

**DATA SHEET**

# SKY65623-682LF: GPS/GLONASS/Galileo/Compass Low-Noise Amplifier

## Applications

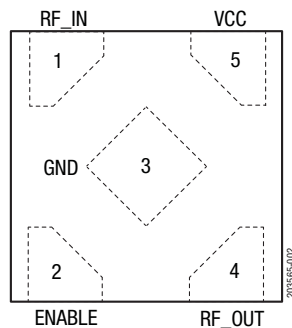
- GPS/GLONASS/Galileo/Compass radio receivers
- Smartwatches
- Personal asset trackers
- Action cameras
- Personal navigation devices

## Features

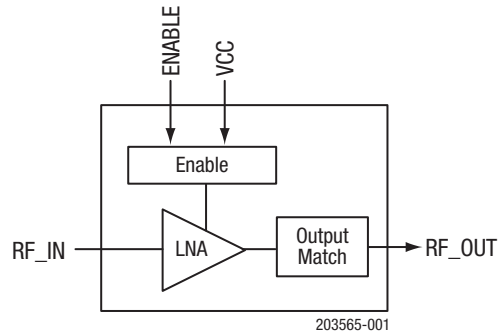
- Small signal gain: 16.5 dB typical
- Low noise figure: 0.85 dB typical
- Out-of-band IIP3: -11.5 dBm typical
- Low current consumption: 1 mA typical
- Low shutdown current: 0.1  $\mu$ A typical
- Output impedance internally matched to 50  $\Omega$
- Single external input matching inductor
- Single DC supply: 1.5 to 3.6 V
- Minimal number of external components required
- Small QFN (5-pin, 0.8  $\times$  0.8 mm) package (MSL1, 260  $^{\circ}$ C per JEDEC J-STD-020)



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**Figure 2. SKY65623-682LF Pinout (Top View)**



**Figure 1. SKY65623-682LF Block Diagram**

## Description

The SKY65623-682LF is a Microwave Monolithic Integrated Circuit (MMIC) front-end low-noise amplifier (LNA) designed for Global Navigation Satellite System (GNSS) radio receiver applications. The device provides low current consumption, excellent gain, and a superior noise figure (NF). Output matching components are embedded inside the device. Only one external input matching inductor is required.

The SKY65623-682LF is optimized to operate at 1559 to 1606 MHz, which makes it ideal for GPS/GLONASS/Galileo/Compass radio receiver applications.

The SKY65623-682LF is fabricated using advanced SiGe BiCMOS technology. The LNA uses surface-mount technology (SMT) in the form of a 0.8  $\times$  0.8 mm Quad Flat No-Lead (QFN) package, which allows for a highly manufacturable and low-cost solution.

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.

**Table 1. SKY65623-682LF Signal Descriptions**

| Pin | Name   | Description | Pin | Name   | Description    |
|-----|--------|-------------|-----|--------|----------------|
| 1   | RF_IN  | RF input    | 4   | RF_OUT | RF output      |
| 2   | ENABLE | LNA enable  | 5   | VCC    | Supply voltage |
| 3   | GND    | Ground      |     |        |                |

**Technical Description**

The ENABLE signal (pin 2) enables or disables the LNA DC power. A logic high signal powers on the LNA and a logic low signal powers off the device.

**Electrical and Mechanical Specifications**

The absolute maximum ratings of the SKY65623-682LF are provided in Table 2. The recommended operating conditions are specified in Table 3, and electrical specifications are provided in Tables 4 and 5.

**Table 2. SKY65623-682LF Absolute Maximum Ratings<sup>1</sup>**

| Parameter                            | Symbol | Minimum | Maximum | Units |
|--------------------------------------|--------|---------|---------|-------|
| RF input power                       | Pin    |         | 0       | dBm   |
| Supply voltage                       | Vcc    | 0       | 4.5     | V     |
| Enable voltage                       | VEN    | 0       | 3.6     | V     |
| Storage temperature                  | TSTG   | -55     | +125    | °C    |
| Junction temperature                 | TJ     |         | +125    | °C    |
| Electrostatic discharge:             | ESD    |         |         |       |
| Charged Device Model (CDM), Class C1 |        |         | 250     | V     |
| Human Body Model (HBM), Class 2      |        |         | 2000    | V     |

<sup>1</sup> 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. Specifications are based on simulations.

