# AXL2319 Data Sheet

*Ultra Low Noise Amplifier for SDARS Antenna*

## 1. Product Overview

### 1.1 General Description

AXL2319 has high linearity and low noise to be suitable for use in automotive SDARS antenna. The amplifier is available in a TDFN8 package and passes the stringent DC, RF, and reliability tests.

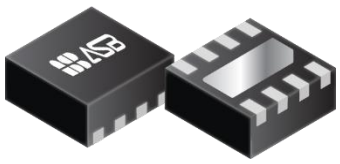
### 1.2 Features

- 0.35 dB NF at 2332 MHz
- 37.0 dB OIP3 at 2332 MHz
- 19.1 dB Gain at 2332 MHz
- 19.0 dB P1dB at 2332 MHz
- Integrated LNA on/off Control
- MTTF > 100 Years
- Flexible Bias Voltage and Current

### 1.3 Applications

- SDARS antenna

### 1.4 Package Profile & RoHS Compliance

| | |
|---|---|
|  | RoHS-compliant GREEN Package |
| TDFN8, 2.0x2.0 mm$^2$, surface mount | RoHS-compliant |

# 2. Summary on Product Performances

## 2.1 Typical Performance

Supply voltage = +4 V, Bias Voltage = +4 V, Control Voltage = 0 V, $T_A$ = +25 °C, $Z_O$ = 50 Ω.

| Parameter | Typical | | | Unit |
|---|---|---|---|---|
| Frequency | 2332 | 2332 | 2332 | MHz |
| Gain | 18.7 | 18.9 | 19.1 | dB |
| S11 | -11.0 | -11.0 | -12.0 | dB |
| S22 | -12.0 | -12.0 | -13.0 | dB |
| Noise Figure 1) | 0.36 | 0.35 | 0.35 | dB |
| Output IP3 2) | 34.0 | 36.0 | 37.0 | dBm |
| Output P1dB | 18.0 | 18.5 | 19.0 | dBm |
| Current | 45 | 55 | 65 | mA |
| Device Voltage | 4.0 | 4.0 | 4.0 | V |

1) Noise figure is measured at the SMA connectors of the evaluation board (i.e., not de-embedded to the device).
2) OIP3 is measured with two tones at the output power of +4 dBm/tone separated by 1 MHz.

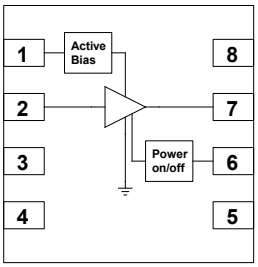
| Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Power Shutdown Control (Vc) | On state | | 0 | | V |
| | Off state | | 1.0 | Vd | V |
| Current | On state | | 65 | | mA |
| | Off state | | 3 | | mA |
| Switching Speed | Rise time (10% to 90%) | | 150 | | ns |
| | Fall time (90% to 10%) | | 150 | | ns |

## 2.2 Product Specification

Supply voltage = +4 V, Bias Voltage = +4 V, Control Voltage = 0 V, $T_A$ = +25 °C, $Z_O$ = 50 Ω.

| Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|
| Frequency | 2320 | 2332 | 2345 | MHz |
| Noise Figure | | 0.35 | | dB |
| Gain | | 19.1 | | dB |
| S11 | | -12.0 | | dB |
| S22 | | -13.0 | | dB |
| Output IP3 | | 37.0 | | dBm |
| Output P1dB | | 19.0 | | dBm |
| Current | | 65 | | mA |
| Device Voltage | | 4.0 | | V |

## 2.3 Pin Configuration

| Pin | Description | Simplified Outline |
|---|---|---|
| 1 | Vbias |  |
| 2 | RF IN | |
| 6 | Vc (on/off function) | |
| 7 | RF OUT | |
| 3, 4, 5, 8 | NC or GND | |
| Backside paddle | GND | |



## 2.4 Absolute Maximum Ratings

| Parameters | Max. Ratings |
|---|---|
| Operation Case Temperature | -40 to +105 °C |
| Storage Temperature | -40 to +150 °C |
| Device Voltage | +6 V |
| Operation Junction Temperature | +150 °C |
| Input RF Power (CW, 50 Ω matched) | +27 dBm |

## 2.5 Thermal Resistance

| Symbol | Description | Typ | Unit |
|---|---|---|---|
| $R_{th}$ | Thermal resistance from junction to lead | 90 | °C/W |

