

DATA SHEET

# SKY12207-478LF: 0.9 to 4.0 GHz 50 W High Power Silicon PIN Diode SPDT Switch

## Applications

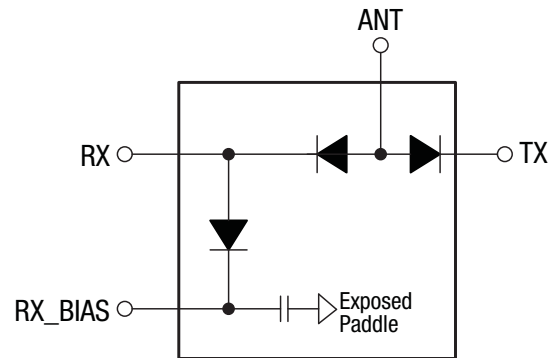
- Transmit/receive switching and failsafe switching in TD-SCDMA, WiMAX, and LTE base stations
- Transmit/receive switching in land mobile radios and military communication systems

## Features

- High power handling: 50 W CW, 300 W peak
- Low insertion loss: 0.4 dB typical
- High antenna-to-receive isolation: 42 dB @ 2.6 GHz typical
- Controlled with positive power supply
- Bias driver circuit available on request
- 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.



S2403

Figure 1. SKY12207-478LF Block Diagram

## Description

The SKY12207-478LF is a high power handling, Single-Pole, Double-Throw (SPDT) silicon PIN diode switch. The device operates over the 900 MHz to 4 GHz band. It features low insertion loss, excellent power handling, and superb linearity with low DC power consumption.

The SKY12207-478LF is well-suited for use as a high power transmit/receive switch in a variety of telecommunication systems such as WiMAX, TD-SCDMA, or LTE base stations.

The device 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. SKY12207-478LF Pinout – 16-Pin QFN (Top View)**

**Table 1. SKY12207-478LF Signal Descriptions**

| Pin | Name | Description  | Pin | Name    | Description  |
|-----|------|--|-----|---------|--|
| 1   | GND  | Ground. Must be connected to ground using lowest possible impedance. | 9   | RX_BIAS | RF ground port and DC bias input port                                |
| 2   | ANT  | Antenna RF port and DC bias input port                               | 10  | N/C     | No connection  |
| 3   | GND  | Ground. Must be connected to ground using lowest possible impedance. | 11  | N/C     | No connection  |
| 4   | N/C  | No connection  | 12  | N/C     | No connection  |
| 5   | N/C  | No connection  | 13  | GND     | Ground. Must be connected to ground using lowest possible impedance. |
| 6   | GND  | Ground. Must be connected to ground using lowest possible impedance. | 14  | TX      | Transmit RF input port and DC bias input port                        |
| 7   | RX   | Receive output port and DC bias input port                           | 15  | GND     | Ground. Must be connected to ground using lowest possible impedance. |
| 8   | GND  | Ground. Must be connected to ground using lowest possible impedance. | 16  | N/C     | No connection  |

**Electrical and Mechanical Specifications**

The absolute maximum ratings of the SKY12207-478LF are provided in Table 2. Recommended operating conditions are specified in Table 3 and electrical specifications are provided in Table 4.

Typical performance characteristics of the SKY12207-478LF are illustrated in Figures 3 through 9.

The state of the SKY12207-478LF is determined by the logic provided in Table 6. Table 7 provides the logic for use with the SKY12207-478LF Evaluation Board.

Power derating data is plotted against temperature in Figures 10 and 11. Equivalent circuit diagrams for transmit and receive are shown in Figure 12.

**Table 2. SKY12207-478LF Absolute Maximum Ratings**

| Parameter  | Symbol           | Minimum | Maximum | Units              |
|--|------------------|---------|---------|--------------------|
| RF CW input power, TX and ANT ports ( $T_{\text{SUBSTRATE}} = 25\text{ }^{\circ}\text{C}$ )  | $P_{\text{IN}}$  |         | 75      | W                  |
| RF peak input power, TX and ANT ports ( $T_{\text{SUBSTRATE}} = 25\text{ }^{\circ}\text{C}$ , RF burst width = 10 $\mu\text{s}$ , RF burst repetition rate = 25 kHz) | $P_{\text{IN}}$  |         | 300     | W                  |
| RF CW input power, RX port ( $T_{\text{SUBSTRATE}} = 25\text{ }^{\circ}\text{C}$ )   | $P_{\text{IN}}$  |         | 60      | W                  |
| RF peak input power, RX port ( $T_{\text{SUBSTRATE}} = 25\text{ }^{\circ}\text{C}$ , RF burst width = 10 $\mu\text{s}$ , RF burst repetition rate = 25 kHz)          | $P_{\text{IN}}$  |         | 240     | W                  |
| Control port reverse voltage   | $V_{\text{CTL}}$ |         | 200     | V                  |
| Control port forward current   | $I_{\text{CTL}}$ |         | 200     | mA                 |
| Operating temperature  | $T_{\text{OP}}$  | -55     | +175    | $^{\circ}\text{C}$ |
| Storage temperature  | $T_{\text{STG}}$ | -55     | +200    | $^{\circ}\text{C}$ |
| Electrostatic discharge:   | ESD              |         |         |                    |
| Charged Device Model (CDM), Class 4  |                  |         | 1000    | V                  |
| Human Body Model (HBM), Class 1C   |                  |         | 1000    | V                  |
| Machine Model (MM), Class B  |                  |         | 200     | 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. Recommended Operating Conditions (Per ANT, TX, RX, and RX\_BIAS Inputs)**

| Parameter                    | Symbol           | Min | Typical | Max | Units |
|------------------------------|------------------|-----|---------|-----|-------|
| Control port reverse voltage | $V_{\text{CTL}}$ | 5   | 28      | 100 | V     |
| Control port forward current | $I_{\text{CTL}}$ | 20  | 50      | 100 | mA    |

