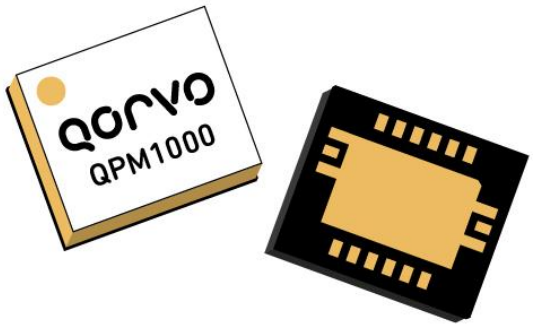
# QPM1000

## 2 – 20 GHz Limiter/Low-Noise Amplifier

## Product Description

The Qorvo QPM1000 is an integrated limiter/LNA providing robust, high performance over the 2–20GHz frequency range. The QPM1000 delivers 17 dB small signal gain with gain control and > 18 dBm P1dB with a range of noise figure of 1.5 – 4 dB across frequency. In addition, the integrated limiter provides a robustness level of up to 4 W of incident power without performance degradation.

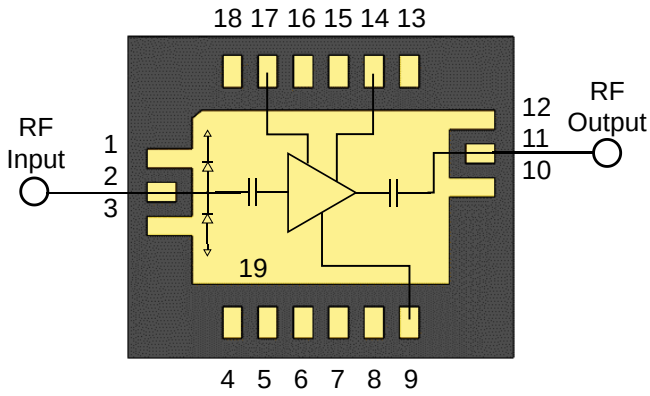
The QPM1000 is packaged in an air cavity, laminate-based 6 x 5 mm QFN for easy handling. With a small form factor coupled with both ports matched to 50 ohms, the QPM1000 is ideally suited to support both commercial and defense related applications where robust receiver front ends are required.




## Product Features

- Frequency Range: 2 – 20 GHz
- Input Power CW Survivability: 4 W
- Gain: > 17 dB
- Adjustable gain (> 30 dB using $V_{G2}$)
- Noise Figure: < 2.0 dB (3-12 GHz)
- Noise Figure: < 4.0 dB (outer frequencies)
- IM3: < −21 dBc ($P_{IN}$ ≤ 0 dBm)
- Bias: $V_D$ = 5 V, $I_D$ = 100 mA, $V_{G1}$ = -0.6 V typical, $V_{G2}$ = +1.3 V
- Package dimensions: 6.00 x 5.00 x 1.72 mm

## Functional Block Diagram




## Applications

- Receiver Front End Building Block

## Ordering Information

| Part No. | Description |
|---|---|
| QPM1000 | 2 – 20 GHz Limiter/LNA, Waffle Pack, Qty 25 |
| QPM1000TR7 | Tape and Reel 7 ″, Qty 750 |
| QPM1000EVB01 | QPM1000 Evaluation Board, Qty 1 |

## Absolute Maximum Ratings

| Parameter | Value / Range |
|---|---|
| Drain Voltage ($V_D$) | 7 V |
| Gate Voltage Range ($V_{G1}$) | −2 to 0 V |
| Gate Voltage Range ($V_{G2}$) | −2 to +3 V |
| Drain Current ($I_D$) | 144 mA |
| Gate Current Range ($I_{G1}$) | -24 to +24 mA |
| Gate Current Range ($I_{G2}$) | -24 to +24 mA |
| RF Input Power, CW, 50 Ω, 25 °C | 36 dBm |
| RF Input Power, CW, 50 Ω, 85 °C | 33 dBm |
| Incident Power, Pulsed[1], 50 Ω, 85 °C | 40 dBm |
| Channel Temperature ($T_{CH}$) | 200 °C |
| Mounting Temperature (30 Seconds) | 260 °C |
| Storage Temperature | −55 to 150 °C |

Note:
[1] Pulse conditions: PW = 100 us, Duty Cycle = 10%

Operation of this device outside the parameter ranges given above may cause permanent damage. These are stress ratings only, and functional operation of the device at these conditions is not implied.

## Recommended Operating

| Parameter | Value / Range |
|---|---|
| Drain Voltage ($V_D$) | 5 V |
| Drain Current ($I_{DQ}$) | 100 mA |
| Gate Voltage ($V_{G1}$)[1], typical | -0.6 V |
| Gate Voltage ($V_{G2}$) | +1.3 V |
| Operating Temperature Range ($T_{BASE}$) | −40 to 85 °C |

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

Note:
[1] Adjust $V_{G1}$ to achieve the required $I_{DQ}$.

