PRELIMINARY DATA SHEET

SKY65329-NP: 900 MHz Front-End Module

Applications

- Paging
- Remote metering
- WLL and ISM transmitters

Features

- 900 MHz transmit saturated output power > 24 dBm
- 900 MHz high efficiency PA and LNA
- Auxiliary bidirectional broadband RF path
- Internal switching and control circuits
- Internal RF match and bias circuits
- Internal DC block on RF ports
- Externally adjustable bias setting
- Single DC supply = 3.6 V
- Small footprint, MCM (28-pin, 8 x 8 mm) Pb-free (MSL3, 260 °C per JEDEC J-STD-020) SMT package

NEW

Skyworks Green™ products are RoHS (Restriction of Hazardous Substances)-compliant, conform to the EIA/EICTA/JEITA Joint Industry Guide (JIG) Level A guidelines, are halogen free according to IEC-61249-2-21, and contain <1,000 ppm antimony trioxide in polymeric materials.

Description

Skyworks SKY65329-NP is a fully matched, high-efficiency RF Front-End Module (FEM) with 900 MHz transmit and receive paths. There are also routing switches to connect auxiliary broadband signals between the RFIC and antenna ports. By using three control signals (CTRL1, CTRL2, and PWR_DOWN), the module can be configured to one of five operational modes (900 MHz transmit, 900 MHz receive, auxiliary RF bypass, auxiliary power, or power down).

The 900 MHz transmit path consists of an harmonic filter and high efficiency Power Amplifier (PA). The 900 MHz receive path contains a low-power Low-Noise Amplifier (LNA). Both the PA and LNA can be switched to power-down mode for low leakage current. The auxiliary RF path is a low-loss, broadband, bidirectional RF path that allows easy switching of signal between the RFIC and the antenna port.

Breakout ports are available for adding external filters. Switchable auxiliary power can supply up to 10 mA of VDD power to external circuitry through pin 26 (VDD_OUT).

The SKY65329-NP is manufactured with advanced InGaP HBT and silicon CMOS processes, which provide a positive DC voltage supply while maintaining high efficiency and good linearity.

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 SKY65329-NP is shown in Figure 1. The device package and pinout for the 28-pin MCM are shown in Figure 2.

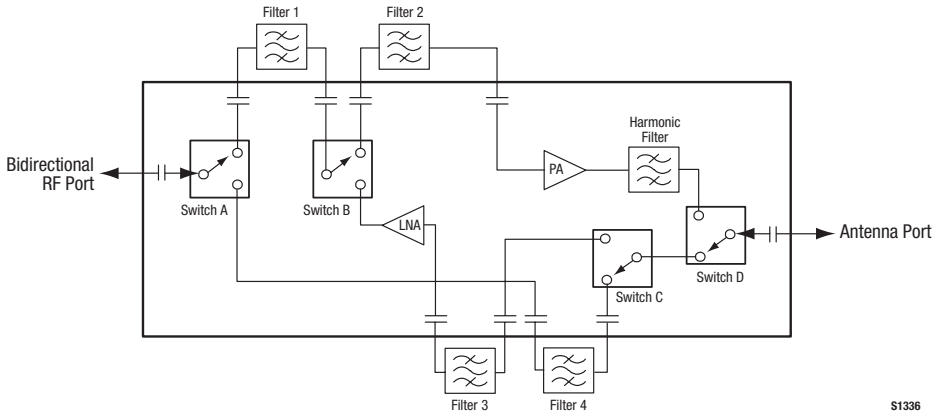


Figure 1. SKY65329-NP Block Diagram

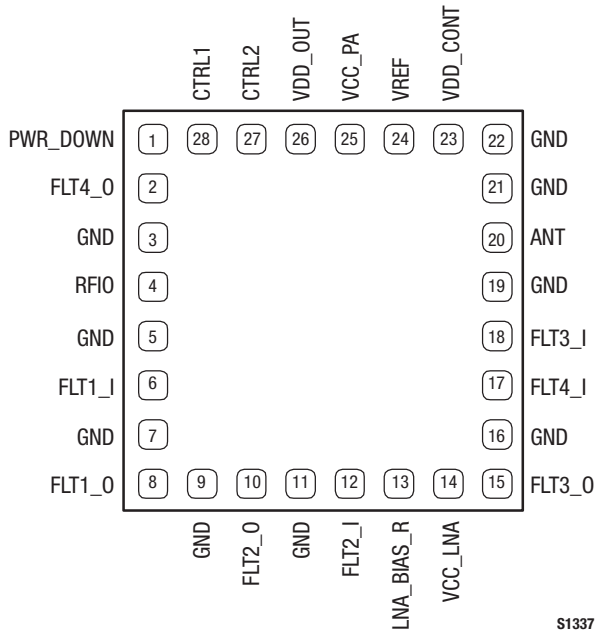


Figure 2. SKY65329-NP Pinout – 28-Pin MCM (Top View)

