

*S P I L B A*

# USER MANUAL

## ONYX 2



*User manual V1.0*



## Introduction

SPILBA ONYX 2 is a 3-in-1 Motorsport-grade data acquisition system that merges the power of a 25Hz GNSS engine, a 6-axis Inertial Measurement Unit (IMU), and an expandable SD memory module. It is the answer to your most demanding needs and an indispensable companion among your tools.

The ONYX 2 enclosure is crafted from precision CNC-machined and anodized aluminium. Its robustness, complemented by a Deutsch connector, not only ensures durability but also raises the standard of resilience even in the face of the most extreme challenges. Additionally, for user convenience, a LED panel is incorporated to always indicate the datalogger's status.

Equipped with a 25Hz sampling rate GNSS module, ONYX 2 stands out for receiving and processing signals in GPS (L1), GLONASS (L1), Galileo (E1), and Beidou (B1) bands, simultaneous reception of SBAS and QZSS. This capability provides faster equipment startup and ensures functionality even in adverse conditions (clouds, rain, mountains, etc.). You'll be able to appreciate details that only this equipment can reveal, achieving always maximum position and speed resolution.

With the inclusion of a 6-axis IMU, you can measure lateral, longitudinal, and vertical acceleration, as well as rotations: pitch, roll, and yaw. Understanding the inconvenience of calibrating a sensor, this model incorporates an automatic calibration system. Each time the equipment is turned on, it self-detects its position and corrects future measurements considering its own inclination.

Data recording is synonymous with ease with ONYX 2, compatible with external SD or SDHC memories with capacities of up to 2 TB formatted in FAT32. An intelligent synchronization algorithm is incorporated to prevent data loss during potential temporary power cuts.

## The kit

- **ONYX 2:** The main data acquisition unit, featuring the 3-in-1 Motorsport-grade system with GNSS, IMU, and SD memory capabilities.
- **2mts harness:** A 2-meter main wiring harness that facilitates the connection between ONYX 2 and other relevant components.
- **GNSS ANTENNA HG:** A high-gain GNSS data antenna, essential for receiving accurate positioning signals.

Customers have the option to purchase the complete kit, which includes all the mentioned components together. Alternatively, individual elements can be bought separately based on the user's specific needs.



ONYX 2



Harness (2 mts)



ANTENNA GNSS HG  
(GPS + GLONASS High  
Gain)



## How does it connect?

The simplicity of ONYX 2 lies in its design, crafted to free the user from any concerns, allowing them to focus exclusively on enhancing their performance. The device features only two connectors: one dedicated to the GNSS antenna and another for power and communication



*Note: The antenna used is an active dual-band antenna (+5VDC). The use of any other antenna in its place could lead to damage or improper functioning of the acquisition*

The equipment is powered by +9VDC to 24VDC. While the equipment has protections for excessive voltages, extreme values could potentially damage it. It is recommended to use a 1A fuse between the power cable and the battery.

Please remember that when you power up the equipment, it will initiate the accelerometer calibration. For this reason, it is advised to first secure your ONYX 2 in the final position before supplying power to ensure proper calibration.

Once powered, the 'POWER' LED on the front panel will illuminate. If it does not respond as expected, please contact technical support

## Communication

ONYX 2 is your perfect companion for GNSS-based information gathering from your vehicle. This versatile data logger not only excels in its ability to operate independently but also stands as a comprehensive ally by incorporating RS-232 and CAN BUS data output. This way, you can extend your information to a DASH or another data acquisition unit already present in your vehicle, leveraging the potential of the 25Hz GNSS engine and the powerful 6-axis IMU.

### CAN BUS

The CAN BUS output, with a BUS speed of 1Mbit/s, provides all parameters related to GNSS at 25Hz and those related to the IMU at 100Hz. This precise synchronization allows you to make the most of the potential of the 25Hz GNSS core and the robust 6-axis IMU, taking your data acquisition experience to new heights.