## Electrical Specifications

| Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|
| Operational Frequency Range | 2 | – | 20 | GHz |
| Small Signal Gain | – | > 17 | – | dB |
| Input Return Loss | – | > 9.7 | – | dB |
| Output Return Loss | – | > 7.6 | – | dB |
| Noise Figure: 2 GHz | – | 2.8 | – | dB |
| Noise Figure: 8 GHz | – | 1.7 | – | dB |
| Noise Figure: 14 GHz | – | 2.3 | – | dB |
| Noise Figure: 20 GHz | – | 4.0 | – | dB |
| Third-Order Intermodulation Distortion ($P_{IN}$ ≤ 0 dBm / Tone, 10 MHz Tone Spacing) | – | < −21 | – | dBc |
| Output Power (Saturation; $P_{IN}$ = 10 dBm) | – | > 21 | – | dBm |
| Output Power (1 dB Compression) | – | > 17 | – | dBm |
| Small Signal Gain Temperature Coefficient | – | -0.010 | – | dB/°C |
| Noise Figure Temperature Coefficient | – | 0.010 | – | dB/°C |
| Output Power Temperature Coefficient | – | −0.004 | – | dBm/°C |

Test conditions unless otherwise noted: 25 °C, $V_D$ = +5 V, $I_{DQ}$ = 100 mA, $V_{G1}$ = −0.6 V Typical, $V_{G2}$ = 1.3 V

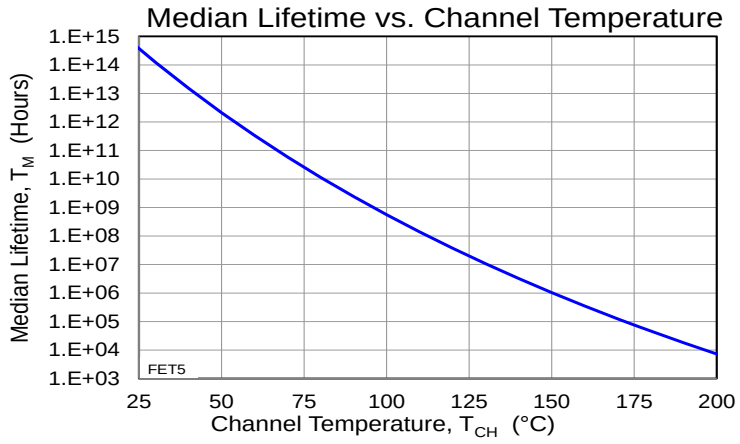
## Thermal and Reliability Information

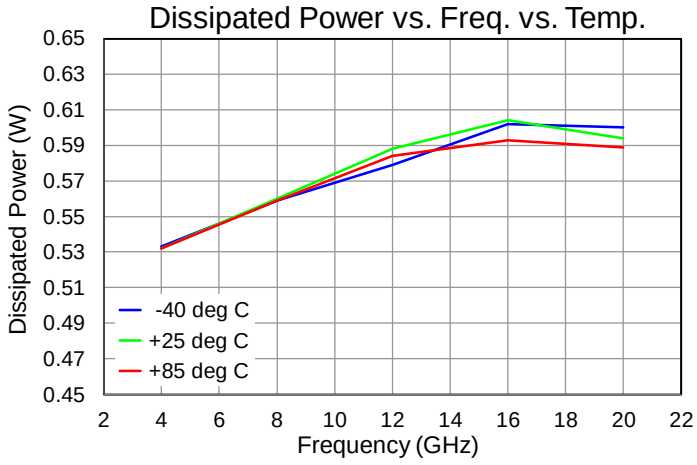
| Parameter | Test Conditions | Value | Units |
|---|---|---|---|
| Thermal Resistance ($\theta_{JC}$) (1) | $T_{BASE}$ = 85 °C, $V_D$ = 5 V<br>At Freq = 16 GHz, $P_{IN}$ = 10 dBm:<br>$I_{DQ}$ = 100 mA, $I_{D\_Drive}$ = 144 mA<br>$P_{OUT}$ = 20.3 dBm, $P_{DISS}$ = 0.562 W | 30.2 | °C/W |
| Channel Temperature ($T_{CH}$) (Under RF drive) | | 102 | °C |
| Median Lifetime ($T_M$) | | 4.77E+8 | Hrs |

Notes:
1. Thermal resistance measured to back of package.

