DATA SHEET

SKY65344-21: 2.4 GHz Transmit/Receive Front-End Module with Integrated Low-Noise Amplifier

Applications

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

Features

- Transmit output power > +20 dBm
- Receive path NF < 2.2 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 = 3.3 V
- Interfaces seamlessly with Ember EM250, EM260, and EM35x ZigBee transceivers
- All RF ports are internally DC blocked
- Small footprint, MCM (20-pin, 6 x 6 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.

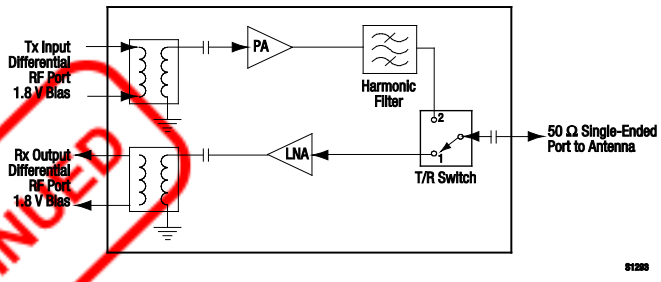


Figure 1. SKY65344-21 Block Diagram

Description

The Skyworks SKY65344-21 is a high-efficiency front-end module (FEM) for ZigBee and other 2.4 GHz ISM band applications. The small, 6 x 6 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 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 20-pin, 6 x 6 mm MCM surface-mount technology (SMT) package, which allows for a highly manufacturable low-cost solution.

A block diagram of the SKY65344-21 is shown in Figure 1. The device package and pinout for the 20-pin MCM are shown in Figure 2. Signal pin assignments and functional pin descriptions are described in Table 1.

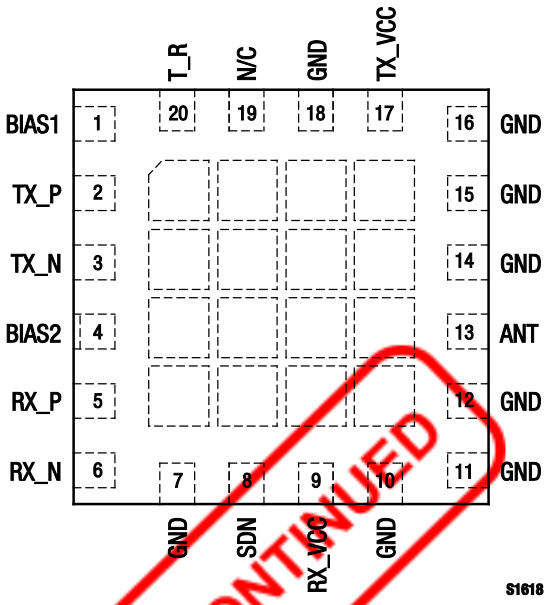


Figure 2. SKY65344-21 Pinout (Top View)

Table 1. SKY65344-21 Signal Descriptions[1]

Pin	Name	Description	Pin	Name	Description
1	BIAS1	Transmit port bypass voltage	11	GND	Ground
2	TX_P	Positive transmit input port	12	GND	Ground
3	TX_N	Negative transmit input port	13	ANT	Antenna port
4	BIAS2	Receive port bypass voltage	14	GND	Ground
5	RX_P	Positive receive output port	15	GND	Ground
6	RX_N	Negative receive output port	16	GND	Ground
7	GND	Ground	17	TX_VCC	Transmit DC supply, +3.3 V
8	SDN	Shut down enable	18	GND	Ground
9	RX_VCC	Receive DC supply, +3.3 V	19	N/C	No connection
10	GND	Ground	20	T_R	Transmit/receive control

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

Technical Description

Shut Down and T/R Switch Mode Control

Pin 8 (SDN) is used to enable the device while pin 20 (T_R) enables transmit or receive mode. The following control logic is used to configure the transmit, receive, or shut down mode of the SKY65344-21:

SDN (Pin 8)	T_R (Pin 20)	Mode
High	High	Transmit mode
High	Low	Receive mode
Low	Low	Shut Down 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 can be used as a guide for RF ground and thermal layout.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY65344-21 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 SKY65344-21 are shown in Figures 3, 4, and 5.

