



# TQP3M9035

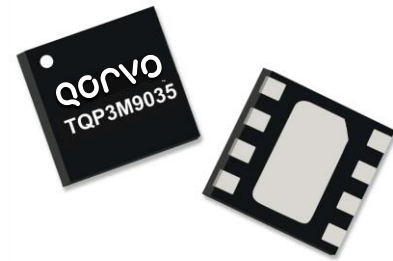
## High Linearity LNA Gain Block

### General Description

The TQP3M9035 is a high-linearity, low noise gain block amplifier in a low-cost surface-mount package. At 1900 MHz, the amplifier typically provides 16.5 dB gain, +37 dBm OIP3, and 0.65 dB Noise Figure. The LNA is also designed to be broadband without the requirement for external matching. The device is housed in a lead-free/green/RoHS-compliant industry-standard 2x2 mm package.

The TQP3M9035 has the benefit of having high linearity while also providing very low noise across a broad range of frequencies. This allows the device to be used in both receive and transmit 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 low noise amplifier integrates a shut-down biasing capability to allow for operation for TDD applications.

The TQP3M9035 covers the 50–6000 MHz frequency band and is targeted for wireless infrastructure or other applications requiring high linearity and/or low noise figure.

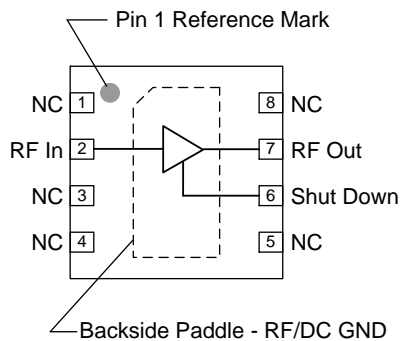


8 Pin 2X2 mm DFN Package

### Product Features

- 50–6000 MHz Operating Range
- 0.65 dB Noise Figure @ 1900 MHz
- 16.5 dB Gain @ 1900 MHz
- +37 dBm Output IP3
- +22.5 dBm P1dB
- Shut-down capability
- Unconditionally stable
- 50 Ohm Cascadable Gain Block
- +5V Single Supply, 115 mA Current
- 2x2 mm 8 Pin DFN plastic package

### Functional Block Diagram



Top View

### Applications

- Repeaters
- Mobile Infrastructure
- LTE / WCDMA / CDMA / GSM
- General Purpose Wireless
- TDD or FDD systems

### Ordering Information

| Part No.      | Description                   |
|---------------|-------------------------------|
| TQP3M9035     | High Linearity LNA Gain Block |
| TQP3M9035-PCB | 500–6000 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> ) | +6 V         |
| RF Input Power, CW, 50Ω, T = 25°C | +23 dBm      |

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> )              | +3.3 | +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 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    |      | 6000            | MHz   |
| Test Frequency                        |  |       | 1900 |                 | MHz   |
| Gain                                  |  | 15    | 16.5 | 18              | dB    |
| Input Return Loss                     |  |       | 13   |                 | dB    |
| Output Return Loss                    |  |       | 10   |                 | dB    |
| Output P1dB                           |  | +20   | +23  |                 | dBm   |
| Output IP3                            | P <sub>out</sub> = +4 dBm/tone, Δf = 1 MHz | +32.5 | +37  |                 | dBm   |
| Noise Figure <sup>(1)</sup>           |  |       | 0.65 | 1.0             | dB    |
| Switching Speed                       | Rise Time (10%-90%)                        |       | 165  |                 | ns    |
|                                       | Fall Time (90%-10%)                        |       | 255  |                 | ns    |
| Power Shutdown Control <sup>(2)</sup> | On state                                   | 0     |      | 0.8             | V     |
|                                       | Off state (Power down)                     | 3     |      | V <sub>DD</sub> | V     |
| Current, I <sub>DD</sub>              | On state                                   |       | 115  | 150             | mA    |
|                                       | Off state (Power down)                     |       | 3    |                 | mA    |
| Shutdown pin current, I <sub>SD</sub> | V <sub>PD</sub> ≥ 3 V                      |       | 100  |                 | μA    |
| Thermal Resistance, θ <sub>jc</sub>   | channel to case                            |       |      | 50              | °C/W  |

Notes:

1. Noise figure data has input trace loss de-embedded.
2. Voltage referred to J5 turret on evaluation board (pg.4).

## S-Parameters

Test conditions unless otherwise noted:  $V_{DD}=+5\text{ V}$ ,  $I_{DD}=115\text{ mA}$  (typ.),  $Temp=+25^{\circ}\text{C}$ , 50 Ohm system

