



HIGH ALTITUDE BALLOON SYSTEMS

FOR SCIENTIFIC AND COMMERCIAL APPLICATIONS

CONTROLLED AND STEERABLE NEAR SPACE FLIGHT

Aerostar is the world leader in stratospheric and lighter-than-air technologies. Leveraging high altitude wind patterns, our platforms can navigate to, and persist over, areas of interest at near-space altitudes. Aerostar is ready to help across the entire lifecycle of your experiment or mission, offering test planning, hardware integration, logistics, launch and recovery support. Our standard gondola packages, documented hardware, software, electrical and mechanical interfaces make payload integration quick and painless. Our flight operations team has performed hundreds of launches around the world and stands ready to support any scenario.

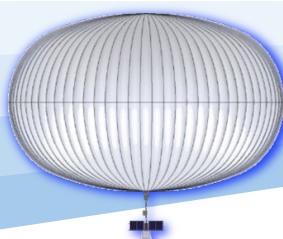
Stratospheric balloons provide the ability to carry instrumentation to the edge of space and remain there for weeks at a time at a relatively low cost. They are ideal platform for long-duration earth observations, long-distance communications, scientific experimentation, and spaceflight risk reduction.

AEROSTAR FAMILY OF SYSTEMS

LARGE BALLOON
Large Zero-
Pressure Balloon
System



THUNDERHEAD
Super-Pressure
Balloon System



CYCLONE
Zero-Pressure
Balloon
System



LIGHTNING
Tactical Zero-
Pressure Balloon
System



NS3
High-Altitude
Glider
for Recovery
or ALE

Family of Systems Share Common Operational Framework



**Field
Deployment
and Logistics**

**Thunderstorm
C2 and Mission
Planning**



**Common
Electronics with
Defined Interfaces**

**Payload
Integration and
Engineering**

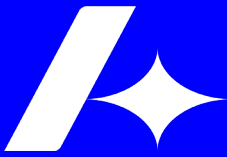


For more than 65 years, Aerostar has designed, manufactured, and integrated systems that solve challenges in Aerospace. From engineering services, design, and development to highly-technical products and support, we offer tailored turnkey solutions for a multitude of missions.



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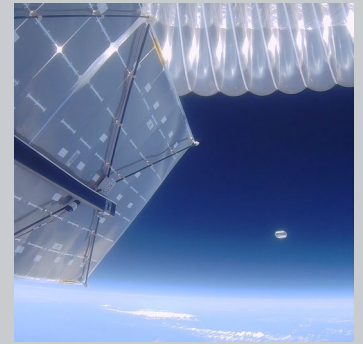
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THUNDERHEAD BALLOON SYSTEM

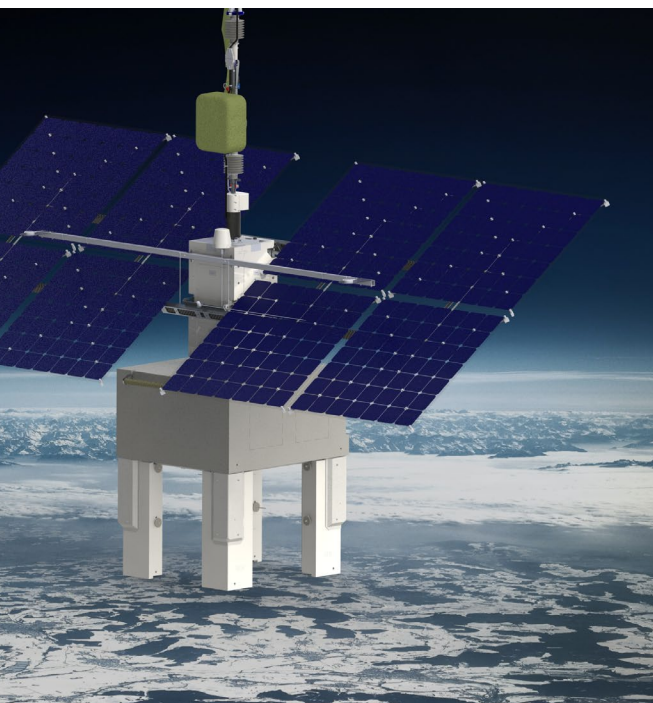
FOR SCIENCE APPLICATIONS

Aerostar's Thunderhead super pressure balloon system has spent more time in the stratosphere than any other HAB system. The Thunderhead Balloon System can achieve altitudes from 45,000 ft – 95,000 ft with a wide variety of user payloads ranging from 125-200 pounds. Mission duration of 60+ days are possible, allowing for data collection over a wide area of interest. The Thunderhead balloon system supports ISR, Earth Observation, communications extension, and other applications.



