

Applications

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

Product Features

- 500–2000 GHz Operational Bandwidth
- LNA with Integrated Bypass Mode
- Ability To Turn LNA and Bypass Mode OFF
- Ultra Low Noise, 0.42 dB at 900 MHz
- 19 dB Gain
- +36 dBm Output IP3
- +43 dBm Input IP3 in Bypass Mode
- Internally Matched
- Positive Supply Only, +3.3 to +5 V
- 3 x 3 mm 10-pin DFN Plastic Package

General Description

The TQL9042 is a high-linearity, ultra-low noise gain block amplifier with a bypass mode functionality integrated in the product. At 900 MHz, the amplifier typically provides 19 dB gain, +36 dBm OIP3, and 0.42 dB noise figure while drawing 70 mA current from a +5 V supply. The component also provides high linearity in the bypass mode with +43 dBm IIP3.

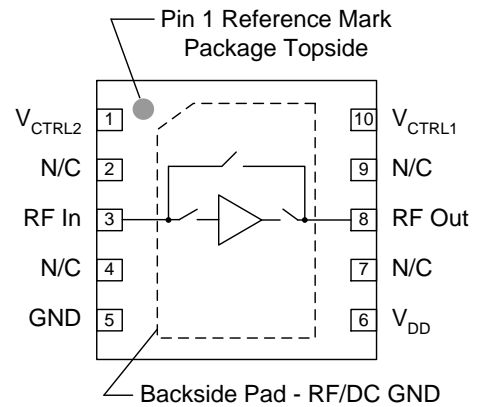
The TQL9042 is internally matched using a high performance E-pHEMT process and only requires four external components for operation from a single positive supply: an external RF choke and blocking/bypass capacitors. This low noise amplifier contains an internal active bias to maintain high performance over temperature.

The TQL9042 covers the 500–2000 MHz frequency band and is targeted for wireless infrastructure. The TQL9042 is packaged in a 3x3mm and is pin compatible with the 1.5–2.7 GHz TQL9043 and 1.5–4.0 GHz TQL9044.



10-pin 3 x 3 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 |
|-------------|-------------------------|
| TQL9042 | 500–2000 MHz Bypass LNA |
| TQL9042-PCB | 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 | | 500 | | 2000 | MHz |
| Test Frequency | | | 900 | | MHz |
| Gain | Bypass OFF | 17.5 | 19 | 20.5 | dB |
| Input Return Loss | Bypass OFF | | 11 | | dB |
| Output Return Loss | Bypass OFF | | 20 | | dB |
| Noise Figure | Bypass OFF | | 0.42 | 0.8 | dB |
| Output P1dB | Bypass OFF | | +23 | | dBm |
| Output IP3 | Bypass OFF, P _{out} =+5 dBm/tone, Δf=1 MHz | +30 | +36 | | dBm |
| Insertion Loss | Bypass ON | | 1 | 1.9 | dB |
| Return Loss | Bypass ON | | 13 | | dB |
| Input IP3 | Bypass ON P _{in} =+6 dBm/tone, Δf=1 MHz | | +43 | | dBm |
| Isolation | LNA OFF, Bypass OFF | | -8.5 | | 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 | 40 | 70 | 110 | mA |
| | Bypass ON | | 3 | 4.5 | mA |
| Switching Speed ⁽²⁾ | Bypass to LNA Mode | | 483 | 900 | ns |
| | LNA to Bypass Mode | | 400 | 800 | ns |
| Thermal Resistance, θ _{jc} | Channel to case | | 100 | | °C/W |

Notes:

- The limits shown are true when using the external resistive divider values as shown on the Qorvo app board.
- To achieve these fast switching speeds it is required to place a shunt 30K resistor at the RFout pin 8. Refer to pg. 6.

