1. Description

- The M3509L is low noise amplifier fabricated on GaAs p-HEMT MMIC process in a 2.5mm x 2mm LGA package. It operates over 17-22GHz and provides 23dB gain with 1dB positive slope and achieves 1.3dB noise figure. It can be biased from a single positive supply of 3V.



M3509L-PDS-F01

Figure 1. M3509L Functional Block Diagram

2. Applications

- Satellite Communication
- Radar Modules

3. Features

- Frequency: 17-22GHz
- Typical Gain: 23dB, 1dB positive slope
- Noise Figure: 1.3dB
- Input/Output Return Loss: -13dB/-15dB
- Output P_{-1dB}: -3.5dBm
- Single Positive Supply: +3V (I_{DQ}=7mA)
- 50Ohm Matched Input/Output
- Package Size: 2.50 x 2.00 x 0.88mm

4. Brief Typical Performance

Table 1. Brief Typical Performance

Parameter	17-22GHz	Units
Small-Signal Gain	23	dB
Noise Figure	1.3	dB
Input Return Loss	-13	dB
Output Return Loss	-15	dB
Output P_{-1dB}	-3.5	dBm
Power Consumption	21	mW

Table of Contents

No.	Contents	Page
1	Description	1
2	Applications	1
3	Features	1
4	Brief Typical Performance	1
5	Absolute Maximum Ratings	3
6	Recommended Operating Conditions	3
7	RF Characteristics	3
8	Typical Performance Curve	4
9	Package Outline	5
10	Application Circuit	6
11	Recommended Solder Temperature Profile	7
12	Handling Precautions	7
13	Contact Information	7
14	Disclaimer	8

5. Absolute Maximum Ratings

Table 2. Absolute Maximum Ratings

Parameter	Symbol	Rating	Units
Operating Voltage Range	V_D	0 ~ +6	V
Maximum Input Power	P_{IN}	16	dBm
Storage Temperature Range	T_{STG}	- 55 ~ 150	°C

6. Recommended Operating Conditions

Table 3. Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Units
Operating Temperature Range	-55	25	125	°C
Supply Voltage, V_D	-	3	-	V
Supply Current, I_{DQ}	-	7	-	mA

7. RF Characteristics (V_D=3V, T_C = 25˚C)

Table 4. RF Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
Operating Frequency	Freq.	17	-	22	GHz
Small-Signal Gain	Gain	22.3	23	23.6	dB
Noise Figure	NF	-	1.3	1.4	dB
Input Return Loss	IN RL	-24	-13	-12	dB
Output Return Loss	OUT RL	-23	-15	-13	dB
Output Power for 1dB Compression	OP1dB	-	-3.5	-	dBm
Supply Current	I_D	5	7	8	mA

• Typical performance at these conditions: Temp=25°C, V_D=3V, P_{IN}=-40dBm, 50Ohm system.

