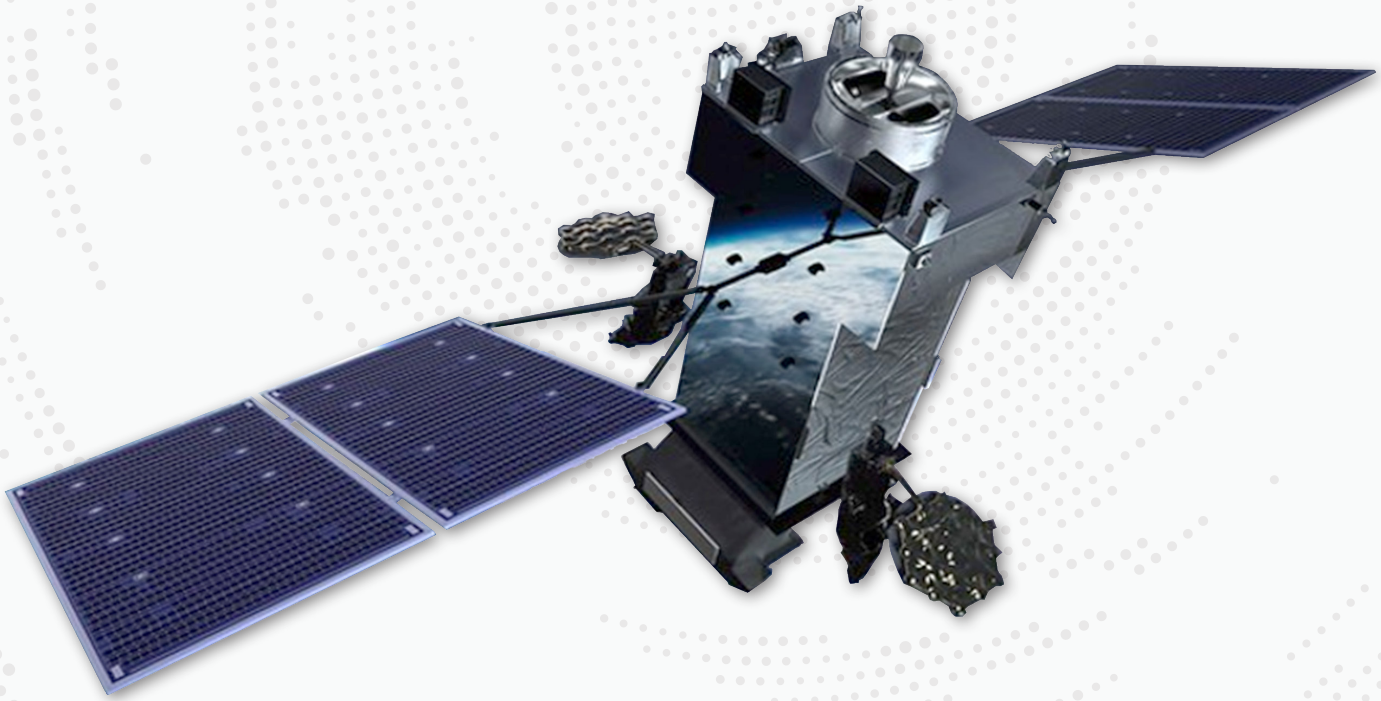


LM2100

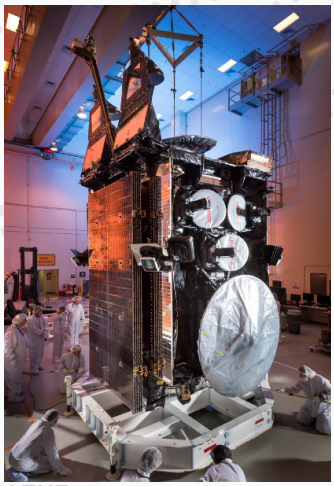
Proven & Powerful

Proven Pedigree for All Missions

We've modernized our high-power satellite to become the LM2100. It is our most advanced evolution of our largest and most popular satellite bus, the heritage A2100. Same high performance. Same reliability. Same ease of operation. But now enhanced by significant investments in technology and process improvements.