CAN BUS (1Mbit/s)										
Name	Address	Byte	Length	Order	Type	Multiplier	Divider	Adder	Unit	Freq
Latitude	0x02D0	1	4	Intel	Signed	1	10,000,000	0	DD.DDDDDDD	25 Hz
Longitude	0x02D0	5	4	Intel	Signed	1	10,000,000	0	DD.DDDDDDD	25 Hz
UTC_TIME*	0x02D4	1	3	Intel	Unsigned	1	100	0	seg/100	25 Hz
Speed	0x02D4	5	2	Intel	Unsigned	1	100	0	km/h	25 Hz
Heading	0x02D4	7	2	Intel	Unsigned	1	100	0	°	25 Hz
Sats	0x02D8	1	1	Intel	Unsigned	1	1	0	unit	25 Hz
Height	0x02D8	2	2	Intel	Unsigned	6	100	0	meters	25 Hz
Vbatt	0x02D8	4	1	Intel	Unsigned	1	10	0	Volts	25 Hz
Temp	0x02D8	5	2	Intel	Signed	1	10	0	°C	25 Hz
ACCX	0x02DC	1	2	Intel	Signed	1	1000	0	G	100 Hz
ACCY	0x02DC	3	2	Intel	Signed	1	1000	0	G	100 Hz
ACCY	0x02DC	5	2	Intel	Signed	1	1000	0	G	100 Hz
GYROX	0x02E0	1	2	Intel	Signed	1	131	0	°/s	100 Hz
GYROY	0x02E0	3	2	Intel	Signed	1	131	0	°/s	100 Hz
GYROZ	0x02E0	5	2	Intel	Signed	1	131	0	°/s	100 Hz

## RS 232

The RS-232 output transmits the corresponding NMEA RMC and GGA at a speed of 115,200 baud, every 25Hz. This detail not only ensures fast transmission but also guarantees the timely delivery of critical information.

Output RS232 (25 Hz)	
Configuration	115.200-8-N-1 (The baudrate can be configured to 57,600 upon request)
NMEA	GGA y RMC

## Technical specifications

Power supply, consumption, and operating conditions	
Power supply	+9 a +24V DC
Current consumption	130mA typical
Protections	Overvoltage, reverse voltage, and overcurrent protection with self-resetting fuse, varistors, and protection diodes.
Operating temperature	-25 °C ~ +70 °C

Core	
Core	32 bit ARM Cortex-M4
Performance	80 MHz

GNSS	
Frequency bands	GPS (L1) GLONASS (L1) Galileo (E1) Beidou (B1) + SBAS y QZSS
Sampling Rate	25 Hz
Accuracy	< 2 m CEP
Sensitivity	Acquisition -160 dbm
	Navigation -167 dbm
	Tracking -167 dbm

GNSS antenna	
Frequencies	1575 Mhz/ 1602 Mhz
Total gain with LNA	26 ± 3dBic @ Zenith @ 1575.42MHz 27 ± 3dBic @ Zenith @ 1602MHz
Nominal output impedance	50 Ω 66.52 +j3.85 Ohm@ 1575MHz 46.77 +j0.98 Ohm@ 1602MHz
Polarization	Right-hand circular
VSWR	2.6 dB max.
Mounting	Base magnetic
Protection	IP67
Connector type	SMA 26 GHz bandwidth
Operation temp.	-40C +85C

<b>ACC</b>	
<b>Axis</b>	3 (X, Y, Z)
<b>Max sampling rate</b>	1000 Hz
<b>Range</b>	±4 G
<b>Resolution</b>	0,0001 G

<b>GYRO</b>	
<b>Axis</b>	3 (X, Y, Z)
<b>Max sampling rate</b>	8000 Hz
<b>Range</b>	±250 °/s
<b>Resolution</b>	0,01 °/s

<b>Memory</b>	
<b>Card supported</b>	SD SDHC
<b>File system supported</b>	FAT32
<b>Size supported</b>	Up to 2TB
<b>Recording time</b>	It depends on the capacity of the used card. Typically, 3.2 Mb/hour.



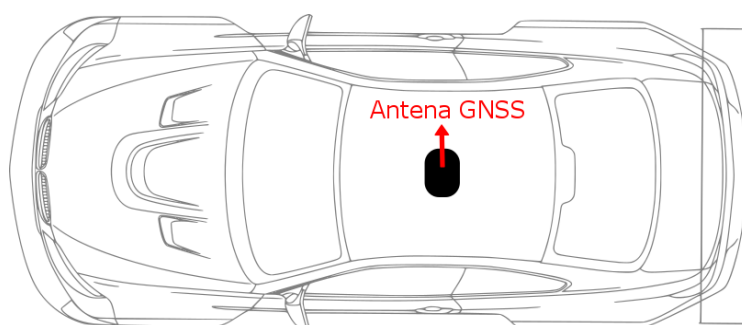
## Positioning of the GNSS antenna

The GNSS antenna provided with the equipment is a high-gain active dual-band antenna. To achieve the best possible signal and prevent damage, it is important to avoid sharp angles or excessively small bending radii in the connection cable. Before connecting it to the equipment, make sure there are no dust particles in the connector. In case of breakage, malfunction, or significant deterioration, contact an authorized dealer for a replacement.

