RF1146

BROADBAND LOW POWER SP4T SWITCH

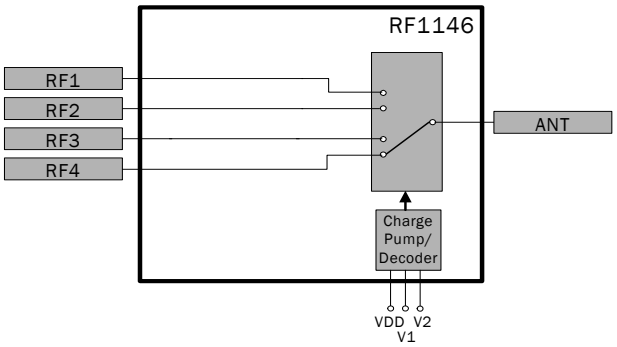
Package Style: QFN, 16-pin, 3mmx3mm

Features

- Low Frequency - 2.5GHz 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: No DC Blocking Capacitors Required on the RF Paths

Applications

- Cellular Handset Applications
- Cellular Infrastructure Applications



Functional Block Diagram

Product Description

The RF1146 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 RF1146 is ideally suited for battery operated applications requiring high performance switching with very low DC power consumption. The RF1146 features very low insertion loss with excellent linearity performance down to 1.8V control voltage. Additionally, RF1146 includes integrated decoding logic, allowing just two control lines needed for switch control. The RF1146 is packaged in a very compact 3mmx3mmx0.6mm, 16-pin, leadless QFN package. No DC-blocking capacitors are required on RF paths, unless DC is applied externally to the device ports.

Ordering Information

RF1146	Broadband Low Power SP4T Switch
RF1146PCBA-410	Fully Assembled Evaluation Board

Optimum Technology Matching® Applied

☐ GaAs HBT	☐ SiGe BiCMOS	☑ GaAs pHEMT	☐ GaN HEMT
☐ GaAs MESFET	☐ Si BiCMOS	☑ Si CMOS	☐ RF MEMS
☐ InGaP HBT	☐ SiGe HBT	☐ Si BJT	☐ LDMOS

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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	-30 to +85	°C
Storage Temperature	-65 to +100	°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 EUDirective2002/95/EC (at time of this document revision).

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}=26dBm unless otherwise specified.
Insertion Loss					
RF1-ANT, RF2-ANT, RF3-ANT, RF4-ANT		0.35	0.50	dB	824MHz to 960MHz
		0.35	0.60	dB	1574MHz to 1577MHz
		0.45	0.65	dB	1850MHz to 1990MHz
		0.55	0.70		2170MHz to 2500MHz
Isolation					
RF1-ANT, RF2-ANT, RF3-ANT, RF4-ANT	18	29		dB	824MHz to 960MHz
	22	24		dB	1574MHz to 1577MHz
	20	22		dB	1850MHz to 1990MHz
	17	20		dB	2170MHz to 2500MHz
Return Loss					
RF1-ANT, RF2-ANT, RF3-ANT, RF4-ANT	19			dB	600MHz to 2500MHz, All RF ports in Insertion Loss state.
Harmonics					
Second Harmonic ($2f_0$)	70	86		dBc	f=880MHz, P_{IN}=26dBm
	70	88		dBc	f=1880MHz, P_{IN}=26dBm
Third Harmonic ($3f_0$)	70	81		dBc	f=880MHz, P_{IN}=26dBm
	70	79		dBc	f=1880MHz, P_{IN}=26dBm
IIP2					
RF1-ANT, RF2-ANT, RF3-ANT, RF4-ANT (Cell)	102	106		dBm	Tone 1: 824MHz @ 16dBm, Tone 2: 1693MHz @ -20dBm, Receive Freq: 869MHz
RF1-ANT, RF2-ANT, RF3-ANT, RF4-ANT (AWS)	104	108		dBm	Tone 1: 1710MHz @ 16dBm, Tone 2: 3820MHz @ -20dBm, Receive Freq: 2110MHz
RF1-ANT, RF2-ANT, RF3-ANT, RF4-ANT (PCS)	106	110		dBm	Tone 1: 1850MHz @ 16dBm, Tone 2: 3780MHz @ -20dBm, Receive Freq: 1930MHz
Triple Beat Ration (TBR)					
RF1-ANT, RF2-ANT, RF3-ANT, RF4-ANT (Cell)	65	68		dBc	VSWR=2:1; Temp=15°C, 25°C, 60°C; Jammer Freq=881.5MHz
RF1-ANT, RF2-ANT, RF3-ANT, RF4-ANT (PCS)	65	68		dBc	VSWR=2:1; Temp=15°C, 25°C, 60°C; Jammer Freq=1960MHz
0.1dB Compression (P0.1dB)					
	28			dBm	f=900MHz
	28			dBm	f=1800MHz

