# TGL2767-SM

## 2 – 31GHz Voltage Variable Attenuator

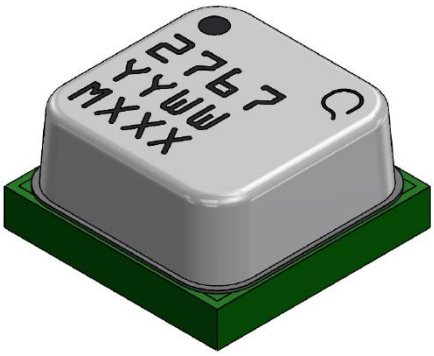
## Product Description

The TGL2767–SM is a packaged wideband voltage-variable attenuator using Qorvo's production 0.15um GaAs pHEMT process (QPHT15). Operating from 2 – 31 GHz, the TGL2767–SM offers > 20 dB of attenuation range with < 2 dB insertion loss in the reference state. The TGL2767–SM'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–SM is fully matched to 50 ohms and offered in a small 3.00 x 3.00 mm surface mount package. This, along with using standard control and reference voltages, allows users to integrate the TGL2767–SM into their system with minimal effort.

Lead-free and RoHS compliant.

Evaluation Boards available on request.

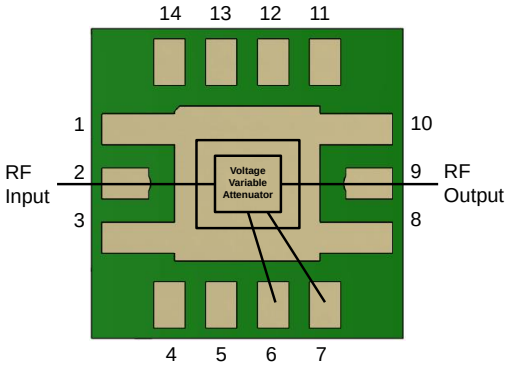



## Product Features

- Frequency Range: 2 – 31 GHz
- Attenuation Range: 20 dB
- Insertion Loss (Ref. State): < 2 dB
- Control Voltage: 0.0 to 1.5 V
- Reference Voltage: 1.5 V
- Package Size: 3.00 x 3.00 x 1.53 mm

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

## Block Diagram




## Applications

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

## Ordering Information

| Part No. | ECCN | Description |
|---|---|---|
| TGL2767-SM | EAR99 | 2–31 GHz Voltage Variable Attenuator |
| TGL2767-SM-EVB | EAR99 | 2–31 GHz Voltage Var. Attenuator Evaluation Board |

## Electrical Specifications

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

| Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|
| Operational Frequency Range | 2 | – | 31 | 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 spacing, $P_{IN}$/Tone=10 dBm) | | | | |
| $V_C$ set for 0 dB | | > 38 | | dBm |
| $V_C$ set for 5 dB | | > 24 | | 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 |

## Recommended Operating Conditions

| Parameter | Value / Range |
|---|---|
| Reference Voltage[1] ($V_S$) | 1.5 V |
| Control Voltage ($V_C$) | 0 - 1.5 V |
| Temperature Range | -40 to +85 $^0$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.

## Absolute Maximum Ratings

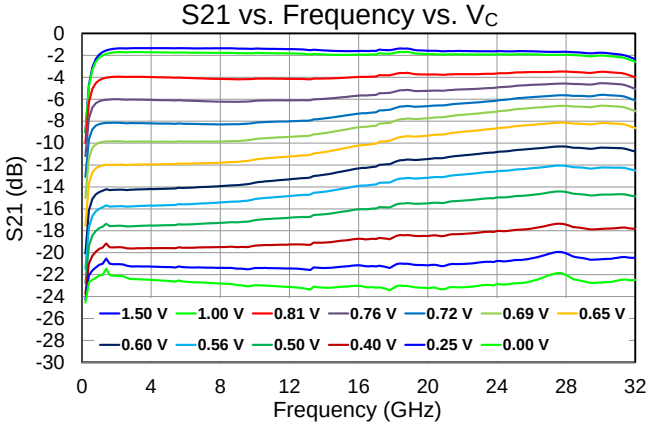
| Parameter | Value / Range |
|---|---|
| Control Voltage ($V_C$, $V_S$) | ± 3.0 V |
| Control Current ($I_C$, $I_S$) | 5 mA |
| Input Power, ($P_{IN}$) | 30 dBm |
| Power Dissipation ($P_{DISS}$) | 1 W |
| Operating Channel Temperature | 150 °C |
| Storage Temperature | -40 °C to 150 °C |
| Mounting Temperature (30 seconds) | 260 °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.

