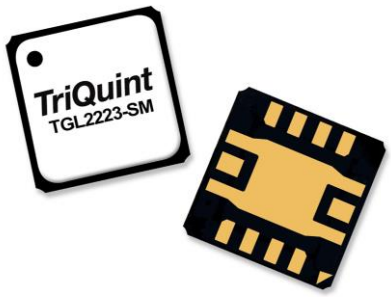
TGL2223-SM

0.1-31 GHz 5-Bit Attenuator

Applications

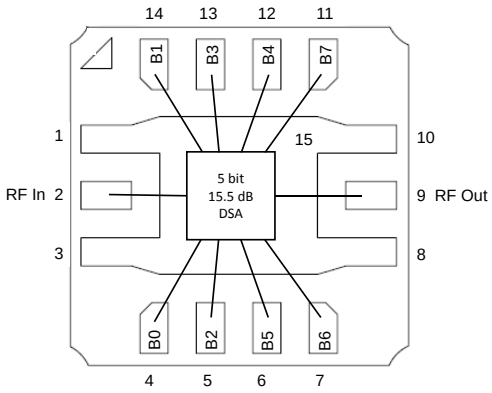
- Commercial and Military Radar
- Electronic Warfare
- Satellite Communications
- Point to Point Radio
- General Purpose



Product Features

- Frequency Range: 0.1-31 GHz
- 5-Bit Digital Attenuator
- Attenuation Step Size (LSB): 0.5 dB
- Attenuation Range: 15.5 dB
- Insertion Loss (Ref. State): 1.8-4.2 dB
- RMS Attenuation Error: < 0.9 dB
- RMS Step Error: < 0.5 dB
- Control Voltage: -3.3 to -5.0 V
- Package Size: 3.0 x 3.0 x 1.45 mm

Functional Block Diagram



General Description

TriQuint's TGL2223-SM is a wideband, 5-bit digital attenuator using TriQuint's TQPHT15 production 0.15um GaAs pHEMT process. Operating from 0.1 - 31 GHz, the TGL2223-SM offers a low LSB of 0.5 dB and supports > 15.5 dB of attenuation range with a low RMS step error of < 0.5 dB.

Using standard, negative control voltages from -3.3 to -5 V coupled with excellent broadband performance, the TGA2223-SM is ideal for supporting of a variety of commercial and military applications.

The TGL2223-SM is packaged in a 3 x 3 (mm) ceramic air-cavity QFN 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, 8, 10 ,15	Package ground
2	RF Input
4	Comp. control line for 8.0 dB bit
5	Control line for 0.5 dB bit
6	Control line for 1.0 dB bit
7	Comp. control line for 4.0 dB bit
9	RF Output
11	Comp. control line for 4.0 dB bit
12	Comp. control line for 2.0 dB bit
13	Comp. control line for 2.0 dB bit
14	Comp. control line for 8.0 dB bit

Ordering Information

Part	ECCN	Description
TGL2223-SM	EAR99	0.1-31 GHz 5-Bit Digital Attenuator

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Absolute Maximum Ratings

Parameter	Value
Control Voltage (V_C)	-6 V
Control Current (I_C)	1 mA
Input Power (P_{IN})	30 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)	-3.3 to -5 V
Control Voltage (logic H)	0 V

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

Parameter	Min	Typical	Max	Units
Frequency Range	0.1		31	GHz
LSB Attenuation		0.5		dB
Attenuation range		15.5		dB
Reference State Insertion Loss: 1-6 GHz		< 2.0		dB
Reference State Insertion Loss: 6-18 GHz		< 3.0		dB
Reference State Insertion Loss: 18-30 GHz		< 4.5		dB
Input Return Loss		> 10		dB
Output Return Loss		> 7		dB
IIP3 (1.0 MHz spacing, P_{IN}/Tone = 5 dBm, 14 GHz)		> 32		dBm
Switching Speed (10%-90%, 90%-10%)		< 30		ns
RMS Attenuation Error		< 0.9		dB
RMS Step Error		< 0.5		dB
Max. Attenuation Error		< 1.5		dB

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Specifications

Thermal and Reliability Information

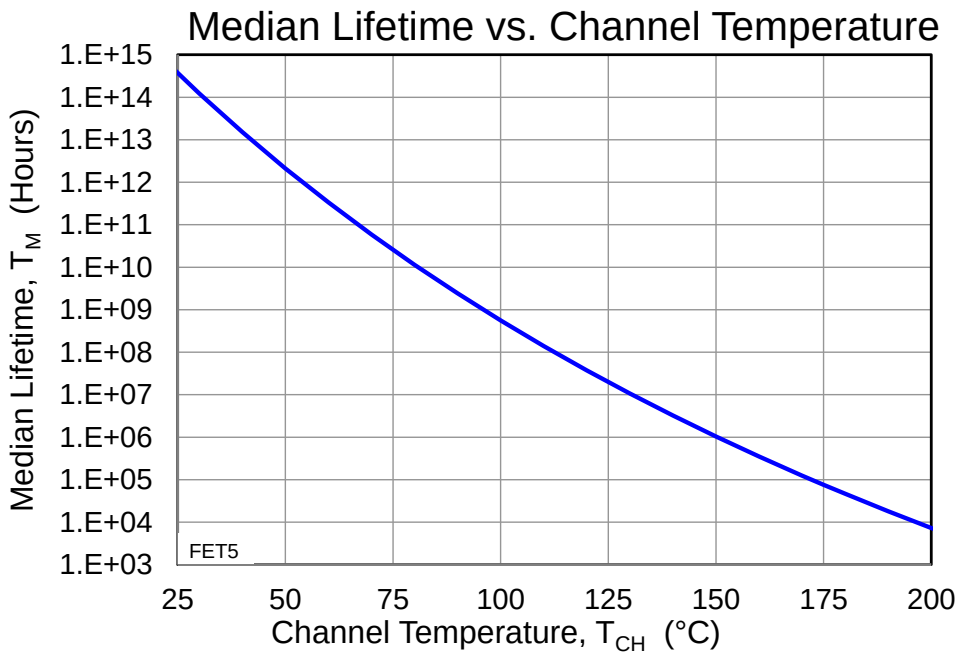
Parameter	Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	T_{BASE} = 85°C, V_C = -5.0 V, P_{DISS} = 0.222 W	103.6	ºC/W
Channel Temperature (T_{CH}) (1)		108	°C
Median Lifetime (T_M)		2.24E08	Hrs

