SKY65241-12: WLAN 802.11a, b, g, n Dual-Band Intera™ Front-End Module Single Antenna

Features

- 2.4 to 2.5 GHz and 4.9 to 5.9 GHz operation
- Cardbus, mini PCI, PCIe and AP applications
- Linear power 16 dBm (a), 21 dBm (b), 18 dBm (g)
- Gain: 27 dB
- Integrated PA, filters, directional detector and SPDT switch
- Single supply voltage : 3.0 to 3.6 V
- Single antenna
- Small, ultra thin package 5 x 5 x 0.9 mm
- Lead (Pb)-free, RoHS-compliant, and halogen-free

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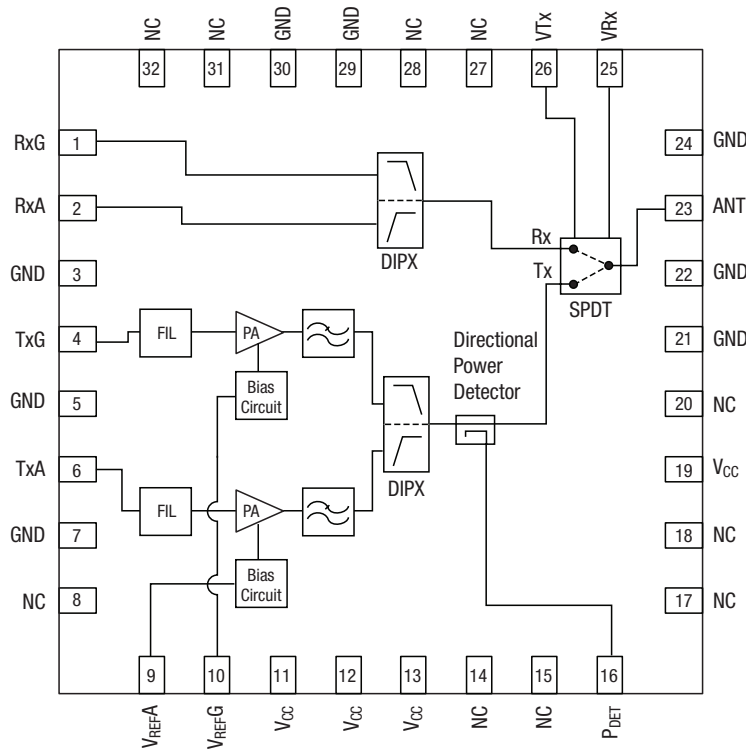
Description

The SKY65241-12 Intera FEM contains one complete dual-band transmit/receive chain in a compact RF front-end module. It includes one 5 GHz PA and one 2 GHz PA each with integrated input filtering for 3–4 GHz rejection, and temperature-compensated directional power detector with 20 dB dynamic range. Also included are low loss, high rejection diplexers and a SPDT TR switch which provides high linearity in transmit and low loss in receive paths. All RF ports are matched to 50 Ω.

The SKY65241-12 is packaged in a lead (Pb)-free, RoHS-compliant, and halogen-free laminate package, which measures 25 mm^2.

Functional Block Diagram

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Absolute Maximum Ratings

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}		-0.3		5.5	V
Reference voltage	$V_{REF}G$, $V_{REF}A$		-0.3		3.6	V
Supply current	I_{CC}				400	mA
Input power	TxG, TxA				10	dBm
Dissipated power	P_0			0.6	1.0	W
Thermal resistence	θ_{JC}				55	°C/W
Moisture sensitivity level	MSL-3				250	°C
Operating temperature range	T_{OP}		-20		85	°C
Storage temperature range	T_{STO}		-65		150	°C

Performance is guaranteed only under the conditions listed in the specifications table and is not guaranteed under the full range(s) described by the Absolute Maximum specifications. Exceeding any of the absolute maximum/minimum specifications may result in permanent damage to the device and will void the warranty.

Recommended Operating Conditions

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}		3	3.3	3.6	V
Reference voltage	$V_{REF}G$, $V_{REF}A$		2.8	2.9	3.0	V
Operating temperature	T_{OP}		-10	25	85	°C

DC Characteristics

Conditions: V_{CC} = 3.3 V, T_{OP} = 25 °C. Measurements made on Skyworks EVB with all losses de-embedded. All unused ports terminated into 50 Ω unless otherwise specified.

