Solar B - EIS

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MHC Functional Requirements

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1. Introduction

The Mechanism and Heater Controller (MHC) contains the drive electronics for the EIS mechanisms and heaters. It has power and data interfaces to the Instrument Control Unit (ICU). This document outlines the functionality and interfaces that the MHC requires.

2. Applicable Documents

Interface Control Document MSSL/SLB-EIS/SP003
NRL Interface Control Document NRL/SLB-EIS/SP202
Perdix Corporation MHC PRD Package 27 Dec 99

3. Model Philosophy

Prototype model (PM):
The PM will be built from commercial-off-the-shelf (COTS) parts. The digital, analogue, auxiliary and backplane boards will be built by Perdix Corporation on behalf of NRL, with the power board and the housing built by MSSL. The embedded software will be written by Perdix Corporation also.

Flight Model (FM):
The FM will be built from qualified parts and is the responsibility of MSSL alone. The responsibility includes the software.

Flight Spares(FS)

The FS plan covers electrical components only.

4. Mechanisms

There are eight mechanisms to be controlled:

Mirror coarse position
This uses a four phase stepper motor and linear ball screw actuator made by CDA Intercorp, with integrated brushless resolver.

Mirror fine position
A Physik Instrumente p-845.40 piezo-electic translator with integrated strain guage is used in a closed loop system to provide mirror fine positioning.

Slit exchange
This is a wheel with positions for four slits. The rotary actuator uses a four phase stepper motor made by CDA Intercorp, with an integrated brushless position resolver.

Shutter
A brushless DC motor with optical encoding for position feedback is used to give precise control of exposure times. The design uses expertise gained on SOHO/MDI.

Grating focus
The mechanism holds the optics in a linear translation carriage driven by a four phase stepper motor. Optical sensors are used to indicate limits or mid - position.

Front clamshell
This is a single shot paraffin wax actuator driving a latch holding the door shut. Spring tension opens the door and position sensors are used give to fully closed and fully open indications.

Rear clamshell
(As front clamshell)

Launch lock
The details are TBD, but it uses a one shot mechanism. The interface is required even though the mechanism is currently not in the instrument baseline design.

5. Other Systems

There are four other systems to be controlled:

Operational heaters
20 individually programmable heater circuits form a precision temperature control system for all parts of the instrument except the ICU. Up to 32 sensor circuits are availablefor temperature monitoring. The temperature of the ICU is controlled through thermal coupling to the spacecraft.

Quartz contamination monitors (QCM)
These generate a signal equal to the difference in frequency between two crystal oscillators. One is a reference and the other has the quartz plate open to the environment. Contamination lowers lowers the frequency of the open element.

CCD light source
About six blue LEDs are arranged to illuminate the CCDs for flat field calibration use. They may also be used for pre-flash surface state filling of the CCDs to reduce image noise. They require to be driven with a programmable constant current source and switched on for a period of 100ms (TBC) or greater.

Clamshell Vacuum Gauge
The vacuum gauge in the clamshell is read by the telemetry system of the MHC.

6. Data Interface

Commands from the ICU to the MHC and telemetry from the MHC to the ICU are carried over a bidirectional RS-422 link at 9600 Baud, with TBD stop bits, TBD parity, TBD start bits.

7. Power

All power comes from the ICU. Primary power (28V) is used to power the mechanisms directly. Secondary power is used for the control circuits. Secondary power is supplied loosly regulated to the MHC and local regulators are used to provide the specified voltages. All secondary power is referenced to the same local ground. Opto-isolators are required to separate rpimary and secondary grounds.

Supplies to MHC:
28V (primary power)
+7.0V
-7.0V
+15V
-15V

Internal MHC supplies:
+5.0V (digital)
+5.0V (analogue)
-5.0V
+15.0V
-15.0V
+150V / 120V (Piezo-electric actuator drive)
-20V (Piezo-electric actuator drive)

8. Commands and Telemetry

Preliminary command and telemetry lists exist in the MHC PDR package dated 27 Dec 99. They are currently under discussion.

9. Hardware Status

There is a spacecraft facility for up to four mechanisms to be monitored using a simple contact closure. This will allow the spacecraft to monitor for example the launch lock state without the instrument being powered. This is likely to be implemented for the FM only.

10. Housing

The housing must supply:
The mechanical support for the three boards plus backplane.
A venting path for escape of atmosphere and volatiles.
Radiation shielding.
Mechanical support for the connectors all of which must be on one face.
Thermal paths for dissipating heat generated internally.
External ground stud for connecting system ground.

11. Status Monitoring

Voltage and current monitoring of key circuit nodes will be carried out, as well as temperature monitoring of strategic components.

12. Health Monitoring

Simple health monitoring may be implemented either in the MHC or in conjunction with the ICU to provide protection against the following:
A fault allowing a motor to become too hot. The risk is of volatiles outgassing and damaging the optics.
Abnormal current demand on any power rail.

13. Command Inhibit

Risk of accidental operation of the clamshell doors or launch lock during ground test is reduced by use of an arming panel and red-tagged connectors.

14. Software

Embedded software for the microcontroller is required to provide the following functionality. Some of these points are already outlined above.

- Servo loop control for the coarse and fine mirror positioners, shutter and slit exchange.
- Limits control for the other mechanisms.
- Command interpreter.
- Telemetry collection.
- RS-422 link management.
- Code patching.
- Management of twenty closed loop heater control circuits.