

# MAGICS BIG SCIENCE FORUM 2022

NUCLEARISATION AND AUTOMATION FOR WORLDS  
MOST CHALLENGING RADIATION ENVIRONMENTS

CEO  
[jens.verbeeck@magics.tech](mailto:jens.verbeeck@magics.tech)

Business development and sales  
[luisa.leroy@magics.tech](mailto:luisa.leroy@magics.tech)



# INTRO

# ABOUT MAGICS TECHNOLOGIES NV

**“Becoming a market leader on high reliability ASICs in space, nuclear and defence markets”**

Magics Technologies is based in Geel, Belgium. The spark for Magics is a shared conviction that autonomous machines are the keys to unlocking secure, sustainable sources of energy and exploring other planets.

Magics continuously leveraged their rad-hard-by-design methodology and library into five ITAR-free product lines:

- Motion series: enabler for nuclear robotics and motion and instrumentation subsystems in space.
- Time series: on-board clock generation and time-of-flight sensors in space and nuclear applications.
- Power series: DCDC applications in nuclear and space.
- Vision Series: Rad-hard imaging solutions for nuclear applications.
- AI series: AI accelerator ASICs and solutions.

Doubling in staff and revenue almost every year and turning revenues above 3M Euro. Magics has the ambition to become the European market leader in Semiconductor chips for Energy, Space and Defense markets.



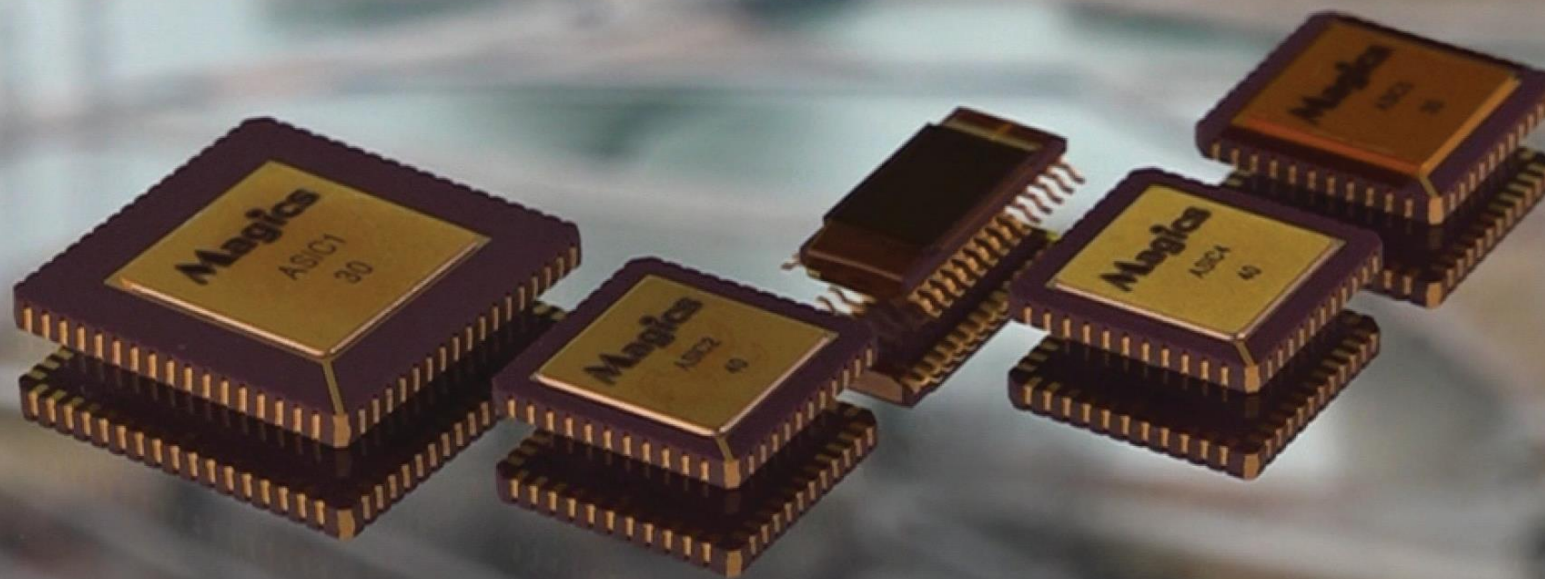
**TID Immunity and  
SEL/SEU/SET tolerant**

