SKY13388-465LF: 0.1-2.7 GHz SP4T Switch With Integrated Logic Decoder
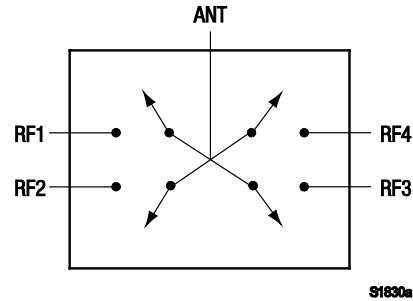
Applications

- WCDMA/CDMA/LTE front-end/antenna switches
- Diversity receive antenna switches

Features

- Broadband frequency range: 0.1 GHz to 2.7 GHz

- Low insertion loss: 0.60 dB typical @ 2.2 GHz, 0.65 dB typical @ 2.7 GHz

- High isolation: >30 dB typical @ 1.0 GHz, 23 dB typical @ 2.7 GHz

- V_{DD}: 2.5 to 5.5 V

- IIP3: +65 dBm typical @ 0.90 GHz

- Good 2nd and 3rd harmonic performance >75 dBc @ 2.2 GHz

- Low voltage compatible (V_{HIGH} = 1.8 V)

- No external components required

- Small, QFN (12-pin, 2 x 2 mm) 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. SKY13388-465LF Block Diagram

Description

The SKY13388-465LF is a symmetrical, single-pole, four-throw (SP4T) switch. The device is designed for broadband, medium power switching applications that demand high linearity and low insertion loss. This is a general purpose switch optimized for 3GPP bands from 0.70 to 2.7 GHz.

The switch is manufactured with an industry-leading Silicon-on-Insulator (SOI) process. The SKY13388-465LF features on-chip energy management circuitry that uses only two control lines for the switch operation. The low current consumption makes the device suitable for battery-operated applications.

The SKY13388-465LF SP4T switch is provided in a compact Quad Flat No-Lead (QFN) 2 x 2 mm 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.
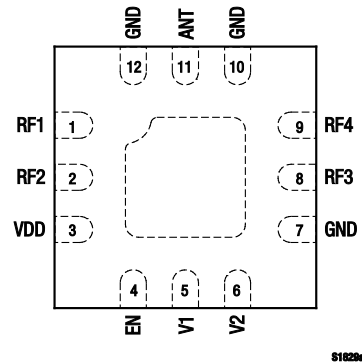
Figure 2. SKY13388-465LF Pinout – 12-Pin QFN (Top View)

Table 1. SKY13388-465LF Signal Descriptions

Pin #	Name	Description	Pin #	Name	Description
1	RF1	RF input 1	7	GND	Ground
2	RF2	RF input 2	8	RF3	RF input 3
3	VDD	DC power supply	9	RF4	RF input 4
4	EN	Enable	10	GND	Ground
5	V1	DC control input 1 (see Table 4)	11	ANT	RF common (antenna) port
6	V2	DC control input 2 (see Table 4)	12	GND	Ground

Note: Exposed pad must be grounded.

Table 2. SKY13388-465LF Absolute Maximum Ratings

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage	V_{DD}			5.5	V
Control voltage	V_{CTL}			3.3	V
Input power	P_{IN}			+37	dBm
Storage temperature	T_{STG}	−40		+125	°C
Operating temperature	T_{OP}	−40		+85	°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.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY13388-465LF are provided in Table 2. Electrical specifications are provided in Table 3.

The state of the SKY13388-465LF is determined by the logic provided in Table 4.

Typical performance characteristics of the SKY13388-465LF are illustrated in Figures 3 through 8.