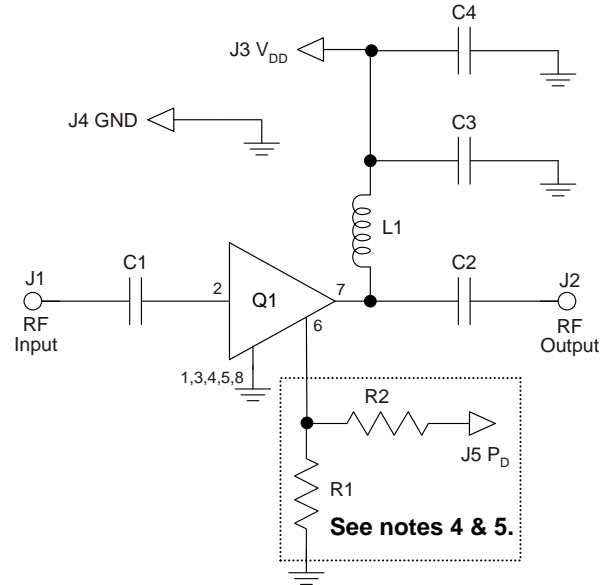
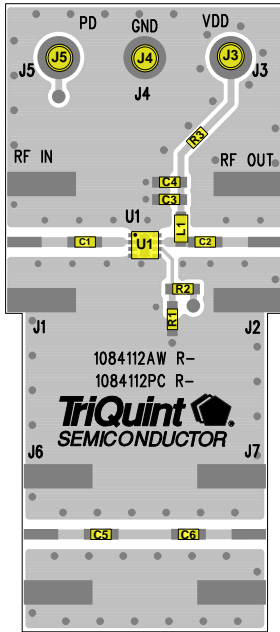
| Freq (GHz) | S11 (dB) | S11 (ang) | S21 (dB) | S21 (ang) | S12 (dB) | S12 (ang) | S22 (dB) | S22 (ang) |
|------------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| 50         | -11.5    | -43.9     | 28.8     | 165.0     | -31.8    | 13.5      | -22.0    | -106.8    |
| 100        | -13.8    | -43.3     | 28.2     | 161.3     | -31.5    | 8.5       | -26.5    | 172.1     |
| 200        | -14.8    | -50.7     | 27.6     | 151.4     | -31.4    | 6.5       | -20.1    | 99.9      |
| 400        | -15.0    | -74.6     | 26.1     | 132.1     | -31.4    | 9.2       | -14.9    | 57.7      |
| 600        | -15.0    | -93.2     | 24.5     | 116.9     | -31.3    | 13.3      | -13.1    | 35.6      |
| 800        | -14.9    | -106.9    | 23.0     | 104.8     | -30.9    | 17.6      | -12.2    | 19.5      |
| 1000       | -15.0    | -117.2    | 21.6     | 94.8      | -30.3    | 21.5      | -11.8    | 6.5       |
| 1200       | -15.0    | -125.4    | 20.4     | 86.1      | -29.7    | 23.5      | -11.6    | -5.1      |
| 1400       | -15.1    | -131.8    | 19.4     | 78.2      | -29.0    | 25.1      | -11.4    | -16.0     |
| 1600       | -15.2    | -137.5    | 18.5     | 71.0      | -28.3    | 25.8      | -11.2    | -26.4     |
| 1800       | -15.4    | -142.3    | 17.6     | 64.2      | -27.6    | 25.5      | -11.0    | -36.2     |
| 2000       | -15.6    | -147.1    | 16.9     | 57.7      | -27.0    | 25.1      | -10.7    | -45.5     |
| 2200       | -15.8    | -151.7    | 16.2     | 51.4      | -26.4    | 24.4      | -10.4    | -54.5     |
| 2400       | -15.9    | -156.6    | 15.6     | 45.4      | -25.9    | 22.8      | -10.1    | -62.8     |
| 2600       | -16.1    | -161.5    | 15.0     | 39.5      | -25.4    | 21.2      | -9.7     | -70.6     |
| 2800       | -16.1    | -166.5    | 14.5     | 33.6      | -25.0    | 19.3      | -9.3     | -77.8     |
| 3000       | -16.5    | -174.6    | 14.0     | 27.9      | -24.6    | 17.4      | -8.7     | -82.9     |
| 3200       | -16.4    | 179.5     | 13.6     | 22.3      | -24.2    | 15.1      | -8.3     | -88.4     |
| 3400       | -16.0    | 176.3     | 13.2     | 16.8      | -23.8    | 12.8      | -8.0     | -94.5     |
| 3600       | -15.4    | 173.5     | 12.8     | 11.2      | -23.5    | 10.3      | -7.8     | -100.7    |
| 3800       | -14.8    | 170.9     | 12.5     | 5.6       | -23.2    | 7.9       | -7.6     | -106.8    |
| 4000       | -14.2    | 169.0     | 12.2     | -0.1      | -22.9    | 4.7       | -7.4     | -113.2    |
| 4200       | -14.4    | -174.7    | 11.7     | -7.3      | -22.7    | -2.9      | -8.3     | -124.1    |
| 4400       | -14.2    | -178.1    | 11.4     | -14.2     | -22.6    | -6.7      | -8.0     | -134.6    |
| 4600       | -14.2    | 178.5     | 11.0     | -21.3     | -22.5    | -11.6     | -7.6     | -145.4    |
| 4800       | -13.9    | 176.9     | 10.6     | -28.2     | -22.4    | -16.2     | -7.1     | -155.6    |
| 5000       | -13.5    | 177.2     | 10.2     | -35.3     | -22.4    | -21.0     | -6.5     | -164.7    |
| 5200       | -13.0    | 177.4     | 9.8      | -42.2     | -22.5    | -25.2     | -5.9     | -173.2    |
| 5400       | -12.2    | 176.6     | 9.3      | -49.2     | -22.6    | -30.3     | -5.3     | 179.4     |
| 5600       | -11.4    | 178.1     | 8.8      | -55.7     | -23.0    | -34.5     | -4.7     | 173.3     |
| 5800       | -10.5    | 177.9     | 8.2      | -62.3     | -23.3    | -38.2     | -4.2     | 168.1     |
| 6000       | -9.4     | 177.1     | 7.7      | -68.7     | -23.7    | -41.3     | -3.8     | 163.9     |

