



AH116 / ECP052G

1/2 Watt, High Linearity InGaP HBT Amplifier

The Communications Edge™

Product Information

Product Features

- 800 – 1000 MHz
- +28 dBm P1dB
- +43 dBm Output IP3
- 17.5 dB Gain @ 900 MHz
- +5V Single Positive Supply
- MTTF > 100 Years
- Lead-free/green/RoHS-compliant SOIC-8 SMT Pkg.

Applications

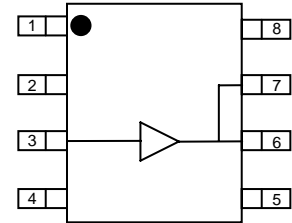
- Final stage amplifiers for Repeaters
- Mobile Infrastructure

Product Description

The AH116 / ECP052G is a high dynamic range driver amplifier in a low-cost surface mount package. The InGaP/GaAs HBT is able to achieve high performance for various narrow-band tuned application circuits with up to +43 dBm OIP3 and +28 dBm of compressed 1-dB power and is housed in a lead-free/green/RoHS-compliant SOIC-8 package. All devices are 100% RF and DC tested.

The product is targeted for use as driver amplifiers for wireless infrastructure where high linearity and medium power is required. The internal active bias allows the AH116 / ECP052G to maintain high linearity over temperature and operate directly off a +5 V supply. This combination makes the device an excellent fit for transceiver line cards and power amplifiers in current and next generation multi-carrier 3G base stations.

Functional Diagram



| Function | Pin No. |
|------------|-----------------|
| Vref | 1 |
| Input | 3 |
| Output | 6, 7 |
| Vbias | 8 |
| GND | Backside Paddle |
| N/C or GND | 2, 4, 5 |

Specifications ⁽¹⁾

| Parameters | Units | Min | Typ | Max |
|--|-------|-----|-------|-----|
| Frequency Range | MHz | | 900 | |
| Gain | dB | 15 | 17.5 | |
| Input R.L. | dB | | 18 | |
| Output R.L. | dB | | 7 | |
| Output P1dB | dBm | +27 | +28.7 | |
| Output IP3 ⁽²⁾ | dBm | +42 | +43 | |
| IS-95A Channel Power @ -45 dBc ACPR | dBm | | +23 | |
| Noise Figure | dB | | 7 | |
| Operating Current Range ⁽³⁾ | mA | 200 | 250 | 300 |
| Device Voltage | V | | +5 | |

1. Test conditions unless otherwise noted: 25 °C, +5V Vsupply, 900 MHz, in tuned application circuit.
2. 3OIP measured with two tones at an output power of +13 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. This corresponds to the quiescent current or operating current under small-signal conditions. It is expected that the current can increase up to 300mA at P1dB.

Typical Performance ⁽¹⁾

| Parameters | Units | Typical |
|-------------------------------------|-------|---------------|
| Frequency | MHz | 900 |
| Gain | dB | 17.5 |
| S11 | dB | -18 |
| S22 | dB | -7 |
| Output P1dB | dBm | +28.7 |
| Output IP3 ⁽²⁾ | dBm | +43 |
| IS-95A Channel Power @ -45 dBc ACPR | dBm | +23 |
| Noise Figure | dB | 7 |
| Supply Bias | | +5 V @ 250 mA |

Absolute Maximum Rating

| Parameter | Rating |
|-----------------------------|----------------|
| Operating Case Temperature | -40 to +85 °C |
| Storage Temperature | -65 to +150 °C |
| RF Input Power (continuous) | +22 dBm |
| Device Voltage | +8 V |
| Device Current | 400 mA |
| Device Power | 2 W |
| Junction Temperature | +250 °C |

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

Ordering Information

| Part No. | Description |
|----------------|--|
| AH116-S8* | 1/2 Watt, High Linearity InGaP HBT Amplifier (lead-tin SOIC-8 Pkg) |
| ECP052G* | 1/2 Watt, High Linearity InGaP HBT Amplifier (lead-tin SOIC-8 Pkg) |
| AH116-S8G | 1/2 Watt, High Linearity InGaP HBT Amplifier (lead-free/green/RoHS-compliant SOIC-8 Pkg) |
| AH116-S8PCB900 | 900 MHz Evaluation Board |