Table 2. SKY65344-21 Absolute Maximum Ratings[1]

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	RX_VCC, TX_VCC	1.8	4	V
Control voltage	SDN, T_R		3.6	V
Bypass voltage	BIAS1, BIAS2		4	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

[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. SKY65344-21 Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Units
Frequency range	f	2400		2500	MHz
Supply voltage (TX_VCC, RX_VCC)	VCC	2.7	3.3	3.6	V
Shut down and T/R control voltage:					
Low	T_R_L, SDN_L		0	0.1	V
High	T_R_H, SDN_H	1.62	1.80	3.60	V

Table 4. SKY65344-21 Electrical Specifications[1]
(Vcc = 3.3 V, Tc = 25 °C, PIN = +3 dBm, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Frequency range	f		2400		2500	MHz
Return loss[2]	RL	All RF ports		10		dB
Transmit differential port (TX_P, TX_N) impedance[2]	ZDTX			29 + j75		Ω
Receive differential port (RX_P, RX_N) impedance[2]	ZDRX			68 + j38		Ω
Transmitter Section						
Input power range	PIN			+3		dBm
Maximum output power[2]	PSAT			+21.5		dBm
Transmit output power	POUT		+19.5	+20.0		dBm
Operating current	IOP_H			105	130	mA
2nd harmonic	Pn2	IEEE 802.15.4 OQPSK modulated		–48	–43	dBm
3rd harmonic	Pn3	IEEE 802.15.4 OQPSK modulated		–49	–43	dBm
Small signal gain[2]	GH	PIN = –10 dBm		20		dB
Spur[2]		VSWR up to 10:1 (all phase angles)	No parasitic oscillation > –44 dBm			–
Ruggedness[2]		VSWR up to 10:1 (all phase angles)	No module damage or permanent degradation			–
Receive Section						
Small signal gain	G	CW	7	10		dB
Noise figure	NF			2.2	3.0	dB
1 dB input compression point[2]	IP1dB	CW		–11		dBm
Third order input intercept point[2]	IIP3	Two CW tones, spaced 1 MHz apart @ PIN = –9 dBm		–1		dBm
Operating current	ICC	CW		7	10	mA
Leakage current	ILEAK	No RF input, VCC = 3.3 V, SDN = 0 V, T_R = 0 V		4	10	µA

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

2 Parameter is characterized under the conditions in this Table but is not production tested.

Typical Performance Characteristics

(Vcc = 3.3 V, Tc = 25 °C, PIN = +3 dBm, Unless Otherwise Noted)

