QPB9348

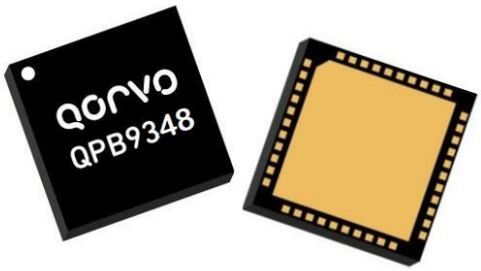
Dual-Channel Switch LNA Module

Product Overview

The QPB9348 is a highly integrated front-end module targeted for TDD base stations. The LNA switch module integrates a two-stage LNA and a high-power switch in a dual channel configuration. Power down capability for the LNAs can be controlled with shut-down pins on the module.

The QPB9348 can be operated across the 1.7 – 4.2 GHz range. It provides 1.2 dB noise figure at 3.5GHz for operation in the receive mode and 0.5 dB insertion loss in the transmit mode. The LNAs utilize Qorvo's high performance E-pHEMT process while the SOI based switch supports input RF power signals of up to 10W average power assuming 9 dB PAR.

The QPB9348 is packaged in a RoHS-compliant, compact 6 x 6 mm surface-mount leadless package. The switch LNA module is targeted for wireless infrastructure applications configured for TDD-based MIMO architectures.

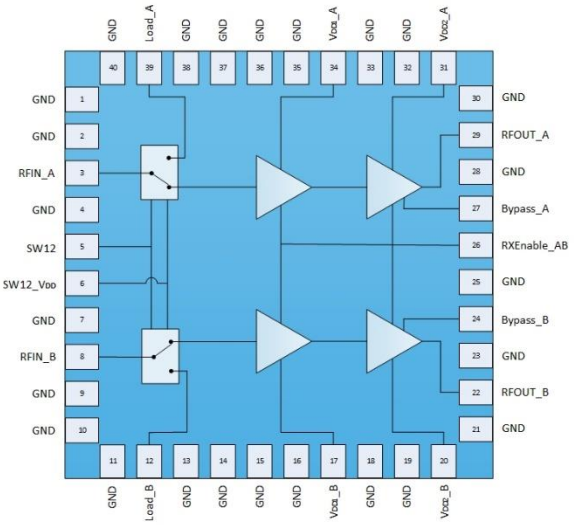


40 Pin 6 x 6 mm Leadless SMT Package

Key Features

- 1.7 – 4.2 GHz Frequency Range
- Dual Channel
- Second LNA has bypass mode
- 10 W average power handling (Tx mode)
- 35 dB Gain (Rx mode, High Gain state)
- 15 dB Gain (Rx mode, Low Gain state)
- +34 dBm OIP3 (Rx mode, High Gain state)
- +28 dBm OIP3 (Rx mode, Low Gain state)
- 1.2 dB Noise Figure (Rx mode)
- 0.5 dB Insertion Loss (Tx mode)
- Compact package size, 6 x 6 mm

Functional Block Diagram



Top View

Applications

- 5G m-MIMO
- Wireless Infrastructure
- Small cell BTS
- TDD-based architectures

Ordering Information

Part No.	Description
QPB9348TR13	2500 pcs on 13" reel (standard)
QPB9348EVB05	Evaluation Board

Absolute Maximum Ratings

Parameter	Rating
Storage Temperature	-65 to +150°C
Supply Voltage (All V_{DD})	+6 V
Switch Control Voltage (SW12)	-0.3V to +5.8 V
Input Power, RX Mode (Avg, 8dB PAR, 100% DC, T_C 105°C)	+25 dBm
Input Power, TX Mode, > 10 yrs. (Avg, 8dB PAR, 8.8ms frame max 88% DC, T_C 105°C)	+40.0 dBm
Input Power, TX Mode, < 30 min. (Avg, 8dB PAR, 8.8ms frame max 88% DC, T_C 105°C)	+41.7 dBm
Input Power, TX Mode, ≤10 sec. (Avg, 8dB PAR, 8.8ms frame max 88% DC, T_C 105°C)	+43.0 dBm

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage instantly to the device. Extended application beyond recommended operating conditions towards Absolute Maximum Ratings the reliability of device will be reduced.

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
LNA Supply Voltage (V_{DD})	+4.75	+5	+5.25	V
Control Logic High Voltage	+1.17	+1.8	V_{DD}+0.3	V
Control Logic Low Voltage	0		0.63	V
T_{CASE}	−40		+105	°C
Tj (Tx path), >10^6 hours MTTF			+125	°C
Tj (Rx path), >10^6 hours MTTF			+190	°C

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

Electrical Specifications

Parameter	Conditions (1)	Min	Typ	Max	Units
Operational Frequency Range		1700		4200	MHz
Test Frequency			3500		MHz
Gain	Rx mode, High gain state		35		dB
	Rx mode, Low gain state		15		dB
Gain Flatness	Rx mode, Any 100 MHz in 2.3-3.8GHz, High gain state		0.4		dB
	Rx mode, Any 100 MHz in 2.3-3.8GHz, Low gain state		0.3		dB
Input Return Loss	Rx mode		-10		dB
Output Return Loss	Rx mode		-10		dB
Noise Figure	Rx mode		1.2		dB
Output IP3	Rx mode, High gain state Pout = +2 dBm/tone, Δf = 1 MHz		+34		dBm
	Rx mode, Low gain state Pout = +2 dBm/tone, Δf = 1 MHz		+28		dBm
OP1dB	Rx mode, High gain state		+20		dBm
	Rx mode, Low gain state		+15		dBm
Switch Insertion Loss	Tx mode		0.5		dB

Notes:

1. Test conditions unless otherwise noted: V_{DD} = +5.0 V, Temp = +25 °C, 50 Ω system.

Electrical Specifications (Continue)

Parameter	Conditions [1]	Min	Typ	Max	Units
Switch Isolation	ANT to TX in RX mode		25		dB
	ANT to RX in TX mode		60		dB
Channel Isolation	Rx mode		40		dB
	Tx mode		40		dB
LNA Current	Rx mode, High gain state, per channel		100		mA
	Rx mode, Low gain state, per channel		50		mA
Switch Current	Tx mode, RXENABLE_AB Low (LNA Off)		5		mA
Logic Control Current	0V or +1.8V, Source or sink		±150		µA
Switching Time	Switch between Rx mode and Tx mode, Ton/Toff (50% ctrl to 1/99% RF)		500		nsec
	Between high gain state and low gain state		150		nsec
Thermal Resistance, θ_{jc}	Tx Mode, 15W RFIN applied to one channel		8.6		°C/W
	Rx Mode		20.9		°C/W

