



QPP2209

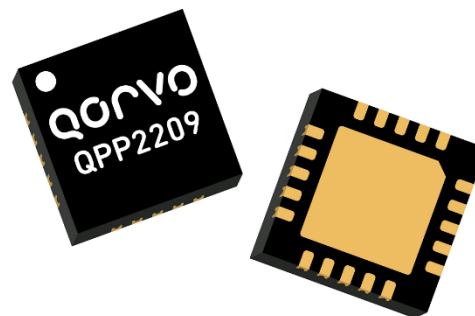
8 – 12 GHz 40 W VPIN Limiter

Product Overview

Qorvo's QPP2209 is a high power VPIN limiter robust to short-pulse input signals up to 40W. It offers exceptionally low insertion loss over a wide bandwidth and requires no DC bias. The QPP2209 is housed in a low-cost plastic over-molded QFN package.

The QPP2209 is internally matched to 50 ohms and operates from 8 to 12 GHz with typical insertion loss less than 0.5dB and flat leakage below 19dBm. It is capable of withstanding 40W of incident power under short-pulse conditions. It is well suited for both commercial and defense related applications.

Lead-free and RoHS compliant.



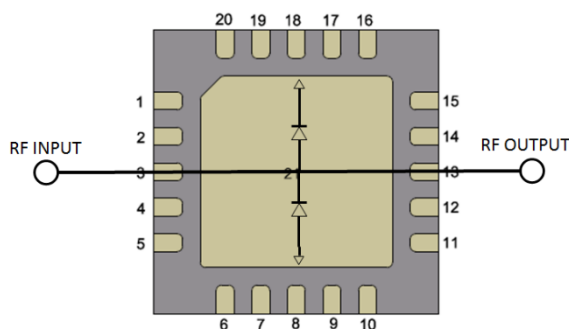
20L 4 x 4 mm OVM QFN Package

Key Features

- Frequency Range: 8 to 12 GHz
- Insertion Loss: < 0.5 dB
- Peak Power Handling: 40 W (pulsed)
- Flat Leakage: < 19 dBm
- Spike Leakage < 20.5 dBm
- Passive (no DC bias required)
- Recovery time < 30 ns
- Package Dimensions: 4.00 x 4.00 x 0.85 mm

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

Functional Block Diagram



Top View

Applications

- Receive Chain Protection
- Commercial and Military Radar

Ordering Information

Part	Description
QPP2209TR7	8–12 GHz 40W VPIN Limiter, 500 pcs, 7-inch reel
QPP2209TR7X	8–12 GHz 40W VPIN Limiter, 50 pcs, 7-inch reel
QPP2209EVB01	Evaluation Board

Absolute Maximum Ratings

Parameter	Rating
Incident Power, Pulsed ¹ , 50 Ω, 25 °C	46 dBm
Incident Power, Pulsed ¹ , 50 Ω, 85 °C	46 dBm
Incident Power, CW, 50 Ω, 25 °C	37 dBm
Incident Power, CW, 50 Ω, 85 °C	34 dBm
Mounting Temperature (30 s max)	260 °C
Storage Temperature	-40 to 150 °C

Note:

¹ Pulse conditions: PW = 100 us, Duty Cycle = 10%

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
Passive – No Bias				
Temperature Range	-40	+25	+85	°C

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

Electrical Specifications

Parameter	Conditions ⁽¹⁾	Min	Typ.	Max	Units
Operational Frequency Range		8.0		12.0	GHz
Insertion Loss	8 GHz		0.32	0.75	dB
	10 GHz		0.35	0.90	
	12 GHz		0.47	1.00	
Input Return Loss	8 GHz		25		dB
	10 GHz		21		
	12 GHz		15		
Output Return Loss	8 GHz		30		dB
	10 GHz		21		
	12 GHz		15		
Flat Leakage Power at P _{IN} > 30 dBm (Pulse)	8 GHz	14	18.2	19.5	dBm
	10 GHz	14	18.0	19.5	
	12 GHz	14	18.2	19.5	
Pulse Recovery Time			<30		ns
Spike Leakage			20.5		dBm
Insertion Loss Temperature Coefficient			0.004		dB/ °C

Notes:

1. Test conditions unless otherwise noted: Temp = +25 °C, 50 Ω system. S-Parameter CW, Power Pulse Parameter: PW = 100μs, Duty Cycle = 10%.

Thermal and Reliability Information

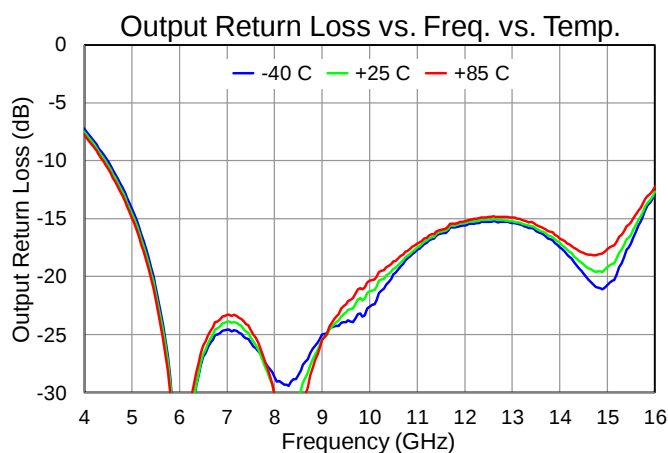
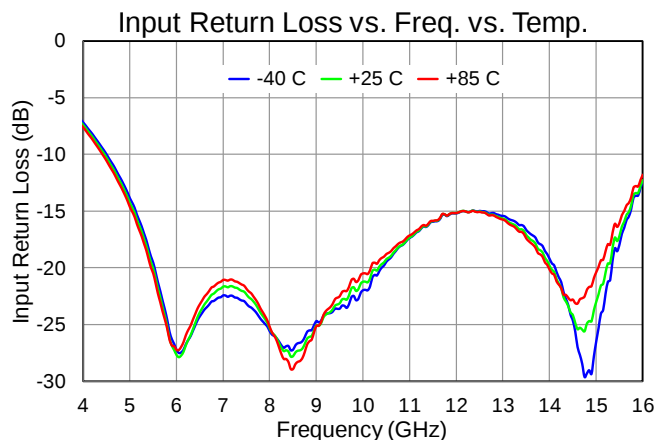
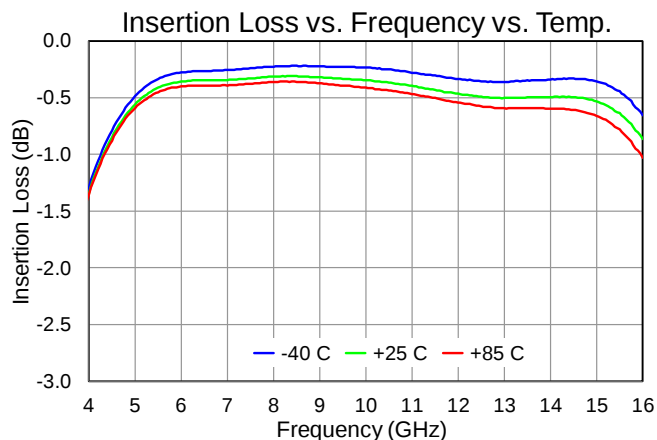
Parameter	Test Conditions	Value	Units
Incident Power (RF Operational Life Test ⁽¹⁾)	10 GHz Pulsed, PW=100 us, DC=10%, 50 Ω, 25 °C	40	W

Notes:

1. Test terminated after 100 hours.

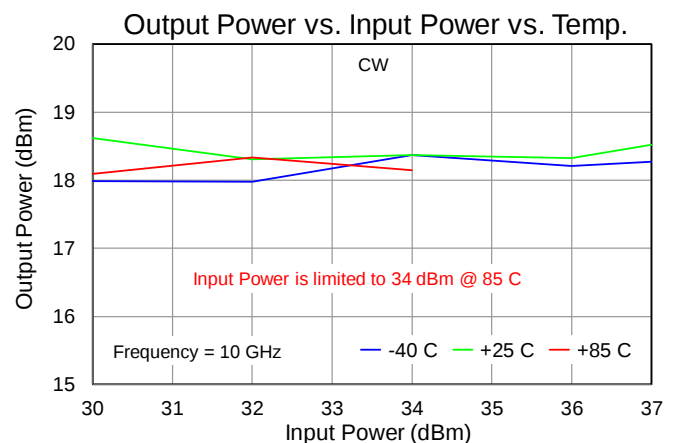
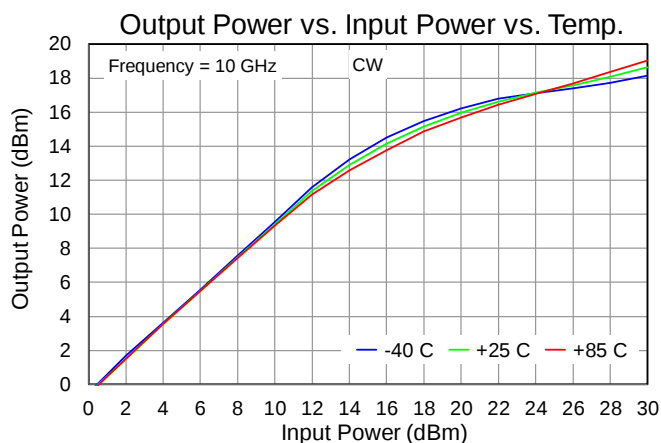
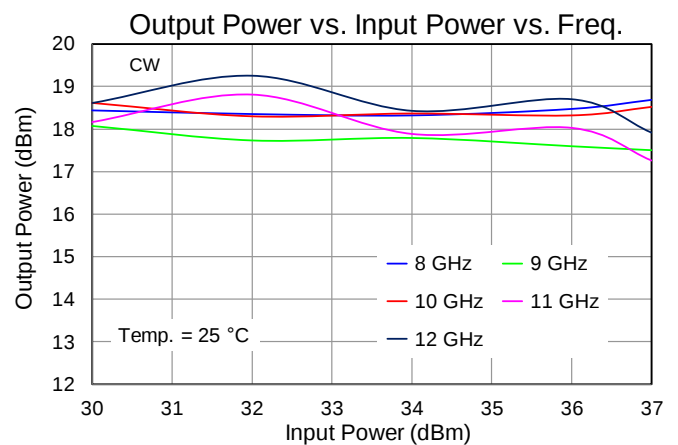
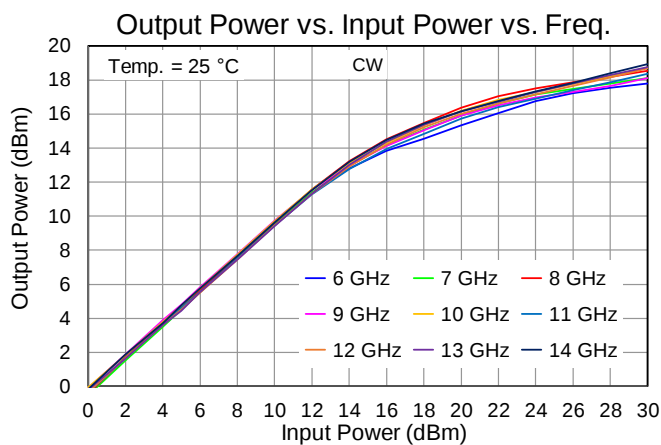
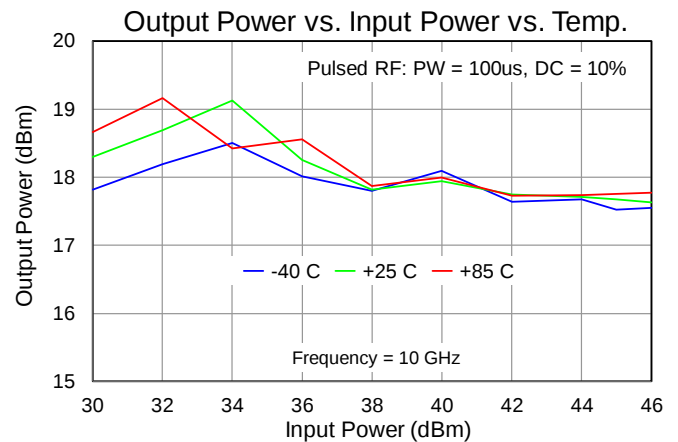
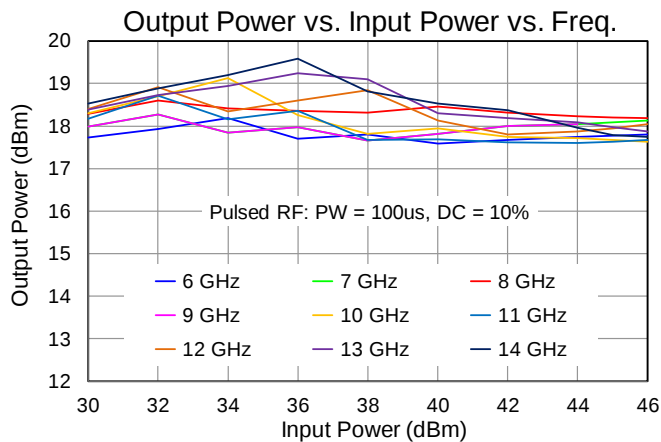
Performance Plots – Small Signal

Test conditions unless otherwise noted: Temp.=+25 °C, CW

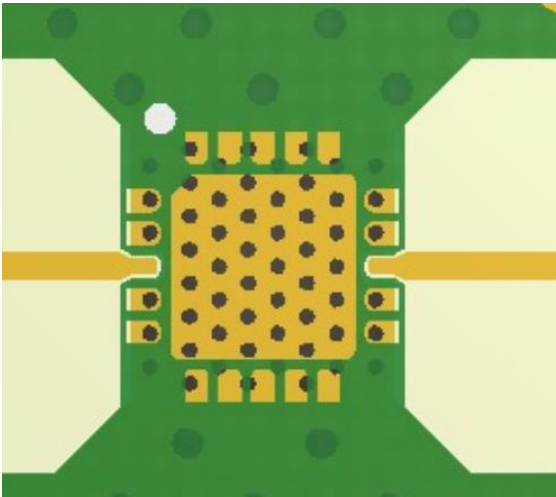
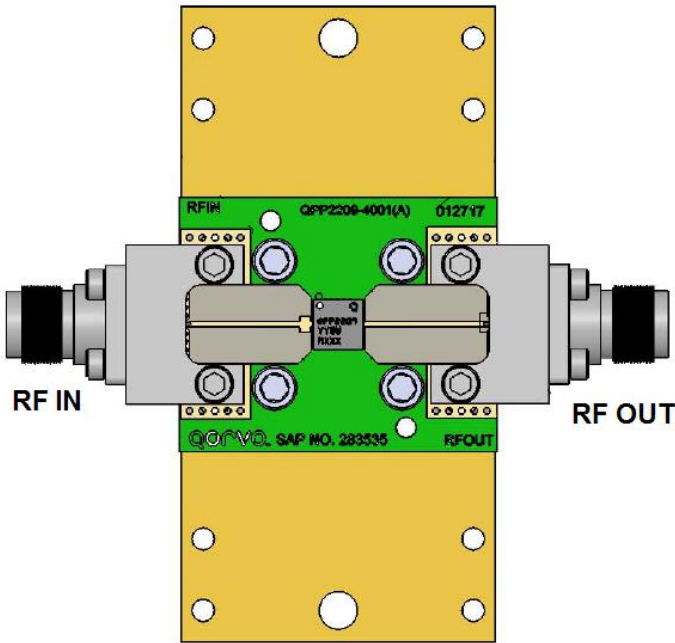


Performance Plots – Large Signal

Test conditions unless otherwise noted: Pulsed RF: PW = 100us, DC = 10%; Temp.=+25 °C



Application Circuit and Evaluation Board (EVB) and Mounting Detail



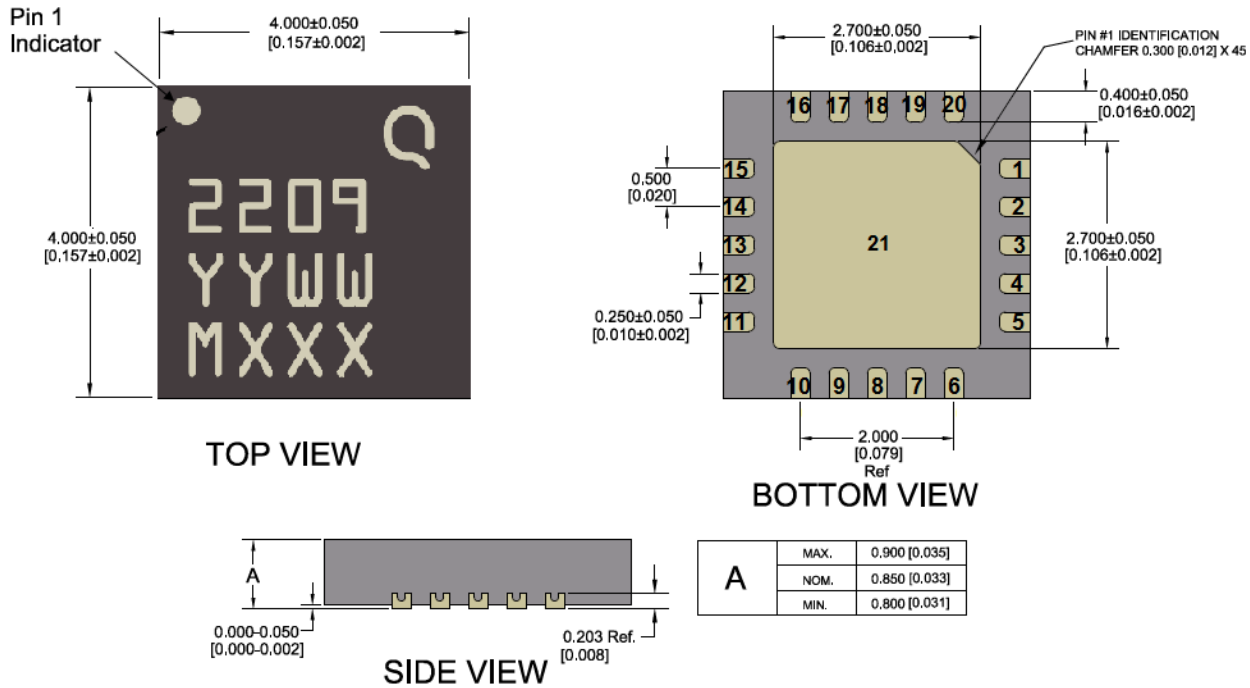
- Notes:
- 1. See Evaluation Board PCB Information for material and stack up.

Evaluation Board PCB Information

Layer Stack Legend

Material	Layer	Thickness	Dielectric Material	Type
	SILKSCREEN_TOP			Legend
Surface Material	SOLDERMASK_TOP	0.4mil	Solder Resist	Solder Mask
Copper	METAL1_TOP	0.7mil		Signal
Core		8.0mil	ROGERS 4003C	Dielectric
Copper	METAL2_BOT	0.7mil		Signal
Total thickness: 9.8mil				

Package Marking, Pad Configuration and Description



LASER MARK NOTES:

- 2209 IS PART #
- YY IS THE LAST TWO DIGITS OF THE CALENDAR YEAR
- WW IS THE WEEK NUMBER OF THE ASSEMBLY LOT START
- MXXX IS THE BATCH ID

NOTES: UNLESS OTHERWISE SPECIFIED;

1. TESTED QPP2209
2. PACKAGE IS MOLD ENCAPSULATED.
3. PACKAGE EXPOSED METALLIZATION ARE GOLD PLATED.

UNLESS OTHERWISE
SPECIFIED: DIMENSIONS ARE IN mm [INCHES]

.XX = ± .25 [.001]
TOLERANCES .XXX = ± .100 [.004] ANGLES = 0.5 °
.XXXX = ± .0254 [.001]

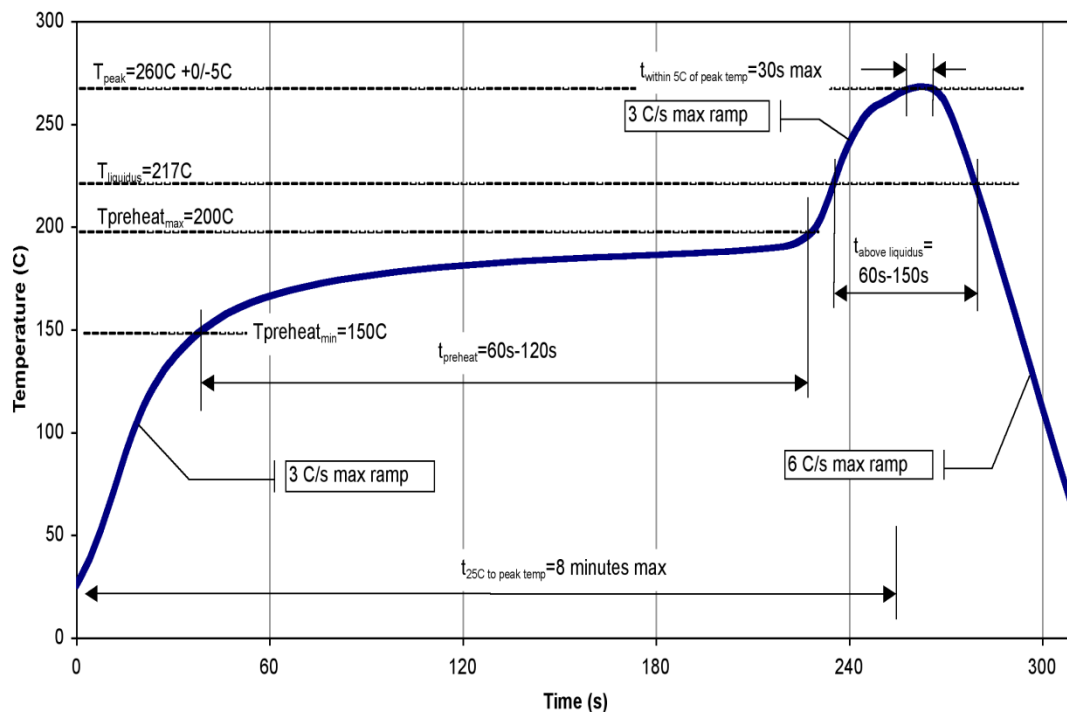
Pad No.	Label	Description
1, 2, 4–12, 14–20	NC	No connection; may be grounded if desired
3	RF Input	RF Input, matched to 50 Ohms, not DC blocked
13	RF Output	RF Output, matched to 50 Ohms, not DC blocked
21 (Slug)	GND	On PCB, multiple copper-filled vias should be employed under the center pad to minimize inductance and thermal resistance

NOTE: The RF Input and RF Output ports are not interchangeable.

Assembly Notes

1. Compatible with lead-free soldering process with 260°C peak reflow temperature.
2. The use of no-clean solder to avoid washing after soldering is recommended.
3. Contact plating: Ni-Pd-Au

Recommended Soldering Profile



Handling Precautions

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



Caution!
ESD-Sensitive Device

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 (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free

Contact Information

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

Web: www.qorvo.com

Tel: 1-844-890-8163

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Product Description

Qorvo's TGL2201 is a wideband dual stage limiter fabricated on Qorvo's proven GaAs VPIN process. Operating from 2 to 25 GHz, the TGL2201 has < 1dB of insertion loss under small signal operation and flat leakage of < 18 dBm under large signal.

The TGL2201 is suitable for a variety of wideband systems such as LNA/receiver protection in radars, phased arrays and jammers.

Lead-free and RoHS compliant.

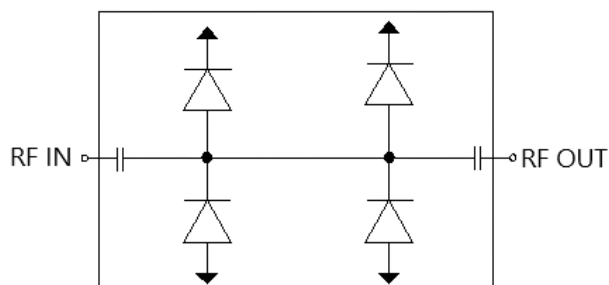


Product Features

- Frequency Range: 2 – 25 GHz
- Insertion Loss: < 1 dB
- Return Loss: > 12 dB
- Input Power CW Survivability up to 5 W
- Flat Leakage: < 18 dBm
- Passive (no DC bias required)
- Integrated DC Block on the output
- Recovery Time: < 115 nS
- Die Size: 1.1 x 1.1 x 0.1 mm

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

Functional Block Diagram



Applications

- Receive Chain Protection
- Commercial and Military Radar

Ordering Information

Part No.	Description
TGL2201	2 – 25 GHz VPIN Limiter Waffle Pack, 100 pieces

Absolute Maximum Ratings

Parameter	Rating
Incident Power, CW, 50 Ω , 25 °C	5 W
Mounting Temperature (30 seconds)	320 °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	Min	Typ	Max	Units
Operating Temperature Range	-55	+25	+85	°C
Passive – No Bias				

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

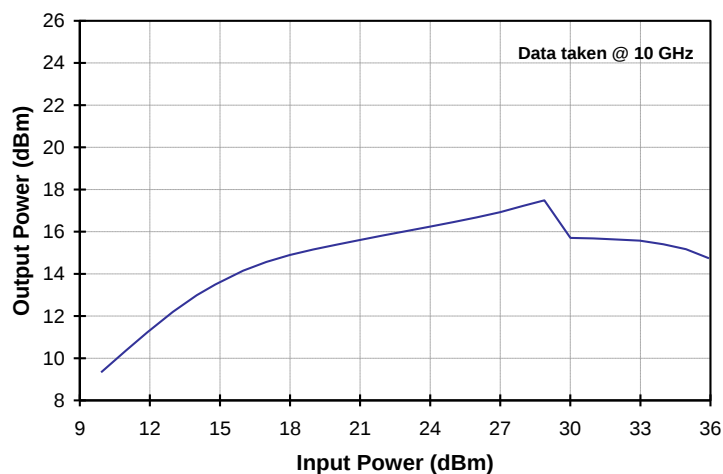
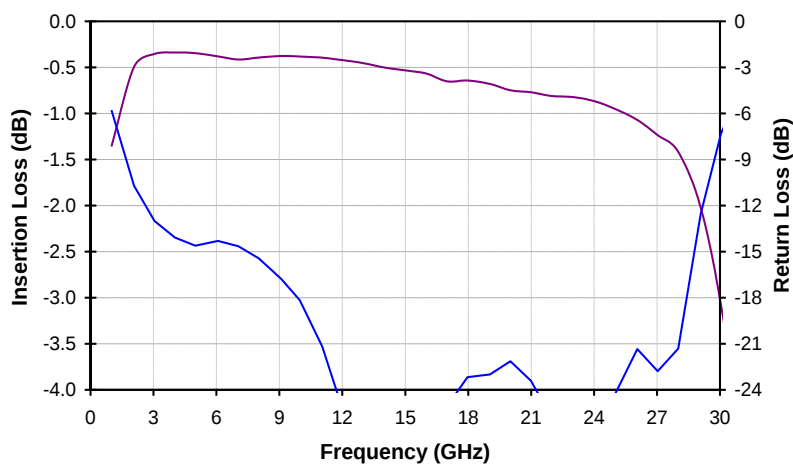
Electrical Specifications

Test conditions, unless otherwise noted: 25 °C

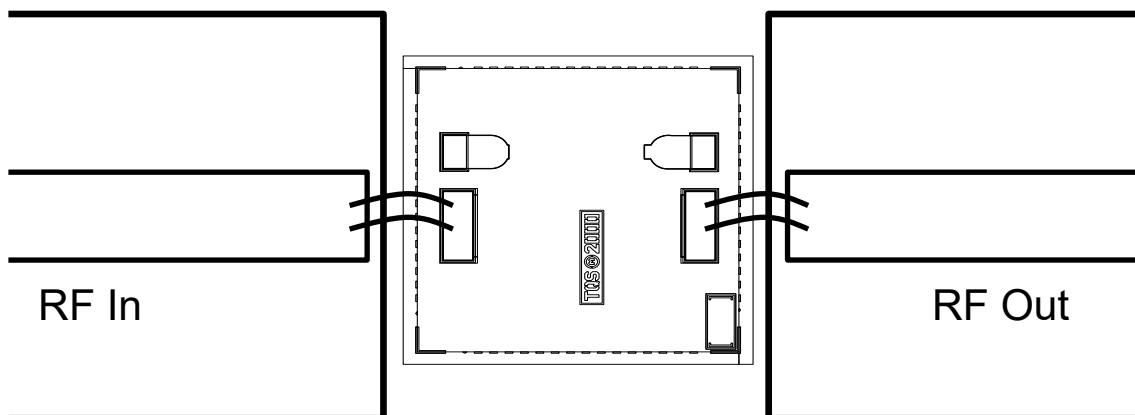
Parameter	Min	Typ.	Max	Units
Operational Frequency Range	2	–	25	GHz
Insertion Loss		< 1		dB
Input Return Loss	12	–		dB
Output Return Loss	12	–		dB
Flat Leakage Power @ $P_{IN} > 27$ dBm		< 18		dBm
Pulse Recovery Time		< 115		nS

Performance Plots

Test conditions unless otherwise noted: Temp. = 25 °C

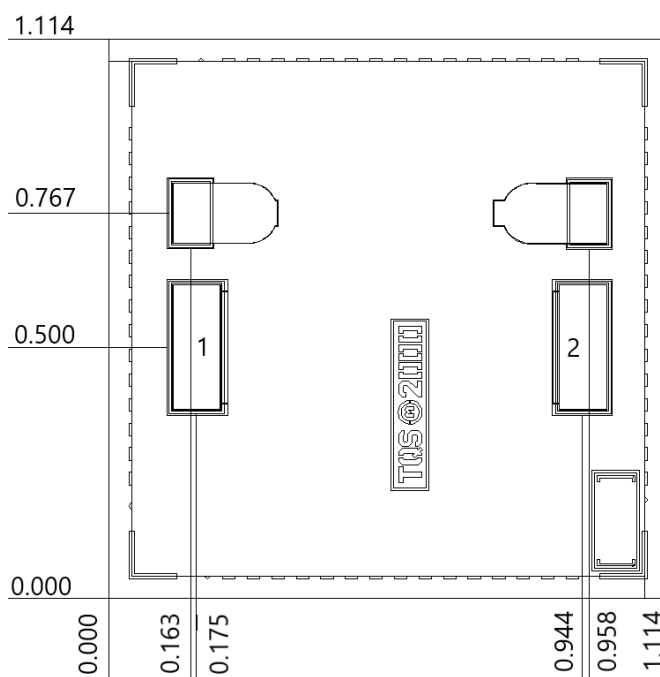


Assembly Drawing



Note: RF Input and RF Output ports are not interchangeable.

Mechanical Drawing and 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

Pad No.	Symbol	Description	Pad Size (mm x mm)
1	RF Input	RF Input, 50 Ω , DC Blocked	0.096 x 0.250
2	RF Output	RF Output, 50 Ω , DC Blocked.	0.096 x 0.250

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 are critical parameters.
- Aluminum wire should not be used.
- Devices with small pad sizes should be bonded with 0.0007-inch wire.

Handling Precautions

Parameter	Rating	Standard		Caution! ESD-Sensitive Device
ESD – Human Body Model (HBM)	Class 1B	ESDA / JEDEC JS-001		

Solderability

Use only AuSn (80/20) solder and limit exposure to temperatures above 300 °C to 3 – 4 minutes, maximum.

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 (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free

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TGL2201-SM

Wideband Dual Stage VPIN Limiter

Product Overview

Qorvo's TGL2201-SM is a packaged dual stage Limiter fabricated on Qorvo's proven GaAs VPIN process. Operating over 2 to 12 GHz, the TGL2201-SM provided the limiting action at high input signal levels and low loss at small signal.

The TGL2201-SM is suitable for a variety of wideband systems such as LNA/receiver protection in radars, phased arrays and jammers.

Lead-free and RoHS compliant.

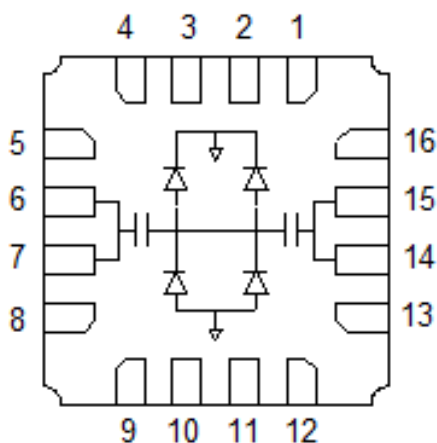


QFN 3 x 3 mm 16 L Package

Key Features

- 2 to 12 GHz Passive, High Isolation Limiter
- Insertion Loss: < 1.0 dB, X-band
- Return Loss: > 10 dB
- Input Power CW Survivability up to 5 W
- Flat Leakage: < 18 dBm
- Recovery Time: < 115 ns
- Integrated DC Block on both input and output
- Package Dimensions: 3.00 x 3.00 x 1.35 mm

Functional Block Diagram



Applications

- LNA Receive Chain Protection
- Military Radar

Ordering Information

Part	Description
TGL2201-SM	Wideband VPIN Limiter
TGL2201-SM T/R	Wideband VPIN Limiter T/R
TGL2201-SM EVAL	EVAL BOARD

Standard Order Quantity = 100 pieces in a waffle pack
Standard T/R size = 500 pieces on a 7" reel.

Absolute Maximum Ratings

Parameter	Rating
RF Input Power, CW, 50 Ω , 25 °C	37 dBm
Mounting Temperature (30 s max)	260 °C
Storage Temperature	-55 to 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 device may reduce device reliability.	

