

Product Description

The TQP3M9007 is a high linearity low noise gain block amplifier in a low-cost surface-mount package. At 1.9 GHz, the amplifier typically provides 13 dB gain, +41 dBm OIP3, and 1.3 dB Noise Figure while drawing 125 mA current. The device is housed in a lead-free green RoHS compliant industry-standard SOT-89 package.

The TQP3M9007 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 +5 V supply. The internal active bias circuit also enables stable operation over bias and temperature variations.

The TQP3M9007 covers the 0.1 – 4 GHz frequency band and is targeted for wireless infrastructure or other applications requiring high linearity and/or low noise figure.



SOT-89 Package

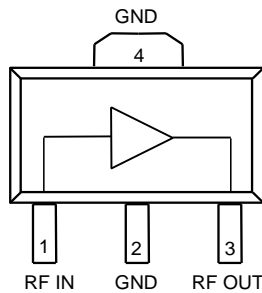
Product Features

- 100 – 4000 MHz
- 13 dB Gain at 1.9 GHz
- 1.3 dB Noise Figure at 1.9 GHz
- +41 dBm Output IP3
- +23.6 dBm P1dB
- 50 Ω Cascadable Gain Block
- Unconditionally Stable
- High Input Power Capability
- +5 V Single Supply, 125 mA Current
- SOT-89 Package

Applications

- Repeaters
- Mobile Infrastructure
- LTE / WCDMA / CDMA / EDGE
- General Purpose Wireless

Functional Block Diagram



Ordering Information

| Part No. | Description |
|---------------|-------------------------------------|
| TQP3M9007 | 1000 pieces on a 7" reel (standard) |
| TQP3M9007-PCB | 0.5–4 GHz Evaluation Board |

Absolute Maximum Ratings

| Parameter | Rating |
|-----------------------------------|---------------|
| Storage Temperature | -55 to +150°C |
| RF Input Power, CW, 50 Ω, T=25 °C | +20 dBm |
| Device Voltage (V _{DD}) | +7 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 _{DD}) | +3.0 | +5.0 | +5.25 | V |
| T _{CASE} | -40 | | +105 | °C |
| T _j for >10 ⁶ 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.

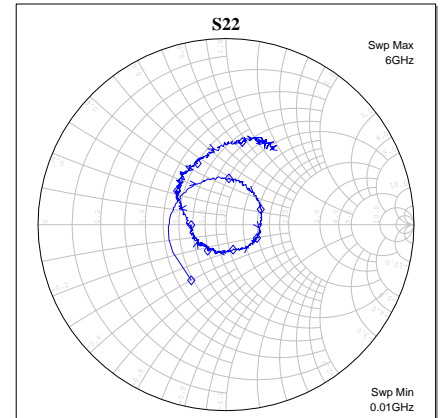
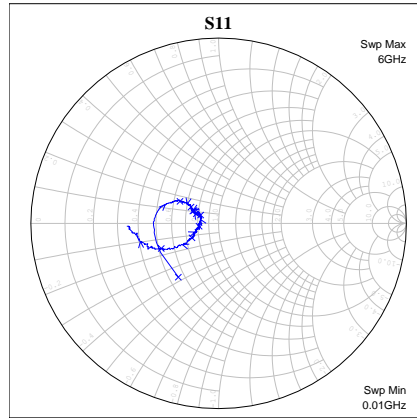
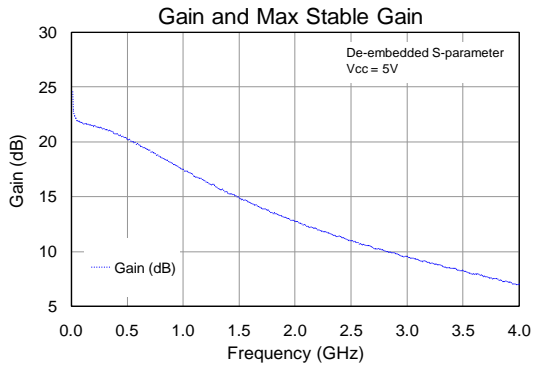
Electrical Specifications

| Parameter | Conditions | Min | Typ | Max | Units |
|-------------------------------------|------------------------------------|------|-------|------|-------|
| Operational Frequency Range | | 100 | | 4000 | MHz |
| Test Frequency | | | 1900 | | MHz |
| Gain | | 11.5 | 13 | 14.5 | dB |
| Input Return Loss | | | 18 | | dB |
| Output Return Loss | | | 13 | | dB |
| Output P1dB | | | +23.6 | | dBm |
| Output IP3 | See Note 1. | +37 | +41 | | dBm |
| Noise Figure | | | 1.3 | | dB |
| Current, I _{DD} | | | 125 | 150 | mA |
| Thermal Resistance, θ _{jc} | Junction to backside ground paddle | | 52 | | °C/W |

Notes:

1. Test conditions unless otherwise noted: V_{DD}=+5 V, Temp=+25 °C, 50 Ω system
2. OIP3 is measured with two tones at an output power of 4 dBm / tone separated by 1 MHz. The suppression on the largest IM3 product is used to calculate the OIP3 using 2:1 rule. 2:1 rule gives relative value with respect to fundamental tone.

