

## DATA SHEET

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

## Applications

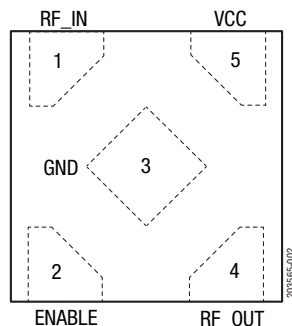
- GPS/GLONASS/Galileo/Compass radio receivers
- Smartwatches
- Personal asset trackers
- Action cameras
- Personal navigation devices

## Features

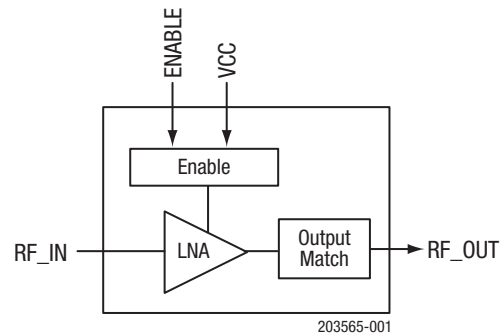
- Small signal gain: 16.5 dB typical
- Low noise figure: 0.85 dB typical
- Out-of-band IIP3: -11.5 dBm typical
- Low current consumption: 1 mA typical
- Low shutdown current: 0.1  $\mu$ A typical
- Output impedance internally matched to 50  $\Omega$
- Single external input matching inductor
- Single 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)



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. 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	P <sub>IN</sub>		0	dBm
Supply voltage	V <sub>CC</sub>	0	4.5	V
Enable voltage	V <sub>EN</sub>	0	3.6	V
Storage temperature	T <sub>STG</sub>	−55	+125	°C
Junction temperature	T <sub>J</sub>		+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)	V <sub>CC</sub>	1.5	1.8	3.6	V
Enable voltage	V <sub>EN</sub>	1.5	1.8	3.6	V
Case operating temperature	T <sub>c</sub>	−40		+85	°C

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

Enable OFF voltage: 0.3 V (highest)

Enable ON voltage: V<sub>CC</sub>−0.3 V (lowest)

**Table 4. SKY65623-682LF Electrical Specifications<sup>1</sup>**  
**(f = 1575 MHz, V<sub>CC</sub> = 1.8 V, V<sub>EN</sub> = 1.8 V, T<sub>c</sub> = +25 °C, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Small signal gain	S <sub>21</sub>	P <sub>IN</sub> = -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	f <sub>1</sub> = 1575 MHz @ P <sub>IN</sub> = -40 dBm f <sub>2</sub> = 1576 MHz @ P <sub>IN</sub> = -40 dBm		-21		dBm
Out-of-band third order input intercept point <sup>2</sup>	OOB-IIP3	f <sub>1</sub> = 1713 MHz @ P <sub>IN</sub> = -20 dBm f <sub>2</sub> = 1851 MHz @ P <sub>IN</sub> = -65 dBm IMD3 @ 1575 MHz = -90 dBm at output		-11.5		dBm
Reverse isolation	S <sub>12</sub>	P <sub>IN</sub> = -40 dBm		32		dB
Input return loss	S <sub>11</sub>	P <sub>IN</sub> = -40 dBm		10		dB
Output return loss	S <sub>22</sub>	P <sub>IN</sub> = -40 dBm		15		dB
Supply current	I <sub>CC</sub>	No RF		1	1.2	mA
Shutdown current	I <sub>LEAK</sub>	No RF, V <sub>EN</sub> = 0 V		0.1	1	μA
2 <sup>nd</sup> harmonic of 787 MHz <sup>2</sup>	HD2_787	P <sub>IN</sub> = -25 dBm, f <sub>1</sub> = 787 MHz, measure output at 1574 MHz		-35		dBm
Turn ON/OFF time <sup>2</sup>		f = 1575 MHz, P <sub>IN</sub> = -30 dBm, V <sub>CC</sub> = 1.8 V, 50% of V <sub>EN</sub> 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, V<sub>CC</sub> = 2.8 V, V<sub>EN</sub> = 2.8 V, T<sub>c</sub> = +25 °C, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Small signal gain	S <sub>21</sub>	P <sub>IN</sub> = -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	f <sub>1</sub> = 1575 MHz @ P <sub>IN</sub> = -40 dBm f <sub>2</sub> = 1576 MHz @ P <sub>IN</sub> = -40 dBm		-21		dBm
Out-of-band third order input intercept point <sup>2</sup>	OOB-IIP3	f <sub>1</sub> = 1713 MHz @ P <sub>IN</sub> = -20 dBm f <sub>2</sub> = 1851 MHz @ P <sub>IN</sub> = -65 dBm IMD3 @ 1575 MHz = -93 dBm at output		-12.5		dBm
Reverse isolation	S <sub>12</sub>	P <sub>IN</sub> = -40 dBm		32		dB
Input return loss	S <sub>11</sub>	P <sub>IN</sub> = -40 dBm		10		dB
Output return loss	S <sub>22</sub>	P <sub>IN</sub> = -40 dBm		15		dB
Supply current	I <sub>CC</sub>	No RF		1.1	1.3	mA
Shutdown current	I <sub>LEAK</sub>	No RF, V <sub>EN</sub> = 0 V		0.1	1	μA
2 <sup>nd</sup> harmonic of 787 MHz <sup>2</sup>	HD2_787	P <sub>IN</sub> = -25 dBm, f <sub>1</sub> = 787 MHz, measure output at 1574 MHz		-35		dBm
Turn ON/OFF time <sup>2</sup>		f = 1575 MHz, P <sub>IN</sub> = -30 dBm, V <sub>CC</sub> = 2.8 V, 50% of V <sub>EN</sub> 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

