

DATA SHEET

SKY13713-21: RX Diversity FEM with Gain (B29, B26, B8, B20, B12/13, B28A and B28B)

Applications

- Antenna cable loss compensation circuit for LTE data antenna
- 3G/4G multimode cellular tablets and handsets (LTE, UMTS, CDMA2000, EDGE, and GSM)
- Embedded data cards

Features

- RX diversity FEM with seven selectable filters and LNA paths, one Aux path and optional bypass mode
- Low insertion loss thru path
- Integrated SAW filter and discrete LNA gain stage
- SAW filters:
 - B29 (717 to 728 MHz)
 - B26 (859 to 894 MHz)
 - B8 (925 to 960 MHz)
 - B20 (791 to 821 MHz)
 - B12/13 (729 to 756 MHz)
 - B28A (758 to 788 MHz)
 - B28B (773 to 803 MHz)
- Integrated MIPI interface
- Small (4 × 3 × 0.7 mm) 24-lead MCM package (MSL3, 260 °C per JEDEC J-STD-020)



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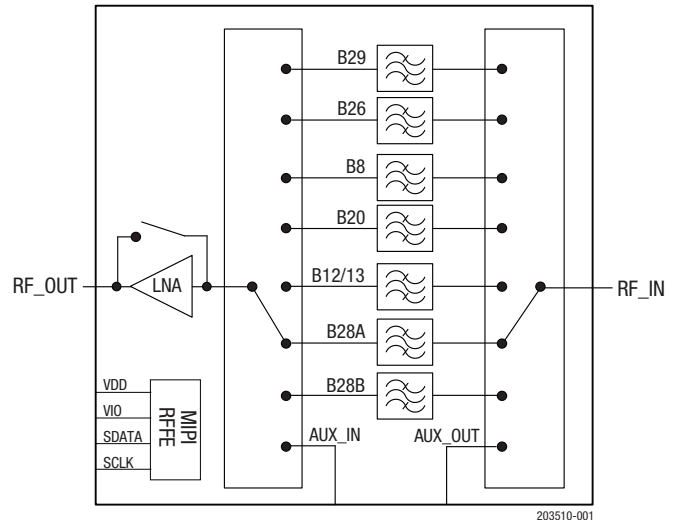


Figure 1. SKY13713-21 Block Diagram

Description

The SKY13713-21 is an LNA diversity module to be used in a cellular mobile device. It supports cellular diversity receiver and localization service receiver functions.

It is compatible with 3GPP GSM, WCDMA, LTE and LTE standards and supports the following service bands: B29, B26, B8, B20, B12/13, B28A and B28B for the cellular part.

The SKY13713-21 is packaged in a small 4 × 3 × 0.7 mm, 24-lead surface mount package. No external DC blocking capacitors are required on the RF paths as long as no DC voltage is applied. The part can operate over the temperature range of –30 °C to +85 °C.

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.

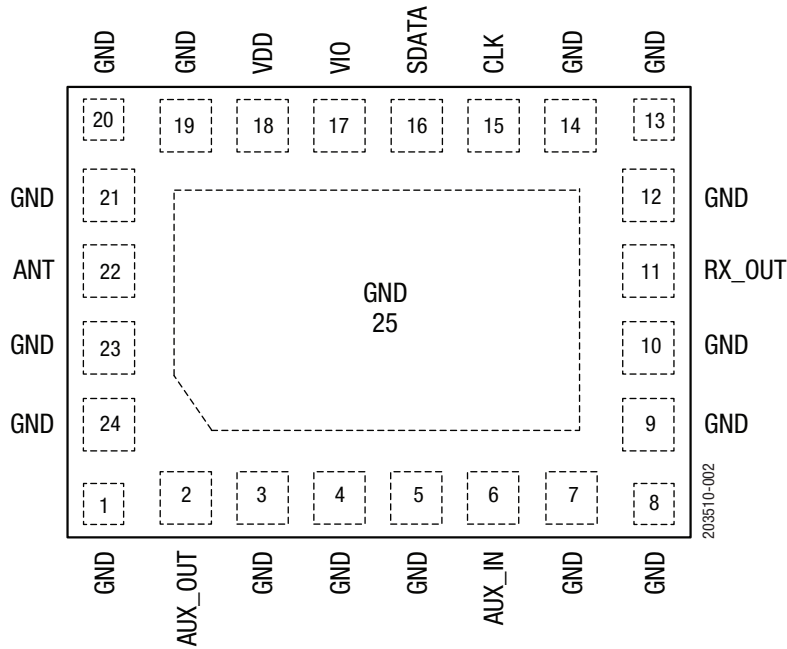


Figure 2. SKY13713-21 Pinout (Top View)

