

AH31

High Dynamic Range IF Amplifier

Product Information



Product Features

- 50 – 1000 MHz
- ISO & EPC compliant
- 19 dB Gain
- +22 dBm P1dB
- +42 dBm OIP3
- 1.8 dB Noise Figure
- Single Voltage Supply (+5 V)
- MTTF > 100 years
- SOT-89 SMT Package

Applications

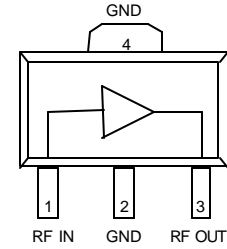
- RFID: HF, UHF, microwave
- Readers
 - Industrial
 - Portable
 - Handheld

Product Description

The AH31 is a high dynamic range amplifier in a low-cost surface-mount package. Its robustness and ease of use make it an ideal candidate for the core of any RFID reader application. It is compliant with EPC and ISO standards. The combination of low noise figure, high gain, and high output IP3 is ideal as an IF amplifier for receiver and transmitter applications. The device combines dependable performance with consistent quality to maintain MTTF values exceeding 100 years at mounting temperatures of +85°C and is housed in a SOT-89 industry-standard SMT package.

The broadband MMIC amplifier can be directly applied to various current and next generation RFID technologies such as EPC, ISO, ETSI, and ANSI. Their small size makes them ideal for PCMCIA applications.

Functional Diagram



| Function | Pin No. |
|-------------|---------|
| Input | 1 |
| Output/Bias | 3 |
| Ground | 2, 4 |

Specifications

| Parameter | Units | Min | Typ | Max |
|--|--------|-----|-----|------|
| Frequency Range | MHz | 50 | 240 | 1000 |
| Gain | dB | | 19 | |
| Input Return Loss | dB | | 15 | |
| Output Return Loss | dB | | 17 | |
| Output P1dB | dBm | | +22 | |
| Output IP3 (2) | dBm | | +42 | |
| Output IP3 (50 Ω _{test} fixture, 800, 810 MHz) | dBm | +37 | | |
| Noise Figure | dB | | 1.8 | |
| Supply Voltage | V | | +5 | |
| Operating Current Range | mA | 120 | 150 | 180 |
| Thermal Resistance | °C / W | | | 59 |
| Junction Temperature (3) | °C | | | 160 |

Test conditions unless otherwise noted.

1. T = 25°C, V_{dd} = +5 V, Frequency = 240 MHz in a tuned application circuit.
2. 3OIP measured with two tones at an output power of +10 dBm/tone separated by 1 MHz. The suppression on the largest IM3 product is used to calculate the 3OIP using a 2:1 rule.
3. The junction temperature ensures a minimum MTTF rating of 1 million hours of usage.

Typical Performance

| Parameter | Units | Typical | | | | |
|--------------|-------|---------|-----|-----|-----|------|
| Frequency | MHz | 75 | 170 | 240 | 500 | 900 |
| S21 | dB | 19 | 19 | 19 | 18 | 16.8 |
| S11 | dB | -25 | -13 | -15 | -15 | -14 |
| S22 | dB | -25 | -20 | -17 | -10 | -11 |
| Output P1dB | dBm | +22 | +22 | +22 | +22 | +21 |
| Output IP3 | dBm | +42 | +42 | +42 | +42 | +41 |
| Noise Figure | dB | 2.4 | 1.8 | 1.8 | 1.7 | 2.1 |

Typical parameters reflect performance in an application circuit.

Absolute Maximum Rating

| Parameter | Rating |
|-----------------------------|-----------------------|
| Operating Case Temperature | -40 to +85 °C |
| Storage Temperature | -55 to +125 °C |
| DC Voltage | +6 V |
| RF Input Power (continuous) | 4 dB above Input P1dB |
| Junction Temperature | +220° C |

Operation of this device above any of these parameters may cause permanent damage.

Ordering Information

| Part No. | Description |
|-------------|--|
| AH31 | High Dynamic Range IF Amplifier |
| AH31-PCB75 | 65 – 85 MHz Fully Assembled Evaluation Board |
| AH31-PCB170 | 155 – 185 MHz Fully Assembled Evaluation Board |
| AH31-PCB240 | 220 – 260 MHz Fully Assembled Evaluation Board |
| AH31-PCB500 | 450 – 550 MHz Fully Assembled Evaluation Board |