## 2.6 ESD Classification & Moisture Sensitivity Level

### ESD Classification

| | |
|---|---|
| HBM | TBD |

CAUTION: Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

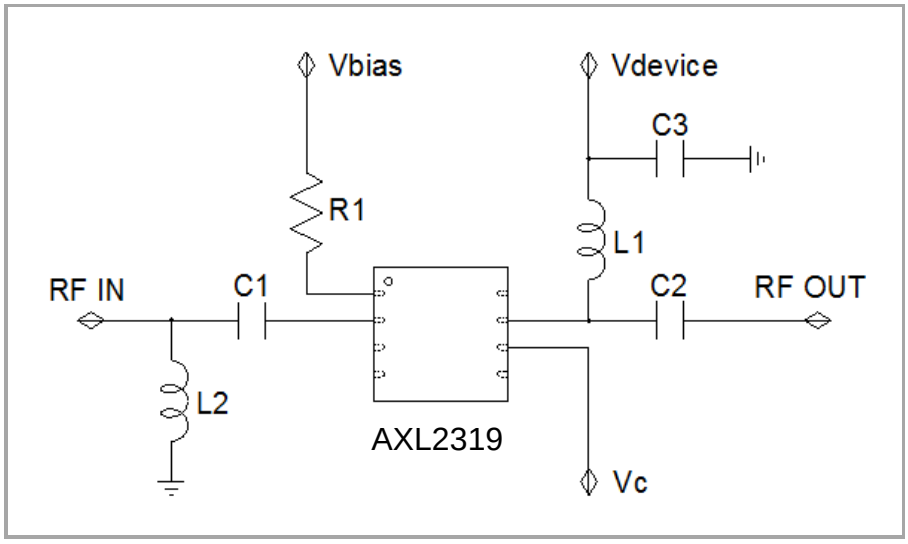
### Moisture Sensitivity Level

MSL 3 at 260 °C reflow

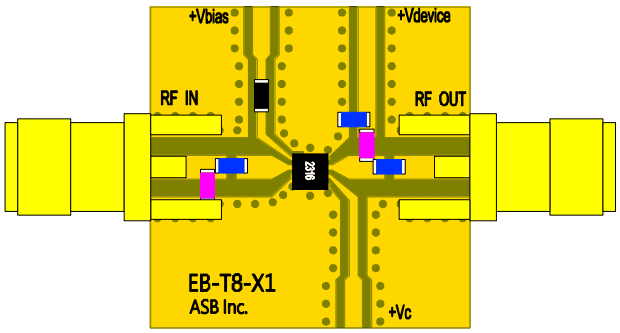
*(Intentionally Blanked)*

# 3. Application: 2320~2345 MHz ($V_{DEVICE}$ = +4.0 V)

## 3.1 Application Circuit & Evaluation Board




* Backside paddle is RF/ DC ground.




| State | Vc (V) |
|---|---|
| LNA ON | 0 or GND |
| OFF | 1.0 ~ Vd |

| PCB Information | |
|---|---|
| Material | FR4 |
| Thickness (mm) | 0.8 |
| Size (mm) | 18x18 |
| EB No. | EB-T8-X1 |

### Bill of Material

| Symbol | Value | Size | Description | Manufacturer |
|---|---|---|---|---|
| AXL2319 | - | - | MMIC amplifier | ASB |
| C1 | 10 pF | 0603 | DC blocking capacitor | Murata |
| C2 | 100 pF | 0603 | DC blocking capacitor | Murata |
| C3 | 1 μF | 0603 | Decoupling capacitor | Murata |
| L1 | 6.8 nH | 0603 | RF choke inductor | Murata |
| L2 | 10 nH | 0603 | Input matching inductor | Murata |
| R1 | 1.5 kΩ | 0603 | Bias resistor | Samsung |

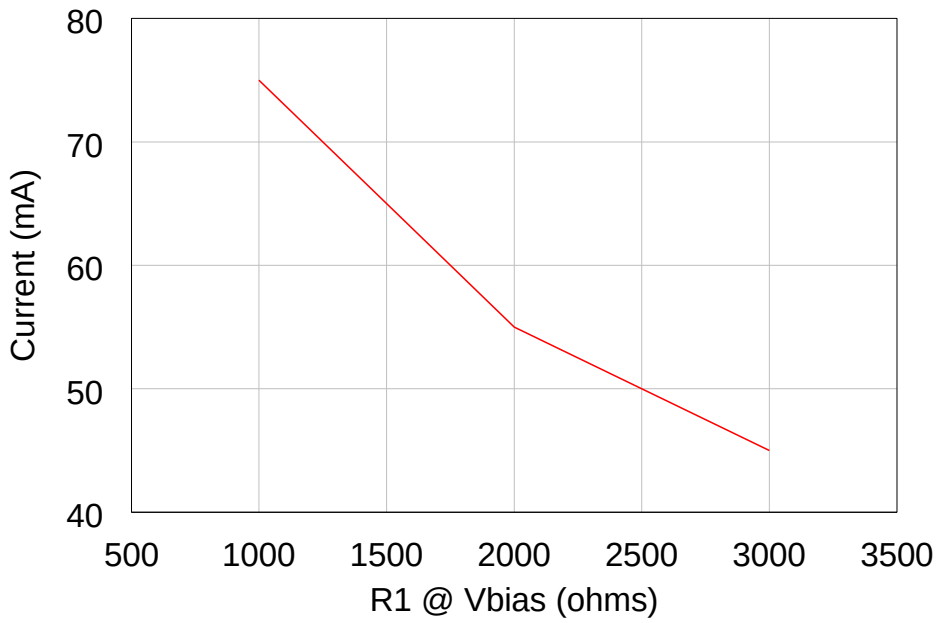
## 3.2 Performance Table

Supply voltage = +4 V, Bias Voltage = +4 V, Control Voltage = 0 V, $T_A$ = +25 °C, $Z_O$ = 50 Ω.

