

Part of the **POLARIS™ TOTAL RADIO™** Solution  
RoHS Compliant & Pb-Free Product  
Package Style: LFM, 48-Pin, 7 mm x 7 mm x 0.9 mm

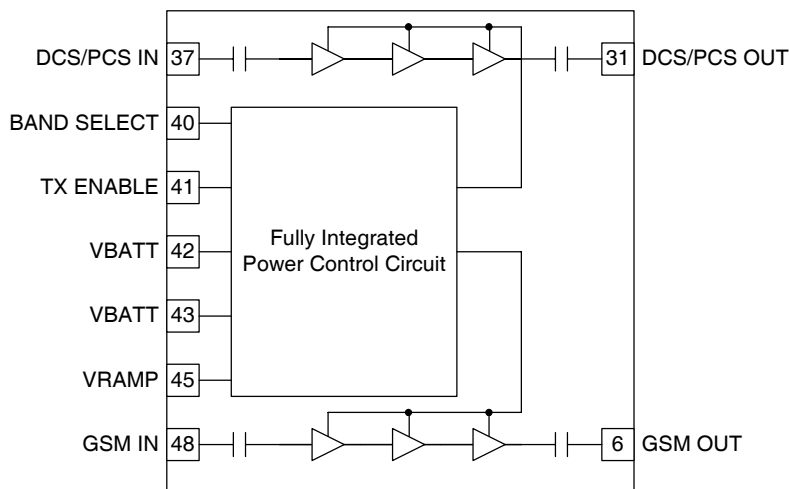


### Features

- Integrated  $V_{REG}$
- 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  $EFF$
- 7 mm x 7 mm x 0.9 mm 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 RF3146 is a high-power, high-efficiency power amplifier module with integrated power control. The device is a self-contained 7 mm x 7 mm x 0.9 mm lead frame module (LFM) with 50Ω input and output terminals. The power control function is also incorporated, eliminating the need for directional couplers, detector diodes, power control ASICs and other power control circuitry; this allows the module to be driven directly from the DAC output. 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. On-board power control provides over 50dB of control range with an analog voltage input; and, power down with a logic “low” for standby operation.

The RF3146 is part of the POLARIS™ TOTAL RADIO™ solution.

### Ordering Information

RF3146	Quad-Band GSM850/GSM900/DCS/PCS Power Amp Module
RF3146 SB	Power Amp Module 5-Piece Sample Pack
RF3146PCBA-41X	Fully Assembled Evaluation Board

### Optimum Technology Matching® Applied

- |  |                                      |   |                                   |
|--|--------------------------------------|---|-----------------------------------|
| <input checked="" type="checkbox"/> GaAs HBT | <input type="checkbox"/> SiGe BiCMOS | <input type="checkbox"/> GaAs pHEMT         | <input type="checkbox"/> GaN HEMT |
| <input type="checkbox"/> GaAs MESFET         | <input type="checkbox"/> Si BiCMOS   | <input checked="" type="checkbox"/> Si CMOS |                                   |
| <input type="checkbox"/> InGaP HBT           | <input type="checkbox"/> SiGe HBT    | <input type="checkbox"/> Si BJT             |                                   |

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### Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	-0.3 to +6.0	V <sub>DC</sub>
Power Control Voltage (V <sub>RAMP</sub> )	-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.

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

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
<b>Overall Power Control</b>					
V <sub>RAMP</sub>					
Power Control "ON"			1.5	V	Max. P <sub>OUT</sub> , Voltage supplied to the input
Power Control "OFF"		0.2	0.25	V	Min. P <sub>OUT</sub> , Voltage supplied to the input
V <sub>RAMP</sub> Input Capacitance		15	20	pF	DC to 2MHz
V <sub>RAMP</sub> Input Current			10	μA	V <sub>RAMP</sub> = V <sub>RAMP MAX</sub>
Turn On/Off Time			2	μs	V <sub>RAMP</sub> = 0.2V to V <sub>RAMP MAX</sub>
TX Enable "ON"	1.4			V	
TX Enable "OFF"			0.5	V	
GSM Band Enable			0.5	V	
DCS/PCS Band Enable	1.4			V	
<b>Overall Power Supply</b>					
Power Supply Voltage	3.0	3.5	5.5	V	Specifications
				V	Nominal operating limits
Power Supply Current		1		μA	P <sub>IN</sub> < -30dBm, TX Enable = Low, Temp = -20 °C to +85 °C
				mA	V <sub>RAMP</sub> = 0.2V, TX Enable = High
<b>Overall Control Signals</b>					
Band Select "Low"	0	0	0.5	V	
Band Select "High"	1.4	2.0	3.0	V	
Band Select "High" Current		20	50	μA	
TX Enable "Low"	0	0	0.5	V	
TX Enable "High"	1.4	2.0	3.0	V	
TX Enable "High" Current		1	2	μA	