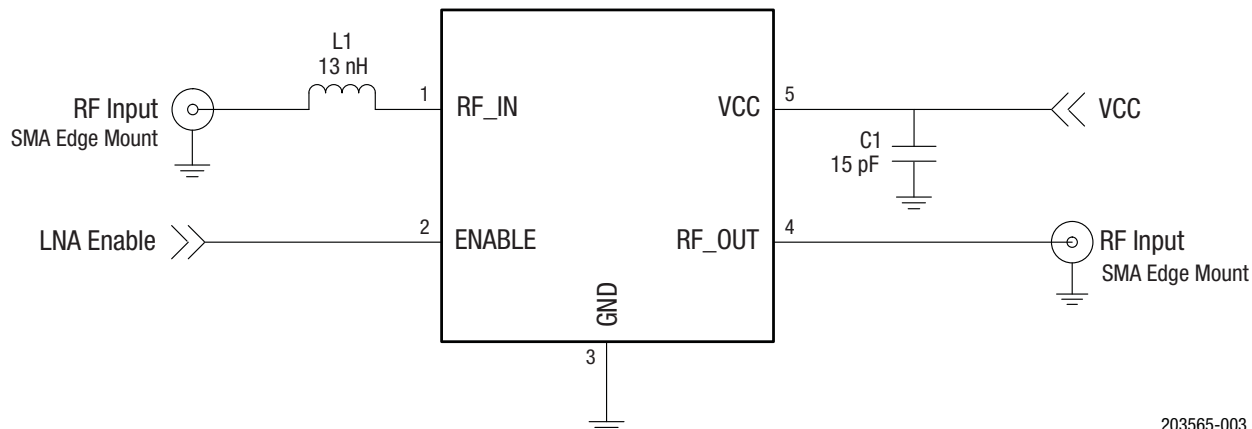
The PCB layout footprint for the SKY65623-682LF is provided in Figure 7. The typical part marking for the SKY65623-682LF is shown in Figure 8. Package dimensions for the 5-pin QFN are shown in Figure 9, and tape and reel dimensions are provided in Figure 10.

