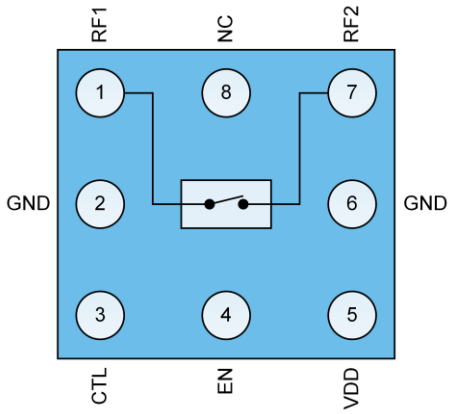
RF1117

SPST (Single Pole Single Throw Switch)

Product Overview

RF1117 is a single-pole single-throw (SPST) switch designed for static antenna/impedance tuning applications. It offers low insertion loss, rugged power handling, and extremely low power consumption during operation. RF1117 delivers excellent linearity performance, making it ideal for use in multi-mode GSM/GPRS/EDGE/WCDMA/LTE applications. The switch state is controlled through standard GPIO interface for easy control and includes an integrated LDO (Low Drop Out) regulator for consistent operation over a wide voltage supply range. All pins are ESD protected to ensure 1.5 kV HBM ESD tolerance. The RF1117 is designed into a small chip-scale package (WLCSP) for extremely low packaging parasitics and ultra-compact solution size of 1.26 x 1.26 mm.

Functional Block Diagram



Functional Block Diagram

WLCSP, 8-pin, 1.26 mm x 1.26 mm

Key Features

- Low insertion loss: 0.2 dB typ
- High peak voltage handling
- High linearity
- 1.5 kV HBM ESD protection at all ports
- Ultra small package
- WLCSP, 8-pin, 1.26 mm x 1.26 mm
- No external DC blocking capacitor required (unless external DC is applied to the RF ports)
- Wide voltage range (V_{BAT} compatible)

Applications

- Antenna Tuning
- Band Switching
- Impedance Tuning

Ordering Information

Part Number	Description
RF1117PCBA-410	Evaluation Board
RF1117SR	100-pc 7” Reel
RF1117TR13	5000-pc, 13” Tape and Reel

Absolute Maximum Ratings

Parameter	Rating	Unit
Power supply voltage, V_{DD}	6.0	V
Control voltage, V_{CTL}	3.0	V
Enable voltage, V_{EN}	3.0	V
ESD All Pins, HBM, JESD22-A114	1.5	kV
Storage temperature	-40 to 150	°C
Operating temperature	-30 to 85	°C
Max differential RF voltage between the RF ports, V_{RF}	31.6	V_P
RF Input power 50 Ω	40	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.

Nominal Operating Parameters

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
					Nominal conditions unless otherwise specified. V_{DD} = 3.5 V, V_{EN} = 1.8/0 V, V_{CTL} = 1.8/0 V, Temp = 25 °C, 50 Ω.
Operating supply voltage, V_{DD}	2.4	–	4.5	V	
Supply current, I_{DD}	–	85	100	µA	Active Mode, V_{EN} = 1.8 V
	–	4	10	µA	Low Power Mode, V_{EN} = 0 V
Control voltage – High, V_{CTLH} & V_{ENH}	1.2	1.8	2.8	V	
Control voltage – Low, V_{CTLL} & V_{ENL}	0.0	–	0.45	V	
Control current – High, I_{CTLH}	–	–	1	µA	
Control current – Low, I_{CTLL}	–	–	1	µA	

