

Package Style: QFN, 16-pin, 3mmx3mm

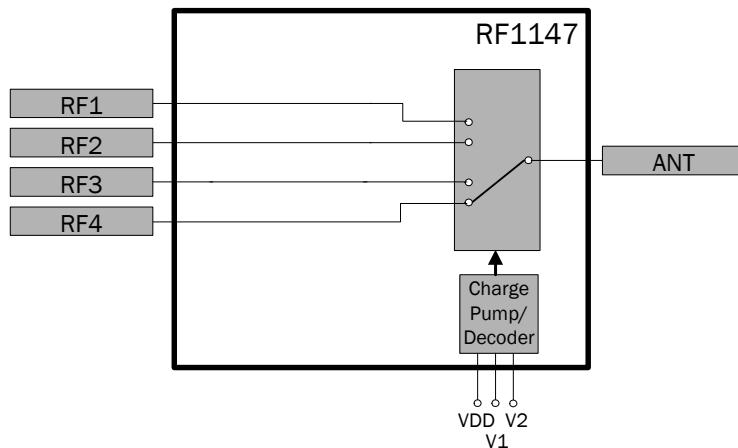


## Features

- Low Frequency - 2.7GHz Operation
- Very Low Insertion Loss:  
Cell Band 0.35dB  
PCS Band 0.45dB
- High Isolation:  
Cell Band 29dB  
PCS Band 22dB
- Compatible With Low Voltage Logic: ( $V_{HIGH} = 1.8V$ )
- Excellent Linearity Performance (IIP2):  
Cell Band 106dBm  
PCS Band 110dBm
- Lowest BOM Cost and Small Solution Size

## Applications

- Cellular Handset Applications
- Cellular Infrastructure Applications



Functional Block Diagram

## Product Description

The RF1147 is a single-pole four-throw (SP4T) switch designed for general purpose switching applications which require very low insertion loss and low power handling capability.

The RF1147 is ideally suited for battery operated applications requiring high performance switching with very low DC power consumption. The RF1147 features very low insertion loss with excellent linearity performance down to 1.8V control voltage. Additionally, RF1147 includes integrated decoding logic, allowing just two control lines needed for switch control. The RF1147 is packaged in a very compact 3mmx3mmx0.6mm, 16-pin, leadless QFN package. Unless external DC is presented to the device RF ports, no external DC blocking capacitors are needed.

## Ordering Information

RF1147                   Broadband Low Power SP4T Switch  
RF1147PCBA-410       Fully Assembled Evaluation Board

## Optimum Technology Matching® Applied

<input type="checkbox"/> GaAs HBT	<input type="checkbox"/> SiGe BiCMOS	<input checked="" type="checkbox"/> GaAs pHEMT	<input type="checkbox"/> GaN HEMT
<input type="checkbox"/> GaAs MESFET	<input type="checkbox"/> Si BiCMOS	<input checked="" type="checkbox"/> Si CMOS	<input type="checkbox"/> RF MEMS
<input type="checkbox"/> InGaP HBT	<input type="checkbox"/> SiGe HBT	<input type="checkbox"/> Si BJT	<input type="checkbox"/> LDMOS

## Absolute Maximum Ratings

Parameter	Rating	Unit
$V_{DD}$ , V1, V2	6.0	V
Maximum Input Power (DC to 2.5GHz, 2.5V Control)	28	dBm
Operating Temperature	-40 to +90	°C
Storage Temperature	-65 to +125	°C



Caution! ESD sensitive device.

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.

RoHS status based on EU Directive 2002/95/EC (at time of this document revision).

