NEWSLETTER

(March 2021 - Dezember 2023)

ISSUE #2

MORAL

Export free rad-hard microcontroller for space applications

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H2020 MORAL Project

DEAR READER,

Welcome to the second newsletter of the MORAL project.

Let's start with some project background. Do you know predictions for 2025-2030 indicate that small satellites will generate a huge market?

Low-cost small satellites (from 10 kg to 500 kg) came to the focus of researchers in recent years and already demonstrated their potential for scientific research and practical applications in the fields of Earth Observation, Science Mission, Human Spaceflight, Space Transportation, Telecommunications, Navigation, Space Security, Robotic Exploration, Unmanned Aircraft Systems (UAS), Defence Applications, etc. The availability of low-cost small satellites is an important issue for various scientific and commercial projects, and here comes MORAL.

The MORAL project aims to change the European space landscape by opening new business opportunities. MORAL is focused on developing a complete European, International Traffic in Arms Regulations (ITAR) free, high-performance, 32-bit microcontroller for space applications focused on small satellites.

In this second issue of the MORAL newsletter, we highlight the main achievements of the last couple of years of work and development.

We hope you enjoy reading our newsletter. We invite you to check our previous newsletter, our website (moral-project.eu), and our social media, or contact us for more information.

Yours sincerely,

MORAL CONSORTIUM

Project Coordinator

IHP GMBH - Innovations for High Performance Microelectronics
LEIBNIZ - INSTITUT FUER INNOVATIVE MIKROELEKTRONIK
(Germany)

REDCAT DEVICES SRL
(Italy)

SYSGO GMBH
(Germany)

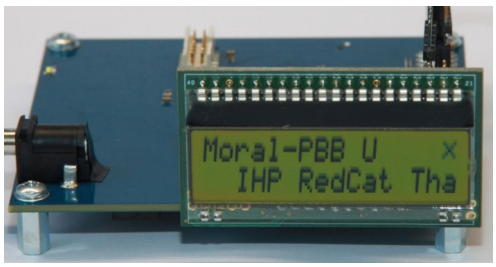
THALES ALENIA SPACE ESPANA, SA
(Spain)

ABSINT ANGEWANDTE INFORMATIK GMBH
(Germany)

MORAL PROJECT ROADMAP

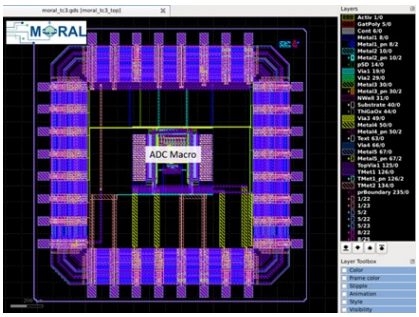
2021

- The wafer tests of the first test chip (TC01) were completed. TC1 contains SRAM blocks.
- The FPGA test platform shown in the picture below was made available for the partners to support the Compiler and Operating System developments.



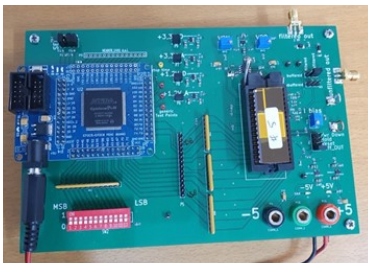
March'21

- The 12-bit ADC design was completed and the third test chip (TC03) including it, was submitted for fabrication. The TC03 layout is shown below.



April'21

- - Electrical characterization of the preliminary 10-bit DAC integrated into the second test chip (TC02) was finalized by RedCat, and encouraging results pushed the use of the same approach for the final 12-bit DAC. The test board used for the electrical measurements is shown in the picture.



June'21

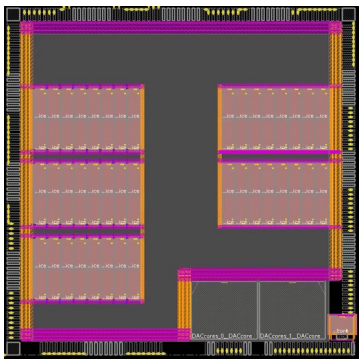
- The 12-bit DAC design was completed, and the fourth test chip (TC04), including it, was submitted for fabrication.
- Partner released a new version of the C Compiler.
- IHP started to work on the floorplanning of the entire microcontroller.

