DATA SHEET

SKY67161-306LF: 0.6 to 1.1 GHz Two-Stage, High Linearity and High Gain Low-Noise Amplifier

Applications

- GSM, CDMA, WCDMA, cellular infrastructure systems
- Ultra low-noise, high gain and high linearity systems

Features

- Ultra-low NF: 0.30 dB @ 849 MHz
- High gain: 38 dB @ 849 MHz
- +5 V operation
- Wideband performance, useable to 1.1 GHz
- Small, QFN (16-pin, 4 x 4 mm) Pb-free package (MSL1, 260 °C per JEDEC J-STD-020)

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

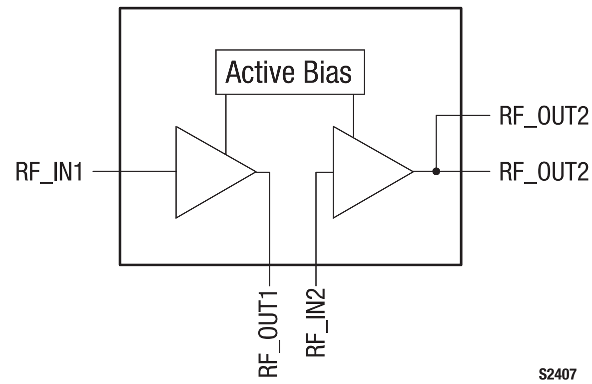

Figure 1. SKY67161-306LF Block Diagram

Description

The SKY67161-306LF is a GaAs pHEMT and HBT two-stage, Low-Noise Amplifier (LNA) with active bias and high linearity performance. The pHEMT front end of the device provides an ultra-low Noise Figure (NF) while the HBT output stage provides high gain, linearity, and efficiency.

The SKY67161-306LF operates in the frequency range of 0.6 to 1.1 GHz and is provided in a 4 x 4 mm, 16-pin Quad Flat No-Lead (QFN) 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.

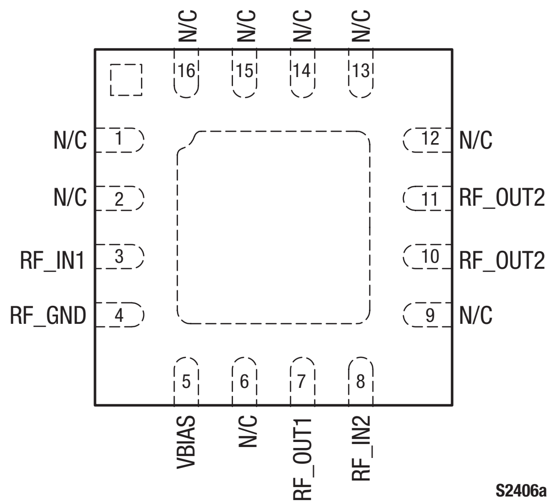

Figure 2. SKY67161-306LF Pinout – 16-Pin QFN (Top View)

Table 1. SKY67161-306LF Signal Descriptions

Pin	Name	Description	Pin	Name	Description
1	N/C	No connection. May be grounded with no change in performance.	9	N/C	No connection. May be grounded with no change in performance.
2	N/C	No connection. May be grounded with no change in performance.	10	RF_OUT2	RF output of second stage amplifier. Bias to the output of stage 2 is supplied through pins 10 and 11.
3	RF_IN1	RF input to first stage amplifier	11	RF_OUT2	RF output of second stage amplifier. Bias to the output of stage 2 is supplied through pins 10 and 11.
4	RF_GND	RF ground for first stage amplifier	12	N/C	No connection. May be grounded with no change in performance.
5	VBIAS	Bias for first stage amplifier. External resistor sets current consumption.	13	N/C	No connection. May be grounded with no change in performance.
6	N/C	No connection. May be grounded with no change in performance.	14	N/C	No connection. May be grounded with no change in performance.
7	RF_OUT1	RF output of first stage amplifer	15	N/C	No connection. May be grounded with no change in performance.
8	RF_IN2	RF input to second stage amplifier	16	N/C	No connection. May be grounded with no change in performance.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY67161-306LF are provided in Table 2. Electrical specifications are provided in Table 3.

Typical performance characteristics of the SKY67161-306LF are illustrated in Figures 3 through 15.

