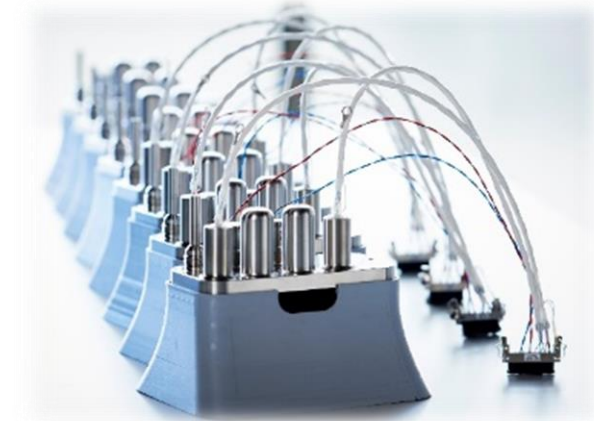


# High-Pressure Flow Control Unit (HP-FCU)

AST's High-Pressure Flow Controller (HP-FCU) can be used to provide a constant massflow to one or two devices in the low-pressure section. For that, the HP-FCU combines the functions of a two-stage pressure regulator and flow controller in one unit. The high pressure at unit inlet is measured and reduced by controlled expansion in two steps to intermediate pressures. The massflow control is achieved through precision massflow limiters.



The unit can control one or two output massflows, while the two flow-lines will be served with a fixed massflow splitting. Typically, a fixed operation point (e.g. one fixed massflow setting) is selected for the HP-FCU but a variation of massflows around the design-point is possible by different operation-parameter settings (e.g. in-orbit).



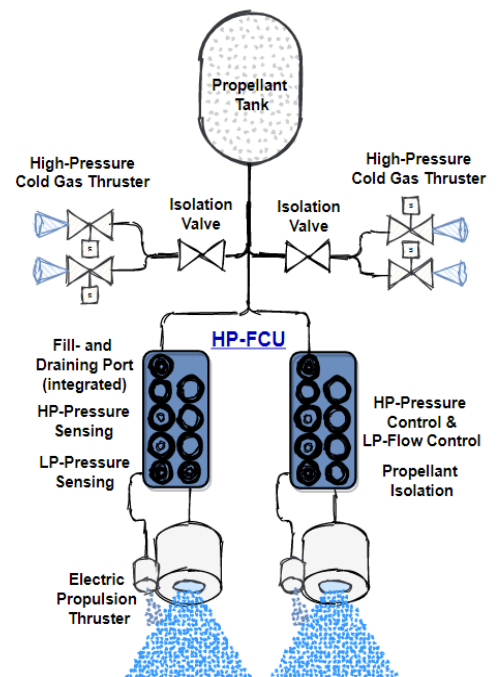
The stainless-steel HP-FCU is an all-welded design which provides robustness against rupture and propellant loss. All high-pressure joints are made by electron-beam welding and each unit is proof-pressure and leakage tested before shipment. Inlet and outlet filters protect the unit during handling and integration.

Customers can select from a large range of configuration options to make it best fitting to specific operational and interface needs. AST proposes a generic set of acceptance tests – specific verification can be added to customer's needs.

Through its integrated functions, the HP-FCU can simplify the fluidic architecture of an EP subsystem. The typical use-case is for a single- or dual-thruster configuration with one operation mode. For this, the fluidic system can benefit from the very compact HP-FCU design which can also be equipped with a Fill-and-Drain Valve for direct filling of the propellant tank.

The HP-FCU design is fully qualified for use with Xenon and has extensive flight-heritage. The configuration operating at higher pressures (e.g. for Krypton) is currently under qualification.

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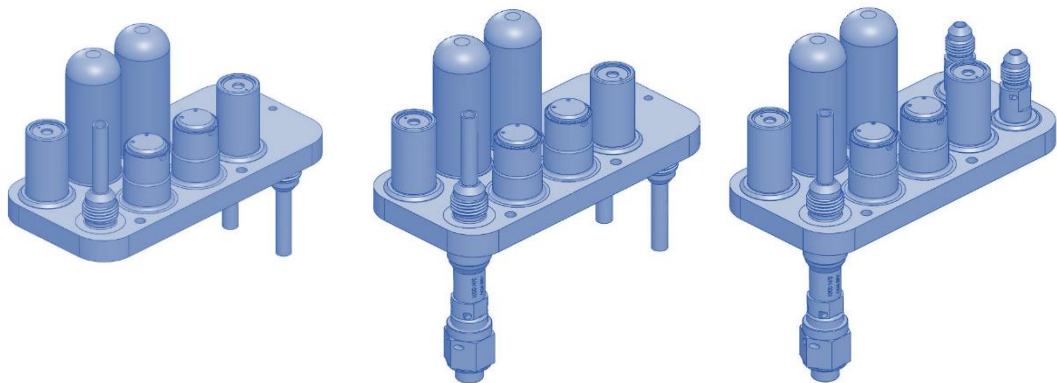
## HP-FCU - Characteristics

