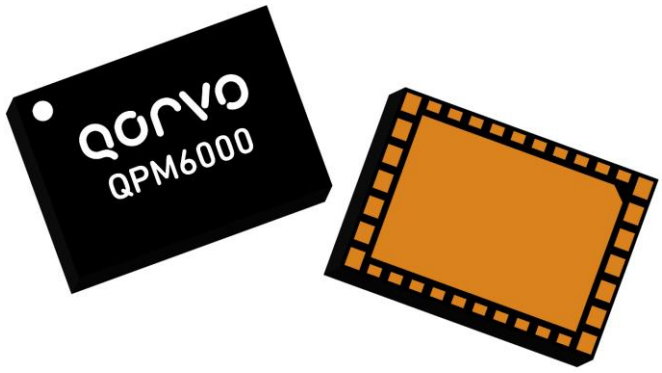
QPM6000

8 – 14 GHz Limiter / Low-Noise Amplifier

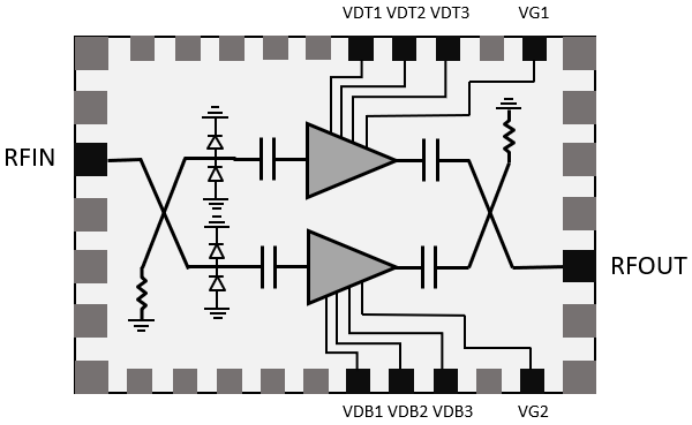
Product Description

The Qorvo QPM6000 is an integrated limiter/LNA providing robust, high RF performance covering 8 –14GHz frequency range. The QPM6000 provides 23 dB small signal gain with 18 dBm P1dB power and a low noise figure of 1.5 dB across application frequency band. In addition, the integrated limiter provides a robustness level of up to 20 W of incident power for CW and 100 W for pulse application without performance degradation.

The QPM6000 is packaged in an overmold, laminate-based 8.5 x 6 mm QFN for easy handling. With a small form factor coupled with both ports matched to 50 ohms, the QPM6000 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: 8 – 14 GHz
- Input Power Survivability: 20 W CW, 100 W Pulse
- Gain: 23 dB
- Noise Figure: 1.6 dB
- Output Power: 18 dBm
- OTOI: 23 dBm @ 10 dBm Pout / tone
- Bias: VD = 2.0 V, IDQ = 180 mA, VG = - 0.5 V typical
- Plastic Overmold QFN Package
- Package dimensions: 8.5 x 6 x 1.6 mm

Performance is typical across frequency.
Please reference electrical specification table and data plots for more details.

Applications

- Receiver Front End Building Block
- Radar Applications
- Electronic War

Ordering Information

Part No.	Description
QPM6000SR	Limiter / LNA, Tape and Reel, 7", Qty 100
QPM6000EVB01	QPM6000 Evaluation Board, Qty 1

Absolute Maximum Ratings

Parameter [1]	Min Value	Max Value	Units
Drain Voltage (VD1, VD2)	-	4.5	V
Gate Voltage Range (VG1, VG2)	−1.3	0	V
Drain Current (VD1, VD2, each)	-	319	mA
Gate Current Range (IG1, IG2, each)[2]	-	20	mA
RF Input Power, CW, 50 Ω, 25 °C	-	43	dBm
Incident Power, Pulsed [3], 50 Ω, 25 °C	-	50	dBm
Channel Temperature (T_{CH})	-	175	°C
Storage Temperature	−55	150	°C

1. 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.
2. Max value of 20mA is under high RF drive.
3. Pulse conditions: PW = 100 us, Duty Cycle = 10%

Recommended Operating Conditions

Parameter	Value / Range	Units
Drain Voltage (VD1, VD2, drain connected together each side)	2.0	V
Drain Current (VD1 + VD2, drain connected together each side)	2 x 90	mA
Gate Voltage (VG1, VG2), typical	-0.5	V
Operating Temperature Range	−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	8		14	GHz
Small Signal Gain		23		dB
Input Return Loss		20		dB
Output Return Loss		17		dB
Noise Figure		1.6		dB
OTOI (P_{out} = 10 dBm / Tone, 10 MHz Tone Spacing)		23		dBm
Output Power (Saturation; P_{IN} = 10 dBm)		18		dBm
Output Power (1 dB Compression)		16		dBm
Small Signal Gain Temperature Coefficient		-0.017		dB/°C
Noise Figure Temperature Coefficient		-0.01		dB/°C
Output Power Temperature Coefficient		−0.003		dBm/°C