8. Typical Performance Curve

■ Small-signal Characteristics Curve

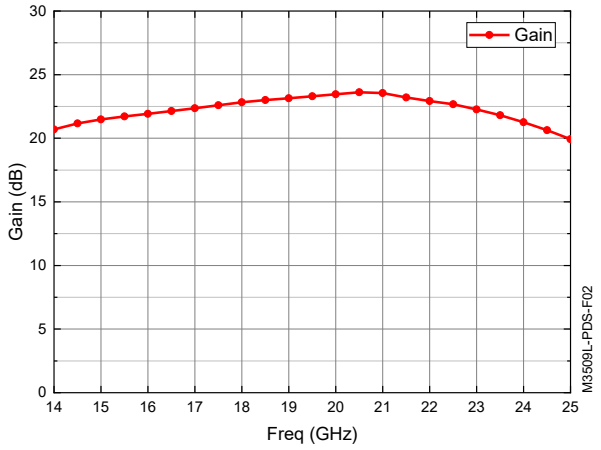


Figure 2. Small-signal Gain Characteristics

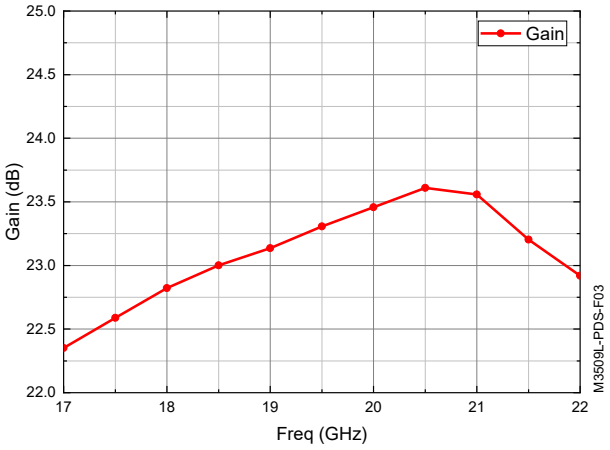


Figure 3. Small-signal Gain Characteristics

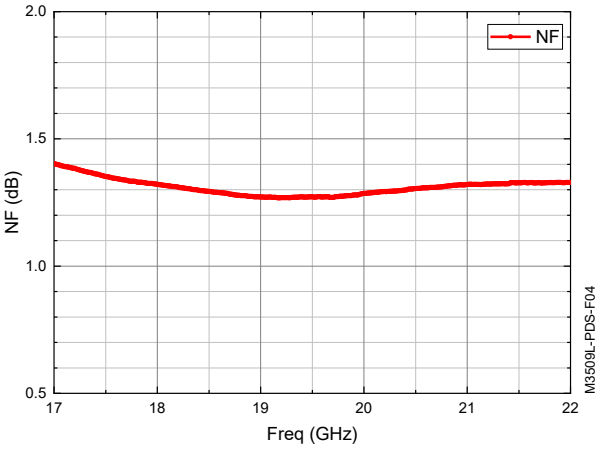


Figure 4. Noise Figure Characteristics

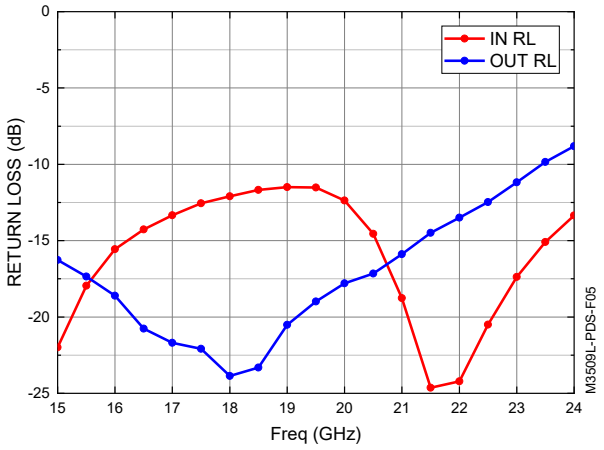


Figure 5. Input\Output Return Loss Characteristics

■ Power Characteristics Curve

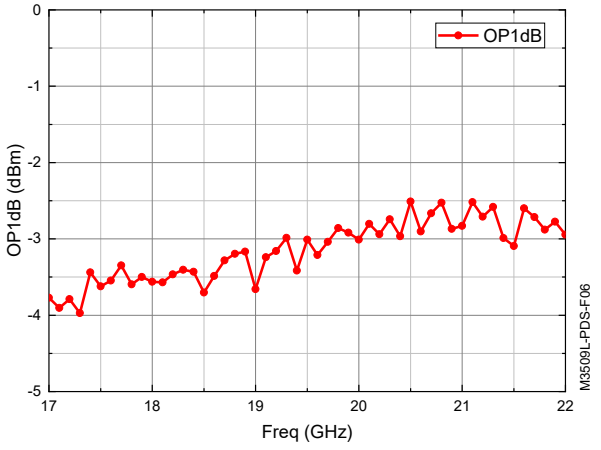
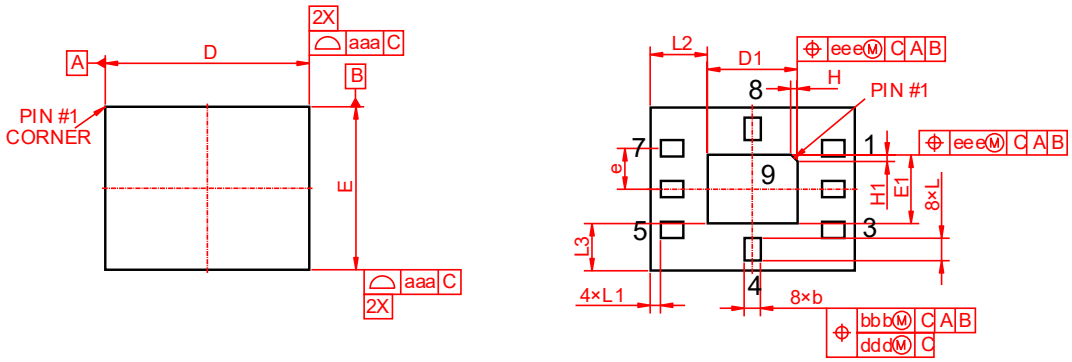


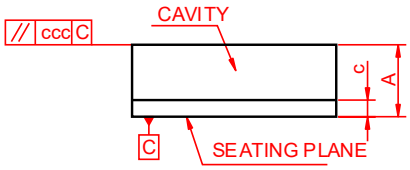
Figure 6. OP-1dB Characteristics

9. Package Outline



Top View

Bottom View



Side View

symbol	Dimension in mm			Dimension in inch		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.784	0.884	0.984	0.031	0.035	0.039
c	0.174	0.204	0.234	0.007	0.008	0.009
D	2.450	2.500	2.550	0.096	0.098	0.100
E	1.950	2.000	2.050	0.077	0.079	0.081
D1	1.000	1.100	1.200	0.039	0.043	0.047
