



SKY65728-11: Shielded Low-Noise Amplifier Front-End Module with Pre-Filter for GPS L5 Applications

Applications

- GPS L5 radio receivers
- Fitness/activity trackers
- Smartphones
- Laptop PCs and tablets

Features

- Innovative proprietary shielded technology
- Wideband pre-filter
- Small signal gain: 16 dB typical
- Excellent out-of-band rejection
- Low noise figure: 1.6 dB typical
- Low current consumption
- Input/output impedance internally matched to 50 Ω
- Single DC supply: 1.1 to 2.85 V
- Minimal number of external components required
- Small MCM 9-pin, 1.6 x 1.6 x 0.7 [nominal] mm (MSL3, 260°C per JEDEC J-STD-020)



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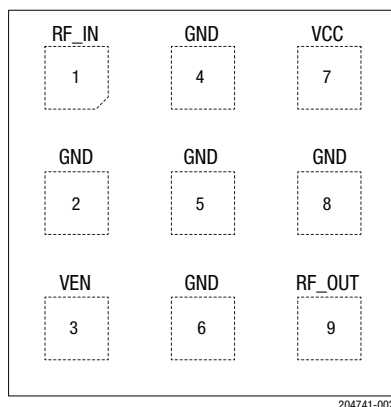


Figure 1. SKY65728-11 Pinout (Top View)

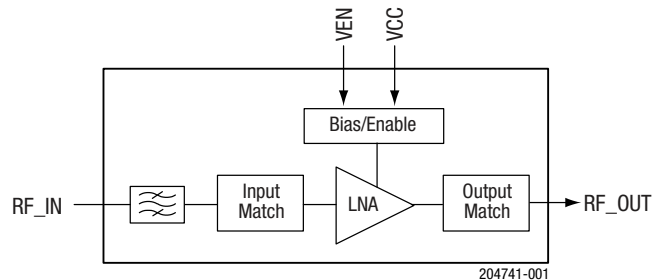


Figure 2. SKY65728-11 Block Diagram

Description

The SKY65728-11 is a shielded front-end module (FEM) with an integrated low-noise amplifier (LNA) and pre-filter designed for Global Positioning System (GPS) L5 band receiver applications. The device provides high linearity, excellent gain, a high 1 dB input compression point (IP1dB), and a 1.6 dB typical noise figure (NF).

The pre-filter provides low in-band insertion loss and integrated notch filtering for excellent rejection of the cellular, PCS, and WLAN frequency bands.

The SKY65728-11 uses surface-mount technology (SMT) in a Multi-Chip Module (MCM) package, which allows for a highly manufacturable and low-cost solution.

The pin configuration and package are shown in Figure 1. A functional block diagram is shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.

Table 1. SKY65728-11 Signal Descriptions

Pin	Name	Description	Pin	Name	Description
1	RF_IN	RF input	6	GND	Ground
2	GND	Ground	7	VCC	Supply voltage
3	VEN	LNA enable	8	GND	Ground
4	GND	Ground	9	RF_OUT	RF output
5	GND	Ground			

Technical Description

LNA Enable

The VEN signal (pin 3) 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 SKY65728-11 are provided in Table 2. The recommended operating conditions are specified in Table 3, and electrical specifications are provided in Tables 4, 5, and 6.

Table 2. SKY65728-11 Absolute Maximum Ratings¹

Parameter	Symbol	Minimum	Maximum	Units
RF input power	Pin		+10	dBm
Supply voltage	Vcc	0	3.1	V
Storage temperature	Tstg	-55	+150	°C
Junction temperature	Tj		+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. 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. SKY65728-11 Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units
Frequency range	f	1164	1176	1189	MHz
Supply voltage	Vcc	1.1	1.2	2.85	V
LNA enable: Enable (high) Disable (low)	LNA _{ENABLE} LNA _{DISABLE}	1.1	0	2.85 0.3	V V
Case operating temperature	Tc	-30	+25	+85	°C

