DATA SHEET

# SKY12208-306LF: 0.02-2.7 GHz 50 W High Power Silicon PIN Diode SPDT Switch

## Applications

- Transmit/receive and fail-safe switching in land mobile radios, public safety radios, and military communication systems

## Features

- High power handling: 50 W CW, 200 W peak
- Low insertion loss: 0.3 dB typical
- High isolation: 42 dB typical
- Controlled with positive power supply
- 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.

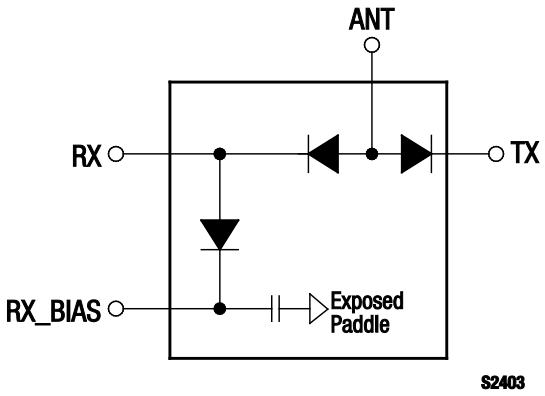



**Figure 1. SKY12208-306LF Block Diagram**

## Description

The SKY12208-306LF is a high power handling, Single-Pole, Double-Throw (SPDT) silicon PIN diode switch. The device can cover two frequency bands, 0.02 to 0.70 GHz or 0.05 to 2.7 GHz, by changing the value of an RF choke in the SMT bias network. The different Evaluation Board components for each band are noted in Table 10.

The SKY12208-306LF features low insertion loss, excellent power handling, and superb linearity with low DC power consumption. The device is well-suited for use as a high power transmit/receive switch in a variety of telecommunication systems.

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.

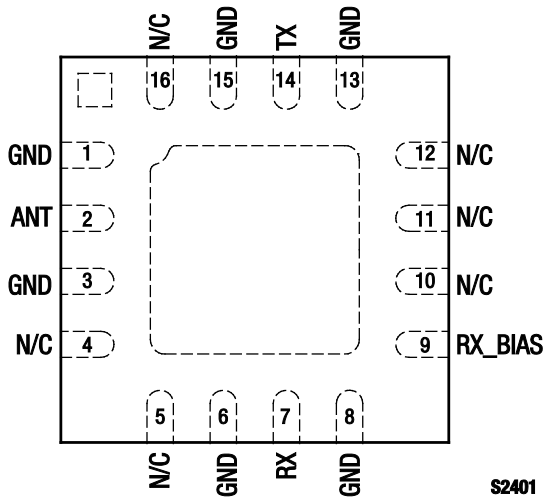



**Figure 2. SKY12208-306LF Pinout – 16-Pin QFN (Top View)**

**Table 1. SKY12208-306LF 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 SKY12208-306LF are provided in Table 2. Recommended operating conditions are specified in Table 3 and electrical specifications are provided in Table 4 (28 V bias @ 0.25 GHz), Table 5 (5 V bias @ 0.25 GHz), Table 6 (5 V bias @ 2.0 GHz), and Table 7 (28 V bias @ 2.0 GHz).

Typical performance characteristics of the SKY12208-306LF are illustrated in Figures 3 through 8 (0.25 GHz) and Figures 9 through 18 (2.0 GHz).

The state of the SKY12208-306LF is determined by the logic provided in Table 8. Table 9 provides the logic for use with the SKY12208-306LF Evaluation Board.

Power derating data is plotted against temperature in Figures 19 and 20. Equivalent circuit diagrams for transmit and receive are shown in Figure 21.

**Table 2. SKY12208-306LF Absolute Maximum Ratings**

| Parameter | Symbol | Minimum | Maximum | Units |
|---|---|---|---|---|
| RF CW input power, TX and ANT ports ($T_{SUBSTRATE}$ = 25 °C) | $P_{IN}$ | | 75 | W |
| RF peak input power, TX and ANT ports ($T_{SUBSTRATE}$ = 25 °C, RF burst width = 10 µs, RF burst repetition rate = 25 kHz) | $P_{IN}$ | | 300 | W |
| RF CW input power, RX port ($T_{SUBSTRATE}$ = 25 °C) | $P_{IN}$ | | 60 | W |
| RF peak input power, RX port ($T_{SUBSTRATE}$ = 25 °C, RF burst width = 10 µs, RF burst repetition rate = 25 kHz) | $P_{IN}$ | | 240 | W |
| Control port reverse voltage | $V_{CTL}$ | | 200 | V |
| Control port forward current | $I_{CTL}$ | | 200 | mA |
| Operating temperature | $T_{OP}$ | –55 | +175 | °C |
| Storage temperature | $T_{STG}$ | –55 | +200 | °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.*

**Table 3. Recommended Operating Conditions (Per ANT, TX, RX, and RX_BIAS Inputs)**

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

**Table 4. SKY12208-306LF Electrical Specifications, Bias Voltage = 28 V (1 of 2) (Note 1)**
**($T_{OP}$ = +25 °C, Characteristic Impedance [$Z_0$] = 50 Ω, EVB Optimized for 0.02 to 0.70 GHz Operation, Unless Otherwise Noted)**

| Parameter | Symbol | Test Condition | Min | Typical | Max | Units |
|---|---|---|---|---|---|---|
| Insertion loss, TX to ANT ports | $IL_{TX-ANT}$ | $V_{PIN\_2}$ = 1 V,<br>$I_{PIN\_14}$ = –50 mA,<br>$I_{PIN\_9}$ = –50 mA,<br>$V_{PIN\_7}$ = 28 V,<br>TX port $P_{IN}$ @ pin 14 = 0 dBm: | | | | |
| | | 0.02 GHz | | 0.39 | 0.50 | dB |
| | | 0.05 GHz | | 0.16 | 0.30 | dB |
| | | 0.25 GHz | | 0.10 | 0.25 | dB |
| | | 0.50 GHz | | 0.18 | 0.40 | dB |
| | | 0.70 GHz | | 0.40 | 0.90 | dB |
| Insertion loss, ANT to RX ports | $IL_{ANT-RX}$ | $V_{PIN\_2}$ = 1 V,<br>$V_{PIN\_14}$ = 28 V,<br>$I_{PIN\_7}$ = –50 mA,<br>$V_{PIN\_9}$ = 28 V,<br>ANT port $P_{IN}$ @ pin 2 = 0 dBm: | | | | |
| | | 0.02 GHz | | 0.29 | 0.50 | dB |
| | | 0.05 GHz | | 0.16 | 0.30 | dB |
| | | 0.25 GHz | | 0.10 | 0.25 | dB |
| | | 0.50 GHz | | 0.17 | 0.40 | dB |
| | | 0.70 GHz | | 0.40 | 0.90 | dB |
| Isolation, TX to RX ports | $ISO_{\_TX-RX}$ | $V_{PIN\_2}$ = 1 V,<br>$I_{PIN\_14}$ = –50 mA,<br>$I_{PIN\_9}$ = –50 mA,<br>$V_{PIN\_7}$ = 28 V,<br>TX port $P_{IN}$ @ pin 14 = 0 dBm: | | | | |
| | | 0.02 GHz | 45 | 49 | | dB |
| | | 0.05 GHz | 45 | 50 | | dB |
| | | 0.25 GHz | 38 | 42 | | dB |
| | | 0.50 GHz | 35 | 39 | | dB |
| | | 0.70 GHz | 34 | 39 | | dB |
| Isolation, ANT to TX ports | $ISO_{\_ANT-TX}$ | $V_{PIN\_2}$ = 1 V,<br>$V_{PIN\_14}$ = 28 V,<br>$I_{PIN\_7}$ = –50 mA,<br>$V_{PIN\_9}$ = 28 V,<br>ANT port $P_{IN}$ @ pin 2 = 0 dBm: | | | | |
| | | 0.02 GHz | 45 | 58 | | dB |
| | | 0.05 GHz | 45 | 49 | | dB |
| | | 0.25 GHz | 33 | 36 | | dB |
| | | 0.50 GHz | 27 | 31 | | dB |
| | | 0.70 GHz | 25 | 29 | | dB |
| Isolation, ANT to RX ports | $ISO_{\_ANT-RX}$ | $V_{PIN\_2}$ = 1 V,<br>$I_{PIN\_14}$ = –50 mA,<br>$I_{PIN\_9}$ = –50 mA,<br>$V_{PIN\_7}$ = 28 V,<br>ANT port $P_{IN}$ @ pin 2 = 0 dBm: | | | | |
| | | 0.02 GHz | 45 | 49 | | dB |
| | | 0.05 GHz | 45 | 49 | | dB |
| | | 0.25 GHz | 38 | 41 | | dB |
| | | 0.50 GHz | 35 | 39 | | dB |
| | | 0.70 GHz | 34 | 39 | | dB |

