

# SKY13398-000: 0.02 – 6.0 GHz pHEMT GaAs SP3T Switch

## Applications

- 802.11 a/b/g/n WLAN networks
- Bluetooth® systems

## Features

- Positive low voltage control: 0/1.8 to 5.0 V
- Low insertion loss: 0.8 dB @ 2.5 GHz
- Excellent linearity performance: P1dB = +33 dBm
- Advanced pHEMT process
- Bare pHEMT die: 650 x 450 x 127 μm



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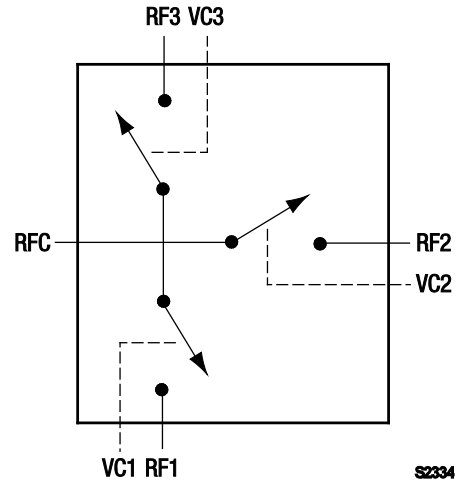
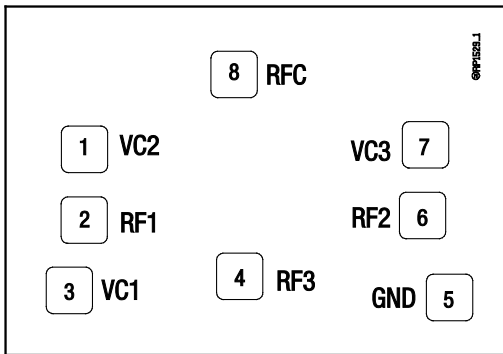


Figure 1. SKY13398-000 Block Diagram



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Figure 2. SKY13398-000 Pinout (Top View)

## Description

The SKY13398-000 is a GaAs pHEMT Single-Pole, Triple-Throw (SP3T) antenna switch that operates in the 0.1 to 6.0 GHz frequency range. Switching between the antenna (RFC signal) and the RF1, RF2, and RF3 ports is accomplished with three control voltages (VC1, VC2, and VC3). This switch is a reflective short when in the isolation state.

The low loss, high isolation, high linearity, small size, and low cost make this switch ideal for all WLAN and Bluetooth systems operating in the 2.4 to 2.5 and 4.9 to 5.9 GHz bands.

The SKY13398-000 is provided as a bare die in an ultra-compact 650 x 450 x 127 μm design. A functional block diagram is shown in Figure 1. The pin configuration and package are shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.

**Table 1. SKY13398-000 Signal Descriptions**

Pin #	Name	Description	Pin #	Name	Description
1	VC2	Switch logic control (see Table 4)	5	GND	Ground
2	RF1	RF port 1. DC blocking capacitor required.	6	RF2	RF port 2. DC blocking capacitor required.
3	VC1	Switch logic control (see Table 4)	7	VC3	Switch logic control (see Table 4)
4	RF3	RF port 3. DC blocking capacitor required.	8	RFC	Antenna. DC blocking capacitor required.

**Table 2. SKY13398-000 Absolute Maximum Ratings**

Parameter	Symbol	Minimum	Maximum	Units
Control voltage (VC1, VC2, VC3)	V <sub>CC</sub>		+6	V
RF input power	P <sub>IN</sub>		+33	dBm
Operating temperature	T <sub>OP</sub>	-40	+85	°C
Storage temperature	T <sub>STG</sub>	-65	+150	°C

**Note:** Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.

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**CAUTION:** *Although this device is designed to be as robust as possible, Electrostatic Discharge (ESD) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD precautions should be used at all times.*

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**Electrical and Mechanical Specifications**

The absolute maximum ratings of the SKY13398-000 are provided in Table 2. Electrical specifications are provided in Table 3.

Typical performance characteristics of the SKY13398-000 are illustrated in Figures 3 through 6.

The state of the SKY13398-000 is determined by the logic provided in Table 4.

