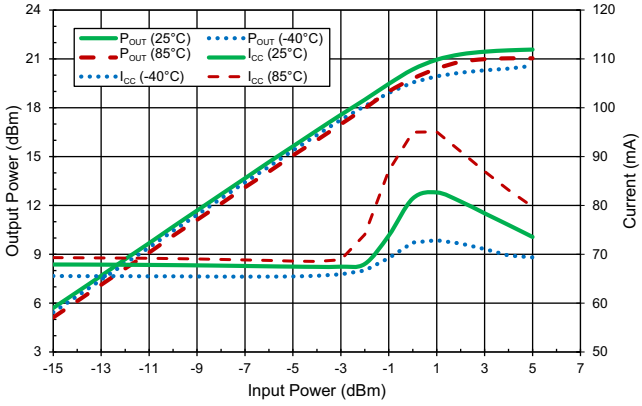
### Noise Figure versus Frequency



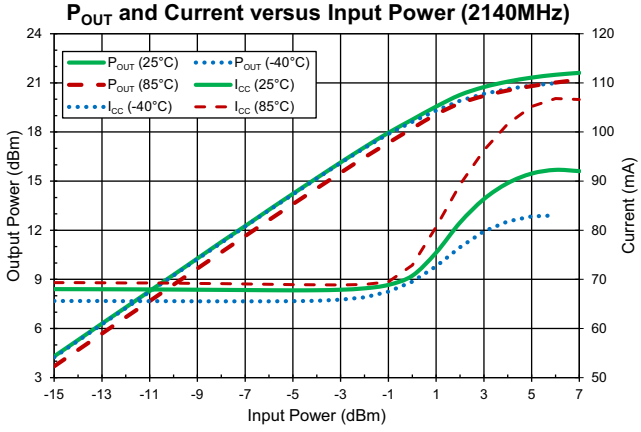

### Current versus Voltage



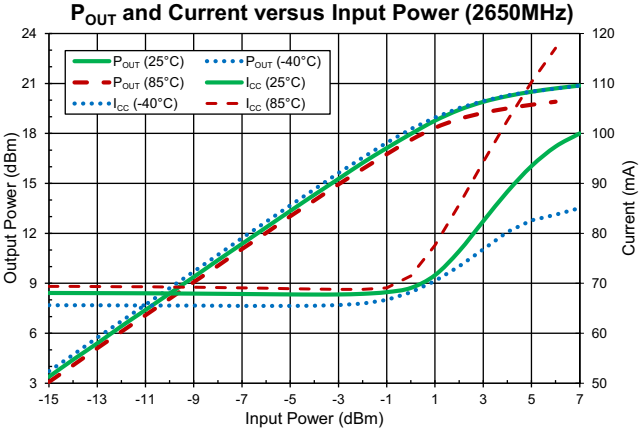

### $P_{OUT}$ and Current versus Input Power (850MHz)




### $P_{OUT}$ and Current versus Input Power (2140MHz)

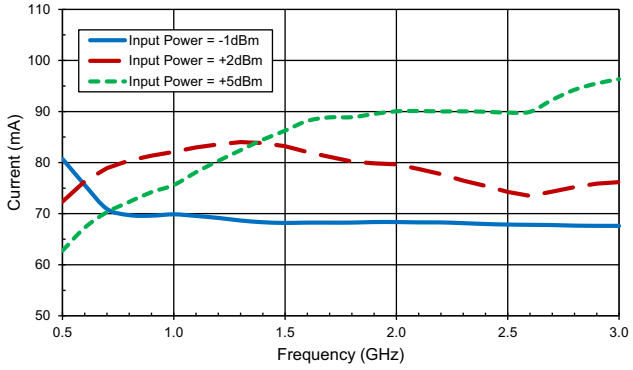



### $P_{OUT}$ and Current versus Input Power (2650MHz)




### Large Signal Current versus Frequency

**(25°C, 50Ω)**



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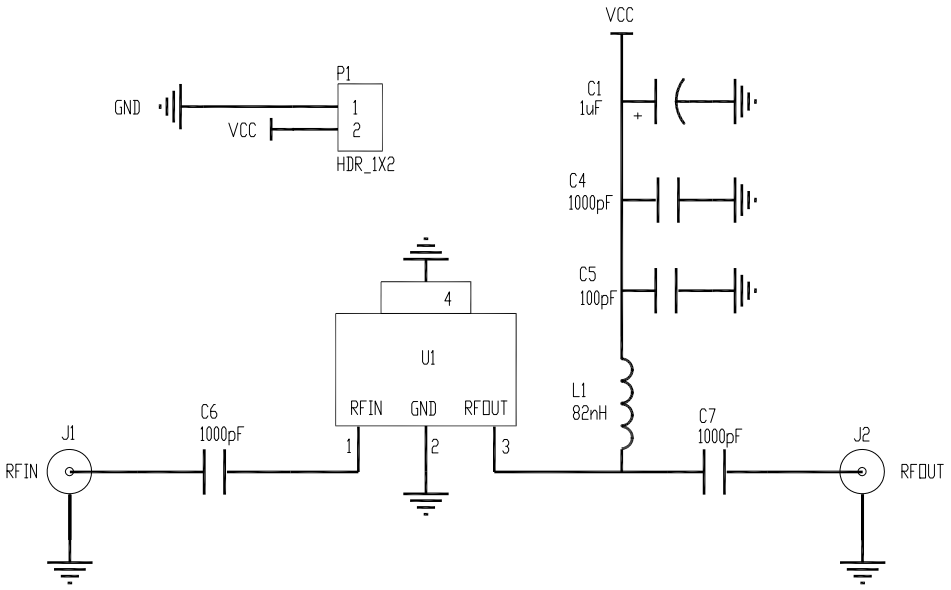
## Evaluation Board Schematic

500MHz to 3000MHz Application Circuit for Linear Operation

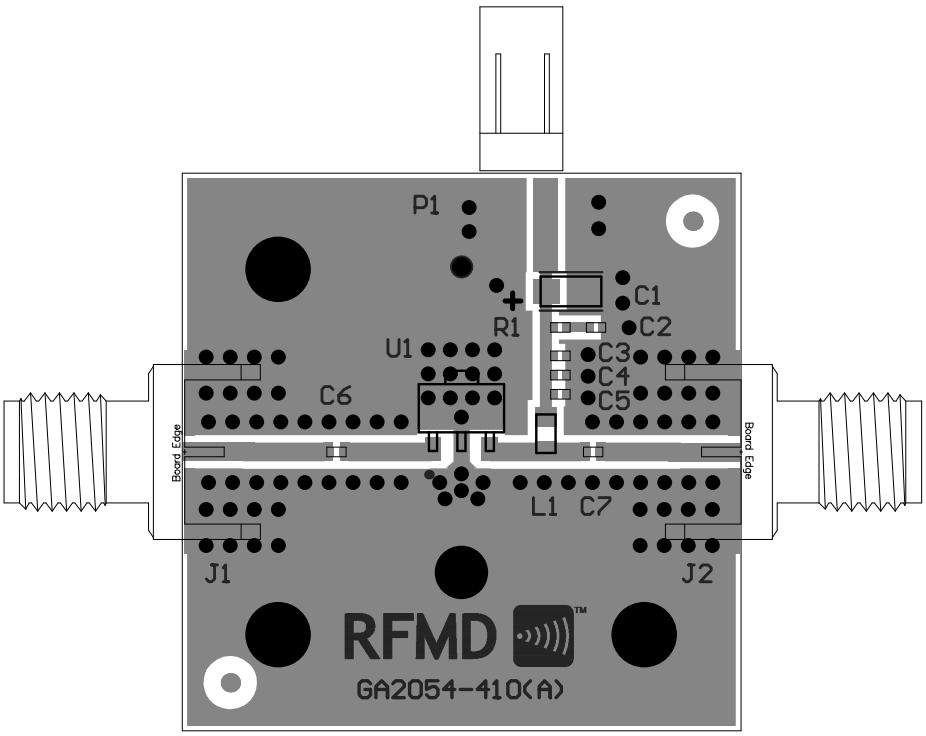



## Evaluation Board Bill of Materials (BOM)

500MHz to 3000MHz Application Circuit

