olixSense™
X2 Ultra

Inertial measurement. Relative and magnetometer-aided orientation.



olixAI™
Sensor fusion

olixOS™
Embedded platform

PoE
Power + Ethernet

Multi-Redundant MEMS with Advanced Skew-Redundant Geometry Mounting. Fused orientation, angular velocity and acceleration in one virtual measurement frame.

IMU + AHRS
Relative or magnetometer-aided orientation

ROS 2 native
DDS topics · TCP / UDP JSON
Browser configuration

1,000 Hz
Maximum publish-rate setting[1]
100 Hz default

NETWORK / POWER
100 Mb/s Ethernet · IEEE 802.3af PoE

NOMINAL ENVELOPE[2]
66 × 57 × 42 mm

[1] Effective throughput depends on configuration and network. [2] Includes mounting tabs and sensor-side connector. Performance figures and their status are specified on page 3.

02 Architecture 03 Performance 06 Connection 10 Mechanical 12 Disclaimer

01 / SENSING AND OPERATING MODES

Architecture and operating modes

A unified sensing pipeline delivers fused and filtered motion data in a common virtual measurement frame.

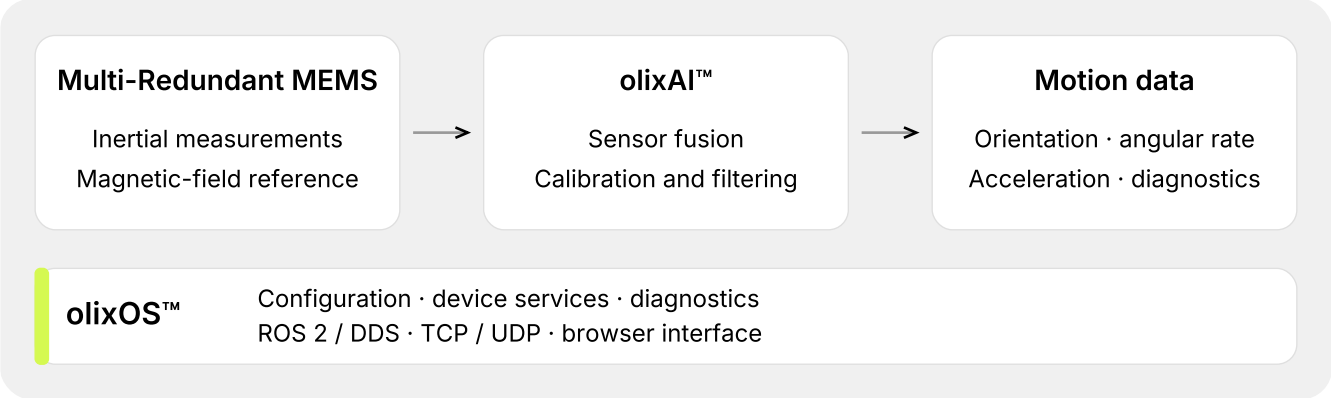


Figure 1. Product-level sensing and software architecture.

Function	Description
Sensing technology	Multi-Redundant MEMS with Advanced Skew-Redundant Geometry Mounting
Sensor fusion	olixAI™ combines inertial measurements, calibration and filtering into a unified output
Operating system	olixOS™ manages sensor services, configuration, diagnostics and network access
Measurement reference	Virtual origin at the board centre, aligned with the central inertial reference frame
Published data	Orientation quaternion, angular velocity, acceleration and auxiliary diagnostic streams

IMU and AHRS modes

Characteristic	IMU mode	AHRS mode
Orientation reference	Relative to the initialized or user-defined orientation	Orientation with magnetic heading aiding; local zero is configurable
Fusion inputs	Inertial acceleration and angular-rate measurements	Inertial measurements with magnetometer data
Magnetometer role	Excluded from the orientation solution	Included in the orientation solution
Typical application	Relative motion tracking and externally aided estimation	Attitude estimation with magnetic heading reference

For AHRS operation, perform magnetic calibration in the installed configuration and maintain suitable separation from magnets, high-current wiring and ferromagnetic structures. Local orientation zero and magnetic heading reference serve different purposes.

02 / FUSED DATA

Fused-output performance

Relative orientation, noise and stability at the olixAI™ fused output.

