OWL 2 - Orbital Whereabout Locator

OWL 2 is a modular, plug-and-play spacecraft subsystem designed to provide independent navigation, attitude determination, telemetry, communication, for small satellites. Building on the flight heritage of OWL 1., it combines dual-antenna GNSS, IMU and magnetometer measurements with onboard state estimation based on an Extended Kalman Filter (EKF) for attitude determination.

The system provides independent Position, Velocity and Time (PVT), attitude, and angular-rate telemetry, along with spacecraft health information, supporting Collision Avoidance Manoeuvre (CAM) readiness assessment and safe mission operations, particularly when the primary AOCS telemetry is degraded, unavailable, or cannot be fully trusted. Flexible interfaces and optional independent battery and optional solar cells further enhance spacecraft autonomy and resilience throughout the mission lifecycle.

General information

The OWL is a **plug-and-play** subsystem designed for easy integration into a satellite platform. It provides a range of functions to support spacecraft operations, including:

- GNSS-based positioning and tracking;
- independent Position, Velocity and Time (PVT), attitude and angular-rate telemetry;
- satellite attitude determination using an onboard Extended Kalman Filter (EKF) based on multiple sensors;
- monitoring of key spacecraft housekeeping parameters;
- data downlink via an omnidirectional antenna, regardless of spacecraft orientation;
- Inter-Satellite Link (ISL) communication;
- control of an optional thruster controller or other external electronics via a data bus, enabling functions such as collision avoidance.

Main features

- ✓ **Independent battery isolated from the host platform**, which can be charged:
  - via the host satellite through a wide input-voltage range
  - via the OWL's integrated solar panel inputs using a Maximum Power Point Tracker (MPPT)
  - Flexible solar array options: OWL's own solar panel or the host satellite's solar array.
- ✓ Overcurrent protected power input against single point of failure
- ✓ **TC/TM interface to the host satellite** via registers with OWL capable of serving as a fallback TM communication channel.
- ✓ Potential capability to provide an emergency TC channel towards the host satellite subject to applicable authorization and mission requirements.
- ✓ Easy integration **into the payload bay or onto the satellite surface.**
- ✓ **Radiation telemetry** using a TID sensor
- ✓ **Dual-antenna GNSS-based** position and heading
- ✓ The Main Board can accommodate optional simpler GNSS modules as an alternative to the dual-antenna GNSS configuration.
- ✓ **1 PPS** timing signal output for the host satellite
- ✓ **Low susceptibility to corrosion** and **stress-corrosion cracking**

- Source: ECSS-E-ST-32-08C

✓ **Deployable monopole antenna:** providing reliable communications even during spacecraft tumbling
✓ **Inter-Satellite Link communication** supporting up to 20 OWL units
✓ **Configurable operational parameters,** adjustable up to launch, including:

- RF parameters, antenna deployment timing
- Measurement & Beacon transmission intervals data
- Calibration constants for onboard measurements

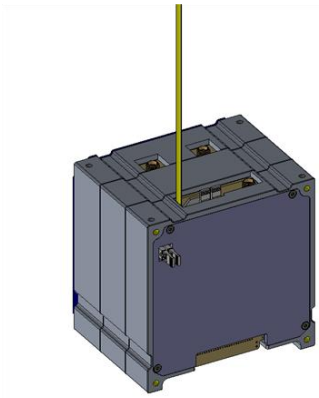
Further technical information

MASS	**Max. 860 g (depends on configuration)**
DIMENSIONS	Max. 94 x 94 x 73 mm (depends on configuration)
INPUT VOLTAGE	8 – 20 V
INPUT POWER	Average: 4.15 W (max: 10.0 W during charging)
BATTERY OPERATING TIME	**Worst-case conditions** (Heater 100%, GNSS 100%, SoC 80%): 4.3 h **Power-safe mode conditions** (Heater 0%, GNSS 0%, SoC 80%): 23.0 h *The values above represent two reference boundary conditions. Intermediate operating modes can be customized between the worst-case and power-safe configurations according to mission-specific requirements.
TELEMETRY DATA	**Positional data** (GNSS) • Supported systems: GPS, Beidou, Galileo, GLONASS, QZSS • Position and accuracy depend on the selected GNSS module **Position, Velocity and Time (PVT) telemetry** **Attitude telemetry (EKF-derived)** **Angular-rate telemetry** **Rotational data** (3-axis MEMS gyroscope) **Magnetometer data** (3-axis MEMS magnetometer) **Temperature telemetries** **Voltage telemetry** • Platform bus voltage • OWL battery voltage **Radiation dose** suffered by the satellite Any other **satellite platform telemetry**

