

DATA SHEET

SKY12406-360LF: 50-600 MHz One-Bit Digital Attenuator (12 dB LSB)

Applications

- Cellular radio
- Wireless data
- WLL gain level control circuits

Features

- Positive voltage control: 0/3 V
- High bit accuracy
- Low loss
- Absorptive in 50 W systems
- Small, QFN (8-pin, 2 x 2 mm) package (MSL1, 260 °C per JEDEC J-STD-020)



Skyworks Green™ products are RoHS (Restriction of Hazardous Substances)-compliant, conform to the EIA/EICTA/JEITA Joint Industry Guide (JIG) Level A guidelines, are halogen free according to IEC-61249-2-21, and contain <1,000 ppm antimony trioxide in polymeric materials.

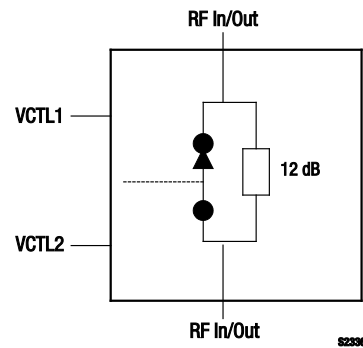


Figure 1. SKY12406-360LF Block Diagram

Description

The SKY12406-360LF is a pHEMT GaAs FET I/C single bit attenuator designed for low-cost commercial applications where high attenuation accuracy, low insertion loss, and low intermodulation products are required. The attenuator has an LSB of 12 dB.

The SKY12406-360LF is manufactured in a compact, 2 x 2 mm, 8-pin exposed pad plastic 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.

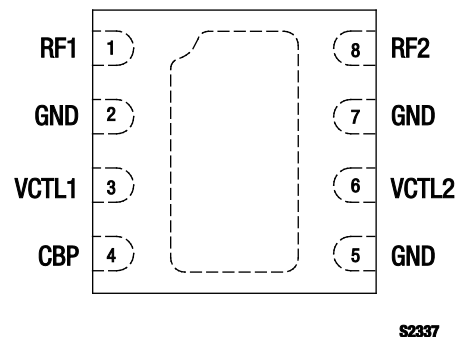


Figure 2. SKY12406-360LF Pinout – 8-Pin QFN (Top View)

Table 1. SKY12406-360LF Signal Descriptions

| Pin # | Name | Description | Pin # | Name | Description |
|-------|-------|--|-------|-------|--------------------|
| 1 | RF1 | RF port | 5 | GND | Ground |
| 2 | GND | Ground | 6 | VCTL2 | DC control voltage |
| 3 | VCTL1 | DC control voltage | 7 | GND | Ground |
| 4 | CBP | RF ground. Must be AC-coupled to ground. | 8 | RF2 | RF port |

Table 2. SKY12406-360LF Absolute Maximum Ratings

| Parameter | Symbol | Minimum | Maximum | Units |
|--|------------------|---------|------------|------------|
| RF input power: 3 V @ 50 MHz 3 V @ 600 MHz | P _{IN} | | +24 +27 | dBm dBm |
| Operating temperature | T _{OP} | -40 | +85 | °C |
| Storage temperature | T _{STG} | -65 | +150 | °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 SKY12406-360LF are provided in Table 2. Electrical specifications are provided in Table 3.

Typical performance characteristics of the SKY12406-360LF are illustrated in Figures 3 through 6.

The state of the SKY12406-360LF is determined by the logic provided in Table 4.

Table 3. SKY12406-360LF Electrical Specifications (Note 1)

($V_{CTL} = 0/3\text{ V}$, $T_{OP} = +25\text{ °C}$, $P_{IN} = 0\text{ dBm}$, Characteristic Impedance [Z_0] = $50\ \Omega$, Unless Otherwise Noted)

