

Example Averiti Model – Electrostatic_Thruster

This paper presents an example Averiti design of a spacecraft electrostatic thruster system.

An electrostatic thruster is a spacecraft propulsion system that works by accelerating ions at very high specific impulse but very low thrust levels. Thrust is produced by pumping a propellant into an ion production chamber where ions and electrons are separated. The ions are then passed through an electromagnetic field and accelerated through the exhaust. Electrostatic thrusters require large amounts of electrical power to function.

Electrostatic_Thruster Example

Type: Package
Status: Proposed. Version 1.0. Phase 1.0.
Package: Model
Detail: Created on 21/03/2015. Last modified on 26/03/2015
GUID: {B074C3BB-3ACE-492d-9AD4-7C811472191A}

Electrostatic Thruster Example - (Class diagram)

Created By: Chris on 21/03/2015
Last Modified: 26/03/2015
Version: 1.0. **Locked:** False
GUID: {C6AD8093-F0D2-4395-A9A3-377FBEE63CC4}

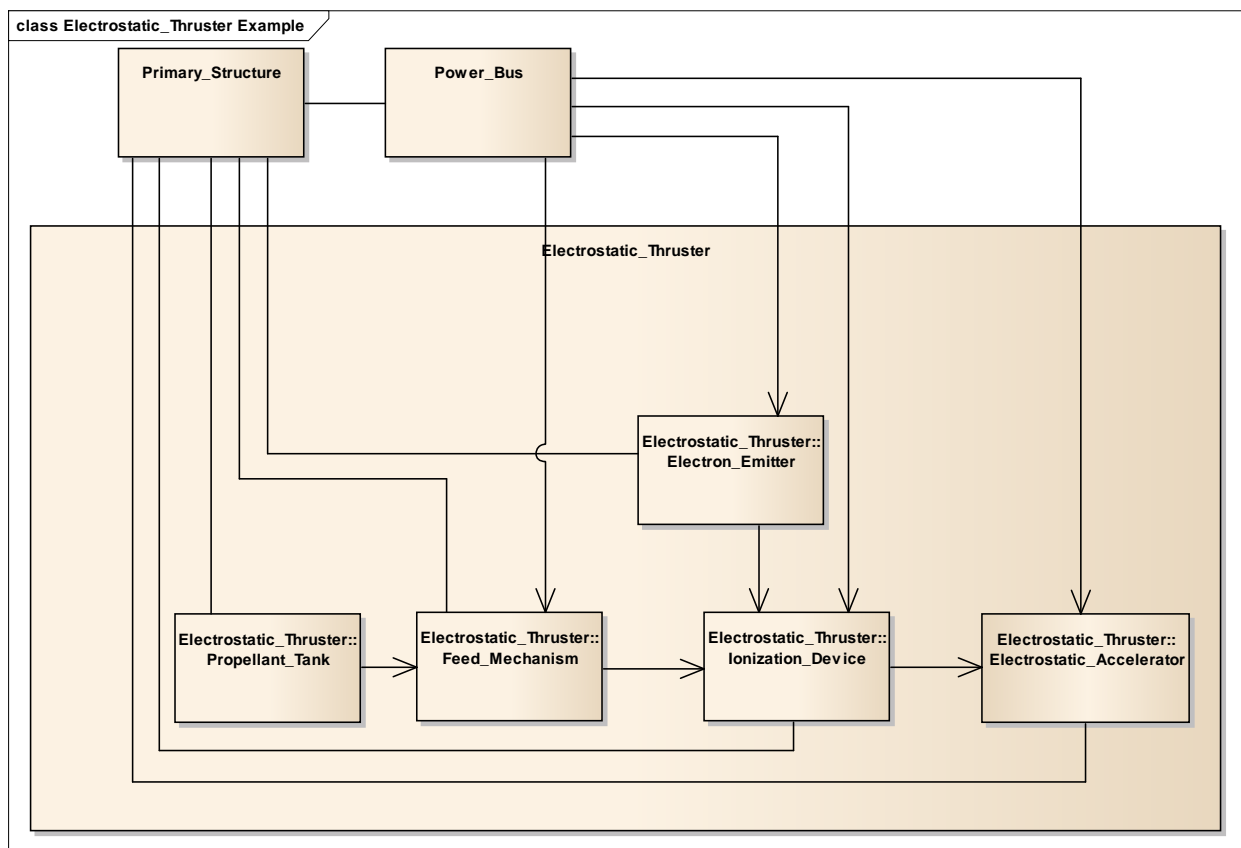


Figure 29: Electrostatic Thruster Example

Electrostatic_Thruster

Type: Class
Status: Proposed. Version 1.0. Phase 1.0.

Package: Electrostatic_Thruster Example *Keywords:*
Detail: Created on 21/03/2015. Last modified on 21/03/2015.
GUID: {C7AE7E67-65DE-4550-9E04-3230BAE81518}

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- Edited by Averiti -->
<subsystem>
  <subsystem_name>Electrostatic_Thruster</subsystem_name>
  <instance_of>Electrostatic_Thruster</instance_of>
  <number_made_of>5</number_made_of>
  <made_of>Electron_Emitter</made_of>
  <made_of>Propellant_Tank</made_of>
  <made_of>Feed_Mechanism</made_of>
  <made_of>Ionization_Device</made_of>
  <made_of>Electrostatic_Accelerator</made_of>
  <number_part_of>0</number_part_of>
  <primary_function>provide_thrust</primary_function>
  <subsystem_notes>notes on the subsystem here</subsystem_notes>
