MULTI-MODAL ELECTRIC PROPULSION ENGINE FOR CUBESATS AND SMALLSATS

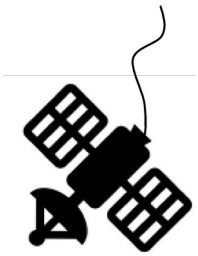
EXECUTIVE SUMMARY

WHY? - The challenge

Need for efficient propulsion and accurate attitude control with minimal form factor and operational complexity. Capability for reliable orbital control. Test technology for deep space or close proximity missions.

+ Highly integrated solution
+ Reduce launch cost with orbital control capabilities
+ Secure the operation of your constellation
+ Capability or IOD for deep space operations

Read more: Use case descriptions



WHAT? - The solution

The MEPE is able to provide two functionalities in a minimal form factor with Aurora's ARM thrusters for attitude control. And Aliena's Hall-based thruster for orbital changes. Both thrusters are fed from the same tank and propellant management system which saves both volume and mass. Closely integrated, the systems work in harmony with each other.

Read more: Product concept

HOW? – The technology in more detail

The ARM resistojet works by the pressure of the propellant and resistor is used as a heat source to gain more impulse. Aliena's engine MUlti-Staged Ignition Compact (MUSIC) Hall thruster, is an Ion engine and utilizes Hall effect for the propulsion.

Read more: Technology in more detail

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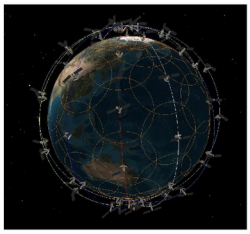
2022-04-01
APT-SM-DS-009 rev0.1

THE CHALLENGE - MEPE USE CASES

There are two main use cases for the MEPE: 1) MEPE for constellations 2) MEPE for deep space missios

MEPE for Constellations

Constellations



✓ THRUSTERS

PLASMA BRAKE

Challenges	Solution	Business case
Formation flying with minimal interference to payload operation Need for efficient propulsion and accurate attitude control. Mass manufacturing of satellites, need for modularity.	Hall-derived thruster for orbital changes and resistojet thrusters for attitude control, the MEPE is able to provide both functionalities in a minimal form factor. The system is ideal propulsion for managing constellation advanced formation flying. With MEPE, 100 kg SmallSat capable of station keeping, orbital changes and enabling attitude control.	Value : One system will take care of everything you need for propulsion for your constellation. Reduced operational complexity and size of your spacecraft. Lower launch cost with increased mission capabilities. Example: Constellation of 100 kg SmallSats capable of station keeping saving 200k€ yearly operating cost per satellite.

MEPE for Deep space missions

Deep space missions

✓ THRUSTERS

PLASMA BRAKE

Challenges	Solution	Business case
Launch cost to outside LEO are order of magnitude higher. In deep space there has to be a way to desaturate reaction wheels. Need for efficient propulsion and accurate attitude control	Hall-derived thruster for orbital changes and resistojet thrusters for attitude control, the MEPE is able to provide both functionalities in a minimal form factor. The system can be used on or off LEO as it provides propulsive attitude control. With MEPE, a 50 – 100 kg satellite can perform maneuvers requiring complex 4-degrees-of-freedom orbital control.	Value : One system will take care of everything you need for propulsion in the deep space mission. Lower launch cost with increased mission capabilities. Example: 50 kg satellite capable of Lunar orbital operations. 20 % smaller satellite which reduces launch cost by 500 k€.

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THE SOLUTION - PRODUCT CONCEPT

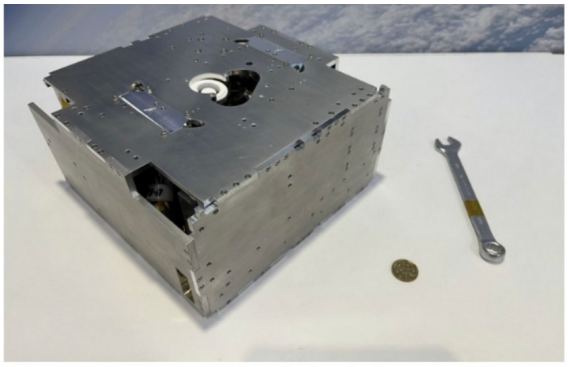
MEPE IN A NUTSHELL

With the Multi-modal Electric Propulsion Engine you can effectively control your satellite up to 150 kg mass and it works on any orbit.

MEPE brings many benefits, save your satellites space for payload and achieve more with smaller size. It brings savings on integration and lowers launch cost by allowing the control of your orbit.

Main components of the MEPE are

1. 4 Aurora ARM thrusters
2. Aliena MUSIC engine for orbital changes
3. Best of both: high thrust & high impulse
4. Highly compact (5U)
5. Integrated actuation electronics
6. Modular housing, easy to mount to any satellite



Engineering model of the MEPE

MEPE IS SAFE AND DEPENDABLE

The MEPE is inherently safe and reliable due to its simplicity. The system uses green propellant. Both systems are state of art technology and they are integrated with patience and precision.

ONE SOLUTION AND MODULAR SCALABILITY

One system will take care of everything you need for propulsion in the deep space mission. Reduced operational complexity and size of your spacecraft. Lower launch cost with increased mission capabilities.

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TECHNOLOGY IN MORE DETAIL

With Aliena's Hall-based MUSIC thruster for orbital changes and Aurora's ARM thrusters for attitude control, the MEPE is able to provide both functionalities in a minimal form factor. Both thrusters are fed from the same tank and propellant management system which saves both volume and mass. Closely integrated, the systems work in harmony with each other.

Resistojet is like a turbocharged cold gas thruster, which is the most simple and traditional propulsion. In the resistojet the propellant is heated with a resistor coil up to hundreds of degrees of celsius, enables higher flow and therefore increases the impulse up to 2 times compared to a cold gas thruster. It keeps the added components as simple as possible, and increases reliability of the system. In the MEPE there are 4 resistojets in the system.

The Hall derived Music thruster is masterpiece of Ion engines. Compact size and powerful. The high impulse is based on the exerted propellant speed, that is basically plasma shooting out of the system in the order of km / s. The system uses a magnetic field to limit the electrons' axial motion and then use them to ionize propellant, efficiently accelerate the ions to produce thrust, and neutralize the ions in the plume.

SPECS

Quantity	Value
Form factor	125 x 220 x 220 mm^3
Wet mass	~ 5 kg
Target satellite	From 12 U CubeSat to 250 kg
Degrees of Freedom	1 translation; 3 rotation
Thrusters	1x MUSIC, 4x ARM
Propellant mass	~ 1 kg
MUSIC thrust	3 mN
MUSIC Isp	~ 1000 s
MUSIC power	100 W
ARM thrust	1 mN (per thruster)
ARM Isp	~ 40 s
ARM power	4 W (per thruster)
Command	RS422
Total impulse	10 kNs
Availability	8-12 months from order