| Description | Reference Designator | Manufacturer | Manufacturer's P/N |
|---|---|---|---|
| GA2054 Evaluation Board | | | GA2054-410(A) |
| CAP, 1μF, 20%, 25V, TANT-A | C1 | AVX Corporation | TAJA105M025 |
| CAP, 1000pF, 10%, 50V, X7R, 0402 | C4, C6, C7 | Taiyo Yuden (USA), Inc. | RM UMK105BJ102KV-F |
| CAP, 100pF, 5%, 50V, C0G, 0402 | C5 | Taiyo Yuden (USA), Inc. | RM UMK105CG101JV-F |
| IND, 82nH, 10%, W/W, 0805 | L1 | Coilcraft, Inc. | 0805CS-820XKBC |
| CONN, SMA, END LNCH, FLT, 0.062" | J1-J2 | Johnson Components, Inc. | 142-0701-821 |
| CONN, HDR, ST, PLRZD, 2-PIN, 0.100" | P1 | ITW Pancon | MPSS100-2-C |
| InGaP Darlington HBT Gain Block | U1 | RFMD | GA2054 |
| Do Not Place | C2-C3, R1-R2 | | |

## Evaluation Board Assembly Drawing




NOTE: R2 not shown. For saturated operation mount R2 shunt to GND between C6 and Pin 1.

