



SKY55951-11: Sky 5® GNSS L1 + L5 Dual-Frequency Low-Noise Amplifier Front-End Module with Post Filter

Applications

- 4G/5G cellular IoT modules
- Smartwatches
- Personal trackers
- Vehicle trackers
- Personal navigation devices
- Handheld computers
- Wi-Fi® 6E enterprise access points

Features

- Dedicated L1 and L5 receive paths
- Small signal gain: 17 dB typical
- Low current consumption:
L1 = 1 mA, L5 = 1.9 mA @ 1.8 V
- Integrated input and output matching on L1 and L5 paths
- Integrated B13 notch on L1 path
- Single, wide dc supply range: 1.5 to 3.3 V
- Small MCM package
20-pin, 2.0 x 1.6 x 0.7 (nominal) mm
MSL3, 260 °C per JEDEC J-STD-020
- For RoHS and other product compliance information, see the [Skyworks Certificate of Conformance](#).

Description

The SKY55951-11 features an integrated L1 low-noise amplifier (LNA) and post-filter along with an L5 LNA and post-filter designed for Global Navigation Satellite System (GNSS) receiver applications. The SKY55951-11 is part of our Sky5® product portfolio.

The front-end module provides high gain, low current consumption, and integrated input and output matching for L1 and L5, all in a compact package.

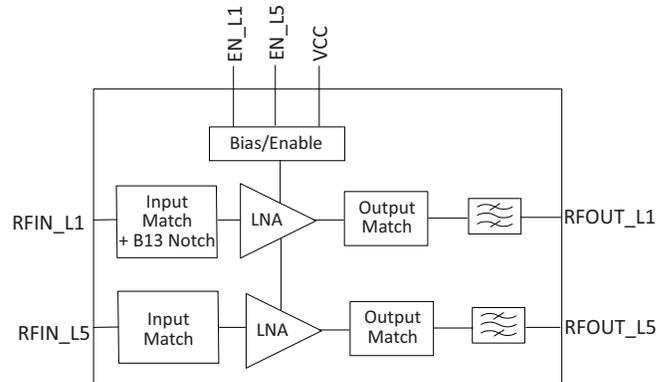


Figure 1. Functional Block Diagram

The L1 path also features an integrated B13 notch filter, providing excellent suppression (–50 dBm) of cellular low-band second harmonic signals impacting GPS L1 reception. The post-filtering on the L5 path also provides high (> 45 dBc) out-of-band rejection for interference below 1 GHz.

The SKY55951-11 uses surface-mount technology (SMT) in a multi-chip module (MCM), a proven and highly manufacturable 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 shown in Table 1.

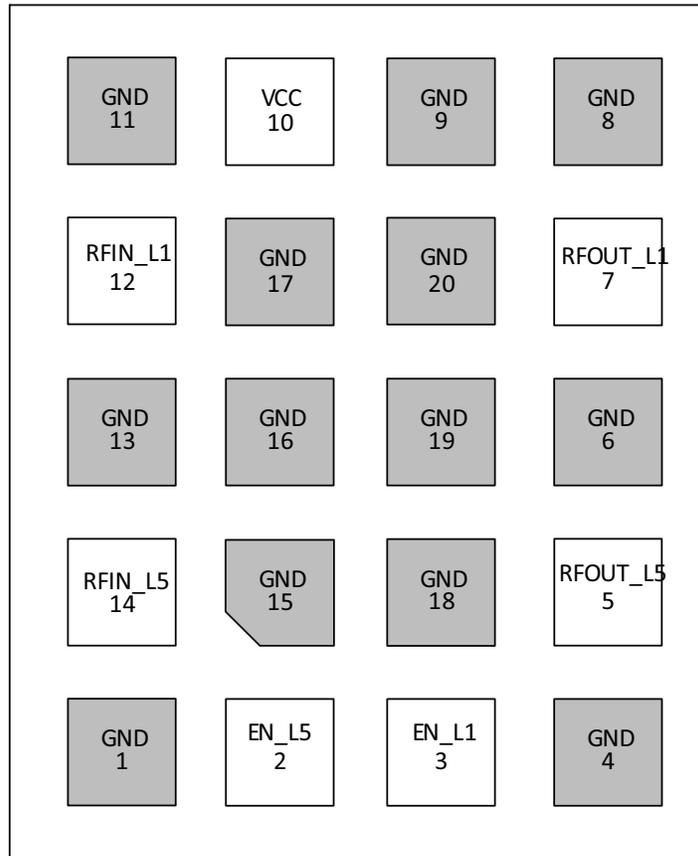


Figure 2. Pinout (Top View)

