DATA SHEET

# SKY13593-690LF: 2.4 to 2.5 GHz SP3T Switch

## Applications

- 802.11 a/b/g/n/ac WLAN networks
- For devices that support Bluetooth® signals
- Smartphones
- Connectivity modules

## Features

- Positive low voltage control: 0/3.0 to 3.6 V
- Low insertion loss: 0.6 dB (typical) @ 2.4 GHz
- High isolation
  31 dB (typical) at 2.4 GHz
  36 dB (typical) at 2.4 GHz (RF1 to RF2)
- Excellent linearity performance
  P0.1dB +31 dBm
- Integrated DC blocking capacitors
- Miniature, ultra-thin MLP (8-pin, 1.5 × 1.5 mm) package (MSL1, 260 °C per JEDEC J-STD-020)

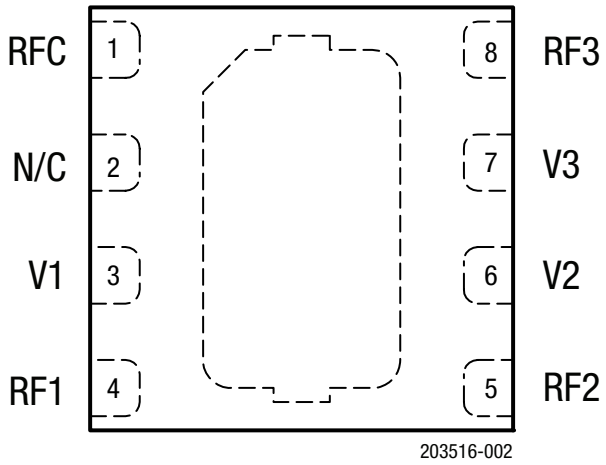



**Figure 1. SKY13593-690LF Pinout (Top View)**

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.

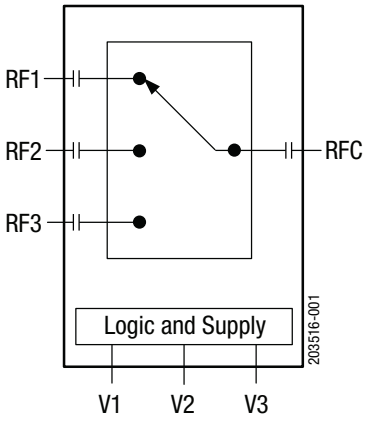



**Figure 2. SKY13593-690LF Block Diagram**

## Description

The SKY13593-690LF is a single-pole, triple-throw (SP3T) antenna switch that operates in the 2.4 to 2.5 GHz frequency range. Switching between the antenna (RFC signal) and the RF1, RF2, and RF3 ports is accomplished with three control voltages.

The low loss, high isolation, high linearity, small size, and low cost make this switch ideal for all WLANs and devices that support Bluetooth® signals operating in the 2.4 to 2.5 GHz band.

The SKY13593-690LF has integrated DC blocking capacitors, so no external DC blocking capacitors are required.

The SKY13593-690LF is manufactured in a compact, 1.5 x 1.5 mm, 8-pin Micro Leadframe Package (MLP).

The pin configuration and package are shown in Figure 1. A functional block diagram is shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.

**Table 1. SKY13593-690LF Signal Descriptions**

| Pin | Name | Description | Pin | Name | Description |
|---|---|---|---|---|---|
| 1 | RFC | Antenna | 5 | RF2 | RF port 2 |
| 2 | N/C | No connect | 6 | V2 | Switch logic control (see Table 5) |
| 3 | V1 | Switch logic control (see Table 4) | 7 | V3 | Switch logic control (see Table 5) |
| 4 | RF1 | RF port 1 | 8 | RF3 | RF port 3 |

## Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY13593-690LF are provided in Table 2. The DC electrical specifications, recommended operating conditions and other parameters are shown in the tables that follow.

**Table 2. SKY13593-690LF Absolute Maximum Ratings[1]**

| Parameter | Symbol | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|
| Input power | Pin | | | +32 | dBm |
| Control voltage | Vctl | | | 3.7 | V |
| Storage temperature | Tstg | –65 | | +150 | °C |
| Operating temperature | Top | –40 | | +90 | C |

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.

