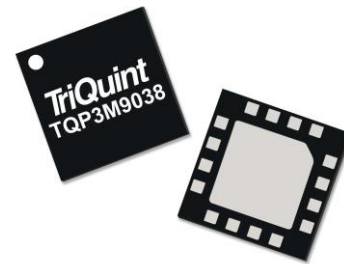


Product Overview

The TQP3M9038 is a cascadable, high linearity gain block amplifier in a low-cost surface-mount package. At a frequency of 1900 MHz, the amplifier typically provides 15dB gain, +40 dBm OIP3, and 2 dB Noise Figure while only drawing 85 mA current. The device is housed in a lead-free/green /RoHS-compliant QFN Package.

The TQP3M9038 has the benefit of having excellent gain flatness across a broad range of frequencies. The low noise figure and high linearity performance allows the device to be used in both receiver and transmitter chains for high performance systems. The amplifier is internally matched using a high-performance E-pHEMT process and only requires an external RF choke and blocking/bypass capacitors for operation from a single +5V supply. The internal active bias circuit also enables stable operation over bias and temperature variations.

The TQP3M9038 covers the 50–4000 MHz frequency band and is targeted for wireless infrastructure or other applications requiring high linearity and/or low noise figure.

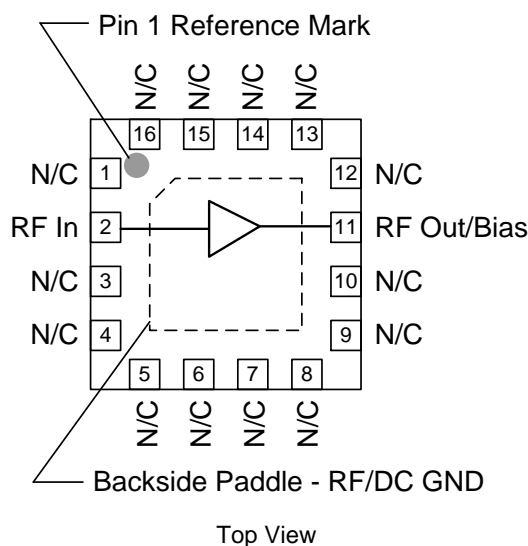


3x3 mm 16 Pin QFN Package

Key Features

- 50–4000 MHz Operating Range
- Flat gain (14.7 ± 0.3 dB) from 50 to 3500 MHz
- +39.5 dBm Output IP3
- 2 dB Noise Figure at 1900 MHz
- 50 Ω gain block; No RF matching required
- Unconditionally stable
- +5V Single Supply, 85 mA Current
- 3x3mm 16 pin QFN plastic package

Functional Block Diagram



Applications

- Repeaters
- Mobile Infrastructure
- Defense/Aerospace
- LTE / WCDMA / CDMA / GSM
- General Purpose Wireless
- IF Amplifier, RF Driver Amplifier

Ordering Information

Part No.	Description
TQP3M9038	High Linearity LNA Gain Block
TQP3M9038-PCB_IF	50–500 MHz Eval. Board
TQP3M9038-PCB_RF	500–4000 MHz Eval. Board

Standard T/R size = 2500 pieces on a 7" reel.

Absolute Maximum Ratings

Parameter	Rating
Storage Temperature	-65 to +150°C
Supply Voltage (V _{DD})	+7 V
RF Input Power, CW, 50Ω, T = 25°C	+23 dBm
Reverse Device Voltage	-0.3 V

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

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Supply Voltage (V _{DD})	+4.75	+5	+5.25	V
T _{CASE}	-40		+105	°C
T _J (for >10 ⁶ hours MTTF)			190	°C

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions. Application of conditions to the device outside the Recommended Operating Conditions may reduce device reliability and performance.

