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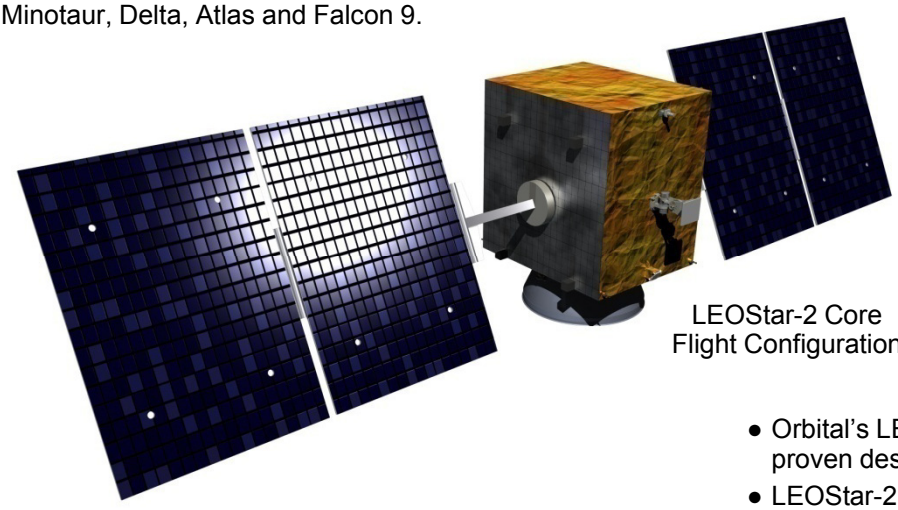
RSDO Rapid III LEOStar-2 Specification/Data Sheet

Orbital's LEOStar-2 Spacecraft is an affordable, versatile, spacecraft bus suitable for both Commercial and Government Payloads. LEOStar-2 is designed to support programs such as Explorer, Earth Science Decadal Survey and Discovery and can be configured for compatibility with numerous payloads and launch vehicles such as Pegasus, Falcon 1e, Taurus, Taurus II, Minotaur, Delta, Atlas and Falcon 9.



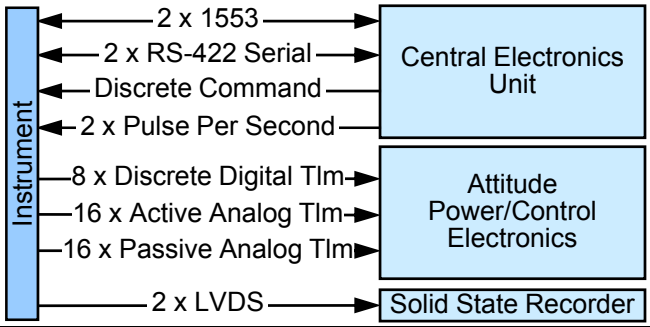
LEOStar-2 Core Flight Configuration

Highlights & Features:

- Extensive NASA Flight Heritage Missions Include SORCE, GALEX, AIM & Dawn
- The LEOStar-2 Architecture Can be Applied to Both Low Earth Orbiting and Interplanetary Space Missions
- LEOStar-2 Has Been Configured in Both Redundant and Single String Variations
- Flexible Avionics Architecture Allows Payload Accommodations to be Easily Tailored to Meet Mission Specific Needs
- Demonstrated Contamination Control Processes for Sensitive Science Payloads
- Compatible with Most US Launch Vehicles

Core Spacecraft Performance Parameters	
Parameter	**Performance**
Spacecraft Dry Mass	938 kg
Propellant Load	289 kg
Spacecraft Bus Voltage	24-34 VDC
Orbit Knowledge	9 m (3σ)
Pointing Knowledge	42 arcsec (3σ)
Pointing Control	48 arcsec (3σ)
Max. Maneuver Rate	1 °/sec
Timing Accuracy	2 microseconds
Total Radiation Dose	>30 kRads
Spacecraft Ps @ 5 years	0.88
Core Payload Accommodation Parameters	
Parameter	**Performance**
Instrument Mass	500 kg
Instrument OAP	850 W
Instrument Data Storage	500 Gbits
Achievable Downlink Rate	300 Mbps

Payload Digital Interfaces



- Orbital's LEOStar-2 spacecraft utilizes a mature low-risk flight-proven design with established vendor sources
- LEOStar-2 is a fully-redundant 3-axis stabilized spacecraft intended for missions with a 5-year nominal duration
- Spacecraft resources and propellant capacity are sized for 7 years of operation
- LEOStar-2 spacecraft have also been configured as Single String for missions with shorter lifetimes

LEOStar-2 Additional Capabilities

In addition to our Core LEOStar-2 Rapid III capabilities, we have demonstrated the capabilities shown below in other LEOStar-2 missions. Some of these capabilities would require additional funding or schedule adjustments to our Baseline Rapid III offering.

