

EDHPC 2025

EUROPEAN DATA HANDLING & DATA PROCESSING
CONFERENCE FOR SPACE

Advanced Data Handling Architecture (ADHA)

"Working towards a European solution for standardized Data Handling Systems"

Tutorial: ADHA 101 – ADHA documents datapack *...and how to participate in the ADHA eco-system*

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EDHPC 2025 Tutorial: ADHA 101
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ADHA Datapack: Document Releases/Versions Overview



ADHA iss1rev0 – October 2023

- The first public release of ADHA standards documents – coinciding with the EDHPC 2023 conference
- Documents prepared through the “ADHA-2” System Study by the system study consortia (TAS, ADS, OHB, Beyond Gravity, DSI, and ESA)

Since then the ADHA iss1rev0 document package has been **used as AD for many ADHA hardware (modules and units)**

- Full list of activities to be presented tomorrow in the ADHA A1 Session.

New release currently under preparation – **iss1rev1, expected during 2025**

- In the following slides: will present from the perspective of the ADHA iss1rev1 release

The ADHA datapack is available for entities in ESA Member States under the ADHA Document License on <https://essr.esa.int>

- Note that entities outside of an ESA Member States can request access, will be considered on a case-to-case basis

ADHA Datapack: Major differences between iss1rev1 and iss1rev0

Based on feedback from community:

To simplify the ADHA structure, and to lower the entry threshold for new users

– the iss1rev1 ADHA datapack introduces the following changes:

	iss1rev1	iss1rev0	Change between rev0 and rev1
Updated document configuration control and document reference numbers	Single reference per document, e.g. ADHA-RS-017	“ADxxx” number for documents + ESA TEC document reference	• Previous “ADxxx” numbers map to new “ADHA-RS-xxx” number one-to-one. • ESA TEC reference number removed
Simplified document hierarchy and folder structure	Single set of folders	Multiple levels of folders, e.g. level2a/2b	Multi-level folder hierarchy removed
Reduced total number of documents	Only ADHA generic specifications	Included both ADHA generic specifications (ADHA-Ux) and specific documents for the reference ADHA unit (ADHA-U1), as well as system references	• ADHA-U1 documents move to separate “ADHA-U1 Reference Design” Datapack (to be issued) • System reference documents not relevant to hardware developers removed

ADHA Datapack: Overview *(iss1rev1)*



Folder	Purpose	Applicable Doc. (AD) / Reference Doc. (RD)	Key documents
/	Introductory and overview documents	<i>RD</i>	<i>ADHA-TN-002 ADHA Document Configuration List</i>
00 – Generic Specifications/	Generic specifications, applicable to all ADHA units, and modules – including interface specifications	<u>AD</u>	<i>ADHA-RS-005 ADHA Units Generic Req. Spec. ADHA-RS-017 ADHA Modules Generic Req. Spec. ADHA-RS-006 ADHA Module Design Interface Req. (MDIR) ...and CAN/SpaceWire/SpaceFibre specifications</i>
01 – Module Functional Specifications/	Specifications applicable only to specific ADHA module types	<u>AD</u>	<i>ADHA-RS-025 ADHA Power Module Spec. ADHA-RS-026 ADHA OBC Module Spec. ADHA-RS-027 ADHA SSMM Module Spec. ADHA-RS-032 ADHA Data Processing Module Spec.</i>
02 – Environmental Specifications/	Reference ADHA environments and orbits	<u>AD</u>	<i>ADHA-RS-007 ADHA Generic Environmental Spec.</i>
03 – Development and PA/	Development and Product Assurance (PA) specifications, applicable to all ADHA units/modules	<u>AD</u>	<i>ADHA-RS-008 Generic PA Req. for ADHA Units ADHA-RS-012 Generic PA Req. for ADHA Modules ADHA-RS-069 Generic Development Req. for ADHA Units ADHA-RS-062 Generic Development Req. for ADHA Modules</i>
04 – ICDs/	Interface Control Documents – description of ADHA interfaces	<i>RD</i>	<i>ADHA-IF-018 ADHA Backplane EICD ADHA-IF-022 ADHA MICD</i>
05 – DJF/	Design Justification Files – analysis documents provided as references for ADHA	<i>RD</i>	<i>ADHA-DD-014 ADHA Unit Generic Design Description ADHA-DD-073 ADHA HMS Design Description ADHA-AN-037 ADHA Unit Thermal Analysis Report</i>

