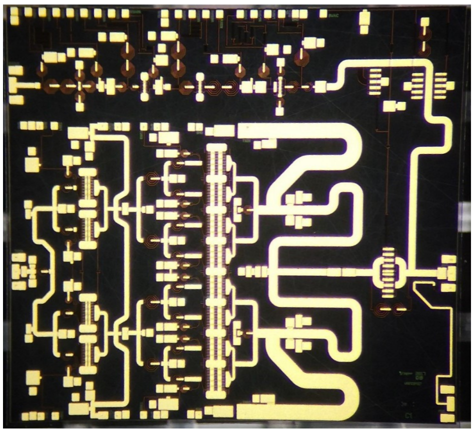
# VRFC0127-BD

## C-Band GaN Single Chip Radar Front End MMIC

*Preliminary Datasheet v1*

### Features

- Integrated single chip front end MMIC incorporating LNA, transmit-receive switch and HPA functions
- Frequency Range: 5.2GHz to 5.6GHz
- Tx (pulsed): Psat 47dBm, >40% PAE typical at TXVd = 30V
- Rx (CW): NF 2.4dB, Gain >35dB typical at RXVd = 7V
- Limited RX output power <12dBm at RXVd = 7V
- Tx/RX switch control voltage (Vswc) between 0V (Tx ON) and –25V (Rx ON)



### Description

The VRFC0127-BD is a C-band integrated single chip front end MMIC incorporating a low noise amplifier, a transmit-receive switch and a high power amplifier. The MMIC is designed on a European space qualified process and operates over 5.2GHz to 5.6GHz. The Rx function demonstrates a nominal noise figure of 2.4dB at 5.4GHz with small signal gain greater than 35dB. The Tx function delivers 47dBm at 5.4GHz with a PAE > 40%. The RF ports are DC blocked and matched to 50Ω. Typical applications include satellite communications.

**Electrical Specifications**

| Parameter | Specification | | | Unit |
|---|---|---|---|---|
| | Min. | Typ. | Max. | |
| Frequency Bandwidth | 5.2 | | 5.6 | GHz |
| TX Mode (pulsed) *T = 25°C baseplate, Vd = 30V, Vg = -3.3V, Pulse = 30µs, Duty = 1%, Vswc = 0V* | | | | |
| Small Signal Gain | | 31@5.4GHz | | dB |
| Saturated Output Power | | 47@5.4GHz | | dBm |
| Power Added Efficiency | | >40% | | % |
| I/P Return Loss | | -10 | | dB |
| RX Mode (CW) *T = 25°C baseplate, Vd = 7V, Id = 30mA, Vswc = -25V* | | | | |
| Small Signal Gain | | 37@5.4GHz | | dB |
| Noise Figure | | 2.4@5.4GHz | | dB |
| I/P Return Loss | | -10.9@5.4GHz | | dB |
| O/P Return Loss | | -24@5.4GHz | | dB |
| P1dB Output Power | | 9 | | dBm |

## C-Band GaN Single Chip Radar Front End MMIC

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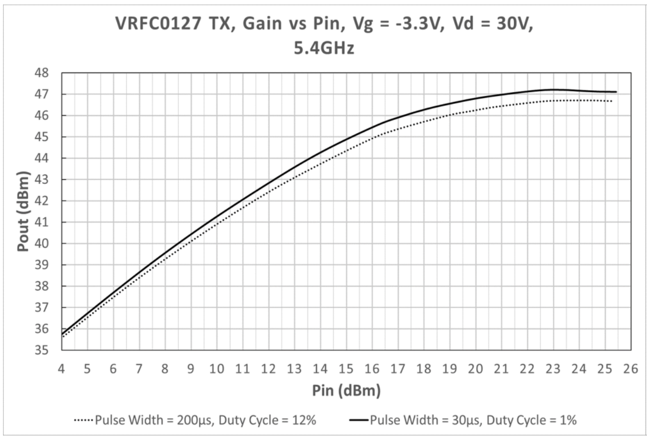
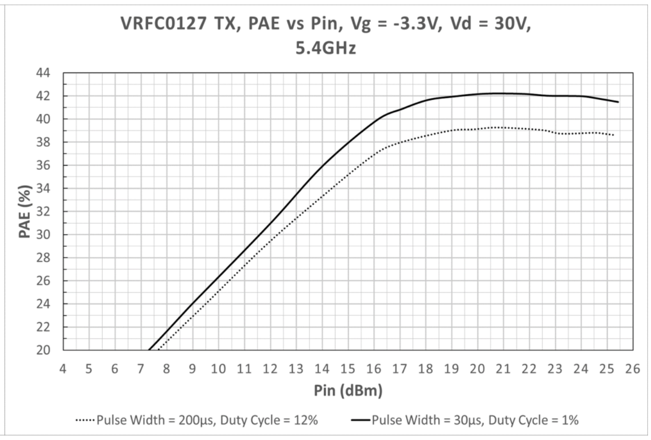
## Measured Performance Tx Mode (in test jig), Vswc = 0V

