

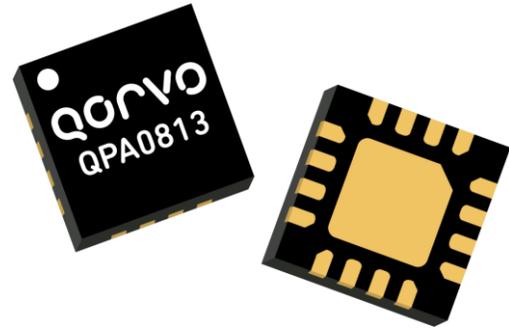
QPA0813

0.5 Watt X-Band Driver Amplifier

Product Overview

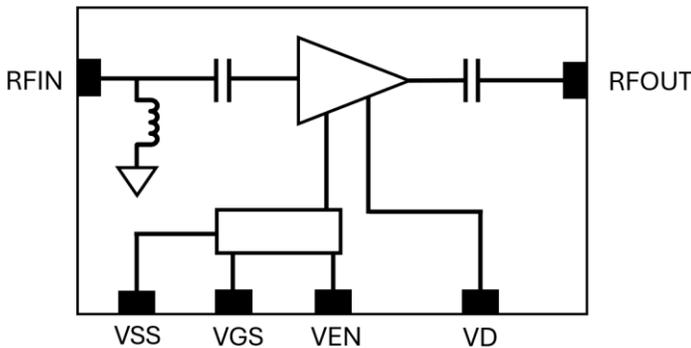
Qorvo's QPA0813 is a packaged, high performance driver amplifier fabricated on Qorvo's production 0.15 um GaAs pHEMT process (QPHT15). Covering 8-11 GHz, the QPA0813 provides 0.7 W of saturated output power with 50% power-added efficiency. The device has an Enable / Disable function for fast RF On and Off control, allowing RF pulse mode applications. For linear applications, it can provide 19 dB of small-signal gain with a good return loss.

Packaged in a compact 3 x 3 mm plastic overmold QFN, RF input and output ports are matched to 50Ω. The small package sized makes the part ideal to be used on tight lattice spacing requirements for phased array radar applications.



3 mm x 3 mm plastic overmold QFN

Functional Block Diagram



Key Features

- Frequency Range: 8.0 – 11.0 GHz
- Output Power: 28.5 dBm
- PAE ($P_{IN} = 16$ dBm): 50 %
- Small Signal Gain: 19 dB
- Input Return Loss: 15 dB
- Output Return Loss: 10 dB
- Enable/Disable Feature for Pulse Application
- Recommended Bias: $V_D = 5$ V, $I_{DQ} = 140$ mA
- Package Size: 3.0 mm x 3.0 mm x 0.85 mm

Applications

- Radar
- Communications
- Satcom

Ordering Information

Part No.	Description
QPA0813	0.5 Watt X-Band Driver Amplifier
QPA0813TR7	500 pcs. on 7 inch reel
QPA0813EVB	QPA0813 Evaluation Board

Absolute Maximum Ratings

Parameter	Min Values	Max Values	Units
Drain Voltage (V_D)	-	6.5	V
Gate Voltage Range (V_G)	-2	0.5	V
Drain Current (I_D)	-	724	mA
VEN Current	-	3.5	mA
VSS Current	-	20	mA
Gate Current	-	37.6	mA
Power Dissipation (P_{DISS}), $T_{BASE} = 85\text{ }^\circ\text{C}$ (Pulse 500us / 15%)	-	2.8	W
Input Power (P_{IN}), Pulse 500us/15%, 50 Ω , 5 V, $T_{BASE} = 85\text{ }^\circ\text{C}$	-	23	dBm
Input Power (P_{IN}), Pulse 500us/15%, VSWR 3:1, $V_D = 5\text{ V}$, $T_{BASE} = 85\text{ }^\circ\text{C}$	-	23	dBm
Mounting Temperature (30 seconds max.)	-	260	$^\circ\text{C}$
Storage Temperature	-55	150	$^\circ\text{C}$

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability.

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Drain Voltage (V_D)		5		V
Drain Current (I_{DQ})		140		mA
Drain Current under RF Drive (I_{D_DRIVE})		See plots		
Gate Voltage Range if Use V_G Control (V_G)	-1.5	-0.5	0	V

