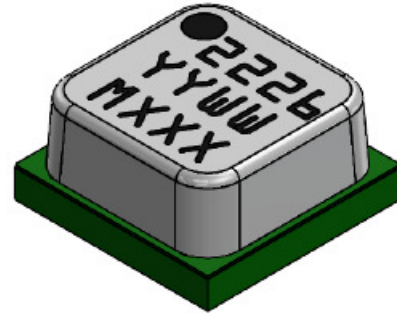


Applications

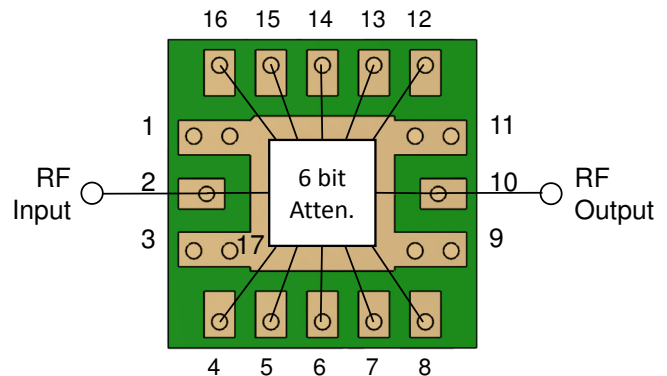
- Commercial and Military Radar
- Electronic Warfare
- Satellite Communications
- Point to Point Radio
- General Purpose



Product Features

- Frequency Range: 0.1-15 GHz
- 6-Bit Digital Attenuator
- Attenuation Step Size (LSB): 0.5 dB
- Attenuation Range: 31.5 dB
- Insertion Loss (Ref. State): 3.0–4.0 dB
- RMS Attenuation Error: < 2.2 dB
- Control Voltage: –3.0 to –5.0 V
- Package Size: 3.0 x 3.0 x 1.5 mm

Functional Block Diagram



General Description

Qorvo's TGL2226–SM is a wideband, 6–bit digital attenuator fabricated using Qorvo's production 0.15um GaAs pHEMT process (QPHT15). Operating from 0.1–15 GHz, the TGL2226–SM offers a low LSB of 0.5 dB and provides 31.5 dB of attenuation range while supporting low insertion loss and RMS attenuation errors.

Using standard, negative control voltages from –3.0 V to –5.0 V coupled with excellent broadband performance, the TGA2226–SM is ideal for supporting a variety of commercial and military applications.

The TGL2226–SM is packaged in a 3.0 x 3.0 mm surface mount package, with both RF ports matched to 50 ohms for simple system integration.

Lead-free and RoHS compliant.

Evaluation Boards available on request.

Pad Configuration

Pad Number	Symbol
1,3,7,9,11,17	Ground
2	RF Input
4	B7
5	B1
6	B2
7	B5
8	B9
10	RF Output
12	B10
13	B6
14	B3
15	B4
16	B8

Ordering Information

Part	ECCN	Description
TGL2226-SM	EAR99	0.1-15 GHz 6-Bit Digital Attenuator

Absolute Maximum Ratings

Parameter	Value
Control Voltage (V _C)	-6 V
Control Current (I _C)	1 mA
Input Power (P _{IN})	23 dBm
Power Dissipation (P _{DISS})	0.7 W
Operating Channel Temperature	150 °C

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

Recommended Operating Conditions

Parameter	Value
Control Voltage (logic L) ¹	-5 V
Control Voltage (logic H)	0 V

¹ Control voltage down to -3.0V is acceptable

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

Electrical Specifications

Test conditions, unless otherwise noted: 25 °C, V_C = 0 / -5.0 V. Tested with DUT on EVB, reference plane at package.

Parameter	Min	Typical	Max	Units
Frequency Range	0.1		15	GHz
LSB Attenuation		0.5		dB
Attenuation range		31.5		dB
Reference State Insertion Loss: 0.1-5 GHz		< 3.0		dB
Reference State Insertion Loss: 5-10 GHz		< 3.6		dB
Reference State Insertion Loss: 10-15 GHz		< 4.0		dB
Input Return Loss		> 13		dB
Output Return Loss		> 11		dB
IIP3 (1.0 MHz spacing, P _{IN} /Tone = 5 dBm, 8 GHz)		> 31.5		dBm
Switching Speed (10%-90%, 90%-10%)		< 30		ns
RMS Attenuation Error		< 2.2		dB
Max. Attenuation Error		< 5.7		dB