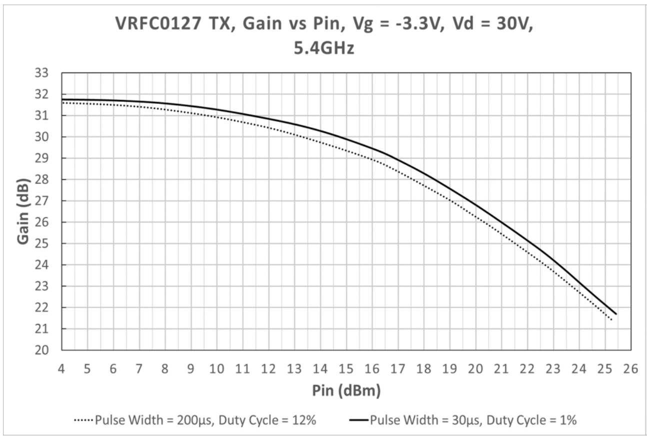
*T = 25°C baseplate, Vd = 30V*



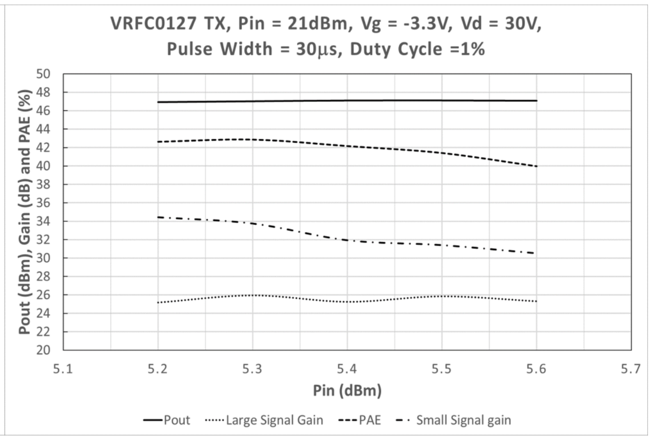

*Pout vs. Pin at 5.4GHz as function of duty cycle*



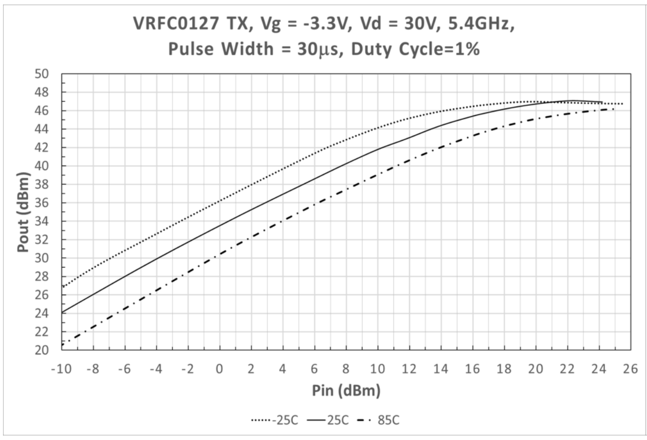

*PAE vs. Pin at 5.4GHz as function of duty cycle*



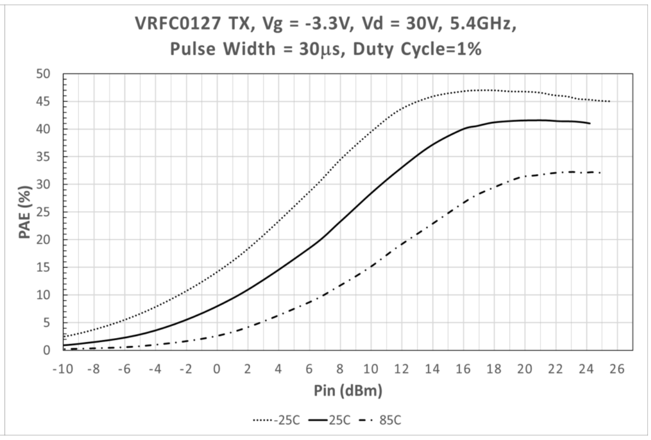

*Gain vs. Pin at 5.4GHz as function of duty cycle*




*Pout, PAE and Gain at Pin=21dBm over frequency*