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Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Switching Speed					
		0.55	1.5	us	50% control to 10%/90%
Supply and Control Signal Characteristics					
Switch Supply Voltage (V_{DD})	2.50	2.75	3.30	V	Continuously
Supply Current (I_{DD})		650	990	µA	At Pin=16dBm
Control Voltage					
V_{HIGH}	1.3	1.8	2.9	V	
V_{LOW}	0		0.4	V	
Control Current		0.1	1	uA	P_{IN}=16dBm

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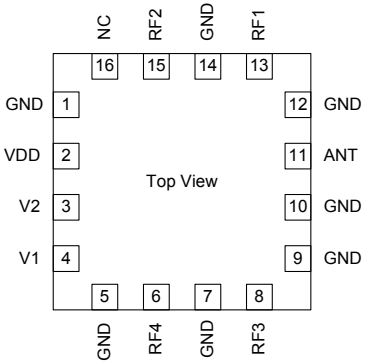
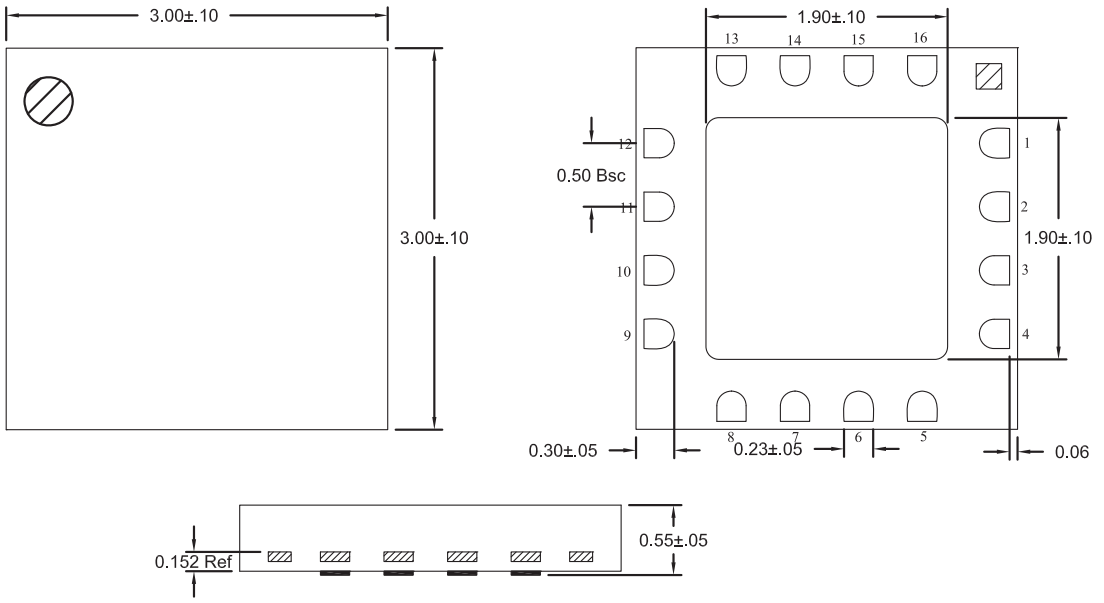
Pin	Function	Description
1	GND	Ground
2	VDD	Supply
3	V2	Control Signal 2
4	V1	Control Signal 1
5	GND	Ground
6	RF4	RF Output 4
7	GND	Ground
8	RF3	RF Output 3
9	GND	Ground
10	GND	Ground
11	ANT	RF input. Connected to antenna
12	GND	Ground
13	RF1	RF Output 1
14	GND	Ground
15	RF2	RF Output 2
16	NC	Can be left floating or grounded
PKG BASE	GND	Ground

Pin Out



Package Drawing



NOTES:
1) PIN 1 SHADED AREA

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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_{DD} signal. When VDD is high, the switch is active.