  <number_attached_to>0</number_attached_to>
  <number_adjacent_from>0</number_adjacent_from>
  <adjacent_from>Propellant_Tank</adjacent_from>
  <number_adjacent_to>0</number_adjacent_to>
  <status>OK</status>
</subsystem>
```

Custom Properties

- isActive = False

Electron_Emitter

Type: **Class**
Status: Proposed. Version 1.0. Phase 1.0.
Package: Electrostatic_Thruster Example *Keywords:*
Detail: Created on 21/03/2015. Last modified on 21/03/2015.
GUID: {4686E24F-D404-4f90-8593-98D439DFCED4}

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- Edited by Averiti -->
<subsystem>
  <subsystem_name>Electron_Emitter</subsystem_name>
  <instance_of>Spacecraft.Electrostatic_Thruster.Electron_Emitter</instance_of>
  <number_made_of>0</number_made_of>
  <number_part_of>1</number_part_of>
  <part_of>Electrostatic_Thruster</part_of>
  <primary_function>emit_electrons</primary_function>
  <subsystem_notes>A device which ensures electron current discharged from vehicle to prevent
charge build up</subsystem_notes>
  <number_attached_to>1</number_attached_to>
  <attached_to>Primary_Structure</attached_to>
  <number_adjacent_from>1</number_adjacent_from>
  <adjacent_from>Power_Bus</adjacent_from>
```

```

<number_adjacent_to>1</number_adjacent_to>
<adjacent_to>
  <adjacent_to_name>Ionization_Device</adjacent_to_name>
  <function>provide</function>
  <media>electric_charge</media>
  <caption>electric_charge</caption>
</adjacent_to>
<status>GREEN</status>
</subsystem>

```

Custom Properties

- isActive = False

Connections

| Connector | Source | Target | Notes |
|---|-----------------------------|-----------------------------|-------|
| Association Source -> Destination | Public Electron_Emitter | Public Ionization_Device | |
| Association Source -> Destination | Public Power_Bus | Public Electron_Emitter | |
| Association Unspecified | Public Primary_Structure | Public Electron_Emitter | |

