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RF3863

WIDE BANDWIDTH, HIGH LINEARITY LOW NOISE AMPLIFIER

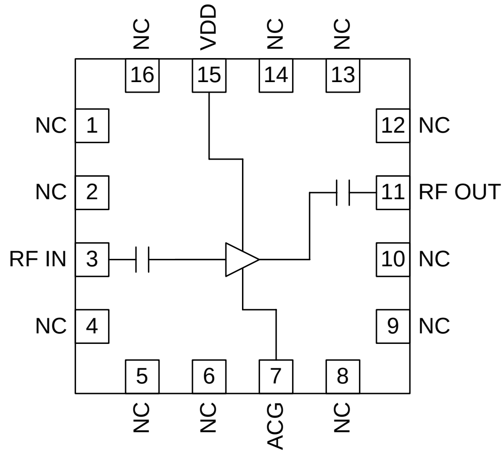
Package Style: QFN, 16-Pin, 3mmx3mm

Features

- Low Noise and High Intercept Point
- Adjustable Bias Current for Enhanced IP3
- Single 2.5V to 6.0V Power Supply
- 700MHz to 3800MHz Operation
- QFN16 3mmx3mm Package

Applications

- First Stage CDMA, PCS, GSM/EDGE, UMTS LNA/Linear Driver
- First Stage WLAN LNA/Linear Driver
- First Stage WiMAX LNA/Linear Driver
- General Purpose Amplification



Functional Block Diagram

Product Description

The RF3863 is a low noise amplifier with a high output IP3. The amplifier is self-biased from a single voltage supply with 50Ω input and output ports. The useful frequency range is from 700MHz to 3800MHz. A 0.8dB noise figure and 36dBm OIP3 performance is achieved with a 5V V_{DD}, 90mA. Current can be increased to raise OIP3 while having minimal effect on noise figure. The IC is featured in a standard QFN, 16-pin, 3mmx3mm package.

Ordering Information

RF3863	Wide Bandwidth, High Linearity Low Noise Amplifier
RF3863PCK-410	Fully Assembled Evaluation Board with 5 Sample Parts 1.5GHz to 2.7GHz

Optimum Technology Matching® Applied

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

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Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	6	V
Input RF Level	+10	dBm
Current Drain, I_{DD}	150	mA
Operating Ambient Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C

Note 1: Max continuous RF IN is +10dBm. The max transient RF IN is +20dBm.

Caution! ESD sensitive device.

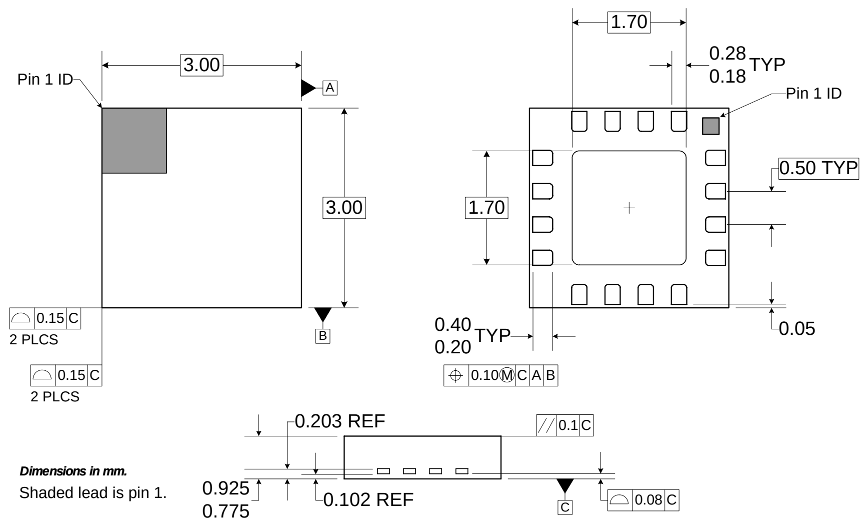
Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute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

