# FireSat Physical Structure

**Development**

**Prepared by**

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## FireSat Physical Structure

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# Overview

This document details the physical decomposition of the systems involved in the example fire detection satellite system described by the OML vocabulary. This includes information about the assemblies used, what assemblies are used to create other assemblies, and mass constraints for all the assemblies.

# 1. Assemblies

The FireSat system is composed of multiple assemblies that have a mass constraint that must be met. Some assemblies are built by multiple base assemblies put together.

### Table 1.1. Subsystems

| Subsystem | Mass |
|---|---|
| ADCS and GNC | 9.74 |
| ADCS Electronics Unit | 2.0 |
| Earth Sensor | 2.75 |
| GPS Antenna | 0.25 |
| GPS Receiver Unit | 1.0 |
| Magnetometer | 0.85 |
| Magnetorquer 1 | 0.5 |
| Magnetorquer 2 | 0.5 |
| Magnetorquer 3 | 0.5 |
| Reaction Wheel 1 | 0.1975 |
| Reaction Wheel 2 | 0.1975 |
| Reaction Wheel 3 | 0.1975 |
| Reaction Wheel 4 | 0.1975 |
| Sun Sensor | 0.6 |
| Command and Data Handling | 38.07 |
| Avionics Stack Section | 0.6 |
| Base Plate | 1.32 |
| Base Plate Module | 0.6 |
| Launch Vehicle Adapter | 5.0 |
| Launch Vehicle Interface Module | 0.6 |
| Payload Structural Interface | 3.5 |
| Pressurant Tank Mounting Panel | 2.7 |
| Primary Flight Computer Unit | 2.35 |
| Propellant Tank Mounting Panel | 2.7 |
| Propulsion Structure Post 1 | 0.6 |
| Propulsion Structure Post 2 | 0.6 |
| Propulsion Structure Post 3 | 0.6 |
| Propulsion Structure Post 4 | 0.6 |
| Separation System | 3.0 |
| Side Panel 1 | 0.8 |
| Side Panel 2 | 0.8 |
| Side Panel 3 | 0.8 |
| Side Panel 4 | 0.8 |

| Subsystem | Mass |
|---|---|
| Side Panel 5 | 0.8 |
| Side Panel 6 | 0.8 |
| Structure Post 1 | 0.6 |
| Structure Post 2 | 0.6 |
| Structure Post 3 | 0.6 |
| Structure Post 4 | 0.6 |
| Structure Post 5 | 0.6 |
| Structure Post 6 | 0.6 |
| Top Panel | 2.7 |
| Top Panel Module | 0.6 |
| Communications | 3.26 |
| Receive Whip Antenna | 0.08 |
| Receiver Unit | 1.0 |
| Transmit Hi-Gain Antenna | 0.04 |
| Transmit Whip Antenna | 0.04 |
| Transmitter Unit | 2.1 |
| Electric Power System | 9.31 |
| Battery Pack 1 | 3.103 |
| Battery Pack 2 | 3.103 |
| Battery Pack 3 | 3.103 |
| Payload System | 28.1 |
| Payload Module | 0.6 |
| Sensor | 28.1 |
| Propulsion | 44.14 |
| ACS Thruster 1 | 0.5 |
| ACS Thruster 2 | 0.5 |
| ACS Thruster 3 | 0.5 |
| ACS Thruster 4 | 0.5 |
| ACS Thruster 5 | 0.5 |
| ACS Thruster 6 | 0.5 |
| BP Propellant Line Unit | 2.695 |
| Fill/Drain Valve Unit | 3.75 |
| PM Propellant Line Unit | 2.695 |
| Pressurant Tank | 10.0 |
| Primary Thruster | 1.0 |
| Propellant Handling Section | 0.6 |
| Propellant Tank | 20.0 |
| Propulsion Module | 0.6 |
| Propulsion System Control Unit | 1.0 |

| Subsystem | Mass |
|---|---|
| Spacecraft System | 235.1 |
| Spacecraft System Segment | 0.6 |
| Structures and Mechanisms | 5.0 |
| EPS Regulators and Converters Unit | 14.48 |
| Power Control Unit | 5.96 |
| Solar Array with SADA 1 | 7.965 |
| Solar Array with SADA 2 | 7.965 |
| Thermal Control | 3.9 |
| Thermal Blankets | 3.9 |