Electrical Specifications – Linear Parameters

Parameter & Description	Specification			Unit	Condition
	Min.	Typ.	Max.		
					Nominal conditions unless otherwise specified. V_{DD} = 3.5 V, V_{EN} = 1.8/0 V, V_{CTL} = 1.8/0 V, Temp = 25 °C, 50 Ω.
Insertion Loss (RF1 to RF2) Logic State 2 – Switch ON	–	0.20	0.35	dB	700 MHz to 2700 MHz
Isolation (RF1 to RF2) Logic State 3 – Switch OFF	18	22	–	dB	700 MHz to 960 MHz
	13	15	–	dB	1700 MHz to 2170 MHz
	11	13	–	dB	2300 MHz to 2700 MHz
Return Loss Logic State 2 – Switch ON	25	30	–	dB	1000 MHz
ON Resistance (RF1 to RF2) Logic State 2 – Switch ON	–	1.5	2.0	Ω	
OFF Capacitance (RF1 to RF2) Logic State 3 – Switch OFF	–	150	190	fF	
Start-up time, $t_{start-up}$	–	7	10	µs	50% V_{DD} to large signal fully compliant
ON Switching speed, t_{ON}	–	2.5	5	µs	50% control to 90% RF ON
OFF Switching speed, t_{OFF}	–	2.5	5	µs	50% control to 10% RF OFF

Electrical Specifications – Nonlinear Parameters

Parameter & Description	Specification			Unit	Condition
	Min.	Typ.	Max.		
					Nominal conditions unless otherwise specified. V_{DD} = 3.5 V, V_{EN} = 1.8/0 V, V_{CTL} = 1.8/0 V, Temp = 25 °C, 50 Ω.
Second Harmonics, $2f_0$	–	-108	-95	dBc	Pin = 35 dBm 915 MHz
Third Harmonics, $3f_0$	–	-100	-85	dBc	
Second Harmonics, $2f_0$	–	-115	-100	dBc	Pin = 33 dBm 1910 MHz
Third Harmonics, $3f_0$	–	-102	-85	dBc	
Second Harmonics, $2f_0$	–	-110	-95	dBc	Pin = 33 dBm 2300 MHz
Third Harmonics, $3f_0$	–	-110	-95	dBc	
IIP2, Low	115	125	–	dBm	Refer to IIP2 conditions table
IIP2, High	125	135	–	dBm	
IIP3 Cell	72	77	–	dBm	Refer to IIP3 conditions table
IIP3 IMT	72	77			
IIP3 SV – LTE1	72	76			
IIP3 SV – LTE2	76	80			
Receive Spurious, $P_{OUT\ Spur}$ 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

Logic State	V_{EN}	V_{CTL}	Switch	RF Path
1	V_{LOW}	X	X	Low power state
2	V_{HIGH}	V_{HIGH}	ON	RF1 to RF2 low insertion loss
3	V_{HIGH}	V_{LOW}	OFF	RF1 to RF2 high isolation

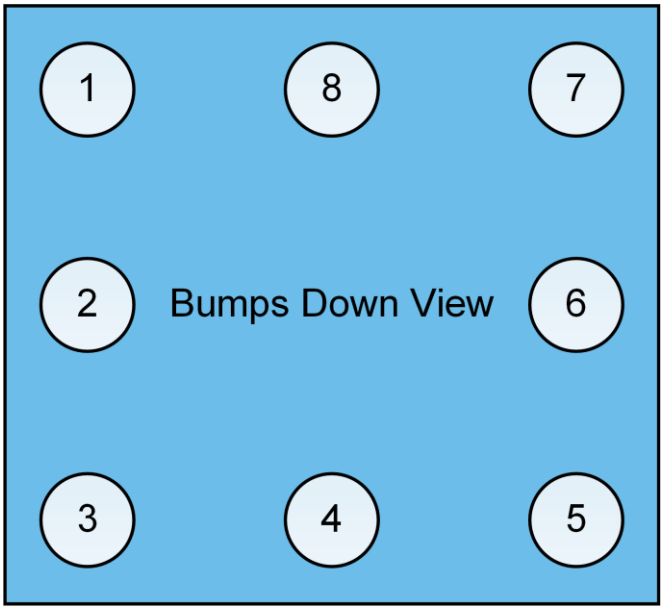
IIP2 Test Conditions

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 V High (Cell)	881.5	836.5	+20	791.5	-15
SV – LTE test 1	747	825	+11	786	+24
SV – LTE test 2	872	827	+11	782	+24