**Table 4. SKY12207-478LF Electrical Specifications, Bias Voltage = 28 V (1 of 2) (Note 1)**  
**(T<sub>OP</sub> = +25 °C, Characteristic Impedance [Z<sub>0</sub>] = 50 Ω, EVB Optimized for 2.6 GHz Operation, Unless Otherwise Noted)**

| Parameter                       | Symbol                | Test Condition   | Min  | Typical                              | Max  | Units                      |
|---------------------------------|-----------------------|--|------|--------------------------------------|------|----------------------------|
| Insertion loss, TX to ANT ports | IL <sub>TX-ANT</sub>  | V <sub>PIN_2</sub> = 1 V,<br>I <sub>PIN_14</sub> = -50 mA,<br>I <sub>PIN_9</sub> = -50 mA,<br>V <sub>PIN_7</sub> = 28 V,<br>TX port P <sub>IN</sub> @ pin 14 = 0 dBm:<br><br>900 MHz<br>1.80 GHz<br>2.01 GHz<br>2.60 GHz<br>3.50 GHz |      | 0.25<br>0.29<br>0.31<br>0.32<br>0.41 | 0.55 | dB<br>dB<br>dB<br>dB<br>dB |
| Insertion loss, ANT to RX ports | IL <sub>ANT-RX</sub>  | V <sub>PIN_2</sub> = 1 V,<br>V <sub>PIN_14</sub> = 28 V,<br>I <sub>PIN_7</sub> = -50 mA,<br>V <sub>PIN_9</sub> = 28 V,<br>ANT port P <sub>IN</sub> @ pin 2 = 0 dBm:<br><br>900 MHz<br>1.80 GHz<br>2.01 GHz<br>2.60 GHz<br>3.50 GHz   |      | 0.28<br>0.32<br>0.33<br>0.39<br>0.70 | 0.60 | dB<br>dB<br>dB<br>dB<br>dB |
| Isolation, TX to RX ports       | ISO <sub>TX-RX</sub>  | V <sub>PIN_2</sub> = 1 V,<br>I <sub>PIN_14</sub> = -50 mA,<br>I <sub>PIN_9</sub> = -50 mA,<br>V <sub>PIN_7</sub> = 28 V,<br>TX port P <sub>IN</sub> @ pin 14 = 0 dBm:<br><br>900 MHz<br>1.80 GHz<br>2.01 GHz<br>2.60 GHz<br>3.50 GHz | 37.0 | 34.0<br>37.0<br>38.5<br>42.0<br>32.0 |      | dB<br>dB<br>dB<br>dB<br>dB |
| Isolation, ANT to TX ports      | ISO <sub>ANT-TX</sub> | V <sub>PIN_2</sub> = 1 V,<br>V <sub>PIN_14</sub> = 28 V,<br>I <sub>PIN_7</sub> = -50 mA,<br>V <sub>PIN_9</sub> = 28 V,<br>ANT port P <sub>IN</sub> @ pin 2 = 0 dBm:<br><br>900 MHz<br>1.80 GHz<br>2.01 GHz<br>2.60 GHz<br>3.50 GHz   | 17.0 | 26.0<br>22.0<br>21.0<br>20.0<br>16.0 |      | dB<br>dB<br>dB<br>dB<br>dB |
| Isolation, ANT to RX ports      | ISO <sub>ANT-RX</sub> | V <sub>PIN_2</sub> = 1 V,<br>I <sub>PIN_14</sub> = -50 mA,<br>I <sub>PIN_9</sub> = -50 mA,<br>V <sub>PIN_7</sub> = 28 V,<br>ANT port P <sub>IN</sub> @ pin 2 = 0 dBm:<br><br>900 MHz<br>1.80 GHz<br>2.01 GHz<br>2.60 GHz<br>3.50 GHz | 39   | 33<br>37<br>38<br>42<br>30           |      | dB<br>dB<br>dB<br>dB<br>dB |

**Table 4. SKY12207-478LF Electrical Specifications, Bias Voltage = 28 V (2 of 2) (Note 1)**  
**(T<sub>OP</sub> = +25 °C, Characteristic Impedance [Z<sub>0</sub>] = 50 Ω, EVB Optimized for 2.6 GHz Operation, Unless Otherwise Noted)**

| Parameter  | Symbol             | Test Condition   | Min | Typical | Max | Units |
|--|--------------------|--|-----|---------|-----|-------|
| Input return loss                                    | RL                 | 1.8 to 2.5 GHz:<br>RX insertion loss state, ANT port<br>(@ pin 2)  |     | 28      |     | dB    |
|  |                    | TX insertion loss state, TX port<br>(@ pin 14)   |     | 26      |     | dB    |
| Transmit 2 <sup>nd</sup> harmonic                    | 2fo                | TX insertion loss state,<br>TX port P <sub>IN</sub> @ pin 14 =<br>+30 dBm:   |     |         |     |       |
|  |                    | 900 MHz  |     | -72     |     | dBc   |
|  |                    | 1.80 GHz   |     | -66     |     | dBc   |
|  |                    | 2.01 GHz   |     | -84     |     | dBc   |
|  |                    | 2.60 GHz   |     | -68     |     | dBc   |
| 3.50 GHz   |                    | -71  |     | dBc     |     |       |
| Transmit 3 <sup>rd</sup> harmonic                    | 3fo                | TX insertion loss state,<br>TX port P <sub>IN</sub> @ pin 14 =<br>+30 dBm:   |     |         |     |       |
|  |                    | 900 MHz  |     | -88     |     | dBc   |
|  |                    | 1.80 GHz   |     | -80     |     | dBc   |
|  |                    | 2.01 GHz   |     | -84     |     | dBc   |
|  |                    | 2.60 GHz   |     | -81     |     | dBc   |
| 3.50 GHz   |                    | -74  |     | dBc     |     |       |
| Transmit 3 <sup>rd</sup> Order Input Intercept Point | IIP3               | V <sub>PIN_2</sub> = 1 V,<br>I <sub>PIN_14</sub> = -50 mA,<br>I <sub>PIN_9</sub> = -50 mA,<br>V <sub>PIN_7</sub> = 28 V,<br>TX port P <sub>IN</sub><br>@ pin 14 = +30 dBm/tone,<br>tone spacing = 1 MHz,<br>@ 2.60 GHz |     | +78     |     | dBm   |
| Transmit 0.1 dB Compression Point                    | IPO.1dB            | V <sub>PIN_2</sub> = 1 V,<br>I <sub>PIN_14</sub> = -50 mA,<br>I <sub>PIN_9</sub> = -50 mA,<br>V <sub>PIN_7</sub> = 28 V,<br>@ 2.60 GHz   |     | +47     |     | dBm   |
| Receive 0.1 dB Compression Point                     | IPO.1dB            | V <sub>PIN_2</sub> = 1 V,<br>V <sub>PIN_14</sub> = 28 V,<br>I <sub>PIN_7</sub> = -50 mA,<br>V <sub>PIN_9</sub> = 28 V,<br>@ 2.60 GHz   |     | +46     |     | dBm   |
| Maximum transmit CW input power                      | P <sub>IN_CW</sub> | V <sub>PIN_2</sub> = 1 V,<br>I <sub>PIN_14</sub> = -50 mA,<br>I <sub>PIN_9</sub> = -50 mA,<br>V <sub>PIN_7</sub> = 28 V,<br>0.9 to 3.5 GHz   |     | 50      |     | W     |
| Maximum receive CW input power                       | P <sub>IN_CW</sub> | V <sub>PIN_2</sub> = 1 V,<br>V <sub>PIN_14</sub> = 28 V,<br>I <sub>PIN_7</sub> = -50 mA,<br>V <sub>PIN_9</sub> = 28 V,<br>0.9 to 3.5 GHz   |     | 40      |     | W     |
| Transmit RF switching time                           | t <sub>sw</sub>    | 10% to 90% RF on, repetition<br>rate = 0.1 MHz, @ 2.6 GHz  |     | 170     |     | ns    |
| Thermal resistance (junction to case)                | Θ <sub>JC</sub>    |  |     | 32      |     | °C/W  |

