1 Watt, High Gain HBT Amplifier

**Product Information** 



#### **Product Features**

- 400 2300 MHz
- +31.5 dBm P1dB
- +46 dBm Output IP3
- 18 dB Gain @ 900 MHz
- Single Positive Supply (+5 V)
- Lead-free/green/RoHS-compliant SOIC-8 SMT Pkg.

#### **Applications**

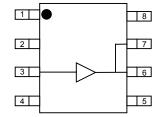
- Final stage amplifiers for Repeaters
- Mobile Infrastructure
- Defense / Homeland Security

#### **Product Description**

The AH215 / ECP100 is a high dynamic range driver amplifier in a low-cost surface mount package. The InGaP/GaAs HBT is able to achieve superior performance for various narrowband-tuned application circuits with up to +46 dBm OIP3 and +31.5 dBm of compressed 1-dB power. The part 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 amplifier for various current and next generation wireless technologies such as GPRS, GSM, CDMA, W-CDMA, and UMTS, where high linearity and high power is required. The internal active bias allows the AH215 / ECP100 to maintain high linearity over temperature and operate directly off a +5 V supply.

#### **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	Тур	Max	
Operational Bandwidth	MHz	400		2300	
Test Frequency	MHz		2140		
Gain	dB	10	10 11		
Input Return Loss	dB		18		
Output Return Loss	dB		8		
Output P1dB	dBm	+29	+31.5		
Output IP3 (2)	dBm	+43.8	+45		
Noise Figure	dB		6.3		
IS-95 Channel Power @-45 dBc ACPR, 1960MHz	dBm		+25.5		
W-CDMA Channel Power @ -45 dBc ACPR, 2140 MHz	dBm		+23		
Operating Current Range, Icc (3)	mA	400	450	500	
Device Voltage, Vcc	V		5		

- 1. Test conditions unless otherwise noted: 25°C, +5V Vsupply, 2140 MHz, in tuned application circuit.
- 3OIP measured with two tones at an output power of +15 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 into pins 6, 7, and 8. It is expected that the current can increase by an additional 90 mA at P1dB. Pin 1 is used as a reference voltage for the internal biasing circuitry. It is expected that Pin 1 will pull 10.8 mA of current when used with a series bias resistor of R1=51  $\Omega$ . (ie. total device current typically will be 461 mA.)

#### Typical Performance (4)

Parameters	Units		Typical		
Frequency	MHz	900	1960	2140	
S21 – Gain	dB	18	12	11	
S11	dB	-13	-11	-18	
S22	dB	-7	-10	-8	
Output P1dB	dBm	+31	+32	+31.5	
Output IP3	dBm	+46	+46	+45	
IS-95A Channel Power @ -45 dBc ACPR	dBm	+25.5	+25.5		
W-CDMA Channel Power @ -45 dBc ACPR	dBm			+23	
Noise Figure dB		7.0	5.5	6.2	
Supply Bias		+5 V @ 450 mA			

<sup>4.</sup> Typical parameters reflect performance in a tuned application circuit at +25° C.

### **Absolute Maximum Rating**

Parameter	Rating
Operating Case Temperature	-40 to +85 °C
Storage Temperature	-65 to +150 °C
RF Input Power (continuous)	+26 dBm
Device Voltage	+8 V
Device Current	900 mA
Device Power	5 W
Junction Temperature	+250 °C

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

#### **Ordering Information**

Part No.	Description
AH215-S8*	1 Watt, High Linearity InGaP HBT Amplifier
ECP100G*	1 Watt, High Linearity InGaP HBT Amplifier (lead-tin SOIC-8 Pkg)
AH215-S8G	1 Watt, High Linearity InGaP HBT Amplifier (lead-free/green/RoHS-compliant SOIC-8 Pkg)
AH215-S8PCB900	900 MHz Evaluation Board
AH215-S8PCB1960	1960 MHz Evaluation Board
AH215-S8PCB2140	2140 MHz Evaluation Board

<sup>\*</sup> This package is being phased out in favor of the green package type which is backwards compatible for existing designs. Refer to Product Change Notification WJPCN06MAY05TC1 on the WJ website.

