

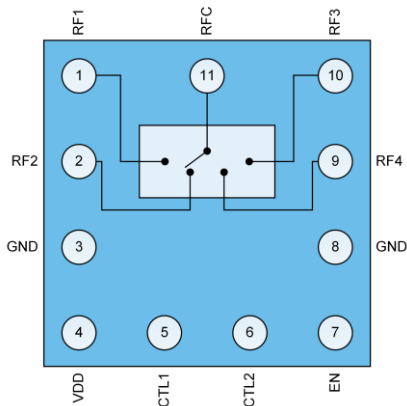
### Product Overview

The RF1119A is a single-pole four-throw (SP4T) switch designed for static Antenna/impedance tuning applications which requires very low insertion loss and high power handling capability with a minimum of DC power consumption. The high linearity performance achieved by the RF1119A make it ideal for use in multi-mode GSM/GPRS/EDGE/WCDMA/LTE applications. The RF1119A is controlled by a standard GPIO interface for easy control. The RF1119A includes an integrated LDO (Low Drop Out) regulator, which enables operation over a very wide supply range. All pins are ESD protected to ensure 2 kV HBM ESD tolerance. The RF1119A is packaged in an ultra-compact 1.6 mm x 1.6 mm, 11-pin, WLCSP package.



Package: WLCSP, 11-pin, 1.6 mm x 1.6 mm

### Functional Block Diagram



### Key Features

- Low insertion loss: 0.3 dB at 1 GHz
- High peak voltage handling
- High linearity
- Ultra small package: WLCSP, 11-pin, 1.6 mm x 1.6 mm
- No external DC blocking capacitor required (Unless external DC is applied to the RF ports)
- Wide V<sub>DD</sub> voltage range
- 2 kV HBM ESD protection at all ports

### Applications

- Antenna Tuning
- Band Switching
- Impedance Tuning

### Ordering Information

Part Number	Description
RF1119APCBA-410	Evaluation Board
RF1119ASR	100-pc 7" Reel
RF1119ATR7	2500-pc, 7" Tape and Reel

## Absolute Maximum Ratings

Parameter	Rating	Unit
Power supply voltage, $V_{DD}$	5.0	V
Control voltage, $V_{CTL}$	3.0	V
Enable voltage, $V_{EN}$	5.0	V
ESD voltage HBM $V_{ESD}$	2	kV
Storage temperature $T_{st}$	-40 to 150	°C
Operating temperature $T_{OP}$	-30 to 85	°C
Max differential RF voltage between RFC and RF ports $V_{RF}$	39	$V_P$
RF Input power 50 $\Omega$	41.8	dBm

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. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

Notes:

1. No operation above 6.0 volts.
2. Average power + PAR combined, 50  $\Omega$ , 25 °C.
3. Defined as measured at ground plane under or adjacent to chip.

## Nominal Operating Parameters

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
					Nominal conditions unless otherwise specified. $V_{DD} = 3.5\text{ V}$ , $V_{CTL1}$ & $V_{CTL2} = 1.8\text{ V/0 V}$ , $V_{EN} = 1.8\text{ V}$ , Temp = 25 °C, 50 $\Omega$ .
Operating Frequency	400	–	3000	MHZ	
Supply Voltage $V_{DD}$	2.4	3.5	4.5	V	
Supply Current $I_{DD}$	–	85	100	$\mu\text{A}$	Active Mode
	–	5	10	$\mu\text{A}$	Low Power Mode, $V_{EN}$ , $V_{CTL1}$ & $V_{CTL2} = 0\text{ V}$
EN Control Voltage High, $V_{HIGH\_EN}$	1.2	1.8	$V_{DD}$	V	
Control Voltage High, $V_{HIGH\_CTL}$	1.2	1.8	2.8	V	
Control voltage – Low, $V_{LOW}$	0.0	0.0	0.45	V	
Control current – High, $I_{HIGH}$	–	–	5	$\mu\text{A}$	
Control current – Low, $I_{LOW}$	–	–	5	$\mu\text{A}$	

