

SKY73092-459LF51: 400-6000 MHz Quadrature Modulator

Applications

- Cellular base station systems: GSM/EDGE, CDMA2000, W-CDMA, TD-SCDMA, LTE
- WiMAX/broadband wireless access systems
- Satellite modems

Features

- RF frequency operation range: 400 to 6000 MHz
- Baseband common-mode voltage: 1.50 V to 1.75 V
- Side-band suppression better than -45 dBc
- Carrier feedthrough of -40 dBm
- Noise floor of -161 dBm/Hz
- Single supply: 4.75 to 5.25 V
- QFN (24-pin, 4 x 4 mm) package (MSL1, 260 °C per JEDEC J-STD-020)



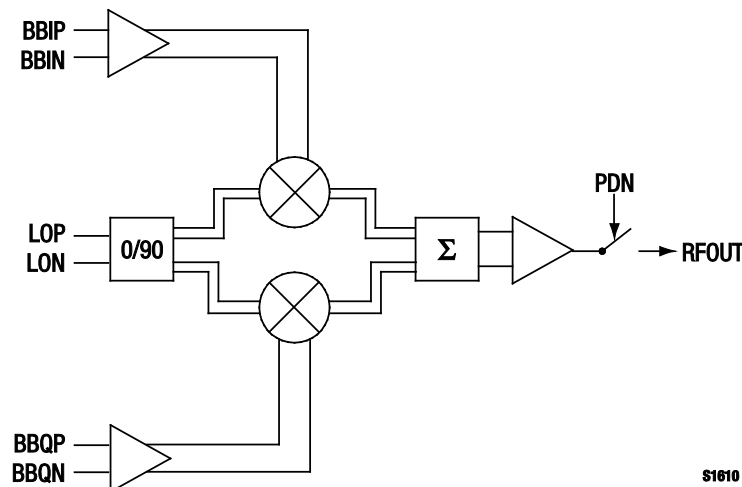
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Description

Skyworks SKY73092-459LF51 is an integrated quadrature modulator for the upconversion of complex modulated baseband/IF signals directly up to RF. The device is designed for use in the 400 to 6000 MHz range. The high linearity, and excellent I/Q phase accuracy and amplitude balance of the SKY73092-459LF51 make it ideal for use in high performance communication systems.

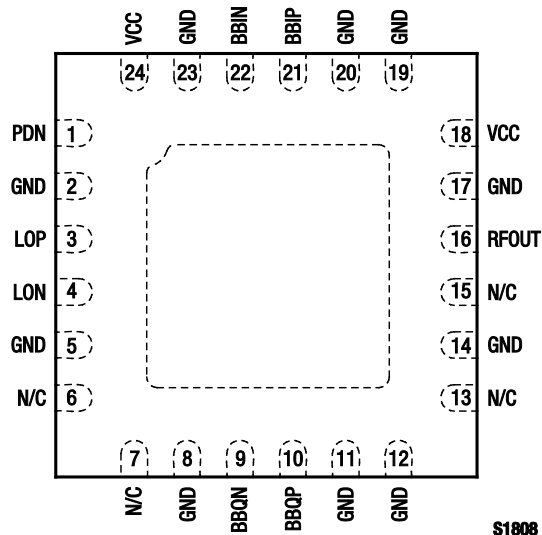
The modulator accepts two differential baseband inputs and a single-ended Local Oscillator (LO), and generates a single-ended RF output. The baseband input buffers accept an input common-mode voltage of 1.50 V to 1.75 V. The LO input is broadband matched on-chip to 50 Ω , which enables a direct connection to a 50 Ω LO source. The RF output is a broadband, single-ended 50 Ω port, designed for a direct connection to a 50 Ω load.

Figure 1 shows a functional block diagram for the SKY73092-459LF51. The device package and pinout for the 24-pin Quad Flat No-Lead (QFN) package are shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.



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Figure 1. SKY73092-459LF51 Functional Block Diagram



**Figure 2. SKY73092-459LF51 Pinout, 24-Pin QFN
(Top View)**

Table 1. SKY73092-459LF51 Signal Descriptions

Pin #	Name	Description	Pin #	Name	Description
1	PDN	Power down, output disable. A logic high disables the RF output. Connect to ground or leave floating to enable the RF output.	13	N/C	No connection. Can be left open or tied to ground.
2	GND	Ground	14	GND	Ground
3	LOP	50 Ω single-ended positive LO input. Pin must be AC-coupled to the LO.	15	N/C	No connection. Can be left open or tied to ground.
4	LON	50 Ω single-ended negative LO input. Pin must be AC-coupled to ground.	16	RFOUT	RF output. Pin should be AC-coupled to the load.
5	GND	Ground	17	GND	Ground
6	N/C	No connection. Can be left open or tied to ground.	18	VCC	+5 VDC supply
7	N/C	No connection. Can be left open or tied to ground.	19	GND	Ground
8	GND	Ground	20	GND	Ground
9	BBQN	High impedance negative Q input. Should be externally DC-biased to 1.50 V to 1.75 V.	21	BBIP	High impedance positive I input. Should be externally DC-biased to 1.50 V to 1.75 V.
10	BBQP	High impedance positive Q input. Should be externally DC-biased to 1.50 V to 1.75 V.	22	BBIN	High impedance negative I input. Should be externally DC-biased to 1.50 V to 1.75 V.
11	GND	Ground	23	GND	Ground
12	GND	Ground	24	VCC	+5 VDC supply

Technical Description

The SKY73092-459LF51 is comprised of four main functional areas: the LO chain, the baseband input level shifters, the mixers, and the differential to single-ended converter.

