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RF5146

QUAD-BAND GSM850/GSM900/DCS/PCS POWER AMP MODULE

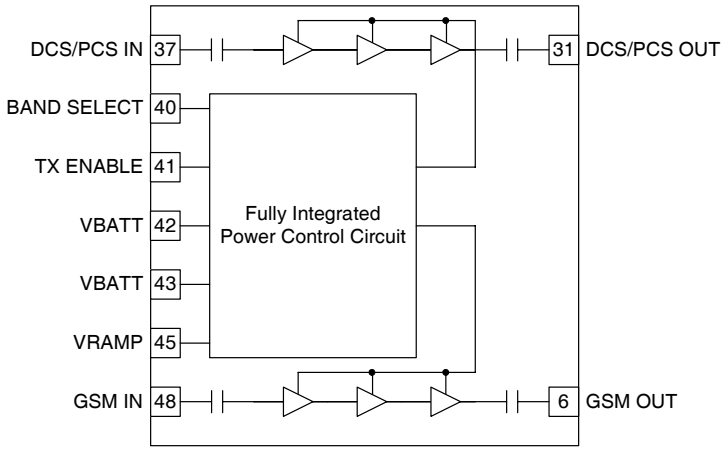
RoHS Compliant & Pb-Free Product
Package Style: LFM, 48-Pin, 7 mm x 7 mm x 0.9 mm

Features

- V_{RAMP} Limiter
- Complete Power Control Solution
- +35dBm GSM Output Power at 3.5V
- +33dBm DCS/PCS Output Power at 3.5V
- 60% GSM and 55% DCS/PCS $_{EFF}$
- 7mmx7mmx0.9mm Package Size

Applications

- 3V Quad-Band GSM Handsets
- Commercial and Consumer Systems
- Portable Battery-Powered Equipment
- GSM850/EGSM900/DCS/PCS Products
- GPRS Class 12 Compatible
- Power Star™ Module



Functional Block Diagram

Product Description

The RF5146 is a high-power, high-efficiency power amplifier module with integrated power control that provides over 50dB of control range. The device is a self-contained 7mmx7mmx0.9mm lead frame module (LFM) with 50Ω input and output terminals. The device is designed for use as the final RF amplifier in GSM850, EGSM900, DCS and PCS handheld digital cellular equipment and other applications in the 824MHz to 849MHz, 880MHz to 915MHz, 1710MHz to 1785MHz and 1850MHz to 1910MHz bands. With the integration of a V_{RAMP} limiting circuit, the RF5146 can regulate the V_{RAMP} voltage to ensure minimum switching transients. The V_{RAMP} limiter function is fully integrated into the CMOS controller and requires no additional inputs from the user.

Ordering Information

RF5146	Quad-Band GSM850/GSM900/DCS/PCS Power Amp Module
RF5146 SB	Power Amp Module 5-Piece Sample Pack
RF5146PCBA-41X	Fully Assembled Evaluation Board

Optimum Technology Matching® Applied

☑ GaAs HBT	☐ SiGe BiCMOS	☐ GaAs pHEMT	☐ GaN HEMT
☐ GaAs MESFET	☐ Si BiCMOS	☑ Si CMOS	
☐ InGaP HBT	☐ SiGe HBT	☐ Si BJT	

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Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	-0.3 to +6.0	V_{DC}
Power Control Voltage (V_{RAMP})	-0.3 to +1.8	V
Input RF Power	+10	dBm
Max Duty Cycle	50	%
Output Load VSWR	10:1	
Operating Case Temperature	-20 to +85	°C
Storage Temperature	-55 to +150	°C

Caution! ESD sensitive device.

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

RoHS status based on EU Directive 2002/95/EC (at time of this document revision).

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Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Overall Power Control V_{RAMP}					
Power Control "ON"			1.6	V	Max. P_{OUT}, Voltage supplied to the input
Power Control "OFF"		0.2	0.25	V	Min. P_{OUT}, Voltage supplied to the input
V_{RAMP} Input Capacitance		15	20	pF	DC to 2MHz
V_{RAMP} Input Current			10	µA	V_{RAMP}=1.6V
Turn On/Off Time			2	µs	V_{RAMP}=0.2V to 1.6V
TX Enable "ON"	1.9			V	
TX Enable "OFF"			0.5	V	
GSM Band Enable			0.5	V	
DCS/PCS Band Enable	1.9			V	
Overall Power Supply					
Power Supply Voltage		3.5		V	Specifications
				V	Nominal operating limits
Power Supply Current		1		µA	P_{IN}<-30dBm, TX Enable=Low, Temp=-20°C to +85°C
				mA	V_{RAMP}=0.2V, TX Enable=High
Overall Control Signals					
Band Select "Low"	0	0	0.5	V	
Band Select "High"	1.9	2.0	3.0	V	
Band Select "High" Current		20	50	µA	
TX Enable "Low"	0	0	0.5	V	
TX Enable "High"	1.9	2.0	3.0	V	
TX Enable "High" Current		1	2	µA	