## Table 1.2. Assemblies

| Assembly | Mass Constraint |
|---|---|
| ACS Thruster 1 | 0.5 |
| ACS Thruster 2 | 0.5 |
| ACS Thruster 3 | 0.5 |
| ACS Thruster 4 | 0.5 |
| ACS Thruster 5 | 0.5 |
| ACS Thruster 6 | 0.5 |
| ADCS Electronics Unit | 2.0 |
| Avionics Stack Section | 0.6 |
| BP Propellant Line Unit | 2.695 |
| Base Plate | 1.32 |
| Base Plate Module | 0.6 |
| Battery Pack 1 | 3.103 |
| Battery Pack 2 | 3.103 |
| Battery Pack 3 | 3.103 |
| EPS Regulators and Converters Unit | 14.48 |
| Earth Sensor | 2.75 |
| Fill/Drain Valve Unit | 3.75 |
| GPS Antenna | 0.25 |
| GPS Receiver Unit | 1.0 |
| Launch Vehicle Adapter | 5.0 |
| Launch Vehicle Interface Module | 0.6 |
| Magnetometer | 0.85 |
| Magnetorquer 1 | 0.5 |
| Magnetorquer 2 | 0.5 |
| Magnetorquer 3 | 0.5 |
| PM Propellant Line Unit | 2.695 |
| Payload Module | 0.6 |

| Assembly | Mass Constraint |
|---|---|
| Payload Structural Interface | 3.5 |
| Power Control Unit | 5.96 |
| Pressurant Tank | 10.0 |
| Pressurant Tank Mounting Panel | 2.7 |
| Primary Flight Computer Unit | 2.35 |
| Primary Thruster | 1.0 |
| Propellant Handling Section | 0.6 |
| Propellant Tank | 20.0 |
| Propellant Tank Mounting Panel | 2.7 |
| Propulsion Module | 0.6 |
| Propulsion Structure Post 1 | 0.6 |
| Propulsion Structure Post 2 | 0.6 |
| Propulsion Structure Post 3 | 0.6 |
| Propulsion Structure Post 4 | 0.6 |
| Propulsion System Control Unit | 1.0 |
| Reaction Wheel 1 | 0.1975 |
| Reaction Wheel 2 | 0.1975 |
| Reaction Wheel 3 | 0.1975 |
| Reaction Wheel 4 | 0.1975 |
| Receive Whip Antenna | 0.08 |
| Receiver Unit | 1.0 |
| Sensor | 28.1 |
| Separation System | 3.0 |
| Side Panel 1 | 0.8 |
| Side Panel 2 | 0.8 |
| Side Panel 3 | 0.8 |
| Side Panel 4 | 0.8 |
| Side Panel 5 | 0.8 |
| Side Panel 6 | 0.8 |
| Solar Array with SADA 1 | 7.965 |
| Solar Array with SADA 2 | 7.965 |
| Spacecraft System Segment | 0.6 |
| Structure Post 1 | 0.6 |
| Structure Post 2 | 0.6 |
| Structure Post 3 | 0.6 |
| Structure Post 4 | 0.6 |
| Structure Post 5 | 0.6 |
| Structure Post 6 | 0.6 |
| Sun Sensor | 0.6 |

| Assembly | Mass Constraint |
| --- | --- |
| Thermal Blankets | 3.9 |
| Top Panel | 2.7 |
| Top Panel Module | 0.6 |
| Transmit Hi-Gain Antenna | 0.04 |
| Transmit Whip Antenna | 0.04 |
| Transmitter Unit | 2.1 |

# 1.1. ACS Thruster 1

The mass of ACS Thruster 1 is 0.5.

# 1.2. ACS Thruster 2

The mass of ACS Thruster 2 is 0.5.

# 1.3. ACS Thruster 3

The mass of ACS Thruster 3 is 0.5.

# 1.4. ACS Thruster 4

The mass of ACS Thruster 4 is 0.5.

# 1.5. ACS Thruster 5

The mass of ACS Thruster 5 is 0.5.

# 1.6. ACS Thruster 6

The mass of ACS Thruster 6 is 0.5.

# 1.7. ADCS Electronics Unit

The mass of ADCS Electronics Unit is 2.0.

# 1.8. Avionics Stack Section

The mass of Avionics Stack Section is 0.6.

**Table 1.3. Avionics Stack Section Contained Assemblies**

| Assembly | Mass |
|---|---|
| ADCS Electronics Unit | 2.0 |
| EPS Regulators and Converters Unit | 14.48 |
| GPS Receiver Unit | 1.0 |
| Magnetorquer 1 | 0.5 |
| Magnetorquer 2 | 0.5 |
| Magnetorquer 3 | 0.5 |
| Power Control Unit | 5.96 |
| Primary Flight Computer Unit | 2.35 |
| Propulsion System Control Unit | 1.0 |
| Receiver Unit | 1.0 |
| Transmitter Unit | 2.1 |

# 1.9. BP Propellant Line Unit

The mass of BP Propellant Line Unit is 2.695.