*Pout at 5.4GHz at different baseplate temperatures*



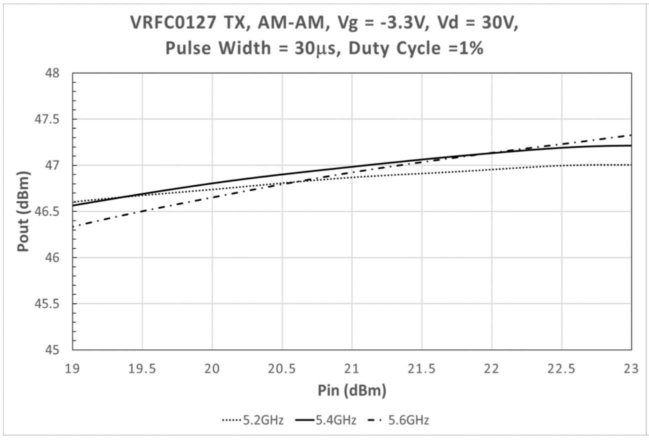

*PAE at 5.4GHz at different base temperatures*

## C-Band GaN Single Chip Radar Front End MMIC

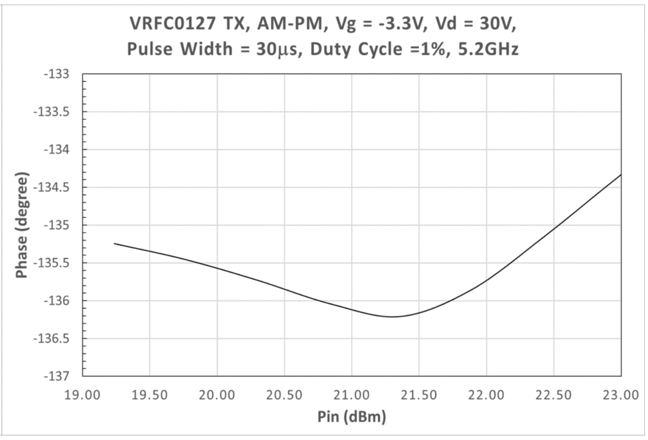
*Preliminary Datasheet v1*

## Measured Performance Tx Mode (in test jig), Vswc = 0V

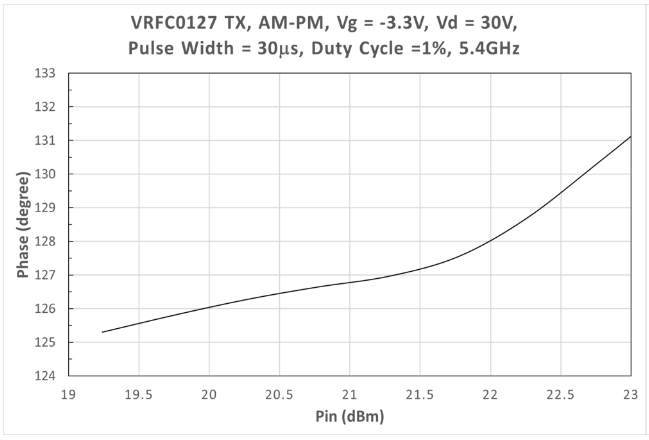
*T = 25°C baseplate, Vd = 30V*



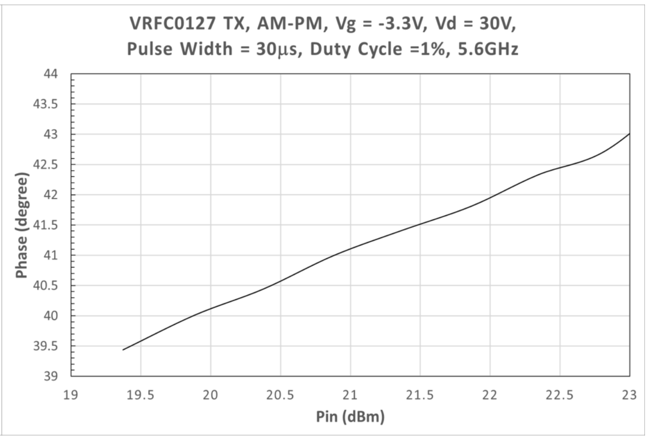

