

### Product Description

The TQP3M9028 is a cascadable, high linearity gain block amplifier in a low-cost surface-mount package. At 1.9 GHz, the amplifier typically provides 14.7 dB gain, +40 dBm OIP3, and 1.8 dB Noise Figure while only drawing 85 mA current. The device is housed in a leadfree/green/RoHS-compliant industry-standard SOT-89 package.

The TQP3M9028 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 TQP3M9028 covers the 50-4000 MHz frequency band and is targeted for wireless infrastructure or other applications requiring high linearity and/or low noise figure.

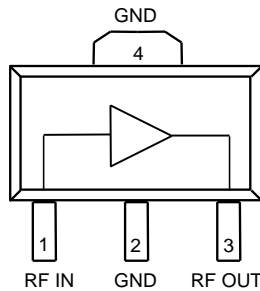


SOT-89 Package

### Product Features

- 50-4000 MHz
- Flat gain (14.7 ± 0.3 dB) from 0.5 – 3.5 GHz
- +40 dBm Output IP3
- 1.8 dB Noise Figure @ 1900 MHz
- No RF components needed; 50 Ohm Gain Block
- Unconditionally Stable
- +5V Single Supply, 85 mA Current
- SOT-89 Package

### Functional Block Diagram



### Applications

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

### Ordering Information

Part No.	Description
TQP3M9028	High Linearity LNA Gain Block
TQP3M9028-PCB_IF	50-500 MHz Evaluation Board
TQP3M9028-PCB_RF	0.5-4 GHz Evaluation Board

Standard T/R size = 1000 pieces on a 7" reel

## Absolute Maximum Ratings

Parameter	Rating
Storage Temperature	-65 to +150°C
RF Input Power, CW, 50 Ω, T=25 °C	+23 dBm
Device Voltage (V <sub>DD</sub> )	+7 V
Reverse Supply Voltage	-0.3 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
Supply Voltage (V <sub>DD</sub> )	4.75	5.0	5.25	V
T <sub>CASE</sub>	-40		+105	°C
T <sub>j</sub> for >10 <sup>6</sup> hours MTTF			+190	°C

Electrical specifications are measured under bias, signal and temperature conditions as specified. Specifications are not guaranteed over all recommended operating conditions.

## Electrical Specifications

Parameter	Conditions	Min	Typ	Max	Units
Operational Frequency Range		50		4000	MHz
Test Frequency			1900		MHz
Gain		13	14.5	16	dB
Input Return Loss			18		dB
Output Return Loss			19		dB
Output P1dB			+20.7		dBm
Output IP3	P <sub>out</sub> =+4 dBm/tone, Δf= 1 MHz	+36.0	+40		dBm
Noise Figure			1.8		dB
Device Current, I <sub>DD</sub>			85	100	mA
Thermal Resistance, θ <sub>jc</sub>	Junction to backside paddle		36.6		°C/W

Notes:

1. Test conditions unless otherwise noted: V<sub>DD</sub>= +5V, Temp= +25°C, 50Ω system

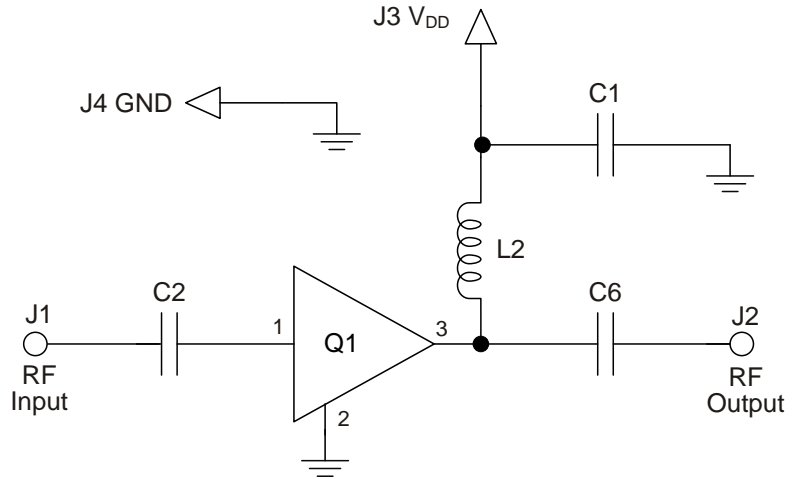
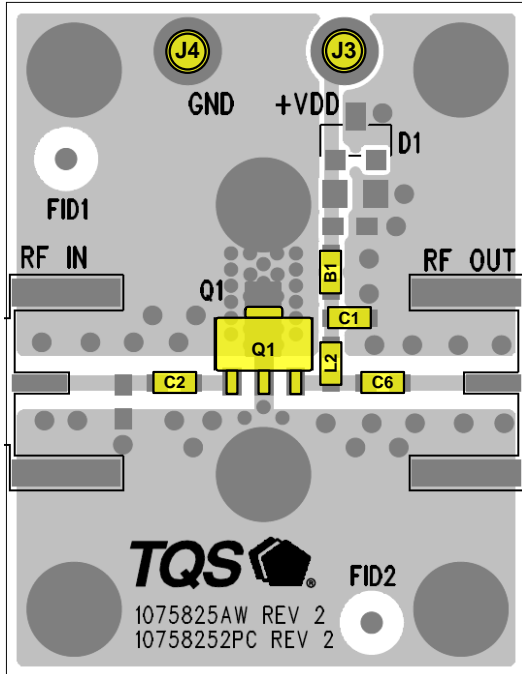
## S-Parameters