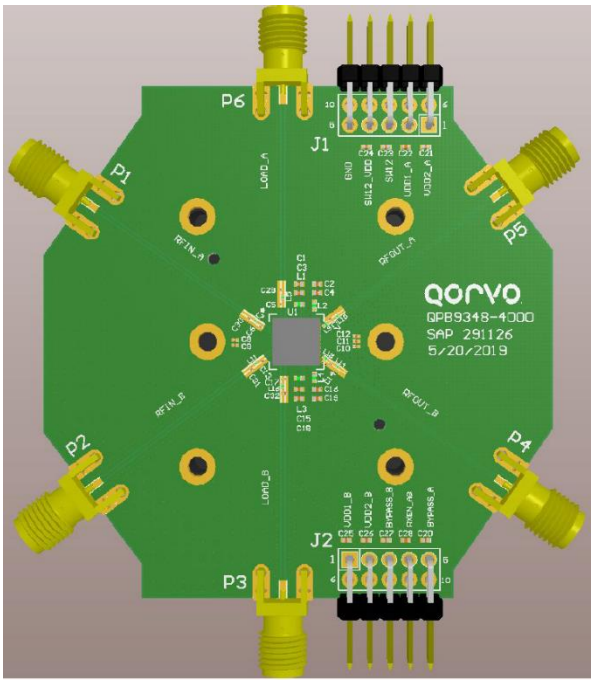
Notes:
1. Test conditions unless otherwise noted: V_{DD} = +5.0 V, Temp = +25 °C, 50 Ω system.

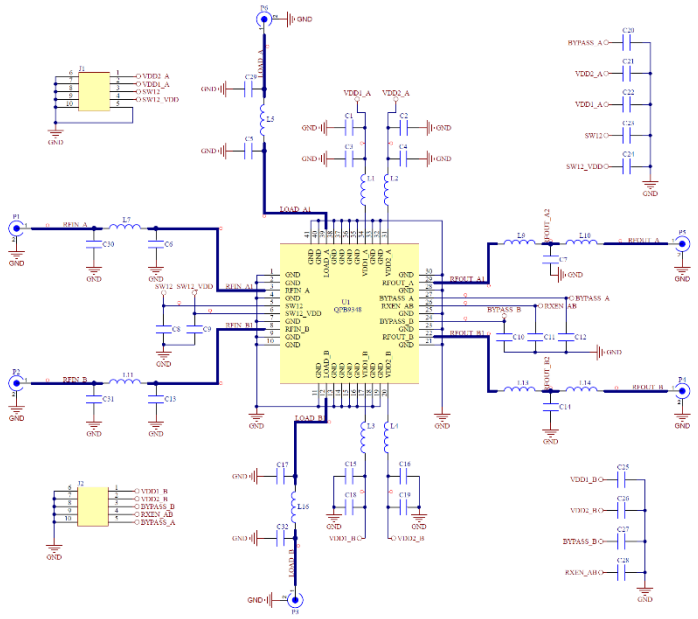
Control Logic Truth Table

Parameter, V_{PD}	SW12[1]	RXEnable_AB[1]	Bypass_A/B
RX Mode, LNA Normal (High Gain)	0	0	0
RX Mode, LNA Bypass (Low Gain)	0	0	1
TX Mode, LNA Disable	1	1	Don't care

Note:
1. Synchronize SW12 and RXEnable-AB for better performance and smooth transitions

Evaluation Board





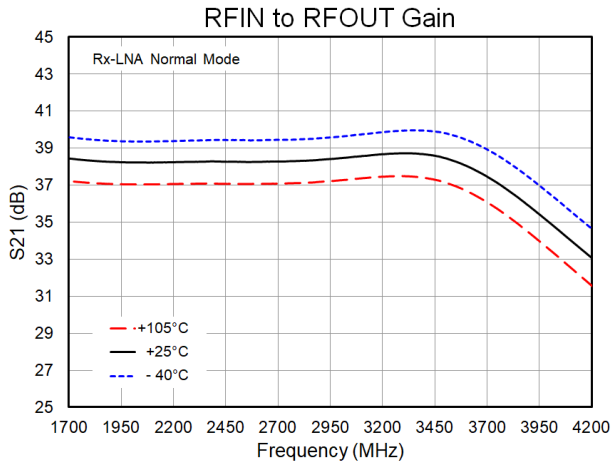
Notes:
1. See Evaluation Board PCB Information for material and stack up