## Pin Names and Descriptions

| Pin | Name | Description |
|---|---|---|
| 1 | RF IN | RF Input. External DC block is required. |
| 2 | GND | DC and RF Ground |
| 3 | RF OUT/VCC | RF Output, Device Collector |
| 4 | GND | DC and RF Ground. Must be soldered to EVB ground plane over a bed of vias for thermal and RF performance. |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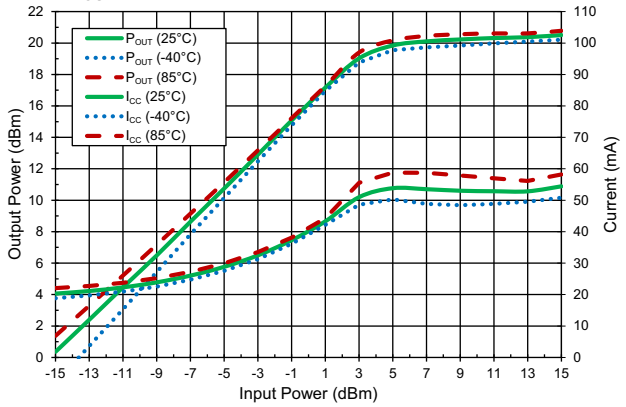
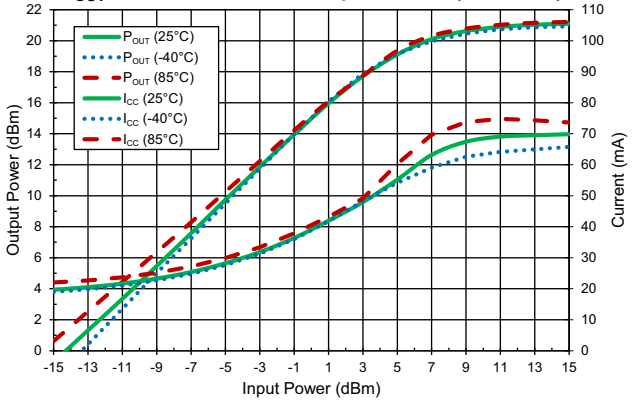
## Typical Performance under Saturated Operation, R2 = 5.1 KΩ

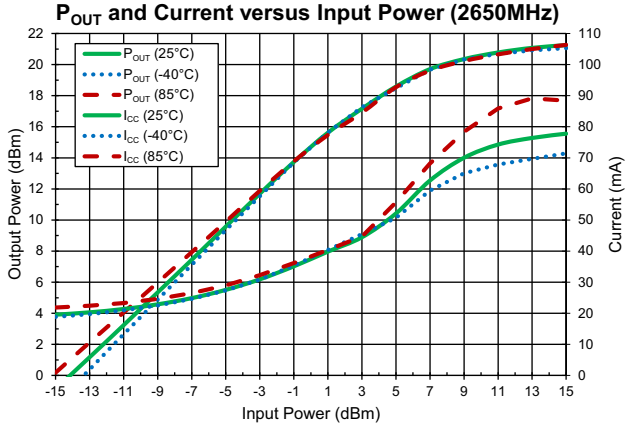
$P_{OUT}$ and Current versus Input Power (850MHz)



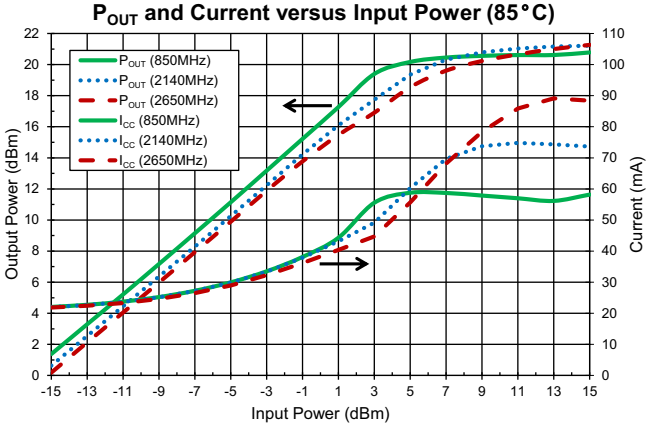

$P_{OUT}$ and Current versus Input Power (2140MHz)