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Total 802.11g Tx supply current	I_{CC}-g	P_{OUT} = 18 dBm, 54 Mbps OFDM, $V_{REF}G$ = 2.9 V, V_{CC} = 3.3 V $V_{REF}A$ = 0 V		180		mA
Total 802.11g Tx quiescent current	I_{CQ}-g	No RF		95		mA
Total 802.11b Tx supply current	I_{CC}-b	P_{OUT} = 20 dBm, 11 Mbps CCK $V_{REF}G$ = 2.9 V, V_{CC} = 3.3 V $V_{REF}A$ = 0 V		210		mA
Total 802.11a Tx supply current, T0a or T1a	I_{CC}-a	P_{OUT} = 15 dBm, 54 Mbps OFDM, $V_{REF}A$ = 2.9 V, V_{CC} = 3.3 V $V_{REF}G$ = 0 V		180		mA
Total 802.11a Tx quiescent current, T0g or T1g	I_{CQ}-a	No RF		135		mA

PA Logic Characteristics

Conditions: V_{CC} = 3.3 V, T_{OP} = 25 °C. Measurements made on Skyworks EVB with all losses de-embedded. All unused ports terminated into 50 Ω unless otherwise specified.

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Reference voltage high	$V_{REF}G$–H, $V_{REF}A$		2.8	2.9	3.0	V
Reference voltage low	$V_{REF}G$–L, $V_{REF}A$		0		0.3	V
Reference current high	$I_{REF}G$–H, $I_{REF}A$			5		mA
Reference current low	$I_{REF}G$–L, $I_{REF}A$			20		µA

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Switch Characteristics

Conditions: V_CC = 3.3 V, T_OP = 25 ºC. Measurements made on Skyworks EVB with all losses de-embedded.
All unused ports terminated into 50 Ω unless otherwise specified.

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Control voltage - ON state	V_{CTL_on}		3	3.3	3.6	V
Control voltage - OFF state	V_{CTL_off}		0		0.2	V
Control current - ON state	I_{CTL_on}	RF ON		10	75	uA
Control current - ON state	I_{CTL_on}	RF OFF		2	20	uA

Truth Table

Mode	VRx	VTx
Rx-ANT	3.3	0
Tx-ANT	0	3.3
TxRx-ANT0	3.3	3.3

All other combinations undefined.

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 employed at all times.*

802.11b,g Transmit Specifications

Conditions: V_{CC} = 3.3 V, V_{REF}G = 2.9 V, T_{OP} = 25 °C. PA enables and control voltages set according to Truth Table. Measurements made on Skyworks EVB with all losses de-embedded. All unused ports terminated into 50 Ω unless otherwise specified.

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Frequency range	F		2.4		2.5	GHz
Linear output power - g	Plin_g	54 Mbps OFDM, 64 QAM, EVM = 3.2%		18		dBm
Compliant output power - b	P_{OUT}_b	11 Mbps CCK		21		dBm
Backed off EVM	BEVM	54 Mbps OFDM, 64 QAM, P_{OUT} = 8 dBm		1.5		%
1 dB compression point	$P_{1\,dB}$		22.5	25		dBm
Small signal gain	$|S_{21}|$			27		dB
Small signal gain variation over frequency band	$\Delta|S_{21}|$			2		dB
Gain, 3.2–3.3 GHz	$|S_{21}|$ - 3.2			0		dB
Harmonics	2f, 3f	P_{OUT} = 18 dBm, 2 Mbps, CCK, 802.11b		-50	-42	dBm/MHz
Tx switching time	t_sw	50% of V_{CTL} to 90/10% RF output		1		µs
Input return loss	$|S_{11}|$	TxA or TxG		-10		dB
Output return loss	$|S_{22}|$	Ant		-8		dB
Stability	STAB	P_{OUT} ≤ 18 dBm, load VSWR = 3:1	All non-harmonically related outputs less than -50 dBc/1 MHz			

802.11b,g Receive Specifications

Conditions: V_{CC} = 3.3 V, V_{REF}G = 2.9 V, T_{OP} = 25 °C. PA enables and control voltages set according to Truth Table. Measurements made on Skyworks EVB with all losses de-embedded. All unused ports terminated into 50 Ω unless otherwise specified.

