PRELIMINARY DATA SHEET

SKY65336-21: 2.4 GHz Transmit/Receive Front-End Module with Integrated LNA

Applications

- 2.4 GHz ISM band radios
- ZigBee® FEMs
- IEEE 802.15.4 applications

Features

- Transmit output power > +20 dBm
- Receive NF < 3 dB
- High efficiency PA
- Programmable transmit power levels
- Configurable transmit/receive paths
- Internal switching and control circuits
- Internal RF match and bias circuits
- Single DC supply = 3.0 V
- Interfaces seamlessley with Ember EM250 and EM260 ZigBee transceivers
- Small footprint, MCM (28-pin, 8 x 8 mm) Pb-free (MSL3, 260 °C per JEDEC J-STD-020) SMT package

NEW

Skyworks offers lead (Pb)-free RoHS (Restriction of Hazardous Substances) compliant packaging.

Description

Skyworks SKY65336-21 is a high-efficiency Front-End Module (FEM) for ZigBee and other 2.4 GHz ISM band applications. The small
8 x 8 mm Multi-Chip Module (MCM) contains a 2400-2500 MHz high-efficiency transmit path and a low-noise linear receive path.

The transmit path consists of an harmonic filter and high efficiency Power Amplifier (PA) capable of providing +20 dBm of power at the antenna port. Also included is an internal balun to allow use of differential input signals.

The receive path contains a high isolation Transmit/Receive (T/R) switch, Low Noise Amplifier (LNA), and balun for low noise differential output.

The device is mounted in a 28-pin, 8 x 8 mm MCM Surface-Mounted Technology (SMT) package, which allows for a highly manufacturable low-cost solution.

A block diagram of the SKY65336-21 is shown in Figure 1. The device package and pinout for the 28-pin MCM are shown in Figure 2.

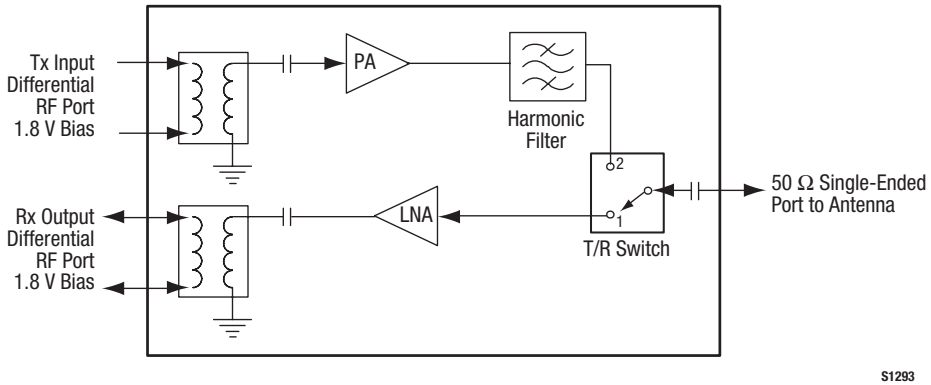


Figure 1. SKY65336-21 Block Diagram

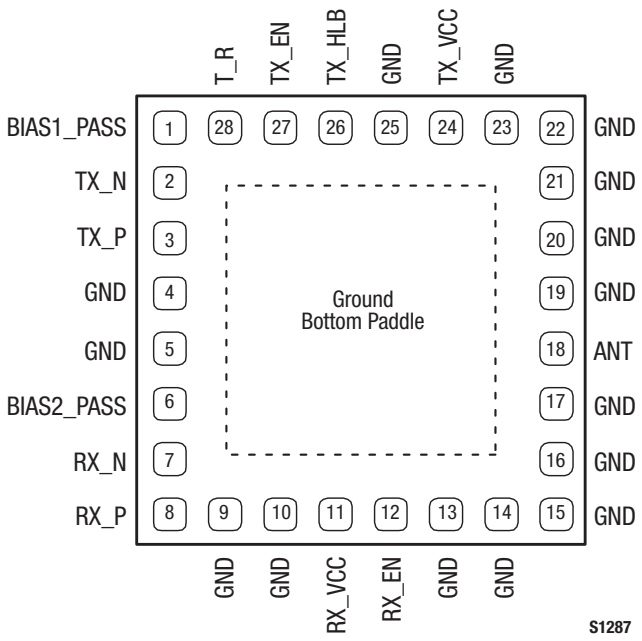


Figure 1. SKY65336-21 Pinout – 28-Pin MCM (Top View)

Technical Description

Transmit/Receive (T/R) Enable

Pin 27 (TX_EN) and pin 12 (RX_EN) are used to enable the transmit and receive port, respectively.