Table 4. SKY65728-11 Electrical Specifications¹
(VCC = 1.2 V, VEN = 1.8 V, f = 1176 MHz, Tc = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Small signal gain (GPS, L5 band)	S21	PIN = -30 dBm	14	16	18	dB
Noise figure (GPS, L5 band)	NF			1.6		dB
In-band third order input intercept point	IIP3	f1 = 1175 MHz @ PIN = -30 dBm f2 = 1176 MHz @ PIN = -30 dBm		-12		dBm
1 dB input compression point (in-band)	IP1dB			-18		dBm
Reverse isolation	S12	PIN = -30 dBm		50		dB
Input return loss	S11	PIN = -30 dBm		9		dB
Output return loss	S22	PIN = -30 dBm		20		dB
Supply current	Icc	No RF		3.9	5	mA
Shutdown current	Ileak	No RF, VEN = 0 V		0.1	1	uA
Out-of-band rejection	OOB	In-band referred: @ 13 to 829 MHz @ 830 to 925 MHz @ 1427 to 1785 MHz @ 1815 to 1919 MHz @ 1920 to 2690 MHz @ 3168 to 4223 MHz @ 4224 to 5825 MHz	58 55 40 45 50 55 55	65 64 50 51 57 67 64		dBc dBc dBc dBc dBc dBc dBc
Input referred second order out-of-band intercept point	IIP2	f1 = 1930 MHz, Pin1= -10 dBm (CA1A-28A) f2= 738 MHz, Pin2 = -10 dBm		+103		dBm
Input referred third order out-of-band intercept point	IIP3	f1 = 1890 MHz, Pin1= -10 dBm (CA39A-41A) f2= 2593 MHz, Pin2 = -10 dBm		+60		dBm
LNA turn-on time	ton	PIN = -30 dBm, VCC = 1.2 V, 50% of VENABLE to 90% final RF power		2	3	uS
LNA turn-off time	toff	PIN = -30 dBm, VCC = 1.2 V, 50% of VENABLE to 10% final RF power		0.2	1	uS

1. Performance is guaranteed only under the conditions listed in this Table and is not guaranteed over the full operating or storage temperature ranges. Operation at elevated temperatures may reduce reliability of the device.

Table 5. SKY65728-11 Electrical Specifications¹
(VCC = 1.8 V, VEN = 1.8 V, f = 1176 MHz, Tc = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Small signal gain (GPS, L5 band)	S21	PIN = -30 dBm	14.5	16.5	18.5	dB
Noise figure (GPS, L5 band)	NF			1.6		dB
In-band third order input intercept point	IIP3	f1 = 1175 MHz @ PIN = -30 dBm f2 = 1176 MHz @ PIN = -30 dBm		-12		dBm
1 dB input compression point (in-band)	IP1dB			-18		dBm
Reverse isolation	S12	PIN = -30 dBm		50		dB
Input return loss	S11	PIN = -30 dBm		9		dB
Output return loss	S22	PIN = -30 dBm		20		dB
Supply current	icc	No RF		4.4	5.5	mA
Shutdown current	Ileak	No RF, VEN = 0 V		0.1	1	uA
Out-of-band rejection	OOB	In-band referred:				
		@ 13 to 829 MHz	58	65		dBc
		@ 830 to 925 MHz	55	64		dBc
		@ 1427 to 1785 MHz	40	50		dBc
		@ 1815 to 1919 MHz	45	50		dBc
		@ 1920 to 2690 MHz	50	57		dBc
@ 3168 to 4223 MHz	55	67		dBc		
@ 4224 to 5825 MHz	55	64		64		dBc
Input referred second order out-of-band intercept point	IIP2	f1 = 1930 MHz, Pin1= -10 dBm (CA1A-28A) f2= 738 MHz, Pin2 = -10 dBm		+103		dBm
Input referred third order out-of-band intercept point	IIP3	f1 = 1890 MHz, Pin1= -10 dBm (CA39A-41A) f2= 2593 MHz, Pin2 = -10 dBm		+60		dBm
LNA turn-on time	ton	PIN = -30 dBm, VCC = 1.8 V, 50% of VENABLE to 90% final RF power		2	3	uS
LNA turn-off time	toff	PIN = -30 dBm, VCC = 1.8 V, 50% of VENABLE to 10% final RF power		0.2	1	uS

1. Performance is guaranteed only under the conditions listed in this Table and is not guaranteed over the full operating or storage temperature ranges. Operation at elevated temperatures may reduce reliability of the device.