***ESD Handling:*** *Industry-standard ESD handling precautions must be adhered to at all times to avoid damage to this device.*

**Table 3. SKY13593-690LF Recommended Operating Conditions**

| Parameter | Symbol | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|
| Operating frequency | fo | 2.4 | | 2.5 | GHz |
| Control voltage:<br>Low<br>High | <br>$V_{CTL\_L}$<br>$V_{CTL\_H}$ | <br><br>3.0 | <br>0<br>3.3 | <br>0.4<br>3.6 | <br>V<br>V |
| Operating temperature | Top | | +25 | | °C |

**Table 4. SKY13593-690LF DC Electrical Specifications[1]**

| Parameter | Symbol | Test Condition | Min | Typical | Max | Units |
|---|---|---|---|---|---|---|
| Insertion loss | IL | 2.4 to 2.5 GHz | | 0.6 | 0.8 | dB |
| Isolation RFC to RF1/RF2 or RF3 | ISO | 2.4 to 2.5 GHz | 28 | 31 | | dB |
| Isolation RF1 to RF2 | ISO | 2.4 to 2.5 GHz | 34 | 36 | | dB |
| Return loss | RL | 2.4 to 2.5 GHz | | 15 | | dB |
| P0.1dB compression point | P0.1dB | 2.4 to 2.5 GHz | | +31 | | dBm |
| Harmonics:<br>2fo<br>3fo | | fo =2.4 GHz, $P_{IN}$ = +24 dBm,<br>50 Ω, VCTL = 3.3 V | | <br>–52<br>–48 | | <br>dBm<br>dBm |
| Input IP3 | IP3 | $P_{IN}$ = +20 dBm/tone, fo = +2.4 GHz | 50 | 54 | | dBm |
| Error vector magnitude | EVM | 802.11g, 2.4 GHz, $P_{IN}$ = +24 dBm | | –47 | –43 | dB |
| | | 802.11g, 2.4 GHz, $P_{IN}$ = +25.5 dBm | | –45 | –42 | dB |
| Switching speed | tsw | 50% $V_{CTL}$ to 90% RF | | 340 | 400 | ns |
| Raise/fall time | | 10%/90% or 90%/10% RF | | 150 | 200 | ns |
| Control current | Ictl | $V_{CTL}$ = 3.3 V | | 5 | 10 | µA |

1. Performance is guaranteed only under the conditions listed in this Table and is not guaranteed over the full operating or storage temperature ranges. Operation at elevated temperatures may reduce reliability of the device.

**Table 5. SKY13593-690LF Truth Table[1]**

| V1 | V2 | V3 | RFC - RF1 | RFC - RF2 | RFC - RF3 |
|---|---|---|---|---|---|
| 1 | 0 | 0 | ON | OFF | OFF |
| 0 | 1 | 0 | OFF | ON | OFF |
| 0 | 0 | 1 | OFF | OFF | ON |

1. “1” indicates Vctl = 3.0 to 3.6 V.
“0” indicates
Vctl = 0 to 0.4 V.
Any state other than described in this table places the switch into an undefined state. An undefined state will not damage the device.

## Evaluation Board Description

The SKY13593-690LF Evaluation Board is used to test the performance of the SKY13593-690LF SP3T 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