Specifications

Thermal and Reliability Information

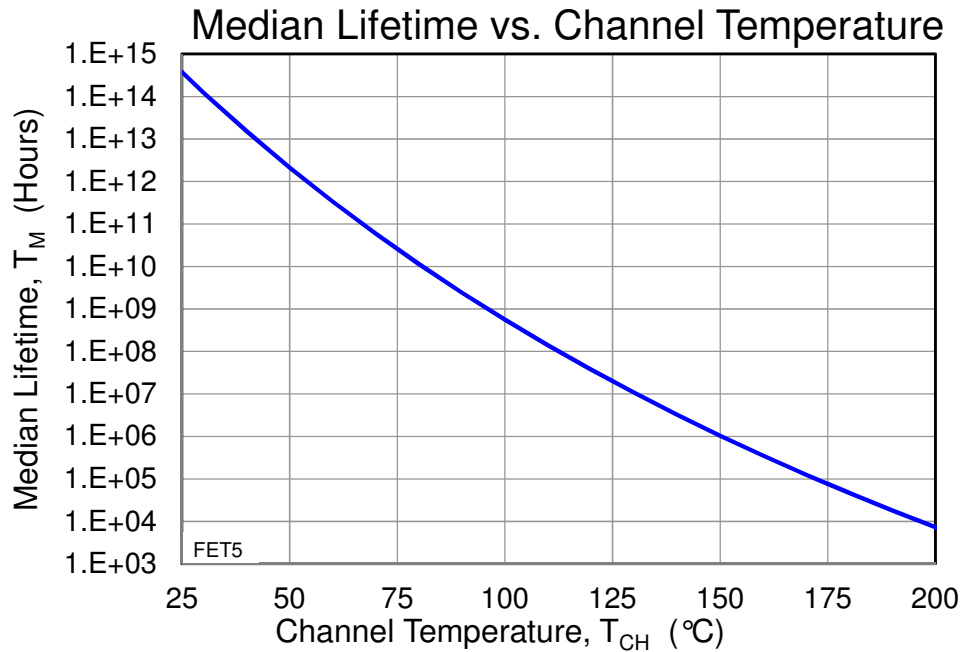
Parameter	Conditions	Value	Units
Thermal Resistance (θ_{JC}) ⁽¹⁾	$T_{BASE} = 85\text{ }^{\circ}\text{C}$, $V_C = -5.0\text{ V}$, $P_{IN} = 23\text{ dBm}$, $P_{DISS} = 0.105\text{ W}$	56.9	$^{\circ}\text{C/W}$
Channel Temperature (T_{CH}) ⁽¹⁾		102	$^{\circ}\text{C}$
Median Lifetime (T_M)		5.6E08	Hrs

Note:

1. Package base backside temperature fixed at 85 $^{\circ}\text{C}$.

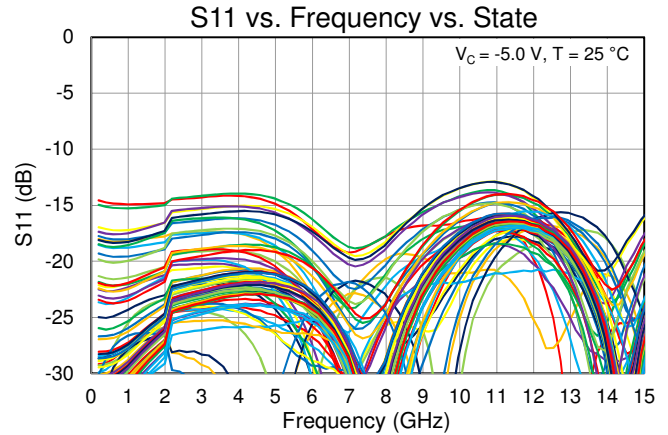
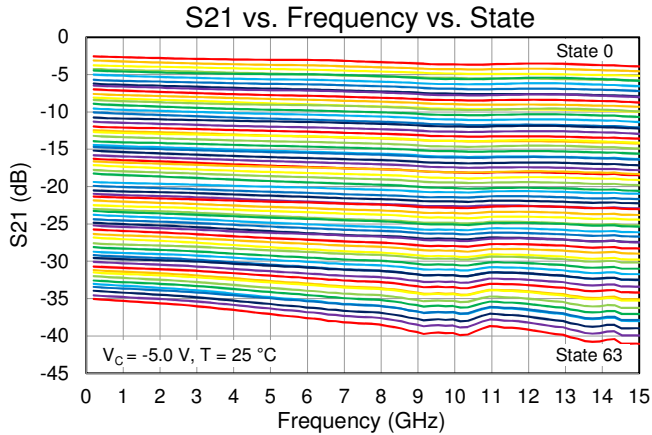
Median Lifetime

