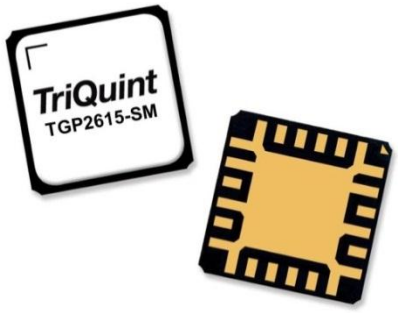
RFMD + TriQuint = Qorvo

TGP2615-SM

15-19 GHz 6-Bit Digital Phase Shifter

Applications

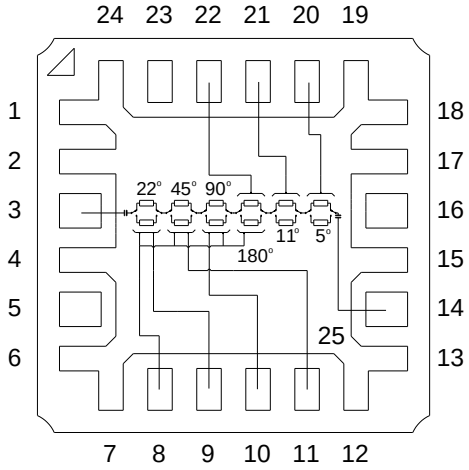
- Phased-Array Radar
- Satellite Communications



Product Features

- 6-Bit Digital Phase Shifter
- Frequency Range: 15 to 19 GHz
- 360° Coverage, LSB = 5.625°
- RMS Phase Error: 4°
- RMS Amplitude Error: 0.85 dB
- Insertion Loss: 7 dB
- Input Return Loss: >10 dB
- Output Return Loss: >9 dB
- Input P1dB: >23 dBm
- Positive Control Logic: 0/+3.3 V
- Package Dimensions: 4.00 x 4.00 x 1.47 mm

Functional Block Diagram



General Description

TriQuint's TGP2615-SM is a 6-bit digital phase shifter fabricated on TriQuint's high-performance PHT15 GaAs pHEMT process. It operates over 15 to 19 GHz, and provides 360° of phase coverage with a LSB of 5.625°. It also achieves a low RMS phase error of 4°, with 7 dB average insertion loss over all states.

The TGP2615-SM uses positive single-control-line switch logic, eliminating the need for a negative voltage rail or complimentary logic. This, combined with low insertion loss and a high degree of resolution makes the TGP2615-SM ideally suited for applications in phased-array radar and satellite communications.

The device is lead-free and RoHS compliant.
Evaluation boards are available on request.

Pin Configuration

Pin	Function	Pin	Function
3	RF OUT	14	RF IN
8	V_{REF}	20	5°
9	22°	21	11°
10	90°	22	180°
11	45°		
1, 2, 4, 6, 7, 12, 13, 15, 17, 18, 19, 24, 25	GND		

Ordering Information

Part	ECCN	Description
TGP2615-SM	EAR99	6-Bit Digital Phase Shifter

Absolute Maximum Ratings

Parameter	Value
Control and Reference Voltage	6 V
Power Dissipation	0.8 W
Input Power, CW, 50 Ω, 85°C	30 dBm
Channel Temperature	200°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°, 11°, 22°, 45°, 90°, 180°)	0/+3.3 V
Reference Voltage (V_{REF})	+3.3 V
Control Current (I_{CTRL})	10 µA

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°, 11°, 22°, 45°, 90°, 180°) = 0/+3.3 V; See Bias Truth Table.

Parameter	Conditions	Min	Typ	Max	Units
Operational Frequency Range		15		19	GHz
Insertion Loss	Average across all phase states		6 - 8		dB
Input Return Loss	Average across all phase states		>10		dB
Output Return Loss	Average across all phase states		>9		dB
RMS Phase Error			4		deg
RMS Amplitude Error			0.85		dB
Input P1dB			>23		dBm
Insertion Loss Temperature Coefficient	Average all phase states, 19 GHz		0.002		dB/°C