Note:

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

Median Lifetime

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



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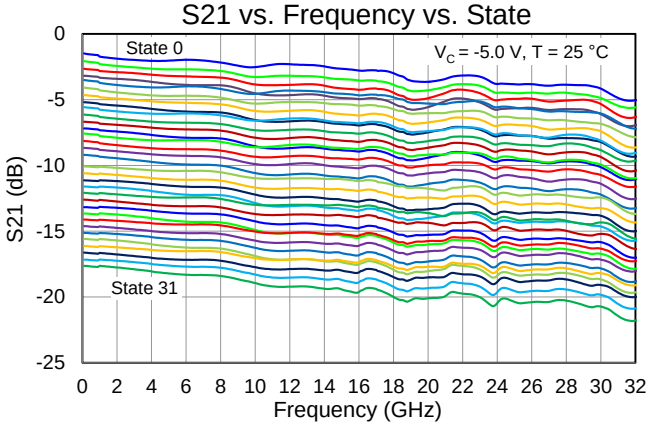
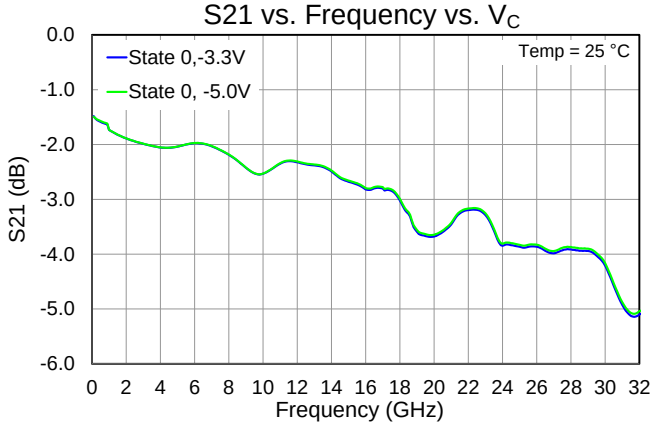
Typical Performance

