



### Product Features

- 50 – 1000 MHz
- ±0.2 dB Gain Flatness
- +24 dBm P1dB
- -74 dBc CTB / CSO  
+39dBmV/channel, 77 channels
- +42 dBm Output IP3
- +76 dBm Output IP2
- Matched amplifiers for a push-pull configuration
- +5V Single Positive Supply
- MTTF > 1000 years

### Applications

- CATV Head End Equipment
- CATV Line Amplifiers
- FTTH Repeaters

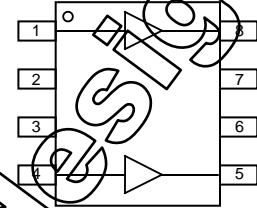
### Product Description

The AH22 is a high dynamic range amplifier targeting cable TV markets. The combination of gain flatness, high linearity, and bandwidth makes it ideal for CATV distribution, cable modem, and laser diode driver applications.

The device uses two matched AH2 devices and is ideal for operation in a push-pull configuration to achieve high second order linearity. A mature and reliable GaAs MESFET technology is employed to maximize linearity at low power dissipation.

The package is thermally enhanced in a SOIC-8 with all devices being 100% RF and dc tested.

### Functional Diagram



Function	Pin No.
Amp 1 Input	1
Amp 2 Input	4
Amp 2 Output	5
Amp 1 Output	8
Ground	2, 3, 6, 7, Backside paddle

### Single-ended Device Specifications

Parameter	Units	Min	Typ	Max
Test Frequency	MHz		800	
Gain	dB	13	14.5	
Output IP3 <sup>(2)</sup>	dBm	+37	+40	
Device Current	mA	120	150	180
Device Voltage	V		5	

Test conditions unless otherwise noted.

1. T = 25°C, Vdd = +5 V, 800 MHz on each individual single-branch amplifier in a 50Ω test fixture.
2. 3OIP measured with two tones at an output power of +5 dBm/ tone separated by 10 MHz. The suppression on the largest IM3 product is used to calculate the 3OIP using a 2:1 rule.
3. Typical parameters reflect performance in a push-pull application circuit as shown on page 3. The only difference in the currently recommended design and the previous one is that R1 = R2 = 390Ω. The configuration and all other component values have remained the same.
4. Balun, board, and connector losses have not been extracted, but typically account of 0.4 dB loss midband and 1.1 dB loss at 860 MHz.
5. Measured at +39 dBmV/channel, 77 channels Flat Loading.
6. OIP2 is measured at f1 + f2 at 8 dBm / tone.
7. OIP3 is measured at 8 dBm / tone with 10 MHz spacing.
8. Typical parameters reflect performance in a push-pull application circuit as shown on page 4. The circuit is same as on the previous AH22 datasheets with R1 = R2 = 560Ω. The linearity and compression performance are the same as the performance shown in the first table on the right-hand column.

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

Configuration A (with R1 = R2 = 390 Ω feedback resistors)

Parameter	Units	Typical			
Frequency	MHz	50	250	450	860
Gain <sup>(4)</sup>	dB	9.8	9.6	9.6	9.3
Input Return Loss	dB	14	14	14.3	15.5
Output Return Loss	dB	16	17	17	23
CTB <sup>(5)</sup>	dBc	-77	-74	-74	
CSO <sup>(5)</sup>	dBc	-72	-80	-75	
XMOD <sup>(5)</sup>	dBc	-64	-64	-64	
Output P1dB	dBm	+25.2	+24.5	+24.1	+23
Output IP2 <sup>(6)</sup>	dBm	+76	+75	+77	+76
Output IP3 <sup>(7)</sup>	dBm	+43	+45	+42	+42
Noise Figure	dB	5.5	4.5	4.6	4.6
Device Bias	V	+5 V @ 300 mA			

### Typical Performance<sup>(8)</sup>

Configuration B (with R1 = R2 = 560 Ω feedback resistors)

Parameter	Units	Typical			
Frequency	MHz	50	250	450	860
Gain <sup>(4)</sup>	dB	11	10.8	10.9	10.5
Input Return Loss	dB	11.8	11.7	12.5	14.3
Output Return Loss	dB	13.6	12.7	12.0	17.1
Device Bias	V	+5 V @ 300 mA			

### Absolute Maximum Rating

Parameters	Rating
Operating Case Temperature	-40 to +85 °C
Storage Temperature	-55 to +125 °C
RF Input Power (continuous)	+13 dBm
DC Voltage	+6 V
Junction Temperature	220 °C

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

### Ordering Information

Part No.	Description
AH22	High Dynamic Range CATV Amplifier

Specifications and information are subject to change without notice.