### Electrical Specifications – Linear Parameters

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
					Nominal conditions unless otherwise specified. $V_{DD} = 3.5\text{ V}$ , $V_{CTL1}$ & $V_{CTL2} = 1.8\text{ V}/0\text{ V}$ , $V_{EN} = 1.8\text{ V}$ , Temp = 25 °C, 50 $\Omega$
Insertion Loss (RFC to RFx) Switch ON	–	0.30	0.45	dB	1000 MHz
	–	0.40	0.55	dB	1910 MHz
	–	0.50	0.70	dB	2700 MHz
Isolation (RFC to RFx) Switch OFF	26.0	30.0	–	dB	700 MHz
	25.0	30.0	–	dB	1000 MHz
	18.0	21.5	–	dB	1910 MHz
	16.0	19.5	–	dB	2700 MHz
Return Loss (RFC to RFx) Switch ON	20.0	25.0	–	dB	1000 MHz
$R_{ON}$ (RFC to RFx) Switch ON	–	1.7	2.1	$\Omega$	
$C_{OFF}$ (RFC to RFx) Switch OFF	–	0.14	0.18	pF	
Start-up time, $t_{start-up}$	–	6	20	$\mu\text{s}$	50% $V_{DD}$ to large signal fully compliant
ON Switching speed, $t_{ON}$	–	2	5	$\mu\text{s}$	50% control to 90% RF ON
OFF Switching speed, $t_{OFF}$	–	2	5	$\mu\text{s}$	50% control to 10% RF OFF

### Electrical Specifications – Nonlinear Parameters

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
					Nominal conditions unless otherwise specified. $V_{DD} = 3.5\text{ V}$ , $V_{CTL1}$ & $V_{CTL2} = 1.8\text{ V}/0\text{ V}$ , $V_{EN} = 1.8\text{ V}$ , Temp = 25 °C, 50 $\Omega$
Second Harmonics	–	-104	-90	dBc	915 MHz, Pin = 35 dBm
Third Harmonics	–	-90	-75	dBc	
Second Harmonics	–	-104	-85	dBc	1910 MHz, Pin = 33 dBm
Third Harmonics	–	-90	-75	dBc	
IIP2, Low	110	120	–	dBm	Refer to IIP2 conditions table
IIP2, High	120	130	–	dBm	Refer to IIP2 conditions table
IIP3	70	75	–	dBm	Refer to IIP3 conditions table
Receive Spurious 700 – 2700 MHz	–	-117	-112	dBm	No RF Signal
	–	-112	-107	dBm	RF – 915 MHz at 35 dBm
	–	-112	-107	dBm	RF – 1910 MHz at 33 dBm

## Control Logic

State	V <sub>EN</sub>	V <sub>CTL1</sub>	V <sub>CTL2</sub>	RF Path
RF1	V <sub>HIGH_EN</sub>	V <sub>LOW</sub>	V <sub>LOW</sub>	RFC to RF1
RF2	V <sub>HIGH_EN</sub>	V <sub>LOW</sub>	V <sub>HIGH_CTL</sub>	RFC to RF2
RF3	V <sub>HIGH_EN</sub>	V <sub>HIGH_CTL</sub>	V <sub>LOW</sub>	RFC to RF3
RF4	V <sub>HIGH_EN</sub>	V <sub>HIGH_CTL</sub>	V <sub>HIGH_CTL</sub>	RFC to RF4
LPM <sup>[1]</sup>	V <sub>LOW</sub>	X	X	Low power mode

Note [1] – RF signal should not be applied in the low power mode.

