QPA2511

100 W, 50 V, 1.2 – 1.4 GHz, GaN on SiC Power Amplifier

Product Overview

The QPA2511 is a 2-stage L-Band internally matched GaN Power Amplifier Module. The QPA2511 operates at pulsed RF conditions in frequency range 1.2 – 1.4 GHz providing typically 50 dBm of saturated output power with 29 dB of large-signal gain and 60% of power added efficiency.
The QPA2511 is matched to 50 Ohms with integrated bias circuits and DC blocking capacitor at input port. The QPA2511 in a SMD package provides good thermal properties and is ideal for use in both military and commercial pulsed radar systems.

Evaluation boards are available upon request.

25.0 x 12.5 x 3.488 mm SMD

Key Features

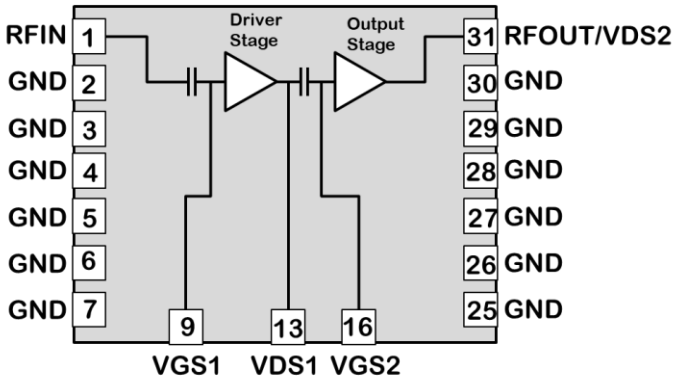
- Operating Frequency Range: 1.2 – 1.4 GHz
- Saturated Output Power P_{SAT} > 50 dBm (1) (2)
- Power Added Efficiency at P_{SAT} > 60% (1) (2)
- Large Signal Gain at P_{SAT} > 29 dB (1) (2)
- Bias: $V_{DS1,2}$=+50 V, I_{DQ1}=10 mA, I_{DQ2}=100 mA
- Package Type: SMD
- Package Dimensions: 25.0 x 12.5 x 3.488 mm

Notes:

1. Pulsed RF signal on a reference fixture plane.
2. 3 dB gain compression.

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

Functional Block Diagram



Applications

- Military Radar
- Commercial Radar

Ordering Information

Part Number	Description
QPA2511	QPA2511 50 Piece Tray
QPA2511EVBLPR2	QPA2511 Evaluation Board

Absolute Maximum Ratings

Parameter	Rating
Breakdown Voltage (BV_{DG})	+145 V
Gate Voltage ($V_{G1,2}$)	−7 to +2 V
Drain Voltage ($V_{D1,2}$)	+55 V
RF Input Power, 50 Ohm load (3)(4)	25 dBm
RF Input Power, 10:1 output VSWR (3)(4)	25 dBm
Channel Temperature	275°C
Storage Temperature	−65 to +150°C

Notes:

3. At temperature +25°C
4. Pulse signal 10% Duty Cycle, 100 µs Pulse Width

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	Unit
Driver Stage Gate Voltage (V_{G1})		−2.8		V
Output Stage Gate Voltage (V_{G2})		−2.8		V
Drain Voltage ($V_{D1,2}$)		+50		V
Driver Stage Quiescent Current (I_{DQ1})		10		mA
Output Stage Quiescent Current (I_{DQ2})		100		mA
Operating Temperature	-40		+85	°C

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
Operating Frequency Range		1.2		1.4	GHz
Saturated Output Power	3 dB Gain Compression		51.6		dBm
Large Signal Gain	3 dB Gain Compression		32.8		dB
Drain Efficiency	3 dB Gain Compression		69.0		%
Small Signal Gain	Frequency Range 1.2-1.4 GHz		35.8		dB
Input Return Loss	Frequency Range 1.2-1.4 GHz		-10		dB
Output Return Loss	Frequency Range 1.2-1.4 GHz		-10		dB
Driver Stage Gate Leakage (I_{G1})	V_{G1} = −3.7 V, V_{D1} = +10 V	-4.0			mA
Output Stage Gate Leakage (I_{G2})	V_{G2} = −3.7 V, V_{D2} = +10 V	-21.0			mA

Test conditions unless otherwise noted: $V_{D1,2}$ = +50 V, I_{DQ1} = 10 mA, I_{DQ2} = 100 mA, T = +25°C, Pulsed RF CW (Duty Cycle = 10%, Pulse Width = 100 µs) on a reference fixture plane for 1.2-1.4 GHz.

Thermal Information

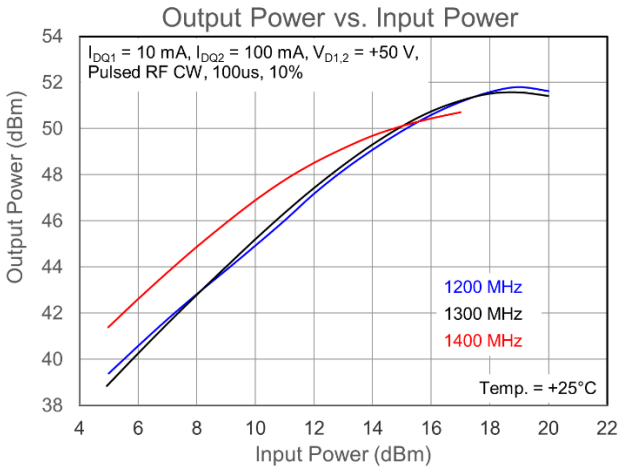
Parameter	Test Conditions	Values	Units
Thermal Resistance (θ_{JC}) (5)(6)	T_{CASE} = +85°C, $V_{DS1,2}$ = +50 V, I_{DQ1} = 10 mA, I_{DQ2} = 100 mA. P_{DISS} = 90.72 W, Pulsed RF CW	1.07	°C/W
Peak IR Surface Temperature (T_{CH}) (5)(6)		151	°C

