

## Applications

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

## Product Features

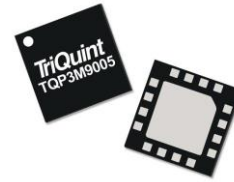
- 50–4000 MHz
- 15.3 dB Gain at 1.9 GHz
- 0.8 dB Noise Figure at 1.9 GHz
- <1.5:1 I/O VSWR (>14 dB I/O Return Loss)
- +34 dBm Output IP3
- +22.3 dBm P1dB
- 50 Ohm Cascadable Gain Block
- Unconditionally Stable
- High Input Power Capability
- Single Supply, 50 mA Current

## General Description

The TQP3M9005 is a high linearity low noise gain block amplifier in a low-cost surface-mount package. At 1.9 GHz, the amplifier typically provides 15.3 dB gain, +34 dBm OIP3, and 0.8 dB Noise Figure while only drawing 50 mA current. The device is housed in a leadfree/green/RoHS-compliant industry-standard 16-pin 3x3 mm QFN package.

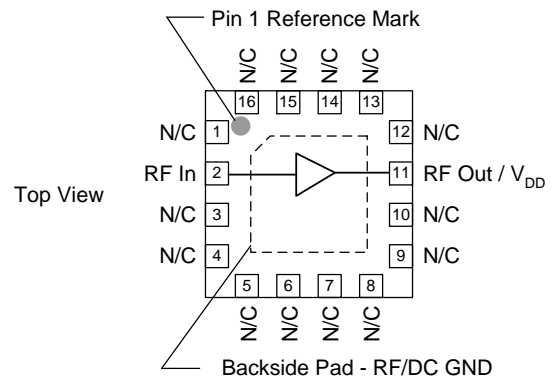
The TQP3M9005 has the benefit of having high linearity while also providing very low noise across a broad range of frequencies. This allows the device to be used in both receive and transmit chains for high performance systems. The amplifier is internally matched using a high performance E-pHEMT process and only requires an external RF choke and blocking/bypass capacitors for operation from a single supply. The internal active bias circuit also enables stable operation over bias and temperature variations.

The TQP3M9005 covers the 0.05–4 GHz frequency band and is targeted for wireless infrastructure or other applications requiring high linearity and/or low noise figure.



16-pin 3x3 mm QFN Package

## Functional Block Diagram



## Pin Configuration

| Pin No.        | Label                    |
|----------------|--------------------------|
| 2              | RF In                    |
| 11             | RF Out / V <sub>DD</sub> |
| All Other Pins | N/C                      |
| Backside Pad   | RF/DC GND                |

## Ordering Information

| Part No.      | Description                |
|---------------|----------------------------|
| TQP3M9005     | LNA Gain Block             |
| TQP3M9005-PCB | 0.5–4 GHz Evaluation Board |

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

### Absolute Maximum Ratings

| Parameter                         | Rating        |
|-----------------------------------|---------------|
| Storage Temperature               | -55 to 150 °C |
| RF Input Power, CW, 50Ω, T=25°C   | +20 dBm       |
| Device Voltage (V <sub>DD</sub> ) | +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 <sub>DD</sub> )              | +3.0 | +5.0 | +5.25 | V     |
| T <sub>CASE</sub>                              | -40  |      | +105  | °C    |
| T <sub>j</sub> for >10 <sup>6</sup> hours MTTF |      |      | +190  | °C    |

