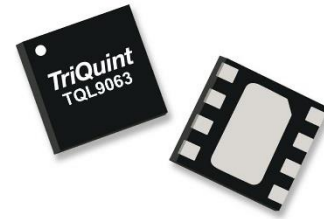


Product Overview

The TQL9063 is a high-linearity, ultra-low noise gain block amplifier with a bypass mode functionality integrated in the product. At 1.95 GHz, the amplifier typically provides 19 dB gain, +36.3 dBm OIP3, and 0.7 dB noise figure while drawing 77 mA current from a +5 V supply. The component also provides high linearity in the bypass mode with +39 dBm IIP3.

The TQL9063 is internally matched using a high-performance E-pHEMT process and only requires four external components for operation from a single positive supply: an external RF choke and blocking/bypass capacitors. This low noise amplifier contains an internal active bias to maintain high performance over temperature.

The TQL9063 covers the 0.5 – 4.0 GHz frequency band and is targeted for wireless infrastructure. The TQL9063 is packaged in a 2 x 2 mm DFN.

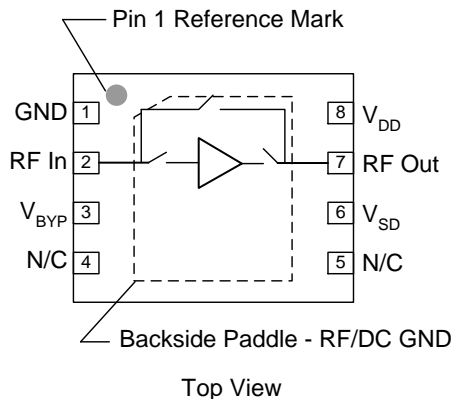


8-pin 2x2 mm DFN Package

Key Features

- 0.5 – 4.0 GHz Operational bandwidth
- LNA with integrated bypass mode
- Ability to turn LNA and bypass mode OFF
- Ultra low noise, 0.7 dB at 1.95 GHz
- 19 dB Gain at 1.95 GHz
- +36.3 dBm Output IP3 in LNA Mode
- +39 dBm Input IP3 in Bypass Mode
- Internally matched
- Positive supply only, +3.3 to +5 V
- 2x2 mm 8-pin DFN plastic package

Functional Block Diagram



Applications

- Base Station Receivers
- Tower Mount Amplifiers
- Repeaters
- FDD-LTE, TDD-LTE, WCDMA
- General Purpose Wireless

Ordering Information

| Part No. | Description |
|-------------|-------------------------------|
| TQL9063 | 500–4000 MHz Bypass LNA |
| TQL9063-PCB | 500–4000 MHz Evaluation Board |

Standard T/R size = 2500 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 | +22 dBm |
| Device Voltage (V _{DD}) | +7 V |

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

Recommended Operating Conditions

| Parameter | Min | Typ | Max | Units |
|--|------|------|-------|-------|
| Device Voltage (V _{CC}) | +3.3 | +5.0 | +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.

Electrical Specifications

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

| Parameter | Conditions | Min | Typ | Max | Units |
|---|--|------|-------|-----------------|-------|
| Operational Frequency Range | | 500 | | 4000 | MHz |
| Test Frequency | | | 1950 | | MHz |
| Gain | LNA ON, Bypass OFF | 17.5 | 19 | 20.5 | dB |
| Input Return Loss | LNA ON, Bypass OFF | | 12 | | dB |
| Output Return Loss | LNA ON, Bypass OFF | | 9.5 | | dB |
| Noise Figure | LNA ON, Bypass OFF | | 0.7 | 0.9 | dB |
| Output P1dB | LNA ON, Bypass OFF | | +21.2 | | dBm |
| Output IP3 | LNA ON, Bypass OFF, P _{out} =+0 dBm/tone, Δf=1 MHz | +31 | +36.3 | | dBm |
| Insertion Loss | LNA OFF, Bypass ON | | 1.4 | | dB |
| Return Loss | LNA OFF, Bypass ON | | 18 | | dB |
| Input IP3 | LNA OFF, Bypass ON P _{in} =+3 dBm/tone, Δf=1 MHz | | +39 | | dBm |
| Isolation | LNA OFF, Bypass OFF | | 17 | | dB |
| Control Voltage, V ₁ , V ₂ ⁽¹⁾ | V _{IH} | 1.6 | | V _{DD} | V |
| | V _{IL} | 0 | | 0.5 | V |
| Current, I _D | Bypass OFF | 60 | 77 | 100 | mA |
| | Bypass ON | | 3 | | mA |
| Switching Speed ⁽²⁾ | Bypass to LNA Mode | | 983 | | ns |
| | LNA to Bypass Mode | | 1.9 | | μs |
| | LNA to OFF | | 200 | | ns |
| Thermal Resistance, θ _{Jc} | Channel to case | | 44 | | °C/W |

Notes:

1. These voltages are reference at the turrets labelled V1 and V2 on the circuit schematic on page 3.
2. To achieve these fast switching speeds it is required to place a 91K shunt resistor at the RFout pin 7. Refer pg. 6.

