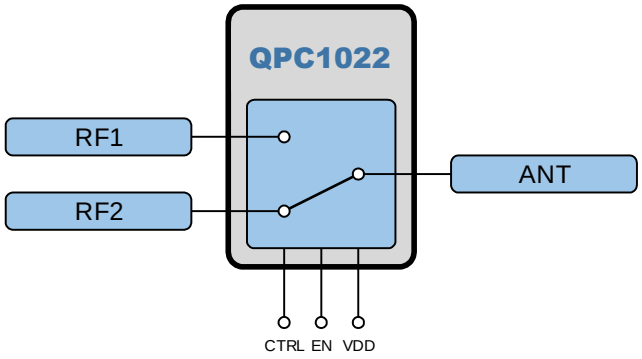
QPC1022

Broad Band Low Distortion SPDT Switch

General Description

The QPC1022 is a single pole dual-throw (SPDT) switch designed for switching applications requiring very low insertion loss and high power handling capability with minimal DC power consumption. The excellent linearity performance achieved by the QPC1022 makes it ideal for use in cellular base. This switch offers very high isolation between RF ports providing greater separation between transmit and receive paths. The QPC1022 is packaged in a very compact 1.1mm x 1.5mm x 0.375mm (typical) 9-Pin LGA package.

Functional Block Diagram



9 Pin 1.1 x 1.5 mm LGA Package

Product Features

- 5MHz to 6GHz Operation
- Low Insertion Loss: 0.25dB at 2GHz
- Harmonics:
  2fo of -106dBc at 1980MHz
  3fo of -94dBc at 1980MHz
- High Isolation:
  56dB at 204MHz
  39dB at 2GHz
- High IP3:
  76 dBm at 1.9GHz
- Compatible with Low Voltage Logic
  (VHIGH Minimum = 1.3V)
- No External DC Blocking Capacitors Required on RF Paths Unless DC is Applied Externally
- 1000V HBM ESD Rating on All Ports

Applications

- Cellular BTS
- Post PA Switching
- General Purpose Switching Applications

Ordering Information

Part No.	Description
QPC1022SB	Sample Bag with 5 pieces
QPC1022SR	Sample Reel with 100 pieces
QPC1022TR7	Standard 7” Reel with 2,500 pieces
QPC1022PCK401	Fully Assembled 50 Ohm Evaluation Board and Sample Bag with 5 pieces

Absolute Maximum Ratings

Parameter	Rating
Storage Temperature	−40 to +150 °C
Operating Temperature (Tcase)	-40 to 105 °C
Maximum Vdd	6.0 V
Maximum EN	3.0 V
Maximum CTRL	3.0 V
Max Input Power at 105 °C	33 dBm : 5MHz
	37 dBm : >20MHz

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
Device Voltage (V_{dd})	+2.4	+5	+5.8	V
T_{CASE}	−40		+105	°C
Tj			+125	°C
RF input Power 5MHz @ 85 °C			33	dBm
RF input power >20MHz @ 85 °C			37	dBm

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		5		6000	MHz
Insertion Loss RF1/RF2 to ANT	5.0MHz to 1.0GHz		0.2	0.4	dB
	1GHz to 2.0GHz		0.25	0.4	dB
	2.0GHz to 2.5GHz		0.26		dB
	2.5GHz to 3.5GHz		0.35		dB
	3.5GHz to 3.8GHz		0.38		dB
	3.8GHz to 6GHz		0.46		dB
Isolation RF1 to RF2	5.0MHz to 200MHz		56		dB
	200MHz to 1.0GHz	39	46		dB
	1.0GHz to 2.0GHz	32	39		dB
	2.0GHz to 2.5GHz		36		dB
	2.5GHz to 3.5GHz		34		dB
	3.5GHz to 3.8GHz		33		dB
	3.8GHz to 6GHz		29		dB
RF Port Return Loss (ANT, RF1, RF2)	5.0MHz to 1.0GHz		31		dB
	1GHz to 2.0GHz		23		dB
	2.0GHz to 2.5GHz		22		dB
	2.5GHz to 3.5GHz		18		dB
	3.5GHz to 3.8GHz		17.5		dB
	3.8GHz to 6GHz		14.5		dB
Harmonics 2fo	RFin = 35dBm, 915MHz		-109		dBc
	RFin = 33dBm, 1980MHz		-106	-80	dBc
Harmonics 3fo	RFin = 35dBm, 915MHz		-98		dBc
	RFin = 33dBm, 1980MHz		-94	-80	dBc

