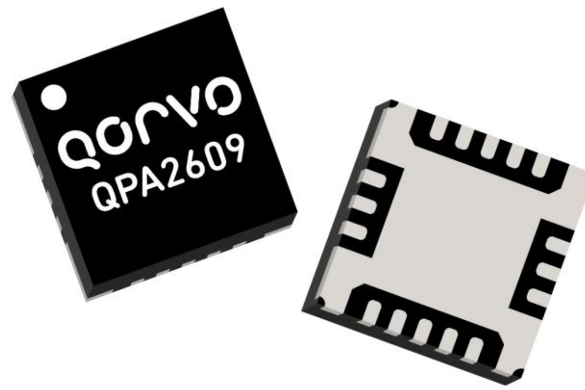
General Description

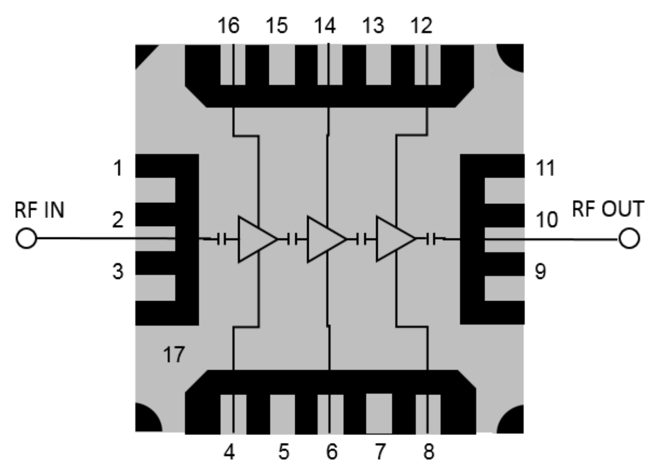
Qorvo's QPA2609 is a packaged, high-performance, low noise amplifier fabricated on Qorvo's production 90 nm pHEMT (QPHT09) process. Covering 7 – 14 GHz, the QPA2609 provides 26 dB small signal gain with a low noise figure of 1.1dB. The device can deliver 20dBm of power with P1dB of 18 dBm, while supporting an IM3 level of −50 dBc (at Pout=0 dBm / tone).

Packaged in a small 4 mm x 4 mm plastic overmold QFN, the QPA2609 is matched to 50 ohms with integrated DC blocking caps on both I/O ports for easy handling and simple system integration.

The QPA2609 high performance and ease of handling makes it an ideal component for satellite and point to point communication system applications.



Functional Block Diagram



Product Features

- Frequency Range: 7 – 14 GHz
- Noise Figure: 1.1 dB
- Small Signal Gain: 26 dB
- P1dB: 18 dBm
- IM3: −50 dBc (@ Pout=0 dBm/tone)
- Bias: V_D = 3.5 V, I_{DQ} = 120 mA, V_G = −0.46 V
- Plastic Overmold Package
- Package Dimensions: 4.0 x 4.0 x 0.85 mm

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

Applications

- Satellite Communications
- Point to Point Communications
- Military and Commercial Radar Applications

Ordering Information

Part No.	Description
QPA2609S2	QPA2609 Sample Bag, Qty 2
QPA2609SR	QPA2609 Tape and Reel, Qty 100
QPA2609TR7	QPA2609 Tape and Reel, Qty 750
QPA2609EVB1	QPA2609 Evaluation Board

Absolute Maximum Ratings

Parameter	Value	Units
Drain Voltage (V_D)	4.5	V
Drain Current ($I_{D1}/I_{D2}/I_{D3}$)	96/115/192	mA
Gate Voltage Range	-1.3 to 0	V
Gate Current ($I_{G1}/I_{G2}/I_{G3}$ at 125 °C)	5.0/5.0/6.6	mA
RF Input Power (50 Ω, 85 °C)	20	dBm
Channel Temperature, T_{CH}	175	°C
Mounting Temperature (30 seconds)	260	°C
Storage Temperature	−55 to 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 may reduce device reliability.

Recommended Operating Conditions

Parameter	Value	Units
Drain Voltage	3.5	V
Drain Current (quiescent, I_{DQ})	120	mA
Gate Voltage (typical)	−0.46	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.

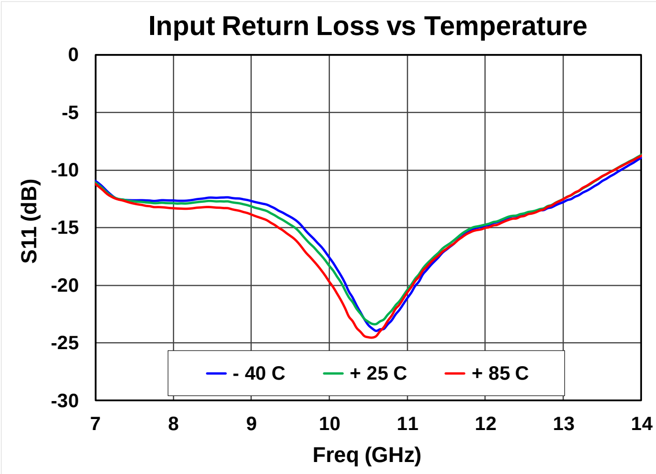
Electrical Specifications

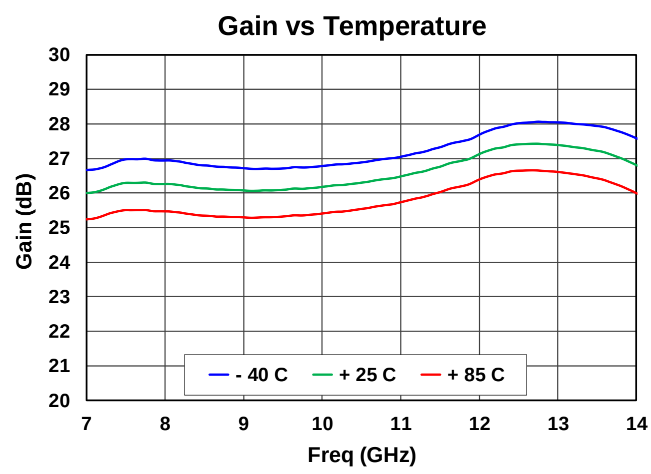
Test Conditions unless otherwise stated: V_D = 3.5V, I_{DQ} = 120mA, 25 °C. Data de-embedded to device reference planes

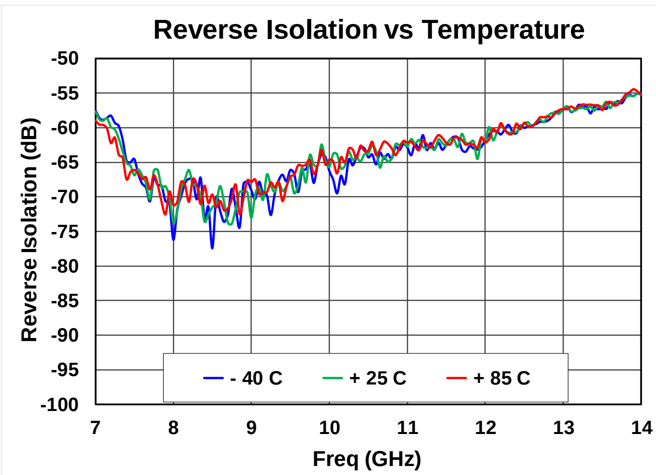
Parameter	Min	Typical	Max	Units
Frequency	7		14	GHz
Small Signal Gain		26		dB
Noise Figure		1.1		dB
1-dB Compression Point		18		dBm
Input Return Loss		12		dB
Output Return Loss		16		dB
3^{RD} Order Intermodulation level (Pout=0 dBm/tone)		−50		dBc
Output TOI (Pout=0 dBm/tone)		23		dBm
Gain Temperature Coefficient		−0.013		dB/°C