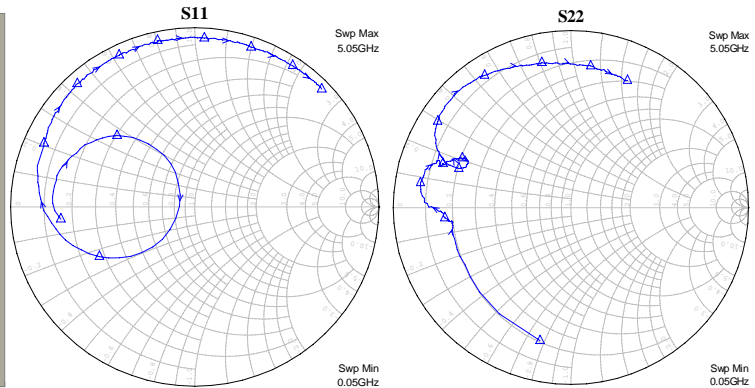
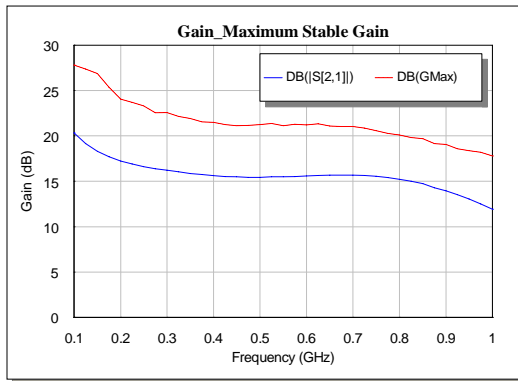
* This package is being phased out in favor of the green package type which is backward compatible for existing designs.

Specifications and information are subject to change without notice



Typical Device Data

S-Parameters ($V_{cc} = +5\text{ V}$, $I_{cc} = 250\text{ mA}$, $T = 25\text{ }^\circ\text{C}$, calibrated to device leads)



Notes:

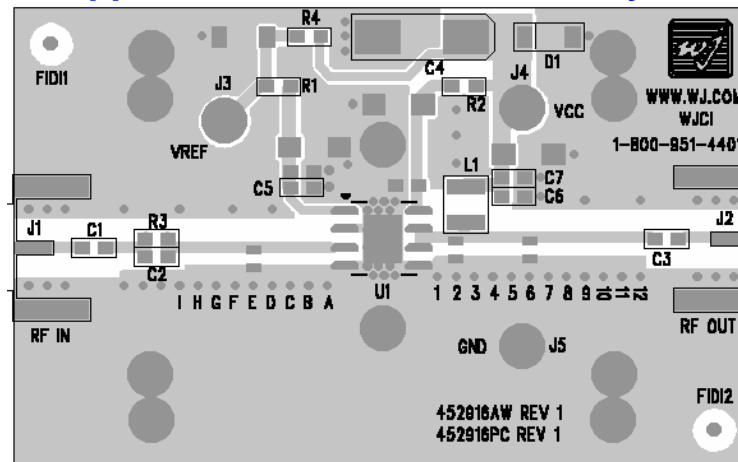
The gain for the unmatched device in 50 ohm system is shown as the trace in black color. For a tuned circuit for a particular frequency, it is expected that actual gain will be higher, up to the maximum stable gain. The maximum stable gain is shown in the dashed red line. The return loss plots are shown from 50 – 5050 MHz, with markers placed at 0.5 – 5.05 GHz in 0.5 GHz increments.

S-Parameters ($V_{cc} = +5\text{ V}$, $I_{cc} = 250\text{ mA}$, $T = 25\text{ }^\circ\text{C}$, unmatched 50 ohm system, calibrated to device leads)

| Freq (MHz) | S11 (dB) | S21 (dB) | S21 (ang) | S12 (dB) | S12 (ang) | S22 (dB) | S22 (ang) |
|------------|----------|----------|-----------|----------|-----------|----------|-----------|
| 50 | -2.72 | 24.16 | 133.35 | -36.72 | 29.75 | -2.23 | -102.97 |
| 100 | -2.25 | 20.33 | 124.95 | -35.31 | 13.96 | -3.08 | -137.03 |
| 200 | -2.31 | 17.23 | 119.37 | -34.90 | 2.32 | -3.32 | -159.63 |
| 400 | -3.08 | 15.63 | 98.28 | -33.62 | -16.36 | -3.48 | -172.70 |
| 600 | -5.79 | 15.58 | 69.70 | -32.10 | -37.73 | -2.87 | -176.25 |
| 800 | -19.72 | 15.22 | 25.60 | -31.19 | -78.95 | -2.27 | -179.74 |
| 1000 | -6.06 | 11.91 | -22.67 | -33.26 | -129.67 | -1.40 | 173.15 |

