PRODUCT DATASHEET

PILLE – Portable TL Space Dosimetry System

4th generation

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TABLE OF CONTENTS

1 Purpose and Scope 4
2 Application and Key Features 5
2.1 APPLICATION 5
2.2 KEY FEATURES 5
3 Specification 6
3.1 GENERAL SPECIFICATION 6
3.2 ENVIRONMENTAL SPECIFICATION 6
3.3 INTERFACES 7
3.4 MEASUREMENT CAPABILITIES 7
4 Flight Heritage 8
5 List of Abbreviations 9
6 List of Figures 10
7 List of Tables 11
8 References 12
8.1 APPLICABLE AND NORMATIVE DOCUMENTS 12
8.2 REFERENCE DOCUMENTS 12

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1 Purpose and Scope

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

Figure 1 – PILLE System (4th generation)

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2 Application and Key Features

2.1 APPLICATION

✓ **Space dosimetry monitoring during manned space missions**
- A unique, proven space dosimetry instrument for manned space missions
- To measure the absorbed dose at different locations in the space vehicle/station (space dosimetry mapping)
- To study radiation shielding effects of the surrounding environment
- To provide early warnings for astronauts about dose levels
- Utilized for routine and extravehicular activity (EVA) individual dosimetry of astronauts

2.2 KEY FEATURES

✓ **Space dosimetry instrument for manned space missions to determine the absorbed dose from space radiation**

✓ **High reliability in space environment**
- Proven >10years operation in space (on-board ISS at LEO)

✓ **Thermoluminescent detector system (TLD) including detector(s) and reader**

✓ **Unlimited number of passive detectors with memory chip inside containing the identification code and the individual calibration parameters of the dosimeter**

✓ **Easy-to-use, compact, lightweight microprocessor controlled on-board Reader Unit for providing the preliminary evaluation of the dose absorbed by the dosimeters**

✓ **The Reader Unit provides**
- User interface for astronauts (via numerical display and keyboard)
- Automatic identification of the detectors
- The measured dose and a series of parameters are displayed and stored on a removable memory card
- A dosimeter inserted in the reader permanently is dedicated for automatic cyclic measurements

✓ **RS-232 interface to connect to a PC for using a dedicated PC software (“PILLE Controller”) for downloading, listing and displaying the results of the measurements and setting the parameters of the Reader and the dosimeters**

✓ **CAN interface to connect to the data acquisition system of the space station**

✓ **Operated on-board space stations Salyut-6,-7; Mir and the ISS**

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3 Specification

3.1 GENERAL SPECIFICATION

1. Table – General specification

Parameters	Reader	Detector
Power	0.1/1/7W (standby/ready/readout)	-
Mass	~ 1.4 kg	70g (with carrying case)
Dimensions (H, W, D)	70mm, 190 mm, 120 mm	ø 20 mm * 60 mm
Operational temperature range	-20˚C…+40˚C	-40˚C…+50˚C
Non-operatioinal temperature range	-40˚C…+85˚C	-40˚C…+85˚C
Operational pressure range	1.2 10^5 Pa…7 10^{-4} Pa	2 10^5 Pa…$^{-4}$ Pa
Data rate	512 byte / readout	-

3.2 ENVIRONMENTAL SPECIFICATION

2. Table – Environmental specification

Parameters		Values
Thermal	**Temperature environment**	-40˚C…+85˚C
	Pressure environment	Up to 1.2 10^5 Pa
	Humidity environment	25…65%relH
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	>10 years proven lifetime in LEO

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3.3 INTERFACES

3. Table – Interfaces

Parameters	Values
Input power bus*	17.0 V…34V (non-redundant)
TM/TC interface*	CAN Bus / RS-232 (redundant/parallel)
*For Reader only	

3.4 MEASUREMENT CAPABILITIES

4. Table – Measurement capabilities

Dosimeters	
Type	bulb
Material	$CaSO_4$:Dy
Reader	
Measuring range (s<10%)	3µGy…10 Gy
TLD Efficiency (e=1±%)	$LET_{\infty H20}$ < 10 keV/µm
Read-out precision	3 digits + exp.
Accuracy (above 10 µGy)	δ < 5%
Measuring modes	manual / automatic read-out
Display	8-digit alphanumeric LED
Displayed information	dose in µGy (air kerma); date and time of measurement; identification codes; mean dose rate; error codes
Storage of information	PCMCIA memory card (> 4000 data sets)

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4 Flight Heritage

5. Table – Flight heritage

Mission name	Hosting platform	Orbit details	Duration	Remarks
PILLE	Salyut-6 SS	LEO 200-300 km	1,5 years	16 dosimeters and one Reader
PILLE	Salyut-7 SS	LEO 300-400 km	3 years	16 dosimeters and one Reader
PILLE'S	STS 41G / Challenger-6	LEO 300-400 km	8 years	8 dosimeters and one Reader
PILLE	Mir SS	LEO 300-400 km	4 years	16 dosimeters and one Reader
PILLE'95	Mir SS	LEO 300-400 km	5 months	6 dosimeters and one Reader
PILLE'96	Mir SS (NASAMir4)	LEO 300-400 km	5 months	8 dosimeters and one Reader
PILLE ISS	ISS – Destiny (U.S. Lab)	LEO 330-420 km	3 month / 10 years	50 dosimeters and one Reader
PILLE-MKS	ISS –Zvezda (Rus.Lab)	LEO 330-420 km	15 years	12-17 dosimeters and one Reader

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5 List of Abbreviations

AD	Applicable Documents
COTS	Commercial Off-The-Shelf
ECSS	European Cooperation for Space Standardization
EVA	ExtraVehicular Activity
ISS	International Space Station
LEO	Low Earth Orbit
LET	Linear Energy Transfer
PC	Computer
RD	Reference Documents
SS	Space Station
LT	Thermoluminescent
TLD	Thermoluminescent detector system

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6 List of Figures

Figure 1 – PILLE System (4th generation) 4

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7 List of Tables

1. Table – General specification 6
2. Table – Environmental specification 6
3. Table – Interfaces 7
4. Table – Measurement capabilities 7
5. Table – Flight heritage 8
6. Table – Applicable and Normative Documents 12
7. Table – Reference Documents 12

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8 References

8.1 APPLICABLE AND NORMATIVE DOCUMENTS

6. 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

7. Table – Reference Documents

RD	Title	Reference	Issue
[RD 1]	-	-	-

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