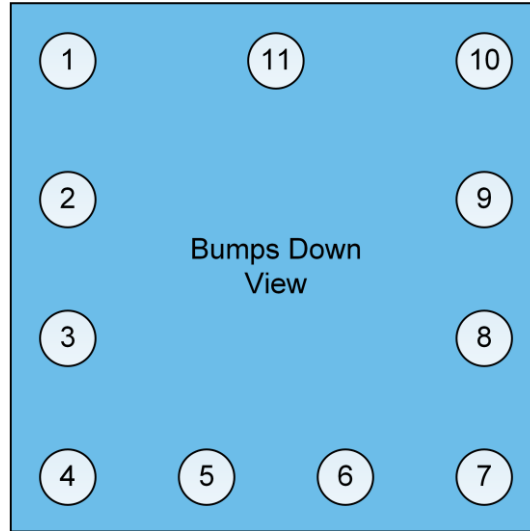
## IIP2 Test Conditions

Band	In-Band Freq	CW Tone 1		CW Tone 2	
	[MHz]	[MHz]	[dBm]	[MHz]	[dBm]
Band I Low (IMT)	2140	1950	+20	190	-15
Band I High (IMT)	2140	1950	+26	4090	-20
Band II Low (PCS)	1960	1880	+20	80	-15
Band II High (PCS)	1960	1880	+26	3840	-20
Band V Low (Cell)	881.5	836.5	+20	45	-15
Band V High (Cell)	881.5	836.5	+26	1718	-20
Band VIII Low	942.5	897.5	+20	45	-15
Band VIII High	942.5	897.5	+26	1840	-20

## IIP3 Test Conditions

Band	In-Band Freq	CW Tone 1		CW Tone 2	
	[MHz]	[MHz]	[dBm]	[MHz]	[dBm]
Band I High (IMT)	2140	1950	+20	1760	-15
Band II High (PCS)	1960	1880	+20	1800	-15
Band V High (Cell)	881.5	836.5	+20	791.5	-15
Band VIII High	942.5	897.5	+20	852.5	-15

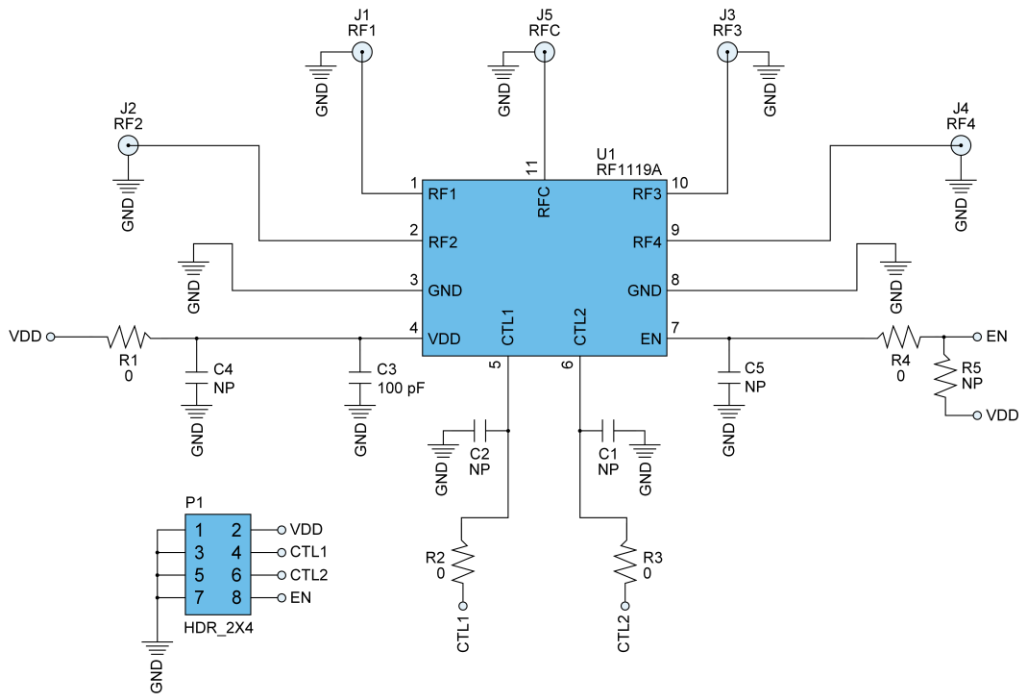
Pin Configuration



Pin Description

Pin	Name	Details
1	RF1	RF port 1
2	RF2	RF port 2
3	GND	Ground
4	V <sub>DD</sub>	Voltage Supply
5	CTL1	Control Voltage 1
6	CTL2	Control Voltage 2
7	EN	Enable
8	GND	Ground
9	RF4	RF port 4
10	RF3	RF port 3
11	RFC	Common RF port

