

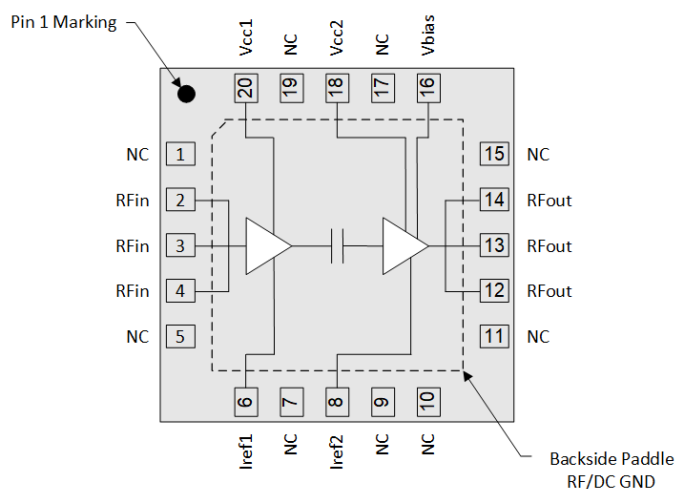
### Product Overview

The TQP9111 is a high efficiency two-stage driver amplifier in a low-cost surface mount package. The amplifier is able to achieve high performance with +46 dBm OIP3 and +32.5 dBm P1dB. This linear amplifier integrates two high performance amplifier stages onto a module allow for a compact system design. The integrated inter-stage match minimizes performance variation that would otherwise be attributed to external matching component value and placement tolerances.

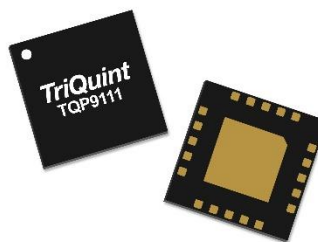
Both the input and output stage amplifiers are bias adjustable allowing the amplifier's power consumption to be reduced for occasions when high power performance is not required. Both stages can also be turned off when not being used for power saving or for TDD systems. The output match is externally tunable to allow the amplifier to be optimized for high power or high linearity applications.

The TQP9111 is in a RoHS-compliant 20-pin 4 x 4 mm surface mount package.

### Functional Block Diagram



Top View



4 x 4 mm Leadless SMT Package

### Key Features

- 1.8 – 2.7 GHz Frequency Range
- 29.8 dB Gain Typical
- +32.5 dBm P1dB
- +46 dBm Output IP3 at +14 dBm/tone
- Integrated Inter-stage Matching
- Bias Adjustable
- Internal RF Overdrive Protection
- Internal DC Overvoltage Protection
- Shut-down Capability

### Applications

- Wireless Infrastructure
- Repeaters, Boosters, DAS
- High Power Amplifiers
- Pico and Macro Base Stations
- FDD or TDD

### Ordering Information

Part No.	Description
TQP9111	2,500 pieces on a 13" reel (standard)
TQP9111-PCB2140	1.8 – 2.2 GHz Evaluation Board
TQP9111-PCB2600	2.3 – 2.7 GHz Evaluation Board

## Absolute Maximum Ratings

Parameter	Rating
Storage Temperature	–55 to +150 °C
RF Input Power, CW, 50 Ω, T +25 °C	+23 dBm
Device Supply Voltage (V <sub>CC</sub> )	+6.5 V

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability.

## Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Device Voltage (V <sub>CC</sub> )		+5.0	+5.25	V
T <sub>CASE</sub>	–40		+105	°C
T <sub>j</sub> for >10 <sup>6</sup> hours MTTF			+170	°C

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

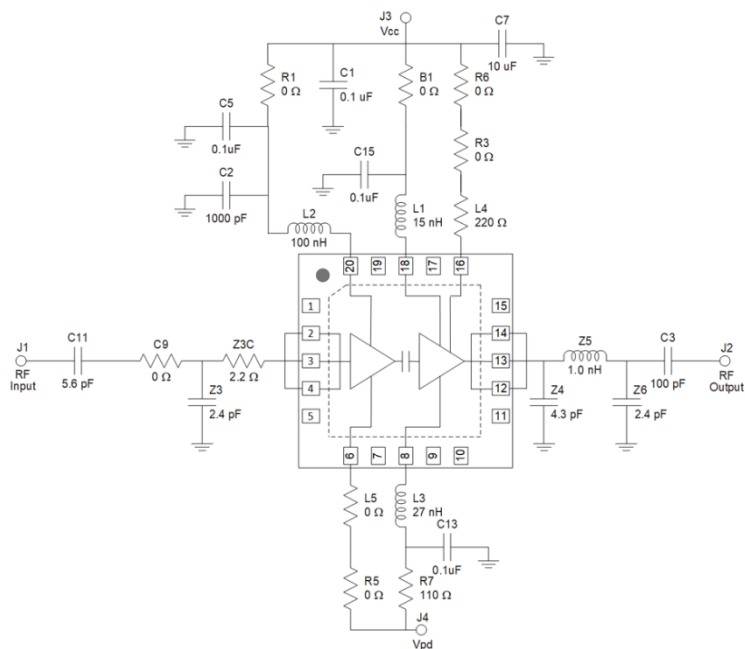
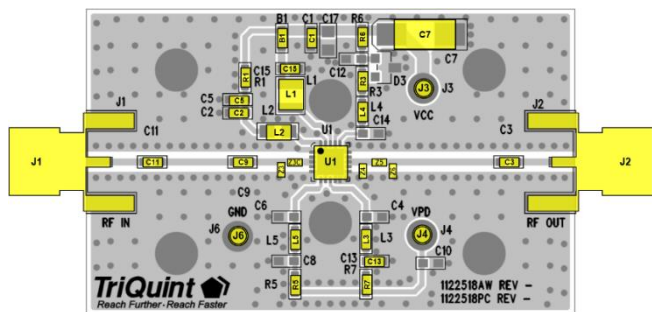
## Electrical Specifications

Parameter	Conditions <sup>(1)</sup>	Min	Typ	Max	Units
Operational Frequency Range		1800		2700	MHz
Test Frequency			2140		MHz
Gain		27.0	29.8		dB
Input Return Loss			13		dB
Output Return Loss			20		dB
Output P1dB		29.0	32.5		dBm
Output IP3	P <sub>out</sub> = +11 dBm/tone, Δf = 1 MHz	42	46		dBm
Noise Figure			6.2		dB
Reference current, I <sub>REF1</sub>			4.5		mA
Reference current, I <sub>REF2</sub>			19.5		mA
Current, I <sub>CC</sub>		400	521	600	mA
Total Current			545		mA
Thermal Resistance, θ <sub>JC</sub>	Junction to case		22.6		°C/W

Notes:

1. Test conditions unless otherwise noted: V<sub>CC</sub> = +5.0 V, I<sub>CC</sub> = 521 mA, I<sub>REF1</sub> = 4.5 mA, I<sub>REF2</sub> = 19.5 mA, Temp = +25 °C, 50 Ω system.