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Table 3. SKY13388-465LF Electrical Specifications (Note 1)
(V_{DD} = 2.5 to 5.5 V, V_{CTL} = 1.8 V, T_{OP} = +25 °C, All Unused RF Ports are Terminated in a 50 Ω Load, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Insertion loss (ANT to RF1, RF2, RF3, RF4)	IL	0.1 to 1.0 GHz 1.0 to 2.2 GHz 2.2 to 2.7 GHz		0.50 0.60 0.65	0.55 0.80 1.00	dB dB dB
Isolation (ANT to RF1, RF2, RF3, RF4)	ISO	0.1 to 1.0 GHz 1.0 to 2.2 GHz 2.2 to 2.7 GHz	25 22 20	31 23 21		dB dB dB
Input return loss (ANT to RF1, RF2, RF3, RF4)	|S11|	0.1 to 2.7 GHz	20	25		dB
Harmonics (ANT to RF1, RF2, RF3, RF4)		P_{IN} = +26 dBm 2fo: 0.8 to 1.0 GHz 3fo: 0.8 to 1.0 GHz 2fo: 1.7 to 2.2 GHz 3fo: 1.7 to 2.2 GHz 2fo: 2.5 to 2.7 GHz 3fo: 2.5 to 2.7 GHz		 −75 −81 −81 −78 −81 −83		 dB dB dB dB dB dB
Input 0.1 dB compression point (ANT to RF1, RF2, RF3, RF4)	P0.1dB	0.8 to 2.7 GHz		+36		dBm
3rd Order Input Intercept Point (ANT to RF1, RF2, RF3, RF4)	IIP3			+65		dBm

Control voltage:
    High
    Low
	V_{CTL}		
			1.65
			0
					
					3.30
					0.4
						
						V
						V

Control current	I_{CTL}			5		µA
Supply current	I_{CC}	V_{DD} = 2.6 V		50		µA
Supply voltage	V_{DD}		2.5		5.5	V
Switching time		RF1, RF2, RF3, RF4: 50% V_{CTL} to 10/90% RF		550		ns
Shutdown to active mode timing		Standby to 90%		5		µs

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

Table 4. SKY13388-465LF Truth Table

State	EN (Pin 4)	V1 (Pin 5)	V2 (Pin 6)
Shutdown	0	X	X
ANT to RF1	1	0	0
ANT to RF2	1	0	1
ANT to RF3	1	1	0
ANT to RF4	1	1	1

Note: 1 = 1.65 to 3.30 V
0 = 0 to 0.4 V
X = "don't care"
Any state other than described in this Table places the switch into an undefined state.

Typical Performance Characteristics

(V_{DD} = 2.5 to 5.5 V, V_{CTL} = 1.8 V, T_{OP} = +25 °C, All Unused RF Ports are Terminated in a 50 Ω Load, Unless Otherwise Noted)
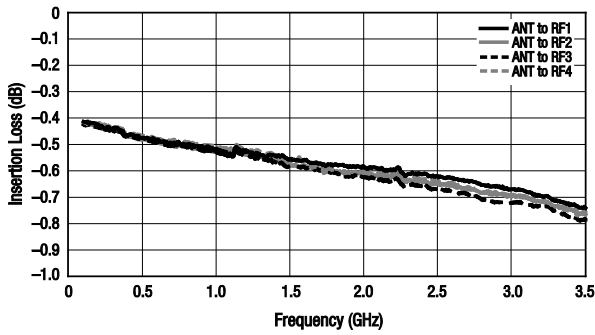
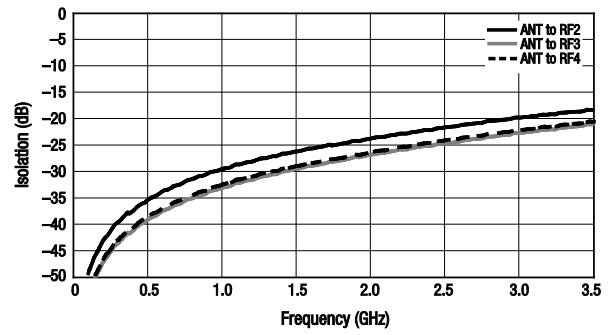**Figure 3. Insertion Loss vs Frequency**