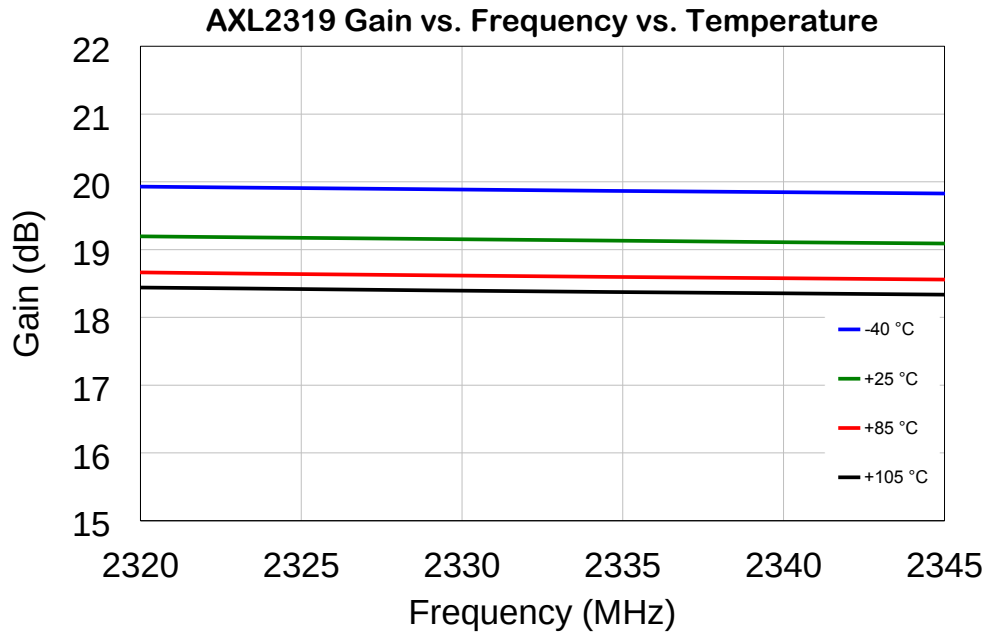
| Parameter | Typical | | | Unit |
|---|---|---|---|---|
| Frequency | 2332 | 2332 | 2332 | MHz |
| Gain | 18.7 | 18.9 | 19.1 | dB |
| S11 | -11.0 | -11.0 | -12.0 | dB |
| S22 | -12.0 | -12.0 | -13.0 | dB |
| Noise Figure [1)] | 0.36 | 0.35 | 0.35 | dB |
| Output IP3 [2)] | 34.0 | 36.0 | 37.0 | dBm |
| Output P1dB | 18.0 | 18.5 | 19.0 | dBm |
| Current | 45 | 55 | 65 | mA |
| Device Voltage | 4.0 | 4.0 | 4.0 | V |

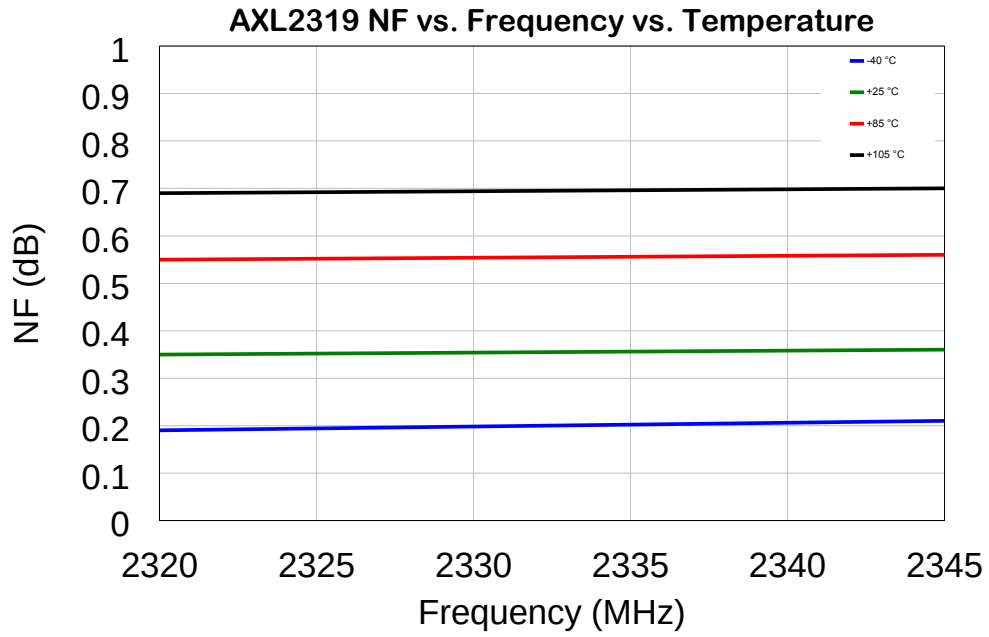
1) Noise figure is measured at the SMA connectors of the evaluation board (i.e., not de-embedded).
2) OIP3 is measured with two tones at the output power of +4 dBm/tone separated by 1 MHz.

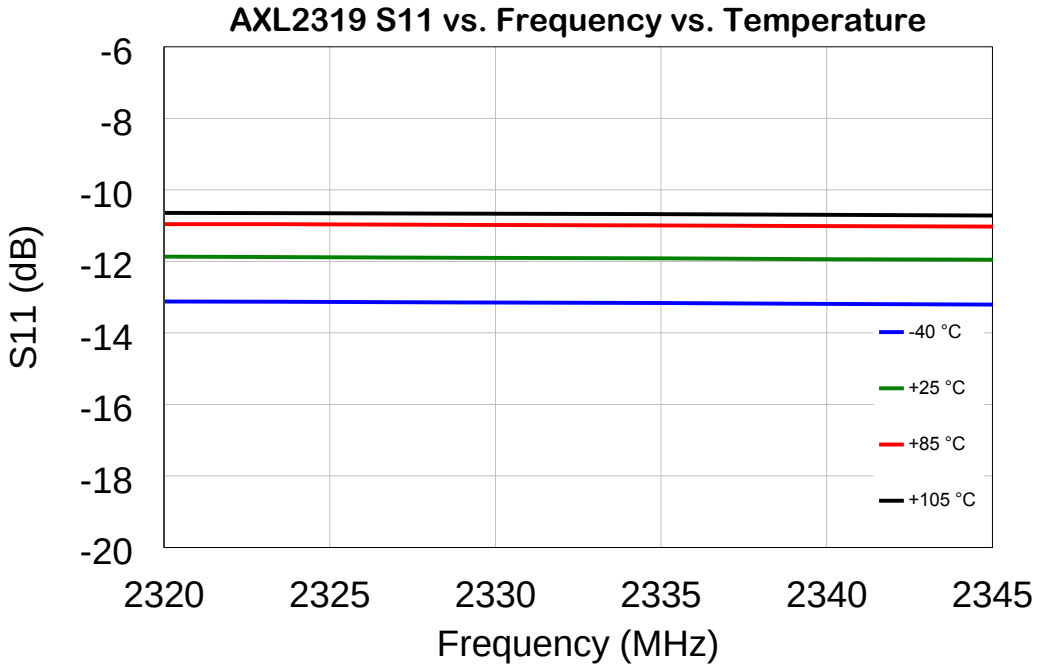
## 3.3 Bias Resistor Curve ($V_{DEVICE}$ = +4.0 V, $V_{BIAS}$ = +4.0 V)