**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. SKY65623-682LF Recommended Operating Conditions<sup>1</sup>**

| Parameter  | Symbol | Min  | Typ  | Max  | Units |
|--|--------|------|------|------|-------|
| Frequency range  | f      | 1559 | 1575 | 1606 | MHz   |
| Supply voltage (measured at terminals of Evaluation Board) | Vcc    | 1.5  | 1.8  | 3.6  | V     |
| Enable voltage   | VEN    | 1.5  | 1.8  | Vcc  | V     |
| Case operating temperature                                 | Tc     | -40  |      | +85  | °C    |

<sup>1</sup> Specifications based on simulations.  
 Enable OFF voltage: 0.3 V (highest)  
 Enable ON voltage: Vcc-0.3 V (lowest)  
 Enable ON voltage should not exceed Vcc at any time.

**Table 4. SKY65623-682LF Electrical Specifications<sup>1</sup>**  
**(f = 1575 MHz, Vcc = 1.8 V, VEN = 1.8 V, Tc = +25 °C, Unless Otherwise Noted)**

| Parameter  | Symbol            | Test Condition  | Min | Typ   | Max | Units |
|--|-------------------|---|-----|-------|-----|-------|
| Small signal gain  | IS21I             | PIN = -40 dBm   | 15  | 16.5  | 18  | dB    |
| 1 dB input compression point                               | IP1dB             |   |     | -30   |     | dBm   |
| Noise figure   | NF                |   |     | 0.85  |     | dB    |
| In-band third order input intercept point <sup>2</sup>     | IIP3              | f1 = 1575 MHz @ PIN = -40 dBm<br>f2 = 1576 MHz @ PIN = -40 dBm  |     | -21   |     | dBm   |
| Out-of-band third order input intercept point <sup>2</sup> | OOB-IIP3          | f1 = 1713 MHz @ PIN = -20 dBm<br>f2 = 1851 MHz @ PIN = -65 dBm<br>IMD3 @ 1575 MHz = -90 dBm at output |     | -11.5 |     | dBm   |
| Reverse isolation  | IS12I             | PIN = -40 dBm   |     | 32    |     | dB    |
| Input return loss  | IS11I             | PIN = -40 dBm   |     | 10    |     | dB    |
| Output return loss   | IS22I             | PIN = -40 dBm   |     | 15    |     | dB    |
| Supply current   | ICC               | No RF   |     | 1     | 1.2 | mA    |
| Shutdown current   | I <sub>LEAK</sub> | No RF, VEN = 0 V  |     | 0.1   | 1   | μA    |
| 2 <sup>nd</sup> harmonic of 787 MHz <sup>2</sup>           | HD2_787           | PIN = -25 dBm, f1 = 787 MHz,<br>measure output at 1574 MHz  |     | -35   |     | dBm   |
| Turn ON/OFF time <sup>2</sup>                              |                   | f = 1575 MHz, PIN = -30 dBm, Vcc = 1.8 V,<br>50% of VEN to 90%/10% of final RF power                  |     | 1     |     | μs    |

<sup>1</sup> Performance is guaranteed only under the conditions listed in this table. Specifications based on simulations.

<sup>2</sup> Verified by characterization.

