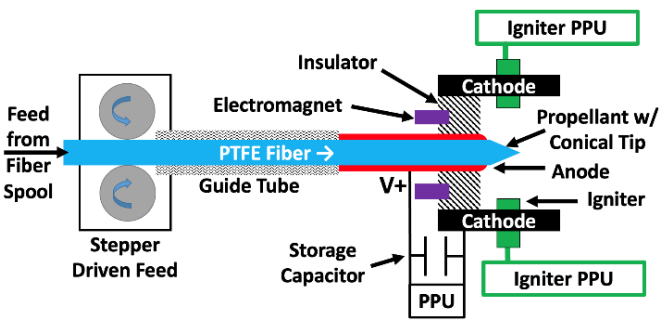
FIBER-FED PULSED PLASMA THRUSTER (FPPT) SYSTEM
SOLID INERT POLYMER PROPELLANT
AUGUST 2024

CU Aerospace (CUA) has developed a family of satellite propulsion technologies to offer versatility to the CubeSat community. The Fiber-fed Pulsed Plasma Thruster (FPPT) self-contained system uses PTFE (Teflon®) fiber as propellant (no liquid or gaseous propellant requiring pressure vessels or valving). FPPT provides a CubeSat with significant orbit altitude change, collision avoidance, and ultimately deorbit capabilities. In a 1.7U form factor, FPPT can provide a peak total impulse of 29,000 N-s, a peak steady pulsed thrust of 0.21 mN at 51 W input power, and a maximum specific impulse of 3,870 seconds. The design incorporates a modularized 32 J energy storage unit (ESU), typically charged to 19 J to achieve a balance between performance and lifetime. Steady operation at 0.5Hz has been demonstrated with 2Hz capability in shorter duration burns. The FPPT has a unique gimbal-less thrust vectoring capability allowing reaction wheel desaturation and attitude control outside Earth's magnetic field. An MVP Flight Unit is now qualified for integration into CUA's NASA-funded Dual Propulsion Experiment ("DUPLEX") 6U CubeSat mission in Q2 of 2025 to achieve TRL 7 or higher. Thrust vectoring of > ±5° in the pitch and yaw axes has been measured on a laboratory FPPT system and will be demonstrated on the DUPLEX mission.

OPERATION AND TYPICAL PERFORMANCE

FPPT fires on demand without warmup. It mechanically feeds PTFE propellant fiber from a non-rotating spool through the anode, utilizing a pulsed discharge to electromagnetically accelerate fuel to provide thrust. Power, thrust, mass flow rate, and resultant specific impulse levels are user-selectable by adjusting propellant feed rate, pulse rate, and bank voltage.



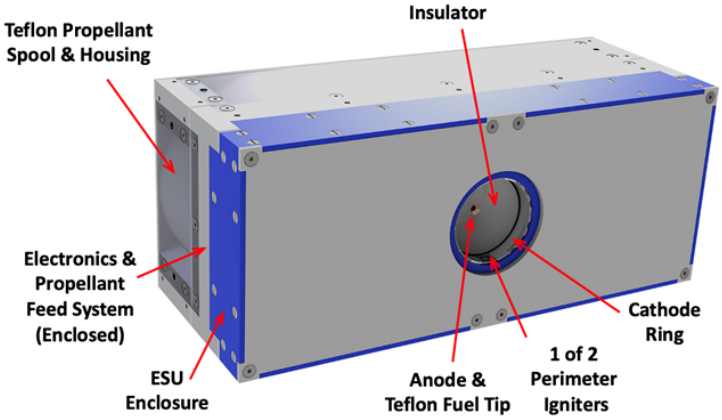
System Information		
System Lifetime	> 2 x 10^8 pulses	
System Temperature Range [°C]	– 40 to +75	
Nominal Pulse Energy [J]	19	
Propulsion System Volume	1.7U	
Pulse Rate [Hz]	0.64	2
Nominal Power to PPU [W]	16	51
Nominal Mass Flow Rate [mg/s]	0.00179	0.0056
Nominal Thrust [mN]	0.07	0.21
Minimum Impulse Bit [µN-s]	109	
Specific Impulse [s]	3,870	
Total Impulse [N-s]	29,000	
Propellant Mass [kg]	0.78	
Total propulsion wet mass [kg]	3.03	
Spacecraft ΔV, M(initial)=10.5 kg [m/s]	2,900	
TRL	6	