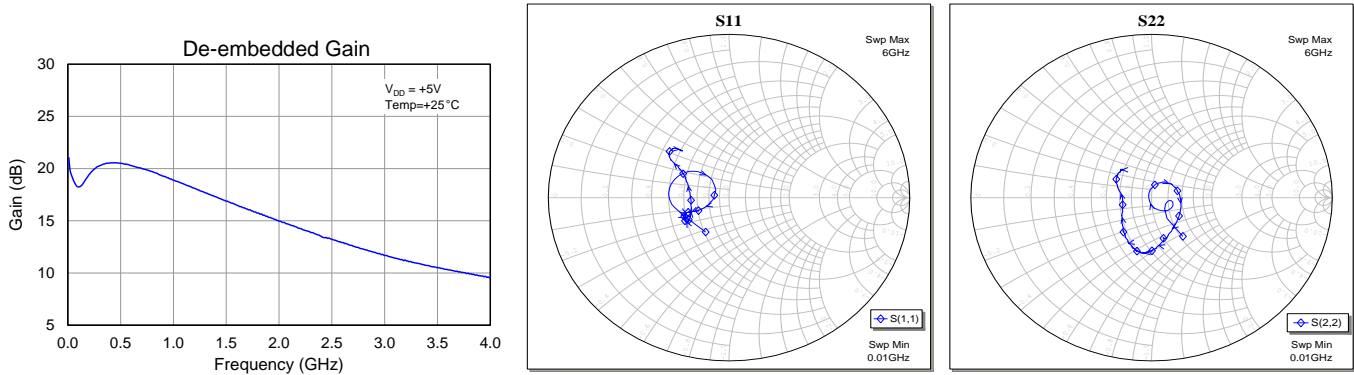
Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

### Electrical Specifications

Test conditions unless otherwise noted: V<sub>DD</sub>=+5 V, Temp=+25 °C, 50 Ω system

| Parameter                           | Conditions                              | Min  | Typ   | Max  | Units |
|-------------------------------------|---|------|-------|------|-------|
| Operational Frequency Range         |   | 50   |       | 4000 | MHz   |
| Test Frequency                      |   |      | 1900  |      | MHz   |
| Gain                                |   | 13.9 | 15.3  | 16.9 | dB    |
| Input Return Loss                   |   |      | 12    |      | dB    |
| Output Return Loss                  |   |      | 14    |      | dB    |
| Output P1dB                         |   |      | +22.3 |      | dBm   |
| Output IP3                          | P <sub>out</sub> =+2 dBm/tone, Δf=1 MHz | +30  | +34   |      | dBm   |
| Noise Figure                        |   |      | 0.8   |      | dB    |
| Current, I <sub>DD</sub>            |   | 35   | 50    | 68   | mA    |
| Thermal Resistance, θ <sub>jc</sub> | Junction to case                        |      | 76.8  |      | °C/W  |

**Device Characterization Data**

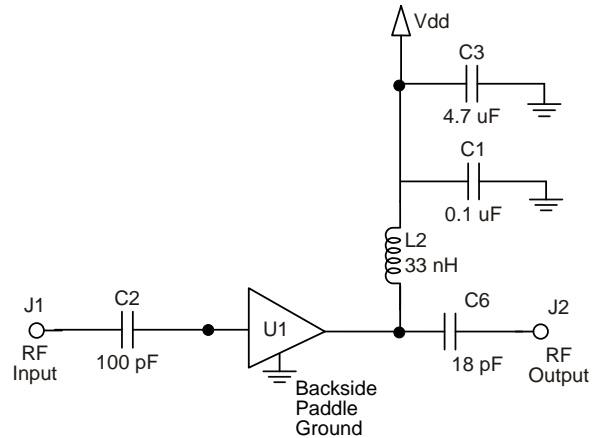
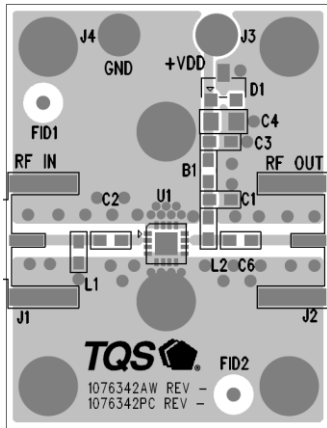


