Preliminary RF2670

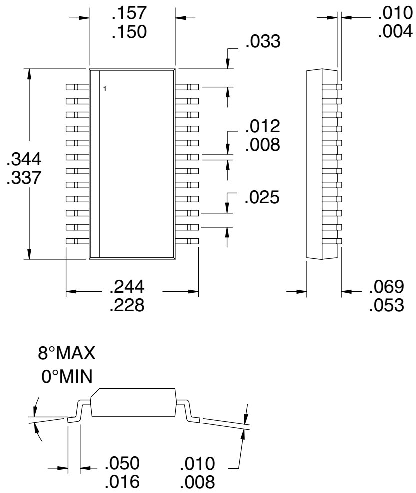
8MHZ DUAL BASEBAND AGC WITH PROGRAMMABLE LOW PASS FILTERING

Typical Applications

- Digital Cordless Telephones
- Secure Communication Links
- Wireless LANs
- Inventory Tracking
- Wireless Security
- Battery Powered Applications

Product Description

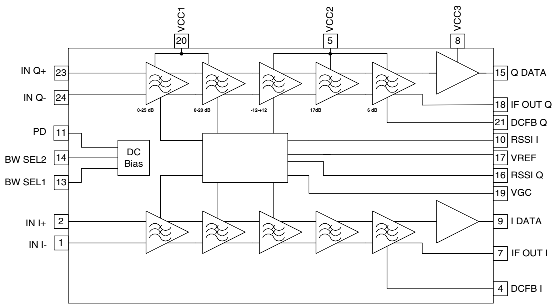
The RF2670 is a monolithic integrated circuit specifically designed for direct conversion to baseband QPSK receivers. The part provides dual baseband amplifiers with a 70dB gain range (single pin analog input) and separate I and Q RSSI. On-chip programmable baseband filters are incorporated into each amplifier providing 1MHz, 2MHz, 4MHz, or 8MHz bandwidth with a 5-pole Bessel response. I and Q output are available in digital or analog form. The data comparators use a self generated DC reference to track DC offsets in the received signal. The analog outputs have a 500mVpp swing with approximately 1.7V DC offset. A 2.0V reference voltage is also available for A/D converters changing DC bias.



Package Style: SSOP-24

Optimum Technology Matching® Applied

- ☐ Si BJT
- ☑ Si Bi-CMOS
- ☐ GaAs HBT
- ☐ SiGe HBT
- ☐ GaAs MESFET
- ☐ Si CMOS



Functional Block Diagram

Features

- I/Q Baseband Receivers
- 10dB to 80dB Gain Range
- Digital and Analog Outputs
- On-Chip Selectable IF Bandwidths
- Reference Voltage for A/D Converter
- 2.7V to 3.6V Operation

Ordering Information

RF2670	8MHz Dual Baseband AGC with Programmable Low Pass Filtering
RF2670PCBA	Fully Assembled Eval Board.

RF Micro Devices, Inc.
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Absolute Maximum Ratings

Parameter	Ratings	Unit
Supply Voltage	-0.5 to +3.6	V_{DC}
Control Voltages	-0.5 to +3.6	V_{DC}
Input RF Level	+20	dBm
Operating Ambient Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C

Caution! ESD sensitive device.