LO Chain

The LO chain consists of an input linear buffer, a polyphase quadrature phase splitter, and limiting amplifiers. The input buffer provides an internal 50 Ω match while generating an amplified differential signal to the polyphase splitters.

The LO can be driven either single-ended or differentially. For single-ended LO signals, the LON signal (pin 4) should be AC-grounded using a capacitor. Each quadrature LO signal is passed through limiting amplifiers before driving the mixers.

Baseband Input Level Shifters

The baseband inputs present a high input impedance while providing proper DC levels for the mixer inputs. The recommended baseband DC bias voltage is provided in Table 3.

Mixers

The SKY73092-459LF51 incorporates two Gilbert-type, double-balanced mixers for both the In-Phase (I) and Quadrature (Q) channels. The differential output currents are summed together into an on-chip balun, which converts the differential signal to a single-ended output.

Differential to Single-Ended Converter

The differential to single-ended converter is an on-chip balun that converts the differential mixer output signal to a single-ended signal. The output of the balun is designed to have a broadband 50 Ω output impedance.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY73092-459LF51 are provided in Table 2. The recommended operating conditions are specified in Table 3 and electrical specifications are provided in Tables 4 through 8.

Table 2. SKY73092-459LF51 Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage, +5 V	VCC		5.5	V
Supply current	I _{CC}		300	mA
LO input power	P _{LO}		+6	dBm
Operating temperature	T _C	–40	+85	°C
Junction temperature	T _J		+150	°C
Storage temperature	T _{STG}	–40	+125	°C

Notes: 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.

Nominal thermal resistance (junction to case) is 5.1 °C/W.

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 SKY73092-459LF51 ESD threshold level is 2500 VDC using Human Body Model (HBM) testing. This level applies to RF signal lines >100 MHz, analog and RF lines <100 MHz, digital lines, power supply lines, and ground pins.

Table 3. SKY73092-459LF51 Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage, +5 V	VCC	4.75	5.00	5.25	V
Supply current: I/Q V _{DC} = 1.50 V I/Q V _{DC} = 1.75 V	I _{CC}		190 220		mA mA
RF frequency	V _{RF}	400		6000	MHz
Baseband input frequency	F _{BB}	0		500	MHz
LO input power	P _{LO}	-6	0	+6	dBm
LO frequency range	F _{LO}	400		6000	MHz
Baseband input DC bias voltage	V _{CM}	1.50		1.75	V
Operating case temperature	T _C	-40		+85	°C

Table 4. SKY73092-459LF51 Electrical Characteristics: RF Output (1 of 5) (Note 1)

(V_{CC} = 5 V, T_A = 25 °C, LO Amplitude = 0 dBm, I/Q Amplitude = 600 mVpp Differential, I/Q Input DC Bias Voltage = 1.50 V, F_{BB} = 1 MHz, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
400 MHz						
RF output power	P _{OUT}			-3.8		dBm
Voltage gain		Output rms voltage divided by input (I or Q) rms voltage		-3.4		dB
1 dB Output Compression Point	OP1dB			+8.2		dBm
Carrier feedthrough				-45.5		dBm
Sideband suppression				-41.1		dBc
2nd harmonic	2f _o	P _{OUT} = -3.8 dBm, harmonic output @ F _{LO} ± 2F _{BB}		-83.8		dBc
3rd harmonic	3f _o	P _{OUT} = -3.8 dBm, harmonic output @ F _{LO} -3F _{BB}		-80.1		dBc
2 nd Order Output Intercept Point	OIP2	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+77.8		dBm
3 rd Order Output Intercept Point	OIP3	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+26.3		dBm
Noise floor		@ 20 MHz offset, I/Q = 0 V _{DIFF} , LO amplitude = +8 dBm		-164.4		dBm/Hz
RF output return loss				-12		dB
900 MHz						
RF output power	P _{OUT}			-2.0		dBm
Voltage gain		Output rms voltage divided by input (I or Q) rms voltage		-1.6		dB
1 dB Output Compression Point	OP1dB			+9.5		dBm

Table 4. SKY73092-459LF51 Electrical Characteristics: RF Output (2 of 5) (Note 1)