Table 6. SKY65728-11 Electrical Specifications¹
(VCC = 2.8 V, VEN = 2.8 V, f = 1176 MHz, Tc = +25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Small signal gain (GPS, L5 band)	S21	PIN = -30 dBm	15	17	19	dB
Noise figure (GPS, L5 band)	NF			1.6		dB
In-band third order input intercept point	IIP3	f1 = 1175 MHz @ PIN = -30 dBm f2 = 1176 MHz @ PIN = -30 dBm		-12		dBm
1 dB input compression point (in-band)	IP1dB			-18		dBm
Reverse isolation	S12	PIN = -30 dBm		50		dB
Input return loss	S11	PIN = -30 dBm		9		dB
Output return loss	S22	PIN = -30 dBm		20		dB
Supply current	Icc	No RF		5.3	6.5	mA
Shutdown current	Ileak	No RF, VEN = 0 V		0.1	1	uA
Out-of-band rejection	OOB	In-band referred: @ 13 to 829 MHz	60	65		dBc
		@ 830 to 925 MHz	55	64		dBc
		@ 1427 to 1785 MHz	40	50		dBc
		@ 1815 to 1919 MHz	45	50		dBc
		@ 1920 to 2690 MHz	50	57		dBc
		@ 3168 to 4223 MHz @ 4224 to 5825 MHz	55 55	67 65		dBc dBc
Input referred second order out-of-band intercept point	IIP2	f1 = 1930 MHz, Pin1 = -10 dBm (CA1A-28A) f2 = 738 MHz, Pin2 = -10 dBm		+103		dBm
Input referred third order out-of-band intercept point	IIP3	f1 = 1890 MHz, Pin1 = -10 dBm (CA39A-41A) f2 = 2593 MHz, Pin2 = -10 dBm		+60		dBm
LNA turn-on time	ton	PIN = -30 dBm, VCC = 2.8 V, 50% of VENABLE to 90% final RF power		2	3	uS
LNA turn-off time	toff	PIN = -30 dBm, VCC = 2.8 V, 50% of VENABLE to 10% final RF power		0.2	1	uS

1. Performance is guaranteed only under the conditions listed in this Table and is not guaranteed over the full operating or storage temperature ranges. Operation at elevated temperatures may reduce reliability of the device.

Evaluation Board Description

The SKY65728-11 Evaluation Board is used to test the performance of the SKY65728-11. A schematic of the Evaluation Board is provided in Figure 3. An assembly diagram of the Evaluation Board is shown in Figure 4. Table 7 provides the Evaluation Board Bill of Materials.