Table 2. SKY67161-306LF Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	V_{DD}		5.5	V
RF input power	P_{IN}		+15	dBm
Operating temperature	T_{OP}	–40	+85	°C
Storage temperature	T_{STG}	–40	+125	°C
Junction temperature	T_J		+150	°C
Thermal resistance: Stage 1 Stage 2	Θ_{JC}		 45 130	 °C/W °C/W
Electrostatic Discharge: Charged Device Module (CDM), Class 2 Human Body Model (HBM), Class 1A Machine Model (MM), Class A	ESD		 250 250 25	 V V V

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. SKY67161-306LF Electrical Specifications: V_{DD} = +5 V (Note 1)
(T_{OP} = +25 °C, P_{IN} = –30 dBm, Characteristic Impedance [Z_0] = 50 Ω, Optimized for 849 MHz Operation, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
RF Specifications						
Noise Figure (includes Evaluation Board losses)	NF	@ 849 MHz		0.30	0.50	dB
Small signal gain	$\|S_{21}\|$	@ 849 MHz	36	38		dB
Input return loss	$\|S_{11}\|$	@ 849 MHz		20		dB
Output return loss	$\|S_{22}\|$	@ 849 MHz		14		dB
Reverse isolation	$\|S_{12}\|$	@ 849 MHz		57		dB
3rd Order Input Intercept Point	IIP3	@ 849 MHz, Δf = 1 MHz, P_{IN} = –37 dBm/tone	–2	+1		dBm
3rd Order Output Intercept Point	OIP3	@ 849 MHz, Δf = 1 MHz, P_{IN} = –37 dBm/tone	+36	+39		dBm
1 dB Input Compression Point	IP1dB	@ 849 MHz	–14.5	–12.5		dBm
1 dB Output Compression Point	OP1dB	@ 849 MHz	+22.5	+24.5		dBm
DC Specifications						
Supply voltage	V_{DD}			5.0		V
Quiescent current	I_{DD}	Set with external resistor		115		mA
Supply current @ IP1dB	I_{DD_P1DB}	Set with external resistor		160		mA

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

Typical Performance Characteristics

(V_{DD} = +5 V, T_{OP} = +25 °C, P_{IN} = –30 dBm, Characteristic Impedance [Z_0] = 50 Ω, Optimized for 849 MHz Operation, Unless Otherwise Noted)

