		Ref: UPM-ADSF-RP-1001951990 Issue: 01 Date: Jun 14, 2024	UPM
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GSTP 4 UPM - FINAL REPORT [public version]

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UNIVERSAL PROCESSING MODULE

GSTP 4 UPM - FINAL REPORT

ESA Contract No. 4000135741/21/NL/GLC/vr

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DOCUMENT CHANGE RECORD

Issue	Date	Sheet/Section	Description
1	14.06.2024	all	Initial Issue

1 ACTIVITY OVERVIEW

The Universal Processing Module is a produce initiative of Airbus Defence and Space Microwave Instruments. The module is supposed to satisfy the broad spectrum of Radar Digital Backend needs from small reflector missions to ultra-wide-bandwidth applications and massive digital on-board beamforming.

The related GSTP activity was focused on the background technology and infrastructure development which has been successfully achieved.

Highlights are:

- Megtron 7N high speed PCB material qualified to ECSS-Q-ST-70-60 which sets a new benchmark for ESA qualified HDI PCBs
- GaN based power supply for 30A and more core supply voltages of FPGAs
- SMT qual demonstration for new complex packages such as the CNA1517 package from Xilinx
- Introduction of innovative thermal filler material to handle the very high dissipation of the XQRKU060
- JESD204B synchronization scheme combined with phase matching algorithms for coherent sampling and on-board combination of up to 56 Rx channels. A prerequisite for on board digital beamforming.

The UPM is deployed for use in current missions. An EM+ was built (outside this activity) and successfully demonstrated TRL6. EQM models for ROSE-L are in the final steps of production and 16 flight models will be built for ROSE-L and are the foundation for the innovative on-board digital beamforming of ROSE-L. The background technology developed in this activity was the clear enabler for this.

