

# TQP7M9101

## ¼W High Linearity Amplifier

### Applications

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

### Product Features

- 400-4000 MHz
- +25 dBm P1dB
- +39.5 dBm Output IP3
- 17.5 dB Gain at 2140 MHz
- +5V Single Supply, 87 mA Current
- No output matching required
- Internal RF overdrive protection
- Internal DC overvoltage protection
- On chip ESD protection
- SOT-89 Package

### General Description

The TQP7M9101 is a high-linearity driver amplifier in a standard SOT-89 surface mount package. This InGaP/GaAs HBT delivers high performance across a broad range of frequencies with +40 dBm OIP3 and with +25 dBm P1dB while only consuming 87 mA quiescent current. All devices are 100% RF and DC tested.

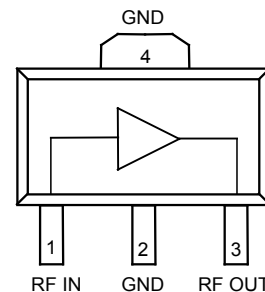
The TQP7M9101 incorporates on-chip features that differentiate it from other products in the market. The RF output is internally matched in to 50 ohms. Only input matching is required for optimal performance in specific frequency bands making the component easy for design engineers to implement in their systems. The amplifier integrates an on-chip DC over-voltage and RF over-drive protection. This protects the amplifier from electrical DC voltage surges and high input RF input power levels that may occur in a system. On-chip ESD protection allows the amplifier to have a very robust Class 2 HBM ESD rating.

The TQP7M9101 is targeted for use as a driver amplifier in wireless infrastructure where high linearity, medium power, and high efficiency are required. The device an excellent candidate for transceiver line cards in current and next generation multi-carrier 3G / 4G base stations.



3-pin SOT-89 Package

### Functional Block Diagram



### Pin Configuration

| Pin # | Symbol          |
|-------|-----------------|
| 1     | RF Input        |
| 3     | RF Output / Vcc |
| 2, 4  | Ground          |

### Ordering Information

| Part No.          | Description                    |
|-------------------|--------------------------------|
| TQP7M9101         | 0.25W High Linearity Amplifier |
| TQP7M9101-PCB900  | 869-960 MHz EVB                |
| TQP7M9101-PCB2140 | 2.11-2.17 GHz EVB              |

Standard T/R size = 1000 pieces on a 7" reel.

## Specifications

### Absolute Maximum Ratings

| Parameter                | Rating         |
|--------------------------|----------------|
| Storage Temperature      | -65 to +150 °C |
| Device Voltage, $V_{cc}$ | +8 V           |
| Maximum Input Power      | +23 dBm        |

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

### Recommended Operating Conditions

| Parameter                      | Min | Typ | Max   | Units |
|--------------------------------|-----|-----|-------|-------|
| $V_{cc}$                       | +3  | +5  | +5.25 | V     |
| $T_{case}$                     | -40 |     | +85   | °C    |
| $T_j$ (for $>10^6$ hours MTTF) |     |     | +170  | °C    |

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

## Electrical Specifications

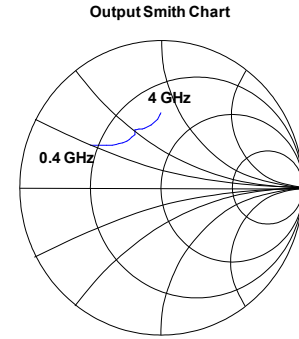
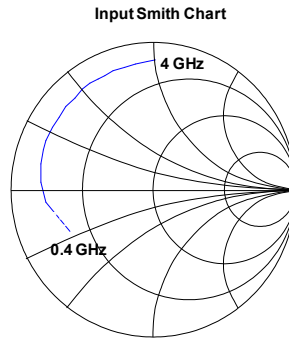
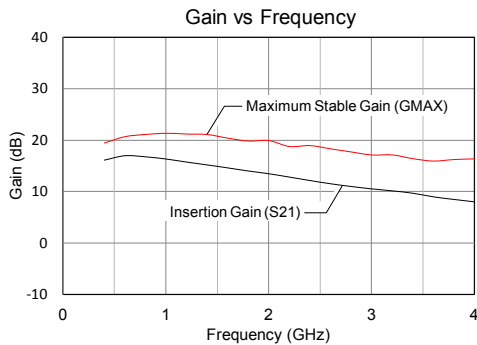
Test conditions unless otherwise noted: +25°C, +5V  $V_{cc}$ , in a tuned application circuit

| Parameter                                      | Conditions                            | Min   | Typical | Max  | Units |
|------------------------------------------------|---------------------------------------|-------|---------|------|-------|
| Operational Frequency Range                    |                                       | 400   |         | 4000 | MHz   |
| Test Frequency                                 |                                       |       | 2140    |      | MHz   |
| Gain                                           |                                       | 15.6  | 17.5    | 18.6 | dB    |
| Input Return Loss                              |                                       |       | 15      |      | dB    |
| Output Return Loss                             |                                       |       | 13.5    |      | dB    |
| Output P1dB                                    |                                       | +23.5 | +25     |      | dBm   |
| Output IP3                                     | +8 dBm/tone, $\Delta f = 1\text{MHz}$ | +36.5 | +39.5   |      | dBm   |
| WCDMA Pout @ -55 dBc ACLR                      | See Note 1.                           |       | +14.5   |      | dBm   |
| Noise Figure                                   |                                       |       | 3.9     |      | dB    |
| $V_{cc}$                                       |                                       |       | 5       |      | V     |
| Quiescent Current, $I_{cq}$                    |                                       | 70    | 87      | 105  | mA    |
| Thermal Resistance (jnc to case) $\theta_{jc}$ |                                       |       |         | 71   | °C/W  |

#### Notes

1. ACLR Test set-up: 3GPP WCDMA, TM1+64 DPCH, +5 MHz offset, PAR = 10.2 dB at 0.01% Prob.

### Device Characterization Data



Note: The gain for the unmatched device in a 50 ohm system is shown as the trace labelled "Insertion Gain (S21)". In a circuit tuned for a particular frequency band, it is expected that actual gain will be higher, up to the Maximum Stable Gain (GMAX).