Device Characterization Data



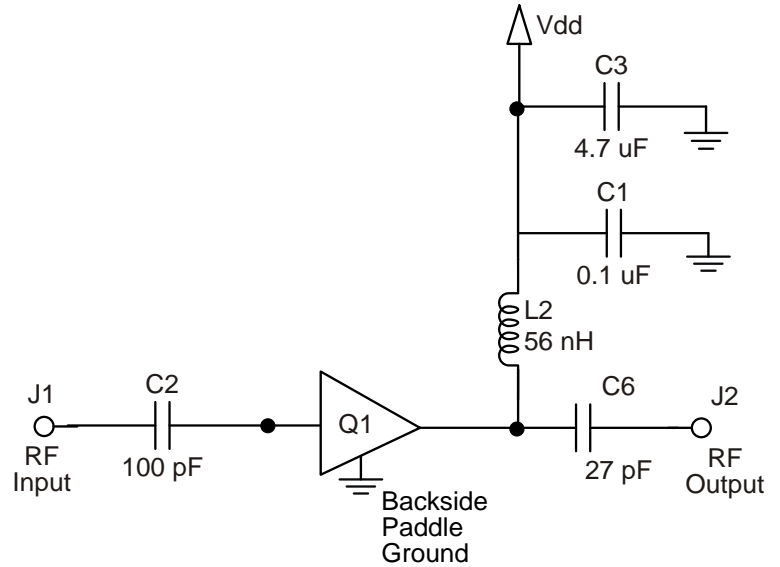
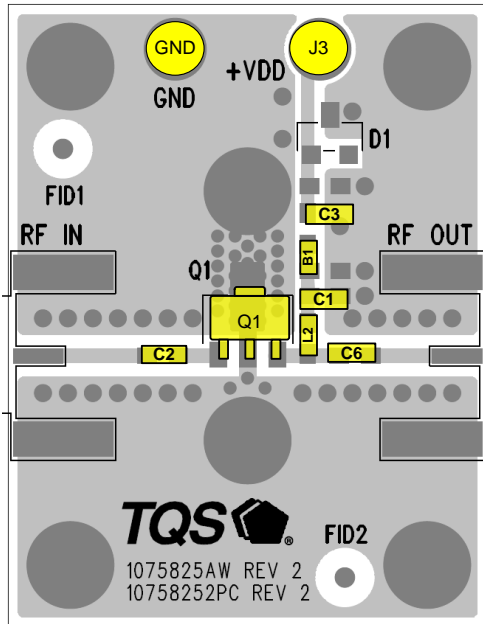
S-Parameters

| Freq (MHz) | S11 (dB) | S11 (ang) | S21 (dB) | S21 (ang) | S12 (dB) | S12 (ang) | S22 (dB) | S22 (ang) |
|------------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| 50 | -9.21 | -171.69 | 21.92 | 165.87 | -28.66 | 7.52 | -10.26 | -177.68 |
| 100 | -9.18 | 178.66 | 21.72 | 164.31 | -28.54 | 8.08 | -10.62 | 166.81 |
| 200 | -9.58 | 168.58 | 21.39 | 154.89 | -28.25 | 11.48 | -10.93 | 145.14 |
| 400 | -11.09 | 155.91 | 20.71 | 134.86 | -27.05 | 16.59 | -11.61 | 112.74 |
| 800 | -13.55 | 148.37 | 18.58 | 99.19 | -24.58 | 17.74 | -12.39 | 63.78 |
| 1000 | -14.69 | 147.37 | 17.47 | 84.06 | -23.58 | 14.87 | -13.43 | 40.99 |
| 1200 | -15.31 | 148.14 | 16.33 | 70.48 | -22.59 | 12.31 | -13.72 | 23.70 |
| 1500 | -16.32 | 152.38 | 14.85 | 52.18 | -21.45 | 6.08 | -14.84 | -3.77 |
| 1900 | -16.36 | 155.45 | 13.11 | 30.26 | -19.96 | -2.85 | -15.21 | -32.08 |
| 2000 | -16.44 | 154.43 | 12.73 | 25.52 | -19.77 | -5.72 | -15.43 | -42.20 |
| 2200 | -16.55 | 154.33 | 11.98 | 15.20 | -19.13 | -12.30 | -16.18 | -54.41 |
| 2500 | -16.78 | 153.75 | 10.97 | 0.51 | -18.24 | -20.16 | -16.76 | -84.02 |
| 2600 | -16.83 | 154.69 | 10.59 | -4.70 | -18.14 | -23.60 | -16.24 | -91.43 |
| 3000 | -17.62 | 157.51 | 9.53 | -24.26 | -17.17 | -36.43 | -16.21 | -128.42 |
| 3500 | -18.79 | 154.34 | 8.24 | -48.07 | -16.19 | -53.90 | -14.74 | -165.72 |
| 4000 | -20.11 | 176.37 | 7.01 | -72.56 | -15.53 | -72.99 | -11.54 | 154.74 |

Notes:

1. Test Conditions: $V_{DD}=+5\text{ V}$, $I_{DD}=125\text{ mA}$, $T=+25\text{ }^{\circ}\text{C}$, $50\ \Omega$ system, calibrated to device leads

Application Circuit Configuration



Notes:

1. See PC Board Layout, under Application Information section, 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. All components are of 0603 size unless stated on the schematic.
5. C6 and L2 value are critical for linearity performance.

