

DATA SHEET

SKY65362-11: 900 to 930 MHz High-Power RF Front-End Module

Applications

- Smart meters
- In-home appliances
- Smart thermostats

Features

- Integrated PA with +30.5 dBm output power
- Integrated LNA with programmable bypass
- Low FEM NF of 2.5 dB, typical
- Single-ended 50 Ω transmit/receive RF interface
- Supply voltage: 3.00 V to 5.25 V
- Sleep mode current: <1 μA
- Small MCM (36-pin, 6 x 6 mm) package (MSL3, 260 °C per JEDEC J-STD-020)

Description

The SKY65362-11 is a high-performance, highly integrated RF front-end module (FEM) designed for high-power Industrial, Scientific, Medical (ISM) band applications operating in the 900 to 930 MHz frequency range.

The FEM is designed for ease of use and maximum flexibility with fully matched, 50 Ω power amplifier (PA) input and output, and digital controls compatible with 1.6 to 3.3 V CMOS levels.

The RF blocks operate over a wide supply voltage range from 3.00 to 5.25 V that allows the SKY65362-11 to be used in battery powered applications over a wide spectrum of the battery discharge curve.

The SKY65362-11 is packaged in a 36-pin, 6 x 6 mm Multi-Chip Module (MCM), which allows for a highly manufacturable low-cost solution.

A functional block diagram of the SKY65362-11 is shown in Figure 1. The 36-pin MCM package and pinout are shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.



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.

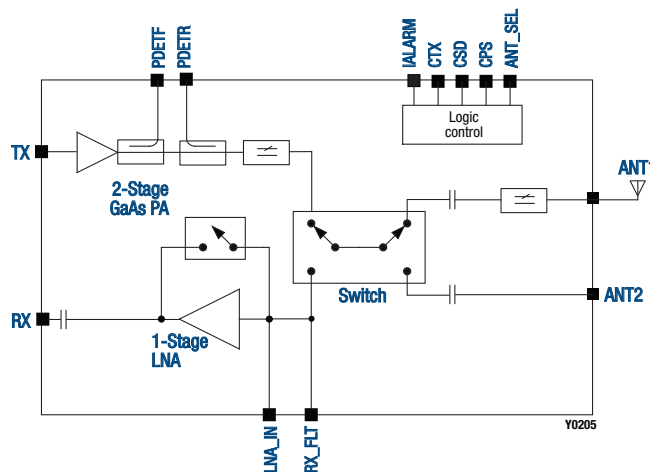


Figure 1. SKY65362-11 FEM Block Diagram

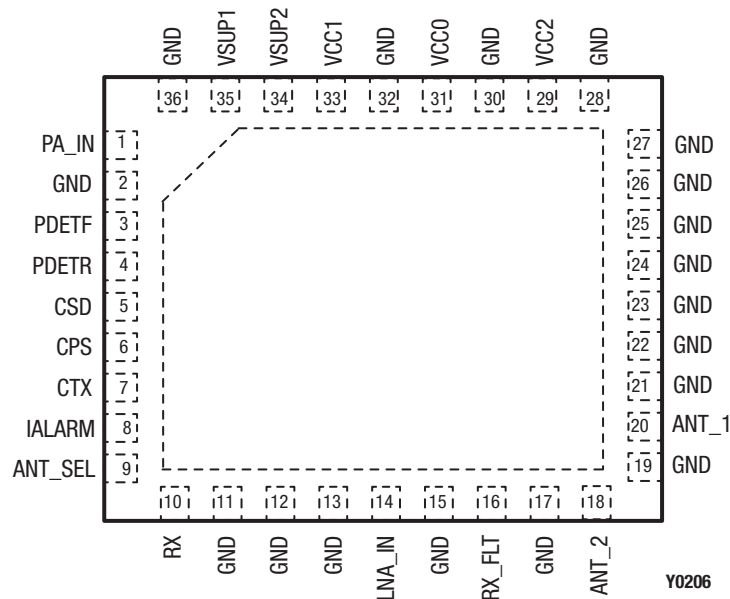


Figure 2. SKY65362-11 Pinout – 36-Pin MCM (Top View)

