Presentation 6th Round Table of MNT, 9th Oct, ESTEC:

Development of new MEMS components and their maiden space flight on PRISMA 2009

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Outline

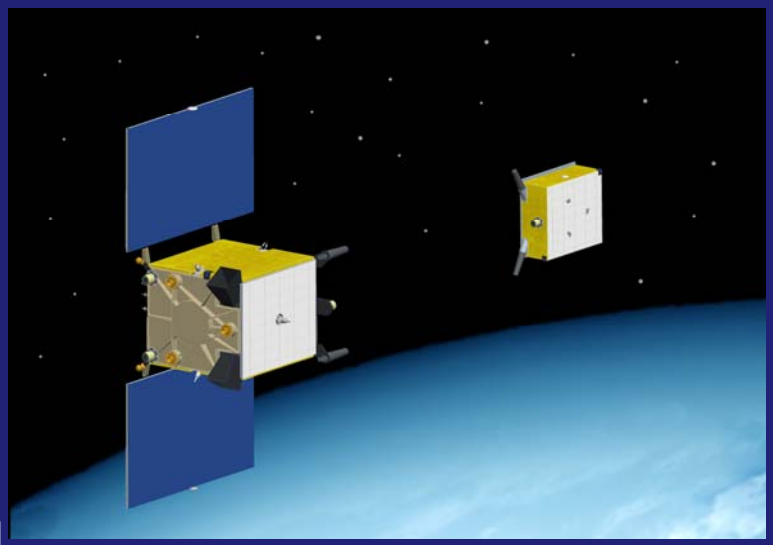
- Intro
- PRISMA mission
- Micropropulsion on PRISMA
- MEMS Isolation Valve
- MEMS Pressure Sensors
- MEMS Pressure Relief Valve
- MEMS Thruster Pod Assembly
    - **Thruster, filters and heaters**
    - **Proportional Flow Control Valves**
- Summary

Micropropulsion on PRISMA

About PRISMA

A two spacecraft technology demonstration mission for rendezvous and autonomous formation flying

- RF metrology for Darwin
- Precise orbit determination with GPS
- Green Propulsion and **Micropropulsion**



The flight experiment

Different methods to evaluate micropropulsion:

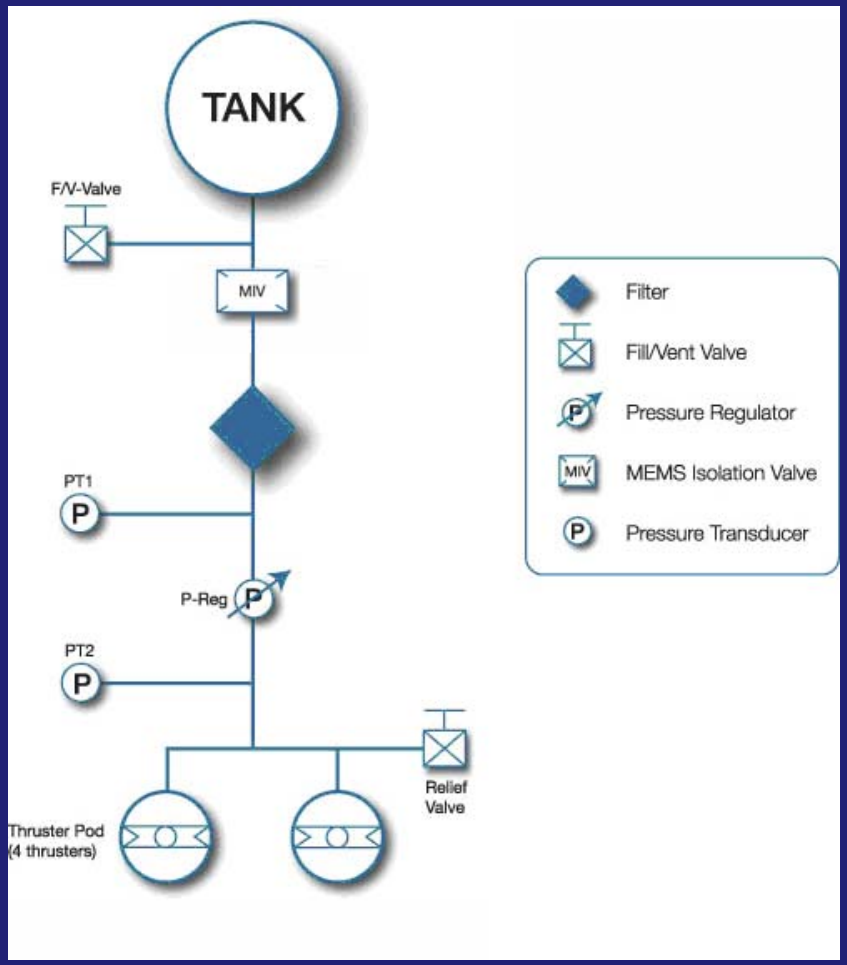
- GPS-data
- Reaction wheel response
- RF metrology data in proximity operations

