

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 (MLSL3, 260 °C per JEDEC J-STD-020) SMT package

NEW

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



Description

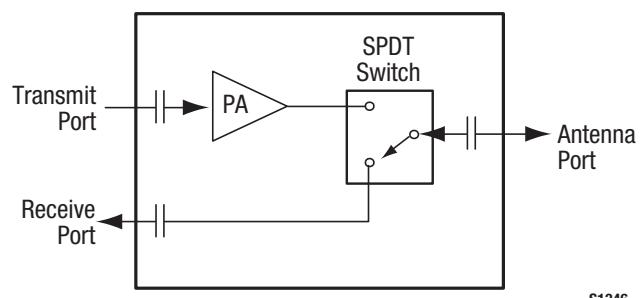
Skyworks SKY65326-11 is a high-efficiency Front-End Module (FEM) that incorporates a transmit and receive path, and an antenna transmit/receive (T/R) switch.

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.

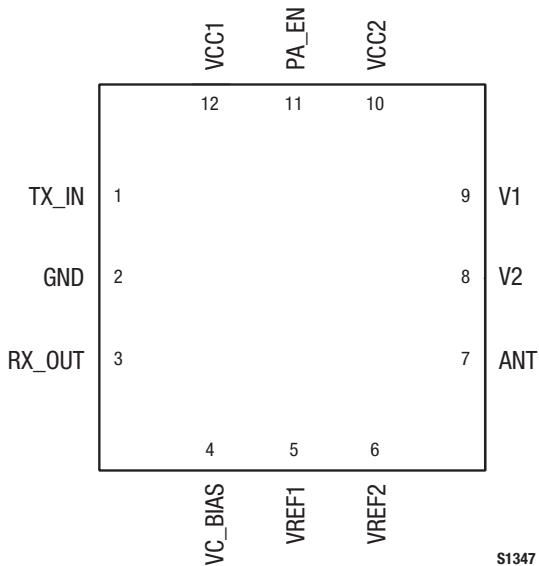
The device is mounted in a 12-pin, 8 x 8 mm Multi-Chip Module (MCM) Surface-Mounted Technology (SMT) package, which allows for a highly manufacturable low-cost solution.

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.



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Figure 1. SKY65326-11 Block Diagram



**Figure 2. SKY65326-11 Pinout – 12-Pin MCM
(Top View)**

Table 1. SKY65326-11 SPDT Switch Control Logic

Mode	V1 Signal (Pin 9)	V2 Signal (Pin 8)
Transmit	1	0
Receive	0	1

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

Technical Description

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.

The SKY65326-11 is internally matched for optimum linearity and efficiency. The input and output stages are independently supplied using the VCC1 and VCC2 supply lines (pins 12 and 10, respectively). The bias reference voltages for stages 1 and 2 are supplied using common lines VREF1 and VREF2 (pins 5 and 6, respectively). The DC control voltage that sets the bias for stages 1 and 2 is supplied by the VC_BIAS signal, pin 4.

Operational Modes

The module's receive and transmit modes are configured using the V1 and V2 control signals (pins 9 and 8, respectively). The transmit path provides a high efficiency PA. The receive path

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.

Electrical and Mechanical Specifications

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	PIN		+5	dBm
Supply current	Icc		800	mA
Case operating temperature	Tc	-40	+85	°C
Storage temperature	Tst	-65	+125	°C
Junction temperature	Tj		+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	Tc	-40		+85	°C
Storage temperature	Tst	-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 _{IN} = -30 dBm	32.8	34.0		dB
Transmit saturated output power	P _{SAT}	CW, P _{IN} = +2 dBm	+30	+30.7		dBm
Transmit path Noise Figure	NF			5.5	6.5	dB
Transmit path harmonics (2 nd to 10 th)	Pf2 Pf3 Pf4 Pf5 Pf6 to Pf10	CW, P _{OUT} = +30 dBm	30 30 30 30 30	32 36 41 50 55		dBc dBc dBc dBc dBc
Power Added Efficiency	PAE	CW, P _{OUT} = +30 dBm	42	45		%
Receive path insertion loss	R _X _LOSS			0.5	0.7	dB
Transmit/receive path isolation	I _{SOL}	CW	27	30		dB
Input return loss	S ₁₁		15	17		dB
Output return loss	S ₂₂		10	12		dB
Quiescent current	I _Q	No RF		60	66	mA
Operating current	I _{OP}	P _{OUT} = +30 dBm		615	660	mA
Leakage current	I _{LEAK} , PA_EN < 0.2 V	No RF input, module in standby mode		1	2	µA
Maximum VSWR for stable operation	VSWR _{MAX}	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_J), 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.