**Table 5. SKY65623-682LF Electrical Specifications<sup>1</sup>**  
**(f = 1575 MHz, Vcc = 2.8 V, VEN = 2.8 V, Tc = +25 °C, Unless Otherwise Noted)**

| Parameter  | Symbol            | Test Condition  | Min  | Typ   | Max  | Units |
|--|-------------------|---|------|-------|------|-------|
| Small signal gain  | IS21I             | PIN = -40 dBm   | 15.3 | 16.8  | 18.3 | dB    |
| 1 dB input compression point                               | IP1dB             |   |      | -30   |      | dBm   |
| Noise figure   | NF                |   |      | 0.85  |      | dB    |
| In-band third order input intercept point <sup>2</sup>     | IIP3              | f1 = 1575 MHz @ PIN = -40 dBm<br>f2 = 1576 MHz @ PIN = -40 dBm  |      | -21   |      | dBm   |
| Out-of-band third order input intercept point <sup>2</sup> | OOB-IIP3          | f1 = 1713 MHz @ PIN = -20 dBm<br>f2 = 1851 MHz @ PIN = -65 dBm<br>IMD3 @ 1575 MHz = -93 dBm at output |      | -12.5 |      | dBm   |
| Reverse isolation  | IS12I             | PIN = -40 dBm   |      | 32    |      | dB    |
| Input return loss  | IS11I             | PIN = -40 dBm   |      | 10    |      | dB    |
| Output return loss   | IS22I             | PIN = -40 dBm   |      | 15    |      | dB    |
| Supply current   | ICC               | No RF   |      | 1.1   | 1.3  | mA    |
| Shutdown current   | I <sub>LEAK</sub> | No RF, VEN = 0 V  |      | 0.1   | 1    | μA    |
| 2 <sup>nd</sup> harmonic of 787 MHz <sup>2</sup>           | HD2_787           | PIN = -25 dBm, f1 = 787 MHz, measure<br>output at 1574 MHz  |      | -35   |      | dBm   |
| Turn ON/OFF time <sup>2</sup>                              |                   | f = 1575 MHz, PIN = -30 dBm, Vcc = 2.8 V,<br>50% of VEN to 90%/10% of final RF power                  |      | 1     |      | μs    |

<sup>1</sup> Performance is guaranteed only under the conditions listed in this table. Specifications based on simulations.

<sup>2</sup> Verified by characterization.

### Evaluation Board Description

The SKY65623-682LF Evaluation Board is used to test the performance of the SKY65623-682LF LNA. An application schematic diagram is shown in Figure 3. Table 6 provides the Bill of Materials (BOM) list for Evaluation Board components. An assembly drawing for the Evaluation Board is shown in Figure 4. Evaluation Board layer details are shown in Figure 5, and the layer detail physical characteristics are shown in Figure 6.

### Package Dimensions

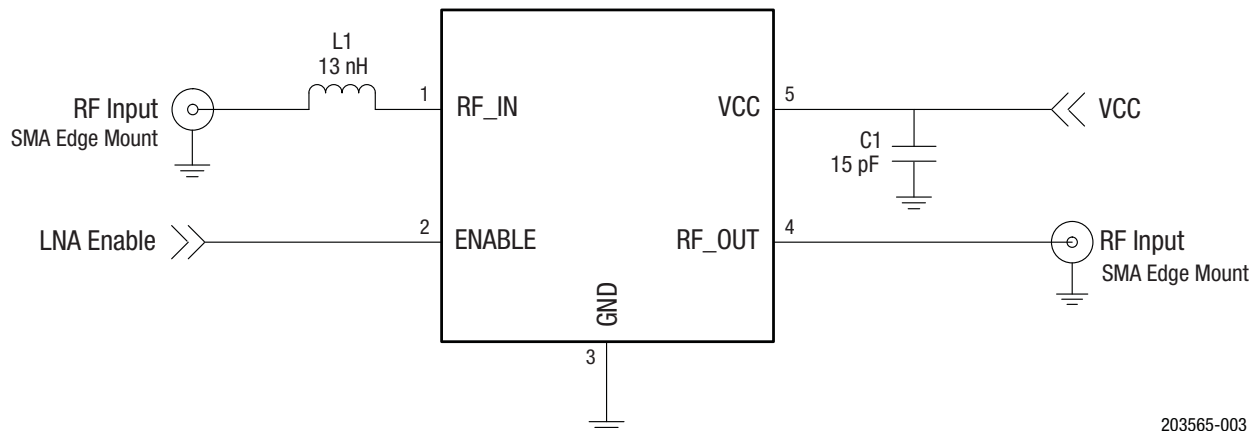
The PCB layout footprint for the SKY65623-682LF is provided in Figure 7. The typical part marking for the SKY65623-682LF is shown in Figure 8. Package dimensions for the 5-pin QFN are shown in Figure 9, and tape and reel dimensions are provided in Figure 10.

