

## DATA SHEET

# SKY65326-11: 380-500 MHz Transmit/Receive Front-End Module

## Applications

- Tetra radio
- Remote metering
- GSM
- WLL transmitters

## Features

- Transmit output power > +30 dBm
- High PAE = 45%
- High gain in transmit path: 34 dB
- High transmit/receive isolation > 30 dB
- Internal RF match and bias circuits
- All RF ports internally DC blocked
- Single DC supply = +3.6 V
- Small footprint, MCM (12-pin, 8 x 8 mm) Pb-free (MSL3, 260 °C per JEDEC J-STD-020) SMT package

## Description

Skyworks SKY65326-11 is a high-efficiency Front-End Module (FEM) that incorporates a transmit and receive path, and an antenna transmit/receive (T/R) switch.

The transmit path consists of a high efficiency Power Amplifier (PA). The PA is implemented using Skyworks high reliability Heterojunction Bipolar Transistor (HBT) process and is Class AB biased to provide maximum efficiency with a low spurious output.

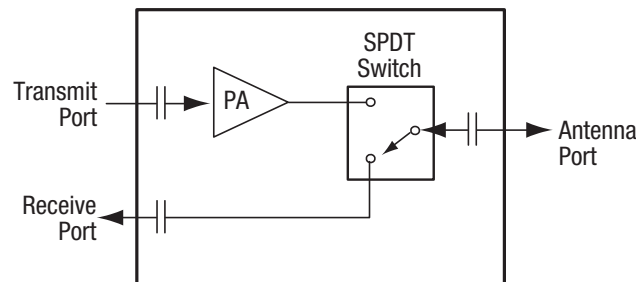
A high linearity and high isolation Single-Pole Double-Throw (SPDT) switch is used at the common antenna interface between the transmit and receive paths. The receive path is a low insertion loss through-path with input and output ports internally matched to 50 Ω.

The device is mounted in a 12-pin, 8 x 8 mm Multi-Chip Module (MCM) Surface-Mounted Technology (SMT) package, which allows for a highly manufacturable low-cost solution.

A block diagram of the SKY65326-11 is shown in Figure 1. The device package and pinout for the 12-pin MCM are shown in Figure 2.

**NEW**

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



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**Figure 1. SKY65326-11 Block Diagram**



### Table 1. SKY65326-11 SPDT Switch Control Logic

**Note:** Logic level 0: 0 V to 0.2 V  
Logic level 1: 2.0 V to 5.0 V

The SKY65326-11 provides input and output amplifier stages, and is internally matched for optimum efficiency. An active bias circuit provides the 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

provides a low loss  $<1$  dB bypass between the antenna port and the receive port.

Table 1 provides the SPDT transmit/receive switch control logic.

Signal pin assignments and functional pin descriptions are described in Table 2. The absolute maximum ratings of the SKY65326-11 are provided in Table 3. The recommended operating conditions are specified in Table 4 and electrical specifications are provided in Table 5.

Typical performance characteristics of the SKY65326-11 are illustrated in Figures 3 through 6.

## 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 SKY65326-11 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. For packaging details, refer to the Skyworks Application Note, *Tape and Reel*, document number 101568.

**Table 2. SKY65326-11 Signal Descriptions**

Pin #	Name	Description	Pin #	Name	Description
1	TX_IN	Transmit RF input	7	ANT	Antenna
2	GND	Ground	8	V2	Switch logic (see Table 1)
3	RX_OUT	Receive RF output	9	V1	Switch logic (see Table 1)
4	VC_BIAS	+3.6 V DC supply	10	VCC2	+3.6 V DC supply
5	VREF1	+3.6 V DC supply	11	PA_EN	PA enable switch (On = 2.5-3.6 V; Off = 0-0.2 V)
6	VREF2	+3.6 V DC supply	12	VCC1	+3.6 V DC supply

**Table 3. SKY65326-11 Absolute Maximum Ratings (Note 1)**

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	VCC		4.4	V
Input power	P <sub>IN</sub>		+5	dBm
Supply current	I <sub>CC</sub>		800	mA
Case operating temperature	T <sub>C</sub>	−40	+85	°C
Storage temperature	T <sub>ST</sub>	−65	+125	°C
Junction temperature	T <sub>J</sub>		+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. SKY65326-11 Recommended Operating Conditions**