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

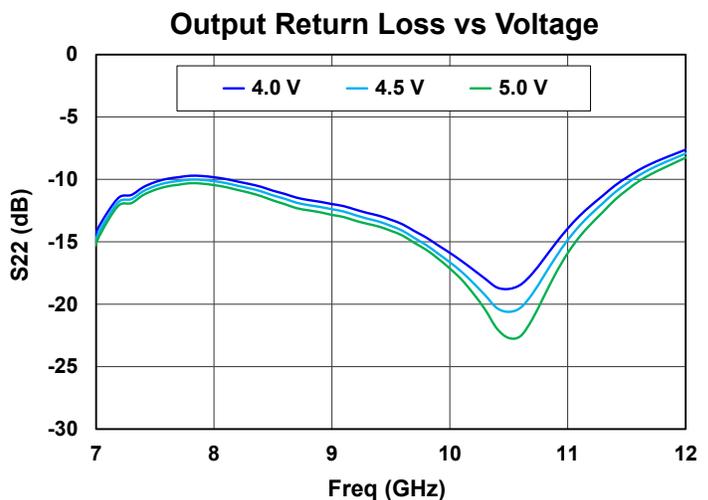
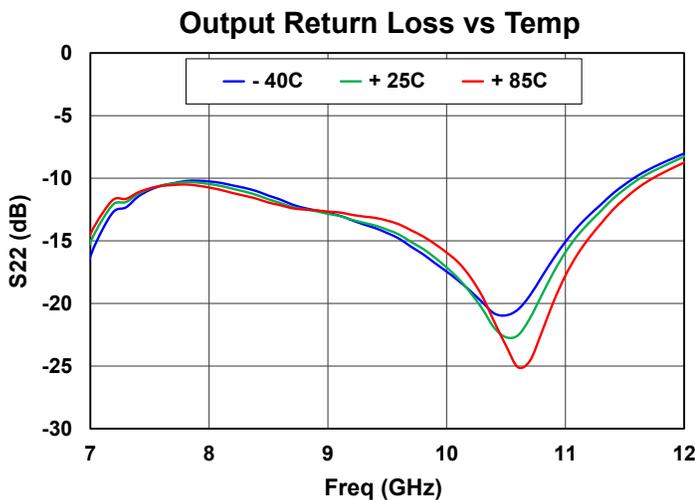
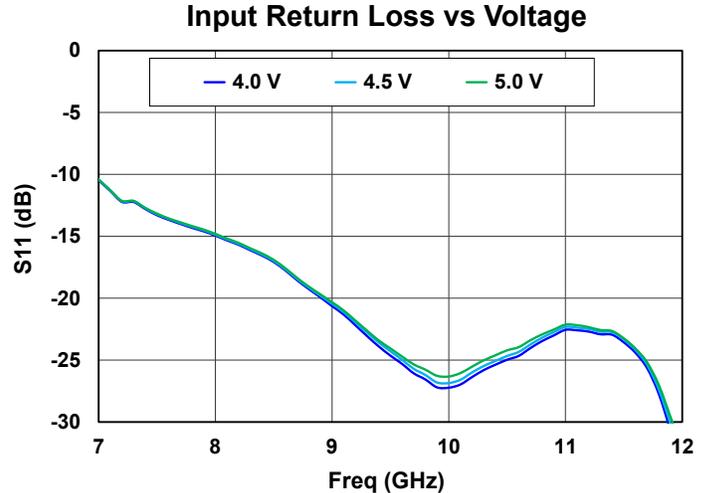
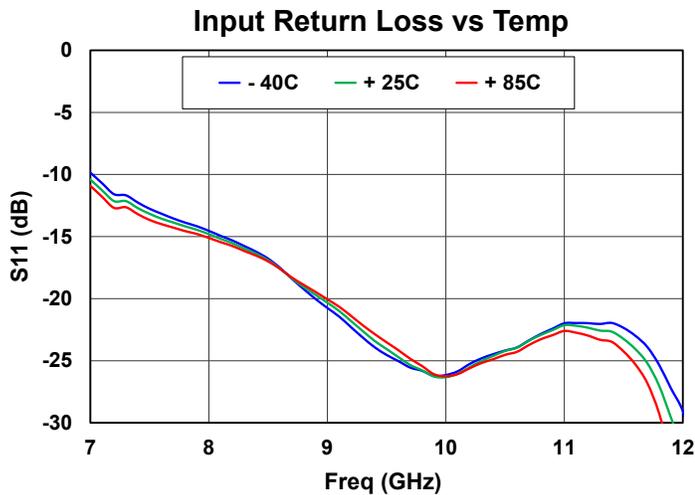
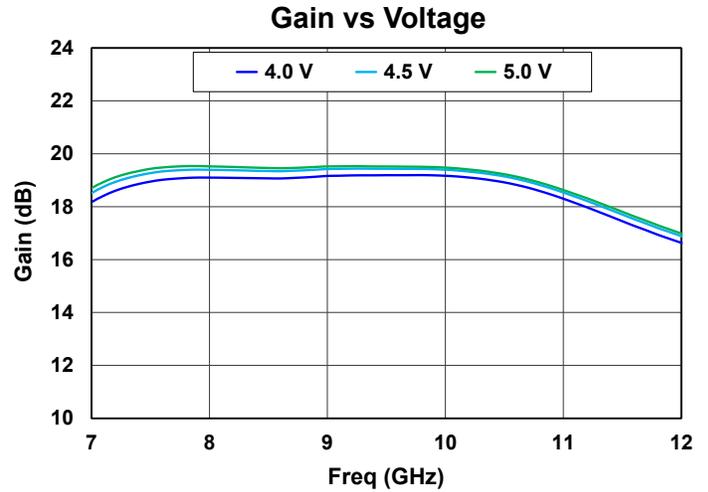
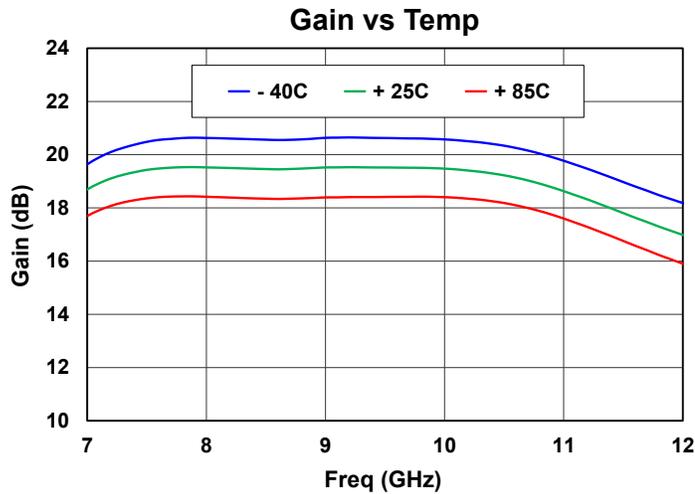
Electrical Specifications

Parameter	Conditions	Min	Typ	Max	Units
Operational Frequency		8		11	GHz
Output Power ($P_{IN} = 16\text{ dBm}$, Pulsed VD)			28.5		dBm
Power Added Efficiency ($P_{IN} = 16\text{ dBm}$, Pulsed VD)			50		%
Small Signal Gain (CW)			19		dB
Input Return Loss (CW)			15		dB
Output Return Loss (CW)			10		dB
2nd Harmonic Suppression ($P_{IN} = 16\text{ dBm}$, Pulsed VD)			20		dBc
3rd Harmonic Suppression ($P_{IN} = 16\text{ dBm}$, Pulsed VD)			35		dBc
Small Signal Gain Temp. Coeff.			-0.016		dB/ $^\circ\text{C}$

Test conditions, unless otherwise noted: $V_D = 5\text{ V}$, $I_{DQ} = 140\text{ mA}$ with auto bias, Pulse Width = 100 us, Duty Cycle = 10%, $25\text{ }^\circ\text{C}$

