

DATA SHEET

SKY55950-11: Sky5® Low-Current GNSS LNA Front-End Module with Integrated Pre-Filter and Post-Filter

Applications

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

Features

- Small signal gain: 16 dB
- Out-of-band P1dB: +8 dBm
- Out-of-band rejection: +94 dBc, 1627 to 1629 MHz
- Low noise figure: 1.9 dB
- Low current consumption: 1 mA @ 1.8 V
- Input/output impedance internally matched to 50 Ω
- Single DC supply: 1.5 to 3.6 V
- Minimum number of external SMT devices required
- Small MCM (10-pin, 2.5 x 2.5 x 0.56 [typical] mm) package (MSL3, 260 °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.

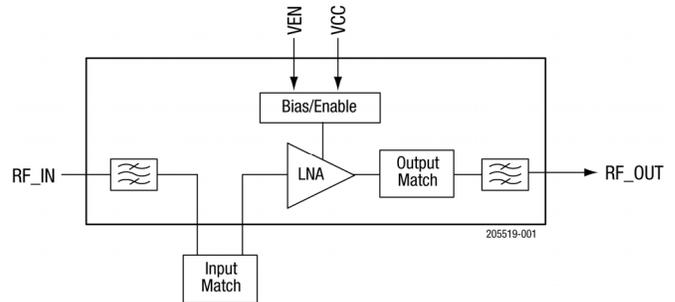


Figure 1. SKY55950-11 Block Diagram

Description

The SKY55950-11 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 SKY55950-11 is part of our Sky5® product portfolio. The device provides low-current, excellent out-of-band rejection, and low noise figure. The pre-filter and post-filter provide low in-band insertion loss and excellent rejection for the cellular, PCS, and WLAN frequency bands. Output matching components are embedded inside the device. Only one external input matching inductor is required.

The SKY55950-11 is optimized to operate at 1559 to 1606 MHz, which makes it ideal for GPS/GLONASS/Galileo/Compass/QZSS radio receiver applications.

The SKY55950-11 uses surface-mount technology (SMT) in the form of a 2.5 x 2.5 x 0.56 (typical) mm Multi-Chip Module (MCM) 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.

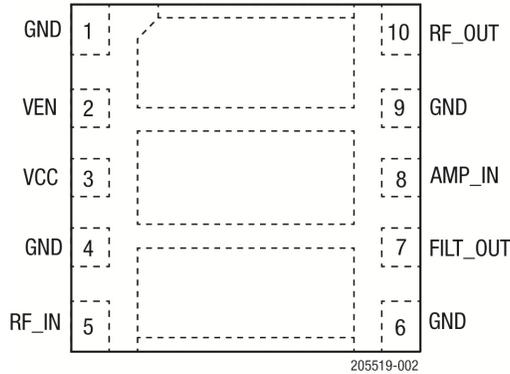


Figure 2. SKY55950-11 Pinout (Top View)

Table 1. SKY55950-11 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 SKY55950-11 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. SKY55950-11 Absolute Maximum Ratings¹

Parameter	Symbol	Minimum	Maximum	Units
RF input power	P _{IN}		+10	dBm
Supply voltage	V _{CC}	0	4.5	V
Enable voltage	VEN	0	3.6	V
Storage temperature	T _{STG}	-55	+150	°C
Junction temperature	T _J		+150	°C
Electrostatic discharge:	ESD			
Charged-Device Model (CDM), Class C1			250	V
Human Body Model (HBM), Class 1A			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. SKY55950-11 Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Units
Frequency	f	1559	1575	1606	MHz
Supply voltage	V _{CC}	1.5		3.6	V
LNA enable:					
Enable (high)	LNA _{ENABLE}	V _{CC} - 0.3		V _{CC}	V
Disable (low)	LNA _{DISABLE}		0	0.3	V
Case temperature	T _C	-40	+25	+85	°C