Test conditions unless otherwise noted: Tested with DUT on EVB

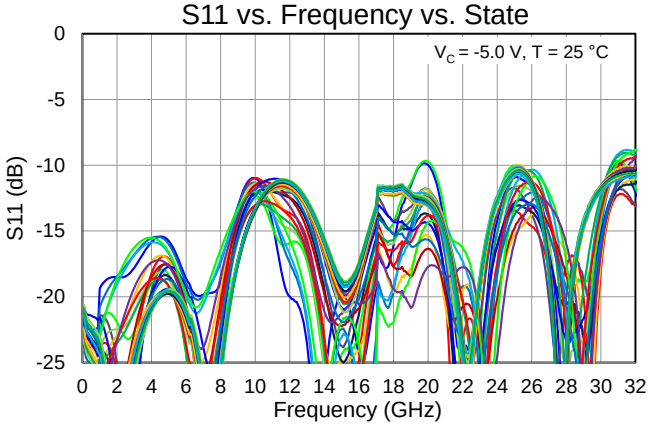
S21 vs. Frequency vs. State



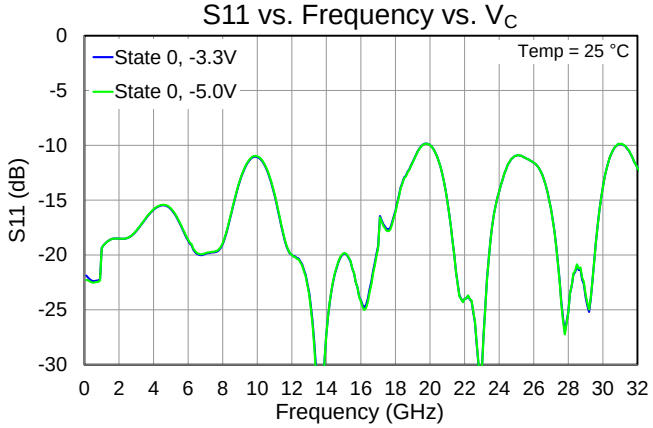
S21 vs. Frequency vs. V_C



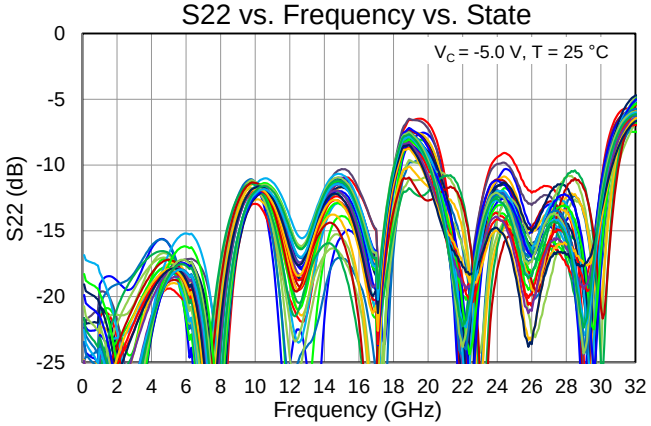
S11 vs. Frequency vs. State



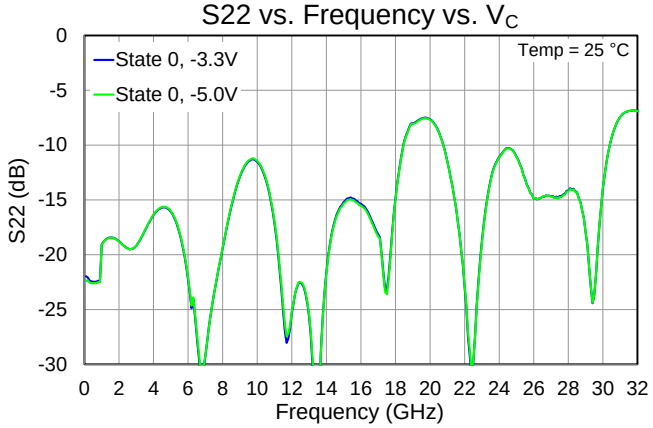
S11 vs. Frequency vs. V_C



S22 vs. Frequency vs. State



S22 vs. Frequency vs. V_C



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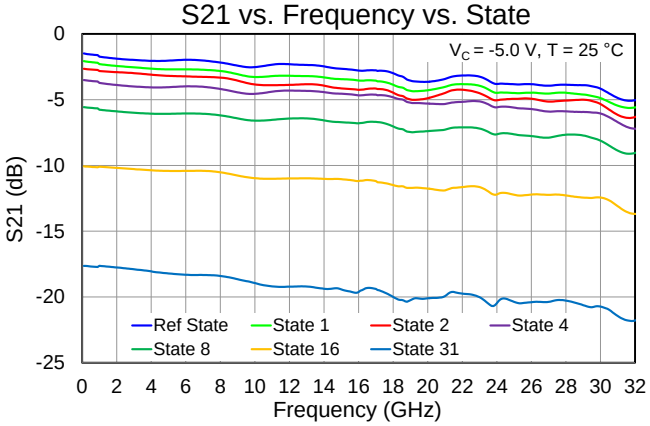
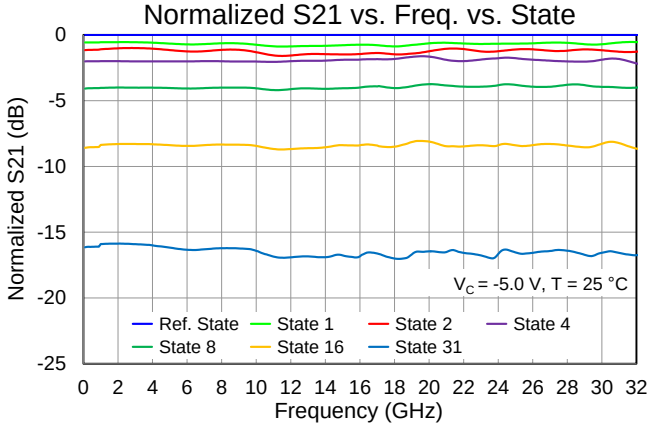
Typical Performance