Additional Capabilities
Increased Pointing Knowledge and Control Through Co-Location of Attitude Sensors on Instrument Platform
Increased Science Data Downlink and On-board Science Data Storage Capacity
Payload Instruments can be Thermally Isolated from the Spacecraft or the Spacecraft Can Provide Thermal Control for the Instruments or Instrument Electronics
Increased Slew/Maneuver Capability Using Alternate or Increased Number of Reaction Wheels
Provision for On-Orbit Operations Using Orbital's Mission Operations Center
Single-String Configurations with No Propulsion and Reduced Payload Capabilities are Also Available for Missions with Less Demanding Payload Accommodation Requirements and Shorter Mission Durations
Spacecraft Structure Tailorable in Width and Height to Accommodate Varying Payload Dimensional Requirements
Propellant Load Capacity Can be Raised or Lowered by Substituting Another Qualified Propellant Tank or Tailoring the Fill Fraction

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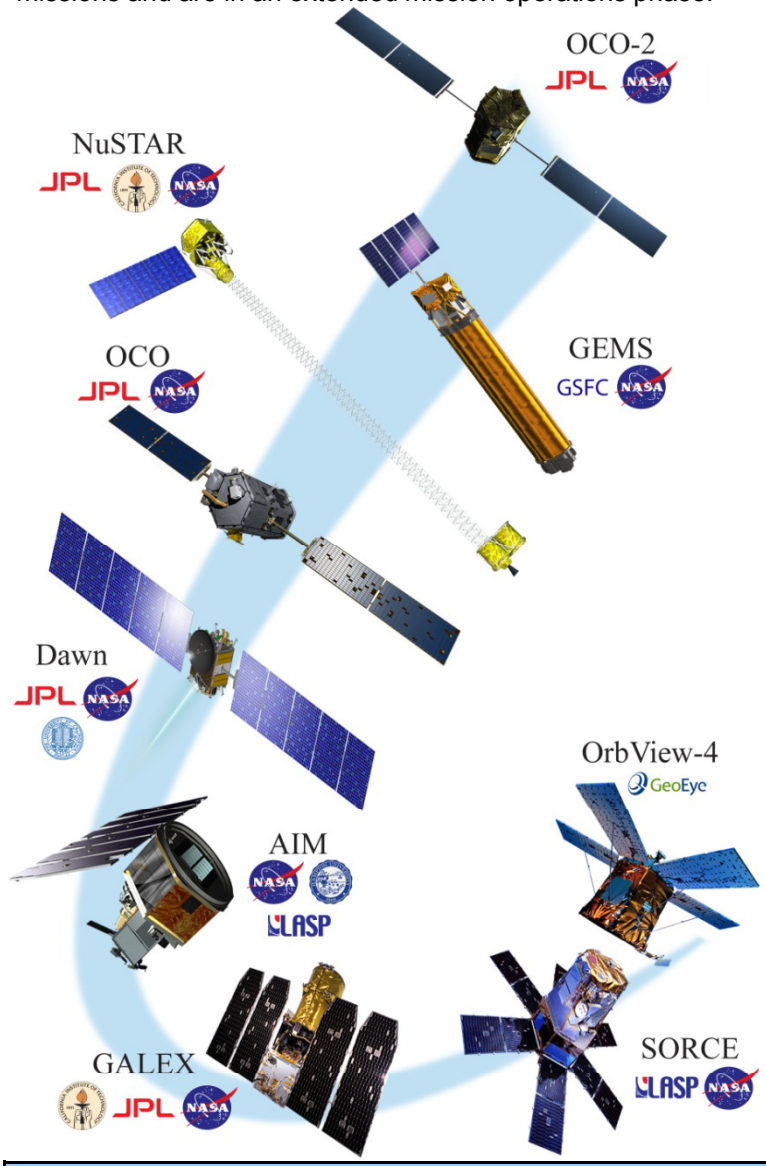
Mission Heritage

LEOStar-2 spacecraft have previously been configured to support both Earth observing and astronomical science missions and have flown in numerous low-earth orbits and one Interplanetary mission (Dawn).

