

Product Description

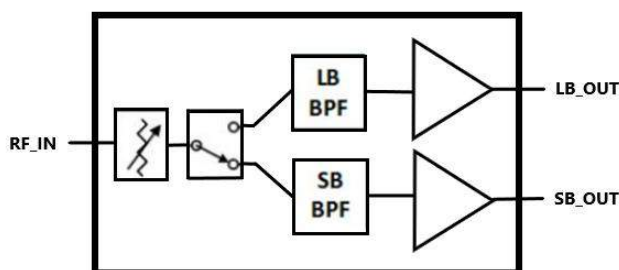
QPB9026 is a dual-band digital variable gain amplifier (DVGA) featuring high RF performance and integration of various functions. The DVGA integrates an SPDT switch, digital step attenuator (DSA), band pass filters and high-performance low noise amplifiers (LNA) covering both L and S frequency bands.

The device has compatible CMOS control of channel switching, power up / down capability and bias adjustability for the LNAs controlled through external pins. The device has built-in filters for out of band signal suppression; gain control is implemented through DSA with 31.75 dB of attenuation range in 0.25 dB steps. The QPB9026 is packaged with overmold compound in a RoHS-compliant, compact 46 - pin 9 x 8 mm surface-mount leadless and shielded package.



46 Pin 9 x 8 mm leadless OVM Package

Functional Block Diagram



Applications

- Electronics Warfare (EW)
- Commercial and Military Radar
- Communication Systems

Product Features

- L - Band Frequency Range: 0.6 - 1.5 GHz
- Noise Figure: <5 dB
- Gain @ P3dB: >18 dB
- OP3dB: >20 dBm
- S - Band Frequency Range: 2.9 GHz - 3.5 GHz.
- Noise Figure: <10 dB
- Gain @ P3dB: >29 dB
- OP3dB: >26.5 dBm
- DSA Attenuation Range: 31.75 dB
- Attenuation LSB: 0.25 dB
- Direct Device Function Disable / Enable
- 1.8 V Logic Compatible Serial Inputs.
- External Bias Adjust
- Package Dimensions: 9 x 8 x 1.525 mm

Performance is typical at room temperature.

Please reference electrical specification table and data plots for more details.

Ordering Information

Part	Description
QPB9026TR7X	Dual Band Amplifier and Filter Module 1000 Piece 7" Reel
QPB9026TR7	250 Piece 7" Reel
QPB9026SR	100 Piece 7" Reel
QPB9026S2	2 Piece WP Sample
QPB9026EVB	QPB9026 Evaluation Board

Absolute Maximum Ratings

Parameter ¹	Min Value	Max Value	Units
Power Supply Voltage (VCC_AMP1, VCC_AMP2, VCC_AMP2B, V_BIAS) ²	-0.3	6.0	V
Switch Control Voltage (SW_CTRL)	-0.3	6.0	V
DSA Power Supply (VCC_DSA)	-0.3	6.0	V
RF Input Power (25°C, 50 Ohm)	L-Band	23	dBm
	S-Band	10	
Operating Temperature	-10	+55	°C
Storage Temperature	-65	+150	°C
Junction Temperature	-	+170	°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 may reduce device reliability.
2. Amplifiers bias currents are internally controlled, referring to Nominal Operating Conditions Table for these and other control bias value ranges.

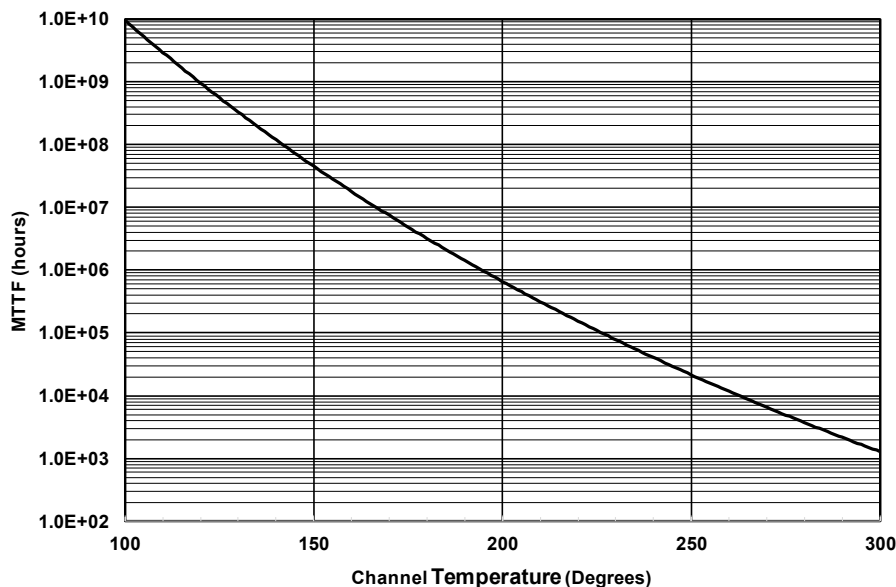
Thermal and Reliability Information

Parameter	Values	Units	Conditions
Thermal Resistance (θ_{JC}) ⁽¹⁾	35.11	°C/W	T _{BASE} = + 55 °C, V _{CC1} , V _{CC2} , V _{CC2B} = 5V, Freq. = 1.5GHz, RF P _{IN} = 23 dBm, P _{out} = 20.3 dBm, P _{DISS} = 1.07W ⁽²⁾
Channel Temperature (T _{CH}) ⁽²⁾	93	°C	
Thermal Resistance (θ_{JC}) ⁽¹⁾	72.68	°C/W	T _{BASE} = + 55 °C, V _{CC1} , V _{CC2} , V _{CC2B} = 5V, Freq. = 3.5GHz, RF P _{IN} = 10 dBm, P _{out} = 27.41 dBm, P _{DISS} = 1.36 W ⁽²⁾
Channel Temperature (T _{CH}) ⁽²⁾	155	°C	

Notes:

1. Thermal resistance is referenced to package backside; the base temperature is + 55 °C
2. The channel temperature is dominated by preamp and LNAs.

MTTF vs Channel Temperature





QPB9026

Dual Band Amplifier and Filter Module

Normal Operating Conditions

Parameter ¹	Min	Typ.	Max	Units
Amplifier Power Supply Voltage: VCC_AMP1, VCC_AMP2, VCC_AMP2B, VBIAS	4.75	5	5.25	V
Switch Control Voltage High (SW_CTRL, Logic 1, S Band)	1.17	1.8	2.4	V
Switch Control Voltage Low (SW_CTRL, Logic 0, L Band)	-0.3	0	0.63	V
Amplifier 1 Current (VCC_AMP1, ON State)	40	68	90	mA
Amplifier 1 Current (VCC_AMP1, OFF State)	-	5	-	mA
Amplifier 2 Current (VCC_AMP2, VCC_AMP2B, ON State)	90	120	160	mA
Amplifier 2 Current (VCC_AMP2, VCC_AMP2B, OFF State)	-	3	4	mA
Amplifier 1 Control Voltage (AMP1_EN, ON State, Logic 1)	1.17	1.8	2.4	V
Amplifier 1 Control Voltage (AMP1_EN, OFF State, Logic 0)	-0.3	0	0.63	V
Amplifier 2 Control Voltage (AMP2_EN, ON State, Logic 1)	1.17	1.8	2.4	V
Amplifier 2 Control Voltage (AMP2_EN, OFF State, Logic 0)	-0.3	0	0.63	V
DSA Power Supply	2.7	5	5.5	V
Operating Temperature Range	-10	-	+55	°C
Junction Temperature for > 10 ⁶ Hours MTTF	-	-	170	°C

¹ Electrical specification is measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.



QPB9026

Dual Band Amplifier and Filter Module

Electrical Specifications – Module Performance

Test conditions unless otherwise noted: Temp = +25 °C, 50 Ω system

Parameter	Conditions	Min	Typ.	Max	Units
RF Gain Control		31.75	-	-	dB
Gain Control Resolution	Main Step = 0,0.25,0.5,1,2,4,8,16,31.75 dB Attenuation	0.25	-	-	dB
Gain Flatness1	L-Band: 1215 -1390 MHz S-Band: 2900 – 3500 MHz	-	-	±1.0	dB
Gain Flatness2	Narrow Band IBW (40 MHz)	-	-	±0.25	dB
Gain Flatness3	Wide Band IBW (200 MHz)	-	-	±0.5	dB
Switch Isolation		20	-	-	dB
Band/Filter Switching Time	To 0.5 dB	-	-	1	μs
Gain Control Switching Time	To 0.5 dB	-	-	1	μs
Spurious	Non-Harmonics	-	-	-80	dBc
DC Power Dissipation, L-Band		-	-	0.3	W
DC Power Dissipation, S-Band		-	1.25	1.25	W



QPB9026

Dual Band Amplifier and Filter Module

Electrical Specifications – L Band Performance

Test conditions unless otherwise noted: Temp = +25 °C, 50 Ω system

Parameter	Conditions	Min	Typ.	Max	Units
Operational Frequency		600		1500	MHz
Cutoff Frequency, Low		-	300	-	MHz
Cutoff Frequency, High		-	1920	-	MHz
Rejection ≤ Cutoff Frequency, Low	Compared to passband average. Rejection held down to 1 MHz	-	57.5	-	dBc
Rejection ≥ Cutoff Frequency, High	Compared to passband average. Rejection held down to 12 MHz	-	42.5	-	dBc
Gain @P3dB		-	18.3	-	dB
NF	@ DSA = MIN Attenuation	-	4.2	-	dB
OP3dB	@ DSA = MIN Attenuation	-	21.3	-	dBm
Input Return Loss	@ DSA = MIN Attenuation	-	12	-	dB
Output Return Loss	@ DSA = MIN Attenuation	-	15	-	dB