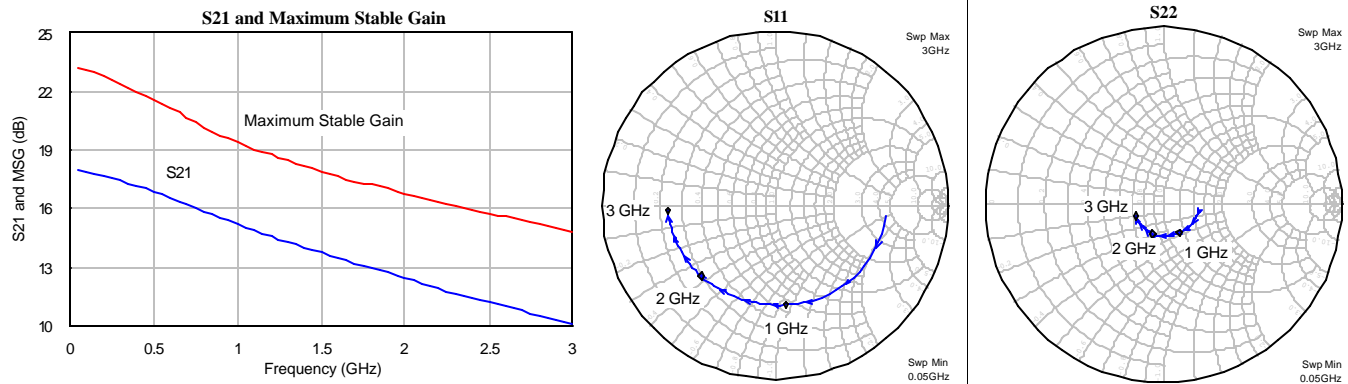
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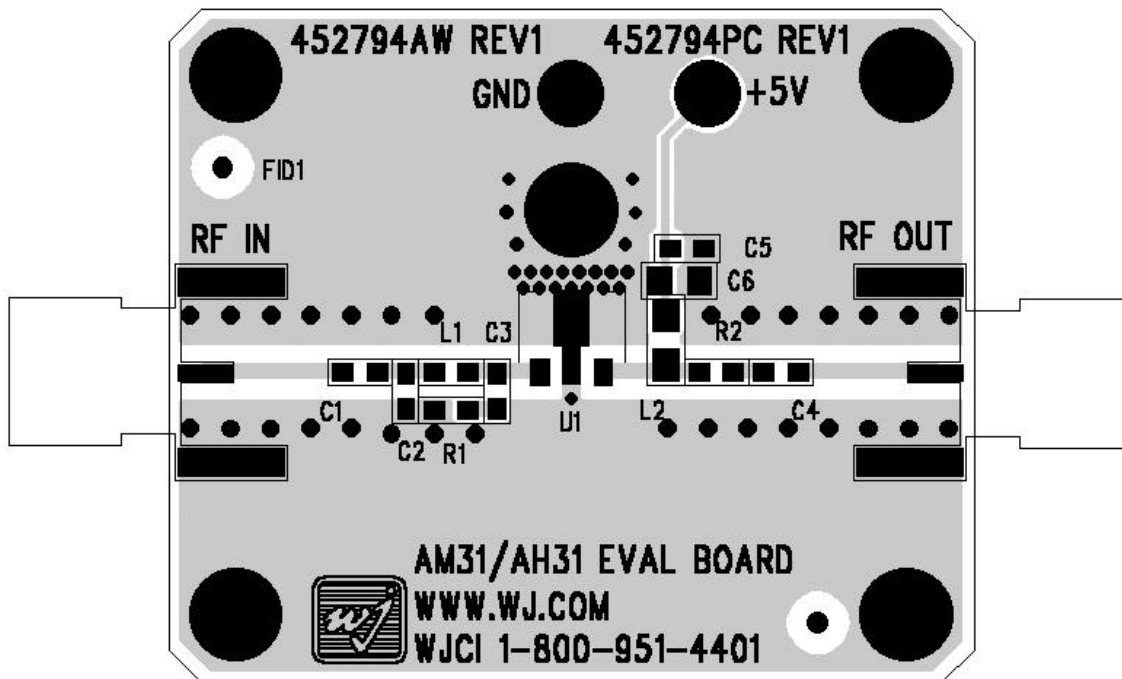
Typical Device Data

S-parameters ($V_d = +5\text{ V}$, $I_d = 150\text{ mA}$, unmatched $50\ \Omega$ system).

- Measurements are shown for an unmatched packaged device with the data being de-embedded to the device leads.
- The amplifier requires a matching network at the input for proper operation. The amplifier is intrinsically well matched at the output and ideally should “look” into $50\ \Omega$. Any deviation from this can affect the linearity IP3 performance for the device.