Test conditions unless otherwise noted: Tested with DUT on EVB

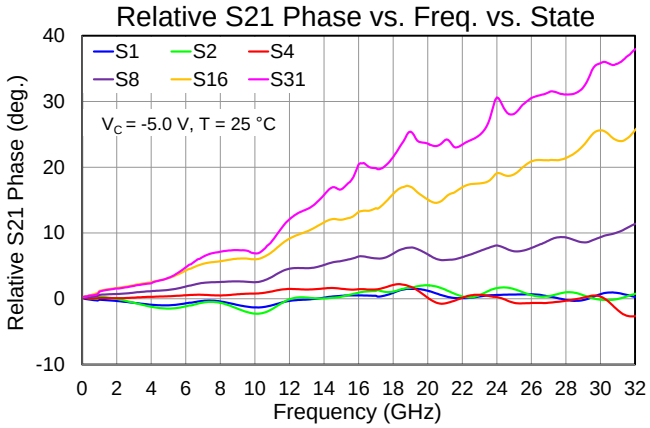
S21 vs. Frequency vs. State



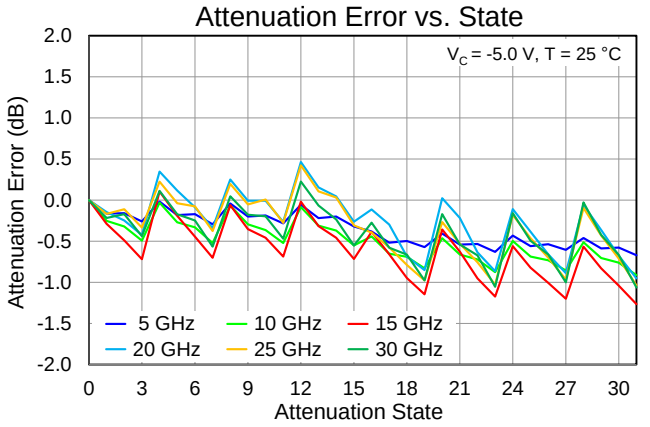
Normalized S21 vs. Freq. vs. State



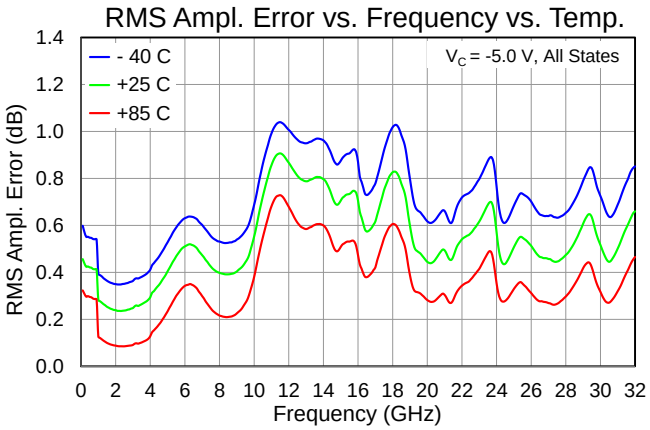
Relative S21 Phase vs. Freq. vs. State



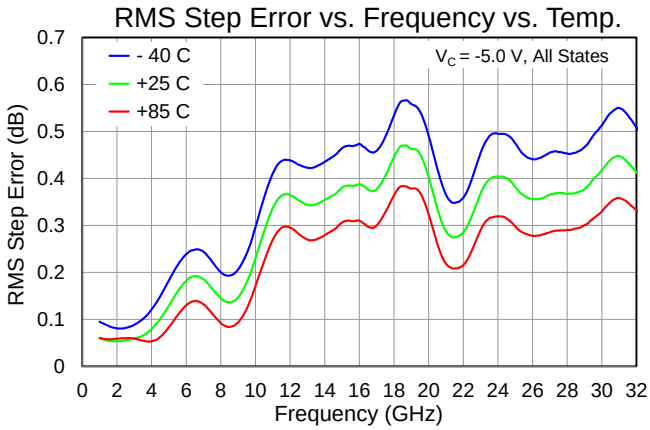
Attenuation Error vs. State



RMS Ampl. Error vs. Frequency vs. Temp.



RMS Step Error vs. Frequency vs. Temp.



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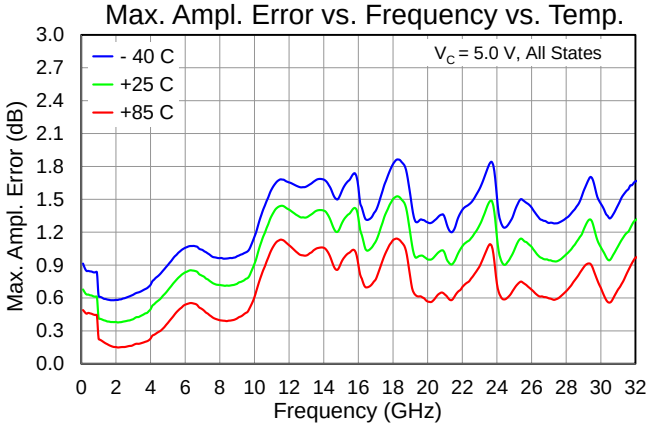
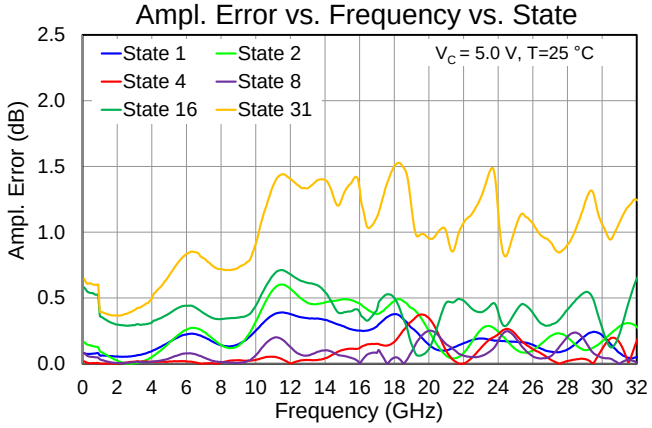
Typical Performance

Test conditions unless otherwise noted: Tested with DUT on EVB

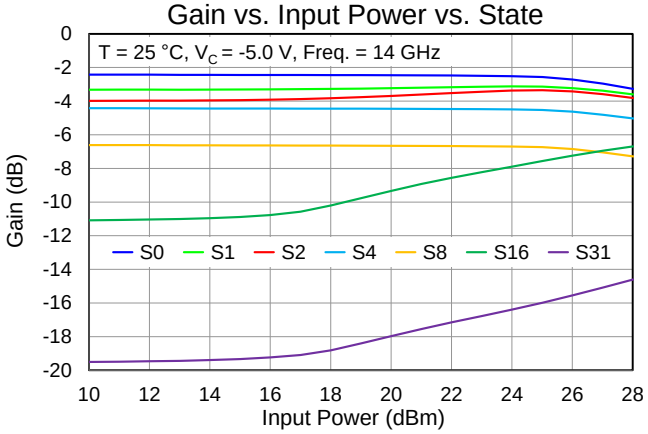
Max. Ampl. Error vs. Frequency vs. Temp.