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage	VCC1, VCC2, VREF1, VREF2, VC_BIAS	3.0	3.6	4.0	V
Case operating temperature	T <sub>C</sub>	−40		+85	°C
Storage temperature	T <sub>ST</sub>	−55		+125	°C

**Table 5. SKY65326-11 Electrical Specifications****(Frequency = 460 MHz, VCC1 = VCC2 = VREF1 = VREF2 = VC\_BIAS = 3.6 V, Tc = +25 °C, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Operating frequency range	f			460		MHz
Transmit path small signal gain	G	CW, P <sub>IN</sub> = -30 dBm	32.8	34.0		dB
Transmit saturated output power	P <sub>SAT</sub>	CW, P <sub>IN</sub> = +2 dBm	+30	+30.7		dBm
Transmit path Noise Figure	NF			5.5	6.5	dB
Transmit path harmonics (2 <sup>nd</sup> to 10 <sup>th</sup> )	Pf2	CW, P <sub>OUT</sub> = +30 dBm	30	32		dBc
	Pf3		30	36		dBc
	Pf4		30	41		dBc
	Pf5		30	50		dBc
	Pf6 to Pf10		30	55		dBc
Power Added Efficiency	PAE	CW, P <sub>OUT</sub> = +30 dBm	42	45		%
Receive path insertion loss	Rx_LOSS			0.5	0.7	dB
Transmit/receive path isolation	ISOL	CW	27	30		dB
Input return loss	S11		15	17		dB
Output return loss	S22		10	12		dB
Quiescent current	I <sub>Q</sub>	No RF		60	66	mA
Operating current	I <sub>OP</sub>	P <sub>OUT</sub> = +30 dBm		615	660	mA
Leakage current	I <sub>LEAK</sub> , PA_EN < 0.2 V	No RF input, module in standby mode		1	2	μA
Maximum VSWR for stable operation	VSWR <sub>MAX</sub>	CW	6:1	8:1		—

## Evaluation Board Description

The SKY65326-11 Evaluation Board is used to test the performance of the SKY65326-11 FEM. The Evaluation Board schematic diagram is shown in Figure 7. An assembly drawing for the Evaluation Board is shown in Figure 8 and the layer detail is provided in Figure 9. The layer detail physical characteristics are noted in Figure 10. Table 6 provides the Bill of Materials (BOM) list for Evaluation Board components.

## 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 pad of the SKY65326-11 has special electrical and thermal grounding requirements. This pad is 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.

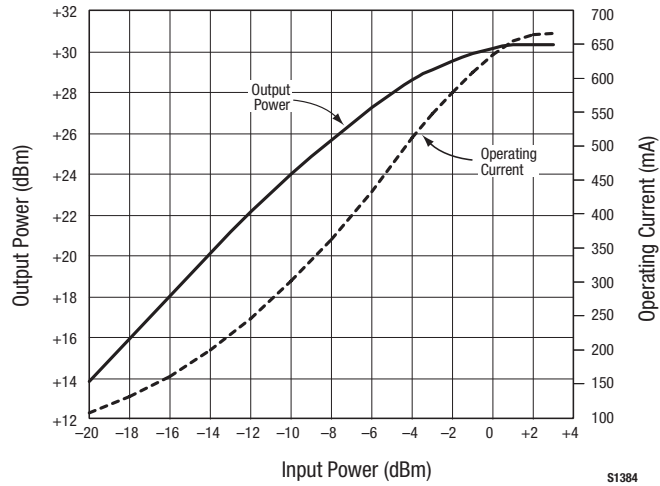
**NOTE:** A poor connection between the slug and ground increases junction temperature (T<sub>J</sub>), which reduces the lifetime of the device.

## Package Dimensions

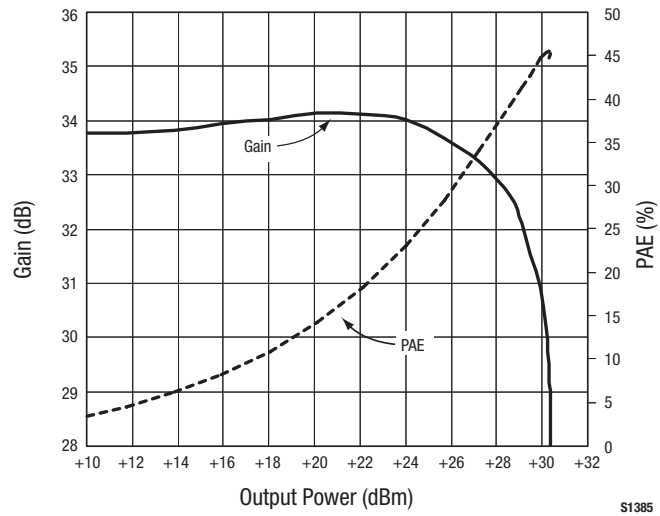
The phone board layout footprint for the SKY65326-11 is shown in Figure 11. Package dimensions for the 12-pin MCM are shown in Figure 12, and tape and reel dimensions are provided in Figure 13.

