

## Applications

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

## Product Features

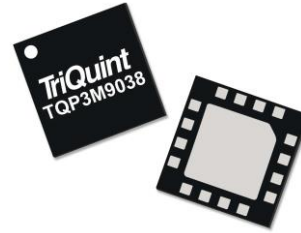
- 50–4000 MHz Operating Range
- Flat gain ( $14.7 \pm 0.3$  dB) from 50 to 3500 MHz
- +39.5 dBm Output IP3
- 2 dB Noise Figure at 1900 MHz
- 50  $\Omega$  gain block; No RF matching required
- Unconditionally stable
- +5V Single Supply, 85 mA Current
- 3x3mm 16 pin QFN plastic package

## General Description

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 15 dB 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.

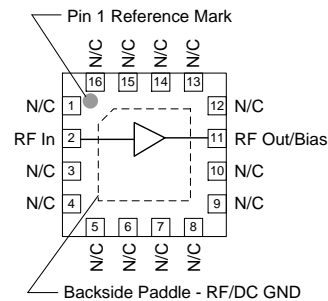
The TQP3M9038 has the benefit of having excellent gain flatness across a broad range of frequencies. The low noise figure and high linearity performance allows the device to be used in both receiver and transmitter chains for high performance systems. The amplifier is internally matched using a high 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

## Functional Block Diagram



## Pin Configuration

Pin No.	Symbol
2	RF IN
11	RF OUT/BIAS
All other pins	N/C
Backside paddle	RF/DC GND

## 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 <sub>DD</sub> )	+7 V
RF Input Power, CW, 50Ω, T = 25°C	+23 dBm
Reverse Device Voltage	-0.3 V

Operation of this device outside the parameter ranges given above may cause permanent damage.

### Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Supply Voltage (V <sub>DD</sub> )	+4.75	+5	+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 at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

### Electrical Specifications

Test conditions unless otherwise noted: V<sub>DD</sub> = +5V, 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			2		dB
Output P1dB			+21.6		dBm
Output IP3	P <sub>out</sub> = +4 dBm/tone, Δf = 1 MHz	+35.5	+39.5		dBm
Current, I <sub>DD</sub>			85	100	mA
Thermal Resistance, θ <sub>Jc</sub>	Channel to case			36.6	°C/W

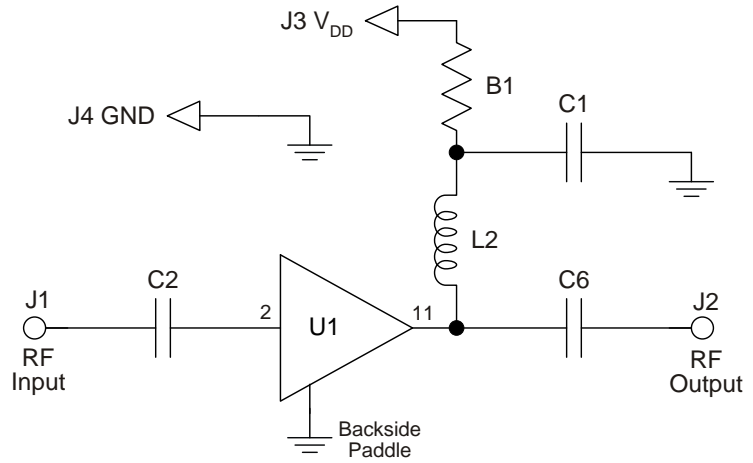
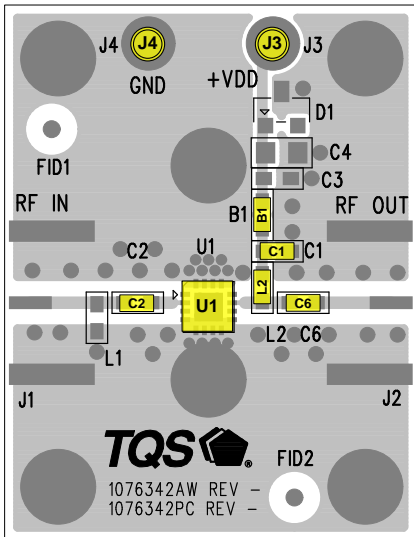
### Device Characterization Data

#### S-Parameters

Test conditions unless otherwise noted: V<sub>DD</sub> = +5 V, I<sub>DD</sub> = 85 mA (typ.), Temp = +25°C, 50 Ohm system