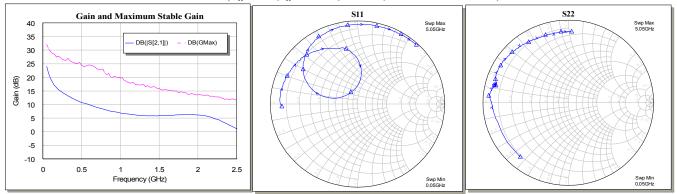
1 Watt, High Gain HBT Amplifier

**Product Information** 



#### **Typical Device Data**

S-Parameters ( $V_{cc} = +5 \text{ V}$ ,  $I_{cc} = 450 \text{ mA}$ ,  $T = 25^{\circ}\text{C}$ , calibrated to device leads)

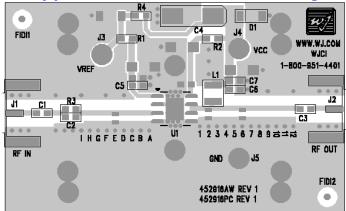


The gain for the unmatched device in 50 ohm system is shown as the trace in black color. For a tuned circuit for a particular frequency, it is expected that actual gain will be higher, up to the maximum stable gain. The maximum stable gain is shown in the dashed red line. The impedance loss plots are shown from 0.05 - 5.05 GHz, with markers placed in 0.5 GHz increments.

S-Parameters ( $V_{cc}$  = +5 V,  $I_{cc}$  = 450 mA, T = 25°C, unmatched 50 ohm system, calibrated to device leads)

Freq (MHz)	S11 (dB)	S11 (ang)	S21 (dB)	S21 (ang)	S12 (dB)	S12 (ang)	S22 (dB)	S22 (ang)
50	-1.23	-177.95	24.07	122.55	-40.25	17.32	-1.26	-130.4
100	-1.01	178.17	19.55	116.55	-39.49	10.63	-1.33	-155.43
200	-1.01	172.63	15.55	112.97	-40.13	15.98	-1.17	-169.92
400	-1.03	163.72	12.03	98.68	-38.83	10.31	-0.93	179.61
600	-1.21	155.20	9.86	85.80	-39.30	-4.249	-0.66	173.43
800	-1.34	146.17	8.11	73.18	-37.70	-2.398	-0.83	168.67
1000	-1.52	136.69	6.92	61.43	-37.73	-16.27	-0.95	166.34
1200	-2.00	126.65	6.13	49.60	-37.14	-14.34	-1.05	165.13
1400	-2.65	115.04	5.80	37.55	-36.23	-28.50	-1.04	164.55
1600	-3.86	97.52	6.01	21.48	-36.45	-46.08	-1.11	166.24
1800	-6.72	86.05	6.17	1.700	-34.63	-68.99	-1.10	164.44
2000	-14.09	94.99	6.15	-23.83	-35.91	-100.68	-1.00	162.35
2200	-9.98	166.89	4.98	-52.92	-36.75	-147.66	-0.77	158.42
2400	-4.27	157.68	2.52	-80.08	-39.10	171.86	-0.79	154.12
2600	-2.13	142.95	-0.42	-100.8	-37.80	123.26	-0.81	149.03
2800	-1.24	130.88	-3.40	-116.44	-38.58	89.55	-0.84	144.09
3000	-0.82	120.68	-6.09	-128.99	-39.37	67.22	-0.92	138.4

#### **Application Circuit PC Board Layout**



Circuit Board Material: Top RF layer is .014" Getek, 4 total layers (0.062" thick) for mechanical rigidity

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.