## Electrostatic Discharge (ESD) Sensitivity

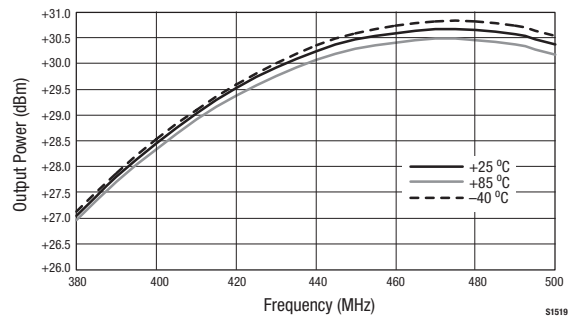
The SKY65326-11 is a static-sensitive electronic device. Do not operate or store near strong electrostatic fields. Take proper ESD precautions.



**Figure 3. Output Power and Current Consumption vs Input Power**



**Figure 4. Gain and PAE vs Output Power**



**Figure 5. Saturated Power vs Frequency Over Temperature (VCC = 3.6 V)**

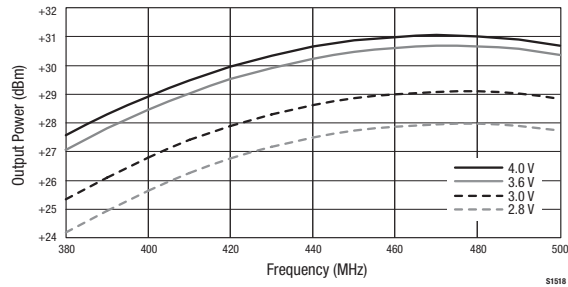


Figure 6. Saturated Power vs Frequency Over Supply Voltage (Tc = 25 °C)