Bill of Material – TQP3M9007-PCB

| Reference Designation | Value | Description | Manufacturer | Part Number |
|-----------------------|-------------|----------------------------------|--------------|-------------|
| Q1 | | High Linearity LNA Gain Block | Qorvo | TQP3M9007 |
| C2 | 100 pF | Cap, Chip, 0603, +50V, NPO, 5% | various | |
| C6 | 27 pF | Cap, Chip, 0603, +50V, NPO, 5% | various | |
| C1 | 0.1 μ F | Cap, Chip, 0603, +16V, X7R, 10% | various | |
| L2 | 56 nH | Ind, Chip, 0603, 5% | various | |
| C3 | 4.7 μ F | Cap, Chip, 0603, +6.3V, X5R, 20% | various | |
| B1 | 0 Ω | Res, Chip, 0603, 1/16W, 5% | various | |

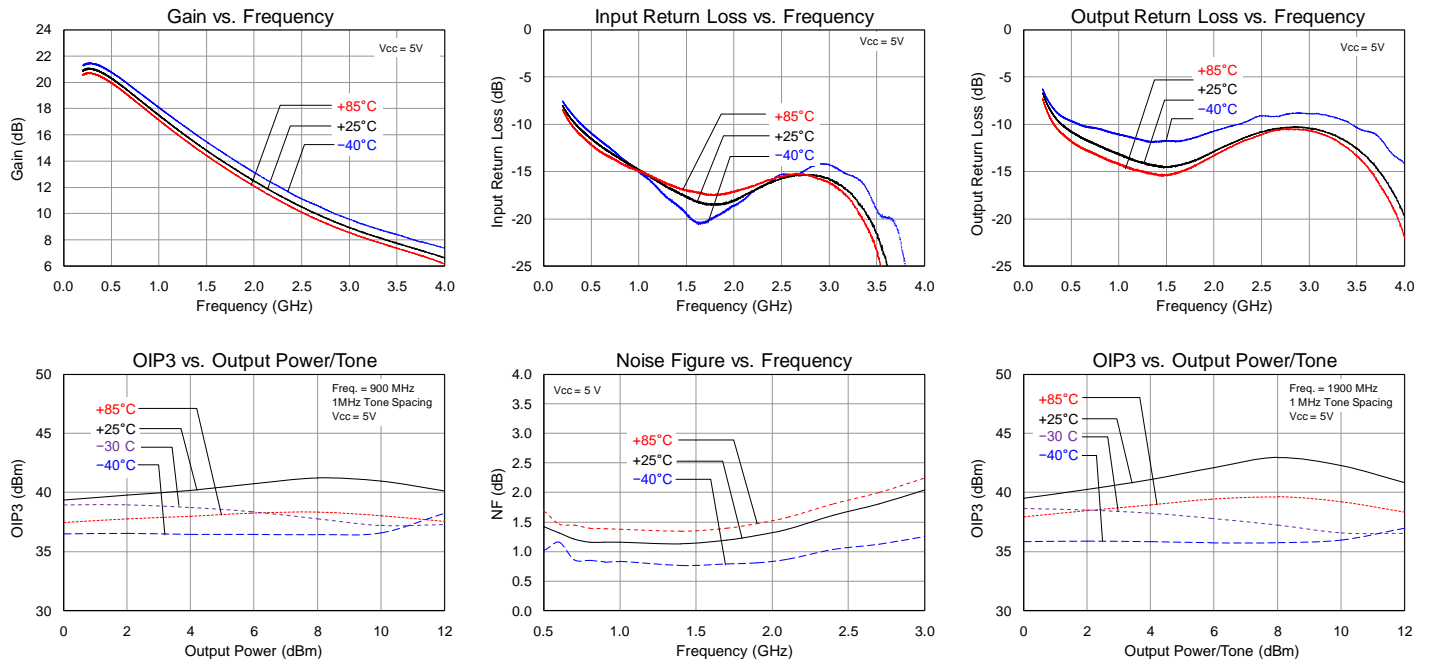
Typical Performance – TQP3M9007-PCB

| Parameter | Typical Value | | | | | Units |
|-----------------------------|---------------|-------|-------|-------|-------|-------|
| Frequency | 500 | 900 | 1900 | 2100 | 2600 | MHz |
| Gain | 20 | 18 | 13 | 12 | 10 | dB |
| Input Return Loss | 11.5 | 14.0 | 18.0 | 17.5 | 15.5 | dB |
| Output Return Loss | 10.5 | 13.0 | 13.0 | 12.0 | 10.5 | dB |
| Output P1dB | +22.9 | +23.3 | +23.5 | +23.8 | +24.0 | dBm |
| OIP3 ⁽²⁾ | +39.3 | +40.2 | +41.1 | +42.2 | +42.2 | dBm |
| Noise figure ⁽³⁾ | 1.4 | 1.2 | 1.3 | 1.4 | 1.8 | dB |

Notes:

1. Test conditions unless otherwise noted: $V_{DD}=+5V$, $I_{DD}=125mA$, $Temp=+25^{\circ}C$, $50\ \Omega$ system.
2. OIP3 measured with two tones at an output power of +4 dBm / tone separated by 1 MHz. The suppression on the largest IM3 product is used to calculate the OIP3 using 2:1 rule.
3. Noise figure data shown in the table above is measured on evaluation board and corrected for the board loss of about 0.13 dB at 1.9 GHz.

