# YC309

20-4000MHz Driver Amplifier


## Description

The YC309 is a high performance GaAs HBT MMIC amplifier with an active bias network. The active bias network provides stable current over temperature and process Beta variations.

Designed to run directly from a 5V supply, the YC309 does not require a dropping resistor as compared to typical Darlington amplifiers.

The YC309 product is designed for high linearity 5V Gain block applications that require small size and minimal external components. It is internally matched to 50Ω.

## Applications

- PA Driver Amplifier
- GSM, UMTS, LTE, 5G
- Wideband Instrumentation
- Wireless Data, Satellite Terminals

## Features

- 20-4000MHz
- OIP3=39.7dBm @900MHz
- P1dB=23.5dBm @900MHz
- Gain=22.5dB @900MHz
- Internally matched to 50Ω
- SOT-89 Package
- RoHS Compliant/Lead-free

## Electrical Specification

| Parameter | Specification | | | Condition | Units |
|---|---|---|---|---|---|
| | Min. | Typ. | Max. | | |
| Gain | 21.5 | 22.5 | | 900MHz | dB |
| | 17.0 | 18.0 | | 1900MHz | dB |
| | 16.2 | 17.2 | | 2100MHz | dB |
| Output P1dB | 22.5 | 23.5 | | 900MHz | dBm |
| | 22.3 | 23.3 | | 1900MHz | dBm |
| | 22.1 | 23.1 | | 2100MHz | dBm |
| Output IP3 | 37.7 | 39.7 | | 900MHz | dBm |
| | 36.9 | 38.9 | | 1900MHz | dBm |
| | 36.0 | 38.0 | | 2100MHz | dBm |
| Input Return Loss | -18.3 | -16.3 | | 900MHz | dB |
| Output Return Loss | -13.7 | -11.7 | | 900MHz | dB |
| Reverse Isolation | -28.7 | -26.7 | | 900MHz | dB |
| Noise Figure | | 3.1 | 3.6 | 900MHz | dB |
| Device Voltage | | 5.0 | | | V |
| Device Current | | 87 | | | mA |
| Thermal Resistance | | 48.6 | | | °C/W |

Notes:
1) Test conditions: VCC = +5 V, Temp. = +25 °C, Zo=50Ω, OIP3:Pout = +9 dBm/tone, Δf = 1 MHz

## Recommended Operating Condition

| Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|
| Device Voltage | | 5 | | V |
| Operating Temperature | -40 | 25 | 85 | °C |
| Junction Temperature | - | | 164 | °C |

## Absolute Maximum Ratings

| Parameter | Rating | Units |
|---|---|---|
| Device Voltage | 6 | V |
| Supply Current | 133 | mA |
| Storage Temperature | -55~+155 | °C |
| RF Input Power | 23 | dBm |

## Typical RF Performance

| Frequency(MHz) | 900 | 1900 | 2100 | 2400 | 3500 | Units |
|---|---|---|---|---|---|---|
| Gain | 22.5 | 18.0 | 17.2 | 16.1 | 13.5 | dB |
| S11 | -16.3 | -28.4 | -33.1 | -18.9 | -19.0 | dB |
| S22 | -11.7 | -11.6 | -12.0 | -12.6 | -13.4 | dB |
| S12 | -26.7 | -24.9 | -24.2 | -24.3 | -21.9 | dB |
| Output P1dB | 25.4 | 24.7 | 24.7 | 25.9 | 24.8 | dBm |
| Output IP3 | 40.0 | 40.1 | 40.6 | 39.9 | 38.3 | dBm |
| Noise Figure | 3.1 | 3.7 | 3.5 | 3.4 | 4.0 | dB |

## MSL Rating

MSL Rating : Level 3
Test : 260℃ Convection Reflow
Standard : JEDEC Standard IPC/JEDEC J-STD-020

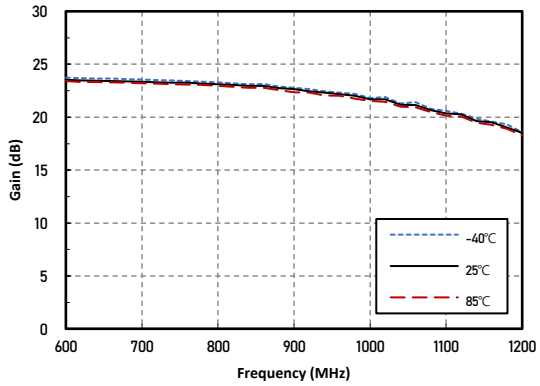

## ESD Sensitivity Ratings

ESD Rating : Class 1C
Test : Human Body Model (HBM)
Standard : JEDEC Standard JS-001-2012

