PRODUCT DATASHEET

TRITEL – 3-dimensional Space Dosimetry System

1st generation

PROJECT TITLE	**-**
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TABLE OF CONTENTS

1 Purpose and Scope

The present document provides detailed technical information about the TRITEL 3-dimensional Space Dosimetry System.
The definitions and glossary of terms from ECSS-S-ST-00-01C [AD 1] apply to this document.

1. Figure – TRITEL System (left: Central Handling Unit, right: Detector Unit, 1st generation)

2 Application and Key Features

2.1 APPLICATION

✓ **Space Dosimetry Monitoring for Manned Missions**
- Proven space dosimetry instrument for manned space missions
- To determine the absorbed dose and dose equivalent of in real time
- To study shielding effects of the surrounding environment
- Operated several times on-board the International Space Station

✓ **Space Radiation Research**
- To determine the LET-spectrum of the incoming space radiation
- To determine the avarage quality factor of the space radiation
- To measure long-term radiation flux profiles
- To obtain space weather related real-time data set
- Operated on-board the ESEO SmallSat

2.2 KEY FEATURES

✓ **Space dosimetry instrument for manned space missions to determine the absorbed dose, dose equivalent, LET-spectrum and quality factor in space**

✓ **Detector unit can be used standalone in satellite missions**

✓ **3 dimensional silicon detector telescope system**

✓ **Central Handling Unit for astronauts**

✓ **Central Handling Unit provides**
- Graphical user interface for astronauts (via touchscreen)
- Visual real-time measurement information for astronauts

✓ **Configurable system**
- External Detector Units
- Central Handling Units
- Up to a maximum number of 3 Detector Units

✓ **Fully autonomous operation**

✓ **Controlled via graphical user interface or TM/TC**

✓ **Available detector interfaces: CAN, RS-485, RS-232**

3 Specification

3.1 GENERAL SPECIFICATION

1. Table – General specification

	Detector Unit	Central Handling Unit
Power	2.6 W	2.0 W
Mass	~ 0.9 kg	~ 1.3 kg
Dimensions (H, W, L)	83 mm; 107 mm; 155 mm	215 mm, 160 mm, 52 mm
Operational temperature range	-40˚C…+40˚C	-40˚C…+70˚C
Non-operatioinal temperature range	-40˚C…+85˚C	-40˚C…+85˚C
Outgassing rate	<1% TML <0.1% CVCM	<1% TML <0.1% CVCM
Data range	0.33 MB/day	N/A
Handling environment humidity	20…65% relH	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. depressurisation 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	>3 years proven lifetime in LEO

3.3 INTERFACES

3. Table – Interfaces

Parameters	Values
Input power bus*	17.0 V…34 V (non-redundant or redundant)
TM/TC interface*	CAN Bus / RS-232 / RS-485 (non-redundant or redundant)
*For Detector Unit and Central Handling Unit as well.	

3.4 MEASUREMENT CAPABILITIES

4. Table – Measurement capabilities

Parameters	Values
Particle types	electrons, protons, heavy ions
Flux range (isotropic)	$1.5 \cdot 10^{-1} – 4.5 \cdot 10^{4}$ $cm^{-2}s^{-1}$
Count rate range (<10% dead time)	0-50,000 cps
LET in water range	0.2 – 230 keV/µm
Deposited energy range	60 keV – 80 MeV
Minimum absorbed dose rate in water	50 nGy/h
(for relativistic protons with energy deposit of =100 keV in SI)	10 mGy/h
Maximum absorbed dose rate in water	0.5 Gy/h
(for relativistic protons with energy deposit of =100 keV in SI)	7 Gy/h

5. Table – 3-dimensional Telescope System specification

Parameters	Values
Radius of the detectors	8.4 mm
Effective surface of the detectors	222 mm^2
Geometric factor G (for one telescope axls in 4 π	5.1 cm^2sr
Maximum angle of incidence (for one detector pair)	62.1°
Average path length in the detector (assuming an isotropic field)	361 µm
Ratio of the maximum and minimum path lengths	2.14

4 Flight Heritage

6. Table – Flight heritage

Mission name	Hosting platform	Orbit details	Duration	Remarks
TRITEL-SURE	ISS Colombus module	LEO 300-400 km	6 months	One detector unit and one central handling unit
TRITEL-RS	ISS Zvezda module	LEO 300-400 km	>3 years	One detector unit and one central handling unit
ESEO-TRITEL	ESEO SmallSat	LEO 500-600 km	-	One detector unit

5 List of Abbreviations

AD	Applicable Documents
COTS	Commercial Off-The-Shelf
CVCM	Collected Volatile Condensed Material
ECSS	European Cooperation for Space Standardization
ESEO	European Student Earth Orbiter
ISS	International Space Station
LEO	Low Earth Orbit
LET	Linear Energy Transfer
RD	Reference Documents
TC	Telecommand
TM	Telemetry
TML	Total Material Loss

6 List of Figures

7 List of Tables

8 References

8.1 APPLICABLE AND NORMATIVE DOCUMENTS

7. Table – Applicable and Normative Documents

AD	Title	Reference	Issue
[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

8. Table – Reference Documents

RD	Title	Reference	Issue
[RD 1]	-	-	-

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