Table 4. SKY55950-11 Electrical Specifications¹

(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	IS21I	P _{IN} = -40 dBm:				
		@ 1559 MHz	13	15		dB
		@ 1575 MHz	14	16		dB
		@ 1606 MHz	14	15.5		dB
Noise figure	NF	@ 1559 MHz		2.2		dB
		@ 1575 MHz		1.9		dB
		@ 1606 MHz		2.5		dB
Out-band third order input intercept point	IIP3			-21		dBm
Out-of-band 1 dB input compression point	OOB_IP1dB	f _{OOB} = 1627 MHz, IP1dB @ f = 1575 MHz		25		dBm
		f _{OOB} = 1540 MHz, IP1dB @ f = 1575 MHz		8		dBm
Reverse isolation	IS12I	P _{IN} = -40 dBm	30	35		dB
Input return loss	IS11I	P _{IN} = -40 dBm		9		dB
Output return loss	IS22I	P _{IN} = -40 dBm		22		dB
Supply current	I _{CC}	No RF		1	1.4	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		+99		dBc
		@ 300 to 700 MHz		+98		dBc
		@ 700 to 1525 MHz		+77		dBc
		@ 1525 to 1540 MHz		+80		dBc
		@ 1627 to 1629 MHz		+94		dBc
		@ 1630 to 1660 MHz		+97		dBc
@ 1660 to 2500 MHz		+75		dBc		
@ 2500 to 6000 MHz		+71		dBc		
777 MHz harmonic	B13_2f0	Input jammer tone: 777 MHz at -25 dBm Measure the harmonic tone at 1554 MHz at RF output, V _{CC} = V _{enable} = 1.8 V		-114		dBm
787 MHz harmonic	B13_2f0	Input jammer tone: 787 MHz at -25 dBm Measure the harmonic tone at 1574 MHz at RF output, V _{CC} = V _{enable} = 1.8 V		-107		dBm
798 MHz harmonic	B14_2f0	Input jammer tone: 798 MHz at -25 dBm Measure the harmonic tone at 1596 MHz at RF output, V _{CC} = V _{enable} = 1.8 V		-106		dBm
LNA turn-on time	t _{ON}	P _{IN} = -30 dBm, V _{CC} = 1.8 V, 50% of V _{enable} to 90% final RF power		0.7	3	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 guaranteed only under the conditions listed in this table.

Table 5. SKY55950-11 Electrical Specifications¹
(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	IS21I	P _{IN} = -40 dBm: @ 1559 MHz @ 1575 MHz @ 1606 MHz	13.5 14.5 14	15.5 16 16		dB dB dB
Noise figure	NF	@ 1559 MHz @ 1575 MHz @ 1606 MHz		2.2 1.9 2.5		dB dB dB
Out-band third order input intercept point	IIP3	f ₁ = 1575 MHz @ P _{IN} = -40 dBm f ₂ = 1576 MHz @ P _{IN} = -40 dBm		-21		dBm
Out-of-band 1 dB input compression point	OOB_IP1dB	f _{OOB} = 1627 MHz, IP1dB @ f = 1575 MHz		25		dBm
		f _{OOB} = 1540 MHz, IP1dB @ f = 1575 MHz		8		dBm
Reverse isolation	IS12I	P _{IN} = -40 dBm	30	35		dB
Input return loss	IS11I	P _{IN} = -40 dBm		9		dB
Output return loss	IS22I	P _{IN} = -40 dBm		22		dB
Supply current	I _{CC}	No RF		1.1	1.4	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		+100		dBc
		@ 300 to 700 MHz		+97		dBc
		@ 700 to 1525 MHz		+77		dBc
		@ 1525 to 1540 MHz		+80		dBc
		@ 1627 to 1629 MHz		+94		dBc
		@ 1630 to 1660 MHz		+97		dBc
		@ 1660 to 2500 MHz		+75		dBc
@ 2500 to 6000 MHz		+71		dBc		
777 MHz harmonic	B13_2f0	Input jammer tone: 777 MHz at -25 dBm Measure the harmonic tone at 1554 MHz at RF output, V _{CC} = V _{enable} = 2.8 V		-114		dBm
787 MHz harmonic	B13_2f0	Input jammer tone: 787 MHz at -25 dBm Measure the harmonic tone at 1574 MHz at RF output, V _{CC} = V _{enable} = 2.8 V		-107		dBm
798 MHz harmonic	B14_2f0	Input jammer tone: 798 MHz at -25 dBm Measure the harmonic tone at 1596 MHz at RF output, V _{CC} = V _{enable} = 2.8 V		-106		dBm
LNA turn-on time	t _{ON}	P _{IN} = -30 dBm, V _{CC} = 1.8 V, 50% of V _{enable} to 90% final RF power		0.4	3	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 guaranteed only under the conditions listed in this table.

