

Applications

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

Product Features

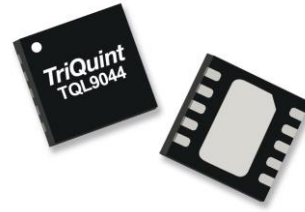
- 1.5 – 4.0 GHz Operational bandwidth
- LNA with integrated bypass mode
- Ability to turn LNA and bypass mode OFF
- Ultra low noise, 0.6 dB at 1.9 GHz
- 19.4 dB Gain at 1.9 GHz
- +34.5 dBm Output IP3 in LNA Mode
- +36 dBm Input IP3 in Bypass Mode
- Internally matched
- Positive supply only, +3.3 to +5 V
- 3x3 mm 10-pin DFN plastic package

General Description

The TQL9044 is a high-linearity, ultra-low noise gain block amplifier with a bypass mode functionality integrated in the product. At 1.9 GHz, the amplifier typically provides 19.4 dB gain, +34.5 dBm OIP3, and 0.6 dB noise figure while drawing 70 mA current from a +5 V supply. The component also provides high linearity in the bypass mode with +36 dBm IIP3.

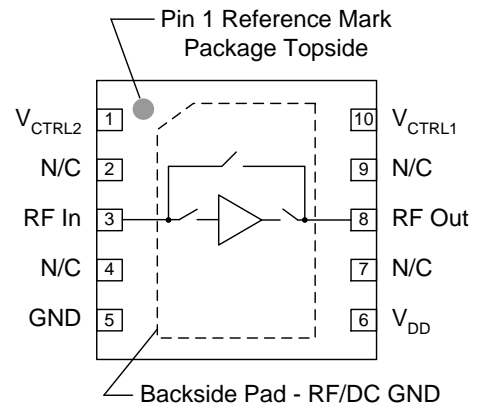
The TQL9044 is internally matched using a high performance E-pHEMT process and only requires four external components for operation from a single positive supply: an external RF choke and blocking/bypass capacitors. This low noise amplifier contains an internal active bias to maintain high performance over temperature.

The TQL9044 covers the 1.5–4.0 GHz frequency band and is targeted for wireless infrastructure. The TQL9044 is packaged in a 3x3 mm and is pin compatible with the 0.5–2.0 GHz TQL9042 and 1.5–2.7GHz TQL9043.



10-pin 3x3 mm DFN Package

Functional Block Diagram



Pin Configuration

| Pin No. | Label |
|-----------------|--------------------|
| 1 | V _{CTRL2} |
| 2, 4, 7, 9 | N/C |
| 3 | RF _{In} |
| 5 | GND |
| 6 | V _{DD} |
| 8 | RF _{Out} |
| 10 | V _{CTRL1} |
| Backside Paddle | RF/DC GND |

Ordering Information

| Part No. | Description |
|-------------|--------------------------------|
| TQL9044 | Ultra Low Noise Bypass LNA |
| TQL9044-PCB | 1500–4000 MHz Evaluation Board |

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

Absolute Maximum Ratings

| Parameter | Rating |
|----------------------------------|---------------|
| Storage Temperature | -65 to 150 °C |
| Drain Voltage (V _{DD}) | +7 V |
| Input Power (CW) | +22 dBm |

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

Recommended Operating Conditions

| Parameter | Min | Typ | Max | Units |
|---|------|------|-------|-------|
| Drain Voltage (V _{DD}) | +3.3 | +5.0 | +5.25 | V |
| Operating Temp. Range | -40 | | +105 | °C |
| T _{ch} (for >10 ⁶ hrs 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 | | 1500 | | 4000 | MHz |
| Test Frequency | | | 2600 | | MHz |
| Gain | LNA ON, Bypass OFF | 15.5 | 17.0 | 18.5 | dB |
| Input Return Loss | LNA ON, Bypass OFF | | 6.6 | | dB |
| Output Return Loss | LNA ON, Bypass OFF | | 10 | | dB |
| Noise Figure | LNA ON, Bypass OFF | | 0.8 | 1.1 | dB |
| Output P1dB | LNA ON, Bypass OFF | | +20 | | dBm |
| Output IP3 | LNA ON, Bypass OFF, P _{out} =+5 dBm/tone, Δf=1 MHz | +30 | +34.3 | | dBm |
| Insertion Loss | LNA OFF, Bypass ON | | 1.3 | 1.9 | dB |
| Return Loss | LNA OFF, Bypass ON | | 15 | | dB |
| Input IP3 | LNA OFF, Bypass ON Pin=+6 dBm/tone, Δf=1 MHz | | +35.6 | | dBm |
| Isolation | LNA OFF, Bypass OFF | | 13 | | dB |
| Control Voltage, V ₁ , V ₂ ⁽¹⁾ | V _{IH} | 2.4 | | V _{DD} | V |
| | V _{IL} | 0 | | 0.4 | V |
| Current, I _D | Bypass OFF | | 70 | 110 | mA |
| | Bypass ON | | 3 | 4.5 | mA |
| Switching Speed | Bypass to LNA Mode | | 683 | 1100 | ns |
| | LNA to Bypass Mode | | 250 | 600 | ns |
| Thermal Resistance, θ _{jc} | Channel to case | | 54 | | °C/W |

