SKY65249-11: WLAN 802.11b, g, n Intera™ Front-End Module

Features

- 2.4 to 2.5 GHz operation
- Cardbus, mini PC1, PCIe and AP applications
- P_{OUT} @ 2.5% EVM (OFDM54): 18 dBm
- Gain: 25 dB
- Integrated PA, filters, directional detector and diversity switch
- Single supply voltage : 3.0 to 3.6 V
- Dual antennas
- Small, ultra thin package 4 x 4 x 0.9 mm
- Lead (Pb)-free and RoHS-compliant

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

Description

The SKY65249-11 Intera FEM contains one complete 2.4 GHz transmit/receive chain in a compact RF front-end module optimized for single band 2.4–2.5 GHz operation. The SKY65249-11 includes a PA with integrated input filtering for 3.2–3.3 GHz rejection, and temperature-compensated directional power detector with 20 dB dynamic range. Also included are low loss, high rejection harmonic filters and a diversity switch which provide high linearity in transmit and low loss in receive paths.
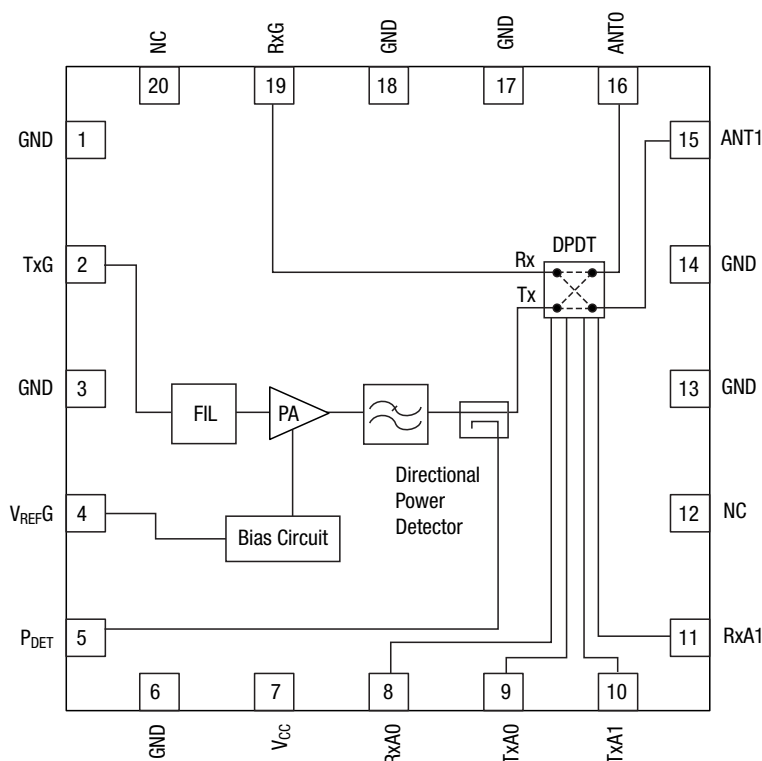
The SKY65249-11 is packaged in a lead (Pb)-free, RoHS-compliant laminate package, which measures 16 mm^2.

Functional Block Diagram

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Absolute Maximum Ratings

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
V_{CC}	V_{CC}		-0.3		5.5	V
$V_{REF}G$	$V_{REF}G$		-0.3		5.5	V
Tx In	Tx IN				10	dBm
Junction temperature	T_J				150	°C
Dissipated power	P_D			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	$V_{REF}G$		2.8	2.9	3.0	V
Operating temperature	T_{OP}		0	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		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		210		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	$V_{REF}G–H$		2.8	2.9	3.0	V
Reference voltage low	$V_{REF}G–L$		0		0.3	V
Reference current high	$I_{REF}G–H$			4		mA
Reference current low	$I_{REF}G–L$			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	RxA0 (V)	RxA1 (V)	TxA0 (V)	TxA1 (V)	V_{CC} (V)	V_{REF}G (V)
Rx-ANT0	3.3	0	0	0	3.3	0
Rx-ANT1	0	3.3	0	0	3.3	0
Tx-ANT0	0	0	3.3	0	3.3	2.9
Tx-ANT1	0	0	0	3.3	3.3	2.9
TxRx-ANT0	3.3	0	3.3	0	3.3	2.9

All other conditions not recommended.