($V_{CC} = 5\text{ V}$, $T_A = 25\text{ }^{\circ}\text{C}$, LO Amplitude = 0 dBm, I/Q Amplitude = 600 mVpp Differential, I/Q Input DC Bias Voltage = 1.50 V, $F_{BB} = 1\text{ MHz}$, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
900 MHz (continued)						
Carrier feedthrough				-37.7		dBm
Sideband suppression				-52.0		dBc
2nd harmonic	2fo	$P_{OUT} = +2\text{ dBm}$, harmonic output @ F_{LO} $\pm 2F_{BB}$		-84.0		dBc
3rd harmonic	3fo	$P_{OUT} = +2\text{ dBm}$, harmonic output @ F_{LO} $-3F_{BB}$		-75.0		dBc
2 nd Order Output Intercept Point	OIP2	$F_{BB} = 3.5\text{ and }4.5\text{ MHz}$, $P_{OUT} = -10\text{ dBm}$ each tone		+78.3		dBm
3 rd Order Output Intercept Point	OIP3	$F_{BB} = 3.5\text{ and }4.5\text{ MHz}$, $P_{OUT} = -10\text{ dBm}$ each tone		+27.2		dBm
Noise floor		@ 20 MHz offset, I/Q = 0 V_{DIFF} , LO amplitude = +8 dBm		-160		dBm/Hz
RF output return loss				-12.1		dB
1900 MHz						
RF output power	P_{OUT}			-1.1		dBm
Voltage gain		Output rms voltage divided by input (I or Q) rms voltage		-0.7		dB
1 dB Output Compression Point	OP1dB			+10.1		dBm
Carrier feedthrough				-34.6		dBm
Sideband suppression				-62.4		dBc
2nd harmonic	2fo	$P_{OUT} = +1\text{ dBm}$, harmonic output @ F_{LO} $\pm 2F_{BB}$		-74.8		dBc
3rd harmonic	3fo	$P_{OUT} = +1\text{ dBm}$, harmonic output @ F_{LO} $-3F_{BB}$		-65.2		dBc
2 nd Order Output Intercept Point	OIP2	$F_{BB} = 3.5\text{ and }4.5\text{ MHz}$, $P_{OUT} = -10\text{ dBm}$ each tone		+79.1		dBm
3 rd Order Output Intercept Point	OIP3	$F_{BB} = 3.5\text{ and }4.5\text{ MHz}$, $P_{OUT} = -10\text{ dBm}$ each tone		+26.6		dBm
Noise floor		@ 20 MHz offset, I/Q = 0 V_{DIFF} , LO amplitude = +8 dBm		-161		dBm/Hz
RF output return loss				-14		dB

Table 4. SKY73092-459LF51 Electrical Characteristics: RF Output (3 of 5) (Note 1)

($V_{CC} = 5\text{ V}$, $T_A = 25\text{ }^{\circ}\text{C}$, LO Amplitude = 0 dBm, I/Q Amplitude = 600 mVpp Differential, I/Q Input DC Bias Voltage = 1.50 V, $F_{BB} = 1\text{ MHz}$, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
2600 MHz						
RF output power	P_{OUT}			-0.7		dBm
Voltage gain		Output rms voltage divided by input (I or Q) rms voltage		-0.3		dB
1 dB Output Compression Point	OP1dB			+10.3		dBm
Carrier feedthrough				-32.8		dBm
Sideband suppression				-50.1		dBc
2nd harmonic	$2f_o$	$P_{OUT} = -0.7\text{ dBm}$, harmonic output @ $F_{LO} \pm 2F_{BB}$		-72.3		dBc
3rd harmonic	$3f_o$	$P_{OUT} = -0.7\text{ dBm}$, harmonic output @ $F_{LO} - 3F_{BB}$		-63.7		dBc
2 nd Order Output Intercept Point	OIP2	$F_{BB} = 3.5\text{ and }4.5\text{ MHz}$, $P_{OUT} = -10\text{ dBm}$ each tone		+72.4		dBm
3 rd Order Output Intercept Point	OIP3	$F_{BB} = 3.5\text{ and }4.5\text{ MHz}$, $P_{OUT} = -10\text{ dBm}$ each tone		+26.4		dBm
Noise floor		@ 20 MHz offset, I/Q = 0 V _{DIFF} , LO amplitude = +8 dBm		-158.3		dBm/Hz
RF output return loss				-13		dB
3500 MHz						
RF output power	P_{OUT}			-0.2		dBm
Voltage gain		Output rms voltage divided by input (I or Q) rms voltage		0.6		dB
1 dB Output Compression Point	OP1dB			+11.2		dBm
Carrier feedthrough				-29.4		dBm
Sideband suppression				-45.8		dBc
2nd harmonic	$2f_o$	$P_{OUT} = 0\text{ dBm}$, harmonic output @ $F_{LO} \pm 2F_{BB}$		-56.2		dBc
3rd harmonic	$3f_o$	$P_{OUT} = 0\text{ dBm}$, harmonic output @ $F_{LO} - 3F_{BB}$		-62.6		dBc
2 nd Order Output Intercept Point	OIP2	$F_{BB} = 3.5\text{ and }4.5\text{ MHz}$, $P_{OUT} = -10\text{ dBm}$ each tone		+75.9		dBm
3 rd Order Output Intercept Point	OIP3	$F_{BB} = 3.5\text{ and }4.5\text{ MHz}$, $P_{OUT} = -10\text{ dBm}$ each tone		+27.3		dBm