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

**Table 5. SKY12207-478LF Electrical Specifications, Bias Voltage = 5 V (1 of 2) (Note 1)**  
**(T<sub>OP</sub> = +25 °C, Characteristic Impedance [Z<sub>0</sub>] = 50 Ω, EVB Optimized for 2.6 GHz Operation, Unless Otherwise Noted)**

| Parameter                       | Symbol                | Test Condition  | Min  | Typical                              | Max  | Units                      |
|---------------------------------|-----------------------|---|------|--------------------------------------|------|----------------------------|
| Insertion loss, TX to ANT ports | IL <sub>TX-ANT</sub>  | V <sub>PIN_2</sub> = 1 V,<br>I <sub>PIN_14</sub> = -50 mA,<br>I <sub>PIN_9</sub> = -50 mA,<br>V <sub>PIN_7</sub> = 5 V,<br>TX port P <sub>IN</sub> @ pin 14 = 0 dBm:<br><br>900 MHz<br>1.80 GHz<br>2.01 GHz<br>2.60 GHz<br>3.50 GHz |      | 0.25<br>0.30<br>0.32<br>0.34<br>0.43 | 0.55 | dB<br>dB<br>dB<br>dB<br>dB |
| Insertion loss, ANT to RX ports | IL <sub>ANT-RX</sub>  | V <sub>PIN_2</sub> = 1 V,<br>V <sub>PIN_14</sub> = 5 V,<br>I <sub>PIN_7</sub> = -50 mA,<br>V <sub>PIN_9</sub> = 5 V,<br>ANT port P <sub>IN</sub> @ pin 2 = 0 dBm:<br><br>900 MHz<br>1.80 GHz<br>2.01 GHz<br>2.60 GHz<br>3.50 GHz    |      | 0.28<br>0.31<br>0.33<br>0.41<br>0.72 | 0.60 | dB<br>dB<br>dB<br>dB<br>dB |
| Isolation, TX to RX ports       | ISO <sub>TX-RX</sub>  | V <sub>PIN_2</sub> = 1 V,<br>I <sub>PIN_14</sub> = -50 mA,<br>I <sub>PIN_9</sub> = -50 mA,<br>V <sub>PIN_7</sub> = 5 V,<br>TX port P <sub>IN</sub> @ pin 14 = 0 dBm:<br><br>900 MHz<br>1.80 GHz<br>2.01 GHz<br>2.60 GHz<br>3.50 GHz | 40.0 | 33.0<br>36.4<br>38.0<br>43.0<br>31.0 |      | dB<br>dB<br>dB<br>dB<br>dB |
| Isolation, ANT to TX ports      | ISO <sub>ANT-TX</sub> | V <sub>PIN_2</sub> = 1 V,<br>V <sub>PIN_14</sub> = 5 V,<br>I <sub>PIN_7</sub> = -50 mA,<br>V <sub>PIN_9</sub> = 5 V,<br>ANT port P <sub>IN</sub> @ pin 2 = 0 dBm:<br><br>900 MHz<br>1.80 GHz<br>2.01 GHz<br>2.60 GHz<br>3.50 GHz    | 17.0 | 25.0<br>22.0<br>21.0<br>19.0<br>15.0 |      | dB<br>dB<br>dB<br>dB<br>dB |
| Isolation, ANT to RX ports      | ISO <sub>ANT-RX</sub> | V <sub>PIN_2</sub> = 1 V,<br>I <sub>PIN_14</sub> = -50 mA,<br>I <sub>PIN_9</sub> = -50 mA,<br>V <sub>PIN_7</sub> = 5 V,<br>ANT port P <sub>IN</sub> @ pin 2 = 0 dBm:<br><br>900 MHz<br>1.80 GHz<br>2.01 GHz<br>2.60 GHz<br>3.50 GHz | 39   | 33<br>36<br>37<br>42<br>31           |      | dB<br>dB<br>dB<br>dB<br>dB |

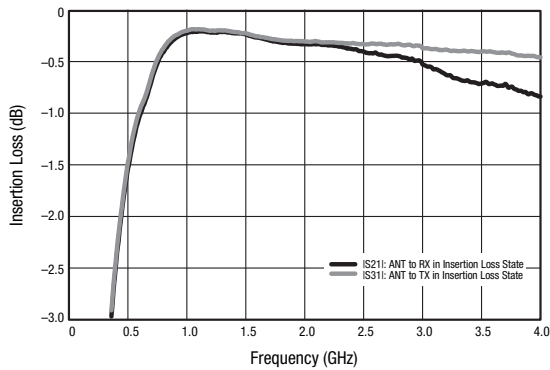
**Table 5. SKY12207-478LF Electrical Specifications, Bias Voltage = 5 V (2 of 2) (Note 1)**  
**(T<sub>OP</sub> = +25 °C, Characteristic Impedance [Z<sub>0</sub>] = 50 Ω, EVB Optimized for 2.6 GHz Operation, Unless Otherwise Noted)**

