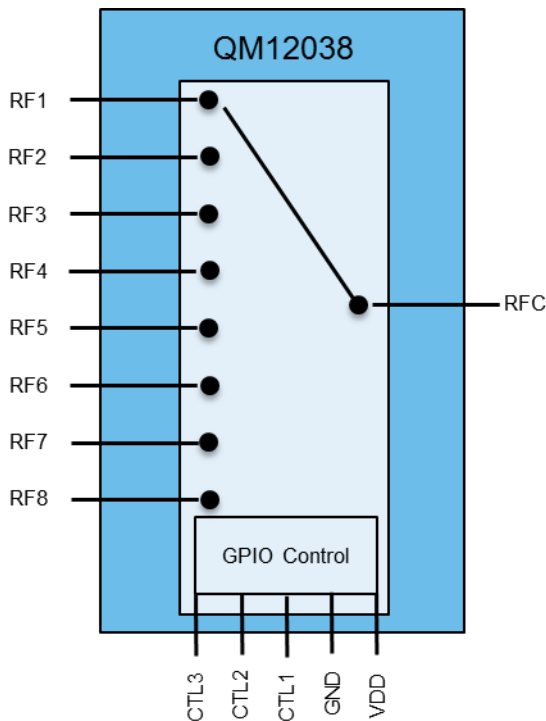


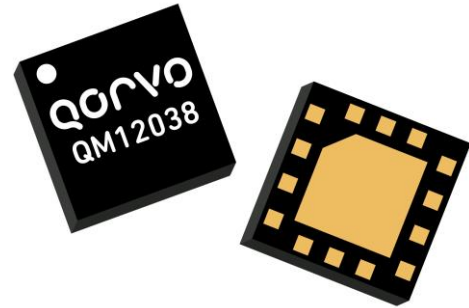
### Product Description

The QM12038 is a low loss, high isolation SP8T switch with performance optimized for CDMA, WCDMA & LTE applications requiring high linearity. The QM12038 is compatible with +1.3V control logic, which is a key requirement for most cellular transceivers. This part is packaged in a compact 2mm x 2mm, 15-pin, Module package which allows for a small solution size with no need for external DC blocking capacitors (when no external DC is applied to the device ports).

### Functional Block Diagram



Top View



15 Pin 2 x 2 x 0.57 mm Module Package

### Feature Overview

- Excellent insertion loss and isolation performance
  - 0.5dB Typ IL, Band 5
  - 40dB Typ Isolation, Band 5
- Multi-Band operation 700MHz to 2700MHz
- GPIO compatible to 1.8V typ (1.3V min)
- Power handling +32dBm, 50Ω
- Compact 2mm x 2mm, Module package
- No DC blocking capacitors required (unless external DC is applied to the RF ports)

### Applications

- Cellular Handset Applications
- Cellular Modems and USB Devices
- Multi-Mode WCDMA, and LTE Applications

### Ordering Information

| PART NO.       | DESCRIPTION                             |
|----------------|---|
| QM12038SB      | 5-pc Sample Bag                         |
| QM12038SR      | 100-pc, 7" Reel                         |
| QM12038TR13-5K | 5000-pc, 13" Reel                       |
| QM12038PCK410  | Fully Assembled EVB and 5-pc Sample Bag |

## Absolute Maximum Ratings

| PARAMETER  | RATING                               |
|--|--------------------------------------|
| Storage Temperature                                    | -45 to +125 °C                       |
| Operating Temperature                                  | -30 to +90°C                         |
| V <sub>DD</sub>  | 6.0 V                                |
| C <sub>TL1</sub> , C <sub>TL2</sub> , C <sub>TL3</sub> | 3.0 V                                |
| Maximum Input Power                                    |                                      |
| Momentary Infrequent Occurrence                        | 35 dBm, 1:1 VSWR<br>33 dBm, 6:1 VSWR |
| Continuous Operation                                   | 32 dBm, 1:1 VSWR<br>30 dBm, 6:1 VSWR |

Operation of this device outside the parameter ranges given above may cause permanent damage.

