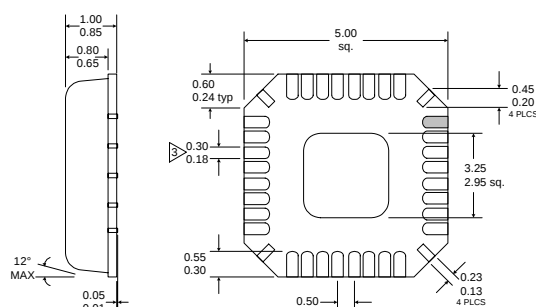


Typical Applications

- CDMA/Cellular/PCS Handsets
- TDMA Cellular/PCS Handsets
- GSM/DCS/PCS Handsets
- Commercial and Consumer Systems
- Portable Battery-Powered Equipment

Product Description

The RF2477 is a fully-functional, integrated dual-band downconverter for tri-mode CDMA applications. The device features two complete RF downconverters with low noise amplifiers and mixers for PCS and cellular band frequencies. Multiple gain control options are available to conserve current and meet IS-98B specifications. The mixer design allows for a common IF filter for CDMA cellular and PCS operation. The RF2477 is fabricated on an advanced silicon SiGe HBT process and is packaged in an industry-standard 32 pin plastic leadless chip carrier.

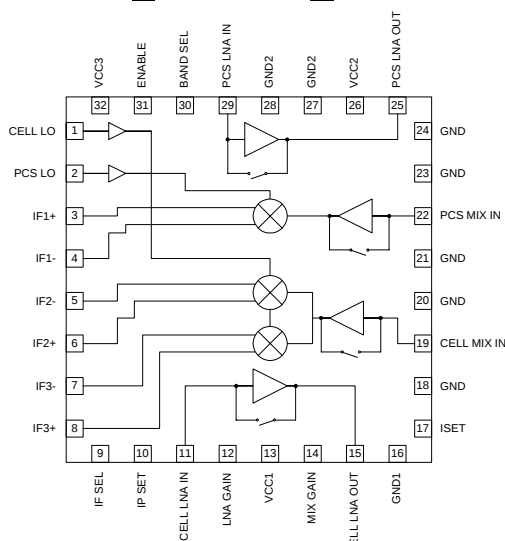


NOTES:

- 1 Shaded Pin is Lead 1.
- 2 Pin 1 identifier must exist on top surface of package by identification mark or feature on the package body. Exact shape and size is optional.
- 3 Dimension applies to plated terminal: to be measured between 0.02 mm and 0.25 mm from terminal end.
- 4 Package Warp: 0.05 mm max.
- 5 Die Thickness Allowable: 0.305 mm max.

Optimum Technology Matching® Applied

- | | | |
|-------------------------------------|--|--------------------------------------|
| ☐ Si BJT | ☐ GaAs HBT | ☐ GaAs MESFET |
| ☐ Si Bi-CMOS | ☒ SiGe HBT | ☐ Si CMOS |



Functional Block Diagram

Package Style: LCC, 32-Pin, 5 x 5

Features

- Complete Dual Band Receiver Front End
- Stepped LNA/Mixer Gain Control
- Adjustable LNA Bias Current
- Adjustable LNA IIP3
- Meets IS-98B Specifications

Ordering Information

- | | |
|-------------|---|
| RF2477 | Dual-Band/Tri-Mode CDMA Low Noise Amplifier/Mixer |
| RF2477 PCBA | Fully Assembled Evaluation Board |

RF Micro Devices, Inc.
7625 Thorndike Road
Greensboro, NC 27409, USA

Tel (336) 664 1233
Fax (336) 664 0454
<http://www.rfmd.com>

Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	-0.5 to +5.0	V _{DC}
Input LO and RF Levels	+6	dBm
Operating Ambient Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C



Caution! ESD sensitive device.

RF Micro Devices believes the furnished information is correct and accurate at the time of this printing. However, RF Micro Devices reserves the right to make changes to its products without notice. RF Micro Devices does not assume responsibility for the use of the described product(s).