| Parameter | Symbol | Test Condition | Min | Typical | Max | Units |
|--|--------------|---|------------|------------|------|---------------|
| Insertion loss | IL | 50-600 MHz | | 0.3 | 0.4 | dB |
| Attenuation | Attn | 50-600 MHz | 11.6 | 12.0 | 12.4 | dB |
| Return loss | RL | 50-600 MHz | 15 | 20 | | dB |
| Switching characteristics: Rise/fall time | | 10/90% or 90/10% RF | | 7 | 35 | ns |
| On/off time | | 50% V_{CTL} to 90/10% RF | | 8 | 35 | ns |
| Input power for 0.1 dB compression | | @ 50 MHz @ 600 MHz | +18 +20 | +22 +25 | | dBm dBm |
| 3 rd Order Input Intercept Point | IIP3 | Two tone input power, +10 dBm/tone, 50 MHz, 1 MHz spacing | +42 | +46 | | dBm |
| | | Two tone input power, +10 dBm/tone, 600 MHz | +44 | +50 | | dBm |
| Control voltage: Low | V_{CTL_L} | | 0 | | 0.2 | V |
| High | V_{CTL_H} | | 2.7 | | 3.3 | V |
| Control current | I_{CC} | | | 10 | 50 | μA |

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

Typical Performance Characteristics

($V_{CTL} = 3\text{ V}$, $T_{OP} = +25\text{ °C}$, $P_{IN} = 0\text{ dBm}$, Characteristic Impedance [Z_0] = $50\ \Omega$, $CBP = 560\text{ pF}$, Blocking Capacitor = 560 pF Unless Otherwise Noted)

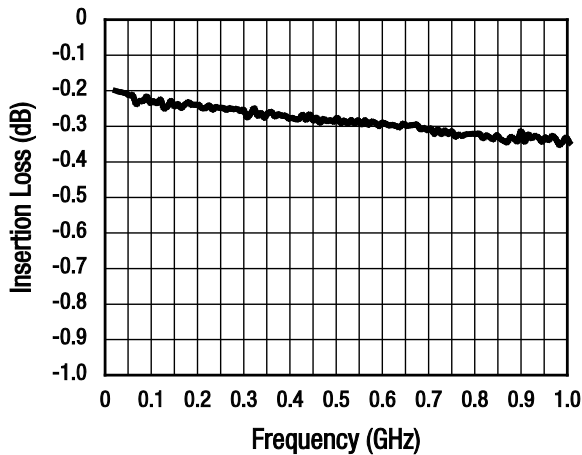


Figure 3. Typical Insertion Loss

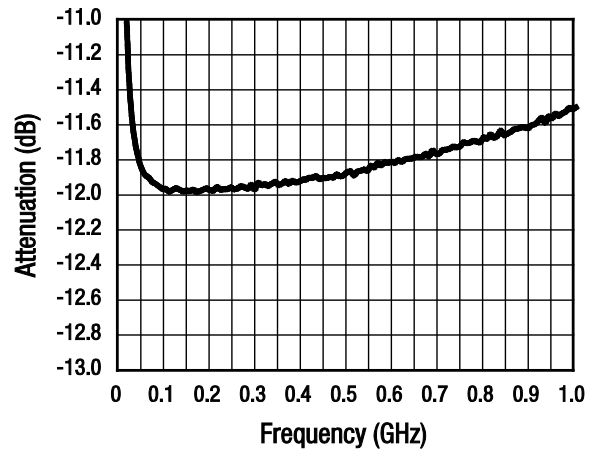


Figure 4. Typical Attenuation

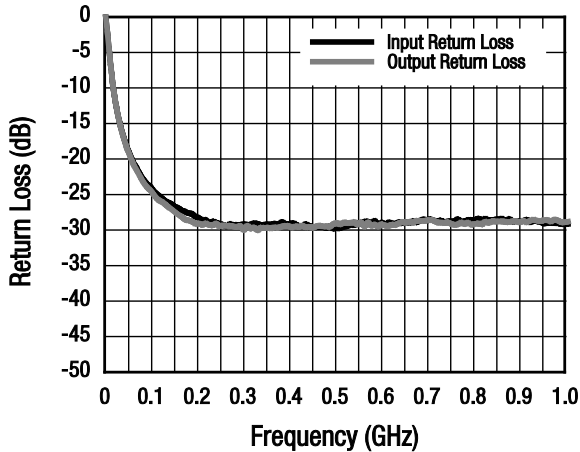


Figure 5. Typical Return Loss (Insertion Loss State)

