# TGL2767

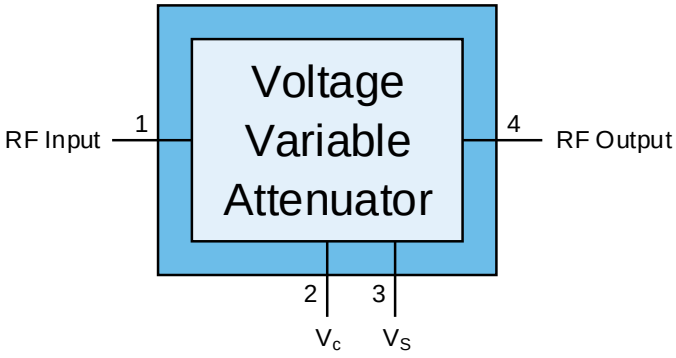
## 2–25 GHz Voltage Variable Attenuator

## General Description

The TGL2767 is a wideband voltage-variable attenuator using Qorvo's production 0.15 um GaAs pHEMT process (QPHT15). Operating from 2 – 25GHz, the TGL2767 offers > 20 dB of attenuation range with < 2 dB insertion loss in the reference state. The TGL2767's broadband performance allows it to be a single solution for a number of radar and communication bands; as well as electronic warfare, instrumentation and other general RF–based applications.

The TGL2767 is fully matched to 50 ohms and offered in a small 1.17 x 0.98 mm footprint. This along with using standard control and reference voltages, allows users to integrate the TGL2767 into their system with minimal effort.


## Functional Block Diagram




## Product Features

- Frequency Range: 2 – 25 GHz
- Attenuation Range: 20 dB
- Insertion Loss (Ref. State): < 2 dB
- Control Voltage: 0.0 – 1.5 V
- Reference Voltage: 1.5 V
- Die Size: 1.17 x 0.98 x 0.10 mm

*Performance is typical across frequency. Please reference electrical specification table and data plots for more details.*

## Applications

- Commercial and Military Radar
- Electronic Warfare
- Satellite Communications
- Point to Point Radio
- Instrumentation
- General Purpose

## Ordering Information

| Part No. | Description |
|---|---|
| TGL2767 | 2 – 25 GHz Voltage Variable Attenuator, Gel Pack, 100 pieces |
| TGL2767 EVB | 2 – 25 GHz Voltage Var. Attenuator Evaluation Board |
| QPC2767S | 2 – 25 GHz Voltage Var. Attenuator Space Inspected Version, Contact Sales. |

## Absolute Maximum Ratings

| Parameter | Value/Range |
|---|---|
| Control Voltage ($V_C$, $V_S$) | ± 3.0 V |
| Control Current ($I_C$, $I_S$) | 3 mA |
| Input Power ($P_{IN}$) | 30 dBm |
| Power Dissipation ($P_{DISS}$) | 1 W |
| Mounting Temperature (30 seconds) | 320 °C |
| Operating Channel Temperature | 150 °C |
| Storage Temperature | -55 to 150 °C |

Operation of this device outside the parameter ranges given above may cause permanent damage. These are stress ratings only, and functional operation of the device at these conditions is not implied.

## Recommended Operating Conditions

| Parameter | Value/Range |
|---|---|
| Control Voltage ($V_C$); $V_C \leq V_S$ | 0 – 1.5 V |
| Reference Voltage[1] ($V_S$) | 1.5 V |
| Operating Temperature Range | -40 to +85 °C |

Note: [1] $V_S$ can be adjusted as needed to compensate for the FET threshold variations among wafer/lots.

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

## Electrical Specifications

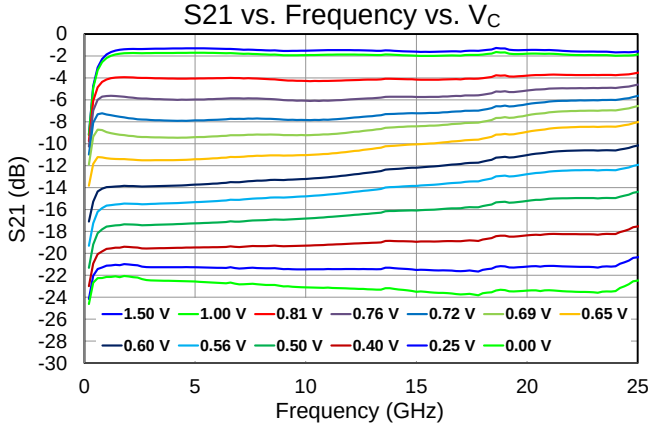
Test conditions, unless otherwise noted: 25 °C, $V_C$ = 0 – 1.5 V, $V_S$ = 1.5 V; $V_C \leq V_S$