1 Watt, High Gain HBT Amplifier

**Product Information** 

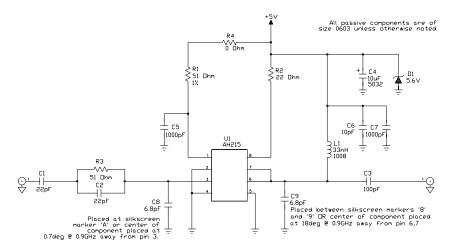


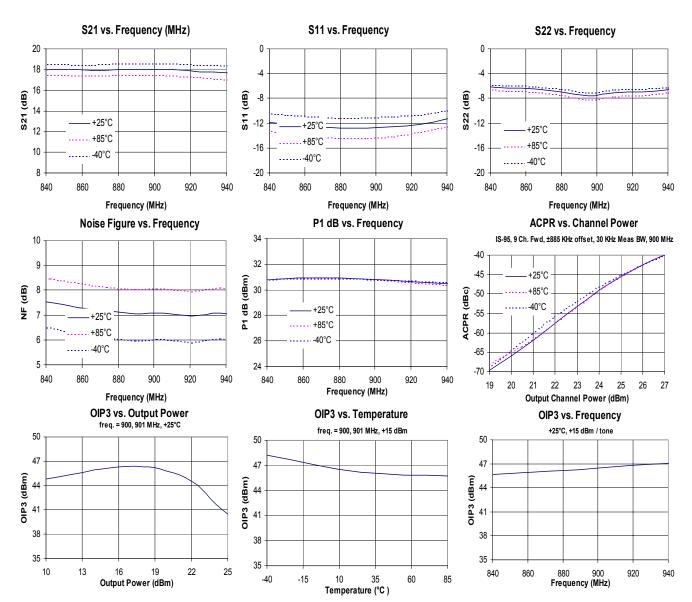
#### 900 MHz Application Circuit (AH215-S8PCB900)

Typical RF Performance at 25°C

Frequency	900 MHz		
S21 – Gain	18 dB		
S11 – Input Return Loss	-13 dB		
S22 – Output Return Loss	-7.0 dB		
Output P1dB	+31 dBm		
Output IP3 (+15 dBm / tone, 1 MHz spacing)	+46 dBm		
Channel Power (@-45 dBc ACPR, IS-95 9 channels fwd)	+25.5 dBm		
Noise Figure	7.0 dB		
Device / Supply Voltage	+5 V		
Quiescent Current (1)	450 mA		

This corresponds to the quiescent current or operating current under small-signal conditions into pins 6, 7, and 8.



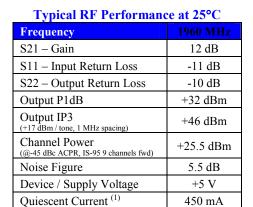


1 Watt, High Gain HBT Amplifier

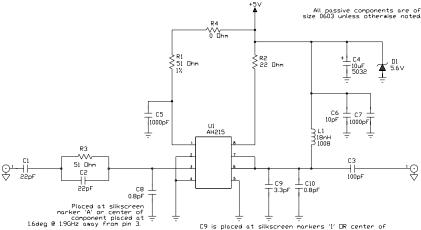
**Product Information** 



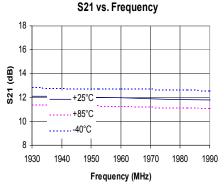
#### 1960 MHz Application Circuit (AH215-S8PCB1960)

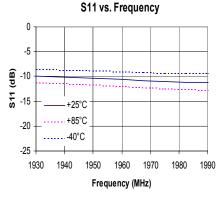


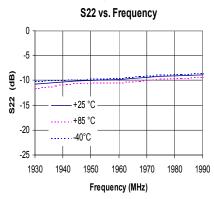
This corresponds to the quiescent current or operating current under small-signal conditions into pins 6, 7, and 8.

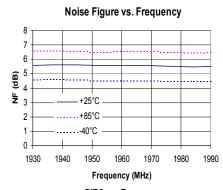


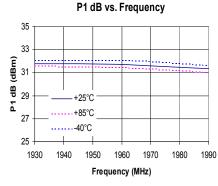
C9 is placed at silkscreen markers '1' DR center of component is placed at 1.6deg @ 1.90Hz away from pins 6,7. C10 is placed at 31.6xcreen marker '6' or center of component is placed at 34 deg @ 1960MHz away from pins 6,7.