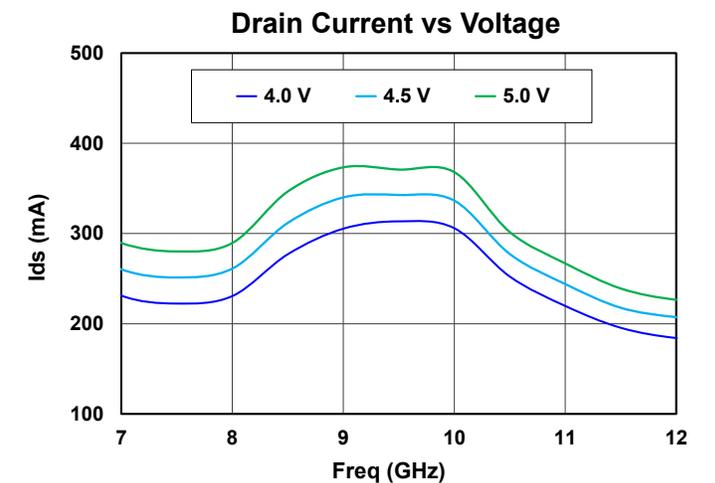
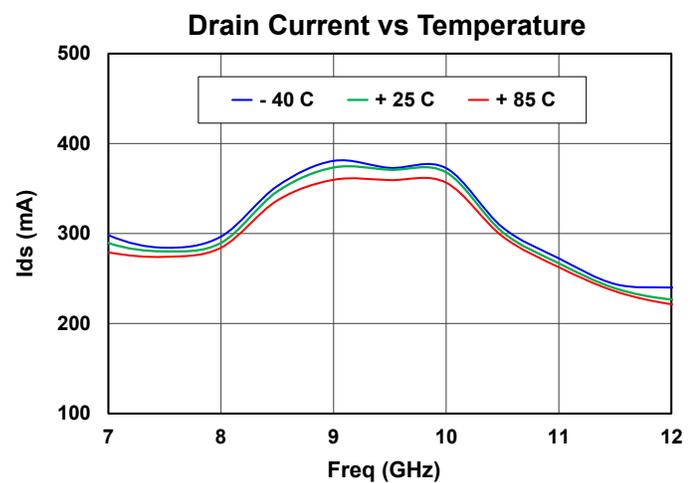
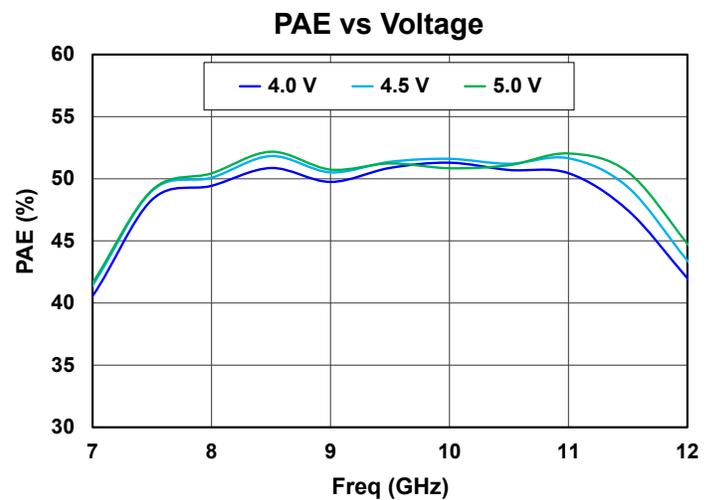
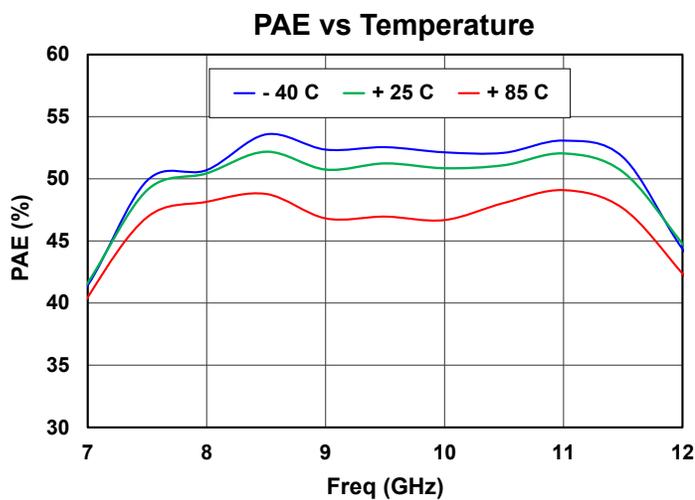
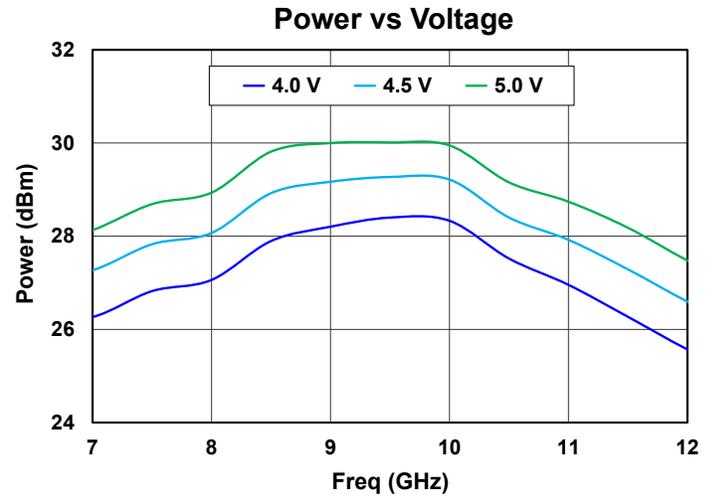
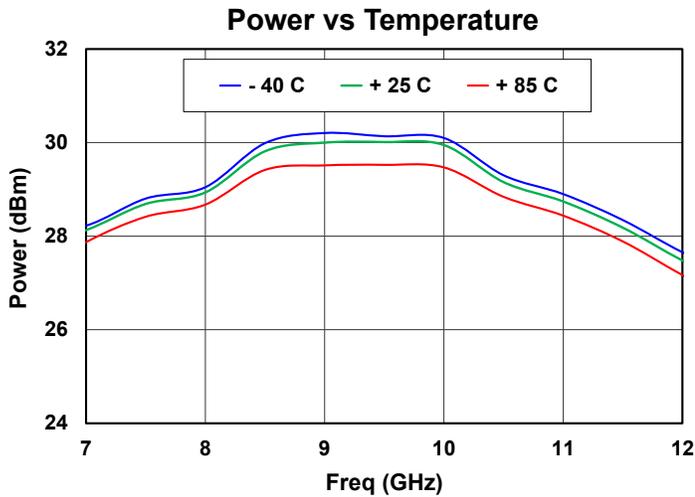
Performance Plots – Small Signal

Test conditions unless otherwise noted: $V_D = 5\text{ V}$, $I_{DQ} = 140\text{ mA}$ (typical), $V_{EN} = -5\text{ V}$, $V_{SS} = -5\text{ V}$, $25\text{ }^\circ\text{C}$



