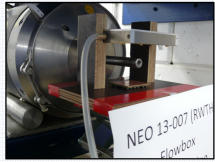
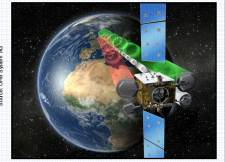


# Radiation Effects in PTFE based RF Substrates to be Used as Antennas in Geostationary Orbits

Ralf Wilke, Korbinian Schraml, Dirk Heberling – RWTH Aachen University

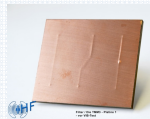
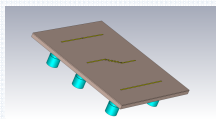
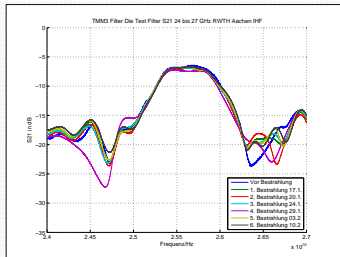


The GeReLEO-SMART payload on the German Heinrich-Hertz satellite will carry a multi layer antenna array with integrated LNA. This structure will be exposed directly to free space without shielding. PTFE based RF substrates are used. Therefore the influence of radiation in terms of permittivity and losses have to be studied. A stepwise test procedure was conducted to investigate the possible material degradation over Total Irradiation Dose (TID).

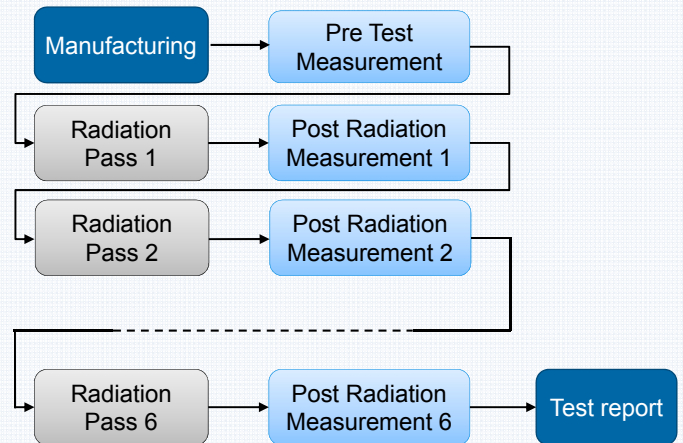


## Rogers TMM3

The test structure for Rogers TMM3 was a band pass filter with a center frequency at 25.5 GHz combined with a buried attenuator die for verification of the bonding process. The active band pass filter area has been exposed to the nominal TID.

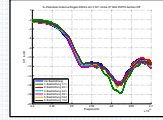
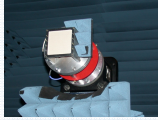
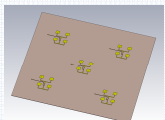
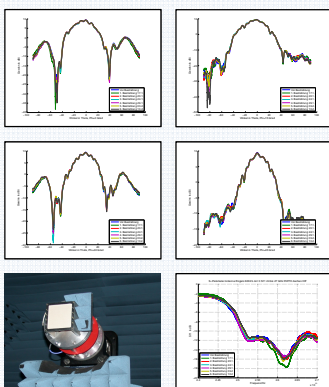


## Test Procedure



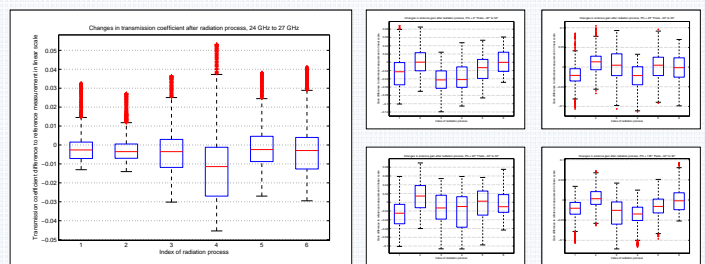
## Rogers RT 6002

The test structure for Rogers RT 6002 was a five 2x2 patch array with LHCP at 26 GHz. Farfield and S-Parameters have been evaluated at the IHF Compact Range. Only the middle patch array has been exposed to the nominal TID.



## Statistical Results

Linear differences between the pre-radiation reference and the consecutive passes of the test procedure have been evaluated in a range where GeReLEO-SMART will operate.



S-Parameters TMM3

Farfield RT 6002

## Conclusion

The radiation tests were performed according to the test procedure in 6 passes leading to a TID of 100 MRad(Air). This is a reference value for 15 years lifetime in GEO. Effects of the radiation procedure have not been found for both materials Rogers RT 6002 and TMM3. The tests were performed measuring the farfield of a 26 GHz patch array antenna and the transmission coefficient of a band pass filter at RWTH Aachen University. The radiation procedure was conducted at the TK1000A Co-60 gamma facility at Fraunhofer INT in Euskirchen, Germany in winter 2014.