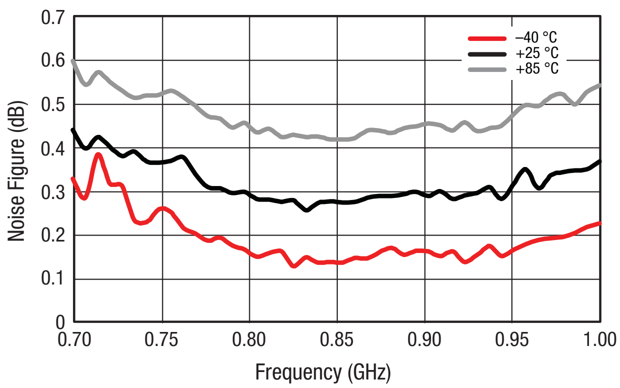

Figure 3. Noise Figure vs Frequency Over Temperature

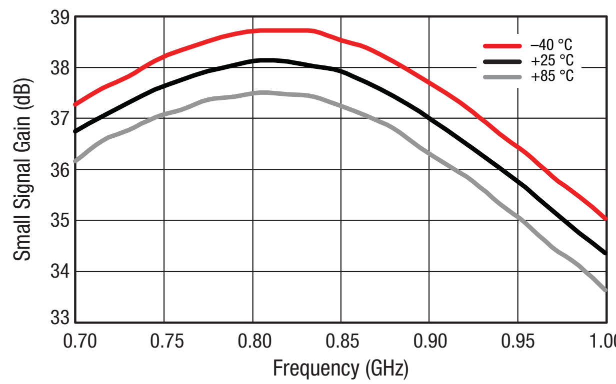

Figure 4. Small Signal Gain vs Frequency Over Temperature, Narrow Band

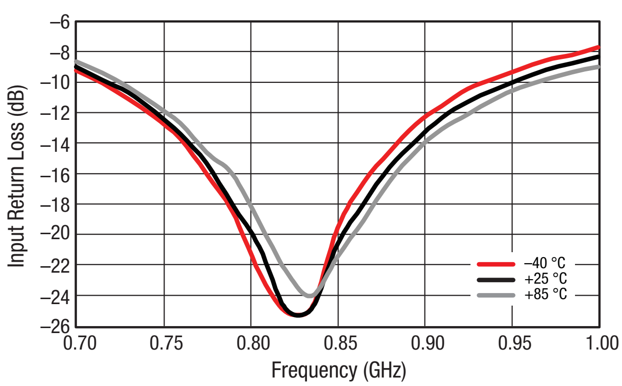

Figure 5. Input Return Loss vs Frequency Over Temperature

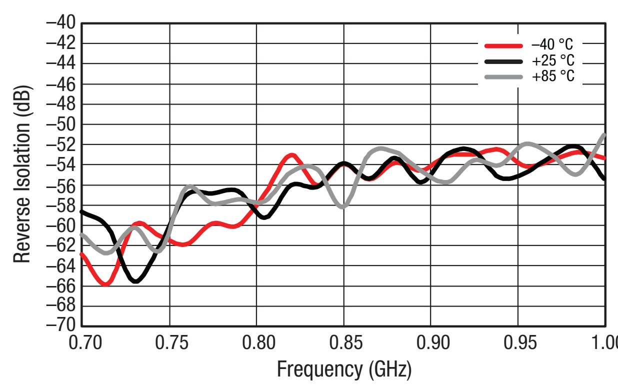

Figure 6. Reverse Isolation vs Frequency Over Temperature, Narrow Band

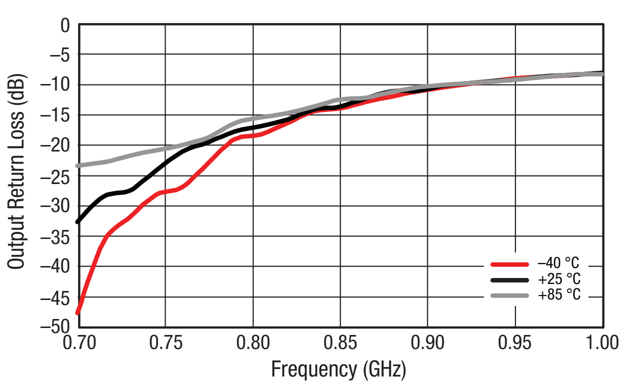

Figure 7. Output Return Loss vs Frequency Over Temperature, Narrow Band

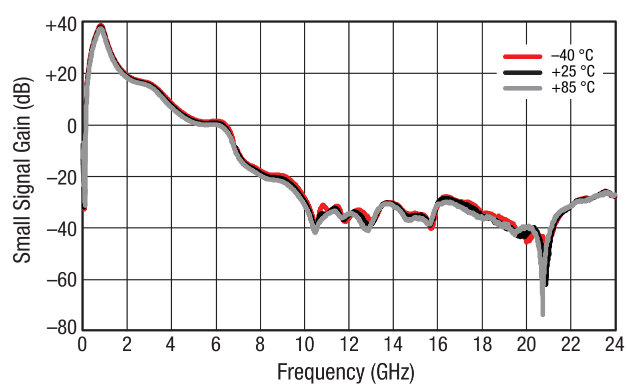

Figure 8. Small Signal Gain vs Frequency Over Temperature, Wide Band

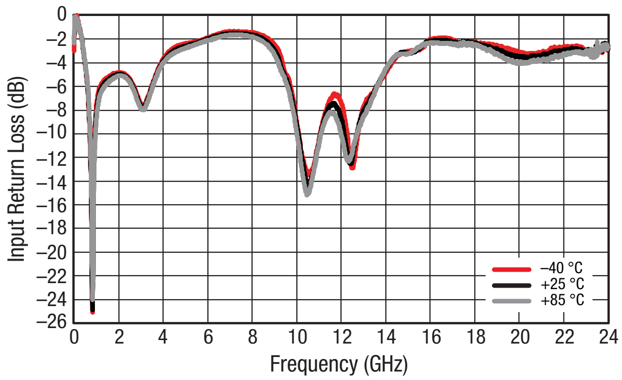

Figure 9. Input Return Loss vs Frequency Over Temperature, Wide Band

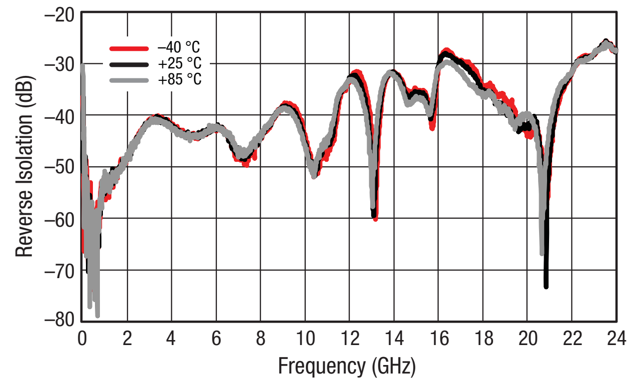