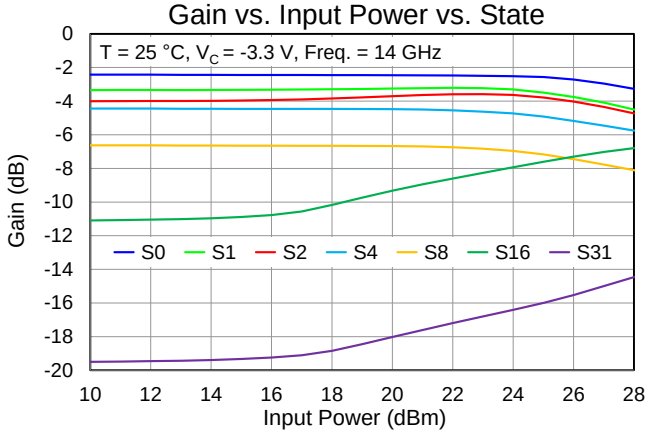
Ampl. Error vs. Frequency vs. State



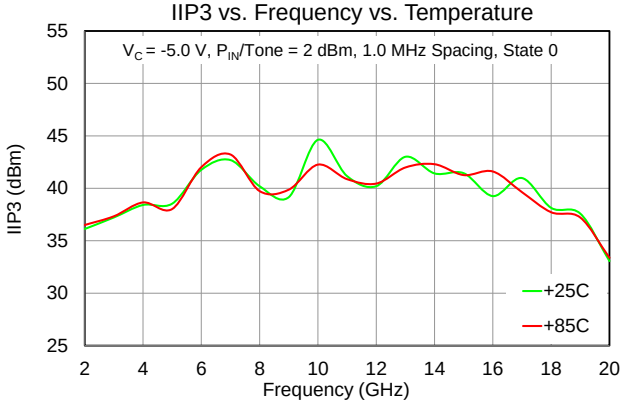
Gain vs. Input Power vs. State



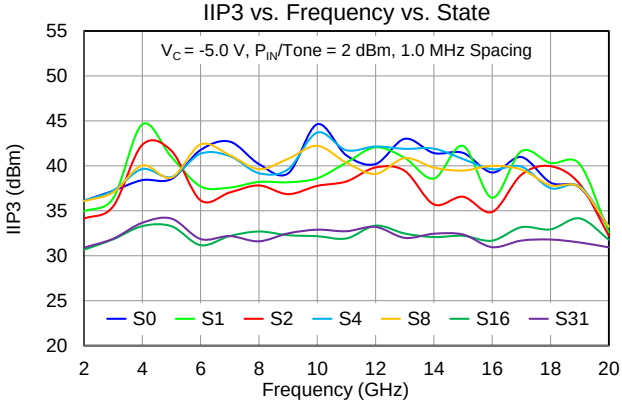
Gain vs. Input Power vs. State



IIP3 vs. Frequency vs. Temperature



IIP3 vs. Frequency vs. State



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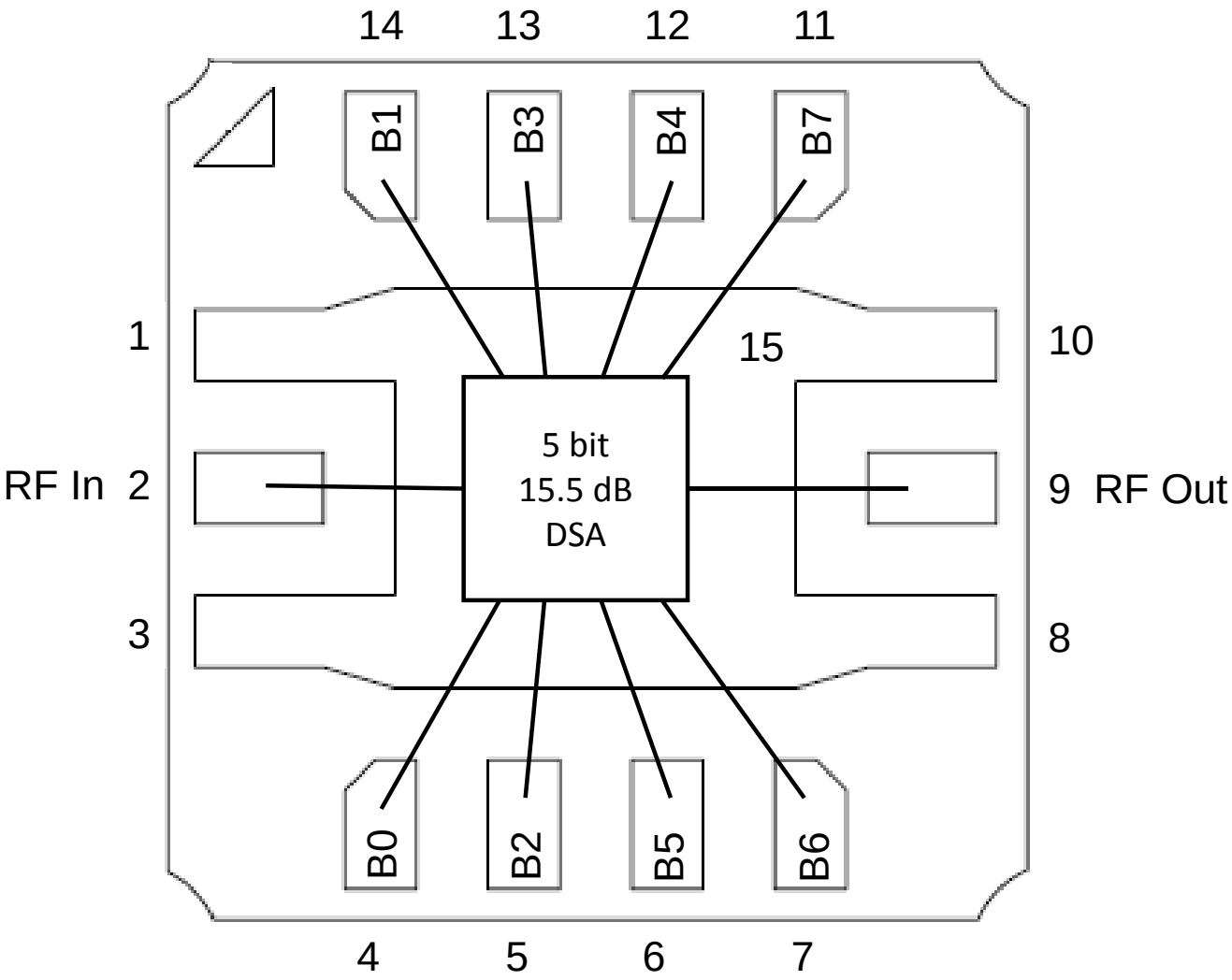
Application Circuit



Function Table – Major States

Parameter	State	B0	B1	B2	B3	B4	B5	B6	B7
0.0 dB Attenuation (Ref. State)	State 0	1	0	0	0	1	0	1	0
