DATA SHEET

SKY65943-11: Global Navigation Satellite System (GNSS) Low-Noise Amplifier Front-End Module with Integrated Pre- and Post-Filter

Applications

- GNSS radio receivers
- Personal navigation devices
- Wearables
- Action cameras
- Drones

Features

- Small signal gain: 16 dB
- Out-of-band P1dB: +6 dBm
- Out-of-band rejection: +80 dBc, 1627 to 1660 MHz
- Low noise figure: 1.7 dB
- Low current consumption: 2.9 mA @ 1.8 V
- Input/output impedance internally matched to 50 Ω
- Single DC supply: 1.62 to 3.3 V
- Minimum number of external SMT devices required
- Small 10-pin, 2.5 x 2.5 mm MCM package (MSL3, 260 °C per JEDEC J-STD-020)
- For RoHS and other product compliance information, see Skyworks Certificate of Conformance.

Description

The SKY65943-11 is a front-end module (FEM) with an integrated low-noise amplifier (LNA) and pre-filter and post-filter designed for Global Navigation Satellite System (GNSS) receiver applications.

The device provides high gain, excellent out-of-band rejection, and low noise figure. The filters provide low in-band insertion loss and excellent rejection for the cellular, PCS, and WLAN frequency bands.

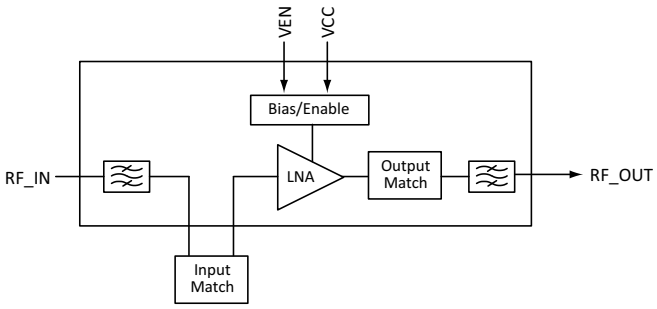


Figure 1. Functional Block Diagram

Output matching components are embedded inside the device. Only one external input matching inductor is required.

The SKY65943-11 is optimized to operate at 1559 to 1606 MHz, making it ideal for GPS, GLONASS, Galileo, Compass, and QZSS receiver applications.

The SKY65943-11 uses surface-mount technology (SMT) in the form of a 2.5 x 2.5 mm Multi-Chip Module (MCM) package, enabling 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.

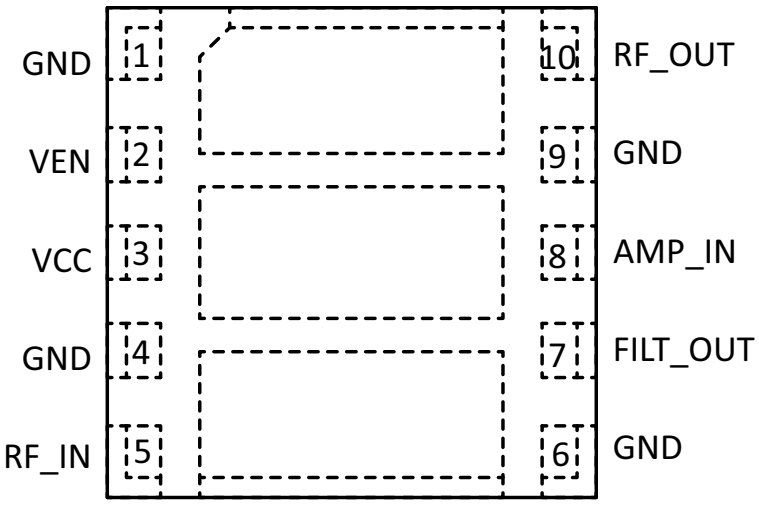


Figure 2. Pinout (Top View)

Table 1. Signal Descriptions

Pin	Name	Description	Pin	Name	Description
1	GND	Ground	6	GND	Ground
2	VEN	LNA enable	7	FILT_OUT	Filter output
3	VCC	LNA power supply	8	AMP_IN	LNA input
4	GND	Ground	9	GND	Ground
5	RF_IN	RF input	10	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 SKY65943-11 are provided in Table 2. The recommended operating conditions are specified in Table 3, followed by other electrical specifications and control logic.

