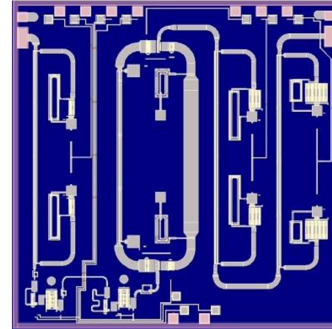
TGP2107

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

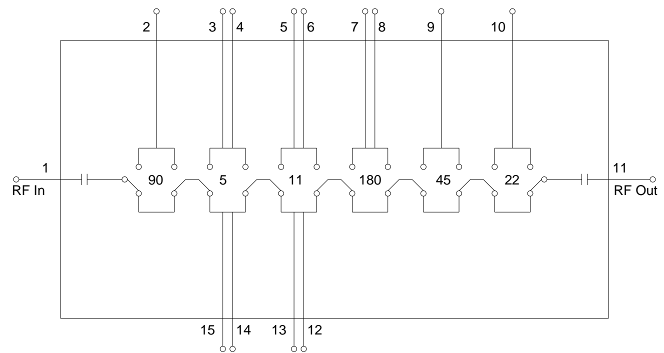
Product Description

Qorvo's TGP2107 is a 6-bit, digital phase shifter fabricated on Qorvo'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 5° with 8 dB of insertion loss over all states.

The TGP2107 uses negative switch logic, eliminating the need for a reference voltage. That, along with low insertion and a high degree of resolution makes the TGP2107 ideally suited for a variety of wideband phased array applications, including commercial and military radars, satellite-based communication systems and electronic warfare.



Block Diagram



Product Features

- Frequency Range: 6 to 18 GHz
- 6-Bit Digital Phase Shifter
- 360° Coverage, LSB = 5.625°
- RMS Phase Error: 5°
- RMS Amplitude Error: 0.55 dB
- Insertion Loss: <10 dB
- Return Loss: >12 dB
- Input P1dB: >25 dBm
- Input IP3: >41 dBm
- Control Voltage: -5/0 V
- Chip Dimensions: 3.15 x 3.15 x 0.10 mm

Applications

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

Ordering Information

Part No.	Description
1110743	Waffle Pack, Qty 20
1110744	Waffle Pack, Sample, Qty 1
1101243	TGP2107 Evaluation Board, Qty 1

Absolute Maximum Ratings

Parameter	Value	Units
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.

Bias and Truth Table

Control voltage Logic “0” = VL, value between -5 to -3 V; Logic “1” = VH, value between +0 to +0.2 V

Phase Shift	5P	5N	11P	11N	22	45	90	180P	180N
0° (Reference)	0	1	0	1	0	0	0	0	1
5°	1	0	0	1	0	0	0	0	1
11°	0	1	1	0	0	0	0	0	1
22°	0	1	0	1	1	0	0	0	1
45°	0	1	0	1	0	1	0	0	1
90°	0	1	0	1	0	0	1	0	1
180°	0	1	0	1	0	0	0	1	0
355°	1	0	1	0	1	1	1	1	0

