SKYWORKS

DATA SHEET

SKY67226-11: 2.2-3.0 GHz Integrated Low-Noise Amplifier Module

Applications

- Satellite Digital Audio Radio Service (SDARS)
- LTE systems
- Cellular infrastructure
- ISM band systems

Features

- Requires only one external component
- Optimized for 2.2 to 3.0 GHz operation
- Noise Figure: 1.02 dB typical @ 2.5 GHz
- Gain: 16.6 dB typical @ 2.5 GHz
- Input return loss: 22 dB typical @ 2.5 GHz
- Operating voltage range: 3.3 to 5.0 V
- Adjustable supply current: 30 to 110 mA
- High linearity IIP3: +20.9 dBm typical @ 2.5 GHz
- MCM (16-pin, 4 x 4 mm) package (MSL3, 260 °C per JEDEC J-STD-020) package



Skyworks GreenTM products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green*TM, document number SQ04-0074.



Figure 2. SKY67226-11 Pinout – 16-Pin MCM Package (Top View)





Description

The SKY67226-11 is a high performance, integrated Low-Noise Amplifier (LNA) designed for use in 2.2 to 3.0 GHz wireless infrastructure applications. The device consists of a single high linearity, LNA and all associated matching components. The only external component necessary for proper operation is an external resistor, used to set the DC current. The device is also completely DC bypassed.

The package design nearly eliminates external surface mount components, greatly reduces printed circuit board area, and offers low thermal resistance for enhanced Mean Time Between Failures (MTBFs).

For optimum performance in the following frequency ranges, refer to the following product Data Sheets (all devices are pin-to-pin compatible with the SKY67226-11):

- 0.4 GHz to 0.7 GHz: SKY67215-11 (document #201842)
- 0.7 GHz to 1.2 GHz: SKY67216-11 (document #201808)
- 1.6 GHz to 2.1 GHz: SKY67221-11 (document #201838)

The SKY67226-11 is packaged in a 16-pin, 4 x 4 mm Multi-Chip Module (MCM). A block diagram of the SKY67226-11 is shown in Figure 1. The device package and pinout are shown in Figure 2.

Electrical and Mechanical Specifications

Signal pin assignments and functional pin descriptions are described in Table 1. The absolute maximum ratings of the SKY67226-11 are provided in Table 2. Electrical specifications are provided in Table 3.

Typical performance characteristics of the SKY67226-11 are illustrated in Figures 3 through 24 (89 mA supply current).

Package and Handling Information

Since the device package is sensitive to moisture absorption, it is baked and vacuum packed before shipping. 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 SKY67226-11 is rated to Moisture Sensitivity Level 3 (MSL3) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note *PCB Design and SMT Assembly/Rework Guidelines for MCM-L Packages*, document number 101752.

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.

Pin #	Name	Description	Pin #	Name	Description
1	VBIAS	Low current bias for amplifier. External resistor sets current consumption.	9	GND	Ground
2	GND	Ground	10	RF_OUT	RF output, AC coupled. No external components required.
3	RF_IN	RF input, AC coupled. No external components required.	11	GND	Ground
4	GND	Ground	12	VDD	High current amplifier bias connection. No external bypassing required.
5	N/C	No connection	13	N/C	No connection
6	GND	Ground	_14	GND	Ground
7	N/C	No connection	15	N/C	No connection
8	GND	Ground	16	GND	Ground

Table 1. SKY67226-11 Signal Descriptions

Table 2. Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	Vdd		5.5	V
RF input power	Рім		+20	dBm
Channel temperature	Тсн		150	°C
Operating temperature	Та	-55	+100	°C
Storage temperature	Тята	-65	+150	°C
Thermal resistance	Ore		68.8	°C/W

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. The SKY67226-11 ESD threshold level is 500 VDC using Human Body Model (HBM) testing (Class 1B), 50 VDC using Man-Machine (MM) model testing (Class A), and 1000 VDC using Charged Device Model (CDM) testing (Class IV).