**S-Parameters**

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

| Freq (MHz) | S11 (dB) | S11 (ang) | S21 (dB) | S21 (ang) | S12 (dB) | S12 (ang) | S22 (dB) | S22 (ang) |
|------------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| 50         | -10.60   | -165.03   | 18.97    | 169.37    | -28.21   | 3.31      | -20.93   | -16.62    |
| 100        | -9.49    | 175.55    | 18.25    | 174.21    | -28.93   | 7.02      | -18.17   | -16.66    |
| 200        | -10.87   | 147.24    | 19.40    | 177.58    | -27.58   | 15.94     | -20.08   | -53.04    |
| 400        | -17.37   | 131.91    | 20.53    | 160.55    | -26.03   | 13.26     | -35.69   | 161.57    |
| 800        | -19.08   | -162.95   | 19.71    | 130.50    | -25.55   | 10.38     | -18.59   | 54.50     |
| 1000       | -16.31   | -155.70   | 18.89    | 118.70    | -25.42   | 10.64     | -17.17   | 35.91     |
| 1200       | -14.56   | -155.11   | 18.10    | 108.64    | -25.21   | 11.47     | -16.62   | 16.88     |
| 1500       | -13.21   | -157.04   | 16.88    | 94.87     | -24.85   | 13.11     | -15.65   | -9.94     |
| 1900       | -12.17   | -158.41   | 15.32    | 79.10     | -24.31   | 13.69     | -14.06   | -43.51    |
| 2000       | -11.91   | -158.36   | 14.97    | 75.77     | -24.10   | 13.71     | -13.59   | -50.29    |
| 2200       | -11.68   | -157.13   | 14.26    | 68.76     | -23.87   | 13.48     | -12.60   | -62.64    |
| 2500       | -11.30   | -155.40   | 13.24    | 59.49     | -23.35   | 12.97     | -11.28   | -75.63    |
| 2600       | -11.23   | -154.34   | 12.92    | 56.53     | -23.20   | 12.81     | -10.96   | -79.40    |
| 3000       | -11.03   | -150.07   | 11.67    | 45.14     | -22.54   | 11.37     | -9.77    | -89.57    |
| 3500       | -11.47   | -147.07   | 10.53    | 31.94     | -21.61   | 7.86      | -9.39    | -100.67   |
| 4000       | -13.13   | -160.94   | 9.56     | 16.71     | -20.66   | 1.90      | -10.56   | -116.49   |

**TQP3M9005-PCB Evaluation Board**



Notes:

1. See PC Board Layout in Applications 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 – TQP3M9005-PCB**

| Reference Des. | Value        | Description                     | Manufacturer | Part Number |
|----------------|--------------|---------------------------------|--------------|-------------|
| U1             | n/a          | High Linearity LNA Gain Block   | Qorvo        | TQP3M9005   |
| C2             | 100 pF       | Cap, Chip, 0603, 50V, NPO, 5%   | various      |             |
| C6             | 18 pF        | Cap, Chip, 0603, 50V, NPO, 5%   | various      |             |
| C1             | 0.1 uF       | Cap, Chip, 0603, 16V, X7R, 10%  | various      |             |
| L2             | 33 nH        | Ind, Chip, 0603, 5%             | various      |             |
| C3             | 4.7 uF       | Cap, Chip, 0603, 6.3V, X5R, 20% | various      |             |
| B1             | 0 Ω          | Res, Chip, 0603, 1/16W, 5%      | various      |             |
| L1, D1, C4     | Do Not Place |                                 | various      |             |

**Typical Performance – TQP3M9005-PCB**

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

| Parameter          | Typical Value |       |       |       |       | Units |
|--------------------|---------------|-------|-------|-------|-------|-------|
|                    | 500           | 900   | 1900  | 2100  | 2600  |       |
| Frequency          | 500           | 900   | 1900  | 2100  | 2600  | MHz   |
| Gain               | 20.6          | 19.4  | 15.3  | 14.5  | 12.8  | dB    |
| Input Return Loss  | 19            | 16    | 12    | 11    | 11    | dB    |
| Output Return Loss | 17            | 16    | 14    | 13    | 11    | dB    |
| Output P1dB        | +22.2         | +22.2 | +22.3 | +22.5 | +22.5 | dBm   |
| OIP3               | +32           | +32.9 | +34.0 | +33.6 | +33.8 | dBm   |
| Noise figure       | 1.0           | 0.9   | 0.8   | 0.85  | 1.1   | dB    |