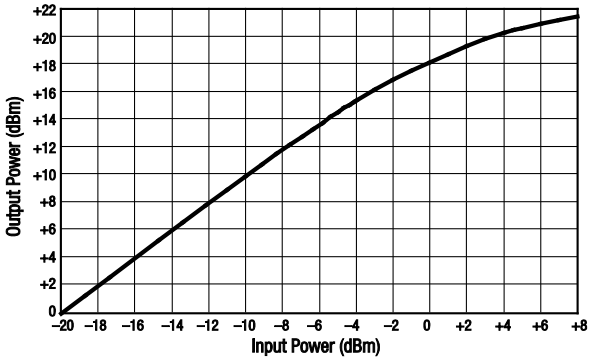


Figure 3. Output Power vs Input Power @ 2445 MHz

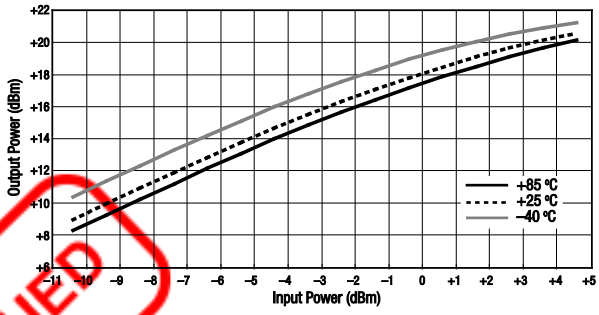


Figure 4. Output Power vs Input Power Over Temperature @ 2445 MHz

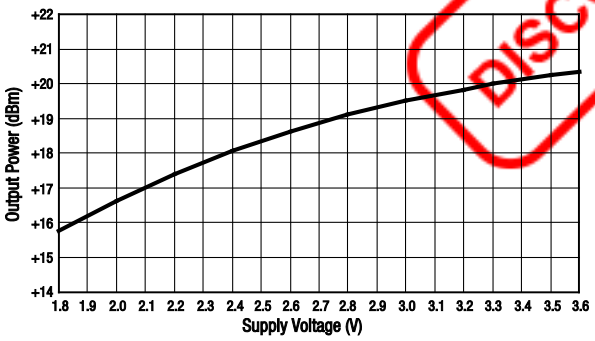
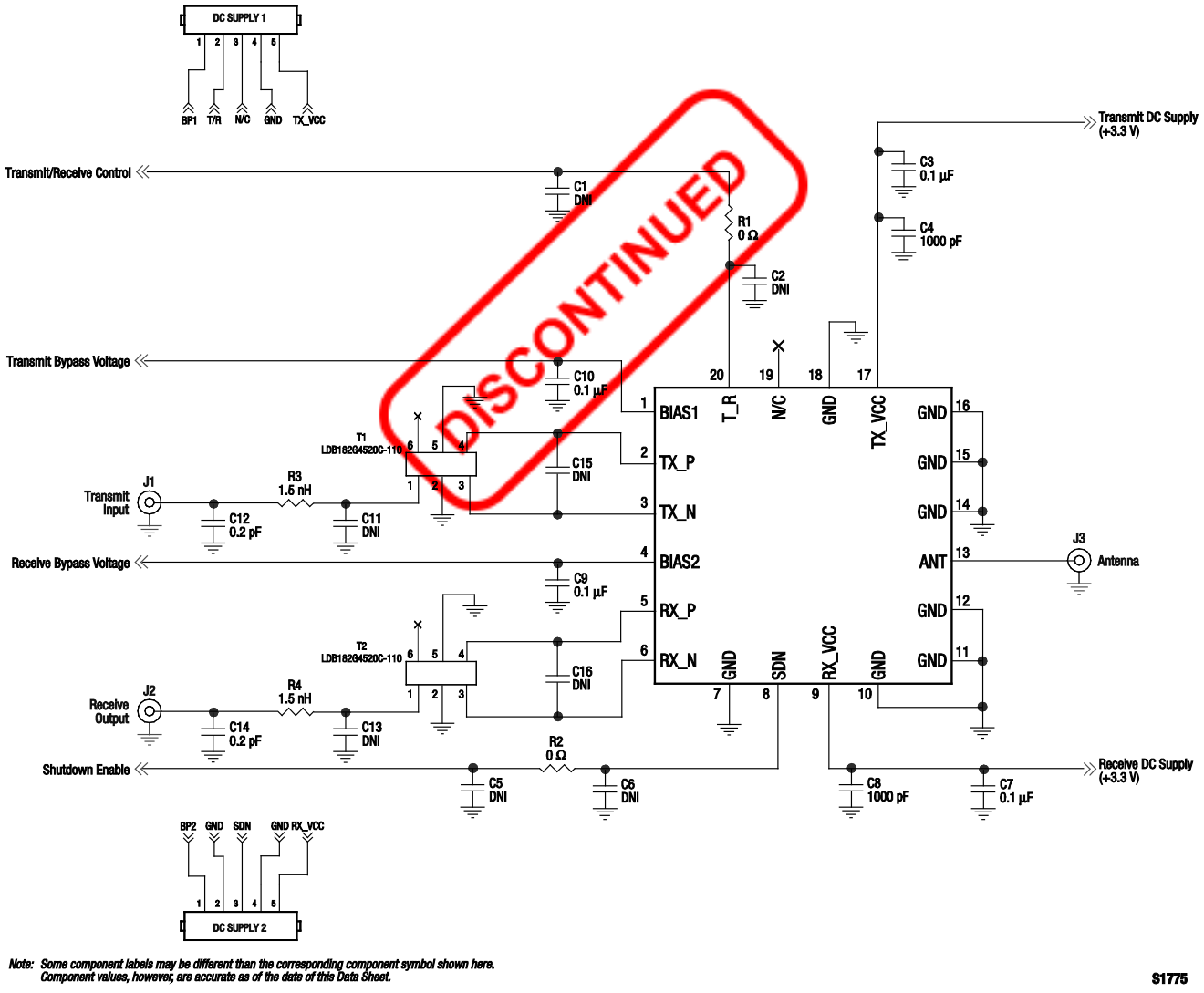


Figure 5. Output Power vs Supply Voltage @ 2445 MHz

Evaluation Board Description

The SKY65344-21 standalone Evaluation Board is used to test the performance of the SKY65344-21 FEM. The Evaluation Board schematic diagram is shown in Figure 6. An assembly drawing for the Evaluation Board is shown in Figure 7.