| Parameter  | Symbol             | Test Condition  | Min | Typical | Max | Units |
|--|--------------------|---|-----|---------|-----|-------|
| Input return loss                                    | RL                 | 1.8 to 2.5 GHz:<br>RX insertion loss state, ANT port<br>(@ pin 2)   |     | 28      |     | dB    |
|  |                    | TX insertion loss state, TX port<br>(@ pin 14)  |     | 26      |     | dB    |
| Transmit 2 <sup>nd</sup> harmonic                    | 2fo                | TX insertion loss state,<br>TX port P <sub>IN</sub> @ pin 14 =<br>+30 dBm:  |     |         |     |       |
|  |                    | 900 MHz   |     | -36     |     | dBc   |
|  |                    | 1.80 GHz  |     | -43     |     | dBc   |
|  |                    | 2.01 GHz  |     | -61     |     | dBc   |
|  |                    | 2.60 GHz  |     | -51     |     | dBc   |
| 3.50 GHz   |                    | -58   |     | dBc     |     |       |
| Transmit 3 <sup>rd</sup> harmonic                    | 3fo                | TX insertion loss state,<br>TX port P <sub>IN</sub> @ pin 14 =<br>+30 dBm:  |     |         |     |       |
|  |                    | 900 MHz   |     | -57     |     | dBc   |
|  |                    | 1.80 GHz  |     | -55     |     | dBc   |
|  |                    | 2.01 GHz  |     | -59     |     | dBc   |
|  |                    | 2.60 GHz  |     | -59     |     | dBc   |
| 3.50 GHz   |                    | -52   |     | dBc     |     |       |
| Transmit 3 <sup>rd</sup> Order Input Intercept Point | IIP3               | V <sub>PIN_2</sub> = 1 V,<br>I <sub>PIN_14</sub> = -50 mA,<br>I <sub>PIN_9</sub> = -50 mA,<br>V <sub>PIN_7</sub> = 5 V,<br>TX port P <sub>IN</sub><br>@ pin 14 = +30 dBm/tone,<br>tone spacing = 1 MHz,<br>@ 2.60 GHz |     | +74     |     | dBm   |
| Transmit 0.1 dB Compression Point                    | IPO.1dB            | V <sub>PIN_2</sub> = 1 V,<br>I <sub>PIN_14</sub> = -50 mA,<br>I <sub>PIN_9</sub> = -50 mA,<br>V <sub>PIN_7</sub> = 5 V,<br>@ 2.60 GHz   |     | +33     |     | dBm   |
| Receive 0.1 dB Compression Point                     | IPO.1dB            | V <sub>PIN_2</sub> = 1 V,<br>V <sub>PIN_14</sub> = 5 V,<br>I <sub>PIN_7</sub> = -50 mA,<br>V <sub>PIN_9</sub> = 5 V,<br>@ 2.60 GHz  |     | +34     |     | dBm   |
| Maximum transmit CW input power                      | P <sub>IN_CW</sub> | V <sub>PIN_2</sub> = 1 V,<br>I <sub>PIN_14</sub> = -50 mA,<br>I <sub>PIN_9</sub> = -50 mA,<br>V <sub>PIN_7</sub> = 5 V,<br>0.9 to 3.5 GHz   |     | 15      |     | W     |
| Maximum receive CW input power                       | P <sub>IN_CW</sub> | V <sub>PIN_2</sub> = 1 V,<br>V <sub>PIN_14</sub> = 5 V,<br>I <sub>PIN_7</sub> = 50 mA,<br>V <sub>PIN_9</sub> = 5 V,<br>0.9 to 3.5 GHz   |     | 10      |     | W     |
| Transmit RF switching time                           | t <sub>sw</sub>    | 10% to 90% RF on, repetition<br>rate = 0.1 MHz, @ 2.60 GHz  |     | 170     |     | ns    |
| Thermal resistance (junction to case)                | Θ <sub>JC</sub>    |   |     | 32      |     | °C/W  |

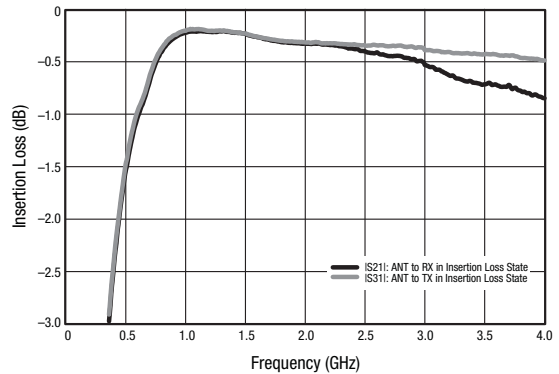
**Note 1:** Performance is guaranteed only under the conditions listed in this Table.

### Typical Performance Characteristics

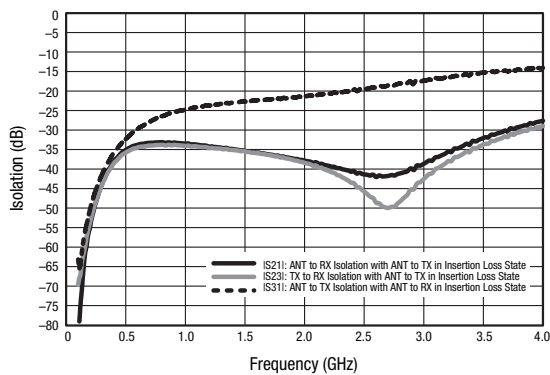
( $T_{OP} = +25\text{ }^{\circ}\text{C}$ , Characteristic Impedance [ $Z_0$ ] = 50  $\Omega$ , EVB Optimized for 2.6 GHz Operation, Unless Otherwise Noted)



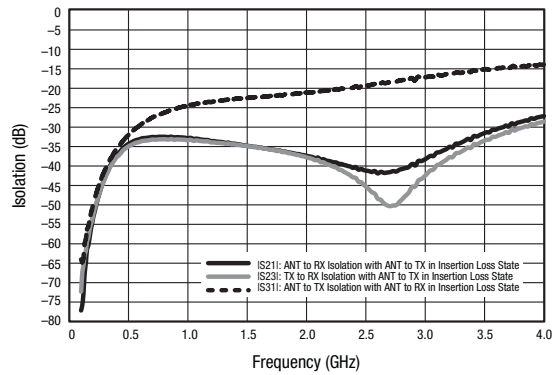
**Figure 3. Insertion Loss vs Frequency**  
(ANT to RX and ANT to TX Ports;  $V_{CTL} = 28\text{ V}$ ,  $I_{CTL} = -50\text{ mA}$ )



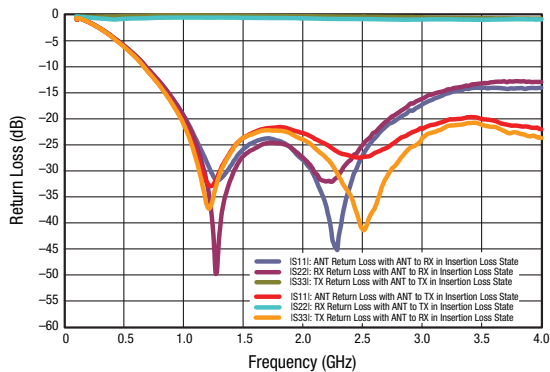
**Figure 4. Insertion Loss vs Frequency**  
(ANT to RX and ANT to TX Ports;  $V_{CTL} = 5\text{ V}$ ,  $I_{CTL} = -50\text{ mA}$ )



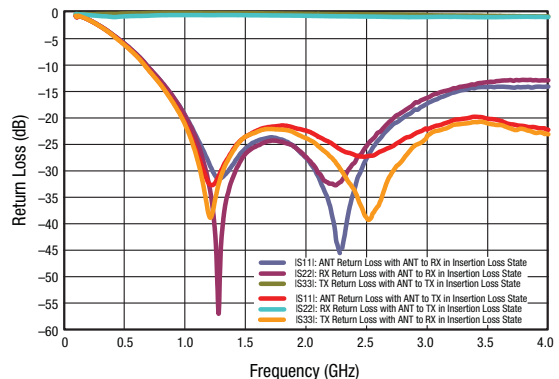
**Figure 5. Isolation vs Frequency**  
(ANT to RX, TX to RX, and ANT to TX Ports;  
 $V_{CTL} = 28\text{ V}$ ,  $I_{CTL} = -50\text{ mA}$ )