Control Truth Table

| V _{BYP} | V _{SD} | State |
|------------------|-----------------|---------------------|
| 0 | 0 | LNA ON, Bypass OFF |
| 0 | 1 | LNA OFF, Bypass OFF |
| 1 | x | LNA OFF, Bypass ON |

De-embedded S-Parameters (LNA Mode)

Test Conditions: $V_{DD}=+5\text{ V}$, $I_{DD}=75\text{ mA}$ (typ.), $T=+25^{\circ}\text{C}$, unmatched 50 ohm system, calibrated to device leads

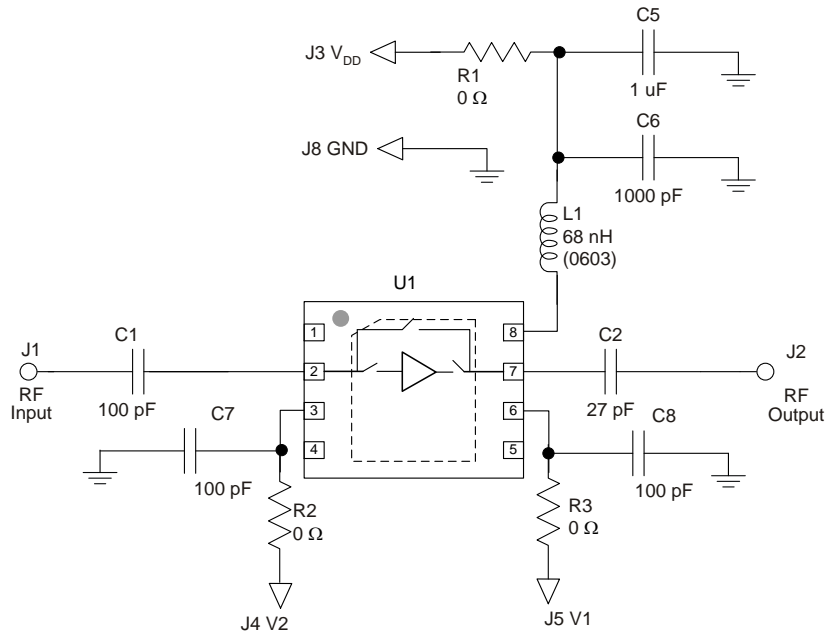
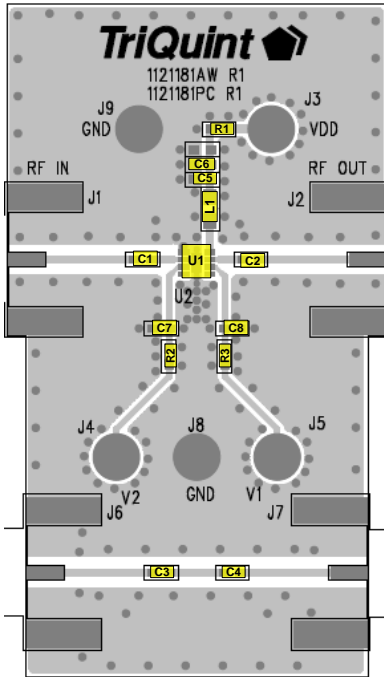
| Freq (GHz) | S11 (dB) | S11 (ang) | S21 (dB) | S21 (ang) | S12 (dB) | S12 (ang) | S22 (dB) | S22 (ang) |
|------------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| 0.1 | -0.34 | -18.46 | 10.47 | -40.24 | -49.61 | 153.06 | -0.20 | -49.20 |
| 0.3 | -2.46 | -56.16 | 25.14 | -126.62 | -33.50 | 92.83 | -4.56 | -154.92 |
| 0.4 | -4.03 | -65.89 | 26.03 | -156.47 | -31.84 | 74.30 | -8.52 | 162.29 |
| 0.6 | -5.84 | -77.87 | 25.55 | 166.99 | -30.62 | 57.06 | -14.43 | 89.93 |
| 0.7 | -6.38 | -83.02 | 25.03 | 154.63 | -30.24 | 52.96 | -15.50 | 58.24 |
| 0.8 | -6.80 | -87.84 | 24.47 | 144.39 | -29.91 | 50.25 | -15.55 | 32.10 |
| 1 | -7.45 | -96.37 | 23.34 | 127.97 | -29.31 | 47.05 | -14.41 | -4.20 |
| 1.2 | -7.92 | -103.39 | 22.23 | 114.95 | -28.74 | 45.37 | -13.04 | -27.33 |
| 1.3 | -8.11 | -106.38 | 21.70 | 109.30 | -28.47 | 44.80 | -12.41 | -36.16 |
| 1.4 | -8.27 | -109.05 | 21.18 | 104.07 | -28.20 | 44.35 | -11.83 | -43.80 |
| 1.5 | -8.41 | -111.43 | 20.67 | 99.21 | -27.93 | 43.96 | -11.30 | -50.53 |
| 1.6 | -8.52 | -113.55 | 20.18 | 94.65 | -27.67 | 43.62 | -10.81 | -56.56 |
| 1.7 | -8.62 | -115.44 | 19.69 | 90.36 | -27.42 | 43.31 | -10.36 | -62.02 |
| 1.8 | -8.71 | -117.11 | 19.23 | 86.30 | -27.17 | 43.01 | -9.95 | -67.01 |
| 1.9 | -8.78 | -118.58 | 18.77 | 82.44 | -26.92 | 42.72 | -9.57 | -71.62 |
| 2 | -8.83 | -119.88 | 18.33 | 78.75 | -26.68 | 42.42 | -9.22 | -75.91 |
| 2.1 | -8.88 | -121.03 | 17.90 | 75.22 | -26.45 | 42.13 | -8.90 | -79.92 |
| 2.2 | -8.91 | -122.03 | 17.48 | 71.83 | -26.22 | 41.83 | -8.60 | -83.70 |
| 2.3 | -8.93 | -122.92 | 17.07 | 68.57 | -26.00 | 41.51 | -8.33 | -87.26 |
| 2.4 | -8.94 | -123.69 | 16.66 | 65.42 | -25.78 | 41.19 | -8.08 | -90.64 |
| 2.5 | -8.94 | -124.36 | 16.27 | 62.37 | -25.56 | 40.86 | -7.85 | -93.86 |
| 2.6 | -8.92 | -124.95 | 15.89 | 59.42 | -25.35 | 40.52 | -7.64 | -96.93 |
| 2.7 | -8.91 | -125.47 | 15.52 | 56.55 | -25.15 | 40.17 | -7.45 | -99.87 |
| 2.8 | -8.88 | -125.92 | 15.15 | 53.76 | -24.95 | 39.81 | -7.27 | -102.69 |
| 3 | -8.80 | -126.67 | 14.45 | 48.39 | -24.56 | 39.06 | -6.97 | -108.03 |
| 3.2 | -8.69 | -127.26 | 13.77 | 43.26 | -24.18 | 38.26 | -6.73 | -113.00 |
| 3.4 | -8.56 | -127.74 | 13.12 | 38.32 | -23.82 | 37.41 | -6.53 | -117.68 |
| 3.6 | -8.41 | -128.16 | 12.50 | 33.56 | -23.46 | 36.52 | -6.39 | -122.10 |
| 3.8 | -8.24 | -128.54 | 11.90 | 28.94 | -23.12 | 35.57 | -6.30 | -126.30 |
| 4 | -8.05 | -128.93 | 11.32 | 24.43 | -22.78 | 34.56 | -6.26 | -130.29 |