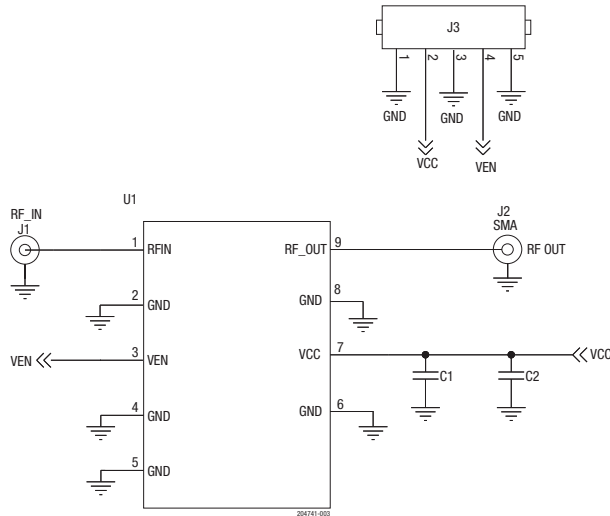


Figure 3. SKY65728-11 Evaluation Board Schematic

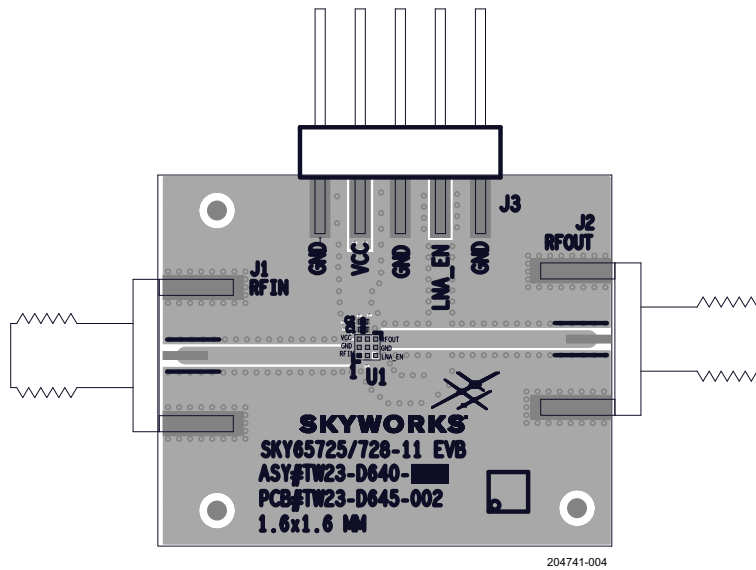


Figure 4. SKY65728-11 Evaluation Board Assembly Diagram

Table 7. SKY65728-11 Evaluation Board Bill of Materials

Component	Size	Value
C1	0201	DNI
C2	0201	DNI

Package Dimensions

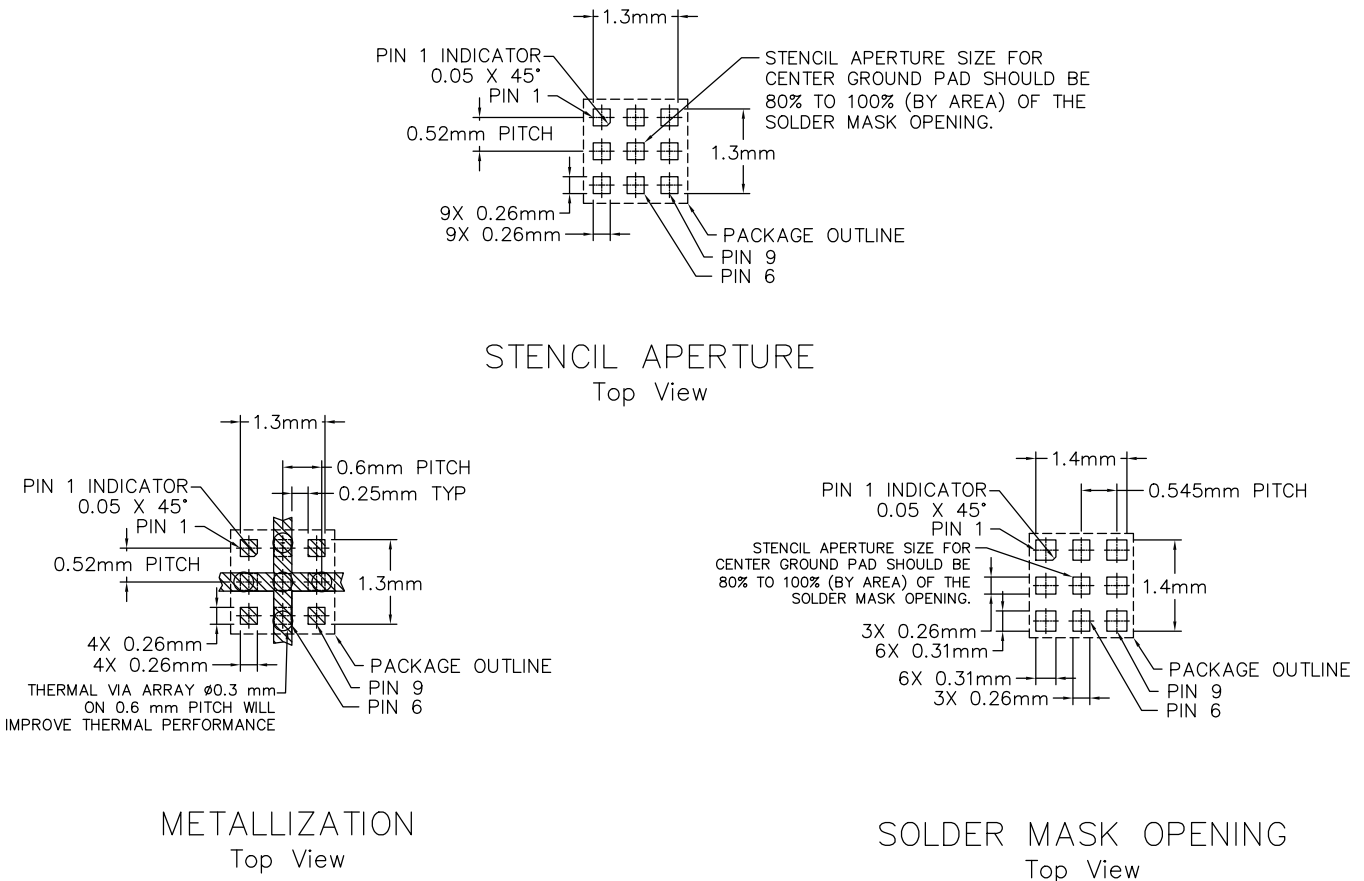
The PCB layout footprint for the SKY65728-11 is provided in Figure 5. Typical part marking is shown in Figure 6. Package dimensions are shown in Figure 7, and tape and reel dimensions are provided in Figure 8.