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Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Overall (GSM850 Mode)					Temp=+25 °C, V_{BATT}=3.5V, V_{RAMP}=1.6V, P_{IN}=3dBm, Freq=824MHz to 849MHz, 25% Duty Cycle, Pulse Width=1154µs
Operating Frequency Range		824 to 849		MHz	
Maximum Output Power	+34.2			dBm	Temp = 25 °C, V_{BATT}=3.5V, V_{RAMP}=1.6V
	+32.0			dBm	Temp=+85 °C, V_{BATT}=3.0V, V_{RAMP}=1.6V
Total Efficiency		55		%	At $P_{OUT\ MAX}$, V_{BATT}=3.5V
Input Power Range	0	+3	+5	dBm	Maximum output power guaranteed at minimum drive level
Output Noise Power		-88		dBm	RBW=100kHz, 869MHz to 894MHz, $P_{OUT} \geq$ +5dBm
Forward Isolation 1		-50		dBm	TXEnable=Low, P_{IN}=+5dBm
Forward Isolation 2		-35		dBm	TXEnable=High, P_{IN}=+5dBm, V_{RAMP}=0.2V
Cross Band Isolation at $2f_0$				dBm	V_{RAMP}=0.2V to $V_{RAMP\_R_P}$
Second Harmonic		-15		dBm	V_{RAMP}=0.2V to $V_{RAMP\_R_P}$
Third Harmonic		-25		dBm	V_{RAMP}=0.2V to $V_{RAMP\_R_P}$
All Other Non-Harmonic Spurious			-36	dBm	V_{RAMP}=0.2V to 1.6V
Input Impedance		50		Ω	
Input VSWR			2.5:1		V_{RAMP}=0.2V to 1.6V
Output Load VSWR Stability	8:1				Spurious<-36dBm, RBW=3MHz Set V_{RAMP} where $P_{OUT} \leq$34.2dBm into 50Ω load
Output Load VSWR Ruggedness	10:1				Set V_{RAMP} where $P_{OUT} \leq$34.2dBm into 50Ω load. No damage or permanent degradation to part.
Output Load Impedance		50		Ω	Load impedance presented at RF OUT pad
Power Control V_{RAMP}					
Power Control Range		55		dB	V_{RAMP}=0.2V to 1.6V

Notes:

$V_{RAMP\_R_P}$=V_{RAMP} set for 34.2dBm at nominal conditions.

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Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Overall (GSM900 Mode)					Temp=+25 °C, V_{BATT}=3.5V, V_{RAMP}=1.6V, P_{IN}=3dBm, Freq=880MHz to 915MHz, 25% Duty Cycle, Pulse Width=1154µs
Operating Frequency Range		880 to 915		MHz	
Maximum Output Power	+34.2			dBm	Temp = 25 °C, V_{BATT}=3.5V, V_{RAMP}=1.6V
	+32.0			dBm	Temp=+85 °C, V_{BATT}=3.0V, V_{RAMP} =1.6V
Total Efficiency		58		%	At $P_{OUT\ MAX}$, V_{BATT}=3.5V
Input Power Range	0	+3	+5	dBm	Maximum output power guaranteed at minimum drive level
Output Noise Power		-86		dBm	RBW=100kHz, 925MHz to 935MHz, $P_{OUT} \geq$ +5dBm
		-88		dBm	RBW=100kHz, 935MHz to 960MHz, $P_{OUT} \geq$ +5dBm
Forward Isolation 1		-45		dBm	TXEnable=Low, P_{IN}=+5dBm
Forward Isolation 2		-30		dBm	TXEnable=High, V_{RAMP}=0.2V, P_{IN}=+5dBm
Cross Band Isolation $2f_0$				dBm	V_{RAMP}=0.2V to V_{RAMP_RP}
Second Harmonic		-15		dBm	V_{RAMP}=0.2V to V_{RAMP_RP}
Third Harmonic		-25		dBm	V_{RAMP}=0.2V to V_{RAMP_RP}
All Other Non-Harmonic Spurious			-36	dBm	V_{RAMP}=0.2V to 1.6V
Input Impedance		50		Ω	
Input VSWR			2.5:1		V_{RAMP}=0.2V to 1.6V
Output Load VSWR Stability	8:1				Spurious<-36dBm, RBW=3MHz Set V_{RAMP} where $P_{OUT} \leq$34.2dBm into 50Ω load
Output Load VSWR Ruggedness	10:1				Set V_{RAMP} where $P_{OUT} \leq$34.2dBm into 50Ω load. No damage or permanent degradation to part.
Output Load Impedance		50		Ω	Load impedance presented at RF OUT pad
Power Control V_{RAMP}					
Power Control Range		50		dB	V_{RAMP}=0.2V to 1.6V