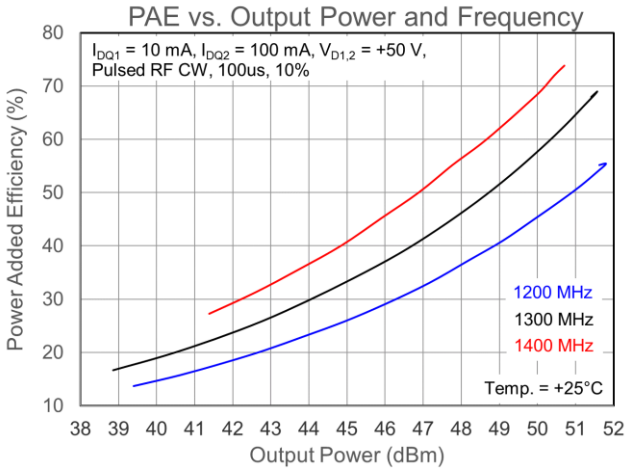
Notes:

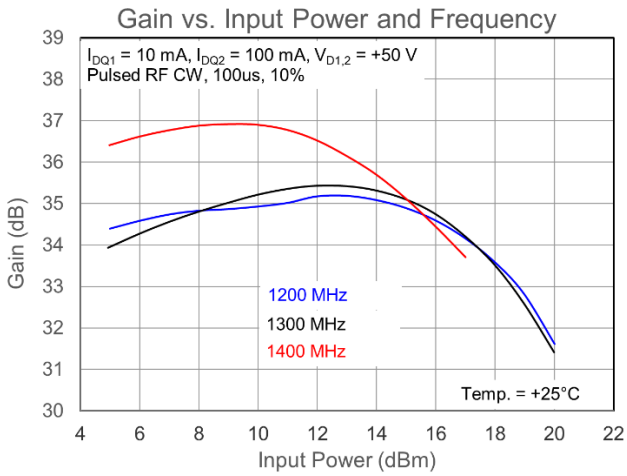
5. Thermal resistance is measured to package backside.
6. Pulsed CW (Duty Cycle = 10%, Pulse Width = 100 µs).
7. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

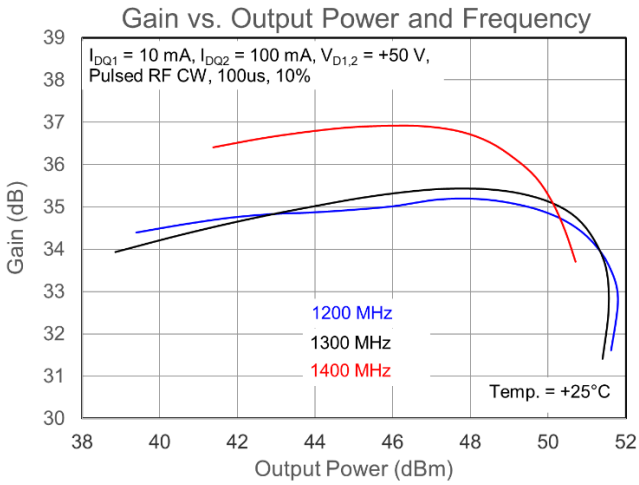
QPA2511 EVB Performance Plots – 1200 – 1400 MHz Reference Design

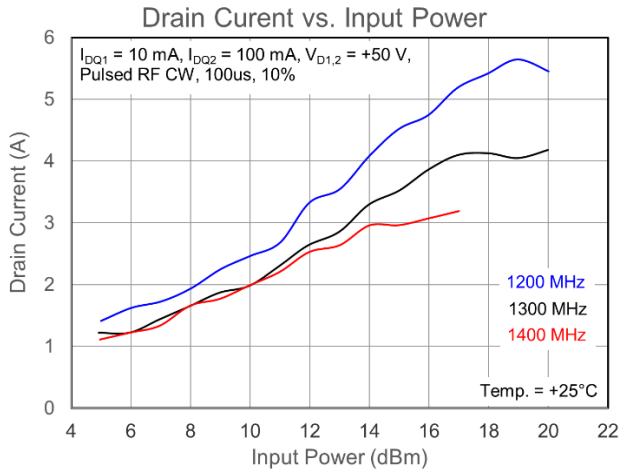
Notes: Refer to device reference planes where the performance was measured.