- Health flags defined by the RILDOS standard
- Pre-defined registers

COMMUNICATION INTERFACE (TOWARDS PLATFORM)	**UART, CAN**
RF PARAMETERS	**Center frequency:** 137.1 – 137.925 MHz (VHF) **Modulation:** CSS (LoRa) **Bandwidth:** 125 kHz **Transmit power:** 20 dBm **Rx sensitivity:** -136 dBm **Inter-Satellite Link range**: 4 000 km (estimated) **Data rate:** 0.3 – 27 kbit/s (typical)

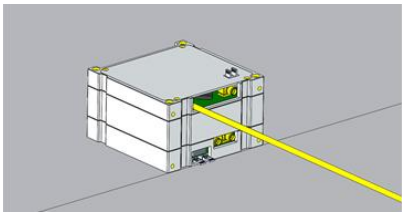
Subsystem and mechanical configuration



3D mechanical model (open internal VHF antenna)

Integration into the payload bay

Integration onto the satellite surface



The unit includes the following subsystems:

1. **Structure:** The frame of the unit providing the necessary mechanical interface and structural rigidity.

2. **Main Board**
   - **OBC**: Microcontroller-based central intelligence of the OWL.
   - **COM:** Highly integrated satellite transceiver with a TCXO It can be used to send and receive Beacon frames.
   - **EPS:** Battery charger and energy distribution (DCDC converters and LCLs).
   - **Internal Antenna (optional):** Internal deployable antenna (optional): For GS and ISL communication. The OWL can use its own antenna or use the provided one by the satellite.
   - Optional simple **GNSS module**.
   - **Sensors:** IMU (3-axis gyroscope, 3-axis accelerometer and 3-axis magnetometer

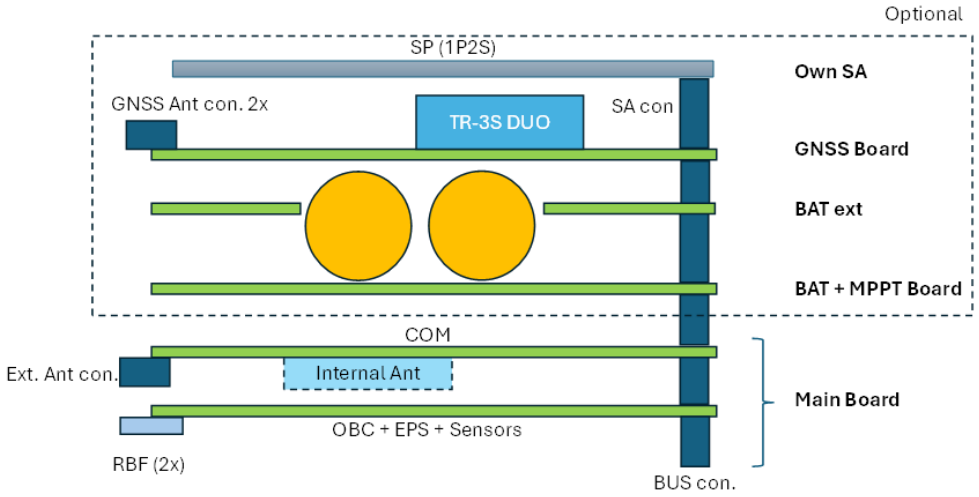
to support attitude determination) and RadNano (electrical dosimeter module to measure radiation).

3. **BAT + MPPT Board (optional):** Ensures independent operation with battery cells and hosts the MPPT hardware to manage the incoming energy from solar array (own or provided by the satellite).

4. **GNSS Board (optional):** Provides space for a high-precision, dual-antenna GNSS receiver, enabling the accurate attitude determination.

5. **Own Solar Array (optional):**
Includes a dedicated solar array to enable completely independent operation from the host satellite.

Subsystems and Boards



System block diagram