Electrical Specifications – S Band Performance

Test conditions unless otherwise noted: Temp = +25 °C, 50 Ω system

Parameter	Conditions	Min	Typ.	Max	Units
Operational Frequency		2900		3500	MHz
Cutoff Frequency, Low		-	1500	-	MHz
Cutoff Frequency, High		-	4500	-	MHz
Rejection ≤ Cutoff Frequency, Low	Compared to passband average. Rejection held down to 1 MHz	-	35.5	-	dBc
Rejection ≥ Cutoff Frequency, High	Compared to passband average. Rejection held down to 12 MHz	-	52.5	-	dBc
Gain @P3dB		-	30.1	-	dB
NF	@ DSA = MIN Attenuation	-	8.8	-	dB
OP3dB	@ DSA = MIN Attenuation	-	27.3	-	dBm
Input Return Loss	@ DSA = MIN Attenuation	-	15	-	dB
Output Return Loss	@ DSA = MIN Attenuation	-	15	-	dB

DSA Address Setting Truth Table

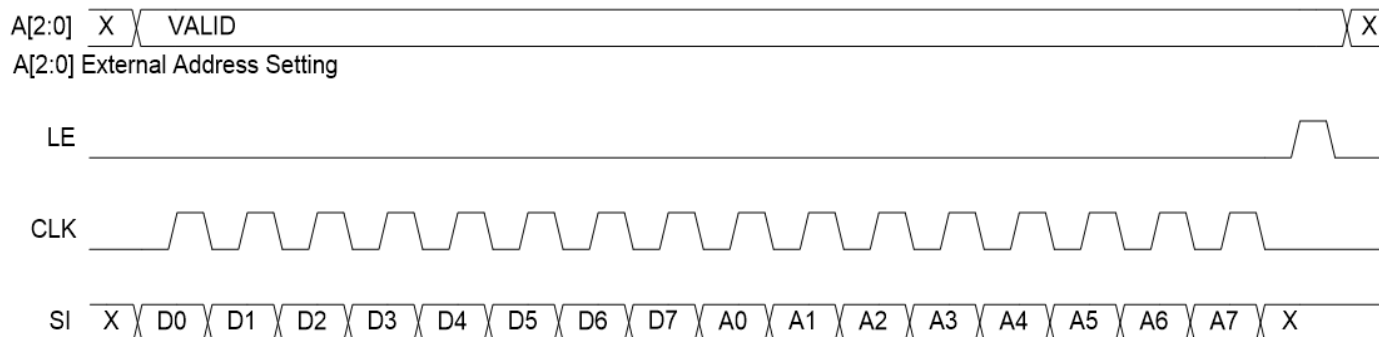
Address Settings	A7 (MSB)	A6	A5	A4	A3	A2	A1	A0
000	X	X	X	X	X	0	0	0
001	X	X	X	X	X	0	0	1
010	X	X	X	X	X	0	1	0
011	X	X	X	X	X	0	1	1
100	X	X	X	X	X	1	0	0
101	X	X	X	X	X	1	0	1
110	X	X	X	X	X	1	1	0
111	X	X	X	X	X	1	1	1

DSA Attenuation State Logic Truth Table

Attenuation States	D7 (MSB)	D6	D5	D4	D3	D2	D1	D0 (LSB)
0.0 dB / Reference State	X	0	0	0	0	0	0	0
0.25 dB	X	0	0	0	0	0	0	1
0.5 dB	X	0	0	0	0	0	1	0
1 dB	X	0	0	0	0	1	0	0
2 dB	X	0	0	0	1	0	0	0
4 dB	X	0	0	1	0	0	0	0
8 dB	X	0	1	0	0	0	0	0
16 dB	X	1	0	0	0	0	0	0
31.75 dB	X	1	1	1	1	1	1	1

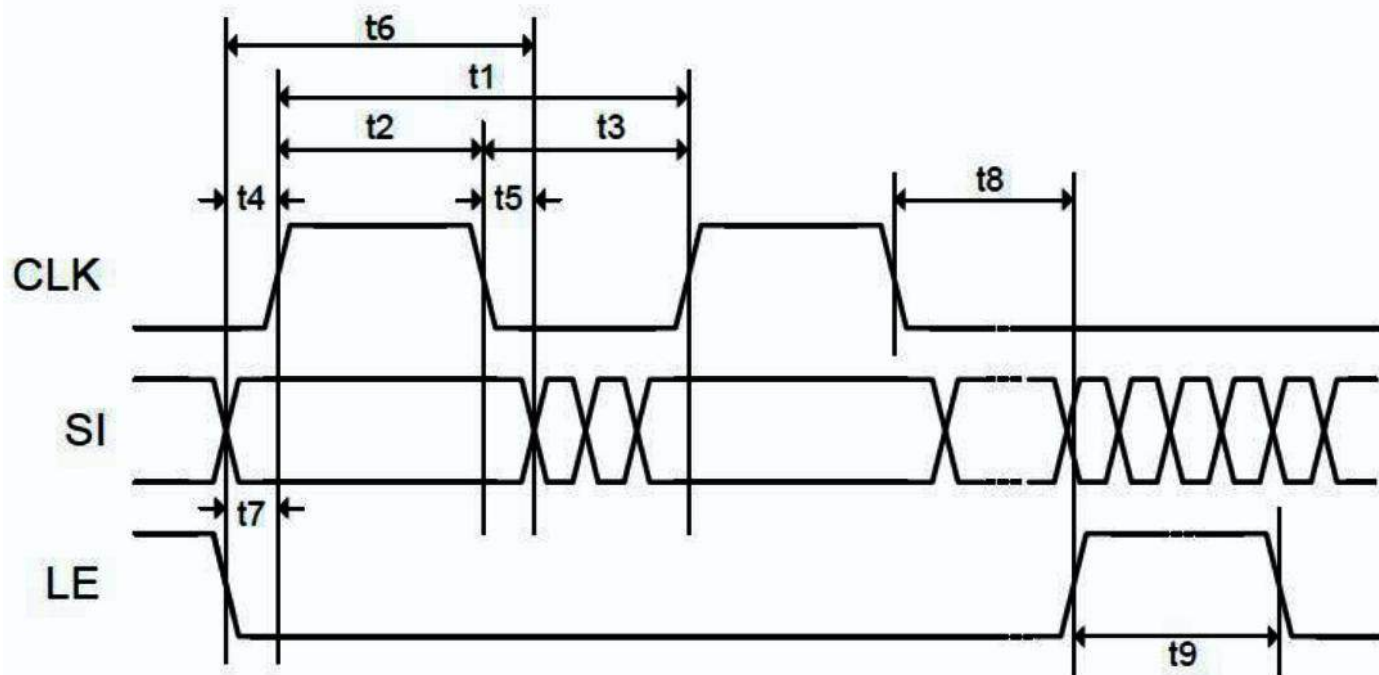
Note: Logic "0" and Logic "1" levels, refer to Nominal Operating Conditions Table

