

## Product Features

- DC – 4 GHz
- +24 dBm P1dB at 1 GHz
- +40 dBm OIP3 at 1 GHz
- 15 dB Gain at 1 GHz
- 4.6 dB Noise Figure
- Available in Lead-free / green SOT-89 Package Style
- Internally matched to 50  $\Omega$

## Applications

- Mobile Infrastructure
- CATV / FTTX
- W-LAN / ISM
- RFID
- WiMAX / WiBro

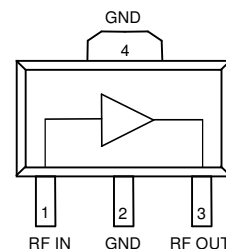
## Product Description

The ECG008 is a general-purpose buffer amplifier that offers high dynamic range in a low-cost surface-mount package. At 1000 MHz, the ECG008 typically provides 15 dB of gain, +40 dBm Output IP3, and +24 dBm P1dB.

The ECG008 consists of Darlington pair amplifiers using the high reliability InGaP/GaAs HBT process technology and only requires DC-blocking capacitors, a bias resistor, and an inductive RF choke for operation. The device is ideal for wireless applications and is available in a lead-free/green/RoHS-compliant SOT-89 package. All devices are 100% RF and DC tested.

The broadband MMIC amplifier can be directly applied to various current and next generation wireless technologies such as GPRS, GSM, CDMA, and W-CDMA. In addition, the ECG008 will work for other various applications within the DC to 4 GHz frequency range such as CATV and mobile wireless.

## Functional Diagram



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

## Specifications <sup>(1)</sup>

| Parameter                 | Units | Min | Typ  | Max  |
|---------------------------|-------|-----|------|------|
| Operational Bandwidth     | MHz   | DC  |      | 4000 |
| Test Frequency            | MHz   |     | 1000 |      |
| Gain                      | dB    |     | 15   |      |
| Output P1dB               | dBm   |     | +24  |      |
| Output IP3 <sup>(3)</sup> | dBm   |     | +40  |      |
| Noise Figure              | dB    |     | 4.6  |      |
| Test Frequency            | MHz   |     | 2000 |      |
| Gain                      | dB    | 13  | 14.3 |      |
| Input Return Loss         | dB    |     | 25   |      |
| Output Return Loss        | dB    |     | 14   |      |
| Output P1dB               | dBm   |     | +23  |      |
| Output IP3 <sup>(2)</sup> | dBm   | +34 | +37  |      |
| Noise Figure              | dB    |     | 4.8  |      |
| Device Voltage            | V     | 6.8 | 7.3  | 7.8  |
| Device Current            | mA    |     | 120  |      |
| Output mismatch w/o spurs | VSWR  |     | 10:1 |      |

1. Test conditions unless otherwise noted: 25 °C, Supply voltage = +9 V, Rbias = 14  $\Omega$ , 50  $\Omega$  system.
2. 3OIP measured with two tones at an output power of +9 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 <sup>(1)</sup>

| Parameter    | Units | Typical |       |       |       |
|--------------|-------|---------|-------|-------|-------|
| Frequency    | MHz   | 500     | 900   | 1900  | 2140  |
| S21          | dB    | 14.7    | 14.6  | 14.3  | 14.3  |
| S11          | dB    | -26     | -28.5 | -28   | -19.5 |
| S22          | dB    | -19.4   | -17.4 | -13.4 | -15   |
| Output P1dB  | dBm   | +24.3   | +24   | +23.3 | +19.0 |
| Output IP3   | dBm   | +41     | +40   | +37   | +30.5 |
| Noise Figure | dB    | 4.7     | 4.6   | 4.7   | 4.8   |

## Absolute Maximum Rating

| Parameter                   | Rating         |
|-----------------------------|----------------|
| Operating Case Temperature  | -40 to +85 °C  |
| Storage Temperature         | -65 to +150 °C |
| RF Input Power (continuous) | +15 dBm        |
| Device Current              | 160 mA         |
| Junction Temperature        | +250 °C        |