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

Application Circuit PC Board Layout



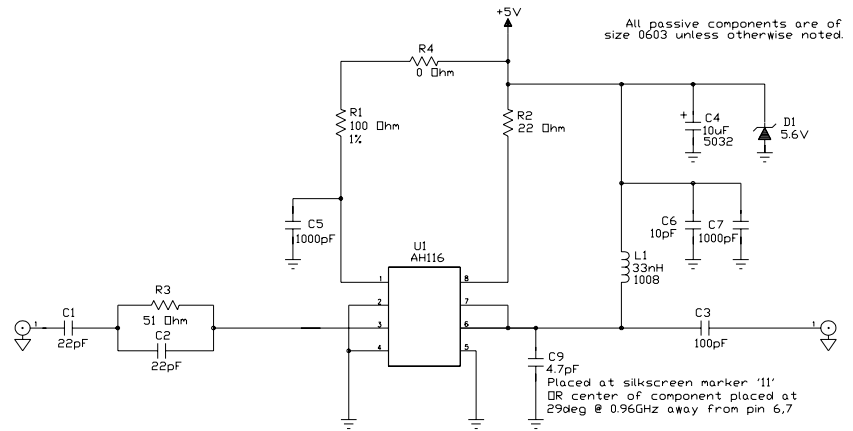
Circuit Board Material: .014" Getek, 4 - layer, 1 oz copper, Microstrip line details: width = .026", spacing = .026"
The silk screen markers 'A', 'B', 'C', etc. and '1', '2', '3', etc. are used as placemarkers for the input and output tuning
Shunt capacitors – C8 and C9. The markers and vias are spaced in .050" increments.



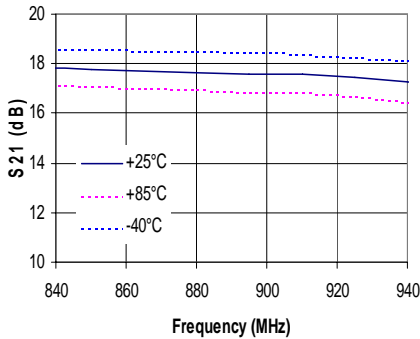
900 MHz Application Circuit (AH116-S8PCB900)

Typical RF Performance at 25°C

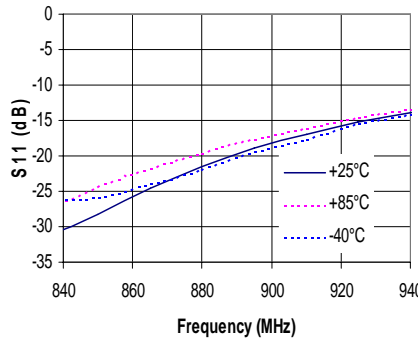
| Frequency | 900 MHz |
|--|-----------|
| S21 – Gain | 17.5 dB |
| S11 – Input Return Loss | -18 dB |
| S22 – Output Return Loss | -7 dB |
| Output P1dB | +28.7 dBm |
| Output IP3 (+17 dBm / tone, 1 MHz spacing) | +43 dBm |
| Channel Power (@-45 dBc ACPR, IS-95 9 channels fwd) | +23 dBm |
| Noise Figure | 7 dB |
| Device / Supply Voltage | +5 V |
| Quiescent Current | 250 mA |