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Overall					T = 25°C, V _{CC} =2.75V
RF Frequency Range		869 to 894		MHz	
IF Frequency Range		1930 to 1990		MHz	
		0.1 to 400		MHz	
Cellular Band					Freq=869MHz to 894MHz
LNA (On)					LNA 50Ω match. Noise match improves noise figure by approximately 0.5dB.
Gain	13.5	14.5	15.5	dB	LNA set for max IIP3
	13	14.0	15	dB	LNA set for Nominal IIP3
Noise Figure		2.0	2.2	dB	LNA set for max IIP3
		1.8	2.0	dB	LNA set for Nominal IIP3
		1.5		dB	Noise match
IIP3	+9.0	+11.0		dBm	LNA set for max IIP3
		+5.0		dBm	LNA set for Nominal IIP3
Isolation		22		dB	
LNA (Off)					
Gain		-7.5		dB	
Noise Figure		7.5		dB	
IIP3		+20.0		dBm	
Isolation		22		dB	
Mixer					
Gain	12.5	13.5	14.5	dB	Mixer RF amplifier ON; Z _{LOAD} =1kΩ single-ended
		4.5		dB	Mixer RF amplifier OFF
Noise Figure		7.0	8	dB	Mixer RF amplifier ON
		14.0		dB	Mixer RF amplifier OFF
IIP3		+3.0		dBm	Mixer RF amplifier ON
	+10.0	+12.5		dBm	Mixer RF amplifier OFF
Input P1dB		-12		dBm	Mixer RF amplifier ON
LO to RF Isolation	36	45		dB	Mixer RF amplifier ON
	36	45		dB	Mixer RF amplifier OFF
LO Input Level	-12	-10	-8	dBm	

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Cascade (LNA On)					3dB Filter
Gain	23.0 22.5	25.0		dB	LNA set for max IIP3; Mixer RF amp ON
		24.5		dB	LNA set for Nominal IIP3; Mixer RF amp ON
		16.0		dB	LNA set for max IIP3; Mixer RF amp OFF
		15.5		dB	LNA set for Nominal IIP3; Mixer RF amp OFF
Noise Figure		2.8		dB	LNA set for max IIP3; Mixer RF amp ON
		2.7		dB	LNA set for Nominal IIP3; Mixer RF amp ON
		5.2		dB	LNA set for max IIP3; Mixer RF amp OFF
		5.4		dB	LNA set for Nominal IIP3; Mixer RF amp OFF
IIP3		-8.5		dBm	LNA set for max IIP3; Mixer RF amp ON
		-8.0		dBm	LNA set for Nominal IIP3; Mixer RF amp ON
		+0.5		dBm	LNA set for max IIP3; Mixer RF amp OFF
		0		dBm	LNA set for Nominal IIP3; Mixer RF amp OFF
Cascade (LNA Off)					3dB Filter
Gain		3.0		dB	Mixer RF amp ON
		-6.0		dB	Mixer RF amp OFF
Noise Figure		17.5		dB	Mixer RF amp ON
		24.5		dB	Mixer RF amp OFF
IIP3		+12		dBm	Mixer RF amp ON
		+18		dBm	Mixer RF amp OFF
LO to IF Isolation		40		dB	
RF to IF Isolation		40		dB	IF1
LO to LNA IN Isolation	35	45		dB	IF2
PCS Band					Freq=1930MHz to 1990MHz
LNA (On)					LNA 50Ω match. Noise match improves noise figure by approximately 0.3dB.
Gain	13.5 13	14.5	15.5	dB	LNA set for max IIP3
		13.5	15	dB	LNA set for Nominal IIP3
Noise Figure		1.7	2.0	dB	LNA set for max IIP3
		1.6	1.9	dB	LNA set for Nominal IIP3
IIP3	+8.0	1.4		dB	Noise match
		+10.0		dBm	LNA set for max IIP3
Isolation		+3		dBm	LNA set for Nominal IIP3
		22		dB	
LNA (Off)					
Gain		-6.0		dB	
Noise Figure		6.0		dB	
IIP3		+24.0		dBm	
Isolation		6		dB	
Mixer					
Gain	12.5	13.5	14.5	dB	Mixer RF amp ON; Z _{LOAD} =1kΩ single-ended
		3.5		dB	Mixer RF amp OFF
Noise Figure		8.0	9	dB	Mixer RF amp ON
		15.0		dB	Mixer RF amp OFF
IIP3		+2		dBm	Mixer RF amp ON
		+12		dBm	Mixer RF amp OFF
Input P1dB		-12		dBm	Mixer RF amp ON
LO to RF Isolation	36	45		dB	Mixer RF amp ON
	36	45		dB	Mixer RF amp OFF
LO Input Level	-13	-10	-8	dBm	