| Parameter | Min | Typical | Max | Units |
|---|---|---|---|---|
| Frequency Range | 2 | | 25 | GHz |
| Attenuation Range | | 20 | | dB |
| Reference State Insertion Loss ($V_C$ = 1.5 V) | | <2.0 | | dB |
| Input Return Loss | | >12 | | dB |
| Output Return Loss | | >12 | | dB |
| IIP3 (10 MHz tone spacing, $P_{IN}$/Tone = 10 dBm) | | | | |
| $V_C$ set for 0 dB | | >38 | | dBm |
| $V_C$ set for 5 dB | | >25 | | dBm |
| $V_C$ set for 10 dB | | >22 | | dBm |
| $V_C$ set for 15 dB | | >22 | | dBm |
| $V_C$ set for 20 dB | | >30 | | dBm |

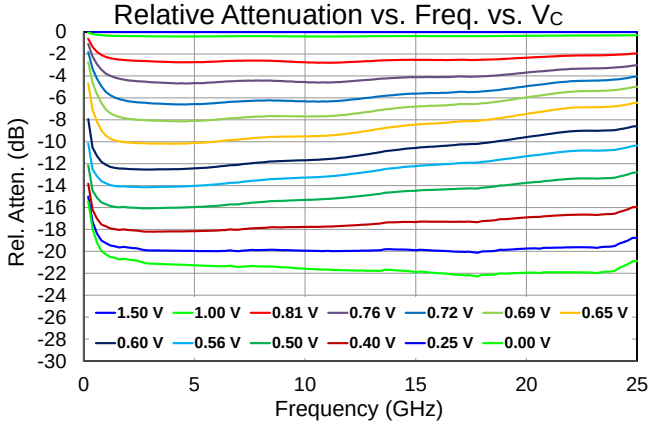
## Typical Performance (Small Signal)

Test conditions unless otherwise noted: Temp. = 25 °C, $V_S$ = 1.5 V, tested with DUT mounted to EVB

