

Nitrous Oxide Resistojet



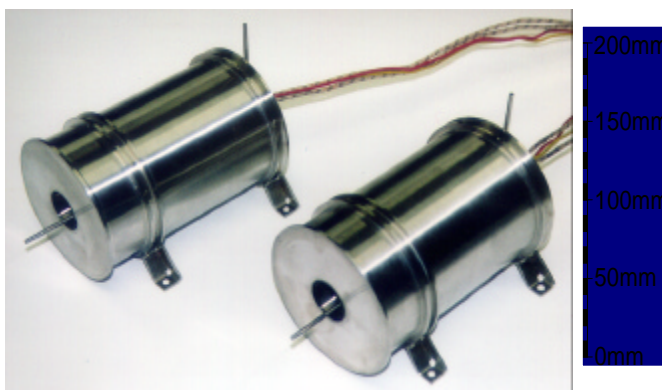
The Surrey Satellite Technology Resistojets are low cost thrusters for drag compensation in low orbits, minor orbit manoeuvres and station keeping. The nitrous oxide resistojet, from the SSTL resistojet series, is operational on UoSAT-12 (launched April 1999).

The SSTL nitrous oxide resistojet is a thruster designed to produce maximum performance for minimum cost. Use of commercial, flight proven, components and low cost construction techniques lead to low cost hardware. Ground operations and handling costs are also kept low as N_2O is a non-toxic propellant and is stored in relatively low-pressure vessels.

SSTL is also researching other forms of resistojets. Contact SSTL for further details.

The resistojet is operated by controlling the power supply to the heater. Prior to operation the resistojet is heated, typically for 15 minutes, to achieve a minimum temperature throughout the chamber. Nitrous oxide is fed into the thruster and its temperature is raised to 1000 K. The hot gas is expelled through the outlet nozzle to produce a thrust in the order of tens to hundreds of mN, depending on the feed pressure. The resistojet is thermally insulated in order to keep the interior chamber temperatures even and isolate the spacecraft from these high temperatures, which can be monitored via a thermocouple. The design is very flexible and the parameters specified can be varied over a large range to customise the thruster suit a wide range of mission requirements. The thruster has been tested extensively under sea level and vacuum conditions.

The N_2O resistojet can be modified to operate at higher power levels of up to around 600 Watts. Raising the power also increases efficiency, giving an I_{SP} of 182 seconds and 270 mN of thrust. SSTL can also supply a full feed system and support electronics to support all resistojet applications.



Engineering unit for MIGHTYSAT II programme

Nitrous Oxide Resistojet Features

- **Low cost** parts and construction inherent to design
- **Non-hazardous** propellants reduce handling costs and safety requirements
- **Self Pressurisation** of N_2O means no additional expulsion system required
- **Piggyback launches** - the combination of non-hazardous gases and low pressure makes the system inherently compatible with piggyback launches
- **Alternative liquid fuels** to suit applications - Water, Nitrous Oxide, Ammonia, Carbon Dioxide, Propane etc.
- **Testing and PA** plans available. Environmental and Acceptance Testing and PA plans can be tailored to suit customer

Applications

Low-thrust thruster suitable for small satellites:

- Drag compensation
- Constellation deployment and maintenance
- Minor Orbit Adjustment
- Station Keeping

Specifications

- Propellant: Nitrous Oxide
- Thrust: Typically 125 mN
- Specific Impulse: 127 s
- Feed Pressure: 10 bar
- Flow Rate: 0.1 g/s
- Throat Diameter: 0.4 mm
- Restartable
- Lifetime: Propellant is typically the limiting lifetime factor

Options

- Variable Power Supply: 100 to 600 W
- Variable Working Fluids: Water, Nitrous Oxide, Ammonia, Carbon Dioxide, Propane and others
- Available as part of an integrated system