Noise Parameters (LNA Mode)

Test conditions unless otherwise noted: $V_{DD}=+5\text{ V}$, $I_{DD}=75\text{ mA}$ (typ.), $\text{Temp}=+25^{\circ}\text{C}$, 50 Ohm system

| Freq (GHz) | NF _{min} (dB) | GammaOpt (mag) | GammaOpt (deg) | Rn (Ω) |
|------------|------------------------|----------------|----------------|--------|
| 1.5 | 0.46 | 0.27 | 73.07 | 3.17 |
| 1.6 | 0.47 | 0.27 | 76.39 | 3.15 |
| 1.7 | 0.47 | 0.28 | 79.57 | 3.14 |
| 1.8 | 0.48 | 0.28 | 82.63 | 3.12 |
| 1.9 | 0.49 | 0.29 | 85.57 | 3.11 |
| 2 | 0.50 | 0.29 | 88.39 | 3.10 |
| 2.1 | 0.50 | 0.30 | 91.10 | 3.08 |
| 2.2 | 0.51 | 0.31 | 93.70 | 3.07 |
| 2.3 | 0.52 | 0.31 | 96.20 | 3.06 |
| 2.4 | 0.53 | 0.32 | 98.60 | 3.04 |
| 2.5 | 0.54 | 0.33 | 100.91 | 3.03 |
| 2.6 | 0.55 | 0.33 | 103.13 | 3.02 |
| 2.7 | 0.56 | 0.34 | 105.27 | 3.00 |

TQL9063-PCB Evaluation Board



See Evaluation Board PCB Information section for PCB material and stack-up.