Trusted, ITAR free European  
semiconductor supplier

Enable automation in  
radiation environments

Create lightweight and  
compact end-products with  
highest reliability

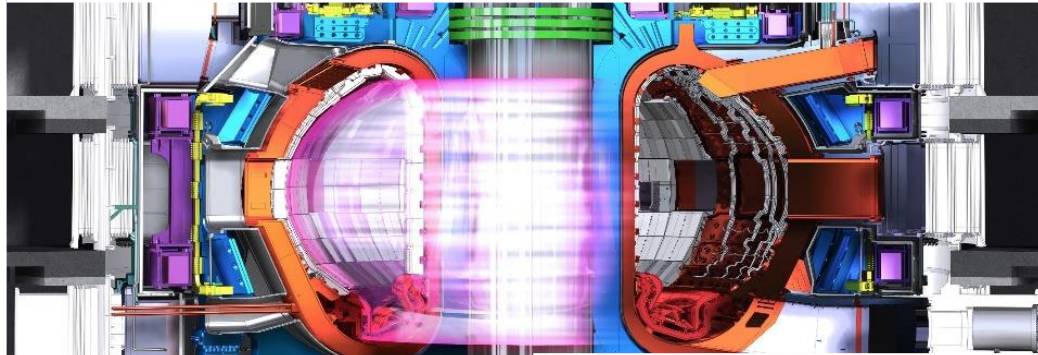
Reduce cabling and increase  
sensory information





# FROM BIG SCIENCE TO OTHER HIGH-DEMANDING MARKETS

## CHALLENGING RADIATION ENVIRONMENTS ON EARTH



### NUCLEARISATION OF INSTRUMENTATION AND CONTROL

### AUTOMATION

BIG SCIENCE REMOTE HANDLING

AUTOMATED GRASPING OF OBJECTS

REMOTE HANDLING , INSPECTION ROBOTICS FOR INSPECTION AND DECOM.

DIGITAL TWINS IN WASTE MANAGEMENT FACILITIES

SENSORS (CAMERAS PRESSURE/FORCE SENSORS,...)

ENGINEERING SERVICES TO NUCLEARIZE COMPONENTS

## SPACE



### SATS

### LANDERS

### ROVERS

SPACE LIDAR (DOCKING, RENDEZ-VOUS, ...), NAVIGATION

OBJECT DETECTION AND AUTOMATION

CLOCK GENERATION FOR SUB SYSTEMS AND COMMUNICATIONS

SPACE SUBSYSTEMS (OPTICAL PAYLOADS, ATTITUDE AND CONTROL SYSTEM , REMOTE TERMINAL UNITS)