1. Test conditions unless otherwise noted: 25 °C
2. Data shown in table or in plots are de-embedded of fixture losses

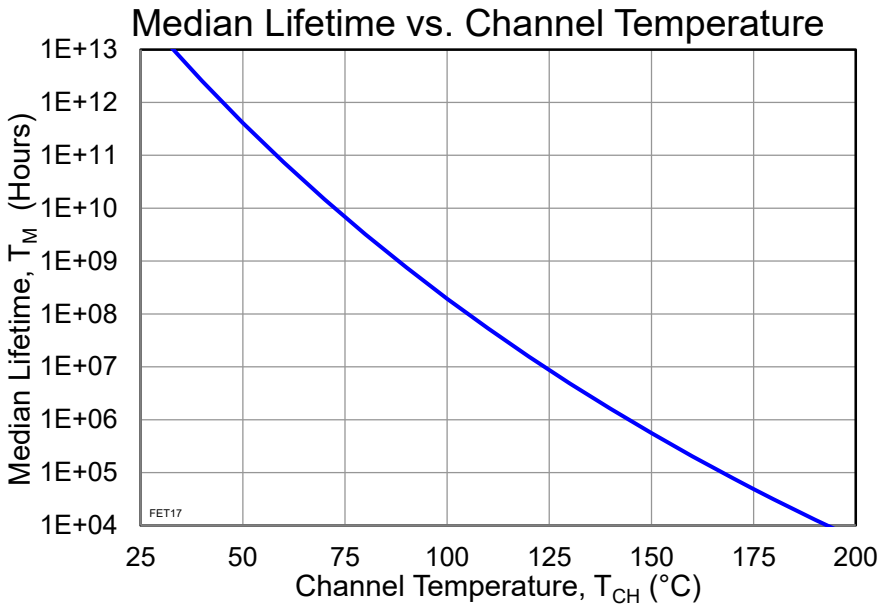
Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	T_{base} = 85°C, VD = 2.0 V, I_{DQ} = 180 mA Quiescent / Small Signal operation P_{DISS} = 0.36 W	23.8	°C/W
Channel Temperature (T_{CH})		93.6	°C
Median Lifetime (T_M)		4.6E08	Hrs

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

Median Lifetime

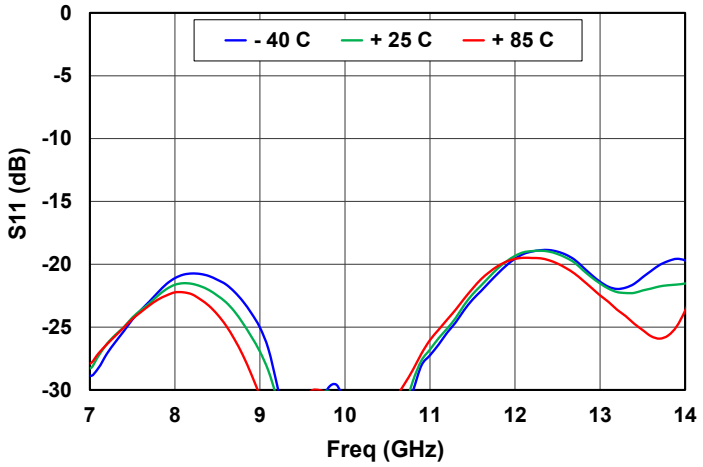
Test Conditions: VD = 4 V
Failure Criteria = 10% reduction in I_{D_MAX}



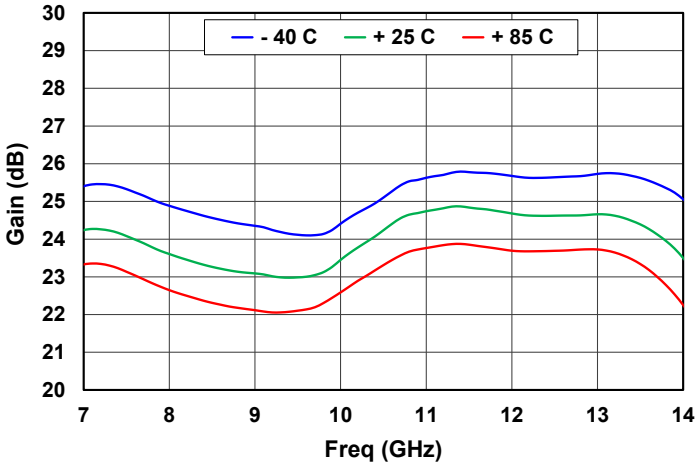
Performance Plots – Small Signal

Conditions unless otherwise specified: VD = 2.0 V, I_{DQ} = 180 mA (total), 25 °C