Application Circuit PC Board Layout



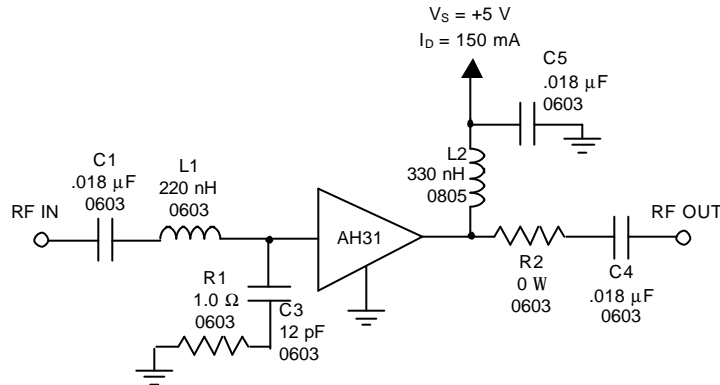
Circuit Board Material: .014" FR-4, 4 layers (other layers added for rigidity), .062" total thickness, 1 oz copper
Microstrip line details: width = .024", spacing = .036"



Application Circuit: 65 – 85 MHz (AH31-PCB75)

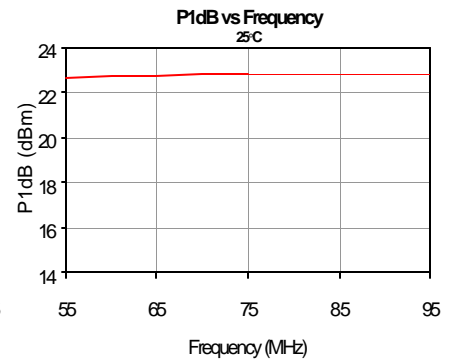
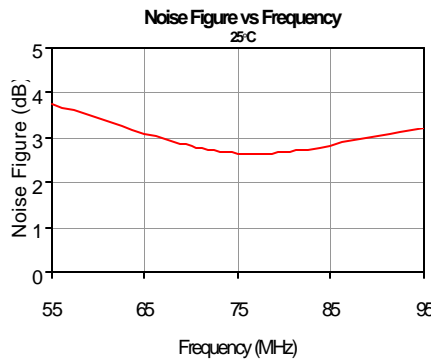
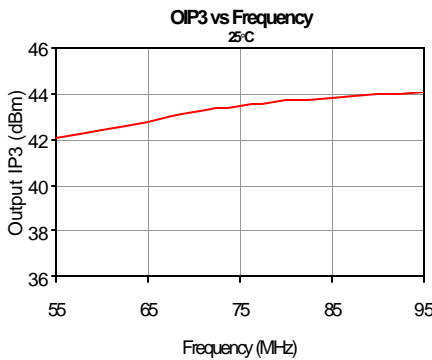
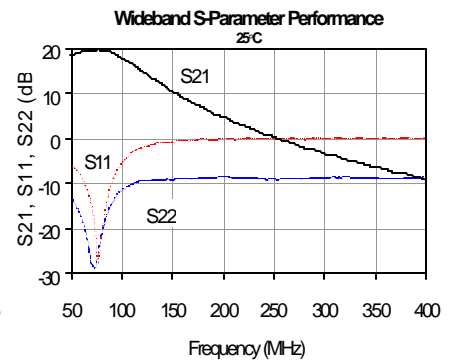
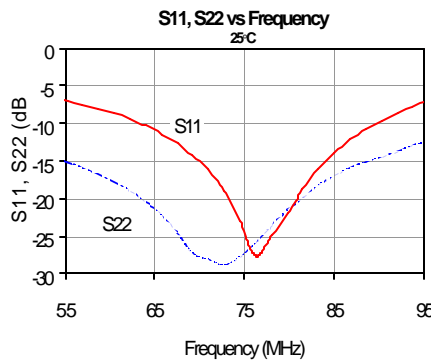
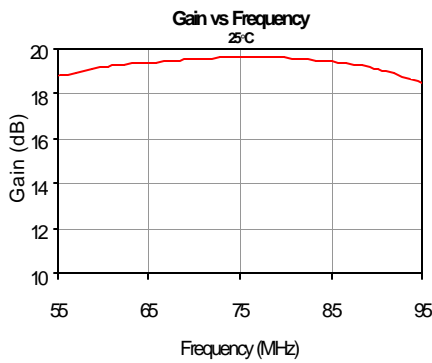
Typical Performance

| Frequency | 75 MHz |
|--------------|---------------|
| S21 - Gain | 19 dB |
| S11 | -25 dB |
| S22 | -25 dB |
| Output P1dB | +22 dBm |
| Output IP3 | +42 dBm |
| Noise Figure | 2.4 dB |
| Bias | +5 V @ 150 mA |



Notes:

1. The amplifier should be connected directly to a +5 V regulator; no dropping resistor is required.
2. If no DC signal is present at the input (pin 1), C1 can be removed. The gate is internally grounded in the amplifier.
3. R2 is used as a placeholder for a different application circuit. It can be removed from the circuit.
4. C2 (from the silkscreen) is not utilized in this application circuit.

