

### Applications

- Repeaters
- BTS Transceivers
- BTS High Power Amplifiers
- CDMA / WCDMA / LTE
- General Purpose Wireless

### Product Features

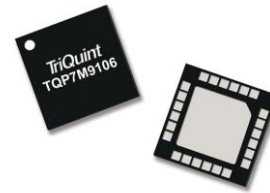
- 50–1500 MHz
- +33 dBm P1dB at 940 MHz
- +50 dBm Output IP3 at 940 MHz
- 20.8 dB Gain at 940 MHz
- +5V Single Supply, 455 mA Current
- Patented internal RF overdrive protection
- Patented internal DC overvoltage protection
- On chip ESD protection
- Shut-down capability
- Capable of handling 10:1 VSWR at  $V_{cc}=+5$  V, 0.9 GHz, 33 dBm CW Pout or 23.5 dBm WCDMA Pout

### General Description

The TQP7M9106 is a high linearity, high gain 2W driver amplifier in industry standard, RoHS compliant, QFN surface mount package. This InGaP/GaAs HBT delivers high performance across 0.05 to 1.5 GHz range of frequencies while achieving 20.8 dB gain, +50 dBm OIP3 and +33 dBm P1dB at 940MHz while only consuming 455 mA quiescent current. All devices are 100% RF and DC tested.

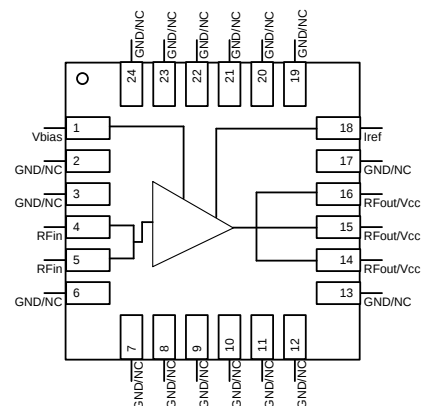
The TQP7M9106 incorporates patented on-chip circuit techniques that differentiate it from other products in the market. The amplifier integrates an on-chip DC over-voltage and RF over-drive protection. This protects the amplifier from electrical DC voltage surges and high input RF input power levels that may occur in a system.

The TQP7M9106 is targeted for use as a driver amplifier in wireless infrastructure where high linearity, medium power, and high efficiency are required. The device is an excellent candidate for transceiver line cards and high power amplifiers in current and next generation multi-carrier 3G / 4G base stations.



24 Pin 4x4 mm QFN Package

### Functional Block Diagram



### Pin Configuration

| Pin No.               | Symbol    |
|-----------------------|-----------|
| 1                     | Vbias     |
| 4, 5                  | RFin      |
| 14, 15, 16            | RFout/Vcc |
| 18                    | Iref      |
| 2, 3, 6-13, 17, 19-24 | GND/NC    |

### Ordering Information

| Part No.         | Description                  |
|------------------|------------------------------|
| TQP7M9106        | 2 W High Linearity Amplifier |
| TQP7M9106-PCB900 | 920–960 MHz Evaluation Board |

Standard T/R size = 2500 pieces on a 13" reel.

## Absolute Maximum Ratings

| Parameter                         | Rating       |
|-----------------------------------|--------------|
| Storage Temperature               | -65 to 150°C |
| RF Input Power, CW, 50Ω, T=25°C   | +30 dBm      |
| Device Voltage (V <sub>CC</sub> ) | +8 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>CC</sub> )  | 4.75 | 5.0 | 5.25 | V     |
| Case Temperature                   | -40  |     | +85  | °C    |
| Tj for >10 <sup>6</sup> hours MTTF |      |     | +170 | °C    |