Bias Truth Table

Logic “0” = 0 V, Logic “1” = V_{REF} = +3.3 V

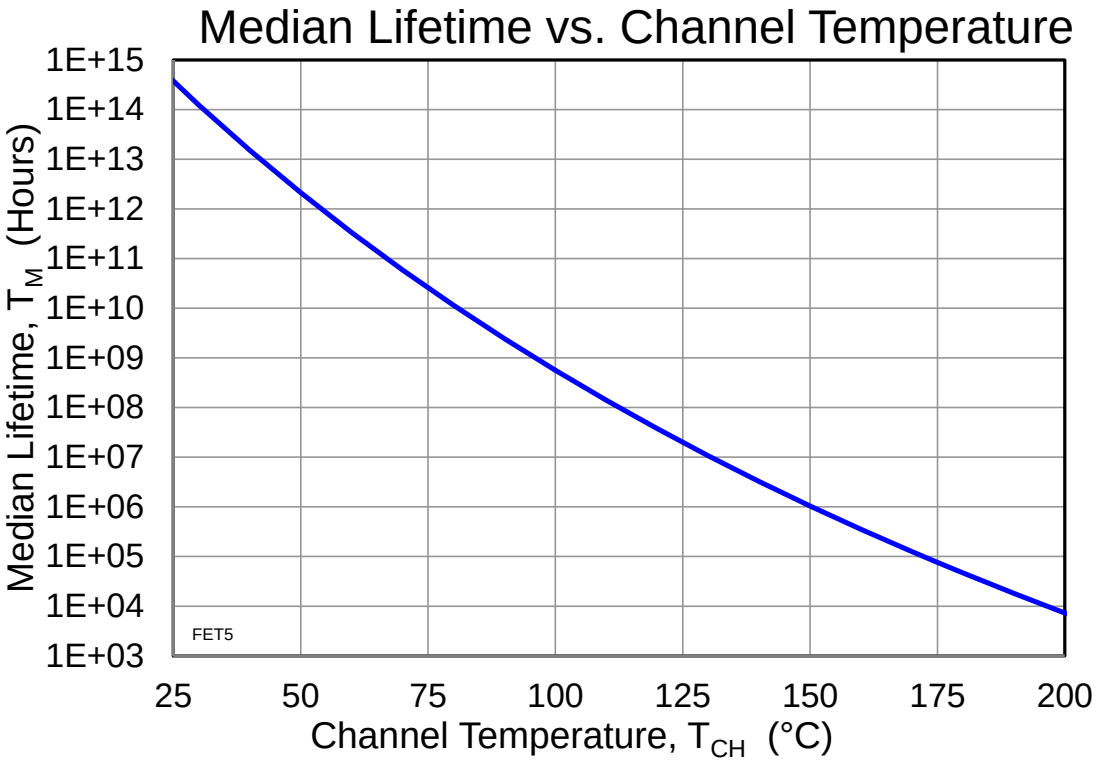
Phase Shifter Setting	5°	11°	22°	45°	90°	180°
0° (Reference)	0	0	0	0	0	0
5°	1	0	0	0	0	0
11°	0	1	0	0	0	0
22°	0	0	1	0	0	0
45°	0	0	0	1	0	0
90°	0	0	0	0	1	0
180°	0	0	0	0	0	1
355°	1	1	1	1	1	1

Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Channel Temperature (T_{CH})	$T_{BASEPLATE}$ = 85°C	85	°C
Median Lifetime (T_M)		5.2E+9	Hrs

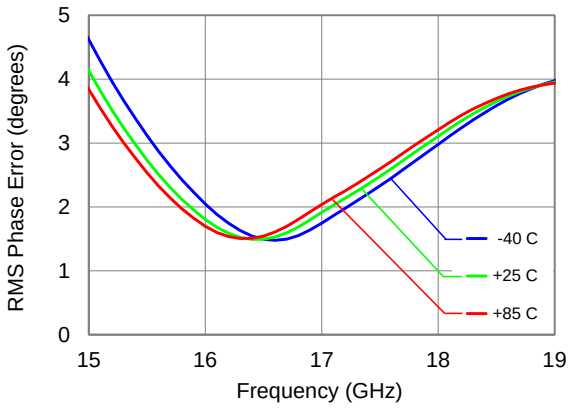
Notes:
1. Under normal (lifetime) operating conditions, self-heating is not a significant contributor to channel temperature.

