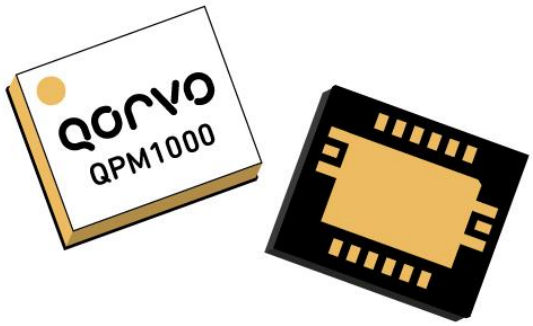
QPM1000

2 – 20 GHz Limiter/Low-Noise Amplifier

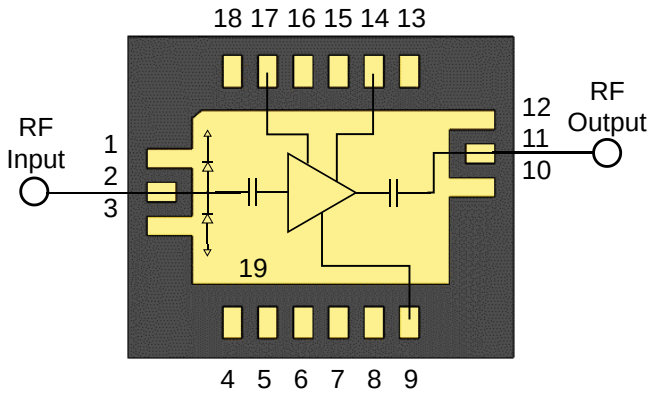
Product Description

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.



Functional Block Diagram



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

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 250
QPM1000EVB01	QPM1000 Evaluation Board, Qty 1

Absolute Maximum Ratings

Parameter	Min Value	Max Value	Units
Drain Voltage (V_D)	-	7	V
Gate Voltage Range (V_{G1})	−2	0	V
Gate Voltage Range (V_{G2})	−2	3	V
Drain Current (I_D)	-	144	mA
Gate Current Range (I_{G1}, I_{G2} each)	-24	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, PW = 100 uS, Duty Cycle = 10%, 50 Ω, 85 °C	-	40	dBm
Mounting Temperature (30 Seconds)	-	260	°C
Storage Temperature	−55	150	°C

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. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability.

Recommended Operating Conditions

Parameter	Value / Range
Drain Voltage (V_D)	5 V
Drain Current (I_{DQ})	100 mA
Gate Voltage (V_{G1})[1], typical, can be adjusted to get required I_{DQ}	-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.

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
Data de-embedded of test fixture losses.

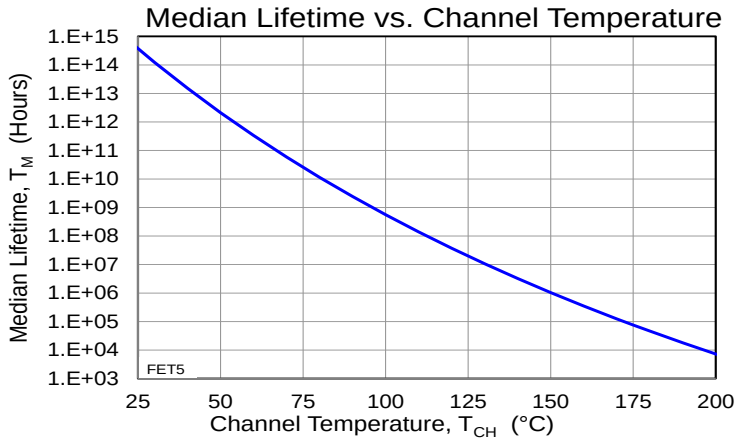
Thermal and Reliability Information

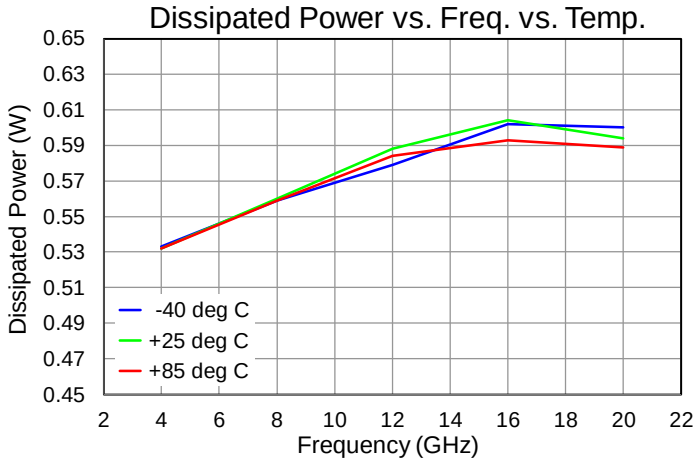
Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	T_{BASE} = 85 °C, V_D = 5 V At Freq = 16 GHz, P_{IN} = 10 dBm: I_{DQ} = 100 mA, I_{D_Drive} = 144 mA P_{OUT} = 20.3 dBm, P_{DISS} = 0.562 W	30.2	°C/W
Channel Temperature (T_{CH}) (Under RF drive)		102	°C
Median Lifetime (T_M)		4.77E+8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