T/R Switch

Pin 28 (T_R) is used to control the T/R switch.

T/R Enable and T/R Switch Mode Control

The following control logic is used to configure the transmit or receive mode of the SKY65336-21:

TX_EN	RX_EN	T/R	Mode
High	Low	High	Transmit mode
Low	High	Low	Receive mode

High Power and Low Power Modes

High power mode output is 20 dBm and low power mode output is 10 dBm. Pin 26 (TX_HLB) sets the transmit path in high power or low power mode according to the following logic:

TX_HLB	State
Low	High power mode
High	Low power mode

Bottom Center Paddle

The bottom center paddle must be electrically grounded for proper RF performance. Customers should place adequate thermal vias under this ground paddle for optimum thermal performance. The Evaluation Board layout (see Figures 3 and 4) can be used as a guide for RF ground and thermal layout.

Tx/ Rx Mode Control with limited Fast Control Lines

If only one fast analog control line is available for module configuration, users can connect the RX_EN pin to 3 V, and connect the TX_EN and T_R control lines together as follows:

TX_EN	T_R	RX_EN	Module Configuration
High	High	High	Transmit mode
Low	Low	High	Receive mode

Electrical and Mechanical Specifications

Signal pin assignments and functional pin descriptions are described in Table 1. The absolute maximum ratings of the SKY65336-21 are provided in Table 2. Recommended operating conditions are noted in Table 3 and electrical specifications are provided in Table 4.

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 SKY65336-21 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 Skyworks Application Note, *PCB Design and 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. For packaging details, refer to the Skyworks Application Note, *Tape and Reel*, document number 101568.

Table 1. SKY65336-21 Signal Descriptions

Pin #	Name	Description	Pin #	Name	Description
1	BIAS1_PASS	Transmit port bias supply	15	GND	Ground
2	TX_N	Positive transmit input port	16	GND	Ground
3	TX_P	Negative transmit input port	17	GND	Ground
4	GND	Ground	18	ANT	Antenna input
5	GND	Ground	19	GND	Ground
6	BIAS2_PASS	Receive port bias supply	20	GND	Ground
7	RX_N	Positive receive output port	21	GND	Ground
8	RX_P	Negative receive output port	22	GND	Ground
9	GND	Ground	23	GND	Ground
10	GND	Ground	24	TX_VCC	Transmit DC supply, +3 V
11	RX_VCC	Receive DC supply, +3 V	25	GND	Ground
12	RX_EN	Receive enable	26	TX_HLB	Transmit power mode
13	GND	Ground	27	TX_EN	Transmit enable
14	GND	Ground	28	T_R	Transmit/receive switch

Note: The bottom ground pad **must be** connected to RF ground.

Table 2. SKY65336-21 Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	RX_VCC, TX_VCC	2.1	4	V
Control Voltage	BIAS1_PASS, BIAS2_PASS, TX_EN, RX_EN, TX_HLB, T_R		3.6	V
Bypass voltage	BIAS1_PASS, BIAS2_PASS		1.9	V
RF input power, antenna port	P_{IN_ANT}		10	dBm
RF input power, transmit port	P_{IN_TX}		+8	dBm
Case operating temperature	T_C	–40	+85	°C
Storage temperature	T_{ST}	–55	+125	°C
Junction temperature	T_J		+150	°C

Note 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.

