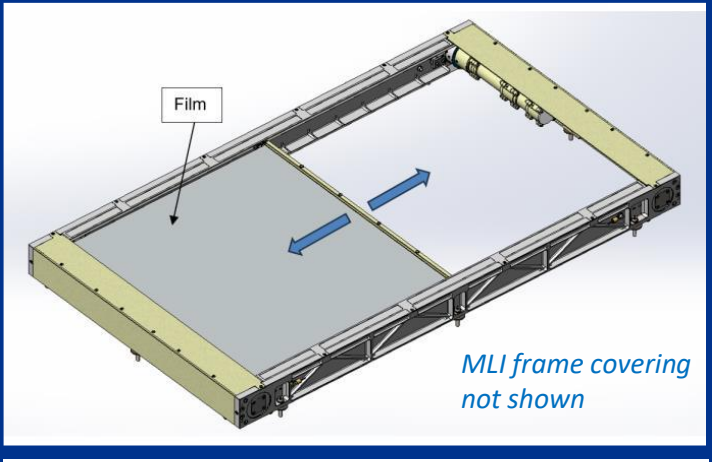
ESR Space
Insight into Motion

in collaboration with Almatech SA and SpaceMech Limited

almatech

SpaceMech

Lunar Thermal Shutter (LTS) + Radiator – ESA Development (TRL 4 achieved August 2024)



MLI frame covering not shown

The **L**unar **T**hermal **S**hutter device has been developed under ESA funding (programme referred to as **LDRLR**) and has successfully completed thermal vacuum testing, lifetime assessment and dust resilience testing. Refer to AMS 2024 or ICES 2023 paper for more details.

A follow-on EM/Qualification programme is being actively pursued.

- **Provides active control of radiator area for optimal heat rejection/temperature regulation through lunar day/ night**
- **Protects radiator from degrading effects of lunar dust, improving thermal performance**
- **Radiator skin provided, for mounting onto client S/C structure beneath or mounts to rover/instrument structure (horizontal or vertical)**
- **Stepper motor drive solution provides a simple drive interface, with optional redundant motor**
- **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, larger 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	< 2.1kg (excludes radiator and optional redundant motor or 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, (Breadboard completed 2000)
Power when actuated	< 1.5 W
Temperature Range	Operation from -150 to +70oC, survival 50K to +120oC

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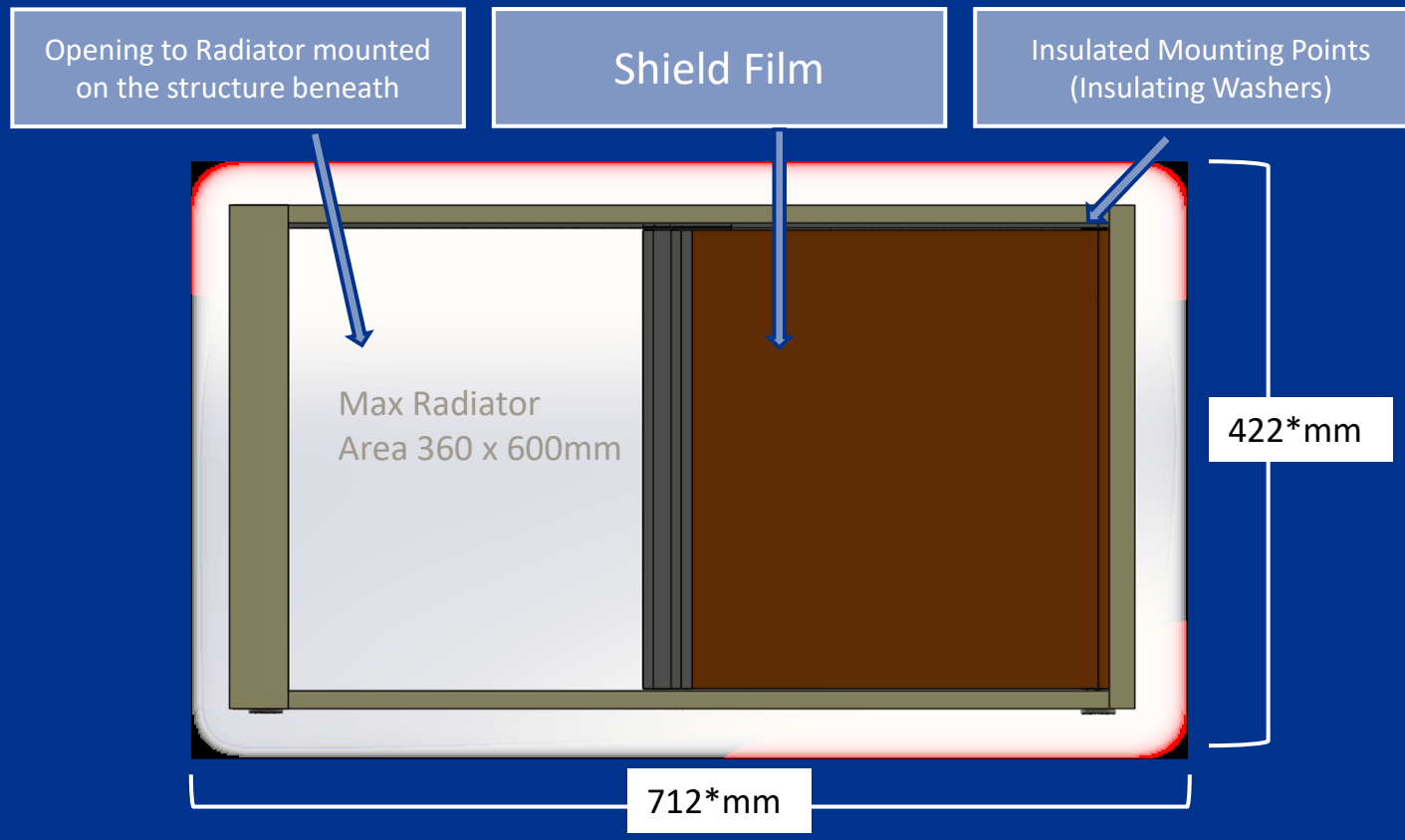
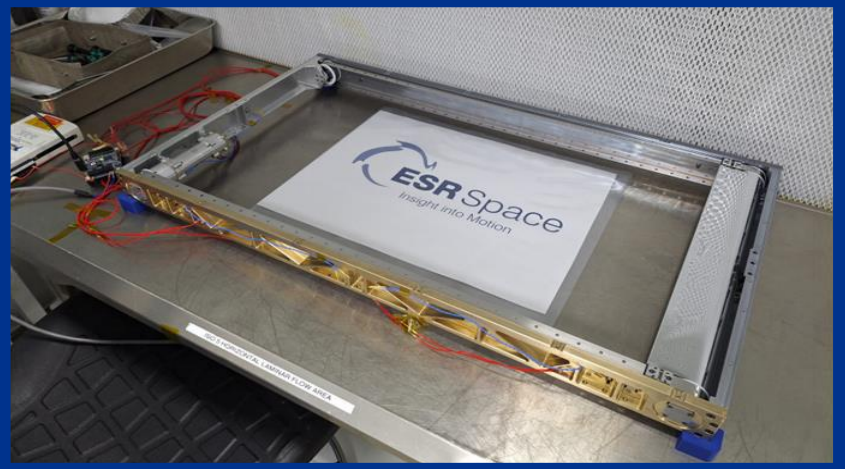
Lunar Dust-Resilient Compact Thermal Shutter (Baseline Dimensions)