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Baseband Amplifiers					T=25°C, V_{CC}=3.0V
Frequency Range	0.01		8	MHz	Minimum frequency is dependent upon input blocking cap, DC feedback cap, and gain setting. Recommended components yields a minimum frequency of less than 10kHz.
Voltage Gain	77	80	83	dB	
Noise Figure		5		dB	At maximum gain setting
		35		dB	At minimum gain setting
Input IP3		-65		dBm	At maximum gain setting
		+2		dBm	At minimum gain setting
Output DC offset		0	25	mV	
Gain Control Range	65	70		dB	
Gain Control Voltage Range	1.2		2.0	V	
Gain Control Sensitivity		-0.08		dB/mV	
VGA Output Voltage		500		mV_{PP}	
VGA DC Output Voltage		1.7		V	
Output P1dB	1	1.64		V_{PP}	Driving a 5kΩ load
RSSI Range	55	60		dB	At maximum gain setting
RSSI Output Voltage Compliance		0.5 to 2.4		V	Maximum RSSI is 2.5V or V_{CC}-0.3, whichever is less.
Input Impedance	1.5	2	2.5	kΩ	Differential
Integrated Filters					
Characteristics		Five pole Bessel			Five pole Bessel internal LPF. Three pole external LPF.
Bandwidth		1, 2, 4, 8		MHz	Selectable from 1MHz, 2MHz, 4MHz, and 8MHz.
Passband Ripple			1	dB	
Group Delay			100	ns	At 8MHz, increasing as bandwidth decreases.
Ultimate Rejection	50	80		dB	
Data Amplifiers					
Voltage Gain		100		dB	
Bandwidth	8			MHz	
Rise and Fall Time		2	5	ns	5pF Load
Logic High Output	V_{CC}-0.3V			V	Can sink/source 1mA and maintain these logic levels.
Logic Low Output			0.3	V	Can sink/source 1mA and maintain these logic levels.
Hysteresis		40		mV	
Power Down Control					
Logical Controls “ON”	V_{CC}-0.3V			V	Voltage supplied to the input
Logical Controls “OFF”			0.3	V	Voltage supplied to the input
Control Input Impedance		>1		MΩ	
Turn on Time		10	13	ms	With recommended DC feedback cap (270nF)

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Power Supply					
Voltage	2.7	3.0	3.6	V	
Current Consumption		13	17	mA	V_{CC}=3.0V; PD=High
			1	µA	V_{CC}=3.0V; Sleep Mode, PD=Low

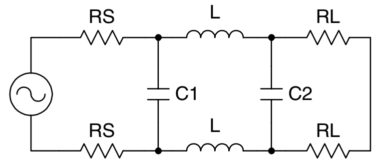
Pin	Function	Description	Interface Schematic
1	IN I-	Complementary input for the in-phase IF channel.	
2	IN I+	Input for the in-phase IF channel.	
3	GND2	Ground for VCC2.	
4	DCFB I	DC feedback capacitor for in-phase channel.	
5	VCC2	Power supply for VGA amplifier 3, differential to single-ended converter, and post filter.	
6	GND3	Ground for VCC3.	
7	IF OUT I	Analog signal IF output for in-phase channel.	
8	VCC3	Power supply for data amplifier.	
9	I DATA	Logic-level data output for the in-phase channel. This is a digital output signal obtained from the output of a Schmitt trigger.	
10	RSSI I	Received signal strength indicator for the in-phase channel.	
11	PD	Enable pin for the receiver circuits. PD>2.0V powers up all of the functions. PD<1.0V turns off all of the functions.	
12	GND1	Ground for VCC1 for both the in-phase and quadrature channels.	
13	BW SEL1	Bandwidth select logic input. Pin 13 and pin 14 provide a two bit control word for the setting of the IF bandwidth. See Table1. Additional filtering should be used at the amplifiers to precisely control the 3dB bandwidth of the system. See design information details about differential input filters.	
14	BW SEL2	See pin 13.	
15	Q DATA	Logic-level data output for the quadrature channel. This is a digital output signal obtained from the output of a Schmitt trigger.	
16	RSSI Q	Received signal strength indicator for the quadrature channel.	
17	VREF	Gain control reference voltage.	
18	IF OUT Q	Analog signal IF output for quadrature channel.	
19	VGC	Gain control voltage.	
20	VCC1	Power supply for bias circuits and VGA amplifiers for both the in-phase and quadrature channels.	
21	DCFB Q	DC feedback capacitor for quadrature channel.	
22	GND1	Ground for VCC1 for both the in-phase and quadrature channels.	
23	IN Q+	Plus input for quadrature channel	
24	IN Q-	Minus input for quadrature channel	