**Table 4. SKY12208-306LF Electrical Specifications, Bias Voltage = 28 V (2 of 2) (Note 1)**
**($T_{OP}$ = +25 °C, Characteristic Impedance [$Z_0$] = 50 Ω, EVB Optimized for 0.02 to 0.70 GHz Operation, Unless Otherwise Noted)**

| Parameter | Symbol | Test Condition | Min | Typical | Max | Units |
|---|---|---|---|---|---|---|
| Input return loss | | 0.02 to 0.70 GHz: | | | | |
| | | RX insertion loss state, ANT port (@ pin 2) | | 22 | | dB |
| | | TX insertion loss state, TX port (@ pin 14) | | 23 | | dB |
| Transmit 2nd harmonic | 2fo | TX insertion loss state, TX port $P_{IN}$ @ pin 14 = +30 dBm: | | | | |
| | | 0.05 GHz | | –78 | | dBc |
| | | 0.25 GHz | | –82 | | dBc |
| | | 0.50 GHz | | –95 | | dBc |
| | | 0.70 GHz | | –88 | | dBc |
| Transmit 3rd harmonic | 3fo | TX insertion loss state, TX port $P_{IN}$ @ pin 14 = +30 dBm: | | | | |
| | | 0.05 GHz | | –92 | | dBc |
| | | 0.25 GHz | | –85 | | dBc |
| | | 0.50 GHz | | –81 | | dBc |
| | | 0.70 GHz | | –78 | | dBc |
| Transmit 3rd Order Input Intercept Point | IIP3 | $V_{PIN\_2}$ = 1 V, $I_{PIN\_14}$ = –50 mA, $I_{PIN\_9}$ = –50 mA, $V_{PIN\_7}$ = 28 V, TX port $P_{IN}$ @ pin 14 = 0 dBm/tone, tone spacing = 1 MHz, @ 0.25 GHz | | +45 | | dBm |
| Maximum transmit CW input power | $P_{IN\_CW}$ | $V_{PIN\_2}$ = 1 V, $I_{PIN\_14}$ = –50 mA, $I_{PIN\_9}$ = –50 mA, $V_{PIN\_7}$ = 28 V, 0.02 to 0.70 GHz | | 50 | | W |
| Maximum receive CW input power | $P_{IN\_CW}$ | $V_{PIN\_2}$ = 1 V, $V_{PIN\_14}$ = 28 V, $I_{PIN\_7}$ = –50 mA, $V_{PIN\_9}$ = 28 V, 0.02 to 0.70 GHz | | 40 | | W |
| Transmit RF switching time | $t_{SW}$ | 10% to 90% RF on, repetition rate = 0.5 MHz, @ 0.25 GHz | | 85 | | ns |

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

**Table 5. SKY12208-306LF Electrical Specifications, Bias Voltage = 5 V (1 of 2) (Note 1)**
**($T_{OP}$ = +25 °C, Characteristic Impedance [$Z_0$] = 50 Ω, EVB Optimized for 0.02 to 0.70 GHz Operation, Unless Otherwise Noted)**

| Parameter | Symbol | Test Condition | Min | Typical | Max | Units |
|---|---|---|---|---|---|---|
| Insertion loss, TX to ANT ports | $IL_{TX-ANT}$ | $V_{PIN\_2}$ = 1 V,<br>$I_{PIN\_14}$ = –50 mA,<br>$I_{PIN\_9}$ = –50 mA,<br>$V_{PIN\_7}$ = 5 V,<br>TX port $P_{IN}$ @ pin 14 = 0 dBm: | | | | |
| | | 0.02 GHz | | 0.37 | 0.50 | dB |
| | | 0.05 GHz | | 0.13 | 0.30 | dB |
| | | 0.25 GHz | | 0.10 | 0.25 | dB |
| | | 0.50 GHz | | 0.17 | 0.40 | dB |
| | | 0.70 GHz | | 0.41 | 0.90 | dB |
| Insertion loss, ANT to RX ports | $IL_{ANT-RX}$ | $V_{PIN\_2}$ = 1 V,<br>$V_{PIN\_14}$ = 5 V,<br>$I_{PIN\_7}$ = –50 mA,<br>$V_{PIN\_9}$ = 5 V,<br>ANT port $P_{IN}$ @ pin 2 = 0 dBm: | | | | |
| | | 0.02 GHz | | 0.26 | 0.50 | dB |
| | | 0.05 GHz | | 0.13 | 0.30 | dB |
| | | 0.25 GHz | | 0.10 | 0.25 | dB |
| | | 0.50 GHz | | 0.17 | 0.40 | dB |
| | | 0.70 GHz | | 0.41 | 0.90 | dB |
| Isolation, TX to RX ports | $ISO_{\_TX-RX}$ | $V_{PIN\_2}$ = 1 V,<br>$I_{PIN\_14}$ = –50 mA,<br>$I_{PIN\_9}$ = –50 mA,<br>$V_{PIN\_7}$ = 5 V,<br>TX port $P_{IN}$ @ pin 14 = 0 dBm: | | | | |
| | | 0.02 GHz | 45 | 49 | | dB |
| | | 0.05 GHz | 45 | 49 | | dB |
| | | 0.25 GHz | 38 | 41 | | dB |
| | | 0.50 GHz | 35 | 39 | | dB |
| | | 0.70 GHz | 34 | 39 | | dB |
| Isolation, ANT to TX ports | $ISO_{\_ANT-TX}$ | $V_{PIN\_2}$ = 1 V,<br>$V_{PIN\_14}$ = 5 V,<br>$I_{PIN\_7}$ = –50 mA,<br>$V_{PIN\_9}$ = 5 V,<br>ANT port $P_{IN}$ @ pin 2 = 0 dBm: | | | | |
| | | 0.02 GHz | 45 | 61 | | dB |
| | | 0.05 GHz | 45 | 50 | | dB |
| | | 0.25 GHz | 33 | 37 | | dB |
| | | 0.50 GHz | 27 | 31 | | dB |
| | | 0.70 GHz | 25 | 29 | | dB |
| Isolation, ANT to RX ports | $ISO_{\_ANT-RX}$ | $V_{PIN\_2}$ = 1 V,<br>$I_{PIN\_14}$ = –50 mA,<br>$I_{PIN\_9}$ = –50 mA,<br>$V_{PIN\_7}$ = 5 V,<br>ANT port $P_{IN}$ @ pin 2 = 0 dBm: | | | | |
| | | 0.02 GHz | 45 | 49 | | dB |
| | | 0.05 GHz | 45 | 49 | | dB |
| | | 0.25 GHz | 38 | 41 | | dB |
| | | 0.50 GHz | 35 | 39 | | dB |
| | | 0.70 GHz | 34 | 39 | | dB |

**Table 5. SKY12208-306LF Electrical Specifications, Bias Voltage = 5 V (2 of 2) (Note 1)**
**($T_{OP}$ = +25 °C, Characteristic Impedance [$Z_0$] = 50 Ω, EVB Optimized for 0.02 to 0.70 GHz Operation, Unless Otherwise Noted)**

| Parameter | Symbol | Test Condition | Min | Typical | Max | Units |
|---|---|---|---|---|---|---|
| Input return loss | | 0.02 to 0.70 GHz: | | | | |
| | | RX insertion loss state, ANT port (@ pin 2) | | 22 | | dB |
| | | TX insertion loss state, TX port (@ pin 14) | | 24 | | dB |
| Transmit 2nd harmonic | 2fo | TX insertion loss state, TX port $P_{IN}$ @ pin 14 = +30 dBm: | | | | |
| | | 0.05 GHz | | –31 | | dBc |
| | | 0.25 GHz | | –40 | | dBc |
| | | 0.50 GHz | | –50 | | dBc |
| | | 0.70 GHz | | –55 | | dBc |
| Transmit 3rd harmonic | 3fo | TX insertion loss state, TX port $P_{IN}$ @ pin 14 = +30 dBm: | | | | |
| | | 0.05 GHz | | –36 | | dBc |
| | | 0.25 GHz | | –43 | | dBc |
| | | 0.50 GHz | | –52 | | dBc |
| | | 0.70 GHz | | –67 | | dBc |
| Transmit 3rd Order Input Intercept Point | IIP3 | $V_{PIN\_2}$ = 1 V, $I_{PIN\_14}$ = –50 mA, $I_{PIN\_9}$ = –50 mA, $V_{PIN\_7}$ = 5 V, TX port $P_{IN}$ @ pin 14 = 0 dBm/tone, tone spacing = 1 MHz, @ 0.25 GHz | | +45 | | dBm |
| Maximum transmit CW input power | $P_{IN\_CW}$ | $V_{PIN\_2}$ = 1 V, $I_{PIN\_14}$ = –50 mA, $I_{PIN\_9}$ = –50 mA, $V_{PIN\_7}$ = 5 V, 0.02 to 0.70 GHz | | 15 | | W |
| Maximum receive CW input power | $P_{IN\_CW}$ | $V_{PIN\_2}$ = 1 V, $V_{PIN\_14}$ = 5 V, $I_{PIN\_7}$ = 50 mA, $V_{PIN\_9}$ = 5 V, 0.02 to 0.70 GHz | | 10 | | W |
| Transmit RF switching time | $t_{SW}$ | 10% to 90% RF on, repetition rate = 0.5 MHz, @ 0.25 GHz | | 85 | | ns |