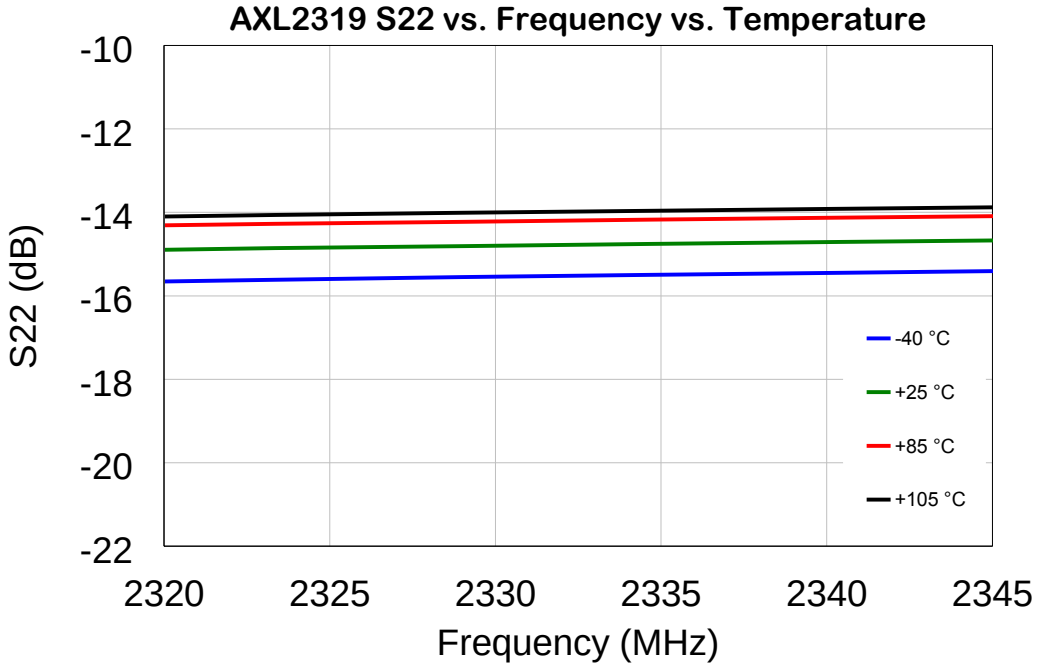


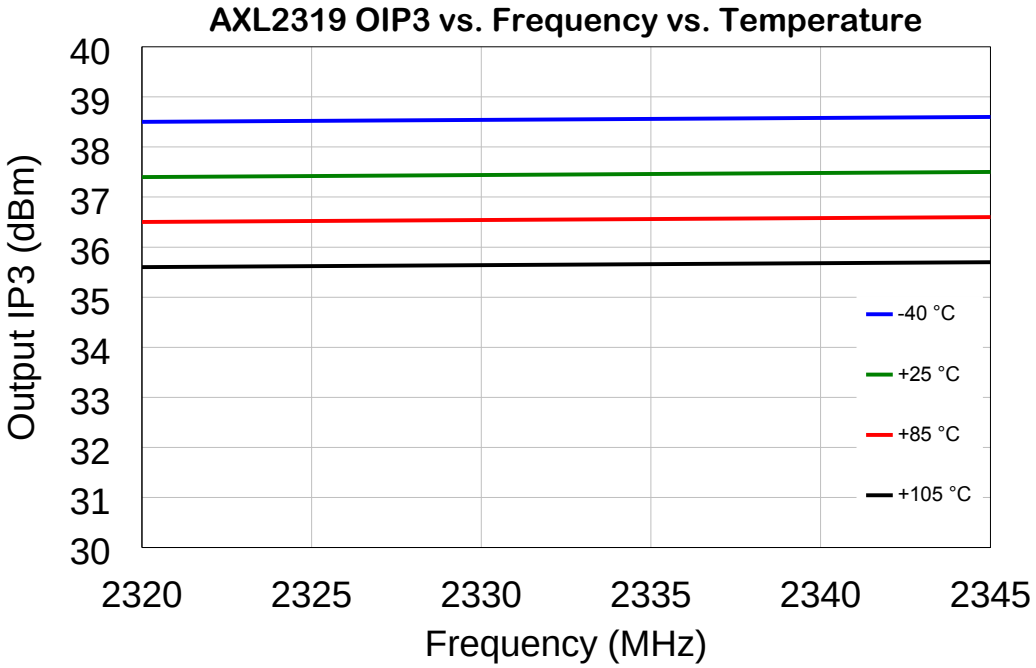
## 3.4 Plots of Noise Figure and Performances with Temperature