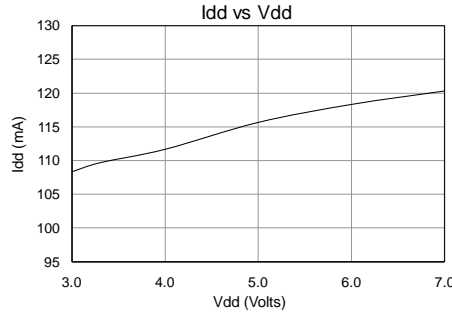
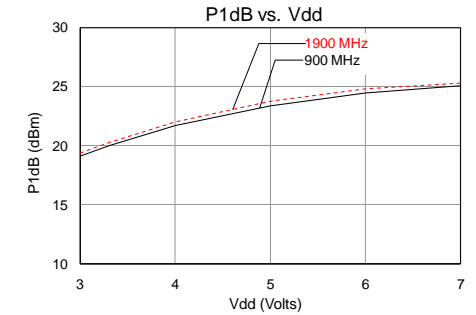
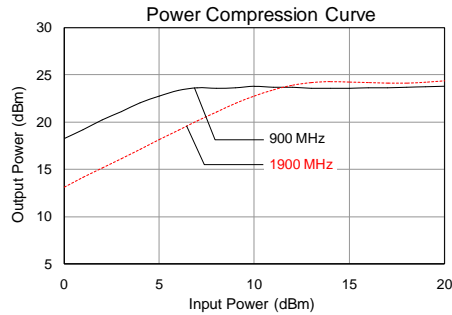
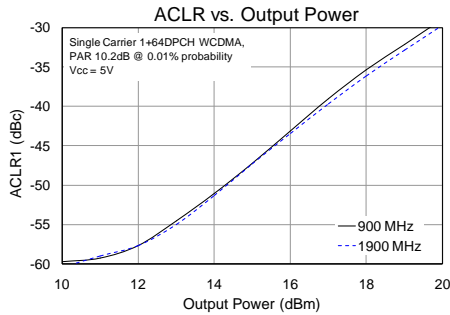
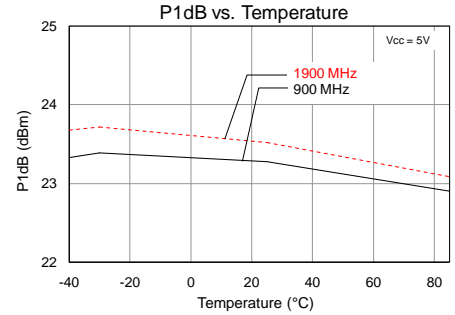
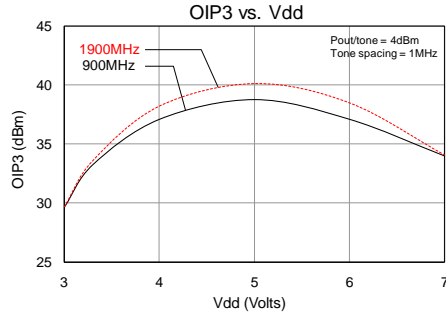
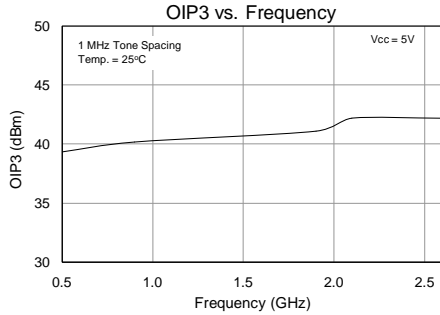
Performance Plots – TQP3M9007-PCB



Notes:

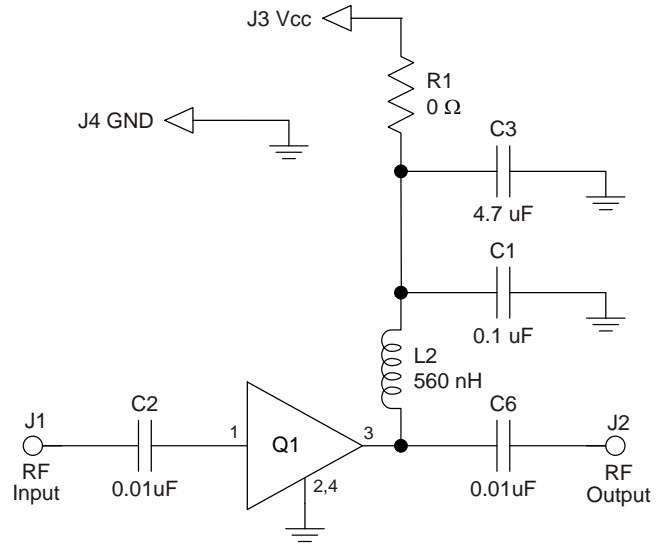
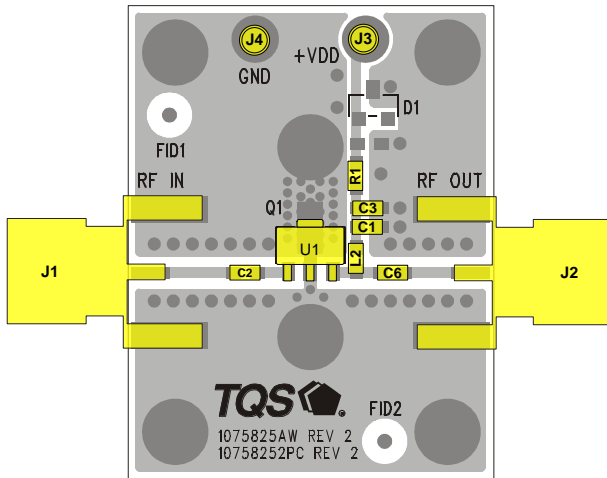
1. Performance plots data is measured using TQP3M9007-PCB. Noise figure plot has been corrected for evaluation board loss of 0.13 dB at 1.9 GHz.
2. Test conditions unless otherwise noted: $V_{DD}=+5V$, $I_{DD}=125mA$, $Temp=+25^{\circ}C$, $50\ \Omega$ system.

