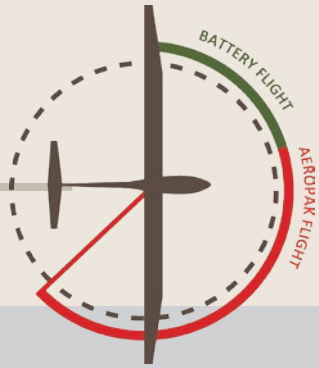
World's Lightest Fuel Cells for use in Electric UAS

AEROSTAKS 200W/500W/1000W

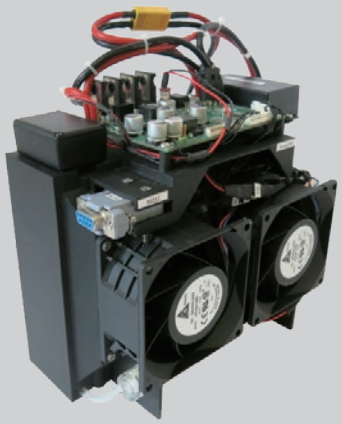
The world's lightest, highest power density PEMFC stacks



Customization is available for voltage, shape, size & power ratings

A-200 PEM FUEL CELL 200W
AST01-01

Number of cells 35
(can be changed on based on V Requirement)
Rated power .....200 W
Peak power .....220 W
Hydrogen supply voltage.....12 V
Purging valve voltage .....12 V
Blower voltage.....12 V
Reactants ..... Hydrogen and Air
Ambient temperature .....5-30 ˚C (41 -86 ˚F)
Max stack temperature .....65 ˚C (131 ˚F)
Hydrogen Pressure..... 0.5-0.6 Bar (7.3-8.7 PSI)
Humidification ..... Self-humidified
Cooling..... Air (integrated cooling fan)
Stack weight(with fan & casing)..... .570g
Controller weight 80g
Stack size (with casing .....107 X 126 X 120 mm
Flow rate at max output ..... 2.8 L/min
Hydrogen purity..... 99.999% dry H2
Start up time.....< 30s (room temperature)
Low voltage protection.....21 V
Over temperature protection.....65 ˚C
External power supply..... 25V (±1V), < 5A



A-500 PEM FUEL CELL 500W
AST02-01

Number of cells 45
(can be changed on based on V Requirement)
Rated power ..... 500 W
Peak power .....adjustable on request
Hydrogen supply voltage ..... 12 V
Purging valve voltage ..... 12 V
Blower voltage ..... 12 V
Reactants .....Hydrogen and Air
Ambient temperature ..... 5-30 ˚C (41 -86 ˚F)
Max stack temperature ..... 65 ˚C (131 ˚F)
Hydrogen Pressure..... 0.5-0.6 Bar (7.3-8.7 PSI)
Humidification ..... Self-humidified
Cooling ..... Air (integrated cooling fan)
Stack weight (with fan & casing) ..... . 1150g (±50g)
Controller weight ..... 250g (±30g)
Stack size (excl. electronics) ..... 192 x 107 x 146 mm
Flow rate at max output..... 6.5 L/min
Hydrogen purity..... 99.999% dry H2
Start up time.....< 30s (room temperature)
Low voltage protection.....22.5 V
Over temperature protection.....65 ˚C
External power supply.....28V (±1V), < 5A
Hybrid battery size/weight adjustable, depending on peak power requirement

A-1000 PEM FUEL CELL 1000W
AST03-01

Number of cells 50
(can be changed on based on V Requirement)
Rated power ..... 1000 W
Peak power ..... adjustable on request
Hydrogen supply voltage..... 12 V
Purging valve voltage ..... 12 V
Blower voltage..... 12 V
Reactants ..... Hydrogen and Air
Ambient temperature ..... 5-35 ˚C (41 -86 ˚F)
Max stack temperature ..... 65 ˚C (131 ˚F)
Hydrogen Pressure..... 0.55-0.7 Bar (7.3-8.7 PSI)
Humidification ..... Self-humidified
Cooling..... ..... Air (integrated cooling fan)
Stack weight(with fan & casing)..... 2000g (±50g)
Controller weight ..... 250g(±30g)
Stack size (excl. electronics)... 252 x 126 x 190 mm
Flow rate at max output 14L/min
Hydrogen purity..... 99.999% dry H2
Start up time.....< 30s (room temperature)
Low voltage protection..... 24V
Over temperature protection..... 65 ˚C
External power supply..... 36V (±1V)
Hybrid battery size/weight adjustable, depending on peak power requirement

AEROSTAKS are special fuel cell stack designs that are up to 10 times lighter and smaller than other Horizon fuel cells. These fuel cells are typically used in specialty applications where weight is a critical factor. They are available in three standard ratings and specifications, but can be modified at additional costs according to other nominal and peak power, or voltage requirements. Our engineering team can support you in your selection, as well as to discuss possible customization options. Please contact us at **sales@hes.com** if you have special requests.