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Frequency range	F		2.4		2.5	GHz
Insertion loss	$|S_{21}|$			1.1	1.6	dB
Input/output return loss	$|S_{11}|$, $|S_{22}|$	RxG–Ant		-15		dB
Antenna to Rx isolation		PA off, switch in Tx–Ant mode		23		dB

802.11b,g Power Detector Specification

Conditions: V_{CC} = 3.3 V, V_{REF}G = 2.9 V, T_{OP} = 25 °C. PA enables and control voltages set according to Truth Table. Measurements made on Skyworks EVB with all losses de-embedded. All unused ports terminated into 50 Ω unless otherwise specified.

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Power detect range	PDR	Ant	5		22	dBm
Power detector accuracy	PDacc2	Over 3:1 VSWR		±1		dB
P_{DET} load impedance				22.5		kΩ
P_{DET} output impedance					3	kΩ
Voltage limits		Over power range	0.1		1.1	V
Voltage range			0.3	0.6		V
Power detector -3 dB corner frequency	LPF-3 dB	10 kΩ load	270	300	400	kHz

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802.11a Transmit Specifications

Conditions: V_{CC} = 3.3 V, $V_{REF}A$ = 2.9 V, T_{OP} = 25 °C. PA enables and control voltages set according to Mode Control Voltage table. Measurements made on Skyworks EVB with all losses de-embedded. All unused ports terminated into 50 Ω unless otherwise specified.

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Frequency range	F		4.9		5.85	GHz
Linear output power - a	Plin_a	54 Mbps OFDM, 64 QAM, EVM = 3.0%		16		dBm
Backed off EVM	BEVM	54 Mbps OFDM, 64 QAM, P_{OUT} = 7 dBm		1.5		%
1 dB compression point	$P_{1\,dB}$		21.5	24		dBm
Small signal gain	$|S_{21}|$			25		dB
Small signal gain variation over any 20 MHz band	$\Delta|S_{21}|$			2		dB
Gain matching, T0g to A0 vs. T1g to A1	$|S_{21}|$ - M	Compared frequency by frequency		2		dB
Gain, 3.2–3.9 GHz	$|S_{21}|$ - 3.9			0		dB
Harmonics	2f, 3f	P_{OUT} = 15 dBm, 6 Mbps, OFDM		-50	-42	dBm/MHz
Tx switching time	t_sw	50% of V_{CTL} to 90/10% RF output power level		0.5		µS
Input return loss	$|S_{11}|$	TxA or TxG		-6		dB
Output return loss	$|S_{22}|$	Ant		-10		dB
Stability	STAB	$P_{OUT} \leq$ 18 dBm, load VSWR = 3:1	All non-harmonically related outputs less than -50 dBc/1 MHz			

802.11a Receive Specifications

Conditions: V_{CC} = 3.3 V, $V_{REF}A$ = 2.9 V, T_{OP} = 25 °C. PA enables and control voltages set according to Mode Control Voltage table. Measurements made on Skyworks EVB with all losses de-embedded. All unused ports terminated into 50 Ω unless otherwise specified.

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Frequency range	F		4.9		5.85	GHz
Insertion loss	$|S_{21}|$			2.5	3	dB
Input/output return loss	$|S_{11}|$, $|S_{22}|$	RxG –Ant		-15		dB
Antenna to Rx isolation	$|S_{21}|$	PA off, switch in Tx–Ant mode		22		dB

802.11a Power Detector Specification

Conditions: V_{CC} = 3.3 V, $V_{REF}A$ = 2.9 V, T_{OP} = 25 °C. PA enables and control voltages set according to Mode Control Voltage table. Measurements made on Skyworks EVB with all losses de-embedded. All unused ports terminated into 50 Ω unless otherwise specified.