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
PCS Band, cont'd					
Cascade (LNA On)					3dB Filter
Gain	23.0	25.0		dB	LNA set for max IIP3; Mixer RF amplifier ON
	22.5	24.0		dB	LNA set for Nominal IIP3; Mixer RF amplifier ON
		15		dB	LNA set for max IIP3; Mixer RF amp OFF
		14		dB	LNA set for Nominal IIP3; Mixer RF amplifier OFF
Noise Figure		2.8		dB	LNA set for max IIP3; Mixer RF amplifier ON
		2.9		dB	LNA set for Nominal IIP3; Mixer RF amplifier ON
		5.7		dB	LNA set for max IIP3; Mixer RF amp OFF
		6.25		dB	LNA set for Nominal IIP3; Mixer RF amplifier OFF
IIP3		-9.5		dBm	LNA set for max IIP3; Mixer RF amplifier ON
		-8.8		dBm	LNA set for Nominal IIP3; Mixer RF amplifier ON
		0		dBm	LNA set for max IIP3; Mixer RF amp OFF
		-0.5		dBm	LNA set for Nominal IIP3; Mixer RF amplifier OFF
Cascade (LNA Off)					3dB Filter
Gain		+4.5		dB	Mixer RF amplifier ON
		-5.5		dB	Mixer RF amplifier OFF
Noise Figure		17		dB	Mixer RF amplifier ON
		24.0		dB	Mixer RF amplifier OFF
IIP3		+10		dBm	Mixer RF amplifier ON
		+19		dBm	Mixer RF amplifier OFF
LO to IF Isolation		40		dB	
RF to IF Isolation (IF1)		40		dB	
RF to IF Isolation (IF2)		40		dB	
LO to LNA IN Isolation	35	45		dB	
Power Supply					
Supply Voltage	2.7	2.75	3.3	V	
Cellular					
LNA Current		6.5		mA	Cellular; LNA On, Max IIP3
		4		mA	Cellular; LNA On, Nominal IIP3
		0		mA	Cellular; LNA Off
Mixer Current		26		mA	Cellular; Mixer RF Amplifier ON
		21		mA	Cellular; Mixer RF Amplifier OFF
PCS					
LNA Current		6.5		mA	PCS; LNA On, Max IIP3
		4.0		mA	PCS; LNA On, Nominal IIP3
		0		mA	PCS; LNA Off
Mixer Current		26		mA	PCS; Mixer RF Amplifier ON
		21		mA	PCS; Mixer RF Amplifier OFF
Power Down			1	μA	Enable=0

State Table (Typical Values for $V_{CC}=2.75V$)

