ACCEDE 2019
Low-Cost and High-Flexibility SEL Testing Unit

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a Thales / Leonardo company

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INTRODUCTION

The space industry is changing very fast since the last few years. This industry used to move very slowly towards new technologies that were common in other industries. With the explosion of the information society a lot of new players have come into the space market. Thanks to them, the customers are demanding better specifications and lower prices. This situation is pushing most of the companies to explore new ways of making satellites: when it comes to components, traditional rad-hard parts are progressively been replaced by commercial off-the-shelf (COTS) ones in a lot of applications.

The usage of COTS is only possible after a lot of testing of this parts has been done. As the cost of the testing could increase the cost of the final product, the tests have to be very fast and efficient to prevent this potential problem.

In order to have an excellent time performance in the Single Event Latch up (SEL) tests, a low-cost and high-flexibility testing unit has been developed by Thales Alenia Space Spain called CLARK (Control de Latch up Ajustable y Regulable para Kits de Evaluación).

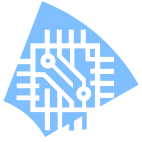
TESTING UNIT DEVELOPMENT MOTIVATION

Issues from previous campaigns:

TIME CONSUMING
during preparation and test

EXPENSIVE
new setup for each device under test, not reusable

COMPLEX
different setups, risk of human mistakes, etc.



OBJETIVES

Needs for the the design:

FLEXIBLE
valid for a wide variety of components

ECONOMIC
maximum quantity in minimum time

SINGLE SET UP
versatile and travel friendly

04/11/2019
Ref. = YAMAL601-TASB-PPT-0480
Ref. Model = 83230347-DOC-TAS-EN-005

SYSTEM DESIGN

OBJETIVES

TEST NEEDS:

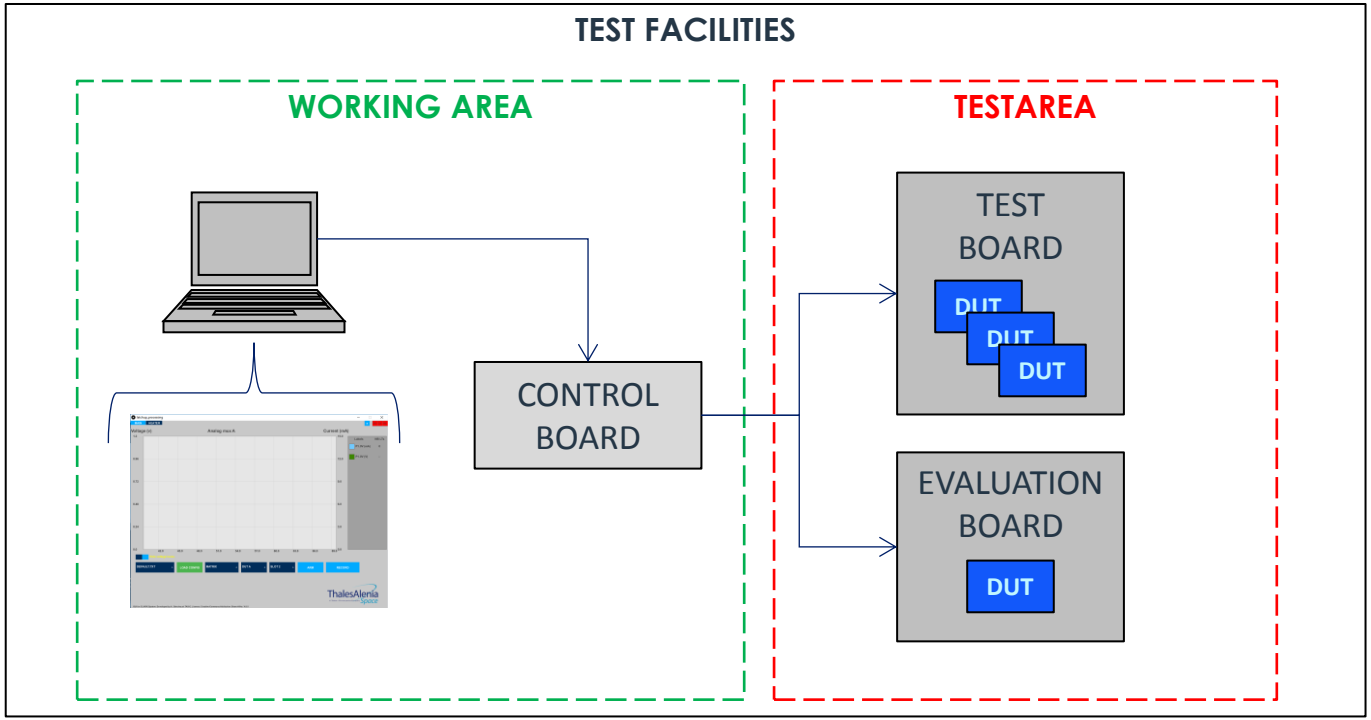
- Voltage supply of the DUT
- Heat control
- Current monitoring