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

Median Lifetime

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

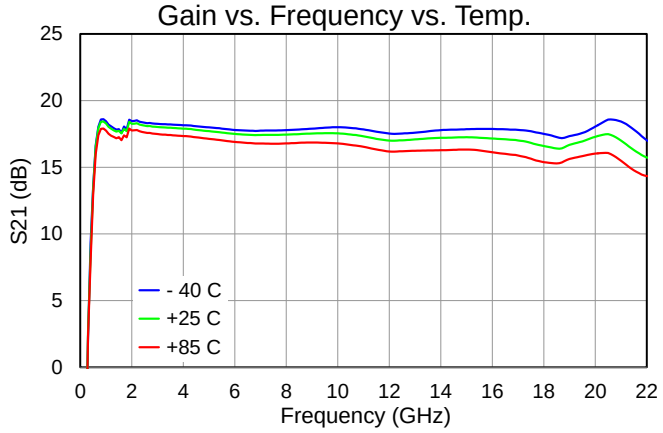




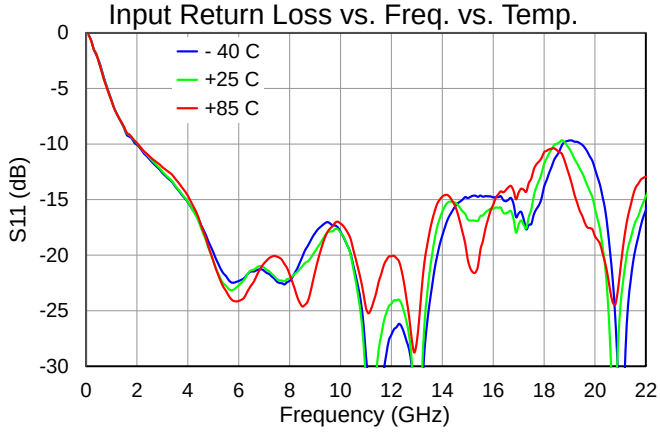
Performance Plots – Small Signal

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

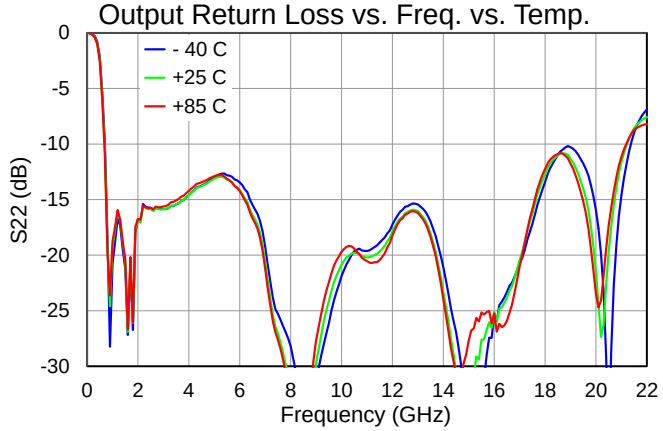
Gain vs. Frequency vs. Temp.



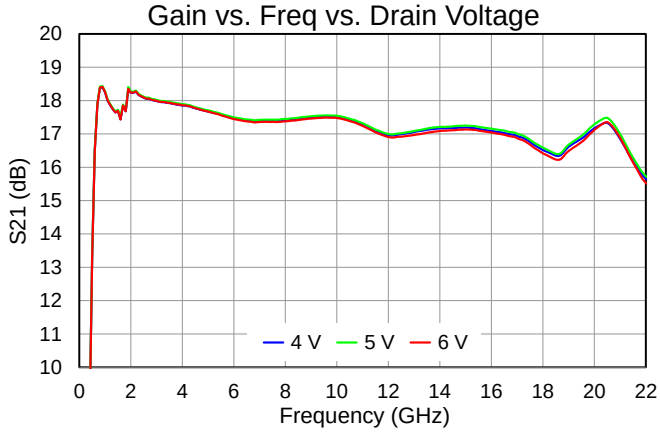
Input Return Loss vs. Freq. vs. Temp.