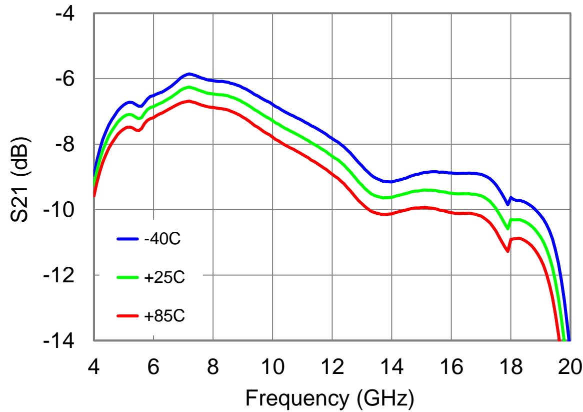
Electrical Specifications

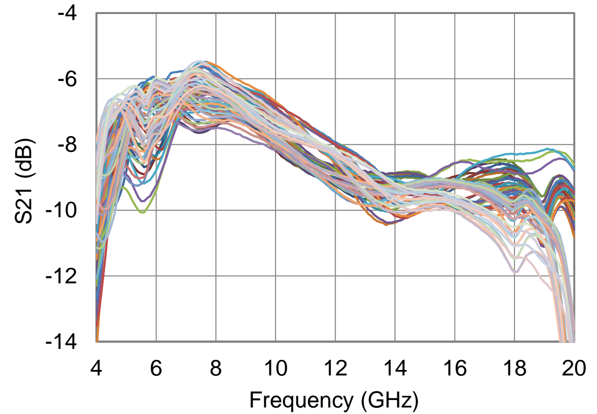
Test conditions unless otherwise noted: 25 °C
Data de-embedded to device reference planes at end of feeds, data include bond wire effects
Control Voltage (5N, 5P, 11N, 11P, 22, 45, 90, 180N, 180P) = −5 / 0 V; See Bias Truth Table.

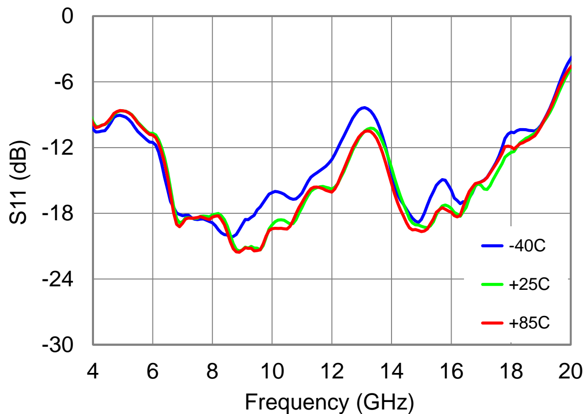
Parameter	Min	Typical	Max	Units
Operational Frequency Range	6		18	GHz
Insertion Loss		6 - 10		dB
Input Return Loss		>12		dB
Output Return Loss		>12		dB
RMS Phase Error		5		deg
RMS Amplitude Error		0.55		dB
Input P1dB		>25		dBm
Input IP3, Tone spacing = 10 MHz, Pin/Tone = 15 dBm		>41		dBm
Insertion Loss Temperature Coefficient		0.008		dB/°C

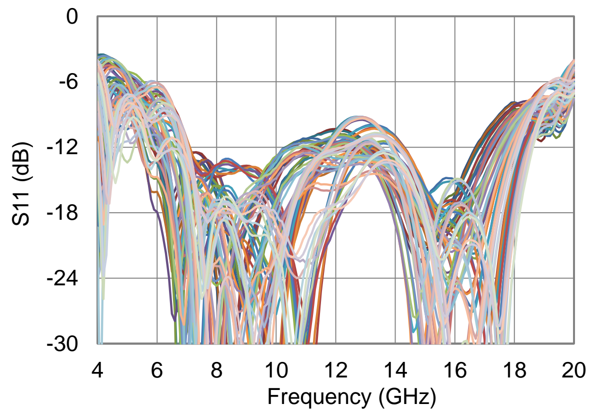
Performance Plots – Small Signal

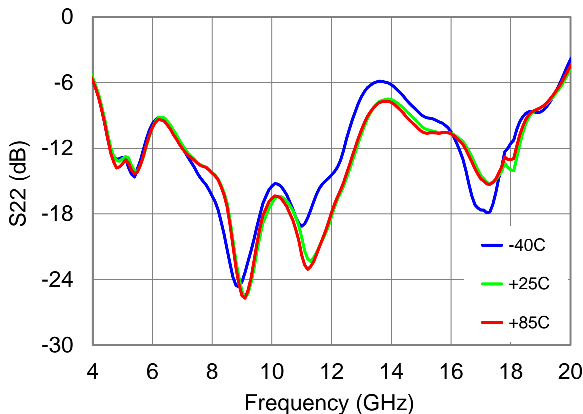
Test conditions unless otherwise noted: 25 °C