Table 1. SKY65362-11 Signal Descriptions

Pin	Name	Description	Pin	Name	Description
1	PA_IN	PA input	19	GND	Ground
2	GND	Ground	20	ANT1	Antenna 1
3	PDETF	Forward power detector output	21	GND	Ground
4	PDETR	Reverse power detector output	22	GND	Ground
5	CSD	Standby control (see Table 9)	23	GND	Ground
6	CPS	Receive mode gain control (see Table 9)	24	GND	Ground
7	CTX	Transmit/receive control (see Table 9)	25	GND	Ground
8	IALARM	PA current alarm output (see Table 9)	26	GND	Ground
9	ANT_SEL	Antenna select control input (see Table 9)	27	GND	Ground
10	RX	Receive output	28	GND	Ground
11	GND	Ground	29	VCC2	PA voltage supply
12	GND	Ground	30	GND	Ground
13	GND	Ground	31	VCC0	Decoupling capacitor
14	LNA_IN	LNA input	32	GND	Ground
15	GND	Ground	33	VCC1	PA voltage supply
16	RX_FLT	Receive path after internal switches that connect ANT1 and ANT2	34	VSUP2	FEM voltage supply
17	GND	Ground	35	VSUP1	FEM voltage supply
18	ANT2	Antenna 2. No integrated filtering.	36	GND	Ground

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY65362-11 are provided in Table 2. The recommended operating conditions are specified in Table 3.

Electrical specifications are provided in Tables 4 through 8. The state of the SKY65362-11 is determined by the logic provided in Table 9.

Table 2. SKY65362-11 Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage (no RF)	V _{CC}	-0.3	+6.0	V
Control pin (CSD, CPS, CTX, IALARM, and ANT_SEL) voltage		-0.3	V _{CC} (V _{CC} < 5 V)	V
Operating temperature	T _A	-40	+85	°C
Storage temperature	T _{STG}	-40	+125	°C
Transmit input power	P _{IN_TX_MAX}		+10	dBm
Receive RF input power @ ANT1 or ANT2 ports	P _{IN_RX_MAX}		+10	dBm
Voltage Standing Wave Ratio @ ANT1 or ANT2 ports	VSWR		10:1	-
Electrostatic discharge: Human Body Model (HBM), Class 1C	ESD		1000	V

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. Exceeding any of the limits listed here may result in permanent damage to the device.

CAUTION: 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. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD precautions should be used at all times.

Table 3. SKY65362-11 Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage	V _{CC}	4.75	5.00	5.25	V
Operating temperature	T _A	-40	+25	+85	°C

Table 4. SKY65362-11 DC Electrical Specifications (Note 1)
(V_{CC} = +5.0 V, T_A = +25 °C, as Measured on the SKY65362-11 Evaluation Board [De-Embedded to Device], Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Total supply current, transmit mode	I _{CC_TX30}	P _{OUT} = +30.5 dBm (Note 2)		515		mA
	I _{CC_TX27}	P _{OUT} = +27 dBm		300		mA
	I _{CC_TX24}	P _{OUT} = +24 dBm		230		mA
Quiescent current, transmit mode	I _{CO_TX}	No RF		85		mA
Total supply current, receive mode	I _{CC_RX}			6		mA
Total supply current, receive bypass mode	I _{CC_RXBYP}			820		μA
Sleep supply current	I _{CC_OFF}	No RF		0.05	1.00	μA

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

Note 2: Typical current listed into VSWR = 1:1. I_{CC} = 700 mA into VSWR = 2.5:1 guaranteed by characterization.