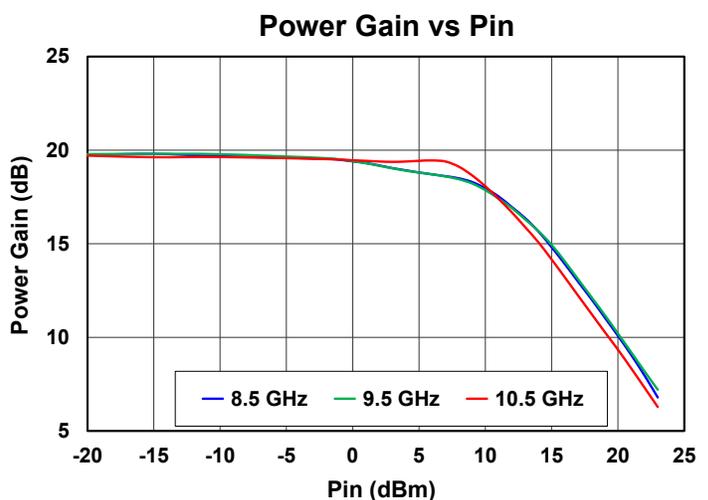
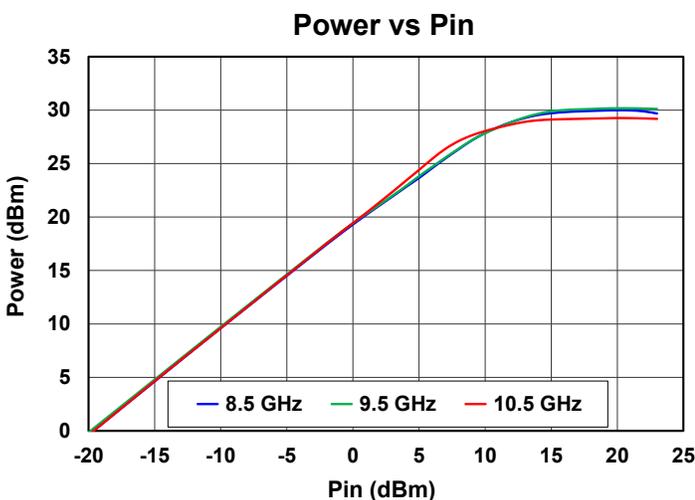
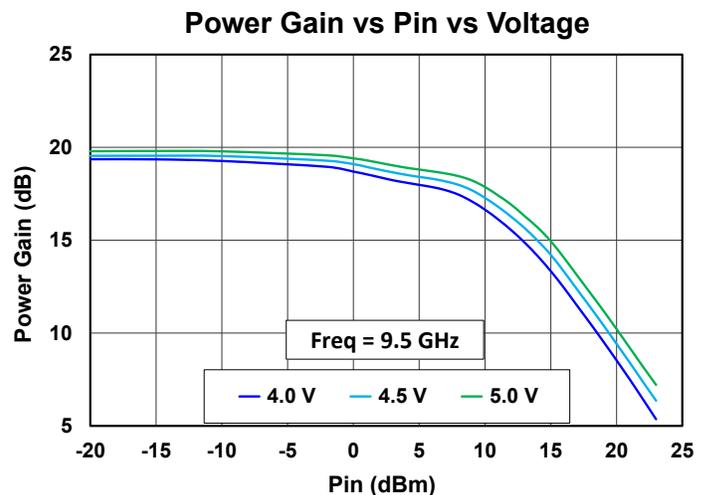
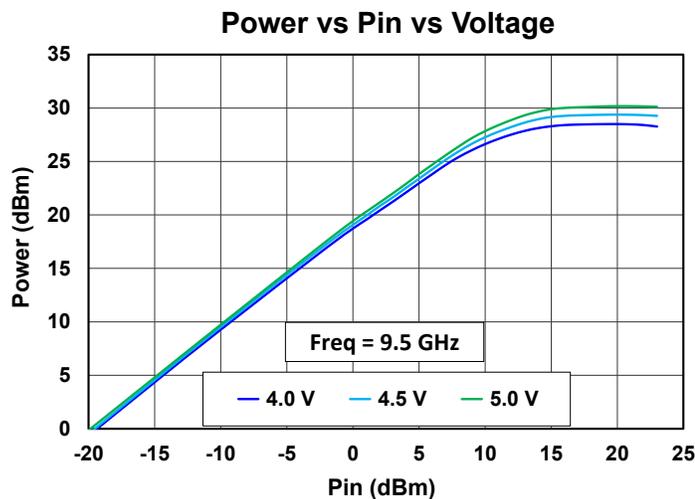
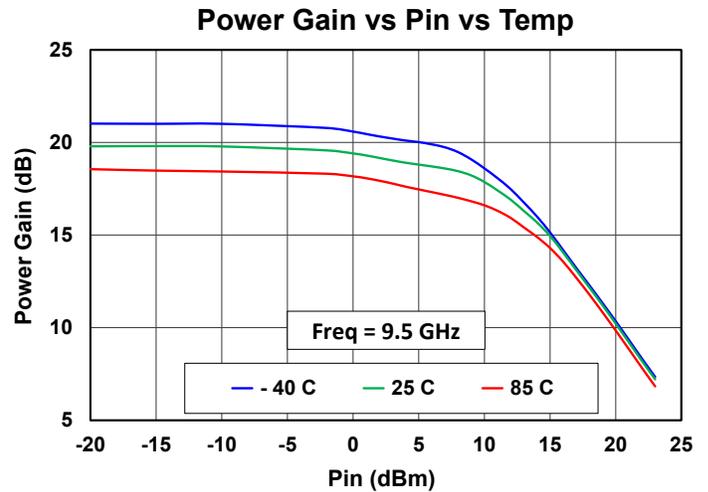
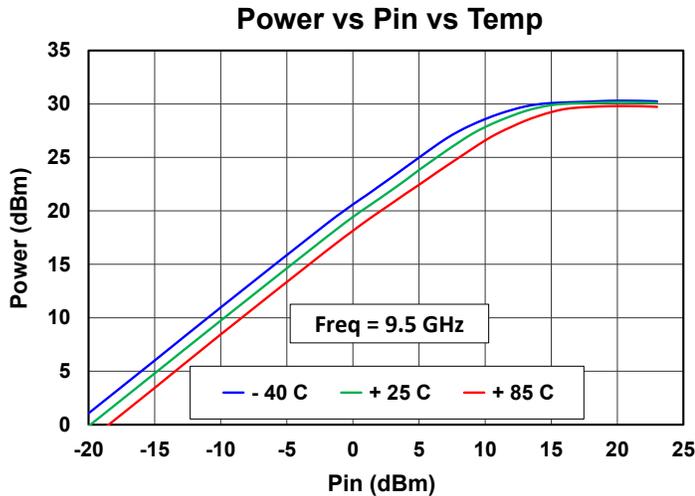
Performance Plots – Large Signal (Pulsed)

Test conditions unless otherwise noted: $V_D = 5\text{ V}$, $I_{DQ} = 140\text{ mA}$ (typical), $P_{IN} = 16\text{ dBm}$, $PW = 100\text{ }\mu\text{s}$, $DC = 10\%$, $25\text{ }^\circ\text{C}$



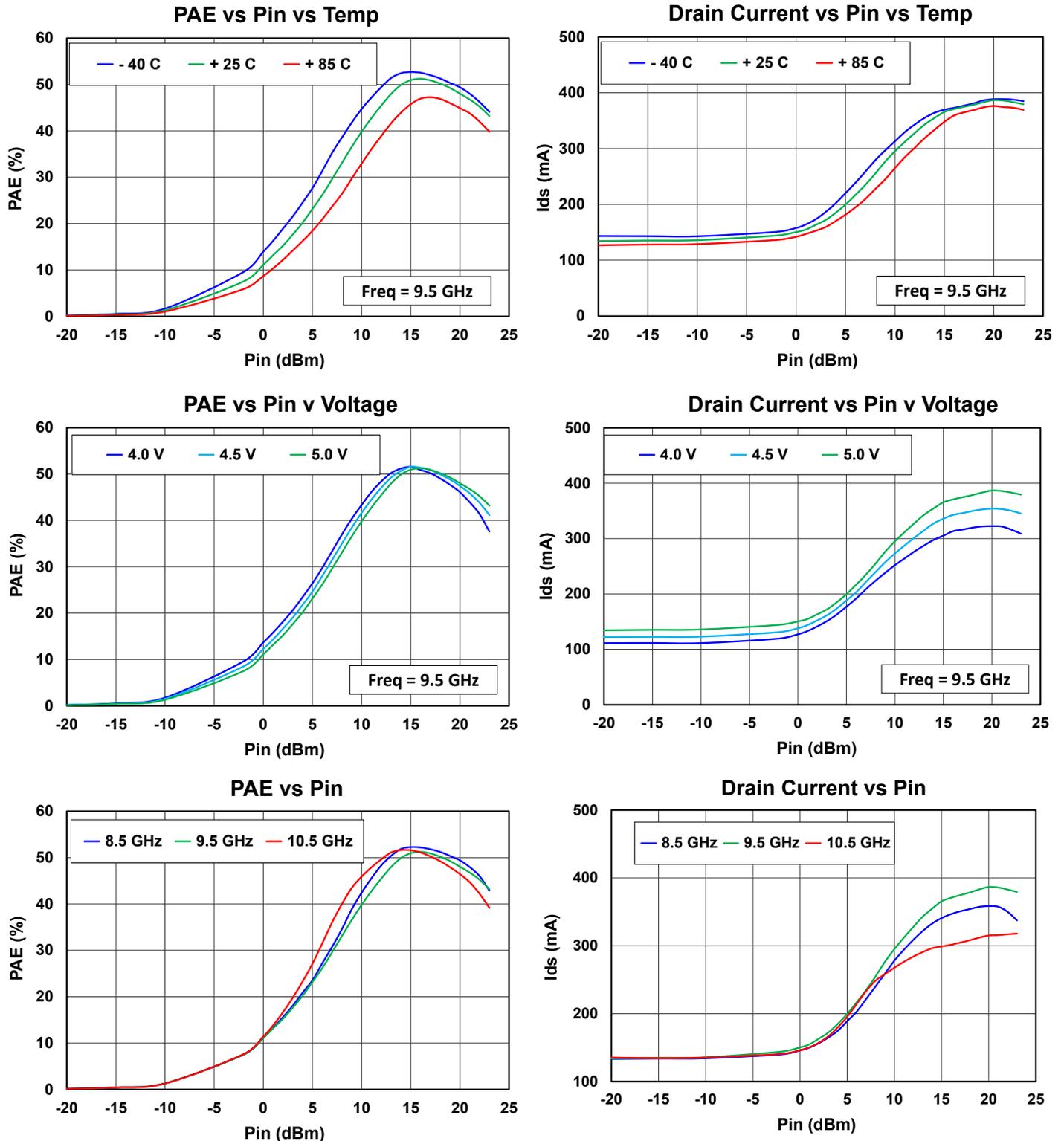
Performance Plots – Large Signal (Pulsed)