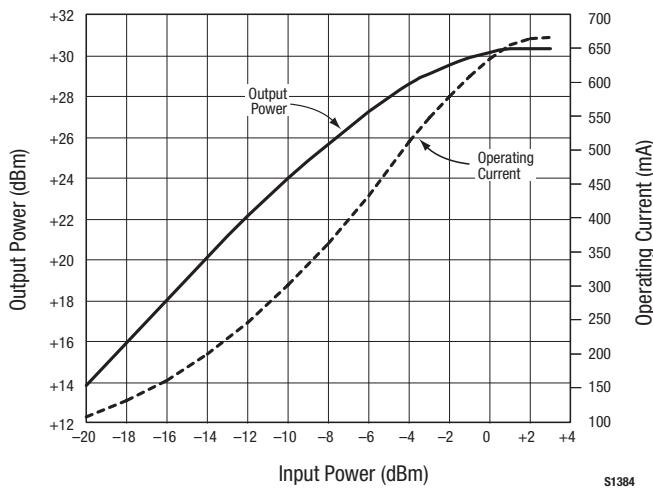


Figure 3. Output Power and Current Consumption vs Input Power

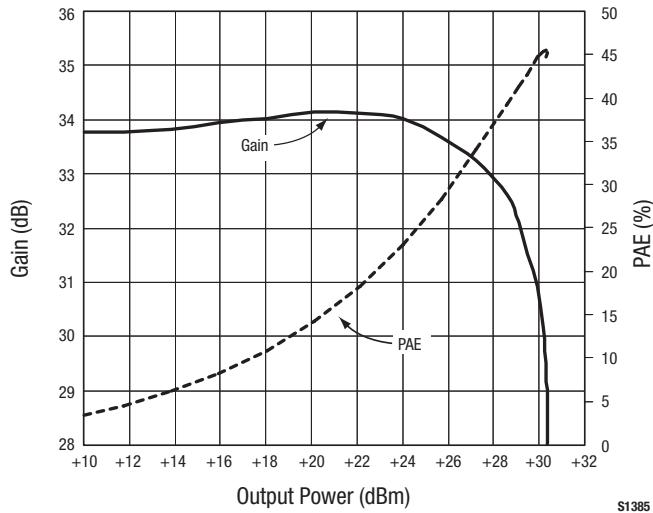
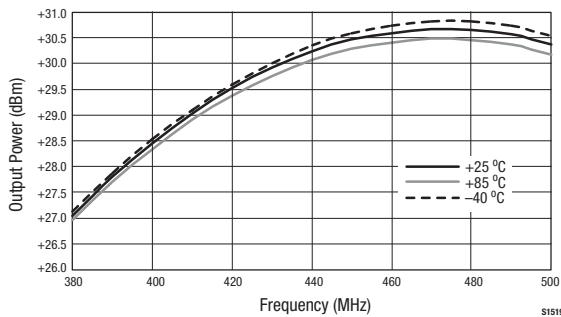


Figure 4. Gain and PAE vs Output Power

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

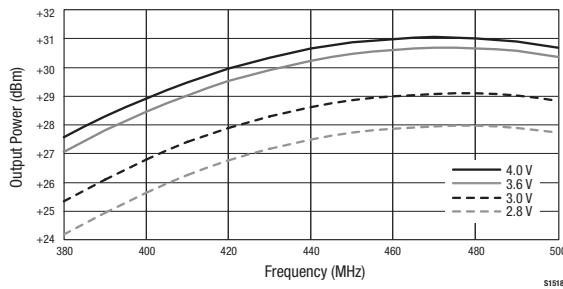


Figure 6. Saturated Power vs Frequency Over Supply Voltage (Tc = 25 °C)