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

## Ordering Information

| Part No.    | Description                                                             |
|-------------|-------------------------------------------------------------------------|
| ECG008B-G   | InGaP HBT Gain Block<br>(lead-free/green/RoHS-compliant SOT-89 package) |
| ECG008B-PCB | 700–2400 MHz Fully Assembled Eval. Board                                |

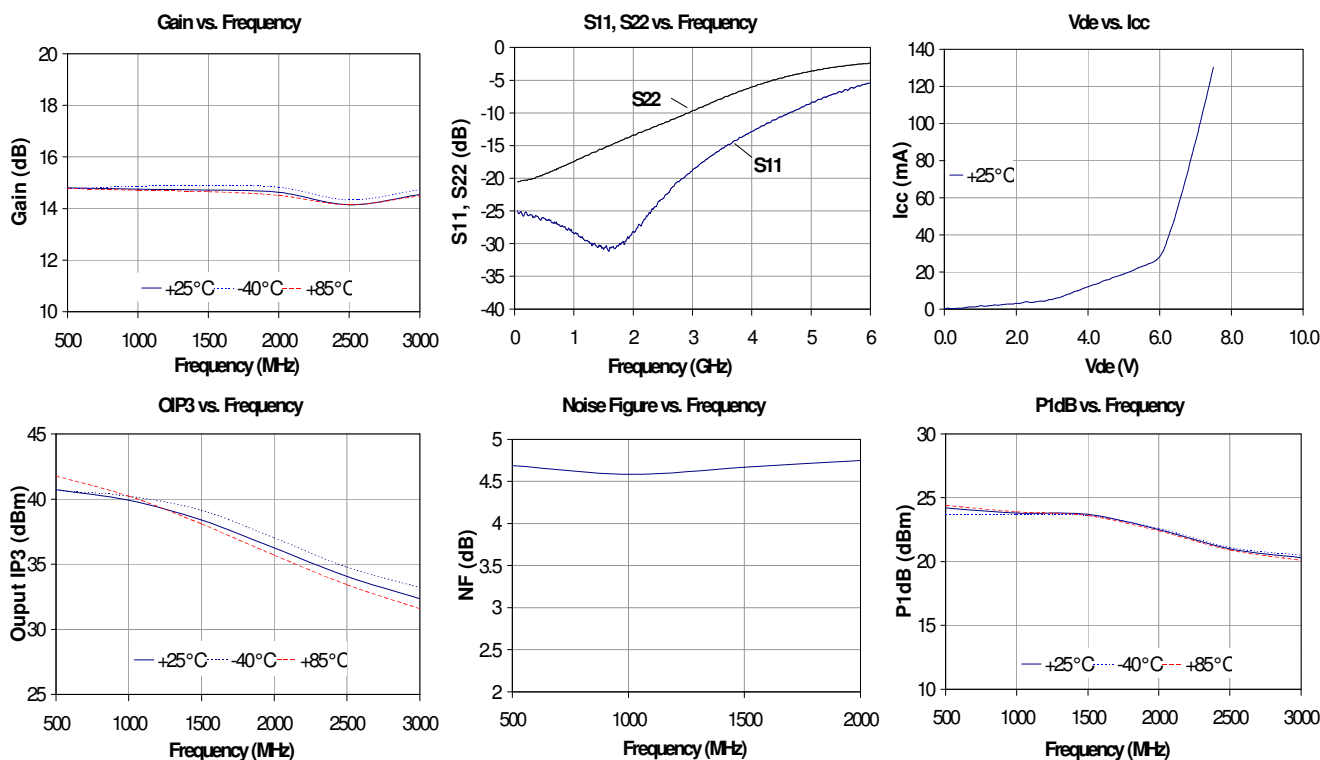
Specifications and information are subject to change without notice