DSA Serial Addressable Mode Control Data Diagram



Note: Bts D0, D7, A3-A7 are not used and can be set to logic high or low

Serial Interface Timing Diagram



Serial Control Interface Timing Specifications

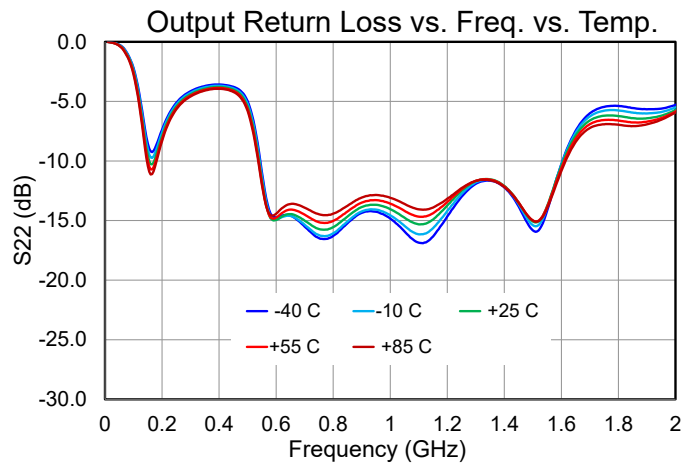
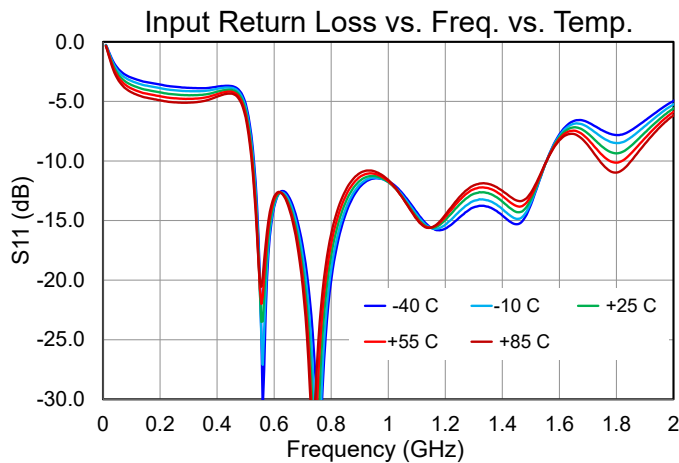
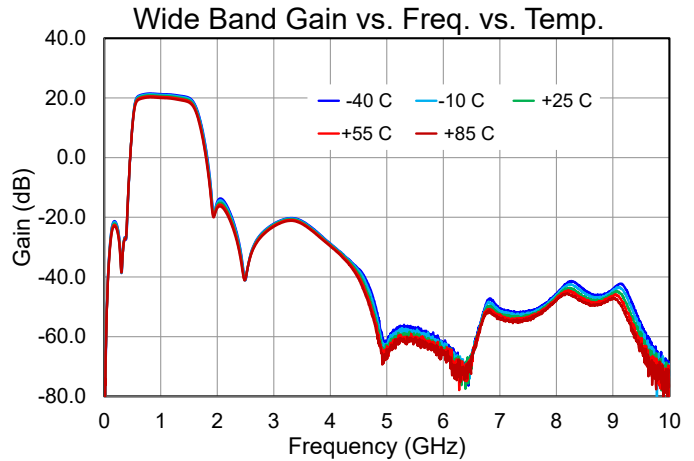
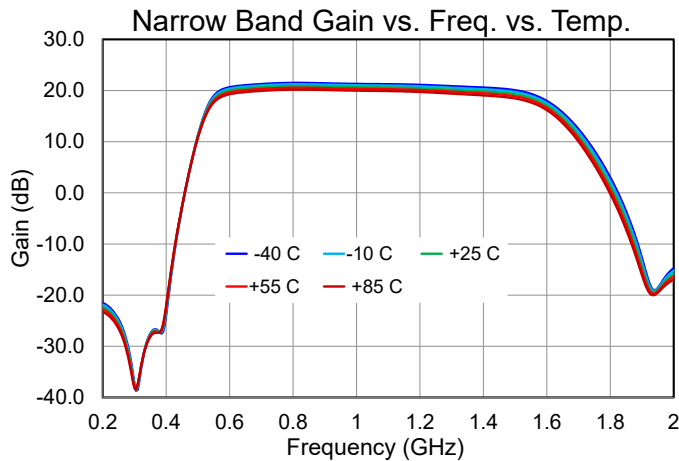
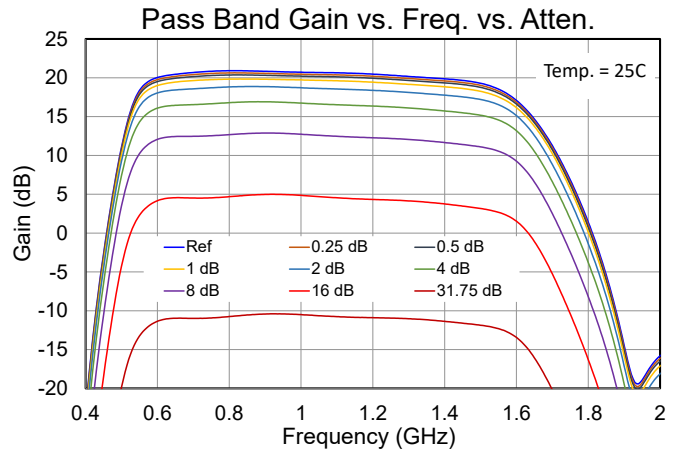
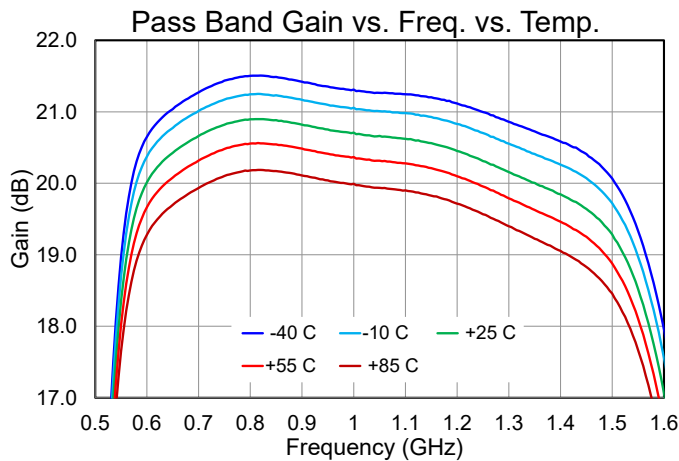
Parameters	Limits	Units	Comments
t1	20	MHz max	CLK Frequency
t2	20	ns min	CLK High
t3	20	ns min	CLK Low
t4	5	ns min	SI to CLK Setup Time
t5	5	ns min	SI to CLK Hold Time
t6	30	ns min	SI Valid
t7	5	ns min	LE to CLK Setup Time
t8	5	ns min	CLK to LE Setup Time
t9	10	ns min	LE Pulse Width

DSA Serial Mode Controls

The DSAs and Switch are controlled using serial mode. Both channel DSA's address pins are connected, attenuation state will be the same for both. Refer to Qorvo's Control Bit Generator (CBG) Software Reference Manual for detailed instructions on how to set up the software for use. Select 'QPB9026' from the Qorvo parts list of the CBG user interface. Set the attenuation value using the CBG user interface and measurement can be taken. The default power on attenuation state is maximum (31.75dB).

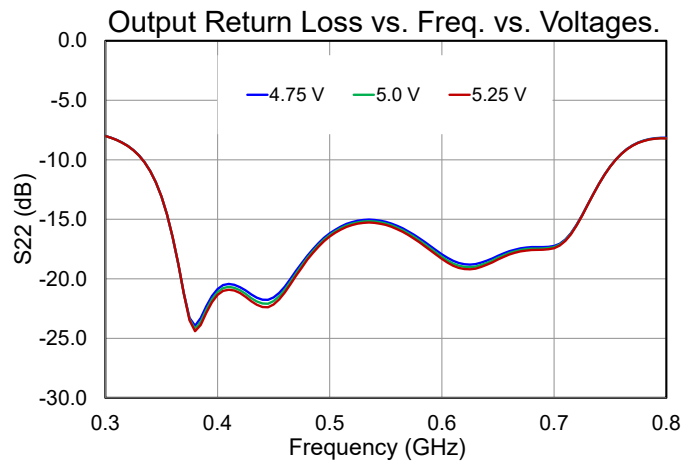
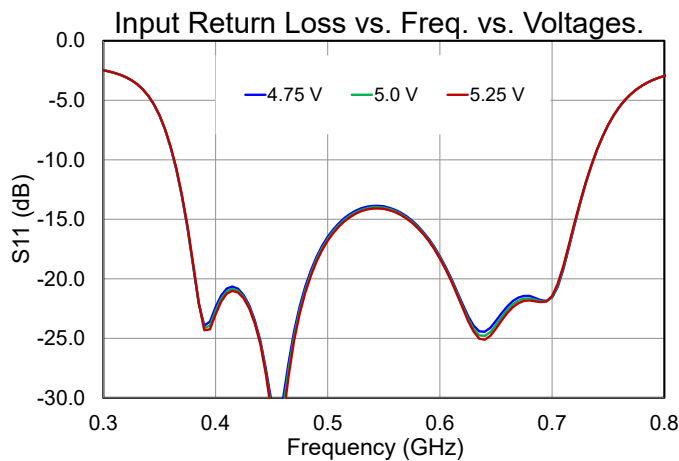
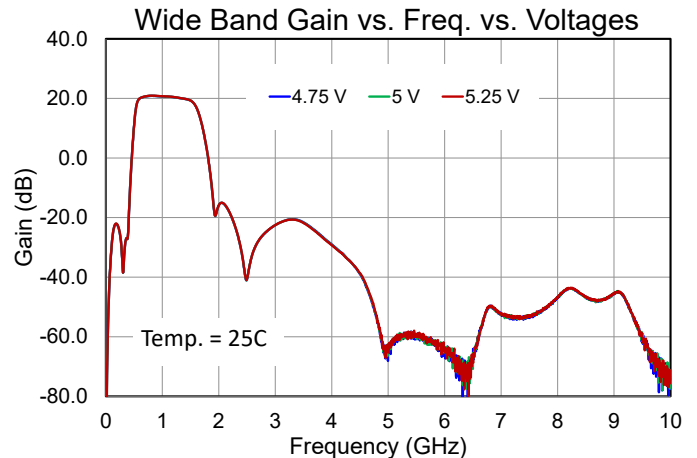
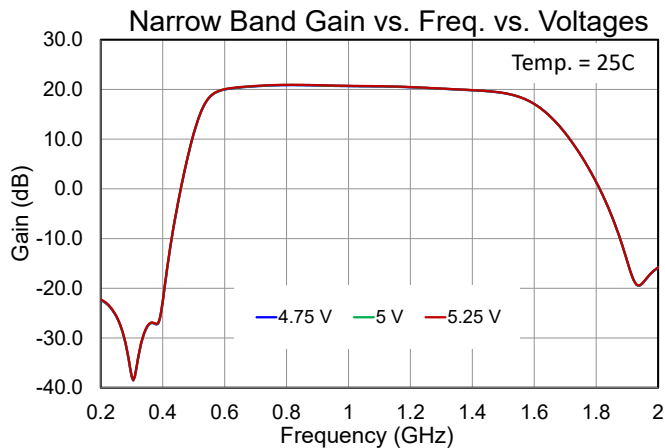
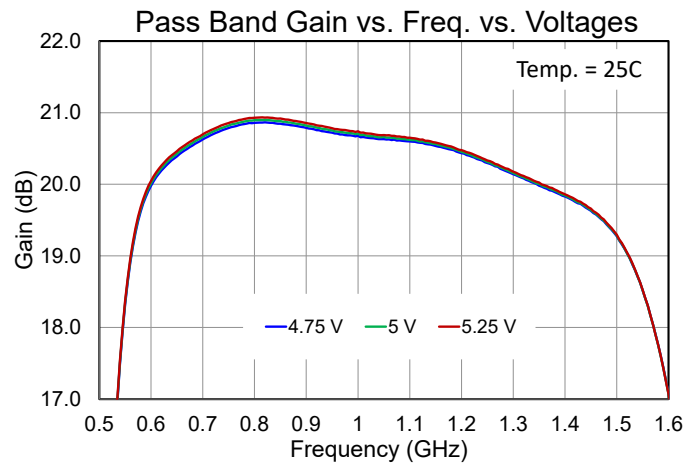
Performance Plots - Small Signal (L Band)