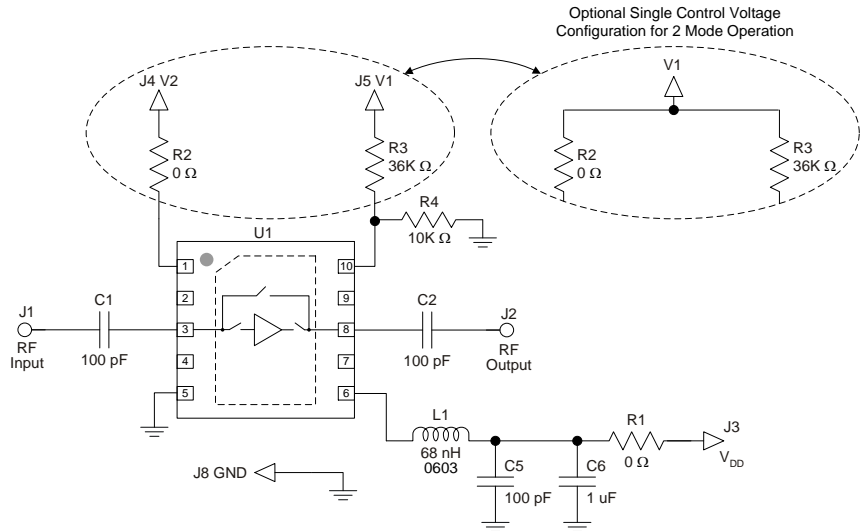
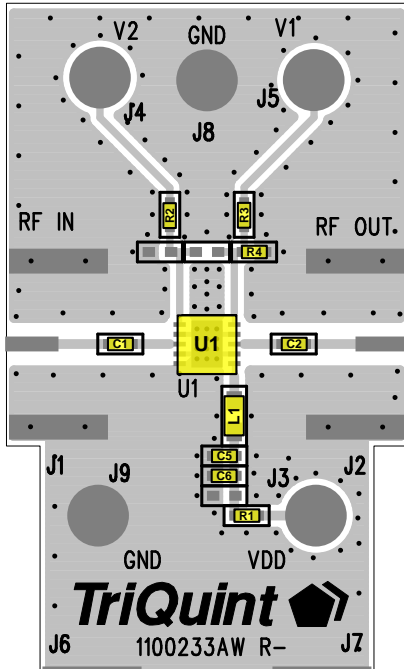
Control Truth Table

| V _{CTRL2} | V _{CTRL1} | State |
|--------------------|--------------------|-----------------------|
| 0 | 1 | LNA OFF, Bypass OFF |
| 1 | 1 | LNA OFF, Bypass ON |
| 0 | 0 | LNA ON, Bypass OFF |
| 1 | 0 | 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 |

TQL9042-PCB Evaluation Board



Note:
If a TQL9042 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 |

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

Bill of Material – TQL9042-PCB

| Reference Des. | Value | Description | Manuf. | Part Number |
|--------------------|--------|--------------------------|-----------|---------------|
| U1 | n/a | Bypass LNA | Qorvo | TQL9042 |
| 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 | |
| R3 | 36K | RES, 0402, +/-5%, 1/10W | Various | |
| R4 | 10K | RES, 0402, +/-5%, 1/10W | Various | |
| L1 | 68 nH | IND, 0603, +/-5%, 600mA | Coilcraft | 0603CS-68NXJL |

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 | 700 | 800 | 900 | 1000 | MHz |
| Gain | 20.8 | 19.9 | 19.0 | 18.2 | dB |
| Noise Figure | 0.37 | 0.37 | 0.42 | 0.46 | dB |
| Input Return Loss | 9.6 | 10.2 | 10.8 | 11.4 | dB |
| Output Return Loss | 21.0 | 20.4 | 19.8 | 19.1 | dB |
| Output P1dB | +23.1 | +23.1 | +23.1 | +23.2 | dBm |
| OIP3 (Pout/tone=+5 dBm, $\Delta f = 1\text{ MHz}$) | +35.3 | +35.5 | +36.0 | +36.0 | 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 | 700 | 800 | 900 | 1000 | MHz |
| Insertion Loss | 0.95 | 0.96 | 0.98 | 1.00 | dB |
| Input Return Loss | 12.5 | 12.6 | 12.7 | 12.6 | dB |
| Output Return Loss | 13.1 | 13.4 | 13.6 | 13.7 | dB |
| Input IP3 (Pin/tone=+6 dBm, $\Delta f = 1\text{ MHz}$) | +41.2 | +40.8 | +43.0 | +40.2 | dBm |