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

**Table 6. SKY12208-306LF Electrical Specifications, Bias Voltage = 28 V (1 of 2) (Note 1)**
**($T_{OP}$ = +25 °C, Characteristic Impedance [$Z_0$] = 50 Ω, EVB Optimized for 0.05 to 2.70 GHz Operation, Unless Otherwise Noted)**

| Parameter | Symbol | Test Condition | Min | Typical | Max | Units |
|---|---|---|---|---|---|---|
| Insertion loss, TX to ANT ports | $IL_{TX-ANT}$ | $V_{PIN\_2}$ = 1 V,<br>$I_{PIN\_14}$ = –50 mA,<br>$I_{PIN\_9}$ = –50 mA,<br>$V_{PIN\_7}$ = 28 V,<br>TX port $P_{IN}$ @ pin 14 = 0 dBm: | | | | |
| | | 0.05 GHz | | 0.36 | | dB |
| | | 0.50 GHz | | 0.25 | | dB |
| | | 1.00 GHz | | 0.29 | | dB |
| | | 1.50 GHz | | 0.35 | | dB |
| | | 2.00 GHz | | 0.42 | | dB |
| | | 2.50 GHz | | 0.46 | | dB |
| Insertion loss, ANT to RX ports | $IL_{ANT-RX}$ | $V_{PIN\_2}$ = 1 V,<br>$V_{PIN\_14}$ = 28 V,<br>$I_{PIN\_7}$ = –50 mA,<br>$V_{PIN\_9}$ = 28 V,<br>ANT port $P_{IN}$ @ pin 2 = 0 dBm: | | | | |
| | | 0.05 GHz | | 0.43 | | dB |
| | | 0.50 GHz | | 0.24 | | dB |
| | | 1.00 GHz | | 0.30 | | dB |
| | | 1.50 GHz | | 0.40 | | dB |
| | | 2.00 GHz | | 0.49 | | dB |
| | | 2.50 GHz | | 0.53 | | dB |
| Isolation, TX to RX ports | $Iso_{\_TX-RX}$ | $V_{PIN\_2}$ = 1 V,<br>$I_{PIN\_14}$ = –50 mA,<br>$I_{PIN\_9}$ = –50 mA,<br>$V_{PIN\_7}$ = 28 V,<br>TX port $P_{IN}$ @ pin 14 = 0 dBm: | | | | |
| | | 0.05 GHz | | 48 | | dB |
| | | 0.50 GHz | | 42 | | dB |
| | | 1.00 GHz | | 46 | | dB |
| | | 1.50 GHz | | 49 | | dB |
| | | 2.00 GHz | | 41 | | dB |
| | | 2.50 GHz | | 34 | | dB |
| Isolation, ANT to TX ports | $Iso_{\_ANT-TX}$ | $V_{PIN\_2}$ = 1 V,<br>$V_{PIN\_14}$ = 28 V,<br>$I_{PIN\_7}$ = –50 mA,<br>$V_{PIN\_9}$ = 28 V,<br>ANT port $P_{IN}$ @ pin 2 = 0 dBm: | | | | |
| | | 0.05 GHz | | 51 | | dB |
| | | 0.50 GHz | | 31 | | dB |
| | | 1.00 GHz | | 25 | | dB |
| | | 1.50 GHz | | 23 | | dB |
| | | 2.00 GHz | | 21 | | dB |
| | | 2.50 GHz | | 20 | | dB |
| Isolation, ANT to RX ports | $Iso_{\_ANT-RX}$ | $V_{PIN\_2}$ = 1 V,<br>$I_{PIN\_14}$ = –50 mA,<br>$I_{PIN\_9}$ = –50 mA,<br>$V_{PIN\_7}$ = 28 V,<br>ANT port $P_{IN}$ @ pin 2 = 0 dBm: | | | | |
| | | 0.05 GHz | | 49 | | dB |
| | | 0.50 GHz | | 42 | | dB |
| | | 1.00 GHz | | 44 | | dB |
| | | 1.50 GHz | | 45 | | dB |
| | | 2.00 GHz | | 38 | | dB |
| | | 2.50 GHz | | 33 | | dB |

**Table 6. SKY12208-306LF Electrical Specifications, Bias Voltage = 28 V (2 of 2) (Note 1)**
**($T_{OP}$ = +25 °C, Characteristic Impedance [$Z_0$] = 50 Ω, EVB Optimized for 0.05 to 2.70 GHz Operation, Unless Otherwise Noted)**

| Parameter | Symbol | Test Condition | Min | Typical | Max | Units |
|---|---|---|---|---|---|---|
| Input return loss | | 0.05 to 2.70 GHz: | | | | |
| | | RX insertion loss state, ANT port (@ pin 2) | | 21 | | dB |
| | | TX insertion loss state, TX port (@ pin 14) | | 20 | | dB |
| Transmit 2nd harmonic | 2fo | TX insertion loss state, TX port $P_{IN}$ @ pin 14 = +30 dBm: | | | | |
| | | 0.05 GHz | | –78 | | dBc |
| | | 0.50 GHz | | –82 | | dBc |
| | | 1.00 GHz | | –95 | | dBc |
| | | 1.50 GHz | | –88 | | dBc |
| | | 2.00 GHz | | –85 | | dBc |
| | | 2.50 GHz | | –80 | | dBc |
| Transmit 3rd harmonic | 3fo | TX insertion loss state, TX port $P_{IN}$ @ pin 14 = +30 dBm: | | | | |
| | | 0.05 GHz | | –92 | | dBc |
| | | 0.50 GHz | | –85 | | dBc |
| | | 1.00 GHz | | –81 | | dBc |
| | | 1.50 GHz | | –78 | | dBc |
| | | 2.00 GHz | | –75 | | dBc |
| | | 2.50 GHz | | –70 | | dBc |
| Transmit 3rd Order Input Intercept Point | IIP3 | $V_{PIN\_2}$ = 1 V, $I_{PIN\_14}$ = –50 mA, $I_{PIN\_9}$ = –50 mA, $V_{PIN\_7}$ = 28 V, TX port $P_{IN}$ @ pin 14 = 0 dBm/tone, tone spacing = 1 MHz, @ 2.0 GHz | | +42 | | dBm |
| Maximum transmit CW input power | $P_{IN\_CW}$ | $V_{PIN\_2}$ = 1 V, $I_{PIN\_14}$ = –50 mA, $I_{PIN\_9}$ = –50 mA, $V_{PIN\_7}$ = 28 V, 0.05 to 2.70 GHz | | 50 | | W |
| Maximum receive CW input power | $P_{IN\_CW}$ | $V_{PIN\_2}$ = 1 V, $V_{PIN\_14}$ = 28 V, $I_{PIN\_7}$ = 50 mA, $V_{PIN\_9}$ = 28 V, 0.05 to 2.70 GHz | | 40 | | W |
| Transmit RF switching time | $t_{SW}$ | 10% to 90% RF on, repetition rate = 0.5 MHz, @ 2.0 GHz | | 85 | | ns |