Table 4. SKY73092-459LF51 Electrical Characteristics: RF Output (4 of 5) (Note 1)

($V_{CC} = 5\text{ V}$, $T_A = 25\text{ }^{\circ}\text{C}$, LO Amplitude = 0 dBm, I/Q Amplitude = 600 mVpp Differential, I/Q Input DC Bias Voltage = 1.50 V, $F_{BB} = 1\text{ MHz}$, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
3500 MHz (continued)						
Noise floor		@ 20 MHz offset, I/Q = 0 V _{DIFF} , LO amplitude = +8 dBm		-148.2		dBm/Hz
RF output return loss				-9		dB
4800 MHz						
RF output power	P _{OUT}			-5.9		dBm
Voltage gain		Output rms voltage divided by input (I or Q) rms voltage		-5.5		dB
1 dB Output Compression Point	OP1dB			+6.8		dBm
Carrier feedthrough				-36.3		dBm
Sideband suppression				-33.5		dBc
2nd harmonic	2f _o	P _{OUT} = -6 dBm, harmonic output @ F _{LO} ± 2F _{BB}		-53.4		dBc
3rd harmonic	3f _o	P _{OUT} = -6 dBm, harmonic output @ F _{LO} -3F _{BB}		-61.8		dBc
2 nd Order Output Intercept Point	OIP2	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+49.6		dBm
3 rd Order Output Intercept Point	OIP3	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+22.0		dBm
Noise floor		@ 20 MHz offset, I/Q = 0 V _{DIFF} , LO amplitude = +8 dBm		-154.1		dBm/Hz
RF output return loss				-7.4		dB
5800 MHz						
RF output power	P _{OUT}			-7.4		dBm
Voltage gain		Output rms voltage divided by input (I or Q) rms voltage		-7.0		dB
1 dB Output Compression Point	OP1dB			+5.4		dBm
Carrier feedthrough				-34.5		dBm
Sideband suppression				-25.1		dBc
2nd harmonic	2f _o	P _{OUT} = -7.5 dBm, harmonic output @ F _{LO} ± 2F _{BB}		-54.5		dBc
3rd harmonic	3f _o	P _{OUT} = -7.5 dBm, harmonic output @ F _{LO} -3F _{BB}		-60.1		dBc

Table 4. SKY73092-459LF51 Electrical Characteristics: RF Output (4 of 5) (Note 1)

(V_{CC} = 5 V, T_A = 25 °C, LO Amplitude = 0 dBm, I/Q Amplitude = 600 mVpp Differential, I/Q Input DC Bias Voltage = 1.50 V, F_{BB} = 1 MHz, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
5800 MHz (continued)						
2 nd Order Output Intercept Point	OIP2	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+47.1		dBm
3 rd Order Output Intercept Point	OIP3	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+18.5		dBm
Noise floor		@ 20 MHz offset, I/Q = 0 V _{DIFF} , LO amplitude = +8 dBm		-155.5		dBm/Hz
RF output return loss				-11.2		dB

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

Table 5. SKY73092-459LF51 Electrical Characteristics: RF Output (1 of 5) (Note 1)

(V_{CC} = 5 V, T_A = 25 °C, LO Amplitude = 0 dBm, I/Q Amplitude = 600 mVpp Differential, I/Q Input DC Bias Voltage = 1.75 V, F_{BB} = 1 MHz, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
400 MHz						
RF output power	P _{OUT}			-3.8		dBm
Voltage gain		Output rms voltage divided by input (I or Q) rms voltage		-3.3		dB
1 dB Output Compression Point	OP1dB			+10.2		dBm
Carrier feedthrough				-44.5		dBm
Sideband suppression				-41.0		dBc
2nd harmonic	2f _o	P _{OUT} = -4 dBm, harmonic output @ F _{LO} ± 2F _{BB}		-83.4		dBc
3rd harmonic	3f _o	P _{OUT} = -4 dBm, harmonic output @ F _{LO} -3F _{BB}		-86.8		dBc
2 nd Order Output Intercept Point	OIP2	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+76.7		dBm
3 rd Order Output Intercept Point	OIP3	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+28.8		dBm
Noise floor		@ 20 MHz offset, I/Q = 0 V _{DIFF} , LO amplitude = +8 dBm		-164		dBm/Hz
RF output return loss				-12		dB

Table 5. SKY73092-459LF51 Electrical Characteristics: RF Output (2 of 5) (Note 1)