CUSTOMIZED ASICS FOR DEDICATED APPLICATIONS

## DEFENCE



### DRONES

OBJECT DETECTION AND NAVIGATION

VISUAL TRACKING OF OBJECTS

# SOME OF OUR WORLD-RENOWNED CUSTOMERS

## National R&D Centers



## Big science organizations



## Engineering services



## Product companies



## Waste managements facilities

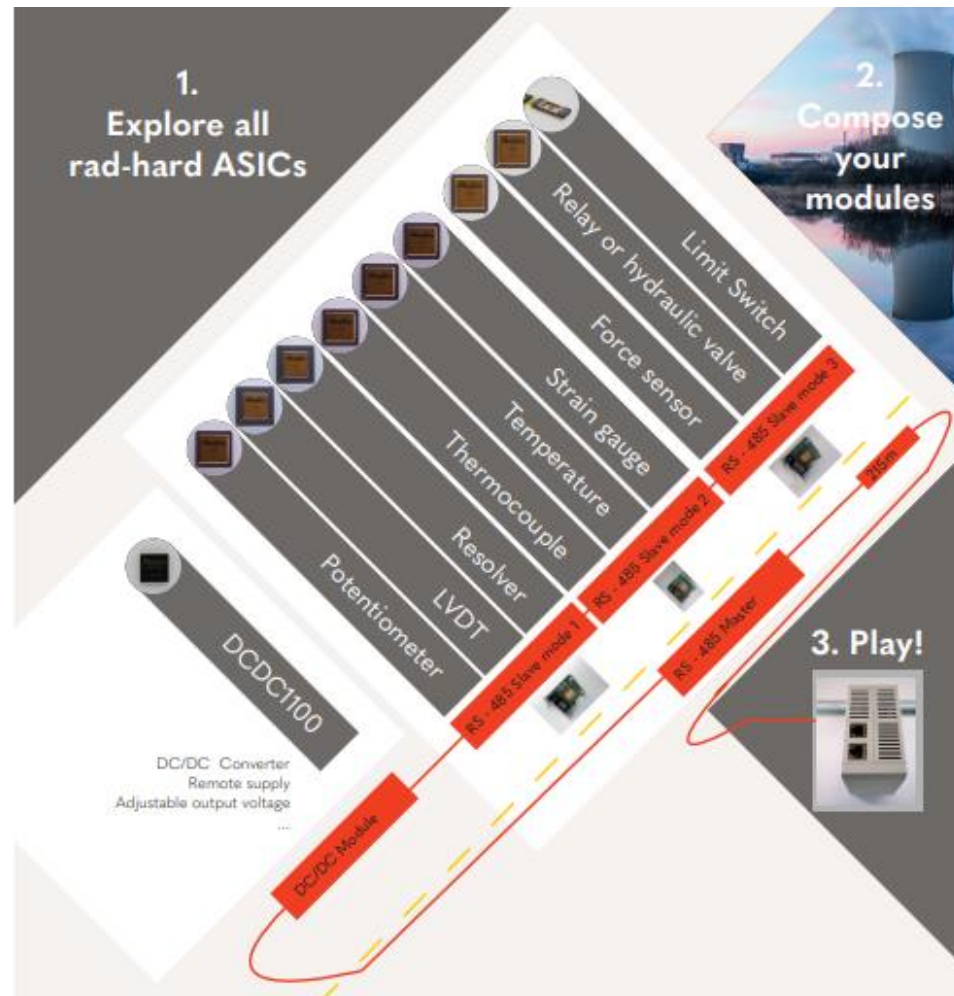




# EXAMPLES PRODUCTS

# INSTRUMENTATION AND CONTROL SOLUTIONS

Plug and play system for nuclear inspection, - maintenance or –decommissioning robotics and diagnostics



## Product-overview:

- Compose easily in 3-Steps:
  - Explore all rad-hard ASICs
  - Compose your modules
  - Integrate into your system
- Digitalize and upgrade your robotic system with Magics subsystems up to +1MGy TID immunity.
- Read-out:
  - low voltage sensors (temperature, thermocouple, force, pressure,...)
  - rotational and linear displacement sensors (Resolvers and LVDTs)
- Drive hydraulic valves, relays and actuators
- Reduce cabling through local digitalization
- Ease up creation of high Safety integrity levels through build-in diagnostic and redundancy options .



## Prime Power Performance Rad-hard DC/DC Converter

Radiation and Magnetic tolerant Point of Load  
For space and nuclear applications



# POWER SERIES

DC/DC module [Also available as an ASIC]

In-stock, ready for shipment in module or as single chip

DC/DC1100 is a single-phase synchronous buck converter developed to provide an efficient solution for the distribution of power in High Energy Physics experiments. As such, it has been designed for flawless functionality in a harsh radiation and magnetic field environment.

### Features:

- Continuous 4 A load capability
- Configurable output voltage between 1.2V and 5V
- Integrated Power N-channel MOSFETs
- Adjustable switching frequency 1-3 MHz
- Synchronous Buck topology with continuous mode operation
- High bandwidth feedback loop (150 KHz) for good transient performance

### Protection features:

- Over-current protection
- Over-temperature protection
- Input under-voltage lockup
- Line protection

### Applications:

- Power distribution
- Voltage supply for sensors
- Accelerators

## VISION SERIES: CHIPSETS FOR NEXT GENERATION CAMERA APPLICATIONS

Demonstrators available

The Full package:

- Imaging and serialization
- Motion control chipset is used for mechanical functions:
  - Pan and tilt, zooming,...
- DC DC modules available to supply power.