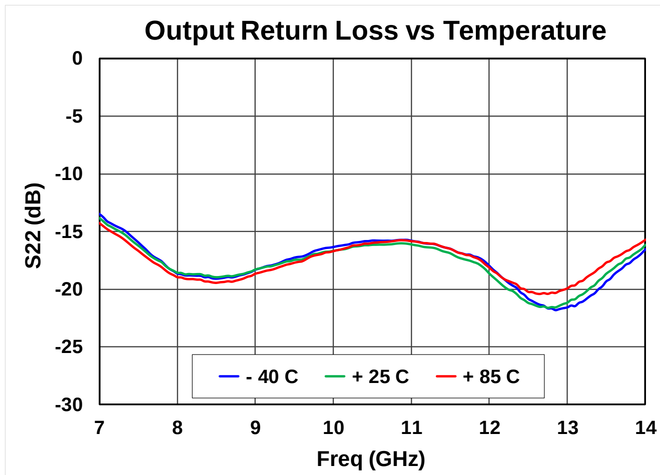
Performance Plots – Small Signal

Test Conditions unless otherwise stated: V_D = 3.5V, I_{DQ} = 120mA, 25 °C. Data de-embedded to device reference planes





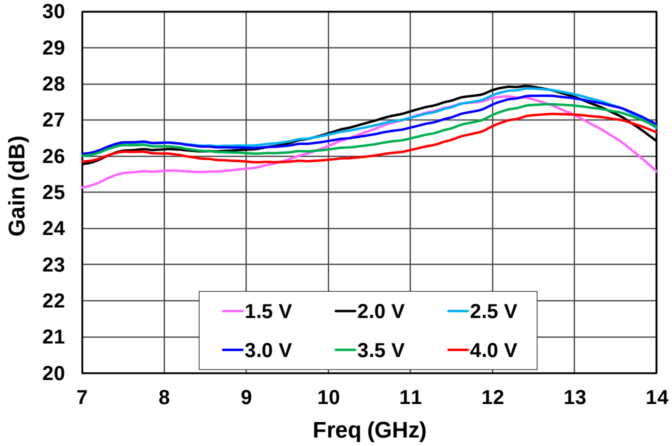




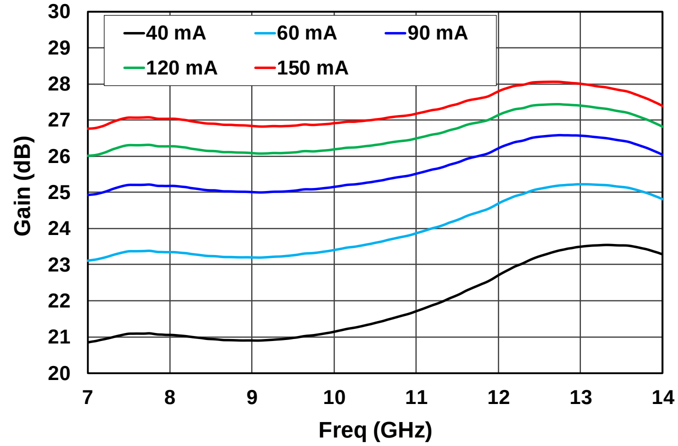
Performance Plots – Small Signal

Test Conditions unless otherwise stated: V_D = 3.5V, I_{DQ} = 120mA, 25 °C. Data de-embedded to device reference planes