### 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 SKY65623-682LF 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.



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**Figure 3. SKY65623-682LF Application Schematic**

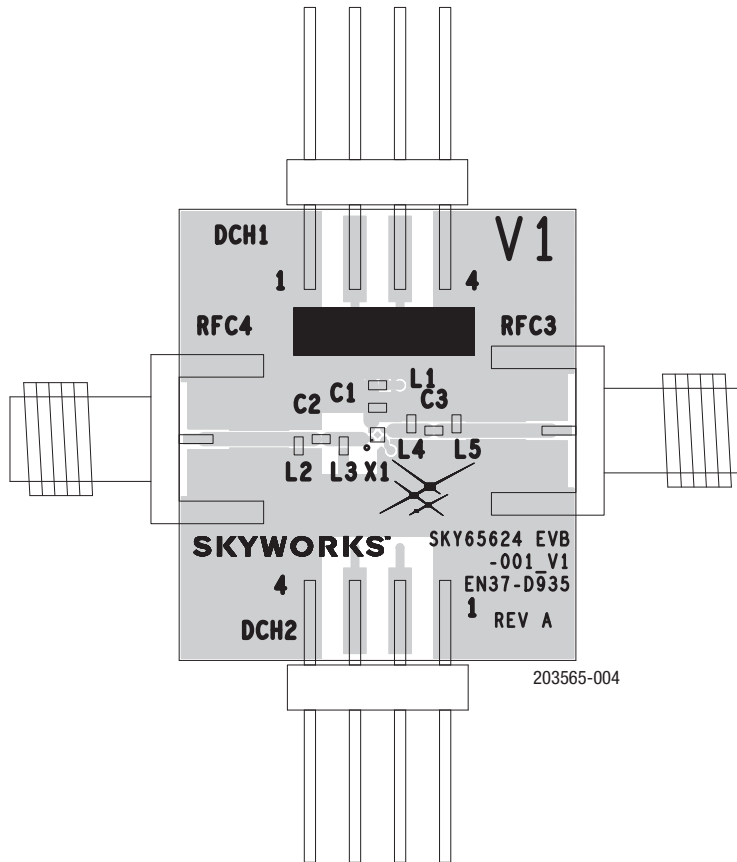


Figure 4. SKY65623-682LF Evaluation Board Assembly Diagram

Table 6. SKY65623-682LF Evaluation Board Bill of Materials

| Component       | Size | Value |
|-----------------|------|-------|
| C1 <sup>1</sup> | 0402 | 15 pF |
| L1              | 0402 | 13 nH |

<sup>1</sup> C1 needs to be placed as close as possible to the device in the application circuit.