# EXPERIENCES BIG SCIENCE MARKET

## **Fusion For Energy and ITER**

**NUCLEARIZATION OF INSTRUMENTATION AND CONTROL FOR  
AND ITER'S MAINTENANCE OPERATIONS AND DIAGNOSTICS**



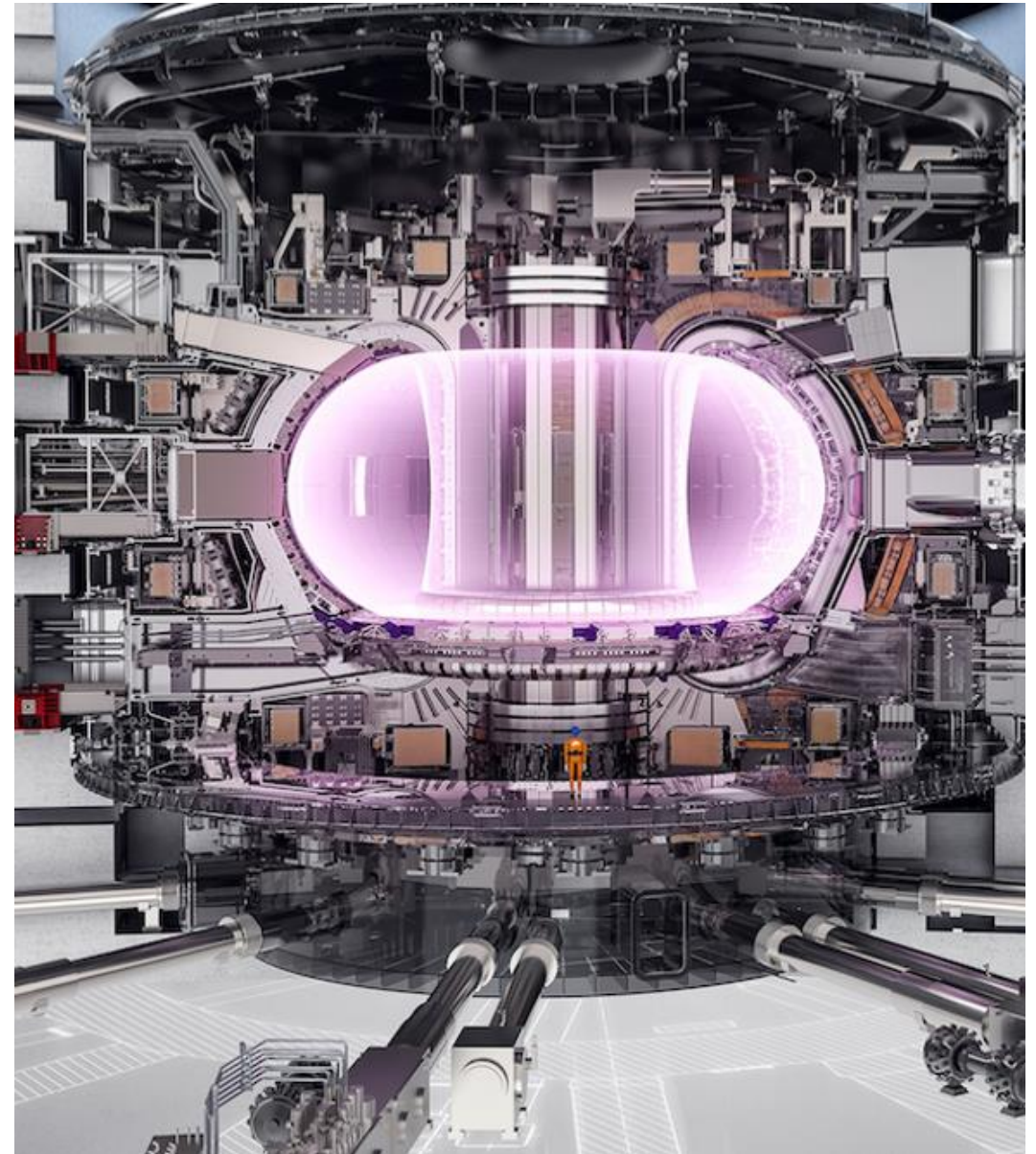


Rad-hard ICS, used to support maintenance at ITER.  
Enabling rad-hard nuclear robotic systems and fully automated solutions (AI/ML) in harsh environments



## MAGICS AS SUPPLIER FOR F4E | REMOTE HANDLING

- Operating in the core of ITER requires many challenges and reliable solutions. Many components available on the market cannot survive the challenging radiation conditions.
- Of the shelf electronics cannot survive in high radiation environments ( $> 1$  kGy). Magics offers electronic solutions for automation that survive more than 1MGy of accumulated ionizing radiation.
- Remote maintenance and inspection activities need be done with precision and efficient. Magics enables high levels of automation by offering digital controls systems and provides F4E with rad-hard ICs to realize remote handling processes for ITER' maintenance.
- Engineers from Magics have qualified electronics that can operate in the ITER Torus core during its maintenance.
- Due to the levels of radiation, engineers will not be able to access the ITER Torus to fix or replace components. Similarly, not all material qualifies to operate in Torus. Exactly for this reason, experts from the fields of remote handling, robotics, diagnostics, electronics, need to collaborate to produce the equipment that will help us maintain the fusion device from a distance.