## 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**

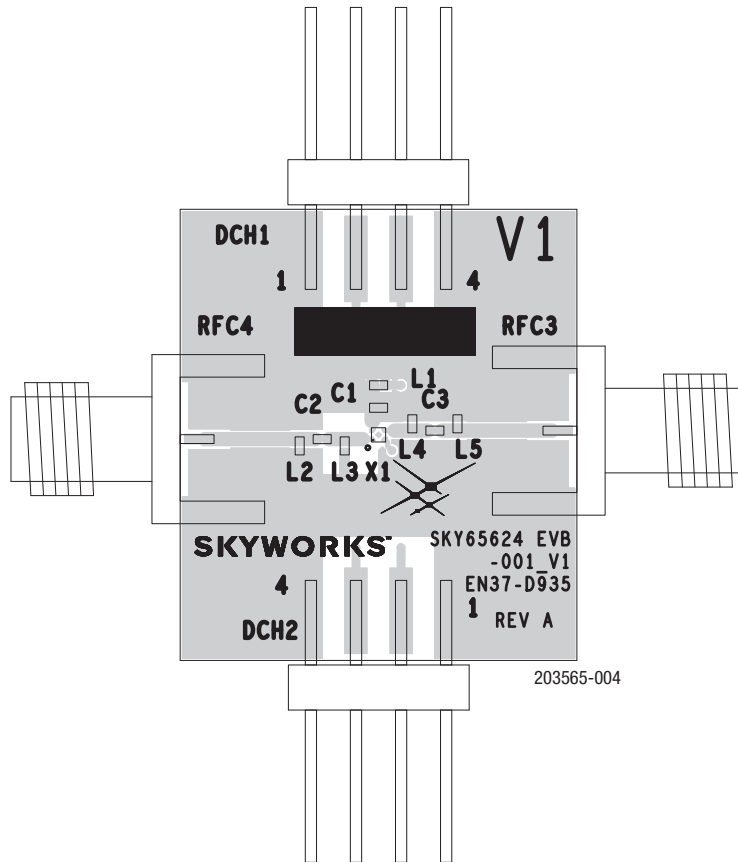


Figure 4. SKY65623-682LF Evaluation Board Assembly Diagram