Parameter	Symbol	Test Conditions	Minimum	, Typical	Maximum	Units		
RF Specifications								
Noise Figure (Note 4)	NF	@ 2.5 GHz		1.02	1.35	dB		
Small signal gain	S21	@ 2.5 GHz	14.6	16.6		dB		
Input return loss	IS11I	@ 2.5 GHz	15.0	22.0		dB		
Output return loss	IS221	@ 2.5 GHz	12	16		dB		
Reverse isolation	IS12I	@ 2.5 GHz	28.6	30.6		dB		
3 rd Order Input Intercept Point	IIP3	@ 2.5 GHz, $\Delta f = 1$ MHz, $P_{IN} = -20$ dBm/tone	+17.9	+20.9		dBm		
3 rd Order Output Intercept Point	OIP3	@ 2.5 GHz, $\Delta f = 1$ MHz, $P_{IN} = -20$ dBm/tone	+34.5	+37.5		dBm		
Input 1dB Compression Point	IP1dB	@ 2.5 GHz	+4.4	+6.4		dBm		
Output 1dB Compression Point	0P1dB	@ 2.5 GHz	+20	+22		dBm		
Stability (Note 3)	μ1, μ2, Κ, Β	Up to 18 GHz, -40 °C to +85 °C		>1		-		
DC Specifications								
Supply voltage	Vdd			5		V		
Quiescent current	ldd	RBIAS = $6.8 \text{ k}\Omega$		89		mA		

Table 3. SKY67226-11 Electrical Characteristics (Note 1) (Note 2) (Note 3)

(VDD = VBIAS = 5 V Nominal, IDD = 89 mA, TA = +25 °C, Characteristic Impedance [Zo] = 50 Ω, Unless Otherwise Noted)

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

Note 2: Circuit topology optimized for best compromise between NF, S11, IIP3, and IP1dB.

Note 3: Applies to typical application circuit and components shown in Figure 24.

Note 4: Loss from input SMA connector and Evaluation Board up to pin 3 of device has been de-embedded (0.08 dB @ 2.5 GHz) from the NF measurement.

Table 4. SKY67226-11 Electrical Characteristics (Note 1) (Note 2) (VDD = VBIAS = 5 V Nominal, IDD = 110 mA, TA = +25 °C, Characteristic Impedance [ZO] = 50 Ω , Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Minimum	Typical	Maximum	Units	
RF Specifications							
Noise Figure (Note 4)	NF	@ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		0.95 1.05 1.35		dB dB dB	
Small signal gain	IS21I	@ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		17.3 16.6 14.3		dB dB dB	
Input return loss	IS11I	@ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		14.8 23.0 14.0		dB dB dB	
Output return loss	IS22I	@ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		12.5 14.5 9.5		dB dB dB	
Reverse isolation	IS12I	@ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		31.5 31.0 31.0		dB dB dB	
3 rd Order Input Intercept Point	IIP3	$\Delta f = 1 \text{ MHz},$ $P_{IN} = -20 \text{ dBm/tone}:$ @ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		+19.2 +21.0 +20.1		dBm dBm dBm	
3 rd Order Output Intercept Point	OIP3	$\Delta f = 1 \text{ MHz},$ $P_{IN} = -20 \text{ dBm/tone:}$ @ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		+36.5 +37.6 +34.4		dBm dBm dBm	
Input 1dB Compression Point	IP1dB	@ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		+3.4 +6.0 +9.0		dBm dBm dBm	
Output 1dB Compression Point	OP1dB	@ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		+19.7 +21.6 +22.3		dBm dBm dBm	
Stability (Note 3)	μ1, μ2, K, B	Up to 18 GHz, -40 °C to +85 °C		>1		-	
DC Specifications							
Supply voltage	VDD			5		V	
Quiescent current	ldd	$R_{BIAS} = 5.6 \ k\Omega$		110		mA	

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

Note 2: Circuit topology optimized for best compromise between NF, S11, IIP3, and IP1dB.

Note 3: Applies to typical application circuit and components shown in Figure 25.

Note 4: Loss from input SMA connector and Evaluation Board up to pin 3 of device has been de-embedded from the NF measurement (0.08 dB).

able 5. SKY67226-11 Electrical Characteristics (Note 1) (Note 2)
Vod = VBIAS = 5 V Nominal, lod = 45 mA, Ta = +25 °C, Characteristic Impedance [Zo] = 50 Ω , Unless Otherwise Notec

Parameter	Symbol	Test Conditions	Minimum	Typical	Maximum	Units		
RF Specifications								
Noise Figure (Note 4)	NF	@ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		0.90 0.97 1.30		dB dB dB		
Small signal gain	S21	@ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		16.4 15.7 13.4		dB dB dB		
Input return loss	S11	@ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		12.2 19.0 12.0		dB dB dB		
Output return loss	IS22I	@ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		12.2 14.0 9.0		dB dB dB		
Reverse isolation	S12	@ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		31.5 31.2 31.5		dB dB dB		
3 rd Order Input Intercept Point	IIP3	$\Delta f = 1 \text{ MHz},$ $P_{IN} = -20 \text{ dBm/tone}:$ @ 2.2 GHz		+16.4		dBm		
		@ 2.5 GHz @ 3.0 GHz		+17.2 +16.4		dBm dBm		
3 rd Order Output Intercept Point	OIP3	$\Delta f = 1 \text{ MHz},$ P _{IN} = -20 dBm/tone:						
		@ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		+32.8 +32.9 +29.8		dBm dBm dBm		
Input 1dB Compression Point	IP1dB	@ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		+3.9 +6.4 +9.1		dBm dBm dBm		
Output 1dB Compression Point	OP1dB	@ 2.2 GHz @ 2.5 GHz @ 3.0 GHz		+19.3 +21.1 +21.5		dBm dBm dBm		
Stability (Note 3)	μ1, μ2, K, B	Up to 18 GHz, -40 °C to +85 °C		>1		-		
DC Specifications								
Supply voltage	Vdd			5		V		
Quiescent current	ldd	$R_{BIAS} = 12 \ k\Omega$		45		mA		