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 SKY65728-11 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, 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.



NOTE: THERMAL VIAS SHOULD BE RESIN FILLED AND CAPPED IN ACCORDANCE WITH IPC-4761 TYPE VII VIAS. 30-35UM Cu THICKNESS IS RECOMMENDED.

204741-005

Figure 5. SKY65728-11 PCB Layout Footprint

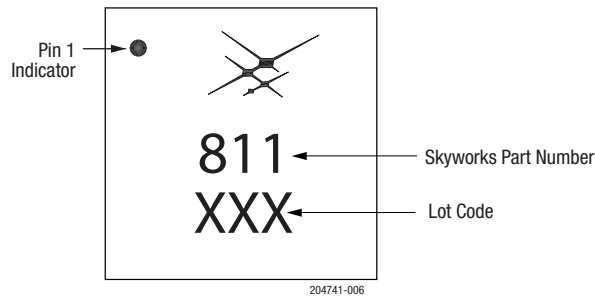
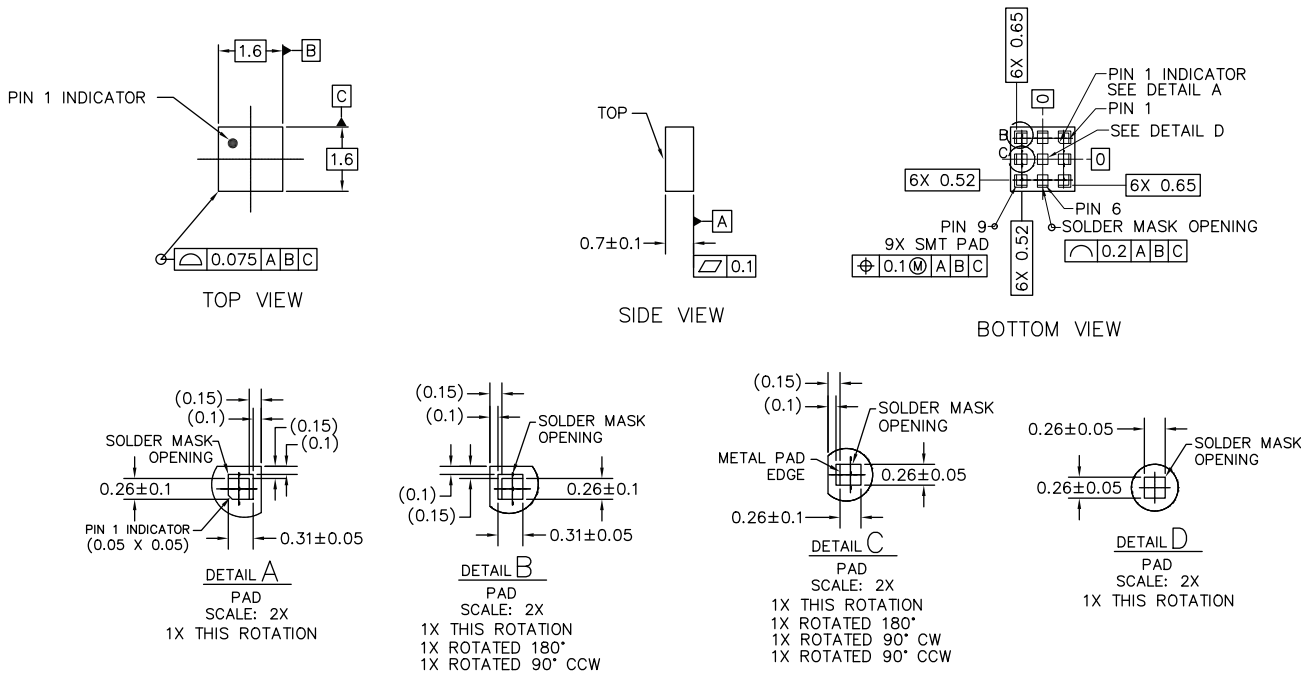


