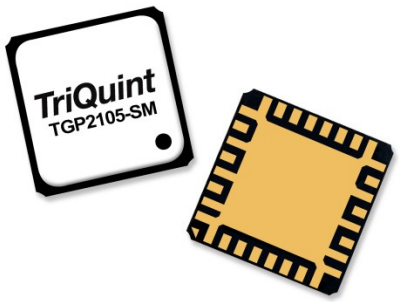
TGP2105-SM

6-18 GHz 6-Bit Digital Phase Shifter (+Vc)

Applications

- Phased Array Antenna Systems
- Satellite Communication Systems
- Electronic Warfare

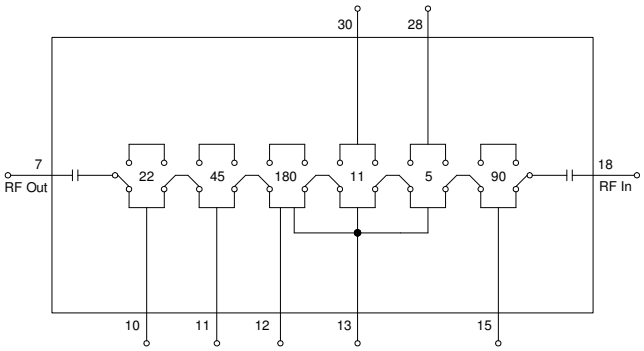


QFN 5x5 mm 32L

Product Features

- Frequency Range: 6 to 18 GHz
- 6-Bit Digital Phase Shifter
- 360° Coverage, LSB = 5.625°
- RMS Phase Error: 4°
- RMS Amplitude Error: 0.45 dB
- Insertion Loss: <10 dB
- Return Loss: >12 dB
- Input P1dB: >25 dBm
- Input IP3: >41 dBm
- Control Voltage: 0/+5 V
- Package Dimensions: 5.0 x 5.0 x 1.45 mm

Functional Block Diagram



General Description

TriQuint's TGP2105-SM is a packaged 6-bit digital phase shifter, fabricated on TriQuint's high performance 0.15µm GaAs pHEMT process. It operates over 6 to 18 GHz and provides 360° of phase coverage with a LSB of 5.625°. It also achieves a low RMS phase error of 4° with 8 dB of insertion loss over all states.

The TGP2105-SM uses positive switch logic, eliminating the need for a negative voltage rail. That, along with low insertion and a high degree of resolution makes the TGP2105-SM ideally suited for a variety of wideband phased array applications, including commercial and military radars, satellite-based communication systems and electronic warfare.

The device is lead-free and RoHS compliant.

Evaluation Boards are available upon request.

Pad Configuration

Pad No.	Symbol
1 - 6, 8 - 9, 14, 16 - 17, 19 - 27, 29, 31 – 32, 33	Gnd
7	RF Out
10	22° Bit
11	45° Bit
12	180° Bit
13	REF
15	90° Bit
18	RF In
28	5° Bit
30	11° Bit

Ordering Information

Part	ECCN	Description
TGP2105-SM	EAR99	6-Bit Digital Phase Shifter ($+V_c$)

Absolute Maximum Ratings

Parameter	Value
Control and Reference Voltage	6 V
Control Current	–15 to +5 mA
Power Dissipation	0.9 W
Input Power, CW, 50 Ω, 85°C	30 dBm
Channel Temperature	200 °C
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	Value
Control Voltage (5^0, 11^0, 22^0, 45^0, 90^0, 180^0, REF)	0/+5 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. Control Voltage (REF, 5^0, 11^0, 22^0, 45^0, 90^0, 180^0) = 0/+5 V; See Bias Truth Table.

Parameter	Conditions	Min	Typ	Max
Operational Frequency Range		6		18
Insertion Loss			6 - 10	
Input Return Loss			>12	
Output Return Loss			>12	
RMS Phase Error			4	
RFM Amplitude Error			0.45	
Input P1dB			>25	
Input IP3	Tone spacing = 10 MHz Pin/Tone = 15 dBm		>41	
Insertion Loss Temperature Coefficient			0.008	

Bias Truth Table

Logic “0” = 0 V, Logic “1” = +5 V
Voltage for Logic “1” of V_{CTRL} (5^0, 11^0, 22^0, 45^0, 90^0, 180^0) must be the same with V_{REF}