Table 1. SKY65329-NP Control Logic

Configuration	Logic Input Control Bits			States		
	CTRL1	CTRL2	PWR_DOWN	PA	LNA	VDD Output
Auxiliary power	0	0	0	Off	Off	On
900 MHz receive	0	1	0	Off	On	Off
900 MHz transmit	1	0	0	On	Off	Off
Auxiliary RF bypass	1	1	0	Off	Off	Off
Power down	X	X	1	Off	Off	Off

Note: Logic level 0: 0 V to 0.3 V
Logic level 1: 2.5 V to VCC.

Technical Description

The SKY65329-NP provides input and output amplifier stages and is internally matched for optimum efficiency. An active bias circuit provides both input and output stages with excellent gain tracking over temperature and voltage variations. The module operates with positive DC voltages, and maintains high efficiency and good linearity. The nominal operating voltage is 3.6 V for maximum power, but the device can be operated at slightly lower voltages for other mobile applications.

Operational Modes

By using three control signals (CTRL1, CTRL2, and PWR_DOWN), the module can be configured to one of five operational modes:

Auxiliary power. In this mode, the PA and LNA are off and the VDD_OUT signal (pin 26) can be used for auxiliary power, which can supply up to 10 mA of VDD power to external circuitry.

900 MHz receive. In this mode, the SKY65329-NP amplifies the received signal at the antenna port through the LNA.

900 MHz transmit. In this mode, the transmit path provides an harmonic filter and high efficiency PA.

Auxiliary RF bypass. In this mode, a low-loss broadband bidirectional RF path allows easy switching of the signal between the transceiver and the antenna port.

Power down. In this mode, the PA and LNA are powered down for minimal current consumption and low leakage current (5 µA).

Table 1 provides the control logic for each of the five operational modes.

Electrical and Mechanical Specifications

Signal pin assignments and functional pin descriptions are described in Table 2. The absolute maximum ratings of the SKY65329-NP are provided in Table 3. The recommended operating conditions are specified in Table 4 and electrical specifications are provided in Table 5.

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 SKY65329-NP 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 2. SKY65329-NP Signal Descriptions

Pin #	Name	Description	Pin #	Name	Description
1	PWR_DOWN	Power down	15	FLT3_O	Filter 3 output port
2	FLT4_O	Filter 4 output port	16	GND	Ground
3	GND	Ground	17	FLT4_I	Filter 4 input port
4	RFIO	RF input/output (internally DC blocked)	18	FLT3_I	Filter 3 input port
5	GND	Ground	19	GND	Ground
6	FLT1_I	Filter 1 input port	20	ANT	Antenna port (internally DC blocked)
7	GND	Ground	21	GND	Ground
8	FLT1_O	Filter 1 output port	22	GND	Ground
9	GND	Ground	23	VDD_CONT	CMOS controller supply voltage
10	FLT2_O	Filter 2 output port	24	VREF	PA bias reference voltage
11	GND	Ground	25	VCC_PA	PA collector voltage
12	FLT2_I	Filter 2 input port	26	VDD_OUT	Auxiliary supply
13	LNA_BIAS_R	LNA bias resistor	27	CTRL2	Control 2
14	VCC_LNA	LNA collector voltage	28	CTRL1	Control 1

Table 3. SKY65329-NP Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	VCC		4	V
Transmit input power	P_{IN_TX}			dBm
Receive input power	P_{IN_RX}			dBm
Supply current	I_{CC}			mA
Power dissipation	P_{DISS}			W
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 4. SKY65329-NP Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage	VCC	2.8	3.6	3.8	V
Frequency range	f	902		928	MHz
Auxiliary frequency range	f_{AUX}	400		2500	MHz
Transmit input power range	P_{IN}	–3		–1	dBm
Case operating temperature	T_C	–40		+85	°C
Storage temperature	T_{ST}	–55		+125	°C