### S-Parameter Data

$V_{cc} = +5\text{ V}$ ,  $I_{cc} = 87\text{ mA}$ ,  $T = +25^\circ\text{C}$ , unmatched 50 Ohm system, reference plane at device leads

| Freq (MHz) | S11 (dB) | S11 (ang) | S21 (dB) | S21 (ang) | S12 (dB) | S12 (ang) | S22 (dB) | S22 (ang) |
|------------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| 400        | -3.74    | -154.94   | 16.08    | 172.65    | -30.84   | 32.65     | -4.47    | 155.03    |
| 600        | -2.43    | -174.00   | 16.93    | 152.42    | -28.85   | 13.25     | -6.02    | 149.89    |
| 800        | -2.00    | 175.84    | 16.72    | 137.72    | -28.64   | 3.42      | -6.63    | 147.55    |
| 1000       | -1.81    | 167.43    | 16.29    | 123.90    | -28.38   | -4.74     | -7.05    | 144.48    |
| 1200       | -1.71    | 160.50    | 15.71    | 112.48    | -28.45   | -10.23    | -7.29    | 142.81    |
| 1400       | -1.68    | 155.82    | 15.15    | 102.29    | -28.29   | -15.72    | -7.67    | 139.67    |
| 1600       | -1.66    | 149.16    | 14.58    | 91.96     | -28.34   | -19.66    | -7.92    | 136.04    |
| 1800       | -1.65    | 143.36    | 13.98    | 82.32     | -28.40   | -25.64    | -8.05    | 132.86    |
| 2000       | -1.56    | 137.28    | 13.45    | 72.43     | -28.25   | -30.76    | -8.05    | 129.68    |
| 2200       | -1.60    | 131.41    | 12.80    | 64.37     | -28.52   | -35.06    | -7.96    | 125.67    |
| 2400       | -1.43    | 126.29    | 12.14    | 56.45     | -28.43   | -39.47    | -7.47    | 122.90    |
| 2600       | -1.41    | 122.01    | 11.52    | 48.81     | -28.73   | -42.87    | -7.49    | 122.21    |
| 2800       | -1.43    | 117.57    | 10.99    | 41.39     | -28.68   | -47.17    | -7.71    | 119.34    |
| 3000       | -1.45    | 114.12    | 10.53    | 34.73     | -28.78   | -49.96    | -7.92    | 116.57    |
| 3200       | -1.36    | 109.38    | 10.15    | 27.42     | -28.85   | -52.90    | -7.87    | 114.37    |
| 3400       | -1.40    | 103.72    | 9.69     | 19.90     | -29.00   | -59.40    | -7.85    | 106.77    |
| 3600       | -1.32    | 98.51     | 8.99     | 12.40     | -29.04   | -63.10    | -7.32    | 100.14    |
| 3800       | -1.19    | 93.06     | 8.49     | 5.24      | -29.04   | -68.03    | -6.75    | 96.77     |
| 4000       | -1.11    | 89.37     | 8.02     | -0.57     | -29.02   | -70.86    | -6.53    | 95.94     |

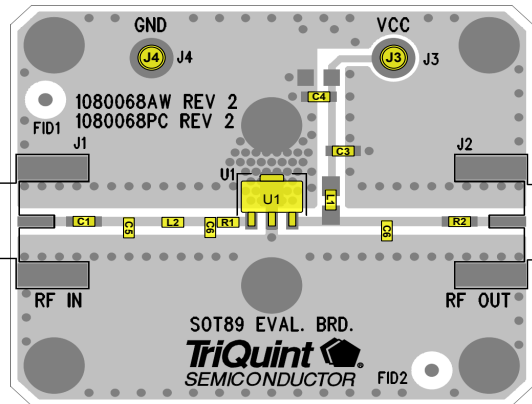
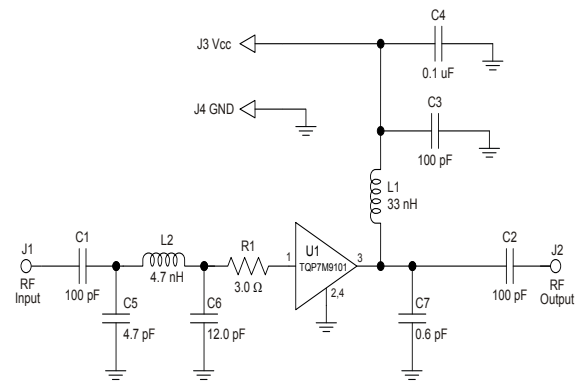
# TQP7M9101