## Noise Parameters

Test conditions unless otherwise noted:  $V_{DD}=+5\text{ V}$ ,  $I_{DD}=115\text{ mA}$  (typ.),  $Temp=+25^{\circ}\text{C}$ , 50 Ohm system

| Freq (MHz) | NF <sub>min</sub> (dB) | MagOpt (mag) | AngOpt (deg) | Rn (Ω) |
|------------|------------------------|--------------|--------------|--------|
| 700        |                        | 0.41         | 0.100        | 118    |
| 1100       |                        | 0.50         | 0.127        | 140    |
| 1500       |                        | 0.59         | 0.113        | 165    |
| 1900       |                        | 0.49         | 0.229        | 166    |
| 2300       |                        | 0.59         | 0.267        | 179    |
| 2700       |                        | 0.74         | 0.300        | -166   |

## TQP3M9035 – PCB Evaluation Board



**Notes:**

1. See Evaluation Board PCB Information section for material and stack-up.
2. R3 (0  $\Omega$  jumper) is not shown on the schematic and may be replaced with copper trace in the target application layout.
3. All components are of 0402 size unless stated on the schematic.
4. C1, C2, and C3 are non-critical values. The reactive impedance should be as low as possible at the frequency of operation for optimal performance.
5. The L1 value is non-critical and needs to provide high reactive impedance at the frequency of operation.
6. R1 and R2 are optional and do not need to be loaded if the shut-down functionality is not needed; i.e. FDD applications. If R1 and R2 are not loaded, the LNA will operate in its standard "ON" state.
7. A through line is included on the evaluation board to de-embed the board losses.

## Bill of Material – TQP3M9035 Evaluation Board

| Reference Des.                    | Value        | Description                        | Manuf.  | Part Number |
|-----------------------------------|--------------|------------------------------------|---------|-------------|
| N/A                               | N/A          | Printed Circuit Board              | Qorvo   | 1084112     |
| U1                                | n/a          | High Linearity LNA Gain Block      | Qorvo   | TQP3M9035   |
| R1                                | 10K $\Omega$ | Resistor, Chip, 0402, 5%, 1/16W    | various | various     |
| R2                                | 33K $\Omega$ | Resistor, Chip, 0402, 5%, 1/16W    | various | various     |
| R3                                | 0 $\Omega$   | Resistor, Chip, 0402, 5%, 1/16W    | various | various     |
| L1 <sup>(1)</sup>                 | 68 nH        | Inductor, 0603, 5%, Ceramic        | various | various     |
| C4                                | 1.0 uF       | Cap., Chip, 0402, 10%, 10V, X5R    | various | various     |
| C1, C2, C3, C5, C6 <sup>(1)</sup> | 100 pF       | Cap., Chip, 0402, 5%, 50V, NPO/COG | various | various     |
| J3, J4, J5                        | n/a          | Solder Turret                      | various | various     |

**Notes:**

1. For 50-500 MHz operation set L1=82 nH and C1, C2, C5, C6=1000 pF.

## Typical Performance TQP3M9035-PCB $V_{DD} = +5\text{ V}$

Test conditions unless otherwise noted:  $I_{DD}=115\text{ mA}$  (typ.),  $Temp=+25^{\circ}\text{C}$

