

# TQP369181

## DC-6 GHz Gain Block

### Applications

- Wireless Infrastructure
- CATV / SATV / MoCA
- Point to Point
- Defense & Aerospace
- Test & Measurement Equipment
- General Purpose Wireless

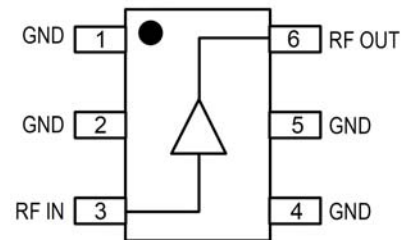


SOT-363 Package

### Product Features

- DC-6000 MHz
- Flat, broadband frequency response
- 15.3 dB Gain @ 1.9 GHz
- 3.6 dB Noise Figure @ 1.9 GHz
- +29 dBm Output IP3 @ 1.9 GHz
- +14.4 dBm P1dB @ 1.9 GHz
- 50 Ohm Cascadable Gain Block
- Single Supply, 45 mA Current
- SOT-363 Package

### Functional Block Diagram



### General Description

The TQP369181 is a general-purpose buffer amplifier that offers high dynamic range in a low-cost surface-mount package. At 1.9 GHz, the amplifier typically provides 15.3 dB gain, +29 dBm OIP3, and 3.6 dB Noise Figure while drawing 45 mA current. The device combines dependable performance with consistent quality to maintain MTTF values exceeding 100 years at mounting temperatures of +85°C. The device is housed in a lead-free/green/RoHS-compliant industry-standard SOT-363 package.

The TQP369181 consists of a Darlington-pair amplifier using the high reliability InGaP/GaAs HBT process technology. Only DC-blocking capacitors, a bias resistor, and an inductive RF choke are required for operation.

This broadband MMIC amplifier can be directly applied to various current and next generation wireless technologies such as CDMA, W-CDMA, and LTE. In addition, the TQP369181 will work for other applications within the DC to 6 GHz frequency range.

### Pin Configuration

| Pin #      | Symbol |
|------------|--------|
| 3          | RF IN  |
| 6          | RF OUT |
| 1, 2, 4, 5 | GND    |

### Ordering Information

| Part No.      | Description                |
|---------------|----------------------------|
| TQP369181     | InGaP/GaAs HBT Gain Block  |
| TQP369181-PCB | 0.5-4 GHz Evaluation Board |

Standard T/R size = 3000 pieces on a 7" reel

### Specifications

#### Absolute Maximum Ratings

| Parameter                           | Rating        |
|-------------------------------------|---------------|
| Storage Temperature                 | -55 to 150 °C |
| RF Input Power, CW, 50 Ω, T=25°C    | +27 dBm       |
| Device Voltage, V <sub>device</sub> | 5.2 V         |

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

#### Recommended Operating Conditions

| Parameter  | Min | Typ | Max  | Units |
|--|-----|-----|------|-------|
| T <sub>case</sub>                                | -40 |     | +85  | °C    |
| T <sub>j</sub> (for >10 <sup>6</sup> hours MTTF) |     |     | +160 | °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: I<sub>CC</sub> = 45 mA, T<sub>CASE</sub> = +25°C, 50 Ω system.

| Parameter  | Conditions  | Min   | Typical | Max  | Units |
|--|-------------|-------|---------|------|-------|
| Operational Frequency Range                      |             | DC    |         | 6000 | MHz   |
| Test Frequency                                   |             |       | 1900    |      | MHz   |
| Gain   |             | 13.8  | 15.3    | 16.8 | dB    |
| Input Return Loss                                |             |       | -30     |      | dB    |
| Output Return Loss                               |             |       | -24     |      | dB    |
| Output P1dB                                      |             |       | +14.6   |      | dBm   |
| Output IP3                                       | See Note 1. | +26.0 | +29.0   |      | dBm   |
| Noise Figure                                     |             |       | 3.6     |      | dB    |
| Device Voltage, V <sub>device</sub>              |             |       | 3.9     | 4.5  | V     |
| Current, I <sub>cc</sub>                         |             |       | 45      |      | mA    |
| Thermal Resistance (jnc to case) θ <sub>jc</sub> |             |       |         | 226  | °C/W  |