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Passive – No Bias				
Temperature Range	-40	+25	+85	°C

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

Electrical Specifications

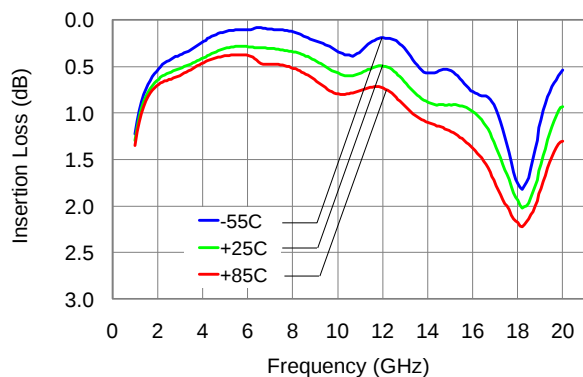
Test conditions unless otherwise noted: 25 °C

Parameter	Min	Typical	Max	Units
Operational Frequency Range	2		12	GHz
Insertion Loss		0.5	1.0	dB
Input Return Loss	10	12		dB
Output Return Loss	10	12		dB
Flat Leakage Power @ $P_{IN} > 27$ dBm		18		dBm
Recovery Time		< 115		ns

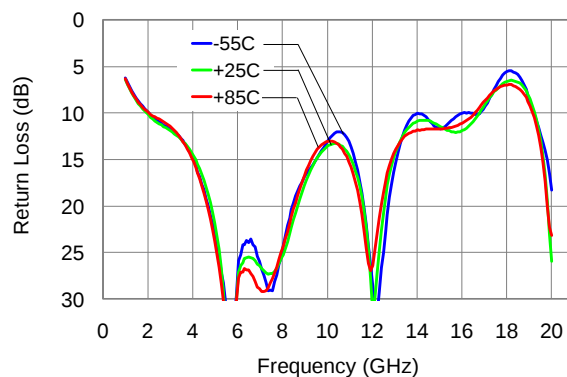
Performance Plots

Test conditions unless otherwise noted: Temp.=+25 °C

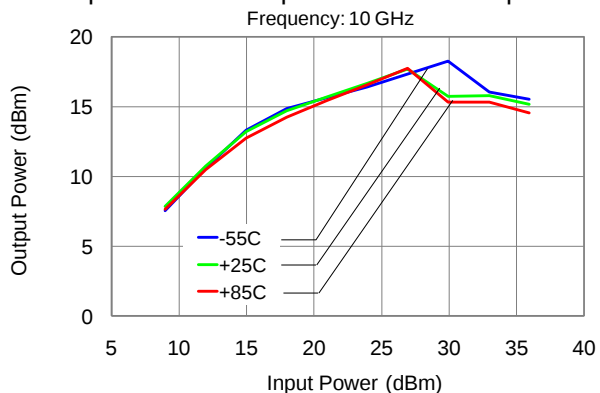
Insertion Loss vs. Frequency vs. Temperature



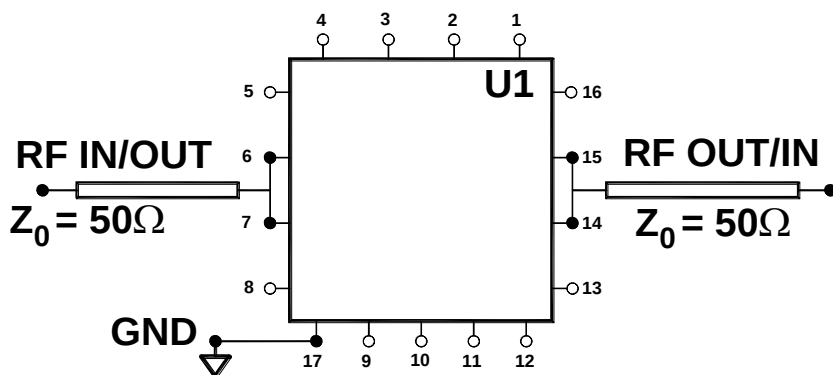
Return Loss vs. Frequency vs. Temperature



Output Power vs. Input Power vs. Temperature

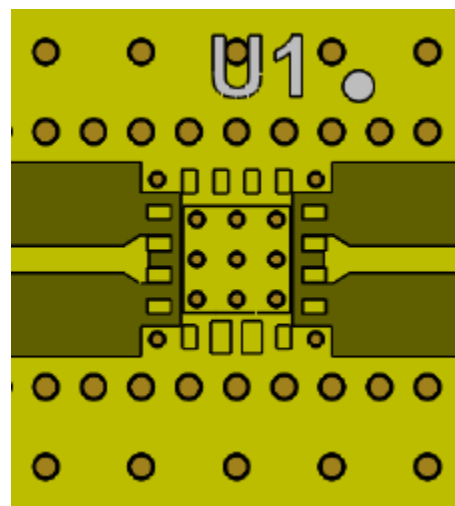
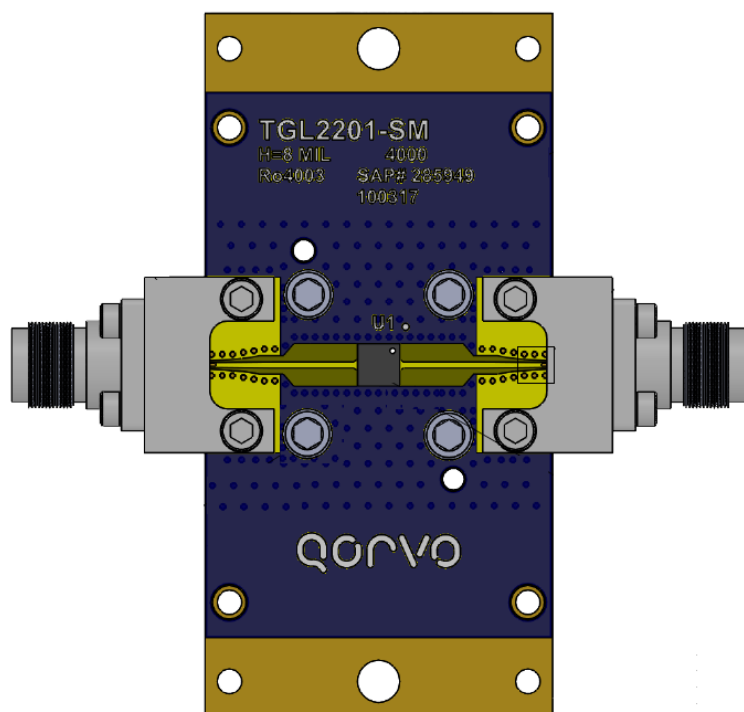


Application Circuit



Notes: A heat sink is recommended for high power operation (RF input > 1 W).

Evaluation Board (EVB) Layout & Mounting Detail

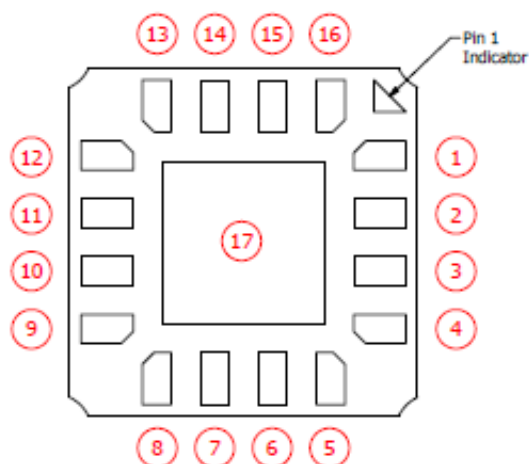


Mounting Detail

Notes:

1. Top RF layer is 0.008" thick Rogers RO4003, $\epsilon_r = 3.55$. Metal layers are 1-oz copper. Microstrip 50 Ω line width is .0174". The microstrip line tapers to a 0.014" width at the connector interface. This PCB is designed for the Southwest Microwave end launch connector 1092-01A-5.
2. 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.
3. Ground / thermal vias are critical for the proper performance of this device. Vias should use a .35mm (#80 / .0135") diameter drill and have a final plated thru diameter of 0.25 mm (.010").
4. Add as much copper as possible to inner and outer layers near the part to ensure optimal thermal performance.

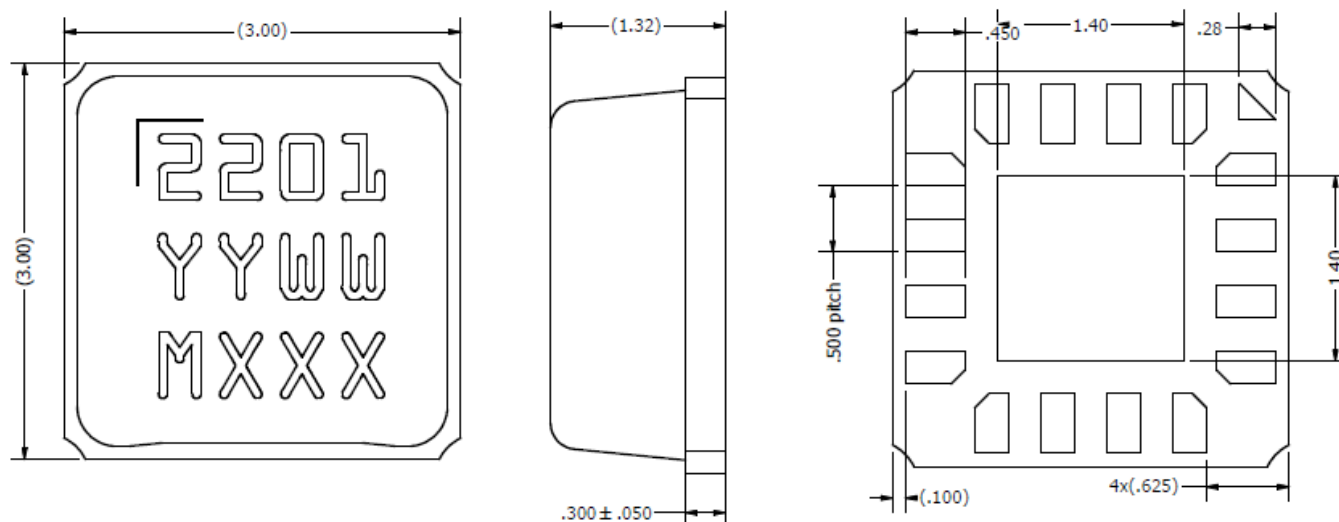
Pin Configuration and Description



Pin Description

Pin No.	Symbol	Description
1, 4, 9, 12	GND	Ground; Pins 1,4,9, and 12 connected to 17 (backside paddle) inside package.
2, 3, 5, 8, 10, 11, 13, 16	N/C	No internal connection; may be grounded or left open on PCB
6, 7	RF IN/OUT	Input or output, matched to 50 ohms
14, 15	RF OUT/IN	Output or input, matched to 50 ohms
17	GND	On PCB, multiple vias should be employed under 17 to minimize inductance and thermal resistance; see page 8 for suggested mounting configuration.

Package Marking and Dimensions



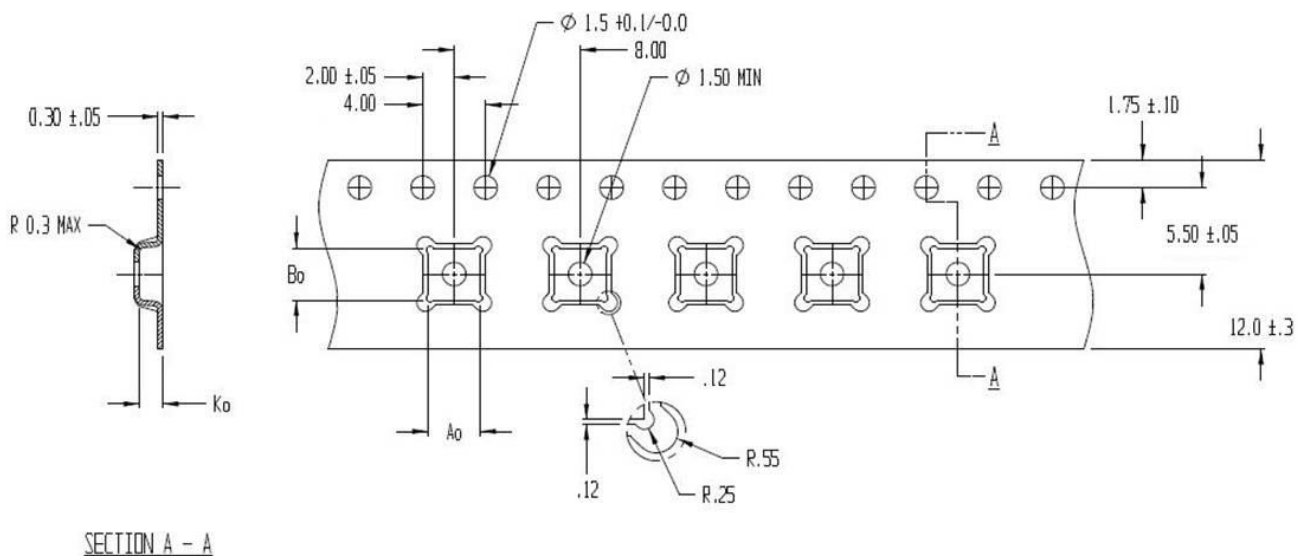
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS.
TOLERANCE IS +/- 0.075

NOTES:

1. PACKAGE BASE: ALUMINUM NITRIDE (AlN)
2. PACKAGE LID: LCD (Liquid Crystal Polymer)
3. PAD FINISH ON PACKAGE BASE:
 - Electroless Gold (Au): 0.5 – 1.5 μm OVER
 - Electroless Nickel (Ni): 2.0 μm minimum
4. PART MARKING:
 - 2201: PART NUMBER
 - YY: PART ASSY YEAR
 - WW: PART ASSY WEEK
 - MXXX: BATCH ID

Tape and Reel Information

Standard T/R size = 500 pieces on a 7" reel.

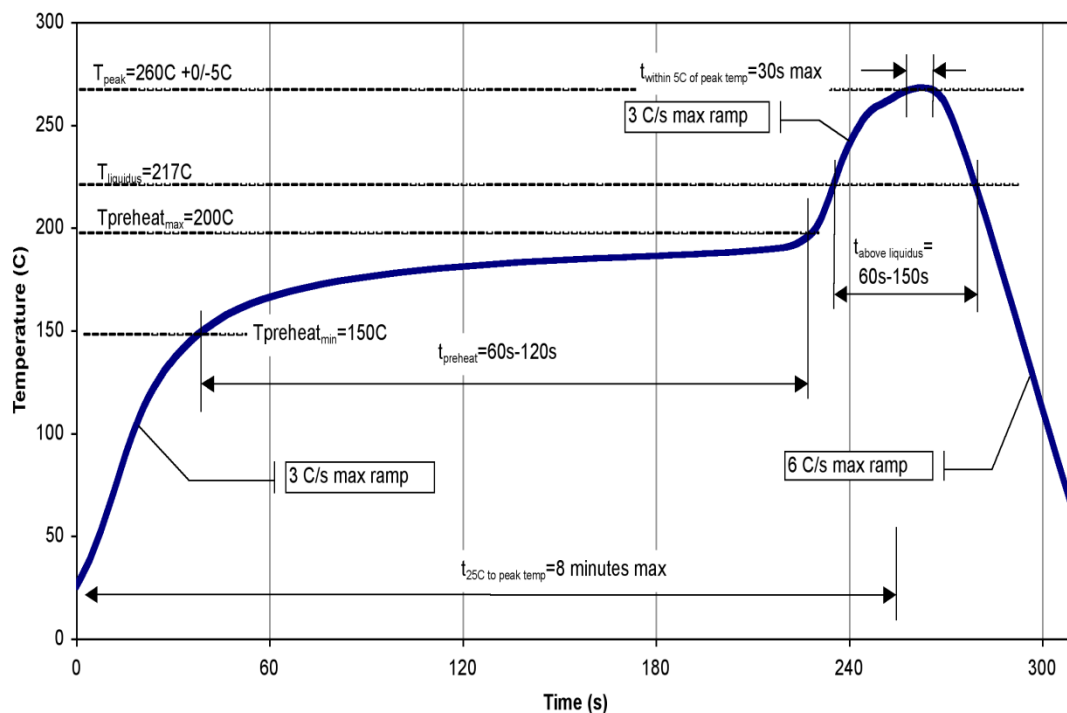


Part	Feature	Symbol	Size (in)	Size (mm)
Cavity	Length	A0	0.130	3.30
	Width	B0	0.130	3.30
	Depth	K0	0.059	1.50

Solderability

1. Compatible with the latest version of J-STD-020, Lead-free solder, 260° C.
2. The use of no-clean solder to avoid washing after soldering is recommended.
3. The package base is Aluminum Nitride (AlN) and the plating material on the leads is gold over nickel (Au-Ni).

Recommended Soldering Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1B	ESDA / JEDEC JS-001
MSL – Moisture Sensitivity Level	Level 3	IPC/JEDEC J-STD-020



Caution!
ESD-Sensitive Device

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 (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free

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Product Description

The Qorvo TGL2205 is a high power, wideband MMIC GaAs VPIN limiter capable of protecting sensitive receive channel components against high power incident signals. The TGL2205 does not require DC bias and achieves a low insertion loss all in a small form factor. These features allow for simple integration with minimal impact to system performance.

The TGL2205 operates from 1 to 6 GHz and achieves low insertion loss of 0.5 dB and return loss of 12 dB. It can limit up to 100 W incident pulsed-power with a low flat leakage of 16 dBm.

The TGL2205 has a protective surface passivation layer providing environmental robustness and is ideally suited to support both commercial and defense related applications.

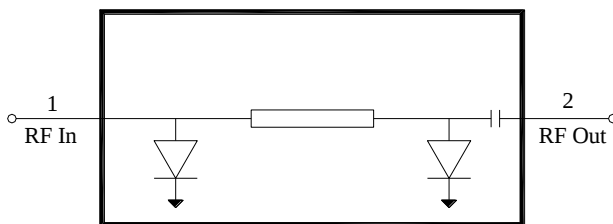


Product Features

- Frequency Range: 1 – 6 GHz
- Insertion Loss: < 0.5 dB
- Peak Power Handling: 100 W (pulsed)
- Flat Leakage: < 16 dBm
- Spike Leakage: < 17 dBm
- Passive (no DC bias required)
- Integrated DC Block on the output
- Recovery Time: < 115 nS
- Die Size: 2.00 x 2.00 x 0.10 mm

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

Block Diagram



Applications

- Receive Chain Protection
- Commercial and Military Radar

Ordering Information

Part No.	Description
TGL2205	S and C-Band 100W VPIN Limiter
TGL2205 EVB	Evaluation Board

Absolute Maximum Ratings

Parameter	Rating
Incident Power, CW or Pulsed, 50 Ω , 25 °C	100 W
Incident Power, CW or Pulsed, 50 Ω , 85 °C	50 W
Mounting Temperature (30 seconds)	320 °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	Min	Typ	Max	Units
Operating Temperature Range	-40	+25	+85	°C
Passive – No Bias				

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

Parameter	Min	Typ	Max	Units
Operational Frequency Range	1	–	6	GHz
Insertion Loss		< 0.5		dB
Input Return Loss		12		dB
Output Return Loss		12		dB
Flat Leakage Power at $P_{IN} > 30$ dBm		< 16		dBm
Pulse Recovery Time		< 115		nS
Spike Leakage		< 17		dBm
Insertion Loss Temperature Coefficient		0.003		dB/ °C

Thermal and Reliability Information

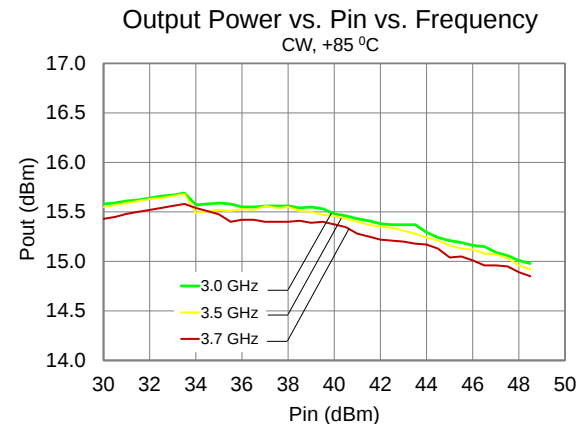
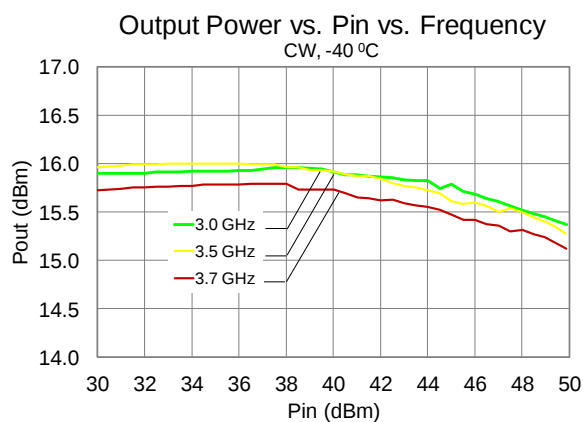
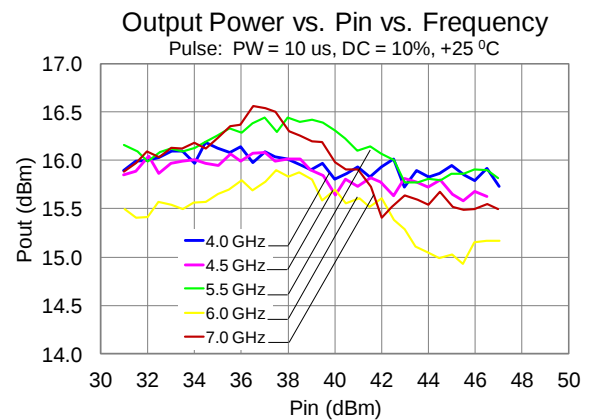
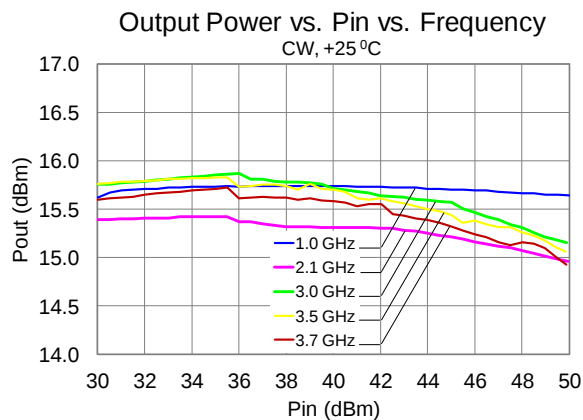
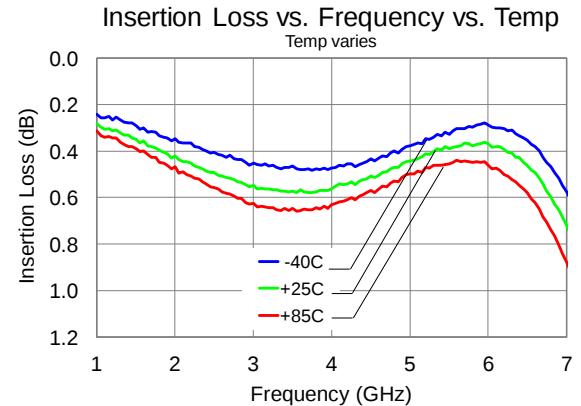
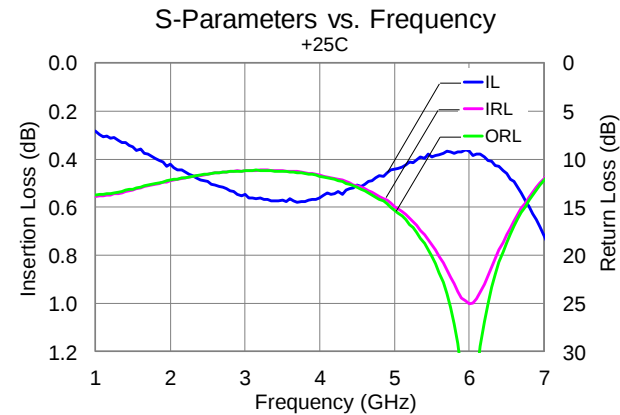
Parameter	Test Conditions	Value	Units
Incident Power (RF Operational Life Test ⁽¹⁾)	Freq. = 4.5 GHz, CW, 50 Ω , 25°C	31	W
	Freq. = 4.5 GHz, Pulsed: PW=100 μ s, DC=10%, 50 Ω , 25°C	100	

Notes:

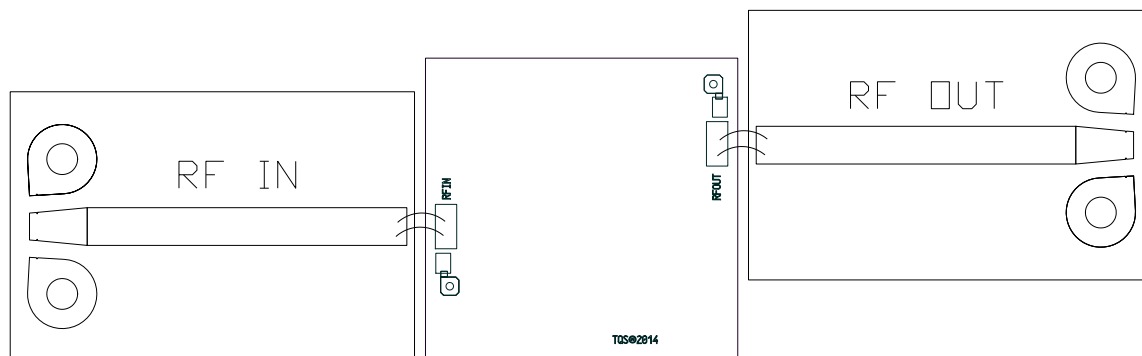
1. Test terminated after 168 hours. Insertion Loss remained ≤ 1 dB for device under test.

Performance Plots

Test conditions unless otherwise noted: Temp. = 25 °C

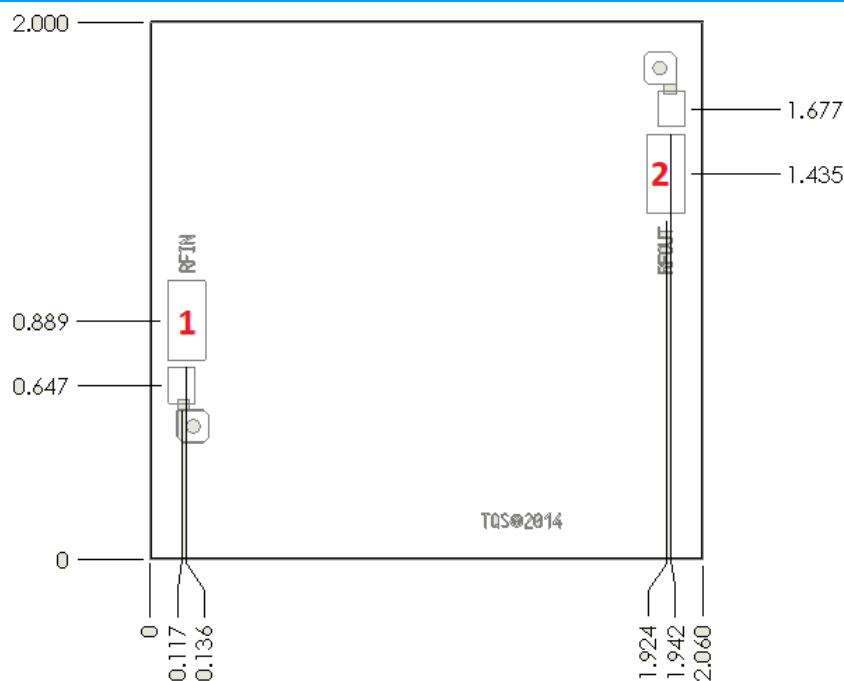


Assembly Drawing



Note: RF Input and RF Output ports are not interchangeable.

Mechanical Drawing and 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

Pad No.	Symbol	Description	Pad Size (mm x mm)
1	RF Input	RF Input, 50 Ω	0.141 x 0.293
2	RF Output	RF Output, 50 Ω , DC Blocked.	0.141 x 0.293

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 are critical parameters.
- Aluminum wire should not be used.
- Devices with small pad sizes should be bonded with 0.0007-inch wire.

Handling Precautions

Parameter	Rating	Standard		Caution! ESD-Sensitive Device
ESD – Human Body Model (HBM)	Class 2	ESDA / JEDEC JS-001-2012		

Solderability

Use only AuSn (80/20) solder and limit exposure to temperatures above 300 °C to 3 – 4 minutes, maximum.

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 (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free

Contact Information

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

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TGL2205-SM

2–6 GHz 100 Watt VPIN Limiter

Product Overview

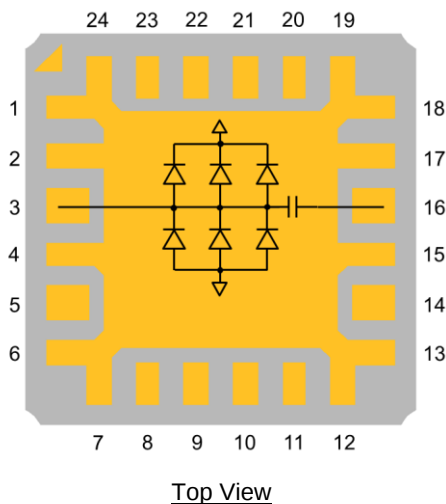
The Qorvo TGL2205-SM is a high power, wideband GaAs VPIN limiter capable of protecting sensitive receive channel components against high power incident signals. The TGL2205-SM does not require DC bias, and achieves a low insertion loss all in a small form factor. These features allow for simple integration with minimal impact to system performance.

The TGL2205-SM operates from 2–6 GHz with low insertion loss of less than 0.6 dB. It can limit up to 100 W incident pulsed-power with a low flat leakage of less than 16.5 dBm.

The TGL2205-SM is offered as a packaged limiter, and is well suited for both commercial and defense related applications.

Lead-free and RoHS compliant.