Table 5. SKY65329-NP Electrical Specifications
(VCC = 3.6 V, T_C = +25 °C, External PA VCC Bias Resistor [R28] = 2 kΩ, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
General						
Return loss	RL	All RF ports except ANT in transmit mode, 50 Ω	12			dB
Thermal resistance	Θ_{JC}			22		°C/W
Auxiliary Power Mode						
Auxiliary power	VCC Ext	Load current < 10 mA	VCC – 0.1		VCC	V
900 MHz Receive Mode (0 Ω Between FLT1_I/FLT1_O and FLT3_I/FLT3_O Pins in Place of External Filters)						
Small signal gain	G_{SS} (Rx)	CW		18.5		dB
Noise Figure	NF (Rx)			2.0		dB
Input 1dB compression	IP1dB (Rx)	CW		–13		dBm
Input IP3	IIP3	Two –30 dBm CW tones		–2		dBm
Operating current	I_{OP} (Rx)	P_{OUT} = IP1dB (Rx)		4.5		mA
900 MHz Transmit Mode (0 Ω Between FLT1_I/FLT1_O and FLT2_I/FLT2_O Pins in Place of External Filters)						
Saturated output power	P_{SAT}	CW, P_{IN} = –3 dBm CW, P_{IN} = –1 dBm	+21.0	+24.3 +24.9		dBm dBm
Saturated output power cold droop (Note 1)	DP_{SAT}Cold	CW, VCC = 2.8 V, T_C = –40 °C		2	3	dB
Small signal gain	G_{SS} (Tx)	CW		28		dB
Noise Figure	NF (Tx)	CW		7.5		dB
Power Added Efficiency	PAE	CW, P_{IN} = –3 dBm CW, P_{IN} = –1 dBm		48.0 48.6		% %
2nd harmonic	Pf2	CW, P_{IN} = –3 dBm		–39	–30	dBc
3rd to 8th harmonic	Pf3 to Pf8	CW, P_{IN} = –3 dBm		–66	–60	dBc
Operating current	I_{OP} (Tx)	CW, P_{IN} = –3 dBm CW, P_{IN} = –1 dBm		150 167		mA mA
Output return loss	ORL (Tx)	CW, P_{IN} = –3 dBm	8			dB
Auxiliary RF Bypass Mode (0 Ω Between FLT4_I and FLT4_O Pins in Place of External Filters)						
450 MHz loss	IL (Aux)	f = 450 MHz		1.5	2.5	dB
FEM Power-Down Mode						
Leakage current	I_{LEAK}	No RF input		0.2		µA

Note 1: Saturated transmit output power cold droop is defined as the drop in P_{SAT} at VCC = 2.8 V and T_C = –40 °C relative to P_{SAT} at VCC = 3.6 V and T_C = +25 °C.

Evaluation Board Description

The SKY65329-NP Evaluation Board is used to test the performance of the SKY65329-NP FEM. The Evaluation Board schematic diagram is shown in Figure 3. An assembly drawing for the Evaluation Board is shown in Figure 4 and the layer detail is provided in Figure 5. The layer detail physical characteristics are noted in Figure 6. Table 6 provides the Bill of Materials (BOM) list for Evaluation Board components.

The four external filters shown in Figure 3 are configured as throughputs so that the device can be tested immediately. External resistors are installed with values that allow the unit to operate immediately with the electrical specifications provided in Table 4. Refer to the *SKY65329 T/R FEM Evaluation Board Information Application Note* (document # ***** TBD *****) for additional testing information.

The digital ground pin of the SKY65329-NP (pin 22) is not connected to the other ground pins internally. Therefore, an external common ground connection is needed. If this is not provided, the digital controller may operate at a different potential than the RF section, which could damage the part.

The separate digital ground pin allows flexibility when connecting the ground between the digital and RF sections of the device. This connection is through resistor R21 and capacitor C11 (loaded with a 0 Ω resistor by default). If RF isolation is desired between the digital and RF sections, an appropriate component may be placed instead. Pin 16 of connector P1 is used to connect the source of the digital controls to a common ground point with the test fixture through components R21 and C11.

Circuit Design Considerations

The following design considerations are general in nature and must be followed regardless of final use or configuration:

1. Paths to ground should be made as short as possible.
2. The ground pads of the SKY65329-NP have special electrical and thermal grounding requirements. These pads are the main thermal conduit for heat dissipation. Since the circuit board acts as the heat sink, it must shunt as much heat as possible from the device. Therefore, design the connection to the ground pad to dissipate the maximum wattage produced by the circuit board. Multiple vias to the grounding layer are required.
3. Two external output bypass capacitors (0.022 µF and 22 µF) are required on pin 25 (VCC_PA). The same two capacitor values are also required on pin 14 (VCC_LNA). The capacitors should be placed in parallel between the supply line and ground.
4. Pins 14 and 25 (VCC_LNA and VCC_PA, respectively) may be connected together at the supply.