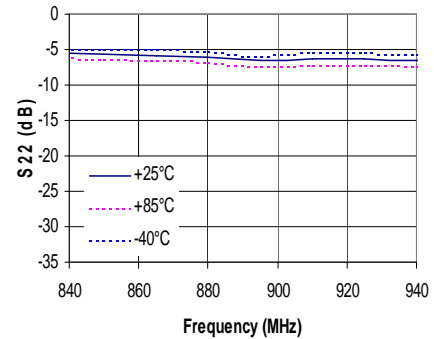
S21 vs Frequency



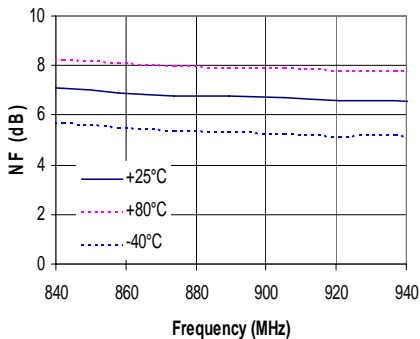
S11 vs. Frequency



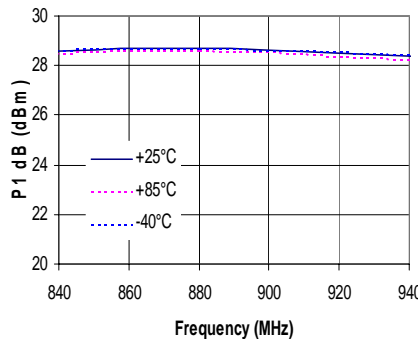
S22 vs. Frequency



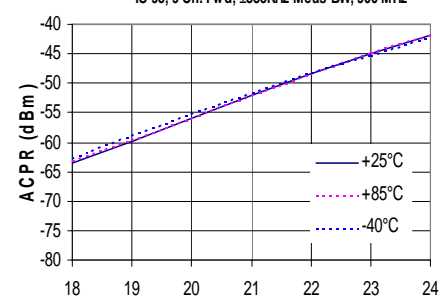
Noise Figure vs. Frequency



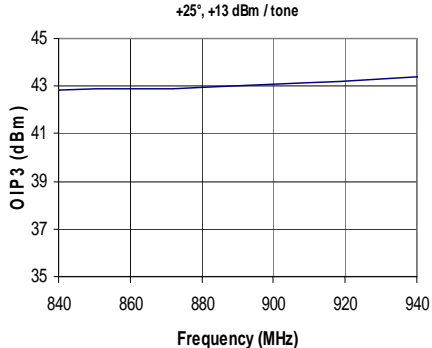
P1 dB vs. Frequency



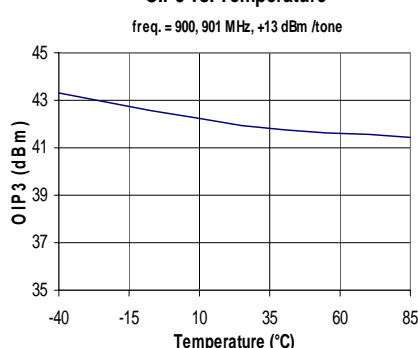
ACPR vs. Channel Power
IS-95, 9 Ch. Fwd, ±885KHz Meas BW, 900 MHz



OIP3 vs. Frequency

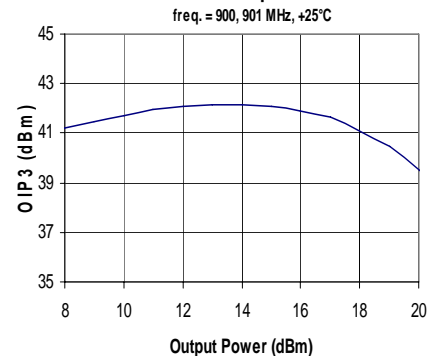


OIP3 vs. Temperature



Output Channel Power (dBm)

OIP3 vs. Output Power





AH116 / ECP052G

1/2 Watt, High Linearity InGaP HBT Amplifier

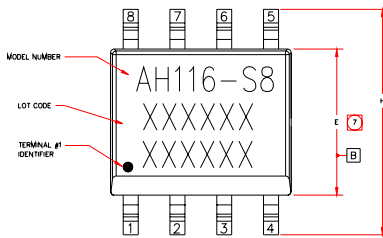
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Product Information

AH116-S8 (SOIC-8 Package) Mechanical Information

This package may contain lead-bearing materials. The plating material on the leads is SnPb.

Outline Drawing



- NOTES:
- EXCEPT WHERE NOTED, THIS PART OUTLINE CONFORMS TO JEDEC STANDARD MS-012, ISSUE C FOR SMALL OUTLINE (SO) PERIPHERAL TERMINALS 3.75mm BODY WIDTH (PLASTIC).
 - DIMENSIONS & TOLERANCING CONFORM TO ASME Y14.5M-1994.
 - ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
 - DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR DATE BUMPS, WHICH SHALL NOT EXCEED .15mm(.006in) PER SIDE.
 - DEVIATION FROM JEDEC MS-012 STANDARD.
 - LENGTH OF TERMINAL FOR SOLDERING TO A SUBSTRATE.
 - DOES NOT INCLUDE INTER-LEAD FLASH OR PROTRUSIONS, WHICH SHALL NOT EXCEED .25mm(.010in) PER SIDE.

