



# WJA1500

+5V Active-Bias InGaP HBT Gain Block

## Product Features

- 50 – 1000 MHz
- 20 dB Gain
- +20 dBm P1dB
- +43 dBm OIP3
- +5V Single Voltage Supply
- Internal Active Bias Supply
- Internally matched to 50 Ω
- Lead-free / RoHS-compliant / Green SOT-89 package

## Applications

- IF Amplifier
- Repeaters, BTS Transceivers
- VHF/UHF
- Wireless Infrastructure
- General Purpose

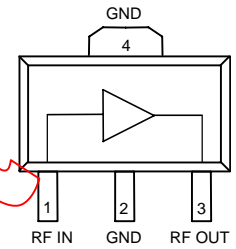
## Product Description

The WJA1500 is a high performance amplifier that offers high linearity in a low-cost surface-mount package. At 200 MHz, the WJA1500 typically provides 20 dB gain, +43 dBm OIP3, and +20 dBm P1dB. The device is housed in a lead-free/green/RoHS-compliant SOT-89 industry-standard SMT package using a NiPdAu plating to eliminate the possibility of tin whiskering.

The WJA1500 consists of Darlington pair amplifiers using a high reliability InGaP/GaAs HBT process technology. The MMIC amplifier is internally matched to 50Ω and only requires DC-blocking capacitors and an inductive RF choke for operation. Biased directly from a 5V supply, an internal active bias network enables stable operation over temperature, eliminating the need for the typical dropping bias resistor.

The amplifier is targeted for high performance IF applications in existing and next generation wireless technologies. In addition, the WJA1500 will work for various other applications within the 50 to 1000 MHz frequency range.

## Functional Diagram



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

## Specifications

| Parameter                 | Units | Min | Typ  | Max  |
|---------------------------|-------|-----|------|------|
| Operational Bandwidth     | MHz   | 50  |      | 1000 |
| Test Frequency            | MHz   |     | 200  |      |
| Gain                      | dB    |     | 19.7 |      |
| Input Return Loss         | dB    |     | 18   |      |
| Output Return Loss        | dB    |     | 16   |      |
| Output P1dB               | dBm   |     | +20  |      |
| Output IP3 <sup>(2)</sup> | dBm   |     | +43  |      |
| Noise Figure              | dB    |     | 3.8  |      |
| Device Voltage            | V     |     | 5    |      |
| Device Current            | mA    |     | 87   |      |

1. Test conditions: 25 °C, Supply Voltage = +5 V, 50 Ω System.

2. 3OIP measured with two tones at an output power of 0 dBm/ tone separated by 1 MHz. The suppression on the largest IM3 product is used to calculate the 3OIP using a 2:1 rule.

## Typical Performance

| Parameter                 | Units | Typical |      |      |       |
|---------------------------|-------|---------|------|------|-------|
| Frequency                 | MHz   | 50      | 100  | 200  | 500   |
| S21                       | dB    | 20.1    | 19.9 | 19.7 | 19    |
| S11                       | dB    | -18     | -19  | -18  | -14   |
| S22                       | dB    | -17     | -18  | -16  | -10   |
| Output P1dB               | dBm   | +20     | +20  | +20  | +20   |
| Output IP3 <sup>(2)</sup> | dBm   | +44     | +44  | +43  | +40.5 |
| Noise Figure              | dB    | 5       | 4    | 3.8  | 3.8   |

## Absolute Maximum Rating

| Parameter                  | Rating         |
|----------------------------|----------------|
| Operating Case Temperature | -40 to +85 °C  |
| Storage Temperature        | -55 to +150 °C |

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

## Ordering Information

| Part No.    | Description   |
|-------------|---|
| WJA1500     | +5V Active Bias InGaP HBT Gain Block<br>(lead-free/green/RoHS-compliant SOT-89 Package) |
| WJA1500-PCB | 50 – 1000 MHz Fully Assembled Eval. Board   |