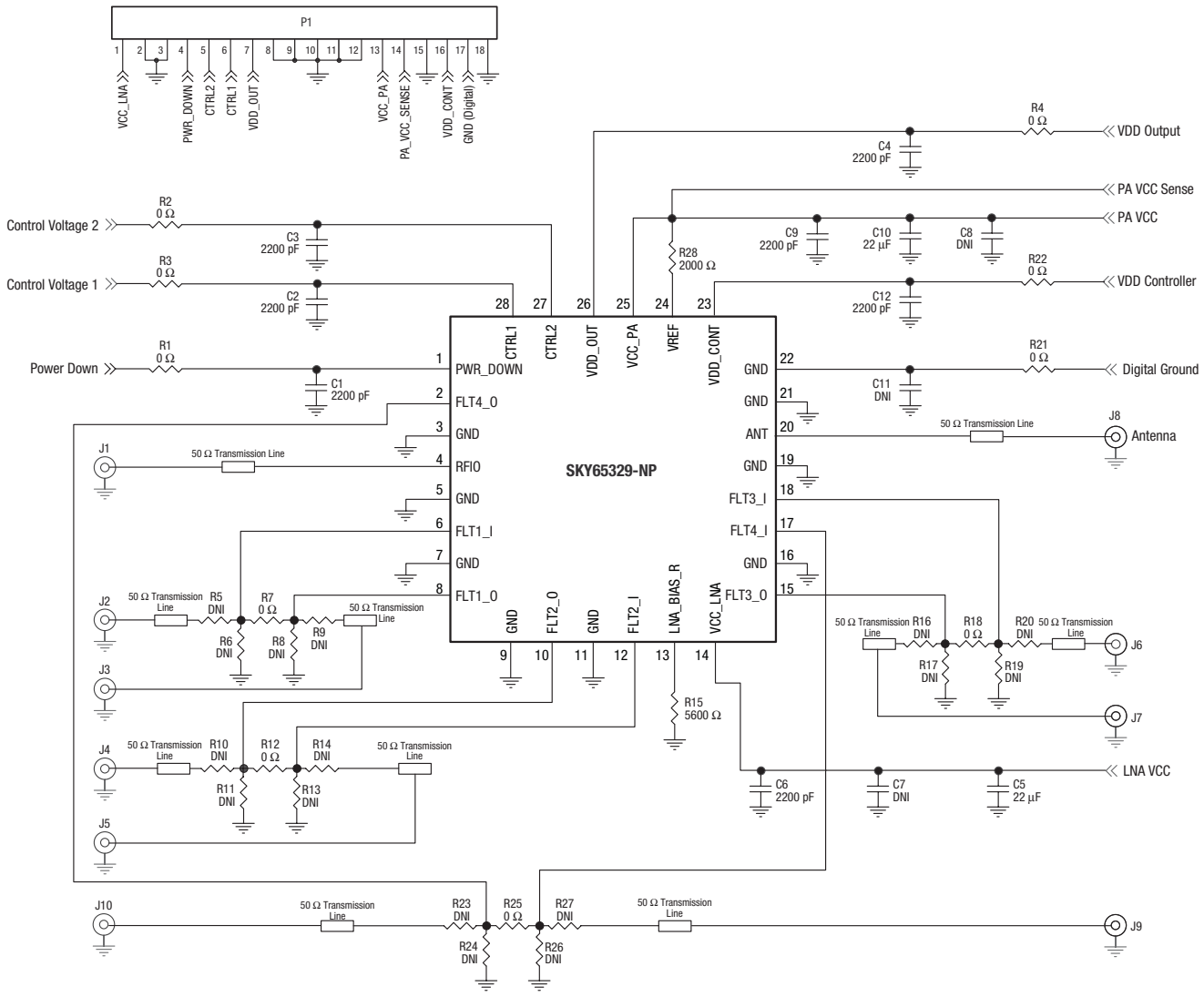
NOTE: *A poor connection between the slug and ground increases junction temperature (T_J), which reduces the lifetime of the device.*

Package Dimensions

The phone board layout footprint for the SKY65329-NP is shown in Figure 7. Package dimensions for the 28-pin MCM are shown in Figure 8, and tape and reel dimensions are provided in Figure 9.

Electrostatic Discharge (ESD) Sensitivity

The SKY65329-NP is a static-sensitive electronic device. Do not operate or store near strong electrostatic fields. Take proper ESD precautions.



Note: Some component labels may be different than the corresponding component symbol shown here. Component values, however, are accurate as of the date of this Data Sheet.

