

DATA SHEET

SKY66108: 2.4 GHz Smart Energy/ZigBee® Front-End Module

Applications

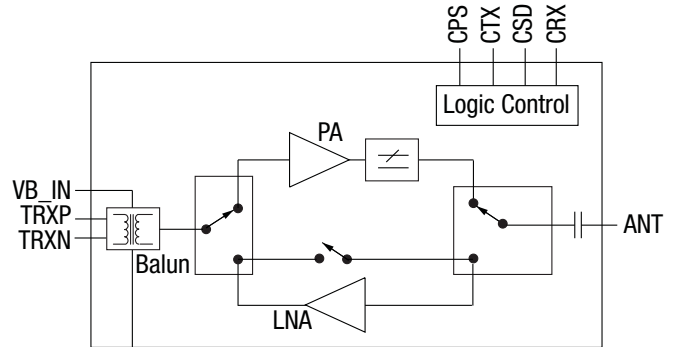
- Smart meters
- In-home appliances
- Smart thermostats

Features

- Integrated:
 - PA with up to +16 dBm output power
 - LNA with programmable bypass
 - Transmit and receive switching function
- +2.7 dB FEM Rx NF
- Differential Rx/Tx interface with integrated balun
- Fast switch on/off time <800 ns
- 2.0 V to 3.6 V supply operation
- Sleep mode current 0.05 μ A typical
- QFN (20-pin, 3.0 mm x 3.0 mm x 0.55 mm) package (MSL1 @ 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.



K072

Figure 1. SKY66108 Block Diagram

Description

The SKY66108 is a high-performance, fully integrated RF Front-End Module (FEM) that is designed for ZigBee®/Smart Energy applications.

The SKY66108 is designed for ease of use and maximum flexibility, with integrated fully matched input balun, integrated inter-stage matching and harmonic filter, and digital controls that are compatible with 1.6 V to 3.6 V Complementary Metal Oxide Semiconductor (CMOS) levels.

The RF blocks operate over a wide supply voltage range from 2.0 V to 3.6V, which allows the SKY66108 to be used in battery-powered applications over a wide spectrum of the battery discharge curve.

A functional block diagram is shown in Figure 1. The pin configuration and package are shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.

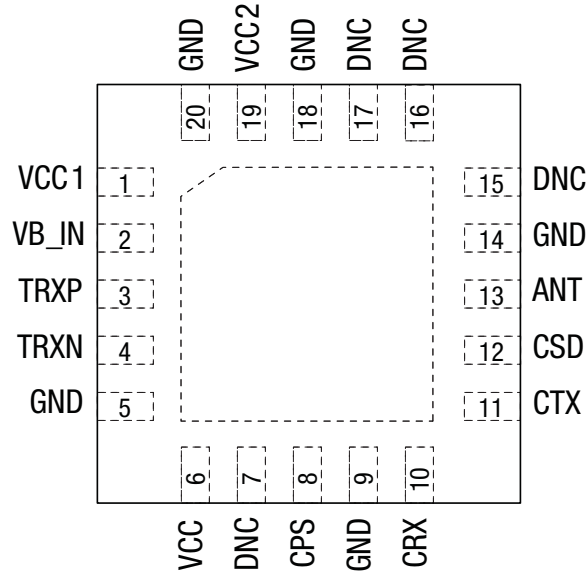


Figure 2. SKY66108 Pinout—20-Pin QFN (Top View)

Table 1. SKY66108 Signal Descriptions

Pin #	Name	Description	Pin #	Name	Description
1	VCC1	Positive supply	12	CSD	Sleep mode control
2	VB_IN	Bias voltage input supply to the transceiver	13	ANT	Connect to 50 Ω antenna
3	TRXP	Input/output signal to the transceiver, 100 Ω differential	14	GND	Connect to PCB ground
4	TRXN	Input/output signal to the transceiver, 100 Ω differential	15	DNC	Leave unconnected
5	GND	Connect to PCB ground	16	DNC	Leave unconnected
6	VCC	Positive supply	17	DNC	Leave unconnected
7	DNC	Leave unconnected.	18	GND	Connect to PCB ground
8	CPS	Bypass mode control, connect to RFIC or SoC GPIO	19	VCC2	Positive supply
9	GND	Connect to PCB the ground	20	GND	Connect to PCB ground
10	CRX	Receive function control	Paddle	GND	Exposed die paddle; electrical and thermal ground; connect to PCB ground
11	CTX	Transmit function control			

