DATA SHEET

SKY65337-11: 2.4 GHz Transmit/Receive Front-End Module

Applications

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

Features

- Transmit output power > +20 dBm
- Bidirectional path NF < 2 dB
- High efficiency PA
- Programmable transmit power levels
- Configurable transmit/bidirectional paths
- Internal switching and control circuits
- Internal RF match and bias circuits
- Single DC supply = 3.0 V
- Interfaces seamlessly with Ember EM250 and EM260 ZigBee transceivers
- All RF ports are internally DC blocked
- Small footprint MCM (28-pin, 8 x 8 mm) SMT 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.

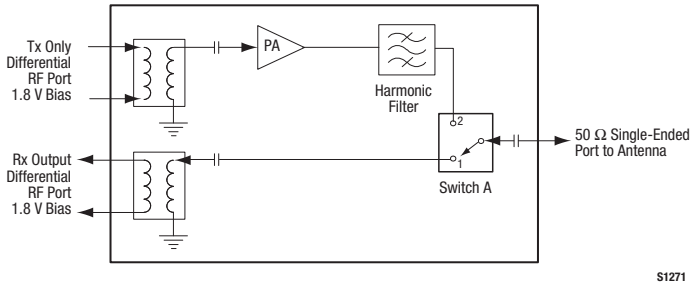


Figure 1. SKY65337-11 Block Diagram

Description

Skyworks SKY65337-11 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 to 2500 MHz high-efficiency transmit path and a low-loss bidirectional path. The bidirectional path can be used to directly connect the antenna port to a directional RF port.

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 bidirectional path contains a high isolation transmit/receive (T/R) switch and balun for low-noise differential output. The bidirectional path can be used for either transmit or receive.

The differential output receiver port is bidirectional and can be used to operate the module in a low-power transmit mode.

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

A block diagram of the SKY65337-11 is shown in Figure 1. The device package and pinout for the 28-pin MCM are shown in Figure 2. Signal pin assignments and functional pin descriptions are described in Table 1.

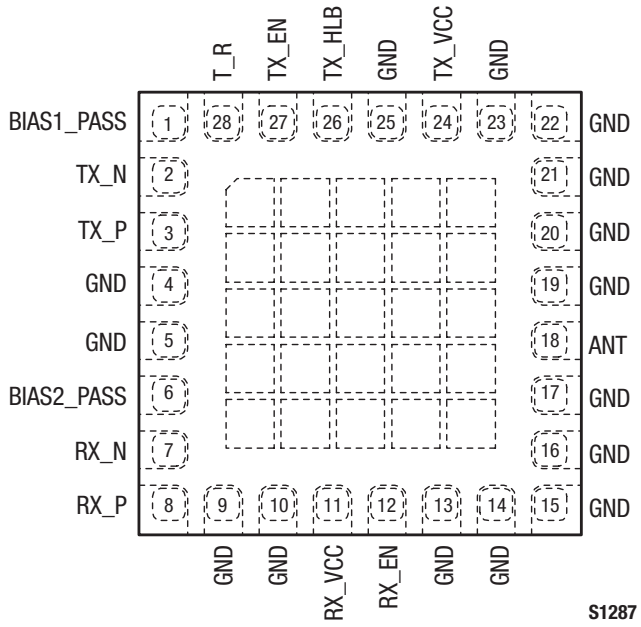


Figure 2. SKY65337-11 Pinout
(Top View)

Table 1. SKY65337-11 Signal Descriptions[1]

Pin	Name	Description	Pin	Name	Description
1	BIAS1_PASS	Transmit port bias supply	15	GND	Ground
2	TX_N	Negative transmit input port	16	GND	Ground
3	TX_P	Positive 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	Negative receive output port	21	GND	Ground
8	RX_P	Positive 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

[1] The bottom ground pad **must be** connected to RF ground.

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 SKY65337-11:

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 paddles must be electrically grounded for proper RF performance. Customers should place adequate thermal vias under the ground paddles 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

The absolute maximum ratings of the SKY65337-11 are provided in Table 2. The recommended operating conditions are specified in Table 3 and electrical specifications are provided in Table 4.