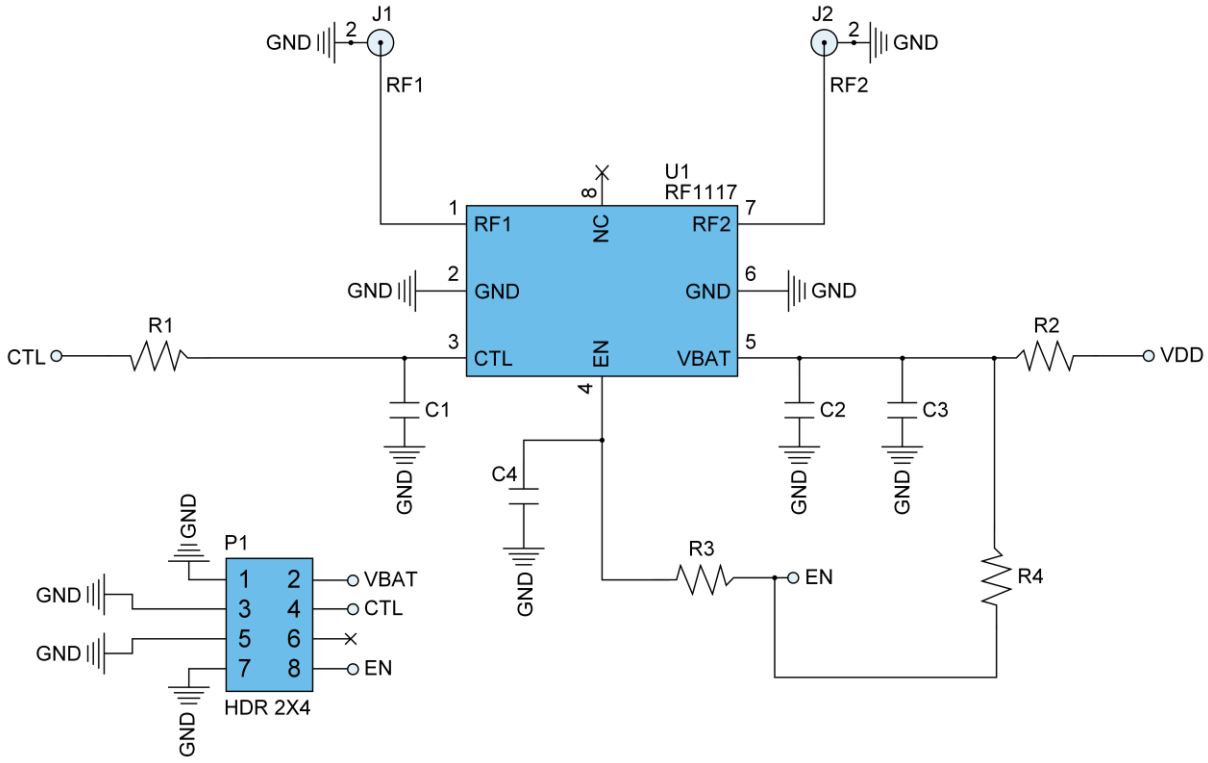
Pin Out



Pin Names and Descriptions

Pin	Name	Details
1	RF1	RF port 1
2	GND	Ground
3	CTL	Control pin
4	EN	Chip enable
5	V_{DD}	Supply voltage
6	GND	Ground
7	RF2	RF port 2
8	NC	No connect