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

Note 2: Circuit topology optimized for best compromise between NF, S11, IIP3, and IP1dB.

Note 3: Applies to typical application circuit and components shown in Figure 25.

Note 4: Loss from input SMA connector and Evaluation Board up to pin 3 of device has been de-embedded from the NF measurement (0.08 dB).

Typical Performance Characteristics @ IDD = 89 mA

(VDD = VBIAS = 5 V Nominal, TA = +25 °C, Characteristic Impedance [Zo] = 50 Ω , Unless Otherwise Noted)



Figure 3. Broadband Gain Response vs Frequency Over Temperature



Figure 5. Broadband Input Return Loss vs Frequency Over Temperature



Figure 7. Broadband Reverse Isolation vs Frequency Over Temperature



Figure 4. Narrowband Gain Response vs Frequency Over Temperature



Figure 6. Narrowband Input Return Loss vs Frequency Over Temperature







Figure 9. Broadband Output Return Loss vs Frequency Over Temperature



Figure 11. Stability Factor (µ1) vs Frequency Over Temperature



Figure 13. Stability Factor (K) vs Frequency Over Temperature



Figure 10. Narrowband Output Return Loss vs Frequency Over Temperature



Figure 12. Stability Factor (µ2) vs Frequency Over Temperature



Figure 14. Stability Factor (B) vs Frequency Over Temperature



Figure 15. Noise Figure vs Frequency Over Temperature



Figure 17. IIP3 vs Input Power Over Temperature @ 2500 MHz ($P_{IN} = -20 \text{ dBm}$, Tone Spacing = 1 MHz)







Figure 16. IIP3 vs Input Power Over Temperature @ 2300 MHz ($P_{IN} = -20 \text{ dBm}$, Tone Spacing = 1 MHz)



Figure 18. IIP3 vs Input Power Over Temperature @ 2700 MHz ($P_{IN} = -20$ dBm, Tone Spacing = 1 MHz)



Figure 20. Gain vs Input Power Over Temperature @ 2300 MHz



Figure 21. Gain vs Input Power Over Temperature @ 2500 MHz



Figure 23. Gain vs Input Power Over Frequency and Temperature



Figure 22. Gain vs Input Power Over Temperature @ 2700 MHz



Figure 24. Resistor R1 vs Current Over Voltage

Evaluation Board Description

The SKY67226-11 Evaluation Board is used to test the performance of the SKY67226-11 LNA. The Evaluation Board schematic diagram is shown in Figure 25. An assembly drawing for the Evaluation Board is shown in Figure 26. The layer detail physical characteristics are noted in Figure 27. Table 6 provides the Bill of Materials (BOM) list for Evaluation Board components.

Package Dimensions

The PCB layout footprint for the SKY67226-11 is shown in Figure 28. Typical case markings are shown in Figure 29. Package dimensions for the 16-pin MCM are shown in Figure 30, and tape and reel dimensions are provided in Figure 31.



Figure 25. SKY67226-11 Schematic Diagram



Figure 26. SKY67226-11 Evaluation Board Assembly Drawing



S2574

Figure 27. Layer Detail Physical Characteristics

Table 6. SKY67226-11 Evaluation Board Bill of Materials

Component	Size	Value	Vendor	Part Number
C1		DNI		
C2		DNI		
R1 for 89 mA operation (Note 1)	0402	6800 Ω	Panasonic	

Note 1: Placement in relation to component package is not critical.



All dimensions are in millimeters

Figure 28. SKY67226-11 PCB Layout Footprint



(Top View)



Dimensioning and tolerancing according to ASME Y14.5M-1994

S2870





S2031

Figure 31. SKY67226-11 Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY67226-11 2.2-3.0 GHz Integrated LNA Module	SKY67226-11	SKY67226-11-EVB

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