

ENPULSION  
**NANO IR<sup>3</sup>**

**FIELD EMISSION ELECTRIC PROPULSION (FEEP)**

The *ENPULSION NANO IR<sup>3</sup>* 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 IR<sup>3</sup>* – features increased reliability, radiation tolerance, and environmental resilience, and is configured to enable higher-thrust operating points.



**RAD-TOLERANT ELECTRONICS**

All EEE components of the *ENPULSION NANO IR<sup>3</sup>* 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 IR<sup>3</sup>* is an updated version of the space proven *ENPULSION NANO* with **more than 37 units in space\***. It is directly building on its heritage, leveraging the proven design and component selection.

\*as per September 2020



**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**

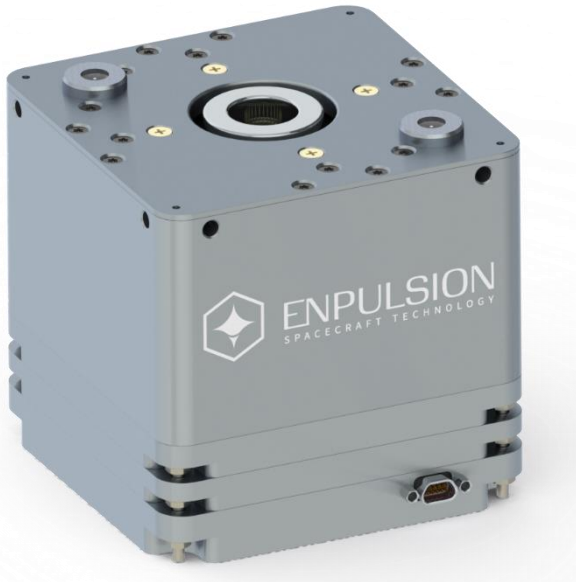
Thrust can be controlled through the electrode voltages, providing **excellent controllability** over the full thrust range and a low thrust noise. Due to the efficient ionization process, the *ENPULSION NANO IR<sup>3</sup>* can provide a higher specific impulse than any other ion propulsion system currently on the market.



**SAFE AND INERT SYSTEM**

The *ENPULSION NANO IR<sup>3</sup>* 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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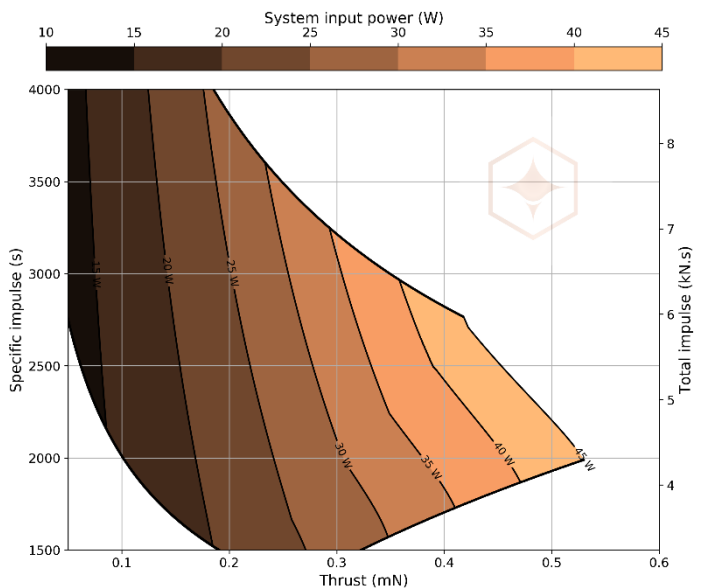


**PROPERTIES AND PERFORMANCE**

While the required power to operate the *ENPULSION NANO IR<sup>3</sup>* starts at around 8 W, at higher power levels one can choose between high thrust and high specific impulse operation. The *ENPULSION NANO IR<sup>3</sup>* has been configured to enable thrust values up to 500  $\mu\text{N}$ , and can operate at an  $I_{sp}$  range of 1,500 to 4,000 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                      | 10 TO 500 $\mu\text{N}$                    |
| NOMINAL THRUST                            | 500 $\mu\text{N}$                          |
| SPECIFIC IMPULSE                          | 1,500 TO 4,000 s                           |
| PROPELLANT MASS                           | 220 g                                      |
| TOTAL IMPULSE                             | 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)                          | <1200 / <1420 g                            |
| TOTAL SYSTEM POWER                        | 8 – 45 W                                   |
| HOT STANDBY POWER                         | 3.5 W                                      |
| COMMAND INTERFACE                         | RS422 / RS485                              |
| TEMPERATURE ENVELOPE<br>(NON-OPERATIONAL) | -40 TO 95°C                                |
| TEMPERATURE ENVELOPE<br>(OPERATIONAL)     | -20 TO 40 °C                               |
| SUPPLY VOLTAGE                            | 12 V, 28 V, OTHER VOLTAGES<br>UPON REQUEST |



Depending on available power, the user can choose from any operational point. Performance model is based on heritage *ENPULSION NANO* and modified to the *ENPULSION NANO IR<sup>3</sup>* parameters.