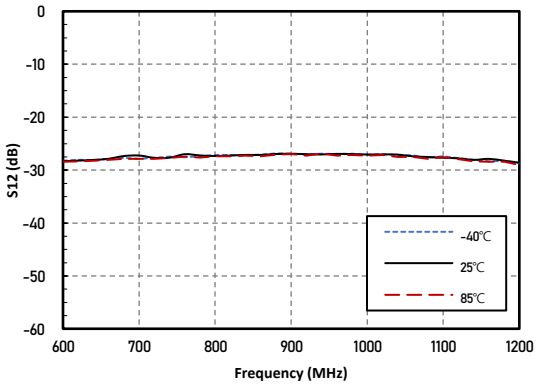
## Performance Plots

*$V_{CC}$ = +5V, $I_C$ = 87mA, T = 25℃, Freq = 600 ~ 1200 MHz, $Z_O$ = 50Ω*

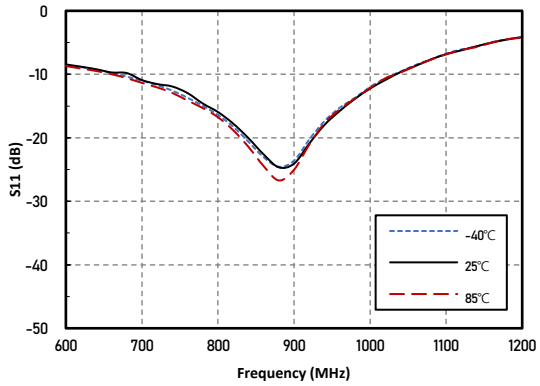
**Gain**



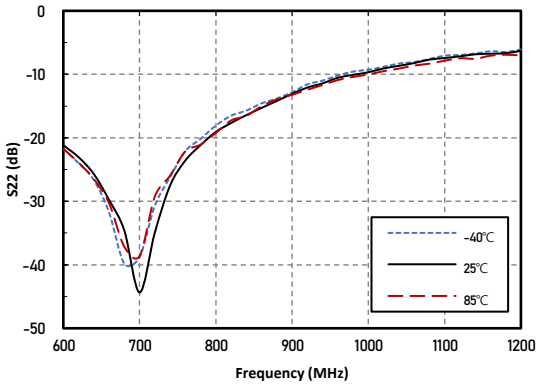

**Isolation**



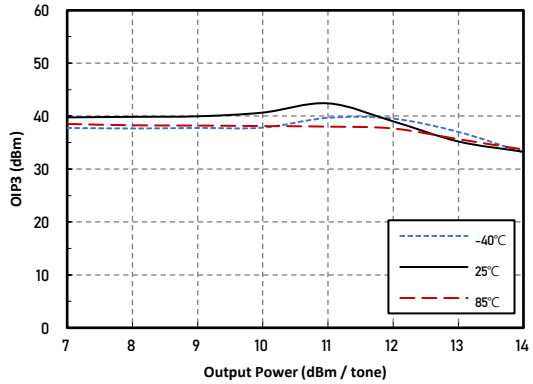

**Input Return Loss**




**Output Return Loss**



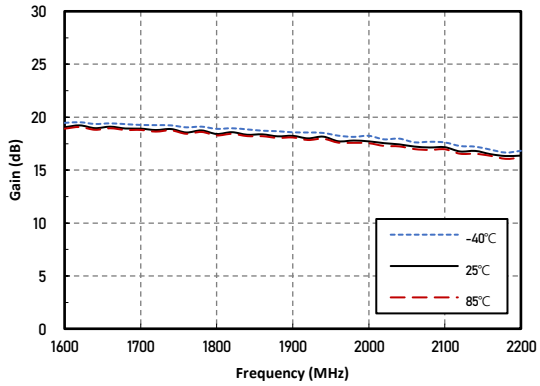

**OIP3 vs. Frequency**



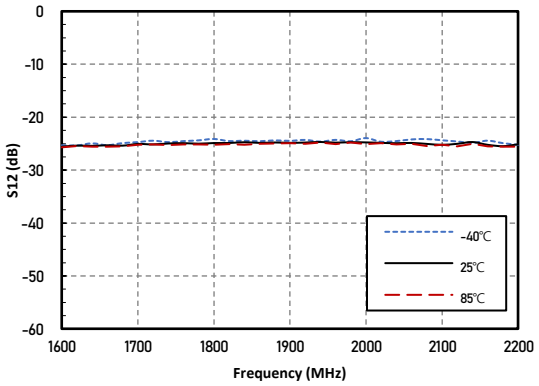
## Performance Plots

*$V_{CC}$ = +5V, $I_C$ = 87mA, T = 25℃, Freq = 1600 ~ 2200 MHz, $Z_O$ = 50Ω*

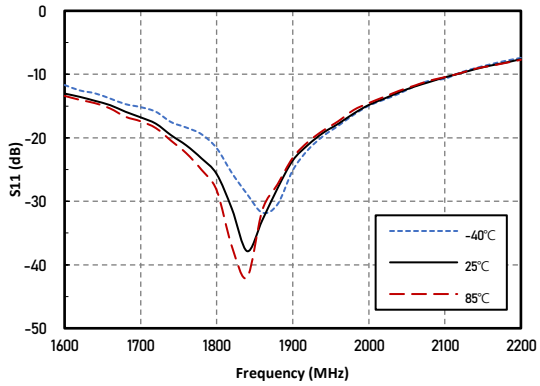
**Gain**



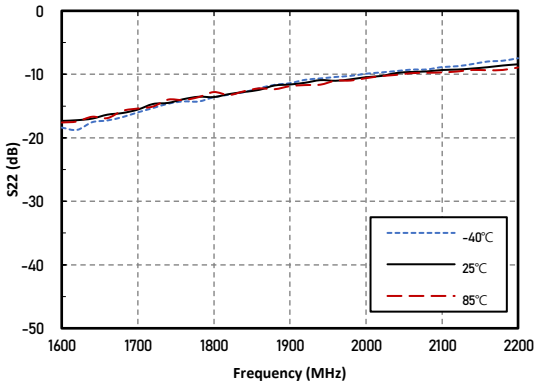

**Isolation**



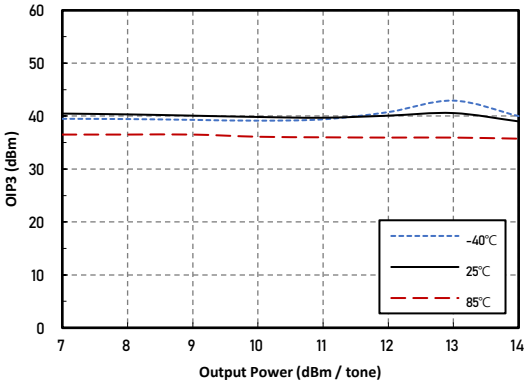