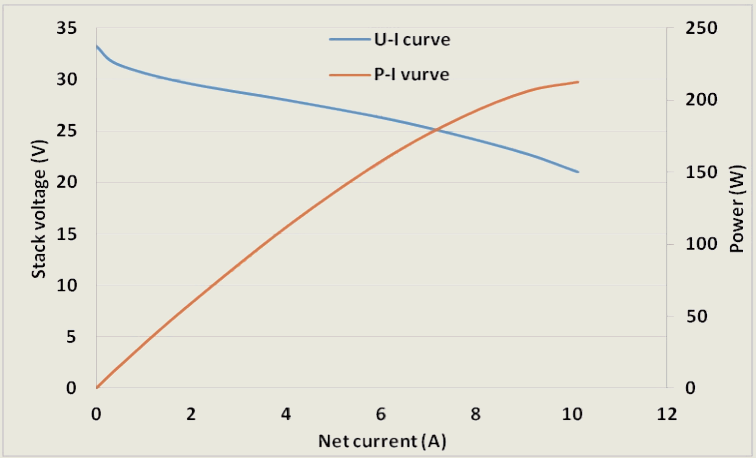
World's Lightest Fuel Cells for use in Electric UAS

A-200 PEM FUEL CELL / 200W

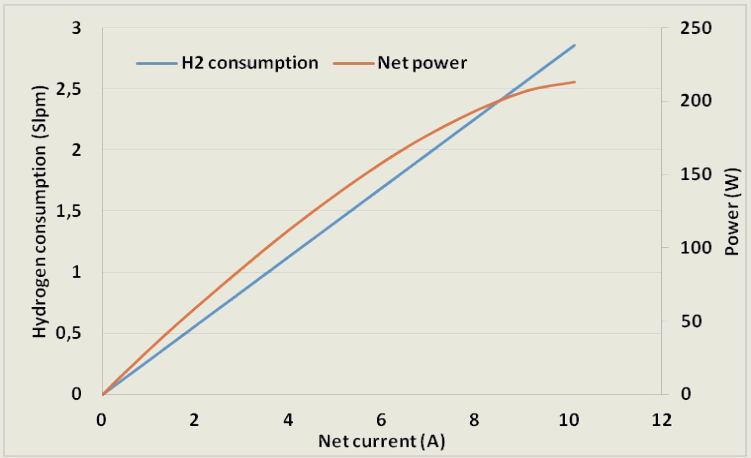
AST01-01 **Includes:**

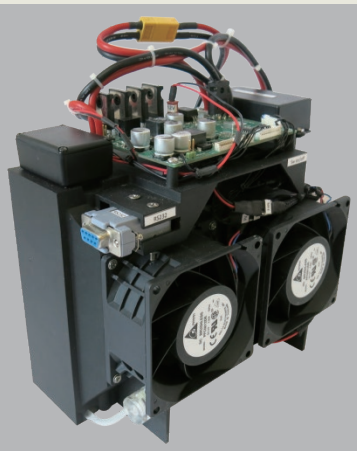
- Control electronics
- Hybrid battery card (hybrid battery charging)
- Integrated blower and casing
- Low pressure protection