Control Logic

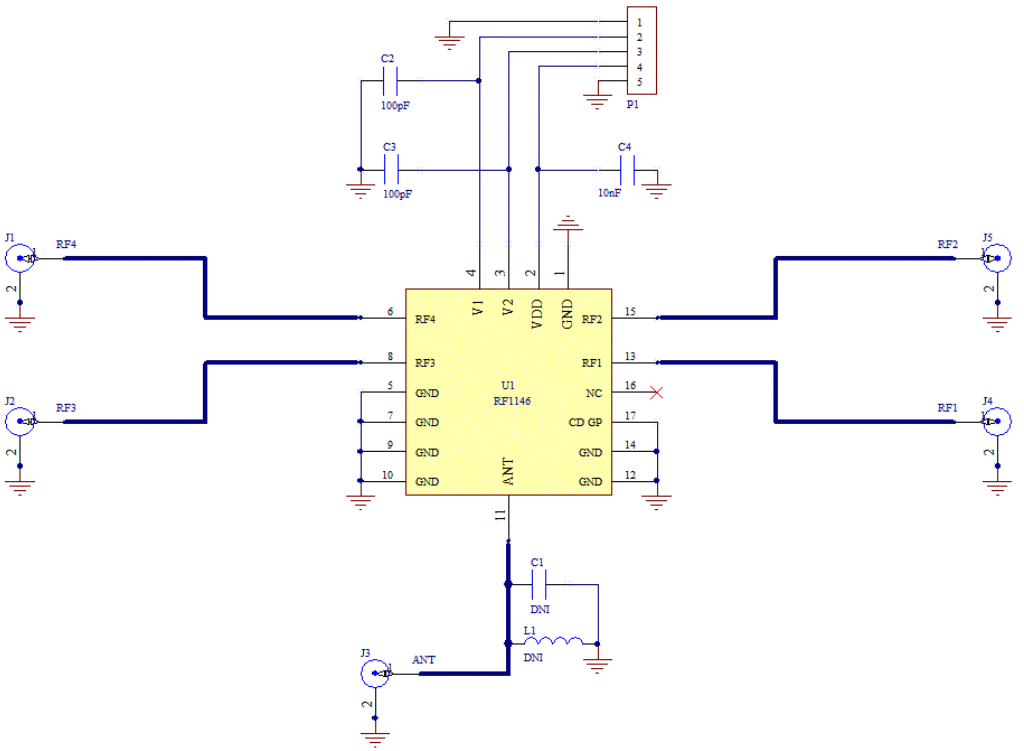
Mode	V1	V2	S1	S2	S3	S4
ANT-RF1	Low	Low	ON	OFF	OFF	OFF
ANT-RF2	High	Low	OFF	ON	OFF	OFF
ANT-RF3	Low	High	OFF	OFF	ON	OFF
ANT-RF4	High	High	OFF	OFF	OFF	ON

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.

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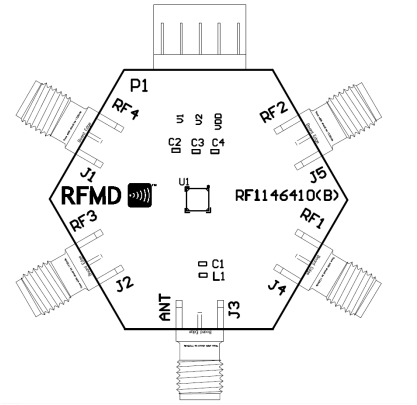
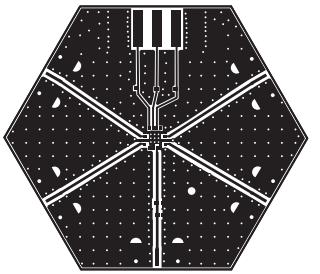
Evaluation Board Layout