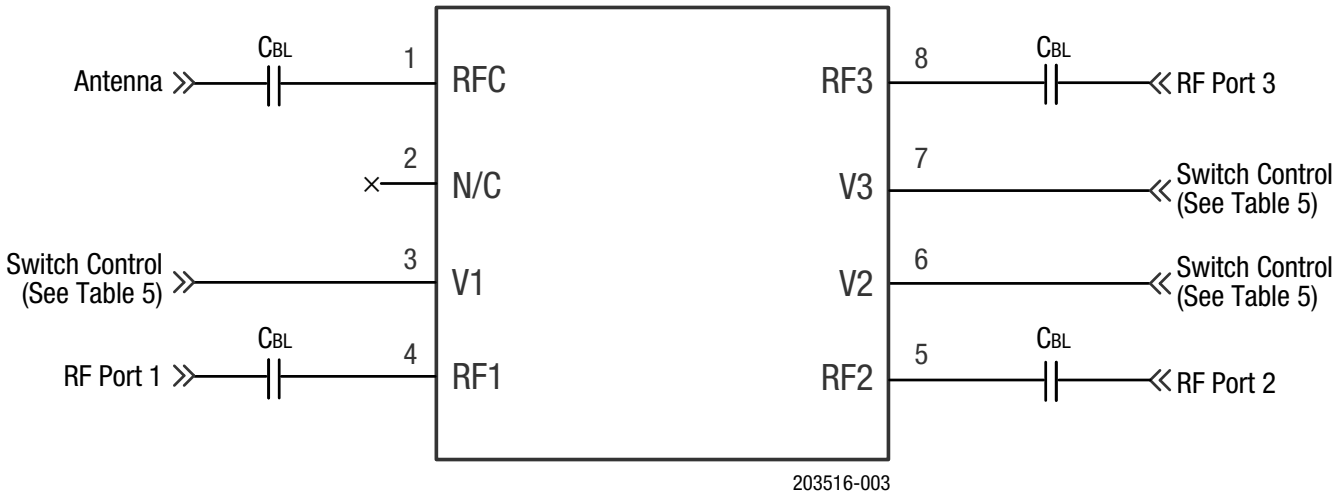
The PCB layout footprint for the SKY13593-690LF is provided in Figure 5. Typical part markings are shown in Figure 6. Package dimensions are shown in Figure 7, and tape and reel dimensions are provided in Figure 8.

## 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 SKY13593-690LF 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 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.