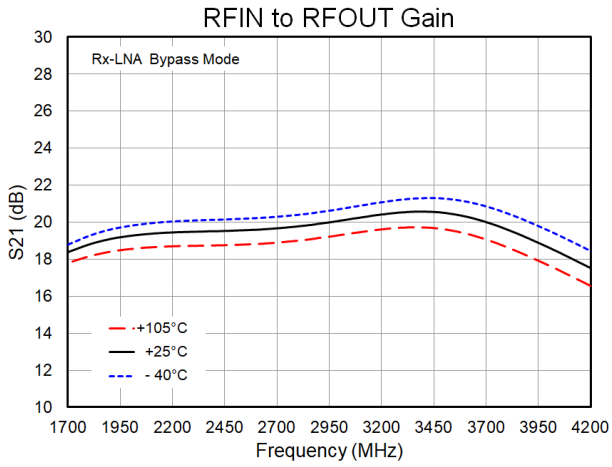
Bill of Materials

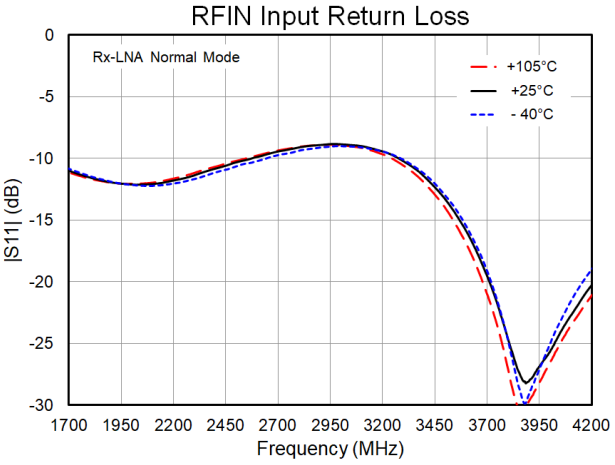
Reference Des.	Value	Description	Manuf.	Part Number
U1	-	MOD, 1.7-4.2 Dual channel Switch LNA	Qorvo	
PCB1	-	PCB, QPB9348	Qorvo	291126
C1, C2, C18, C19, C21, C22, C24-C26	1 µF	CAP, 1 µF, 10%, 6.3V, X7R, 0402	Murata	GRM155R70J105KA12D
C3, C4, C15, C16	100 pF	CAP, 100 pF, 5%, 50V, COG, 0402	TAIYO	RM UMK105 CG101JV-F
C8, C10, C11, C12	100 pF	CAP, 100pF, ±5%, 25V, C0G, 0201	Murata	GRM0335C1E101JA01D
C9, L10, L14	0.1 µF	CAP, 0.1 µF, 10%, 10V, X7R, 0201	Murata	GRM033Z71A104KE14D
C20, C27	1000 pF	CAP, 1000 pF, X7R, 0402	Johanson	500R07W102KV4T
C23	10 pF	CAP, 10 pF, 5%, 50V, Hi-Q, 0402	Murata	GJM1555C1H100JB01D
C28	4700 pF	CAP, 4700 pF, 10%, 100V, X7S, 0402	TDK	C1005X7S2A472K
J1, J2	-	CONN, HDR RT-ANG, 2x5, 0.100”	SAMTEC	TSW-105-08-L-D-RA
L1, L3	18 nH	IND, 18 nH, 2%, W/W, 0402	Murata	LQW15AN18NG00D
L2, L4	3.9 nH	IND, 3.9 nH, ±0.1 nH, 0.17A, 0402	Murata	LQP15MN3N9B02D
L5, L7, L9, L11, L13, L16	0 Ω	RES, Jumper, 0, 0201	Kamaya	RMC1/20JPPA15
P1-P6	SMA	CONN, SMA, EL FLT	various	-

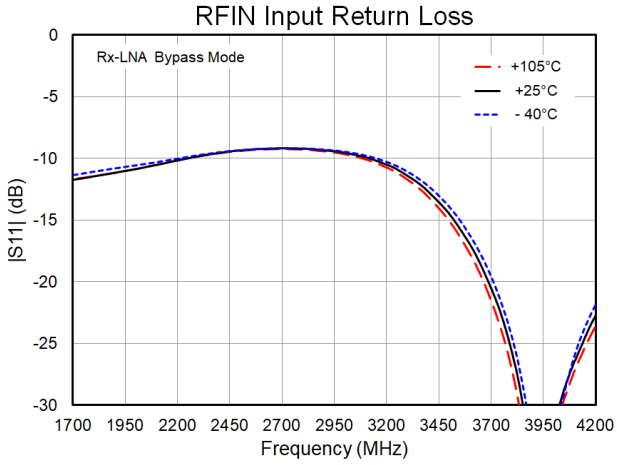
Performance Plots – QPB9348EVB05

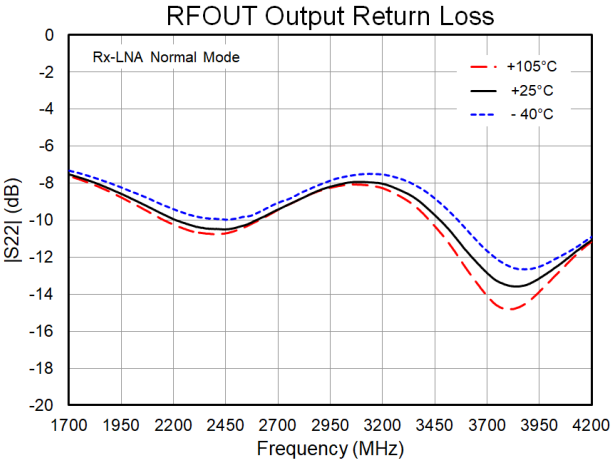
Test conditions unless otherwise noted: V_{DD} on EVB = +5.0 V, Temp.=+25 °C