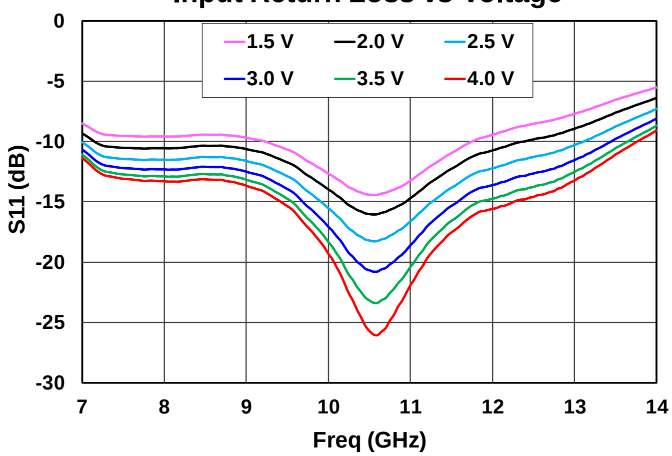
Gain vs Voltage



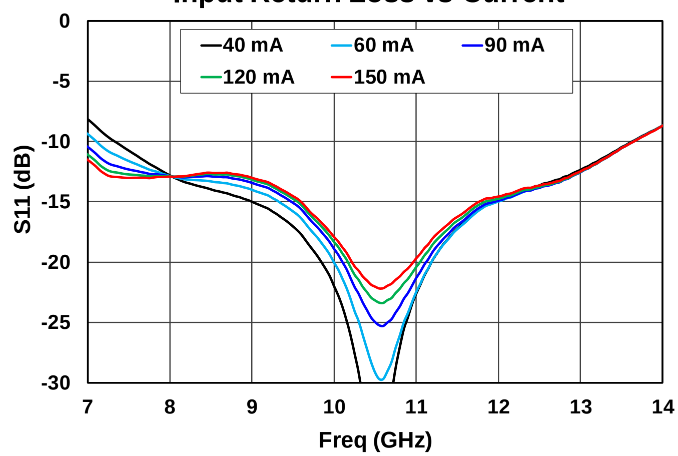
Gain vs Current



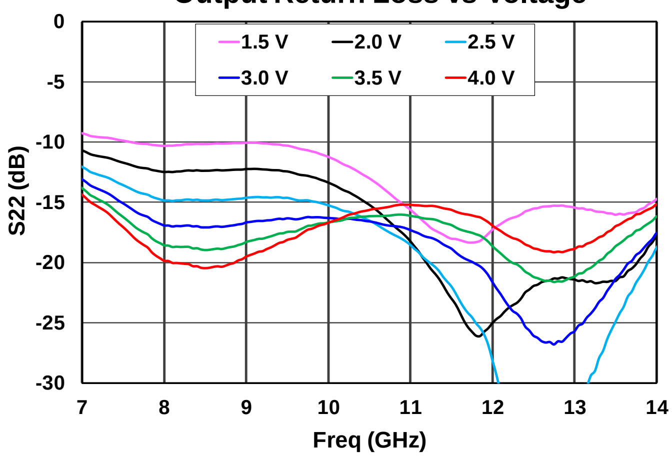
Input Return Loss vs Voltage



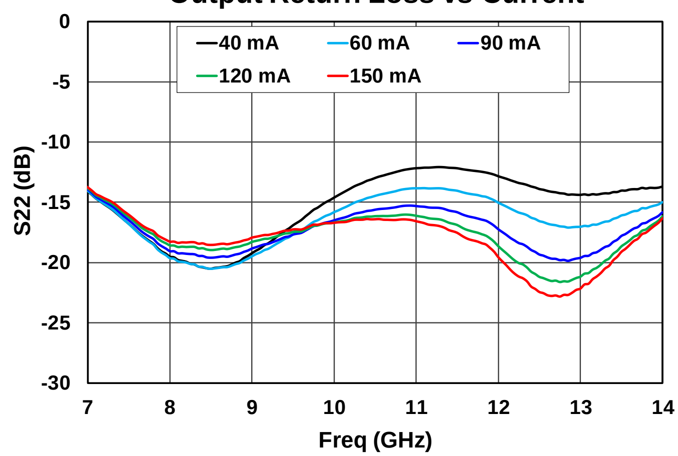
Input Return Loss vs Current



Output Return Loss vs Voltage

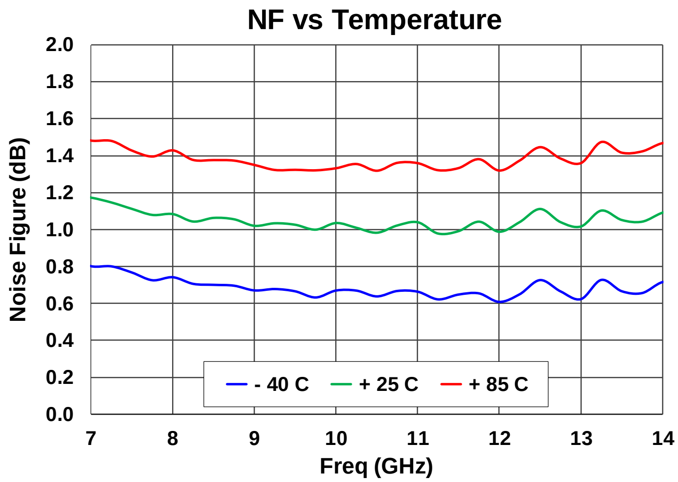


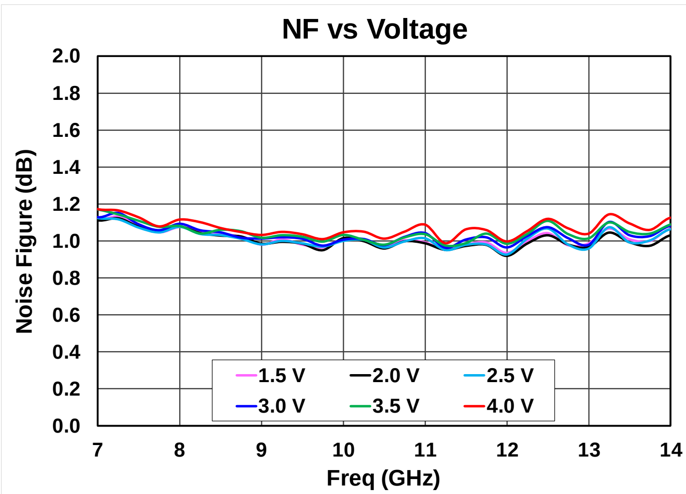
Output Return Loss vs Current

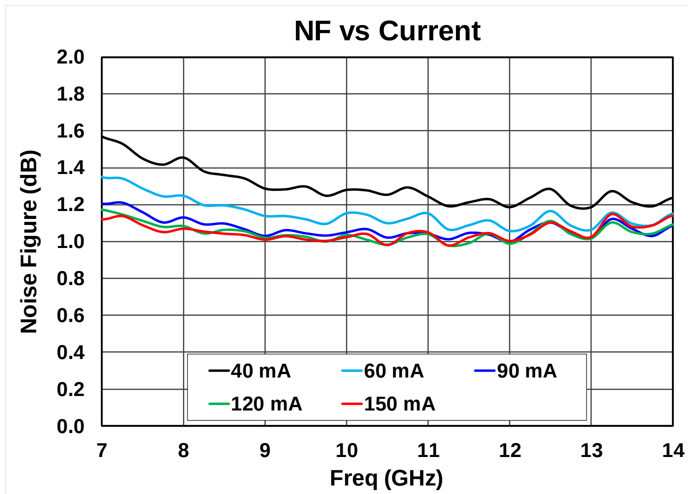


Performance Plots – Noise Figure

Test Conditions unless otherwise stated: V_D = 3.5V, I_{DQ} = 120mA, 25 °C. Data de-embedded to device reference planes

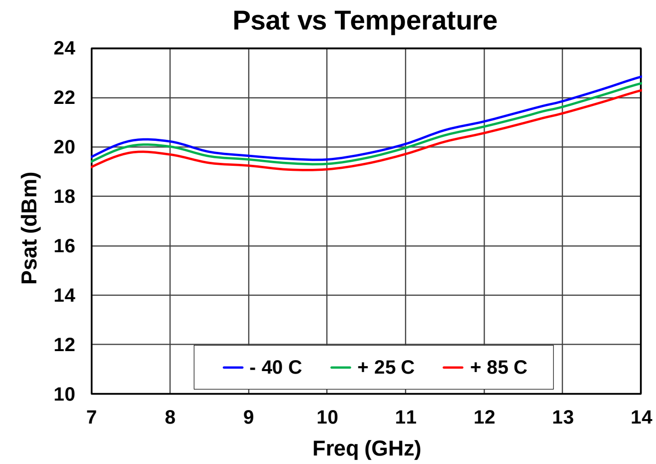


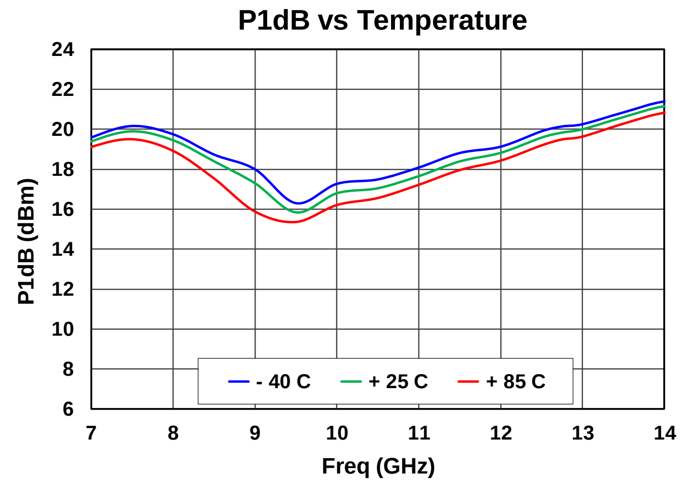


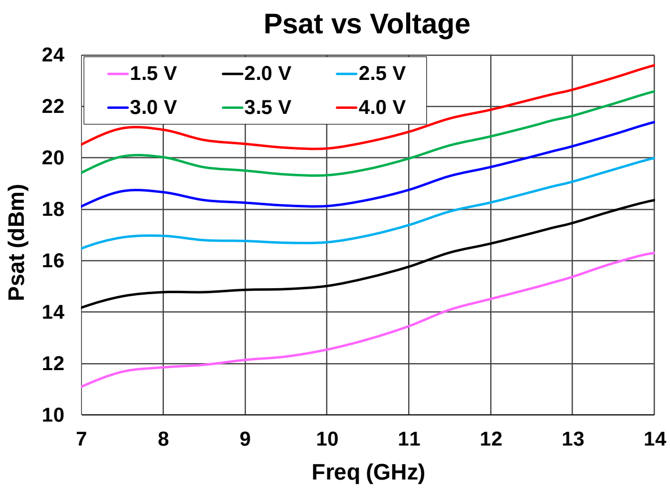


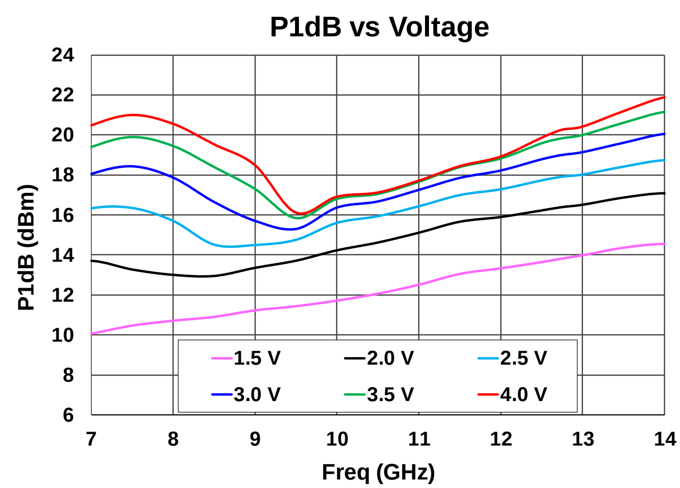
Performance Plots – Power

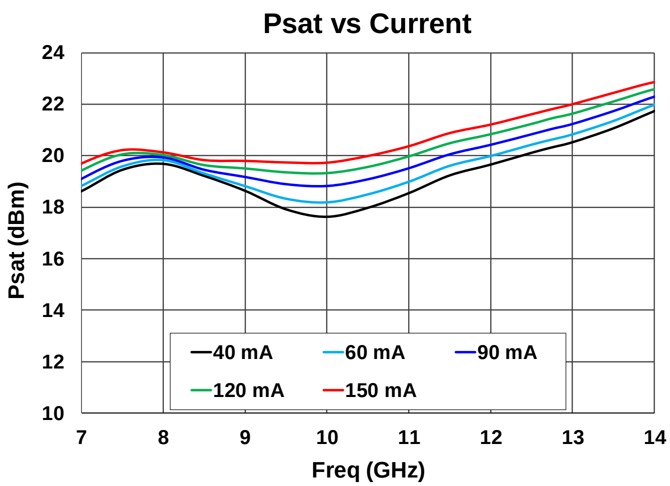
Test Conditions unless otherwise stated: V_D = 3.5V, I_{DQ} = 120mA, 25 °C. Data de-embedded to device reference planes