**Table 3. SKY13398-000 Electrical Specifications (Note 1)**  
**(V<sub>HIGH</sub> = 3.3 V, T<sub>OP</sub> = +25 °C, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Insertion loss	IL	RFC to RF1, RF2, RF3				
		0.02 to 1.0 GHz		0.55	0.70	dB
		1.0 to 2.5 GHz		0.80	0.90	dB
		2.5 to 6.0 GHz		1.50	1.80	dB
Isolation	ISO	RFC to RF1, RF2, RF3				
		0.02 to 1.0 GHz	25	27	dB	
		1.0 to 2.5 GHz	18	20	dB	
		2.5 to 6.0 GHz	12	15	dB	
Return loss (insertion loss state)	RL	RFC to RF1, RF2, RF3				
		0.02 to 1.0 GHz	20	22	dB	
		1.0 to 2.5 GHz	15	18	dB	
		2.5 to 6.0 GHz	13	15	dB	
Switching speed		50% control to 90/10% RF		50		ns
Harmonics, 2 <sup>nd</sup> , 3 <sup>rd</sup> , 4 <sup>th</sup>	2fo, 3fo, 4fo	P <sub>IN</sub> = +20 dBm		-70		dBc
1 dB Input Compression Point	IP1dB	@ 2450 MHz		+33		dBm
3 <sup>rd</sup> Order Input Intercept Point	IIP3	@ 2450 MHz, Δf = 1 MHz, P <sub>IN</sub> = +17 dBm/tone, V <sub>LOW</sub> = 0 V, V <sub>HIGH</sub> = 3.3 V		+50		dBm
Current leakage		V <sub>CTL</sub> = 3.3 V		50		μA
Control voltage:	V <sub>CTL</sub>					
		Low	0		0.2	V
High		1.8		5.0	V	

**Note 1:** Performance is guaranteed only under the conditions listed in this Table.

### Typical Performance Characteristics

(RFC to RF1/RF2/RF3 [0, 3.3 V],  $T_{OP} = +25\text{ }^{\circ}\text{C}$ , Characteristic Impedance [ $Z_0$ ] = 50  $\Omega$ , Performance Includes Wirebond Inductance, Unless Otherwise Noted)

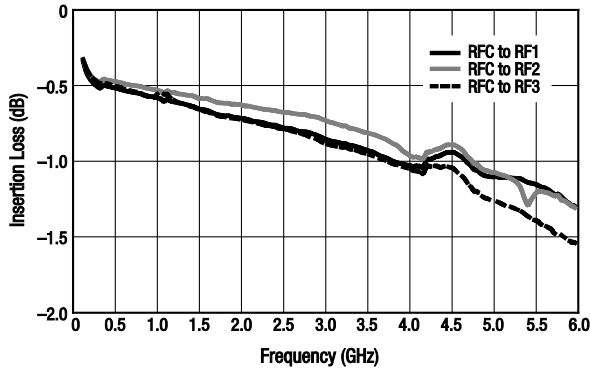


Figure 3. Insertion Loss vs Frequency

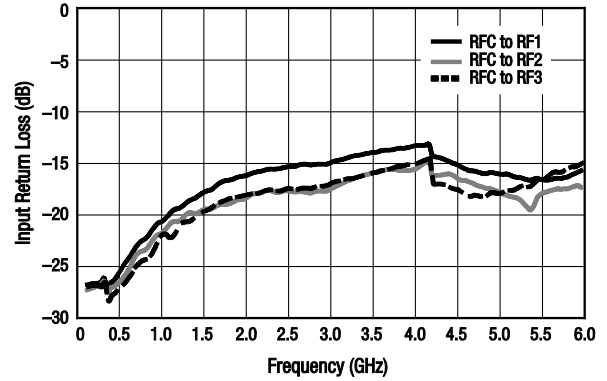


Figure 4. Input Return Loss vs Frequency  
(Insertion Loss State,  $V_{CTL} = 3.0\text{ V}$ )