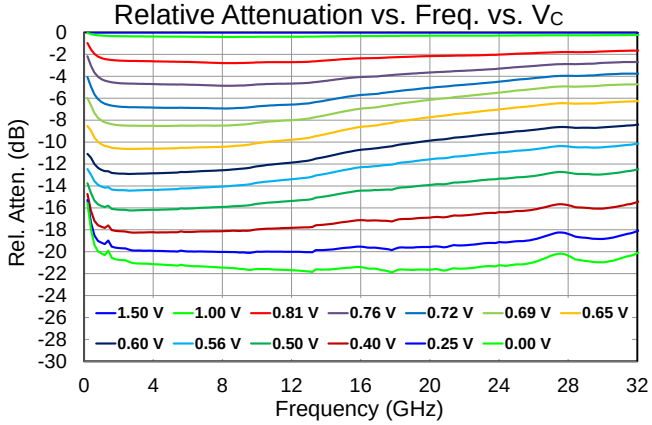
## Performance Plots – Small Signal

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

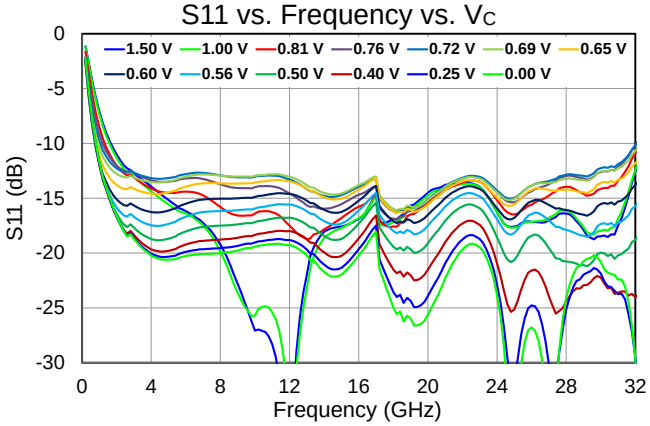
S21 vs. Frequency vs. $V_C$



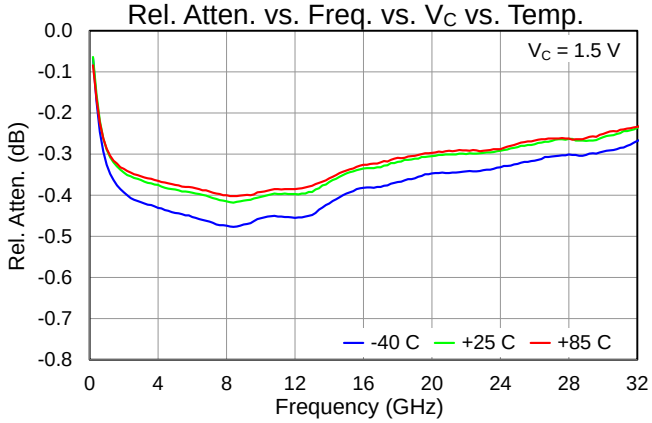

Relative Attenuation vs. Freq. vs. $V_C$



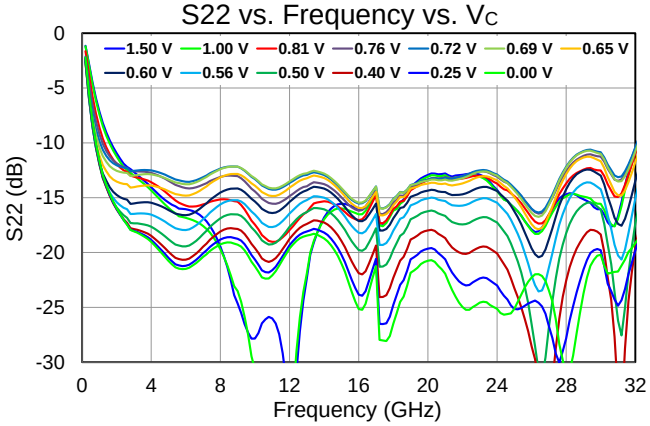

S11 vs. Frequency vs. $V_C$



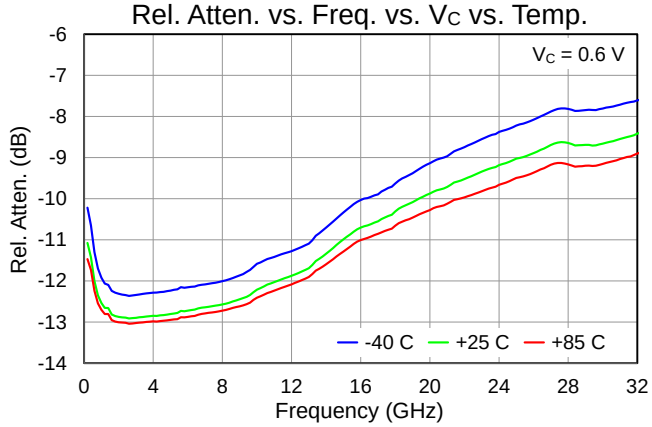

Rel. Atten. vs. Freq. vs. $V_C$ vs. Temp.