Table 3. SKY65336-21 Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage (TX_VCC, RX_VCC)	VCC	2.7	3.0	3.6	V
T/R bias supply voltage	BIAS1_PASS, BIAS2_PASS	1.7	1.8	1.9	V
T/R enable voltage: Low High	 TX_EN_L, RX_EN_L TX_EN_H, RX_EN_H	 1.62	 0 1.80	 0.1 3.60	 V V
T/R control voltage: Low High	 T_R_L, TX_HLB_L T_R_H, TX_HLB_H	 1.62	 0 1.80	 0.1 3.60	 V V
Frequency range	f	2400		2500	MHz

Table 4. SKY65336-21 Electrical Specifications (VCC = 3.0 V, Tc = 25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Frequency range	f		2400		2500	MHz
Return loss	RL	All RF ports	10	14		dB
Transmitter Section						
Input power range	P_{IN}	CW, high or low power mode		+3	+5	dBm
Transmit saturated output power	P_{SAT_H} P_{SAT_L}	High power mode Low power mode	+19.7 +8.3	+20 +10		dBm dBm
Operating current	I_{OP_H} I_{OP_L}	P_{OUT} = +20- dBm in high power mode P_{OUT} = +10- dBm in low power mode		145 70	150 75	mA mA
Harmonic levels	P_N	CW, P_{OUT} = +20- dBm in high power mode, P_{OUT} = +10- dBm in low power mode		–44		dBm
Saturated gain	G_H G_L	CW, high power mode CW, low power mode		17 7		dB dB
Transmit path Noise Figure	NF	CW, high or low power mode		6		dB
Leakage current	I_{LEAK}	No RF input, VCC = 3.0 V, RX_EN = 0 V, TX_EN = 0 V		0.5		µA
Receiver Section (Frequency = 2445 MHz)						
Small signal gain	G	CW		10.5		dB
Noise Figure	NF			2.5		dB
Input 1 dB compression	IP1dB	CW		–11		dBm
Input IP3	IIP3	Two CW tones spaced 1 MHz apart @ P_{IN} = –9 dBm		–1		dBm
Operating current	I_{CC}	CW		7.2		mA
Leakage current	I_{LEAK}	No RF input, VCC = 3.0 V, RX_EN = 0 V, TX_EN = 0 V		0.5		µA

Evaluation Board Description

The SKY65336-21 Evaluation Board is used to test the performance of the SKY65336-21 FEM. The Evaluation Board schematic diagram is shown in Figure 3. An assembly drawing for the Evaluation Board is shown in Figure 4.

Package Dimensions

The phone board layout footprint for the SKY65336-21 is shown in Figure 5. Package dimensions for the 28-pin MCM are shown in Figure 6, and tape and reel dimensions are provided in Figure 7.

Electrostatic Discharge (ESD) Sensitivity

The SKY65336-21 is a static-sensitive electronic device. Do not operate or store near strong electrostatic fields. Take proper ESD precautions.