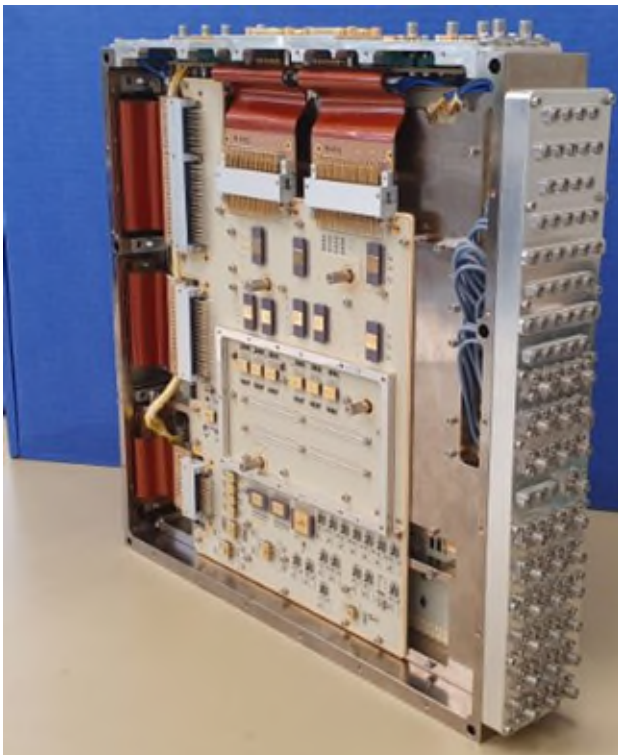


Figure 1 UPM-EM+ Module

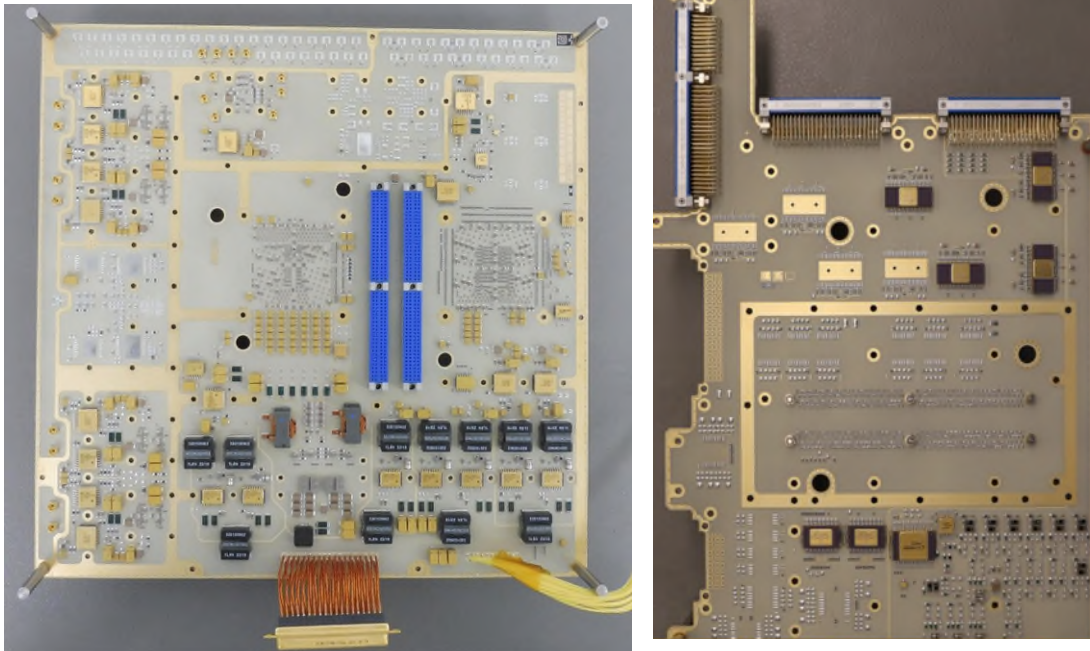


Figure 2 UPM-EQM PCB Set

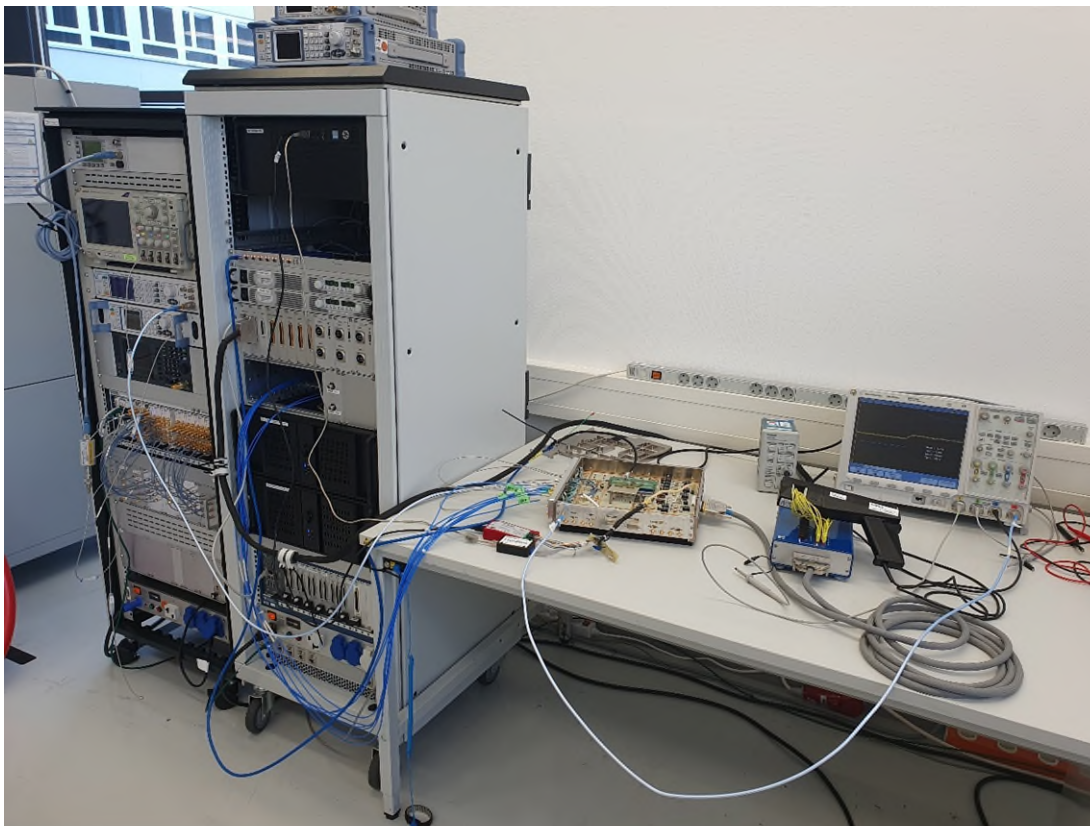


Figure 3 -EM+ under Test using the Generic EGSE

2 TECHNICAL

2.1 Overview of Work Package Result

WP100 - Management

Management activities supporting execution of the technical work packages were executed through the program and are now closed to be closed at final review

WP200 – System Engineering

System engineering activities supporting execution of the technical work packages were executed through the program and are now closed to be closed at final review

WP310 – Synchronisation

Work package closed by submission of UPM-ADSF-TN-1001397803 (TD-02) and presentation in PM#2.

