SKY13524-639LF: 0.7 to 3.0 GHz High Isolation SP4T Switch

Applications

- CDMA/WCDMA/TD-SCDMA/LTE single-ended filter switching

Features

- Broadband frequency range: 0.7 to 3.0 GHz
- High isolation: 47 dB @ 2.0 GHz (typical)
- Small QFN (14-pin, 1.6 x 1.6 mm) package (MSL1, 260 °C per JEDEC J-STD-020)

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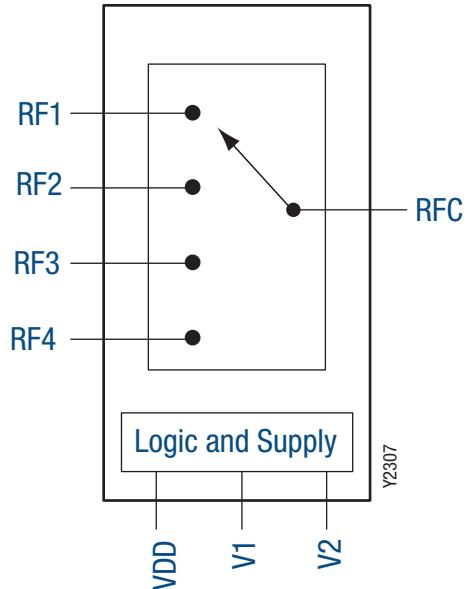

Figure 1. SKY13524-639LF Block Diagram

Description

The SKY13524-639LF is a single-pole, four-throw (SP4T) switch used for single-ended filter switching in cellular applications. The SKY13524-639LF maintains low insertion loss and high isolation for all switching paths.

Depending on the logic voltage level applied to the control pins (V1 and V2), the RFC pin is connected to one of four switched RF outputs (RF1 to RF4) using a low insertion loss path, while the paths between the RFC pin and the other RF pins are in a high isolation state.

The SKY13524-639LF is manufactured in a compact, 14-pin 1.6 x 1.6 mm, 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.
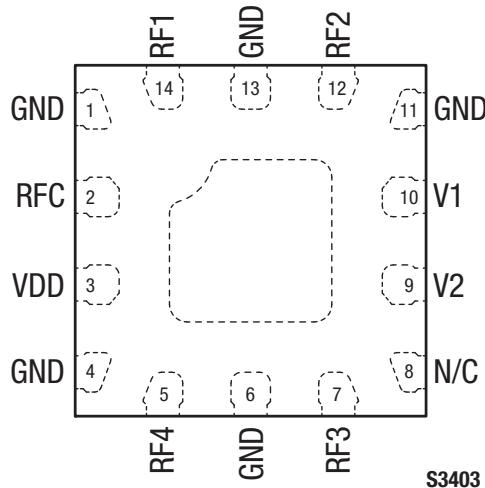
Figure 2. SKY13524-639LF Pinout – 14-Pin QFN
(Top View)

Table 1. SKY13524-639LF Signal Descriptions (Note 1)

Pin	Name	Description	Pin	Name	Description
1	GND	Ground	8	N/C	Not connected
2	RFC	Antenna port. No DC blocking capacitor required.	9	V2	Control voltage 2
3	VDD	DC power supply	10	V1	Control voltage 1
4	GND	Ground	11	GND	Ground
5	RF4	RF input/output port 4. DC blocking capacitor required.	12	RF2	RF input/output port 2. DC blocking capacitor required.
6	GND	Ground	13	GND	Ground
7	RF3	RF input/output port 3. DC blocking capacitor required.	14	RF1	RF input/output port 1. DC blocking capacitor required.

Note 1: Bottom ground paddles must be connected to ground.

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Functional Description

The SKY13524-639LF includes an internal decoder and internal blocking capacitors on the RF common ports. External DC blocking capacitors are required on the RF1, RF2, RF3, and RF4 ports for proper operation. DC decoupling capacitors may be added on the VDD and control lines if necessary.

Switching is controlled by two control voltage inputs, V1 and V2. Depending on the logic voltage level applied to the control pins, the antenna pin is connected to one of four switched RF outputs.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY13524-639LF are provided in Table 2. Electrical specifications are provided in Table 3.

The state of the SKY13524-639LF is determined by the logic shown in Table 4.