Electrical Specifications

Test conditions unless otherwise noted: V_{DD}=+5 V, Temp.=+25 °C, 50 Ω system

Parameter	Conditions	Min	Typ	Max	Units
Operational Frequency Range		50		4000	MHz
Test Frequency			1900		MHz
Gain		13	14.9	16	dB
Input Return Loss			21		dB
Output Return Loss			23		dB
Noise Figure ⁽¹⁾			2		dB
Output P1dB			+21.6		dBm
Output IP3	P _{out} =+4 dBm/tone, Δf=1 MHz	+35.5	+39.5		dBm
Current, I _{DD}			85	100	mA
Thermal Resistance, θ _{Jc}	Channel to case			36.6	°C/W

Notes:

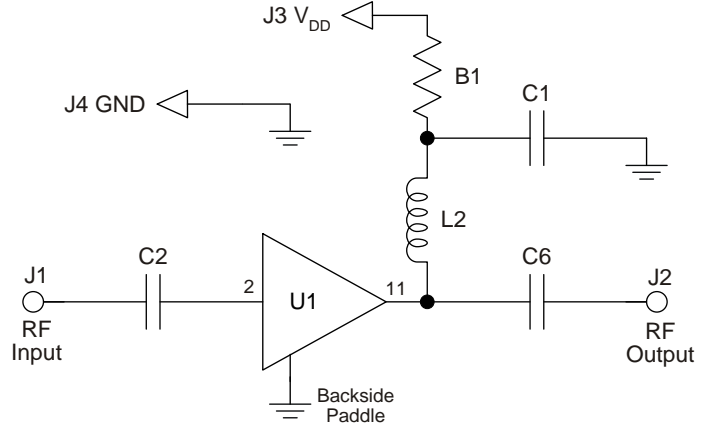
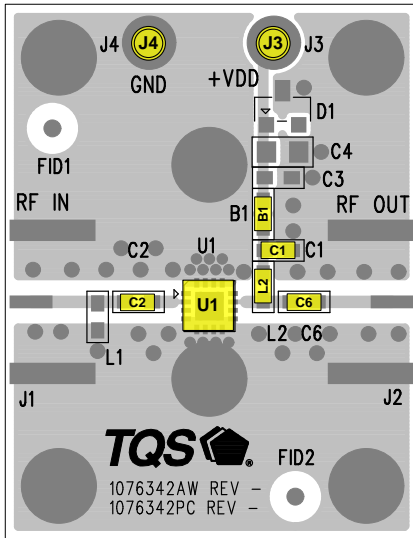
- NF data includes board losses.

S-Parameters

Test Conditions: V_{DD}=+5 V, I_{DD}=85 mA (typ.), T=+25°C, unmatched 50 Ω system, calibrated to device leads

Freq (GHz)	S11 (dB)	S11 (ang)	S21 (dB)	S21 (ang)	S12 (dB)	S12 (ang)	S22 (dB)	S22 (ang)
10	-12.2	-61.9	17.7	167.0	-20.6	12.1	-17.9	-94.7
20	-13.5	-39.4	17.2	169.7	-20.4	10.0	-17.5	-52.1
50	-15.9	-50.9	16.4	168.8	-19.6	6.6	-20.1	-79.8
100	-20.7	-73.2	15.9	167.6	-19.1	1.7	-22.8	-112.9
200	-25.5	-85.5	15.5	163.8	-18.9	-4.6	-24.8	-144.3
500	-28.6	-91.1	15.4	146.9	-18.8	-18.2	-27.2	-177.2
900	-27.0	-99.7	15.3	122.7	-19.0	-34.2	-29.8	175.9
1000	-26.3	-101.9	15.3	116.5	-19.0	-38.2	-30.7	179.6
1500	-23.4	-117.6	15.2	85.5	-19.3	-58.3	-28.7	-137.4
1900	-21.4	-136.1	15.1	60.2	-19.6	-74.8	-23.5	-131.5
2000	-21.0	-141.8	15.1	53.9	-19.7	-79.0	-22.4	-132.7
2500	-18.8	-174.7	15.0	21.3	-20.1	-100.5	-18.1	-143.2
3000	-15.9	137.8	14.9	-12.9	-20.6	-122.9	-15.2	-150.9
3500	-13.5	106.2	14.7	-49.9	-21.2	-146.4	-12.0	-175.7
4000	-12.3	72.3	14.2	-89.5	-21.7	-170.4	-9.4	157.3

Evaluation Board – TQP3M9038-PCB_(RF/IF)



Notes:

1. See Evaluation Board PCB Information section for material and stack-up.
2. Package pins 3 through 9 and 13 through 16 are grounded for PCB mounting integrity and optimal isolation.
3. B1 (0 Ω jumper) may be replaced with copper trace in the target application layout.
4. The recommended component values are dependent upon the frequency of operation.
5. All components are 0603 size unless stated on the schematic.