Notes:

V_{RAMP_RP}=V_{RAMP} set for 34.2dBm at nominal conditions.

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Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Overall (DCS Mode)					Temp=25°C, V_{BATT}=3.5V, V_{RAMP}=1.6V, P_{IN}=3dBm, Freq=1710MHz to 1785MHz, 25% Duty Cycle, pulse width=1154µs
Operating Frequency Range		1710 to 1785		MHz	
Maximum Output Power	+32.0			dBm	Temp=25°C, V_{BATT}=3.5V, V_{RAMP}=1.6V
	+30.0			dBm	Temp=+85°C, V_{BATT}=3.0V, V_{RAMP}=1.6V
Total Efficiency		50		%	At $P_{OUT\ MAX}$, V_{BATT}=3.5V
Input Power Range	0	+3	+5	dBm	Maximum output power guaranteed at minimum drive level
Output Noise Power		-85		dBm	RBW=100kHz, 1805MHz to 1880MHz, P_{OUT} ≥ 0dBm, V_{BATT}=3.5V
Forward Isolation 1		-50		dBm	TXEnable=Low, P_{IN}=+5dBm
Forward Isolation 2		-25		dBm	TXEnable=High, V_{RAMP}=0.2V, P_{IN}=+5dBm
Second Harmonic		-15		dBm	V_{RAMP}=0.2V to $V_{RAMP\_R_P}$
Third Harmonic		-20		dBm	V_{RAMP}=0.2V to $V_{RAMP\_R_P}$
All Other Non-Harmonic Spurious			-36	dBm	V_{RAMP}=0.2V to 1.6V
Input Impedance		50		Ω	
Input VSWR			2.5:1		V_{RAMP}=0.2V to 1.6V
Output Load VSWR Stability	8:1				Spurious<-36dBm, RBW=3MHz Set V_{RAMP} where P_{OUT}≤32dBm into 50Ω load
Output Load VSWR Ruggedness	10:1				Set V_{RAMP} where P_{OUT}≤32dBm into 50Ω load. No damage or permanent degradation to part.
Output Load Impedance		50		Ω	Load impedance presented at RF OUT pin
Power Control V_{RAMP}					
Power Control Range		50		dB	V_{RAMP}=0.2V to 1.6V, P_{IN}=+5dBm

Notes:

$V_{RAMP\_R_P}$=V_{RAMP} set for 32dBm at nominal conditions.

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Overall (PCS Mode)					Temp=25°C, V_{BATT}=3.5V, V_{RAMP}=1.6V, P_{IN}=3dBm, Freq=1850MHz to 1910MHz, 25% Duty Cycle, pulse width=1154µs
Operating Frequency Range		1850 to 1910		MHz	
Maximum Output Power	+32.0			dBm	Temp=25°C, V_{BATT}=3.5V, V_{RAMP}=1.6V, 1850MHz to 1910MHz
	+30.0			dBm	Temp=+85°C, V_{BATT}=3.0V, V_{RAMP}=1.6V
Total Efficiency		52		%	At $P_{OUT\ MAX}$, V_{BATT}=3.5V
Input Power Range	0	+3	+5	dBm	Full output power guaranteed at minimum drive level
Output Noise Power		-85		dBm	RBW=100kHz, 1930MHz to 1990MHz, $P_{OUT} \geq$ 0dBm, V_{BATT}=3.5V
Forward Isolation 1		-40		dBm	TX_ENABLE=Low, P_{IN}=+5dBm
Forward Isolation 2		-20		dBm	TXEnable=High, V_{RAMP}=0.2V, P_{IN}=+5dBm
Second Harmonic		-15		dBm	V_{RAMP}=0.2V to V_{RAMP_RP}
Third Harmonic		-20		dBm	V_{RAMP}=0.2V to V_{RAMP_RP}
All Other Non-Harmonic Spurious			-36	dBm	V_{RAMP}=0.2V to 1.6V
Input Impedance		50		Ω	
Input VSWR			2.5:1		V_{RAMP}=0.2V to 1.6V
Output Load VSWR Stability	8:1				Spurious<-36dBm, RBW=3MHz Set V_{RAMP} where $P_{OUT} \leq$ 32dBm into 50Ω load
Output Load VSWR Ruggedness	10:1				Set V_{RAMP} where $P_{OUT} \leq$ 32dBm into 50Ω load. No damage or permanent degradation to part.
Output Load Impedance		50		Ω	Load impedance presented at RF OUT pin
Power Control V_{RAMP}					
Power Control Range		50		dB	V_{RAMP}=0.2V to 1.6V, P_{IN}=+5dBm