## Recommended Operating Conditions

| PARAMETER                          | MIN. | TYP. | MAX. | UNITS |
|------------------------------------|------|------|------|-------|
| V <sub>DD</sub> Supply Voltage     | 2.4  | 2.85 | 4.5  | V     |
| V <sub>DD</sub> Supply Current     |      | 80   | 120  | μA    |
| C <sub>TL</sub> Logic Low Voltage  | 0.00 | 0.00 | 0.45 | V     |
| C <sub>TL</sub> Logic High Voltage | 1.3  | 1.8  | 2.7* | V     |
| C <sub>TL</sub> Logic High Current |      | 0.1  | 5    | μA    |
| Turn-On Time                       |      | 4    |      | μs    |
| Switching Speed                    |      |      | 2    | μs    |

\* V<sub>DD</sub> Must be > V<sub>CTL</sub> at all times

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

## Electrical Specifications

Test conditions unless otherwise stated: all unused RF ports terminated in 50Ω, Input and Output = 50Ω, T = 25°C, V<sub>DD</sub> = 2.85V, V<sub>HIGH</sub>/V<sub>LOW</sub> = 1.8V/0V

| PARAMETER             | CONDITIONS   | MIN. | TYP. | MAX. | UNITS |
|-----------------------|--|------|------|------|-------|
| <b>Insertion Loss</b> |  |      |      |      |       |
| RFx to RFC            | 698MHz to 960MHz   |      | 0.52 |      | dB    |
| RFx to RFC            | 1710MHz to 1980MHz   |      | 0.68 |      | dB    |
| RFx to RFC            | 2110MHz to 2170MHz   |      | 0.71 |      | dB    |
| RFx to RFC            | 2300MHz to 2690MHz   |      | 0.85 |      | dB    |
| <b>Harmonics</b>      |  |      |      |      |       |
| Low Band, 2fo         | Pin = +28dBm, 50Ω, fo= 824MHz  |      | -98  |      | dBc   |
| Low Band, 3fo         | Pin = +28dBm, 50Ω, fo= 824MHz  |      | -84  |      | dBc   |
| Mid Band, 2fo         | Pin = +28dBm, 50Ω, fo= 1980MHz   |      | -98  |      | dBc   |
| Mid Band, 3fo         | Pin = +28dBm, 50Ω, fo= 1980MHz   |      | -84  |      | dBc   |
| High Band, 2fo        | Pin = +28dBm, 50Ω, fo= 2570MHz   |      | -97  |      | dBc   |
| High Band, 3fo        | Pin = +28dBm, 50Ω, fo= 2570MHz   |      | -80  |      | dBc   |
| <b>IIP2</b>           |  |      |      |      |       |
| Low Band              | TX Carrier @ 897.5MHz at +21dBm<br>CW Blocker @ 1840 MHz at -15dBm<br>Measured RX frequency @ 942.5MHz |      | 117  |      | dBm   |
| High Band             | TX Carrier @ 1880MHz at +21dBm<br>CW Blocker @ 3840 MHz at -15dBm<br>Measured RX frequency @ 1960MHz   |      | 118  |      | dBm   |
| <b>IIP3</b>           |  |      |      |      |       |
| Low Band              | TX Carrier @ 897.5MHz at +21dBm<br>CW Blocker @ 852.5MHz at -15dBm<br>Measured RX frequency @ 942.5MHz |      | 68   |      | dBm   |
| High Band             | TX Carrier @ 1880MHz at +21dBm<br>CW Blocker @ 1800MHz at -15dBm<br>Measured RX frequency @ 1960MHz    |      | 67   |      | dBm   |
| <b>VSWR</b>           |  |      |      |      |       |
|                       | 698MHz to 2690MHz  |      | 1.1  |      | :1    |

