Electric Propulsion System based on Small Hall Thruster SPT-20M for Microsatellites

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Based on great experience in Electric Propulsion gained in KhAI from 60’s we are focused on development of Electric Propulsion System (EPS) for Microsatellites as one of the main tasks. We select Hall thruster (or SPT) as a promising candidate with high enough specific impulse 1500 s. Studies of developed small Hall Thruster SPT-20M has shown acceptable level of efficiency (30-35%) on low power consumption (100 W) [1]. Such system will serves for drag compensation of residual atmosphere, solar pressure and other disturbance of environment and orbit maintenance with prescribed accuracy.

General structure of developed EPS is shown on fig. 1.

**Figure 1 - Scheme of EPS:**

**GFD** – gas-filling device;  
**GDU** – Gas-Distributing Unit;  
**PSU-MD** – Main Discharge Power Supply Unit;  
**PSU-MS** – Power Supply Unit for Magnetic System;  
**DCS** – Diagnostic and Control System;  
**PPSU** – Precise Pressure Stabilization Unit

Thruster description (fig. 2):

- Hall Effect Thruster assembly consists of Anode block and two cathodes;
- Thruster type – Hall effect thruster SPT-20M;
- Cathode type – heaterless hollow cathode;
- Working gas – Xe (99,9998%);
- Total efficiency – 30-35 %;
- Gas flow rate - 0.32 mg/s;
- Xe ions energy – 220…260 eV;
- Mass - less 240 gr;
PPU Description (table 1; fig. 3):

- individual for each thruster;
- total efficiency 92%;
- overall dimension 97x85x50 mm;
- mass - 210 grams + 560 grams radiation protection;

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Main discharge unit</th>
<th>Ignition unit</th>
<th>Magnetic system supply unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Const; 290+/-5 V</td>
<td>800 V; special VAC</td>
<td>up to 5 V I=</td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>320 mA</td>
<td>60 mA</td>
<td>Const; 4.2 A</td>
</tr>
<tr>
<td>Operation time</td>
<td>long duration</td>
<td>start mode</td>
<td>long duration</td>
</tr>
</tbody>
</table>

All systems of EPS pass complex long duration qualification tests on vacuum test bench, on vibration and environment stands. And as next obvious step we see manufacturing qualification and flight model with corrected parameters for concrete task.

References