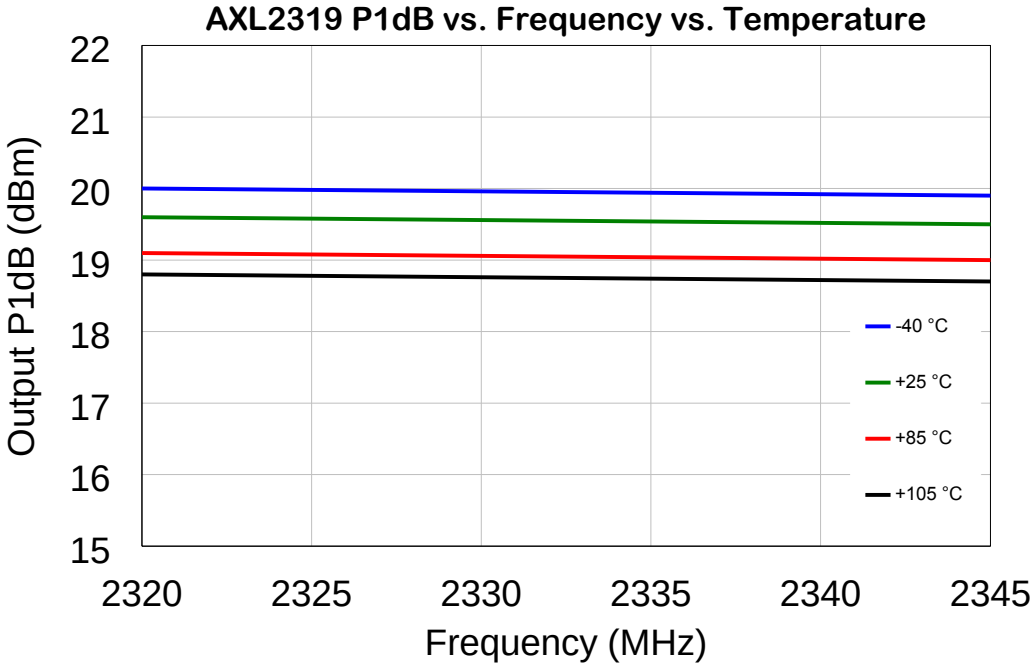


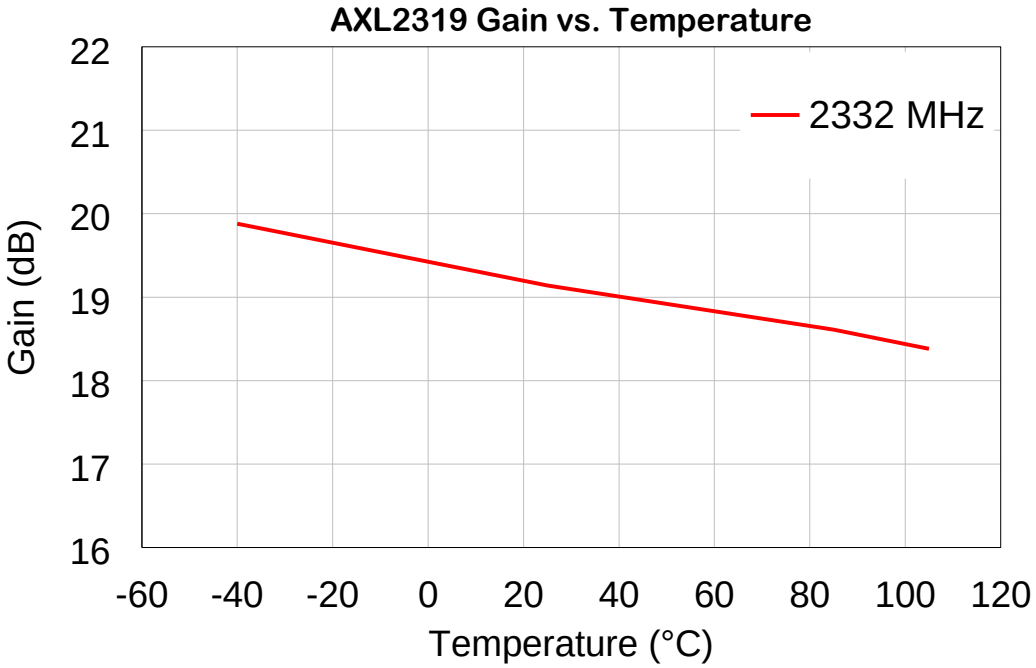



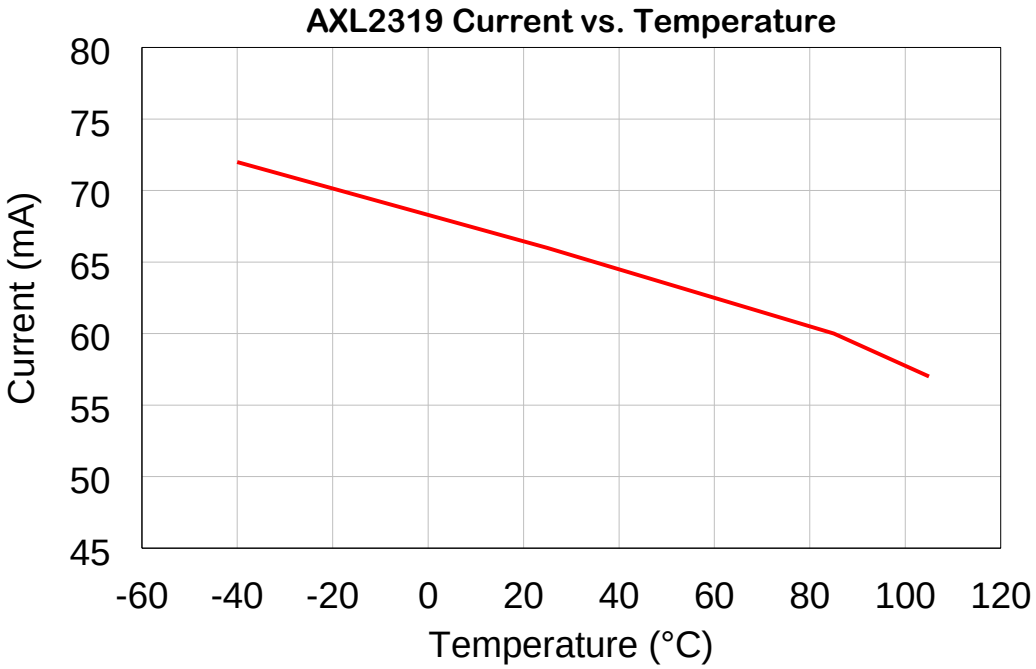

AXL2319 S11 vs. Frequency vs. Temperature
S11 (dB)
-6
-8
-10
-12
-14
-16
-18
-20
2320
2325
2330
2335
2340
2345
Frequency (MHz)
-40 °C
+25 °C
+85 °C
+105 °C


AXL2319 S22 vs. Frequency vs. Temperature
S22 (dB)
-10
-12
-14
-16
-18
-20
-22
2320
2325
2330
2335
2340
2345
Frequency (MHz)
-40 °C
+25 °C
+85 °C
+105 °C


AXL2319 OIP3 vs. Frequency vs. Temperature
Output IP3 (dBm)
40
39
38
37
36
35
34
33
32
31
30
2320
2325
2330
2335
2340
2345
Frequency (MHz)
-40 °C
+25 °C
+85 °C
+105 °C

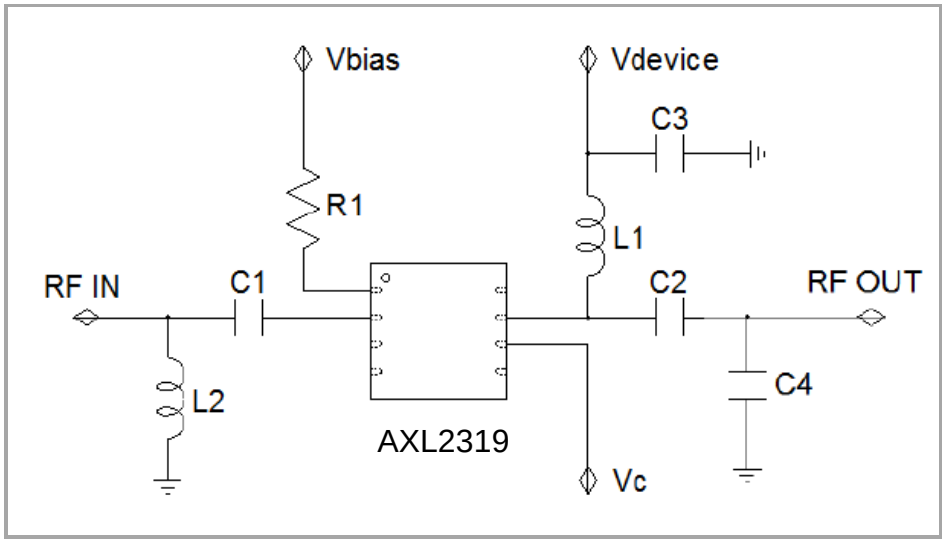

AXL2319 P1dB vs. Frequency vs. Temperature
Output P1dB (dBm)
22
21
20
19
18
17
16
15
2320
2325
2330
2335
2340
2345
Frequency (MHz)
-40 °C
+25 °C
+85 °C
+105 °C


AXL2319 Gain vs. Temperature
2332 MHz
Gain (dB)
22
21
20
19
18
17
16
-60
-40
-20
0
20
40
60
80
100
120
Temperature (°C)