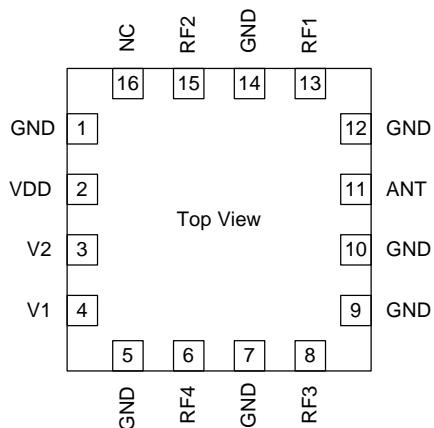
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Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Operating Characteristics					Active Mode: $V_{HIGH} \geq 1.8V$ , $V_{LOW} \leq 0.4V$ ; $V_{DD} = 2.75V$ ; Temp = 25 °C; $P_{IN} = 26$ dBm unless otherwise specified.
<b>Insertion Loss</b>					
RF1-ANT, RF2-ANT, RF3-ANT, RF4-ANT	0.35	0.50	dB	824 MHz to 960 MHz	
	0.35	0.60	dB	1574 MHz to 1577 MHz	
	0.45	0.65	dB	1850 MHz to 1990 MHz	
	0.55	0.70	dB	2170 MHz to 2500 MHz	
	0.55	0.75	dB	2510 MHz to 2690 MHz	
<b>Isolation</b>					
RF1-ANT, RF2-ANT, RF3-ANT, RF4-ANT	26	29	dB	824 MHz to 960 MHz	
	22	24	dB	1574 MHz to 1577 MHz	
	20	22	dB	1850 MHz to 1990 MHz	
	17	20	dB	2170 MHz to 2500 MHz	
	17	20	dB	2510 MHz to 2690 MHz	
<b>Return Loss</b>					
RF1-ANT, RF2-ANT, RF3-ANT, RF4-ANT	19	25	dB	For above listed frequency ranges, all RF ports in Insertion Loss state.	
<b>Harmonics</b>					
Second Harmonic ( $2f_0$ )	70	86	dBc	$f = 880$ MHz, $P_{IN} = 26$ dBm	
	70	88	dBc	$f = 1880$ MHz, $P_{IN} = 26$ dBm	
Third Harmonic ( $3f_0$ )	70	81	dBc	$f = 880$ MHz, $P_{IN} = 26$ dBm	
	70	79	dBc	$f = 1880$ MHz, $P_{IN} = 26$ dBm	
<b>IIP2</b>					
RF1-ANT, RF2-ANT, RF3-ANT, RF4-ANT (Cell)	102	106	dBm	Tone 1: 824 MHz @ 16 dBm, Tone 2: 1693 MHz @ -20 dBm, Receive Freq: 869 MHz	
RF1-ANT, RF2-ANT, RF3-ANT, RF4-ANT (AWS)	104	108	dBm	Tone 1: 1710 MHz @ 16 dBm, Tone 2: 3820 MHz @ -20 dBm, Receive Freq: 2110 MHz	
RF1-ANT, RF2-ANT, RF3-ANT, RF4-ANT (PCS)	106	110	dBm	Tone 1: 1850 MHz @ 16 dBm, Tone 2: 3780 MHz @ -20 dBm, Receive Freq: 1930 MHz	
<b>Triple Beat Ratio (TBR)</b>					
RF1-ANT, RF2-ANT, RF3-ANT, RF4-ANT (Cell)	65	68	dBc	VSWR = 2:1; Temp = 15 °C, 25 °C, 60 °C; Jammer Freq = 881.5 MHz	
RF1-ANT, RF2-ANT, RF3-ANT, RF4-ANT (PCS)	65	68	dBc	VSWR = 2:1; Temp = 15 °C, 25 °C, 60 °C; Jammer Freq = 1960 MHz	

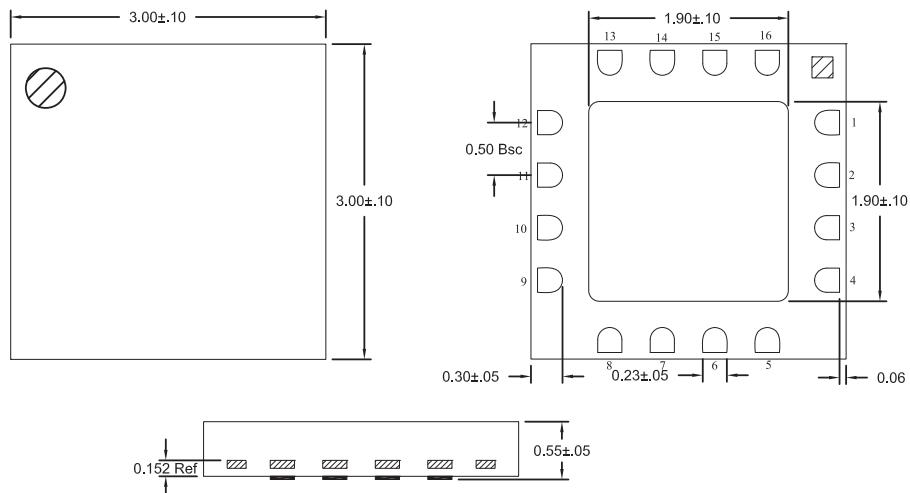
Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
<b>0.1dB Compression (P<sub>0.1dB</sub>)</b>					
	28			dBm	f=900 MHz
	28			dBm	f=1800 MHz
<b>Switching Speed</b>					
		0.55	1.5	μs	50% control to 10%/90%
<b>Supply and Control Signal Characteristics</b>					
Switch Supply Voltage (V <sub>DD</sub> )	2.50	2.75	3.30	V	Continuously
Supply Current (I <sub>DD</sub> )		600	900	μA	
Control Voltage					
V <sub>HIGH</sub>	1.3	1.8	2.9	V	
V <sub>LOW</sub>	0		0.4	V	
Control Current		0.1	1	μA	P <sub>IN</sub> =16 dBm