Bill of Material – TQL9063-PCB

| Reference Des. | Value | Description | Manuf. | Part Number |
|--------------------|------------|---------------------------------|-----------|---------------|
| U1 | n/a | Bypass LNA | Qorvo | TQL9063 |
| C2 | 27 pF | CAP, chip, 0402 | Various | |
| C1, C3, C4, C7, C8 | 100 pF | CAP, 0402, +/-5%, 50V | Panasonic | ECJ-0EC1H101J |
| C6 | 1000 pF | CAP, 0402 | various | |
| C5 | 1.0 uF | Cap., Chip, 0402, 10%, 10V, X5R | various | |
| R1, R2, R3 | 0 Ω | RES, 0402, +/-5%, 1/10W | various | |
| L1 | 68 nH | IND, 0603, +/-5% | Coilcraft | 0603CS-68NXJL |

Typical Performance (LNA Mode)

Test conditions unless otherwise noted: $V_{DD} = +5\text{ V}$, $V_1 = 0.5\text{ V}$, $V_2 = 0.5\text{ V}$, $I_D = 77\text{ mA}$, $\text{Temp.} = +25\text{ }^\circ\text{C}$.

| Parameter | Typical Value | | | | Units |
|---|---------------|-------|-------|-------|-------|
| Frequency | 700 | 1950 | 2600 | 3500 | MHz |
| Gain | +24.3 | 19.2 | 17.3 | 14 | dB |
| Noise Figure | 0.64 | 0.7 | 0.8 | 1.1 | dB |
| Input Return Loss | 7.8 | 12 | 15.3 | 13.7 | dB |
| Output Return Loss | 9.4 | 9.3 | 9.5 | 6 | dB |
| OIP3 (Pout/tone=+0 dBm, $\Delta f = 1\text{ MHz}$) | +35.5 | +36.3 | +36.1 | +36.4 | dBm |
| P1dB | +21.7 | +21.2 | +21.6 | +19.8 | dBm |

Typical Performance (Bypass Mode)

Test conditions unless otherwise noted: $V_{DD} = +5\text{ V}$, $V_1 = 0.5\text{ V}$ or 1.6 V , $V_2 = 1.6\text{ V}$, $I_d = 3\text{ mA}$, $\text{Temp.} = +25\text{ }^\circ\text{C}$.

| Parameter | Typical Value | | | | Units |
|---|---------------|------|------|-------|-------|
| Frequency | 700 | 1950 | 2600 | 3500 | MHz |
| Insertion Loss | 1.2 | 1.4 | 1.5 | 1.6 | dB |
| Input Return Loss | 13.6 | 20 | 25 | 20 | dB |
| Output Return Loss | 13.6 | 18 | 18 | 17 | dB |
| Input IP3 (Pin/tone=+3 dBm, $\Delta f = 1\text{ MHz}$) | +38.2 | +39 | +39 | +36.6 | dBm |

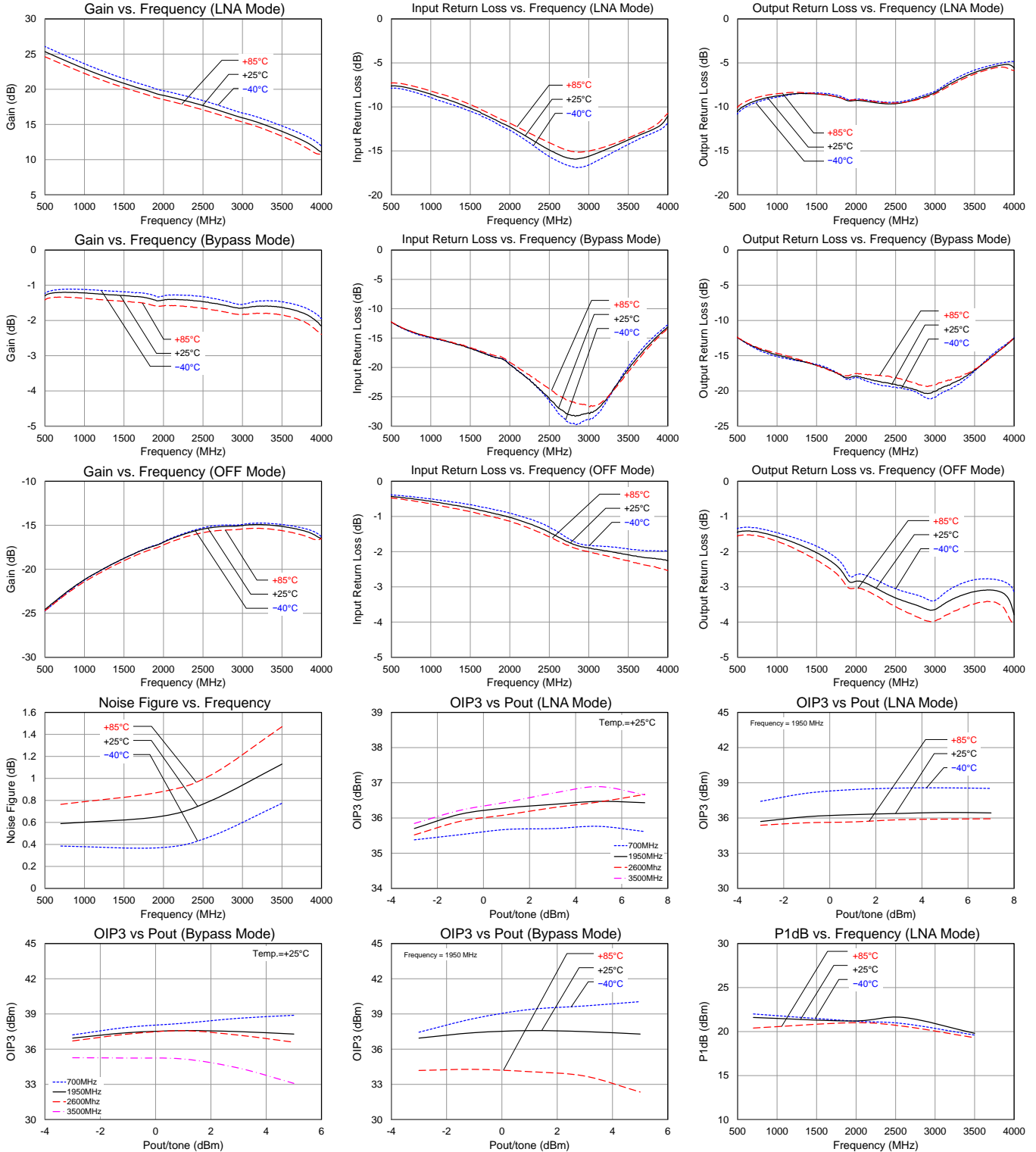
Typical Performance (LNA OFF, Bypass OFF Mode)