## 1/4 W High Linearity Amplifier



### Reference Design 700-1000 MHz

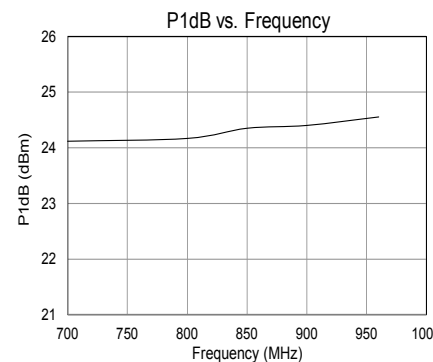
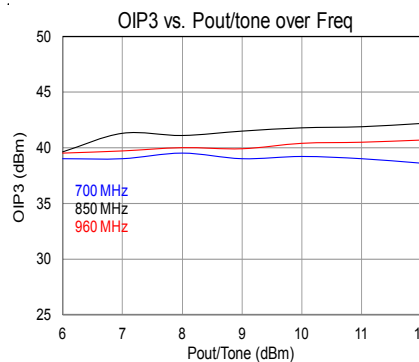
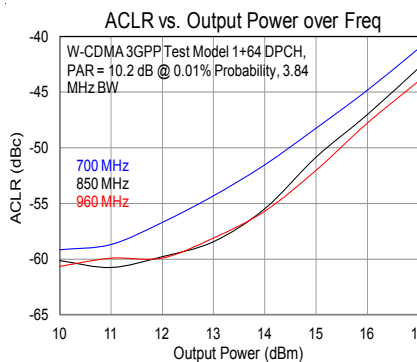
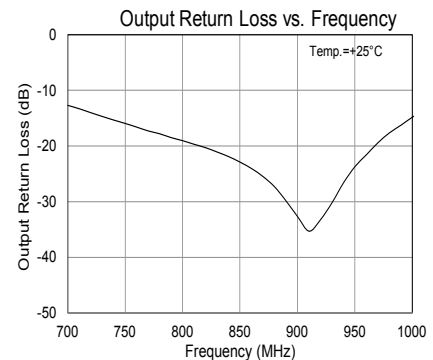
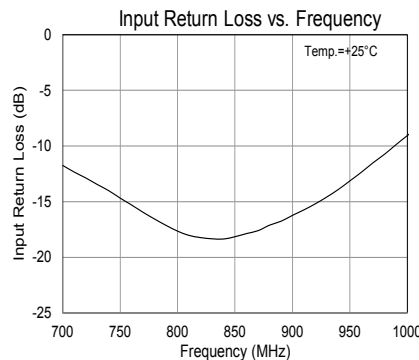
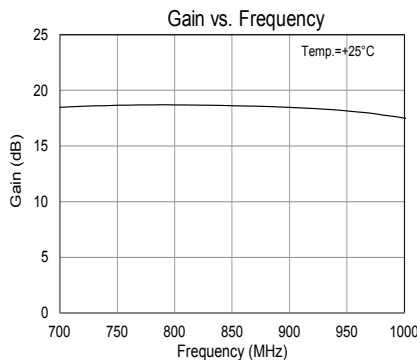
| Frequency (MHz)                       | Units | 700   | 800   | 850   | 900   | 960   |
|---------------------------------------|-------|-------|-------|-------|-------|-------|
| Gain                                  | dB    | 18.5  | 18.7  | 18.6  | 18.5  | 18.2  |
| Input Return Loss                     | dB    | -11.8 | -17.7 | -18.2 | -16.2 | -13.1 |
| Output Return Loss                    | dB    | -12.8 | -19.1 | -22.9 | -32.7 | -23.7 |
| Output P1dB                           | dBm   | +24.1 | +24.2 | +24.4 | +24.4 | +24.6 |
| Output IP3 (+8 dBm/tone, Δf = 1 MHz)  | dBm   | +39.6 | +40.4 | +41.2 | +39.7 | +39.8 |
| WCDMA Channel Power (at -55 dBc ACLR) | dBm   | +12.8 | +13.2 | +13.5 | +14.0 | +14.0 |
| Noise Figure                          | dB    | 5.0   | 5.0   | 5.1   | 5.2   | 5.9   |
| Supply Voltage, Vcc                   | V     | +5    |       |       |       |       |
| Quiescent Collector Current, Icq      | mA    | 85    |       |       |       |       |



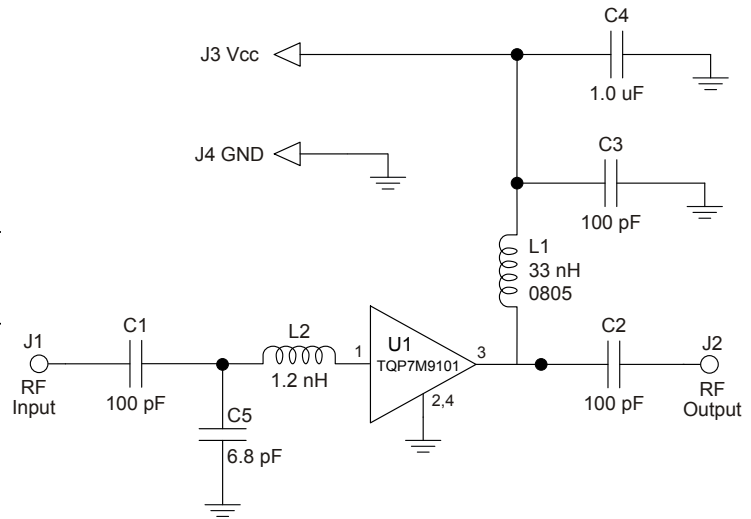
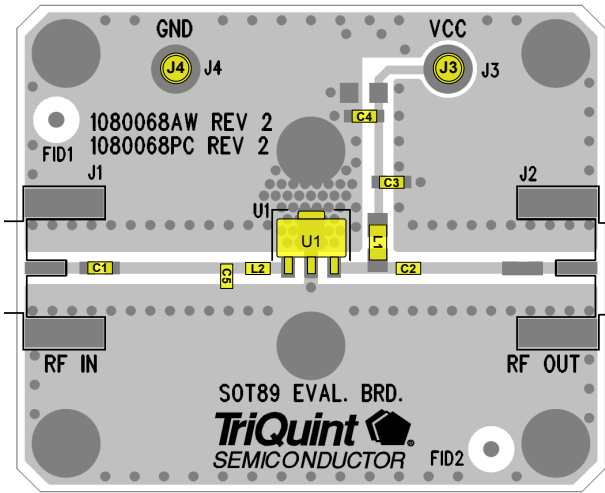
#### Notes:

1. See PC Board Layout, page 11 for more information.
2. All components are of 0603 size unless otherwise stated.
3. Critical component placement locations (referenced center to center):
  - Distance from U1 Pin 1 Pad (left edge) to R1 (right edge): 10 mils (0.5° at 900 MHz)
  - Distance from R1 (left edge) to C6 (right edge): 5 mils (0.2° at 900 MHz)
  - Distance from C6 (left edge) to L2 (right edge): 60 mils (2.8° at 900 MHz)
  - Distance from L2 (left edge) to C5 (right edge): 60 mils (2.8° at 900 MHz)
  - Distance from U1 Pin 3 Pad (right edge) to C7 (left edge): 250 mils (11.7° at 900 MHz)