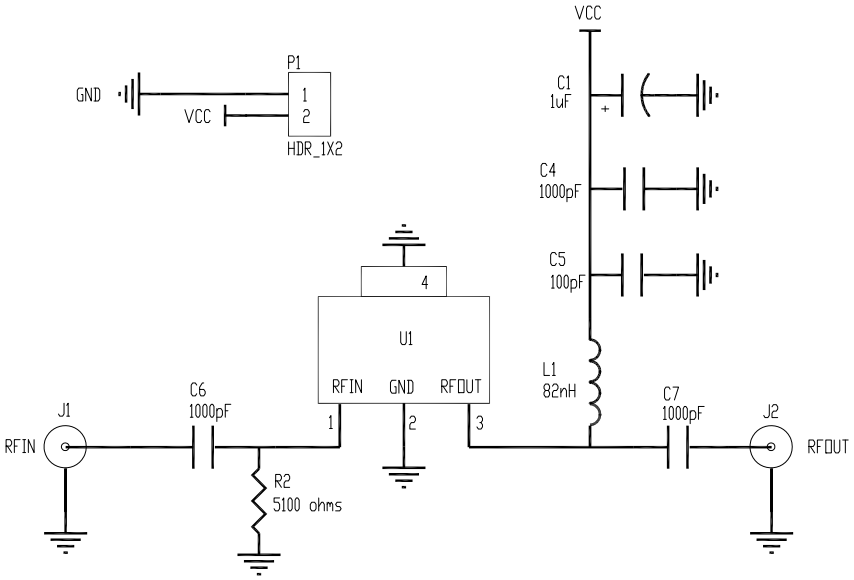

$P_{OUT}$ and Current versus Input Power (2650MHz)




$P_{OUT}$ and Current versus Input Power (85°C)

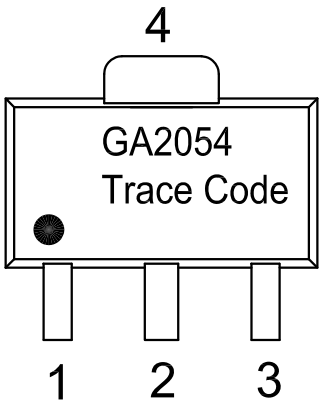



## Evaluation Board Schematic for Saturated Operation



## Branding Diagram

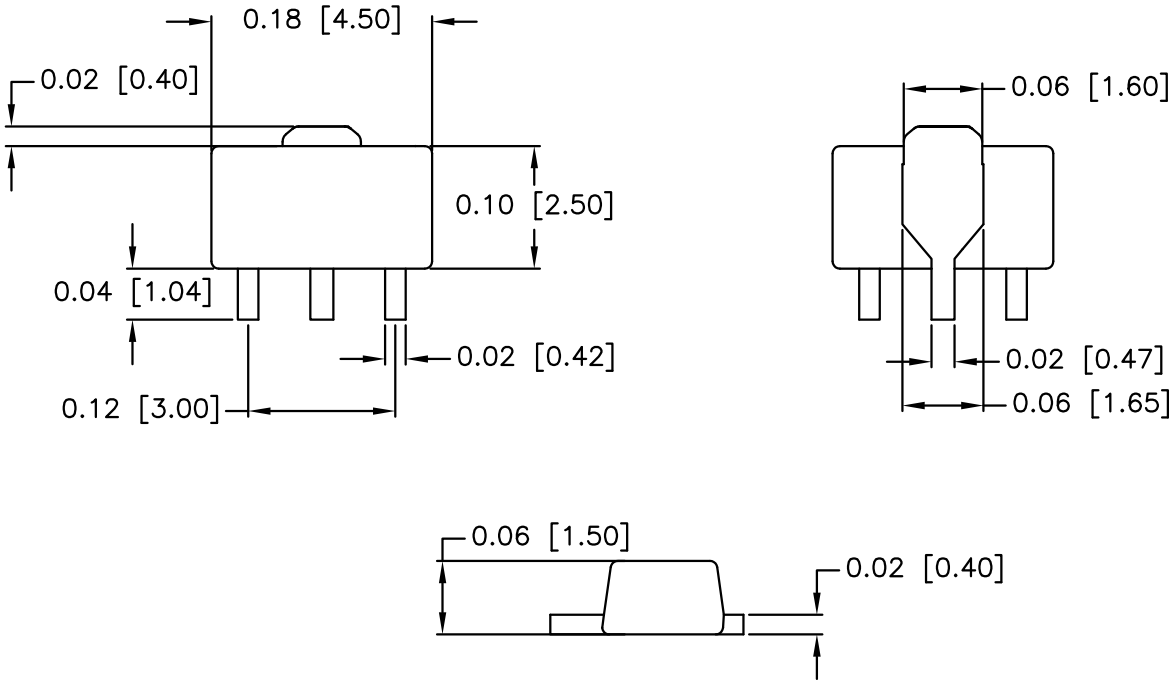
Trace Code to be assigned by the assembly SubCon.




## Package Drawing

Dimensions in millimeters [inches]

Refer to drawing posted at www.rfmd.com for tolerances.



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