

Infineon RF Bipolar Transistors

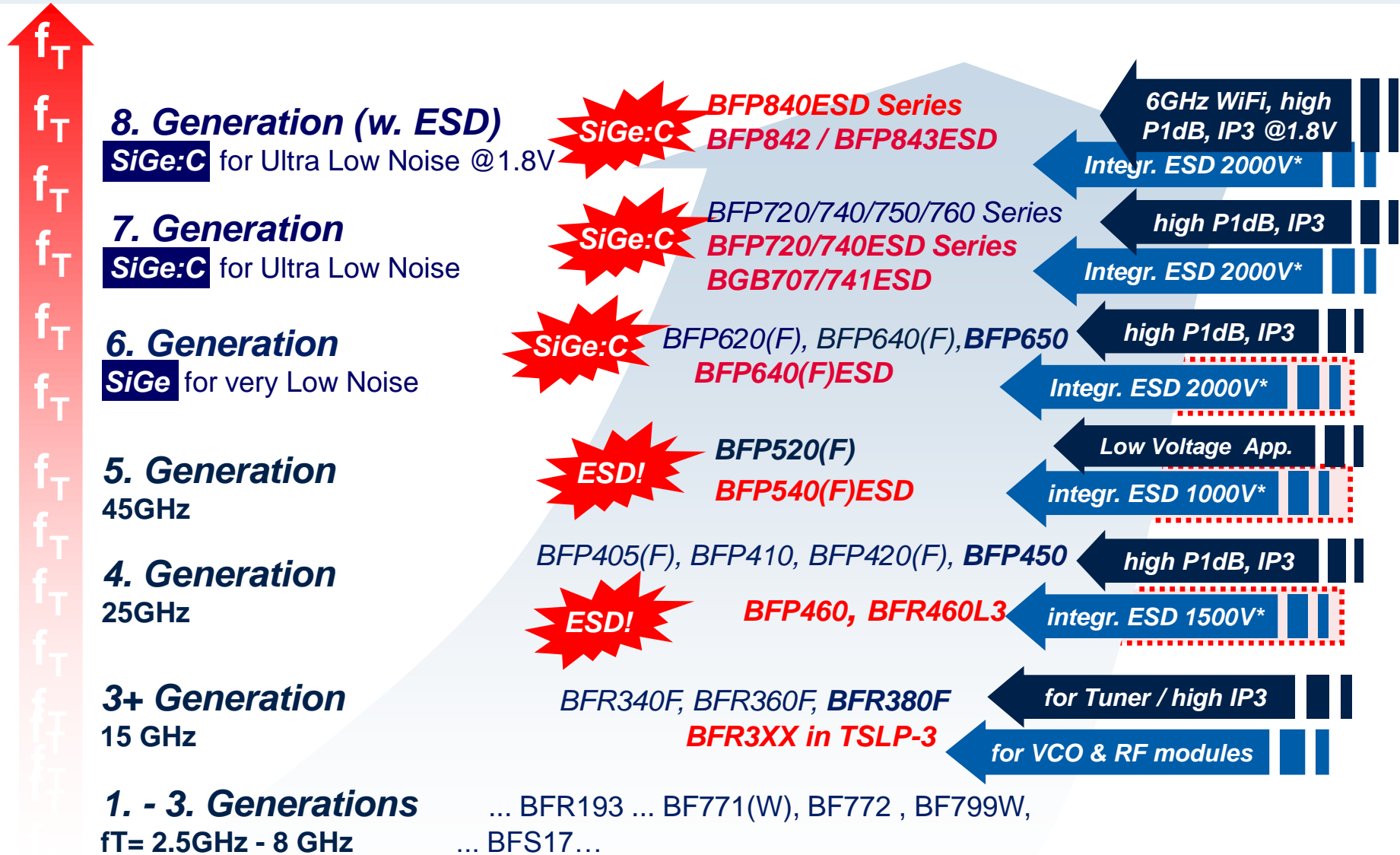


Chih-I Lin

May 2014



Infineon RF Transistor Portfolio Overview



*Typical values Human Body Model

RF Bipolar Transistors – Our Key focuses

Performance – ESD Protection / Features – Miniaturization

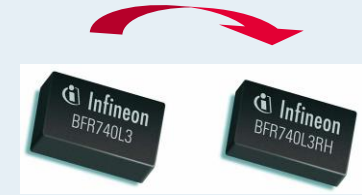


Ultra
Low Noise and
High Linearity
@ 1.8V
SiGe:C
e.g. BFP8xxseries
0.65dB



Integrated
Features &
ESD
Protection
e.g. BFP8xxseries
***2kV**

20% height reduction



Super Small
Very Flat
Leadless
Package
e.g. BFR840L3RH
0.32mm

*SiGe:C ESD series at all pins

Transistor LNA

2G: BFX840, BFP760, BFX740 Series

5G: BFX840, BFP760, BFX740 Series

Dual Band: BFX843 Series



RF Switches

SPDT: BGS12SN6 (IL 0.7dB @ 6 GHz)

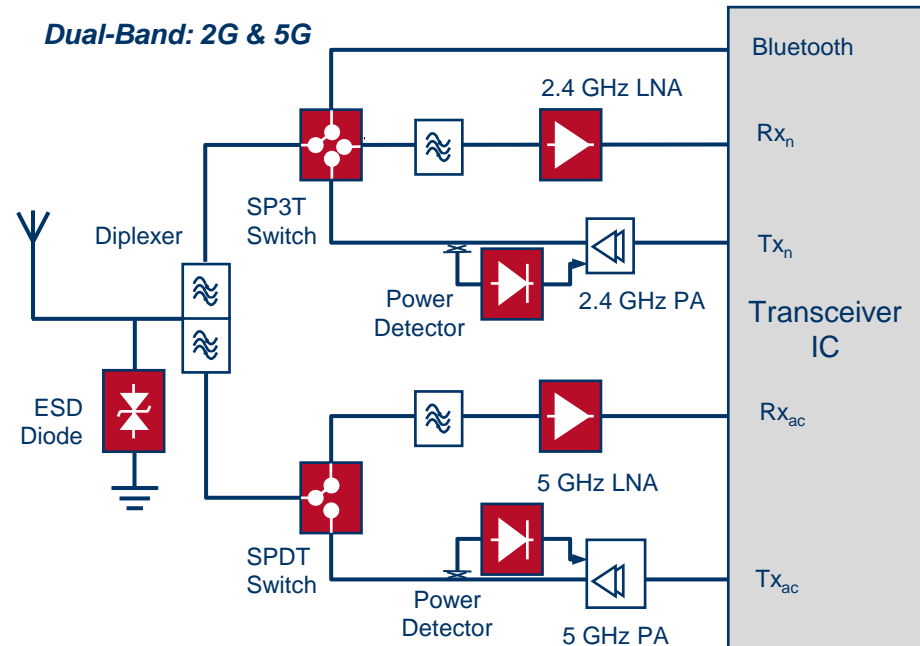
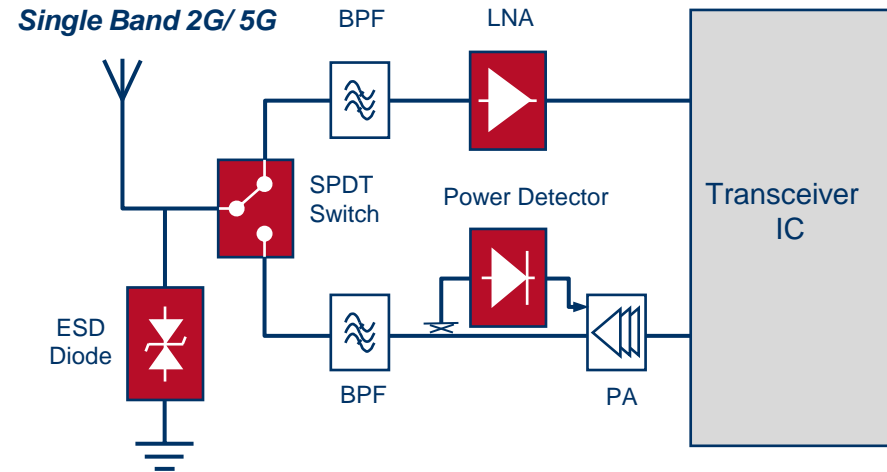
SP3T: BGS13SL9