A reference design Evaluation Board is also available to test the SKY65344-21 with an Ember EM35x series transceiver (see **Ordering Information** on the last page of this data sheet).



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 6. SKY65344-21 Standalone Evaluation Board Schematic

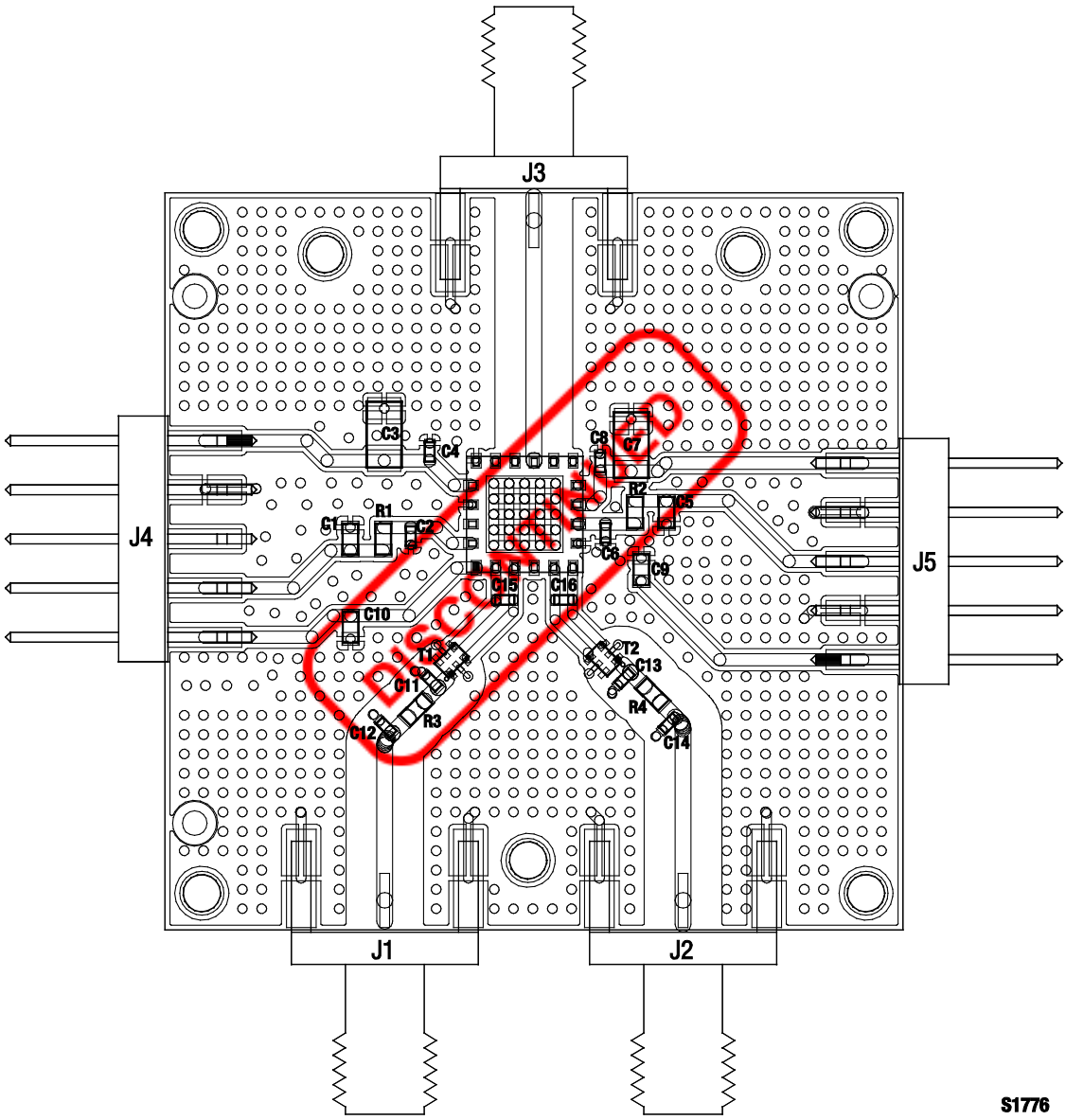