Test Conditions unless otherwise stated: Min. Atten. State, $V_{CC1} = 5V$, $I_{CQ1} = 68mA$, $V_{CC2} = 5V$, $I_{CQ2} = 93mA$, $V_{CC2B} = 5V$, $I_{CQ2B} = 31mA$, $25^{\circ}C$



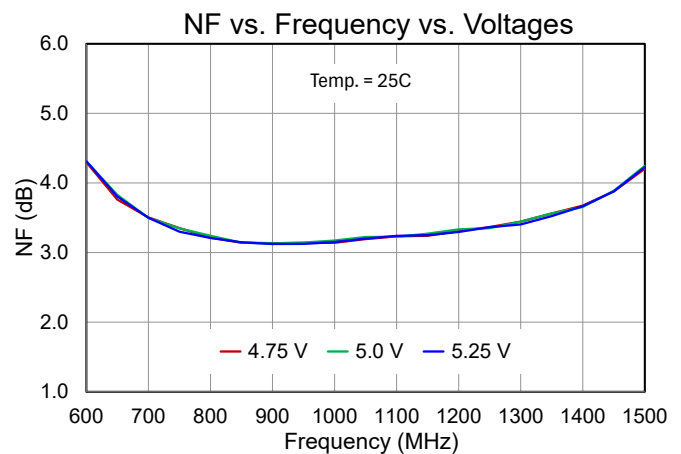
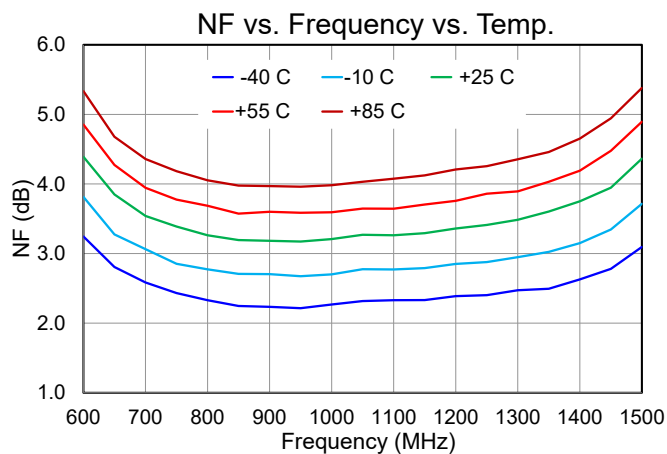
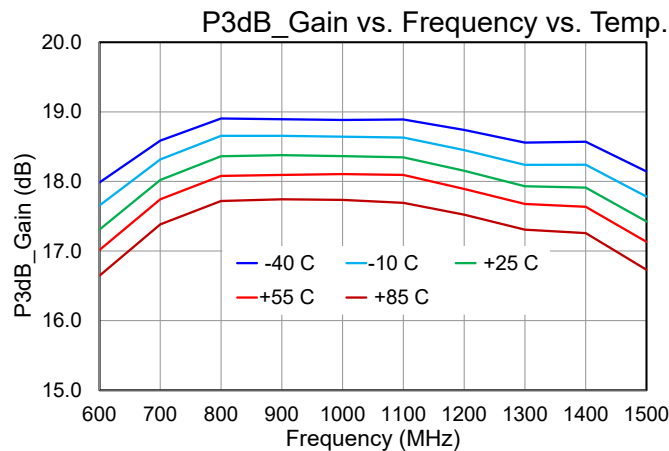
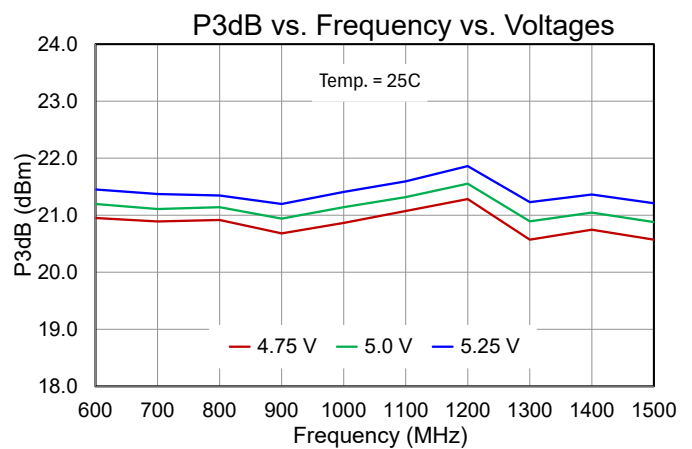
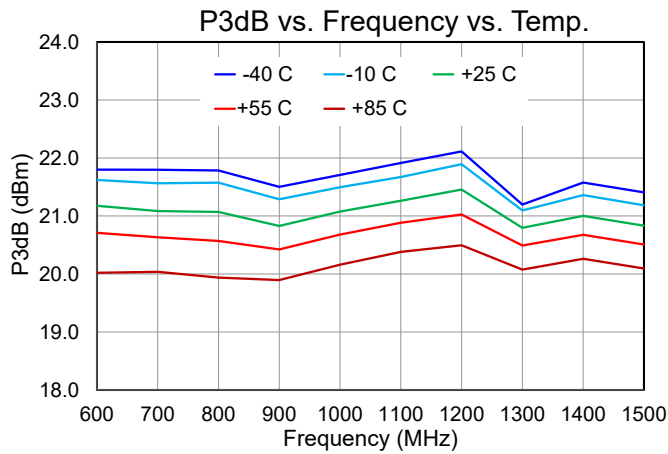
Performance Plots - Small Signal (L Band)

Test Conditions unless otherwise stated: Min. Atten. State, $V_{CC1} = 5V$, $I_{CQ1} = 68mA$, $V_{CC2} = 5V$, $I_{CQ2} = 93mA$, $V_{CC2B} = 5V$, $I_{CQ2B} = 31mA$, 25 °C



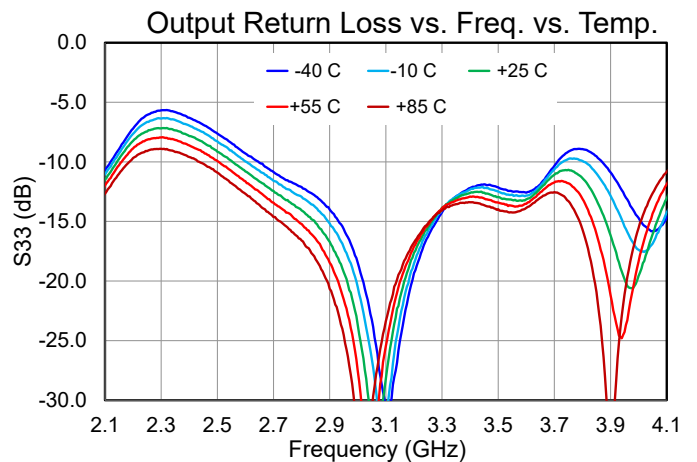
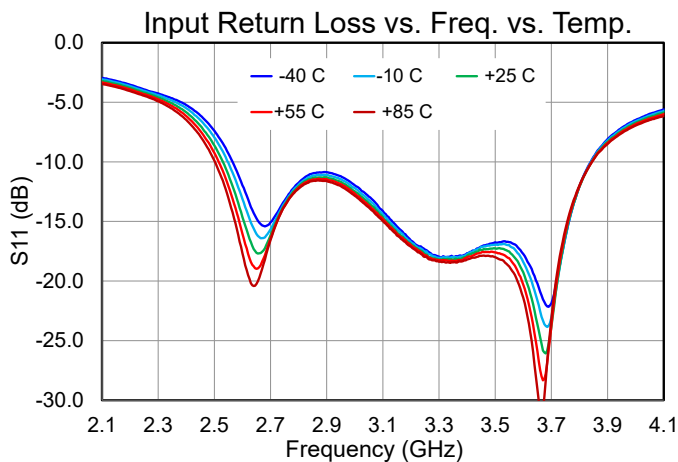
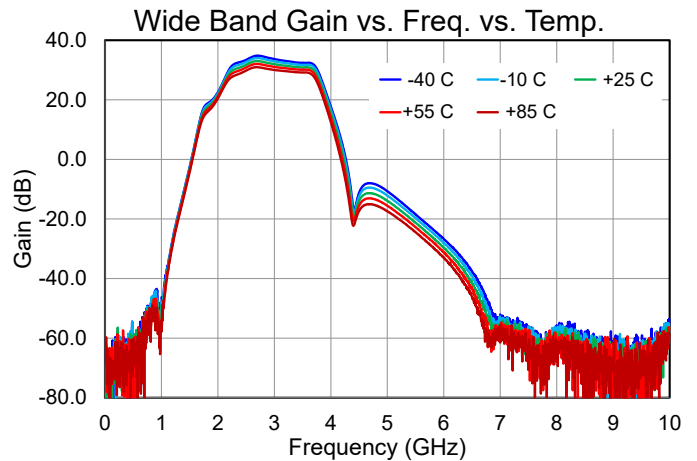
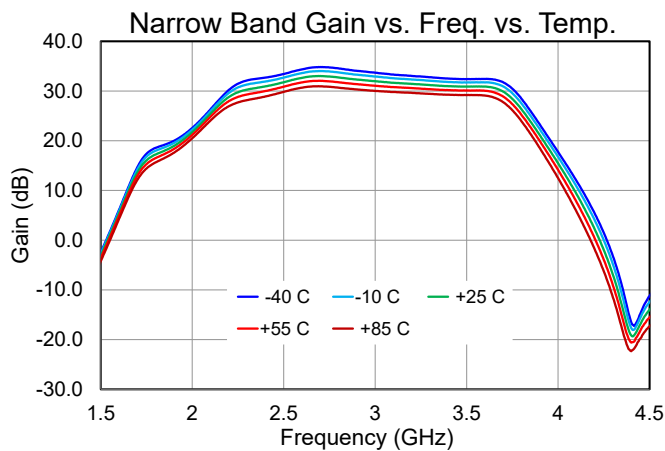
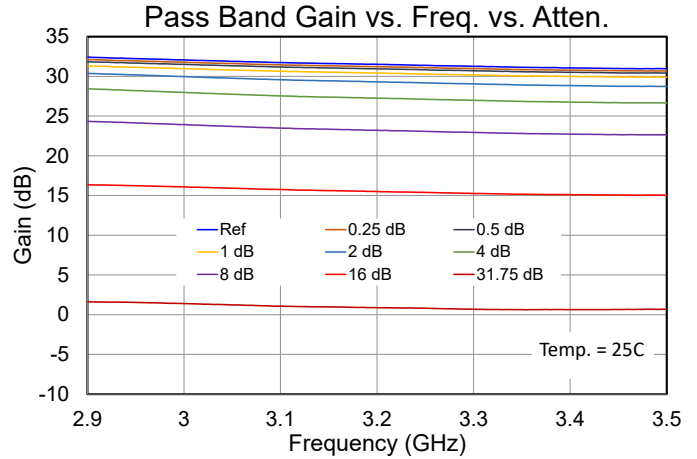
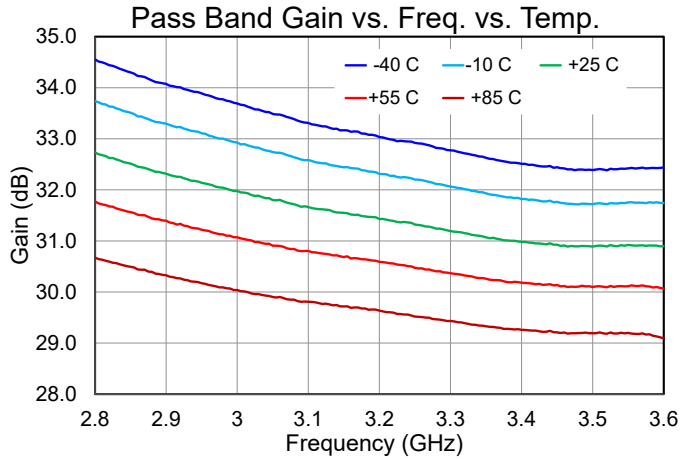
Performance Plots – Large Signal & NF (L Band)