Diodes

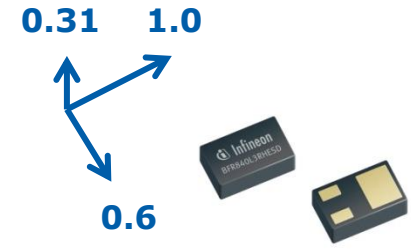
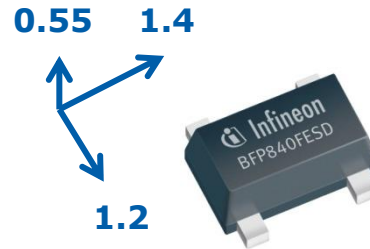
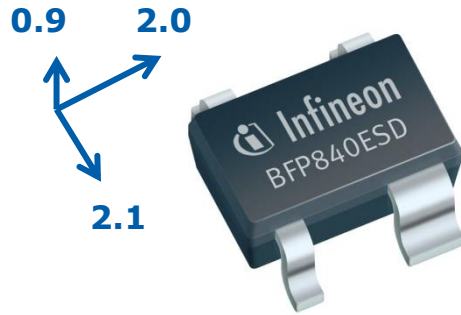
TVS ESD : ESD0P2RF-02LRH/02LS

RF: BAR90-02LS



BFx84xESD Series

Best in Class Discrete RF LNAs



Package:

SOT343

Flat lead TSFP-4

Low height TSLP

General Purpose
up to 12 GHz

BFP840ESD
 $f = 5.5$ GHz
 NFmin: **0.85** dB
 Gmax: **22.5** dB
 ESD: 1.5kV (HBM)

BFP840FESD
 $f = 5.5$ GHz
 NFmin: **0.75** dB
 Gmax: **23** dB
 ESD: 1.5kV (HBM)

BFR840L3RHESD
 $f = 5.5$ GHz
 NFmin: **0.65** dB
 Gmax: **22** dB
 ESD: 1.5kV (HBM)

