Features

- 6—14 GHz Low Noise and Driver Amplifier
- 27 dB Small-Signal Gain
- 1.8 dB Typical Noise Figure
- 20 dBm Typical Output P1dB
- 10 dB Input and Output Return Loss
- 28 dBm Output IP3
- Single Supply from 3 V to 8 V, with 60 mA current draw
- 3 mm × 3 mm QFN Package

Applications

- Test and Measurement
- Aerospace and Defense
- Satcom

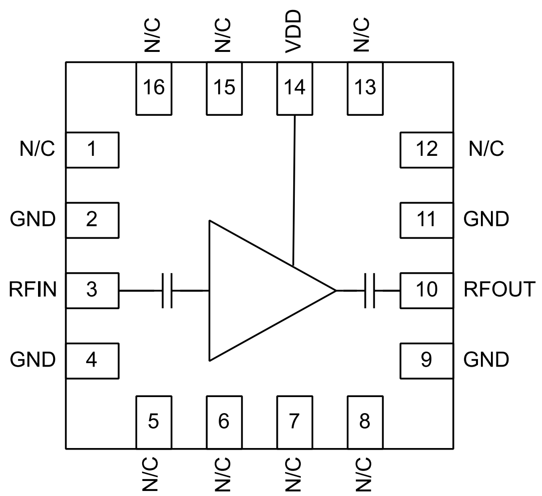
Description

ARF1211Q3 is a low noise and driver amplifier designed for high data-rate applications. With 27 dB of linear gain, 1.8 dB noise figure, 20 dBm output P1dB and low-current operation, it is well suited to multiple roles in Satcom and A&D radio systems. The circuit draws 60 mA from a single DC supply, and can be operated from 3 V, for minimum noise figure (1.7 dB), up to 8 V, for higher output power (20 dBm P1dB). The part is internally matched to 50 Ω with ESD protection.

The part is RoHS* compliant and built with the latest manufacturing techniques to optimize for reliability and quality control.

Export from The Netherlands/EU, no licence.

Functional Diagram



Pin	Pin Name	Description
3	RF_{IN}	RF Input
10	RF_{OUT}	RF Output
14	V_{DD}	Supply Voltage
1, 5, 6, 7, 8, 12, 13, 15, 16	N/C	Unconnected Pins
2, 4, 9, 11, Paddle	GND	Ground

All not connected (N/C) pins should be connected to DC, RF and thermal ground.

*RoHS compliant — European Union Directive 2011/65/EU

Electrical Specifications[1,2]

Parameter	Test Conditions	Min	Typ	Max	Units
Frequency Range		6		14	GHz
Small-Signal Gain	6 GHz 8 GHz 10 GHz 12 GHz 14 GHz	26.0 25.0 25.5 24.0 22.0	28.0 27.0 27.5 26.0 24.0	30.0 29.0 29.5 28.0 26.0	dB
Gain Flatness			±1		dB
Gain Variation over Temperature			0.02		dB/°C
Noise Figure	8 GHz 10 GHz 12 GHz		1.7 1.8 1.8		dB
Input Return Loss	6 GHz 8 GHz 10 GHz 12 GHz 14 GHz		17.2 10.0 9.5 9.0 3.8		dB
Output Return Loss	6 GHz 8 GHz 10 GHz 12 GHz 14 GHz		14.7 11.0 10.0 11.0 9.4		dB
V_{DD} Voltage		3	5	8	V
I_{DD} Current		50	60	70	mA

1. Parameters tested at 25°C in laboratory environment with standard 50 Ω matched equipment.
2. Nominal bias of V_{DD} = 5 V and I_{DDQ} ≈ 60 mA (quiescent current)

Electrical Specifications[1,2]

Parameter	Test Conditions	Min	Typ	Max	Units
Frequency Range		6		14	GHz
Output P1dB	6 GHz 8 GHz 10 GHz 12 GHz 14 GHz		14 16 17 16 15		dBm
Output P3dB	6 GHz 8 GHz 10 GHz 12 GHz 14 GHz		15 16 18 17 16		dBm
Output IP3	P_{OUT} = +10 dBm/tone, ΔF = 11 MHz 6 GHz 8 GHz 10 GHz 12 GHz 14 GHz		 15 24 25 25 21		dBm

Electrical Specifications, 8 V Bias[1,3]

Parameter	Test Conditions	Min	Typ	Max	Units
Frequency Range		6		14	GHz
Output P1dB	6 GHz 8 GHz 10 GHz 12 GHz 14 GHz		18 19 20 20 19		dBm
Output P3dB	6 GHz 8 GHz 10 GHz 12 GHz 14 GHz		19 20 21 21 20		dBm
Output IP3	P_{OUT} = +10 dBm/tone, ΔF = 11 MHz 6 GHz 8 GHz 10 GHz 12 GHz 14 GHz		 20 28 28 28 28		dBm

3. Bias of V_{DD} = 8 V and I_{DDQ} ≈ 70 mA (quiescent current)

Absolute Maximum Ratings

Parameter	Conditions	Min	Max	Units
Drain Voltage V_{DD}		0	8.8	V
Drain Current I_{DD}		0	125	mA
Total Dissipated Power			1	W
Maximum RF Input Power	Peak power		+22	dBm
Channel Temperature			+150	°C
Operating Temperature Range		-40	+85	°C
Storage Temperature Range		-50	+125	°C
Moisture Sensitivity Level	IPC/JEDEC J-STD-020E	MSL1		
ESD Human Body Model (HBM)	JEDEC JS-001-2023	Class 1B		
ESD Charged Device Model (CDM)	JEDEC JS-002-2022	Class C3		

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

ESD Sensitive Device

These devices are ESD sensitive. Proper handling for assembly and use must be maintained at all times. Please see JEDEC JESD625B for further information.

Thermal and Reliability Data

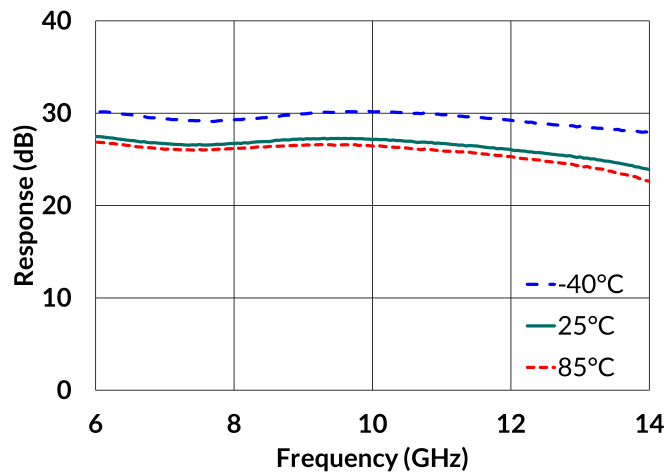
Parameter	Conditions[3,4]	Value	Units
Thermal Resistance (R_{TH})[5]	V_{DD} = 5 V, No RF V_{DD} = 5 V, F_{IN} = 10 GHz, P_{IN} = -6 dBm, CW	138.5 79.2	°C/W
Channel Temperature (T_{CH})	V_{DD} = 5 V, No RF V_{DD} = 5 V, F_{IN} = 10 GHz, P_{IN} = -6 dBm, CW	132.9 107.8	°C
Mean Time To Failure (MTTF)	V_{DD} = 5 V, No RF V_{DD} = 5 V, F_{IN} = 10 GHz, P_{IN} = -6 dBm, CW	4.9×10^6 $> 1 \times 10^7$	Hours

4. All thermal and reliability data is measured or simulated with 85°C at the package base (solder junction).
5. Thermal resistance is the difference between the package base (solder junction) temperature and the channel temperature, divided by the DC power consumption