**Isolation Matrix Low Band (698MHz – 960MHz)**

| STATE | INSERTION PORT | ISOLATION, TYPICAL (dB) |     |     |     |     |     |     |     |
|-------|----------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|
|       |                | RF1                     | RF2 | RF3 | RF4 | RF5 | RF6 | RF7 | RF8 |
| RF1   | RF1            |                         | 42  | 32  | 44  | 43  | 45  | 44  | 41  |
| RF2   | RF2            | 42                      |     | 43  | 32  | 45  | 42  | 41  | 44  |
| RF3   | RF3            | 32                      | 43  |     | 45  | 34  | 46  | 42  | 42  |
| RF4   | RF4            | 44                      | 32  | 45  |     | 46  | 33  | 42  | 42  |
| RF5   | RF5            | 43                      | 45  | 34  | 46  |     | 47  | 40  | 43  |
| RF6   | RF6            | 45                      | 42  | 46  | 33  | 47  |     | 43  | 40  |
| RF7   | RF7            | 44                      | 41  | 42  | 42  | 40  | 43  |     | 43  |
| RF8   | RF8            | 41                      | 44  | 42  | 42  | 43  | 40  | 43  |     |
| RF1   | RFC            |                         | 43  | 42  | 41  | 41  | 41  | 34  | 33  |
| RF2   | RFC            | 42                      |     | 42  | 41  | 41  | 41  | 34  | 33  |
| RF3   | RFC            | 42                      | 43  |     | 41  | 41  | 41  | 34  | 33  |
| RF4   | RFC            | 42                      | 43  | 42  |     | 41  | 41  | 34  | 33  |
| RF5   | RFC            | 42                      | 43  | 42  | 41  |     | 41  | 34  | 33  |
| RF6   | RFC            | 42                      | 43  | 42  | 41  | 41  |     | 34  | 33  |
| RF7   | RFC            | 42                      | 43  | 42  | 41  | 41  | 41  |     | 33  |
| RF8   | RFC            | 42                      | 43  | 42  | 41  | 41  | 41  | 34  |     |

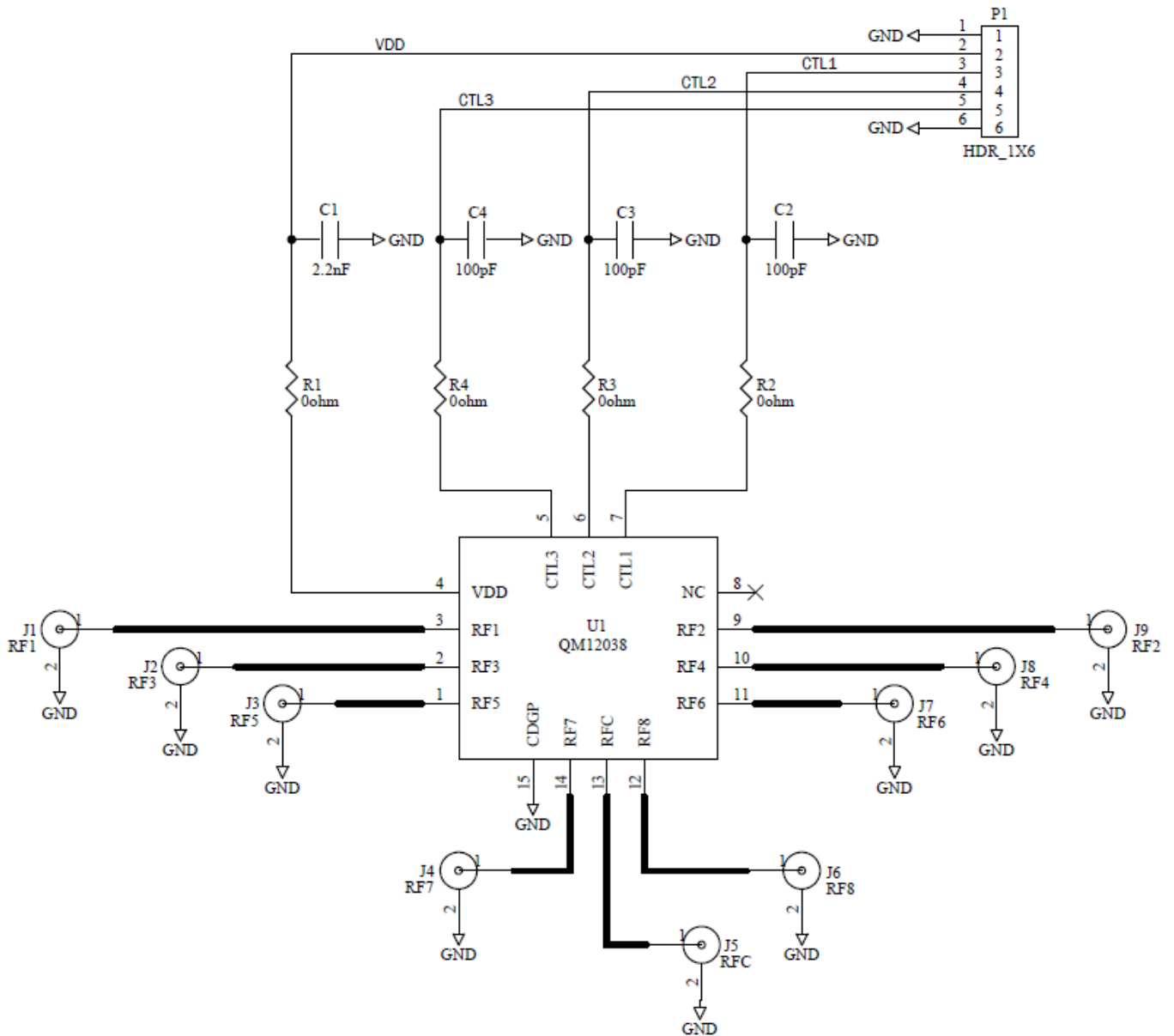
**Isolation Matrix Mid Band (1710MHz – 2170MHz)**