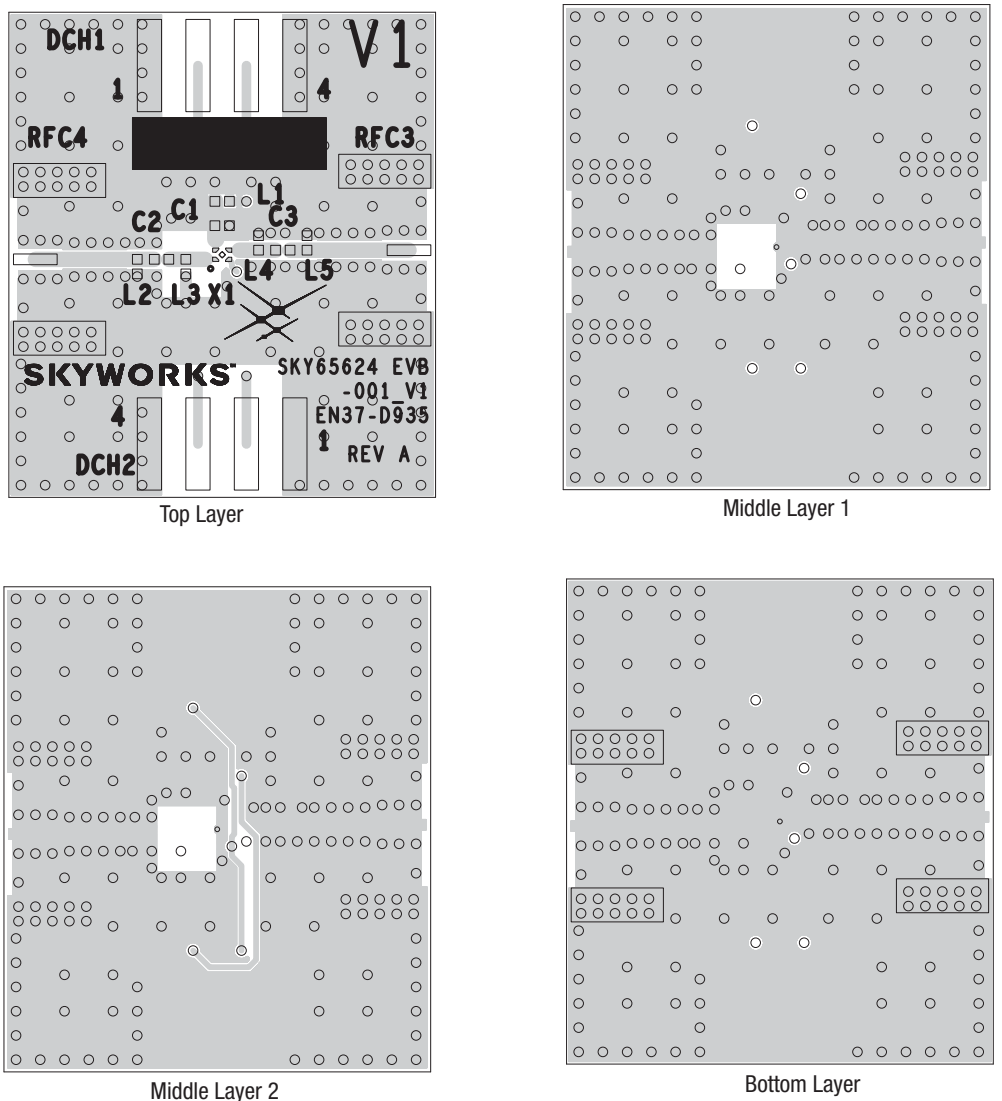
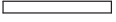

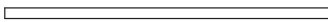









Figure 5. Evaluation Board Layer Details

| 50 Ω  | CROSS SECTION   | NAME       | THICKNESS | MATERIALS     |
|---|---|------------|-----------|---------------|
| W = 0.500 mm<br> |  | TMASK      | 0.010 mm  | SOLDER RESIST |
|   |  | L1         | 0.025 mm  | Cu – 1 oz     |
|   |  | DIELECTRIC | 0.250 mm  | R04350B       |
|   |  | L2         | 0.035 mm  | Cu – 1 oz     |
|   |  | DIELECTRIC | 1.000 mm  | FR4           |
|   |  | L3         | 0.035 mm  | Cu – 1 oz     |
|   |  | DIELECTRIC | 0.250 mm  | FR4           |
|   |  | L4         | 0.200 mm  | Cu – 1 oz     |
|   |  | BMASK      | 0.010 mm  | SOLDER RESIST |