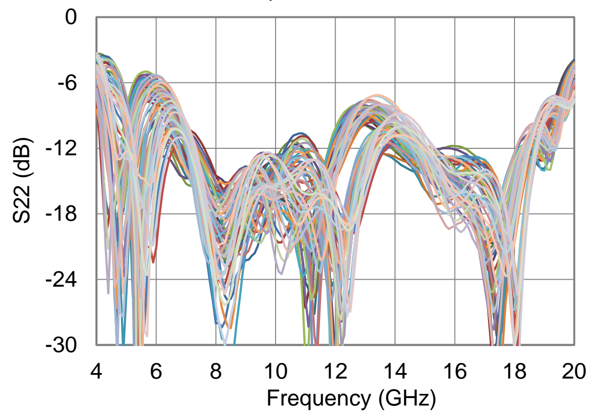












Performance Plots – Small Signal

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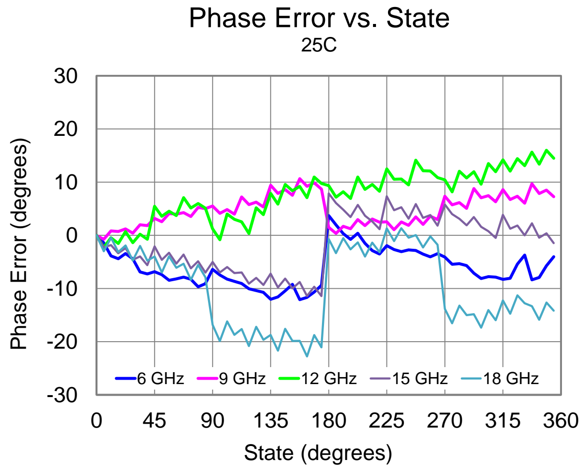
