instituto de telecomunicações

universidade de aveiro

language

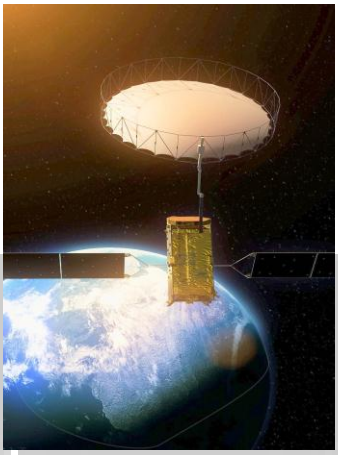
The first European GaN Experiment in Space.

The experiment regarding the ESA's AlphaBus Project was led by EFACEC with the collaboration of Instituto de Telecomunicações – Universidade de Aveiro, Portugal and with the support of FBH (Ferdinand Braun Institute, Leibniz-Institut für Höchstfrequenztechnik), Germany and ESA.

Team:

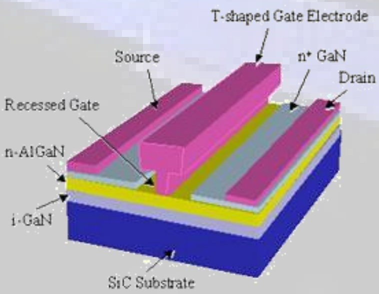
Nuno Borges de Carvalho	nbcarvalho@ua.pt
Hugo Mostardinha	hmostardinha@av.it.pt
Pedro Cabral	pcabral@ua.pt

Instituto de Telecomunicações – Grupo de Sistemas Rádio
Universidade de Aveiro - 3810-193 Aveiro - Portugal
Tel: +351 234 377 900
www.it.pt/medidas/space e-mail: nbcarvalho@ua.pt



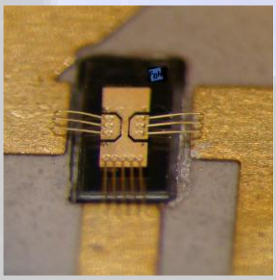
Inmarsat is a Geostationary Communication Satellite with launch date scheduled in 2012. The commercial satellite, that will provide the multimedia mobile services, will provide the true *habitat:* space for the experiment regarding new transistor technologies. **It will be the first European technology space mission to send European Gallium Nitride Transistors for outer Space**.

Launch is planned for 2012, Alphasat I-XL will be carried by an Ariane 5 ECA from the Guiana Space Center, Europe's spaceport in Kourou, French Guinea. The satellite will be built by Astrium using an Alphabus platform. The new-generation Alphasat I-XL will be positioned at 25 degrees East, and will join Inmarsat's current satellite fleet of 11 geostationary satellites to offer advanced mobile voice and data communications services across Europe, Africa and the Middle East. Its design life is 15 years.



Gallium Nitride (GaN) is currently used in terrestrial applications such as LEDs (Light Emitting Diodes) and Radio frequency applications up to 60 GHz. It provides several advantages compared to more conventional semiconductor technologies based on Silicon and GaAs (Gallium Arsenide). The most important feature is its high breakdown voltage (10-fold as compared to Si) allowing for compact high speed devices with significantly increased output power For space applications, its reduced sensitivity **to cosmic radiation is of particular importance and a decisive advantage over Si devices**.

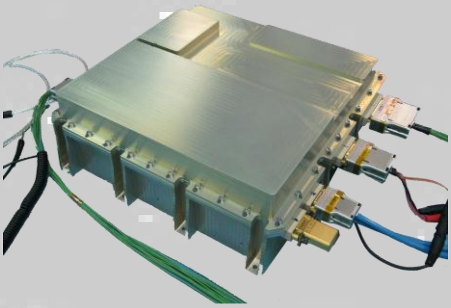
Transistors, soon to be in Space were produced by FBH (Ferdinand Braun Institute) in Germany in the frame of the ESA funded project "Performance Benchmarking of European GaN >Epitaxial Wafer Suppliers" They are in a chip circuit with 660x360nm (nanometers) connected directly to the circuit with gold wire bonding. They rely on FBH´s experience in GaN-on-SiC epitaxy and device processing. These transistors have proven to work up to 20 GHz.



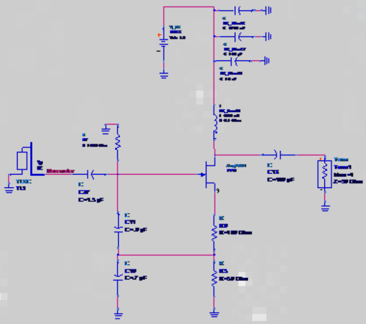
Instituto de Telecomunicações – Grupo de Sistemas Rádio
Universidade de Aveiro - 3810-193 Aveiro - Portugal
Tel: +351 234 377 900
www.it.pt/medidas/space   e-mail: nbcarvalho@ua.pt

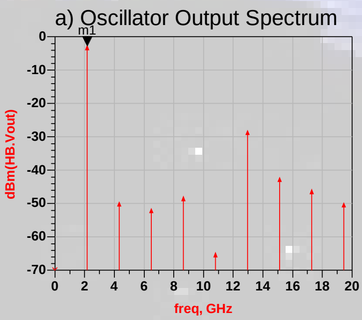
Success of this technology in space applications will have an enormous potential for future satellite industry. It will allow the replacement of current telecommunication electronic devices by devices based on GaN, with a higher power density per unit volume and thus much lighter systems.