**Figure 6. Isolation vs Frequency**  
(ANT to RX, TX to RX, and ANT to TX Ports;  
 $V_{CTL} = 5\text{ V}$ ,  $I_{CTL} = -50\text{ mA}$ )

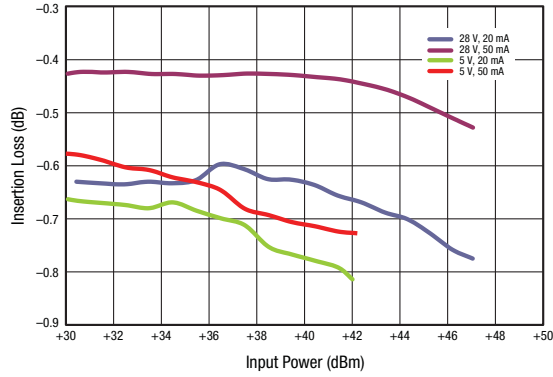


**Figure 7. Return Loss vs Frequency**  
(ANT, TX, and RX Ports;  $V_{CTL} = 28\text{ V}$ ,  $I_{CTL} = -50\text{ mA}$ )



**Figure 8. Return Loss vs Frequency**  
(ANT, TX, and RX Ports;  $V_{CTL} = 5\text{ V}$ ,  $I_{CTL} = -50\text{ mA}$ )





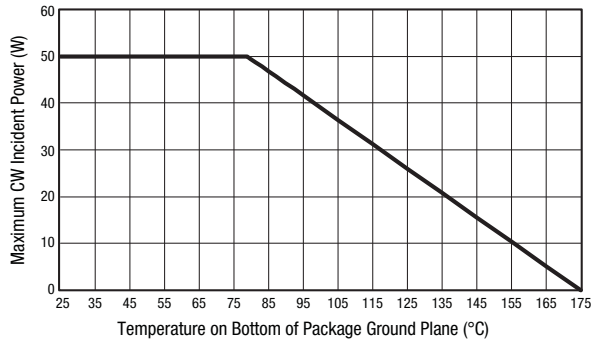
**Figure 9. Insertion Loss vs CW Input Power (TX to ANT Port, f = 2.6 GHz)**

**Table 6. SKY12207-478LF Truth Table**

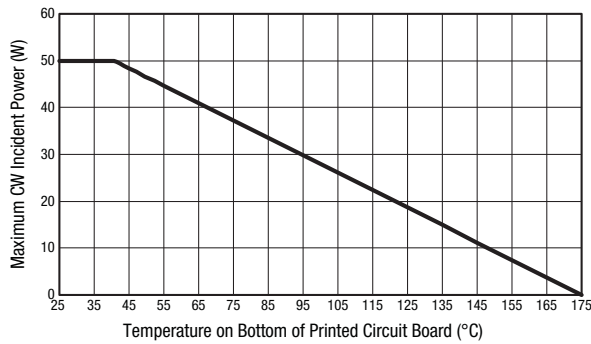
| Switch State             | Path                                      |   | Control Conditions              |                                      |  |                       |
|--------------------------|---|---|---------------------------------|--------------------------------------|--|-----------------------|
|                          | Antenna-to-Receiver Port (Pin 2 to Pin 7) | Transmitter-to-Antenna Port (Pin 14 to Pin 2) | Antenna Port Bias Input (Pin 2) | Nominal Receiver Output Port (Pin 7) | Nominal Transmitter Port Bias Input (Pin 14) | RX_BIAS Input (Pin 9) |
| Receive (see Figure 12)  | Low insertion loss                        | High isolation                                | 1 V                             | -50 mA                               | 28 V   | 28 V                  |
| Transmit (see Figure 12) | High isolation                            | Low insertion loss                            | 1 V                             | 28 V                                 | -50 mA                                       | -50 mA                |

**Table 7. SKY12207-478LF Evaluation Board Truth Table**

| Switch State             | Path                     |                             | Control Conditions      |                      |                             |               |
|--------------------------|--------------------------|-----------------------------|-------------------------|----------------------|-----------------------------|---------------|
|                          | Antenna-to-Receiver Port | Transmitter-to-Antenna Port | Antenna Port Bias Input | Receiver Output Port | Transmitter Port Bias Input | RX_BIAS Input |
| Receive (see Figure 12)  | Low insertion loss       | High isolation              | 5 V                     | 0 V (ground)         | 28 V                        | 28 V          |
| Transmit (see Figure 12) | High isolation           | Low insertion loss          | 5 V                     | 28 V                 | 0 V (ground)                | 0 V (ground)  |



**Figure 10. Transmit Power Derating, Maximum CW Incident Power (Insertion Loss = 0.3 dB) vs Temperature on Bottom of Package Ground Plane**



**Figure 11. Transmit Power Derating, Maximum CW Incident Power (Insertion Loss = 0.3 dB) vs Temperature on Bottom of Printed Circuit Board**

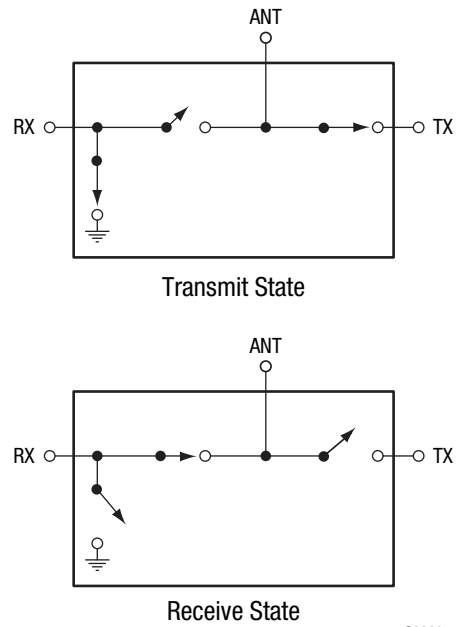
### Evaluation Board Description

The SKY12207-478LF Evaluation Board is used to test the performance of the SKY12207-478LF PIN Diode SPDT switch. An assembly drawing for the Evaluation Board is shown in Figure 13. The layer detail is provided in Figure 14.

The SKY12207-478LF is designed to handle very large signals. Sufficient power may be dissipated by this switch to cause heating of the PIN diodes contained in the switch. It is very important to use a printed circuit board design that provides adequate cooling capability to keep the junction temperature of the PIN diodes below their maximum rated operating temperature.

As indicated in Figure 10, the x-axis temperature is referenced to the bottom of the QFN package. A printed circuit board with a very low thermal resistance and external heat sink design must be used to achieve the results shown in this Figure. The power derating curve with the x-axis temperature referenced to the bottom of the printed circuit board is provided in Figure 11.