WP320 – Calibration

Work package closed by submission of UPM-ADSF-TN- 1001380782 and presentation in PM#2.

WP330 – Embedded ICU

Work package closed by submission of UPM-ADSF-DD-1001014126 (TD-01) and UPM-ADSF-DD-1001350642 (TD-10)

Meanwhile the design has been matured outside the R&D activity on Airbus R&D and first software prototype was tested on hardware.

WP340 – Radiation Mitigation

Work package closed by submission of UPM-ADSF-AN-1001018846 and presentation in PM#2.

WP410 – Thermal Control

Work package closed by submission of UPM-ADSF-PL-1001099000 (TD-03) and 63.1504.013.90DRE (TD-04)

WP420 – FPGA Power Supply

Work package closed by submission of UPM-ADSF-AN-1001096782 (TD-19), UPM-ADSF-TR-1001428662 and provision of hardware.

The design has been successfully incorporated into UPM EM+ / EQM and successfully validated there. Life test of GaN components is ongoing.

WP430 – High Speed PCB

Manufacturing Capability exercise between the three potential suppliers was performed. The activity was closed by UPM-ADSF-TN-1001431604 (TD-05).

Aspocomp: Failed after initial batch production due to demarcation lines in micro-vias

ACB: First batch production failed due to core via interconnect issue. Additional investigation by ACB solved the root cause (cleaning process before via plating).
In frame of ROSE-L (outside this activity) an EQM module is currently manufactured as risk mitigation and will be batch qualification tested

TESAT: TESAT PCB passed the batch qualification testing with minor findings. Therefore, TESAT was selected as PCB source. Meanwhile EQM PCB's are produced, tested and populated (in Frame of ROSE-L), ROSE-L FM PCB release will be performed near term.

WP440 – Assembly Qualification

Assembly qualification de-risk activates successfully finished and documented by 63.1504.013.53 (TD-18)

WP510 – Generic EGSE

EGSE built up and in use for EM+ and EQM testing. Design Description provided (UPM-ADSF-DD-1001355381, TD-06).

WP520 – Generic PCM

ROSE-L PDR Data pack provided together with delta assessment to generic product requirements. As it turns out, a single design was technically not possible and the current design hence implemented for ROSE-L needs. The delta assessment elaborates on required changes for other applications and provides a VCD to identify requirements that are affected.

WP530 – Generic Firmware

Arbiter Firmware:

- Activity closed by provision of TD09, TD-10, TD-11 and TD-12
- Firmware prototype is successfully running on UPM EM+ and EQM

DSP Test Firmware

- Activity closed by provision of TD-13 and TD-14
- Firmware binaries and source code received from IMST

2.2 Status per Work Package

Table 2-1 - Status per Work Package

WBS	Description	Progress
100	Management	100%
200	System Engineering	100%
300	Key Design Maturity	
310	Synchronisation	100%
320	Calibration	100%
330	Embedded ICU	100%
340	Radiation Mitigation	100%
400	Key Technology Maturity	
410	Thermal Control	100%
420	FPGA Power Supply	100%
430	High Speed PCB	100%
440	Assembly Qualification	100%
500	Infrastructure Maturity	
510	Generic EGSE	100%
520	Generic PCM	100%
530	Generic Firmware	100%

3 MANAGEMENT

3.1 Meeting Plan and Milestones

Table 3-1 – Milestone Planning

Milestone	Planned Date	Current Date	Realized Date	Description
KO (Technical)	02/2021	Realized	02/2021	Kick-off of technical activities by submission of full proposal
KO (Contract)	07/2021	Realized	09/2021	Contract signature and work-scope freeze
PM1	08/2021	11/2021	11/2021	Progress Meeting 1
PM2	02/2022	07/2022	10/2022	Progress Meeting 2
FR	08/2022	10/2022	04/2024	Final Review

3.2 Deliverable Status

Table 3-2 – Deliverable Documents Status

Document Reference	Deliverable Document	Doc. Number	Date / Issue	Remark
TD-01	Generic UPM Design Description	UPM-ADSF-DD-1001014126	02/10.02.2023	PM#2 Data Pack
TD-02	UPM Synchronization Design Report	UPM-ADSF-TN-1001397803-UPM	01/10.0.9.2022	PM#2 Data Pack
TD-02	UPM Calibration Design Report	UPM-ADSF-RP-1001380782	01/20.09.2022	PM#2 Data Pack
-	Embedded ICU concept (as part of TD-01)	See TD-01 and TD-09		