Test conditions unless otherwise noted: $V_{DD} = +5\text{ V}$, $V_1 = 1.6\text{ V}$, $V_2 = 0.5\text{ V}$, $\text{Temp.} = +25\text{ }^\circ\text{C}$.

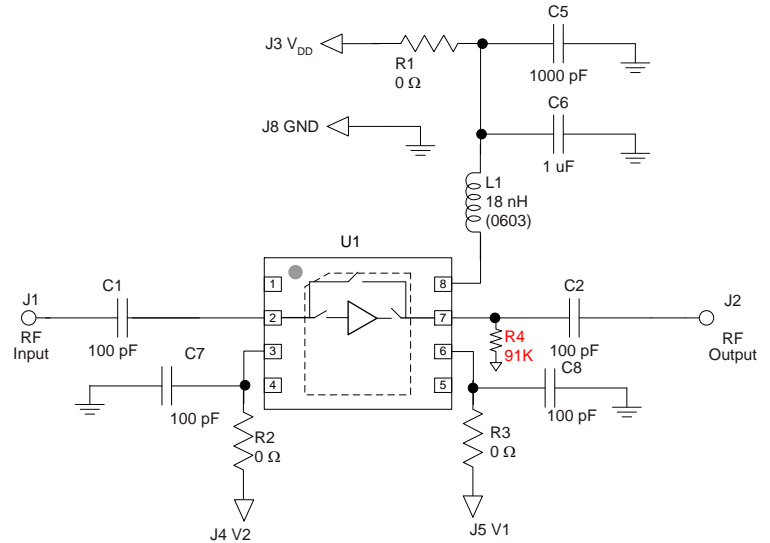
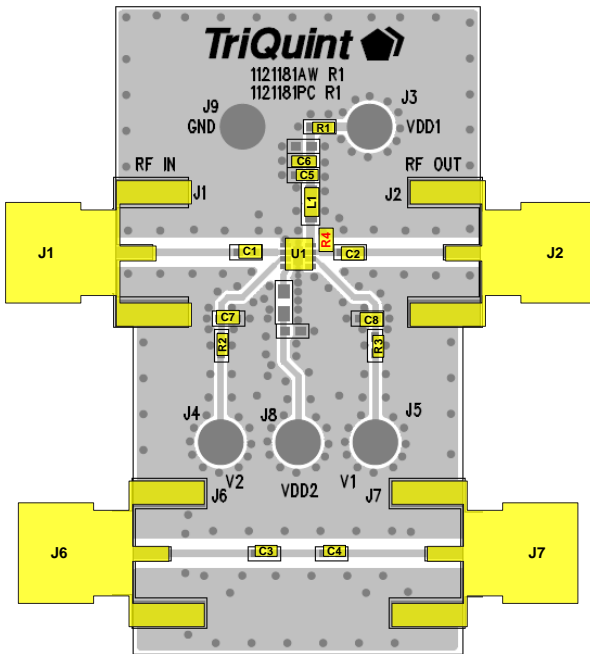
| Parameter | Typical Value | | | | Units |
|-----------|---------------|------|------|------|-------|
| Frequency | 700 | 1950 | 2600 | 3500 | MHz |
| Isolation | 23 | 17 | 15 | 15 | dB |