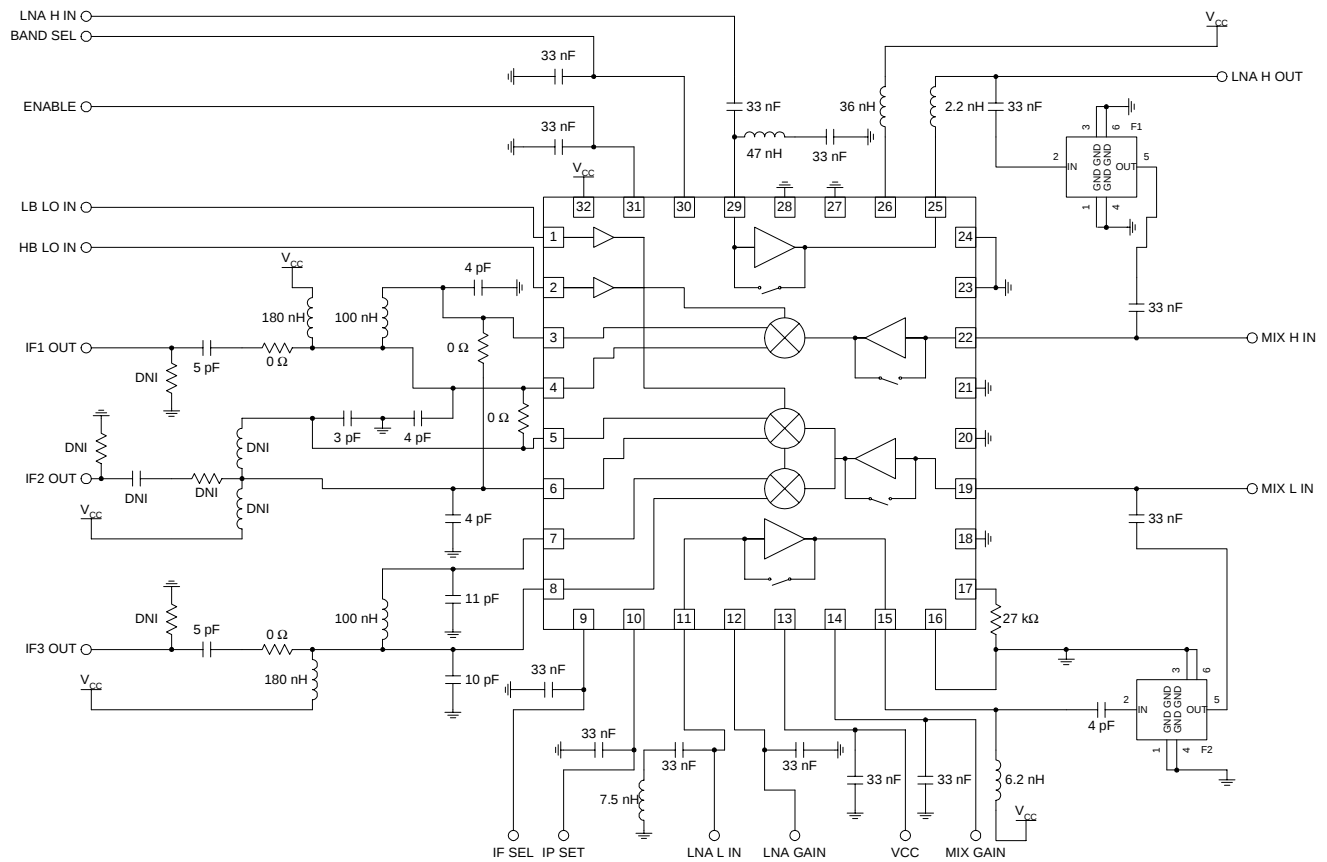
Parameter	Cellular						PCS					
	LNA On				LNA Off		LNA On				LNA Off	
	LNA at Max IIP3		LNA at Nom IIP3				LNA at Max IIP3		LNA at Nom IIP3			
	Mixer Amp On	Mixer Amp Off	Mixer Amp On	Mixer Amp Off	Mixer Amp On	Mixer Amp Off	Mixer Amp On	Mixer Amp Off	Mixer Amp On	Mixer Amp Off	Mixer Amp On	Mixer Amp Off
Cascade												
Gain (dB)	25	16	24.5	15	3	-6	25	15	24.5	14	4.5	-5.5
Noise Figure (dB)	2.8	5.2	2.7	5.4	17.5	24.5	2.8	5.7	2.6	5.9	16	24
Input IP3 (dBm)	-8.5	0	-8	0.5	12	18	-9.5	0	-8.8	-0.5	+10	+19
LO to IF Isolation (dB)	40	40	40	40	40	40	40	40	40	40	40	40
RF to IF1 Isol (dB)	40	40	40	40	40	40	40	40	40	40	40	40
RF to IF2 Isol (dB)	40	40	40	40	40	40	40	40	40	40	40	40
LO to LNA IN Isol (dB)	45	45	45	45	45	45	45	45	45	45	45	45
Total Current	32.8	27.5	30	25	26	21	32.5	27.5	30	25	26	21
LNA												
Gain (dB)	14.5	14.5	14	14	-7.5	-7.5	14.5	14.5	13.5	13.5	-6	-6
Noise Figure (dB)	2	2	1.8	1.8	7.5	1.7	1.7	1.1	1.6	1.5	6	6
Input IP3 (dBm)	+11	+11	+5	+5	+20	+20	+10	+10	+3	+3	+24	+24
Isolation (dB)	22	22	22	22	-9	-9	22	22	22	22	-9	-9
LNA Current (mA)	6.5	6.5	4	4	0	0	6.5	6.5	4	4	0	0
Mixer												
Gain (dB)	13.5	4.5	13.5	4.5	13.5	4.5	13.5	3.5	13.5	3.5	13.5	4
Noise Figure (dB)	7	14	7	14	7	14	8	15	8	15	8	15
Input IP3 (dBm)	+3	12.5	+3	12.5	+3	12.5	+2	+12	+2	+12	+2	+12
Input P1dB (dBm)	-12		-12		-12		-12		-12		-12	
LO Input Level (dBm)	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10
LO to RF Isolation(dB)	45	45	45	45	45	45	45	45	45	45	45	45
Mixer Current (mA)	26	21	26	21	26	21	26	21	26	21	26	21