Figure 4. Isolation vs Frequency
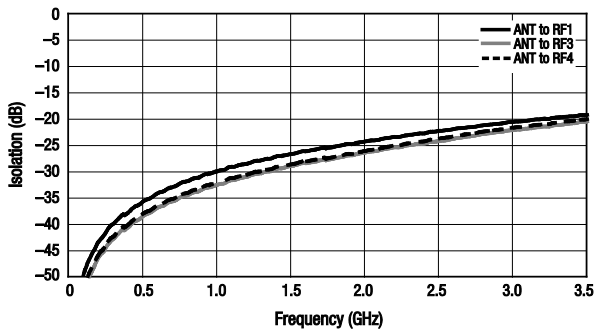**(ANT to RF1 Insertion Loss State)**

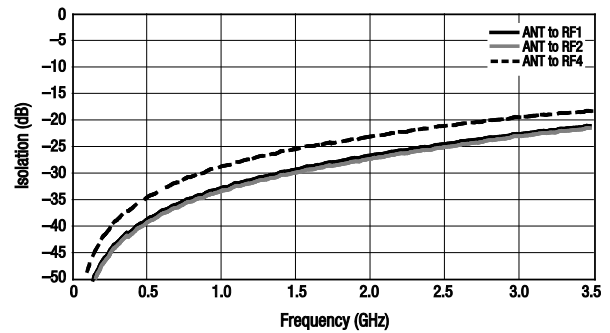**Figure 5. Isolation vs Frequency**
(RFC to V2 Insertion Loss State)

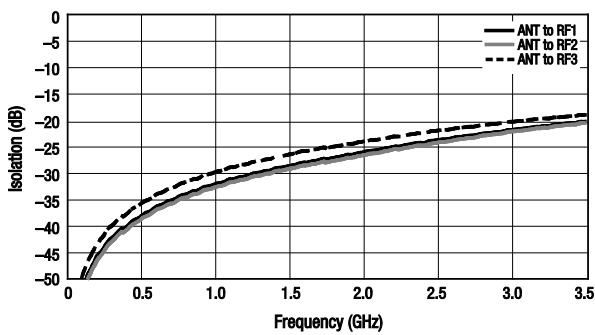**Figure 6. Isolation vs Frequency**
(ANT to RF3 Insertion Loss State)

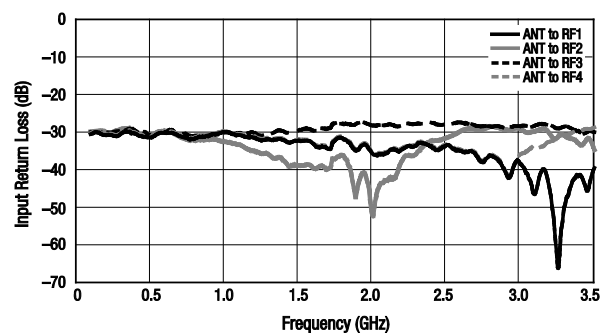**Figure 7. Isolation vs Frequency**
(ANT to RF4 Insertion Loss State)

Figure 8. Input Return Loss vs Frequency

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Evaluation Board Description

The SKY13388-465LF Evaluation Board is used to test the performance of the SKY13388-465LF SP4T Switch. An Evaluation Board schematic diagram is provided in Figure 9. An assembly drawing for the Evaluation Board is shown in Figure 10.

Package Dimensions

The PCB layout footprint for the SKY13388-465LF is provided in Figure 11. Typical case markings are shown in Figure 12. Package dimensions for the 12-pin QFN are shown in Figure 13, and tape and reel dimensions are provided in Figure 14.