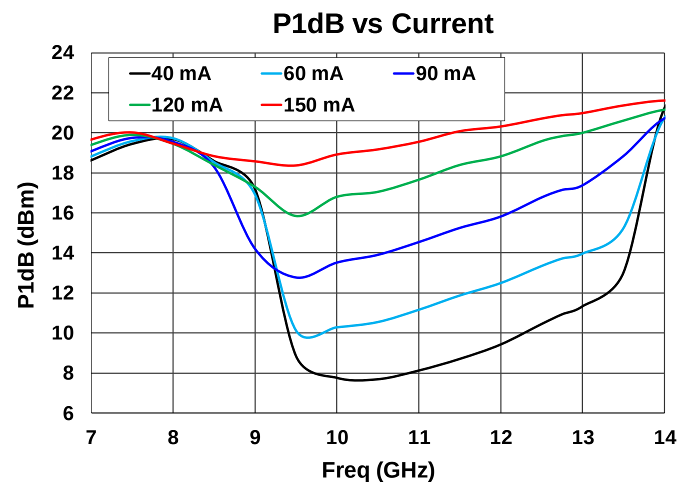






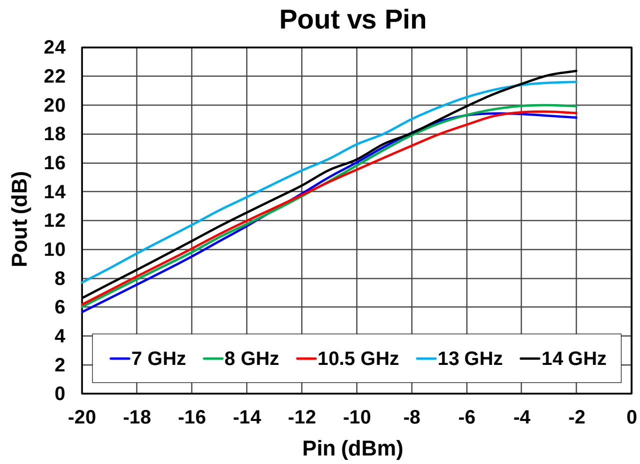


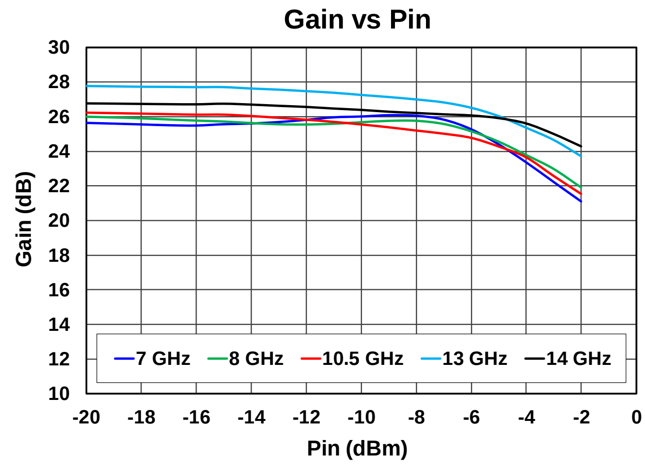


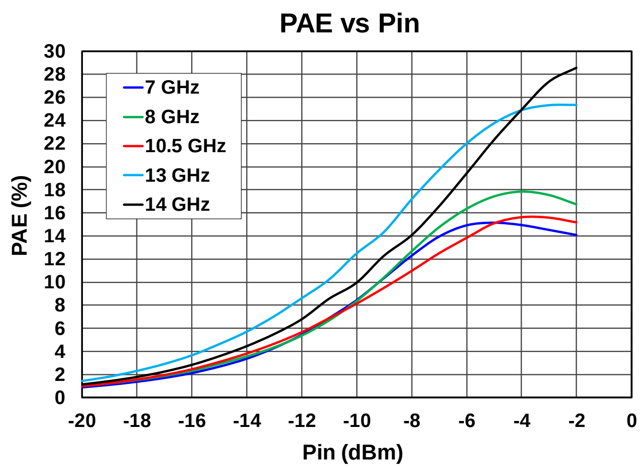


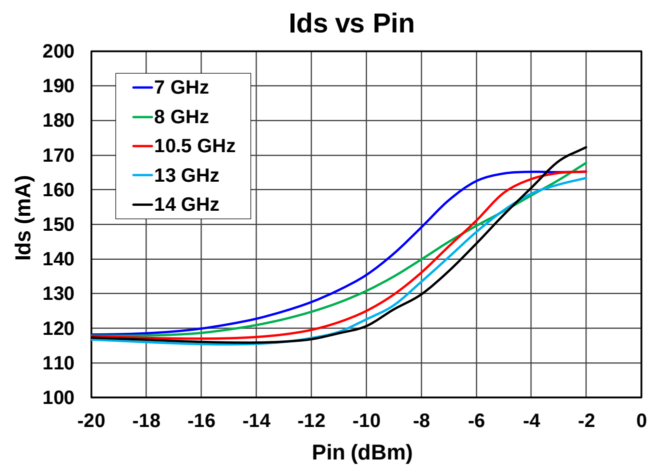
Performance Plots – Power Sweep

Test Conditions unless otherwise stated: V_D = 3.5V, I_{DQ} = 120mA, 25 °C. Data de-embedded to device reference planes



