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DEVELOPMENT OF THE PROPULSION CONTROLLER OF THE HALL THRUSTER FOR SCIENCE TECHNOLOGY SATELLITE-3 (STSAT-3)

Abstract

We have developed Hall Thruster Propulsion System(HPS) which is the first electric thruster for the Science Technology Satellite-3 (STSAT-3) scheduled to be launched in Korea in 2010.We have developed Propulsion Control Module(PCM) for HPS. The paper present the PCM design and the determination of the control parameter. The HPS largely consists of Xenon Feeding System (XFS), Propulsion Control Module (PCM), Hall Thruster (HT), and Power Processing Module (PPM). The PCM control the Xenon flow rate and get the thrust from HT. The PCM measures temperatures, pressures, voltages, and currents from all modules in HPS. All commands from the On-Board Computer (OBC) are sent to the PCM through the RS422 UART which has a speed of the 38400bps. All operation scenarios are operated by the OBC. The heater power of xenon tank is controlled by the Tele Command Tele command Module (TCTM). The heater is automatically controlled by the thermostat which has the low and high temperature limit. The HPS power is transferred to the PPM. The PPM supplies the power for the PCM and received the PPM control power from the PCM. The control the XFS using the sensing signal and Proportional Flow Control Valve (PFCV). The PPM supply all powers for the HT which has the anode, the cathode, the keeper, the magnet1, and the magnet2 electrode. The PCM controls on and off command for the PPM. Also, the PCM performs the house keeping of the HPS monitoring the voltages and currents of the HPS. The PCM performs the house keeping function of the HPS and periodically send the telemetry data to the OBC. The high pressure xenon tank of the pressure of 100 bars is reduced to about 3 bars. The first feedback control loop performs the pressure reduction operation using the PFCV and the high pressure sensor. The second feedback control loop performs the flow rate control using the PFCV and the low pressure sensor. This controller provides the maximum flow with 8-sccm for the anode and cathode of the HT. The control parameter for each controller is simulated by the MATLAB and verified by the real test. The control parameter is tuned by Integral Test (IT) with the XFS, PCM, PPM, and HT. The test of the PCM will be carried out at the vacuum chamber of the Gas Discharge Physics Laboratory (GDPL) in KAIST. The thrust command of the OBC is sent to the PCM controller which controls the flow through the XFS. The PCM gets the thrust value from the HT and the command thruster versus the real thruster graph. We obtain the thrust error characteristic through those experiments on the PCM. We will perform the try and error method to minimize and optimize the residual error of the controller. The disturbance and noise rejection matter will be analyzed and be tested by the IT. We design the controller of the HPS which has a thrust of less than 10mN and determine the control parameter. We will on-orbit function test and performance test in the future. We will try to test the LEO orbit transfer and a precise actuator for the attitude control.