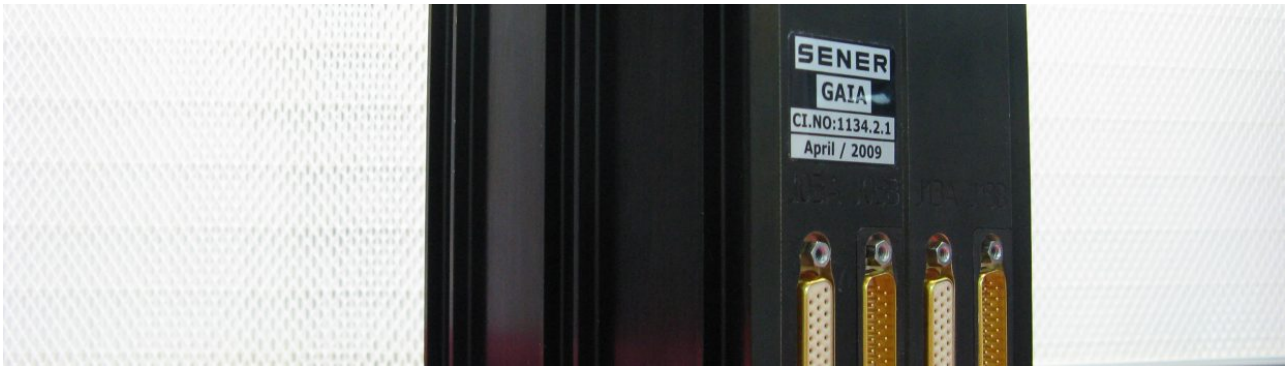
GAIA. M2MM Mechanism drive electronics (MDE)



SENER XSPACE / XSCIENCE & EARTH OBSERVATION

GAIA. M2MM MECHANISM DRIVE ELECTRONICS (MDE)

Cliente: ADS F / ESA

GAIA M2M MDE is an electrical unit designed to control up to ten stepper motors per MDE section (Main or Redundant) one at a time that will move the M2 mirrors for GAIA. The mechanisms will allow the M2M repositioning in 5 degrees of freedom.

The MDE is an electrical unit designed to control up to 10 stepper motors per section (Main or Redundant) with one motor powered at a time.

The MDE is housed in a single aluminum box, and it is internally divided in two fully similar sections, denoted as main and redundant, which are working in cold redundancy. The spacecraft is in charge of selection the nominal or redundant section.

Every section is comprised of a hybridised DC/DC converter eith integrated EMI filter, and one semi-rigid board.

Each section shall command the motor using a current control loop. This scheme allows reducing the power deliver to the motor in the low temperatures where the motor resistance is lower.

A MIL-STD-1553 bus is used to manage the communication between the MDE units and the spacecraft. This

link shall be used to send and receive all the telecommands and telemetries involving the motor commanding.

The **main functions** of the MDE are:

- DC/DC power conversion to provide secondary supplies to internal electronic part and to actuator drivers
- Acquisition of command to be applied to the actuators from 1553B bus of GAIA PLM Housekeeping Monitoring and status transmission to 1553B bus of GAIA PLM
- Generation of signal to drive the 10 actuators (5 per Mechanism) according to the command received
- Acquisition of the actuator status to be transmitted

The redundancy philosophy is a cold redundancy, i.e. 2 electronic parts drive the 10 actuators on their nominal and redundant interfaces, only one is ON in operational mode. Both redundant and nominal electronics are kept within one MDE electronics.

- **Key requirements:**
- **Radiation environment:** The unit is designed to tolerate a uniformly distributed total dose of 22 krad inside the box.
- **Mass:** MDE 2.5 kg. Harness 1.5 Kg. Mechanism 4.95 kg
- **Size:** 175 high, 130 long and 95 wide.
- **Thermal:**
  – MDE operating range: 250K — 313K; non operating range: 230K – 313K
  – M2MM operating range [110K — 313K].
  – Max. dissipation by conduction for MDE < 8W .
  – Max. dissipation by radiation for MDE < 2W.
  – Harness operating range from 110K to 313K and support a gradient of 203K.
  – Harness transfer in cryogenic zone < 0.0005 W in non-operational mode
- **Functional:** Mechanical Resolution is half micron resolution over a travel of +/-275 µm with stable positions and high load capability to withstand launch loads without losing a given position in a compact volume.
- **Redundancy:** Two fully redundant sections in a single box.
- **Power:** Each section powered by a 10W isolation converter
  – Power input bus: +28V
  – Power Consumption: 15W (Duty cycle 100%); 12W (Duty cycle 75%); 9W (Duty cycle 50%)

  - The max. dissipation by conduction for MDE < 8W
  - The max. dissipation by radiation for MDE < 2W

- **Control:** Each section provided with an “intelligent” device capable of decoding all telecommands received via serial channels, providing the switching sequences required by the motors, and encoding the status information to provide serial telemetry.
- **Motors drive:** Ten independently biphased motors (with main and redundant wiring) can be managed by MDE main and redundant section in cold redundancy.
- **Reliability:** The duration of the mission is 7-year in-orbit.