Settled relative orientation · RMSE[1]

Operating mode	Roll	Pitch	Yaw
AHRS	< 0.4°	< 0.6°	< 0.5°
IMU	< 0.4°	< 0.4°	< 0.2°

Estimated aggregate RMSE for settled single-axis rotations. The metric describes relative angular displacement after motion has stopped.

Moving-platform settled-angle RMSE[1]

Operating mode	Roll	Pitch	Yaw
AHRS	< 1.1°	< 1.2°	< 1.7°
IMU	< 1.1°	< 1.2°	< 1.3°

Estimated relative-angle error between settled poses on a moving platform. This metric does not specify continuous tracking or absolute magnetic-heading accuracy.

Fused inertial noise and stability[1]

Parameter	Estimated bound	Unit
Gyroscope noise density	< 0.01	°/s/√Hz
Angle random walk	< 0.6	°/√h
Gyroscope bias instability	< 7	°/h
Accelerometer noise density	< 200	µg/√Hz
Velocity random walk	< 0.11	m/s/√h
Accelerometer bias instability	< 0.001	m/s^2

Noise and stability estimates represent three-axis means for stationary operation at room temperature. Allan-derived white-noise coefficients and bias instability are distinct from absolute bias and thermal drift.

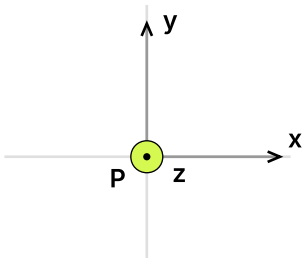
[1] **Specification basis.** Engineering estimates, rounded conservatively toward larger error or noise. The < notation denotes an estimated aggregate bound; it is not a measured X2 acceptance limit, a maximum sample error or a production guarantee. Model-specific performance validation remains pending.

Performance depends on operating mode, calibration, temperature, measurement range, output bandwidth and installation. Compare results using matching filter and publication settings.

03 / MEASUREMENT REFERENCE

Virtual measurement frame

Fused and filtered data is published at a virtual measurement origin located at the board centre.



Virtual measurement origin

One reference for the fused output

Position: board centre

Pose: central inertial reference frame

Orientation · angular velocity · acceleration
Fused and filtered by olixAI™

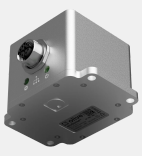
Right-handed schematic; output convention set in olixOS™.

Figure 2. Virtual origin P in a simplified board view. Axis arrows illustrate a right-handed reference frame; physical installation orientation follows the selected output convention.

Reference	Definition
Measurement origin P	Board centre; a virtual reference point for the fused output
Reference orientation	Aligned with the central inertial reference coordinate frame
Published quantities	Orientation, angular velocity and acceleration expressed in the configured output frame
Robot integration	Apply the installation transform from the sensor output frame to the robot frame

Measurement ranges

Parameter	Range / specification	Condition
Acceleration	±2, ±4, ±8, ±16 g	Selectable in IMU mode; ±4 g in AHRS mode
Angular-rate front end	±125, ±250, ±500, ±1,000, ±2,000 °/s	Hardware full-scale options; selectable settings depend on the software configuration
Magnetic field	±1,300 µT (x/y); ±2,500 µT (z), typical	Native magnetic sensing axes
Temperature	Internal temperature data	Diagnostic output



Installation reference

Use one output convention and installation transform consistently in olixOS™, the robot model and the state estimator.

04 / ELECTRICAL AND PROCESSING

Power, network and processing

Isolated PoE and local processing support a single-cable sensor connection.

Electrical parameter	Specification	Condition
Network link	100 Mb/s Ethernet	Sensor data, configuration and diagnostics
PoE	IEEE 802.3af	Powered-device input
PoE input range	37–57 V DC	Use a compliant power-sourcing device
PoE power-stage capacity	12.95 W[1]	Power-stage rating
PoE isolation rating	1.5 kV[1]	Power-stage input-to-output isolation
Power-feed support	End-span / mid-span	Mode A / Mode B
Protection	Short-circuit protection	PoE power stage

Embedded Physical AI for Sensors & Robots.