The evaluation circuit is designed to facilitate control of the SKY12207-478LF transmit/receive switch with bias signals



**Figure 12. SKY12207-478LF Equivalent Circuit Diagrams**

derived from positive voltages. The state of the PIN diodes within the SKY12207-478LF is controlled with 5 V applied to the ANT port and bias voltages of either 28 V or 0 V applied to the remaining bias inputs (RX and TX ports). The switch state circuit diagrams are shown in Figure 12.

The value of resistor R1, 80 Ω, is selected to provide 50 mA of forward current through the "on" series diode with 5 V applied to the ANT port bias pin. The R2 resistance value of 540 Ω is selected to produce approximately 50 mA of forward bias current in the RX shunt diode with a source voltage of 28 V.

The magnitudes of the voltages applied to the TX and RX ports determine which of the RX or TX series diodes is biased into forward conduction. For example, to place the SKY12207-478LF into the transmit state, 0 V is applied to the TX port (which forward biases the diode between pins 2 and 14), 28 V is applied to the RX port (which reverse biases the diode between pins 2 and 7), and 0 V is applied to the RX\_BIAS port (which applies a forward bias through R2 to the diode connected between pins 7 and 9).

The component values shown in the Evaluation Board circuit diagram (Figure 15) were selected to optimize performance in the 2.0 to 3.5 GHz band.

Refer to Table 8 for the Evaluation Board Bill of Materials. Table 9 provides voltage, current, and resistor values for bias adjustments.

**Package Dimensions**

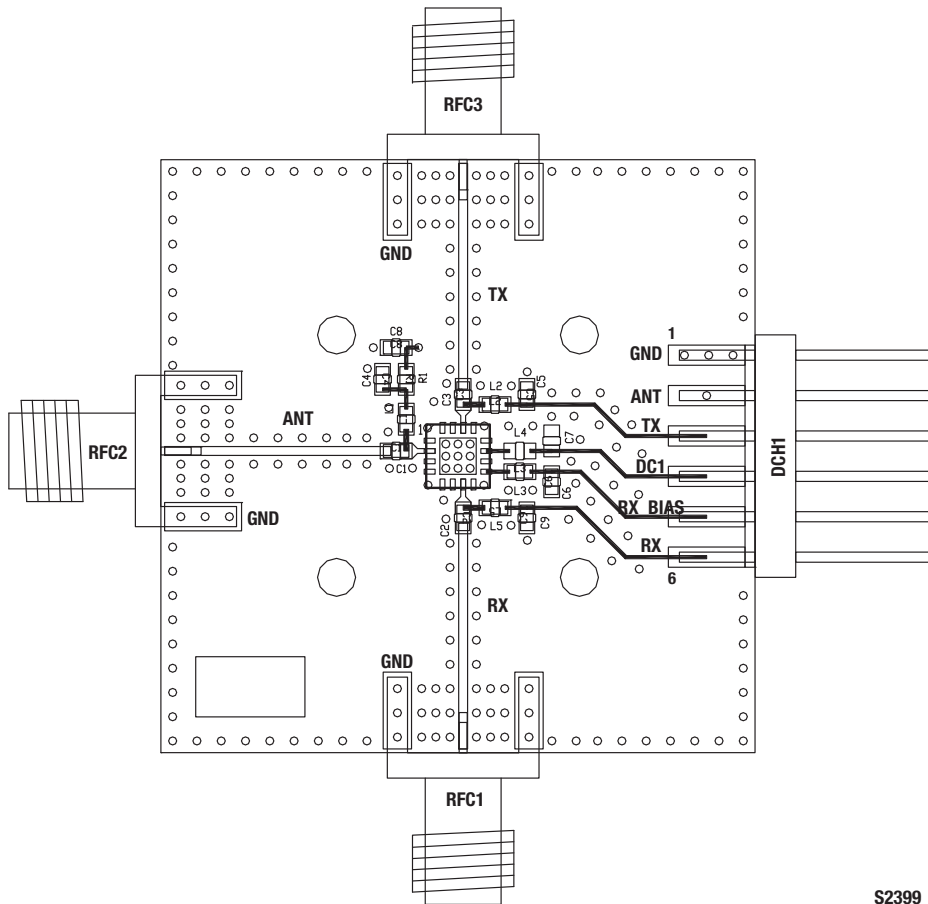
The PCB layout footprint for the SKY12207-478LF is shown in Figure 15. Typical case markings are noted in Figure 17. Package dimensions for the 16-pin QFN are shown in Figure 18, and tape and reel dimensions are provided in Figure 19.

**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.



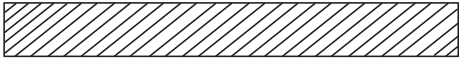



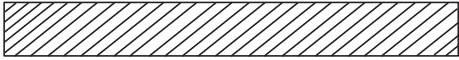


The SKY12207-478LF is rated to Moisture Sensitivity Level 1 (MSL1) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *Solder Reflow Information*, document number 200164.

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.



S2399

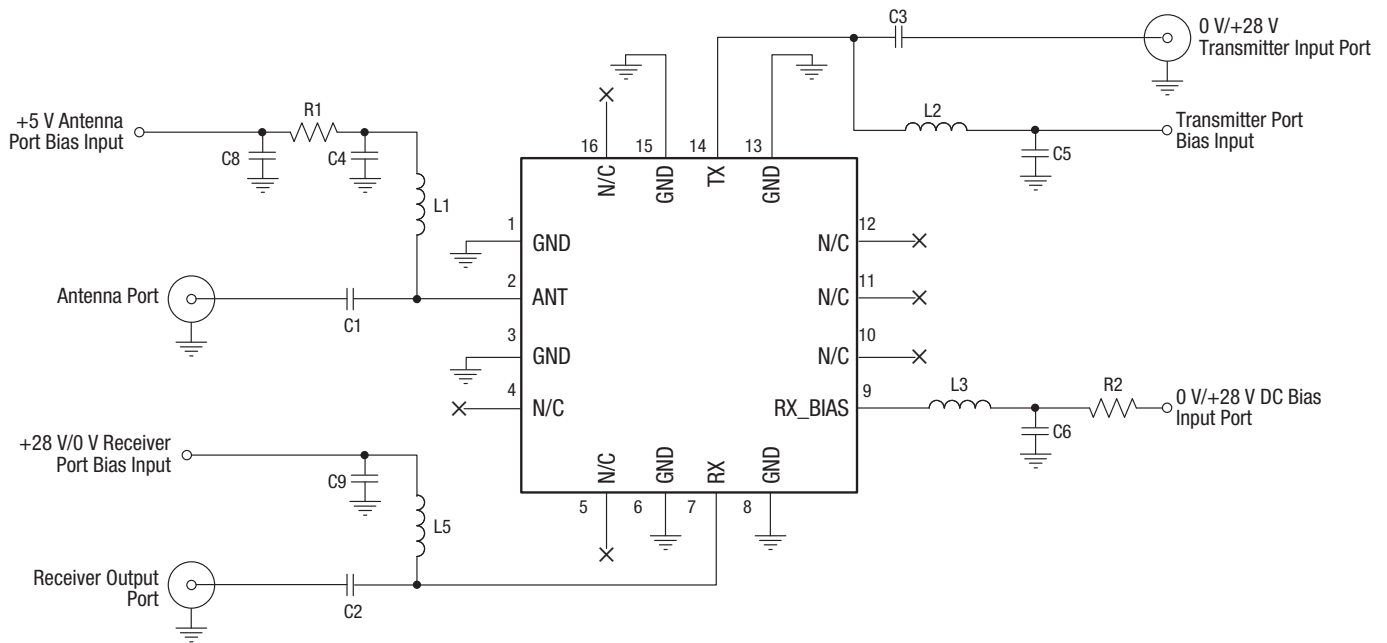
**Figure 13. SKY12207-478LF Evaluation Board Assembly Diagram**