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

## Electrical Specifications

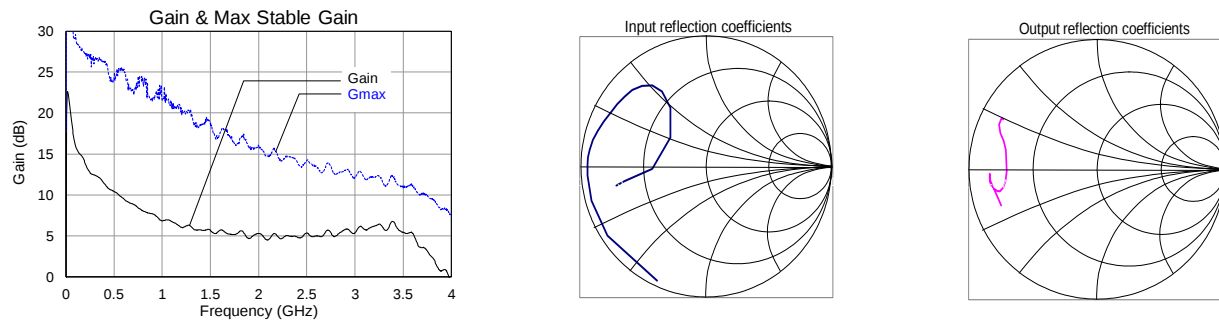
Test conditions unless otherwise noted: V<sub>CC</sub>=+5 V, Temp= +25°C, tuned application circuit

| Parameter                             | Conditions                      | Min | Typ   | Max  | Units |
|---------------------------------------|---------------------------------|-----|-------|------|-------|
| Operational Frequency Range           |                                 | 50  |       | 1500 | MHz   |
| Test Frequency                        |                                 |     | 940   |      | MHz   |
| Gain                                  |                                 | 19  | 20.8  | 22   | dB    |
| Input Return Loss                     |                                 |     | 9.2   |      | dB    |
| Output Return Loss                    |                                 |     | 12.7  |      | dB    |
| Output P1dB                           |                                 | 32  | +33.1 |      | dBm   |
| Output IP3                            | Pout = +17 dBm/tone, Δf = 1 MHz | +46 | +50.3 |      | dBm   |
| WCDMA Channel Power                   | ACLR=-50 dBc <sup>(1)</sup>     |     | +23.5 |      | dBm   |
| Noise Figure                          |                                 |     | 4.8   |      | dB    |
| Quiescent Current (I <sub>CQ</sub> )  |                                 | 360 | 455   | 510  | mA    |
| Reference Current (I <sub>ref</sub> ) |                                 |     | 8.9   |      | mA    |
| Thermal Resistance, θ <sub>jc</sub>   | Junction to case                |     | 17.2  |      | °C/W  |

Notes:

1. ACLR Test set-up: 3GPP WCDMA, TM1+64 DPCH, +5 MHz offset, PAR = 9.7 dB at 0.01% Prob.

## Device Characterization Data



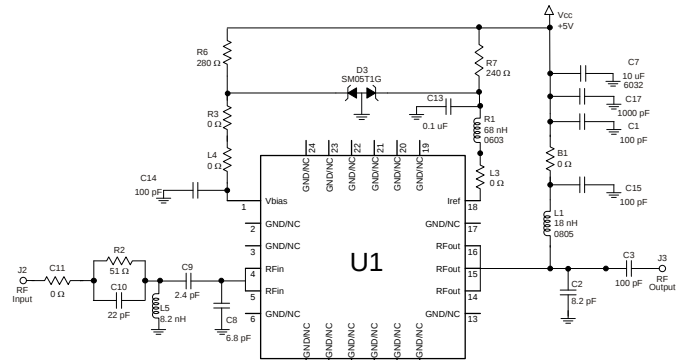
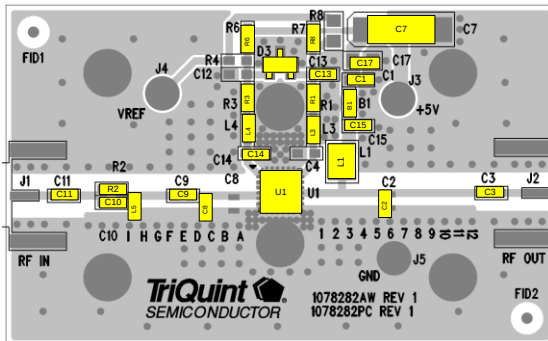
Note: The gain for the unmatched device in 50 ohm system is shown as the trace in black color, [gain (S(21))]. For a tuned circuit for a particular frequency, it is expected that actual gain will be higher, up to the maximum stable gain. The maximum stable gain is shown as the blue trace [Gmax]. The impedance plots are shown from 0.05 – 4 GHz.