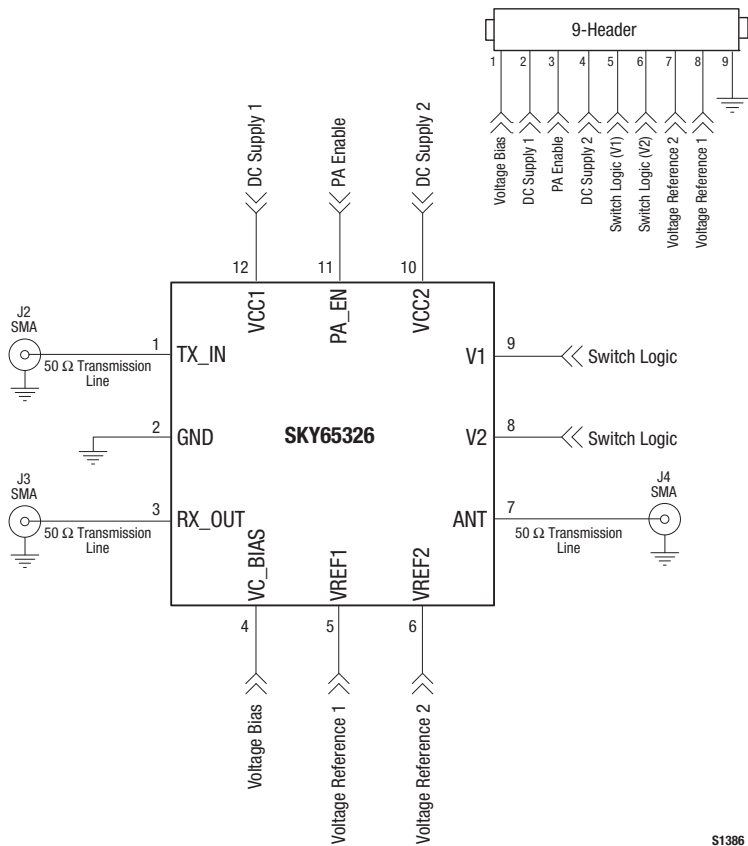
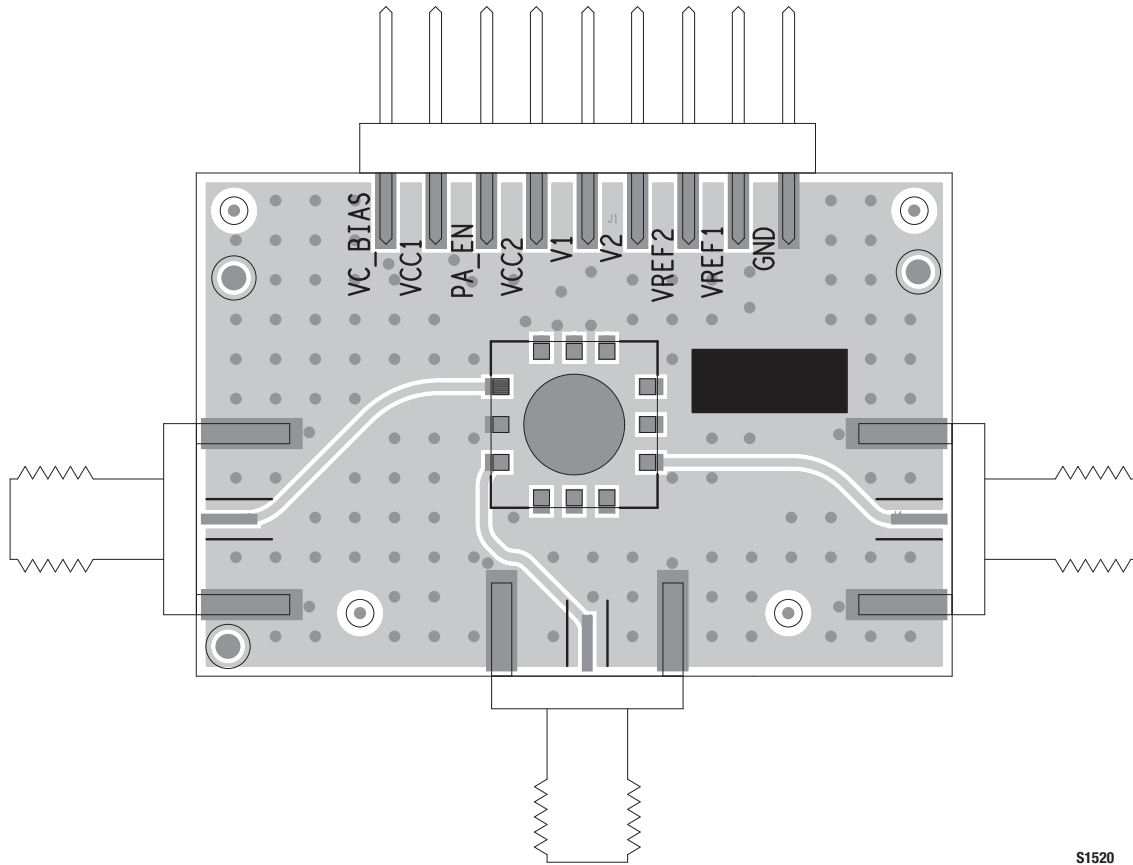
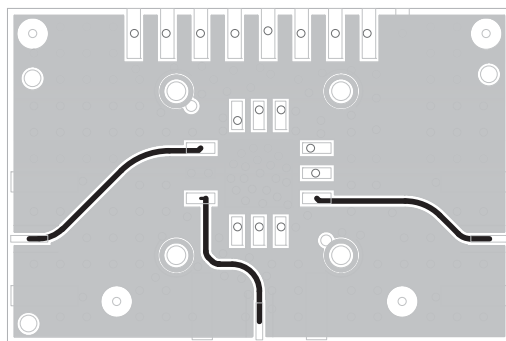


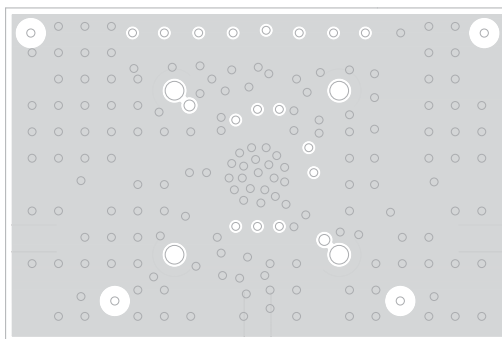
Figure 7. SKY65326-11 Evaluation Board Schematic