Typical performance characteristics of the SKY65337-11 are illustrated in Figures 3 through 12.

Table 2. SKY65337-11 Absolute Maximum Ratings[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}		2	W
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

[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. SKY65337-11 Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	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. SKY65337-11 Electrical Specifications[1]
(VCC = 3.0 V, Tc = 25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Frequency range	f		2400		2500	MHz
Return loss	RL	All RF ports	6	10		dB
Transmitter Section						
Input power range	P_{IN}	CW		+3		dBm
Transmit saturated output power	P_{SAT_H} P_{SAT_L}	High power mode Low power mode	+19.5 +8.3	+20.1 +10.5		dBm dBm
Operating current	I_{OP_H} I_{OP_L}	High power mode, total current Low power mode, total current		145 72	150 80	mA mA
2nd harmonic[2]	Pn2	CW, P_{OUT} = +20 dBm		-44	-39	dBm
3rd harmonic[2]	Pn3	CW, P_{OUT} = +20 dBm		-44	-39	dBm
Saturated gain	G_H G_L	CW, high power mode CW, low power mode		17 7		dB dB
Leakage current	I_{LEAK}	No RF input, VCC = 3.0 V, RX_EN = 0 V, TX_EN = 0 V		0.5		µA
Bidirectional (Receive) Section						
Insertion loss	IL	CW		1.6	2.0	dB
Leakage current	I_{LEAK}	No RF input, VCC = 3.0 V, RX_EN = 0 V, TX_EN = 0 V		0.5		µA

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

1 Harmonic levels using the Zigbee modulated signal are +6 dBm lower than the values shown here.

Typical Performance Characteristics

(VCC = 3.0 V, Tc = 25 °C, Unless Otherwise Noted)

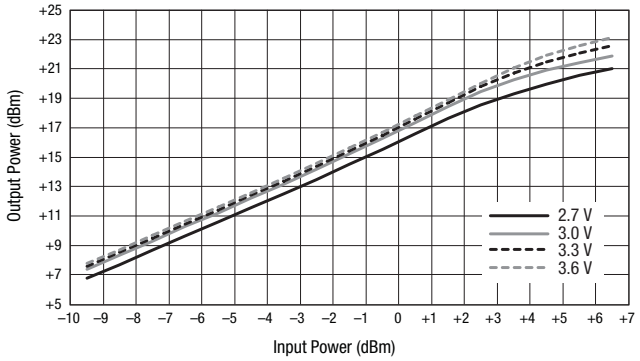


Figure 3. High Power Mode, Output Power vs Input Power Over VCC @ 2450 MHz

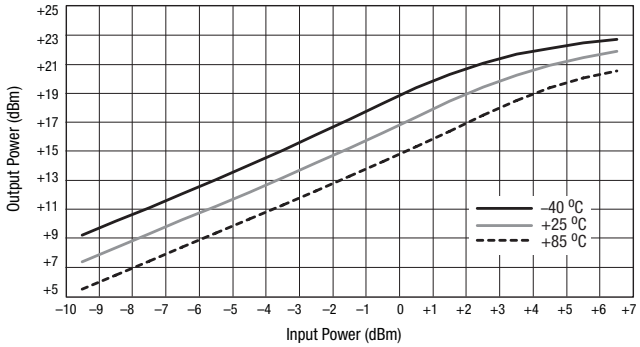


Figure 4. High Power Mode, Output Power vs Input Power Over Temperature @ 2450 MHz