## S-Parameters

Test Conditions:  $V_{CC}=+5$  V,  $I_{CQ}=450$  mA,  $T=+25^{\circ}$ C, unmatched 50 ohm system, calibrated to device leads

| Freq (GHz) | S11 (dB) | S11 (ang) | S21 (dB) | S21 (ang) | S12 (dB) | S12 (ang) | S22 (dB) | S22 (ang) |
|------------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| 0.05       | -0.44    | -114.25   | 19.78    | 144.69    | -42.10   | 39.11     | -1.98    | -159.88   |
| 0.1        | -0.52    | -146.09   | 16.00    | 138.73    | -43.22   | 20.45     | -1.71    | -170.16   |
| 0.2        | -0.50    | -164.26   | 13.87    | 132.03    | -40.75   | 6.76      | -1.50    | -175.13   |
| 0.4        | -0.54    | -176.18   | 11.35    | 121.63    | -40.83   | 3.60      | -1.55    | -177.80   |
| 0.6        | -0.53    | 178.67    | 9.50     | 112.30    | -41.24   | 0.84      | -1.56    | -176.22   |
| 0.8        | -0.56    | 175.24    | 8.04     | 104.69    | -40.31   | 1.88      | -1.53    | -175.02   |
| 1.0        | -0.62    | 171.69    | 6.85     | 98.63     | -39.99   | 3.20      | -1.53    | -173.42   |
| 1.2        | -0.72    | 167.05    | 6.03     | 91.72     | -39.96   | 4.12      | -1.56    | -172.13   |
| 1.4        | -0.89    | 162.02    | 5.70     | 85.91     | -39.07   | 0.13      | -1.69    | -171.07   |
| 1.6        | -1.08    | 156.59    | 5.69     | 79.97     | -37.92   | -5.54     | -1.79    | -169.68   |
| 1.8        | -1.27    | 150.93    | 5.48     | 72.26     | -37.57   | -7.78     | -1.95    | -168.21   |
| 2.0        | -1.38    | 145.46    | 5.28     | 63.03     | -36.04   | -20.25    | -2.21    | -167.59   |
| 2.2        | -1.48    | 139.99    | 4.89     | 53.16     | -36.36   | -23.44    | -2.57    | -169.42   |
| 2.4        | -1.62    | 134.72    | 4.85     | 45.77     | -35.84   | -33.51    | -2.83    | -173.07   |
| 2.6        | -1.90    | 129.34    | 5.02     | 36.67     | -34.86   | -43.30    | -3.01    | -178.95   |
| 2.8        | -2.39    | 124.31    | 4.93     | 26.06     | -34.10   | -48.61    | -2.94    | 174.59    |
| 3.0        | -3.38    | 121.03    | 5.32     | 14.17     | -33.25   | -62.68    | -2.76    | 167.99    |
| 3.2        | -5.41    | 121.85    | 6.17     | -3.37     | -32.23   | -83.93    | -2.38    | 163.09    |
| 3.4        | -8.79    | 141.69    | 6.71     | -26.85    | -31.82   | -110.34   | -1.88    | 159.52    |
| 3.6        | -7.36    | -178.09   | 5.31     | -52.42    | -32.46   | -138.25   | -1.53    | 155.58    |
| 3.8        | -3.69    | -170.72   | 0.70     | -76.13    | -36.73   | -172.04   | -1.47    | 151.81    |
| 4.0        | -2.78    | -168.72   | -0.74    | -86.65    | -37.56   | 176.73    | -1.65    | 152.04    |