*AM-AM Conversion at 5.2GHz, 5.4GHz and 5.6GHz*




*AM-PM Conversion at 5.2GHz*




*AM-PM Conversion at 5.4GHz*




*AM-PM Conversion at 5.6GHz*

# VRFC0127-BD

## C-Band GaN Single Chip Radar Front End MMIC

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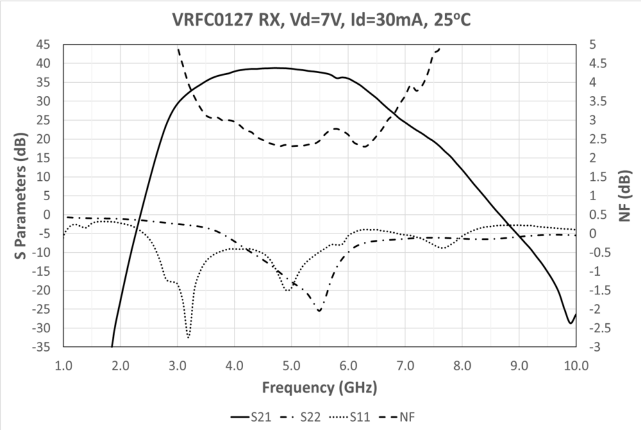
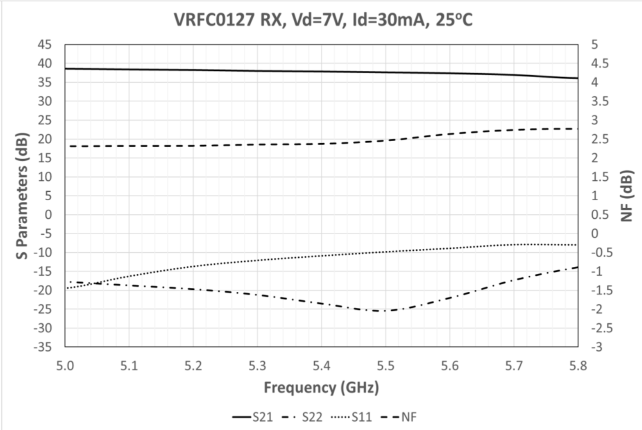
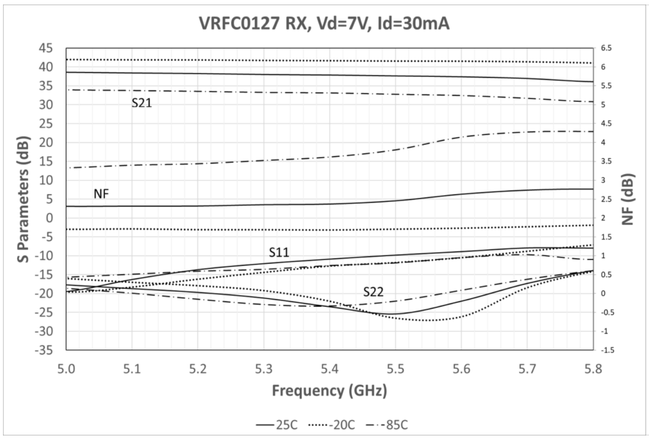
## Measured Performance Rx Mode (in test jig), Vswc = -25V