Freq (GHz)	S11 (dB)	S11 (ang)	S21 (dB)	S21 (ang)	S12 (dB)	S12 (ang)	S22 (dB)	S22 (ang)
0.05	-17.781	-79.977	16.426	168.24	-19.626	4.3045	-19.220	-103.67
0.1	-20.687	-111.11	15.710	165.75	-19.125	-0.3832	-19.244	-133.67
0.2	-23.728	-139.82	15.333	161.88	-18.801	-5.7231	-19.718	-156.97
0.4	-26.055	-167.83	15.114	150.42	-19.148	-15.433	-20.556	179.38
0.6	-27.432	-174.22	15.068	138.49	-19.086	-24.010	-22.047	170.39
0.8	-28.336	175.58	14.970	124.69	-19.086	-32.722	-22.058	163.66
1.0	-28.090	168.62	14.889	112.00	-19.259	-42.486	-23.024	152.72
1.2	-27.851	173.63	14.837	98.392	-19.196	-50.978	-24.702	147.54
1.4	-27.744	-176.1	14.787	85.391	-19.461	-59.544	-27.618	150.45
1.6	-25.498	-170.21	14.785	71.784	-19.643	-67.665	-30.371	178.07
1.8	-23.299	-171.85	14.681	58.795	-19.718	-76.829	-30.117	-137.55
2.0	-21.873	-177.68	14.742	45.335	-19.786	-86.241	-24.898	-137.73
2.2	-19.991	174.69	14.585	31.380	-20.202	-94.784	-21.473	-136.81
2.4	-18.395	168.24	14.660	17.730	-20.964	-105.89	-18.570	-137.28
2.6	-16.954	156.32	14.540	3.3697	-20.584	-113.76	-16.815	-144.20
2.8	-15.635	143.92	14.468	-10.871	-21.081	-123.83	-15.001	-146.29
3.0	-14.526	132.69	14.390	-25.665	-21.170	-134.66	-13.630	-160.04
3.2	-13.585	121.19	14.321	-40.604	-21.463	-143.32	-12.590	-169.39
3.4	-13.396	109.54	14.295	-55.994	-21.608	-153.10	-11.447	-179.44
3.6	-13.267	95.204	14.103	-71.813	-22.114	-164.82	-10.288	168.78
3.8	-13.490	73.954	14.022	-88.474	-22.248	-174.45	-9.8699	161.57
4.0	-13.580	51.354	13.694	-105.82	-22.604	175.38	-9.6061	156.49

Notes:

1. Test Conditions:  $V_{DD}=+5\text{ V}$  (typ.),  $I_{DD}=85\text{ mA}$  (typ.),  $T=+25\text{ }^{\circ}\text{C}$ , unmatched 50 ohm system, calibrated to device leads

## TQP3M9028-PCB\_RF Evaluation Board (500–4000 MHz)



**Notes:**

1. See PC Board Layout, page 8 for more information.
2. Components shown on the silkscreen but not on the schematic are not used.
3. B1 (0  $\Omega$  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 of 0603 size unless stated on the schematic.