ADHA Datapack: Key documents: 00 – Generic Specifications/



For ADHA Unit and Module suppliers, the following generic specifications are key documents:

ADHA-RS-005 ADHA Units Generic Requirements Specification

- Specifies technical requirements that are applicable to all ADHA units, including enclosure and backplane design

ADHA-RS-017 ADHA Modules Generic Requirements Specification

- Specifies technical requirements that are applicable to all ADHA modules

ADHA-RS-006 ADHA Module Design Interface Req. (MDIR)

- Specifies requirements that are applicable to all ADHA electrical interfaces, backplane and front-panel

ADHA-RS-019 / -020 / -021 ADHA SpaceWire / SpaceFibre / CAN bus specifications

- Three documents that specifies the main electrical interfaces on the ADHA backplane

The following provide functional (and performance) specifications applicable for specific data-handling functions:

ADHA-RS-025 ADHA Power Module Specification -- for ADHA power modules, providing local down-conversions (bus voltage to 5V / 12V / 28V), power conditioning and protections to an ADHA unit

ADHA-RS-026 ADHA OBC Module Specification -- for platform on-board computers (OBC), i.e. hosting the central control software of the spacecraft platform, TM/TC encoding/decoding, essential TM and TC, command pulse distribution unit, and optional GNSS function

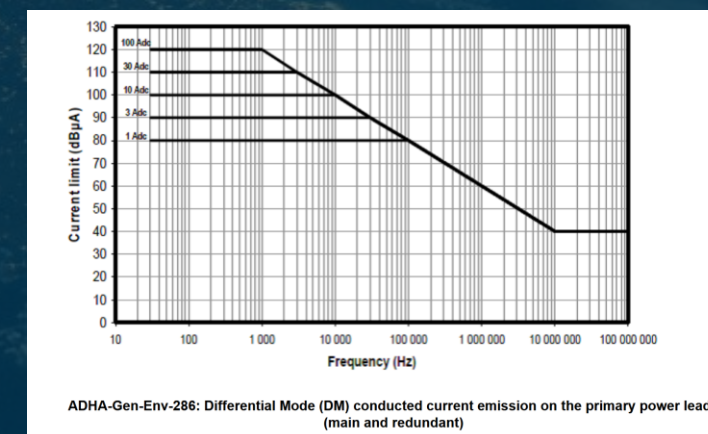
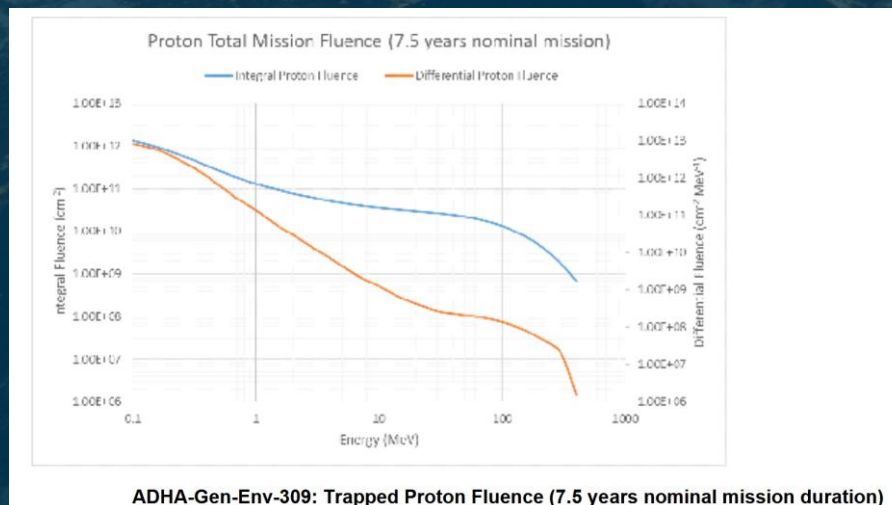
ADHA-RS-027 ADHA SSMM Module Specification -- for ADHA mass-memories, targeting high-speed payload data recording

ADHA-RS-032 ADHA DPM Module Specification -- for high-performance (payload) data processing (prev. called “co-processor module”)

Note that a single module hardware design can serve for multiple functions, by changing the SW/FPGA design (and possibly external interfaces) – e.g. both the mass-memory master module and data processing modules both require large FPGAs with multiple SpFi I/F!