Of the four LEOStar-2 missions currently in orbit (SORCE, GALEX, AIM and Dawn), three have completed their baseline missions and are in an extended mission operations phase.



LEOStar-2 Missions

Orbiting Carbon Observatory-2 (OCO-2)
Mission: Atmospheric Monitoring
Launch: 2013, LV TBD
Status: In Formulation

Gravity and Extreme Magnetism SMEX (GEMS)
Mission: X-ray Polarization of Black Holes
Launch: 2014, LV TBD
Status: In Development

Nuclear Spectroscopic Telescope Array (NuSTAR)
Mission: X-Ray Detection of Black Holes
Launch: 2011, Pegasus XL
Status: In Development

Orbiting Carbon Observatory (OCO)
Mission: Atmospheric Monitoring
Launch: 2009, Taurus XL
Status: Lost Due to LV Failure

Dawn
Mission: Asteroid Investigation
Launch: 2007, Delta II
Status: Fully Operational Since Launch

Aeronomy of Ice in the Mesosphere (AIM)
Mission: Atmospheric Monitoring
Launch: 2007, Pegasus XL
Status: In Extended Operations

Galaxy Evolution Explorer (GALEX)
Mission: Astronomic Exploration
Launch: 2003, Pegasus XL
Status: In Extended Operations

Solar Radiation and Climate Experiment (SORCE)
Mission: Solar Irradiance Measurement and Monitoring
Launch: 2003, Pegasus XL
Status: In Extended Operations

OrbView-4
Mission: Earth Observing/Remote Sensing
Launch: 2001, Taurus
Status: Lost Due to LV Failure

Previously Launched LEOStar-2 Top Level Spacecraft Parameters						
Parameter	**OrbView-4**	**SORCE**	**GALEX**	**AIM**	**Dawn**	**OCO**
Orbit (km x inclination)	480 x SSO	645 x 40°	690 x 28°	600 x SSO	Interplanetary	705 x SSO
Design Life (mos)	60	60	29	26	120	24
Redundancy	Selective	Redundant	Single String	Single String	Redundant	Selective
Propulsion	Yes	No	No	No	Yes	Yes
Payload Mass (kg)	52	96	131	64	46	149
Bus Mass (kg)	184	191	151	133	702	290
Payload Power (watts OAP)	10	158	132	113	30	136
Bus Power (watts OAP)	162	166	160	155	3000	193

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LEOStar-2 Spacecraft Description

