

PRELIMINARY DATA SHEET

SKY85606-11: 5 GHz, 802.11ac Switch/Low-Noise Amplifier Front-End

Applications

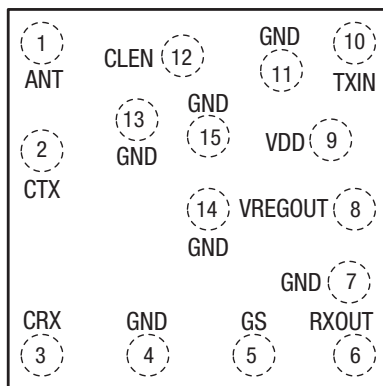
- WiFi-enabled handsets, tablets, and mobile systems
- System-in-Package (SiP) modules for embedded systems
- 802.11n/ac smartphones and tablets

Features

- Integrates an SP2T switch and LNA with bypass mode
- Receive gain: 12 dB
- Noise Figure: 2.5 dB
- Integrated regulator for external PA bias
- Small flip chip die (15-bump, 1.04 x 1.04 mm) package (MSL1, 260 °C per JEDEC-J-STD-020)

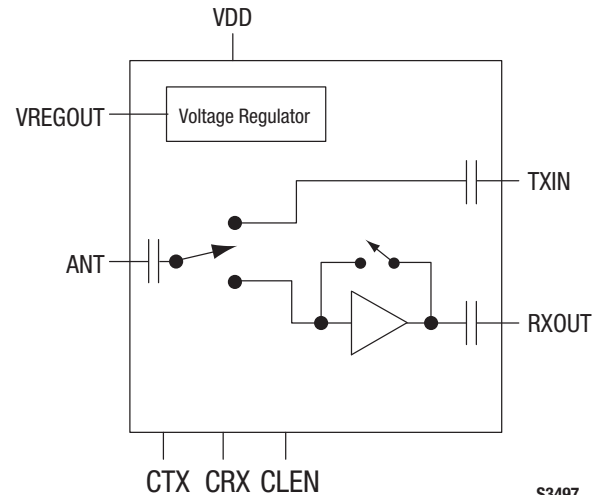


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Figure 2. SKY85606-11 Pinout – 15-Bump Flip Chip Die (Top View, Bumps Down)



S3497

Figure 1. SKY85606-11 Block Diagram

Description

The SKY85606-11 integrates a Single-Pole, Double-Throw (SP2T) switch and Low-Noise Amplifier (LNA) with a bypass mode in an ultra-compact package. The device is capable of switching between WLAN receive and WLAN transmit.

The SKY85606-11 is provided in a small, 15-bump, 1.04 x 1.04 mm flip chip die package. 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. SKY85606-11 Signal Descriptions

Pin	Name	Description	Pin	Name	Description
1	ANT	Antenna port	9	VDD	Supply voltage
2	CTX	Control signal	10	TXIN	Transmit input
3	CRX	Control signal	11	GND	Ground
4	GND	Ground	12	CLEN	Control signal
5	GS	Ground	13	GND	Ground
6	RXOUT	LNA output	14	GND	Ground
7	GND	Ground	15	GND	Ground
8	VREGOUT	Regulated output			

Table 2. SKY85606-11 Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	V _{BAT} , V _{CC}	−0.3	+5.5	V
DC input on control pins	V _{IN}	−0.3	+3.6	V
LNA input power (RXOUT terminated in 50 Ω match)	P _{IN}	+5		dBm
Operating temperature	T _A	−40	+85	°C
Storage temperature	T _{STG}	−40	+140	°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.

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.

Table 3. Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage relative to ground (= 0 V)	V _{DD}	2.7	3.6	5.0	V
Control voltage:					
High	V _{IH}	1.6		3.6	V
Low	V _{IL}	0		0.4	V
Control current:					
High	I _{IH}			5	μA
Low	I _{IL}			1	μA
Operating temperature	T _A	−40	+25	+85	°C

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY85606-11 are provided in Table 2. The recommended operating conditions are specified in Table 3, and electrical specifications are provided in Tables 4, 5, and 6.

The state of the SKY85606-11 is determined by the logic provided in Table 7.