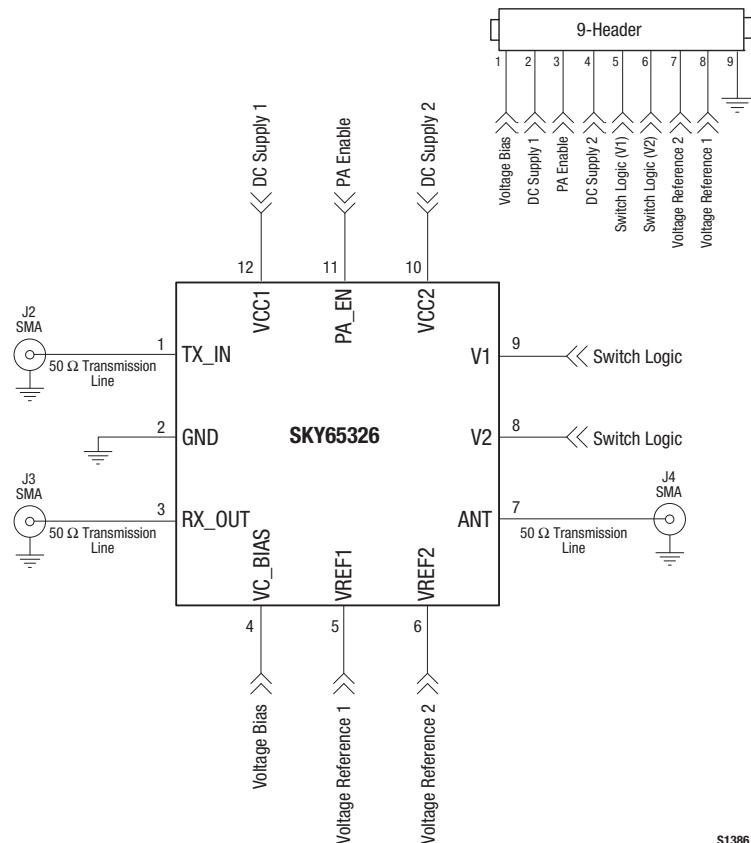


Figure 7. SKY65326-11 Evaluation Board Schematic

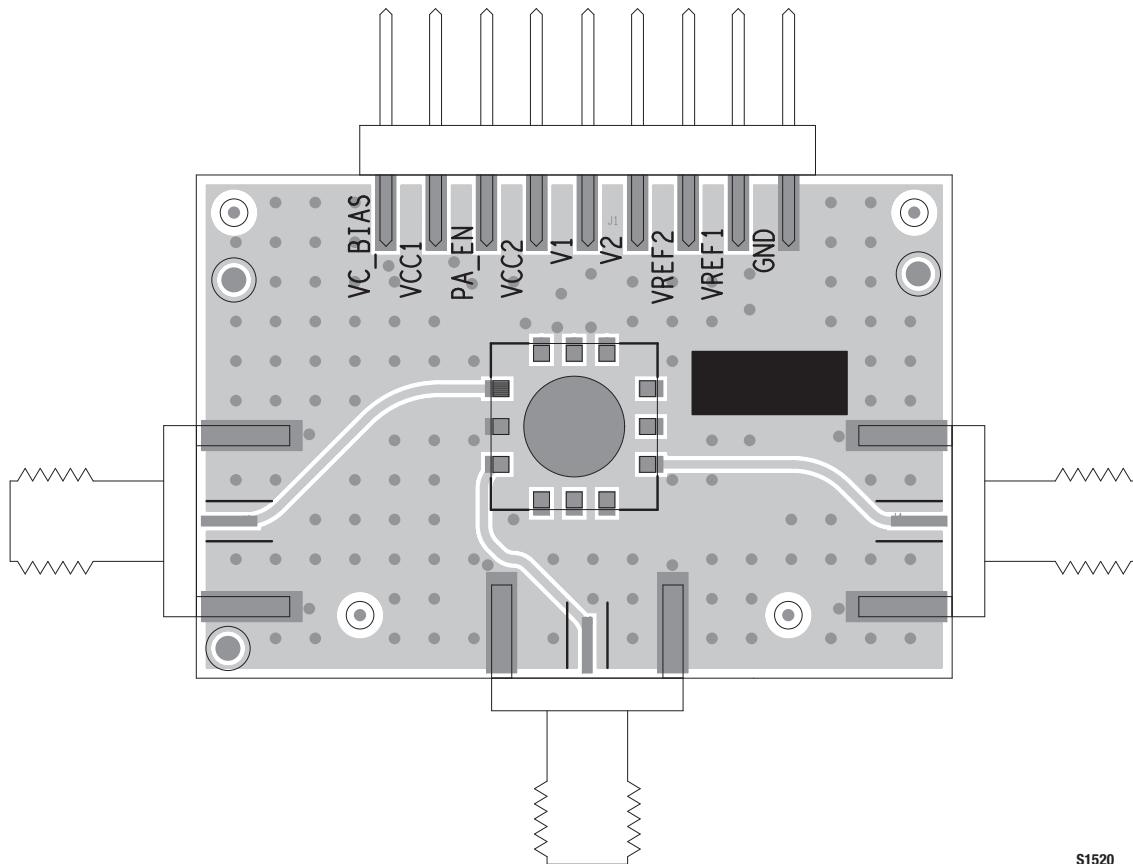


Figure 8. SKY65326-11 Evaluation Board Assembly Drawing