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

**Table 7. SKY12208-306LF Electrical Specifications, Bias Voltage = 5 V (1 of 2) (Note 1)**
**($T_{OP}$ = +25 °C, Characteristic Impedance [$Z_0$] = 50 Ω, EVB Optimized for 0.05 to 2.70 GHz Operation, Unless Otherwise Noted)**

| Parameter | Symbol | Test Condition | Min | Typical | Max | Units |
|---|---|---|---|---|---|---|
| Insertion loss, TX to ANT ports | $IL_{TX-ANT}$ | $V_{PIN\_2}$ = 1 V,<br>$I_{PIN\_14}$ = –50 mA,<br>$I_{PIN\_9}$ = –50 mA,<br>$V_{PIN\_7}$ = 5 V,<br>TX port $P_{IN}$ @ pin 14 = 0 dBm: | | | | |
| | | 0.05 GHz | | 0.27 | | dB |
| | | 0.50 GHz | | 0.25 | | dB |
| | | 1.00 GHz | | 0.31 | | dB |
| | | 1.50 GHz | | 0.37 | | dB |
| | | 2.00 GHz | | 0.44 | | dB |
| | | 2.50 GHz | | 0.50 | | dB |
| Insertion loss, ANT to RX ports | $IL_{ANT-RX}$ | $V_{PIN\_2}$ = 1 V,<br>$V_{PIN\_14}$ = 5 V,<br>$I_{PIN\_7}$ = –50 mA,<br>$V_{PIN\_9}$ = 5 V,<br>ANT port $P_{IN}$ @ pin 2 = 0 dBm: | | | | |
| | | 0.05 GHz | | 0.40 | | dB |
| | | 0.50 GHz | | 0.25 | | dB |
| | | 1.00 GHz | | 0.33 | | dB |
| | | 1.50 GHz | | 0.42 | | dB |
| | | 2.00 GHz | | 0.50 | | dB |
| | | 2.50 GHz | | 0.58 | | dB |
| Isolation, TX to RX ports | $Iso_{\_TX-RX}$ | $V_{PIN\_2}$ = 1 V,<br>$I_{PIN\_14}$ = –50 mA,<br>$I_{PIN\_9}$ = –50 mA,<br>$V_{PIN\_7}$ = 5 V,<br>TX port $P_{IN}$ @ pin 14 = 0 dBm: | | | | |
| | | 0.05 GHz | | 49 | | dB |
| | | 0.50 GHz | | 41 | | dB |
| | | 1.00 GHz | | 45 | | dB |
| | | 1.50 GHz | | 49 | | dB |
| | | 2.00 GHz | | 40 | | dB |
| | | 2.50 GHz | | 34 | | dB |
| Isolation, ANT to TX ports | $Iso_{\_ANT-TX}$ | $V_{PIN\_2}$ = 1 V,<br>$V_{PIN\_14}$ = 5 V,<br>$I_{PIN\_7}$ = –50 mA,<br>$V_{PIN\_9}$ = 5 V,<br>ANT port $P_{IN}$ @ pin 2 = 0 dBm: | | | | |
| | | 0.05 GHz | | 51 | | dB |
| | | 0.50 GHz | | 31 | | dB |
| | | 1.00 GHz | | 25 | | dB |
| | | 1.50 GHz | | 22 | | dB |
| | | 2.00 GHz | | 21 | | dB |
| | | 2.50 GHz | | 19 | | dB |
| Isolation, ANT to RX ports | $Iso_{\_ANT-RX}$ | $V_{PIN\_2}$ = 1 V,<br>$I_{PIN\_14}$ = –50 mA,<br>$I_{PIN\_9}$ = –50 mA,<br>$V_{PIN\_7}$ = 5 V,<br>ANT port $P_{IN}$ @ pin 2 = 0 dBm: | | | | |
| | | 0.05 GHz | | 48 | | dB |
| | | 0.50 GHz | | 41 | | dB |
| | | 1.00 GHz | | 44 | | dB |
| | | 1.50 GHz | | 44 | | dB |
| | | 2.00 GHz | | 38 | | dB |
| | | 2.50 GHz | | 32 | | dB |

**Table 7. SKY12208-306LF Electrical Specifications, Bias Voltage = 5 V (2 of 2) (Note 1)**
**($T_{OP}$ = +25 °C, Characteristic Impedance [$Z_0$] = 50 Ω, EVB Optimized for 0.05 to 2.70 GHz Operation, Unless Otherwise Noted)**

| Parameter | Symbol | Test Condition | Min | Typical | Max | Units |
|---|---|---|---|---|---|---|
| Input return loss | | 0.05 to 2.70 GHz: | | | | |
| | | RX insertion loss state, ANT port (@ pin 2) | | 21 | | dB |
| | | TX insertion loss state, TX port (@ pin 14) | | 20 | | dB |
| Transmit 2nd harmonic | 2fo | TX insertion loss state, TX port $P_{IN}$ @ pin 14 = +30 dBm: | | | | |
| | | 0.05 GHz | | –31 | | dBc |
| | | 0.50 GHz | | –40 | | dBc |
| | | 1.00 GHz | | –50 | | dBc |
| | | 1.50 GHz | | –55 | | dBc |
| | | 2.00 GHz | | –50 | | dBc |
| | | 2.50 GHz | | –45 | | dBc |
| Transmit 3rd harmonic | 3fo | TX insertion loss state, TX port $P_{IN}$ @ pin 14 = +30 dBm: | | | | |
| | | 0.05 GHz | | –36 | | dBc |
| | | 0.50 GHz | | –43 | | dBc |
| | | 1.00 GHz | | –52 | | dBc |
| | | 1.50 GHz | | –67 | | dBc |
| | | 2.00 GHz | | –55 | | dBc |
| | | 2.50 GHz | | –45 | | dBc |
| Transmit 3rd Order Input Intercept Point | IIP3 | $V_{PIN\_2}$ = 1 V, $I_{PIN\_14}$ = –50 mA, $I_{PIN\_9}$ = –50 mA, $V_{PIN\_7}$ = 5 V, TX port $P_{IN}$ @ pin 14 = 0 dBm/tone, tone spacing = 1 MHz, @ 2.0 GHz | | +42 | | dBm |
| Maximum transmit CW input power | $P_{IN\_CW}$ | $V_{PIN\_2}$ = 1 V, $I_{PIN\_14}$ = –50 mA, $I_{PIN\_9}$ = –50 mA, $V_{PIN\_7}$ = 5 V, 0.05 to 2.70 GHz | | 15 | | W |
| Maximum receive CW input power | $P_{IN\_CW}$ | $V_{PIN\_2}$ = 1 V, $V_{PIN\_14}$ = 5 V, $I_{PIN\_7}$ = 50 mA, $V_{PIN\_9}$ = 5 V, 0.05 to 2.70 GHz | | 10 | | W |
| Transmit RF switching time | $t_{SW}$ | 10% to 90% RF on, repetition rate = 0.5 MHz, @ 2.0 GHz | | 85 | | ns |

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

## Typical Performance Characteristics

**($T_{OP}$ = +25 °C, Characteristic Impedance [$Z_0$] = 50 Ω, EVB Optimized for 0.02 to 0.70 GHz Operation, Unless Otherwise Noted)**