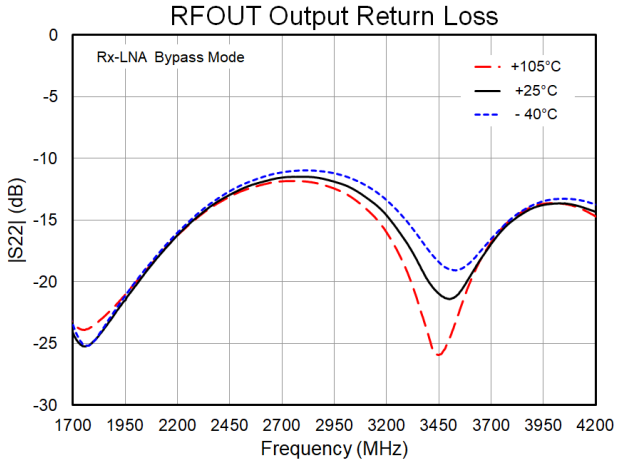












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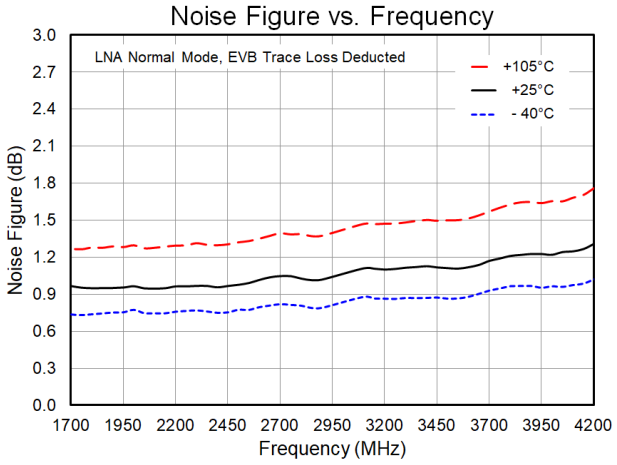
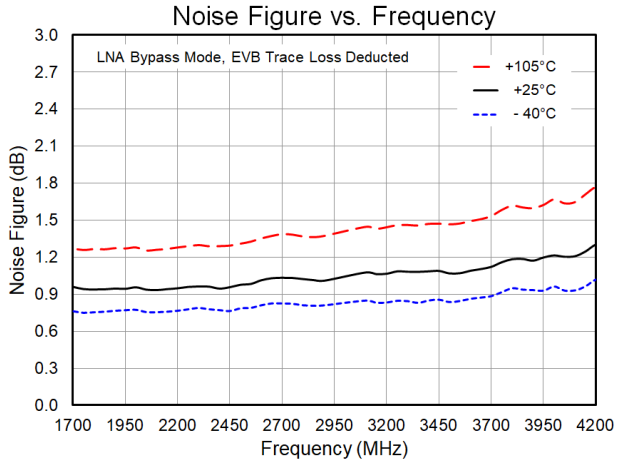
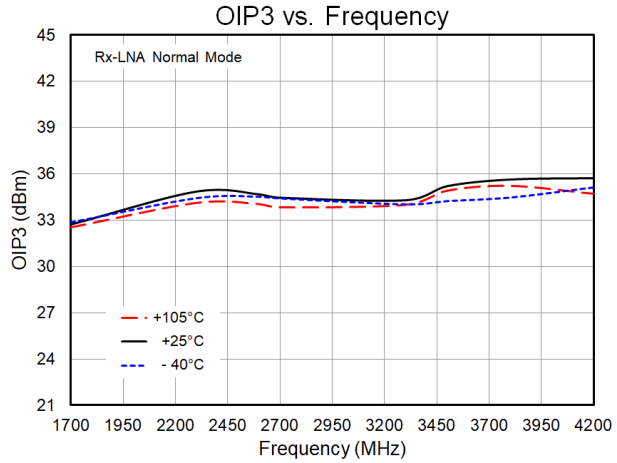
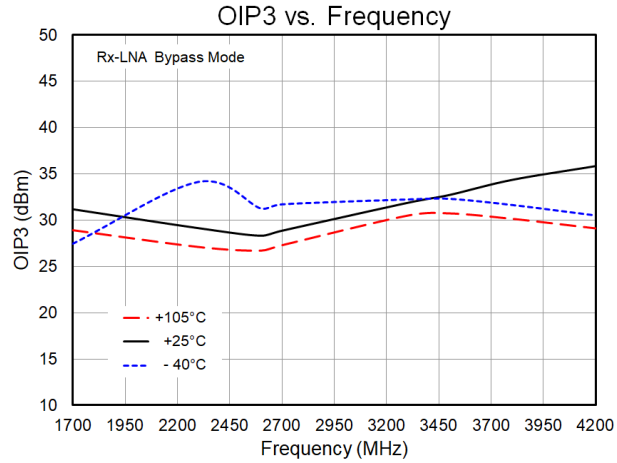
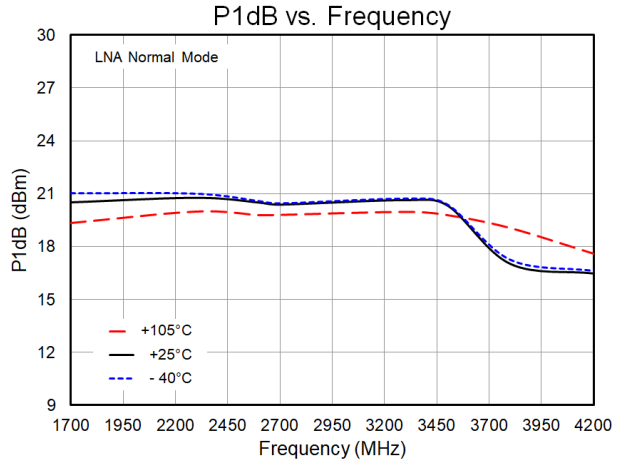
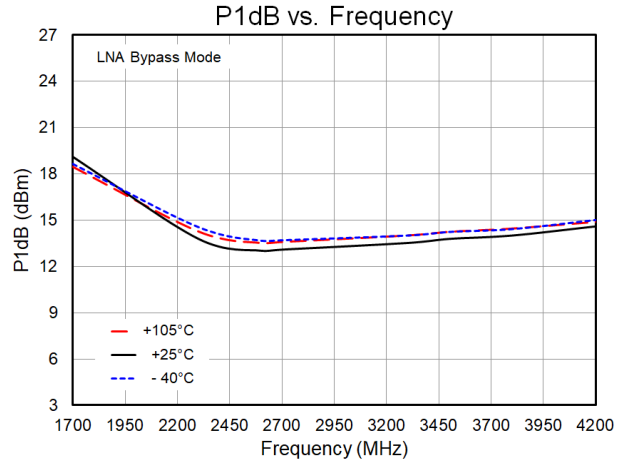