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

Electrical Specifications

Parameter	Conditions[1]	Min	Typ	Max	Units
OIP2 RFx to ANT (5MHz)	Tone 1: 5MHz at 10dBm Tone 2: 4.95MHz at 10dBm		103		dBm
OIP2 RFx to ANT(450MHz)	Tone 1: 450MHz at 10dBm Tone 2: 445.5MHz at 10dBm		131		dBm
OIP2 RFx to ANT	Tone 1: 2480MHz at 10dBm Tone 2: 2690MHz at 10dBm		132		dBm
OIP3 RFX to ANT (5MHz)	Tone 1: 5MHz at 10dBm Tone 2: 4.95MHz at 10dBm Tone 3: 4.85MHz at 10dBm		73		dBm
OIP3 RFX to ANT (450MHz)	Tone 1: 450MHz at 10dBm Tone 2: 445.5MHz at 10dBm Tone 3: 436.5MHz at 10dBm		73		dBm
OIP3 RFX to ANT(850MHz)	30MHz spacing at 20dBm/Tone		76		dBm
OIP3 RFX to ANT (1900MHz)	30MHz spacing at 20dBm/Tone		76		dBm
Supply Current Idd	EN = High EN = Low		52 2	100 5	uA
Control Voltage (EN, CTRL)	VHigh Vlow	1.3	1.8 0	2.75 0.45	V
Control Current (EN, CTRL)	Ihigh ILow		2.5 0.1	5 3	uA
Switching Speed RF ON	50% control to 90% RF ON		2.6		us
Switching Speed RF OFF	50% control to 10% RF ON		1.5		us
Startup Time from Shutdown	Maximum time for switch to reach full compliant operation		6		us
Turn on Time	Time from Vdd 50% of operational voltage to RF signal at 90%		5	20	us

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

Thermal Information

Parameter	Conditions	Value	Units
Thermal Resistance (θ_{JC}) [1]	37dBm @ 2GHz, 85C Stage Temperature	156	ºC/W
Channel Temperature, T_{CH} (Under RF)	37dBm@ 2GHz, 85C Stage Temperature	125	°C

Notes:
1. Thermal Resistance is referenced to back of EVB.

Power-Up, Power-Down sequence and operation controls

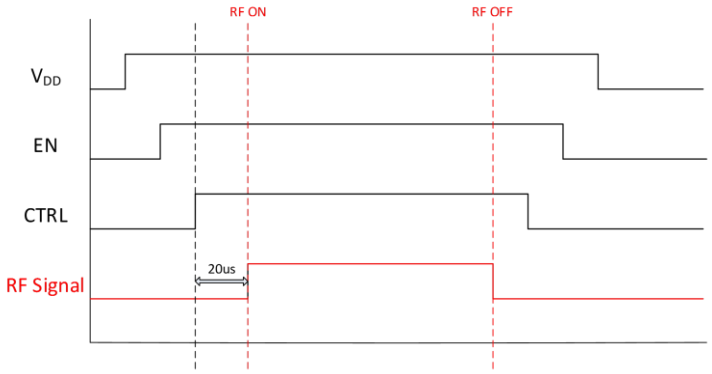
Sequence for Power UP and Power DOWN from the supply that is connected to QPC1022 V_{DD} pin.

Power–up Sequence:

1) Turn on V_{DD} (supply)
2) Then EN
3) Then CTRL
4) Then (20µs or greater)
5) Apply RF signal

Power-Down Sequence:

1) Turn off RF signal
2) Then CTRL
3) Then EN
4) Turn off V_{DD} (supply)



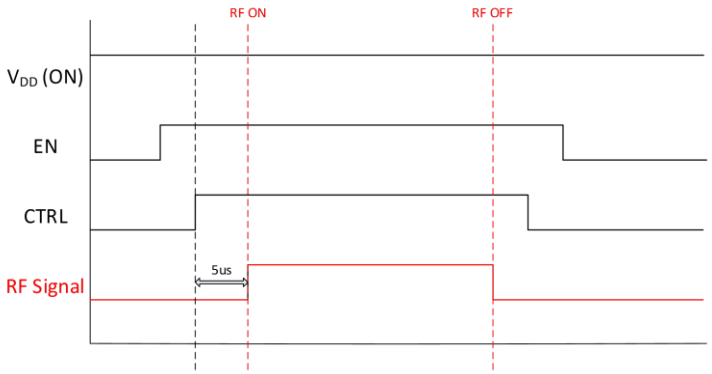
Sequence for going in and out of a shutdown mode, keeping the V_{DD} or supply on, but disabling/enabling the QPC1022 by the EN pin.