*T = 25°C baseplate, Vd = 7V, Id = 30mA*

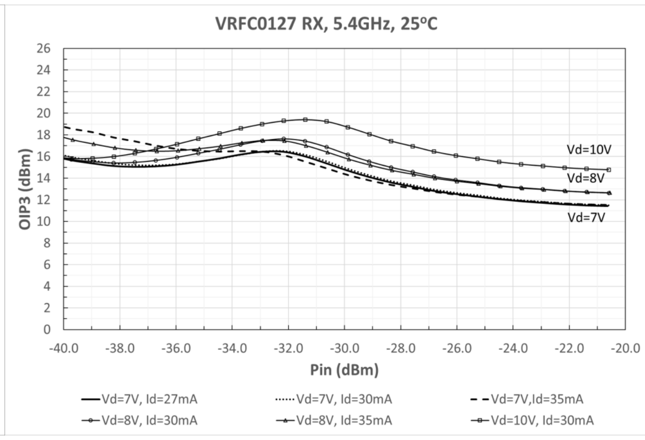


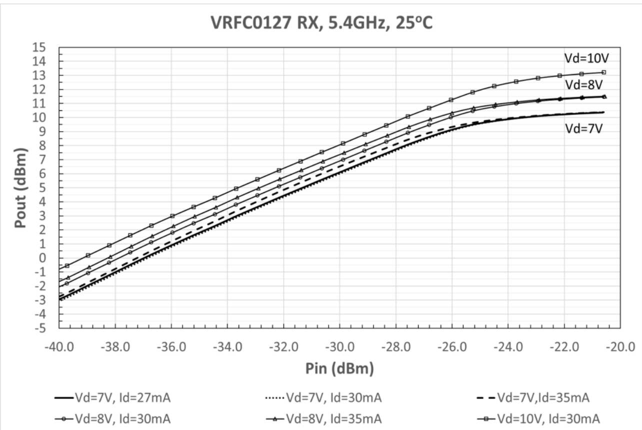

*Typical measured S-Parameters and Noise Figure*




*Effect of temperature on small signal*




*OIP3: Effect of bias conditions at 5.4GHz*




*Pout: Effect of bias point at 5.4GHz*

## Recommended Absolute Maximum Ratings [1]

| Parameter | Symbol | Value | Notes |
|---|---|---|---|
| Drain bias voltage | Vd | 55V | |
| Gate bias voltage | Vg | -20V | For amplifier gate voltage |
| Gate bias voltage | Vswc | -60V | For switch control voltage |
| Gate Current | Ig | 5mA | |
| RF input power | RFin | 30dBm/10dBm | For TX input/RX input |
| Junction Temperature | $T_j$ | 160°C/230°C | 160°C for space applications/230°C for non-space applications<br>For maximum median device lifetime, $T_j$ should be minimised |
| Storage Temperature | $T_{storage}$ | -55 to 150°C | |

*[1] Operation outside these conditions may cause permanent damage to the device. Combination of maximum rating conditions may reduce the values. Device performance at these ratings is not implied.*

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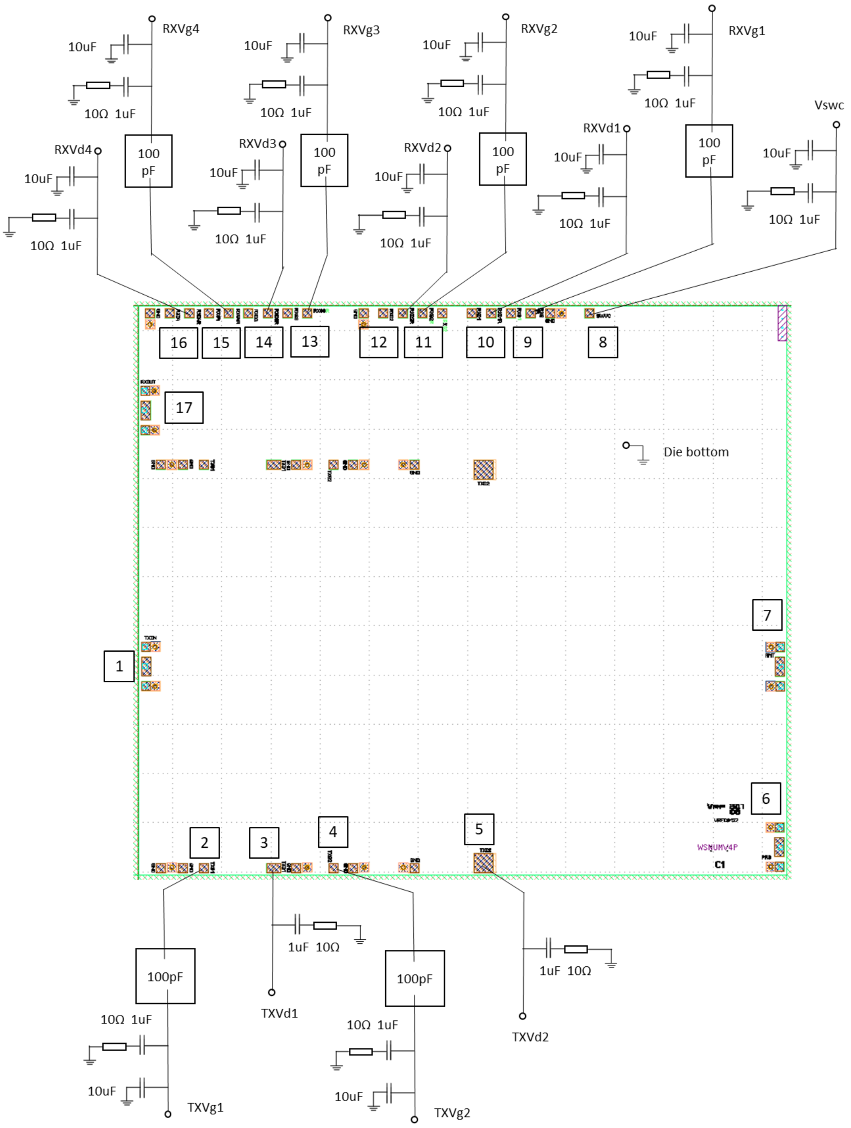
## Assembly & Bonding Diagram