Notes:

1. These voltages are reference at the turrets labelled V1 and V2 on the circuit schematic on page 3.

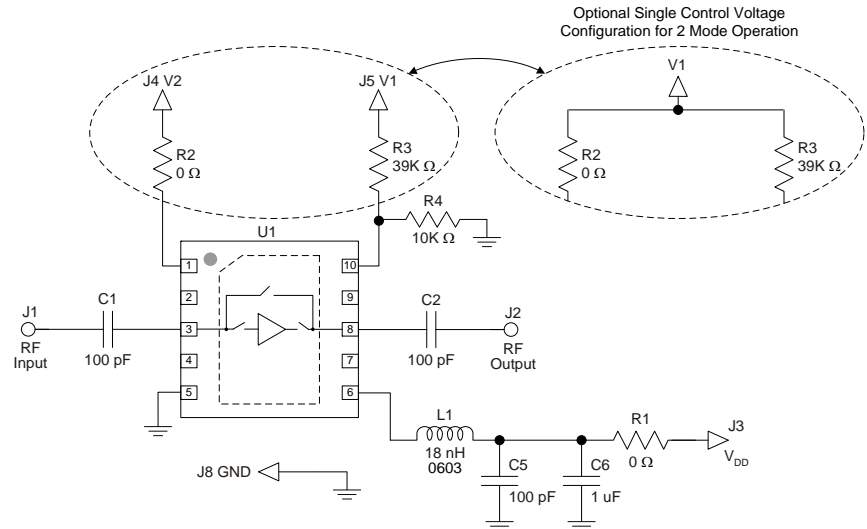
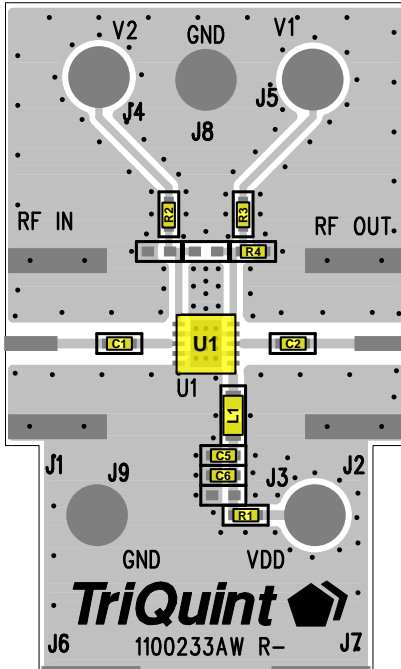
Control Truth Table

| V _{CTRL2} | V _{CTRL1} | State |
|--------------------|--------------------|-----------------------|
| Low | High | LNA OFF, Bypass OFF |
| High | High | LNA OFF, Bypass ON |
| Low | Low | LNA ON, Bypass OFF |
| High | Low | Reserved (Do not use) |

Control Voltage Limits (at device pins)

| | State | Bias Condition |
|--------------------|-------|----------------|
| V _{ctrl1} | Low | ≤ 0.1 V |
| | High | ≥ 0.52 V |
| V _{ctrl2} | Low | ≤ 0.4 V |
| | High | ≥ 1.3 V |

TQL9044-PCB Evaluation Board



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

Note: If a TQL9044 application requires only two operational modes, LNA and bypass, the modes may be set using a single control voltage with the control lines tied together as shown above right. The corresponding truth table is shown below.