Table 2. SKY13524-639LF Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	V_{DD}		3.7	V
Control voltage (V1, V2)	V_{CTL}	−0.5	+3.3	V
RF input power	P_{IN}		+26	dBm
Operating temperature	T_{OP}	−30	+90	°C
Storage temperature	T_{STG}	−55	+150	°C

Note 1: 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. SKY13524-639LF General Electrical Specifications (Note 1)
(V$_{DD}$ = 3.3 V, V1 = V2 = High = 1.8 V, P$_{IN}$ = 0 dBm, T$_{OP}$ = +25 °C, Characteristic Impedance [Z$_0$] = 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition (Note 2)	Min	Typical	Max	Units
DC Specifications						
Supply voltage	V$_{DD}$		2.5		3.3	V
Supply current	I$_{DD}$	VDD = 3.3 V		5	10	µA

Control voltage:
    High
    Low
	V$_{CTL\_H}$
	V$_{CTL\_L}$
			1.35
			0
				1.80	3.30
					0.45
						V
						V

Control current	I$_{CTL}$	V1 = V2 = 1.8 V, VDD = 3.3 V			5	µA
RF Specifications						
Insertion loss (RFC pin to RF1/2/3/4 pins)	IL	704 to 960 MHz 1710 to 2170 MHz 2300 to 2690 MHz		0.7 0.8 0.85	0.9 1.0 1.05	dB dB dB
Isolation (RFC pin to RF1/2/3/4 pins)	Iso	704 to 960 MHz 1710 to 2170 MHz 2300 to 2690 MHz	47 46 45	50 49 48		dB dB dB
Voltage standing wave ratio, all ports	VSWR	0.7 to 3.0 GHz, referenced to 50 Ω		1.4		–
0.1 dB input compression point (RFC pin to RF1/2/3/4 pins)	IP0.1dB	0.7 to 3.0 GHz		+32		dBm
Third order input intercept point	IIP3	0.7 to 3.0 GHz, all RF ports, fo = 0.8 to 3.0 GHz, Δf = 1 MHz, P$_{IN}$ = +20 dBm/tone		+56		dBm
Turn-on/turn-off time		Measured from 50% of final VDD supply voltage to final RF power ±1 dB		400	550	ηs
Switching speed		Measured from 50% of final VCTRL voltage to final RF power ±1 dB		500	650	ηs

Table 4. SKY13524-639LF Control Logic

VDD (Pin 3)	V1 (Pin 10)	V2 (Pin 9)	Insertion Loss Path
1	1	0	RFC to RF1
1	0	0	RFC to RF2
1	0	1	RFC to RF3
1	1	1	RFC to RF4

Note: "1" = 1.8 V; "0" = 0 V. Any state other than that described in this Table places the switch into an undefined state. An undefined state will not damage the device.

Evaluation Board Description

The SKY13524-639LF Evaluation Board is used to test the performance of the SKY13524-639LF SP4T Switch. An Evaluation Board schematic diagram is provided in Figure 3. An assembly drawing for the Evaluation Board is shown in Figure 4.

Package Dimensions

The PCB layout footprint for the SKY13524-639LF is provided in Figure 5. Typical case markings are shown in Figure 6. Package dimensions for the 14-pin QFN 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 SKY13524-639LF 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.
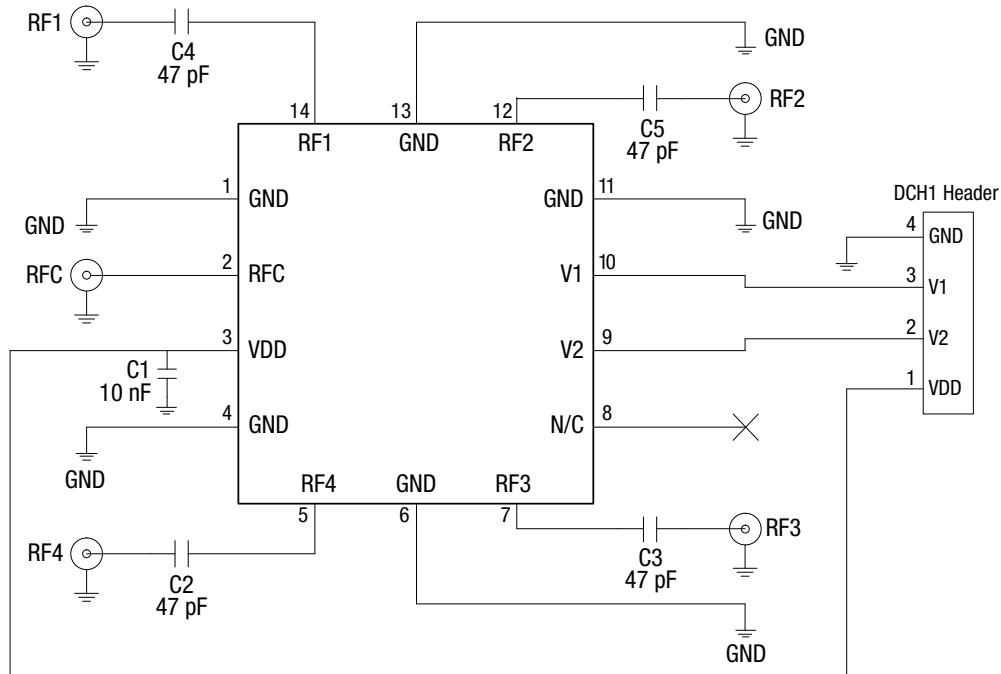
ts185