| STATE | INSERTION PORT | ISOLATION, TYPICAL (dB) |     |     |     |     |     |     |     |
|-------|----------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|
|       |                | RF1                     | RF2 | RF3 | RF4 | RF5 | RF6 | RF7 | RF8 |
| RF1   | RF1            |                         | 30  | 23  | 31  | 31  | 33  | 33  | 31  |
| RF2   | RF2            | 30                      |     | 31  | 23  | 33  | 31  | 31  | 33  |
| RF3   | RF3            | 23                      | 31  |     | 32  | 24  | 30  | 32  | 31  |
| RF4   | RF4            | 31                      | 23  | 32  |     | 34  | 24  | 31  | 32  |
| RF5   | RF5            | 31                      | 33  | 24  | 34  |     | 34  | 29  | 32  |
| RF6   | RF6            | 33                      | 31  | 30  | 24  | 34  |     | 32  | 29  |
| RF7   | RF7            | 33                      | 31  | 32  | 31  | 29  | 32  |     | 32  |
| RF8   | RF8            | 31                      | 33  | 31  | 32  | 32  | 29  | 32  |     |
| RF1   | RFC            |                         | 33  | 32  | 32  | 32  | 31  | 25  | 25  |
| RF2   | RFC            | 31                      |     | 32  | 32  | 32  | 31  | 25  | 25  |
| RF3   | RFC            | 31                      | 33  |     | 32  | 32  | 31  | 25  | 25  |
| RF4   | RFC            | 31                      | 33  | 32  |     | 32  | 31  | 25  | 25  |
| RF5   | RFC            | 31                      | 33  | 32  | 32  |     | 31  | 25  | 25  |
| RF6   | RFC            | 31                      | 33  | 32  | 32  | 32  |     | 25  | 25  |
| RF7   | RFC            | 31                      | 33  | 32  | 32  | 32  | 31  |     | 25  |
| RF8   | RFC            | 31                      | 33  | 32  | 32  | 32  | 31  | 25  |     |