Freq (MHz)	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	-21.9	-130.7	15.1	66.6	-19.5	-70.6	-24.6	-131.1
2000	-21.4	-136.1	15.1	60.2	-19.6	-74.8	-23.5	-131.5
2500	-21.0	-141.8	15.1	53.9	-19.7	-79.0	-22.4	-132.7
3000	-20.6	-147.7	15.0	47.5	-19.8	-83.2	-21.4	-134.4
3500	-18.8	-174.7	15.0	21.3	-20.1	-100.5	-18.1	-143.2
4000	-17.9	170.3	15.0	7.9	-20.3	-109.3	-16.6	-149.0

**TQP3M9038-PCB\_(RF / IF) Evaluation Board**



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 uF	0.01 uF
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**

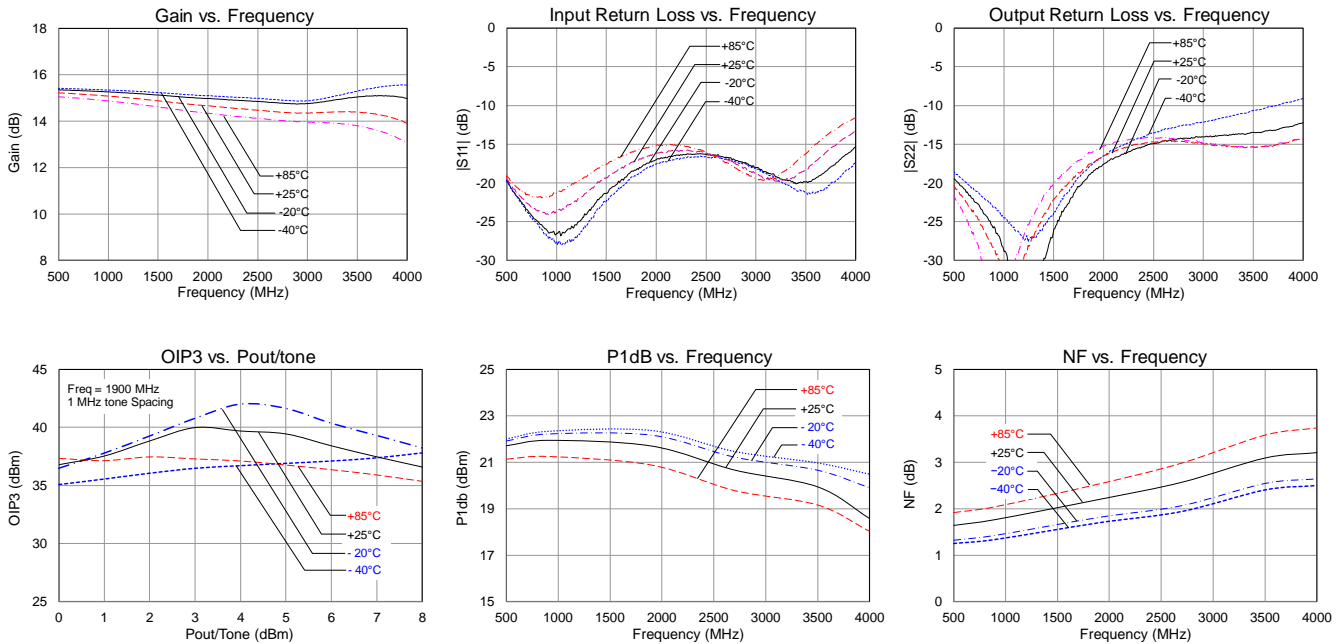
Test conditions unless otherwise noted:  $V_{DD} = +5V$ ,  $I_{DD} = +85\text{ mA}$  (typ.),  $Temp = +25^{\circ}C$

Parameter	Typical Performance						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 <sup>(1)</sup>	+41.1	+41.4	+39.5	+38.0	+35.3	+32.3	dBm
Noise Figure <sup>(2)</sup>	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**