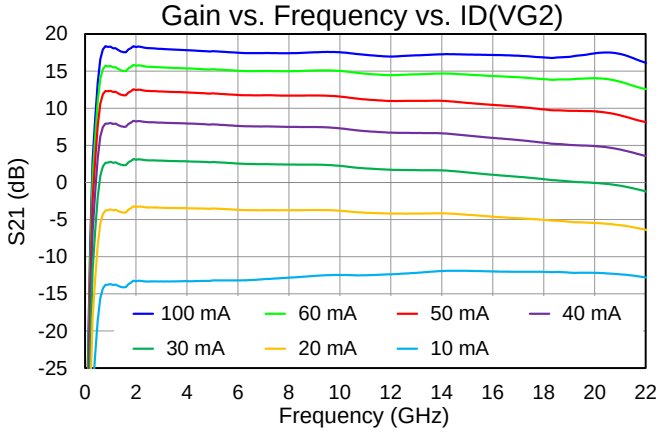
Output Return Loss vs. Freq. vs. Temp.



Gain vs. Freq vs. Drain Voltage



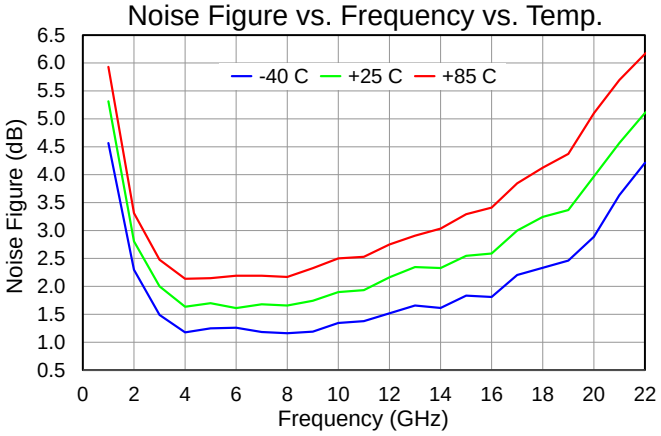
Gain vs. Frequency vs. ID(VG2)



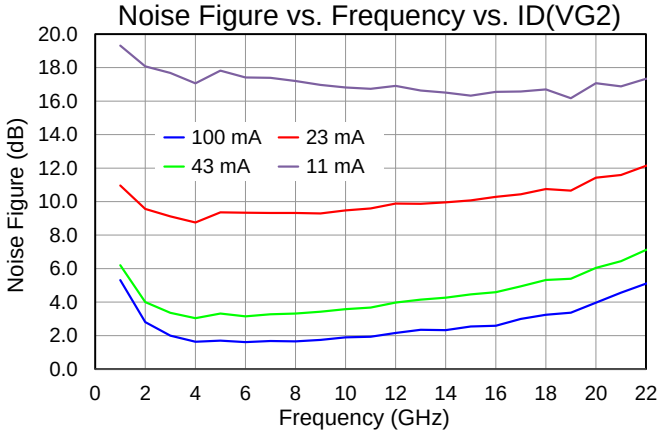
Performance Plots – Noise Figure & Large Signal

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

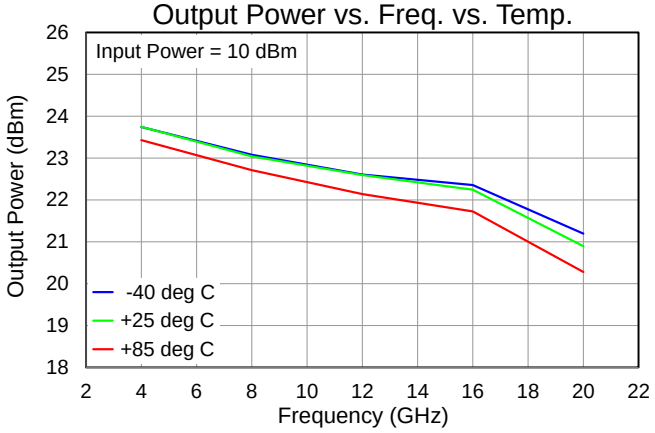
Noise Figure vs. Frequency vs. Temp.