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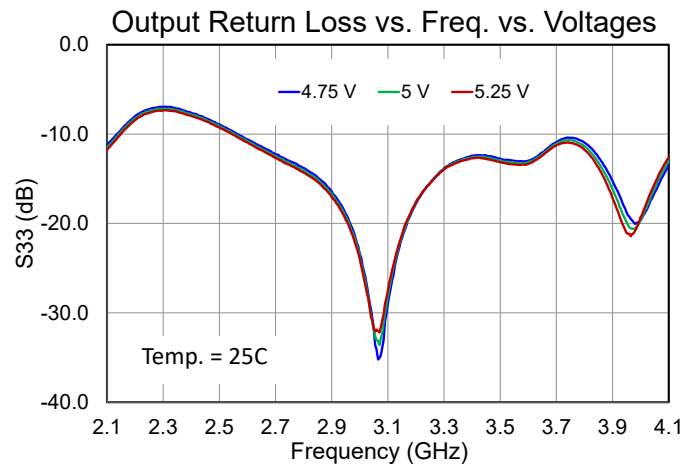
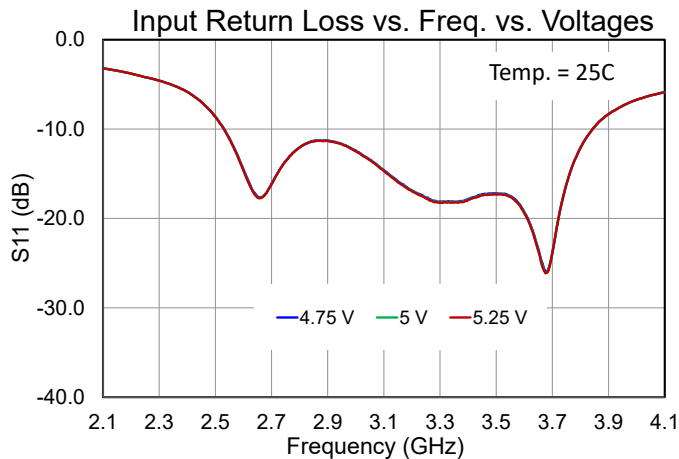
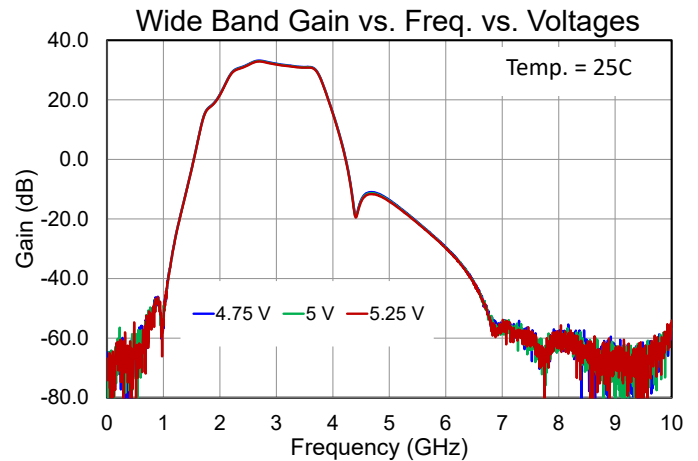
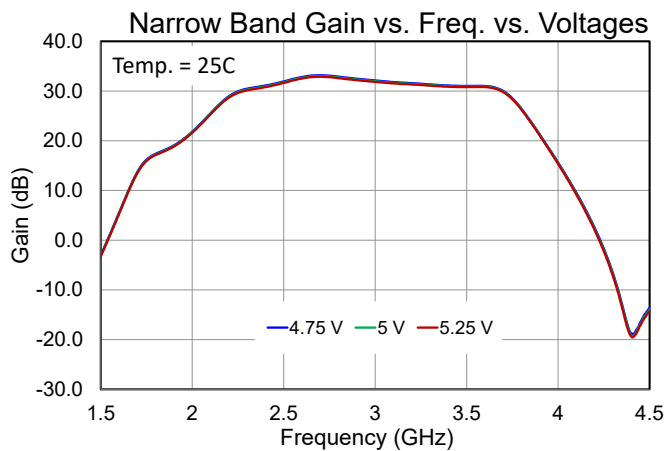
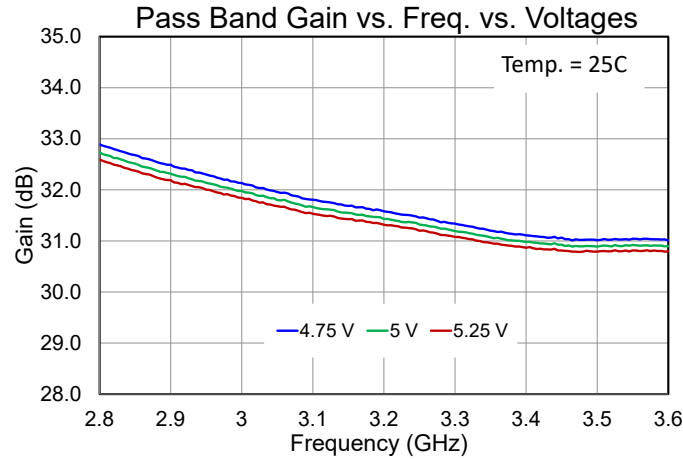
Performance Plots - Small Signal (S Band)

Test Conditions unless otherwise stated: Min. Atten. State, $V_{CC1} = 5V$, $I_{CQ1} = 68mA$, $V_{CC2} = 5V$, $I_{CQ2} = 93mA$, $V_{CC2B} = 5V$, $I_{CQ2B} = 31mA$, $25^{\circ}C$