Bill of Material – TQP3M9038-PCB_(RF/IF)

Reference Designation	TQP3M9038-PCB_IF	TQP3M9038-PCB_RF
	50–500 MHz	500–4000 MHz
U1	TQP3M9038	
C2, C6	1000 pF	100 pF
C1	0.01 μ F	0.01 μ F
L2	330 nH	68 nH
L1, D1, C3, C4	Do Not Place	
B1	0 Ω	

Performance may be further optimized at frequency of interest by using recommended component values given below.

Reference Designation	500 MHz	2000 MHz	2500 MHz	3500 MHz
C2, C6	100 pF	22 pF	22 pF	22 pF
L2	82 nH	22 nH	18 nH	15 nH

Typical Performance – TQP3M9038-PCB_RF

Test conditions unless otherwise noted: $V_{DD} = +5\text{ V}$, $I_{DD} = 85\text{ mA}$ (typ.), Temp = +25°C

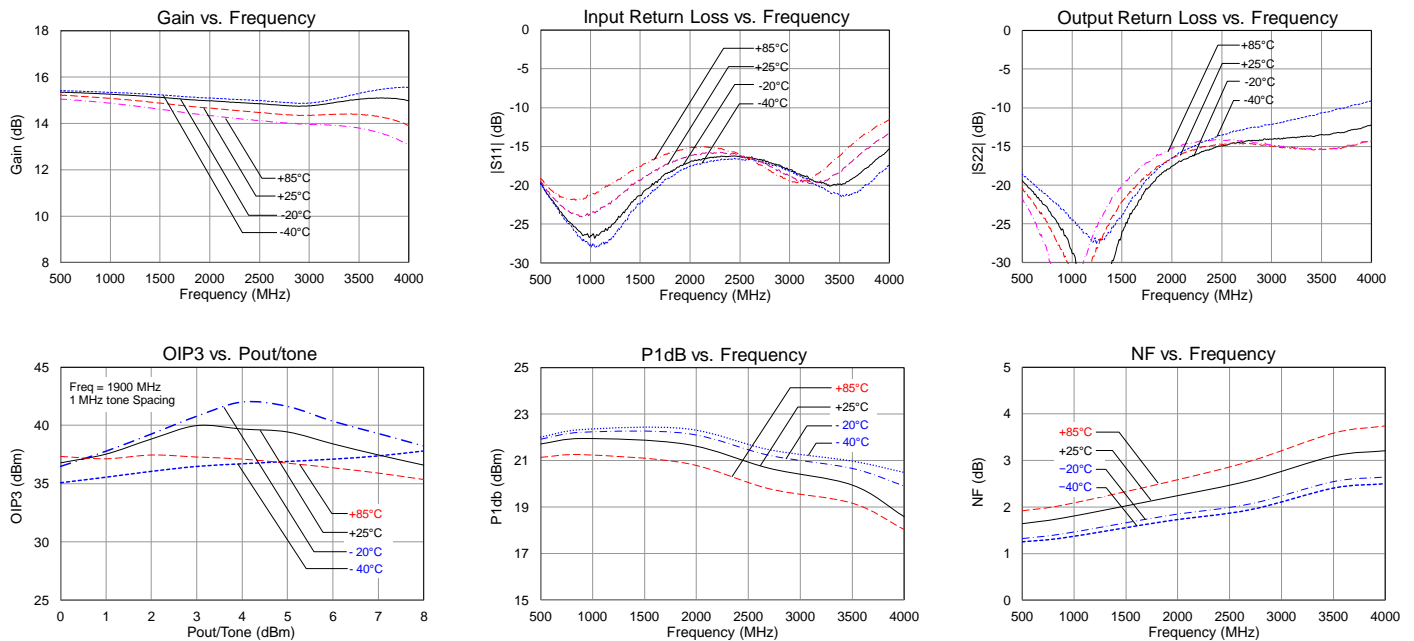
Parameter	Typical Values						Units
Frequency	500	900	1900	2700	3500	4000	MHz
Gain	15.2	15.1	14.9	14.5	14.5	14.5	dB
Input Return Loss	-19.2	-24.0	-20.9	-13.7	-14.5	-16.1	dB
Output Return Loss	-17.9	-20.0	-22.6	-12.8	-11.3	-12.0	dB
Output P1dB	+21.7	+21.9	+21.6	+20.6	+19.8	+18.5	dBm
OIP3	+41.1	+41.4	+39.5	+38.0	+35.3	+32.3	dBm
Noise figure ⁽¹⁾	1.7	1.8	1.9	2.2	2.8	3.0	dB