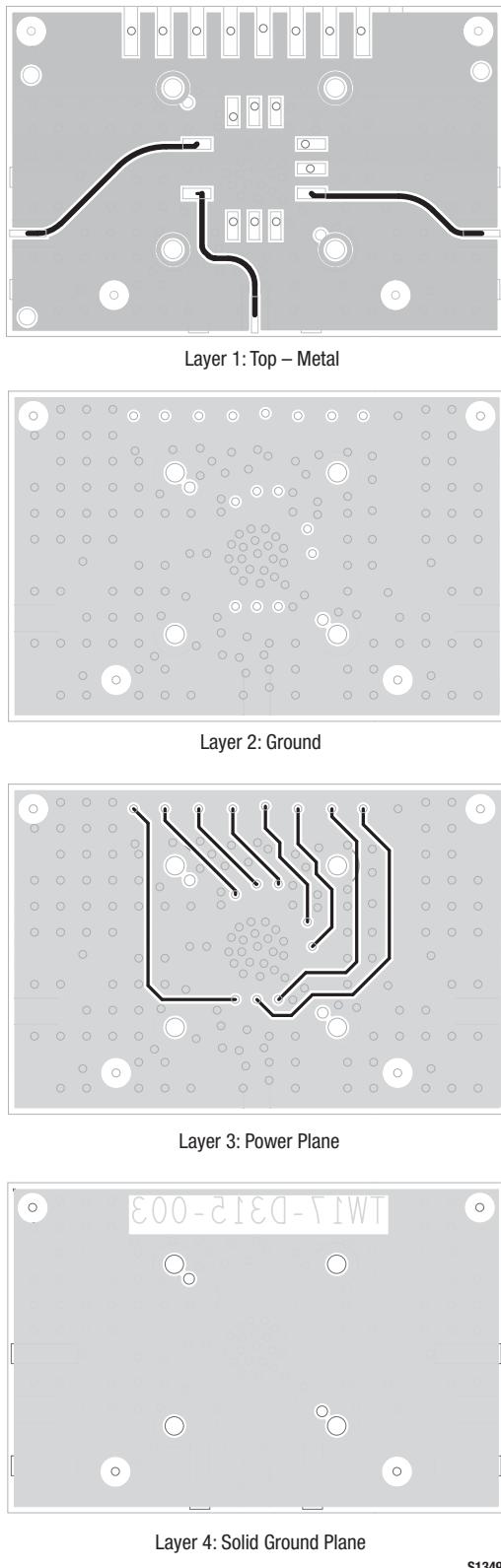


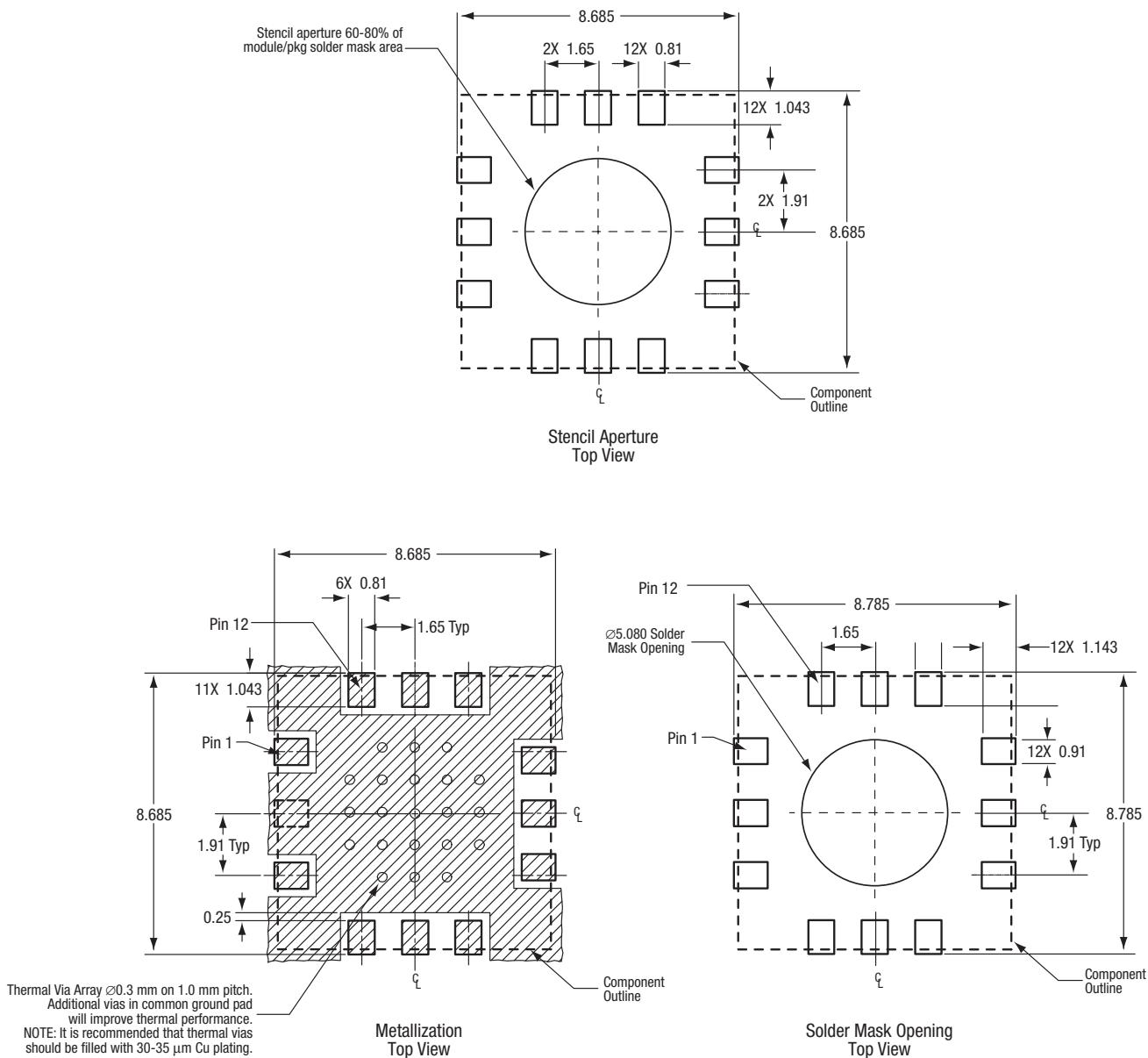
Figure 9. SKY65326-11 Evaluation Board Layer Detail

Cross Section	Name	Thickness (mm)	Material
	Tmask	0.010	Solder Resist
	L1	0.035	Cu, 1 oz.
	Dielectric	0.300	Rogers 4003
	L2	0.035	Cu, 1 oz
	Dielectric	0.100	FR4
	L3	0.035	Cu, 1 oz
	Dielectric	0.300	FR4
	L4	0.035	Cu, 1 oz
	Bmask	0.010	Solder resist

