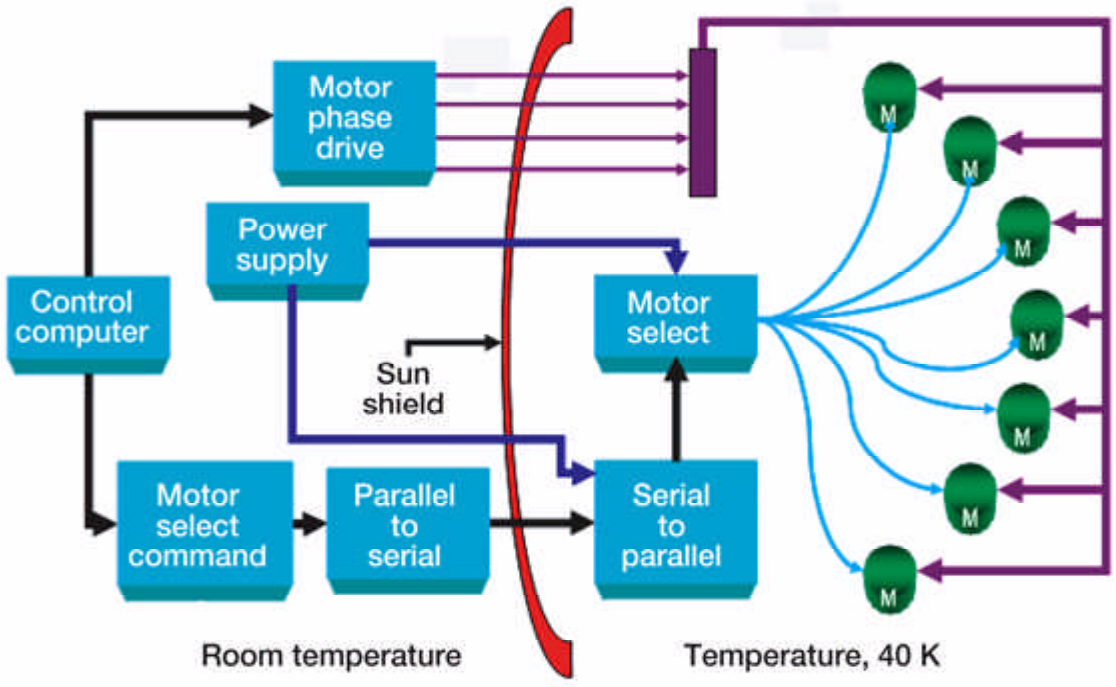
Prototype Motor Controllers Demonstrated for the James Webb Space Telescope Cryogenic Environment

NASA is in the process of designing the James Webb Space Telescope. This telescope will investigate images of objects in deep space (stars, galaxies, etc.) by using light in the infrared region of the light spectrum. To make such observations, the telescope must have light sensors that operate at very cold temperatures, near absolute zero. To achieve this low-temperature tolerance, designers must place the light sensors behind a Sun shield that will prevent sunlight, and its heat, from reaching the sensors.

In this cold region inside the telescope, electric motors and some motor controls must operate at temperatures near 40 K (40 degrees above absolute zero). These motors will be used to position light filters needed by the telescope. There are motors that operate at the low temperatures, but there is little technology for low-temperature motor-control electronics. The drawing shows how the motors and their controls are positioned behind the Sun shield.



Simplified layout of motors and controller electronics on the James Webb Space Telescope.

Simplified version of the layout of the motor and control electronics that are located, as dictated by mission requirements, in the cold zone of the James Webb Space Telescope. A Sun shield provides protection and isolation of these electronics from the heat of the rays of the Sun. Diagram shows room temperature components (control computer, motor

select command, motor phase drive, power supply, parallel to serial, and sun shield) as well as 40-kelvin components (motor select, serial to parallel, and motors).

The Low Temperature Electronics Group at the NASA Glenn Research Center has been working to develop motor control electronics that will operate at a temperature of 40 K. The group conducted tests to determine which electronic components will operate at such very low temperatures. Then, components that were determined to operate successfully at the low temperatures were used to design low-temperature motor-controller circuits. A prototype motor controller circuit was built, evaluated, and demonstrated to operate at 70 K. Next, Glenn researchers plan to determine circuit performance at much colder temperatures--down to 40 K.

This low-temperature program was supported by the James Webb Space Telescope Electrical Systems Design Group at the NASA Goddard Space Flight Center and by the NASA Electronic Parts and Packaging Program at NASA Headquarters and the Jet Propulsion Laboratory.

Find out more about this research: http://www.grc.nasa.gov/WWW/epbranch/

Glenn contact: Richard L. Patterson, 216-433-8166, Richard.L.Patterson@nasa.gov
Authors: Richard L. Patterson and Ahmad Hammoud
Headquarters program office: OSS
Programs/Projects: JWST, NEPP, NEPAG, Mars 07, JIMO, Europa Lander