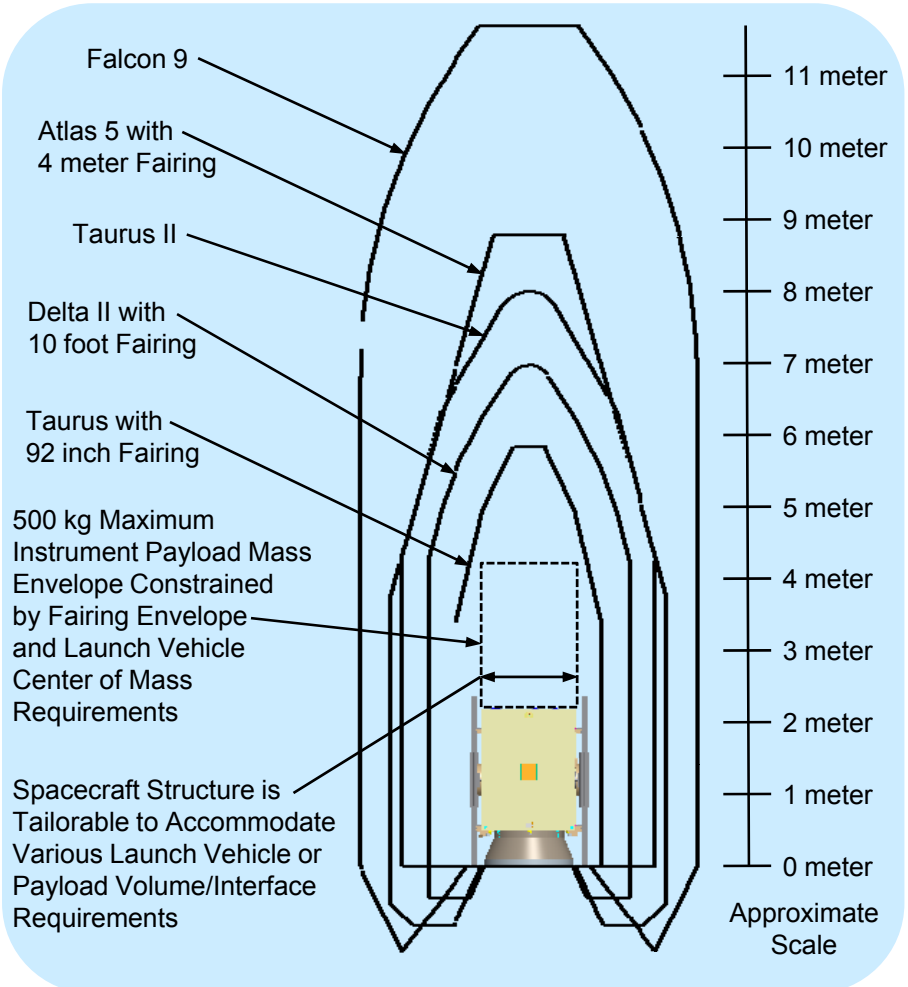
Command and Data Handling
- Central Electronics Unit (CEU)
- Attitude/Power Control Electronics (APE/ACE)
- MIL-STD-1553 data bus and RS-422 serial interfaces provided
- 8 Gbits memory for Spacecraft SOH telemetry Storage
- 500 Gbit Solid State Recorder for Payload Data Storage

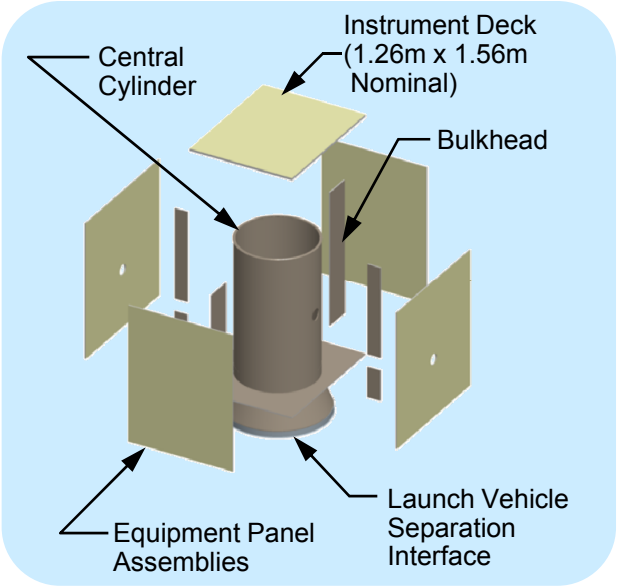
Communications
- Features both low rate S-Band communications for command and telemetry functions and wideband X-Band communications for payload data downlink
- S-band system has low-rate TDRSS forward and return link compatibility
- X-band rate capability of 300 Mbps

Electrical Power
- Features a direct (solar) energy transfer system with a Shunt Regulator Electronics (SRE)
- Power Distribution Unit (PDU) and Fuse Assembly provided for instrument and spacecraft load control

LEOStar-2 Stowed Configuration

LEOStar-2 is Compatible with Several Launch Vehicles and Fairing Configurations.





Structure
- Composed of a Core Structure Assembly (CSA) & Equipment Panel Assemblies (EPA)
  - CSA : all-bonded graphite/epoxy composite honeycomb central thrust tube with interface bulkheads
  - EPA: Aluminum honeycomb
- Instrument deck panel provides unobstructed field of view for the instrument
- Instrument mounting is usually accomplished through low thermal conductivity attachment points

Thermal –
- Primarily passive design; MLI blankets, paints, and tapes used to control temperatures
- Software controlled heaters provide fine temperature control with thermostatically controlled heaters used as backup
- Heat pipes embedded in the equipment panels to conduct heat away from high-dissipating electrical power components

Attitude Control
- Utilizes high accuracy star tracker/gyros, GPS, and zero momentum bias reaction wheels
- Precise pointing and attitude knowledge in any attitude including earth, solar, and inertial as needed for mission requirements
- Proven attitude control algorithms assure flight performance