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 = 2.5 %		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	IS$_{21}$I			25		dB
Small signal gain variation over frequency band	ΔIS$_{21}$I			2		dB
Gain, 3.2–3.3 GHz	IS$_{21}$I - 3.2			0		dB
Harmonics	2f, 3f	P$_{OUT}$ = 18 dBm, 1 Mbps, CCK, 802.11b		-50	-42	dBm/MHz
Tx switching time	t_sw	50 % of V$_{CTL}$ to 90/10 % RF output			500	ns
Input return loss	IS$_{11}$I	Tx In		-10		dB
Output return loss	IS$_{22}$I	Ant A or Ant B		-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	IS$_{21}$I			1.1	1.6	dB
Input/output return loss	IS$_{11}$I, IS$_{22}$I	RxG, Ant 0, 1		-15		dB
Antenna to Rx isolation		PA off, switch in Tx–Ant0 (Ant1) mode		23		dB
Antenna to antenna isolation		Isolation between Ant0 and Ant1 parts Switch in any mode		19		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 0 or Ant 1	5		22	dBm
Power detector accuracy	PDacc2	Over 3:1 VSWR		±1		dB
P$_{DET}$ load impedance				27		kΩ
P$_{DET}$ output impedance					6	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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Typical Performance Data (2.4–2.5 GHz)