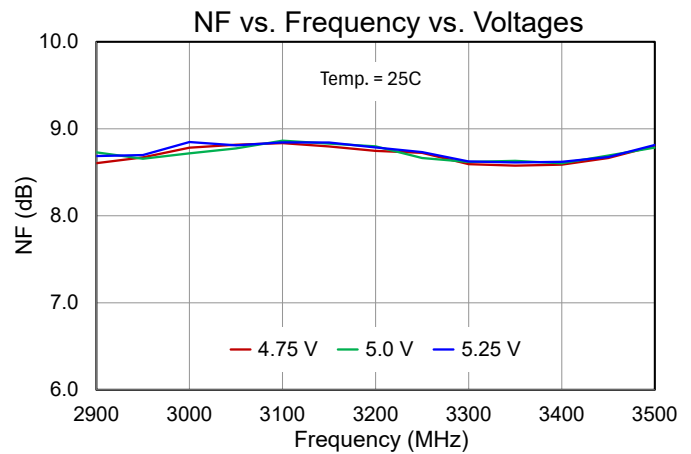
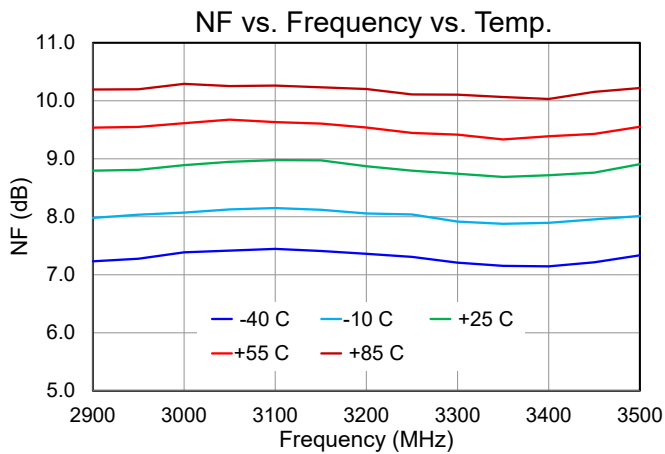
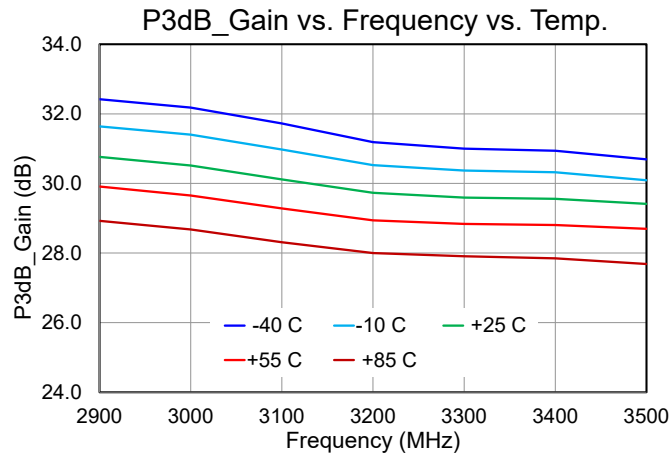
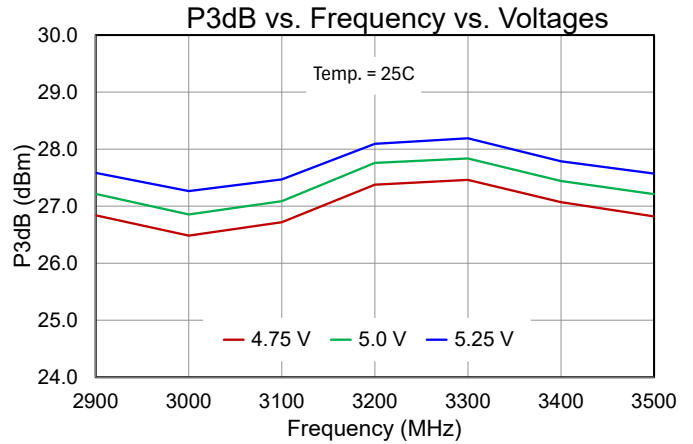
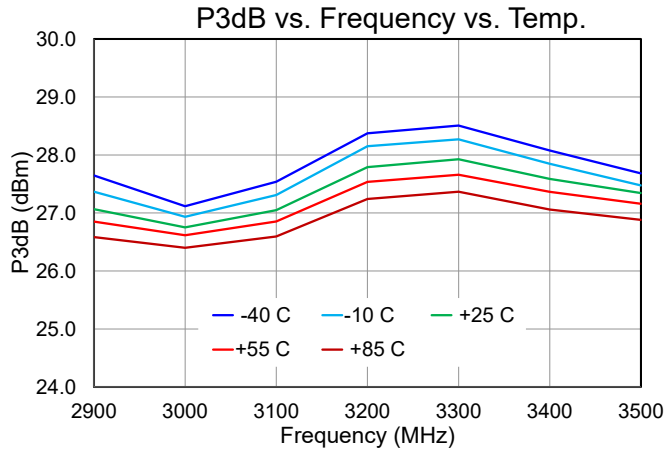
Performance Plots - Small Signal (S Band)

Test Conditions unless otherwise stated: Min. Atten. State, $V_{CC1} = 5V$, $I_{CQ1} = 68mA$, $V_{CC2} = 5V$, $I_{CQ2} = 93mA$, $V_{CC2B} = 5V$, $I_{CQ2B} = 31mA$, 25 °C

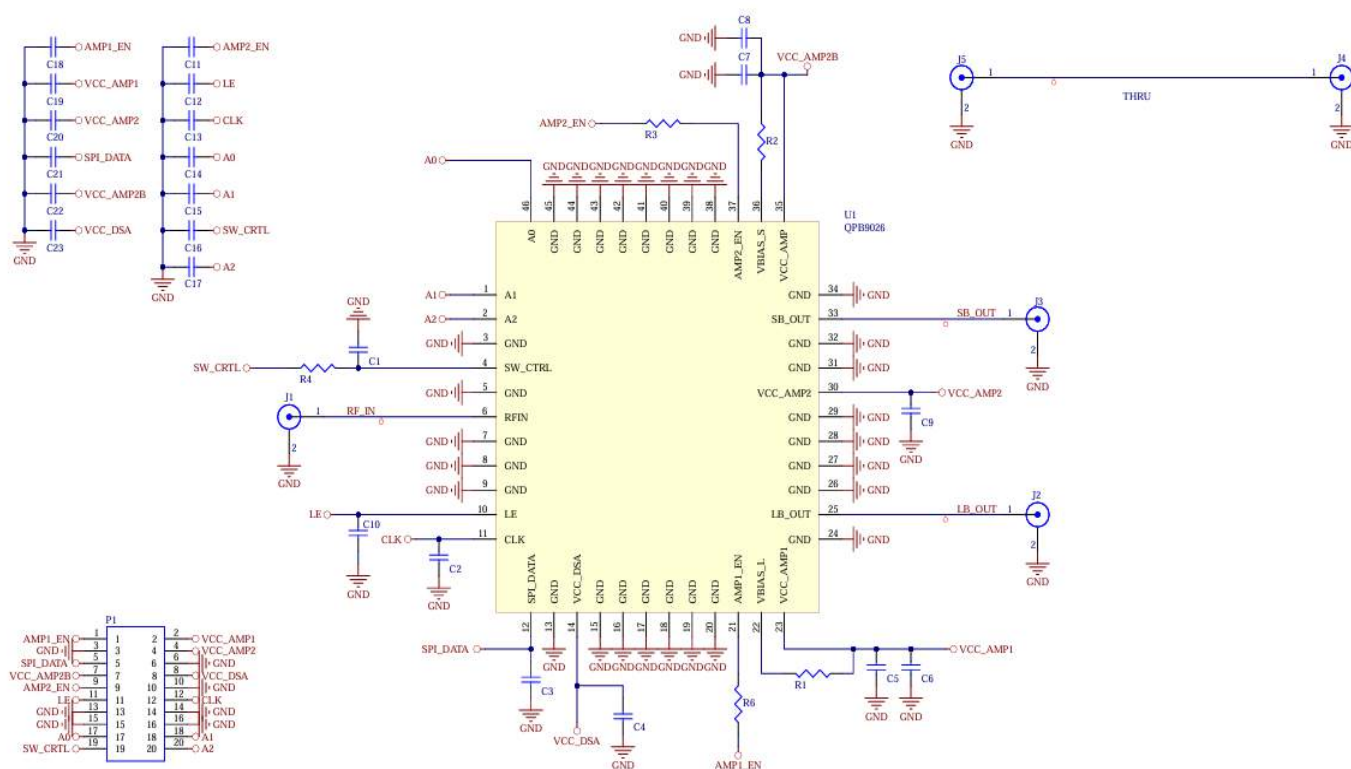


Performance Plots – Large Signal & NF (S Band)

Test Conditions unless otherwise stated: Min. Atten. State, $V_{CC1} = 5V$, $I_{CQ1} = 68mA$, $V_{CC2} = 5V$, $I_{CQ2} = 93mA$, $V_{CC2B} = 5V$, $I_{CQ2B} = 31mA$, $25^{\circ}C$



Application Circuit



Power ON Sequence

1. Set limits to $I_{CC1} = 100\text{mA}$, $I_{CC2} = 150\text{mA}$, $I_{CC2B} = 350\text{mA}$, $I_{DSA} = 1\text{mA}$
2. Apply V_{CC1} , V_{CC2} , V_{CC2B} , V_{DSA} to 5V.
3. Apply RF