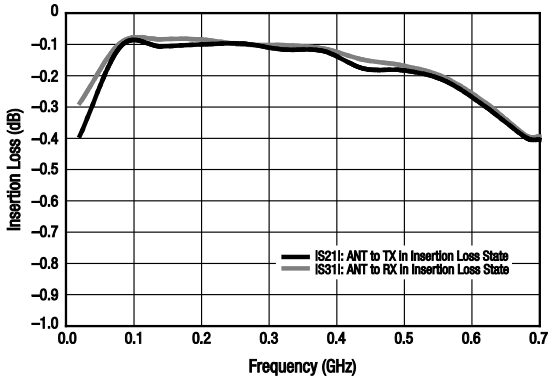



**Figure 3. Insertion Loss vs Frequency (ANT to RX and ANT to TX Ports; $V_{CTL}$ = 28 V, $I_{CTL}$ = –50 mA)**

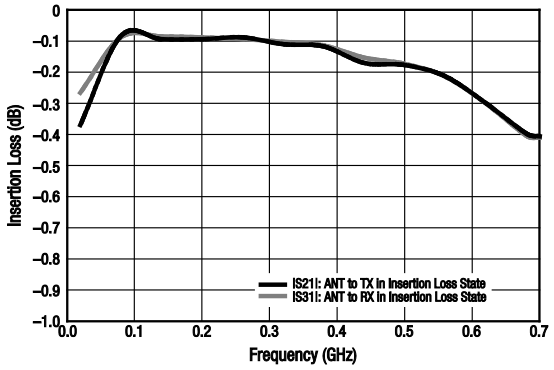



**Figure 4. Insertion Loss vs Frequency (ANT to RX and ANT to TX Ports; $V_{CTL}$ = 5 V, $I_{CTL}$ = –50 mA)**

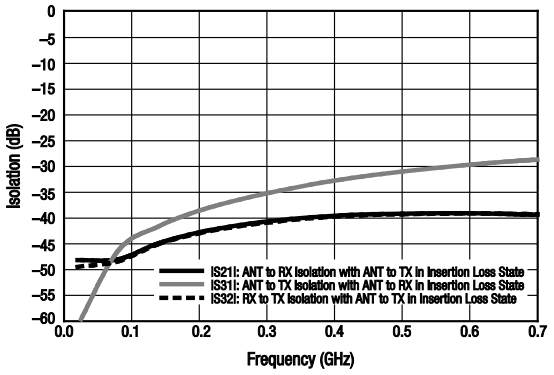



**Figure 5. Isolation vs Frequency (ANT to RX, TX to RX, and ANT to TX Ports; $V_{CTL}$ = 28 V, $I_{CTL}$ = –50 mA)**

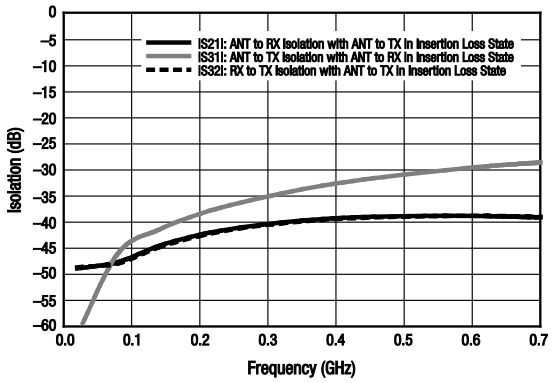



**Figure 6. Isolation vs Frequency (ANT to RX, TX to RX, and ANT to TX Ports; $V_{CTL}$ = 5 V, $I_{CTL}$ = –50 mA)**

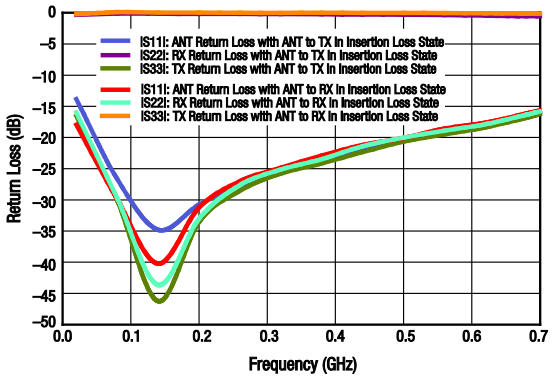



**Figure 7. Return Loss vs Frequency (ANT, TX, and RX Ports; $V_{CTL}$ = 28 V, $I_{CTL}$ = –50 mA)**

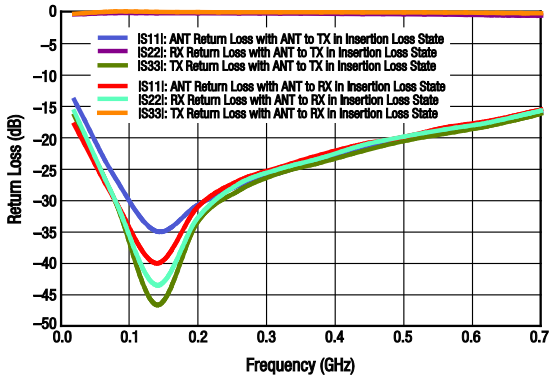



**Figure 8. Return Loss vs Frequency (ANT, TX, and RX Ports; $V_{CTL}$ = 5 V, $I_{CTL}$ = –50 mA)**

## Typical Performance Characteristics

**($T_{OP}$ = +25 °C, Characteristic Impedance [$Z_0$] = 50 Ω, EVB Optimized for 0.05 to 2.70 GHz Operation, Unless Otherwise Noted)**