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

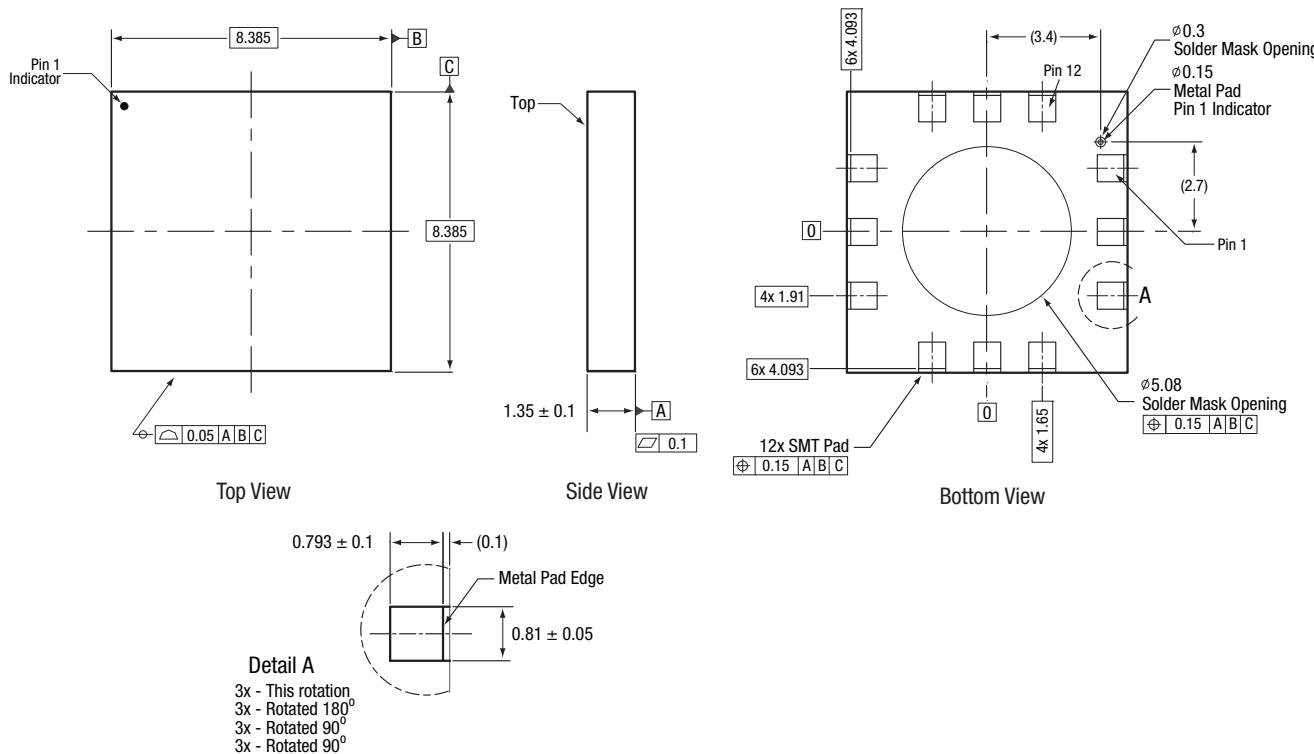
Component	Quantity	Size	Value	Vendor	Part Number
J2, J3, J4	3				615R54-021
SC1, SC2, SC3, SC4	4				92196A052
Backframe	1				1056-101



All measurements are in millimeters

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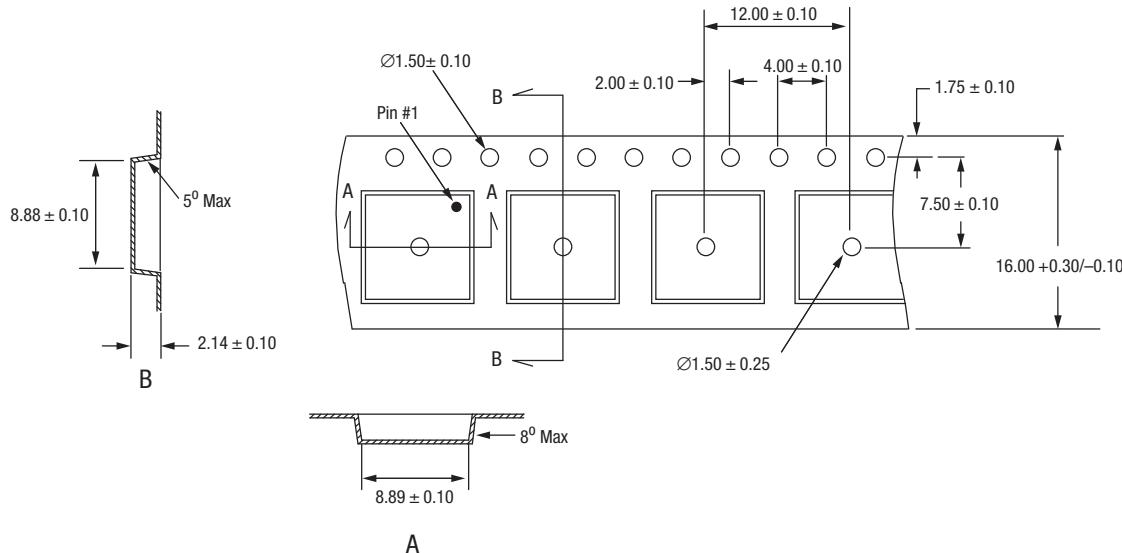
Figure 11. SKY65326-11 Phone Board Layout Footprint



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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