### Typical Performance - TQP3M9038-PCB\_IF

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

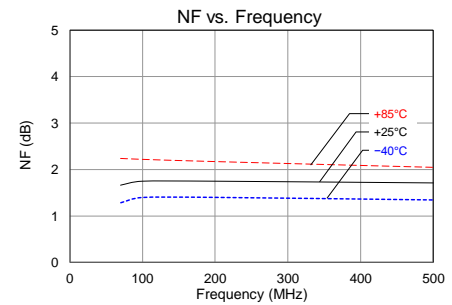
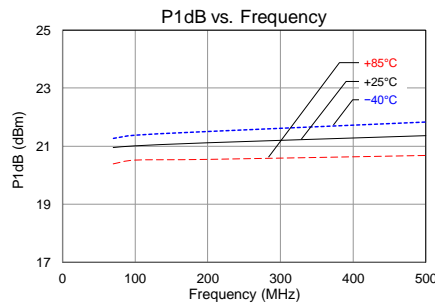
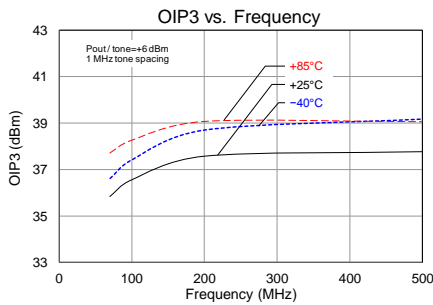
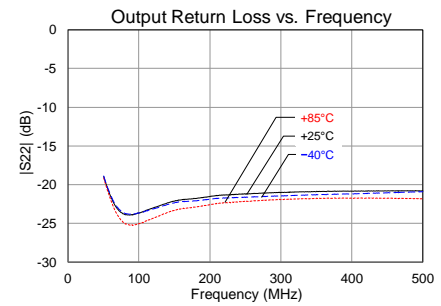
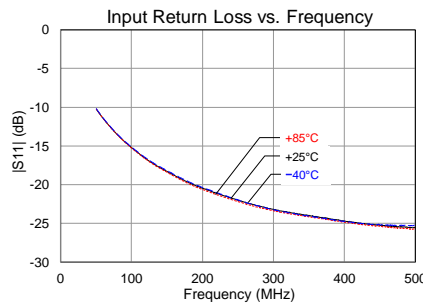
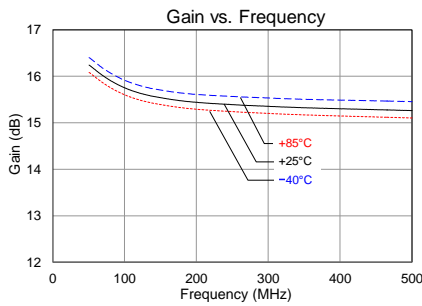
Parameter	Typical Performance				Units
Frequency	70	100	200	500	MHz
Gain	15.9	15.7	15.4	15.2	dB
Input Return Loss	-12.3	-15.0	-20.4	-26.4	dB
Output Return Loss	-23.0	-24.5	-22.4	-21.4	dB
Output P1dB	+20.9	+21.0	+21.0	+21.3	dBm
OIP3 <sup>(1)</sup>	+39.5	+39.7	+40.7	+40.0	dBm
Noise Figure <sup>[2]</sup>	1.65	1.75	1.75	1.70	dB

Notes:

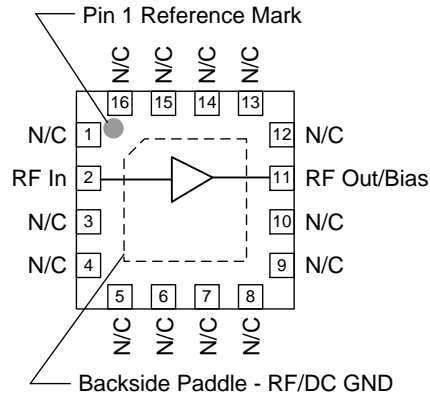
- OIP3 measured with two tones at an output power of +6 dBm / tone separated by 1 MHz.
- Noise figure data shown in the table above includes board losses.