Power-Up Sequence:

1) Turn-on EN (enable)
2) Then CTRL
3) Then (5µs or greater)
4) Turn-on RF signal

Power-Down Sequence:

1) Turn-off RF signal
2) Then CTRL
3) Then EN (disable)



When changing switch positions between RF1 and RF2, no RF signal should be applied to any RF port while the CTRL is changing states.

Switching Ports:

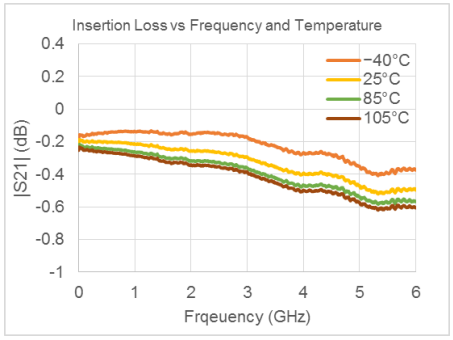
1) Turn-off RF signal
2) Then change CTRL state
3) Then (5µs or greater)
4) Turn-on RF signal

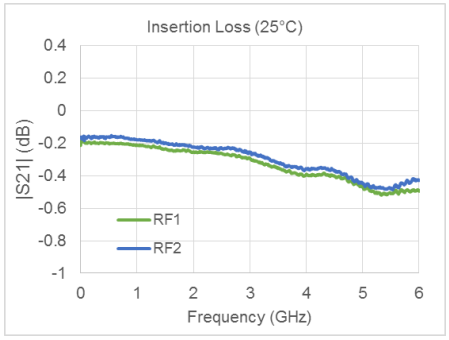
Control Logic for Valid Operational States

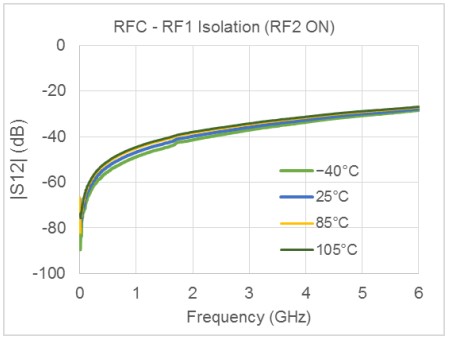
State	V_{DD}	CTRL	EN	RF Path
1	2.4V to 5.8V	V_{HIGH}	V_{HIGH}	ANT-RF1
2	2.4V to 5.8V	V_{LOW}	V_{HIGH}	ANT-RF2
Shutdown	2.4V to 5.8V	X	V_{LOW}	Shutdown

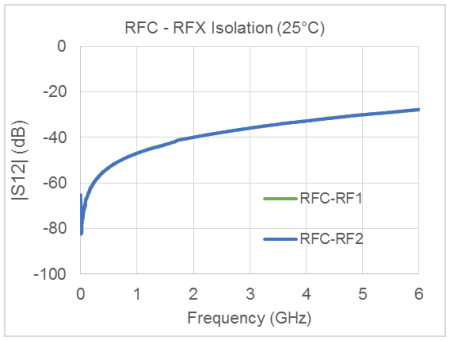
Performance Plots – 50 Ω

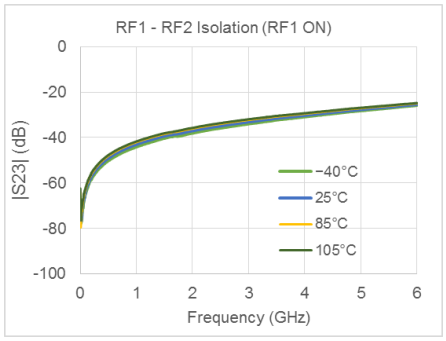
Test conditions unless otherwise noted: V_{DD} = +5V