The antenna features a magnetic mount for easy and quick placement on the vehicle's roof. To achieve optimal signal reception, ensure it is positioned at the highest point of the vehicle, free from any obstructions that may block satellite reception.

Note that when using a GNSS device, having an unobstructed view of the sky is crucial. Objects such as tall buildings, trees, etc., can attenuate the received signal, causing a reduction in the number of satellites or introducing unwanted reflections that may decrease the accuracy of the equipment.

Place the antenna in the center of the vehicle's roof as shown in the figure. This way, the antenna will be positioned at the highest point, and subsequent measurements will be referenced to the central point of the vehicle.



## Positioning the device

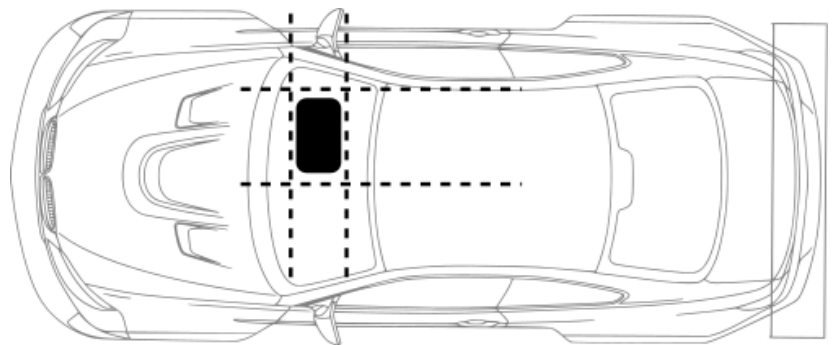
ONYX 2 incorporates 6-axis IMU technology, meaning it has an integrated accelerometer and gyroscope in all three axes (X, Y, Z). For this reason, the installation position is of utmost importance.

The equipment should be positioned as horizontally as possible, with the front side (the side with indicator LEDs and the SD card slot) facing towards the rear of the vehicle. For optimal use of the obtained parameters, it is recommended to place the device as close as possible to the vehicle's center of mass.

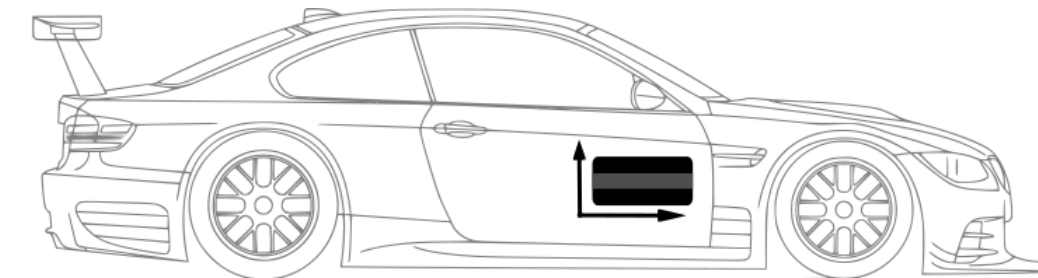
**Note:** Any slight deviation from the optimal position will be automatically corrected by the equipment



Front view of the vehicle. The rear part of the device, i.e., the power connector and GNSS antenna, should be visible


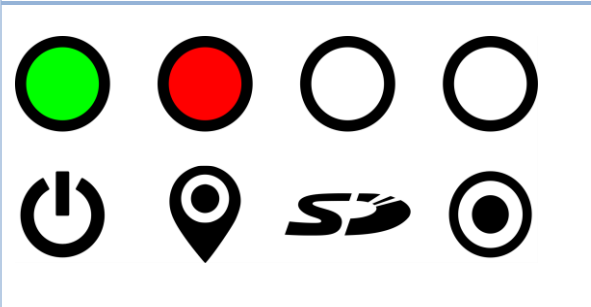




Top view of the vehicle. The equipment should be aligned with the vehicle's axes



Side view of the vehicle. The equipment should be positioned horizontally


















## Power-on sequence

	<p><b>POWER ON:</b></p> <p>As soon as the equipment is connected to the battery, the POWER indicator light turns on, and the automatic calibration of the IMU begins</p>
	<p><b>LOOKING FOR SATELLITES:</b></p> <p>Once the IMU calibration is complete, the GNSS status indicator light will turn red, and the equipment will begin searching for satellite signals</p>
	<p><b>ALMOST READY:</b></p> <p>During the satellite search process (whether completed or not), the other peripherals are checked, the CAN BUS and RS232 outputs are activated, and the REC LED is turned on</p>
	<p><b>ON TRACK!</b></p> <p>With the SD CARD inside the equipment, you can now enjoy your data acquisition</p>

Onyx 2 will start storing data on its own when the vehicle exceeds 10 km/h for more than 1 second. An indication that the equipment has started acquisition is the flashing red 'REC' indicator. Once the vehicle is stopped, Onyx 2 will automatically stop recording. Before removing the memory card, ensure that the 'REC' indicator is green. If it is off or red, it means there was an issue with the memory during the recording process, and the file could be corrupted. Data transmission through the CAN BUS and RS 232 will start once the equipment is turned on and the accelerometer is calibrated, and it will not cease at any time.