Table 1. Signal Descriptions

Pin	Name	Description	Pin	Name	Description
1	GND	Ground	11	GND	Ground
2	EN_L5	L5 enable	12	RFIN_L1	L1 RF input
3	EN_L1	L1 enable	13	GND	Ground
4	GND	Ground	14	RFIN_L5	L5 RF input
5	RFOUT_L5	L5 RF output	15	GND	Ground
6	GND	Ground	16	GND	Ground
7	RFOUT_L1	L1 RF output	17	GND	Ground
8	GND	Ground	18	GND	Ground
9	GND	Ground	19	GND	Ground
10	VCC	Supply	20	GND	Ground

Technical Description

LNA Enable

The V_{EN} signal (pin 3) enables or disables the LNA. A logic-high signal turns the LNA on and a logic-low signal turns the device off.

Electrical Specifications

Table 2. Absolute Maximum Ratings¹

Parameter	Symbol	Min	Max	Units
RF input power	P_{IN}		+10	dBm
Supply voltage	V_{CC}	0	3.6	V
Storage temperature	T_{STG}	-40	+85	°C
Junction temperature	T_J		+85	°C
Electrostatic discharge: Charged-Device Model (CDM), Class 3 Human Body Model (HBM), Class 1A	ESD		1000 500	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: 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 range	f_{L1} f_{L5}	1559 1164	1575 1176	1606 1189	MHz
Supply voltage	V_{CC}	1.5	1.8	3.3	V
LNA enable: Enable (high) Disable (low)	LNA_{ENABLE} $LNA_{DISABLE}$	1.5	1.8 0	V_{CC} 0.3	V
Case operating temperature	T_C	-40	+25	+85	°C

Table 4. Electrical Specifications, 1575 MHz¹
 (V_{CC} = 1.8 V, V_{EN} = 1.8 V, f_{L1} = 1575 MHz, T_C = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Small signal gain f = 1561 MHz f = 1575 MHz f = 1602 MHz	S21	P _{IN} = -40 dBm	14.5 14.5 14.5	16.5 17 16.5	19.5 19.5 19.5	dB
Noise figure f = 1561 MHz f = 1575 MHz f = 1602 MHz	NF			1.4 1.4 1.5	2.2 2.2 2.2	dB
In-band third order input intercept point	IIP3	f1 = 1575 MHz @ P _{IN} = -40 dBm f2 = 1576 MHz @ P _{IN} = -40 dBm		-21		dBm
1 dB input compression point (in-band)	IP1dB			-29		dBm
Reverse isolation	S12	P _{IN} = -40 dBm		30		dB
Input return loss	S11	P _{IN} = -40 dBm		8		dB
Output return loss	S22	P _{IN} = -40 dBm		15		dB
Group delay	GDlay			22		ns
Supply current	I _{CC}	No RF		1.0	2	mA
Shutdown current	I _{Leak}	No RF, V _{EN} = 0 V		0.01	1	μA
Logic current	I _{Logic}	V _{CC} 1.8 V, EN_L1 = 1.8 V V _{CC} 1.8 V, EN_L1 = 0 V		0.01 0.01	1 1	μA
Out-of-band rejection	OOB	P _{IN} = 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		93 87 70 77 69		dBc
B13 second harmonic	B13 _{2fo}	P _{IN} = -10 dBm @ 787.76 MHz measured @ 1575.52 MHz output referred		-53		dBm
Stability factor	k-factor		1	2.3		k
LNA turn-on time	ton	P _{IN} = -40 dBm, V _{CC} = 1.8 V, 50% of V _{ENABLE} to 90% final RF power		1		μs
LNA turn-off time	toff	P _{IN} = -40 dBm, V _{CC} = 1.8 V, 50% of V _{ENABLE} to 10% final RF power		0.06		μs