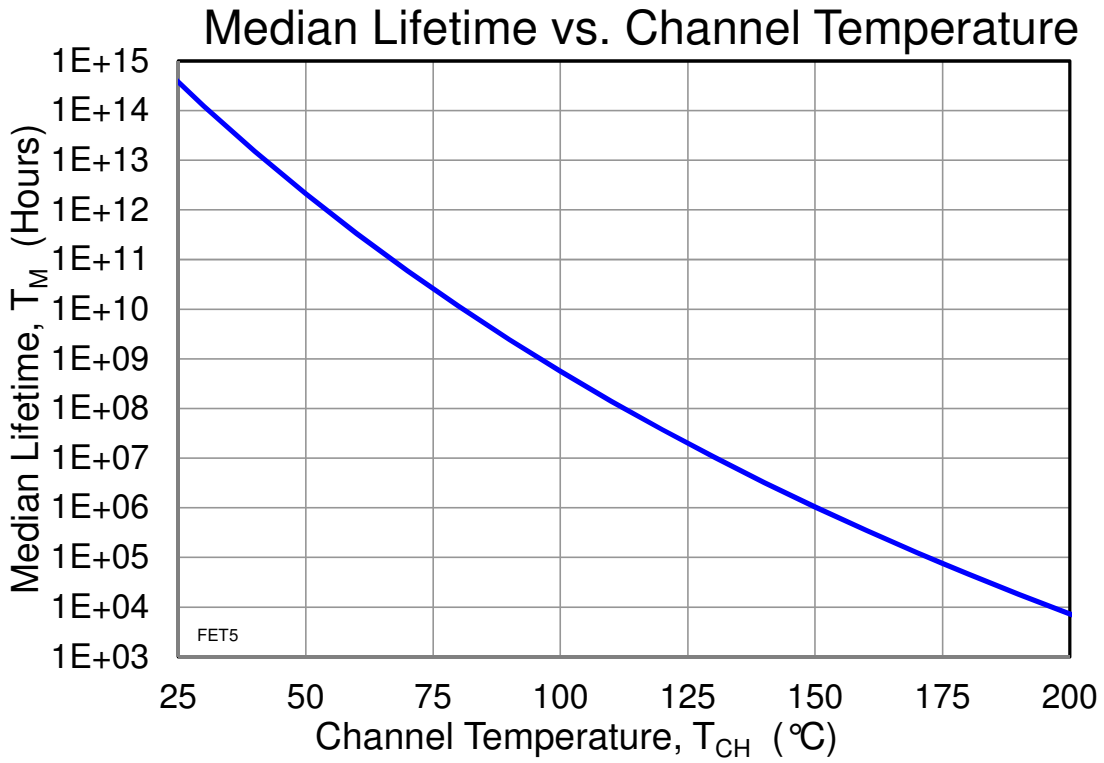
Phase Shifter	5^0	11^0	22^0	45^0	90^0	180^0	REF
0° (Reference)	0	0	0	0	0	0	1
5°	1	0	0	0	0	0	1
11°	0	1	0	0	0	0	1
22°	0	0	1	0	0	0	1
45°	0	0	0	1	0	0	1
90°	0	0	0	0	1	0	1
180°	0	0	0	0	0	1	1
355°	1	1	1	1	1	1	1

Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	P_{DISS} = 0.09 W, $T_{BASEPLATE}$ = 85°C	22	°C/W
Channel Temperature (T_{CH})		87	°C
Median Lifetime (T_M)		3.8E+9	Hrs

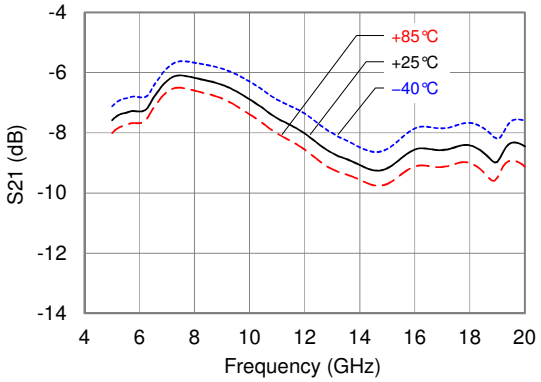
Notes:
1. Thermal resistance measured to back of package.