## 1.8–2.2 GHz Evaluation Board – TQP9111-PCB2140



## Bill of Material – TQP9111-PCB2140

Reference Des.	Value	Description	Manuf.	Part Number
U1	-	Module, TQP9111 Amplifier	Qorvo	TQP9111
B1, C9, L5, R1, R3, R5, R6	0 $\Omega$	RES, 0 $\Omega$ , 5%, 1/16 W, 0603	various	
C1, C5, C13, C15	0.1 $\mu$ F	CAP, 0.1 $\mu$ F, 10%, 50 V, X7R, 0603	various	
C2	1000 pF	CAP, 1000 pF, 5%, 50 V, NPO, 0603	various	
C3	100 pF	CAP, 100 pF, 5%, 50 V, NPO, 0603	various	
C7	10 $\mu$ F	CAP, 10 $\mu$ F, 20%, 50 V, Tantalum	various	
C11	5.6 pF	CAP, 5.6 pF, $\pm$ 0.1 pF, 200 V, NPO, 0603	various	
L1	15 nH	IND, 15 nH, 5%, 1008	various	
L2	100 nH	IND, 100 nH, 5%, 0805	various	
L3	27 nH	IND, 27 nH, 5%, Ceramic	various	
L4	220 $\Omega$	RES, 220 $\Omega$ , 1%, 1/16 W, 0603	various	
R7	110 $\Omega$	RES, 110 $\Omega$ , 1%, 1/10 W, 0603	various	
Z3, Z6	2.4 pF	CAP, 2.4 pF, $\pm$ 0.1 pF, 50 V, NPO, 0402	various	
Z3C	2.2 $\Omega$	RES, 2.2 $\Omega$ , 5%, 1/16 W, 0402	various	
Z4	4.3 pF	CAP, 4.3 pF, $\pm$ 0.25 pF, 50 V, C0G, 0402	various	
Z5	1.0 nH	IND, 1.0 nH, $\pm$ 0.3 nH, 0402	various	

## Typical Performance – TQP9111-PCB2140

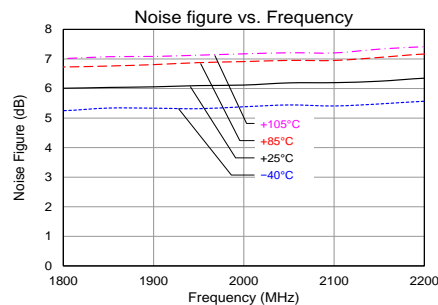
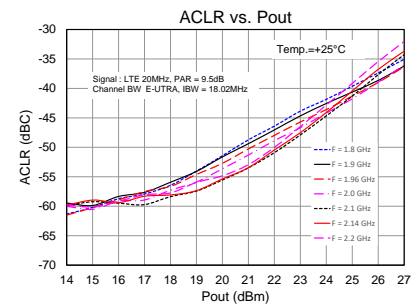
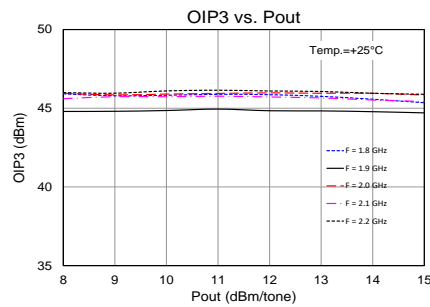
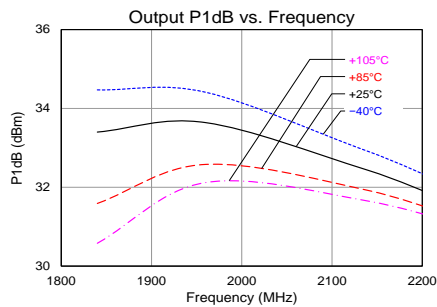
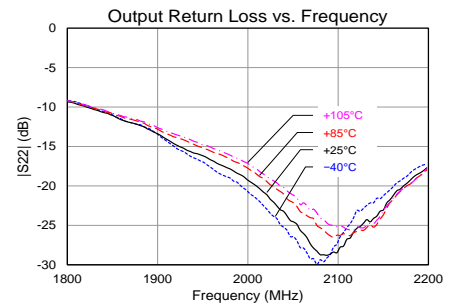
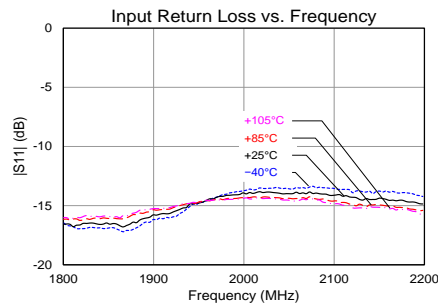
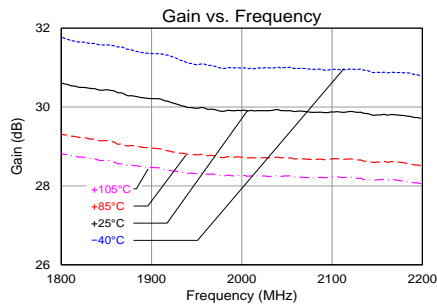
Parameter	Conditions <sup>(1)</sup>	Typical Value			Units
Frequency		1800	1960	2140	MHz
Gain		30.4	30.0	29.8	dB
Input Return Loss		15	14	13	dB
Output Return Loss		9	15	20	dB
Output P1dB		+33.4	+32.5	+32.5	dBm
OIP3	Pout= +14 dBm/tone, Δf=1 MHz	+46	+46	+46	dBm
Noise Figure		6.0	6.1	6.2	dB