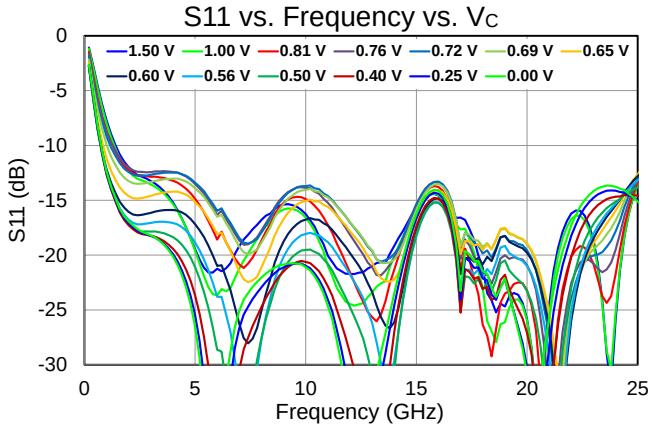
S21 vs. Frequency vs. $V_C$



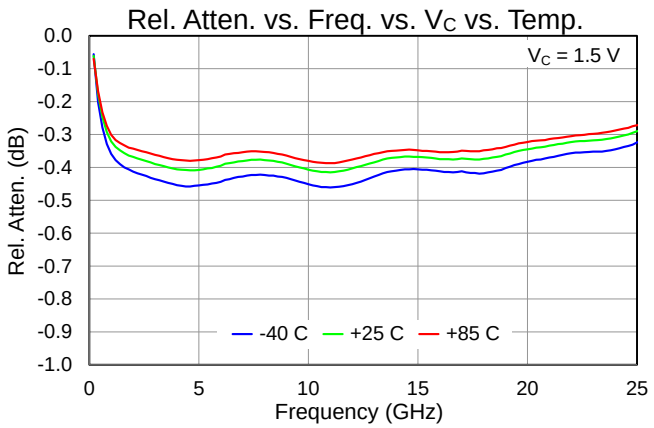

Relative Attenuation vs. Freq. vs. $V_C$



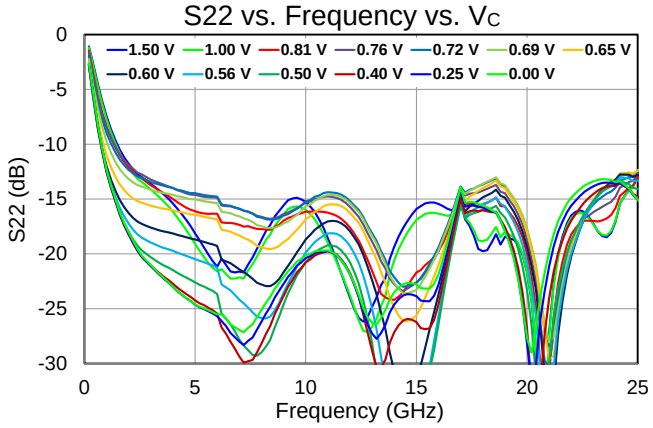

S11 vs. Frequency vs. $V_C$



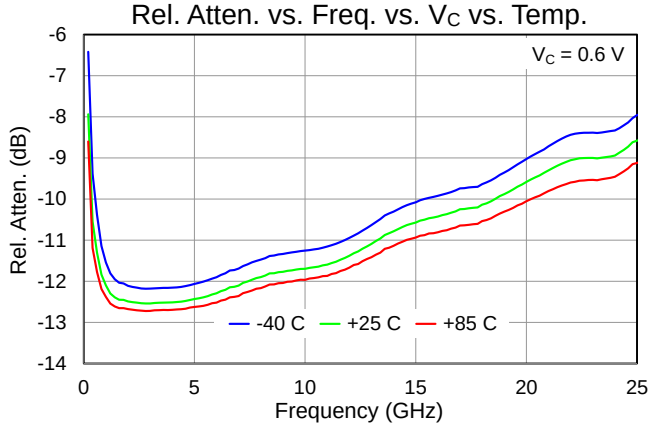

Rel. Atten. vs. Freq. vs. $V_C$ vs. Temp.




S22 vs. Frequency vs. $V_C$

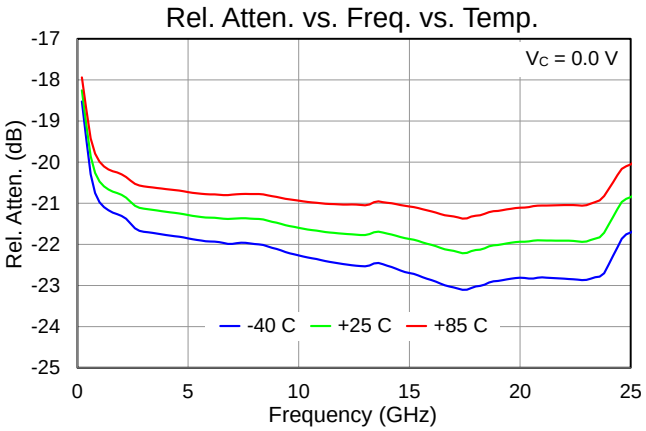


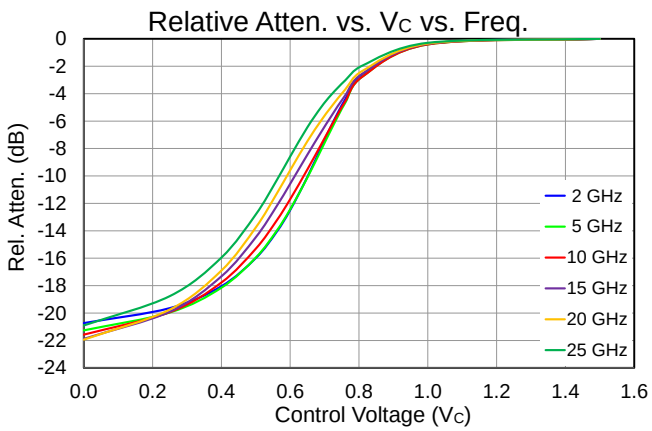

Rel. Atten. vs. Freq. vs. $V_C$ vs. Temp.