### Performance Plots - TQP3M9038-PCB\_IF

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



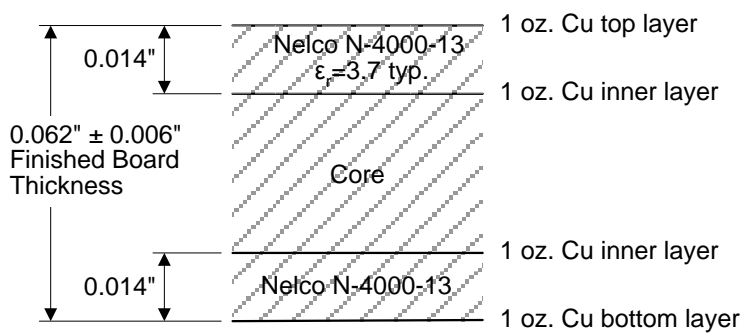
**Pin Configuration and Description**



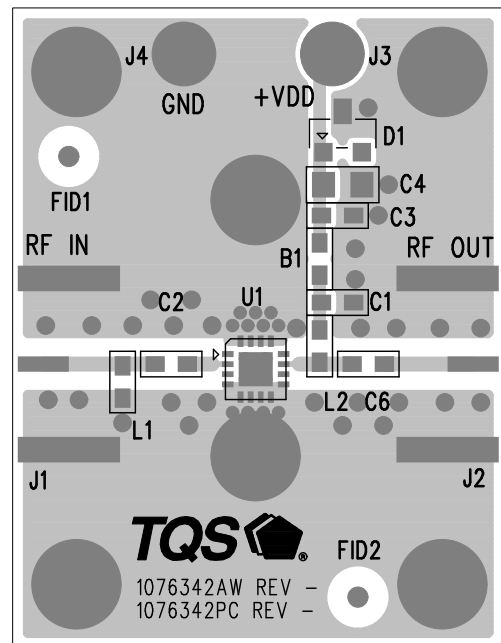
Pin No.	Symbol	Description
2	RF IN	RF input, matched to 50 ohms. External DC Block is required.
11	RF OUT DC BIAS	RF output, matched to 50 ohms. Bias voltage and external DC Block are required.
All other pins	N/C	No electrical connection. Provide grounded land pads for PCB mounting integrity.
Backside 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**

TriQuint PCB 1076342 Material and Stack-up



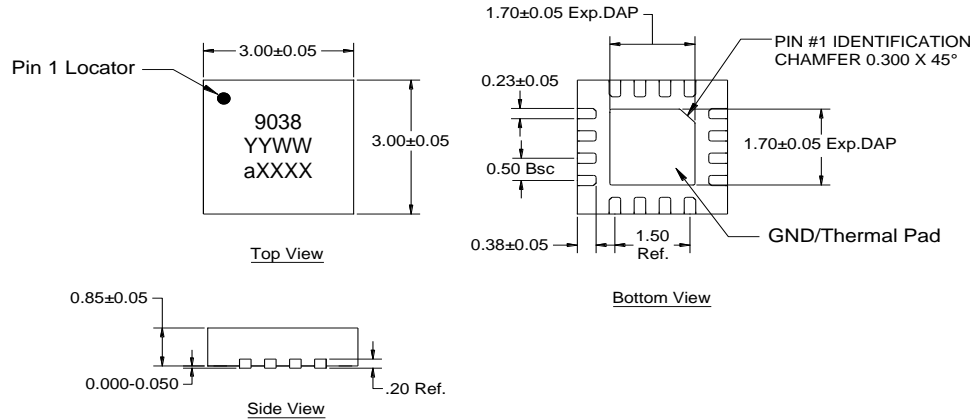
50 ohm line dimensions: width = .031", spacing = .035



**Mechanical Information**

**Package Marking and Dimensions**

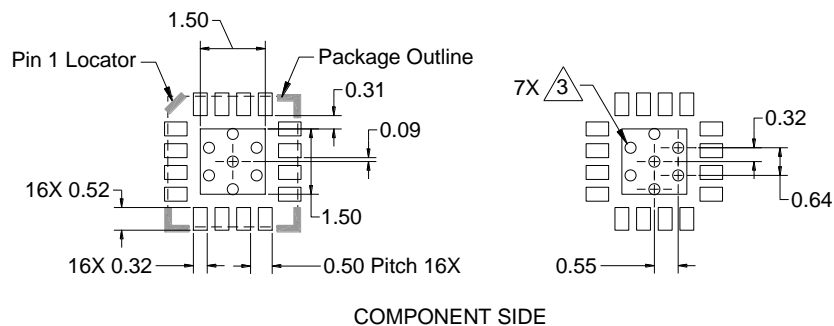
Marking: Part number – 9038  
 Date Code – YYWW  
 Assembly Code – aXXXX



**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.

**PCB Mounting 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. Vias 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 ( $0.10$ " ).
4. Ensure good package backside paddle solder attach for reliable operation and best electrical performance.

**Product Compliance Information**

**ESD Sensitivity Ratings**



Caution! ESD-Sensitive Device

ESD Rating: Class 1A  
Value: Passes  $\geq 250$  V to  $< 500$  V  
Test: Human Body Model (HBM)  
Standard: JEDEC Standard JESD22-A114

ESD Rating: Class C3  
Value: Passes  $\geq 1000$  V min.  
Test: Charged Device Model (CDM)  
Standard: JEDEC Standard JESD22-C101

**MSL Rating**

MSL Rating: Level 1  
Test: 260°C convection reflow  
Standard: JEDEC Standard IPC/JEDEC J-STD-020

**Solderability**

Compatible with both lead-free (260°C max. reflow temperature) and tin/lead (245°C max. reflow temperature) soldering processes.

Package contact plating: Annealed Matte Tin

**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<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.triquint.com](http://www.triquint.com)      **Tel:** 877-800-8584  
**Email:** [customer.support@qorvo.com](mailto:customer.support@qorvo.com)

For information about the merger of RFMD and TriQuint as Qorvo:

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

For technical questions and application information:

**Email:** [sjcappliations.engineering@qorvo.com](mailto:sjcappliations.engineering@qorvo.com)

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