

DATA SHEET

# SKY65405-21: 2.4 GHz Low-Noise Amplifier

## Applications

- 802.11b/g/n PC cards, NICs, and USB dongles
- 802.11b/g/n tablets
- 802.11b/g/n access points, routers, and gateways
- 2.4 GHz ISM radios

## Features

- Ultra-low noise figure: 1.1 dB
- 2.4 to 2.5 GHz operation
- Enable/disable mode
- High IIP3: +9 dBm
- High gain: 15 dB
- 2.8 to 5.0 V single-supply operation
- DFN (6-pin, 1.5 x 1.5 mm) package (MSL1, 260 °C per JEDEC J-STD-020)



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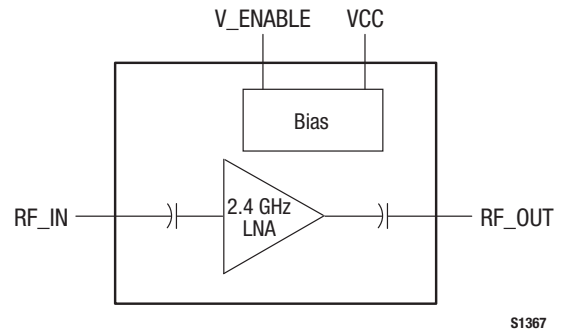


Figure 1. SKY65405-21 LNA Block Diagram

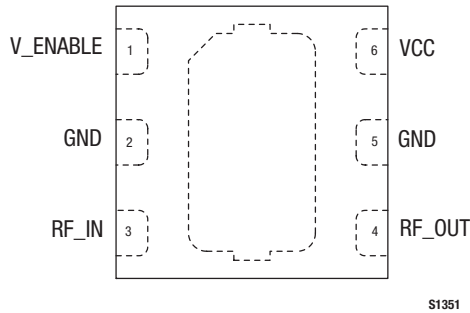
## Description

The SKY65405-21 is an ultra-low-noise amplifier (LNA) intended for 2.4 GHz wireless receiver applications. Its industry-leading noise figure (NF), together with high linearity, makes it ideal as a first-stage LNA in 802.11b/g wireless local area network (WLAN) radios.

Operating with a single supply voltage, the SKY65405-21 consumes only 12 mA of current. The device includes a shutdown mode to save power when the receiver is inactive.

The tiny package footprint of the SKY65405-21, requiring only four external components, enables the industry's smallest PCB area needed to implement a 2.4 GHz LNA.

A block diagram of the SKY65405-21 is shown in Figure 1. The device package and pinout for the 6-pin Dual Flat No-Lead (DFN) are shown in Figure 2. Signal pin assignments and functional pin descriptions are described in Table 1.



**Figure 2. SKY65405-21 Pinout (Top View)**

**Table 1. SKY65405-21 Pin Assignments and Signal Descriptions**

Pin	Name	Description
1	V_ENABLE	Enable control input
2	GND	Ground
3	RF_IN	LNA input
4	RF_OUT	LNA output
5	GND	Ground
6	VCC	Supply voltage for LNA

### Technical Description

The SKY65405-21 is fully 50 Ω matched requiring only a simple bypass circuit on pin 6 (VCC). An external resistor on the V\_ENABLE signal (pin 1) allows a wide range of control voltages to be used. Shutdown mode is achieved by switching the V\_ENABLE signal to 0 V.

### Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY65405-21 are provided in Table 2. The recommended operating conditions are specified in Table 3, and electrical specifications are provided in Table 4. Table 5 provides the control logic for the SKY65405-21.

Performance characteristics for the SKY65405-21 are illustrated in Figures 3, 4, and 5.

**Table 2. Absolute Maximum Ratings**

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	VCC	0	5.5	V
DC voltage at control ports	VENABLE	0	5.0	V
Power into LNA inputs	P <sub>IN</sub> , LNA		+2	dBm
Operating temperature	T <sub>A</sub>	-40	+85	°C
Storage temperature	T <sub>STG</sub>	-40	+125	°C

**ESD HANDLING:** *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 when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.*

**Table 3. Recommended Operating Conditions (@ +25 °C, V<sub>CC</sub> = 3 V)**

Parameter	Symbol	Min	Typ	Max	Units
Supply voltage	V <sub>CC</sub>	2.8	3.3	5.0	V
Enable voltage: High	V <sub>EN</sub>	2.5	3.3	3.5	V
Low		0	0	0.2	V
RF frequency range	f	2400		2500	MHz
Operating temperature range	T <sub>A</sub>	-40	+25	+85	°C

