

Horizon Europe project DEEP PPU

Filtering the high frequency harmonics caused by the parasitic elements of the RF harness

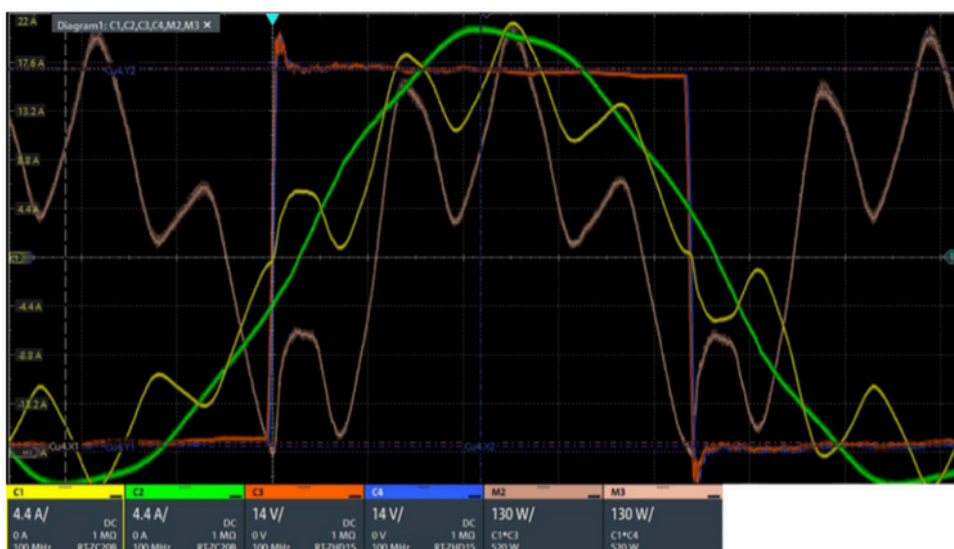
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CENTRO DE ELECTRÓNICA INDUSTRIAL