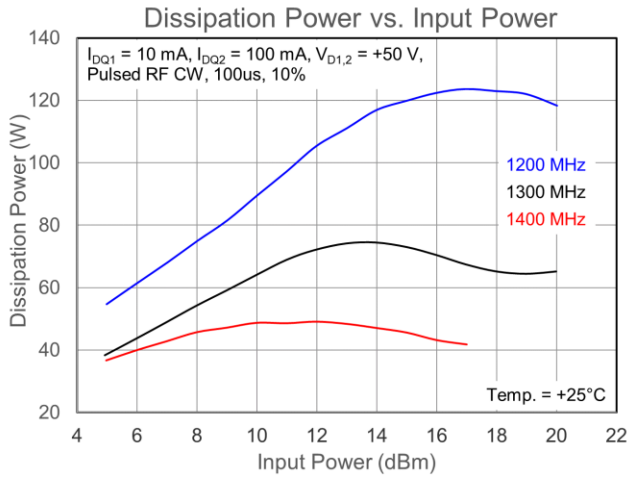






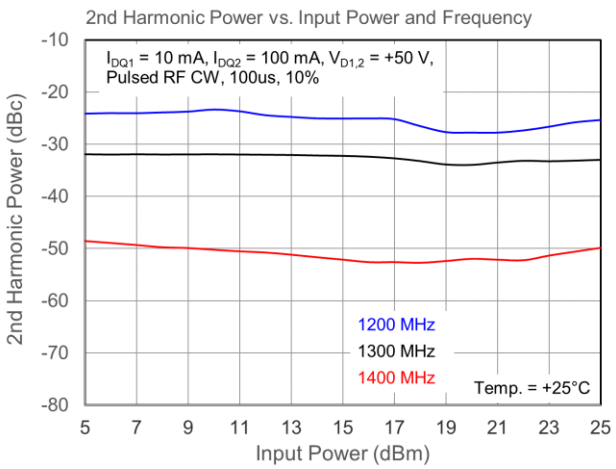


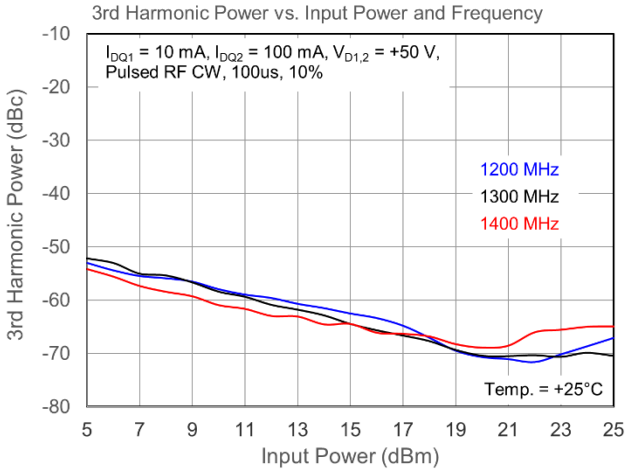


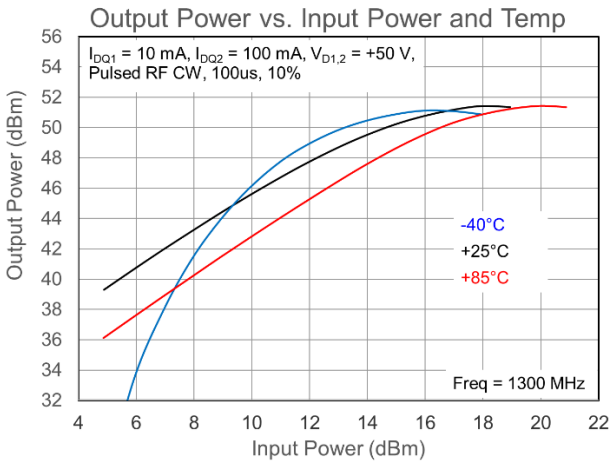


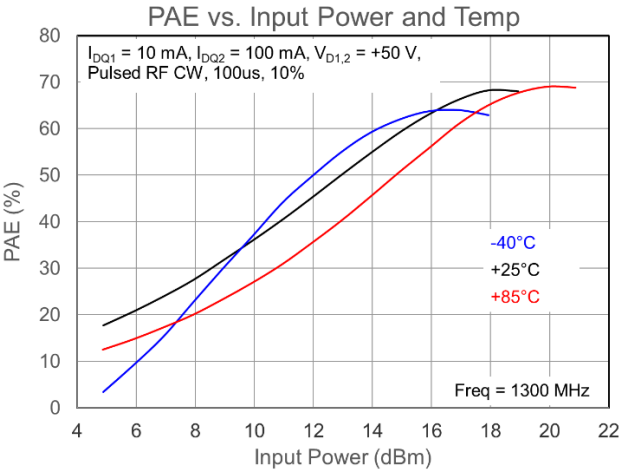
QPA2511 EVB Performance Plots – 1200 – 1400 MHz Reference Design

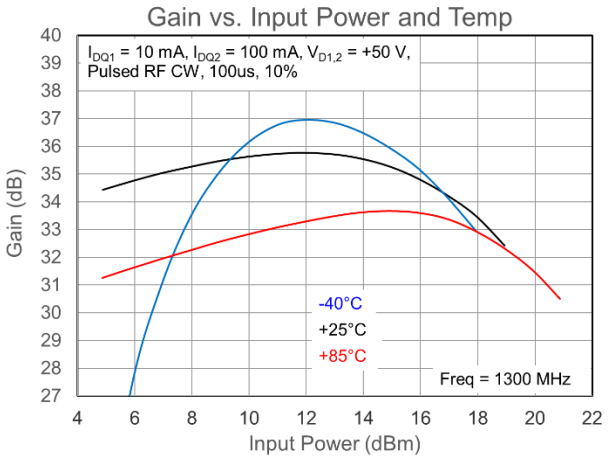
Notes: Refer to device reference planes where the performance was measured.





