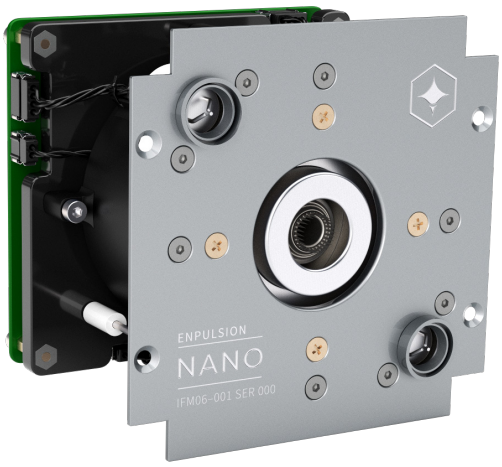
ENPULSION
NANO

FEEP | FIELD EMISSION
ELECTRIC PROPULSION

as of Jan 2024

The ENPULSION NANO, also referred to as our “heritage model”, is the most successful FEEP propulsion system to date. With more than 170 units in space as of January 2024, hundreds of propulsion systems tested and an ongoing lifetime test with more than 30,000 h of firing without degradation of emitter performance, the ENPULSION NANO is the most reliable and most well-known FEEP system on the market.

With its highest precision, excellent controllability over the full thrust range and the highest specific impulse, the ENPULSION NANO is apt for a wide range of use cases including constellation deployment, formation flight, station keeping, orbit raising, and even de-orbiting maneuvers.



FLIGHT HERITAGE

The ENPULSION NANO propulsion system was successfully verified in orbit for the first time in early 2018. By early 2024 more than 170 propulsion systems have been launched on various spacecraft.

DYNAMIC PRECISE THRUST CONTROL

Thrust can be controlled through the electrode voltages, providing excellent controllability over the full thrust range and a low thrust noise.

MATURE TECHNOLOGY

The ENPULSION NANO propulsion system is a mature technology, developed under ESA contracts for 15 years.
Hundreds of emitters have been tested and an ongoing lifetime test has demonstrated more than 30,000 h of firing without degradation of the emitter performance.

COMPACT BUILDING BLOCKS

The ENPULSION NANO is used as a compact pre-qualified building block to provide custom solutions at a commodity price and ultra-short lead times. Although building blocks are completely self-contained propulsion systems, the whole cluster can be operated as a single plug-and-play unit.

SAFE AND INERT SYSTEM COMPLIANT DURING LAUNCH

The ENPULSION NANO propulsion system contains no moving parts and the 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.

REDUNDANT NEUTRALIZER CATHODES

As the ENPULSION NANO expels an ion current of up to 4 mA, the module needs means to prevent spacecraft charging. This is achieved by the use of two electron sources acting as neutralizers. Once electrons have left the neutralizer, they will be pulled towards the positive potential of the ion plume. The PPU is able to measure and control this charge balancing electron current.

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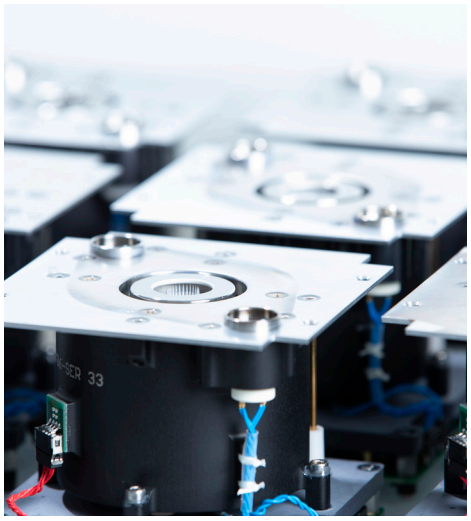
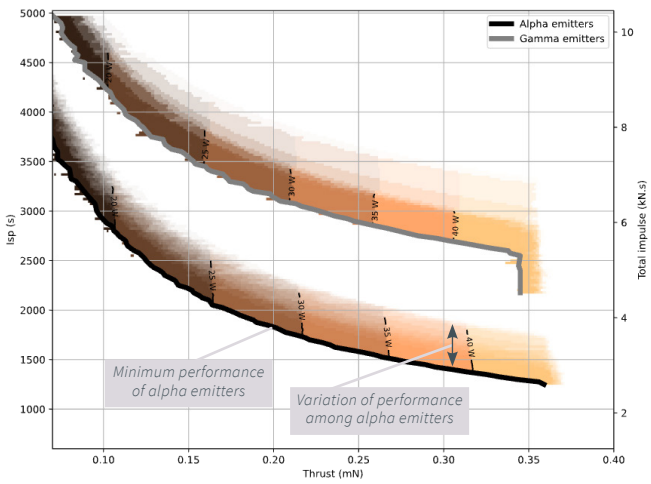


PROPERTIES AND PERFORMANCE

While the required power to fire the ENPULSION NANO starts at around 10 W, at higher thrust levels one can choose between high-thrust and high-specific-impulse operation. The ENPULSION NANO can operate at an Isp range of 1,500 to 5,000 s. At any given thrust point, higher Isp operation will increase the total impulse, while it will also increase the power demand. The thruster can be operated along the full dynamic range throughout the mission. This means that high Isp and low Isp maneuvers can be included in a mission planning, as well as high-thrust orbit maneuvers and low-thrust precision control maneuvers. The firmware of the ENPULSION NANO has been optimized with lessons learnt from in-orbit verification..



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

DYNAMIC THRUST RANGE:[1]	10–350 µN
NOMINAL THRUST:	330 µN
SPECIFIC IMPULSE:	1,500–5,000 s
PROPELLANT MASS:	220 g ±5%
TOTAL IMPULSE:[2]	MORE THAN 5,000 Ns
POWER AT NOMINAL THRUST:	40 W INCL. NEUTRALIZER
OUTSIDE DIMENSIONS:	100.0* × 100.0* × 82.5 mm
MASS (DRY/WET):	680 g / 900 g
TOTAL SYSTEM POWER:	8–40 W
HOT STANDBY POWER:[3]	3–5 W
COMMAND INTERFACE:	RS422/RS485
SUPPLY VOLTAGE: (OTHER VOLTAGES UPON REQUEST)	12 V, 28 V

** can be customized*

EMITTER SELECTION SERVICE

Since the company was founded in 2016 we have delivered hundreds of thrusters to customers worldwide, close to 200 of which are currently in space. Therefore we have 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, to offer our customers our new Emitter Selection Service which allows you to select between two distinct types of crown emitters:

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

1 The ENPULSION NANO 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.