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

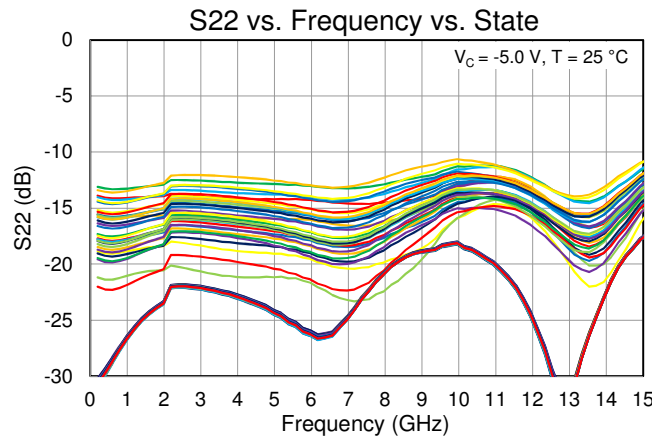


Typical Performance

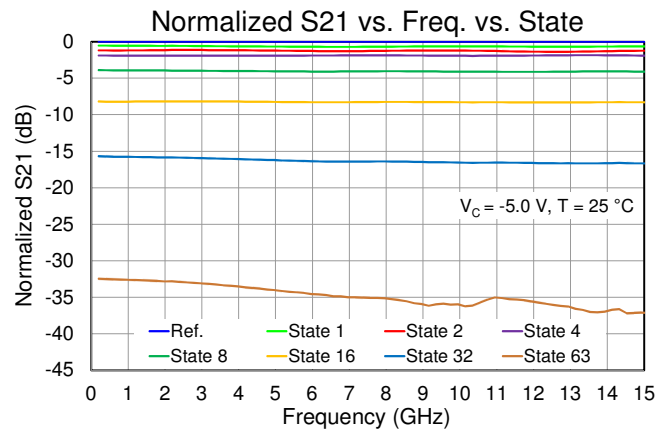
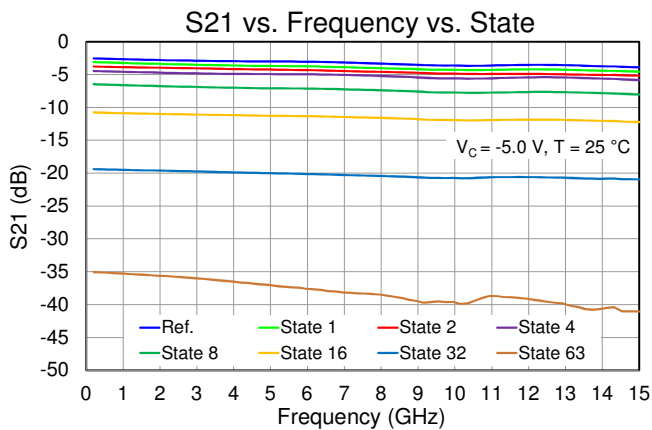
Test conditions unless otherwise noted: Tested with DUT on EVB, reference plane at package.