**Table 4. Electrical Characteristics (2400 to 2500 MHz)<sup>1</sup>**  
(V<sub>CC</sub> = 3 V, T<sub>A</sub> = +25 °C, V<sub>ENABLE</sub> = 3 V, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
<b>Enable Mode</b>						
Gain	S <sub>21</sub>		13	15	17	dB
Noise figure	NF			1.1	1.5	dB
Third order input intercept point	IIP3		+7	+9		dBm
In-band 1 dB compression point at input	IP1dB		-2	0		dBm
Out-of-band 1 dB compression point at input	IP1dB		+12	+15		dBm
Input/output return loss	S <sub>11</sub> , S <sub>22</sub>	Z <sub>s/L</sub> = 50 Ω		-10	-6	dB
Reverse isolation	S <sub>12</sub>		18	22		dB
Current		V <sub>ENABLE</sub> = 3 V		12	16	mA
		V <sub>ENABLE</sub> = 0 V		<1	5	μA
V <sub>ENABLE</sub> current	I <sub>EN_HIGH</sub>	V <sub>ENABLE</sub> = 3 V		2.3	3.0	mA
Rise time	t <sub>RISE</sub>			175	280	ns
Fall time	t <sub>FALL</sub>			145	250	ns
<b>Disable Mode (Small Signal Input)</b>						
Gain	S <sub>21</sub>		-17	-14	-11	dB
Input return loss	S <sub>11</sub>			-2	-1	dB
Output return loss	S <sub>22</sub>			-3	-2	dB
V <sub>ENABLE</sub> current	I <sub>EN_LOW</sub>	V <sub>ENABLE</sub> = 0 V to 0.2 V		1.7	1.9	μA

<sup>1</sup> Performance is guaranteed only under the conditions listed in this table.**Table 5. Mode Control Logic**