Notes:

1. OIP3 is measured with two tones at an output power of 0 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-Parameter Data

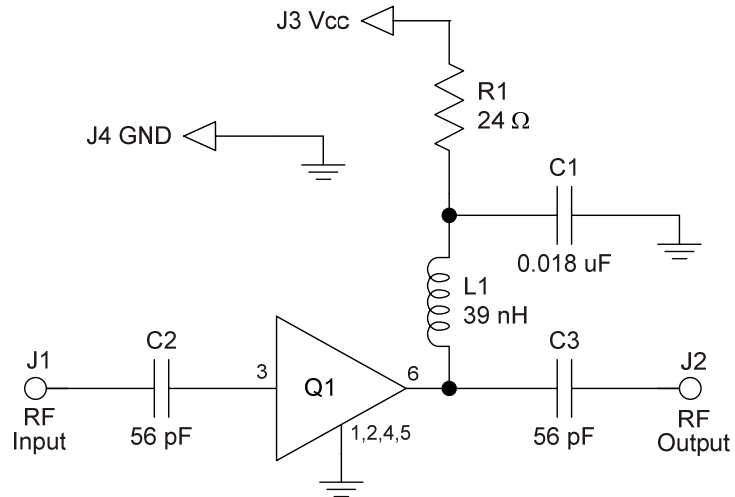
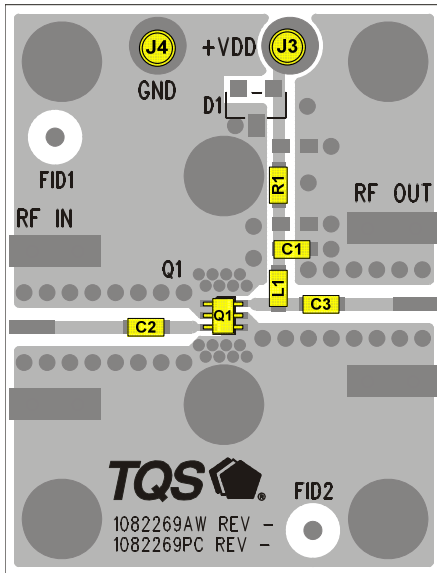
$V_{\text{device}} = 3.9 \text{ V (typ.)}$ ,  $I_{\text{cc}} = 45 \text{ mA (typ.)}$ ,  $T_{\text{case}} = +25^{\circ}\text{C}$