2 GHz discontinuity due to calibration artifact.

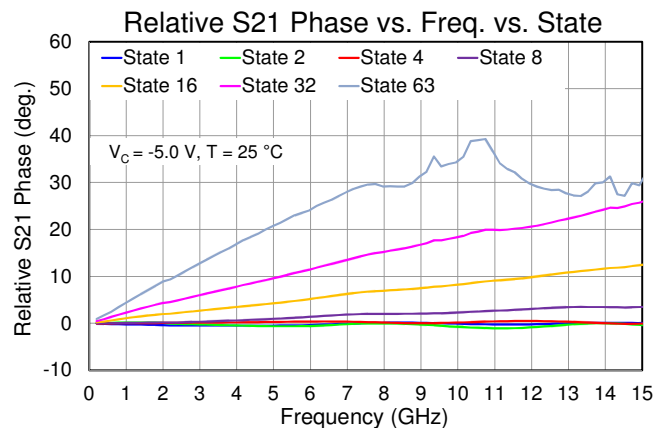
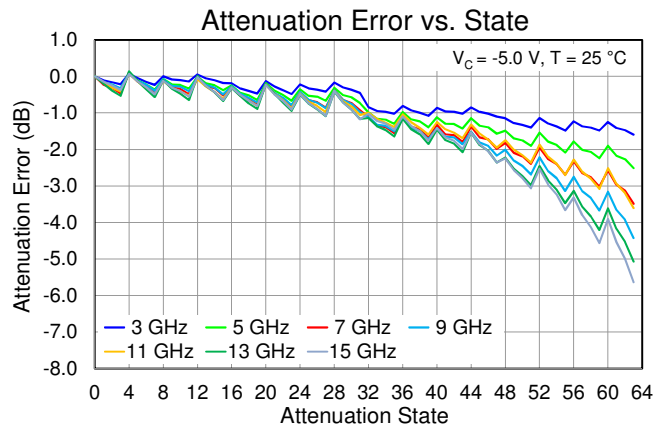
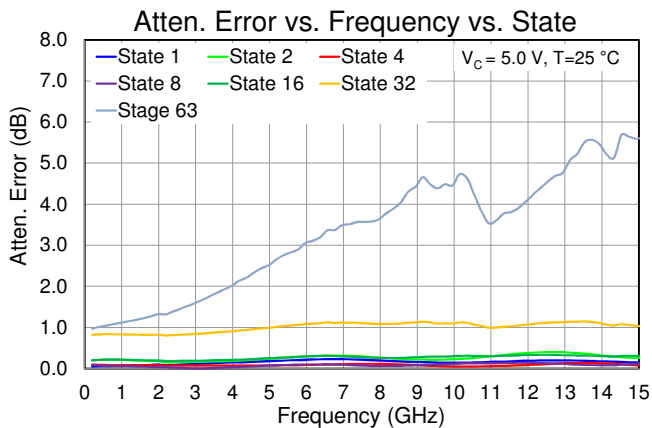
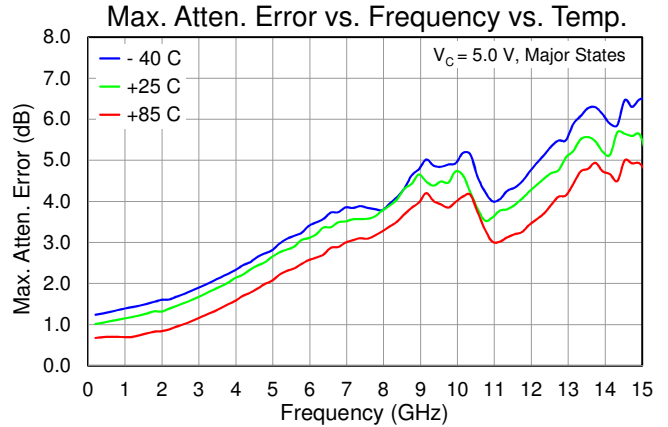
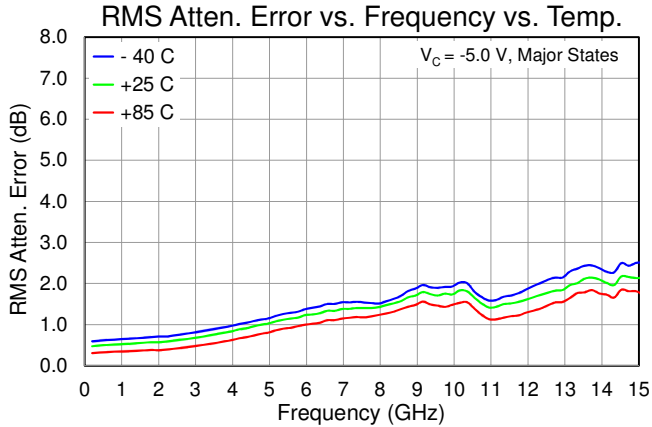