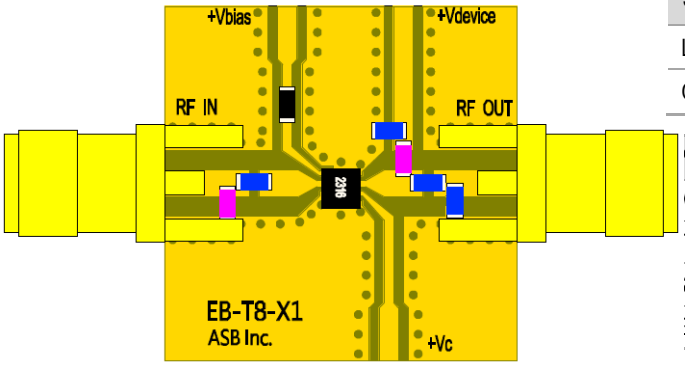

AXL2319 Current vs. Temperature
Current (mA)
80
75
70
65
60
55
50
45
-60
-40
-20
0
20
40
60
80
100
120
Temperature (°C)

# 4. Application: 3700~4000 MHz ($V_{DEVICE}$ = +4.0 V)

## 4.1 Application Circuit & Evaluation Board




* Backside paddle is RF/ DC ground.




| State | Vc (V) |
|---|---|
| LNA ON | 0 or GND |
| OFF | 1.0 ~ Vd |

| CB Information | |
|---|---|
| laterial | FR4 |
| hickness (mm) | 0.8 |
| ize (mm) | 18x18 |
| B No. | EB-T8-E1 |

### Bill of Material

| Symbol | Value | Size | Description | Manufacturer |
|---|---|---|---|---|
| AXL2319 | - | - | MMIC amplifier | ASB |
| C1 | 10 pF | 0603 | DC blocking capacitor | Murata |
| C2 | 100 pF | 0603 | DC blocking capacitor | Murata |
| C3 | 1 μF | 0603 | Decoupling capacitor | Murata |
| C4 | 0.5 pF | 0603 | Output matching capacitor | Murata |
| L1 | 6.8 nH | 0603 | RF choke inductor | Murata |
| L2 | 10 nH | 0603 | Input matching inductor | Murata |