Product Marking

The component will be marked with the "AH116-S8" designator with an alphanumeric lot code on the top surface of the package.

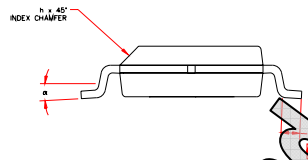
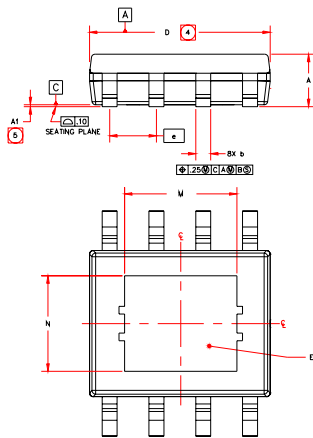
Tape and reel specifications for this part are located on the website in the Application Notes section.

ESD / MSL Information

Caution: ESD sensitive device.

ESD Rating: Class 1B
 Value: Passes ≥500V to <1000V
 Test: Human Body Model (HBM)
 Standard: JEDEC Standard JESD22-A114

MSL Rating: Level 3 at +235° C convection reflow
 Standard: JEDEC Standard J-STD-020

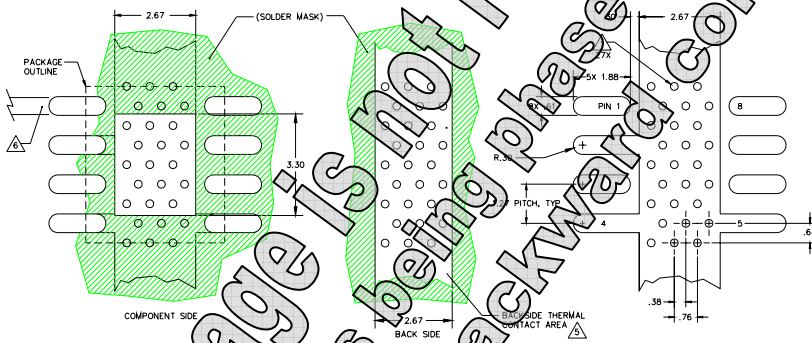


| SYMBOL | MILLIMETERS | INCHES |
|--------|-------------|--------|
| | MIN. | MAX. |
| A | 1.30 | 1.50 |
| A1 | 0 | .10 |
| b | .38 | .41 |
| C | .18 | .20 |
| D | 4.80 | 5.00 |
| E | 3.80 | 4.00 |
| e | 1.27 | 1.27 |
| H | .20 | .20 |
| h | .20 | .228 |
| h1 | .20 | .20 |
| h2 | .20 | .20 |
| h3 | .20 | .20 |
| h4 | .20 | .20 |
| h5 | .20 | .20 |
| h6 | .20 | .20 |
| h7 | .20 | .20 |
| h8 | .20 | .20 |
| h9 | .20 | .20 |
| h10 | .20 | .20 |
| h11 | .20 | .20 |
| h12 | .20 | .20 |
| h13 | .20 | .20 |
| h14 | .20 | .20 |
| h15 | .20 | .20 |
| h16 | .20 | .20 |
| h17 | .20 | .20 |
| h18 | .20 | .20 |
| h19 | .20 | .20 |
| h20 | .20 | .20 |
| h21 | .20 | .20 |
| h22 | .20 | .20 |
| h23 | .20 | .20 |
| h24 | .20 | .20 |
| h25 | .20 | .20 |
| h26 | .20 | .20 |
| h27 | .20 | .20 |
| h28 | .20 | .20 |
| h29 | .20 | .20 |
| h30 | .20 | .20 |
| h31 | .20 | .20 |
| h32 | .20 | .20 |
| h33 | .20 | .20 |
| h34 | .20 | .20 |
| h35 | .20 | .20 |
| h36 | .20 | .20 |
| h37 | .20 | .20 |
| h38 | .20 | .20 |
| h39 | .20 | .20 |
| h40 | .20 | .20 |
| h41 | .20 | .20 |
| h42 | .20 | .20 |
| h43 | .20 | .20 |
| h44 | .20 | .20 |
| h45 | .20 | .20 |
| h46 | .20 | .20 |
| h47 | .20 | .20 |
| h48 | .20 | .20 |
| h49 | .20 | .20 |
| h50 | .20 | .20 |

Mounting Config. Notes

- 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").
- Add as much copper as possible to inner and outer layers near the part to ensure optimal thermal performance.
- 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.
- Do not put solder mask on the backside of the PC board in the region where the board contacts the heatsink.
- RF trace width depends upon the PC board material and construction.
- Use 1 oz. Copper minimum.
- All dimensions are in millimeters (inches). Angles are in degrees.