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Figure 3. SKY65329-NP Evaluation Board Schematic

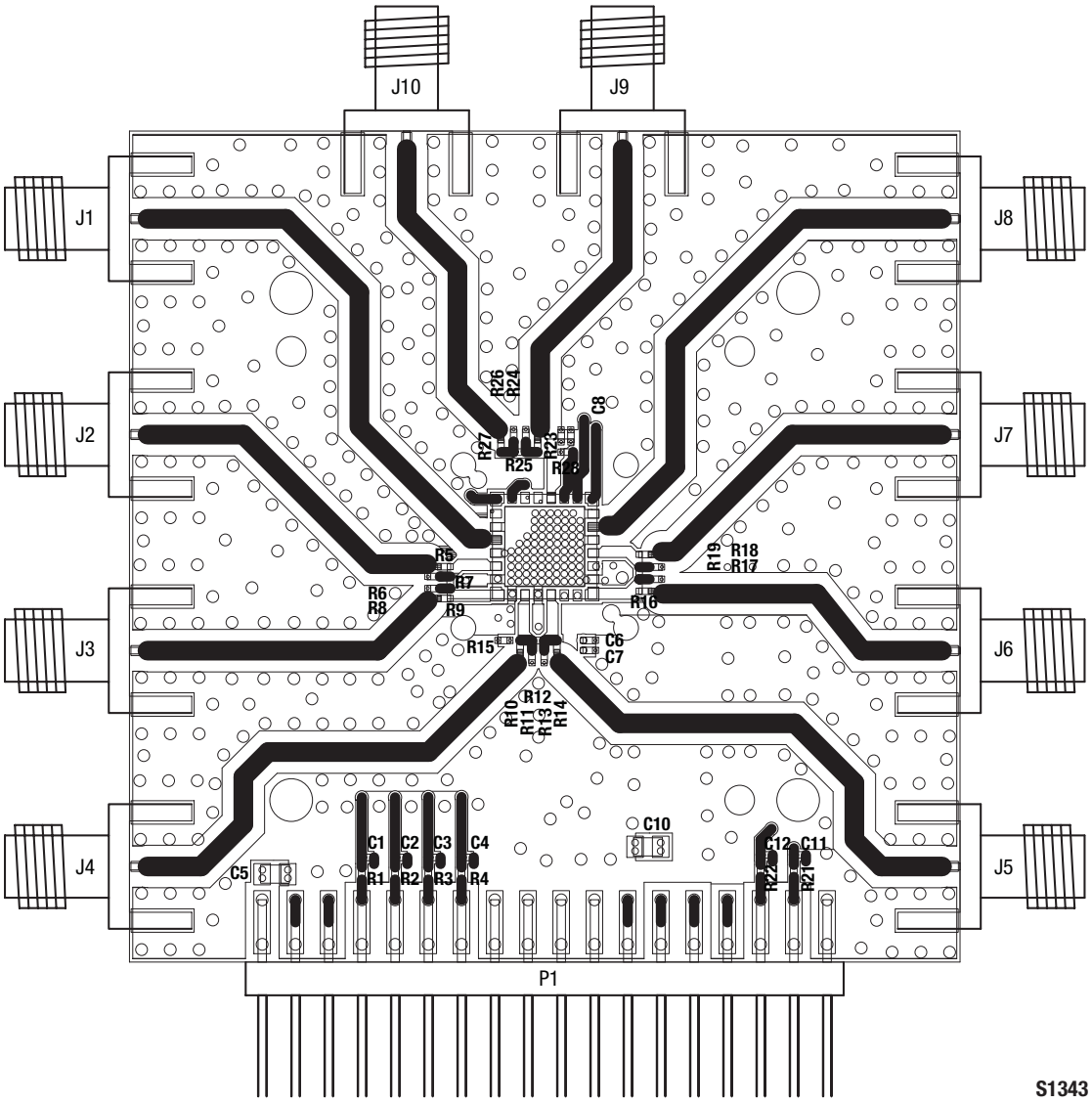
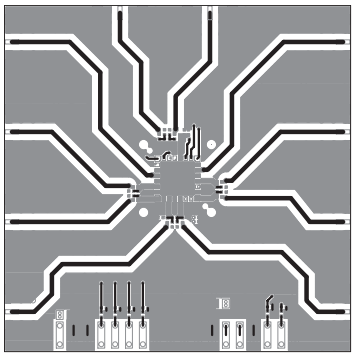
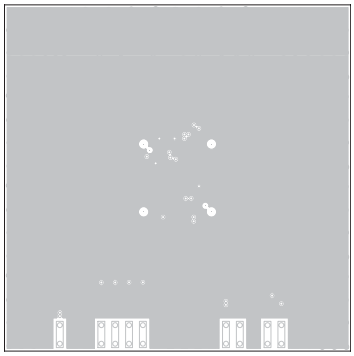