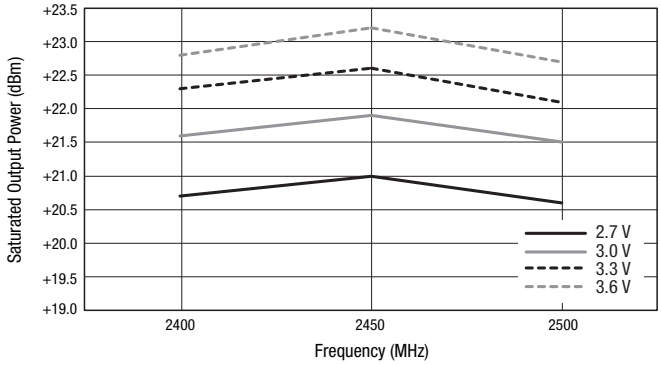


Figure 5. High Power Mode, Saturated Output Power vs Frequency Over Voltage

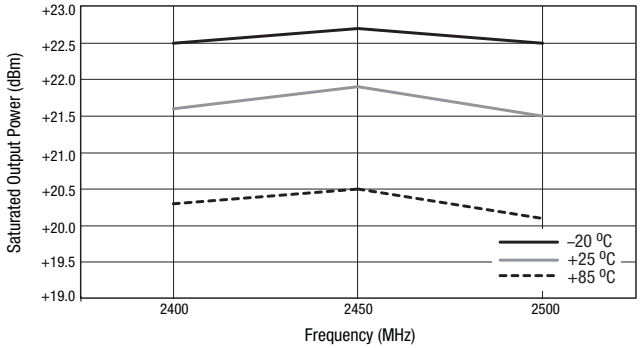


Figure 6. High Power Mode, Saturated Output Power vs Frequency Over Temperature

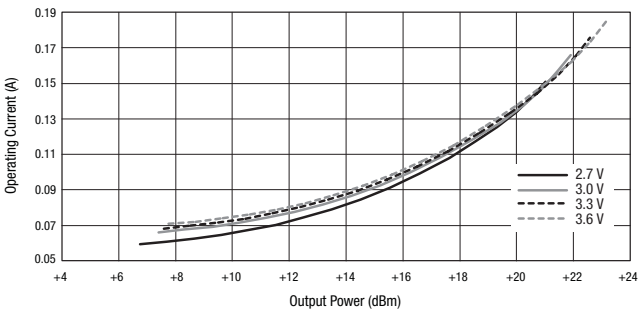


Figure 7. High Power Mode Operating Current vs Output Power Over VCC @ 2450 MHz

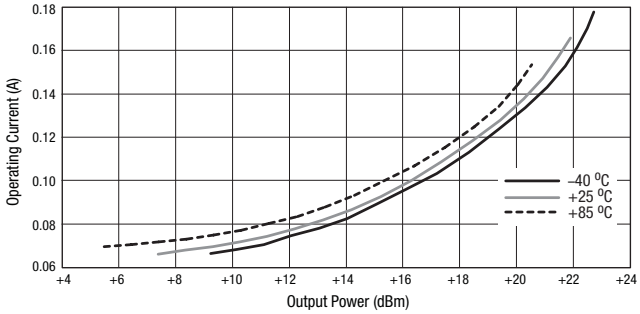


Figure 8. High Power Mode, Operating Current vs Output Power Over Temperature @ 2450 MHz

