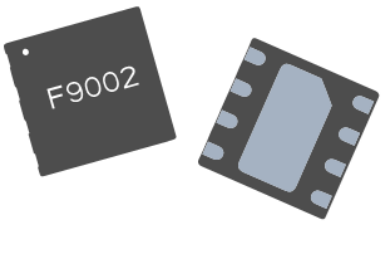
1. Description

- The F9002 is a low noise amplifier (LNA) provides a flat-gain, high-linearity and low noise figure from 0.5GHz to 4.5GHz.
- The F9002 integrates a shut-down biasing capability to allow for operation in TDD applications. The F9002 is 2.0 × 2.0 mm, 8 pins DFN package.



F9002-PDS-F01

Figure 1. F9002 Package Outline

2. Applications

- LTE/WCDMA/CDMA/GSM/MIMO
- Repeaters/DAS
- TDD or FDD Systems
- General Purpose Wireless

3. Features[1]

- Operating Frequency: 500-4500MHz
- Small Signal Gain: 23.2dB
- Output P1dB: 20.5dBm
- Output OIP3: 34.5dBm
- Noise Figure: 0.6dB
- Operating Voltage/Current: 5V/75mA
- Package: 2.0 x 2.0 x 0.55mm DFN

1. Measured in Raytron DEMO @1900MHz

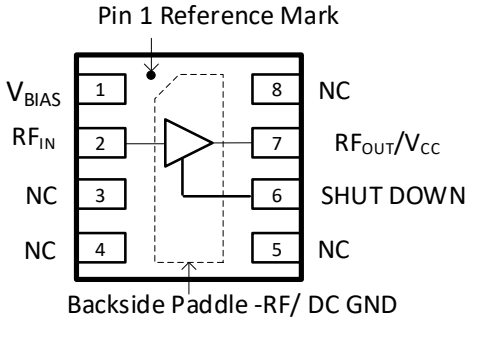
4. Brief Typical Performance

Table 1. Brief Typical Performance

Parameter[1]	900MHz	1900MHz	2600MHz	3500MHz	Units
Gain, Small Signal	24.3	23.2	22.1	20.7	dB
Output P1dB[2]	21.2	20.5	19.8	19.0	dBm
Output IP3[3]	35.9	34.5	35.0	35.3	dBm
Noise Figure[4]	0.58	0.60	0.70	0.94	dB

1. V_{CC}=5V, I_{CQ}=75mA, Temp=25℃, 50Ω test system
2. Input signal: CW
3. Input signal: 2-tone, P_{OUT}=5dBm/tone, Δf=1MHz
4. De-embedded Data

5. Block Diagram



F9002-PDS-F02

Figure 2. F9002 Block Diagram TOP View

Table of Contents

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6. Absolute Maximum Ratings

Table 2. Absolute Maximum Ratings

Parameter	Symbol	Rating	Units
Operating Voltage	V_{CC}	5.5	V
Input Power	P_{IN}	30	dBm
Storage Temperature Range	T_{STG}	- 55 ~ +125	°C
Operating Junction Temperature	T_J	150	°C

7. Recommended Operating Conditions

Table 3. Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Units
Operating Temperature Range	-40	25	105	°C
Operating Voltage (V_{CC}, V_{BIAS})	3.0	5.0	5.25	V
Power Shut Down Control (Pin 6), On State	0	-	0.7	V
Power Shut Down Control (Pin 6), Off State	1.1	-	5.5	V
Operating Frequency	500	-	5000	MHz

8. Typical Performance

8.1 Typical Performance at 5V

8.1.1 Electrical Characteristics

Table 4. Electrical Characteristics (V_{CC}=V_{BIAS}=5V, I_{CQ}=75mA, Temp=25℃, 50Ω test system)