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

Table 5. Electrical Specifications, 1176 MHz¹
 (V_{CC} = 1.8 V, V_{EN} = 1.8 V, f_{L1} = 1176 MHz, T_C = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Small signal gain: f = 1164 MHz f = 1176 MHz f = 1189 MHz	S21	P _{IN} = -40 dBm	14 14 14	17.5 17.5 17.5	20.5 20.5 20.5	dB
Noise figure: f = 1164 MHz f = 1176 MHz f = 1189 MHz	NF			1.1 1.1 1.1	1.7 1.7 1.7	dB
In-band third order input intercept point	IIP3	f1 = 1176 MHz @ P _{IN} = -40 dBm f2 = 1177 MHz @ P _{IN} = -40 dBm		-18		dBm
1 dB input compression point (in-band)	IP1dB			-13.8		dBm
Reverse isolation	S12	P _{IN} = -40 dBm		47		dB
Input return loss	S11	P _{IN} = -40 dBm		7		dB
Output return loss	S22	P _{IN} = -40 dBm		18		dB
Group delay	GD _{lay}			15		ns
Supply current	I _{CC}	No RF		2	3	mA
Shutdown current	I _{Leak}	No RF, V _{EN} = 0 V		0.01	1	μA
Logic current	I _{Logic}	V _{CC} 1.8 V, EN_L5 = 1.8 V V _{CC} 1.8 V, EN_L5 = 0 V		0.01 0.01	1 1	μA
Out-of-band rejection	OOB	P _{IN} = 0 dBm, in-band referred: @ 777 to 960 MHz @ 1427 to 1463 MHz @ 1710 to 1980 MHz @ 2400 to 2500 MHz @ 5160 to 5560 MHz		48 33 56 48 52		dBc
Stability factor	k-factor		1	13		k
LNA turn-on time	t _{ON}	P _{IN} = -40 dBm, V _{CC} = 1.8 V, 50% of V _{ENABLE} to 90% final RF power		1.2		μs
LNA turn-off time	t _{OFF}	P _{IN} = -40 dBm, V _{CC} = 1.8 V, 50% of V _{ENABLE} to 10% final RF power		0.1		μs

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

Evaluation Board

An evaluation board is used to test the performance of the SKY55951-11. A schematic is provided in Figure 3. An assembly diagram is shown in Figure 4. Table 6 provides the Evaluation Board Bill of Materials.