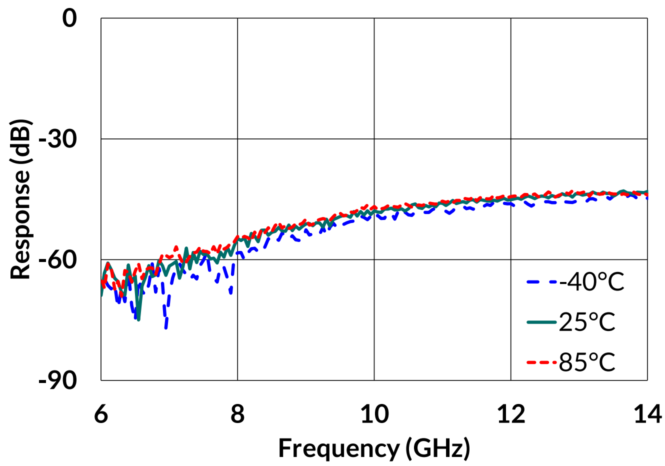
Measured Performance – Small Signal

Nominal Bias: V_{DD} = 5 V, I_{DDQ} ≈ 60 mA

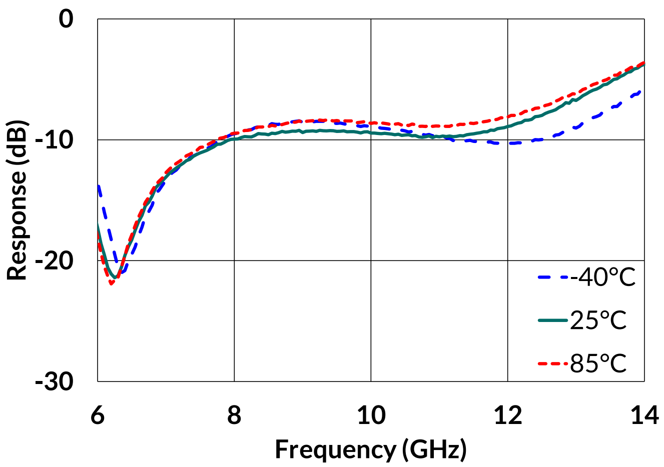
Gain



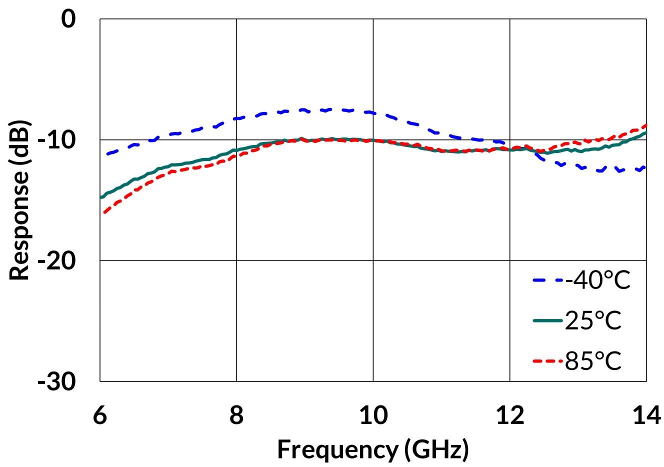
Reverse Isolation



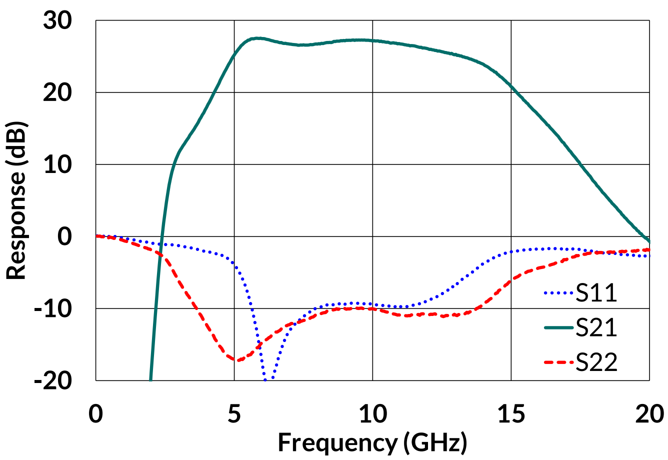
Input Return Loss



Output Return Loss



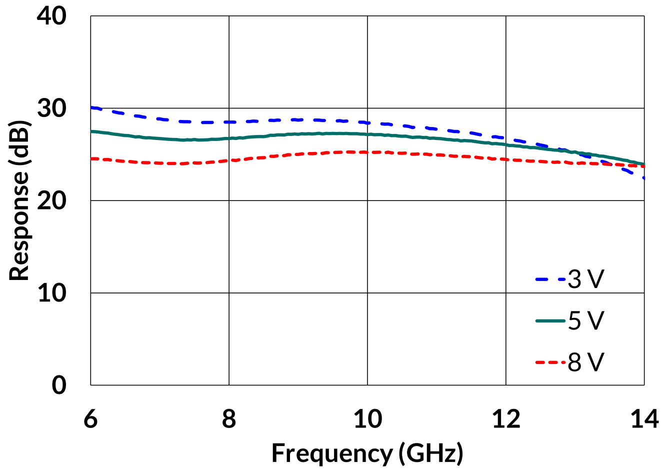
Broadband S-Parameters at 25 °C



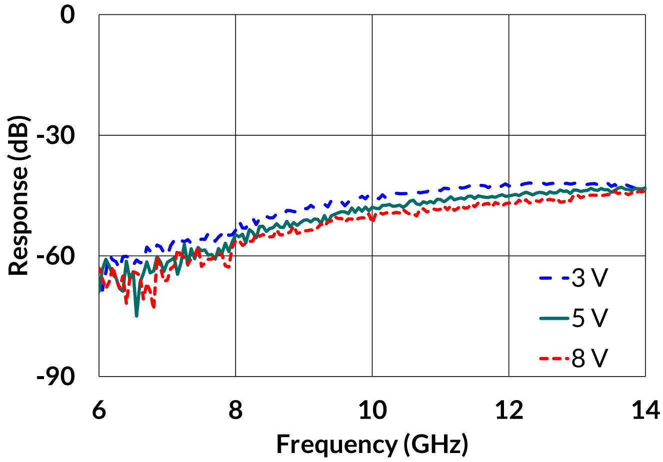
Measured Performance – Small Signal

Room temperature: V_{DD} = 3 V, 5 V, and 8 V

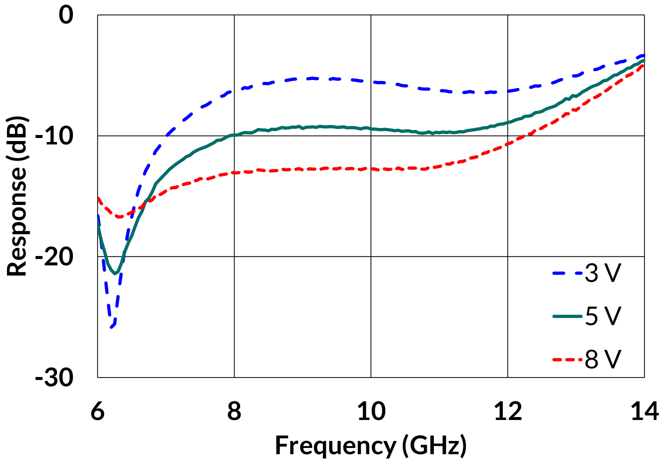
Gain



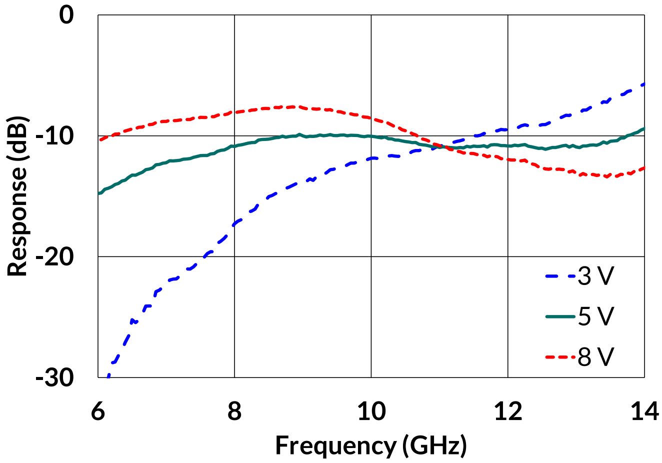
Reverse Isolation



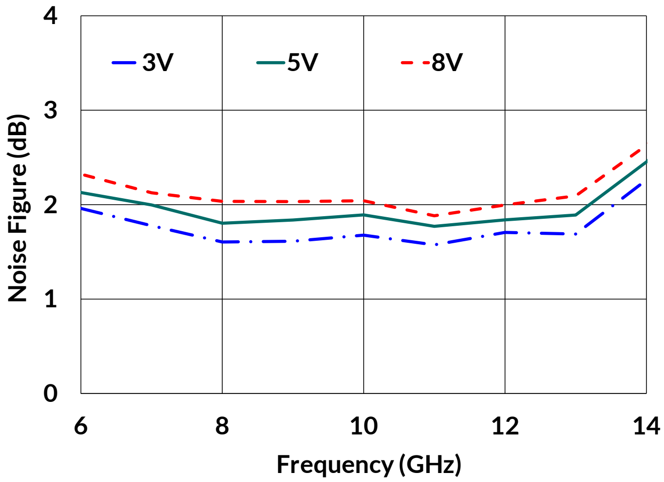