Evaluation Board Description

The SKY55950-11 Evaluation Board is used to test the performance of the SKY55950-11 LNA. An assembly drawing for the Evaluation Board is shown in Figure 3. The Evaluation Board schematic diagram is shown in Figure 4. Table 6 provides the Bill of Materials (BOM) list for Evaluation Board components.

Package Dimensions

The PCB layout footprint for the SKY55950-11 is provided in Figure 5. Typical part markings are 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 SKY55950-11 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.

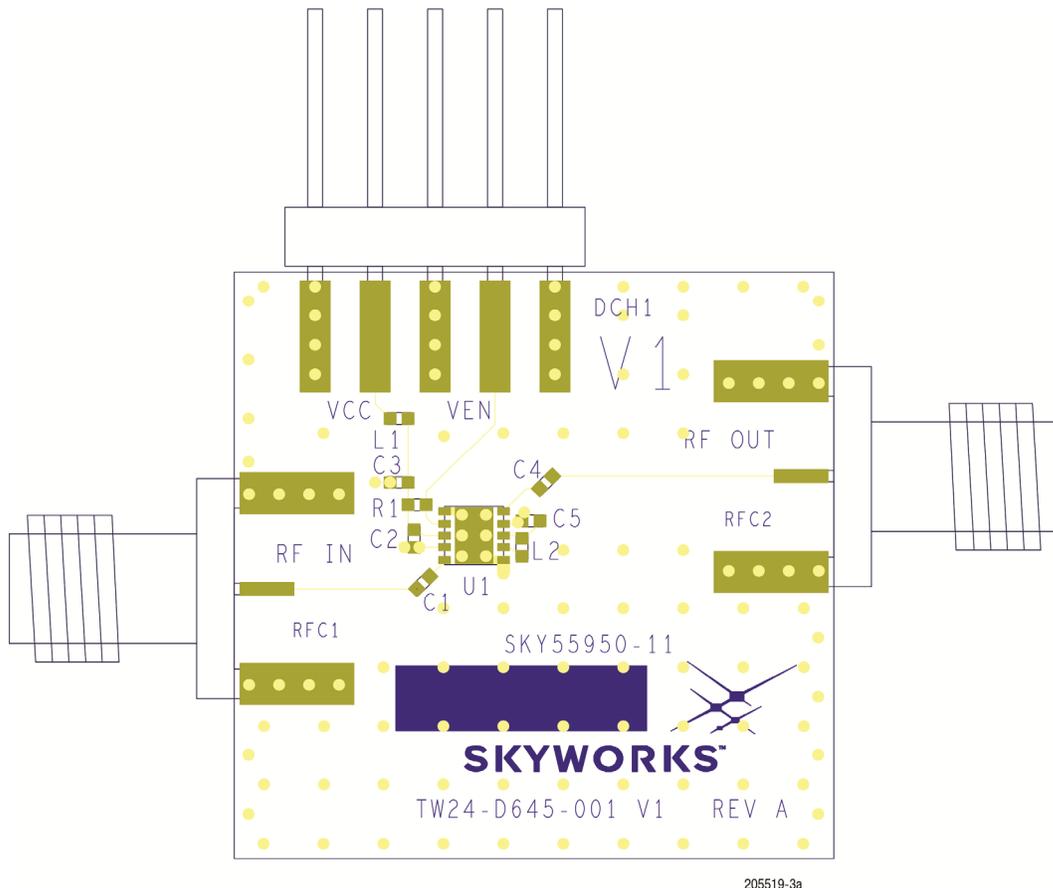
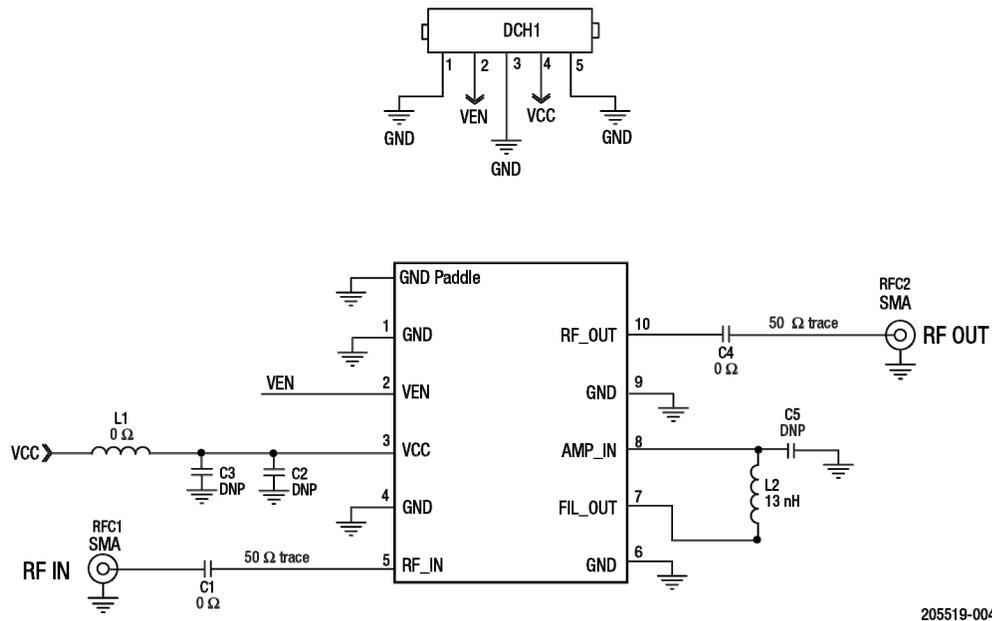