## Median Lifetime

Test Conditions: $V_D$ = 6 V; Failure Criteria = 10 % reduction in ID_MAX during DC Testing

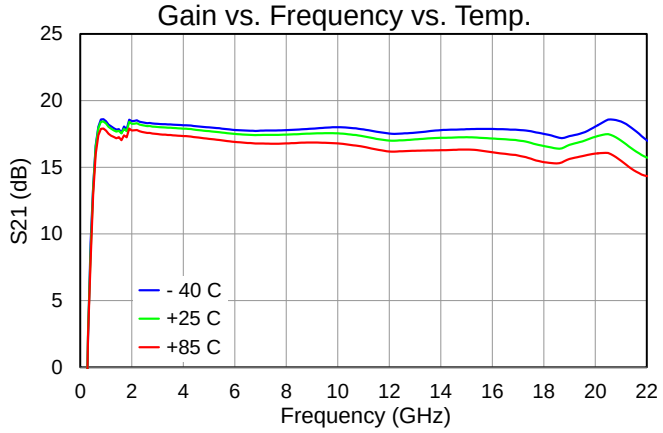


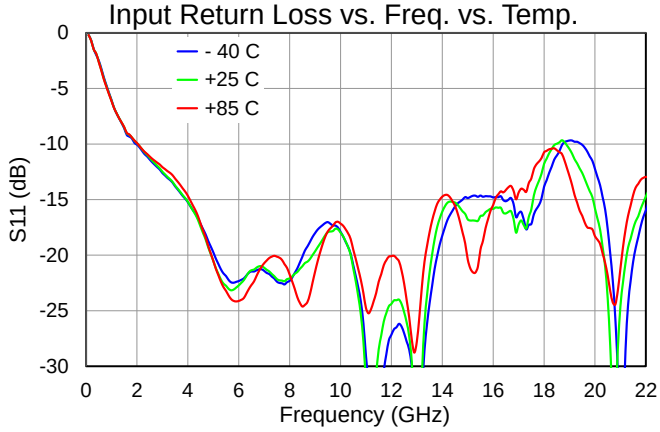
## Performance Plots – Small Signal

Conditions unless otherwise specified: $V_D$ = 5 V, $I_{DQ}$ = 100 mA, $V_{G2}$ = 1.3 V

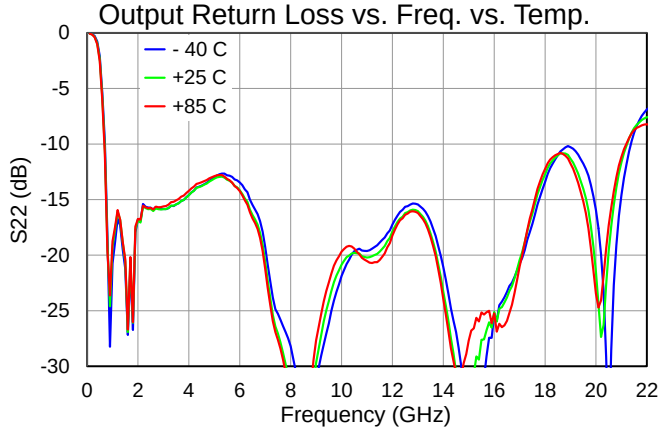
Gain vs. Frequency vs. Temp.



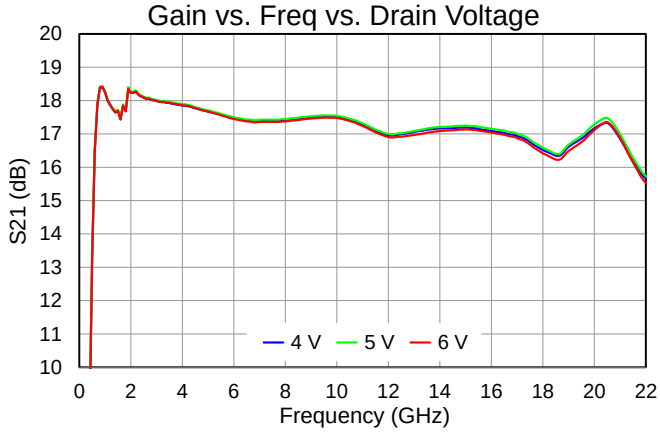

Input Return Loss vs. Freq. vs. Temp.



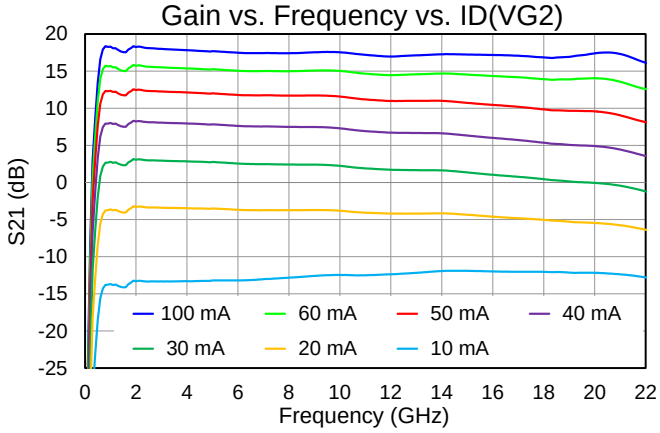

Output Return Loss vs. Freq. vs. Temp.