Table 5. SKY65362-11 Receive Mode Electrical Specifications (Note 1)
(V_{CC} = +5.0 V, T_A = +25 °C, as Measured on the SKY65362-11 Evaluation Board [De-Embedded to Device], All Unused Ports Terminated with 50 Ω, Input Port = ANT1, Output Port = RX, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Frequency range	f		900		930	MHz
Gain	S _{21_RX}	900 to 930 MHz		16		dB
Noise figure	NF	900 to 930 MHz		2.5		dB
Third order input intercept point	IIP3	900 to 930 MHz, -20 dBm/tone, 200 kHz tone separation	-5	-2		dBm
1 dB Input compression point	IP1dB	900 to 930 MHz	-15	-12		dBm
Antenna port return loss	S _{11_RX}	900 to 930 MHz, into 50 Ω, ANT1 or ANT2 port		-12	-6	dB
Receive port return loss in receive or receive bypass mode	S _{22_RX}	ANT1 terminated in 50 Ω		-12	-6	dB
Turn-on/off time	t _{ON_RX} , t _{OFF_RX}	Receive or receive bypass to "off," "off" to receive or receive bypass, from 50% of CTX edge to 10% of final RF output power (Note 2)			11	μs
Gain in receive bypass mode	S _{21_RXBYP}		-4	-3		dB
1 dB Input compression point in receive bypass mode	IP1dB_RXBYP		+10			dBm

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

Note 2: Not production tested. Guaranteed by characterization.

Table 6. SKY65362-11 Transmit Mode Electrical Specifications (1 of 2) (Note 1)**(V_{CC} = +5.0 V, T_A = +25 °C, as Measured on the SKY65362-11 Evaluation Board [De-Embedded to Device], All Unused Ports Terminated with 50 Ω, Input Port = PA_IN, Output Port = ANT1, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Frequency range	f		900		930	MHz
Output power @ ANT1 port	P _{OUT}	900 to 930 MHz with specified matching network on EVB, CW, P _{IN} = 0 dBm: V _{CC} = 5.0 V V _{CC} = 4.0 V V _{CC} = 3.6 V		+30.5 +28 +26		dBm dBm dBm
PA power added efficiency	PAE	P _{OUT} = +30.5 dBm @ ANT1 port, 915 MHz		43		%
Input return loss	S _{11_TX}	902 to 928 MHz		-10		dB
Small signal gain	S _{21_900}	902 to 928 MHz		33		dB
Output return loss	S _{22_TX}	900 to 930 MHz, into 50 Ω, ANT1 and ANT2 ports		-10		dB
2 nd , 6 th , 7 th , and 10 th harmonics (HD 2, 6, 7, and 10)	2fo, 6fo, 7fo, 10fo	900 to 930 MHz with specified matching network on EVB, CW, P _{OUT} = +30.5 dBm @ ANT1 port (Note 2)		-35	-30	dBc
3 rd , 4 th , 5 th , 8 th , and 9 th harmonic (HD 3, 4, 5, 8, and 9)	3fo, 4fo, 5fo, 8fo, 9fo	900 to 930 MHz with specified matching network on EVB, CW, P _{OUT} = +30.5 dBm @ ANT1 port (Note 2)		-50	-45	dBc
Non-harmonic spurious	Spurious	P _{OUT} = +30.5 dBm @ ANT1 port, resolution bandwidth = 100 kHz, CW (Note 3)		-55	-50	dBm
Change in output power under VSWR	P _{OUT_VSWR}	VSWR = 2.5:1, CW, reference P _{OUT} = +30.5 dBm into 50 Ω (Note 3)	-3		+1.5	dB
Turn-on/off time	t _{ON_TX} , t _{OFF_TX}	"Off" to transmit or transmit to "off," from 50% of CTX edge to 90% of final RF output power (Note 3)			11	μs
Mode change time	t _{MODE_CHANGE}	Transmit to receive or receive bypass, receive or receive bypass to transmit, from 50% of CTX edge to 10% of final RF output power (Note 3)			11	μs

Table 6. SKY65362-11 Transmit Mode Electrical Specifications (2 of 2) (Note 1)

(V_{CC} = +5.0 V, T_A = +25 °C, as Measured on the SKY65362-11 Evaluation Board [De-Embedded to Device], All Unused Ports Terminated with 50 Ω, Input Port = PA_IN, Output Port = ANT1, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Forward power detect	PFWD	Up to VSWR = 2.5:1	0.35		1.2	V
Reverse power detect	PREV	Up to VSWR = 2.5:1	0.35		1.2	V
Power detector accuracy	PDET_ACC	VSWR = 2.5:1 (Note 3)		±1		dB
Current alarm trigger output	IALARM	Low if I _{CC} < 800 mA, High if I _{CC} > 800 mA (Note 4)		800		mA
Stability	STAB	CW, P _{OUT} = +30.5 dBm into 50 Ω, 0.1 to 20 GHz, load VSWR = 6:1 (Note 3)	All non-harmonically related outputs < -43 dBm			
Ruggedness	RUG	CW, P _{OUT} = +30.5 dBm into 50 Ω load, VSWR = 10:1 (Note 3)	No permanent damage			

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

Note 2: Harmonics above 5th are not production tested. Guaranteed by characterization.