AST02-01 stack performance



AST02-01 Hydrogen flow rate



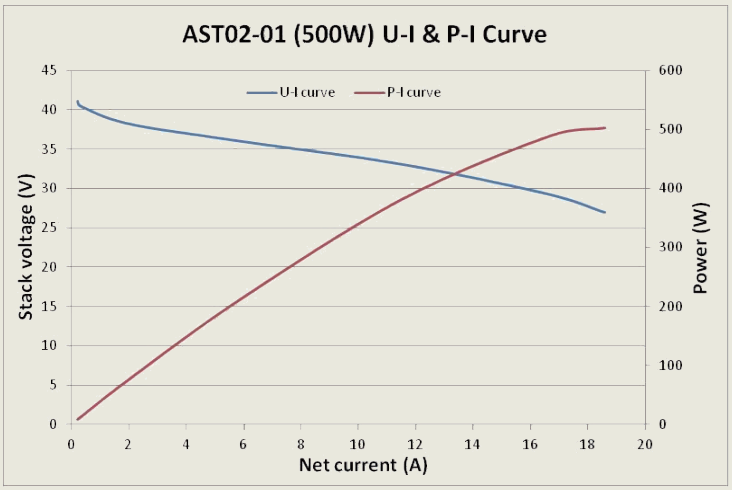


A-500 PEM FUEL CELL / 500W

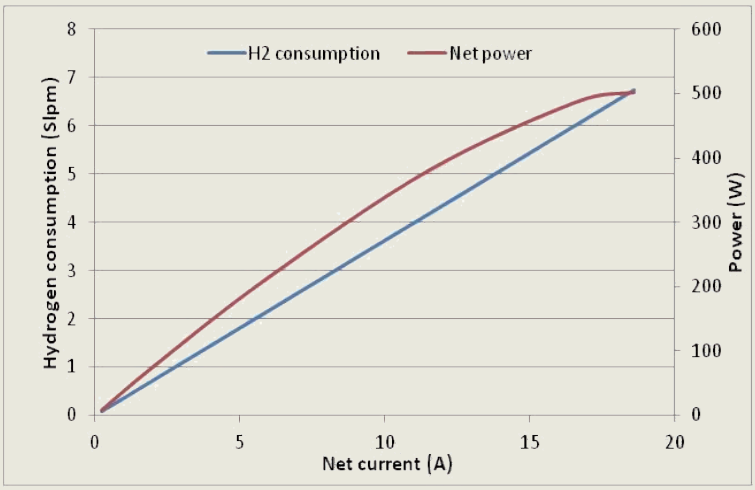
AST02-01 **Includes:**

- Control electronics
- Hybrid battery card (hybrid battery charging)
- Integrated RS232 connector
- Inlet control valve
- Integrated blower and casing
- Low pressure protection

AST02-01 stack performance



AST02-01 Hydrogen flow rate



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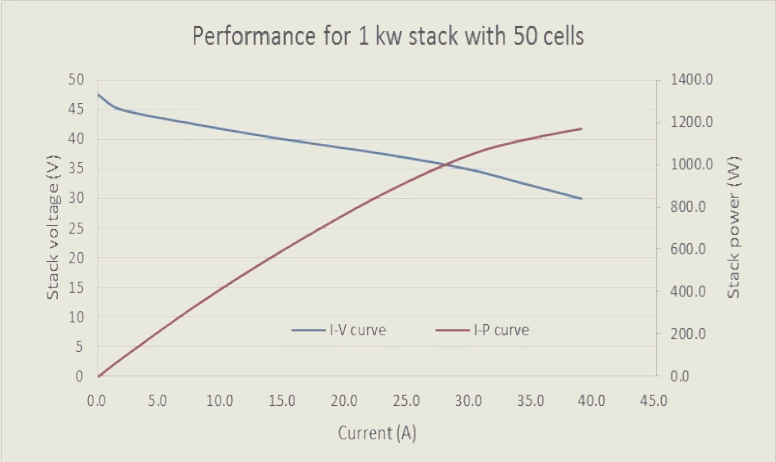
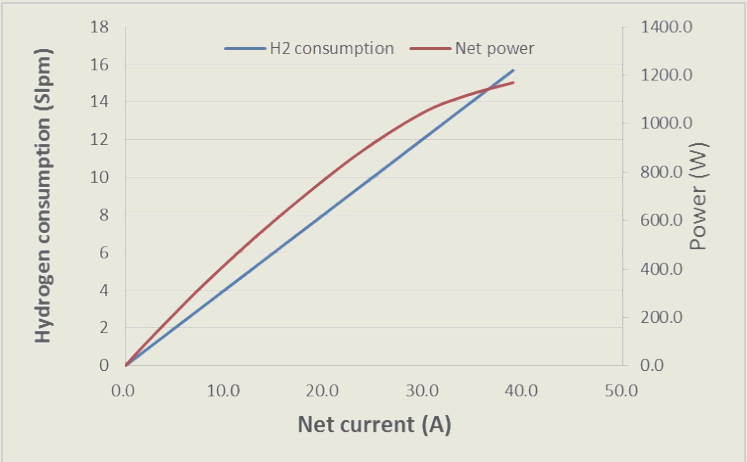