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
<b>Overall (GSM850 Mode)</b>					Temp = +25 °C, V <sub>BATT</sub> = 3.5V, V <sub>RAMP</sub> = V <sub>RAMP MAX</sub> , P <sub>IN</sub> = 3dBm, Freq = 824 MHz to 849 MHz, 25% Duty Cycle, Pulse Width = 1154 μs
Operating Frequency Range		824 to 849		MHz	
Maximum Output Power	+34.2			dBm	Temp = 25 °C, V <sub>BATT</sub> = 3.5V, V <sub>RAMP</sub> = V <sub>RAMP MAX</sub>
	+32.0			dBm	Temp = +85 °C, V <sub>BATT</sub> = 3.0V, V <sub>RAMP</sub> = V <sub>RAMP MAX</sub>
Total Efficiency	47	55		%	At P <sub>OUT MAX</sub> , V <sub>BATT</sub> = 3.5V
Input Power Range	0	+3	+5	dBm	Maximum output power guaranteed at minimum drive level
Output Noise Power		-88	-81	dBm	RBW = 100kHz, 869 MHz to 894 MHz, P <sub>OUT</sub> ≥ +5 dBm
Forward Isolation 1		-50	-35	dBm	TXEnable = Low, P <sub>IN</sub> = +5 dBm
Forward Isolation 2		-35	-15	dBm	TXEnable = High, P <sub>IN</sub> = +5 dBm, V <sub>RAMP</sub> = 0.2V
Cross Band Isolation at 2f <sub>0</sub>			-18	dBm	V <sub>RAMP</sub> = 0.2V to V <sub>RAMP-RP</sub>
Second Harmonic		-15	-7	dBm	V <sub>RAMP</sub> = 0.2V to V <sub>RAMP-RP</sub>
Third Harmonic		-25	-15	dBm	V <sub>RAMP</sub> = 0.2V to V <sub>RAMP-RP</sub>
All Other Non-Harmonic Spurious			-36	dBm	V <sub>RAMP</sub> = 0.2V to V <sub>RAMP MAX</sub>
Input Impedance		50		Ω	
Input VSWR			2.5:1		V <sub>RAMP</sub> = 0.2V to V <sub>RAMP MAX</sub>
Output Load VSWR Stability	8:1				Spurious < -36 dBm, RBW = 3 MHz Set V <sub>RAMP</sub> where P <sub>OUT</sub> ≤ 34.2 dBm into 50 Ω load
Output Load VSWR Ruggedness	10:1				Set V <sub>RAMP</sub> where P <sub>OUT</sub> ≤ 34.2 dBm into 50 Ω load. No damage or permanent degradation to part.
Output Load Impedance		50		Ω	Load impedance presented at RF OUT pad
<b>Power Control V<sub>RAMP</sub></b>					
Power Control Range		55		dB	V <sub>RAMP</sub> = 0.2V to V <sub>RAMP MAX</sub>

Notes:

$$V_{RAMP\ MAX} = 0.4 * V_{BATT} + 0.06 \leq 1.5V$$

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

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
<b>Overall (GSM900 Mode)</b>					Temp = +25 °C, V <sub>BATT</sub> = 3.5V, V <sub>RAMP</sub> = V <sub>RAMP MAX</sub> , P <sub>IN</sub> = 3dBm, Freq = 880MHz to 915 MHz, 25% Duty Cycle, Pulse Width = 1154 μs
Operating Frequency Range		880 to 915		MHz	
Maximum Output Power	+34.2			dBm	Temp = 25 °C, V <sub>BATT</sub> = 3.5V, V <sub>RAMP</sub> = V <sub>RAMP MAX</sub>
	+32.0			dBm	Temp = +85 °C, V <sub>BATT</sub> = 3.0V, V <sub>RAMP</sub> = V <sub>RAMP MAX</sub>
Total Efficiency	54	58		%	At P <sub>OUT MAX</sub> , V <sub>BATT</sub> = 3.5V
Input Power Range	0	+3	+5	dBm	Maximum output power guaranteed at minimum drive level
Output Noise Power		-86	-80	dBm	RBW = 100kHz, 925 MHz to 935 MHz, P <sub>OUT</sub> ≥ +5 dBm
		-88	-84	dBm	RBW = 100kHz, 935 MHz to 960 MHz, P <sub>OUT</sub> ≥ +5 dBm
Forward Isolation 1		-45	-35	dBm	TX Enable = Low, P <sub>IN</sub> = +5 dBm
Forward Isolation 2		-30	-15	dBm	TX Enable = High, V <sub>RAMP</sub> = 0.2V, P <sub>IN</sub> = +5 dBm
Cross Band Isolation 2f <sub>0</sub>			-17	dBm	V <sub>RAMP</sub> = 0.2V to V <sub>RAMP_RP</sub>
Second Harmonic		-15	-10	dBm	V <sub>RAMP</sub> = 0.2V to V <sub>RAMP_RP</sub>
Third Harmonic		-25	-15	dBm	V <sub>RAMP</sub> = 0.2V to V <sub>RAMP_RP</sub>
All Other Non-Harmonic Spurious			-36	dBm	V <sub>RAMP</sub> = 0.2V to V <sub>RAMP MAX</sub>
Input Impedance		50		Ω	
Input VSWR			2.5:1		V <sub>RAMP</sub> = 0.2V to V <sub>RAMP MAX</sub>
Output Load VSWR Stability	8:1				Spurious < -36 dBm, RBW = 3 MHz Set V <sub>RAMP</sub> where P <sub>OUT</sub> ≤ 34.2 dBm into 50Ω load
Output Load VSWR Ruggedness	10:1				Set V <sub>RAMP</sub> where P <sub>OUT</sub> ≤ 34.2 dBm into 50Ω load. No damage or permanent degradation to part.
Output Load Impedance		50		Ω	Load impedance presented at RF OUT pad
<b>Power Control V<sub>RAMP</sub></b>					
Power Control Range		50		dB	V <sub>RAMP</sub> = 0.2V to V <sub>RAMP MAX</sub>

Notes:

$$V_{RAMP\ MAX} = 0.4 * V_{BATT} + 0.06 \leq 1.5V$$

V<sub>RAMP\_RP</sub> = V<sub>RAMP</sub> set for 34.2 dBm at nominal conditions.

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
<b>Overall (DCS Mode)</b>					Temp=25°C, V <sub>BATT</sub> =3.5V, V <sub>RAMP</sub> =V <sub>RAMP MAX</sub> , P <sub>IN</sub> =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 <sub>BATT</sub> =3.5V, V <sub>RAMP</sub> =V <sub>RAMP MAX</sub>
	30			dBm	Temp=+85°C, V <sub>BATT</sub> =3.0V, V <sub>RAMP</sub> =V <sub>RAMP MAX</sub>
Total Efficiency	45	52		%	At P <sub>OUT MAX</sub> , V <sub>BATT</sub> =3.5V
Input Power Range	0	+3	+5	dBm	Maximum output power guaranteed at minimum drive level
Output Noise Power		-85	-80	dBm	RBW=100kHz, 1805MHz to 1880MHz, P <sub>OUT</sub> ≥ 0dBm, V <sub>BATT</sub> =3.5V
Forward Isolation 1		-50	-35	dBm	TXEnable=Low, P <sub>IN</sub> =+5dBm
Forward Isolation 2		-25	-15	dBm	TXEnable=High, V <sub>RAMP</sub> =0.2V, P <sub>IN</sub> =+5dBm
Second Harmonic		-15	-7	dBm	V <sub>RAMP</sub> =0.2V to V <sub>RAMP-RP</sub>
Third Harmonic		-20	-15	dBm	V <sub>RAMP</sub> =0.2V to V <sub>RAMP-RP</sub>
All Other Non-Harmonic Spurious			-36	dBm	V <sub>RAMP</sub> =0.2V to V <sub>RAMP MAX</sub>
Input Impedance		50		Ω	
Input VSWR			2.5:1		V <sub>RAMP</sub> =0.2V to V <sub>RAMP MAX</sub>
Output Load VSWR Stability	8:1				Spurious<-36dBm, RBW=3MHz Set V <sub>RAMP</sub> where P <sub>OUT</sub> ≤32.0dBm into 50Ω load
Output Load VSWR Ruggedness	10:1				Set V <sub>RAMP</sub> where P <sub>OUT</sub> ≤32.0dBm into 50Ω load. No damage or permanent degradation to part.
Output Load Impedance		50		Ω	Load impedance presented at RF OUT pin
<b>Power Control V<sub>RAMP</sub></b>					
Power Control Range		50		dB	V <sub>RAMP</sub> =0.2V to V <sub>RAMP MAX</sub> , P <sub>IN</sub> =+5dBm