Note 3: Not production tested. Guaranteed by characterization.

Note 4: Current Alarm trigger point is adjustable by external components R2, R3, R4, R5 in Figure 3. Contact Sales support for further information.

Table 7. SKY65362-11 Diversity Antenna Electrical Specifications (Note 1)

(V_{CC} = +5.0 V, T_A = +25 °C, f = 900 MHz to 930 MHz, as Measured on the SKY65362-11 Evaluation Board [De-Embedded to Device], All Unused Ports Terminated with 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Isolation between ANT1 and ANT2 ports	ISOL_ANT1/2			-20		dB
ANT1 to ANT2 switching time, transmit mode	t _{ANT1-ANT2_TX}	(Note 2)		1		μs
ANT1 to ANT2 switching time, receive mode	t _{ANT1-ANT2_RX}	(Note 2)		1		μs

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

Note 2: Not production tested. Guaranteed by characterization.

Table 8. SKY65362-11 Electrical Specifications: Control Logic Characteristics (Note 1)

(T_A = +25 °C, as Measured on the SKY65362-11 Evaluation Board [De-Embedded to Device], Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Control voltage:						
High	V _{IH}	(Note 2)	1.6		3.6	V
Low	V _{IL}		0		0.3	V
Input current:						
High	I _{IH}	(Note 2)			1	μA
Low	I _{IL}				1	μA
Current alarm output voltage	V _{OH}	V _{CC} = 5 V		3.3		V

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

Note 2: Not production tested. Guaranteed by characterization.

Table 9. SKY65362-11 Mode Control Logic (Note 1)

Mode	CPS (Pin 6)	CSD (Pin 5)	CTX (Pin 7)	ANT_SEL (Pin 9)
Sleep (all off)	0	0	0	X
Receive bypass	0	1	0	X
Receive LNA mode	1	1	0	X
Transmit	X	1	1	X
ANT1 port enabled	X	X	X	0
ANT2 port enabled	X	X	X	1

Note 1: "1" = 1.6 to 3.6 V, "0" = 0 to 0.3 V, "X" = don't care.

Evaluation Board Description

The SKY65362-11 Evaluation Board is used to test the performance of the SKY65362-11 FEM. An Evaluation Board schematic diagram is provided in Figure 3. An assembly drawing for the Evaluation Board is shown in Figure 4.

Package Dimensions

The PCB layout footprint for the SKY65362-11 is provided in Figure 5. Figure 6 shows the package dimensions for the 36-pin MCM, and Figure 7 provides the tape and reel dimensions.

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 SKY65362-11 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 the 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.