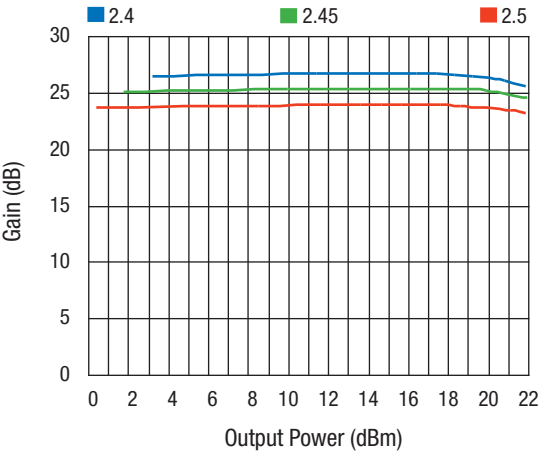V_{CC} = 3.3 V, T_A = 25 °C, OFDM 54 Mbps, Z_0 = 50 Ω, unless otherwise noted
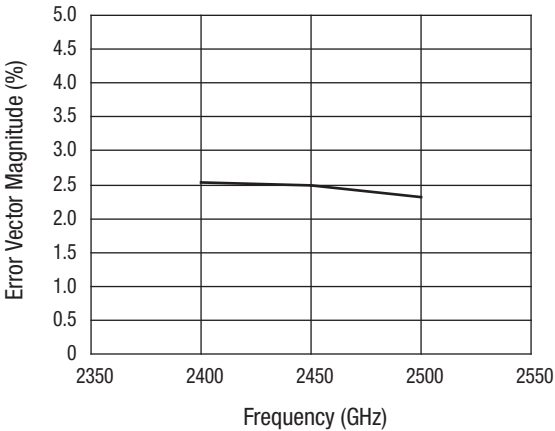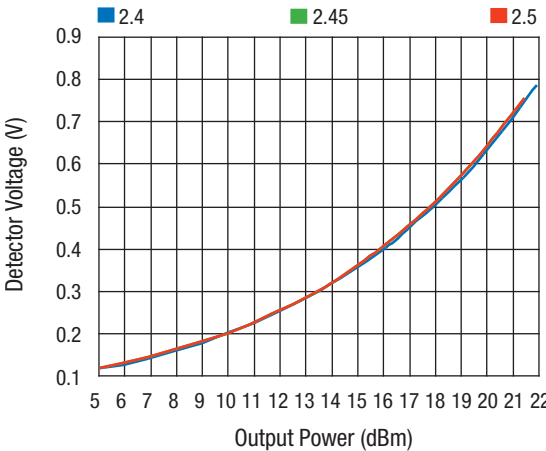
EVM vs. Frequency
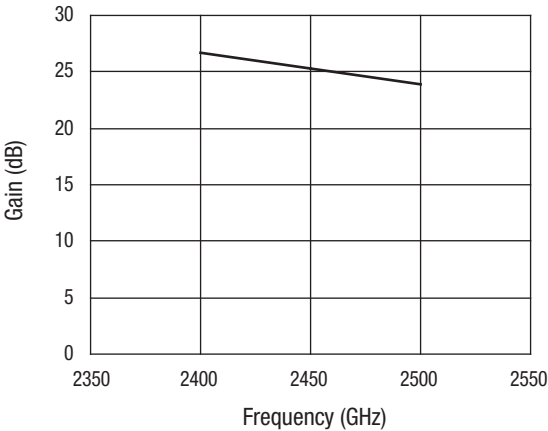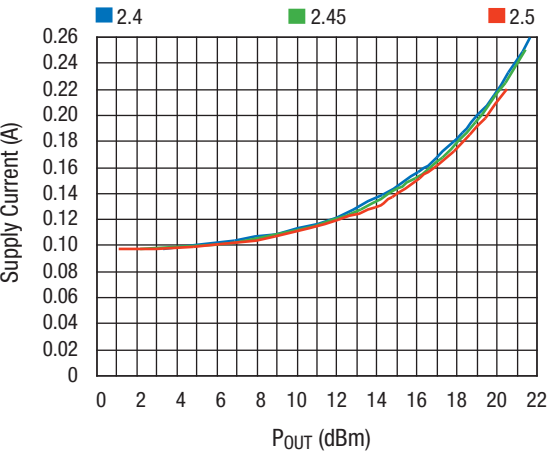
Gain vs. Frequency
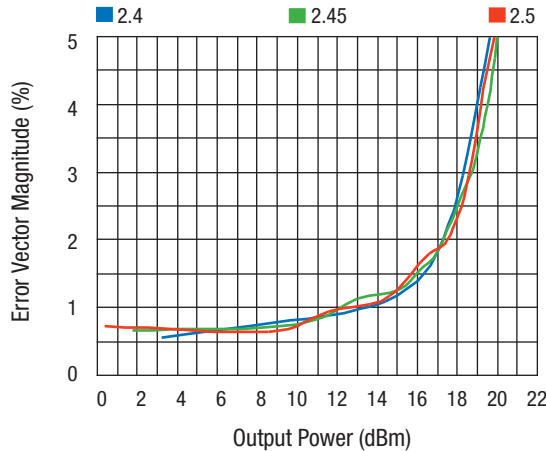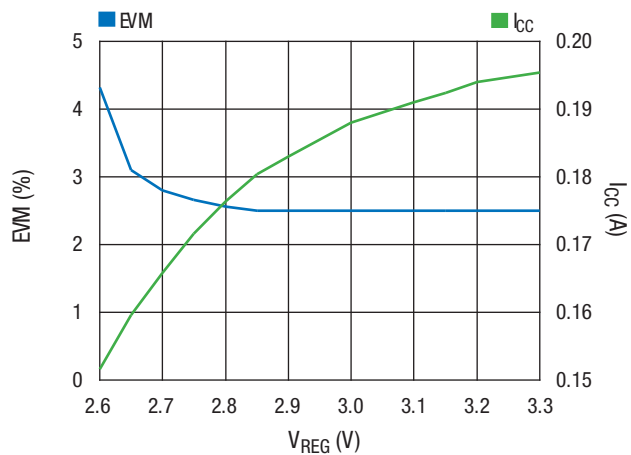
EVM vs. Output Power
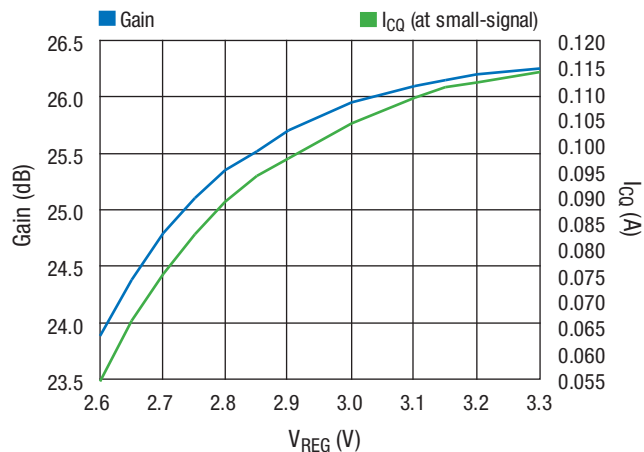
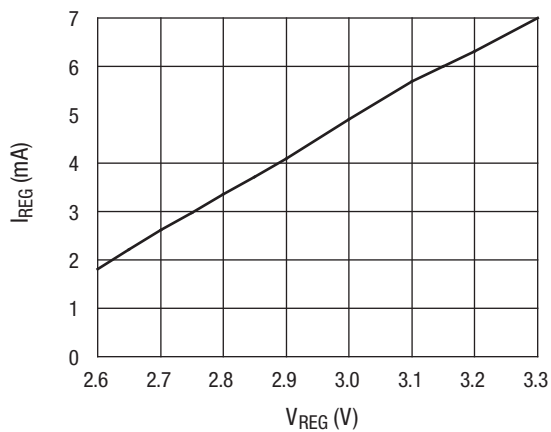**Gain vs. Output Power**