Gain vs. Freq vs. Drain Voltage

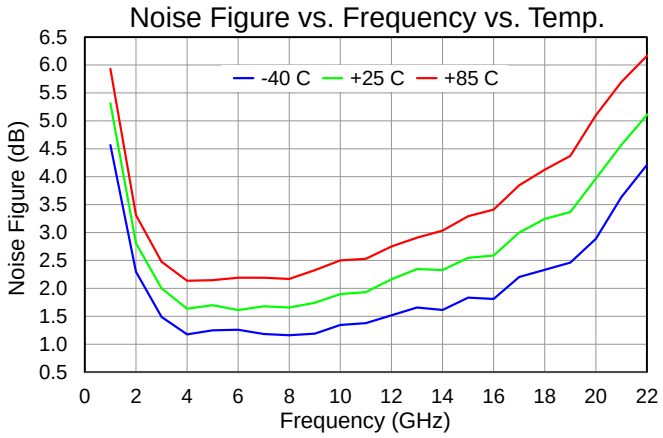


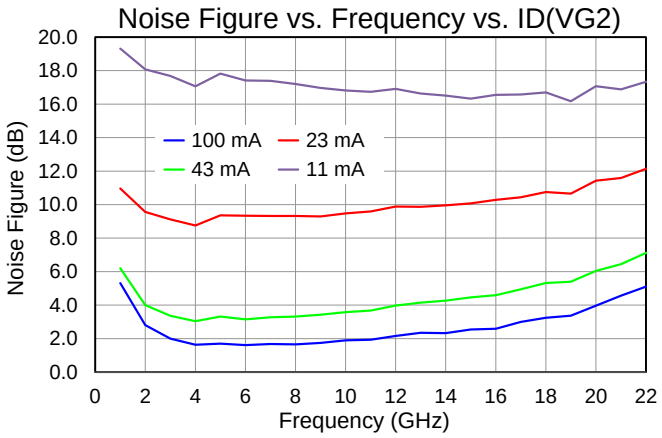

Gain vs. Frequency vs. ID(VG2)

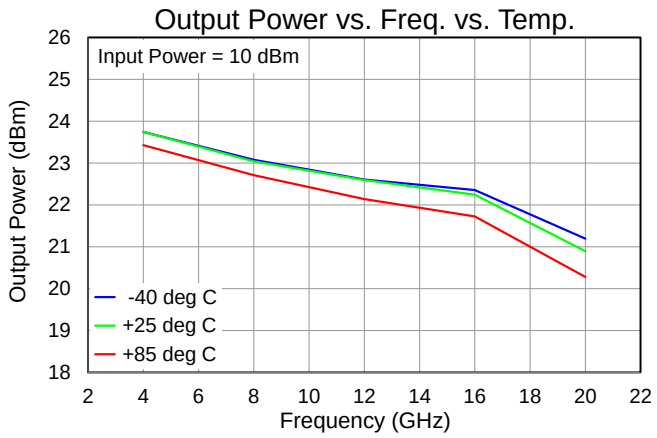


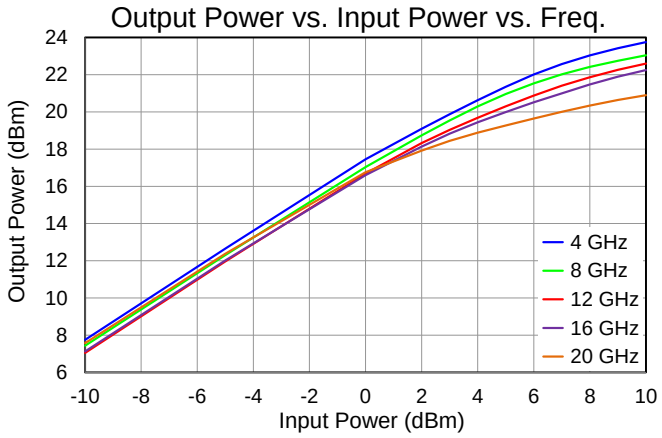
## Performance Plots – Noise Figure & Large Signal

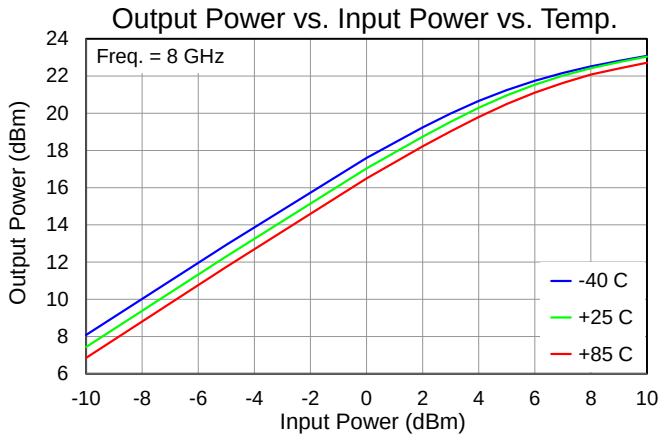
Conditions unless otherwise specified: $V_D$ = 5 V, $I_{DQ}$ = 100 mA, $V_{G2}$ = 1.3 V

