

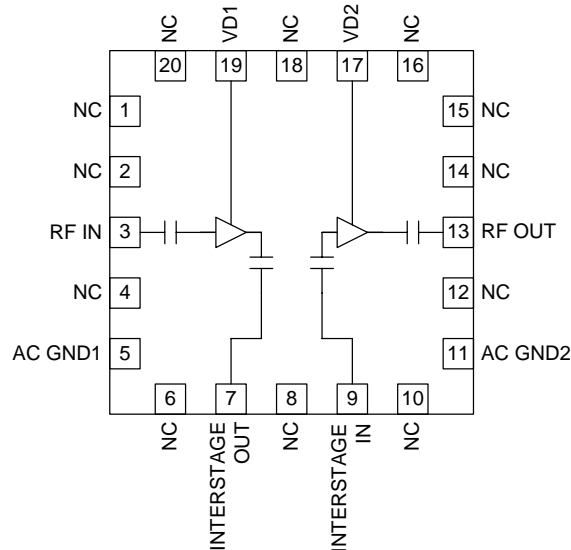


**Features**

- Low Noise and High Intercept Point
- Adjustable Bias Current for enhanced IP3
- Single 2.5V to 6.0V Power Supply
- 400MHz to 3800MHz Operation
- QFN20, 5mmx5mm Package

**Applications**

- WiMAX LNA or Linear Driver
- GSM 900, CDMA, PCS, UMTS LNA
- WLAN LNA
- High Gain Linear Amplification



Functional Block Diagram

**Product Description**

The RF3865 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 400MHz to 3800MHz. A 1dB noise figure and 36dBm OIP3 performance is achieved with a 5V V<sub>DD</sub>, 180mA. Current can be increased to raise OIP3 while having minimal effect on noise figure. The IC is featured in a standard QFN, 20-pin, 5mmx5mm package.

**Ordering Information**

RF3865	Wide Bandwidth, High Linearity Low Noise Amplifier/Linear Driver
RF3865PCK-410	Fully Assembled Evaluation Board with 5 Sample Parts 1.8GHz to 3.8GHz 700MHz to 1100MHz

**Optimum Technology Matching® Applied**

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

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## Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	6	V
Input RF Level (See Note 1)	+10	dBm
Current Drain, I <sub>DD</sub>	150 per stage	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 EUDirective2002/95/EC (at time of this document revision).

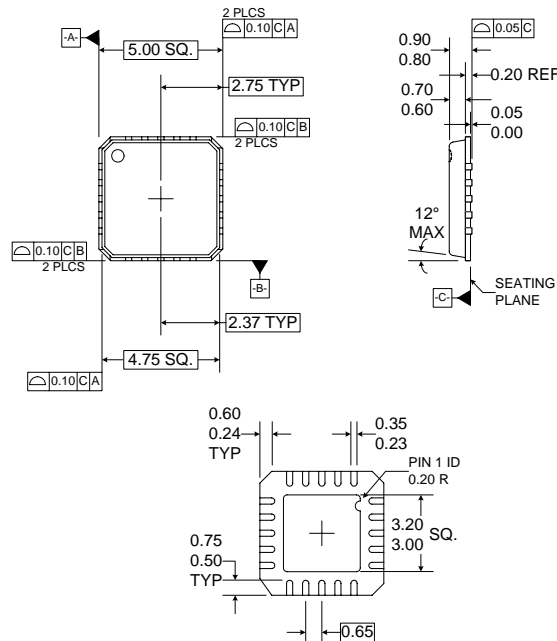
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Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
<b>High Band</b>					
Frequency	3300		3800	MHz	
Current		180	220	mA	V <sub>DD</sub> =5V
Gain		20		dB	+25 °C, V <sub>DD</sub> =5V, I <sub>DD</sub> =180mA, 3500MHz unless specified
Noise Figure		1.1		dB	
Output IP3		37		dBm	f <sub>1</sub> =3500MHz, f <sub>2</sub> =3501MHz
Output P1dB		22		dBm	
S11		-17		dB	
S22		-17		dB	
S12		-33		dB	
<b>Mid Band</b>					
Frequency	1800		2700	MHz	
Current		180	220	mA	V <sub>DD</sub> =5V
Gain	27.5	28.5	31.0	dB	+25 °C, V <sub>DD</sub> =5V, I <sub>DD</sub> =180mA, 2000MHz unless specified
Noise Figure	1.0	1.2		dB	
Output IP3	34	36		dBm	f <sub>1</sub> =2000MHz, f <sub>2</sub> =2001MHz
Output P1dB	21.0	22.5	25.0	dBm	
S11		-10		dB	
S22		-20		dB	
S12		-40		dB	
<b>Low Band</b>					
Frequency	700		1100	MHz	
Current		180	220	mA	V <sub>DD</sub> =5V
Gain		33		dB	+25 °C, V <sub>DD</sub> =5V, I <sub>DD</sub> =180mA, 850MHz unless specified
Noise Figure		1.2		dB	
OIP3		36		dBm	f <sub>1</sub> =851MHz, f <sub>2</sub> =851MHz
OP1dB		22		dBm	
S11		-15		dB	
S22		-18		dB	
S12		-40		dB	