Table 2. SKY66108 Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	V _{cc1} , V _{cc2} , V _{cc3}	-0.3	3.6	V
Control pin voltages		-0.3	3.6	V
Operating temperature	T _A	-40	125	°C
Storage temperature	T _{STG}	-40	125	°C
ESD voltage, <i>all</i> pins (HBM)			1000	V
Tx output power at the ANT port into 50 Ω load	P _{out_Tx_max}		+16	dBm
Tx input power at the TR port	P _{in_Tx_max}		+6	dBm
Rx input power at the ANT port	P _{in_Rx_max}		+5	dBm
Thermal resistance	θ _{JC}		69	°C/W

Note: 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. Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units
Ambient temperature	T _A	-40	+25	+125	°C
Supply voltage for transceiver core	V _{B_IN}	1.6		3.6	V
Supply voltage on Vcc pins	V _{cc1} , V _{cc2} , V _{cc3}	2.0	3.0	3.6	V

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY66108 are provided in Table 2. The recommended operating conditions are specified in Table 3, and electrical specifications are provided in Tables 4 through 7.

The state of the SKY66108 is determined by the logic provided in Table 8.

Table 4. SKY66108 Electrical Specifications: DC (Note 1)
(VCC = VCC1 = VCC2 = 3 V, TA = +25 °C, as Measured on Skyworks SKY66108-EK1 Evaluation Board [De-embedded to the Device], Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Total supply current	I _{CC_TX14}	Tx mode P _{OUT} = +14 dBm		33		mA
Total supply current	I _{CC_TX12}	Tx mode P _{OUT} = +12 dBm		25		mA
Total supply current	I _{CC_TX10}	Tx mode P _{OUT} = +10 dBm		20		mA
Quiescent current	I _{CC_TX}	No RF		6		mA
Total supply current	I _{CC_RXHG}	Rx Low Noise Amplifier (LNA) High Gain mode		5.5		mA
Total supply current	I _{CC_RXLG}	Rx LNA Low Gain mode		2.7		mA
Total supply current	I _{CC_RxBypass}	Rx Bypass mode			10	μA
Sleep supply current	I _{CC_OFF}	No RF		0.05	1.0	μA

Note 1: Performance is guaranteed only under the conditions listed in the above Table.

Table 5. SKY66108 Electrical Specifications: Logic Characteristics (Note 1)
(VB_IN = 1.6 to 3.6 V, VCC = VCC1 = VCC2 = 3.0 V, TA = +25 °C, as Measured on Skyworks SKY66108-EK1 Evaluation Board [De-embedded to the Device], Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Logic input high voltage	V _{BIH}		1.6		3.6	V
Logic input low voltage	V _{BIL}		0		0.3	V
Logic input high current	I _{BIH}				1	μA
Logic input low current	I _{BIL}				1	μA

Note 1: Performance is guaranteed only under the conditions listed in the above Table.