Table 2. Absolute Maximum Ratings[1]

Parameter	Symbol	Minimum	Maximum	Units
RF input power	P_{IN}		+10	dBm
Supply voltage	V_{CC}	0	3.4	V
Storage temperature	T_{STG}	–55	+150	°C
Junction temperature	T_J		+150	°C
Electrostatic discharge: Human Body Model (HBM), Class 1A	ESD		250	V

1. Exposure to maximum rating conditions for extended periods may reduce device reliability. Exceeding any of the limits listed here may result in permanent damage to the device.

ESD Handling: *Industry-standard ESD handling precautions must be adhered to at all times to avoid damage to this device.*

Table 3. Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Units
Frequency	f	1559	1575	1606	MHz
Supply voltage	V_{CC}	1.62		3.3	V
LNA enable (high)	LNA_{ENABLE}	V_{CC} - 0.3		V_{CC}	V
LNA disable (low)	$LNA_{DISABLE}$		0	0.3	
Case temperature	T_C	–40	+25	+85	°C

Table 4. Electrical Specifications[1]

(V_{CC} = 1.8 V, V_{EN} = 1.8 V, f = 1575 MHz, T_C = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Small signal gain	|S21|	P_{IN} = –30 dBm, 1559 MHz	12	15		dB
		P_{IN} = –30 dBm, 1575 MHz	13.5	15		
		P_{IN} = –30 dBm, 1606 MHz	12	15		
Noise figure	NF	1559 MHz		2.2	2.6	dB
		1575 MHz		1.7	2.0	
		1606 MHz		2.0	2.4	
In-band third order input intercept point	IIP3	f1 = 1575 MHz, P_{IN} = –30 dBm f2 = 1576 MHz, P_{IN} = –30 dBm		–7		dBm
In-band 1 dB input compression point	IP1dB			–13.5		dBm
Out-of-band 1dB input compression point	OOB_IP1dB	f_OOB = 1627 MHz, IP1dB, f = 1575 MHz f_OOB = 1540 MHz, IP1dB, f = 1575 MHz	6			dBm
Reverse isolation	|S12|	P_{IN} = –30 dBm	30	38		dB
Input return loss	|S11|	P_{IN} = –30 dBm		10		dB
Output return loss	|S22|	P_{IN} = –30 dBm		13		dB
Supply current	I_{CC}	No RF		2.9	4.0	mA
Shutdown current	I_{LEAK}	No RF, V_{EN} = 0 V		0.1	1	µA
Out-of-band rejection	OOB	P_{IN} = 0 dBm (in-band referred), 10 to 300 MHz		+80		dBc
		P_{IN} = 0 dBm (in-band referred), 300 to 700 MHz		+90		
		P_{IN} = 0 dBm (in-band referred), 700 to 1525 MHz		+85		
		P_{IN} = 0 dBm (in-band referred), 1525 to 1540 MHz		+60		
		P_{IN} = 0 dBm (in-band referred), 1627 to 1660 MHz		+80		
		P_{IN} = 0 dBm (in-band referred), 1660 to 2500 MHz		+75		
		P_{IN} = 0 dBm (in-band referred), 2500 to 6000 MHz		+65		
LNA turn-on time	t_{ON}	P_{IN} = –30 dBm, V_{CC} = 1.8 V, 50% of V_{ENABLE} to 90% final RF power		1	1.5	µs
LNA turn-off time	t_{OFF}	P_{IN} = –30 dBm, V_{CC} = 1.8 V, 50% of V_{ENABLE} to 10% final RF power		0.1	0.2	µs

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

Table 5. Electrical Specifications[1]

