



*NANOskey I 2nd-Generation satellite platform
for multi-mission constellation projects*

5th ESA CubeSat Industry Space Days, 1-3 June 2021

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NANOsky I Platform



Nano/micro satellite platform

Platform provider
for the emerging
space market.

NANOsky I Platform 2nd Gen

Overview

- Designed for **high production rates** and delivering **cost efficiency** for emerging constellation mission
- **Scalable platform** to fit 2-3U nanosatellites up to micro scale satellites (25-50kg)
- Platform is based on fully distributed approach and multifunctional architecture, to enhance performance and reduce complexity on system level, and finally increasing platform versatility.
 - Each equipment features local intelligence, while its functions are tuned equipment specific tasks
- Major improvements w.r.t. to 1st Generation
 - Increasing reliability and overall quality assurance
 - Introducing strict standards on the supply chain, manufacturing and assembly (ISO, AEC, IPC, ECSS,...)
 - Unifying equipment qualification and acceptance testing approach
 - Equipment re-designed to enable automotive like production flow and quality checks
 - More features with even higher robustness
- NANOsky I Platform 2nd Gen is today equipping 4 upcoming constellation missions

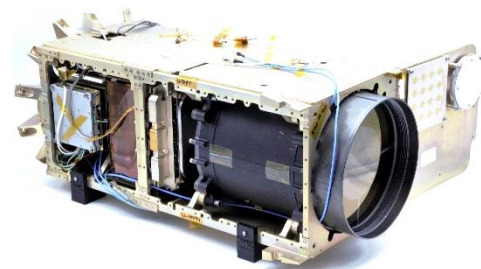


Image: Example of 20U EAGLET-2 Microsatellite with NANOsky I avionics (photo courtesy of OHB-Italia)

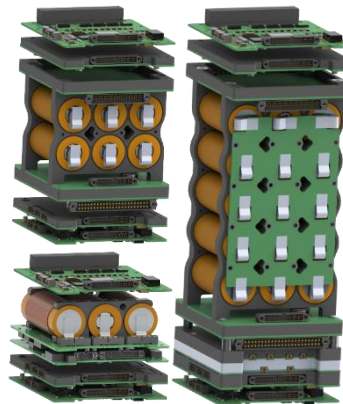


Image: Scalable NANOsky I avionics platform

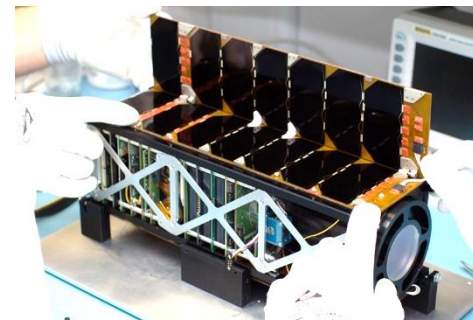


Image: Example of 3U Nanosatellite with NANOsky I avionics (photo courtesy of UM)

NANOsky I Platform 2nd Gen

Building Block

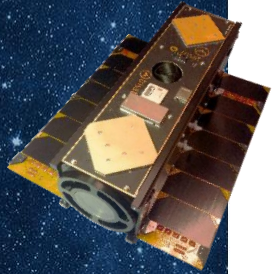


Image: TRISAT-PFM

- *TRISAT based on First generation of NANOsky I platform (on VV16)*
- *Common building blocks distributed across each subsystem*
 - *Reducing the risk – lower number of component types*
 - *Careful component selection*
 - *Expertise on radiation effects on semi-conductor level*
 - *Good knowledge on components mitigation techniques against (SEE)*
 - *Reusing radiation proven building blocks across platform*
- *Sophisticated three-level FDIR approach*
 - *Protection at system, subsystem and the most importantly on component levels*
- *Utilization of key European technologies developed by SkyLabs:*
 - *PicoSkyFT processor*
 - *Advanced LCL protection*
 - *Robust analogue MPPT circuitry*

NANOsky I Platform 2nd Gen

Building Blocks - Latching Current Limiters

- *Protection of components and subsystems against SEL effects*
- *Enables use of potentially SEE susceptible COTS components*
- *Extensive radiation testing of the LCL technology and other building block*
 - *Tested at PSI (230 MeV proton)*
 - *ChipIR (up to 800 MeV neutrons)*
- *SkyLabs is implementing LCL technology with some new features into a LCL ASIC component (ESA Contract).*
 - *EM samples will be available in Q4/2021*