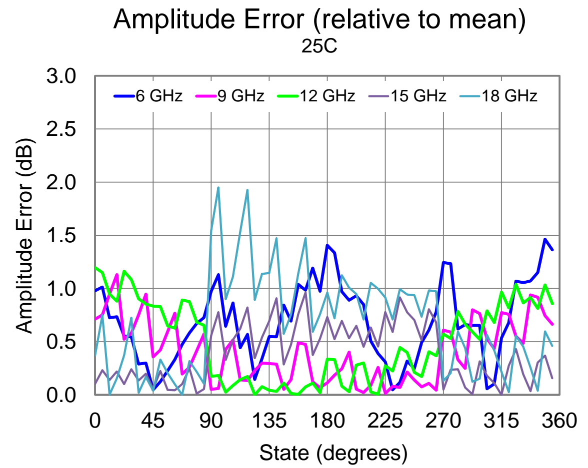
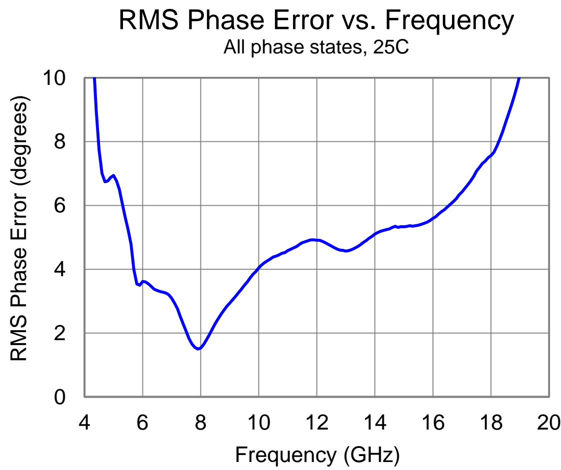
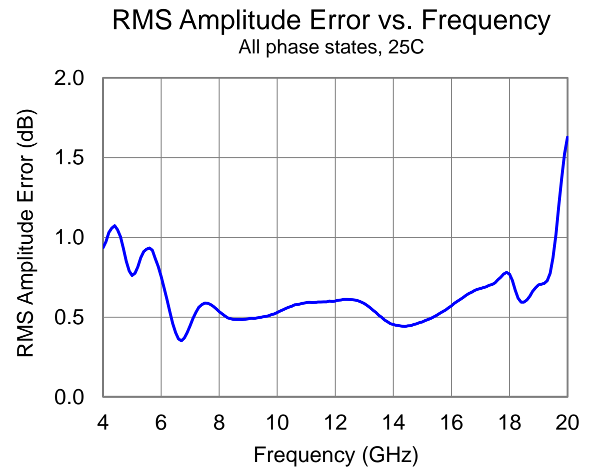
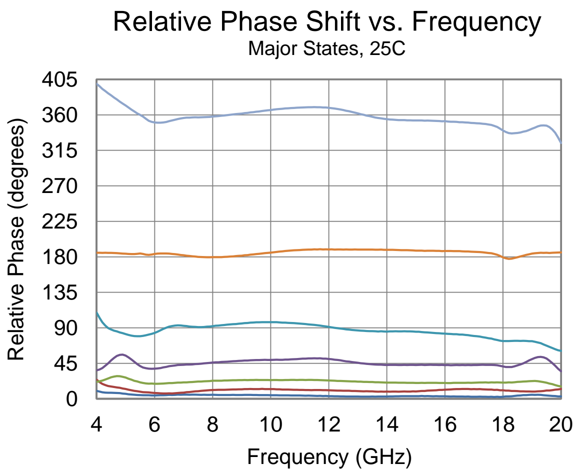
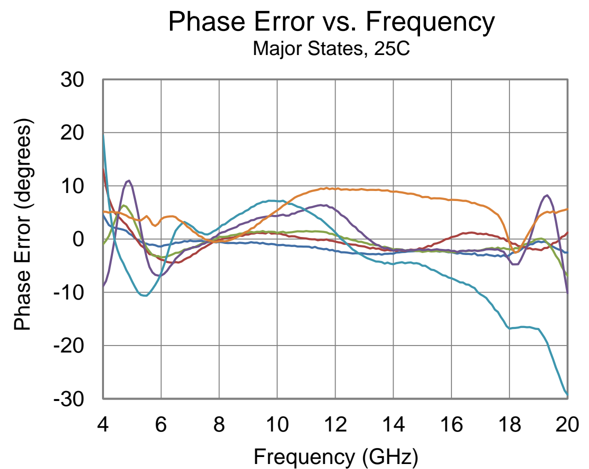