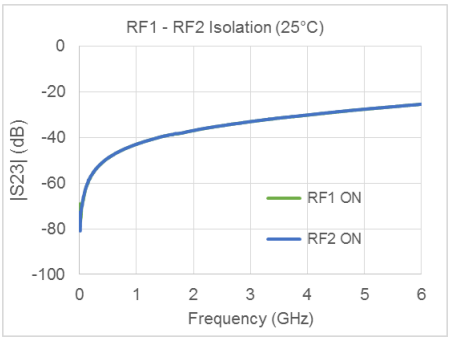


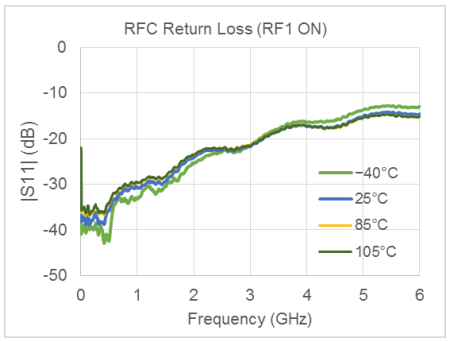


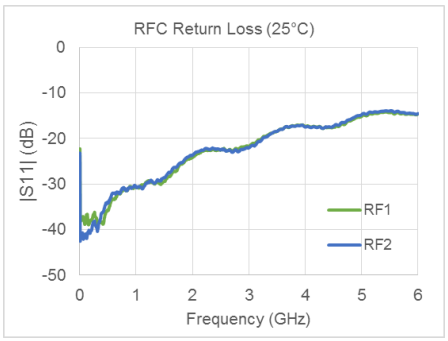


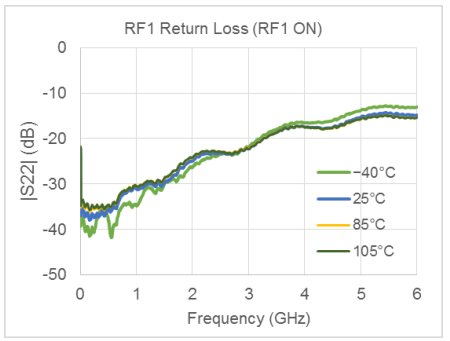


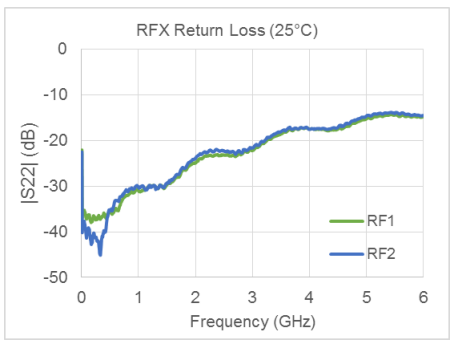


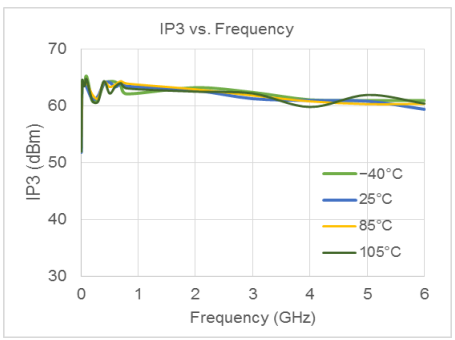


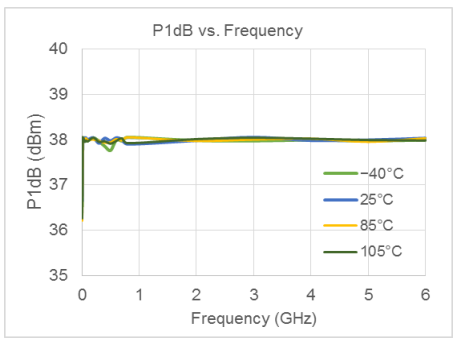




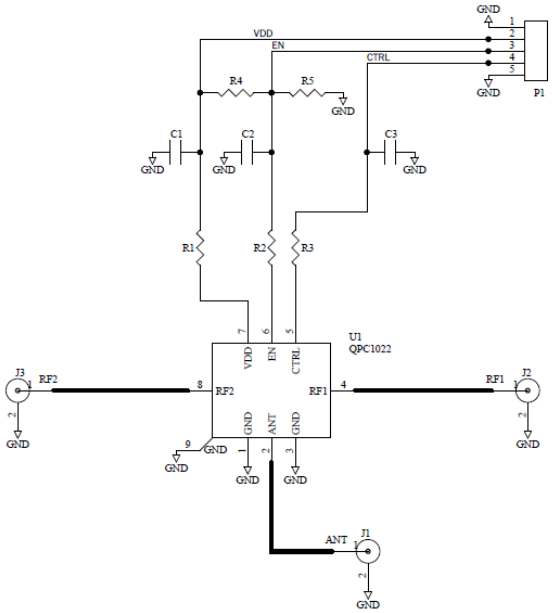


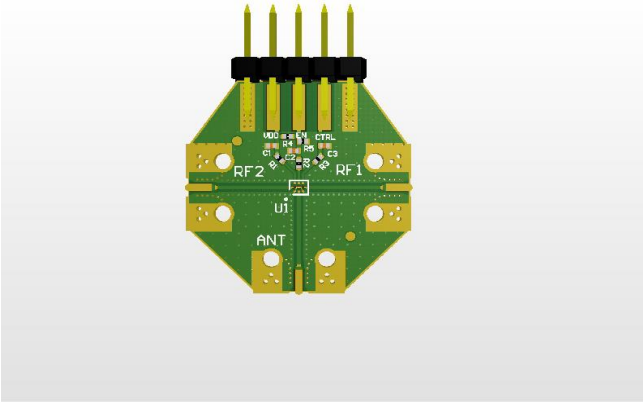






Evaluation Board Schematic & Layout for 50 Ω Application