Pre-Matched
RF-Transistors

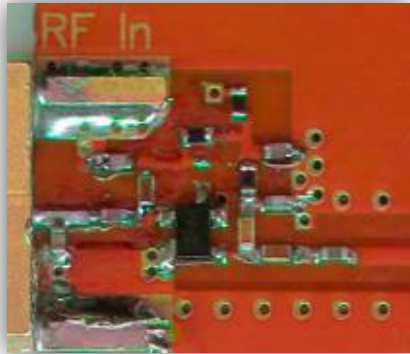
BFP842ESD
 2G **Pre-matched**

BFP843
 Dual Band
Pre-matched

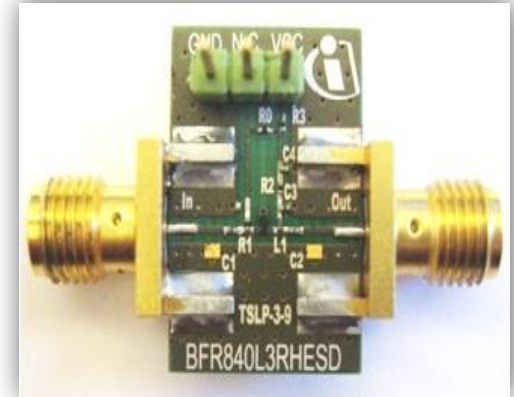
BFP843F
 Dual Band
Pre-matched

BFR843EL3
 Dual Band
Pre-matched

Better Performance while Size & Cost Saving with less External Parts-Count

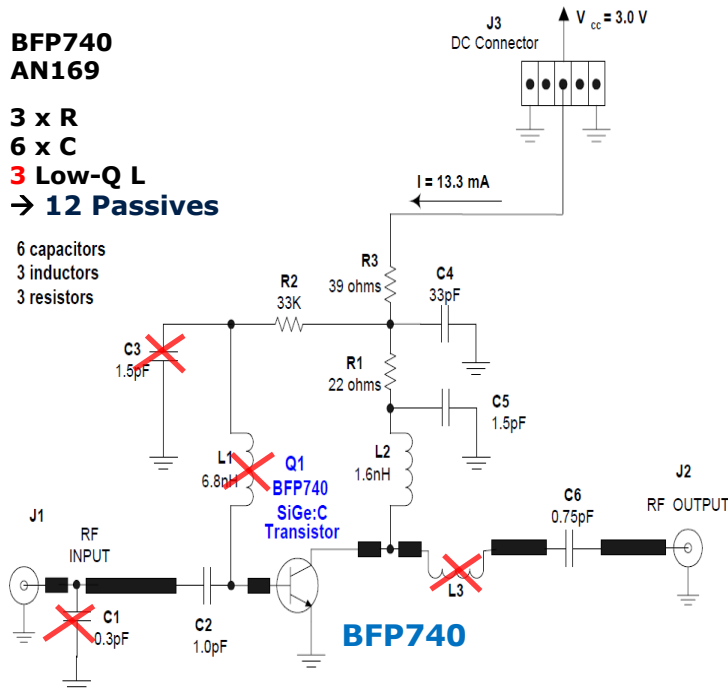


1.5 dB Higher Gain
0.3 dB Lower NF
4 Passives Less
5mA less current



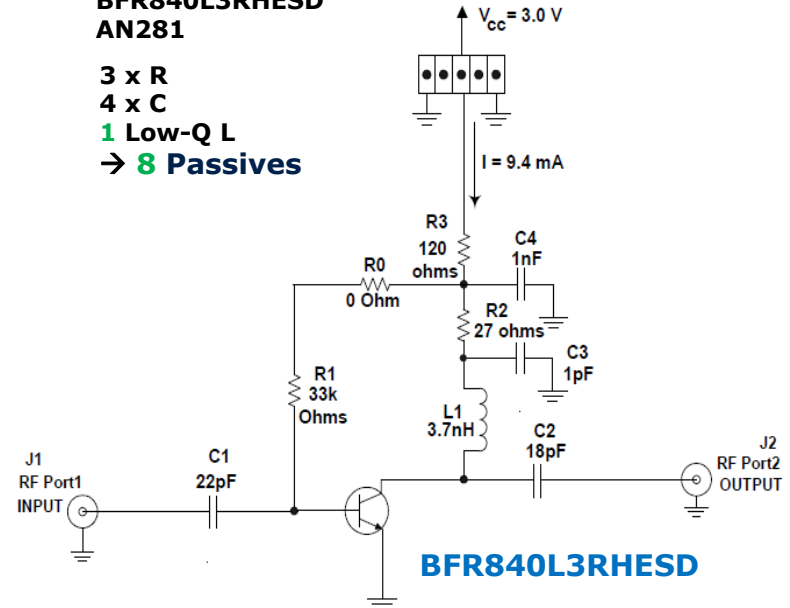
**BFP740
AN169**
3 x R
6 x C
3 Low-Q L
→ 12 Passives

6 capacitors
3 inductors
3 resistors



**BFR840L3RHESD
AN281**

3 x R
4 x C
1 Low-Q L
→ 8 Passives



Overview Application Circuit Examples for 2.4 GHz and 5.5 GHz Wi-Fi Connectivity



2.4 -2.5 GHz Wi-Fi (IEEE802.11b/g/n) LNA

Device	Package	Appl. Note	Comment
BFP842ESD	SOT343	AN322	Best Noise Figure 0.75 dB
BFP760	SOT343	TR1134	Off-mode as bypass mode (29dB delta gain)
BFR843EL3 & BAR86-02LRH	TSLP-3-9	TR1145	w. by-pass mode (PIN Diodes 2xBAR86-02LRH)

5 - 6 GHz Wi-Fi (IEEE802.11a/n/ac) LNA

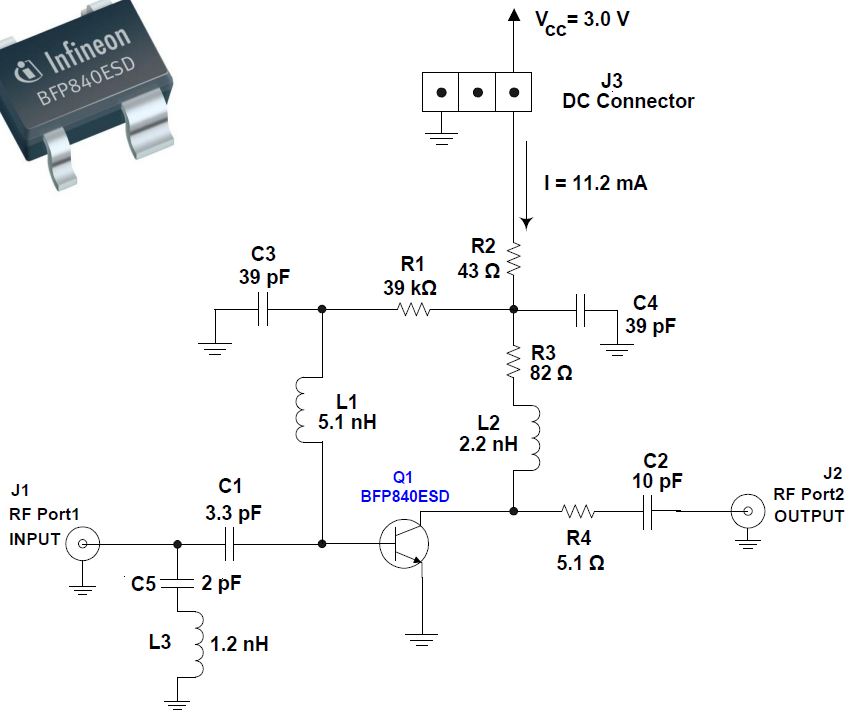
Device	Package	Appl. Note	Comment
BFP840	SOT343	AN317	Best Noise Figure 1.15 dB
BFP760	SOT343	TR1131	Off-mode as bypass mode (23dB gain delta), 2.4GHz rejection optional
BFR840L3ESD & BAR86-02ELS	TSLP-3-9	TR1144	w. by-pass mode (PIN Diodes 2xBAR86 -02ELS)

2.4 GHz and 5.5 GHz Dualband Wi-Fi LNA

Device	Package	Appl. Note	Comment
BFP843	SOT343	AN312	Broadband, matched
BFP843F	TSFP-4-1	AN315	
BFR843EL3	TSLP-3-9	AN307	

BFP840ESD: 5G LNA Example (AN317)

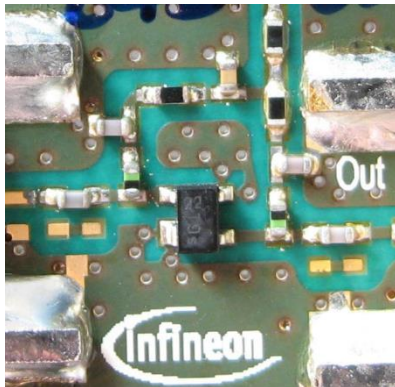
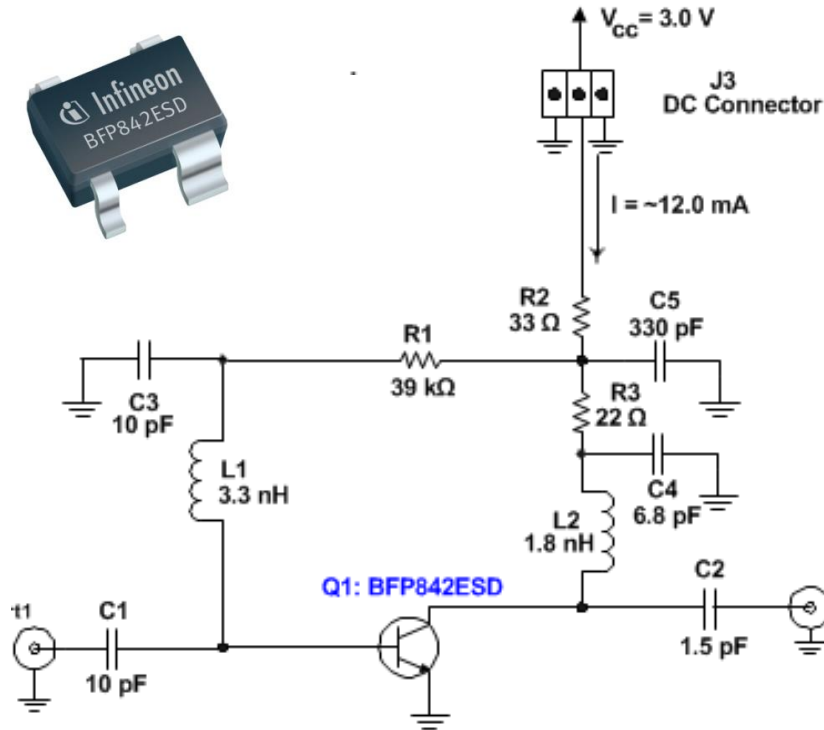
Best-In-Class Performance @ 5 – 6GHz