Table 6. SKY66108 Electrical Specifications: AC Characteristics (Note 1)
(VB_IN = 1.6 V to 3.6 V, VCC = VCC1 = VCC2 = 3.0 V, TA = +25 °C, as Measured on Skyworks SKY66108-EK1 Evaluation Board [De-embedded to the Device], All Unused Ports Terminated with 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Minimum	Typical	Maximum	Units
Transmit (Tx)						
Frequency range	f _{IN}		2400		2483	MHz
Output power at ANT port	P _{OUT_HI}	2400 MHz to 2483 MHz, OEVM = 1% typical: VCC = VCC1 = VCC2 = 3.6 V VCC = VCC1 = VCC2 = 3.3 V VCC = VCC1 = VCC2 = 3.0 V VCC = VCC1 = VCC2 = 2.0 V VCC = VCC1 = VCC2 = 1.8 V		+16.0 +15.0 +14.0 +11.0 +9.5		dBm
Small signal gain high power mode	S _{21_HI}	2400 MHz to 2483 MHz	14			dB
Small signal gain variation	ΔS ₂₁	2400 MHz to 2483 MHz Gain variation across all 802.15.4 channels			1	dBp-p
Second and third harmonics	H _{D2} , H _{D3}	2400 MHz to 2483 MHz IEEE 802.15.4 source P _{OUT} = +14 dBm Measured with the antenna match and filter components per the SKY66108-EK1 evaluation board			-42	dBm/ MHz
Spectral mask	ACP	2400 MHz to 2483 MHz Integrated power from the band edges to f _c ± 3.5 MHz			-30	dBm
Turn on and off times	t _{ON} t _{OFF}	From 50% of the CTX edge to 90% of the final RF output power. From 50% of the CTX edge to 10% of the final RF output power.			800	ns
Stability	STAB	CW, PIN = +0 dBm 0.1 GHz to 20.0 GHz Load VSWR = 6:1	All non-harmonically related outputs <-35.0 dBm/MHz			
Ruggedness	Ru	CW, PIN = +6 dBm, Load VSWR = 10:1	No permanent damage			
Receive (Rx)						
Frequency range	f _{IN}		2400		2483	MHz
Rx gain high gain mode	Rx_gain_HG	2400 MHz to 2483 MHz	10.3	12.3	14.3	dB
Rx gain low gain mode	Rx_gain_LG	2400 MHz to 2483 MHz	5	7	9	dB
Rx Noise Figure (NF) high gain mode	NF_HG	2400 MHz to 2483 MHz		2.7		dB
Rx NF low gain mode	NF_LG	2400 MHz to 2483 MHz		+3.8		dB
Input 1-dB compression point high gain mode	IP1dB_HG	2400 MHz to 2483 MHz	-13	-8		dBm
Input 1-dB compression point low gain mode	IP1dB_LG	2400 MHz to 2483 MHz	-3	+2		dBm
Turn on and off times	t _{ON} t _{OFF}	From 50% of the CTX edge to 90% of the final RF output power. From 50% of the CTX edge to 10% of the final RF output power.			800	ns
Gain in bypass mode	G_bp			-3.5		dB
Input 1-dB compression point in bypass mode	IP1dB		+10			dBm

Note 1: Performance is guaranteed only under the conditions listed in the above Table.

Table 7. SE2431L Electrical Specifications: AC Characteristics, Antenna Switch (Note 1)
(Vcc1 = Vcc2 = Vcc3 = 3 V, TA = +25 °C, as Measured on Skyworks SE2432L-EK1 Evaluation Board [De-embedded to the Device], All Unused Ports Terminated with 50 Ω, Unless Otherwise Noted)

Parameter	Symbol	Min	Typical	Max	Units
Input return loss at ANT port, Rx mode	S11		-10	-5	dB
Output return loss at ANT port, Tx mode	S22		-10	-5	dB

Note 1: Performance is guaranteed only under the conditions listed in the above Table.

Table 8. SKY66108 Logic Controls (Note 1)
(VB_IN = 1.6 V to 3.6 V, VCC = VCC1 = VCC2 = 3.0 V, TA = +25 °C, Unless Otherwise Noted)

Mode	Description	CPS	CSD	CRX	CTX
0	All off (Power-Down mode) (Notes 2, 3, 4)	0	0	0	0
0	All off (Power-Down mode) (Notes 2, 3, 4)	0	1	0	0
1	Rx Bypass mode (Notes 2, 3)	0	1	1	0
2	Rx LNA High Gain mode (Notes 2, 3)	1	1	1	0
3	Rx LNA Low Gain (Notes 2, 3)	1	1	0	0
4	Tx Bypass mode (Notes 2, 3, 5)	0	1	0	1
5	Tx High Power mode (Notes 2, 3)	1	1	0	1

Note 1: Performance is guaranteed only under the conditions listed in the above Table.

Note 2: Logic 0 level is compliant to VBILB as specified in the “Logic Characteristics” Table.

Note 3: Logic 1 level is compliant to VBINH as specified in the “Logic Characteristics” Table.

Note 4: Unless otherwise specified, all controls must be at logic 0 to achieve the specified sleep current.

Note 5: Functionally and parametrically equivalent to the Rx Bypass mode.