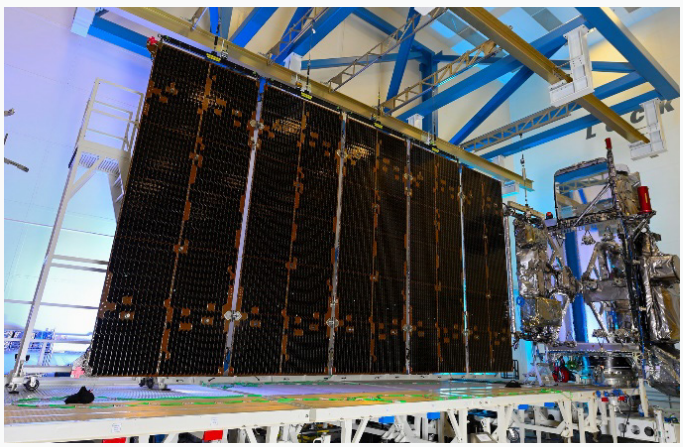
Lockheed Martin's A2100 bus has been the foundational platform used for numerous satellites built and flown over the last 20 years including over 70 satellites launched to various orbits serving multiple missions. LM2100 leverages hardware that has demonstrated flight performance of A2100 satellites on orbit.

The LM2100 bus is designed for a range of mission applications and has heritage on military (Advanced Extremely High Frequency (AEHF) and Global Positioning System (GPS)), communications (HellasSat-4), and remote sensing satellites (Geostationary Operational Environmental Satellite-R series (GOES-R)).