Table 1: Bandwidth Selection Controls

BWSEL1	BWSEL2	IF_{-3dB} Frequency
0	0	1MHz
0	1	2MHz
1	0	4MHz
1	1	8MHz

Differential Filter Design Information

Butterworth Response

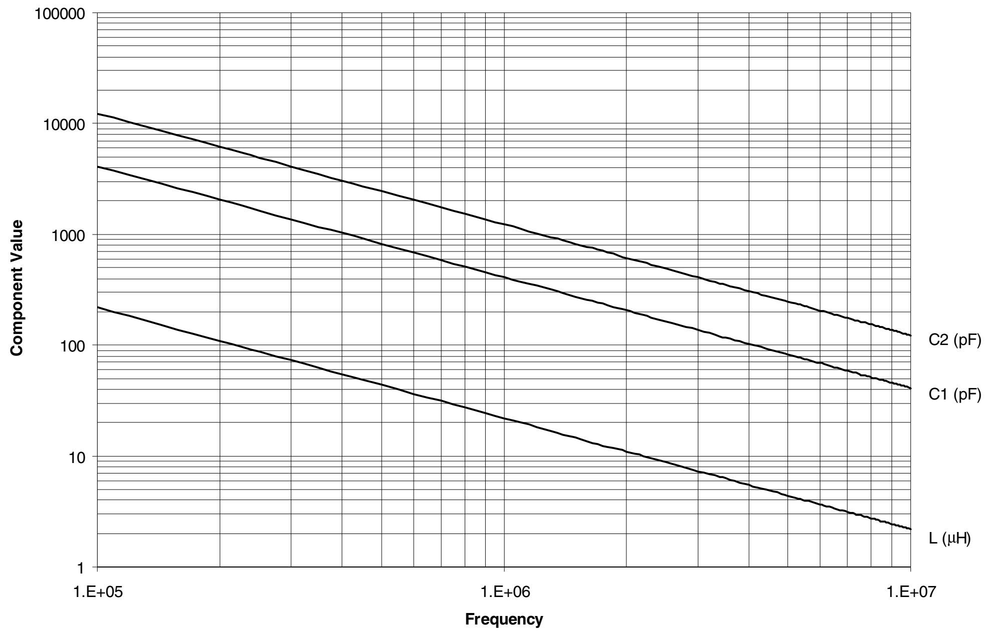


$$C1 = \frac{C1bw \cdot \frac{1}{2} \cdot 10^{12}}{2 \cdot \pi \cdot fc \cdot RL}; C2 = \frac{C2bw \cdot \frac{1}{2} \cdot 10^{12}}{2 \cdot \pi \cdot fc \cdot RL}; L = \frac{Lbw \cdot RL \cdot 10^{6}}{2 \cdot \pi \cdot fc}$$

$$C1bw = 5.1672; C2bw = 15.4554; Lbw = 0.1377$$

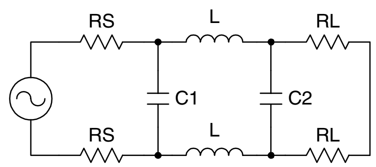
$$RS = 125; RL = 1000; \frac{RS}{RL} = 0.125$$

Differential LC Filter Component Values
(Butterworth Response)



Differential Filter Design Information (Cont.)