Notes:

$$V_{RAMP\ MAX} = 0.4 * V_{BATT} + 0.06 \leq 1.5V$$

$$V_{RAMP\_RP} = V_{RAMP} \text{ set for } 32.0\text{dBm at nominal conditions.}$$

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Overall (PCS Mode)					Temp = 25 °C, V <sub>BATT</sub> = 3.5V, V <sub>RAMP</sub> = V <sub>RAMP MAX</sub> , P <sub>IN</sub> = 3 dBm, Freq = 1850 MHz to 1910 MHz, 25% Duty Cycle, pulse width = 1154 μs
Operating Frequency Range		1850 to 1910		MHz	
Maximum Output Power	+32.0			dBm	Temp = 25 °C, V <sub>BATT</sub> = 3.5V, V <sub>RAMP</sub> = V <sub>RAMP MAX</sub> , 1850 MHz to 1910 MHz
	30			dBm	Temp = +85 °C, V <sub>BATT</sub> = 3.0V, V <sub>RAMP</sub> = V <sub>RAMP MAX</sub>
Total Efficiency	48	55		%	At P <sub>OUT MAX</sub> , V <sub>BATT</sub> = 3.5V
Input Power Range	0	+3	+5	dBm	Full output power guaranteed at minimum drive level
Output Noise Power		-85	-80	dBm	RBW = 100 kHz, 1930 MHz to 1990 MHz, P <sub>OUT</sub> ≥ 0 dBm, V <sub>BATT</sub> = 3.5V
Forward Isolation 1		-40	-33	dBm	TX_ENABLE = Low, P <sub>IN</sub> = +5 dBm
Forward Isolation 2		-20	-15	dBm	TXEnable = High, V <sub>RAMP</sub> = 0.2V, P <sub>IN</sub> = +5 dBm
Second Harmonic		-15	-7	dBm	V <sub>RAMP</sub> = 0.2V to V <sub>RAMP-RP</sub>
Third Harmonic		-20	-15	dBm	V <sub>RAMP</sub> = 0.2V to V <sub>RAMP-RP</sub>
All Other Non-Harmonic Spurious			-36	dBm	V <sub>RAMP</sub> = 0.2V to V <sub>RAMP MAX</sub>
Input Impedance		50		Ω	
Input VSWR			2.5:1		V <sub>RAMP</sub> = 0.2V to V <sub>RAMP MAX</sub>
Output Load VSWR Stability	8:1				Spurious < -36 dBm, RBW = 3 MHz Set V <sub>RAMP</sub> where P <sub>OUT</sub> ≤ 32.0 dBm into 50 Ω load
Output Load VSWR Ruggedness	10:1				Set V <sub>RAMP</sub> where P <sub>OUT</sub> ≤ 32.0 dBm into 50 Ω load. No damage or permanent degradation to part.
Output Load Impedance		50		Ω	Load impedance presented at RF OUT pin
<b>Power Control V<sub>RAMP</sub></b>					
Power Control Range		50		dB	V <sub>RAMP</sub> = 0.2V to V <sub>RAMP MAX</sub> , P <sub>IN</sub> = +5 dBm

Notes:

$$V_{RAMP MAX} = 0.4 * V_{BATT} + 0.06 \leq 1.5V$$

V<sub>RAMP-RP</sub> = V<sub>RAMP</sub> set for 32.0 dBm at nominal conditions.