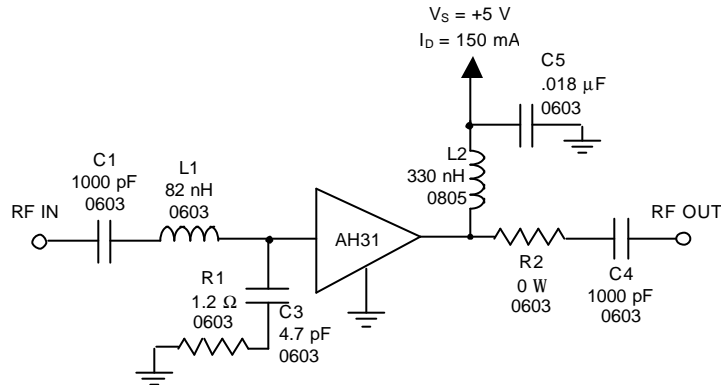




Application Circuit: 155 – 185 MHz (AH31-PCB170)

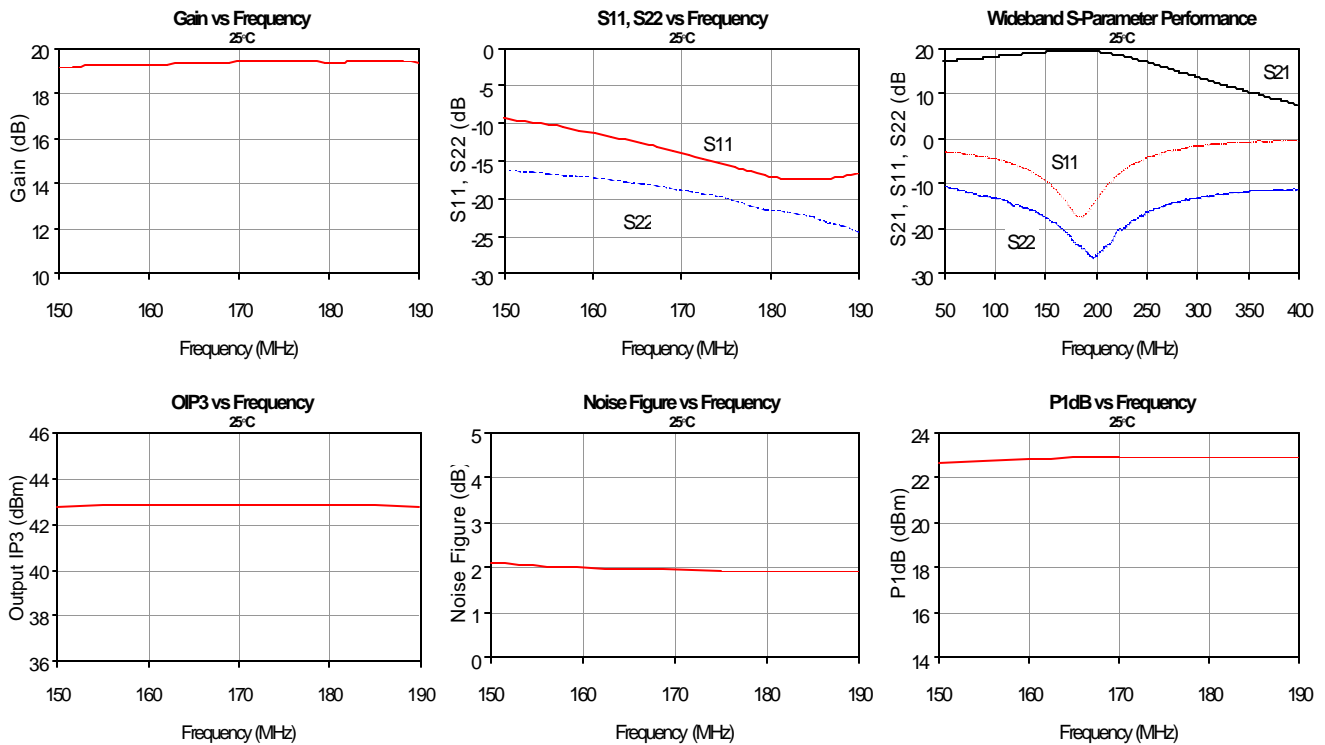
Typical Performance

| Frequency | 170 MHz |
|--------------|---------------|
| S21 - Gain | 19 dB |
| S11 | -18 dB |
| S22 | -20 dB |
| Output P1dB | +21 dBm |
| Output IP3 | +42 dBm |
| Noise Figure | 1.8 dB |
| Bias | +5 V @ 150 mA |



Notes:

1. The amplifier should be connected directly to a +5 V regulator; no dropping resistor is required.
2. If no DC signal is present at the input (pin 1), C1 can be removed. The gate is internally grounded in the amplifier.
3. R2 is used as a placeholder for a different application circuit. It can be removed from the circuit.
4. C2 (from the silkscreen) is not utilized in this application circuit.

