

SKY73010: 300 – 2500 MHz Direct Quadrature Modulator

Applications

- QPSK/GMSK/QAM/DQPSK modulators
- Single-sideband modulators
- Image reject mixers
- CDMA base stations
- GSM/EDGE, TDMA/TDMA-EDGE, and Trans-European Trunked Radio (TETRA) base stations
- First upconverter in dual conversion receivers

Features

- Broad RF and LO frequency range: 300 to 2500 MHz
- Carrier suppression greater than 35 dBc
- Sideband suppression greater than 45 dBc
- Modulation bandwidth DC to 250 MHz
- Noise floor less than -153 dBm/Hz
- Broadband LO/RF flatness
- RFLGA™ (16-pin, 4 x 4 mm) Pb-free package (MSL3, 260 °C per JEDEC J-STD-020)

Description

The SKY73010 is an integrated quadrature modulator for direct modulation of high frequency Amplitude Modulated (AM), Phase Modulated (PM), or compound carriers. A SiGe Bipolar Complementary Metal Oxide Semiconductor (BiCMOS) process is used to offer excellent linearity, noise floor, and carrier suppression performance.

The device package and pinout for the 16-pin RF Land Grid Array (RFLGA) are shown in Figure 1. Figure 2 shows a functional block diagram for the SKY73010. Signal pin assignments and functional pin descriptions are provided in Table 1.



Skyworks offers this part as a lead (Pb)-free “environmentally friendly” package that is RoHS compliant (European Parliament for the Restriction of Hazardous Substances).

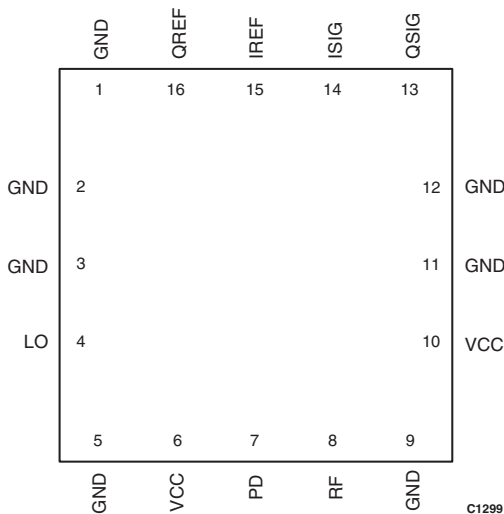


Figure 1. SKY73010 Pinout– 16-Pin RFLGA Package (Top View)

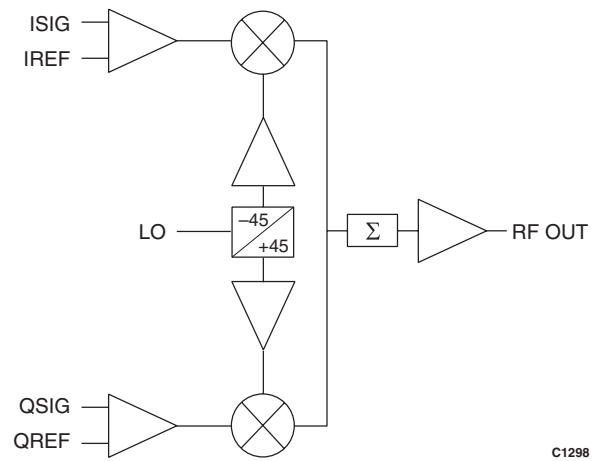


Figure 2. SKY73010 Functional Block Diagram

Table 1. SKY73010 Signal Descriptions

| Pin # | Name | Description | Pin # | Name | Description |
|-------|------|---------------|-------|------|---------------|
| 1 | GND | Ground | 9 | GND | Ground |
| 2 | GND | Ground | 10 | VCC | +5 VDC supply |
| 3 | GND | Ground | 11 | GND | Ground |
| 4 | LO | LO input | 12 | GND | Ground |
| 5 | GND | Ground | 13 | QSIG | Q input |
| 6 | VCC | +5 VDC supply | 14 | ISIG | I input |
| 7 | PD | Power down | 15 | IREF | I reference |
| 8 | RF | Ground | 16 | QREF | Q reference |

Circuit Design Considerations

The following design considerations are general in nature and must be followed regardless of final use or configuration.