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.

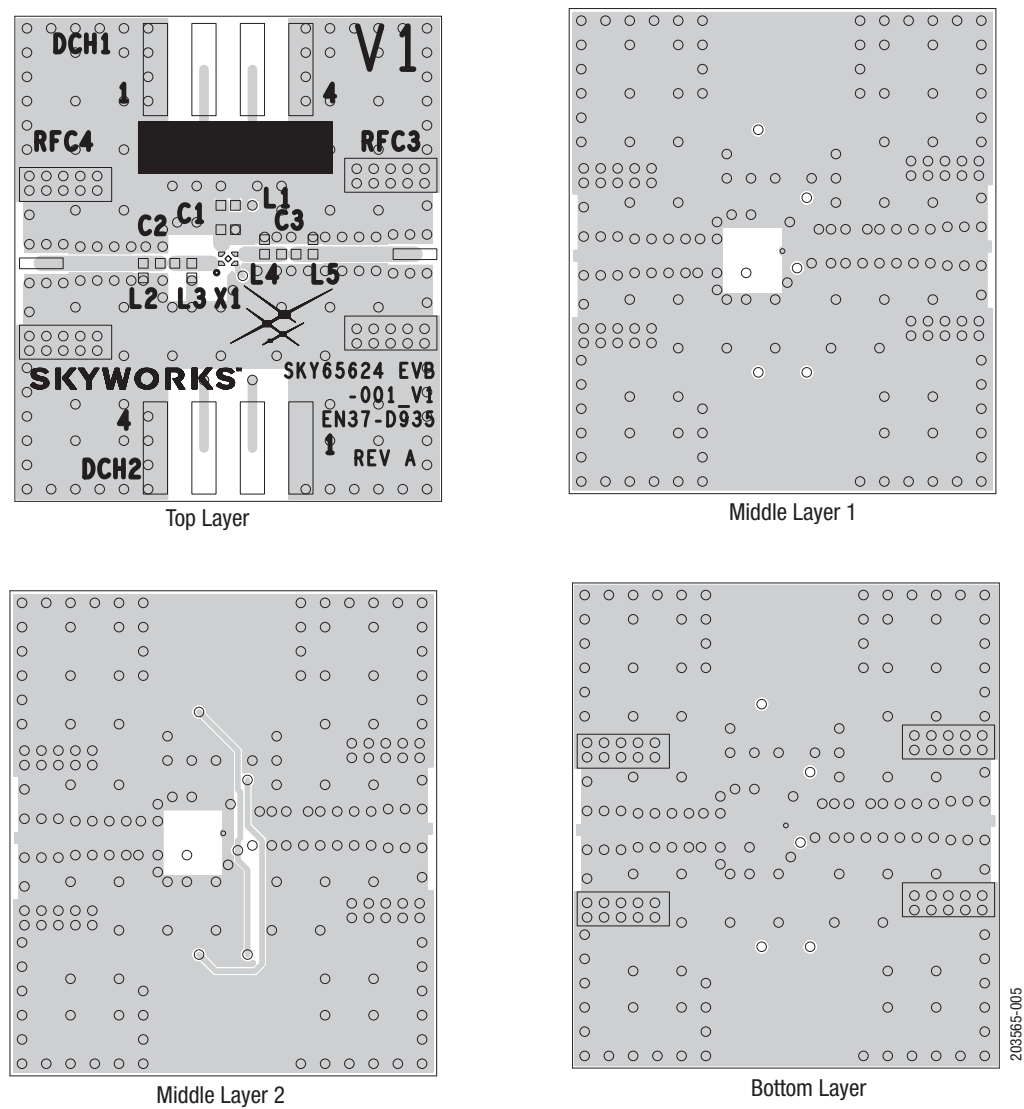
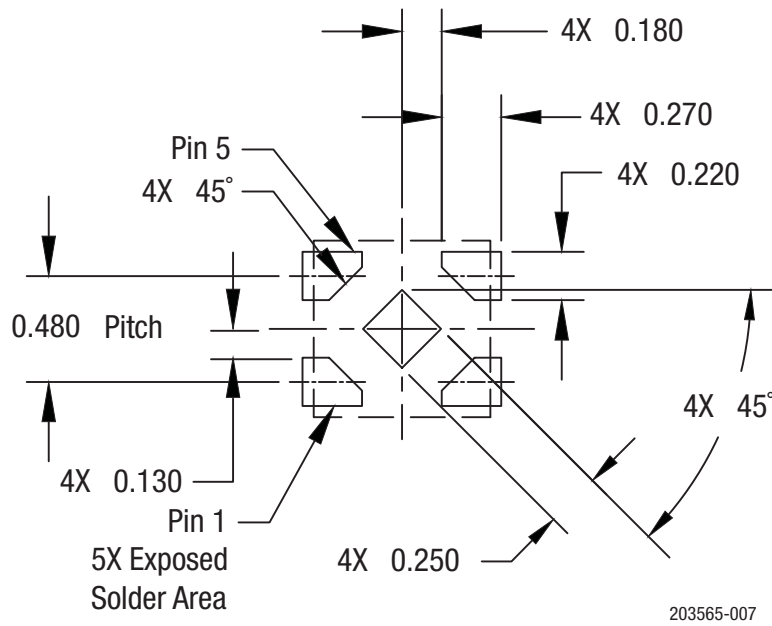