Control Truth Table – 2 Mode Operation

| V ₁ | State |
|----------------|--------------------|
| 1 | LNA OFF, Bypass ON |
| 0 | LNA ON, Bypass OFF |

Bill of Material – TQL9044-PCB

| Reference Des. | Value | Description | Manuf. | Part Number |
|--------------------|--------|---------------------------------|-----------|---------------|
| U1 | n/a | Bypass LNA | Qorvo | TQL9044 |
| C1, C2, C3, C4, C5 | 100 pF | CAP, 0402, +/-5%, 50V | Panasonic | ECJ-0EC1H101J |
| C6 | 1.0 uF | Cap., Chip, 0402, 10%, 10V, X5R | various | |
| R1, R2 | 0 Ω | RES, 0402, +/-5%, 1/10W | various | |
| R3 | 39K | RES, 0402, +/-5%, 1/10W | various | |
| R4 | 10K | RES, 0402, +/-5%, 1/10W | various | |
| L1 | 18 nH | IND, 0603, +/-5% | Coilcraft | 0603CS-18NXJL |

Power-up and Power-down Sequencing

| | | V _{DD} | V _{CTRL1} & V _{CTRL2} |
|--------------------|------------|-----------------|---|
| LNA ON, Bypass OFF | Power-up | 1 st | 2 nd |
| | Power-down | 1 st | 2 nd |
| LNA OFF, Bypass ON | Power-up | 1 st | 2 nd |
| | Power-down | 1 st | 2 nd |

Typical Performance (LNA Mode)

Test conditions unless otherwise noted: $V_{DD} = +5\text{ V}$, $I_D = 70\text{ mA}$, $Temp. = +25\text{ }^\circ\text{C}$.

| Parameter | Typical Value | | | | | | Units |
|---|---------------|-------|-------|-------|-------|-------|-------|
| Frequency | 1700 | 1900 | 2300 | 2500 | 2600 | 2700 | MHz |
| Gain | 20.2 | 19.4 | 18 | 17.3 | 17 | 16.7 | dB |
| Noise Figure | 0.55 | 0.6 | 0.63 | 0.7 | 0.8 | 0.8 | dB |
| Input Return Loss | 6.0 | 6.2 | 6.4 | 6.4 | 6.6 | 6.6 | dB |
| Output Return Loss | 9.8 | 9.8 | 9.9 | 10 | 10.1 | 10.2 | dB |
| Output P1dB | +19.8 | +20.4 | +20 | +20 | +19.9 | +19.8 | dBm |
| OIP3 (Pout/tone=+5 dBm, $\Delta f = 1\text{ MHz}$) | +34.6 | +34.5 | +34.5 | +34.5 | +34.3 | +34.8 | dBm |

Typical Performance (Bypass Mode)

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

| Parameter | Typical Value | | | | | | Units |
|---|---------------|-------|-------|-------|-------|-------|-------|
| Frequency | 1700 | 1900 | 2300 | 2500 | 2600 | 2700 | MHz |
| Insertion Loss | 1 | 1 | 1.1 | 1.2 | 1.3 | 1.4 | dB |
| Input Return Loss | 16.3 | 16 | 15.6 | 15.5 | 15.4 | 15.1 | dB |
| Output Return Loss | 19.2 | 19.8 | 19.6 | 19.7 | 19.4 | 19 | dB |
| Input IP3 (Pin/tone=+6 dBm, $\Delta f = 1\text{ MHz}$) | +36.1 | +36.2 | +36.4 | +35.1 | +35.6 | +35.5 | dBm |