Pin	Function	Description
1	<b>GND</b>	Ground
2	<b>VDD</b>	Supply
3	<b>V2</b>	Control Signal 2
4	<b>V1</b>	Control Signal 1
5	<b>GND</b>	Ground
6	<b>RF</b>	RF Output 4
7	<b>GND</b>	Ground
8	<b>RF3</b>	RF Output 3
9	<b>GND</b>	Ground
10	<b>GND</b>	Ground
11	<b>ANT</b>	RF input. Connected to antenna
12	<b>GND</b>	Ground
13	<b>RF1</b>	RF Output 1
14	<b>GND</b>	Ground
15	<b>RF2</b>	RF Output 2
16	<b>NC</b>	Can be left floating or grounded
<b>PKG BASE</b>	<b>GND</b>	Ground

## Pin Out



## Package Drawing



NOTES:

## General Information

### Control Logic

The switch is operable in four states (see Truth table, below). The switch is designed for two modes: Active and Stand-by. These modes are controlled by the V<sub>DD</sub> signal. When V<sub>DD</sub> is high, the switch is active.

### Truth Table

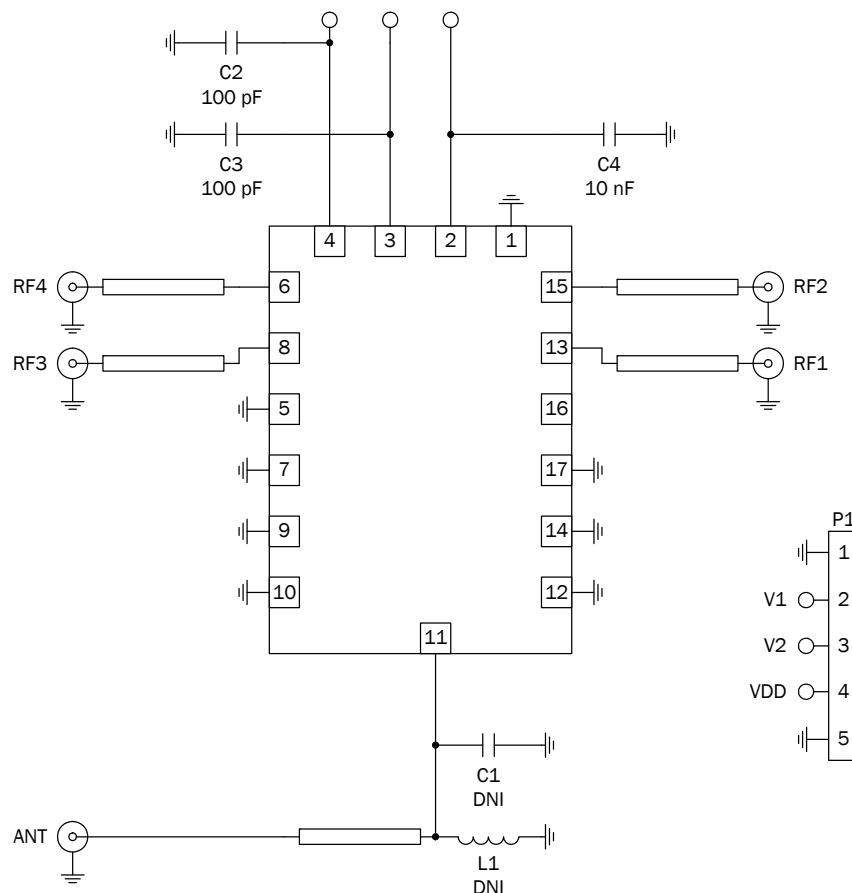
Mode	V1	V2	S1	S2	S3	S4
ANT-RF1	Low	Low	ON	OFF	OFF	OFF
ANT-RF2	Low	High	OFF	ON	OFF	OFF
ANT-RF3	High	Low	OFF	OFF	ON	OFF
ANT-RF4	High	High	OFF	OFF	OFF	ON