DEVICE UNDER TEST NEEDS:

- Small and simple
- More complex: Evaluation Boards

SYSTEM DESIGN

ARCHITECTURE



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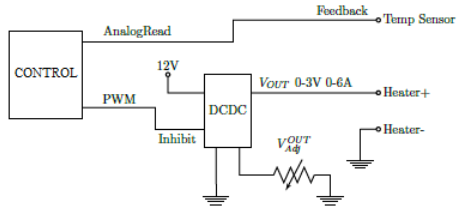
SYSTEM ARCHITECTURE

CONTROL BOARD

- POWER SUPPLY
  - INTERNAL SOURCE
    - Digitally-adjustable output voltage level
    - Internal DCDC from -30 to 30V
      - 3 different DCDC levels for + supply (0-5V, 5-15V, 15-30V)
      - 2 levels for – supply (0-15V, 15-30V)
  - EXTERNAL SOURCE
    - Availability to connect an external source through the control board
  - EV. BOARD SOURCE
    - Same power supply for the Ev. Board
  - CUTTING POWER
    - In the event of a SEL a photoMos relay for each DUT is placed in the circuit and will cut down the current if a Latch up is detected

- HEATER
  - INSIDE VACUUM CHAMBER
    - The temperature will be raised with a long resistive path placed under the dice.
    - The temperature is sensed with a NTC resistor and the microprocessor The current flowing through this resistive path will be controlled by a control loop performed with the microprocessor.



  - NO VACUUM CHAMBER
    - other kind of heat sources could be used such as a heat gun

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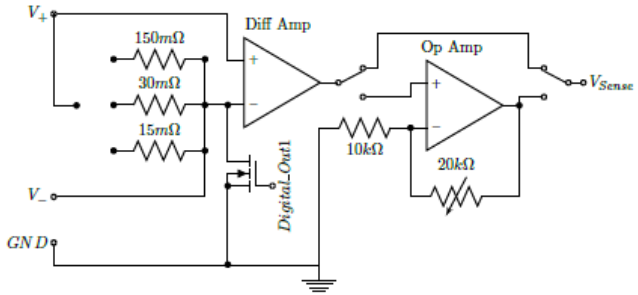
SYSTEM ARCHITECTURE

CONTROL BOARD

- CURRENT SENSING
  - **Shunt resistor** located in series with the component that is going to be tested
  - The current going through the component crosses previously this resistor producing a voltage drop. This shunt resistor has typically a value of a few mΩ. The voltage drop is amplified with a differential amplifier, which produces an output voltage proportional to the current flowing through the shunt resistor.



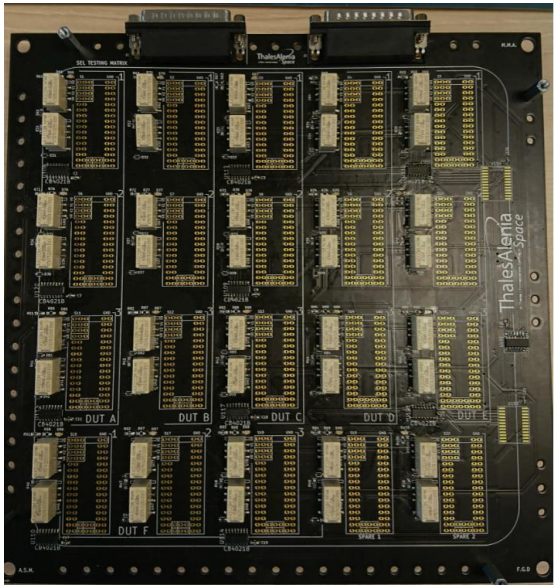
- CONTROL AND COORDINATION
  - MICROPROCESSOR
    - A single microprocessors takes control of the system by receiving the information from the different modules and commanding the actions to be made.
    - When the SEL is detected and the processor commands a cut down of the voltage, it takes some time to open the switches.
  - TIME PERFORMANCE
    - The detection time is the time that will pass from the moment the SEL begins, making the current go up, until the system commands a turn-off of the DUT. With just one device activated at a time, the worst case detection time is 20µs.