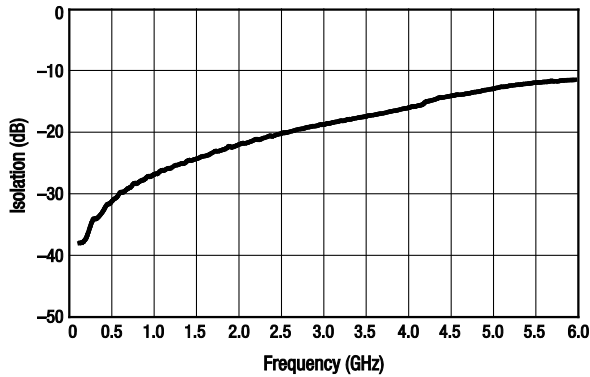


Figure 5. Isolation vs Frequency

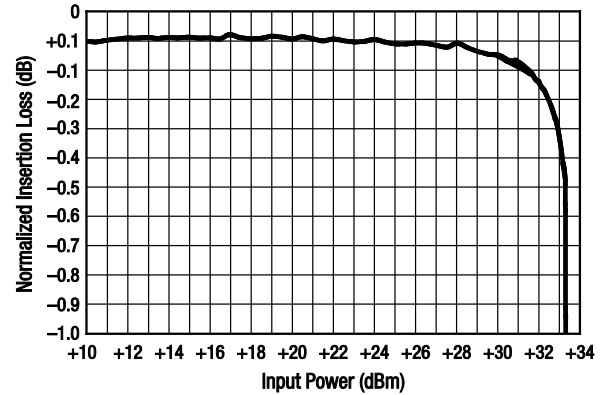


Figure 6. Normalized Insertion Loss vs Input Power

**Table 4. SKY13398-000 Truth Table**

VC1 (Pin 3)	VC2 (Pin 1)	VC3 (Pin 7)	Low Insertion Loss Path
High	Low	Low	RFC to RF1
Low	High	Low	RFC to RF2
Low	Low	High	RFC to RF3

**Note:** High = 1.8 V to 5.0 V. Low = 0 V to 0.2 V. Any state other than described in this Table places the switch into an undefined state. An undefined state will not damage the device.

**Evaluation Board Description**

The SKY13398-000 Evaluation Board is used to test the performance of the SKY13398-000 SP3T Switch. An Evaluation Board schematic diagram is provided in Figure 7. An assembly Board drawing for the Evaluation Board is shown in Figure 8.