Symbol	Value				Unit
V_{CC}	3.0				V
I_{CC}	11.2				mA
Freq	2400	5100	5500	5900	MHz
G_{ON}	-9	16.2	16.3	15.6	dB
G_{OFF}	-	-25	-26.2	-27.5	dB
NF	-	1.1	1.17	1.22	dB
RL_{in}	-	12.2	15.4	20.3	dB
RL_{out}	-	20.3	17	13	dB
IR_{ev}	-	25.7	24.9	24.3	dB
IP1dB _{ON}	5	-9.5	-9.3	-9.2	dBm
IP1dB _{OFF}	-	>10	>10	>10	dBm
OP1dB	-5	5.7	6	5.4	dBm
IIP3	0.5				dBm
OIP3	16.8				dBm
k	>1				--

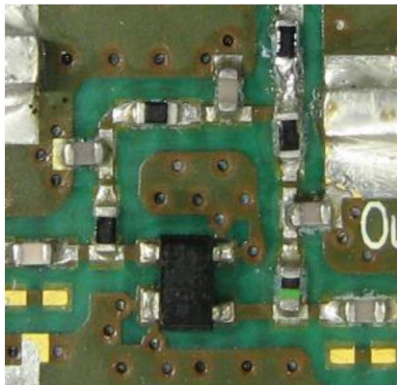
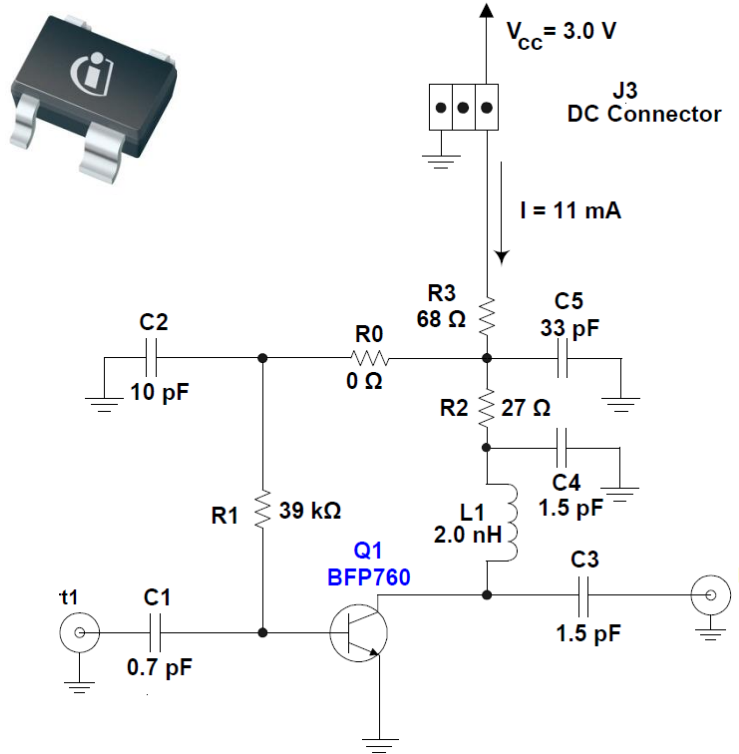
BFP842ESD: 2.4GHz LNA (AN322)

Easy to Use / Best Performance at 2.4G



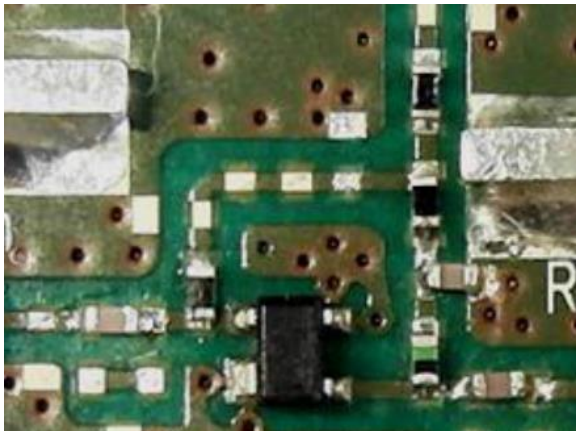
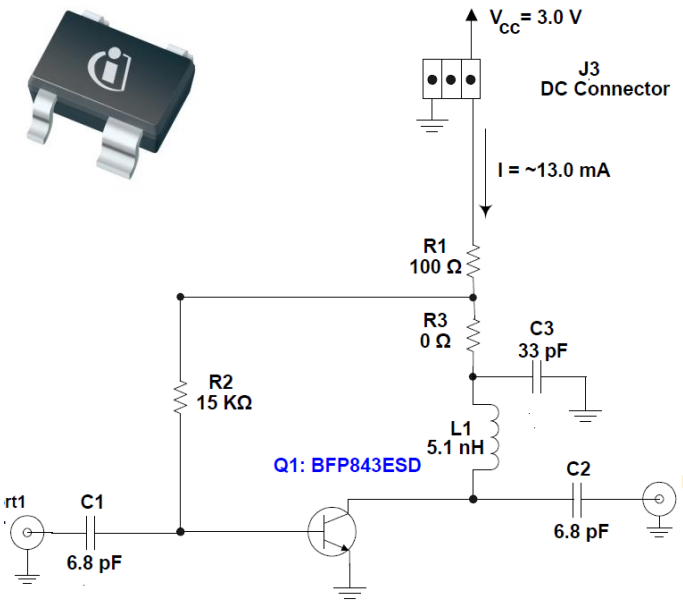
Symbol	Value		Unit
Vcc	3.0		V
Icc	11.9		mA
Freq	2400	2500	MHz
G _{ON}	19.3	19.0	dB
G _{OFF}	-17.6	-17.5	dB
NF	0.76	0.76	dB
R _{Lin}	13.2	16.6	dB
R _{lout}	26.6	18.3	dB
I _{rev}	23.5	23.5	dB
IP1dB _{ON}	-9.9	-9.0	dBm
IP1dB _{OFF}	> 10	> 10	dBm
OP1dB _{ON}	8.4	9.0	dBm
OP1dB _{OFF}	--	--	dBm
IIP3	2,6	3,7	dBm
OIP3	21.9	22,7	dBm
k	> 1		--

BFP760: 5-6GHz LNA Drop-in Solution for Atheros QCA98x reference designs (TR1131)