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Power detect range	PDR	Ant	5		22	dBm
Power detector accuracy	PDacc2	Over 3:1 VSWR		±1		dB
P_{DET} load impedance				22.5		kΩ
P_{DET} output impedance					3	kΩ
Voltage limits		Over power range	0.1		1.1	V
Voltage range			0.3	0.6		V
Power detector -3 dB corner frequency	LPF-3 dB	10 kΩ load	270	300	400	kHz

Pin Out (Top View)
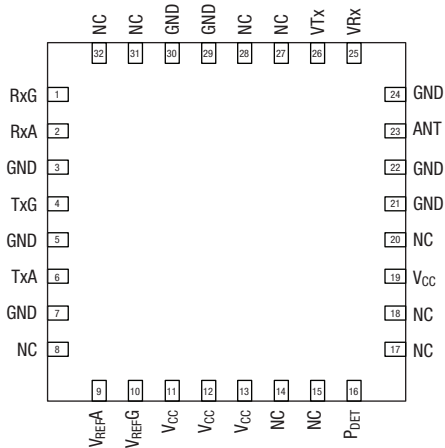
Application Circuit
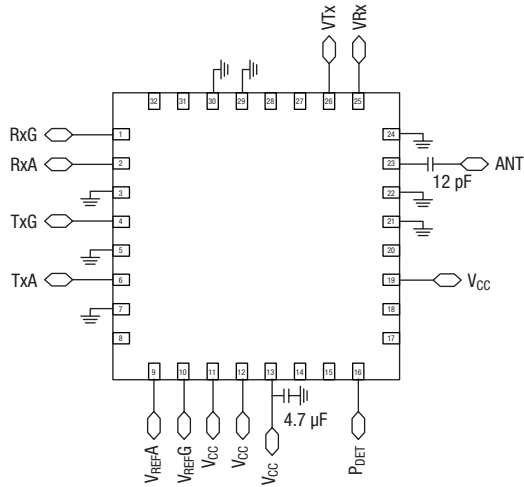
Pin Descriptions

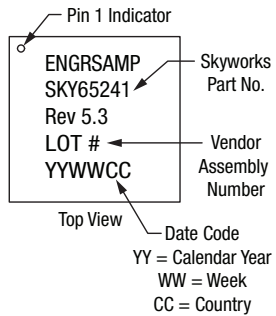| Pin Number	Symbol	Description
1	RxG	Low-band receive output port. Internally matched to 50 Ω and DC blocked.
2	RxA	High-band receive output port. Internally matched to 50 Ω and DC blocked.
3	GND	Ground
4	TxG	Low-band transmit input port. Internally matched to 50 Ω and DC blocked.
5	GND	Ground
6	TxA	High-band transmit input port. Internally matched to 50 Ω and DC blocked.
7	GND	Ground
8	NC	No connection inside the module.
9	$V_{REF}A$	External reference voltage for the high-band PA.
10	$V_{REF}G$	External reference voltage for the low-band PA.
11	V_{CC}	Power supply 3.3 V, A band
12	V_{CC}	Power supply 3.3 V, A band
13	V_{CC}	Power supply 3.3 V, A band
14	NC	No connection inside the module.
15	NC	No connection inside the module.
16	P_{DET}	Directional power detector output.
17	NC	No connection inside the module.
18	NC	No connection inside the module.
19	V_{CC}	Power supply 3.3 V, G band
20	NC	No connection inside the module.
21	GND	Ground
22	GND	Ground
23	Ant	Antenna RF port. Internally matched to 50 Ω. External DC block cap required.
24	GND	Ground
25	VRx	Digital control input for SPDT switch
26	VTx	Digital control input for SPDT switch
27	NC	No connection inside the module.
28	NC	No connection inside the module.
29	GND	Ground
30	GND	Ground
31	NC	No connection inside the module.
32	NC	No connection inside the module.