(V_{CC} = 2.8 V, V_{EN} = 2.8 V, f = 1575 MHz, T_C = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Small signal gain	|S21|	P_{IN} = –30 dBm, 1559 MHz	13.5	16		dB
		P_{IN} = –30 dBm, 1575 MHz	14.5	16		
		P_{IN} = –30 dBm, 1606 MHz	13.0	15.5		
Noise figure	NF	1559 MHz		2.2	2.6	dB
		1575 MHz		1.7	2.0	
		1606 MHz		2.0	2.4	
In-band third order input intercept point	IIP3	f1 = 1575 MHz, P_{IN} = –30 dBm f2 = 1576 MHz, P_{IN} = –30 dBm		–7		dBm
In-band 1 dB input compression point	IP1dB			–13.0		dBm
Out-of-band 1dB input compression point	OOB_IP1dB	f_OOB = 1627 MHz, IP1dB@ f = 1575 MHz	6			dBm
		f_OOB = 1540 MHz, IP1dB@ f =1575 MHz	6			dBm
Reverse isolation	|S12|	P_{IN} = –30 dBm		40		dB
Input return loss	|S11|	P_{IN} = –30 dBm		12		dB
Output return loss	|S22|	P_{IN} = –30 dBm		18		dB
Supply current	ICC	No RF		3	4.5	mA
Shutdown current	ILEAK	No RF, V_{EN} = 0 V		0.1	1	µA
Out-of-band rejection	OOB	P_{IN} = 0 dBm (in-band referred), 10 to 300 MHz		+80		dBc
		P_{IN} = 0 dBm (in-band referred), 300 to 700 MHz		+90		
		P_{IN} = 0 dBm (in-band referred), 700 to 1525 MHz		+85		
		P_{IN} = 0 dBm (in-band referred), 1525 to 1540 MHz		+60		
		P_{IN} = 0 dBm (in-band referred), 1627 to 1660 MHz		+80		
		P_{IN} = 0 dBm (in-band referred), 1660 to 2500 MHz		+75		
		P_{IN} = 0 dBm (in-band referred), 2500 to 6000 MHz		+65		
LNA turn-on time	T_{ON}	P_{IN} = –30 dBm, V_{CC} = 2.8 V, 50% of V_{ENABLE} to 90% final RF power		1	1.5	µs
LNA turn-off time	T_{OFF}	P_{IN} = –30 dBm, V_{CC} = 2.8 V, 50% of V_{ENABLE} to 10% final RF power		0.1	0.2	µs

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

Evaluation Board Description

The SKY65943-11EK1 evaluation board is designed to demonstrate the performance of the SKY65943-11. An assembly drawing is shown in Figure 3, followed by the schematic diagram and Bill of Materials (BOM).

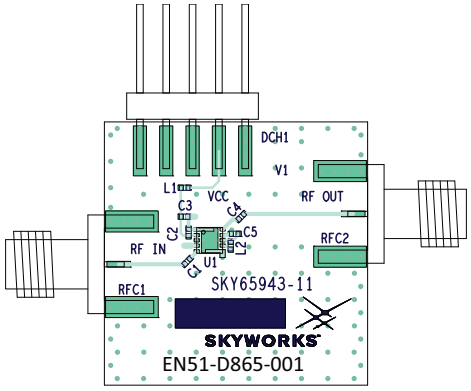
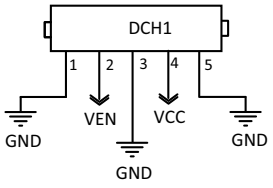