| Freq (MHz) | S11 (dB) | S11 (ang) | S21 (dB) | S21 (ang) | S12 (dB) | S12 (ang) | S22 (dB) | S22 (ang) |
|------------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| 10         | -36.7    | -179.3    | 15.9     | 179.7     | -18.8    | 0.3       | -30.2    | 14.8      |
| 20         | -35.9    | 178.4     | 15.9     | 179.3     | -18.8    | -0.1      | -30.0    | 5.6       |
| 50         | -34.6    | 171.4     | 15.9     | 178.5     | -18.8    | -0.3      | -30.8    | 0.4       |
| 100        | -34.1    | 164.0     | 15.9     | 177.2     | -18.8    | -0.7      | -31.2    | -5.2      |
| 200        | -32.6    | 153.3     | 15.9     | 174.6     | -18.9    | -0.9      | -30.7    | -10.9     |
| 500        | -30.6    | 137.1     | 15.8     | 167.0     | -18.9    | -2.6      | -32.3    | -16.0     |
| 900        | -29.1    | 115.5     | 15.6     | 157.3     | -19.0    | -3.8      | -33.1    | -59.1     |
| 1000       | -29.1    | 118.6     | 15.6     | 154.9     | -19.0    | -4.1      | -32.0    | -59.5     |
| 1500       | -27.9    | 74.3      | 15.3     | 143.1     | -19.1    | -6.1      | -28.2    | -75.7     |
| 1900       | -26.7    | 28.5      | 15.1     | 133.6     | -19.4    | -7.5      | -22.9    | -63.3     |
| 2000       | -24.9    | 17.8      | 15.0     | 131.3     | -19.4    | -8.0      | -21.7    | -64.4     |
| 2500       | -18.2    | -18.4     | 14.6     | 120.4     | -19.7    | -9.8      | -16.6    | -62.9     |
| 3000       | -14.4    | -24.2     | 14.2     | 110.1     | -20.2    | -11.3     | -14.0    | -57.5     |
| 3500       | -13.1    | -26.3     | 13.8     | 100.4     | -20.5    | -13.1     | -12.9    | -54.0     |
| 4000       | -13.1    | -26.2     | 13.5     | 91.2      | -20.8    | -12.4     | -13.7    | -50.2     |
| 4500       | -15.0    | -20.5     | 13.3     | 81.7      | -21.2    | -14.4     | -16.5    | -41.9     |
| 5000       | -19.1    | 0.7       | 13.1     | 71.2      | -21.7    | -15.9     | -24.0    | 0.6       |
| 5500       | -20.6    | 60.7      | 12.9     | 60.7      | -22.4    | -17.4     | -18.9    | 84.1      |
| 6000       | -17.1    | 100.0     | 12.6     | 48.8      | -23.2    | -18.4     | -13.5    | 105.3     |

Notes:

1. Measured on TQP369181-PCB using external off-board, wide-band bias tee and DC blocks (50 Ohm system).
2. SOLT Ecal at network analyzer test cable ends.
3. Input and output reference planes extended to the device leads.

### Application Circuit Configuration



**Notes:**

1. See PC Board Layout, under Application Information section, for more information.
2. All components are of 0603 size unless otherwise stated.

### Bill of Material: TQP369181-PCB

| Reference Des. | Value    | Description                    | Manufacturer | Part Number |
|----------------|----------|--------------------------------|--------------|-------------|
| Q1             | n/a      | Gain Block                     | TriQuint     | TQP369181   |
| C1             | 0.018 uF | Cap, Chip, 0603, 16V, X7R, 10% | various      |             |
| C2, C3         | 56 pF    | Cap, Chip, 0603, 50V, NPO, 5%  | various      |             |
| L1             | 39 nH    | Inductor, 0603, 5%, CS Series  | Coilcraft    |             |
| R1             | 24 Ω     | Res, Chip, 0805, 1/10W, 5%     | various      |             |

### Component Values for Specific Frequencies

Use the component values in this table for optimal operation at specific frequencies.

| Reference Designator | Frequency (MHz) |         |        |       |       |       |       |
|----------------------|-----------------|---------|--------|-------|-------|-------|-------|
|                      | 50              | 500     | 900    | 1900  | 2200  | 2500  | 3500  |
| L1                   | 820 nH          | 220 nH  | 68 nH  | 27 nH | 22 nH | 18 nH | 15 nH |
| C2, C3               | .018 uF         | 1000 pF | 100 pF | 68 pF | 68 pF | 56 pF | 39 pF |

### Bias Resistor Values for Various Supply Voltages

Select R1 to satisfy 45 mA operating current at the available supply voltage.

|          | V <sub>supply</sub> (Volts) |      |      |      |       |       |       |
|----------|-----------------------------|------|------|------|-------|-------|-------|
|          | 5                           | 6    | 7    | 8    | 9     | 10    | 12    |
| R1 Value | 24 Ω                        | 47 Ω | 68 Ω | 91 Ω | 110 Ω | 130 Ω | 180 Ω |
| Size     | 0805                        | 1206 | 1210 | 1210 | 1210  | 2010  | 2010  |