Performance Plots – TQP3M9007-PCB



- Notes:**
1. Performance plots data is measured using TQP3M9007-PCB. Noise figure plot has been corrected for evaluation board loss of 0.13 dB at 1.9 GHz.
 2. Test conditions unless otherwise noted: V_{DD}=+5 V, I_{DD}=125 mA, Temp=+25°C, 50 Ω system.

Application Circuit Configuration – 30 MHz to 500 MHz



Notes:

1. See PC Board Layout, under Application Information section, for more information.
2. Components shown on the silkscreen but not on the schematic are not used.
3. The recommended component values are dependent on the frequency of operation.

Bill of Material – TQP3M9007, 30 MHz to 500 MHz

| Reference Designation | Value | Description | Manufacturer | Part Number |
|-----------------------|--------------|----------------------------------|--------------|-------------|
| Q1 | | High Linearity LNA Gain Block | Qorvo | TQP3M9007 |
| C2, C6 | 0.01 μ F | Cap, Chip, 0603, +50V, X7R, 5% | various | |
| C1 | 0.1 μ F | Cap, Chip, 0603, +16V, X7R, 10% | various | |
| L2 | 560 nH | Ind, Chip, 0603, 5% | various | |
| C3 | 4.7 μ F | Cap, Chip, 0603, +6.3V, X5R, 20% | various | |
| R1 | 0 Ω | Res, Chip, 0603, 1/16W, 5% | various | |

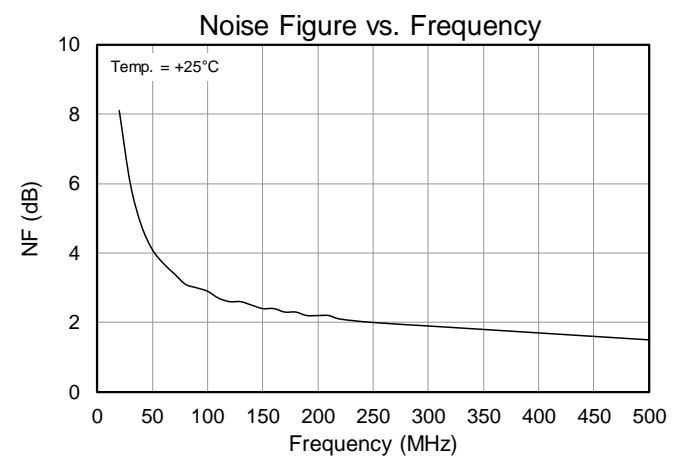
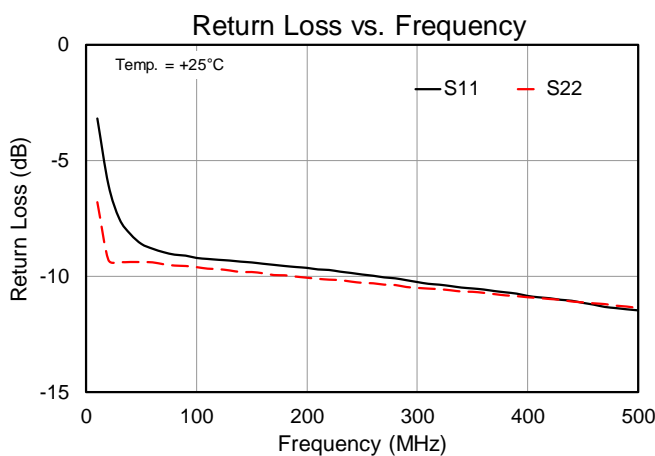
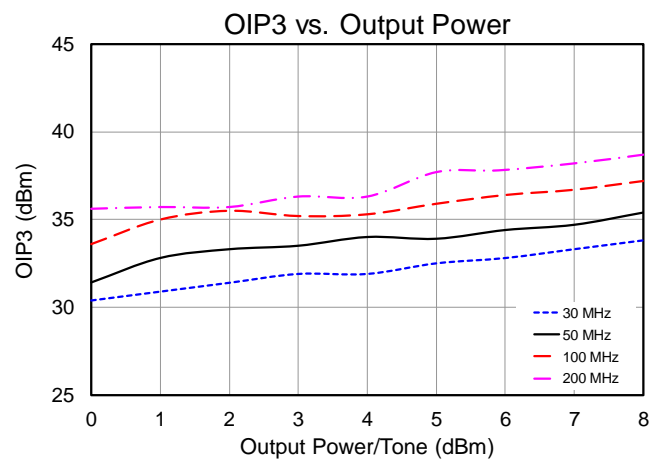
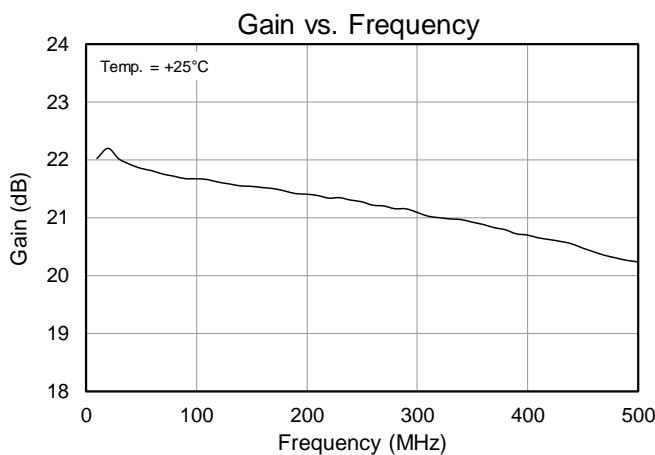
Typical Performance – TQP3M9007, 30 MHz to 500 MHz