(V_{CC} = 5 V, T_A = 25 °C, LO Amplitude = 0 dBm, I/Q Amplitude = 600 mVpp Differential, I/Q Input DC Bias Voltage = 1.75 V, F_{BB} = 1 MHz, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
900 MHz						
RF output power	P _{OUT}			-1.9		dBm
Voltage gain		Output rms voltage divided by input (I or Q) rms voltage		-1.5		dB
1 dB Output Compression Point	OP1dB			+11.4		dBm
Carrier feedthrough				-36.4		dBm
Sideband suppression				-51.7		dBc
2nd harmonic	2f _o	P _{OUT} = +2 dBm, harmonic output @ F _{LO} ± 2F _{BB}		-82.7		dBc
3rd harmonic	3f _o	P _{OUT} = +2 dBm, harmonic output @ F _{LO} -3F _{BB}		-73.4		dBc
2nd Order Output Intercept Point	OIP2	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+78.7		dBm
3rd Order Output Intercept Point	OIP3	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+29.4		dBm
Noise floor		@ 20 MHz offset, I/Q = 0 V _{DIFF} , LO amplitude = +8 dBm		-158.8		dBm/Hz
RF output return loss				-12.1		dB
1900 MHz						
RF output power	P _{OUT}			-1.1		dBm
Voltage gain		Output rms voltage divided by input (I or Q) rms voltage		-0.6		dB
1 dB Output Compression Point	OP1dB			+10.9		dBm
Carrier feedthrough				-32.7		dBm
Sideband suppression				-69.8		dBc
2nd harmonic	2f _o	P _{OUT} = +1 dBm, harmonic output @ F _{LO} ± 2F _{BB}		-73.7		dBc
3rd harmonic	3f _o	P _{OUT} = +1 dBm, harmonic output @ F _{LO} -3F _{BB}		-73.4		dBc
2 nd Order Output Intercept Point	OIP2	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+79.8		dBm
3 rd Order Output Intercept Point	OIP3	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+28.3		dBm

Table 5. SKY73092-459LF51 Electrical Characteristics: RF Output (3 of 5) (Note 1)

($V_{CC} = 5\text{ V}$, $T_A = 25\text{ }^{\circ}\text{C}$, LO Amplitude = 0 dBm, I/Q Amplitude = 600 mVpp Differential, I/Q Input DC Bias Voltage = 1.75 V, $F_{BB} = 1\text{ MHz}$, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
1900 MHz (continued)						
Noise floor		@ 20 MHz offset, I/Q = 0 V _{DIFF} , LO amplitude = +8 dBm		-159.4		dBm/Hz
RF output return loss				-14		dB
2600 MHz						
RF output power	P _{OUT}			-0.7		dBm
Voltage gain		Output rms voltage divided by input (I or Q) rms voltage		-0.3		dB
1 dB Output Compression Point	OP1dB			+11.0		dBm
Carrier feedthrough				-31.0		dBm
Sideband suppression				-52.4		dBc
2nd harmonic	2f _o	P _{OUT} = -0.7 dBm, harmonic output @ F _{LO} ± 2F _{BB}		-72.7		dBc
3rd harmonic	3f _o	P _{OUT} = -0.7 dBm, harmonic output @ F _{LO} -3F _{BB}		-72.4		dBc
2nd Order Output Intercept Point	OIP2	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+73.2		dBm
3rd Order Output Intercept Point	OIP3	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+27.9		dBm
Noise floor		@ 20 MHz offset, I/Q = 0 V _{DIFF} , LO amplitude = +8 dBm		-156.9		dBm/Hz
RF output return loss				-13		dB
3500 MHz						
RF output power	P _{OUT}			-0.2		dBm
Voltage gain		Output rms voltage divided by input (I or Q) rms voltage		0.4		dB
1 dB Output Compression Point	OP1dB			+10.7		dBm
Carrier feedthrough				-27.3		dBm
Sideband suppression				-43.5		dBc
2nd harmonic	2f _o	P _{OUT} = 0 dBm, harmonic output @ F _{LO} ± 2F _{BB}		-56.1		dBc
3rd harmonic	3f _o	P _{OUT} = 0 dBm, harmonic output @ F _{LO} -3F _{BB}		-70.6		dBc

Table 5. SKY73092-459LF51 Electrical Characteristics: RF Output (4 of 5) (Note 1)

(V_{CC} = 5 V, T_A = 25 °C, LO Amplitude = 0 dBm, I/Q Amplitude = 600 mVpp Differential, I/Q Input DC Bias Voltage = 1.75 V, F_{BB} = 1 MHz, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
3500 MHz (continued)						
2 nd Order Output Intercept Point	OIP2	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+67.6		dBm
3 rd Order Output Intercept Point	OIP3	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+27.0		dBm
Noise floor		@ 20 MHz offset, I/Q = 0 V _{DIFF} , LO amplitude = +8 dBm		-147.9		dBm/Hz
RF output return loss				-9		dB
4800 MHz						
RF output power	P _{OUT}			-7.5		dBm
Voltage gain		Output rms voltage divided by input (I or Q) rms voltage		-7.0		dB
1 dB Output Compression Point	OP1dB			+7.4		dBm
Carrier feedthrough				-33.3		dBm
Sideband suppression				-32.2		dBc
2nd harmonic	2f _o	P _{OUT} = -7.5 dBm, harmonic output @ F _{LO} ± 2F _{BB}		-54.0		dBc
3rd harmonic	3f _o	P _{OUT} = -7.5 dBm, harmonic output @ F _{LO} -3F _{BB}		-67.9		dBc
2 nd Order Output Intercept Point	OIP2	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+49.1		dBm
3 rd Order Output Intercept Point	OIP3	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+23.3		dBm
Noise floor		@ 20 MHz offset, I/Q = 0 V _{DIFF} , LO amplitude = +8 dBm		-153.3		dBm/Hz
RF output return loss				-7.4		dB
5800 MHz						
RF output power	P _{OUT}			-9.1		dBm
Voltage gain		Output rms voltage divided by input (I or Q) rms voltage		-8.7		dB
1 dB Output Compression Point	OP1dB			+6.2		dBm
Carrier feedthrough				-32.1		dBm
Sideband suppression				-24.0		dBc