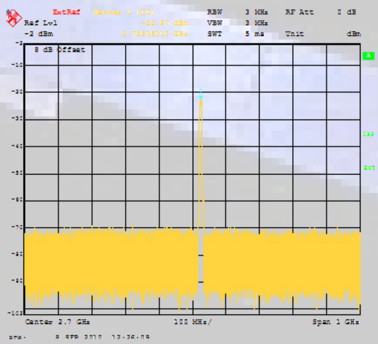
Experience on remotely measuring the output power of a microwave oscillator was used to set-up the power monitoring circuits for the satellite mission. The experiment consists of 4 oscillators. This number has finally been a trade-off between having statistical information and the physical space allocated in the experiment. Furthermore the level of cosmic radiation as well as the temperature will be continuously measured. These data will be transmitted to earth for further analysis.



Project development had several stages ranging from with the requisites definition in conjunction with ESA, project and simulation with last generation CAD tools with innumerous intermediate prototypes for practical tests. Functional and certification tests of requisites, validation and procedure validation, such as mechanical resistance, vacuum, thermal behavior and EMC (Electromagnetic Compatibility), executed in collaboration with several entities from ANACOM in Portugal to ESTEC (European Space Research and Technology Centre) in Netherlands.





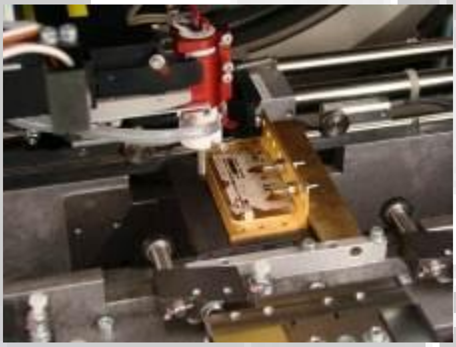


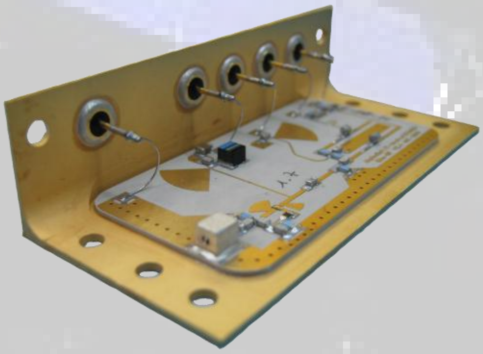
Hugo Mostardinha, Nuno Borges, Joachim Wuerfl and Costa Pinto @ Set. 2011

Instituto de Telecomunicações – Grupo de Sistemas Rádio
Universidade de Aveiro - 3810-193 Aveiro - Portugal
Tel: +351 234 377 900
www.it.pt/medidas/space e-mail: nbcarvalho@ua.pt

Prototype was designed and built facing a new challenge for academic and industrial environment imposed by strict space rules, requiring adaptation to space components and strict quality control.

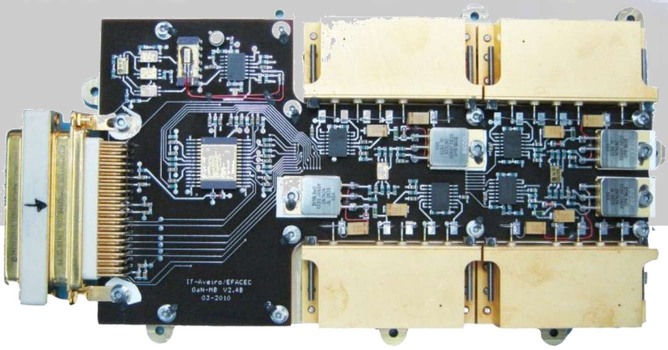
Functional testing, certification requirements and test duration standards were exceeded. This included mechanical, vacuum, thermal performance and EMC (electromagnetic compatibility) tests. These tests have been performed in partnership with several entities from the ANACON in Portugal to ESTEC (European Space Research and Technology Centre) in the Netherlands.





Oscillators focused on this experiment as well as the respective power detectors are placed in four aerospace alloy housings. These housings made of aluminum and silicon was selected according to the thermal expansion factor of all the involved materials. They are extremely light, allowing an excellent thermal dissipation of power and an excellent electric conductivity as well. This makes sure that the radio signals generated inside the housings are not interfering with the remaining satellite electronics. Signal generation and oscillator performance monitoring takes place inside the housings.

Control card will continuously monitor important oscillator parameters such as power level, heat dissipation, radiation level and temperature. It will provide a self-check of the whole electronics. It’ is furthermore prepared to shut of any part of the circuits in case of malfunction or only to ensure the energetic autonomy of the satellite.



Instituto de Telecomunicações – Grupo de Sistemas Rádio
Universidade de Aveiro - 3810-193 Aveiro - Portugal
Tel: +351 234 377 900
www.it.pt/medidas/space   e-mail: nbcarvalho@ua.pt