Processing and software platform

olixAI™ sensor fusion
olixOS™ device services

Resource	Specification
Operating system	olixOS™
Sensor fusion	olixAI™
Processor	8-core, 64-bit CPU; up to 2.2 GHz[2]
AI acceleration	Up to 6 TOPS peak[2]
Memory	4 GB
Storage	64 GB eMMC, nominal
Configuration	Integrated browser interface
Device services	Sensor streaming, calibration, diagnostics and software maintenance

[1] Ratings apply to the isolated PoE power stage; power capacity is distinct from device consumption. [2] Peak platform capability. Sustained processing performance depends on workload and thermal conditions.

Use the supplied or approved mating cable and PoE source. Order-specific memory, storage and accessory configuration is stated in the quotation.

05 / CONNECTION

Ethernet and PoE connection

Power and motion data through one Ethernet cable.

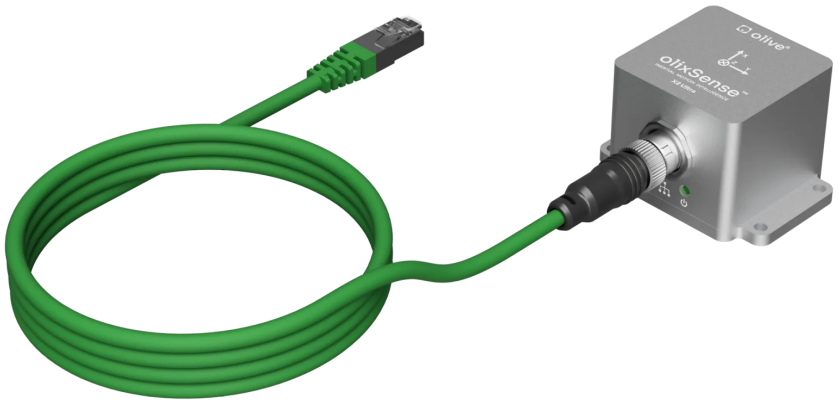


Figure 3. X2 Ultra with an M12-to-RJ45 Ethernet cable. Cable appearance and length follow the ordered configuration.



Connector panel

Connection overview

Interface	Function
M12 network connector	Ethernet data and PoE power input
RJ45 cable end	Connect to an IEEE 802.3af PoE switch or injector
Front-panel indicators	Power and system indication
Diagnostics	System status and configuration through olixOS™

Installation sequence

Step	Action
01 · Mount	Secure the sensor on a rigid surface and establish its installation pose.
02 · Connect	Align and secure the approved M12 cable; connect the RJ45 end to the PoE source.
03 · Configure	Open the olixOS™ interface and select the operating mode, output frame and publication rate.
04 · Integrate	Read the ROS 2 or JSON stream and verify axis directions, timestamp handling and the installation transform.

Use the approved cable and the connection drawing supplied with the order. Provide cable strain relief and clearance for the coupling and bend radius.

06 / CONNECTIVITY

Data interfaces and protocols

Native ROS 2 integration and timestamped JSON streaming support direct access to the sensor output.

ROS 2 topic suffix[1]	Message type	Output
`imu`	sensor_msgs/msg/Imu	Quaternion, angular velocity, acceleration and covariance
`acceleration`	geometry_msgs/msg/AccelStamped	Gravity-compensated acceleration
`velocity`	geometry_msgs/msg/TwistStamped	Integrated velocity estimate[2]
`magneticfield`	sensor_msgs/msg/MagneticField	Magnetic field in tesla; auxiliary stream in IMU mode
`temperature`	sensor_msgs/msg/Temperature	Internal temperature
`status`	diagnostic_msgs/msg/DiagnosticStatus	System diagnostics
`/tf`	tf2_msgs/msg/TFMessage	Optional transform publication

[1] Example namespace: `/olive/olixSense/x2/id001/`. Device identifier and namespace are configurable. Topic availability follows the selected operating mode. [2] Use external aiding for sustained velocity estimation.

TCP / UDP data export

Setting	Specification
Transport	TCP or UDP server; configurable port, default **5600**
Data format	JSON; schema `olive_imu.v1`; TCP uses one newline-delimited object per sample
Timestamp and frame	`stamp.sec`, `stamp.nanosec`, `frame_id`
Orientation	Quaternion `x, y, z, w`
Motion units	Angular velocity: rad/s · acceleration: m/s²
Covariance	3 × 3 arrays for orientation, angular velocity and acceleration
UDP registration	An initial client packet registers the stream destination

Native ROS 2 integration

olixOS™ provides browser access to operating modes, parameters, calibration and diagnostics. ROS 2 services support bias setting, orientation zero, standby and restart. ROS 1 systems can integrate through a compatible bridge.