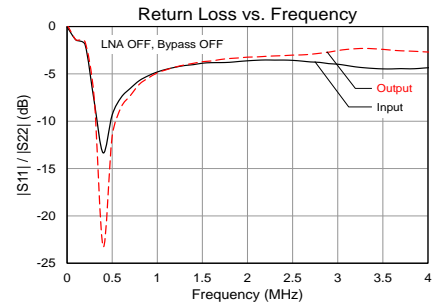
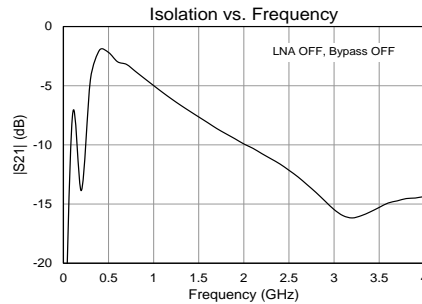
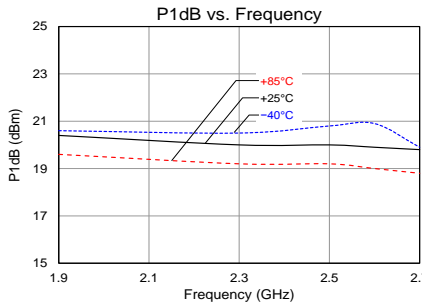
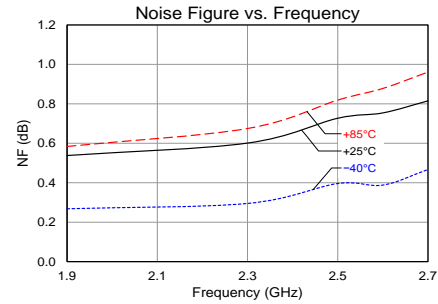
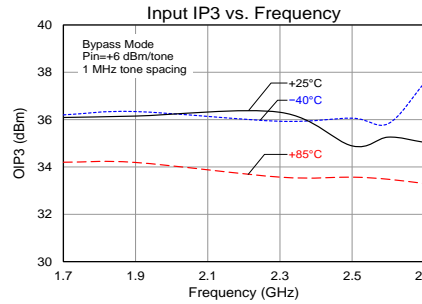
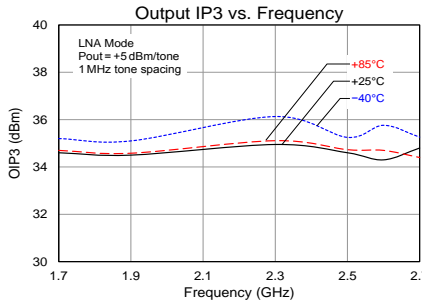
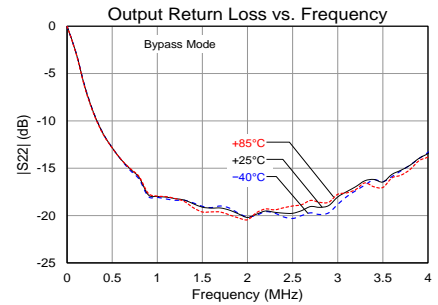
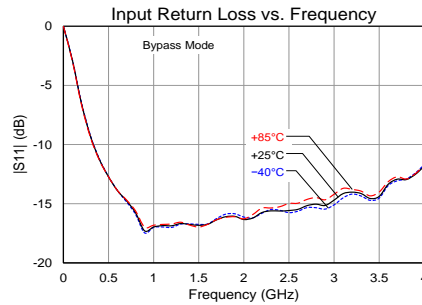
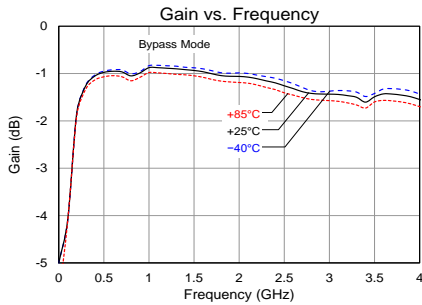
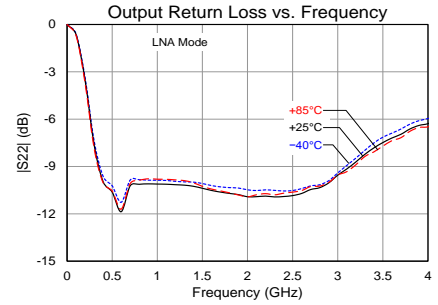
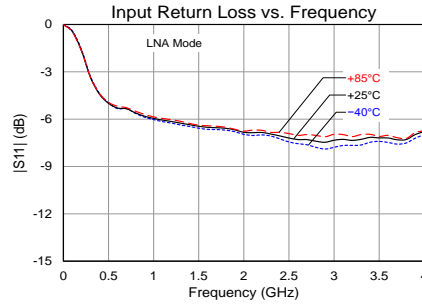
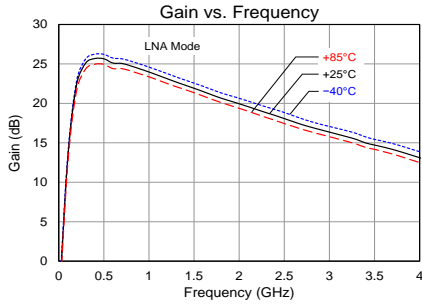
Typical Performance (LNA OFF, Bypass OFF Mode)