Table 1. SKY13713-21 Signal Descriptions¹

Pin	Name	Description	Pin	Name	Description
1	GND	RF and DC ground	13	GND	RF and DC ground
2	AUX_OUT	Aux output	14	GND	RF and DC ground
3	GND	RF and DC ground	15	CLK	MIPI clock
4	GND	RF and DC ground	16	SDATA	MIPI data
5	GND	RF and DC ground	17	VIO	Voltage for the MIPI logic
6	AUX_IN	Aux input	18	VDD	Power supply voltage
7	GND	RF and DC ground	19	GND	RF and DC ground
8	GND	RF and DC ground	20	GND	RF and DC ground
9	GND	RF and DC ground	21	GND	RF and DC ground
10	GND	RF and DC ground	22	ANT	Antenna port
11	RX_OUT	RX output port	23	GND	RF and DC ground
12	GND	RF and DC ground	24	GND	RF and DC ground

¹ Exposed pads must be connected to ground.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY13713-21 are provided in Table 2. Electrical specifications are provided in Tables 3 and 4. Table 5 shows the register map information for the SKY13713-21.

Table 2. SKY13713-21 Absolute Maximum Ratings¹
(**T_{OP} = +25 °C, Characteristic Impedance [Z₀] = 50 Ω, Unless Otherwise Noted**)

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	VDD		3.5	V
RFFE VIO	VCTL		1.95	V
RF input power (Peak power at ANT port) at bypass mode	PI _N		+30	dBm
Storage temperature	TSTG	-40	+125	°C
Operating temperature	T _{OP}	-30	+85	°C

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: 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. SKY13713-21 General Electrical Specifications¹
(**V_{DD} = 2.85 V, V_{IO} = 1.8 V, T_{OP} = +25 °C, Characteristic Impedance [Z₀] = 50 Ω, Unless Otherwise Noted**)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Supply voltage	VDD			2.85		V
Digital control signal:	VCTL					
High	V _{IH}		0.8 × V _{IO}	V _{IO}		V
Low	V _{IL}		0	0.2 × V _{IO}		V
RFFE VIO	VCTL		1.65	1.8	1.95	V
Supply current:	I _{DD}					
High-gain mode				4.5	6	mA
Bypass mode				60		μA

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

Table 4. SKY13713-21 RF Electrical Specifications¹ (1 of 2)
(V_{DD} = 2.85 V, V_{IO} = 1.8 V, T_{OP} = +25 °C, Characteristic Impedance [Z₀] = 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
In-Band gain:	G	Cascaded gain				
B29 @ 722.5 MHz			12	13	15	dB
B12/13 @ 742 MHz			12	14	16	dB
B28A @ 773 MHz			12	14	16	dB
AUX @ 860.5 MHz			13	15	16.5	dB
SW @ 860.5 MHz			-1.5	-0.5	0	dB
B28B @ 788 MHz			12	13.5	16	dB
B20 @ 806 MHz			12	13.5	16	dB
B26 @ 876.5 MHz			12	14	16.5	dB
B8 @ 942.5 MHz			12	13.5	15.5	dB
In-Band noise figure:	NF	Cascaded noise figure				
B29 @ 722.5 MHz			1	2.5	4	dB
B12/13 @ 742 MHz			1	2.7	4	dB
B28A @ 773 MHz			1	2.5	4	dB
AUX @ 860.5 MHz			0.5	1.5	4	dB
B28B @ 788 MHz			1	2.5	4	dB
B20 @ 806 MHz			1	3.0	5	dB
B26 @ 876.5 MHz			1	2.6	4	dB
B8 @ 942.5 MHz			1	2.6	4	dB
In-Band input return loss:	S11					
B29 @ 722.5 MHz				-9	-6.5	dB
B12/13 @ 742 MHz				-10	-6.5	dB
B28A @ 773 MHz				-7.5	-6	dB
AUX @ 860.5 MHz				-8	-5	dB
SW @ 860.5 MHz				-15	-10	dB
B28B @ 788 MHz				-8.5	-7	dB
B20 @ 806 MHz				-10	-8	dB
B26 @ 876.5 MHz				-9	-7	dB
B8 @ 942.5 MHz				-10	-7	dB
In-Band output return loss:	S22					
B29 @ 722.5 MHz				-14	-8	dB
B12/13 @ 742 MHz				-15	-9	dB
B28A @ 773 MHz				-14	-7.5	dB
AUX @ 860.5 MHz				-15	-8.5	dB
SW @ 860.5 MHz				-15	-10	dB
B28B @ 788 MHz				-13	-7.5	dB
B20 @ 806 MHz				-15	-9	dB
B26 @ 876.5 MHz				-12	-7	dB
B8 @ 942.5 MHz				-15	-8	dB

