

PHL-50: Building the Future of University-based Microsatellites in the Philippines

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ASIA-PACIFIC REGIONAL SPACE AGENCY FORUM SE4AWG SPACE EDUCATION FOR ALL WORKING GROUP



University-based Satellites of the Philippines



Maya-1 (BIRDS 2) Maya-2 (BIRDS 4) Maya-3 Maya-4 Maya-5 Maya-6

STAMIN ASPACE in Space" Volume-1 2020 PhilSA ""



Class Microsatellite (Microsat)

Mass 52.40 kg

- Type Scientific Earth Observation
- **Dimensions** 55 cm x 35cm x 55 cm
 - Orbit Low Earth
 - Payloads High Precision Telescope (HPT), Spaceborne Multispectral Imager with Liquid Crystal Tunable Filter (SMI w/ LCTF), MIddle Field Camera (MFC), Wide Field Camera (WFC)
 - Launch 23 March 2016 via Atlas V Rocket from Kennedy Space Center (Cape Canaveral, Florida)
 - Release27 April 2016 from the International Space Station
(ISS)Mission/sDisaster Response and Management
Environment and Natural Resource Assessment
- Image acquisition Disaster Response and Management Environment and Natural Resource Assessment

Status Decommissioned (06 April 2020)







Trivia

Diwata-1 is the **first Filipino-built satellite** under the Development of Philippine Scientific Earth Observation Microsatellite (**PHL-Microsat**) Program, in partnership with Japanese Universities: **Hokkaido University** and **Tohoku University**.

© JAXA/NASA



- Class Microsatellite (Microsat)
- Mass 57.36 kg
- Type Earth Observation
- **Dimensions** 50 cm x 50 cm (Stowed State)
 - **Orbit** Low Earth, Sun Synchronous
 - Payloads High Precision Telescope (HPT), Spaceborne Multispectral Imager with Liquid Crystal Tunable Filter (SMI w/ LCTF), MIddle Field Camera (MFC), Wide Field Camera (WFC), Enhanced Resolution Camera (ERC), Amateur Radio Unit (ARU), Zenith Sun Sensor Module (SAS-Z) and an Extended Attitude Control unit (ACU-Ex)
 - Launch 29 October 2018
 - Release Direct release to space via rocket
 - Mission/s Multi-spectral Earth Observation for remote sensing applications Data collection by Store-and-Forward Mechanism Provide satellite data to fisheries, agriculture and other sectors Amateur Radio Communications, APRS
- Image acquisition Approximately 80% or 245,063 sq. km of Philippine land area covered (as of June 2020)
 - Status In orbit (since 29 October 2018)









STAMINA4Space

Space Technology and Applications Mastery, Innovation and Advancement

- To further development of local expertise in Space Science and Technology Applications (SSTA)
- To spur the development of high-value industries in the country
- To address our manifold needs in scientific earth observation for disaster risk reduction and management, resource assessment, environmental monitoring and other applications.



STAMINA4Space





Building PHL-50: Localizing the Diwata-1, 2 Bus System as the Country's Space Heritage 50 kg Microsatellite Bus (PHL-50)



This project aims to **build on** and **sustain the gains** from Diwata-1 and Diwata-2 Microsatellites by **developing a reference bus platform** that can cater to **various satellite components** and **university-based missions**.



Funded by Department of Science and Technology Philippine Council for Industry, Energy, and Emerging Technology Research and Development (DOST-PCIEERD)



Implemented by University of the Philippines Diliman - Electrical and Electronics Engineering Institute (UPD-EEEI)



PHL-50 OBJECTIVES











RO 1 Develop a bus platform and its key components RO 2 Conduct extensive research on critical components RO 3 Establish a smallsatellite simulation system

Engage with private and public institutions

CO 1

CO 2 Proliferate knowhow on small satellites





RO1: Develop a bus platform and its key components

Experimental Science & Engineering Payload



<u>ESEP</u>

- Integration of PHL-50 small satellite subsystems for evaluating the unit level and inter-module performance of the identified key components for localization.
- Acts as a controlled ecosystem for conducting major functionalities in a small satellite, which are:
 - Satellite command & data traffic handling
 - Mission control & data handling
 - Satellite attitude management.
 - Amateur radio communications