Detector Voltage vs. Output Power
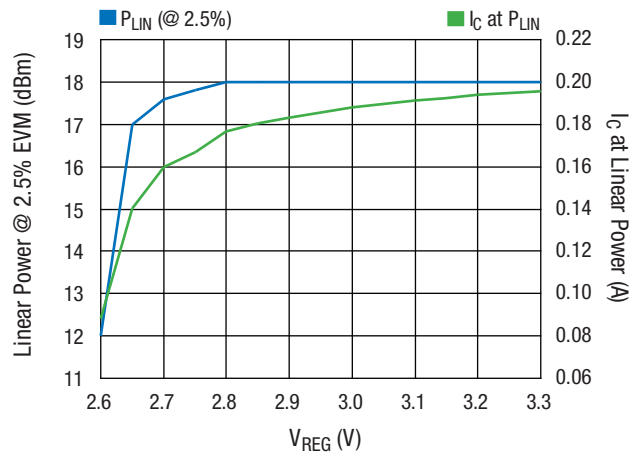
Supply Current vs. Output Power

Parameters @ 18 dBm vs. V_{REG}

Gain vs. V_{REG}

Parameters vs. V_{REG}

Parameters vs. V_{REG}

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Pin Out
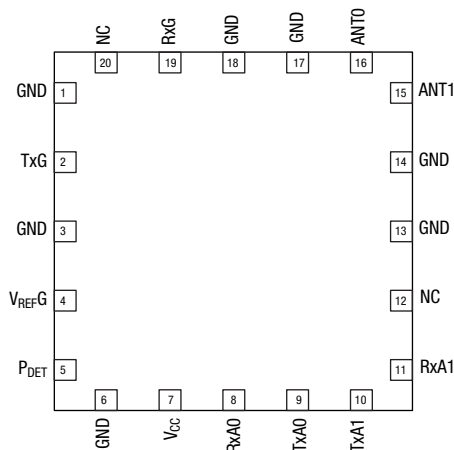
Application Circuit
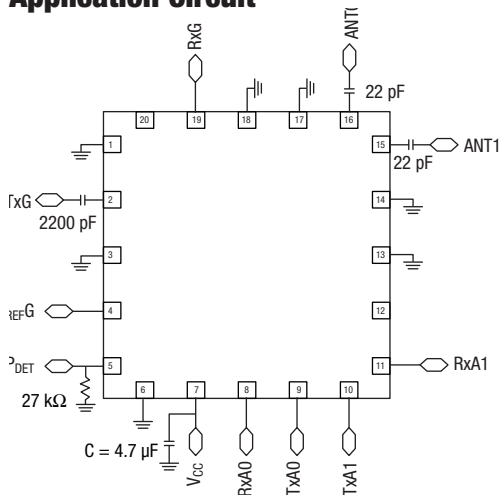
Branding Specifications
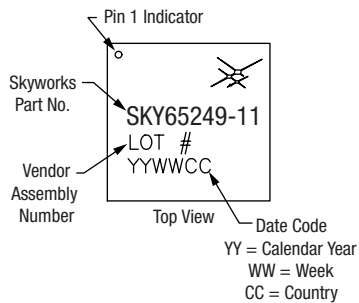
Pin Descriptions

Pin Number	Symbol	Description
1	GND	Ground
2	TxG	Transmit input port. Internally matched to 50 Ω. External DC block required (2200 pF recommended)
3	GND	Ground
4	V$_{REF}$G	External reference voltage for the PA
5	P$_{DET}$	Directional power detector output
6	GND	Ground
7	V$_{CC}$	Power supply 3.3 V
8	RxA0	Digital control input DPDT
9	TxA0	Digital control input DPDT
10	TxA1	Digital control input DPDT
11	RxA1	Digital control input DPDT
12	NC	Not connected to anything externally
13	GND	Ground
14	GND	Ground
15	Ant1	Auxiliary antenna port. Internally matched to 50 Ω. External DC block required (22 pF recommended)
16	Ant0	Main antenna port. Internally matched to 50 Ω. External DC block required (22 pF recommended)
17	GND	Ground
18	GND	Ground
19	RxG	Receive output port. Internally matched to 50 Ω and DC blocked. No external DC block required
20	NC	Not connected to anything externally

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.