Test conditions unless otherwise noted: $V_D = 5\text{ V}$, $I_{DQ} = 140\text{ mA}$ (typical), $P_{IN} = 16\text{ dBm}$, $PW = 100\text{ }\mu\text{s}$, $DC = 10\%$, $25\text{ }^\circ\text{C}$



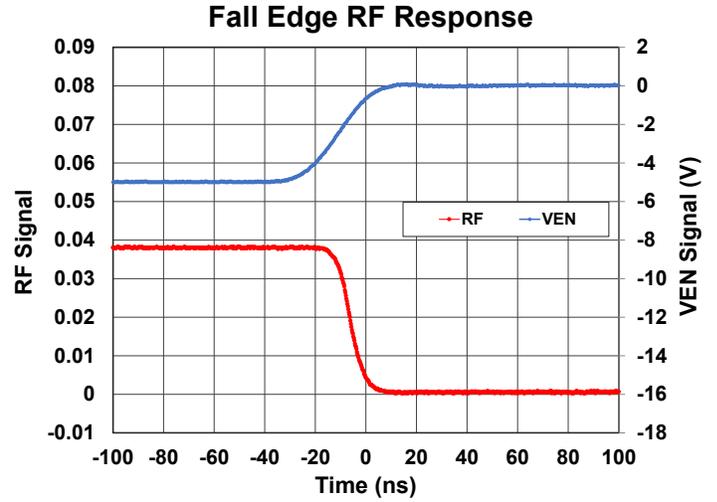
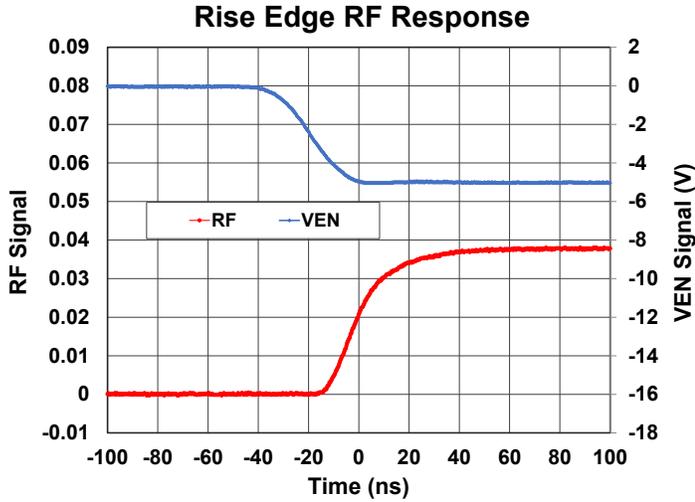
Performance Plots – Large Signal (Pulsed)

Test conditions unless otherwise noted: $V_D = 5\text{ V}$, $I_{DQ} = 140\text{ mA}$ (typical), $P_{IN} = 16\text{ dBm}$, $PW = 100\text{ }\mu\text{s}$, $DC = 10\%$, $25\text{ }^\circ\text{C}$



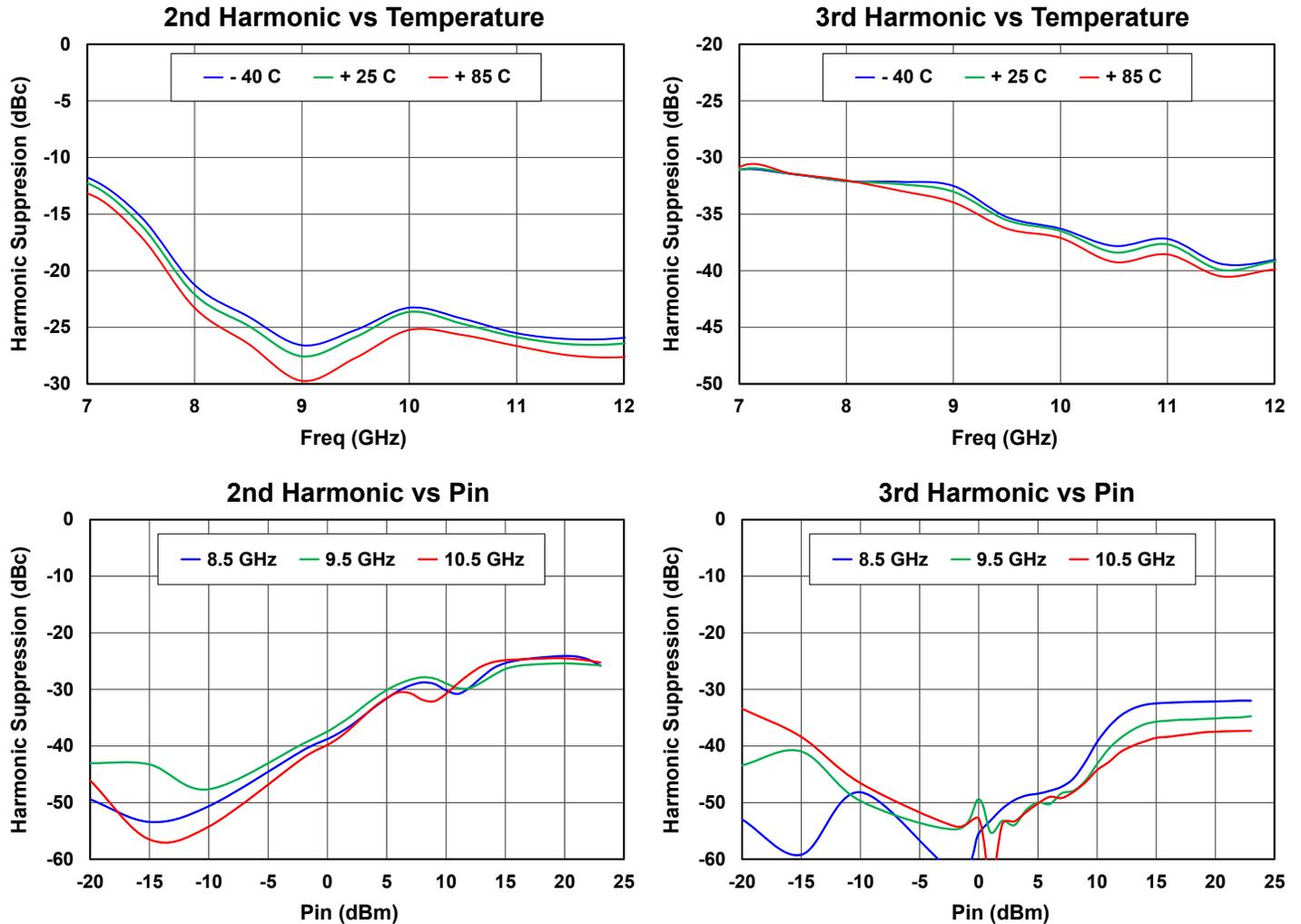
Performance Plots – RF Pulse Mode Transients