E1	0.740	0.840	0.940	0.029	0.033	0.037
H	---	0.080	---	---	0.003	---
H1	---	0.080	---	---	0.003	---
L	0.225	0.275	0.325	0.009	0.011	0.013
L1	0.050	0.125	0.200	0.002	0.005	0.008
L2	0.625	0.700	0.775	0.025	0.028	0.031
L3	0.505	0.580	0.655	0.020	0.023	0.026
e	---	0.500	---	---	0.020	---
b	0.150	0.200	0.250	0.006	0.008	0.010
aaa	0.100			0.004		
bbb	0.150			0.006		
ccc	0.100			0.004		
ddd	0.050			0.002		
eee	0.150			0.006		

M3509L-PDS-F07

- Dimensions shown in millimetre

Figure 7. M3509L Outline Dimensions

Table 5. PIN Description

Pin Number	Symbol	Description
2	RF_{IN}	RF Input. 50 ohm. DC blocking capacitor is not required.
6	RF_{OUT}	RF Output. 50 ohm. DC blocking capacitor is not required.
8	V_D	Supply Voltage. External bypass capacitors are required, refer to Figure 8.
1, 3, 5, 7, 9	GND	Package bottom must be connected to RF/DC ground
4	N/C	This pin is not connected and will not affect any performance