Notes:

V_{RAMP_RP}=V_{RAMP} set for 32dBm at nominal conditions.

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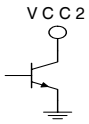
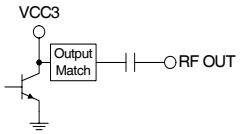
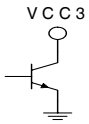
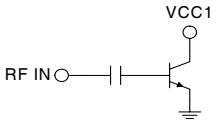
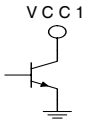
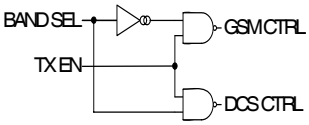
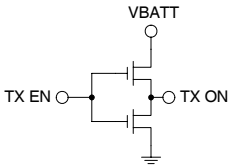
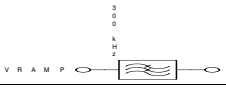
Pin	Function	Description	Interface Schematic
1	NC	Internal circuit node. Do not externally connect.	
2	VCC2 GSM	Controlled voltage input to the GSM driver stage. This voltage is part of the power control function for the module. This node must be connected to VCC OUT. This pin should be externally decoupled.	
3	NC	Internal circuit node. Do not externally connect.	
4	GND	Internally connected to the package base.	
5	GND	Internally connected to the package base.	
6	GSM850/ GSM900 OUT	RF output for the GSM bands. This is a 50Ω output. The output matching circuit and DC-block are internal to the package.	
7	GND	Internally connected to the package base.	
8	NC	Internal circuit node. Do not externally connect.	
9	NC	Internal circuit node. Do not externally connect.	
10	NC	Internal circuit node. Do not externally connect.	
11	NC	Internal circuit node. Do not externally connect.	
12	NC	Internal circuit node. Do not externally connect.	
13	NC	No internal or external connection.	
14	NC	Internal circuit node. Do not externally connect.	
15	NC	Internal circuit node. Do not externally connect.	
16	NC	Internal circuit node. Do not externally connect.	
17	NC	Internal circuit node. Do not externally connect.	
18	VCC3 GSM	Controlled voltage input to the GSM output stage. This voltage is part of the power control function for the module. This node must be connected to VCC OUT. This pin should be externally decoupled.	
19	VCC OUT	Controlled voltage output to feed VCC2 and VCC3. This voltage is part of the power control function for the module. It cannot be connected to any pins other than VCC2 and VCC3.	
20	VCC OUT	Controlled voltage output to feed VCC2 and VCC3. This voltage is part of the power control function for the module. It cannot be connected to any pins other than VCC2 and VCC3.	
21	VCC3 DCS/PCS	Controlled voltage input to the DCS/PCS output stage. This voltage is part of the power control function for the module. This node must be connected to VCC OUT. This pin should be externally decoupled.	See pin 18.
22	NC	Internal circuit node. Do not externally connect.	
23	NC	Internal circuit node. Do not externally connect.	
24	NC	No internal or external connection.	
25	NC	Internal circuit node. Do not externally connect.	
26	NC	Internal circuit node. Do not externally connect.	
27	NC	Internal circuit node. Do not externally connect.	
28	NC	Internal circuit node. Do not externally connect.	
29	NC	Internal circuit node. Do not externally connect.	
30	GND	Internally connected to the package base.	