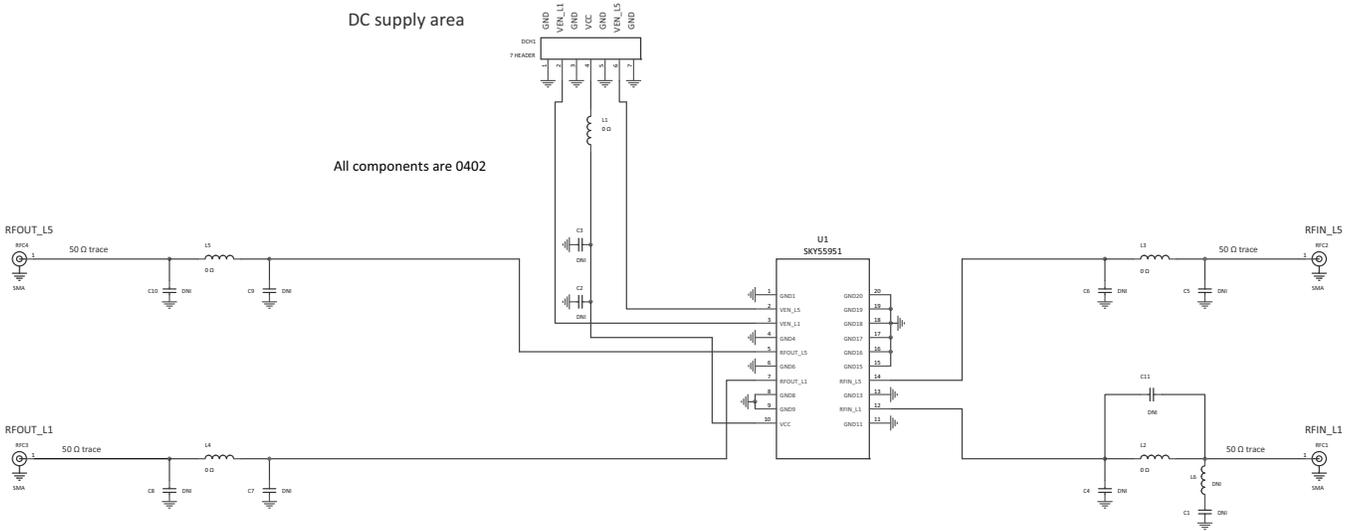


Figure 3. Evaluation Board Schematic

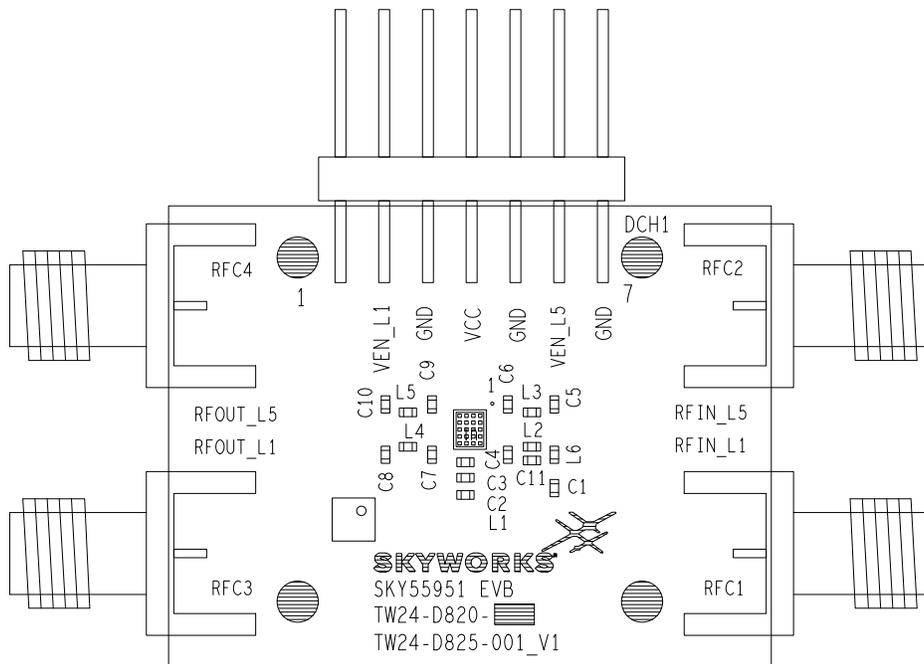


Figure 4. Evaluation Board Assembly Diagram

Table 6. Evaluation Board Bill of Materials

Component	Part Number	PCB Variant	Size	Description
L1, L2, L4, L5 ¹	5424R27-134		0402	Resistor, 0 Ω, 5%, 0.063 W
RFC1, RFC2, RFC3, RFC4				SMA, 0.062 edge connector
DCH1				7-pin header
U1	SKY55951			SKY55951-11
C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, L6	Do not install			
L3	GRM1555C1H560JZ01		0402	Murata® ceramic capacitor, 56 pF
	TW24-D825-001	V1		PCB, SKY55951-11

1. 56 pF dc block required at RFIN_L5 pin

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 SKY55951-11 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.