SYSTEM ARCHITECTURE

TEST BOARD AND EVALUATION BOARD

- TEST BOARD
  - 18 slots available
  - 1 component sample / slot
  - 3 independent power lines / slot
  - Each line monitored from the control board
  - Slots are versatile enough to allow the testing of different basic devices with up to 3 different power rails

- EVALUATION BOARD
  - For more complex components a specific adapter shall be designed to plug into the test board



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SYSTEM ARCHITECTURE

OPERATING MODES

- TEST BOARD + INTERNAL POWER SUPPLY
  - SIMPLE PARTS
  - VARIOUS PARTS AT THE SAME TIME
  - POWER SUPPLY BETWEEN -30V AND +30V
  - DESIGN OF SLOT BOARD
- TEST BOARD + EXTERNAL POWER SUPPLY
  - SIMPLE PARTS
  - VARIOUS PARTS AT THE SAME TIME
  - POWER SUPPLY >30V
  - DESIGN OF SLOT BOARD
- EVALUATION BOARD + EV. BOARD POWER SUPPLY
  - COMPLEX PARTS
  - ONE PART AT A TIME
  - POWER SOURCE AND EVALUATION BOARD PURCHADED FORM MANUFACTURER

SUCCESSFUL EXPERIECES

TEST FACILITIES

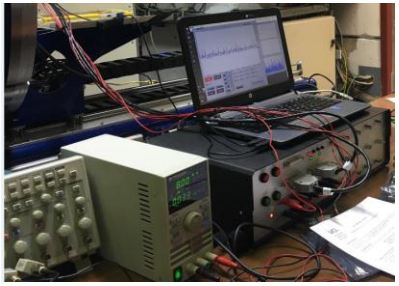
The proposed system has been successfully tested in radiation campaigns at:

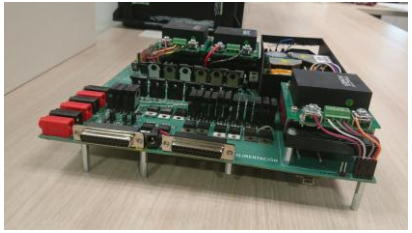
Texas A&M University (TAMU):

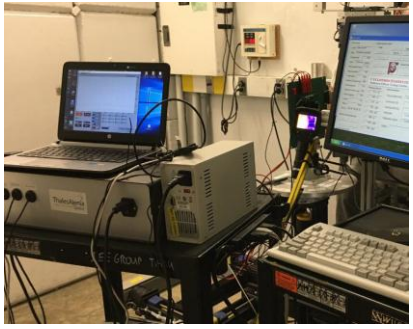
UCL (Lovaina) – Heavy Ion Facility (HIF)

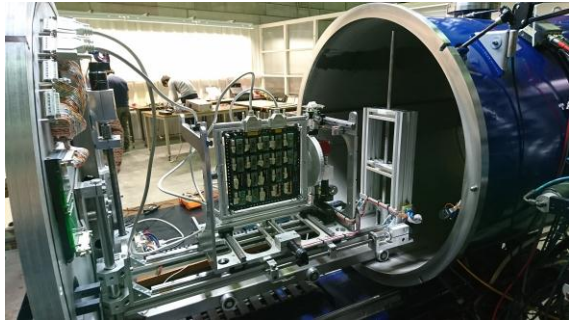
KVI-CART (University of Groningen)

GANIL









CONCLUSIONS

Making a flexible and affordable testing unit for SEL should help to increase the number of components that could be tested for campaign. Increasing this number shall also increase the final number of COTS that could potentially be used in space applications and reducing thus the final price of electronic equipment for space.