Parameter	Conditions	Typical Values				Units
Frequency	-	900	1900	2600	3500	MHz
Small Signal Gain	-	24.3	23.2	22.1	20.7	dB
Input Return Loss (S11)	-	20.8	16.9	12.2	10.0	dB
Output Return Loss (S22)	-	11.4	11	7.8	5.9	dB
Output P1dB	-	21.2	20.5	19.8	19.0	dBm
Output IP3	P_{OUT}=5dBm/tone,Δf=1MHz	35.9	34.5	35	35.3	dBm
Noise Figure	De-Embedded	0.58	0.60	0.70	0.94	dB
Device Operating Current	On State	75				mA
Shutdown Current	Off State	3				mA
Shutdown Pin Current, I_{SD}	V_{PD}≥1.1V	194				uA
LNA ON to OFF	50% V_{PD} to 10% RF Output	100				ns
LNA OFF to ON	50% V_{PD} to 90% RF Output	100				ns

8.1.2 Performance Plot

(V_{CC}=V_{BIAS}=5V, I_{CQ}=75mA, 50Ω test system)

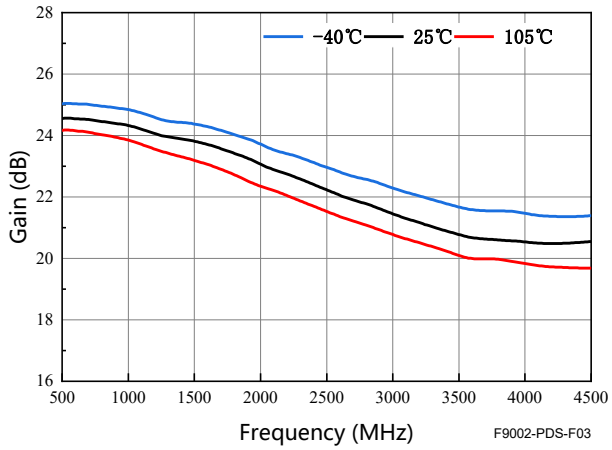


Figure 3. Gain vs. Freq.

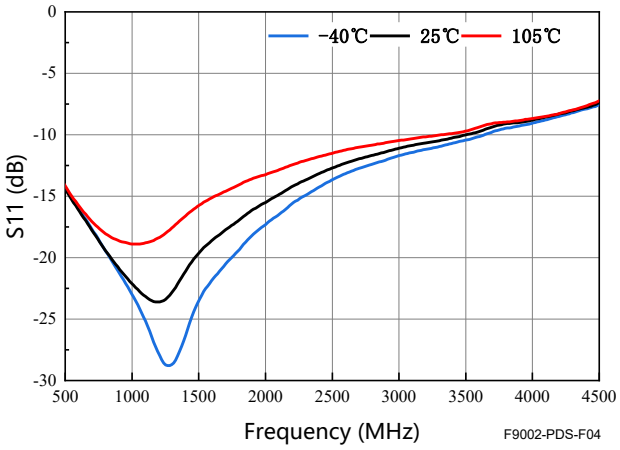


Figure 4. S11 vs. Freq.

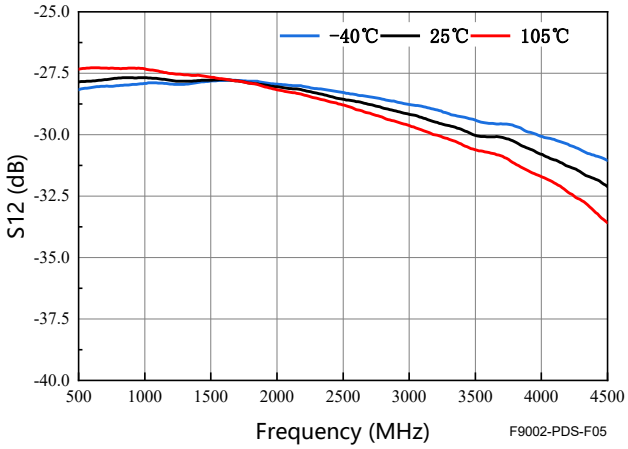


Figure 5. S12 vs. Freq.