## Bill of Material – TQP369180-PCB

Reference Des.	Value	Description	Manuf.	Part Number
n/a	n/a	Printed Circuit Board	Qorvo	1075825
Q1	n/a	High Linearity LNA Gain Block	Qorvo	TQP3M9028
C2, C6	100 pF	CAP, 0603, 5%, 100V, NPO/COG	various	
C1	0.01 $\mu$ F	CAP, 0603, 5%, 50V, X7R	various	
L2	68 nH	IND, 0603, 5%	CoilCraft	0603CS-68NXJL
B1	0 $\Omega$	RES, 0603	various	
L1, D1, C3, C4	DNP	n/a	n/a	n/a

Note: Performances can be optimized at frequency of interest by using recommended component values shown in the table below. Inductors are wirewound Coilcraft.

## Component Values for Specific Frequencies

Frequency (MHz)	500	2000	2500	3500
C2, C6	100 pF	22 pF	22 pF	22 pF
L2	82 nH	22 nH	18 nH	15 nH

### Typical Performance – TQP3M9028-PCB\_RF

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

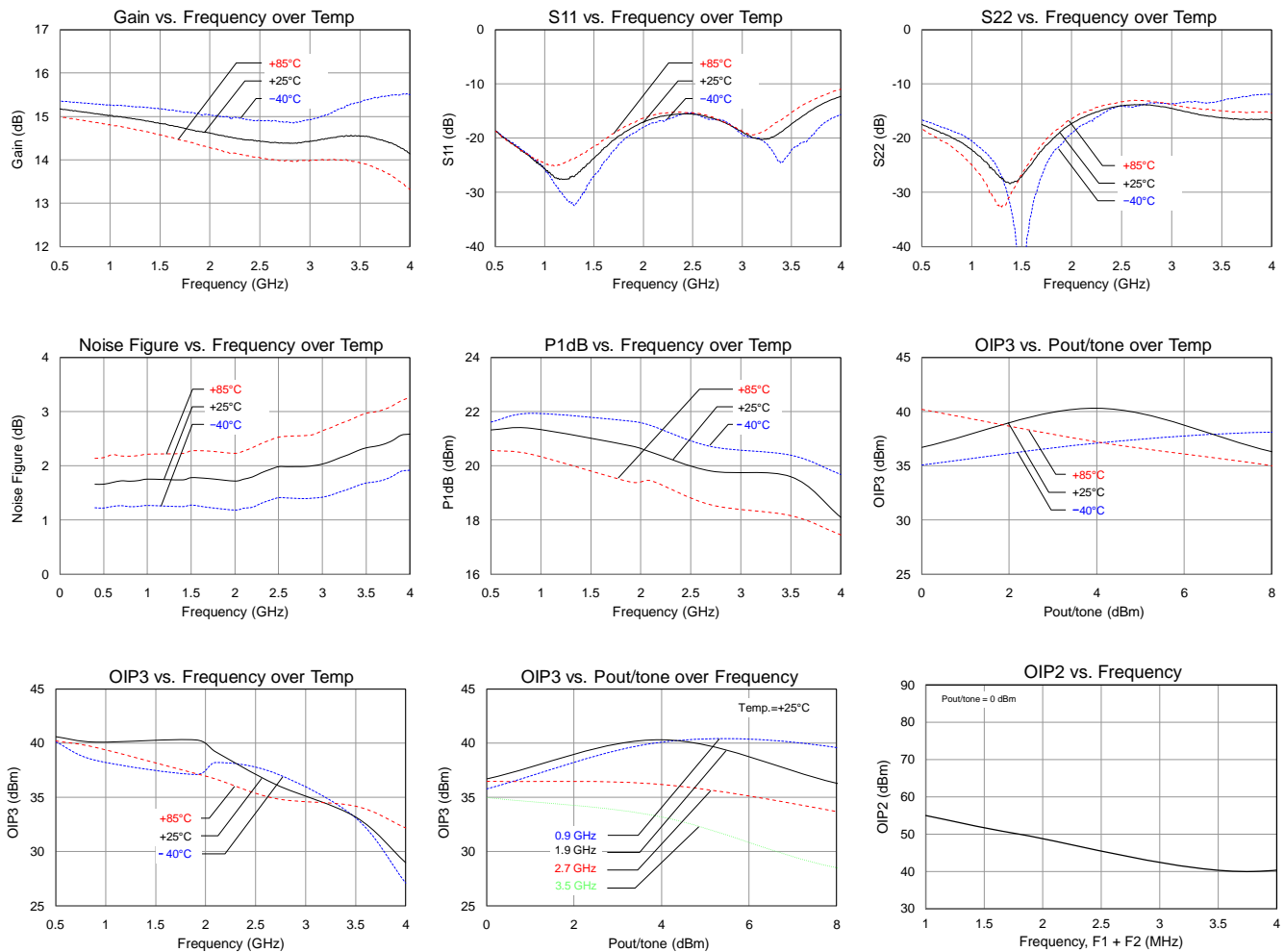
Parameter	Typical Value						Units
Frequency	500	900	1900	2700	3500	4000	MHz
Gain	15.2	15.1	14.7	14.4	14.6	14.2	dB
Input Return Loss	19	24	18	16	17	12	dB
Output Return Loss	17.5	21	19	14	16	16.5	dB
Output P1dB	+21.3	+21.4	+20.7	+19.8	+19.6	+18.1	dBm
OIP3 <sup>(1)</sup>	+40.6	+40.1	+40.3	+36.2	+33.2	+29	dBm
Noise figure <sup>(2)</sup>	1.6	1.7	1.8	2.0	2.3	2.6	dB