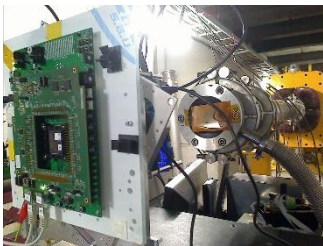


Image: CERN UHE facility
Testing campaign



Image: ChipIR Neutron facility
Testing campaign

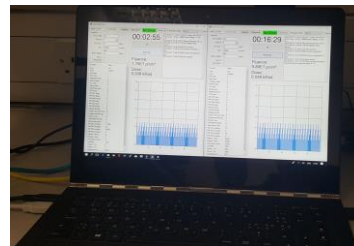


Image: Sophisticated Radiation
monitoring platform

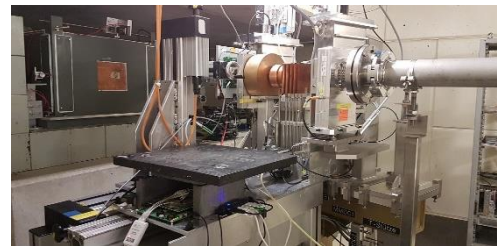
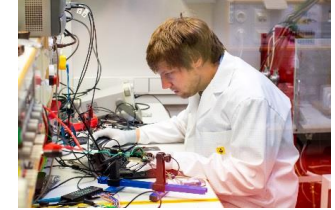


Image: PSI Proton facility
testing campaign

NANOskey I Platform 2nd Gen

Qualification

- *NANOskey I platform is qualified according to ISO 19683:2017 qualification flow:*
 - *Space systems – Design qualification and acceptance tests of small spacecraft and units*
- *Certain qualification and acceptance tests are added, as defined by ECSS standards (ECSS-E-ST-10-02C, ECSS-E-ST-10-03C, ECSS-Q-ST-70-12C,...) in order to test more thoroughly and thus providing equipment with ECSS like confidence level.*
- *The flow of QT/AT steps:*
 - *FFT/RFT, EMC, Physical Property Measurement,*
 - *Sinusoidal Vibration Test, Random Vibration Test, Shock Test*
 - *Thermal Vacuum Test, Functional test in vacuum, Cold/hot start, Thermal Cycle Functional Test, Thermal Cycle Endurance Test, and Burn-In*



Images: Qualifications (vibration, functional, shock, TVAC testing)

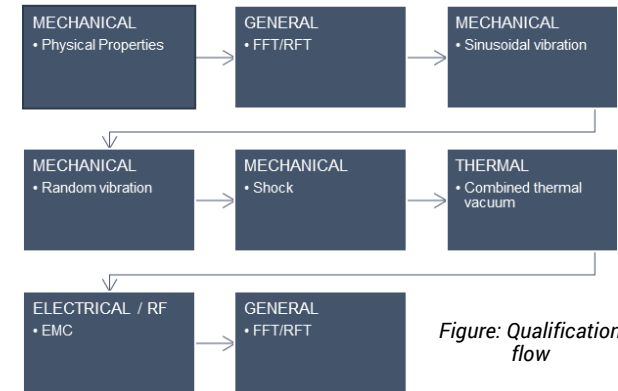


Figure: Qualification flow

NANOsky I Platform

S/C equipment



Nano/micro satellite platform

Platform provider
for the emerging
space market.

Miniaturised On-Board Computers for small, micro and nano scale satellites

NANO_{hpm-obc}

High Performance Fault Tolerant RISC-V OBC

- Fault Tolerant **NEOL-V processor** @ 80 MHz
 - **RISC-V** 32-bit architecture
 - Single precision FPU
 - L2 cache optional
- 256 MB DDR3 memory
- 4 Mbit NMV for TM storage (unlimited read/write endurance)
- Redundant 2Gb NAND Flash for mass storage
- Redundant CAN for TM/TC
- 2x High-speed LVDS or RS422/485 channels
- 8x GPIO (with multifunction support UART/SPI/TWI and OBT trigger)
- GNSS receiver on board (GPS / GLONASS / Galileo / BDS / QZSS)
- Compatible with the PC-104 form factor.



NANO_{obc} Gen2

Fault tolerant on-board computer for a mission critical operation

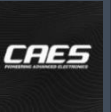
- Fault Tolerant **PicoSkyFT processor** @ 16 MHz
 - PicoSkyFT-L 8/16-bit architecture
 - Single precision FPU (optional)
- 2 MB MRAM for program memory
- 1 MB SRAM for data memory
- 4 Mbit NMV for TM storage (unlimited read/write endurance)
- Redundant 2Gb NAND Flash for mass storage
- Redundant CAN-TS for TM/TC
- 2x High-speed LVDS or RS422/485 channels
- 8x GPIO (with multifunction support UART/SPI/TWI and OBT trigger)
- GNSS receiver on board (GPS / GLONASS / Galileo / BDS / QZSS)
- Compatible with the PC-104 form factor.

Common features

Radiation hardened by design to increase reliability and robustness

- Constant current monitoring and limiting (proprietary LCL with error injection capability)
- LUT-based supervisor
- A two-bank program/code memory architecture
- Selective components technology selection with flight heritage
- EDAC protected memories/registers
- Advance FDIR techniques

Fault Tolerant processors and SoC designs by SkyLabs and CAES (Cobham Gaisler) Space proven IP Cores, having more than 30 years' of experiences.



