

Hardware Description

The equipment for the neuromuscular experiments aboard Cosmos 2229 includes implants and preamplifiers for electromyogram (EMG) signals and implants, transducers, and preamplifiers for tendon force measurements. EMG and tendon force data are logged by the Russian Data Recorder.

Subsystems

EMG Electrodes: The EMG implants are bipolar intramuscular electrodes made of very fine multi-stranded, teflon-coated, stainless steel wires. For the Cosmos 2229 mission, six electrodes were implanted in four sites.

EMG/ECG Boards: Located in the Russian Preamplifier Box, the circuit boards provide preamplification of the EMG electrode signals, which are used to analyze foot pedal, locomotor, and postural motor control.

Tendon Force Sensor Assembly: The Tendon Force Buckle, an active strain gauge half-bridge, is surgically implanted in the subject for measurement of tendon force. The Tendon Force Compensation Module, providing temperature compensation and voltage scaling, makes up the other half of the bridge. The sensor and the module are connected by an integral cable. Tendon activity is achieved through subject use of the Russian Foot Pedal hardware.

Tendon Force Signal Conditioner Board: Located in the Russian Amplifier and Test Control Box, the circuit board provides excitation to the Tendon Force Sensor as well as offset, gain, and filtering of the signal derived from the sensor.

Specifications

Dimensions: N/A

Weight: N/A

Power: 27 VDC

Maximum Strain: 40 lbs (tendon force)

Data Acquisition

Electromyogram data, tendon force data

Related Ground-Based Hardware

Ground Test Unit-2 (GTU-2): The GTU-2 is used to test the tendon force and EMG/ECG boards.

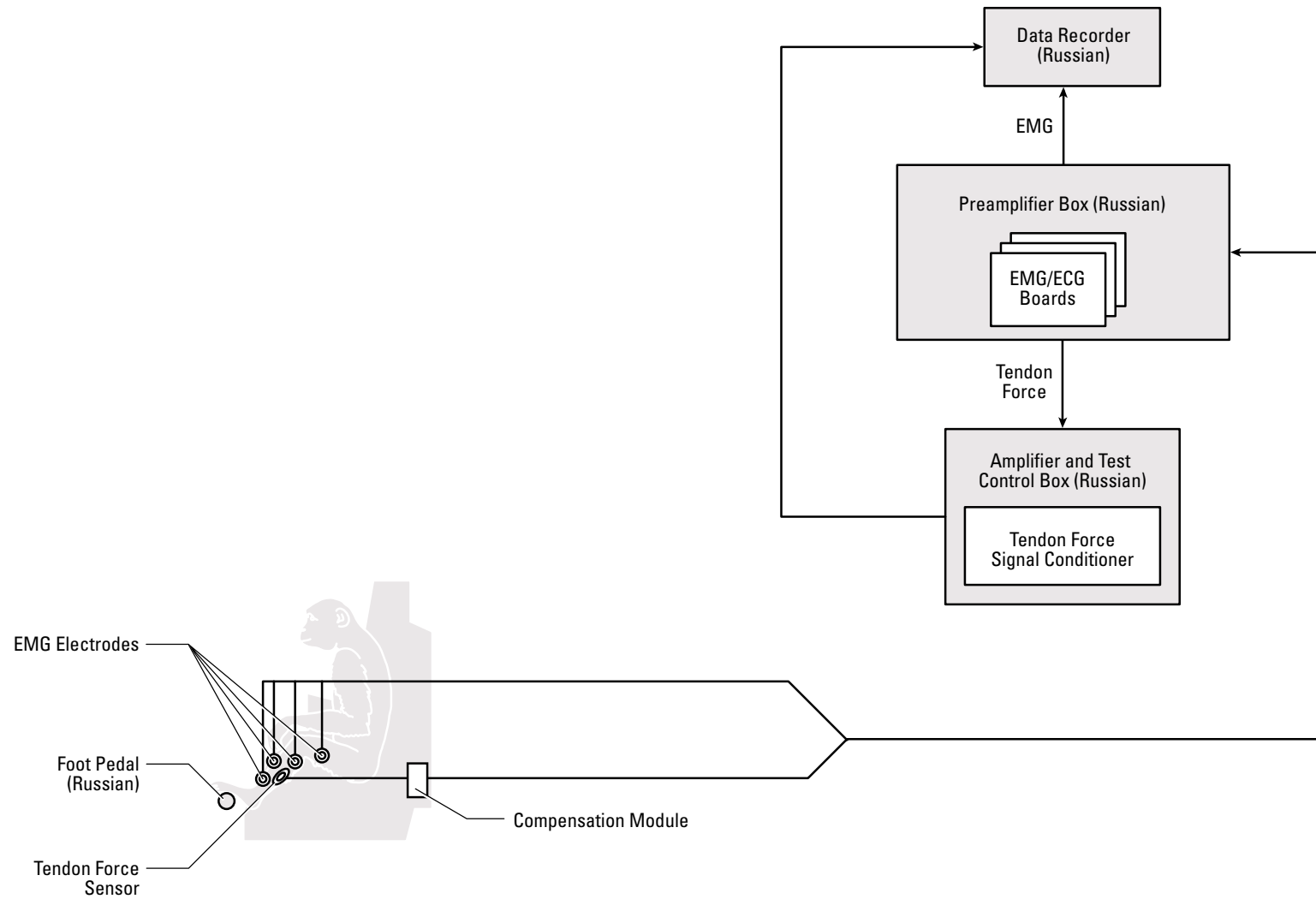
Lab Test Unit (LTU): The LTU is used for ground-based animal studies requiring EMG/ECG and tendon force measurements. The LTU has hardware identical to the flight suite, contains EMG/ECG and tendon force boards, and provides preamplification of the EMG/ECG and tendon force signals.