## Typical Performance – Small Signal

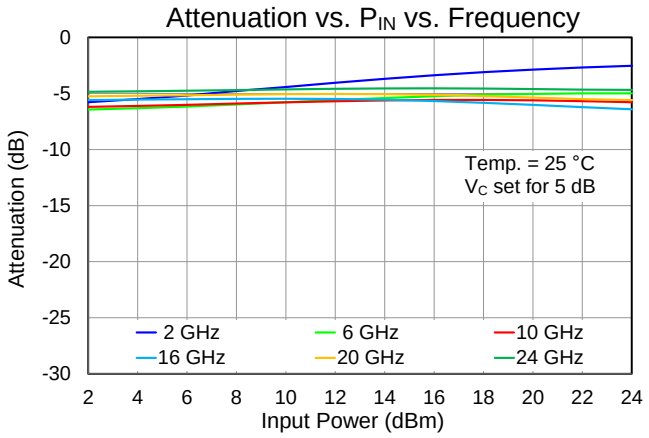
Test conditions unless otherwise noted: Temp. = 25 °C, $V_S$ = 1.5 V, tested with DUT mounted to EVB

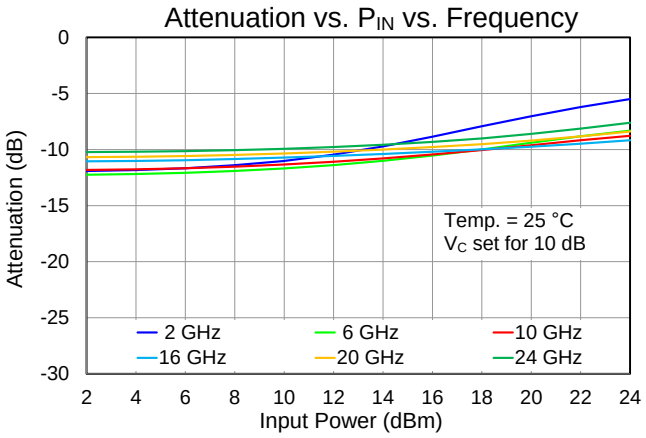


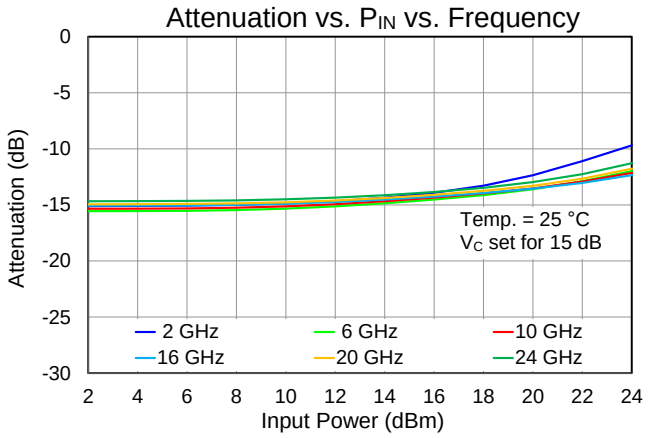



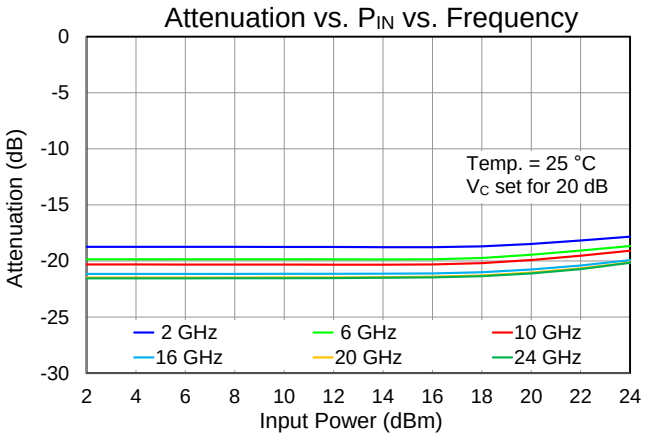
## Typical Performance – Power Performance

Test conditions unless otherwise noted: Temp. = 25 °C, $V_S$ = 1.5 V, tested with DUT mounted to EVB