Figure 10. Reverse Isolation vs Frequency Over Temperature, Wide Band

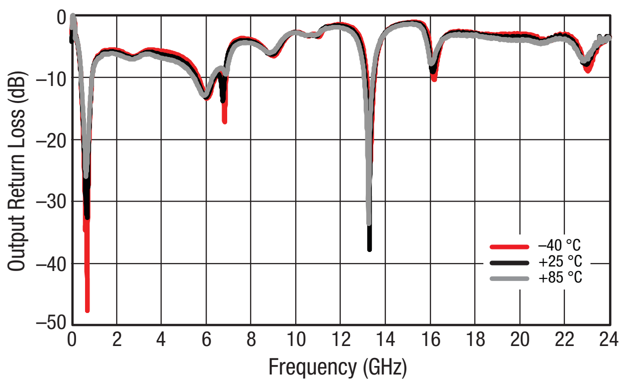

Figure 11. Output Return Loss vs Frequency Over Temperature, Wide Band

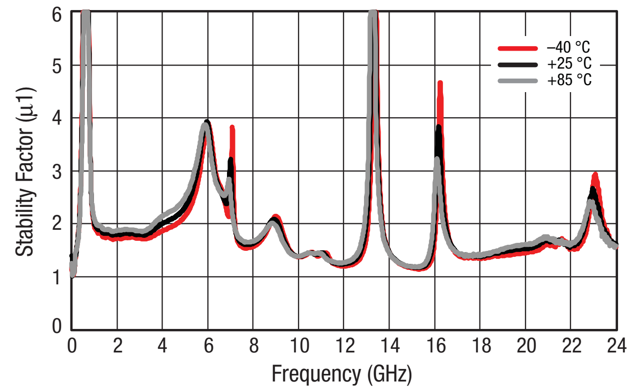

Figure 12. Stability Factor (μ1) vs Frequency Over Temperature

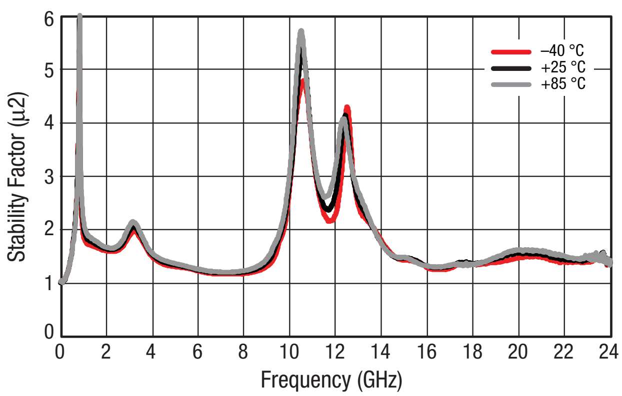

Figure 13. Stability Factor (μ2) vs Frequency Over Temperature

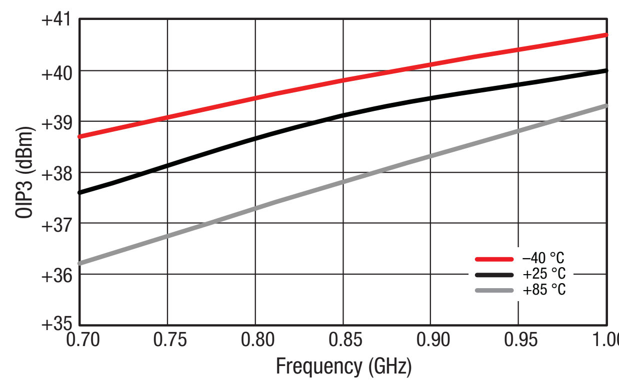

Figure 14. OIP3 vs Frequency Over Temperature

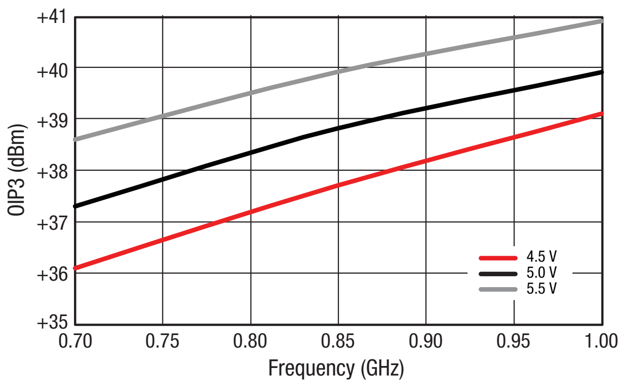

Figure 15. OIP3 vs Frequency Over Voltage

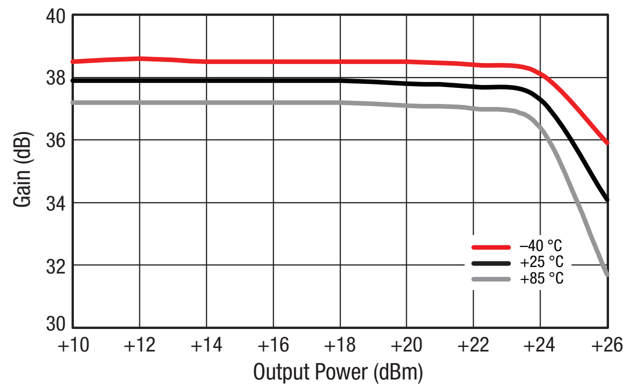

Figure 16. Gain vs Output Power Over Temperature

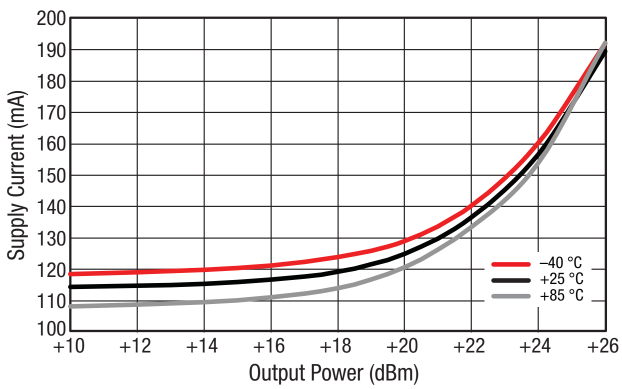

Figure 17. Supply Current vs Output Power Over Temperature

Evaluation Board Description