THUNDERHEAD FEATURES

The Thunderhead Balloon System is a cost-effective platform that provides many advantages for a range of complex, tactical missions by providing a uniquely high SWAP, long duration platform maneuverable anywhere in the world. Stratospheric balloons provide the ability to carry instrumentation to the edge of space and remain there for weeks at a time. They are an ideal platform for long-duration earth observation, long-distance communications, scientific experimentation, and spaceflight risk reduction. Thunderheads have made long duration and navigational stratospheric missions a proven reality. By leveraging directional wind patterns at high altitudes, Thunderhead offers groundbreaking capabilities for navigation and persistence over areas of interest. With Thunderhead, controlled flight and long duration capabilities can be planned and executed at a fraction of the cost and time of traditional platforms.



THUNDERHEAD BALLOON SYSTEM

PARAMETER

SPECIFICATION

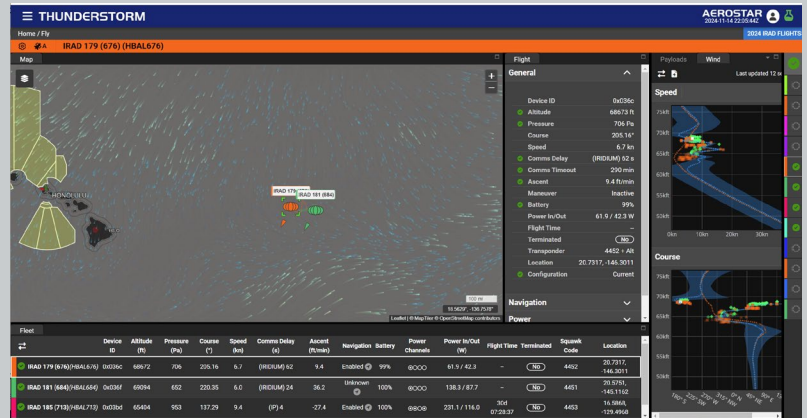
Duration	60+ days
Operating Altitude	55-75,000 ft Typical (Other Altitudes Available from 45-95,000 ft)
Max Payload Mass	125-200 lbs
Payload Envelope	42" x 42" x 42", or larger with consultation
Payload Power Provided	+28V/+12V/+5V, up to 375 W/rail, 1200W max*
Gondola Thermal Control	200W+ heat transfer and programmable heaters
BLOS/LOS Comms	Iridium, Optional High Bandwidth Line-of-Sight Mesh or Satellite Comms
Payload Data Services	Real-time GPS/INS Data via Ethernet

**Total energy availability depends on flight profile and geography*

Contact Aerostar for the full User's Guide, including detailed interface specifications, concepts of operations, and more!

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The Thunderstorm software suite provides a host of mission planning tools and piloting capabilities. All of Aerostar's stratospheric platforms, including Lightning, Cyclone, Thunderhead, and Large Balloon System are supported by the Thunderstorm software suite. Thunderstorm is a server-based software suite that is remotely accessible through secure VPN anywhere in the world.



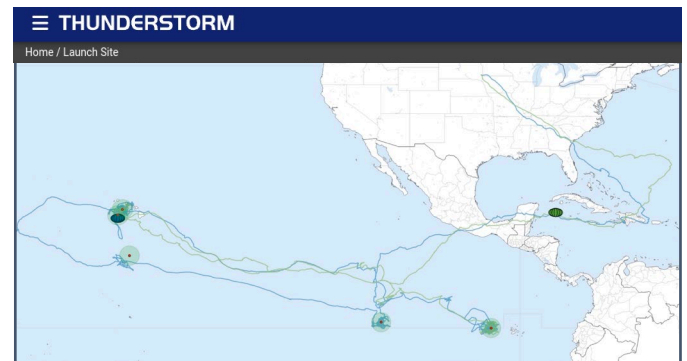
STRATOSPHERIC OPERATIONS

Thunderstorm provides real-time situational awareness for stratospheric missions. The Thunderstorm mission view provides a map showing all assets involved in the mission, payload field of regard, and mission-specific views of airspace restrictions, area of operation, or other important information. Operators can choose dynamic layouts to bring the most important information to the forefront, including detailed flight information, more compact information about multiple balloons in a fleet, in-situ wind data. Operators can also use direction assist or autopiloting modes to automate operation of the balloon systems.