On-board GNSS receiver with OBT controller provides PPS signal distribution and fail over to synthetic PPS in case of lost GNSS.

Compliant with **NANOsky CMM Ψ Software Development Kit** to enable Control, Monitor and Management (CMM™) of NANOsky platform subsystems

Qualification and acceptance criteria: ISO 19683:2017, ECSS-E-ST-10-02C, ECSS-E-ST-10-03C, ECSS-Q-ST-70-12C

Heritage: TRISAT, TRISAT-R, EAGLET-2, HERMES-SP,...

Miniaturised TM/TC communication subsystems for LEO missions (1/2)

NANOLink Gen2 - Product family

A full duplex CCSDS Communication subsystems in S-band frequency

NANOLink-base

- Best **SWaP-optimized** product in its class
- CCSDS compliant S-band full duplex transceiver
- Software Defined Radio architecture
- Advanced FDIR supervision functionality of SDR functionality
- RF output power: Up to 30 dBm
- Frequency band: Tx 2.200 - 2.300 GHz
Rx 2.025 - 2.110 GHz
- Input sensitivity: -86 dBm @ 4 Mbps OQPSK
- Data rates: Up to 4 Mbps @ 2.5 MHz (OQPSK)
Adjustable data rate in flight
- Interface: Redundant CAN-TS and LVDS-TS
- Power consumption: 6 W (Rx + Tx @ 1W RF output power)
1.9 W (Rx only)
- Comprehensive housekeeping telemetry (voltages, currents, temperatures,...)
- Redundant CAN for TM/TC

NANOLink-boost Gen2

- Additional PA to boost RF output power
- RF output power: Up to 37 dBm (5 W)
- Power consumption: 17 W (Rx + Tx @ 5W RF output power)

NANOLink-boost-dp Gen2

- Integrated diplexer interfaces to the splitter/combiner on two antenna ports
- Integrated additional RX filter coupled with an LNA
- RF output power: Up to 32 dBm (1.5 W) per antenna port
- Power consumption: 17 W (Rx + Tx @ 1.5 W per each antenna)

Common features

Embedded intelligence, powered by PicoSkyFT. Several intelligent built-in functions enable the use of the NANOLink Gen2 as a fully autonomous system, making the acquisition of satellite diagnostic data practically autonomous.

Radiation hardened by design to increase reliability and robustness

- Fault Tolerant SoC design with embedded **PicoSkyFT** processor
- Constant current monitoring and limiting (proprietary LCL with error injection capability)
- LUT-based supervisor
- A two-bank program/code memory architecture
- Selective components technology selection with flight heritage
- EDAC protected memories/registers
- Advance FDIR techniques

Flight Heritage: TRISAT, TRISAT-R, EAGLET-2, HERMES-SP,...

EGSE support

Compliant with **NANOSky CMMΨ Software Development Kit** to enable Control, Monitor and Management (CMM™) of NANOSky platform subsystems

NANOLink-2 is a turn-key solution with **skyEGSE-comm** CCSDS compliant SDR equipment.

Miniaturised TM/TC communication subsystems for LEO missions (2/2)



NANOcomm Gen2

A full duplex CCSDS Communication subsystem in UHF/VHF frequency bands

- **Best SWaP-optimized** product in its class
- CCSDS compliant UHF and VHF full-duplex transceiver
- Two independent RF transceivers chains for superior reliability
- RF output power: Up to 31 dBm
- Input sensitivity: -114 dBm @ 10% PER (GMSK 9600bps)
LNA on the receive path
- Frequency band: 420 - 450 MHz /
130 - 200 MHz
- Data rates: Up to 25 kbps @ 25 kHz (GFSK)
Adjustable data rate in flight
- Baseband bandwidth: 12 kHz, 18 kHz, 25 kHz
- Interface: Redundant CAN-TS
RF Tx out (SMPM connector)
RF Rx in (SMPM connector)
- Power consumption: 8W (Rx + Tx @ 31 dBm output power)
2W (Rx only)
- 4 Mbit NMV for housekeeping telemetry storage (unlimited read/write endurance)
- Comprehensive housekeeping telemetry (voltages, currents, temperatures,...)

Common features

Embedded intelligence, powered by PicoSkyFT. Several intelligent built-in functions enable the use of the NANOcomm Gen2 as a fully autonomous system, making the acquisition of satellite diagnostic data practically autonomous.

Radiation hardened by design to increase reliability and robustness

- Fault Tolerant SoC design with embedded **PicoSkyFT** processor
- Constant current monitoring and limiting (proprietary LCL with error injection capability)
- LUT-based supervisor
- A two-bank program/code memory architecture
- Selective components technology selection with flight heritage
- EDAC protected memories/registers
- Advance FDIR techniques

Flight Heritage: TRISAT, TRISAT-R, EAGLET-2, HERMES-SP,...