Pin	Function	Description	Interface Schematic
31	DCS/PCS OUT	RF output for the DCS/PCS bands. This is a 50Ω output. The output matching circuit and DC-block are internal to the package.	See pin 6.
32	GND	Internally connected to the package base.	
33	NC	Internal circuit node. Do not externally connect.	
34	GND	Internally connected to the package base.	
35	VCC2 DCS/PCS	Controlled voltage input to the DCS/PCS driver stage. This voltage is part of the power control function for the module. This node must be connected to VCC OUT. This pin should be externally decoupled.	See pin 2.
36	GND	Internally connected to the package base.	
37	DCS/PCS IN	RF input to the DCS/PCS band. This is a 50Ω output.	
38	GND	Internally connected to the package base.	
39	VCC1 DCS/PCS	Controlled voltage on the GSM and DCS/PCS preamplifier stages. This voltage is applied internal to the package. This pin should be externally decoupled.	
40	BAND SEL	Allows external control to select the GSM or DCS/PCS bands with a logic high or low. A logic low enables the GSM bands, whereas a logic high enables the DCS/PCS bands.	
41	TX ENABLE	This signal enables the PA module for operation with a logic high. Both bands are disabled with a logic low.	
42	VBATT	Power supply for the module. This pin should be externally decoupled and connected to the battery.	
43	VBATT	Power supply for the module. This pin should be externally decoupled and connected to the battery.	
44	NC	Internal circuit node. Do not externally connect.	
45	VRAMP	Ramping signal from DAC. A 300kHz lowpass filter is integrated into the CMOS. No external filtering is required. A VRAMP limiter function is also integrated into the CMOS.	
46	VCC1 GSM	Internally connected to VCC1 (pin 39). No external connection required.	See pin 39.
47	GND1 GSM	Ground connection for the GSM preamplifier stage. Connect to ground plane close to the package pin.	
48	GSM850/ GSM900 IN	RF input to the GSM band. This is a 50Ω input.	See pin 37.
Pkg Base	GND	Connect to ground plane with multiple via holes. See recommended footprint.	

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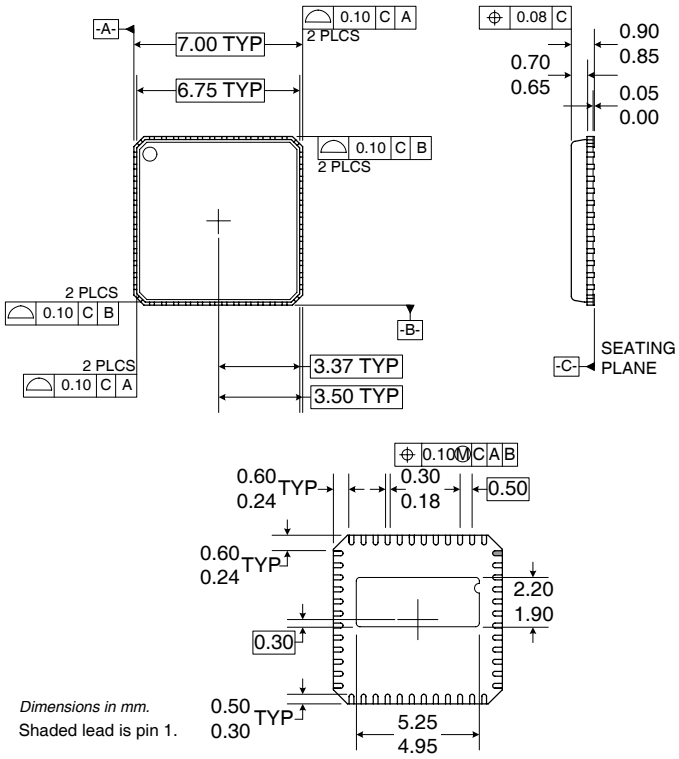
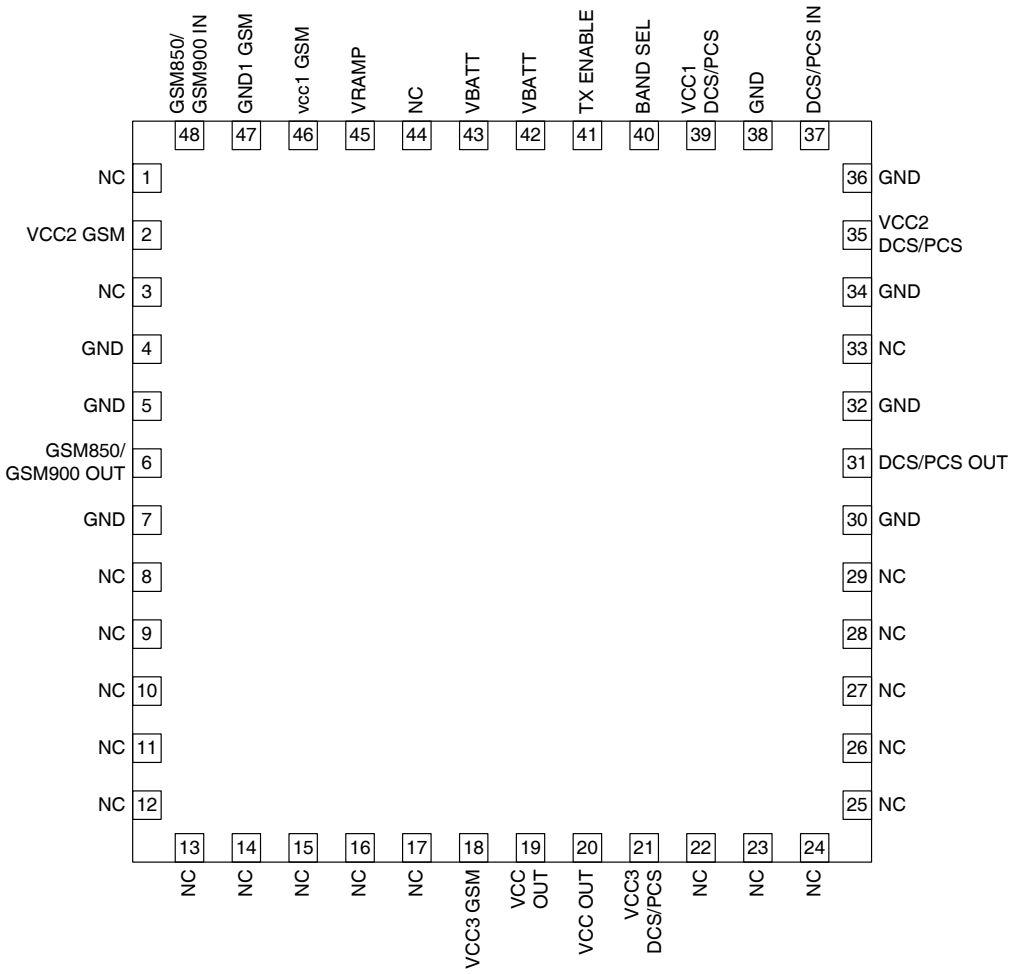
Package Drawing