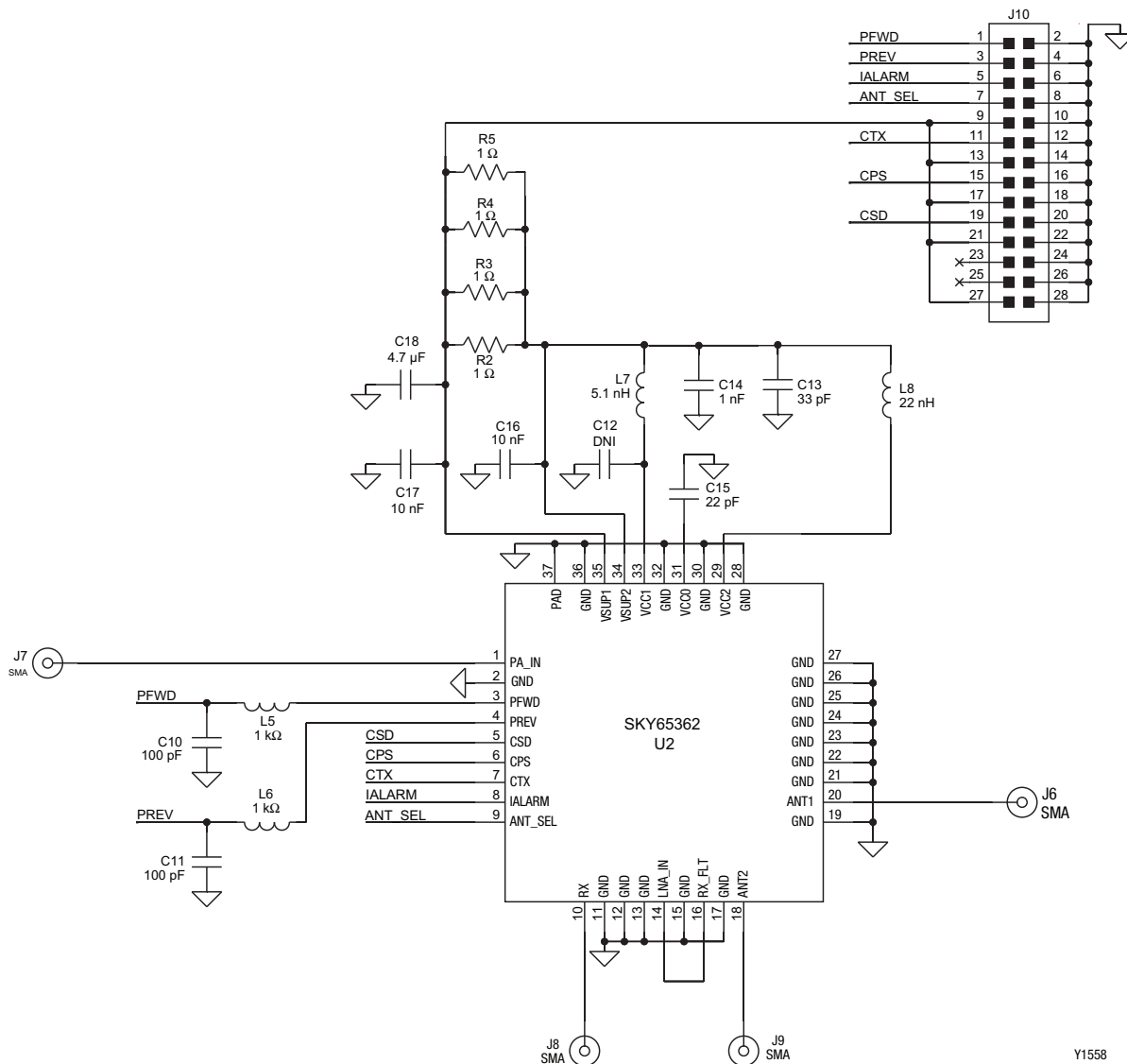


Figure 3. SKY65362-11 Evaluation Board Schematic

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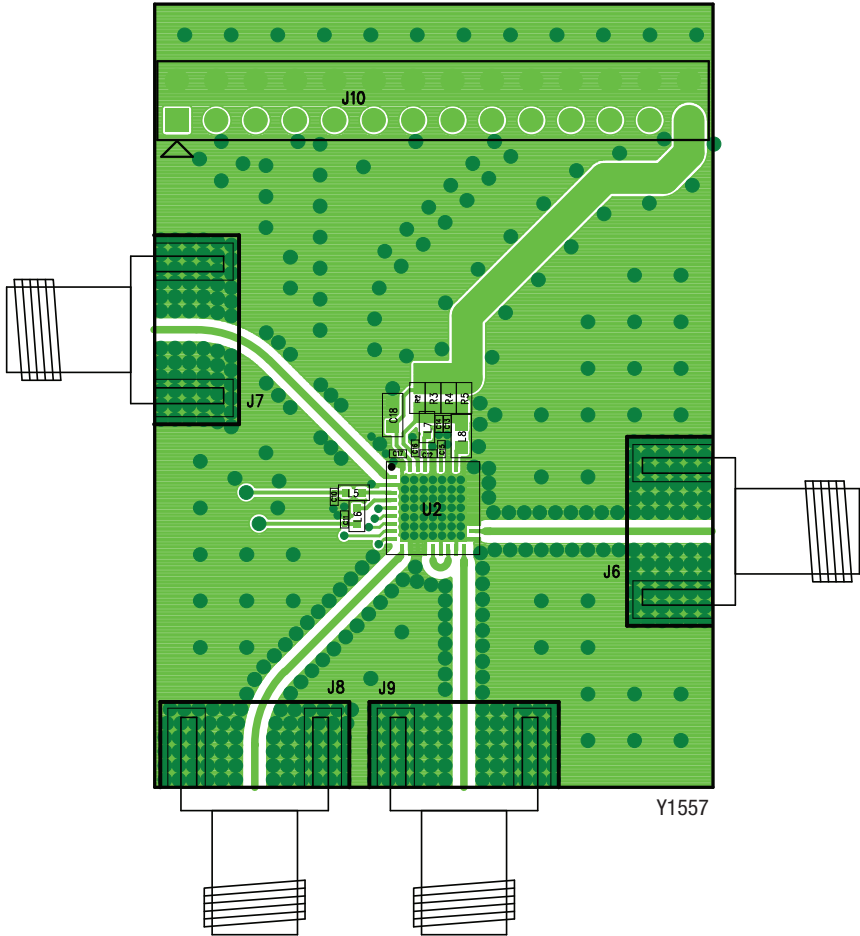