Table 4. SKY13713-21 RF Electrical Specifications¹ (2 of 2)**(V_{DD} = 2.85 V, V_{IO} = 1.8 V, T_{OP} = +25 °C, Characteristic Impedance [Z₀] = 50 Ω, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
In-Band Bypass Mode gain:	G					
B29 @ 722.5 MHz			-6	-4.0	-3	dB
B12/13 @ 742 MHz			-6	-4.6	-3	dB
B28A @ 773 MHz			-6	-4.3	-3	dB
AUX @ 860.5 MHz			-6	-3.0	-2	dB
B28B @ 788 MHz			-6	-4.3	-3	dB
B20 @ 806 MHz			-6	-4.8	-2	dB
B26 @ 876.5 MHz			-6	-4.3	-2	dB
B8 @ 942.5 MHz			-6	-4.0	-2	dB
Tx rejection:						
B12/13 @ 782 MHz				-30	-25	dB
B28A @ 718 MHz				-35	-25	dB
B28B @ 733 MHz				-30	-25	dB
B20 @ 847 MHz				-33	-25	dB
B26 @ 831.5 MHz				-30	-25	dB
B8 @ 897.5 MHz				-35	-20	dB

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

Table 5. SKY13713-21 Register Map (1 of 2)

Address	Register Type	Register Name	Data Bits	Function	Default	Type	Description	Broadcast ID Support	Trigger Support	Active Trigger
0x00	Static	ANTENNA SWITCH CONTROL	7:4	RESERVED	0x0	R	Reserved for future use	No	Yes	OR function of Trigger0, Trigger1 and Trigger2
			3:0	BAND_SELECT	0x0	R/W	0x00: Isolation			
							0x01: B12			
							0x02: B29			
							0x03: B13			
							0x04: B28A			
							0x05: B28B			
							0x06: AUX			
							0x07: B26			
							0x08: B20			
							0x09: B8			
0x0A-0x0F: Reserved										
0x01	Static	POST SWITCH & LNA CONTROL	7:4	RESERVED	0x0	R	Reserved for future use	No	Yes	OR function of Trigger0, Trigger1 and Trigger2
			3:0	BAND_SELECT	0x0	R/W	0x00: Isolation			
							0x01: B12			
							0x02: B29			
							0x03: B13			
							0x04: B28A			
							0x05: B28B			
							0x06: AUX			
							0x07: B26			
							0x08: B20			
							0x09: B8			
0x0A-0x0F: Reserved										
0x02	Dynamic	LNA_GAIN_CTRL	7:4	RESERVED	0x0	R	Reserved for future use	No	Yes	OR function of Trigger0, Trigger1 and Trigger2
			3:0	GAIN_CTRL	0x0	R/W	0x0: LNA Bypass Mode			
							0x9: High Gain Mode			

Table 5. SKY13713-21 Register Map (2 of 2)