Notes:

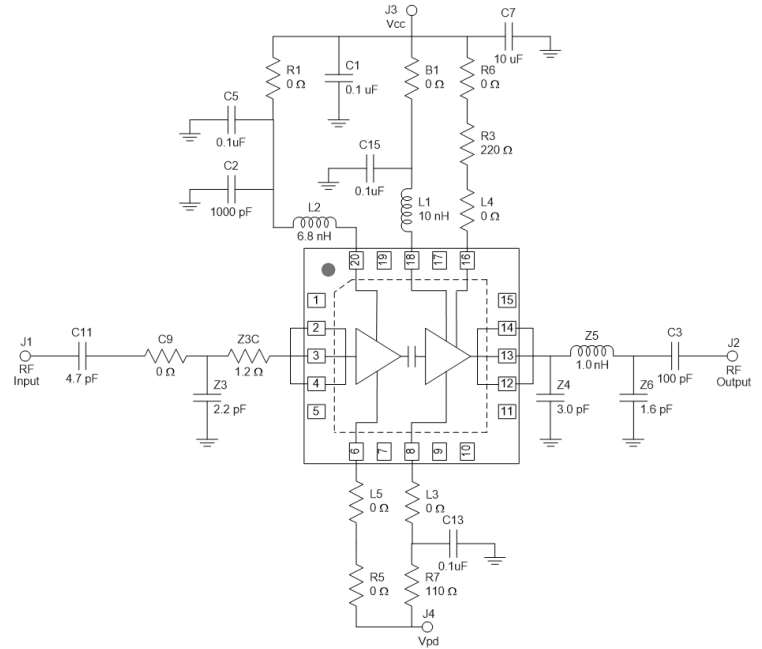
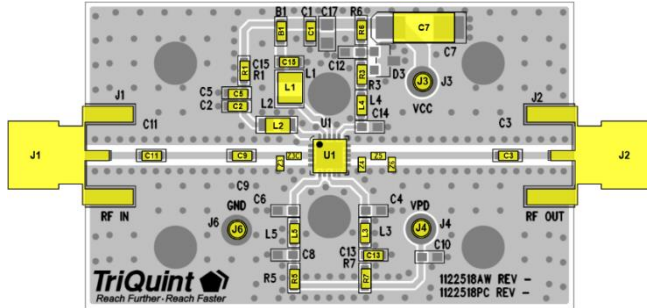
1. Test conditions unless otherwise noted:  $V_{CC} = V_{PD} = +5V$ ,  $I_{CQ} = 545$  mA, Temp.=+25 °C

## Performance Plots – TQP9111-PCB2140

Test conditions unless otherwise noted:  $V_{CC} = V_{PD} = +5V$ ,  $I_{CQ} = 545$  mA, Temp.=+25 °C



## 2.3–2.7 GHz Evaluation Board – TQP9111-PCB2600



## Bill of Material – TQP9111-PCB2600

Ref Des	Value	Description	Manuf.	Part Number
U1	-	TQP9111	Qorvo	TQP9111
B1, L3, L4, L5, R1, R5, C9, R6	0 Ω	RES, 0 Ω, 5%, 1/16W, 0603	various	
C1, C5, C13, C15	0.1 μF	CAP, 0.1 μF, 10%, 50V, X7R, 0603	various	
C2	1000 pF	CAP, 1000 pF, 5%, 50V, NPO, 0603	various	
C3	100 pF	CAP, 100 pF, 5%, 50V, C0G, 0603	various	
C7	10 μF	CAP, 10 μF, 20%, 50V, Tantalum, 6032	various	
C11	4.7 pF	CAP, 4.7 pF, ±0.1pF. 200V. NPO, 0603	various	
L1	10 nH	IND, 10 nH, 5%, 1008	various	
L2	6.8 nH	IND, 6.8 nH, 5%, 0805	various	
R3	220 Ω	RES, 220 Ω, 1%, 1/16W, 0603	various	
R7	110 Ω	RES, 110 Ω, 1%, 1/10W, 0603	various	
Z3	2.2 pF	CAP, 2.2 pF, ±0.1pF. 50V. NPO, 0402	various	
Z3C	1.2 Ω	RES, 1.2 Ω, 5%, 1/16W. 0402	various	
Z4	3.0 pF	CAP, 3.0 pF, ±0.25pF. 50V. C0G, 0402	various	
Z5	1.0 nH	IND, 1.0 nH, ±0.3 nH, 0402	various	
Z6	1.6 pF	CAP, 1.6 pF, ±0.1pF. 50V. C0G, 0402	various	