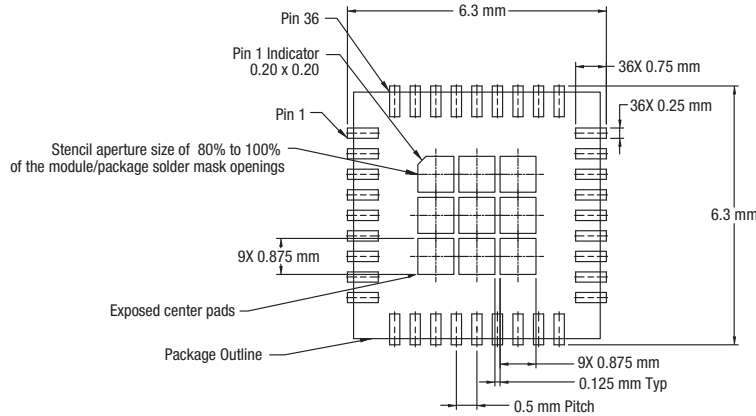
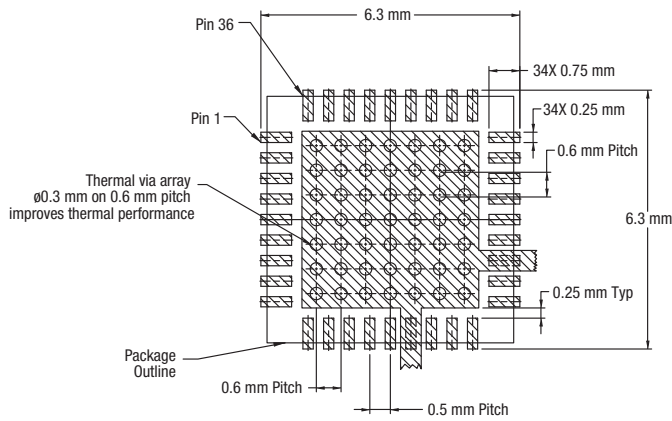


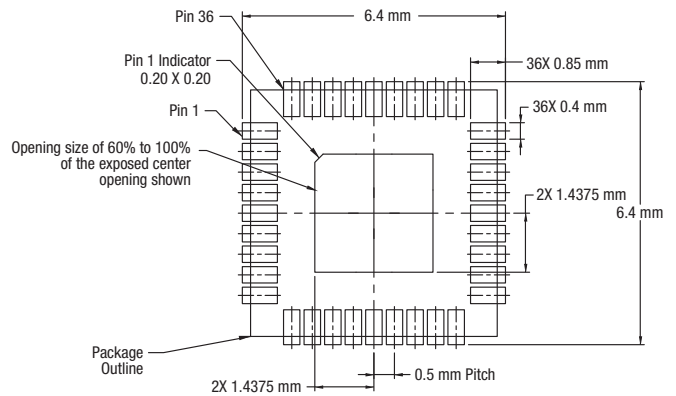
Figure 4. SKY65362-11 Evaluation Board Assembly Drawing