Figure 3. SKY55950-11 Evaluation Board Assembly Diagram



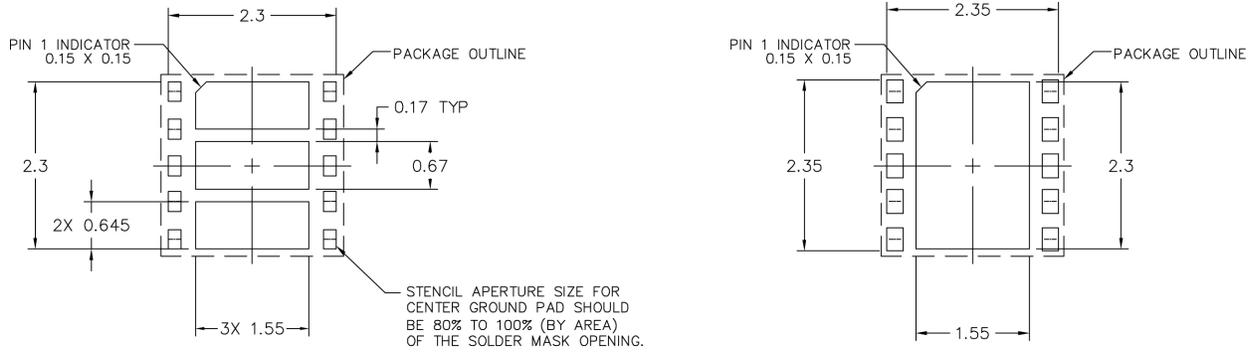
205519-004

Figure 4. SKY55950-11 Evaluation Board Schematic

Table 6. SKY55950-11 Evaluation Board Bill of Materials

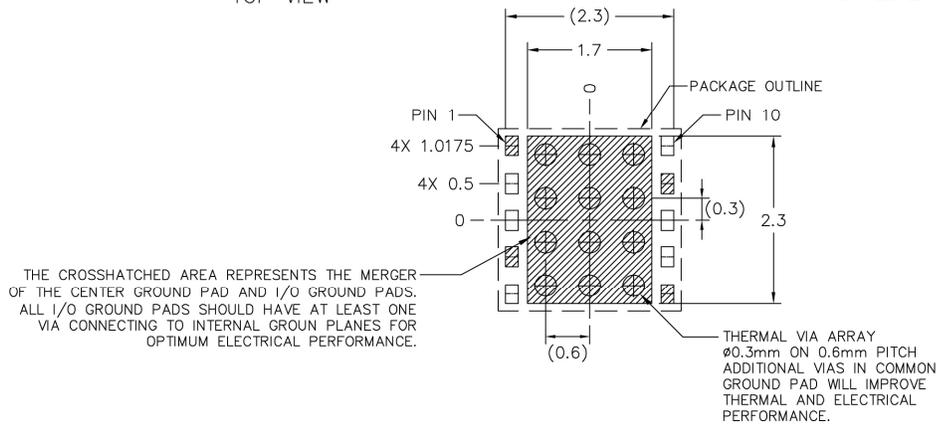
Item Number	Quantity	Part Number	Part Reference	Description	Value	PCB Footprint
1	3	5424R27-134	C1, C4, L1	RES, 0 ohm, 5%, 0.063 W, 0402	0 ohm	402
2	1	LQW15AN13NG00	L2	Murata, 13 NH, WW 0402 IND 2%	13 nH	402
3	2	615R54-021	RFC1, RFC2	SMA, 0.062 edge connector [EF-Johnson]	SMA	HDR2540P1RST-6
4	1	HDR2540P1RST-6	DCH1	5 HEADER_3_HDR2540P1RST-6_8 HEA	5 HEADER	
5	1	SKY55950	U1	Sky5 [®] Low-Current GNSS LNA Front-End Module		

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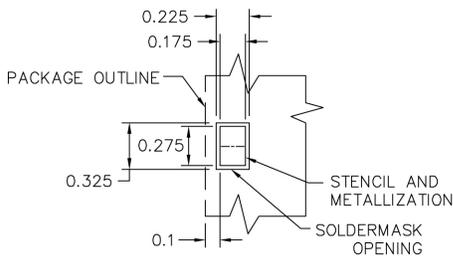


**STENCIL APERTURE
TOP VIEW**

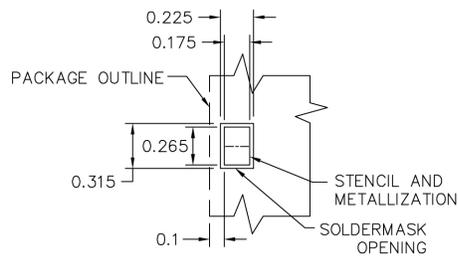
**SOLDER MASK OPENING
TOP VIEW**



**METALLIZATION
TOP VIEW**



**SMT PAD DETAIL
SCALE: 2X
3X THIS ROTATION
3X ROTATED 180°**



**SMT PAD DETAIL
SCALE: 2X
2X THIS ROTATION
2X ROTATED 180°**

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.