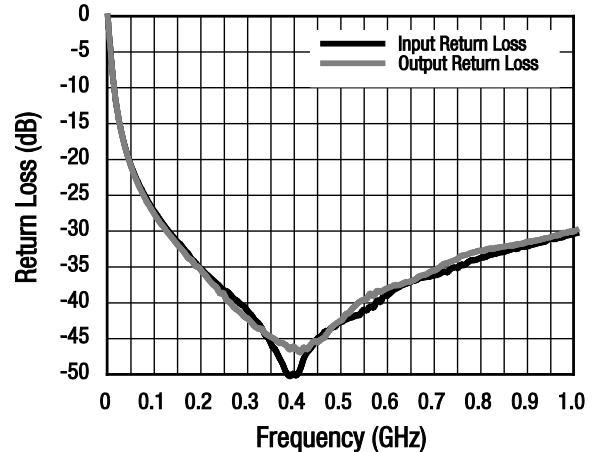


Figure 6. Typical Return Loss (Attenuation State)

Table 4. SKY12406-360LF Truth Table

| VCTL1 (Pin 3) | VCTL2 (Pin 6) | RF1 to RF2 Path |
|---------------|---------------|-----------------|
| 1 | 0 | Insertion loss |
| 0 | 1 | Attenuation |

Note: "1" = +3 V. "0" = 0 V. Any state other than that described in this Table places the attenuator into an undefined state.

Evaluation Board Description

The SKY12406-360LF Evaluation Board is used to test the performance of the SKY12406-360LF Attenuator. An assembly drawing for the Evaluation Board is shown in Figure 7.

DC blocks are required on RF1 (pin 1) and RF2 (pin 8). A blocking capacitor (CBLK) of 560 pF and a bypass capacitor (CBP) of 560 pF are required for 50 MHz operation.

Package Dimensions

The PCB layout footprint for the SKY12406-360LF is provided in Figure 8. Typical case markings are shown in Figure 9. Package dimensions for the 8-pin QFN are shown in Figure 10, and tape and reel dimensions are provided in Figure 11.

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 SKY12406-360LF 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.

