

DATA SHEET

# SKY65723-11: Low-Noise Amplifier Front-End Module with GPS/GNSS/BDS Pre-Filter

## Applications

- GPS/GNSS/BDS radio receivers
- Global Navigation Satellite Systems (GLONASS)
- Fitness/activity trackers
- Smartphones
- Laptop PCs and tablets

## Features

- Small signal gain: 17 dB typical
- Low noise figure: 1.8 dB typical
- Excellent out-of-band rejection
- Low current consumption
- Input/output impedance internally matched to 50 Ω
- Single DC supply: 1.62 to 3.6 V
- Minimal number of external components required
- Small MCM (6-pin, 1.7 x 2.3 mm) package (MSL3, 260 °C per JEDEC J-STD-020)



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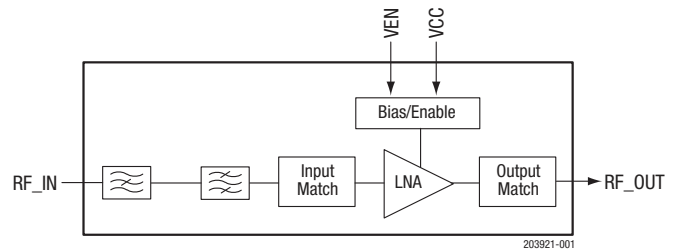


Figure 1. SKY65723-11 Block Diagram

## Description

The SKY65723-11 is a front-end module (FEM) with an integrated low-noise amplifier (LNA) and pre-filter designed for Global Positioning System/Global Navigation Satellite System/Beidou Navigation Satellite System (GPS/GNSS/BDS) receiver applications. The device provides high linearity, excellent gain, a high 1 dB input compression point (IP1dB), and a superior noise figure (NF).

The pre-filter provides the low in-band insertion loss and integrated notch filtering for excellent rejections of the cellular, PCS, and WLAN frequency bands. The SKY65723-11 uses surface-mount technology (SMT) in the form of a 1.7 x 2.3 mm Multi-Chip Module (MCM) package, which allows for a highly manufacturable and low-cost solution.

An additional filter is incorporated in the SKY65723-11 to improve performance in the presence of a Band 13 blocker.

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.

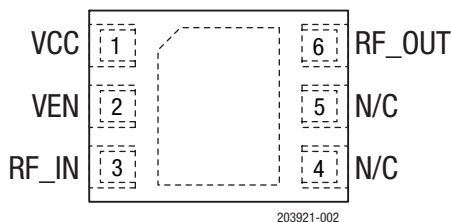


Figure 2. SKY65723-11 Pinout (Top View)

**Table 1. SKY65723-11 Signal Descriptions**

Pin	Name	Description	Pin	Name	Description
1	VCC	Source voltage	4	N/C	Not connected or grounded with no impact to performance
2	VEN	LNA enable	5	N/C	Not connected or grounded with no impact to performance
3	RF_IN	RF input	6	RF_OUT	RF output

## Technical Description

### LNA Enable

The VEN signal (pin 2) enables or disables the LNA. 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 SKY65723-11 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. SKY65723-11 Absolute Maximum Ratings<sup>1</sup>**

Parameter	Symbol	Minimum	Maximum	Units
RF input power	P <sub>IN</sub>		+10	dBm
Supply voltage	V <sub>CC</sub>	0	4.5	V
Storage temperature	T <sub>STG</sub>	-55	+150	°C
Junction temperature	T <sub>J</sub>		+150	°C
Electrostatic discharge: Human Body Model (HBM), Class 1A (at RF_IN pin)	ESD		250	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.

**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. SKY65723-11 Recommended Operating Conditions**

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>	1.62	1.80	3.6	V
LNA enable:					
Enable (high)	LNA <sub>ENABLE</sub>	V <sub>CC</sub> - 0.3		V <sub>CC</sub>	V
Disable (low)	LNA <sub>DISABLE</sub>		0	0.3	V
Case operating temperature	T <sub>C</sub>	-40		+85	°C