Functional Block Diagram



24 Pad 4 x 4 mm Air Cavity QFN Package

Key Features

- Frequency Range: 2 to 6 GHz
- Insertion Loss: < 0.6 dB
- Peak Power Handling: 100 W
- Flat Leakage: < 16.5 dBm
- Spike Leakage < 17 dBm
- Passive (no DC bias required)
- Integrated DC Blocks on the output
- Recovery time < 115 ns
- Package Dimensions: 4.00 x 4.00 x 1.47 mm

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

Applications

- Receive Chain Protection
- Commercial and Military Radar

Ordering Information

Part	Description
1095765	2-6 GHz 100W VPIN Limiter
1095768	TGL2205-SM, EVAL BOARD
TGL2205-SMTR7	250 Piece 7" Reel

Absolute Maximum Ratings

Parameter	Rating
Incident Power, CW or Pulsed, 50 Ω , 25 °C	100 W
Incident Power, CW or Pulsed, 50 Ω , 85 °C	50 W
Mounting Temperature (30 s max)	260 °C
Storage Temperature	-40 to 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
Passive – No Bias				
Operating Temperature Range	-40	+25	+85	°C

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

Electrical Specifications

Parameter	Conditions ⁽¹⁾	Min	Typ.	Max	Units
Operational Frequency Range		2		6	GHz
Insertion Loss			< 0.6		dB
Input Return Loss			12		dB
Output Return Loss			12		dB
Flat Leakage Power at $P_{IN} > 30$ dBm			< 16.5		dBm
Pulse Recovery Time			< 115		ns
Spike Leakage			< 17		dBm
Insertion Loss Temperature Coefficient			0.003		dB/ °C

Notes:

1. Test conditions unless otherwise noted: Temp = +25 °C, Tuned EVB Results.

Thermal and Reliability Information

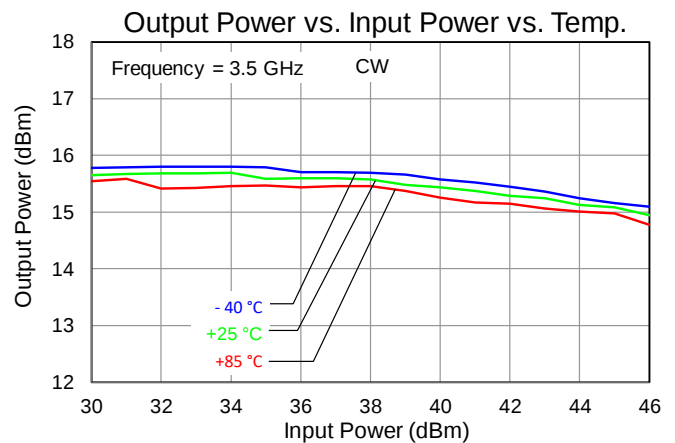
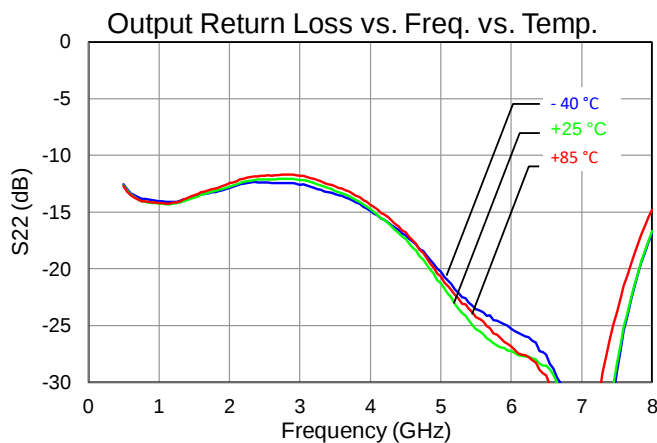
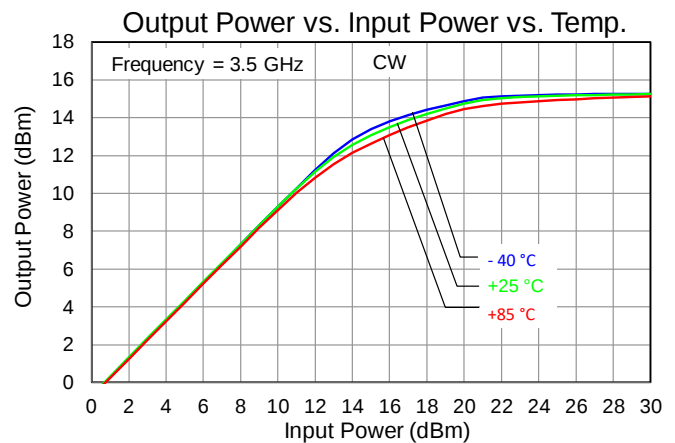
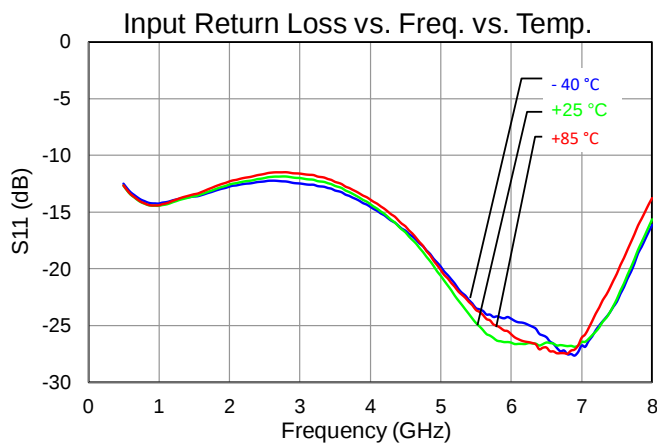
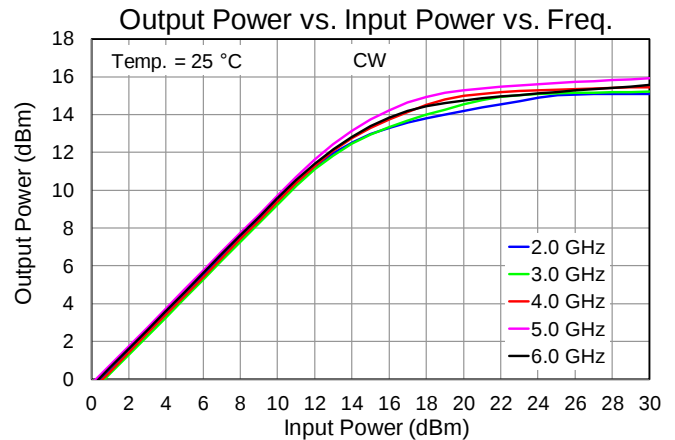
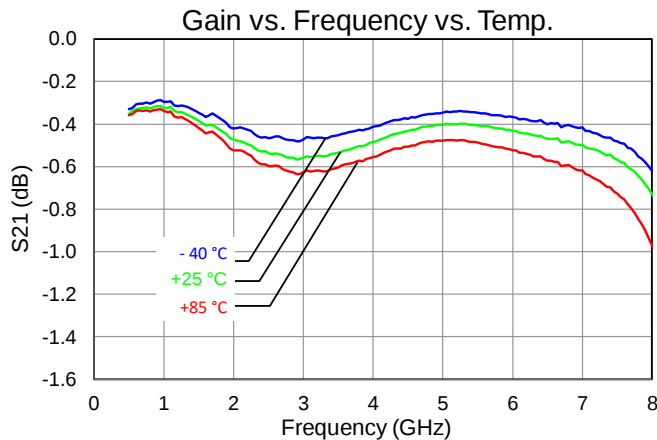
Parameter	Test Conditions	Value	Units
Incident Power (RF Operational Life Test ⁽¹⁾)	4.5 GHz, CW, 50 Ω , 25 °C	31	W
	4.5 GHz, Pulsed, PW=10 μ s, DC=10%, 50 Ω , 25 °C	100	W

Notes:

1. Test terminated after 168 hours. Insertion Loss remained ≤ 1 dB for device under test.

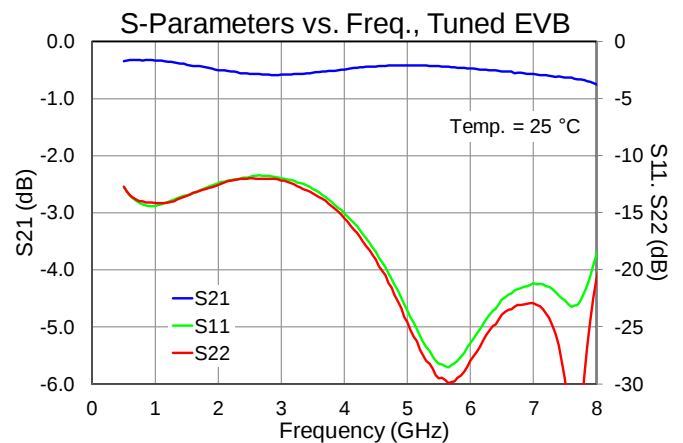
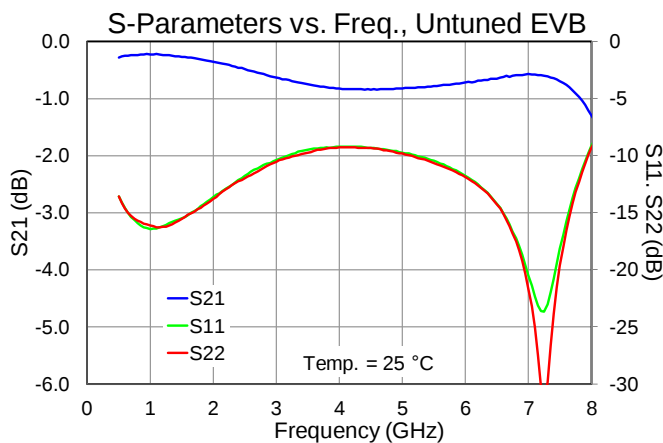
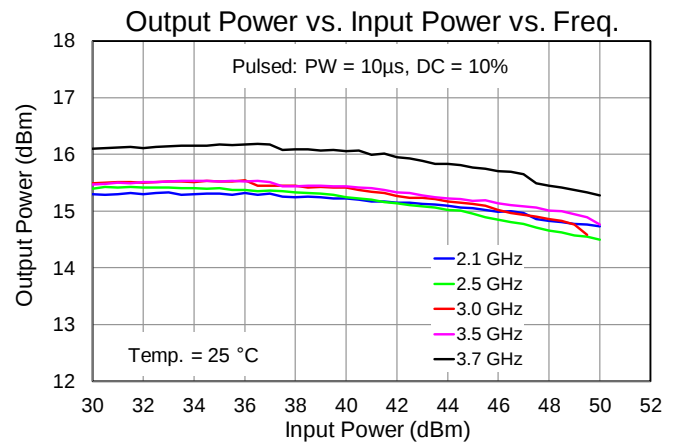
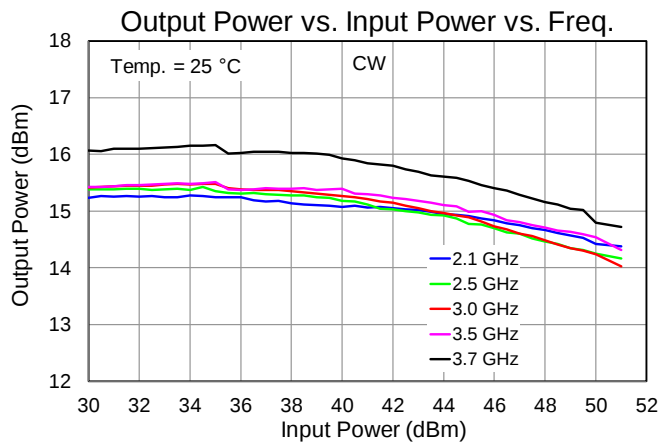
Performance Plots – Small & Large Signal

Test conditions unless otherwise noted: CW Power, Temp.=+25 °C, Tuned EVB Performance

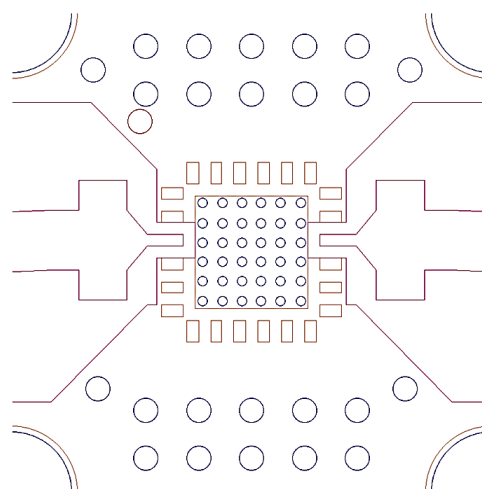
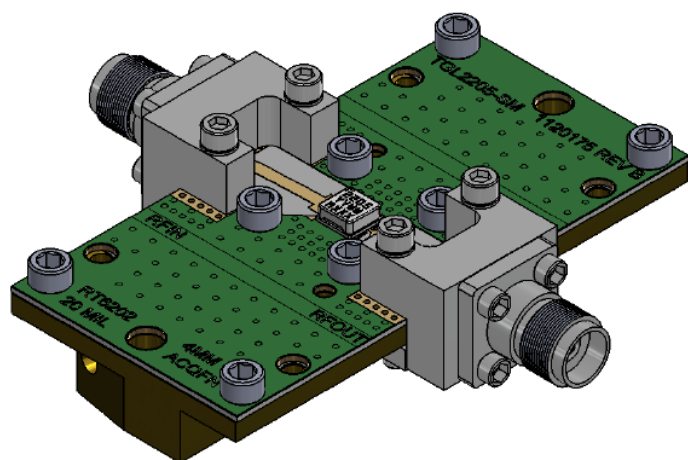


Performance Plots – Small & Large Signal

Test conditions unless otherwise noted: CW power, Temp.=+25 °C, Tuned EVB Performance



Evaluation Board (EVB) & Mounting Detail

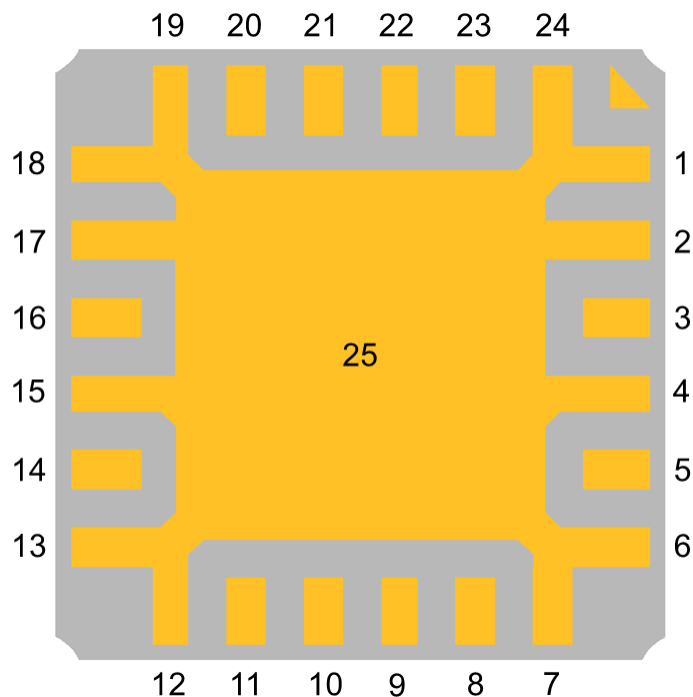


Mounting Detail

Notes:

1. RF layer is 0.020" thick Rogers RO6202, $\epsilon_r = 2.94$. Metal layers are 1-oz copper. Microstrip 50 Ω line width is 0.050". The microstrip line taper at the connector interface is optimized for the Southwest Microwave end-launch connector 1092-02A-5.
2. 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.
3. Ground / thermal vias under the DUT are critical for the proper performance of this device.
4. The EVB shown herein utilizes copper filled vias (8 mil diameter) under the DUT to maximize heat transfer away from the DUT under large signal conditions.
5. Thermal dissipation is low for normal non-limiting operation.

Pad Configuration and Description

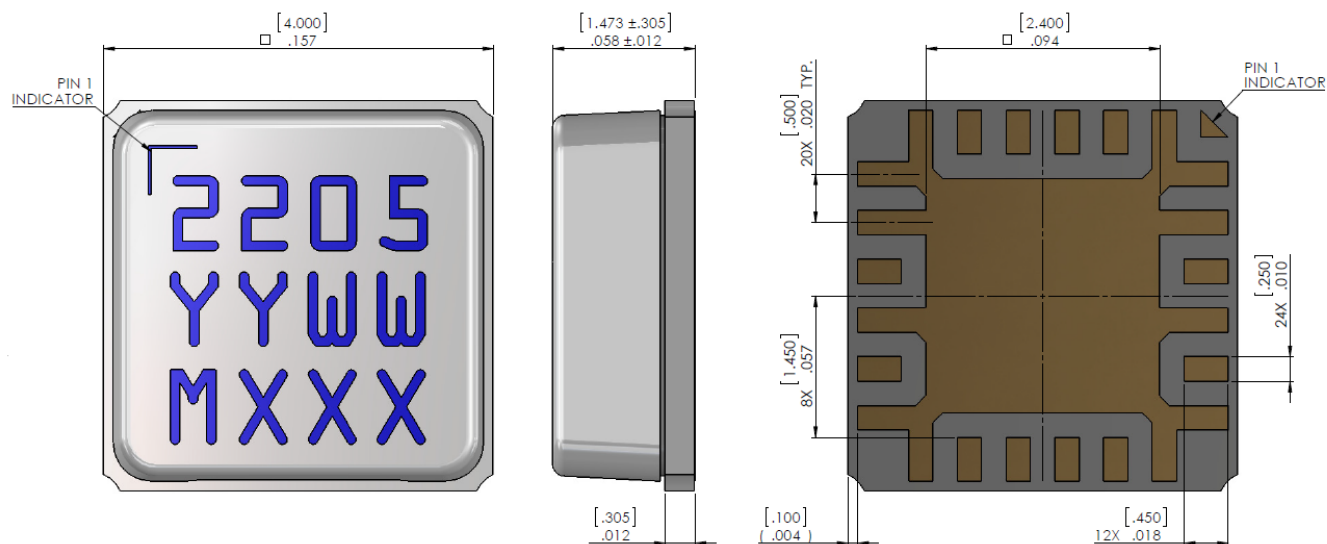


Bottom View

Pad No.	Label	Description
1,2,4,6,7,12,13,15,17-19,24,25	GND	On PCB, multiple copper-filled vias should be employed under the center pad to minimize inductance and thermal resistance. See page 5 for suggested mounting configuration
3	RF Input	RF Input, matched to 50 Ohms, not DC blocked
5,8-11,14,20-23	NC	No connection; may be grounded if desired
16	RF Output	RF Output, matched to 50 Ohms, DC blocked

NOTE: The RF Input and RF Output ports are not interchangeable.

Mechanical Information & Package Marking



NOTES:

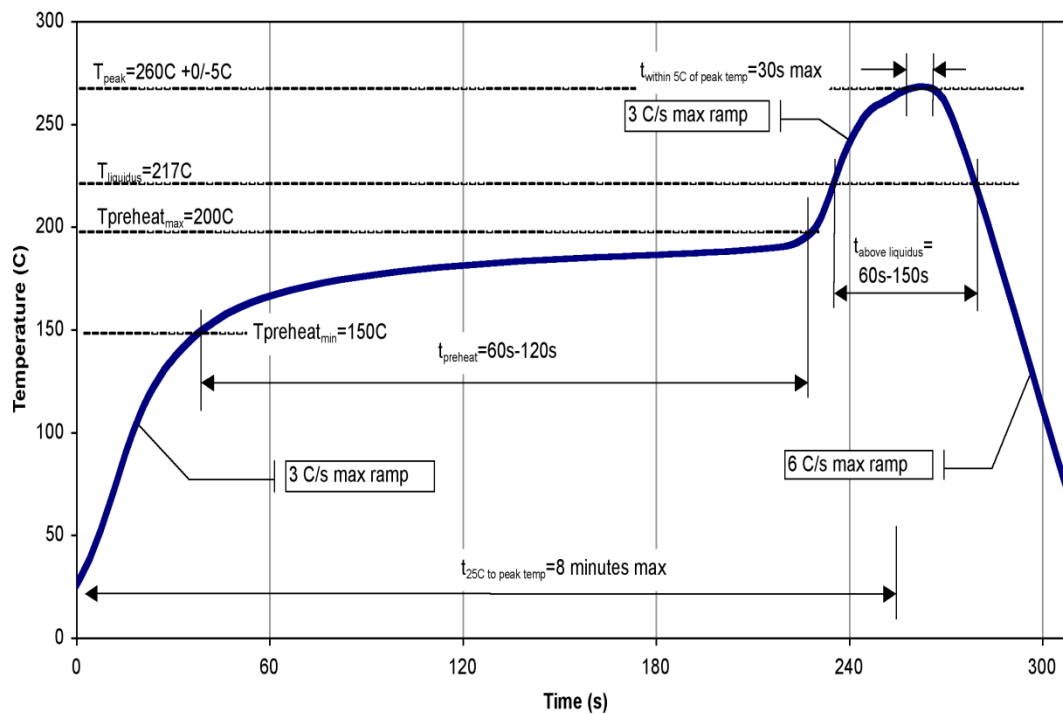
1. MATERIAL:
 - PACKAGE BASE: CERAMIC
 - PACKAGE LID: PLASTIC
 - ALL METALIZED FEATURES ARE GOLD PLATED.
 - PART IS EPOXY SEALED.
2. PART MARKING:
 - 2205 - PART NUMBER
 - YY - PART NUMBER YEAR
 - WW - PART ASSEMBLY WEEK
 - MXXX - BATCH ID

Dimensions are in millimeter. Tolerances are +/- 0.127 mm

Assembly Notes

- Compatible with lead-free soldering process with 260°C peak reflow temperature.
- This package is non-hermetic, and therefore cannot be subjected to aqueous washing. The use of no-clean solder to avoid washing after soldering is recommended
- Solder rework not recommended.
- Contact plating: Ni-Au

Recommended Soldering Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 2	ESDA / JEDEC JS-001-2012
ESD – Charged Device Model (CDM)	Class C3	JEDEC JESD22-C101
MSL – Moisture Sensitivity Level	Level 3	IPC/JEDEC J-STD-020



Caution!
ESD-Sensitive Device

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 (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free



Contact Information

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Email: customer.support@qorvo.com

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Product Overview

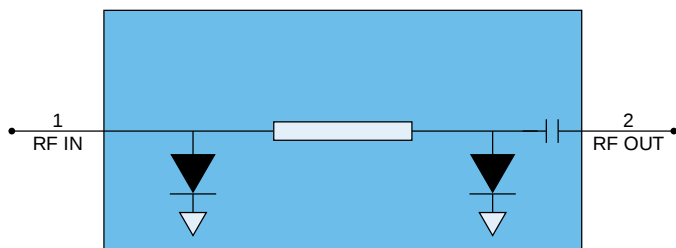
The Qorvo TGL2206 is a high power, wideband MMIC GaAs VPIN limiter capable of protecting sensitive receive channel components against high power incident signals. The TGL2206 does not require DC bias and achieves a low insertion loss all in a small form factor. These features allow for simple integration with minimal impact to system performance.

The TGL2206 operates from 2 to 4.5 GHz and achieves low insertion loss of 0.5 dB and return loss of 15 dB. It can limit up to 100 W incident pulsed-power with a low flat leakage of 15 dBm.

The TGL2206 has a protective surface passivation layer providing environmental robustness and is ideally suited to support both commercial and defense related applications.

Lead-free and RoHS compliant.

Functional Block Diagram



Key Features

- Frequency Range: 2–4.5 GHz
- Insertion Loss: <0.5 dB
- Peak Power Handling: 100 W (pulsed)
- Flat Leakage: ≤ 15 dBm
- Return Loss: 15 dB
- Recovery Time: < 115 ns
- Passive (no DC bias required)
- Integrated DC Block on output
- Chip Dimensions: 2.2 x 2.5 x 0.1 mm

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

Applications

- Receive Chain Protection
- Commercial and Military Radar

Ordering Information

Part No.	Description
TGL2206	S-Band 100 W VPIN Limiter

Absolute Maximum Ratings

Parameter	Value
Incident Power, CW or Pulsed, 50 Ω , 25 °C	100 W
Incident Power, CW or Pulsed, 50 Ω , 85 °C	70 W
Mounting Temperature (30 Seconds)	320 °C
Storage Temperature	-40 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	Min	Typ.	Max	Units
Passive – no bias				
Temperature Range	-40	+25	+85	°C

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

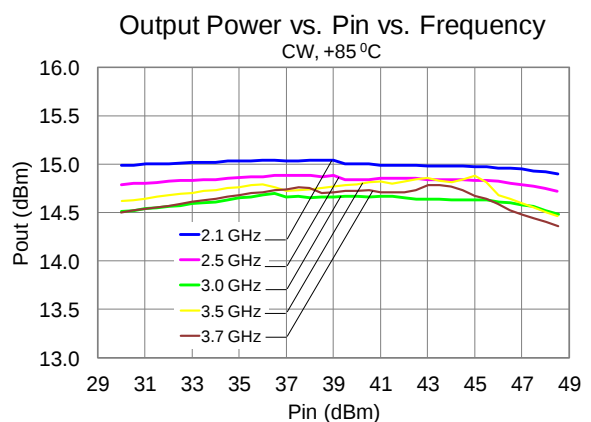
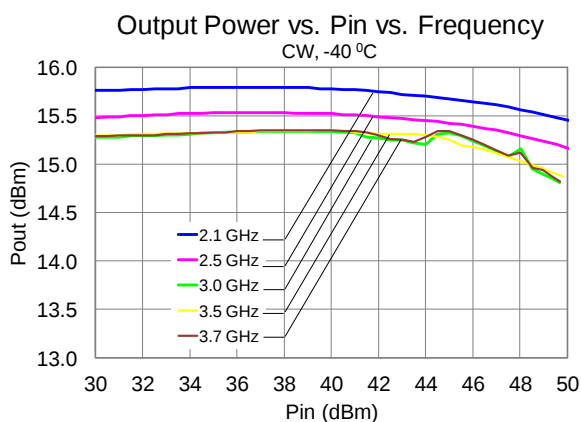
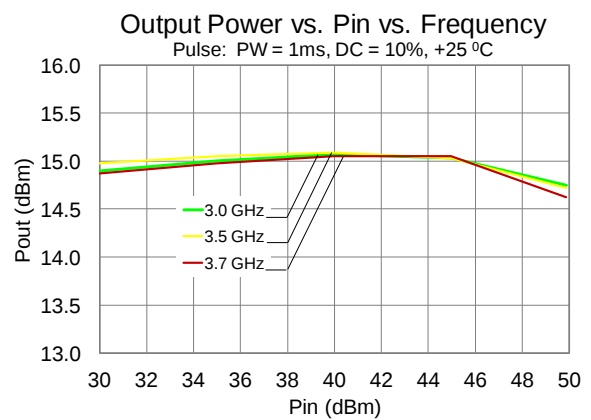
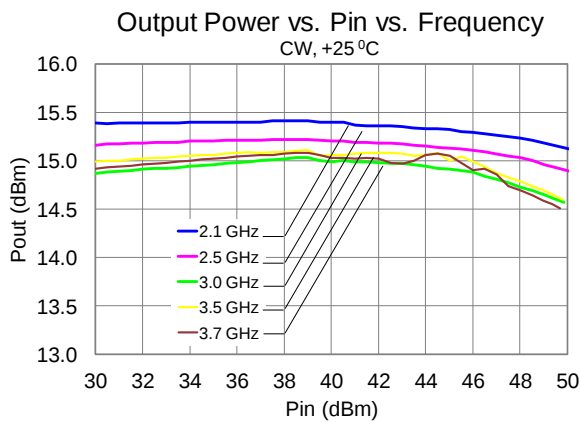
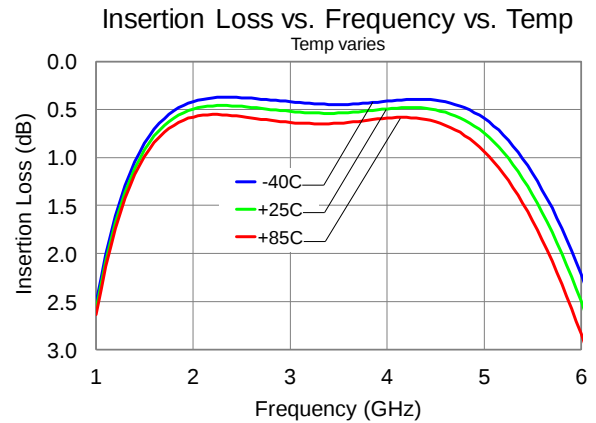
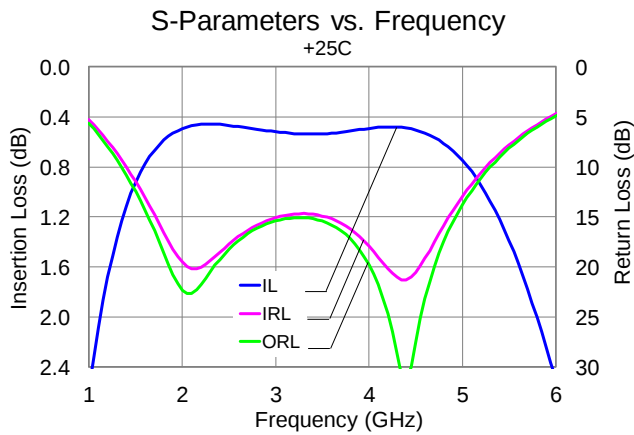
Parameter	Min	Typical	Max	Units
Operational Frequency Range	2		4.5	GHz
Insertion Loss		< 0.5		dB
Input Return Loss		15		dB
Output Return Loss		15		dB
Flat Leakage Power @ Pin >30 dBm		≤ 15		dBm
Insertion Loss Temperature Coefficient		0.003		dB/°C

Thermal and Reliability Information

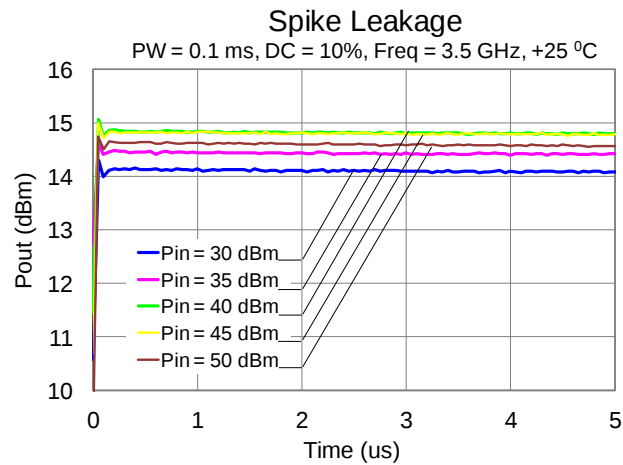
Parameter	Test Conditions	Value	Units
Incident Power – 168 hr RF Operational Life Test*	Frequency = 4.5 GHz, CW, 50 Ω , 25 °C	50	W
	Frequency = 4.5 GHz, Pulsed, PW = 10 μ s, DC = 10%, 50 Ω , 25 °C	100	W

*Test was terminated at 168 Hrs. Insertion Loss remained ≤ 1 dB for device under test.

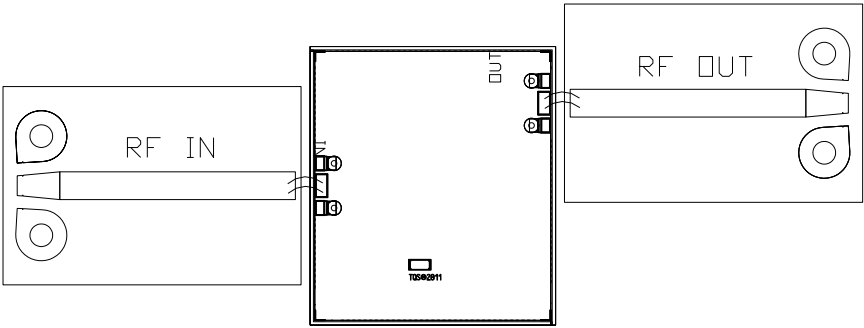
Typical Performance



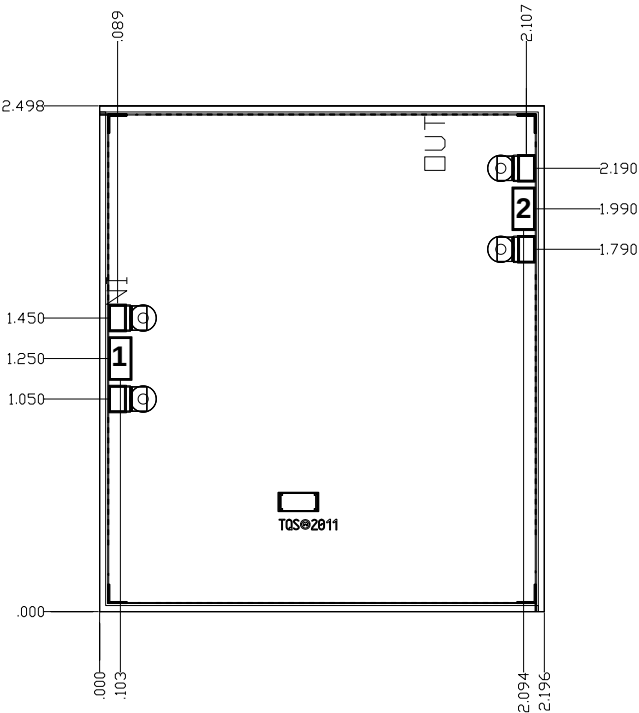
Typical Performance



Assembly Drawing



Mechanical Drawing



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

Pad Number	Symbol	Description	Pad Size
1	RF In	Input; matched to 50 Ω .	0.100 x 0.200
2	RF Out	Output; matched to 50 Ω .	0.100 x 0.200

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.
- Curing should be done in a convection oven; proper exhaust is a safety concern.

Solder attachments 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.

Organic adhesive attachment assembly notes:

- The organics such as epoxy or polyimide can be used.
- Epoxies cure at temperatures of 100 °C to 200 °C.

Interconnect process assembly notes:

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

Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1B	ESDA/JEDEC JS-001



Caution!

ESD-Sensitive Device

Solderability

Use only AuSn (80/20) solder, and limit exposure to temperatures above 300 °C to 3–4 minutes, maximum.

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 (C15H12Br4O2) Free
- PFOS Free
- SVHC Free

Contact Information

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

Web: www.qorvo.com

Tel: 1-844-890-8163

Email: customer.support@qorvo.com

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TGL2206-SM

2.0 – 5.5 GHz 100 Watt VPIN Limiter

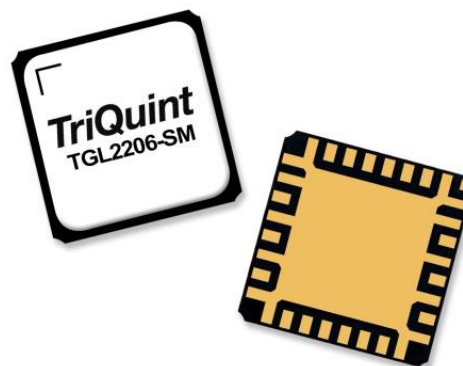
Product Overview

The Qorvo TGL2206-SM is a high power, wideband GaAs VPIN limiter capable of protecting sensitive receive channel components against high power incident signals. The TGL2206-SM does not require DC bias and achieves a low insertion loss all in a small form factor. These features allow for simple integration with minimal impact to system performance.

The TGL2206-SM operates from 2.0 to 5.5 GHz with low insertion loss of less than 1.0 dB. It can limit up to 100 W incident pulsed power with a low flat leakage of less than 15.5 dBm.

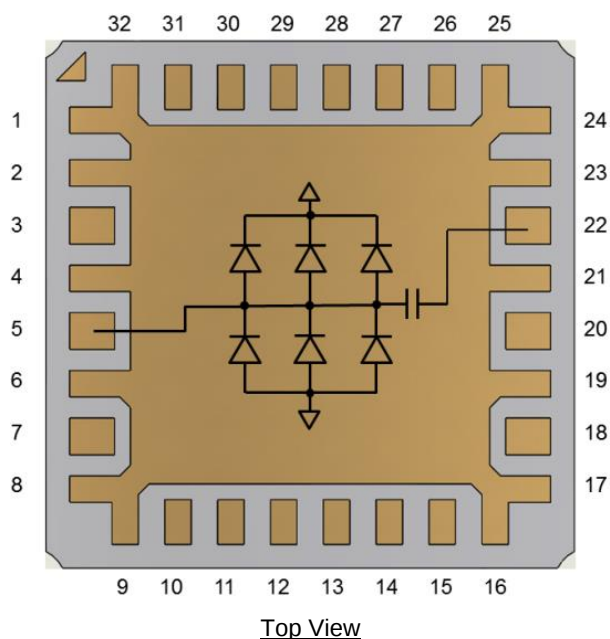
The TGL2206-SM is offered in a 5x5 mm air-cavity QFN packaged limiter comprised of an aluminum-nitride base with a plastic epoxy-sealed lid. It is well suited for both commercial and defense related applications.

Lead-free and RoHS compliant.



5 mm x 5 mm Air Cavity QFN Package

Functional Block Diagram



Key Features

- Frequency Range: 2.0 to 5.5 GHz
- Insertion Loss: < 1.0 dB
- Peak Power Handling: 100 W (pulsed)
- Flat Leakage: < 15.5 dBm
- Passive (no DC bias required)
- Integrated DC Block on Output
- Spike Leakage < 16 dBm
- Recovery Time < 115 ns
- Package Dimensions: 5.0 x 5.0 x 1.45 mm

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

Applications

- Receive Chain Protection
- Commercial and Military Radar

Ordering Information

Part	Description
TGL2206-SM	2.0 to 5.5 GHz 100W VPIN Limiter
TGL2206-SMEVB-01	2.0 to 5.5 GHz 100W VPIN Limiter EVB

Absolute Maximum Ratings

Parameter	Rating
Incident Power, CW or Pulsed, 50 Ω , 25 °C	100 W
Incident Power, CW or Pulsed, 50 Ω , 85 °C	70 W
Mounting Temperature (30 seconds max)	260 °C
Storage Temperature	-40 to 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
Passive – No Bias				
Operating Temperature Range	-40	+25	+85	°C

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

Electrical Specifications

Parameter	Min	Typical	Max	Units
Operational Frequency Range	2		5.5	GHz
Insertion Loss		< 1.0		dB
Input Return Loss		15		dB
Output Return Loss		15		dB
Flat Leakage Power at $P_{IN} > 30$ dBm		< 15		dBm
Pulse Recovery Time		< 115		ns
Spike Leakage		< 16		dBm
Insertion Loss Temperature Coefficient		0.003		dB / °C

Notes: Test conditions unless otherwise noted: Temp = +25 °C, Tuned EVB Results.