1. Paths to ground should be made as short as possible.
2. The downset paddle of the SKY73010 direct quadrature modulator has special electrical and thermal grounding requirements. This pad is the main thermal conduit for heat dissipation. Since the circuit board acts as the heat sink, it must shunt as much heat as possible from the device. As such, design the connection to the ground pad to dissipate the maximum wattage produced to the circuit board. Multiple vias to the grounding layer are required.
3. Two external output bypass capacitors are required on the VCC pin. The values of these capacitors change with respect to the desired RF frequency. One capacitor should be used for low frequency bypassing and the other capacitor for high frequency bypassing. Special attention should be given so that the smaller value capacitor does not go into self-resonance at the desired RF frequency.

Testing Procedure

The following In-Phase and Quadrature (I/Q) input settings were used to measure the CDMA Adjacent Channel Power Reduction (ACPR):

- Pilot Channel Active
- Sync Channel Active
- Paging Channel Active
- Six Traffic Channels Active
- 32x oversampling
- Equifilter

Package and Handling Information

Since the device package is sensitive to moisture absorption, it is baked and vacuum packed before shipping. 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 SKY73010 is rated to Moisture Sensitivity Level 3 (MSL3) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *PCB Design & SMT Assembly/Rework Guidelines for RFLGA Packages*, document number 103147.

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. For packaging details, refer to the Skyworks Application Note, *Tape and Reel*, document number 101568.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY73010 are provided in Table 2. The recommended operating conditions are specified in Table 3 and electrical specifications are provided in Table 4.

Typical performance characteristics are shown in Figures 3 through 7. Figure 8 provides a typical evaluation board schematic. Package dimensions for the 16-pin RFLGA are shown in Figure 9, and tape and reel dimensions are shown in Figure 10.

Electrostatic Discharge (ESD) Sensitivity

The SKY73010 is a static-sensitive electronic device. Do not operate or store near strong electrostatic fields. Take proper ESD precautions.

Table 2. SKY73010 Absolute Maximum Ratings
($T_A = +25\text{ }^\circ\text{C}$, unless otherwise noted)

| Parameter | Symbol | Min | Typical | Max | Units |
|----------------------------|-------------------|-----|---------|------|-----------------|
| +3 V supply voltage | VCC | 4.5 | | 6.0 | V |
| Power dissipation | P _{DIS} | | | 750 | mW |
| LO input power | P _{LOIN} | | 0 | +6 | dBm |
| IF input voltage | | | | 1.5 | V _{pp} |
| Thermal resistance | R _{TH} | | 44 | | °C/W |
| Operating case temperature | T _{OPR} | -40 | | +85 | °C |
| Storage case temperature | T _{STG} | -40 | | +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 values.

Table 3. SKY73010 Recommended Operating Conditions

| Parameter | Symbol | Min | Typical | Max | Units |
|----------------------------|------------------|-----|---------|-----|-------|
| +5 V supply voltage | VCC | 4.5 | 5.0 | 5.5 | V |
| Current consumption | I _{CC} | | 90 | 110 | mA |
| Operating case temperature | T _{OPR} | -40 | | +85 | °C |

Table 4. SKY73010 Electrical Characteristics (1 of 2)
(VCC = 5 V, IF = 2 MHz, LO input power = -3 dBm, Tc = 25 °C, unless otherwise noted)

| Parameter | Symbol | Test Conditions | Min | Typical | Max | Units |
|-----------------------------------|--------|---|-----|---------|------|--------|
| Local Oscillator | | | | | | |
| Input frequency range | | | 300 | | 2500 | MHz |
| Input power level | | | -3 | | +3 | dBm |
| Input impedance | | | | 2.0:1 | | VSWR |
| I/Q Signal Reference Input | | | | | | |
| Input frequency range | | | DC | | 250 | MHz |
| Reference voltage | | | 3.6 | 4.1 | | V |
| RF Output (400 MHz) | | | | | | |
| Output -1 dB compression point | | | | 3 | | dBm |
| CDMA output channel power | | | | -12 | | dBm |
| CDMA ACPR | | CDMA RF output power = -12 dBm | | 73 | | dBc |
| Optimized carrier suppression | | Optimized I/Q DC offsets | 50 | | | dBc |
| Carrier suppression | | | 28 | 35 | | dBc |
| Sideband suppression | | | 30 | 35 | | dBc |
| Optimized sideband suppression | | Optimized I/Q phase and amplitude balance | 50 | | | dBc |
| Broadband noise floor | | @ 20 MHz offset from carrier | | -152 | -150 | dBm/Hz |
| Output impedance | | | | 2.0:1 | | Ω |