Input Return Loss



Output Return Loss



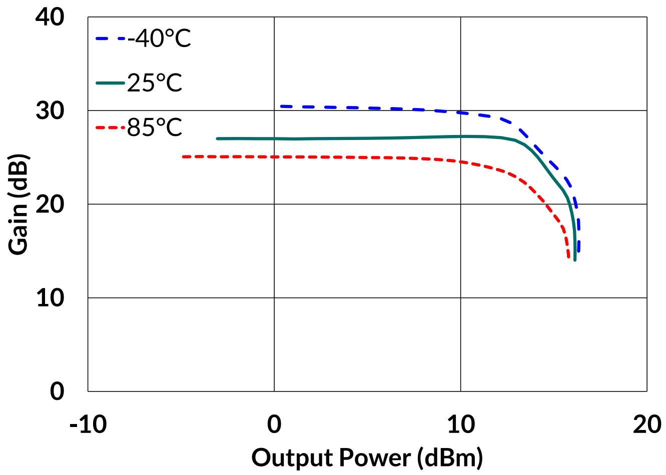
Noise Figure



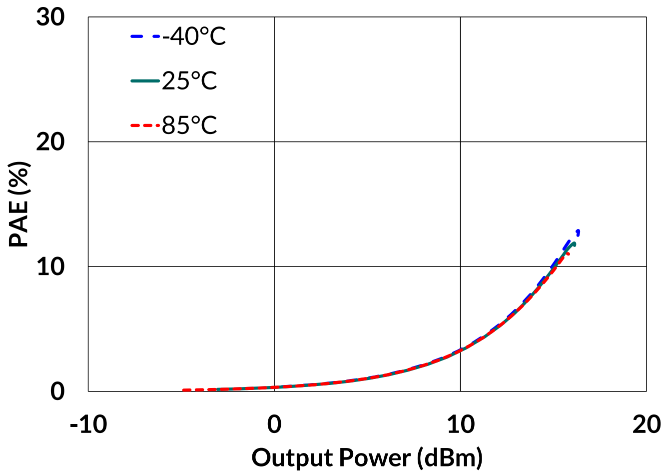
Measured Performance – Large Signal

Nominal Bias: V_{DD} = 5 V, I_{DDQ} ≈ 60 mA

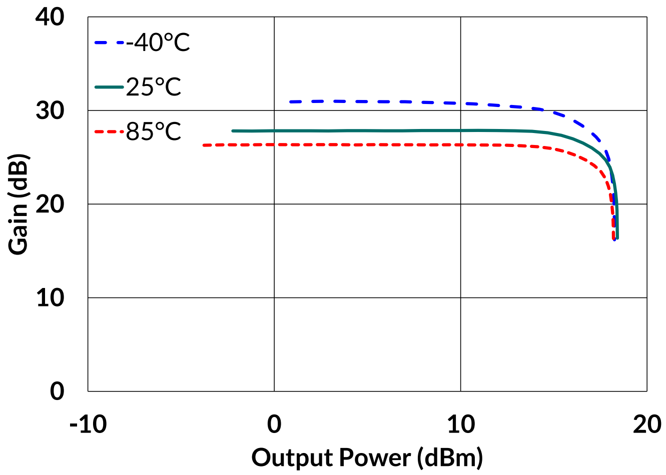
Gain vs Output Power at 6 GHz



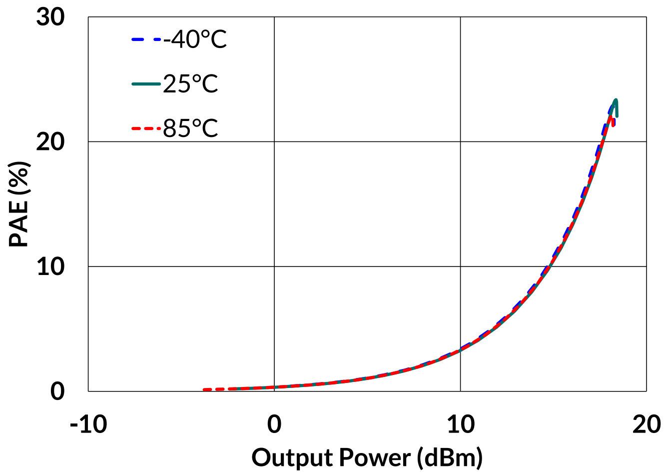
PAE vs Output Power at 6 GHz



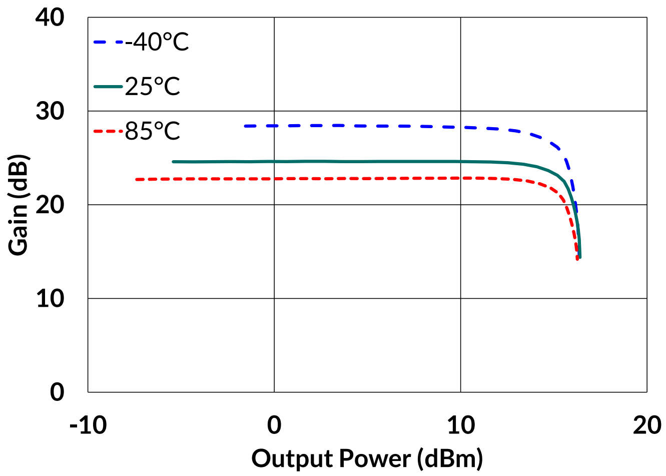
Gain vs Output Power at 10 GHz



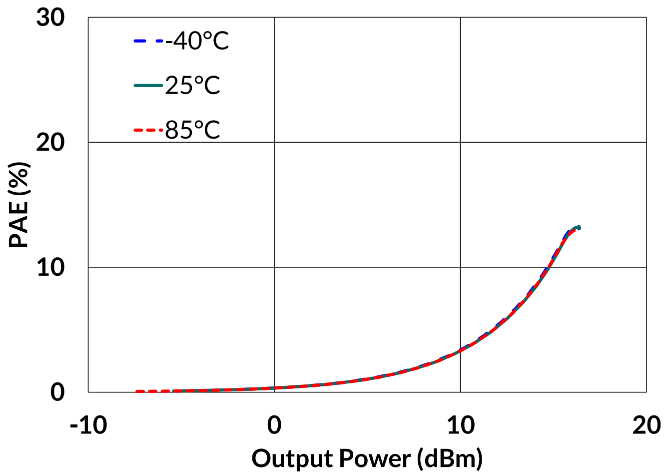
PAE vs Output Power at 10 GHz



Gain vs Output Power at 14 GHz



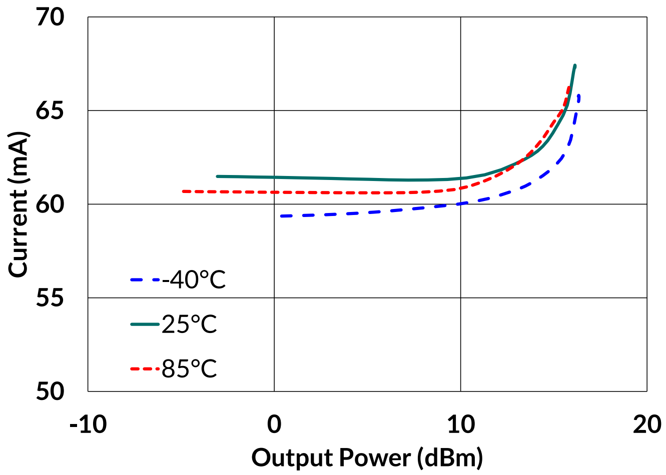
PAE vs Output Power at 14 GHz



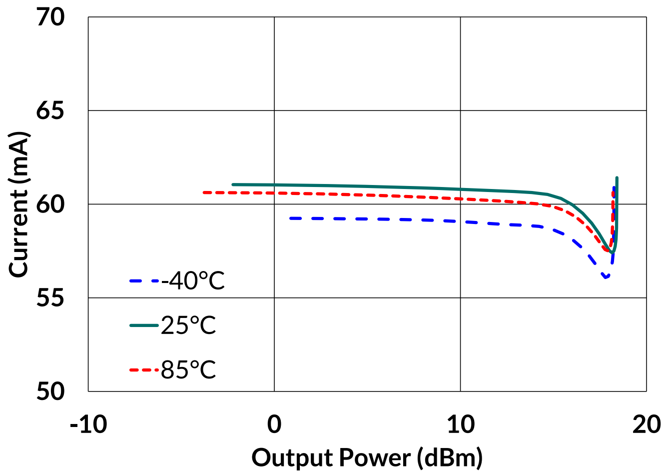