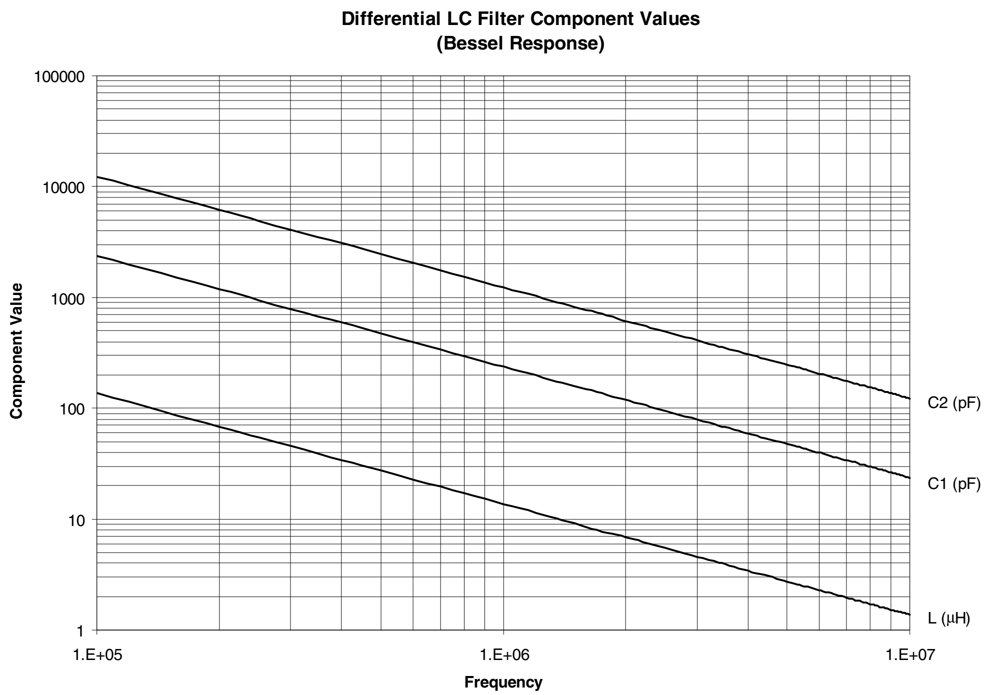
Bessel Response



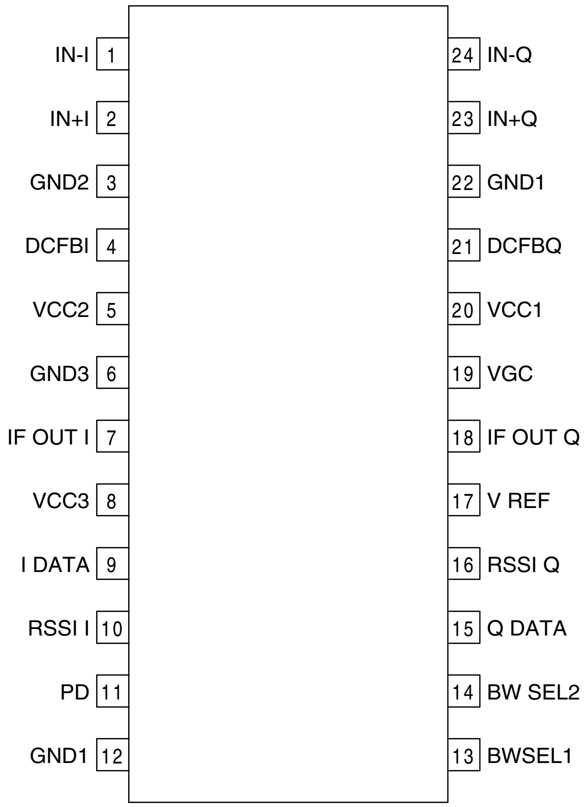
$$C1 = \frac{C1bw \cdot \frac{1}{2} \cdot 10^{12}}{2 \cdot \pi \cdot fc \cdot RL}; C2 = \frac{C2bw \cdot \frac{1}{2} \cdot 10^{12}}{2 \cdot \pi \cdot fc \cdot RL}; L = \frac{Lbw \cdot RL \cdot 10^{6}}{2 \cdot \pi \cdot fc}$$