**Table 4. SKY65723-11 Electrical Specifications<sup>1,2</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	IS21I	P <sub>IN</sub> = -30 dBm	14	16.5		dB
Noise figure	NF		1	1.8 <sup>3</sup>	3	dB
In-band third order input intercept point	IIP3	f <sub>1</sub> = 1575 MHz, f <sub>2</sub> = 1576 MHz, P <sub>IN</sub> = -30 dBm		-8.5		dBm
1 dB input compression point	IP1dB			-15.5		dBm
Reverse isolation	IS12I	P <sub>IN</sub> = -30 dBm		31		dB
Input return loss	IS11I	P <sub>IN</sub> = -30 dBm		12		dB
Output return loss	IS22I	P <sub>IN</sub> = -30 dBm		10		dB
Supply current	I <sub>CC</sub>	No RF		4	5	mA
Shutdown current	I <sub>LEAK</sub>	No RF, V <sub>EN</sub> = 0 V		0.1	1	μA
Out-of-band rejection	OOB	P <sub>IN</sub> = 0 dBm (in-band referred): @ 777 to 798 MHz @ 806 to 928 MHz @ 1710 to 1980 MHz @ 2400 to 2500 MHz @ 5160 to 5560 MHz		70 65 45 45 50		dBc dBc dBc dBc dBc
Band 13 2 <sup>nd</sup> harmonic	B13 <sub>2to</sub>	P <sub>IN</sub> = +15 dBm @ 787.76 MHz measured @ 1575.52 MHz output referred		-80		dBm
LNA turn-on time	T <sub>ON</sub>	P <sub>IN</sub> = -30 dBm, V <sub>CC</sub> = 1.8 V, 50% of V <sub>ENABLE</sub> to 90% final RF power		1		μs
LNA turn-off time	T <sub>OFF</sub>	P <sub>IN</sub> = -30 dBm, V <sub>CC</sub> = 1.8 V, 50% of V <sub>ENABLE</sub> to 10% final RF power		0.2		μs

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

<sup>2</sup> Not tested in production. Verified by characterization.

<sup>3</sup> 0.1 dB has been de-embedded for input connector and trace loss.

**Table 5. SKY65723-11 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	IS21I	PIN = -30 dBm	14	17		dB
Noise figure	NF		1	1.8 <sup>2</sup>	3	dB
In-band third order input intercept point	IIP3	f1 = 1575 MHz, f2 = 1576 MHz, PIN = -30 dBm		-8		dBm
1 dB input compression point	IP1dB			-14.5		dBm
Reverse isolation	IS12I	PIN = -30 dBm		32		dB
Input return loss	IS11I	PIN = -30 dBm		12		dB
Output return loss	IS22I	PIN = -30 dBm		10		dB
Supply current	I <sub>CC</sub>	No RF		4.2	6	mA
Shutdown current	I <sub>LEAK</sub>	No RF, V <sub>EN</sub> = 0 V		0.1	1	µA
Out-of-band rejection	OOB	PIN = 0 dBm (in-band referred): @ 777 to 798 MHz @ 806 to 928 MHz @ 1710 to 1980 MHz @ 2400 to 2500 MHz @ 5160 to 5560 MHz		70 65 45 45 50		dBc dBc dBc dBc dBc
Band 13 2 <sup>nd</sup> harmonic <sup>3</sup>	B13 <sub>2to</sub>	PIN = +15 dBm @ 787.76 MHz measured @ 1575.52 MHz output referred		-80		dBm
LNA turn-on time <sup>3</sup>	T <sub>ON</sub>	PIN = -30 dBm, V <sub>CC</sub> = 1.8 V, 50% of V <sub>ENABLE</sub> to 90% final RF power		1		µs
LNA turn-off time <sup>3</sup>	T <sub>OFF</sub>	PIN = -30 dBm, V <sub>CC</sub> = 1.8 V, 50% of V <sub>ENABLE</sub> to 10% final RF power		0.2		µs

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

<sup>2</sup> 0.1 dB has been de-embedded for input connector and trace loss.

<sup>3</sup> Not tested in production. Verified by characterization.

## Evaluation Board Description

The SKY65723-11 Evaluation Board is used to test the performance of the SKY65723-11 LNA. The Evaluation Board schematic diagram is shown in Figure 3. An assembly drawing for the Evaluation Board is shown in Figure 4. Table 6 provides the Bill of Materials (BOM) list for Evaluation Board components.