Measured Performance – Large Signal

Nominal Bias: V_{DD} = 5 V, I_{DDQ} ≈ 60 mA

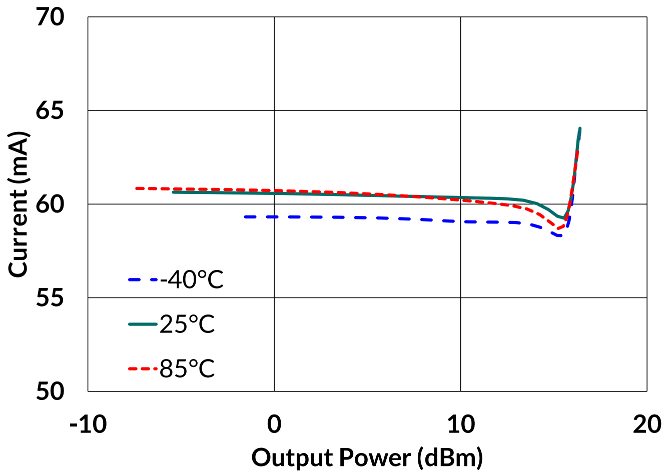
Drain Current vs Output Power at 6 GHz



Drain Current vs Output Power at 10 GHz



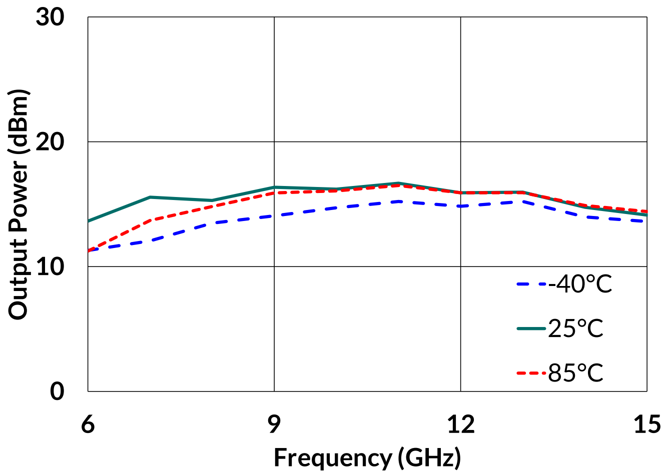
Drain Current vs Output Power at 14 GHz



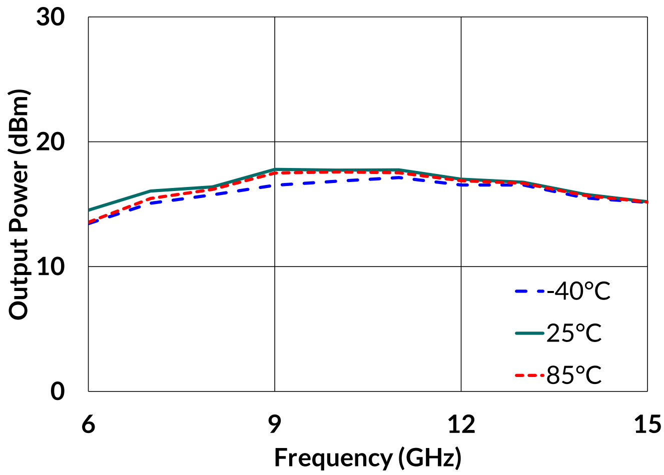
Measured Performance – Large Signal

Nominal Bias: V_{DD} = 5 V, I_{DDQ} ≈ 60 mA

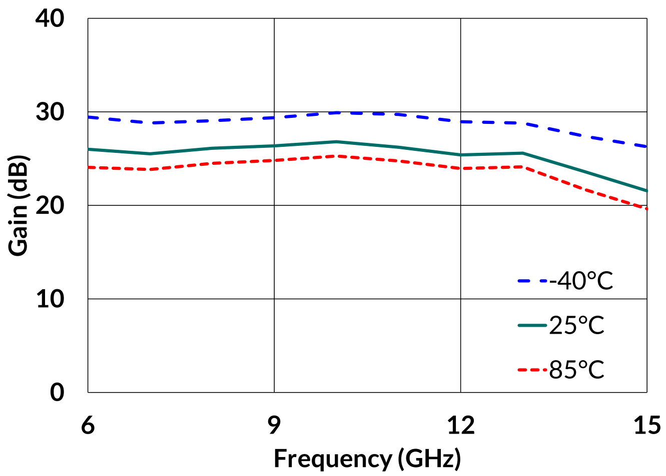
Output Power at P1dB



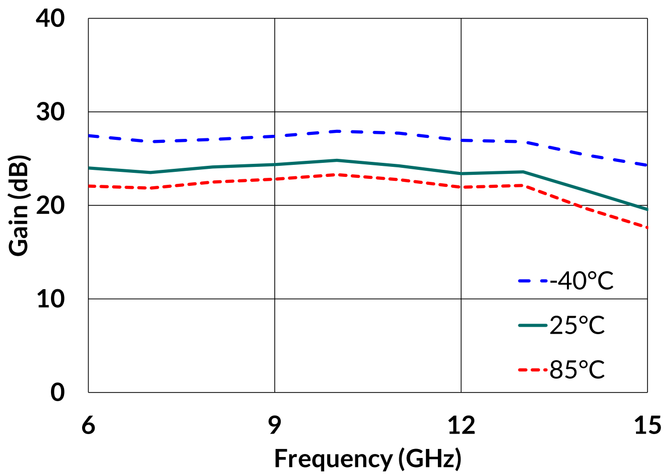
Output Power at P3dB



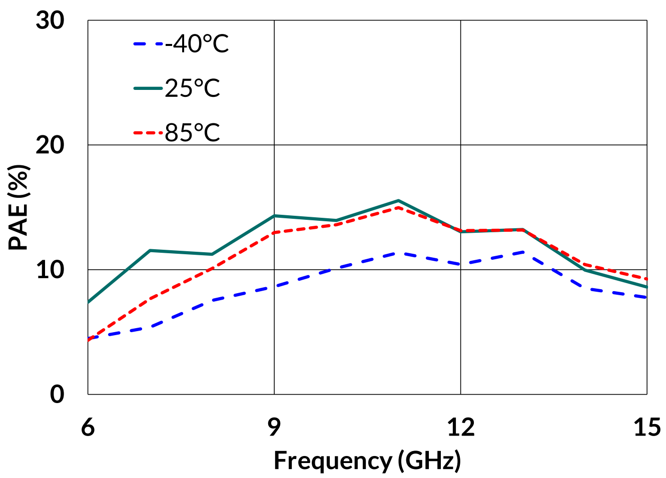
Gain at P1dB



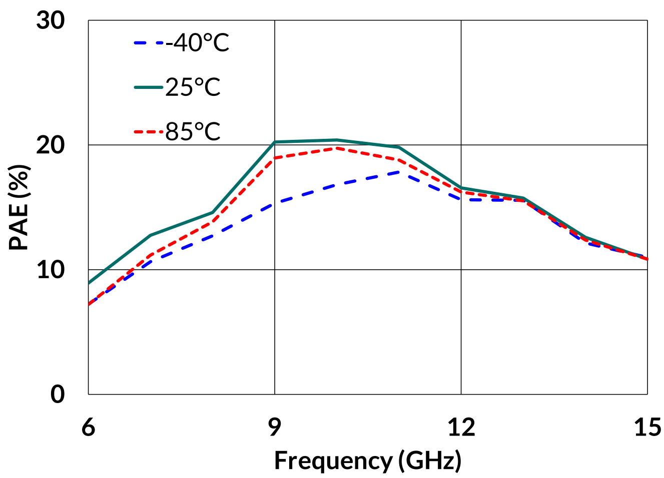
Gain at P3dB