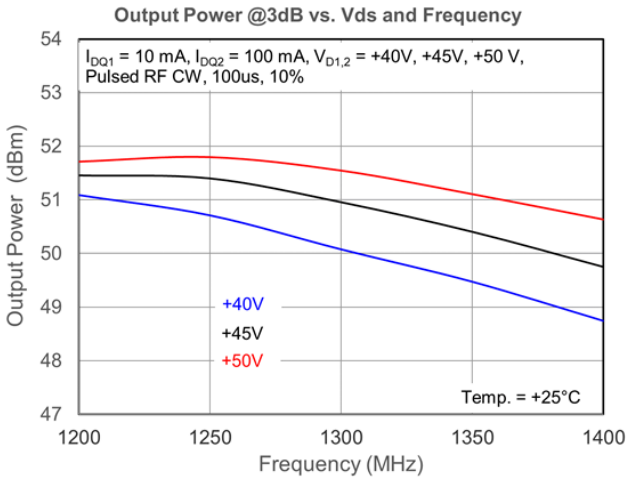


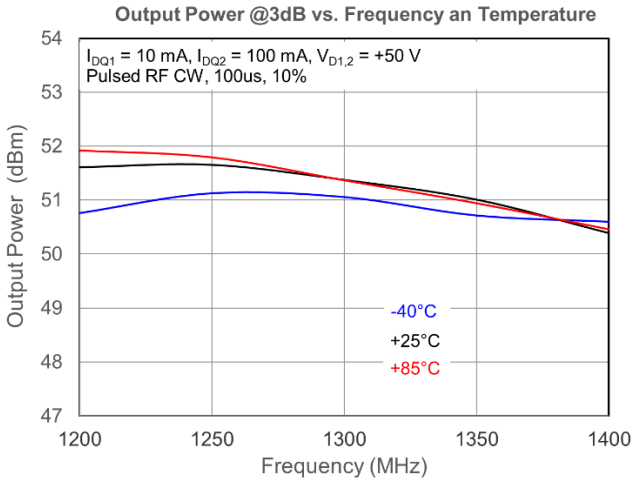


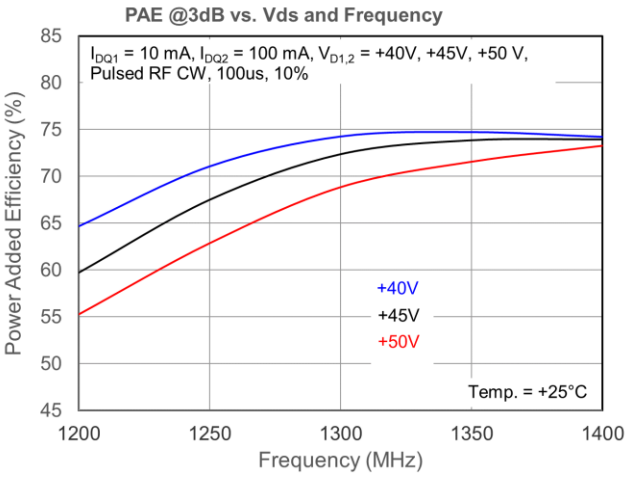


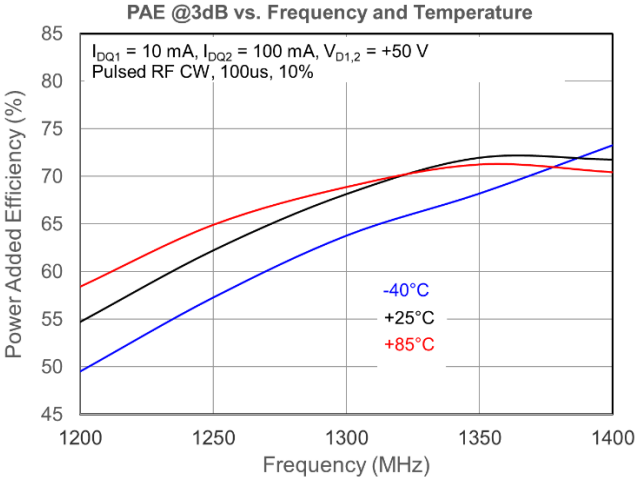
QPA2511 EVB Performance Plots at 3dB Gain Compression

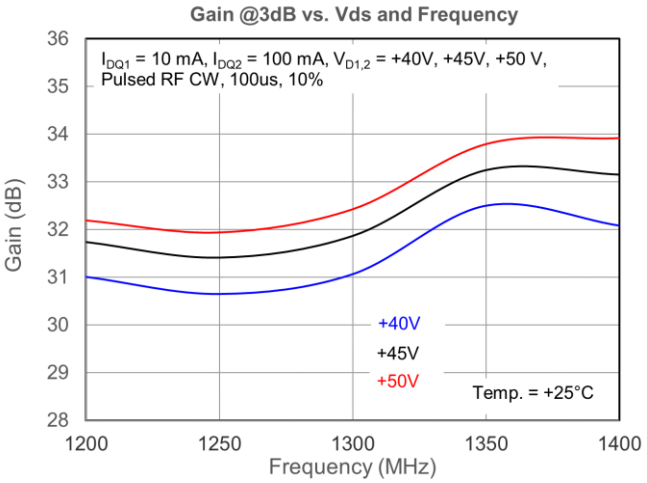
Notes: Refer to device reference planes where the performance was measured.