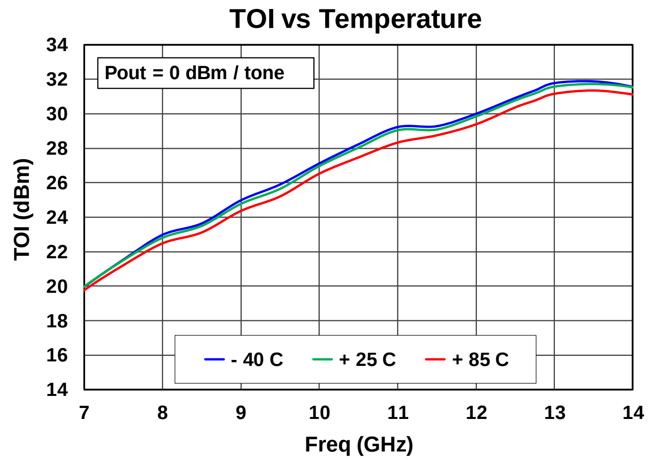


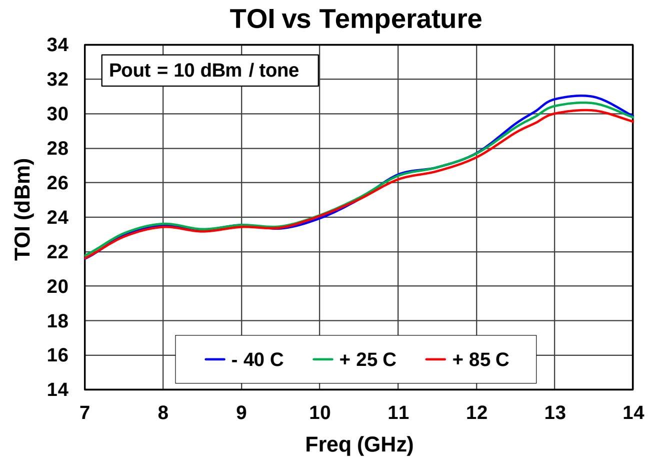


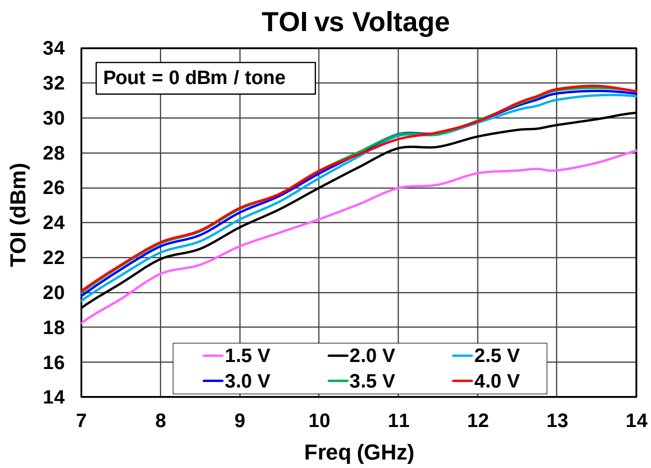


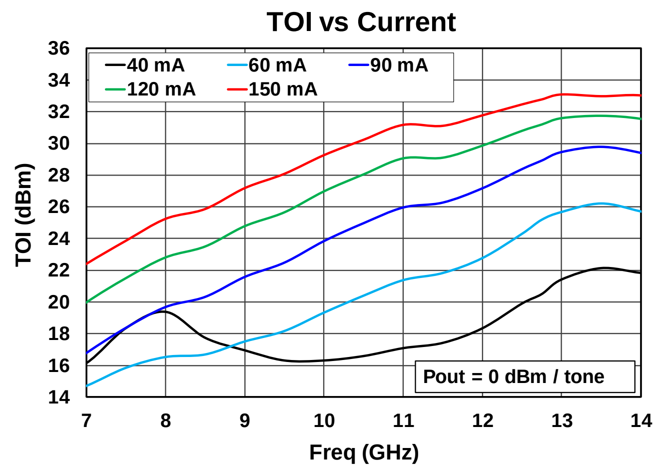
Performance Plots – Linearity

Test Conditions unless otherwise stated: V_D = 3.5V, I_{DQ} = 120mA, Δf = 11 MHz, 25 °C. Data de-embedded to device reference planes



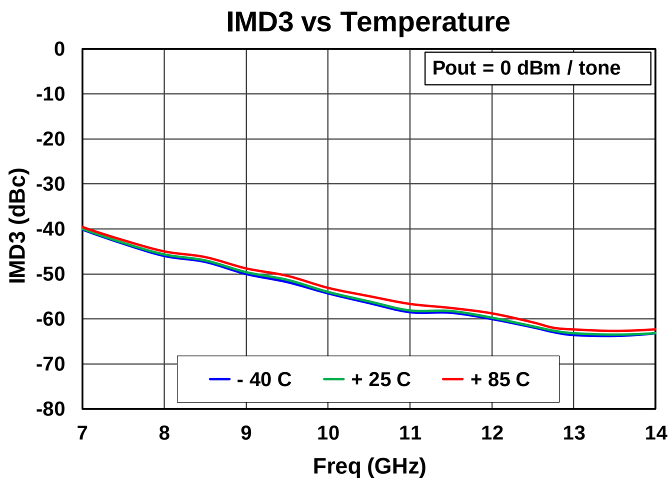


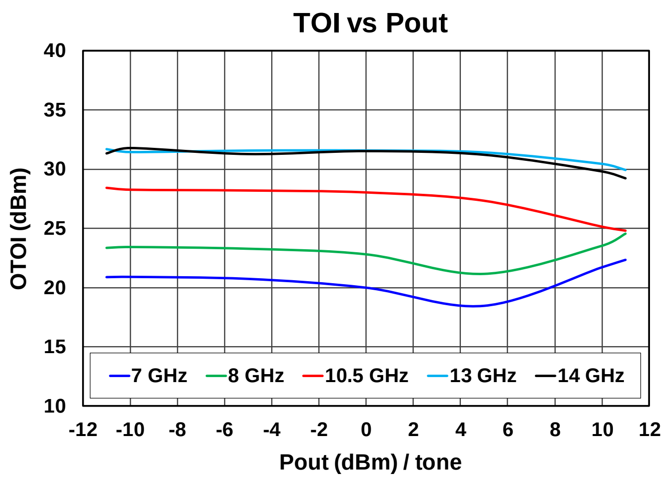


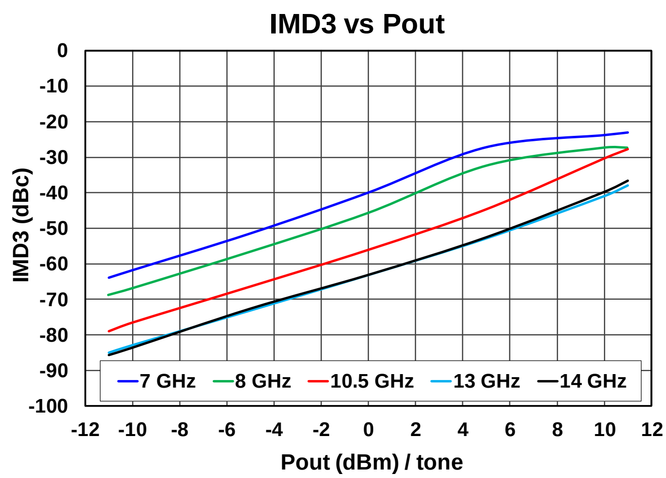


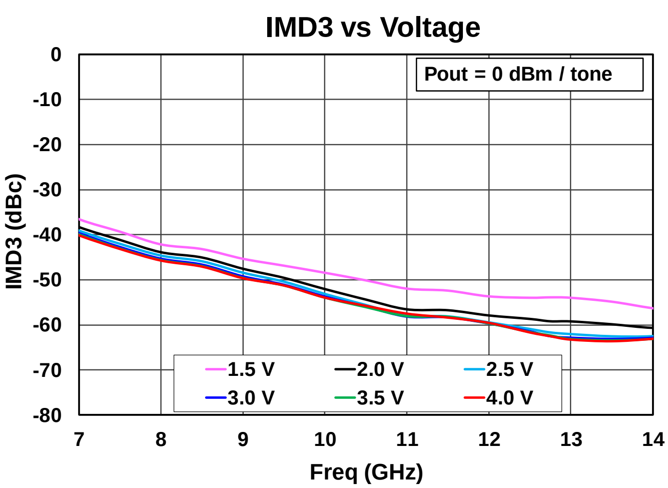
Performance Plots – Linearity

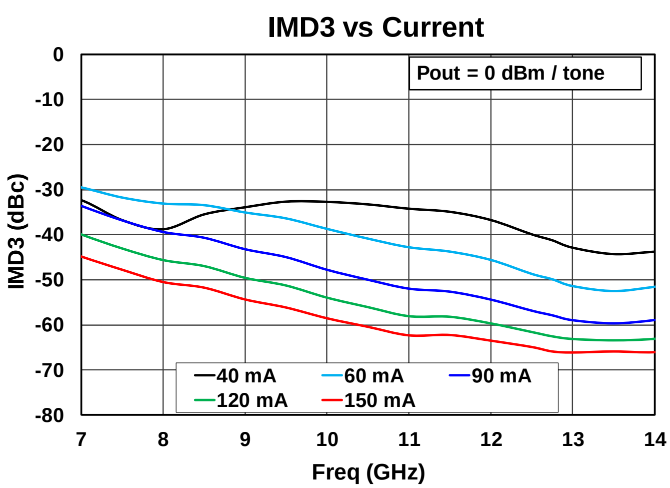
Test Conditions unless otherwise stated: V_D = 3.5V, I_{DQ} = 120mA, Δf = 11 MHz, 25 °C. Data de-embedded to device reference planes