205519-005

Figure 5. SKY55950-11 PCB Layout Footprint

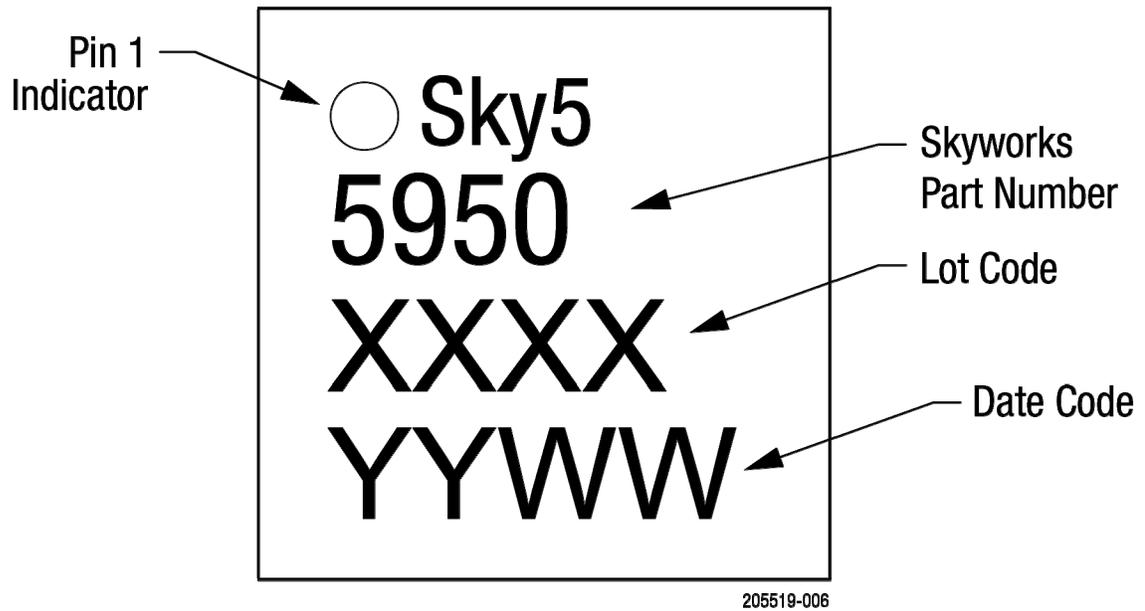
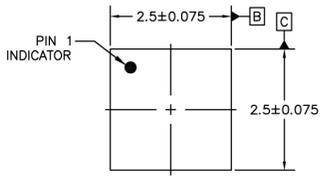
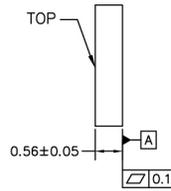


Figure 6. SKY55950-11 Typical Part Markings (Top View)

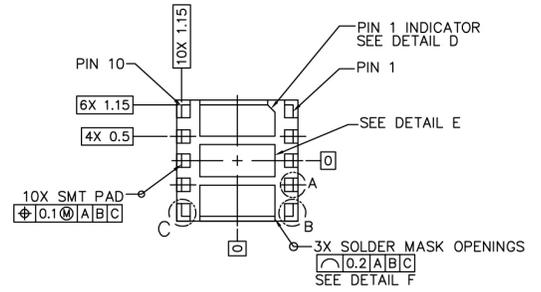
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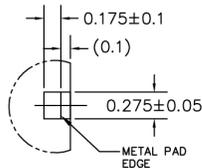
TOP VIEW



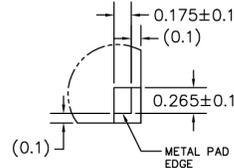
SIDE VIEW



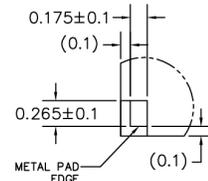
BOTTOM VIEW



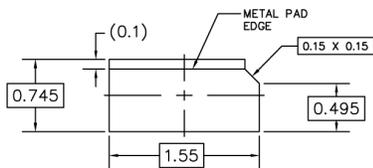
DETAIL A
PAD
SCALE: 2X
3X THIS ROTATION
3X ROTATED 180°



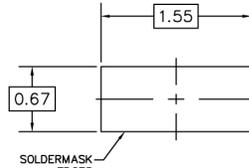
DETAIL B
PAD
SCALE: 2X
1X THIS ROTATION
1X ROTATED 180°



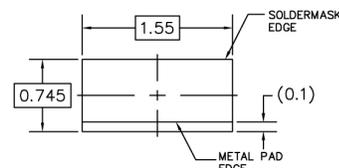
DETAIL C
PAD
SCALE: 2X
1X THIS ROTATION
1X ROTATED 180°