S22 vs. Frequency vs. $V_C$



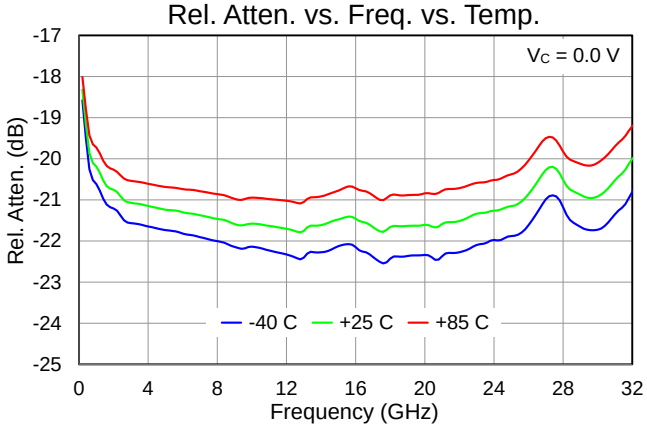

Rel. Atten. vs. Freq. vs. $V_C$ vs. Temp.



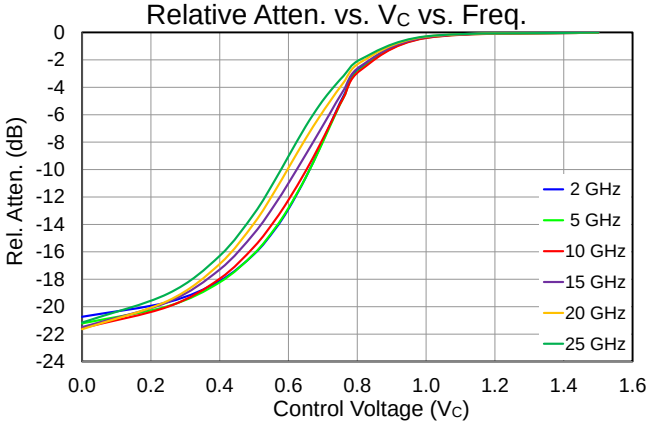
## Performance Plots – Small Signal & Power Performance

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

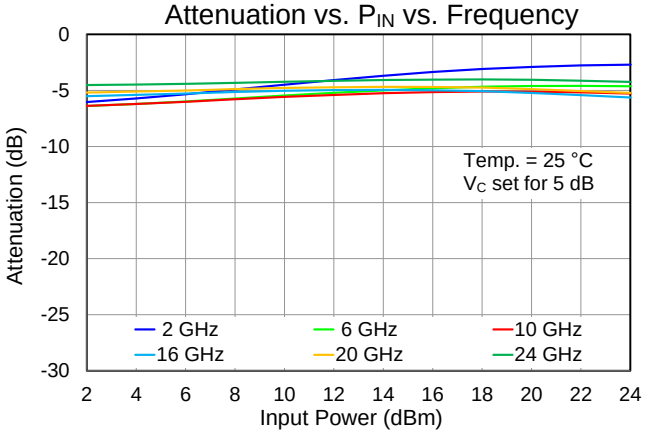
Rel. Atten. vs. Freq. vs. Temp.



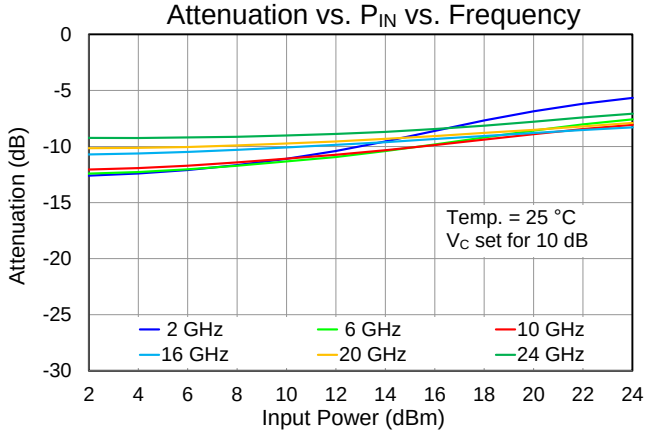

Relative Atten. vs. $V_C$ vs. Freq.