Package Dimensions

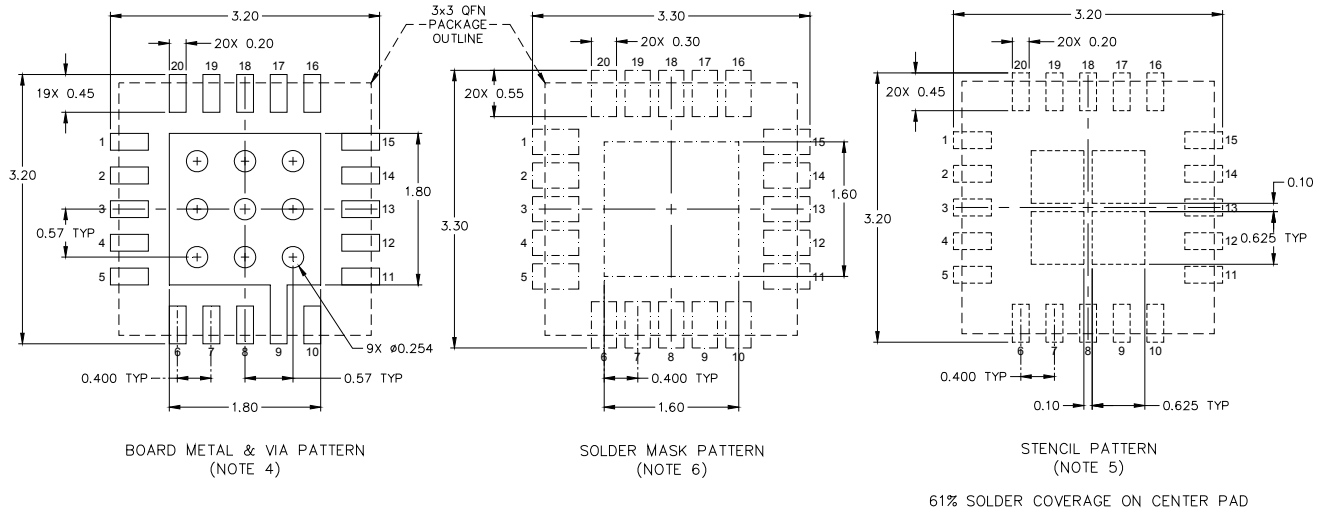
The PCB layout footprint for the SKY66108 is provided in Figure 3. Typical case markings for the SKY66108 are shown in Figure 4. Package dimensions are shown in Figure 5, and tape and reel dimensions are provided in Figure 6.

Package and Handling Information

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 SKY66108 package is Pb free, RoHS compliant, halogen free, and rated to Moisture Sensitivity Level 1 (MSL1). For additional information, refer to the Skyworks Application Note, *Solder Reflow Information*, document number 200164.

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 DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
3. UNLESS SPECIFIED DIMENSIONS ARE SYMMETRICAL ABOUT CENTER LINES.
4. VIA HOLE RECOMMENDATIONS: 30-35um Cu VIA WALL PLATING, VIA HOLES SHOULD BE TENTED WITH SOLDER MASK ON THE BACKSIDE AND FILLED WITH SOLDER.
5. STENCIL RECOMMENDATIONS: 0.125mm STENCIL THICKNESS, LASER CUT APERTURES, TRAPEZODIAL WALLS AND ROUNDED CORNERS WILL OFFER BETTER PASTE RELEASE.
6. SOLDER MASK RECOMMENDATIONS: CONTACT BOARD FABRICTOR FOR RECOMMENDED SOLDER MASK OFFSET AND TOLERANCE.