Specifications and information are subject to change without notice

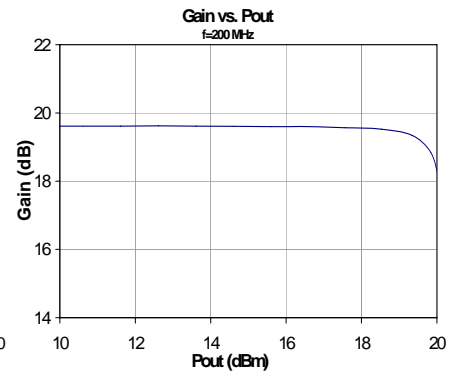
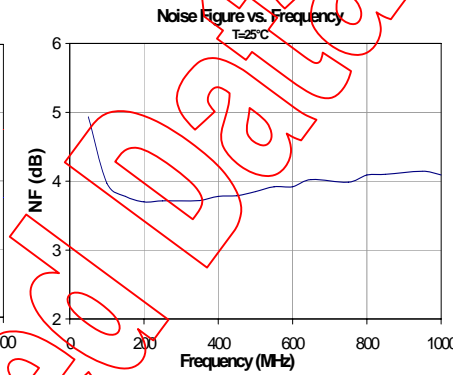
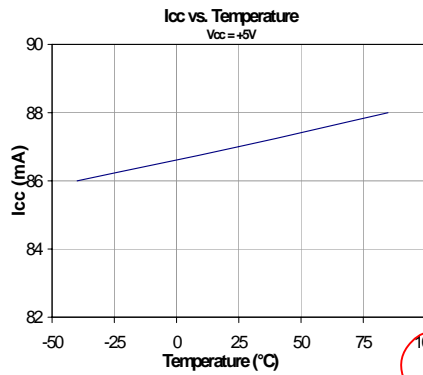
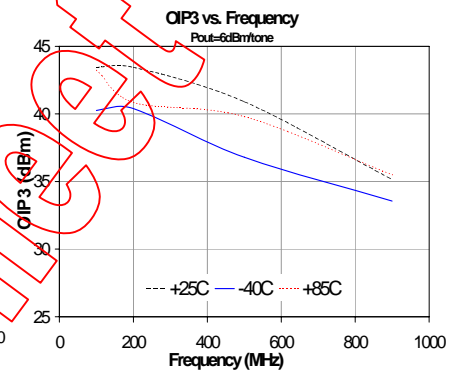
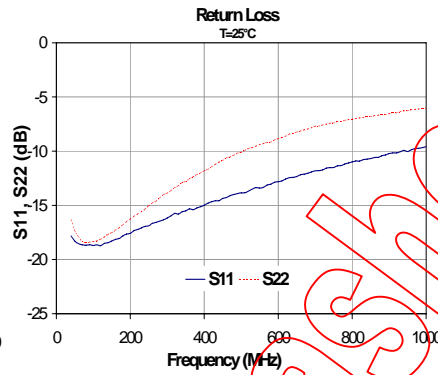
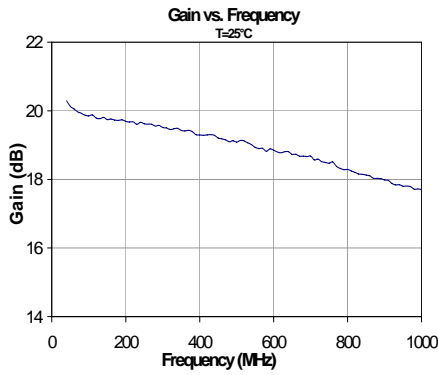


# WJA1500

+5V Active-Bias InGaP HBT Gain Block

## Typical Device RF Performance Supply Bias = +5 V, $I_{cc} = 87$ mA

1. Test conditions:  $T = 25^\circ\text{C}$ , Supply Voltage = +5 V,  $I_{cc} = 87$  mA typical, 50  $\Omega$  System.
2. 3OIP measured with two tones at an output power of 0 dBm/tone separated by 1 MHz. The suppression on the largest IM3 product is used to calculate the OIP3 using a 2:1 rule.



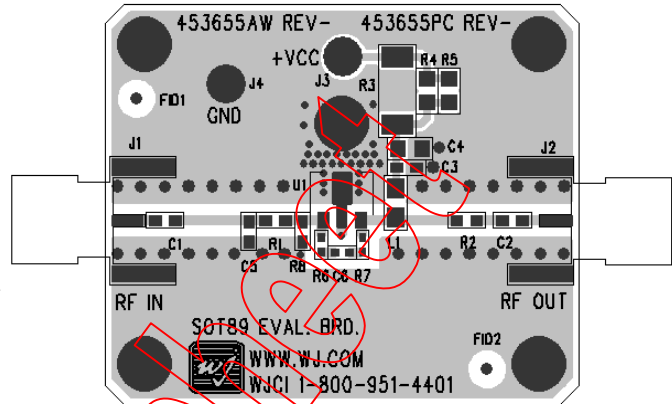
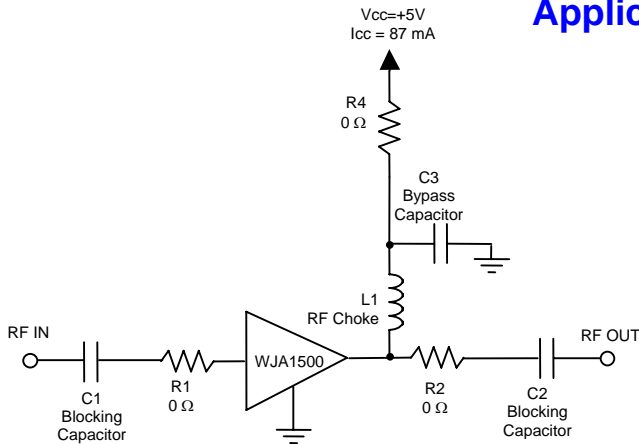
Advanced Data Sheet