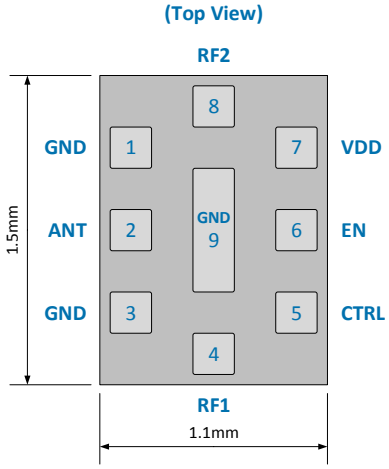




Bill of Material – QPC1022 - 50Ω

Reference Des.	Value	Description	Manuf.	Part Number
		Printed Circuit Board	Qorvo	QPC1022-411(B)
U1		QPC1022 Switch, QFN pkg.	Qorvo	QPC1022SB
R1, R2, R3	0 Ω	Resistor, Chip, 0402	various	
R4, R5	DNI			
C2, C3	100pF	Cap., Chip, 0402, 5%, 50V. NPO/COG	various	
C1	2200pF	Cap, 10%, 50V, X7R, 0402	various	
J1, J2, J3		CONN, SMA, EL FLT VIPER, MAT-21-1038		
P1		CONN, HDR, ST, PLRZD, 5-PIN, 0.100"		