Median Lifetime

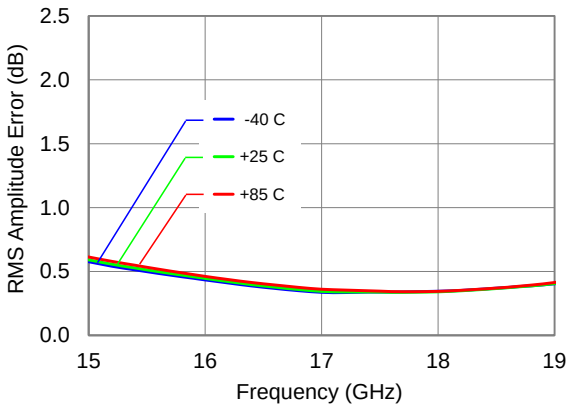


Typical Performance

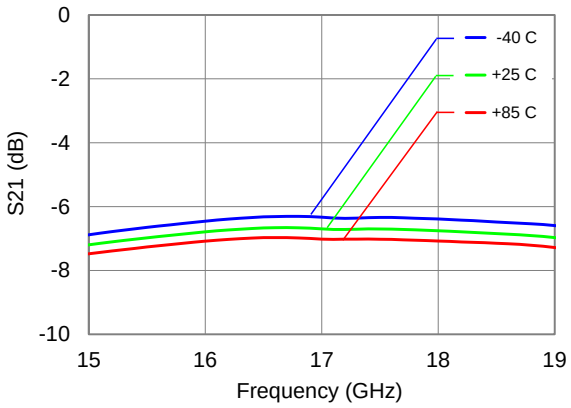
RMS Phase Error vs Frequency
All Phase States, V_{REF} = 3.3 V



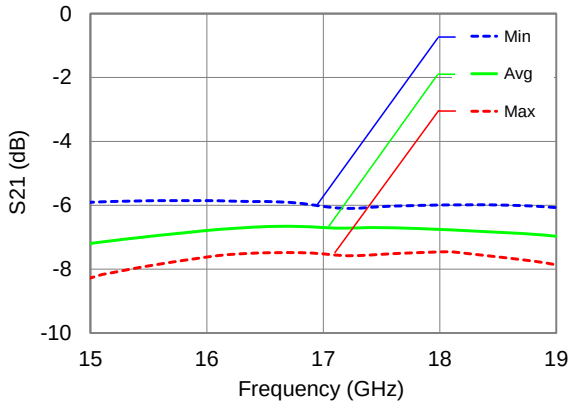
RMS Amplitude Error vs Frequency
All Phase States, V_{REF} = 3.3 V



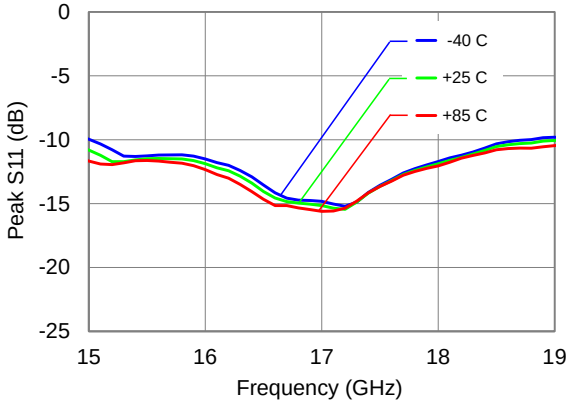
Average Insertion Loss vs Temperature
All Phase States, V_{REF} = 3.3 V



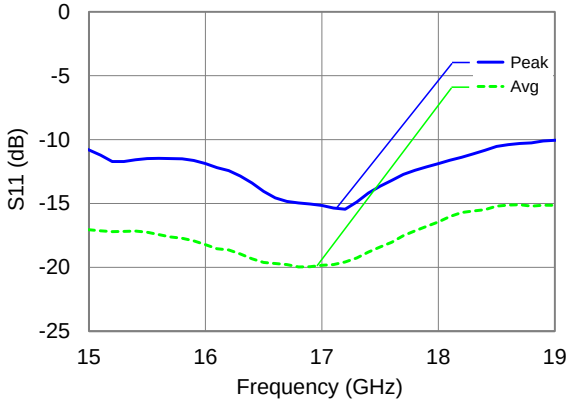
Insertion Loss vs Frequency
All Phase States, 25 ºC, V_{REF} = 3.3 V