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
<b>Thermal</b>					
Theta <sub>JC</sub>		30		°C/W	Dissipated power = V <sub>DD</sub> * (I <sub>DD1</sub> + I <sub>DD2</sub> )
<b>Power Supply</b>					
Device Operating Voltage	2.5	5.0	6.0	V	
Operating Current	130	180	220	mA	V <sub>DD</sub> = 5V, R3 = open

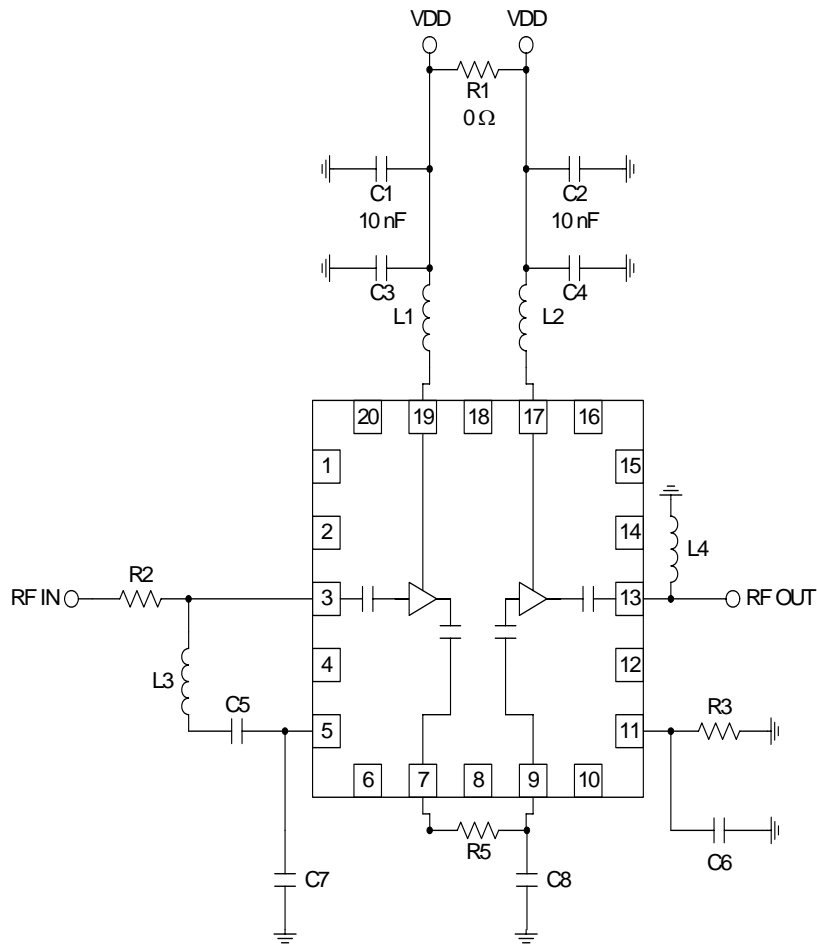
Pin	Function	Description
1	NC	Not connected.
2	NC	Not connected.
3	RF IN	RF input pin. 50Ω matched. This pin is DC-blocked.
4	NC	Not connected.
5	AC GND1	AC ground. Shunt cap may be added for tuning.
6	NC	Not connected.
7	INTERSTAGE OUT	Interstage RF output.
8	NC	Not connected.
9	INTERSTAGE IN	Interstage RF input.
10	NC	Not connected.
11	AC GND2	AC ground. Shunt resistor may be added to increase I <sub>DD</sub> and OIP3.
12	NC	Not connected.
13	RF OUT	RF output pin. 50Ω matched. This pin is DC-blocked
14	NC	Not connected.
15	NC	Not connected.
16	NC	Not connected.
17	VD2	Bias voltage. 2.5V to 6.0V applied through bias inductor.
18	NC	Not connected.
19	VD1	Bias voltage. 2.5V to 6.0V applied through bias inductor.
20	NC	Not connected.
Pkg Base	GND	Ground connection and heat sink.

