

GaAs power devices and Mixed signal technologies.

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CNES/ESA Radiation Effects Final Presentation Days.
Toulouse, 09 & 10 March 2015

Radiation Characterization of GaAs power devices in support of European radiation Hardness (I)



Introduction

In 2008, ESA released Alert (EA) No: EA-2008-EEE-05-B applies to GaAs MESFETs after the in-flight failure of a power MESFET. The alert investigations showed failure under protons and heavy ions depending on the operating conditions. The alert recommends following the same product assurance process also for other type of GaAs technologies used in power amplifier applications, in particular for new device types produced on new or modified GaAs processes.

SEE tests have been performed by ESA and industry on different GaAs MESFET, HEMT and PHEMT test vehicles but analysis and comparison is made difficult for several reasons:

- Lack of statistics (limited number of tested samples, low fluence applied ...).
- Difficulty when testing in the application conditions (DC+RF) (the DUT is often placed in vacuum for heavy ion experiments)
- Different test strategies wrt the DC and RF parameters (the variation of V_{gs} , V_{ds} , V_{dg} , I_{ds} , etc, differs depending on the experiments and application).

The activity aims at obtaining a better understanding of the relationship between failure in GaAs devices under heavy ion irradiation and the application conditions (DC+RF). The final goal of the activity is to generate and / or improve test guidelines for the radiation hardness assurance of power GaAs devices.

Radiation Characterization of GaAs power devices in support of European radiation Hardness (II)



Status of the activity

- Activity started in September 2014. Expected to end in March 2016.
- Companies Involved: TAS-E (Main), TAS-F & TRAD.
- 7 different devices will be submitted to SEE test at UCL before July 2015.
 - a. FHX35LR- Low Noise - SUMITOMO*
 - b. FLL120MK SUMITOMO H2P Technology.*
 - c. MGF2430S 0.4 MESFET Mitsubishi*
 - d. ED02AH OMMIC using TCVPM42B*
 - e. HP07 UMS*
 - f. PPH25X UMS*
 - g. D01PH OMMIC*
 - h. CHA105 UMS (back-up)*
- Test conditions will include RF multicarrier modulations when applicable as well as different gain compression levels.
- Output power and gate current (when possible) will be monitored in real time.

Introduction

Feasibility studies have demonstrated that the radiation levels encountered during the Juice mission will be significantly higher than those on typical Earth orbiting or interplanetary missions.

ESA has initiated three TRP activities to develop radiation tolerant high-performance electronic instrumentation components as required for the instrumentation payload:

- Front-end Readout ASIC Technology Study and Development Test Vehicles for Front-end Readout ASICS, Contract 4000101556/10/NL/AF
- Radiation Tolerant Analogue / Mixed Signal Technology Survey and Test Vehicle Design, Contract 400101621/10/NL/AF
- DAREPLUS (Design Against Radiation Effects) ASICS for extremely Rad. Hard & Harsh Environments. Contract number 4000104087/0/0/1.

The goal of this activity is **to perform the TID and SET testing** of the ASIC devices obtained in the three aforementioned activities. The data obtained will be used **to produce better TID and SET hardened ASICS for JUICE and better models of SET impact and propagation.**

Radiation Characterization of GaAs power devices in support of European radiation Hardness (II)



Status of the activity

- Activity started in February 2014. Expected end in April 2016.
- Companies Involved: ALTER (main), IMEC.
- 4 different ASIC devices will be tested in this activity.
 - a. TID test vehicle based on DARE+ rad hard library generated by IMEC based on UMC 0.18um CMOS technology. TID test has been performed, test results under analysis.*
 - b. SET test vehicle based on DARE+ rad hard library generated by IMEC based on UMC 0.18um CMOS technology. ASIC design finished by the University of Sevilla and pending tape out.*
 - c. TID test vehicle based on XFAB 0.25 um CMOS technology, includes high power bipolar transistors. ASIC design finished by SITAEL and currently under tape out, TID test expected before July 2015.*
 - d. SET test vehicle based on XFAB 0.25 um CMOS technology, includes high power bipolar transistors. ASIC design on-going by SITAEL.*
- Each ASIC contains tens to few hundreds of different transistor types and test structures in order to evaluate the performance of each radiation hardened library.