MORPHEUS
SPACE

DESIGNED TO OUTPERFORM

Morpheus Space
The Cradle of Innovation

nanoFEEP

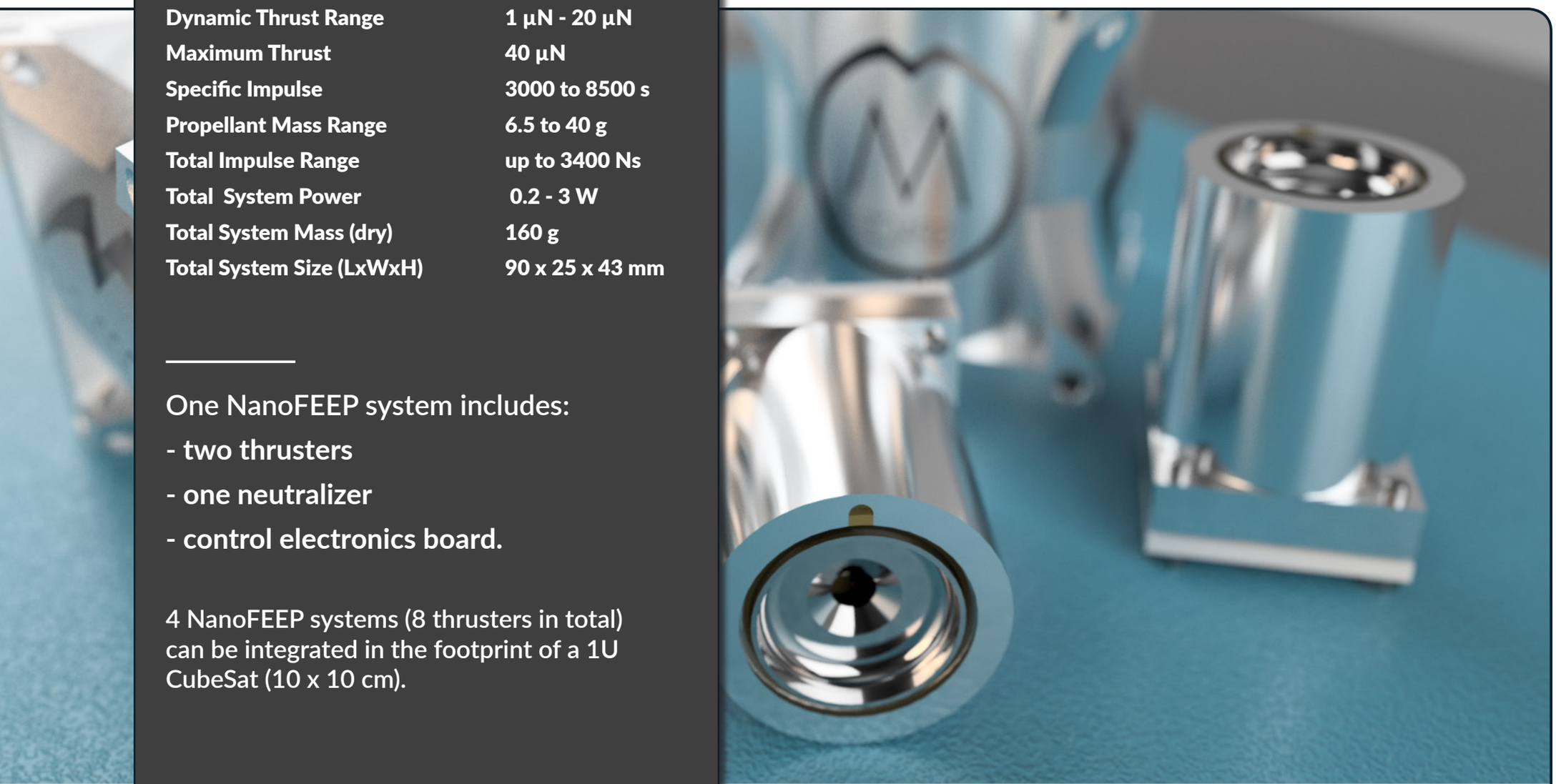
HIGHEST EFFICIENCY

Dynamic Thrust Range	**1 µN - 20 µN**
Maximum Thrust	**40 µN**
Specific Impulse	**3000 to 8500 s**
Propellant Mass Range	**6.5 to 40 g**
Total Impulse Range	**up to 3400 Ns**
Total System Power	**0.2 - 3 W**
Total System Mass (dry)	**160 g**
Total System Size (LxWxH)	**90 x 25 x 43 mm**

One NanoFEEP system includes:

- two thrusters
- one neutralizer
- control electronics board.

