

DATA SHEET

SKY66113-11: 2.4 GHz Bluetooth® Low Energy/802.15.4/Thread/ZigBee® Front-End Module

Applications

- In-home appliances
- Smart thermostats
- Sensors
- Beacons
- Gateways
- Wearable devices

Features

- Integrated LNA with 12 dB gain
- Integrated switch with receive LNA and transmit bypass function
- Low noise figure: 2 dB typical
- Single-ended transmit/receive interface
- Fast switch on/off time: < 2 μ s
- Supply range: 1.7 V to 3.6 V
- Sleep mode current: < 1 μ A typical
- No external bias resistor is required
- Small MCM (16-pin, 2.4 × 2.4 × 0.8 mm) package, NiPdAu-plated (MSL3, 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.

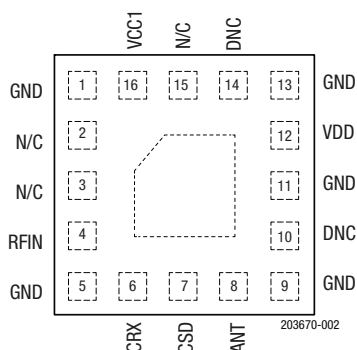


Figure 2. SKY66113-11 Pinout (Top View)

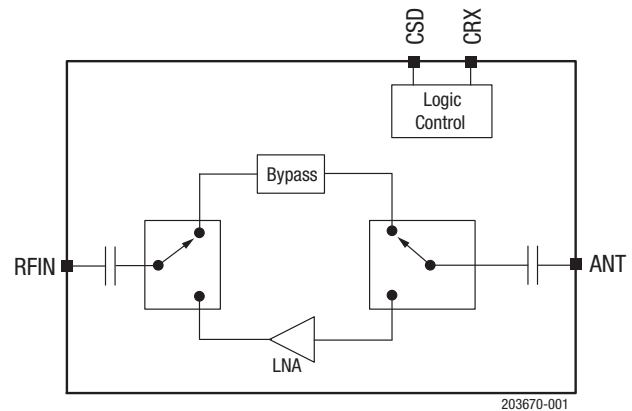


Figure 1. SKY66113-11 Block Diagram

Description

The SKY66113-11 is a high-performance, fully integrated RF front-end module (FEM) designed for Bluetooth Low Energy/Bluetooth Smart, 802.15.4, Thread, and ZigBee applications.

The SKY66113-11 is designed for ease of use and maximum flexibility. The device integrates a high-gain, low-noise LNA, transmit bypass path, and digital controls compatible with 1.6 V to 3.6 V CMOS levels.

The RF blocks operate over a wide supply voltage range from 1.7 V to 3.6 V that allows the SKY66113-11 to be used in battery powered applications over a wide spectrum of the battery discharge curve.

A functional block diagram is shown in Figure 1. The SKY66113-11 is provided in a small, 16-pin, 2.4 × 2.4 mm Multi-Chip Module (MCM) package. The pin configuration and package are shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.

Table 1. SKY66113-11 Signal Descriptions¹

| Pin | Name | Description | Pin | Name | Description |
|-----|------|---|-----|------|----------------------------|
| 1 | GND | Ground | 9 | GND | Ground |
| 2 | N/C | Not connected internally | 10 | DNC | Do not connect |
| 3 | N/C | Not connected internally | 11 | GND | Ground |
| 4 | RFIN | RF input power | 12 | VDD | Connect to positive supply |
| 5 | GND | Ground | 13 | GND | Ground |
| 6 | CRX | Connect to GPIO signal for mode control | 14 | DNC | Do not connect |
| 7 | CSD | Connect to GPIO signal for mode control | 15 | N/C | Not connected internally |
| 8 | ANT | Connect to 50 Ω antenna | 16 | VCC1 | Connect to positive supply |

¹ The paddle should be connected to ground.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY66113-11 are provided in Table 2. The recommended operating conditions are specified in Table 3.

Electrical specifications are provided in Tables 4 and 5. The state of the SKY66113-11 is determined by the logic provided in Table 6.