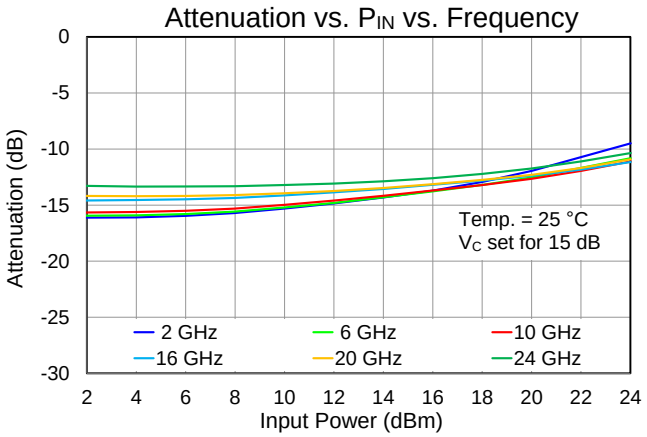

Attenuation vs. $P_{IN}$ vs. Frequency



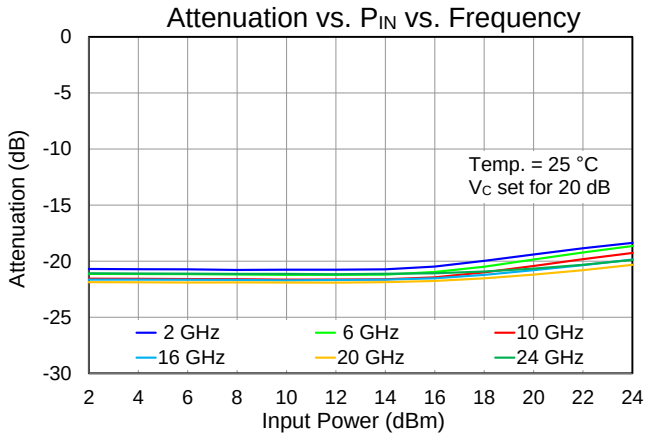

Attenuation vs. $P_{IN}$ vs. Frequency




Attenuation vs. $P_{IN}$ vs. Frequency

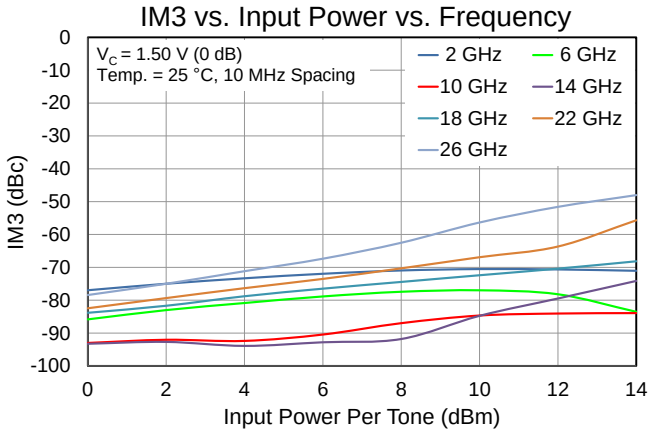


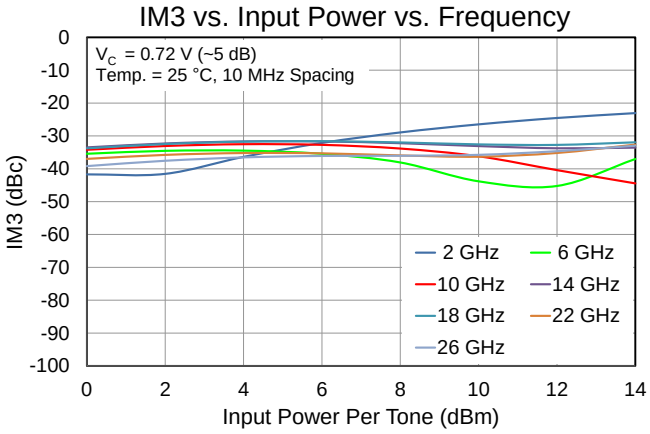