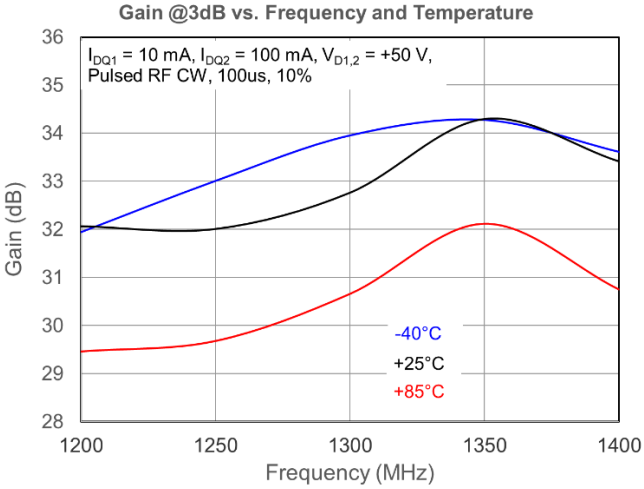






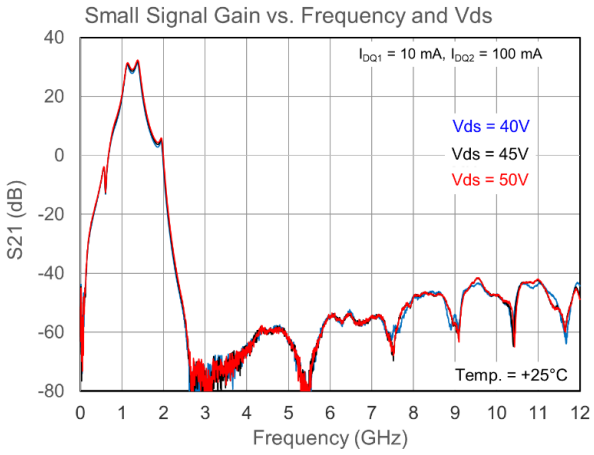


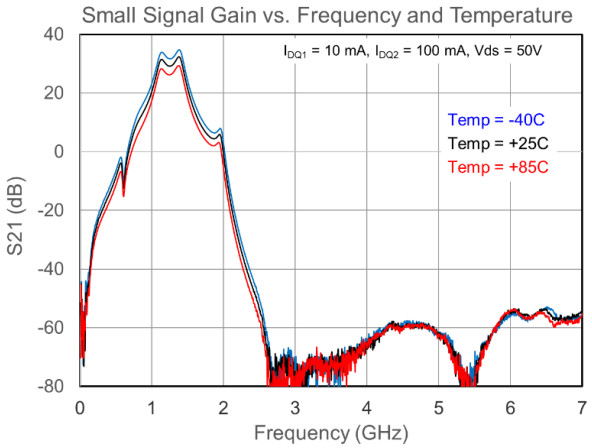


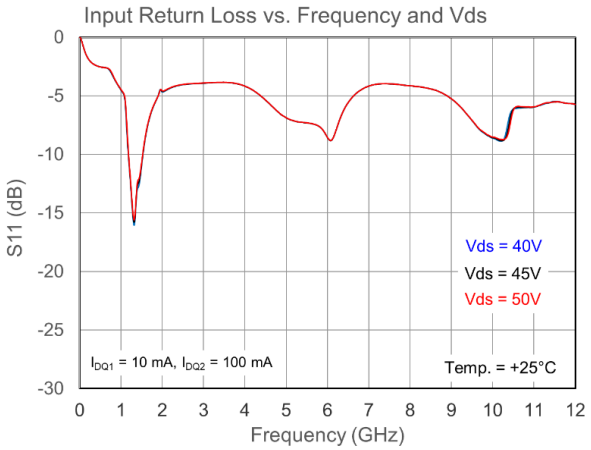


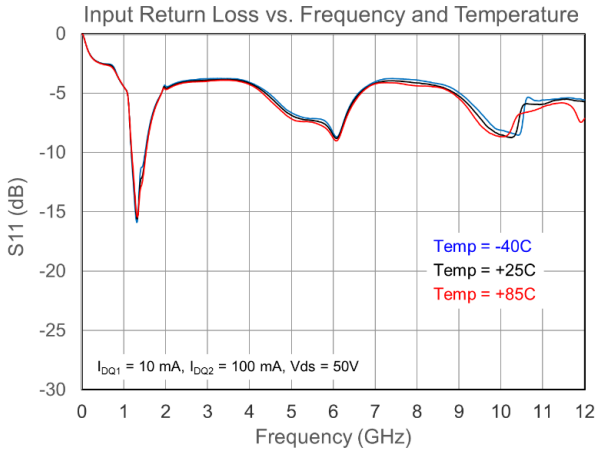
QPA2511 Typical Performance – S-Parameters

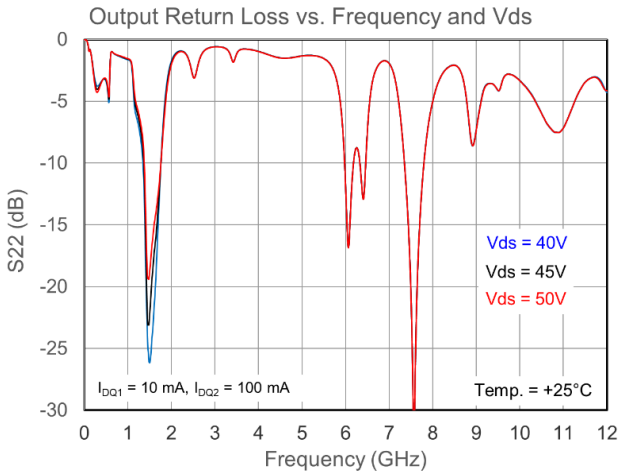
Notes: Refer to EVB reference planes where S-Parameters were measured.