EGSE support

*Compliant with **NANOSky CMMΨ Software Development Kit** to enable Control, Monitor and Management (CMM™) of NANOSky platform subsystems*

*NANOLink-2 is a turn-key solution with **skyEGSE-comm** CCSDS compliant SDR equipment.*

Intelligent Remote Terminal Units with unified TM/TC interface for micro scale satellites

NANOif Gen2

Miniaturised RTU with build-in intelligent functions

NANOif Gen2 interface board represents an intelligent remote terminal unit for interconnection of satellite's on-board sensors, instruments, or payloads into a seamless and unified NANOsky on-board data handling architecture.

- User interfaces:
 - 2x auxiliary CAN bus (CSP protocol)
 - 5x RS422/485 full duplex channels (protocol independent)
 - 24x Analog input channels with concurrent acquisition and dedicated power interface
 - 20x GPIO 3V3 compliant
 - 8x GPIO with remap capability (GPIO, UART, SPI, I2C)
- User interfaces available on standard connector or alternatively support for legacy PC104 connector
- Remote Terminal Interfaces:
 - Redundant CAN interface for TM/TC
- 4 Mbit NMV for housekeeping telemetry storage (unlimited read/write endurance)
- Instant boot up at power on
- Comprehensive local subsystem telemetry (currents, voltages, temperatures, etc.)
- Power consumption 1.2 W

Common features

Embedded intelligence, powered by PicoSkyFT. Several intelligent built-in functions enable the use of the NANOif as a fully autonomous system, making the acquisition of satellite diagnostic data practically autonomous.

Radiation hardened by design to increase reliability and robustness

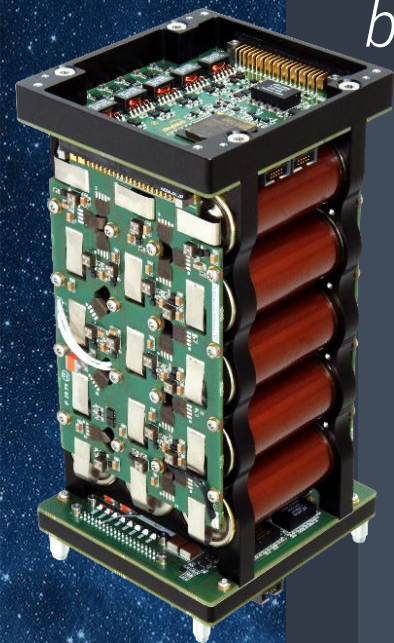
- Fault Tolerant SoC design with embedded **PicoSkyFT** processor
- Constant current monitoring and limiting (proprietary LCL with error injection capability)
- LUT-based supervisor
- A two-bank program/code memory architecture
- Selective components technology selection with flight heritage
- EDAC protected memories/registers
- Advance FDIR techniques

Compliant with **NANOsky CMM Ψ Software Development Kit** to enable Control, Monitor and Management (CMM[™]) of NANOsky platform subsystems

Qualification and acceptance criteria: ISO 19683:2017, ECSS-E-ST-10-02C, ECSS-E-ST-10-03C, ECSS-Q-ST-70-12C

Heritage: TRISAT, TRISAT-R, EAGLET-2,...

A versatile Electrical Power Systems with scalable battery capacity for nano and micro scale satellites



NANOeps Gen2

Highly integrated EPS with BMM, scalable battery pack and PCDU in a single unit.

Battery Management Module (BMM) and battery pack

- Scalable capacity of **31/63/95/126/158Wh**
- Battery lifetime **more than 15000 re-charge cycles** @ 20% DoD (80% EOL capacity) - 3 years in LEO
- Superior thermal and chemical stability of LiFePO₄, stable under overcharge or short circuit
- No capacity lost, due to low temperature conditions
- High efficiency Inductive Couple Battery Balancer
- Integrated **Autonomous Battery Heaters** per each battery cell
- Individually Monitored and Controlled Power Distribution

Power Control and Distribution Unit (PCDU)

- 5x redundant DA interfaces with redundant TLM inputs
- 3x separation switches
- Provided up to 23 dedicated LCL protected output channels
 - 3V3, 5V, 12V and Unregulated
 - Redundant architecture for essential outputs
 - Each output channel is adjustable with current up to 5 Amps

NANOeps-AMPPT

The safest and most accurate solar array energy conversion unit

- Provides up to 10x solar array (SA) input channels
- Robust, reliable and fully autonomous Analog Maximum Power Point Tracking Algorithm
- Compliant for the best performance with 7S 3J solar cell configuration

Common features

Radiation hardened by design to increase reliability and robustness

- Constant current monitoring and limiting (proprietary LCL with error injection capability)
- SEE immune design
- Selective components technology selection with flight heritage
- EDAC protected memories/registers
- Advance FDIR techniques

Instant boot up at power on

Comprehensive local subsystem telemetry (currents, voltages, temperatures, etc.)