### Typical Device Data – 50Ω Z<sub>0</sub>

S-Parameters (V<sub>ds</sub> = +5 V, I<sub>ds</sub> = 150 mA, T = 25°C, unmatched 50 ohm system, calibrated to device leads)  
This data represents a single-ended amplifier in the AH22, with there being two matched amplifiers inside the package.

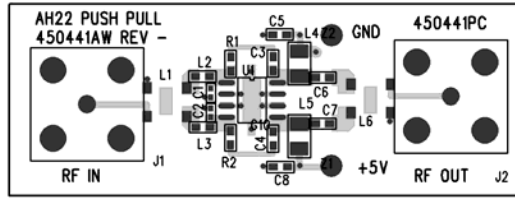
Freq (MHz)	S11 (dB)	S11 (ang)	S21 (dB)	S21 (ang)	S12 (dB)	S12 (ang)	S22 (dB)	S22 (ang)
50	-8.90	-16.39	14.63	168.88	-24.36	-1.02	-11.20	-13.54
100	-9.00	-16.85	14.60	168.22	-24.32	-3.36	-11.34	-13.10
150	-9.02	-19.10	14.59	166.95	-24.30	-3.73	-11.58	-13.00
200	-9.02	-21.81	14.58	165.53	-24.27	-3.61	-11.42	-13.46
250	-9.02	-24.71	14.57	164.04	-24.24	-3.30	-11.46	-14.15
300	-9.02	-27.70	14.56	162.52	-24.21	-2.90	-11.50	-14.94
350	-9.01	-30.75	14.55	160.99	-24.17	-2.47	-11.55	-15.79
400	-9.01	-33.84	14.53	159.46	-24.12	-2.02	-11.61	-16.68
450	-9.00	-36.94	14.52	157.92	-24.07	-1.57	-11.67	-17.58
500	-8.98	-40.07	14.50	156.37	-24.01	-1.13	-11.73	-18.49
550	-8.97	-43.99	14.48	154.05	-23.95	-0.69	-11.81	-19.22
600	-8.95	-47.93	14.46	151.72	-23.88	-0.25	-11.89	-19.97
650	-8.93	-51.88	14.45	149.38	-23.81	0.22	-11.98	-20.73
700	-8.91	-55.84	14.42	147.05	-23.74	0.70	-12.08	-21.50
750	-8.88	-59.81	14.40	144.71	-23.66	1.16	-12.19	-22.28
800	-8.85	-63.79	14.38	142.38	-23.58	1.66	-12.31	-23.08
850	-8.82	-67.77	14.35	140.04	-23.50	2.19	-12.43	-23.88
900	-8.78	-71.75	14.32	137.70	-23.42	2.75	-12.56	-24.69
950	-8.74	-75.74	14.29	135.36	-23.34	3.35	-12.70	-25.52
1000	-8.70	-79.73	14.26	133.02	-23.25	3.99	-12.85	-26.35

### Typical Device Data – 37.5Ω Z<sub>0</sub>

S-Parameters (V<sub>ds</sub> = +5 V, I<sub>ds</sub> = 150 mA, T = 25°C, unmatched 37.5 ohm system, calibrated to device leads)  
This data represents a single-ended amplifier in the AH22, with there being two matched amplifiers inside the package.