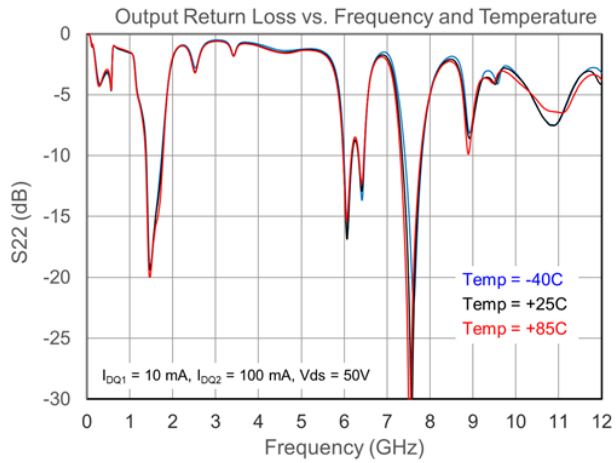




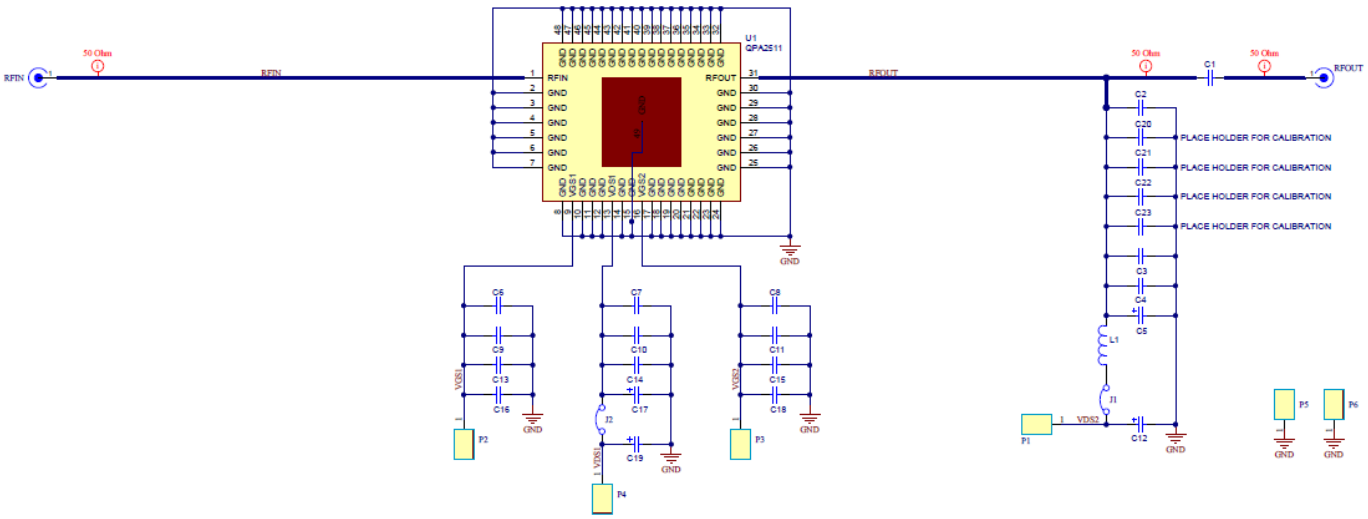








QPA2511 Evaluation Board Schematic

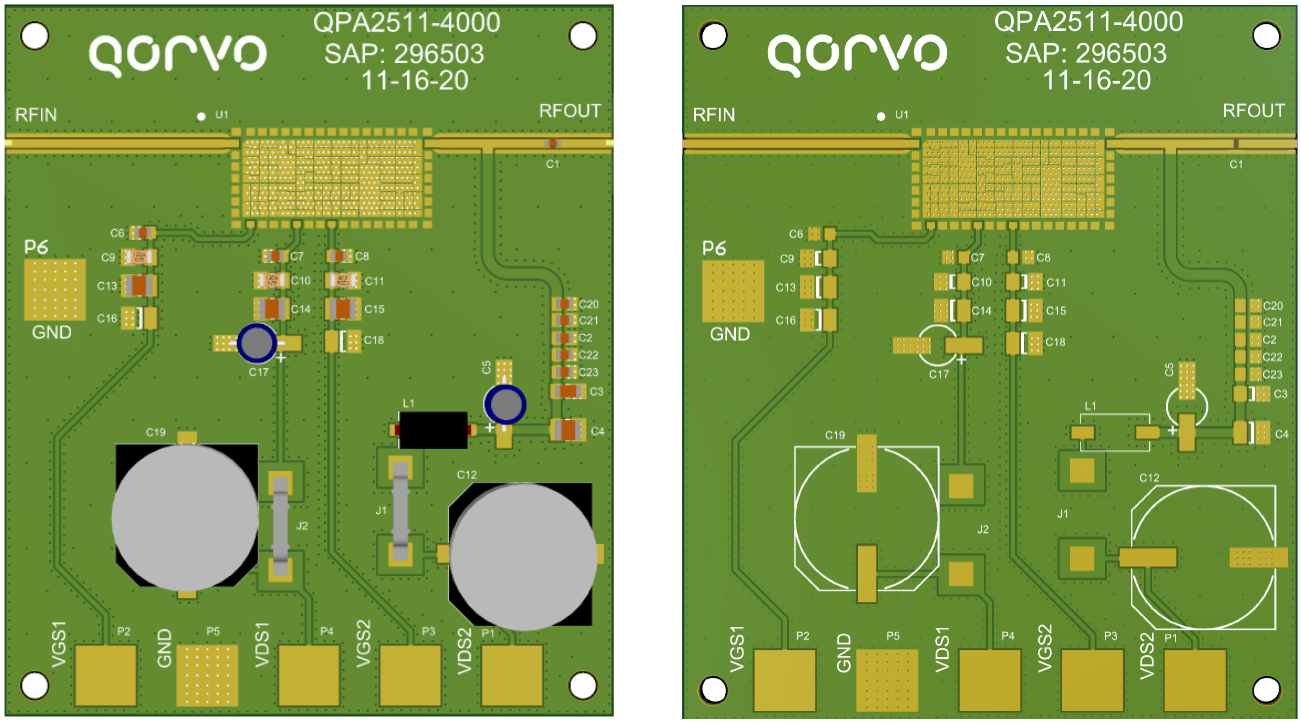


Bill of Materials

Reference Des.	Value	Description	Manuf.	Part Number
C1, C6, C7, C8, C21	27 pF	Capacitor, 27pF, +/-5%, 250V, HI-Q, 0603	ATC	600S270JT250XT
C3, C9, C10, C11	1000 pF	Capacitor, 1000pF, 10%, 500V, X7R, 1206	Samsung	CL31B102KGFNFNE
C4, C13, C14, C15	0.1 µF	Capacitor, 0.1uF, 10%, 100V, X7R, 1206	TDK	C3216X7R2A104K160AA
C5, C17	10 µF	Capacitor, 10uF, 20%, 100V, AL ELEC, AX	Panasonic	ECA-2AM100
C12, C19	220 µF	Capacitor, 220uF, 20%, 100V, ALU-ELECT, SMD	CDE	AFK227M2AR44T-F
C16, C18	10 µF	Capacitor, 10uF, 10%, 25V, X7R, 1210	Kemet	C1210T106K3RALTM
L1	115 Ohm	Ferrite Bead, 115 Ohm, 10A, SMD	Laird	28F0181-1SR-10
RFIN, RFOUT	–	SMA Connector	Powell Electronics	PSF-S00-000
U1	–	100W 50V 1.2 – 1.4 GHz GaN PA EHS	Qorvo	QPA2511.ELPR
J1, J2	-	Jumper Connector		