Notes:

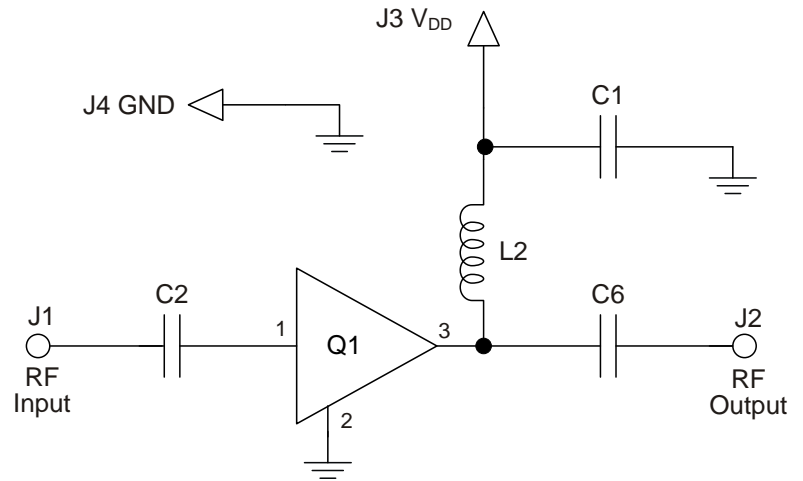
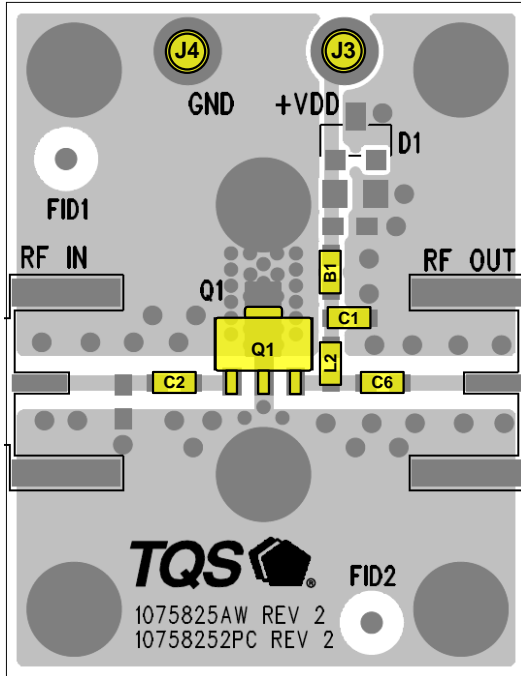
- OIP3 measured with two tones at an output power of +4 dBm / tone separated by 1 MHz.
- Noise figure data shown in the table above is de-embedded from the eval board loss.

### Performance Plots – TQP3M9028-PCB\_RF

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



**TQP3M9028-PCB\_IF Evaluation Board (50–500 MHz)**



**Notes:**

1. See PC Board Layout, page 8 for more information.
2. Components shown on the silkscreen but not on the schematic are not used.
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 of 0603 size unless stated on the schematic.