Freq (MHz)	S11 (dB)	S11 (ang)	S21 (dB)	S21 (ang)	S12 (dB)	S12 (ang)	S22 (dB)	S22 (ang)
50	-5.78	-10.88	13.66	170.31	-25.33	0.41	-7.13	-9.60
100	-5.84	-11.37	13.63	169.60	-25.28	-1.99	-7.20	-8.58
150	-5.87	-12.86	13.63	168.43	-25.25	-2.25	-7.22	-8.66
200	-5.89	-14.63	13.63	167.16	-25.22	-1.98	-7.25	-9.01
250	-5.92	-16.50	13.63	165.82	-25.18	-1.52	-7.27	-9.48
300	-5.94	-18.43	13.63	164.47	-25.13	-0.96	-7.30	-10.01
350	-5.97	-20.41	13.63	163.10	-25.08	-0.36	-7.33	-10.56
400	-6.00	-22.42	13.63	161.73	-25.02	0.25	-7.36	-11.13
450	-6.03	-24.45	13.63	160.35	-24.95	0.86	-7.40	-11.71
500	-6.07	-26.51	13.63	158.96	-24.88	1.46	-7.44	-12.29
550	-6.12	-29.25	13.64	156.85	-24.79	1.32	-7.49	-13.47
600	-6.17	-31.99	13.66	154.73	-24.70	1.15	-7.55	-14.66
650	-6.23	-34.79	13.66	152.60	-24.60	0.95	-7.62	-15.86
700	-6.29	-37.64	13.67	150.46	-24.50	0.71	-7.69	-17.06
750	-6.36	-40.54	13.68	148.30	-24.39	0.43	-7.77	-18.28
800	-6.43	-43.50	13.69	146.14	-24.27	0.10	-7.85	-19.50
850	-6.51	-46.51	13.70	143.95	-24.16	-0.27	-7.94	-20.73
900	-6.59	-49.50	13.70	141.76	-24.04	-0.69	-8.04	-21.96
950	-6.67	-52.73	13.71	139.55	-23.91	-1.16	-8.15	-23.20
1000	-6.76	-53.95	13.72	137.33	-23.79	-1.68	-8.26	-24.44

### 75Ω Push-Pull Application Circuit – Configuration A (This configuration is used on the WJ AH22-PCB Evaluation Boards as of May 2004)

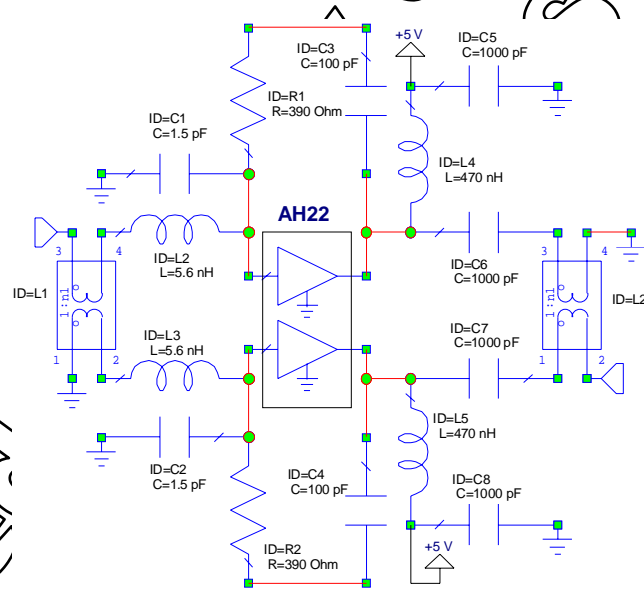


Circuit Board Material: .062" total thickness with a .028" FR4 top RF layer ( $\epsilon_r=4.8$ ), 4 total layers (other layers added for rigidity), 1 oz copper