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

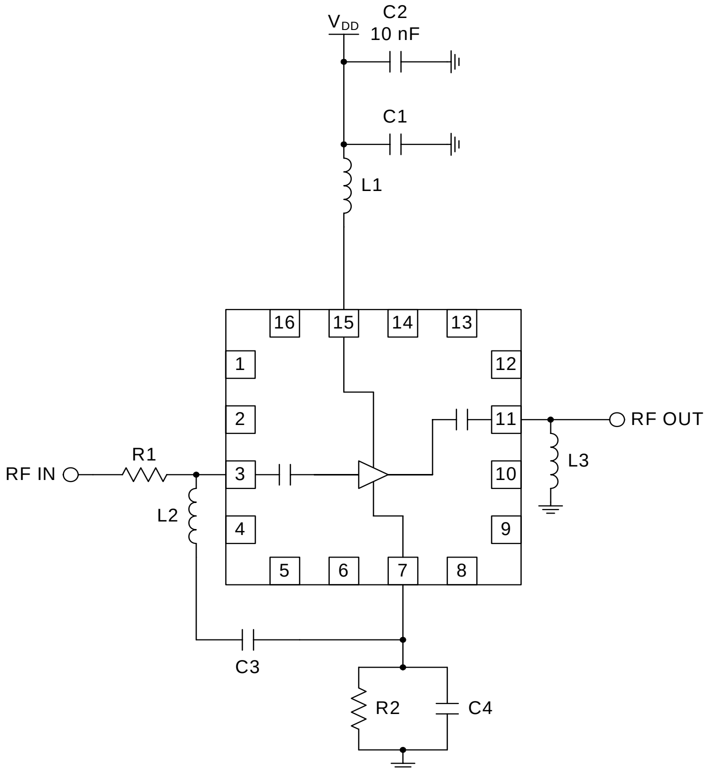
Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
High Band					
Frequency	3.3		3.8	GHz	V_{DD}=5V
Current		90	110	mA	
Gain		10		dB	
Noise Figure		0.9		dB	
OIP3		37.0		dBm	+25°C, V_{DD}=5V, I_{DD}=90mA, 3500MHz unless specified
OP1dB		22.0		dBm	
S11		-11		dB	
S22		-18		dB	f_1=3500MHz, f_2=3501MHz
Mid Band					
Frequency	1.5		2.7	GHz	
Current		90	110	mA	V_{DD}=5V
Gain	14	15	16.5	dB	+25°C, V_{DD}=5V, I_{DD}=90mA, 2000MHz unless specified
Noise Figure		0.8	1.0	dB	
OIP3	33.0	35.5		dBm	f_1=2000MHz, f_2=2001MHz
OP1dB	21.0	22.5	25.0	dBm	
S11		-10		dB	
S22		-17		dB	
Low Band					
Frequency	700		1100	MHz	
Current		90	110	mA	V_{DD}=5V
Gain		18		dB	+25°C, V_{DD}=5V, I_{DD}=90mA, 850MHz unless specified
Noise Figure		0.9		dB	
OIP3		35		dBm	f_1=850MHz, f_2=851MHz
OP1dB		22		dBm	
S11		-10		dB	
S22		-17		dB	
Thermal					
$Theta_{JC}$		51		°C/W	
Power Supply					
Device Operating Voltage	2.5	5.0	6.0	V	
Operating Current	65	90	110	mA	V_{DD}=5.0V, R2=open

Pin	Function	Description	Interface Schematic
1	NC	Not connected.	
2	NC	Not connected.	
3	RF IN	RF input pin. 50Ω matched. This pin is DC-blocked.	
4	NC	Not connected.	
5	NC	Not connected.	
6	NC	Not connected.	
7	ACG	AC ground. Shunt cap may be added for tuning. Shunt resistor may be added to increase I_{DD}/IP3.	
8	NC	Not connected.	
9	NC	Not connected.	
10	NC	Not connected.	
11	RF OUT	RF output pin. 50Ω matched. This pin is DC-blocked.	
12	NC	Not connected.	
13	NC	Not connected.	
14	NC	Not connected.	
15	VD	Bias voltage. 2.5V to 6.0V applied through bias inductor.	
16	NC	Not connected.	
Pkg Base	GND	Ground connection.	