Pin Out



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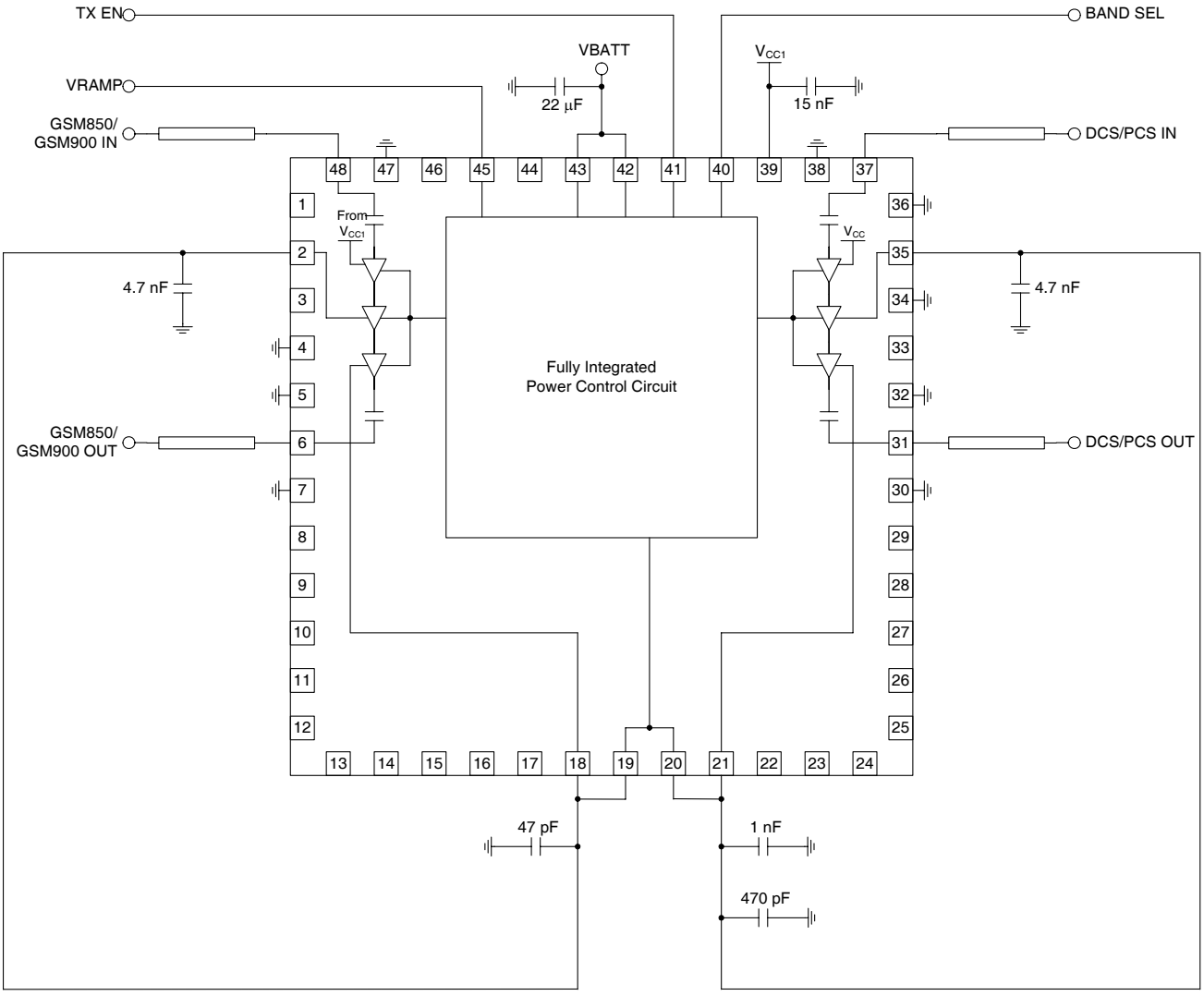