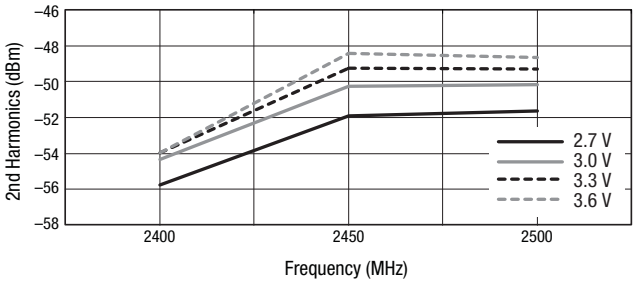


Figure 9. High Power Mode, 2nd Harmonics vs Frequency Over VCC

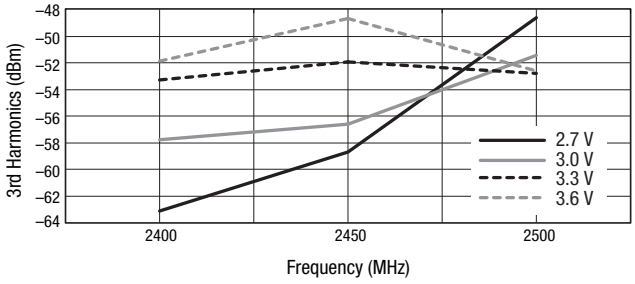


Figure 10. High Power Mode, 3rd Harmonics vs Frequency Over VCC

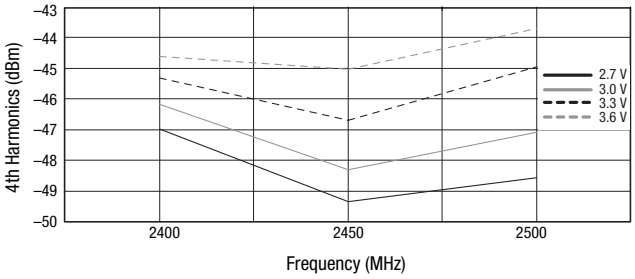


Figure 11. High Power Mode, 4th Harmonics vs Frequency Over VCC

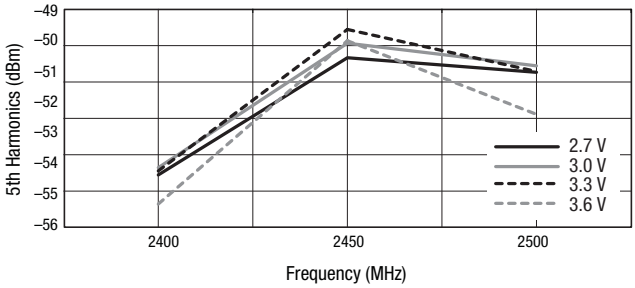
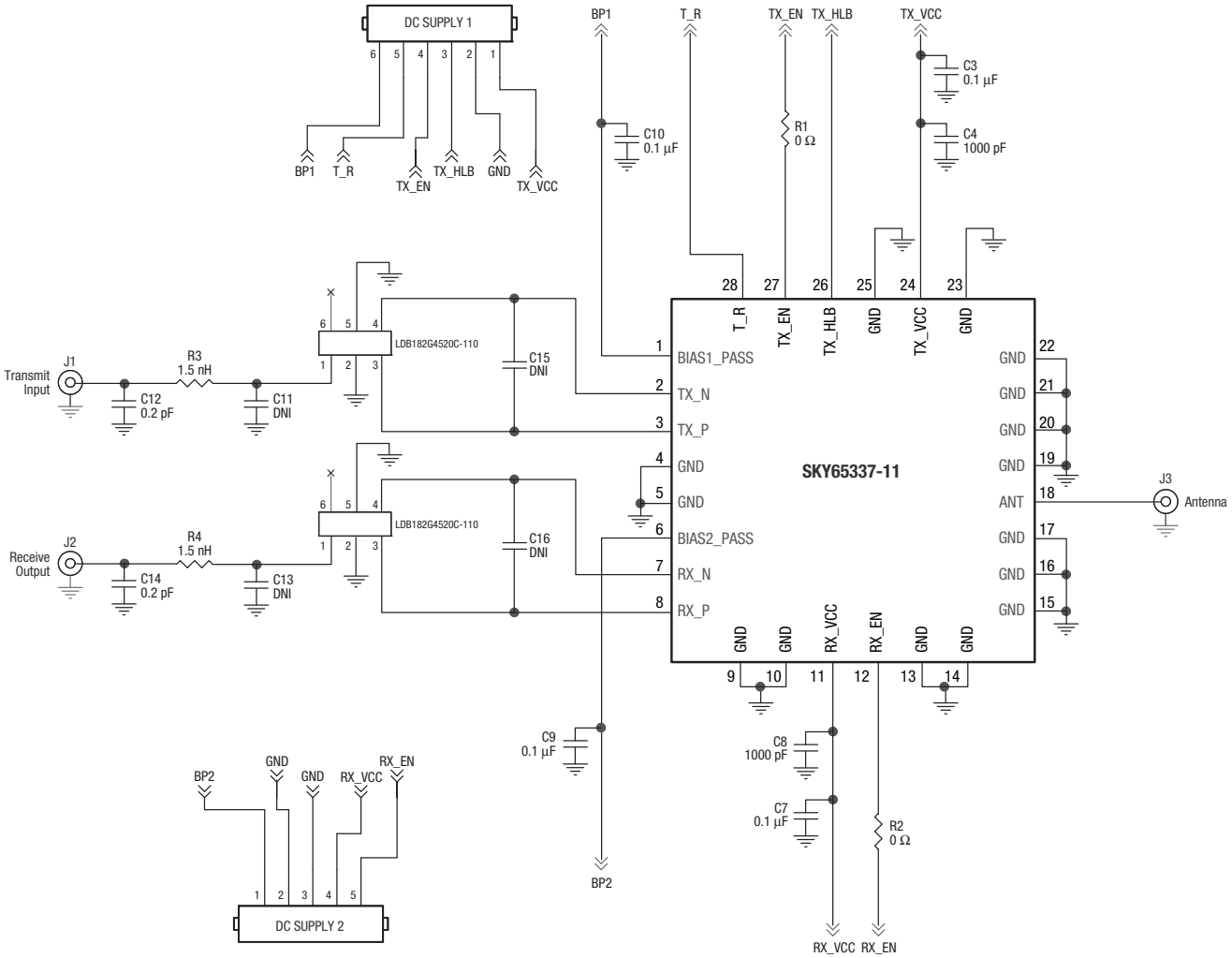