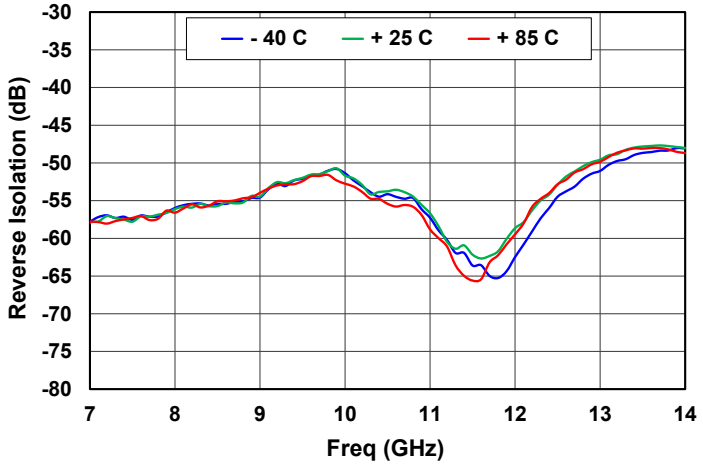
Input Return Loss vs Temperature



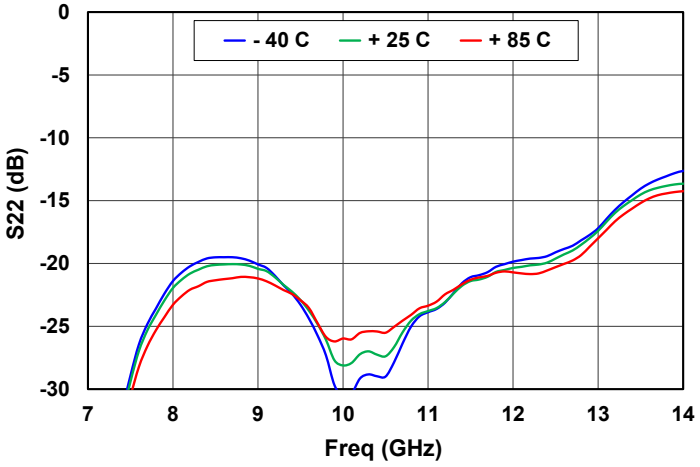
Gain vs Temperature



Reverse Isolation vs Temperature

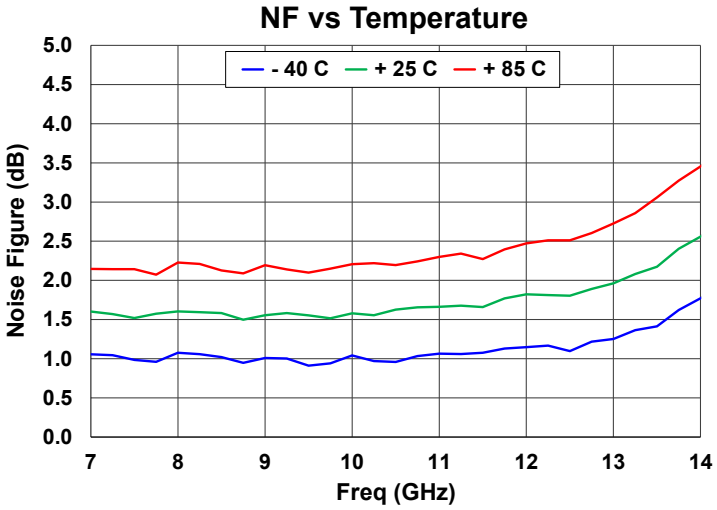


Output Return Loss vs Temperature



Performance Plots – Noise Figure

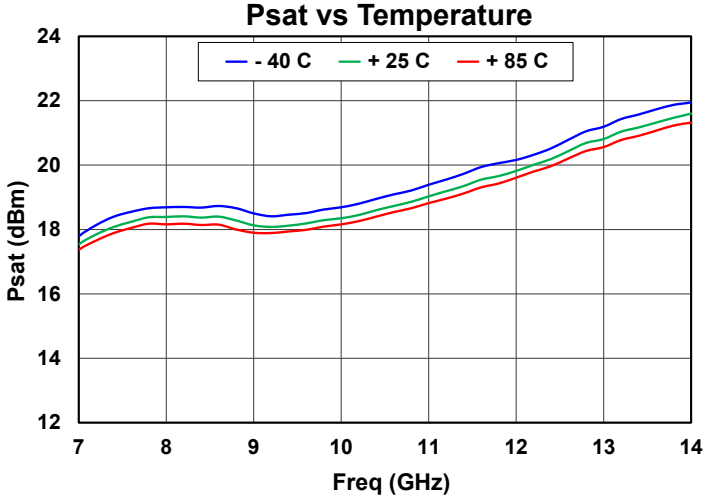
Conditions unless otherwise specified: VD = 2.0 V, I_{DQ} = 180 mA (total), 25 °C



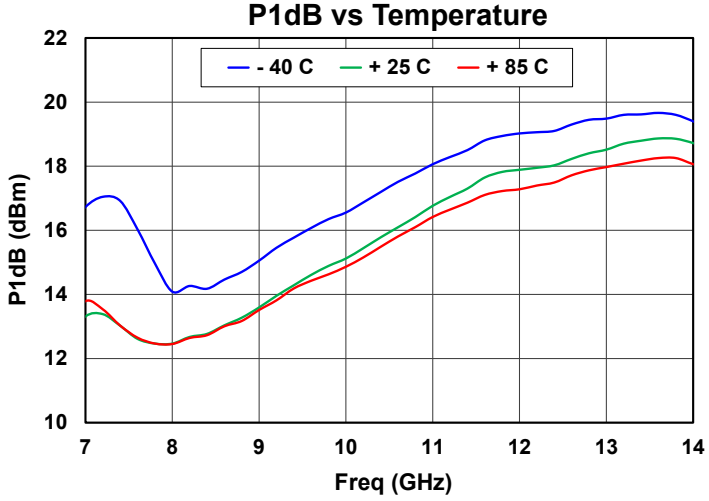
Performance Plots – Large Signal RF

Conditions unless otherwise specified: VD = 2.0 V, I_{DQ} = 180 mA (total), 25 °C