Input Return Loss vs Temperature
All Phase States, V_{REF} = 3.3 V

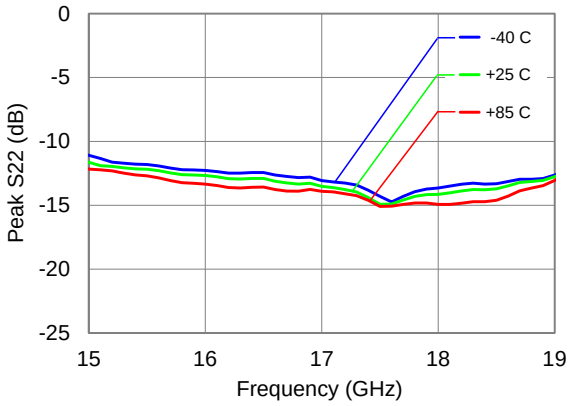


Input Return Loss vs Frequency
All Phase States, 25 ºC, V_{REF} = 3.3 V

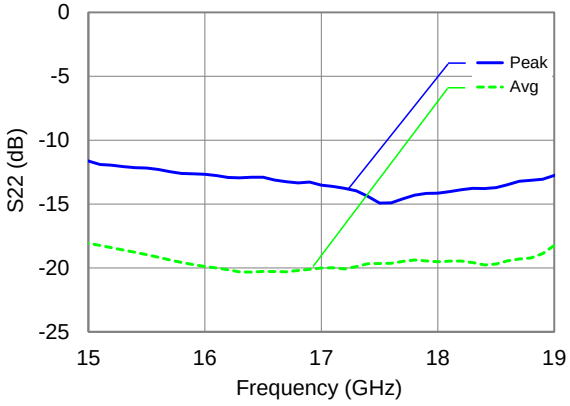


Typical Performance

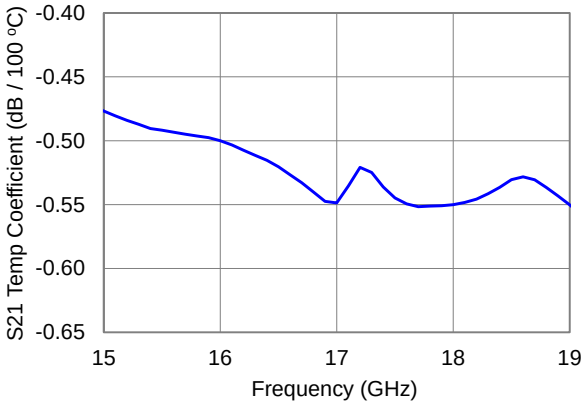
Output Return Loss vs Temperature
All Phase States, V_{REF} = 3.3 V



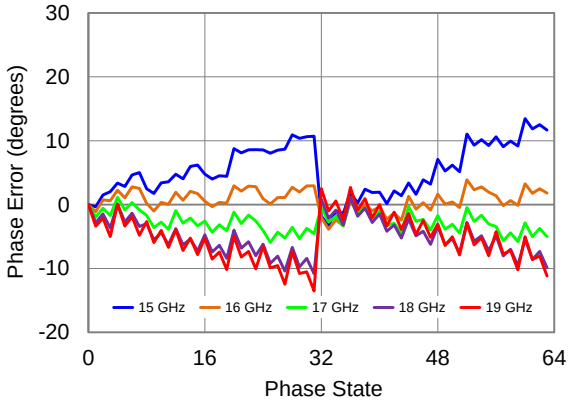
Output Return Loss vs Frequency
All Phase States, 25 °C, V_{REF} = 3.3 V



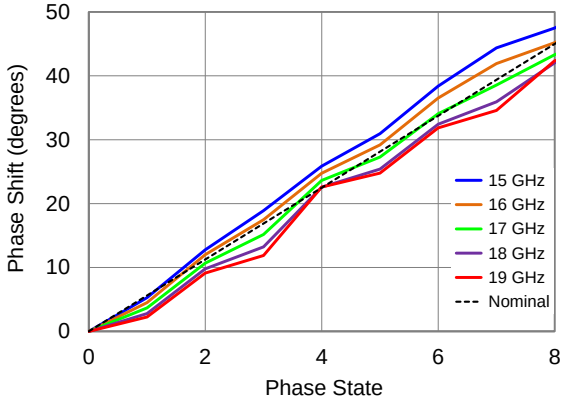
Loss Temperature Coefficient vs Frequency
All Phase States, -40 to +85 °C, V_{REF} = 3.3 V



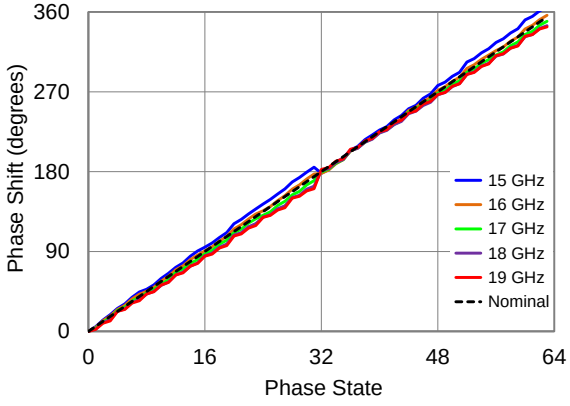
Absolute Phase Error vs State
25 °C, V_{REF} = 3.3 V