Median Lifetime

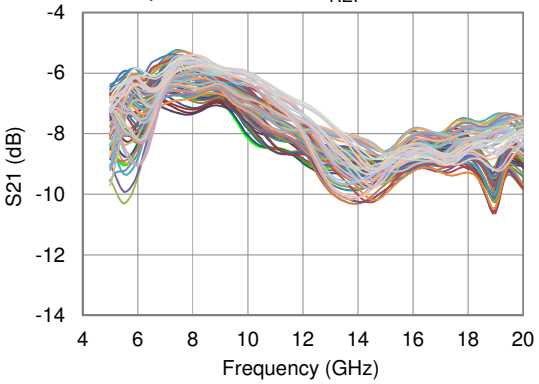


Typical Performance

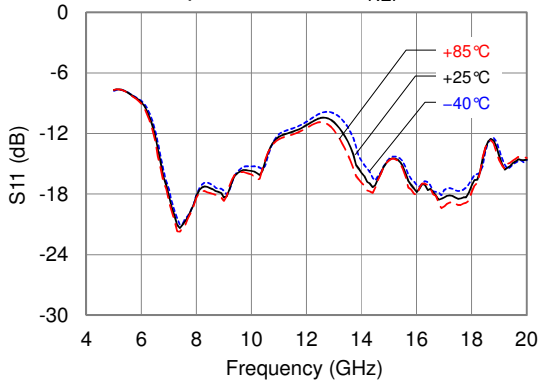
Average Insertion Loss vs. Temperature
All phase states; V_{REF} = 5 V



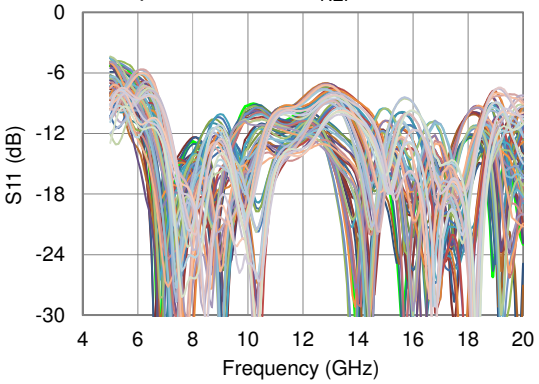
Insertion Loss vs. Frequency
All phase states; V_{REF} = 5 V, 25 °C



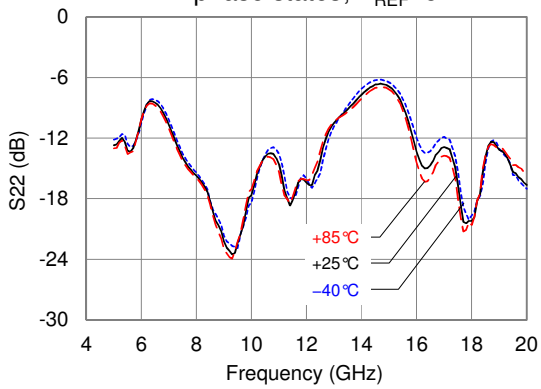
Average IRL vs. Temperature
All phase states; V_{REF}=5 V



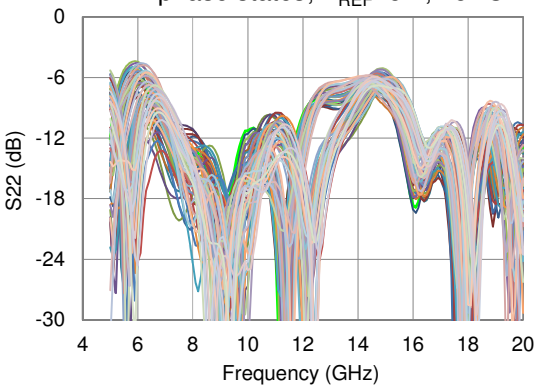
Input Return Loss vs. Frequency
All phase states; V_{REF}=5 V, 25 °C