Address	Register Type	Register Name	Data Bits	Function	Default	Type	Description	Broadcast ID Support	Trigger Support	Active Trigger	
0x1A	NA	RFFE_STATUS	7	SOFTWARE_RESET	0x0	R/W	Reset all configurable registers to default values	No	No	NA	
			6	COMMAND_FRAME_PARITY_ERR	0x0	R/W	Command Sequence received with parity error				
			5	COMMAND_LENGTH_ERR	0x0	R/W	Command length error				
			4	ADDRESS_FRAME_PARITY_ERR	0x0	R/W	Address frame with parity error				
			3	DATA_FRAME_PARITY_ERR	0x0	R/W	Data frame with parity error				
			2	READ_UNUSED_REG	0x0	R/W	Read command to an invalid address				
			1	WRITE_UNUSED_REG	0x0	R/W	Write command to an invalid address				
			0	BID_GID_ERR	0x0	R/W	Read command with a BROADCAST_ID or GROUP_ID				
0x1B	NA	GROUP_SID	7:4	RESERVED	0x0	R	Reserved for future use	No	No	NA	
			3:0	GROUP_SID	0x0	R/W	Group slave ID				
0x1C	NA	PM_TRIG	7:6	POWER MODE 1:0	0x1	R/W	00: Normal operation (ACTIVE)	Yes	No	NA	
							01: Default Settings (STARTUP)				
							10: Low power (LOW POWER)				
							11: Reserved				
			5	TRIGGER_MASK_2	0x0	R/W	Trigger Mask 2				No
			4	TRIGGER_MASK_1	0x0	R/W	Trigger Mask 1				
			3	TRIGGER_MASK_0	0x0	R/W	Trigger Mask 0				
			2	TRIGGER_2	0x0	R/W	Trigger 2. This bit has no effect if TRIGGER_MASK_2 is 1.				Yes
1	TRIGGER_1	0x0	R/W	Trigger 1. This bit has no effect if TRIGGER_MASK_1 is 1.							
0	TRIGGER_0	0x0	R/W	Trigger 0. This bit has no effect if TRIGGER_MASK_0 is 1.							
0x1D	NA	PRODUCT_ID	7:0	PRODUCT_ID[7:0]	0xE1	R	Product Identification	No	No	NA	
0x1E	NA	MANUFACTURER_ID	7:0	MANUFACTURER_ID[7:0]	0xA5	R	LSB Manufacturing Identification	No	No	NA	
0x1F	NA	MAN_USID	7:6	RESERVED	0x0	R	Reserved for future use	No	No	NA	
			5:4	MANUFACTURER_ID[9:8]	0x1	R	MSB Manufacturing Identification				
			3:0	USID[3:0]	0x1	R/W	User Identification				

Evaluation Board Description

The SKY13713-21 Evaluation Board is used to test the performance of the SKY13713-21 RX Diversity FEM. An Evaluation Board schematic diagram is provided in Figure 3. An assembly drawing for the Evaluation Board is shown in Figure 4.

Package Dimensions

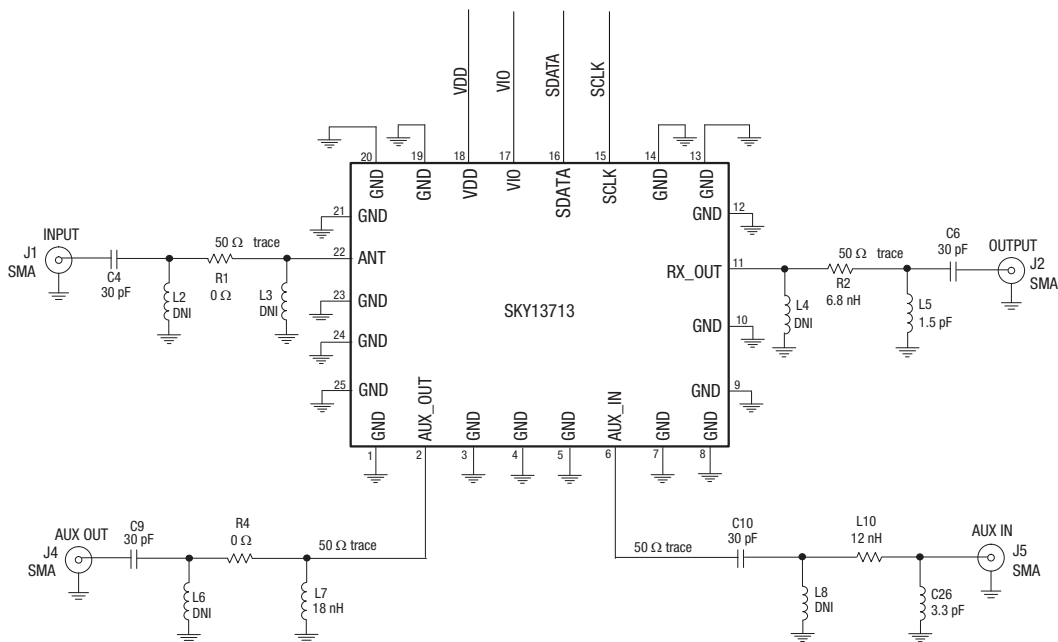
The PCB layout footprint for the SKY13713-21 is shown in Figure 5. Typical part markings are shown in Figure 6. Package dimensions are shown in Figure 7, and tape and reel dimensions are provided in Figure 8.