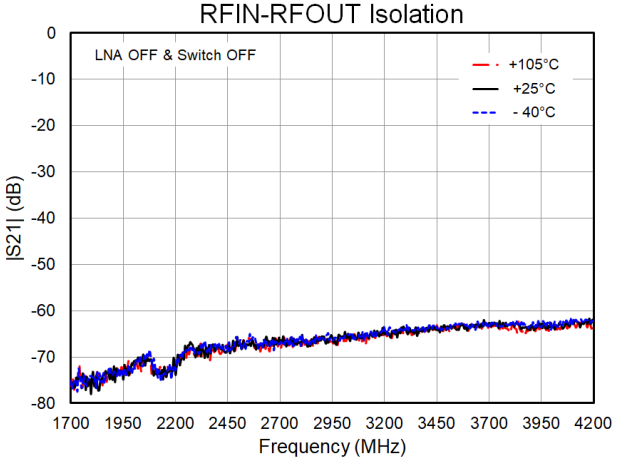




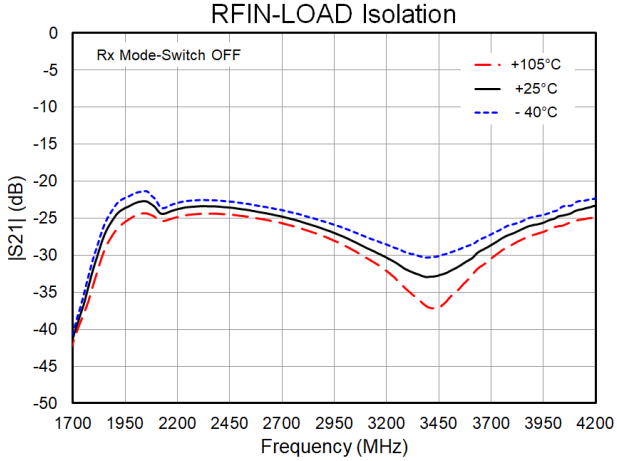
Performance Plots – QPB9348EVB05

Test conditions unless otherwise noted: V_{DD} on EVB = +5.0 V, Temp.=+25 °C

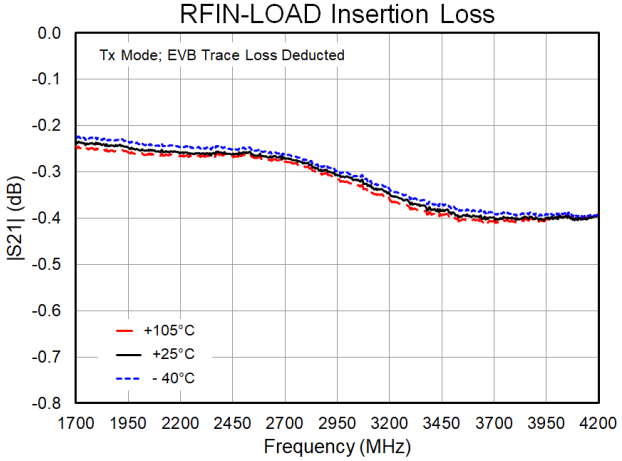
RFIN-RFOUT Isolation



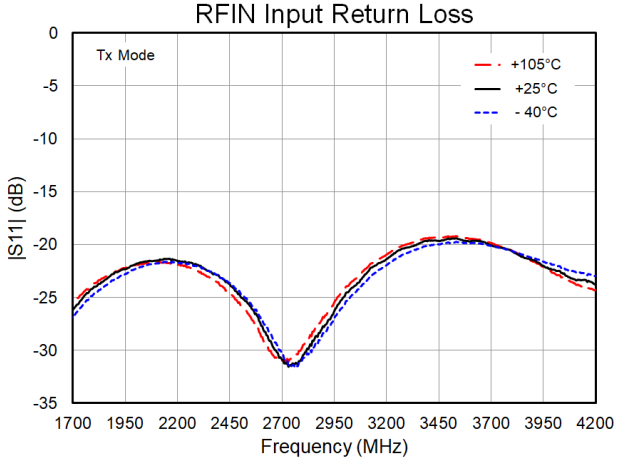
RFIN-LOAD Isolation



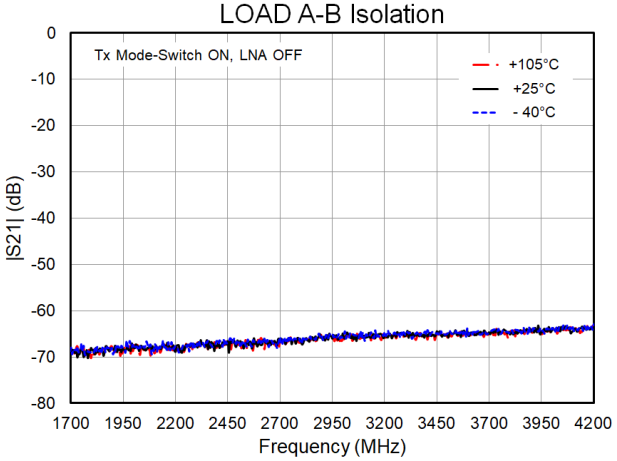
RFIN-LOAD Insertion Loss



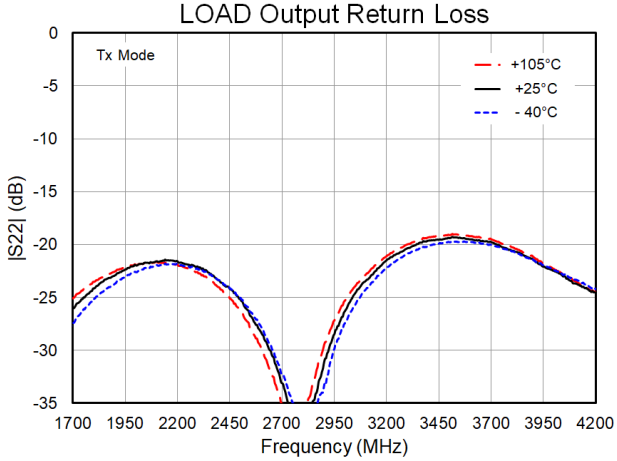
RFIN Input Return Loss



LOAD A-B Isolation



LOAD Output Return Loss



Performance Plots – QPB9348EVB05

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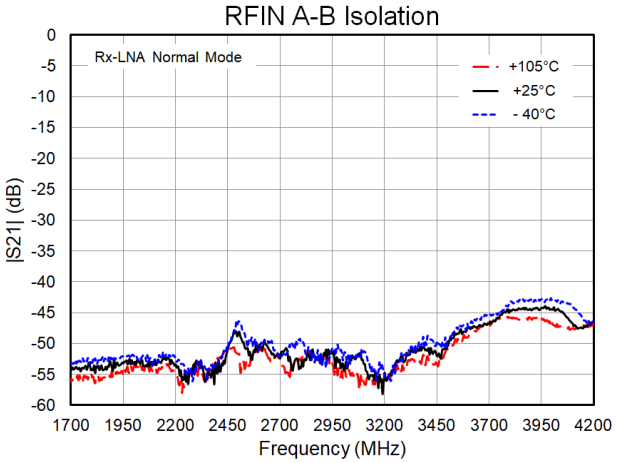
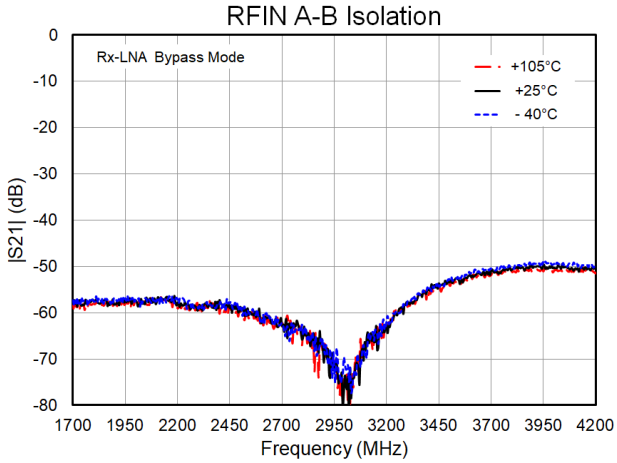
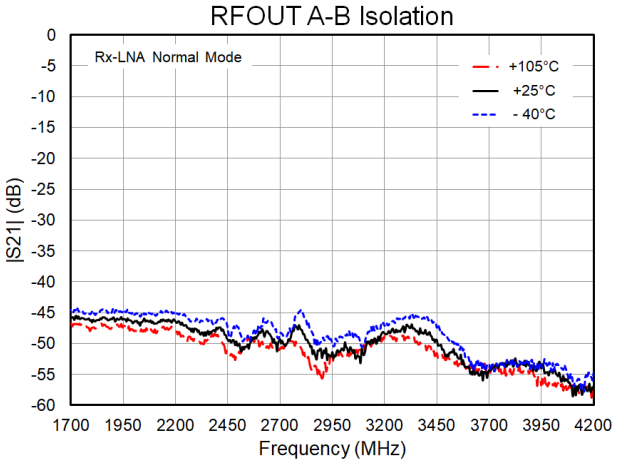
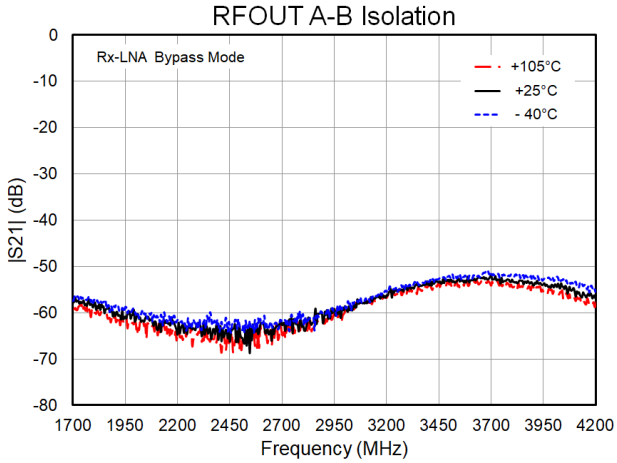
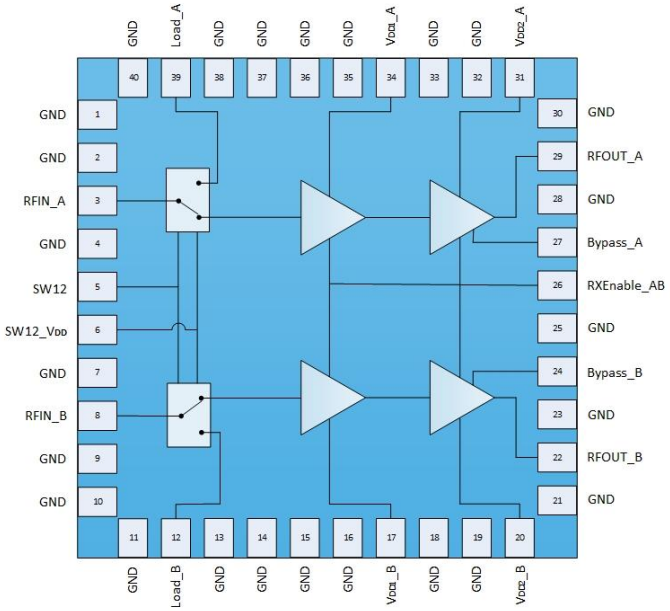








Pad Configuration and Description

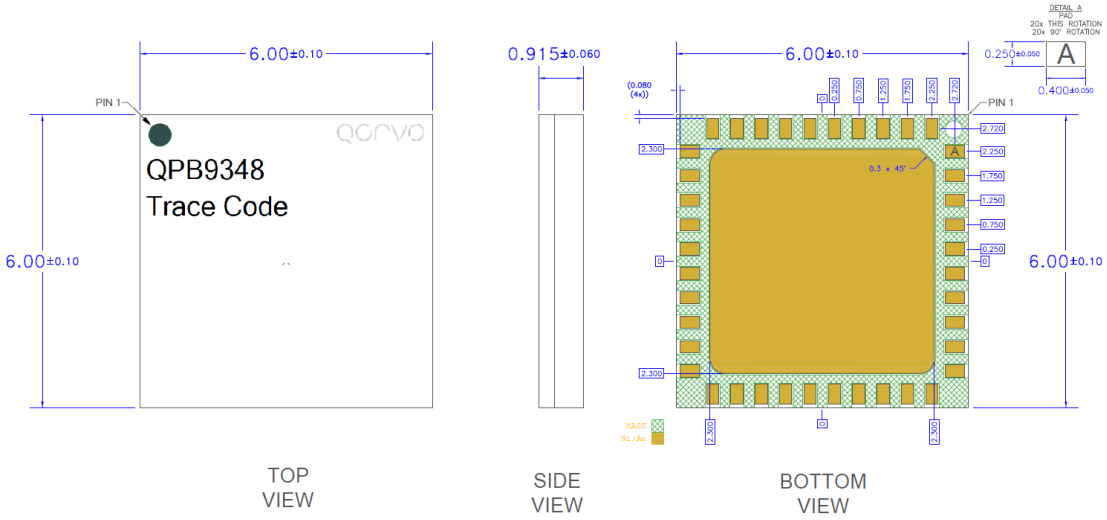


Top View

Pad No.	Label	Description
1, 2, 4, 7, 9, 10, 11, 13, 14, 15, 16, 18, 19, 21, 23, 25, 28, 30, 32, 33, 35, 36, 37, 38, 40	GND	Ground connection, can be left no connection or connect to ground externally
3	RFIN_A	RF Input, Antenna port of switch, Channel A
5	SW12	Control input, Switching path to Rx or Tx, both channel A & B
6	SW12_V_{DD}	DC supply voltage input, Tx-Rx switches, both channel A & B
8	RFIN_B	RF Input, Antenna port of switch, Channel B
12	Load_B	RF output, Tx termination, Channel B
17	V_{DD1}_B	DC supply voltage input, First stage LNA, Channel B
20	V_{DD2}_B	DC supply voltage input, Second stage LNA, Channel B
22	RFOUT_B	RF output, Rx, Channel B
24	Bypass_B	Control input, Second LNA bypass, Channel B
26	RXEnable_AB	Control input, LNA shutdown, both Channel A & B
27	Bypass_A	Control input, Second LNA bypass, Channel A
29	RFOUT_A	RF output, Rx, Channel A
31	V_{DD2}_A	DC supply voltage input, Second stage LNA, Channel A
34	V_{DD1}_A	DC supply voltage input, First stage LNA, Channel A
39	Load_A	RF output, Tx termination, Channel A
Backside Pad	GND	Ground connection. The back side of the package should be connected to the ground plane. PCB via holes under the device are recommended.