**Input Return Loss**




**Output Return Loss**



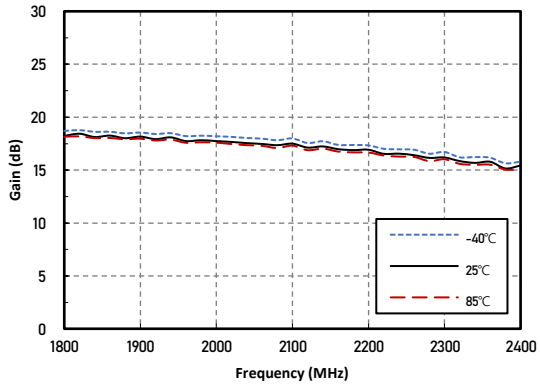

**OIP3 vs. Frequency**



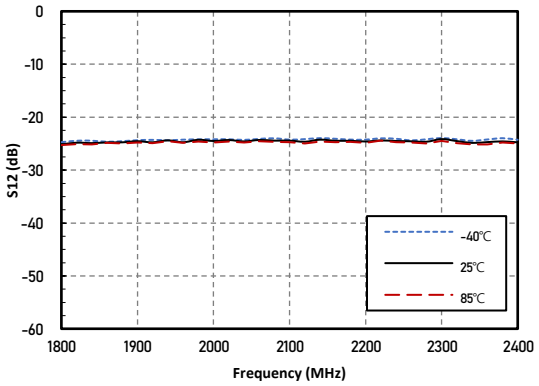
## Performance Plots

*$V_{CC}$ = +5V, $I_C$ = 87mA, T = 25℃, Freq = 1800 ~ 2400 MHz, $Z_O$ = 50Ω*

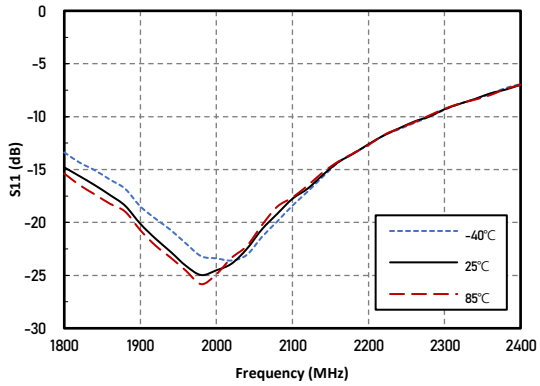
**Gain**



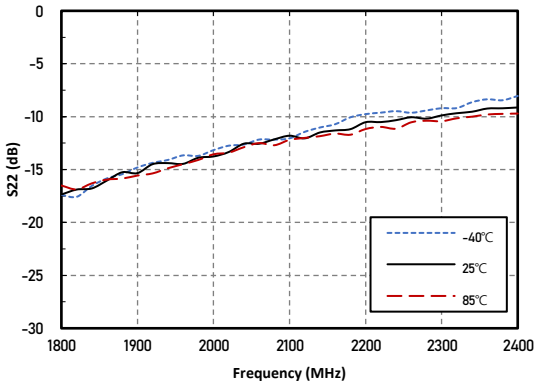

**Isolation**



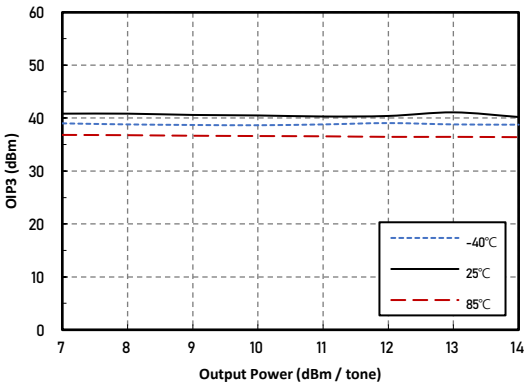

**Input Return Loss**




**Output Return Loss**



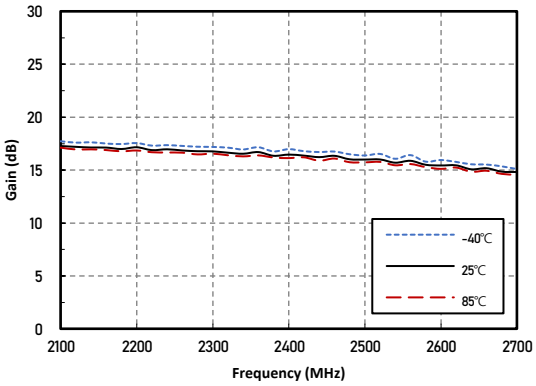

**OIP3 vs. Frequency**



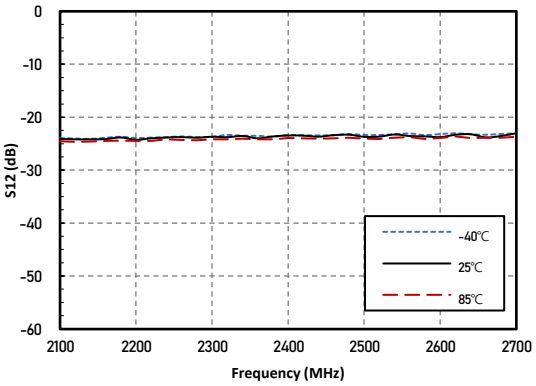
## Performance Plots

*$V_{CC}$ = +5V, $I_C$ = 87mA, T = 25℃, Freq = 2100 ~ 2700 MHz, $Z_O$ = 50Ω*

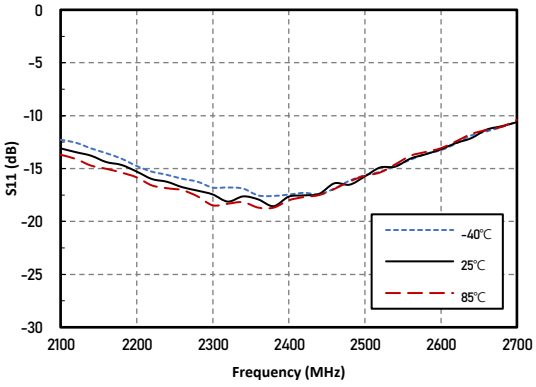
**Gain**



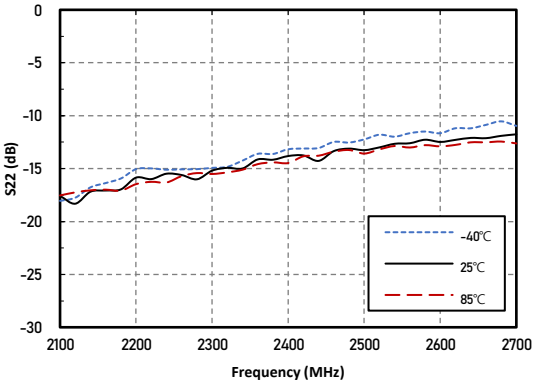