Figure 3. SKY13524-639LF Evaluation Board Schematic

RFC

RF4

RF1

C2

C

C4

B

C1

D

C3

C5

RF3

A

U1

E

RF2

SKYWORKS
639LF EVB BOARD
EN34-D435-001
REV A   V1

J   I   H   G

F

1   4

1   4

C1 = 10 nF
C2, C3, C4, C5 = 47 pF

VDD V2 V1 GND

ts186
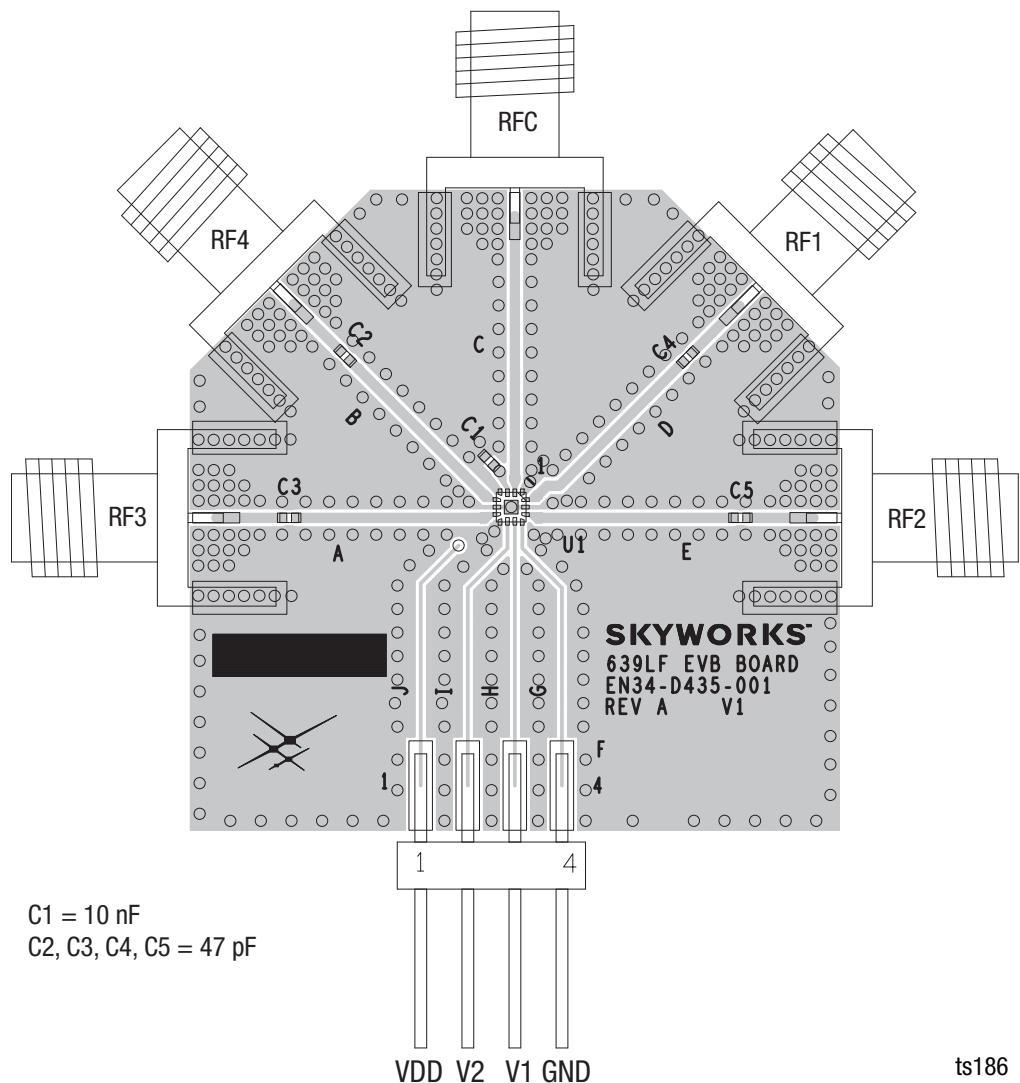
Figure 4. SKY13524-639LF Evaluation Board Assembly Diagram