Notes:

- OIP3 measured with two tones at an output power of +4 dBm / tone separated by 1 MHz.
- Noise figure data shown in the table above includes board losses of 0.1dB @ 2000 MHz.

Performance Plots – TQP3M9038-PCB_RF

Test conditions unless otherwise noted: $V_{DD} = +5\text{ V}$, $I_{DD} = 85\text{ mA}$.



Typical Performance – TQP3M9038-PCB_IF

Test conditions unless otherwise noted: $V_{DD} = +5\text{ V}$, $I_{DD} = 85\text{ mA}$ (typ.), Temp = $+25^\circ\text{C}$

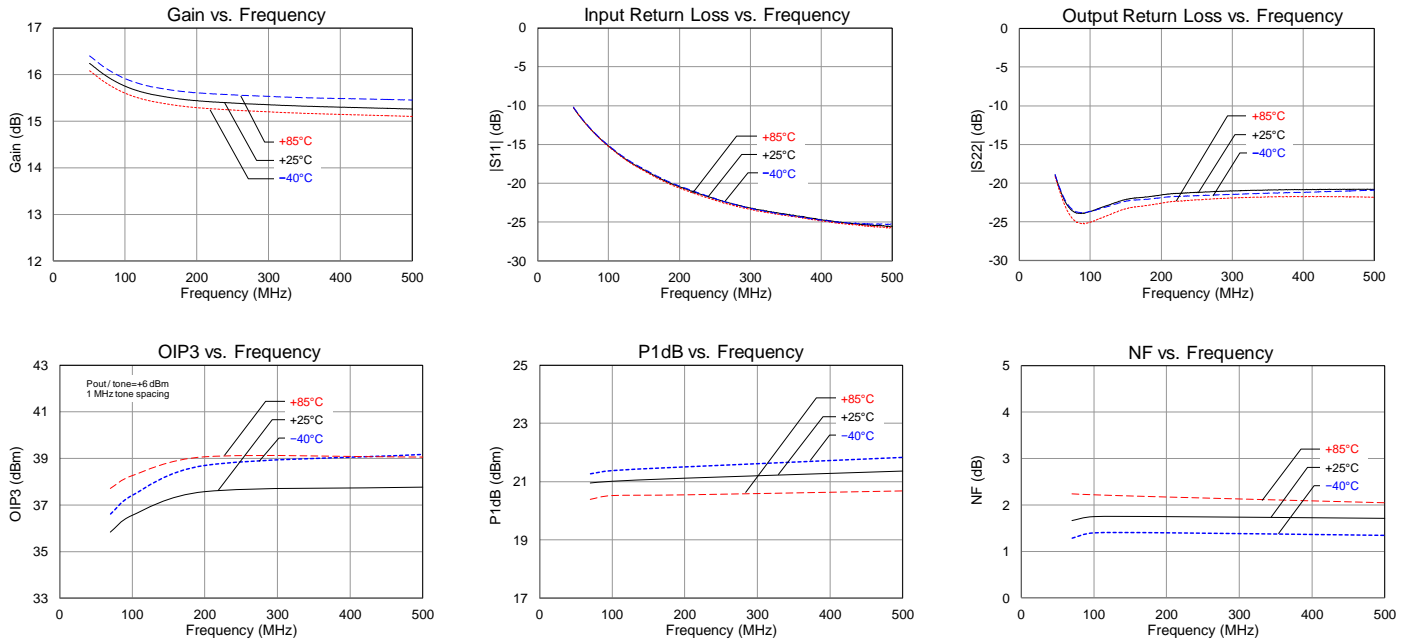
Parameter	Typical Values				Units
Frequency	70	100	200	500	MHz
Gain	15.9	15.7	15.4	15.2	dB
Input Return Loss	-12.3	-15.0	-20.4	-26.4	dB
Output Return Loss	-23.0	-24.5	-22.4	-21.4	dB
Output P1dB	+20.9	+21.0	+21.0	+21.3	dBm
OIP3	+39.5	+39.7	+40.7	+40.0	dBm
Noise figure ⁽¹⁾	1.65	1.75	1.75	1.70	dB