## Package Dimensions

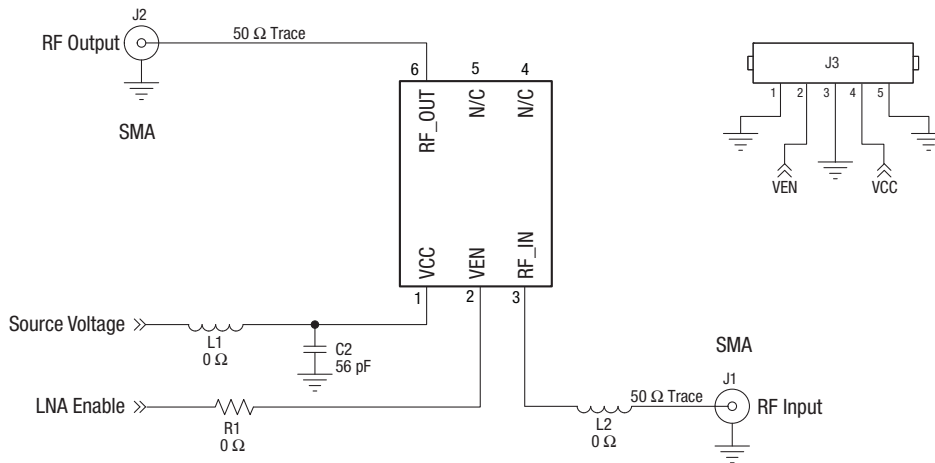
The Evaluation Board layer details for the SKY65723-11 are shown in Figure 5. Layer detail physical characteristics are shown in Figure 6. The PCB layout footprint is provided in Figure 7. Figure 8 shows the typical part marking. Package dimensions are shown in Figure 9, and tape and reel dimensions are provided in Figure 10.

## 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 SKY65723-11 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 & 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.



Note: DNI components are not shown.

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Figure 3. SKY65723-11 Evaluation Board Schematic

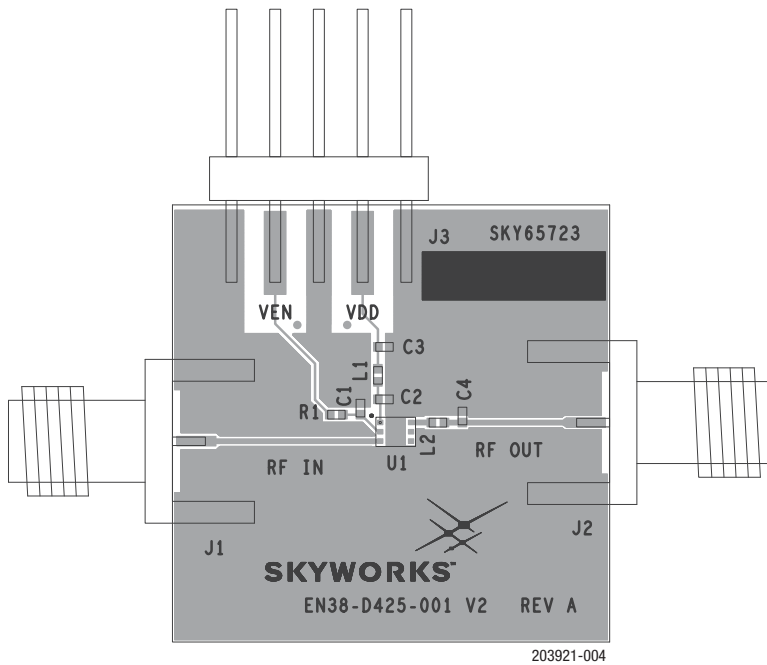
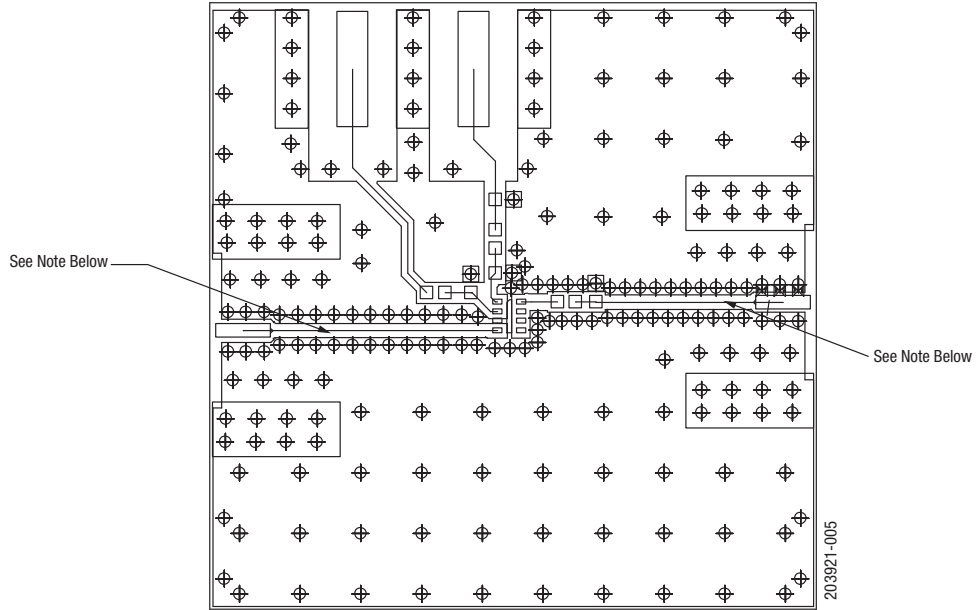