RF2477 Control States

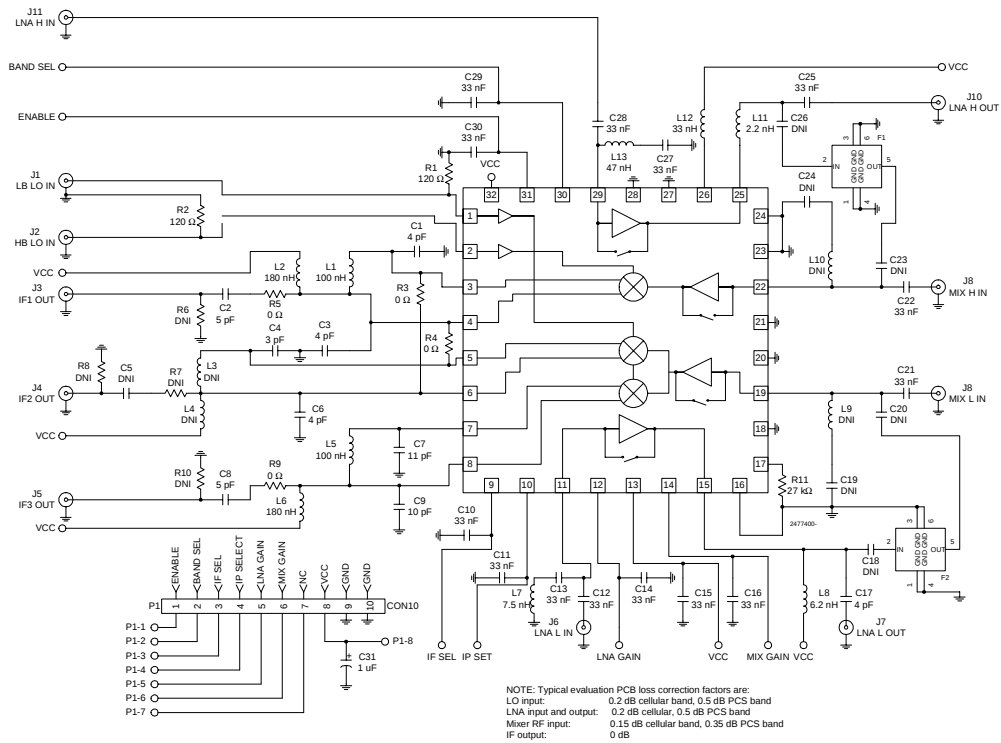
	BAND SEL	IF SEL	LNA GAIN	MIX GAIN	ENABLE	IF Output
PCS CDMA High Gain	1	0	1	1	1	IF1
PCS CDMA Mid1 Gain	1	0	1	0	1	
PCS CDMA Mid2 Gain	1	0	0	1	1	
PCS CDMA Low Gain	1	0	0	0	1	
Cell CDMA High Gain	0	0	1	1	1	IF2
Cell CDMA Mid1 Gain	0	0	1	0	1	
Cell CDMA Mid2 Gain	0	0	0	1	1	
Cell CDMA Low Gain	0	0	0	0	1	
Cell FM High Gain	0	1	1	1	1	IF3
Cell FM Mid1 Gain	0	1	1	0	1	
Cell FM Mid2 Gain	0	1	0	1	1	
Cell FM Low Gain	0	1	0	0	1	
Shutdown	X	X	X	X	0	
Not Defined	1	1	X	X	1	

