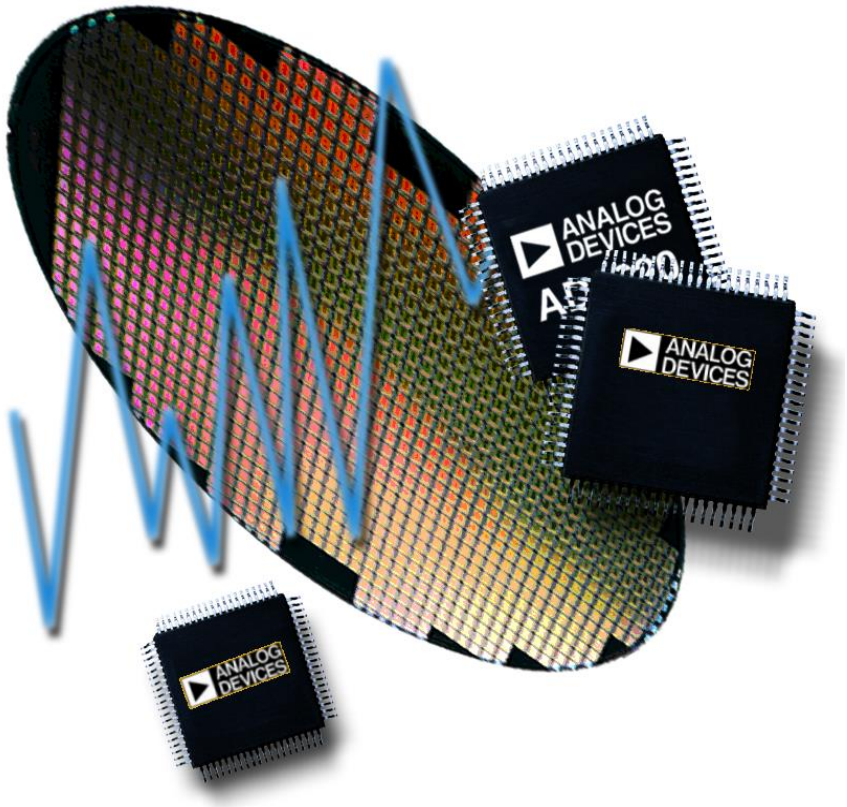

# Reliability Report

**Report Title:** GaAs PHEMT-J Process Cumulative Reliability

**Report Number:** 2013-00285

**Revision:** 10

**Date:** 11 March 2024

## Summary

This report summarizes the process HTOL testing of the GaAs PHEMT-J process.

### Table 1: Process Characteristics

#### Fabrication Details

| | |
|---|---|
| Wafer Fabrication Process | GaAs PHEMT-J |
| Passivation Layer | SiN |
| Bond Pad Metal Composition | Au |

## Description / Results of Tests Performed

The following tables provide a description of the qualification tests conducted and the associated test results for products manufactured on the same technologies as described in Table 1. All devices were electrically tested before and after each stress. Any device that did not meet all electrical data sheet limits following stressing would be considered a valid (stress-attributable) failure unless there was conclusive evidence to indicate otherwise.

## Table 2: Process Qualification Test Results

| Test Name | Specification | Conditions | Device | Lot # | Sample Size | Qty. Failures |
|---|---|---|---|---|---|---|
| High Temperature Operating Life (HTOL) | JESD22-A108 | $T_{j\text{-}stress}$=125°C, Biased, 1,000 Hrs | HMC6488A | QTR2012-00017 | 80 | 0 |
| | | | HMC6484 | QTR2012-00042 | 80 | 0 |
| | | | HMC1190A | Q11869 | 49 | 0 |
| | | $T_{j\text{-}stress}$=150°C, Biased, 1,000 Hrs | HMC284A | QTR2012-00461 | 160 | 0 |
| | | | HMC349A | QTR2014-00445 | 80 | 0 |
| | | | HMC1190A | Q13411 | 148 | 0 |
| | | | ADCA5191 | Q18440 | 98 | 0 |
| | | | ADCA5190 | 18440.1.2 | 82 | 0 |
| | | | ADCS3280 | 18371.2.2 | 32 | 0 |
| | | $T_{j\text{-}stress}$=150°C, Biased, 168 Hrs | HMC472A | QTR2013-00524 | 1134 | 0 |

Samples of the many devices manufactured with these package and process technologies are continuously undergoing reliability evaluation as part of the ADI Reliability Monitor Program. Additional qualification data is available on Analog Devices' web site.

## Approvals

Reliability Engineer: Tom Wood

## Additional Information

Data sheets and other additional information are available on Analog Devices' web site

# Appendix

**GaAs PHEMT-J Failure Rate Estimate**

The failure rate estimation was determined using the process HTOL test results and the parameters shown below:

- Die Use Junction Temperature, $T_{j\text{-use}}$ = 85°C
- GaAs PHEMT-J Activation Energy = 1.46 eV
- Acceleration Factor (AF): $$AF = \exp\left[\left(\frac{E_A}{k}\right)\cdot\left(\left(\frac{1}{T_{USE}}\right)-\left(\frac{1}{T_{STRESS}}\right)\right)\right]$$
- Equivalent hours = Device hours x Acceleration Factor

| Device | Qual Number | Equivalent Device Hours |
|---|---|---|
| HMC6488A | QTR2012-00017 | $9.4\text{x}10^6$ hours |
| HMC6484 | QTR2012-00042 | $9.4\text{x}10^6$ hours |
| HMC1190A | Q11869 | $5.75\text{x}10^6$ hours |
| HMC284A | QTR2012-00461 | $2.34\text{x}10^8$ hours |
| HMC349A | QTR2014-00445 | $1.17\text{x}10^8$ hours |
| HMC1190A | Q13411 | $8.18\text{x}10^7$ hours |
| ADCA5191 | Q18440 | $1.43\text{x}10^8$ hours |
| ADCA5190 | 18440.1.2 | $1.20\text{x}10^8$ hours |
| HMC472A | QTR2013-00524 | $2.78\text{x}10^8$ hours |
| ADCA3280 | 18371.2.2 | $4.09\text{x}10^8$ hours |
| Total Equivalent Device Hours = | | $1.41\text{x}10^9$ hours |

The failure rate was calculated using Chi Square Statistic:

$$\lambda_{CL} = \frac{\chi^2_{\%CL,2f+2} \cdot 10^9}{2 \cdot t \cdot ss \cdot AF}$$ at 60% and 90% Confidence Level (CL), with 0 units out of spec

and an 85°C die junction temperature;

Failure Rate

$\lambda_{60} = [(\chi^2)_{60,2}]/(2X \quad 1.41x10^9 \ )] = 4.1/ \quad 2.81x10^9 \quad = \quad 6.50x10^{-10}$ failures/hour or 0.7 FIT or MTTF = $1.54x10^9$ Hours

$\lambda_{90} = [(\chi^2)_{90,2}]/(2X \quad 1.41x10^9 \ )] = 7.8/ \quad 2.81x10^9 \quad = \quad 1.64x10^{-9}$ failures/hour or 21.6 FIT or MTTF = $6.11x10^8$ Hours