# Control system for the CubeSat micropropulsion module @ SPACE-SI

In the Slovenian Centre of Excellence Space-SI we are developing a control system for the CubeSat micropropulsion module designed by SSC NanoSpace.

Micropropulsion module includes four MEMS (Micro Electro Mechanical Systems) chips and ON/OFF valves. Each MEMS chip contains flow control valve, flow sensor and chamber/nozzle together with the front-end read-out electronics.

The control system is implemented as a separate printed circuit board and serves as a closed-loop control system for the micro-thrusters. It also provides a suitable communication interface to the other modules of the satellite, e.g., on-board computer (OBC) and attitude determination control system.
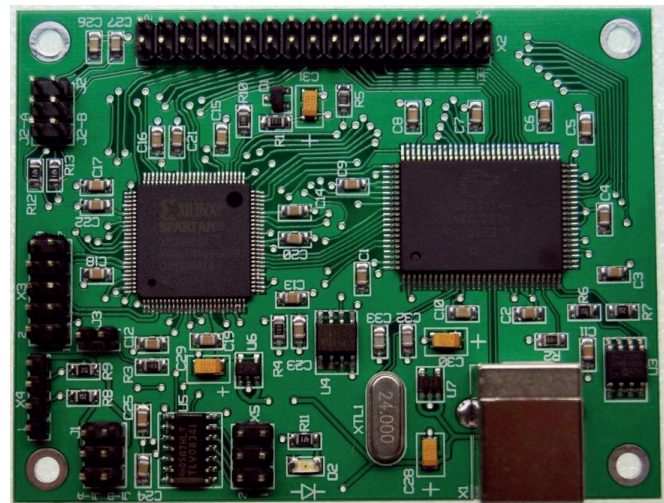


| Controller board | |
|---|---|
| Volume | 10x10x2 cm3 |
| Mass | 80 g |
| Power Consumption | 500 mW (everage, operating) |
| Supply voltage | 5 V, 12 V |
| Communication interface | Via I2C, CAN or RS485 bus |
| **CubeSat propulsion module** | |
| Thrusters | four 1mN thrusters with 10ÒN resolution |
| Total impulse | 40 Ns |
| Weight | 250 g (dry) |
| Propellant capacity | 50 g (butane) |
| Operating pressure | 2-5 bar |
| Power consumption | 2W (average, operating) |
| Electrical interface | 52 pins analog (0-12V) and digital (SPI) |
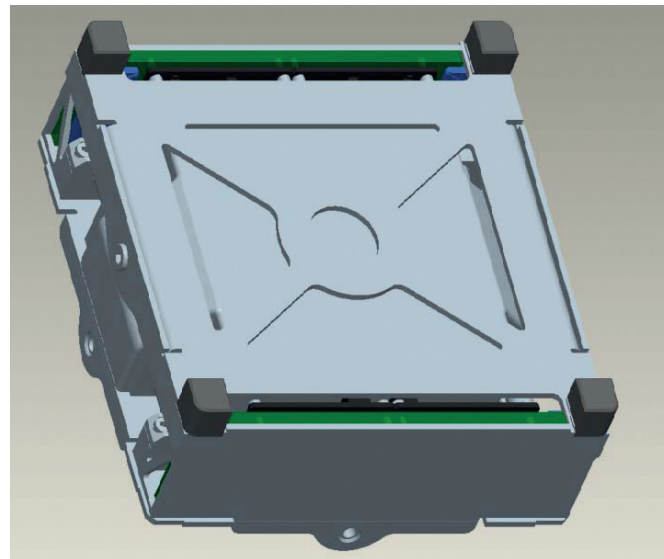
The circuit of the interface board consists of a microcontroller with corresponding peripherals, such as A/D, D/A-PWM convertors and power amplifiers for actuator signals. The outputs from the interface board are electrical signals to actuate the MEMS valves and the ON/OFF valves of the propulsion system.

The controller board controls mass flow through each of the four MEMS thrusters with respect to the desired thrust, which is demanded by the OBC over a data bus. Also the closed-loop's parameters can be changed during the mission and the parameters, which describe the state of the propulsion system, can be transmitted to the OBC.

Filter

ON/OFF valve

S/C Data & Power bus

PCB designed by SPACE-SI

Proportional valve

MT 1

SPI BUS from Mass flow sensor

Heater

T-sensor