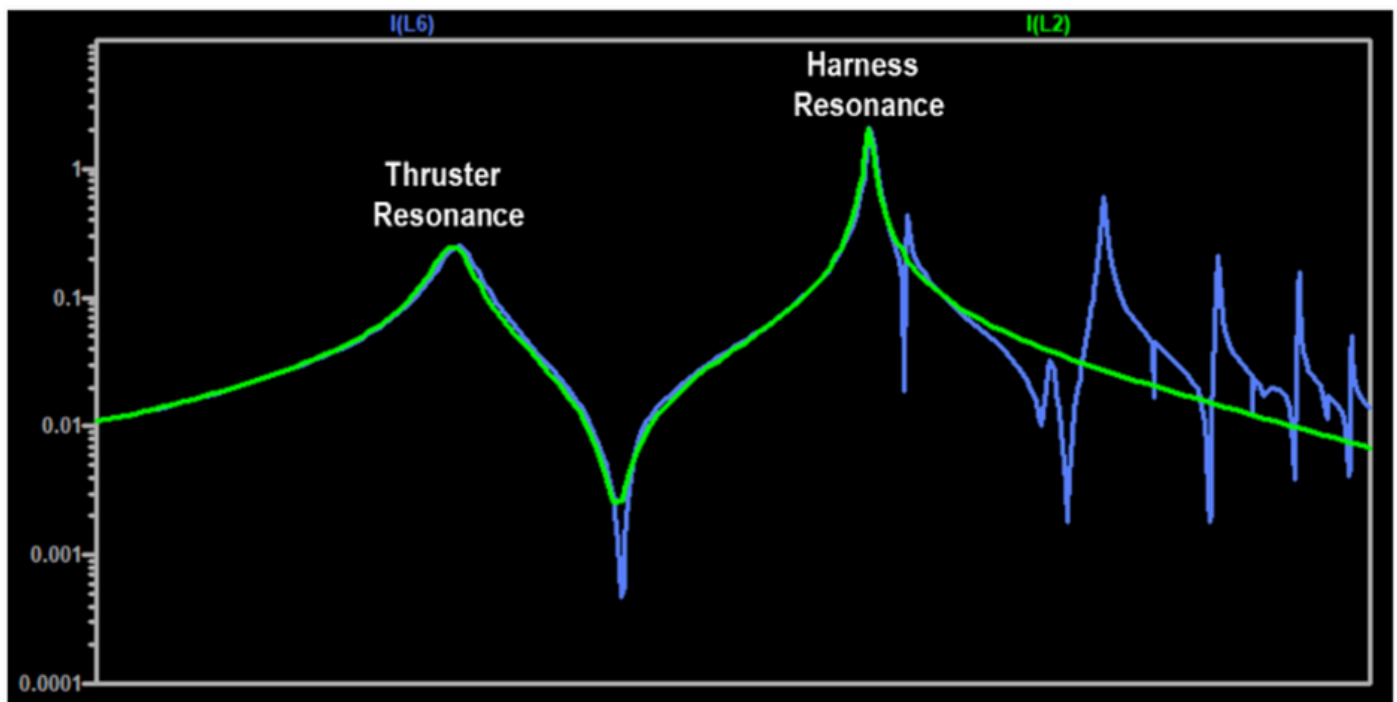
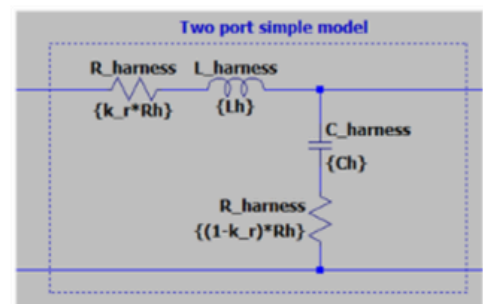
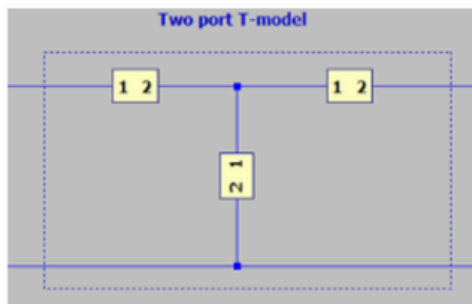
An accurate model of the harness, including its high-frequency behavior, is of great importance in designing the filter in charge of damping unwanted high-frequency harmonics caused by harness parasitics.

RFG output current (yellow) contains unwanted high frequency harmonics caused by the parasitic capacitance of the RF harness:



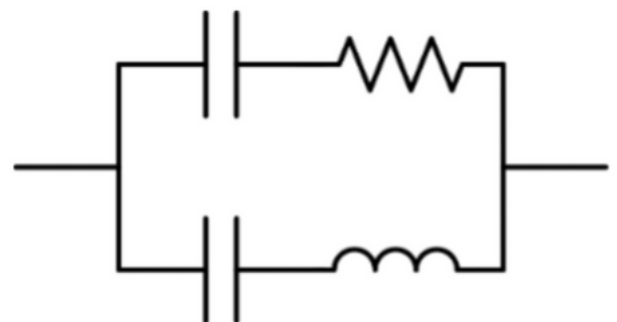
In yellow, the RFG output current, which includes the extra harmonics caused by the harness parasitic capacitance. In green, the thruster current.

To improve the behavior of the RFG inverter and reduce the losses, a precise T-model of the harness was calculated based on the real harness measurements. To be able to run simulations on the time domain, an approximated simple RLC model that only models the first harness resonance was used:



Bode plot of the RFG output current. Frequency response in blue shows the behavior of the T-model based on the real harness measurements. Frequency response in green corresponds to the simple harness model.