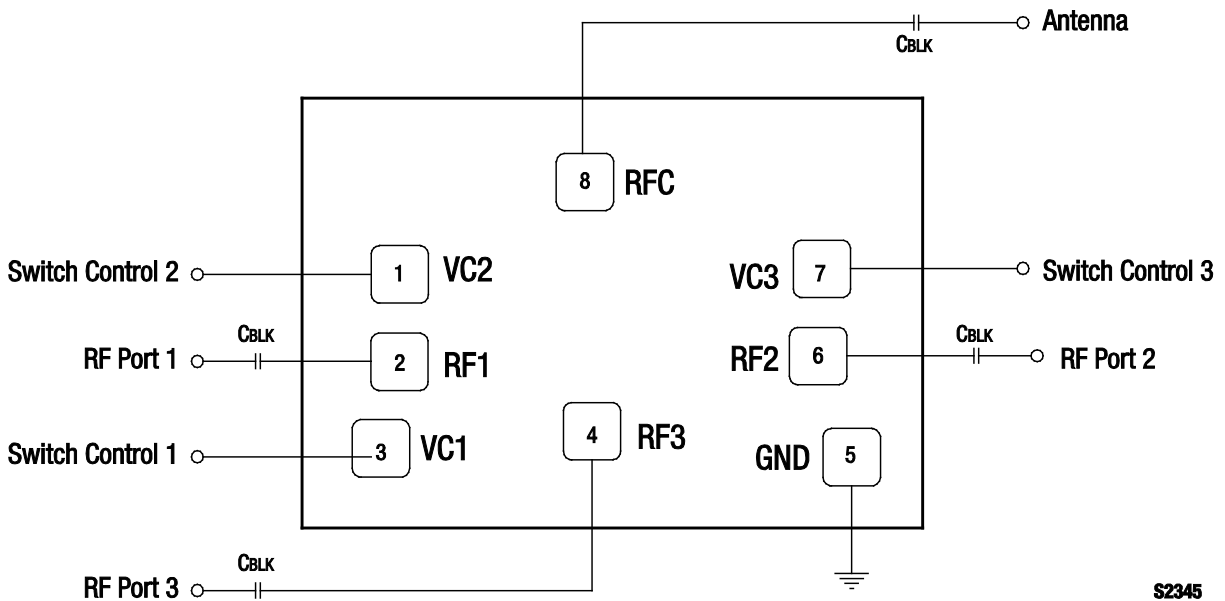
**Package Dimensions**

Package dimensions for the SKY13398-000 die are shown in Figure 9. The SKY13398-000 is shipped on a grip ring as illustrated in Figure 10.

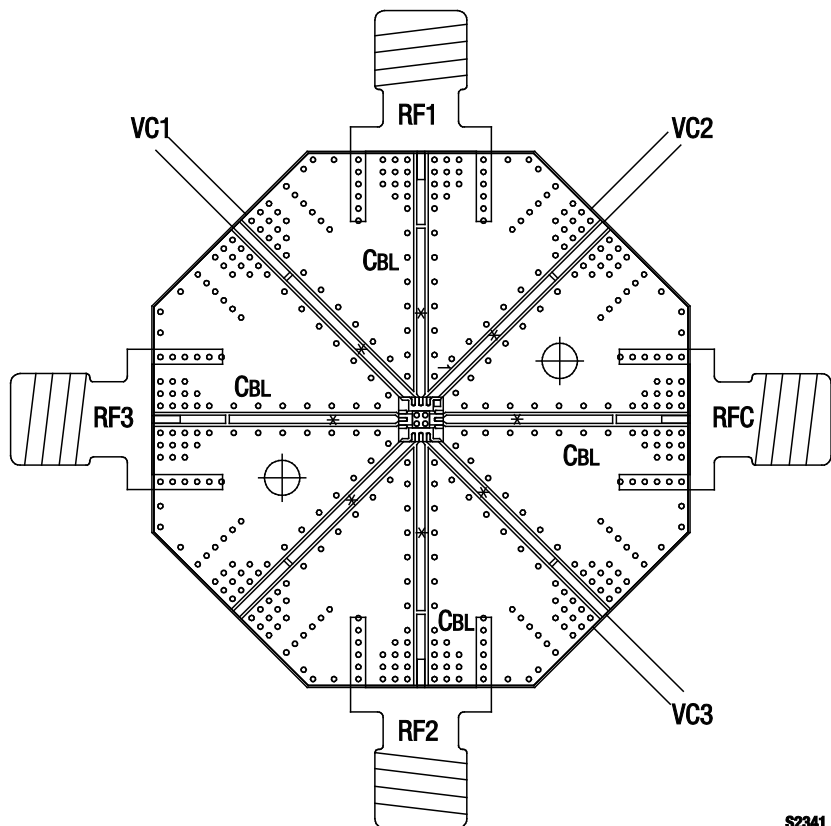
**Package and Handling Information**

Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SKY13398-000 has no backside metal and must be attached using conductive or non-conductive epoxy.