Attenuation vs. $P_{IN}$ vs. Frequency

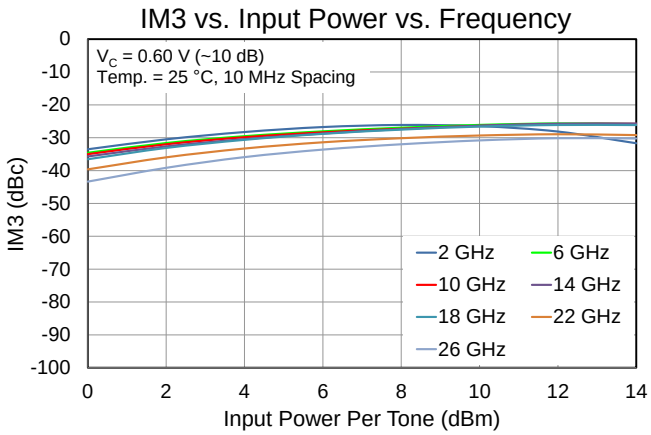


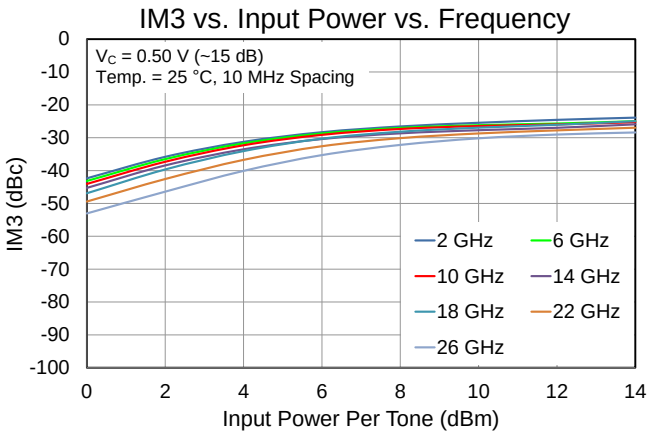
## Performance Plots – Linearity

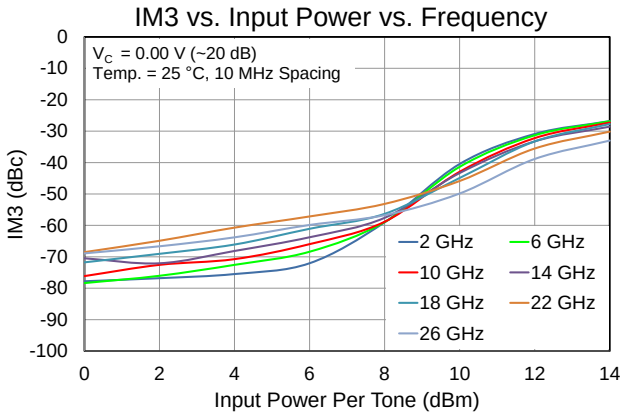
Test conditions unless otherwise noted: Temp. = 25 °C, $V_S$ = 1.5 V, tested with DUT mounted to EVB