Table 2. SKY66113-11 Absolute Maximum Ratings¹

| Parameter | Symbol | Minimum | Maximum | Units |
|--|-------------|---------|---------|-------|
| Supply voltage | VCC1 | −0.3 | +3.6 | V |
| | VDD | −0.3 | +3.6 | V |
| Control pin voltages | VCTL | −0.3 | +3.6 | V |
| Input power at RFIN port | PIN_TR_MAX | | +20 | dBm |
| Receive input power at ANT port | PIN_RX_MAX | | +15 | dBm |
| Bypass input power at ANT port | PIN_BYP_MAX | | +20 | dBm |
| Operating temperature | TA | −40 | +85 | °C |
| Storage temperature | TSTG | −40 | +85 | °C |
| Electrostatic discharge: Human Body Model (HBM), Class 1C | ESD | | 1500 | V |

¹ Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.

ESD HANDLING: 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 when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.

Table 3. Recommended Operating Conditions

| Parameter | Symbol | Min | Typ | Max | Units |
|----------------------------|--------|-----|-----|-----|-------|
| Supply voltage on VCC1 pin | VCC1 | 1.7 | 3.0 | 3.6 | V |
| Supply voltage on VDD pin | VDD | 1.7 | 3.0 | 3.6 | V |
| Operating temperature | TA | −40 | +25 | +85 | °C |

Table 4. SKY66113-11 Electrical Specifications¹
(V_{CC1} = V_{DD} = 3.0 V, T_A = +25 °C, Unless Otherwise Noted)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Units |
|----------------------------------|------------------------------------|----------------|----------|-----|------------------------|----------|
| DC Characteristics | | | | | | |
| Total Rx mode supply current | ICC_RX | | | 4 | 6 | mA |
| Total bypass mode supply current | ICC_BYP | | | 25 | | μA |
| Total sleep mode supply current | ICC_OFF | No RF | | | 1 | μA |
| Logic Characteristics | | | | | | |
| Control voltage: High Low | V _{IH} V _{IL} | | 1.6 0 | | V _{DD} 0.3 | V V |
| Control current: High Low | I _{IH} I _{IL} | | | | 1.0 1.0 | μA μA |

¹ Performance is guaranteed only under the conditions listed in this table.

Table 5. SKY66113-11 Electrical Specifications¹
(V_{CC1} = 1.8 or 3.0 V, V_{DD} = 3.0 V, T_A = +25 °C, All Unused Ports Terminated with 50 Ω, Unless Otherwise Noted)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Units |
|-----------------------------------|-------------------|--|------|------|------|-------|
| Receive Characteristics | | | | | | |
| Frequency range | f | | 2400 | | 2483 | MHz |
| Receive gain | Gain_RX | | | 12 | | dB |
| Receive noise figure | NF | | | 2 | | dB |
| Third order input intercept point | IIP3 | | | 0 | | dBm |
| 1 dB input compression point | IP1dB | | −12 | −8 | | dBm |
| Input return loss | S11 | ANT1 or ANT2 ports | | −10 | | dB |
| Output return loss | S22 | | | −10 | | dB |
| Turn-on time | t _{RISE} | From 50% of CRX edge to 90% of final RF output power | | 0.8 | 2 | μs |
| Turn-off time | t _{FALL} | From 50% of CRX edge to 10% of final RF output power | | 0.8 | 2 | μs |
| Bypass Characteristics | | | | | | |
| Frequency range | f | | 2400 | | 2483 | MHz |
| Bypass gain | Gain_BYP | | | −1.5 | | dB |
| Input return loss | S11 | | | −10 | | dB |
| Output return loss | S22 | | | −10 | | dB |

¹ Performance is guaranteed only under the conditions listed in this table.

Table 6. SKY66113-11 Mode Control Logic¹

| Mode | Description | CSD (Pin 7) | CRX (Pin 6) |
|------|-------------------------------|-------------|-------------|
| 0 | All off (sleep mode) (Note 1) | 0 | |
| 1 | Receive LNA mode | 1 | 1 |
| 2 | Transmit bypass mode | 1 | 0 |

¹ All controls must be at logic "0" to achieve the specified sleep current.

Application Schematic Description

A reference design schematic is provided in Figure 3. An Evaluation Board schematic diagram is shown in Figure 4. A photograph of the Evaluation Board is shown in Figure 5. Table 7 provides the Bill of Materials (BOM) list for Evaluation Board components.