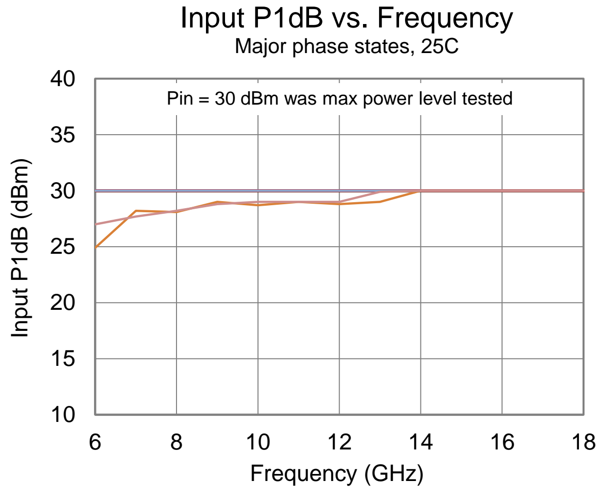


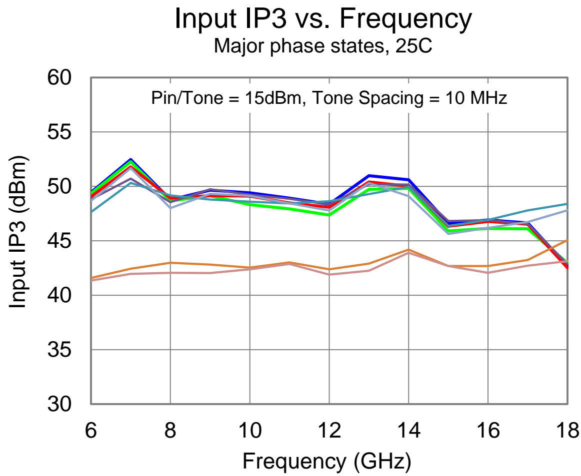


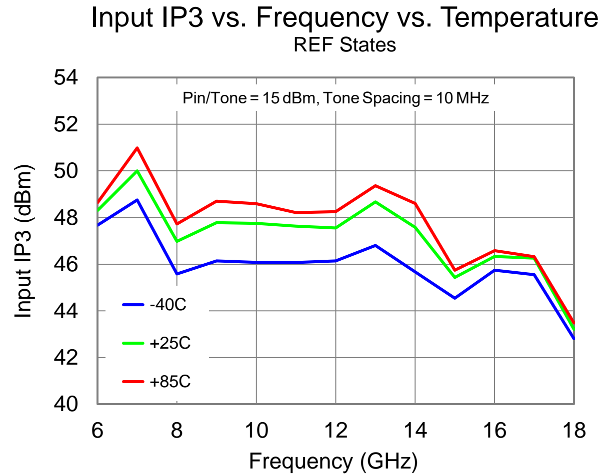


Performance Plots – Large Signal and Linearity

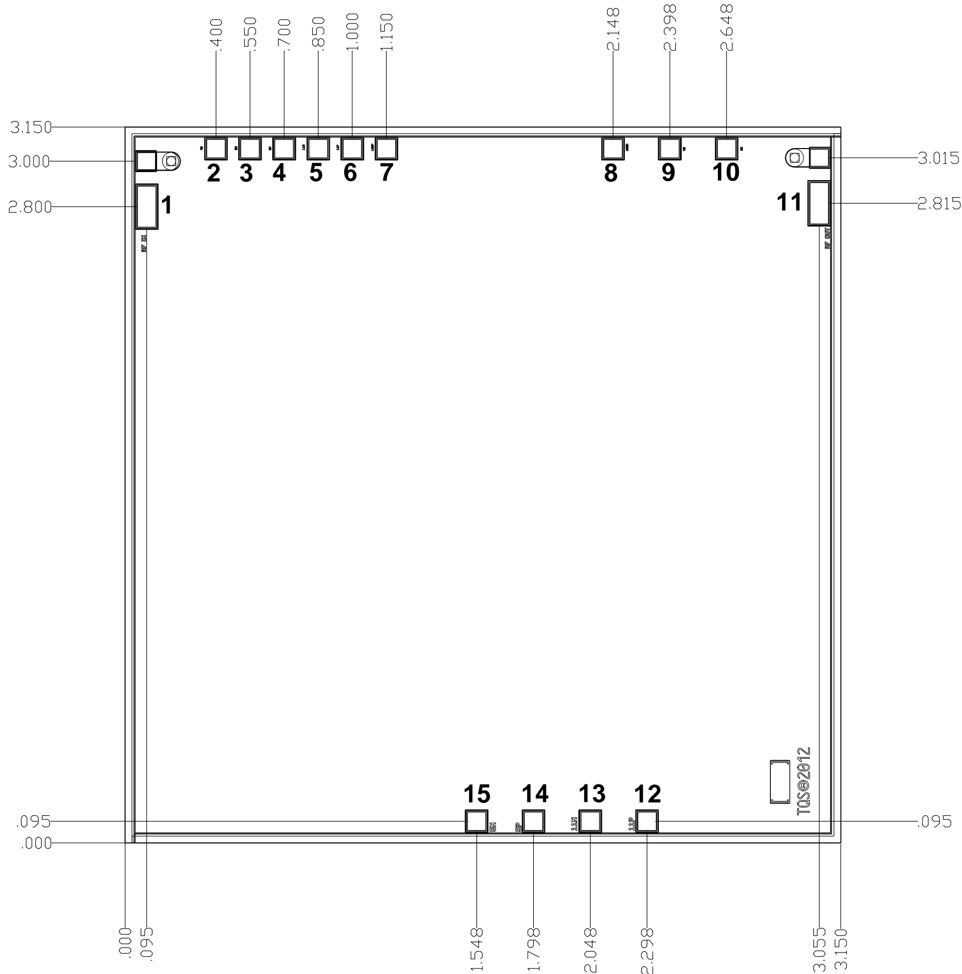
Test conditions unless otherwise noted: 25 °C