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

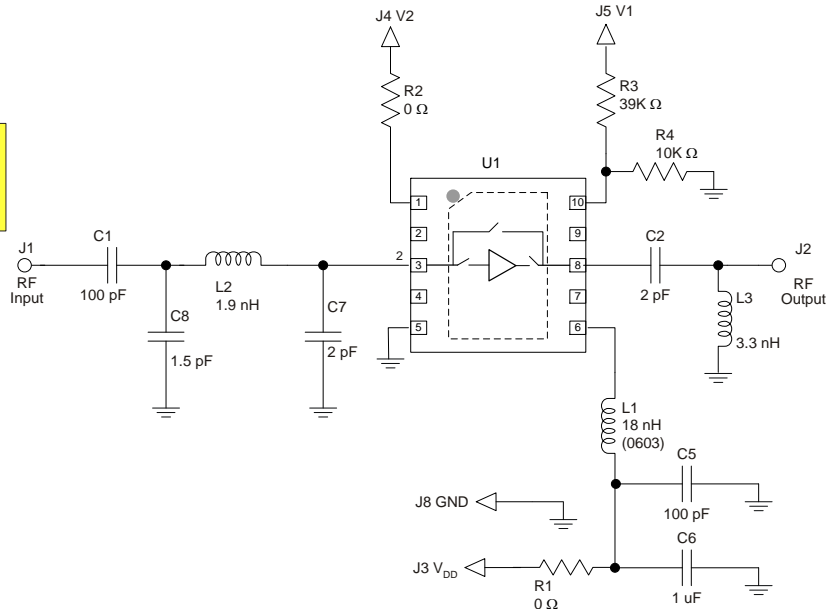
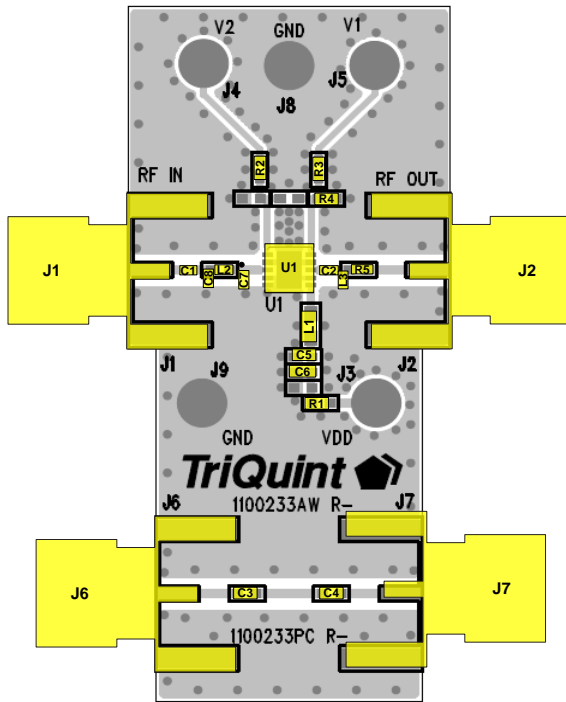
| Parameter | Typical Value | | | | | | Units |
|-----------|---------------|------|------|------|------|------|-------|
| Frequency | 1700 | 1900 | 2300 | 2500 | 2600 | 2700 | MHz |
| Isolation | 8.7 | 9.5 | 11.2 | 12.2 | 13 | 13.5 | dB |

Performance Plots

Test conditions unless otherwise noted: $V_{DD} = +5\text{ V}$, $I_D = 70\text{ mA}$