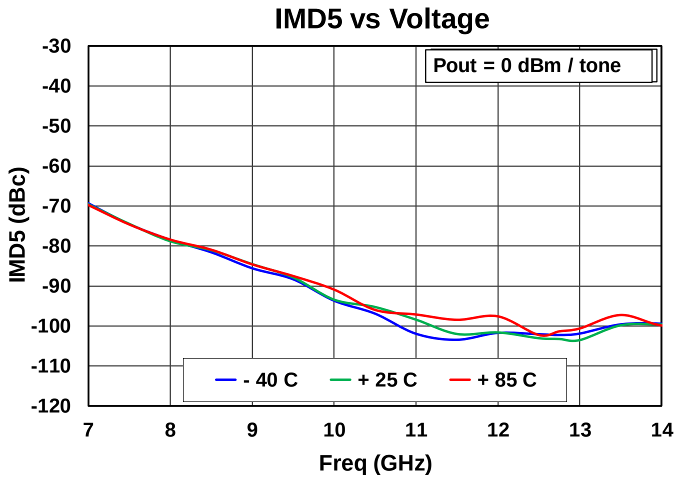


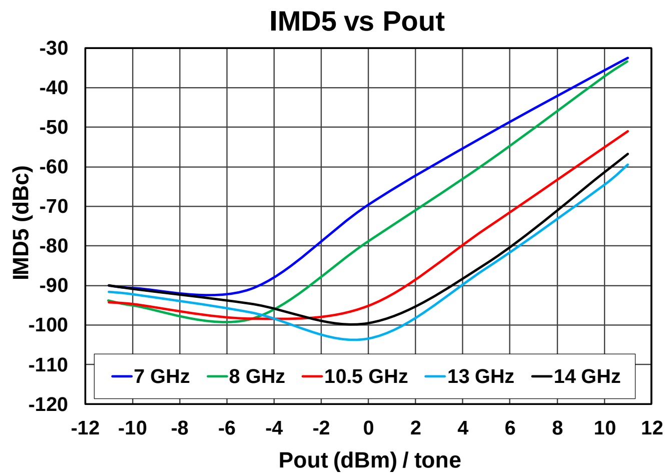


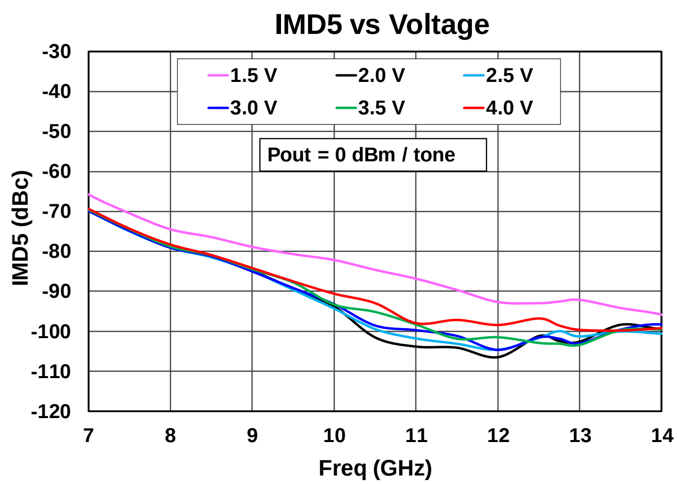


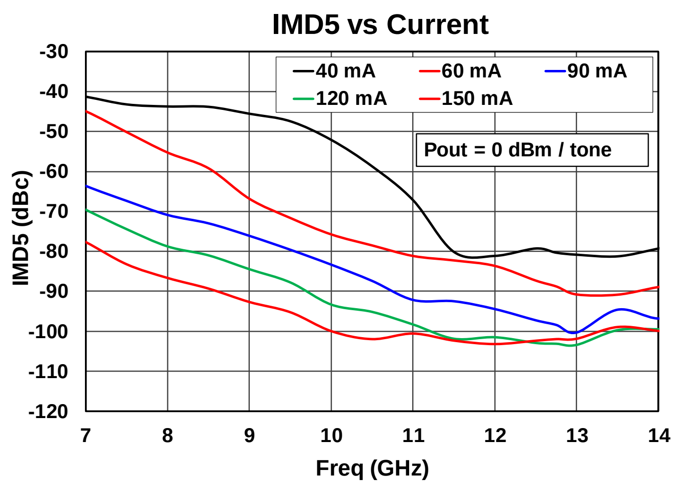
Performance Plots – Linearity

Test Conditions unless otherwise stated: V_D = 3.5V, I_{DQ} = 120mA, Δf = 11 MHz, 25 °C. Data de-embedded to device reference planes