Performance Plots

Test conditions unless otherwise noted: $V_{DD} = +5\text{ V}$

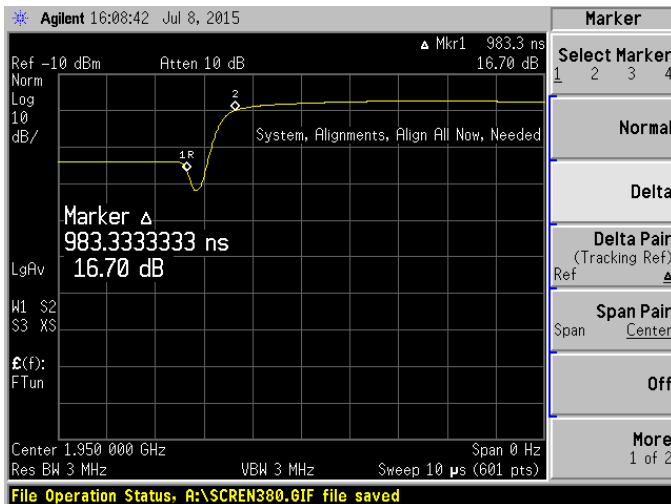


Switching Speed

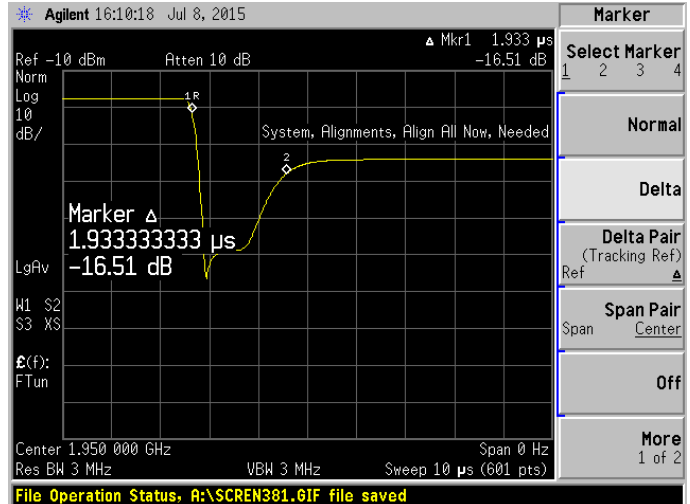


| Transition | Value | Units |
|--------------------|-------|-------|
| Bypass to LNA mode | 983 | ns |
| LNA to Bypass mode | 1.9 | μs |

R4, valued 91K, is required to achieve the fast switching speeds listed above. The placement of R4 is shown on the Qorvo EVB above.

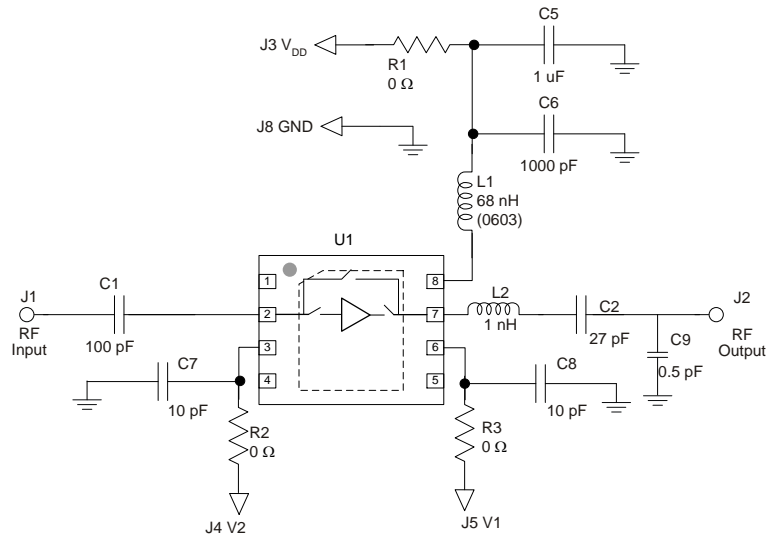
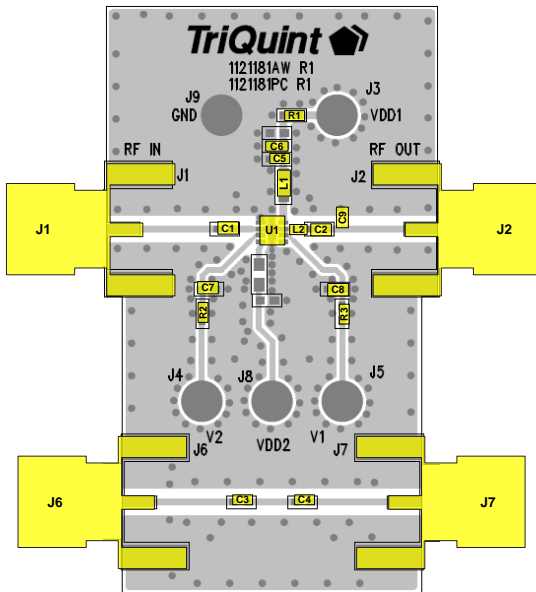