Test conditions unless otherwise noted: $V_D = 5\text{ V}$, $I_{DQ} = 140\text{ mA}$ (typical), $P_{IN} = 16\text{ dBm}$, $PW = 100\text{ }\mu\text{s}$, $DC = 10\%$, $25\text{ }^\circ\text{C}$



Performance Plots – Harmonics

Test conditions unless otherwise noted: $V_D = 5\text{ V}$, $I_{DQ} = 140\text{ mA}$ (typical), $P_{IN} = 16\text{ dBm}$, $PW = 100\text{ }\mu\text{s}$, $DC = 10\%$, $25\text{ }^\circ\text{C}$



Thermal and Reliability Information

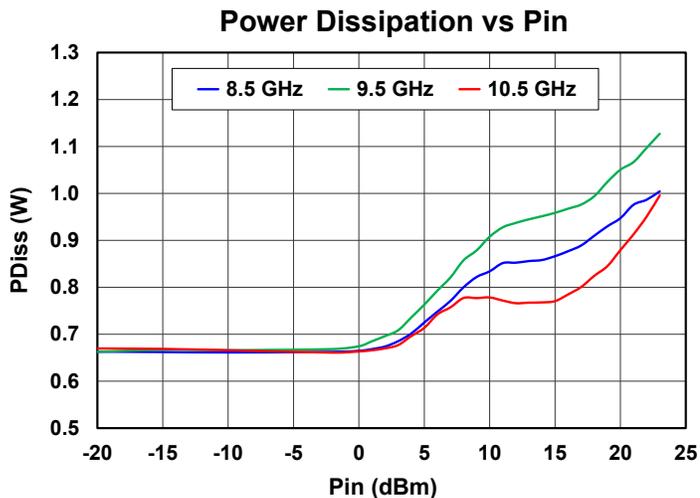
Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) ⁽¹⁾	Quiescent or small signal CW applications, $T_{base} = +85\text{ }^{\circ}\text{C}$, $V_D = 5\text{ V}$, $I_{DQ} = 140\text{ mA}$, $P_{DISS} = 0.7\text{ W}$,	42.40	$^{\circ}\text{C/W}$
Channel Temperature, T_{CH} (Under RF)		114.68	$^{\circ}\text{C}$
Median Life Time		7.5E7	Hours
Thermal Resistance (θ_{JC}) ⁽¹⁾	Pulse Mode, $PW = 100\text{ us}$, $DC = 10\%$, $T_{base} = +85\text{ }^{\circ}\text{C}$, $V_D = 5\text{ V}$, $I_{DQ} = 140\text{ mA}$, Freq. = 9 GHz, $P_{IN} = 16\text{ dBm}$, $P_{OUT} = 29.51\text{ dBm}$, $I_{D_Drive} = 360\text{ mA}$, $P_{DISS} = 0.97\text{ W}$.	32.64	$^{\circ}\text{C/W}$
Channel Temperature, T_{CH} (Under RF)		116.66	$^{\circ}\text{C}$
Median Life Time		5.8E7	Hours
Thermal Resistance (θ_{JC}) ⁽¹⁾	CW Mode Operation, near P1dB, $T_{base} = +85\text{ }^{\circ}\text{C}$, $V_D = 5\text{ V}$, $I_{DQ} = 140\text{ mA}$, Freq. = 9 GHz, $P_{IN} = 10\text{ dBm}$, $P_{OUT} = 26.42\text{ dBm}$, $I_{D_Drive} = 260\text{ mA}$, $P_{DISS} = 0.89\text{ W}$.	40.39	$^{\circ}\text{C/W}$
Channel Temperature, T_{CH} (Under RF)		120.95	$^{\circ}\text{C}$
Median Life Time		3.3E7	Hours

Notes:

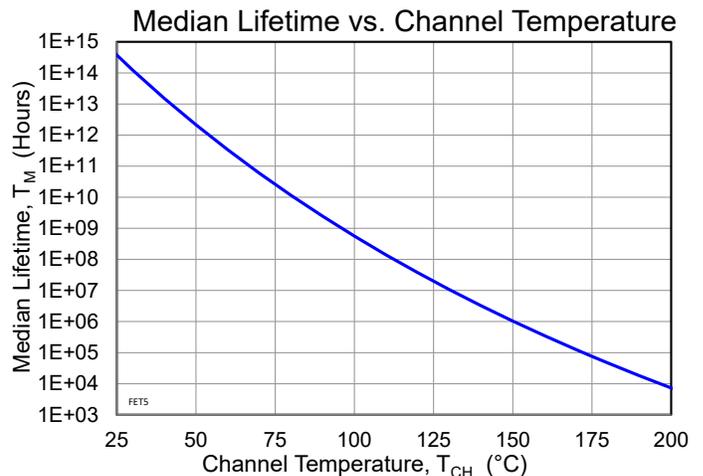
- Thermal resistance is referenced to the bottom base of the package.

Power Dissipation and Maximum Gate Current

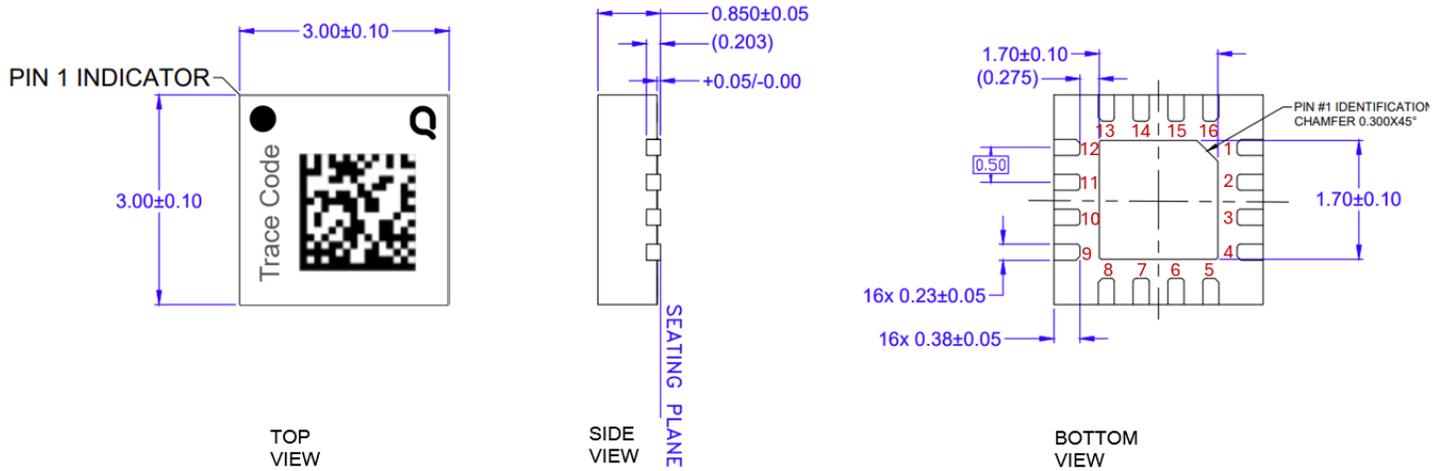
Power Dissipation
Pulse Mode, $V_D = 5\text{ V}$, $PW = 100\text{ us}$, $DC = 10\%$, 85 C



Test Conditions, $V_D = 4\text{ V}$
Failure Criteria = 10% reduction in I_{D_MAX}



Mechanical Drawing and Pin Function Descriptions


NOTES:

Package is QFN overmold, package base and leads are NiPdAu plated.