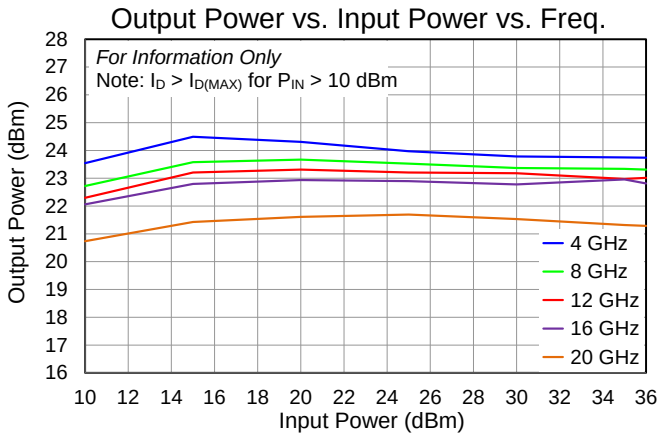


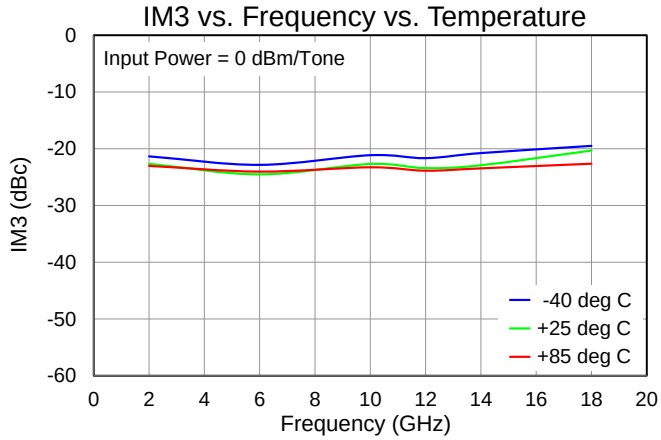



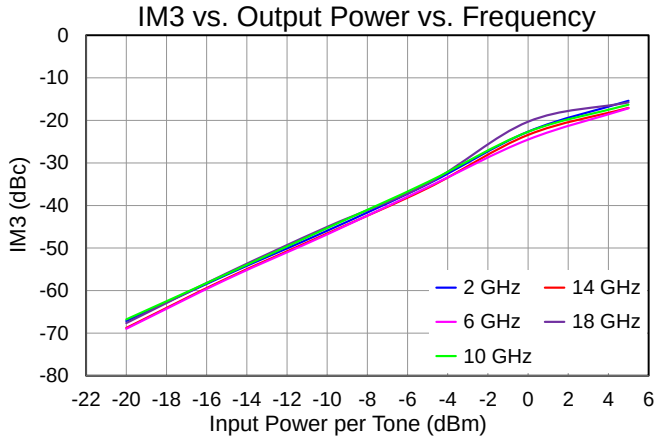



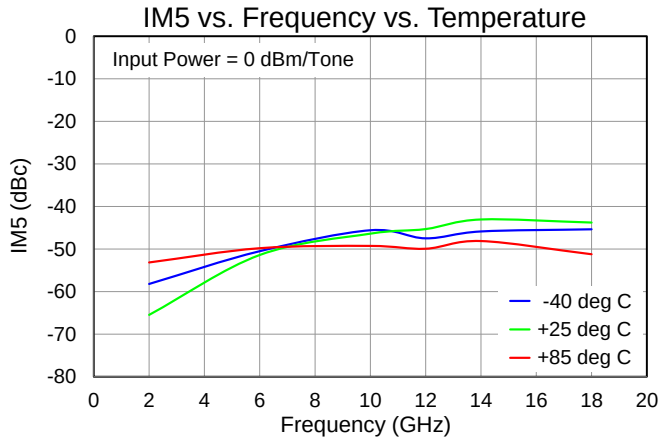



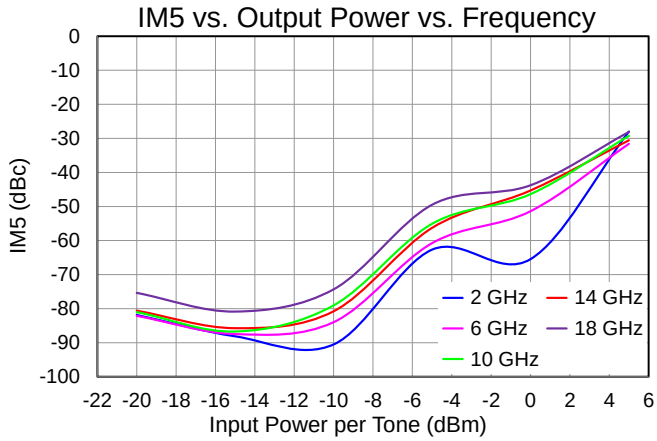
## Performance Plots – Linearity

Conditions unless otherwise specified: $V_D$ = 5 V, $I_{DQ}$ = 100 mA, $V_{G2}$ = 1.3 V