Reference Design – 2.3 – 2.7 GHz Optimized Return Loss

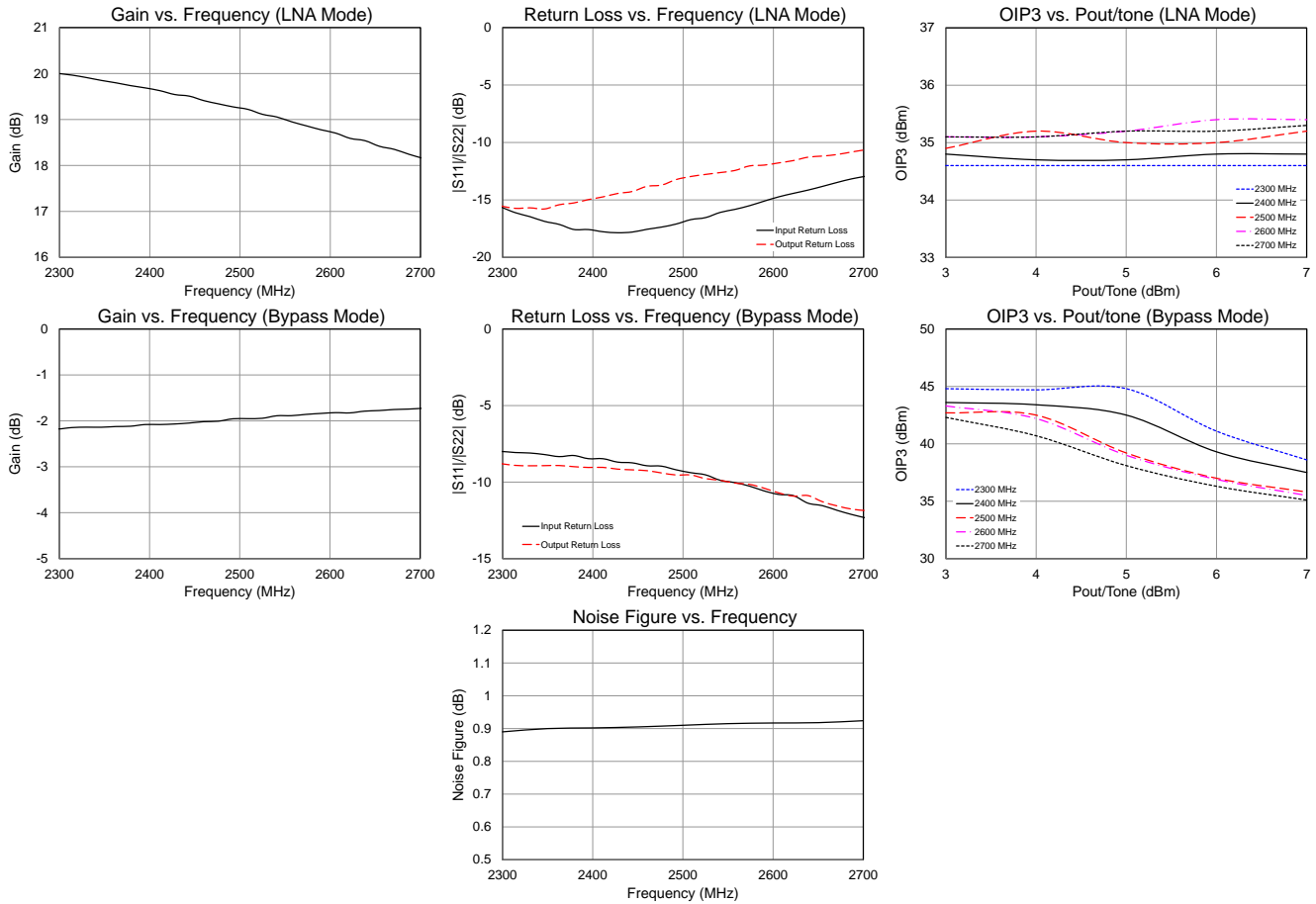


Bill of Material

| Reference Desg. | Value | Description | Manufacturer | Part Number |
|-----------------|--------|-----------------|--------------|----------------|
| U1 | | Bypass LNA | Qorvo | TQL9044 |
| C1, C3, C4, C5 | 100 pF | Cap, chip, 0402 | various | |
| C2, C7 | 2 pF | Cap, chip, 0402 | AVX | 04023J2R0BBSTR |
| C8 | 1.5 pF | Cap, chip, 0402 | AVX | 04023J2R0BBSTR |
| C6 | 0.1 uF | Cap, chip, 0402 | various | |
| L1 | 18 nH | Ind, chip, 0603 | Coilcraft | 0603CS-18NXJL |
| L2 | 1.9 nH | Ind, chip, 0402 | Coilcraft | 0402CS-1N9XJL |
| L3 | 3.3 nH | Ind, chip, 0402 | Coilcraft | 0402CS-3N3XJL |
| R1, R2 | 0 Ω | Res, Chip, 0402 | various | |
| R3 | 39 KΩ | Res, chip, 0402 | various | |
| R4 | 10 KΩ | Res, chip, 0402 | various | |

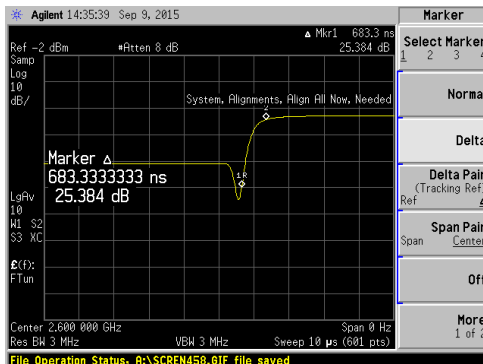
Performance Plots: 2.3 – 2.7 GHz Optimized Return Loss Reference Design

Test conditions unless otherwise noted: $V_{DD} = +5\text{ V}$, $I_D = 80\text{ mA}$

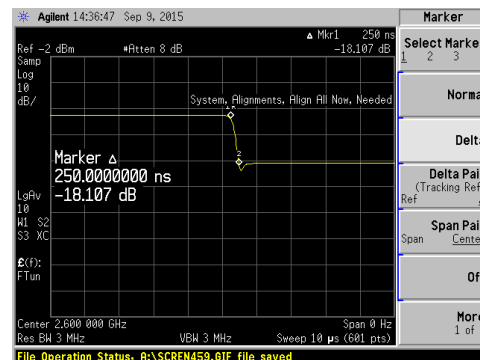


Switching Speed

| Transition | Value | Units |
|--------------------|-------|-------|
| Bypass to LNA mode | 683 | ns |
| LNA to Bypass mode | 250 | ns |