4 NanoFEEP systems (8 thrusters in total) can be integrated in the footprint of a 1U CubeSat (10 x 10 cm).



HIGHEST EFFICIENCY

Compared to other propulsion systems, NanoFEEP can deliver the **highest specific impulse on the market** of up to 8500 s with a power consumption as low as 1 W.

LOWEST WEIGHT

We produce by far the **lowest weight solution** among all propulsion systems currently available on the market while delivering the highest delta-V potential.

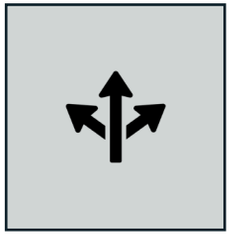
LONGEST LIFETIME

With a lifetime of over **3 years of continuous operation**, NanoFEEP is currently unmatched on the market in delivering stable continuous thrust over the lifetime of a satellite mission.

PROVEN TECHNOLOGY

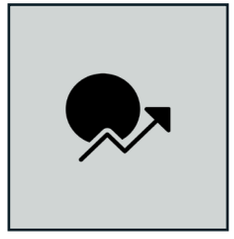
The FEEP technology has flown on **numerous successful satellite missions** for various applications including propulsion.

We developed the technology of the propulsion system during many years of research at the Institute of Aerospace Engineering of TU Dresden. At its core lies the FEEP technology specially developed for miniaturized applications using the low-melting metallic gallium propellant, as well as a chip-based neutralizer with the corresponding supply and control electronics. All of the system's components are optimized to deliver the best propulsion performance for the least amount of space, mass and necessary electrical power, which are the most valuable commodities on board of a nanosatellite. Due to the system's plug-and-play nature the integration into a satellite platform is easy and highly customizable in order to fulfill the propulsion requirements of almost all low Earth orbit missions.



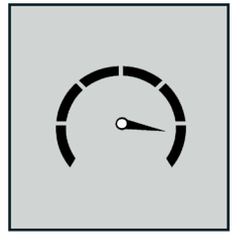
PRECISE THRUST VECTORS

Compared to other propulsion systems, MultiFEEP can generate the most complex 3D thrust profiles on the market independent of the magnitude.



WIDE THRUST RANGE

The MultiFEEP system can deliver a wide thrust range with a sub-micronewton resolution, thus making precision position control within a constellation of satellites as easy as pushing a button.



HIGHEST DELTA-V

Due to the flexibility of MultiFEEP's design, we can tailor the total impulse of the system to our customer, while allowing for a never before seen total delta-V on board of a nanosatellite.

The MultiFEEP design lies at the forefront of micro propulsion technology. We have created this unique system for satellite missions, which have challenging requirements with regard to total delta-V, maximum thrust levels and precise thrust vector control. Through the seamless combination of the independent seven thrust sources and the individually controllable seven thrust vectors, we can create highly complex 3D thrust profiles in order to fulfill demanding space mission challenges. As the underlying technology is the same as with NanoFEEP, we provide the same space mission inheritance and high level of reliability, while delivering ten-times higher thrust and a never before seen maximum delta-V potential in the world of nanosatellite propulsion systems.

multiFEEP

UNMATCHED POWER

Dynamic Thrust Range	**1- 120 µN**
Maximum thrust	**140 µN**
Specific Impulse	**2600 to 8500 s**
Propellant Mass Range	**33 - 156 g**
Total Impulse Range	**up to 13000 Ns**
Total System Power	**0.4 W - 19 W**
Total System Mass (dry)	**280 g**

Smallest Version:

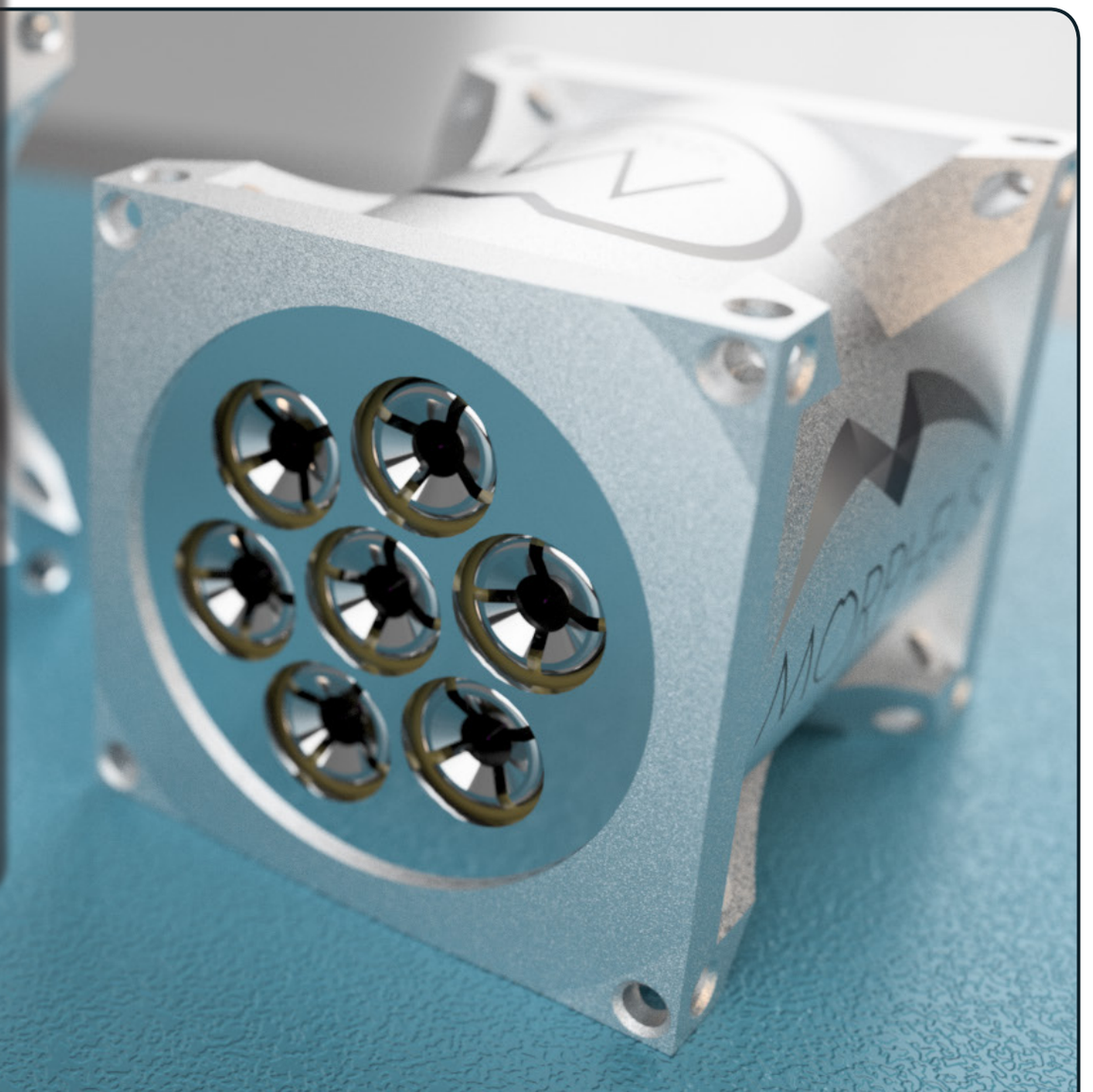
Total System Size (LxWxH)	**90 x 45 x 45 mm**

One MultiFEEP system includes:

- two thrusters
- two neutralizers
- the control electronics board.