## Typical Performance – TQP9111-PCB2600

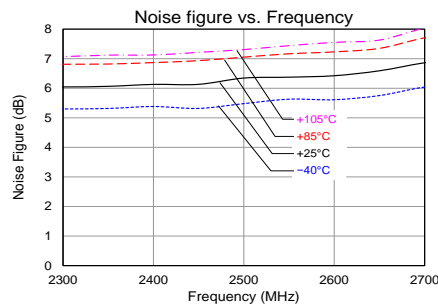
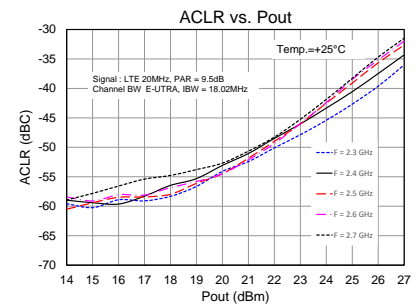
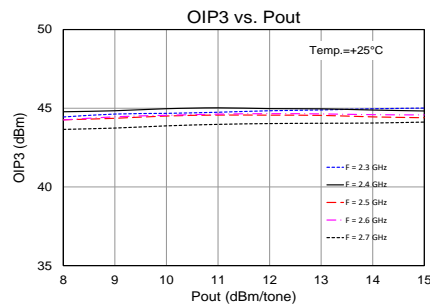
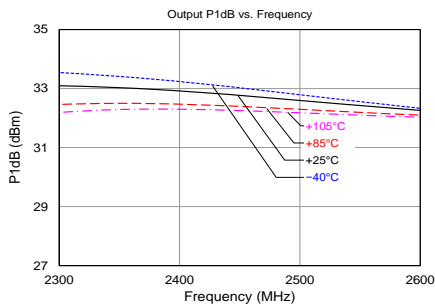
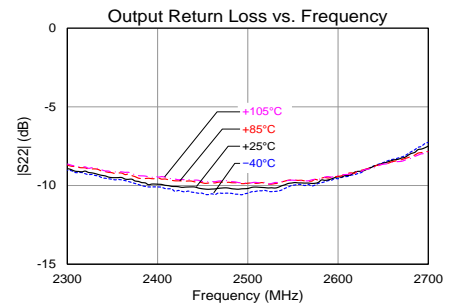
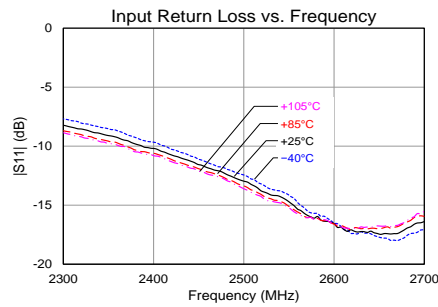
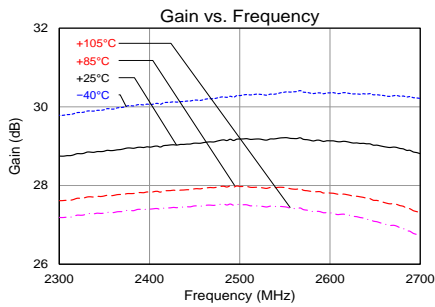
Parameter	Conditions <sup>(1)</sup>	Typical Value			Units
Frequency		2300	2500	2700	MHz
Gain		28.8	29.2	28.8	dB
Input Return Loss		8	13	16	dB
Output Return Loss		9	10	9	dB
Output P1dB		+33.0	+32.8	+32.0	dBm
Output IP3	Pout= +14 dBm/tone, $\Delta f = 1$ MHz	+45.0	+44.5	+44.0	dBm
Noise Figure		6.0	6.3	6.9	dB

Notes:

1. Test Conditions:  $V_{CC} = V_{PD} = +5V$ ,  $I_{CQ} = 545$  mA, Temp.=+25 °C

## Performance Plots – TQP9111-PCB2600

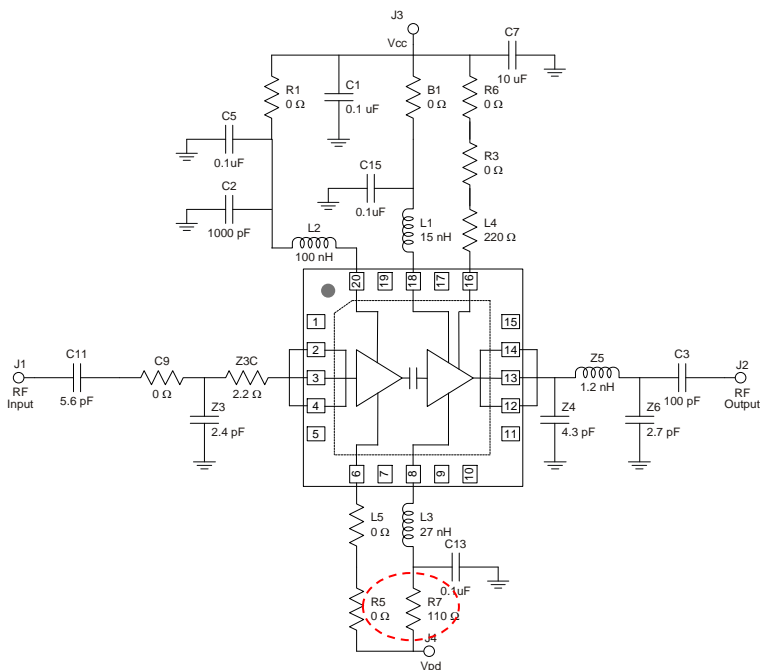
Test conditions unless otherwise noted:  $V_{CC} = V_{PD} = +5V$ ,  $I_{CQ} = 545$  mA, Temp.=+25 °C