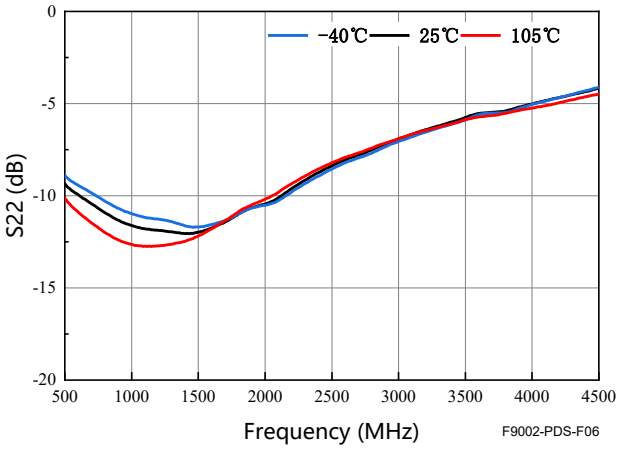


Figure 6. S22 vs. Freq.

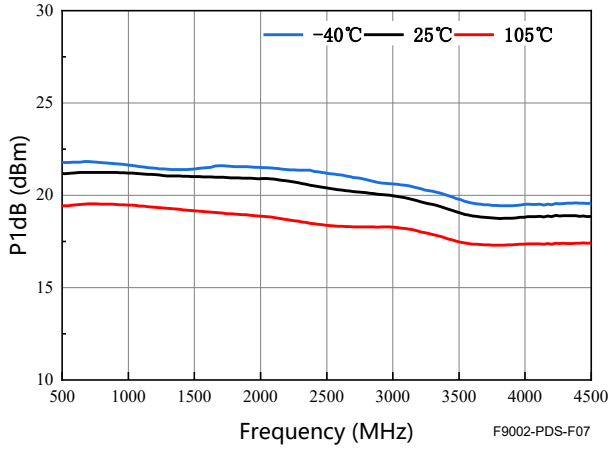


Figure 7. P1dB vs. Freq.

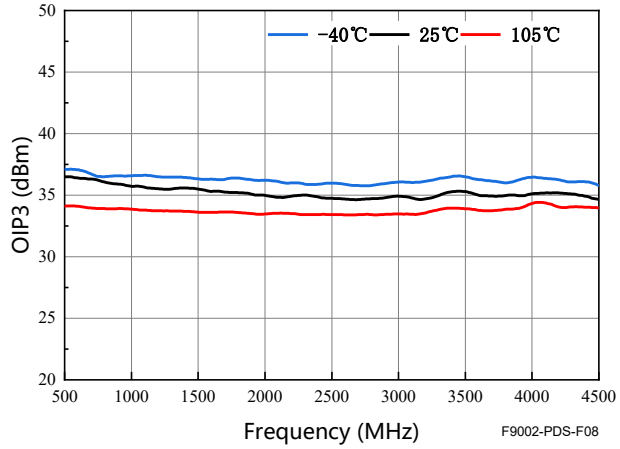


Figure 8. OIP3 vs. Freq.

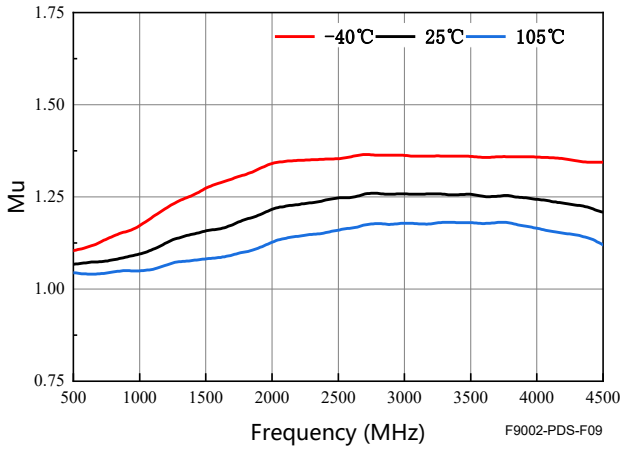


Figure 9. Stability Mu vs. Freq.