Figure 12. High Power Mode, 5th Harmonics vs Frequency Over VCC

Evaluation Board Description

The SKY65337-11 Evaluation Board is used to test the performance of the SKY65337-11 FEM. The Evaluation Board schematic diagram is shown in Figure 13. An assembly drawing for the Evaluation Board is shown in Figure 14.



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 13. SKY65337-11 Evaluation Board Schematic

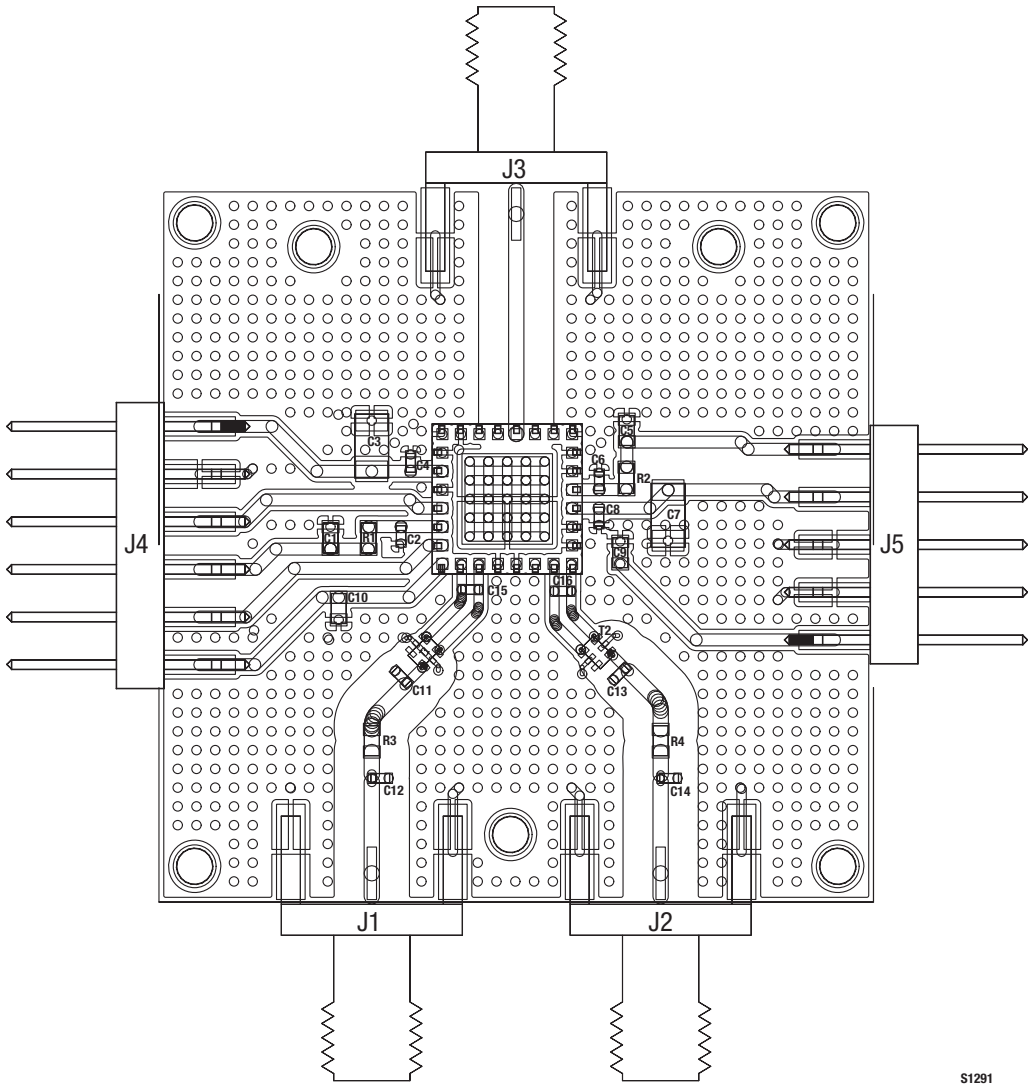


Figure 14. SKY65337-11 Evaluation Board Assembly Drawing

Package Dimensions

The phone board layout footprint for the SKY65337-11 is shown in Figure 15. Package dimensions are shown in Figure 16, and tape and reel dimensions are provided in Figure 17.

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 SKY65337-11 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 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.