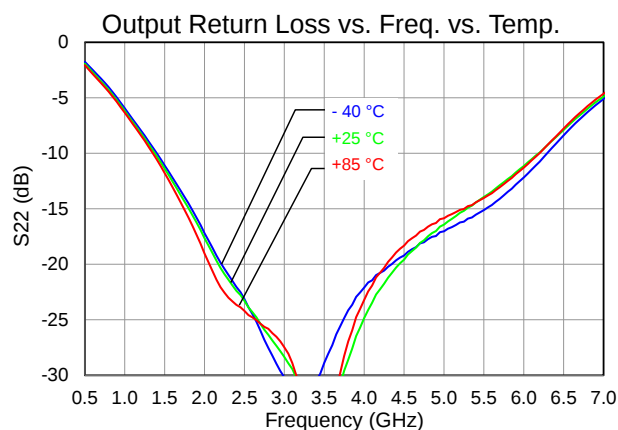
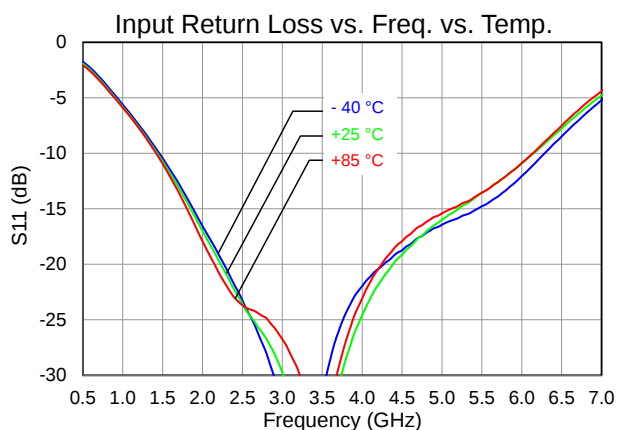
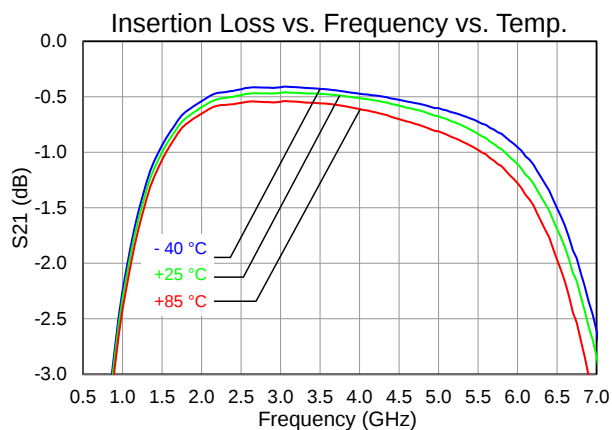
Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Incident Power (168 Hours RF Operational Life Test ⁽¹⁾)	Frequency = 4.5 GHz RF CW, 50 Ω , 25 °C	50	W
	Frequency = 4.5 GHz RF Pulsed, PW=10 μ s, DC=10%, 50 Ω , 25 °C	100	W

Notes: (1) Test terminated after 168 hours. Insertion Loss remained ≤ 1 dB for device under test.

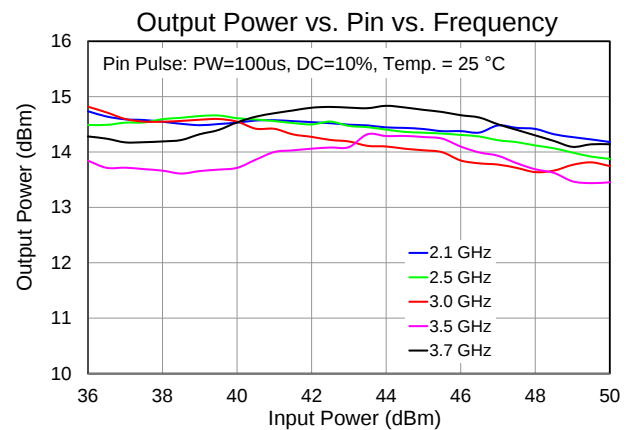
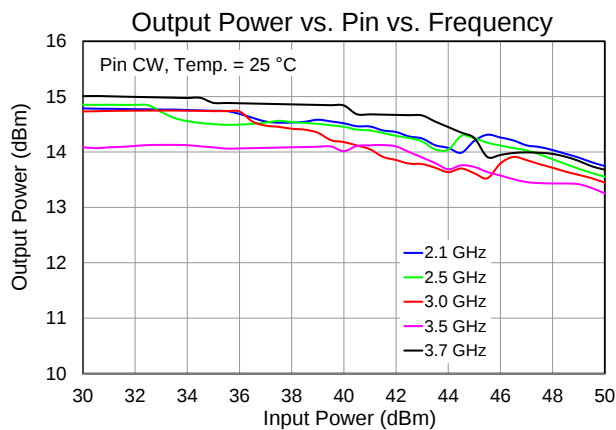
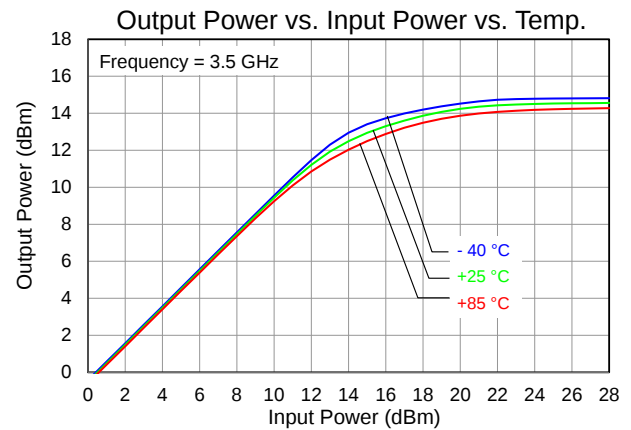
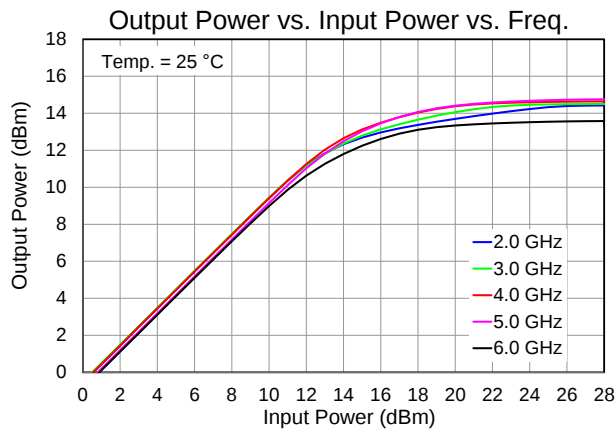
Performance Plots – Small Signal

Test conditions unless otherwise noted: Temp.=+25 °C, Tuned EVB Performance

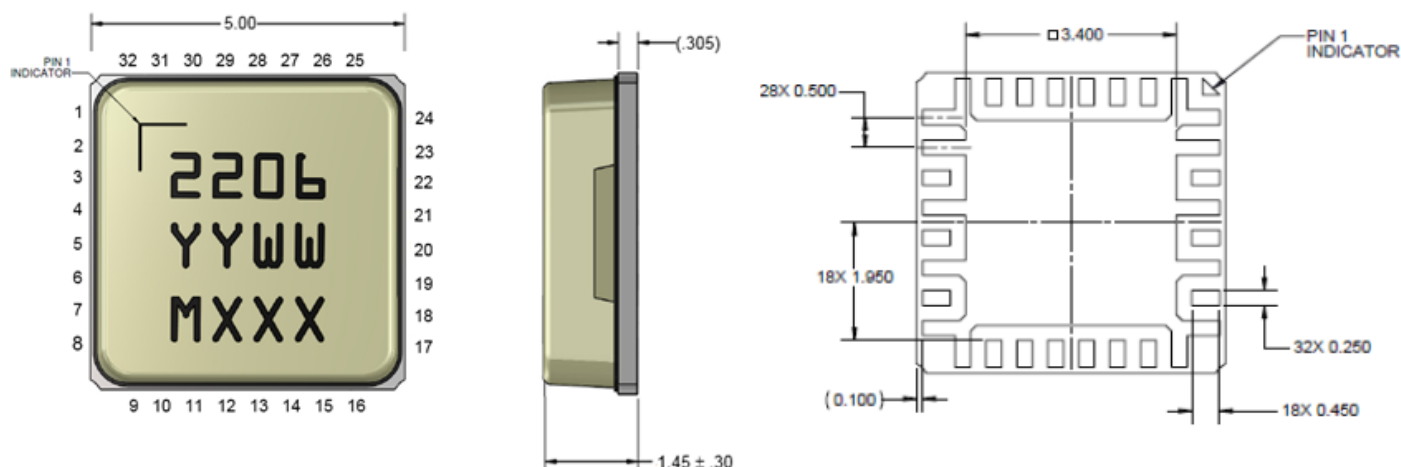


Performance Plots –Large Signal

Test conditions unless otherwise noted: CW input power, Temp.=+25 °C, Tuned EVB Performance



Mechanical Drawing and Pad Configuration



The TGL2206-SM will be marked with the “YYMM” designator and a lot code marked below the part designator. The “YY” represents the last two digits of the year the part was manufactured, the “WW” is the work week, and the “MXXX” is the batch ID.

The package base is ceramic and the plating material on the leads is gold over nickel (Au-Ni), the lid is plastic, the part is epoxy sealed.

Dimensions Units: mm. Tolerance unless specified: .xx = +/- 0.25, .xxx = +/- 0.127

Pad No.	Label	Description
1,2,4,6,8,9,16,17,19,21,23, 24, 25, 32	GND	On PCB, multiple copper-filled vias should be employed under the center pad to minimize inductance and thermal resistance. See page 6 for suggested mounting configuration
5	RF Input	RF Input, matched to 50 Ohms, not DC blocked
22	RF Output	RF Output, matched to 50 Ohms, DC blocked
3,7,10-15,18,20, 26-31	NC	No connection, may be grounded if desired

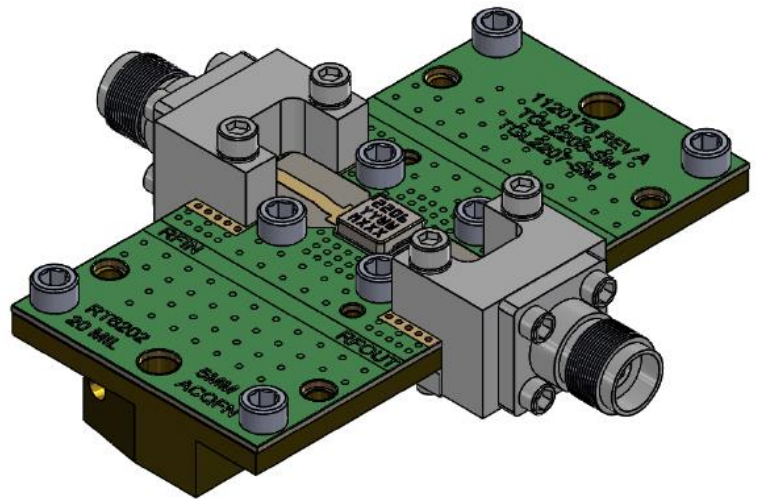
NOTE: The RF Input and RF Output ports are not interchangeable.

EVB and Device Mounting Details

EVB Descriptions

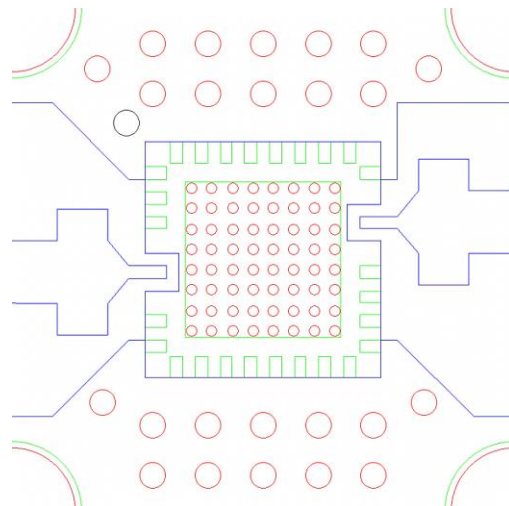
EVB PCB is 0.020" thick Rogers RO6202, $\epsilon_r = 2.94$. Metal layers are 1-oz copper. Microstrip 50 Ω line width is 0.050". The microstrip line taper at the connector interface is optimized for the Southwest Microwave end-launch connector 1092-02A-5.

The pad pattern shown has been developed and tested for optimized assembly at Qorvo Inc. 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.



Device Mounting Details

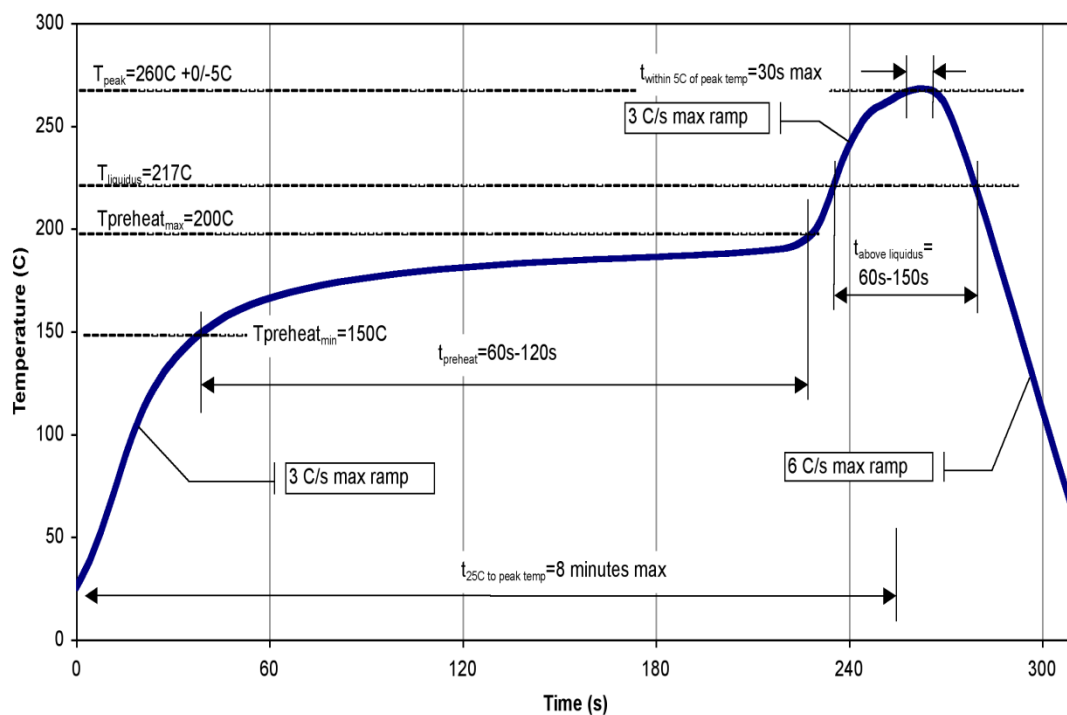
1. Ground / thermal vias under the device are critical for the proper performance of this device.
2. The EVB shown herein utilizes copper filled vias (8 mil diameter) under the device to maximize heat transfer away from the device under large signal conditions.
3. Thermal dissipation is low for normal non-limiting operation.



Assembly Notes

- Compatible with lead-free soldering process with 260°C peak reflow temperature.
- This package is non-hermetic, and therefore cannot be subjected to aqueous washing. The use of no-clean solder to avoid washing after soldering is recommended
- Solder rework not recommended.
- Contact plating: Ni-Au

Recommended Soldering Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1B	ESDA / JEDEC JS-001-2012
ESD – Charged Device Model (CDM)	Class C3	JEDEC JESD22-C101
MSL – Moisture Sensitivity Level	Level 3	IPC/JEDEC J-STD-020



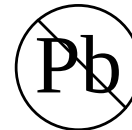
Caution!
ESD-Sensitive Device

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 (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free



Contact Information

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TGL2208-SM

2 - 20 GHz Dual Stage VPIN Limiter

Product Overview

Qorvo's TGL2208-SM is a packaged dual stage Limiter fabricated on Qorvo's proven GaAs VPIN process. Operating over 2 to 20 GHz, the TGL2208-SM has < 1dB of insertion loss under small signal operation and flat leakage of < 18 dBm under large signal input.

The TGL2208-SM is suitable for a variety of systems that require input protection for sensitive receive channel components.

The TGL2208-SM is available in a low-cost, surface mount 14 lead 3 x 3 AIN QFN package comprised of a ceramic base with a plastic epoxy-sealed lid. TGL2208-SM is ideally suited to support both commercial and defense related applications.

Lead-free and RoHS compliant.



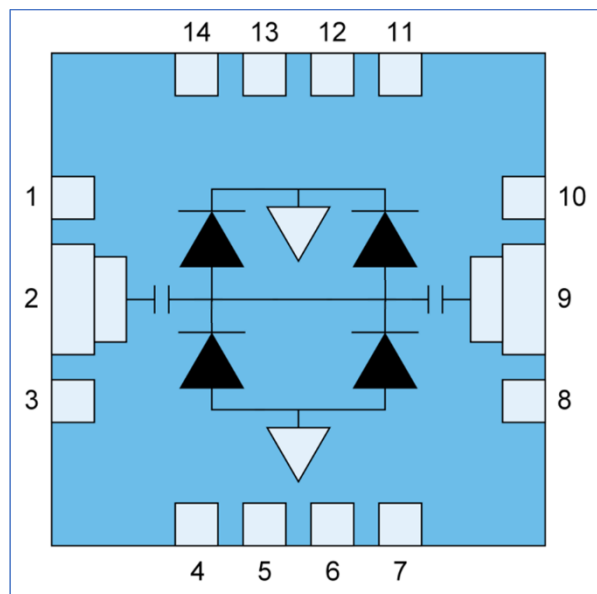
QFN 3 x 3 mm 14 L Package

Key Features

- Frequency Range: 2 to 20 GHz
- Insertion Loss: < 1.0 dB
- Return Loss: > 12 dB
- Input Power CW Survivability up to 5 W
- Flat Leakage: < 18 dBm
- Recovery Time: < 115 ns
- Integrated DC Block on both input and output
- Package Dimensions: 3.00 x 3.00 x 1.35 mm

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

Functional Block Diagram



Top View

Applications

- Receive Chain Protection
- Commercial and Military Radar

Ordering Information

Part	Description
TGL2208-SM	2-20 GHz VPIN Limiter
1100870	TGL2208-SM, EVAL BOARD

Absolute Maximum Ratings

Parameter	Rating
RF Input Power, CW, 50 Ω , 25 °C	37 dBm
Mounting Temperature (30 s max)	260 °C
Storage Temperature	-55 to 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 device may reduce device reliability.

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Passive – No Bias				
Temperature Range	-40	+25	+85	°C

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

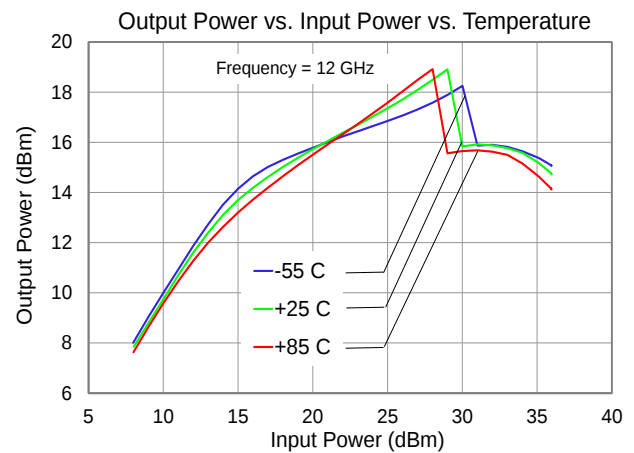
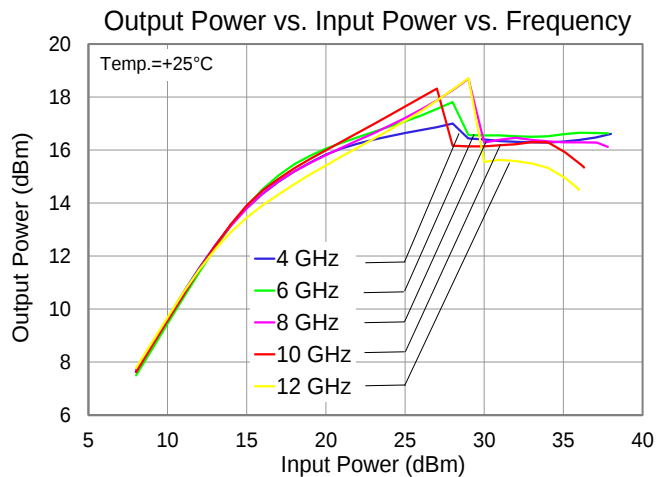
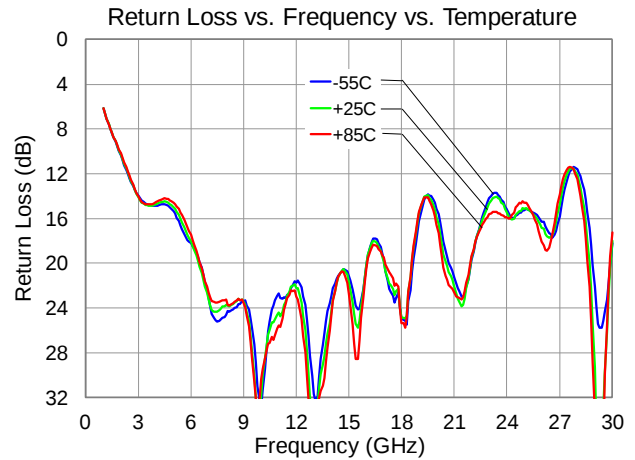
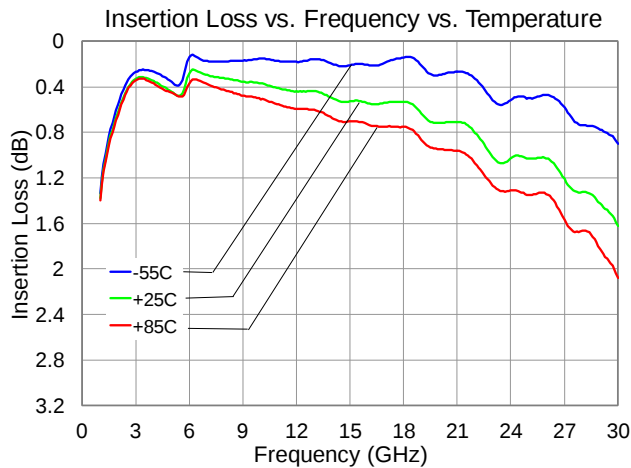
Electrical Specifications

Test conditions unless otherwise noted: 25 °C

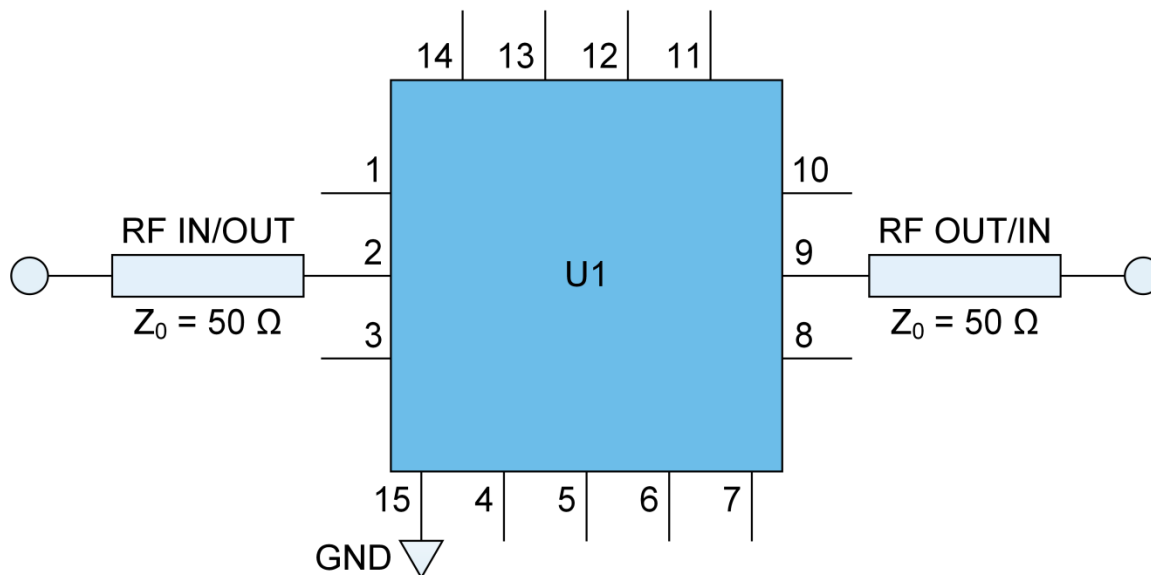
Parameter	Min	Typical	Max	Units
Operational Frequency Range	2		20	GHz
Insertion Loss		0.5		dB
Input Return Loss		15		dB
Output Return Loss		15		dB
Flat Leakage Power @ $P_{IN} > 27$ dBm		18		dBm
Recovery Time		< 115		ns
Insertion Loss Temperature Coefficient		0.003		dB/ °C

Performance Plots

Test conditions unless otherwise noted: Temp.=+25 °C

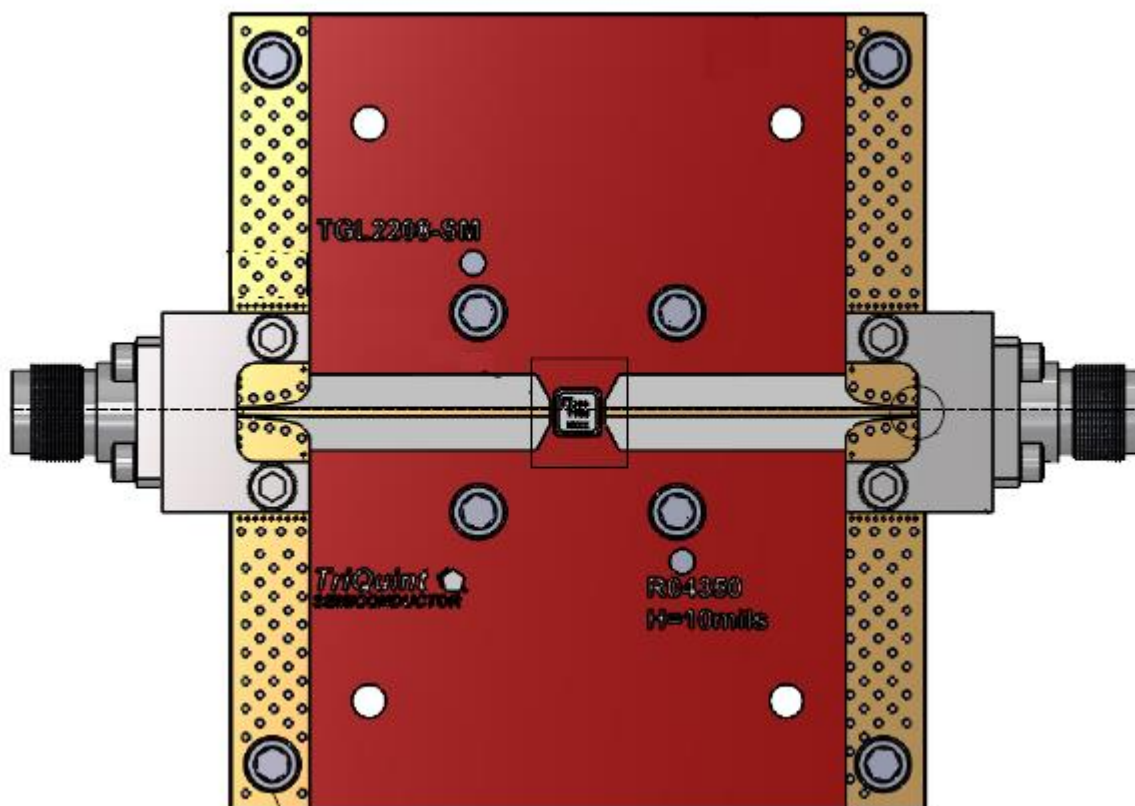


Application Circuit



Notes: A heat sink is recommended for high power operation (RF input > 1 W).

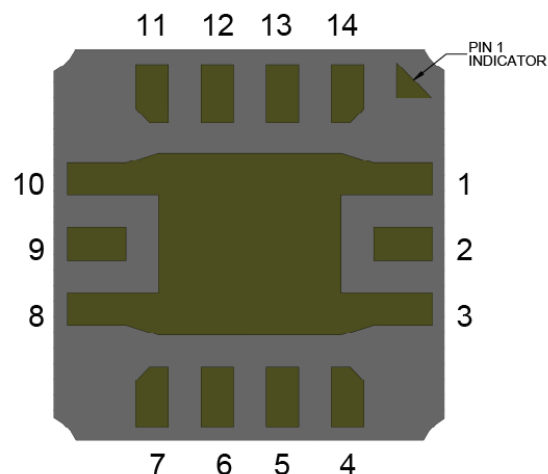
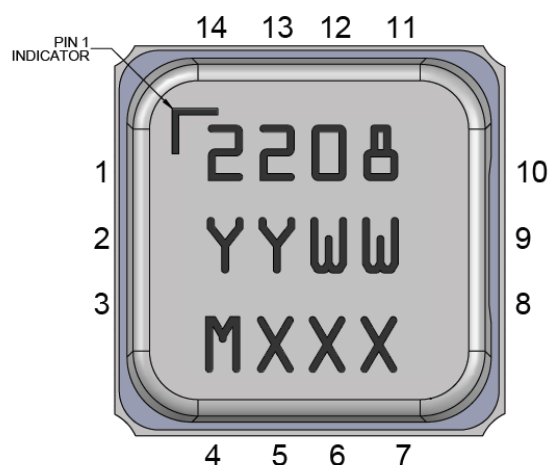
Application Information and Evaluation Board (EVB) Layout



RF layer is 0.010" thick Rogers RO4350. Metal layers are 0.5-oz copper. Microstrip 50 Ω line width is 0.021". The microstrip line taper 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.

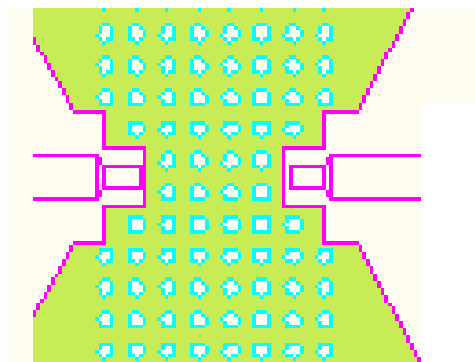
Pad Configuration and Description



Pad No.	Label	Description
1, 3, 8, 10	GND	Pins 1,3,8 and 10 are connected to 15 (backside paddle) inside package.
2	RF Input	RF Input, matched to 50 Ohms.
4 – 7, 11 - 14	N/C	No internal connection; must be grounded or left open on PCB.
9	RF Output	RF Output, matched to 50 Ohms.
15	GND	On PCB, multiple vias should be employed under Pin 15 to minimize inductance and thermal resistance; see page 7 for suggested mounting configuration.

NOTE: The RF Input and RF Output ports are interchangeable.

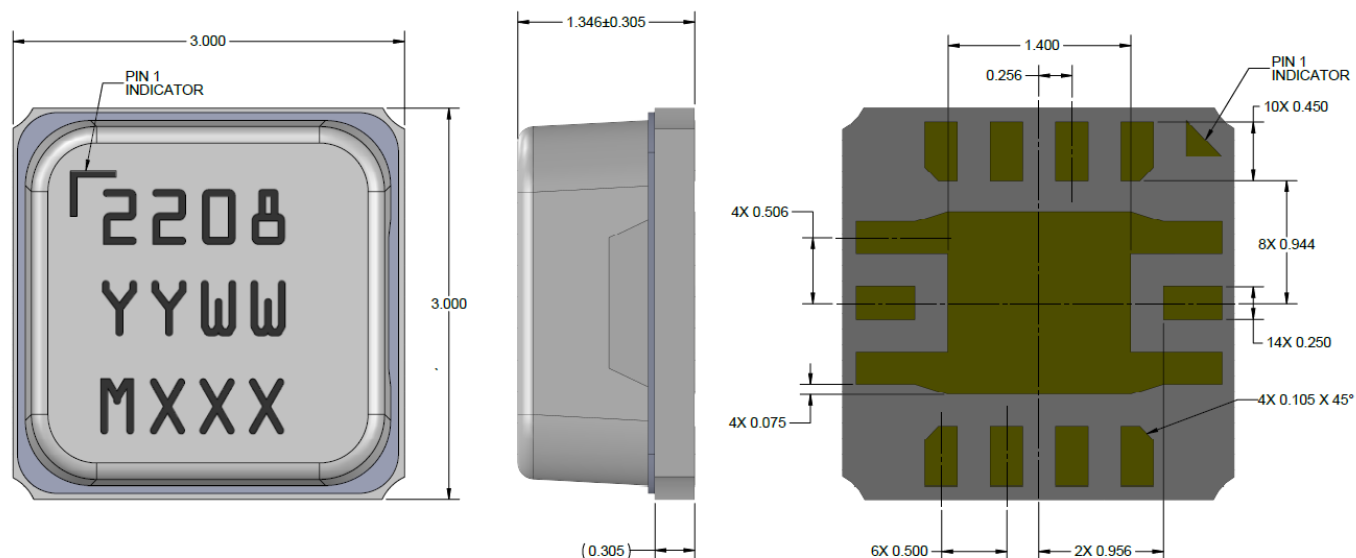
Evaluation Board PCB Mounting Detail



The pad pattern shown above 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.

Ground / thermal vias are critical for the proper performance of this device. Vias should use a 0.008 in. diameter drill, and they are solid filled with non-conductive material and over plated shut.