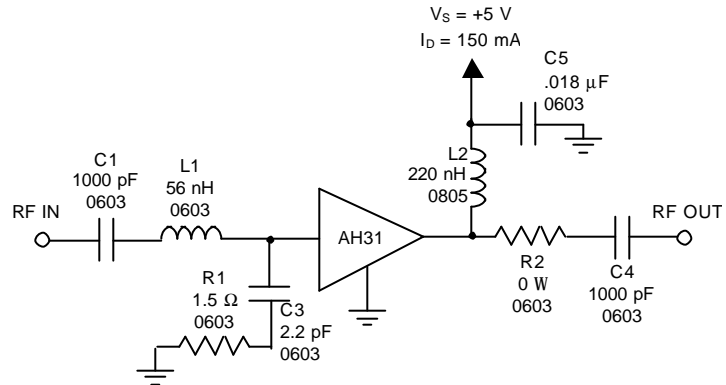




Application Circuit: 220 – 260 MHz (AH31-PCB240)

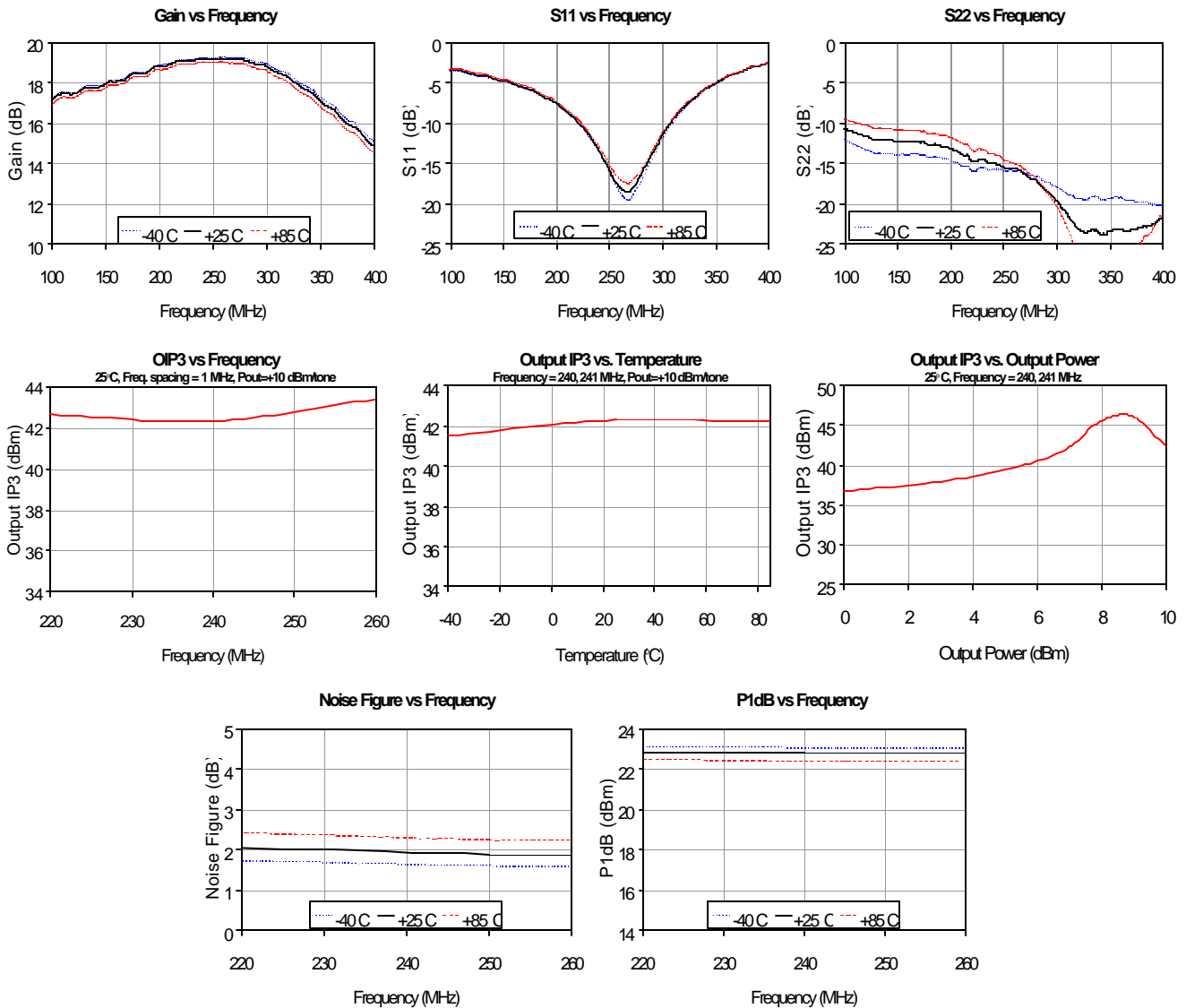
Typical Performance

| Frequency | 240 MHz |
|--------------|---------------|
| S21 - Gain | 19 dB |
| S11 | -15 dB |
| S22 | -17 dB |
| Output P1dB | +22 dBm |
| Output IP3 | +42 dBm |
| Noise Figure | 1.8 dB |
| Bias | +5 V @ 150 mA |



Notes:

1. The amplifier should be connected directly to a +5 V regulator; no dropping resistor is required.
2. If no DC signal is present at the input (pin 1), C1 can be removed. The gate is internally grounded in the amplifier.
3. R2 is used as a placeholder for a different application circuit. It can be removed from the circuit.
4. C2 (from the silkscreen) is not utilized in this application circuit.