Bypass to LNA mode transition



LNA to Bypass mode transition

TQL9063 – Optimized Return Loss Tune



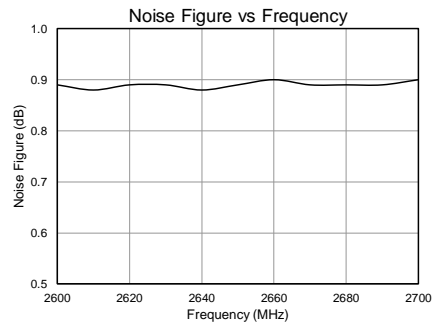
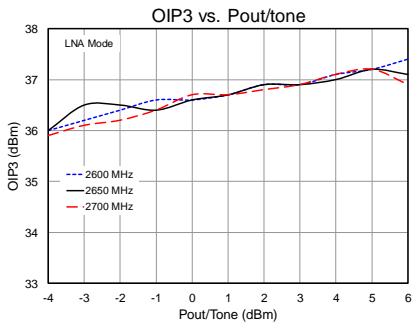
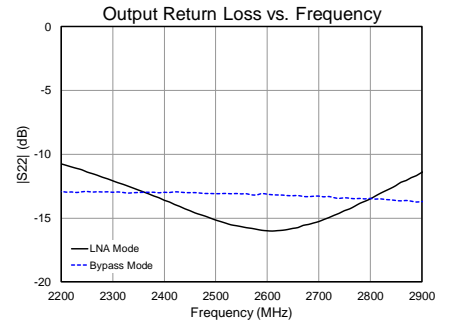
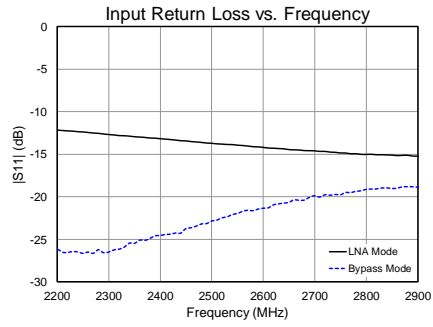
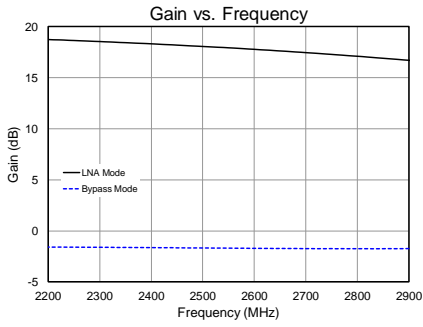
See Evaluation Board PCB Information section for PCB material and stack-up.

Bill of Material – Optimized Return Loss Tune

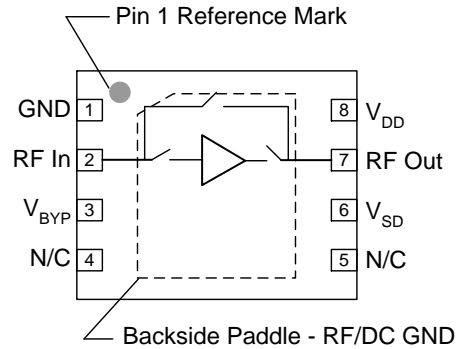
| Reference Des. | Value | Description | Manuf. | Part Number |
|----------------|---------|---------------------------------|-----------|--------------------|
| U1 | n/a | Bypass LNA | Qorvo | TQL9063 |
| C2 | 27 pF | CAP, chip, 0402 | Various | |
| C1, C3, C4 | 100 pF | CAP, 0402, +/-5%, 50V | Panasonic | ECJ-0EC1H101J |
| C6 | 1000 pF | CAP, 0402 | various | |
| C5 | 1.0 uF | Cap., Chip, 0402, 10%, 10V, X5R | various | |
| C9 | 0.5 pF | Cap. Chip, 0402, +/-0.1pF, 50V | Murata | GJM1555C1HR50BB01D |
| R1, R2, R3 | 0 Ω | RES, 0402, +/-5%, 1/10W | various | |
| L1 | 68 nH | IND, 0603, +/-5% | Coilcraft | 0603CS-68NXJL |
| L2 | 1 nH | IND, chip, +/-0.1nH | Murata | LQP15MN1N0B |