**(Please consult VIPER RF if operated in different pulsed conditions)**




| ID | PAD | NOTE |
|---|---|---|
| 1 | TX IN | |
| 2, 4 | TX Gate | Vg=-3.3V typical |
| 3, 5, | TX Drain | Vd=30V typical |
| 6 | Sampling | |
| 7 | ANT | |
| 8 | SW control | Vswc=0V/-25V |
| 9,11,13,15 | RX Gate | Vg=-3V typical |
| 10,12,14,16 | RX Drain | Vd=7V typical |
| 17 | RX OUT | |
| Die Bottom | GND | |

| | |
|---|---|
| Die Size | 5.89mm x 6.7mm |
| Die Thickness | 100µm |
| Minimum Bondpad opening | 100µm x 100µm |

Optimum length (0.24nH) are recommended for RF bondwires. The RF input and output ports are DC blocked.

GaN devices are ESD sensitive and precautions should be observed during storage, handling, assembly and testing.

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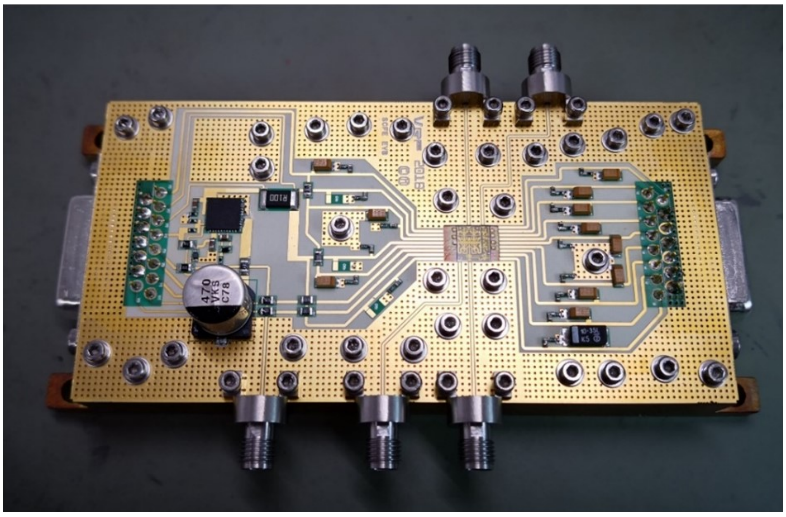
### Evaluation Board



Bias Procedure -

**Tx Mode Bias-Up:**

1. Vg-HPA and Vg-LNA set to - 5V.
2. Vswc set to 0V.
3. Vd-LNA set to 0V.
4. Vd-HPA set from 0V up to 30V.
5. Adjust Vg-HPA (Vg = -3.3V Typical).
6. Apply RF signal.

**TX Mode Bias-Down:**

1. Turn off RF signal.
2. Reduce Vg-HPA to -5V (Id0 ≈ 0mA).
3. Set Vd-HPA to 0V.
4. Turn off Vd-HPA and Vd-LNA.
5. Turn off Vg-HPA and Vg-LNA.
6. Turn off Vswc.

**Rx Mode Bias-Up:**

1. Vg-LNA and Vg-HPA set to - 5V.
2. Vswc set to -25V.
3. Vd-HPA set to 0V.
4. Vd-LNA set from 0V up to 7V.
5. Adjust Vg-LNA until quiescent Id is 30mA (Vg = -3V Typical).
6. Apply RF signal.

**RX Mode Bias-Down**

1. Turn off RF signal.
2. Reduce Vg-LNA to -5V (Id0 ≈ 0mA).
3. Set Vd-LNA to 0V.
4. Turn off Vd-LNA and Vd-HPA.
5. Turn off Vg-LNA and Vg-HPA.
6. Turn off Vswc.