2 MultiFEEP systems (4 thrusters in total) can be integrated in the footprint of a 1U CubeSat (10 x 10 cm).

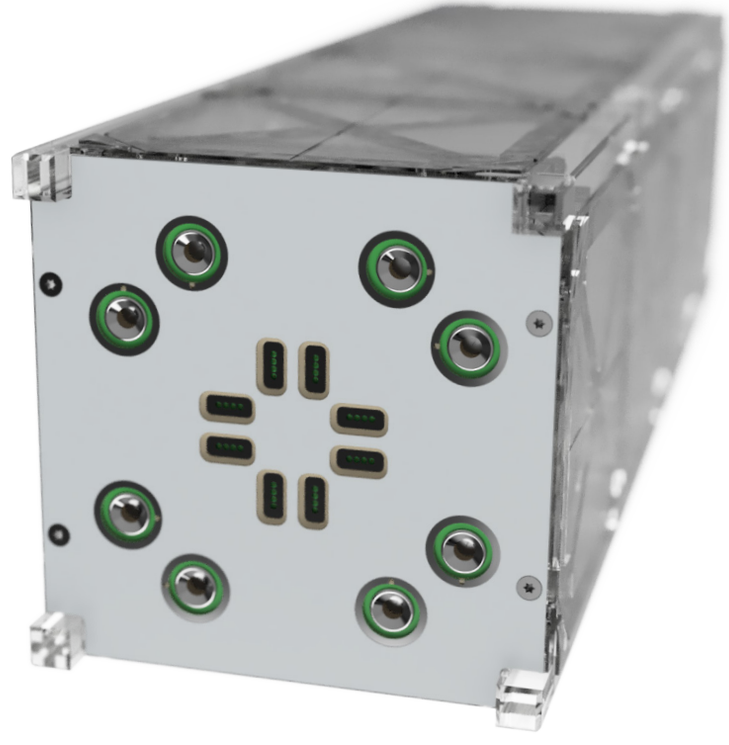
MORPHEUS SPACE



SCENARIOS

4x NanoFEEP Systems on a 3U CubeSat w/ Standard Propellant (Ga)

	Duration	Power
Drag compensation to maintain a 250 km stable orbit altitude	2.6 years	3.4 W
Duration to raise the orbit altitude from 300 km to 600 km	96 days	12 W



4x NanoFEEP Systems on a 3U CubeSat w/ New Propellant

	Duration	Power
Drag compensation to maintain a 250 km stable orbit altitude	3 years	4 W
Duration to raise the orbit altitude from 300 km to 600 km	60 days	12 W

In order to improve the performance of our propulsion systems, we have researched alternative materials to use as propellant. This resulted in a special metallic alloy that increases thrust and total impulse without a significant increase in power consumption.

2x MultiFEEP Systems on a 3U CubeSat w/ Standard Propellant (Ga)

	Duration	Power
Drag compensation to maintain a 250 km stable orbit altitude	10 years	6 W
Duration to raise the orbit altitude from 300 km to 600 km	30 days	35W

2x MultiFEEP Systems on a 3U CubeSat w/ New Propellant

	Duration	Power
Drag compensation to maintain a 250 km stable orbit altitude	11.5 years	6 W
Duration to raise the orbit altitude from 300 km to 600 km	19 days	35 W

MORPHEUS
SPACE

"A current and very serious problem in the space industry is the ever-growing space debris. To continue to use space in the future, the debris must be disposed of much faster as that is the case naturally. We, at Morpheus Space, have aligned our core values with those of the UN when we speak about a sustainable future in space and on Earth.

Our technology can be used for this purpose. With NanoFEEP, a small CubeSat who would otherwise be in orbit for 25 years can be propelled back into the atmosphere within 2 years. With MultiFEEP one can even dispose of a 6U CubeSat within 2 years, which would otherwise orbit for 1000 years as a space debris.

Morpheus Space supports sustainability in space and on Earth by opening up possibilities for the industry to optimize satellite operations."

Reach us at **contact@morpheus-space.com**
You can find us on LinkedIn, Twitter and Facebook **@MorpheusSpace**

achieve MORE with less