**Isolation**



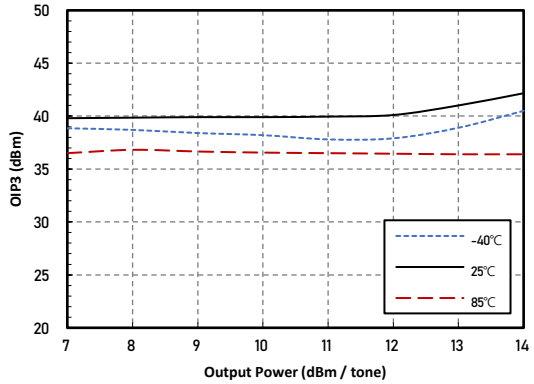

**Input Return Loss**




**Output Return Loss**



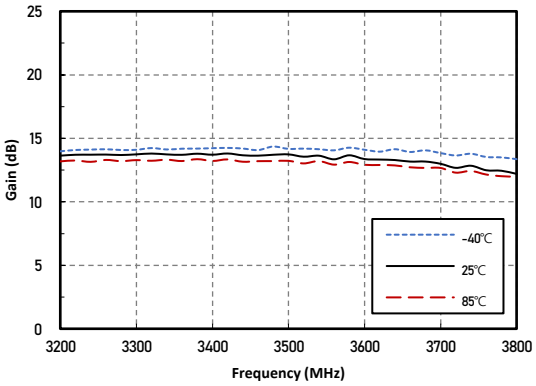

**OIP3 vs. Frequency**



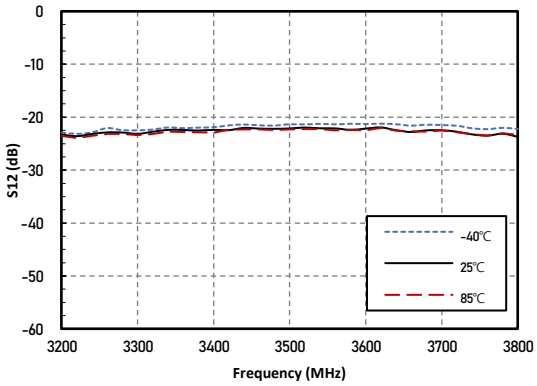
## Performance Plots

*$V_{CC}$ = +5V, $I_C$ = 87mA, T = 25℃, Freq = 3200 ~ 3800 MHz, $Z_O$ = 50Ω*

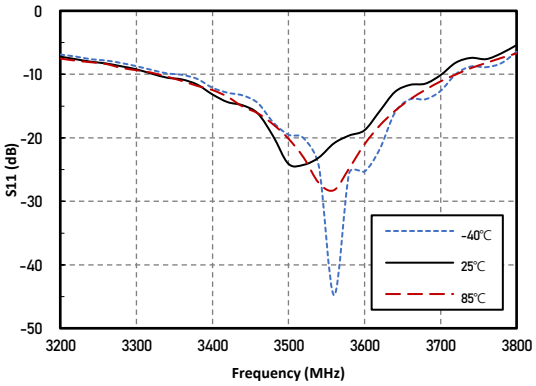
**Gain**



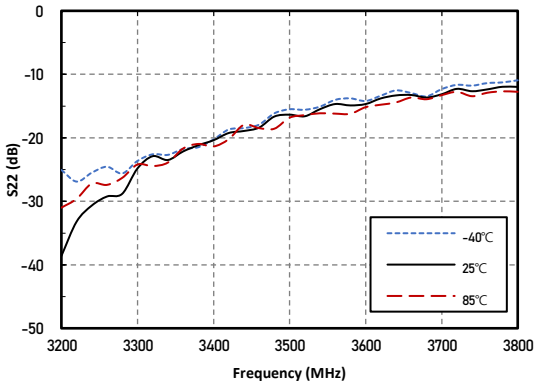

**Isolation**



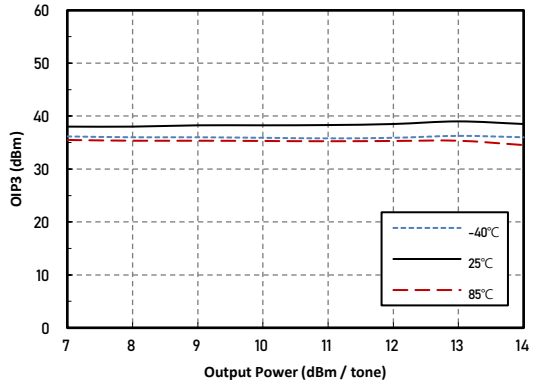

**Input Return Loss**




**Output Return Loss**



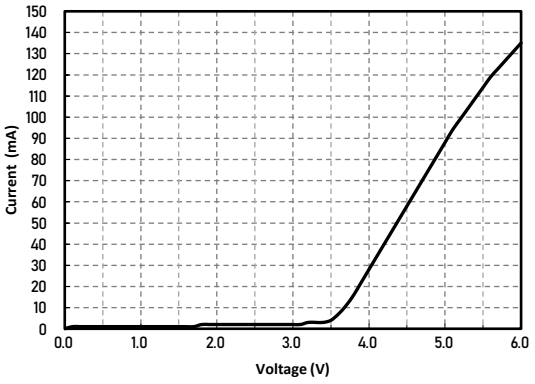

**OIP3 vs. Frequency**



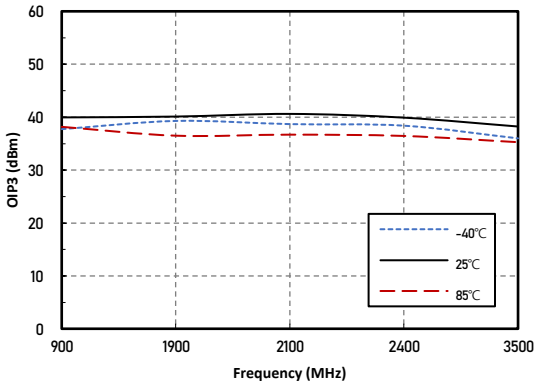
## Performance Plots

*$V_{CC}$ = +5V, $I_C$ = 87mA, T = 25℃, $Z_O$ = 50Ω*

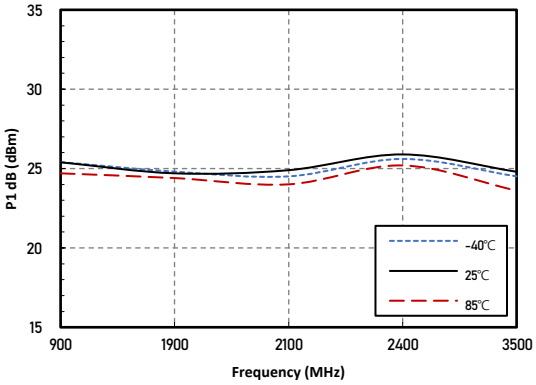