Package Marking and Dimensions



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS (MM)
TOLERANCE IS +/- 0.127

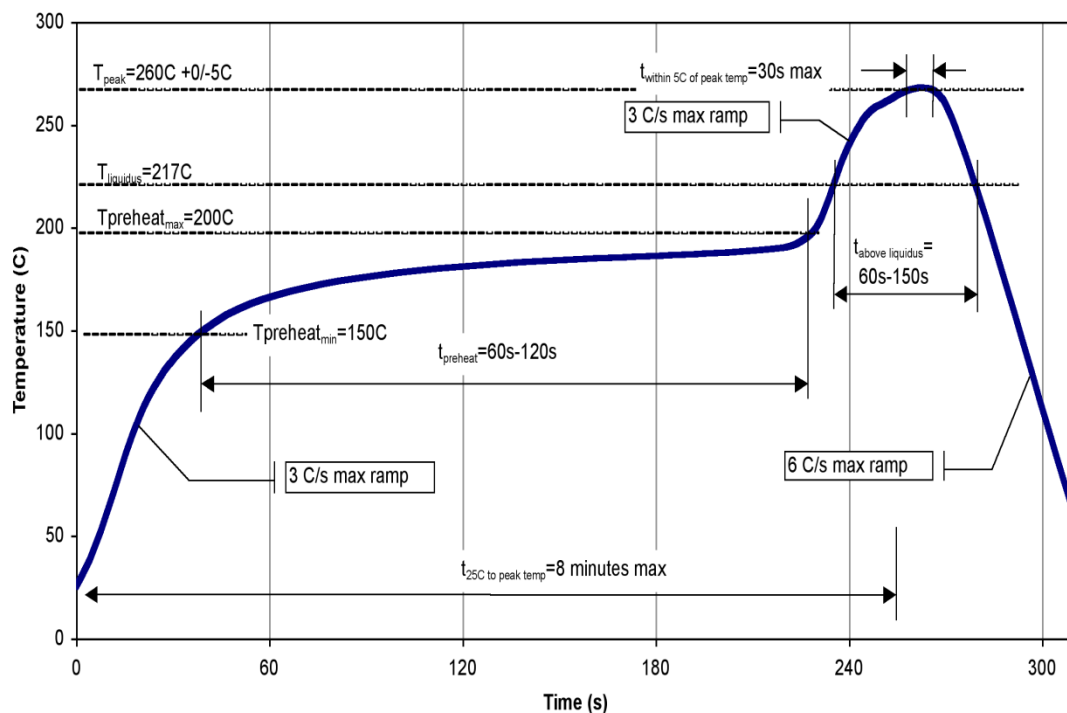
NOTES:

1. PACKAGE BASE: CERAMIC
2. PACKAGE LID: PLASTIC
3. ALL METALIZED FEATURES ARE GOLD PLATED
4. THE PART IS EPOXY SEALED
5. PART MARKING:
2208: PART NUMBER
YY: PART ASSY YEAR
WW: PART ASSY WEEK
MXXX: BATCH ID

Assembly Notes

- Compatible with lead-free soldering process with 260°C peak reflow temperature.
- This package is non-hermetic, and therefore cannot be subjected to aqueous washing. The use of no-clean solder to avoid washing after soldering is recommended
- Solder rework not recommended.
- Contact plating: Ni-Au

Recommended Soldering Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1B	ESDA / JEDEC JS-001
ESD – Charged Device Model (CDM)	Class 3	JEDEC JESD22-C101F
MSL – Moisture Sensitivity Level	Level 3	IPC/JEDEC J-STD-020



Caution!
ESD-Sensitive Device

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 (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free

Contact Information

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Product Description

The Qorvo TGL2209 is a high power, X-band GaAs VPIN limiter capable of protecting sensitive receive channel components against high power incident signals. The TGL2209 does not require DC bias and achieves a low insertion loss in a small form factor. These features allow for simple integration with minimal impact to system performance.

The TGL2209 operates from 8–12 GHz with low insertion loss of less than 0.5 dB. Receive protection is rated up to 50 W incident pulsed-power with a low flat leakage of less than 18 dBm.

The TGL2209 is offered in die form and is well suited for both commercial and defense related applications.

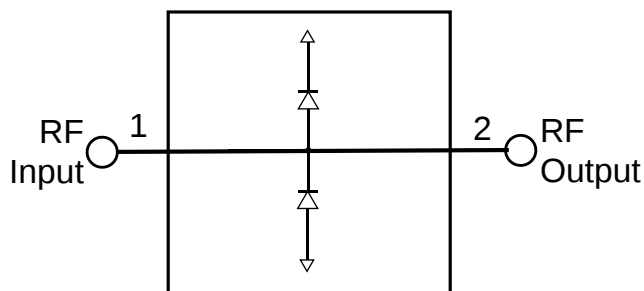


Product Features

- Frequency Range: 8 – 12 GHz
- Insertion Loss: < 0.5 dB
- Peak Power Handling: 50 W (pulsed)
- Flat Leakage: < 18 dBm
- Spike Leakage: < 20 dBm
- Passive (no DC bias required)
- Recovery Time: < 30 nS
- Die Size: 2.00 x 2.00 x 0.10 mm

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

Block Diagram



Applications

- Receive Chain Protection
- Commercial and Military Radar

Ordering Information

Part No.	Description
TGL2209	8–12 GHz 50W VPIN Limiter
1126046	Evaluation Board

Absolute Maximum Ratings

Parameter	Value / Range
Incident Power, Pulsed ¹ , 50 Ω , 25 °C	47 dBm
Incident Power, Pulsed ¹ , 50 Ω , 85 °C	46 dBm
Incident Power, CW, 50 Ω , 25 °C	40 dBm
Incident Power, CW, 50 Ω , 85 °C	36 dBm
Mounting Temperature (30 seconds)	320 °C
Storage Temperature	-40 to 150 °C

Note:

¹ Pulse RF conditions: PW = 100 μ s, Duty Cycle = 10%

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	Min	Typ	Max	Units
Operating Temperature Range	-40	+25	+85	°C
Passive – No Bias				

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

Parameter	Min	Typ	Max	Units
Operational Frequency Range	8	–	12	GHz
Insertion Loss		< 0.5		dB
Input Return Loss		> 12		dB
Output Return Loss		> 12		dB
Flat Leakage Power at $P_{IN} > 30$ dBm		< 18		dBm
Pulse Recovery Time		< 30		nS
Spike Leakage		< 20		dBm
Insertion Loss Temperature Coefficient		0.006		dB/ °C

Thermal and Reliability Information

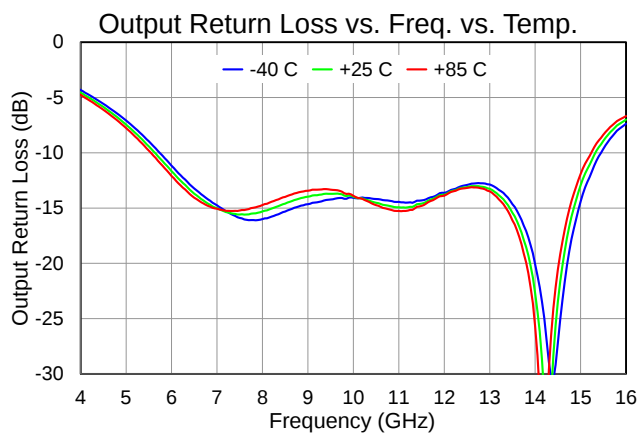
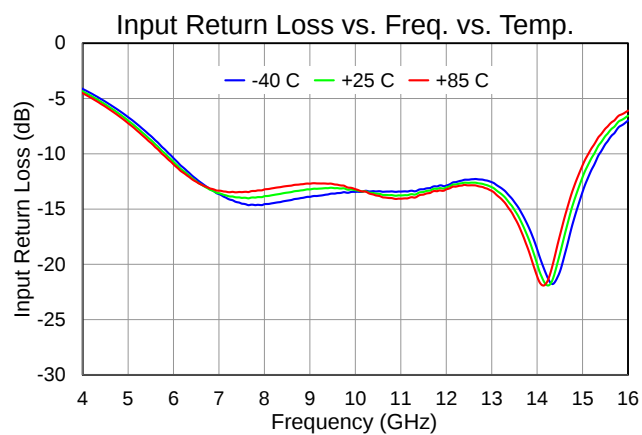
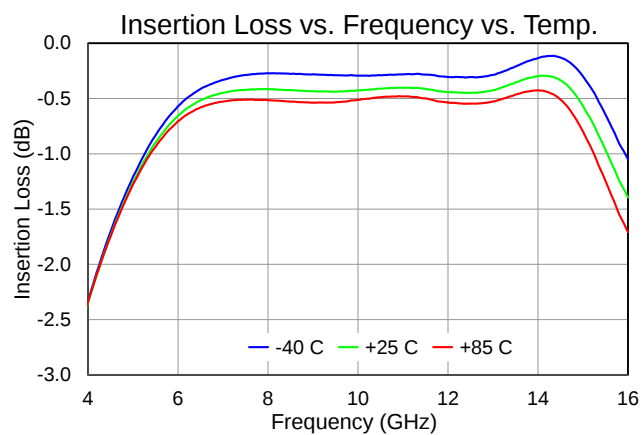
Parameter	Test Conditions	Value	Units
Incident Power (RF Operational Life Test ⁽¹⁾)	10 GHz Pulsed, PW=100 μ s, DC=10%, 50 Ω , 25°C	50	W

Notes:

1. Test terminated after 100 hours.

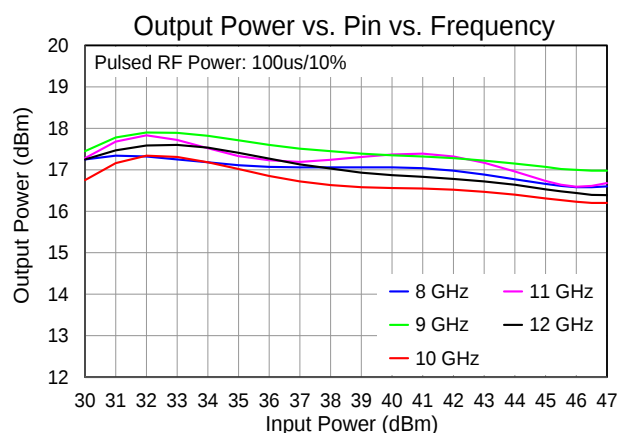
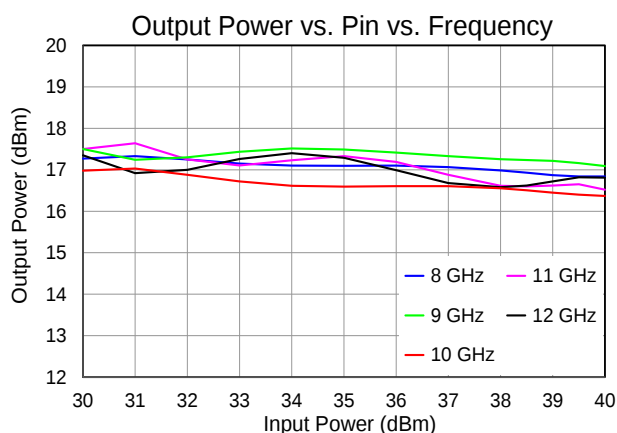
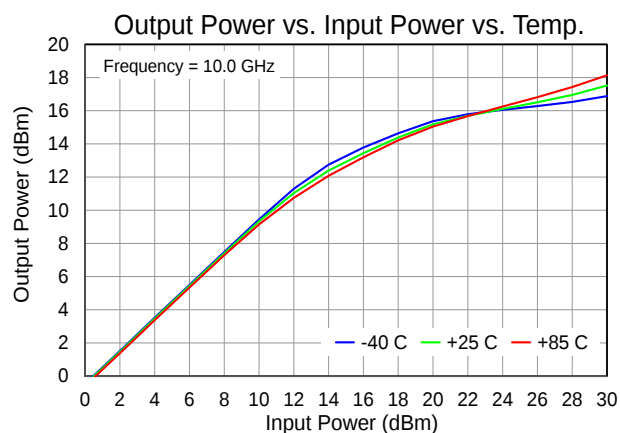
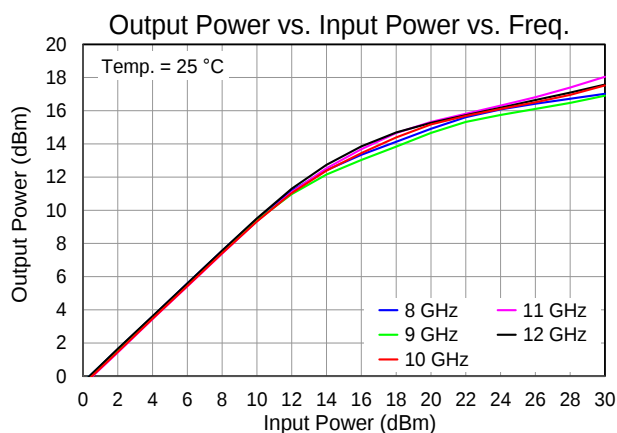
Performance Plots – Small Signal

Test conditions unless otherwise noted: Temp. = 25 °C

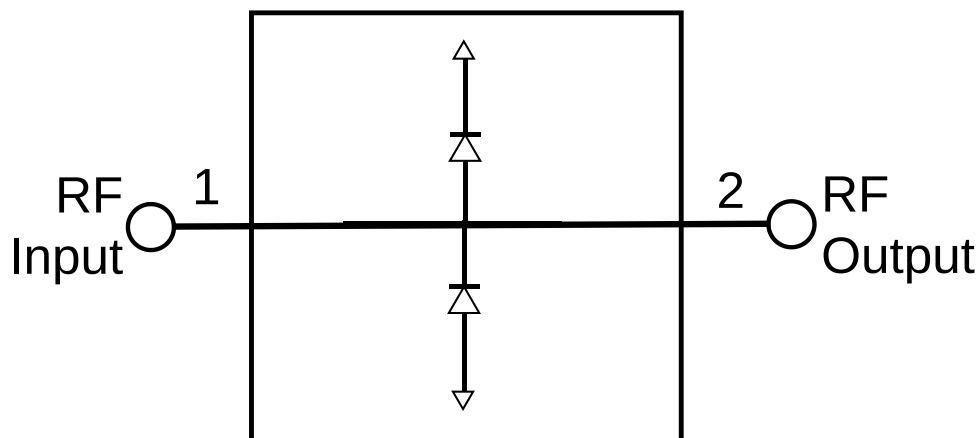


Performance Plots – Large Signal

Test conditions unless otherwise noted: Temp. = 25 °C

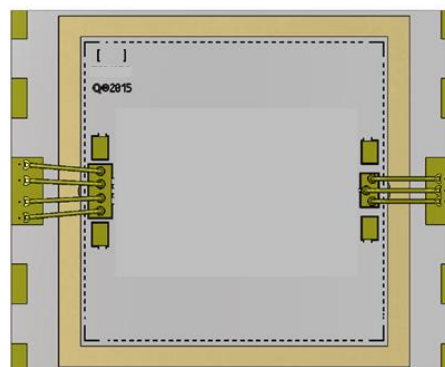
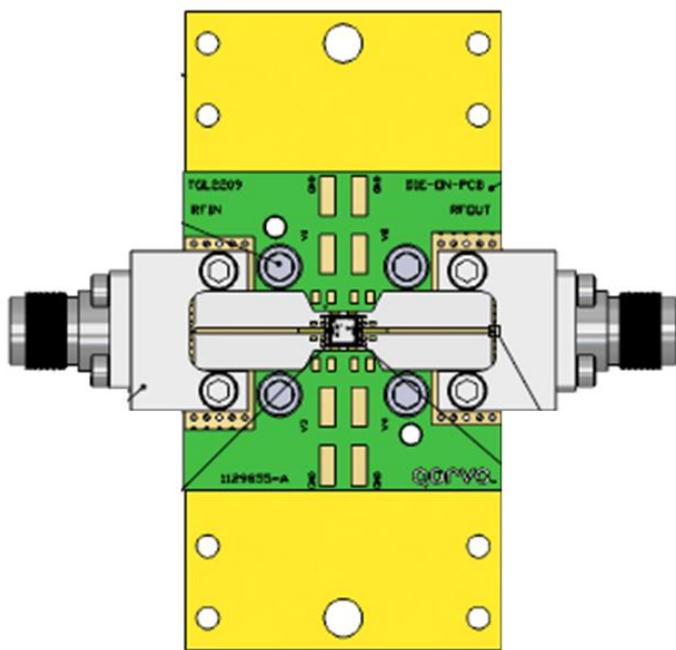


Applications Circuit



Note: RF Input and RF Output ports are not interchangeable.

Evaluation Board (EVB) Layout Assembly & Mounting Detail



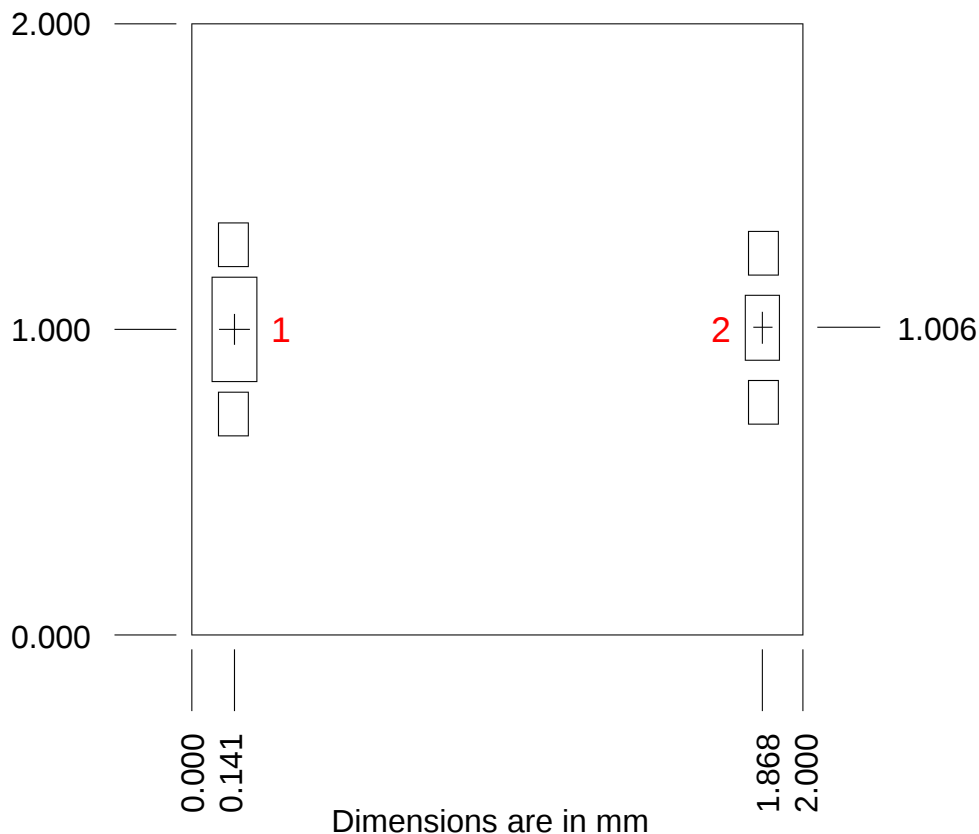
Die Mounting Detail

RF layer is 0.008" thick Rogers RO4003C, $\epsilon_r = 3.38$. Metal layers are 0.5-oz copper. The microstrip line taper 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 die to minimize inductance and thermal resistance.

Mechanical Drawing and 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

Pad No.	Symbol	Description	Pad Size (mm x mm)
1	RF Input	RF Input, 50 Ω , DC coupled	0.145 x 0.340
2	RF Output	RF Output, 50 Ω , DC coupled	0.110 x 0.210

NOTE: The RF Input and RF Output ports are not interchangeable.

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.
- Curing should be done in a convection oven; proper exhaust is a safety concern.

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 are critical parameters.
- Aluminum wire should not be used.
- Devices with small pad sizes should be bonded with 0.0007-inch wire.

Handling Precautions

Parameter	Rating	Standard		Caution! ESD-Sensitive Device
ESD – Human Body Model (HBM)	Class 1C	ESDA / JEDEC JS-001-2012		

Solderability

Use only AuSn (80/20) solder and limit exposure to temperatures above 300 °C to 3 – 4 minutes, maximum.

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 (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free

Contact Information

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

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Web: www.qorvo.com

Email: customer.support@qorvo.com

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TGL2209–SM

8 – 12 GHz 50 Watt VPIN Limiter

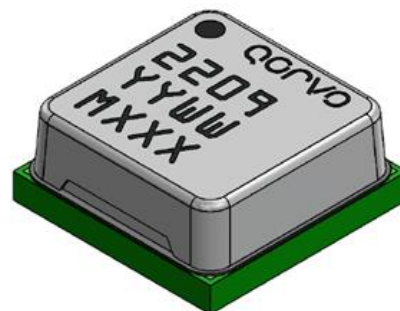
Product Overview

The Qorvo TGL2209–SM is a high power, X-band GaAs VPIN limiter capable of protecting sensitive receive channel components against high power incident signals. The TGL2209–SM does not require DC bias and achieves a low insertion loss in a small form factor. These features allow for simple integration with minimal impact to system performance.

The TGL2209–SM operates from 8.0–12 GHz with low insertion loss of less than 0.5 dB. Receive protection is rated up to 50 W incident pulsed-power with a low flat leakage of less than 18.5 dBm.

The TGL2209–SM is offered as a packaged limiter and is well suited for both commercial and defense related applications.

Lead-free and RoHS compliant.



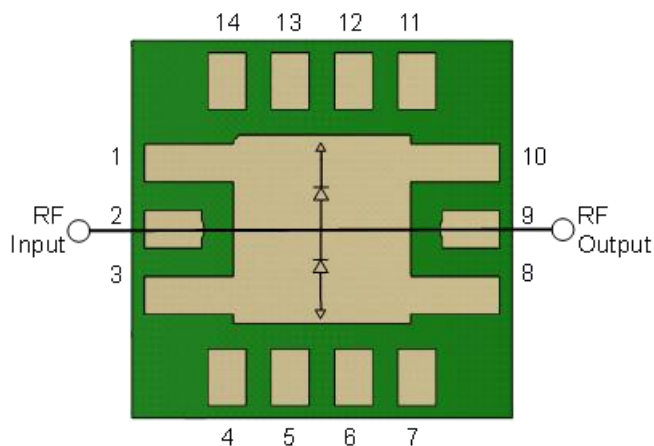
14 Pad 4 x 4 mm QFN Package

Key Features

- Frequency Range: 8.0 to 12.0 GHz
- Insertion Loss: < 0.5 dB
- Peak Power Handling: 50 W (pulsed)
- Flat Leakage: < 18.5 dBm
- Spike Leakage < 20.5 dBm
- Passive (no DC bias required)
- Recovery time < 30 ns
- Package Dimensions: 4.00 x 4.00 x 1.54 mm

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

Functional Block Diagram



Top View

Applications

- Receive Chain Protection
- Commercial and Military Radar

Ordering Information

Part	Description
TGL2209–SM	8.0–12.0 GHz 50W VPIN Limiter
TGL2209–SMEVBP01	8.0–12.0 GHz 50W VPIN Limiter Evaluation Board

Absolute Maximum Ratings

Parameter	Rating
Incident Power, Pulsed ¹ , 50 Ω , 25 °C	47 dBm
Incident Power, Pulsed ¹ , 50 Ω , 85 °C	46 dBm
Incident Power, CW, 50 Ω , 25 °C	40 dBm
Incident Power, CW, 50 Ω , 85 °C	36 dBm
Mounting Temperature (30 s max)	260 °C
Storage Temperature	-40 to 150 °C

Note:

¹ Pulse conditions: PW = 100 μ s, Duty Cycle = 10%

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.

Electrical Specifications

Parameter	Conditions ⁽¹⁾	Min	Typ	Max	Units
Operational Frequency Range		8.0		12.0	GHz
Insertion Loss	8 GHz		0.35	0.75	dB
	9 GHz		0.35	0.75	
	10 GHz		0.35	0.90	
	11 GHz		0.36	1.00	
	12 GHz		0.40	1.00	
Input Return Loss	8 GHz		24		dB
	10 GHz		25		
	12 GHz		19		
Output Return Loss	8 GHz		24		dB
	10 GHz		29		
	12 GHz		20		
Flat Leakage Power at P _{IN} > 30 dBm (Pulse)	8 GHz		18.0		dBm
	10 GHz		17.5		
	12 GHz		18.5		
Pulse Recovery Time			<30		ns
Spike Leakage			20.5		dBm
Insertion Loss Temperature Coefficient			0.006		dB/ °C

Notes:

1. Test conditions unless otherwise noted: Temp = +25 °C, 50 Ω system.

Thermal and Reliability Information

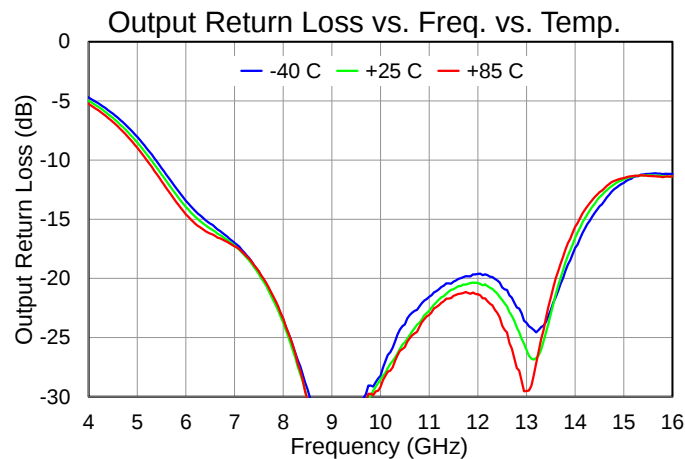
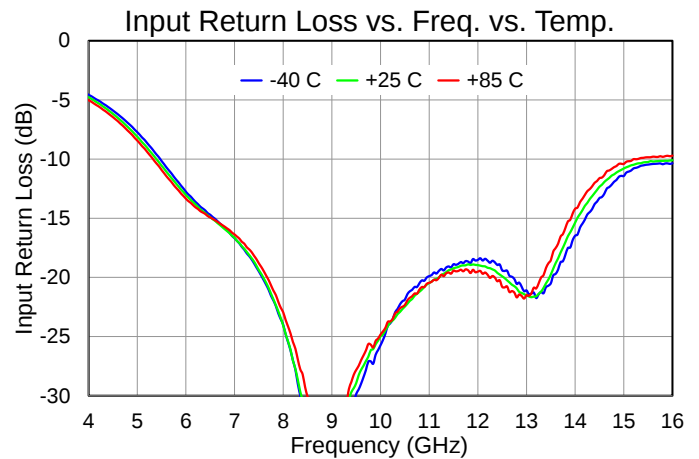
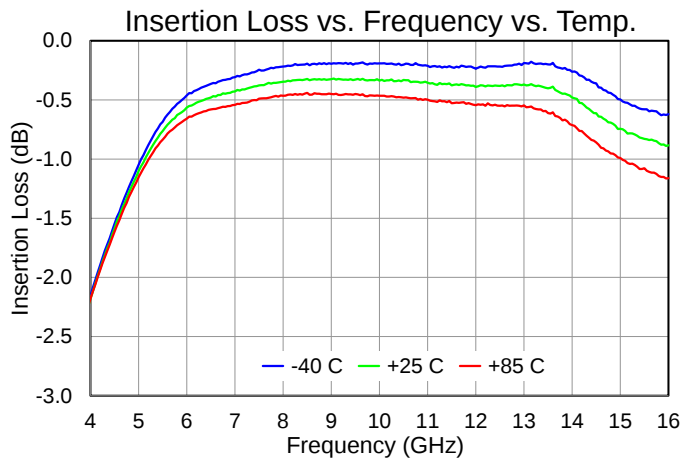
Parameter	Test Conditions	Value	Units
Incident Power (RF Operational Life Test ⁽¹⁾)	10 GHz Pulsed, PW=100 μ s, DC=10%, 50 Ω , 25 °C	50	W

Notes:

1. Test terminated after 100 hours.

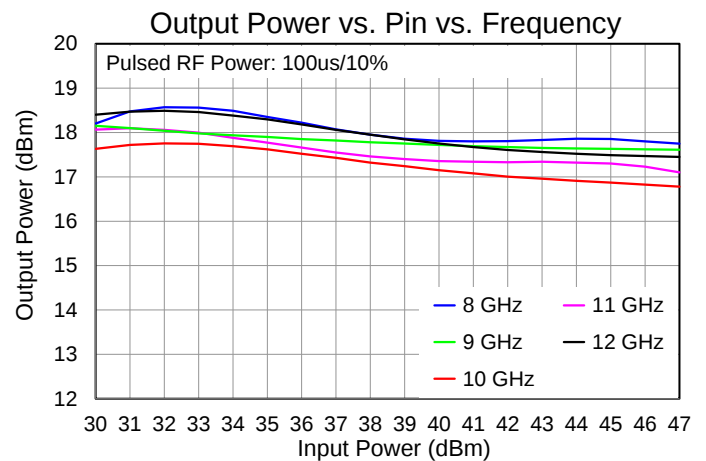
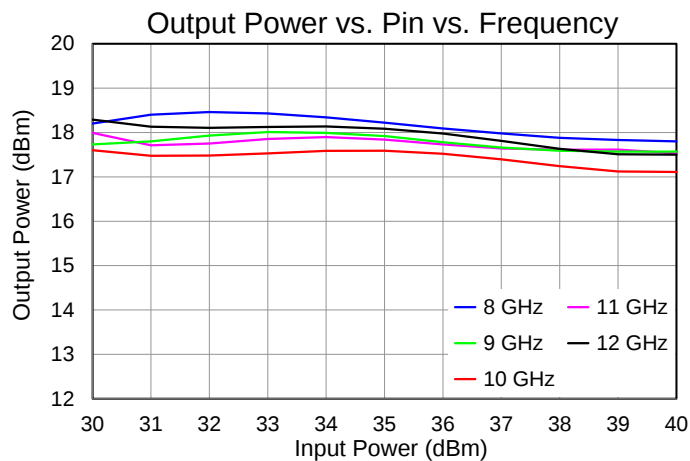
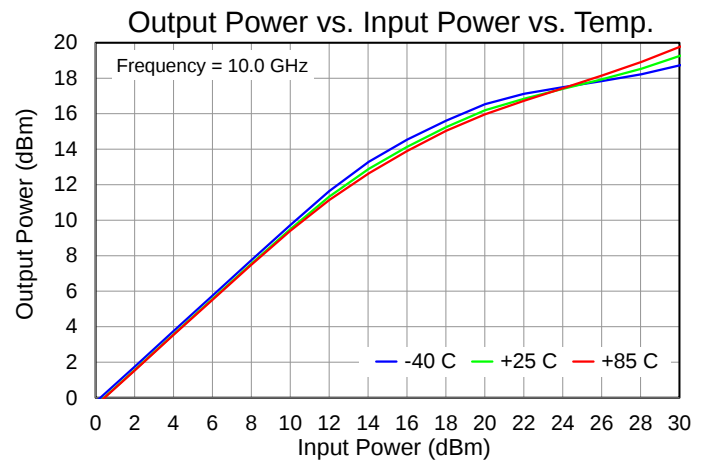
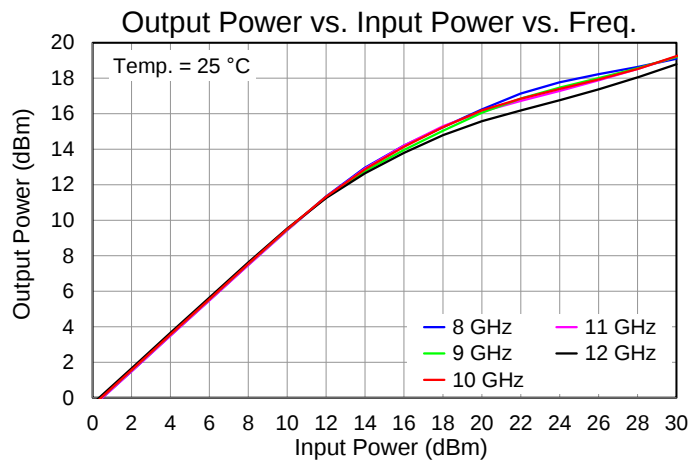
Performance Plots – Small Signal

Test conditions unless otherwise noted: Temp.=+25 °C

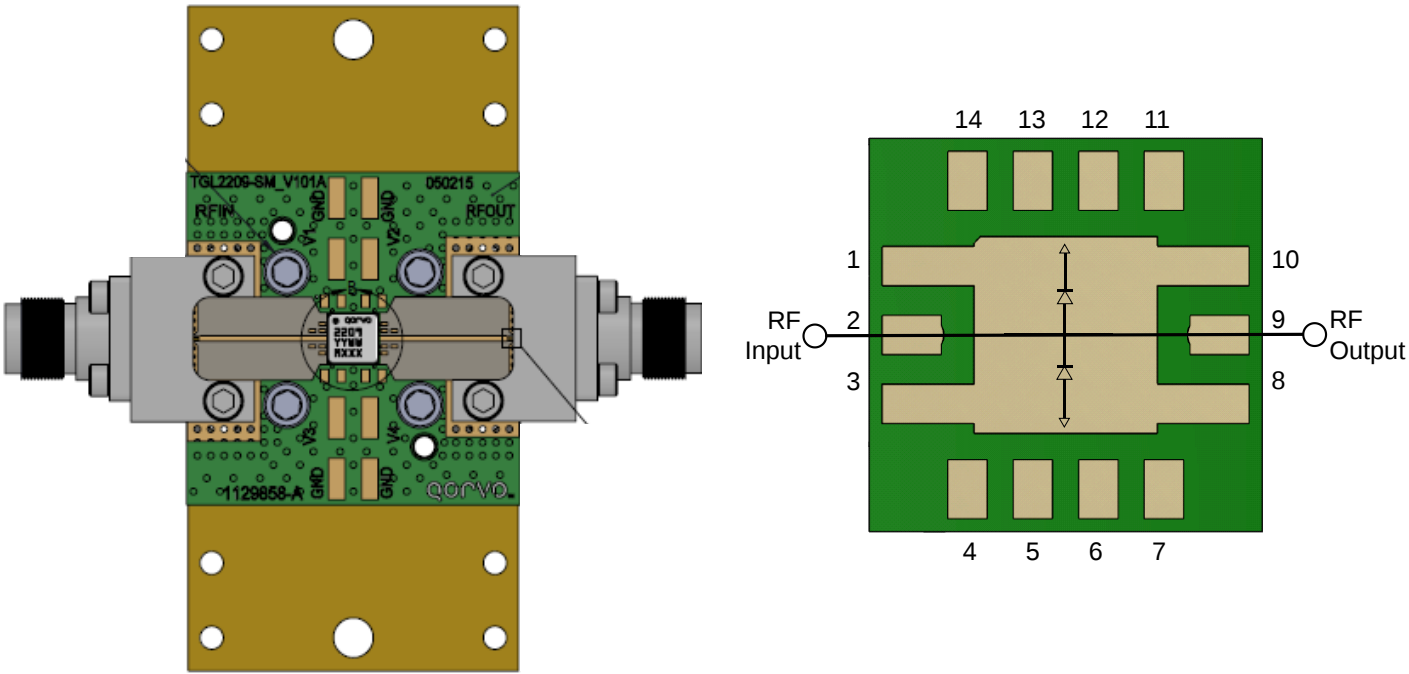


Performance Plots – Large Signal

Test conditions unless otherwise noted: CW power, Temp.=+25 °C



Application Circuit and Evaluation Board (EVB)

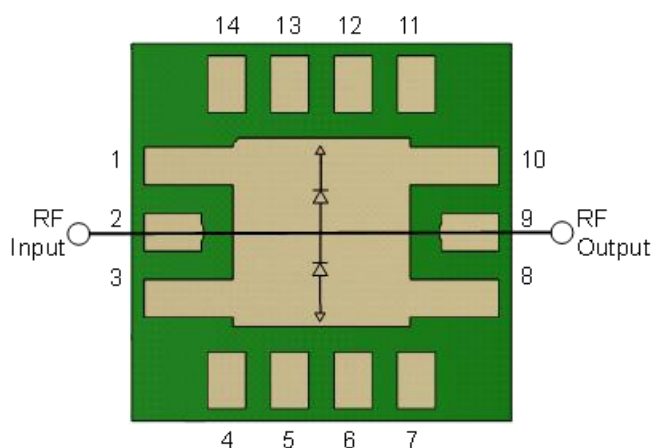


Notes:
1. See Evaluation Board PCB Information for material and stack up.