### RF Performance Plots 700-1000 MHz



### Application Circuit 869-960 MHz (TQP7M9101-PCB900)



**Notes:**

1. See PC Board Layout, page 11 for more information.
2. Component (C2) is a blocking capacitor and its location is not critical to the matching network.
3. The recommended component values are dependent upon the frequency of operation.
4. All components are of 0603 size unless stated on the schematic.
5. Critical component placement locations:
  - Distance from U1 Pin 1 Pad (left edge) to L2 (right edge): 30 mils (1.6° at 920 MHz)
  - Distance from L2 (left edge) to C5 (right edge): 40 mils (2.1° at 920 MHz)

### Bill of Material

| Ref Des    | Value  | Description                              | Manuf.        | Part Number    |
|------------|--------|------------------------------------------|---------------|----------------|
| n/a        | n/a    | Printed Circuit Board                    | TriQuint      | 1080068        |
| U1         | n/a    | Amplifier, SOT-89 pkg.                   | TriQuint      | 1077935        |
| L1         | 33 nH  | Inductor, 0805, 5%, Coilcraft CS Series  | Coilcraft     | 0805CS-330XJLB |
| L2         | 1.2 nH | Inductor, Chip, 0603                     | various       |                |
| C1, C2, C3 | 100 pF | Cap., Chip, 5%, 50V, NPO/COG             | various       |                |
| C4         | 1.0 uF | Cap., Chip, 10%, 10V, X5R                | various       |                |
| C5         | 6.8 pF | Cap., Chip, 0603, +/-0.1pF. 200V NPO/COG | AVX           |                |
| J1, J2     | n/a    | RF SMA Connector                         | Johnson Comp. | 142-0701-851   |
| J3, J4     | n/a    | Solder Turret                            | various       |                |

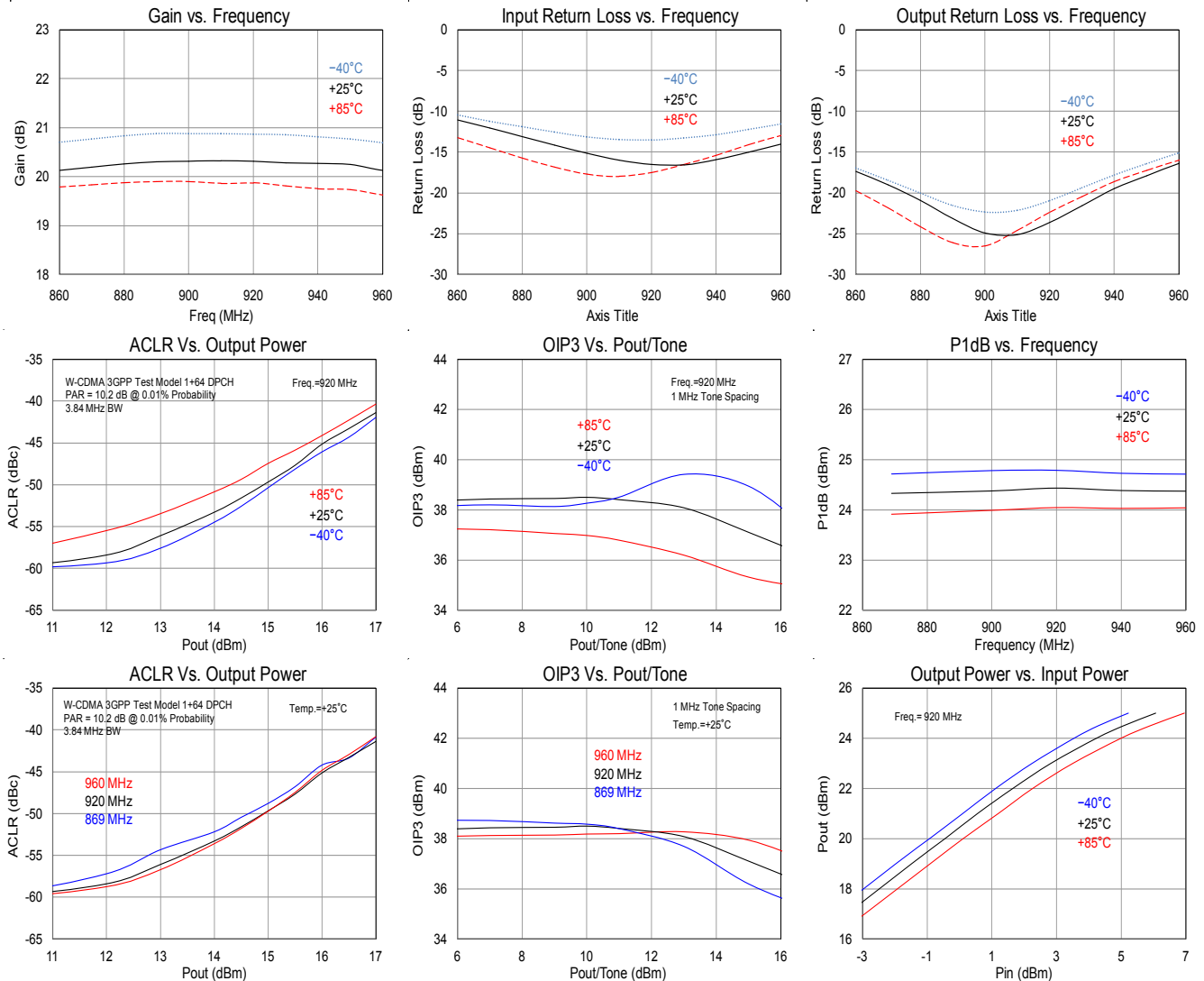
### Typical Performance 869-960 MHz (TQP7M9101-PCB900)

| Frequency                                 | MHz | 869   | 920   | 960   |
|-------------------------------------------|-----|-------|-------|-------|
| Gain                                      | dB  | 20.2  | 20.4  | 20.1  |
| Input Return Loss                         | dB  | 12    | 17    | 14    |
| Output Return Loss                        | dB  | 18    | 23    | 17    |
| Output P1dB                               | dBm | +24.3 | +24.4 | +24.4 |
| Output IP3 (+8 dBm/tone, Δf = 1 MHz)      | dBm | +39.2 | +38.6 | +38.2 |
| WCDMA Channel Power (at -55 dBc ACLR) [1] | dBm | +12.7 | +13.4 | +13.5 |
| Noise Figure                              | dB  | 4.0   | 4.0   | 3.9   |
| Supply Voltage, Vcc                       | V   | +5    |       |       |
| Quiescent Collector Current, Icq          | mA  | 87    |       |       |