<i>Parameter</i>	<i>Value</i>	<i>Remark</i>
<i>Operating Media</i>	<i>Xe, Kr</i>	<i>Xe heritage, Kr under qualification</i>
<i>Inlet Pressure MEOP</i>	<i>300 bar</i>	<i>Xe operation up to 150 bar qualified</i>
<i>Inlet Pressure EOL</i>	<i>2 bar</i>	<i>flow dependent</i>
<i>Proof Pressure</i>	<i>1.5 x MEOP</i>	<i>design value &gt; 450 bar</i>
<i>Low Pressure Line MEOP</i>	<i>1 or 4 bar</i>	<i>depending on LP sensor selection</i>
<i>Low Pressure Lines Proof Pressure</i>	<i>7 bar</i>	<i>limited by LP sensor</i>
<i>Burst Pressure</i>	<i>&gt;2.5 x MEOP</i>	<i>design value &gt; 750 bar</i>
<i>Nominal Anode Flow</i>	<i>0.6mg to 10 mg/s</i>	<i>selectable by design; depends on gas</i>
<i>Nominal Cathode Flow</i>	<i>e.g. 10% of anode flow</i>	<i>selectable by design; depends on gas</i>
<i>Throttle Range</i>	<i>-25% to +50%</i>	<i>settable during operation</i>
<i>Propellant Throughput Capability</i>	<i>&gt;50 kg</i>	<i>depends on flow level</i>
<i>Regulation Precision</i>	<i>better 1%</i>	<i>depending on electronics and control loop</i>
<i>Output Flow Ripple</i>	<i>&lt; +/-2.5%</i>	<i>depending on electronics bandwidth and line volume</i>
<i>Flow Response Time</i>	<i>up &lt;5 s down &lt;20s</i>	<i>to achieve 95% of a full scale step at line outlet port (e.g. during start up).</i>
<i>Internal Leakage</i>	<i>&lt; 1*10<sup>-5</sup> sccs GHe</i>	<i>verified during acceptance tests</i>
<i>External Leakage</i>	<i>&lt; 1*10<sup>-8</sup> sccs GHe</i>	<i>verified during acceptance tests</i>
<i>Thermal Range non-op</i>	<i>-20°C to +80°C</i>	<i>incl. qualification margin</i>
<i>Thermal Range op</i>	<i>+25°C to +65°C</i>	<i>full performance</i>
<i>Thermal Range op (cold start)</i>	<i>-10°C to +65°C</i>	<i>limited performance (heater recommended)</i>
<i>Fluid Filtration Rate</i>	<i>11µm</i>	<i>5µm mesh at inlet and outlet</i>
<i>Mass</i>	<i>&lt; 900 g</i>	<i>w/o harness, varying with configuration</i>
<i>Average Power Consumption</i>	<i>&lt;10 W</i>	<i>depending on valve actuation frequency</i>
<i>Valve Operating Voltage</i>	<i>24V to 32V</i>	<i>min pull-in voltage required for motorization margin; 50% hold-voltage</i>
<i>Pressure Sensor Excitation Voltage</i>	<i>10V</i>	<i>in sensor voltage excitation mode</i>
<i>Vibration Qualification Levels</i>	<i>26.9 gRMS</i>	<i>all 3 axis</i>
<i>Shock Qualification Loads</i>	<i>2000g</i>	<i>At frequencies higher than 1000Hz</i>
<i>Radiation Tolerance</i>	<i>30 Mrad</i>	<i>Total Ionizing Dose (TID)</i>

## HP-FCU - Customization Options

Configuration Discriminators	AST HP-FCU 2.0 - Customization Options			<b>AST</b>   ADVANCED SPACE TECHNOLOGIES
Inlet / Tank Port Type	Straight Tube Stub			
Inlet / Tank Port Position	Top Surface of FPB	Bottom Surface of FPB		
Fill- and Drain Valve	No FDV	on opposite side of Inlet/tank port		
Number of Outlet Ports	One Outlet Port	Two Outlet Ports		
Outlet Port Type	Straight Tube Stub	AN-Interface	VCR-Interface	
Outlet Port Position	Top Surface of FPB	Bottom Surface of FPB		
LP-Sensor Pressure Range	4 bar	1 bar		
Thermistors	None	One	Two	Three
Heater	None	Surface Heater		
Outlet Port 1 nominal massflow	None	..... mg/s		
Outlet Port 2 nominal massflow	None	..... mg/s		

The Configuration Map above shows options that can be selected for each individual configuration. Below see some example configurations of the HP-FCU.



The HP-FCU characteristics and Configuration Map are subject to changes. Please contact AST for details and requests for further options.