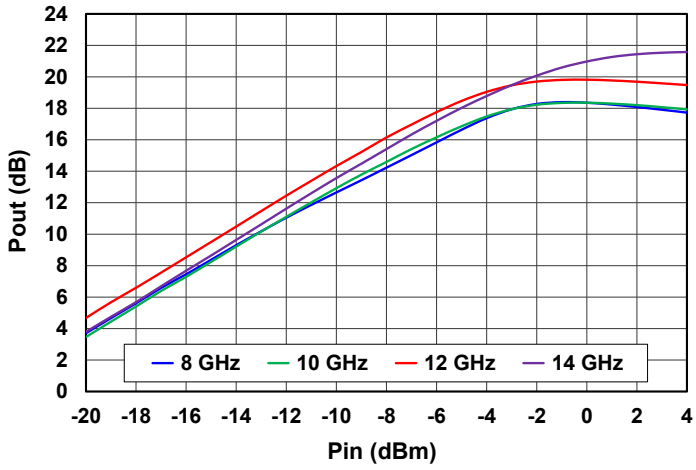
Psat vs Temperature



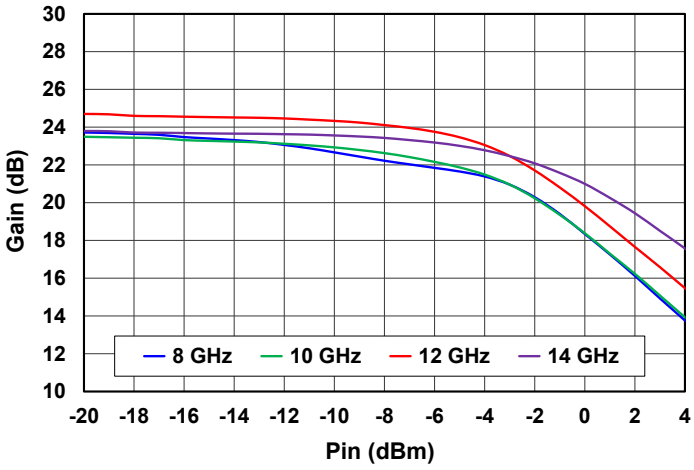
P1dB vs Temperature



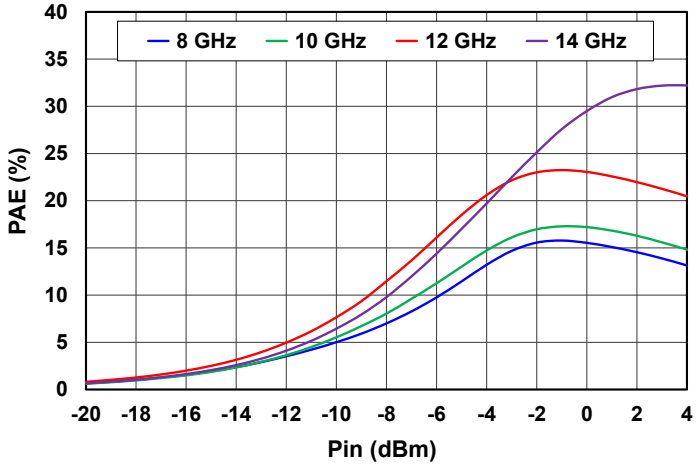
Pout vs Pin



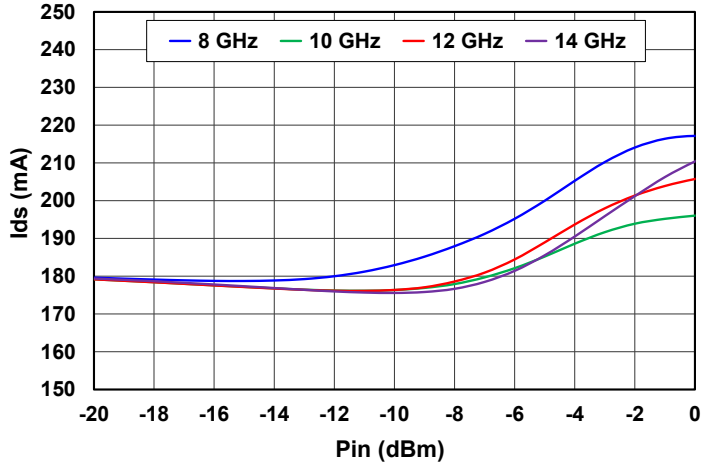
Gain vs Pin



PAE vs Pin

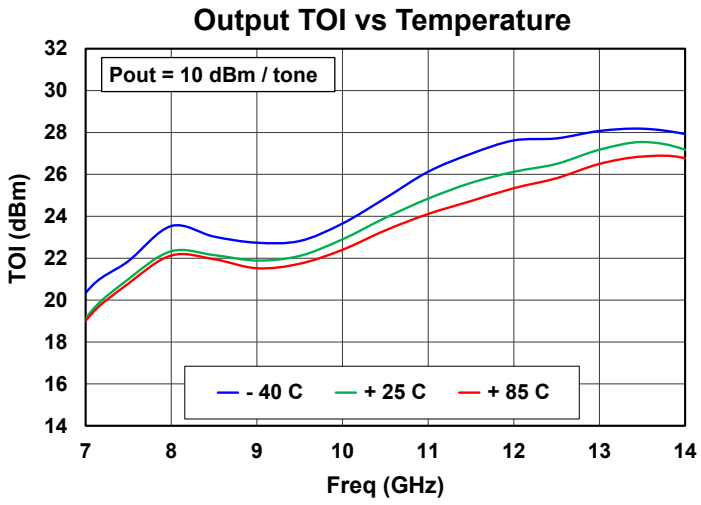


