

## Training Opportunity for Luxembourgish Trainees

Reference	Title	Duty Station
LU-2020-TEC-EFE	Radiofrequency Technologies, Equipment and Techniques	ESTEC

Overview of the unit's mission:

The Radio Frequency Payloads & Technology Division is responsible for RF payloads, instruments and technologies for space and ground applications, including all equipment having a Radio Frequency space/ground interface and its associated Laboratories. The division supports the definition, specification and development/ procurement of laboratories for either ESA projects and technology programmes or external customers.

The TEC-EF division consists of four sections covering the following domains:

- Payloads with RF interface for telecommunication and navigation exploiting different technologies (e.g. analogue, digital, optical) including design, performance analysis tools and testing;
- Earth observation and scientific RF active and passive instruments design, performance analysis, engineering & testing up to sub-millimetre waves;
- RF equipment and technologies, including RF passive technologies, RF active technologies, vacuum electronics and High power RF phenomena.
- Time and frequency references, modelling, design tools, measurements, performance characterisation and calibration techniques.
- Antenna systems, architecture, technologies and techniques for all space applications, including space vehicle TT&C and user segment terminals, as well as antenna engineering and RF testing of antenna and material;
- Wave-propagation and interaction relevant to space communications, navigation and remote sensing, including interference and regulatory aspects;

The Division manages laboratories to test/proof concepts soundness and validation as well as to enable hands-on. They cover:

- Microwave and millimetre wave
- Payload engineering
- Antenna testing
- High power RF phenomena (Multipaction, Corona and PIM)

### **Overview of the field of activity proposed:**

Within the RF equipment and technologies Section, the incumbent will have the opportunity to work **in one** of the following disciplines, depending on her/his background:

**1) Time and Frequency (T&F):** T&F equipment and subsystems (including ESTEC's UTC lab, oscillators and atomic clocks) require extensive characterization and performance analysis in a wide range of operational and environmental conditions. The proposed training opportunity will include the development of new test beds and characterization techniques as required for the validation and verification of new equipment and subsystems for ground and space applications.

**2) RF active technologies:** Investigating RF transistor optimum loading conditions by means of load-pull is key for developing amplifiers with optimum output power and efficiency. This is particularly important for multi-beam active antennas at ka-band and beyond, where high efficiency is required. The proposed training will support the characterisation of state-of-the-art semiconductor technologies, with additional work towards high efficiency architecture concepts and MMIC designs.

**3) RF passive technologies:** Current developments in satellite systems are promising a throughput of > 1 Terabps based on state-of-the-art multibeam payloads. Depending on the architecture selected, the number of waveguide filters to be accommodated in a single platform can be very high. Strategies such as novel synthesis methods for filters or the use of dielectric materials could be used to reduce footprint and mass while maintaining good RF performance. Another key R&D area of such multibeam systems is related to true time-delay analogue/hybrid beamforming networks for active antennas. The work will consist of analysis, design, circuit and/or full electromagnetic simulations and experimental validation in breadboards.

**4) Advanced manufacturing (AM) for RF parts:** AM has matured over the last years up to a point where it becomes a promising solution for RF parts. However, the current approach is mostly replicating conventional topologies mainly oriented for classical manufacturing techniques (e.g. milling). Optimized parts can be built by defining new design and manufacturing rules dedicated and adapted for this specific manufacturing approach. The definition of manufacturing rules has to be done understanding deeply the advantages and constraints provided by the manufacturing method. This YGT opportunity aims to work in a multi-disciplinary environment with material, processes and RF aspects and will try to master some AM approaches to get optimised design and, in general, new design/manufacturing rules for RF/Microwave parts.

**5) Passive Intermodulation (PIM) prediction and mitigation techniques:** The high RF power trend of the satellite payloads impose challenging requirements for PIM on the output RF passive hardware. The main goal of the trainee activity will be the investigation of PIM effect and identification of suitable procedures to mitigate PIM generation. The trainee will study PIM sources, parameters affecting PIM (temperature, pressure, power, frequency, PIM order, etc.) and mitigation techniques, supported by measurements.

**6) High power RF breakdown under modulated signals:** Currently the prediction of high power RF breakdown is performed assuming unmodulated signals and, in most of the cases, single carrier scenarios. Recent studies and experimental results suggest that the use of modulated signal in the prediction would have a significant impact in the reduction of RF breakdown threshold. A reliable approach to predict multipactor breakdown in this case would give a unique possibility to reduce testing requirements, resulting in a significant risk, cost and schedule reduction. The proposed training will be focused on the multipactor prediction in 3D structures considering arbitrary signals (modulated, multicarrier, pulsed) and practical validation activities.

### **Required education:**

- Master-level degree in a technical or scientific discipline, preferably in Telecommunications/Electrical/Electronic/Microwave Engineering
- Knowledge of design tools such as ADS, MWO, HFSS, CST or MICIAN
- Experience in RF testing and programming e.g. MATLAB, LabView is an asset
- Fluency in English and/or French, the working languages of the Agency