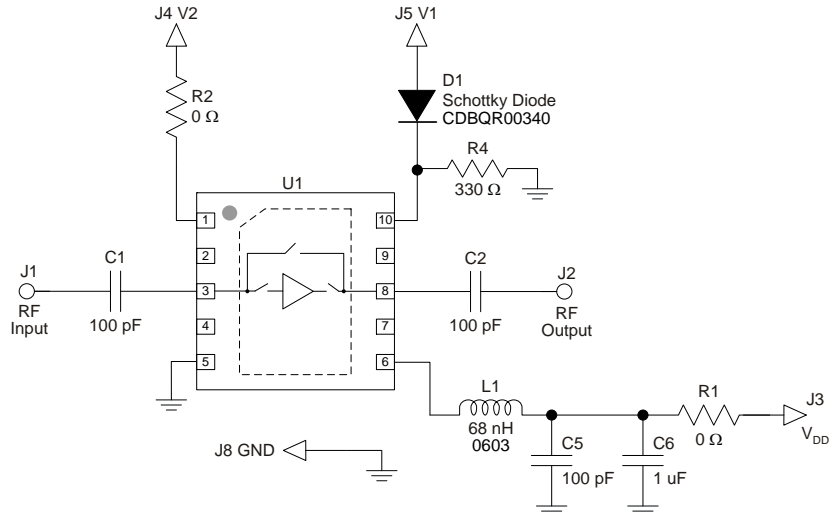
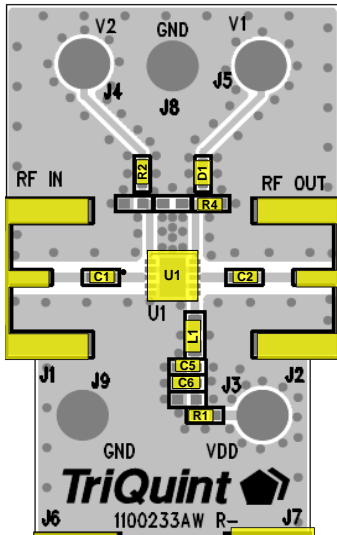


Bypass to LNA mode transition



LNA to Bypass mode transition

TQL9042-PCB for 1.8V TTL Compatibility



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

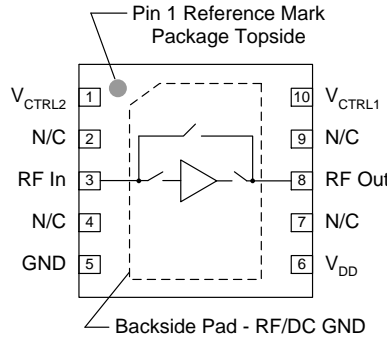
Note:
The control voltage limit for Vctrl1 shown in the table in the bottom right corner of pg. 2 cannot be met with a simple resistive divider network at pin 10 when using a 1.8V TTL logic level. A solution is to use a diode drop as shown above. This guarantees a voltage at pin 10 which is $\geq 0.52V$.

| Parameter | Conditions | Min | Max | Units |
|--|-----------------|-----|-----|-------|
| Control Voltage, V ₁ , V ₂ | V _{IH} | 1.4 | 1.8 | V |
| | V _{IL} | 0 | 0.4 | V |

Bill of Material – TQL9042-PCB

| Reference Des. | Value | Description | Manuf. | Part Number |
|--------------------|--------|--------------------------|-----------|---------------|
| U1 | n/a | Bypass LNA | Qorvo | TQL9044 |
| C1, C2, C3, C4, C5 | 100 pF | CAP, 0402, +/-5%, 50V | Panasonic | ECJ-0EC1H101J |
| C6 | 1.0 uF | CAP, 0402, 10%, 10V, X5R | various | |
| R1, R2 | 0 Ω | RES, 0402, +/-5%, 1/10W | Various | |
| D1 | n/a | Schottky Barrier Diode, | Comchip | CDBQR00340 |
| R4 | 330 Ω | RES, 0402, +/-5%, 1/10W | Various | |
| L1 | 68 nH | IND, 0603, +/-5%, 600mA | Coilcraft | 0603CS-68NXJL |