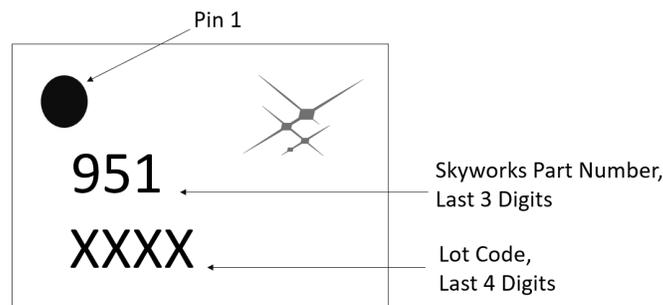
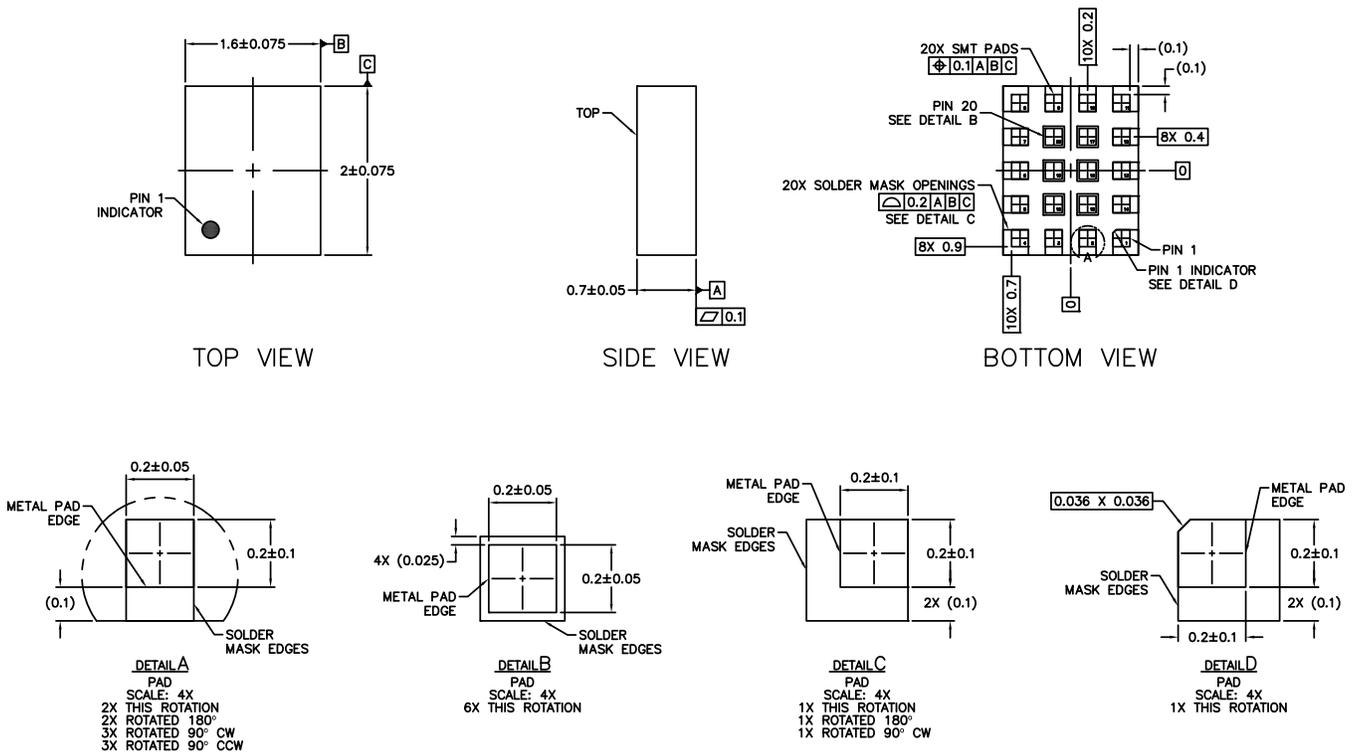


