Investigation of a RF-generator applicable for integration into an ESA-space mission

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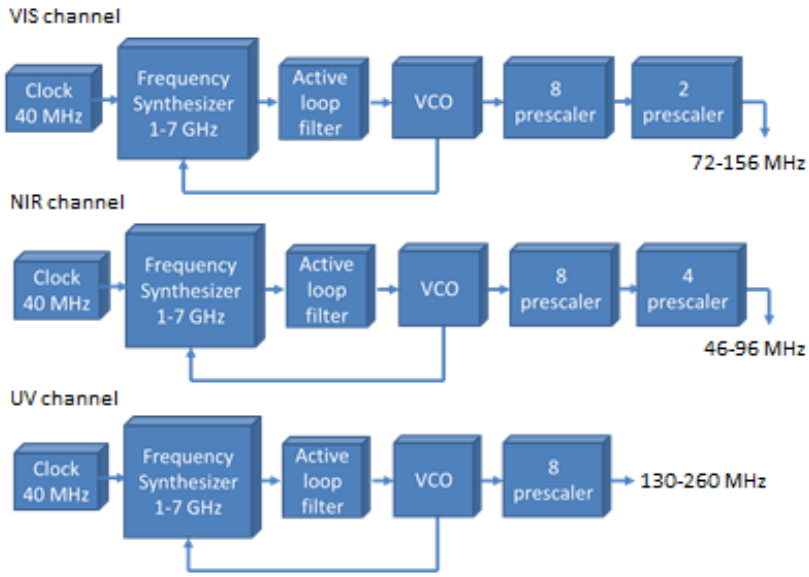
Abstract:

In the frame of an ESA-mission (European Space Agency) a RF-generator which can withstand the harsh space environment is being developed. This RF-generator is a part of the ALTIUS-instrument[1] (Atmospheric Limb Tracker for the Investigation of the Upcoming Stratosphere). The goal of the mission is to make hyper spectral images of the limb of the earth in different wavelength domains. For this, a three-channel spectral imager is implemented, measuring in the ultraviolet (250 nm to 450 nm), visible (440 nm to 800 nm) and near infrared (900 nm to 1800 nm) wavelength domains, that is bound to fly aboard a PROBA-satellite. The RF-generator will apply a RF-signal to an AOTF (Acousto-Optical Tunable Filter). The AOTF manages to convert RF-power into acoustic power which implies a diffracted beam at a different angle at the output of the AOTF as a function of the applied frequency and power[2]. This beam is focused onto a detector which performs the imaging.



In this paper a high frequency RF-generator is discussed based on a PLL (Phase Locked Loop) for the three channels (Figure). Other solutions applicable for space were investigated by the author as well[3, 4]. A merged PCB (Printed Circuit Board) is designed which houses the frequency synthesizer (the ADF4208), an in-house designed loop filter, a VCO (Voltage Controlled Oscillator) and a divide-by-8 prescaler. The selected components are compatible with the ESA standards for space-qualified components. Tests are carried out on the setup for the UV-channel because for this a relatively high frequency has to be generated in comparison with the available RF-generating techniques for space applications. Different design parameters were checked such as the spectral output, spectral resolution, output power, frequency stability and phase noise. The levels of these parameters are based on the harsh environment which the electronics has to withstand. Based on the results it can be stated that the spectral output (130 – 260 MHz) as well as the spectral resolution of 5 kHz is achieved within the requested tolerances. The output power level varies between +2.5 dBm and +3.3 dBm depending on the applied frequency. A long term frequency stability of 5 kHz within 100 seconds is achieved as well. The phase noise at
10 kHz offset is -101 dBc/Hz which is well within specification.

Currently only the UV-channel setup is breadboarded as a merged PCB. For the other channels an additional prescaler is needed (Figure). This will have an impact on the performance of the RF-generator and is under investigation.

References:

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