Pin	Function	Description	Interface Schematic
1	CELL LO	LO Input. Internal DC block. Impedance is approximately $120-j25$. Can be matched to 50Ω with 120Ω shunt resistor.	
2	PCS LO	LO Input. Internal DC block. Impedance is approximately $120-j25$. Can be matched to 50Ω with 120Ω shunt resistor.	
3	IF1+	PCS/DCS band IF output. Open collector. "Current combiner" IF interface to 1000Ω SAW filter recommended.	
4	IF1-	PCS/DCS band IF output. Open collector. "Current combiner" IF interface to 1000Ω SAW filter recommended.	
5	IF2-	Cellular band IF output. Open collector. "Current combiner" IF interface to 1000Ω SAW filter recommended.	
6	IF2+	Cellular band IF output. Open collector. "Current combiner" IF interface to 1000Ω SAW filter recommended.	
7	IF3-	Cellular band IF output. Open collector. "Current combiner" IF interface to 1000Ω SAW filter recommended.	
8	IF3+	Cellular band IF output. Open collector. "Current combiner" IF interface to 1000Ω SAW filter recommended.	
9	IF SEL	Logic input. See Control States table.	
10	IP SET	Logic input. High selects external LNA current reference.	
11	CELL LNA IN	LNA base; simple external matching required for best performance.	
12	LNA GAIN	Logic input. High selects maximum LNA gain.	
13	VCC1	VCC for internal references, logic, and mixer preamplifiers. Internal RF bypass capacitor. External bypass capacitor between 1nF and 47nF required.	
14	MIX GAIN	Logic input; high selects maximum mixer gain.	
15	CELL LNA OUT	LNA collector, simple external L-C matching required.	
16	GND1	LNA emitter; low-inductance ground required.	
17	ISET	Resistor to ground sets LNA current when Pin 10 is high. $20\text{k}\Omega$ results in approximately 10mA LNA current. Higher resistance results in lower current.	
18	GND	Low-inductance ground required.	
19	CELL MIX IN	Low band mixer RF preamplifier base. External L-C network required for best performance.	
20	GND	Low-inductance ground required.	
21	GND	Low-inductance ground required.	
22	PCS MIX IN	High band mixer RF preamplifier base. External L-C network required for best performance.	
23	GND	Low-inductance ground required.	
24	GND	Low-inductance ground required.	
25	PCS LNA OUT	High band LNA output. Small external inductance required for best impedance match to 50Ω .	
26	VCC2	High band LNA VCC connection. Small series inductance required.	
27	GND2	High band LNA emitter. Low-inductance ground required.	
28	GND2	High band LNA emitter Low-inductance ground required.	
29	PCS LNA IN	High band LNA base; simple external matching required for best performance.	
30	BAND SEL	Logic input. See Control States table.	
31	ENABLE	Logic input; high level enables IC. See Control States table.	
32	VCC3	VCC connection for internal LO amplifiers. Internal RF bypass capacitor. External bypass capacitor between 1nF and 47nF required.	