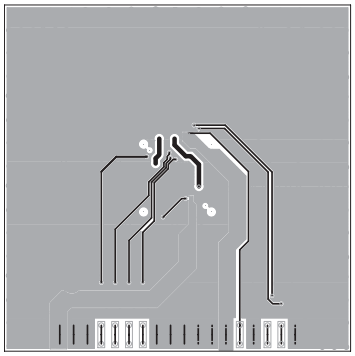
Figure 4. SKY65329-NP Evaluation Board Assembly Drawing



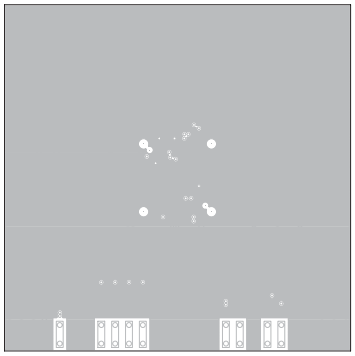
Layer 1: Top – Metal



Layer 2: Ground



Layer 3: Power Plane



Layer 4: Solid Ground Plane

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Figure 5. SKY65329-NP Evaluation Board Layer Detail

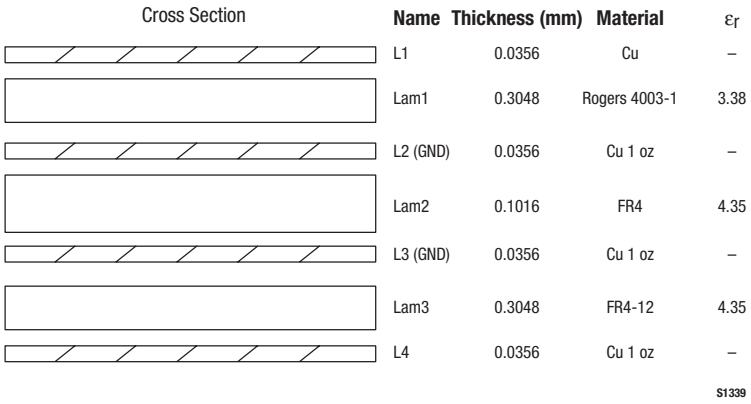
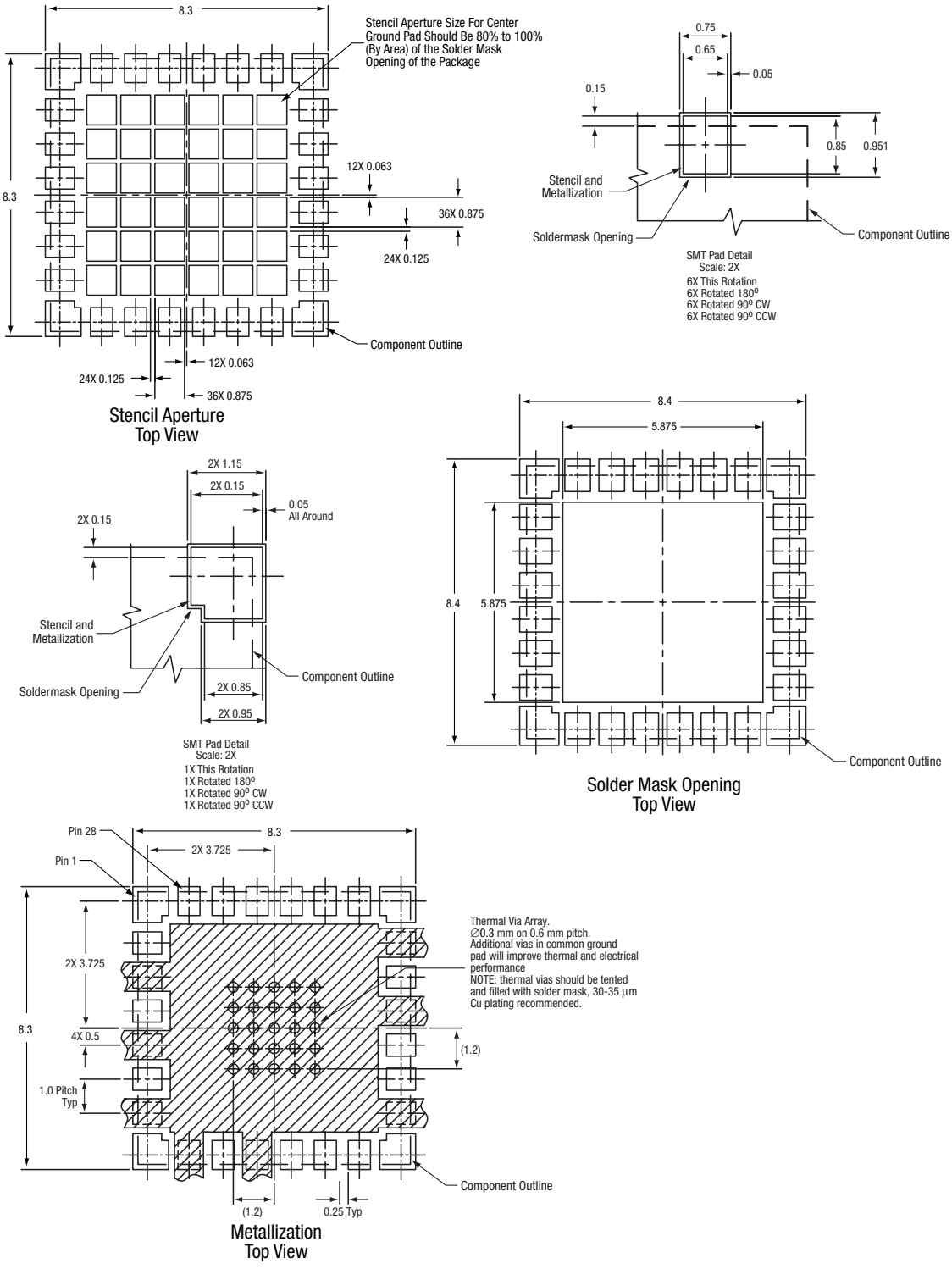