$$C1bw = 2.9825; C2bw = 15.4697; Lbw = 0.0860$$

$$RS = 125; RL = 1000; \frac{RS}{RL} = 0.125$$

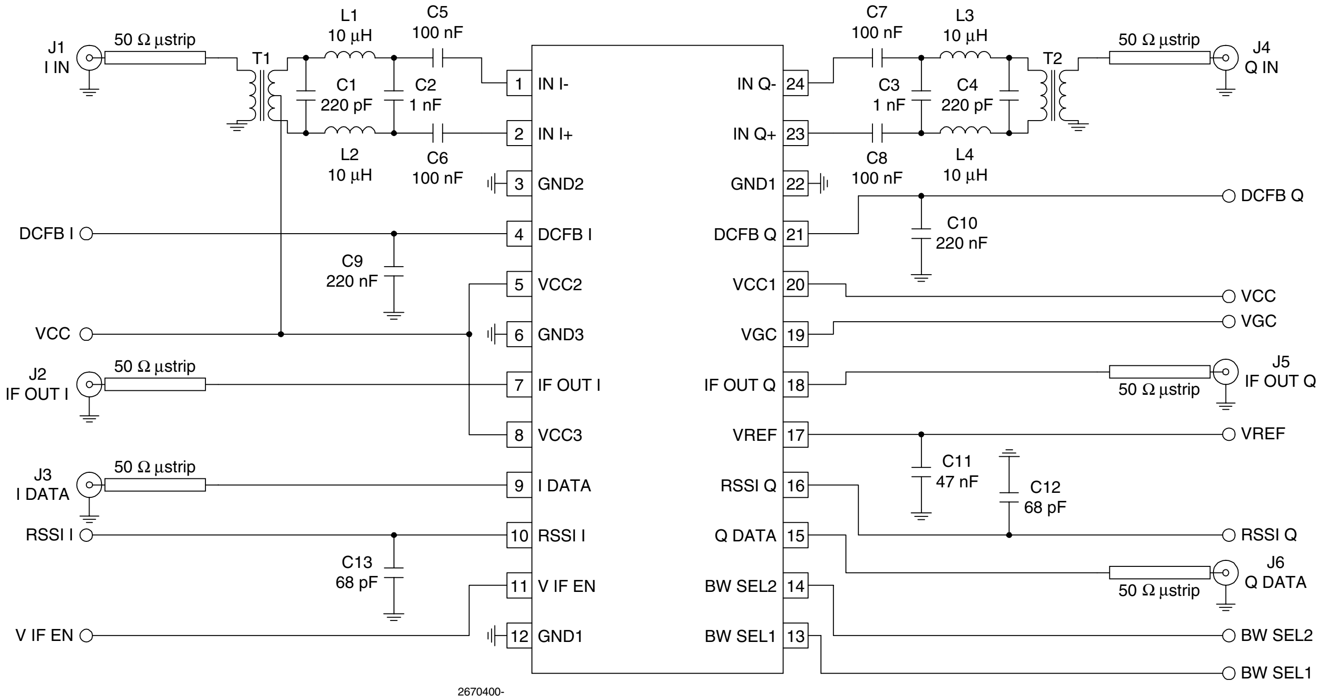


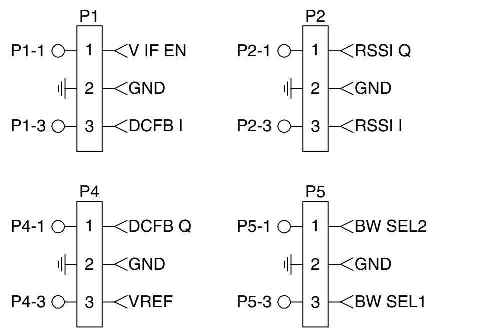
Pin Out


IN-I 1
IN+I 2
GND2 3
DCFBI 4
VCC2 5
GND3 6
IF OUT I 7
VCC3 8
I DATA 9
RSSI I 10
PD 11
GND1 12
24 IN-Q
23 IN+Q
22 GND1
21 DCFBQ
20 VCC1
19 VGC
18 IF OUT Q
17 V REF
16 RSSI Q
15 Q DATA
14 BW SEL2
13 BWSEL1

Evaluation Board Schematic

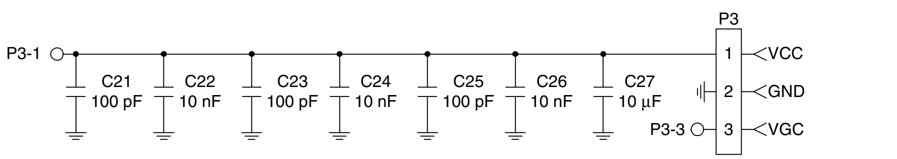
(Download Bill of Materials from www.rfmd.com.)