The SKY67161-306LF Evaluation Board is used to test the performance of the SKY67161-306LF two-stage LNA. An Evaluation Board schematic diagram is provided in Figure 18. Table 4 provides the Evaluation Board Bill of Materials. An assembly drawing for the Evaluation Board is shown in Figure 19.

Package Dimensions

The PCB layout footprint for the SKY67161-306LF is shown in Figure 20. Typical case markings are noted in Figure 21. Package dimensions for the 16-pin QFN are shown in Figure 22, and tape and reel dimensions are provided in Figure 23.

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 SKY67161-306LF 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.

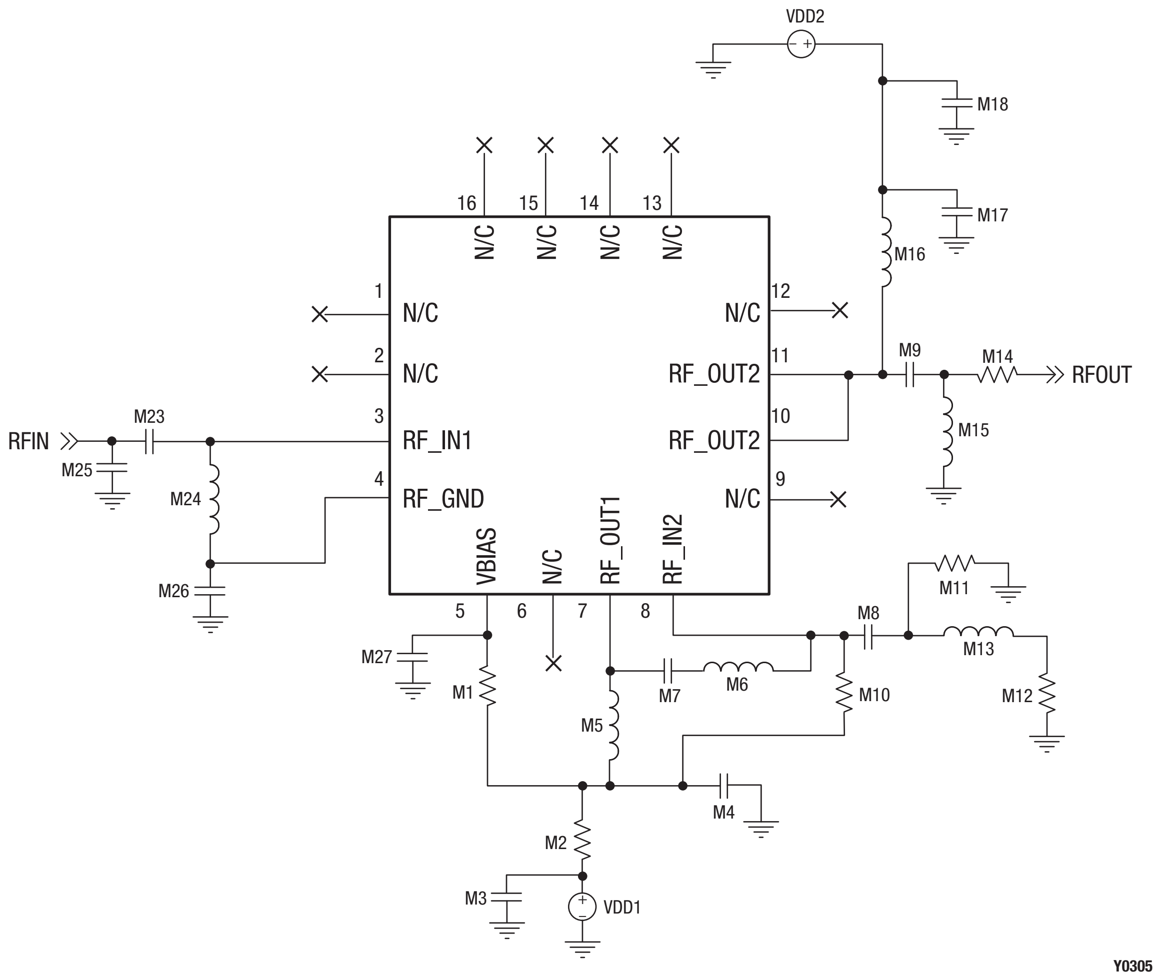

Figure 18. SKY67161-306LF Evaluation Board Schematic (VDD1 = VDD2 = +5 V)