### Typical Performance TQP369181-PCB

Test conditions unless otherwise noted:  $V_{\text{supply}} = 5 \text{ V}$ ,  $R_{\text{bias}} = 24 \Omega$ ,  $I_{\text{cc}} = 45 \text{ mA}$ ,  $T_{\text{case}} = +25^\circ \text{C}$

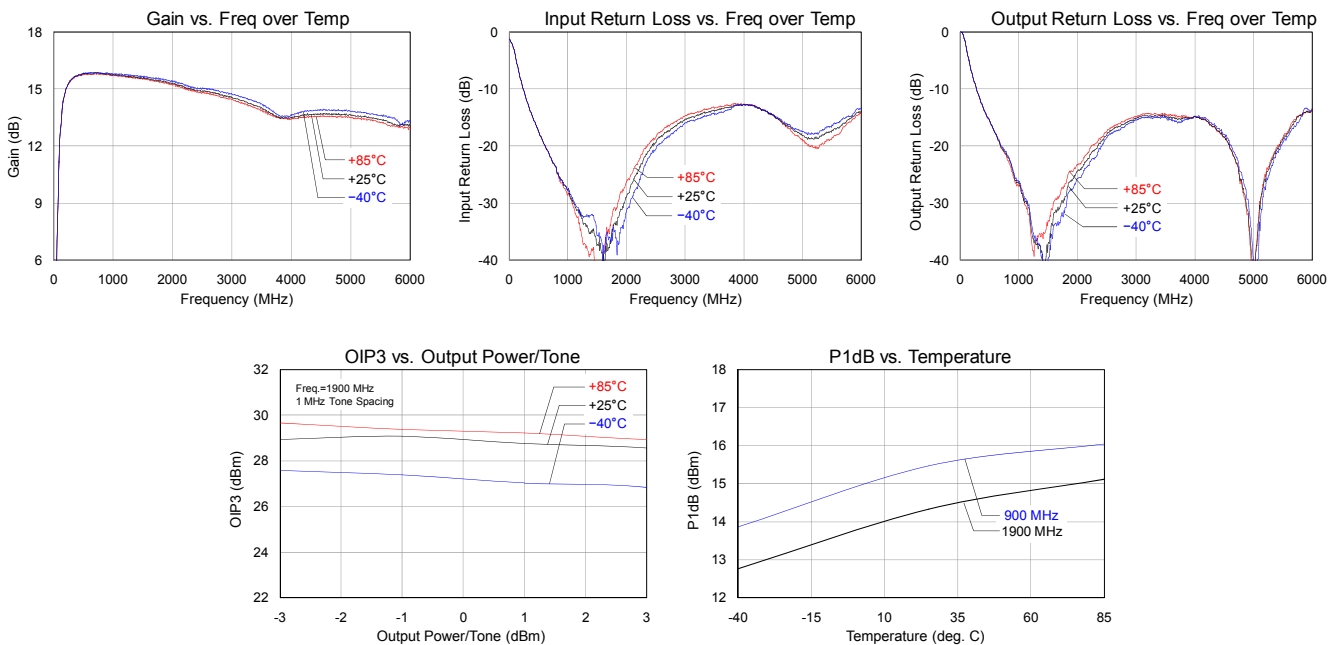
| Frequency          | MHz | 500   | 900   | 1900  | 2100  | 2600  |
|--------------------|-----|-------|-------|-------|-------|-------|
| Gain               | dB  | 15.6  | 15.6  | 15.3  | 15    | 14.7  |
| Input Return Loss  | dB  | -17   | -26   | -30   | -24   | -17   |
| Output Return Loss | dB  | -16   | -24   | -24   | -20   | -16   |
| Output P1dB        | dBm | +15.4 | +15.2 | +14.6 | +14.3 | +14.0 |
| OIP3 [1]           | dBm | +30.6 | +30.0 | +29.0 | +28.5 | +27.7 |
| Noise Figure       | dB  | 3.6   | 3.6   | 3.6   | 3.6   | 3.7   |

Notes:

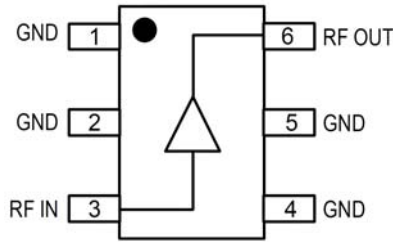
- OIP3 measured with two tones at an output power of 0 dBm / tone separated by 1 MHz. The suppression on the largest IM3 product is used to calculate the OIP3 using 2:1 rule.