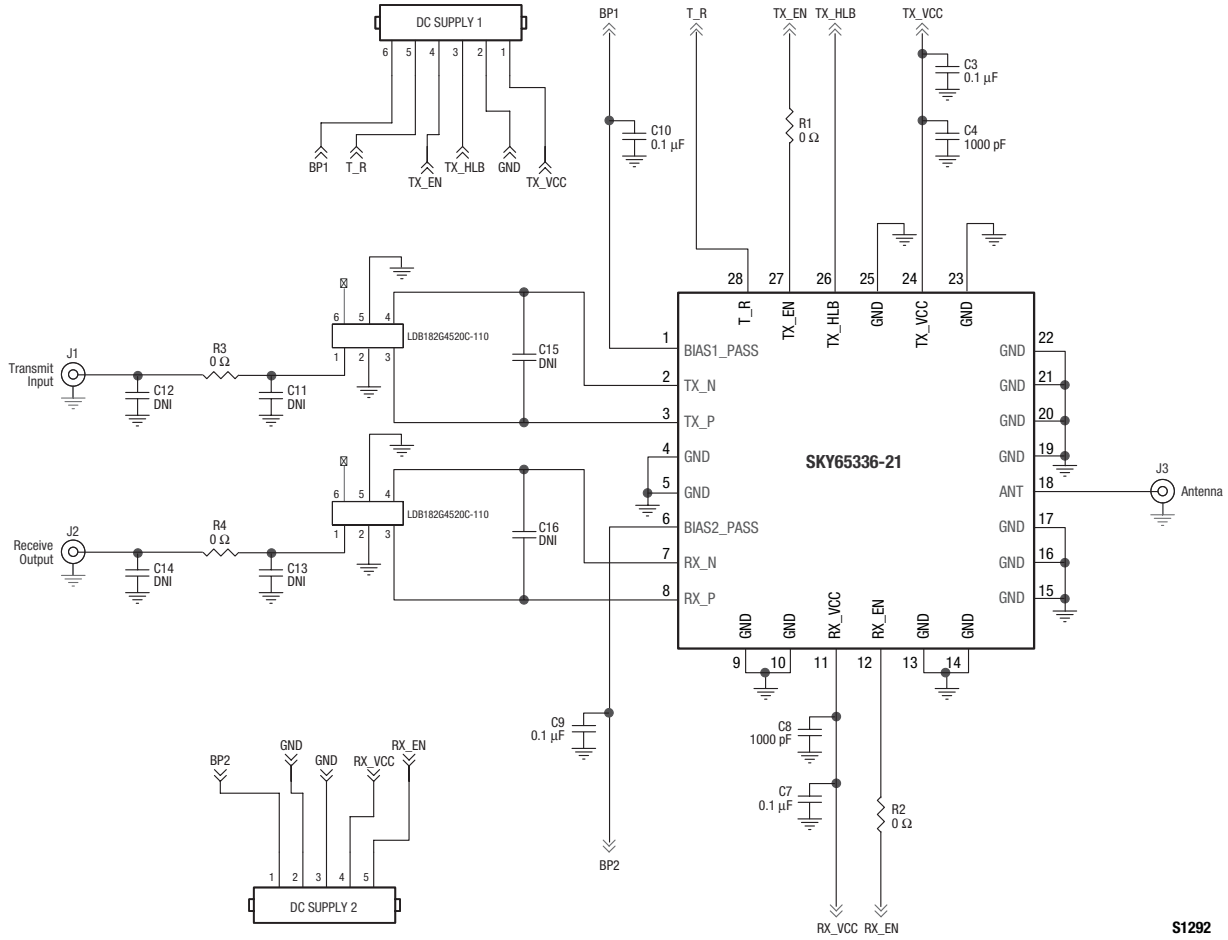


Figure 3. SKY65336-21 Evaluation Board Schematic