2 GHz discontinuity due to calibration artifact.



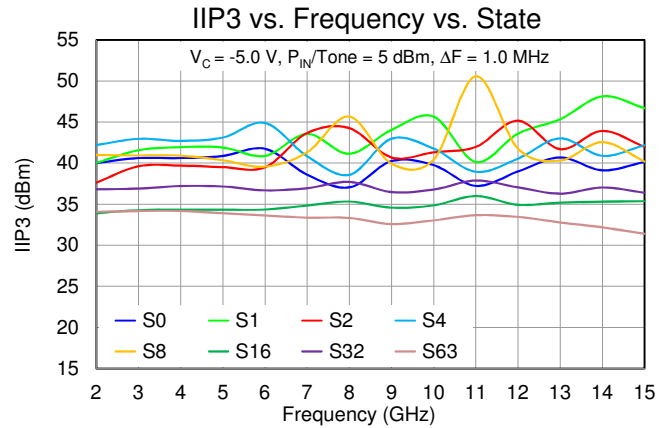
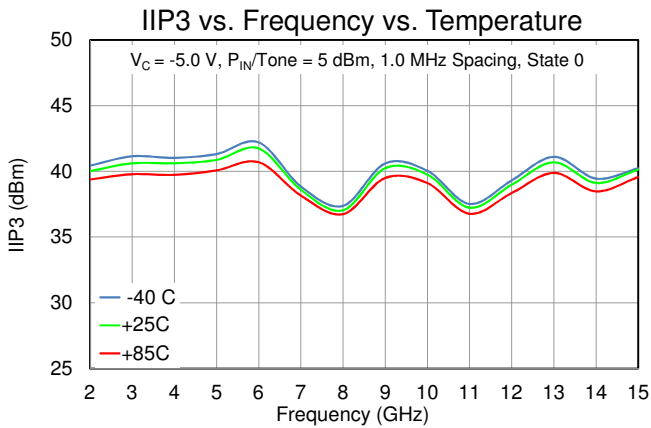
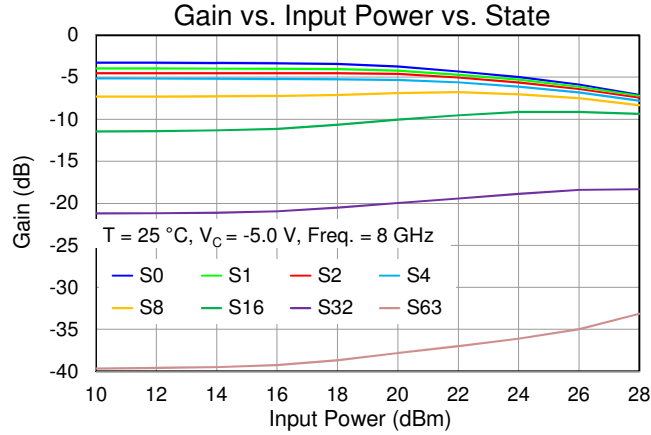
Typical Performance

Test conditions unless otherwise noted: Tested with DUT on EVB, reference plane at package.