Average ORL vs. Temperature
All phase states; V_{REF}=5 V

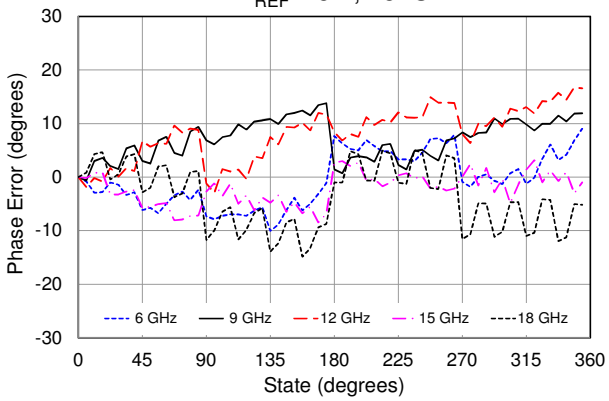


Output Return Loss vs. Frequency
All phase states; V_{REF}=5 V, 25 °C

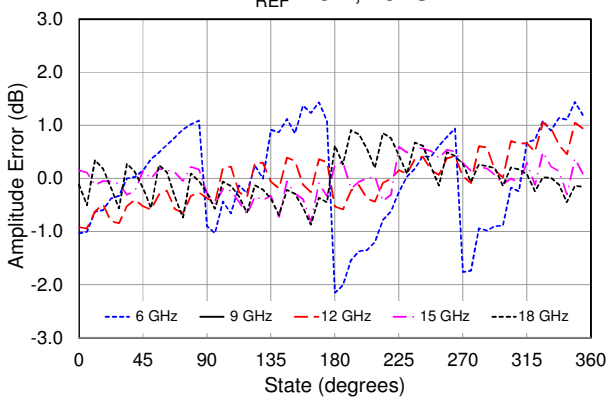


Typical Performance

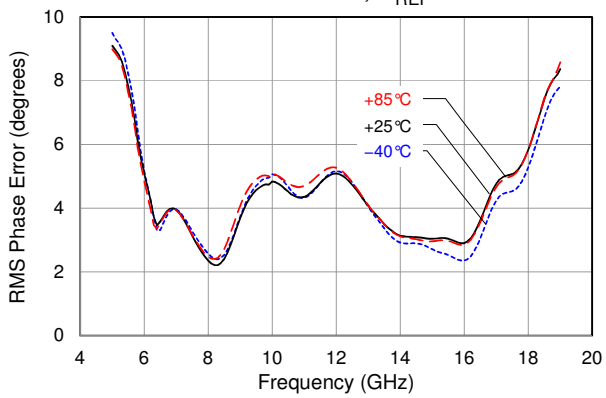
Phase Error vs. State
V_{REF} = 5 V, 25 ℃



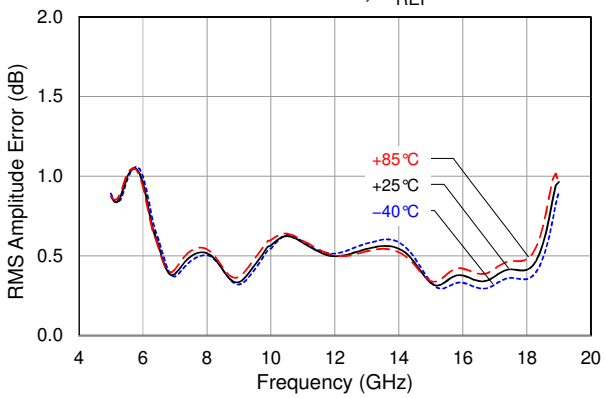
Amplitude Error vs. State
V_{REF} = 5 V, 25 ℃



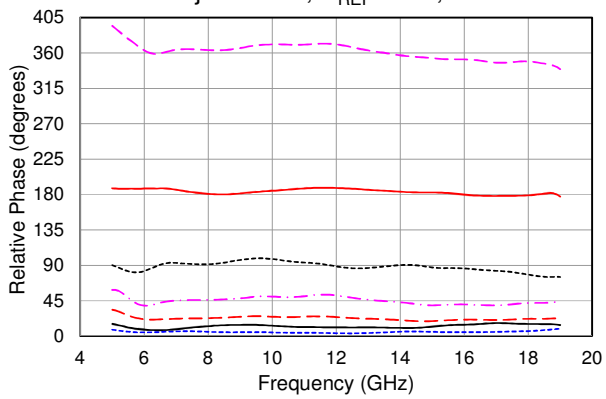
RMS Phase Error vs. Frequency
All Phase States, V_{REF} = 5 V