Experiments to verify thrust from 10 μN to 1 mN

Micropropulsion

Micropropulsion system delivered by NanoSpace to the prime contractor Swedish Space Corporation

Cold Gas Micropropulsion System Overview



Schematic Block Diagram

MEMS Components

- Filter
- Isolation valve
- Pressure sensors
- Relief Valve
- Proportional valves
- Micro thrusters

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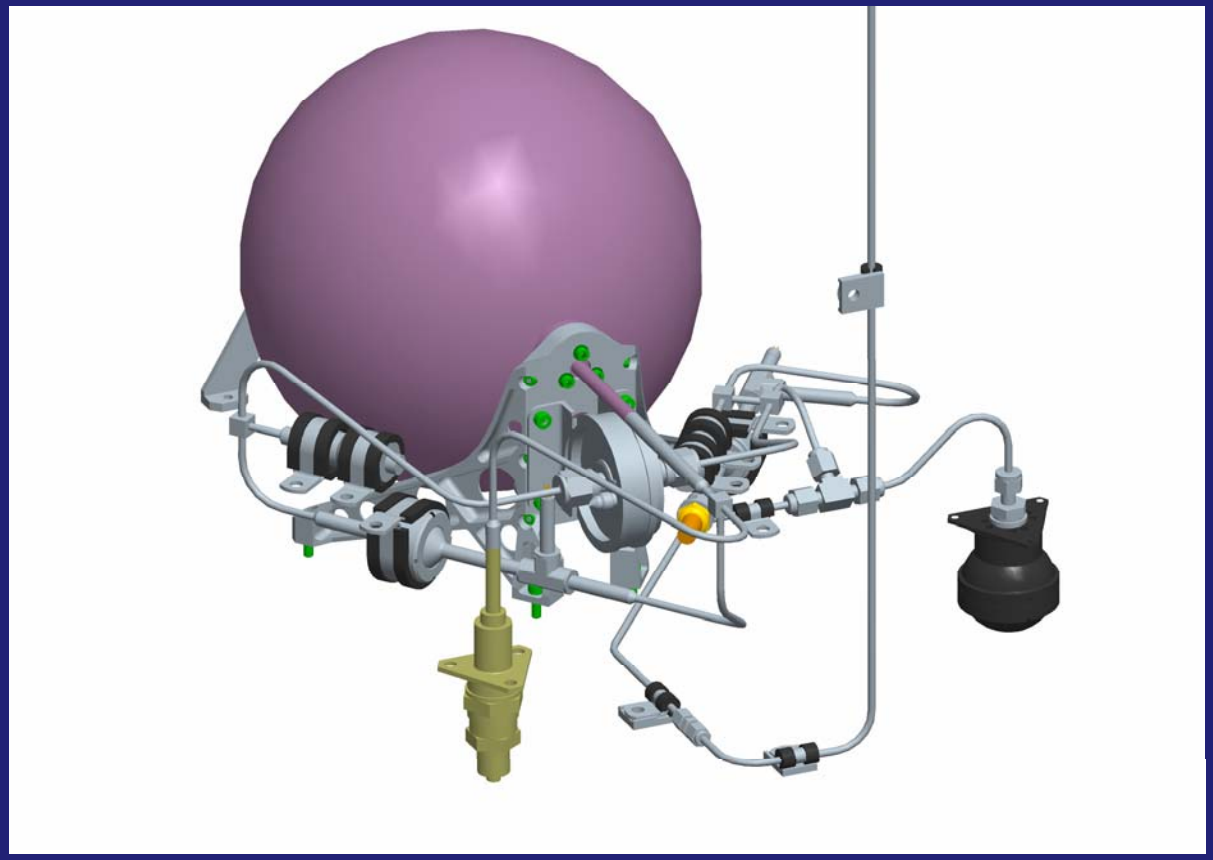
Cold Gas Micropropulsion System Overview



