Get to know the Polytechnic University of Catalonia (UPC) and discover some of its indicators.

THE UPC

Description of the research groups, centers and institutes that generate knowledge in the field of semiconductors and chips.

RESEARCH AND INNOVATION

What is meant by semiconductors? And by chips?

SEMICONDUCTORS AND CHIPS

Selection of R&D projects with the greatest impact on semiconductors and chips.

UPC EXCELLENCE PROJECTS

Degrees, masters, postgraduates and continuous training offered at the UPC and the UPC School in the field of semiconductors and chips.

EDUCATION

Description of the research groups, centers and institutes that generate knowledge in the field of semiconductors and chips.
THE UPC

The Universitat Politècnica de Catalunya (UPC) is a public institution of research and higher education in the fields of engineering, architecture, sciences and technology, and one of the leading technical universities in Europe.

The UPC participates in the innovation system of Catalonia with projects and contracts for research, development, valorization of knowledge and commercialization of technology.
RESEARCH, DEVELOPMENT AND INNOVATION ACTIVITY AT THE UPC IN 2023

141 Research groups
15 TECNIO research centers
331 Thesis

118,9 M€ Projects income
108,35 M€ Contract income

1.011 Active projects
1.033 Contracts

14 Patents
13 New Technology—Based Companies
2,425 Scientific journal articles
Semiconductors are materials that have **electrical conductivity** between the **conductors** (such as metals) and **insulators** (such as plastics).

Semiconductors are formed mainly of materials such as silicon, germanium and gallium arsenide, which have a crystalline structure that allows the controlled movement of electrons.

By adding impurities to the material (which means, doping it), the electrical properties of the semiconductor can be controlled, allowing it to function as a conductor or an insulator as desired.

In electronics, a chip is composed of a semiconductor material cut from a larger wafer of material that is a few millimeters on a side.

Chips and conductors are essential components in electronic devices such as **transistors, diodes and integrated circuits**, and are used in a wide range of applications such as computing, telecommunications and power generation.
AREAS OF APPLICATION OF SEMICONDUCTORS AND CHIPS

COMPUTING AND INFORMATION TECHNOLOGIES
Semiconductors are used in microprocessors, memory chips, and other computer components. They are critical components for the operation of computers, servers and other devices.

TELECOMMUNICATIONS AND NETWORKS
They also have applications in communications systems, including wireless, fiber optic, and satellite communications. These devices enable high-speed data transmission and efficient processing.

ENERGY AND POWER
Integrated circuits are also key in power electronics, such as inverters and converters, critical for energy storage and conversion. They are also used in renewable energy systems such as solar panels and turbines.

TRANSPORT
They are essential for engine control units, anti-lock braking systems and safety systems. They are also used in avionics and aerospace systems.
AREAS OF APPLICATION OF SEMICONDUCTORS AND CHIPS

CONSUMER ELECTRONICS
We also find integrated circuits in consumer electronic products, including smartphones, televisions and video consoles. They are used to enable advanced features and to improve the performance of these devices.

INDUSTRY
Chips and semiconductors are present in a wide range of industrial applications, such as process control, robotics and automation. They are also used in the manufacture of equipment and machinery.

HEALTH TECH
The application of chips and semiconductors in medical devices, biomedical sensors, imaging devices, implants and electronic record systems has revolutionized the healthcare sector, enabling more accurate diagnoses, more effective treatments, as well as better management of medical information.
Examples of activity I

- Design of specific domain architectures for computing systems energy efficient.
- Creation of autonomous devices for detection and release: assembly of biomedical systems for diagnosis and therapy.
- Development of algorithms for the numerical resolution of linear systems of equations in order to carry out simulations specific to computational fluid dynamics (CFD) and heat transfer (HT).
- Energy management in collaborative urban micro-grids.
- Design of accelerators based on RISC technology for the next generation of computers.
- Study and development of ultra-fast optical sensors for three-dimensional metrology of surfaces.
- Development of low-dimensional chalcogenide-halide mixed compounds by physical routes for applications in tandem photovoltaic devices.
Examples of activity II