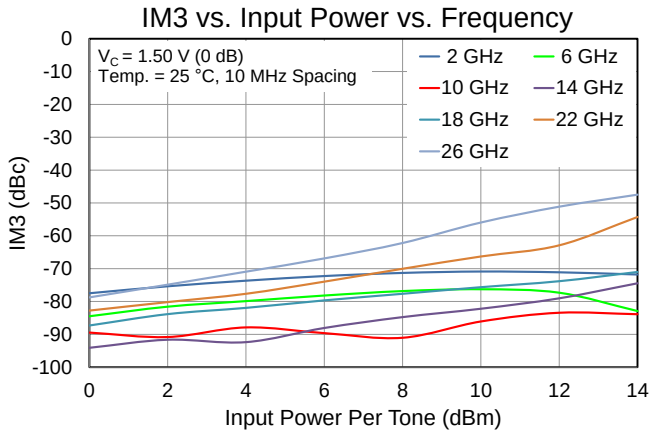



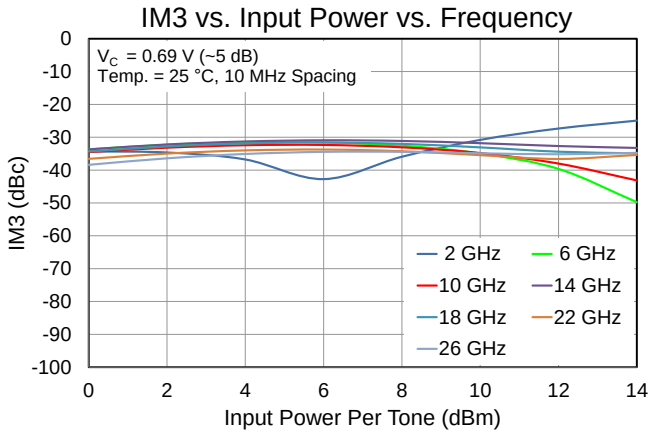



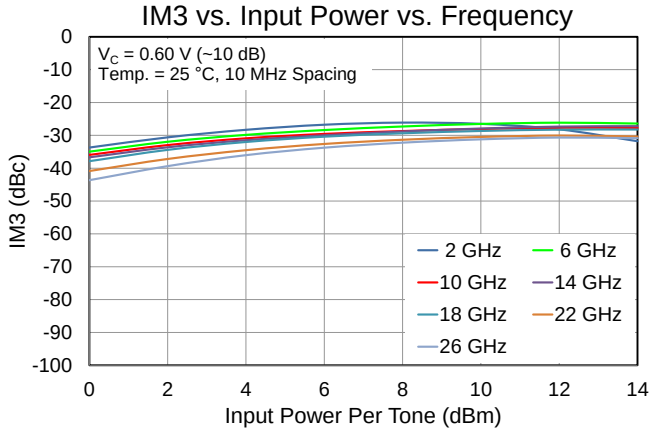



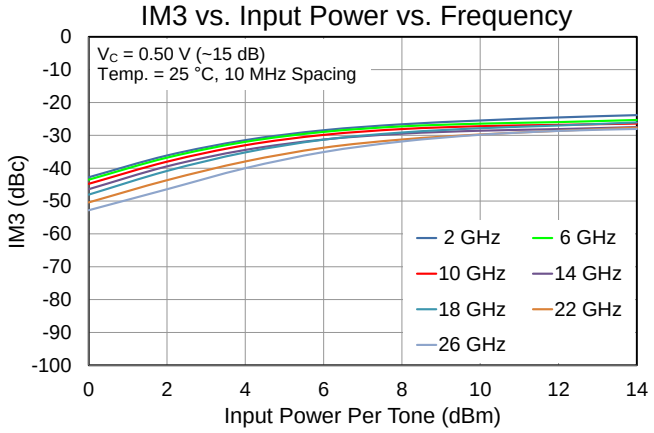
## Typical Performance – Linearity

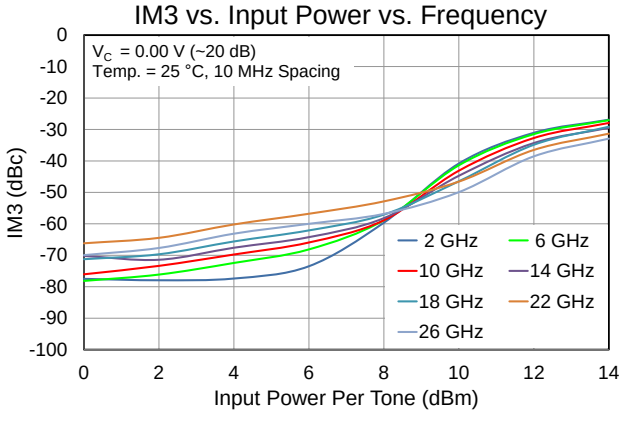
Test conditions unless otherwise noted: Temp. = 25 °C, $V_S$ = 1.5 V, tested with DUT mounted to EVB

