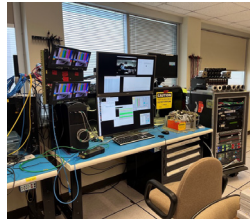


Marshall Space Flight Center

Avionics



Engineer works with engineering model of the StarBurst Central Electronics Box



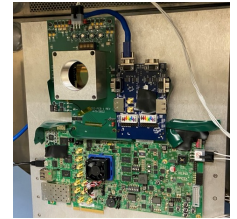
Enhanced Imaging, Launch Monitoring, Real-time System (EFILMRS) development laboratory tests the hardware and software for use on Space Launch System



ECLSS Four Bed Carbon Dioxide Removal System (4BCO2) Avionics Test Bed



Handheld Universal Lunar Camera (HULC) development laboratory is used to develop the camera system for use on the Orion, Gateway and Human Landing System spacecraft as well as spacewalks on the lunar surface



The Dynamic Atmosphere Imaging Spectrograph Investigation (DAISI) Proof of Concept CMOS Camera

Avionics provides in-depth engineering for the research, design, development, fabrication, and evaluation of avionics systems for ground and flight instruments, payloads, satellites, and space flight vehicles. The Avionics Division within the MSFC Space Systems Department represents four branches, encompassing most of the electrical design and support functions for avionics systems. Capabilities consist of multiple state-of-the-art laboratories and facilities to support both direct in-house hardware development and collaborative insight/oversight into the design and integration of work performed by one or more contractors. The engineering staff provides a wealth of subject matter expertise for the avionics disciplines developed over the successful history of MSFC.

The Radio Frequency (RF), Electromagnetic Environmental Effects (E3), and Guidance, Navigation, and Control (GN&C) Hardware Branch consists of three teams. The RF team supports the design, test, operations, and maintenance of communications, range safety, and tracking systems. RF lab capabilities include RF power measurement, input sensitivity, modulation characterization, bandwidth, and simulations for GPS, RF satellite signals, vehicle antenna patterns, and dynamic link analysis. The E3 team provides expertise in electromagnetic compatibility, lightning protection, electrical grounding, and electrical bonding. This team also manages the MSFC Electromagnetic Interference (EMI) Test Facility and performs EMI, lightning indirect effects, electrostatic discharge, and power quality testing. The GN&C team provides GN&C hardware and systems capability including the evaluation, selection, and

test of Inertial Measurement Units (IMUs), sun sensors, star trackers, and specialized systems for automated rendezvous and capture. The GN&C team has unique test facilities such as the Flat Floor Robotics Laboratory (FFRL) to perform both open- and closed-loop testing in either digital or hardware-in-the-loop modes.

The Power and Electrical Integration Branch consists of the Power and Controls team and the Electrical Power and Integration team. The Power and Controls team develops two critical avionics subsystems. Power electronics provides power conditioning, conversion, regulation, distribution, and management of circuits as well as expertise in power quality analysis for system stability. Control electronics provides the drive electronics and feedback for motors, valves, and other electrical actuators. The Electrical Power and Integration team is responsible for energy generation and storage systems such as batteries, fuel cells, and solar arrays. Lab facilities include life testing of battery systems and battery cells over representative thermal environments. Solar array flash testing is performed in the Large Area Pulsed Solar Simulator. Electrical integration manages the avionics system electrical interfaces, including the design and test of the cables/harnesses for instruments, payloads, satellites, and vehicles.

The Electronic Design, Imaging, and Sensors Branch consists of two teams: the Data and Signal Conditioning team and the Imaging and Sensors team. The branch is responsible for the design and development of the flight computers, data and signal conditioning systems, programmable logic devices, instrumentation, and the

imaging/camera/video systems for research, ground, and space applications for instruments, payloads, and vehicles. The branch develops the analog and digital electronic circuits and subsystems designs for motion and thermal control devices, servomechanisms, instrumentation signal conditioning, and embedded controllers for ground and flight hardware. The branch supports the research, test, evaluation, and calibration of advanced measurement sensors. Imaging capabilities include the development and testing of both analog and digital imaging systems and components such as cameras, optics, recorders, and frame grabbers.

The EEE Parts, Packaging, and Fabrication Branch consists of the Electronics Packaging team and the Electrical, Electronic, Electromechanical (EEE) Parts Engineering and Analysis team. The Electronics Packaging Team provides design expertise in mechanical design of avionics packaging and the analysis, fabrication, and assembly of space flight hardware and ground support equipment. The team is proactive in the research of advanced manufacturing techniques for electronics hardware, including the innovative concepts of additive manufacturing of printed electronics. Avionics services are provided for electrical fabrication with an electrical shop certified to NASA and industry workmanship standards for the assembly of printed wiring boards, electronic assemblies,

and full machining of metal components for rapid prototyping of flight hardware. The EEE Parts Engineering and Analysis team provides engineering support in the selection, screening, testing, and analysis of EEE piece parts, cables, and assemblies. This team provides subject matter expertise in EEE parts failure analysis with state-of-the-art labs capable of both destructive and non-destructive evaluation of components or electrical assemblies. In addition, the team is engaged in the research, development, and evaluation of materials and ink formulations for the construction of electrical components through traditional and advanced additive manufacturing techniques.

Capabilities

- Flight data systems
- Instrumentation
- Signal conditioning
- Programmable logic devices
- Power electronics
- Electrical power systems
- Power quality analysis
- Controller design
- Motors and motor controls
- RF communication systems
- GN&C hardware
- Imaging and video systems
- Electrical integration design
- Printed electronics R&D
- EEE parts screening
- Failure analysis

Facilities/Laboratories

Facility	Description
Flight Computer and Data Systems Labs	Development, testing, integration, and verification of computer and data systems
Flight Robotics Labs	Full-scale, integrated simulation capability to support the development of orbital space vehicles
Inertial Navigation Sensors and Test and Navigation Components Labs	Analysis and evaluation of inertial sensors and strap-down inertial navigation systems
Image Research Labs	Development and testing of imaging systems, i.e., analog and digital cameras, optics, recorders, and frame grabbers
MSFC EMI Test Facility (METF)	A test facility for electromagnetic environmental effects related to EMI/electromagnetic capability (EMC), lightning indirect effects, electrostatic discharge, and power quality testing
Control Electronics Development Labs	Development of microprocessor and discrete component-based electronic control systems
RF Lab	Development and analysis of RF communication systems and component subsystems. Also provides sustaining engineering related to range safety and communications/tracking of space vehicles
Electrical Integration Labs	Development and integration of electrical systems for vehicles, payloads, and ground support equipment
Electrical Power Labs	Development and test of power electronics hardware, distribution systems, and energy storage devices/generators
Printed Electronics Labs	Research and development of additively manufactured electrical components and assemblies
EEE Parts and Analysis Labs	EEE parts screening, test, and evaluation
Failure Analysis Labs	Destructive and nondestructive analysis of electrical component and system failures
Electronic Fabrication Shop	Avionics manufacturing capabilities in compliance with NASA and industry workmanship standards

National Aeronautics and Space Administration

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