## Evaluation Board Schematic



## Parts List

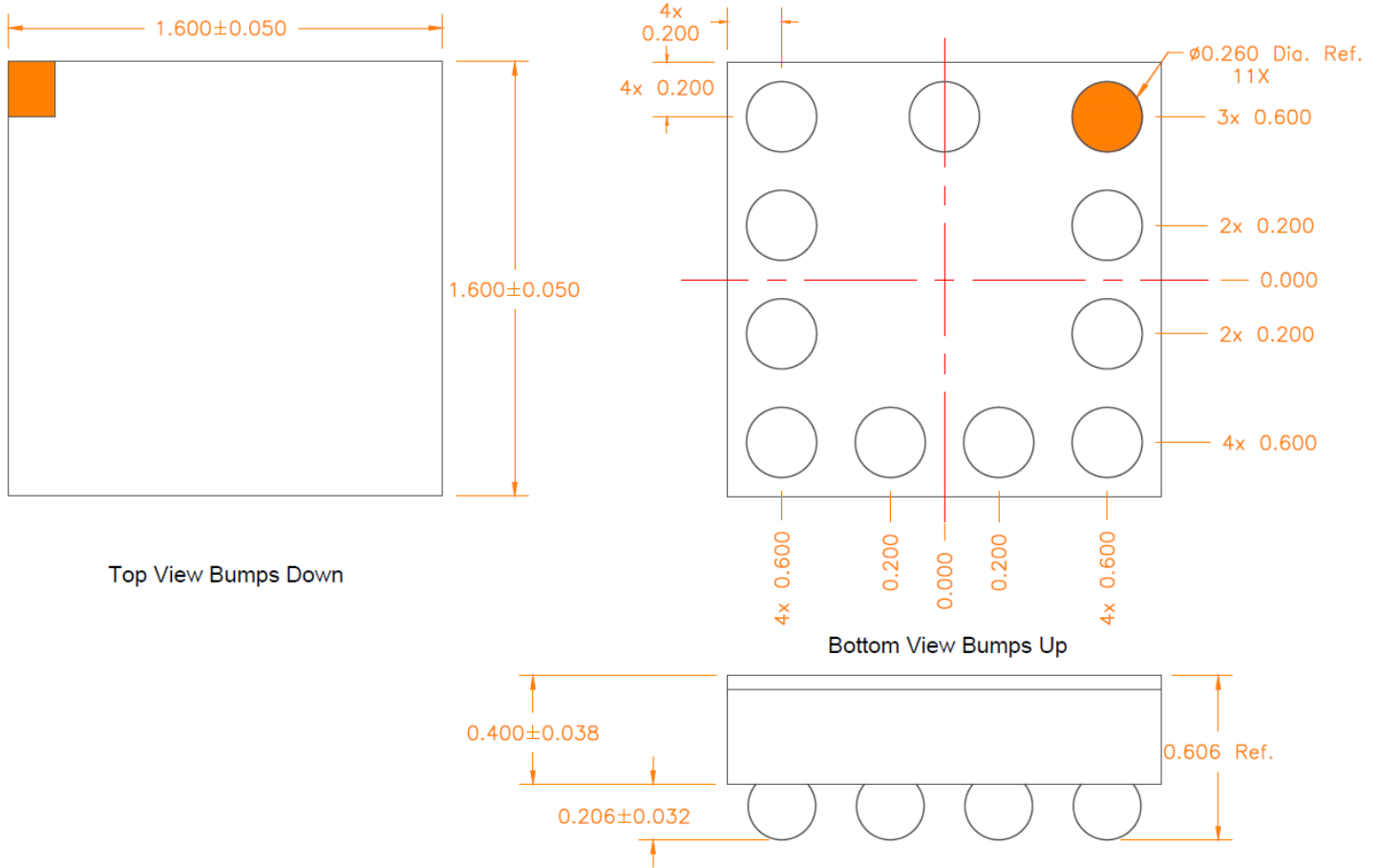
Part Number	Part	Part Description
U1	RF1119A	RF1119A, SP4T Switch
J1, J2, J3, J4 & J5	SMA connector	Edge mount 0.068" SMA connector
C3	100 pF capacitor	(0402) 100 pF de-coupling capacitor
C1, C2, C4 & C5	NP	No Placement - Do not populate
R1, R2, R3 & R4	0 Ω jumper	(0402) 0 Ω resistor
R5	NP	No Placement - Do not populate
P1	2x4 RA header	2x4 right angled header with 0.1" spacing

