

DEFENCE AND SPACE Space Products

NEMO-2

Non-volatile Extendable
Memory On-board



P a y l o a d

D a t a H a n d l i n g



The NEMO-2 is a compact solid-state recorder that provides high-end mass memory storage and performance to a broad range of missions. This product line is the result of over 30 years, where Airbus Defence and Space has gained a strong flight heritage on solid-state technologies.

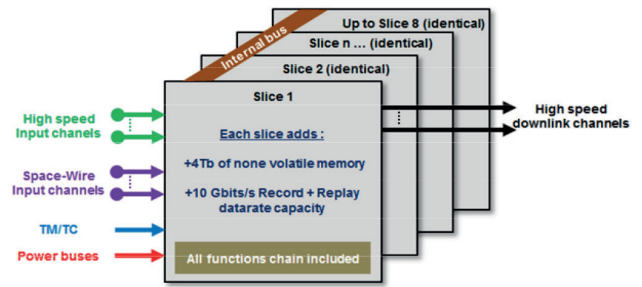
NEMO-2's architecture is modular and scalable, based on qualified building blocks packaged in slice form factor.

This mass memory provides straightforward and simultaneous record and replay capability using Flash technology.

NEMO-2 is a redundant unit, made of two to eight identical slices composed of memory slices with their dedicated DC/DC converters. The NEMO's basic 2040 configuration has a user capacity of 4Tbits for only 22W primary power consumption and 8 Kg mass. Extended versions with 8 to 32Tbits total capacities are available. Real time data compression and cyphering are available as options.

Architecture and key features

- The unit is composed of an assembly of 2 up to 8 identical slices (modules) connected for data exchanges and cross-strapping features.
- Each of the slices is self-contained and is adding inputs, outputs, control and power external interfaces to the mass memory equipment.
- In addition to the interfaces, each of the slices is featuring a memory bank of 4Tb and a high-end processing capability built on an advanced rad-tolerant FPGA coupled with a rad-hard processor.
- The number of slices is depending on the quantity of IOs, the data rates and the memory capacity required for the mission. One slice is generally added for further redundancy.



INTERFACES	
FROM/TO SATELLITE MANAGEMENT UNIT	Primary power input, unregulated redundant power bus 22-38V Redundant MIL-STD-1553B for TM/TC command and telemetry purpose TM/TC possible via the record Space Wire interfaces Power on/off status, secondary voltage telemetry and thermistor telemetry interface
RECORD INTERFACES	Per slice: 4x Nominal + 4x Redundant High Speed Record Interfaces Wizzard links, input data rate up to 2.5 Gbps on each WZL link Per slice: 4 Instrument Record Interfaces SpW links, with internal cross-straps 2x 200Mbps + 2x 100Mbps Per slice: 1x Nominal + 1 Redundant SpW links for housekeeping / Ancillary data record & replay at 100Mbps
REPLAY INTERFACES	Per Slice: 3 high Speed Replay Interfaces Wizzard links with control flow Or in option LVDS 8 bits outputs (Nominal + Redundant) up to 480Mbps

MAIN FUNCTION	KEY FEATURES
<ul style="list-style-type: none"> √ Non volatile Payload and Platform Data Storage (spacecraft housekeeping/ancillary,...) √ Simultaneous record & replay are possible at highest data rates √ Provision of discrete telemetries (power status, internal temperatures & secondary operating voltages) OPTIONAL: <ul style="list-style-type: none"> √ Real time CCSDS121.0 B2 lossless Data Compressor √ Real time payload data security with AES256 data encryption √ Payload data routing 	GENERIC SERVICES PUS-C services MEMORY Large capacity non-Volatile Flash Memory Array composed of the second generation of Airbus qualified flash components CCSDS files based operations (FBO) PROCESSING High performance FPGA SCOC3 System-On-Chip based on the LEON3 sparc v8 core CHANNEL CODING CCSDS Packet Telemetry Standard Transmission over Virtual Channels CADU generator for Formatting of playback TM files CFDP (CCSDS File Delivery Protocol) Class 2 for downlink Security AES 256 cyphering in option
PERFORMANCE PARAMETRES User memory capacity: scalable from 4Tbits up to 32Tbits (3.8Tbits to 30Tbits EOL) Aggregated record + replay data rate: up to 10Gbits/s per slice (i.e. n x 10 Gbit/s for a configuration operating n slices)	ARCHITECTURE LEVEL Unit free of single point failure Each slice is capable to operate autonomously Modular N out N+1 (cold Spare) redundant architecture externally cross-strapped
RELIABILITY & PERFORMANCE VS ENVIRONMENT Life time: 12 years in LEO orbit, behind 2mm aluminium shielding Quality Class: 1 or 2 Operating range: -25°C to +60 °C NAND flash endurance: Minimum 60K Program/ Erase cycles Residual Bit error rate: 5.3×10^{-17} error/bit/day for mission Vibration: 24 g sine; 15 Grms random out of plane Shock: 1000 g at 1600 Hz Reliability: 0.995 over 12 years in-orbit@ 30°C (Model 2040)	DESIGN LEVEL FPGA design triplication Flash wear levelling & bad blocks management The MM array is designed to allow the loss of individual memory component Protected from data errors induced by SEU/MEU by symbol error correction PART LEVEL Usage of latch up free parts High efficiency internal DC/DC converter with protected features
	BUDGETS Mass: 8kg for the 2 slice configuration Power dissipation: <math><22\text{W}</math> per active slice (with simultaneous Record/compression/Replay)

Model	Total memory Capacity	User memory Capacity	Power Consumption (W)	Mass (kg)	Memory Slices	Size LxHxW (mm)
2040	8 Tb	4 Tb	22	8	2	365x220x170
2080	12 Tb	8 Tb	44	11	3	365x220x230
2120	16 Tb	12 Tb	66	14	4	365x220x290

Models expandable up to 32 Tb total memory capacity by addition of slices