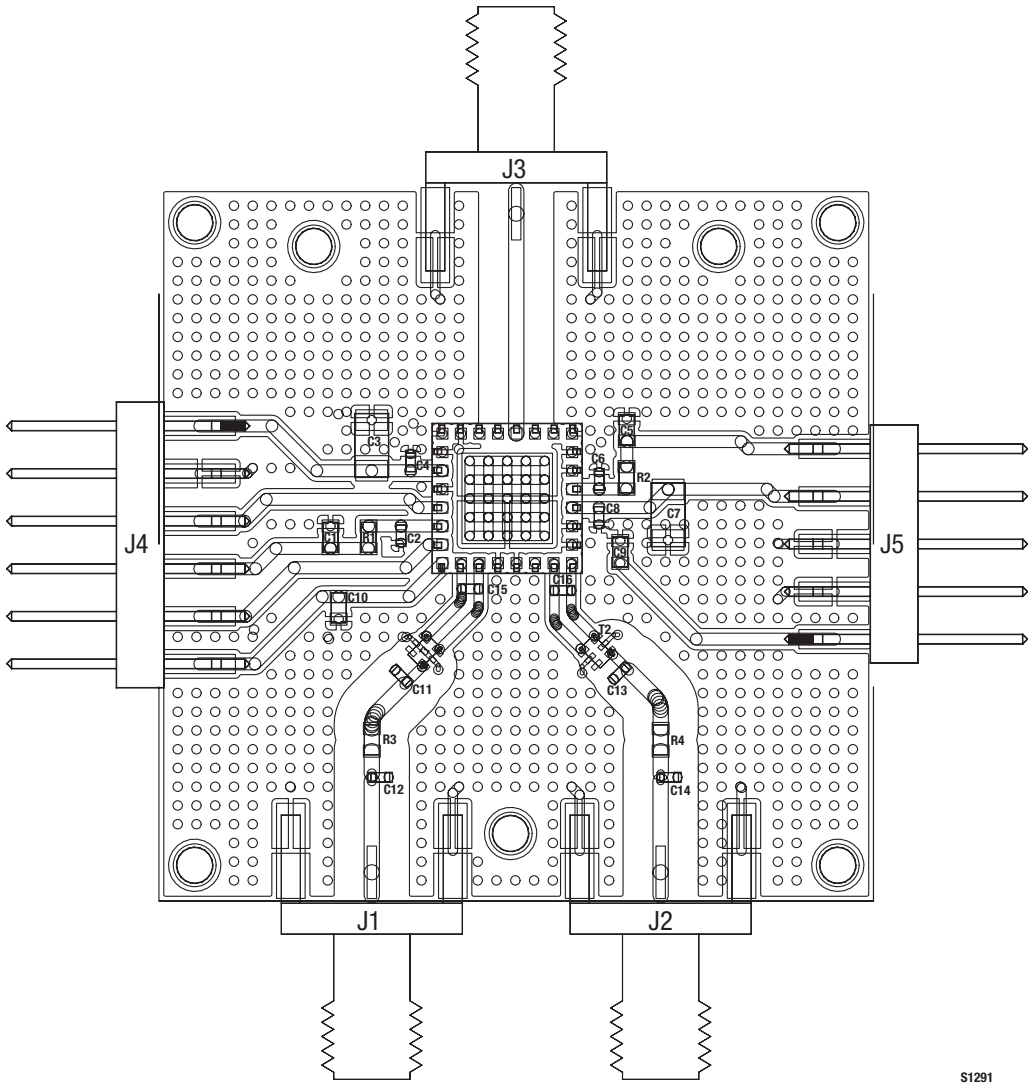
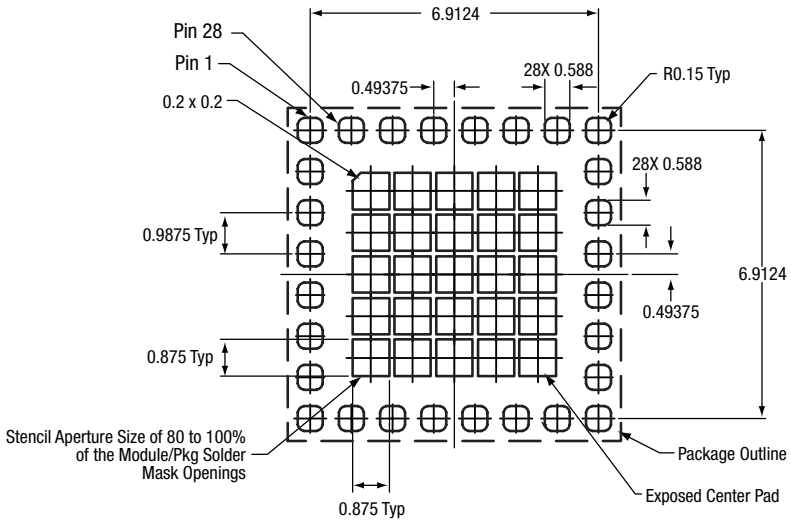
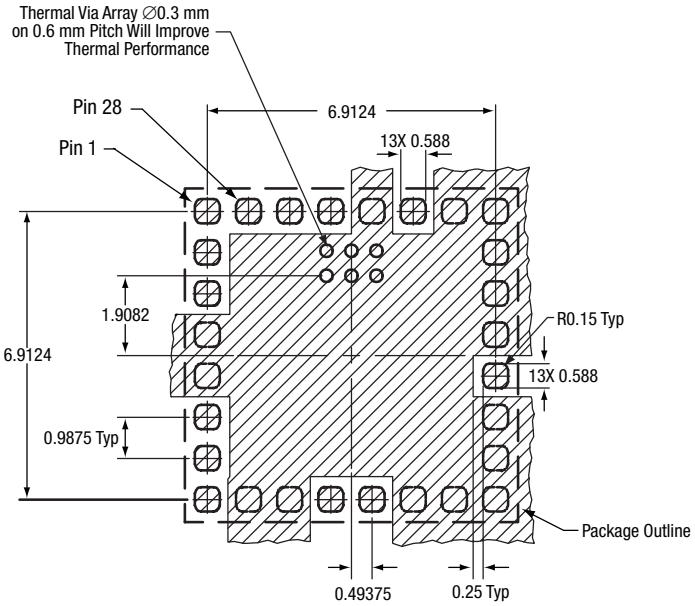