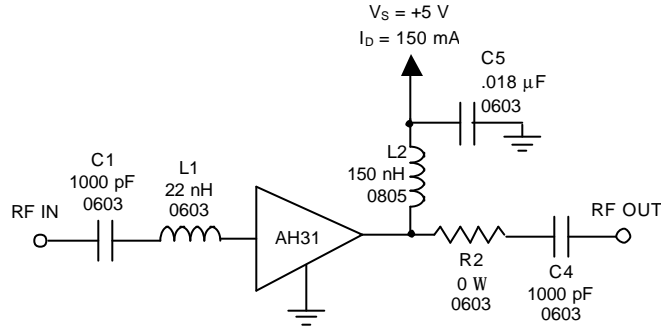
Specifications and information are subject to change without notice



Application Circuit: 450 – 550 MHz (AH31-PCB500)

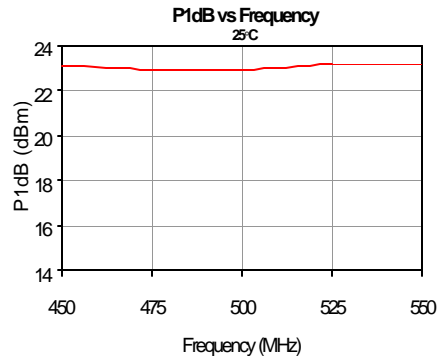
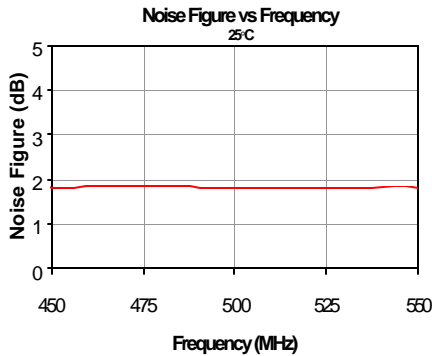
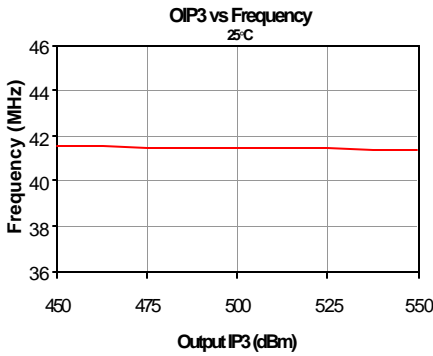
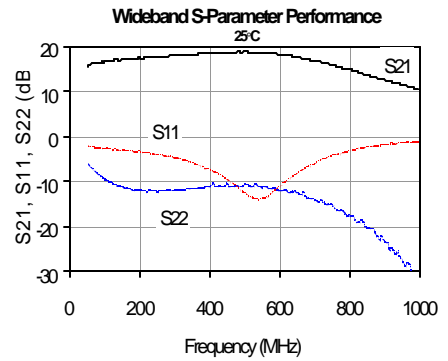
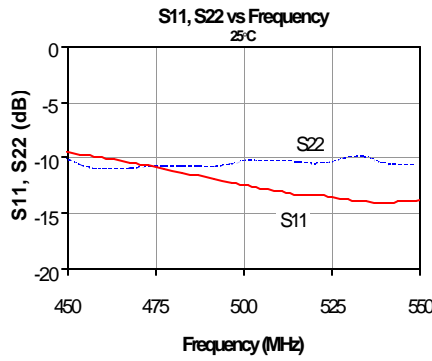
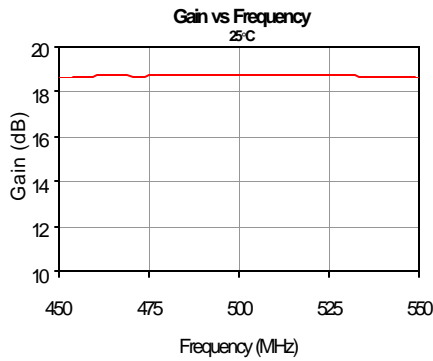
Typical Performance

| Frequency | 500 MHz |
|--------------|---------------|
| S21 - Gain | 18 dB |
| S11 | -15 dB |
| S22 | -10 dB |
| Output P1dB | +22 dBm |
| Output IP3 | +42 dBm |
| Noise Figure | 1.7 dB |
| Bias | +5 V @ 150 mA |



Notes:

1. The amplifier should be connected directly to a +5 V regulator; no dropping resistor is required.
2. If no DC signal is present at the input (pin 1), C1 can be removed. The gate is internally grounded in the amplifier.
3. R2 is used as a placeholder for a different application circuit. It can be removed from the circuit.
4. R1, C2, and C3 (from the silkscreen) are not utilized in this application circuit.