**I-V Curve**



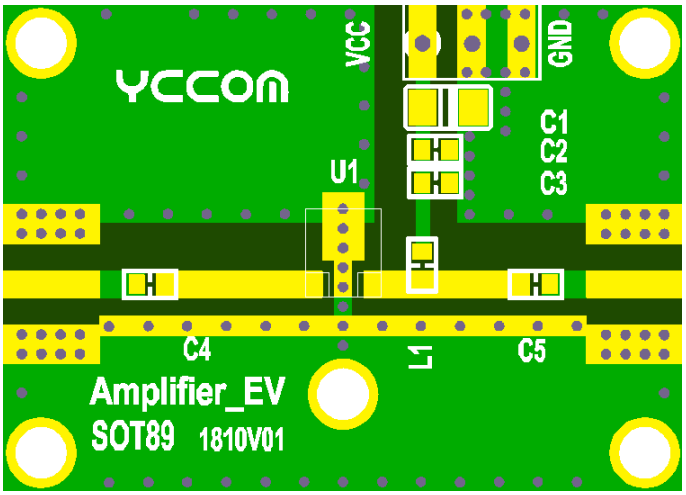

**OIP3 vs. Frequency ($P_{OUT}$ : 9dBm/tone)**




**P1dB vs. Frequency**

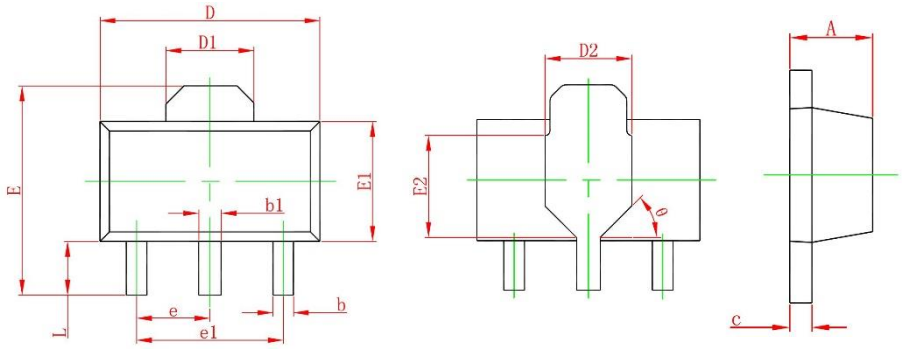


## Evaluation Board PCB Information




① PCB: FR4 ② RF width: 1.34 mm ③ PCB thick: 0.8 mm

## Package Outline Drawing

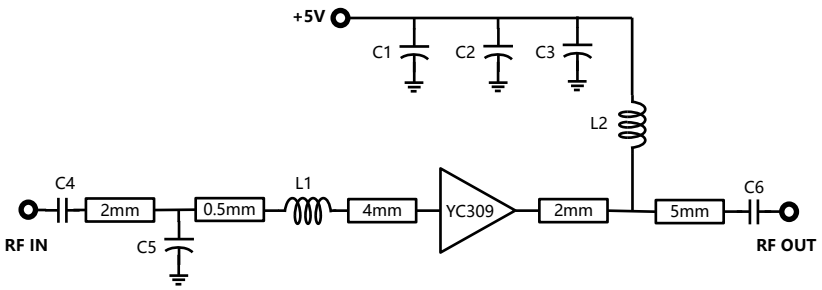



| SOT-89 | | |
|---|---|---|
| Symbol | Min | Max |
| A | 1.400 | 1.600 |
| b | 0.320 | 0.520 |
| b1 | 0.380 | 0.580 |
| c | 0.350 | 0.440 |
| D | 4.400 | 4.600 |
| D1 | 1.550 REF. | |
| D2 | 1.750 REF. | |
| E | 3.940 | 4.250 |
| E1 | 2.300 | 2.600 |
| E2 | 1.900 REF. | |
| e | 1.500 TYP. | |
| e1 | 3.000 TYP. | |
| L | 0.900 | 1.200 |
| θ | 45º | |
| All Dimensions in mm | | |