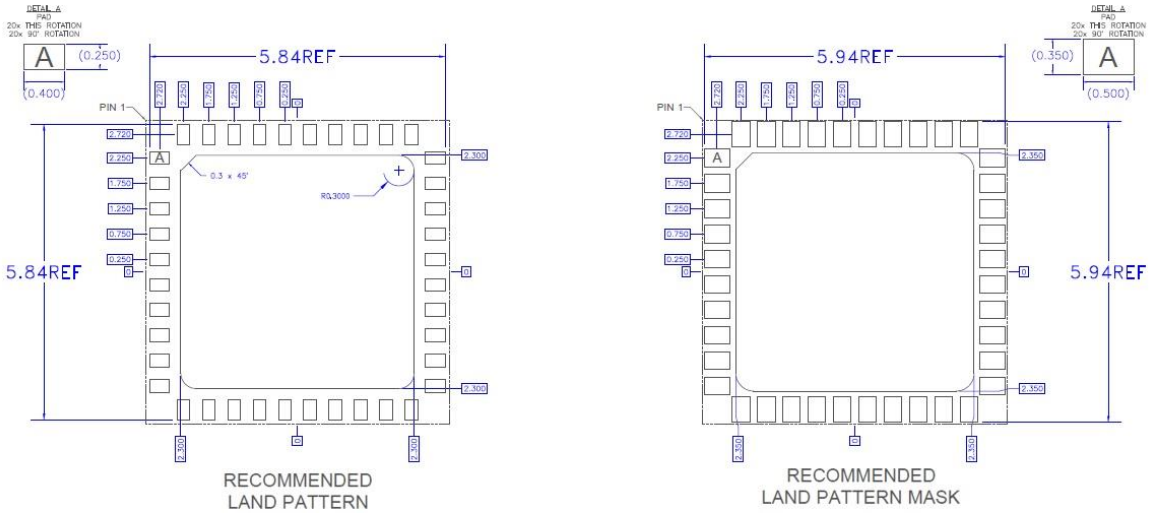
Package Marking and Dimensions

Marking: Pin 1 Indicator and Qorvo Logo
Part Number – QPB9348
Trace Code – Assigned by sub-contractor



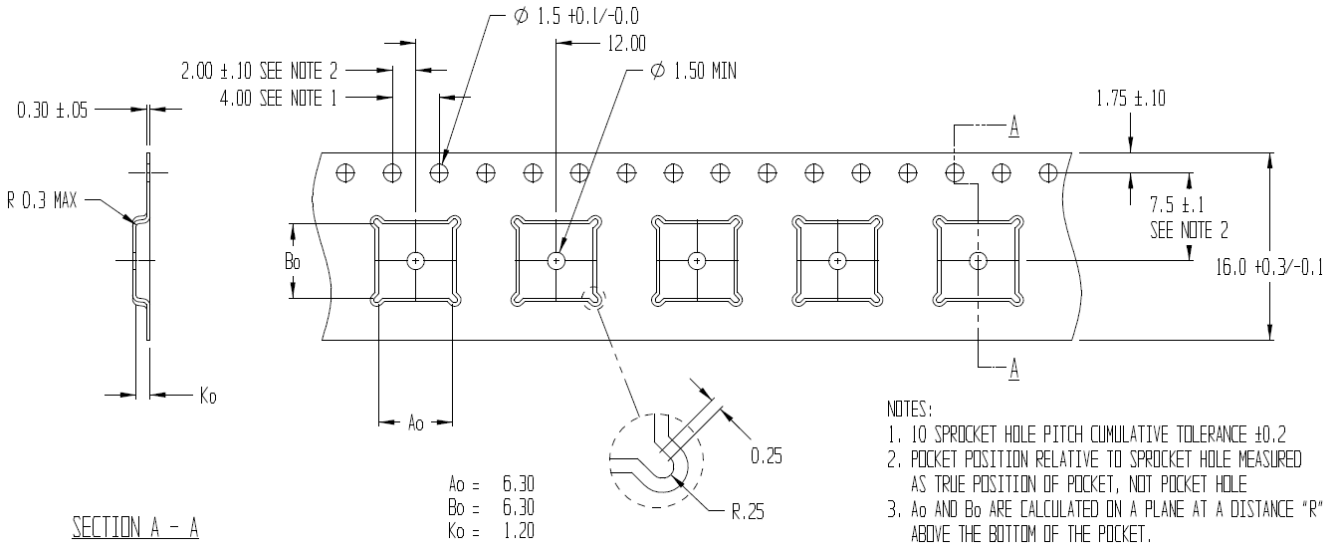
Notes:
1. All dimensions are in millimeters. Angles are in degrees.
2. The terminal #1 identifier and terminal numbering conform to SPE-000677.
3. Contact plating: ENEPIG