**Bill of Material – TQP3M9028-PCB\_IF**

Reference Des.	Value	Description	Manuf.	Part Number
n/a	n/a	Printed Circuit Board	Qorvo	1075825
Q1	n/a	High Linearity LNA Gain Block	Qorvo	TQP3M9028
C2, C6	1000 pF	CAP, 0603, 5%, 50V, X7R	various	
C1	0.01 uF	CAP, 0603, 5%, 50V, X7R	various	
L2	330 nH	IND, 0603, 5%	CoilCraft	0603CS-R33XJL
B1	0 Ω	RES, 0603	various	
L1, D1, C3, C4	DNP	n/a	n/a	n/a

## Typical Performance – TQP3M9028-PCB\_IF

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

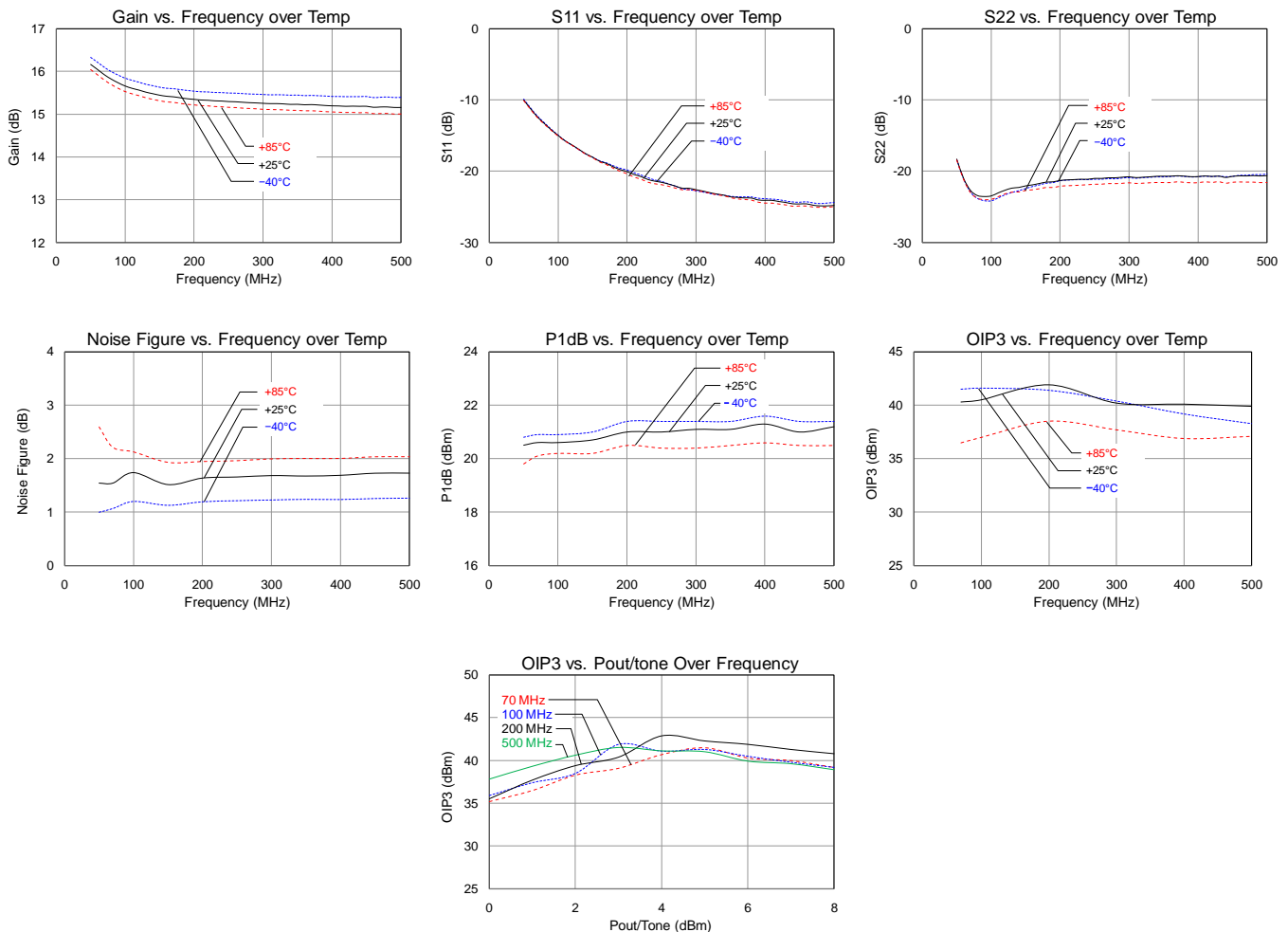
Parameter	Conditions	Typical Values				Units
Frequency		70	100	200	500	MHz
Gain		15.8	15.5	15.3	15.2	dB
Input Return Loss		13	15	20	25	dB
Output Return Loss		23	23	22	20.5	dB
Output P1dB		+20.6	+20.6	+21.0	+21.2	dBm
OIP3	Pout = +6 dBm/tone, $\Delta f = 1$ MHz	+40.3	+40.5	+41.9	+39.9	dBm
Noise figure <sup>(1)</sup>		1.7	1.7	1.7	1.7	dB