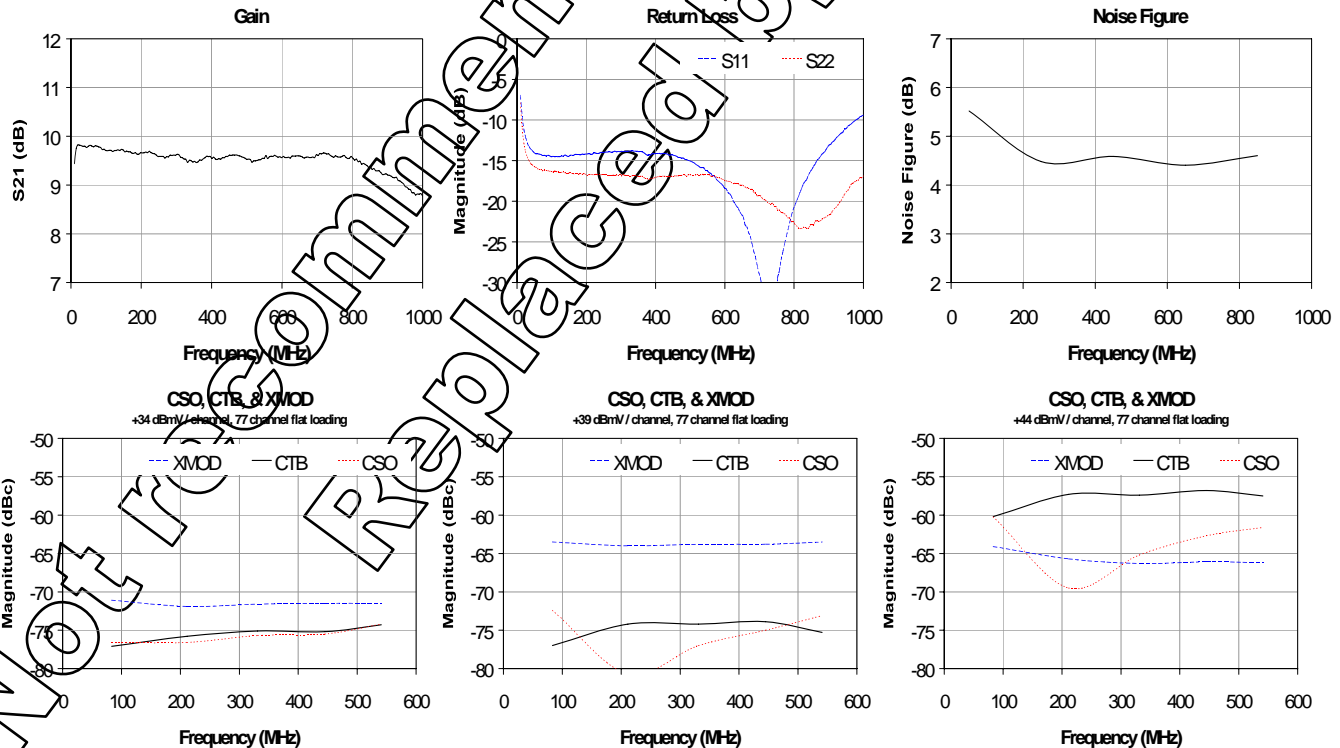
#### Typical RF Performance at 25°C

Frequency	MHz	50	250	450	860
Gain	dB	9.8	9.6	9.6	9.3
Input R.L.	dB	14	14	14.3	15.5
Output R.L.	dB	16	17	17	23
CTB	dBc	-77	-74	-74	
CSO	dBc	-72	-80	-75	
XMOD	dBc	-64	-64	-64	
Output P1dB	dBm	+25.2	+24.5	+24.1	+23
Output IP2	dBm	+76	+75	+77	+76
Output IP3	dBm	+43	+45	+42	+42
Noise Figure	dB	5.5	4.5	4.6	4.6
Device Current	mA	300			
Device Voltage	V	+5			

- Balun, board, and connector losses have not been extracted, but typically account of 0.4 dB loss midband and 1.1 dB loss at 860 MHz.
- CSO, CTB, & XMOD are measured at +39 dBmV/channel, 77 channels Flat Loading.
- OIP2 is measured at f1 + f2 at 8 dBm / tone.
- OIP3 is measured at 8 dBm / tone with 10 MHz spacing.