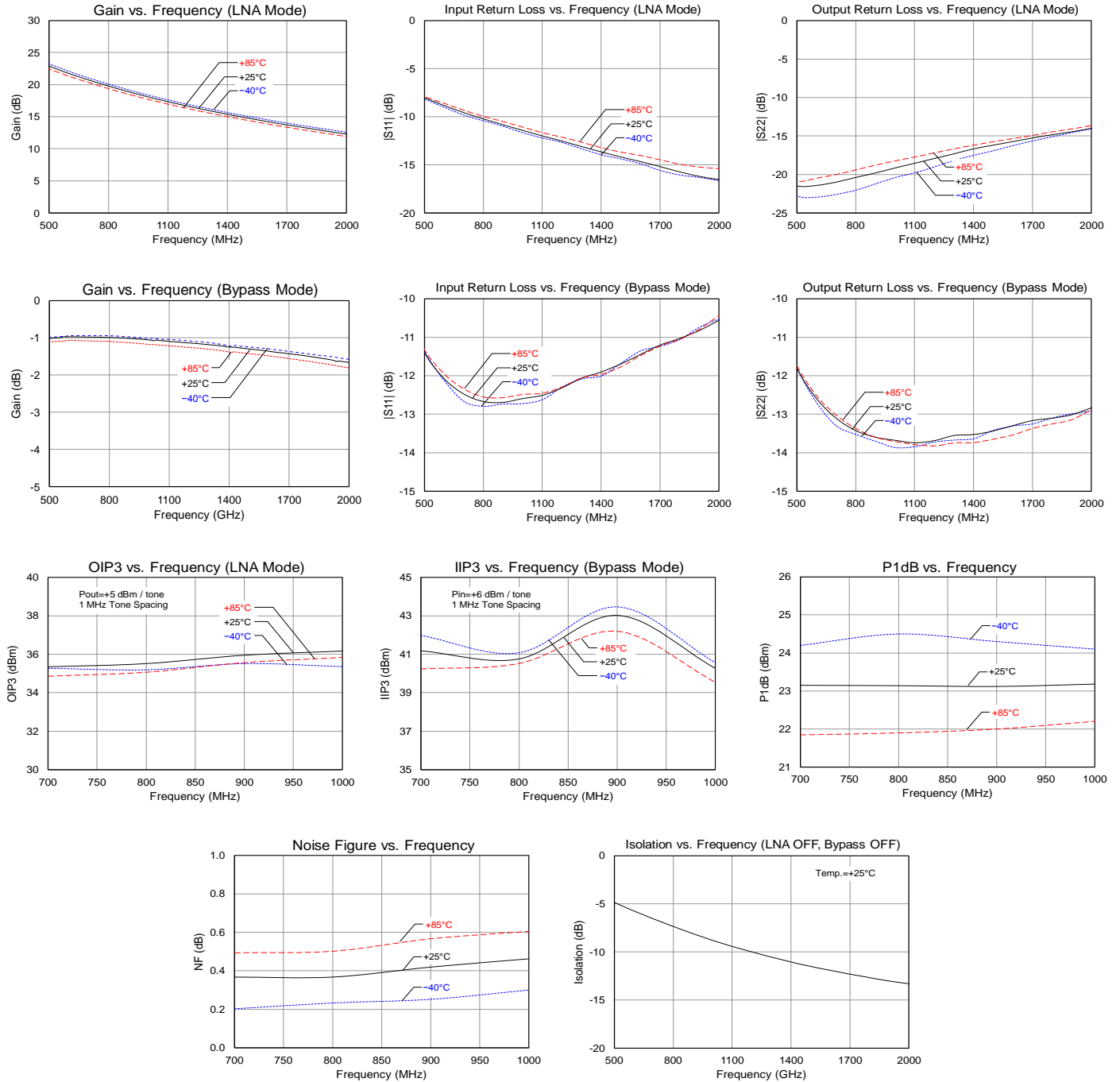
Typical Performance (LNA OFF, Bypass OFF Mode)