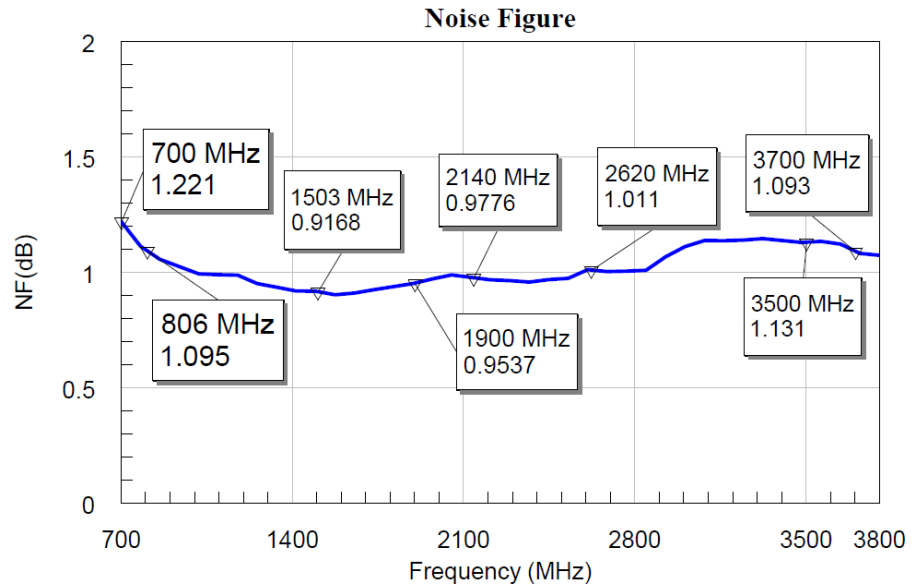
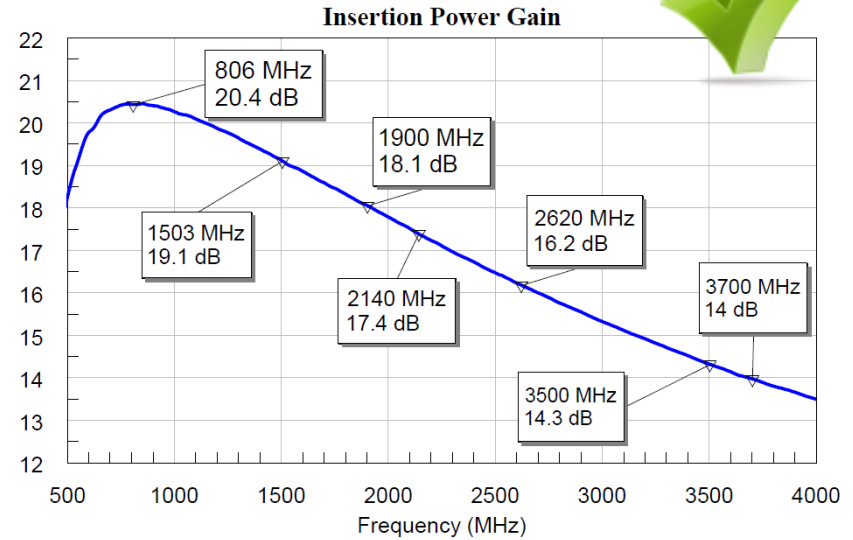
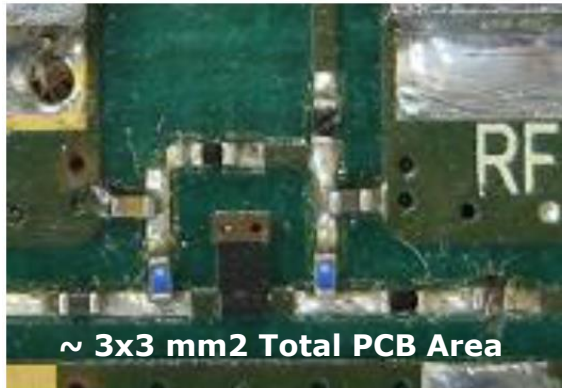
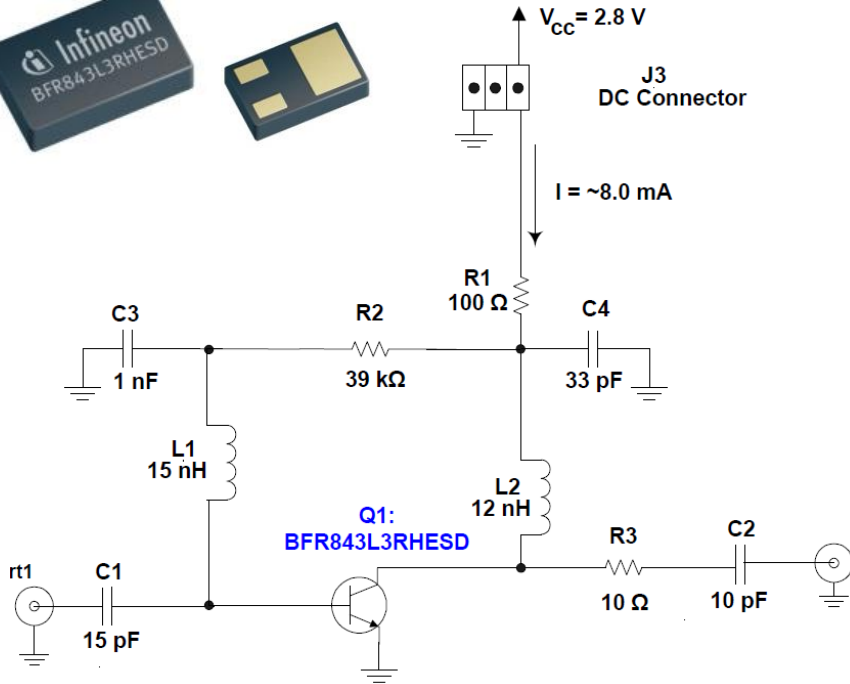
Parameter	Symbol	Value			Unit
DC Voltage	V_{CC}	3			V
DC Current	I_{CC}	11			mA
Frequency Range	Freq	5.1	5.5	5.9	GHz
Gain (On-Mode)	G_{on}	13.5	12.8	11.7	dB
Gain (Off-Mode)	G_{OFF}	-11.4	-9.9	-9.2	dB
Noise Figure	NF	1.22	1.04	1.25	dB
Input Return Loss	RL_{in}	25.2	13.1	8	dB
Output Return Loss	RL_{out}	11.9	14.9	13.7	dB
Reverse Isolation	IR_{ev}	19.2	18.8	18.9	dB
Input P1dB (On-Mode)	$IP1dB_{on}$	-3.7			dBm
Output P1dB (On-Mode)	$OP1dB_{on}$	8.1			dBm
Input P1dB (Off-Mode)	$IP1dB_{off}$	>10			dBm
Input IP3	$IIP3$	7.6			dBm
Output IP3	$OIP3$	20.4			dBm
Stability	k	>1			--

BFP843: Lowest Parts-Count Dual-Band Matched LNA Application (AN312)