Land Pattern

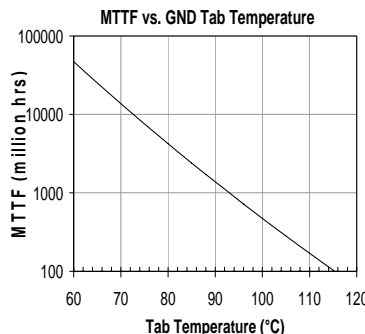


Thermal Specifications

| Parameter | Rating |
|---|---------------|
| Operating Case Temperature (T _{case}) | -40 to +85 °C |
| Thermal Resistance (2), (R _{th(j-c)}) | W |
| Junction Temperature (T _j) | 6 °C |

Notes:

- The amplifier can be operated at 105 °C case temperature for up to 1000 hours. Over its lifetime, it will not degrade in performance and will not degrade device operation at the recommended maximum 85 °C case temperature for the rest of its lifetime.
- The thermal resistance is referenced from the junction-to-case at a case temperature of 85 °C. T_{jc} is a function of the voltage at pins 6 and 7 and the current through pins 6, 7, and 8 and can be calculated by:
 $T_j = T_{case} + R_{th} * V_{ce} * I_{ce}$
- This corresponds to the typical biasing condition of +5V, 250 mA at an 85°C case temperature. A minimum MTTF of 1 million hours is achieved for junction temperatures below 247 °C.



Specifications and information are subject to change without notice



AH116 / ECP052G

1/2 Watt, High Linearity InGaP HBT Amplifier

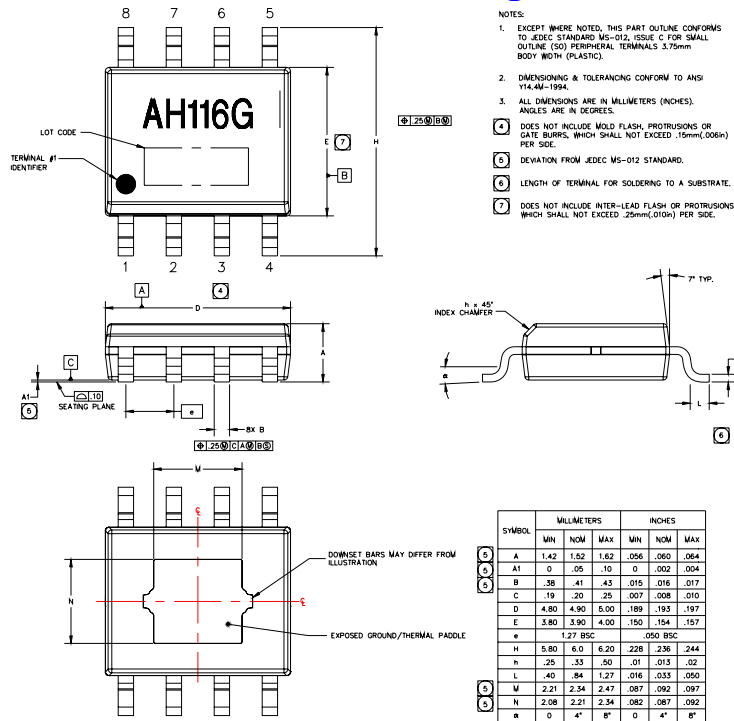
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Product Information

AH116-S8G (Lead-Free Package) 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 lead (maximum 245°C reflow temperature) soldering processes.

Outline Drawing



Product Marking

The component will be marked with an "AH116G" designator with an alphanumeric lot code on the top surface of the package.

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

ESD / MSL Information



Caution! ESD sensitive device.