Table 4. SKY85606-11 Electrical Specifications: DC Characteristics (Note 1)
(V_{DD} = 3.6 V, T_A = +25 °C, All Unused Ports Terminated with 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Supply current	I _{CC}	LNA enabled		12		mA
		Transmit mode (regulator quiescent current)		450		μA
		Bypass mode		8		μA
		All off		8		μA
Regulator output	V _{OUT}	V _{DD} > 3.3 V		3.1		V
Regulator current	I _{OUT}				15	mA
Regulator dropout voltage				200		mV

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

Table 5. SKY85606-11 Electrical Specifications: Transmit (TXIN to ANT) Characteristics (Note 1)
(V_{DD} = 3.6 V, T_A = +25 °C, All Unused Ports Terminated with 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Frequency	f		4900		5925	MHz
Insertion loss	TXIL	Insertion loss from TXIN input to ANT port		0.8		dB
1 dB Input Compression Point (TXIN port)	IP1dB			+30		dBm
Transmit input return loss (TXIN port)	IS11I			11.5		dB
Output return loss (ANT port)	IS22I			13		dB
ANT to RXOUT isolation, bypass (loopback) mode				28		dB

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

Table 6. SKY85606-11 Electrical Specifications: Receive (ANT to RXOUT Port) Characteristics (Note 1)
(V_{DD} = 3.6 V, T_A = +25 °C, All Unused Ports Terminated With 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Frequency	f		4900		5925	MHz
Small signal gain	S21	LNA enabled		+12		dB
		Bypass mode		-7		dB
LNA gain step	Gain_STEP	Gain step change between LNA normal and LNA bypass modes		19		dB
Gain flatness		Over 80 MHz		±0.25		dB
		Full band		±1.0		dB
Noise Figure	NF	LNA enabled		2.5		dB
		Bypass mode		7.0		dB
Third Order Input Intercept Point	IIP3	LNA enabled		+4		dBm
		Bypass mode		+23		dBm
Receive input return loss	S11			10		dB
Receive output return loss	S22			8		dB
Receive to transmit switching time	t _{RX-TX}	10% to 90%			500	ns
Transmit to receive switching time	t _{TX-RX}	10% to 90%			500	ns
Receive gain switching time	t _{RX}	10% to 90%			200	ns

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

Table 7. SKY85606-11 Control Logic

Mode	Regulator Output	CRX (Bump 3)	CLEN (Bump 12)	CTX (Bump 2)
All off	Off	0	0	0
WLAN receive	Off	1	1	0
WLAN receive bypass	Off	1	0	0
WLAN transmit	On	0	0	1

Note: "0" = 0 V to +0.4 V. "1" = +1.6 V to +3.6 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 SKY85606-11 Evaluation Board is used to test the performance of the SKY85606-11 LNA FEM. An Evaluation Board schematic diagram is provided in Figure 3. A photograph of the Evaluation Board is shown in Figure 4.

Evaluation Board Setup Procedure

1. Connect system ground to pin 2 (GND) of the J4 header.
2. Apply 3.6 V to pin 13 (VDD) of the J4 header.
3. Select a path according to the modes shown in Table 7. Set CRX, CLEN, and CTX control signals to appropriate V_{IL} and V_{IH} voltages, as specified in Table 3.
4. Apply an RF signal to connector J2 (ANT) and measure the response from the output of connector J1 (RX) to monitor the WLAN receive path performance.
5. Apply an RF signal to connector J3 (TX) and measure the response from the output of the connector J2 (ANT) to monitor the WLAN transmit path performance.
6. While in transmit mode only, the VREG regulator output can be measured with the desired load (15 mA maximum).

Evaluation Board Losses

The Evaluation Board losses are as follows:

$$\text{ANT} = \text{TX} = \text{RX} = 0.24 \text{ dB}$$

Package Dimensions

The PCB layout footprint for the SKY85606-11 is provided in Figure 5. Typical case markings are shown in Figure 6. Package dimensions for the 15-bump flip chip die are shown in Figure 7, and tape and reel dimensions are provided in Figure 8.

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 SKY85606-11 is rated to Moisture Sensitivity Level 1 (MSL1) at 260 °C. It can be used for lead or lead-free soldering.

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.

Underfill Requirements

The assembly of a flip chip die onto an electrical substrate requires special handling and normally needs an underfill liquid epoxy mold compound. When fully cured, the underfill material forms a rigid, low-stress seal that dissipates stress on solder joints and extends thermal cycling performance.

Pad Coordinates

The SKY85606-11 pad coordinates are provided in Table 8 (also refer to the pinout diagram in Figure 2). The origin of the coordinates (i.e., $X = 0$, $Y = 0$) is located at the center of the SKY85606-11 package. Sense is top view through package (PCB footprint).