AST03-01 Hydrogen flow rate



Accessories / Hydrogen storage

Compatible carbon-fiber reinforced composite H2 vessel (0.5 to 12L) — **CCL01-01**

- Compact and lightweight *(ask for our available sizes)*
- Fast charging time
- Hydrogen charging pressure up to 300bar
- High Energy Density

Compatible 2-step Horizon pressure regulator — **APKCR01-01**

- Lightweight design
- Designed for use with hydrogen gas
- Reduces high pressure (300bar) to low consistent pressure (0.4 to 0.65bar)

HORIZON ENERGY SYSTEMS makes the world's lightest titanium grade pressure regulators able to manage several hundred bars to low output pressure hydrogen delivery to the fuel cell stack.

NEW – *real-time system interface for live diagnostics and monitoring, compatible with any device. Data via CAN, Bluetooth, IP, Serial.*

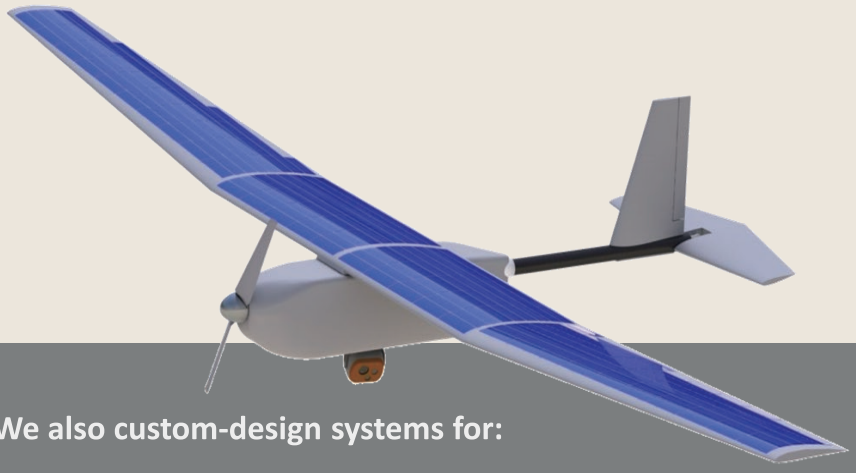
Horizon Energy Systems

www.hes.sg

World's Lightest Fuel Cells for use in Electric UAS

Custom engineering services / endurance power for unmanned vehicles

Fuel cell solutions are typically much lighter, but also take up more space than batteries. To make the most of the endurance benefits, certain adjustments need to be made to the aircraft design. We can help the scientists and engineers on your team – to develop the most optimal solution.



HES systems are scalable and can be offered in various configurations, taking into account nominal, peak, and continuous power levels, as well as duration, or other data communication and software requirements. The systems can be designed to maximize weight efficiency by reviewing the power profile of a typical flight. These are all parameters we analyze together with our clients in great detail prior to engaging on custom designs.

We also custom-design systems for:

- Mini-UAS (5-12kg TOW)
- Small Tactical UAS (12kg-80kg TOW)
- Unmanned Underwater Vehicles
- Ground Robot Vehicle systems
- Soldier Portable & Stationary Systems

Horizon Energy Systems

SMALL DRONES, FOR **BIG** JOBS.

HES is regarded as the most advanced fuel cell technology systems developer in the world, with energy densities already exceeding the 2015 performance targets set by US DOE in 2015. HES has worked under a US DARPA program in 2010 and 2011, focused on novel power solution development in the field of micro-UAVs. Following a new world record flight distance set by NASA-backed teams and DLR engineers with our ultra-light fuel cell design, Horizon Energy Systems was formed in Singapore (2009), where it established its first laboratories. From Singapore, it has developed an international customer base in the field of unmanned aerial vehicles (UAV) in civilian and military applications.

In Singapore, Horizon Energy Systems (HES) develops ultra-light, high energy density power systems enabled by fuel cells and various on demand hydrogen supply solutions. Horizon's lightweight fuel cell systems stem from its **in-cell™** water management technology which avoids the use of heavy and bulky system peripherals. The HES engineering team and field experts work together to creatively solve the most challenging energy storage challenges. HES consistently innovates to create solutions that outperform, bringing out the best of fuel cells, solar, battery and capacitor technologies in optimally balanced hybrid systems.

Global partners & clients

BOEING · Elbit Systems · INSITU · DARPA · NASA · ST Aerospace · BlueBird Aero Systems