AEHF

Hellas-Sat-4



GOES-T

LOCKHEED MARTIN

SV22119

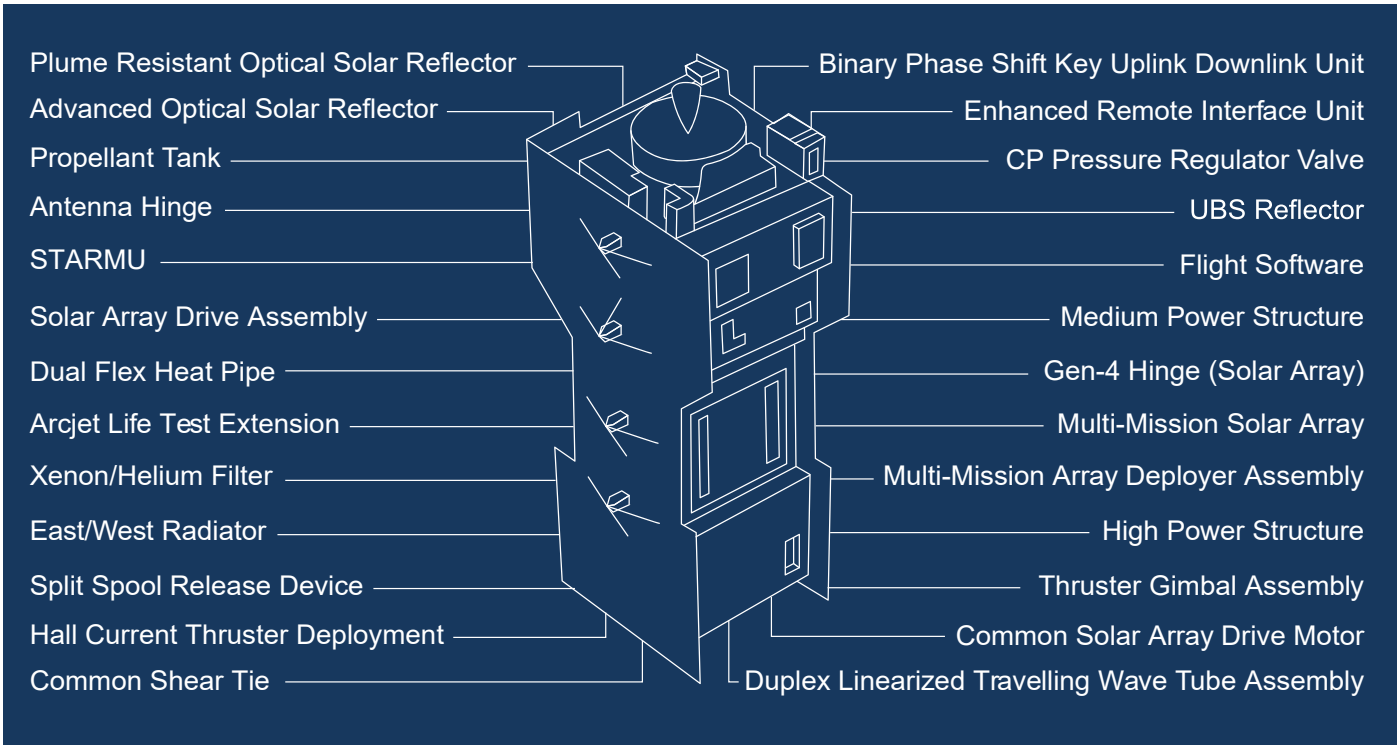
LM2100 Platform Capabilities

The LM2100 bus is a scalable 3-axis stabilized satellite platform for both transfer orbit and on-orbit operations. The LM2100 platform includes a scalable core structure/propulsion module, power, GN&C and C&DH subsystems, flight software, RF components and antenna systems.

Although originally intended for GPS III (MEO) and GEO communications applications, LM2100 may be applied to other orbital regimes, and adapted to satisfy mission-unique requirements such as multiple launch packaging. The LM2100 architecture supports a 15 year life with high reliability and single fault tolerance.

Configure-to-Order for Mission-Specific Needs

The architecture also may be extended to support remote sensing missions and to host optical payloads on communications spacecraft. As an example, the C&DH architecture supports the addition of a plug-in processing/transmit chain for remote sensing data acquisition and downlink. Another example is the GOES-R vibration isolated Earth Pointing Platform (EPP) that accommodates jitter sensitive payloads with a standard LM2100 bus structure and component suite.



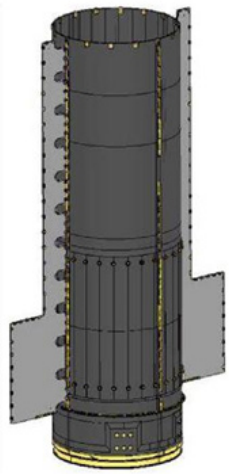
Mission Parameters	
Lifetime, years	15 (up to 21 based on mission configuration)
Orbit	Primarily - GEO, MEO, HEO
Launch vehicle	Atlas V, Falcon 9, Falcon Heavy, Arianne 6, ULA Vulcan
Bus dimensions	~12x6 ft / ~3.7x1.8 m rectangle
Payload mass capacity	300 to 1,275+ kg
Payload power capacity Orbit average, peak	1,400 to 16,000 W; >20,000 W (Peak)
Internal payload volume	Multiple areas each approx 10 m^2; height accommodation varies
External payload volume	Approximate contiguous volume 3.5 m^3; additional external mounting volume available based on mission unique LM2100 configuration and launch vehicle / fairing selection
Pointing	
Type	3-axis stabilized
Pointing modes	Sun, nadir, Earth (additional modes available based on mission unique configuration)
Pointing accuracy	<360 arcsec (option package available to increase accuracy)
Pointing knowledge	<72 arcsec
Propulsion	
Propellant Type	Chemical Propulsion (monopropellant and bipropellant thrusters, Arcjets); Electric Propulsion (HCT propulsion system)

Bus Design Features

Structure

The LM2100 structure consists of aluminum honeycomb panels with an open internal structure that is based around a central cylinder design. The structural core houses all propulsion equipment and provides the load path through the lower transition adapter to the launch vehicle.