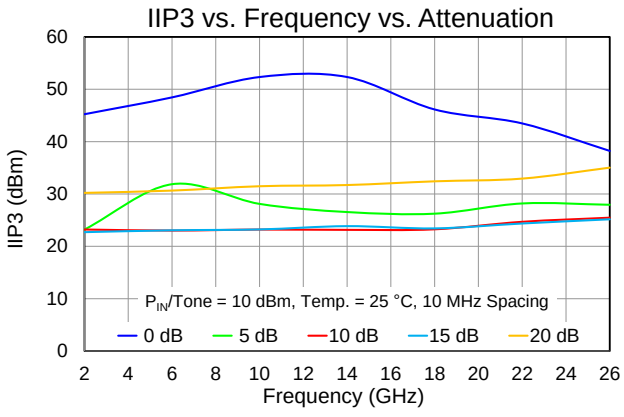


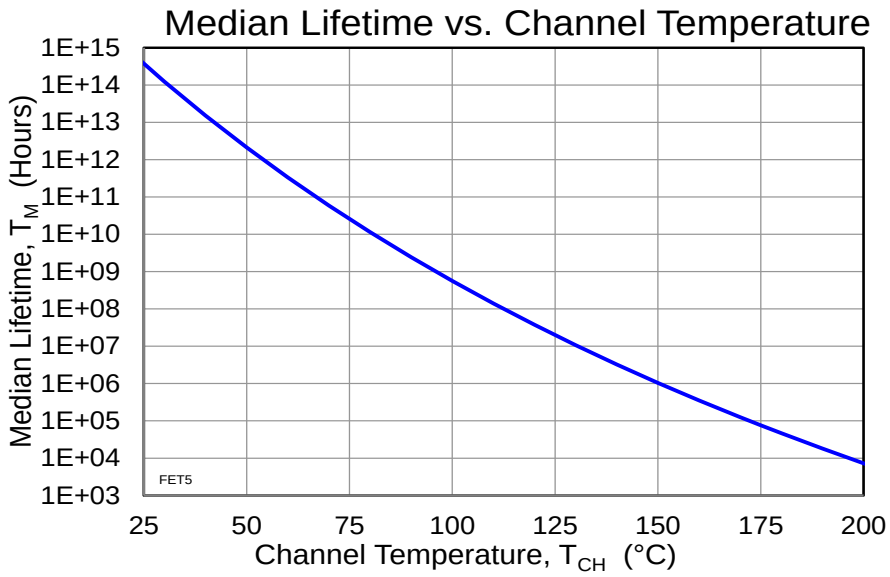
## Thermal and Reliability Information

| Parameter | Test Conditions | Value | Units |
|---|---|---|---|
| Thermal Resistance ($\theta_{JC}$) (1) | $T_{BASE}$ = 85°C, $V_C$ = 0 V, $P_{DISS}$ = 1.0 W | 40.0 | °C/W |
| Channel Temperature ($T_{CH}$) | | 125 | °C |
| Median Lifetime ($T_M$) | | 2.4E+07 | Hrs |

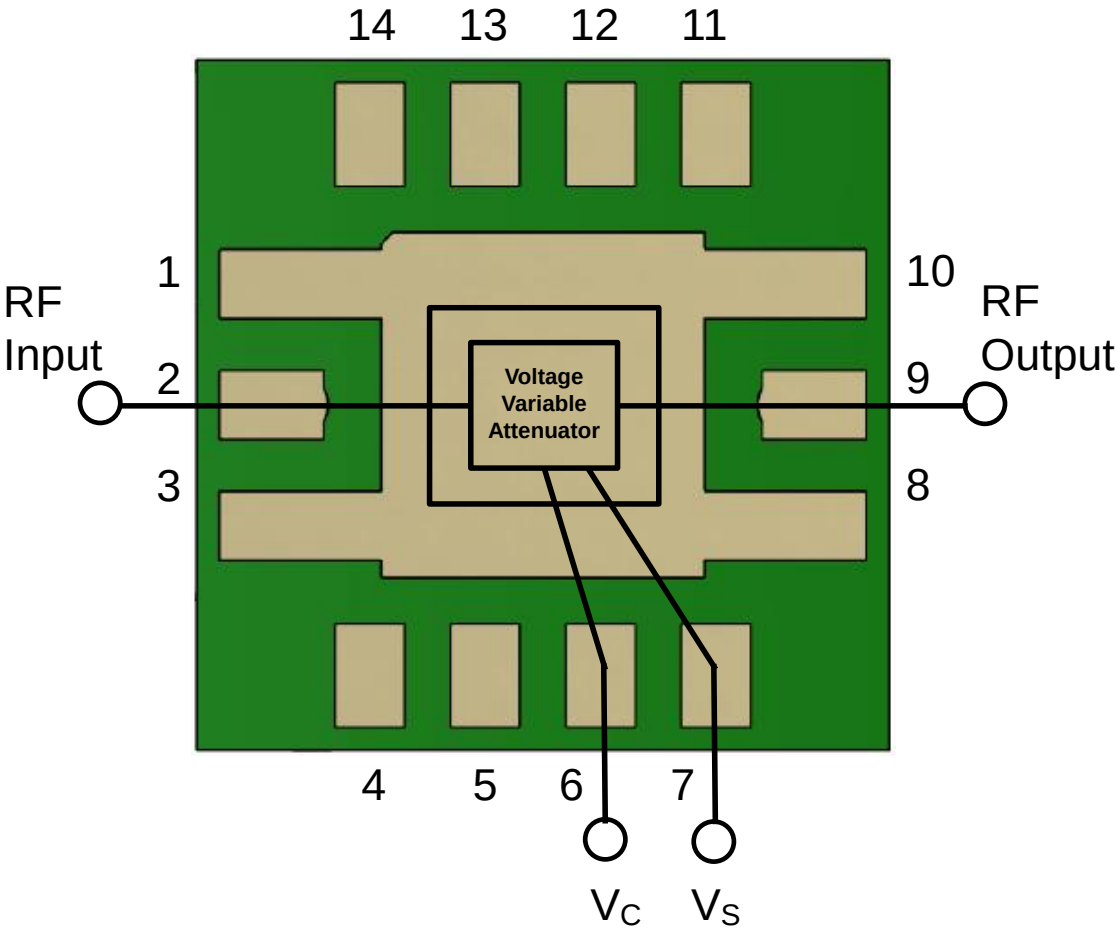
1. Package base backside temperature fixed at 85 °C.