- Development of devices assisted by automatic deep learning for high radio frequency efficiency.
- Development of materials and components for photovoltaic thermionic hybrid devices.
- Integration of advanced CMOS-MEMS for new systems millimeter scale generation.
- Development of semi-transparent photovoltaic solutions that can be integrated into buildings.
- Development of the next generation of instrumentation to characterize the surface-subsurface interface in planetary exploration: wind sensors for Mars and probes for regolith.
- Manufacture of photodiodes for avionics applications.
- 2D/3D simulation of back contact silicon solar cells.
Through the research groups distributed by its Schools and Faculties, the UPC has facilities and resources to provide its own services, in the areas of diagnosis, advice, development, demonstration, training, promotion and support to industry, the public sector and civil society in the promotion and deployment of semiconductors and chips.
UPC RESEARCH GROUPS IN SEMICONDUCTORS AND CHIPS

- **AcaPE** → Advanced Control and Power Electronics Systems
- **ARCO** → Microarchitecture and Compilers
- **CBA** → Communications and Broadband Architectures Lab
- **CIRCUIT** → Communication Circuits and Systems Research Group
- **CSC** → Components and Systems for Communications Research Group
- **EFRICS** → Efficient and Robust Integrated Circuits and Systems
- **EPIC** → Energy Processing and Integrated Circuits
- **GREP** → Power Electronics Research Group
- **HIPICS** → High Performance Integrated Circuits and Systems
- **IMEM-BRT** → Innovation in Materials and Molecular Engineering – Biomaterials for Regenerative Therapies
- **IS2** → Intelligent Sensors and Integrated Systems
- **MNT** → Group of Micro and Nano Technologies for Solar Energy
- **QinE** → Low Power Design, Test, Verification and Security Ics
- **CRAAX** → Advanced Network Architectures Lab
SPECIFIC RESEARCH CENTERS
UPC

CD6
Centre for Sensors, Instruments and Systems Development

IDEAI-UPC
Intelligent Data Science and Artificial Intelligence Research Group

PERC-UPC
Power Electronics Research Centre

SSR-UPC
Smart Sustainable Resources
COLLABORATION WITH COMPANIES

- Albora Technologies SL
- HiSilicon Technologies Co. Ltd, Advantest Corporation, Siemens AG, FormFactor Inc, Infineon Technologies AG, Synopsys Inc
- Huawei Technologies Co. Ltd
- ideaded SL
- Imagination Technologies Ltd
- Kerafit SA
- Microsoft Corporation
- Nanusens SL
- Nec Labs GmbH
- Qorvo Inc:
  - Semidynamics Technology Services SL
  - Software Radio Systems Ltd
  - Solar Memes Technologies SL
  - Virtual Open Systems SAS
- Yocto Technologies SL
In this document are considered excellence projects those in which:

- The scientific process is rigorous and complex with high quality standards.
- They are strategic and tractors.
- They acquire a commitment to both social aspects and to great scientific and socioeconomic impact.
- They have repercussions on the territory.
- They comprise the different entities participating in the quadruple helix, so that the projects remain multidisciplinary.

The UPC excellence projects are financed by various programs, such as the State Plan or Horizon Europe.
WiPLASH - Architecting More Than Moore – Wireless Plasticity for Heterogeneous Massive Computer Architectures

The WiPLASH project aims to initiate an on-chip wireless communication plan that offers architectural plasticity, reconfigurability, and adaptability without sacrificing generality or efficiency. The project focuses on establishing solid experimental foundations for wireless on-chip communication, including functional integration at the unit level and technological aspects.

UPC research group involved: CITCEA-UPC
**SCRAMBLE - Turbulence-On-a-Chip: Supercritically Overcoming the Energy Frontier in Microfluidics.**

The overall goal of the SCRAMBLE project is to overcome the microfluidic frontier by:

I. discovering the fundamentals of turbulent flow induction in microchips using high-pressure supercritical fluids, the discovery of critical conditions to drastically improve and control mixing and transfer processes,

II. designing, manufacturing and testing of a first disruptive series of on-chip turbulence prototypes to transfer power with a hundredfold performance improvement over standard microsystems.