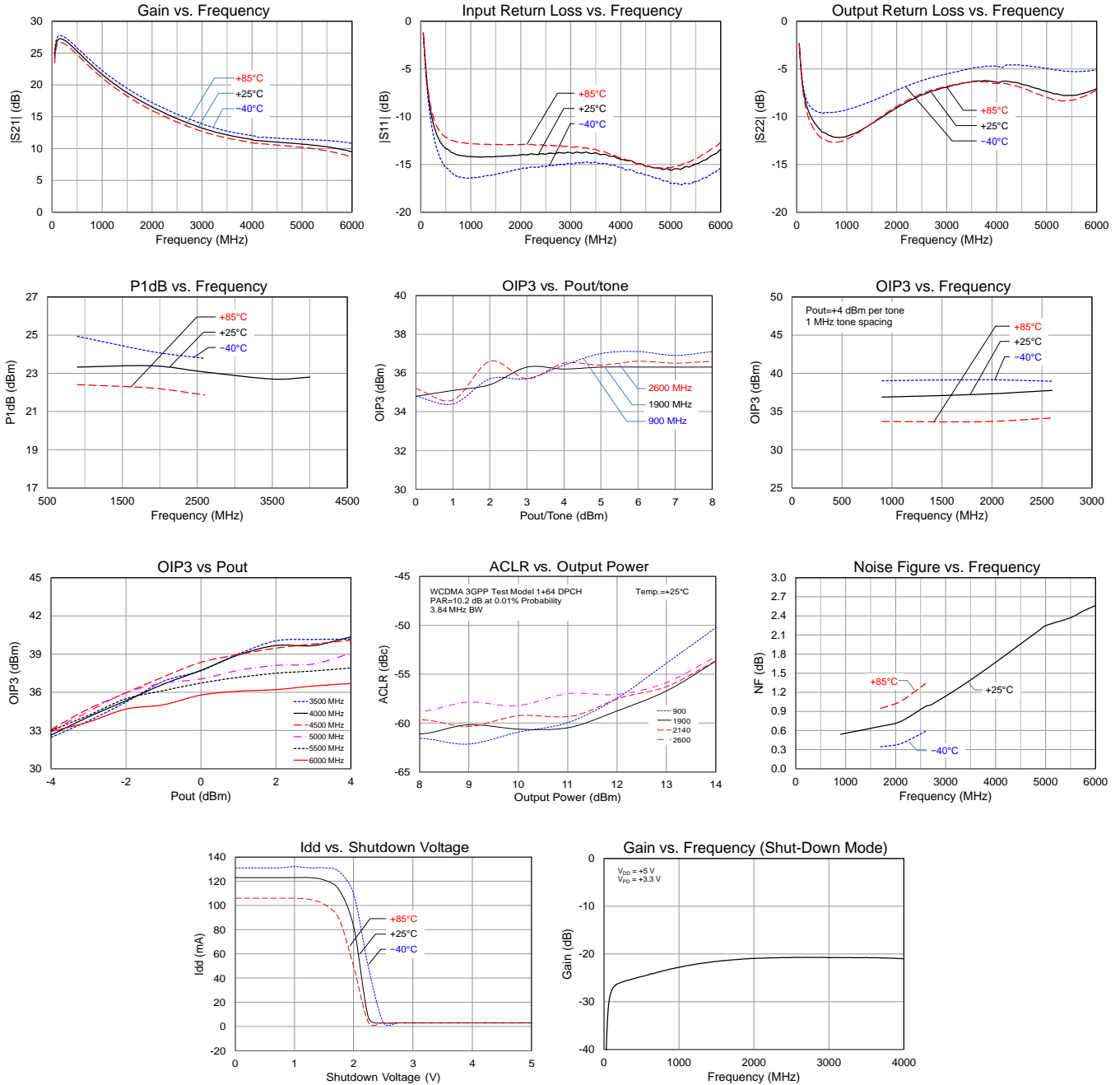
| Parameter                   | Conditions  | Typical Value |       |       |      | Units |
|-----------------------------|---|---------------|-------|-------|------|-------|
| Frequency                   |   | 900           | 1900  | 2600  | 3500 | MHz   |
| Gain                        |   | 22.0          | 16.5  | 14.0  | 12.0 | dB    |
| Input Return Loss           |   | 14            | 14    | 14    | 14   | dB    |
| Output Return Loss          |   | 13            | 10    | 8     | 7    | dB    |
| Output P1dB                 |   | +23           | +23   | +23   |      | dBm   |
| Output IP3                  | $P_{out} = +4\text{ dBm/tone}, \Delta f = 1\text{ MHz}$ | +37.2         | +37.0 | +37.3 |      | dBm   |
| Noise figure <sup>(1)</sup> |   | 0.55          | 0.65  | 1.0   | 1.4  | dB    |

Notes:

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

### Performance Plots - TQP3M9035-PCB $V_{DD} = +5 V$

Test conditions unless otherwise noted:  $I_{DD} = 115 \text{ mA}$  (typ.), Temp =  $+25^\circ\text{C}$



## Typical Performance – TQP3M9035-PCB $V_{DD} = +3.3\text{ V}$

Test conditions unless otherwise noted:  $I_{DD}=67\text{ mA}$  (typ.),  $Temp.=+25^{\circ}\text{C}$

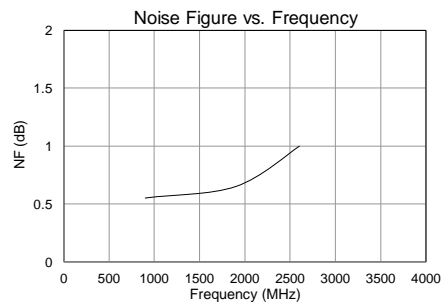
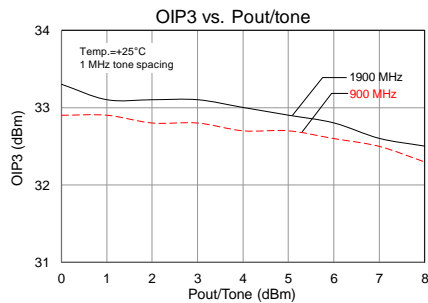
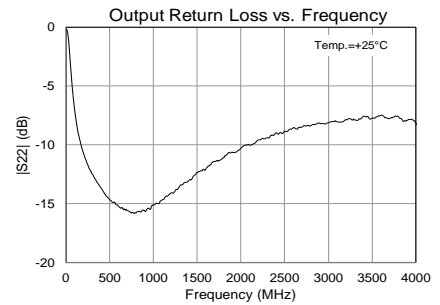
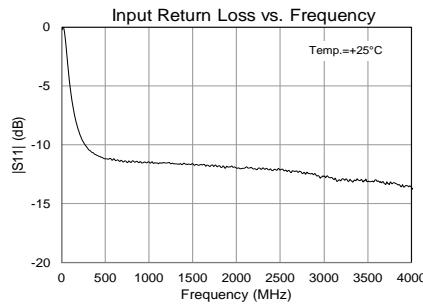
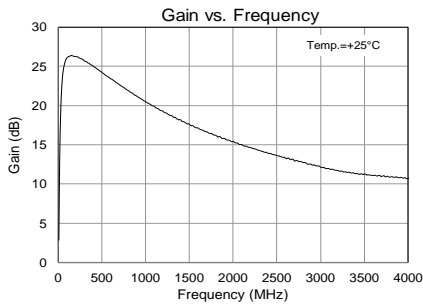
| Parameter                   | Conditions   | Typical Value |       | Units |
|-----------------------------|--|---------------|-------|-------|
| Frequency                   |  | 900           | 1900  | MHz   |
| Gain                        |  | 21.2          | 15.8  | dB    |
| Input Return Loss           |  | 11.4          | 11.9  | dB    |
| Output Return Loss          |  | 15.6          | 10.6  | dB    |
| Output P1dB                 |  | +19           | +18.8 | dBm   |
| Output IP3                  | $P_{out} = +5\text{ dBm/ tone}, \Delta f = 1\text{ MHz}$ | +32.7         | +33   | dBm   |
| Noise figure <sup>(1)</sup> |  | 0.55          | 0.65  | dB    |