Phase Shift vs State
25 °C, V_{REF} = 3.3 V

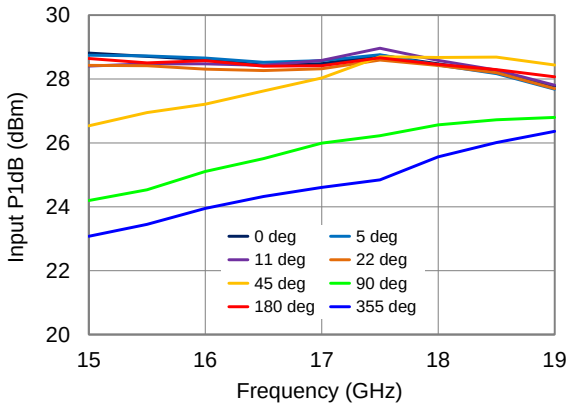


Phase Shift vs State
25 °C, V_{REF} = 3.3 V

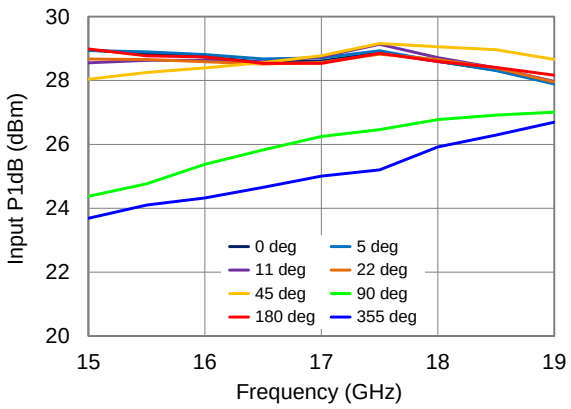


Typical Performance

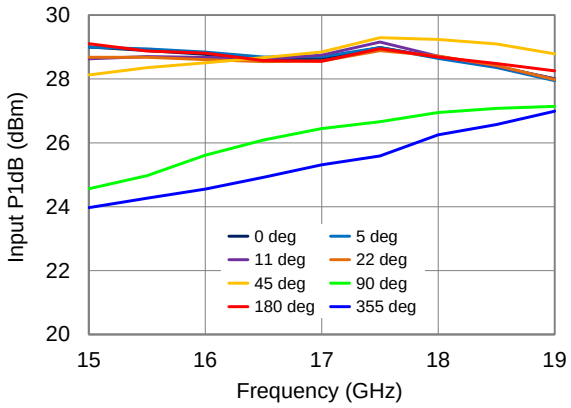
Input P1dB vs Frequency
Major Phase States, -40 °C, V_{REF} = 3.3 V



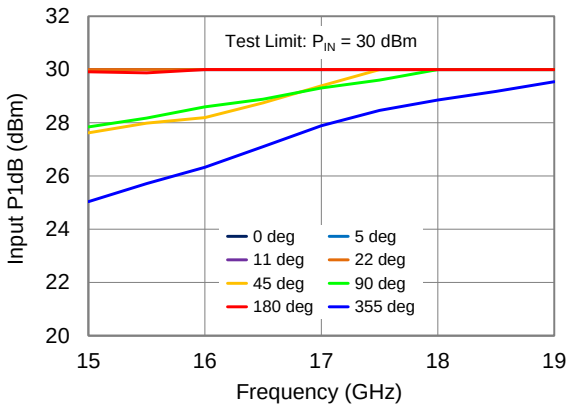
Input P1dB vs Frequency
Major Phase States, 25 °C, V_{REF} = 3.3 V