LM2100 Center Cylinder



Command and Data Handling

The LM2100 retains the simplicity and versatility of the previously flown A2100 C&DH architecture. Significant end items within the C&DH subsystem are the On-Board Computer (OBC), the Uplink/Downlink Unit (UDU), and the Enhanced Remote Interface Unit (ERIU). The UDU provides the uplink/downlink functionality with the ground along with providing encryption as needed. The ERIU provides the functionality to connect with subsystems and sensors, while the OBC provides the processing capability.

Flight Software (FSW)

The LM2100 baseline flight software is an update to the previously flown A2100 TR flight software, and consists of a stable, mature architecture that has flown successfully on multiple commercial and government satellites. It is fully reprogrammable and provides a centralized redundancy management scheme.

Electrical Power Subsystem (EPS)

The Electrical Power subsystem includes a flight-proven Scalable Power Regulation Unit (SPRU) for power conditioning and distribution. The SPRU is scalable to meet payload and electric propulsion needs and provides 70V of primary power for bus and communications equipment and an optional 28V secondary bus.

The battery design for the LM2100 platform uses a Lithium-Ion battery for energy storage in various configurations to support required power for a mission.

The LM2100 baseline configuration uses the Standardized Modular Assembly with Reliable Technology (SMART) rigid solar arrays with modern solar cells.

Guidance, Navigation and Control (GNC)

The baseline LM2100 GNC subsystem is comprised of redundant star trackers, coarse sun sensors, gyros, onboard computing, flight software, reaction wheels, and thrusters that can support all mission phases including orbit raising and on-orbit operations.

Communications

The Telemetry, Tracking & Command (TT&C) subsystem provides reliable communications during all mission phases and spacecraft attitudes, incorporating omni and horn antennas as required to support the mission.

Propulsion

Propulsion options for the LM2100 platform include All-Chemical, All-Electric, or Hybrid configurations. A bipropellant Liquid Apogee Engine (LAE) is used for the main velocity change maneuvers. Monopropellant Hydrazine Rocket Engine Assembly (REA) thrusters or Arcjets are used for ascent control authority, stationkeeping maneuvers, and momentum management.

Thermal Control Subsystem (TCS)

The LM2100 TCS provides reliable, flight-proven performance with a minimum mass. Spacecraft component temperatures are maintained by the use of multilayer thermal insulation blankets and membranes, active heater control, and heat pipes.

Mechanisms

The LM2100 satellite features highly reliable, flight-proven components for all moving assemblies on the satellite. These components include:

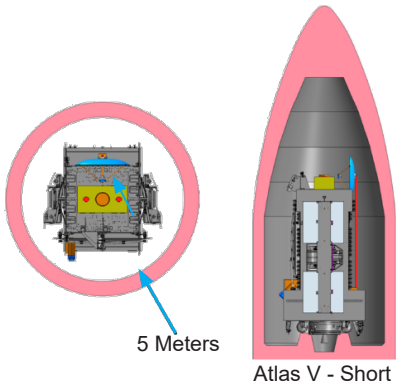
- Solar Array Drive Assemblies (SADA) for solar array tracking and pointing
- Hinges for solar array deployment
- Two-axis gimbals for antenna deployment and pointing
- Solar array and antenna retention systems

LM2100 mechanisms are electrically redundant and, where practical, mechanically redundant. The mechanism design philosophy seeks to maximize performance, efficiency, and reliability, while minimizing complexity, risk, and weight.

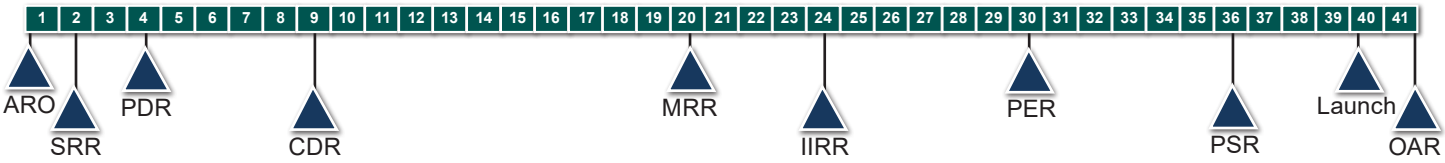
Launch Vehicle Compatibility

The LM2100 bus is compatible with Atlas V, Falcon 9, Falcon Heavy, Arianne 6, and ULA Vulcan launch vehicles.