Table 4. SKY67161-306LF Evaluation Board Bill of Materials (1 of 2)

Component	Value	Size	Manufacturer	Part #	Comments
M1	9.1 kΩ	0402	Kamaya	RMC1/16S-912JTH	Resistor, RMC, 1/16S, 5%
M2	24 Ω	0402	Kamaya	RMC1/16S-240JTH	Resistor, RMC, 1/16S, 5%
M3	1000 pF	0402	Murata	GRM155R71H102KA01	Capacitor
M4	10000 pF	0402	Murata	GRM155R71H103KA88	Capacitor
M5	3.3 nH	0402	Murata	LQG15HS3N3S02	Inductor
M6, M14	0 Ω	0402	Kamaya	RMC1/16SJPTH	Resistor, RMC, 1/16S, 5%
M7	4.7 pF	0402	Murata	GRM1555C1H4R7CZ01	Capacitor
M8	0.1 µF	0402	Murata	GRM155R71C104KA88	Capacitor
M9	12 pF	0402	Murata	GRM1555C1H120JZ01	Capacitor
M10	10 kΩ	0402	Kamaya	RMC1/16S-103JTH	Resistor, RMC, 1/16S, 5%
M11	20 Ω	0402	Kamaya	RMC1/16S-200JTH	Resistor, RMC, 1/16S, 5%
M12, M13, M25	DNI	–	–	–	–
M15	18 nH	0402	Murata	LQG15HS18NJ02	Inductor

Table 4. SKY67161-306LF Evaluation Board Bill of Materials (2 of 2)

Component	Value	Size	Manufacturer	Part #	Comments
M16	33 nH	0402	Coilcraft	0402HP-33NX_L	Inductor
M17	100 pF	0402	Murata	GRM1555C1H101JZ01	Capacitor
M18	1 µF	0402	Murata	GRM155R61A105KE15	Capacitor
M19, M20, M21, M22	Unused	–	–	–	–
M23	33 pF	0402	Murata	GRM155C1H330JZ01	Capacitor
M24	18 nH	0402	Coilcraft	0402HP-18NX_L	Inductor
M26, M27	0.1 µF	0402	Murata	GRM155R71C104KA88	Capacitor

Note: Components M19, M20, M21, and M22 are shown on the Evaluation Board assembly diagram but are not included in the schematic or in Table 4 since they are not needed for this application.

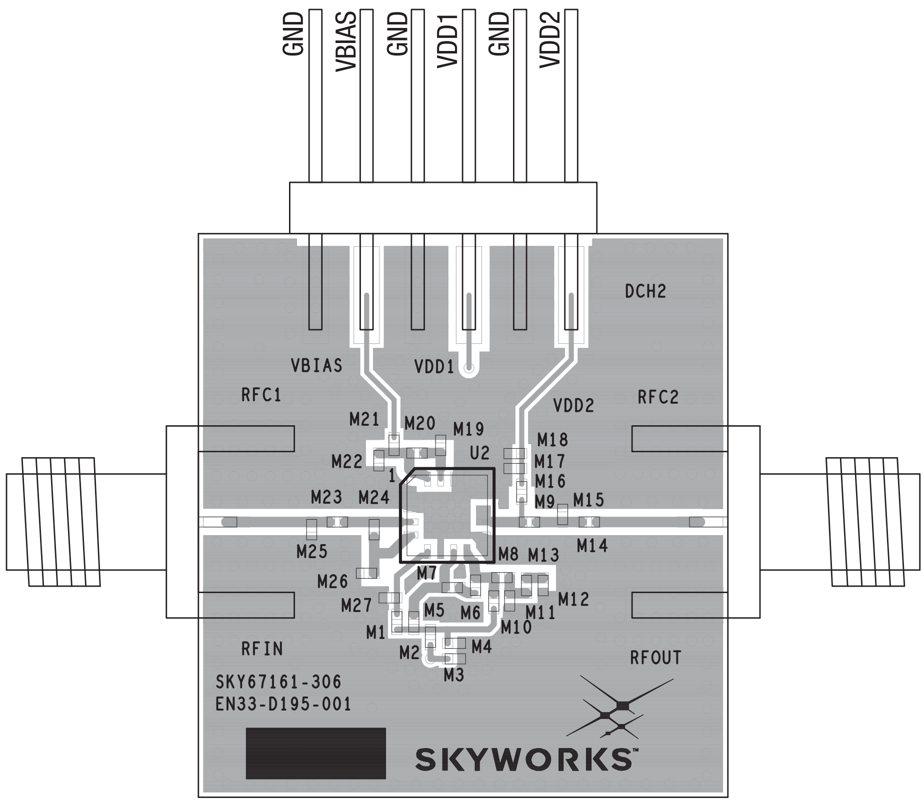

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Figure 19. SKY67161-306LF Evaluation Board Assembly Diagram