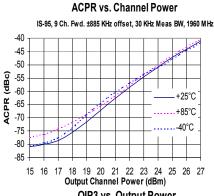


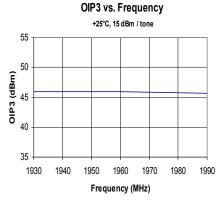


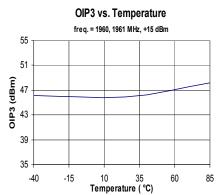


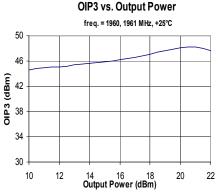












1 Watt, High Gain HBT Amplifier

**Product Information** 

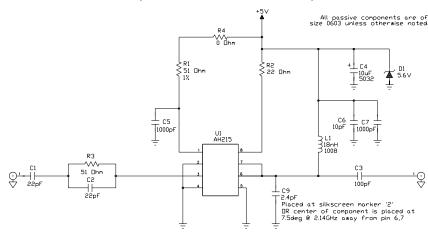


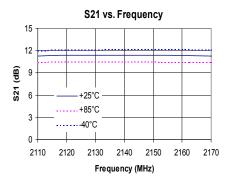
#### 2140 MHz Application Circuit (AH215-S8PCB2140)

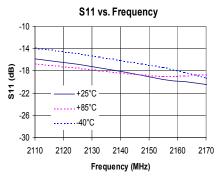
Typical RF Performance at 25°C

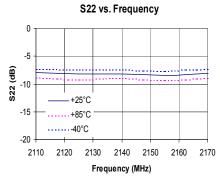
Typical Kr Terior mance at 25 C					
Frequency	2140 MHz				
S21 – Gain	11 dB				
S11 – Input Return Loss	-18 dB				
S22 – Output Return Loss	-8.0 dB				
Output P1dB	+31.5 dBm				
Output IP3 (+15 dBm / tone, 1 MHz spacing)	+45 dBm				
Channel Power (@-45 dBc ACPR, IS-95 9 channels fwd)	+23 dBm				
Noise Figure	6.2 dB				
Device / Supply Voltage	+5 V				
Quiescent Current (1)	450 mA				

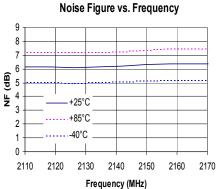
This corresponds to the quiescent current or operating current under small-signal conditions into pins 6, 7, and 8.