Notes:

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

## Performance Plots - TQP3M9035-PCB $V_{DD} = +3.3\text{ V}$

Test conditions unless otherwise noted:  $I_{DD} = 67\text{ mA}$ ,  $T_{CASE} = +25^{\circ}\text{C}$ ,  $50\ \Omega$  system



## 50 to 500 MHz IF Reference Design

TQP3M9035 performance may be optimized for IF operation below 500 MHz by making suitable adjustments to the value of the bias inductor L1 and the DC blocking capacitors C1 and C2. When using the TriQuint evaluation board be sure to match the value of C5 and C6 to that of C1 and C2 for accurate loss de-embedding.

## Typical Performance – 50 to 500 MHz

Test conditions unless otherwise noted: L1=82 nH, C1-C2, C5-C6=1000 pF, V<sub>DD</sub>=+5V, I<sub>DD</sub>=115 mA (typ.), Temp=+25°C

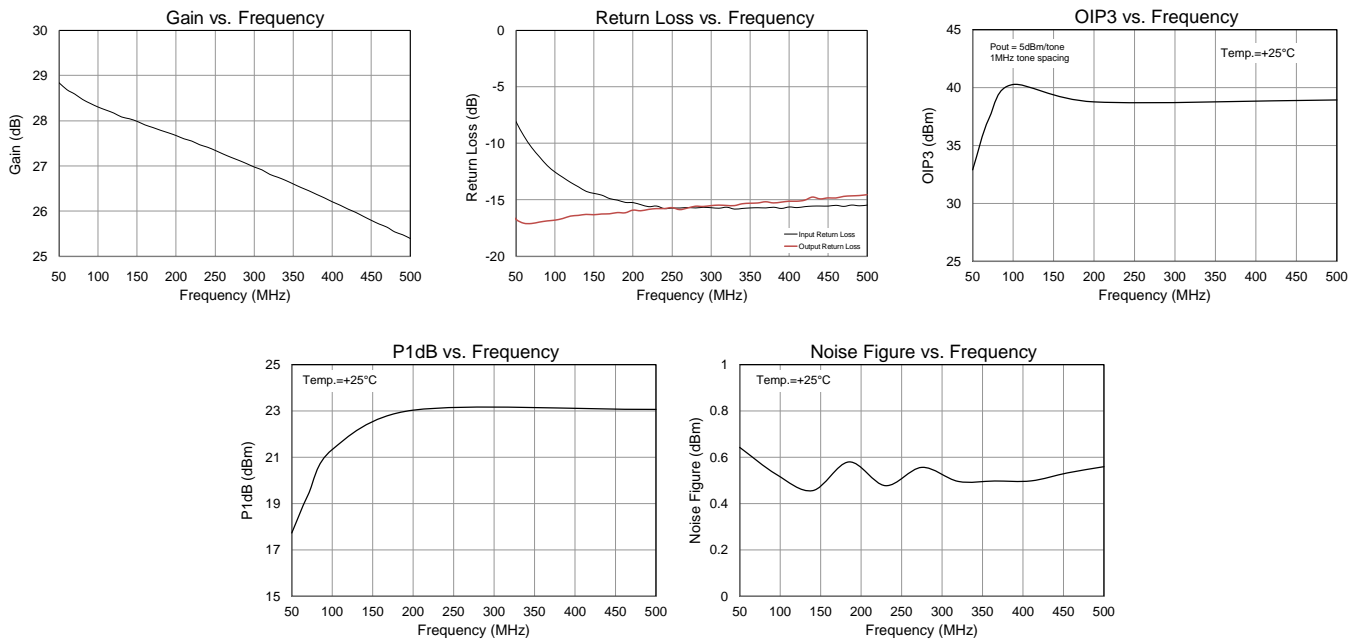
| Parameter                   | Conditions                  | Typical Value |       |       |       | Units |
|-----------------------------|-----------------------------|---------------|-------|-------|-------|-------|
|                             |                             | 50            | 100   | 200   | 500   |       |
| Frequency                   |                             | 50            | 100   | 200   | 500   | MHz   |
| Gain                        |                             | 28.8          | 28.3  | 27.7  | 25.4  | dB    |
| Input Return Loss           |                             | 8             | 12.5  | 15.2  | 15.4  | dB    |
| Output Return Loss          |                             | 16.7          | 16.8  | 15.9  | 14.5  | dB    |
| Output P1dB                 |                             | +17.7         | +21.3 | +23   | +23.1 | dBm   |
| Output IP3                  | Pout= +5 dBm/tone, Δf=1 MHz | +32.9         | +40.3 | +38.8 | +38.9 | dBm   |
| Noise figure <sup>(1)</sup> |                             | 0.64          | 0.52  | 0.56  | 0.56  | dB    |