**TQP7M9106-PCB900 Evaluation Board (920-960 MHz)**



**Notes:**

- Components shown on the silkscreen but not on the schematic are not used.
- 0  $\Omega$  resistor can be replaced with copper trace in the target application layout.
- To power down the device, voltage can be applied to  $V_{ref}$  to control  $I_{ref}$  by placing resistor R8 and removing R7.
- The recommended component values are dependent upon the frequency of operation.
- All components are of 0603 size unless stated on the schematic.
- R1 is critical for device linearity performance.
- Critical component placement locations:  
Distance between center of C8 and TQP7M9106 (U1) device package is 243 mil (11.7° at 940MHz)  
Distance between center of L5 and TQP7M9106 (U1) device package is 452 mil (21.8° at 940MHz)  
Distance between center of C9 and TQP7M9106 (U1) device package is 275 mil (13.3° at 940MHz)  
Distance between center of C2 and TQP7M9106 (U1) device package is 355 mil (17.2° at 940MHz)

**Bill of Material – TQP7M9106-PCB900**

| Reference Des.      | Value        | Description                                        | Manuf.    | Part Number    |
|---------------------|--------------|----------------------------------------------------|-----------|----------------|
| U1                  | n/a          | 2W High Linearity Amplifier                        | TriQuint  | TQP7M9106      |
| n/a                 | n/a          | Printed Circuit Board                              | TriQuint  |                |
| D3                  | n/a          | Zener, dual, SOT-23                                | various   |                |
| B1, L3, L4, R3, C11 | 0 $\Omega$   | Resistor, Chip, 0603, 5%, 1/16W                    | various   |                |
| R2                  | 51 $\Omega$  | Resistor, Chip, 0603, 5%, 1/16W                    | various   |                |
| R6                  | 280 $\Omega$ | Resistor, Chip, 0603, 1%, 1/16W                    | various   |                |
| R7                  | 240 $\Omega$ | Resistor, Chip, 0603, 1%, 1/16W                    | various   |                |
| C2                  | 8.2 pF       | Capacitor, Chip, 0603, $\pm 0.05$ pF, 50 V, Accu-P | AVX       | 06035J8R2ABSTR |
| C7                  | 10 uF        | Capacitor, Tantalum, 6032, 35V, 10%                | various   |                |
| C8                  | 6.8pF        | Capacitor, Chip, 0603, $\pm 0.05$ pF, 50 V, Accu-P | AVX       | 06035J6R8ABSTR |
| C9                  | 2.4 pF       | Capacitor, Chip, 0603, $\pm 0.05$ pF, 50 V, Accu-P | AVX       | 06035J2R4ABSTR |
| C10                 | 22 pF        | Capacitor, Chip, 0603, 5%, 50 V, NPO/COG           | various   |                |
| C1, C3, C14, C15    | 100 pF       | Capacitor, Chip, 0603, 5%, 50V, NPO/COG            | various   |                |
| C13                 | 0.1 uF       | Capacitor, Chip, 0603, 50V, X5R, 10%               | various   |                |
| C17                 | 1000 pF      | Capacitor, Chip, 0603, 10%, 50V, NPO/COG           | various   |                |
| L1                  | 18 nH        | Inductor, 0805, 5%, Coilcraft CS Series            | Coilcraft | 0805CS-180XJLB |
| L5                  | 8.2 nH       | Inductor, 0603, 5%                                 | Toko      | LL1608-FSL8N2  |
| R1                  | 68 nH        | Inductor, 0603, 5%                                 | Toko      | LL1608-FSL68N  |
| R4, C12, C4         | n/a          | Do Not Place                                       |           |                |