PAE at P1dB



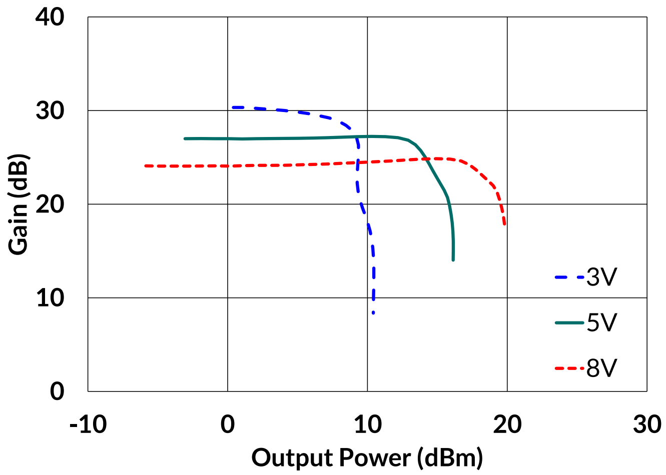
PAE at P3dB



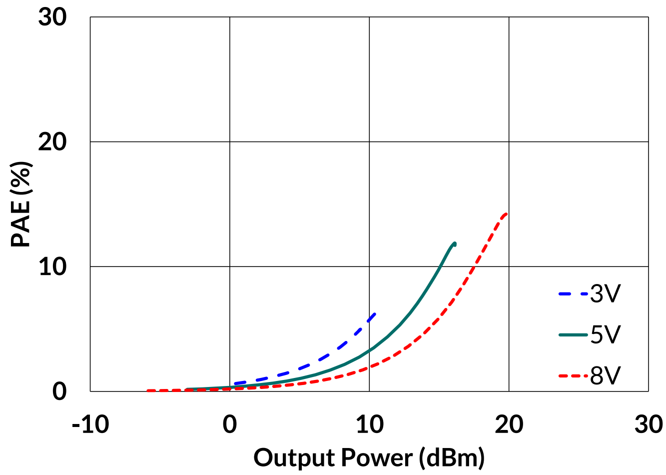
Measured Performance – Large Signal

Room Temperature: V_{DD} = 3, 5 and 8 V

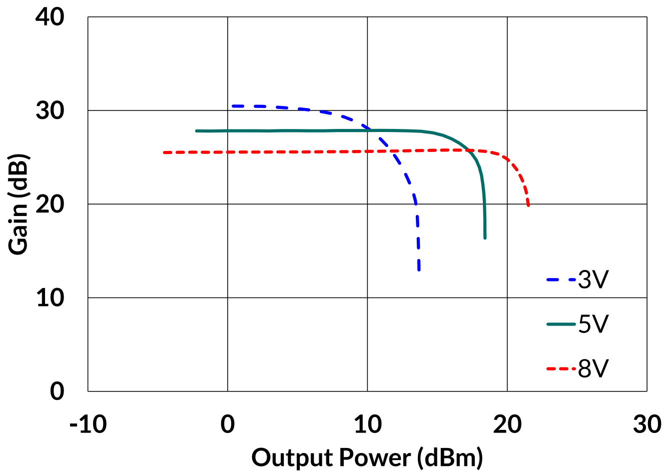
Gain vs Output Power at 6 GHz



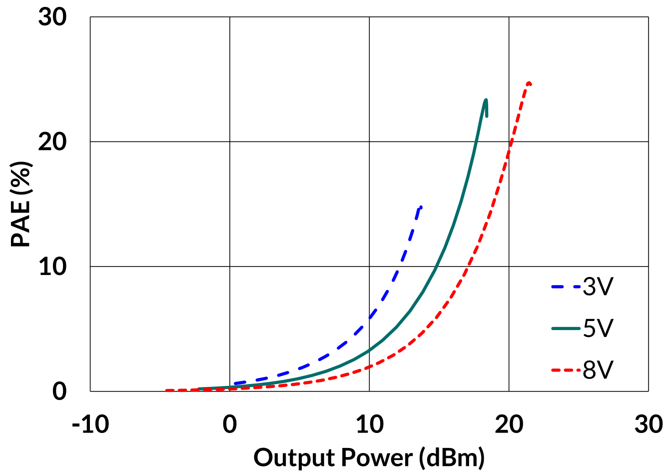
PAE vs Output Power at 6 GHz



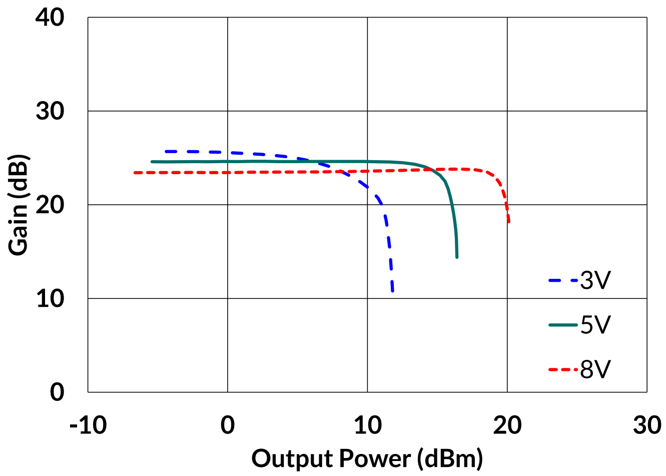
Gain vs Output Power at 10 GHz



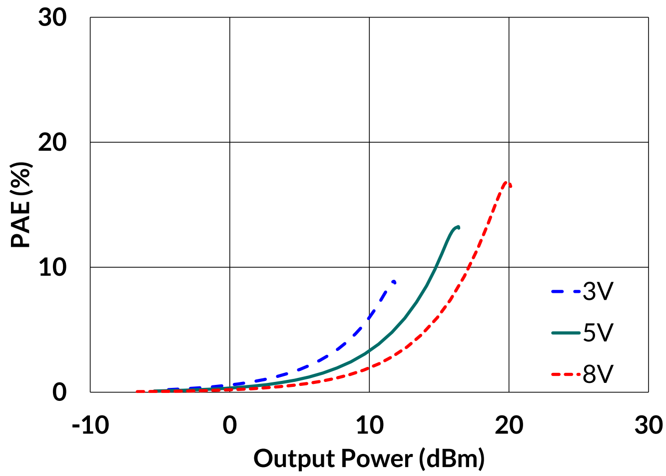
PAE vs Output Power at 10 GHz



Gain vs Output Power at 14 GHz



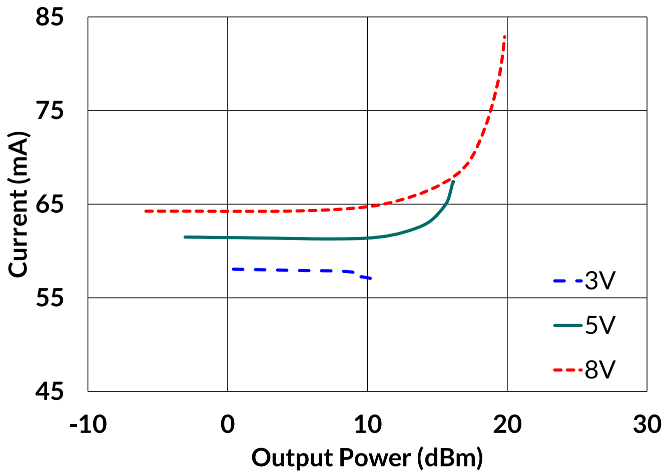
PAE vs Output Power at 14 GHz



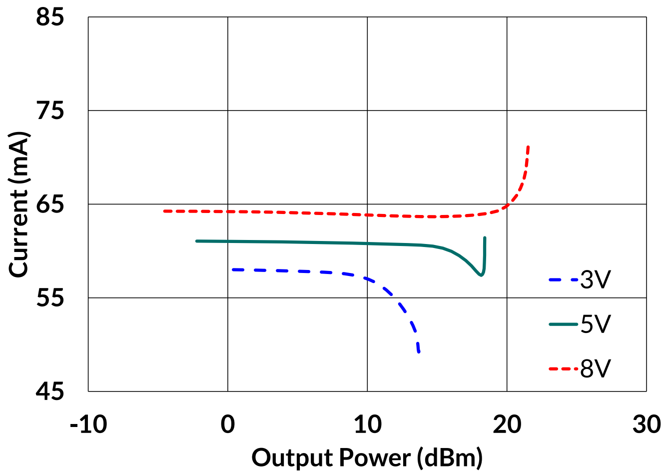
Measured Performance – Large Signal