Evaluation Board Schematic



Parts List

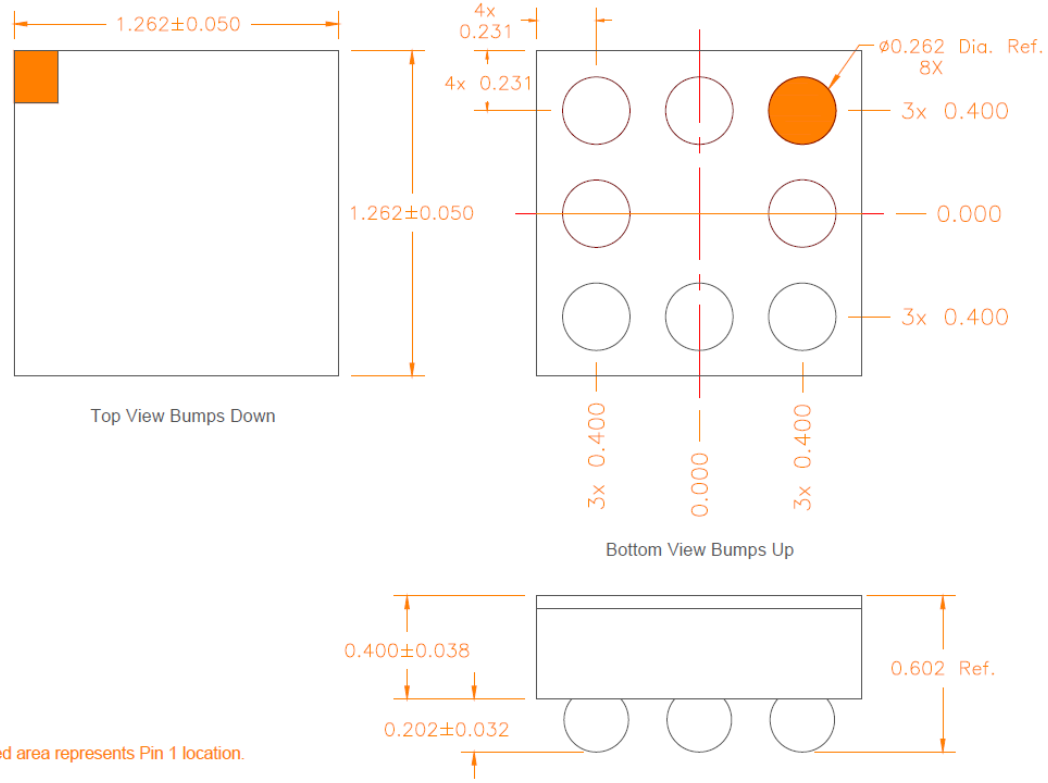
Part Number	Part	Part Description
U1	RF1117	RF1117, SPST Switch
J1, J2,	SMA connector	Edge mount 0.068” SMA connector
C2	100 pF capacitor	(0402) 100 pF de-coupling capacitor
C1 & C3	NP	Do not populate
R1, R2 & R3	0 Ω jumper	(0402) 0 Ω resistor
R4	NP	Do not populate
P1	2x4 RA header	2x4 right angled header with 0.1” spacing

Application Guidelines

Decoupling Capacitors = The decoupling capacitor on V_{DD} 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.

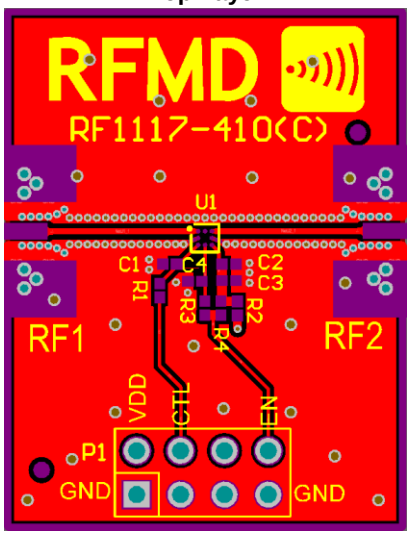
Package Outline and Branding Drawing (Dimensions in Millimeters)