10. Application Circuit

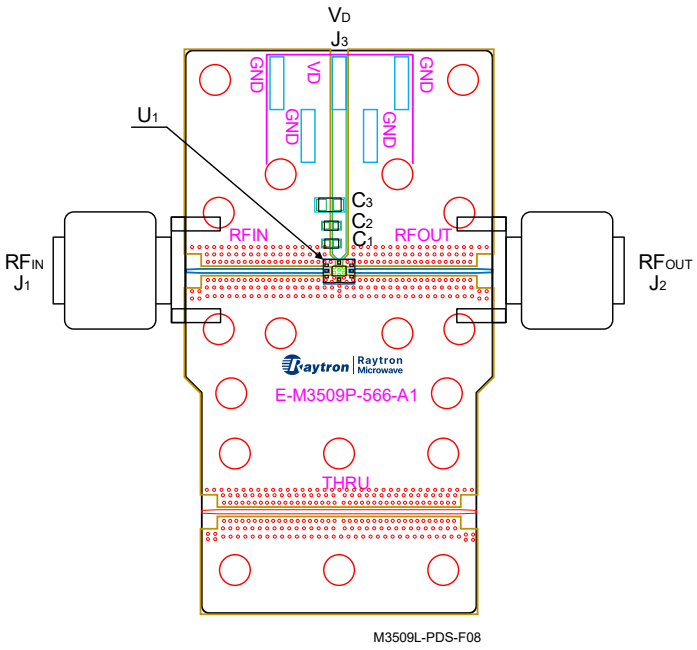


Figure 8. M3509L Evaluation PCB

Table 6. List of Materials for Evaluation PCB

Item	Symbol	Description
J_1-J_2	RF_{IN}, RF_{OUT}	PCB Mount SMA Connector.
J_3	V_D	Supply Voltage. External bypass capacitors are required.
C_1	-	33pF Capacitor, 0402 Pkg.
C_2	-	1uF Capacitor, 0402 Pkg.
C_3	-	10uF Capacitor, 0603 Pkg.
U_1	M3509L	Low Noise Amplifier in 2.5mm x 2.0mm LGA Package

11. Recommended Solder Temperature Profile

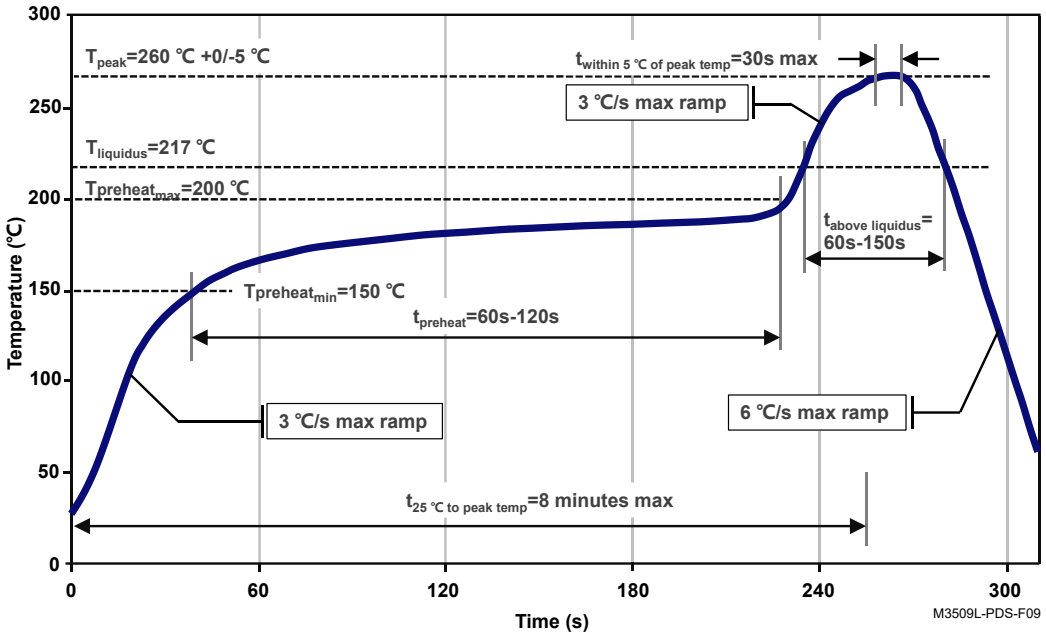


Figure 9. Recommended Solder Temperature Profile

12. Handling Precautions

- **ESD Caution**

  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.



13. 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

14. Disclaimer

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