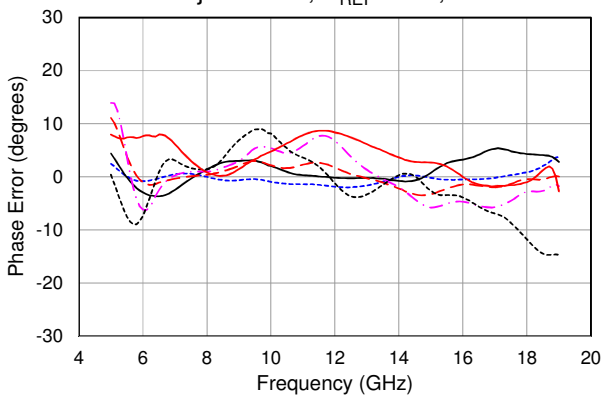
RMS Amplitude Error vs. Frequency
All Phase States, V_{REF} = 5 V



Relative Phase Shift vs. Frequency
Major States, V_{REF} = 5 V, 25 ℃

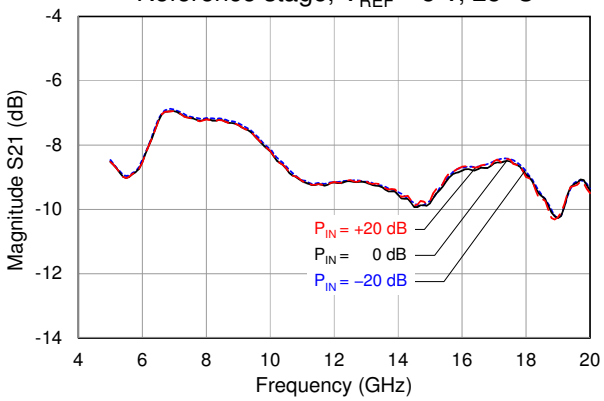


Phase Error vs. Frequency
Major States, V_{REF} = 5 V, 25 ℃