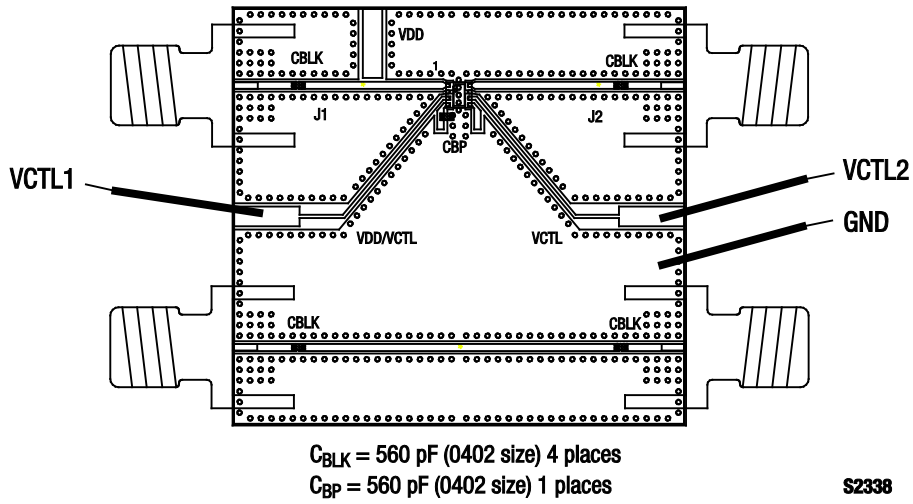


Figure 7. SKY12406-360LF Evaluation Board Assembly Diagram

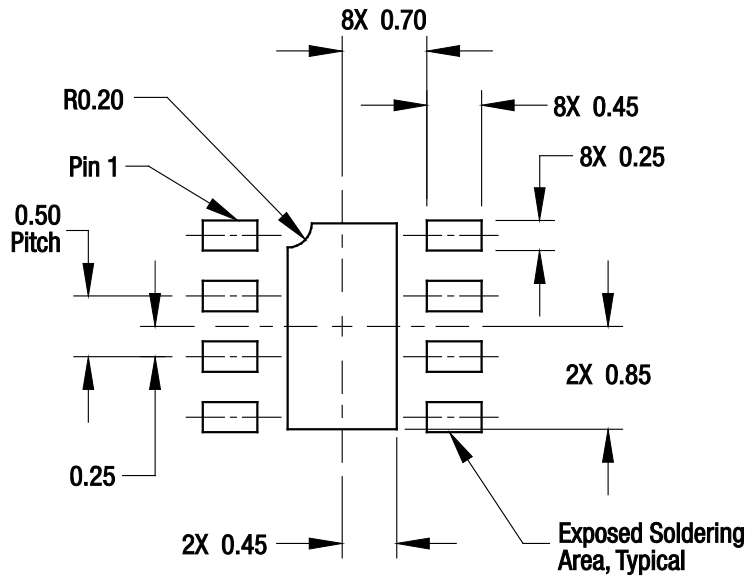


Figure 8. SKY12406-360LF PCB Layout Footprint

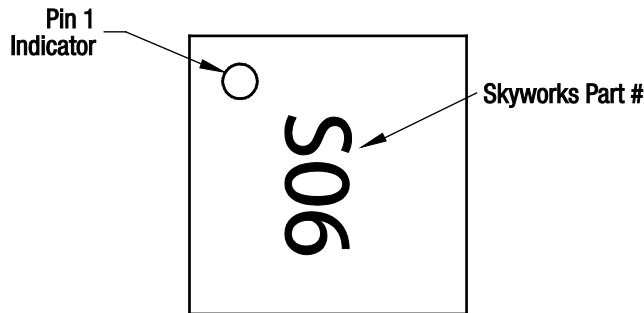
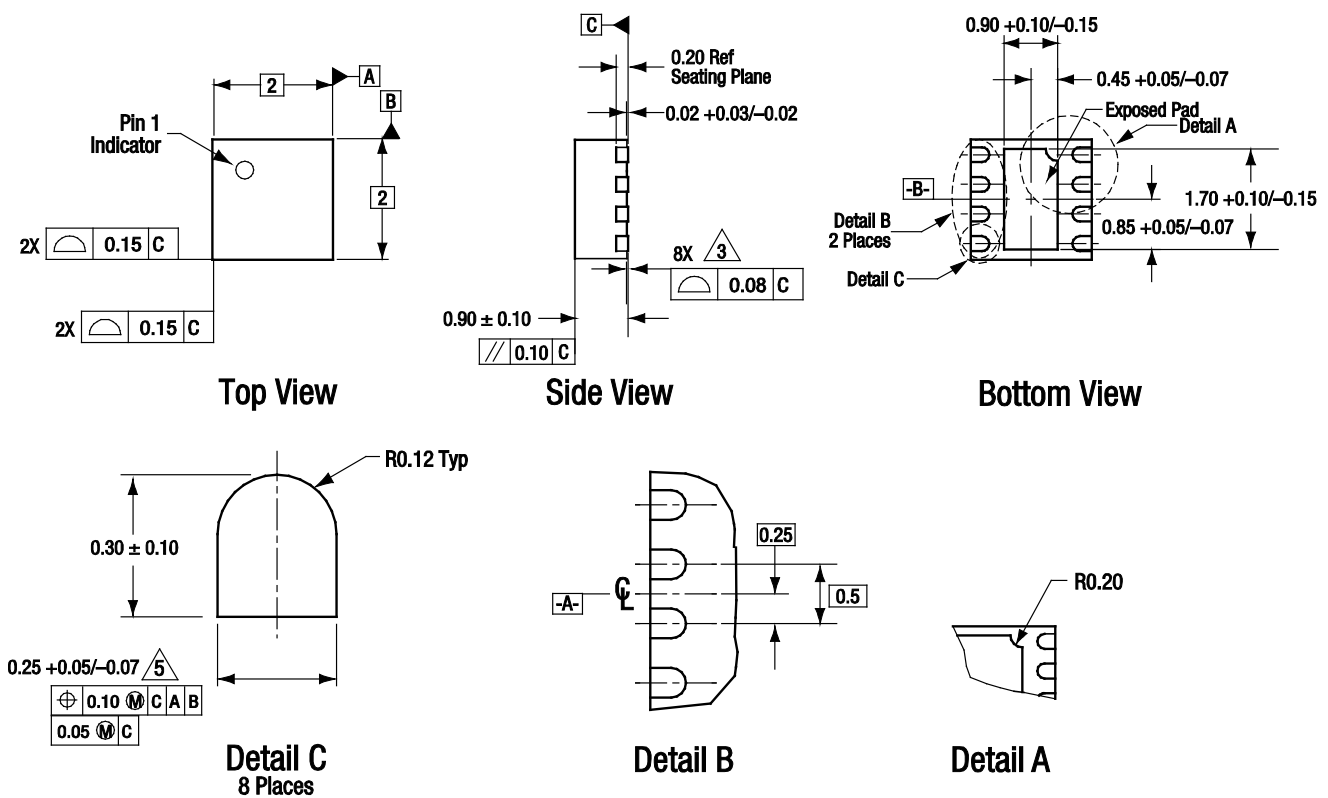