Bill of Material – EVB

Ref. Des.	Value	Description	Manuf.	Part Number
n/a	n/a	Printed Circuit Board	Qorvo	
U1	n/a	8 – 12 GHz 50 W VPIN Limiter	Qorvo	TGL2209-SM
J1, J2	n/a	2.92 mm End Launch Connector	Southwest Microwave	1092-01A-5

Pad Configuration and Description



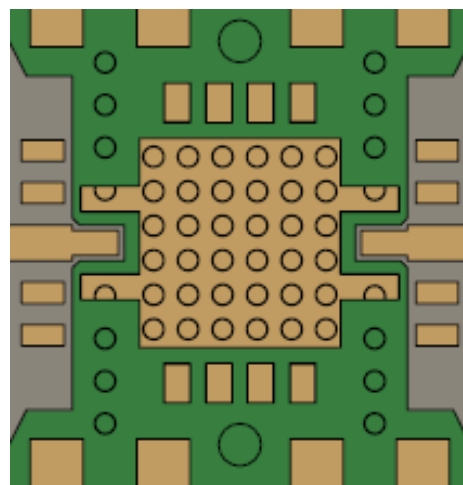
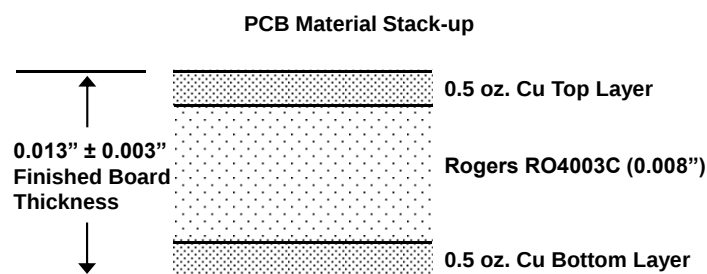
Top View

Pad No.	Label	Description
1, 3, 8, 10	GND	On PCB, multiple copper-filled vias should be employed under the center pad to minimize inductance and thermal resistance
2	RF Input	RF Input, matched to 50 Ohms, not DC blocked
4 – 7, 11 – 14	NC	No connection; may be grounded if desired
9	RF Output	RF Output, matched to 50 Ohms, not DC blocked

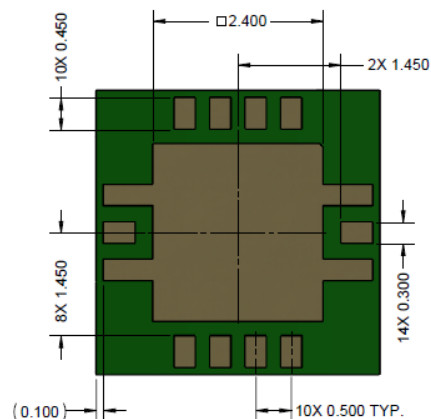
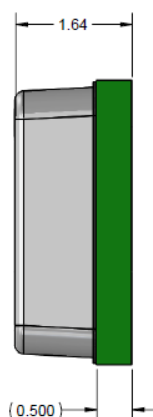
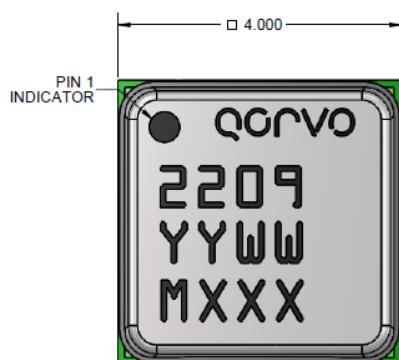
NOTE: The RF Input and RF Output ports are not interchangeable.

Evaluation Board PCB Information and Mounting Detail

EVB PC Board Layout



Package Marking and Dimensions



- NOTES:
1. PACKAGE BASE: LAMINATE
 2. PACKAGE LID: PLASTIC
 3. ALL METALIZED FEATURES ARE GOLD PLATED.
 4. THE PART IS EPOXY SEALED
 5. PART MARKING:
2209: PART NUMBER
YY: PART ASSY YEAR
WW: PART ASSY WEEK
MXXX: BATCH ID

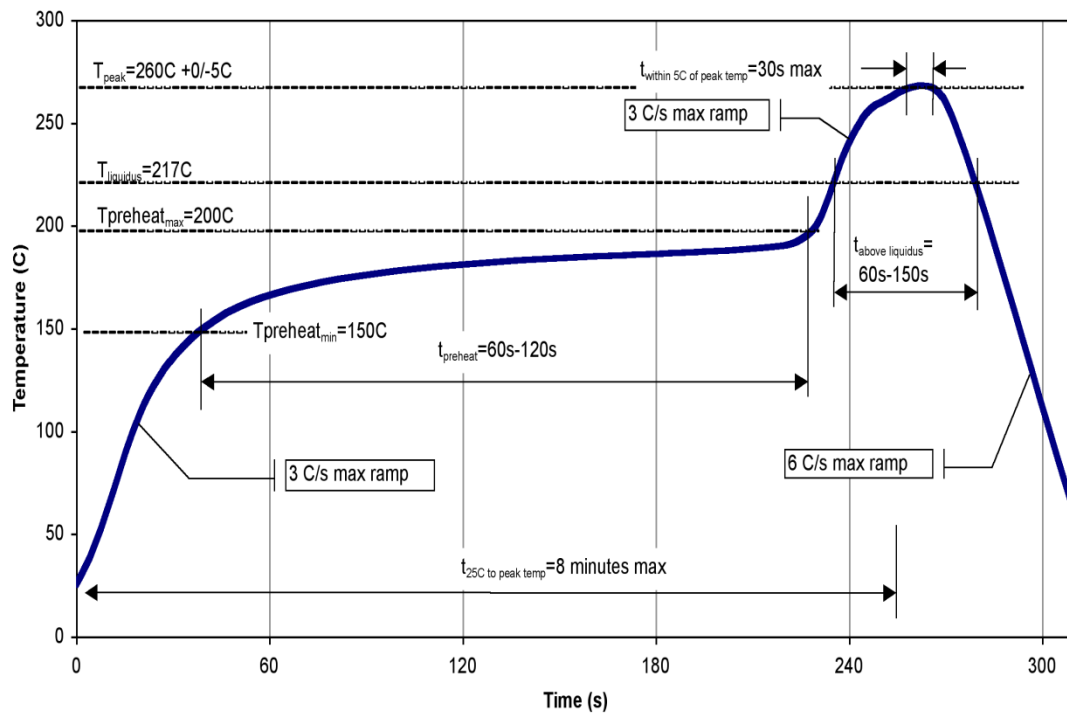
Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Contact plating: Ni-Pd-Au

Assembly Notes

- Compatible with lead-free soldering process with 260°C peak reflow temperature.
- This package is non-hermetic, and therefore cannot be subjected to aqueous washing. The use of no-clean solder to avoid washing after soldering is recommended
- Solder rework not recommended.
- Contact plating: Ni-Pd-Au

Recommended Soldering Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1C	ESDA / JEDEC JS-001-2012
ESD – Charged Device Model (CDM)	Class C3	JEDEC JESD22-C101F
MSL – Moisture Sensitivity Level	Level 3	IPC/JEDEC J-STD-020



Caution!
ESD-Sensitive Device

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 (C₁₅H₁₂Br₄O₂) Free
- PFOS Free



Contact Information

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Email: customer.support@qorvo.com

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TGL2210-SM

0.05–6 GHz 100 Watt VPIN Limiter

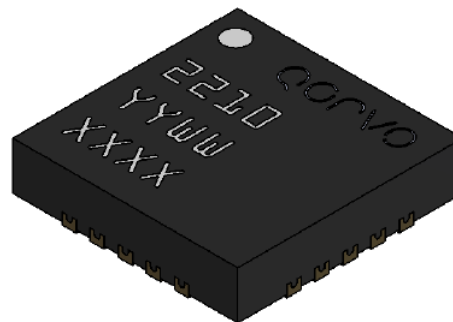
Product Overview

The Qorvo TGL2210-SM is a high-power receive protection circuit (limiter) operating from 0.05-6GHz. Capable of withstanding up to 100 W incident power levels, the TGL2210-SM allows < 17 dBm flat leakage to pass through and contributes < 0.7 dB in insertion loss.

Using Qorvo's passive GaAs VPIN technology, the TGL2210-SM does not require bias and is offered in a small 4 x 4 (mm) plastic overmold package. This simplifies system integration while maximizing performance and protection.

The TGL2210-SM is ideal for commercial and military radar applications, communications systems and electronic warfare where protecting sensitive receive components from damage is critical.

Lead-free and RoHS compliant.

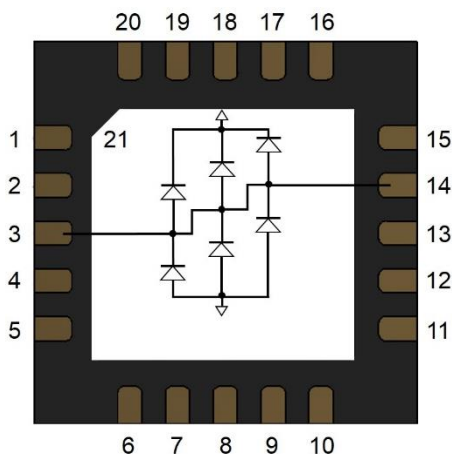


QFN 4x4 mm 20L

Key Features

- Frequency Range: 0.05 to 6.0 GHz
- Insertion Loss: < 0.7 dB
- Peak Power Handling: 100 W (pulsed)
- Flat Leakage: < 17 dBm
- Passive (no DC bias required)
- Recovery time < 40 ns
- QFN Package Dimensions: 4.0 x 4.0 x 0.85 mm

Functional Block Diagram



Top View

Applications

- Receive Chain Protection
- Commercial and Military Radar
- Communications
- Electronic Warfare

Ordering Information

Part	Description
TGL2210-SM	0.05–6.0 GHz 100W VPIN Limiter
TGL2210-SMEVB-01	Evaluation Board

Absolute Maximum Ratings

Parameter	Rating
Incident Power, Pulsed (PW = 10μs, DC = 10%), 50 Ω, 85 °C	110 W
Incident Power, CW, 50 Ω, 25 °C	85 W
Incident Power, CW, 50 Ω, 85 °C	70 W
Mounting Temperature (30 s max)	260 °C
Storage Temperature	-55 to 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
Operating Temperature Range	-40	+25	+85	°C
Passive – No Bias				

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

Electrical Specifications

Parameter	Conditions	Min	Typical	Max	Units
Operational Frequency Range		0.05		6.0	GHz
Insertion Loss, Un-Tuned	Freq = 3.5 GHz		0.6	0.85	dB
Insertion Loss, Tuned	Freq = 3.5 GHz ⁽¹⁾		0.4		dB
Input Return Loss, Un-Tuned		10	11		dB
Output Return Loss, Un-Tuned		10	11.5		dB
Flat Leakage Power	@ P _{IN} > 30 dBm		< 17		dBm
Pulse Recovery Time			< 40		ns
Spike Leakage			< 0.5		dB
Insertion Loss Temperature Coefficient			0.001		dB/ °C

Notes: Test conditions unless otherwise noted: Temp = +25 °C, 50 Ω system.

1. Tuned EVB to improve 2-5 GHz

Thermal and Reliability Information

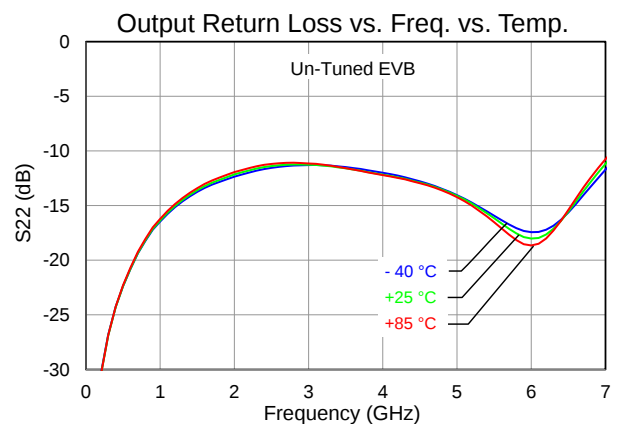
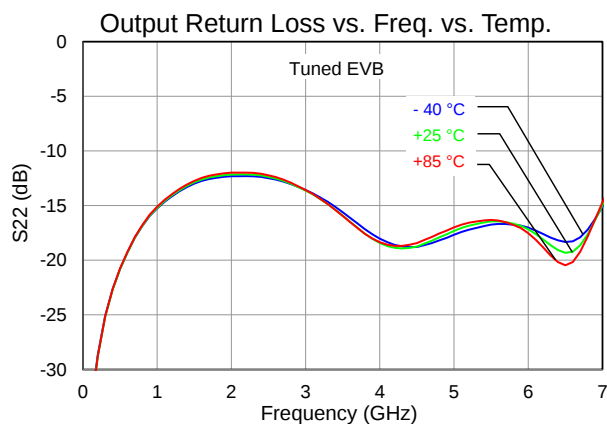
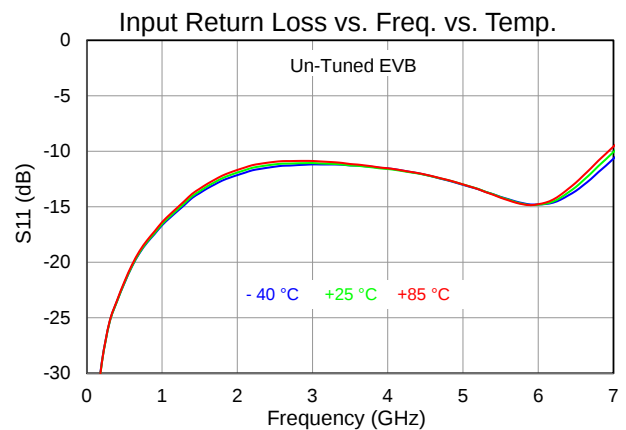
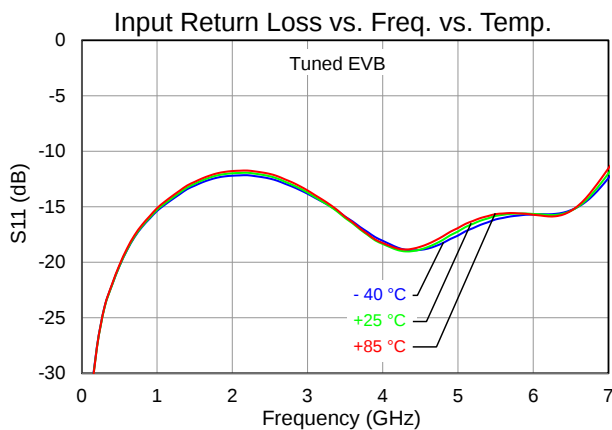
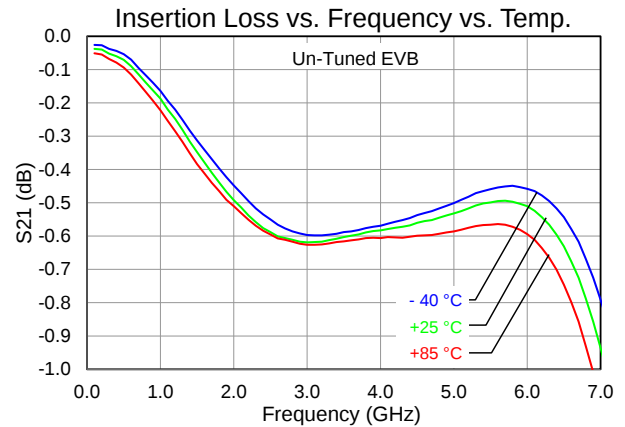
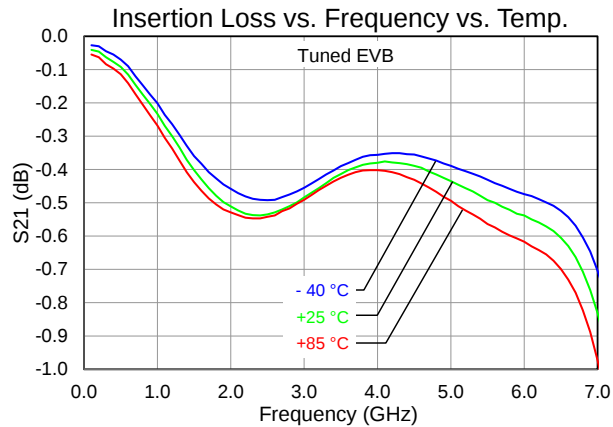
Parameter	Test Conditions	Value	Units
Incident Power	4.5 GHz, CW, 50 Ω, 25 °C	31	W
(168 hours RF Operational Life Test ⁽¹⁾)	4.5 GHz, Pulsed, PW=10 μs, DC=10%, 50 Ω, 25 °C	100	W

Notes:

1. Test was terminated at 168 hours. Insertion Loss remained ≤ 1 dB for device under test.

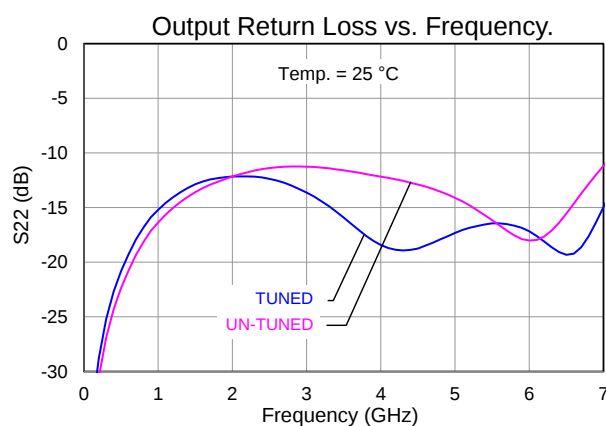
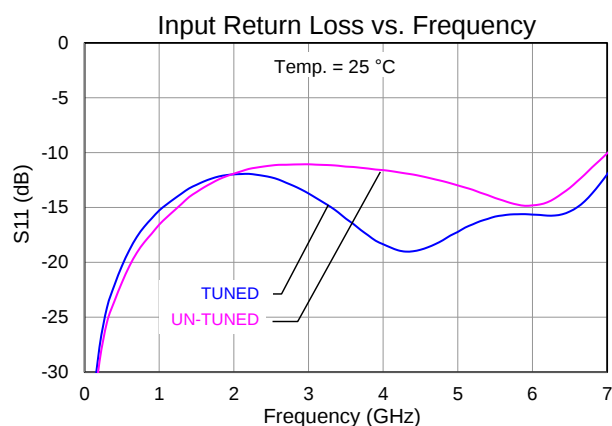
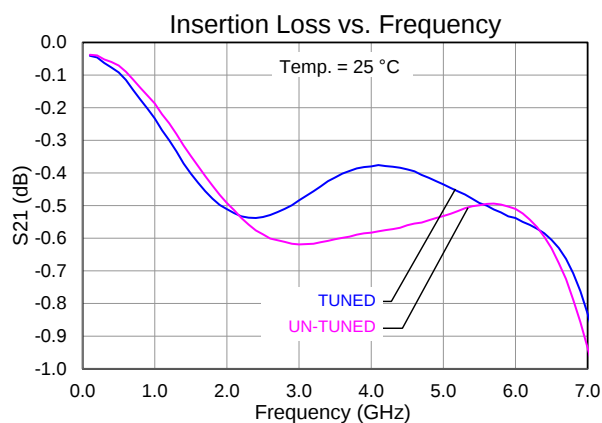
Performance Plots – Small Signal

Test conditions unless otherwise noted: Temp.=+25 °C



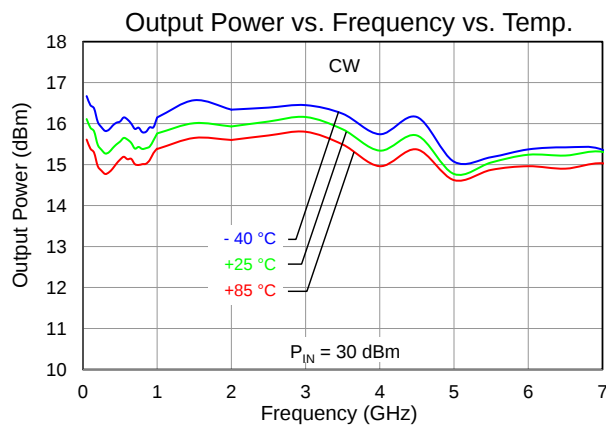
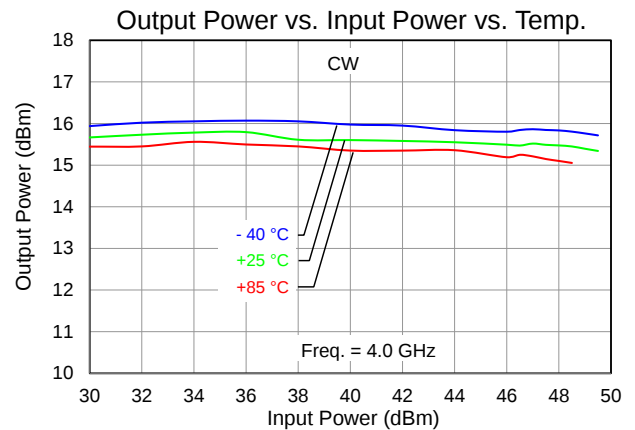
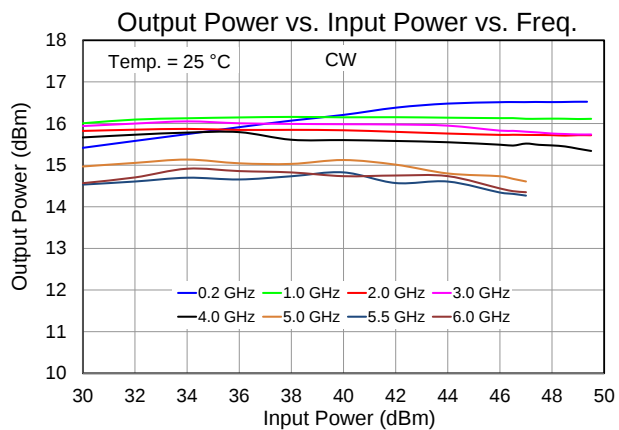
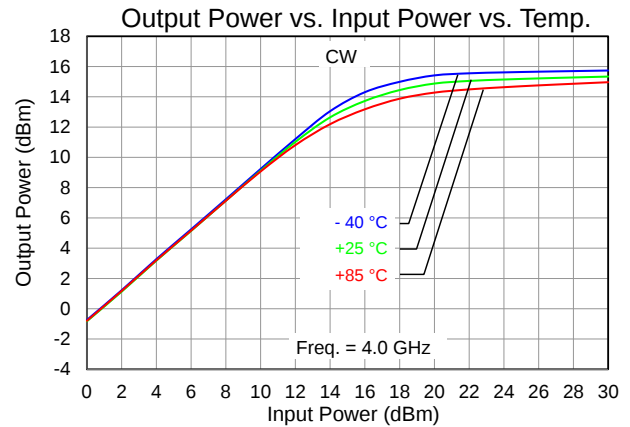
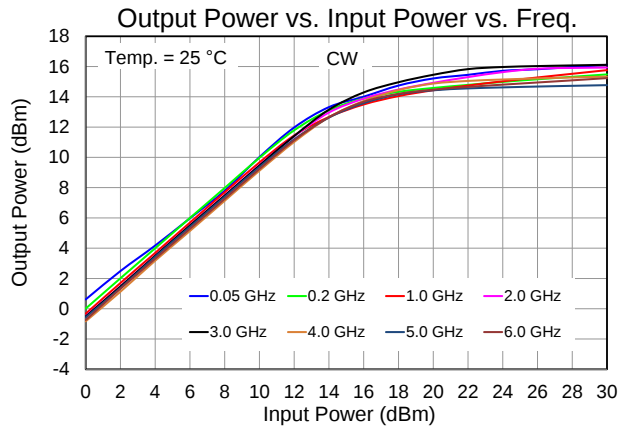
Performance Plots – Small Signal

Test conditions unless otherwise noted: Temp.=+25 °C



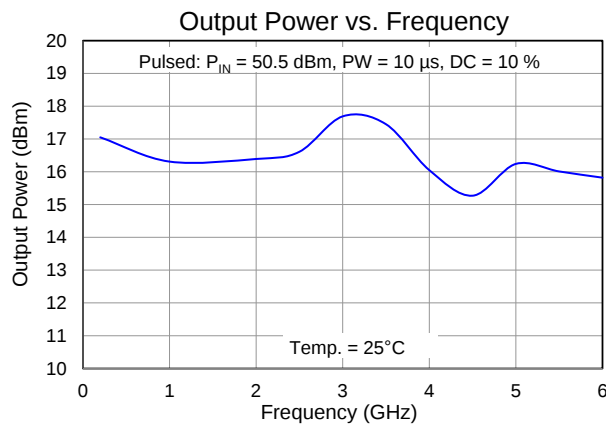
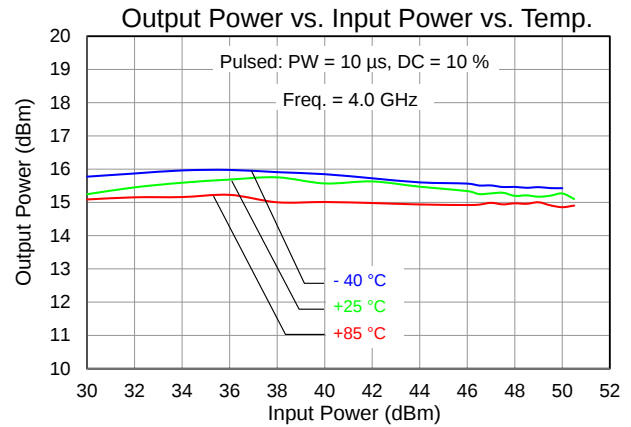
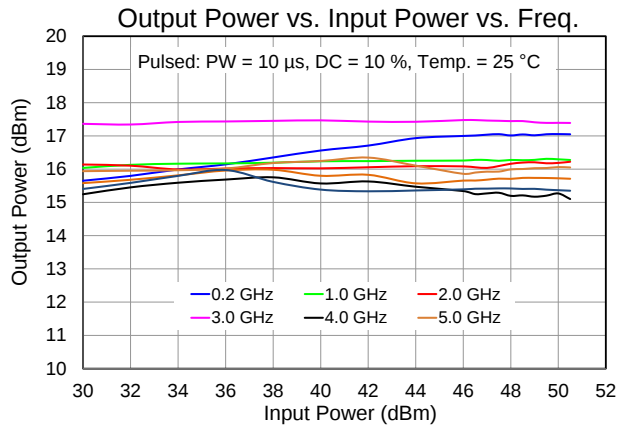
Performance Plots – Large Signal

Test conditions unless otherwise noted: Temp.=+25 °C



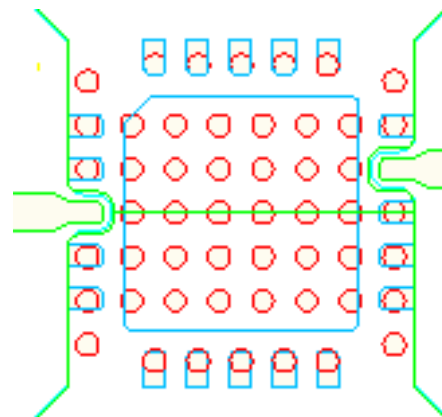
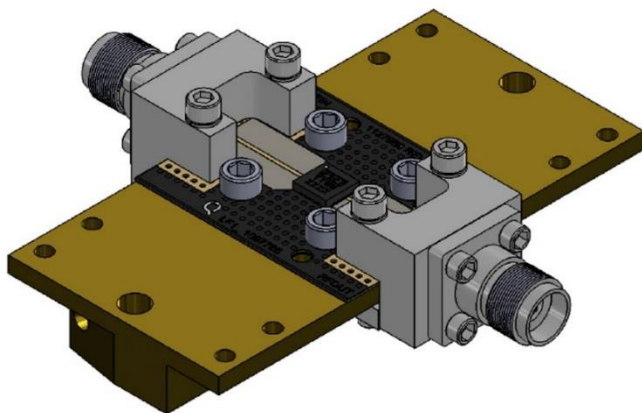
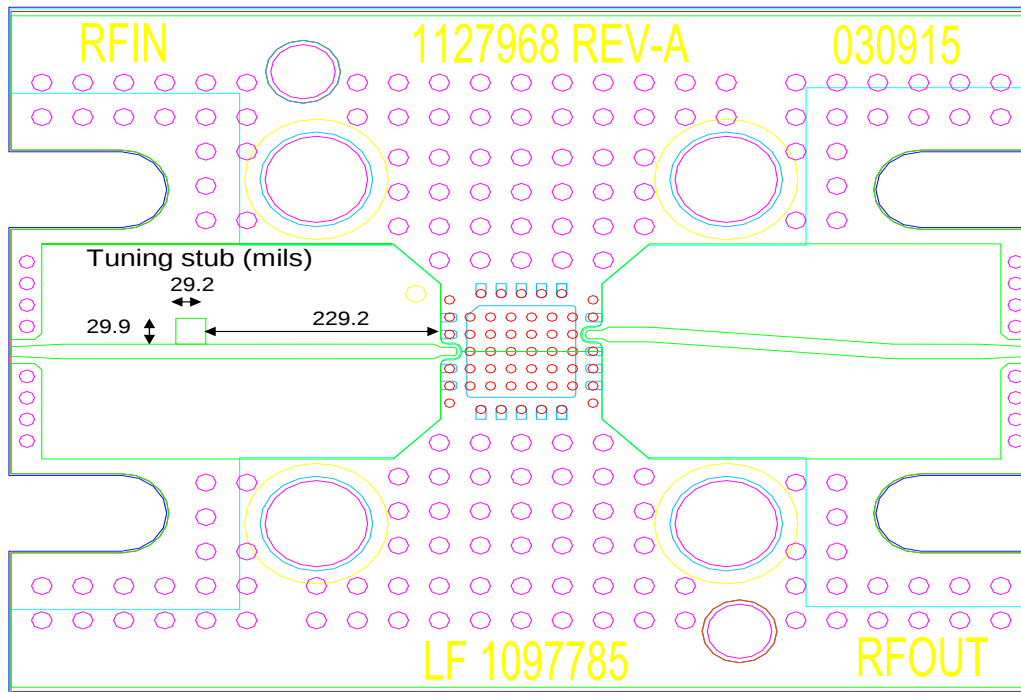
Performance Plots – Large Signal

Test conditions unless otherwise noted: Temp. = +25 °C



Evaluation Board PCB Information and Mounting Detail

TUNED PCB LAYOUT



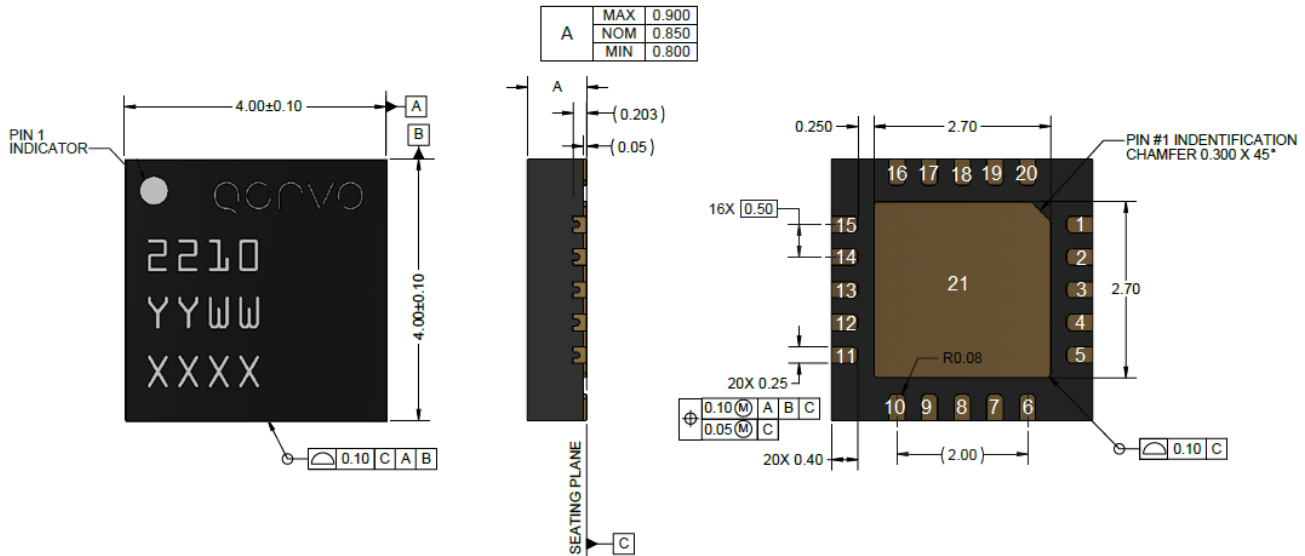
MOUNTING PATTERN

RF layer is 0.008" thick Rogers RO4003C. Metal layers are 0.5-oz copper. Microstrip 50 Ω line width is 0.050". The microstrip line taper at the connector interface is optimized for the Southwest Microwave end-launch connector 1092-02A-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.

