PROJECT : "

Electrical Passivation - PCDU upgrade for power passivation

ESA Contrat N°4000123809/18/NL/AF

D10- Executive summary Report

Written by	***Responsibility*** + handwritten signature if no electronic workflow tool
E. Morales Cas	MORALES Eduardo 2024.02.06 13:34:32 +01'00'
Verified by	
B. Mambour	MAMBOUR Benedicte Signature numérique de MAMBOUR Benedicte Date : 2024.02.06 13:40:02 +01'00'
Approved by	
E. Morales Cas	MORALES Eduardo 2024.02.06 13:34:49 +01'00'

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1. SUBJECT

The present document is executive summary Report of the project Electrical Passivation - PCDU upgrade for power passivation covered by the ESA contract N°4000123809/18/NL/AF

2. OBJECTIVES OF THE ACTIVITIES

The overall objective is to develop and test a passivation technique to provide the isolation of the solar arrays embedded in the PCDU (development and manufacture of electric breadboard for demonstration of proposed approach). The work is organized in 2 phases as follows.

Phase 1 – Passivation technique trade-off and technological tests

Phase 2 – Design, development and test of electrical breadboard

The first challenge of the first phase is to perform a trade-off between the passivation technics of the solar array in the PCDU and to identify all components involved in the passivation technics.

The second challenge of the first phase consists in a technological evaluation of the all the selected components to ensure the robustness to the severe conditions possible during the entire mission of 15 years and the disposal phase of 25years.

Based on the technological test results and the trade-off results, a selected solution is done.

The objective of the second phase is to develop and to manufacture an EBB to be tested under the 3 temperatures.

Finally, the main objective of this activity is to demonstrate that passivating of the solar array in the PCDU is feasible with a limited impact on mass, volume, cost and reliability of the PCDU.

3. MAJOR ACHIEVEMENTS

The main goals of the project are reached:

- Trade-off between the passivation technics of the solar array in the PCDU is done for all platforms
- Selection of the components involved in the passivation technics are provided for all topologies (S3R , S2R , MPPT) and for all bus applications up to 100V.
- Technological evaluation of the selected components is done successfully under the environmental conditions of the entire mission of 15 years and the disposal phase of 25years.
- A Selected passivation solution based on reliable passivation of each reliable S3R cell is developed
- EBB is manufactured and tested successfully
- A compliance matrix to the LSI requirements is provided

4. BB DEVELOPMENT AND MANUFACTURING

Several Technological BBs are developed to evaluate all the components packaging involved in the passivation technics SMDx MOSFET and Diodes; TO diodes, Power and low level relays, low level components (resistors, capacitors, comparators) and high power relays.

In order to validate the complete SA array passivation in the PCDU, A BB is designed and manufactured with the following functions:

- 3 SA section interfaces
- 1 Reliable S3R cell
- 3 Power relays EL 215
- Complete SA passivation interface of one module
- The needed connectors (SA, passivation , battery and user)

The BB definition (sizes, rooting and interfaces) is as the final SUN module witch will be embedded in the PCDU.

5. PROJECT RESULTS

In the activities related to the present contract, the following key issues were successfully addressed and reached by TAS-B:

- Deep Trade-off between all the passivation solutions is provided
- All the selected components are technologically and successfully evaluated under the environmental conditions of the entire mission of 15 years and the disposal phase of 25years
- Full qualification of the BB under three temperatures of the product in a configuration as close as possible to final flight one.
- Recommendation on the passivation technics are provided
- A compliance matrix to the LSI requirements is provided

5.1. Trade-off results

All different solutions have been evaluated against a uniform set of criteria regarding its adequacy to be used as Solar Array passivation solution within the PCDU.

The choice of the passivation solution does not seem to be driven by the platform size as the conclusions are nearly identical for all platform. The only difference is that a passivation interface common to all SUN/POWER module becomes more interesting when there are a lot of power modules.

5.2. Technological tests evaluations results

All the technological test evaluation are done successfully except SMD05 Mosfet. Thus all the identified passivation technics can be implemented for all topologies: S3R, S2R and MPPT.

The SMD05 if needed can be replaced by SMD1 or SMD2.

5.3. S3R and Passivation EBB

The EBB is tested successfully under three temperatures. The main finding is the identification of the passivation constraint under sun mode.

To avoid the stress the power relay due to the high current/high voltage at closure during the shunting of the solar array, we recommend to passivate the Sa:

- During eclipse mode, or
- Sun mode but after shunting all the section by the regulation. This can be done by forcing the battery charge voltage (EOC) at 0 V

6. S3R AND PASSIVATION PERFORMANCES

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNITS	COMMENTS
GENERAL						
Operating Temperature	At PCDU TRP	-30		60	°C	Note 1
Lifetime				15	years	
Disposal phase				25	years	
Mass				1250	g	
Total Ionization Dose	Within PCDU			50	kRad	At component level
SEE immunity threshold				60	MeV	
S3R MAIN CHARACTERISTICS						
SA Max. Voltage				120	V	
SA Current per Section	Bus up to 50V			11	A	
	Bus up to 68V			10	A	
SA Capacitance				2.2	µF	
SA Parasitic Inductance	Including harness			15	µH	
Peak Current Limitation				30	A	
Section Voltage Drop	Section connected to the bus			1.1	V	
Passivation Featue						
Shunting of the Sa in the PCDU	Under Eclipse mode or Sun Mode					Section already shunted by regulation under Sun mode
Arming	MIL1553 command					
Firing	HPC command					Use of power relay

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