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Krejci, D. et al. (2019): JoSS, Vol. 8, No. 2, pp. 881–893  
(Peer-reviewed article available at [www.jossonline.com](http://www.jossonline.com))



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# Full Performance Mapping of the IFM Nano Thruster, Including Direct Thrust Measurements

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## Abstract

The IFM Nano Thruster is a Field Emission Electric Propulsion (FEEP) system using Indium as propellant. The core element of this propulsion technology is a passively fed, porous ion emitter consisting of 28 sharp emitter tips. Using differential biasing of the emitter and extractor electrodes, the IFM Nano Thruster can operate over a wide range of specific impulse from 2000 to 6000 s and beyond. At a total input power of 40 W, including heater for propellant liquefaction and neutralization to maintain neutral spacecraft potential, the IFM Nano Thruster can provide up to 350  $\mu\text{N}$ . This work presents a test campaign conducted at the ESA Propulsion Laboratory (EPL), located at ESA ESTEC. Direct thrust measurements obtained on two thrusters are compared to analytical thrust models. Full performance envelope mapping, including direct thrust measurements, were performed for both thrusters, and a comparison to modelled performance envelope is presented herein, including a discussion of the major emitter parameters concerning their impact on the performance envelope.

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## 1. Introduction

As the maturity and utility of small spacecraft platforms and missions increases, the number of missions including propulsion systems increases, enabling more complex missions, such as significant orbit transfer from the deployment orbit, constellation maintenance, formation flight, and deorbiting (Krejci,

2018; Lemmer, 2017; Selva, 2012). In addition, propulsive capabilities can be used for mission extension in low-Earth orbit (LEO) and high-total-impulse propulsion can enable interplanetary missions (Spangelo, 2015). Envisioned mission applications include high-temporal-resolution Earth observation and telecommunication network applications. The liquid metal

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Publication History: Submitted – 12/24/18; Revision Accepted – 06/28/19; Published – 10/10/19