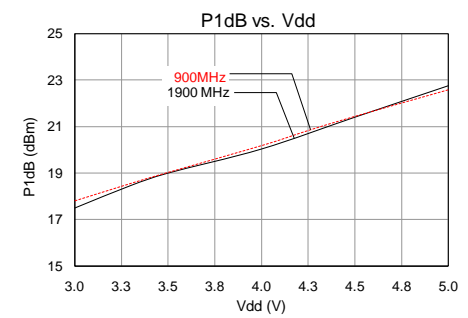
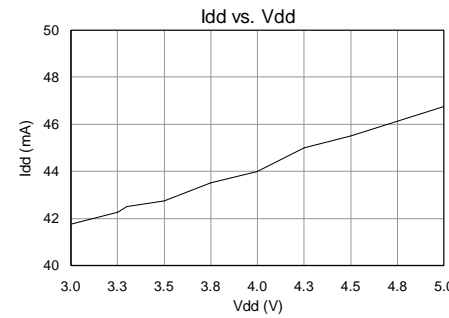
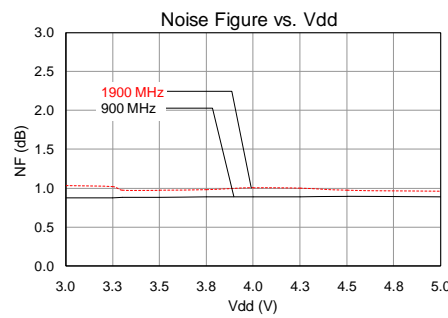
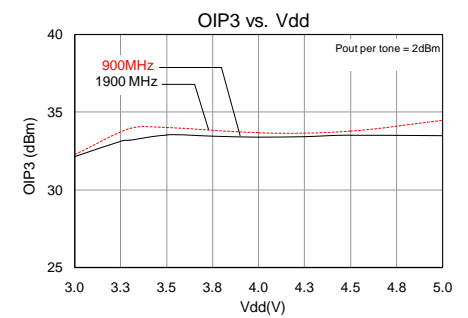
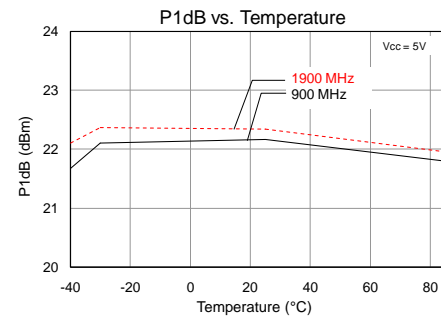
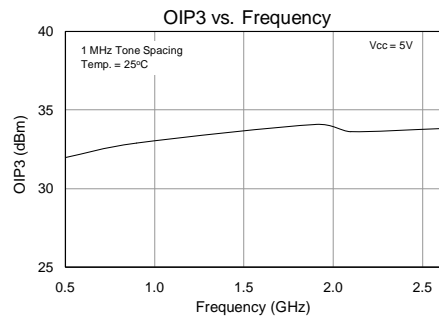
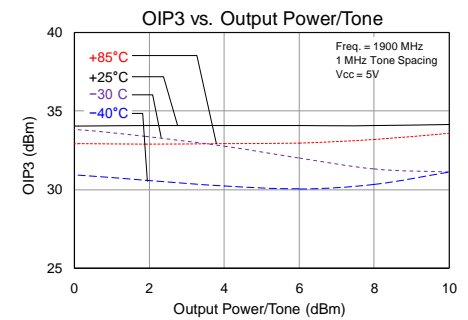
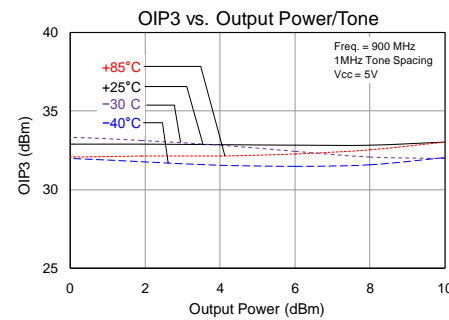
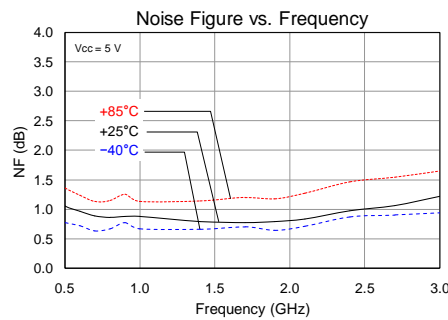
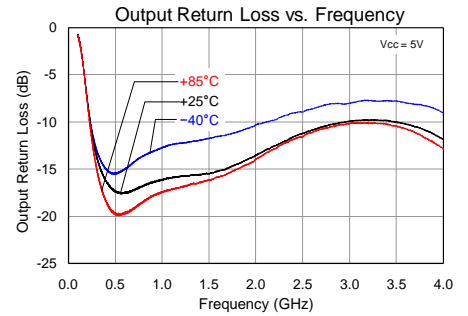
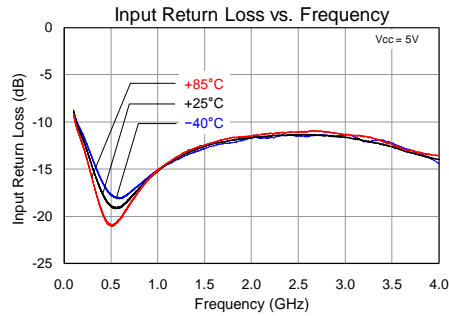
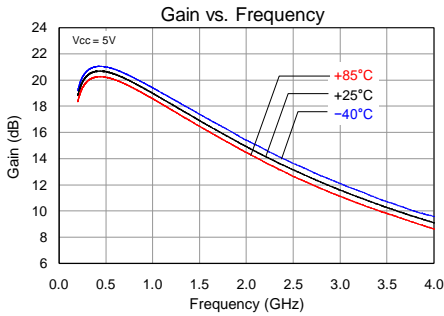
Notes:

1. OIP3 measured with two tones at an output power of +2 dBm / tone separated by 1 MHz.
2. Noise figure data shown in the table above is corrected for PCB losses of 0.11 dB at 0.5 GHz, board loss of 0.08 dB at 0.9 GHz, board loss of 0.13 dB at 1.9 GHz, board loss of 0.14 dB at 2.1 GHz and board loss of 0.17dB at 2.6 GHz.

**Performance Plots – TQP3M9005-PCB**

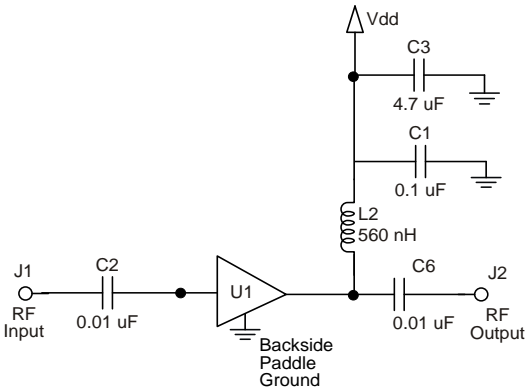
Test conditions unless otherwise noted:  $V_{DD}=+5V$ ,  $I_{DD}=50mA$ , Temp= $+25^{\circ}C$ ,  $50\ \Omega$  system.