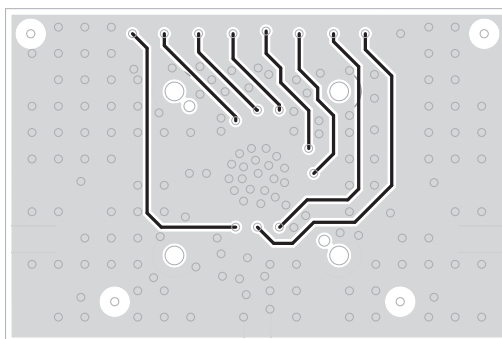
**Figure 8. SKY65326-11 Evaluation Board Assembly Drawing**



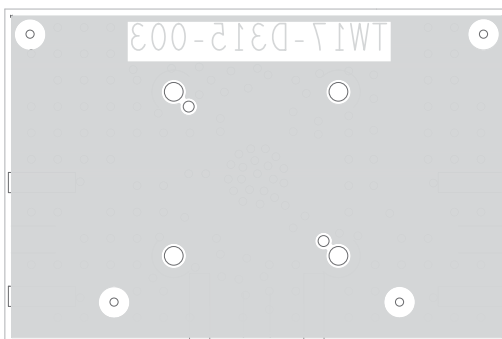
Layer 1: Top – Metal



Layer 2: Ground



Layer 3: Power Plane

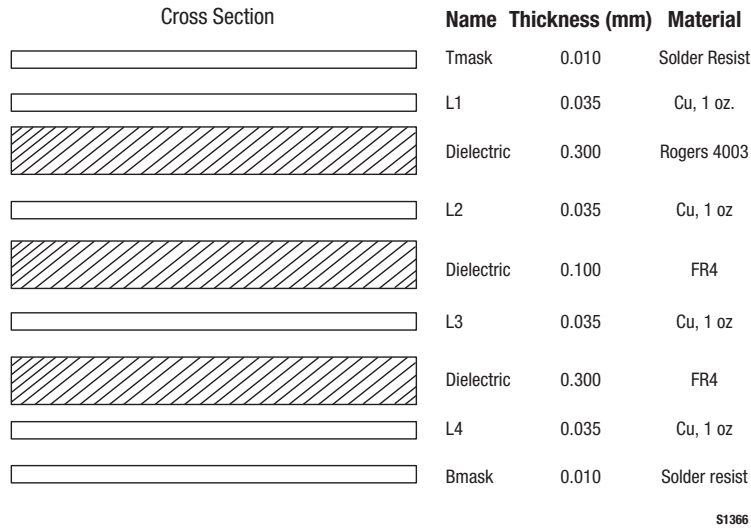


Layer 4: Solid Ground Plane

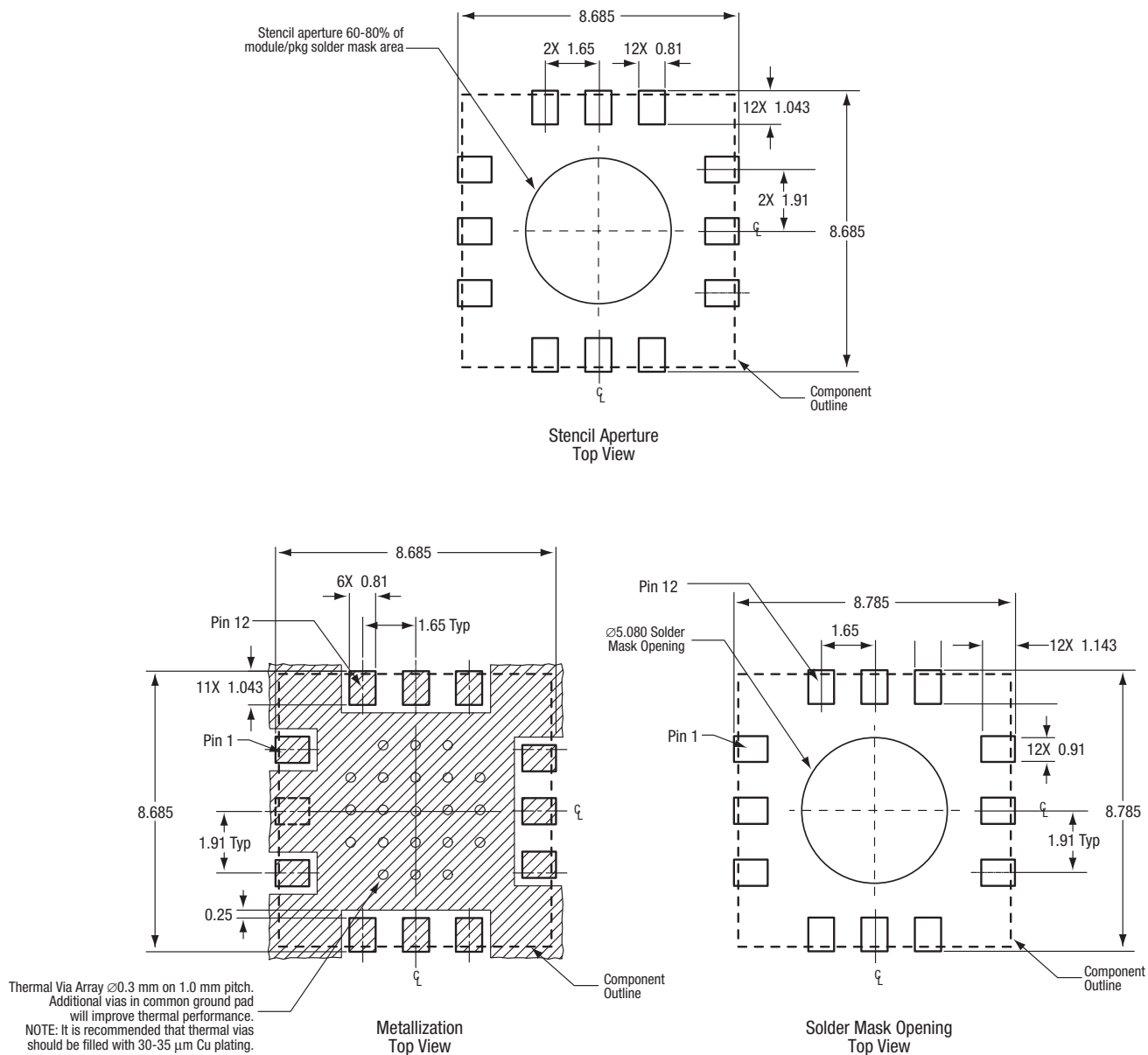