### Performance Plots

Test conditions unless otherwise noted:  $V_{\text{supply}} = 5 \text{ V}$ ,  $R_{\text{bias}} = 24 \Omega$ ,  $I_{\text{cc}} = 45 \text{ mA}$



### Pin Description



| Pin        | Symbol | Description   |
|------------|--------|---|
| 3          | RF IN  | RF input, matched to 50 ohms. External DC Block is required.  |
| 6          | RF OUT | RF output / DC supply, matched to 50 ohms. External DC Block, bias choke, and dropping resistor is required.                                |
| 1, 2, 4, 5 | GND    | Multiple vias should be employed to minimize inductance and thermal resistance; see PCB mounting pattern in Mechanical Information section. |

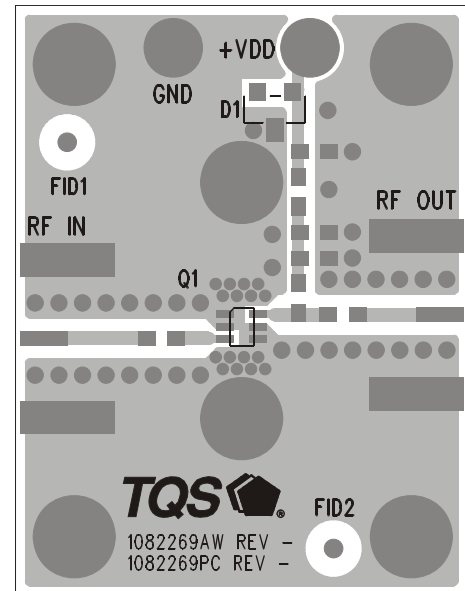
### Applications Information

#### PC Board Layout

Top RF layer is .014" NELCO N4000-13,  $\epsilon_r = 3.7$  typ., 4 total layers (0.062" thick) for mechanical rigidity. Metal layers are 1-oz copper. 50 ohm Microstrip line details: width = .029", spacing = .035"

The pad pattern shown has been developed and tested for optimized assembly at TriQuint Semiconductor. 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.

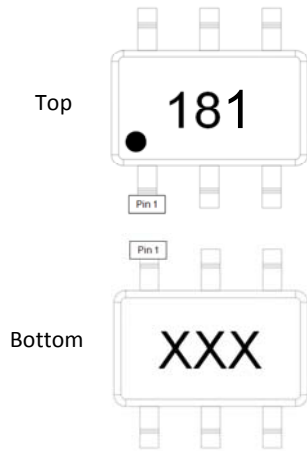
For further technical information, Refer to [www.TriQuint.com](http://www.TriQuint.com)



### Mechanical Information

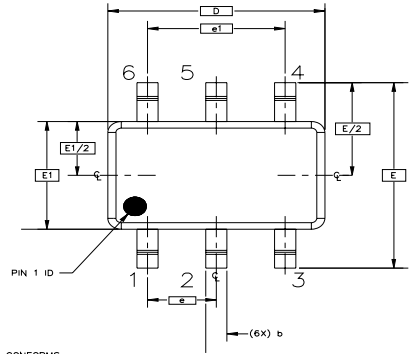
### Package Information and Dimensions

The component is marked on the top surface of the package with a "181" designator and on the bottom surface with an alphanumeric lot code.