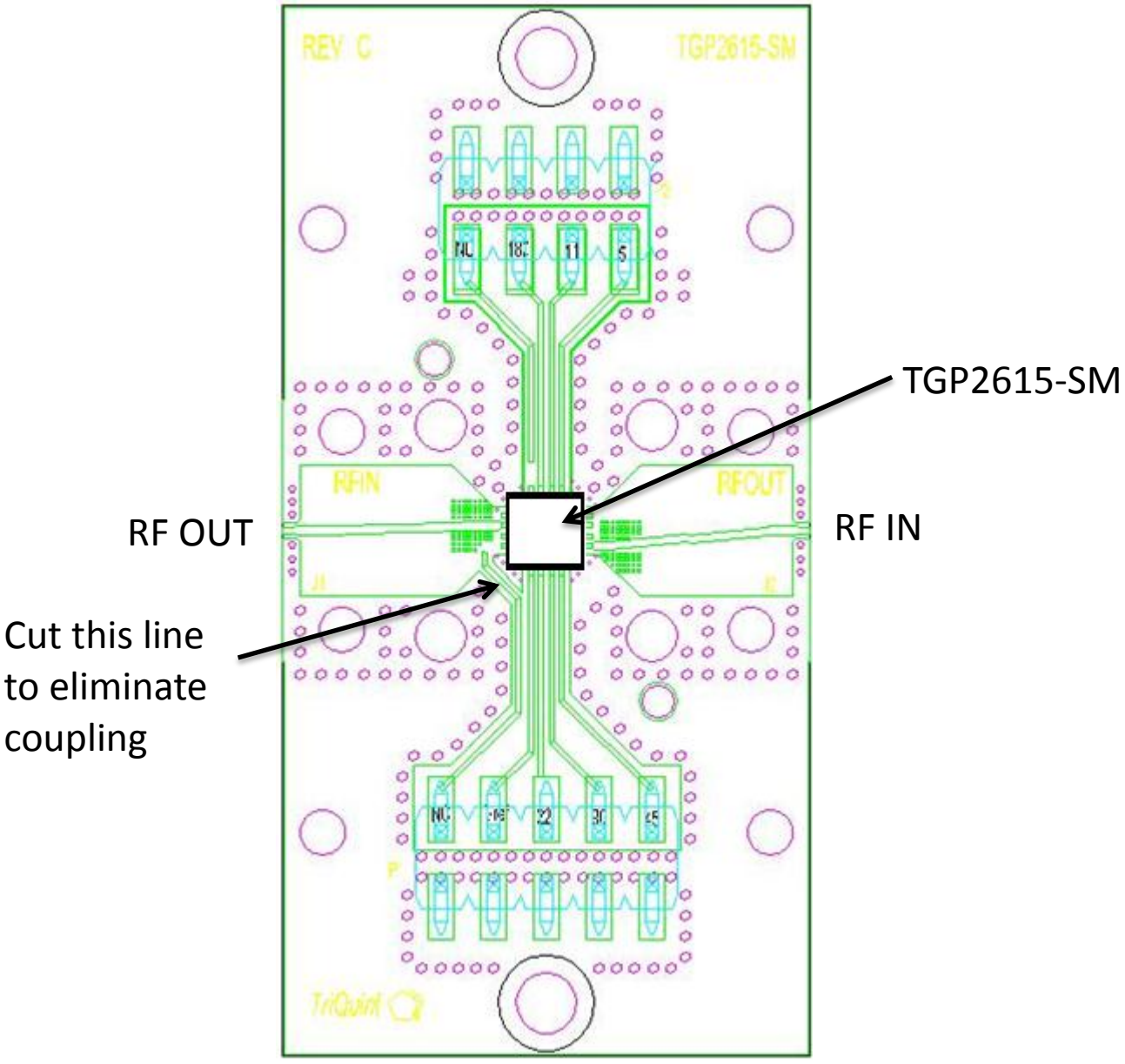
Input P1dB vs Frequency
Major Phase States, 85 °C, V_{REF} = 3.3 V



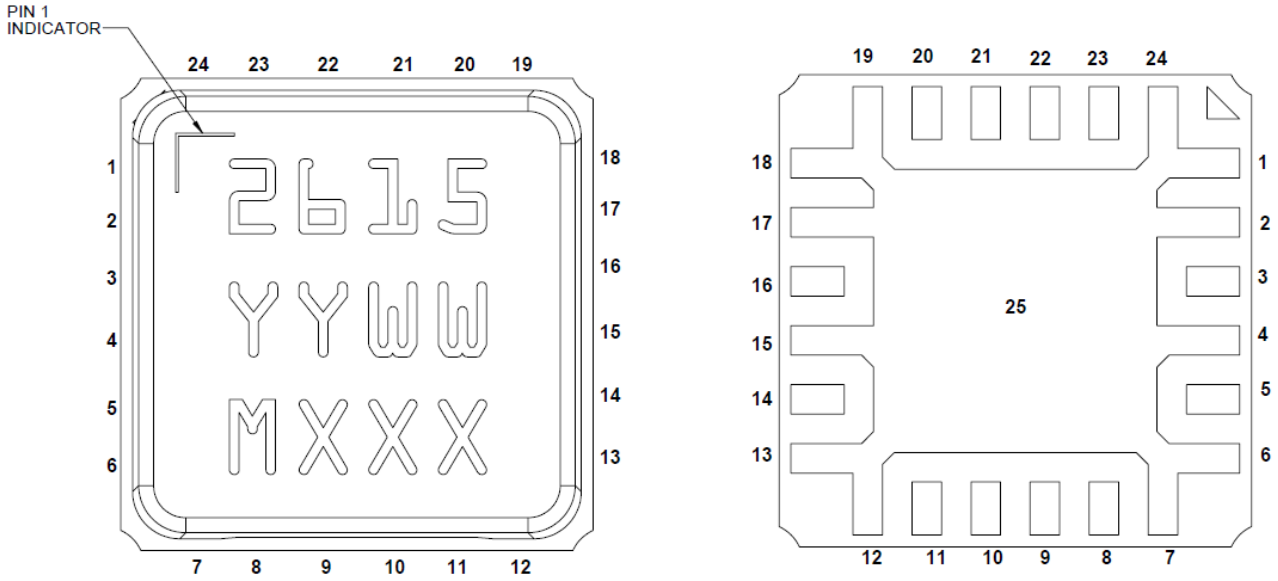
Input P1dB vs Frequency
Major Phase States, 25 °C, V_{REF} = 5.0 V