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

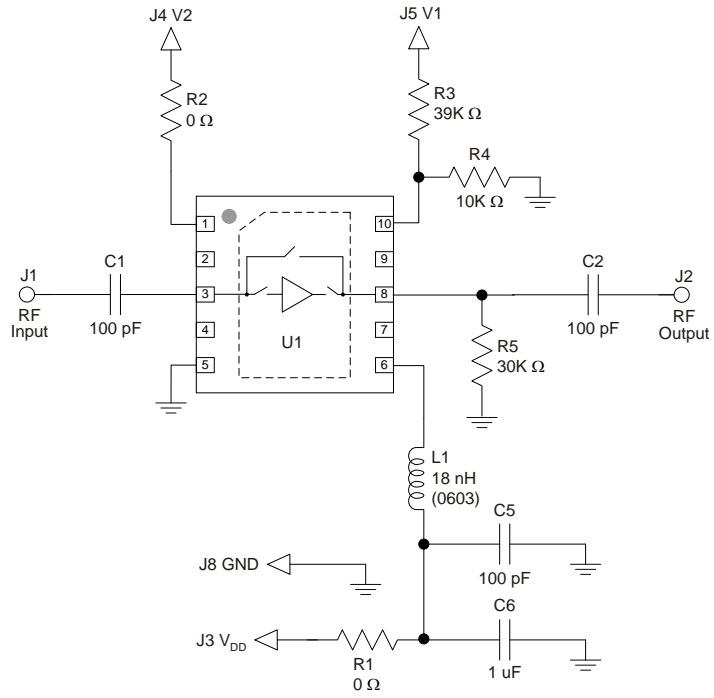
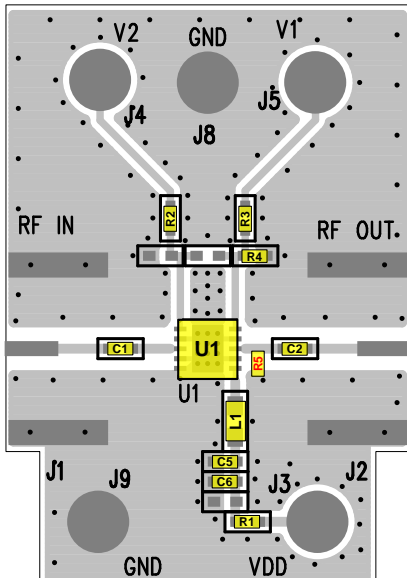
| Parameter | Typical Value | | | | Units |
|-----------|---------------|-----|-----|------|-------|
| Frequency | 700 | 800 | 900 | 1000 | MHz |
| Isolation | 6.6 | 7.4 | 8.2 | 8.8 | dB |

Performance Plots

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

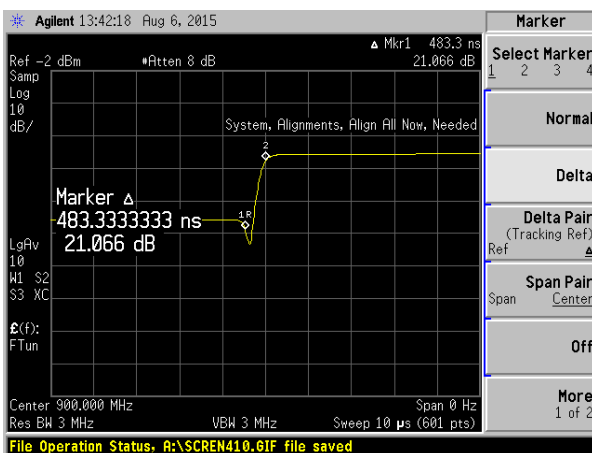


Switching Speed Application Note

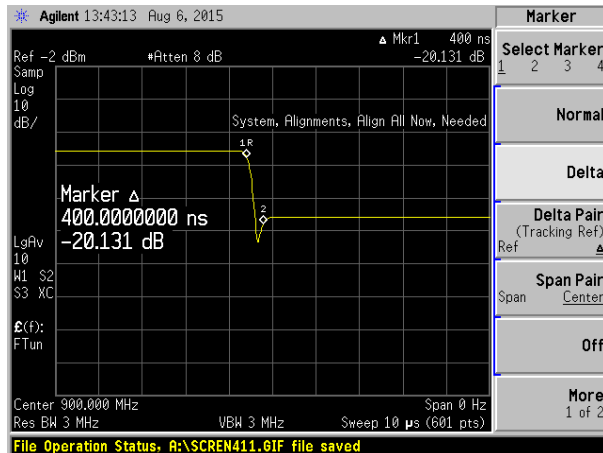


| Transition | Value | Units |
|--------------------|-------|-------|
| Bypass to LNA mode | 483 | ns |
| LNA to Bypass mode | 400 | ns |

R5, valued 30K, is required to achieve the switching speeds listed above. The placement of R5 is shown on the Qorvo Evaluation Board above.