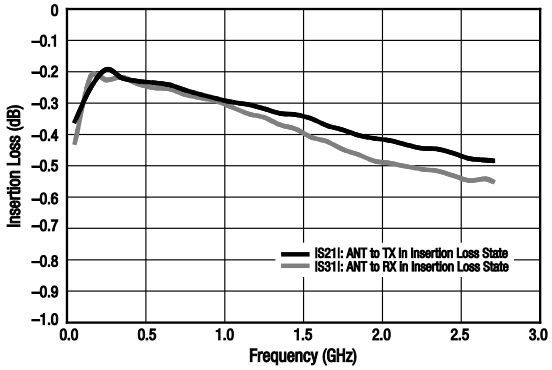



**Figure 9. Insertion Loss vs Frequency (ANT to RX and ANT to TX Ports; $V_{CTL}$ = 28 V, $I_{CTL}$ = –50 mA)**

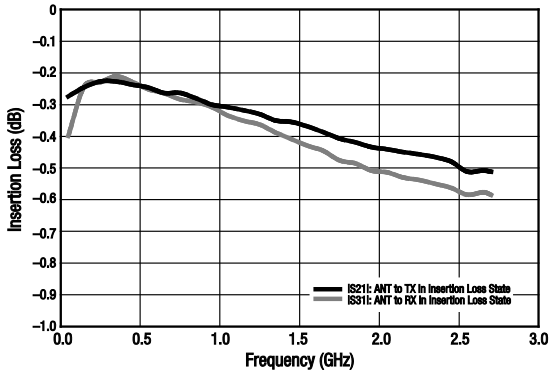



**Figure 10. Insertion Loss vs Frequency (ANT to RX and ANT to TX Ports; $V_{CTL}$ = 5 V, $I_{CTL}$ = –50 mA)**

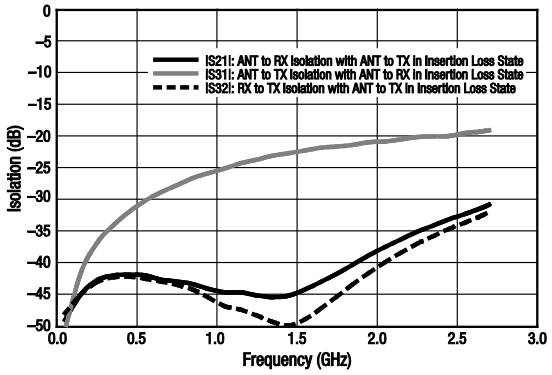



**Figure 11. Isolation vs Frequency (ANT to RX, TX to RX, and ANT to TX Ports; $V_{CTL}$ = 28 V, $I_{CTL}$ = –50 mA)**

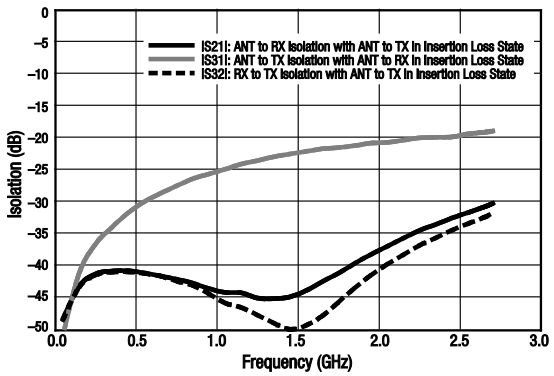



**Figure 12. Isolation vs Frequency (ANT to RX, TX to RX, and ANT to TX Ports; $V_{CTL}$ = 5 V, $I_{CTL}$ = –50 mA)**

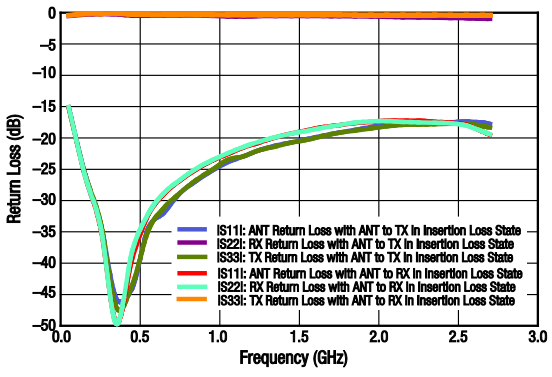



**Figure 13. Return Loss vs Frequency (ANT, TX, and RX Ports; $V_{CTL}$ = 28 V, $I_{CTL}$ = –50 mA)**

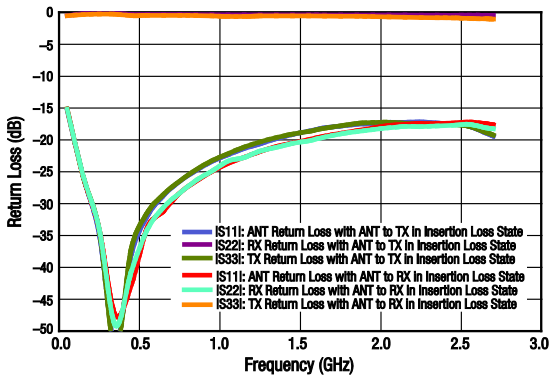



**Figure 14. Return Loss vs Frequency (ANT, TX, and RX Ports; $V_{CTL}$ = 5 V, $I_{CTL}$ = –50 mA)**

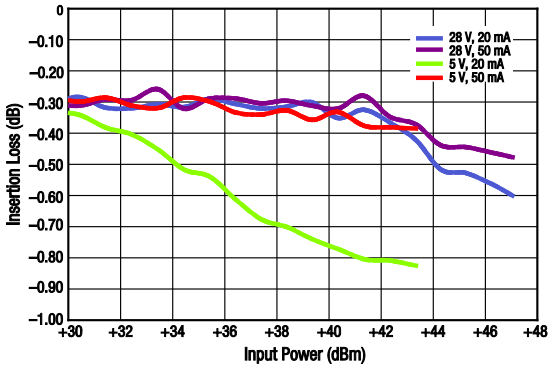



**Figure 15. Insertion Loss vs CW Input Power (ANT to RX Port, f = 0.25 GHz)**

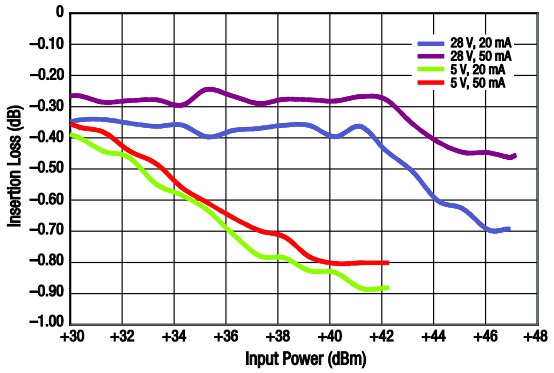



**Figure 16. Insertion Loss vs CW Input Power (TX to ANT Port, f = 0.25 GHz)**

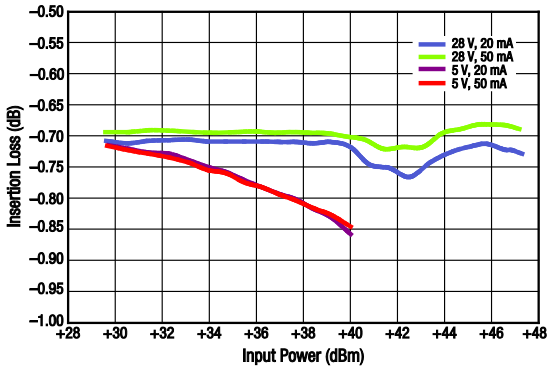



**Figure 17. Insertion Loss vs CW Input Power (ANT to RX Port, f = 2.0 GHz)**

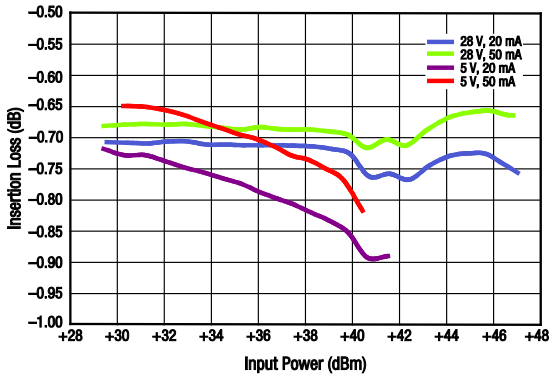



**Figure 18. Insertion Loss vs CW Input Power (TX to ANT Port, f = 2.0 GHz)**

**Table 8. SKY12208-306LF 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 9. SKY12208-306LF 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 | 28 V | 0 V (ground) | 28 V | 28 V |
| Transmit (see Figure 12) | High isolation | Low insertion loss | 28 V | 28 V | 0 V (ground) | 0 V (ground) |

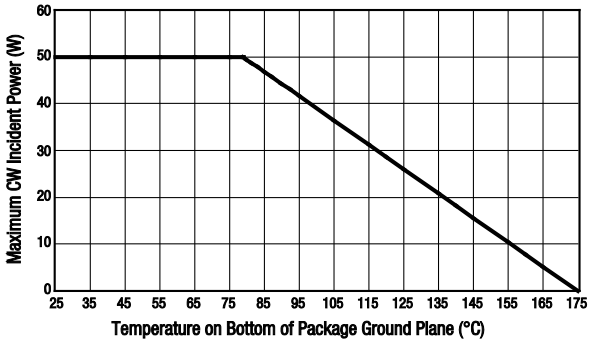



**Figure 19. Transmit Power Derating, Maximum CW Incident Power (Insertion Loss = 0.3 dB) vs Temperature on Bottom of Package Ground Plane**

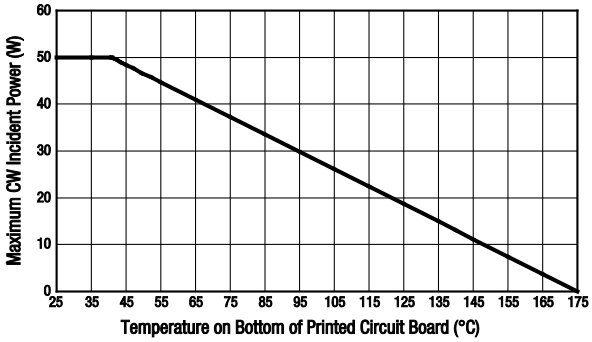



**Figure 20. Transmit Power Derating, Maximum CW Incident Power (Insertion Loss = 0.3 dB) vs Temperature on Bottom of Printed Circuit Board**

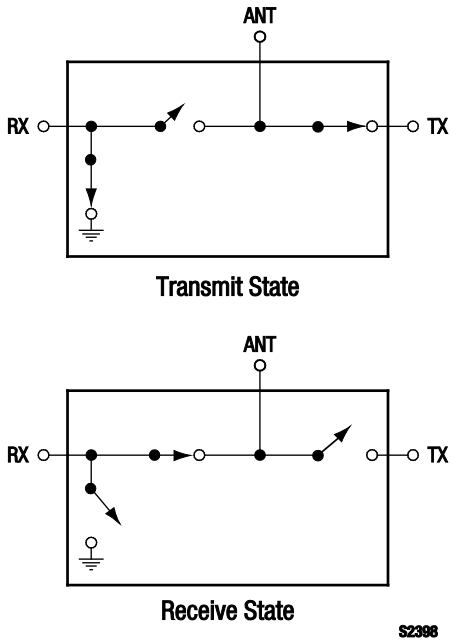



**Figure 21. SKY12208-306LF Equivalent Circuit Diagrams**

## Evaluation Board Description

The SKY12208-306LF Evaluation Board is used to test the performance of the SKY12208-306LF PIN Diode SPDT switch. An assembly drawing for the Evaluation Board is shown in Figure 22. The layer detail is provided in Figure 23.

The SKY12208-306LF 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 19, 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 20.

The evaluation circuit is designed to facilitate control of the SKY12208-306LF transmit/receive switch with bias signals derived from positive voltages. The state of the PIN diodes within the SKY12208-306LF is controlled with 28 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 21.

The values of resistors R2 and R3 (refer to the schematic diagram in Figure 24), which are both nominally 540 Ω, together with the magnitudes of the voltages applied to the TX and RX ports, determine which of the two series of diodes is biased into conduction and how much current flows through the forward biased diode.

For example, to place the SKY12208-306LF 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 R3 to the diode connected between pins 7 and 9).

The values of R2 and R3 may be adjusted to accommodate other bias voltages. Resistance values of 540 Ω are selected to produce

approximately 50 mA of forward bias current in the diodes, which are forced into conduction when the bias source voltage is 28 V.

The component values shown in the Evaluation Board circuit diagram (Figure 24) were selected to optimize performance in the 0.02 to 0.70 GHz and 0.05 to 2.7 GHz bands.

Refer to Table 10 for the Evaluation Board Bill of Materials. Table 11 provides voltage, current, and resistor values for bias adjustments.

## Package Dimensions

The PCB layout footprint for the SKY12208-306LF is shown in Figure 25. Typical case markings are noted in Figure 26. Package dimensions for the 16-pin QFN are shown in Figure 27, and tape and reel dimensions are provided in Figure 28.

## 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 SKY12208-306LF 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.