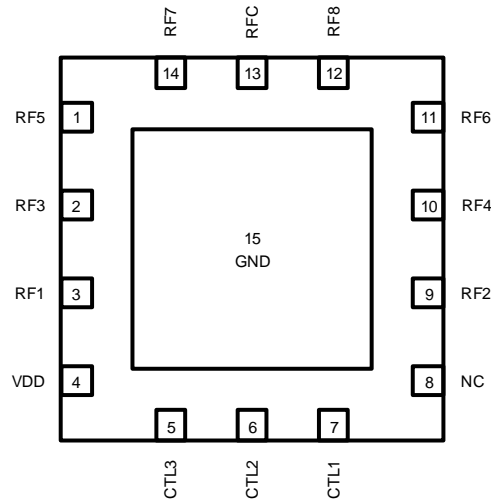
**Isolation Matrix High Band (2300MHz – 2690MHz)**

| STATE | INSERTION PORT | ISOLATION, TYPICAL (dB) |     |     |     |     |     |     |     |
|-------|----------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|
|       |                | RF1                     | RF2 | RF3 | RF4 | RF5 | RF6 | RF7 | RF8 |
| RF1   | RF1            |                         | 28  | 21  | 29  | 28  | 29  | 31  | 29  |
| RF2   | RF2            | 28                      |     | 28  | 21  | 30  | 28  | 28  | 31  |
| RF3   | RF3            | 21                      | 28  |     | 30  | 22  | 30  | 30  | 29  |
| RF4   | RF4            | 29                      | 21  | 30  |     | 30  | 22  | 29  | 30  |
| RF5   | RF5            | 28                      | 30  | 22  | 30  |     | 31  | 26  | 30  |
| RF6   | RF6            | 29                      | 28  | 30  | 22  | 31  |     | 30  | 26  |
| RF7   | RF7            | 31                      | 28  | 30  | 29  | 26  | 30  |     | 29  |
| RF8   | RF8            | 29                      | 31  | 29  | 30  | 30  | 26  | 29  |     |
| RF1   | RFC            |                         | 30  | 29  | 28  | 29  | 29  | 21  | 21  |
| RF2   | RFC            | 30                      |     | 29  | 28  | 29  | 29  | 21  | 21  |
| RF3   | RFC            | 30                      | 30  |     | 28  | 29  | 29  | 21  | 21  |
| RF4   | RFC            | 30                      | 30  | 29  |     | 29  | 29  | 21  | 21  |
| RF5   | RFC            | 30                      | 30  | 29  | 28  |     | 29  | 21  | 21  |
| RF6   | RFC            | 30                      | 30  | 29  | 28  | 29  |     | 21  | 21  |
| RF7   | RFC            | 30                      | 30  | 29  | 28  | 29  | 29  |     | 21  |
| RF8   | RFC            | 30                      | 30  | 29  | 28  | 29  | 29  | 21  |     |

Application Circuit Schematic



## Pin Configuration and Description



*Top View*

| PIN NO. | LABEL            | DESCRIPTION              |
|---------|------------------|--------------------------|
| 1       | RF5              | RF Input / Output        |
| 2       | RF3              | RF Input / Output        |
| 3       | RF1              | RF Input / Output        |
| 4       | V <sub>DD</sub>  | Power Supply             |
| 5       | C <sub>TL3</sub> | Control Logic #3         |
| 6       | C <sub>TL2</sub> | Control Logic #2         |
| 7       | C <sub>TL1</sub> | Control Logic #1         |
| 8       | NC               | No Connect               |
| 9       | RF2              | RF Input / Output        |
| 10      | RF4              | RF Input / Output        |
| 11      | RF6              | RF Input / Output        |
| 12      | RF8              | RF Input / Output        |
| 13      | RFC              | RF Common Input / Output |
| 14      | RF7              | RF Input / Output        |
| 15      | GND              | RF and DC Ground         |

## Control Logic

The Switch is controlled by  $C_{TL1}$ ,  $C_{TL2}$ , and  $C_{TL3}$ .