Recommended PCB Layout Pattern

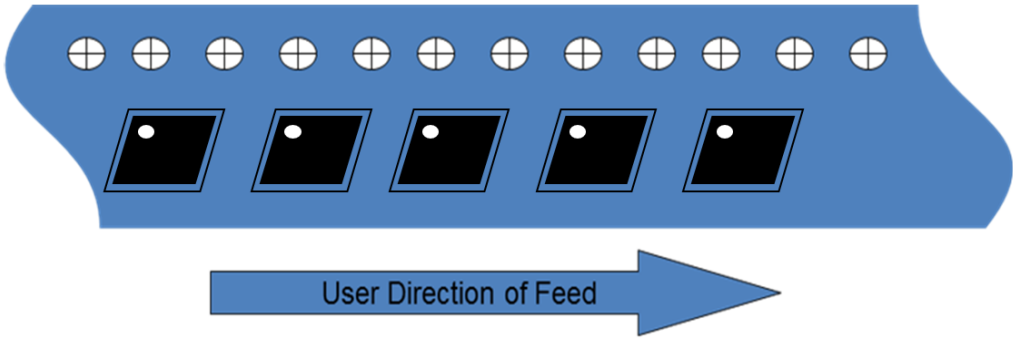


Notes:
1. All dimensions are in millimeters. Angles are in degrees.
2. Use 1 oz. copper minimum for top and bottom layer metal.
3. Via holes are required under the backside paddle of this device for proper RF/DC grounding and thermal dissipation. We recommend a 0.35mm (#80/.0135") diameter bit for drilling via holes and a final plated thru diameter of 0.25 mm (0.01").
4. Ensure good package backside paddle solder attach for reliable operation and best electrical performance.

Tape and Reel Information – Carrier and Cover Tape Dimensions

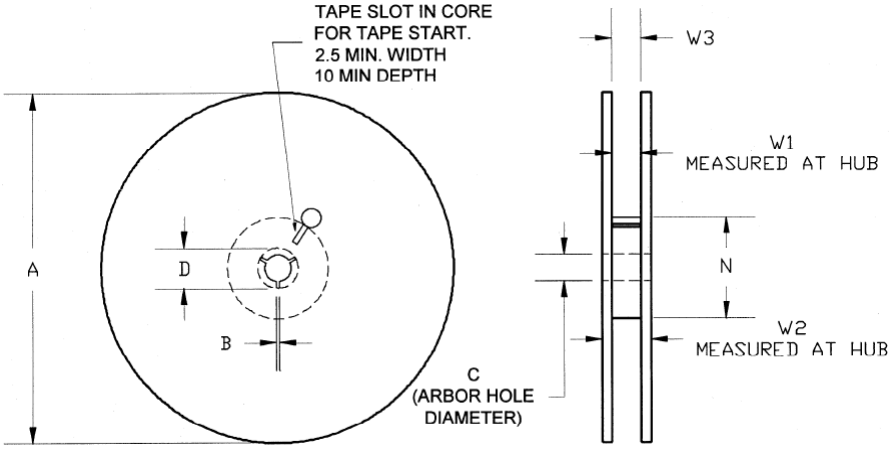


Feature	Measure	Symbol	Size (in)	Size (mm)
Cavity	Length	A0	0.248	6.30
	Width	B0	0.248	6.30
	Depth	K0	0.047	1.20
	Pitch	P1	0.472	12.00
Centerline Distance	Cavity to Perforation - Length Direction	P2	0.079	2.00
	Cavity to Perforation - Width Direction	F	0.295	7.50
Cover Tape	Width	C	0.524	13.30
Carrier Tape	Width	W	0.630	16.00



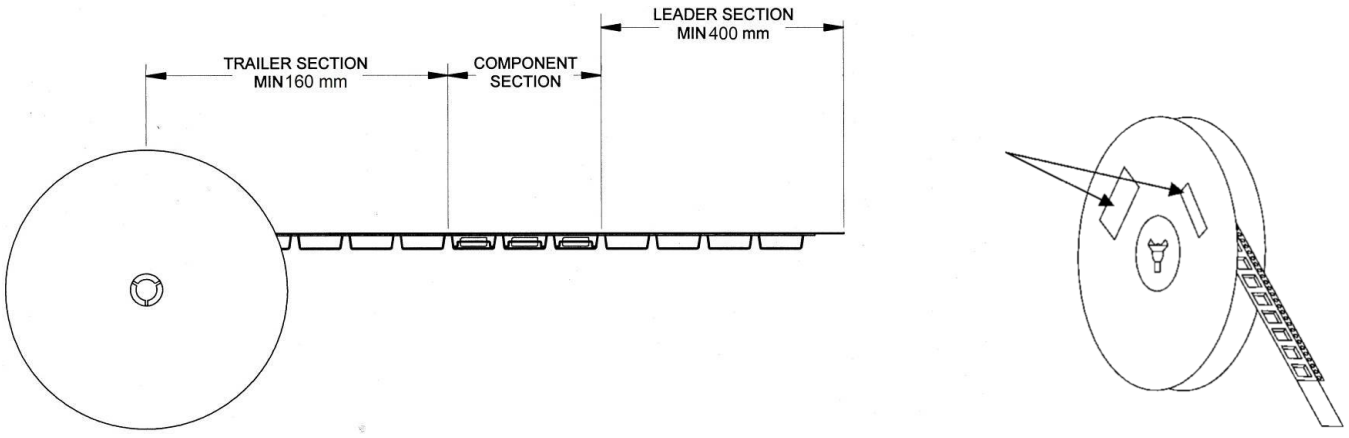
Tape and Reel Information – Reel Dimensions

Standard T/R size = 2,500 pieces on a 13” reel.



Feature	Measure	Symbol	Size (in)	Size (mm)
Flange	Diameter	A	12.992	330.0
	Thickness	W2	0.874	22.2
	Space Between Flange	W1	0.661	16.8
Hub	Outer Diameter	N	4.016	102.0
	Arbor Hole Diameter	C	0.512	13.0
	Key Slit Width	B	0.079	2.0
	Key Slit Diameter	D	0.787	20.0

Tape and Reel Information – Tape Length and Label Placement



Notes:
1. Empty part cavities at the trailing and leading ends are sealed with cover tape. See EIA 481-1-A.
2. Labels are placed on the flange opposite the sprockets in the carrier tape.

Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1C	ESDA / JEDEC JS-001-2017
ESD – Charged Device Model (CDM)	Class C3	JEDEC JESD22-C101F
MSL – Moisture Sensitivity Level	Level 3	IPC/JEDEC J-STD-020E

Caution!
ESD-Sensitive Device

Solderability

Compatible with both lead-free (260°C max. reflow temperature) and tin/lead (245°C max. reflow temperature) soldering processes. Solder profiles available upon request.

Contact plating: ENEPIG

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.

- Product uses RoHS Exemption 7c-I to meet RoHS Compliance requirements.
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_40_2$) 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

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

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