- Ground / thermal vias under the DUT are critical for the proper performance of this device.
- The PCB shown herein utilizes copper filled vias (10 mils diameter) under the DUT to maximize heat transfer away from the DUT under large signal conditions.
- Thermal dissipation is low for normal non-limiting operation.

Package Marking, Dimensions and Pad Description



Notes:

1. All dimensions are in millimeters. Angles are in degrees.
Tolerances: XX = ± .25
XXX = ± .100
2. Package Leads Are Gold Plated (NiPdAu)
3. Part Is Mold Encapsulated
4. Part Marking:
2210: Part Number
YY: Part assembly Year
WW: Part Assembly Week
XXXX: Batch ID

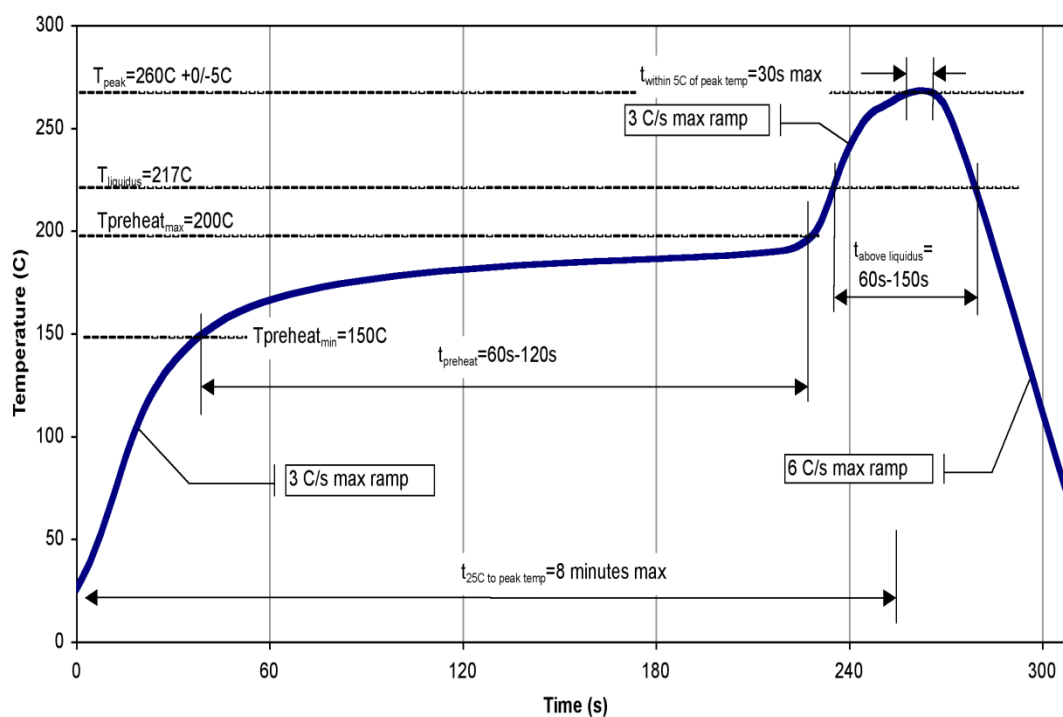
Package Pad	Symbol	Description
1, 2, 4 – 13, 15 – 20	NC	No Connection; recommend GND at the EVB level
3	RF Input	Input; matched to 50 Ohms; not DC blocked
14	RF Output	Output; matched to 50 Ohms; not DC blocked
21 (Slug)	GND	On PCB; multiple vias should be employed under the center pad (21) to minimize inductance and thermal resistance; see page 9 for suggested mounting configuration

Note: The RF Input and Output ports are not interchangeable.

Solderability

Compatible with both lead-free (260°C max. reflow temp.) and tin/lead (245°C max. reflow temp.) soldering processes.
Plating is Ni-Pd-Au, Au thickness of 0.00254-0.01016 µm.

Recommended Soldering Profile



Handling Precautions

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



Caution!
ESD-Sensitive Device

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 (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free



Contact Information

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

Web: www.qorvo.com

Tel: 1-844-890-8163

Email: customer.support@qorvo.com

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

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Product Description

Qorvo's TGL2217 is a high power, wideband GaAs VPIN limiter capable of protecting sensitive receive channel components against high power incident signals. The TGL2217 does not require DC bias and achieves a low insertion loss all in a small form factor. These features allow for simple integration with minimal impact to system performance.

The TGL2217 operates from 0.1–20 GHz with low insertion loss of less than 0.7 dB. Receive protection is rated up to 10 W incident pulsed-power with a low flat leakage of less than 18.5 dBm.

The TGL2217 is offered in die form. It is well suited for both commercial and defense related applications.

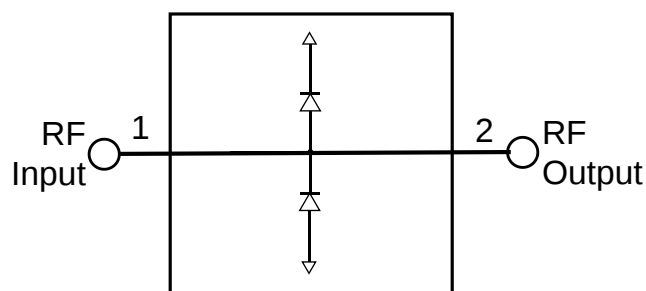


Product Features

- Frequency Range: 0.1 – 20 GHz
- Insertion Loss: < 0.7 dB
- Peak Power Handling: 10 W (pulsed)
- Flat Leakage: < 18.5 dBm (pulsed)
- Spike Leakage: < 20.5 dBm
- Passive (no DC bias required)
- Recovery Time: < 40 nS
- Die Size: 1.50 x 1.0 x 0.10 mm

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

Block Diagram



Applications

- Receive Chain Protection
- Commercial and Military Radar
- Electronic Warfare
- Communications

Ordering Information

Part No.	Description
TGL2217	0.1–20 GHz 10W VPIN Limiter
TGL2217 EVB	Evaluation Board

Absolute Maximum Ratings

Parameter	Value / Range
Incident Power, Pulsed ¹ , 50 Ω , 85 °C	40 dBm
Incident Power, CW, 50 Ω , 25 °C	36 dBm
Incident Power, CW, 50 Ω , 85 °C	33 dBm
Mounting Temperature (30 seconds)	320 °C
Storage Temperature	-40 to 150 °C

Note:

¹ Pulse RF conditions: PW = 100 μ s, Duty Cycle = 10%

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	Min	Typ	Max	Units
Operating Temperature Range	-40	+25	+85	°C
Passive – No Bias				

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, Pulsed RF: PW = 100 μ s, DC = 10%.

Parameter	Min	Typ	Max	Units
Operational Frequency Range	0.1	–	20	GHz
Insertion Loss		< 0.7		dB
Input Return Loss		> 15		dB
Output Return Loss		> 15		dB
Flat Leakage Power at P _{IN} > 30 dBm		< 18.5		dBm
Pulse Recovery Time		< 40		nS
Spike Leakage		< 20.5		dBm
Insertion Loss Temperature Coefficient		0.002		dB/ °C

Thermal and Reliability Information

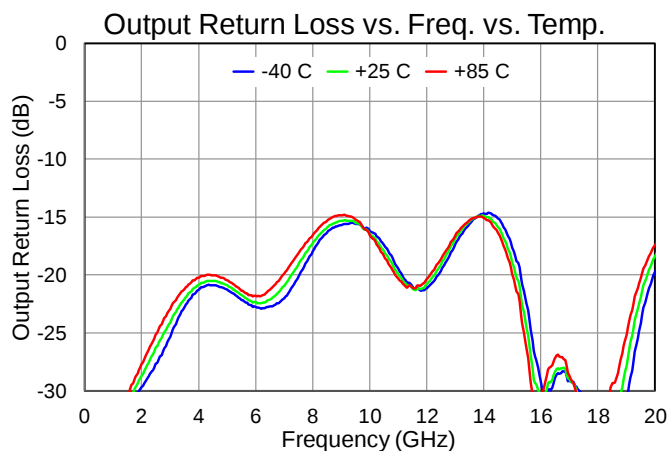
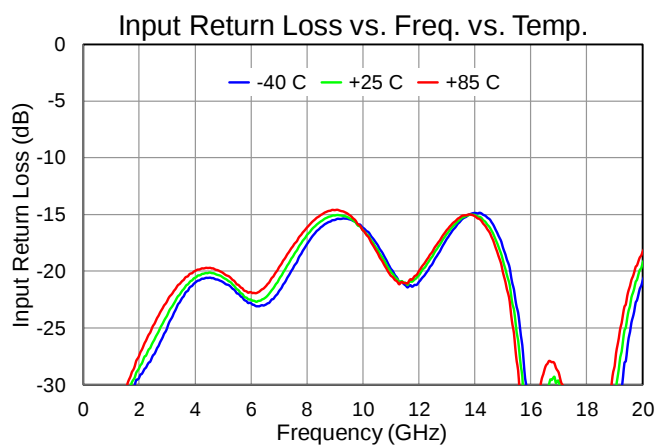
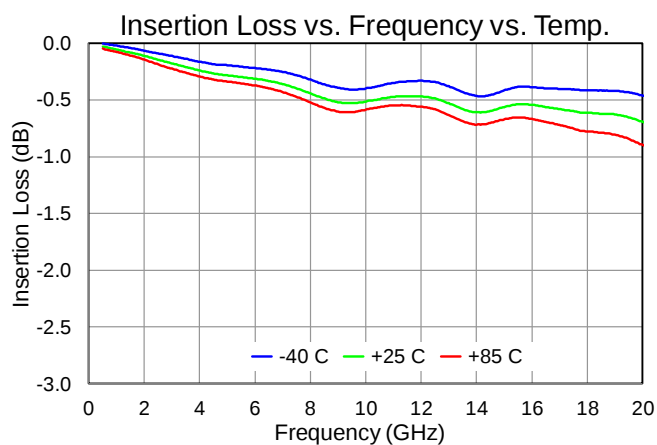
Parameter	Test Conditions	Value	Units
Incident Power ⁽¹⁾ (RF Operational Life Test)	Frequency = 10 GHz, RF Pulsed, PW=100 μ s, DC=10%, 50 Ω , 25°C	10	W

Notes:

1. Test terminated after 168 hours. Insertion Loss remained $\leq$ 1 dB for device under test.

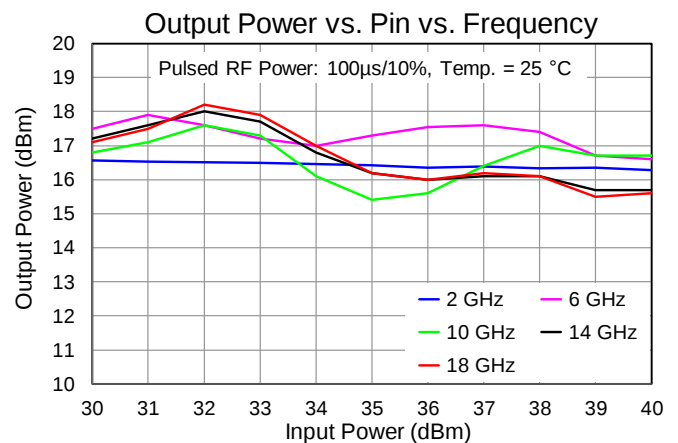
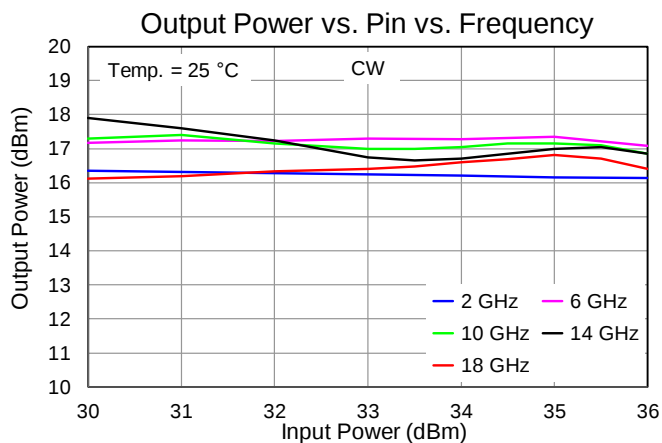
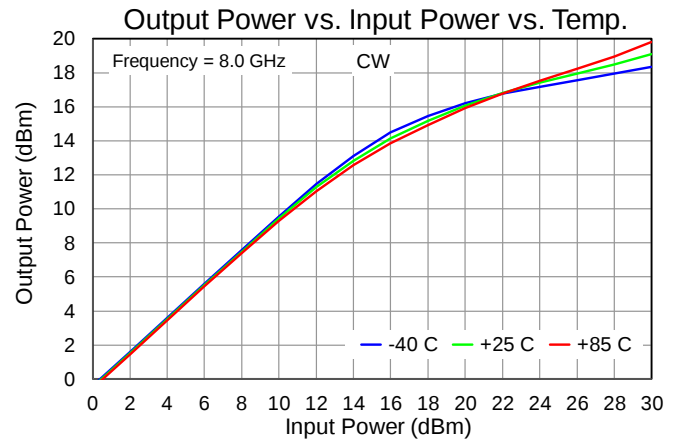
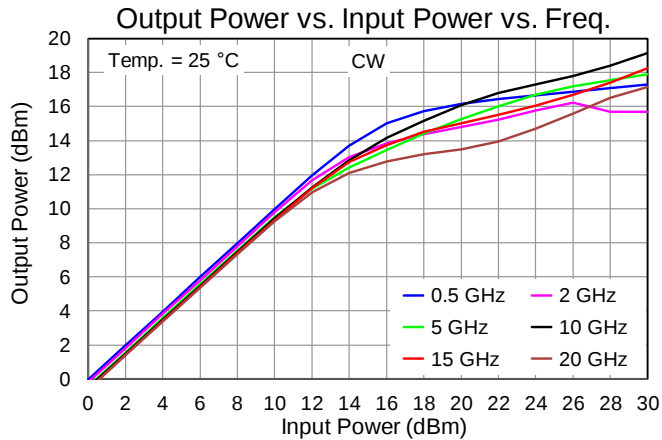
Performance Plots – Small Signal

Test conditions unless otherwise noted: Temp. = 25 °C

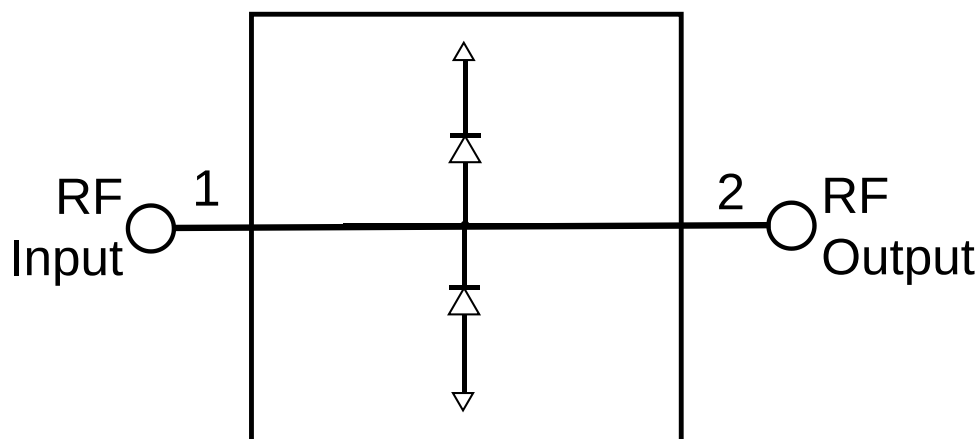


Performance Plots – Large Signal

Test conditions unless otherwise noted: Temp. = 25 °C

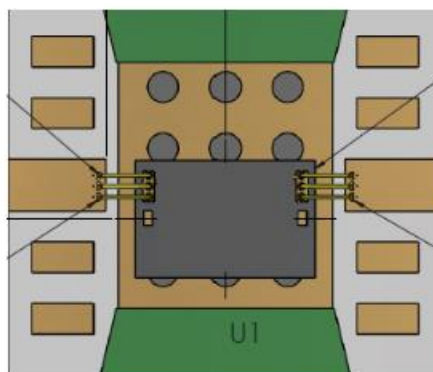
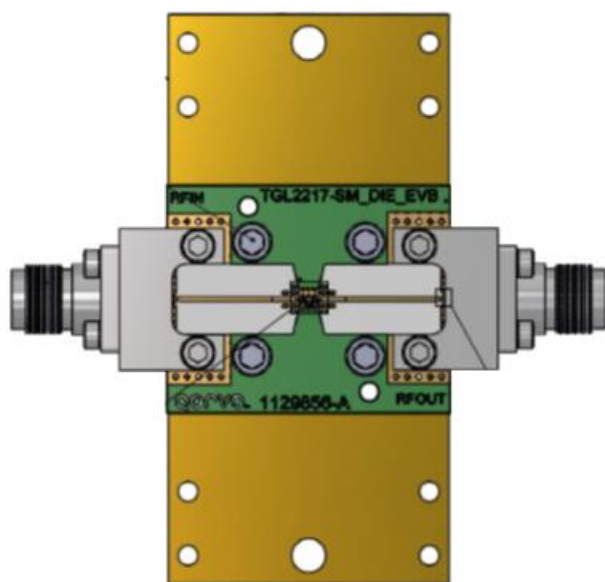


Applications Circuit



Note: RF Input and RF Output ports are not interchangeable.

Evaluation Board (EVB) Layout Assembly & Mounting Detail



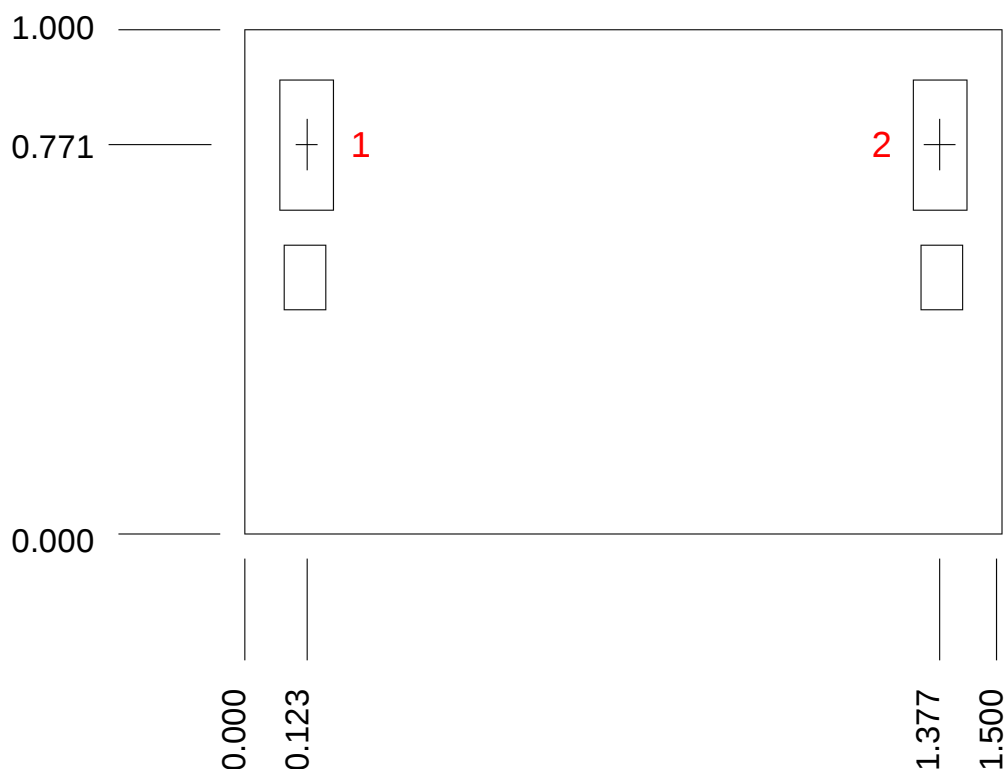
Die Mounting Detail

RF layer is 0.008" thick Rogers RO4003C, $\epsilon_r = 3.38$. Metal layers are 0.5-oz copper. The microstrip line taper 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 die to minimize inductance and thermal resistance.

Mechanical Drawing and 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

Pad No.	Symbol	Description	Pad Size (um x um)
1	RF Input	RF Input, 50 Ω , DC coupled	105 x 255
2	RF Output	RF Output, 50 Ω , DC coupled	105 x 255

NOTE: The RF Input and RF Output ports are not interchangeable.

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.
- Organic attachment (i.e., conductive epoxy) can be used in low-power applications.
- Curing should be done in a convection oven; proper exhaust is a safety concern.

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 are critical parameters.
- Aluminum wire should not be used.
- Devices with small pad sizes should be bonded with 0.0007-inch wire.

Handling Precautions

Parameter	Rating	Standard		Caution! ESD-Sensitive Device
ESD – Human Body Model (HBM)	Class 3B	ESDA / JEDEC JS-001-2012		

Solderability

Use only AuSn (80/20) solder, and limit exposure to temperatures above 300 °C to 3 – 4 minutes, maximum.

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 (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free

Contact Information

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TGL2217-SM

0.1 – 20 GHz 10 Watt VPIN Limiter

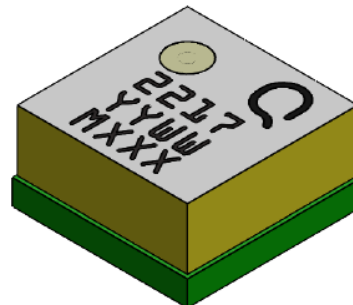
Product Overview

Qorvo's TGL2217-SM is a packaged high power, wideband GaAs VPIN limiter capable of protecting sensitive receive channel components against high power incident signals. The TGL2217-SM does not require DC bias and achieves a low insertion loss all in a small form factor. These features allow for simple integration with minimal impact to system performance.

The TGL2217-SM operates from 0.1–20.0 GHz with low insertion loss of less than 0.9 dB. Receive protection is rated up to 10 W incident pulsed power with a low flat leakage of less than 18.5 dBm.

The TGL2217-SM is offered in a small 3.5 x 3.5 mm QFN package for simple board level assembly. Fully matched to 50 ohms on both RF ports, it is well suited for both commercial and defense related applications.

Lead-free and RoHS compliant.



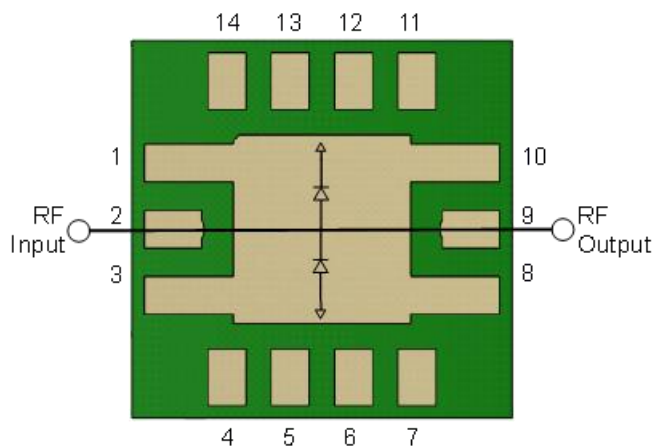
14 Pad 3.5 x 3.5 mm Air Cavity QFN Package

Key Features

- Frequency Range: 0.1 to 20.0 GHz
- Insertion Loss: < 0.9 dB
- Peak Power Handling: 10 W (pulsed)
- Flat Leakage: < 18.5 dBm
- Spike Leakage < 20.5 dBm
- Recovery Time < 40 nS
- Passive (no DC bias required)
- QFN Package Dimensions: 3.50 x 3.50 x 1.715 mm

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

Functional Block Diagram



Top View

Applications

- Receive Chain Protection
- Commercial and Military Radar
- Electronic Warfare
- Communications

Ordering Information

Part	Description
TGL2217-SM	0.1–20.0 GHz 10W VPIN Limiter
TGL2217-SMEVB01	0.1–20.0 GHz 10W VPIN Limiter Evaluation Board

Absolute Maximum Ratings

Parameter	Rating
Incident Power, Pulsed, 50 Ω , 85 °C	40 dBm
Incident Power, CW, 50 Ω , 25 °C	36 dBm
Incident Power, CW, 50 Ω , 85 °C	33 dBm
Mounting Temperature (30 s max)	260 °C
Storage Temperature	-40 to 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
Operating Temperature Range	-40	+25	+85	°C
Passive – No Bias				

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

Parameter	Conditions ⁽¹⁾	Min	Typ	Max	Units
Operational Frequency Range		0.1		20.0	GHz
Insertion Loss	0.5 GHz		0.08	0.3	dB
	5 GHz		0.27	0.5	
	10 GHz		0.45	0.8	
	15 GHz		0.64	1.1	
	20 GHz		0.83	1.2	
Input Return Loss	0.5 GHz		39		dB
	5 GHz		26		
	10 GHz		24		
	15GHz		19		
	20 GHz		17		
Output Return Loss	0.5 GHz		40		dB
	5 GHz		26		
	10 GHz		27		
	15 GHz		18		
	20 GHz		17		
Flat Leakage Power at $P_{IN} > 30$ dBm, (CW)	2 GHz		16.7		dBm
	10 GHz		17.7		
	18 GHz		16.9		
Pulse Recovery Time			< 40		nS
Spike Leakage			20.5		dBm
Insertion Loss Temperature Coefficient			0.002		dB/ °C

Thermal and Reliability Information

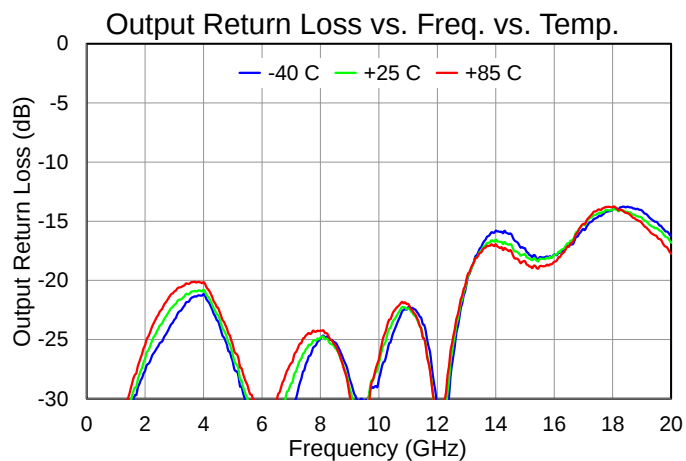
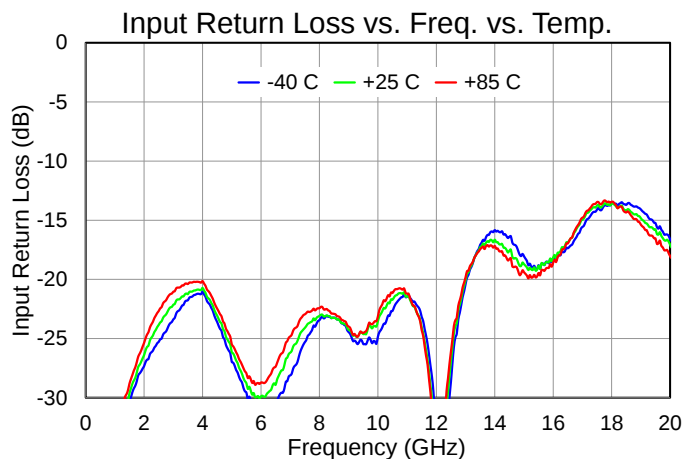
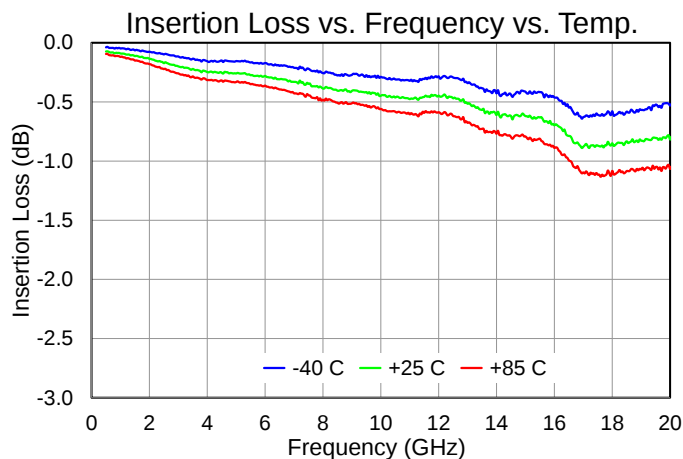
Parameter	Test Conditions	Value	Units
Incident Power ⁽¹⁾ (RF Operational Life Test)	Frequency = 10 GHz, RF Pulsed, PW=100 μ s, DC=10%, 50 Ω , 25°C	10	W

Notes:

1. Test terminated after 168 hours. Insertion Loss remained ≤ 1 dB for device under test.

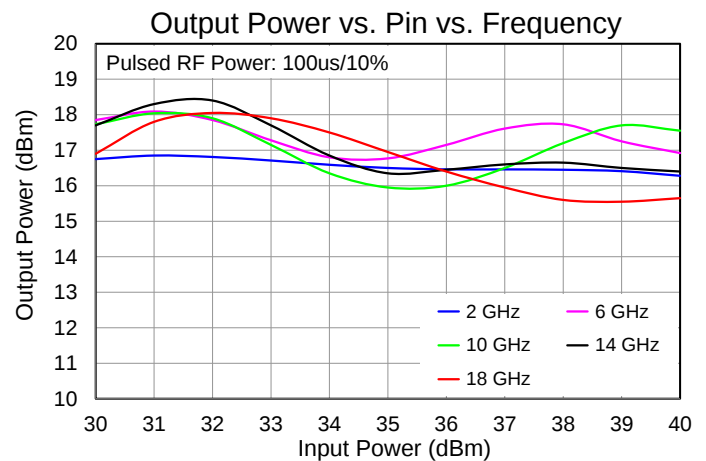
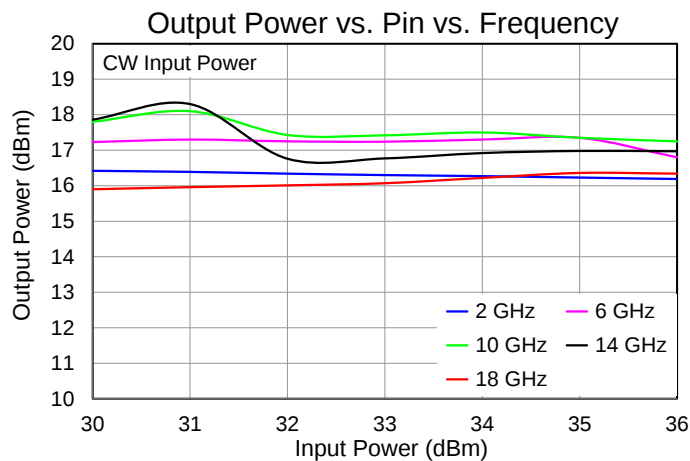
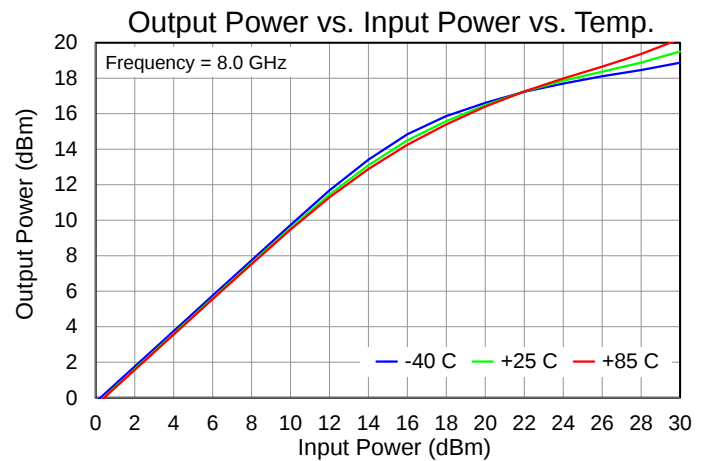
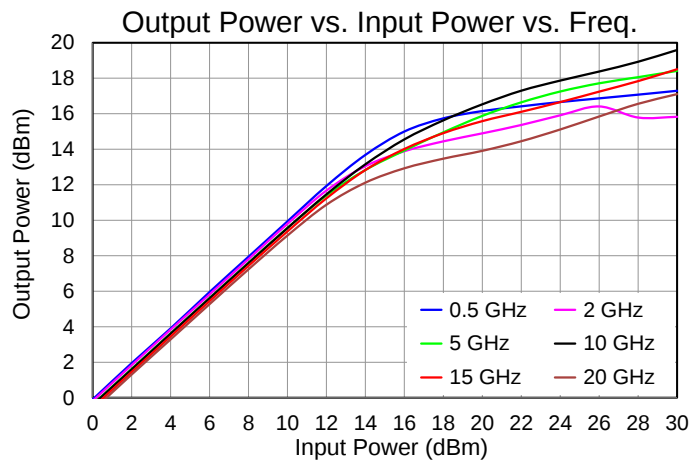
Performance Plots – Small Signal