### Typical Performance – TQP7M9106-PCB900

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

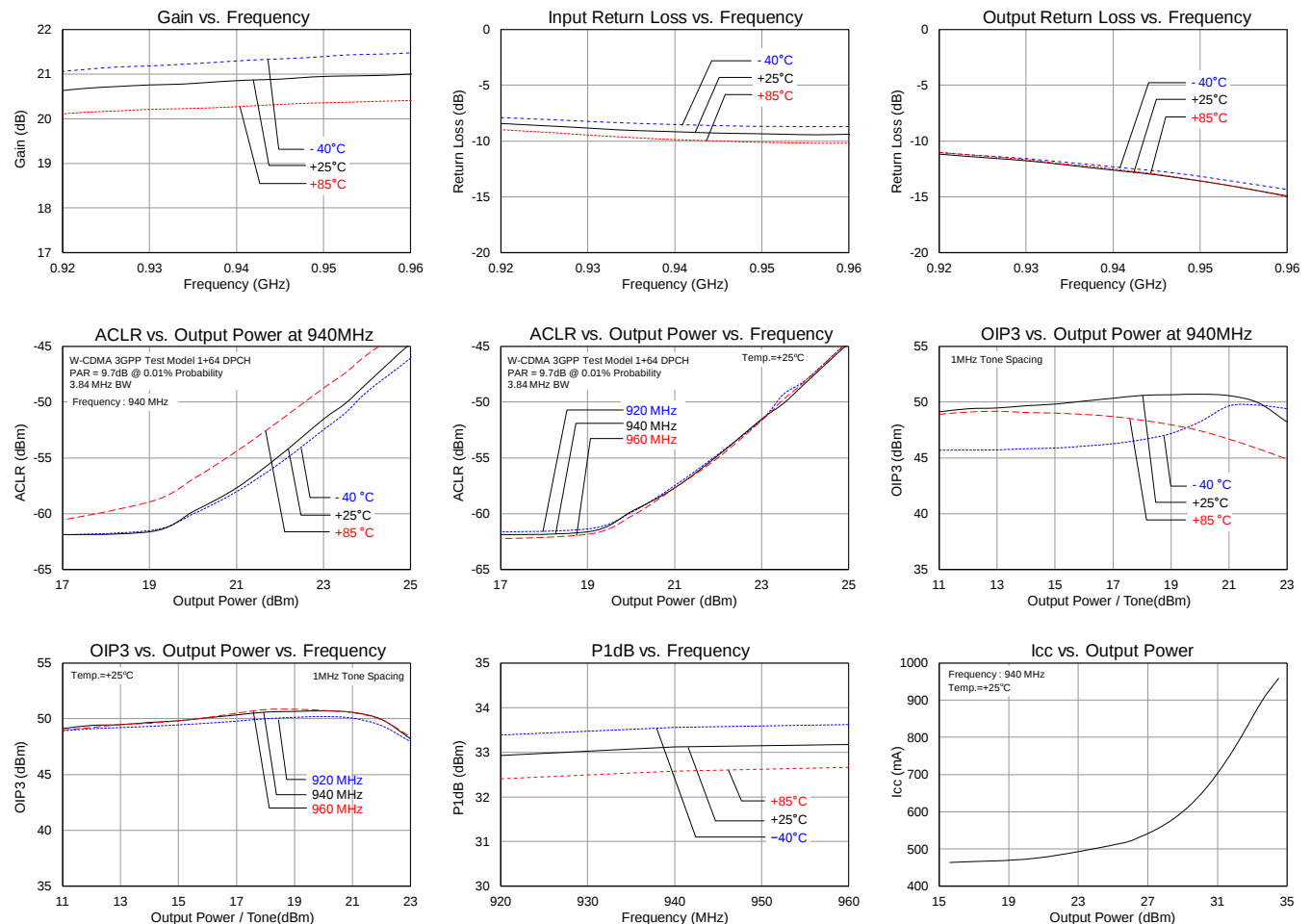
| Parameter                             | Conditions                                   | Typical Value |       |       | Units |
|---------------------------------------|----------------------------------------------|---------------|-------|-------|-------|
| Frequency                             |                                              | 920           | 940   | 960   | MHz   |
| Gain                                  |                                              | 20.6          | 20.8  | 21    | dB    |
| Input Return Loss                     |                                              | 8.5           | 9.2   | 9.4   | dB    |
| Output Return Loss                    |                                              | 11.3          | 12.7  | 14.9  | dB    |
| Output P1dB                           |                                              | +32.9         | +33.1 | +33.2 | dBm   |
| Output IP3                            | $P_{out} = +17$ dBm/tone, $\Delta f = 1$ MHz | +49.8         | +50.3 | +50.5 | dBm   |
| WCDMA Channel Power                   | ACLR= $-50$ dBc <sup>(1)</sup>               | +23.3         | +23.5 | +23.5 | dBm   |
| Noise Figure                          |                                              | 4.8           | 4.8   | 4.8   | dB    |
| Quiescent Collector Current, $I_{CQ}$ |                                              |               | 455   |       | mA    |

