ESR Space
Insight into Motion

in collaboration with Almatech SA and SpaceMech Limited

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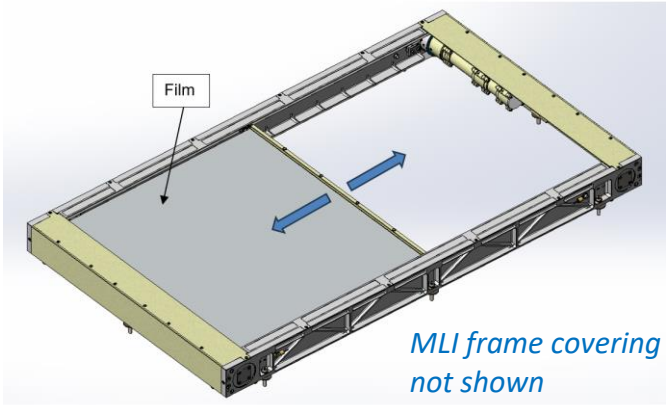
Lunar Thermal Shutter (LTS) + Radiator – ESA Development (TRL 4 by June 2024)



MLI frame covering not shown

The **L**unar **T**hermal **S**hutter device is being developed under ESA funding (programme referred to as **LDRLR**) and is currently in the manufacturing & test stage of development. Thermal vacuum testing and a system level dust resilience test is to be completed on the system breadboard by May 2024. Refer to ICES 2023 paper for more details.

A follow-on qualification programme is also being actively pursued.

- **Provides active control of radiator area for optimal heat rejection / temperature regulation through lunar day / night**
- **Radiator skin provided, for mounting onto client S/C structure beneath or mounts to rover / instrument structure (horizontal or vertical)**
- **Redundant stepper motor drive solution provides simple drive interface**
- **Microswitch end-stop indicators + step counting for position knowledge**
- **Scalable by factor 0.25 to 2**
- **Optional baffle shown for vertical mounted applications**

Parameter	Details / Value
Application	Active thermal control
Suitable platform	Lunar lander, large rover, ISRU or habitat application
Development Programme	ESA EXPRESS PROCUREMENT (EXPRO+)
Area Efficiency (%)	79% (aperture / envelope)
Shield Film Properties (Grounded, tailorable - polyimide material baselined)	IR emissivity < 0.10
	Solar absorptivity < 0.15
Radiator Properties Assumed (typical values – radiator is separate)	IR emissivity > 0.87 Solar absorptivity < 0.15 (OSR) < 0.20 (paint)
Mass	< 2.1 kg (excludes radiator and optional baffle)
Baseline dimensions (scalable – up / down)	Width x Length x Depth = 422 x 712 x 45 mm (plus spacers)
Operating life cycles	Designed for > 10,000 cycles
Power when actuated	< 1.5W
Temperature Range	Operation from -150 to +70°C, survival 50K to +120°C