Docu-ment Ref-erence	Deliverable Docu-ment	Doc. Number	Date / Issue	Remark
-	UPM Generic Radia-tion Analysis	UPM-ADSF-AN-1001018846	02 / 17.03.2023	PM#2 Data Pack
-	UPM Thermal Filler tradeoff Report (as part of TD-03)	See TD-03		
TD-03	Thermal Filler Quali-fication Plan	UPM-ADSF-PL-1001099000	02/ 28.03.2022	PM#2 Data Pack
TD-04	Thermal Filler Quali-fication Report	63.1504.013.90DRE	C / 07.10.2022	PM#2 Data Pack
-	FPGA Power Supply Design Description (as part of TD-01)	See TD-01 and TD-19		
TD-19	FPGA Power Supply Tradeoff and perfor-mance analysis	UPM-ADSF-AN-1001096782	02/ 16.12.2022	FR Data Pack
	FPGA Core Supply Demonstrator Test Report	UPM-ADSF-TR-1001428662	01/12.10.2022	PM#2 Data Pack
TD-05	PCB Evaluation Re-port	UPM-ADSF-TN-1001431604	02/ 23.11.2022	FR Data Pack
TD-06	EGSE Design De-scription	UPM-ADSF-DD-1001355381	01 / 27.09.2022	PM#2 Data Pack
TD-07	Generic PCM Re-quirement Specifica-tion	UPM-ADSF-SP-1000900037	02/ 09.05.2022	PM#2 Data Pack
TD-08	Generic PCM Design Report	Covered by documenta-tion below		
	ROSE-L PDR Data Pack	As per ROSE-DP-ASP-PCM-0004 Issue 02	02/18.09.2023	FR Data Pack
	Delta Assessment for PCM Generic Variant	ROSE-TN-ASP-PCM-0004	03 / 08.03.2024	FR Data Pack
TD-09	Arbiter F/W Require-ment Specification	UPM-ADSF-SP-1000953416	03/ 07.09.2022	PM#2 Data Pack
TD-10	Arbiter F/W Design Description	UPM-ADSF-DD-1001350642	20.07.2022	PM#2 Data Pack

Docu-ment Ref-erence	Deliverable Docu-ment	Doc. Number	Date / Issue	Remark
TD-11	Arbiter F/W Feasibil-ity and risk analysis	UPM-ADSF-AN-1001017140	02/ 08.11.2021	PM#2 Data Pack
TD-12	Arbiter F/W develop-ment plan	UPM-ADSF-PL-1001015898	02/ 08.11.2021	PM#2 Data Pack
TD-13	DSP Test F/W Re-quirement Specifica-tion	UPM-ADSF-SP-1001018841	04/18.05.2022	PM#2 Data Pack
TD-14	DSP Test F/W De-sign Description	IMST Document	1.05 / 23.09.2022	PM#2 Data Pack
TD-15	Final Report	UPM-ADSF-RP-1001932774	1 / 16.04.2024	1 st issue will be provided for FR
TD-16	Website Article Tem-plate	TBD	TBD	
TD-17	Assembly Qualifica-tion De-Risk Plan	63.1504.013.53EPL_A	A/23.09.2021	PM#1 Data Pack
TD-18	Assembly Qualifica-tion De-Risk Report	63.1504.013.53	A/ 01.09.2022	PM#2 Data Pack

Table 3-3 – Deliverable Hardware Status

Deliverable	Description	Status
KU060 Core Sup-ply Prototyping Board	Small scale prototyping board with im-plementation of the KU060 power so-lution and load simulation	Delivered (Nov 2022)

3.3 Change Order Status Log

Table 3-4 – CCN List

Item	Reason for Change	Date	Status
A.2020-4278-0-1_CCN1	Implementation of Third Party Rights for Airbus Defence and Space GmbH	08.12.2021	Approved

3.4 Contractual

There are no contractual issues

4 OPEN ACTION ITEMS

Table 4-1 – Open Action Items

ID #	Date	Action Item	Actionee	Due Date	Status

5 CLOSED ACTION ITEMS

Table 5-1 – Closed Action Items

ID #	Closure Date	Action Item	Result
PM1#2	16.11.2021	Provide cap plating of μ via	Information provided by mail from P.E. Goutorbe
PM1#1	15.11.2021	Check DLR position to fund additional PCB source evaluation	Dismissed after good results from ACB
PM1#3	03.02.11.2021	Check Electrical Noise Generator distribution feasibility	Requirement added to DSP Test FPGA specification