Package Drawing



Evaluation Board Schematic
700 MHz to 3800 MHz



Component	700-1100 MHz	1.5-2.7 GHz	3.3-3.8 GHz
C1 (pF)	10	10	10
C3 (pF)	100	100	100
C4 (pF)	10	DNP	DNP
L1 (nH)	56	5.6	2.2
L2 (nH)	18	4.7	4.7
R1 (ohm)	5.6 nH	0	0
R2 (ohm)	DNP	DNP	DNP
L3 (nH)	15	DNP	DNP

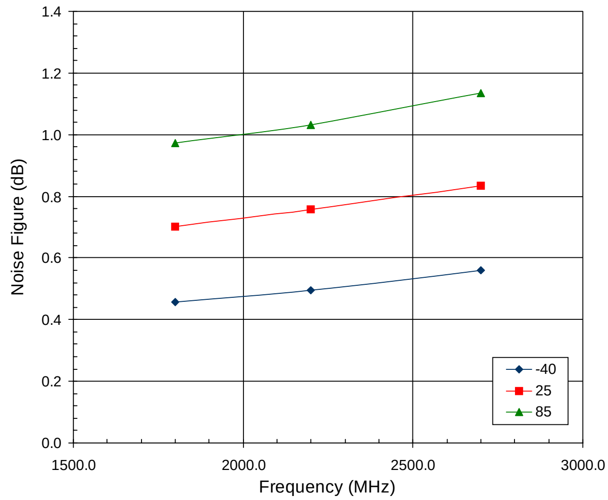
R2 is DNP for standard 90 mA current draw. If R2 is added, the I_{DD} will increase. A 20 Ω R2 will raise the current to achieve higher linearity.

Theory of Operation

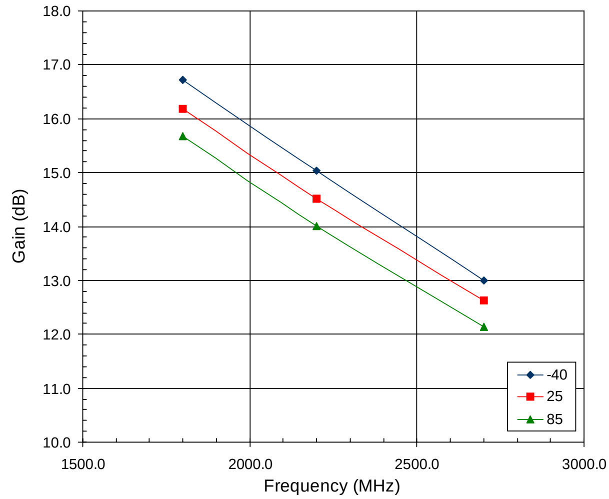
Low noise figure/high IP3 make the RF3863 ideal for use as both a receive LNA and a transmit driver for cellular/DCS/PCS/UMTS and WiMax platforms, in addition to many other general purpose applications. Standard evaluation boards cover 700 MHz to 1100 MHz, 1500 MHz to 2700 MHz, and 3300 MHz to 3800 MHz. Viewing the data sheet evaluation board schematic, refer to the information below for purpose/function of external components:

- R1/L3 (0Ω/unpopulated on standard evaluations boards): These unused components were placed for convenience and flexibility when needed to optimize matching for an out-of-band application.