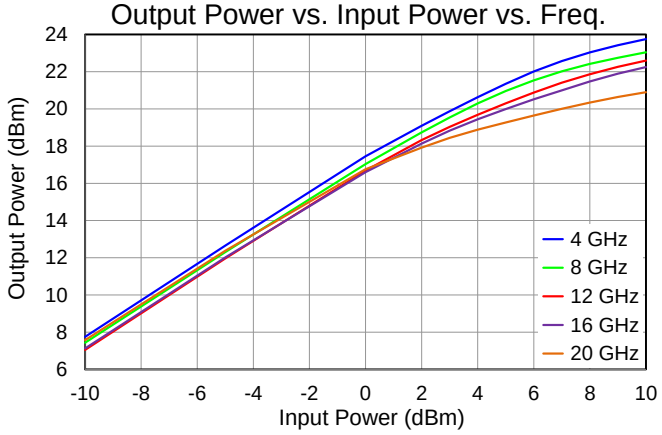
Noise Figure vs. Frequency vs. ID(VG2)



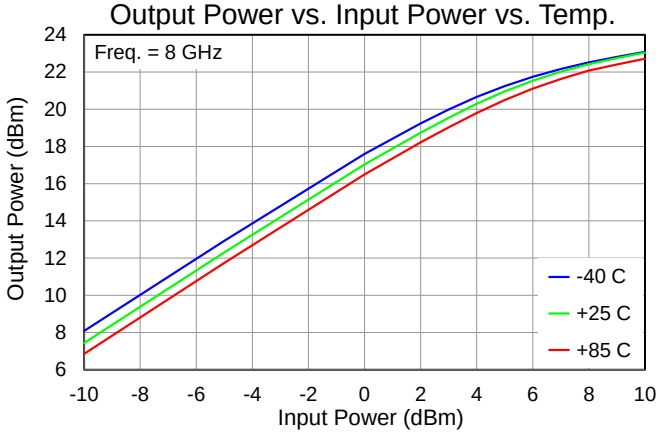
Output Power vs. Freq. vs. Temp.



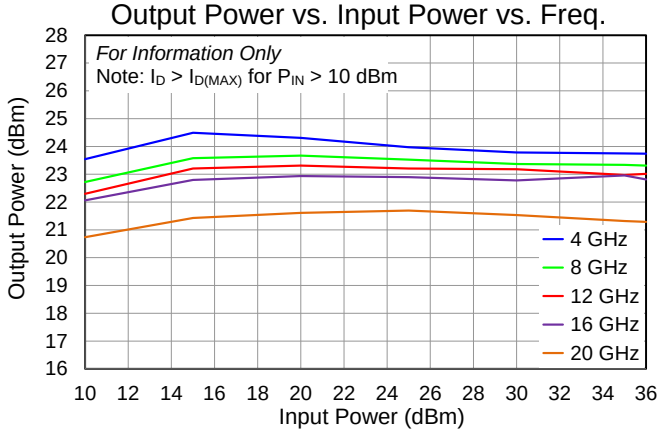
Output Power vs. Input Power vs. Freq.



Output Power vs. Input Power vs. Temp.

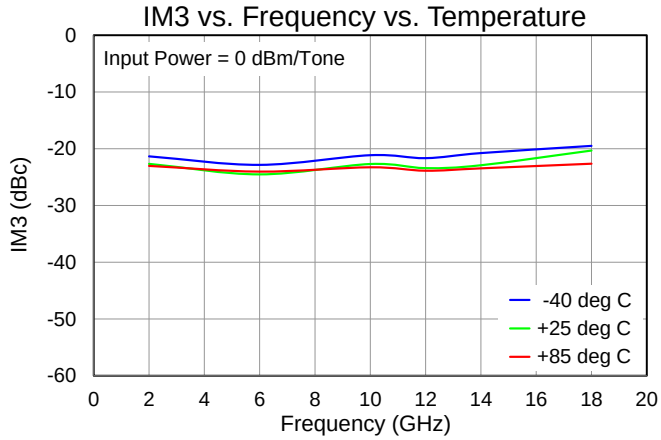


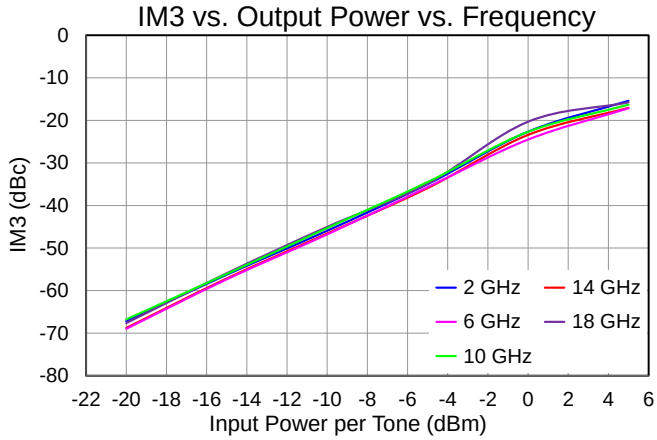
Output Power vs. Input Power vs. Freq.