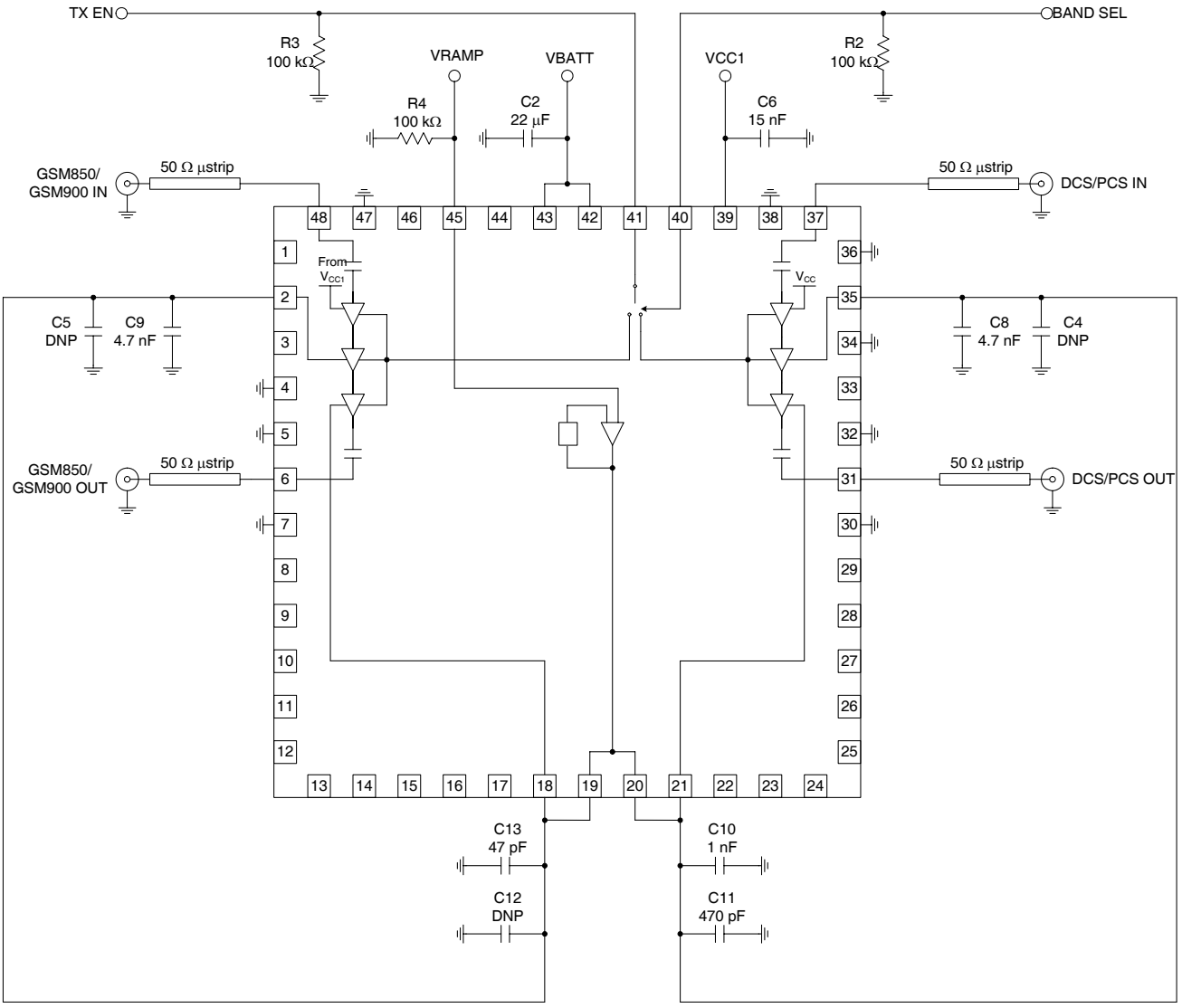
Application Schematic