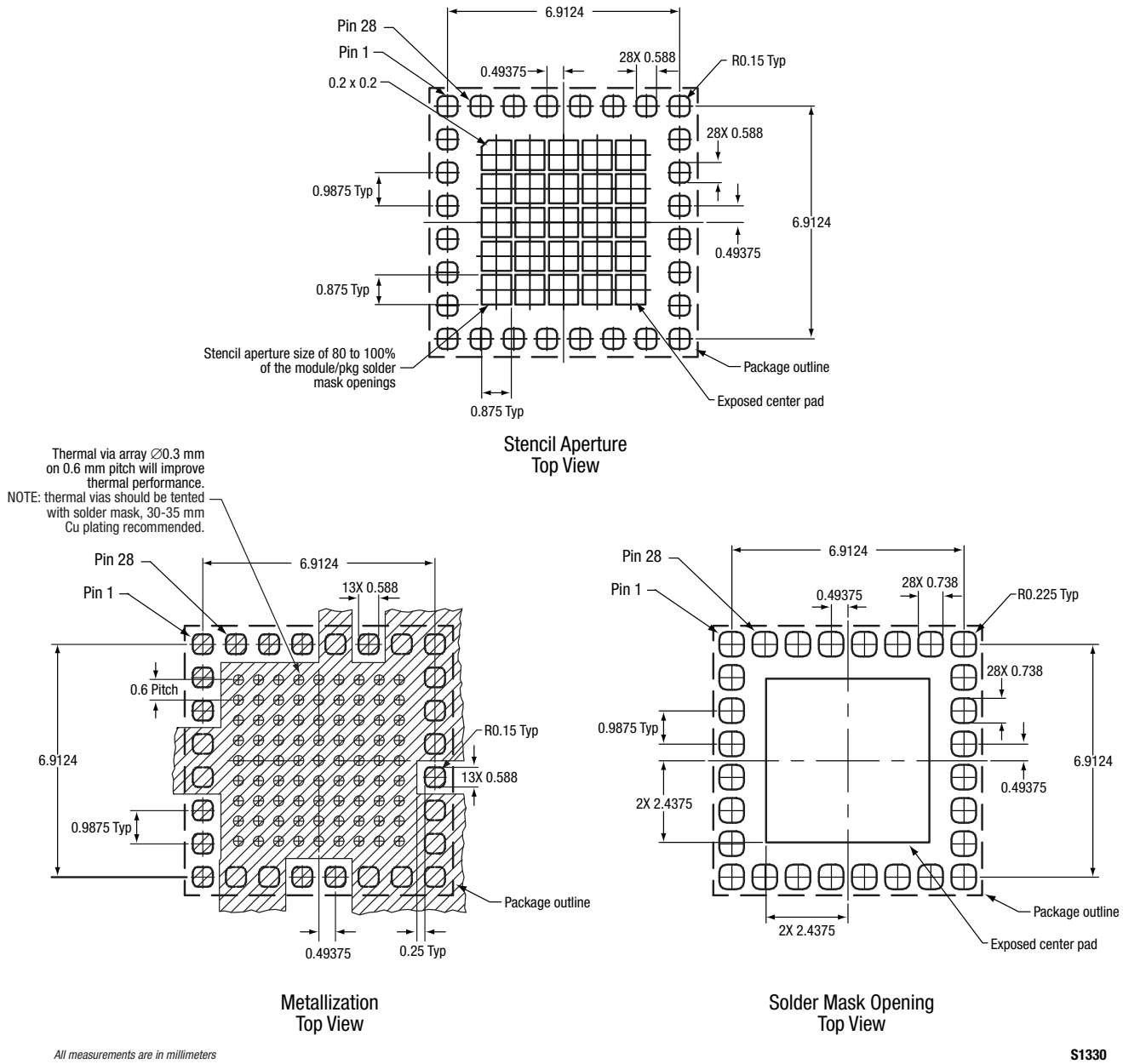