Hardware Publications

- Gregor, R.J. and T.A. Abelew: Tendon Force Measurements and Movement Control: a Review. *Medicine and Science in Sports and Exercise*, vol. 26(11), November 1994, pp. 1359–1372.
- Connolly, J.P., M.G. Skidmore, and D.A. Helwig: *Final Reports of the U.S. Experiments Flown on the Russian Biosatellite Cosmos 2229*. NASA TM-110439, 1997, pp. 38, 42.

Missions Flown 1991-1995

Bion 10/Cosmos 2229



[Shaded areas indicate predominantly Russian hardware items.]

Hardware Description

The Cosmos 2229 flight hardware suite is a highly integrated combination of NASA and Russian systems. The hardware supports neuromuscular, neurovestibular, and circadian rhythm/temperature (CR/T) experiments by U.S. and Russian investigators. Substantial ground-based hardware was developed for pre- and postflight testing, calibration, and data collection.

Subsystems

Head Electronics Assembly (HEA): The HEA provides interface points for head-mounted physiologic sensors and preconditioning for data signals. These signals include eye position, vestibular nuclei response (VNR), electroencephalogram (EEG), electrooculogram (EOG), brain temperature, as well as the following Russian signals: pO₂, electrostimulation, rheophlethysmography, and intracranial pressure (ICP). The assembly also serves as a platform for mounting head motion velocity sensors.

The NASA-developed components of the HEA are three circuit boards: the mother, daughter, and baby boards. These boards are stacked on the Russian-supplied base mounting ring, which is fixed to the primate's skull. The entire assembly is enclosed by the Russian-supplied cranial cap.

Circadian Rhythm/Temperature (CR/T) Hardware: The CR/T hardware consists of a sensor array, a combined signal processor and data recorder unit, and an interconnect box. The sensors measure the following parameters: motor activity, ambient temperature, brain temperature, and three channels of skin temperature. The signal processor records the above parameters, as well as Russian-supplied heart rate and deep body temperature signals. The interconnect box provides an interface between the sensors and the signal processor. The CR/T hardware is battery-powered.