*Note: $C_{BL}$ = 0 Ω (No external DC blocking capacitors are required).*

**Figure 3. SKY13593-690LF Evaluation Board Schematic**

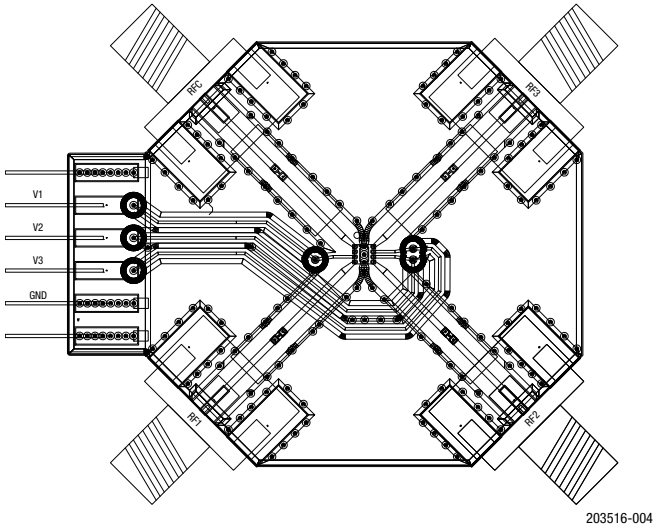



**Figure 4. SKY13593-690LF Evaluation Board Assembly Diagram**

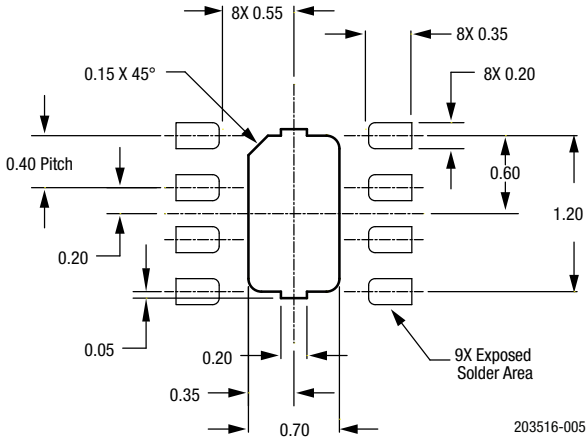



**Figure 5. SKY13593-690LF PCB Layout Footprint (Top View)**

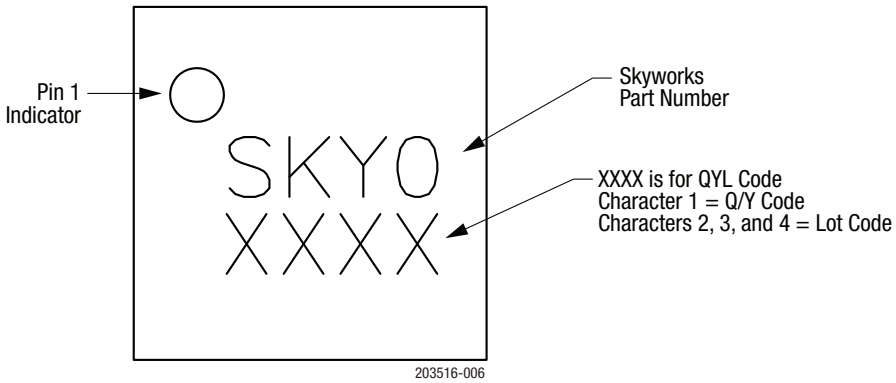
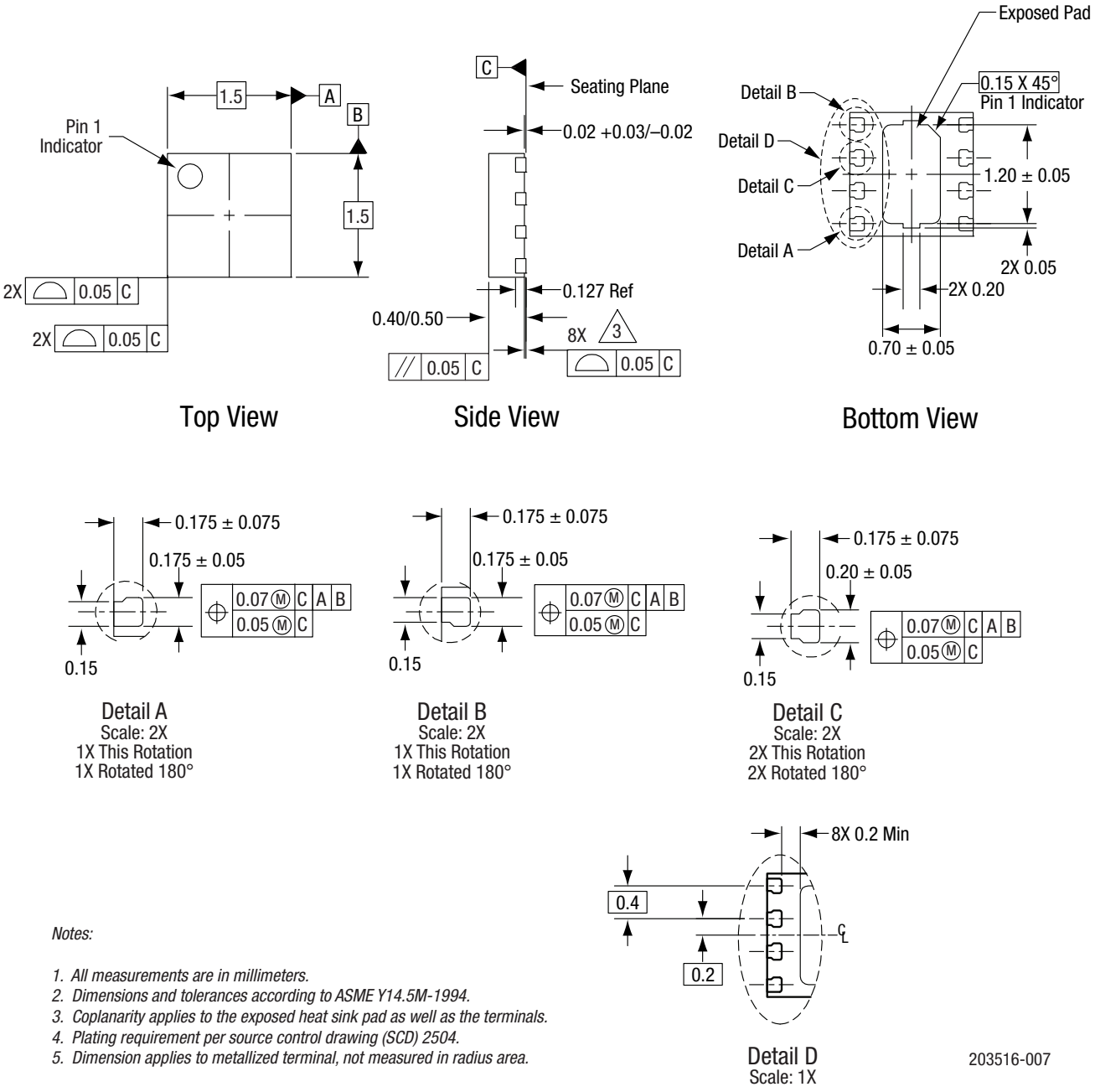