## Application Note – Reduced Bias Configurations of TQP9111-PCB2140

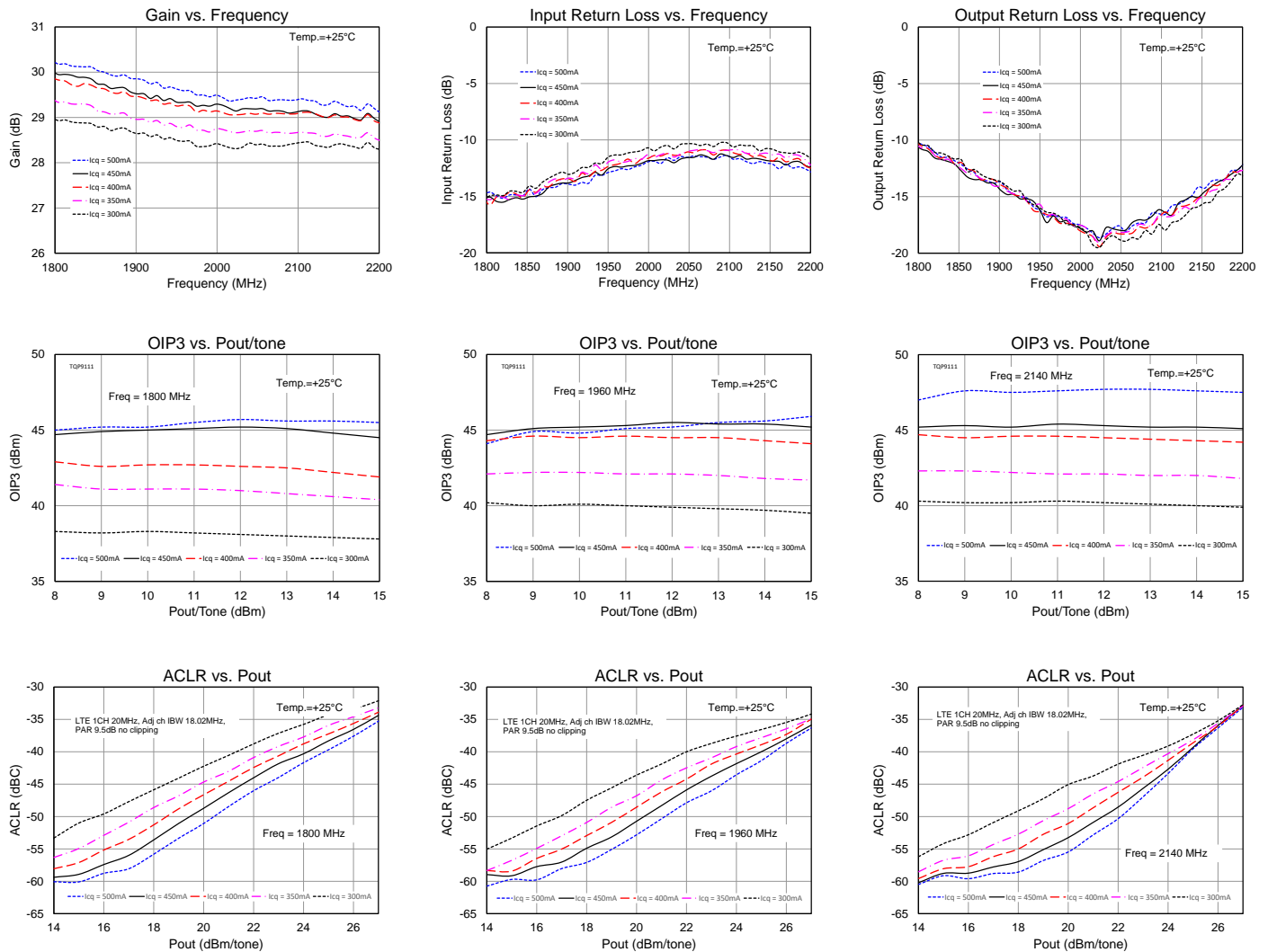
The TQP9111 can be configured to be operated with lower bias current by varying the bias-adjust resistor – R7. The recommended circuit configurations shown previously in this datasheet have the device operating in Class A/B operation. Lowering the current has small effect on the S-parameters and P1dB performance of the device, but will start to lower the OIP3 and ACLR/ACPR performance of the device as shown below. An example of the measured data below represents the TQP9111 measured and configured for 1.8 to 2.2 GHz applications. It is expected that variation of the bias current for other frequency applications will produce similar performance results.

R7 (Ohms)	Ic <sub>q</sub> (mA)	P <sub>diss</sub> (W)	P1dB (dBm)	OIP3 (dBm)
110	500	2.5	+32.3	+47.6
125	450	2.25	+32.3	+45.4
144	400	2.0	+32.3	+44.6
163	350	1.75	+32.3	+42.1
200	300	1.5	+32.3	+40.3



## Performance Plots – Reduced Bias Configurations TQP9111-PCB2140

Test conditions unless otherwise noted:  $V_{CC} = V_{PD} = +5V$ , Temp. = +25 °C



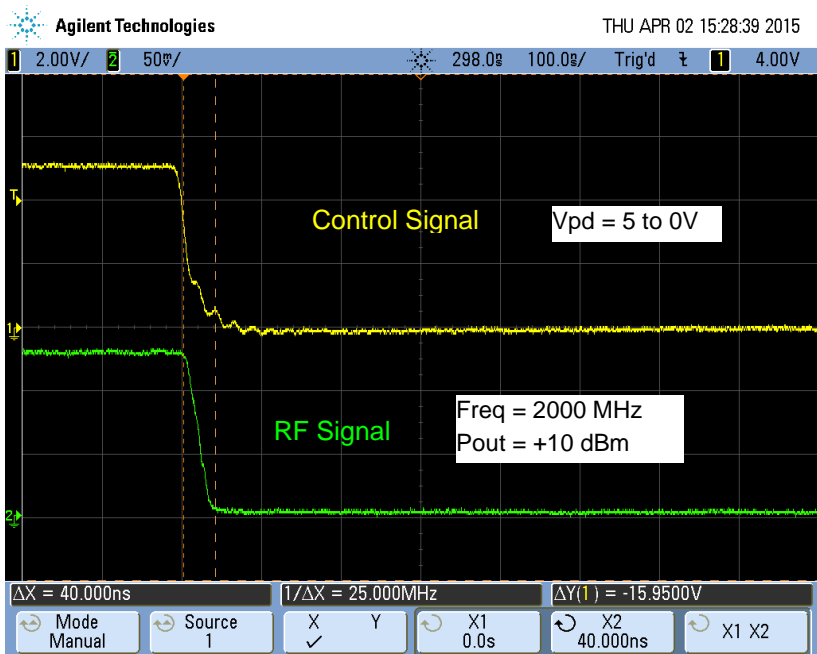
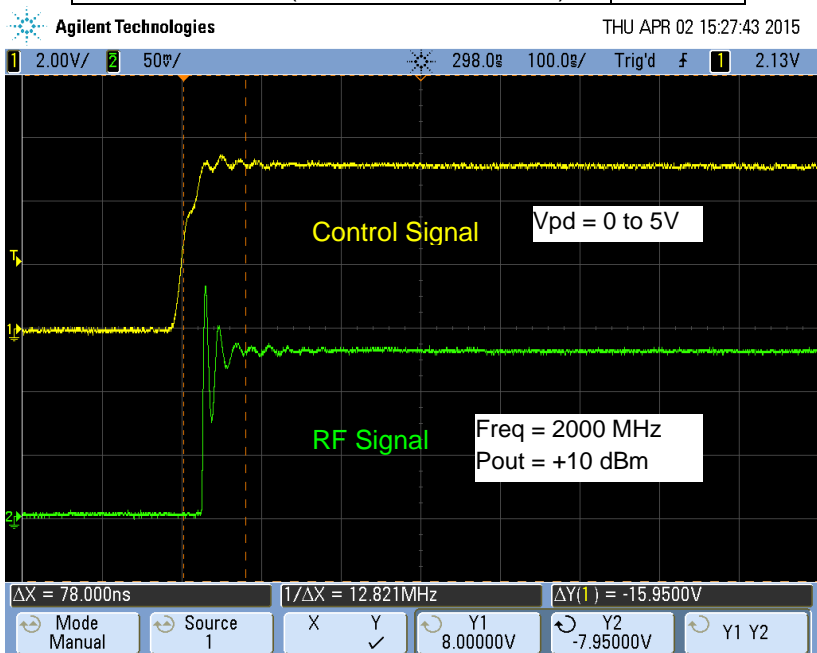