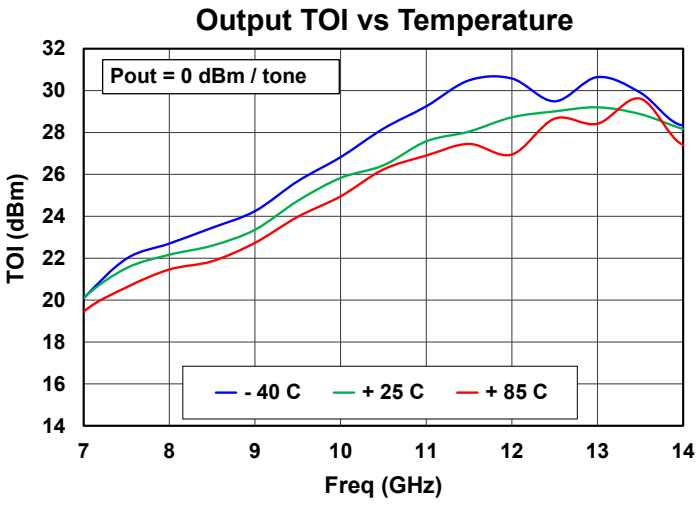
Ids vs Pin

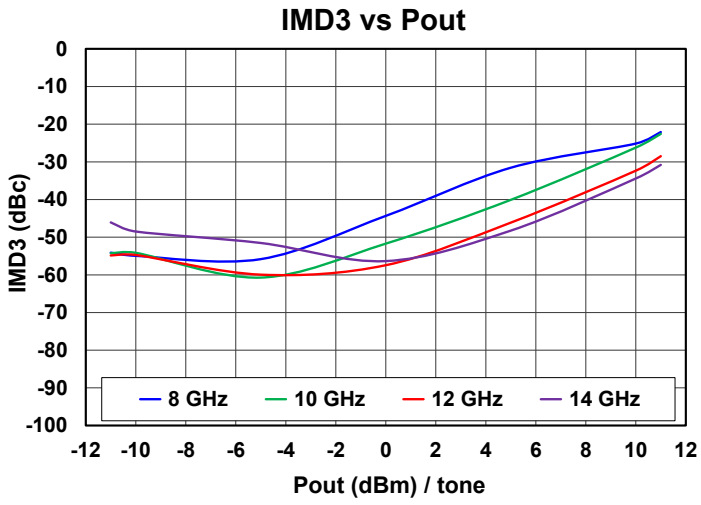


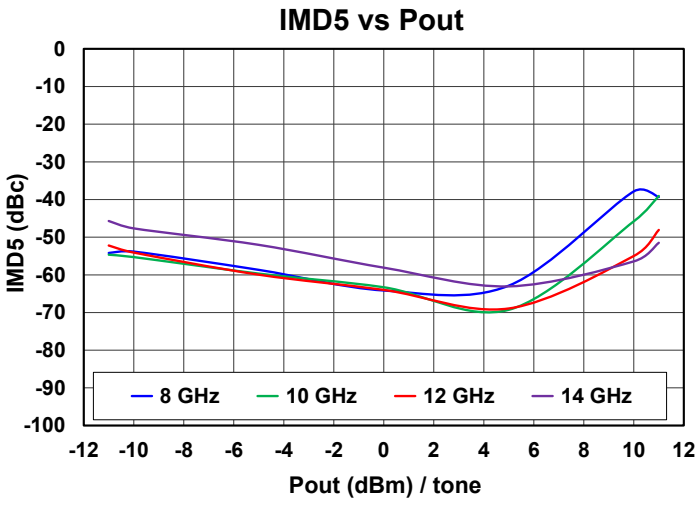
Performance Plots – Linearity

Conditions unless otherwise specified: VD = 2.0 V, I_{DQ} = 180 mA (total), Tone Spacing = 11 MHz, 25 °C