Notes:

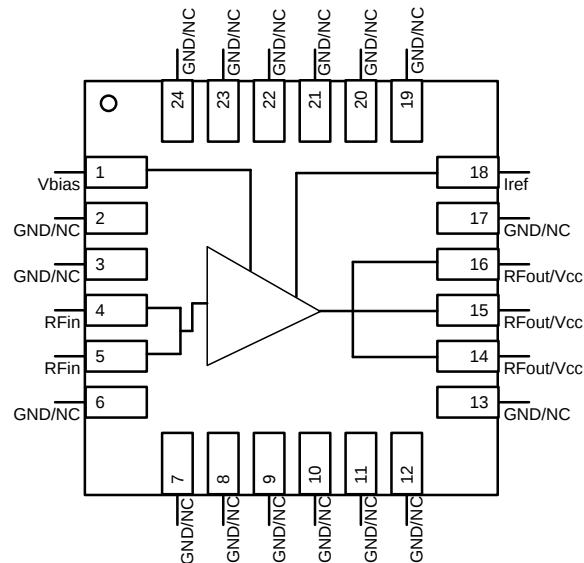
1. ACLR Test set-up: 3GPP WCDMA, TM1+64 DPCH, +5 MHz offset, PAR = 9.7 dB at 0.01% Prob.

### Performance Plots – TQP7M9106-PCB900

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



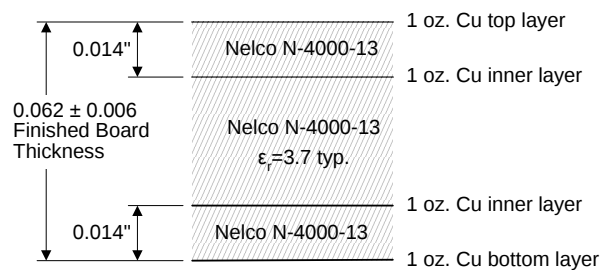
## Pin Configuration and Description



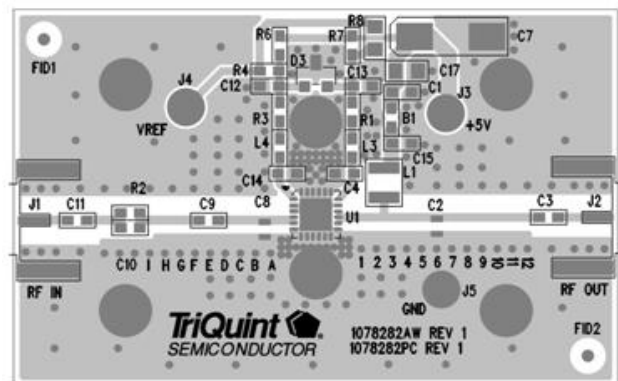
| Pin No.               | Symbol                  | Description                                                                                                                                                   |
|-----------------------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                     | Vbias                   | Voltage supply for active bias for the amp. Connect to same supply voltage as Vcc.                                                                            |
| 4, 5                  | RF IN                   | RF Input. Requires external match for optimal performance. External DC Block required.                                                                        |
| 14, 15, 16            | RFout / V <sub>cc</sub> | RF Output. Requires external match for optimal performance. External DC Block and supply voltage is required.                                                 |
| 18                    | I <sub>ref</sub>        | Reference current into internal active bias current mirror. Current into I <sub>ref</sub> sets device quiescent current. Also, can be used as on/off control. |
| 2, 3, 6-13, 17, 19-24 | GND                     | RF/DC Ground Connection                                                                                                                                       |
| Backside Paddle       | RF/DC GND               | RF/DC ground. Use recommended via pattern to minimize inductance and thermal resistance. See PCB Mounting Pattern for suggested footprint.                    |