## LED INDICATORS

En el *cuadro 1* se muestra la descripción de cada indicador led.

Nombre	Estado	Descripción
 POWER		OFF
		ON
 GNSS STATUS		OFF
		Between 0 and 3 sats in view
		Between 4 and 5 sats in view
 SDCARD STATUS		SDCARD absent or not recognized
		Recognized with less than 30% capacity
		Recognized with less than 70% capacity
 REC		Recognized with more than 70% capacity
		Not available for recording
		Blinking: Logging
		Steady: Error during the recording process
		Ready*

\* Device ready to acquire data or extract SDCARD.

## Using the SDCARD

ONYX 2 works by recording data on an SD (Secure Digital) or SDHC (Secure Digital High Capacity) memory card, which must be formatted in FAT32. The card size can be any, meaning ONYX 2 can handle any memory capacity. However, the maximum size supported by the FAT32 system is 2TB.

Upon inserting the card, a 'Data' folder will be automatically created to store information, preserving the integrity of other stored files. Just before acquisition, a file with the extension '.vbo' will be created, containing information from both the GNSS module and the IMU.

The names of the files generated during acquisition will follow this format:

*ddmmaa\_RUNXYZ.vbo*

Where:

- dd: Day
- mm: Month.
- aa: Year
- XYZ: Run number (e.g., 001, 015, 183).

If the SDCARD is not correctly inserted and recognized by the equipment, it will never start data acquisition (see "LED Indicators" section). Therefore, make sure you have inserted and confirmed that the SDCARD is functioning correctly. If an SD card experiences issues, it is recommended to perform a SLOW FORMAT on it or change it.

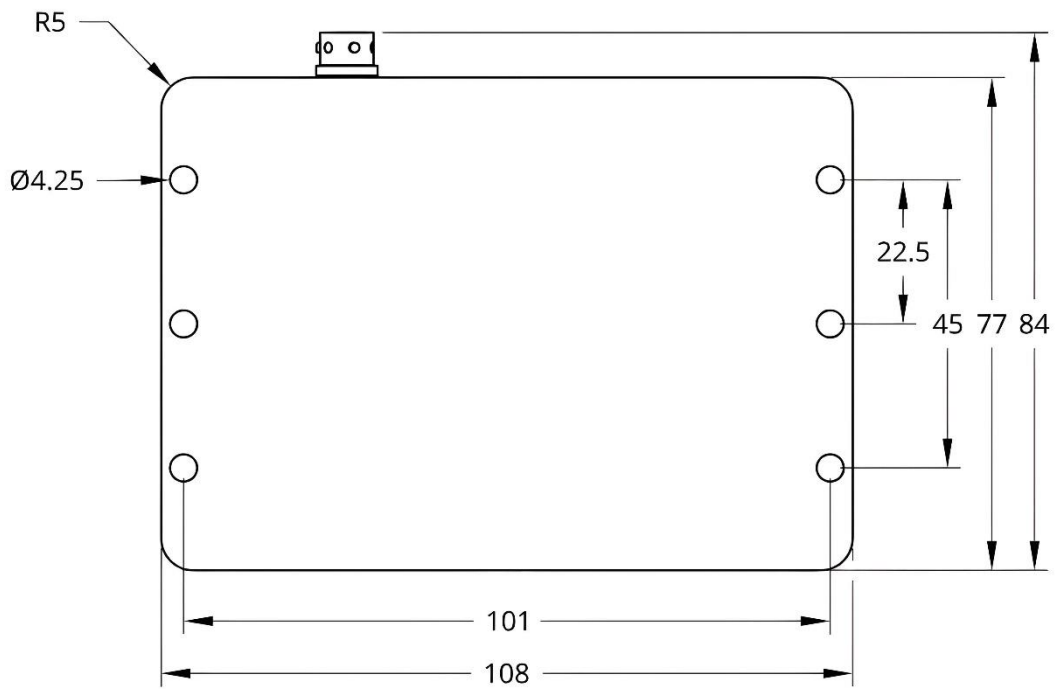
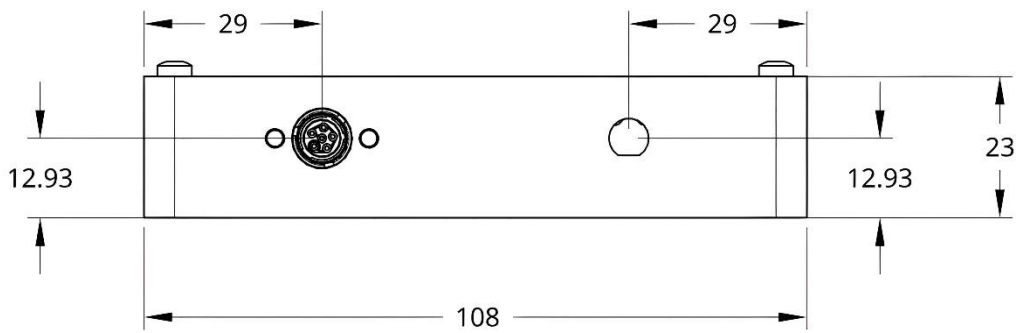
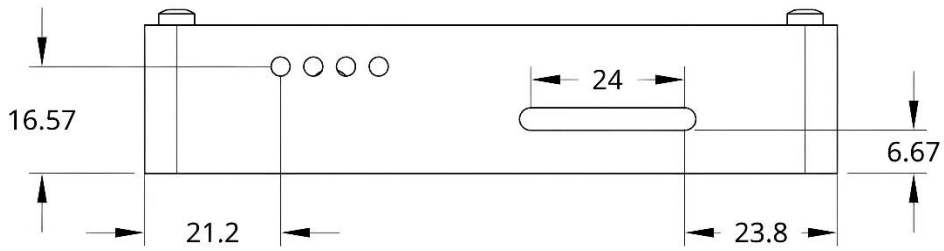
The logging will be started each time the vehicle travels at more than 10 km/h for a period longer than 1 second. This prevents the generation of unwanted data when moving the vehicle within the box. Conversely, it will stop collecting information by closing the file when it detects that the vehicle speed is below 5 km/h.