Figure 3. PCB Layout Footprint

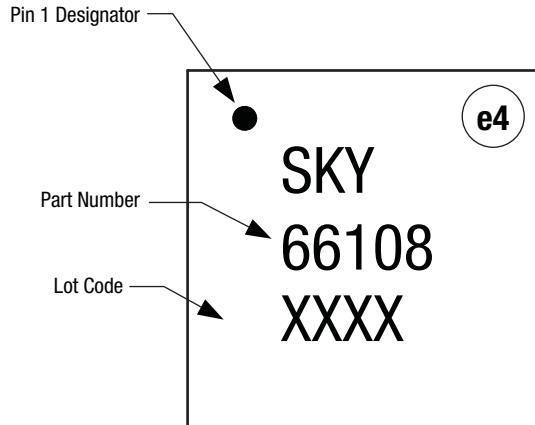
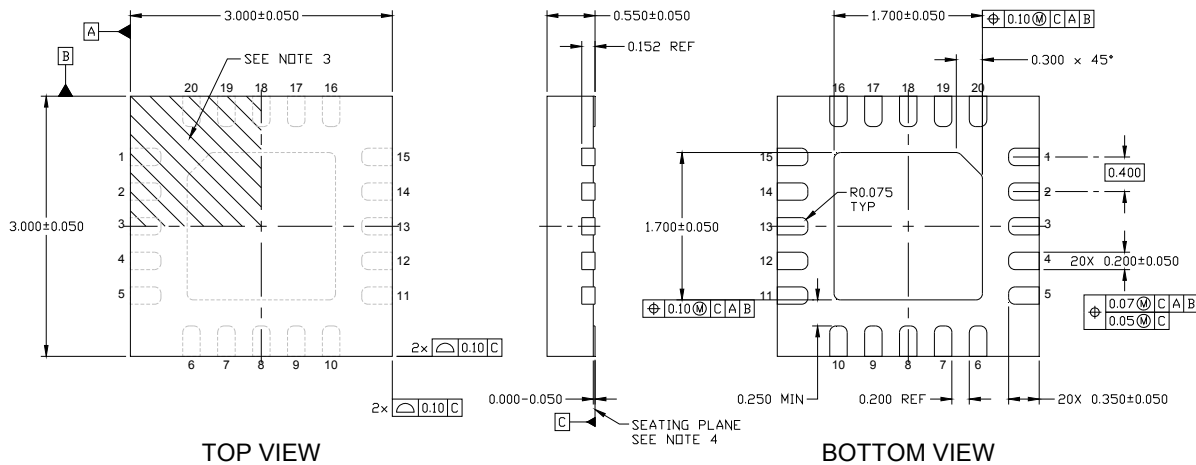
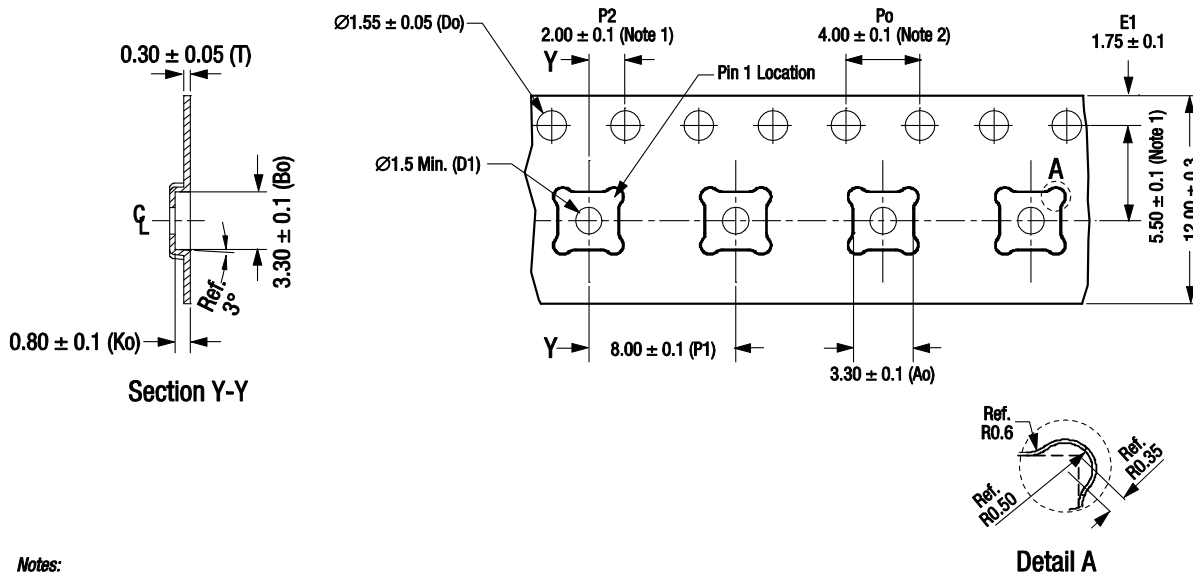


Figure 4. SKY66108 Typical Part Marking (Top View)



NOTES:
 1. ALL DIMENSIONS ARE IN MILLIMETERS.
 2. INTERPRET DIMENSIONS AND TOLERANCING PER ASME Y14.5-1994.
 3. TERMINAL #1 IDENTIFICATION MARK LOCATED WITHIN THIS AREA.
 4. UNILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.

Figure 5. SKY66108 Package Dimensions



Notes:
 1. Measured from center line of sprocket hole to center line of pocket.
 2. Cumulative tolerance of 10 sprocket holes is ± 0.20 mm.
 3. Other material available.
 4. Typical ESD surface resistivity is from 10⁶ to 10¹¹ Ohms/square per EIA, JEDEC tape and reel specification.

All measurements are in millimeters.

S2615

Figure 6. SKY66108-R Tape and Reel Information

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY66108: 2.4 GHz Smart Energy/ZigBee Front-End Module	SKY66108	SKY66108-EK1

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