V <sub>ENABLE</sub> Voltage (V)	Description
3	LNA is enabled
0	LNA is disabled

### Typical Performance Characteristics

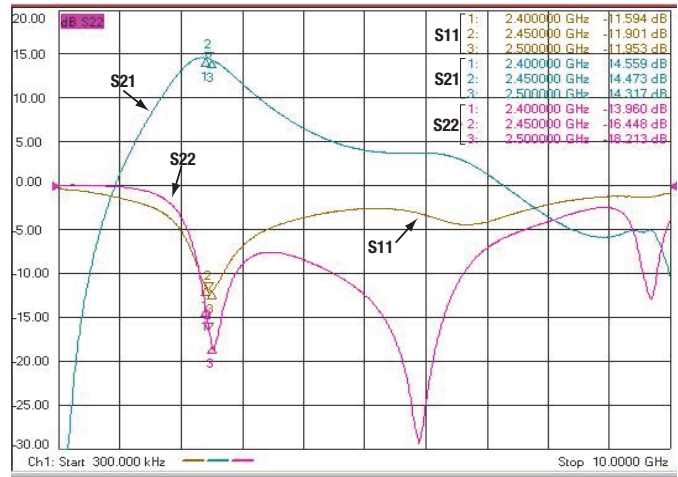


Figure 3. S-Parameter Data

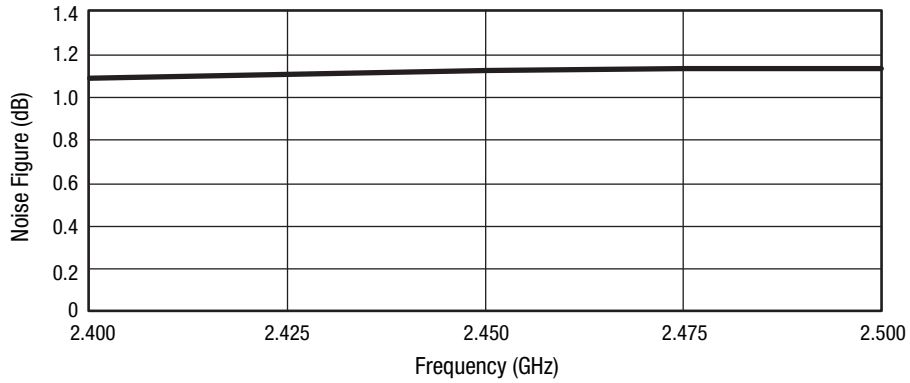


Figure 4. Noise Figure vs Frequency

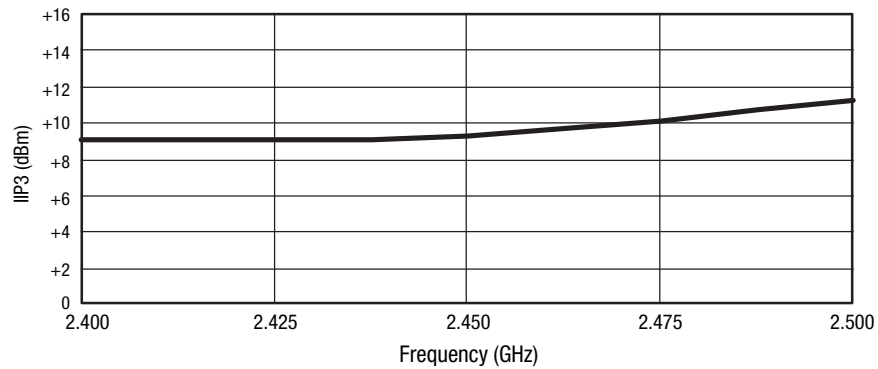
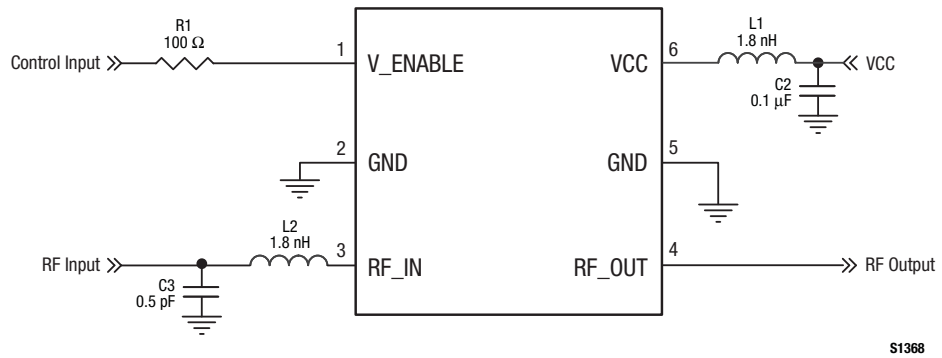


Figure 5. IIP3 vs Frequency

## Evaluation Board Description

An application schematic diagram for the SKY65405-21 is shown in Figure 6.



**Figure 6. SKY65405-21 Schematic Diagram**

### Package Dimensions

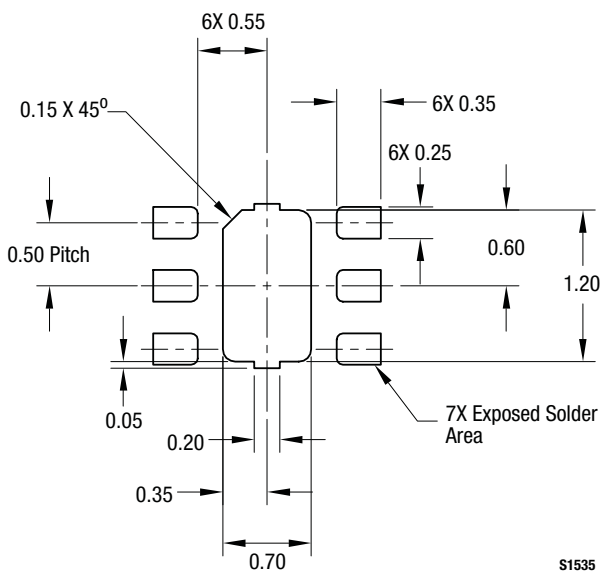
The PCB layout footprint for the SKY65405-21 is provided in Figure 7. Typical part markings are shown in Figure 8. Package dimensions are shown in Figure 9, and tape and reel dimensions are provided in Figure 110.

### Package and Handling Information

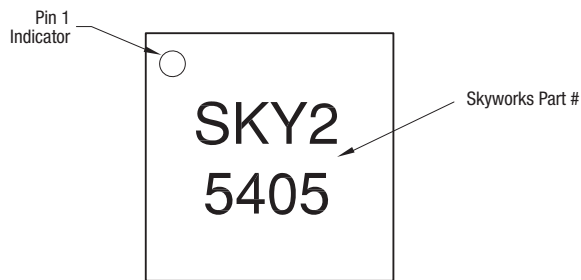
Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SKY65405-21 is rated to Moisture Sensitivity Level 1 (MSL1) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *Solder Reflow Information*, document number 200164.

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.