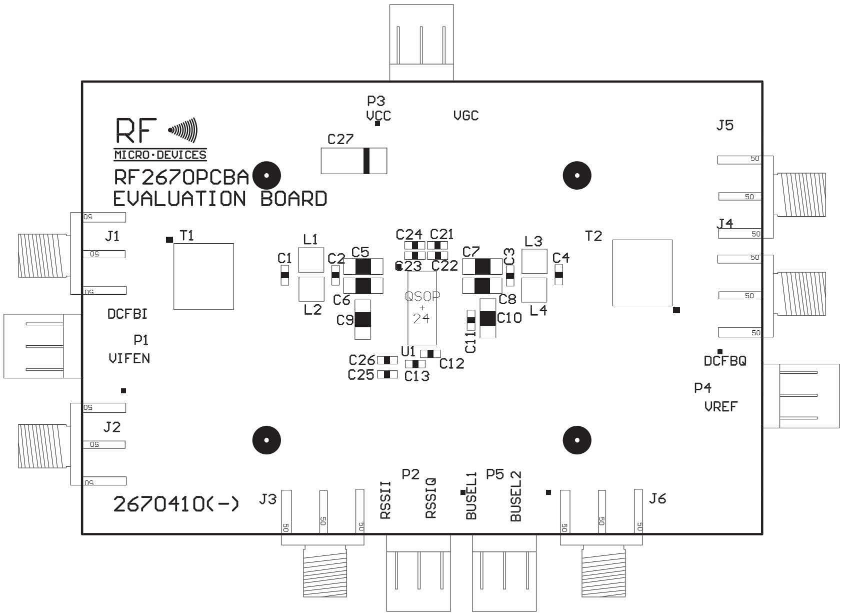


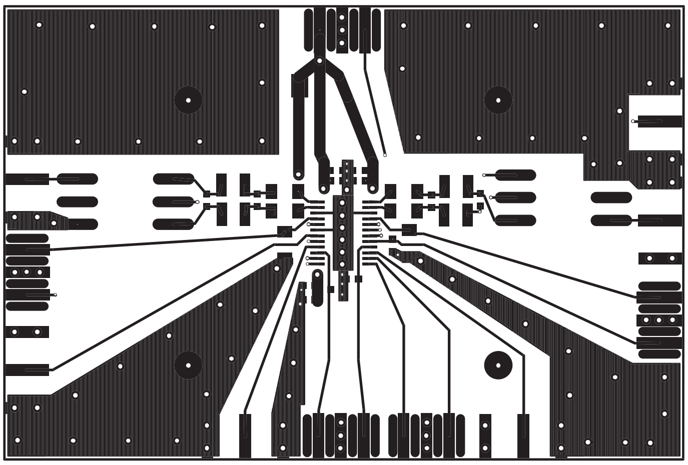
L1-L4 and C1-C4 make two LPFs. The fc of the RF2670 is variable; therefore the L and C components must be variable. The following table gives recommended component values ("std" indicates standard eval board value).

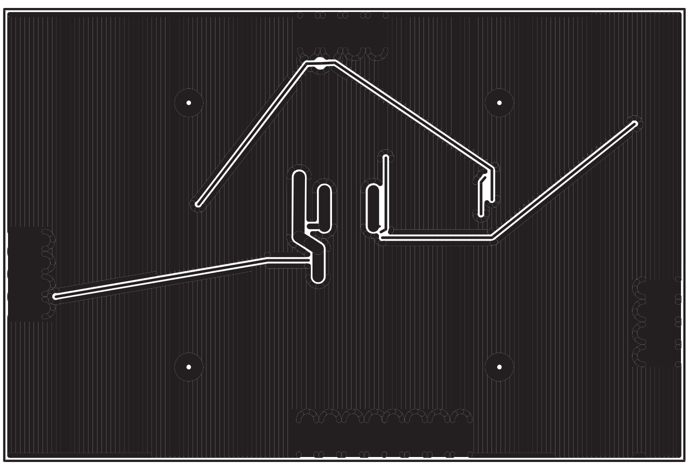
Desired BW	BW1, BW2	C1, C4 (pF)	C2, C3 (pF)	L1-L4 (µH)
700 kHz	0 0	330	1800	22
1.4 MHz	0 1	220 (std)	1000 (std)	10
2.8 MHz	1 0	100	470	4.7
7.0 MHz	1 1	33	180	2.2