## Median Lifetime

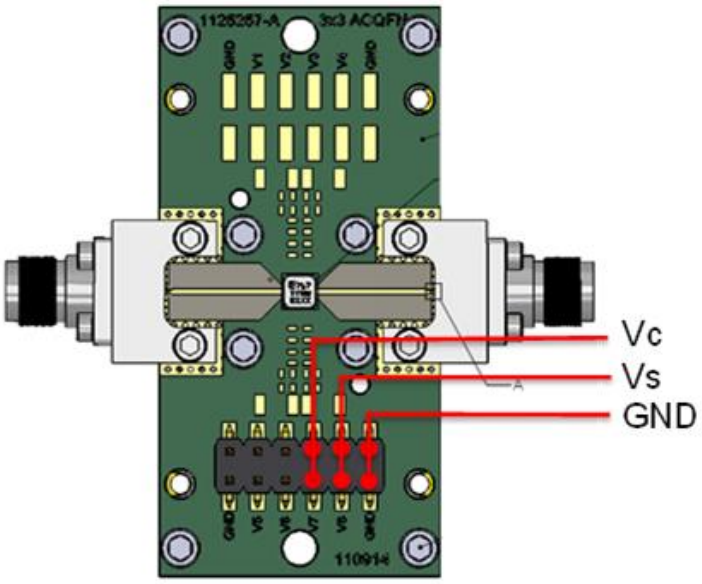
Test Conditions: 6.0 V; Failure Criterion = 10% reduction in $I_{D\ MAX}$

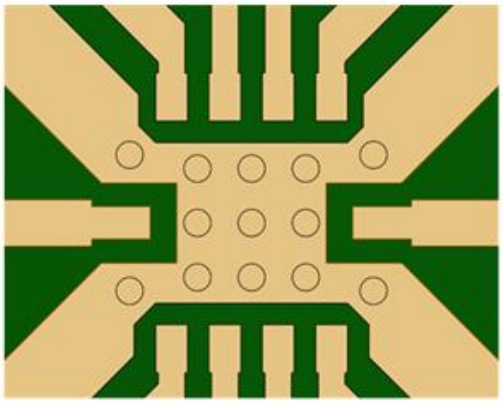


## Applications Circuit



## Evaluation Board (EVB) Layout Assembly & Mounting Detail



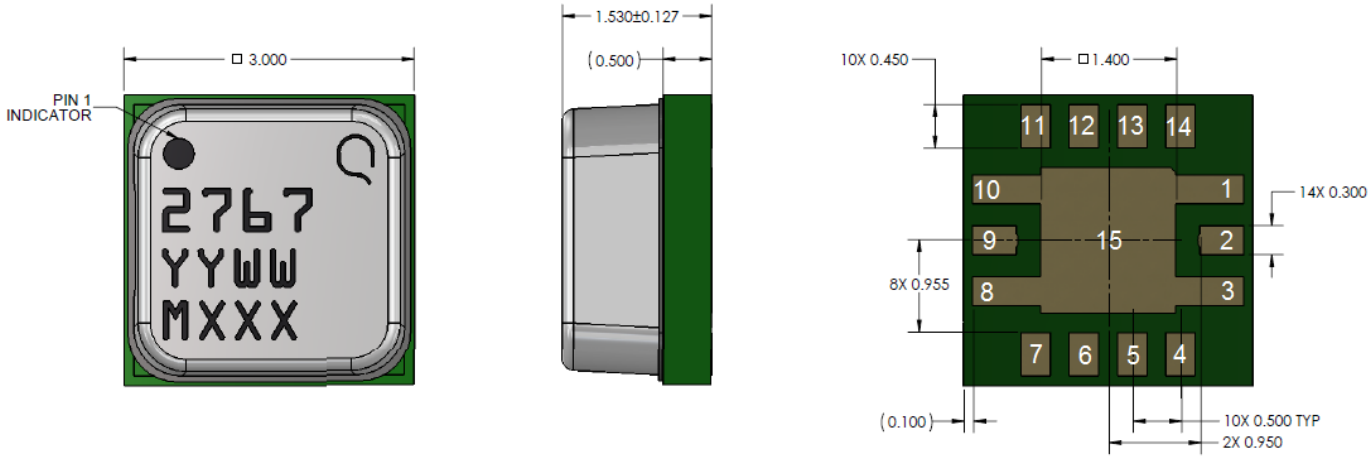
Package Mounting Detail

RF Layer is 0.008” thick Rogers Corp. RO4003C, er = 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. 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.

Note: Multiple vias should be employed under package to minimize inductance and thermal resistance.