Notes:

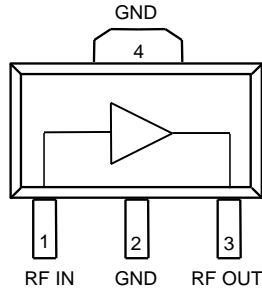
- Noise figure data shown in the table above is de-embedded from the eval board loss.

## Performance Plots – TQP3M9028-PCB\_IF

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



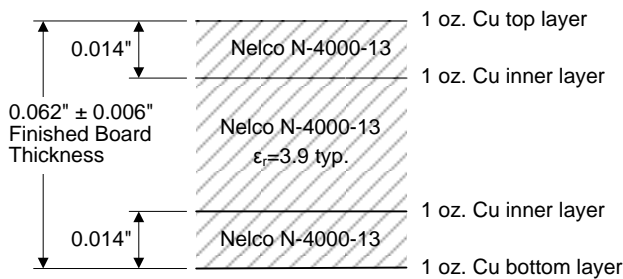
**Pin Configuration and Description**



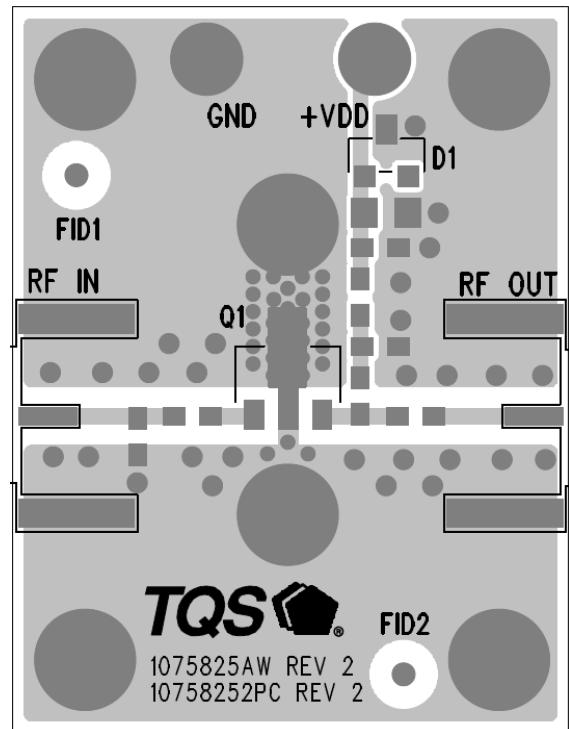
Pin No.	Label	Description
1	RF IN	RF Input, matched to 50 ohms. External DC Block is required.
3	RF OUT / DC Bias	Output, matched to 50 ohms, External DC Block is required and supply voltage
2, 4	Ground	RF/DC Ground Connection

**Application Information**

TriQuint PCB 1075825 Material and Stack-up



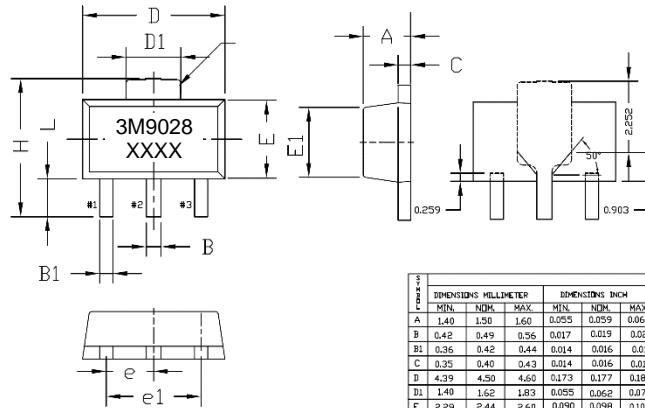
50 ohm line dimensions: width = 0.029", spacing = 0.035"