## Typical Device RF Performance <sup>(3)</sup>

Supply Bias = +9 V,  $R_{bias} = 14 \Omega$ ,  $I_{CC} = 120 \text{ mA}$

| Frequency    | MHz | 100   | 500   | 900   | 1900  | 2140  | 2400  | 3500  | 5800 |
|--------------|-----|-------|-------|-------|-------|-------|-------|-------|------|
| S21          | dB  | 14.8  | 14.7  | 14.6  | 14.3  | 14.3  | 14.2  | 14.5  | 12.4 |
| S11          | dB  | -25   | -26   | -28.5 | -28   | -25   | -23.2 | -15.4 | -6   |
| S22          | dB  | -20   | -19   | -17   | -13   | -13   | -12   | -7.9  | -2.7 |
| Output P1dB  | dBm | +24.5 | +24.3 | +24   | +23.2 | +22.8 | +21.8 | +17.3 |      |
| Output IP3   | dBm | +41.6 | +41   | +40   | +37   | +36   | +34   |       |      |
| Noise Figure | dB  | 4.9   | 4.7   | 4.6   | 4.7   | 4.9   | 5.2   |       |      |

1. Test conditions:  $T = 25^\circ \text{C}$ , Supply Voltage = +9 V, Device Voltage = 7.3 V,  $R_{bias} = 14 \Omega$ ,  $I_{CC} = 120 \text{ mA}$  typical,  $50 \Omega$  System.
2. 3OIP measured with two tones at an output power of +9 dBm/line separated by 1 MHz. The suppression on the largest IM3 product is used to calculate the 3OIP using a 2:1 rule.
3. Data is shown as device performance only. Actual implementation for the desired frequency band will be determined by external components shown in the application circuit. The performance data does not account for losses attributed to recommended input and output series resistances shown in the application circuit on page 3.

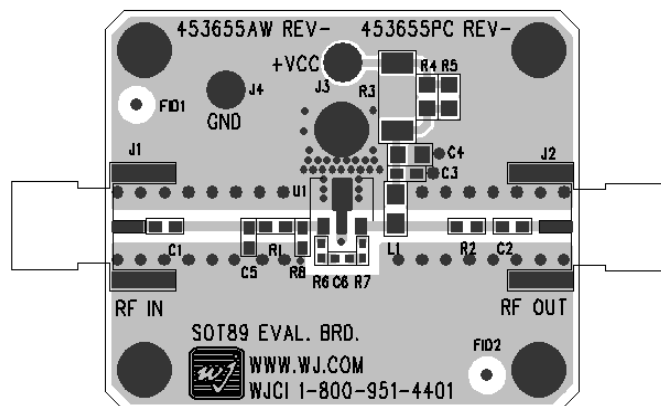
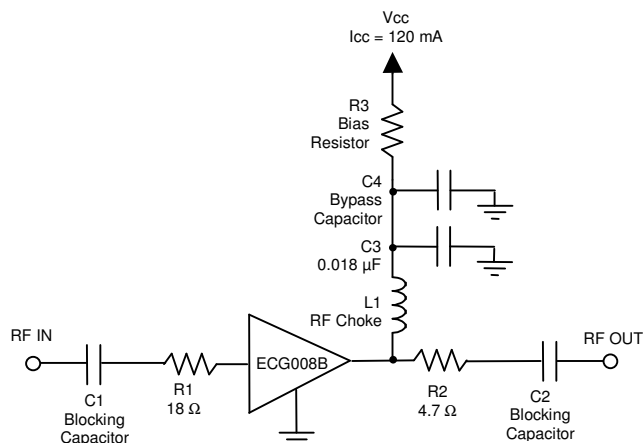


S-Parameters ( $V_{device} = +7.3 \text{ V}$ ,  $I_{CC} = 120 \text{ mA}$ ,  $T = 25^\circ \text{C}$ , calibrated to device leads)