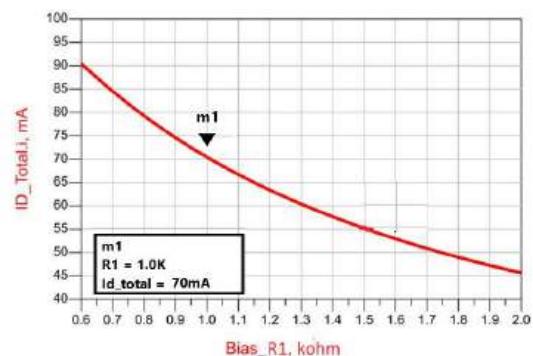
Power OFF Sequence

1. Turn off RF
2. Turn off V_{DSA} , V_{CC2B} , V_{CC2} , V_{CC1}

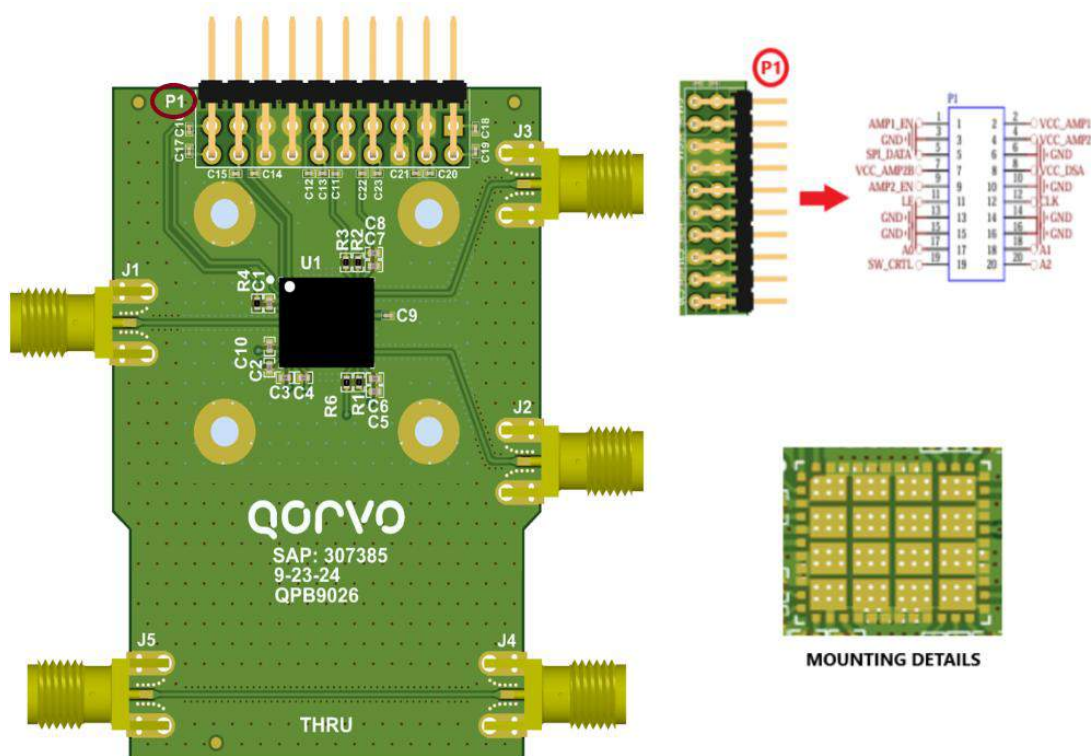
Switch Control Logic Truth Table

Logic “0” and Logic “1” levels refer to Nominal Operating Conditions Table

Operation Modes	SW_CTRL	AMP1_EN	AMP2_EN	Comments
LB	0	1	X	RFC to LB_OUT
SB	1	X	1	RFC to SB_OUT
LNA OFF	x	0	0	LNAs OFF



QPB9026 PCB Evaluation Board



Evaluation Board (EVB) PCB Information

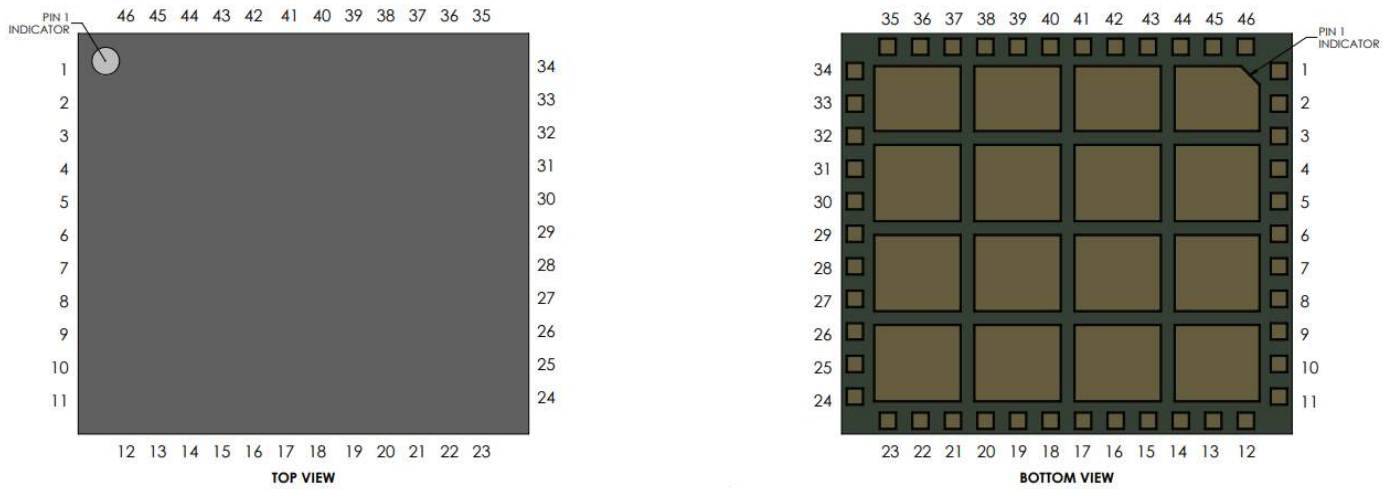
LAYER STACK LEGEND

Material	Layer	Thickness	Dielectric Material	Type	Note
Surface Material	Top Overlay	0.0008in	Solder Resist	Legend	HIGH TEMPERATURE, NON-CONDUCTIVE, WHITE EPOXY BASED INK.
Copper	Top Layer	0.0007in		Solder Mask	LPI (LIQUID PHOTO-IMAGEABLE), OR LDI (LASER DIRECT IMAGEABLE), GREEN. MAX FINISH THICKNESS TO BE 0.001in.
Prepreg		0.0065in	Rogers 4350B	Signal	FINISH THICKNESS = 0.25oz COPPER CLADDING + SURFACE PLATING/VIA PLATING/FINISH
Copper	Layer 2	0.0007in		Dielectric	
Copper		0.0450in	FR4	Signal	
Prepreg	Layer 3	0.0007in		Dielectric	
Copper		0.0060in	FR4	Signal	
Copper	Bottom Layer	0.0007in		Signal	FINISH THICKNESS = 0.25oz COPPER CLADDING + SURFACE PLATING/VIA PLATING/FINISH
Surface Material	Bottom Solder	0.0008in	Solder Resist	Solder Mask	LPI (LIQUID PHOTO-IMAGEABLE), OR LDI (LASER DIRECT IMAGEABLE), GREEN. MAX FINISH THICKNESS TO BE 0.001in.
Total thickness: 0.0620in					

Recommended EVB Bill of Materials – QPB9026

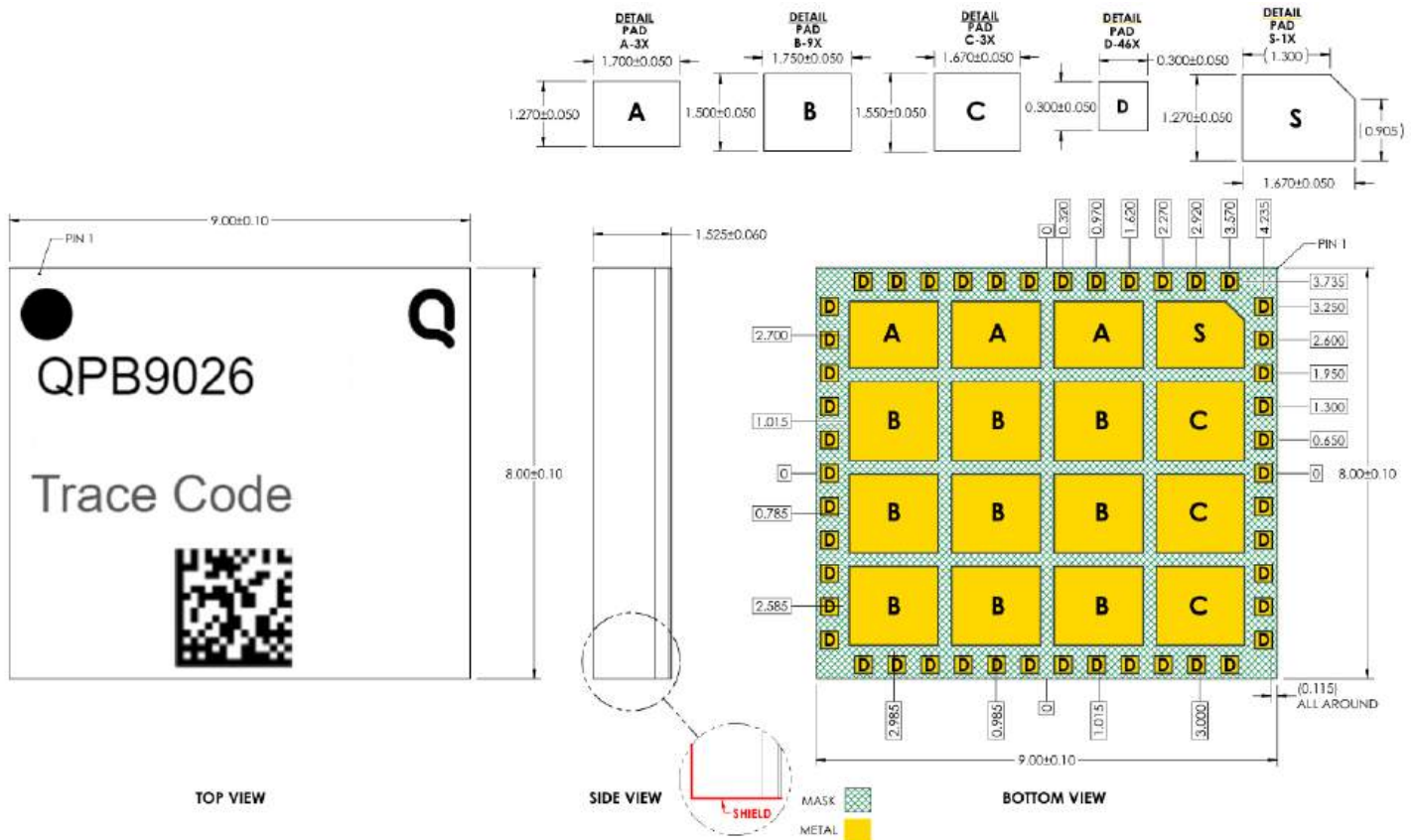
Reference Des.	Value	Description	Manuf.	Part Number
C1-C5, C7, C10	100 pF	CAP, 5%, 50V, COG, 0402	Various	-
C9	100 pF	CAP, 5%, 25V, COG, 0201	Various	-
C6, C8	1 μF	CAP, 10%, 10V, X7S, 0402	Various	-
R1	1.0 KΩ	RES, ROHS, 0402	Various	-
R2	1.2 KΩ	RES, 5%, 1/16W, 0402, Leed Free	Various	-
R3, R4, R6	0 Ω	RES, JUMPER, 1/10W, 0402	Various	-
C11-C23	-	NOT POPULATED	Various	-