0.5 dB Attenuation	State 1	1	0	1	0	1	0	1	0
1.0 dB Attenuation	State 2	1	0	0	0	1	1	1	0
2.0 dB Attenuation	State 4	1	0	0	1	0	0	1	0
4.0 dB Attenuation	State 8	1	0	0	0	1	0	0	1
8.0 dB Attenuation	State 16	0	1	0	0	1	0	1	0
15.5 dB Attenuation	State 31	0	1	1	1	0	1	0	1

Intermediate attenuation states are combinations of the above major states.
Logic H = 0V. Logic L = -3.3 to -5.0 V

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

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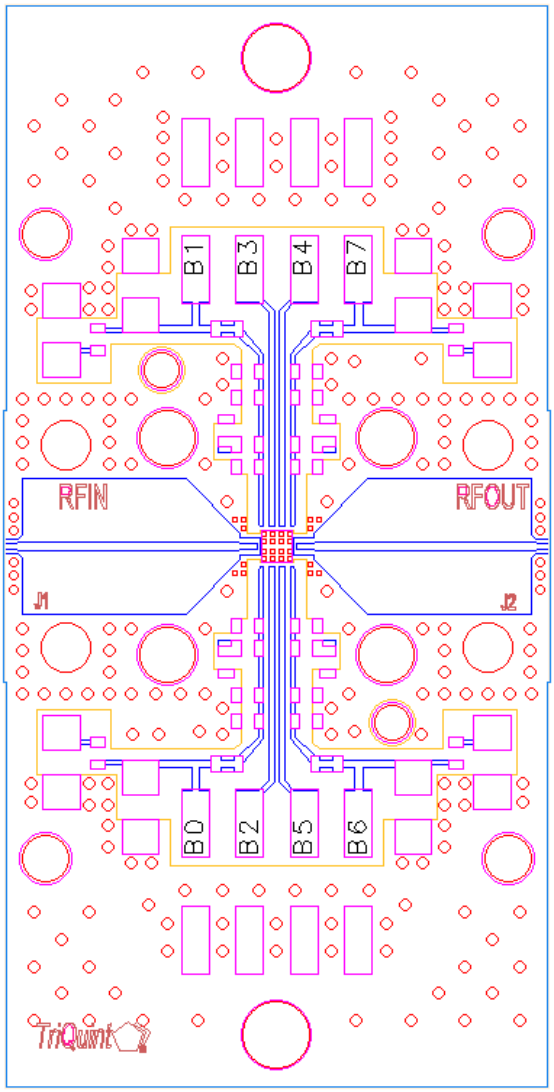
Applications Information