Notes:

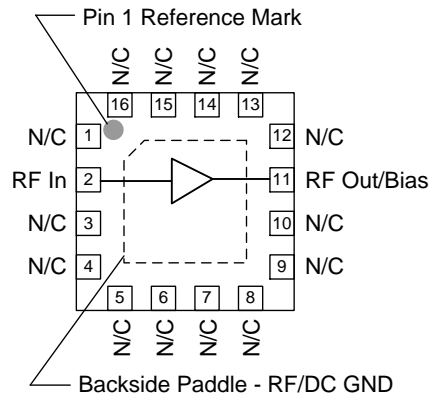
- OIP3 measured with two tones at an output power of +6 dBm / tone separated by 1 MHz.
- Noise figure data shown in the table above includes board losses.

Performance Plots – TQP3M9038-PCB_IF

Test conditions unless otherwise noted: $V_{DD} = +5\text{ V}$, $I_{DD} = 85\text{ mA}$.



Pad Configuration and Description

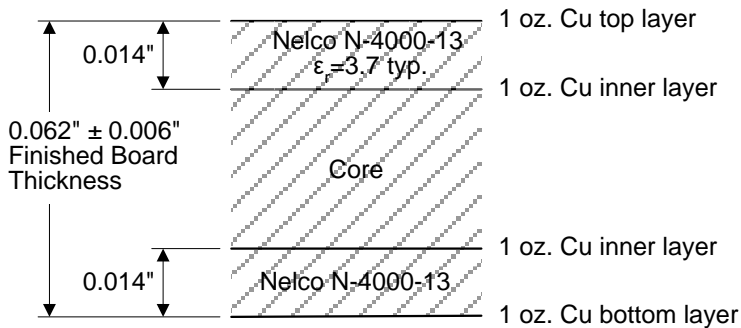


Top View

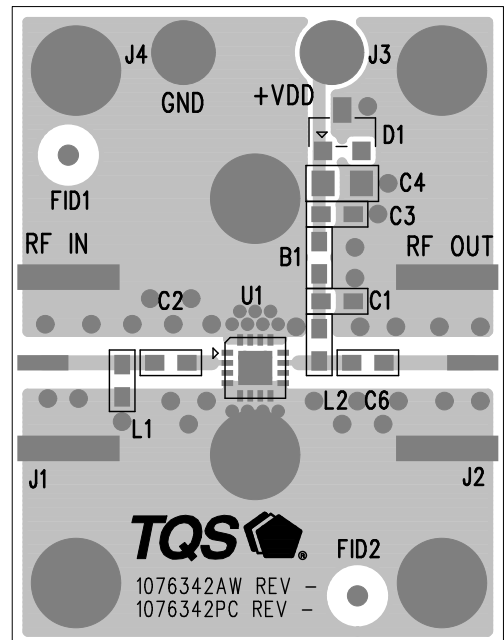
Pad No.	Label	Description
2	RF IN	RF input, matched to 50 ohms. External DC Block is required.
11	RF OUT DC BIAS	RF output, matched to 50 ohms. Bias voltage and external DC Block are required.
All other pins	N/C	No electrical connection. Provide grounded land pads for PCB mounting integrity.
Backside paddle	RF/DC GND	RF/DC ground. Use recommended via pattern to minimize inductance and thermal resistance; see PCB Mounting Pattern for suggested footprint.