Figure 6. Layer Detail Physical Characteristics

Table 6. SKY65329-NP Evaluation Board Bill of Materials

Component	Quantity	Size	Value	Vendor	Part Number
C1, C2, C3, C4, C6, C9, C12	7	0402	2200 pF	Murata	GRM155R71H222KA01
C5, C10	2	0805	22 µF	Murata	GRM21BR60J226KA11
R1, R2, R3, R4, R7, R12, R18, R21, R22, R25	10	0402	0 Ω	Yageo	RC0402JR-*18RL
R28	1	0402	2000 Ω	Yageo	RC0402JR-*2KL
R15	1	0402	5600 Ω	Yageo	RC0402JR-*5K6L
C7, C8, C11, R5, R6, R8, R9, R10, R11, R13, R14, R16, R17, R19, R20, R23, R24, R26, R27	19	N/A	DNI	N/A	N/A

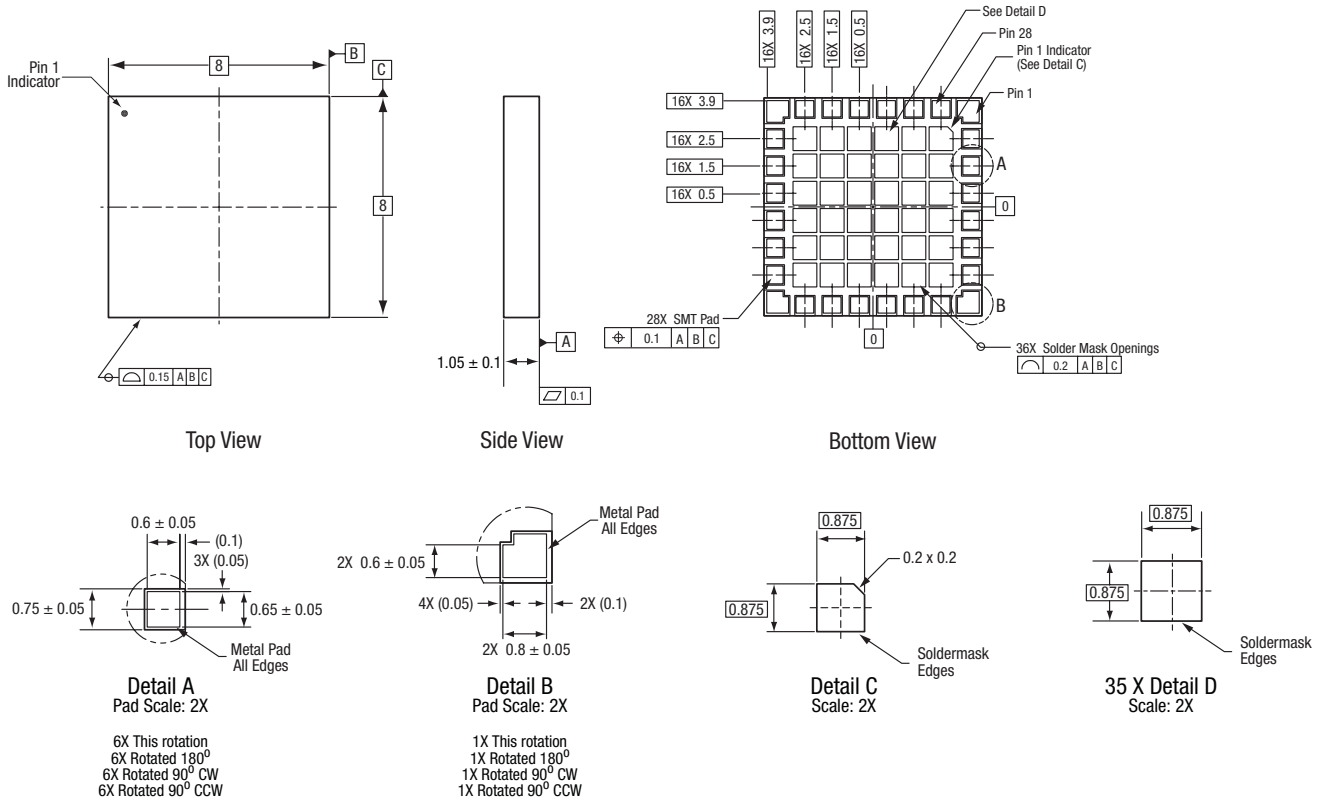