The micropropulsion system CAD layout

MEMS ISOLATION VALVE

Objectives

To provide perfect isolation between storage tank and feed system (replace a pyro valve)

Requirement

- **Must not fail to open**
- **Must withstand high (MEOP 200 Bar) pressure**

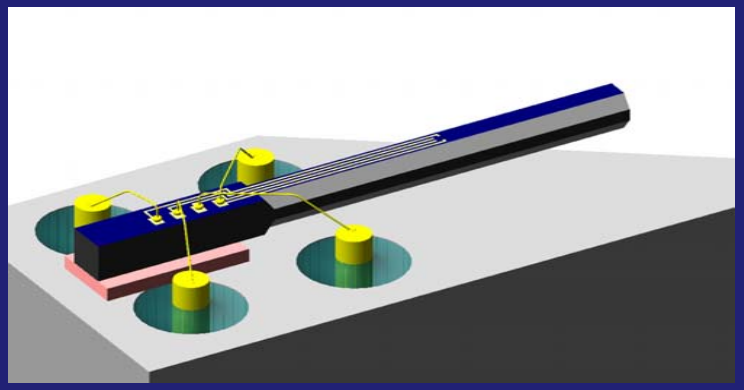
MEMS ISOLATION VALVE with integrated filter

- Patent filed in Dec 2005
- “End-to-end” tested using Micropropulsion RTU at 200 Bar Nitrogen
- Burst proof tested up to 500 Bar
- Redundant inlets and outlets
- Replaces pyro valves
- Integrated filter