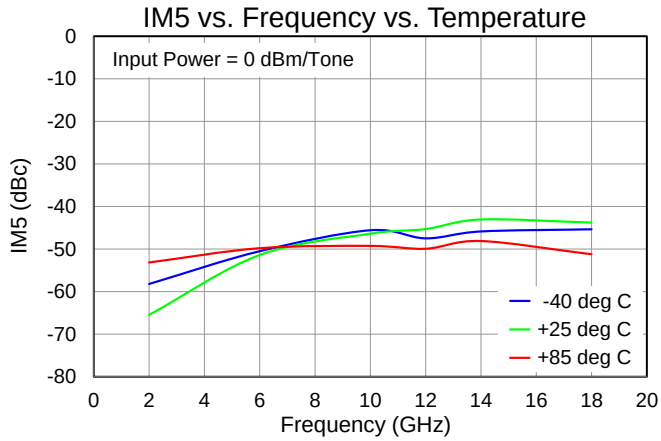


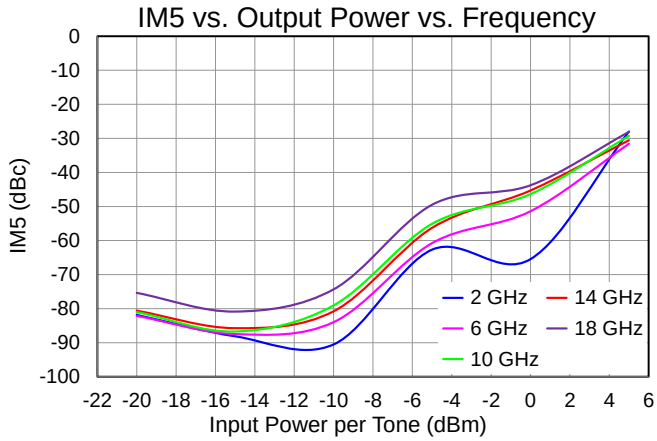
Performance Plots – Linearity

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

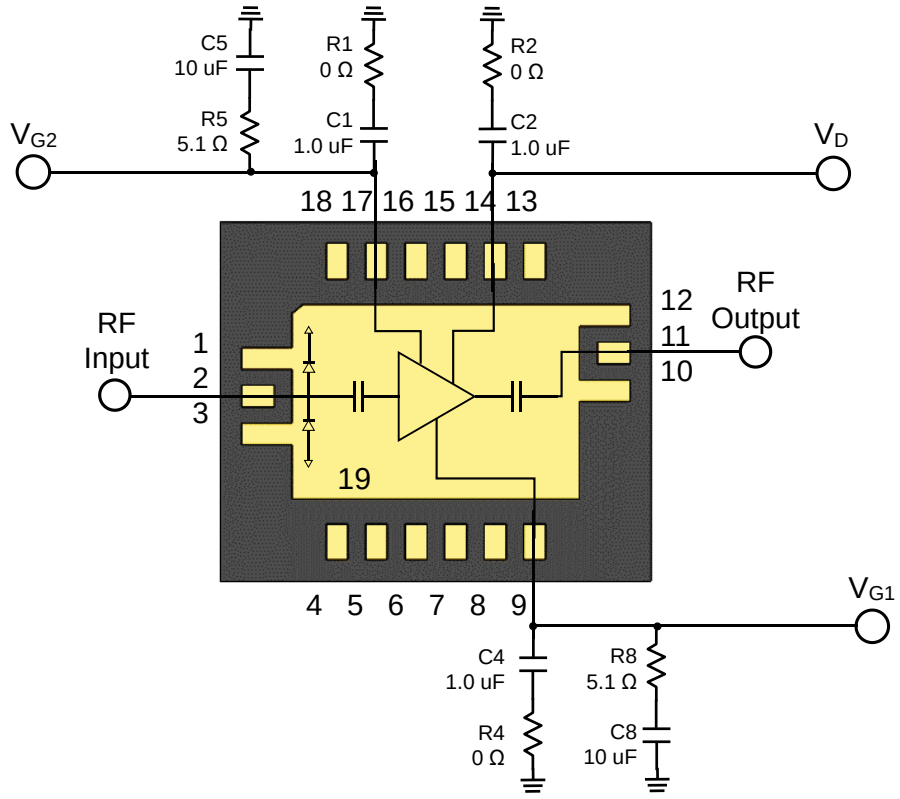








Applications Information and Pin Layout



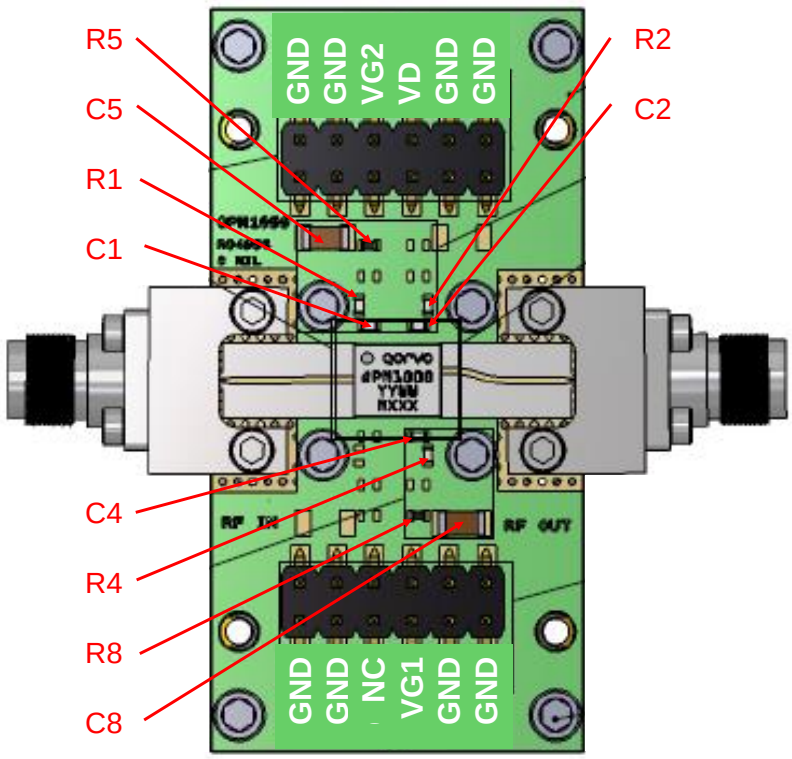
Bias Up Procedure

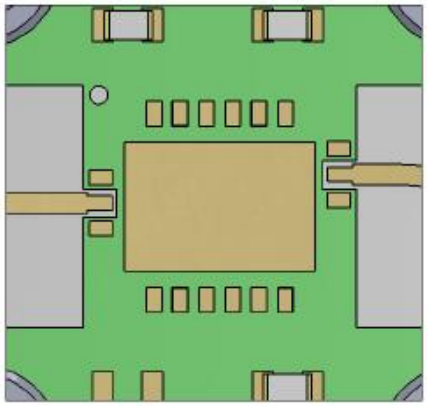
1. Set I_D limit to 145 mA, I_G limit to 24 mA
2. Apply −1.5 V to V_{G1}
3. Apply +5 V to V_D; ensure I_{DQ} is approx. 0 mA
4. Apply +1.3 V to V_{G2}, can apply V_D and V_{G2} at the same time
5. Adjust V_{G1} until I_{DQ} = 100 mA (V_{G1} ~ −0.6 V Typ.)
6. Turn on RF supply

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 (can set V_{G2} and V_D to 0 V at the same time
5. Turn off V_D supply
6. Turn off V_{G1} and V_{G2} supplies