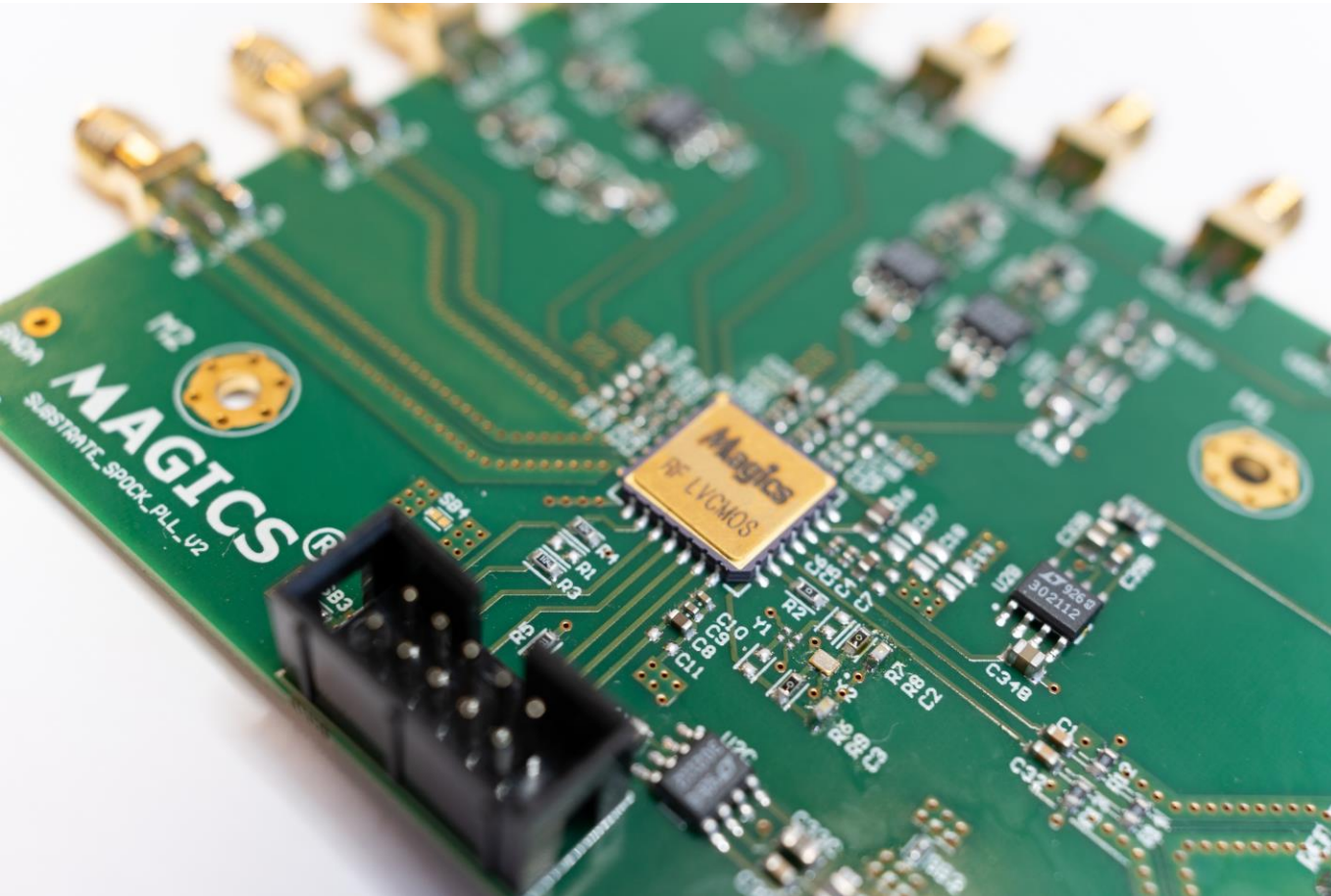


## **European semiconductors**

**TOWARDS EUROPEAN SEMICONDUCTORS FOR SPACE  
WITH THE EUROPEAN SPACE AGENCY**

# TIME SERIES

## PLL Single shot – Frequency Synthesizer



The PLL1001 is a radiation tolerant wideband phase locked loop (PLL), capable of delivering frequencies in the 1 MHz to 3 GHz range.