Figure 3. Evaluation Board Assembly Diagram



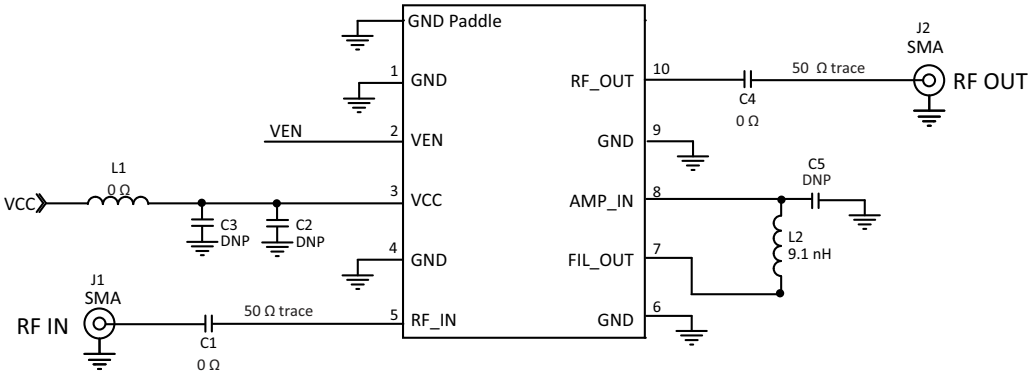


Figure 4. Evaluation Board Schematic

Table 6. Evaluation Board Bill of Materials

Component	Size	Value	Manufacturer	Mfr Part Number
L1 (optional)	0402	0 Ω	Panasonic	ERJ-2GE0R00X
L2	0402	9.1 nH	Murata	LQW15AN9N1J00D
C1, C4	0402	0 Ω	Panasonic	ERJ-2GE0R00X
C2, C3, C5	0402	DNP		DNP

Package and Handling Information

Since the device 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 SKY65943-11 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.

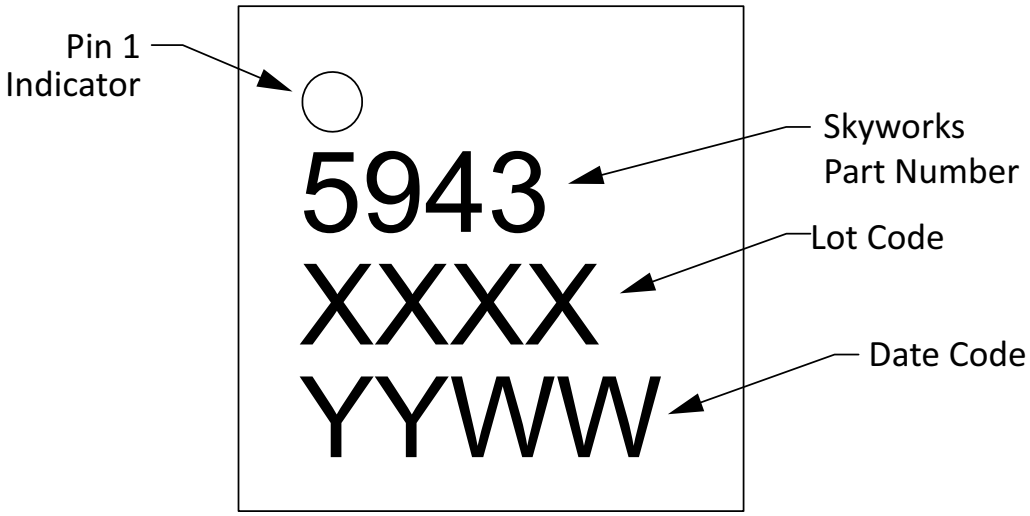
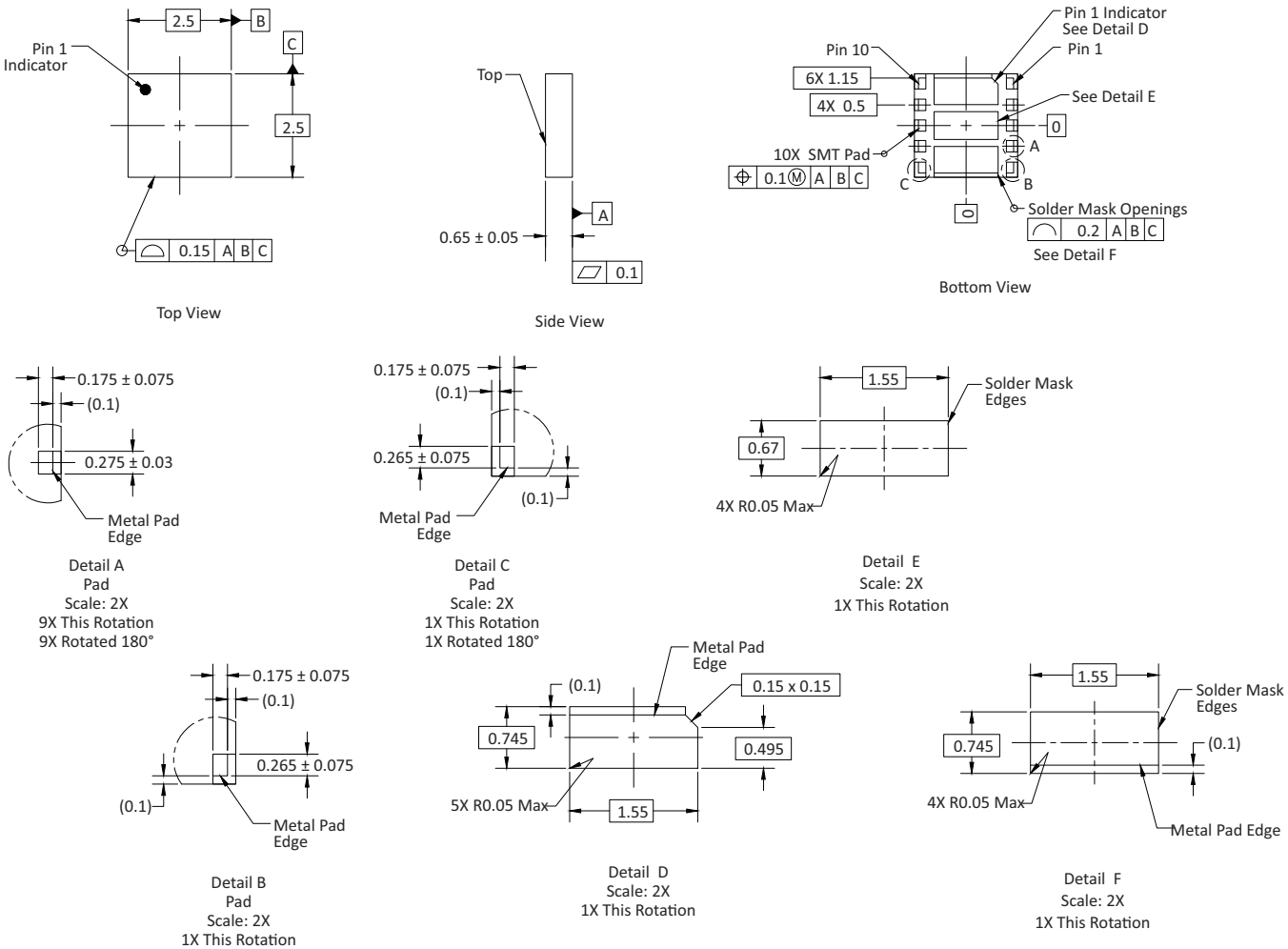