## Package Drawing



Dimensions in mm.

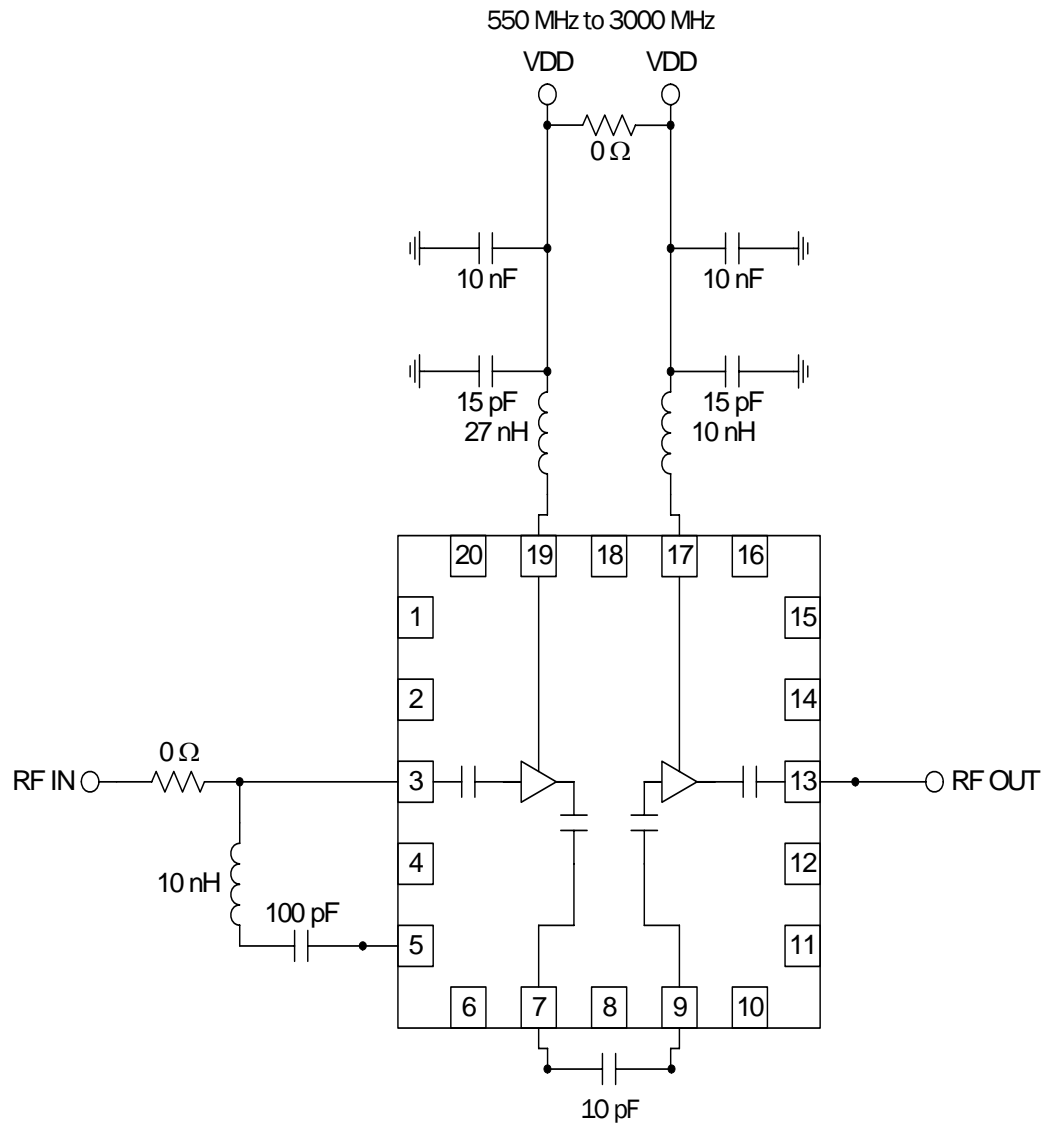
**Evaluation Board Schematic**



Components	700-1100 MHz	1.8-3.8 GHz
C3 (pF)	10	18
C4 (pF)	10	18
C5 (pF)	100	100
C6 (pF)	DNP	DNP
C7 (pF)	DNP	10
C8 (pF)	DNP	0.5
L1 (nH)	10	8.2
L2 (nH)	12	4.7
L3 (nH)	18	4.7
L4 (nH)	DNP	DNP
R2 (ohm)	0	0
R3 (ohm)	DNP	DNP
R5 (ohm)	10 pF	15 pF

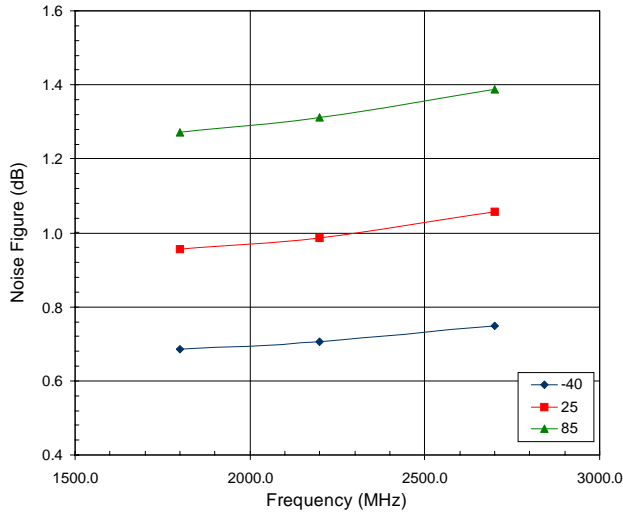