## Application Guidelines

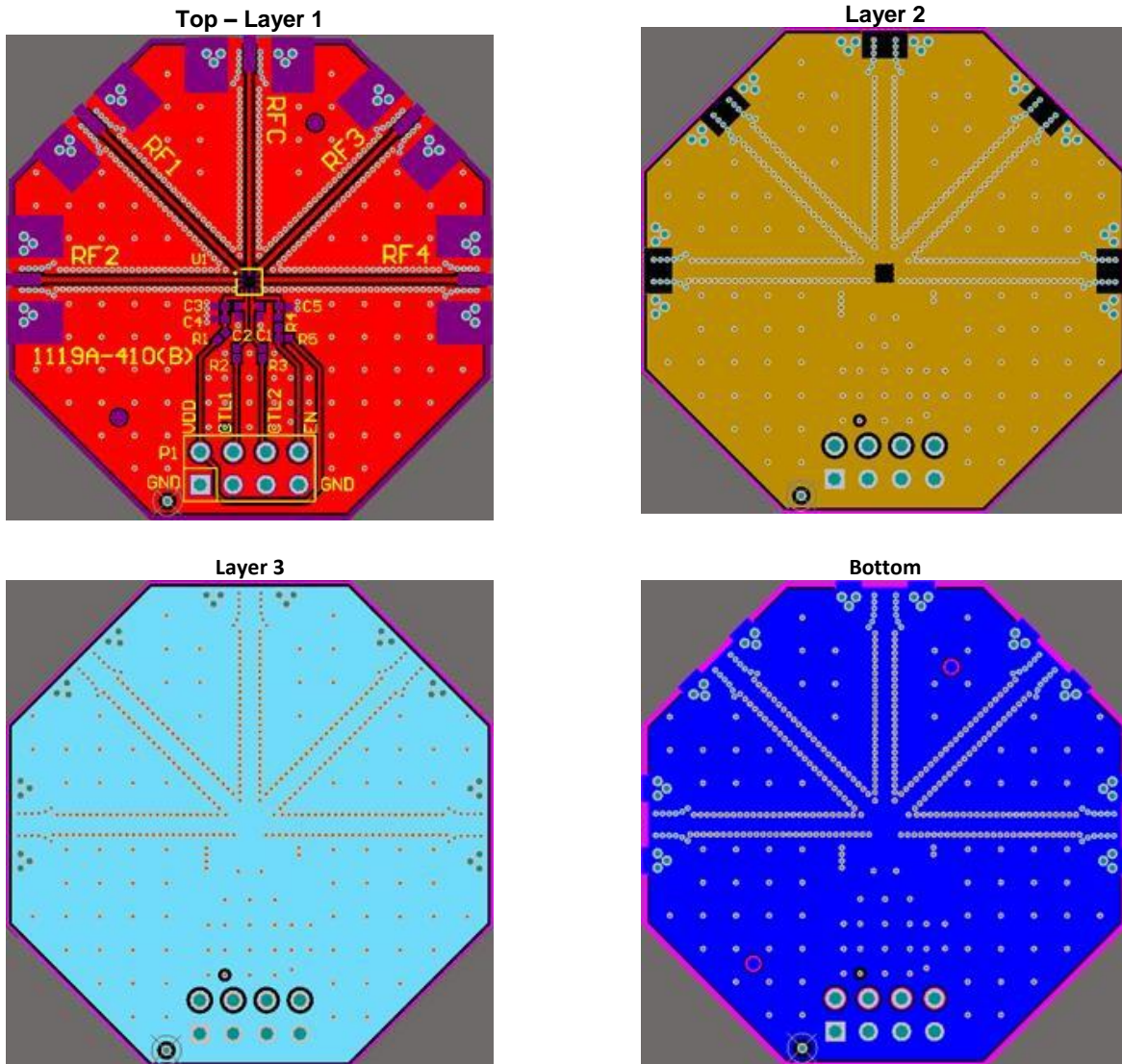
**Decoupling Capacitors** = The decoupling capacitor on V<sub>DD</sub> may be used for noise reduction. The value of the de-coupling capacitor should be selected based on the application.