Evaluation Board Layout

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

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



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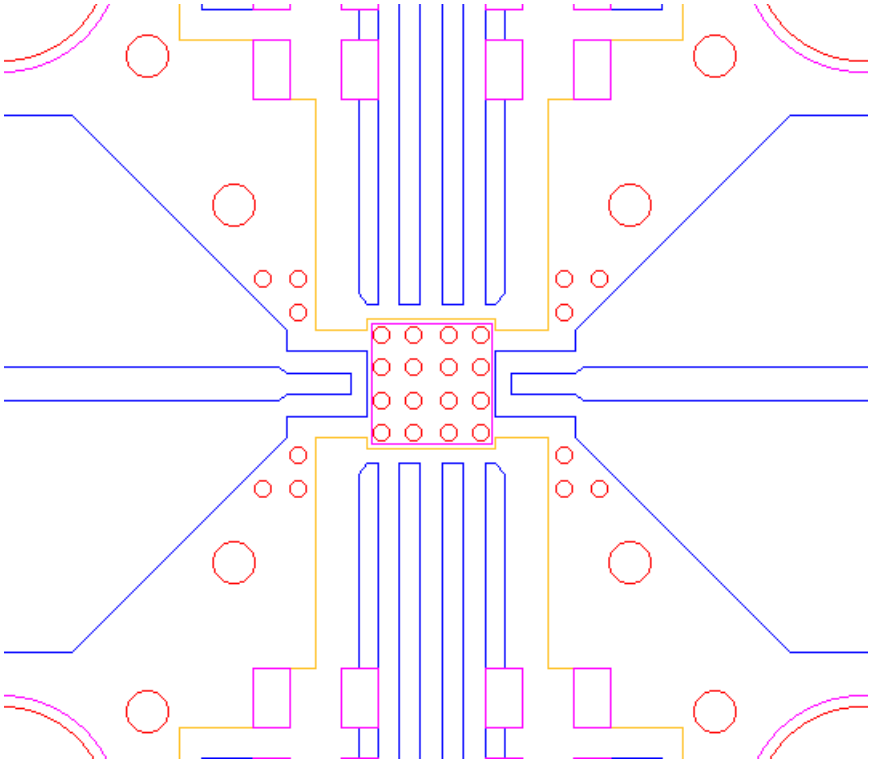
Mounting Detail



Note:

Multiple vias should be employed under package center paddle to minimize inductance and thermal resistance.

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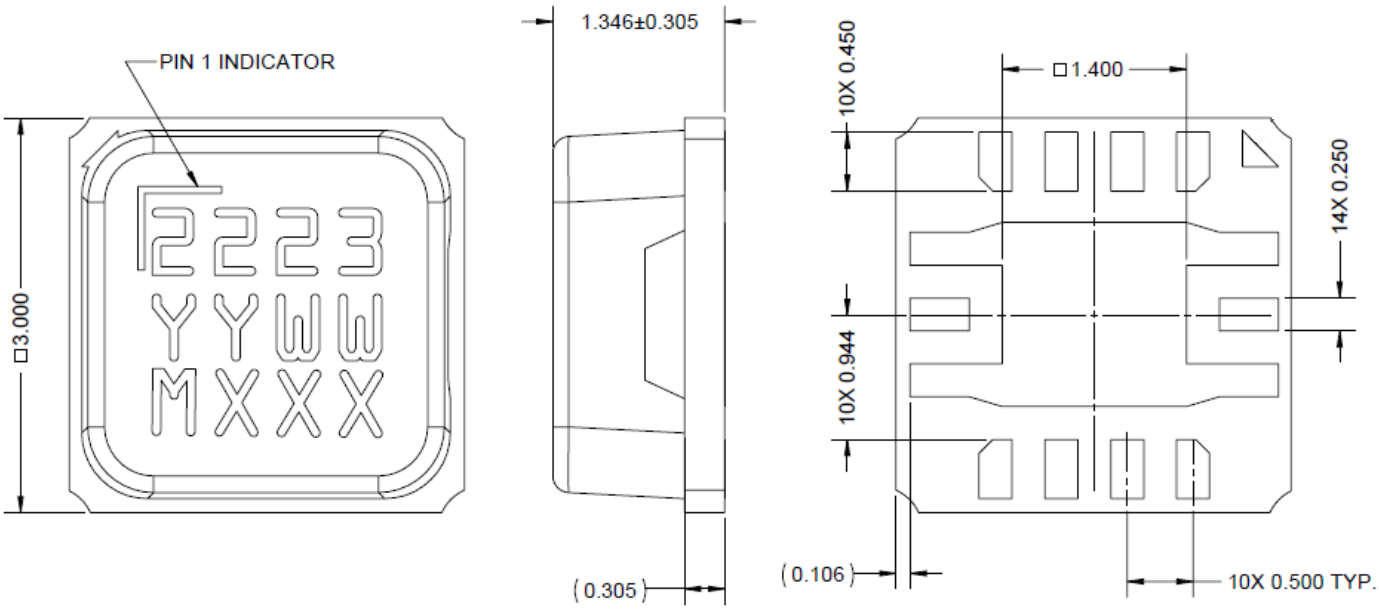
Mechanical Information



Dimensions are in mm.

The TGL2223-SM will be marked with the “YYWW” and “MXXX” designators 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 an auto-generated number.

This package is lead-free/RoHS-compliant. This package is compatible with both lead free and tin-lead soldering processes.

Dimensions are in millimeters.