Notes:

1. ACLR Test set-up: 3GPP WCDMA, TM1+64 DPCH, +5 MHz offset, PAR = 10.2 dB at 0.01% Prob.

### RF Performance Plots 869-960 MHz (TQP7M9101-PCB900)



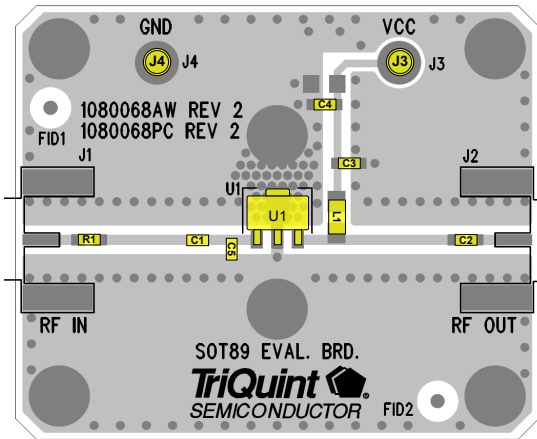
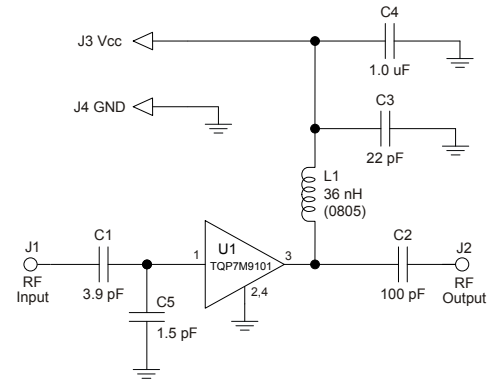
# TQP7M9101

## 1/4 W High Linearity Amplifier



### Reference Design 1805-1990 MHz

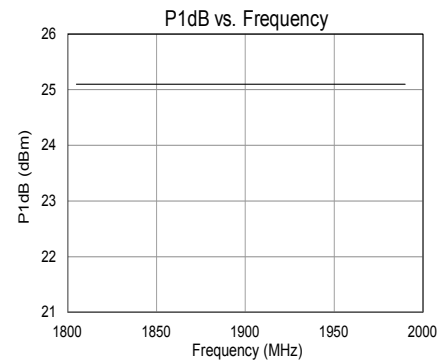
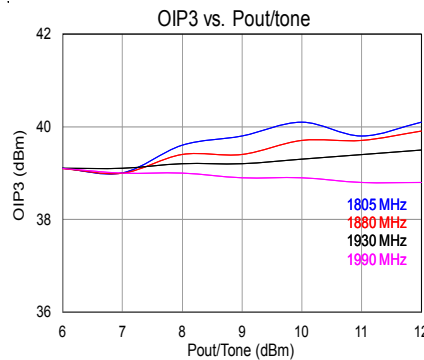
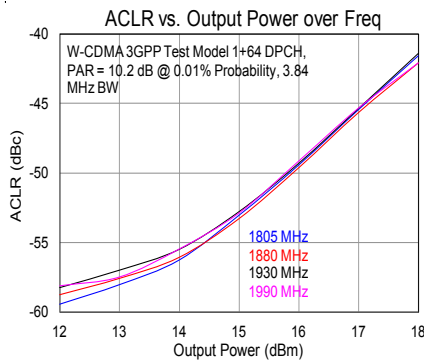
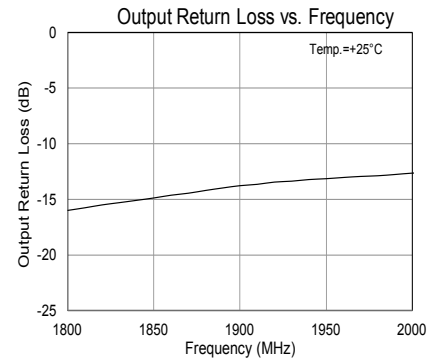
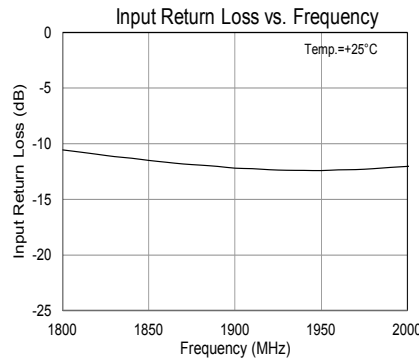
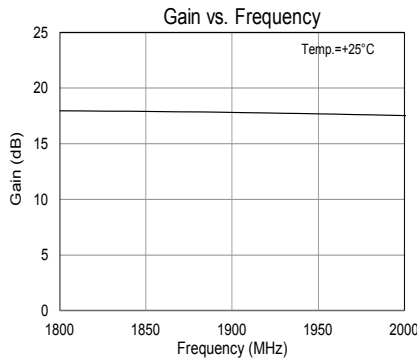
| Frequency (MHz)                       | Units | 1805  | 1850  | 1880  | 1930  | 1960  | 1990  |
|---------------------------------------|-------|-------|-------|-------|-------|-------|-------|
| Gain                                  | dB    | 18.0  | 17.9  | 17.9  | 17.7  | 17.7  | 17.6  |
| Input Return Loss                     | dB    | -10.7 | -11.5 | -11.9 | -12.4 | -12.4 | -12.2 |
| Output Return Loss                    | dB    | -15.8 | -14.9 | -14.2 | -13.4 | -13.1 | -12.8 |
| Output P1dB                           | dBm   | +25.  | +25.1 | +25.1 | +25.1 | +25.1 | +25.1 |
| Output IP3 (+8 dBm/tone, Δf = 1 MHz)  | dBm   | +39.7 | +39.6 | +39.5 | +39.2 | +38.7 | +39.1 |
| WCDMA Channel Power (at -55 dBc ACLR) | dBm   | +14.5 | +14.5 | +14.4 | +14.3 | +14.0 | +14.1 |
| Supply Voltage, Vcc                   | V     | +5    |       |       |       |       |       |
| Quiescent Collector Current, Icq      | mA    | 87    |       |       |       |       |       |