## Switching Time

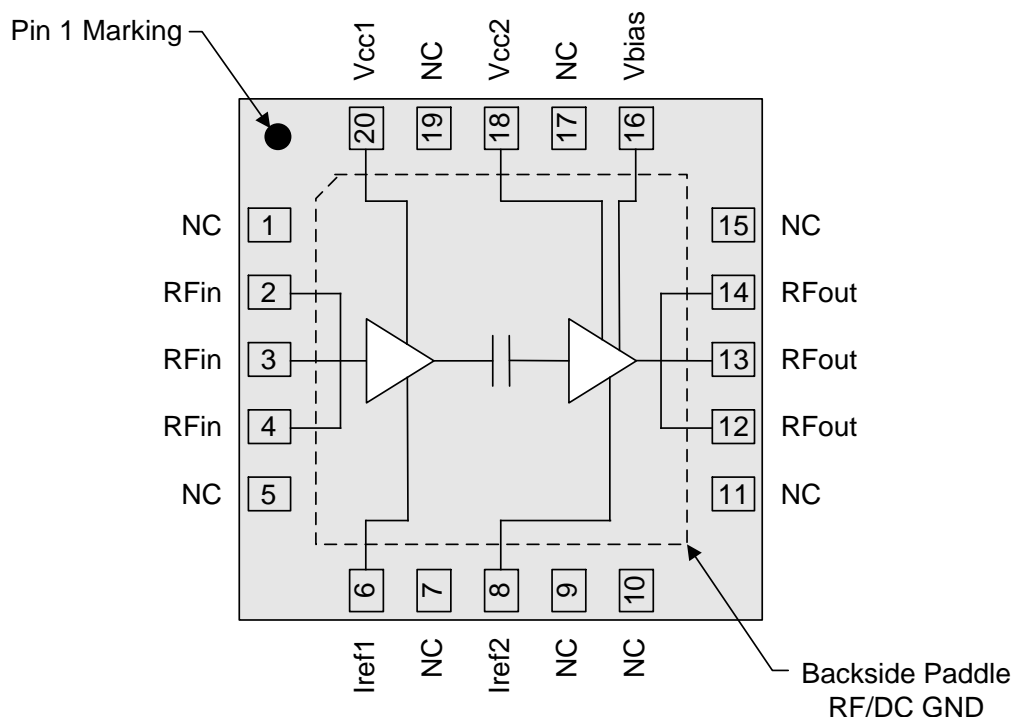
### Switching Time Measurement based on TQP9111-PCB2140 Application Board

Using  $V_{PD}$  as ON/OFF Control:  $V_{PD}=0$  to 5V or 5 to 0V,  $V_{CC}=5V$ ,  $C13=56pF$

Parameter	
Turn-Off Time (50% CNTR – 10% RF)	40nS
Turn-On Time (50% CNTR – 90% RF)	85nS