Board Thickness 0.0658", Board Material FR-4

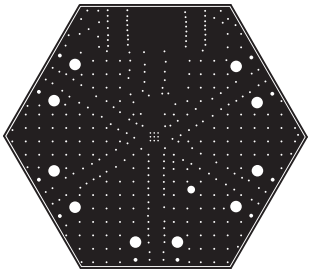
Component Layer



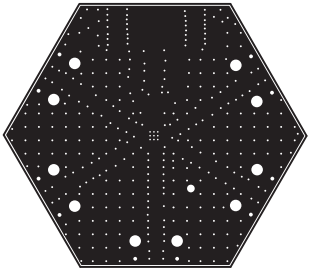
Topside RF Layer



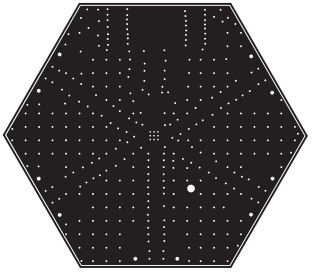
Inner Layer 1



Inner Layer 2



Ground Plane Layer



Typical Performance Data on Evaluation Board

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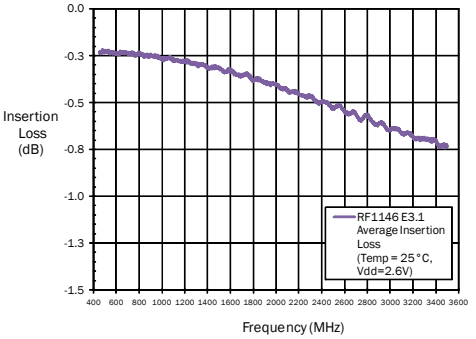
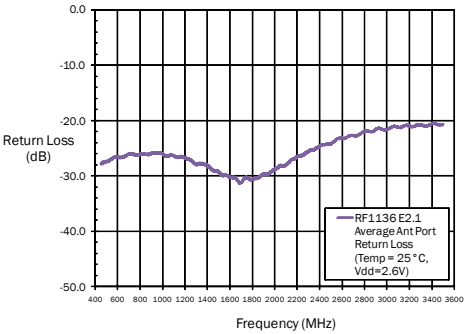
Fixture losses have been de-embedded (Temp=25°C, V_{DD}=2.75V, $V_{CONTROL}$ High=1.8V, $V_{CONTROL}$ Low=0V)

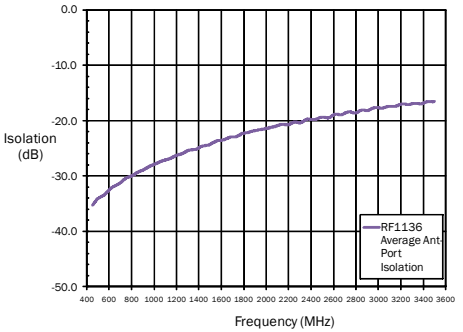
Insertion Loss
(Temp = 25°C, V_{DD}=2.75V)



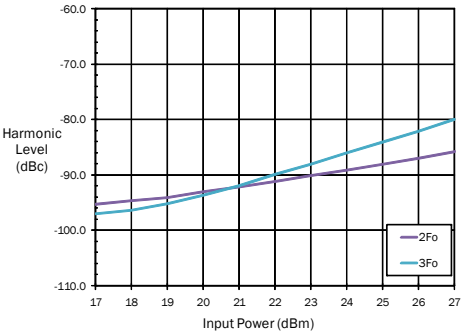
Return Loss
(Temp = 25°C, V_{DD}=2.75V)



Antenna to Port Isolation
(Temp = 25°C, V_{DD}=2.75V)



Harmonics
(Temp=25°C, V_{DD}=2.75v, Frequency=880MHz)



Output Power versus Input Power
(Temperature=25°C, Frequency=1880MHz, V_{DD}=2.75v)