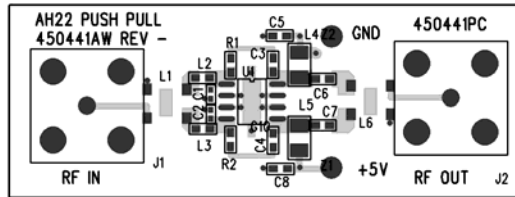


The transformers, L1 and L2, used on the WJ evaluation board are handwound baluns using these materials: 6 turns bifilar wire (MWS B23832-1) around a ferrite core (TDK, H5C2-T3.1-1.3-1.3). An SMT transformer (M/A Com ETC, 1-13) can also be used.



Specifications and information are subject to change without notice.

### 75Ω Push-Pull Application Circuit – Configuration B (This configuration is used on WJ AH22-PCB Evaluation Boards prior to May 2004.)

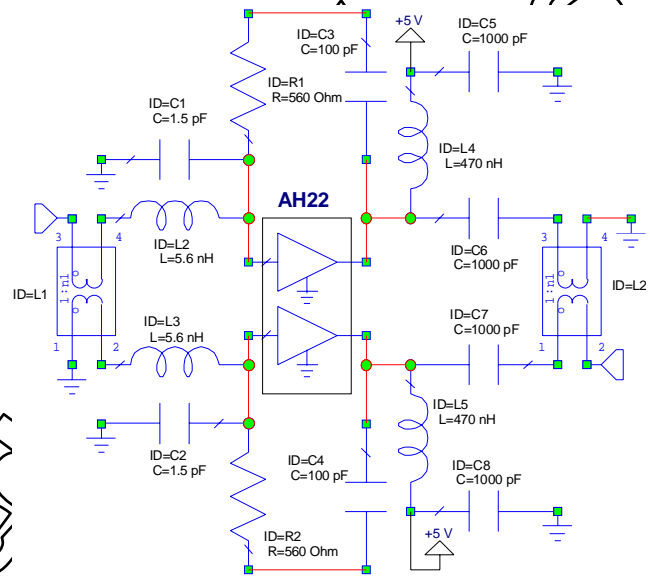


Circuit Board Material: .062" total thickness with a .028" FR4 top RF layer ( $\epsilon_r=4.8$ ), 4 total layers (other layers added for rigidity), 1 oz copper

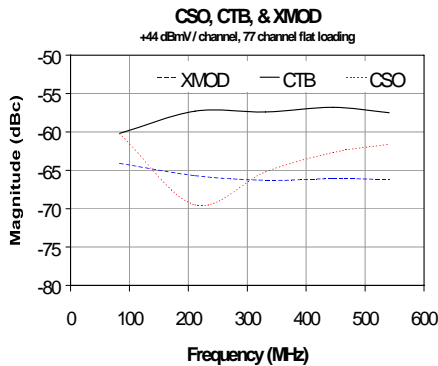
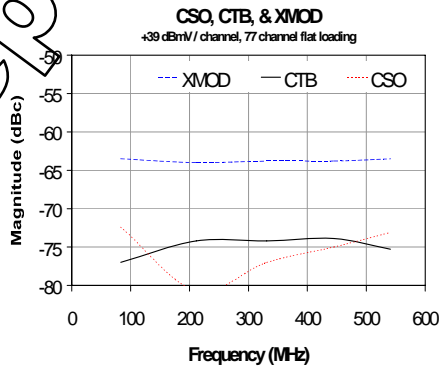
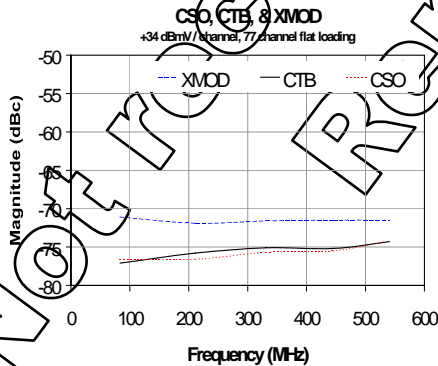
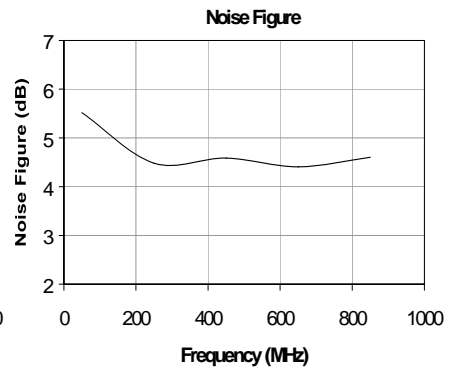
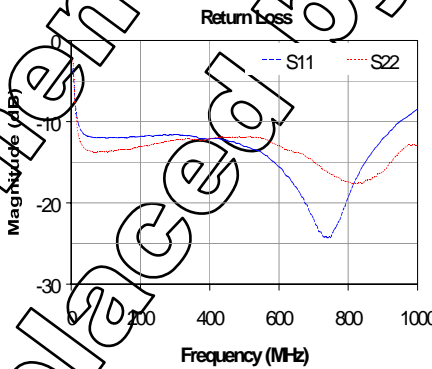
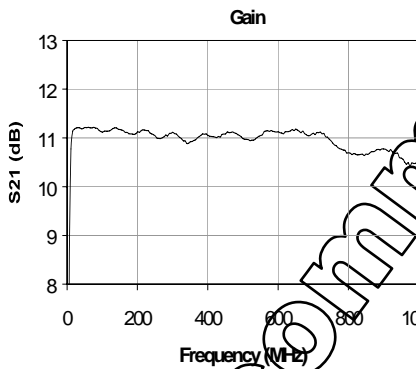
#### Typical RF Performance at 25°C