## Package Marking and Dimensions

Marking: Part number – 3M9028  
Lot code – XXXX

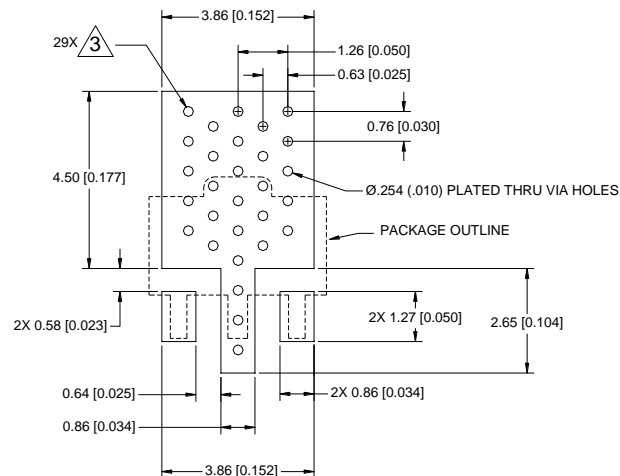


NOTES :  
1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M-1982  
2. CONTROLLING DIMENSION : MILLIMETER CONVERTED INCH ARE NOT NECESSARILY EXACT.  
3. DIMENSION B1, 2 PLACES.

### 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.

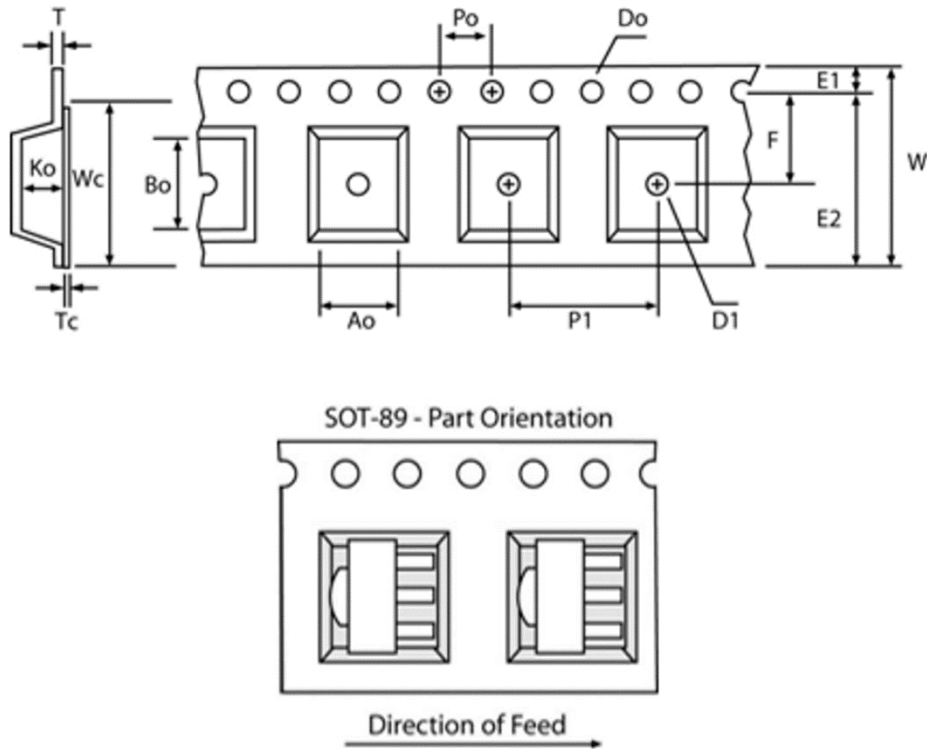
## PCB Mounting Pattern



### NOTES:

1. All dimensions are in millimeters[inches]. Angles are in degrees.
2. Use 1 oz. copper minimum for top and bottom layer metal.
3. Vias are required under the backside paddle of this device for proper RF/DC grounding and thermal dissipation. We recommend a 0.35mm (#80/.0135") diameter bit for drilling via holes and a final plated thru diameter of 0.25mm (0.10").
4. Ensure good package backside paddle solder attach for reliable operation and best electrical performance.