Package Dimensions

The PCB layout footprint for the SKY66113-11 is provided in Figure 6. The typical part marking is shown in Figure 7. Package dimensions are shown in Figure 8, and tape and reel dimensions are provided in Figure 9.

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 SKY66113-11 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 and SMT Assembly/Rework Guidelines for MCM-L Packages*, document number 101752.

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.

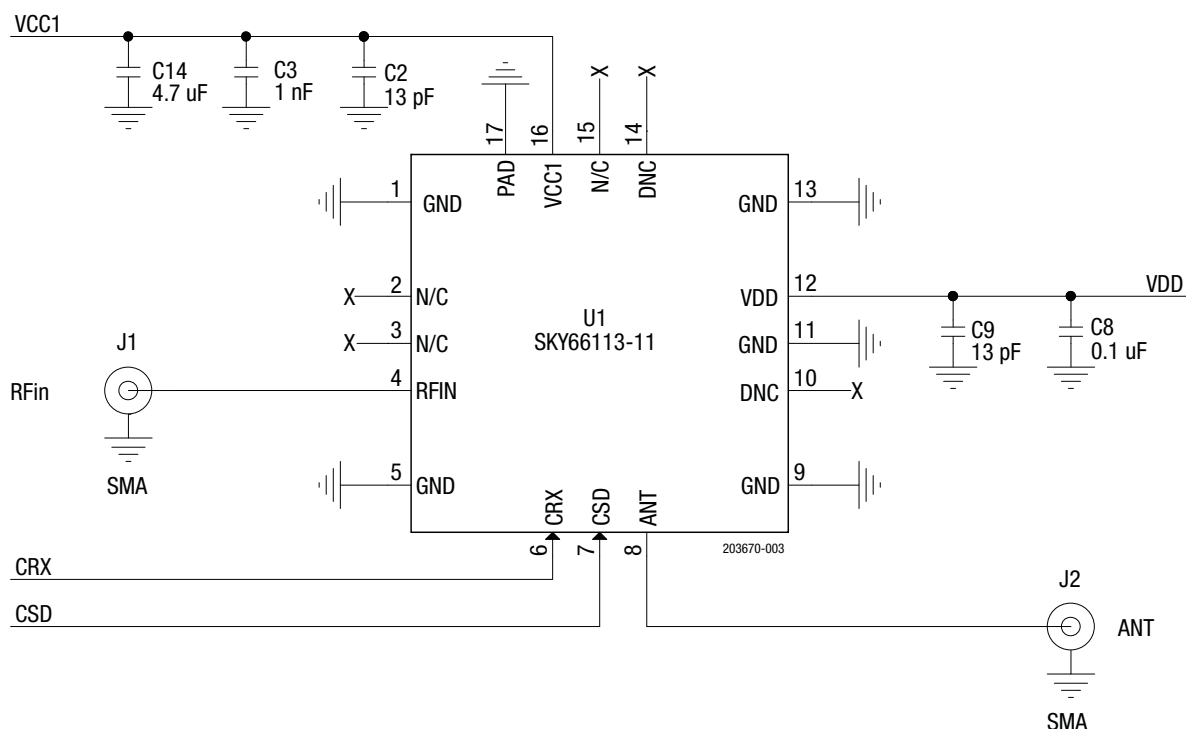


Figure 3. SKY66113-11 Reference Design Schematic