## Application Circuit

*Freq = 600 ~ 1200 MHz*

**Schematic Diagram**



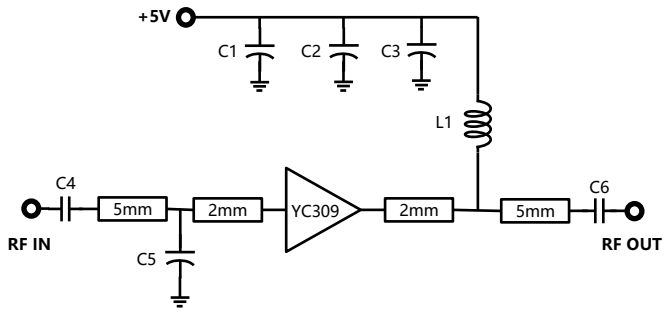

| BOM | | Tolerance |
|---|---|---|
| C1 | None. | |
| C2 | 1nF | ±5% |
| C3 | 100pF | ±5% |
| C4 | 100pF | ±5% |
| C5 | 4.3pF | ±5% |
| C6 | 100pF | ±5% |
| L1 | 2.7nH | ±5% |
| L2 | 39nH | ±5% |

**Note**

1. Distance between the input pin of YC309 and the center of the series inductor(L1) is **4mm**.
2. Distance between the center of the series inductor(L1) and the center of the shunt cap(C5) is **0.5mm**.
3. Distance between the center of the shunt cap(C5) and the center of the series cap(C4) is **2mm**.
4. Distance between the output pin of YC309 and the center of the shunt inductor(L2) is **2mm**.