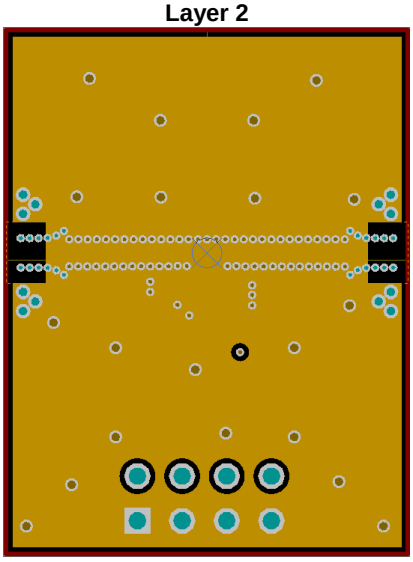
Notes:
1. Shaded area represents Pin 1 location.

Evaluation Board Layout

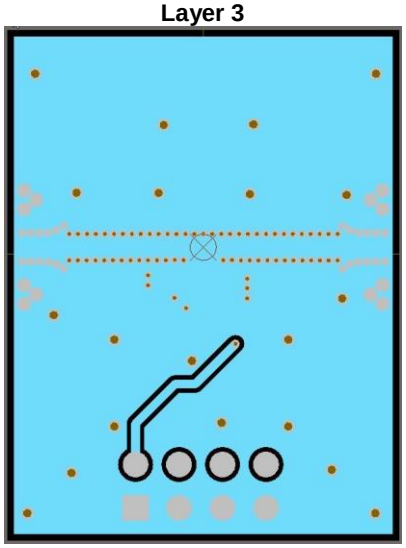
Top Layer



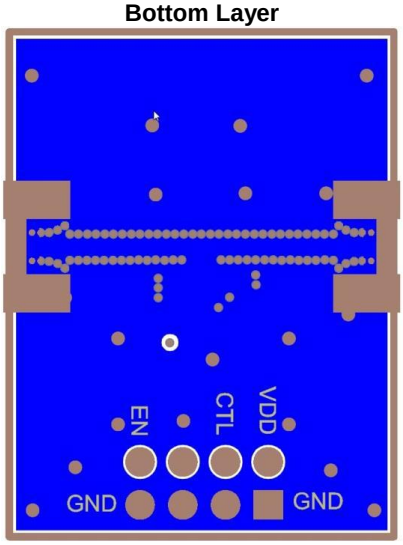
Layer 2



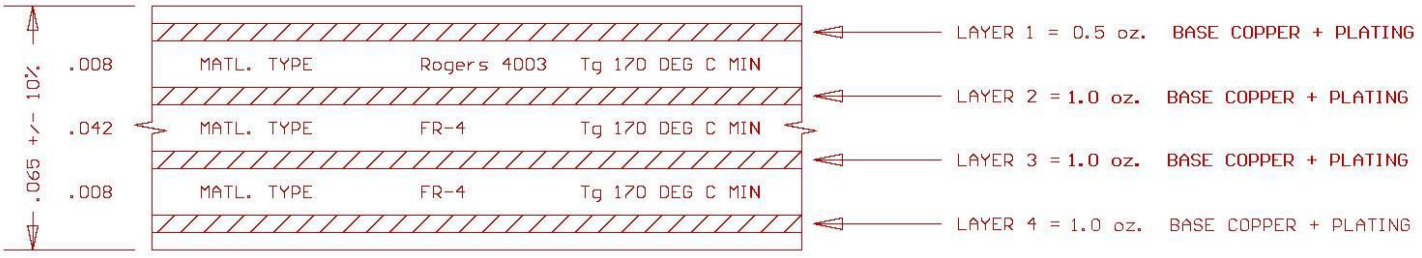
Layer 3



Bottom Layer

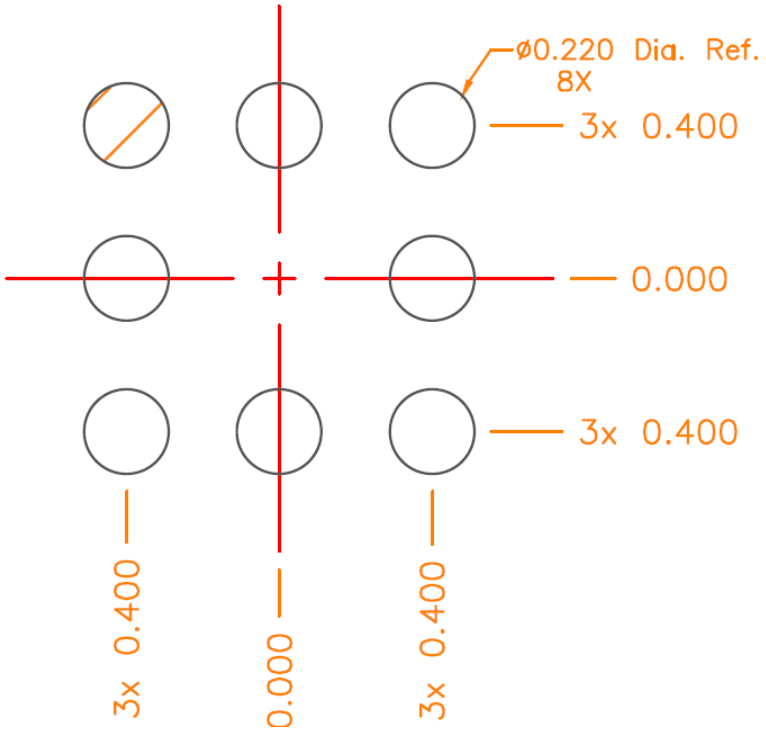


EVB Layer Information

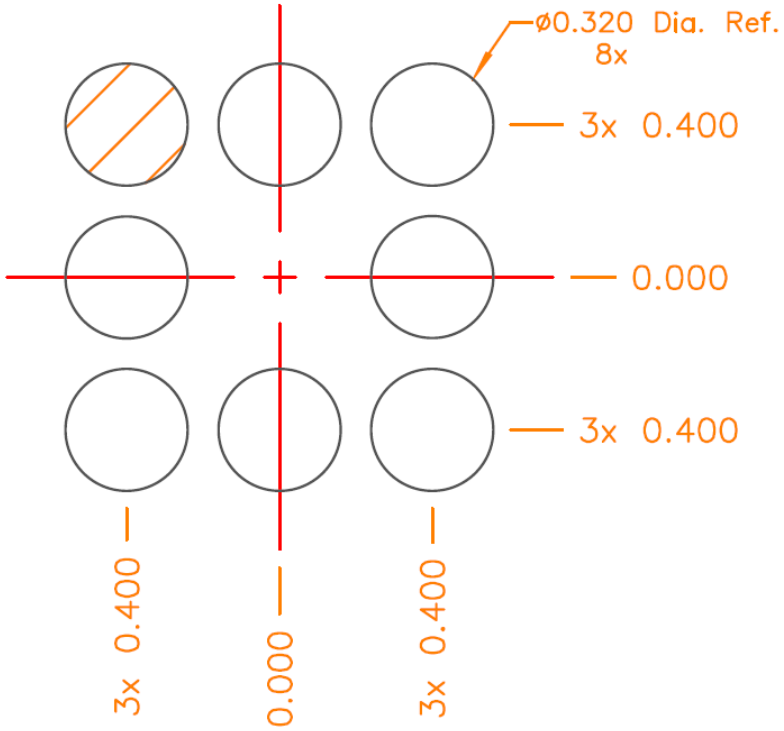


PCB Design Requirements

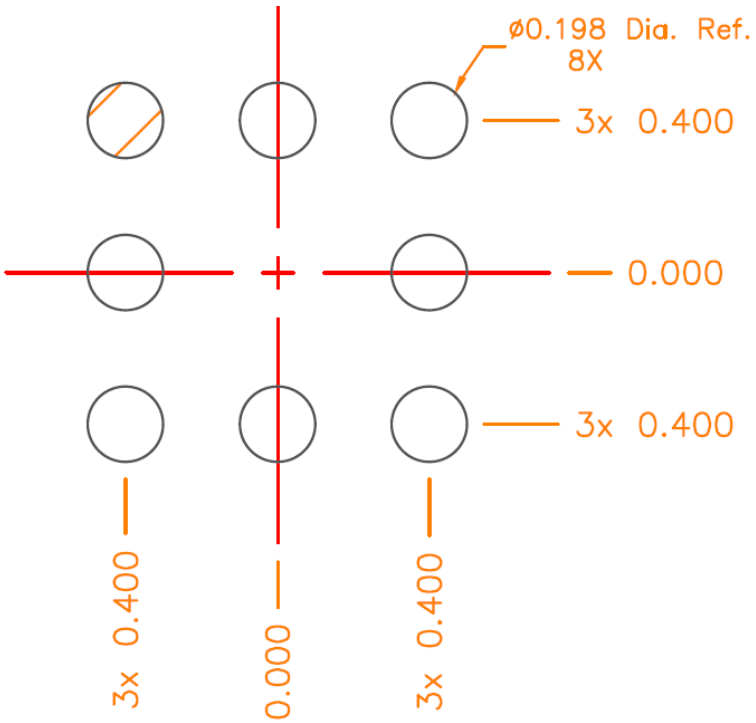
PCB Metal Land Pattern



PCB Soldermask Pattern

