

DATA SHEET

SKY66110-11: Low-Power Bluetooth[®] Low Energy Front-End Module for Range Extension Applications

Applications

- Range extender
- Wearable technology
- Beacons
- Sensors
- Home automation
- Internet of Things (IoT) devices

Features

- Low power consumption: 10 mA @ +10 dBm
- Output: +10 dBm
- Supply operation: 1.8 to 5 V
- \bullet Low sleep current: < 1 μA
- RX bypass
- Small MCM (20-pin, 3.3 x 3.0 x 0.8 mm) package (MSL3, 260 °C per JEDEC-J-STD-020)



Skyworks GreenTM products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green*TM, document number SQ04–0074.





Figure 1. SKY66110-11 Functional Block Diagram

Description

The SKY66110-11 is a highly integrated front-end module (FEM) designed for Bluetooth Low Energy (BLE) range extension applications operating in the 2.4 to 2.485 GHz range.

The device is provided in a $3.3 \times 3.0 \times 0.8 \text{ mm } 20\text{-pin MCM}$ package. A functional block diagram is shown in Figure 1. Pin assignments are shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.

Table 1. SKY66110-11 Signal Descriptions¹

Pin	Name	Description		Name	Description
1	GND	Ground	11	ANT	Antenna port
2	GND	Ground	12	GND	Ground
3	3 GND Ground		13	GND	Ground
4	TR	Common receive/transmit port	14	VCC	Positive power supply
5	GND	Ground	15	GND	Ground
6	GND	Ground	16	GND	Ground
7	GND	Ground	17	CRX	RX control signal
8	GND	Ground	18	GND	Ground
9	GND	Ground	19	CTX	Tx control signal and amplifier bias voltage
10	GND	Ground	20	DNC	Do not connect

¹ The paddle should be connected to ground. See Figure 6.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY66110-11 are provided in Table 2. The recommended operating conditions are specified in Table 3. Electrical specifications are provided in Tables 4 through 8.

Table 2. SKY66110-11 Absolute Maximum Ratings¹

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	Vcc		5.5	V
Control voltages	VCTX, VCRX		5.0	V
RF Input power	Pin		+20	dBm
Voltage standing wave ratio	VSWR		10:1	
Operating temperature	Та	-40	+85	°C
Storage temperature	Tstg	-65	+150	°C
Electrostatic discharge:	ESD			
Human Body Model (HBM), Class 0			150	V

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. Recommended Operating Conditions

Parameter	Symbol	Min	Тур	Max	Units
Frequency	f	2.4		2.485	GHz
Supply voltage	Vcc	1.8	3	5.0	V
Control voltages	VCTX, VCRX	1.7	3	Vcc	V
Operating temperature	ТА		25		°C

Parameter	Symbol	Test Condition	Min	Тур	Мах	Units
RX current (bypass)	ICQ_RX	RX mode		1		μ A
TX quiescent current ²	ICQ_TX	TX mode		6		mA
TX operating current ²	IOP_TX	TX mode ($P_{IN} = -1 \text{ dBm}$):				
		VCC = 1.8 V		8.5		mA
		Vcc = 3.0 V		10		mA
		VCC = 3.3 V		10.5		mA
		Vcc = 5.0 V		11		mA
TX bias current (CTX pin)	Ibias_tx			550		μΑ
Sleep current ³	ICC_0FF	Sleep mode		0.1	1	μ A

Table 4. SKY66110-11 Electrical Specifications: DC Characteristics¹ (Vcc = 3.3 V, Vctx = 1.8 V, TA = +25 °C, R5 = 0 k Ω , Characteristic Impedance [Zo] = 50 Ω , Unless Otherwise Noted)

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

 2 For total current, <code>IBIAS_TX</code> should be added to the values.

 3 VCTX = 0 V.

Table 5. SKY66110-11 Electrical Specifications Transmit Characteristics¹ (Vcc = 3.3 V, Vctx = 1.8 V, Ta = +25 °C, PIN = -1 dBm, R5 = 0 k Ω , Characteristic Impedance [Zo] = 50 Ω , Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Тур	Мах	Units
Output power	Роит	Vcc = 1.8 V Vcc = 3.0 V Vcc = 3.3 V Vcc = 5.0 V		+8 +10 +10.3 +10.8		dBm dBm dBm dBm
Saturated gain ²	G_SAT	Pin = -1 dBm		11		dB
Gain slope	GSLOPE	Over frequency range		0.7	1	dB
Input return loss	S11			-14		dB
Output return loss	S22			-10		dB
Insertion loss (sleep mode) ²	S21_SLEEP			-15	-12	dB
Third order input intercept point ²	IIP3	@ 2.44 GHz, Δ f = ± 1 MHz, PIN = -14 dBm/tone		+5		dBm
Third order output intercept point ²	OIP3	@ 2.44 GHz, Δ f = ± 1 MHz, PIN = -14 dBm/tone		+16		dBm
1 dB input compression point	IP1dB			-1		dBm
1 dB output compression point	OP1dB			+10		dBm
2 nd to 10 th harmonics ²	2fo to 10fo				-30	dBm/MHz
RX to TX transition time ²	tswitch	10% to 90% RF 50% Vctx to 90% RF		500		ns
TX power on time ²	ton	10% to 90% RF 50% Vctx to 90% RF		500		ns
TX power off time ²	toff	90% to 10% RF 50% Vctx to 10% RF		150		ns

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

² Guaranteed by characterization.