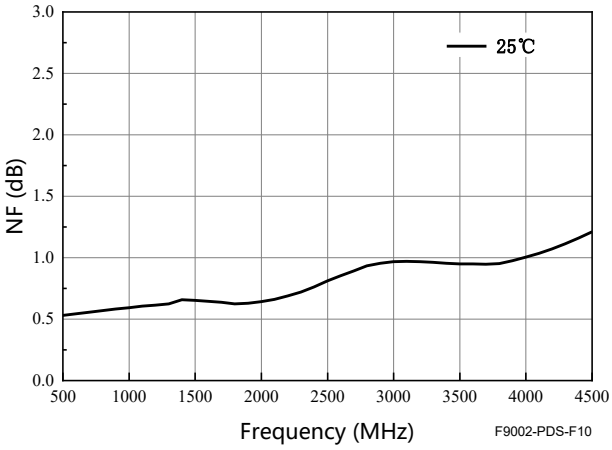


Figure 10. Noise Figure vs. Freq.

8.2 Typical Performance at 3.3V

8.2.1 Electrical Characteristics

Table 5. Electrical Characteristics (V_{CC}=V_{BIAS}=3.3V, I_{CQ}=75mA, Temp=25℃, 50Ω test system)

Parameter	Conditions	Typical Values				Units
Frequency	-	900	1900	2600	3500	MHz
Small Signal Gain	-	24.3	23.2	22.1	21.0	dB
Input Return Loss (S11)	-	12.2	13.5	9.9	8.8	dB
Output Return Loss (S22)	-	8.5	10.4	8.1	6.1	dB
Output P1dB	-	18.8	18.7	18.8	18.5	dBm
Output IP3	P_{OUT}=5dBm/tone,Δf=1MHz	35.7	35.5	35	35.1	dBm
Noise Figure	De-Embedded	0.61	0.60	0.70	0.92	dB
Device Operating Current	On State	75				mA
Shutdown Current	Off State	2				mA
Shutdown Pin Current, I_{SD}	V_{PD}≥1.1V	190				uA

8.2.2 Performance Plot

(V_{CC}=V_{BIAS}=3.3V, I_{CQ}=75mA, 50Ω test system)

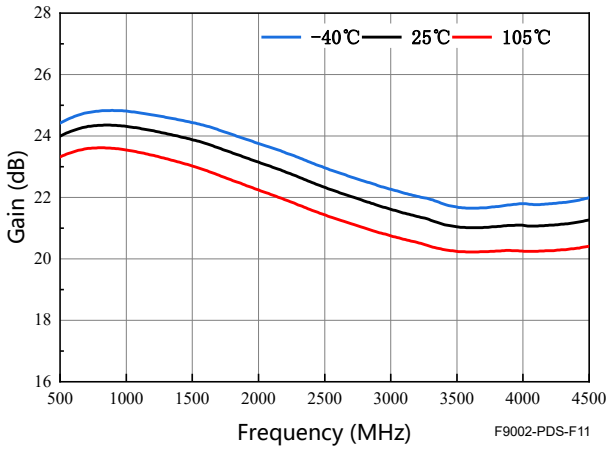


Figure 11. Gain vs. Freq.

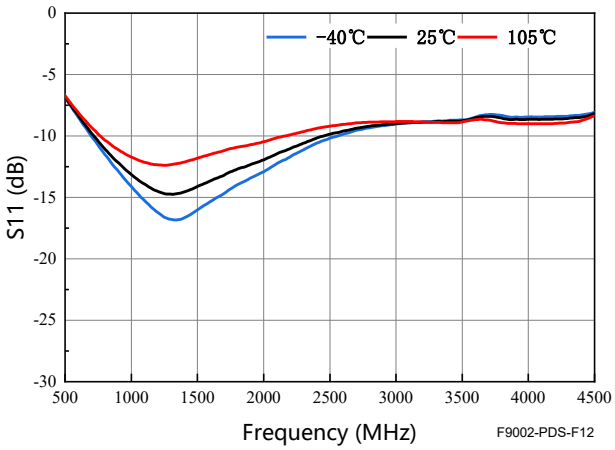


Figure 12. S11 vs. Freq.