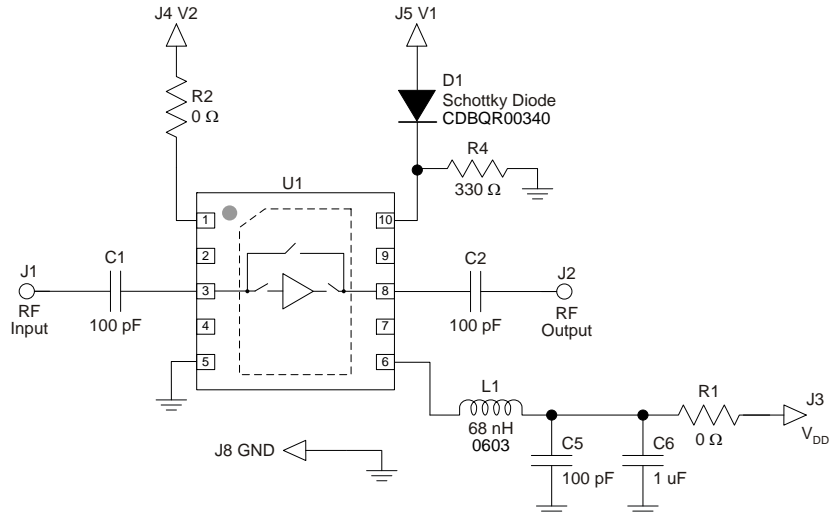
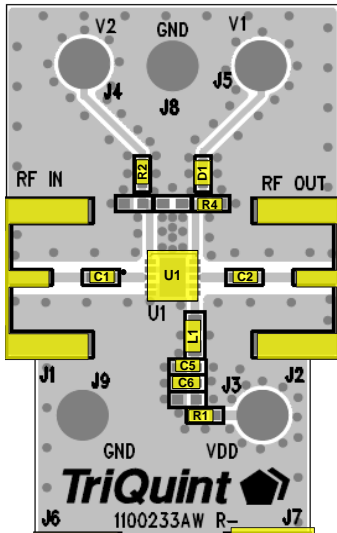


Bypass to LNA mode transition



LNA to Bypass mode transition

TQL9042-PCB for 1.8V TTL Compatibility



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

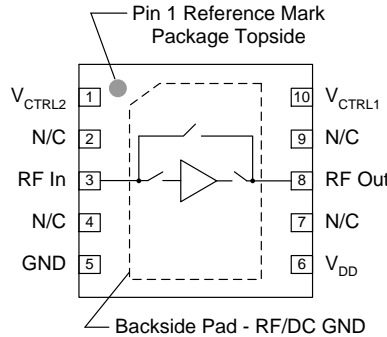
Note:
The control voltage limit for Vctrl1 shown in the table in the bottom right corner of pg. 2 cannot be met with a simple resistive divider network at pin 10 when using a 1.8V TTL logic level. A solution is to use a diode drop as shown above. This guarantees a voltage at pin 10 which is $\geq 0.52V$.

| 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 | TQL9042 |
| 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 |