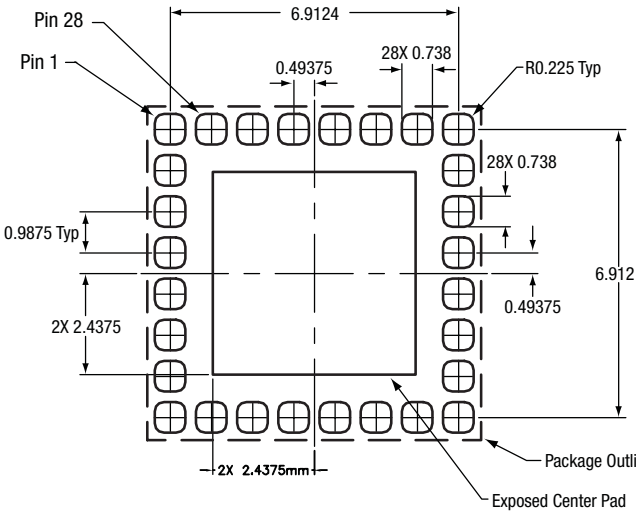
Figure 4. SKY65336-21 Evaluation Board Assembly Drawing



Stencil Aperture
Top View



Metallization
Top View



Solder Mask Opening
Top View

Note: The cross-hatched area represents the merger of the center ground pad +25 individual I/O ground pads. All I/O ground pads should have at least one via connected to internal ground planes for optimum electrical performance.

All measurements are in millimeters

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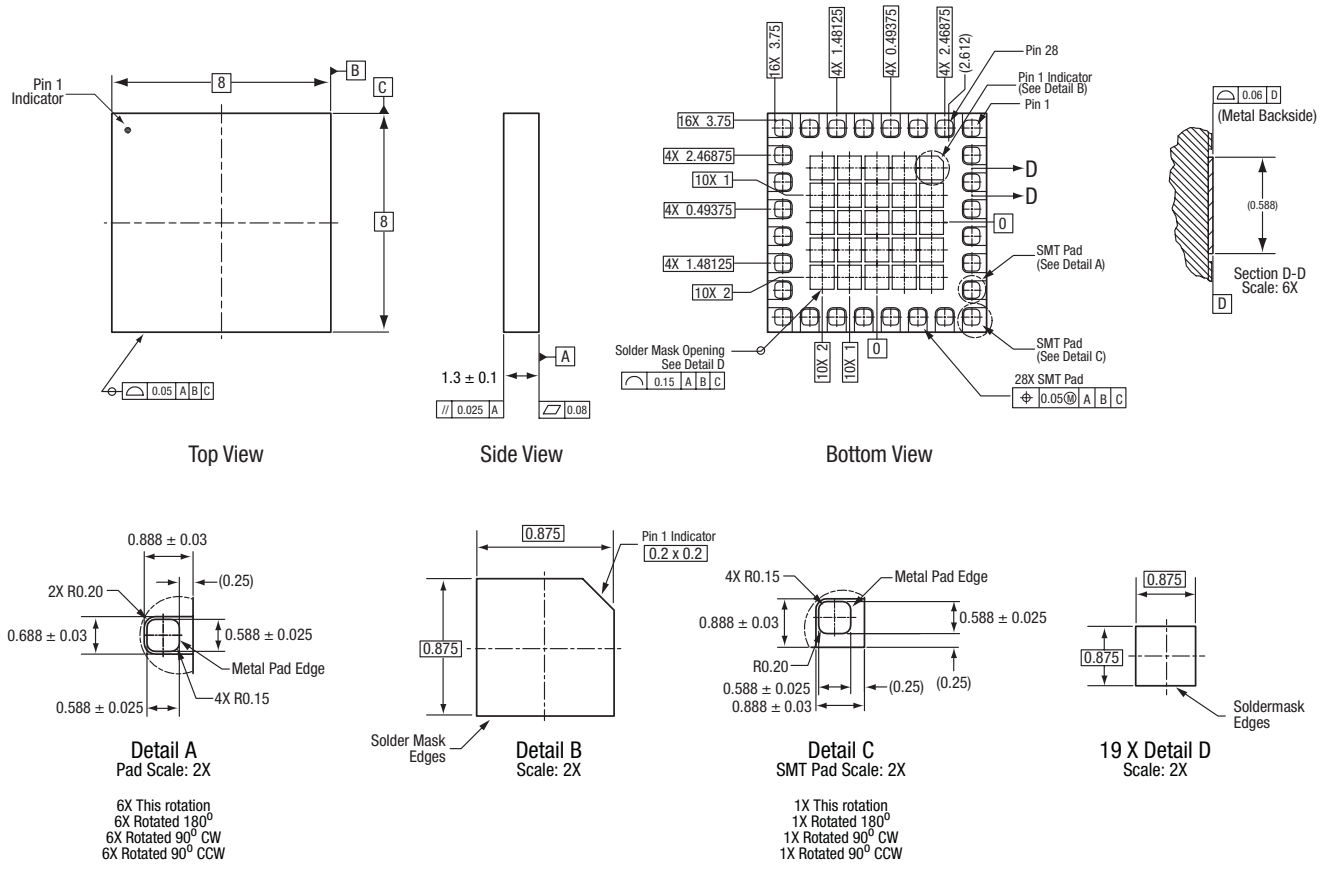
Figure 5. SKY65336-21 Phone Board Layout Footprint