ts517

Figure 6. Layer Detail Physical Characteristics

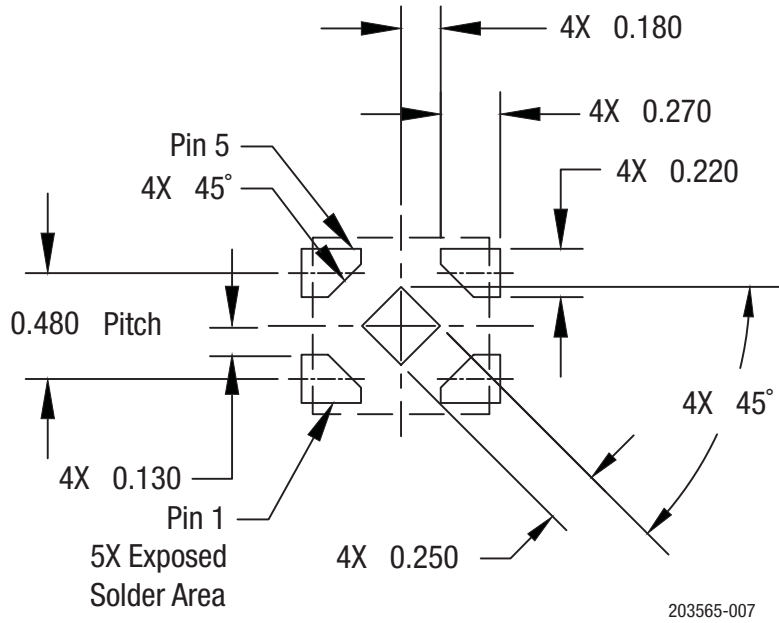


Figure 7. SKY65623-682LF PCB Layout Footprint

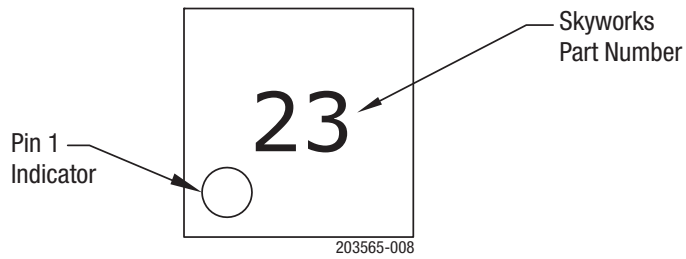


Figure 8. SKY65623-682LF Typical Part Marking (Top View)