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**Figure 9. SKY65326-11 Evaluation Board Layer Detail**



**Figure 10. Layer Detail Physical Characteristics****Table 6. SKY65326-11 Evaluation Board Bill of Materials**

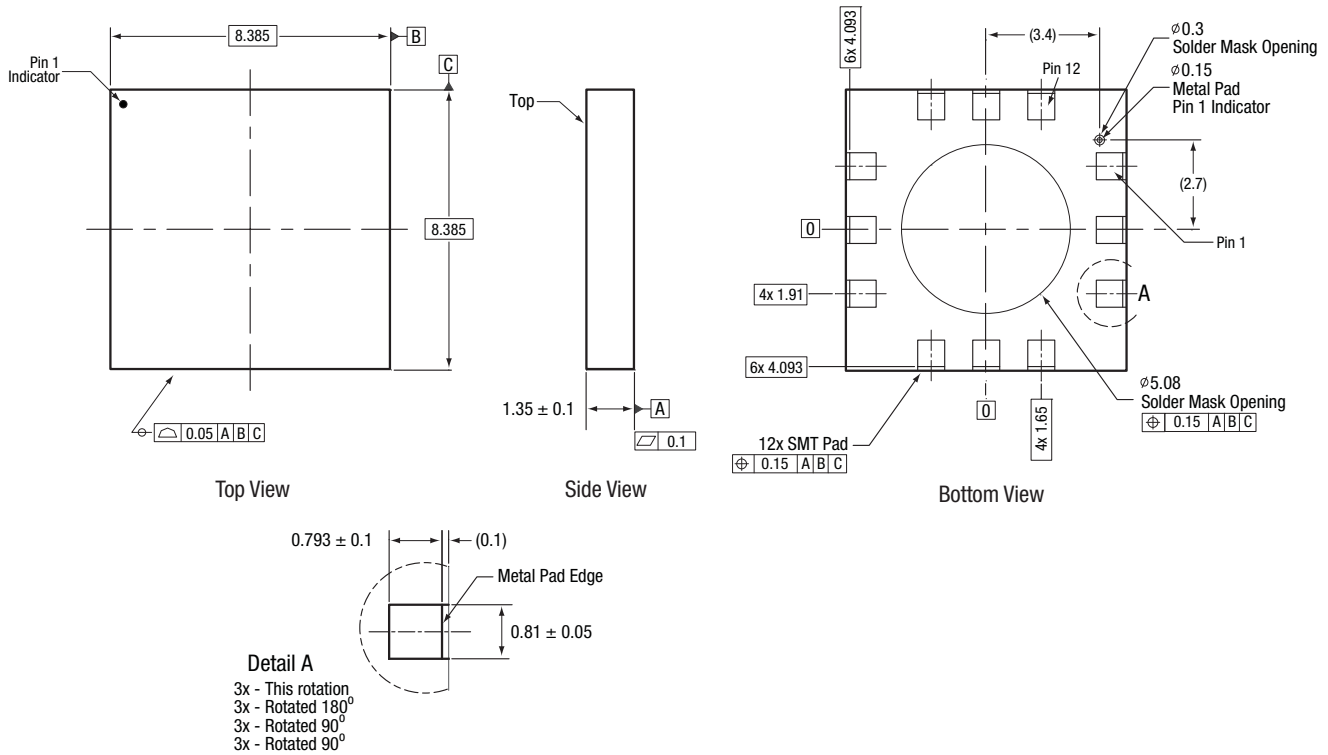
Component	Quantity	Size	Value	Vendor	Part Number
J2, J3, J4	3				615R54-021
SC1, SC2, SC3, SC4	4				92196A052
Backframe	1				1056-101