# WJA1500

## +5V Active-Bias InGaP HBT Gain Block

### Application Circuit



### Recommended Component Values<sup>(1)</sup>

| Ref. Name                            | Value / Type                | Size |
|--------------------------------------|-----------------------------|------|
| L1                                   | 470 nH wire wound inductor  | 1008 |
| C1, C2                               | 1000 pF chip capacitor      | 0603 |
| C3                                   | 0.018 μF chip capacitor     | 0603 |
| R1, R2, R4                           | 0 Ω <sup>(2)</sup>          | 0603 |
| C4, C5, C6,<br>R3, R5, R6,<br>R7, R8 | Do Not Place <sup>(2)</sup> |      |

1. The listed values are contained on the evaluation board to achieve optimal broadband performance.
2. Place holders for the 0Ω resistors and "Do Not Place" references are not needed for final design.

### Typical Device Data

S-Parameters ( $V_{device} = +5V$ ,  $I_{CC} = 87mA$ ,  $T = 25^\circ C$ , calibrated to device leads)

| Freq (MHz) | S11 (dB) | S11 (ang) | S21 (dB) | S21 (ang) | S12 (dB) | S12 (ang) | S22 (dB) | S22 (ang) |
|------------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| 10         | -14.15   | -52.86    | 22.00    | 170.08    | -25.19   | 15.22     | -9.71    | -31.55    |
| 50         | -18.32   | -126.19   | 20.13    | 169.50    | -23.41   | 5.94      | -17.39   | -60.21    |
| 100        | -18.70   | -143.66   | 19.85    | 168.15    | -23.19   | 3.89      | -18.34   | -70.20    |
| 150        | -18.29   | -147.03   | 19.75    | 165.11    | -23.17   | 3.40      | -17.53   | -77.53    |
| 200        | -17.58   | -147.87   | 19.69    | 161.73    | -23.09   | 3.09      | -16.26   | -85.04    |
| 250        | -16.88   | -148.53   | 19.62    | 157.86    | -22.95   | 3.15      | -15.03   | -91.71    |
| 300        | -16.17   | -148.90   | 19.51    | 153.85    | -22.87   | 3.10      | -13.88   | -97.78    |
| 350        | -15.51   | -150.67   | 19.43    | 150.10    | -22.76   | 2.73      | -12.81   | -102.88   |
| 400        | -14.99   | -151.56   | 19.29    | 146.51    | -22.67   | 2.88      | -11.81   | -106.53   |
| 450        | -14.37   | -154.33   | 19.21    | 142.46    | -22.49   | 2.70      | -10.85   | -111.66   |
| 500        | -13.86   | -155.73   | 19.09    | 138.21    | -22.36   | 1.90      | -10.11   | -116.08   |
| 550        | -13.41   | -160.18   | 18.93    | 134.40    | -22.28   | 0.80      | -9.39    | -120.61   |
| 600        | -12.82   | -161.87   | 18.85    | 131.46    | -22.14   | 1.38      | -8.85    | -123.18   |
| 650        | -12.34   | -165.23   | 18.73    | 127.60    | -22.06   | 0.50      | -8.24    | -126.93   |
| 700        | -11.82   | -168.77   | 18.68    | 123.23    | -21.80   | -0.24     | -7.70    | -130.47   |
| 750        | -11.51   | -172.69   | 18.47    | 119.55    | -21.74   | -1.53     | -7.39    | -134.46   |
| 800        | -11.00   | -175.98   | 18.29    | 115.92    | -21.70   | -2.95     | -7.05    | -138.38   |
| 850        | -10.68   | -178.16   | 18.13    | 112.76    | -21.66   | -3.21     | -6.80    | -141.31   |
| 900        | -10.23   | -178.91   | 17.98    | 109.49    | -21.54   | -4.35     | -6.54    | -143.85   |
| 950        | -10.03   | -175.93   | 17.80    | 106.27    | -21.44   | -5.24     | -6.27    | -147.85   |
| 1000       | -9.59    | -172.06   | 17.71    | 102.31    | -21.40   | -6.48     | -6.06    | -151.29   |
| 1050       | -9.30    | -169.80   | 17.54    | 99.33     | -21.35   | -7.19     | -5.85    | -154.63   |
| 1100       | -8.92    | -166.58   | 17.35    | 95.43     | -21.24   | -8.16     | -5.60    | -158.70   |
| 1150       | -8.82    | -163.74   | 17.09    | 92.60     | -21.16   | -9.76     | -5.53    | -161.69   |
| 1200       | -8.51    | -160.75   | 17.00    | 89.44     | -21.16   | -10.80    | -5.34    | -165.40   |