| Cross Section   | Name              | Thickness (in) | Material            |
|---|-------------------|----------------|---------------------|
|  | Top Soldermask    |                |                     |
|  | L1                | (0.0028)       | Cu foil             |
|  | Laminate          | 0.012 ± 0.0006 | Rogers R04003C Core |
|  | L2                | (0.0014)       | Cu foil             |
|  | Laminate          | (Note 1)       | FR4 Prepreg         |
|  | L3                | (0.0014)       | Cu foil             |
|  | Laminate          | 0.010 ± 0.0006 | FR4 Core            |
|  | L4                | (0.0028)       | Cu foil             |
|  | Bottom Soldermask |                |                     |

Note 1: Adjust this thickness to meet total thickness goal of 0.062 ± 0.005 inches.

S2531

**Figure 14. Layer Detail Physical Characteristics**



**NOTE:** The N/C pins (4, 5, 10, 11, 12, and 16) are not internally connected, so they can be left open or grounded.

S2402

**Figure 15. Evaluation Board Schematic**

**Table 8. Evaluation Board Bill of Materials (Note 1)**

| Component                  | Value   | Size | Product Number | Manufacturer | Mfr Part Number | Characteristics          |
|----------------------------|---------|------|----------------|--------------|-----------------|--------------------------|
| C1, C2, C3, C4, C5, C6, C9 | 1000 pF | 0603 | 5404R23-057    | TDK          | C1608C0G1H102JT | COG, 50 V, ±5%           |
| C8                         | 1 μF    | 0603 | 5404R29-070    | TDK          | C2012X7R1H104K  | X7R, 50 V, ±10%          |
| L1, L2, L5                 | 22 nH   | 0603 | 55332R34-028   | Taiyo-Yuden  | HK160822NJ-T    | SRF, 1600 MHz, ±5%       |
| L3                         | 560 nH  | 0603 |                | Coil Craft   | 0603LS-561XJLB  | SRF, 525 MHz, ±5%        |
| R1 (Note 2)                | 80 Ω    | 0603 |                | Panasonic    | ERJ-3GEYJ161V   | 0.1 W, 5%                |
| R2 (Note 3)                | 540 Ω   |      |                |              |                 | Axial leaded (off board) |

**Note 1:** Component values selected are based on the desired frequency and bias level. Values may be adjusted for a specific response.

**Note 2:** Two 160 Ω resistors are combined in parallel to achieve a minimum power handling requirement and an 80 Ω resistance.

**Note 3:** Evaluation Board does not include resistor R2. Operating at 28 V and 50 mA requires the R2 resistor with a power dissipation greater than 1.35 W.

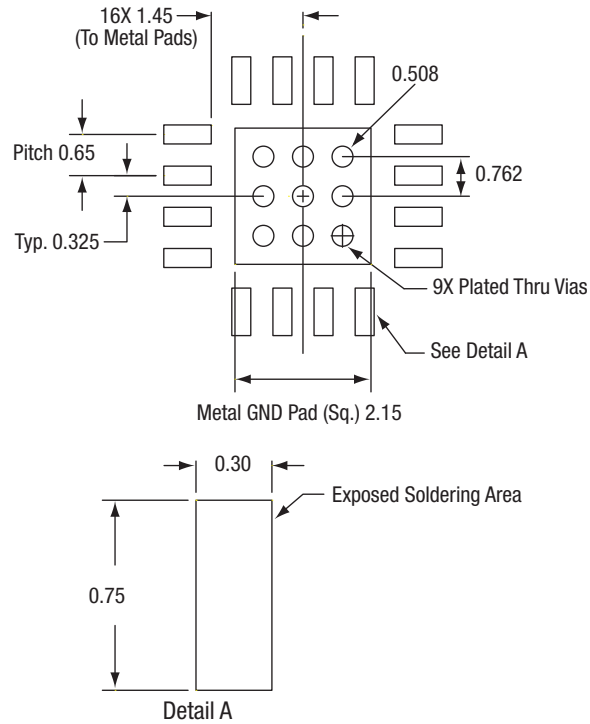
**Table 9. Component Calculation Values**

| Vs (V) | V <sub>DIODE</sub> (V) | V <sub>RES</sub> (V) | Current (A) | Resistance (Ω) | Power Dissipation (W) |
|--------|------------------------|----------------------|-------------|----------------|-----------------------|
| 28     | 1                      | 27                   | 0.05        | 540            | 1.35                  |
| 28     | 1                      | 27                   | 0.02        | 1350           | 0.54                  |
| 5      | 1                      | 4                    | 0.05        | 80             | 0.20                  |
| 5      | 1                      | 4                    | 0.02        | 200            | 0.08                  |

**Notes:** Vs = supply voltage; V<sub>DIODE</sub> = voltage drop across the diode; V<sub>RES</sub> = voltage drop across the resistor.

R1 and R2 values are calculated by  $(V_s - V_{DIODE})/I$ , where I is the desired bias current.

The power dissipation in R1 or R2 is calculated by  $I \times (V_s - V_{DIODE})$ . The resistor selected must be safely rated with a power greater than the dissipated power.