RO1: Develop a bus platform and its key components



Attitude Determination & Control System (ADCS) Board



Unit for Telemetry Acquisition and Command Handling (UTACH) Board

Unit for Satellite Amateur Radio Payload (USAP) Module COMMUNICATIONS PAYLOAD

FPGA Board

ON-BOARD COMPUTERS

ВТАМІНАВРАСЕ 🎦 🌘



RO1: Develop a bus platform and its key components

Star Imager for Precise Attitude Tracking (SIPAT)





Solar, Inertial, Navigation, And Geomagnetic (SINAG) Module



SATELLITE BUS STRUCTURE, PANELS, & MODULE ENCLOSURES





RO2: Conduct extensive research on critical components



Published **Papers**

Conference Presentations

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38th International Communications Satellite Systems Conference (ICSSC)





PO3: Establish a small-satellite simulation system



Mission, Attitude, and Telemetry Analysis (MATA) Software for Microsatellites

STAMINASPACE

RO3: Establish a small-satellite simulation system





RO3: Establish a small-satellite simulation system



Motorized Gimbal System

Target Applications:

- Simulation of attitude control dependent systems
- Simulation of Reaction Wheels and any 3 DOF moving units.

Target Applications:

- Simulation of geomagnetic field that a satellite would experience in orbit
- Magnetic field of about 2G per coil pair
 - Homogeneous magnetic field of at least 0.001 m³



Helmholtz Cage





CO1: Engage with private and public institutions

PRECISION MANUFACTURING





PCB DESIGN, FABRICATION, AND ASSEMBLY



STAMINA SPACE

TESTING SERVICES



The Future in Motion

DEVELOPMENT OF CUSTOM FPGA IP BLOCKS







CO1: Engage with private and public institutions

Joint Research Agreement (JRA) with Department of Science and Technology - Metals Industry Research and Development Center (MIRDC)

Research on Advanced Prototyping for Product Innovation and Development using Additive Manufacturing Technologies (**RAPPID-ADMATEC**) Project



~40% lighter than Maya-1 (BIRDS 2) frame **Development of Cube Satellite Frame**



(L) Star Tracker Electronic Box (R) UTACH Enclosure

Computing Unit Enclosures





Deployable Mechanism Parts





Proliferation of know-how on small satellites to high school and college students





CO2: Proliferate know-how on small satellites

MS/MEng in Electrical Engineering -Nanosatellite Development Track Course Development and Teaching Load





Maya 3 & 4 Nanosatellite Preliminary Design Review







Our System Agent: DIMATA-2 Model Environment: Physics Engine Action: PNW Torque Reaction Wheel Outputs with model accutate applied location Reward: Reward Function



Thesis Proposal and Progress Reports



Online Tutorials

Technical Assistance to Graduate Students (STeP-UP scholars)



Undergraduate Capstone Projects

CO2: Proliferate know-how on small satellites



University Laboratory of Small Satellites and Space Engineering Systems (ULyS³ES)



Facility Tours



Full Anechoic Chamber



CO2: Proliferate know-how on small satellites

.



БТАМІНА БРАСЕ

Speaking Engagements

CONCLUSION

- The PHL-50 Project ended last March 31, 2022
- To seamlessly continue what it started, the **Philippine Space** Agency (PhilSA) proposed and implemented the Adoption of OPTIKAL and PHL-50 Developed Technologies (ADOPT) Project
- Aims to contribute to the **SSTA research and development (R&D)** capabilities of PhilSA by collaborating with two institutes from the **University of the Philippines Diliman (UPD)**





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Philippine Space Agency

Our Vision

The PhilSA envisions a Filipino nation bridged, uplifted and empowered through the peaceful use of outer space

Our Mission

We will promote and sustain a robust Philippine space ecosystem that adds and creates value in space for and from filipinos and for the world