Parameter	Symbol	Value					Unit
DC Voltage	V_{CC}	3.0					V
DC Current	I_{CC}	13.8					mA
Frequency Range	Freq	2400	2500	5100	5500	5900	MHz
Gain (On Mode)	G_{ON}	19.6	19.4	15.3	14.7	14.2	dB
Gain (Off Mode)	G_{OFF}	-21.6	-21.7	-27.3	-31.6	-41.5	dB
Noise Figure	NF	1.06	1.08	1.34	1.36	1.35	dB
Input Return Loss	RL_{in}	12.0	12.1	25.0	21.4	16.7	dB
Output Return Loss	RL_{out}	18.1	17.5	28.4	21.0	15.8	dB
Reverse Isolation	I_{Rev}	27.5	27.6	25.8	25.0	24.3	dB
Input P1dB (On Mode)	$IP1dB_{ON}$	-12.3	-12.5	-8.4	-8.4	-7.4	dBm
Output P1dB (On Mode)	$OP1dB_{ON}$	6.3	5.9	5.9	5.3	5.8	dBm
Input IP3	$IIP3$	-2.1	-3.0	1.4	1.3	1.3	dBm
Output IP3	$OIP3$	17.6	17.0	16.7	16.1	15.2	dBm
Stability	k	> 1					--

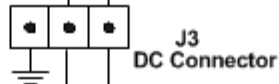
BFR843EL3: Smallest and Simplest Ultra Wide-Band Matched LNA Application **700M-6G** (AN328)



5G Bypass LNA using BFR705L3RH Transistor and 2x BAR86-02ELS Pin Diodes

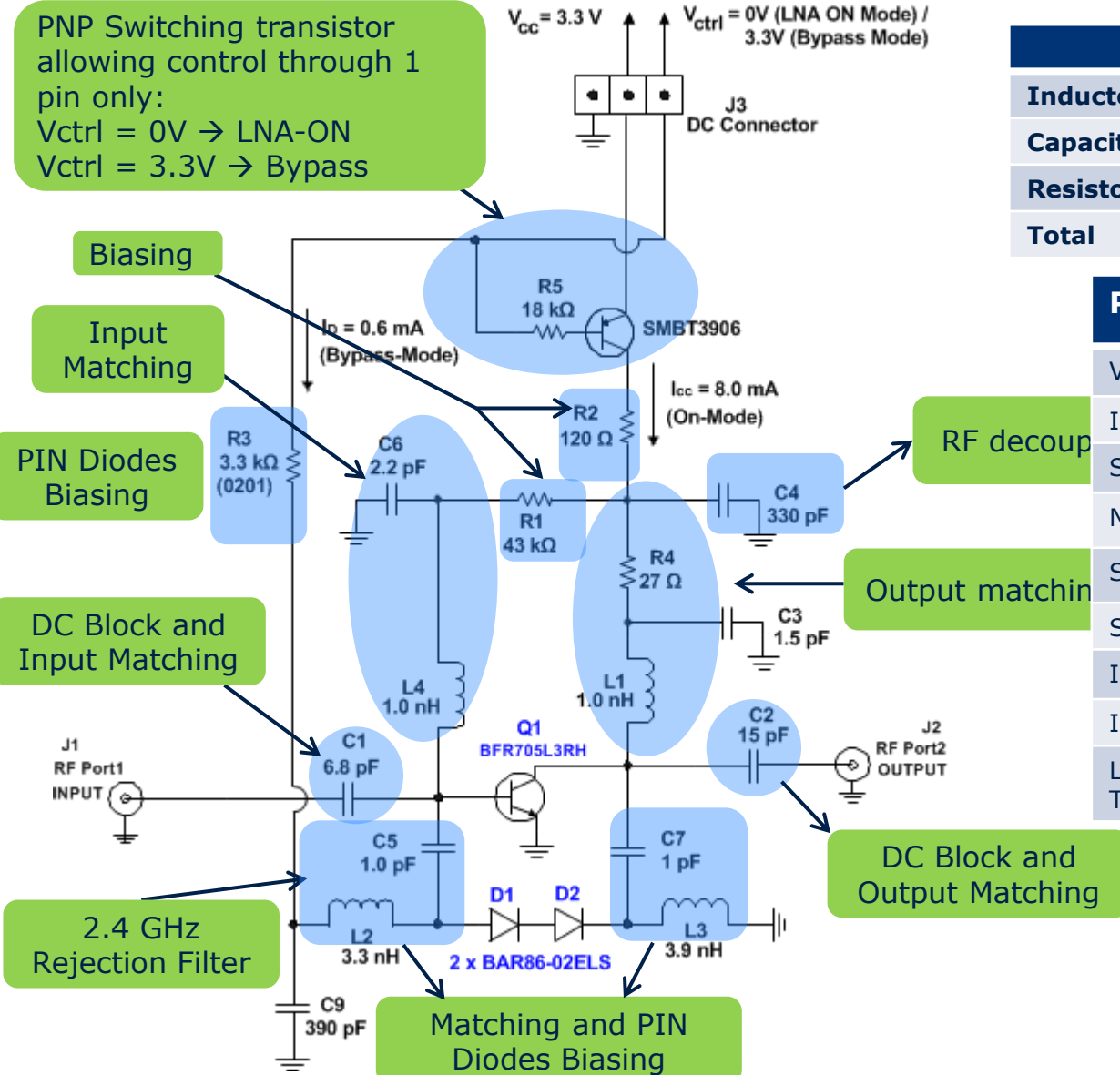
PNP Switching transistor allowing control through 1 pin only:
 $V_{ctrl} = 0V \rightarrow$ LNA-ON
 $V_{ctrl} = 3.3V \rightarrow$ Bypass

$V_{cc} = 3.3V$
 $V_{ctrl} = 0V$ (LNA ON Mode) / $3.3V$ (Bypass Mode)



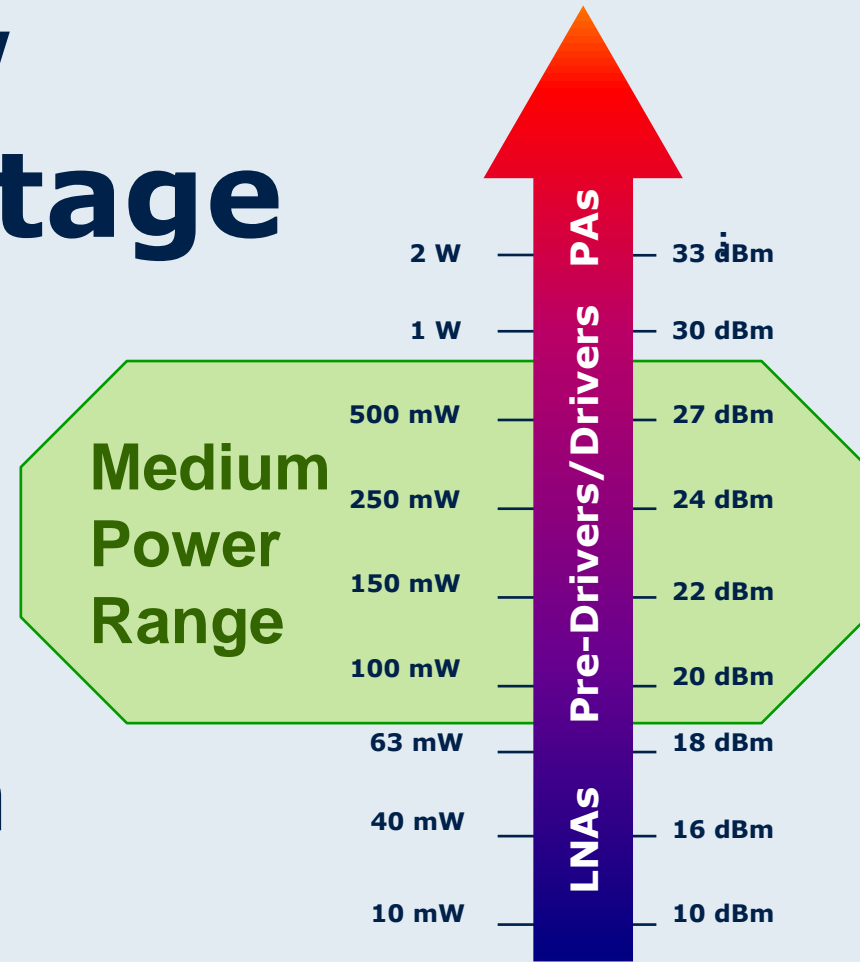
	Type	Count
Inductor	LQG (low Q)	4
Capacitor	Various	8
Resistor	Various	5
Total		17