All measurements in millimeters

S2274

Figure 16. SKY12207-478LF PCB Layout Footprint

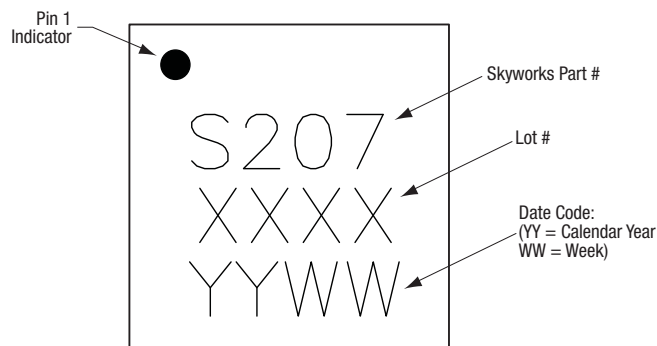
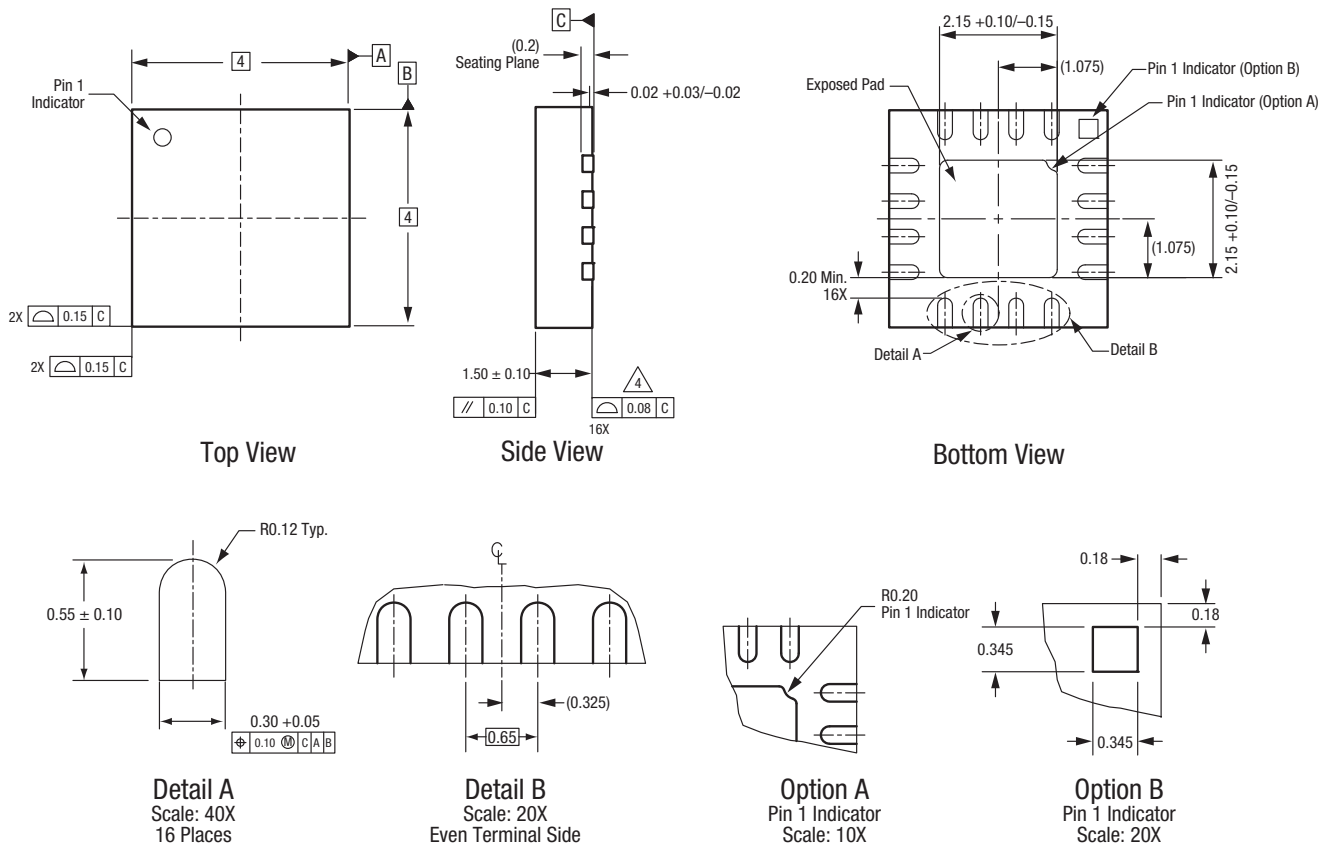


Figure 17. Typical Case Markings

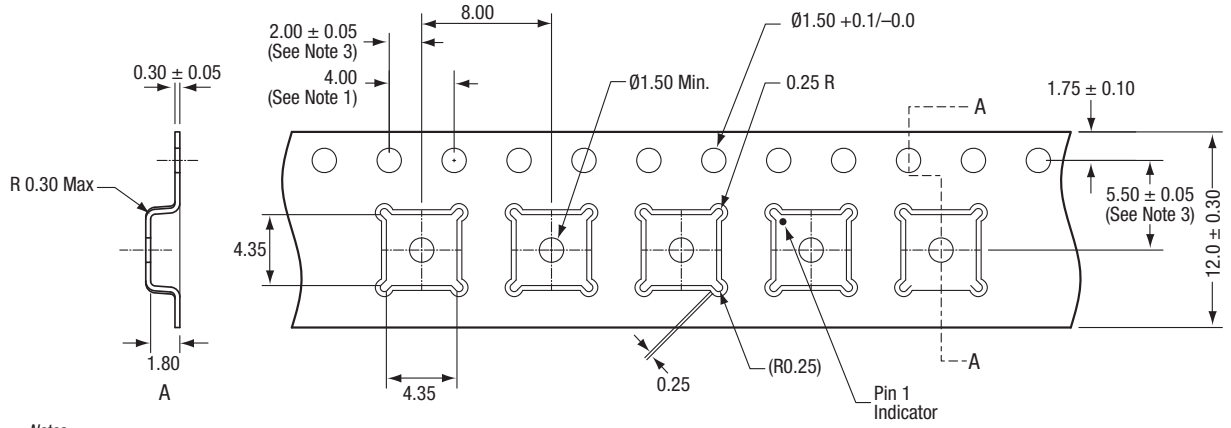


All measurements are in millimeters.  
 Dimensioning and tolerancing according to ASME Y14.5M-1994.  
 Coplanarity applies to the exposed heat sink slug as well as the terminals.  
 Package may have option A or option B pin 1 indicator.

S2400a

Figure 18. SKY12207-478LF 16-Pin QFN Package Dimensions

**DATA SHEET • SKY12207-478LF: 50 W PIN DIODE SPDT SWITCH**



**Notes:**

1. Sprocket hole pitch cumulative tolerance:  $\pm 0.2$  mm
2. Carrier tape: black conductive polystyrene.
3. Pocket position relative to sprocket hole, measure as true position of pocket, not pocket hole.
4. Cover tape material: transparent conductive adhesive.
5. ESD surface resistivity must meet all ESD requirements of Skyworks, specified in GP01-D232.
6. All dimensions are in millimeters.

S2817

**Figure 19. SKY12207-478LF Tape and Reel Dimensions**



**Ordering Information**

| Model Name                           | Manufacturing Part Number | Evaluation Board Part Number |
|--------------------------------------|---------------------------|------------------------------|
| SKY12207-478LF PIN Diode SPDT Switch | SKY12207-478LF            | SKY12207-478LF-EVB           |

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