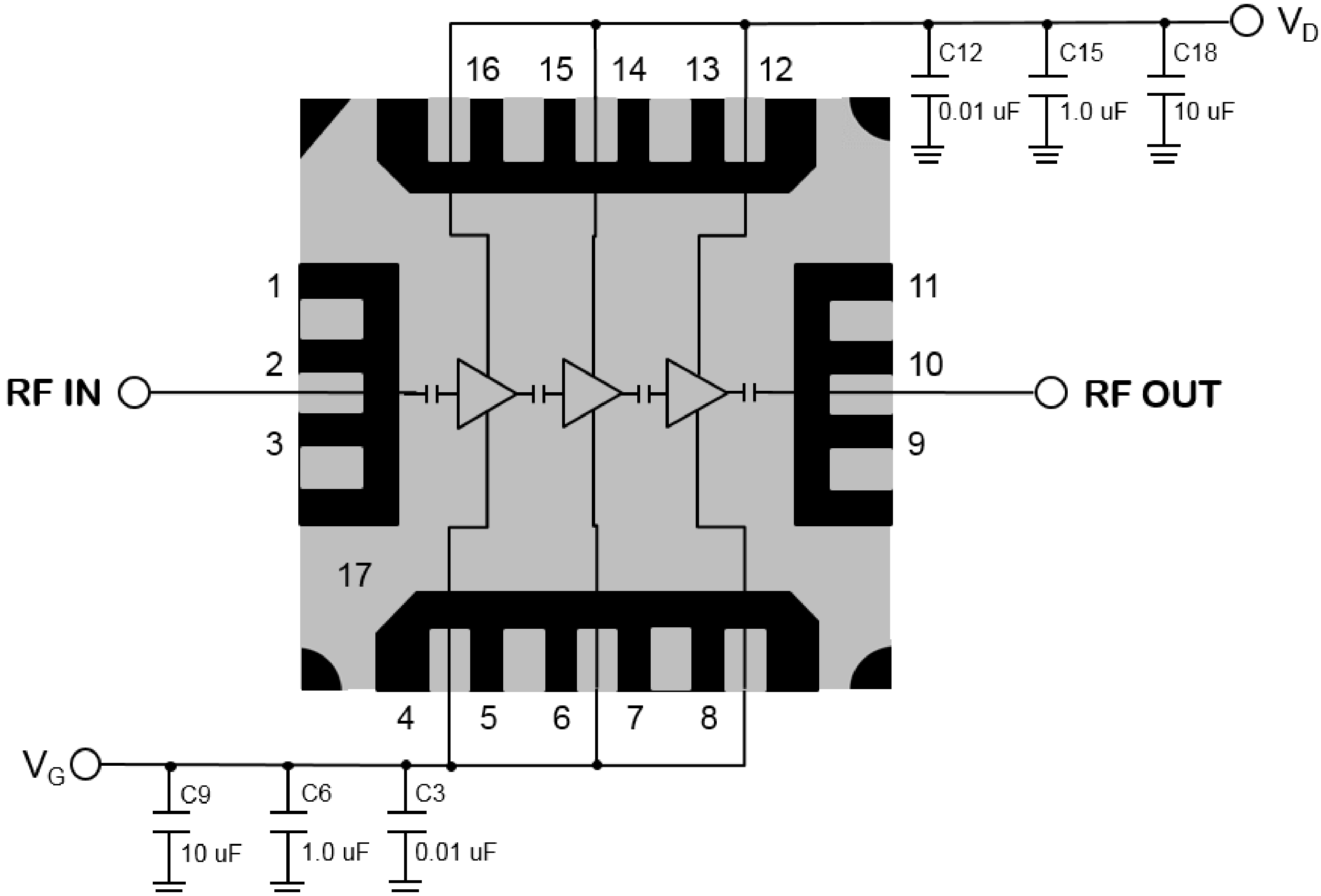








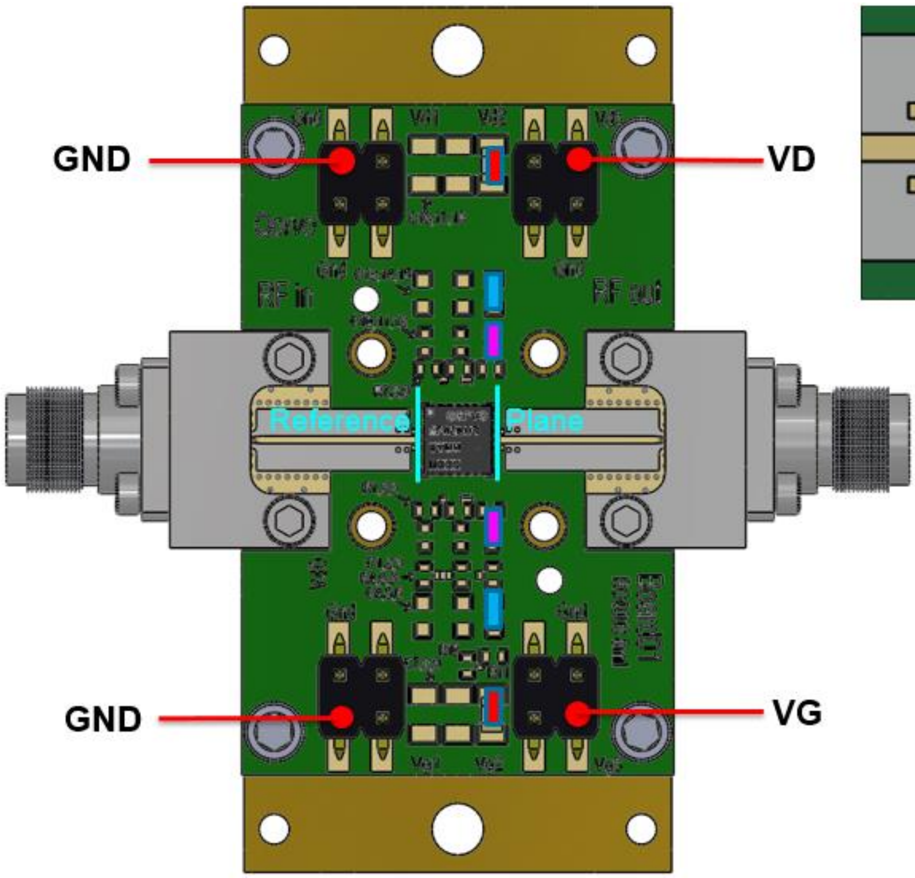
Application Circuit

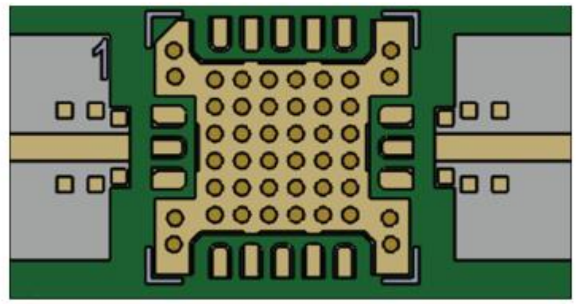


Bias-up Procedure
1. Set I_D limit to 200 mA, I_G limit to 10 mA
2. Set V_G to −1.3 V
3. Set V_D +3.5 V
4. Adjust V_G more positive until I_{DQ} = 120 mA (V_G ~ −0.46 V Typical)
5. Apply RF signal

Bias-down Procedure
1. Turn off RF signal
2. Reduce V_G to −1.3 V. Ensure I_{DQ} ~ 0 mA
3. Set V_D to 0 V
4. Turn off V_D supply
5. Turn off V_G supply

Evaluation Board and Assembly





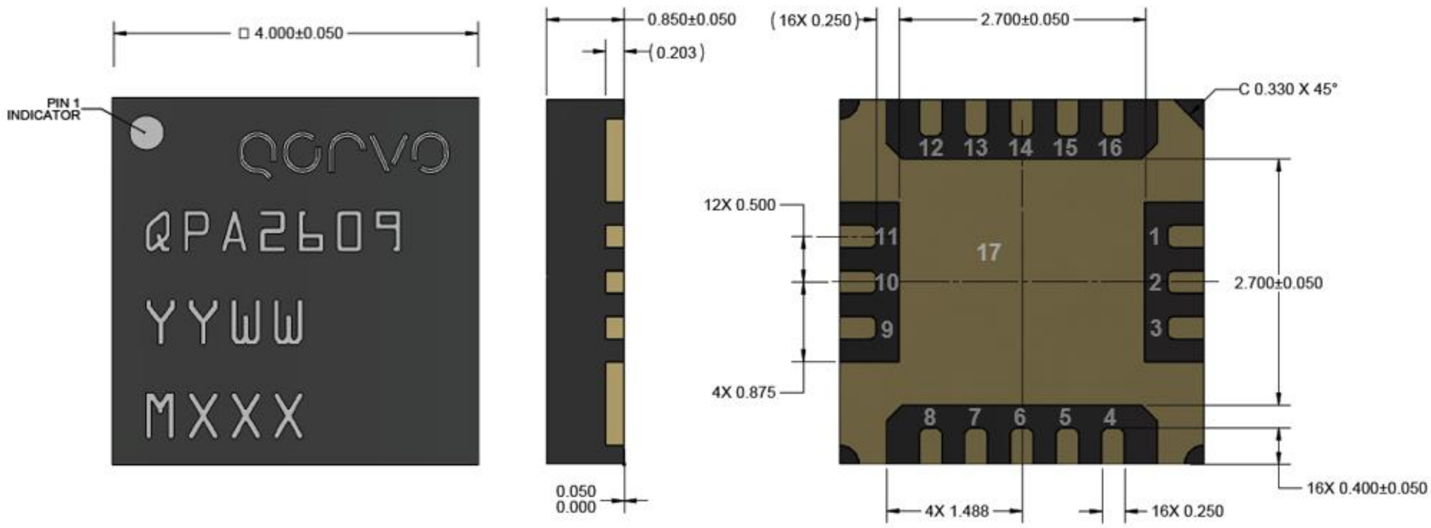
Mounting pad detail

RF Layer is 0.008” thick Rogers Corp. RO4003C (ε_r = 3.35). Metal layers are 0.5 oz. copper. The microstrip line at the connector interface is optimized for the Southwest Microwave end launch connector 1092-01A-5.