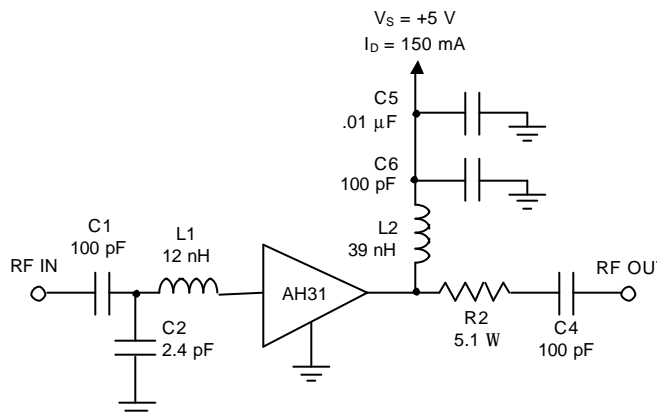




Reference Design: 870 – 960 MHz

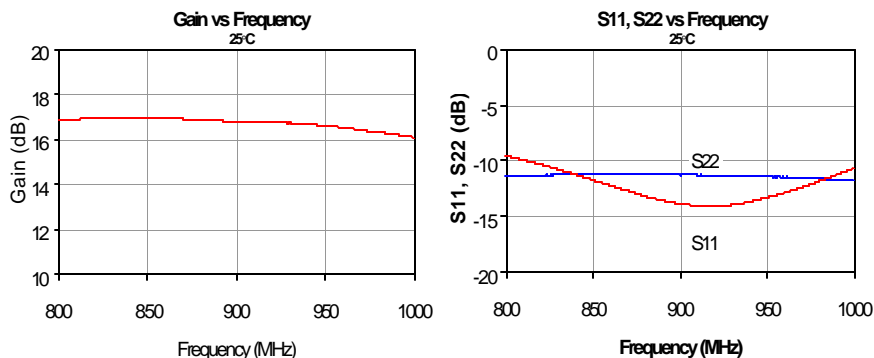
Typical Performance

| Frequency | 900 MHz |
|--------------|--------------|
| S21 | 16.8 dB |
| S11 | -14 dB |
| S22 | -11 dB |
| Output P1dB | +21 dBm |
| Output IP3 | +41 dBm |
| Noise Figure | 2.1 dB |
| Bias | 5 V @ 150 mA |



Notes:

1. The amplifier should be connected directly to a +5 V regulator; no dropping resistor is required.
2. If no DC signal is present at the input (pin 1), C1 can be removed. The gate is internally grounded in the amplifier.
3. All components are of size 0603.
4. **This is a reference design only. Sample evaluation boards are not readily available for this circuit. The actual implementation can be achieved by requesting an AH31 Evaluation board (any frequency) and replacing the passive components with the values given above.**



Typical Device Data

S-Parameters ($V_D = +5\text{ V}$, $I_D = 150\text{ mA}$, $T = 25^\circ\text{C}$, calibrated to device leads)

| Freq (MHz) | S11 (dB) | S11 (ang) | S21 (dB) | S21 (ang) | S12 (dB) | S12 (ang) | S22 (dB) | S22 (ang) |
|------------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| 50 | -2.89 | -5.15 | 16.14 | 175.42 | -29.18 | 5.50 | -11.16 | -10.29 |
| 100 | -2.89 | -8.61 | 16.07 | 173.09 | -29.05 | 8.21 | -11.42 | -11.71 |
| 200 | -2.93 | -16.91 | 15.99 | 167.64 | -28.46 | 13.72 | -11.47 | -17.87 |
| 300 | -2.96 | -25.39 | 15.90 | 162.22 | -27.82 | 17.52 | -11.60 | -25.22 |
| 400 | -3.01 | -33.42 | 15.78 | 156.27 | -27.04 | 20.10 | -11.73 | -32.59 |
| 500 | -3.10 | -41.65 | 15.72 | 150.37 | -26.35 | 22.46 | -11.88 | -40.41 |
| 600 | -3.16 | -49.82 | 15.54 | 144.69 | -25.57 | 23.12 | -12.01 | -48.04 |
| 700 | -3.23 | -57.37 | 15.25 | 139.50 | -24.79 | 22.98 | -12.22 | -55.71 |
| 800 | -3.24 | -65.10 | 15.14 | 134.31 | -24.33 | 21.53 | -12.37 | -62.56 |
| 900 | -3.30 | -72.57 | 14.98 | 129.13 | -23.74 | 19.94 | -12.50 | -69.95 |
| 1000 | -3.38 | -79.77 | 14.74 | 124.24 | -23.15 | 18.03 | -12.67 | -77.38 |