Redundant CAN interface for TM/TC

Debug connector for monitoring output channels and battery voltage during integration

Compliant with NANOsky CMMΨ Software Development Kit to enable Control, Monitor and Management (CMM™) of NANOsky platform subsystems

Qualification and acceptance criteria: ISO 19683:2017, ECSS-E-ST-10-02C, ECSS-E-ST-10-03C, ECSS-Q-ST-70-12C

Heritage: TRISAT, TRISAT-R, EAGLET-2,...



skylabs

A miniaturised Electrical Power Systems for nano scale satellites



NANOeps-mini Gen2

Highly miniaturised all-in-one EPS with Battery Management Module (BMM) with battery pack, Power Control and Distribution Unit (PCDU) and Solar Array input conditioning.

BMM and battery pack

- Capacity of 31Wh - single 3S1P battery configuration
- Battery lifetime **more than 15000 re-charge cycles** @ 20% DoD (80% EOL capacity) - 3 years in LEO
- **Superior thermal and chemical stability** of LiFePO₄, stable under overcharge or short circuit
- No capacity lost, due to low temperature conditions
- High efficiency Inductive Couple Battery Balancer
- Integrated **Autonomous Battery Heaters** per each battery cell
- Individually Monitored and Controlled Power Distribution

PCDU

- 1x deployment interface with redundant TLM and RBF pin
- **5x SA input** channels
 - Robust, reliable and fully autonomous Analog Maximum Power Point Tracking Algorithm
 - Compliant for the best performance with 7S 3J solar cell configuration
- **5x 5V output channels** with current up to 3 Amps (LCL protected)
- Ideal All-in-one EPS for 1-3U CubeSat missions

Radiation hardened by design to increase reliability and robustness

- Constant current monitoring and limiting (proprietary LCL with error injection capability)
- SEE immune design
- Selective components technology selection with flight heritage
- EDAC protected memories/registers
- Advance FDIR techniques

Instant boot up at power on

Comprehensive local subsystem telemetry (currents, voltages, temperatures, etc.)

Redundant CAN interface for TM/TC

*Compliant with **NANOSky CMMΨ Software Development Kit** to enable Control, Monitor and Management (CMM™) of NANOSky platform subsystems*

Qualification and acceptance criteria: ISO 19683:2017, ECSS-E-ST-10-02C, ECSS-E-ST-10-03C, ECSS-Q-ST-70-12C

Heritage: TRISAT, TRISAT-R,...

NANOsky I Platform EGSE equipment



Platform EGSE

Saving time during AIT is the
primary focus of emerging
space market.

A **skyEGSE** family of products provides a turn key solution to NANOsky I platform (1/3)

skyEGSE

Turn key EGSE solution for AIV and mission operations

skyEGSE-GUI

- Real-time monitoring and commanding of NANOsky I platform, solely based on NANOsky SDK

skyEGSE NANOsky CMM Ψ SDK

- Software development kit to Control, Monitor and Management (CMM Ψ) of NANOsky platform subsystems

skyEGSE-comm

- Linux based 4U" server with SDR equipment to establish RF link between NANOcomm/link and skyEGSE-GUI or NANOsky SDK over RF
- Integration ready with majority of Ground Station Network provides

skyEGSE-LINK2

- A USB to CAN/LVDS/RS422 dongle to establish communication with **skyEGSE-GUI** or **NANOsky CMM SDK** and especially enabling ease interfacing to 3rd party EGSE or AIT software

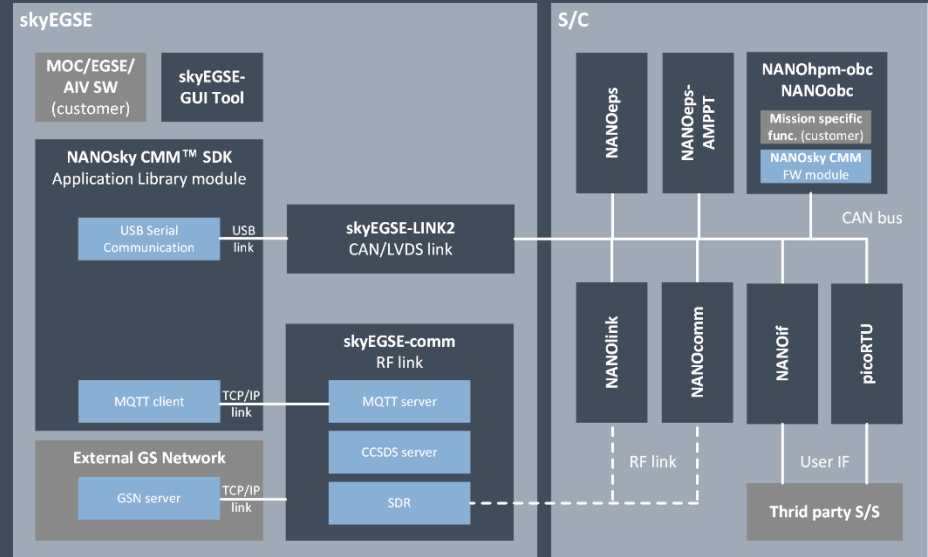


Image: skyEGSE architecture

A **skyEGSE** family of products provides a turn key solution to NANOsky I platform (2/3)



skyEGSE-comm with S-band or UHF/VHF radio support

Ground Station Equipment for communication over S-band or UHF/VHF RF link

skyEGSE-comm is a CCSDS compliant SDR equipment, that enables full duplex communication link with SkyLabs on-board RF communication equipment, S-Band (NANOlink) and/or UHF-VHF bands (NANOcomm).