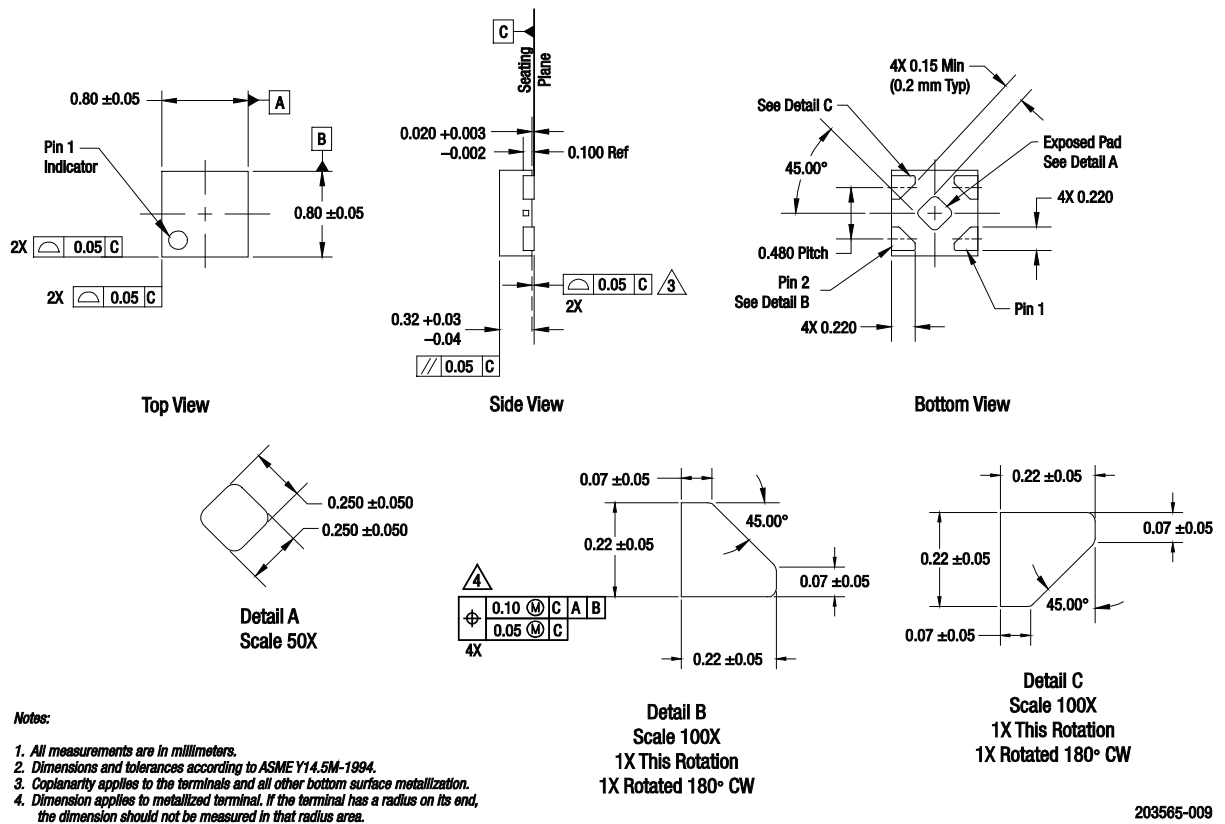


Figure 9. SKY65623-682LF Package Dimensions

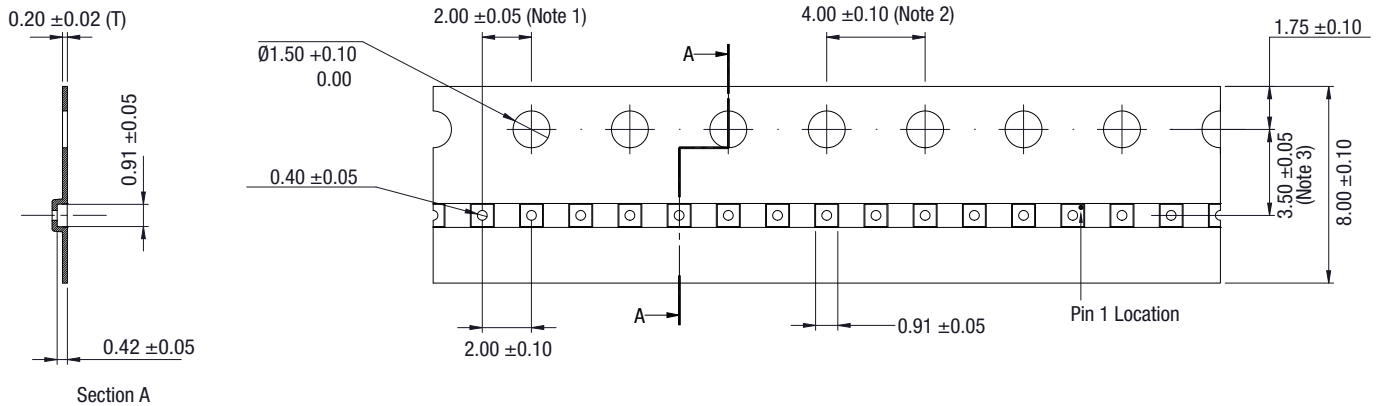


Figure 10. SKY65623-682LF Tape and Reel Dimensions



## Ordering Information

| Model Name  | Manufacturing Part Number | Evaluation Board Part Number |
|---|---------------------------|------------------------------|
| SKY65623-682LF: GPS/GLONASS/Galileo/Compass Low-Noise Amplifier | SKY65623-682LF            | SKY65623-682LF-EVB           |

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