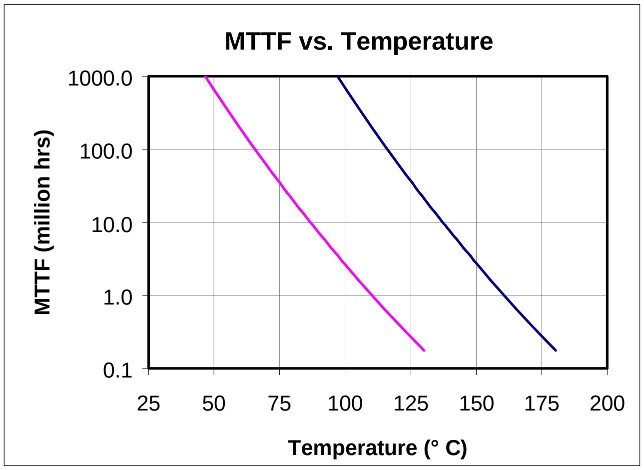
The AH11 and AH22 are GaAs MESFET MMIC amplifiers based on GaAs processes and technology that have been incorporated into WJ's product for more than 15 years. Extensive life testing and field history of our GaAs products have demonstrated excellent robustness and reliability. In general, WJ GaAs MMIC products are capable of operating reliably at channel temperatures of +175° C based on accelerated lifetest measurements of small-signal linear parameters like gain and input/output match. Biased lifetests at 250° C channel temperature for 1000 hours routinely show no Ids failures for a sample size of 10 FET devices.

Long-term aging behavior of two-tone third-order output intercept (3OIP) performance, a non-linear characteristic, has not been as extensively studied as the small-signal linear parameters. As a result, WJ Communications opted to take a conservative position in specifying the maximum operating temperature of the AH1. Currently, the maximum recommended operating temperature is +85° C (referenced to the GND lead of the device) which insures that the maximum channel temperature at worst case power conditions will never be above a very safe **+135° C**. Since releasing the AH1 product in 1996, where the AH11 and AH22 are derivatives of this product, WJ Communications has continued to study the aging characteristics of the AH1's performance. As shown in the AH1 Qualification Report, we have reported no failures over a 4 year study with over 25,000 device hours under an Accelerated Biased Humidity (HAST, +130°C, 85% RH, 33 psia) test. In addition, WJ has not had any failures on over 250,000 device hours with a High Temperature Operating Lifetime (HTOL) test under a biased condition at +125° C ground tab. The results of these tests confirmed that the AH1 temperature failure mode is similar to that found in other WJ GaAs devices, and has an activation energy of about 1.5 eV.

The channel temperature can be calculated using a conservative approach by calculating the temperature rise due to power dissipation of the device, e.g. ground tab temperature (85° C) + voltage (5 V) x current consumption (360 mA max) x thermal resistance (28° C/W) = 135° C. The calculation is conservative because as the temperature of the channel increases in the device, the current consumption of the device typically decreases by 10% from 25° C to 85° C at the ground lead temperature. Using the activation energy of 1.5 eV, the following MTTF estimates have been calculated from the Arrhenius function, detailed in our "MTTF Analysis for AH1" application note:

Channel Temperature (°C)	GND Lead Temperature (°C)	MTTF (million hours)
60.4	10	175678
70.4	20	38406
80.4	30	9151
90.4	40	2359
100.4	50	654
110.4	60	194
120.4	70	61.1
130.4	80	20.4
135.4	85	12.0
140.4	90	7.2
150.4	100	2.7
160.4	110	1.03



As can be seen from the MTTF numbers above, the predicted failure rate is still above 1 million hours, even at operating temperatures up to +110° C (corresponding to channel temperatures of +160° C). Also note that these MTTF estimates are a lower bound as the accelerated testing never resulted in 50% failures.