Test conditions unless otherwise noted: Temp.=+25 °C

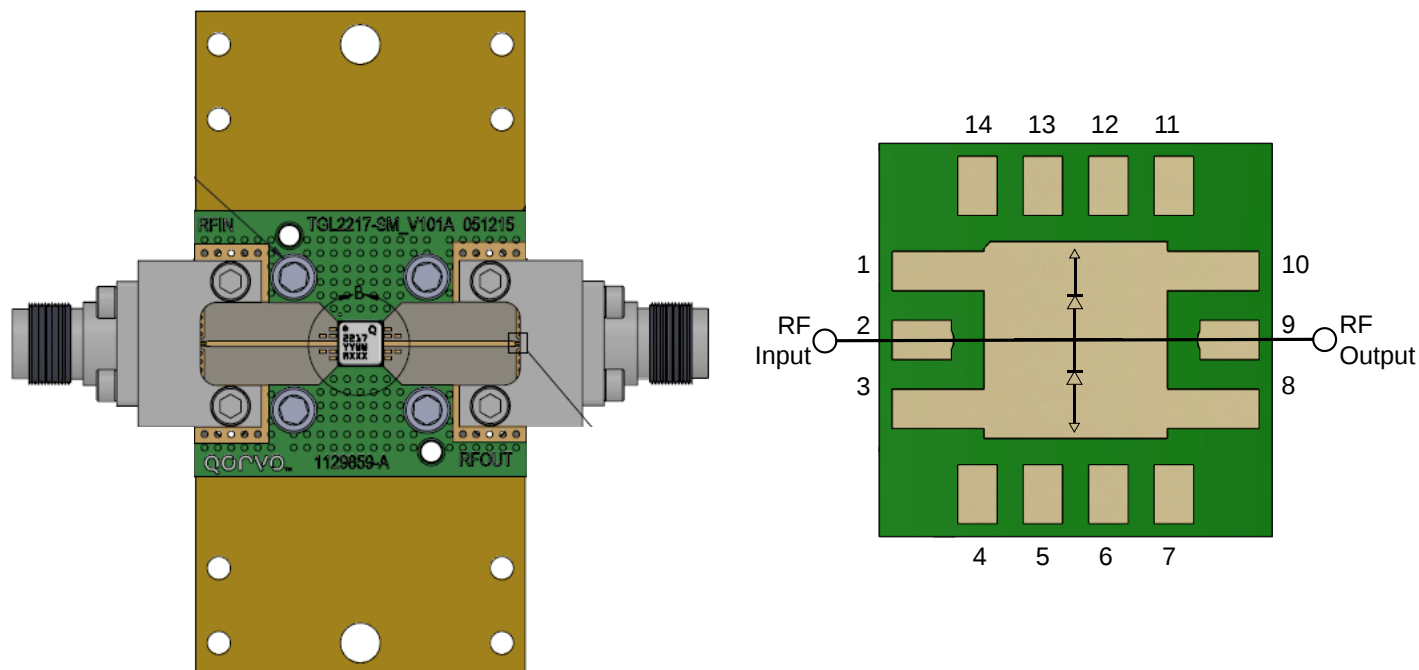


Performance Plots – Large Signal

Test conditions unless otherwise noted: Temp.=+25 °C



Application Circuit and Evaluation Board (EVB)



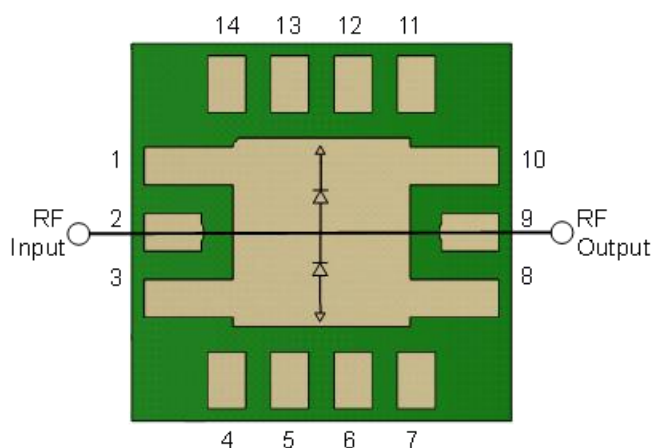
Notes:

1. See Evaluation Board PCB Information for material and stack up.

Bill of Material – EVB

Ref. Des.	Value	Description	Manuf.	Part Number
n/a	n/a	Printed Circuit Board	Qorvo	
U1	n/a	0.1 – 20 GHz 50 W VPIN Limiter	Qorvo	TGL2217-SM
J1, J2	n/a	2.92 mm End Launch Connector	Southwest Microwave	1092-01A-5

Pad Configuration and Description



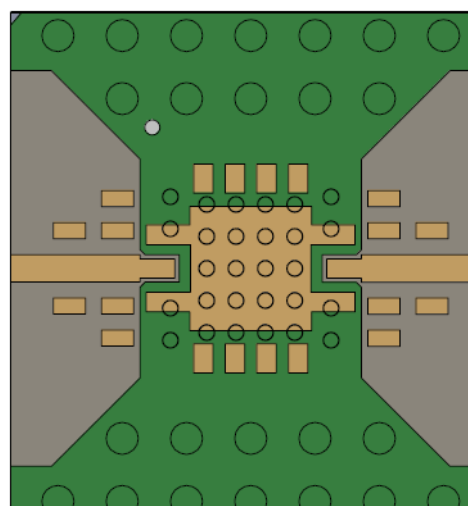
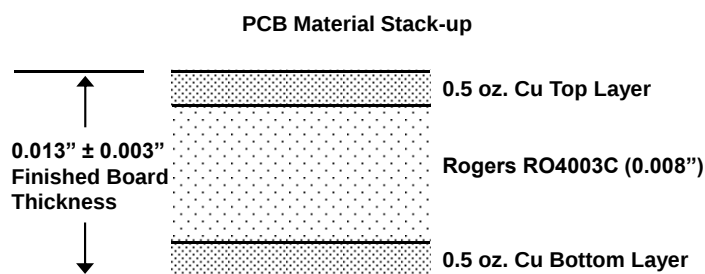
Top View

Pad No.	Label	Description
1, 3, 8, 10	GND	On PCB, multiple copper-filled vias should be employed under the center pad to minimize inductance and thermal resistance
2	RF Input	RF Input, matched to 50 Ohms, not DC blocked
4–7, 11–14	NC	No connection; connecting to ground may improve performance
9	RF Output	RF Output, matched to 50 Ohms, not DC blocked

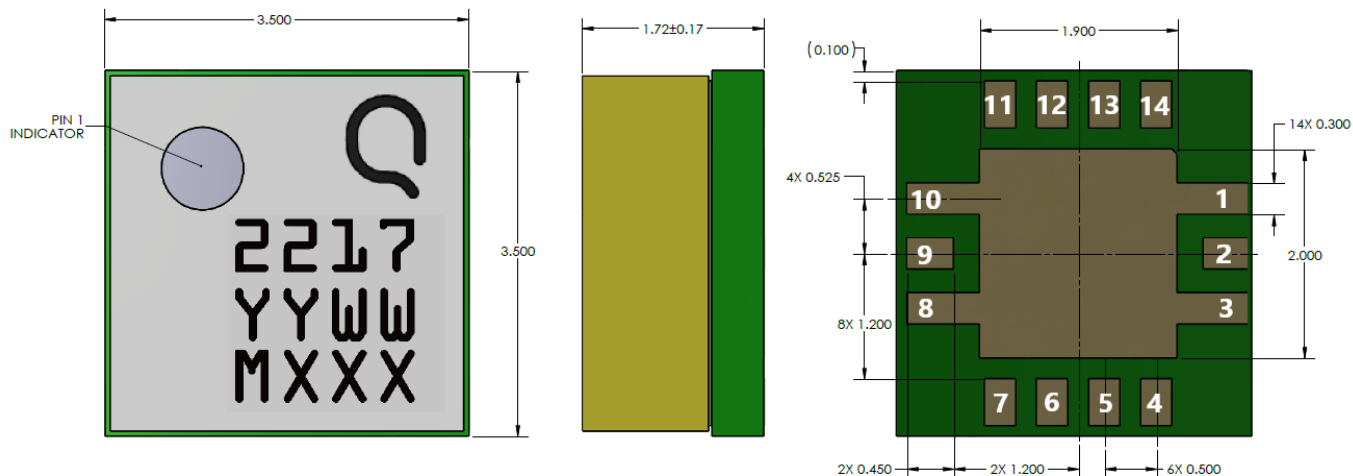
NOTE: The RF Input and RF Output ports are not interchangeable.

Evaluation Board PCB Information and Mounting Detail

EVB PC Board Layout



Package Marking and Dimensions



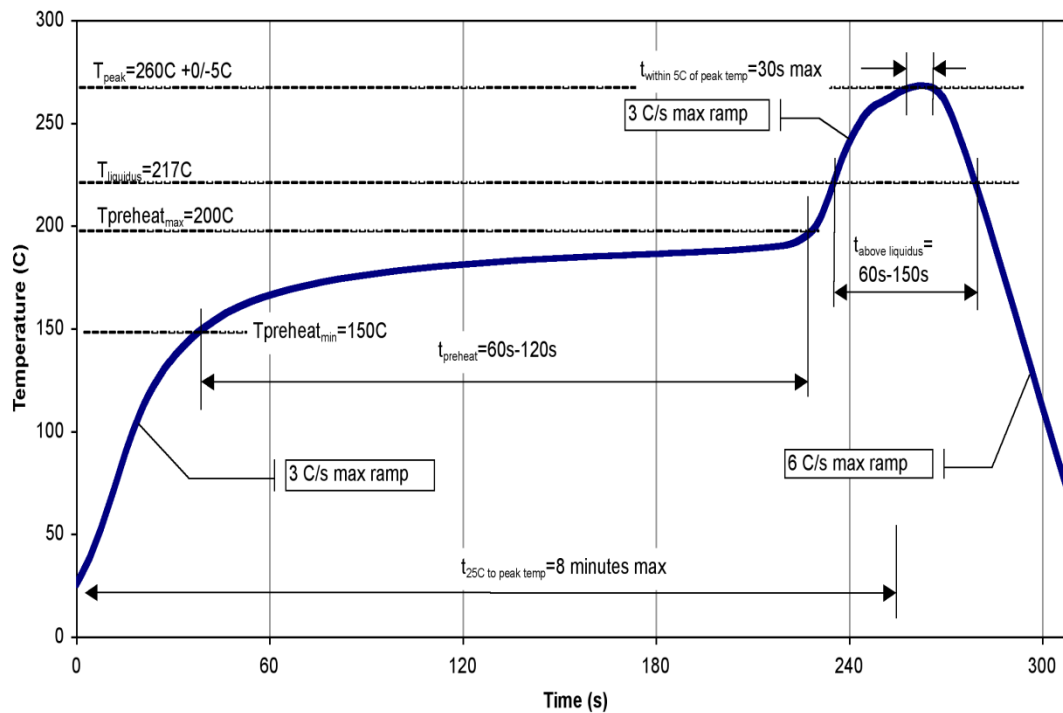
Notes:

- All dimensions are in millimeters. Angles are in degrees.
Tolerances: XX = $\pm .25$
XXX = $\pm .100$
- Package Base: Laminate
- Package Lid: FR4
- All Metalized Features Are Gold Plated.
- The Part Is Epoxy Sealed
- Part Marking:
2217: Part Number
YY: Part assembly Year
WW: Part Assembly Week
MXXX: Batch ID

Assembly Notes

- Compatible with lead-free soldering process with 260°C peak reflow temperature.
- This package is non-hermetic, and therefore cannot be subjected to aqueous washing. The use of no-clean solder to avoid washing after soldering is recommended
- Solder rework not recommended.
- Contact plating: Ni-Au

Recommended Soldering Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 3B	ESDA / JEDEC JS-001-2012
ESD – Charged Device Model (CDM)	Class C3	JEDEC JESD22-C101F
MSL – Moisture Sensitivity Level	Level 3	IPC/JEDEC J-STD-020



Caution!
ESD-Sensitive Device

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
- Antimony Free
- TBBP-A (C₁₅H₁₂Br₄O₂) Free
- PFOS Free

Contact Information

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TGL2927-SM

2 – 4 GHz 200 Watt VPIN Limiter

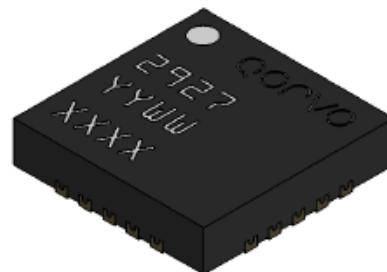
Product Overview

Qorvo's TGL2927-SM is a high-power receive protection circuit (limiter) operating from 2-4 GHz. Capable of withstanding up to 200 W incident power levels, the TGL2927-SM allows < 18 dBm flat leakage to pass through and contributes < 0.6 dB in insertion loss.

Using Qorvo's passive GaAs VPIN technology, the TGL2927-SM does not require bias and is offered in a small 4 x 4 (mm) plastic overmold package. This simplifies system integration while maximizing performance and protection.

The TGL2927-SM is ideal for commercial and military radar applications where protecting sensitive receive components from damage is critical.

Lead-free and RoHS compliant.



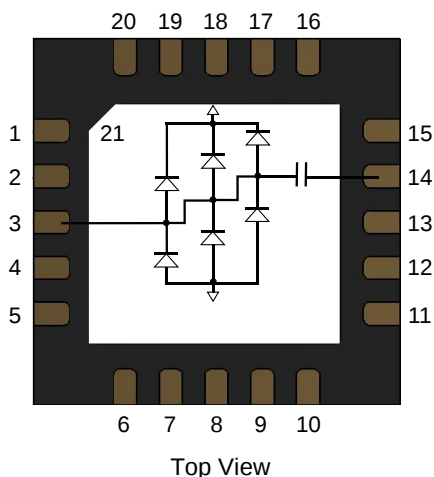
20 Pad 4 x 4 mm QFN Package

Key Features

- Frequency Range: 2 to 4 GHz
- Insertion Loss: 0.5 dB
- Peak Power Handling: 200 W (pulsed)
- Flat Leakage: 15 dBm
- Spike Leakage: < 1 dB
- Recovery Time: < 20 nS
- Passive (no DC bias required)
- Integrated DC Block on output
- Package Dimensions: 4 x 4 x 0.85 mm

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

Functional Block Diagram



Applications

- Receive Chain Protection
- Commercial and Military Radar
- Communications
- Electronic Warfare

Ordering Information

Part	Description
TGL2927-SM	200W S-Band VPIN Limiter
TGL2927-SM_EVB	200W S-Band VPIN Limiter Evaluation Board

Absolute Maximum Ratings

Parameter	Rating
Incident Power, Pulsed (500 us / 15%), 50 Ω , 25 °C	54.0 dBm
Incident Power, Pulsed (500 us / 15%), 50 Ω , 85 °C	50.5 dBm
Mounting Temperature (30 s max)	260 °C
Storage Temperature	-55 to 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
Passive – No Bias				
Temperature Range	-40	25	85	°C

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

Electrical Specifications ⁽¹⁾

Parameter	Conditions	Min	Typ	Max	Units
Operational Frequency Range		2		4.0	GHz
Insertion Loss	2.0 – 4.0 GHz	0.2	0.50	0.85	dB
Input Return Loss		10	15		dB
Output Return Loss		11	15		dB
Flat Leakage Power	@ P _{IN} > 30 dBm		15	20	dBm
Spike Leakage			< 1.0		dB
Pulse Recovery Time			< 20		nS
Insertion Loss Temperature Coefficient			0.001		dB/ °C

Notes:

- Test conditions unless otherwise noted: Temp = +25 °C, S-Parameters CW, Power Pulse Parameters: PW = 500 us, Duty Cycle = 15%

Thermal and Reliability Information

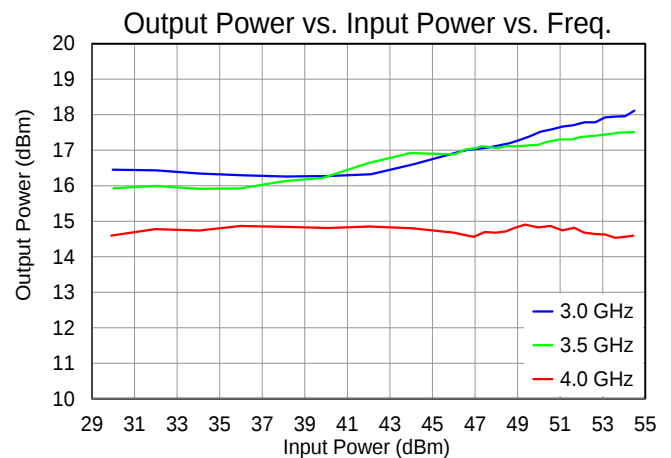
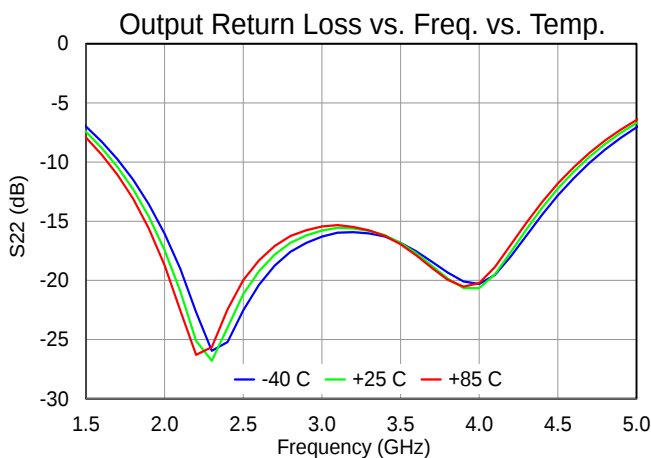
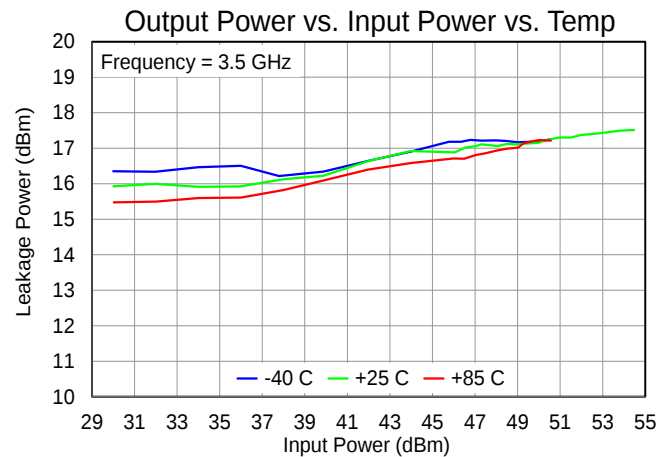
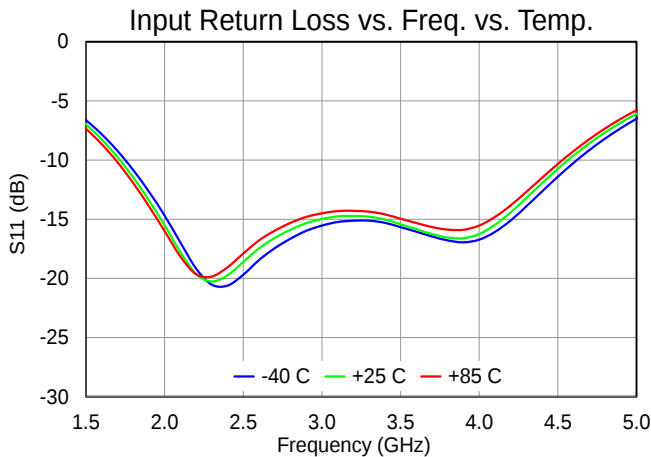
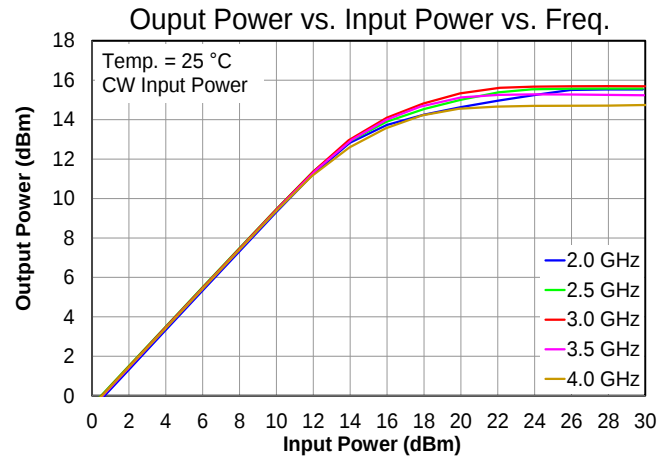
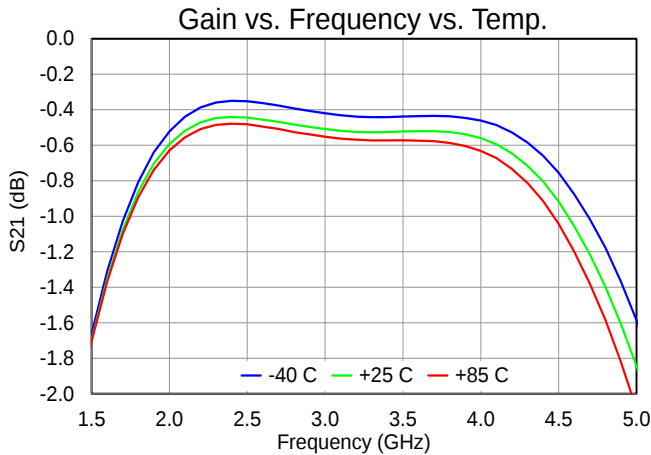
Parameter	Test Conditions	Value	Units
Incident Power (RF Operational Life Test 168 Hours ⁽¹⁾)	Frequency = 3.3 GHz, Pulsed, PW = 100 us, DC = 10%, 50 Ω , 25 °C	200	W

Notes:

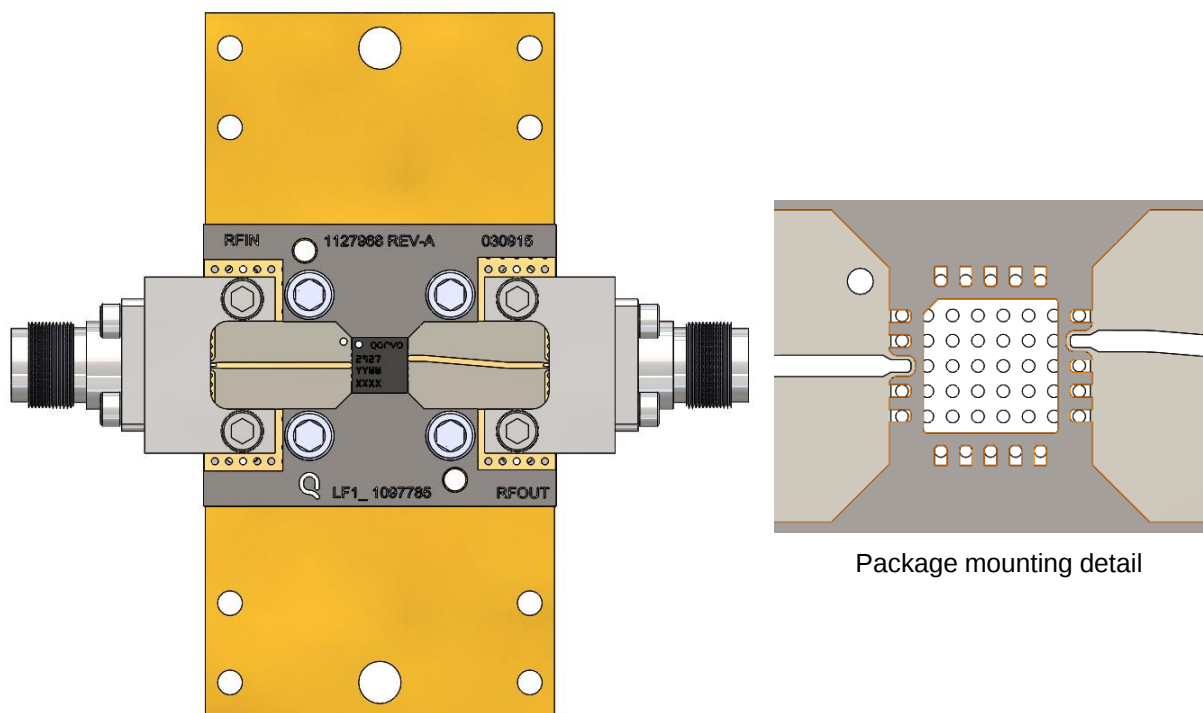
- Test was terminated at 168 hours. Insertion Loss remained $\leq$ 1 dB for device under test.

Performance Plots

Test conditions unless otherwise noted: 25 °C, S-Parameters CW, Power Pulse Parameters: PW = 500 us, Duty Cycle = 15%



Evaluation Board (EVB) and Mounting Detail



RF Layer is 0.010" thick Rogers Corp. RO4003C, $\epsilon_r = 3.38$. Metal layers are 0.5 oz. copper. The microstrip line at the connector interface is optimized for the Southwest Microwave end launch connector 1092-02A-5.

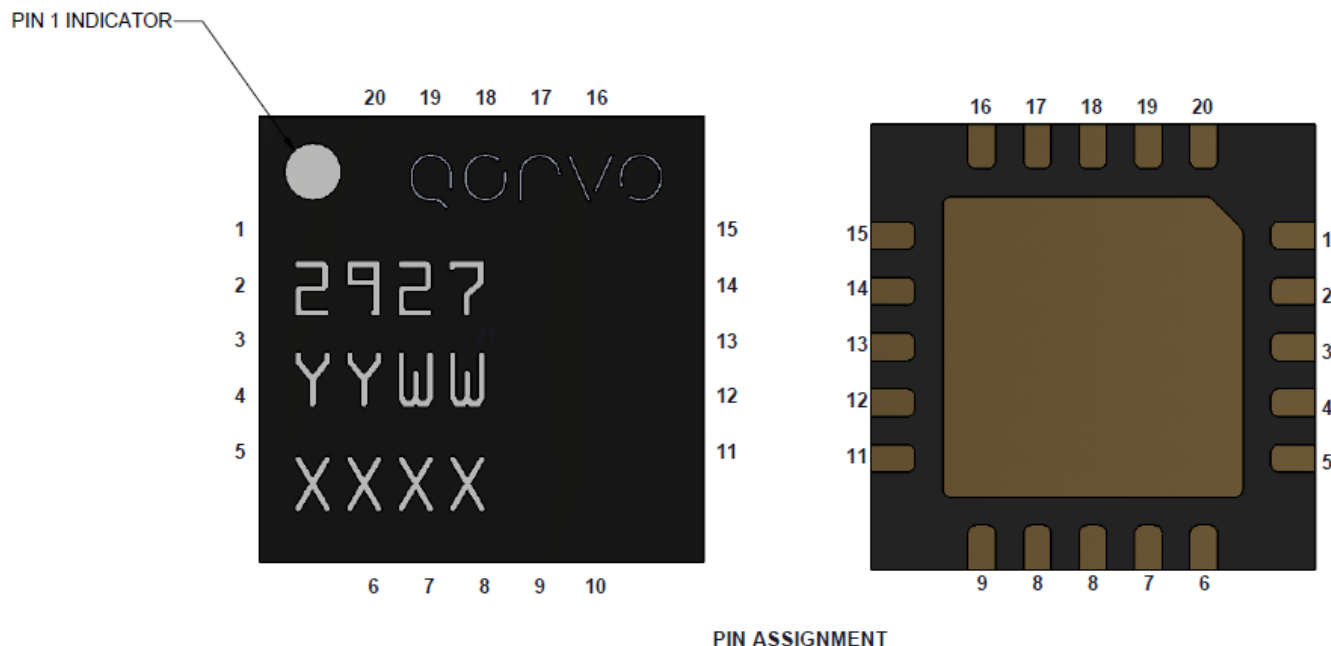
The trace pattern shown has been developed and tested for optimized assembly at Qorvo. The PCB land pattern has been developed to accommodate lead tolerances. Since processes vary from company to company, careful process development is recommended.

For pulsed applications, only. Increased pulse width and/or duty cycle results in lower power handling capability of the EVB.

Notes:

1. Ground / thermal vias under the DUT are critical for the proper performance of this device.
2. The EVB shown herein utilizes copper filled vias (10 mil diameter) under the DUT to maximize heat transfer away from the DUT under large signal conditions.
3. Thermal dissipation is low for normal non-limiting operation.

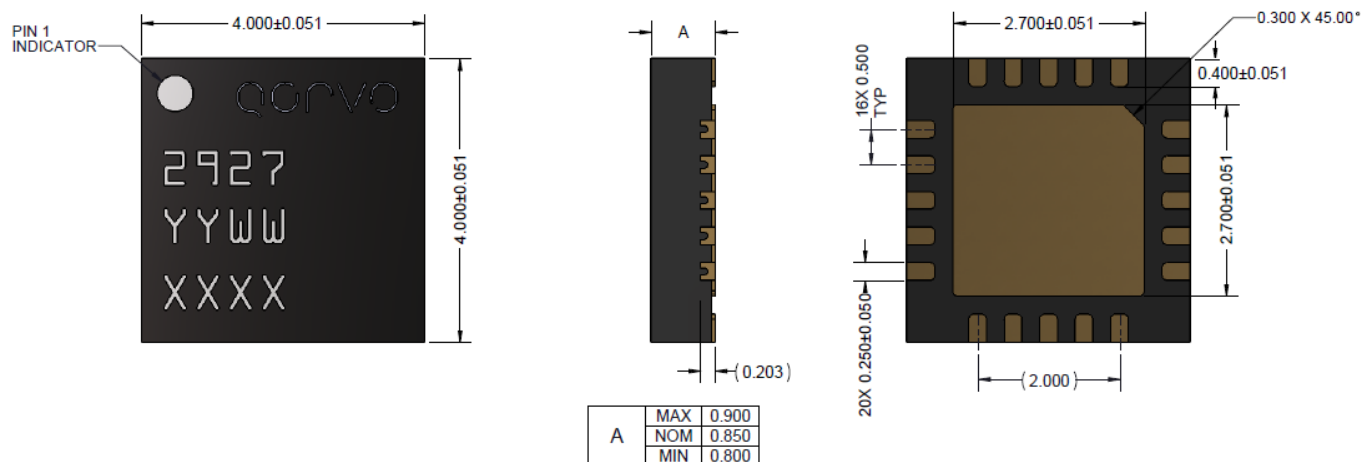
Pad Configuration and Description



Pad No.	Label	Description
1, 2, 4 - 13, 15 - 20	NC	No connection. Recommend connecting to ground at EVB level may improve performance
3	RF Input	RF Input, matched to 50 Ohms, DC coupled
14	RF Output	RF Input, matched to 50 Ohms, DC blocked
21	GND	On PCB, multiple copper-filled vias should be employed under the center pad to minimize inductance and thermal resistance

NOTE: The RF Input and RF Output ports are not interchangeable.

Package Marking and Dimensions



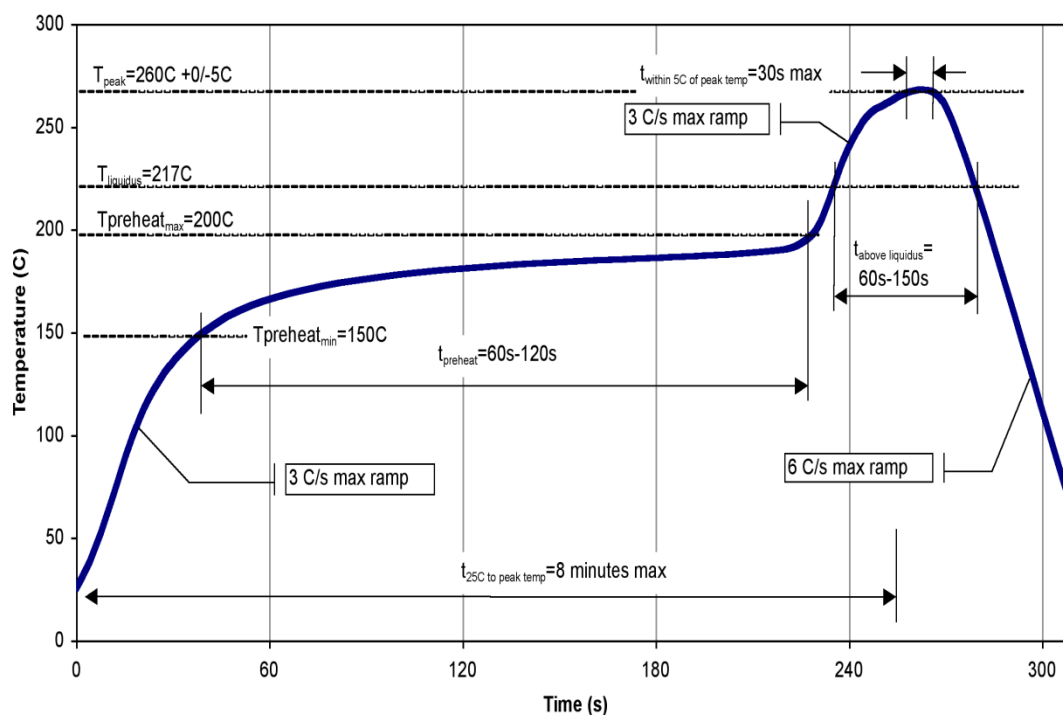
Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Package Lead are Gold Plated
3. Part is Mold Encapsulated
4. Part Marking:
2927: Part Number
YY: Part Assembly Year
WW: Part Assembly Week
XXXX: Batch ID

Solderability

1. Compatible with the latest version of J-STD-020, Lead-free solder, 260° C, and tin/lead (245°C max. reflow temp.) soldering processes.
2. The use of no-clean solder to avoid washing after soldering is recommended.
3. Contact plating: Ni-Pd-Au.

Recommended Soldering Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1C	ESDA / JEDEC JS-001-2012
ESD – Charged Device Model (CDM)	Class C3	JEDEC JESD22-C101F
MSL – Moisture Sensitivity Level	Level 3	IPC/JEDEC J-STD-020



Caution!
ESD-Sensitive Device

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 (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free

Contact Information

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

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