Notes:

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

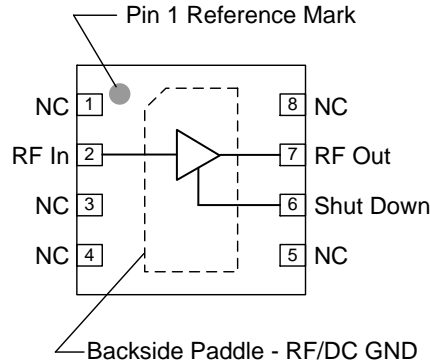
## Performance Plots – 50-500 MHz

Test conditions unless otherwise noted: : L1=82 nH, C1-C2, C5-C6=1000 pF, V<sub>DD</sub>=+5V, I<sub>DD</sub>=115 mA (typ.), Temp=+25°C





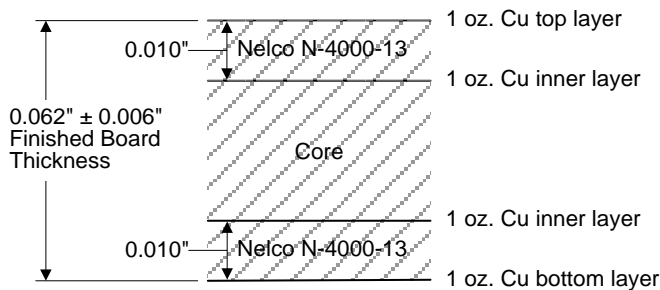
## Pin Configuration and Description



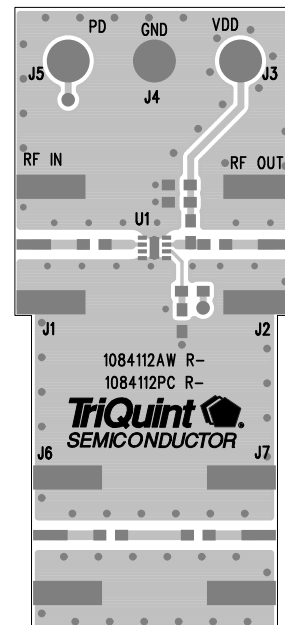
| Pin No.         | Label           | Description  |
|-----------------|-----------------|--|
| 2               | RF In           | RF Input pin. A DC Block is required.  |
| 6               | Shut Down       | High Voltage (0.5 to 1.1V) turns OFF the device and Low Voltage (0 to 0.2V) turns ON the device.   |
| 7               | RF Out / DCBias | RF Output pin. DC bias will also need to be injected through a RF bias choke/inductor for operation.                                       |
| 1, 3, 4, 5, 8   | NC              | 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 1084112 Material and Stack-up



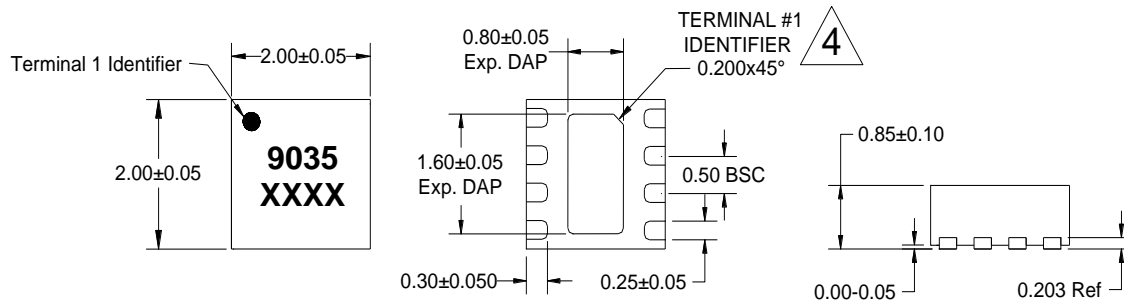
50 ohm line dimensions: width = .031", spacing = .035"