Table 6. SKY66110-11 Electrical Specifications: Receive Characteristics¹

(Vcc = 3.3 V, Vcrx = 1.8 V, Vcrx = 0 V, TA = +25 °C, PIN = -20 dBm, Characteristic Impedance [Zo] = 50 Ω, Unless Otherwise Noted)

<u> </u>	,					
Parameter	Symbol	Test Condition	Min	Тур	Max	Units
Insertion loss	S21			0.9		dB
Isolation	S12	TX Mode (PIN = -20 dBm)		25		dB
Input return loss	S11			-15		dB
Output return loss	S22			-15		dB
TX to RX transition time ²	tswitch	10% to 90% RF 50% Vcrx to 90% RF		500		ns
RX power on time ²	ton	10% to 90% RF 50% Vcrx to 90% RF		150		ns
RX power off time ²	toff	90% to 10% RF 50% Vcrx to 10% RF		150		ns

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

 $^{2}\ \mathrm{Guaranteed}$ by characterization.

Table 7. SKY66110-11 Electrical Characteristics: Logic Characteristics (TA = +25 °C)

Parameter	Symbol	Minimum	Maximum	Units
Voltage logic high ¹	Vhigh	1.8	5	V
Voltage logic low	VLOW	0	0.2	V

¹ Difference between logic high voltages for VCRX and VCTX should not exceed 0.2 V.

Table 8. SKY66110-11 Mode Logic Truth Table

Mode	CTX	CRX
Sleep mode	0	0
Receive (RX) mode	0	1
Transmit (TX) mode	1	0
Non-permissible state ¹	1	1

¹ This state will enable both the TX and RX paths. It is not permitted to operate in this state.

Evaluation Board Description

The SKY66110-11 Evaluation Board is used to test the performance of the SKY66110-11 front-end module. The board is optimized for evaluation, experimentation, and investigation with an 802.15.4 signal source. The design and layout can be quickly and easily transferred into a production design.

An Evaluation Board schematic diagram is provided in Figure 3. A reference design schematic is provided in Figure 4. Table 9 provides the Bill of Materials (BOM) list for Evaluation Board components. A photograph of the Evaluation Board is shown in Figure 5.

Evaluation Board Setup Procedure

Connect Supply

- 1. Connect J1 and J4 to 50 Ω instruments. Terminate all unused ports (if applicable) with 50 Ω .
- 2. Connect the supply ground to Pins 1, 4, and 6 of J2.
- 3. Connect 3.3 V to pin 7 of J2.
- Connect 1.8 V to one of the logic pins (pin 3 or pin 5) on J2 to select RX or TX mode. Connect the other logic pin to ground. Refer to Table 8 for mode control settings.

Measure Performance

TX

Monitor the 2.4 GHz amplifier performance by applying an RF signal to connector J4 (TR) and verify the output power on connector J1 (ANT).

RX

Monitor the 2.4 GHz switch performance by applying an RF signal to connector J1 (ANT) and verify the output signal on connector J4 (TR).

CAUTION: Be careful not to overdrive the switch by applying too much RF on the input to the device. A starting input power of -20 dBm is suitable.

Package Dimensions

The PCB layout footprint for the SKY66110-11 is provided in Figure 6. Typical part markings are shown in Figure 7. Package dimensions are shown in Figure 8, and tape and reel dimensions are provided in Figure 9.

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 SKY66110-11 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. SKY66110-11 Evaluation Board Schematic



Figure 4. SKY66110-11 Reference Design Schematic

Component	Value	Size	Manufacturer	Mfr Part Number	Characteristics
C1, C2	DNI	0201			
C3	1 uF	0402			Capacitor
C4, C5, C6	DNI	0402			
J1, J4	SMA	end launch	Johnson Components	142-0701-851	SMA end launch straight jack receptacle - tab contact
J2	7X1	100 mil	Samtec	TSW-107-07-G-S	100mil header
PCB1	Z720-B		Skyworks Solutions Inc.	Z720-B	РСВ
R1, R2	DNI	0201			Do not install
R3, R4, R5, R6	0Ω	0201	Panasonic	ERJ1GE0R00	Thick film chip resistor
U1	SKY66110-11	MCM50P300X330-20	Skyworks Solutions Inc.	SKY66110-11	Low-power Bluetooth low energy FEM

Table 9. SKY66110-11 Evaluation Board Bill of Materials (BOM)



Figure 5. SKY66110-11 Evaluation Board



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

203184H-006















Ordering Information

Part Number	Product Description	Evaluation Board Part Number
SKY66110-11	Low-Power Bluetooth Low Energy FEM	SKY66110-11-EK1

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