**Figure 7. SKY65405-21 PCB Layout Footprint (Top View)**



**Figure 8. Typical Part Markings**

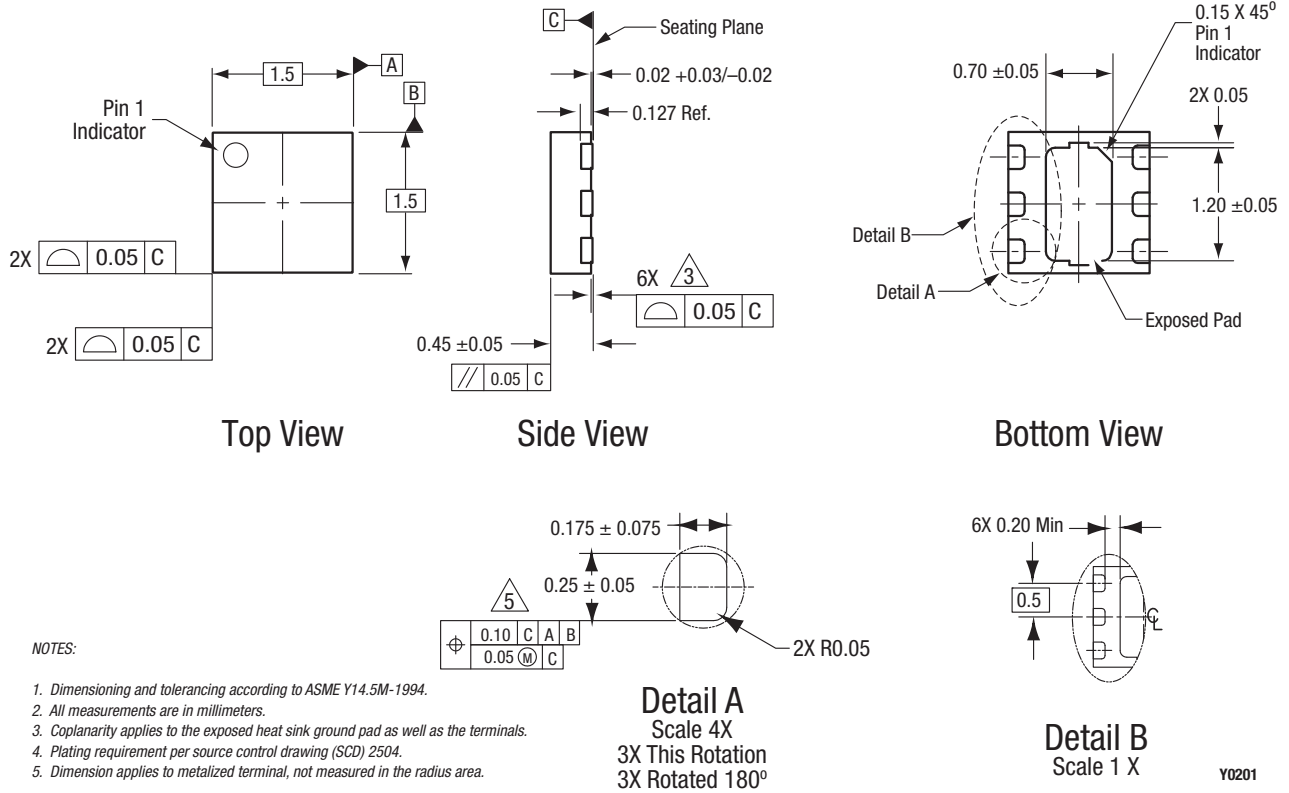


Figure 9. SKY65405-21 Package Dimensions

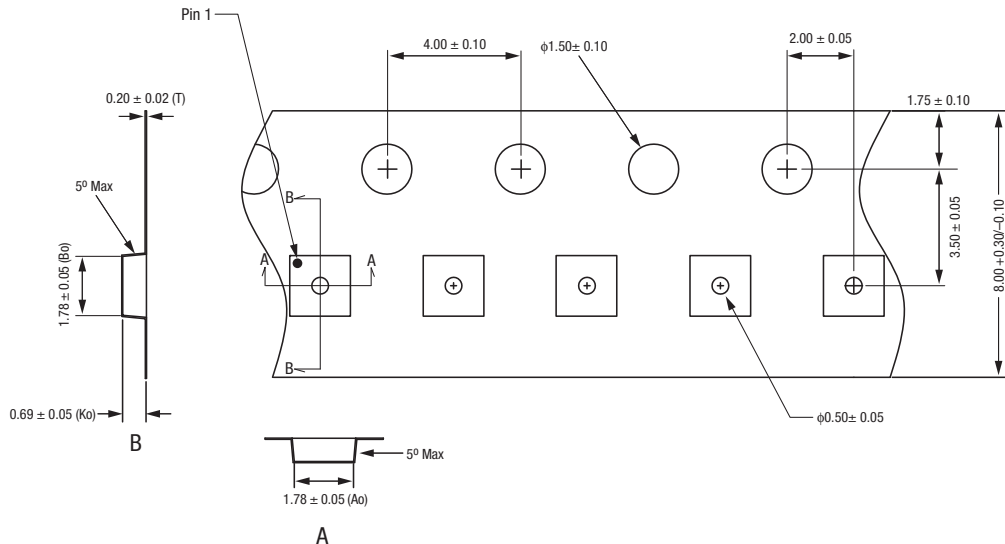


Figure 10. SKY65405-21 Tape and Reel Dimensions