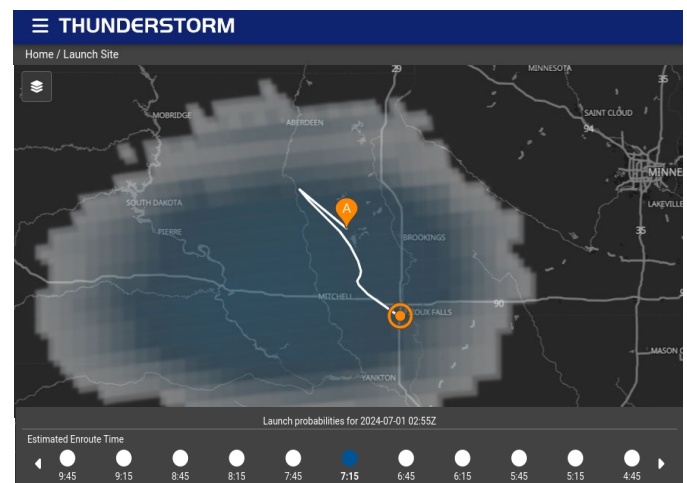
WIND DIVERSITY ASSESSMENTS

Wind Diversity Probability							
Balloon Type	April	May	June	July	August	September	October
100 Series	9%	58%	86%	88%	89%	67%	11%
200 Series	51%	96%	95%	75%	77%	96%	44%
300 Series	58%	81%	30%	10%	12%	72%	51%
400 Series	51%	71%	6%	0%	0%	35%	42%

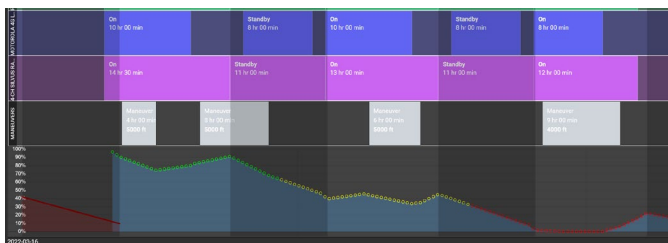
FLIGHT PATH AND STATION SEEKING TOOLS



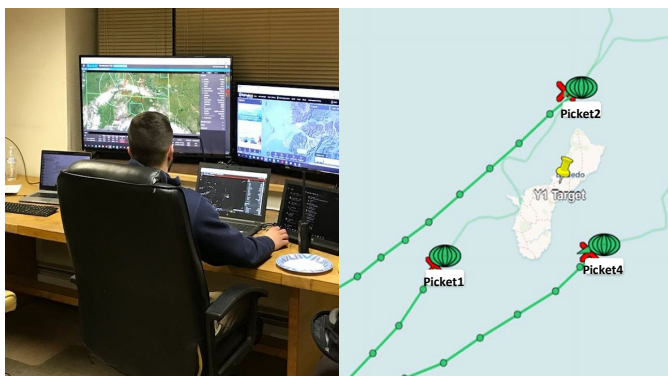
TACTICAL LAUNCH SITE PLANNING



MANEUVERING AND PAYLOAD POWER PLANNING



DESIGNED FOR A SINGLE USER TO PILOT A MULTI-HAB CONSTELLATION





CYCLONE BALLOON SYSTEM

FOR SCIENCE APPLICATIONS

Aerostar's Cyclone medium to large zero pressure balloon system can achieve altitudes from 45,000 ft – 110,000+ ft with a wide variety of user payloads up to 125 pounds. Cyclone flights are well-suited for risk reduction testing or scientific missions lasting 1-2 days. The Cyclone system brings medium to large payloads to the edge of space with multiple options for payload support, including standard or custom gondolas, thermal control, and multiple communications options.