Evaluation Board PCB Information

Qorvo PCB Material and Stack-up

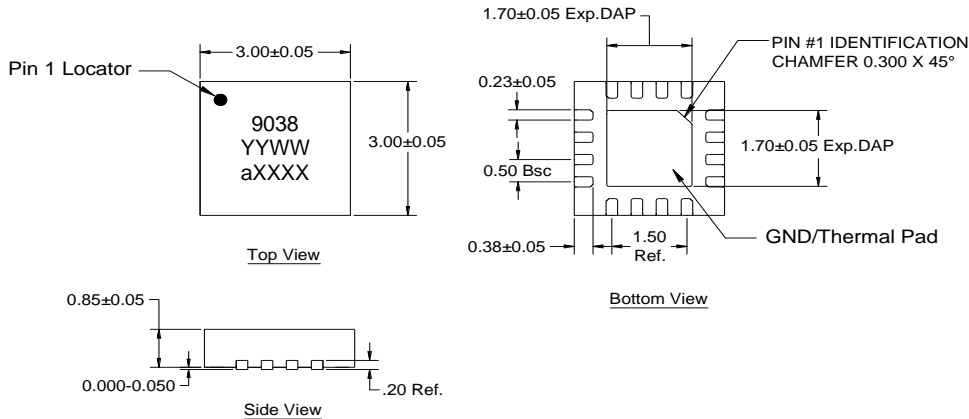


50 ohm line dimensions: width = 0.031", spacing = 0.035"



Package Marking and Dimensions

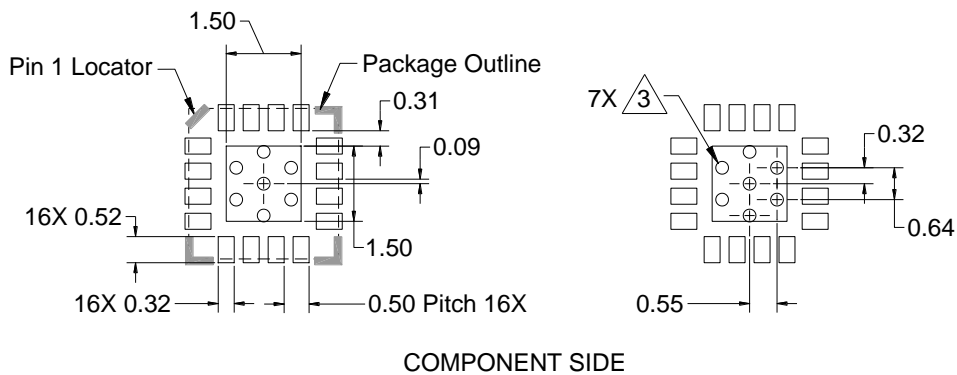
Marking: Part Number – 9038
Date Code – YYWW
Assembly Code - aXXXX



Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Except where noted, this part outline conforms to JEDEC standard MO-220, Issue E (Variation VGGC) for thermally enhanced plastic very thin fine pitch quad flat no lead package (QFN).
3. Dimension and tolerance formats conform to ASME Y14.4M-1994.
4. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