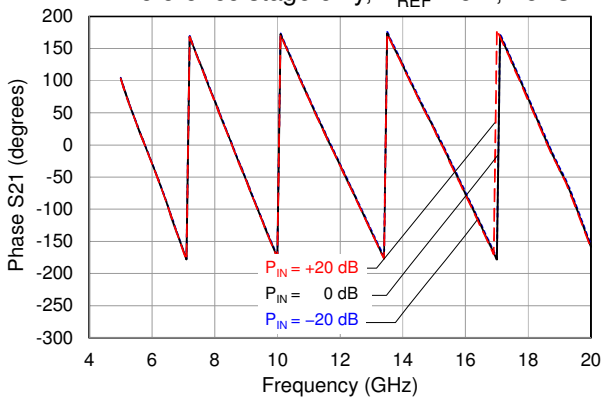


Typical Performance

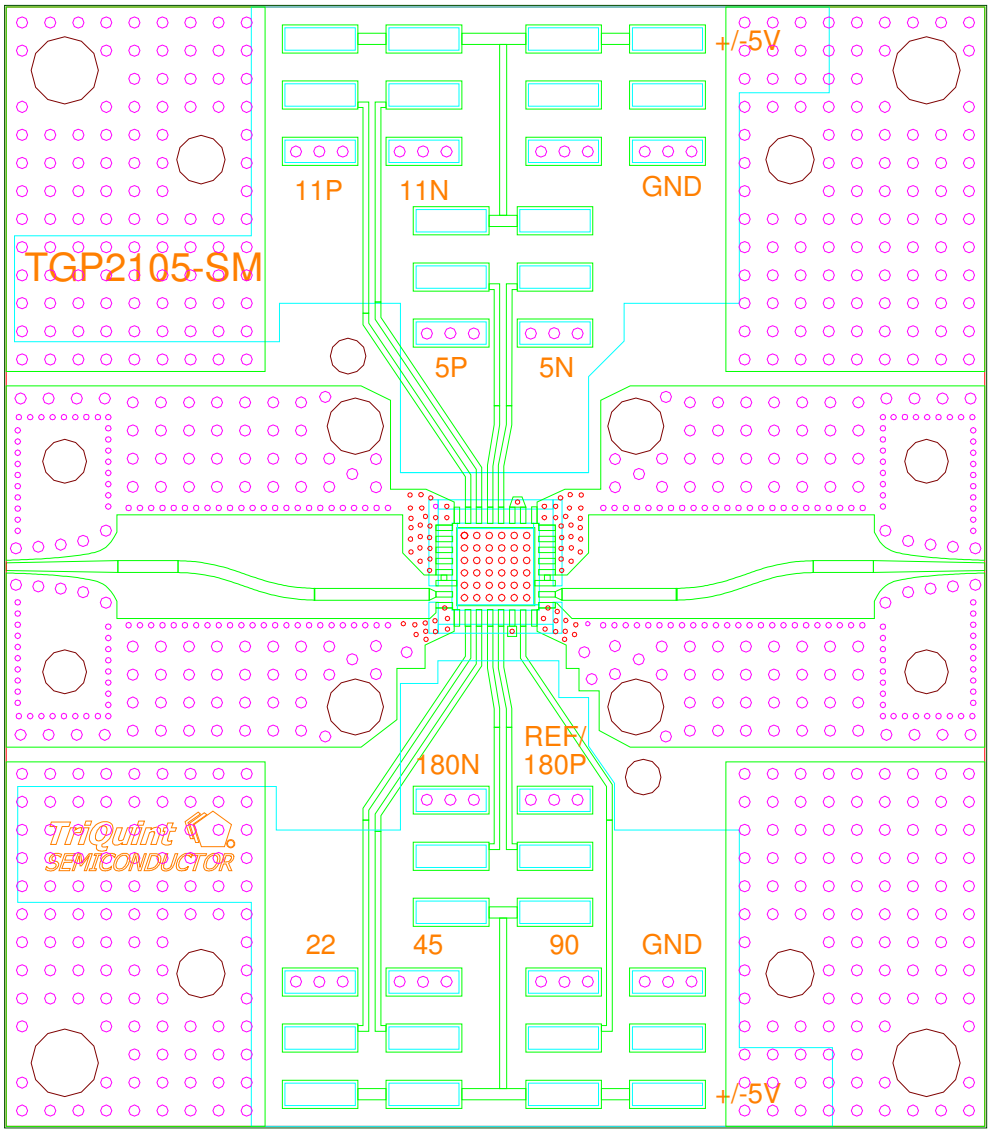
Insertion Loss vs. Freq. vs. P_{IN} (AM/AM)
Reference stage, V_{REF} = 5 V, 25 °C



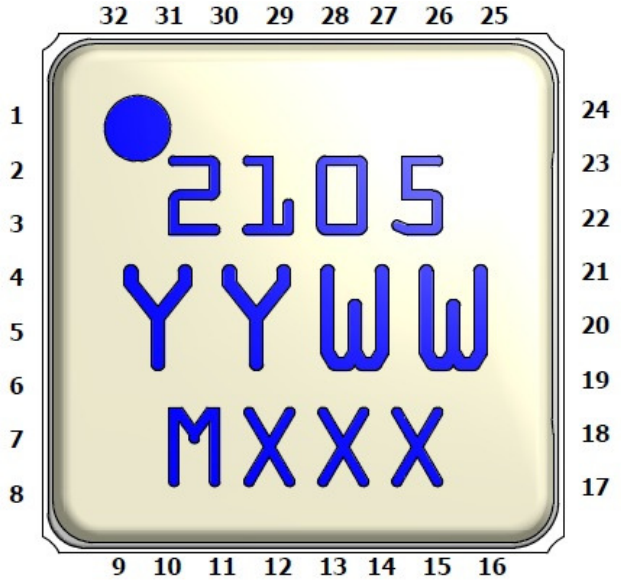
Insertion Loss vs. Freq. vs. P_{IN} (AM/PM)
Reference stage only, V_{REF} = 5 V, 25 °C