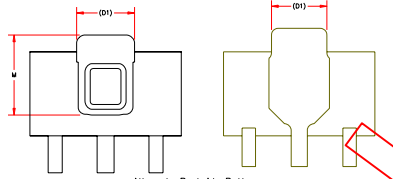
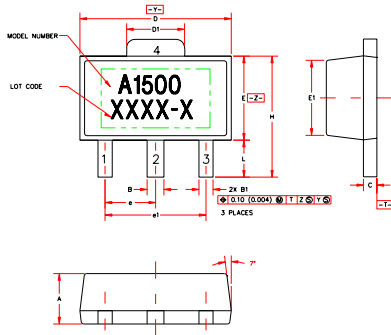
# WJA1500

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### Mechanical Information

This package is lead-free/Green/RoHS-compliant. It is compatible with both lead-free (maximum 260 °C reflow temperature) and leaded (maximum 245 °C reflow temperature) soldering processes. The plating material on the leads is NiPdAu.

### Outline Drawing



| SYMBOL | MIN            | NOM            | MAX            |
|--------|----------------|----------------|----------------|
| A      | 1.40<br>(.055) | 1.50<br>(.059) | 1.60<br>(.063) |
| B      | .44<br>(.017)  | .50<br>(.020)  | .56<br>(.022)  |
| BI     | .36<br>(.014)  | .42<br>(.016)  | .48<br>(.019)  |
| C      | .35<br>(.014)  | .40<br>(.016)  | .45<br>(.017)  |
| D      | 4.40<br>(.173) | 4.50<br>(.177) | 4.60<br>(.181) |
| DI     | 1.62<br>(.064) | 1.75<br>(.069) | 1.88<br>(.074) |
| E      | 2.38<br>(.094) | 2.50<br>(.098) | 2.62<br>(.103) |
| E1     | 2.13<br>(.084) | 2.25<br>(.089) | 2.38<br>(.094) |

|    | 1.50 BSC<br>(.059) |
|----|--------------------|
| e1 | 3.00 BSC<br>(.118) |
| H  | 3.94<br>(.155)     |
| L  | 4.10<br>(.161)     |
| M  | 1.91<br>(.075)     |
|    | 2.40<br>(.094)     |
|    | 2.6<br>(.102)      |

NOTES:  
 1. DIMENSIONS CONFORM WITH JEDEC TO-243C EXCEPT WHERE INDICATED.  
 2. DIMENSIONS ARE EXPRESSED IN MILLIMETERS (INCHES).  
 3. DIMENSIONING AND TOLERANCING ARE AS SHOWN.

### Product Marking

The WJA1500 will be marked with an "A1500" designator with an alphanumeric lot code marked below the part designator.

Tape and reel specifications for this part are located on the website in the "Application Notes" section.

### MSL / ESD Rating

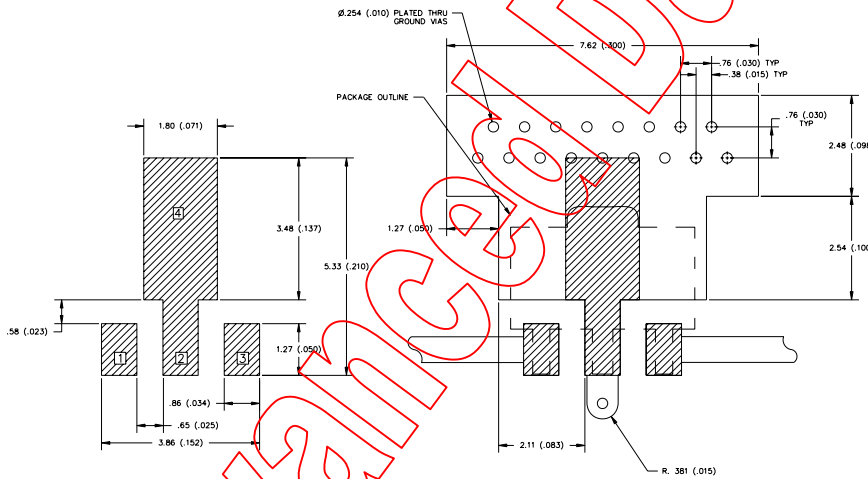


Caution! ESD sensitive device.

ESD Rating: Class 1C  
 Value: Passes  $\geq 1000V$  min.  
 Test: Human Body Model (HBM)  
 Standard: JEDEC Standard JESD22-A114

ESD Rating: Class IV  
 Value: Passes  $\geq 1000V$  min.  
 Test: Charged Device Model (CDM)  
 Standard: JEDEC Standard JESD22-C101

### Land Pattern



### Mounting Config. 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.