### Electrical Test Methods

The electrical parameters for the switch were measured on test Evaluation Board provided by the switch supplier. The test Evaluation Board includes means for decoupling RF signals from control signal port (shunt capacitor at control signal ports).

All measurements are done with calibration plane at switch pins. The effect of test board losses and phase delay has been removed from the results.

## Application Schematic



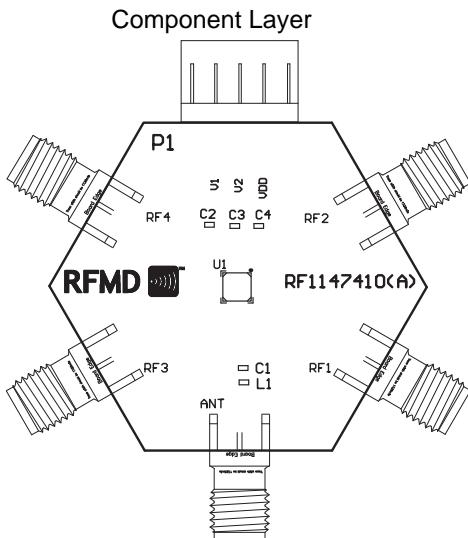
### Application Diagram and Guidelines

The decoupling capacitors are optional and, if necessary, may be used for noise reduction. Decoupling capacitors on the control pins protect the control circuitry from possible RF leakage. DC Blocking capacitors are not needed on the RF paths as there is no DC on the RF paths, however care should be taken to ensure that DC is not injected into the switch from external circuitry. An ESD filter is needed to protect the switch from antenna ESD events. The filter is formed by LESD inductor and CESD capacitor. The switch has a supply input to feed the built-in logic decoding.

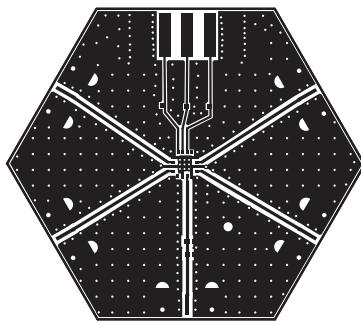
\*LESD value will depend on the level of ESD protection and the loss acceptable in a given application.

## Evaluation Board Layout

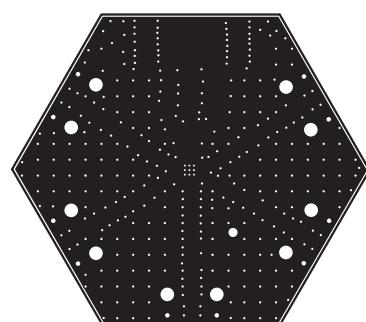
Board Thickness 0.0658", Board Material FR-4 and Rogers R2003



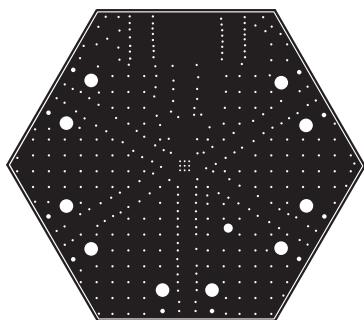
Topside RF Layer



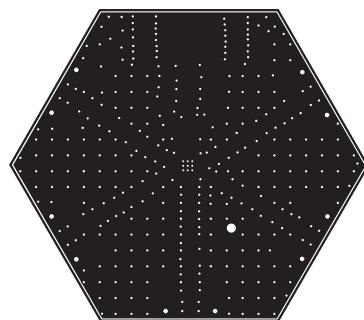
Inner Layer 1



Inner Layer 2



Ground Plane Layer



## Typical Performance Data on Evaluation Board

Fixture losses have been de-embedded (Temp=25 °C, V<sub>DD</sub>=2.75V, V<sub>CONTROL</sub> High=1.8V, V<sub>CONTROL</sub> Low=0V)