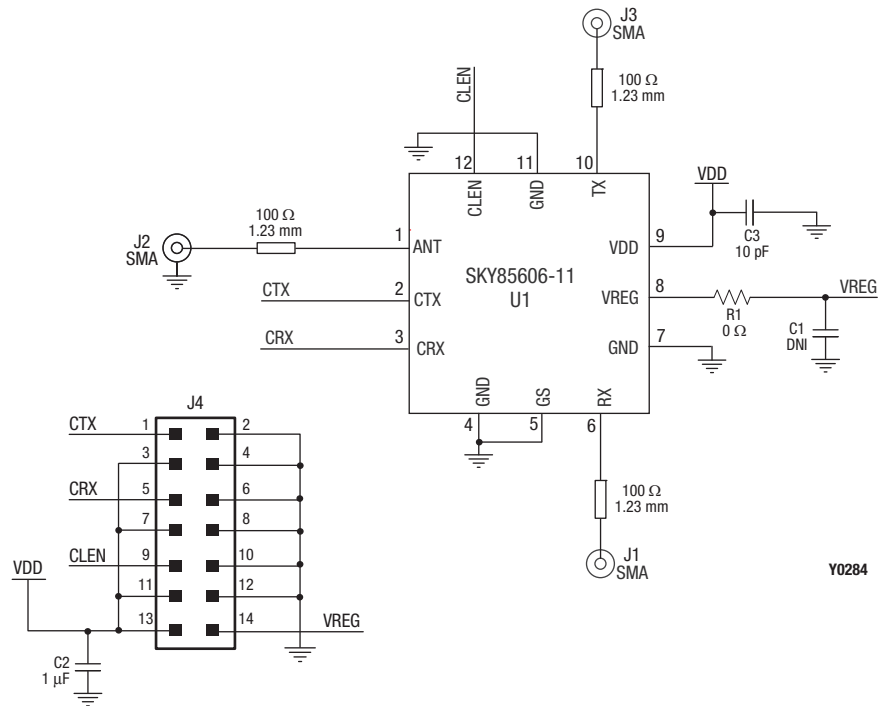


Figure 3. SKY85606-11 Evaluation Board Schematic

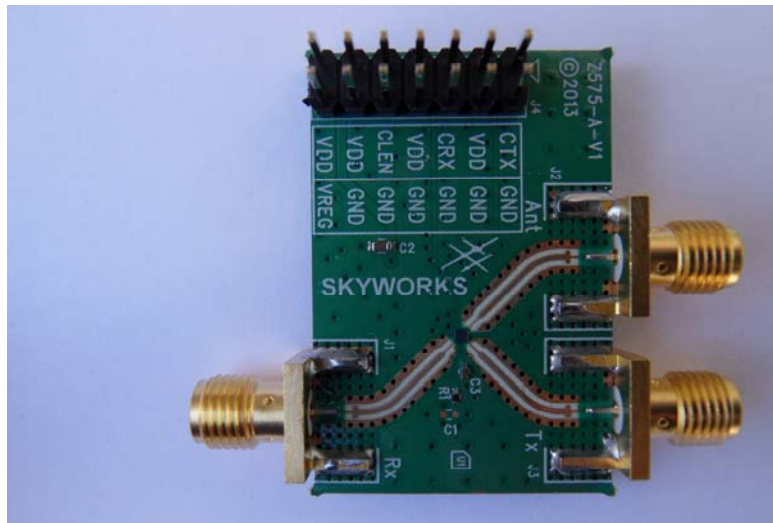
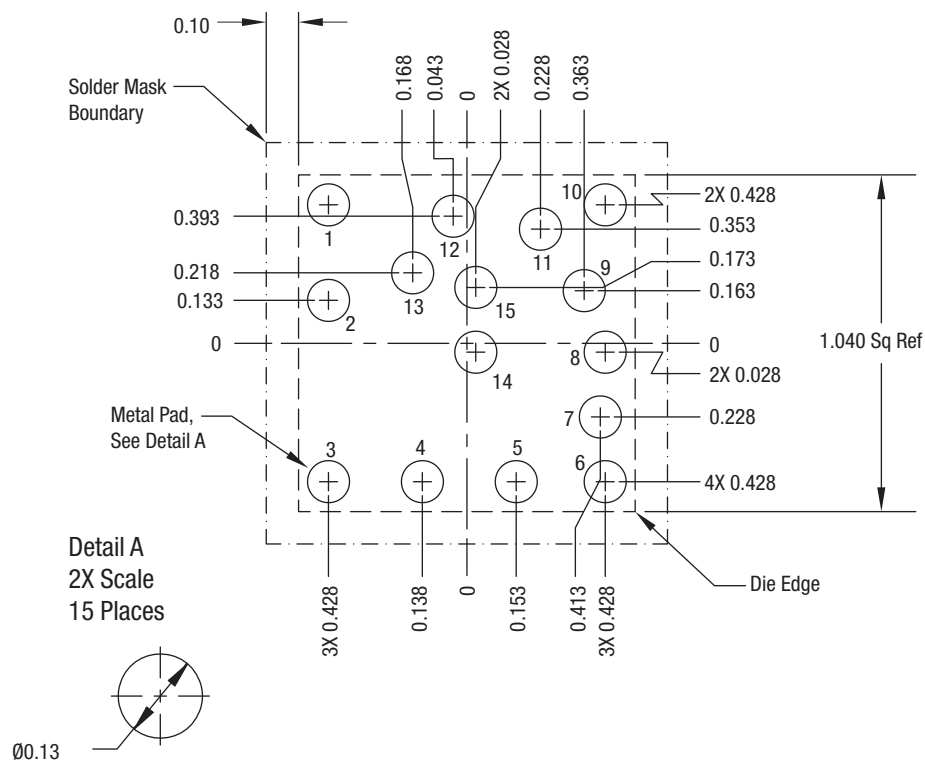