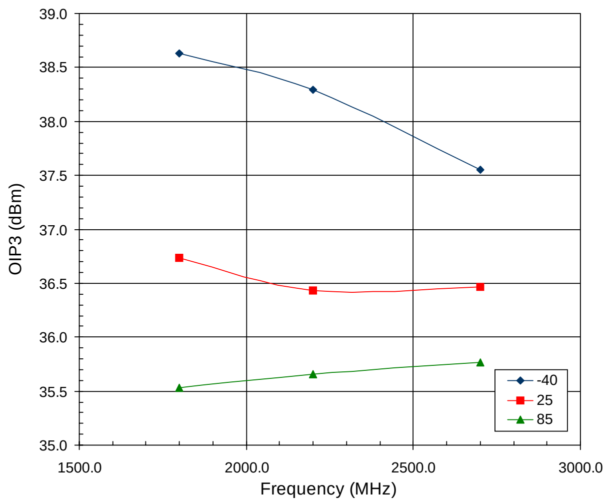
5V Noise Figure versus Temperature



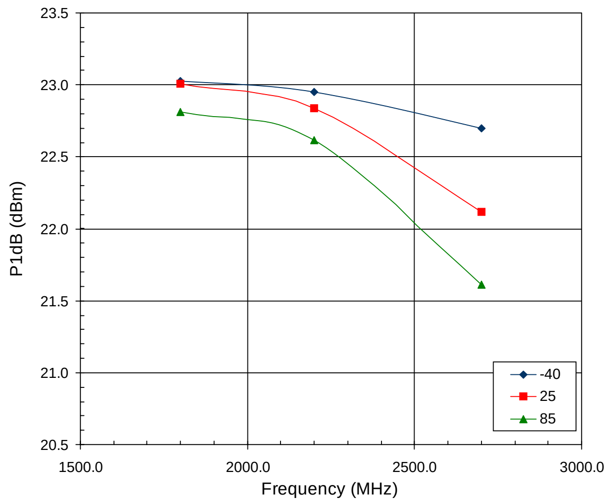
5V Gain versus Temperature



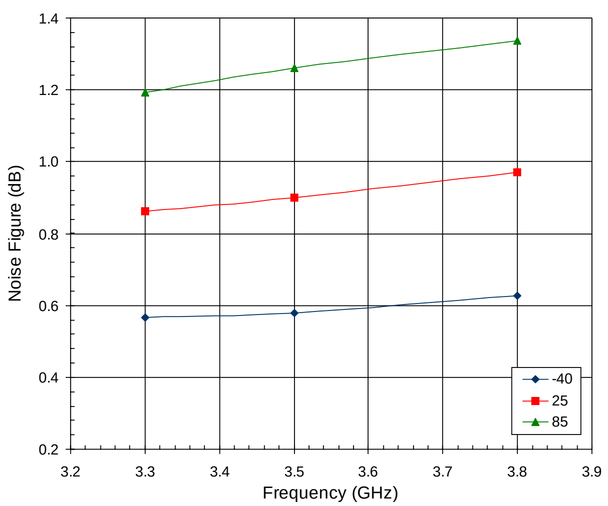
5V OIP3 versus Temperature



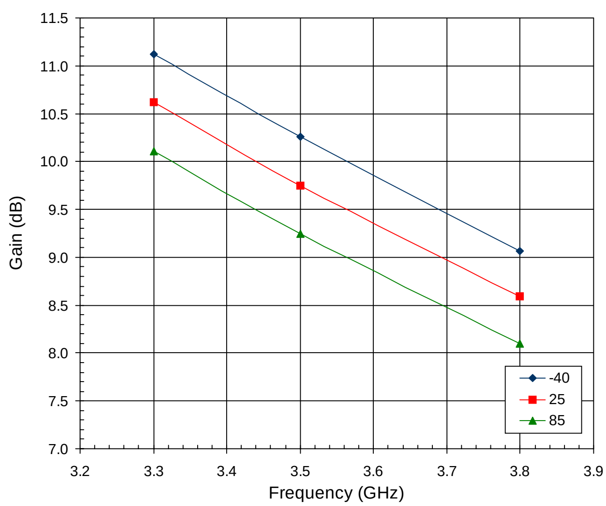
5V P1dB versus Temperature



5V Noise Figure versus Temperature



5V Gain versus Temperature



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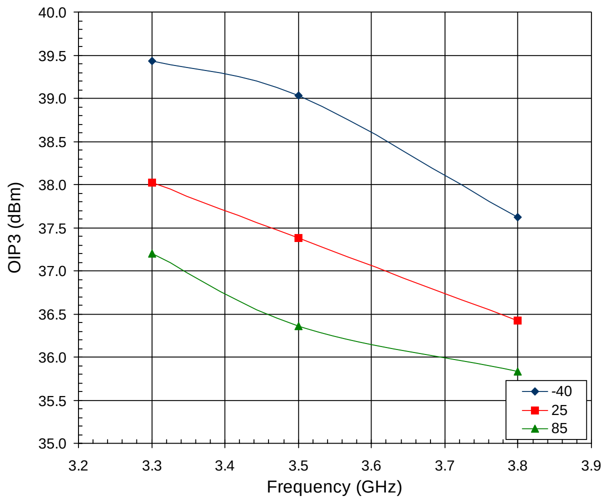
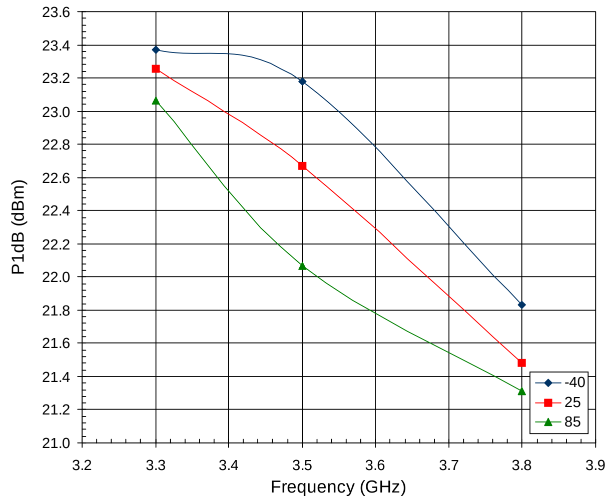
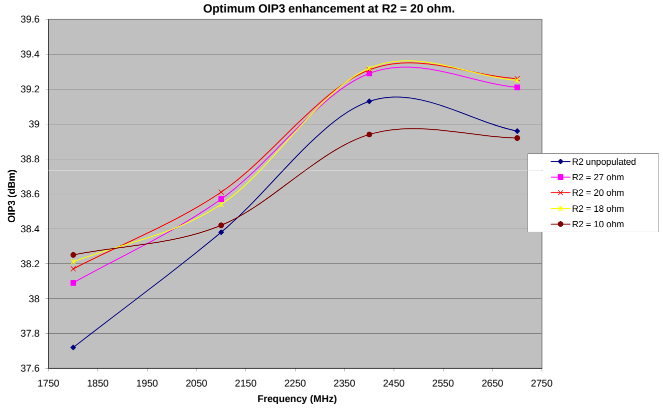
5V OIP3 versus Temperature



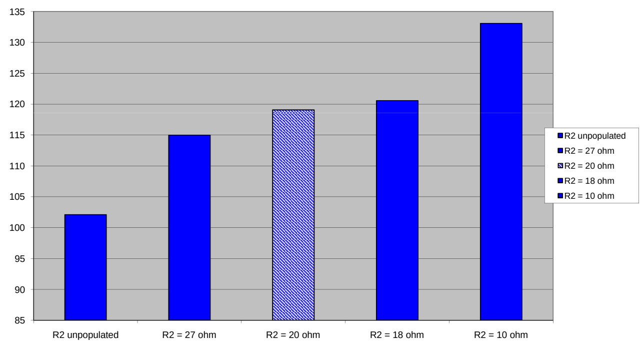
5V P1dB versus Temperature



RF3863- 410 Evaluation Board, OIP3 vs R2 value
Vdd = 5.0 V
Optimum OIP3 enhancement at R2 = 20 ohm.



RF3863 Icc vs R2
Vdd = 5.0 V
R2 = 20 ohm for optimal OIP3



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- L2/C3/C4: Placed to optimize input match and enhance out-of-band low frequency stability.
- R2: Optionally placed to increase bias current and IP3. 20Ω value is found to be the best case. (See graphs.)
- L1/C1: Influence output return loss.

The RF3863 has internal DC-blocking capacitors at RF IN and RF OUT. In addition, impedance seen looking out at pins 7/15 has been shown to influence response. As a result, two port S-parameters become non-applicable. In the event matching is desired for frequency bands outside of those provided with standard evaluation boards, the following approach can be used:

- Start with matching seen for standard evaluation board closest to the desired band of operation.
- Optimize values at L2/C4/L1 to obtain response/performance.

When considering use of RF3863 outside of standard frequency bands, it is advisable to consider RF3861 as an option. We can describe the difference between the two designs here to illustrate that point. That difference, in terms of performance, can be outlined by two statements:

1. RF3863, in the primary bands of interest, shows a lower noise figure.

2. In the trade-off here, RF3861 generally sees better return loss, and matching is more easily accomplished.

“Out-of-band” would primarily involve frequencies below 700MHz. Refer to the RF3861 data sheet’s “Theory of Operation” and “Application Schematic” sections where the 700MHz to 1100MHz standard evaluation board is specified from 400MHz to 1300MHz. Excellent performance is seen, providing an option for lower frequency operation. In addition, RF3861/RF3863 noise figure delta is not present below 700MHz. The conclusion then, for the case of low frequency of operation, is that RF3861 offers the most easily implemented solution. Simply use the standard RF3861 700MHz to 1100MHz evaluation board.

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