Eases integration with a customer's Mission Operations Software, skyEGSE-comm exposes all communication capability over a MQTT, allowing seamless integration over an Ethernet connection.

skyEGSE-comm can be interconnect with existing Ground Station RF chains, as KSATlite, etc.

Compliant with **NANOsky CMM Ψ** Software Development Kit

S-band characteristics:

- Data rates supported: 4, 2, 1, 0.5, 0.0625 Mbps
- Configurable frequency: Tx range: 2025 - 2100 MHz
Rx range: 2200 - 2290 MHz
- Supported modulations: OQPSK
- RF front end: Ettus USRP

UHF/VHF-band characteristics:

- Data rates supported: Up to 25 kbps
- Configurable frequency: Tx range: 130-220 or 420-450 MHz
Rx range: 130-220 or 420-450 MHz
- Supported modulations: GFSK
- RF front end: Ettus USRP

skyEGSE-GUI Tool

Enables user immediate out of the box control, monitor and management of any SkyLabs equipment.

Application establish connection with target equipment via skyEGSE-LINK2 or skyEGSE-comm, and provides features as:

- Equipment real-time TM monitoring
- Provides TC for controlling equipment functions
- Downloading equipment logs
- Equipment parameterisation
- Equipment FW upgrade function
- Execution of customised TM/TC



skyEGSE-LINK2

An USB Interface dongle for communication over CAN/LVDS/RS422 interfaces

Dongle enables high speed and low latency communication between SkyLabs equipment and advanced skyEGSE-GUI software or NANOsky CMM Ψ SDK.

skyEGSE-LINK2 supports the following interfaces:

- Redundant CAN buses
- 2x high-speed LVDS (TIA/EIA-644 compliant)
- 2x RS422 (TIA/EIA-422 compliant)



A *skyEGSE* family of products provides a turn key solution to NANOsky I platform (3/3)

NANOsky CMM Ψ SDK

Software development kit to Control, Monitor and Management (CMM Ψ) of NANOsky platform subsystems

- NANOsky CMM Ψ SDK implements all functions to support controlling, monitoring and management of any SkyLabs satellite equipment.
- Functions provided in C++ library
- Application-level examples for fast prototyping or functionality integration to a third-party software as customer specific EGSE, AIV/T or even MOC software.

NANOsky CMM Ψ SDK is composed out of

- **Application Library** module represents framework in Qt/C++ for Windows and Linux environment that supports all SkyLabs equipment functionalities which furthermore eases integration with third party AIV/T or EGSE software, or building one from scratch.
- **FW module** is standard set of on-board computer functions integrated into RTOS. The C-based FW module is verified and flight proven and includes all essential functions. All functions are embedded in provided RTOS upon which also a application layer of functions is developed.