Qualification / Heritage

- Nitrous Oxide resistojet flown on UoSAT-12, launched 1999
- 354 hours of test firing
- Water resistojet to be qualified on MIGHTYSAT II in 2000

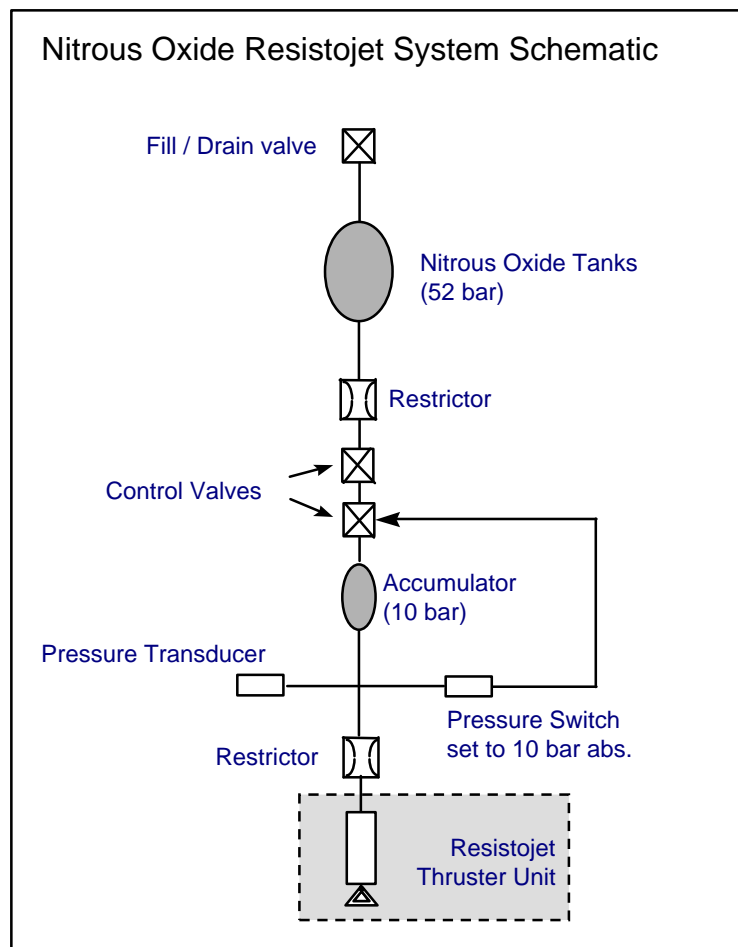
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Nitrous Oxide Resistojet



Integrated System

A N₂O resistojet system has been qualified on the UoSAT-12 minisatellite, launched in April 1999. The schematic of the UoSAT-21 system is shown below. The nitrous oxide is stored as a liquefied gas. At 20 °C it has a vapour pressure of 52 bar. This has regulated to the feed pressure of 10 bar using an electronic 'bang-bang' regulator.



Other SSTL Products

- **Resistojets** based on Water, Ammonia, Carbon Dioxide, Propane fuels.
- **Complete propulsion systems** based on cold gas, resistojet and hybrid technology
- **Complete low cost small satellite solutions**, based on SSTL range of nano, micro, enhanced micro and mini satellites, including know-how transfer and rapid and affordable access to space.
- **ADCS equipment**: magnetometers, Sun and Earth sensors, star mappers, wheels, magnetorquers.
- Other **sub-systems** (CD&H, Power, Communications) and **payloads**

Environmental (Acceptance Level)

- Random Vibration: 6 g rms for 120 s (designed for higher)
- Operational Temperature Range: <-20 °C to >+50 °C
- Radiation: Not radiation sensitive
- EMC: as per MIL-STD-462

Physical Characteristics

- Dimensions: 95 mm, 141 mm length
- Mounting Interface: 4 x M4.5 clearance holes
- Mass: 1.24 kg including 0.5 m flying lead

Power Supply

- Power Consumption: 100 W
- Power Supply: 28 V

Contact



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