QPA2511 Evaluation Board Layout and Stencil

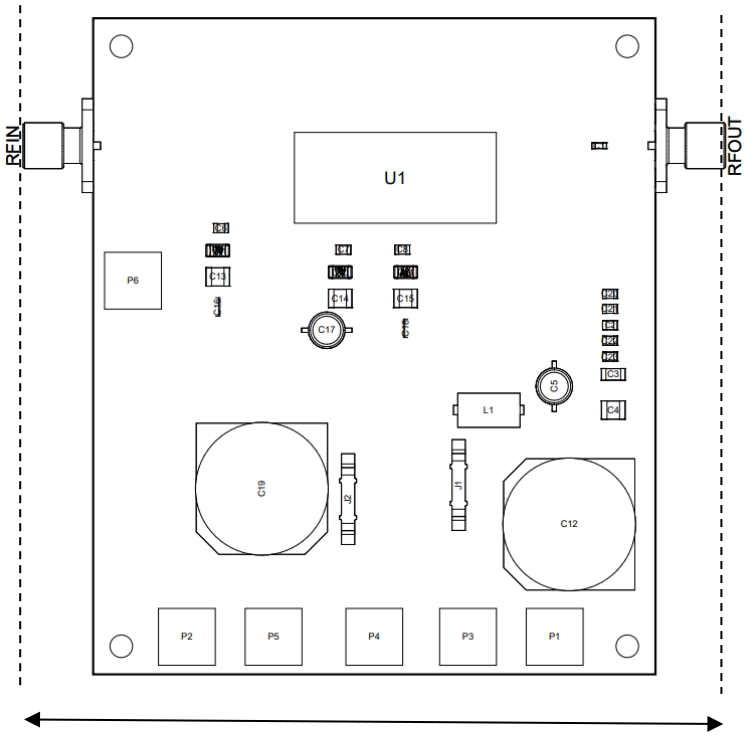
TOP VIEW (POPULATED)



Notes:

1. PCB Rogers 4350B 0.020in, 2 Layers, Copper 1.0oz. (2 oz Finish Thickness)
2. Stencil thickness 0.006” [150 um]

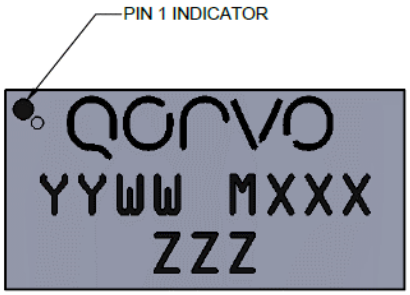
QPA2513 Evaluation Board Reference Plane for S-Parameters

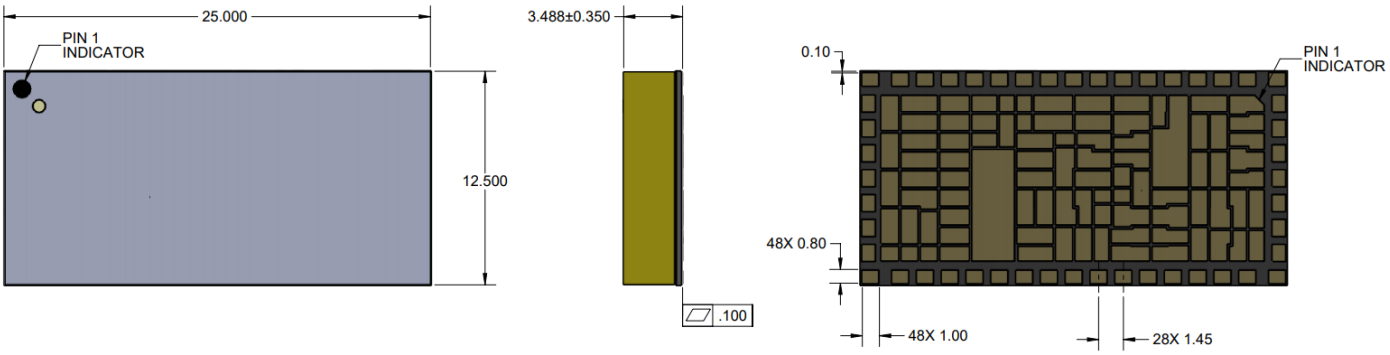


EVB Reference Planes

Package Marking and Dimensions

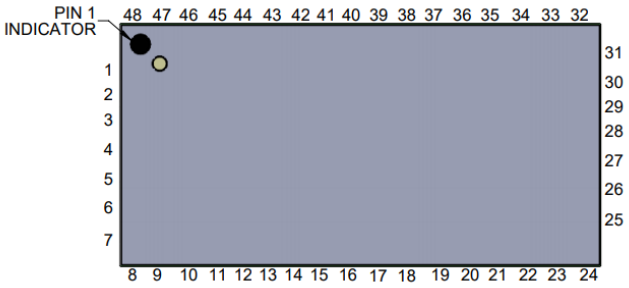
Marking: QORVO Logo
YY – Calendar Year of Assembly Lot
WW – Week Number of the Assembly Lot
MXXX – Batch ID
ZZZ – Part Number Within One Assembly Lot

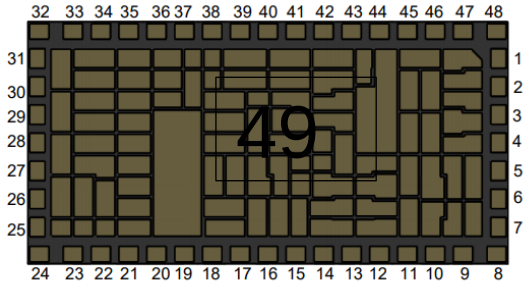




Notes:
1. All dimensions are in millimeters. Angles are in degrees.
2. General tolerance is ±0.05 unless otherwise noted.
3. Package Base: Laminate
4. Package Lid: FR-4.
5. Contact plating: Au, Thickness is 0.1 µm MIN.