Table 5. SKY73092-459LF51 Electrical Characteristics: RF Output (5 of 5) (Note 1)

(V_{CC} = 5 V, T_A = 25 °C, LO Amplitude = 0 dBm, I/Q Amplitude = 600 mVpp Differential, I/Q Input DC Bias Voltage = 1.75 V, F_{BB} = 1 MHz, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
5800 MHz (continued)						
2nd harmonic	2f _o	P _{OUT} = -9 dBm, harmonic output @ F _{LO} ± 2F _{BB}		-55.5		dBc
3rd harmonic	3f _o	P _{OUT} = -9 dBm, harmonic output @ F _{LO} -3F _{BB}		-65.9		dBc
2 nd Order Output Intercept Point	OIP2	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+46.8		dBm
3 rd Order Output Intercept Point	OIP3	F _{BB} = 3.5 and 4.5 MHz, P _{OUT} = -10 dBm each tone		+20.0		dBm
Noise floor		@ 20 MHz offset, I/Q = 0 V _{DIFF} , LO amplitude = +8 dBm		-155.6		dBm/Hz
RF output return loss				-11.2		dB

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

Table 6. SKY73092-459LF51 Electrical Characteristics: LO Input (Note 1)

(V_{CC} = 5 V, T_A = 25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
LO drive level		Single-ended	-6	0	+6	dBm
LO port return loss		Internal 50 Ω match		-10		dB

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

Table 7. SKY73092-459LF51 Electrical Characteristics: Baseband Input (Note 1)

(V_{CC} = 5 V, T_A = 25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Baseband input DC bias common mode voltage	V _{CM}		1.50		1.75	V
I/Q input amplitude		peak-to-peak differential		600		mV
I/Q differential input resistance				13.3		kΩ
I/Q differential input capacitance				1.84		pF
I/Q input bandwidth		50 Ω source @ 1 dB		425		MHz

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

Table 8. SKY73092-459LF51 Electrical Characteristics: PDN Input (Note 1)
(V_{CC} = 5 V, T_A = 25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Supply current		PDN high		107		mA
Off isolation		P _{OUT} (PDN high) to P _{OUT} (PDN low)		126		dB
LO leakage		PDN high, LO = 1 GHz		-64		dBm
Settling time: turn on		PDN low to high (90% of nominal power)		0.3		μs
turn off		PDN high to low (10% of nominal power)		0.2		μs
PDN high level (logic 1)			2.8			V
PDN low level (logic 0)					2.8	V
RF output return loss		PDN high		Note 2		dB
LO port return loss		PDN high		Note 3		dB

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

Note 2: RF output return loss is the same for PDN high and PDN low. Refer to Tables 4 and 5.

Note 3: LO port return loss is the same for PDN high and PDN low. Refer to Table 6.

Evaluation Board Description

The SKY73092-459LF51 Evaluation Board is used to test the performance of the SKY73092-459LF51 quadrature modulator. An assembly drawing for the Evaluation Board is shown in Figure 3 and the layer detail is provided in Figure 4. An Evaluation Board schematic diagram is provided in Figure 5.

Circuit Design Configurations

The following design considerations are critical and must be followed regardless of final use or configuration:

1. Component C106 is an AC ground and should be placed as close as possible to pin 4 (LON) of the device.
2. Components C108 and C121 are bypass capacitors and should be placed as close as possible to pin 18 (VCC).
3. Components C109 and C123 are bypass capacitors and should be placed as close as possible to pin 24 (VCC).

Package Dimensions

Package dimensions for the 24-pin QFN are shown in Figure 6, and tape and reel dimensions are provided in Figure 7.

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 SKY73092-459LF51 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.