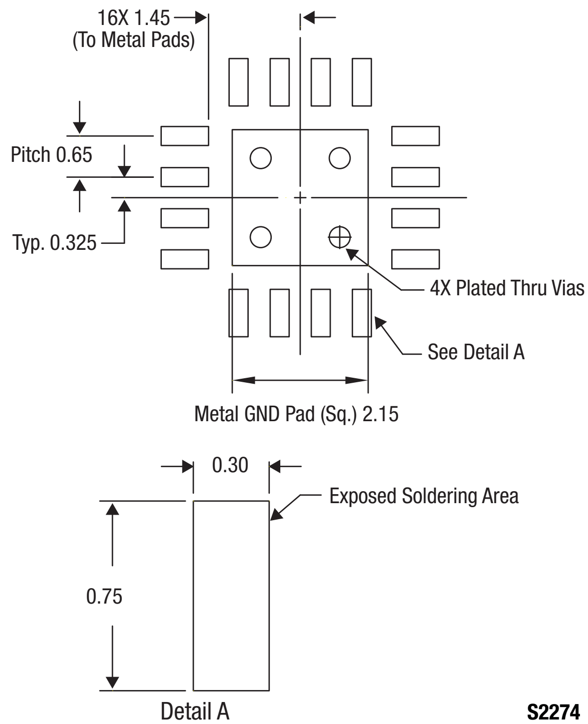


Figure 20. SKY67161-306LF PCB Layout Footprint

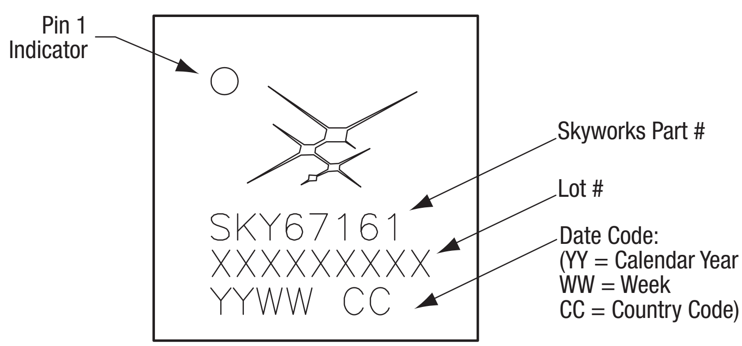
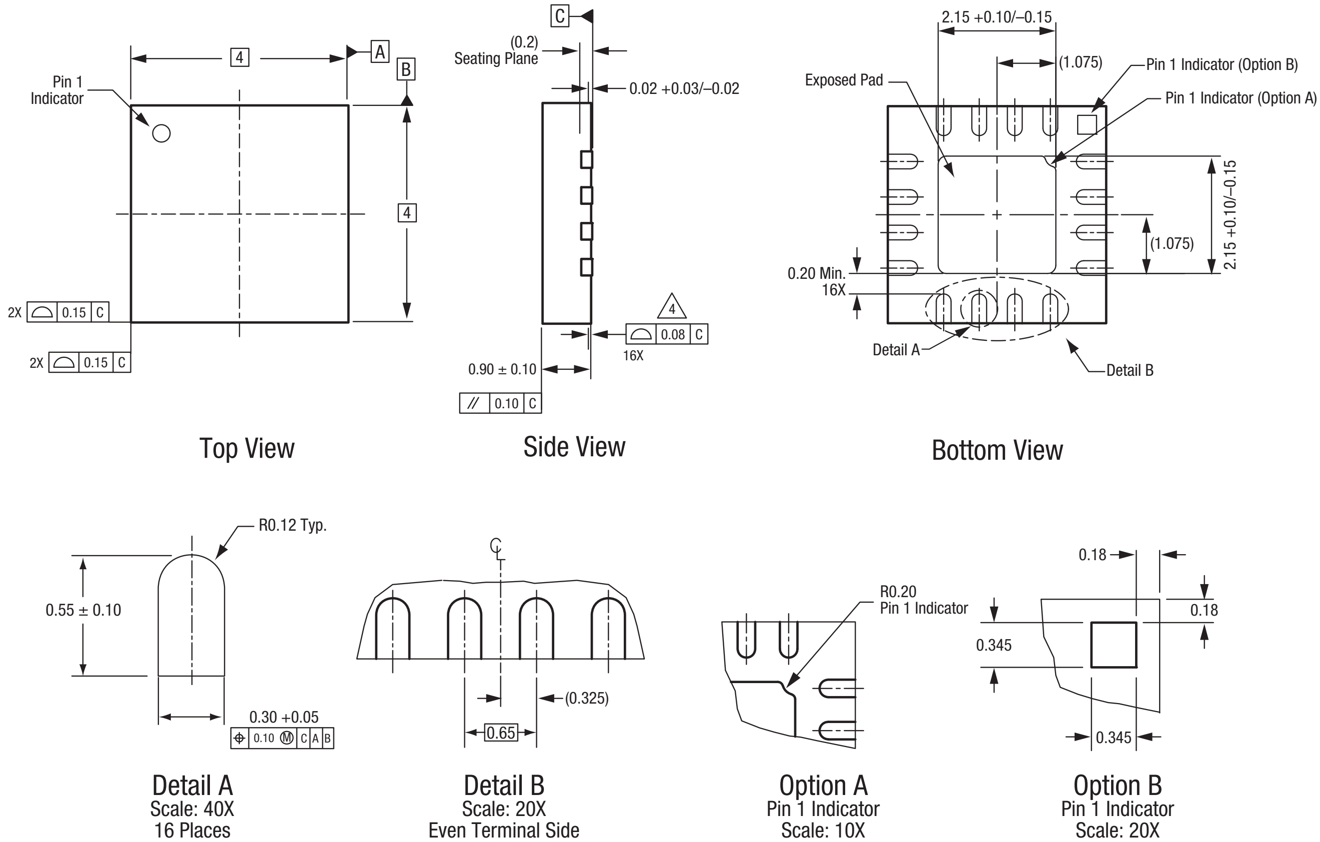


