ENPULSION

NANO R³

FIELD EMISSION ELECTRIC PROPULSION (FEEP)

The *ENPULSION NANO R³* is the next-generation FEEP system based on the flight-proven success story that is the *ENPULSION NANO* (formerly: IFM Nano Thruster). Incorporation of lessons learned from a large number of acceptance test campaigns and in-orbit performance verifications led into an updated electronics design, thermostructural concept, and software functionality. The resulting product – the *ENPULSION NANO R³* – features increased reliability, radiation tolerance, and environmental resilience.

RAD-TOLERANT ELECTRONICS

All EEE components of the *ENPULSION NANO R³* are procured in **lot-controlled batches**. Selected sets of these batches are subjected to radiation testing, so that each thruster can be traced back to a fully representative qualification model. EEE components were selected and integrated to be more tolerant to TID and SEE.

FLIGHT HERITAGE

The *ENPULSION NANO R³* is an updated version of the space proven *ENPULSION NANO* with **more than 100 units in space***. It is directly building on its heritage, leveraging the proven design and component selection.

*as per March 2022

PROTECTIVE CASING

The thruster is assembled into a protective casing that **shields the electronics** from the hazardous space radiation environment, **facilitates handling** during integration, and allows **side mounting**.

VERSATILE PERFORMANCE

Thrust can be controlled through the electrode voltages, providing **excellent controllability** over the full thrust range and a low thrust noise. Due to the efficient ionization process, the *ENPULSION NANO R³* can provide a higher specific impulse than any other ion propulsion system currently on the market.

SAFE AND INERT SYSTEM

The *ENPULSION NANO R³* contains **no moving parts** and the indium propellant is in its solid state at room temperature. Avoiding any liquid and reactive propellants as well as pressurized tanks significantly simplifies handling, integration, and launch procedures.

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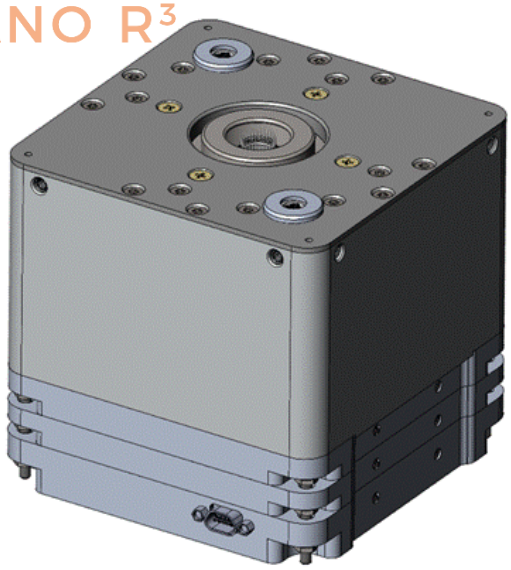
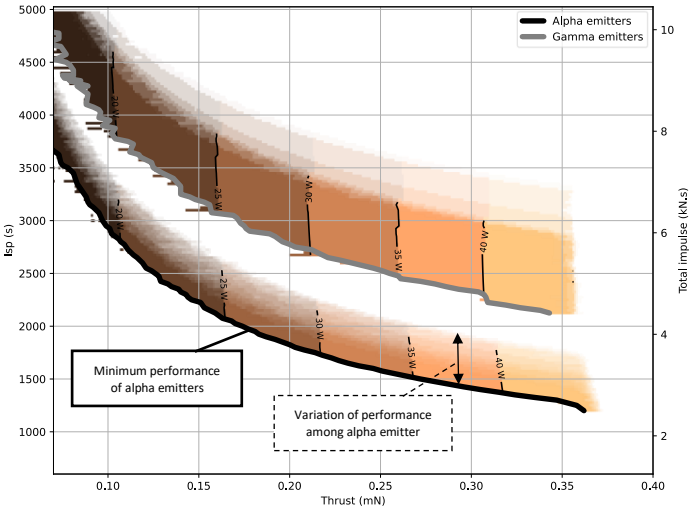


PROPERTIES AND PERFORMANCE

While the required power to operate the *ENPULSION NANO R³* starts at around 15 W, at higher power levels one can choose between high-thrust and high-specific-impulse operation. The *ENPULSION NANO R³* can operate at an I_{sp} range of 1,500 to 5,000 s.

At any given thrust point, higher I_{sp} operation will increase the total impulse, while also increasing the power demand. The thruster can be operated along the full dynamic range throughout the mission. This means that high I_{sp} and low I_{sp} manoeuvres can be included in a mission planning as well as high-thrust orbit manoeuvres and low-thrust precision control manoeuvres.

DYNAMIC THRUST RANGE [1]	10 TO 350 µN
NOMINAL THRUST	350 µN
SPECIFIC IMPULSE	1,500 TO 5,000 s
PROPELLANT MASS	220 g
TOTAL IMPULSE[2]	MORE THAN 4,000 Ns
POWER AT NOMINAL THRUST	45 W INCL. NEUTRALIZER
OUTSIDE DIMENSIONS	98.0 x 99.0 x 95.3 mm
MASS (DRY / WET)	<1180 / <1400 g
TOTAL SYSTEM POWER	15 – 45 W
HOT STANDBY POWER[3]	4 - 7 W
COMMAND INTERFACE	RS422 / RS485
SUPPLY VOLTAGE	12 V, 28 V, OTHER VOLTAGES UPON REQUEST



Depending on available power the user can choose from any operational point - data shown is for 12 V configuration

Since the founding of the company in 2016 we have delivered to customers hundreds of thrusters, more than 100 of which are currently in space. We have, therefore, developed an empirical understanding of the intrinsic variation of the performance and parameters of emitters in these thrusters in their production process and in their application in different types of missions. This enables us, starting from January 1st, 2022, to offer you our new Emitter Selection Service which allows you to select between three distinct types of crown emitters.

- Alpha (α) emitters provide the best balance between price, performance, and guaranteed delivery times. This is the perfect solution for commercial constellation applications.
- Beta (β) emitters are the best solution whenever cost optimization is your most important driver.
- Gamma (γ) emitters are hand-picked for their guaranteed peak performance and are especially appropriate for your missions in deep space, exploration, and others where emitter output needs to be taken to extremes

[1] The ENPULSION NANO R³ can be operated at a wide range of thrust and specific impulse, depending on the power level available. The operational envelope is based on total system power including typical heater and neutralizers consumption. Performances shown above correspond to maximum thrust to power curves for different grades of emitters.
[2] Strongly depends on emitter option. See performance map for selection options.
[3] Depends on accommodation and resulting thermal environment