Stencil Aperture



Metallization



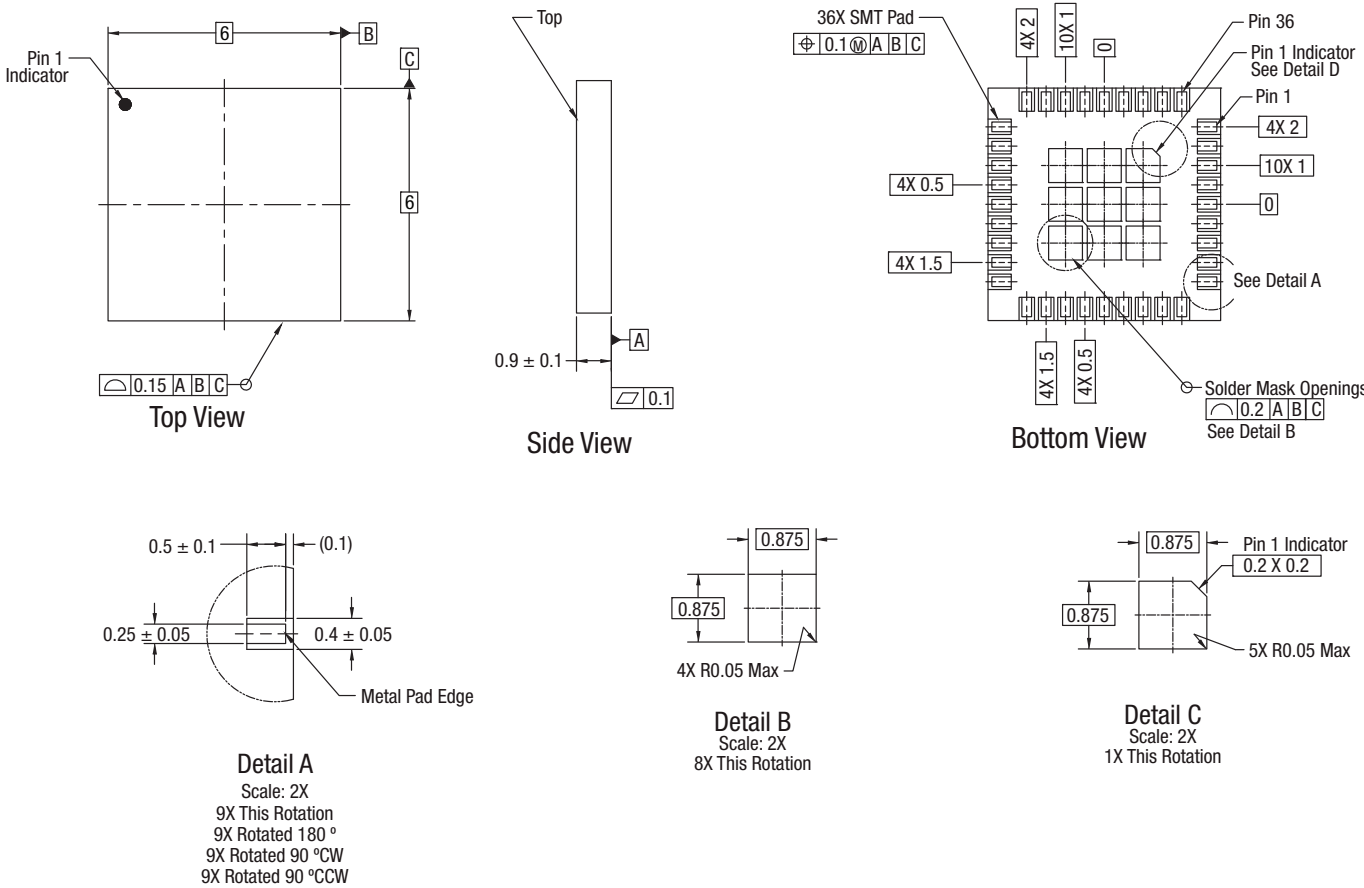
Solder Mask Opening

Notes:

1. All dimensions are in millimeters, unless otherwise specified.
2. Thermal vias should be resin filled and capped in accordance with IPC-4761 Type VII vias. Recommended Cu thickness is 30 to 35 μ m.