| Parameter | Typical Value | | | Units |
|---------------------|---------------|-------|-------|-------|
| Frequency | 30 | 100 | 200 | MHz |
| Gain | 22 | 21.7 | 21.4 | dB |
| Input Return Loss | 7.5 | 9.2 | 9.6 | dB |
| Output Return Loss | 9.4 | 9.6 | 10.1 | dB |
| Output P1dB | +23.2 | +23.3 | +23.4 | dBm |
| OIP3 ⁽²⁾ | +31.9 | +35.3 | +36.3 | dBm |
| Noise figure | 6.0 | 4.1 | 2.2 | dB |

Notes:

1. Test conditions unless otherwise noted: $V_{DD}=+5\text{ V}$, $I_{DD}=125\text{ mA}$, $\text{Temp}=+25^\circ\text{C}$, $50\ \Omega$ system.
2. OIP3 measured with two tones at an output power of +4 dBm / tone separated by 1 MHz. The suppression on the largest IM3 product is used to calculate the OIP3 using 2:1 rule.

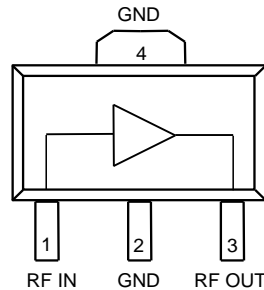
Performance Plots – TQP3M9007, 30 MHz to 500 MHz



Notes:

1. Test conditions unless otherwise noted: $V_{DD}=+5\text{ V}$, $I_{DD}=125\text{ mA}$, $\text{Temp}=+25^\circ\text{C}$, $50\ \Omega$ system.

Pin Configuration and Description



| Pin No. | Label | Description |
|---------|-------|--|
| 1 | RF IN | RF Input, matched to 50 ohms. External DC Block is required. |
| 3 | RFOUT | RF Output and V _{DD} , matched to 50 ohms. External DC block and RF choke are required. |
| 2, 4 | GND | Ground and backside ground Paddle. Multiple ground via holes should be employed to minimize inductance and thermal resistance. |

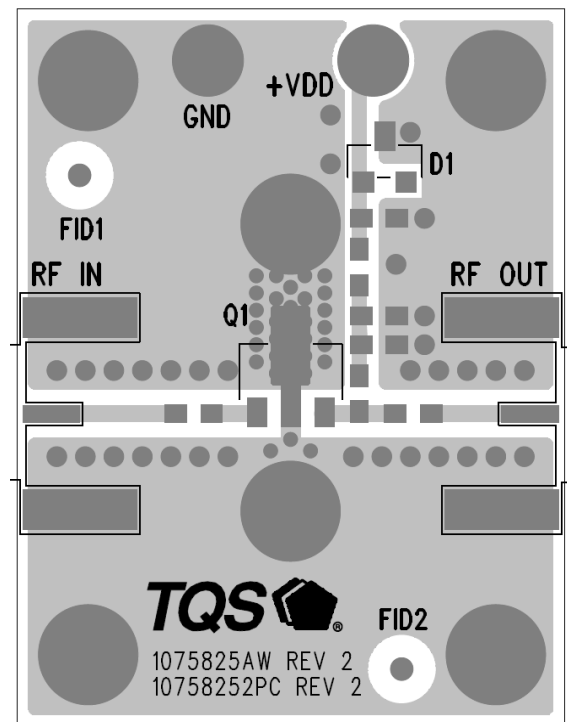
Applications Information

PCB Board Layout

Top RF layer is 0.014" NELCO N4000-13, $\epsilon_r = 3.9$, 4 total layers (0.062" thick) for mechanical rigidity. Metal layers are 1-oz copper.