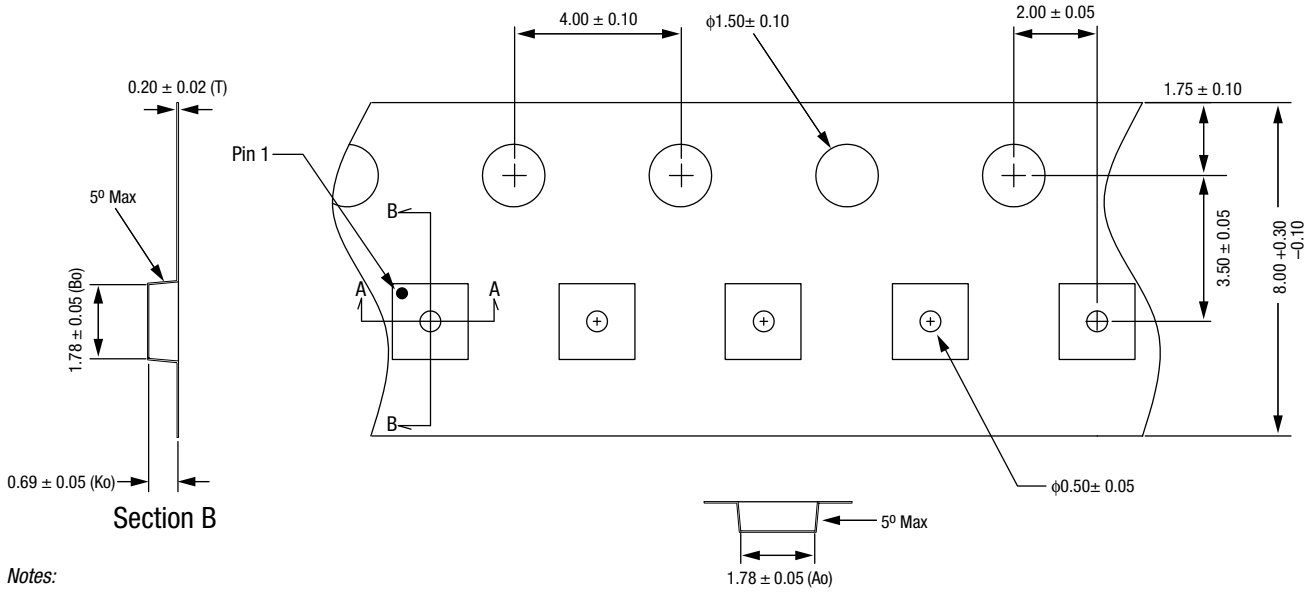

**Figure 6. SKY13593-690LF Typical Part Marking**




*Notes:*

1. *All measurements are in millimeters.*
2. *Dimensions and tolerances according to ASME Y14.5M-1994.*
3. *Coplanarity applies to the exposed heat sink pad as well as the terminals.*
4. *Plating requirement per source control drawing (SCD) 2504.*
5. *Dimension applies to metallized terminal, not measured in radius area.*

**Figure 7. SKY13593-690LF Package Dimensions**




*Notes:*

1. *Carrier tape: black conductive polycarbonate or polystyrene.*
2. *Cover tape: transparent conductive material.*
3. *Cover tape size: 5.4 mm width.*
4. *All measurements are in millimeters.*

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**Figure 8. SKY13593-690LF Tape and Reel Dimensions**

## Ordering Information

| Part Number | Part Description | Evaluation Board Part Number |
|---|---|---|
| SKY13593-690LF | 2.4 to 2.5 GHz SP3T Switch | SKY13593-690LF-EVB |

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