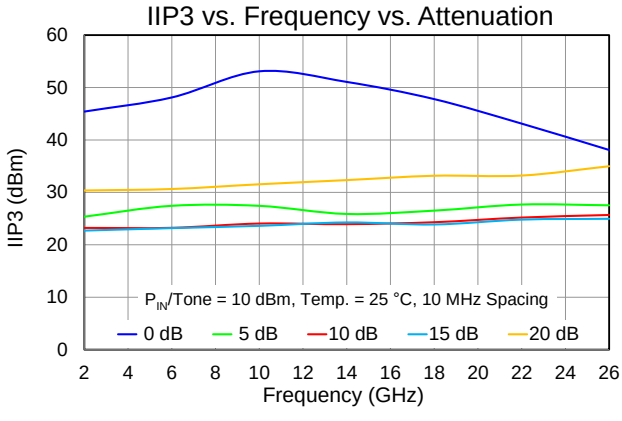


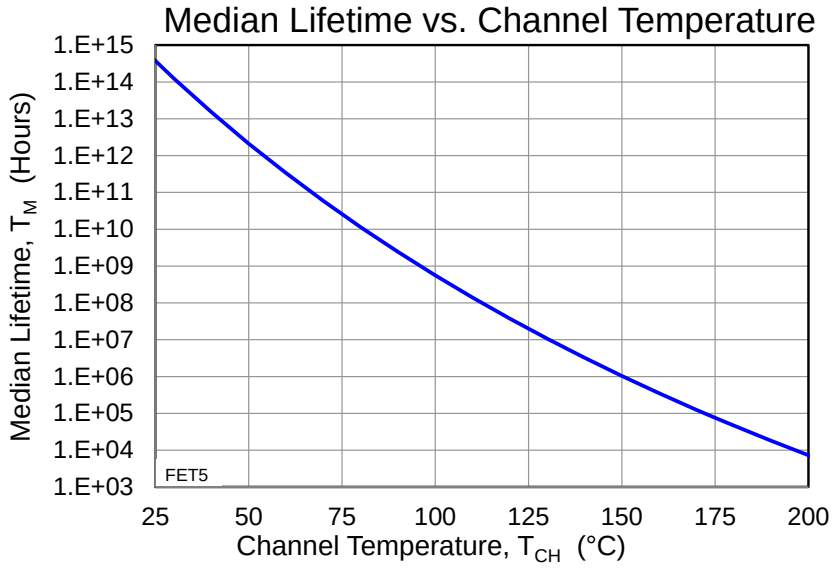
## Thermal and Reliability Information

| Parameter | Conditions | Value | Units |
|---|---|---|---|
| Thermal Resistance ($\theta_{JC}$)(1) | $T_{BASE}$ = 85 °C, $V_C$ = 0 V, $P_{DISS}$ = 1.0 W | 40.0 | ºC/W |
| Channel Temperature ($T_{CH}$)(1) | | 125.0 | °C |
| Median Lifetime ($T_M$) | | 2.4E+7 | Hrs |

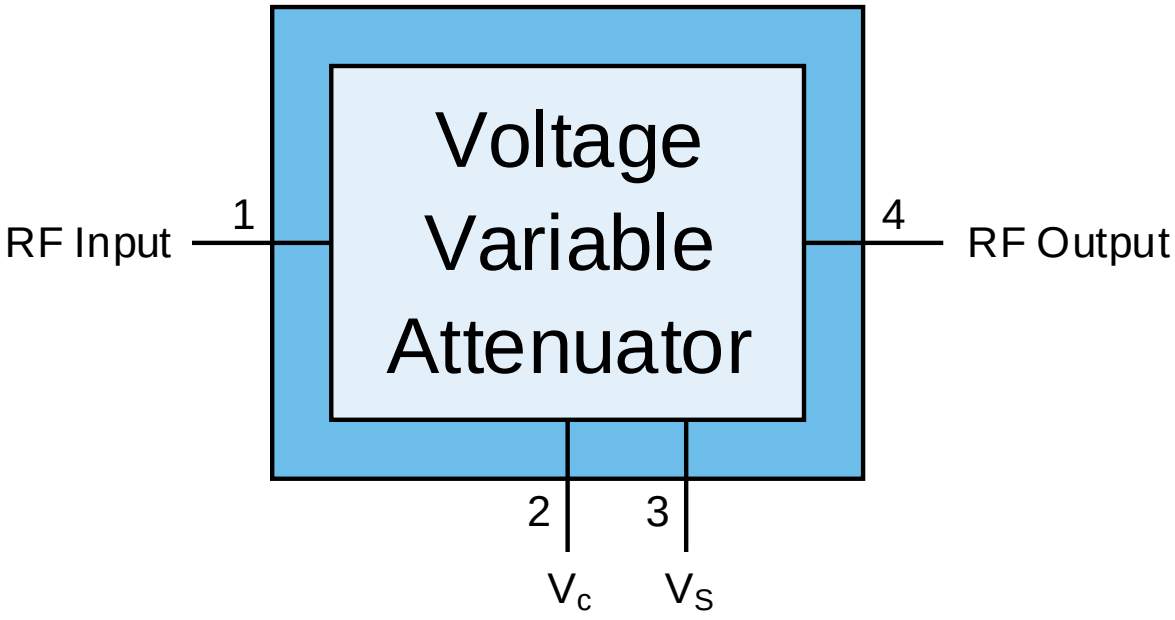
Note:
1. Die mounted to 40 mil thick CuMo carrier plate, with carrier plate backside temperature fixed at 85 °C.