Evaluation Test Assembly



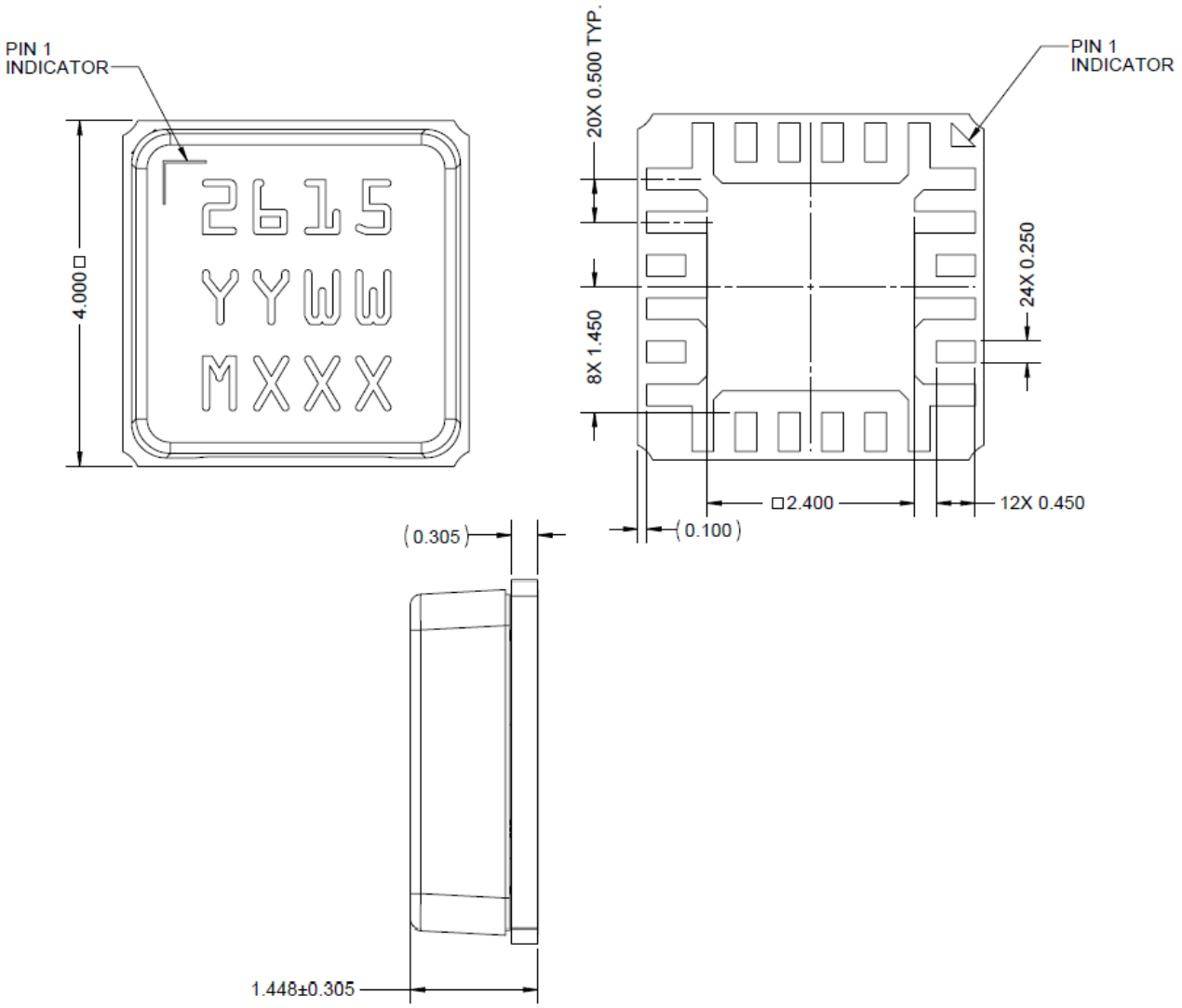
Pin Description



Bond Pads

Pin Number	Symbol	Description
1, 2, 4, 6, 7, 12, 13, 15, 17, 18, 19, 24	GND	Internal grounding and shielding, must be grounded on PCB
25	GND	Backside Paddle; multiple vias should be used on PCB to minimize inductance and thermal resistance
3	RF OUT	RF Output, 50 Ω, DC-Blocked
8	V_{REF}	Reference Voltage for Logic “1” (Nominal 3.3 V)
9	22°	22° Bit Control
10	90°	90° Bit Control
11	45°	45° Bit Control
14	RF IN	RF Input, 50 Ω, DC-Blocked
20	5°	5° Bit Control
21	11°	11° Bit Control
22	180°	180° Bit Control
5, 16, 23	NC	No Connection, Pin Not Used

Mechanical Information



NOTES:

1. Material:
   Package Base: Ceramic
   Lid: Plastic with Epoxy
2. Finish:
   Electroless Gold (Au), 0.5 to 1.5 um, over
   Electroless Nickel (Ni), 2.0 um minimum
3. Part Marking:
   2615: Part Number
   YY: Part Assembly Year
   WW: Part Assembly Week
   MXXX: Batch ID

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

MSL Rating: TBD
Test: 260°C convection reflow
Standard: JEDEC Standard IPC/JEDEC J-STD-020

Solderability

Compatible with lead-free soldering processes, 260 °C maximum reflow temperature.

Package lead plating: NiPdAu.

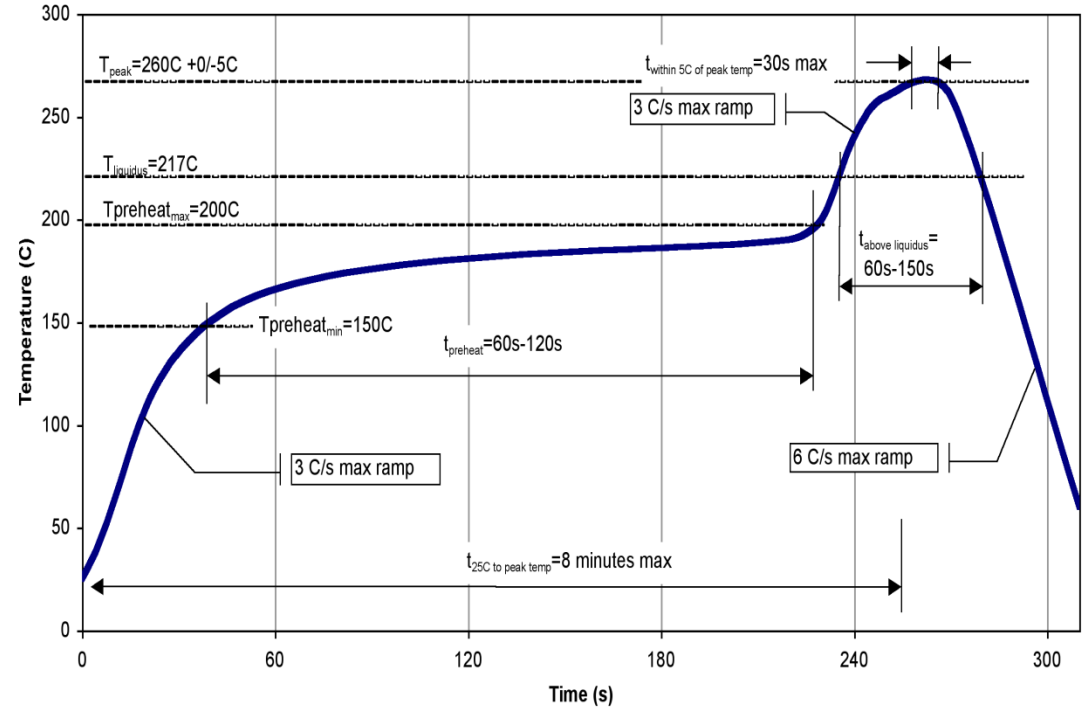
RoHs Compliance

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 ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free

Recommended Soldering Temperature Profile



Contact Information

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