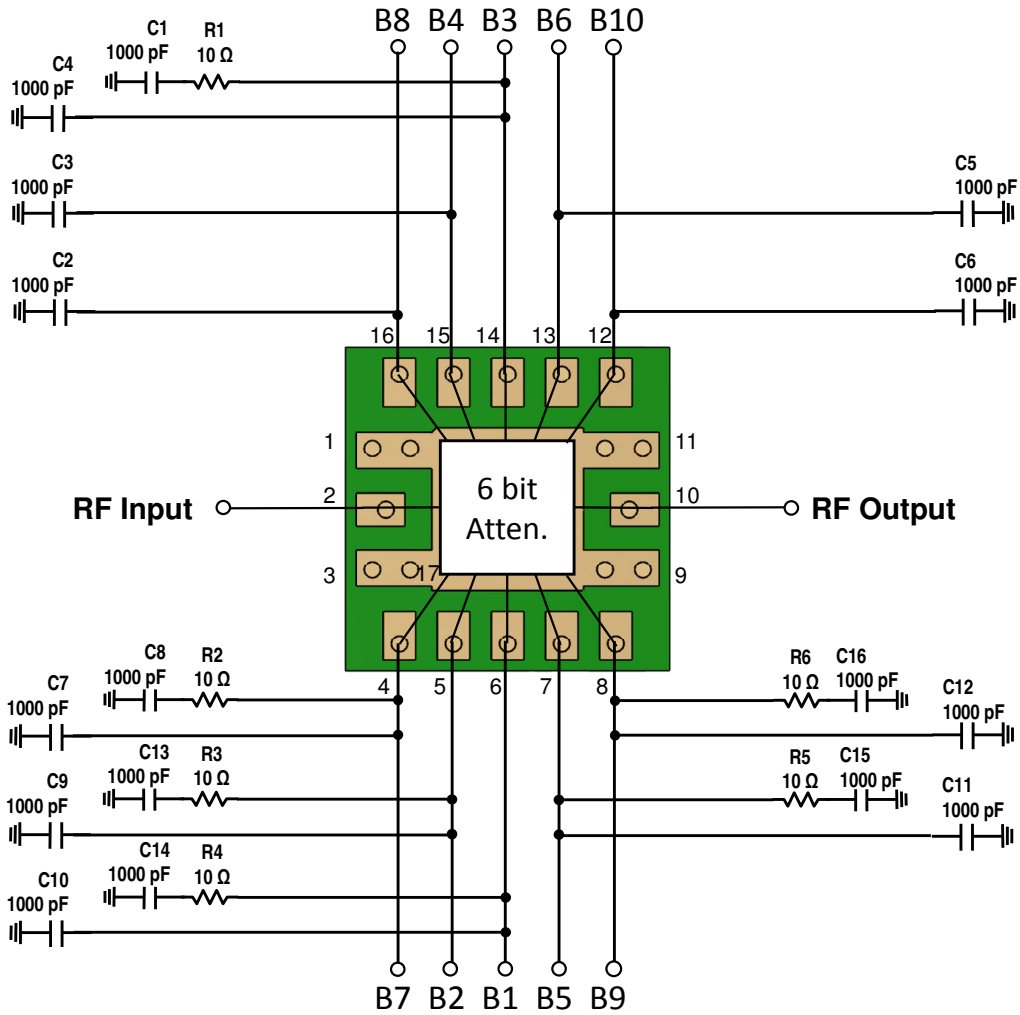


Typical Performance

Test conditions unless otherwise noted: Tested with DUT on EVB, reference plane at package.



Application Circuit



Function Table – Major States

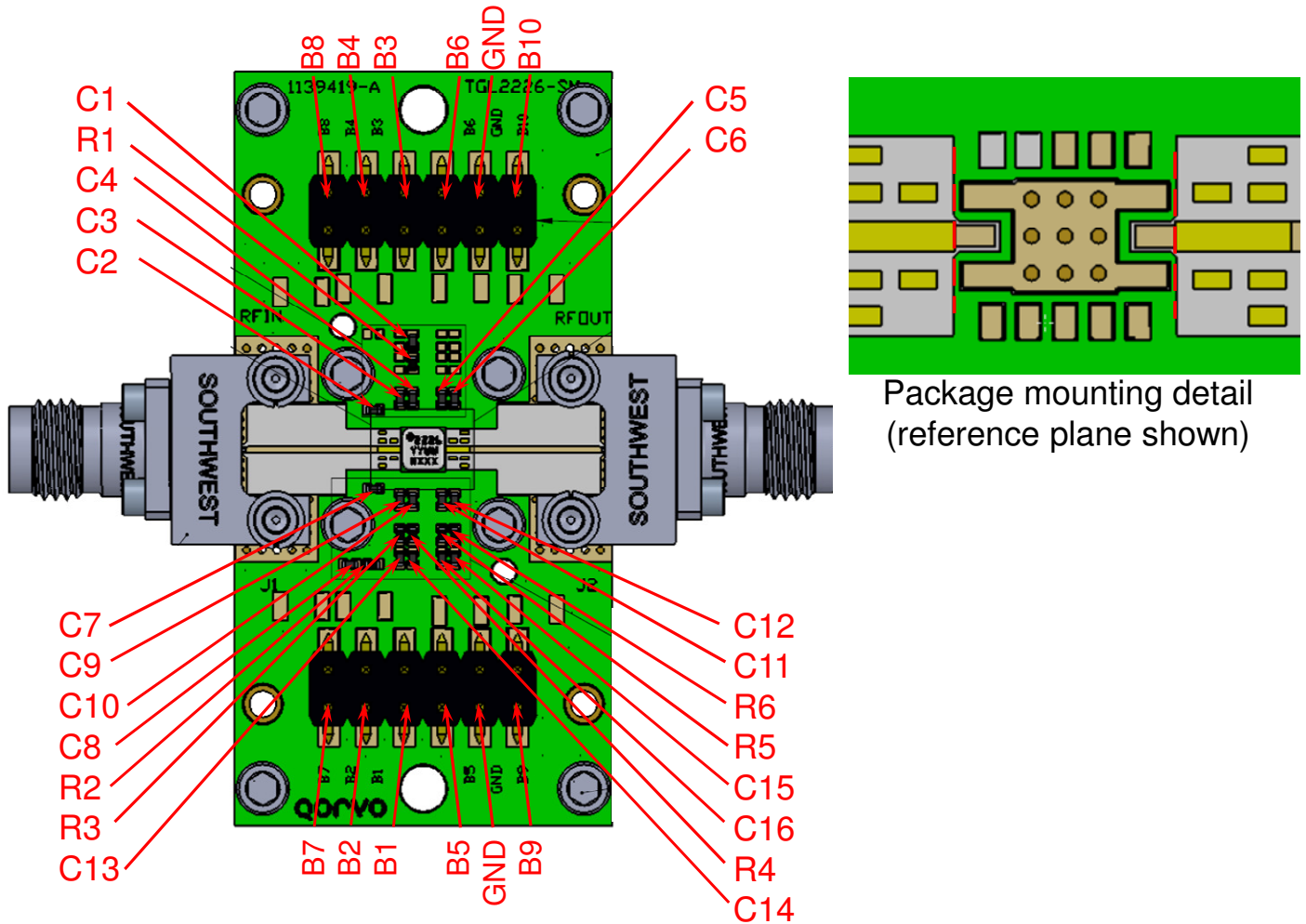
Parameter	State	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
0.0 dB Attenuation (Ref. State)	State 0	0	0	1	0	1	0	1	0	1	0
0.5 dB Attenuation	State 1	1	0	1	0	1	0	1	0	1	0
1.0 dB Attenuation	State 2	0	1	1	0	1	0	1	0	1	0
2.0 dB Attenuation	State 4	0	0	0	1	1	0	1	0	1	0
4.0 dB Attenuation	State 8	0	0	1	0	0	1	1	0	1	0
8.0 dB Attenuation	State 16	0	0	1	0	1	0	0	1	1	0
16.0 dB Attenuation	State 32	0	0	1	0	1	0	1	0	0	1
31.5 dB Attenuation	State 63	1	1	0	1	0	1	0	1	0	1