## Evaluation Board PCB Information

### TriQuint PCB 1078282 Material and Stack-up



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

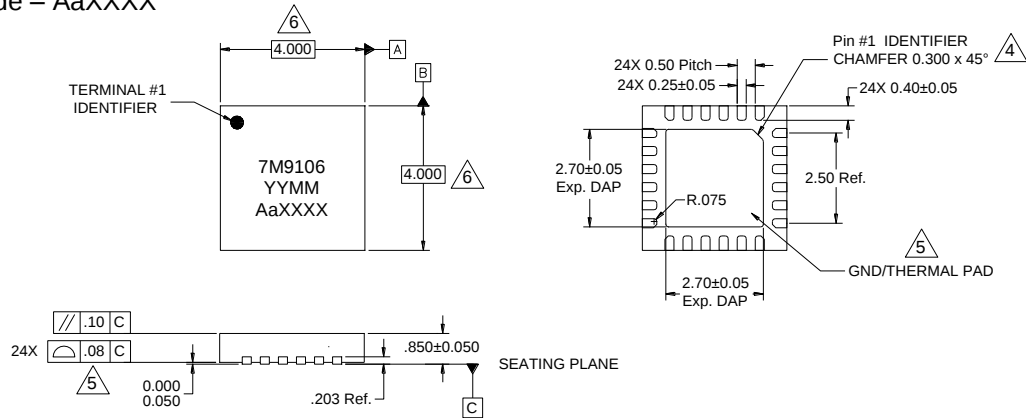


## Package Marking and Dimensions

Marking: Part Number – 7M9106

Date Code – YYMM

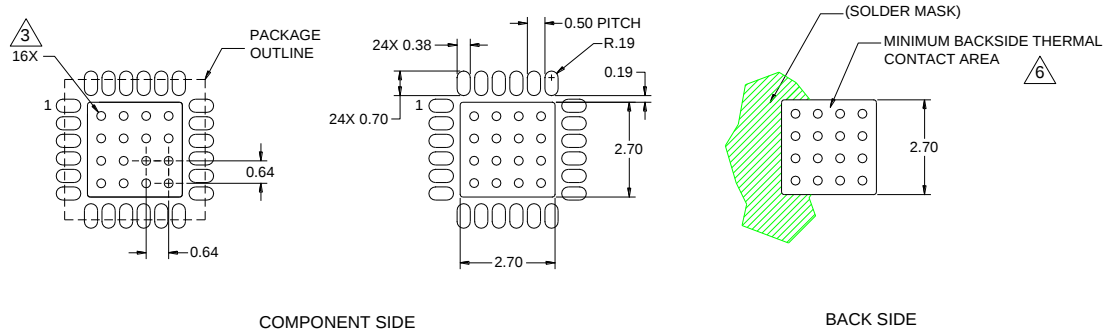
Lot code – AaXXXX



### Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Except where noted, this part outline conforms to JEDEC standard MO-220, Issue E (Variation VGGC) for thermally enhanced plastic very thin fine pitch quad flat no lead package (QFN).
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.
5. Co-planarity applies to the exposed ground/thermal pad as well as the contact pins.
6. Package body length/width does not include plastic flash protrusion across mold parting line.

## 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 0.35mm (#80/.0135") diameter bit for drilling via holes and a final plated thru diameter of 0.25mm (0.10").
4. Ensure good package backside paddle solder attach for reliable operation and best electrical performance.
5. Place mounting screws near the part to fasten a back side heat sink.
6. Do not apply solder mask to the back side of the PC board in the heat sink contact region.
7. Ensure that the backside via region makes good physical contact with the heat sink.

## Product Compliance Information

### ESD Sensitivity Ratings



Caution! ESD-Sensitive Device

ESD Rating: Class 1C  
Value:  $\geq 1000$  V and  $< 2000$  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

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

### Solderability

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

Contact plating: Annealed matte tin over copper.

### 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 ( $\text{C}_{15}\text{H}_{12}\text{Br}_4\text{O}_2$ ) Free
- PFOS Free
- SVHC Free

## Contact Information

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

Web: [www.triquint.com](http://www.triquint.com)  
Email: [info-sales@tqs.com](mailto:info-sales@tqs.com)

Tel: +1.503.615.9000  
Fax: +1.503.615.8902

For technical questions and application information: Email: [sicapplications.engineering@tqs.com](mailto:sicapplications.engineering@tqs.com)

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