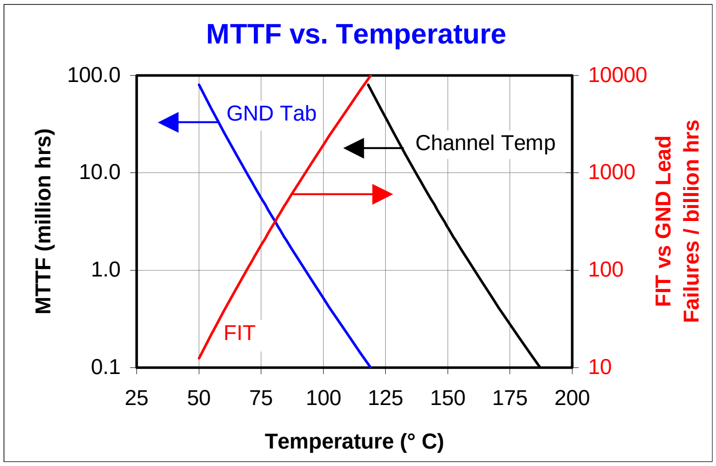
The FP1189 is a 0.5 µm gate length AlGaAs/GaAs ½-Watt HFET based on GaAs processes and technology that have been incorporated into WJ's product for more than 15 years. Extensive life testing and field history of our GaAs products have demonstrated excellent robustness and reliability. In general, WJ GaAs MMIC products are capable of operating reliably at channel temperatures up to +175° C based on accelerated lifetest measurements of small-signal linear parameters like gain and input/output match. Biased lifetests performed at 250° C channel temperature have shown no failures after 1000 hours of operation.

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 FP1189. To support the reliability of the FP1189 under lifetime and stress conditions, a qualification of the FP1189 contains an Accelerated Biased Humidity (HAST, +130°C, 85% RH, 33 psi) test and a High Temperature Operating Lifetime (HTOL) test under a biased condition at +125° C ground tab temperature. As shown in the FP1189 & FP2189 Qualification Report, we have reported no failures with over 16,032 device hours for HAST and no failures on 135,000 device hours for HTOL.

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 will never be above a safe **+153° C**, when operated at the recommended bias of 8 V @ 125 mA. The maximum recommended operating temperature insures a MTTF (mean time to failure) rating of 2.1 million hours. 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 (8 V) x current consumption (125 mA) x thermal resistance (68° C/W) = 153° C. Using the activation energy of 1.5 eV, the following MTTF estimates have been calculated from the Arrhenius function [1]:

GND Lead Temp. (°C)	Channel Temp. (°C)	MTTF (million hours)	FIT per billion hours
50	118	80.2	12.5
60	128	26.4	37.8
70	138	9.19	108
80	148	3.36	297
85	153	2.07	483
90	158	1.29	776
95	163	0.81	1233
100	168	0.52	1940
105	173	0.33	3020
110	178	0.21	4655



As can be seen from the MTTF values above, the predicted failure rate is still above 1 million hours, even at operating temperatures up to +92° 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.

[1] $MTTF = A^* e^{(Ea/kT)}$ Where: $A = 3.71 \times 10^{-12}$ (hrs) (Pre-exponential Factor)
$Ea = 1.5$ (eV) (Activation Energy)
$k = 8.617 \times 10^{-5}$ (eV/°C) (Boltzmann's Constant)