Figure 4. SKY65723-11 Evaluation Board Assembly Diagram

Table 6. SKY65723-11 Evaluation Board Bill of Materials

Component	Size	Value	Manufacturer	Mfr Part Number
C2	0402	56 pF	Murata	GRM0335C1E560JA01D
C1, C3, C4	0402	DNI		
L1, L2, R1	0402	0 Ω	Panasonic	ERJ-2GE0R00X



CONDUCTORS INDICATED SHALL BE 0.0135 +/-0.001 WITH A COPLANAR SPACING OF .005 +/-0.001

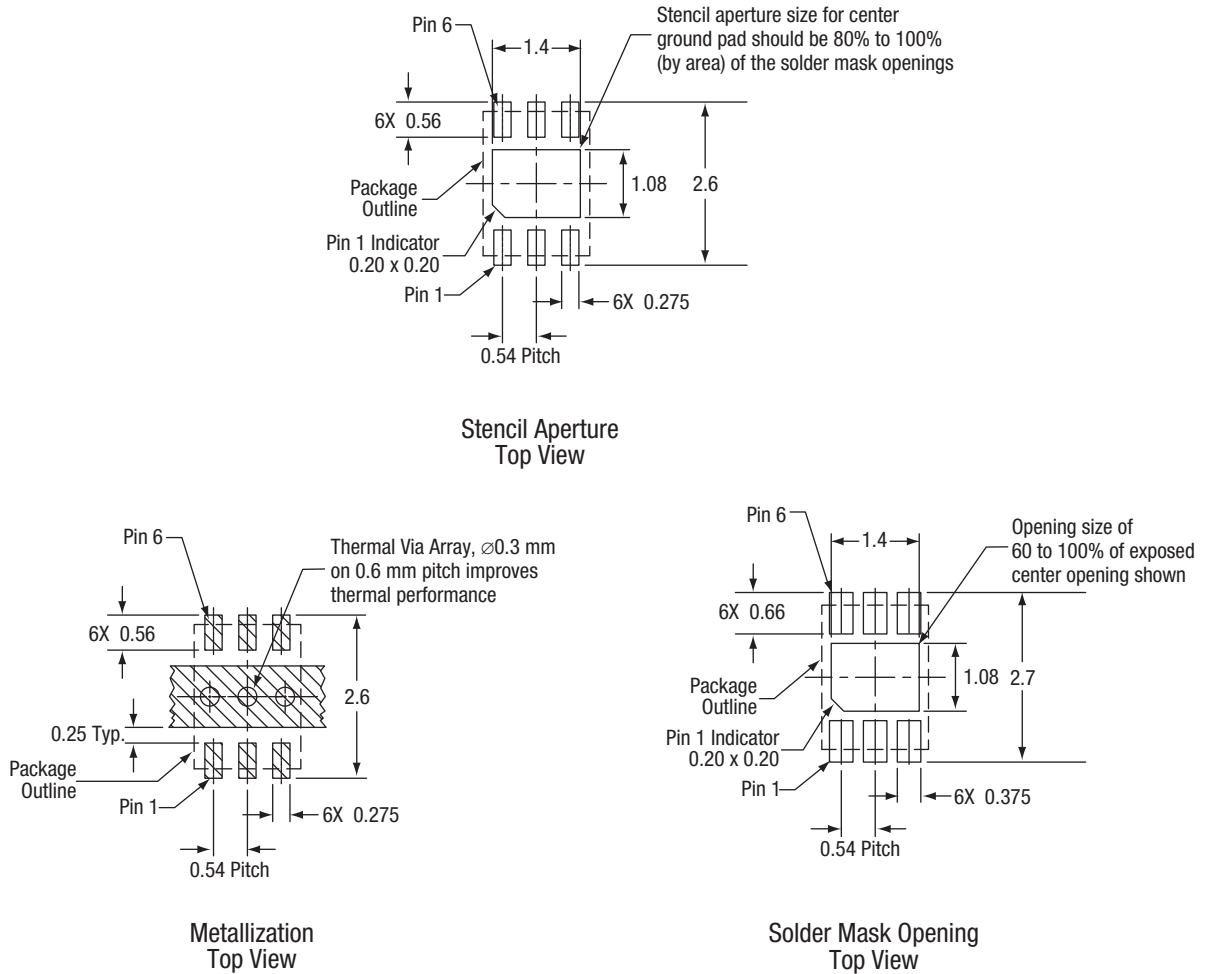
TEST FOR 50 OHMS +/- 10% ON LAYER 1.