| Freq (MHz) | S11 (dB) | S11 (ang) | S21 (dB) | S21 (ang) | S12 (dB) | S12 (ang) | S22 (dB) | S22 (ang) |
|------------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| 50         | -24.87   | 176.05    | 14.88    | 177.77    | -18.94   | -1.51     | -20.41   | -4.20     |
| 500        | -26.14   | 167.68    | 14.71    | 161.26    | -18.94   | -5.99     | -19.43   | -39.76    |
| 1000       | -28.46   | 166.94    | 14.60    | 142.99    | -19.02   | -11.44    | -17.47   | -72.27    |
| 1500       | -30.86   | -178.22   | 14.39    | 125.46    | -18.94   | -16.56    | -15.40   | -95.62    |
| 2000       | -28.14   | -144.76   | 14.30    | 108.38    | -18.86   | -21.00    | -13.40   | -116.18   |
| 2500       | -23.15   | -137.68   | 14.20    | 91.08     | -18.64   | -25.54    | -11.63   | -133.34   |
| 3000       | -18.78   | -150.37   | 14.30    | 74.41     | -18.20   | -29.98    | -9.65    | -151.20   |
| 3500       | -15.39   | -171.26   | 14.48    | 56.29     | -17.52   | -36.74    | -7.83    | -171.17   |
| 4000       | -12.91   | 161.38    | 14.65    | 35.57     | -16.85   | -45.50    | -6.06    | 165.56    |
| 4500       | -10.59   | 132.87    | 14.51    | 13.60     | -16.36   | -56.53    | -4.68    | 141.33    |
| 5000       | -8.44    | 105.27    | 14.04    | -8.75     | -16.20   | -68.74    | -3.62    | 117.07    |
| 5500       | -6.76    | 80.71     | 13.17    | -31.25    | -16.26   | -81.52    | -2.87    | 94.30     |
| 6000       | -5.43    | 61.63     | 12.10    | -50.89    | -16.59   | -93.75    | -2.41    | 73.89     |

Device S-parameters are available for download off of the website at: <http://www.wj.com>

## Recommended Application Circuit



Recommended Component Values

| Reference Designator | Frequency (MHz) |         |        |       |       |       |       |
|----------------------|-----------------|---------|--------|-------|-------|-------|-------|
|                      | 50              | 500     | 900    | 1900  | 2200  | 2500  | 3500  |
| L1                   | 820 nH          | 220 nH  | 68 nH  | 27 nH | 22 nH | 18 nH | 15 nH |
| C1, C2, C3           | .018 μF         | 1000 pF | 100 pF | 68 pF | 68 pF | 56 pF | 39 pF |

- The proper values for the components are dependent upon the intended frequency of operation.
- The component values in the table below are contained on the evaluation board to achieve optimal broadband performance.
- R1 and R2 are shown in the circuit diagram to avoid potential instabilities. The configuration shown above assures of unconditional stability with the use of the device. It is expected that linearity parameters (OIP3 and P1dB) to degrade about only 0.5 dB, while overall gain will be about 2 dB less than the performance shown in page 1 and 2 of this datasheet. Input and output return loss is expected to improve with the use of the I/O series resistances at 2 GHz.

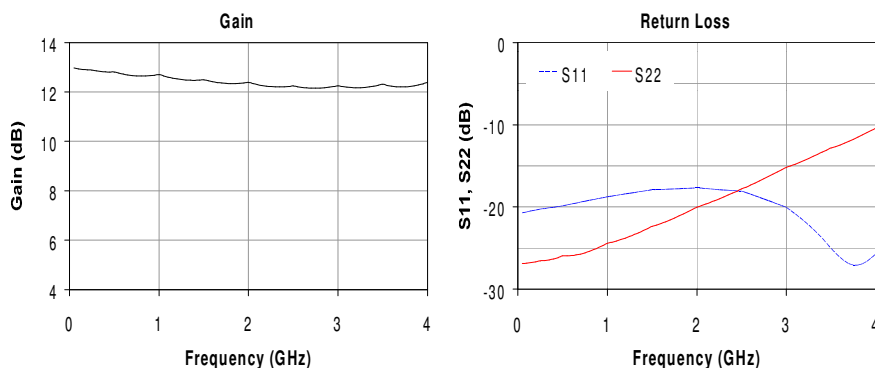
Recommended Bias Resistor Values

| Supply Voltage | R3 value | Size |
|----------------|----------|------|
| 9 V            | 14 ohms  | 2010 |
| 10 V           | 23 ohms  | 2512 |
| 12 V           | 39 ohms  | 2512 |