Figure 4. SKY85606-11 Evaluation Board

Table 8. SKY85606-11 Bump Pad Coordinates

Bump Number	Signal	Bump Coordinates (Top View)	
		X (μm)	Y (μm)
1	ANT	-428	+428
2	CTX	-428	+133
3	CRX	-428	-428
4	GND	-138	-428
5	GS	+153	-428
6	RXOUT	+428	-428
7	GND	+413	-228
8	VREGOUT	+428	-28
9	VDD	+363	+163
10	TXIN	+428	+428
11	GND	+228	+353
12	CLEN	-43	+393
13	GND	-168	+218
14	GND	+28	-28
15	GND	+28	+173



Notes:

1. All measurements are in millimeters.
2. Dimensions and tolerances according to ASME Y14.5M-1994.
3. Unless specified, dimensions are symmetrical about center lines.
4. Unless otherwise specified, the following values apply:

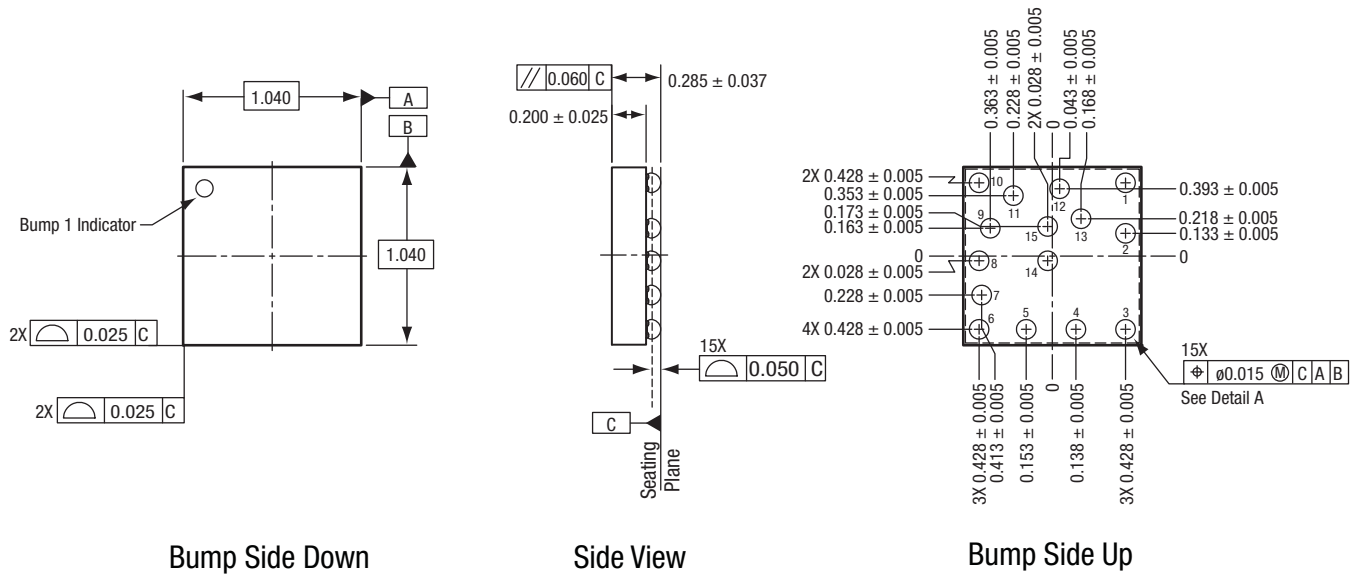
Decimal Tolerance:	Angular Tolerance:
X.X (1 place) ± 0.1 mm	$\pm 1/2^\circ$
X.XX (2 places) ± 0.05 mm	
X.XXX (3 places) ± 0.025 mm	