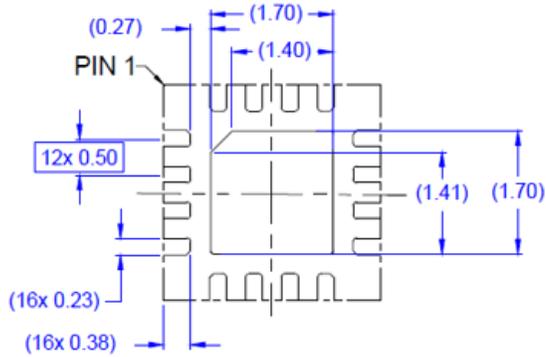
Trace Code can be used to trace manufacturing information.

Dimensions are in millimeters.

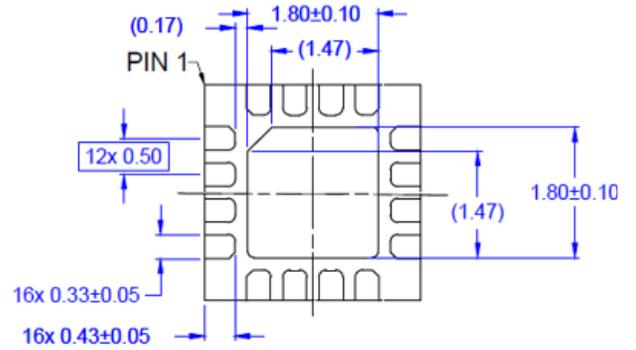
Pin Description

Pin Number	Symbol	Description
1, 3, 4, 9, 11-16	NC	No connection inside of package. Connection to PCB ground recommended
2	RF IN	RF input. 50Ω , DC Blocked
5	VSS	Amplifier bias network power supply
6	VGS	Gate secondary control voltage, can be used to bypass auto-bias, if used, VSS and VEN can be left open, if unused, can leave open
7	VEN	Amplifier enable, amplifier in operational state
8	VDS	Amplifier drain voltage
10	RF OUT	RF output. 50Ω , DC blocked
17	GND	Package center paddle ground

PCB Design Land Pattern and Mask



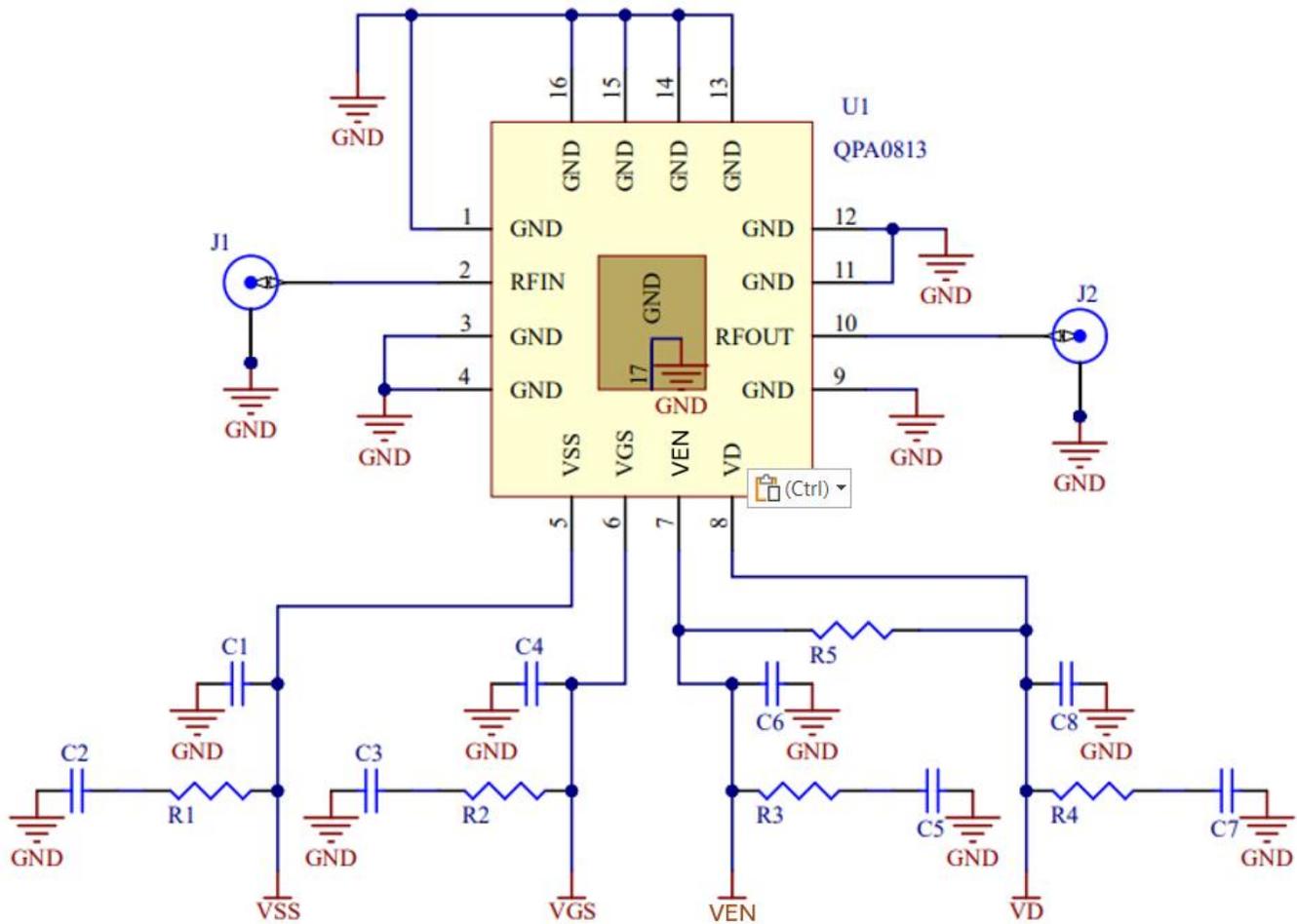
Recommended Land Pattern



Recommended Land Pattern Mask

Note:
 Dimensions are in millimeters.
 The recommended PCB design files can be downloaded from Qorvo Website.

Application Information



Bias-up Procedure

Set VD limit to 600 mA, VSS, VGS, VEN limits to 20 mA each.