## 4.2 Performance Table

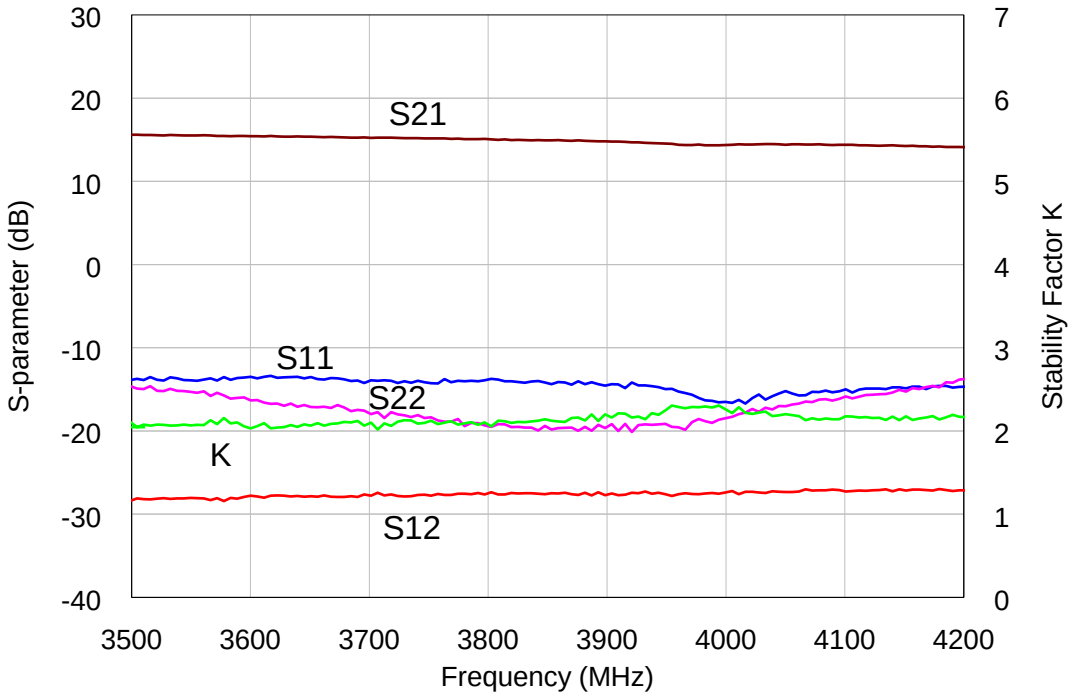
Supply voltage = +4 V, Bias Voltage = +4 V, Control Voltage = 0 V, $T_A$ = +25 °C, $Z_O$ = 50 Ω.

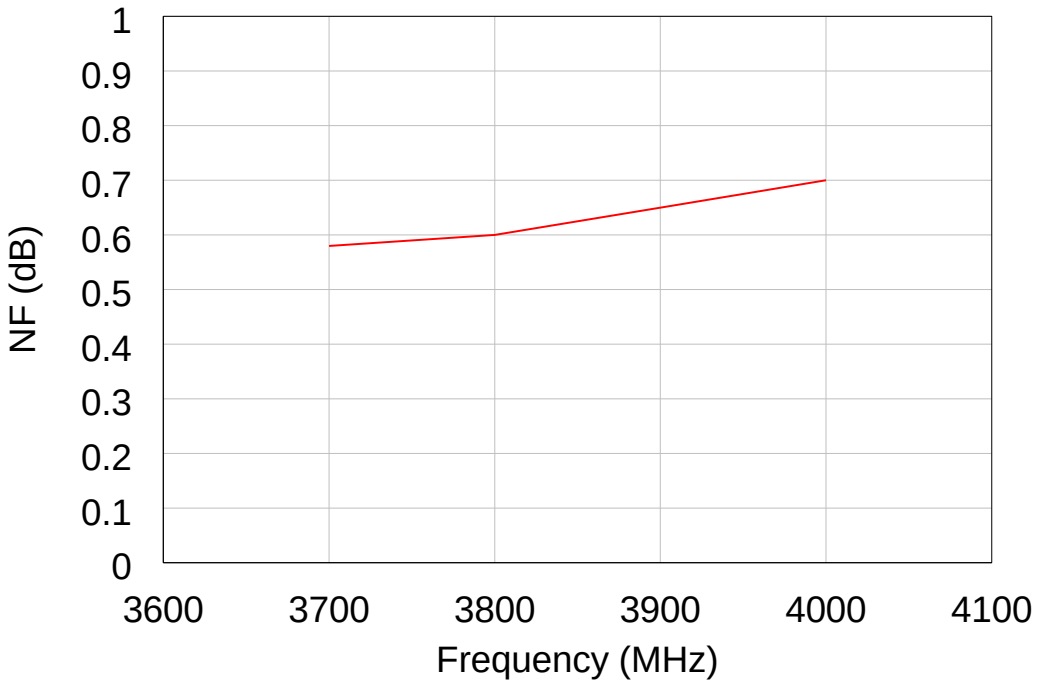
| Parameter | Typical | | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| Frequency | 3700 | 3800 | 3900 | 4000 | 3700 | 3800 | 3900 | 4000 | MHz |
| Gain | 15.2 | 15.0 | 14.8 | 14.3 | 15.0 | 14.9 | 14.6 | 14.2 | dB |
| S11 | -13.0 | -13.0 | -14.0 | -16.0 | -13.0 | -13.0 | -13.0 | -15.0 | dB |
| S22 | -17.0 | -18.0 | -18.0 | -18.0 | -17.0 | -18.0 | -18.0 | -18.0 | dB |
| Noise Figure [1)] | 0.58 | 0.60 | 0.65 | 0.70 | 0.57 | 0.59 | 0.65 | 0.71 | dB |
| Output IP3 [2)] | 34.0 | 35.0 | 35.0 | 32.0 | 33.0 | 33.0 | 32.5 | 30.5 | dBm |
| Output P1dB | 18.0 | 18.0 | 18.0 | 17.0 | 17.0 | 17.0 | 17.0 | 16.0 | dBm |
| Current | 65 | | | | 55 | | | | mA |
| Device Voltage | 4 | | | | 4 | | | | V |

1) Noise figure is measured at the SMA connectors of the evaluation board (i.e., not de-embedded).