50 Ω Microstrip line details: width = .029", spacing = .035"

The pad pattern shown has been developed and tested for optimized assembly at Qorvo, Inc. The PCB land pattern has been developed to accommodate lead and package tolerances. Since surface mount processes vary from company to company, careful process development is recommended.

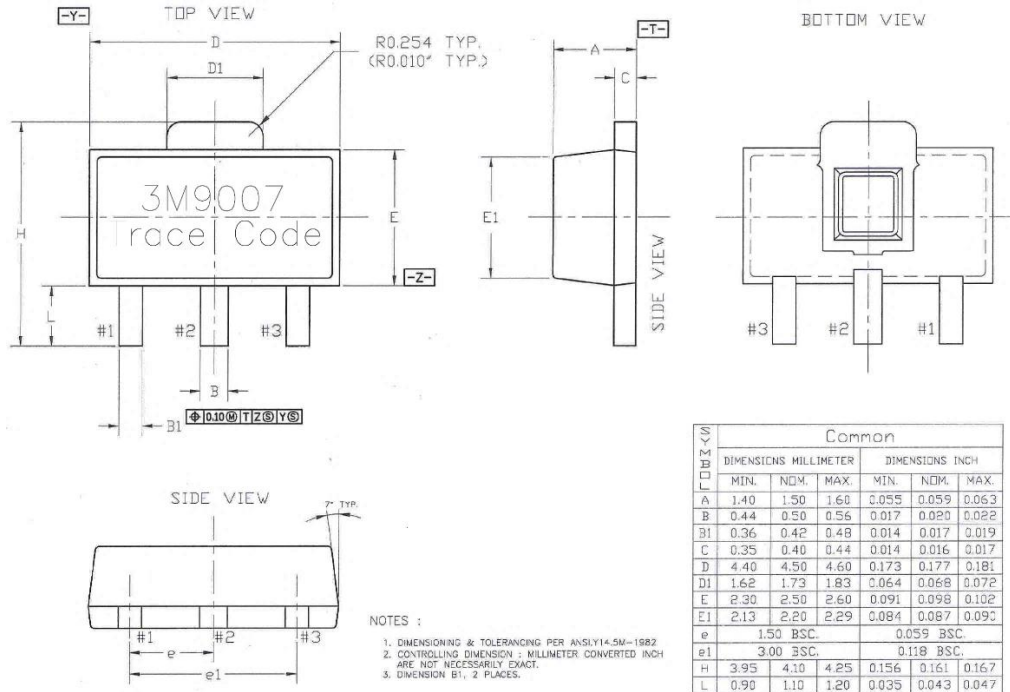


Package Marking and Dimensions

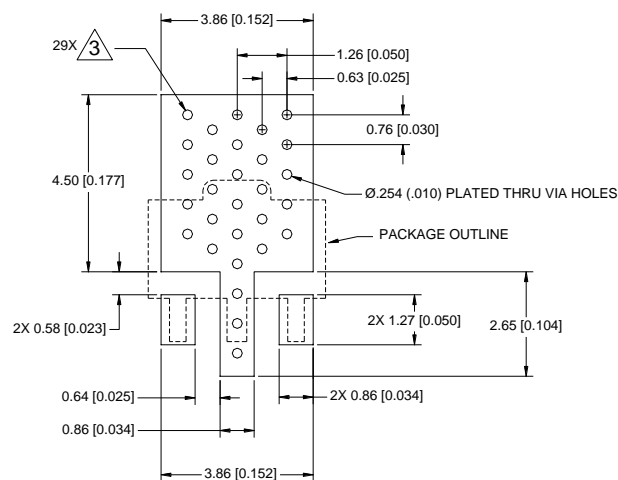
Package Marking

Line 1 - Part Number: 3M9007

Line 2 - Trace Code: XXXX - Up to 4 characters to be assigned by subcontractor



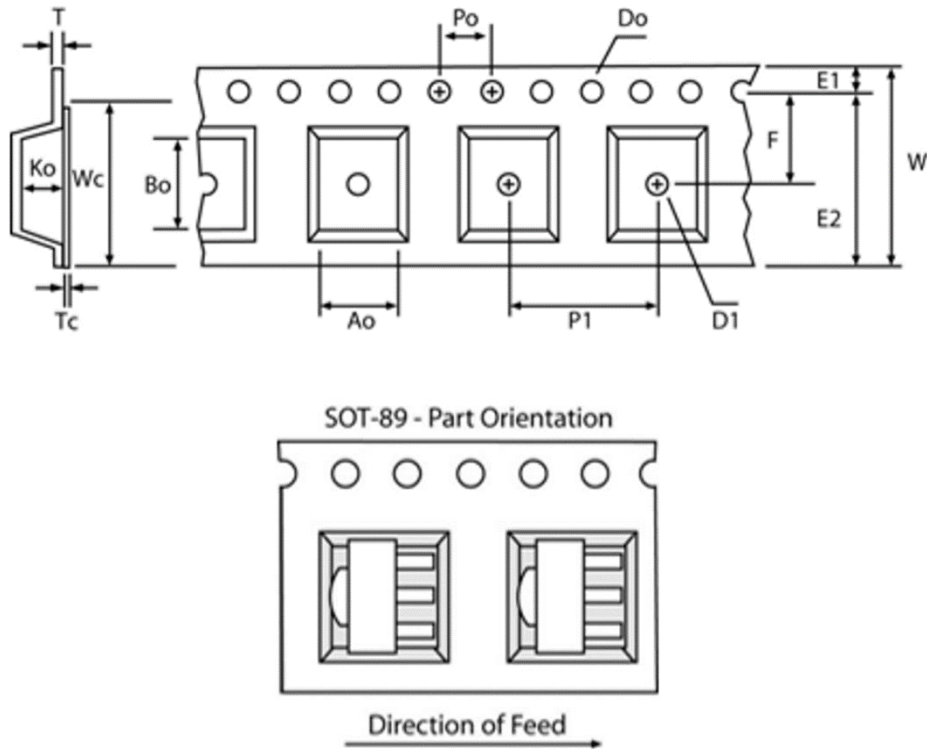
PCB Mounting Pattern



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. Via holes are required under the backside paddle of this device for proper RF & DC grounding and thermal conductivity. We recommend a 0.35mm (#80/.0135") diameter bit for drilling via holes and a final plated thru diameter of 0.25mm (0.01").