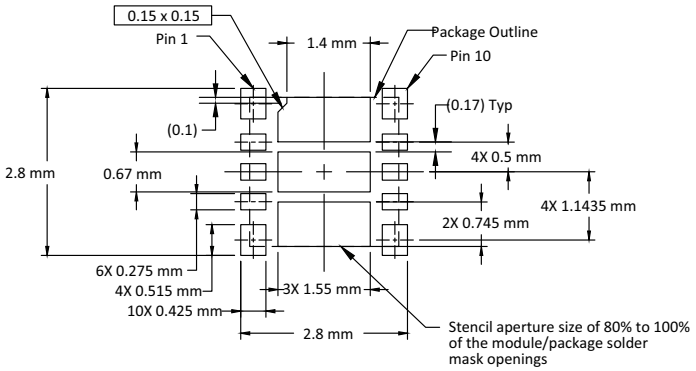
Figure 5. Typical Part Marking



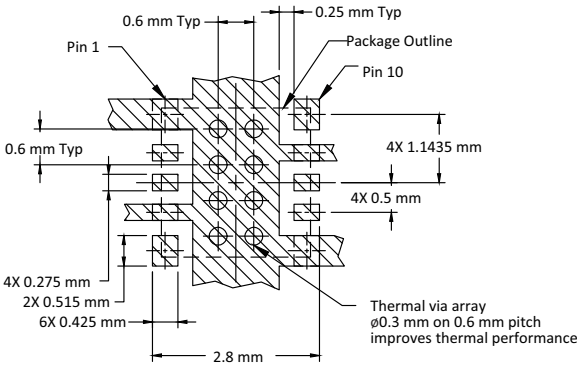
Notes:

1. Dimensions are in millimeters.
2. Dimensions and tolerances according to ASME Y14.5M-1994.
3. Pad definitions per details on drawing.