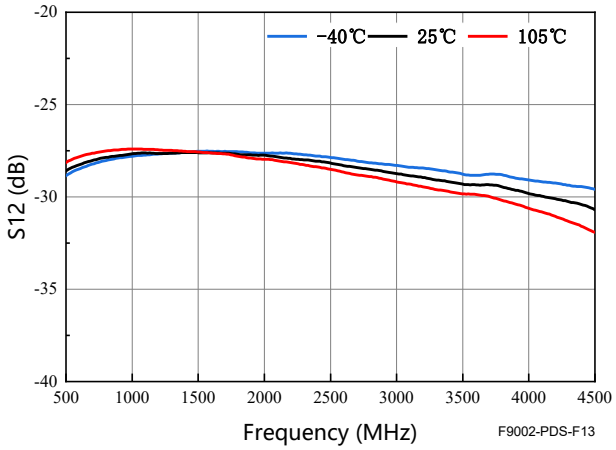


Figure 13. S12 vs. Freq.

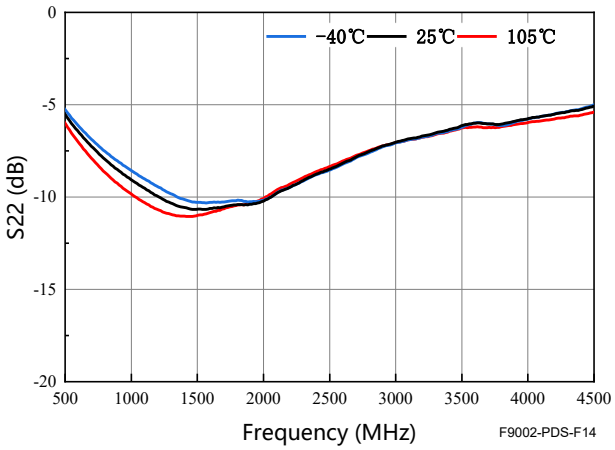


Figure 14. S22 vs. Freq.

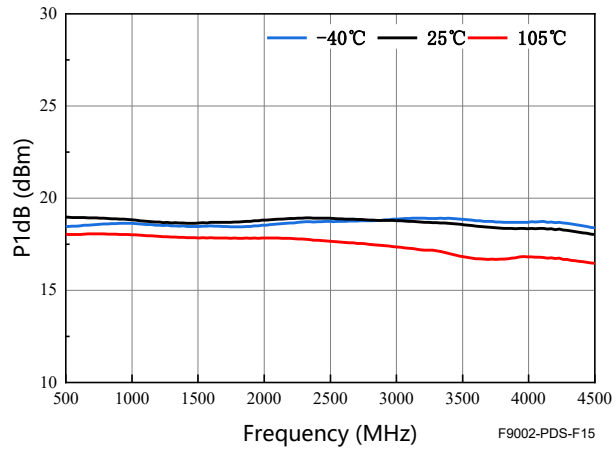


Figure 15. P1dB vs. Freq.

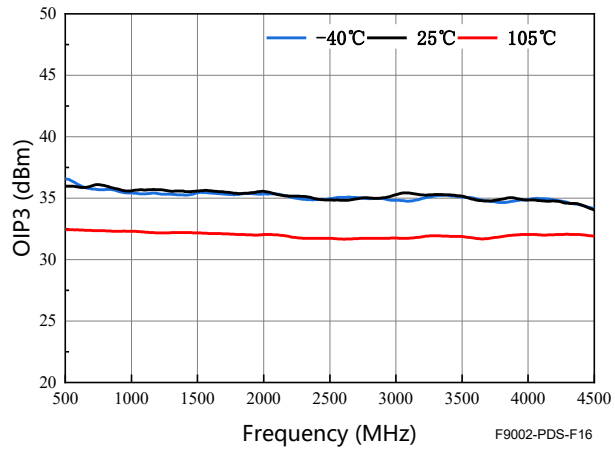


Figure 16. OIP3 vs. Freq.