4. Ensure good package backside paddle solder attach for reliable operation and best electrical performance.

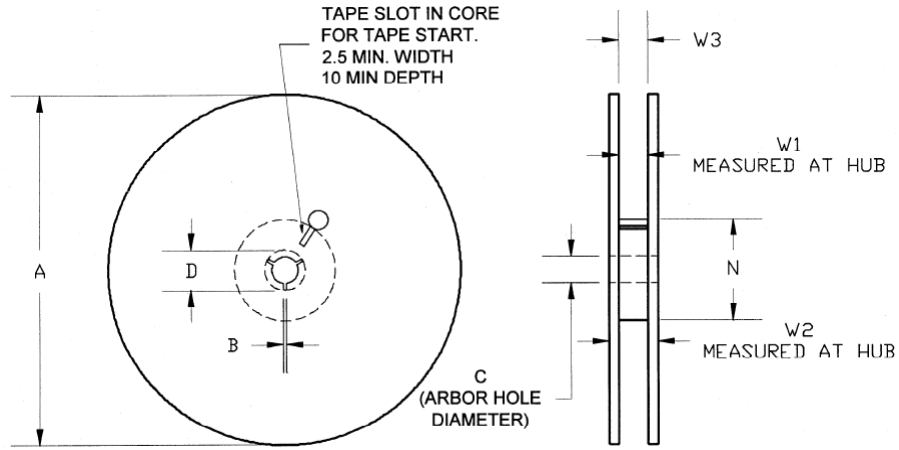
Tape and Reel Information – Carrier and Cover Tape Dimensions



| Feature | Measure | Symbol | Size (in) | Size (mm) |
|---------------------|--|--------|-----------|-----------|
| Cavity | Length | A0 | 0.181 | 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 |

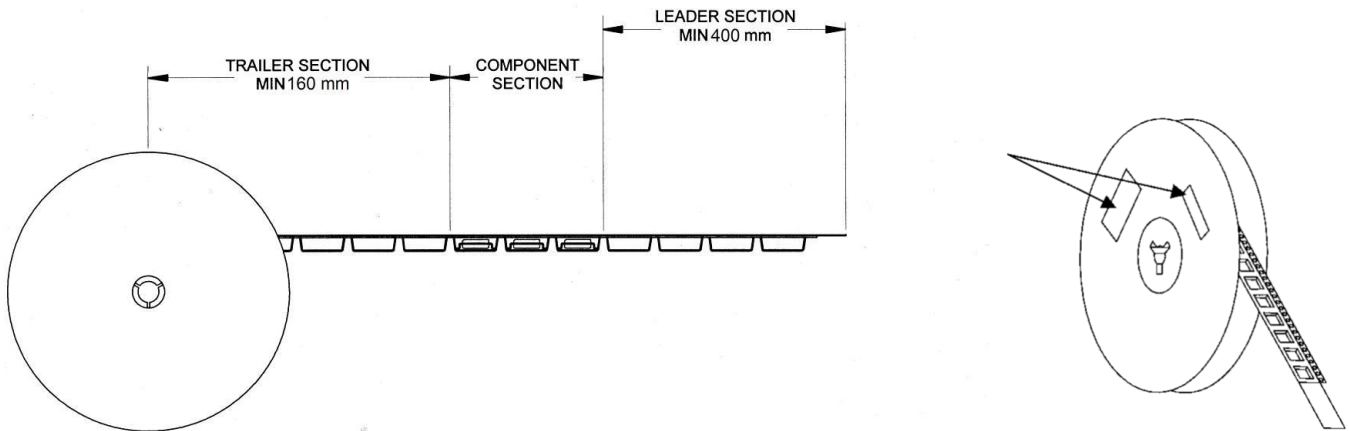
Tape and Reel Information – Reel Dimensions

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 | 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: 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 (C₁₅H₁₂Br₄O₂) Free
- SVHC Free



Contact Information

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

Web: www.qorvo.com

Tel: 1-844-890-8163

Email: customer.support@qorvo.com

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