Electrostatic_Accelerator

Type: **Class**
Status: Proposed. Version 1.0. Phase 1.0.
Package: Electrostatic_Thruster Example *Keywords:*
Detail: Created on 21/03/2015. Last modified on 21/03/2015.
GUID: {9BBD2440-6783-4c4f-A352-B473529998E1}

```

<?xml version="1.0" encoding="UTF-8"?>
<!-- Edited by Averiti -->
<subsystem>
<subsystem_name>Electrostatic_Accelerator</subsystem_name>
  <instance_of>Electrostatic_Thruster.Electrostatic_Accelerator</instance_of>
  <number_made_of>0</number_made_of>
  <number_part_of>1</number_part_of>
  <part_of>Electrostatic_Thruster</part_of>
  <primary_function>accelerate_ions</primary_function>
  <subsystem_notes>notes on the subsystem here</subsystem_notes>
  <number_attached_to>1</number_attached_to>
  <attached_to>Primary_Structure</attached_to>
  <number_adjacent_from>2</number_adjacent_from>
  <adjacent_from>Ionization_Device</adjacent_from>
  <adjacent_from>Power_Bus</adjacent_from>
  <number_adjacent_to>0</number_adjacent_to>
  <status>OK</status>
</subsystem>

```

Custom Properties

- isActive = False

Connections

| Connector | Source | Target | Notes |
|---|-----------------------------|-------------------------------------|-------|
| Association Source -> Destination | Public Ionization_Device | Public Electrostatic_Accelerator | |
| Association Source -> Destination | Public Power_Bus | Public Electrostatic_Accelerator | |
| Association Unspecified | Public Primary_Structure | Public Electrostatic_Accelerator | |

Feed_Mechanism

Type: **Class**

Status: Proposed. Version 1.0. Phase 1.0.

Package: Electrostatic_Thruster Example *Keywords:*

Detail: Created on 21/03/2015. Last modified on 21/03/2015.

GUID: {513851FC-ED73-4047-825F-C6803AADC268}

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- Edited by Averiti -->
<subsystem>
  <subsystem_name>Feed_Mechanism</subsystem_name>
  <instance_of>Electrostatic_Thruster.Feed_Mechanism</instance_of>
  <number_made_of>0</number_made_of>
  <number_part_of>0</number_part_of>
  <part_of>Electrostatic_Thruster</part_of>
  <primary_function>provide_propellant</primary_function>
  <subsystem_notes>notes on the subsystem here</subsystem_notes>
  <number_attached_to>1</number_attached_to>
  <attached_to>Primary_Structure</attached_to>
  <number_adjacent_from>2</number_adjacent_from>
  <adjacent_from>Propellant_Tank</adjacent_from>
  <adjacent_from>Power_Bus</adjacent_from>
  <number_adjacent_to>1</number_adjacent_to>
  <adjacent_to>
    <adjacent_to_name>Ionization_Device</adjacent_to_name>
    <function>provide</function>
    <media>liquid</media>
    <caption>propellant</caption>
  </adjacent_to>
  <status>OK</status>
</subsystem>
```

Custom Properties

- isActive = False

Connections

| Connector | Source | Target | Notes |
|---|-----------------------------|-----------------------------|-------|
| Association Source -> Destination | Public Propellant_Tank | Public Feed_Mechanism | |
| Association Source -> Destination | Public Feed_Mechanism | Public Ionization_Device | |
| Association Source -> Destination | Public Power_Bus | Public Feed_Mechanism | |
| Association Unspecified | Public Primary_Structure | Public Feed_Mechanism | |

Ionization_Device

Type: **Class**

Status: Proposed. Version 1.0. Phase 1.0.

Package: Electrostatic_Thruster Example *Keywords:*

Detail: Created on 21/03/2015. Last modified on 21/03/2015.

GUID: {FDCB0035-EE1E-46aa-9D89-865747FFC3BA}

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- Edited by Averiti -->
<subsystem>
  <subsystem_name>Ionization_Device</subsystem_name>
  <instance_of>Electrostatic_Thruster.Ionization_Device</instance_of>
  <number_made_of>0</number_made_of>
  <number_part_of>1</number_part_of>
  <part_of>Electrostatic_Thruster</part_of>
  <primary_function>ionize_propellant</primary_function>
  <subsystem_notes>notes on the subsystem here</subsystem_notes>
  <number_attached_to>1</number_attached_to>
  <attached_to>Primary_Structure</attached_to>
  <number_adjacent_from>3</number_adjacent_from>
  <adjacent_from>Feed_Mechanism</adjacent_from>
  <adjacent_from>Power_Bus</adjacent_from>
  <adjacent_from>Electron_Emitter</adjacent_from>
  <number_adjacent_to>1</number_adjacent_to>
  <adjacent_to>
    <adjacent_to_name>Electrostatic_Accelerator</adjacent_to_name>
    <function>provide</function>
    <media>plasma</media>
    <caption>ions</caption>
  </adjacent_to>
  <status>OK</status>
</subsystem>
```