Many more data-handling functions to be standardised under ADHA-3, stay put for presentations in Sessions A1/A2 tomorrow!

In iss1rev1, will include definition of additional reference environments for different mission profile.



ADHA Datapack: Key documents: 03 – Development and PA /



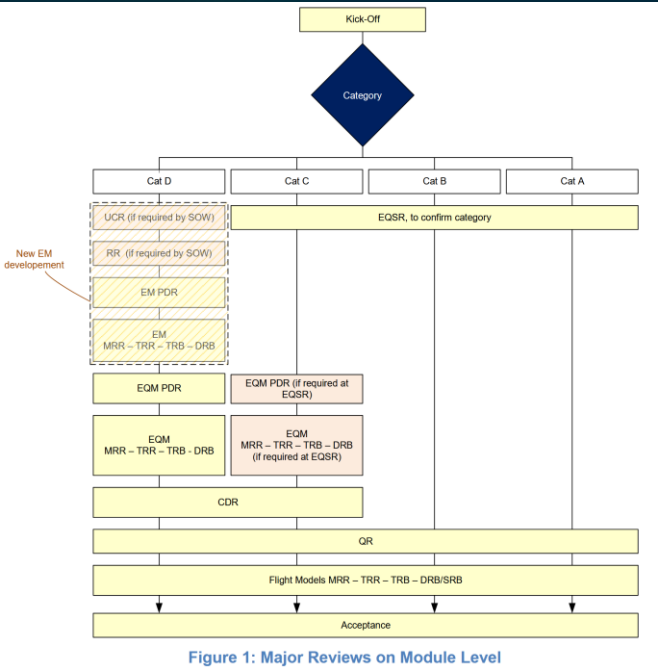
ADHA-RS-008 Generic PA Req. for ADHA Units and ADHA-RS-012 Generic PA Req. for ADHA Modules:

- Documents list of ECSS, CCSDS, etc standards that are applicable to ADHA Units and Module developments.

ADHA-RS-069 Generic Development Req. for ADHA Units and ADHA-RS-062 Generic Development Req. for ADHA Modules:

- Provides a description of the ADHA procurement, development and model philosophy for units and modules, including:
 - What reviews to take place, and their scope
 - Which documents to be provided by supplier, and at what review
 - What tests to be carried out at what level (unit/module) and on what model (EM/EQM/FM)

Note: tailoring of development and PA requirements for 3U-ADHA based on ESA Mission Classifications for Gamma/Delta missions to be done during ADHA-3 – not yet reflected in the datapack – **current requirements are based on ESA Class Alpha/Beta missions.**



	Module BB		Module EM		Module EQM		Module PFM		Module FM (recurrent of the PFM module)	
	Verif. Method	Responsible	Verif. Method	Responsible	Verif. Method	Responsible	Verif. Method	Responsible	Verif. Method	Responsible
Electrical interfaces	T	SubCo	T	SubCo	T	SubCo	T	SubCo	T	SubCo
Functional / performance	T	SubCo	T	SubCo	T	SubCo	T	SubCo	T	SubCo
HW / SW tests	T	SubCo	T	SubCo	T	SubCo	T	SubCo	T	SubCo
Mass / Dimensions / Interfaces	NO	-	(T&A)	(SubCo)	T&A	SubCo	T	SubCo	T&A	SubCo
CoG / MOI	NO	-	(T/A)	(SubCo)	T/A	SubCo	T/A	SubCo	A	SubCo
Sine Vibration	NO	-	NO	-	#T&A	SubCo	#T	SubCo	#T?	SubCo
Random vibration / Acoustic noise	NO	-	NO	-	#T&A	SubCo	#T	SubCo	#T	SubCo
Shock	NO	-	NO	-	#T&A	SubCo	NO	-	NO	-
Thermal cycling Ambient Pressure	(T)	(SubCo)	(T)	(SubCo)	NO	-	NO	-	#T	SubCo
Thermal Vacuum	NO	-	NO	-	#T&A	SubCo	#T	SubCo	#T?	SubCo
Bonding, Isolation	NO	-	NO	-	NO	-	NO	-	NO	-
Power consumption / Inrush	(T)	(SubCo)	T	SubCo	T	SubCo	T	SubCo	T	SubCo
Conducted Emission	(T/A)	(SubCo)	(T/A)	(SubCo)	T&A	SubCo	T&A	SubCo	T	SubCo
Conducted Susceptibility	NO	-	(T/A)	(SubCo)	T&A	SubCo	T&A	SubCo	T?	SubCo
Radiated Emission	(#T)	(SubCo)	(#T)	(SubCo)	#T	SubCo	#T	SubCo	#T?	SubCo
Radiated Susceptibility	NO	-	NO	-	SubCo	SubCo	#T	SubCo	#T?	SubCo
ESD	NO	-	NO	-	#T for DC/DC	DC/DC SubCo	NO	-	NO	-