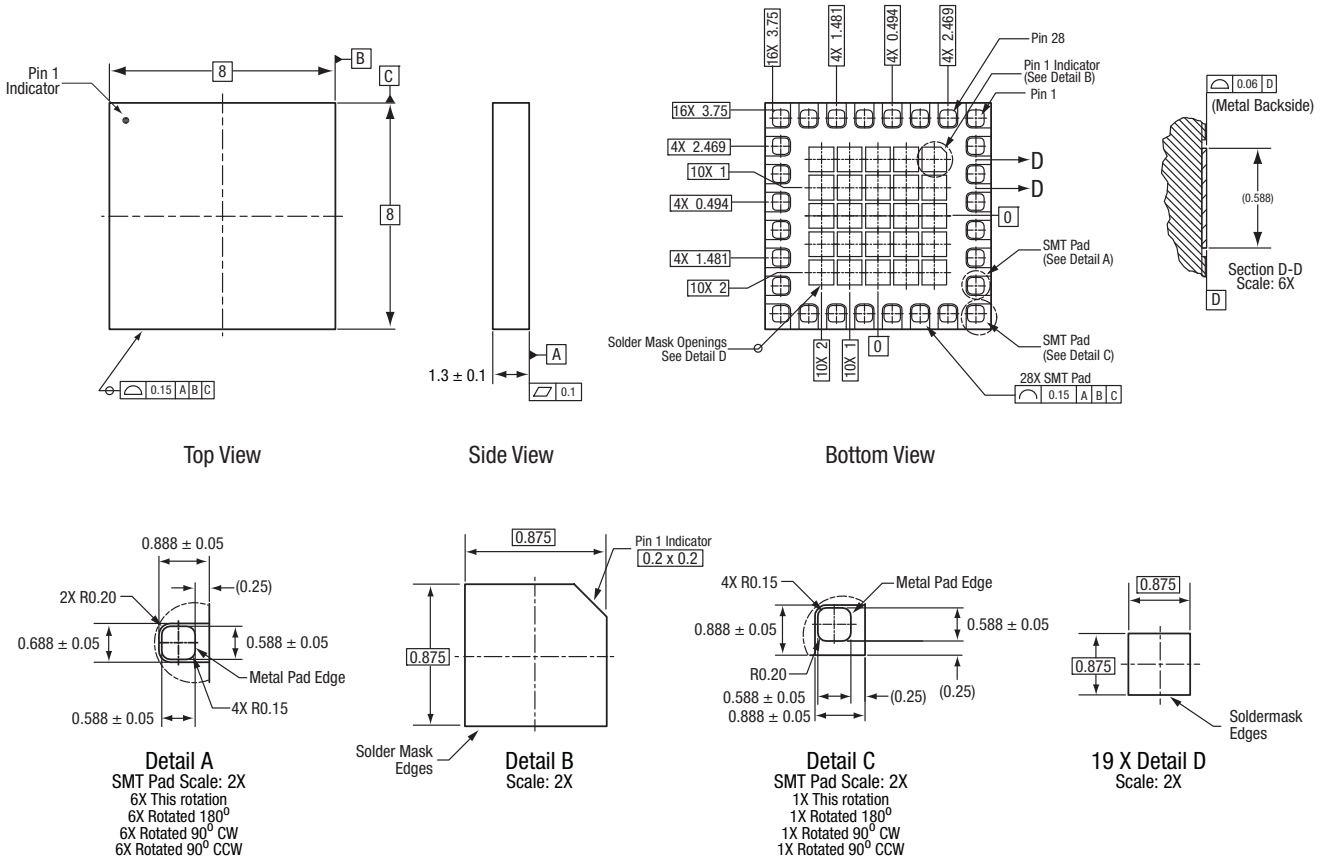