The PLL1001 has an integrated digitally configurable loop filter and digital controlled oscillator (DCO), effectively reducing the number of external components required.

### Features:

- Radiation tolerance
  - > 1 kGy TID
  - > 62.5 MeVcm<sup>2</sup> /mg SEL/SEU
  - SEU mitigation: Triple modular redundant
- 1.2 V core voltage operation
- Output frequency range 1 MHz – 3 GHz
- Phase noise of -99 dBc/Hz at 100 kHz offset with 2.5 GHz carrier

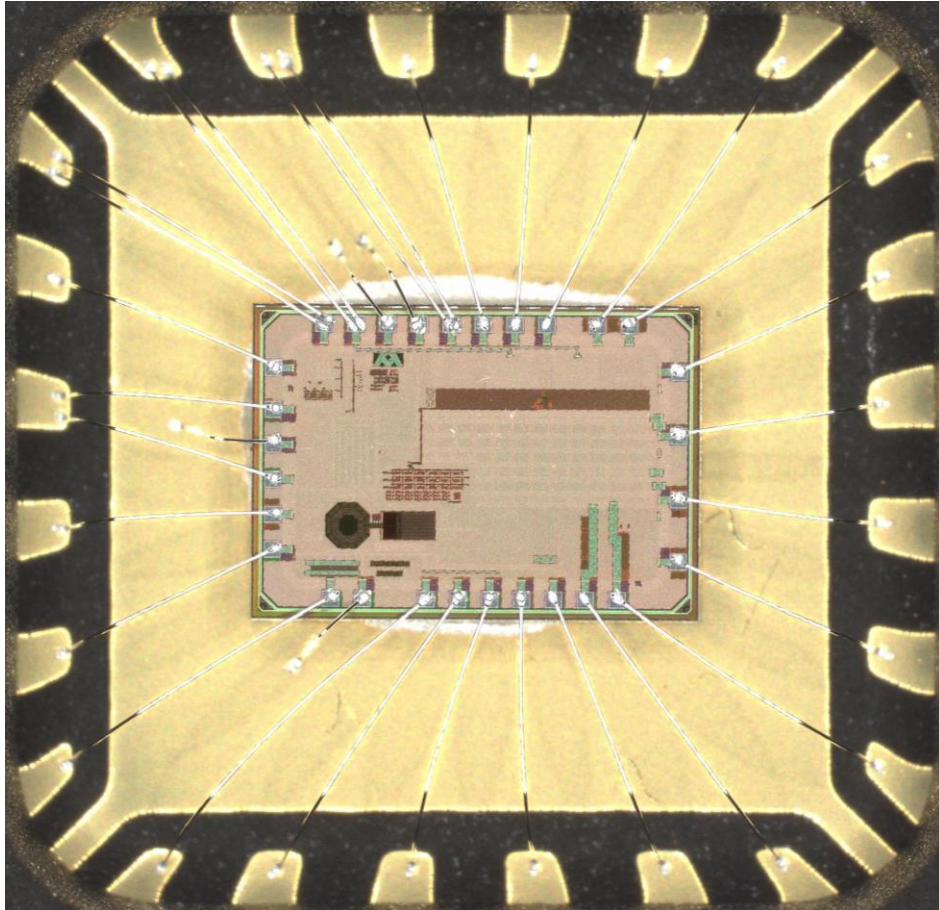
### Applications:

- On-board clock generation
- Serial communication links
- Clock cleaning and jitter filtering
- Switching power supplies



# TIME SERIES

## TDC1001 – Single shot time to digital converter



The TDC1001 is a radiation hardened time to digital converter with a single shot precision smaller than 8ps and zero dead time.

### Features:

- Radiation tolerance
  - > 1 kGy TID
  - > 62.5 MeVcm<sup>2</sup> /mg SEL/SEU
  - SEU mitigation: Triple modular redundant
- 1.8 V voltage operation
- resolution: <16 ps and lower
- Single-Shot Precision
- Dynamic range: 0ps to > 3s (zero dead-zone)

### Applications:

- LIDAR
- Crossed delay lines
- Instrumentation and time of flight applications
- Optical distance measurements in nuclear environments.



# CHALLENGES AS A SME IN THE BIG SCIENCE MARKET

# CHALLENGES AS SME IN THE BIG SCIENCE MARKET

- **Meet the high standards of big European organizations**
  - ISO9001
- **Technical entry barriers**
- **Project management requirements in big science projects**
- **Working with large Institutional partners sometimes requires flexibility**