Neuromuscular Hardware: The neuromuscular hardware consists of a tendon force sensor, six electromyogram (EMG) electrodes, and associated signal conditioning circuitry. A Tendon Force Compensation Module provides temperature compensation and voltage scaling.

Neurovestibular Hardware: Two angular rate sensors, one each for yaw and pitch, are mounted on the cranial cap to measure head motion velocity.

Power Supply: The power supply, located within the Russian preamplifier box, derives its power from the Russian spacecraft power source of 27 VDC. It provides power to all NASA systems other than the CR/T hardware.

Specifications

Dimensions: N/A

Weight: N/A

Power: N/A

Data Acquisition

N/A

Related Ground-Based Hardware

Head Electronics Signal Simulator (HESS): The HESS is used for testing of the Head Electronics Assembly.

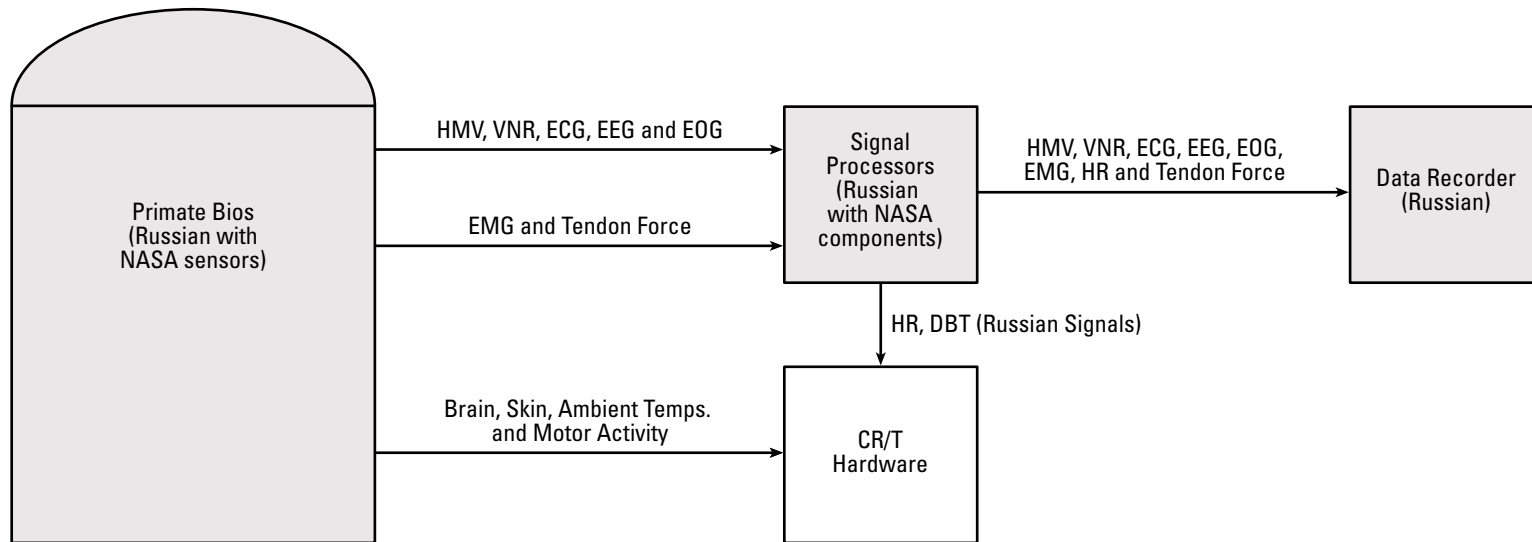
Hardware Publications

- Connolly, J.P., M.G. Skidmore, and D.A. Helwig. *Final Reports of the U.S. Experiments Flown on the Russian Biosatellite Cosmos 2229*. NASA TM-110439, 1997, pp. 35–46.

Missions Flown 1991-1995

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Cosmos 2229 Hardware Suite Overview



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