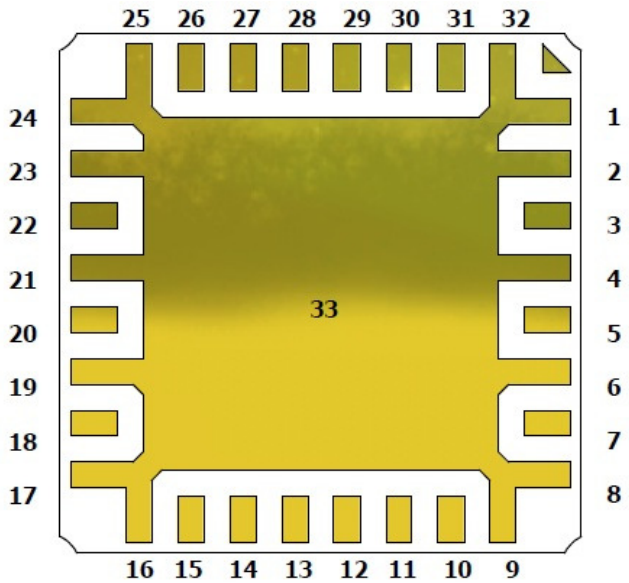


Applications Board



Pin Description



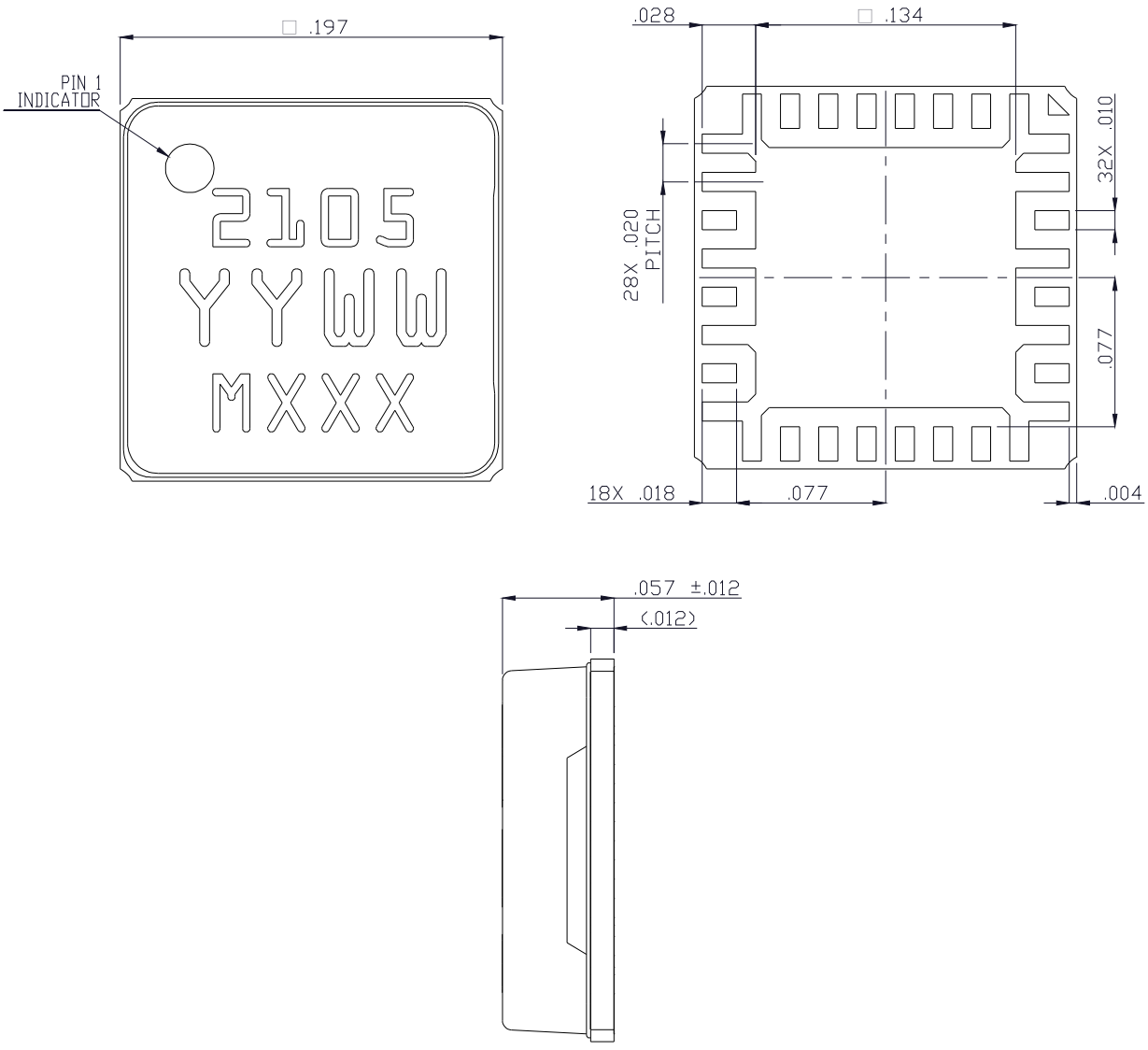


Bond Pads

Pin No.	Symbol	Description
1 - 6, 8 - 9, 14, 16 - 17, 19 - 27, 29, 31 - 32	Gnd	Internal grounding; must be grounded on PCB
7	RF Out	Output; matched to 50 Ω; DC blocked
10	22°	22° Bit; De-Qing network is not required
11	45°	45° Bit; De-Qing network is not required
12	180°	180° Bit; De-Qing network is not required
13	REF	Reference; De-Qing network is not required
15	90°	90° Bit; De-Qing network is not required
18	RF In	Input; matched to 50 Ω; DC blocked
28	5°	5° Bit; De-Qing network is not required
30	11°	11° Bit; De-Qing network is not required
33	Gnd	Backside Paddle; multiple vias should be employed to minimize inductance and thermal resistance

Mechanical Information

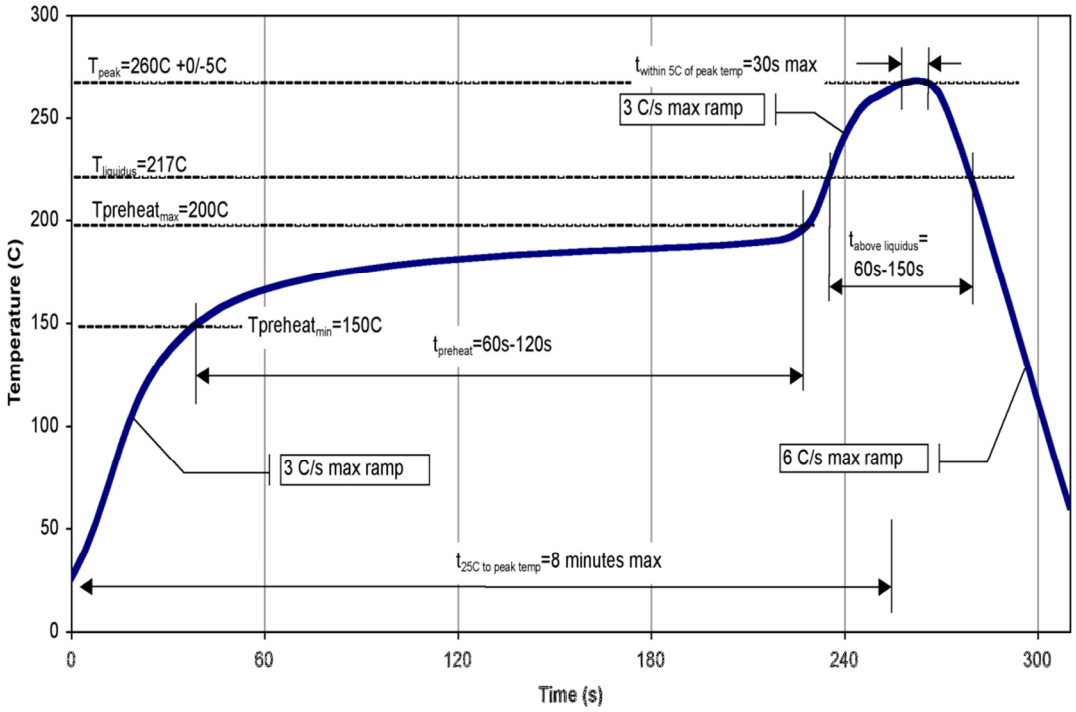
All dimensions are in inches.



NOTES:

1. MATERIAL:
   PACKAGE BASE : ALUMINUM NITRIDE (AIN)
   LID : PLASTIC WITH EPOXY
2. FINISH:
   ELECTROLESS GOLD (Au) : 0.5 - 1.5um
   OVER
   ELECTROLESS NICKEL (Ni) : 2.0um MIN.
3. PART MARKING:
   2105 : PART NUMBER
   YY : PART ASSEMBLY YEAR
   WW : PART ASSEMBLY WEEK
   MXXX : BATCH ID

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

MSL Rating

Level TBD at +260 °C convection reflow
The part is rated Moisture Sensitivity Level TBD at 260°C per JEDEC standard IPC/JEDEC J-STD-020.

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 ($C_{15}H_{12}Br_40_2$) Free
- PFOS Free
- SVHC Free

Contact Information

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

Web: www.triquint.com **Tel:** +1.972.994.8465
Email: info-sales@triquint.com **Fax:** +1.972.994.8504

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

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