## Median Lifetime

Test Conditions: 6.0 V; Failure Criterion = 10% reduction in $I_{D\ MAX}$



## Application Circuit

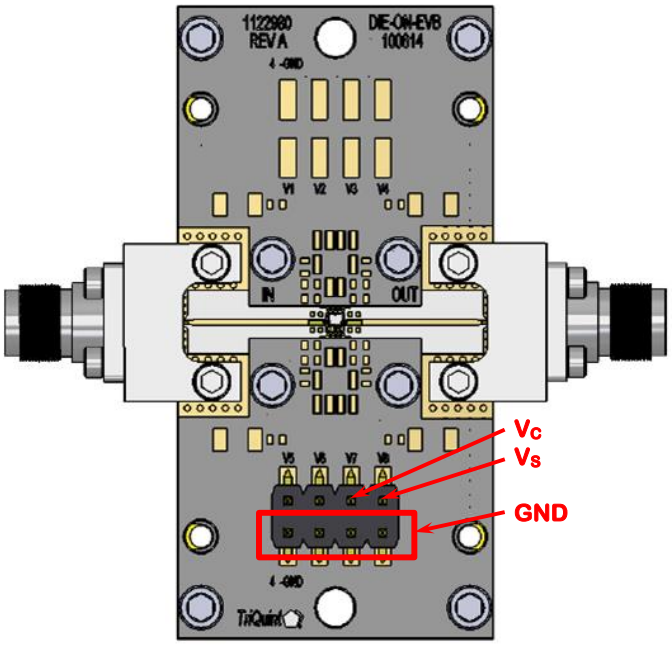



Notes: $V_C \leq V_S$

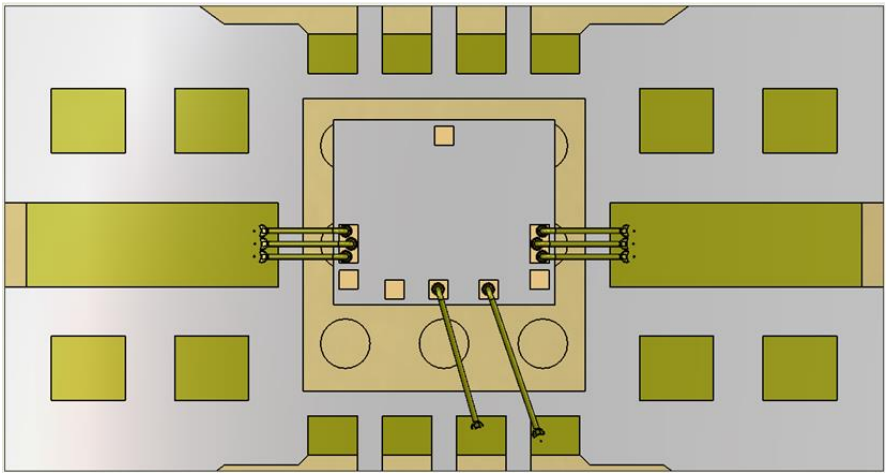
## Evaluation Board Layout

RF Layer is 0.008” thick Rogers Corp. RO4003C, εr = 3.38. Metal layers are 0.5 oz. copper. The microstrip line at the connector interface is optimized for the Southwest Microwave end launch connector 1092-01A-5.

The pad pattern shown has been developed and tested for optimized assembly at Qorvo Semiconductor. The PCB land pattern has been developed to accommodate lead and package tolerances. Since surface mount processes vary from company to company, careful process development is recommended.



