

PRODUCT DATASHEET

RML-RAD – Space Radiation Monitor

1st generation

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2 Application and Key Features

2.1 APPLICATION

✓ **Cosmic Ray and Space Weather Research & Forecast (Service)**

- Space Radiation and Space Weather research and service provision
 - Research
 - Service data production
 - Forecast
 - Data models validation
- Measuring space weather related space radiation data products as defined by the European Space Agency (ESA)
 - Protons
 - Electrons
 - Heavy Ions
- Measuring long-term cosmic ray flux profiles
 - Energy distribution
 - Flux dynamics

2.2 KEY FEATURES

- ✓ **Space radiation and space weather research and forecast**
 - Cost and time effective monitoring solution for constellations
 - Extremely low budgets with relatively high performance
 - Real-time space weather alarm function capability for the hosting spacecraft
- ✓ **High performance measurement specification**
 - Utilising silicon detector telescope system called RADTEL
 - Specification following the data product definitions of ESA
- ✓ **Possibility for optional extension with magnetometer and additional interface units**
- ✓ **Fully autonomous operation**
- ✓ **Controlled via TM/TC**
- ✓ **Available interfaces: CAN, M-LVDS, RS-422**

3 Specification

3.1 GENERAL SPECIFICATION

1. Table – General specification

Parameters	Values
Power	1.5 W
Mass	0.9 kg
Dimensions (H,W,L)	84 mm, 81 mm, 104 mm
Operational temperature range	-40°C...+40°C (+65°C)
Non-operational temperature range	-40°C...+85°C
Operational pressure range	10 ⁵ Pa...10 ⁻⁴ Pa
Outgassing rate	<1% TML <0.1% CVCM
Data range	1.5 MB/day
Handling environment humidity	20...65% relH

3.2 ENVIRONMENTAL SPECIFICATION

2. Table – Environmental specification

Parameters	Values	
Thermal vacuum	Temperature environment	-40°C...+85°C
	Vacuum environment	<10 ⁻³ Pa
	Max. depressurization rate	5.0 kPa/s
Vibration	Sine vibration environment for 3-axis	20...100 Hz, 16.0 g
	Random vibration environment for 3-axis	5...2000Hz, 17.0g ^{RMS}
	Shock pulse for 3 axis	100 g, 0.25 ms
EMC	EMC environment	Tailored ECSS-E-ST-20-07C Rev.1 [AD 2]
Radiation	Used components	COTS
	Proven lifetime	Demonstration is planned at LEO

3.3 INTERFACES

3. Table – Interfaces

Parameters	Values
Input power bus	5V regulated ($\pm 5\%$) 12V unregulated (9.0 V...20.0 V)
TM/TC interface	CAN Bus / M-LVDS / RS-422/485/232

3.4 MEASUREMENT CAPABILITIES

4. Table – Measurement capabilities

Parameters	
Particle types	electrons, protons, heavy ions
Count rate range (<10% dead time)	0-50,000 cps
Time resolution (cadence) range for energy spectra	10-600 s
Minimum electron energy	250 keV
Electron energy range	0.3...3.9 MeV (5 quasi log channels)
Minimum proton energy	1 MeV
Proton energy range	3 MeV – 500 MeV (11 quasi log channels)
Dynamic range of proton flux measurements based on Sapphire 1-in-10-year model (maximum fluxes). Min fluxes are by 1.0E+05 lower per channel	3-6 MeV bin: $2 \cdot 10^5 \text{ cm}^{-2} \text{ s}^{-1} \text{ MeV}^{-1}$ 6-10 MeV bin: $5 \cdot 10^4 \text{ cm}^{-2} \text{ s}^{-1} \text{ MeV}^{-1}$ 10-16 MeV bin: $2 \cdot 10^4 \text{ cm}^{-2} \text{ s}^{-1} \text{ MeV}^{-1}$ 16-25 MeV bin: $4 \cdot 10^3 \text{ cm}^{-2} \text{ s}^{-1} \text{ MeV}^{-1}$ 25-40 MeV bin: $7 \cdot 10^2 \text{ cm}^{-2} \text{ s}^{-1} \text{ MeV}^{-1}$ 40-63 MeV bin: $6 \cdot 10^2 \text{ cm}^{-2} \text{ s}^{-1} \text{ MeV}^{-1}$ 63-100 MeV bin: $1 \cdot 10^2 \text{ cm}^{-2} \text{ s}^{-1} \text{ MeV}^{-1}$ 100-160 MeV bin: $2 \cdot 10^1 \text{ cm}^{-2} \text{ s}^{-1} \text{ MeV}^{-1}$ 160-250 MeV bin: $5 \cdot 10^0 \text{ cm}^{-2} \text{ s}^{-1} \text{ MeV}^{-1}$ 250-500 MeV bin: $6 \cdot 10^{-1} \text{ cm}^{-2} \text{ s}^{-1} \text{ MeV}^{-1}$ >500 MeV bin: $5 \cdot 10^{-1} \text{ cm}^{-2} \text{ s}^{-1} \text{ MeV}^{-1}$
Heavy ion energy range (He ion group (He-3, He-4), CNO ion group (C-12, N-14, O-16), Fe ion group (Si-28, Ne-20, Fe-56, Ni-58))	1 MeV/n...500 MeV/n (11 quasi log channels for He and CNO, 5 quasi log channels for Fe)
Spectra contamination	<10%
Min. field of view (half-angle)	20°
Max. field of view (half-angle)	60°
Orthogonal telescope directions	1 (can be extended up to 2)

4 Flight Heritage

5. Table – Flight heritage

Mission name	Hosting platform	Orbit details	Duration	Remarks
Under selection	SmallSat	LEO	7+ years	planned

5 List of Abbreviations

AD	Applicable Documents
Astorika	Astorika Sp. z.o.o.
COTS	Commercial Off-The-Shelf
ECSS	European Cooperation for Space Standardization
ESA	European Space Agency
ICL	Imperial College London
LEO	Low Earth Orbit
LET	Linear Energy Transfer
RD	Reference Documents
TC	Telecommand
TID	Total Ionising Dose
TM	Telemetry

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8 References

8.1 APPLICABLE AND NORMATIVE DOCUMENTS

6. Table – Applicable and Normative Documents

AD	Title	Reference	Version
[AD 1]	ECSS system - Glossary of terms	ECSS-S-ST-00-01C	1 Oct 2012
[AD 2]	Space engineering – Electromagnetic compatibility	ECSS-E-ST-20-07C Rev.1	7 Feb 2012

8.2 REFERENCE DOCUMENTS

7. Table – Reference Documents

RD	Title	Reference	Version
[RD 1]	-	-	-

END OF DOCUMENT