#### Notes:

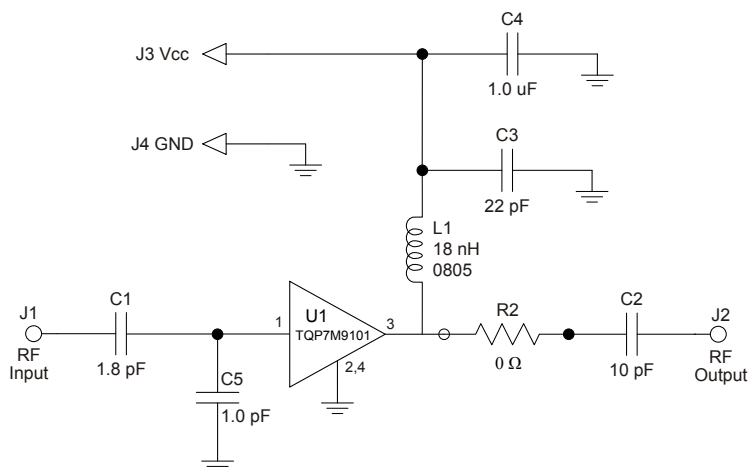
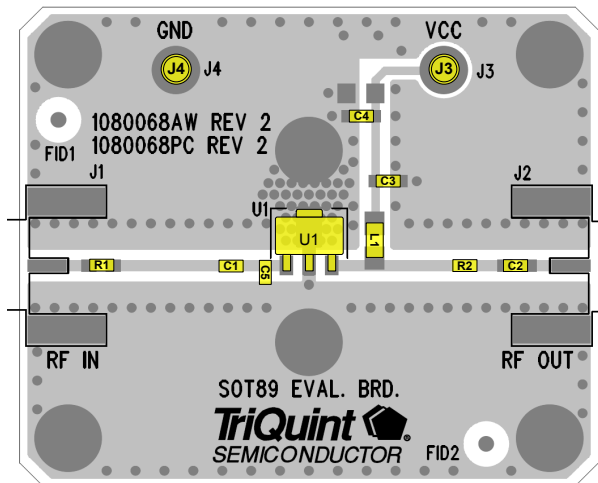
1. See PC Board Layout, page 11 for more information.
2. Component R1 on the PCB is a (0 Ω) Resistor and may be replaced by a copper trace
3. All components are of 0603 size unless otherwise stated.
4. Critical component placement locations (referenced center to center):  
 Distance from U1 Pin 1 Pad (left edge) to C5 (right edge): 35 mils (3.5° at 1900 MHz)  
 Distance from C5 (left edge) to C1 (right edge): 45 mils (4.5° at 1900 MHz)

### RF Performance Plots 1805-1990 MHz





### Application Circuit 2110-2170 MHz (TQP7M9101-PCB2140)



**Notes:**

1. See PC Board Layout, page 11 for more information.
2. Components shown on the silkscreen but not on the schematic are not used.
3. Component (R1) is a 0 Ω resistors and may be replaced with copper trace in the target application layout.
4. The recommended component values are dependent upon the frequency of operation.
5. All components are of 0603 size unless stated on the schematic.
6. Critical component placement locations:  
 Distance from U1 Pin 1 Pad (left edge) to C5 (right edge): 40 mils (4.5° at 2140 MHz)  
 Distance from C5 (left edge) to C1 (right edge): 45 mils (5.0° at 2140 MHz)  
 Distance from U1 Pin 3 (right edge) to R2 (left edge): 295 mils (32.9° at 2140 MHz)  
 Distance from R2 (right edge) to C2 (left edge): 95 mils (10.6° at 2140 MHz)

### Bill of Material

| Ref Des | Value  | Description                               | Manuf.        | Part Number    |
|---------|--------|-------------------------------------------|---------------|----------------|
| n/a     | n/a    | Printed Circuit Board                     | TriQuint      | 1080068        |
| U1      | n/a    | Amplifier, SOT-89 pkg.                    | TriQuint      | TQP7M9101      |
| R1, R2  | 0 Ω    | Resistor, Chip, 0603, 5%, 1/16W           | various       |                |
| L1      | 18 nH  | Inductor, 0805, 5%, Coilcraft CS Series   | Coilcraft     | 0805CS-180XJLB |
| C1      | 1.8 pF | Cap., Chip, 0603, +/-0.1pF. 200V. NPO/COG | AVX           | 06032U1R8BAT2A |
| C5      | 1.0 pF | Cap., Chip, 0603, +/-0.1pF. 200V. NPO/COG | AVX           | 06032U1R0BAT2A |
| C2      | 10 pF  | Cap., Chip, 0603, +/-1%. 200V NPO/COG     | AVX           | 06032U100FAT2A |
| C3      | 22 pF  | Cap., Chip, 5%, 50V, NPO/COG              | various       |                |
| C4      | 1.0 uF | Cap., Chip, 10%, 10V, X5R                 | various       |                |
| J1, J2  | n/a    | RF SMA Connector                          | Johnson Comp. | 142-0701-851   |
| J3, J4  | n/a    | Solder Turret                             | various       |                |