Intermediate attenuation states are combinations of the above major states.

Logic H = 0 V. Logic L = -3.0 to -5.0 V

Note: RF Input and RF Output are both DC coupled.

Evaluation Board and Mounting Detail



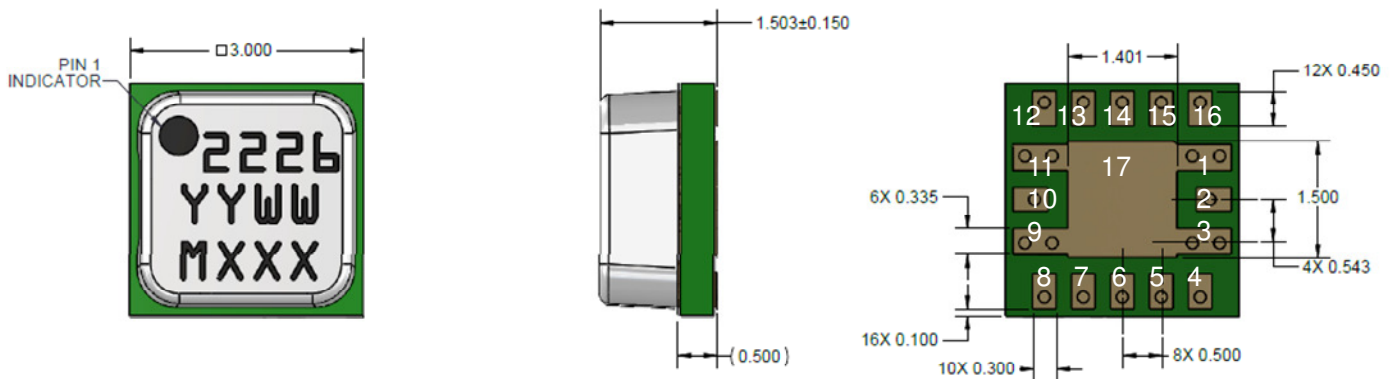
RF Layer is 0.008" thick Rogers Corp. RO4003C, $\epsilon_r = 3.38$. Metal layers are 0.5 oz. copper. The microstrip line at the connector interface is optimized for the Southwest Microwave end launch connector 1492-04A-5.