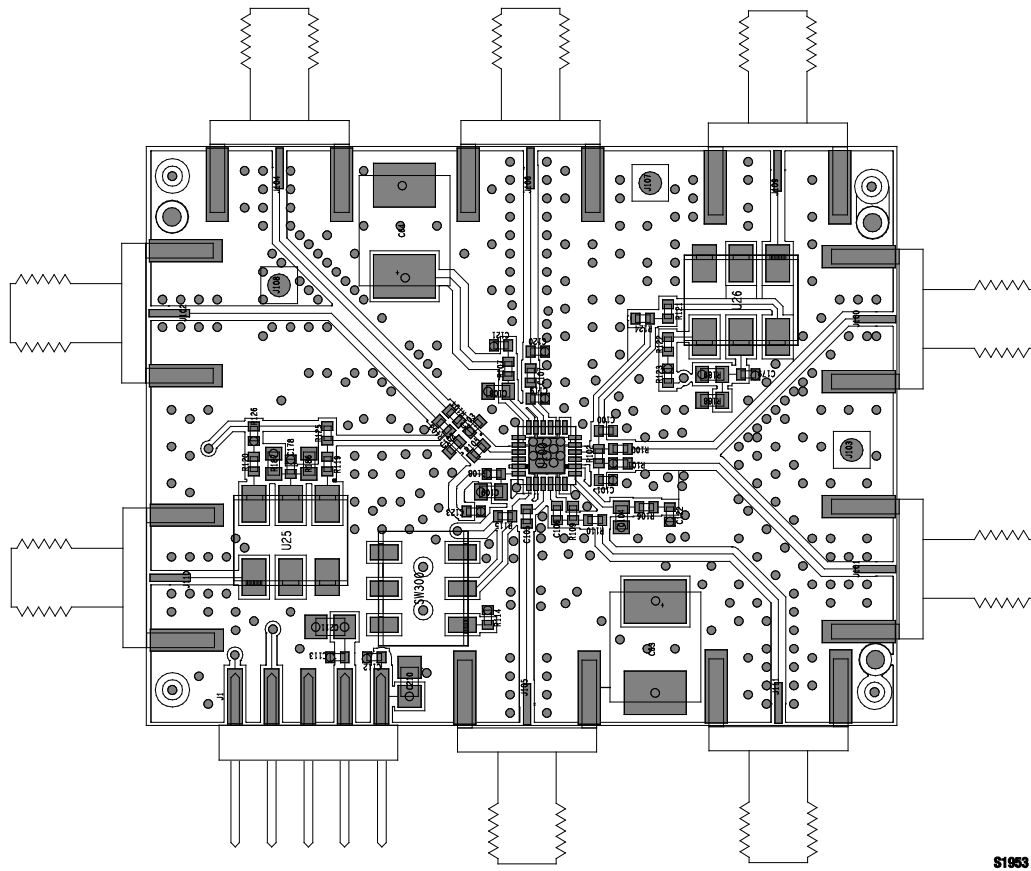
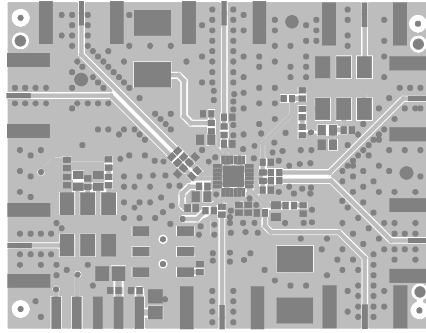
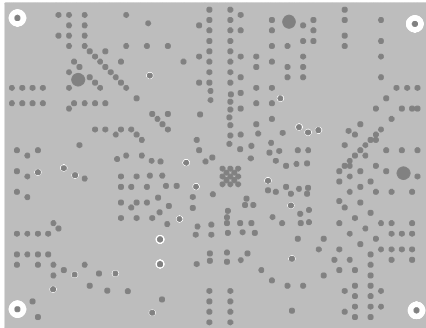


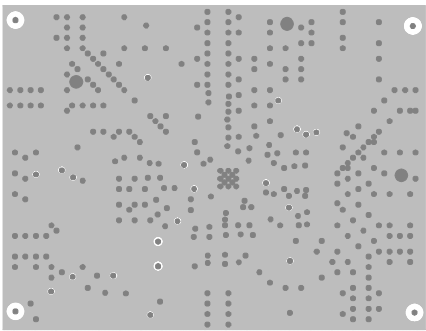
Figure 3. SKY73092-459LF51 Evaluation Board Assembly Diagram