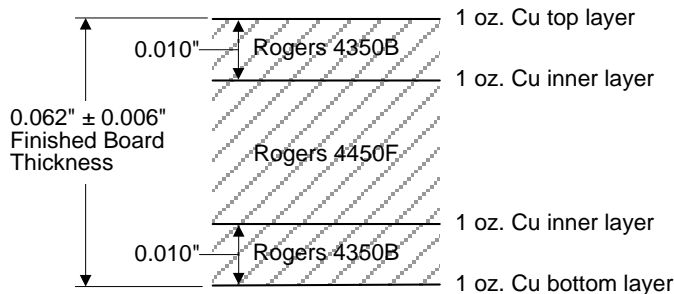
Pin Configuration and Description



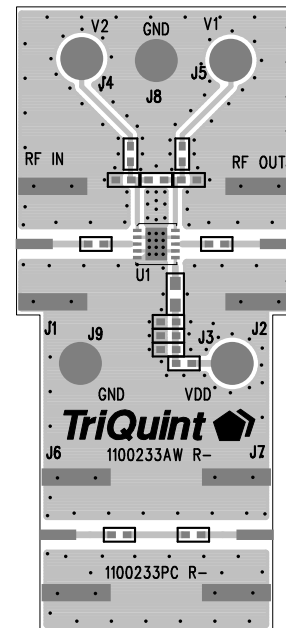
| Pin No. | Label | Description |
|-----------------|--------------------|---|
| 1 | V _{CTRL2} | Control pin for bypass mode and LNA mode. Internal resistor divider. Refer to truth table. |
| 2, 4, 7, 9 | N/C | No internal connection. Provide grounded PCB land pads for mounting integrity. |
| 3 | RFin | 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



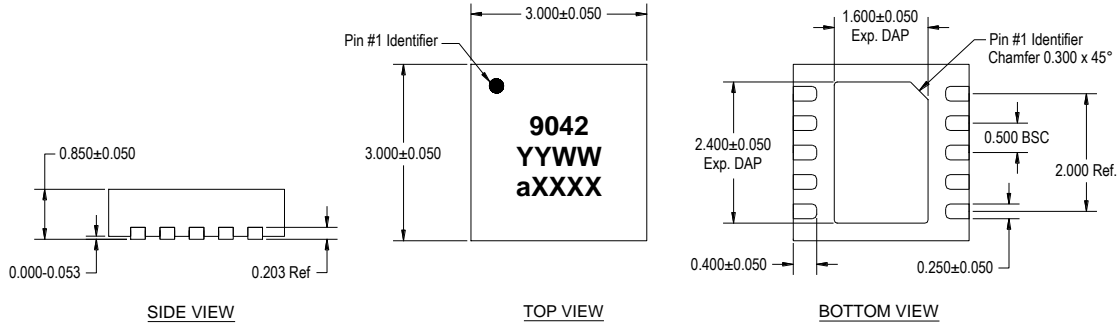
50 ohm line dimensions: width = .020", spacing = .032"



Mechanical Information

Package Marking and Dimensions

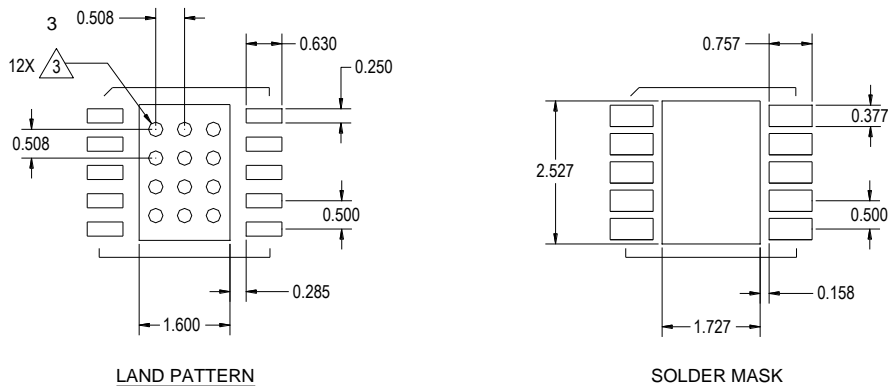
Marking: Part number – 9042
Year/Week – YYWW
Lot Code – aXXXX



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
Value: $\geq 250V$ to $500V$
Test: Human Body Model (HBM)
Standard: JEDEC Standard JS-001-2012

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

MSL Rating

MSL Rating: Level 1
Test: $260^{\circ}C$ convection reflow
Standard: JEDEC Standard IPC/JEDEC J-STD-020

Solderability

Compatible with both lead-free ($260^{\circ}C$ max. reflow temperature) and tin/lead ($245^{\circ}C$ 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 ($C_{15}H_{12}Br_4O_2$) 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:

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For technical questions and application information:

Email: sjcappliations.engineering@qorvo.com

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- 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;
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- 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

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