5. Distance between the center of the shunt inductor(L2) and the center of the series cap(C6) is **5mm.**

*Freq = 1600 ~ 2200 MHz*

**Schematic Diagram**




| BOM | | Tolerance |
|---|---|---|
| C1 | None. | |
| C2 | 1nF | ±5% |
| C3 | 100pF | ±5% |
| C4 | 33pF | ±5% |
| C5 | 1.8pF | ±5% |
| C6 | 33pF | ±5% |
| L1 | 27nH | ±5% |

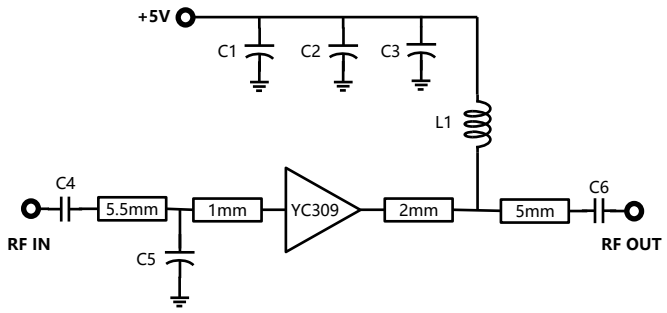
**Note**

1. Distance between the input pin of YC309 and the center of the shunt cap(C5) is 2**mm**.
2. Distance between the center of the shunt cap(C5) and the center of the series cap(C4) is **5mm**.
3. Distance between the output pin of YC309 and the center of the shunt inductor(L1) is **2mm**.
4. Distance between the center of the shunt inductor(L1) and the center of the series cap(C6) is **5mm.**