Developed, manufactured and integrated on PRISMA by NanoSpace

MEMS PRESSURE SENSORS

See also Presens presentation, 8th of Oct



Developed and manufactured by Presens

Integrated on PRISMA by NanoSpace

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Pressure Relief Valve

Objectives

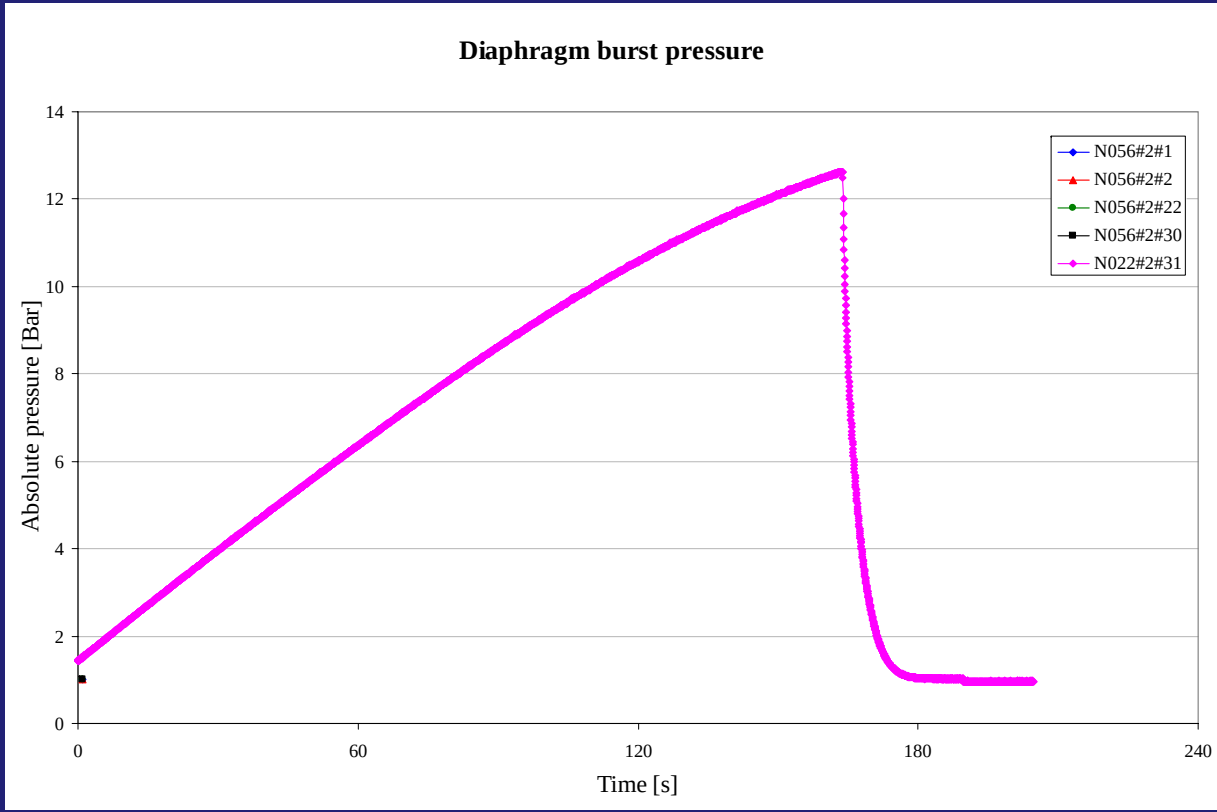
- To act as isolation valve during normal operation
- To act as passive burst membrane
- To act as active one shot valve if pressure builds up in system
- To act as check valve system if opened actively or passively and thus allow continued operation