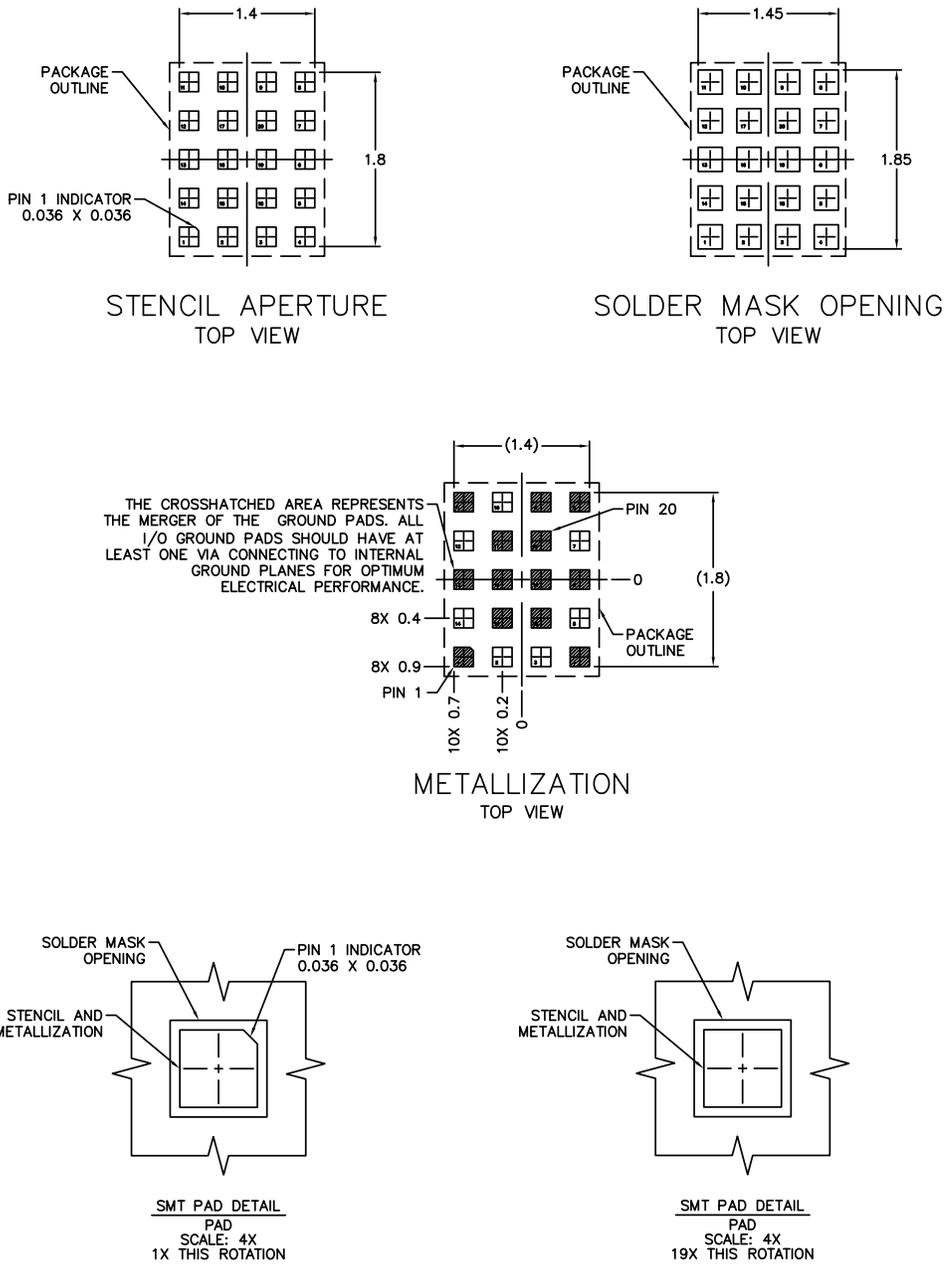
Figure 5. Typical Part Marking



NOTES: UNLESS OTHERWISE SPECIFIED.

1. DIMENSIONING AND TOLERANCING IN ACCORDANCE WITH ASME Y14.5M-1994.
2. DIMENSIONS ARE IN MILLIMETERS
3. PAD DEFINITIONS PER DETAILS ON DRAWING.