Reference plane is at the package.

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

Ref. Des.	Component	Value	Manuf.	Part Number
C1 – C16	Surface Mount Cap.	CAP 1000PF +/-10% 50V 0402 X7R, KEMET	Various	
R1 – R6	Surface Mount Res.	RES 10 OHM 5% 0402, SMD	Various	

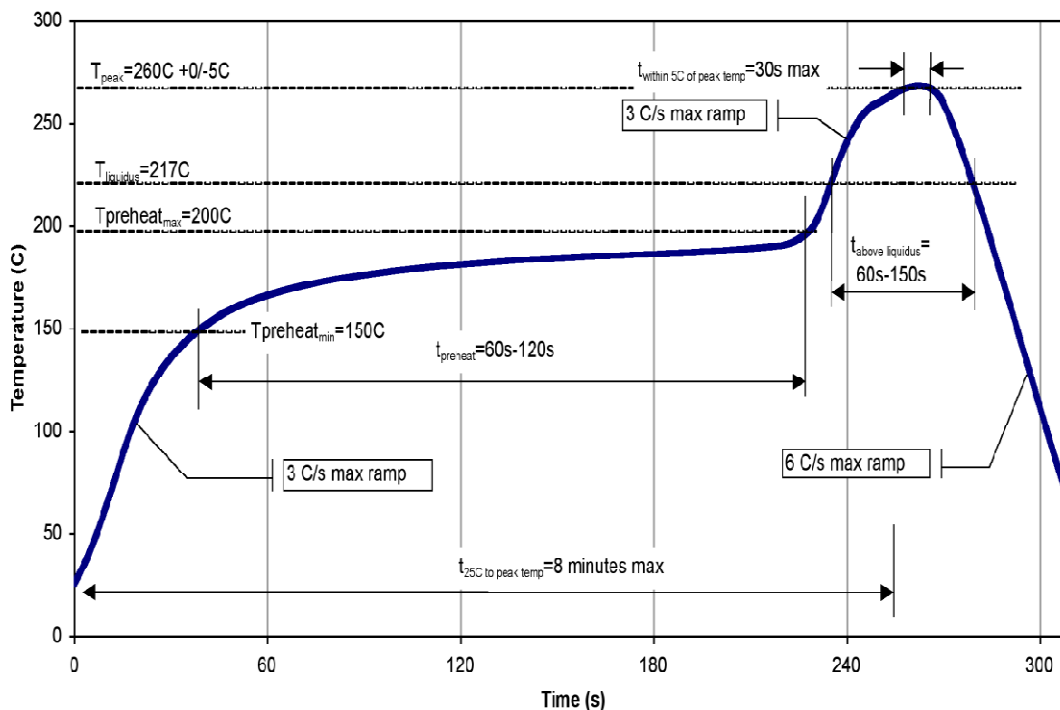
Mechanical Information



PART MARKING:
 2226 = PART NUMBER
 YY= LOT YEAR
 WW = LOT WEEK
 MXXX: LOT NUMBER
 Dimensions are in millimeters

Pin No.	Symbol	Description
1, 3, 7, 9, 11, 17 (slug)	GND	Ground
2	RF Input	Matched to 50 ohms; DC coupled
4	B7	Control Line for 8.0 dB bit (complement of B8)
5	B1	Control Line for 0.5 dB bit
6	B2	Control Line for 1.0 dB bit
7	B5	Control Line for 4.0 dB bit (complement of B6)
8	B9	Control Line for 16.0 dB bit (complement of B10)
10	RF Output	Matched to 50 ohms; DC coupled
12	B10	Control Line for 16.0 dB bit
13	B6	Control Line for 4.0 dB bit
14	B3	Control Line for 2.0 dB bit (complement of B4)
15	B4	Control Line for 2.0 dB bit
16	B8	Control Line for 8.0 dB bit

Recommended Soldering Temperature Profile



Product Compliance Information

ESD Sensitivity Ratings



Caution! ESD-Sensitive Device

ESD Rating: TBD
Value: TBD
Test: Human Body Model (HBM)
Standard: JEDEC Standard JESD22-A114

ECCN

US Department of Commerce: EAR99

Solderability

Compatible with the latest version of J-STD-020 Lead free solder, 260 °C.

RoHS-Compliance

This part is compliant with EU 2002/95/EC RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

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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