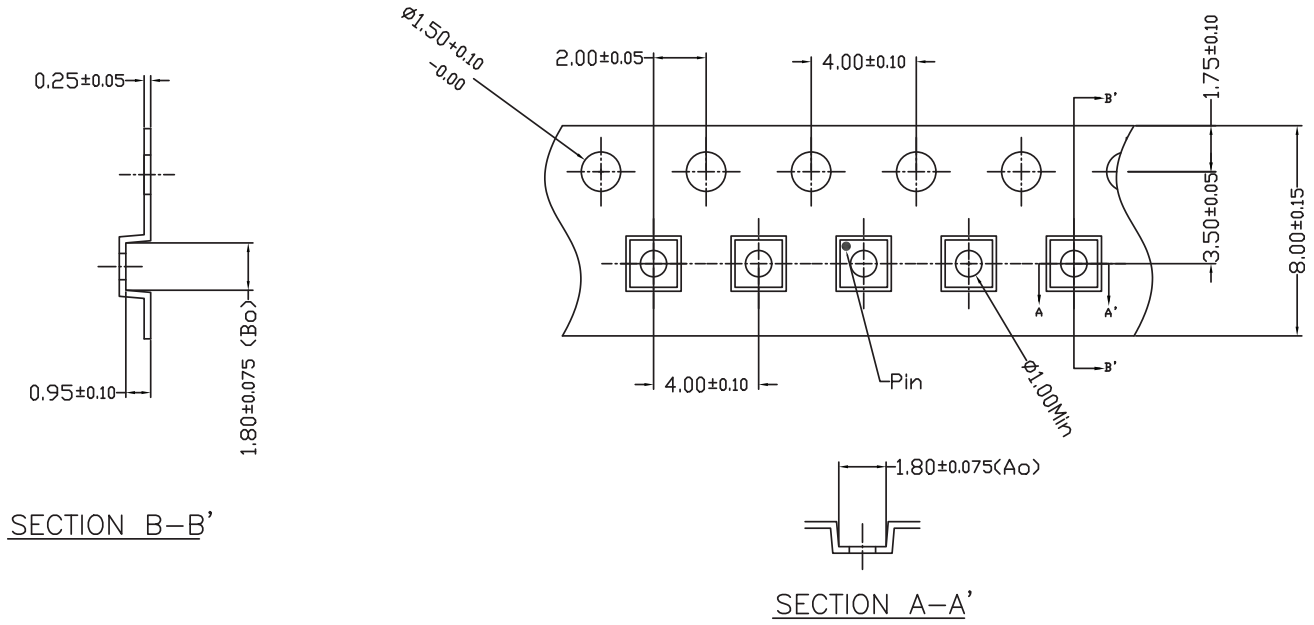
Figure 6. SKY65728-11 Typical Part Marking (Top View)



NOTES: UNLESS OTHERWISE SPECIFIED.
 1. DIMENSIONING AND TOLERANCING IN ACCORDANCE WITH ASME Y14.5M-1994.
 2. DIMENSIONS ARE IN MILLIMETERS.

204741-007

Figure 7. SKY65728-11 Package Dimensions



10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE : ± 0.20 mm
 A_o & B_o MEASURED ON PLANE 0.30mm ABOVE THE BOTTOM OF THE POCKET.
 ALL DIMENSIONS ARE IN MILLIMETERS.

204741-008

Figure 8. SKY65728-11 Tape and Reel Dimensions

Ordering Information

Part Number	Part Description	Evaluation Board Part Number
SKY65728-11	Shielded Low-Noise Amplifier Front-End Module with Pre-Filter for GPS L5 Applications	SKY65728-11EK1

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