In the medium and long term future, the proposed technology could enable the efficient miniaturization of thermodynamic cycles for power generation, the reconceptualization of the next generation of computer processors based on very powerful microfluidic-based cooling, and the adoption of new microfluidic solutions in fuel cells for transport and propulsion.

*UPC research groups involved: Departament d’Enginyeria Electrònica*
The WINC project envisages a revolution in computer architecture made possible by the integration of wireless networks within computer systems and Artificial Intelligence. The main hypothesis is that terahertz wireless technology will lead to at least a tenfold improvement in the speed, efficiency and scalability of both quantum and non-quantum systems.

With a transversal approach, WINC aims to validate the hypothesis:

I. revealing the fundamental limits of wireless communications within computing packages,
II. developing antennas and protocols that operate close to these limits while meeting the strict constraints of the scenario, and
III. developing radically new architectures that translate the unique benefits of wireless vision into order-of-magnitude system-level improvements.

UPC research groups involved: Departament d’Arquitectura de Computadors
The QUADRATURE project aims to develop scalable quantum computing architectures using distributed and interconnected quantum cores via quantum-coherent qubit state transfer links and an integrated wireless interconnect.

The goals include achieving microintegrated qubit state transfer of all RFs, classical wireless data transfer, developing protocols for a quantum coherent integrated network, implementing scalable architectural methods, and demonstrating improved performance.
ComplexData – Experiments and data analysis tools to characterize and forecast the output signals of complex systems

ComplexData was born with the purpose of overcoming the limitations of traditional industrial systems and further improving the performance of power converters. The aim of this project is to demonstrate:

1. the feasibility of implementing a new compact and high-performance device based on a series of switching cells formed by a single power transistor with anti-parallel diode, with a single nominal voltage, plus auxiliary circuits, and
2. that this new device can be used as a building block to implement any desired power conversion over a wide voltage and current range.

UPC research groups involved: DONLI
The RHODaS project aims to develop disruptive power converter topologies using new semiconductor materials as well as cutting-edge digital technologies to improve architecture efficiency, power density, reliability, cost and sustainability.

In addition, multidisciplinary approaches to integrated motor drive (IMD) modular power electronics and eco-design considerations are addressed to create compact solutions that can be integrated into a wide range and heavy-duty vehicles, allowing these electric vehicles to be more sustainable and autonomous throughout the life cycle of their components.

UPC research groups involved: MCIA
SOME ARTICLES (sorted by Journal Impact Factor)


Prades, I. [et al.]. Does Sb2Se3 admit nonstoichiometric conditions? How modifying the overall Se content affects the structural, optical, and optoelectronic properties of Sb2Se3 thin films. ACS applied materials and interfaces, 9 Març 2022, vol. 14, núm. 9, p. 11222-11234. https://futur.upc.edu/32870102

http://hdl.handle.net/2117/371623

http://hdl.handle.net/2117/367766

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https://futur.upc.edu/34922820

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http://hdl.handle.net/2117/351130
05

EDUCATION
EDUCATION – BACHELOR’S DEGREES

Bachelor's degree in Electrical Engineering (EEBE, ESEIAAT, EPSEVG)

Bachelor's degree in Industrial Electronics and Automatic Control Engineering (EEBE i EPSEM)

Bachelor's degree in Electronic Engineering and Telecommunications

Bachelor's degree in Materials Engineering

More information on UPC bachelor’s degrees
EDUCATION – MASTER’S DEGREES

Master's degree in Energy Engineering (linked to the InnoEnergy programme)

Master's degree in Advanced Materials Science and Engineering

Master's degree in Telecommunications Engineering (MET)

Master's degree in Engineering Physics

Erasmus Mundus master's degree in Photonics Engineering, Nanophotonics and Biophotonics (Europhotonics)

Master's degree in Automatic Systems and Industrial Electronics Engineering

More information on UPC master's degrees
DOCTORAL PROGRAMMES

- Electrical Engineering
- Electric Energy Systems
- Automatic Control, Robotics and Vision
- Materials Science and Engineering
- Electronic Engineering
- Network Engineering
RESEARCH AND INNOVATION SUPPORT SERVICE

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