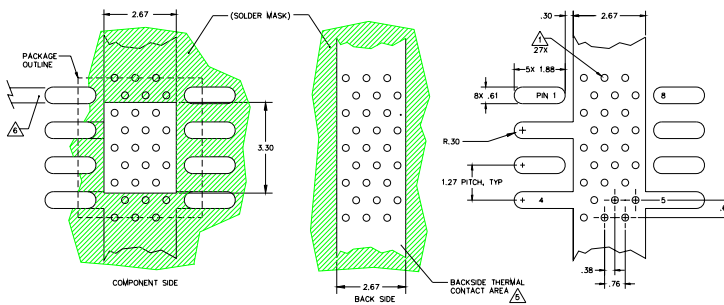
ESD Rating: Class 1B
 Value: Passes ≥500V to <1000V
 Test: Human Body Model (HBM)
 Standard: JEDEC Standard JESD22-A114

MSL Rating: Level 2 at +260° C convection reflow
 Standard: JEDEC Standard J-STD-020

Mounting Config. Notes

- 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").
- Add as much copper as possible to inner and outer layers near the part to ensure optimal thermal performance.
- 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.
- Do not put solder mask on the backside of the PC board in the region where the board contacts the heatsink.
- RF trace width depends upon the PC board material and construction.
- Use 1 oz. Copper minimum.
- All dimensions are in millimeters (inches). Angles are in degrees.

Mounting Configuration / Land Pattern

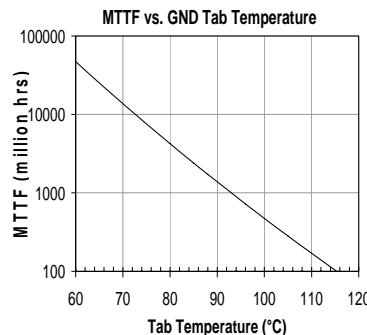


Thermal Specifications

| Parameter | Rating |
|---|---------------|
| Operating Case Temperature ⁽¹⁾ | -40 to +85 °C |
| Thermal Resistance ⁽²⁾ , Rth | 62 °C / W |
| Junction Temperature ⁽³⁾ , Tjc | 162 °C |

Notes:

- The amplifier can be operated at 105 °C case temperature for up to 1000 hours over its lifetime without degradation in performance and will not degrade device operation at the recommended maximum 85 °C case temperature for the rest of its lifetime.
- The thermal resistance is referenced from the junction-to-case at a case temperature of 85 °C. Tjc is a function of the voltage at pins 6 and 7 and the current applied to pins 6, 7, and 8 and can be calculated by:
 $T_{jc} = T_{case} + R_{th} * V_{cc} * I_{cc}$
- This corresponds to the typical biasing condition of +5V, 250 mA at an 85°C case temperature. A minimum MTTF of 1 million hours is achieved for junction temperatures below 247 °C.



Specifications and information are subject to change without notice



AH116 / ECP052G

1/2 Watt, High Linearity InGaP HBT Amplifier

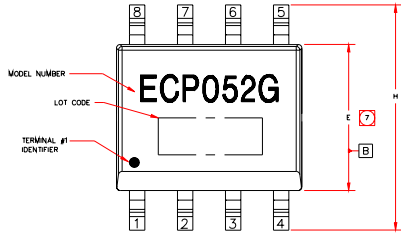
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Product Information

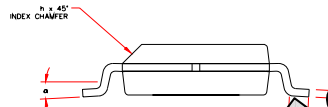
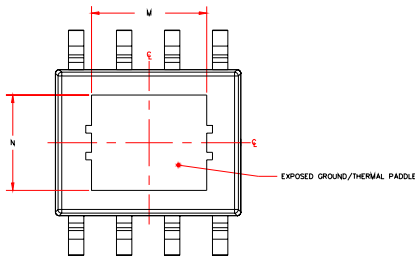
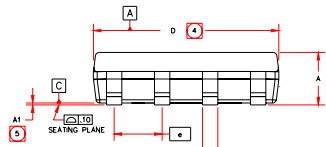
ECP052G (SOIC-8 Package) Mechanical Information

This package may contain lead-bearing materials. The plating material on the leads is SnPb.