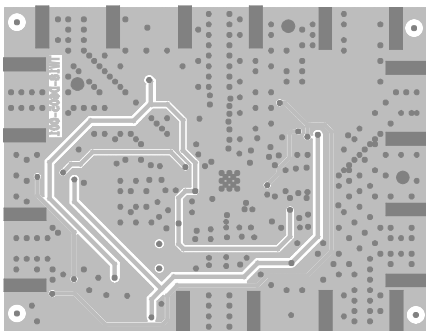
Layer 1: Top – Metal



Layer 2: Ground



Layer 3: Power Plane

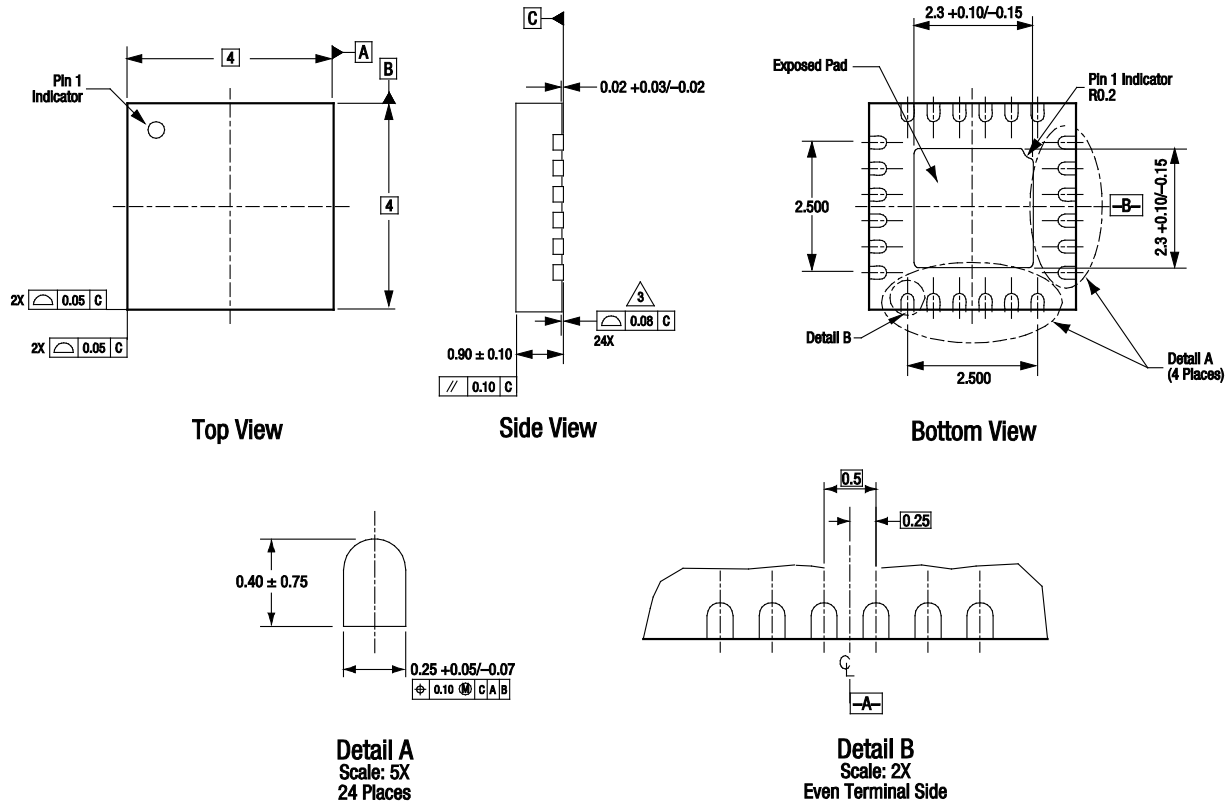


Layer 4: Solid Ground Plane

51057

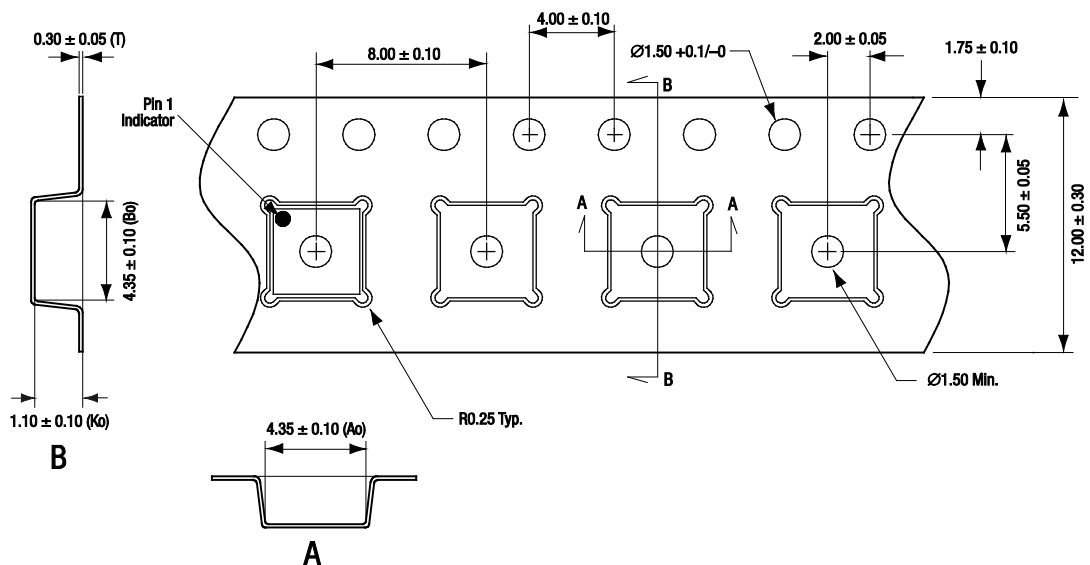
Figure 4. SKY73092-459LF51 Evaluation Board Layer Detail





S1054a

Figure 6. SKY73092-459LF51 24-Pin QFN Package Dimensions



S1846

Figure 7. SKY73092-459LF51 Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY73092-459LF51 400-6000 MHz Quadrature Modulator	SKY73092-459LF51	TW18-D605-001

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