Figure 5. Evaluation Board Layer Details

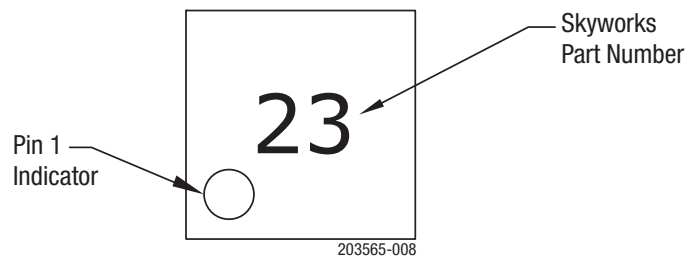
50 Ω	CROSS SECTION	NAME	THICKNESS	MATERIALS
<div>W = 0.500 mm</div> <div></div>		TMASK	0.010 mm	SOLDER RESIST
		L1	0.025 mm	Cu – 1 oz
		DIELECTRIC	0.250 mm	R04350B
		L2	0.035 mm	Cu – 1 oz
		DIELECTRIC	1.000 mm	FR4
		L3	0.035 mm	Cu – 1 oz
		DIELECTRIC	0.250 mm	FR4
		L4	0.200 mm	Cu – 1 oz
		BMASK	0.010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

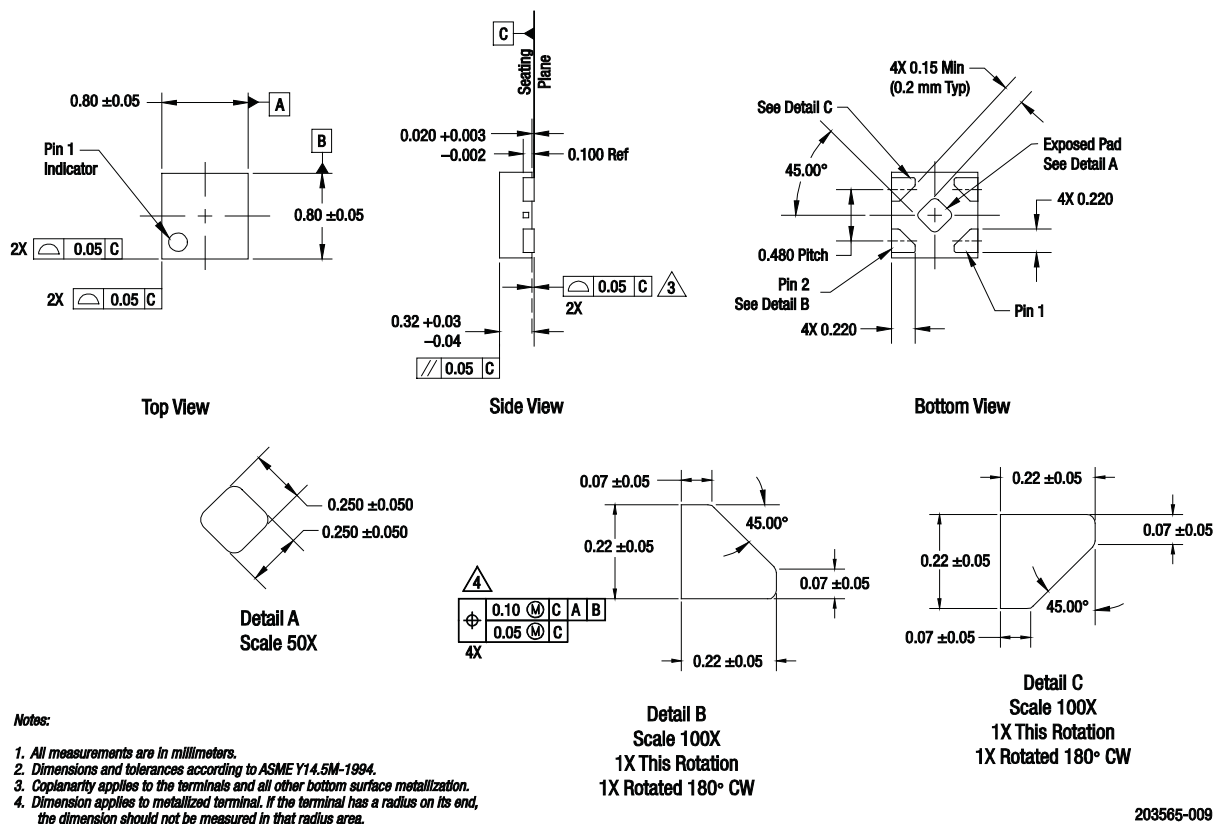


Figure 9. SKY65623-682LF Package Dimensions

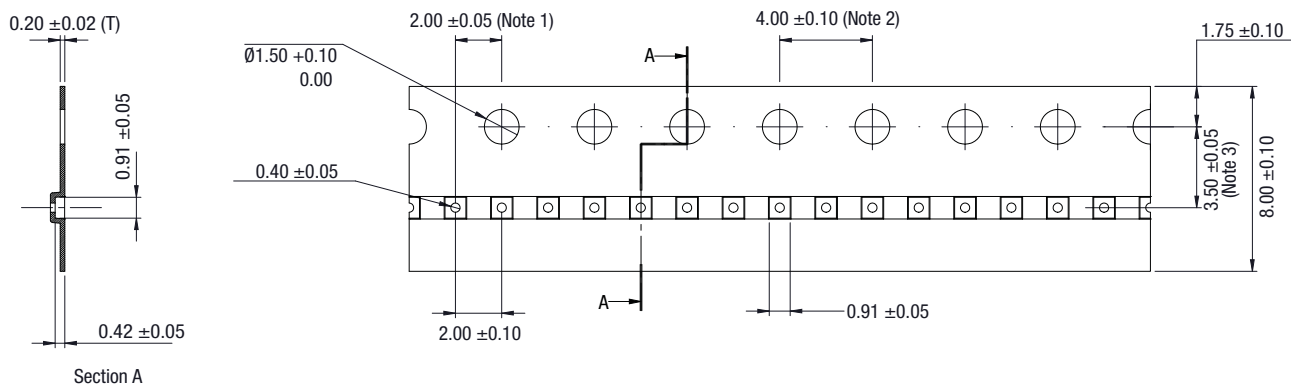


Figure 10. SKY65623-682LF Tape and Reel Dimensions



## Ordering Information

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

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