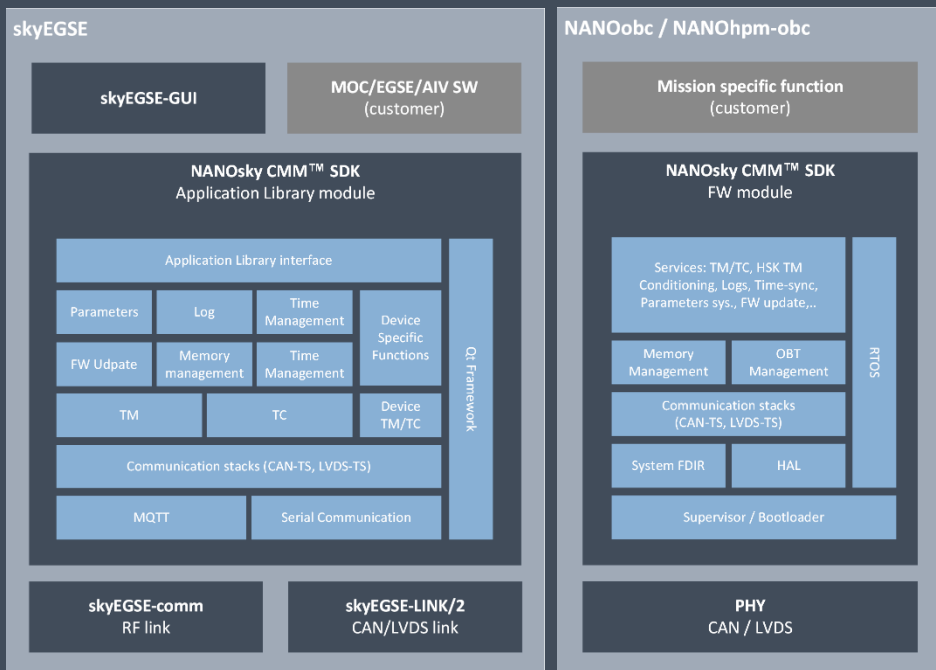


Image: NANOsky CMM Ψ SDK architecture

NANOsky I Platform

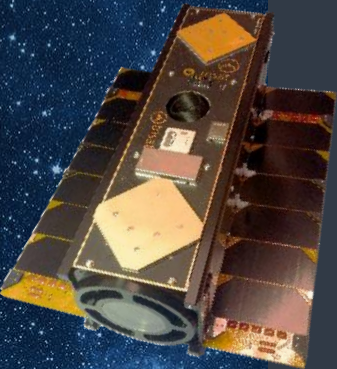


**In orbit experiences and
constellations mission**

Changing economics of Space.

TRISAT mission and upcoming TRISAT-R mission

Pioneer of the SkyLabs' 1st generation platform



TRISAT

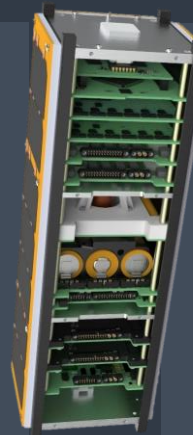
In-orbit demonstration of the Slovenian space technologies by following up the latest trends of technology miniaturization and to address the upcoming changes in the economy of space.

Mission and technologies

- **Prime** University of Maribor, Slovenia
- **Launch vehicle** VEGA, VV16, SSMS PoC, French Guiana
- **Orbit** LEO, 530 km, sun-synchronous
- **Platform** **NANOSky I (1st generation) avionics**
- **Primary payload** Miniaturized Multispectral Short Wave Infrared Hyperspectral Imager (SkyLabs)
- **Status** **Commissioning phase**
Deployment of one solar panel field (limited power budget, 2 SS are shaded)
In operations 270 days

Satellite

- **Dimensions** Nanosatellite, standard 3U form factor
- **Mass** 3.76 kg
- **Stabilisation** AOCS 3-axis stabilized (3 magnetorquers, 5 wheels, star tracker) – provider BST
- **Power** 30 Wh battery, single deployable solar panels
- **Communication** VHF (GFSK, 9766 bps), UHF (GFSK, 9766 bps) and S-band (OQPSK, 4 Mbps UL/DL)
- **Orbit determ.** On-board GNSS receiver



TRISAT-R

3U CubeSat mission targeting a MEO orbit and objective to perform a radiation analysis with four scientific payloads for radiation monitoring and IOD of several other technologies.

Mission and technologies

- **IOD** of a highly miniaturized nanoscale platform with fault tolerant features
- **IOD** of first RISC-V processor (NEOL-V) in Space by CAES (Cobham Gaisler)
- **Provide mapping** of ionizing radiation and radiation effects with on-board instruments:
 - RadMon from CERN
 - CHIMERA RHA from ESA
 - TID monitor from SkyLabs

- **Prime** University of Maribor, Slovenia
- **Status** **Phase D**

- **Launch vehicle** VEGA-C maiden flight Q1/2022
- **Orbit** MEO, 5865 km,
- **Platform** **NANOSky I (1st generation) avionics**
- **Dimensions** Nanosatellite, standard 3U form factor
- **Communication** UHF/VHF (GFSK)

Telemetry	
STATUS	BATTERY VOLTAGE
IN OPERATION	9.00 V
MISSION ELAPSED TIME	BATTERY TEMPERATURE
271 : 22 : 54 : 38	15 °C
TELEMETRY UPDATED	SOLAR PANELS TEMPERATURE
27.05.2021 12:23:13	19 °C
ORBIT INFORMATION	
ALTITUDE	545.9 KM
VELOCITY	7.587 KM/SEC
LATITUDE	-19.8433°
LONGITUDE	-58.5233°

EAGLET-2 satellite mission

Constellation mission for EO applications



EAGLET 2 satellite, Earth Observation 20U satellite with a main optical payload and a secondary AIS payload

