# First ESA missions to use gallium nitride (GaN) - a disruptive technology for space-based payloads

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**Abstract**

**This paper gives an overview on the methodology and results obtained from performing early in-orbit demonstration and space qualification of microwave GaN technology for the European Space Agency PROBA V and Biomass missions.**

## INTRODUCTION

Gallium Nitride (GaN) is a key strategic enabling technology that has the potential to provide an order of magnitude improvement in RF output power, is inherently radiation hard and tolerates higher bus-voltages as well as higher operational temperatures. These characteristics promise to disrupt today's state of the art design for space affecting Telecommunications, Navigation, Science and Earth Observation missions.

The main challenge for space application has been to combine outstanding GaN performance figures and reliable operation. To address this situation ESA launched its GaN Reliability and Technology Transfer initiative (GREAT$^2$) in 2008, with the aim of establishing a European supply chain for the manufacture of high reliability, space compatible, GaN-based microwave transistors and integrated circuits, free from any ITAR or end-user license restrictions.

This paper shall describe the outputs of the reliability improvements achieved, culminating in the first in-orbit demonstration of a GaN X-band telemetry transmitter on PROBA V, illustrated in Fig. 1. Since 2013, this satellite has been used to map land cover and vegetation growth on a daily basis.

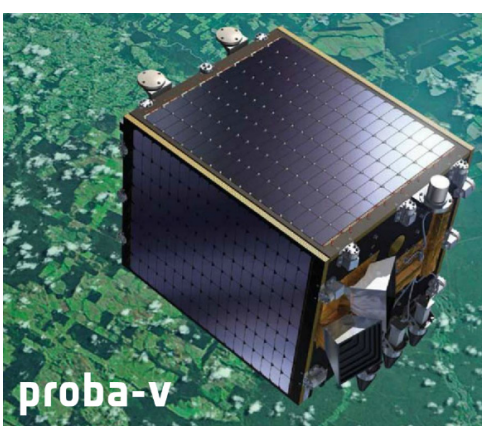


Fig. 1. Overview of PROBA V spacecraft.

As a result of this flight heritage demonstration, a decision was made by ESA to develop and qualify European, hermetically packaged, microwave power transistors for use in the Biomass P-band SAR interferometric mission, aimed at quantifying and mapping changes in the global forest carbon cycle, as illustrated in Fig. 2.

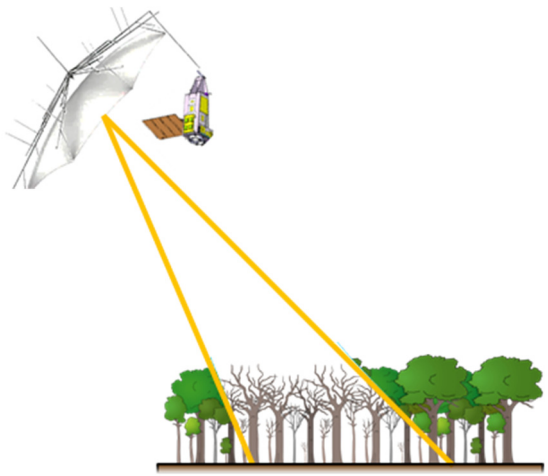

Fig. 2. Schematic of ESA Biomass mission

The mission operating requirements for PROBA V and Biomass shall be described along with the performance benefits achieved by using GaN technology for realization of (i) an X-band telemetry downlink transmitter and (ii) a 240W solid state power amplifier (SSPA) respectively. In addition, the space qualification methodology and lessons learned shall be discussed.

## CONCLUSIONS

The results obtained are an important milestone and illustrate that GaN technology has now matured rapidly and offers significant benefits for realization of future space-based payloads.

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