Note: * Allows for 1mm covering of MLI. A more detailed model is available on request.

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.



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.

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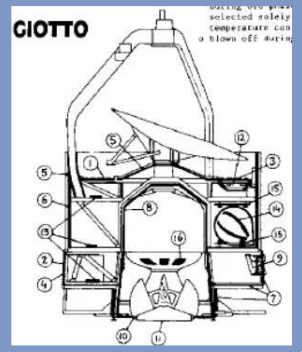
ESR Thermal Shutter Heritage/Evolution

Heritage Mission

Giotto Thermal Shutters
(BAe for Fokker/ESA)

Launched 1985



Rosetta Thermal Shutters
(Sener/BAe for ESA)

Launched 2004

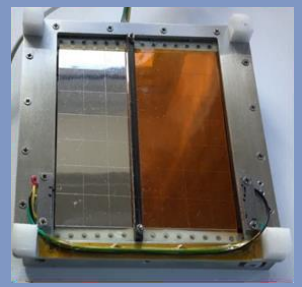
CFESat Boom (Beltdrive mechanism)
(SSTL/ESR/Sula for NRL)

Launched 2007

Development Activity

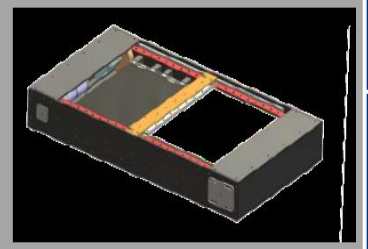
Compact Thermal Shutter (CTS)
(Spacemech for ESA)

Delivered 2019



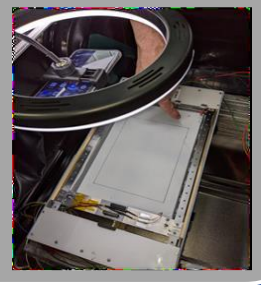
LDRLR Mock-Up
(ESR/ALM/ Spacemech for ESA)

Completed 2022



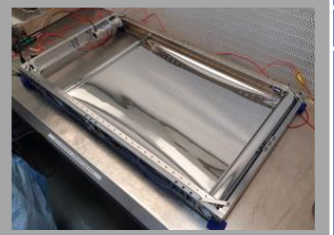
Dust Mitigation Testbed (Ambient)
(ESR/Spacemech forUKSA GEI-40)

Completed 2022



LDRLR Breadboard System
(ESR/ALM/ Spacemech for ESA)

Ongoing 2022-24



Potential Mission/Follow-on Activity

Agronaut Programme ~2030

LDRLR EM/Qualification for EL3 (TBC)
(ESR/Spacemech For ESA)

Development (2024/2025)
Thermal Analysis Study of Lunar Orbiter Thermal Shutter (LOTS) 4-6U version (Proposed collaboration with Univ. of Manchester)

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