Y1554

Figure 5. SKY65362-11 PCB Layout Footprint



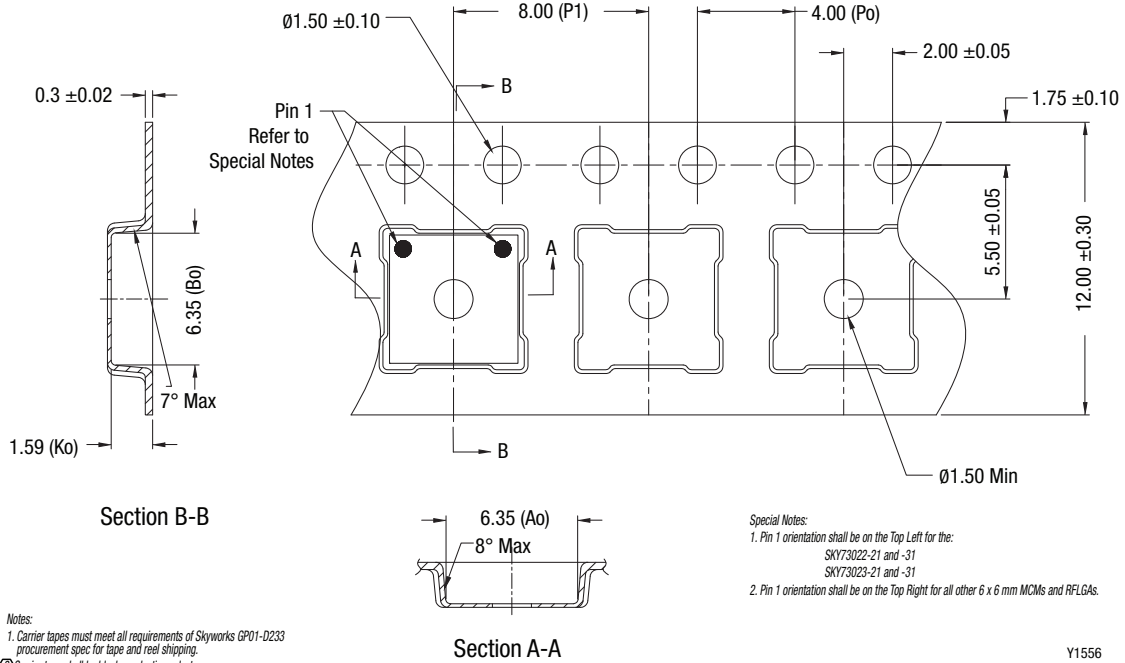
Notes:

1. Dimensions and tolerances per ASME Y14.5-1994.
2. All dimensions are in millimeters unless otherwise specified.
3. Pad definitions per details on drawing.

Y1555

Figure 6. SKY65362-11 36-Pin MCM Package Dimensions

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- Notes:**
- Carrier tapes must meet all requirements of Skyworks GP01-D233 procurement spec for tape and reel shipping.
 - Carrier tape shall be black conductive polystyrene.
 - Cover tape shall be transparent conductive pressure sensitive adhesive (PSA) material with 9.30 mm width.
 - ESD-surface resistivity shall be $<1 \times 10^{10}$ ohms/square per EIA JEDEC TR9 specification.
 - Po/P1 10 pitches cumulative tolerance on tape: ± 0.20 mm.
 - Ao & Bo measurement point to be 0.30 mm from bottom pocket.
 - All dimensions are in millimeters.
 - Part Number: eC3-MCMM0606-12-8-F3-L
(Please indicate on Purchase Order)

Figure 7. SKY65362-11 Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY65362-11: High-Power RF FEM	SKY65362-11	SKY65362-11-EK1

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