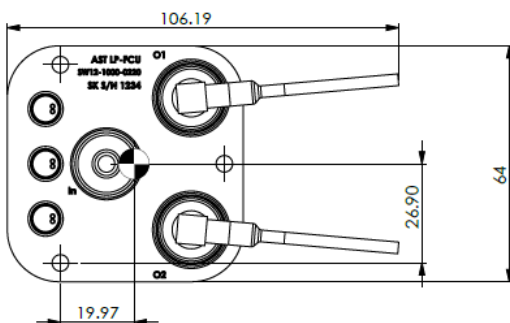
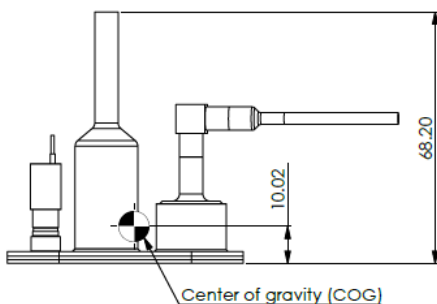
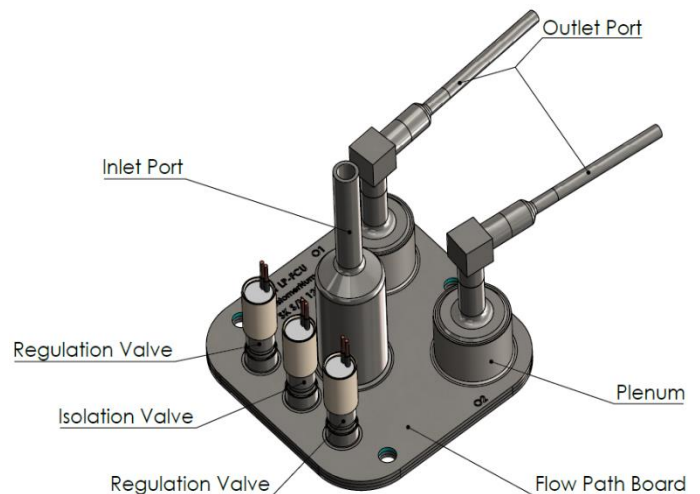


Low-Pressure Flow Control Unit (LP-FCU)

The low pressure FCU is a compact, open-loop flow control unit, which is fed by an upstream pressure regulator with a regulated inlet pressure in the range of 1.0 bar to 4.0 bar. In non-operating mode, the FCU provides double barrier for propellant isolation. In operating mode, it provides mass flow at a regulated rate to the thruster and the corresponding neutralizer. The FCU Inlet and outlet are protected by particle filters.

All components are fluidically connected by the Flow Path Board (FPB) which is a stainless steel element with integrated flow channels. They are electron beam welded into the FPB. This design is a key feature as it significantly reduces complexity and improves the robustness of the unit in orbit.

Inlet and outlet ports are equipped with filter mesh to ensure valve after ground handling.



Flow rate is controlled by actuation of the FCU valves. During operation the common isolation valve is held open permanently. The flow resistor in each of the two flow lines converts the (common) inlet pressure into an (average) flow rate that can be controlled individually for each flow line by actuating the corresponding regulation valve in a pulse width modulation scheme with a typical frequency of 1 to 5 Hz.

The throttling range of both flow lines can be 1 to 10 depending on the chosen nominal mass flow. This allows for a very wide range of operating flows with the very same hardware in orbit.

The LP-FCU can be equipped with foil heaters on the bottom side of the FPB in order to maintain constant temperature conditions. Due to the very low power consumption of the LP valves, the power dissipation on the unit is less than 2W. The unit is mounted to a structure using three M4 screws with thermal washers compatible with the satellite thermal control system.

LP-FCU- Characteristics

<i>Parameter</i>	<i>Value</i>	<i>Remark</i>
Operating Media	Xe, Kr, Ar, ...	Xe in qualification
Inlet Pressure MEOP	5 bar	max operation
Inlet Pressure EOL	1 bar	flow dependent
Proof Pressure	1.5 x MEOP	design value > 7,5 bar
Burst Pressure	>2.5 x MEOP	design value > 12,5 bar
Nominal Anode & Cathode Flow	0.1 mg/s to 10 mg/s	selectable by design;
Throttle Range	Better than 1 to 10	settable during operation
Propellant Throughput Capability	>200 kg	depends on flow level
Regulation Precision	Better than 1%	depending on electronics and control loop
Output Flow Ripple	< +/-2.5%	depending on electronics bandwidth and line volume
Flow Response Time	up <10 s down <30s	to achieve 95% of a full scale step at line outlet port (e.g. during start up).
Internal Leakage	< 1*10 ⁻⁵ sccs GHe	verified during acceptance tests
External Leakage	< 1*10 ⁻⁷ sccs GHe	verified during acceptance tests
Thermal Range non-op	-20°C to +95°C	incl. qualification margin
Thermal Range op	+40°C to +50°C	full performance
Thermal Range op (cold start)	-10°C to +65°C	limited performance (heater recommended)
Fluid Filtration Rate	11µm	5µm mesh at inlet and outlet
Mass	< 200 g	w/o harness, incl. margin
Average Power Consumption	< 2 W	depending on valve actuation frequency
Valve Operating Voltage	24V	min pull-in voltage required for motorization margin; 50% hold-voltage
Vibration Qualification Levels	29.8 gRMS	all 3 axis
Shock Qualification Loads	>1500g	At frequencies higher than 1000Hz
Radiation Tolerance	10 Mrad	Total Ionizing Dose (TID)