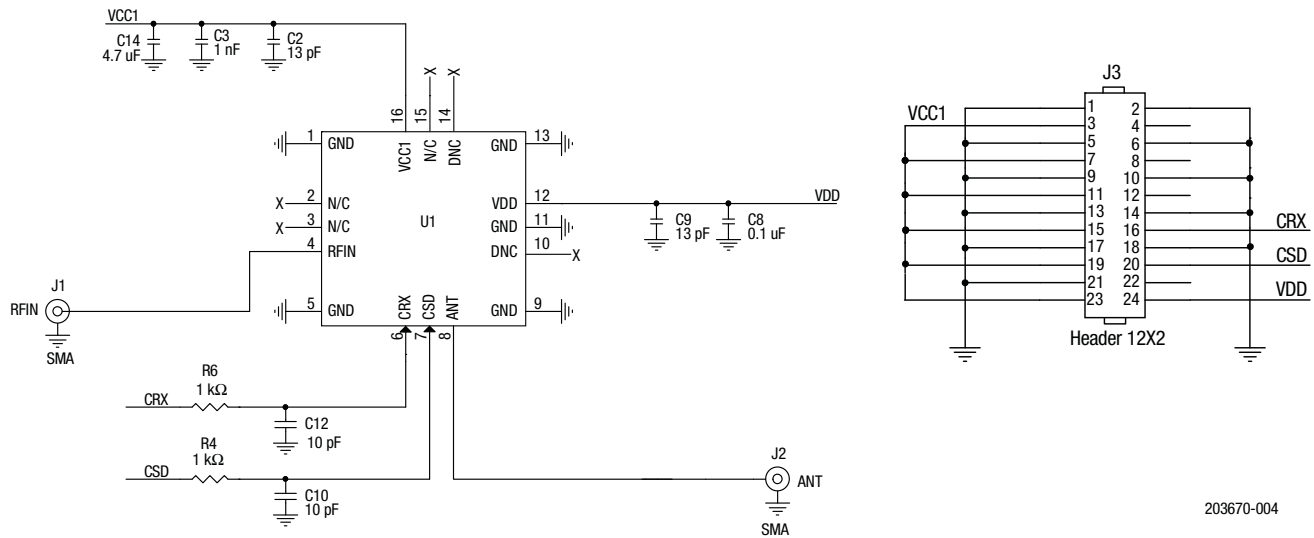


Figure 4. SKY66113-11 Evaluation Board Schematic Diagram

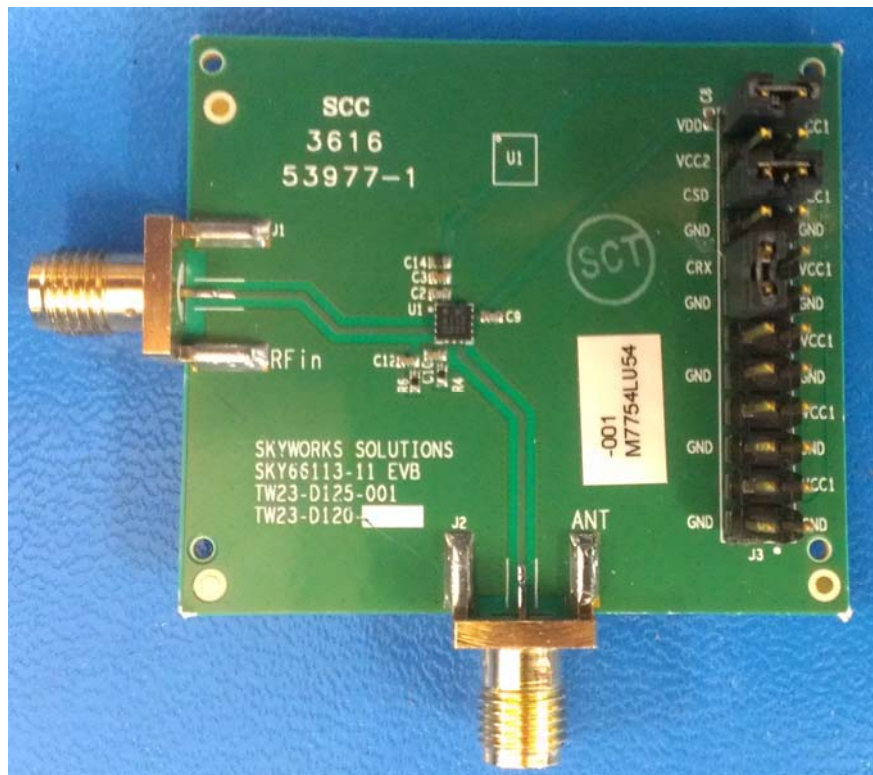
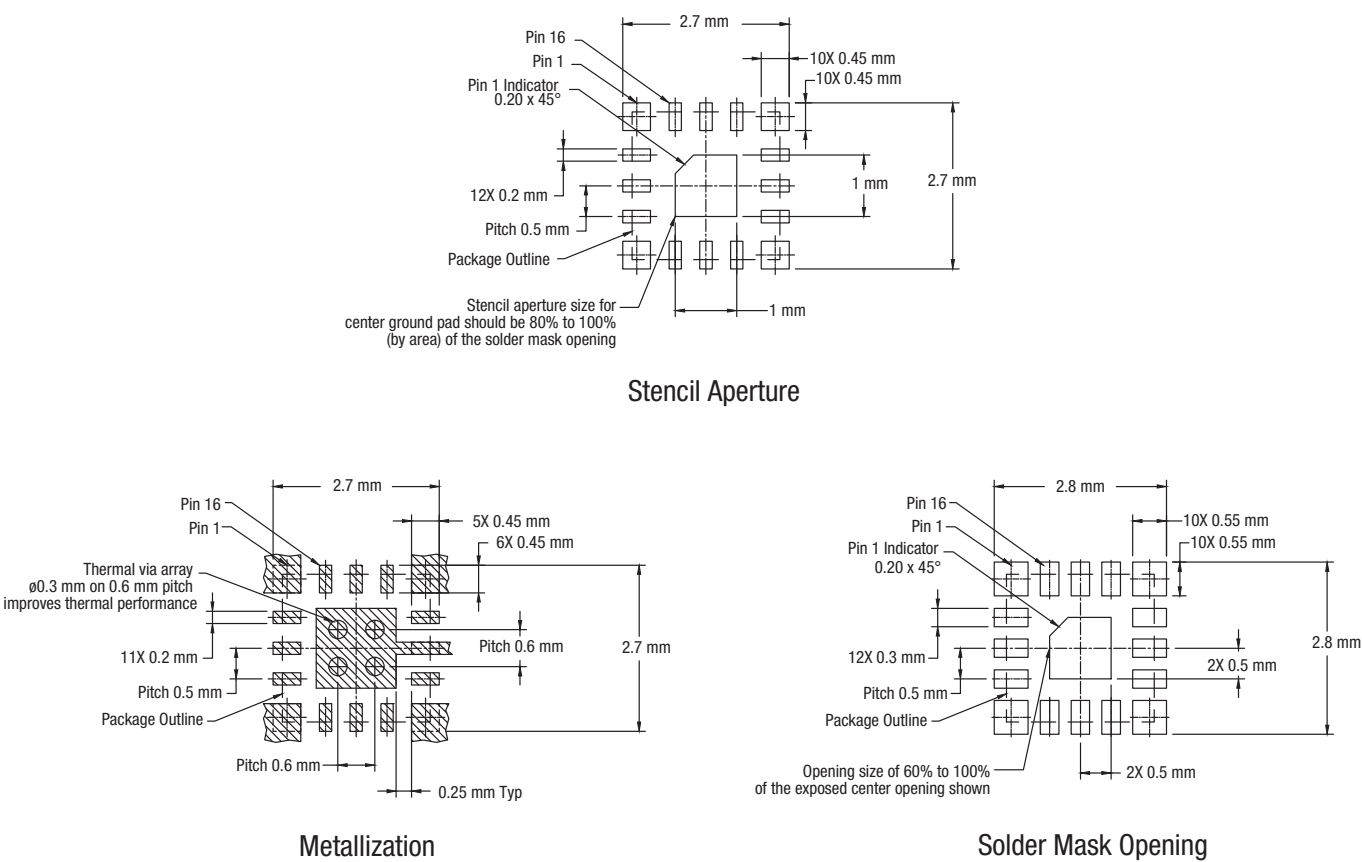


Figure 5. SKY66113-11 Evaluation Board

Table 7. SKY66113-11 Evaluation Board Bill of Materials (BOM)

| Component | Value | Manufacturer | Mfr Part Number | Package | Description |
|-----------|--------|--------------------|--------------------|------------|--|
| C2, C9 | 13 pF | Murata | GRM1555C1H130JA01D | 0402 | Ceramic capacitor, 13 pF, 5%, C0G, 50 V, 0402 |
| C3 | 1 nF | Various | Various | 0402 | Ceramic capacitor, 1000 pF, 10%, X7R, 50 V, 0402 |
| C8 | 0.1 uF | Various | Various | 0402 | Ceramic capacitor, 0.1 uF, 10%, X7R, 16 V, 0402 |
| C10, C12 | 10 pF | Various | Various | 0402 | Ceramic capacitor, 10 pF, 2%, C0G, 50 V, 0402 |
| C14 | 4.7 uF | Various | Various | 0402 | Ceramic capacitor, 4.7 uF, 20%, X5R, 10 V, 0402 |
| R6 R4 | 1 kΩ | Various | Various | 0402 | Resistor, 1000 ohm, 5%, 0.063 W, 0402 |
| J1 J2 | | Johnson Components | 142-0701-851 | End launch | SMA end launch straight jack receptacle |
| J3 | | Samtec | TSW-112-07-G-D | 100 mil | 100 mil header |