Evaluation Board Schematic



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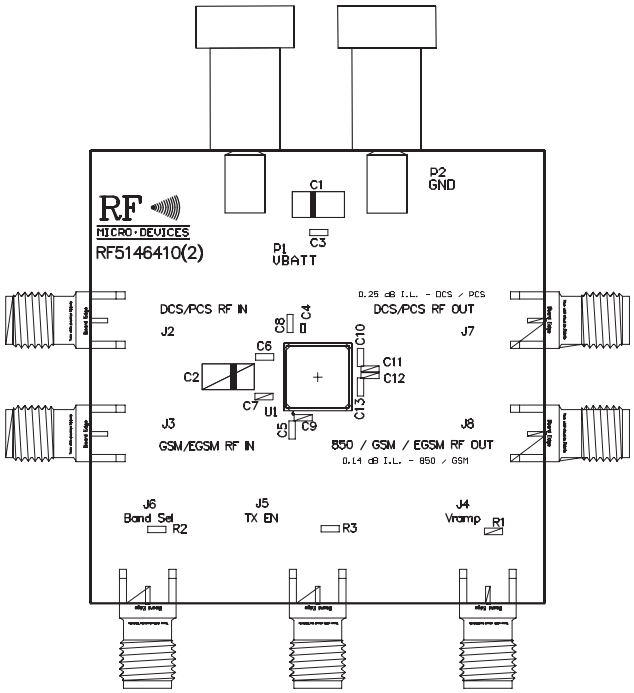
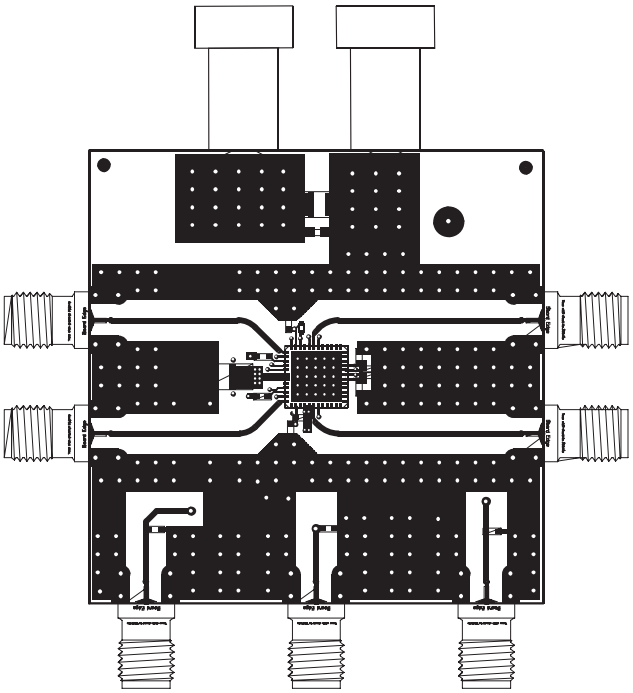
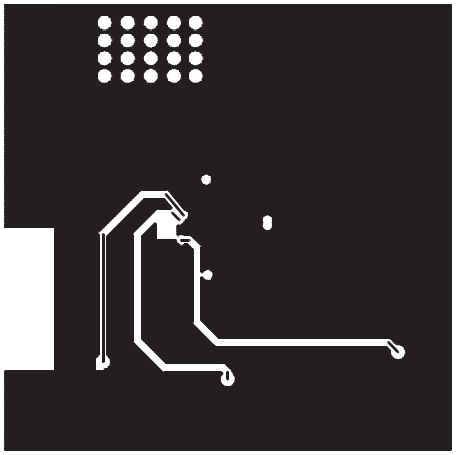
Evaluation Board Layout

Board Size 2.0" x 2.0"

Board Thickness 0.032", Board Material FR-4, Multi-Layer







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