Table 4. SKY73010 Electrical Characteristics (2 of 2)
(VCC = 5 V, IF = 2 MHz, LO input power = -3 dBm, Tc = 25 °C, unless otherwise noted)

| Parameter | Symbol | Test Conditions | Min | Typical | Max | Units |
|--------------------------------|--------|---|------|---------|------|--------|
| RF Output (900 MHz) | | | | | | |
| Output -1 dB compression point | | | -1.5 | +1.5 | | dBm |
| CDMA output channel power | | | | -12 | | dBm |
| CDMA ACPR | | CDMA RF output power = -12 dBm | | 72 | | dBc |
| Optimized carrier suppression | | Optimized I/Q DC offsets | 50 | | | dBc |
| Carrier suppression | | | 24 | 35 | | dBc |
| Sideband suppression | | | 32 | 45 | | dBc |
| Optimized sideband suppression | | Optimized I/Q phase and amplitude balance | 50 | | | dBc |
| Broadband noise floor | | @ 20 MHz offset from carrier | | -153 | -150 | dBm/Hz |
| Output impedance | | | | 2.0:1 | | Ω |
| RF Output (1900 MHz) | | | | | | |
| Output -1 dB compression point | | | -6.0 | -3.5 | | dBm |
| CDMA output channel power | | | | -18 | | dBm |
| CDMA ACPR | | CDMA RF output power = -18 dBm | | 70 | | dBc |
| Optimized carrier suppression | | Optimized I/Q DC offsets | | 50 | | dBc |
| Carrier suppression | | | 20 | 28 | | dBc |
| Sideband suppression | | | 28 | 40 | | dBc |
| Optimized sideband suppression | | Optimized I/Q phase and amplitude balance | | 50 | | dBc |
| Broadband noise floor | | @ 20 MHz offset from carrier | | -155 | -152 | dBm/Hz |
| Output impedance | | | | 2.0:1 | | Ω |

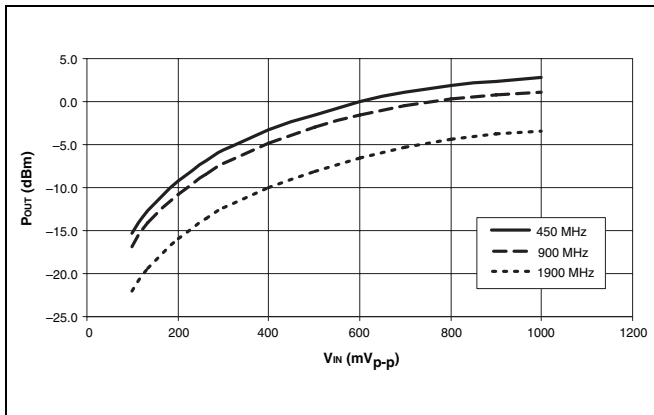


Figure 3. Continuous Wave (CW) Intermediate Frequency (IF) Input Voltage vs Output Power