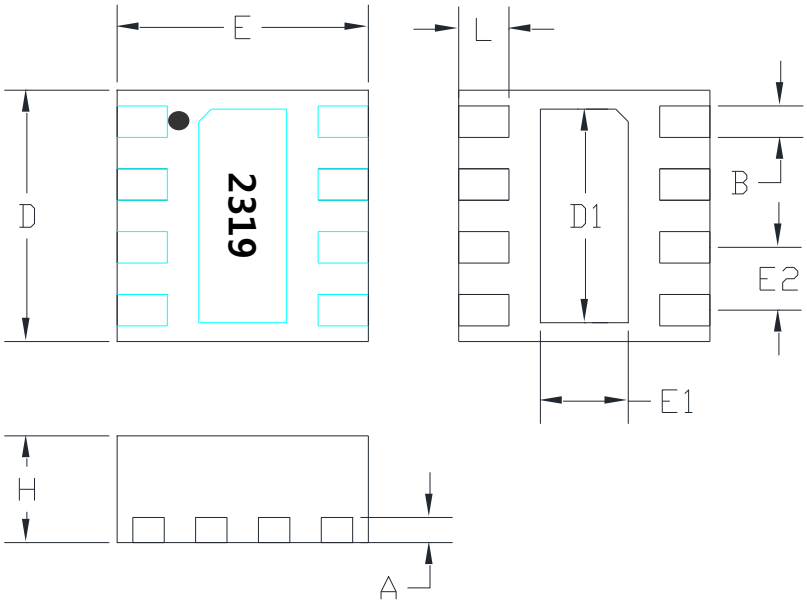
2) OIP3 is measured with two tones at the output power of +4 dBm/tone separated by 1 MHz.

## 4.3 Plot of S-parameters & Noise Figure



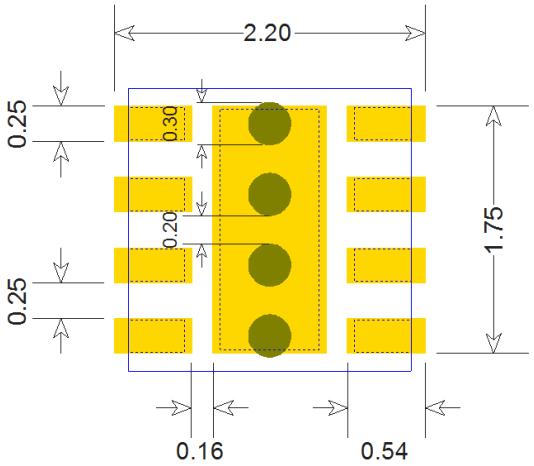

1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
NF (dB)
3600
3700
3800
3900
4000
4100
Frequency (MHz)

## 5. Package Outline (TDFN8)




| Symbols | Dimensions (In mm) | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | - | 0.20REF | - |
| B | 0.18 | 0.23 | 0.28 |
| D | 1.95 | 2.00 | 2.03 |
| D1 | - | 1.7BSC | - |
| E | 1.95 | 2.00 | 2.03 |
| E1 | - | 0.7BSC | - |
| E2 | - | 0.5BSC | - |
| L | 0.35 | 0.40 | 0.45 |
| H | 0.80 | 0.85 | 0.90 |

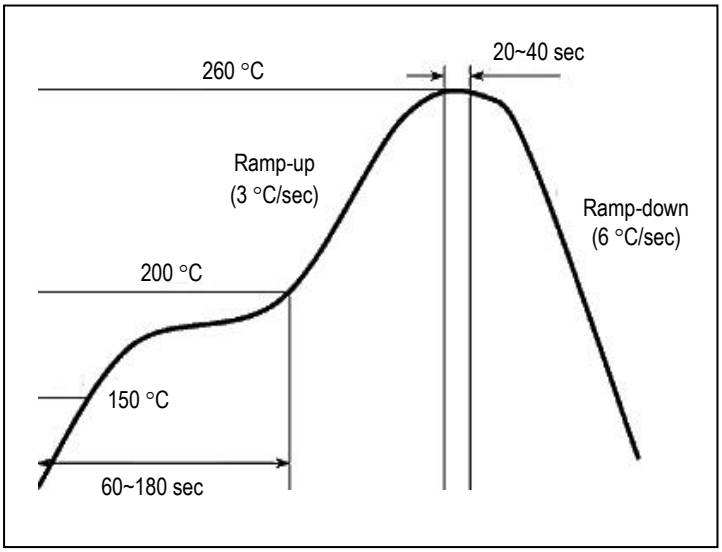
## 6. Surface Mount Recommendation (In mm)




NOTE

1. The number and size of ground via holes in a circuit board is critical for thermal and RF grounding considerations.
2. Recommend is that the ground via holes be placed on the bottom of the lead pin 2 and exposed pad of the device for better RF and thermal performance, as shown in the drawing at the left side.

## 7. Recommended Soldering Reflow Profile




*(End of Datasheet)*