Propulsion
- Features a monopropellant hydrazine blowdown system with four 220 N thrusters and eight 5 N thrusters (fully redundant)
- Qualified cylindrically wrapped carbon-fiber propellant tank with titanium liner
- Propellant load capacity of 289 kg allows for precision orbit maintenance and capability for controlled deorbit to meet orbital debris requirements

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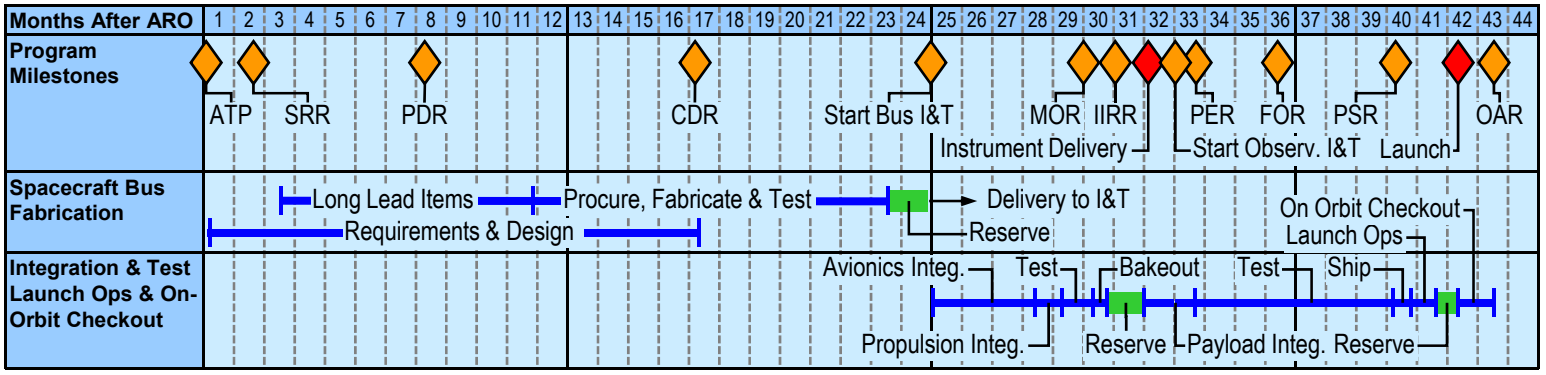
Contract Baseline Delivery Schedule

Orbital's LEOStar-2 Contract Baseline Delivery Schedule of 42 months to launch includes 14 weeks of funded schedule reserve. With several versions of the LEOStar-2 spacecraft already produced for a variety of NASA science missions, our proposed delivery schedule is proven, robust and low risk.



Facilities Overview and Use Plan

Facility	Dulles, VA	Gilbert, AZ
10K Integration Clean Room	Three 800 ft² Class 10,000 Clean Rooms	Two 1,800 ft² Class 10,000 Clean Rooms
100K Integration Clean Room	22,000 ft² Class 100,000 Clean Room	13,000 ft² I&T & 7,000 ft² Deployment Bay
Propulsion Assy	Yes – Full Integration, Weld and Inspection	No
Dynamics Test	Yes - Largest Capable of 40K lbf	Yes – Largest Capable of 60K lbf
Acoustic Test	Yes, Capable of 145 dB OASPL	Yes, Capable of 153 dB OASPL; Simultaneous Vibe & Acoustic
EMC Chamber	Yes - 24' x 20' x 28' high	Yes – 27' x 30' x 21' high
Thermal Vacuum Chambers	Yes - 12' dia X 16' long, Cryogenic Pumps	Yes - 15' dia X 20' long, Cryogenic Pumps


Dulles, VA Satellite Manufacturing Facility


Gilbert, AZ Satellite Manufacturing Facility

Orbital has two spacecraft development facilities located in Dulles, Virginia, and Gilbert, Arizona. Both feature multiple design teams experienced in the formulation, design, build, test, and operation of NASA and DoD satellites and space hardware. Both facilities have executed a variety of observatory integration (including instrument integration) and environmental test programs. Each features integration, EMI/EMC, dynamics, and thermal vacuum testing, all under one roof.

LEOStar-2 spacecraft can be assembled, integrated with their instrument payloads, and tested in either facility.

For Additional Information,

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