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Figure 5. SKY85606-11 PCB Layout Footprint

*** TBD ***

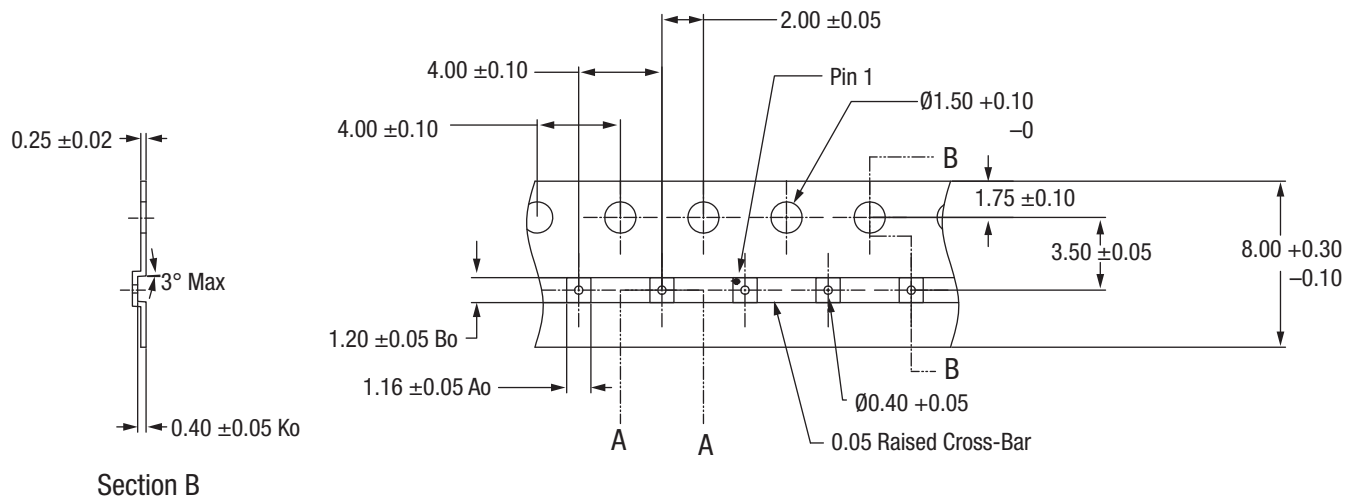
Figure 6. Typical Case Markings

**NOTES:**

1. All measurements are in millimeters.
2. Dimensioning and tolerancing according to ASME Y14.5M-1994.
Unless otherwise specified the following values apply:
Decimal Tolerance: Angular Tolerance:
X.X (1 place) ± 0.1 mm $\pm 1/2^\circ$
X.XX (2 places) ± 0.05 mm
X.XXX (3 places) ± 0.025 mm
3. Unless specified, dimensions are symmetrical about center lines.

S3498

Figure 7. SKY85606-11 15-Bump Flip Chip Die Package Dimensions



Notes:

1. Carrier tape: black conductive polycarbonate.
2. Cover tape material: transparent conductive.
3. All dimensions are in millimeters.
4. 10-sprocket hole pitch cumulative tolerance on tape: ± 0.20 mm.
5. Ao and Bo measurement point to be 0.30 mm from bottom of pocket.
6. Pocket position relative to sprocket hole measured as true position of pocket.

Tolerances:

<i>Decimals:</i>	<i>Angles:</i>
$.x = \pm 0.15$	$\pm 1^\circ$
$.xx = \pm 0.10$	



Section A

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Figure 8. SKY85606-11 Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY85606-11 5 GHz, 802.11ac Switch/LNA Front-End	SKY85606-11	SKY85606-11-EVB

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