



# Innovative generator units *power the next generation of electric rocket propulsion.*

## ***Background***

Ad Astra Rocket Company (AARC) is a Houston, Texas based company developing electric rocket technology for spacecraft propulsion. The company was founded in 2005 by Astronaut Dr. Franklin Chang Díaz with the intent of commercializing his Variable Specific Impulse Magnetoplasma Rocket (VASIMR®) technology.

The power processing unit is fundamental to any electric rocket. It's the part that takes the DC power from a solar array and converts it to something that can drive the plasma.

The VASIMR® technology utilizes radio frequency power to excite and accelerate plasma to produce thrust. Two radio frequency power generators (aka. Power Processing Units or PPUs) are required, one operating at 120kW at frequencies of between 400 kHz and 1 MHz, and a second at 60kW at 6.78 MHz.

*"The Aethera power processing unit is what gave us an edge relative to our competitors whose PPUs are heavier and less efficient."*

- Dr. Franklin Chang Díaz, Founder, AARC

## Business challenges

AARC has partnered with NASA under the NextSTEP program to advance their technology to Technology Readiness Level 5 (TRL 5) which requires that the rocket as well as the power generators operate in a vacuum environment similar to space. The units must be powerful, yet small and lightweight and be unaffected by the engine's magnetic field. In order to meet the NextSTEP requirements, Ad Astra needed a power generator solution engineered with very specific characteristics for space application:

### Lightweight Design

*A lighter propulsion system adds value as it allows the spacecraft to carry more revenue-generating payload. Alternatively, a lighter spacecraft is also more mobile.*

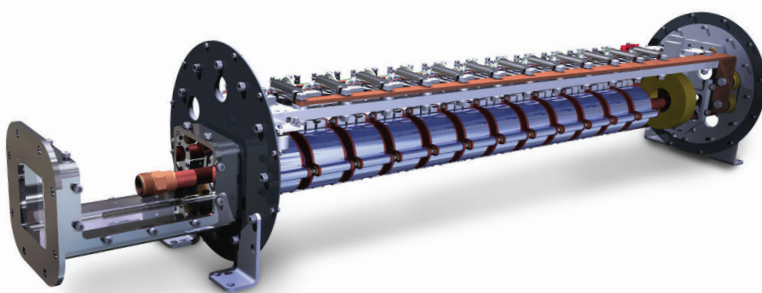
### Energy Efficiency

*If less power is wasted, engineers can reduce the size of the radiators, significantly reducing the overall mass and increasing payload capacity or simply make the spacecraft more mobile.*

### Reliability

With missions costing tens of millions of dollars, reliability is critical. Failure of the rocket's propulsion system would result in total mission failure.

Aethera was one of the few companies capable and willing to take on the challenge.



## The Solution

Aethera proposed a clean sheet design. The design incorporated a new generation of solid-state power transistors, which replaced traditional vacuum tube technology, resulting in more power output in a smaller space with improved energy efficiency. Due in part to the 98% energy efficiency, a very lightweight design was achieved with a mass of just 38kg (84lbs) capable of 120 kW at 1 MHz. This solution also modernized the control system and improved the ability to control the power.

This level of innovative thinking was impressive according to AARC, "at a high level, we were impressed with the team and the can-do attitude. Aethera looked at everything as a challenge, not a problem, all the way through."

## The Business Impact

The impact was really significant. Aethera developed a generator that achieved high power in a lightweight unit enabling AARC to advance beyond competitors in NASA trials.

- Significant weight reduction over previous technologies – 38kg (84lbs).
- In an industry where 1.0 kg per kW is considered an excellent weight to power number, Aethera reduced the ratio to roughly 0.3kg per kW.
- 98% energy efficiency reduced heat management requirements.
- 1 small unit generates 120kW.
- Competitors were using multiple units to generate 100 kW.