## Application Circuit

*Freq = 1800 ~ 2400 MHz*

**Schematic Diagram**



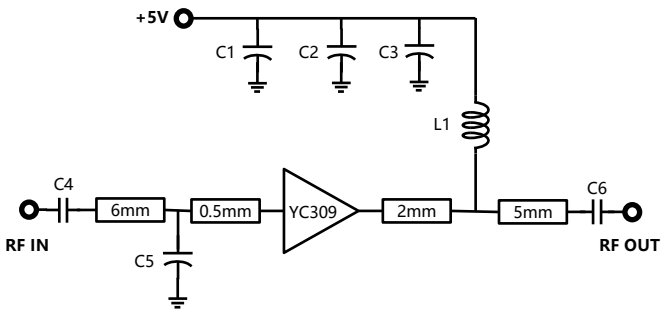

| BOM | | Tolerance |
|---|---|---|
| C1 | None. | |
| C2 | 1nF | ±5% |
| C3 | 100pF | ±5% |
| C4 | 33pF | ±5% |
| C5 | 1.5pF | ±5% |
| C6 | 33pF | ±5% |
| L1 | 18nH | ±5% |

**Note**

1. Distance between the input pin of YC309 and the center of the shunt cap(C5) is **1mm**.
2. Distance between the center of the shunt cap(C5) and the center of the series cap(C4) is **5.5mm**.
3. Distance between the output pin of YC309 and the center of the shunt inductor(L1) is **2mm**.
4. Distance between the center of the shunt inductor(L1) and the center of the series cap(C6) is **5mm.**

*Freq = 2100 ~ 2700 MHz*

**Schematic Diagram**




| BOM | | Tolerance |
|---|---|---|
| C1 | None. | |
| C2 | 1nF | ±5% |
| C3 | 100pF | ±5% |
| C4 | 33pF | ±5% |
| C5 | 1.2pF | ±5% |
| C6 | 33pF | ±5% |
| L1 | 18nH | ±5% |

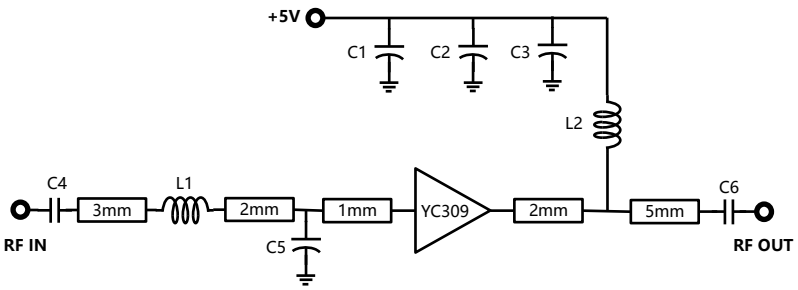
**Note**

1. Distance between the input pin of YC309 and the center of the shunt cap(C5) is **0.5mm**.
2. Distance between the center of the shunt cap(C5) and the center of the series cap(C4) is **6mm**.
3. Distance between the output pin of YC309 and the center of the shunt inductor(L1) is **2mm**.
4. Distance between the center of the shunt inductor(L1) and the center of the series cap(C6) is **5mm.**

## Application Circuit

*Freq = 3200 ~ 3800 MHz*

**Schematic Diagram**

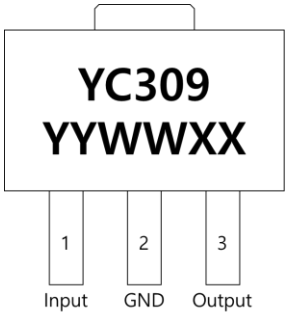



| BOM | | Tolerance |
|---|---|---|
| C1 | None | |
| C2 | 1nF | ±5% |
| C3 | None | |
| C4 | 33pF | ±5% |
| C5 | 0.5pF | ±5% |
| C6 | 33pF | ±5% |
| L1 | 3.3nH | ±5% |
| L2 | 18nH | ±5% |

**Note**

1. Distance between the input pin of YC309 and the center of the series inductor(L1) is **1mm**.
2. Distance between the center of the series inductor(L1) and the center of the shunt cap(C5) is **2mm**.
3. Distance between the center of the shunt cap(C5) and the center of the series cap(C4) is **3mm**.
4. Distance between the output pin of YC309 and the center of the shunt inductor(L2) is **2mm**.
5. Distance between the center of the shunt inductor(L2) and the center of the series cap(C6) is **5mm.**

## Package Marking




P/N : YC309
YY : Year
WW : Week
XX : Wafer No.

## PCB Land Pattern