Room Temperature: V_{DD} = 3, 5 and 8 V

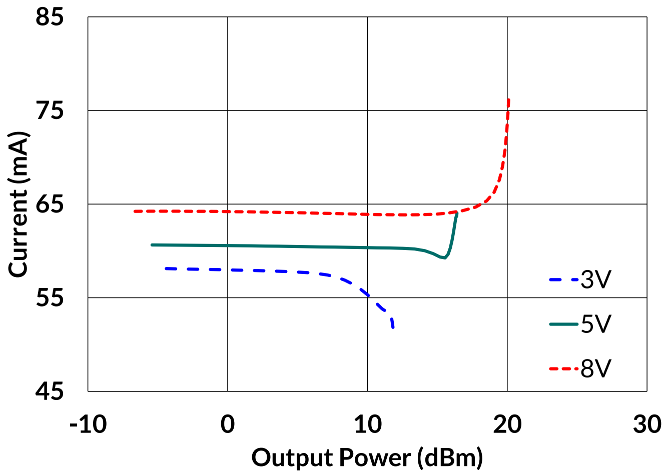
Drain Current vs Output Power at 6 GHz



Drain Current vs Output Power at 10 GHz



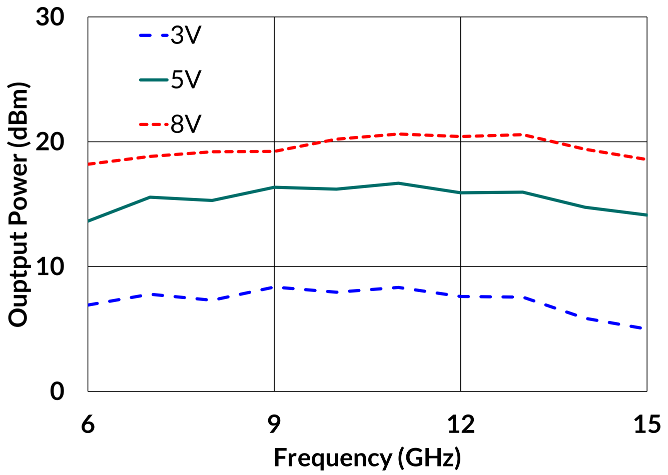
Drain Current vs Output Power at 14 GHz



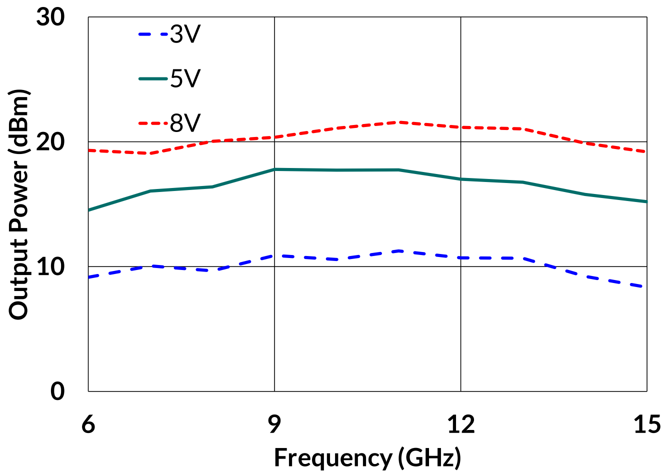
Measured Performance – Large Signal

Room Temperature: V_{DD} = 3, 5 and 8 V

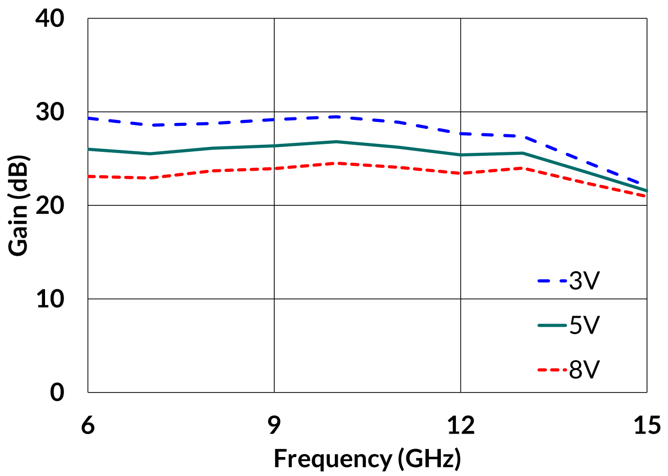
Output Power at P1dB



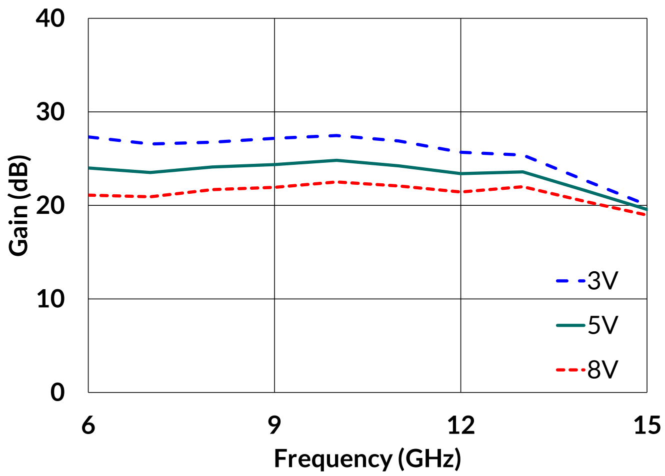
Output Power at P3dB



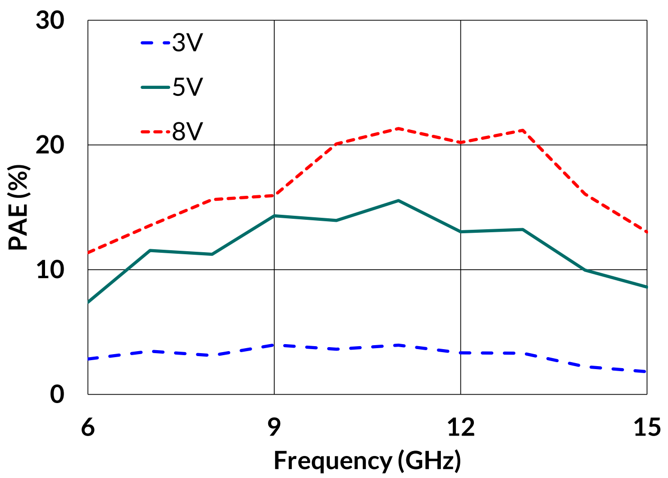
Gain at P1dB



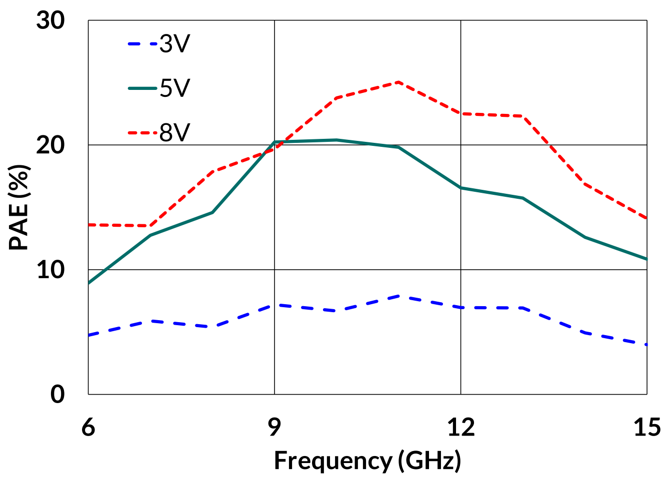
Gain at P3dB



PAE at P1dB



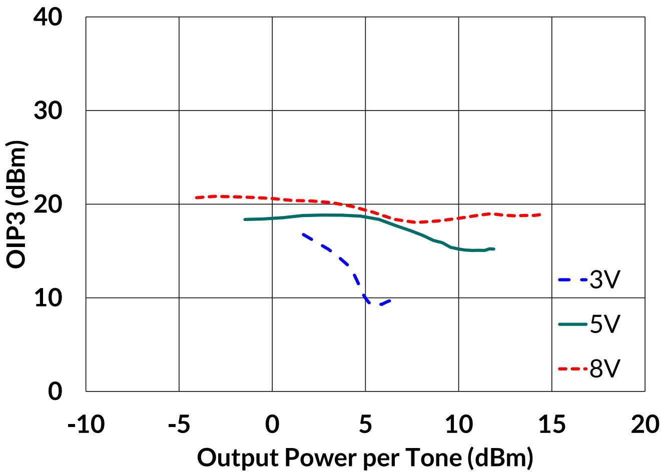