Notes:

- 1. All dimensions are in millimeters, unless otherwise specified.
- 2. Thermal vias should be resin filled and capped in accordance with IPC-4761 Type VII vias. Recommended Cu thickness is 30 to 35 µm.

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Figure 6. SKY66113-11 PCB Layout Footprint

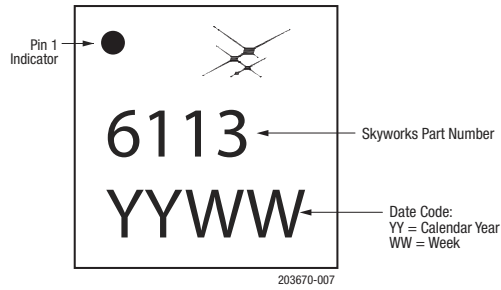
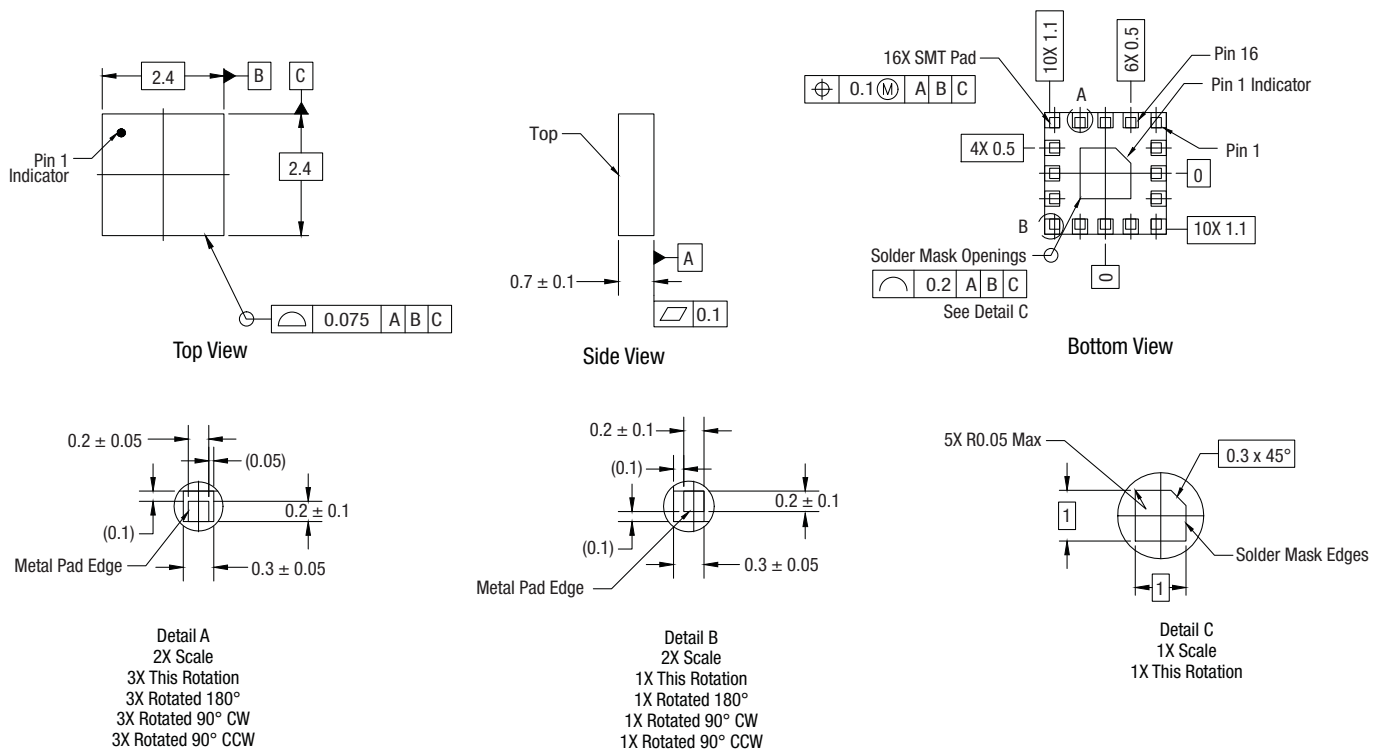