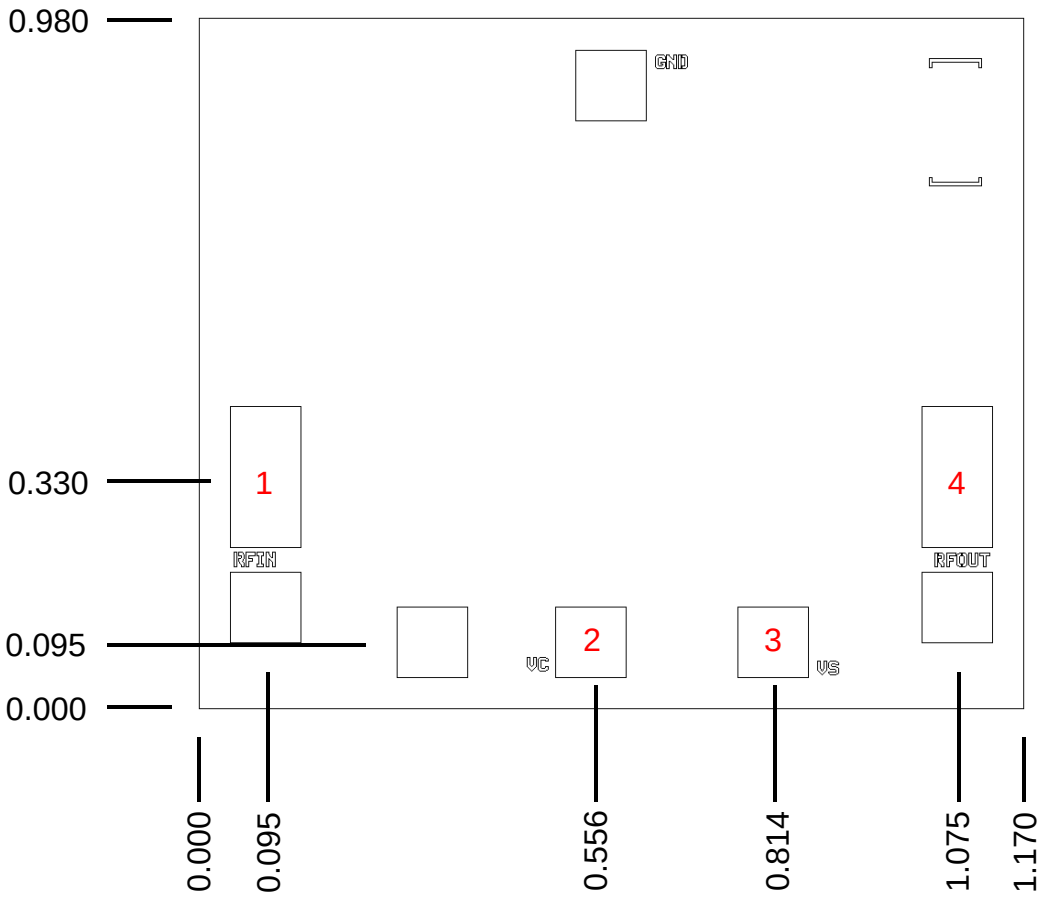

## EVB Die Mounting Detail



Note:

1. Multiple copper-filled vias should be employed under die to minimize inductance and thermal resistance.

## Mechanical Drawing & Bond Pad Description




Unit: millimeters
Thickness: 0.10
Die x, y size tolerance: ± 0.050
Chip edge to bond pad dimensions are shown to center of pad
Ground is backside of die

| Pin No. | Symbol | Pad Size (um x um) | Description |
|---|---|---|---|
| 1 | RF Input | 100 x 200 | RF Input, 50 Ω, AC coupled |
| 2 | $V_C$ | 100 x 100 | $V_C$, control voltage |
| 3 | $V_S$ | 100 x 100 | $V_S$, reference voltage |
| 4 | RF Output | 100 x 200 | RF Output, 50 Ω, AC coupled |

## Assembly Notes

Component placement and adhesive attachment assembly notes:

- Vacuum pencils and/or vacuum collets are the preferred method of pick up.
- Air bridges must be avoided during placement.
- The force impact is critical during auto placement.

Reflow process assembly notes:

- Use AuSn (80/20) solder and limit exposure to temperatures above 300 °C to 3-4 minutes, maximum.
- An alloy station or conveyor furnace with reducing atmosphere should be used.
- Do not use any kind of flux.
- Coefficient of thermal expansion matching is critical for long-term reliability.
- Devices must be stored in a dry nitrogen atmosphere.

Interconnect process assembly notes:

- Thermosonic ball bonding is the preferred interconnect technique.
- Force, time, and ultrasonic levels are critical parameters.
- Aluminum wire should not be used.
- Devices with small pad sizes should be bonded with 0.0007-inch wire.