CYCLONE FEATURES

The Cyclone Balloon System is ideal to meet the needs of the research and defense community, offering short-duration flights in the stratosphere for a wide variety of payloads. In addition, Cyclone is the perfect test platform for payloads targeted at Aerostar's long-duration Thunderhead model. Cyclone offers identical hardware and software interfaces to the Thunderhead platform and provides for more cost-effective launches for early payload risk reduction flight testing. Cyclone flight planning and command and control are integrated into the Thunderstorm ground system, which supports all of Aerostar's Balloon Systems. The Cyclone flight control unit (FCU) provides 360 degree pointing control, real-time GPS and INS data feed to the payload, recovery parachute, and multiple payload power rails. The Cyclone FCU is easily integrated with Aerostar's standard payload gondola, Advanced Payload Gondola, or a custom payload integration solution, for rapid, smooth, and low-risk integration.



CYCLONE BALLOON SYSTEM

PARAMETER	SPECIFICATION
Duration	8-36 hours
Operating Altitude	75-97,000 ft Typical (Other Altitudes Available from 45-110,000 ft)
Max Payload Mass	125-200 lbs
Payload Envelope	42" x 42" x 42", or larger with consultation
Payload Power Provided	+28V/+12V/+5V, up to 375 W/rail, 1200W max*
Gondola Thermal Control	200W+ heat transfer and programmable heaters
BLOS/LOS Comms	Iridium, Optional High Bandwidth Line-of-Sight Mesh or Satellite Comms
Payload Data Services	Real-time GPS/INS Data via Ethernet

**Total energy availability depends on flight profile*

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LIGHTNING BALLOON SYSTEM

TACTICAL STRATOSPHERIC CAPABILITY

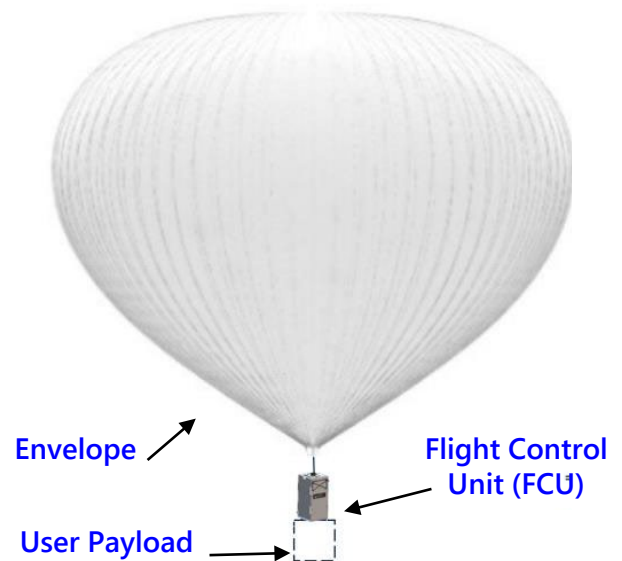
Aerostar's Lightning zero-pressure balloon system can achieve altitudes from 50,000 ft – 78,000 ft with a wide variety of user payloads 20-45 pounds. Aerostar's Lightning balloon system is a tactical solution, paving the way to the stratosphere for small payloads. The Lightning balloon system provides several days of maneuverable flight from a package that can be launched quickly by two personnel out of the back of a truck.



LIGHTNING FEATURES

The Lightning Balloon System is a low-cost, tactical zero-pressure balloon platform that provides many advantages for short-duration missions anywhere in the world. Flexibility, ease of launch, and intuitive user interfaces make the Lightning Balloon System an ideal candidate for small team tactical missions and smaller payloads. The Lightning system is integrated into the Aerostar Thunderstorm software suite, providing unified Command, Control, and Mission Planning which supports all Aerostar Balloon Systems. Aerostar has tested and deployed Lightning Balloon Systems in a variety of austere, maritime, and cold weather environments. Aerostar has also operated the Lightning Balloon Systems with hydrogen gas.