All measurements are in millimeters

Dimensioning and tolerancing according to ASME Y14.5M-1994

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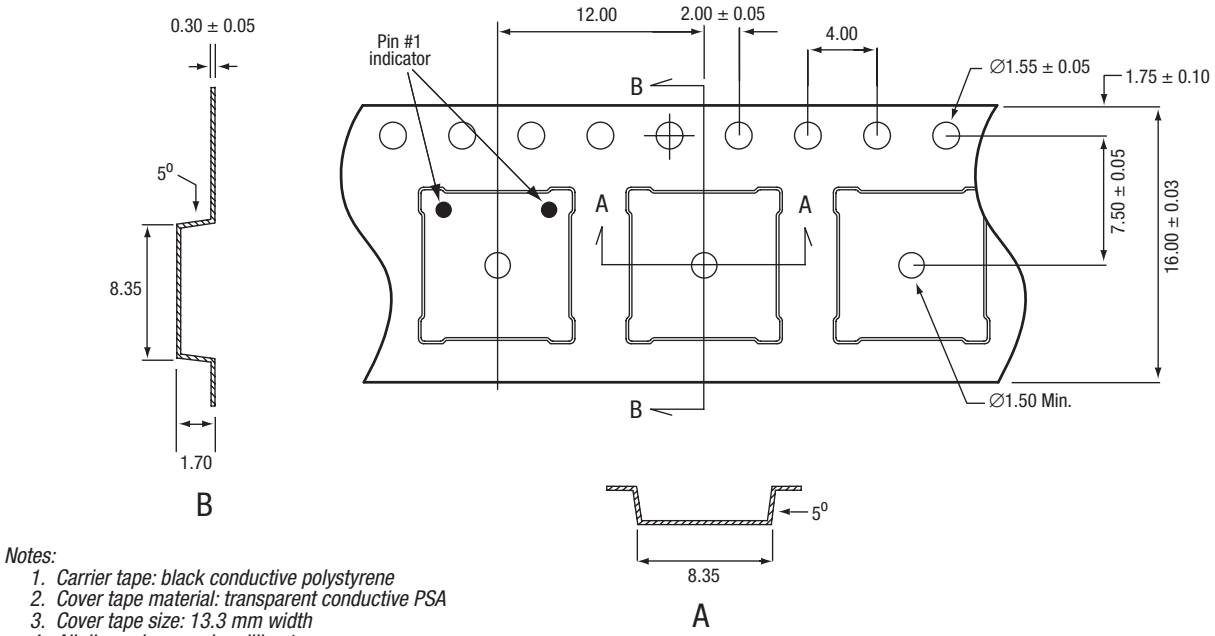
Figure 6. SKY65336-21 28-Pin MCM Package Dimensions



Notes:

1. *Carrier tape: black conductive polystyrene*
2. *Cover tape material: transparent conductive PSA*
3. *Cover tape size: 13.3 mm width*
4. *All dimensions are in millimeters*
5. *Pin 1 orientation is in top left corner for the following Skyworks products:*

   SKY74963-xx
   CX74063-35
   SKY77503-xx
   SKY77506-xx
   SKY77512-xx
   SKY77526-xx
   SKY77343-xx

   For all other 8 x 8 mm MCM/RFLGA products, pin 1 orientation is in top right corner.

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Figure 7. SKY65336-21 28-Pin MCM Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Kit Part Number
SKY65336-21 T/R Front-End Module w/LNA	SKY65336-21 (Pb-free package)	*** TBD ***