Noise figure plot has been corrected for evaluation board loss of 0.13 dB at 1.9 GHz.



## TQP3M9005 Low Frequency Performance

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

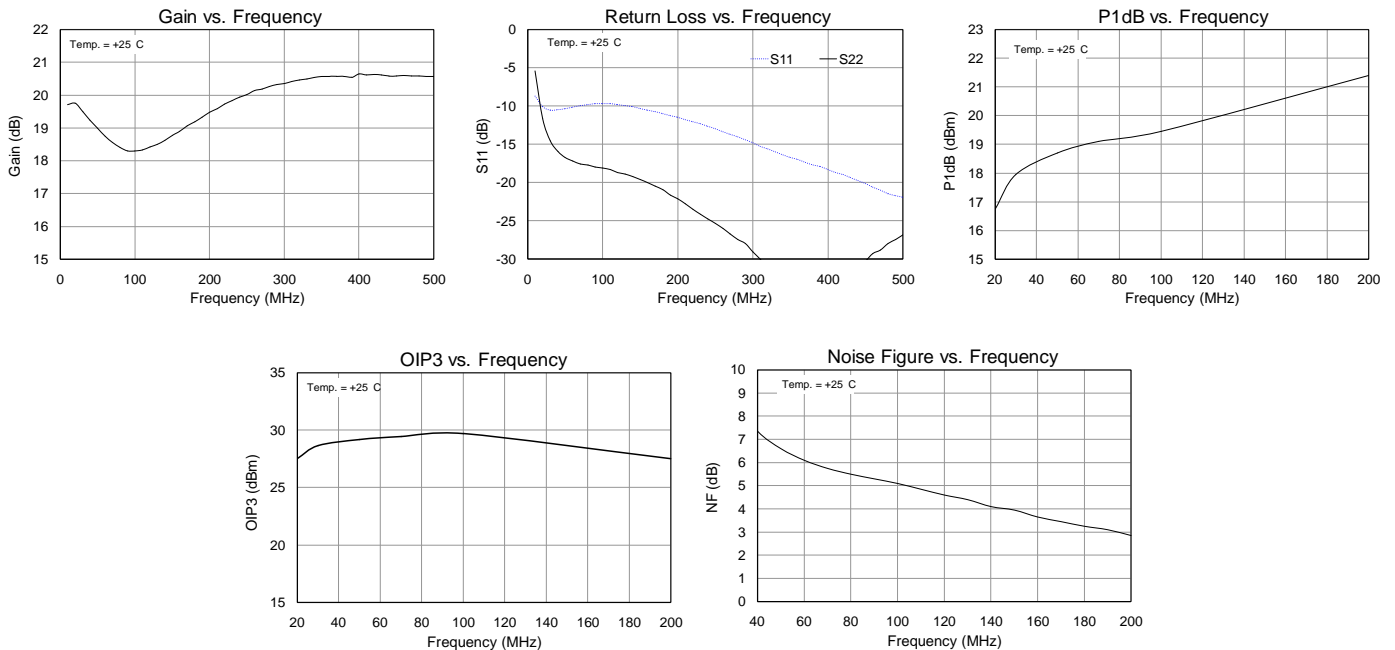
| Parameter          | Typical Value |        |       | Units | Schematic  |
|--------------------|---------------|--------|-------|-------|--|
| Frequency          | 50            | 100    | 200   | MHz   |  |
| Gain               | 18.9          | 18.3   | 19.4  | dB    |  |
| Input Return Loss  | 10            | 9.7    | 11.5  | dB    |  |
| Output Return Loss | 16            | 18     | 22    | dB    |  |
| Output P1dB        | +18.7         | +19.45 | +21.4 | dBm   |  |
| OIP3               | +29.2         | +29.7  | +27.5 | dBm   |  |
| Noise figure       | 6.6           | 5.1    | 2.9   | dB    |  |