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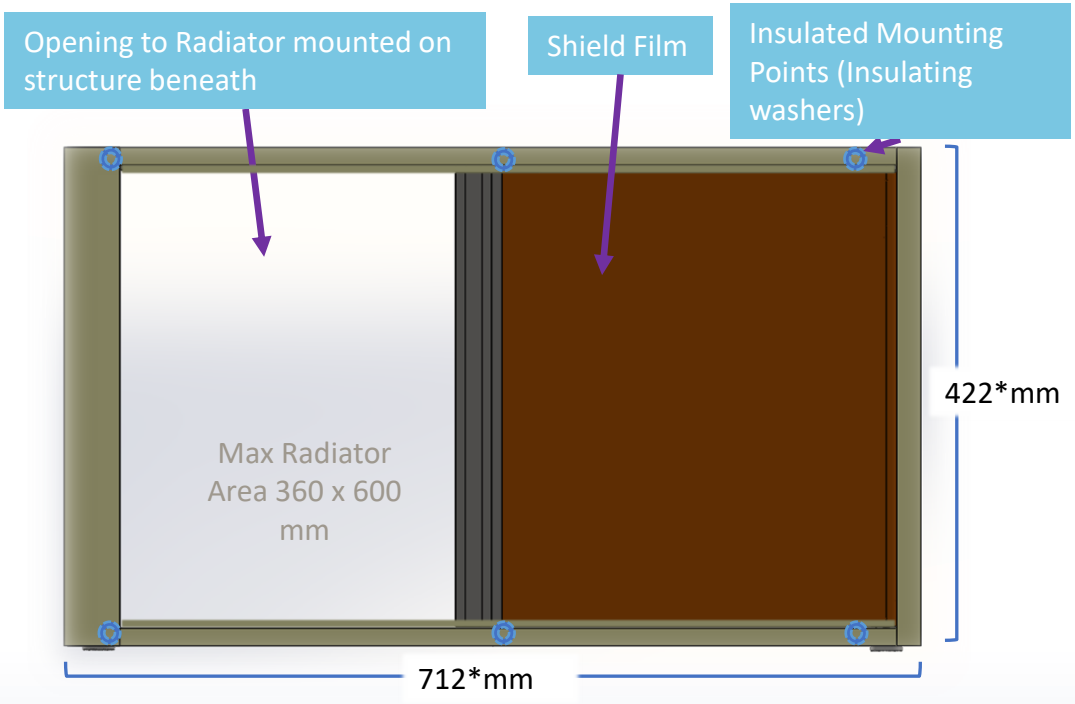
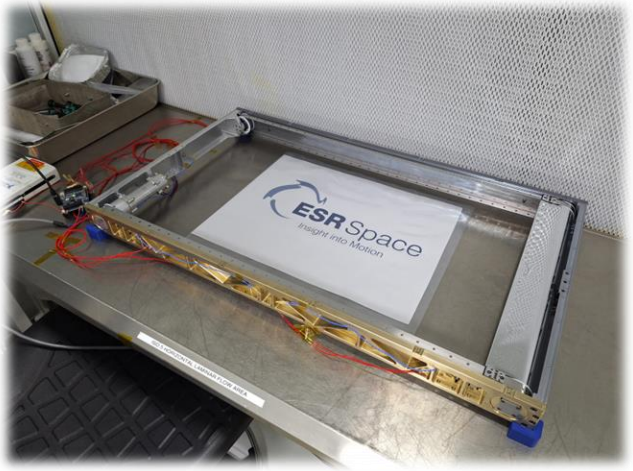
Lunar Dust-Resilient Compact Thermal Shutter (Baseline Dimensions)





Breadboard Model LTS Build Completed April 2024
(End covers removed to show actuator and film spool)

Optional baffle design fits inside belt arrangement and is recommended for vertical orientations where surface IR must be rejected. Baffle angle can be customised and fixed in place.

Note: * Allows for 1mm covering of MLI. A more detailed model will be available shortly as Detailed Design is completed (CDR/MRR)

A highly reflective baffle may be added externally or internally to assist with rejection of IR background for some application. This option is also currently in development.

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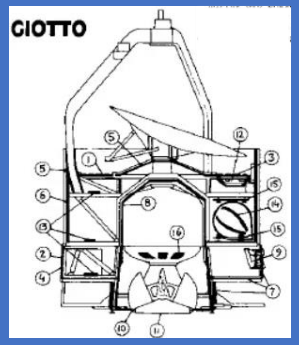
ESR Thermal Shutter Heritage / Evolution

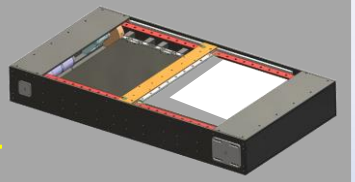
Heritage Mission | **Development Activity** | **Potential Mission/Follow-on Activity**

Giotto Thermal Shutters *(BAe for Fokker/ESA)*
Launched 1985

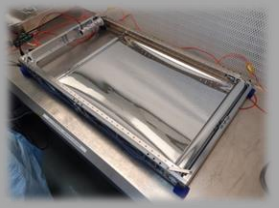


CFESat Boom (Belt-drive mechanism) *(SSTL/ESR/Sula for NRL)*
Launched 2007

LDRLR Mock-Up *(ESR/ALM/ Spacemech for ESA)*
Completed Feb 2022



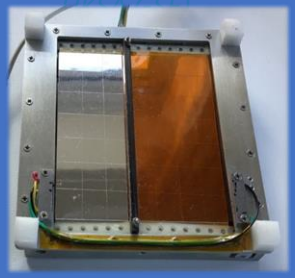
LDRLR Breadboard System *(ESR/ALM/ Spacemech for ESA)*
Ongoing - 2022-2024



LDRLR Qualification for EL3 (TBC) *(ESR/Spacemech For ESA)*
Argonaut Programme ~2030

Rosetta Thermal Shutters
Launched 2004

Compact Thermal Shutter (CTS) *(Spacemech for UKSA GSF)*
Delivered 2019



Dust Mitigation Testbed (Ambient) *(ESR/Spacemech for UKSA GEI-40)*
Completed Mar 2022

Lunar Orbiter Thermal Shutter (LOTS) 4-6U version (proposed)
Development (2024/2025)

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