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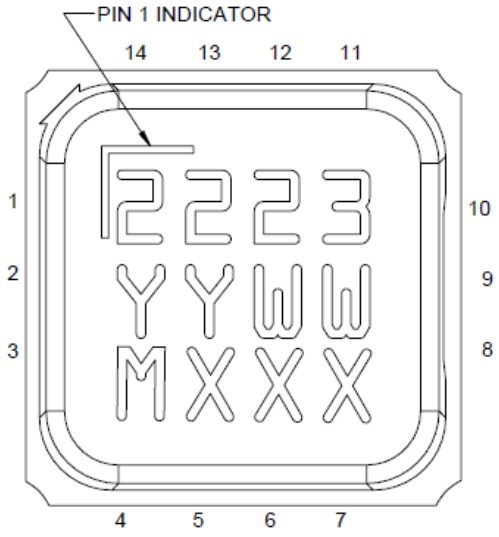
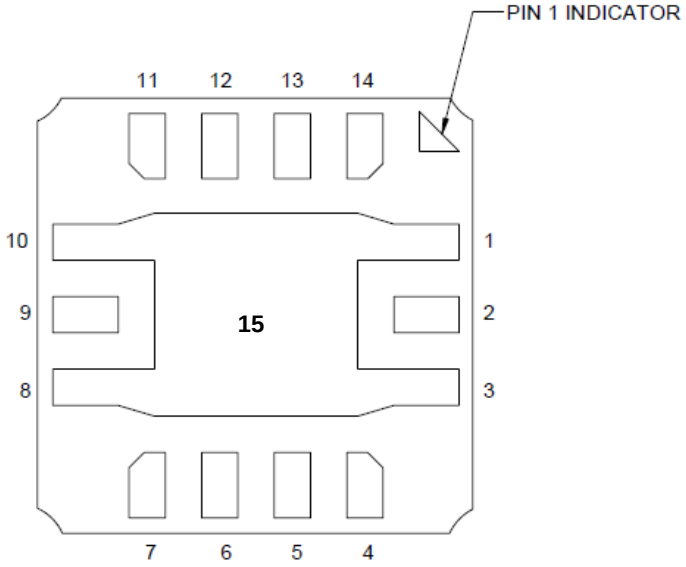
Pad Description





Pin Number	Label	Description
1, 3, 8, 10, 15	GND	Package ground
2	RF Input	RF Input
4	B0	Complementary control line for 8.0 dB bit
5	B2	Control line for 0.5 dB bit
6	B5	Control line for 1.0 dB bit
7	B6	Complementary control line for 4.0 dB bit
9	RF Output	RF Output
11	B7	Complementary control line for 4.0 dB bit
12	B4	Complementary control line for 2.0 dB bit
13	B3	Complementary control line for 2.0 dB bit
14	B1	Complementary control line for 8.0 dB bit

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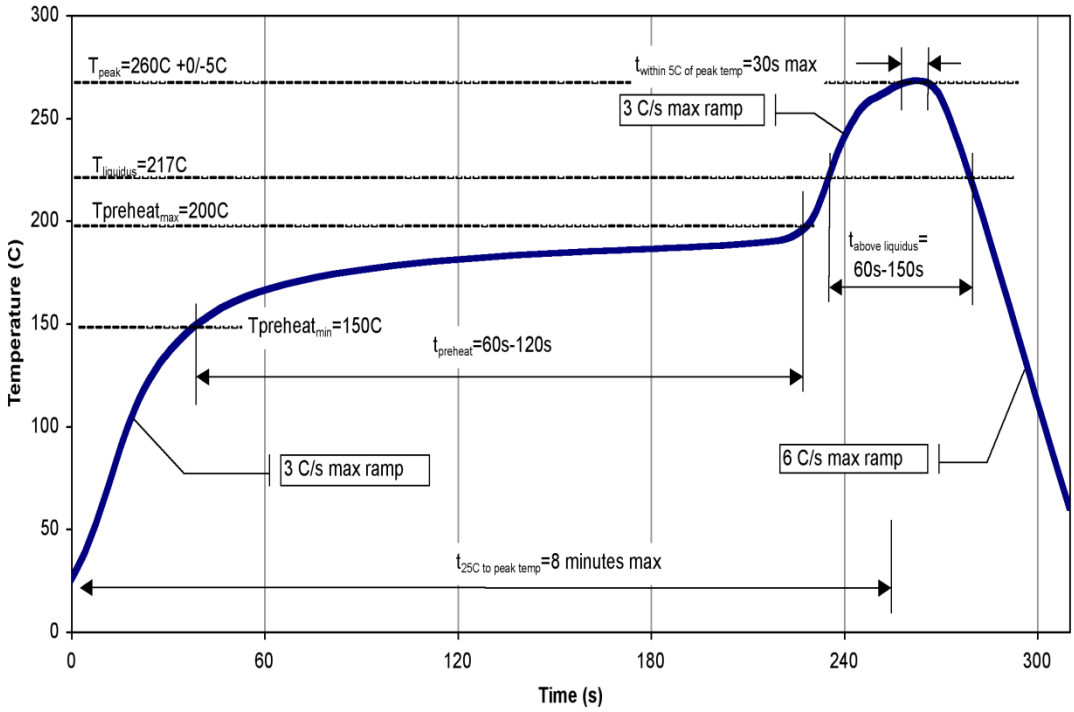
Recommended Soldering Temperature Profile



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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 (C15H12Br402) Free
- PFOS Free
- SVHC Free

Contact Information

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

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Email: info-sales@tqs.com **Fax:** +1.972.994.8504

For technical questions and application information: **Email:** info-products@tqs.com

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