**Notes:**

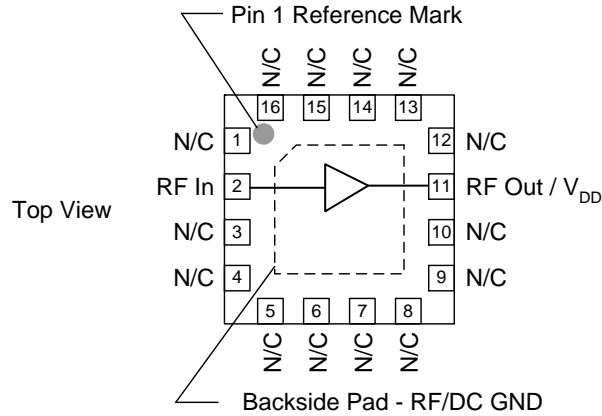
- OIP3 measured with two tones at an output power of +2 dBm / tone separated by 1 MHz.

## Low Frequency Performance Plots

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



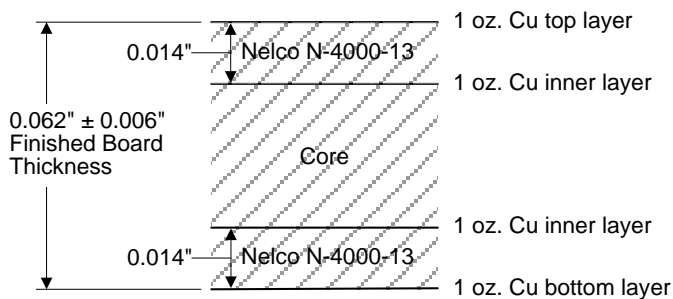
**Pin Configuration and Description**



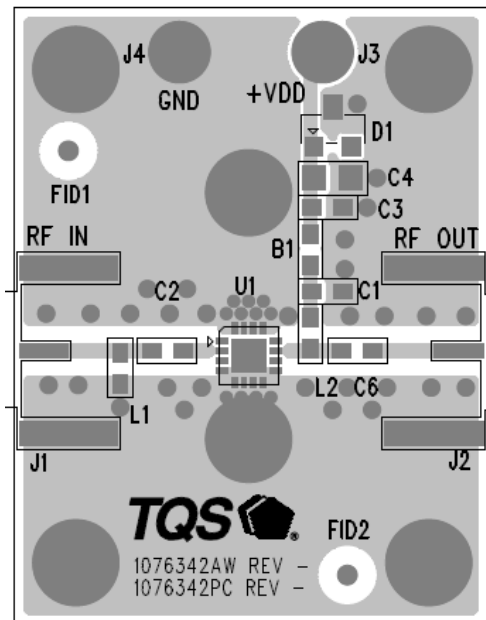
| Pin No.        | Label       | Description   |
|----------------|-------------|---|
| 2              | RF Input    | Input, matched to 50 ohms. External DC Block is required.   |
| 11             | Vdd / RFout | Output, matched to 50 ohms, External DC Block is required and supply voltage.   |
| All other pins | N/C         | No internal connection. Provide grounded pads on PCB land pattern for optimal isolation and mounting integrity..  |
| Backside Pad   | RF/DC GND   | Backside Pad. Multiple vias should be employed to minimize inductance and thermal resistance; see PCB mounting pattern in Mechanical Information section. |