| LOGIC STATE | $C_{TL1}$ | $C_{TL2}$ | $C_{TL3}$ |
|-------------|-----------|-----------|-----------|
| RF1-RFC     | Low       | Low       | High      |
| RF2-RFC     | Low       | Low       | Low       |
| RF3-RFC     | High      | High      | Low       |
| RF4-RFC     | High      | High      | High      |
| RF5-RFC     | Low       | High      | Low       |
| RF6-RFC     | Low       | High      | High      |
| RF7-RFC     | High      | Low       | Low       |
| RF8-RFC     | High      | Low       | High      |

## Power On and Off Sequence

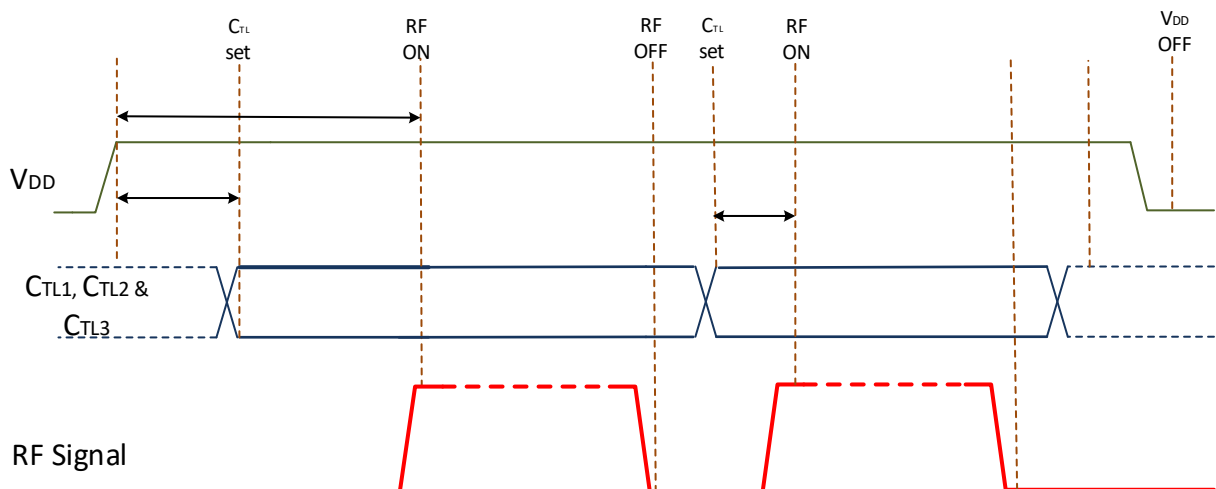
It is very important that the user adheres to the correct power-on/off sequence in order to avoid damaging the part. First apply  $V_{DD}$  before applying a high to  $C_{TL1}$ ,  $C_{TL2}$ , or  $C_{TL3}$ .

### Power On –

1. Apply voltage supply –  $V_{DD}$
2. Apply Logic signal –  $C_{TL1}$ ,  $C_{TL2}$ ,  $C_{TL3}$
3. Apply the RF signal

### Power Off –

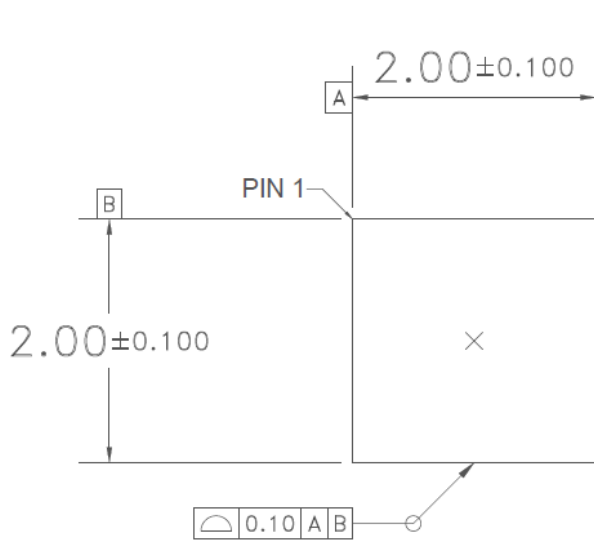
1. Remove the RF signal
2. Remove the logic signal –  $C_{TL1}$ ,  $C_{TL2}$ ,  $C_{TL3}$
3. Remove the voltage supply –  $V_{DD}$