Evaluation Board and Mounting Detail





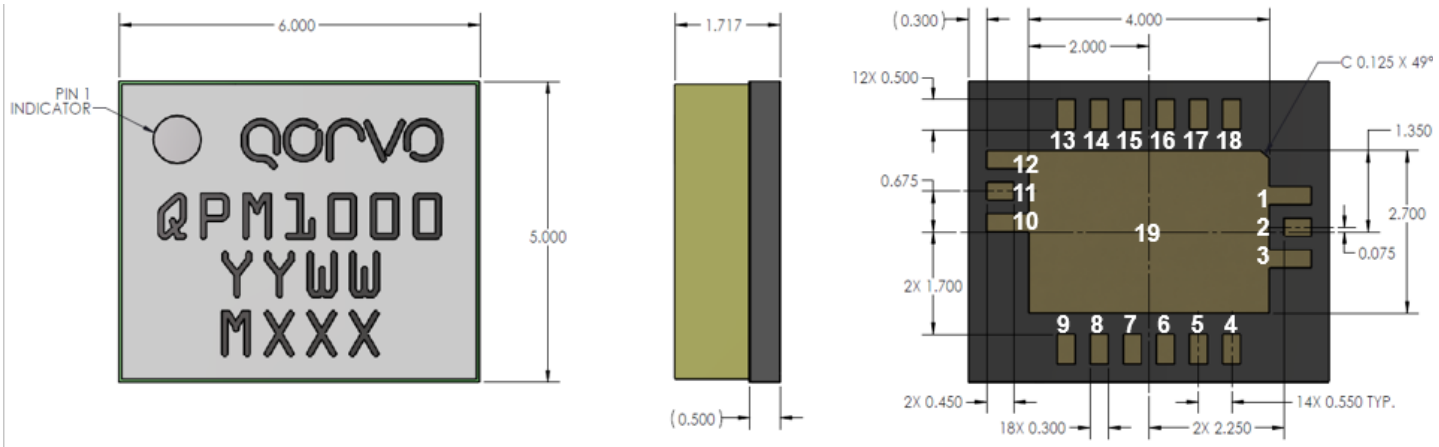
Mounting Detail

RF Layer is 0.008” thick Rogers Corp. RO40003C (ε_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

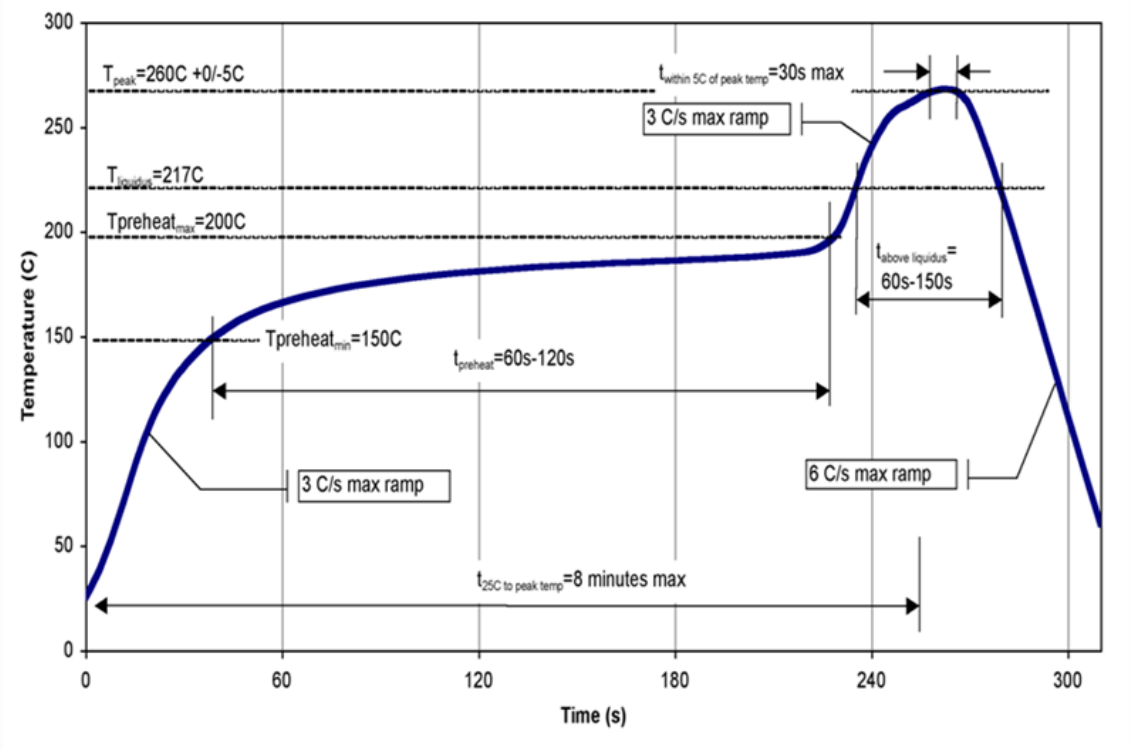
Pad Description

Pin No.	Label	Description
1, 3, 10, 12, 19	GND	RF Ground.
2	RF Input	RF Input; matched to 50 Ω, DC coupled.
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.

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.