DETAIL D
SCALE: 2X
1X THIS ROTATION



DETAIL E
SCALE: 2X
1X THIS ROTATION



DETAIL F
SCALE: 2X
1X THIS ROTATION

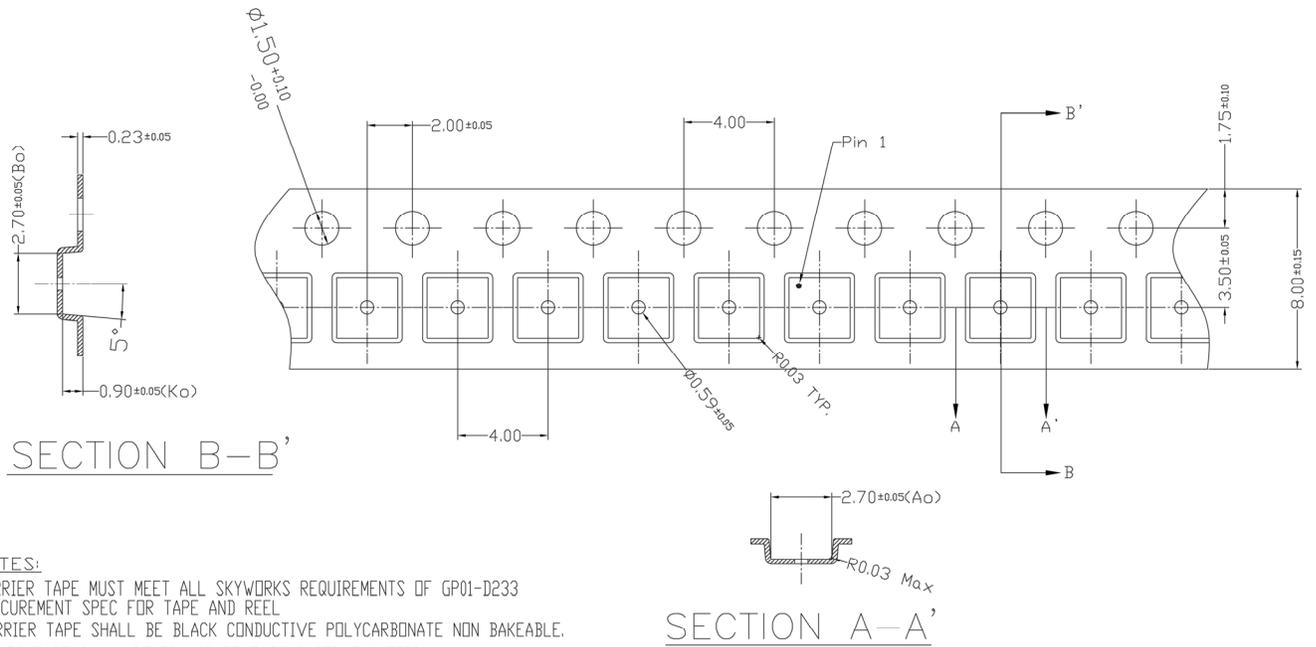
NOTES: UNLESS OTHERWISE SPECIFIED.

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

205519-7b

Figure 7. SKY55950-11 Package Dimensions

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- NOTES:
1. CARRIER TAPE MUST MEET ALL SKYWORKS REQUIREMENTS OF GP01-D233 PROCUREMENT SPEC FOR TAPE AND REEL
 2. CARRIER TAPE SHALL BE BLACK CONDUCTIVE POLYCARBONATE NON BAKEABLE.
 3. COVER TAPE SHALL BE TRANSPARENT CONDUCTIVE MATERIAL
 4. ESD-SURFACE RESISTIVITY SHALL MEET GP01-D233
 5. 10 SPRUCKEL HOLE PITCH CUMULATIVE TOLERANCE : $\pm 0.20\text{mm}$
 6. Ao & Bo MEASURED ON PLANE 0.30mm ABOVE THE BOTTOM OF THE POCKET.
 7. ALL DIMENSIONS ARE IN MILLIMETERS.

SECTION A-A'

205519-008

Figure 8. SKY55950-11 Tape and Reel Dimensions

Ordering Information

Part Number	Product Description	Evaluation Board Part Number
SKY55950-11	Low-Current GNSS LNA FEM with Integrated Pre-Filter and Post-Filter	SKY55950-11EK1

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