Note: The cross-hatched area represents the merger of the center ground pad +8 individual I/O ground pads. All I/O ground pads should have at least one via connected to internal ground planes for optimum electrical performance.

All measurements are in millimeters

S1340

Figure 7. SKY65329-NP Phone Board Layout Footprint

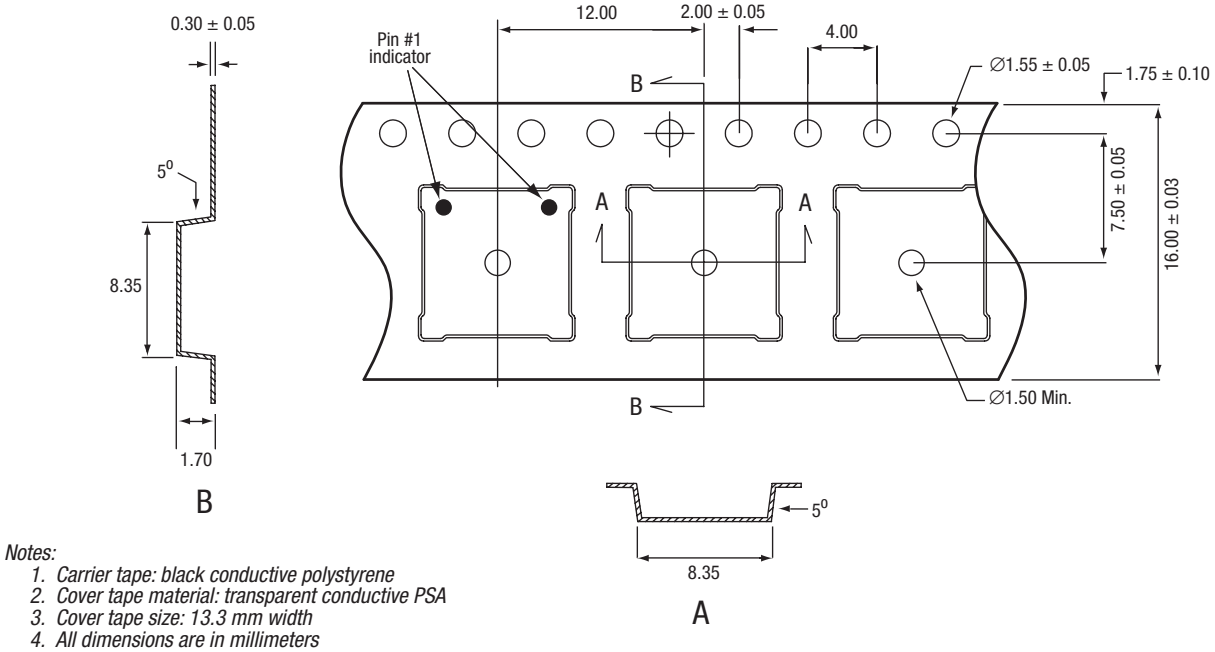


All measurements are in millimeters

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

S1341

Figure 8. SKY65329-NP 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 9. SKY65329-NP 28-Pin MCM Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Kit Part Number
SKY65329-NP 900 MHz Front-End Module	SKY65329-NP (Pb-free package)	TW17-D390