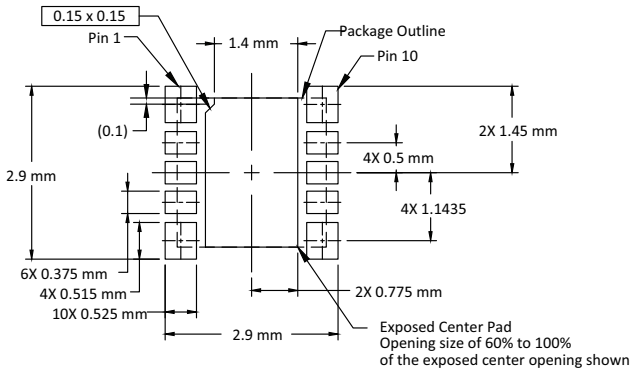
Figure 6. Package Dimensions



Stencil Aperture



Metallization



Solder Mask Opening

Notes:

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

Figure 7. PCB Layout Footprint

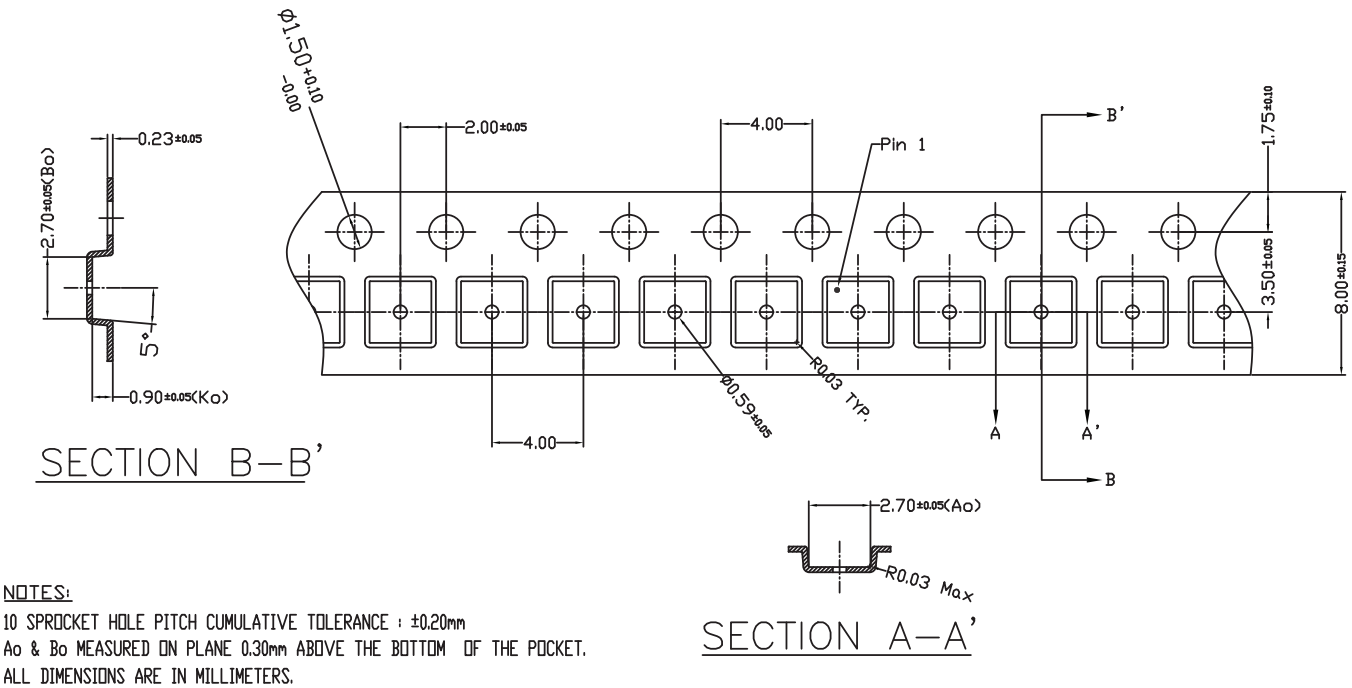


Figure 8. Tape and Reel Information

Ordering Information

Part Number	Description	Evaluation Board Part Number
SKY65943-11	GNSS Low-Noise Amplifier Front-End Module with Integrated Pre- and Post-Filter	SKY65943-11EK1