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 SKY13388-465LF 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.
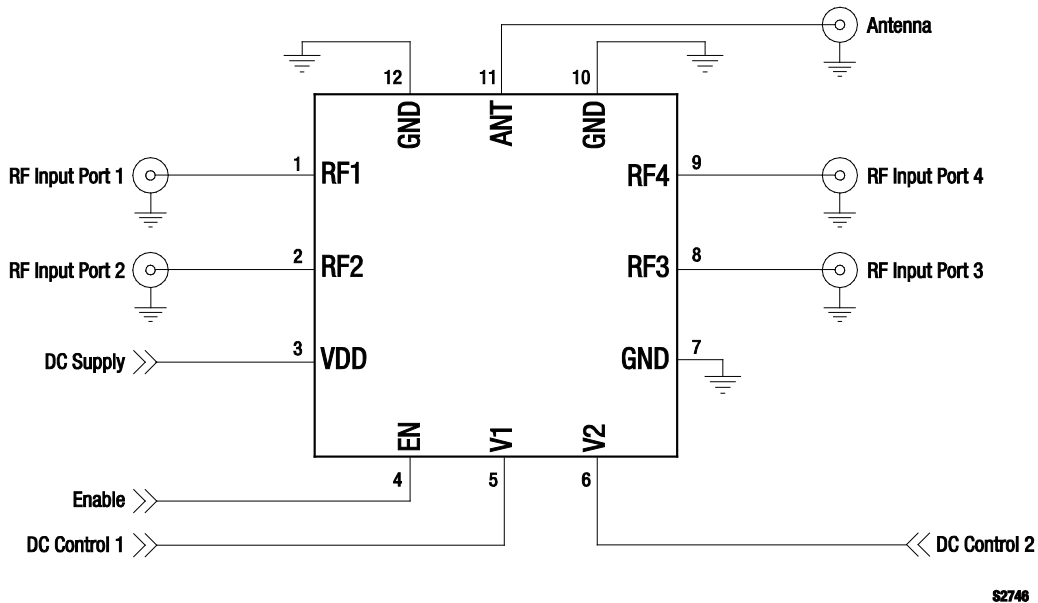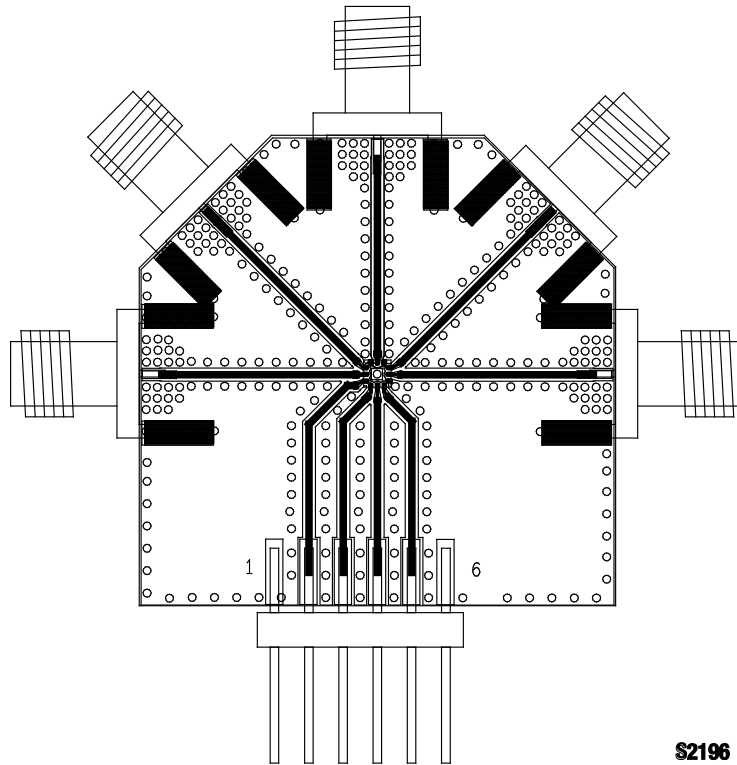