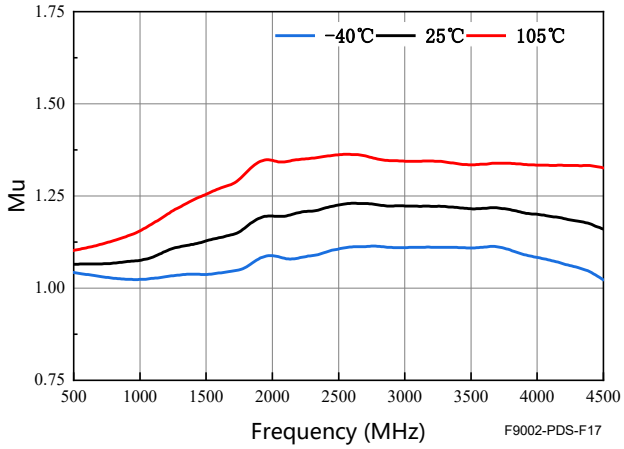


Figure 17. Stability Mu vs. Freq.

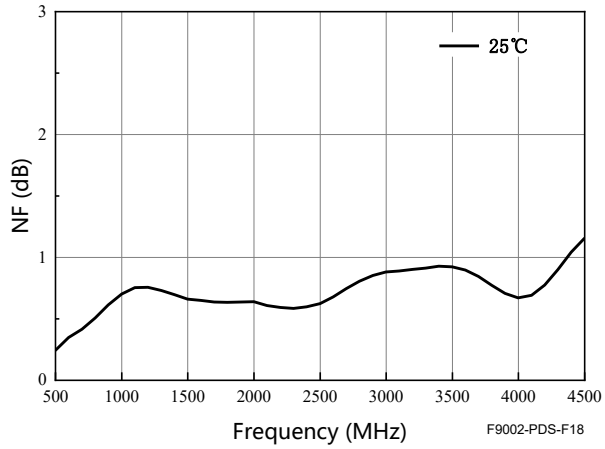


Figure 18. Noise Figure vs. Freq.

9. Package Outline

■ Pin Layout

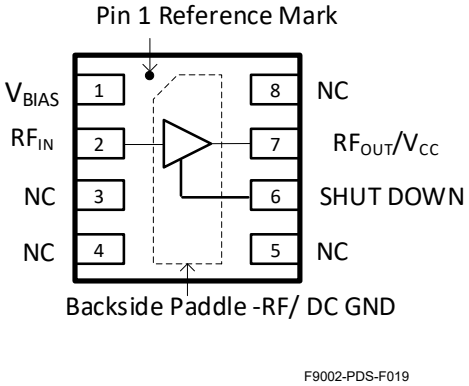


Figure 19. F9002 Pin Layout

Table 6. Pin Description

Pin	Symbol	Description
1	V_{BIAS}	Setting the I_{CQ} bias point for the device.
2	RF_{IN}	RF Input. External DC Block capacitor required.
6	SHUT DOWN	A high voltage(≥1.1V) turns off the device.
7	RF_{OUT}/V_{CC}	RF Output and DC supply input. External DC Block capacitor required.
3, 4, 5, 8	NC	No electrical connection. Provide ground land pads for PCB mounting integrity.
Backside Paddle	GND	RF/DC ground