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 SKY13713-21 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.



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Figure 3. SKY13713-21 Evaluation Board Schematic

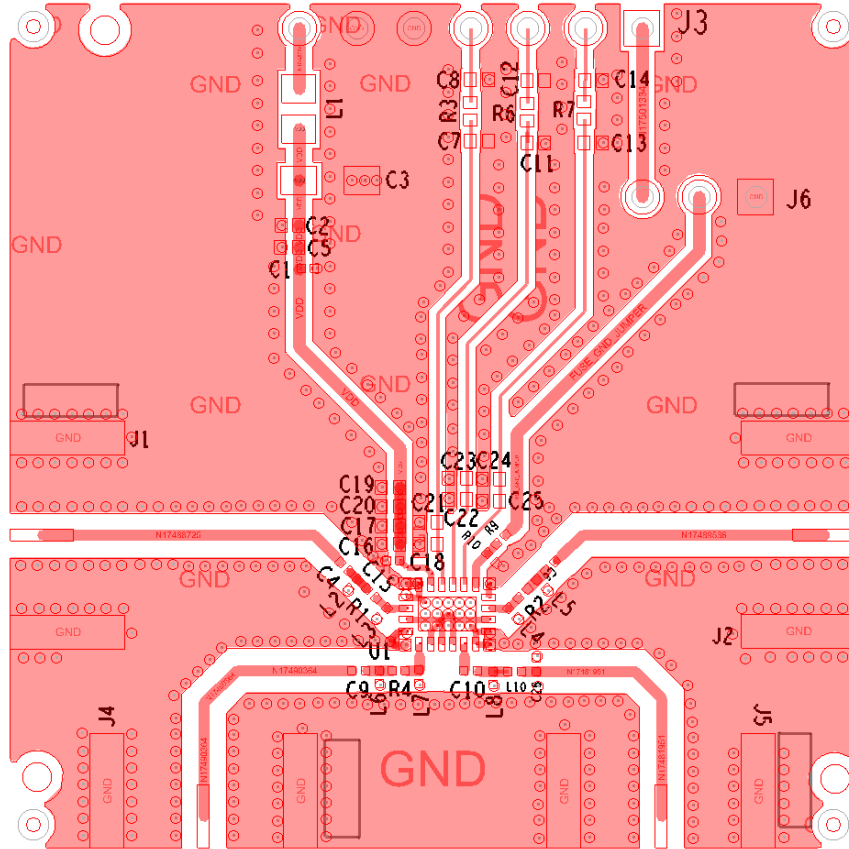
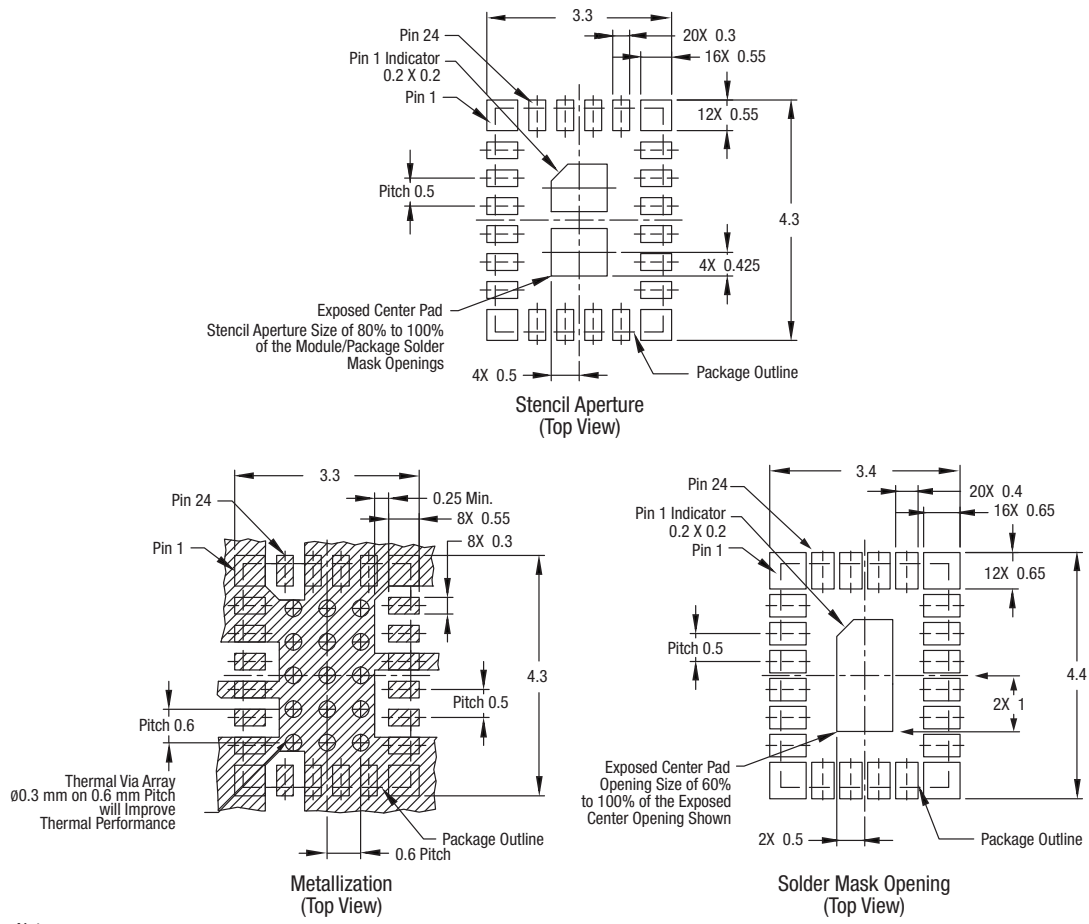