VGS = -1.5V if want to use manual bias.

If use auto-bias, set VEN = -5 V for bias ON, VEN = 0 V for bias OFF. Apply -5 V to VSS if use auto bias.

Apply +5 V to VD.

Toggle VEN to control amplifier ON and OFF.

If use auto-bias, device will automatically set drain current.

When biased ON, drain current should be around 140 mA

When biased OFF, drain current should be less than 10mA
If use manual bias, slowly increase VGS to achieve required drain current.

Turn on RF supply.

Bias-down Procedure

Turn off RF signal

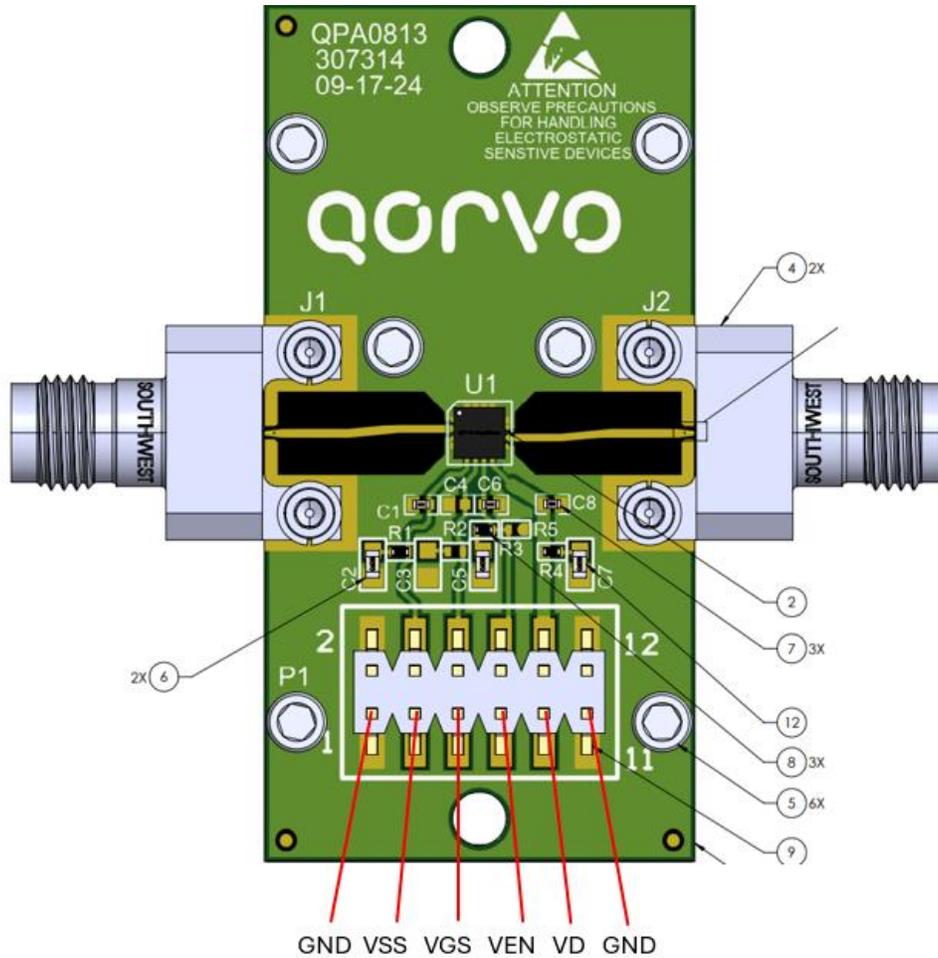
Set VD = 0V.

Reduce VEN to 0 V if use auto-bias.

set VGS = -1.5V if used manual bias.

Turn off VD supply, turn off VEN, turn off VGS, turn off VSS.

Evaluation Board



Bill of Materials

Ref. Des.	Value	Description	Manuf.	Part Number
C2,C5	10 uF	CAP, 10uF, 10%, 10V, 20%, X7R, 0603	various	
C1,C6, C8	1000 pF	CAP, 1000pF, 10%, 100V, X7R, 0402	various	
C7	0.01 uF	CAP, 0.01uF, 10%, 50V, X7R, 0603	various	
R1,R3,R4	5.1 Ω	RES, 5.1 OHM, 5%, 0.1W, 0402	various	
J1, J2	-	2.92mm Female End Launch Connector	Southwest Microwave	1092-01A-12

Note:

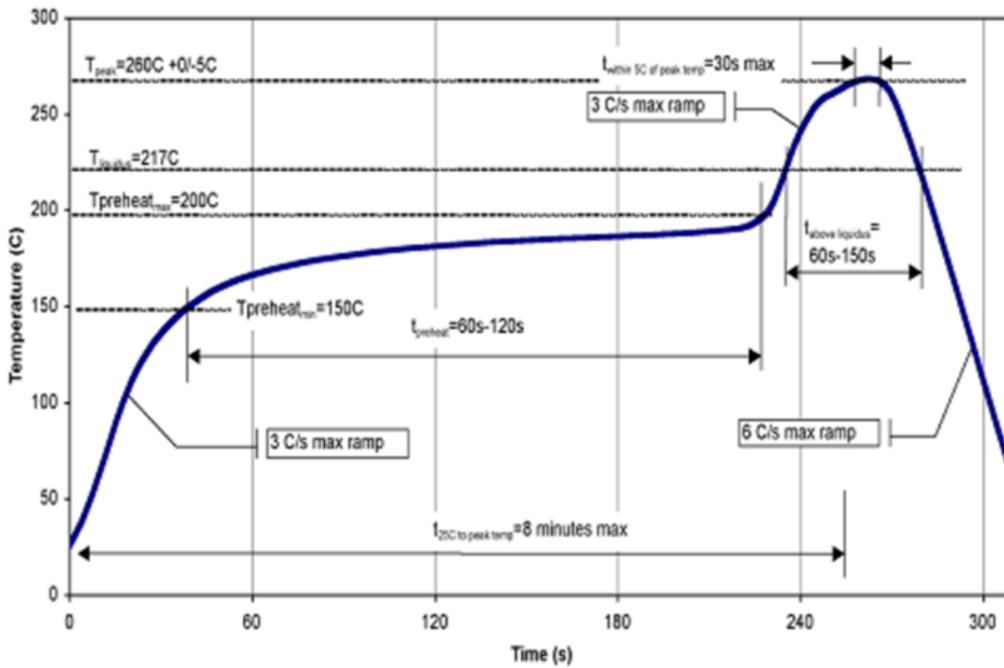
EVB configured as auto - bias.

Components not listed in this table are not populated.

Assembly Notes

Compatible with lead-free soldering processes with 260°C peak reflow temperature.

Contact plating: NiPdAu.



Recommended Soldering Temperature Profile

Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	TBD	ESDA / JEDEC JS-001-2014
ESD – Charged Device Model (CDM)	TBD	ESDA / JEDEC JS-002-2017
MSL – Moisture Sensitivity Level	TBD	IPC/JEDEC J-STD-020



Caution!
ESD-Sensitive Device

RoHS Compliance

This part is compliant with 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 (C₁₅H₁₂Br₄O₂) Free
- SVHC Free
- PFOS Free

Contact Information

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

Web: www.qorvo.com

Tel: 1-844-890-8163

Email: customer.support@qorvo.com

Important Notices

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