July'21

- First internal release of the Real-Time Separation Kernel (RTSK). The RTSK is running on the FPGA platform.

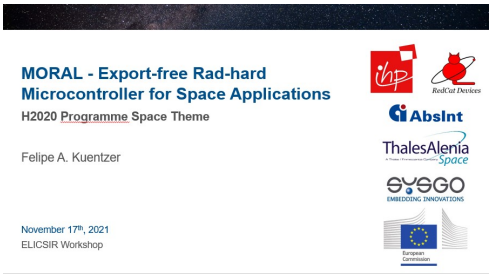
October'21

- Preliminary microcontroller layout developed



September'21

- IHP organized the workshop called "Fault-tolerant Electronics for Radiation Environments." The workshop was a collaboration between MORAL project and ELICSIR project. The MORAL project and some aspects involved in its development were presented at this event.

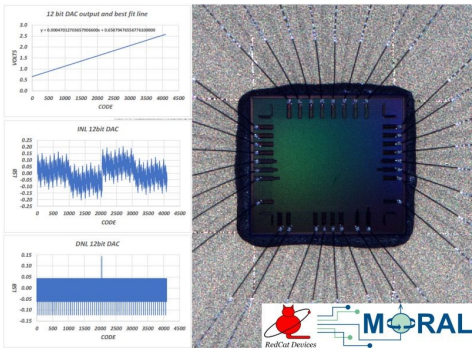


November'21

MORAL PROJECT ROADMAP

2022

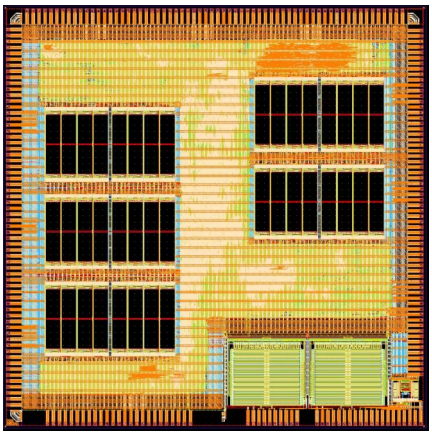
- Functional tests and electrical measurments of the 12-bit ADC (TC03) and DAC (TC04).



May'22

- Preliminary radiation tests (Cobalt 60) with the 12-bit DAC finished. 300 krad (Si) have been obtained without any significant deviation.

- The complete microcontroller was submitted for fabrication. The final layout is shown below.



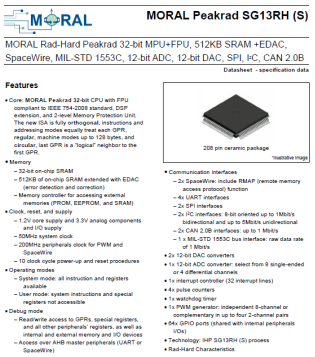
July'22

- Microcontroller's wafer tests preparation began.

- Demonstrator and test boards specifications also began.

November'22

- The first release of MORAL's microcontroller datasheet.


MORAL Peakrad SG13RH (S)

MORAL Rad-Hard Peakrad 32-bit MPU+FPU, 512KB SRAM +EDAC, SpaceWire, MIL-STD 1553C, 12-bit ADC, 12-bit DAC, SPI, I²C, CAN 2.0B

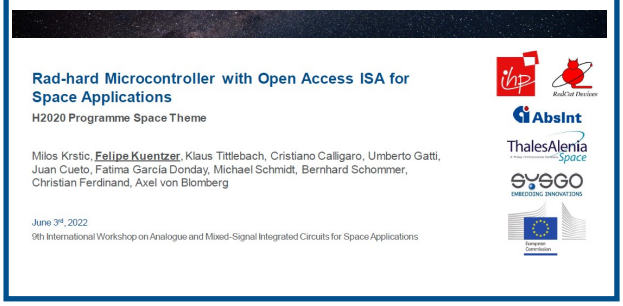
Datasheet - specification data

Features

200 pin ceramic package

January'22

- The MORAL project was part of the 9th International Workshop AMICSA. AMICSA provides an international forum for presenting and discussing recent advances in analogue and mixed-signal VLSI design techniques and technologies for space applications.