## **Usage recommendations**

To ensure optimal operation and extend the product's lifespan, it is recommended to:

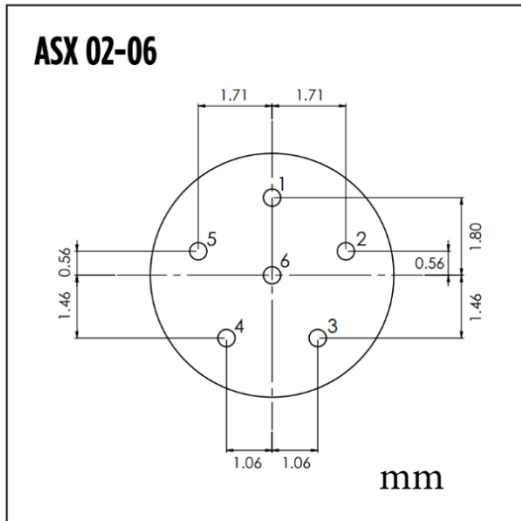
- Follow the user manual during the connection and installation of the product.
- After using the equipment, store it in a dry place, free from dust, and protected from direct sunlight.
- Before using the equipment, check that both the GNSS antenna connector and the power connector are not obstructed by any unwanted particles, and ensure that the connection cables do not show visible damage.
- Securely tighten the equipment's power terminals to the battery contacts to avoid unintended interruptions in acquisition.
- Use the GNSS antenna provided with the equipment; otherwise, you may experience lower performance in acquisition.
- Remember that IMU calibration takes place when the device is turned on. Make sure to place it in the final position before turning it on.
- Format the memory card in FAT32 before using it in the device.
- Avoid excessive impacts on the device.

## Dimension



## Connection

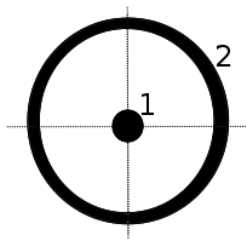
### DEUTSCH AUTOSPORT: ASX002-06PN-HE



MATING CONNECTOR: ASX602-06SN-HE

PIN	Function
1	Vbat +
2	N/C
3	CAN_H
4	CAN_L
5	RS-232 output
6	Vbat -

### SMA AMPHENOL: GNSS HG ANTENNA (GPS + GLONASS)



1 - SEÑAL DE RF / VCC  
2 - GND