R3 is DNP for standard 180mA current draw. If R3 is added, the  $I_{DD}$  will increase. A 20Ω R3 will raise the current to achieve higher linearity.

## Application Schematic

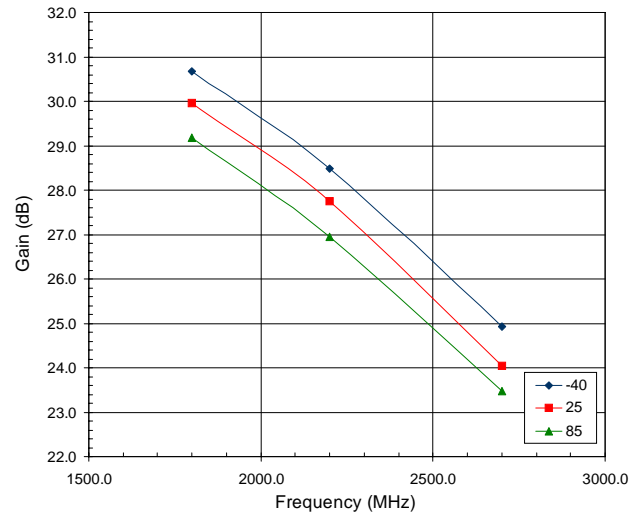


Frequency	VCC	ICC	Gain	OIP3	OP1dB	NF
MHz	(V)	(V)	dB	dBm	dBm	dB
550	5	170	31.1	36.4	22	1.85
1000	5	170	31.3	37	22	1.2
1500	5	170	32	36.1	22	1.2
1800	5	170	32	36	22	1.2
2000	5	170	30.5	36.5	22.5	1.2
2500	5	170	26.6	36.8	22.8	1.2
3000	5	170	22.6	37.2	22.6	1.4