Parameters	Results
Vcc [V]	3.3
Icc [mA]	8.0
S21 [dB]	13.9...12.5
NF (excl. losses) [dB]	1.47...1.4
S11 [dB]	11
S22 [dB]	15
Input P1dB [dBm]	-10...-8.6
IIP3 [dBm]	1
LNA to Bypass Settling Time [ns]	310



Infineon's New Linear Single Stage Medium Power Amplifiers

BFQ790 / BFP780
Product Presentation

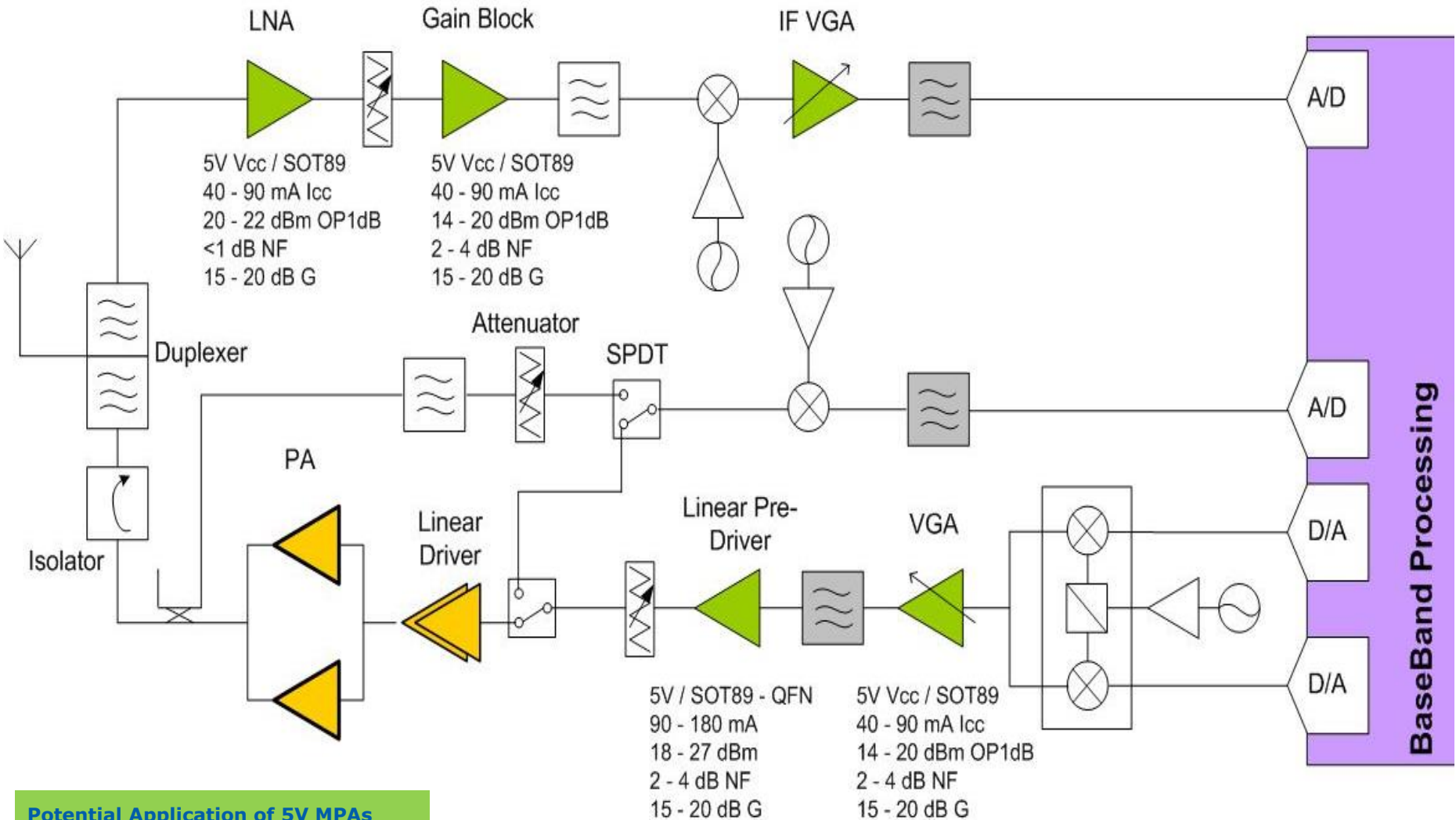


Medium Power Amplifiers at a Glance

Medium Power Amplifiers means ..

- OP1dB of 100mW / 22dBm and 500mW / 27dBm at 5V Supply
- 400 MHz to 3500 MHz frequency range
- Enhanced 3rd order (IP3/CTB) & 2nd order (IP2/CSO) distortion
- Linear Amplifiers with OIP3 > 40 dBm
- Low Noise Figure of NF < 1.4 dB
- High 20dB gain at 900 MHz and 15 dB gain at 2.6 GHz
- Robustness: >1kV ESD HBM & >20dBm RF overdrive protection
- Adopted for industrial reliability requirements
- New B7HFV Bipolar SiGe:C Technology with 23GHz fT / 7.5V VCE0
- Industry standard SOT89 package (SOT343 for 100mW variant)

Wireless Infrastructure Block Diagram Example



Potential Application of 5V MPAs

LDMOS Drivers and Power Amplifiers

May 2014

Key Features

- Broadband SiGe:C medium power amplifier
- OP1dB of 500mW / 27dBm at 5V, 240mA
- 400 MHz to 3500 MHz frequency range
- Highly Linear Amplifiers with OIP3 > 40 dBm
- Low noise figure of 1.7 dB @ 900MHz, 5V, 50mA
- Gmax = 24 dB/940MHz & 15dB/2.4G 5V, 250mA
- Robustness: >1kV ESD HBM
- >20dBm RF overdrive protection
- Adopted for industrial reliability requirements
- Cost effective bipolar SiGe technology running in very high volume
- Industry standard SOT89 package

Applications

- High linearity Driver or Pre-Driver in transmitters, linear LNA in the receive chain, or IF amplifier, in
- Commercial & industrial wireless infrastructure/basestations, small cells and Repeaters, for
- 3G/4G, WLAN, CATV, WiMAX, broadband and general ISM systems.