</subsystem>

Custom Properties

- isActive = False

Connections

| Connector | Source | Target | Notes |
|---|-----------------------------|-------------------------------------|-------|
| <u>Association</u> Source -> Destination | Public Electron_Emitter | Public Ionization_Device | |
| <u>Association</u> Source -> Destination | Public Feed_Mechanism | Public Ionization_Device | |
| <u>Association</u> Source -> Destination | Public Ionization_Device | Public Electrostatic_Accelerator | |
| <u>Association</u> Source -> Destination | Public Power_Bus | Public Ionization_Device | |
| <u>Association</u> Unspecified | Public Primary_Structure | Public Ionization_Device | |

Propellant_Tank

Type: **Class**
Status: Proposed. Version 1.0. Phase 1.0.
Package: Electrostatic_Thruster Example *Keywords:*
Detail: Created on 21/03/2015. Last modified on 21/03/2015.
GUID: {352DD187-9435-4ed2-B53B-8E910938BAAC}

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- Edited by Averiti -->
<subsystem>
  <subsystem_name>Propellant_Tank</subsystem_name>
  <instance_of>Electrostatic_Thruster.Propellant_Tank</instance_of>
  <number_made_of>0</number_made_of>
  <number_part_of>1</number_part_of>
  <part_of>Electrostatic_Thruster</part_of>
  <primary_function>contain_propellant</primary_function>
  <subsystem_notes>notes on the subsystem here</subsystem_notes>
  <number_attached_to>1</number_attached_to>
  <attached_to>Primary_Structure</attached_to>
  <number_adjacent_from>0</number_adjacent_from>
  <number_adjacent_to>1</number_adjacent_to>
  <adjacent_to>
    <adjacent_to_name>Feed_Mechanism</adjacent_to_name>
    <function>provide</function>
    <media>liquid</media>
    <caption>propellant</caption>
  </adjacent_to>
</subsystem>
```

</adjacent_to>
 <status>OK</status>
 </subsystem>

Custom Properties

- isActive = False

Connections

| Connector | Source | Target | Notes |
|--|-----------------------------|---------------------------|-------|
| <u>Association</u> Source -> Destination | Public Propellant_Tank | Public Feed_Mechanism | |
| <u>Association</u> Unspecified | Public Primary_Structure | Public Propellant_Tank | |

Power_Bus

Type: **Class**
 Status: Proposed. Version 1.0. Phase 1.0.
 Package: Electrostatic_Thruster Example *Keywords:*
 Detail: Created on 21/03/2015. Last modified on 21/03/2015.
 GUID: {4D56DDB0-57DD-4a9d-9DC8-3B3B229DCD1E}

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- Edited by Averiti -->
<subsystem>
  <subsystem_name>Power_Bus</subsystem_name>
  <instance_of>Electrical_Systems.Power_Bus</instance_of>
  <number_made_of>0</number_made_of>
  <number_part_of>0</number_part_of>
  <primary_function>provide_power</primary_function>
  <subsystem_notes>notes on the subsystem here</subsystem_notes>
  <number_attached_to>1</number_attached_to>
  <attached_to>Primary_Structure</attached_to>
  <number_adjacent_from>0</number_adjacent_from>
  <number_adjacent_to>4</number_adjacent_to>
  <adjacent_to>
    <adjacent_to_name>Feed_Mechanism</adjacent_to_name>
    <function>provide</function>
    <media>power</media>
    <caption>electricity</caption>
  </adjacent_to>
  <adjacent_to>
    <adjacent_to_name>Ionization_Device</adjacent_to_name>
    <function>provide</function>
    <media>power</media>
    <caption>electricity</caption>
  </adjacent_to>
  <adjacent_to>
    <adjacent_to_name>Electron_Emitter</adjacent_to_name>
```

```

    <function>provide</function>
    <media>power</media>
    <caption>electricity</caption>
  </adjacent_to>
  <adjacent_to>
    <adjacent_to_name>Electrostatic_Accelerator</adjacent_to_name>
    <function>provide</function>
    <media>power</media>
    <caption>electricity</caption>
  </adjacent_to>
  <status>OK</status>
</subsystem>