Requirements

- Burst Pressure: >10 bar
- Cracking Pressure (Check valve): 6 bar

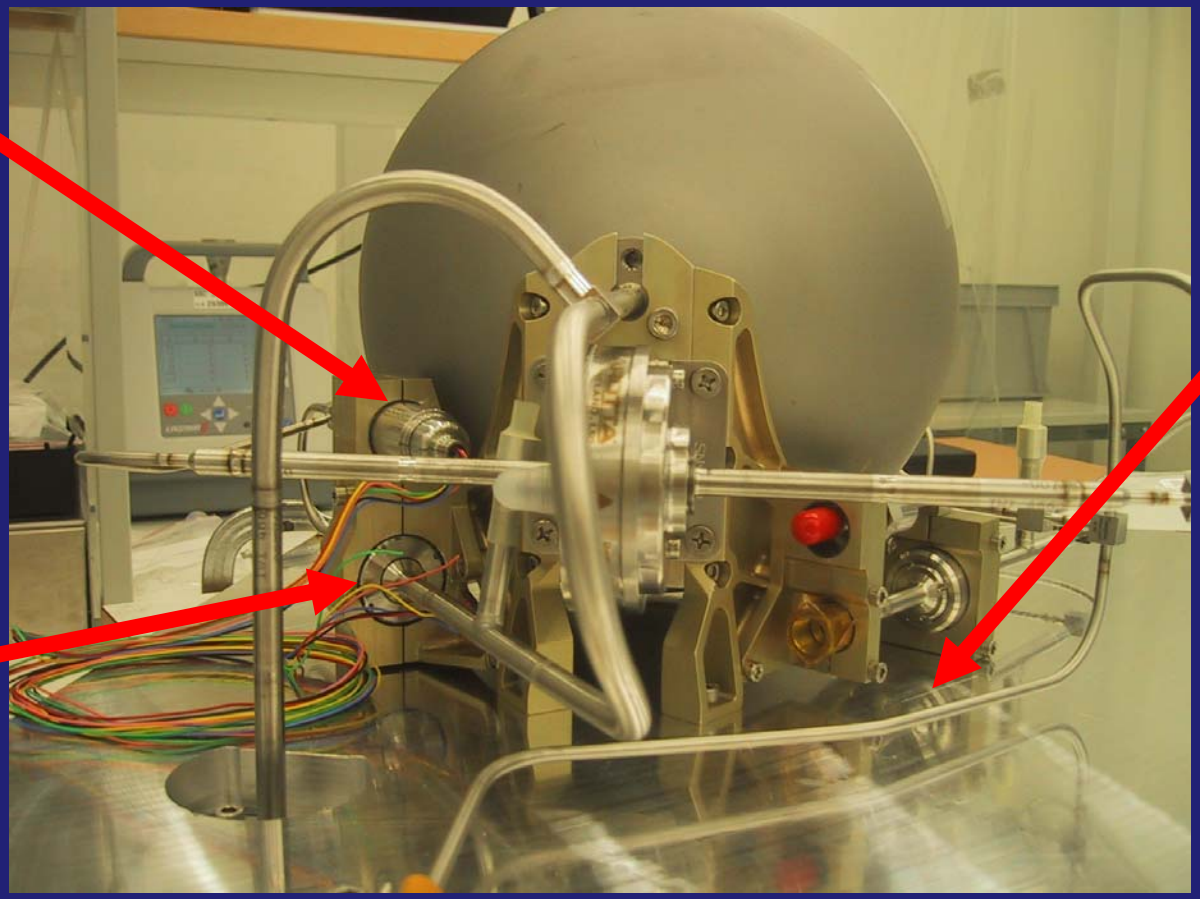
Pressure Relief Valve

Passive Burst



Burst Pressure: > 10 bar

Micropropulsion System Flight H/W



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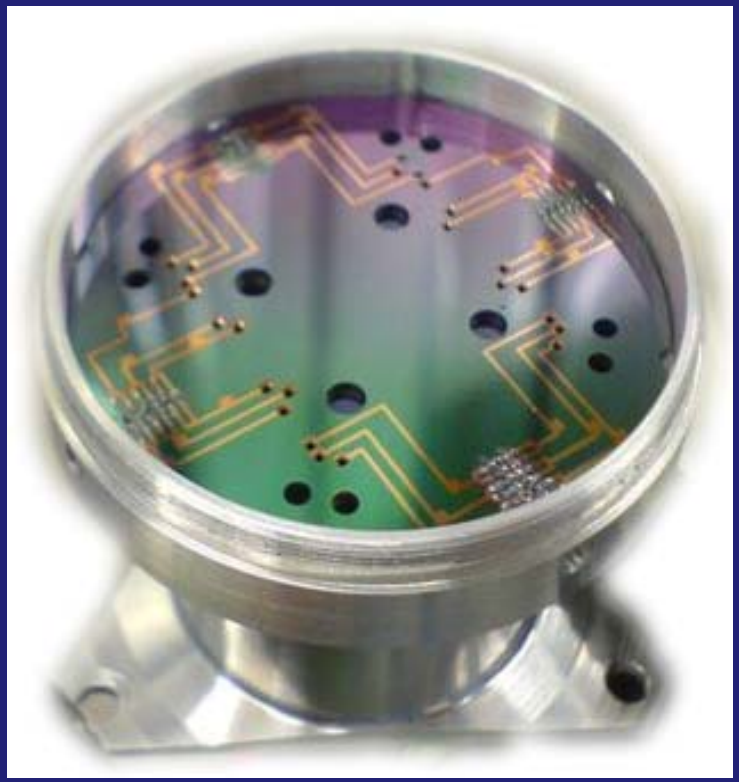
MEMS Thruster Pod Assembly

Micropropulsion on Prisma

- Two thruster pods
- Four orthogonal thrusters/pod
- Proportional thrust

MEMS Thruster Pod Assembly



MEMS in pod assembly

- Four microthrusters per pod
- Heaters for hot gas mode
- Filters
- Six wafer stack
- Four proportional valves

Summary

Several new MEMS components have been developed

- MEMS Isolation Valve including filter
- MEMS Pressures Sensors
- MEMS Pressure Relief Valve
- MEMS Proportional Valves
- MEMS Thrusters

and will be flight demonstrated on Prisma