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KLYSTRON DEVELOPMENT FOR E.O. SENSORS: FEASIBILITY STUDY AND CURRENT DEVELOPMENT

Abstract

Synthetic Aperture Radar (SAR) instruments are essential for Earth Observation purposes since the first instrument in space back in 1978. The operational frequency has progressively evolved from L- to C-, S- and X-band and higher frequency bands are currently under study in Europe.

The key issue relevant to the SAR, is the availability of a vacuum tube amplifier delivering the several kW output power. A trade-off performed in the frame of a Ka-band High Power Amplifier (HPA) feasibility study resulted in the choice of the klystron as a baseline technology.

From a review of the existing devices for space, avionic and ground application, it resulted that there is not a technological limit in the vacuum tube technology to achieve the required performance in terms of peak power and bandwidth. Nevertheless, the development of a new vacuum tube is needed in order to develop a space high power amplifier and achieve the required challenging performances, aiming to an all-European device .

A C-band klystron development is presently running, focused on the MetOp Second Generation Scatterometer, which main characteristic and design driving requirements are:

- Carrier frequency: 5.3GHz
- Peak Power: 1.6kW < Pp < 2.95kW
- Duty cycle: 1% <dc <7%

The peak power and duty cycle shall be set at a defined value but a change of the peak power output/duty cycle must be taken into account even at a later stage of the design phase. The choice of a

klystron as vacuum tube for the power amplifier allows to get the required flexibility, since the RF peak power can be changed in the whole specified range acting on the cathode voltage while keeping good efficiency performances.

The running development is grounded on the Selex ES in space projects and their know how and heritage deriving from production tubes with technologies well proven in military airborne fighter environment. It is aimed to demonstrate the feasibility of the selected technology, through breadboarding and tests of a klystron, with the objective to reach TRL-5 at the beginning of Phase C/D, currently expected to start in the second half of 2015.

The paper presents the status of the development and the achieved results, in terms of validation of the klystron design with respect to all critical parameters (RF performances, potential multipaction issues and thermal control issues). The development plan includes a dedicated cathode life test for verification of the extended lifetime requirements.