14X 0.200

Pin 14

Pin 1 Indicator
0.22 × 0.22

Pin 1

4X 0.180 × 0.075

4X 0.152 × 0.064

Exposed Soldering
Area

0.400 Pitch

3X 1.944

2X 0.370

14X 0.200

4X 0.345

10X 0.400

2X 0.370

4X 1.944
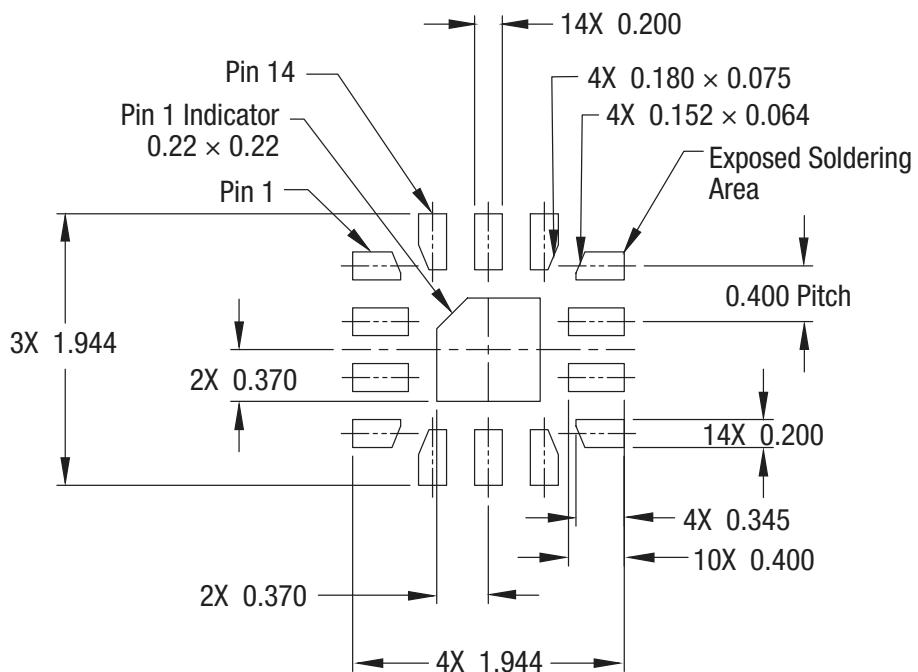
All dimensions are in millimeters.

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**Figure 5. SKY13524-639LF PCB Layout Footprint
(Top View)**

Pin 1
Indicator

Part number

SKY
3524

ts188
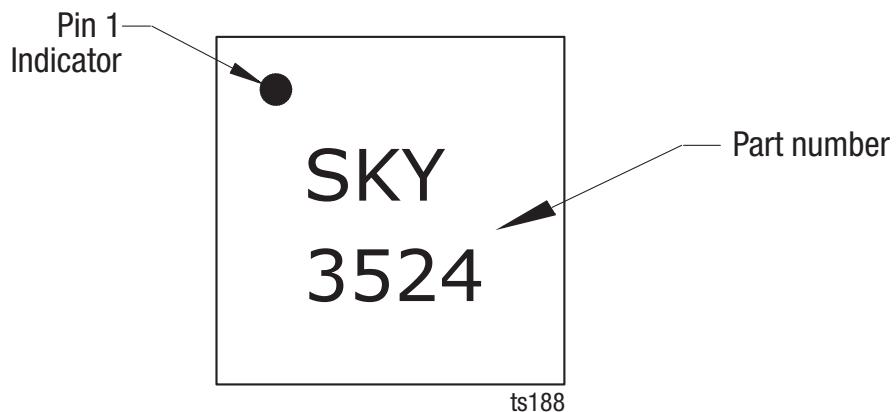
**Figure 6. Typical Part Markings
(Top View)**