Frequency	MHz	50	250	450	860
Gain	dB	11	10.8	10.9	10.5
Input R.L.	dB	11.8	11.7	12.5	14.3
Output R.L.	dB	13.6	12.7	12.0	17.1
CTB	dBc	-77	-74	-74	
CSO	dBc	-72	-80	-75	
XMOD	dBc	-64	-64	-64	
Output P1dB	dBm	+25.2	+24.5	+24.1	+23
Output IP2	dBm	+76	+75	+77	+76
Output IP3	dBm	+43	+45	+42	+42
Noise Figure	dB	5.5	4.5	4.6	4.6
Device Current	mA	300			
Device Voltage	V	+5			

- Balun, board, and connector losses have not been extracted, but typically account of 0.4 dB loss midband and 1.1 dB loss at 860 MHz.
- CSO, CTB, & XMOD are measured at +39 dBmV/channel, 77 channels Flat Loading.
- OIP2 is measured at f1 + f2 at 8 dBm / tone.
- OIP3 is measured at 8 dBm / tone with 10 MHz spacing.



The transformers, L1 and L2, used on the WJ evaluation board are handwound baluns using these materials: 6 turns bifilar wire (M/S B23832-1) around a ferrite core (TDK, H5C2-T3-1.1-3.3). An SMT transformer (M/A Com ETC1-1-13) can also be used.



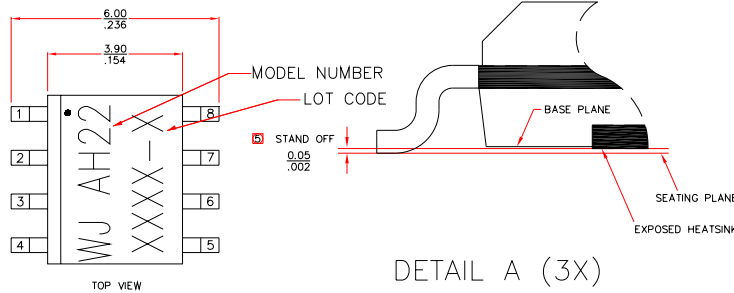
Specifications and information are subject to change without notice.