Figure 4. SKY13713-21 Evaluation Board Assembly Diagram



- Notes:
1. Thermal vias should be resin filled and capped in accordance with IPC-4761 Type VII vias. 30 to 35 μm Cu thickness is recommended.
 2. All measurements are in millimeters.

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Figure 5. SKY13713-21 PCB Layout Footprint

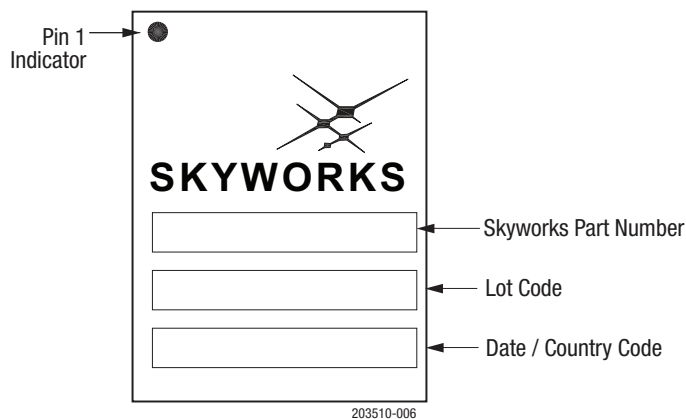
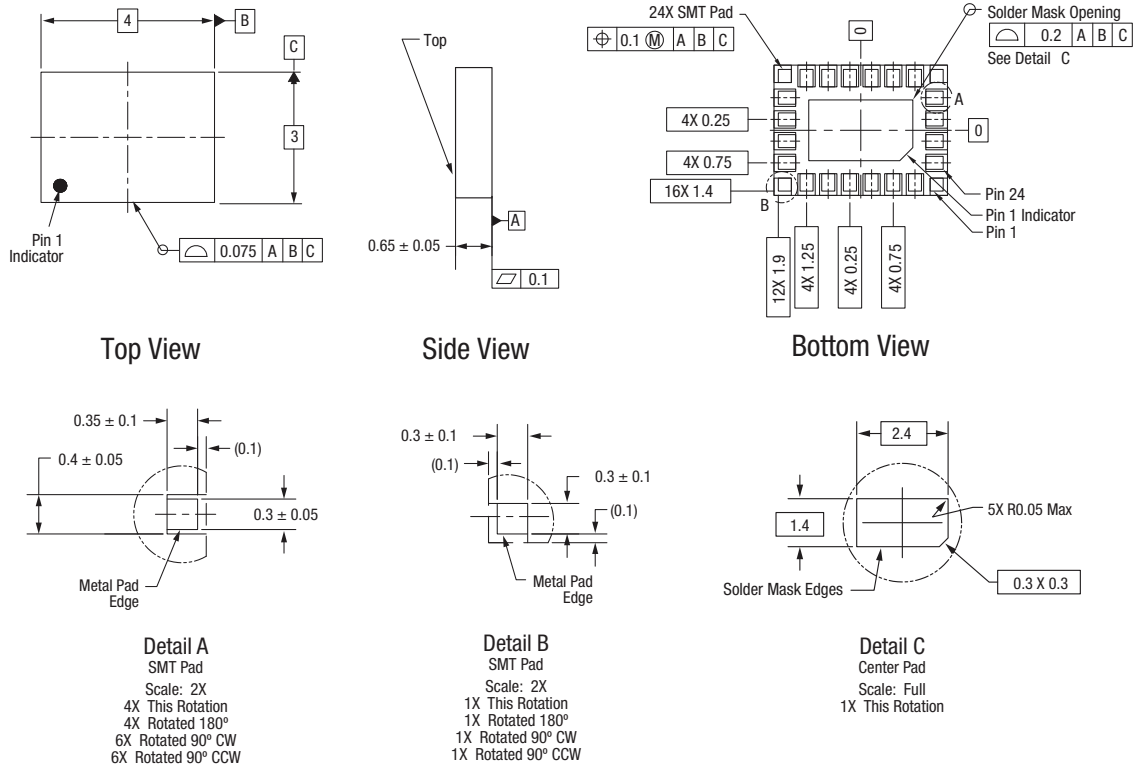