Figure 6. Package Dimensions



NOTES:

1. DIMENSIONS ARE IN MILLIMETERS, UNLESS OTHERWISE SPECIFIED.
2. THERMAL VIAS SHOULD BE RESIN FILLED AND CAPPED IN ACCORDANCE WITH IPC-4761 TYPE VII VIAS. 30-35UM Cu THICKNESS IS RECOMMENDED.

Figure 7. PCB Layout Footprint

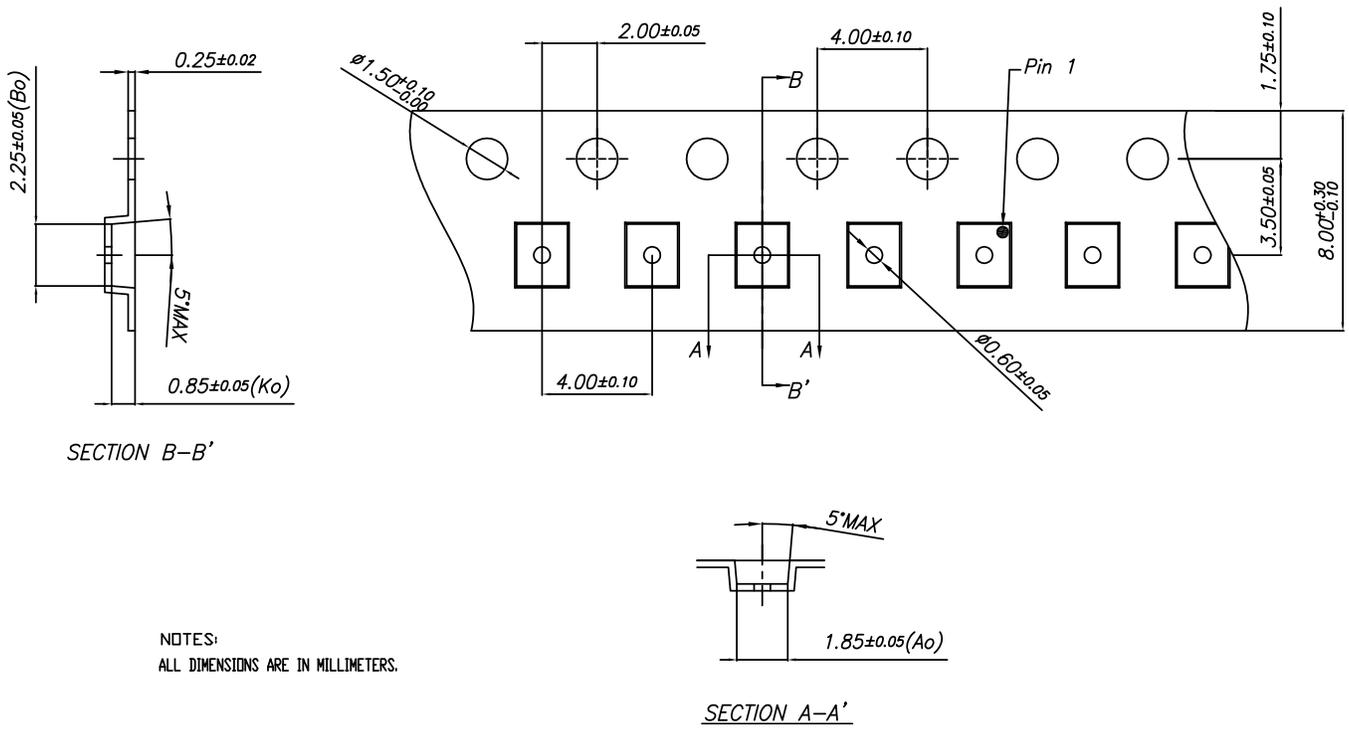


Figure 8. Tape and Reel Information

Ordering Information

Part Number	Description	Evaluation Board Part Number
SKY55951-11	Sky 5® GNSS L1 + L5 Dual-Frequency Low-Noise Amplifier Front-End Module with Post Filter	SKY55951-11EK1

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