## Pad Configuration and Description

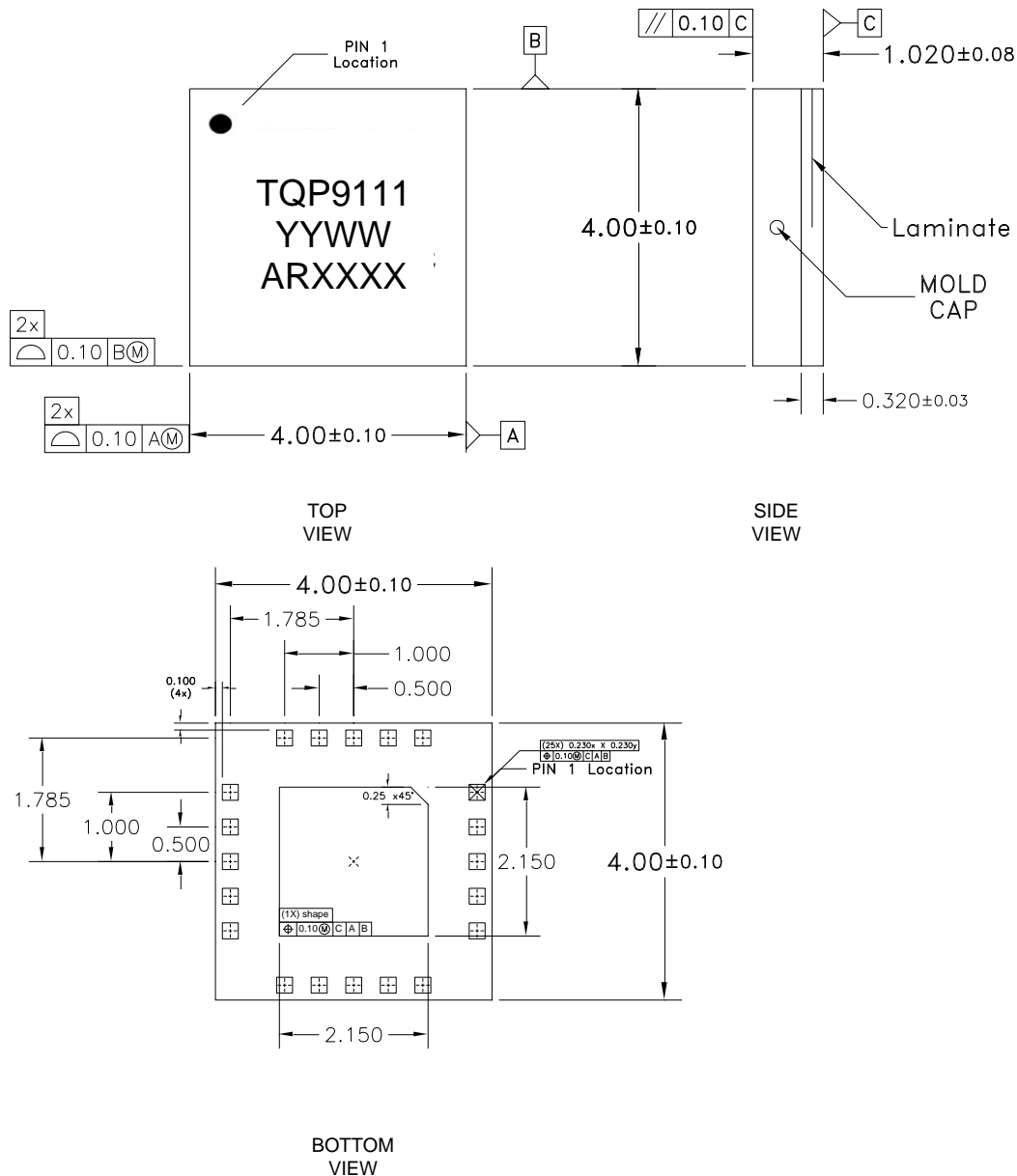


Top View

Pad No.	Label	Description
1, 5, 7, 9, 10, 11, 15, 17, 19	NC	No internal connection. Provide grounded land pads for PCB mounting integrity.
2, 3, 4	RF in	RF input pins. Require DC blocking and RF match for optimal performance.
6	IREF1	Sets the bias current for Amp1. Also can be used to power down.
8	IREF2	Sets the bias current for Amp2. Also can be used to power down.
12, 13, 14	RF out	RF output pins. Require DC blocking and RF match for optimal performance.
16	VBIAS	Voltage supply for active bias for the second stage amp.
18	VCC2	2 <sup>nd</sup> Stage DC voltage supply connection.
20	VCC1	1 <sup>st</sup> Stage DC voltage supply connection.
Backside Pad	GND	RF/DC ground. Use via holes to minimize inductance and thermal resistance.

## Package Marking and Dimensions

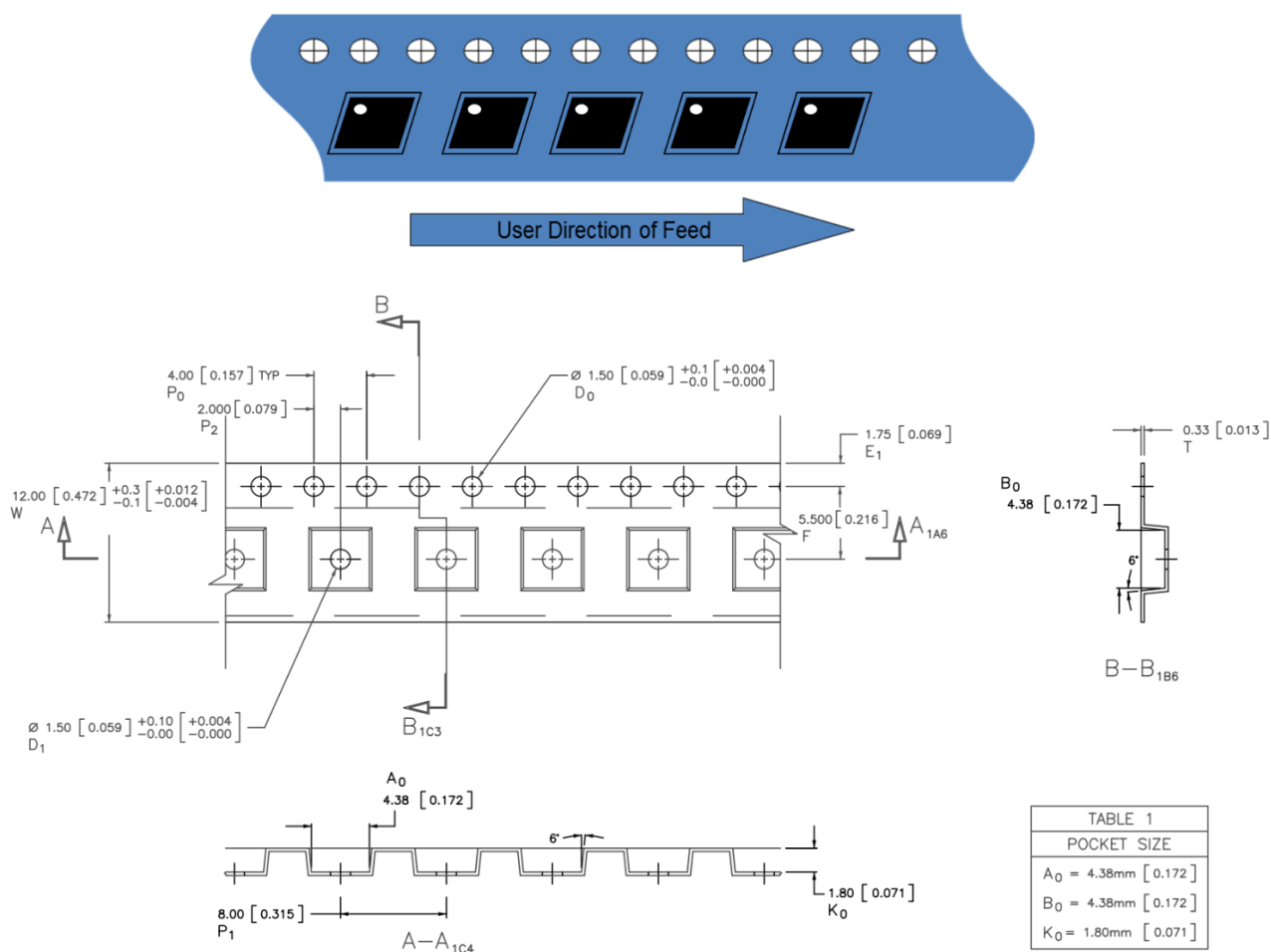
Marking: Part Number – TQP9111  
Date Code – YYWW  
Lot Code – ARXXXX



### Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Dimension and tolerance formats conform to ASME Y14.4M-1994
3. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

## Tape and Reel Information – Carrier and Cover Tape Dimensions



NOTES:

1. ALL DIMENSIONS ARE MILLIMETERS [INCHES]
2. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE  $\pm 0.2\text{mm}$
3. MATERIAL 0.33 [0.013] CARBON POLYSTYRENE
4. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE
5. 325 METERS / 22" CROSSWOUND REEL

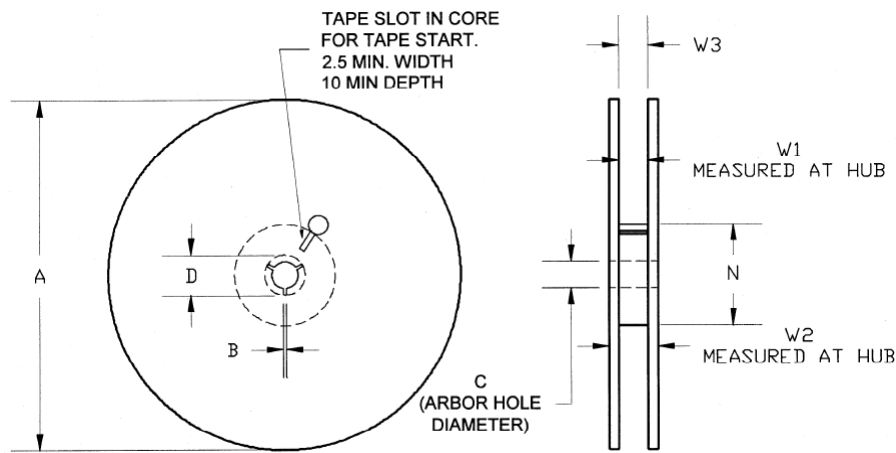
ANGLES  
 $\pm 1^\circ$

TOLERANCES  
XXX  $\pm .10\text{mm}$   
XXX  $\pm .05\text{mm}$

Feature	Measure	Symbol	Size (in)	Size (mm)
Cavity	Length	A0	0.172	4.38
	Width	B0	0.172	4.38
	Depth	K0	0.071	1.80
	Pitch	P1	0.315	8.00
Centerline Distance	Cavity to Perforation - Length Direction	P2	0.079	2.00
	Cavity to Perforation - Width Direction	F	0.217	5.50
Cover Tape	Width (Reference Only)	C	0.362	9.20
Carrier Tape	Width	W	0.472	12.0

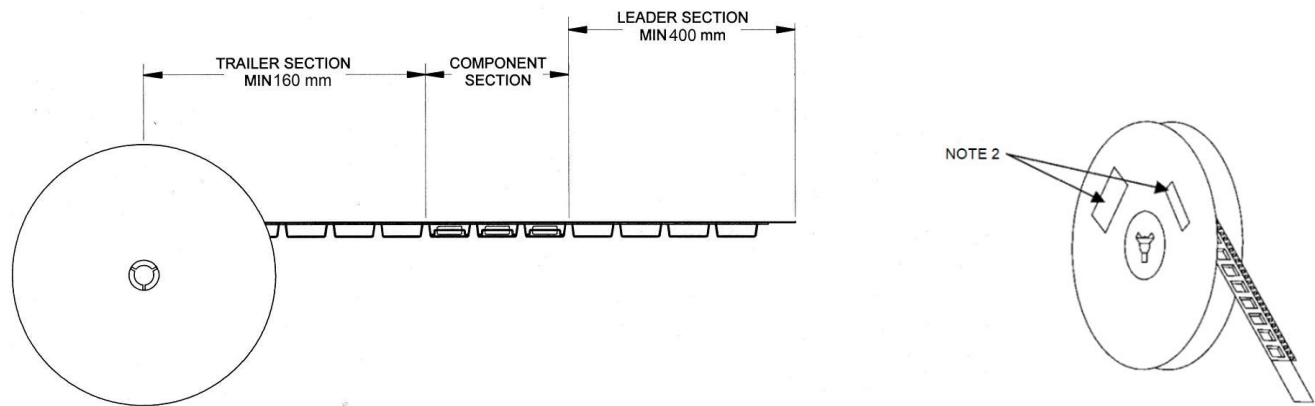
Tape and Reel Information – Reel Dimensions

Standard T/R size = 2,500 pieces on a 13" reel.



Feature	Measure	Symbol	Size (in)	Size (mm)
Flange	Diameter	A	12.992	330.0
	Thickness	W2	0.717	18.2
	Space Between Flange	W1	0.504	12.8
Hub	Outer Diameter	N	4.016	102.0
	Arbor Hole Diameter	C	0.512	13.0
	Key Slit Width	B	0.079	2.0
	Key Slit Diameter	D	0.787	20.0

Tape and Reel Information – Tape Length and Label Placement



- Notes:
1. Empty part cavities at the trailing and leading ends are sealed with cover tape. See EIA 481-1-A.
  2. Labels are placed on the flange opposite the sprockets in the carrier tape.

## Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1C	ESDA / JEDEC JS-001-2012
ESD – Charged Device Model (CDM)	Class C3	JEDEC JESD22-C101F
MSL – Moisture Sensitivity Level	Level 3	IPC/JEDEC J-STD-020



Caution!  
ESD-Sensitive Device

## Solderability

Compatible with both lead-free (260°C max. reflow temp.) and tin/lead (245°C max. reflow temp.) soldering processes. Solder profiles available upon request.

Contact plating: Electrolytic plated Au over Ni (*Plating thickness: Ni 5  $\mu\text{m}$   $\pm$  3  $\mu\text{m}$ , Au 0.75  $\mu\text{m}$   $\pm$  0.25  $\mu\text{m}$* )

## RoHS Compliance

This part is compliant with 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:

- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) Free
- PFOS Free

## Contact Information

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

**Web:** [www.qorvo.com](http://www.qorvo.com)

**Tel:** 1-844-890-8163

**Email:** [customer.support@qorvo.com](mailto:customer.support@qorvo.com)

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