Figure 6. Typical Part Markings (Top View)

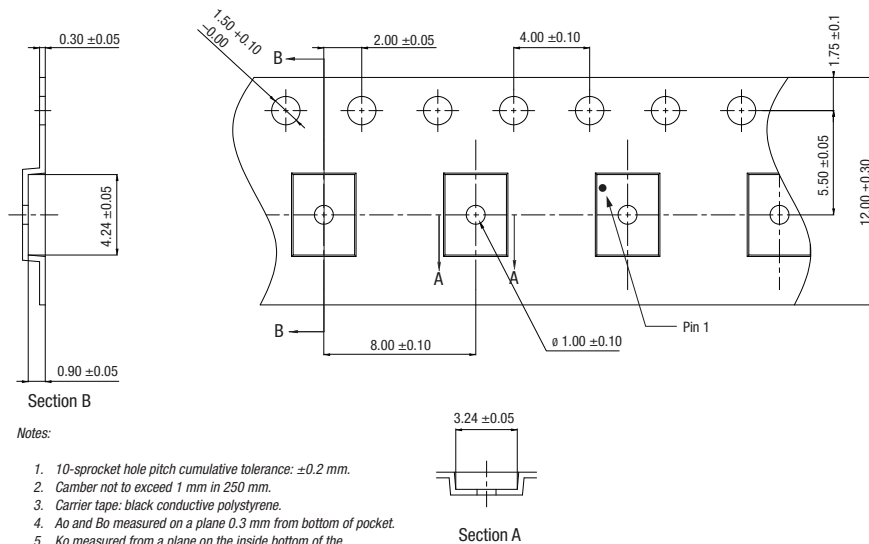


Notes:

1. Dimensions and tolerances according to ASME Y14.5M-1994.
2. Dimensions are in millimeters.

203510-007

Figure 7. SKY13713-21 Package Dimensions



Notes:

1. 10-sprocket hole pitch cumulative tolerance: ±0.2 mm.
2. Camber not to exceed 1 mm in 250 mm.
3. Carrier tape: black conductive polystyrene.
4. A_o and B_o measured on a plane 0.3 mm from bottom of pocket.
5. K_o measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
6. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.
7. Pocket center and pocket hole center must be the same position.
8. All dimensions are in millimeters.

203510-008

Figure 8. SKY13713-21 Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY13713-21: RX Diversity FEM	SKY13713-21	TW22-D405-001

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