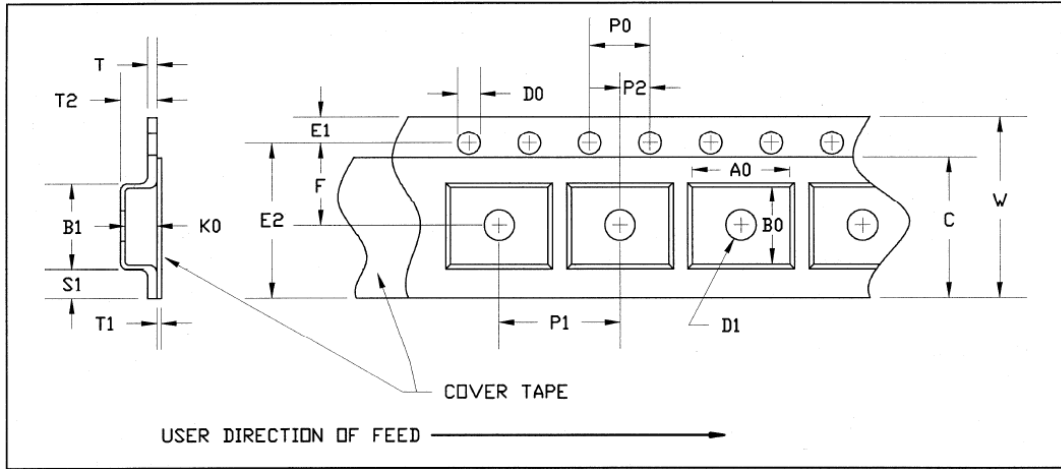
Recommended PCB Layout Pattern



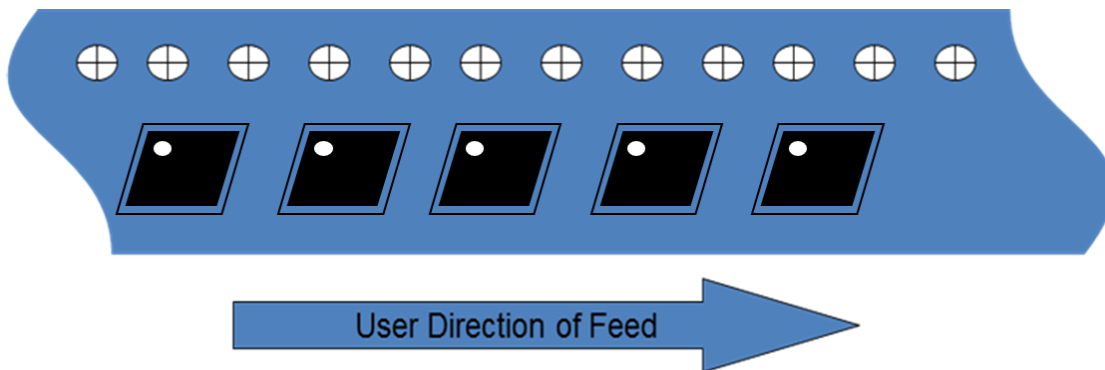
Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Use 1 oz. copper minimum for top and bottom layer metal.
3. Via holes are required under the backside paddle of this device for proper RF/DC grounding and thermal dissipation. We recommend a 0.35 mm ($\#80/.0135$ ") diameter bit for drilling via holes and a final plated thru diameter of 0.25 mm (0.01 ").
4. Ensure good package backside paddle solder attach for reliable operation and best electrical performance.

Tape and Reel Information – Carrier and Cover Tape Dimensions

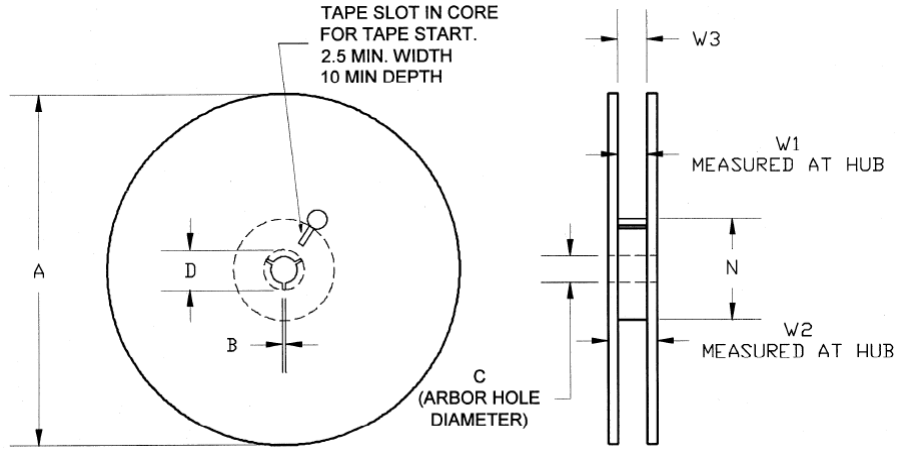


Feature	Measure	Symbol	Size (in)	Size (mm)
Cavity	Length	A0	0.126	3.20
	Width	B0	0.126	3.20
	Depth	K0	0.039	1.0
	Pitch	P1	0.157	4.0
Centerline Distance	Cavity to Perforation - Length Direction	P2	0.079	2.0
	Cavity to Perforation - Width Direction	F	0.217	5.50
Cover Tape	Width	C	0.362	9.20
Carrier Tape	Width	W	0.472	12.0



Tape and Reel Information – Reel Dimensions

Standard T/R size = 2,500 pieces on a 7" reel.



Feature	Measure	Symbol	Size (in)	Size (mm)
Flange	Diameter	A	6.969	177.0
	Thickness	W2	0.717	18.2
	Space Between Flange	W1	0.504	12.8
Hub	Outer Diameter	N	2.283	58.0
	Arbor Hole Diameter	C	0.512	13.0
	Key Slit Width	B	0.079	2.0
	Key Slit Diameter	D	0.795	20.2