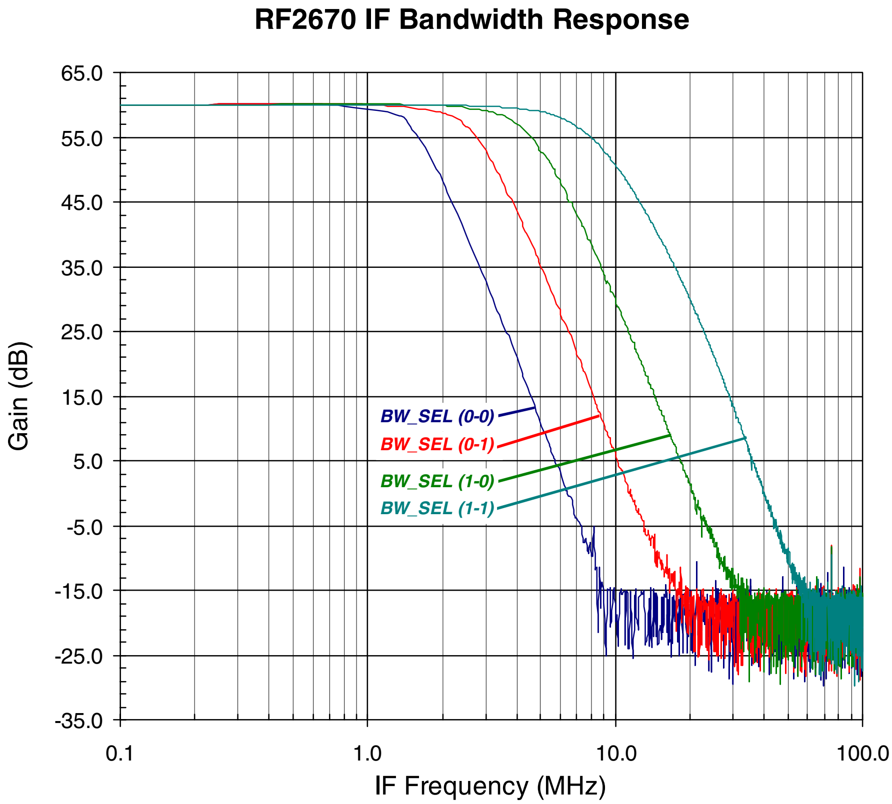


Evaluation Board Layout
Board Size 3.0" x 2.0"

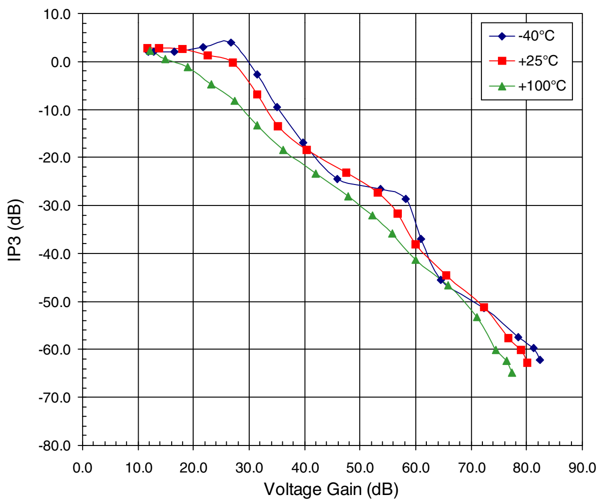




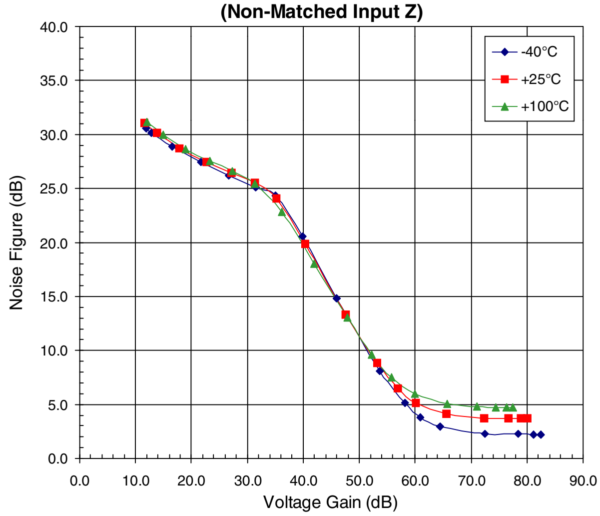



RF2670 IF Bandwidth Response
Gain (dB)
65.0
55.0
45.0
35.0
25.0
15.0
5.0
-5.0
-15.0
-25.0
-35.0
0.1
1.0
10.0
100.0
IF Frequency (MHz)
BW_SEL (0-0)
BW_SEL (0-1)
BW_SEL (1-0)
BW_SEL (1-1)

IIP3 versus Voltage Gain



Noise Figure versus Voltage Gain
(Non-Matched Input Z)



Voltage Gain versus Gain Control Voltage