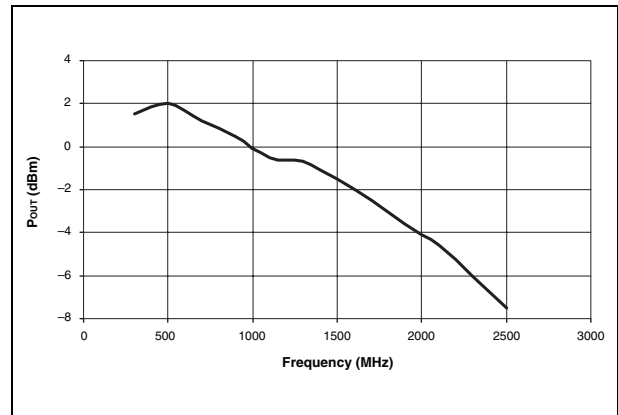


Figure 4. Output 1 dB Compression Points vs RF Frequency

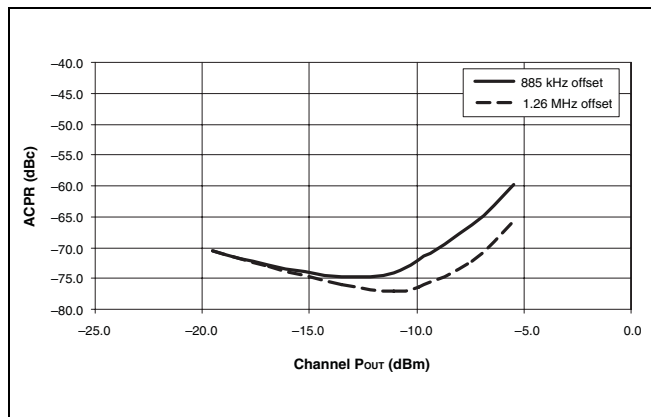


Figure 5. 450 MHz CDMA ACPR vs Channel Output Power

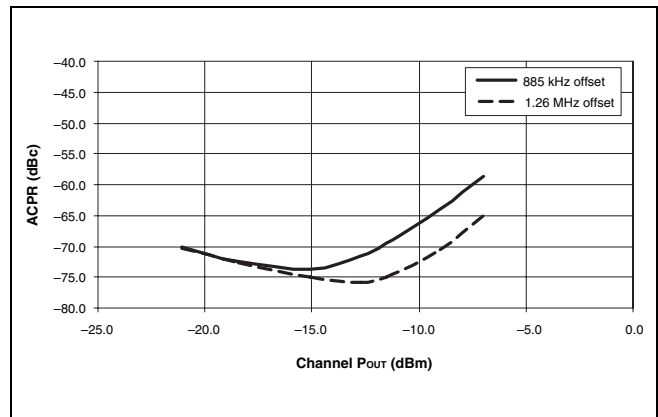


Figure 6. 900 MHz CDMA ACPR vs Channel Output Power

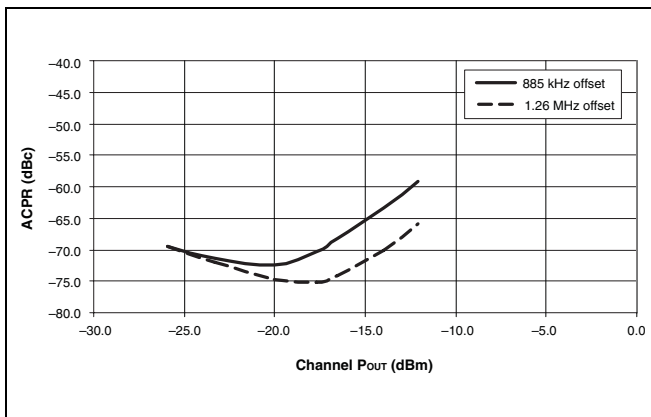