Figure 7. SKY65344-21 Standalone Evaluation Board Assembly Drawing

Package Dimensions

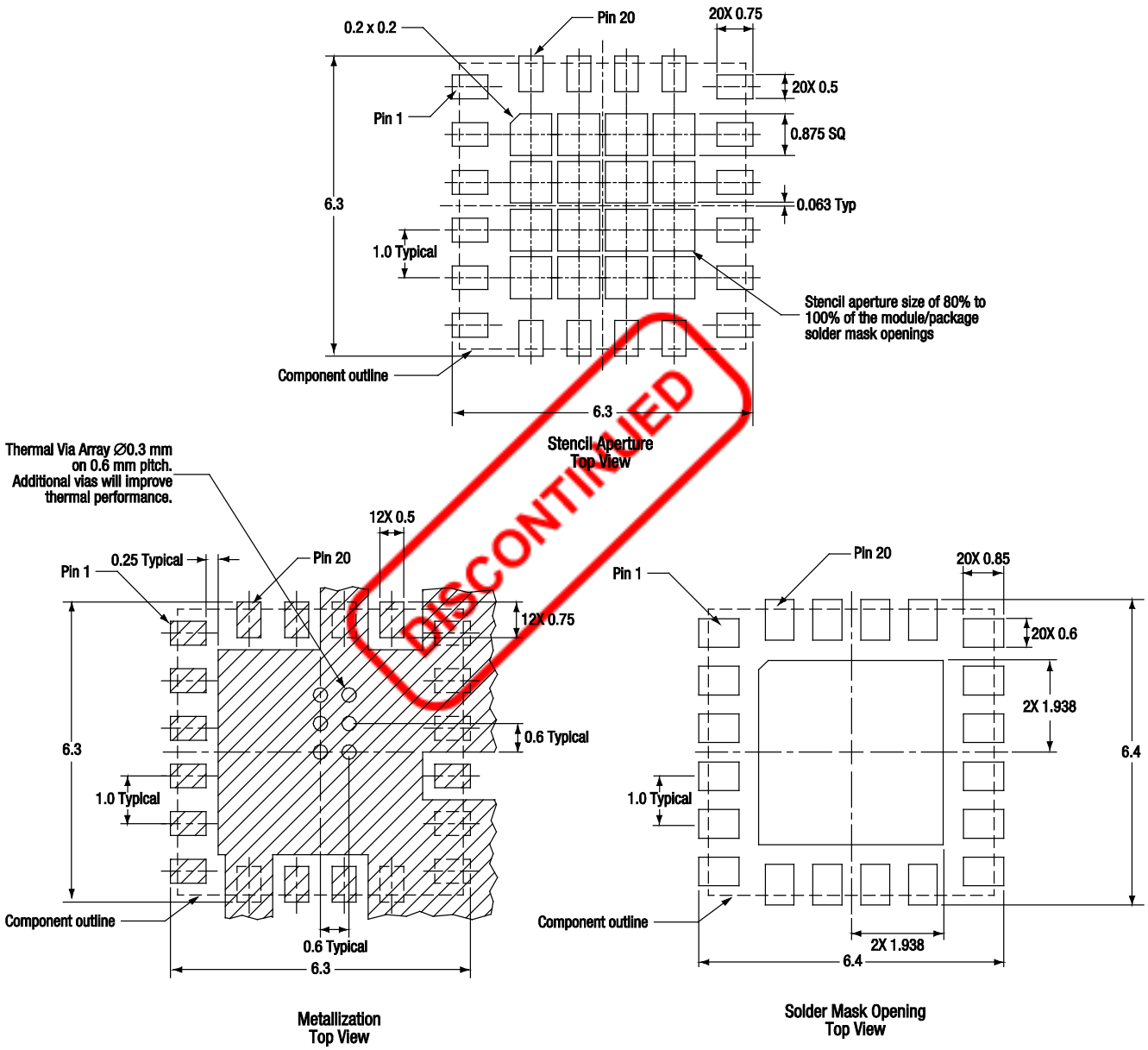
The phone board layout footprint for the SKY65344-21 is shown in Figure 8. Package dimensions are shown in Figure 9, and tape and reel dimensions are provided in Figure 10.