PAE at P3dB



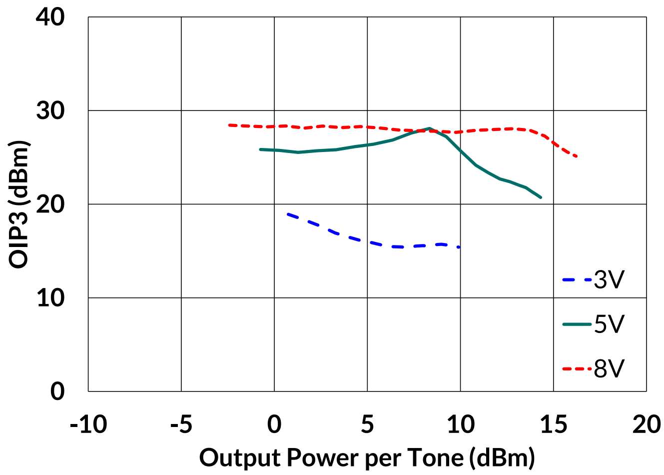
Measured Performance – Linearity

Room Temperature: V_{DD} = 3, 5 and 8 V, ΔF = 11 MHz

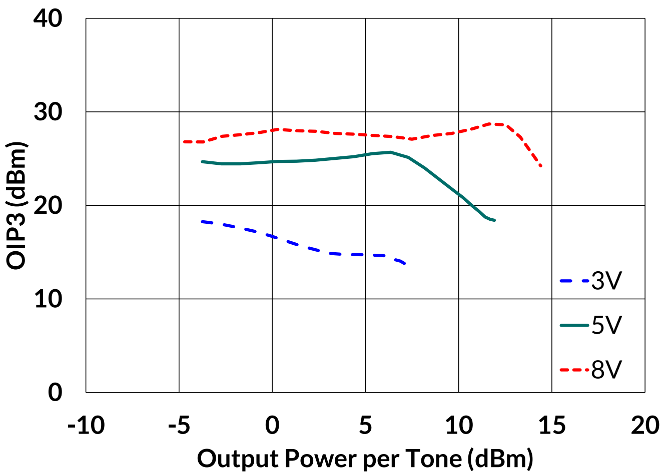
OIP3 versus P_{OUT}/tone at 6 GHz



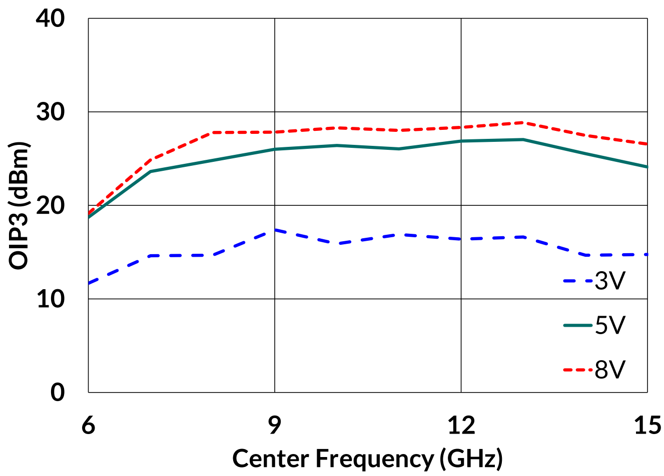
OIP3 versus P_{OUT}/tone at 10 GHz



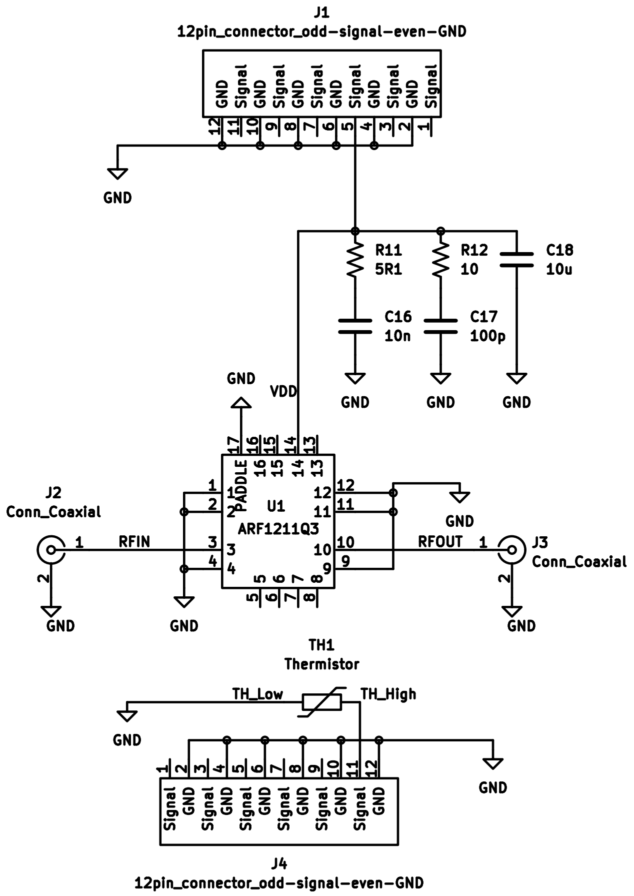
OIP3 versus P_{OUT}/tone at 14 GHz



OIP3 versus Frequency at P_{OUT}/tone = 5 dBm



Evaluation Board Schematic

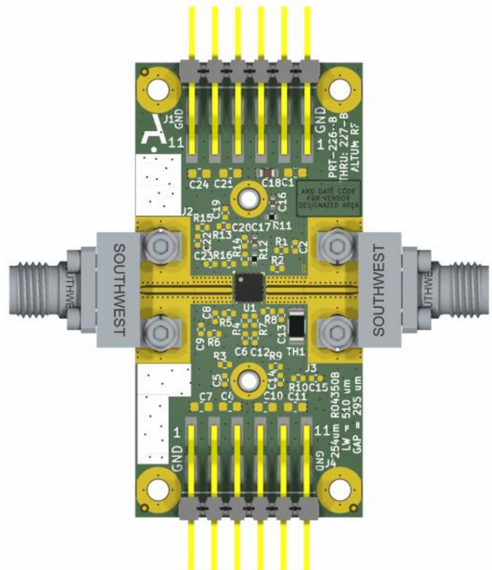


J1 Pin	Description
5	V_{DD}
2,4,6,8,10,12	GND
1,3,7,9,11	Unconnected
J4 Pin	**Description**
11	Thermistor (optional)
2,4,6,8,10,12	GND
1,3,5,7,9	Unconnected