## Mechanical Information

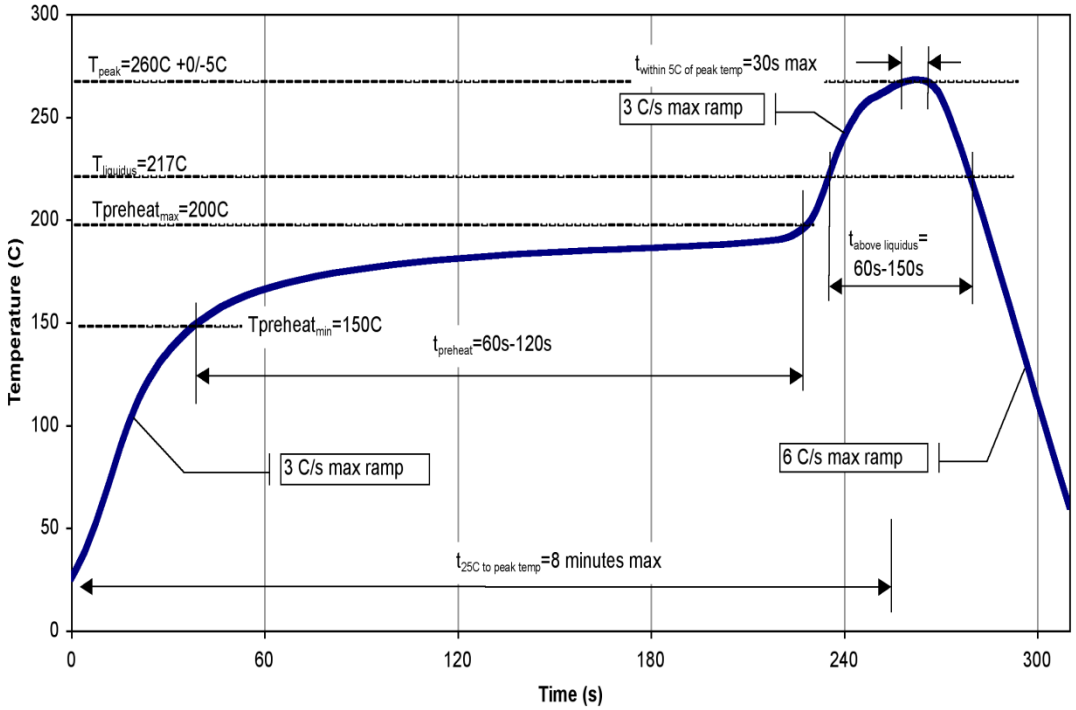



NOTES:
1. PACKAGE BASE: LAMINATE
2. PACKAGE LID: LCP
3. ALL METALIZED FEATURES ARE GOLD PLATED.
4. THE PART IS EPOXY SEALED
5. PART MARKING:
   2767: PART NUMBER
   YY: PART ASSY YEAR
   WW: PART ASSY WEEK
   MXXX: BATCH ID

Units: millimeters
Tolerances: unless specified
x.xx = ±0.25
x.xxx = ± 0.100

| Pin No. | Symbol | Description |
|---|---|---|
| 1, 3, 8, 10 | GND | Package ground |
| 2 | RF Input | RF Input, 50 Ω, AC coupled |
| 4, 5 11-14 | NC | No connect; grounding may improve performance |
| 6 | $V_C$ | $V_C$, control voltage |
| 7 | $V_S$ | $V_S$, reference voltage |
| 9 | RF Output | RF Output, 50 Ω, AC coupled |
| 15 (Slug) | GND | Backside Paddle; multiple vias should be used on PCB to minimize inductance and thermal resistance |

## Recommended Soldering Profile



## Handling Precautions

| Parameter | Rating | Standard |
|---|---|---|
| ESD – Human Body Model (HBM) | Class 1A | ANSI/ESD/JEDEC JS-001 |
| ESD – Charge Device Model (CDM) | Class C3 | JS-002-2014 |
| 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.

## RoHS Compliance

This product is compliant with the 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 ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free

## Contact Information

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

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

**Web:** **www.qorvo.com**

**Email:** **customer.support@qorvo.com**

For technical questions and application information: **Email:** **appsupport@qorvo.com**

## Important Notice

The information contained herein is believed to be reliable; however, Qorvo makes no warranties regarding the information contained herein and assumes no responsibility or liability whatsoever for the use of the information contained herein. All information contained herein is subject to change without notice. Customers should obtain and verify the latest relevant information before placing orders for Qorvo products. The information contained herein or any use of such information does not grant, explicitly or implicitly, to any party any patent rights, licenses, or any other intellectual property rights, whether with regard to such information itself or anything described by such information. **THIS INFORMATION DOES NOT CONSTITUTE A WARRANTY WITH RESPECT TO THE PRODUCTS DESCRIBED HEREIN, AND QORVO HEREBY DISCLAIMS ANY AND ALL WARRANTIES WITH RESPECT TO SUCH PRODUCTS WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

Without limiting the generality of the foregoing, Qorvo products are not warranted or authorized for use as critical components in medical, life-saving, or life-sustaining applications, or other applications where a failure would reasonably be expected to cause severe personal injury or death.