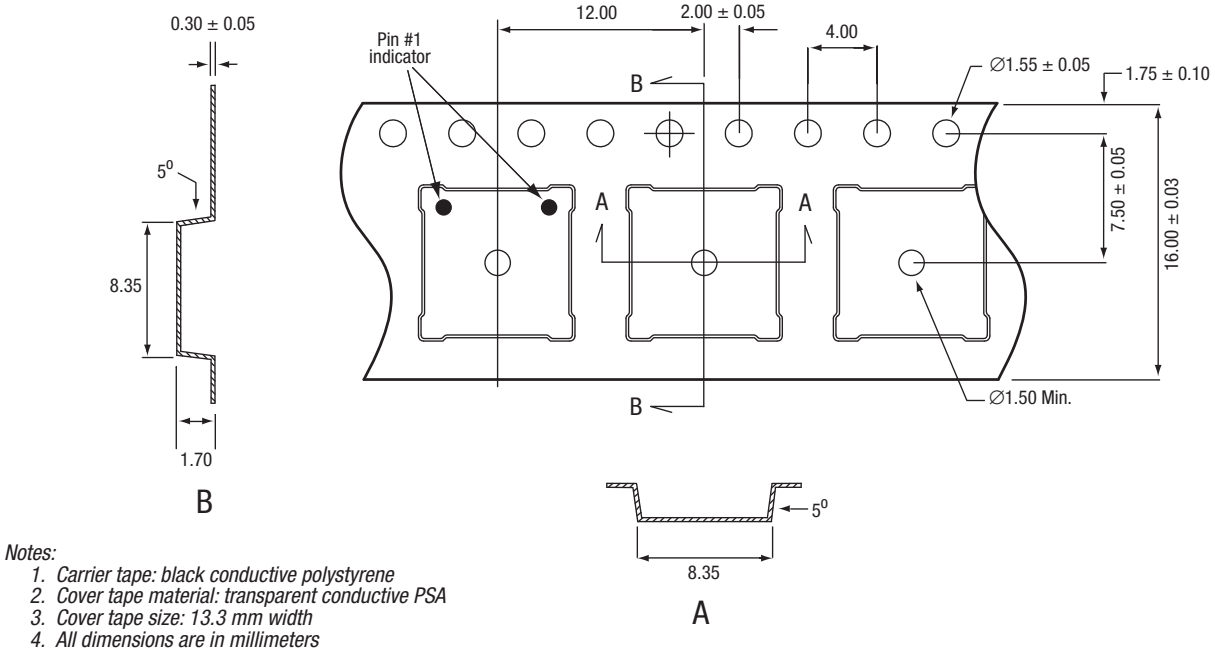
Figure 15. SKY65337-11 Phone Board Layout Footprint



All measurements are in millimeters.
Dimensioning and tolerancing according to ASME Y14.5M-1994.
Pads are metal defined.

S2649

Figure 16. SKY65337-11 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 17. SKY65337-11 Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY65337-11: Transmit/Receive FEM	SKY65337-11	SKY65337-11-EVB