

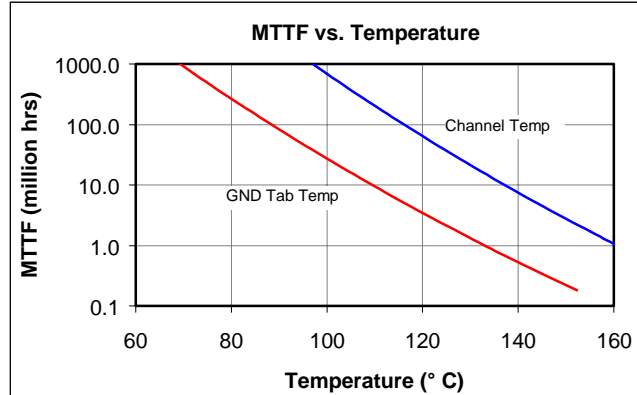


The AG102 is a GaAs MESFET MMIC amplifier based on GaAs processes and technology that have been incorporated into WJ's products for more than 15 years. Extensive life testing and field history of our GaAs products have demonstrated excellent robustness and reliability. In general, WJ GaAs MMIC products 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  $I_{DS}$  failures for a sample size of 10 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 AG102. 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 +121° C. Since releasing the product in 2001, WJ Communications has continued to study the aging characteristics of the AG102's performance. As shown in the [AM1, AG101 and AG102 Qualification Report](#), we have reported no failures with over 7,300 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 77,000 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 AG102 temperature failure mode is similar to that found in other WJ GaAs devices, and has an activation energy of about 1.5 eV [1].

The channel temperature can be calculated using the temperature rise due to power dissipation of the device, e.g. the worst case junction temperature for the typical bias for the AG102 would be **112.7° C**: maximum rated ground tab temperature (85° C) + voltage (4.5 V) x current consumption (70 mA) x thermal resistance (88° C/W) = 110° C. The calculation is conservative because as the temperature of the channel increases in the device, the current consumption of the device typically decreases. A 10% reduction is typical with a temperature increase 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 [1]:

Channel Temperature (°C)	GND Lead Temperature (°C)	MTTF (million hours)
110	82.3	203.32
120	92.3	63.96
130	102.3	21.31
140	112.3	7.49
150	122.3	2.76
155	127.3	1.71
160	132.3	1.07
170	142.3	0.43



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 +130° 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.