Mechanical Information and Bond Pad Description

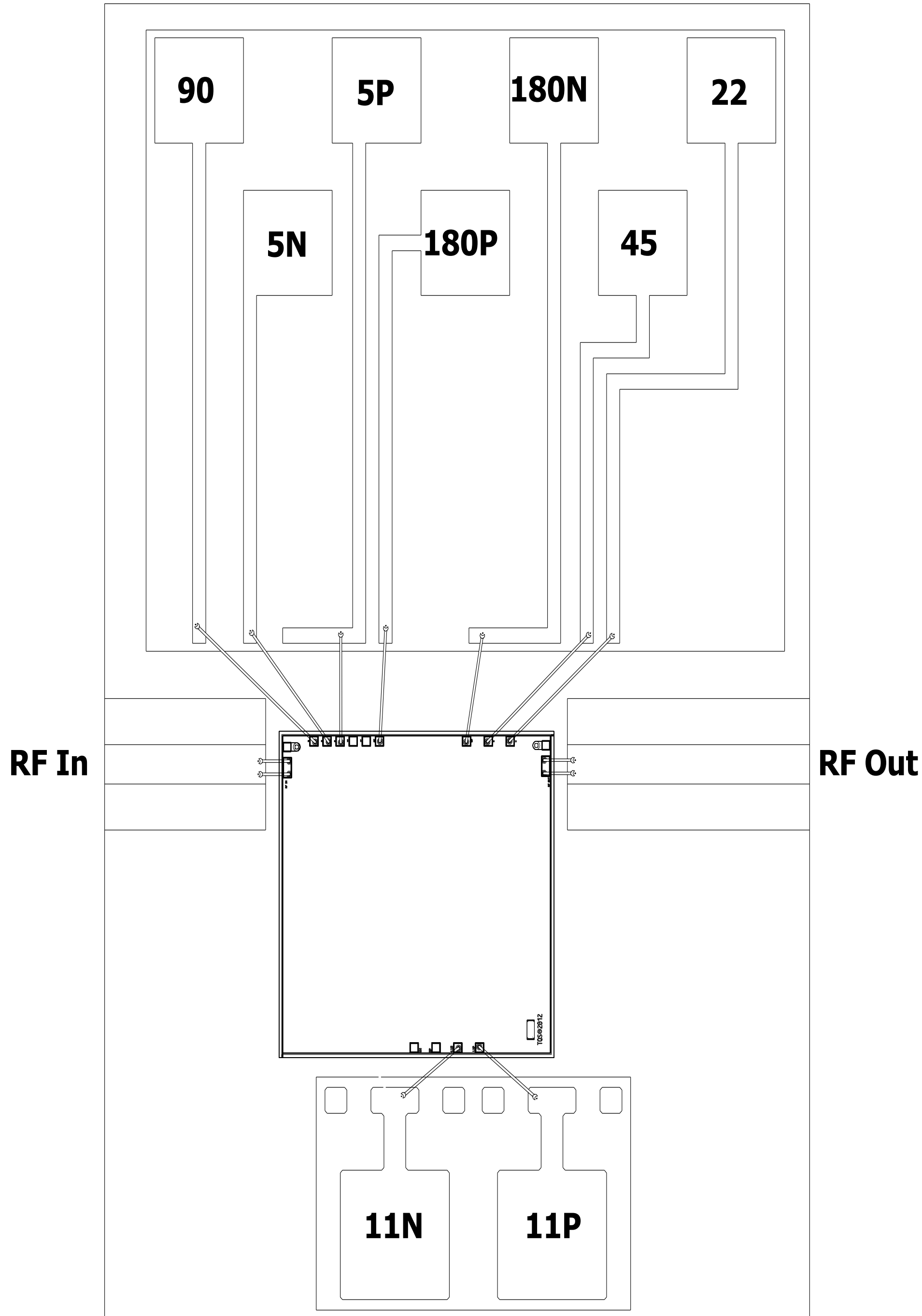


Unit: millimeters, Die thickness: 0.10, Die x, y size tolerance: ± 0.050
Chip edge to bond pad dimensions are shown to center of pad, Ground is backside of die