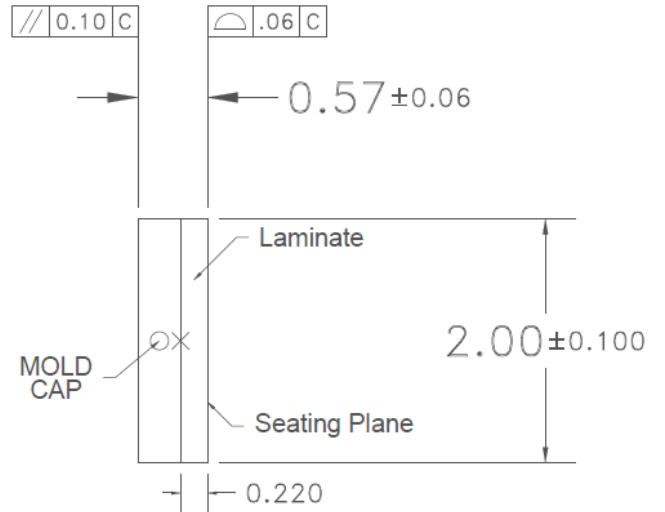


Mechanical Information

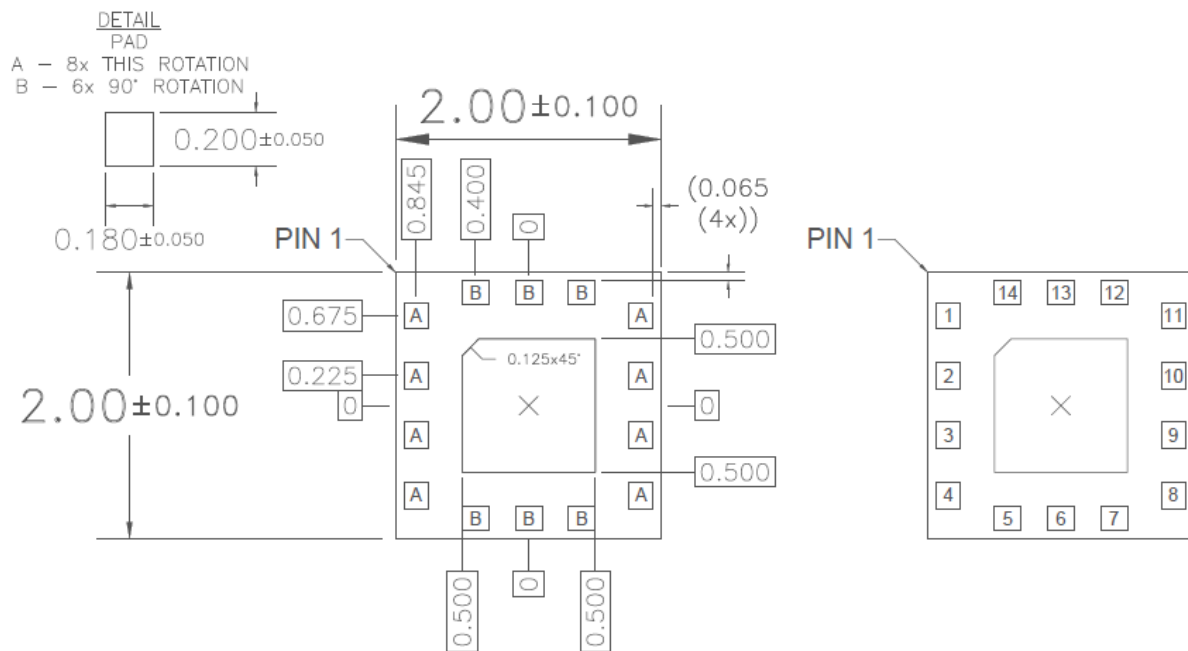
Package Drawing



Top View

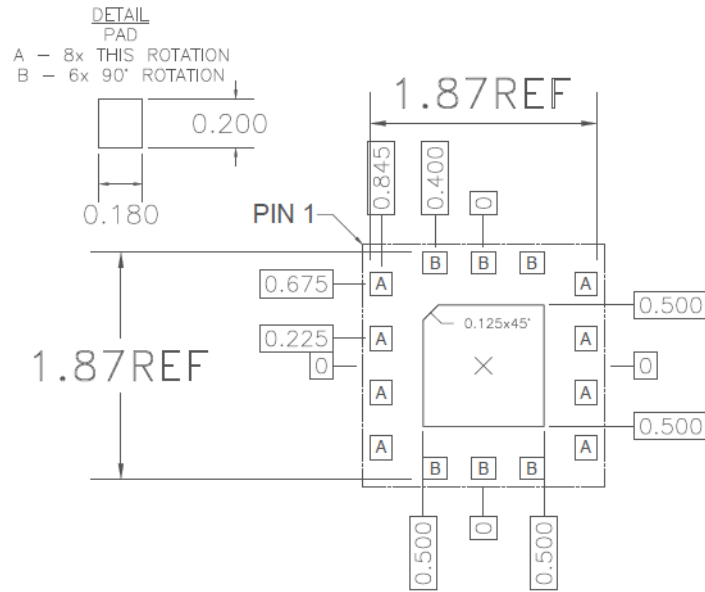


Side View

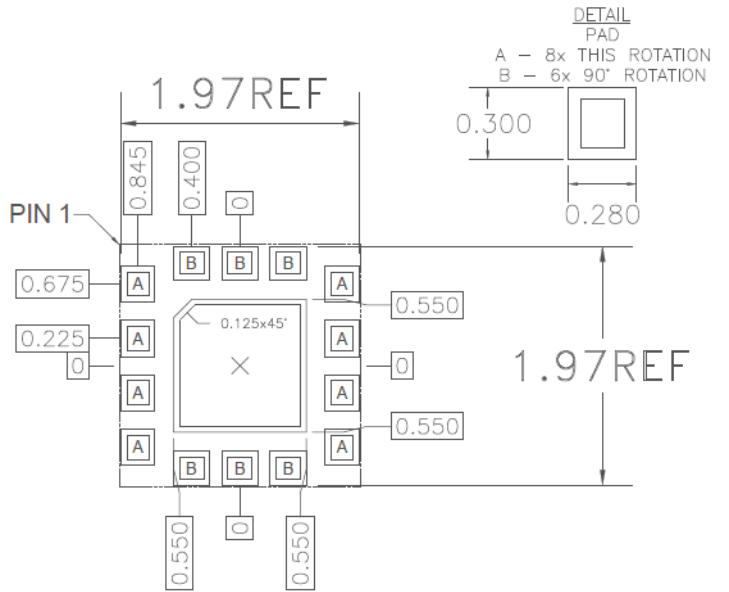


Top View X-Ray

PCB Design Requirements



Recommended Land Pattern



Recommended Land Pattern Mask

Notes:

1. All dimensions are in milimeters. Angles are in degrees.
2. Dimension and tolerance formats conform to ASME Y14.4M-1994.
3. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

## Handling Precautions

| PARAMETER                        | RATING  | STANDARD               |
|----------------------------------|---------|------------------------|
| ESD – Human Body Model (HBM)     | Class 2 | ESDA/JEDEC JS-001-2012 |
| MSL – Moisture Sensitivity Level | Level 3 | IPC/JEDEC J-STD-020    |



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.

Package lead plating: Electrolytic plated Au over Ni

## RoHS Compliance

This part 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:

- Lead free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) Free
- SVHC Free



## Revision History

| Revision Code | Date       | Comments                                    |
|---------------|------------|---|
| B             | 03/01/2018 | Initial Production Release                  |
| C             | 02/19/2020 | Added Not Recommended For New Designs marks |
| D             | 06/15/2020 | Removing NRND Marks                         |

## Contact Information

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

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

**Email:** [customer.support@qorvo.com](mailto:customer.support@qorvo.com)

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