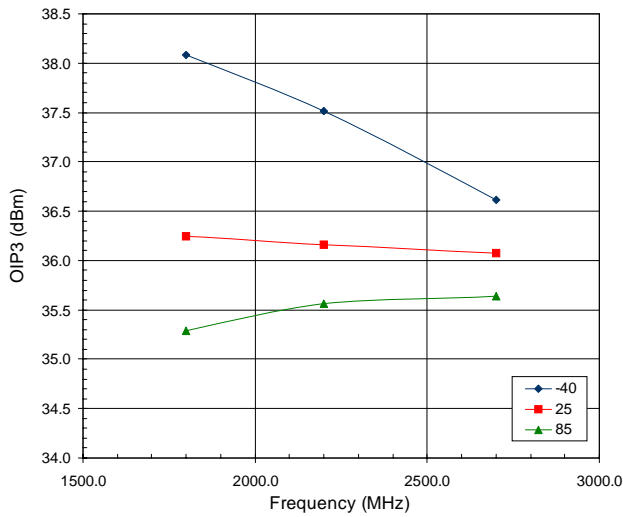
**5V Noise Figure versus Temperature**



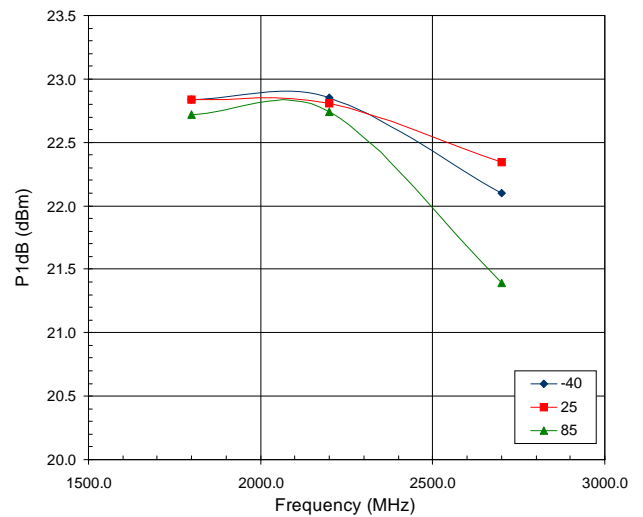
**5V Gain versus Temperature**



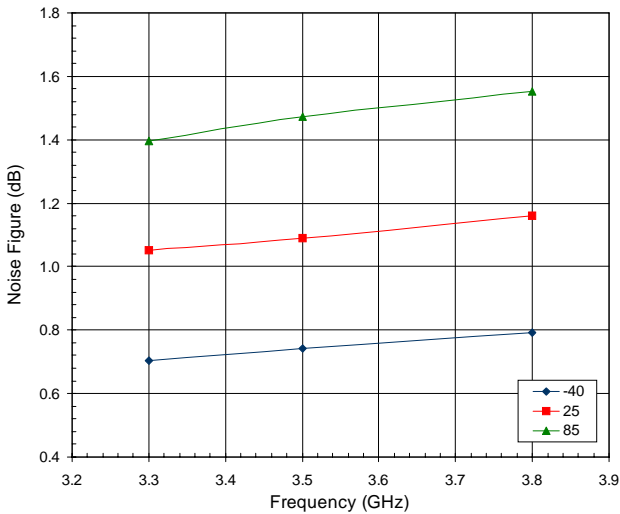
**5V OIP3 versus Temperature**



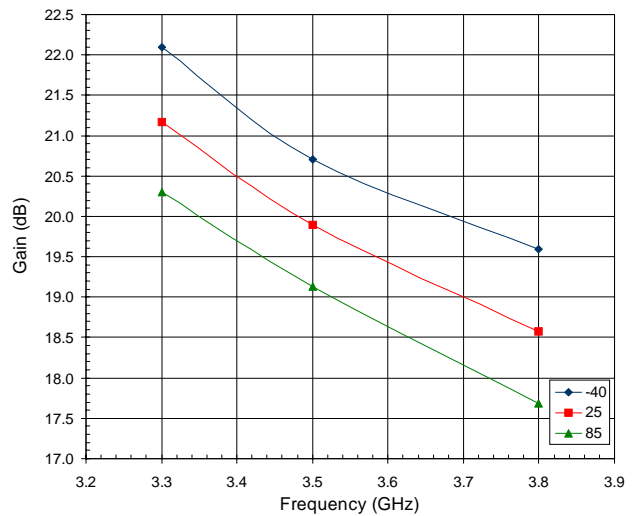
**5V P1dB versus Temperature**



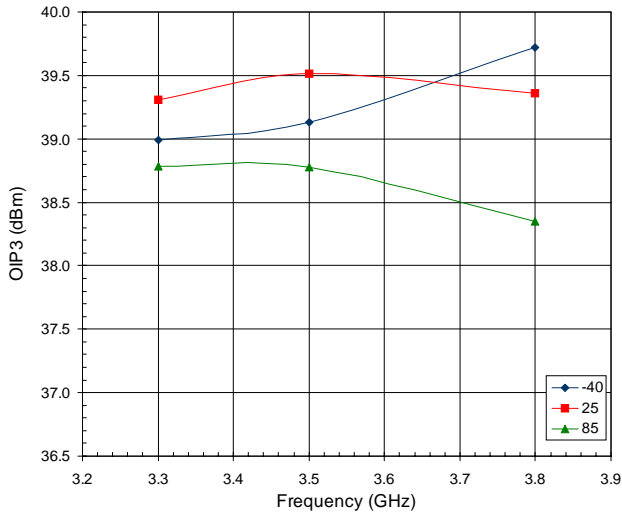
**5V Noise Figure versus Temperature**



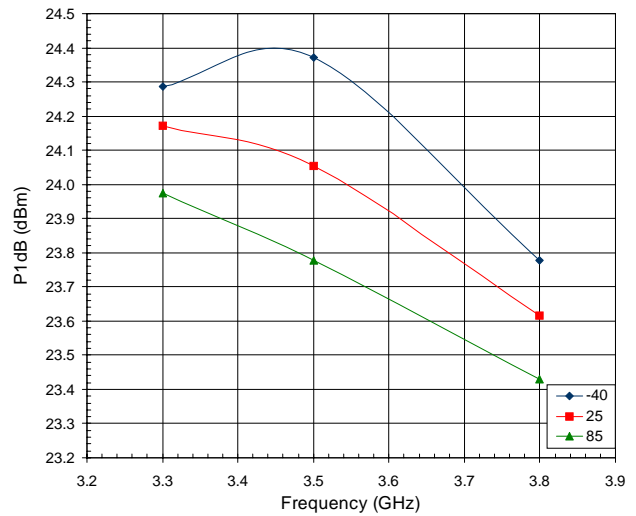
**5V Gain versus Temperature**



5V OIP3 versus Temperature

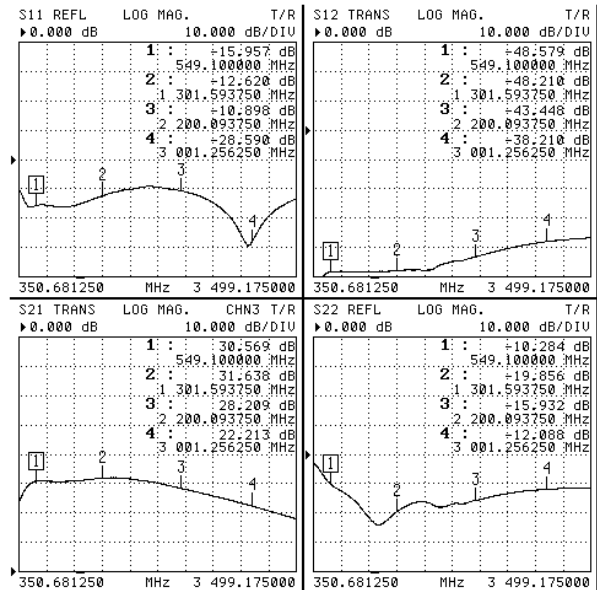
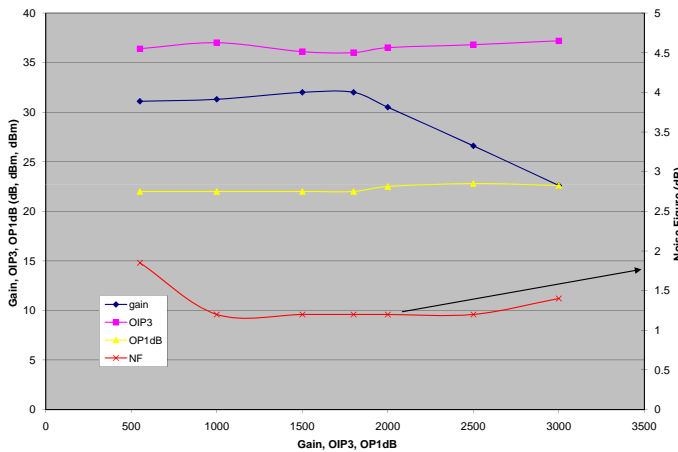


5V P1dB versus Temperature



S-parameter response for 550 to 3000 MHz  
Application Schematic

RF3865 matched from 550 - 3000 MHz (Refer to Application Schematic)  
Vcc = 5 V, Icc = 170 mA





## Theory of Operation

Low noise figure and high gain/IP3 make the RF3865 ideal for use as both receive LNA and transmit driver for cellular/DCS/PCS/UMTS and WiMax platforms, in addition to many other general purpose applications. Standard evaluation boards