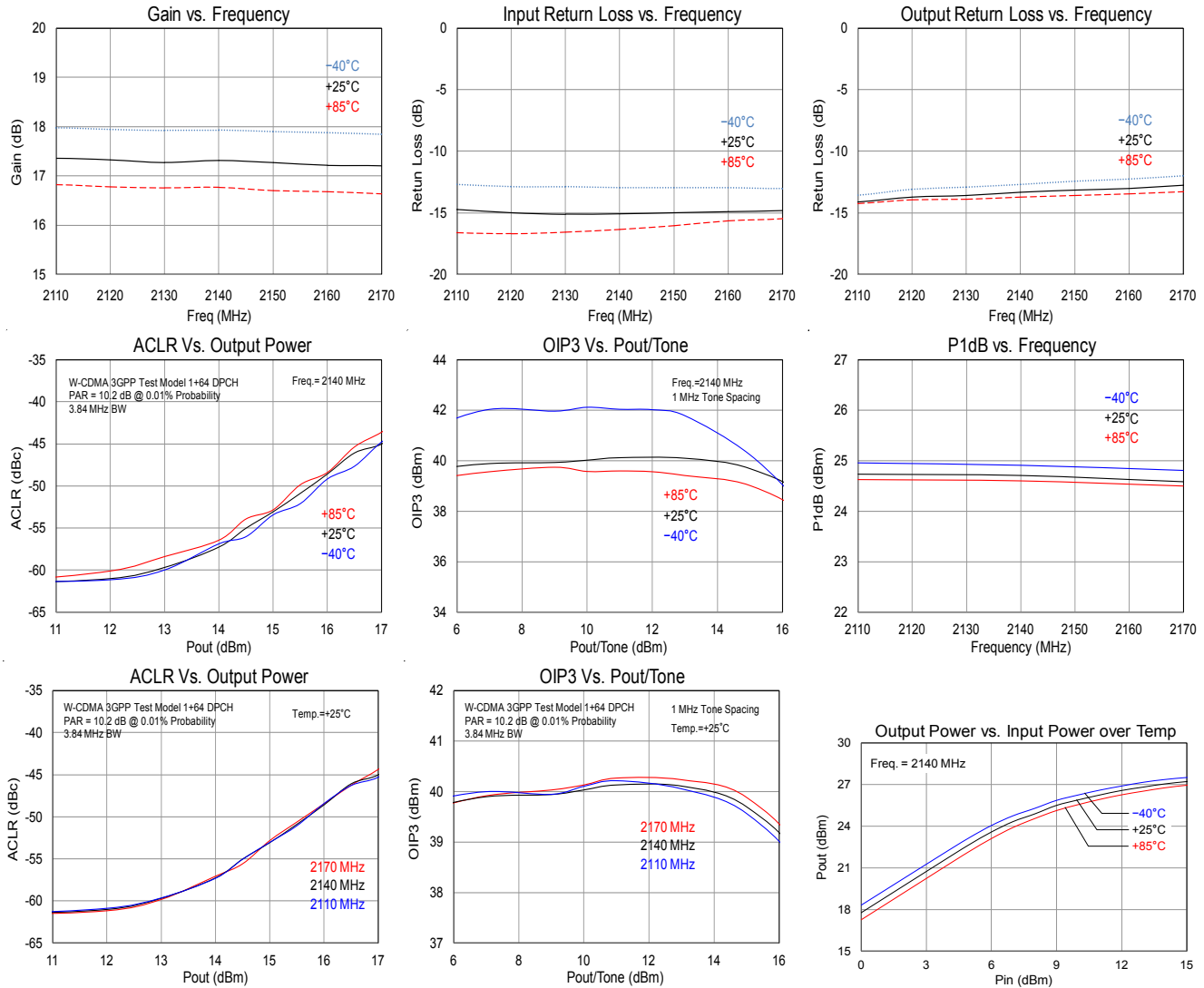
### Typical Performance 2110-2170 MHz (TQP7M9101-PCB2140)

| Frequency                                          | MHz | 2110  | 2140  | 2170  |
|----------------------------------------------------|-----|-------|-------|-------|
| Gain                                               | dB  | 17.6  | 17.5  | 17.4  |
| Input Return Loss                                  | dB  | 15    | 15    | 15    |
| Output Return Loss                                 | dB  | 14    | 13.5  | 13    |
| Output P1dB                                        | dBm | +24.8 | +24.8 | +24.6 |
| Output IP3 (+8 dBm/tone, Δf = 1 MHz)               | dBm | +39.5 | +39.5 | +39.5 |
| WCDMA Channel Power (at -55 dBc ACLR) <sup>1</sup> | dBm | +14.5 | +14.5 | +14.5 |
| Noise Figure                                       | dB  | 4.0   | 3.9   | 4.1   |
| Supply Voltage, Vcc                                | V   | +5    |       |       |
| Quiescent Collector Current, Icq                   | mA  | 87    |       |       |

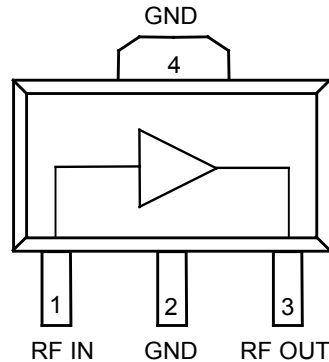
Notes:

1. ACLR Test set-up: 3GPP WCDMA, TM1+64 DPCH, +5 MHz offset, PAR = 10.2 dB at 0.01% Prob.

### RF Performance Plots 2110-2170 MHz (TQP7M9101-PCB2140)



## Pin Configuration and Description

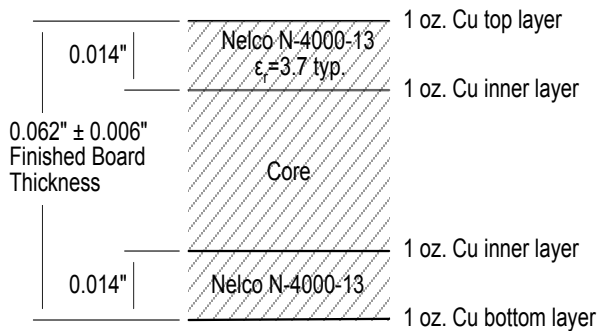


| Pin  | Symbol      | Description                                                                      |
|------|-------------|----------------------------------------------------------------------------------|
| 1    | RF IN       | RF Input. Requires conjugate match for optimal performance.                      |
| 2, 4 | GND         | RF/DC Ground Connection                                                          |
| 3    | RFout / Vcc | RF Output, matched to 50 ohms. External DC Block and supply voltage is required. |

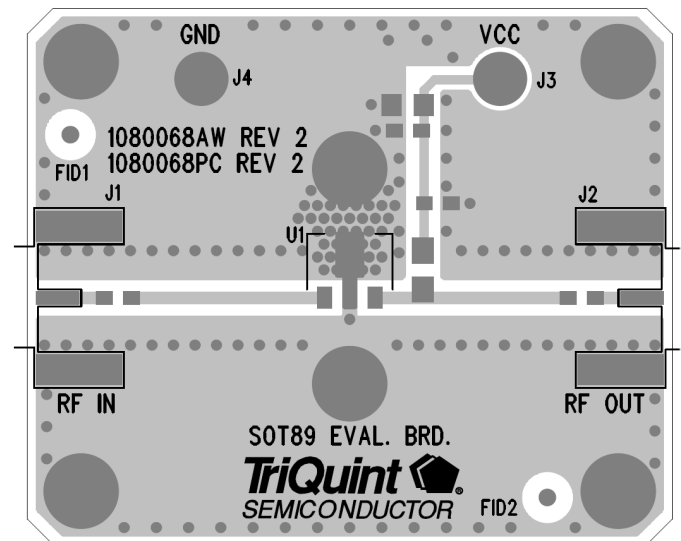
## Evaluation Board PCB Information

### PC Board Layout

TriQuint PCB 1080068 Material and Stack-up



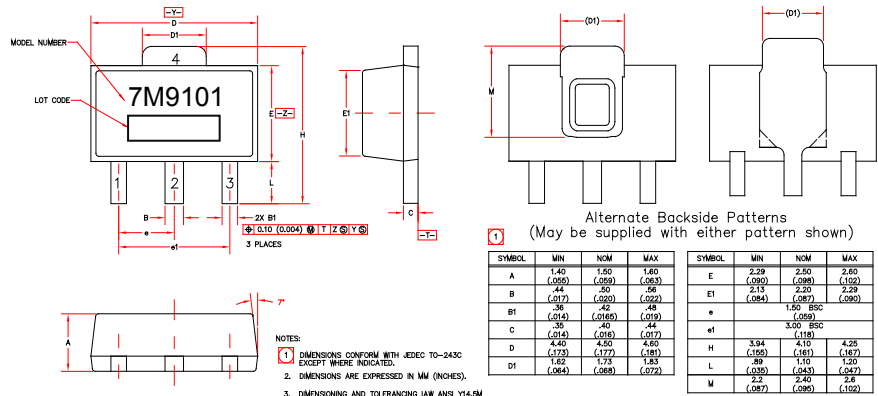
50 ohm line dimensions: width = .031"  
Spacing = .035".



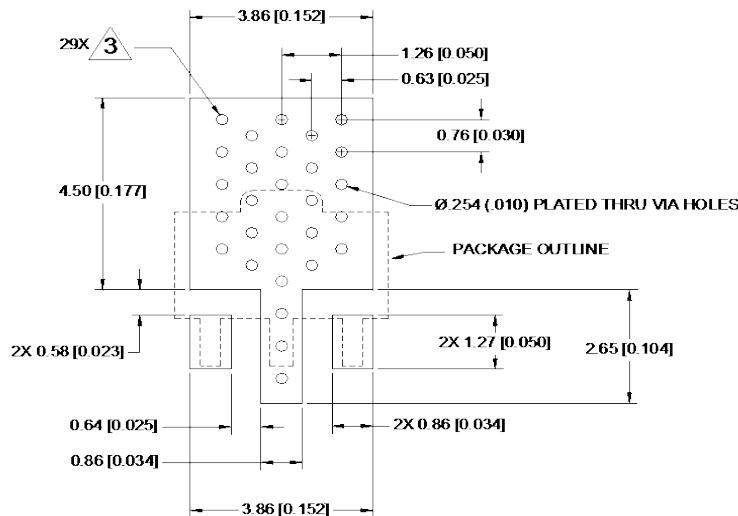
### Mechanical Information

#### Package Marking and Dimensions

The component will be marked with a "7M9101" designator with an alphanumeric lot code on the top surface of package.



#### PCB Mounting Pattern



#### NOTES:

1. 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 supplier to supplier, careful process development is recommended.
2. All dimensions are in millimeters [inches]. Angles are in degrees.
3. Use 1 oz. copper minimum for top and bottom layer metal.
4. 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 0.25mm (0.10").
5. Ensure good package backside paddle solder attach for reliable operation and best electrical performance.
6. Place mounting screws near the part to fasten a back side heat sink.
7. Do not apply solder mask to the back side of the PC board in the heat sink contact region.
8. Ensure that the backside via region makes good physical contact with the heat sink.

## Product Compliance Information

### ESD Information



**Caution! ESD-Sensitive Device**

ESD Rating: Class 2  
Value:  $\geq 2000V$  to  $< 4000V$   
Test: Human Body Model (HBM)  
Standard: JEDEC Standard JESD22-A114

ESD Rating: Class IV  
Value:  $\geq 2000V$   
Test: Charged Device Model (CDM)  
Standard: JEDEC Standard JESD22-C101

### MSL Rating

The part is rated Moisture Sensitivity Level 3 at 260°C per JEDEC standard IPC/JEDEC J-STD-020.

### Solderability

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

Package lead 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<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) 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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