Test Evaluation Board
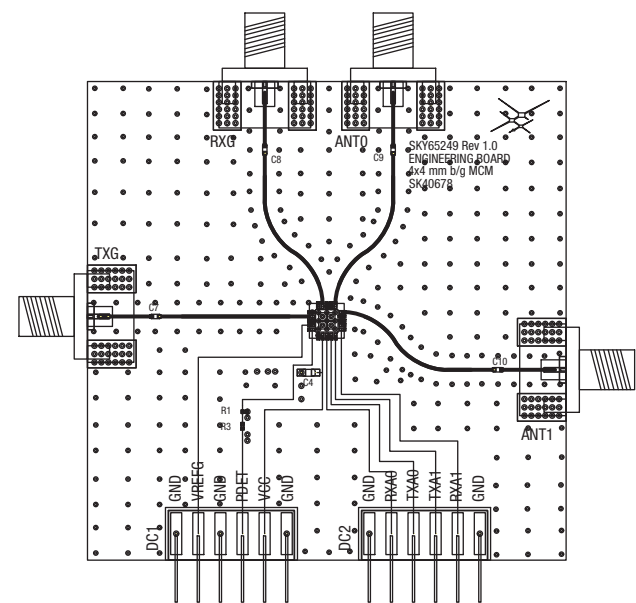
Test Evaluation Board (Center Enlarged)
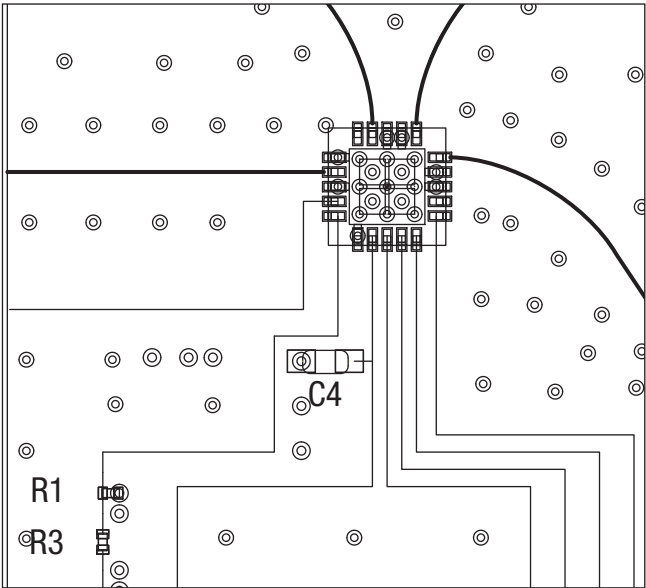
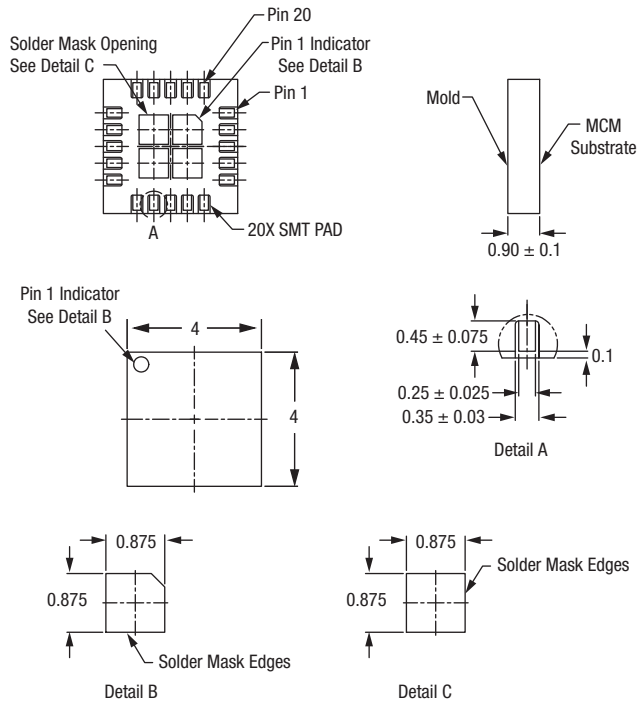## Layer Stackup
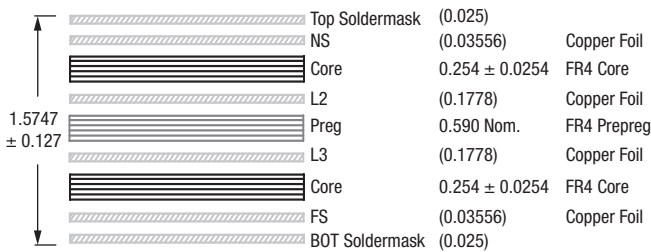
Dimensions in mm.