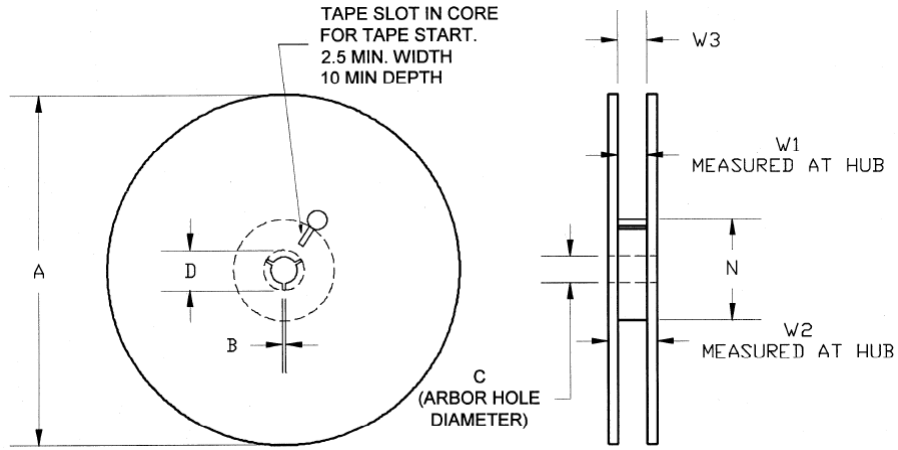
**Tape and Reel Information – Carrier and Cover Tape Dimensions**



Feature	Measure	Symbol	Size (in)	Size (mm)
Cavity	Length	A0	0.181	4.60
	Width	B0	0.193	4.90
	Depth	K0	0.075	1.90
	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	C	0.362	9.20
Carrier Tape	Width	W	0.472	12.0

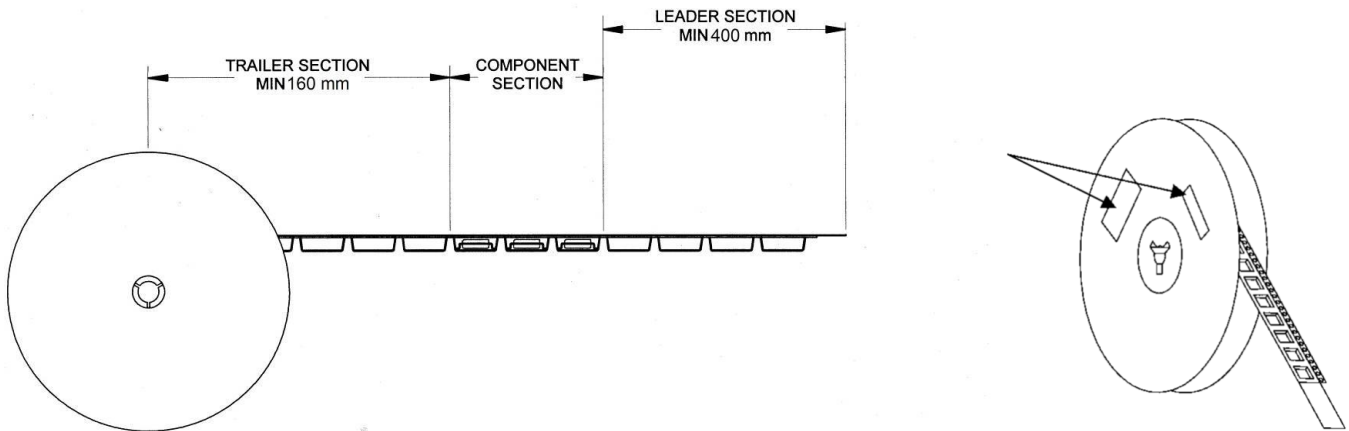
**Tape and Reel Information – Reel Dimensions**

Standard T/R size = 1,000 pieces on a 7" reel.



Feature	Measure	Symbol	Size (in)	Size (mm)
Flange	Diameter	A	6.969	170.0
	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	0.787	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 1A	JEDEC Standard JESD22-A114
ESD – Charged Device Model (CDM)	Class C3	JEDEC Standard JESD22-C101
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: NiPdAu

## 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:

- Lead Free
- 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
- SVHC 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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