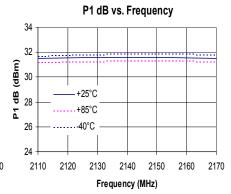


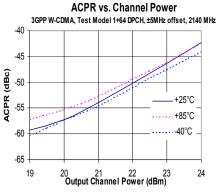


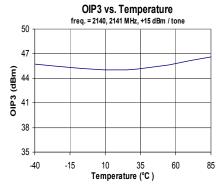


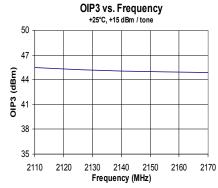


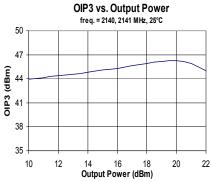












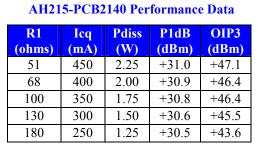
1 Watt, High Gain HBT Amplifier

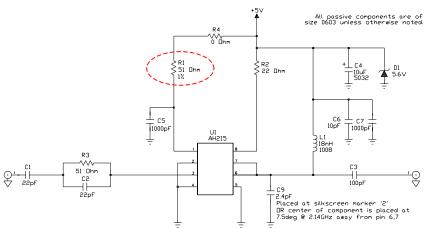
**Product Information** 

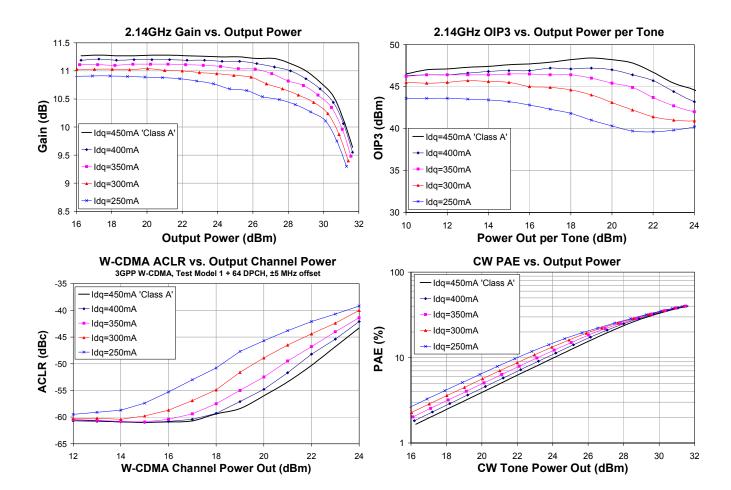


#### **Application Note: Reduced Bias Configurations**

The AH215 / ECP100 can be configured to be operated with lower bias current by varying the bias-adjust resistor – R1. The recommended circuit configurations shown previously in this datasheet have the device operating in Class A operation. Lowering the current has little effect on the gain, OIP3, and P1dB performance of the device, but will slightly lower the ACLR/ACPR performance of the device as shown below. An example of the measured data below represents the AH215 / ECP100 measured and configured for 2.14 GHz applications. It is expected that variation of the bias current for other frequency applications will produce similar performance results.







1 Watt, High Gain HBT Amplifier

**Product Information** 



#### AH215-S8 (SOIC-8 Package) Mechanical Information

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

#### **Outline Drawing** AH215-S8 **⊕** [.25**@**]8**@** XXXXXX 7 XXXXXX

3

● .25@ C A @ B ®

The com "AH215lot code on

part are Application

#### ormation

ESD sensitive device.

lass 1B

Passes /500V to <1000V Human Body Model (HBM) JEDEC Standard JESD22-A114

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

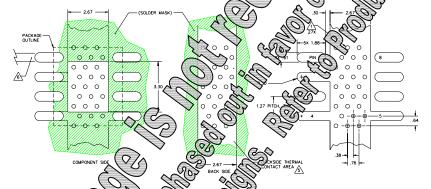


## **Mounting Config. Notes**

- A heatsink underneath the area of the PCB for the mounted device is strictly required for proper thermal operation. Damage to the device can occur without the use of one.

  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
- 5. 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 Patt**



#### Therma

is reference from the junction-to-S° C. Tjc is a function of the current applied to pins culated by:

sponder by typical biasing condition of +5V, at an case temperature. A minimum no hours is achieved for junction € w 247° C.

#### MTTF vs. GND Tab Temperature 1000000 (million hrs) 100000 10000 1000 100 50 70 80 Tab temperature (° C)

1 Watt, High Gain HBT Amplifier

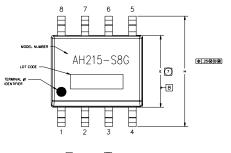
**Product Information** 



#### AH215-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.

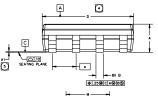
#### **Outline Drawing**

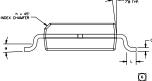


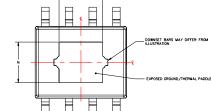
- NOTES:

  1. EXCEPT WHERE NOTED, THIS PART OUTLINE CONFORMS
  TO JEDEC STANDARD MS-012, ISSUE C FOR SMALL
  OUTLINE (SO) PERIPHERAL TERMINALS 3.75mm
  BOOY WIDTH (FLAST)
- DIMENSIONING & TOLERANCING CONFORM TO ANSI Y14.4M-1994.
- 3. ALL DIMENSIONS ARE IN MILLIMETERS (INCHES).
  ANGLES ARE IN DECREES.

  DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR
  CATE BURRS, WHICH SHALL NOT EXCEED .15mm(.00
- 5 DEVIATION FROM JEDEC MS-012 STANDARD.
- 6) LENGTH OF TERMINAL FOR SOLDERING TO A SUBSTRATE.
- DOES NOT INCLUDE INTER-LEAD FLASH OR PROTRUSIONS WHICH SHALL NOT EXCEED .25mm(.010in) PER SIDE.

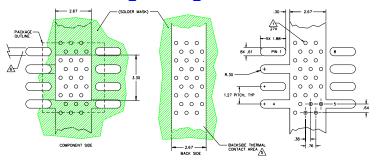






		MILLIMETERS			INCHES		
_	SYMBOL	MIN	NOM	MAX	MIN	NOM	MAX
5	A	1.42	1.52	1.62	.056	.060	.064
5)	A1	0	.05	.10	0	.002	.004
5)	В	.38	.41	.43	.015	.016	.017
_	С	.19	.20	.25	.007	.008	.010
	D	4.80	4.90	5.00	.189	.193	.197
	ε	3.80	3.90	4.00	.150	.154	.157
			1.27 BS	;		050 BSC	
	н	5.80	6.0	6.20	.228	.236	.244
( <u>(</u>	h	.25	.33	.50	.01	.013	.02
	L	.40	.84	1.27	.016	.033	.050
	M	2.21	2.34	2.47	.087	.092	.097
	N	2.08	2.21	2.34	.082	.087	.092
-	۰	0	4'8	8'8	0	4.8	8'8

#### **Mounting Configuration / Land Pattern**



#### **Product Marking**

The component will be marked with an "AH215-S8G" 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**

- A heatsink underneath the area of the PCB for the mounted device is strictly required for proper thermal operation. Damage to the device can occur without the use of one.
- 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 heatsine.
- 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.
- 7. Use 1 oz. Copper minimum.
- All dimensions are in millimeters (inches). Angles are in degrees.

#### Thermal Specifications

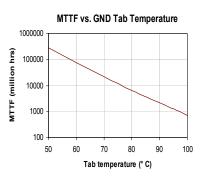
Parameter	Rating
Operating Case Temperature	-40 to +85° C
Thermal Resistance (1), Rth	33° C / W
Junction Temperature (2), Tjc	159° C

#### Notes:

1. The thermal resistance is referenced from the junction-tocase 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:

Tjc = Tcase + Rth \* Vcc \* Icc

2. This corresponds to the typical biasing condition of  $\pm 5V$ , 450 mA at an 85° C case temperature. A minimum MTTF of 1 million hours is achieved for junction temperatures below 247° C.



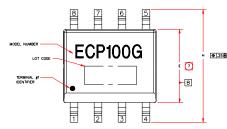
1 Watt, High Gain HBT Amplifier

**Product Information** 

#### **ECP100G (SOIC-8 Package) Mechanical Information**

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

#### **Outline Drawing**



⊕|.25@|C|A@|B©|

- DOES NOT INCLUDE INTER-LEAD FLASH OR PROTRUSION WHICH SHALL NOT EXCEED .25mm(.010in) PER SIDE.

The compon "ECP1000

part are Application

## ormation



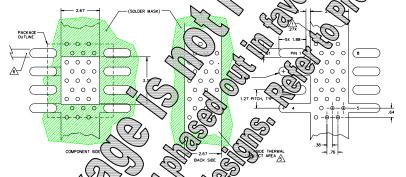
Passes between 500 and 1000V Human Body Model (HBM) JEDEC Standard JESD22-A114

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

## **Mounting Config. Notes**

- A heatsink underneath the area of the PCB for the mounted device is strictly required for proper thermal operation. Damage to the device can occur without the use of one.
- 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
- 5. 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.
- 8. All dimensions are in millimeters (inches). Angles are in degrees.

### **Land P**



#### Thermal

# Operating Q

referenced from the junction-85° C. Tje is a and 7 and the current Sage at pins , and calculated by:

pical biasing condition of mA at Common Com below 247° C.

#### MTTF vs. GND Tab Temperature 1000000 100000 10000 1000 100 70 80 Tab temperature (° C)