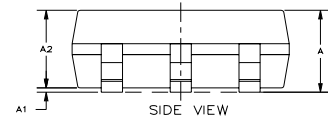
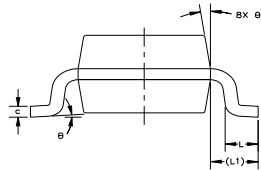


| SYMBOL | MIN            | MAX            |
|--------|----------------|----------------|
| A      | —              | 1.10<br>(.043) |
| A1     | 0              | .10<br>(.004)  |
| A2     | .70<br>(.028)  | 1.00<br>(.039) |
| D      | 2.00<br>(.079) | BASIC          |
| E      | 2.10<br>(.083) | BASIC          |
| E1     | 1.25<br>(.039) | BASIC          |
| L      | .21<br>(.008)  | .41<br>(.016)  |
| L1     | .42<br>(.017)  | REF            |
| L2     | .15<br>(.006)  | BASIC          |
| ø      | 0.8            | 8.8            |
| ø1     | 4.8            | 12.8           |
| b      | .15<br>(.006)  | .30<br>(.012)  |
| c      | .08<br>(.003)  | .22<br>(.009)  |
| e      | .65<br>(.026)  | BASIC          |
| e1     | 1.30<br>(.051) | BASIC          |

NOTES:  
 1. DIMENSIONS AND TOLERANCING PER ASME Y14.5M-1194. PACKAGE CONFORMS TO JEDEC MO-203, ISSUE B.  
 2. DIMENSIONS ARE IN MILLIMETERS (INCHES).



TOP VIEW

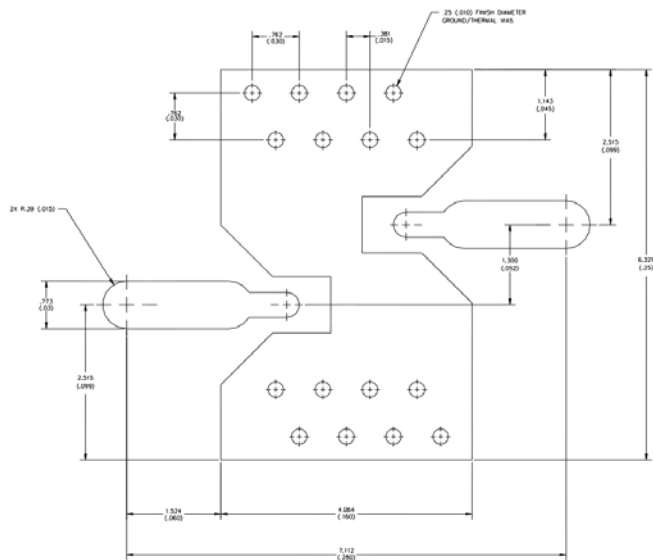


SIDE VIEW

### PCB Mounting Pattern

Notes:

1. All dimensions are in millimeters (inches). Angles are in degrees
2. Ground / thermal vias are critical for the proper performance of this device. Vias should use a .35mm (#80 / .0135") diameter drill and have a final plated thru diameter of .25 mm (.010").
3. Use 1 oz. Copper minimum. Add as much copper as possible to inner and outer layers near the part to ensure optimal thermal performance.
4. RF trace width depends upon the PC board material and construction.



### Product Compliance Information

#### ESD Information



#### Caution! ESD-Sensitive Device

ESD Rating: Class 1C  
Value: Passes  $\geq 1000$  V to  $< 2000$  V  
Test: Human Body Model (HBM)  
Standard: JEDEC Standard JESD22-A114

ESD Rating: Class IV  
Value: Passes  $\geq 1000$  V  
Test: Charged Device Model (CDM)  
Standard: JEDEC Standard JESD22-C101

#### MSL Rating

The part is rated Moisture Sensitivity Level 1 at 260°C per JEDEC standard IPC/JEDEC J-STD-020.

#### Solderability

Package lead plating: annealed matte tin over copper

Compatible with both lead-free (260°C max. reflow temp.) and tin/lead (245°C max. reflow temp.) soldering processes.

#### 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, and information about TriQuint:

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