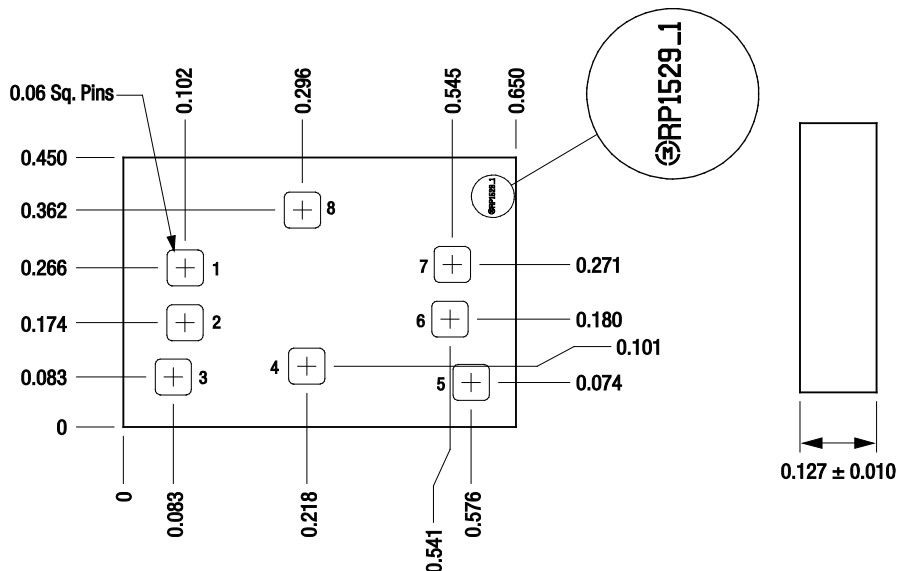


**Figure 7. SKY13398-000 Evaluation Board Schematic**



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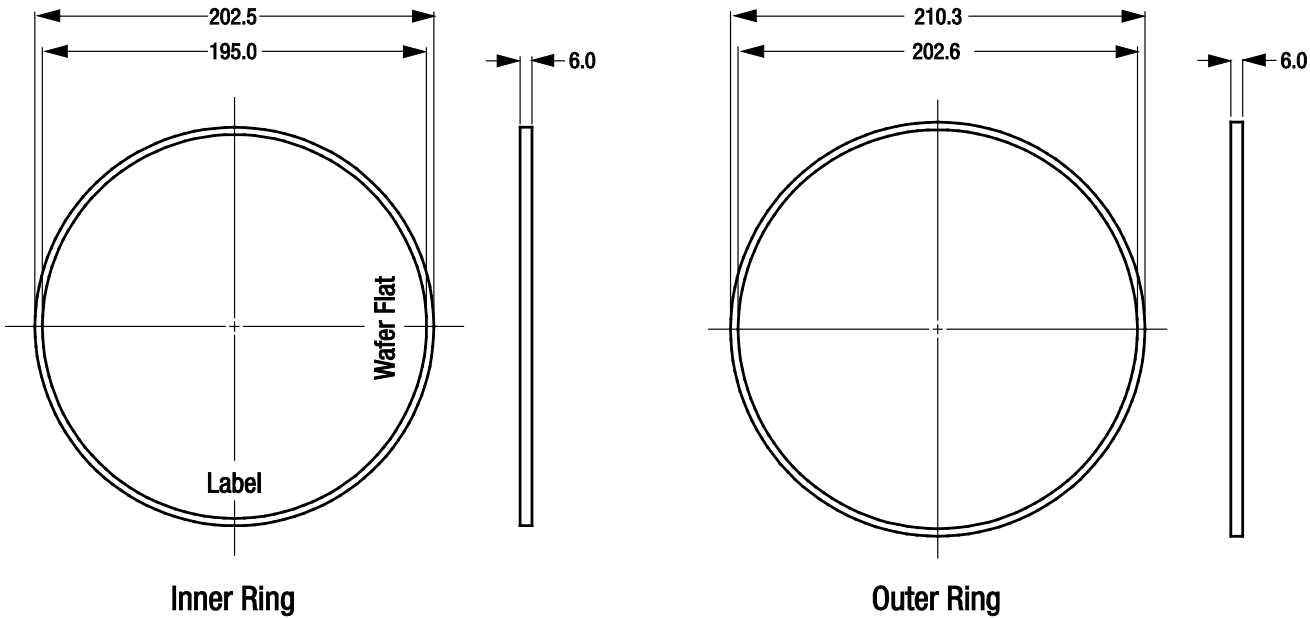
Figure 8. SKY13398-000 Evaluation Board Assembly Diagram



Notes:  
 1. Bond pad metallization: Gold  
 2. Backside metallization: None  
 3. All measurements are in millimeters

S2332

Figure 9. SKY13398-000 8-Pin Package Dimensions



- Notes:**
- 1. All dimensions in millimeters.
  - 2. Tape material: exposed UV tape.
  - 3. Tape adhesion:  $\leq 30$  gm/in.

Grip Ring Number: GRP-2620-6

S2347

Figure 10. SKY13398-000 Grip Ring Dimensions

## Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY13398-000 0.1-6.0 GHz SP3T Switch	SKY13398-000	SKY13398-000-EVB

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