Pin Configuration and Description

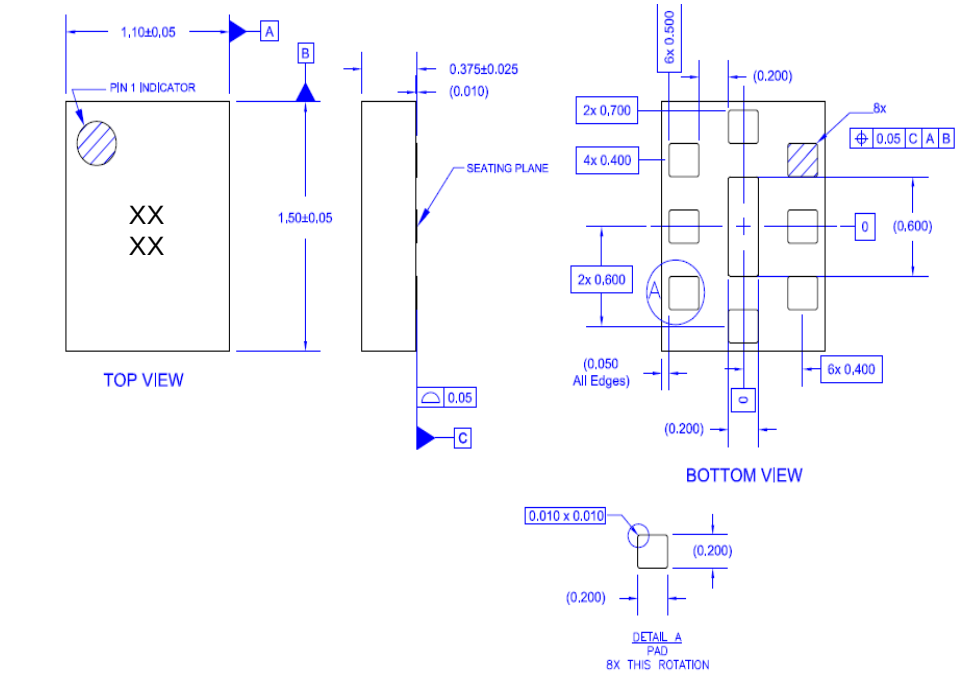


Pad No.	Label	Description
1,3,9	GND	Connect with Low inductive path to ground
2	ANT	Single-Ended RF port
4	RF1	Single-Ended RF port
5	CTRL	Switch Logic control input
6	EN	Shutdown logic control input
7	V_{DD}	Supply Voltage
8	RF2	Single-Ended RF port

Package Marking and Dimensions

Marking:

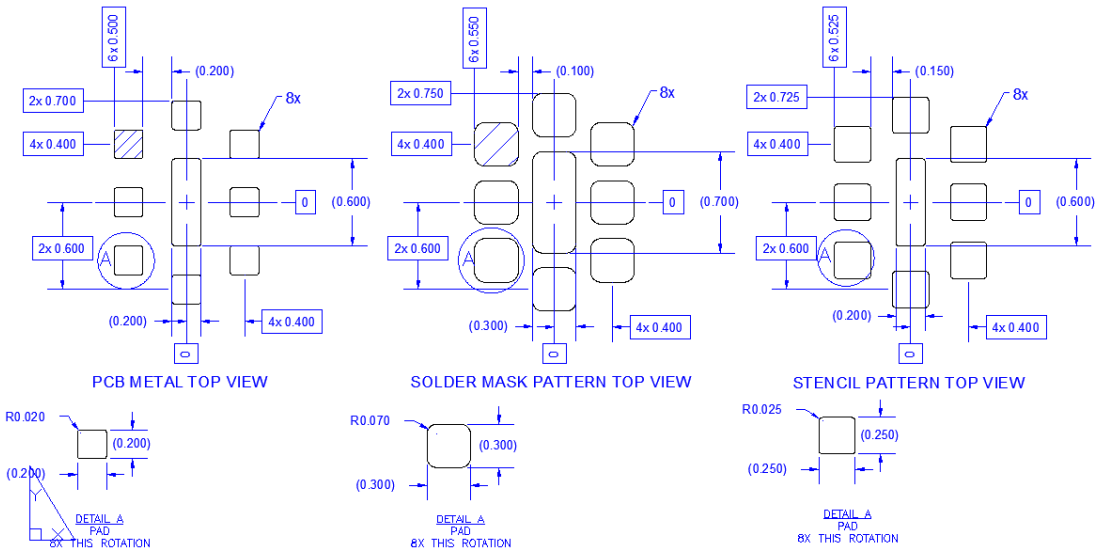
Trace Code –XXXX



Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.
3. Contact plating: NiAu

PCB Mounting Pattern



Notes:

1. All dimensions are in millimeters. Angles are in degrees.

Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 2	ESDA / JEDEC JS-001-2012
ESD – Charged Device Model (CDM)	Class C3	JEDEC JESD22-C101F
MSL – Moisture Sensitivity Level	2	IPC/JEDEC J-STD-020

Caution!
ESD-Sensitive Device

Solderability

Compatible with both lead-free (260°C max. reflow temp.) soldering process.
Solder profiles available upon request.

Contact plating: *Au* plating 0.5µm, over a 2µm *Ni* Plating

RoHS Compliance

This part is compliant with EU 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 ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free
- Qorvo Green

Contact Information

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

Tel: **1-844-890-8163**

Web: www.qorvo.com

Email: customer.support@qorvo.com

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