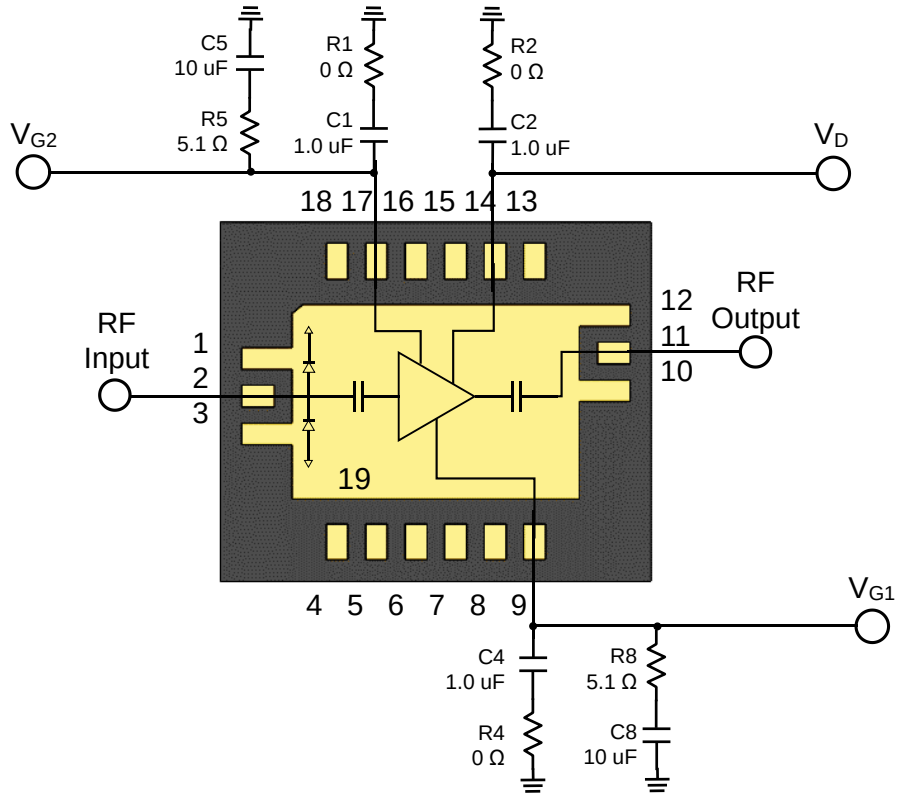


## Applications Information and Pin Layout




## Bias Up Procedure

1. Set $I_D$ limit to 145 mA, $I_G$ limit to 24 mA
2. Apply −1.5 V to $V_{G1}$
3. Apply +5 V to $V_D$; ensure $I_{DQ}$ is approx. 0 mA
4. Apply +1.3 V to $V_{G2}$
5. Adjust $V_{G1}$ until $I_{DQ}$ = 100 mA ($V_{G1}$ ~ −0.6 V Typ.)
6. Turn on RF supply