**DC Blocking Capacitors** = DC blocking capacitor is not required on an RF port if no DC voltage exists on that port.

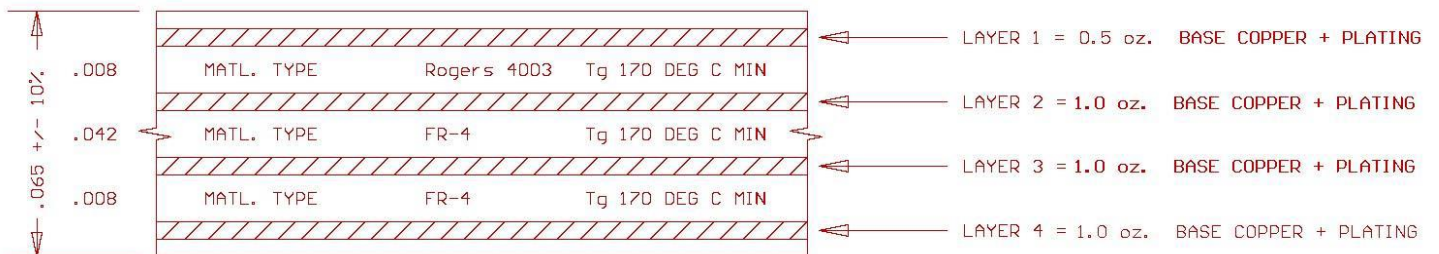
Package Outline and Branding Drawing (Dimensions in Millimeters)