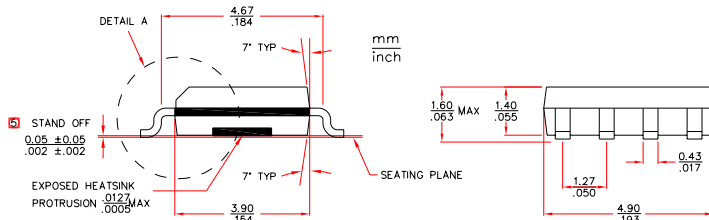
# AH22

## High Dynamic Range CATV Amplifier

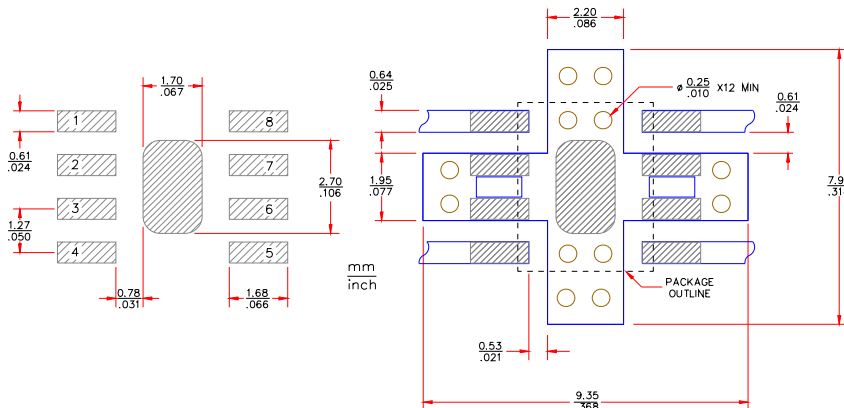
### Outline Drawing



5 "Stand-off" is the distance between "seating plane" and the "exposed heatsink", or base plane of the package, which ever is lower.



### Land Pattern



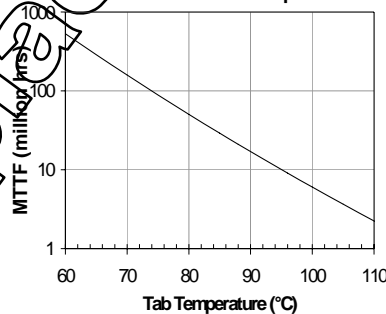
### Thermal Specifications

Parameter	Rating
Operating Case Temperature	-40 to +85° C
Thermal Resistance <sup>1</sup> , R <sub>th</sub>	28° C/W
Junction Temperature <sup>2</sup> , T <sub>j</sub>	127°

#### Notes:

- The thermal resistance is referenced from the hottest part of the junction to ground tab underneath the device.
- This corresponds to the typical biasing condition of +5V, 300 mA at an 85° C case temperature. A minimum MTTF of 1 million hours is achieved for junction temperatures below 160° C.

MTTF vs. GND Tab Temperature



### Product Marking

The component will be marked with an "AH22" 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

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

ESD Rating: Class IV  
 Value: Passes greater than 1000 V  
 Test: Charge Device Model (CDM)  
 Standard: JEDEC Standard JESD22-C101

MSL Rating: Level 1 at +235° C convection reflow  
 Standard: JEDEC Standard J-STD-020A

### Functional Pin Layout

Pin	Function
1	RF input (Amp1 input)
2	Ground
3	Ground
4	RF input (Amp2 input)
5	RF output (Amp2 output)
6	Ground
7	Ground
8	RF output (Amp1 output)

The backside paddle is the Source and should be grounded for thermal and electrical purposes.

### Mounting Config. Notes

- Ground / thermal vias are critical for the proper performance of this device.
- Add as much copper as possible to inner and outer layers near the part to ensure optimal thermal performance.
- To ensure reliable operation, device ground paddle-to-ground pad solder joint is critical.
- Add mounting screws near the part to fasten the board to a heatsink. Ensure that the ground / thermal via region contacts the heatsink.
- For optimal thermal performance, expose soldermask on backside where it contacts the heatsink.
- RF trace width depends upon the PC board material and construction.
- Use 1 oz. Copper minimum.
- If the PCB design rules allow, ground vias should be placed under the land pattern for better RF and thermal performance. Otherwise ground vias should be placed as close to the land pattern as possible.
- A minimum of 12 ground vias are required for .014" and .028" FR4 board.