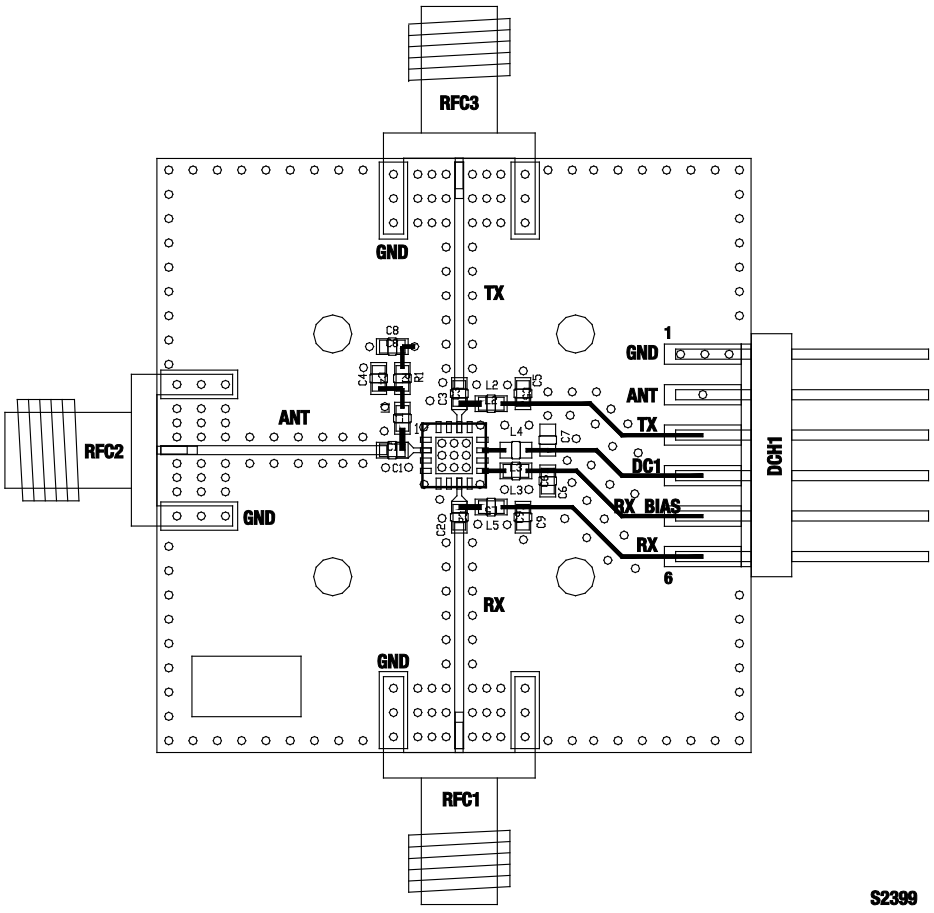



**Figure 22. SKY12208-306LF Evaluation Board Assembly Diagram**

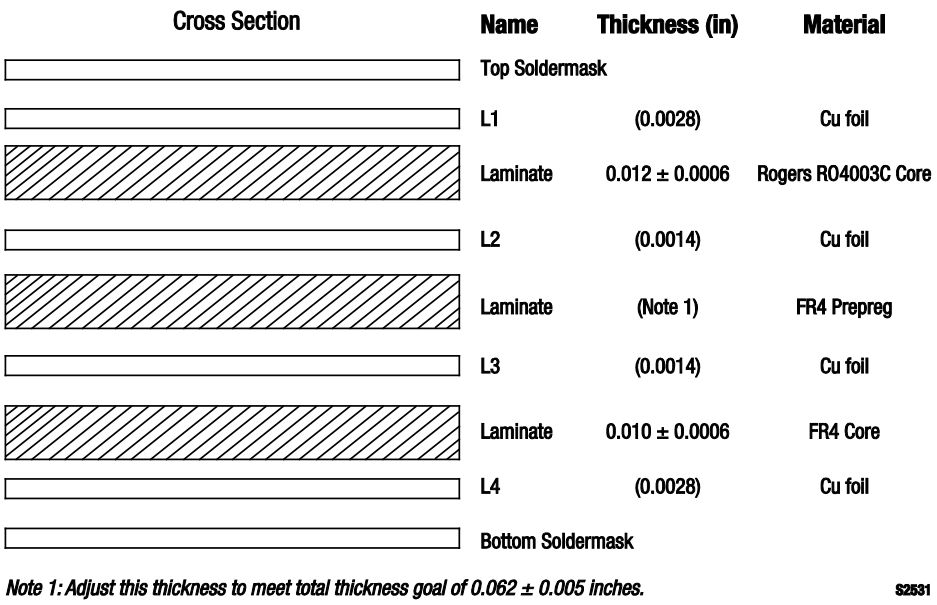



**Figure 23. Layer Detail Physical Characteristics**

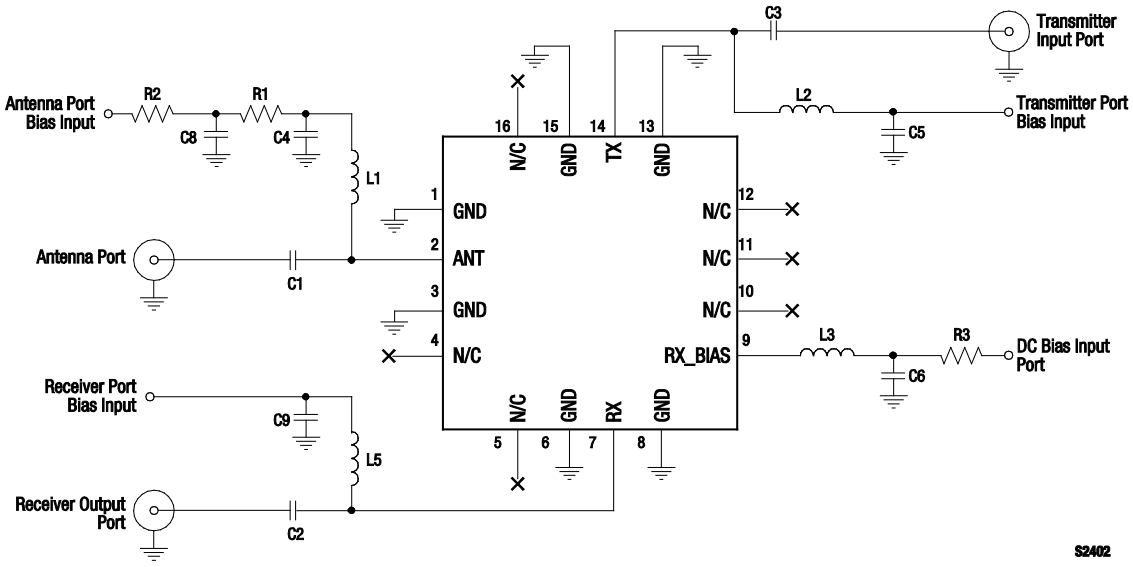



**Figure 24. Evaluation Board Schematic**

**Table 10. Evaluation Board Bill of Materials (Note 1)**

| Component | Value | Size | Product Number | Manufacturer | Manufacturer 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 (for 0.02 to 0.7 GHz operation) | 1200 nH | 0603 | – | Coil Craft | 0603LS-122XJLB | SRF, 160 MHz, ±5% |
| L1, L2, L5 (for 0.05 to 2.7 GHz operation) | 820 nH | 0603 | – | Coil Craft | 0603LS-821XJLB | SRF, 410 MHz, ±5% |
| L3 | 560 nH | 0603 | – | Coil Craft | 0603LS-561XJLB | SRF, 525 MHz, ±5% |
| R1 | 0 Ω | 0603 | 5424R29-001 | Rohm | MCR03EZPJ000 | 50 V, 0.1 W, ±5% |
| R2, R3 (Note 2) | 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:** Evaluation Board does not include 540 Ω values for resistors R2 and R3 for 28 V, 50 mA operation. Operating at 28 V and 50 mA requires R2 and R3 resistors with a power dissipation greater than 1.35 W.

**Table 11. Component Calculation Values**

| $V_S$ (V) | $V_{DIODE}$ (V) | $V_{RES}$ (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:** $V_S$ = supply voltage; $V_{DIODE}$ = voltage drop across the diode; $V_{RES}$ = voltage drop across the resistor.
R2 and R3 values are calculated by (Vs – 1 V)/I, where I is the desired bias current. The approximate voltage drop across the diode is 1 V.
The power dissipation in R2 or R3 is calculated by I x ($V_S$ – $V_{DIODE}$). The resistor selected must be rated to safely power greater than the dissipated power.