# 1.10. Base Plate

The mass of Base Plate is 1.32.

# 1.11. Base Plate Module

The mass of Base Plate Module is 0.6.

**Table 1.4. Base Plate Module Contained Assemblies**

| Assembly | Mass |
|---|---|
| ACS Thruster 1 | 0.5 |
| ACS Thruster 2 | 0.5 |
| ACS Thruster 3 | 0.5 |
| ACS Thruster 4 | 0.5 |
| ACS Thruster 5 | 0.5 |
| ACS Thruster 6 | 0.5 |
| Avionics Stack Section | 0.6 |
| Base Plate | 1.32 |
| Battery Pack 1 | 3.103 |
| Battery Pack 2 | 3.103 |
| Battery Pack 3 | 3.103 |
| GPS Antenna | 0.25 |

| Assembly | Mass |
| --- | --- |
| Magnetometer | 0.85 |
| Primary Thruster | 1.0 |
| Propellant Handling Section | 0.6 |
| Reaction Wheel 1 | 0.1975 |
| Reaction Wheel 2 | 0.1975 |
| Reaction Wheel 3 | 0.1975 |
| Reaction Wheel 4 | 0.1975 |

# 1.12. Battery Pack 1

The mass of Battery Pack 1 is 3.103.

# 1.13. Battery Pack 2

The mass of Battery Pack 2 is 3.103.

# 1.14. Battery Pack 3

The mass of Battery Pack 3 is 3.103.

# 1.15. EPS Regulators and Converters Unit

The mass of EPS Regulators and Converters Unit is 14.48.

# 1.16. Earth Sensor

The mass of Earth Sensor is 2.75.

# 1.17. Fill/Drain Valve Unit

The mass of Fill/Drain Valve Unit is 3.75.

# 1.18. GPS Antenna

The mass of GPS Antenna is 0.25.

# 1.19. GPS Receiver Unit

The mass of GPS Receiver Unit is 1.0.

# 1.20. Launch Vehicle Adapter

The mass of Launch Vehicle Adapter is 5.0.

# 1.21. Launch Vehicle Interface Module

The mass of Launch Vehicle Interface Module is 0.6.

**Table 1.5. Launch Vehicle Interface Module Contained Assemblies**

| Assembly | Mass |
|---|---|
| Launch Vehicle Adapter | 5.0 |
| Separation System | 3.0 |

# 1.22. Magnetometer

The mass of Magnetometer is 0.85.

# 1.23. Magnetorquer 1

The mass of Magnetorquer 1 is 0.5.

# 1.24. Magnetorquer 2

The mass of Magnetorquer 2 is 0.5.

# 1.25. Magnetorquer 3

The mass of Magnetorquer 3 is 0.5.

# 1.26. PM Propellant Line Unit

The mass of PM Propellant Line Unit is 2.695.

# 1.27. Payload Module

The mass of Payload Module is 0.6.

**Table 1.6. Payload Module Contained Assemblies**

| Assembly | Mass |
|---|---|
| Payload Structural Interface | 3.5 |
| Sensor | 28.1 |

# 1.28. Payload Structural Interface

The mass of Payload Structural Interface is 3.5.

# 1.29. Power Control Unit

The mass of Power Control Unit is 5.96.

# 1.30. Pressurant Tank

The mass of Pressurant Tank is 10.0.

# 1.31. Pressurant Tank Mounting Panel

The mass of Pressurant Tank Mounting Panel is 2.7.

# 1.32. Primary Flight Computer Unit

The mass of Primary Flight Computer Unit is 2.35.

# 1.33. Primary Thruster

The mass of Primary Thruster is 1.0.

# 1.34. Propellant Handling Section

The mass of Propellant Handling Section is 0.6.

**Table 1.7. Propellant Handling Section Contained Assemblies**

| Assembly | Mass |
|---|---|
| BP Propellant Line Unit | 2.695 |
| Fill/Drain Valve Unit | 3.75 |

# 1.35. Propellant Tank

The mass of Propellant Tank is 20.0.

# 1.36. Propellant Tank Mounting Panel

The mass of Propellant Tank Mounting Panel is 2.7.

# 1.37. Propulsion Module

The mass of Propulsion Module is 0.6.

**Table 1.8. Propulsion Module Contained Assemblies**

| Assembly | Mass |
|---|---|
| PM Propellant Line Unit | 2.695 |
| Pressurant Tank | 10.0 |
| Pressurant Tank Mounting Panel | 2.7 |
| Propellant Tank | 20.0 |
| Propellant Tank Mounting Panel | 2.7 |
| Propulsion Structure Post 1 | 0.6 |
| Propulsion Structure Post 2 | 0.6 |
| Propulsion Structure Post 3 | 0.6 |
| Propulsion Structure Post 4 | 0.6 |

# 1.38. Propulsion Structure Post 1

The mass of Propulsion Structure Post 1 is 0.6.