All measurements are in millimeters

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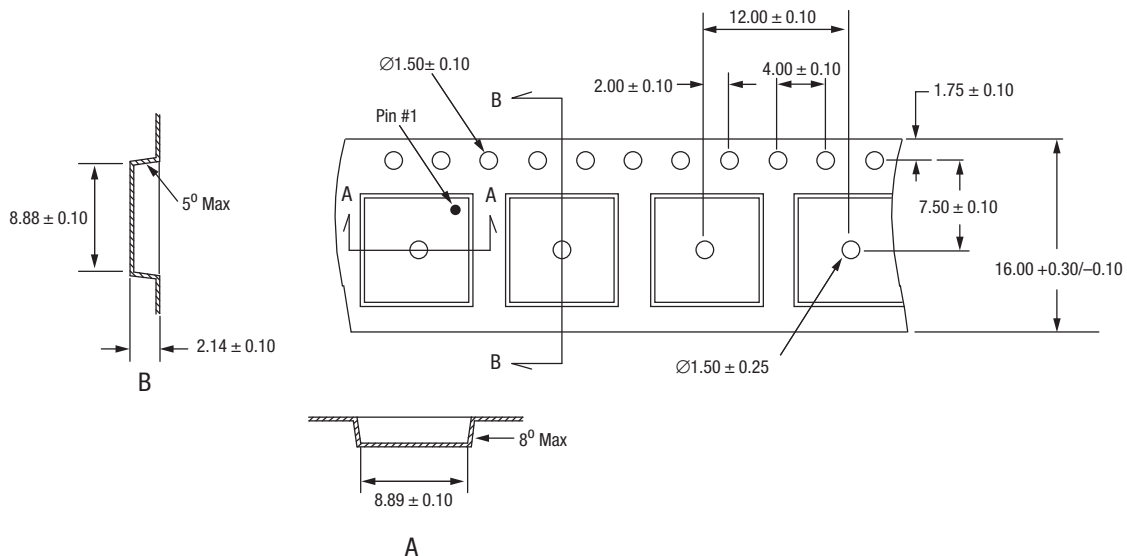
Figure 11. SKY65326-11 Phone Board Layout Footprint



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

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**Figure 12. SKY65326-11 12-Pin MCM Package Dimensions**



Notes:

1. Carrier tape: black conductive poly carbonate or polystyrene.
2. Cover tape material: transparent conductive PSA.
3. Cover tape size: 13.3 mm width.
4. All measurements are in millimeters.

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**Figure 13. SKY65326-11 12-Pin MCM Tape and Reel Dimensions**

## Ordering Information

Model Name	Manufacturing Part Number	Evaluation Kit Part Number
SKY65326-11 450-470 MHz Front-End Module	SKY65326-11 (Pb-free package)	TW17-D315-003

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