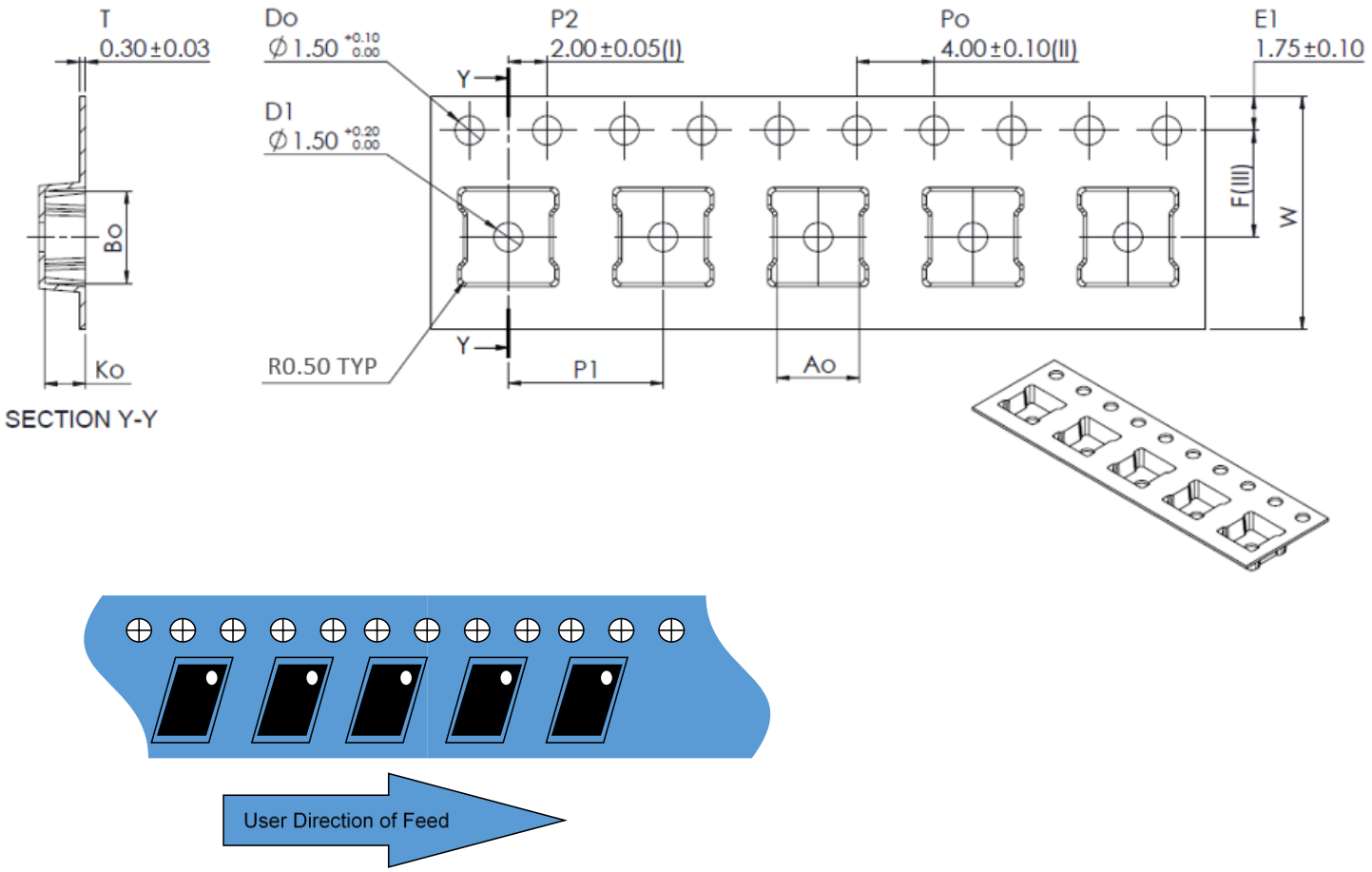
Recommended Soldering Temperature Profile



Tape and Reel Information

Standard T/R size = 250 pieces on a 7" reel.

Material		Cavity (mm)				Distance Between Centerline (mm)		Carrier Tape (mm)	Cover Carrier (mm)
Vendor	Vendor P/N	Length (A0)	Width (B0)	Depth (K0)	Pitch (P1)	Length direction (P2)	Width Direction (F)	Width (W)	Width (W1)
Advantek	BCA389-A	5.30	6.30	2.1	8.0	2.00	5.50	12.0	9.20



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1A	ANSI/ESD/JEDEC JS-001-2012
ESD – Charge Device Model (CDM)	Class C3	ANSI/ESD/JEDEC JS-002-2014
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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