LM2100 in Atlas V – Short fairing

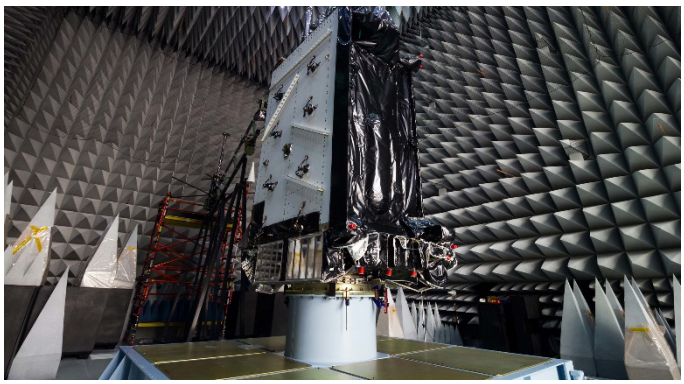


40 Months from ARO to Launch

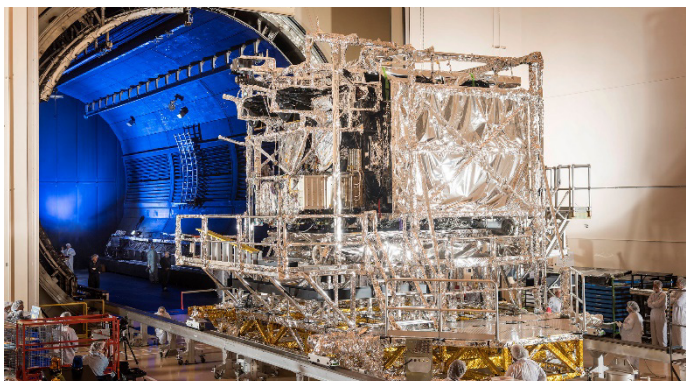


World Class Facilities

The LM2100 program leverages multiple world class Lockheed Martin Space Systems Company facilities in Denver, CO and Sunnyvale, CA. The Denver facility was the home of GOES-R, SBIRS, HellasSat, ArabSat, and JCSAT-17 and currently home to several programs including current production of the GPS IIIF satellites. The Sunnyvale, CA facility also offers the full set of manufacturing and test facilities required for the LM2100 program supporting programs such as Hubble Space Telescope, Spitzer Space Telescope, Defense Meteorological Satellite Program (DMSP), IKONOS, GeoEye-2, IRIS and current programs including SBIRS and Next Gen OPIR.



GPS III EMI/EMC/PIM Testing

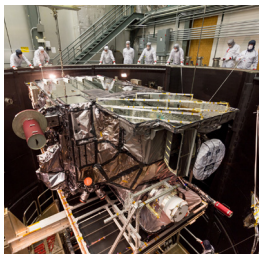


AEHF moves to TVAC

Integration and Test

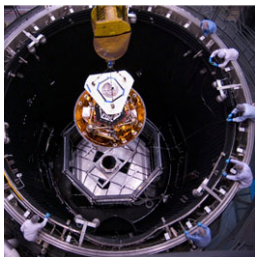
Special Test Facilities

High Bays/Clean Rooms

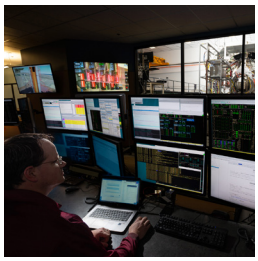


Multifunction Test Facility

Acoustic Lab



Thermal Vacuum Chambers



Test Control Center

Mission Support Area

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