Zero Pressure Balloon



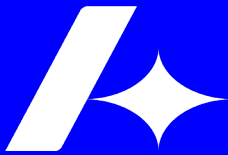
LIGHTNING BALLOON SYSTEM

PARAMETER	SPECIFICATION
Duration	1-3 day
Operating Altitude	50 - 78,000 ft typical (Other Altitudes Available from 45-110,000 ft)
Max Payload Mass	20-45 lbs
Payload Envelope	13" x 16" x 18", or larger with consultation
Payload Power Provided	+28 V (Mult rails), up to 150 W/rail, 300 W max*
BLOS/LOS Comms	Iridium, Optional High Bandwidth Line-of-Sight Mesh or Satellite Comms
Payload Data Services	Real-time GPS/INS Data via Ethernet

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AEROSTAR HURRICANE BALLOON SYSTEM

FOR HEAVY LIFT RESEARCH AND DROP TESTING

The Aerostar Hurricane Large Balloon System provides a turnkey solution to carry large payloads and drop test articles to the stratosphere. Aerostar's 2024 acquisition of Near Space Corporation expanded products and services to include launching large stratospheric and heavy lift balloon systems. Aerostar has applied its 60 plus years of supplying large scientific balloons to NASA, and its industry leading flight command/control hardware and mission planning software to NSC's Legacy Large Balloon capabilities enabling a new world class commercial flight test platform.



AEROSTAR HURRICANE FEATURES

The Aerostar Hurricane Large Balloon System is the result of the coupling of decades of innovation in balloon and flight train design with Aerostar's standard flight control electronics and Thunderstorm Ground System. The Large Balloon System is designed to carry very large payloads to high in the stratosphere to perform drop tests, gather valuable data, utilize a high bandwidth telemetry link and be recovered safely after flights of several hours or multiple days. Multiple launch sites increase mission options, and Aerostar's flight services team is ready to operate our large balloon systems from our Tillamook or Madras Launch Facilities or deploy to a remote location



AEROSTAR HURRICANE LARGE BALLOON SYSTEM

PARAMETER

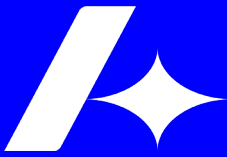
SPECIFICATION

Duration	Drop tests typically <8 hours, can support flights up to 3-4 days
Operating Altitude	50,000-130,000 ft Typical
Max Payload Mass	Up to 4,500 lbs
Payload Envelope	12' x 6' x 6', or larger with consultation
Payload Power Provided	+28V/+12V/+5V, up to 375 W/rail, 1200W max*
Gondola Thermal Control	200W+ heat transfer and programmable heaters
BLOS/LOS Comms	Iridium or Starlink (Option) Line-of-Sight Mesh or Silvus (Option)
Payload Data Services	Real-time GPS/INS Data via Ethernet

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NEAR-SPACE SHUTTLE SYSTEM (NS3)

FLYING GONDOLA FOR PAYLOAD RETURN AND PRECISION LANDING

Aerostar's NS3 is a gliding payload return system designed to support customer payloads throughout the flight including the semi-autonomous flight back to a designated landing location. It can be carried aloft by any one of Aerostar's many balloon systems and be released from altitudes up to 90,000+ft. When the balloon portion of the flight is complete, the NS3 is released and flies a specified flight path to an autonomous landing at a designated landing site.

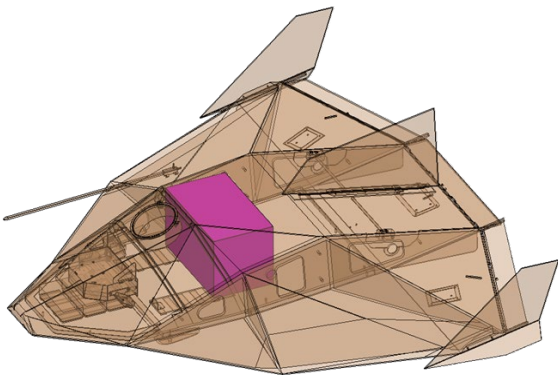


NS3 FEATURES

The NS3 can be integrated with any of Aerostar's balloon systems, but the standard launch system is the Lightning. It includes a Lightning FCU and high-speed LOS Command and Control link (Silvus) which provides support for a payload which fits within the interior of the NS3 and complies with the CG limits to preserve its aerodynamic performance. The NS3 shell is made of non-conductive RF transparent composite materials, which allows antennas to be integrated internally with the payload or within the wings. Aerostar's payload integration team work's closely with the customer to provide suitable mounting, interfaces and required access. The NS3 autopilot allows flight plans to be updated throughout the flight including after release where it performs an autonomous pullout and navigates along the specified flight plan to a predesignated landing site. The NS3 can either land on a runway-like surface or use its Parachute Recovery System (PRS) to land vertically in a remote austere location. Aerostar has a special FAA high-altitude COA established for its Tillamook UAS Test Range where standard NS3 flights are both launched and recovered. Remote operations, including launches and landings from other locations, can also be supported.