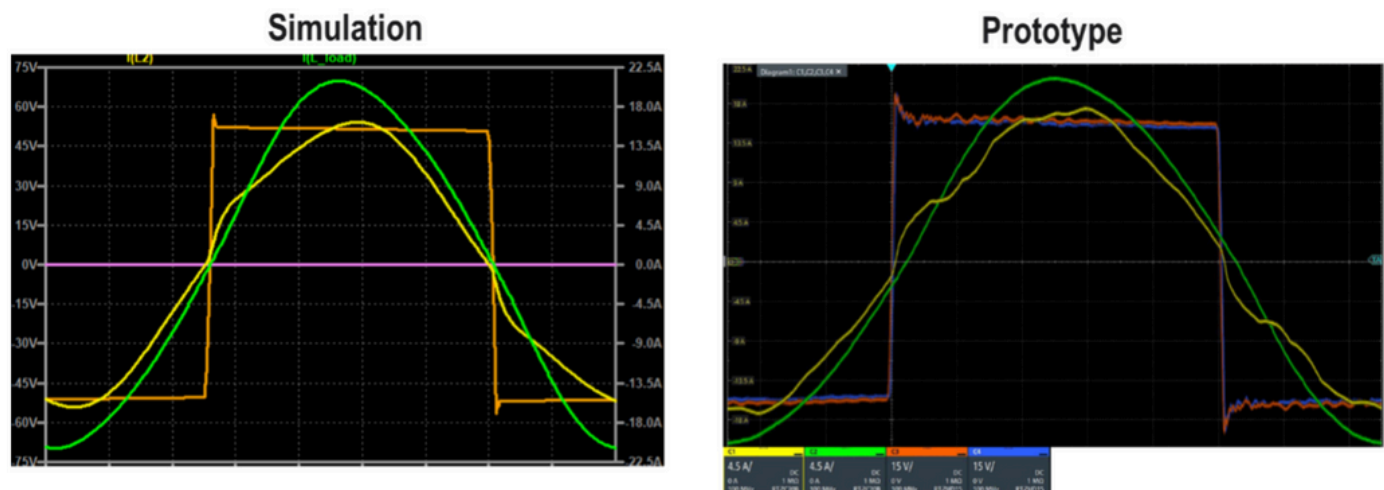
After modeling the harness, a filter to damp the high frequency harmonics was designed:



Filter added at the RFG output to damp the high frequency harmonics.

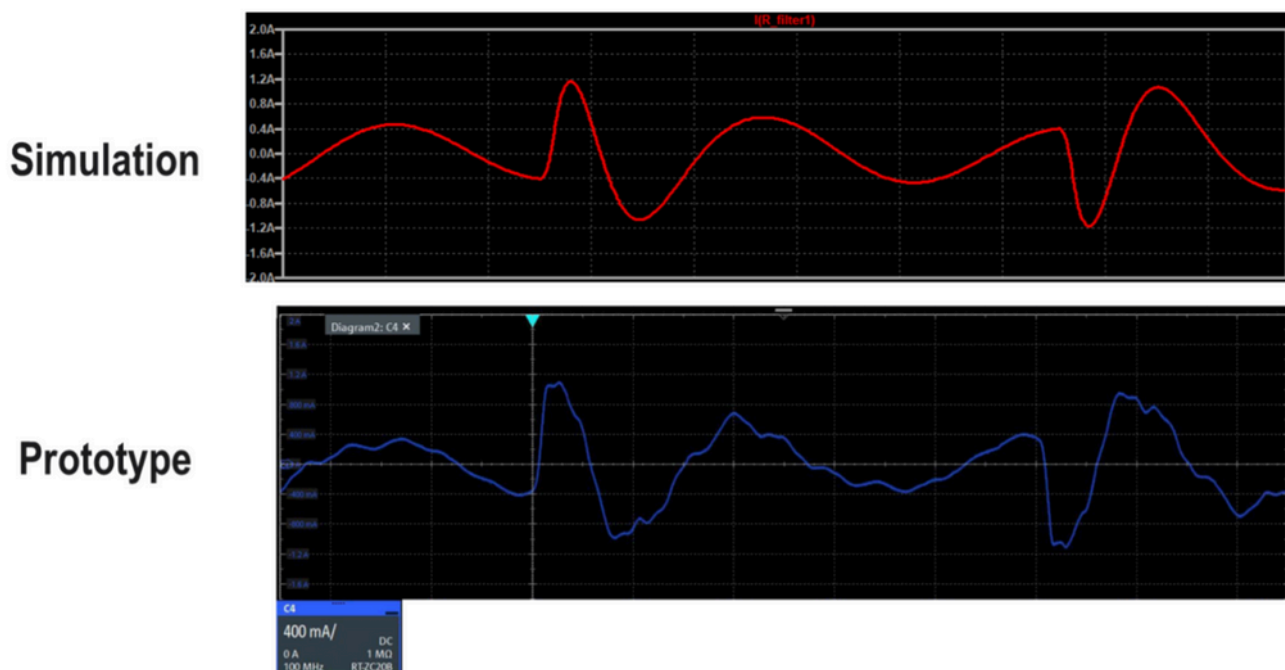
Where one path is a band pass filter for the fundamental frequency and the other is a resistor in charge of damping the high frequency harmonics, with a series capacitor that increases the impedance of the resistor path at a lower frequency, reducing the losses on the resistor.