Pin Configuration and Descriptions



Pin Number	Label	Description
1	A1	External Address Input A1
2	A2	External Address Input A2
3, 5, 7-9, 13, 15-20, 24, 26-29, 31-32, 34, 38-45	GND	Ground
4	SW_CTRL	Switch Control
6	RF IN	RF Input, DC Coupled
10	LE	SPI Enable
11	CLK	SPI Clock
12	SPI_DATA	SPI Data
14	VCC_DSA	Power Supply for DSA
21	AMP1_EN	Amplifier 1 Enable
22	VBIAS_L	Bias Voltage
23	VCC_AMP1	Power Supply for Amplifier 1
25	LB_OUT	Low Band RF Output, DC Coupled
30	VCC_AMP2A	Power Supply for Amplifier 2
33	SB_OUT	S Band RF Output, DC Coupled
35	VCC_AMP2B	Power Supply for Amplifier 2
36	VBIAS_S	Bias Voltage
37	AMP2_EN	Amplifier 2 Enable
46	A0	External Address Input A0
47	GND	Ground Pad

Package Marking and Dimensions

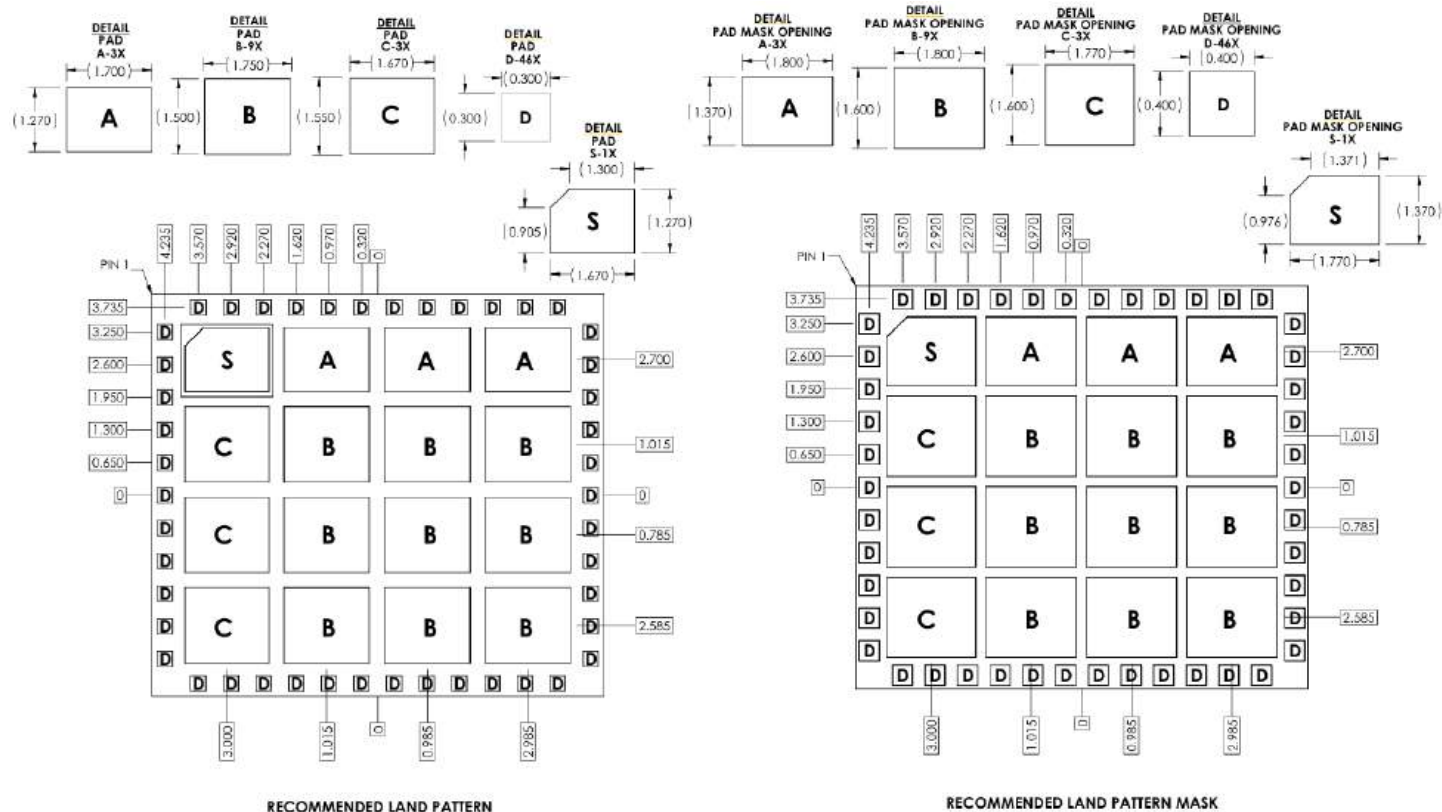


NOTES: UNLESS OTHERWISE SPECIFIED:
Units: millimeters

- MATERIAL:
PACKAGE BASE: LAMINATE
PACKAGE TYPE: MOLD ENCAPSULATED LAMINATE
- PACKAGE EXPOSED METALLIZATION IS GOLD PLATED
- PART MARKING:
9026: PART NUMBER
TRACE CODE TO BE ASSIGNED BY SUBCON
- ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.

PCB Mounting Pattern

WARNING! - CONDUCTIVE SHIELDED COMPONENT.
LAND PATTERN AND PATTERN MASK MUST FOLLOW RECOMMENDATIONS TO AVOID POSSIBLE SHORTS DURING ASSEMBLY



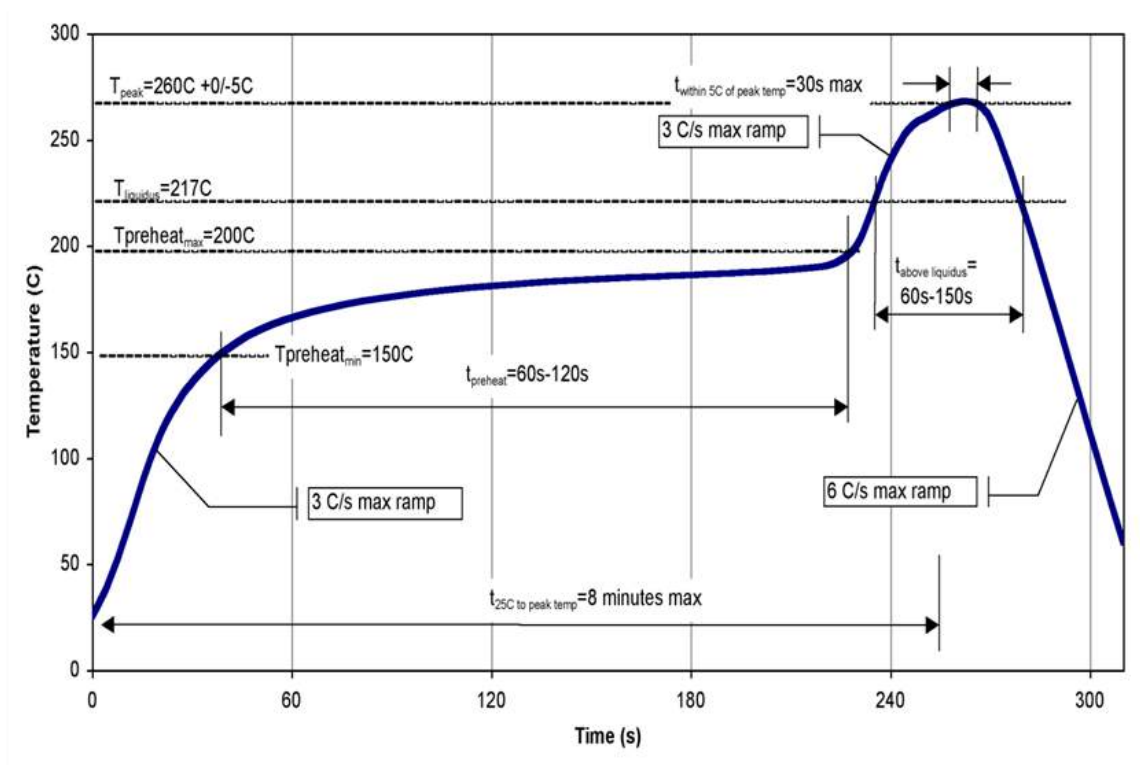
Notes:

1. All dimensions are in millimeters.
2. This drawing specifies the mounting pattern used on the Qorvo evaluation board for this product. Some modification may be necessary to suit end user assembly materials and processes.

Assembly Notes

1. Compatible with lead-free soldering processes with 260°C peak reflow temperature.
2. Contact plating: Thin NiENEPIG

Recommended Soldering Temperature Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1C	ESDA / JEDEC JS-001-2017
ESD – Charged Device Model (CDM)	Class C3	ESDA / JEDEC JS-002-2014
MSL – Convection Reflow 260 °C	Level 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:

- 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:

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Web: www.qorvo.com

Email: customer.support@qorvo.com

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