Bill of Materials

Description	Reference Designator	Quantity
ARF1211Q3	U1	1
10 nF 0402 Capacitor	C16	1
100 pF 0402 Capacitor	C17	1
10 µF 0603 Capacitor	C18	1
5 Ω 0402 Resistor	R11	1
10 Ω 0402 Resistor	R12	1
Thermistor (optional)	TH1	1
12 pin Samtec TSM-106-01-F-DH-P-TR	J1,J4	2
Southwest Microwave 2.92mm 1092-01A-6	J2,J3	2

Evaluation Board Layout



Recommended land-pattern and sample board layout for 254 µm thick RO4350B are available on request.
Contact Altum RF Application Support for further information.

Application Notes

1. Bias Turn-on Sequence

The recommended bias sequence is as follows. Starting with all pins at 0 V:

- i. Increase V_{DD} from 0 V to desired drain voltage (5 V typical).
- ii. Apply RF power.

To turn off the device, follow this sequence in reverse order.

2. Reflow Information

MSL level 1 as per IPC/JEDEC J-STD-020E.

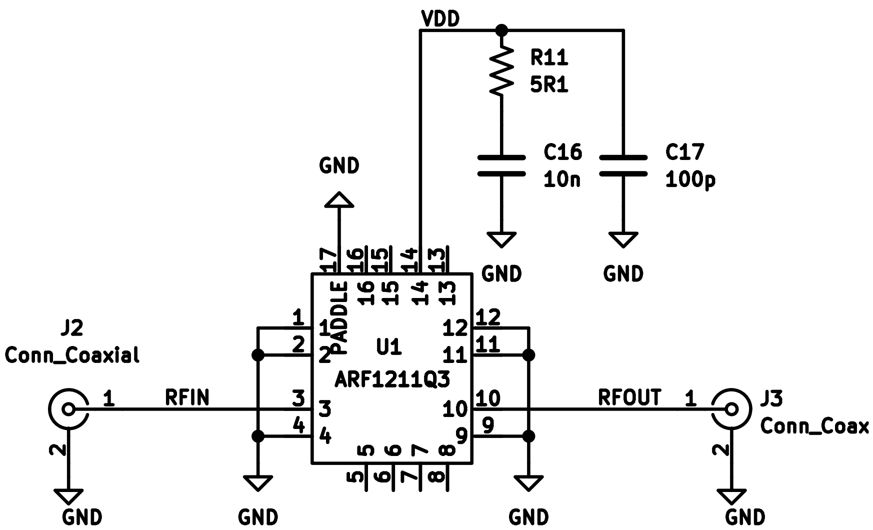
3. Evaluation Board Notes

Use twisted pair or shielded DC leads when biasing up evaluation boards to prevent coupling and feedback on our parts with broadband gain.

4. Application Schematic

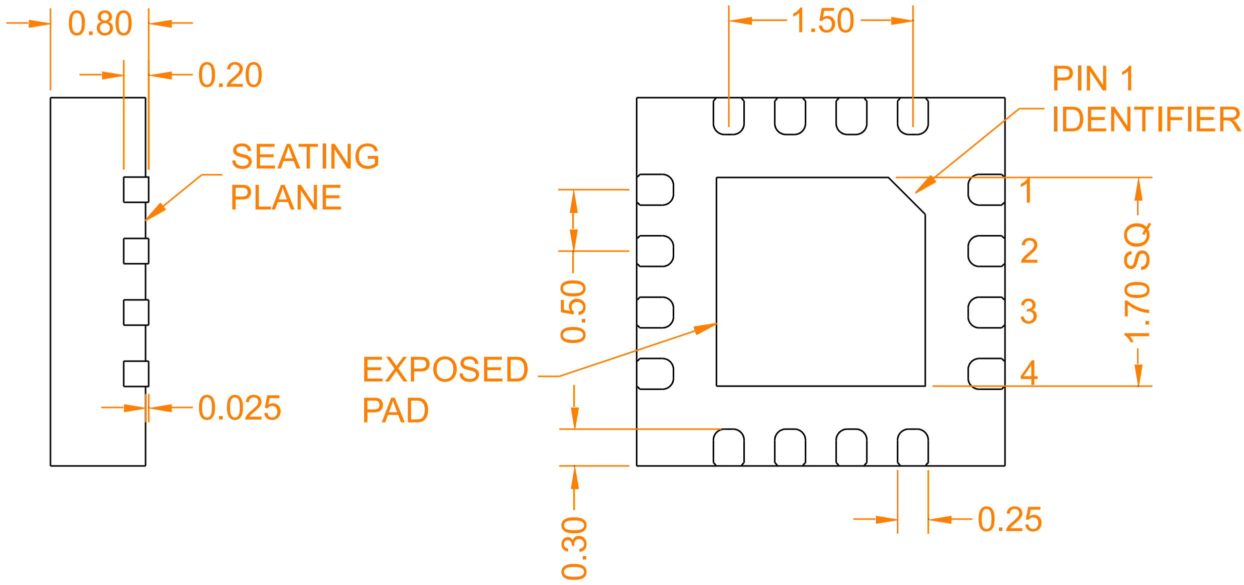
The recommended Application Schematic to ensure fast turn on and turn off times simplifies the de-coupling circuitry compared to the Evaluation Board Schematic. It is recommended to place C17 as close as possible to pin 14.

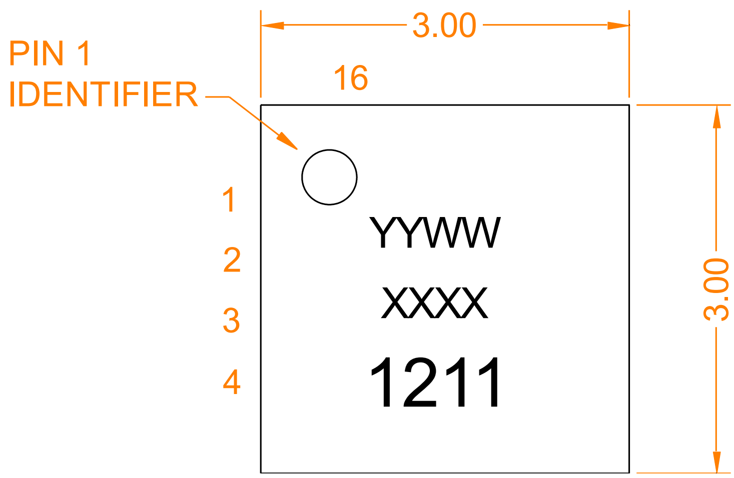
Contact Altum RF for land patterns and advice on using ARF1211Q3.



Package Information

Outline Drawing





YYWW is the date code
XXXX is the lot code
1211 is the part number

All dimensions are in millimeters.
Package leads and exposed pad are plated with NiPdAu.

Ordering Information

Part Number	Delivery Format	Quantity
ARF1211Q3–TR500	Tape and Reel	500 pcs
ARF1211Q3–TR2500	Tape and Reel	2500 pcs

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For further information please visit www.altumrf.com or contact us directly at sales@altumrf.com.

Document Information

Advance: Expected performance based on feasibility analysis, simulations or measured data. All content is subject to change.
Preliminary: Measured performance based on prototype parts. Specifications including maximum and minimum values are subject to change.
Final: Guaranteed performance of qualified and production released part.

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