Rad-hard Microcontroller with Open Access ISA for Space Applications

H2020 Programme Space Theme

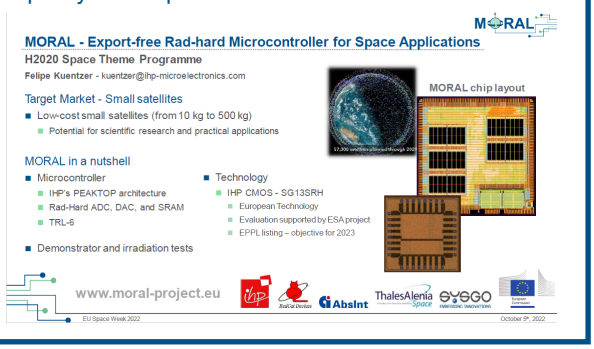
Milos Krstic, Felipe Kuentzer, Klaus Tittlebach, Cristiano Calligaro, Umberto Gatti, Juan Cueto, Fatima Garcia Donday, Michael Schmidt, Bernhard Schommer, Christian Ferdinand, Axel von Blomberg

June 3rd, 2022

9th International Workshop on Analogue and Mixed-Signal Integrated Circuits for Space Applications

June'22

- The MORAL project was invited to be on the panel Horizon, a Booster Space Research, to discuss the impacts of space research in terms of new businesses, breakthrough innovations, and contributions to steering EU policy developments.


MORAL - Export-free Rad-hard Microcontroller for Space Applications

H2020 Space Theme Programme

Felipe Kuentzer - kuentzer@ihp-microelectronics.com

Target Market - Small satellites

- Low-cost small satellites (from 10 kg to 500 kg)
  - Potential for scientific research and practical applications

MORAL in a nutshell

- Microcontroller
  - IHP's PEAKTOP architecture
  - Rad-Hard ADC, DAC, and SRAM
  - TRL-6
- Technology
  - IHP CMOS - SG13SRH
  - European Technology
  - Evaluation supported by ESA project
  - EPPL listing – objective for 2023
- Demonstrator and irradiation tests

MORAL chip layout

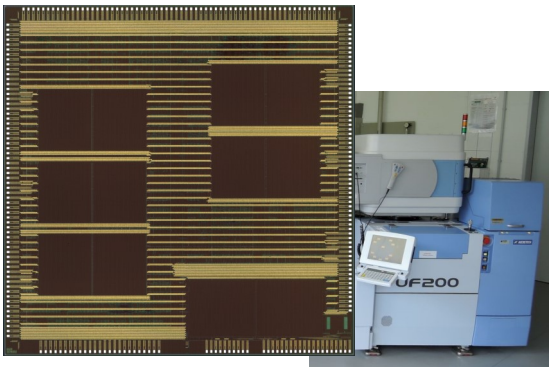
www.moral-project.eu

October'22

MORAL PROJECT ROADMAP

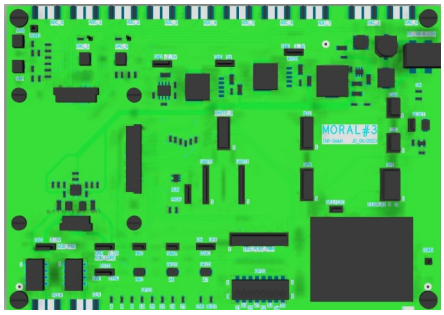
2023

- Wafers were delivered, and wafer tests started at IHP.



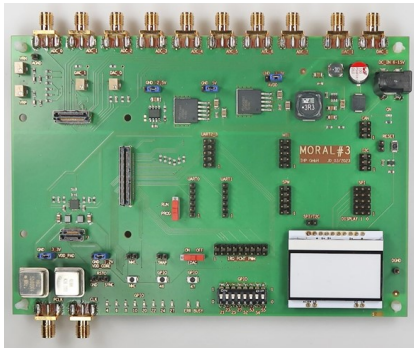
March'23

- Specification and design of the desmonatrator and the test boards were completed. PCBs fabrication and components were ordered.