Figure 9. SKY13388-465LF Evaluation Board Schematic

S2196

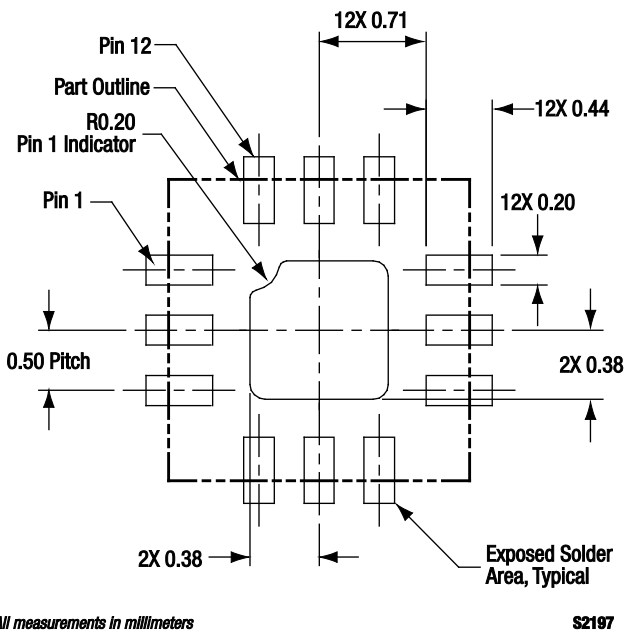**Figure 10. SKY13388-465LF Evaluation Board Assembly Diagram**

12X 0.71

Pin 12

Part Outline

R0.20
Pin 1 Indicator

12X 0.44

Pin 1

12X 0.20

0.50 Pitch

2X 0.38

2X 0.38

Exposed Solder
Area, Typical

All measurements in millimeters

S2197

**Figure 11. SKY13388-465LF PCB Layout Footprint
(Top View)**

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Pin 1
Indicator

Skyworks Part #
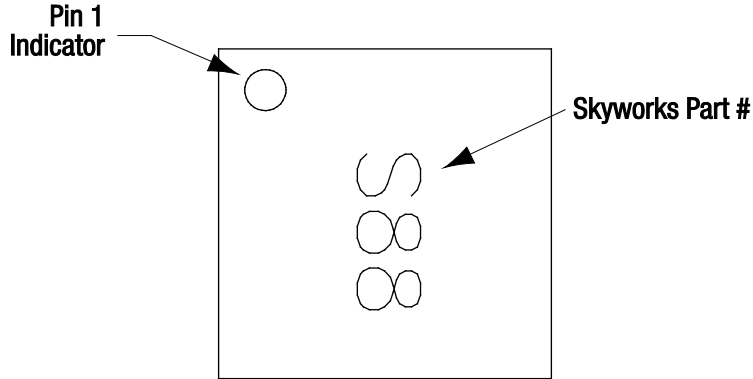
Figure 12. Typical Case Markings
(Top View)

Top View

Side View

Bottom View

2.00

2.00

2X ⌒ 0.05 C

2X ⌒ 0.05 C

-A-

-B-

Pin 1
Indicator

-C-

Seating
Plane

0.02 +0.03/−0.02

0.55 + 0.05/−0.04

// 0.05 C

12X △3

⌒ 0.05 C

0.76 +0.10/−0.15

(0.380)

R0.20
Pin 1 Indicator

Pin 1

Detail A

(0.380)

0.76 +0.10/−0.15

Exposed Pad

12X 0.25 Min.

