

BIT-3

RF Ion Thruster

Compact and efficient iodine gridded ion thruster.

Mission enabling. Featuring high performance and unprecedented efficiency at its size.

Busek's BIT-3 RF ion thruster is a mission enabling, iodine-fueled ion propulsion system scheduled for launch on two deep-space CubeSat missions aboard NASA's Space Launch System rocket in 2021. The 56-75W input propulsion system utilizes a 2.5cm diameter grid RF ion thruster (BIT-3) and a micro RF cathode (BRFC-1) as the neutralizer.

The thruster's unprecedented performance produces thrust up to 1.1 mN and specific impulse up to 2,150 seconds. Performance results were verified with xenon and iodine propellant using a highly-accurate torsional thrust stand. As an optional add-on, Busek has developed an innovative thruster gimbal capable of desaturating reaction wheels as part of the Attitude Control System (ACS).



Figure 1: BIT-3 system, gimbaled



Figure 2: BIT-3 system, non-gimbaled

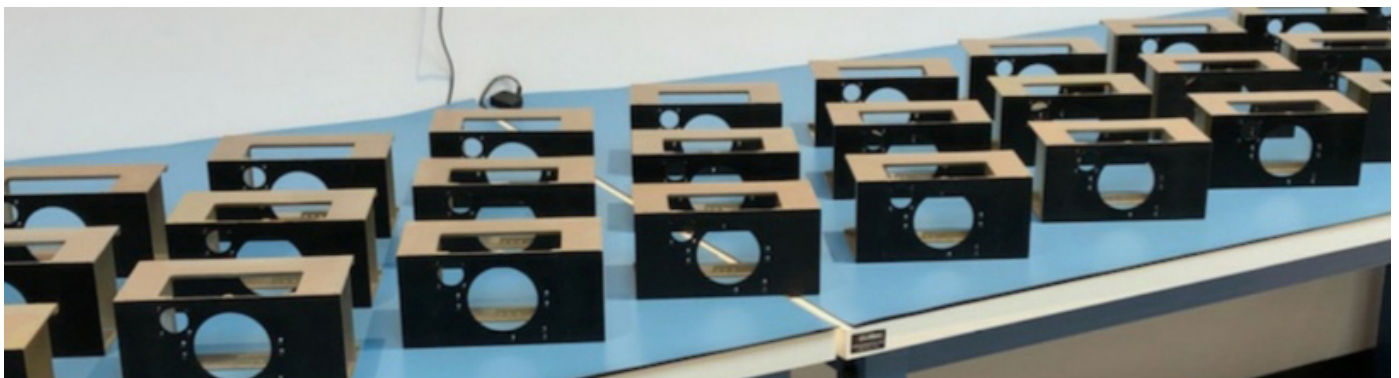


Figure 3: BIT-3 chassis for production ramp

Thruster

Thruster Performance Details

The BIT-3 uses an inductively-coupled plasma (ICP) discharge to eliminate the need for an internal hot cathode and increase overall lifetime.

The most unique feature of BIT-3 is its compatibility with iodine propellant, a demonstrated drop-in replacement for xenon in terms of thrust and Isp performance. Iodine stores as a dense solid (>2x storage density than xenon) and eliminates the need for high-pressure tanks.

Advances in the BIT-3 thruster and BRFC-1 neutralizer are complemented by major breakthroughs in the flight electronics. The BIT-3 power processing unit (PPU) features a ~90% efficient RF power supply with radiation-tolerant components. The state-of-the-art electronics package is highly efficient and compact.

Table: Standard Specifications

Propellant:	Iodine, solid storage
Envelope:	180 x 88 x 102 mm
Dry Mass:	1.28 kg w/o gimbal 1.40 kg w/ gimbal
Propellant Loads:	1.50 kg max
System Power:	56 - 75 W
Input Voltage:	28 VDC (ambient temp.)
Ion Beam Current:	9 - 17 mA
Propellant Mass Flow:	52 µg / sec
Thrust:	Up to 1.1 mN
Specific Impulse:	Up to 2,150 s
Delta-V:	Up to 2.39 km/s (14 kg CubeSat)
Integrated Gimbal: (Optional)	2-axis, ±10° (capable of desaturating reaction wheels)
Communication:	RS-485
Thermal Dissipation Load:	~35 W max
Operating Temperature:	-15° to +45° C

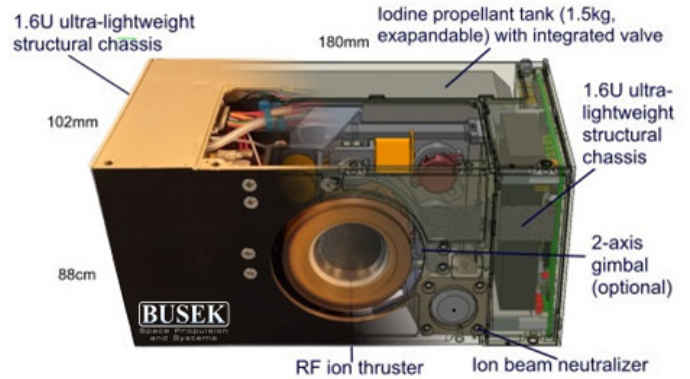


Figure 4: System layout, gimballed

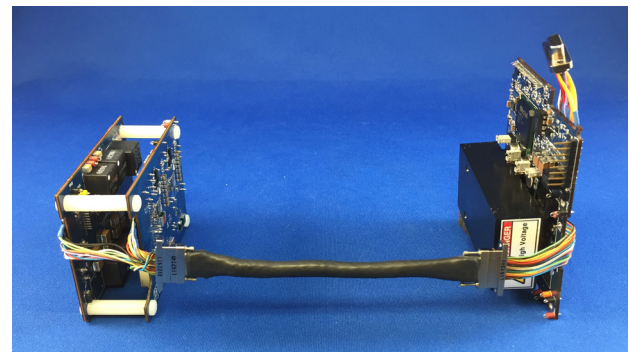


Figure 4: BIT-3 rad-tolerant PPU

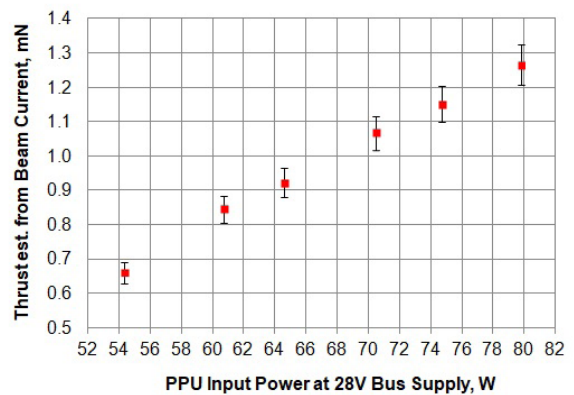


Figure 5: Actual performance of iodine BIT-3 flight system