

PRODUCT DATASHEET

Pille – Portable TL Space Dosimeter System

PROJECT TITLE	-
PROJECT REF.	PRO2020
PREPARED BY	REMRED Space Technologies Ltd.
SUPERVISOR	István Apáthy, istvan.apathy@remred.hu
ISSUE	1.0
DATE OF ISSUE	01/04/2020
STATUS	Issued
TYPE	Product Datasheet, Non-Confidential
REFERENCE	PRO2020-RR-PQA-DS-001_i1.0
CUSTOMER(S)	-
CONTRACT REF.	-
CUSTOMER ID.	-

Template file ref.: QUA2020-RR-PQA-DS-001_i01

APPROVAL

Issue	Date	Signatures		
		Author(s)	Reviewed by	Approved by

1.0	01/04/2020	Andras Gerecs	Anna Baranyai	Istvan Apathy
-----	------------	---------------	---------------	---------------

DISTRIBUTION LIST

Company	Name	No. of copies
N/A	N/A	N/A
REMRED archives		1

CHANGE LOG

Reference	Date	Issue	Revision
PRO2020-RR-PQA-DS-001_i1.0	01/04/2020	1.0	1

CHANGE RECORD

Issue: 1.0	Revision: 1		
Reason for change	Date	Page	Paragraph(s)
N/A (initial release).			

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



1 Purpose and Scope

The present document provides detailed technical information about the Pille Thermoluminescent Space Dosimeter System.

The definitions and glossary of terms from ECSS-S-ST-00-01C [AD 1] apply to this document.



Figure 1 – Pille System

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 astro-nauts

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 re-movable 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**

3 Specification

3.1 GENERAL SPECIFICATION

Table 1 – General specification

Parameters	Reader	Detector
Power	0.1 / 1 / 7 W (standby/ready/readout)	-
Mass	~ 1.4 kg	70 g (with carrying case)
Dimensions (H, W, D)	70 mm, 190 mm, 120 mm	Ø 20 mm * 60 mm
Operational temperature range	-20°C...+40°C	-40°C...+50°C
Non-operational 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...10 ⁻⁴ Pa
Data rate	512 byte / readout	-

3.2 ENVIRONMENTAL SPECIFICATION

Table 2 – 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...2000 Hz, 17.0 g ^{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

3.3 INTERFACES

Table 3 – Interfaces

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

* For Reader only.

3.4 MEASUREMENT CAPABILITIES

Table 4 – Measurement capabilities

Dosimeters	
Type	bulb
Material	CaSO ₄ :Dy
Reader	
Measuring range (s<10%)	3 μGy...10 Gy
TLD Efficiency (e=1±10%)	LET _{∞H2O} < 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)

4 Flight Heritage

Table 5 – 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 days	8 dosimeters and one Reader
Pille	Mir SS	LEO 300-400 km	4 years	16 dosimeters and one Reader
Pille'95	Mir SS (EuroMir-95)	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

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
TL	Thermoluminescent
TLD	Thermoluminescent detector system

6 List of Figures

Figure 1 – Pille System 4



7 List of Tables

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



8 References

8.1 APPLICABLE AND NORMATIVE DOCUMENTS

Table 6 – 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

Table 7 – Reference Documents

RD	Title	Reference	Version
[RD 1]	-	-	-