Branding Specifications

(Both Markings Perform the Same)

SKY65241-12 — Skyworks Part No.
LOT # — Vendor Assembly Number
YYWWCC — Date Code
YY = Calendar Year
WW = Week
CC = Country

Top View

OR

Pin 1 Indicator

ENGRSAMP
SKY65241 — Skyworks Part No.
Rev 5.3
LOT # — Vendor Assembly Number
YYWWCC — Date Code

Top View

YY = Calendar Year
WW = Week
CC = Country

Recommended Footprint

5.3 mm
Pin 32
32X 0.3 mm
Package Outline
Pin 1
5.3 mm
0.25 mm
0.5 mm Typ.
19X 0.65 mm
0.25 mm Typ.
19X 0.3 mm
0.6 mm Typ.
Thermal via array 0.3 mm on 0.6 mm pitch will improve thermal performance

Stencil Pattern

Pin 32
0.20 x 45°
5.3 mm
32X 0.3 mm
32X 0.65 mm
Pin 1
0.25 mm
1.7 mm Typ.
5.3 mm
0.13 mm Typ.
0.5 mm Typ.
Package Outline
Exposed Center Pad
0.25 mm
2X 1.7 mm

Stencil aperture size for center ground pad should be 80%–100% (by area) of the solder mask opening

Solder Mask

Pin 32
0.20 x 45°
5.4 mm
32X 0.4 mm
32X 0.75 mm
Pin 1
0.25 mm
2X 1.7 mm
5.4 mm
0.5 mm Typ.
8X 0.1 x 45°
2X 1.7mm
Package Outline
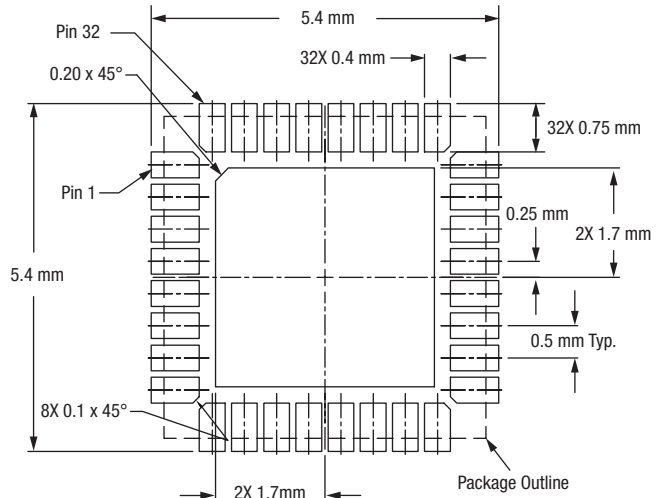
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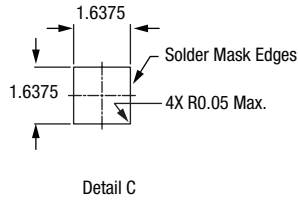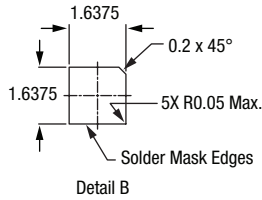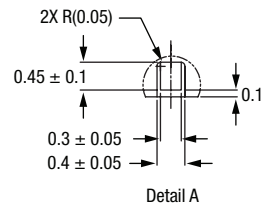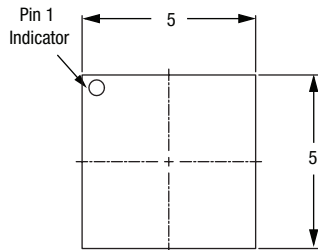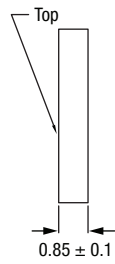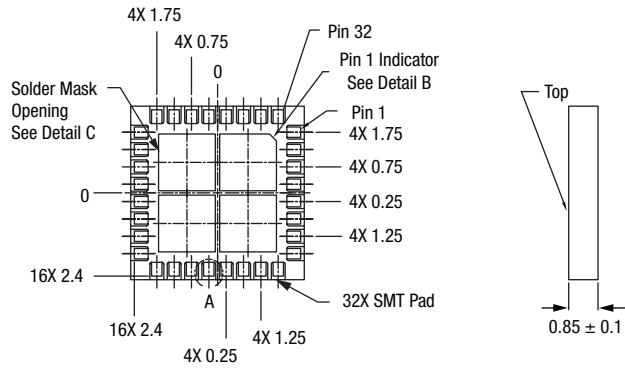
Recommended Solder Reflow Profiles

Refer to the *"Recommended Solder Reflow Profile"* Application Note.

Tape and Reel Information

Refer to the *"Discrete Devices and IC Switch/Attenuators Tape and Reel Package Orientation"* Application Note.

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