**Figure 5. SKY65723-11 Evaluation Board Layer Details**

	Cross Section	Name	Thickness	Materials
		TOP SOLDERMASK		
		L1	(0.0007)	1/2 OZ. COPPER
		DIELECTRIC	0.008	ROGERS 4003
		L2	(0.0014)	1 OZ. COPPER
		DIELECTRIC	ADJUST TO MEET REQUIRED THICKNESS	FR4
		L3	(0.0007)	1/2 OZ. COPPER
		BOTTOM SOLDERMASK		

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**Figure 6. SKY65723-11 Layer Detail Physical Characteristics**



All dimensions are in millimeters

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Figure 7. SKY65723-11 PCB Layout Footprint

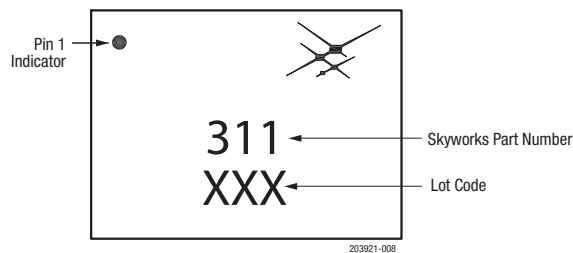
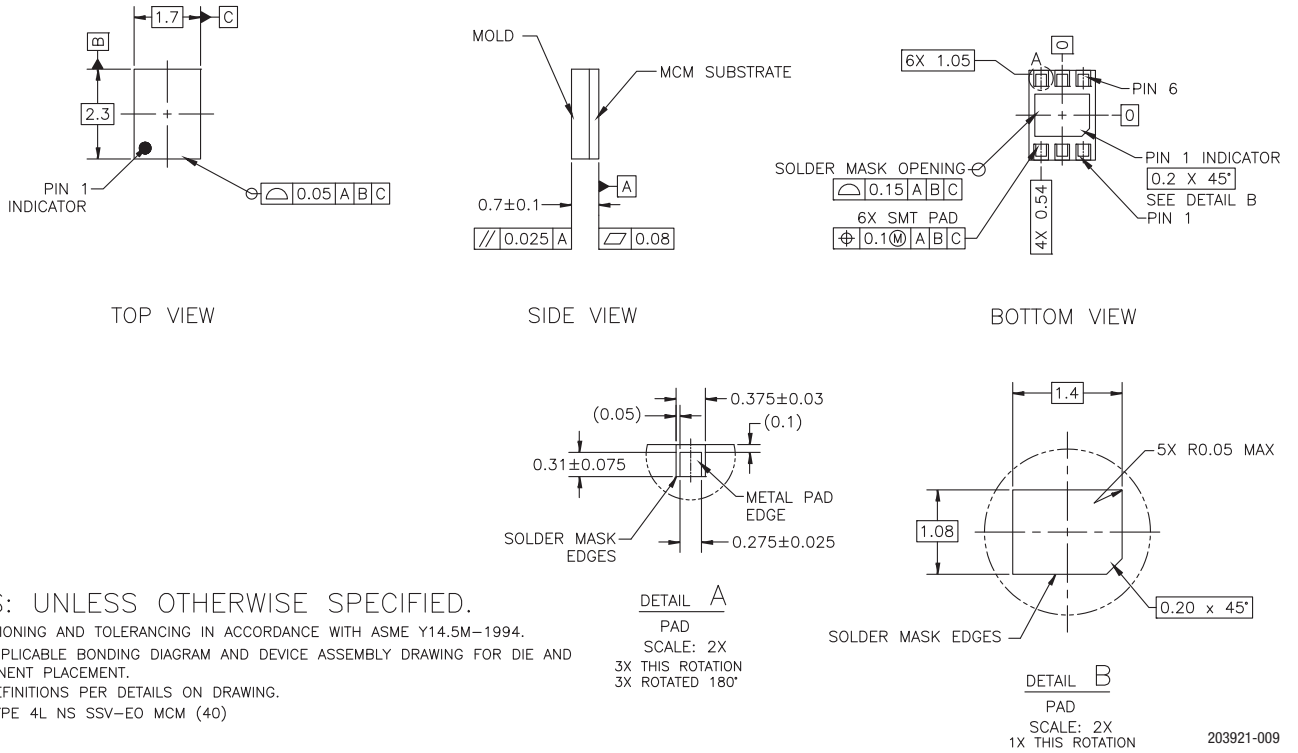