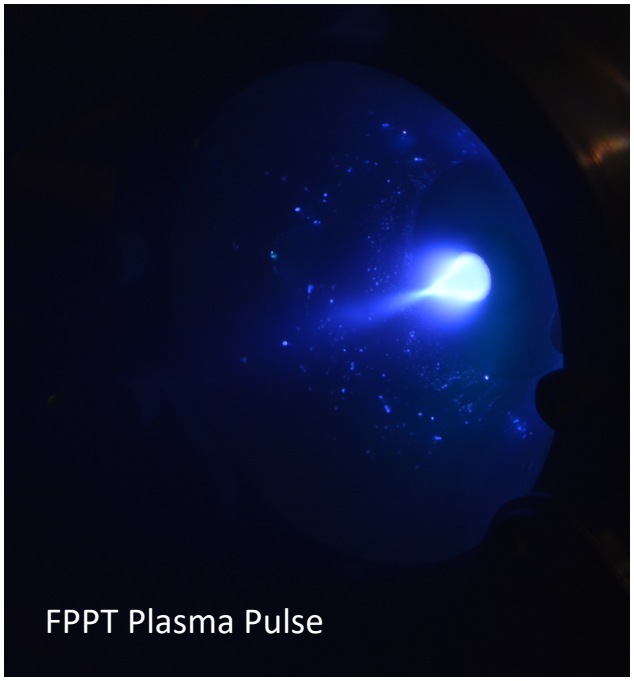
CUA | 3001 NEWMARK DRIVE | CHAMPAIGN, IL 61822
T: (217) 239-1701 | INFO@CUA.SPACE | WWW.CUA.SPACE

Fiber-Fed Pulsed Plasma Thruster (FPPT) System
Solid Inert Polymer Propellant
August 2024

Baseline 1.7U FPPT System Interface

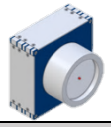
- 12V power interface (can modify on request)
- RS422 or TTL level RS232 comms protocols available
- Mounting interface
  - Designed for typical CubeSat structure with external enclosure
  - Adaptable to customer requirements
- 21.7 x 9.0 x 8.65 cm^3 envelope
- Total mass of 3.03 kg

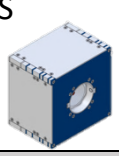



FPPT Plasma Pulse

FPPT Variant Envelopes

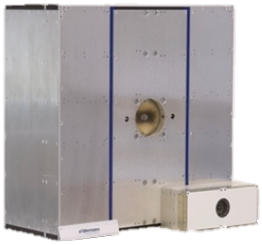
Quick Turn (QT) PPTs





Parameter	QT-PPT (Disk)	QT-PPT (Fiber)
Volume	550 cm^3	670 cm^3
Nominal Power Draw	20 (2 Hz)	20 (2 Hz)
Capacitor Bank Energy	7.4 J	7.4 J
Specific impulse	700 s	1,575 s
Mass per Pulse	0.010 mg	0.0023 mg
Thrust (@ Pulse Rate)	0.14 mN (2 Hz)	0.07 mN (2 Hz)
Total impulse	1,100 N-s	2,700 N-s
Propellant Mass	160 g	170 g
Dry Mass	630 g	750 g
Prop. Sys. Wet Mass	790 g	920 g
Thrust Vectoring	No	Yes (±5°)
Delta-V capability (**for XX kg S/C Wet Mass**)	280 (**4**)	450 (**6**) m/s
TRL	5	5

FPPT-ESPA



FPPT 1.7U

Parameter	FPPT-ESPA
Volume	52,500 cm^3
Nominal Power Draw	185 (2 Hz)
Capacitor Bank Energy	75 J
Specific impulse	3,300 s
Mass per Pulse	0.019 mg
Thrust (@ Pulse Rate)	1.2 mN (@ 2 Hz)
Total impulse	500,000 N-s
Propellant Mass	35,000 g
Dry Mass	20,000 g
Prop. Sys. Wet Mass	55,000 g
Thrust Vectoring	Yes (±5°)
Delta-V capability (**for XX kg S/C Wet Mass**)	4,880 (**250**) m/s
TRL	5

CUA | 3001 Newmark Drive | Champaign, IL 61822
T: (217) 239-1701 | info@cua.space | www.CUA.space