Application Schematic



Evaluation Board Schematic

(Download [Bill of Materials](http://www.rfmd.com) from www.rfmd.com.)

Note:

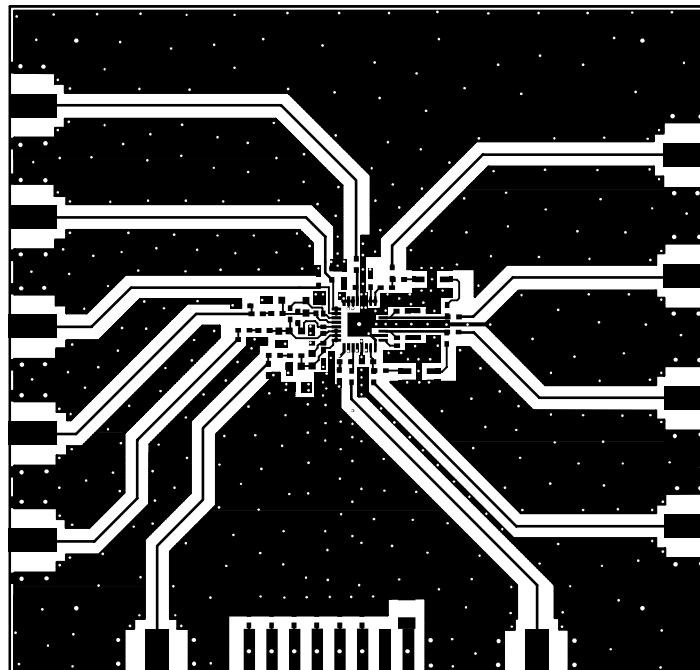
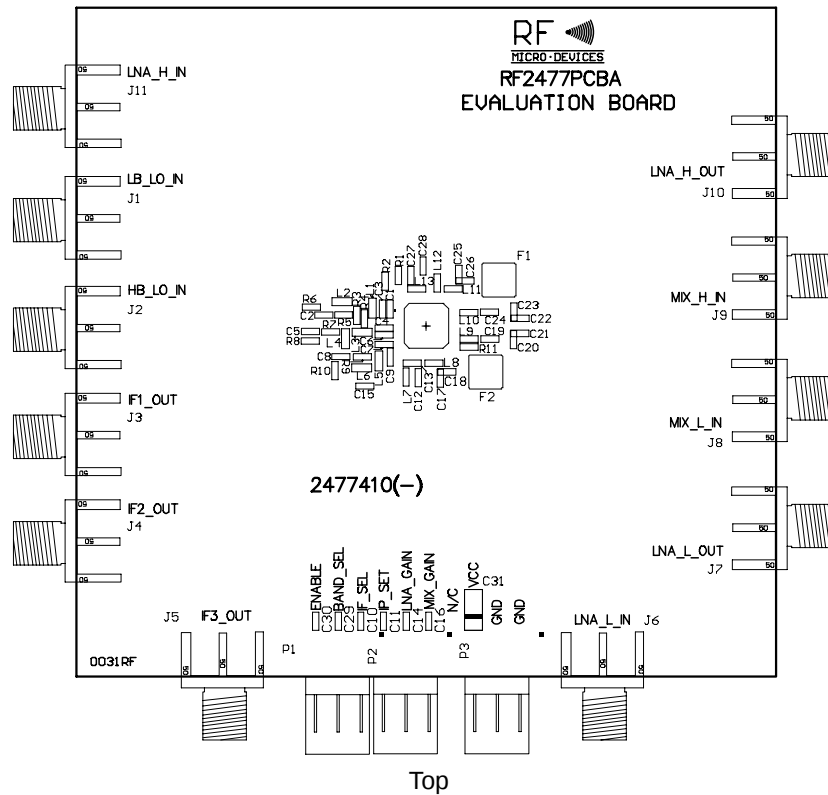
For other IF frequencies and IF configuration	R3	R4	C1 (pF)	C2 (pF)	C3 (pF)	C4 (pF)	C5 (pF)	C6 (pF)	C7 (pF)	C8 (pF)	C9 (pF)
IF tuned to 85MHz; using IF1Out and IF3Out	0	0	18	10	18	3	DNI	4	24	9	24
IF tuned to 85MHz; using IF1Out, IF2Out and IF3Out	DNI	DNI	18	10	18	24	9	24	24	9	24
IF Outputs tuned to 110MHz; using IF1Out and IF3Out	0	0	8	10	7	8	DNI	7	18	9	18
IF1 tuned to 210MHz, IF2 and IF3 tuned to 85MHz; using IF1Out, IF2Out and IF3Out	DNI	DNI	11	4	10	24	9	24	24	9	24
IF tuned to 128MHz; using IF1Out and IF3Out	0	0	7	7	6	6	DNI	4	18	6	16
IF tuned to 238MHz; using IF1Out and IF3Out	0	0	1	5	2	2	DNI	1	5	4	4