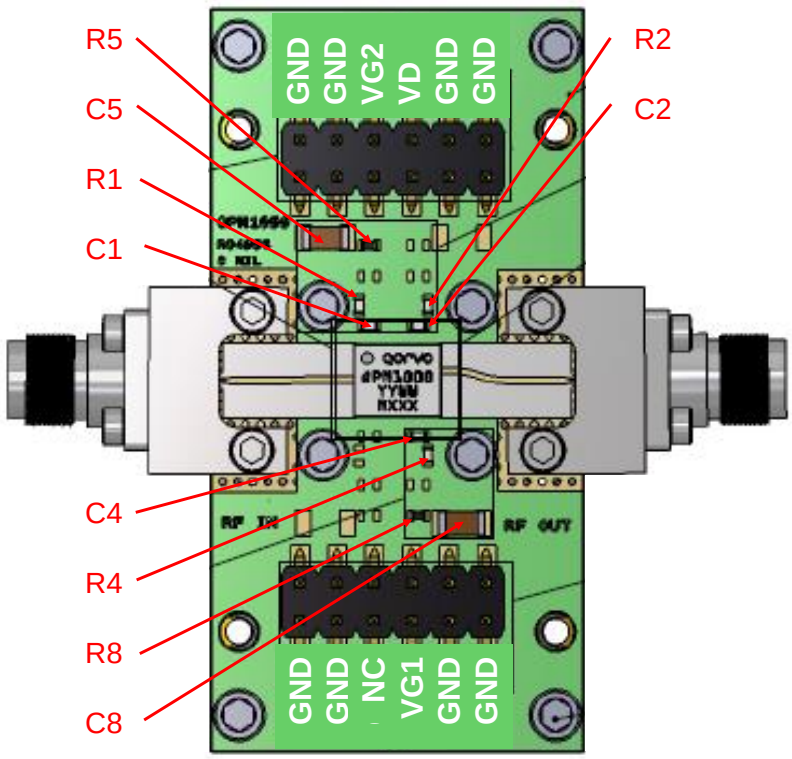
## Bias Down Procedure

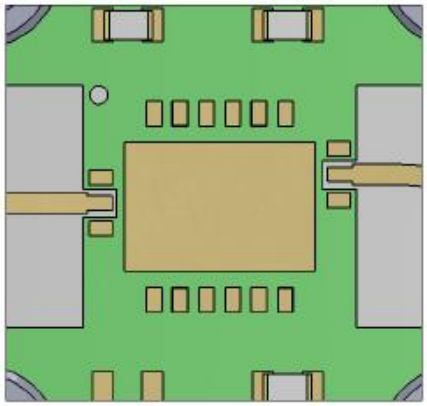
1. Turn off RF supply
2. Reduce $V_{G1}$ to −1.5 V; ensure $I_{DQ}$ is approx. 0 mA
3. Set $V_{G2}$ to 0 V
4. Set $V_D$ to 0 V
5. Turn off $V_D$ supply
6. Turn off $V_{G1}$ and $V_{G2}$ supplies

## Pad Description

| Pin No. | Label | Description |
|---|---|---|
| 1, 3, 10, 12, 19 | GND | RF Ground |
| 2 | RF Input | RF Input; matched to 50 Ω |
| 4 – 8, 13, 15, 16, 18 | NC | No connection in package. Can be grounded on the PCB if desired. |
| 9 | $V_{G1}$ | Gate Voltage 1; Bias network is required; see Application Information above. |
| 11 | RF Output | RF Output; matched to 50 Ω; DC blocked |
| 14 | $V_D$ | Drain voltage; Bias network is required; see Application Information above. |
| 17 | $V_{G2}$ | Gate Voltage 2; Bias network is required; see Application Information above. |

## Evaluation Board and Mounting Detail



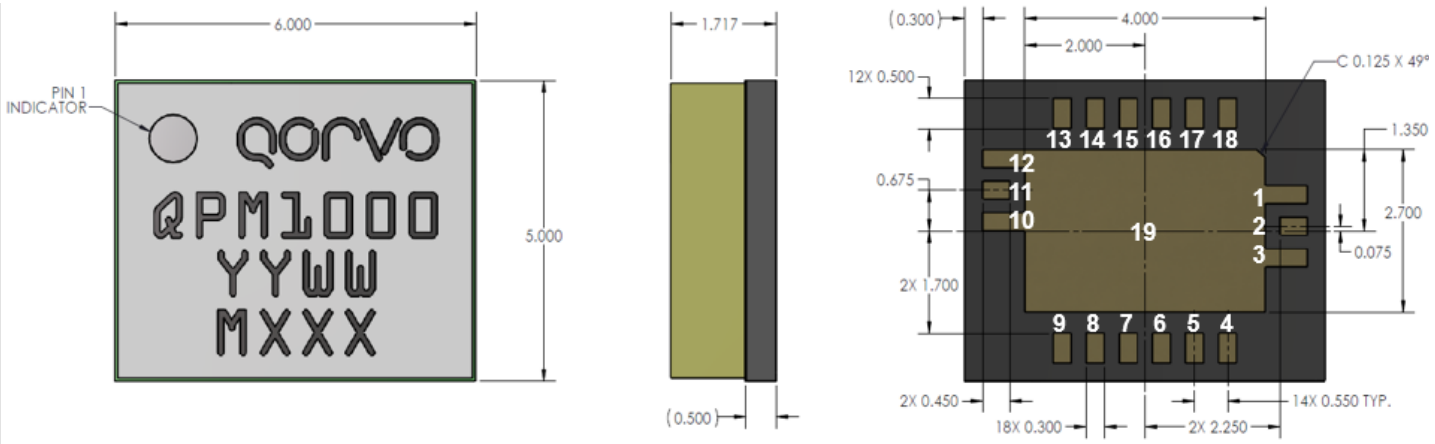
Mounting Detail

RF Layer is 0.008” thick Rogers Corp. RO40003C ($\varepsilon_r$ = 3.35). Metal layers are 1.0 oz. copper. The microstrip line at the connector interface is optimized for the Southwest Microwave end launch connector 1092-01A-5.

## Bill of Materials

| Reference Des. | Value | Description | Manuf. | Part Number |
|---|---|---|---|---|
| C1, C2, C4 | 1.0 µF | Cap, 402, +50 V, ±10 %, X7R | Various | – |
| C5, C8 | 10.0 µF | Cap, 1206, +50 V, ±20 %, X5R | Various | – |
| R1, R2, R4 | 0 Ω | Res, 0402, SMT | Various | – |
| R5, R8 | 5.1 Ω | Res, 0402, SMT | Various | – |

## Mechanical Drawing




NOTES:
PACKAGE METAL BASE AND LEADS ARE GOLD PLATED.