The simulations and the prototype waveforms match closely, being the differences mainly caused because of the simple model only modeling the first harness resonance:



Comparison between simulation and prototype currents.

The filter resistor current also matches the simulation:



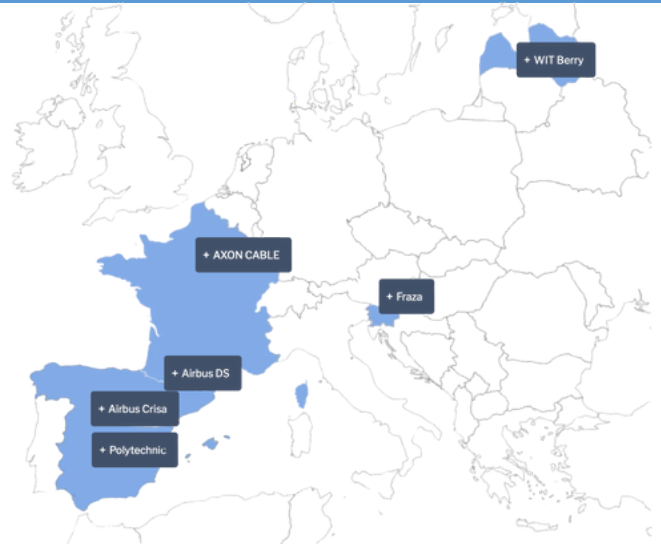
Comparison between simulation and prototype current on the filter resistor.

About project

The DEEP-PPU consortium will develop a disruptive Power Processing Unit for medium and high-power GIT. The project is a natural continuation of GIESEPP-MP, where a first step has been taken to develop a power supply for the screen grid and integrate it within the current PPU design for ArianeGroup RIT-2X thruster. The activity is focused on the improvement and optimization of the power electronics as one of the major cost drivers of an electric propulsion system, in particular for gridded ion technology.

Project consortium

DEEP-PPU team is composed of 6 organisations. Each of the partners is responsible for a specific work package or task within the project. Most of the partners have worked together before. Project coordinator - Airbus Crisa.



Airbus Crisa

Airbus Crisa
Project coordinator & PPU
www.crisa.es

AIRBUS

Airbus DS
Responsible for / definition of space specific requirements
www.airbus.com



Polytechnic University of Madrid Centro de Electrónica Industrial
Responsible for Radiofrequency Generator electronics
www.cei.upm.es



AXON CABLE
Responsible for interconnection of systems / Manufacturer for space harness assemblies
www.axon-cable.com



WIT Berry
Responsible for communication and dissemination activities
www.witberry.eu



Fraza
Responsible for expertise in magnetics design
www.fraza.si

Competitive advantages proposed by DEEP-PPU

DEEP PPU team's proposed solutions stands out with significant mass and cost reduction compared to the existing solutions on the market. It aims to strengthen the EU's space sector competitiveness in the international market and secure the autonomy of supply for critical technologies and equipment.

50%
Cost reduction

30%
Mass and volume reduction



The integration of the RFG unit within the PPU



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