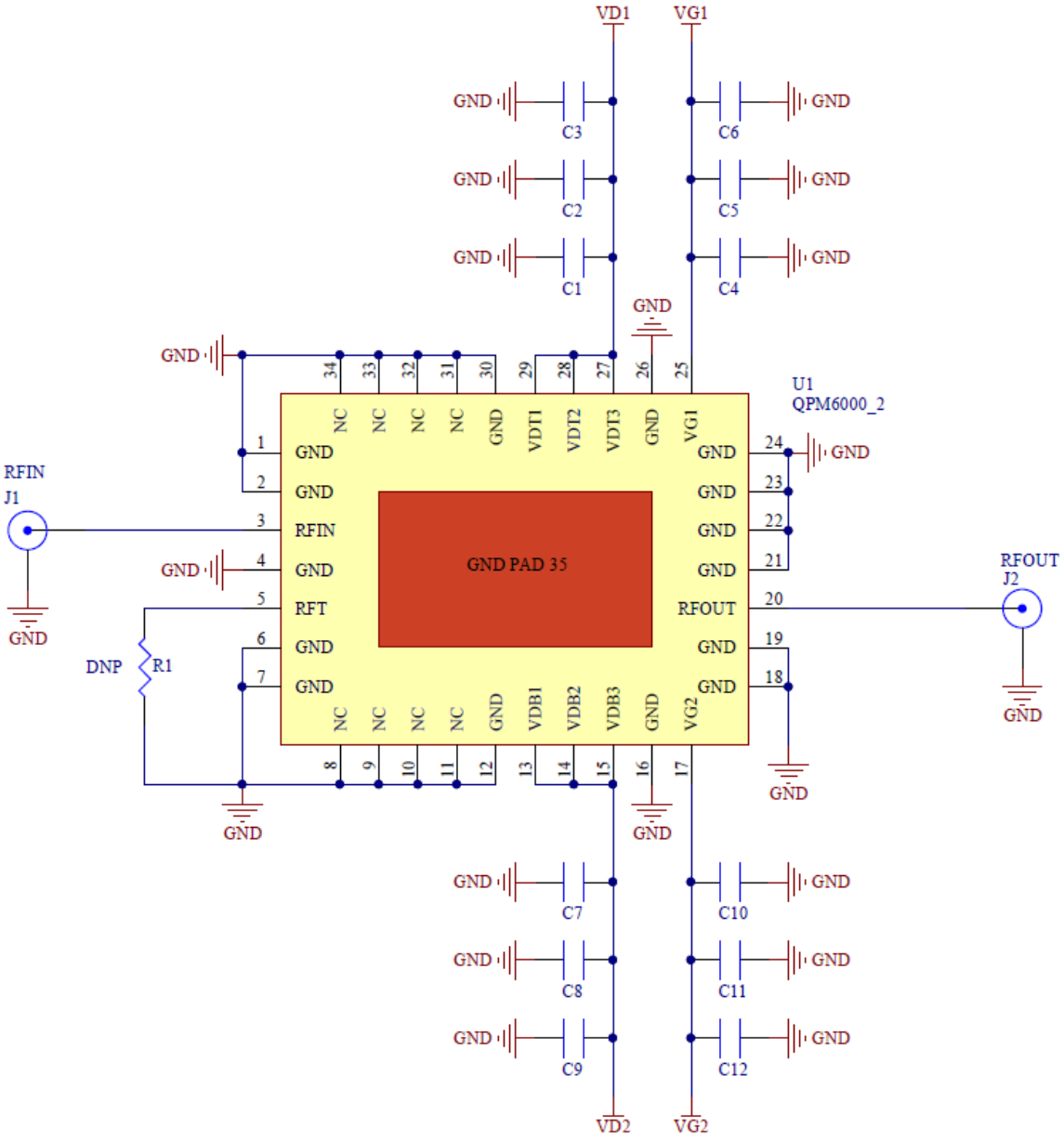








Application Circuit and Biasing Procedure



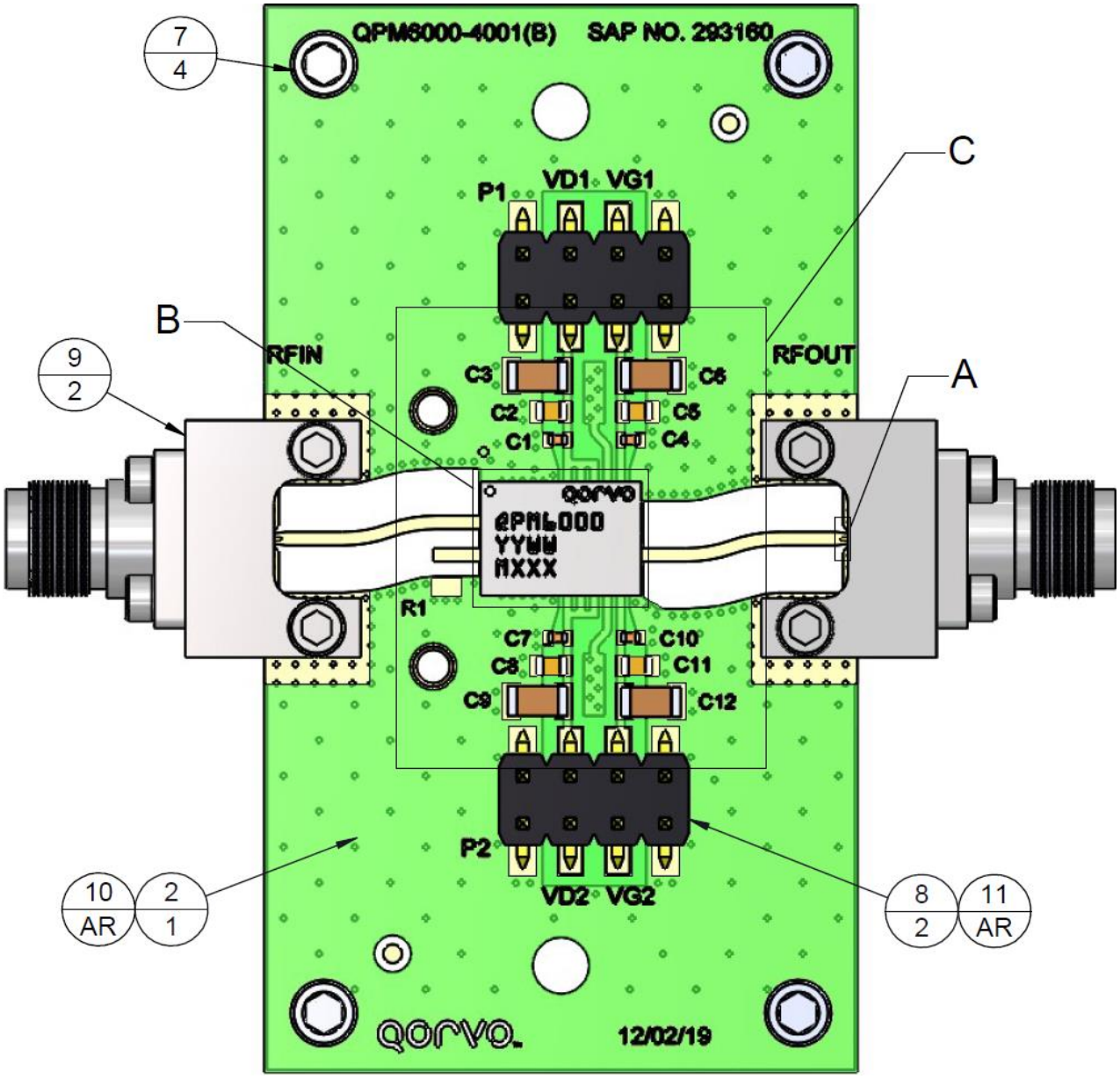
Bias-up Procedure

1. Set VD1, VD2 current limits to 300 mA (each side)
2. Set VG1 and VG2 to -1.3 V
3. Set VD1 and VD2 to +2.0 V (Drains on each side can be connected together as shown in schematic)
2. Set VG1 and VG2 to achieve desired drain currents
3. Apply RF signal

Bias-down Procedure