Bond Pad	Symbol	Description	Pad Size
1	RF In	Input; matched to 50 Ω; DC blocked	0.200 x 0.100
2	90	90° Bit	0.100 x 0.100
3, 15	5N	5N° Bit; use either pad 3 or 15	0.100 x 0.100
4, 14	5P	5P° Bit; use either pad 4 or 14	0.100 x 0.100
5, 13	11N	11N° Bit; use either pad 5 or 13	0.100 x 0.100
6, 12	11P	11P° Bit; use either pad 6 or 12	0.100 x 0.100
7	180P	180P° Bit	0.100 x 0.100
8	180N	180N° Bit	0.100 x 0.100
9	45	45° Bit	0.100 x 0.100
10	22	22° Bit	0.100 x 0.100
11	RF Out	Output; matched to 50 Ω; DC blocked	0.200 x 0.100

Applications Information

1. The spacing between MMIC and TFN at RF In and RF Out is <5 mils typical.
2. RF connections: Bond two 1-mil diameter, <20 mils length gold bond wires at RF In and RF Out for optimum RF performance.



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.
- Conductive epoxy die attach is recommended for PCB mounting.
- Bonding pads plating: Au.
- 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:

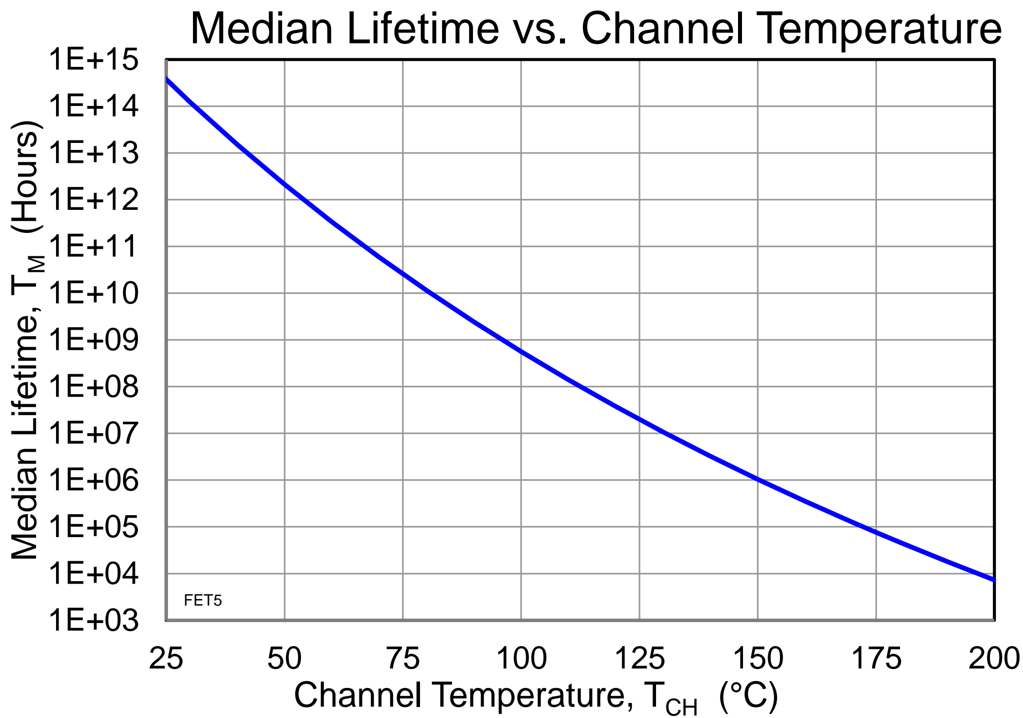
- Thermosonic ball bonding is the preferred interconnect technique.
- Force, time, and ultrasonics are critical parameters.
- Aluminum wire should not be used.
- Devices with small pad sizes should be bonded with 0.0007-inch wire.

Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) [1]	P_{DISS} = 0.09 W, $T_{BASEPLATE}$ = 85°C	22	ºC/W
Channel Temperature, T_{CH} (Under RF)		87	°C
Median Lifetime (T_M)		3.8E09	Hrs

Notes:
1. Thermal resistance measured to back of carrier plate. MMIC mounted on 40 mils thick CuMo carrier using 1.5 mil 80/20 AuSn.

Median Lifetime



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	TBD	ESDA / JEDEC JS-001-2012

Caution!
ESD-Sensitive Device

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 ($C_{15}H_{12}Br_{4}0_{2}$) Free
- PFOS Free
- SVHC Free

Contact Information

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