Table 17: Baseline Module Level Tests

The DJF (Design Justification File) documents provide background information, and analysis to justify the ADHA design. ADHA hardware suppliers are not expected to provide SoC to the DJF files, as they are not requirements specifications

ADHA-DD-014 ADHA Unit Generic Design Description – provides a generic description of ADHA units, and possible use cases.

ADHA-DD-073 ADHA HMS Design Description – provides a reference design implementation of the HMS (Health Monitoring System) circuit, both for peripheral modules, and system controller.

ADHA-AN-037 ADHA Unit Thermal Analysis Report, **ADHA-AN-036 ADHA Unit Mechanical Analysis Report**, and **ADHA-AN-038 ADHA Unit EMC Analysis Report** provides analysis of the ADHA unit design vs the ADHA environmental parameters.

Additional DJF documents cover: grounding, unit margins, power analysis, backplane worst case analysis, etc.

ADHA 101: How to participate in the ADHA eco-system

The ADHA Industrial Supply Chain



Technology, Component, and EEE/microelectronics providers benefit from the standardisation provided in ADHA
→ allowing to promote products towards the ADHA eco-system

Example: backplane/connector suppliers

ADHA Module Suppliers benefit from the standardisation and common functional/interface definitions
→ allowing to promote modules within the ADHA eco-system, to end-users or ADHA unit integrators

Example: mass-memory module suppliers

ADHA Unit Suppliers benefit from the standardisation and reuse of standard modules
→ allowing to promote module/scalable ADHA units towards mission primes

Example: payload data handling unit provider

Note: unit supplier can also be a module supplier

Mission primes benefit from the standardisation – reduces the specification work per mission
→ allowing to procure standard functions from multiple sources

Note: spacecraft bus provider can also be ADHA unit supplier/integrator

How to participate in the ADHA eco-system?

Companies can opt to participate at different levels:

- **As complete ADHA unit / solution provider**
 - Integrate in-house and/or 3rd party modules into complete electronics units for different applications
 - **As ADHA module provider:**
 - Provide recurrent (or custom) ADHA modules for specific purposes to ADHA unit integrators
 - **As building block / component provider**, providing key building blocks for ADHA equipment, such as:
 - Flight hardware: connectors, wedgelocks, thermal solutions, EEE components, etc.
 - Software: application software running on ADHA units
 - EGSE: ADHA test racks and modules for integration support, automated module testers, etc.
- ...and of course: as **end-user / customer, integrating ADHA units in spacecraft** – and providing inputs for ADHA requirements.
- **ADHA-IWG (Industrial Working Group)** forum for discussion on ADHA requirements, and supply chain

ADHA ecosystem: opportunities through ESA



ESA provides funding for ADHA-related activities through several mechanisms:

Fully funded activities (TDE, GSTP Element 1, Discovery, etc)

- Driven by ESA roadmaps
- Published as open competition ITT (invitation to tender) on ESA-Star
- GSTP Element 1 compendium provided as a “wish-list” of ADHA activities.
- Note: GSTP Element 1 activities can also be proposed directly by industry.

Co-funded activities (GSTP Element 2, InCubed, ARTES C&G, NAVISP):

- Industry-driven, triggered by industry proposals, direct negotiation (DN) procurement policy
- Note: different programmes have different requirements in terms of target applications, business case and required target TRL level!

Keep an eye on the ADHA roadmap presentation tomorrow for more details.

→ If in doubt, don't hesitate to contact ESA: David.Steenari@esa.int and Kostas.Marinis@esa.int for more information.

Recap, in these presentations we have outlined an overview of the ADHA architecture, module designs, and document datapack.

In the coming days, there will be a number of ADHA related presentations:

- ADHA Plenary, round-table, and five sessions of many paper presentations

Here next: presentation on possible thermal solutions and technologies for electronics units, including ADHA!

Short Q&A session after last presentation – if any further questions

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Questions?

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