1. Turn off RF signal
2. Set VG1 and VG2 to until drain current is ~ 0 mA
3. Set VD1 and VD2 = 0 V
4. Turn off VD1 and VD2
3. Turn off VG1 and VG2

Evaluation Board and BOM

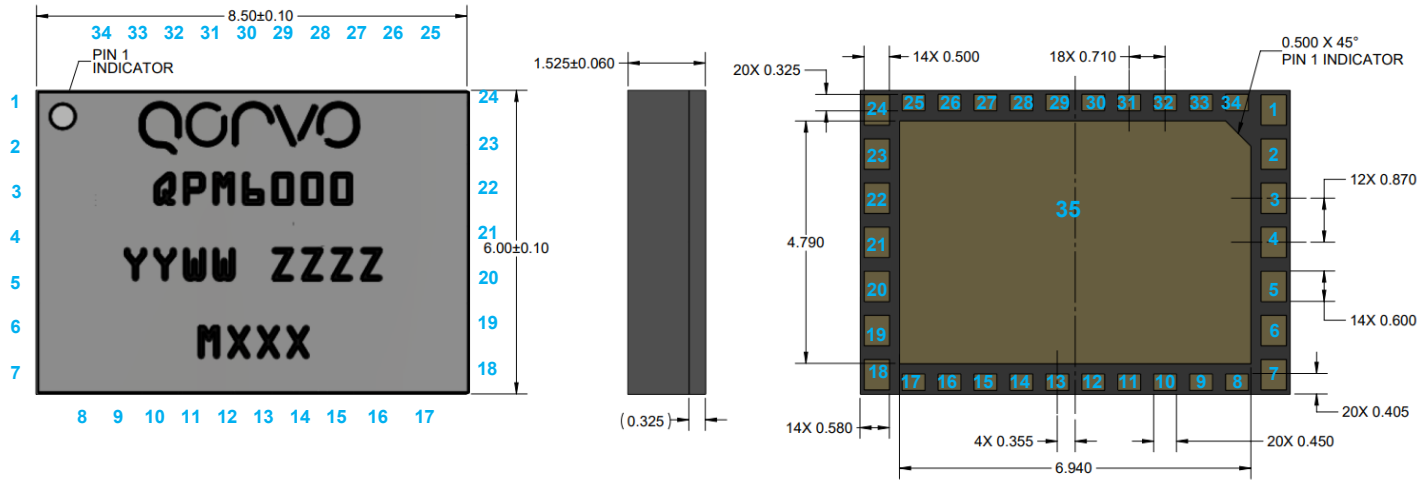


RF Layer is 0.0133” thick Rogers Corp. R4350B (ε_r = 3.48). Metal layers are 1.0 oz. copper. The microstrip line at the connector interface is optimized for the Southwest Microwave end launch connector 1092-01A-5.