0.50

0.29 ± 0.075

0.2 ± 0.05

⊕ 0.10 Ⓜ C A B

△5

Detail A
Scale: 100X
12 Places
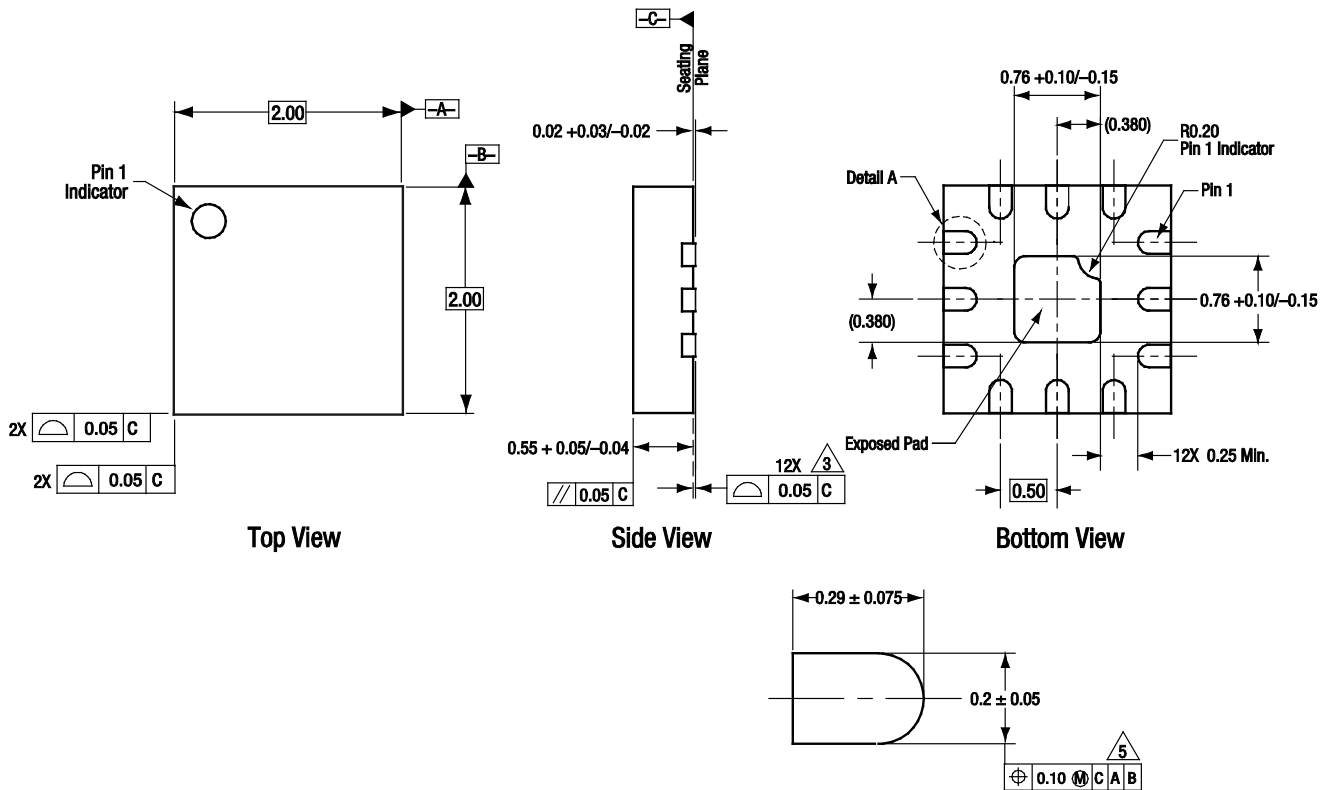
All measurements are in millimeters.
Dimensioning and tolerancing according to ASME Y14.5M-1994.
Coplanarity applies to the terminals and all other bottom surface metalization.
Dimension applies to metalized terminal. If the terminal has a radius on its end,
the width dimension should not be measured in that radius area.

S2198

Figure 13. SKY13388-465LF 12-Pin QFN Package Dimensions

Notes:
1. Carrier tape: black conductive polystyrene.
2. Cover tape material: transparent conductive HSA.
3. Cover tape size: 5.40 mm width.
4. Ten sprocket hole pitch cumulative tolerance = ±0.20 mm.
5. ESD surface resistivity is ≤1 x 10^9 Ohms/square per EIA, JEDEC tape and reel specification.
6. Ao and Bo measurement point to be 0.30 mm from bottom pocket.
7. All measurements are in millimeters.

S1601

Figure 14. SKY13388-465LF Tape and Reel Dimensions

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Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY13388-465LF SP4T Switch	SKY13388-465LF	SKY13388-465LF-EVB