Mission and technologies

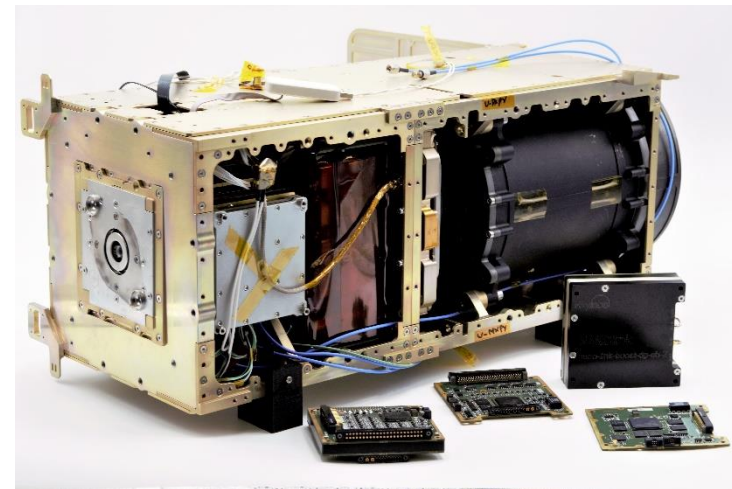
- Prime OHb Italia
- Constellation 60 satellites (2 satellites for IOD)
- Launch ~2022
- Orbit LEO, ~500 km
- Platform **NANOskey I (2st generation) avionics**
NANOobc, NANOlinc-boost-dp, NANOif,
NANOeps 158Wh, NANOeps-AMPPT
- Status **Qualification phase**

Satellite

- Dimensions Microsatellite, 20U form factor
- Mass 25 kg
- Power 158Wh, deployable solar arrays
- Life-time 3 years in LEO
- Stabilisation AOCS 3-axis stabilized, propulsion
- Communication S-band (TM/TC, OQPSK, 1 Mbps), X-Band (Payload data)

M3 satellite platform

M3 (Multi Mission Microsatellite platform) that is the 8U EAGLET 2 platform eligible to accommodate institutional, scientific and commercial payloads (photo courtesy of OHb-Italia).



EAGLET-2 satellite with NANOskey I 2nd Gen avionics platform (photo courtesy of OHb-Italia)



HERMES satellite constellation

A new paradigm for multi-messenger astrophysics with Cubesats



Scientific goal accurate and prompt localisation of bright hard X-ray/soft γ -ray transients such as γ -ray bursts (GRBs) – INAF

Fast high energy transients are among the likely electromagnetic counter parts of:

- Gravitational wave events(GWE)
- Fast Radio Burst

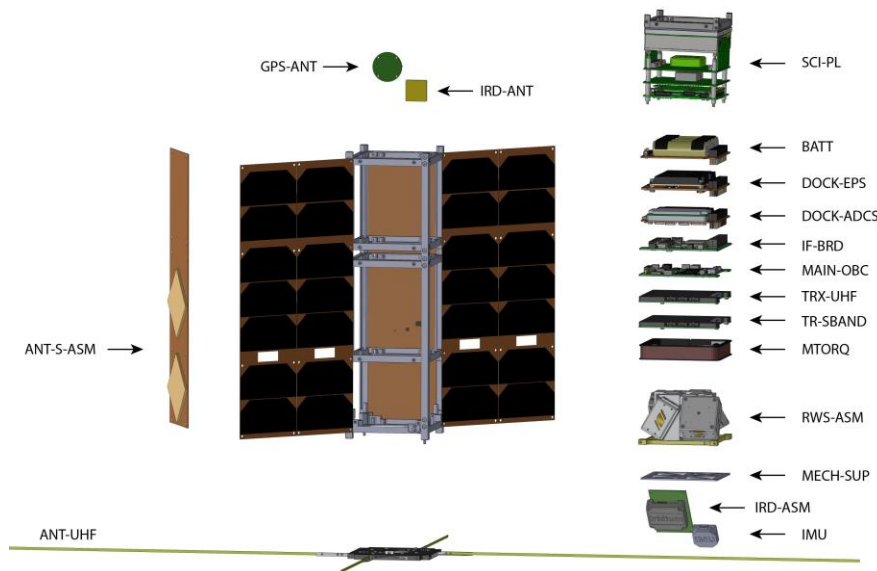
H.E.R.M.E.S. High Energy Rapid Modular Ensemble of Satellites
Distributed detectors network nanosats constellation -

Mission and technologies

- Prime INAF (Project and Scientific Payload)
PoliMI (Satellite bus), 16 other partners
- Constellation 52 CubeSat's (7 satellites for IOD: Hermes-TP, Hermes-SP and SPIRIT)
Future – Moon orbit
- Launch ~2023
- Orbit LEO, ~500 km, equatorial orbit
- Platform **NANOsky I (2st generation)**
NANOobc, NANOcomm, NANOLink, S-Band antennas, custom IF board,...
- Primary payload HERMES – Gamma ray burst detector (INAF)
- Status **CDR phase**

Satellite

- Dimensions Nanosatellite, standard 3U form factor
- Mass 6.6 kg
- Stabilisation AOCS 3-axis stabilized
- Communication VHF/UHF (GFSK) and S-band (OQPSK, 4 Mbps UL/DL)



HERMES-SP satellite with NANOsky I 2nd Gen avionics platform (photo courtesy of PoliMi)

Thank you

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