The proper value for R3 is dependent upon the supply voltage and allows for bias stability over temperature. WJ recommends a minimum supply bias of +9 V. A 1% tolerance resistor is recommended.

| Ref. Desig. | Value / Type             | Size |
|-------------|--------------------------|------|
| L1          | 39 nH wirewound inductor | 0603 |
| C1, C2      | 56 pF chip capacitor     | 0603 |
| C3          | 0.018 μF chip capacitor  | 0603 |
| C4          | Do Not Place             |      |
| R1          | 18 Ω chip resistor       | 0603 |
| R2          | 4.7 Ω chip resistor      | 0603 |
| R3          | 14 Ω 1% tolerance        | 2010 |

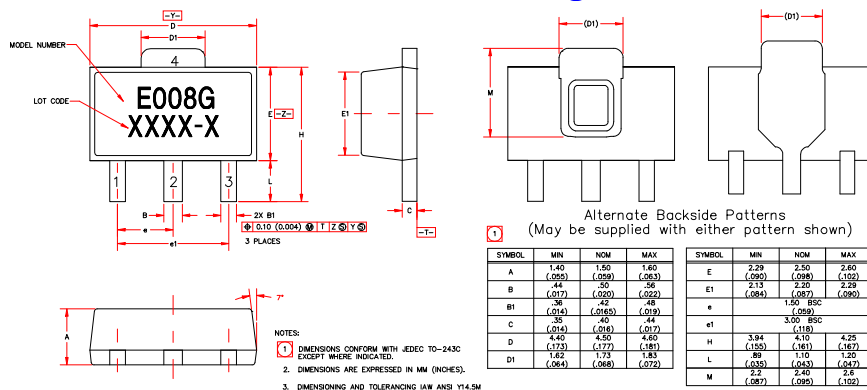
## ECG008B-PCB Performance Data (WJ's evaluation board uses the circuit shown above.)



## ECG008B-G Mechanical Information

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

## Outline Drawing



## Product Marking

The component will be marked with an “E008G” designator with an alphanumeric lot code on the top surface of the package. The obsolete tin-lead package is marked with an “E008” designator followed by an alphanumeric lot code; it may also have been marked with an “6” designator followed by a 3-digit numeric lot code.

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 1A

Value: Passes between 250 and 500V

Test: Human Body Model (HBM)

Standard: JEDEC Standard JESD22-A114

MSL Rating: Level 3 at +260 °C convection reflow

Standard: JEDEC Standard J-STD-020

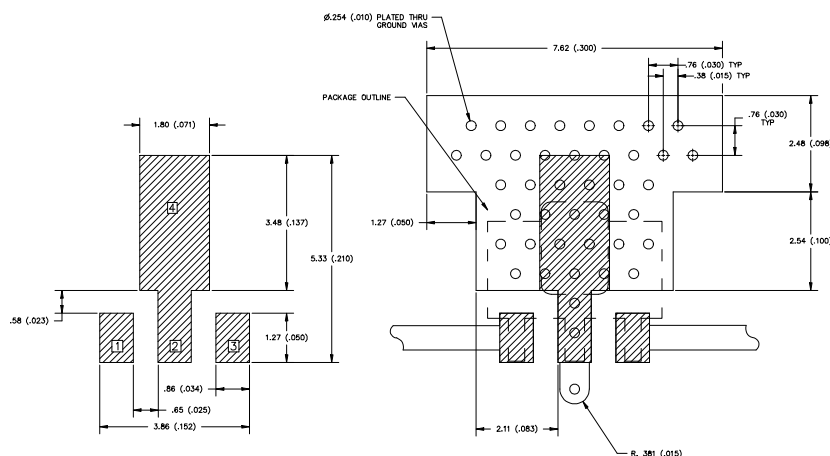
## Mounting Config. Notes

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.

## Thermal Specifications

| Parameter                           | Rating        |
|-------------------------------------|---------------|
| Operating Case Temperature          | -40 to +85 °C |
| Thermal Resistance, R <sub>th</sub> | 86 °C/W       |

## Land Pattern





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