Figure 7. 1900 MHz CDMA ACPR vs Channel Output Power

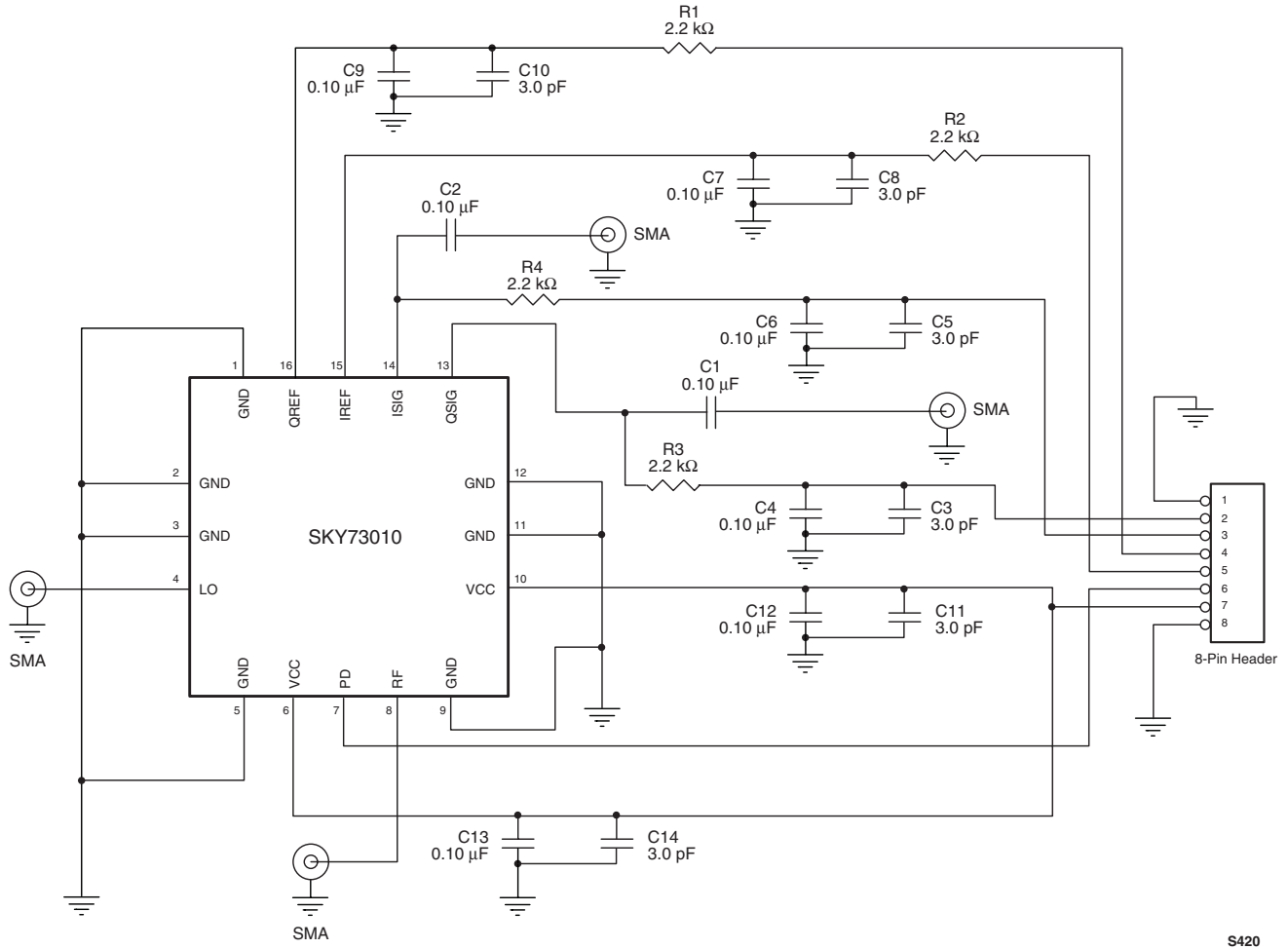


Figure 8. SKY73010 Evaluation Board Schematic

S420

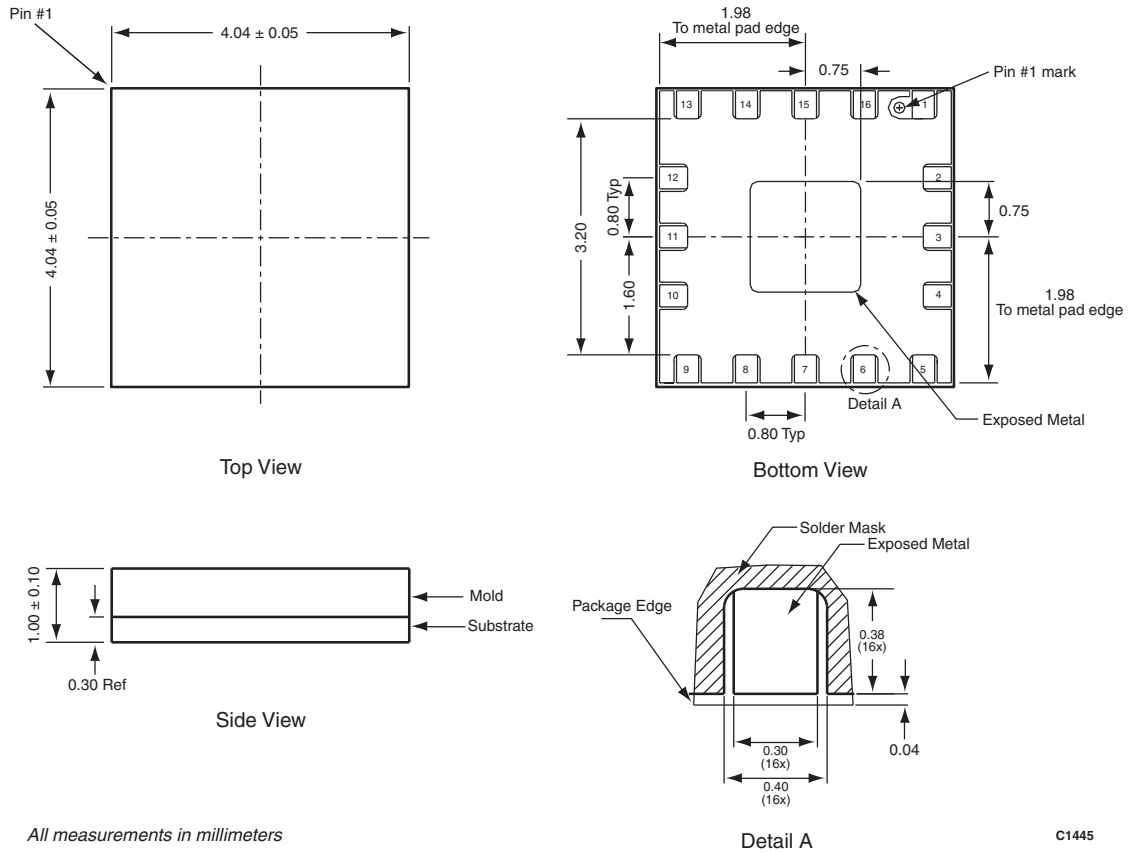


Figure 9. SKY73010 16-Pin RFLGA Package Dimensions

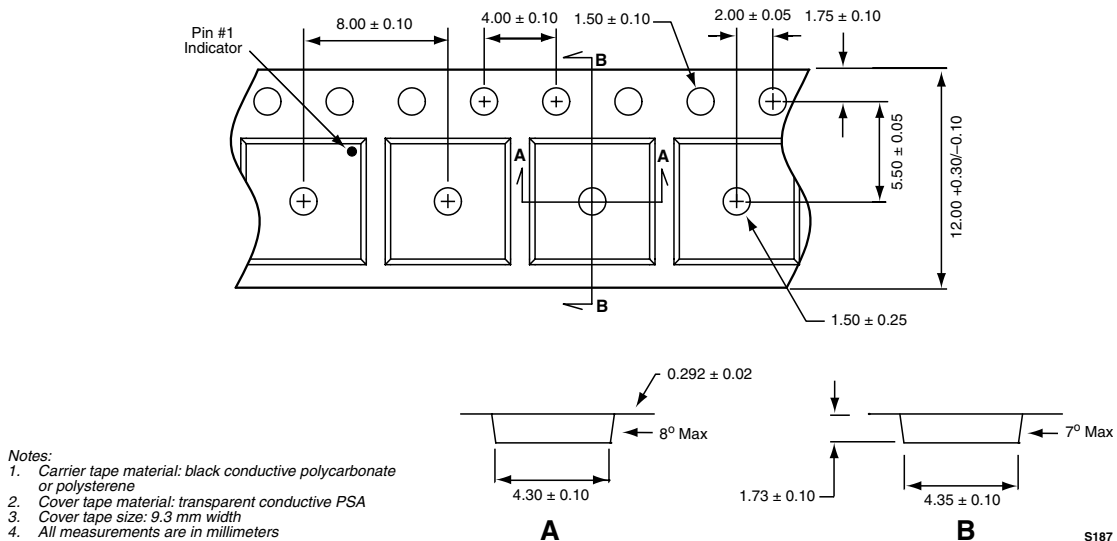


Figure 10. SKY73010 16-Pin RFLGA Tape and Reel Dimensions

Ordering Information

| Model Name | Manufacturing Part Number | Evaluation Kit Part Number |
|---|---------------------------|----------------------------|
| SKY73010 300-2500 MHz Direct Quadrature Modulator | SKY73010-11 | TW12-D692 |

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