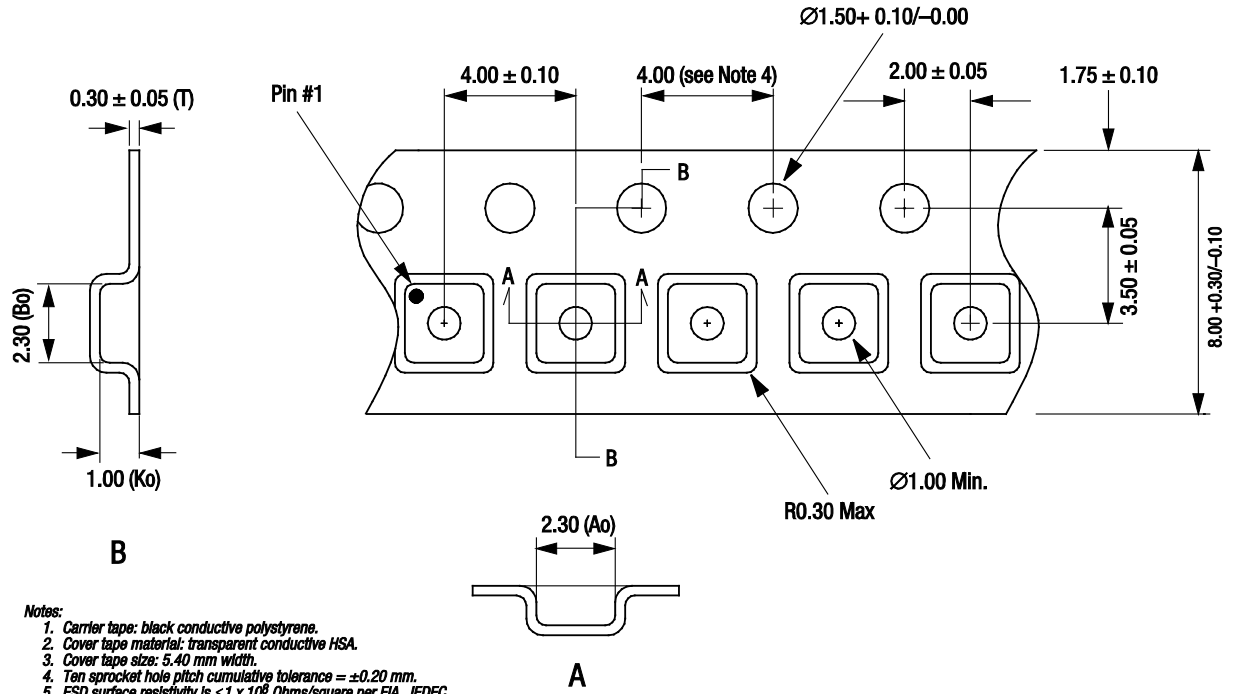
Figure 9. Typical Case Markings (Top View)



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.
 Plating requirement per source control drawing (SCD) 2504.
 Dimension applies to metalized terminal and is measured between 0.15 mm and 0.30 mm from terminal tip.

S1415

Figure 10. SKY12406-360LF 8-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 $\leq 1 \times 10^9$ 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 11. SKY12406-360LF Tape and Reel Dimensions

Ordering Information

| Model Name | Manufacturing Part Number | Evaluation Board Part Number |
|---|---------------------------|------------------------------|
| SKY12406-360LF One-Bit Digital Attenuator | SKY12406-360LF | SKY12406-360LF-EVB |

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