Bill of Materials

Ref. Des.	Component	Value	Manuf.	Part Number
C3, C12	Surface Mount Cap.	CAP 0.01UF +/-10% 50V 0402 X7R ROHS	Various	
C6, C15	Surface Mount Cap.	CAP 1.0UF +/-10% 16V 0603 X7R ROHS	Various	
C9, C18	Surface Mount Cap.	CAP CER 10UF 10V X7R 10% 0805 TDK ROHS	Various	
J1, J2	RF Connector	2.92 MM RF CONNECTOR	Southwest Microwave	1092-01A-5

Mechanical Drawing & Pad Description



Dimensions in mm, package is mold encapsulated with NiPdAu plated leads

Part Marking: QPA2609: Part Number, YY = Part Assembly Year, WW = Part Assembly Week, MXXX = Batch ID

Pin Number	Label	Description
1, 3, 9, 11, 17 (slug)	GND	GROUND
2	RF Input	Matched to 50 ohms, DC blocked
4	VG1	Gate Voltage; bias network is required (V_G can be tied together at PCB)
6	VG2	Gate Voltage; bias network is required (V_G can be tied together at PCB)
8	VG3	Gate Voltage; bias network is required (V_G can be tied together at PCB)
10	RF Output	Matched to 50 ohms, DC blocked
12	VD3	Drain Voltage; bias network is required (V_D can be tied together at PCB)
14	VD2	Drain Voltage; bias network is required (V_D can be tied together at PCB)
16	VD1	Drain Voltage; bias network is required (V_D can be tied together at PCB)
5, 7, 13, 15	N/C	No internal connection. Recommend to GND at the PCB level

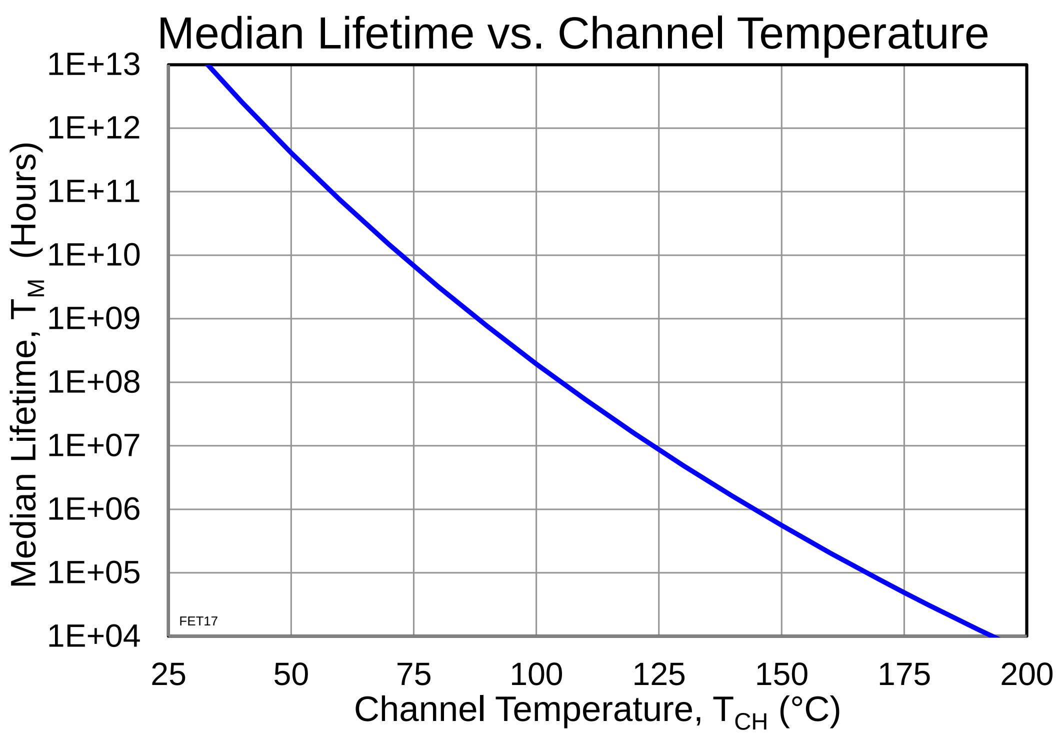
Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) [1]	T_{base} = 85°C, V_D = 3.5 V, I_{DQ} = 120 mA Quiescent / Small Signal operation P_{DISS} = 0.42 W	47.6	°C/W
Channel Temperature (T_{CH})		105	°C
Median Lifetime (T_M)		4.0E07	Hrs

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

Median Lifetime

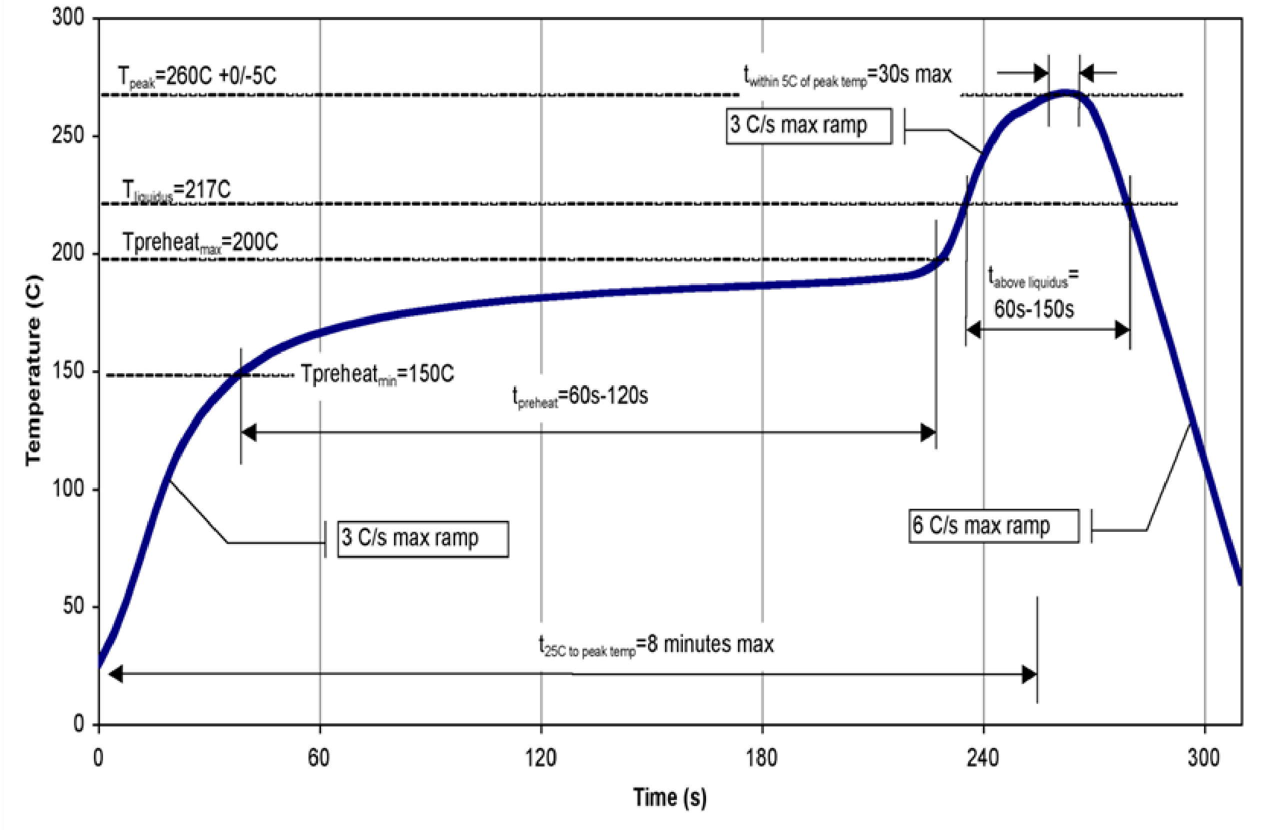
Test Conditions: V_D = 4 V
Failure Criteria = 10% reduction in I_{D_MAX}



Solderability

1. Compatible with the latest version of J-STD-020, Lead-free solder, 260 °C.
2. The use of no-clean solder to avoid washing after soldering is recommended.

Recommended Soldering Temperature Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	1A	ESDA / JEDEC JS-001-2012
ESD – Charged Device Model (CDM)	C3	ESDA / JEDEC JS-002-2014
MSL – Convection Reflow 260 °C	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 ($C_{15}H_{12}Br_{4}0_{2}$) Free
- PFOS Free
- SVHC 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

For technical questions and application information: **Email: appsupport@qorvo.com**

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