Outline Drawing

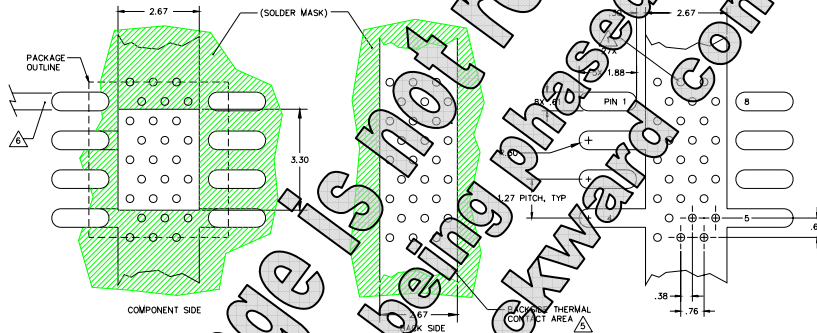


- NOTES:
- EXCEPT WHERE NOTED, THIS PART OUTLINE CONFORMS TO JEDEC STANDARD MS-012, SOIC-C FOR SMALL OUTLINE (SO) PERIPHERAL TERMINALS .375mm BODY WIDTH (PLASTIC).
 - DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.
 - ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
 - DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS, WHICH SHALL NOT EXCEED .15mm(.006in) PER SIDE.
 - DEVIATION FROM JEDEC MS-012 STANDARD.
 - LENGTH OF TERMINAL FOR SOLDERING TO A SUBSTRATE.
 - DOES NOT INCLUDE INTER-LEAD FLASH OR PROTRUSIONS, WHICH SHALL NOT EXCEED .25mm(.010in) PER SIDE.



| SYMBOL | MILLIMETERS | | INCHES |
|--------|-------------|------|----------|
| | MIN. | MAX. | |
| A | 1.30 | 1.50 | .0512 |
| A1 | 0 | .10 | 0.0000 |
| B | .38 | .48 | .0150 |
| C | .18 | .20 | .0070 |
| D | 4.80 | 5.00 | .197 |
| E | 3.50 | 3.60 | .137 |
| e | 1.27 | 1.25 | .050 BSC |
| H | 1.27 | 1.25 | .050 |
| h | 0.25 | 0.25 | .010 |
| L | 0.25 | 0.25 | .010 |
| L1 | 0.25 | 0.25 | .010 |
| N | 1.27 | 1.27 | .050 |
| N1 | 2.54 | 2.54 | .100 |
| h' | 0 | 0 | 0 |
| b | 0 | 0 | 0 |

Land Pattern



Product Marking

The component will be marked with an "ECP052G" designator with an alphanumeric lot code on the top surface of the package.

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

ESD/MSI Information

Caution: ESD sensitive device.

ESD Rating: Class 1B
 Value: Passes between 500 and 1000V
 Test Standard: Human Body Model (HBM)
 Standard: JEDEC Standard JESD22-A114

Moisture Rating: Level 3 at +235° C convection reflow
 Standard: JEDEC Standard J-STD-020

Mounting Config. Notes

- 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").
- Add as much copper as possible to inner and outer layers near the part to ensure optimal thermal performance.
- 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.
- Do not put solder mask on the backside of the PC board in the region where the board contacts the heatsink.
- RF trace width depends upon the PC board material and construction.
- Use 1 oz. Copper minimum.
- All dimensions are in millimeters (inches). Angles are in degrees.

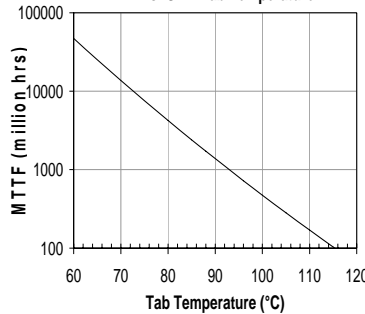
Thermal Specifications

| Parameter | Rating |
|--|----------------|
| Operating Case Temperature | -40 to +105 °C |
| Thermal Resistance (2), R _{th(j-c)} | 1.5 °C/W |
| Junction Temperature (3), T _j | 85 °C |

Notes:

- The amplifier can be operated at 105 °C case temperature for up to 1000 hours over its lifetime without degradation in performance and will not degrade device operation at the recommended maximum 85 °C case temperature for the rest of its lifetime.
- The thermal resistance is referenced to the junction-to-case at a case temperature of 85 °C. T_{j-c} is a function of the voltage at pins 6 and 7 and the current applied at pins 6, 7, and 8 and can be calculated by:
 $T_{j-c} = R_{th(j-c)} * I_{th} * V_{cc}$
- This corresponds to the typical operating condition of +5V, 250 mA at an 85 °C case temperature. A minimum MTTF of 1 million hours is achieved for junction temperatures below 77 °C.

MTTF vs. GND Tab Temperature



Specifications and information are subject to change without notice