Performance Plots- Optimized Return Loss

Test conditions unless otherwise noted: $V_{DD} = +5\text{ V}$



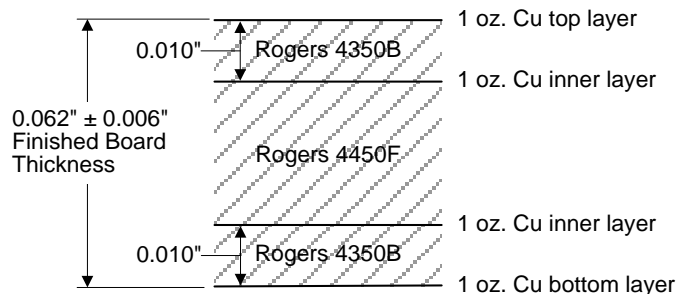
Pin Configuration and Description



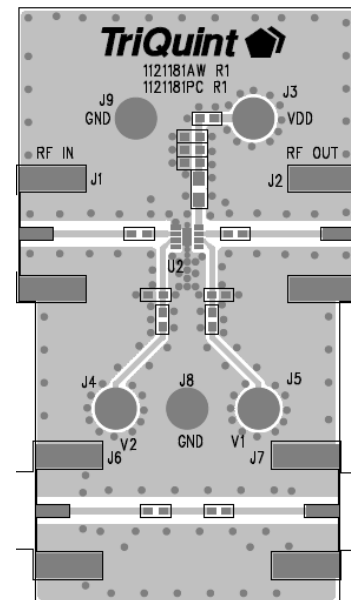
| Pin No. | Label | Description |
|-----------------|------------------|---|
| 1 | GND | RF/DC Ground pin. |
| 2 | RFin | RF input pin. DC block required. |
| 3 | V _{BYP} | Control pin for bypass mode. The LNA is automatically turned off when the bypass mode is activated. Refer to truth table. |
| 4, 5 | N/C | No internal connection. Provide grounded PCB land pads for mounting integrity. |
| 6 | V _{SD} | Control pin to disable the LNA. Refer to truth table. |
| 7 | RFout | RF output pin. DC block required. |
| 8 | V _{DD} | Supply voltage pin. |
| Backside Paddle | RF/DC GND | RF/DC Ground. Follow recommended via pattern and ensure good solder attach for best thermal and electrical performance. |

Evaluation Board PCB Information

Qorvo PCB 1121181 Material and Stack-up

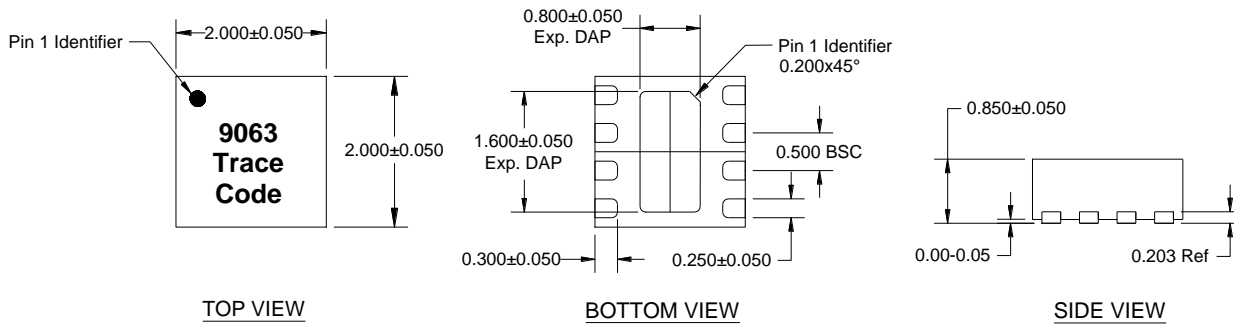


50 ohm line dimensions: width = .020", spacing = .032"



Mechanical Information

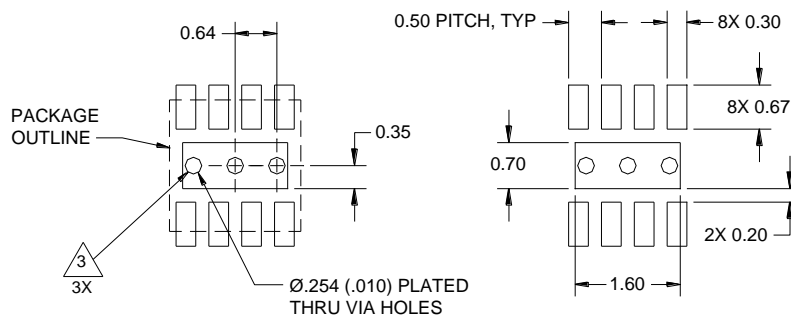
Package Marking and Dimensions



NOTES:

1. All dimensions are in millimeters. Angles are in degrees.
2. Except where noted, this part outline conforms to JEDEC standard MO-229.
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 0.35mm (#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.

Handling Precautions

| Parameter | Rating | Standard |
|----------------------------------|---------|--------------------------|
| ESD – Human Body Model (HBM) | 1B | ESDA / JEDEC JS-001-2012 |
| ESD – Charged Device Model (CDM) | C3 | JEDEC JESD22-C101F |
| MSL – Moisture Sensitivity Level | Level 1 | 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 the 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:

- Product uses RoHS Exemption 7c-I to meet RoHS Compliance requirements.
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C₁₅H₁₂Br₄O₂) Free
- PFOS 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

For technical questions and application information:

Email: appsupport@qorvo.com

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- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

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