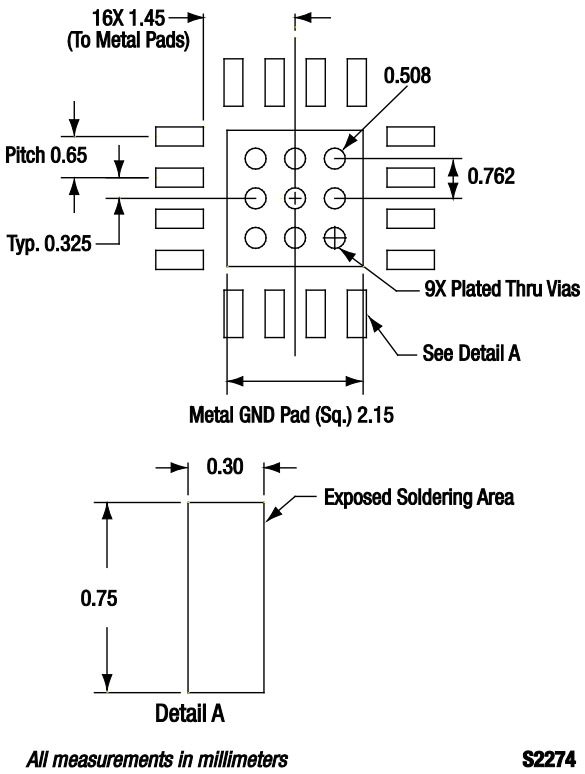



**Figure 25. SKY12208-306LF PCB Layout Footprint**

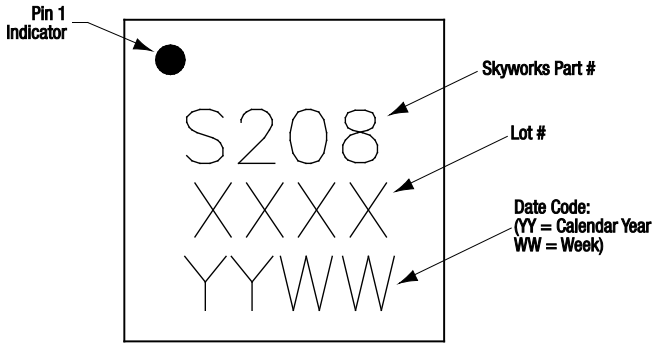
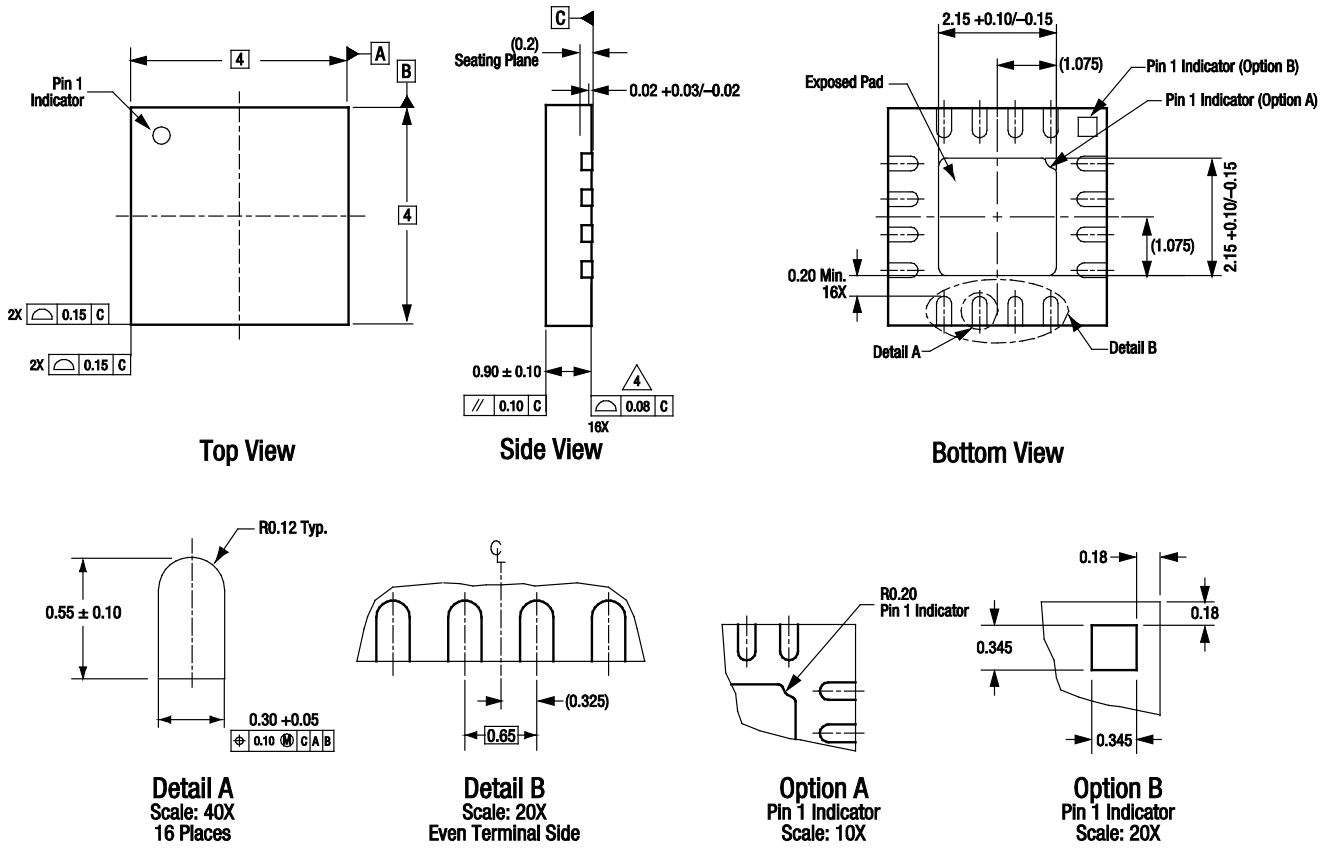


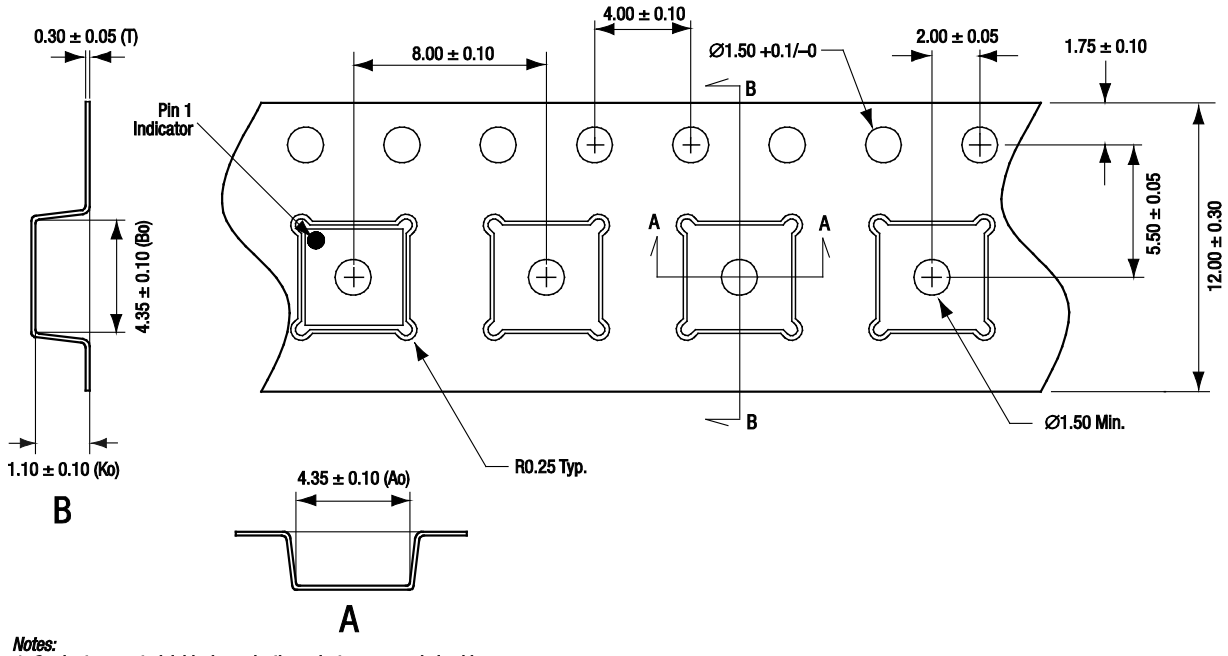

**Figure 26. Typical Case Markings**




*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.*

S2400

**Figure 27. SKY12208-306LF 16-Pin QFN Package Dimensions**




*Notes:*
*1. Carrier tape material: black conductive polystyrene, non-bakeable*
*2. Cover tape material: transparent conductive HSA*
*3. Cover tape size: 9.2 mm width*
*4. ESD surface resistivity is ≥1 x $10^5$ ~ ≤ 1 x $10^{10}$ Ohms/square per EIA, JEDEC TNR Specification.*
*5. All measurements are in millimeters*

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**Figure 28. SKY12208-306LF Tape and Reel Dimensions**

## Ordering Information

| Model Name | Manufacturing Part Number | Evaluation Board Part Number |
|---|---|---|
| SKY12208-306LF PIN Diode SPDT Switch | SKY12208-306LF | SKY12208-306LF-EVB |