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 SKY65344-21 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.



Notes:

1. *All measurements are in millimeters.*
2. *Thermal vias should be tented and filled with solder mask: 30 to 35 µm Cu plating recommended.*

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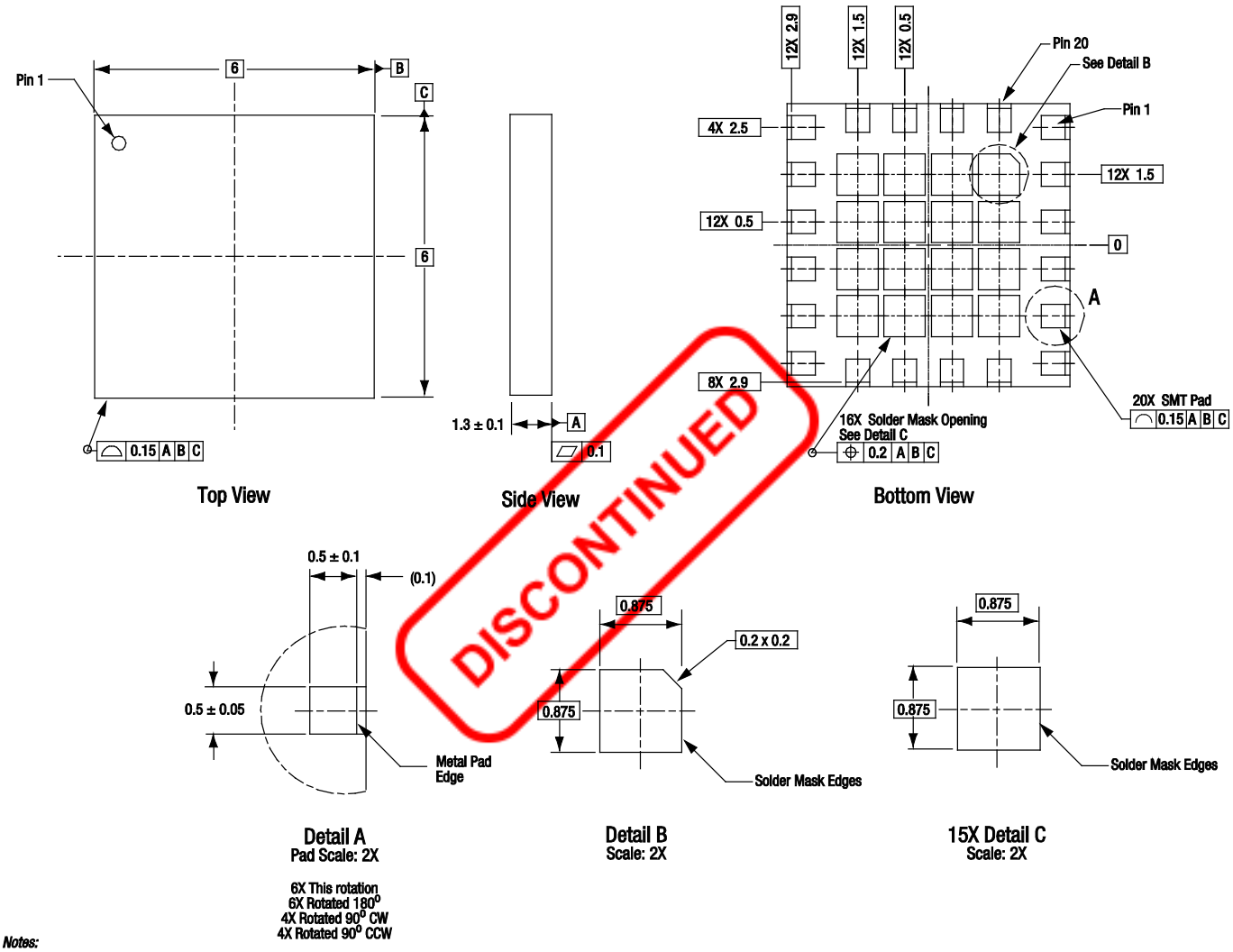
Figure 8. SKY65344-21 Phone Board Layout Footprint



Notes:

1. All dimensions are in millimeters.
2. Dimensioning and tolerancing according to ASME Y14.5M-1994

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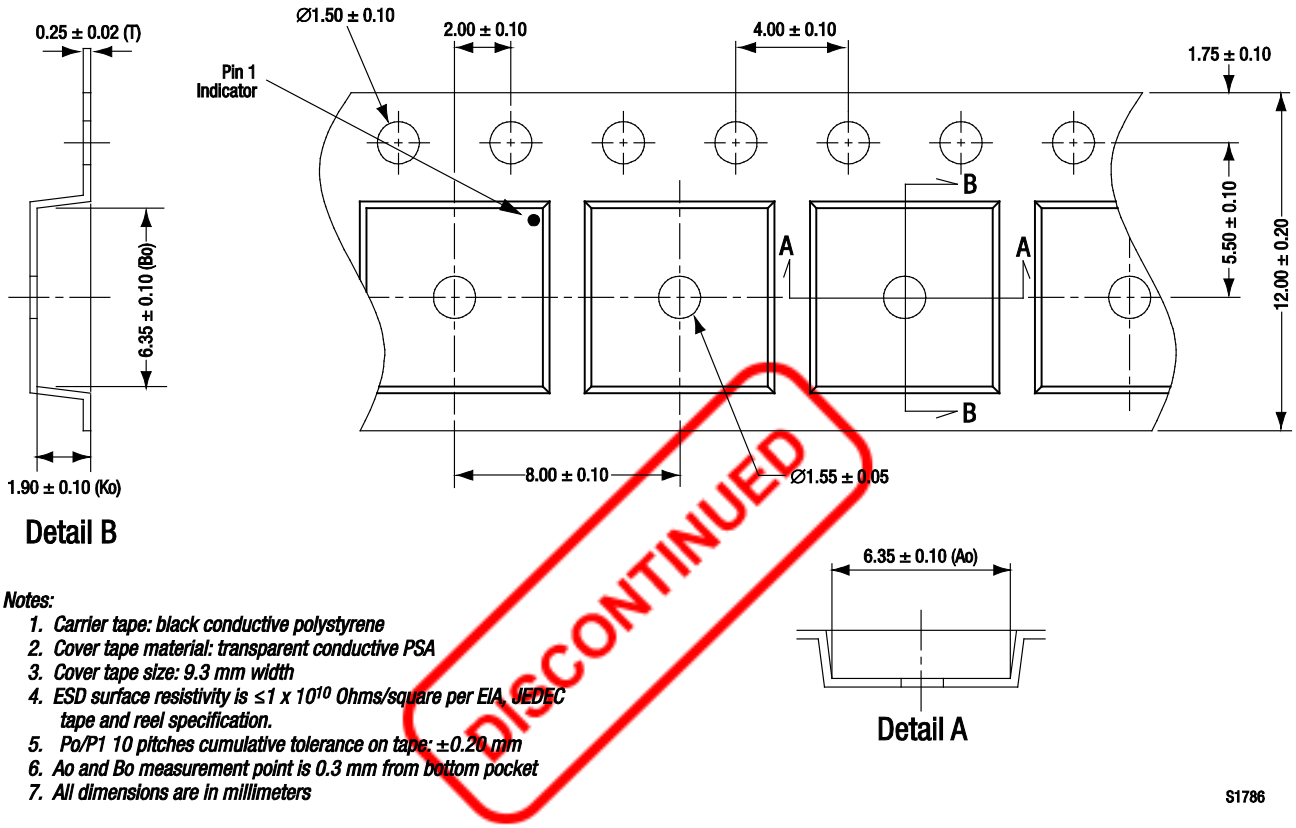
Figure 9. SKY65344-21 Package Dimensions



Notes:

1. *Carrier tape: black conductive polystyrene*
2. *Cover tape material: transparent conductive PSA*
3. *Cover tape size: 9.3 mm width*
4. *ESD surface resistivity is ≤1 x 10^{10} Ohms/square per EIA, JEDEC tape and reel specification.*
5. *Po/P1 10 pitches cumulative tolerance on tape: ±0.20 mm*
6. *Ao and Bo measurement point is 0.3 mm from bottom pocket*
7. *All dimensions are in millimeters*

Figure 10. SKY65344-21 Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY65344-21: T/R Front-End Module with LNA	SKY65344-21	SKY65344-21-EVB (standalone board) EM35X_SKY65344 (EM357 and SKY65344-21 Zigbee Reference Design)