

FEEP Dynamic Characterization with Flight-Standard Power Control Unit

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This paper presents the results of the first field emission thruster performance characterization test with a flight standard power control unit designed to fulfill the stringent requirements of new scientific drag-free missions. The thruster, a 5-mm slit field emission thruster operated with cesium, was driven in open loop by controlling the bean current. The results exceeded expectations by demonstrating a thruster/electronics transient response better than 5 ms (step thrust 10 μ N), bandwidth in the order of 400-800Hz along the thrust range (2 μ N ~150 μ N), and good tracking of the DC thrust also during switch-on conditions. The measurements confirm the adequacy of the current control strategy adopted for thrust control and in general of the PCU design.

Nomenclature

<i>BB</i>	=	Breadboard
<i>DFACS</i>	=	Drag Free Attitude Control System
<i>ESA</i>	=	European Space Agency
<i>FEEP</i>	=	Field Emission Electric Propulsion
<i>PCU</i>	=	Power Control Unit
<i>TRP</i>	=	Technology Research Program

I. Introduction

DRAG-FREE missions for fundamental physics are the new challenging frontier of space science. The unprecedented spacecraft control needed for the scientific measurements require the use of new propulsion systems capable of very low thrust finely controllable in the μ N range. The most imminent of these missions are the ESA/NASA mission LISA Pathfinder (LISA demonstrator) and the CNES/ESA mission MICROSCOPE¹. Both projects have entered Phase B. ESA is investing in the research and development of future μ N-propulsion technologies through the Technology and Research Program and the science Core Technology Program². The LISA demonstrator, LISA Pathfinder (was SMART-2), will be the flight test-bed for several of these new technologies. It is anticipated that several future missions (for instance the ESA missions LISA, GAIA, Darwin and Hyper) will need low thrust and very high precision proportional propulsion systems to allow the spacecraft to fly either in a

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