cover 700MHz to 1100MHz and 800MHz to 3800MHz. Viewing the data sheet evaluation board schematic, refer below for the purpose/function of external components.

- R2/L4/C6 (0 $\Omega$ /unpopulated/unpopulated on standard evaluation boards); These unused components were placed for convenience and flexibility when needed to optimize matching for an out of band application.
- L3/C5/C7: Placed to optimize input match and enhance out of band low frequency stability.
- R3: Optionally placed to increase bias current and IP3. 20 $\Omega$  value is found to be the best case. Refer to RF3861, RF3863, and RF3866 data sheets for graphical demonstration of 20 $\Omega$  optimal value. RF3865 has been confirmed to follow the same trend.
- L1/C3/R5/C8: Interstage tuning.
- L2/C4: Influence output return loss.

RF3865 has internal DC-blocking capacitors at RFin and RFout. In addition, it has been shown impedance seen looking out at pins 7/9/17/19 influence response. As a result, two port s-parameters become non-applicable. If matching is desired for frequency bands outside of those provided with standard evaluation boards, an application schematic within this data sheet for 550MHz to 3000MHz serves as an example. In the 550MHz to 3000MHz application, design goals were as follows:

- Input and output return loss equal to or better than 10dB over the entire 2450MHz bandwidth.
- IP3 and compression point in line with standard evaluation board performance.

These goals were attained, with additional specifications shown in the graph section of the data sheet:

- Noise figure  $\leq 1.2$ dB from 1000MHz to 2500MHz
- Gain  $> 30$ dB from 550MHz to 2000MHz

The above matching discussion should be helpful when considering use in frequency bands outside of those covered by standard evaluation boards. It can be noted here that application schematics and standard boards collectively cover 87% of the usable bandwidth from 400MHz to 3800MHz. As such, choosing from these available schematics should accommodate the majority of applications that come about.