NS3 SYSTEM



PARAMETER	SPECIFICATION
Duration	Standard <8 hrs / days to weeks possible
Operating Altitude	Typical 55-75,000 ft Max 90,000+ ft
Max Payload Mass	20 lbs
Payload Envelope	Volume up to 12U (12000 cm ³ /732 in ³) Must comply with NS3 CG limits
Payload Power Provided	Standard +28 V (Mult rails), up to 150 W/rail, 300 W max*
BLOS/LOS Comms	Iridium, High Bandwidth Line-of-Sight Mesh or Satellite Comms
Payload Data Services	Real-time GPS/INS Data via Ethernet

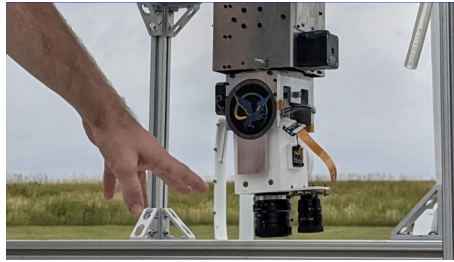
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HIGH ALTITUDE BALLOON SYSTEMS

PAYLOAD INTEGRATION AND SUPPORT

ENGINEERING SERVICES

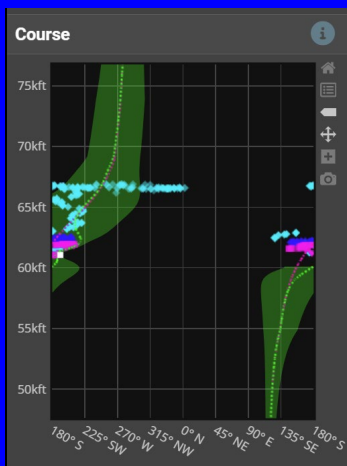
- Payload Integration
- Test Planning
- Sensor Systems Engineering
- RF and Network Modeling
- Systems Engineering
- Data Collections/Processing



Aerostar is the stratospheric expert in payload integration and provides standard payload interfaces. Aerostar can provide thermal vacuum testing, RF co-site interference testing, network setup and testing, and other services for payload providers to ensure flight success. For the first flight of a stratospheric payload, plan several weeks to months for integration design. If integration design is complete, payloads can be shipped pre-integrated allowing for fast checkout and launch within a single launch week.



MISSION PLANNING



Aerostar works together with payload teams to perform launch and mission planning, and has a variety of reliable tools.

- Aerostar's logistics coordinators ensure all equipment is staged and ready
- Aerostar works with payload providers to design to the challenging environmental conditions of the stratosphere, including low temperatures, low pressures, high ozone, high UV, and a low convection environment
- Pre-flight planning tools use Aerostar's historical weather database and flight data to plan missions in advance. These tools assess historical stratospheric wind data to simulate flight trajectories and time on station for the specific areas of interest (AOIs) and time of year for the mission.
- In-flight, real time planning tools allow a pilot to assess trajectories and change speed and direction based on a data-fusion machine learning wind model.

VERSATILE GONDOLA AND DATA BACKHAUL OPTIONS

Aerostar offers a standard 80/20 frame gondola as well as our Advanced Payload Gondola (APG) for the Thunderhead and Cyclone balloon system. The standard gondola provides a highly diverse platform to be accommodating to any payload that meets size, weight and power restrictions. The APG provides solutions to the challenges of stratospheric payload operation: efficient structure, power management, thermal management, recovery protection, and packaging for rapid deployment. Aerostar also offers many LOS and BLOS communications options for payload data backhaul, including Silvus, INMARSAT, and Starlink.



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