Bill of Materials

Reference Des.	Value	Description	Manuf.	Part Number
C1, C4, C7, C10	0.01 µF	Cap, 0402, +16 V, ±10 %, X7R	Various	–
C3, C6, C9, C12	10.0 µF	Cap, 1206, +16 V, ±20 %, X5R	Various	–
C2, C5, C8, C11	1.0 µF	Cap, 0603, +16 V, ±10 %, X5R	Various	–
J1, J2	-	RF CONN, 2.92mm, F, End launch	Southwest Microwave	1092-01A-5

Mechanical Drawing and Bond Pad Descriptions



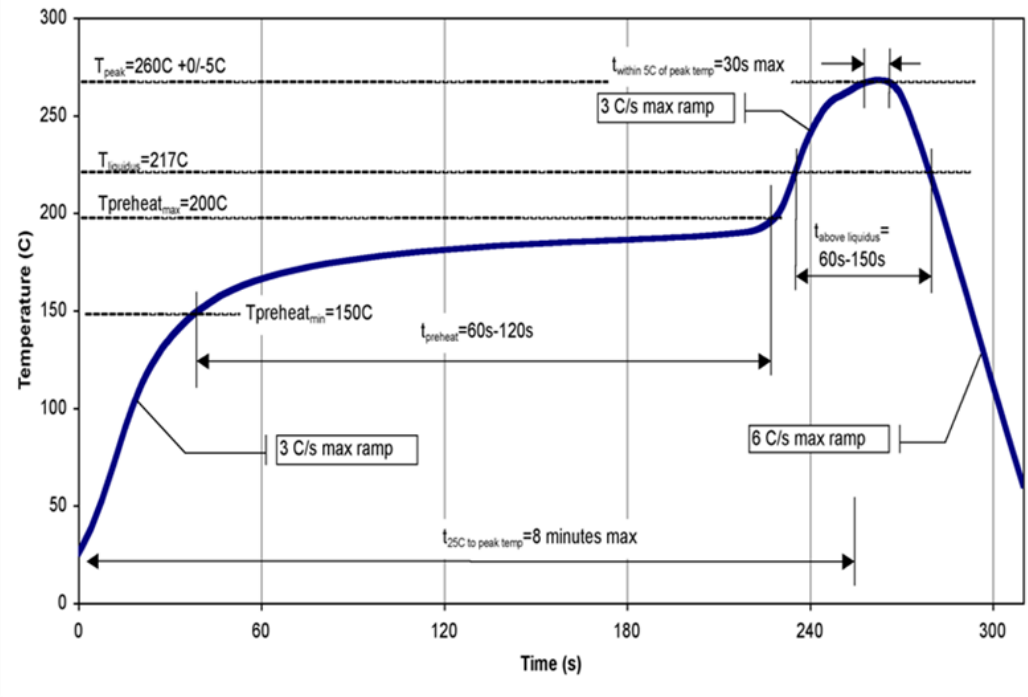
Dimensions in mm
Package is mold encapsulated
Package lead finish: NiPdAu plating with typical gold thickness of 0.095 um
Part Marking: QPM6000 = Part Number; YY = Part Assembly Year, WW = Part Assembly Week, MXXX = Batch ID

Pad No.	Label	Description
1, 2, 4, 6, 7, 17-19, 21-25, 27, 29, 35	GND	Ground
3	RFIN	RF Input, matched to 50 ohms, DC Coupled
5	RFT	No internal connection, can be grounded
13	VDB1	Bottom side LNA drain stage 1
14	VDB2	Bottom side LNA drain stage 2
15	VDB3	Bottom side LNA drain stage 3
17	VG2	Bottom side LNA gate control
20	RFOUT	RF Output, matched to 50 ohms, DC Blocked
25	VG1	Top side LNA gate control
27	VDT3	Top side LNA drain stage 3
28	VDT2	Top side LNA drain stage 2
29	VDT1	Top side LNA drain stage 1
8-12, 30 - 34	N/C	No internal connection, can be grounded

Assembly Notes

1. Compatible with the latest version of J-STD-020, lead-free solder, 260 °C peak reflow temperature.

Recommended Soldering Temperature Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	1A	ESDA / JEDEC JS-001-2017
ESD – Charge Device Model (CDM)	C2b	ESDA / JEDEC JS-002-2014
MSL – 260 °C Convection Reflow	3	JEDEC standard 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
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_4O_2$) Free
- SVHC Free
- PFOS 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

Important Notice

The information contained herein is believed to be reliable; however, Qorvo makes no warranties regarding the information contained herein and assumes no responsibility or liability whatsoever for the use of the information contained herein. All information contained herein is subject to change without notice. Customers should obtain and verify the latest relevant information before placing orders for Qorvo products. The information contained herein or any use of such information does not grant, explicitly or implicitly, to any party any patent rights, licenses, or any other intellectual property rights, whether with regard to such information itself or anything described by such information. **THIS INFORMATION DOES NOT CONSTITUTE A WARRANTY WITH RESPECT TO THE PRODUCTS DESCRIBED HEREIN, AND QORVO HEREBY DISCLAIMS ANY AND ALL WARRANTIES WITH RESPECT TO SUCH PRODUCTS WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

Without limiting the generality of the foregoing, Qorvo products are not warranted or authorized for use as critical components in medical, life-saving, or life-sustaining applications, or other applications where a failure would reasonably be expected to cause severe personal injury or death.