# 1.39. Propulsion Structure Post 2

The mass of Propulsion Structure Post 2 is 0.6.

# 1.40. Propulsion Structure Post 3

The mass of Propulsion Structure Post 3 is 0.6.

# 1.41. Propulsion Structure Post 4

The mass of Propulsion Structure Post 4 is 0.6.

# 1.42. Propulsion System Control Unit

The mass of Propulsion System Control Unit is 1.0.

# 1.43. Reaction Wheel 1

The mass of Reaction Wheel 1 is 0.1975.

# 1.44. Reaction Wheel 2

The mass of Reaction Wheel 2 is 0.1975.

# 1.45. Reaction Wheel 3

The mass of Reaction Wheel 3 is 0.1975.

# 1.46. Reaction Wheel 4

The mass of Reaction Wheel 4 is 0.1975.

# 1.47. Receive Whip Antenna

The mass of Receive Whip Antenna is 0.08.

# 1.48. Receiver Unit

The mass of Receiver Unit is 1.0.

# 1.49. Sensor

The mass of Sensor is 28.1.

# 1.50. Separation System

The mass of Separation System is 3.0.

# 1.51. Side Panel 1

The mass of Side Panel 1 is 0.8.

# 1.52. Side Panel 2

The mass of Side Panel 2 is 0.8.

# 1.53. Side Panel 3

The mass of Side Panel 3 is 0.8.

# 1.54. Side Panel 4

The mass of Side Panel 4 is 0.8.

# 1.55. Side Panel 5

The mass of Side Panel 5 is 0.8.

# 1.56. Side Panel 6

The mass of Side Panel 6 is 0.8.

# 1.57. Solar Array with SADA 1

The mass of Solar Array with SADA 1 is 7.965.

# 1.58. Solar Array with SADA 2

The mass of Solar Array with SADA 2 is 7.965.

# 1.59. Spacecraft System Segment

The mass of Spacecraft System Segment is 0.6.

**Table 1.9. Spacecraft System Segment Contained Assemblies**

| Assembly | Mass |
|---|---|
| Base Plate Module | 0.6 |
| Launch Vehicle Interface Module | 0.6 |
| Payload Module | 0.6 |
| Propulsion Module | 0.6 |
| Side Panel 1 | 0.8 |
| Side Panel 2 | 0.8 |
| Side Panel 3 | 0.8 |

| Assembly | Mass |
| --- | --- |
| Side Panel 4 | 0.8 |
| Side Panel 5 | 0.8 |
| Side Panel 6 | 0.8 |
| Solar Array with SADA 1 | 7.965 |
| Solar Array with SADA 2 | 7.965 |
| Thermal Blankets | 3.9 |
| Top Panel Module | 0.6 |

# 1.60. Structure Post 1

The mass of Structure Post 1 is 0.6.

# 1.61. Structure Post 2

The mass of Structure Post 2 is 0.6.

# 1.62. Structure Post 3

The mass of Structure Post 3 is 0.6.

# 1.63. Structure Post 4

The mass of Structure Post 4 is 0.6.

# 1.64. Structure Post 5

The mass of Structure Post 5 is 0.6.

# 1.65. Structure Post 6

The mass of Structure Post 6 is 0.6.

# 1.66. Sun Sensor

The mass of Sun Sensor is 0.6.

# 1.67. Thermal Blankets

The mass of Thermal Blankets is 3.9.

# 1.68. Top Panel

The mass of Top Panel is 2.7.

# 1.69. Top Panel Module

The mass of Top Panel Module is 0.6.

**Table 1.10. Top Panel Module Contained Assemblies**

| Assembly | Mass |
|---|---|
| Earth Sensor | 2.75 |
| Receive Whip Antenna | 0.08 |
| Structure Post 1 | 0.6 |
| Structure Post 2 | 0.6 |
| Structure Post 3 | 0.6 |
| Structure Post 4 | 0.6 |
| Structure Post 5 | 0.6 |
| Structure Post 6 | 0.6 |
| Sun Sensor | 0.6 |
| Top Panel | 2.7 |
| Transmit Hi-Gain Antenna | 0.04 |
| Transmit Whip Antenna | 0.04 |

# 1.70. Transmit Hi-Gain Antenna

The mass of Transmit Hi-Gain Antenna is 0.04.

# 1.71. Transmit Whip Antenna

The mass of Transmit Whip Antenna is 0.04.

# 1.72. Transmitter Unit

The mass of Transmitter Unit is 2.1.