**Mechanical Information**

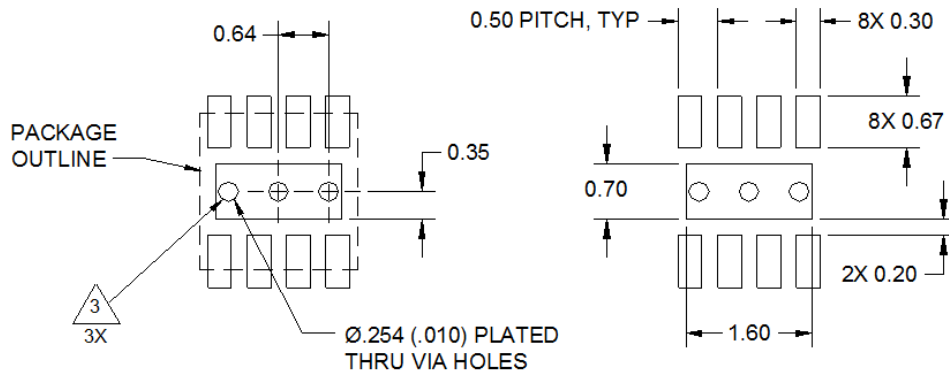
**Package Marking and Dimensions**

Marking: Part number – 9035  
 Lot Code – XXXX



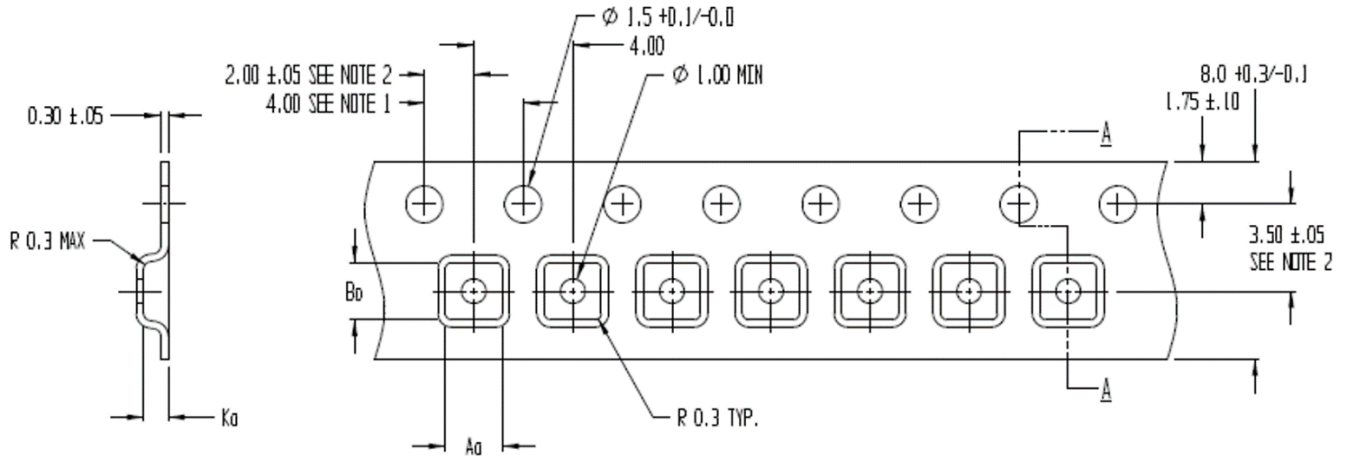
- Notes:
1. All dimensions are in millimeters. Angles are in degrees.
  2. Except where noted, this part outline conforms to JEDEC standard MO-220, Issue E (Variation VGGC) for thermally enhanced plastic very thin fine pitch quad flat no lead package (QFN).
  3. Dimension and tolerance formats conform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

**PCB Mounting Pattern**

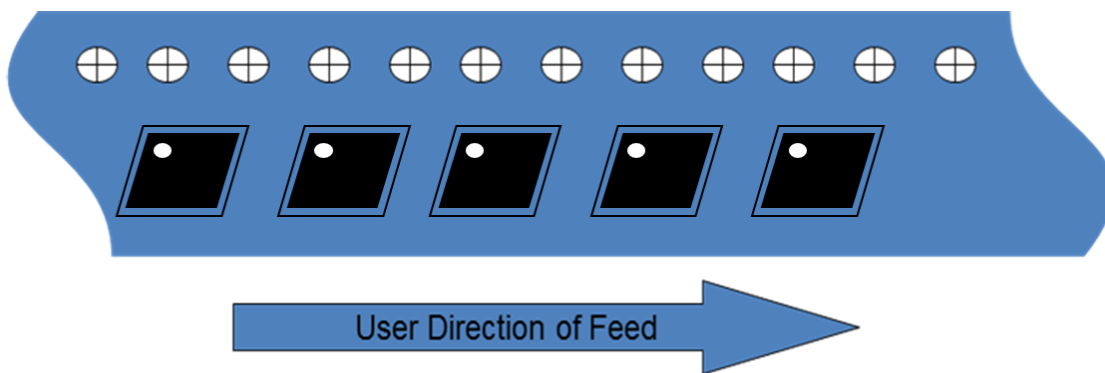


- Notes:
1. All dimensions are in millimeters. Angles are in degrees.
  2. Use 1 oz. copper minimum for top and bottom layer metal.
  3. Vias are required under the backside paddle of this device for proper RF/DC grounding and thermal dissipation. We recommend a  $0.35$  mm ( $\#80/.0135$ ") diameter 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.