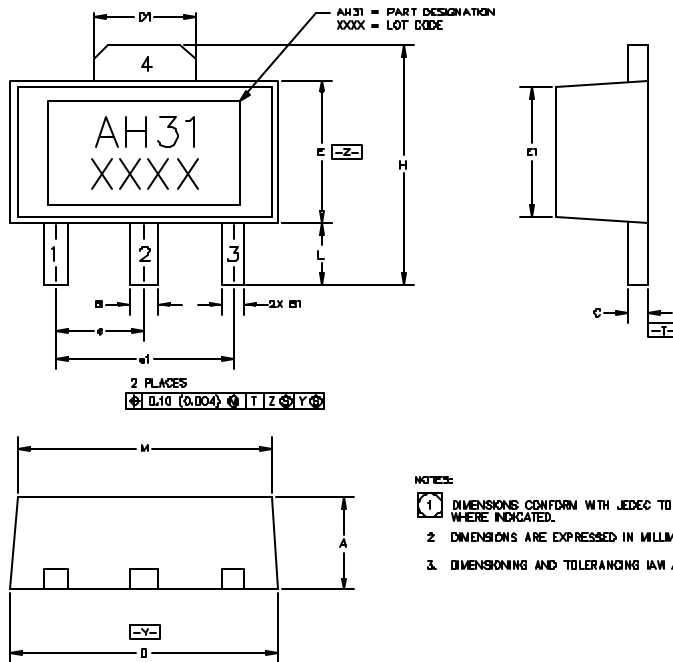
AH31

High Dynamic Range IF Amplifier

Product Information



Outline Drawing

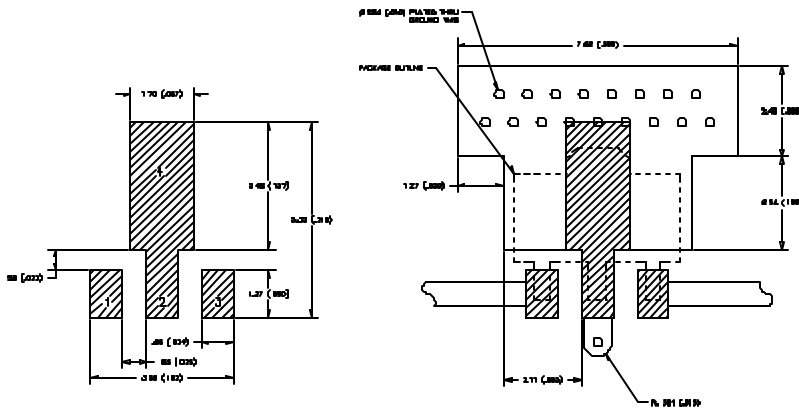


Product Marking

The component will be marked with an “AH31” designator with a four-digit alphanumeric lot code on the top surface of the package. Tape and reel specifications for this part is located on the website in the “Application Notes” section.

| SYMBOL | MIN | MAX |
|--------|--------------------|----------------|
| A | 1.40 (.055) | 1.60 (.063) |
| B | .44 (.017) | .58 (.022) |
| B1 | .38 (.014) | .45 (.019) |
| C | .38 (.014) | .44 (.017) |
| D | 4.40 (.173) | 4.80 (.181) |
| D1 | 1.62 (.064) | 1.83 (.072) |
| E | 2.28 (.089) | 2.80 (.102) |
| E1 | 2.01 (.079) | 2.29 (.090) |
| Ⓢ | 1.50 BSC (.059) | |
| Ⓢ1 | 3.00 BSC (.118) | |
| H | 3.94 (.155) | 4.25 (.167) |
| L | .89 (.035) | 1.20 (.047) |
| M | 4.04 (.159) | 4.19 (.165) |

Land Pattern



ESD / MSL Information

ESD Classification: Class 1B
 Value: Passes at 600 V
 Test: Human Body Model (HBM)
 Standard: JEDEC Standard JESD22-A114

ESD Classification: Class IV
 Value: Passes at 1000 V
 Test: Charged Device Model (CDM)
 Standard: JEDEC Standard JESD22-C101

MSL Rating: Level 3 at +225 °C convection reflow
 Standard: JEDEC Standard J-STD-020A

Mounting Configuration Notes

1. Ground / thermal vias are critical for the proper performance of this device. Vias should use a .35mm (#80/.0135”) diameter drill and have a final plated thru diameter of .25 mm (.010”).
2. Add as much copper as possible to inner and outer layers near the part to ensure optimal thermal performance.
3. Mounting screws can be added near the part to fasten the board to a heatsink. Ensure that the ground / thermal via region contacts the heatsink.
4. Do not put solder mask on the backside of the PC board in the region where the board contacts the heatsink.
5. RF trace width depends upon the PC board material and construction.
6. Use 1 oz. Copper minimum.
7. All dimensions are in millimeters (inches). Angles are in degrees.

Specifications and information are subject to change without notice