■ Mechanical Drawing

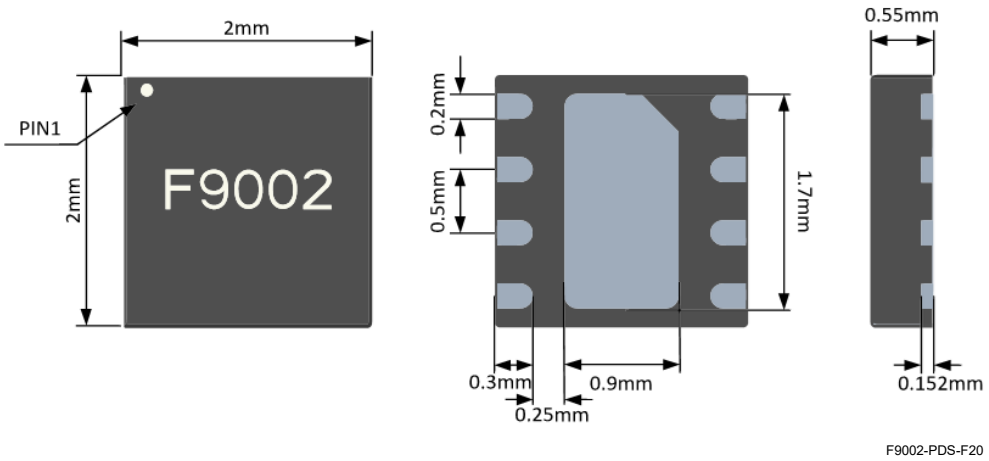


Figure 20. F9002 Mechanical Drawing

10. Application Circuit（500-4500MHz Reference Design）

■ Schematic

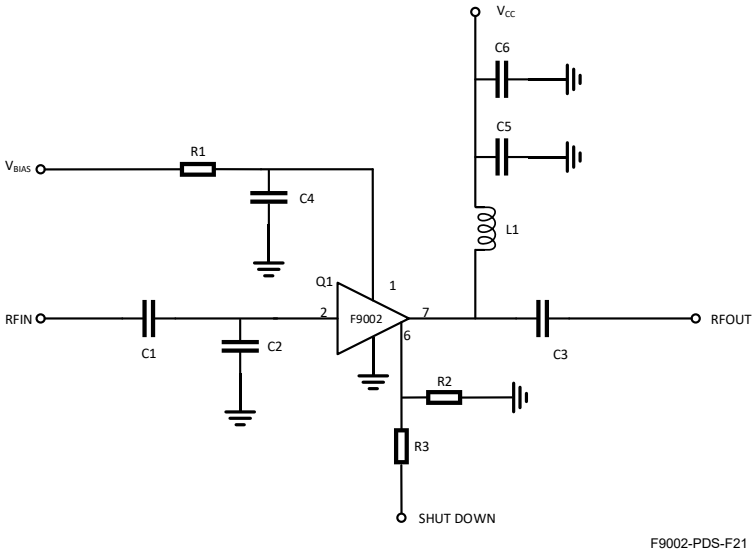


Figure 21. F9002 Application Circuit Schematic

■ Layout

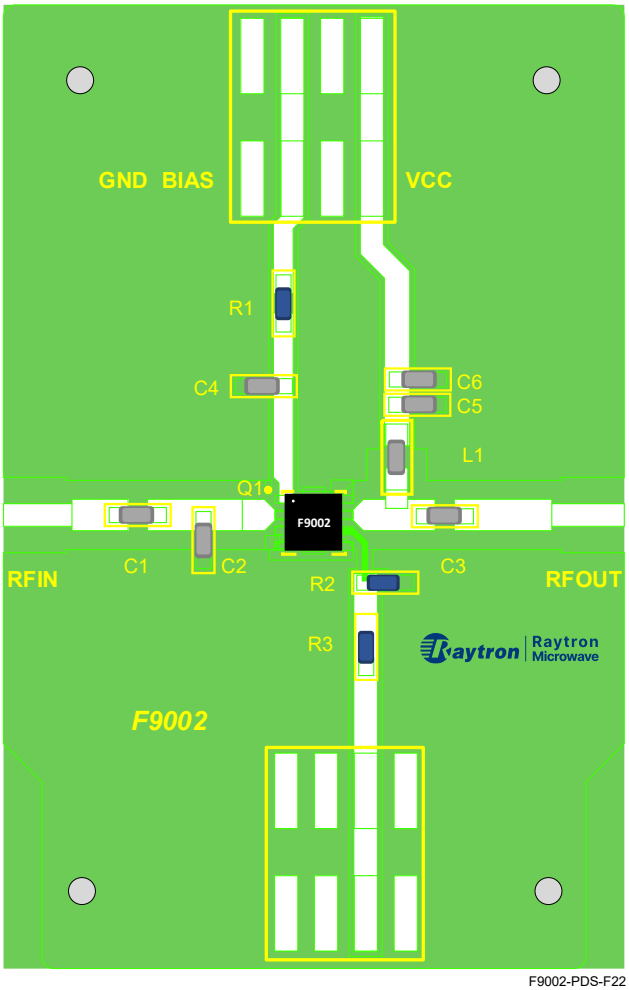


Figure 22. F9002 Application Circuit Layout

Table 7. Bill of Materials (V_{CC}=5V, R1=3KΩ, I_{CQ}=75mA)

Component	Value	Description	Manufacturer	Part Number
PCB	20mil	N/A	Rogers	RO4350B
Q1	N/A	F9002, DFN-8 pkg.	Raytron	F9002
C1	330pF	C0G 250V 0603 Capacitor	Murata	GCM1885C2A331JA16D
C2	N/A	N/A	N/A	N/A
C3	330pF	C0G 250V 0603 Capacitor	Murata	GCM1885C2A331JA16D
C4	1000pF	C0G 250V 0603 Capacitor	Murata	GRM1885C1H102JA01D
C5	100pF	C0G 250V 0603 Capacitor	Murata	GQM1875C2E101GB12
C6	1uF	0603 Capacitor	Various	N/A
L1	30nH	High Q 0603 Inductance	Murata	LQW18AN30NG80D
R1	3KΩ	1/4W 0603 Resistor	Various	N/A
R2	N/A	N/A	N/A	N/A
R3	0Ω	1/4W 0603 Resistor	Various	N/A

Table 8. Bill of Materials (V_{CC}=3.3V, R1=390Ω, I_{CQ}=75mA)

Component	Value	Description	Manufacturer	Part Number
PCB	20mil	N/A	Rogers	RO4350B
Q1	N/A	F9002, DFN-8 pkg.	Raytron	F9002