Tape and Reel Information – Carrier and Cover Tape Dimensions

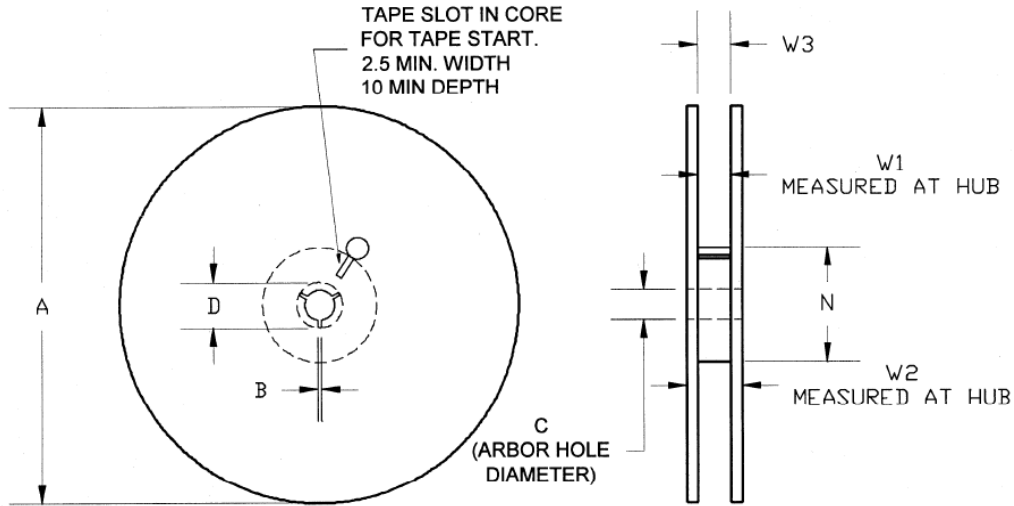


| Feature             | Measure                                  | Symbol | Size (in) | Size (mm) |
|---------------------|--|--------|-----------|-----------|
| Cavity              | Length                                   | A0     | 0.091     | 2.30      |
|                     | Width                                    | B0     | 0.091     | 2.30      |
|                     | Depth                                    | K0     | 0.039     | 1.00      |
|                     | Pitch                                    | P1     | 0.157     | 4.00      |
| Centerline Distance | Cavity to Perforation - Length Direction | P2     | 0.079     | 2.00      |
|                     | Cavity to Perforation - Width Direction  | F      | 0.138     | 3.50      |
| Cover Tape          | Width                                    | C      | 0.213     | 5.40      |
| Carrier Tape        | Width                                    | W      | 0.315     | 8.00      |



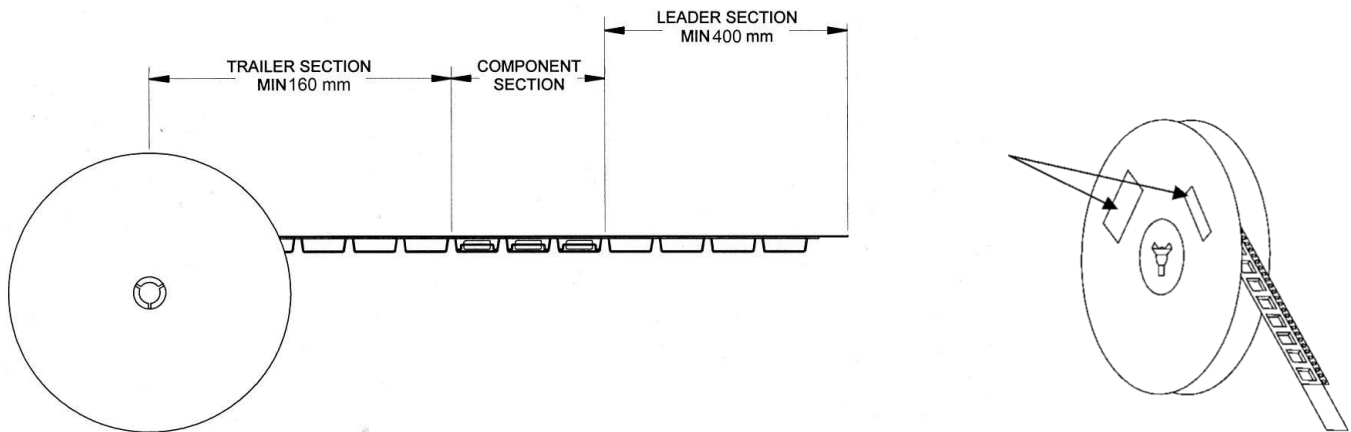
**Tape and Reel Information – Reel Dimensions**

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



| Feature | Measure              | Symbol | Size (in) | Size (mm) |
|---------|----------------------|--------|-----------|-----------|
| Flange  | Diameter             | A      | 6.969     | 177.0     |
|         | Thickness            | W2     | 0.559     | 14.2      |
|         | Space Between Flange | W1     | 0.346     | 8.8       |
| 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)     | 1A      | ESDA / JEDEC JS-001-2014 |
| ESD – Charged Device Model (CDM) | C3      | ESDA / JEDEC JS-002-2014 |
| MSL – Moisture Sensitivity Level | Level 1 | IPC/JEDEC J-STD-020      |



Caution!  
 ESD-Sensitive Device

## Solderability

Compatible with lead-free (260°C max. reflow temp.) soldering process.  
 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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