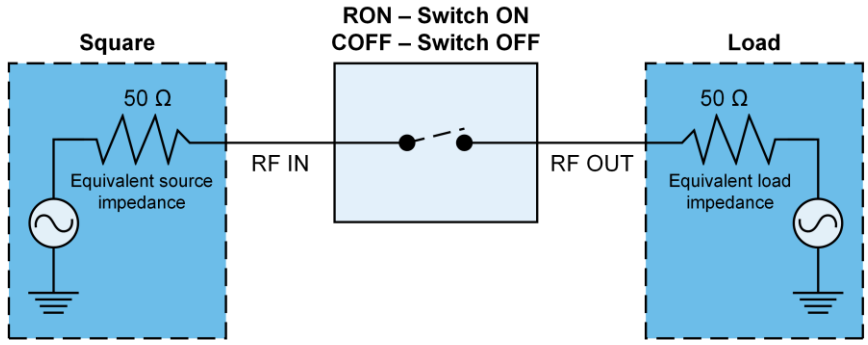


PCB Stencil Pattern

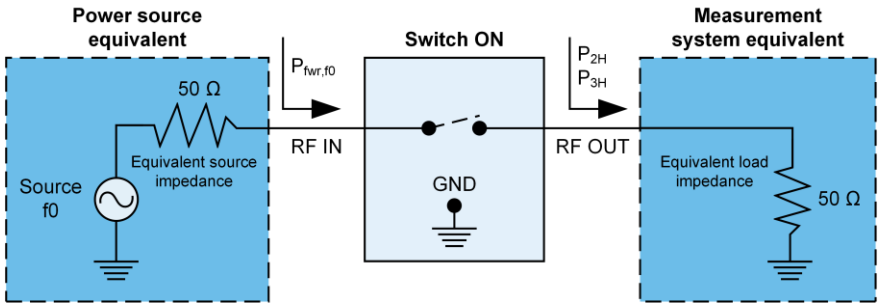


Test Setup

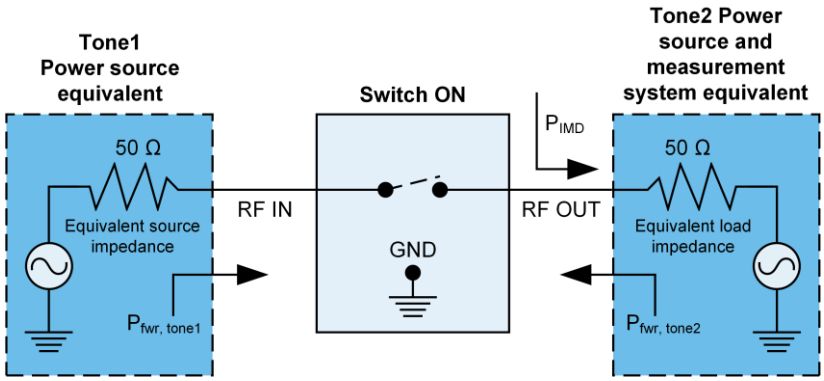
ON resistance and OFF capacitance measurement set-up



Series configuration harmonics measurement set-up



Series configuration IMDs measurement set-up



RF – IN	RF – OUT
RF1	RF2

Timing Diagram

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 CTL should be set to 0 V unless V_{DD} and V_{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 V_{EN} is set below 1.2 V.