Figure 8. Typical Part Marking

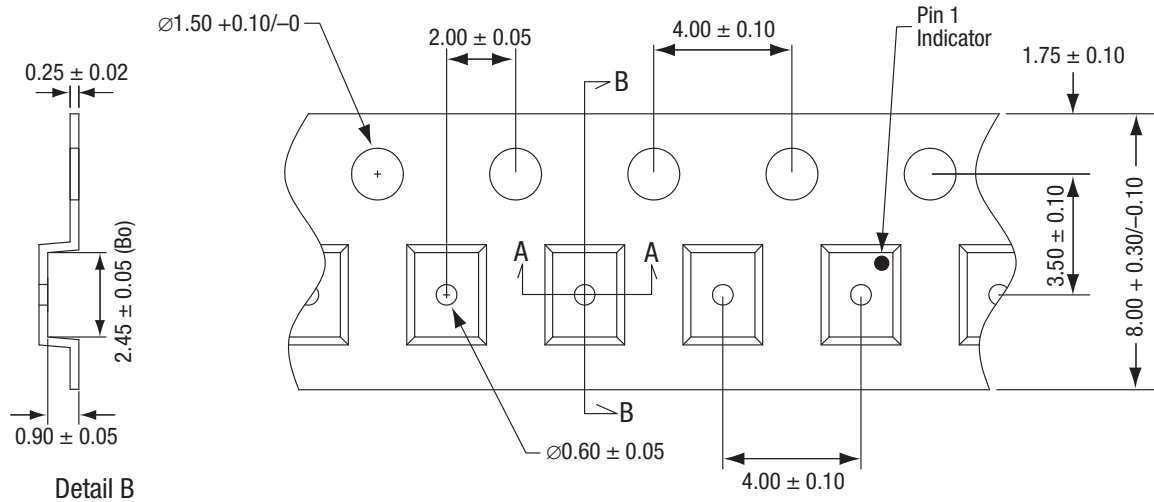


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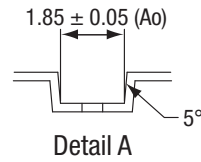
**Figure 9. SKY65723-11 Package Dimensions**

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*Notes:*

1. Carrier tape: black conductive polycarbonate.
2. Cover tape material: transparent adhesive material.
3. ESD-surface resistivity is  $\geq 1 \times 10^5 \sim \leq 1 \times 10^8$  Ohms/square per EIA, JEDEC TNR Specification.
4. 10-sprocket hole pitch cumulative tolerance:  $\pm 0.20$  mm.
5.  $A_o$  and  $B_o$  measured on plane 0.30 mm above the bottom of pocket.
6. Camber not to exceed 1 mm in 250 mm.
7. All measurements are in millimeters.



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**Figure 10. SKY65723-11 Tape and Reel Dimensions**

## Ordering Information

Product Description	Product Part Number	Evaluation Board Part Number
SKY65723-11: Low-Noise Amplifier FEM with GPS/GNSS/BDS Filter	SKY65723-11	65723-11-EVB

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