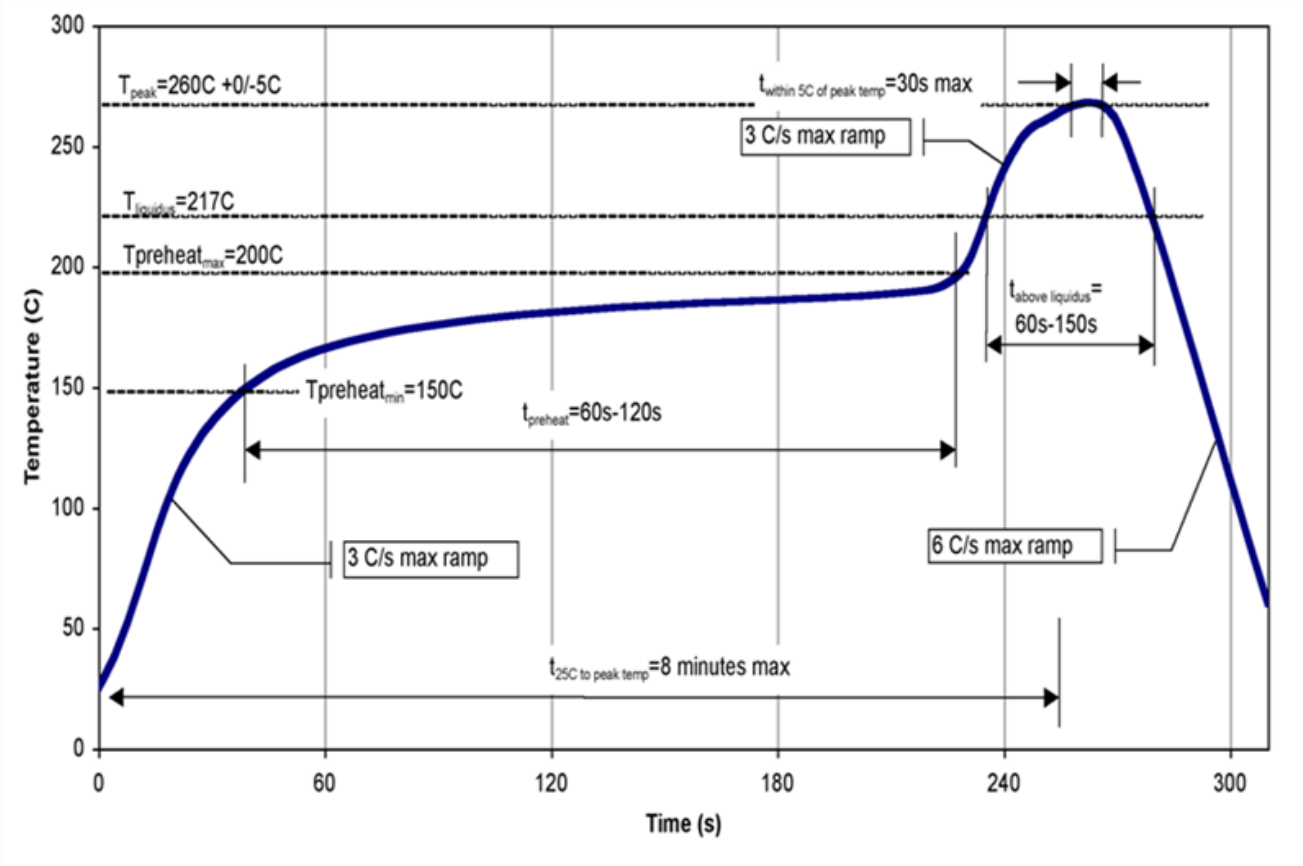
PART MARKING:
- QPM1000: PART NUMBER
- YY: PART ASSY YEAR
- WW: PART ASSY WEEK
- MXXX: LOT NUMBER

DIMENSIONS IN MM

## Solderability

1. Compatible with the latest version of J-STD-020, Lead-free solder, 260 °C.
2. This package is non-hermetic, and therefore cannot be subjected to aqueous washing. The use of no-clean solder to avoid washing is highly recommended.

## Recommended Soldering Temperature Profile



## Handling Precautions

| Parameter | Rating | Standard |
|---|---|---|
| ESD – Human Body Model (HBM) | Class 1A | ANSI/ESD/JEDEC JS-001 |
| ESD – Charge Device Model (CDM) | Class C3 | ANSI/ESD/JEDEC JS-002 |
| MSL – 260 °C Convection Reflow | Level 3 | IPC/JEDEC J-STD-020 |

Caution!
ESD-Sensitive Device

## RoHS Compliance

This product is compliant with the 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment), as amended by Directive 2015/863/EU.
This product also has the following attributes:

- Lead Free
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_4O_2$) Free

## Contact Information

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

**Tel:** **1-844-890-8163**

**Web:** **www.qorvo.com**

**Email:** **customer.support@qorvo.com**

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