Applicable when using application circuit in figure 3.

Power ON –

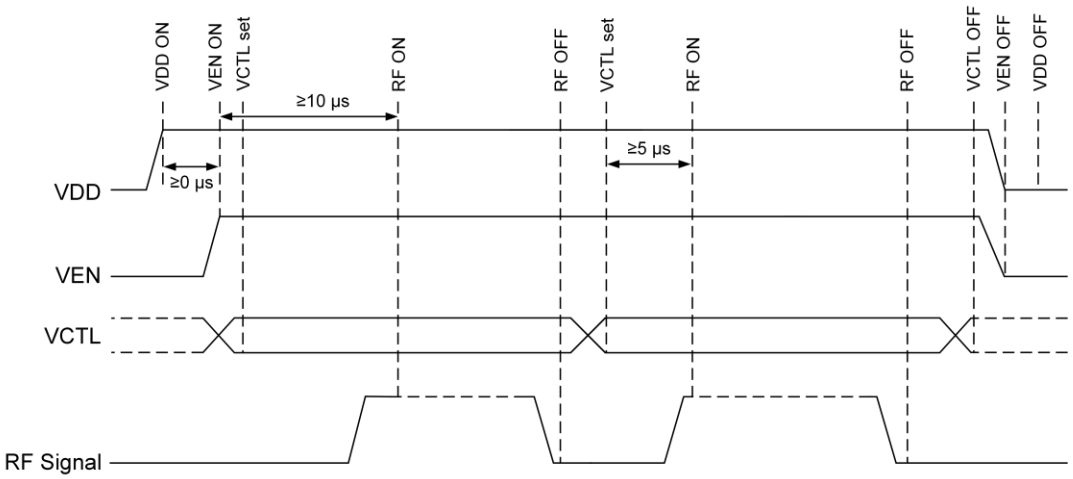
1. Apply voltage supply – V_{DD}
2. Apply enable voltage – V_{EN}
3. Apply control – CTL
4. Wait 10 µs or greater and then apply RF

Change switch position from one RF port to another –

1. Remove RF
2. Change controls CTL to set the switch to ON or OFF
3. Wait 5 µs or greater and then apply RF

Power OFF –

1. Remove RF
2. Remove control – CTL
3. Remove V_{DD} and V_{EN}



Solderability

Compatible with both lead-free (260 °C max. reflow temperature) and tin/lead (245 °C max. reflow temperature) soldering processes.
Package lead plating: Sn/Ag/Cu solder ball

Package lead plating: Sn/Ag/Cu solder ball

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 ($C_{15}H_{12}Br_4O_2$) Free
- SVHC Free

REVISION HISTORY

Revision	Description
DS131004	Initial release
DS20161006	Update to Qorvo template

Contact Information

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

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