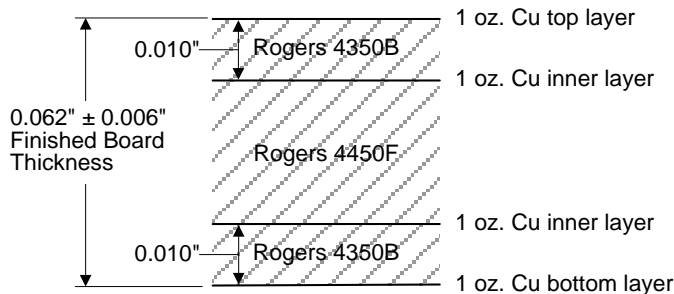
Pin Configuration and Description



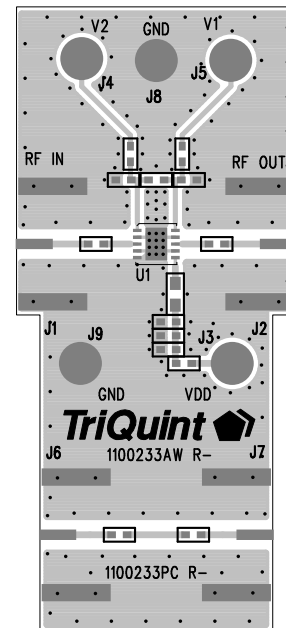
| Pin No. | Label | Description |
|-----------------|--------------------|---|
| 1 | V _{CTRL2} | Control pin for bypass mode and LNA mode. Internal resistor divider. Refer to truth table. |
| 2, 4, 7, 9 | N/C | No internal connection. Provide grounded PCB land pads for mounting integrity. |
| 3 | RFin | RF input pin. DC block required. |
| 5 | GND | RF/DC Ground pin. |
| 6 | V _{DD} | Supply voltage pin. |
| 8 | RFout | RF output pin. DC block required. |
| 10 | V _{CTRL1} | Control pin for bypass mode and LNA mode. Requires external resistor divider. Refer to truth table. |
| 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 1100233 Material and Stack-up



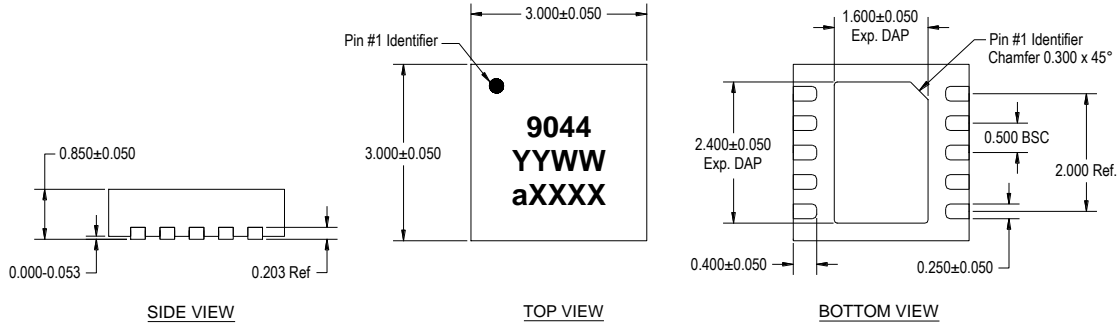
50 ohm line dimensions: width = .020", spacing = .032"



Mechanical Information

Package Marking and Dimensions

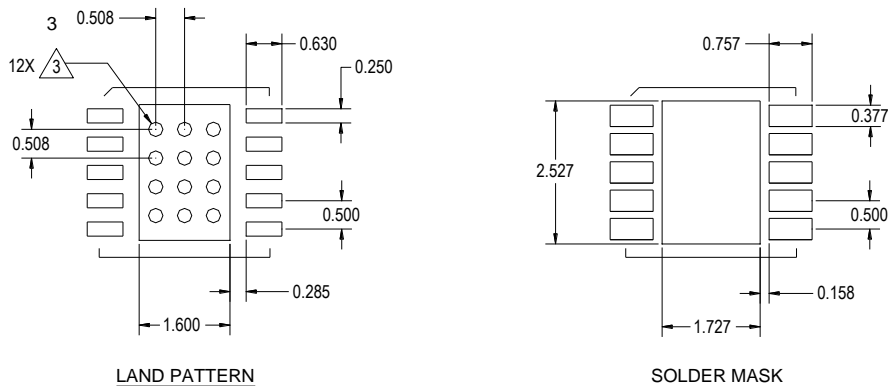
Marking: Part number – 9044
Year/Week – YYWW
Lot Code – aXXXX



NOTES:

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



Caution! ESD-Sensitive Device

ESD Rating: Class 1A
Voltage: $\geq 250V$ to 500V
Test: Human Body Model (HBM)
Standard: JEDEC Standard JS-001-2012

ESD Rating: Class C3
Value: $\geq 1000 V$
Test: Charged Device Model (CDM)
Standard: JEDEC Standard JESD22-C101F

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: NiPdAu

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 (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free

Contact Information

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

Web: www.triquint.com **Tel:** 877-800-8584
Email: customer.support@qorvo.com

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

Web: www.qorvo.com

For technical questions and application information:

Email: sjcapplcations.engineering@qorvo.com

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- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



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