**Evaluation Board PCB Information**

Qorvo PCB 1076342 Material and Stack-up



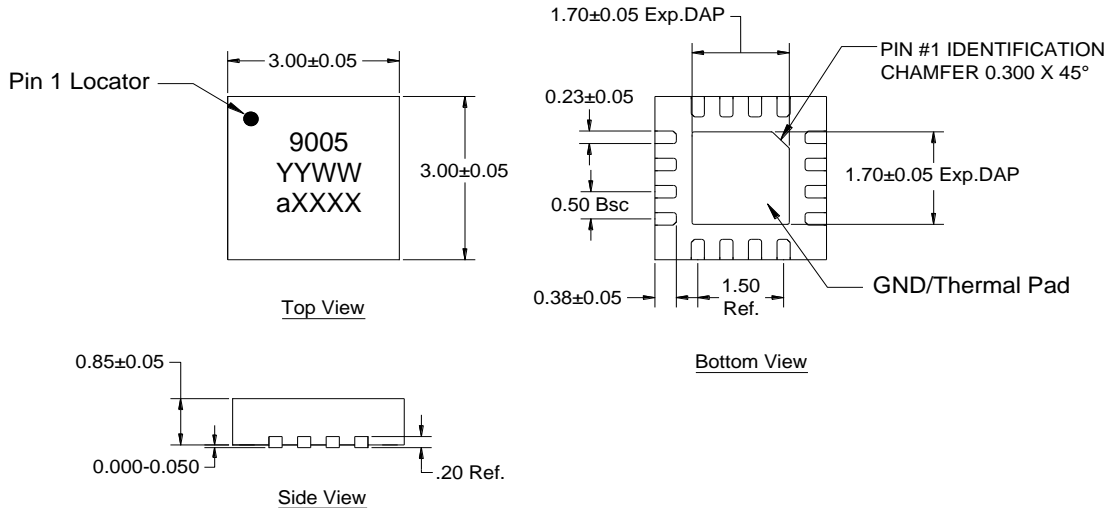
50 ohm line dimensions: width = .029", spacing = .035"



## Package Marking and Dimensions

### Package Marking:

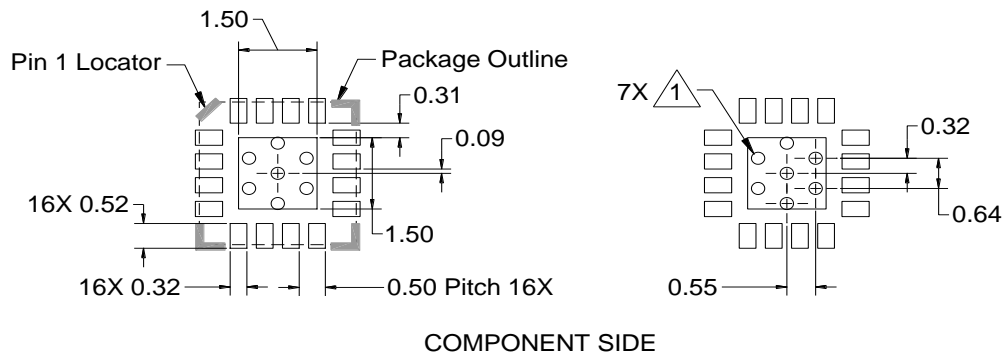
Part number – 9005  
Year, week code - YYWW  
Assembly code – aXXXX



### Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Dimension and tolerance formats conform to ASME Y14.4M-1994.
3. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.
4. Contact plating: Annealed Matte Tin

## 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.
4. 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").
5. Ensure good package backside paddle solder attach for best electrical and thermal performance.



## Product Compliance Information

### ESD Sensitivity Ratings



Caution! ESD-Sensitive Device

ESD Rating: Class 1A  
Value:  $\geq 250V$  to  $< 500 V$   
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:  $260^{\circ}C$  convection reflow  
Standard: JEDEC Standard IPC/JEDEC J-STD-020

### Solderability

Compatible with both lead-free ( $260^{\circ}C$  maximum reflow temperature) and tin/lead ( $245^{\circ}C$  maximum reflow temperature) soldering processes.

Contact plating: Annealed Matte Tin

### 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 Qorvo:

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Email: [info-sales@qorvo.com](mailto:info-sales@qorvo.com) Fax: +1.503.615.8902

For technical questions and application information:

Email: [sjapplications.engineering@qorvo.com](mailto:sjapplications.engineering@qorvo.com)

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- Оперативные сроки поставки под заказ (от 5 рабочих дней);
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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;
- 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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