C1	330pF	C0G 250V 0603 Capacitor	Murata	GCM1885C2A331JA16D
C2	N/A	N/A	N/A	N/A
C3	330pF	C0G 250V 0603 Capacitor	Murata	GCM1885C2A331JA16D
C4	1000pF	C0G 250V 0603 Capacitor	Murata	GRM1885C1H102JA01D
C5	100pF	C0G 250V 0603 Capacitor	Murata	GQM1875C2E101GB12
C6	1uF	0603 Capacitor	Various	N/A
L1	30nH	High Q 0603 Inductance	Murata	LQW18AN30NG80D
R1	390Ω	1/4W 0603 Resistor	Various	N/A
R2	N/A	N/A	N/A	N/A
R3	0Ω	1/4W 0603 Resistor	Various	N/A

11. Handling Precautions

■ ESD Caution

Table 9. ESD/MSL Rating

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1B	ESDA / JEDEC JS-001-2014
ESD – Charged Device Model (CDM)	Class C3	ESDA / JEDEC JS-002-2014
MSL – Moisture Sensitivity Level	Level 1	IPCJEDEC J-STD-020

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore proper ESD precautions should be taken to avoid performance degradation or loss of functionality.



12. Contact Information

For the latest specifications, additional product information, technical support and sales support, please contact:

- **Email:** RF.support@raytrontek.com
- **Web:** www.raytrontek.com

13. Disclaimer

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