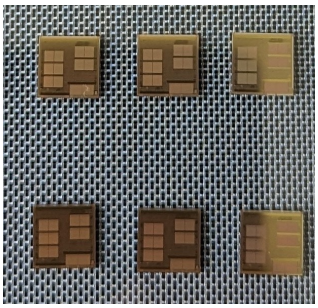
February'23

- Test codes for functional tests and radiation tests under development.
- The demonstrator baseboard's first assembly is shown in the picture.



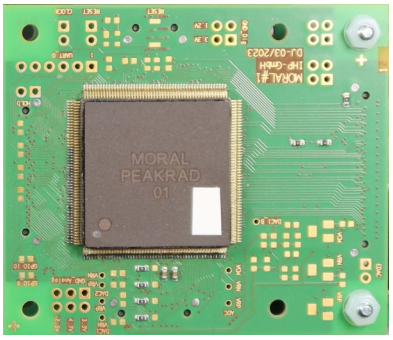
May'23

- Wafer tests completed. Functional samples selected for packaging.
- Samples sent to the external supplier for packaging.



July'23

- Packaged chips were delivered and assembled in the test board.



October'23

- The packaged tests were completed using the fully assembled demonstrator platform.
- The RTSK was also finalized and is running in the demonstrator.
- The stress tests are ongoing, and the radiation tests are scheduled for early 2024.

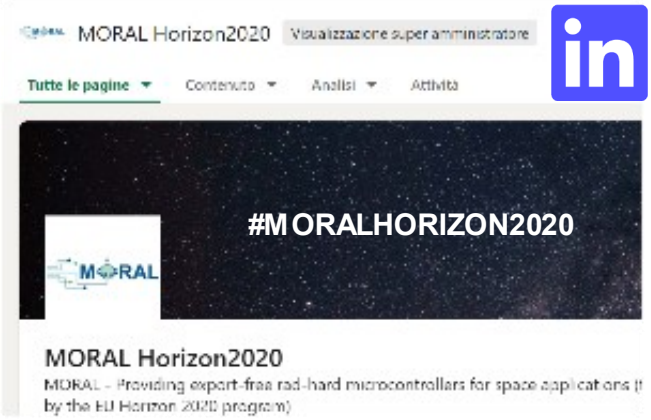
Dezember'23

STAY TUNED WITH UPCOMING NEWS AND RESULTS...

THE MORAL WEBSITE!

A VIRTUAL SPACE, RICH IN DATA, RESULTS AND NEWS ABOUT THE MORAL PROJECT AND NEWS FROM SPACE!

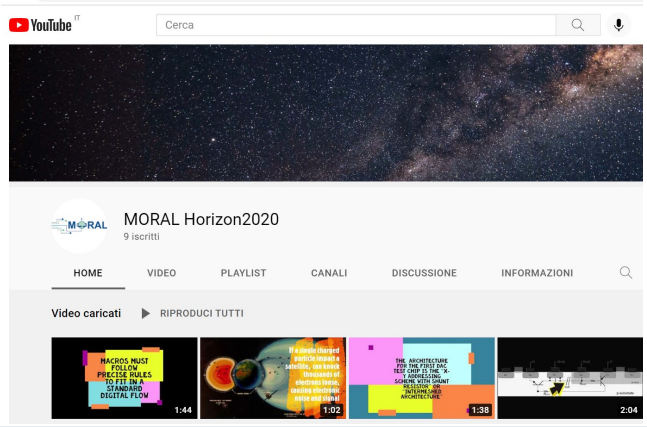
CLICK HERE TO STAY TUNED!



MORAL IS ON LINKEDIN!

THE MOST POWERFUL SOCIAL NETWORK IN THE BUSINESS SECTOR HAS BEEN SELECTED TO ACHIEVE MORAL EXPLOITATION SCOPES!

FOLLOW OUR POSTS TO GET INFORMED ABOUT ANY NEW COMMERCIAL POTENTIAL OFFERED BY MORAL!



A **MORAL YouTube Channel** HAS BEEN ACTIVATED IN ORDER TO SHARE WITH THE COMMUNITY SCIENTIFIC AND TECHNICAL VIDEOS ABOUT THE MORAL ACTIVITIES!

SUBSCRIBE THE MORAL YOUTUBE CHANNEL!

SELECT YOUR FAVOURITE CHANNEL TO STAY TUNED WITH MORAL UPDATES!

MORAL

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