Evaluation Board Layout



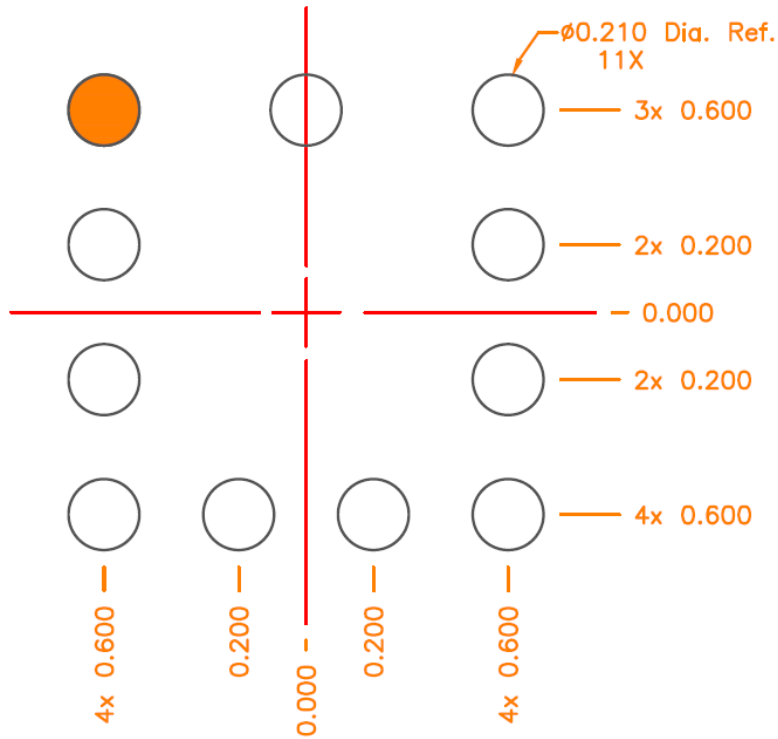
EVB Layer Information



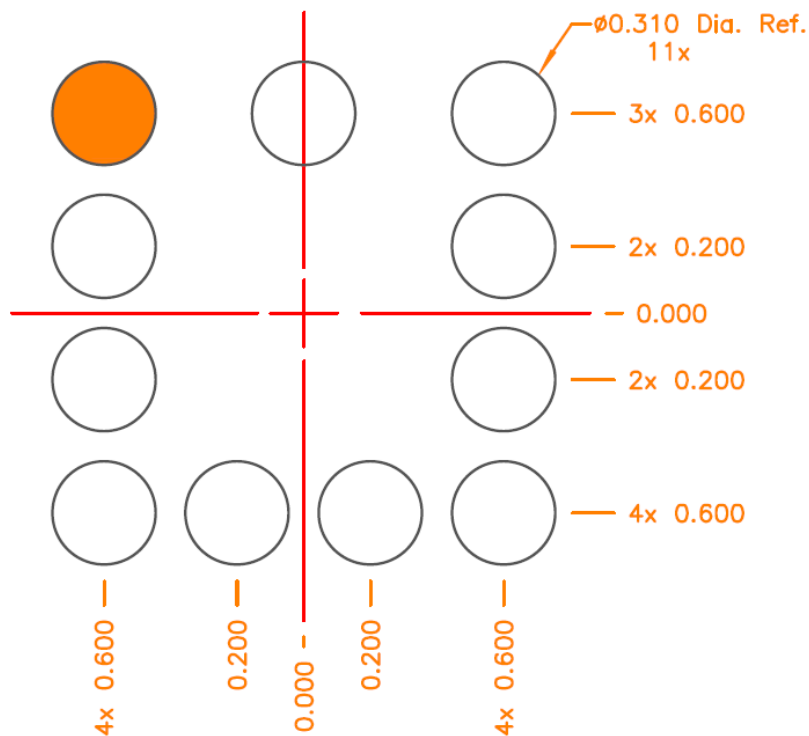


PCB Design Requirements

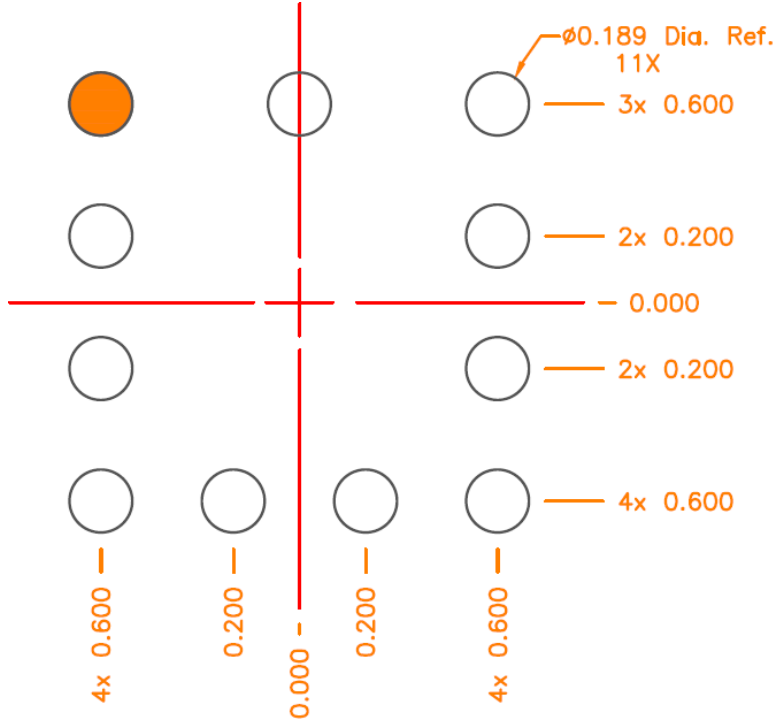
PCB Metal Land Pattern



PCB Soldermask Pattern



PCB Stencil Pattern



## 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 device. The control signals CTL1 and CTL2 should be set to 0 V unless  $V_{DD}$  & EN are set in the operating voltage range.

RF signal should not be applied on any of the RF ports when the  $V_{DD}$  is below 2.4 V and the EN is set below  $V_{HIGH\_EN}$ .

### Power ON –

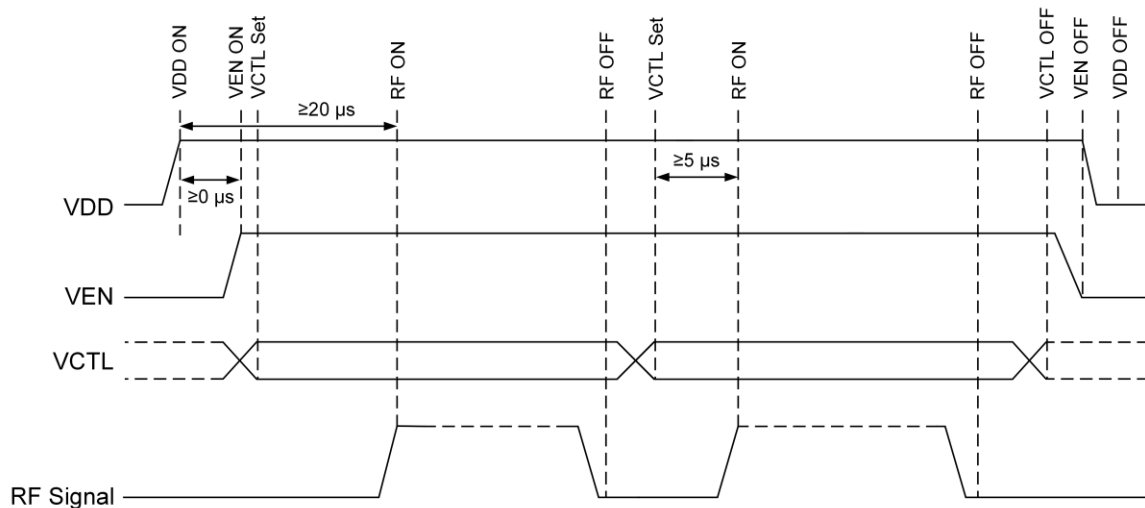
1. Apply voltage supply –  $V_{DD}$
2. Apply Enable –  $V_{EN}$  ( $V_{EN}$  can be connected to  $V_{DD}$  and applied at the same time)
3. Apply controls – CTL1 and CTL2
4. Wait 20  $\mu\text{s}$  or greater and then apply RF

### Change switch position from one RF port to another –

1. Remove RF
2. Change controls CTL1 and CTL2 to set the switch to desired RF port
3. Wait 5  $\mu\text{s}$  or greater and then apply RF

### Power OFF –

1. Remove RF
2. Remove controls – CTL1 & CTL2
3. Remove  $V_{EN}$
4. Remove  $V_{DD}$



## RoHS Compliance

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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	Release Date	Description
DS140224	February 2014	First production release.
DS151020	October 2015	Add R <sub>ON</sub> and C <sub>OFF</sub> limits.

## Contact Information

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

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