Figure 7. SKY66113-11 Typical Part Marking (Top View)

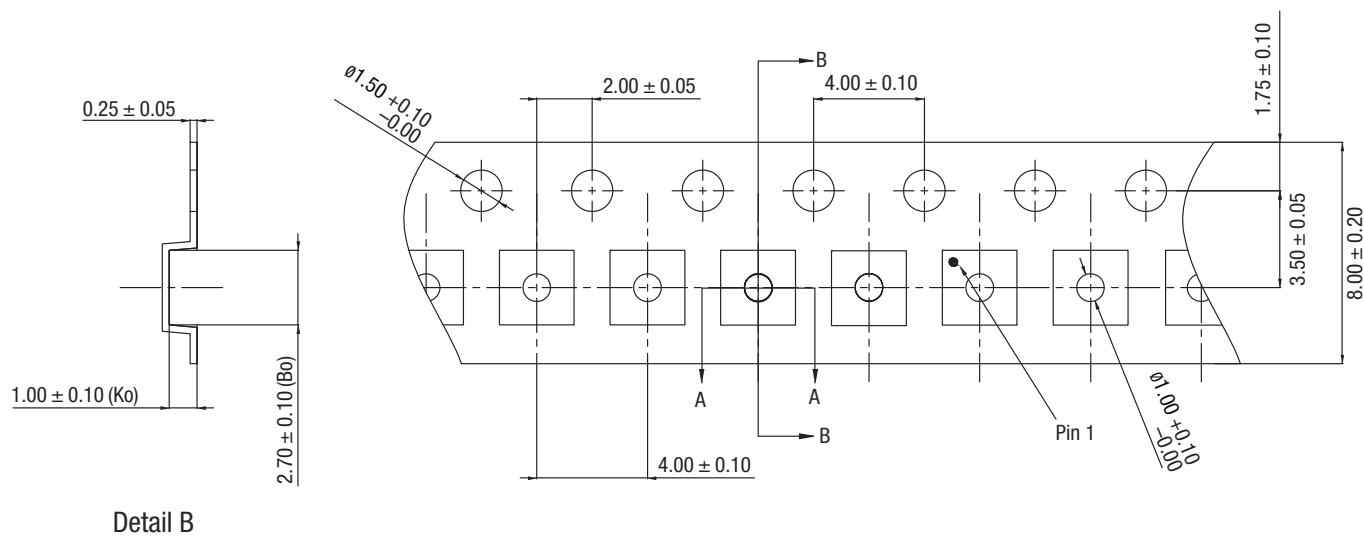


Notes:

1. All measurements are in millimeters.
2. Dimensions and tolerances according to ASME Y14.5M-1994.

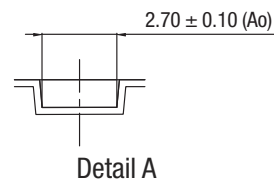
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Figure 8. SKY66113-11 Package Dimensions



Notes:

1. Carrier tape must meet all requirements of Skyworks GP01-D232.
procurement spec for tape and reel shipping.
2. Carrier tape shall be black conductive polystyrene.
3. Cover tape shall be transparent conductive material.
4. ESD-surface resistivity shall meet Skyworks GP01-D232.
5. 10-sprocket hole pitch cumulative tolerance: ± 0.20 mm.
6. Ao and Bo measured on plane 0.30 mm above the bottom of the pocket.
7. All measurements are in millimeters.



203670-009

Figure 9. SKY66113-11 Tape and Reel Dimensions

Ordering Information

| Model Name | T | Evaluation Board Part Number |
|--|-------------|------------------------------|
| SKY66113-11: 2.4 GHz Bluetooth Low Energy/802.15.4/Thread/ZigBee FEM | SKY66113-11 | SKY66113-11EK1 |

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