Human-rated Avionics

Ball developed prototype launch vehicle flight computers equipped to bring safety and reliability to future human spaceflight systems. Distinguished by their superior performance, these computers are a critical part of the electronic command and control flight avionics systems, meeting NASA’s highest-level human safety specification.

Fault-tolerant computing is a key ingredient to human-rated launch vehicle architectures. The Ball flight computers are human-rated by design and provide a potential low-risk path to flight for commercial crew launch systems. The flight computers contain significant advances in throughput performance, I/O interfaces and fault detection. The design supports on-the-fly recovery of a failed flight computer based on hardware or flexible software voting.

Cryogenics

Ball has provided cryogenic (low temperature material storage) on every human space exploration mission since Gemini in 1965 and has actively studied propellant depots for the past six years with NASA and various partners. As a result, NASA selected Ball as one of four companies to develop concepts for the Cryogenic Propulsion Storage and transfer demonstration mission.

Ball has more than 50 years of experience in cryogenics. Products and services include cryostats/dewars, cryocoolers, cryoradiators, cryo thermal management and cryo systems engineering.

Over the decades, we have developed several notable cryogenically-cooled infrared systems, including the Infrared Astronomical Satellite (IRAS); the Cosmic Background Explorer (COBE); Power Reactant Storage Assembly tanks for the Space Shuttle program; the Spitzer Space Telescope; and the Near Infrared Camera and Multi-Object Spectrometer (NICMOS) for the Hubble Space Telescope.

Ball also has a strong background in cryogenic fluid storage in the form of cryocoolers, including our recent completion of the cryocooler for the Thermal Infrared Sensor for the Landsat Data Continuity Mission. Our cryogenic spaceflight instruments flew aboard COBE, IRAS and NASA’s Spitzer Space Telescope.

Ball Aerospace has more than 50 years of experience in space system development. We are experienced providers of cost-effective commercial spacecraft and instruments and the innovative technologies required to support human spaceflight and space exploration.
Space Exploration

Kepler

Ball is the mission prime contractor for NASA’s Kepler Mission. The Kepler spacecraft is discovering hundreds of new planets outside our solar system, known as exoplanets, in its search for rocky, Earth-sized planets around distant stars. Kepler’s primary science objective is to detect and measure the frequency of Earth-sized planets as they occur in a distant star’s habitable zone—the distance from the star where water is present in liquid form. Scientists consider this zone to be the best environment for supporting life.

Through 2016, Kepler will monitor stars similar to Earth’s sun to explore the structure and diversity of planetary systems. Kepler’s photometer measures the brightness of at least 150,000 stars, searching for planets that transit in front of them. When a planet passes in front of its parent star, it blocks a small fraction of the star’s light. The photometer detects this brightness change and uses it to determine the planet’s size and orbital period. The photometer includes the largest focal plane array NASA has ever flown in space.

Ball built the photometer and spacecraft and managed the system integration and testing for the Discovery Class mission. Ball is currently managing on-orbit operation of the satellite for NASA’s Ames Research Center through an extended mission agreement.

James Webb Space Telescope

The seven successful instruments developed by Ball for the Hubble Space Telescope led to Ball’s selection as the principal subcontractor for NASA’s James Webb Space Telescope, Hubble’s successor. Ball’s advanced optical technology and lightweight mirror system lies at the heart of the James Webb Space Telescope.

Many important observations have been made at the limits of Hubble’s capabilities, but Webb will observe in only a few hours objects that take Hubble one or more weeks to record. Launch of Webb will continue our ongoing interest in the earliest formation of stars and galaxies and explore fundamental issues about the earliest epochs of our universe.

Human Spaceflight

Kepler

Beginning in 1981, Ball provided the mechanical components and cryogenic and optical systems for 135 shuttle missions. In the 20-year history of the Space Shuttle program, Ball’s guidance, navigation and control sensor hardware on the shuttles never caused a launch delay, mission failure or in-flight problem.

Enabling Technology for the Moon, Mars and Beyond

The leader in innovation, Ball is advancing technologies for space exploration. These include: near-zero boiloff cryogen storage and fluid transfer; solar electric propulsion; robotics; landing and docking technology; in-situ resource utilization; and sensor system integration.

STORRM

Ball designed and built the Vision Navigation Sensor and the high-definition docking camera to support the Sensor Test for Orion Relative Navigation Risk Mitigation (STORRM) Development Test Objective for the STS-134 mission in May 2011.

These cross-cutting sensor technologies are applicable for future commercial or government orbital debris control; in-space servicing; autonomous rendezvous and docking; formation flying; landing; and small-body proximity operations.

During the STS-134 mission, the Shuttle crew undocked from the International Space Station and rendezvoused again with the station on an Orion CEV-like approach. The system met or exceeded the required accuracy and range capability necessary to meet crew safety, mass, volume and power requirements for a wide variety of future NASA missions, including those into deep space.

Orion Phased Array Antennas

Ball is delivering Phased Array Antennas (PAAs) for the Orion Multi-Purpose Crew Vehicle (CEV), NASA’s first interplanetary spacecraft designed to carry astronauts beyond low Earth orbit on long-duration, deep space missions. The PAA serves as a primary data and voice communication link for NASA astronauts across all mission phases, from launch to flight operations to final capsule recovery. The Orion PAA design uses 36 of Ball’s phased array designs previously delivered for space, airborne, ground and marine applications, as well as 11 fixed-beam array products delivered for space.