Design Information

RF line width	19.3 (0.49)	mils (mm)
DC line width	11.3 (0.29)	mils (mm)
Dielectric constant	4.2	

SMT BOM

Ref Des	Qty.	Description	Value	Tolerance	Size
C4	1	Capacitor	4.7 µF	± 5%	SMT 0603
C7	1	Capacitor	2200 pF	± 5%	SMT 0402
C8	1	Resistor	0 Ω	± 5%	SMT 0402
C9	1	Capacitor	22 pF	± 5%	SMT 0402
C10	1	Capacitor	22 pF	± 5%	SMT 0402
R1	1	Resistor	27 kΩ	± 5%	SMT 0201
R3	1	Resistor	0 Ω	± 5%	SMT 0201

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Package Dimensions

Solder Mask Opening See Detail C
Pin 20
Pin 1 Indicator See Detail B
Pin 1
A
20X SMT PAD

Mold
MCM Substrate
0.90 ± 0.1

Pin 1 Indicator See Detail B
4
4

0.45 ± 0.075
0.1
0.25 ± 0.025
0.35 ± 0.03
Detail A

0.875
0.875
Solder Mask Edges
Detail B

0.875
0.875
Solder Mask Edges
Detail C

Solder Mask Opening (Top View)

4.4 mm
0.2 x 0.2 mm
Pin 20
20X 0.8 mm
Pin 1
4.4 mm
1.88 mm
0.5 mm Typ.
20X 0.4 mm
0.46 mm Typ.
Stencil aperature size for center ground pad should be 80% to 100% (by area) of the solder mask opening
Package Outline
Exposed Center Pad
1.88 mm
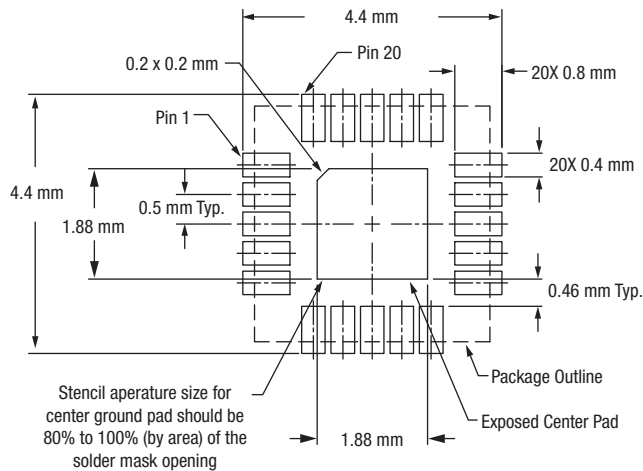
Stencil Aperture (Top View)

4.3 mm
0.2 x 0.2 mm
Pin 20
20X 0.7 mm
Pin 1
4.3 mm
0.5 mm Typ.
20X 0.3 mm
0.88 mm
Stencil aperature size for center ground pad should be 80% to 100% (by area) of the solder mask opening
Package Outline
Exposed Center Pad

Footprint (Top View)

4.3 mm
Pin 20
20X 0.7 mm
Pin 1
4.3 mm
0.5 mm Typ.
20X 0.3 mm
0.25 mm
0.25 mm Typ.
0.6 mm
0.35 mm
Package Outline

Thermal Via Array under PA areas. 0.3 mm on 0.6 mm pitch. Additional vias will improve thermal performance. Note: Thermal vias should be tented and filled with solder mask. 30–35 µm Cu plating is recommended.

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