For other IF frequencies and IF configuration	L1 (nH)	L2 (nH)	L3 (nH)	L4 (nH)	L5 (nH)	L6 (nH)
IF tuned to 85MHz; using IF1Out and IF3Out	270	220	DNI	DNI	270	270
IF tuned to 85MHz; using IF1Out, IF2Out and IF3Out	270	220	270	270	270	270
IF Outputs tuned to 110MHz; using IF1Out and IF3Out	180	270	DNI	DNI	180	270
IF1 tuned to 210MHz, IF2 and IF3 tuned to 85MHz; using IF1Out, IF2Out and IF3Out	82	150	270	270	270	270
IF tuned to 128MHz; using IF1Out and IF3Out	150	270	DNI	DNI	150	270
IF tuned to 238MHz; using IF1Out and IF3Out	82	100	DNI	DNI	100	150

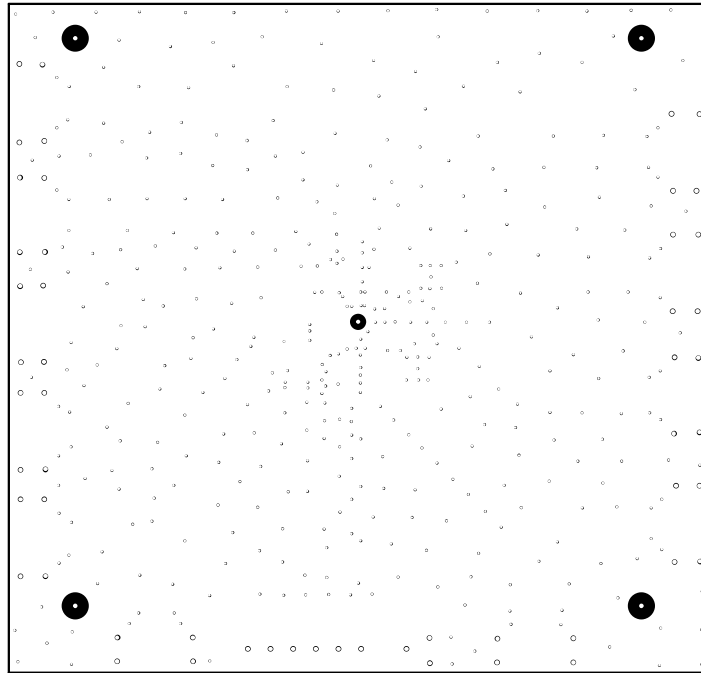
Evaluation Board Layout

Board Size 3.0" x 3.0"

Board Thickness 0.065", Board Material FR-4, Multi-Layer Assembly



Power Plane



Back