```

Custom Properties

- isActive = False

Connections

| Connector | Source | Target | Notes |
|---|-----------------------------|-------------------------------------|-------|
| <u>Association</u> Unspecified | Public Primary_Structure | Public Power_Bus | |
| <u>Association</u> Source -> Destination | Public Power_Bus | Public Feed_Mechanism | |
| <u>Association</u> Source -> Destination | Public Power_Bus | Public Ionization_Device | |
| <u>Association</u> Source -> Destination | Public Power_Bus | Public Electron_Emitter | |
| <u>Association</u> Source -> Destination | Public Power_Bus | Public Electrostatic_Accelerator | |

Primary_Structure

Type: **Class**
Status: Proposed. Version 1.0. Phase 1.0.
Package: Electrostatic_Thruster_Example *Keywords:*
Detail: Created on 21/03/2015. Last modified on 21/03/2015.
GUID: {7FF9B22E-0A95-4aa9-8C16-04EE38759E71}

```

<?xml version="1.0" encoding="UTF-8"?>
<!-- Edited by Averiti -->
<subsystem>
  <subsystem_name>Primary_Structure</subsystem_name>
  <instance_of>Spacecraft.Primary_Structure</instance_of>
  <number_made_of>0</number_made_of>
  <number_part_of>0</number_part_of>
  <primary_function>primary_spacecraft_structure</primary_function>

```



```

<subsystem_notes>notes here</subsystem_notes>
<number_attached_to>6</number_attached_to>
<attached_to>Power_Bus</attached_to>
<attached_to>Electron_Emitter</attached_to>
<attached_to>Propellant_Tank</attached_to>
<attached_to>Feed_Mechanism</attached_to>
<attached_to>Ionization_Device</attached_to>
<attached_to>Electrostatic_Accelerator</attached_to>
<number_adjacent_from>0</number_adjacent_from>
<number_adjacent_to>0</number_adjacent_to>
<status>GREEN</status>
</subsystem>

```

Custom Properties

- isActive = False

Connections

| Connector | Source | Target | Notes |
|-----------------------------------|-----------------------------|-------------------------------------|-------|
| <u>Association</u> Unspecified | Public Primary_Structure | Public Power_Bus | |
| <u>Association</u> Unspecified | Public Primary_Structure | Public Feed_Mechanism | |
| <u>Association</u> Unspecified | Public Primary_Structure | Public Propellant_Tank | |
| <u>Association</u> Unspecified | Public Primary_Structure | Public Ionization_Device | |
| <u>Association</u> Unspecified | Public Primary_Structure | Public Electrostatic_Accelerator | |
| <u>Association</u> Unspecified | Public Primary_Structure | Public Electron_Emitter | |