Figure 21. Typical Case Markings (Top View)



All measurements are in millimeters.
Dimensioning and tolerancing according to ASME Y14.5M-1994.
Coplanarity applies to the exposed heat sink slug as well as the terminals.
Package may have option A or option B pin 1 indicator.

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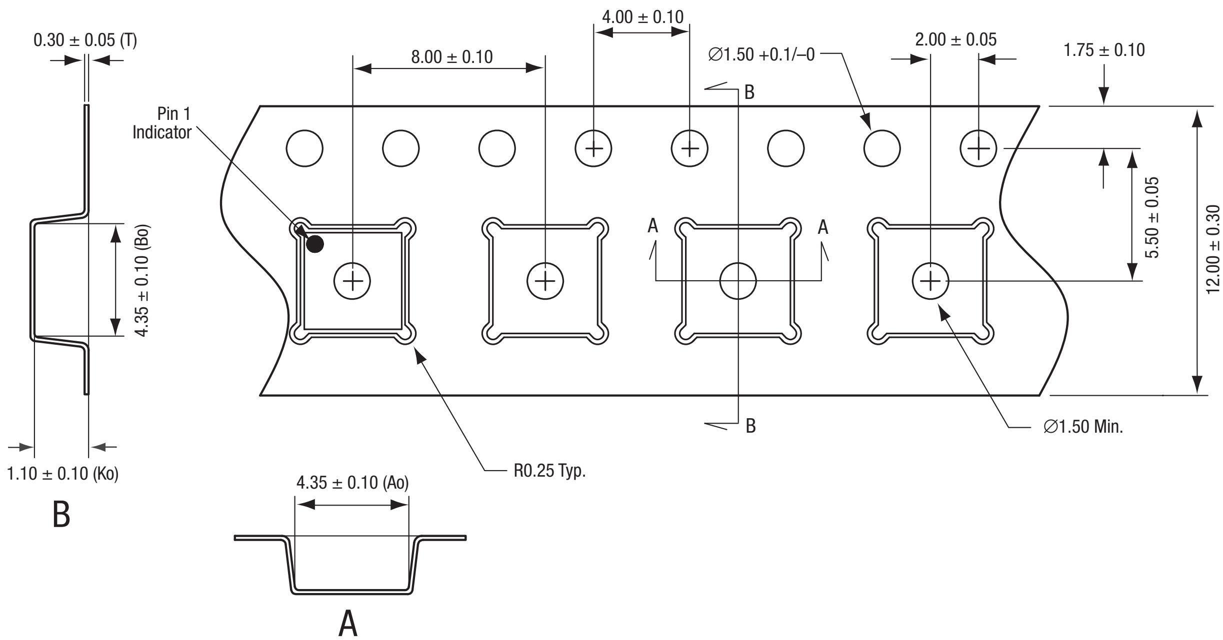
Figure 22. SKY67161-306LF 16-Pin QFN Package Dimensions



Notes:
1. *Carrier tape material: black conductive polystyrene, non-bakeable*
2. *Cover tape material: transparent conductive HSA*
3. *Cover tape size: 9.2 mm width*
4. *ESD surface resistivity is ≥1 x 10^5 ~ ≤ 1 x 10^{10} Ohms/square per EIA, JEDEC TNR Specification.*
5. *All measurements are in millimeters*

S1846

Figure 23. SKY67161-306LF Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY67161-306LF Two-Stage LNA	SKY67161-306LF	SKY67161-306LF-EVB