Description

The BFQ790 is a new single stage medium power Amplifier with very low distortion and high power gain for use at frequencies up to 3.8 GHz. The device is based on Infineon's reliable and cost effective NPN bipolar silicon germanium technology running in high volume. A special collector design as well as an integrated ballasting makes it very rugged and prevent from thermal runaway respectively 2nd breakdown. The design allows safe operation with a single 5V supply.



Performance

	1.9GHz	2.7GHz	Unit
Gain	17	14	dB
OIP3	41.5	42.5	dBm
OP1dB	27.5	27.5	dBm

As measured on evaluation boards incl. external matching

Design-In Support

PROD./SYST. MILESTONES

- Engineering Samples available
- Production start in 03/2014

Evaluation Boards:

- Reference Circuits with gerber files and evaluation boards for lab evaluation

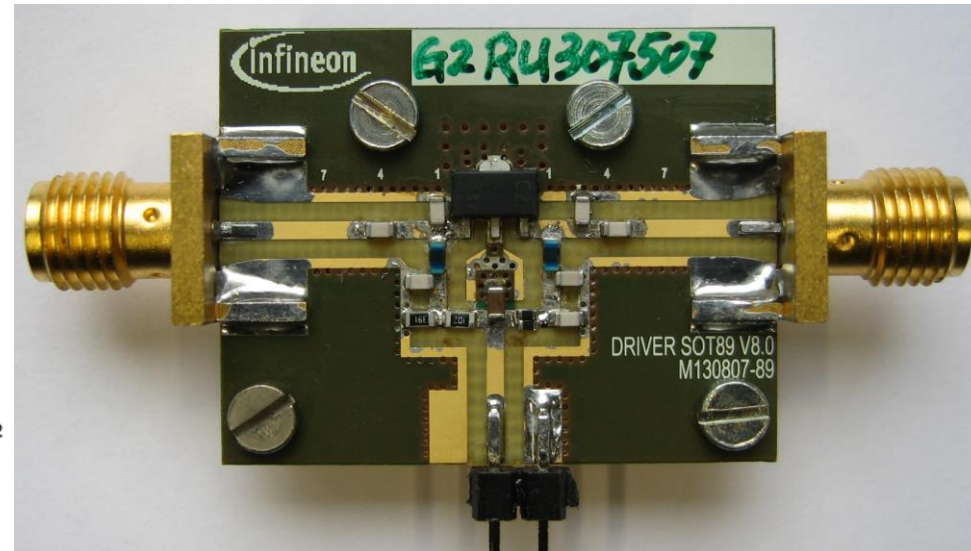
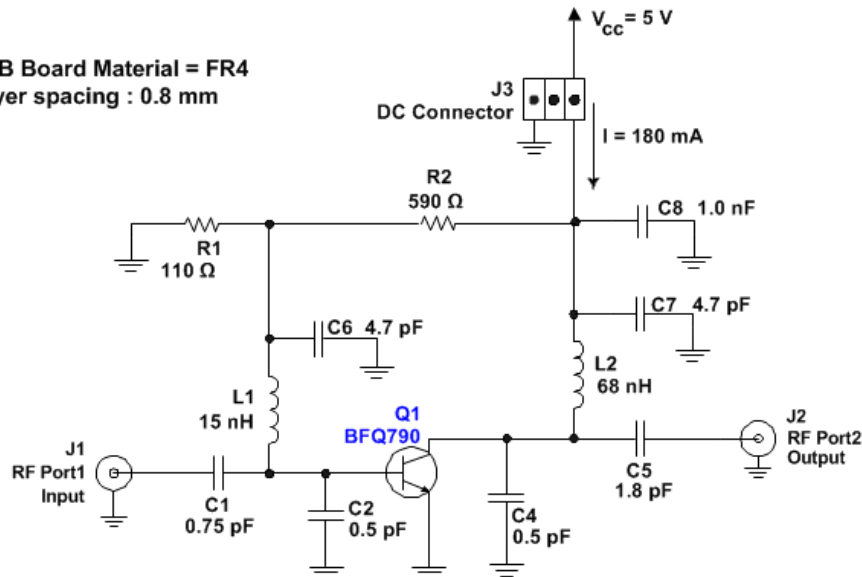
Datasheet & S Parameters:

- Preliminary Data Sheet available

Performance Overview on Evaluation Board

Frequency Range	740 – 840 MHz	2.5 – 2.7 GHz
Gain	21.6 dB	13.5 dB
OP1dB	27.3 dBm	27.5 dBm
OIP3	40.4 dBm	41 dBm
Input Return Loss	14.5 dB	13.3 dB
Output Return Loss	10.3 dB	11.1 dB
Noise Figure	5.3 dB	3.8 dB

PCB Board Material = FR4
Layer spacing : 0.8 mm



Key Features

- Broadband SiGe:C medium power amplifier
- OP1dB of 500mW / 22dBm at 5V, 90 mA
- 400 MHz to 3500 MHz frequency range
- Highly Linear Amplifiers with OIP3 > 37 dBm
- Low noise figure of 1.3 dB @ 900MHz, 5V, 50mA
- Gmax = 24 dB/940MHz & 19dB/2.4G 5V, 90mA
- Robustness: >1kV ESD HBM
- >20dBm RF overdrive protection
- Adopted for industrial reliability requirements
- Cost effective bipolar SiGe technology running in very high volume
- Industry standard SOT343 package

Applications

- High linearity general purpose Pre-Driver for transmitters, linear LNA in the receive chain, or IF amplifier, in
- Commercial & industrial wireless infrastructure equipment and set-top-boxes, for
- 3G/4G, WLAN, CATV, WiMAX and Wibro systems.

Description

The BFP780 is a new single stage medium power Amplifier with very low distortion and high power gain for use at frequencies up to 3.8 GHz. The device is based on Infineon's reliable and cost effective NPN bipolar silicon germanium technology running in high volume. A special collector design as well as an integrated ballasting makes it very rugged and prevent from thermal runaway respectively 2nd breakdown. The design allows safe operation with a single 5V supply.



Performance

	1.9GHz	2.7GHz	Unit
Gain	19	15	dB
OIP3	36	37	dBm
OP1dB	22	22	dBm

As measured on evaluation boards incl. external matching

Design-In Support

PROD./SYST. MILESTONES

- Engineering Samples available
- Production start in 03/2014

Evaluation Boards:

- Reference Circuits with gerber files and evaluation boards for lab evaluation

Datasheet & S Parameters:

- Preliminary Data Sheet available



ENERGY EFFICIENCY MOBILITY SECURITY

Innovative semiconductor solutions for energy efficiency, mobility and security.