Top View

Side View

Bottom View

Detail A

Scale: 100X
1X This Rotation
1X Rotated 180°

Detail B

Scale: 100X
1X This Rotation
1X Rotated 180°
1X Mirrored
1X Mirrored 180°

Detail C

Scale: 100X
1X This Rotation
1X Rotated 180°
1X Rotated 90° CW
1X Rotated 90° CCW

Notes:

1. *All measurements are in millimeters.*
2. *Dimensions and tolerances according to ASME Y14.5M-1994.*
3. *Coplanarity applies to the terminals and all other bottom surface metallization.*
4. *Plating requirement per source control drawing (SCD) 2504.*
5. *Dimension applies to metallized terminal. If the terminal has a radius on its end,*
   the width dimension should not be measured in that radius area.

S3402

Figure 7. SKY13524-639LF 14-Pin QFN Package Dimensions

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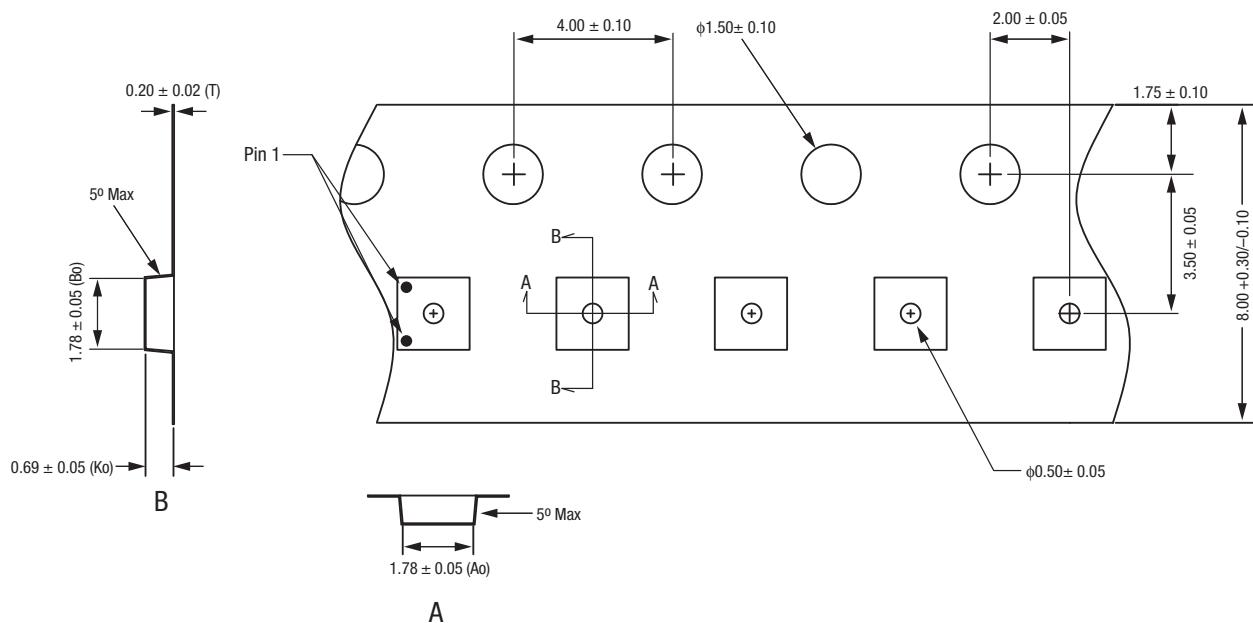
Notes:
1. Carrier tape: black conductive polycarbonate.
2. Cover tape material: transparent conductive PSA.
3. Cover tape size: 5.4 mm width.
4. All measurements are in millimeters.
5. ESD surface resistivity is ≤1 x 10^8 Ohms/square per EIA, JEDEC tape and reel specification.
6. Pin 1 orientation is in lower left corner for SOT-666 packages. Pin 1 orientation is in upper left corner for 1.5 x 1.5 mm and 1.6 x 1.6 mm MLPD, QFN, and DFN packages.

S1382

Figure 8. SKY13524-639LF Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY13524-639LF: 0.7 to 3.0 GHz High Isolation SP4T Switch	SKY13524-639LF	SKY13524-639LF-EVB