Pin Configuration and Description



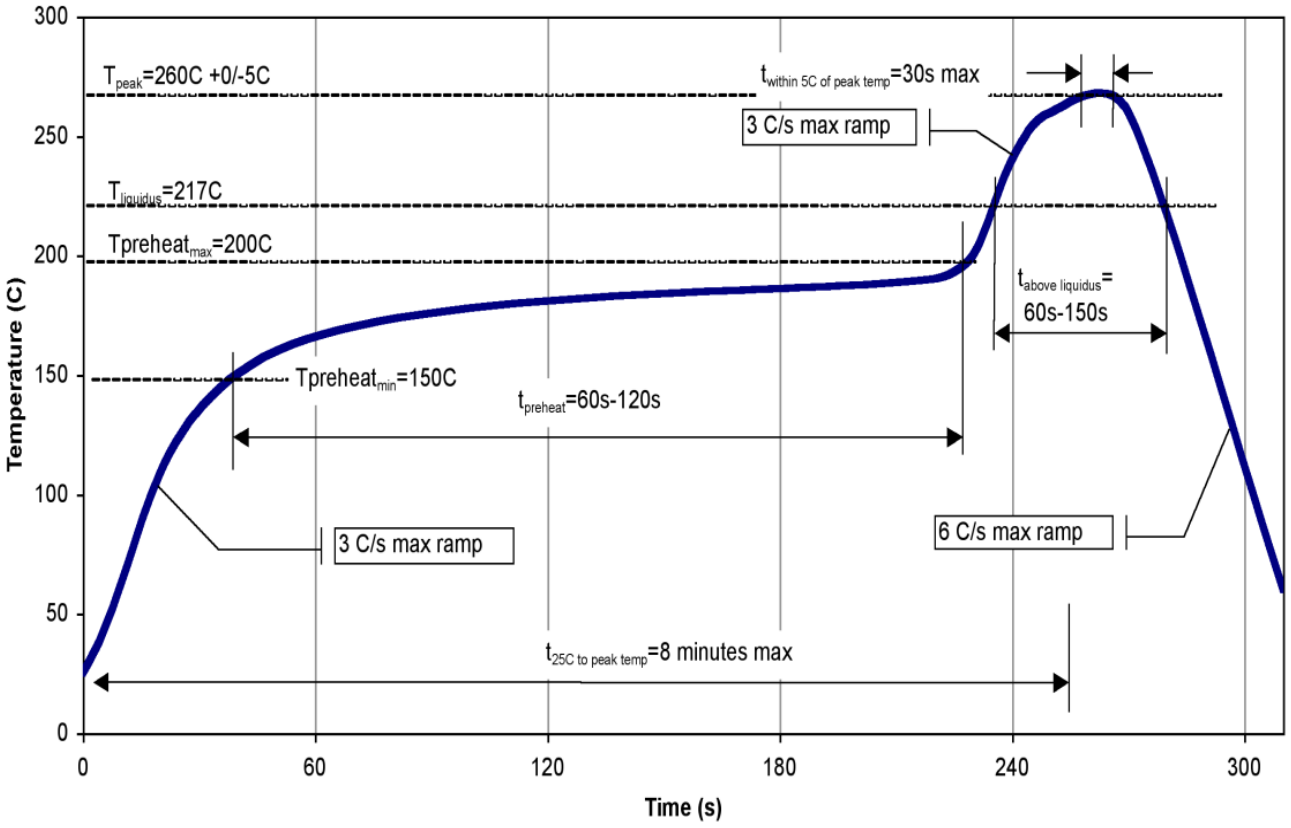


Pin Number	Label	Description
1	RF IN	RF Input
2, 3, 4, 5, 6, 7, 8	GND	RF/DC ground.
9	V_{GS1}	Driver Stage Gate Voltage
10, 11, 12	GND	RF/DC ground.
13	V_{DS1}	Driver Stage Drain Voltage
14, 15	GND	RF/DC ground.
16	V_{GS2}	Output Stage Gate Voltage
17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29. 30	GND	RF/DC ground.
31	RF OUT, V_{DS2}	RF output, Output Stage Drain Voltage
30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48	GND	RF/DC ground.
49 (Backside Paddle)	GND	RF/DC ground.

Power Amplifier Module Biasing Procedure

Bias On	Bias Off
1. Turn ON V_{GS1} to −5 V. 2. Turn ON V_{GS2} to −5 V. 3. Turn ON V_{DS1} and V_{DS2} to +50 V. 4. Slowly adjust V_{GS1} until I_{DQ1} = 10 mA. (Typically, V_{G1} = −2.8 V.) 5. Slowly adjust V_{GS2} until I_{DQ2} = 100 mA. (Typically, V_{G1} = −2.8 V.) 6. Turn ON RF.	1. Turn OFF RF. 2. Adjust V_{GS1} and V_{GS2} to −5 V. 3. Turn OFF V_{DS1} and V_{DS2}. 4. Wait two (2) seconds to allow drain capacitors to discharge. 5. Turn OFF V_{GS1} and V_{GS2}.

Recommended Solder Temperature Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1B	ANSI/ESDA/JEDEC Standard JS-001
ESD – Charged Device Model (CDM)	Class C3	ANSI/ESDA/JEDEC Standard JS-002
MSL – Moisture Sensitivity Level	MSL3	IPC/JEDEC Standard J-STD-020

Caution!
ESD-Sensitive Device

Solderability

Compatible with lead-free (260°C max. reflow temp.) soldering process. Package lead plating is ENEPIG.
Solder rework not recommended.

This package is air-cavity and non-hermetic, and therefore cannot be subjected to water washing. The use of no-clean solder to avoid washing after soldering is highly recommended.

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:

- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC 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

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