07 / HOST INTEGRATION

Network and host integration

Connect a ROS 2 host, a data logger or a custom application directly to the sensor.

Access and addressing

Item	Integration detail
Setup address	Default: `192.168.7.100`. Use the configured address after commissioning.
Browser access	Open the device IP address in a browser on the connected network to access olixOS™.
Network configuration	For initial setup, place the host on the sensor's subnet with a unique IP address.
Multiple sensors	Assign each device a unique IP address and ROS namespace.
ROS 2 host environment	ROS 2 Humble; match topic names and publisher/subscriber QoS.

Select the data interface

Interface	Typical use	Connection behavior
ROS 2 / DDS	Robot state estimation	Topics, services, frame IDs and covariance
UDP / JSON	Live data and visualization	Initial client registration packet; receiver handles sample loss
TCP / JSON	Data logging and custom apps	Client opens a connection; newline-delimited samples; buffering possible

Read the main ROS 2 stream

```
ros2 topic echo /olive/olixSense/x2/id001/imu \
  --qos-reliability best_effort
```

Replace `id001` with the configured namespace. Match the subscriber reliability policy to the selected publisher QoS.

Time and estimator integration

Data item	Integration guidance
Timestamps	`stamp.sec` and `stamp.nanosec` encode message time. Use a shared time reference to correlate devices.
Frames and gravity	Use the configured `frame_id`; select the gravity-compensated `acceleration` stream when required by the estimator.
Covariance	Check the orientation, angular-velocity and acceleration covariance fields for the selected configuration.

The X2 acts as the TCP/UDP server. Enable the desired export in olixOS™ and apply any requested service restart before connecting the client.

08 / CONFIGURATION

Output configuration and calibration

Configure the sensor response and output convention for the application.

Control	Range / options	Default / behavior
Main IMU publish-rate setting	0–1,000 Hz	100 Hz
Auxiliary publish rate	1–200 Hz	100 Hz
System status rate	0–10 Hz	1 Hz
Acceleration / gyro low-pass	0–500 Hz setting	8 Hz; 0 disables the cutoff filter
Acceleration / gyro EMA gain	0–1	0.92
Publisher QoS	Best effort / reliable	Best effort
Operating modes	IMU / AHRS	Select inertial-relative or magnetometer-aided fusion
Application profiles	Drone / Mobile Robot / Humanoid / Raw	Profile-based configuration
Orientation zero	At startup / service command	Defines the local orientation reference

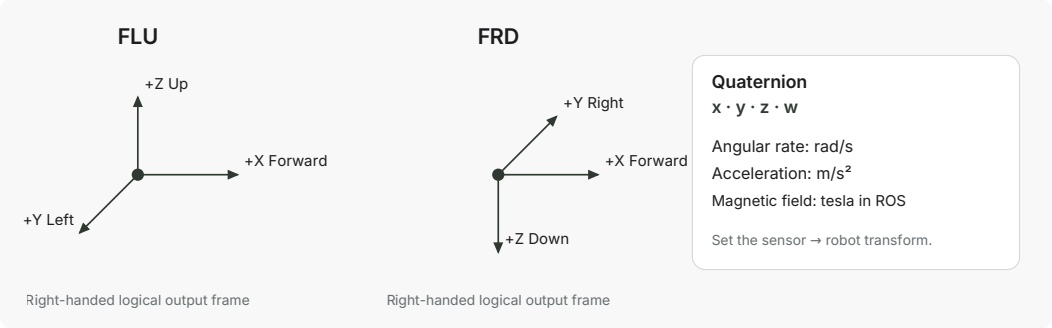


Figure 4. Logical FLU and FRD output conventions. Apply the sensor-to-robot transform for the installed pose.

Publication rate and measurement bandwidth are configured separately. Select filter settings compatible with the actual sampling rate, and verify gravity treatment and covariance conventions when integrating an estimator.

Calibration and reference setup

Operation	Purpose / method
Bias calibration	Keep the device stationary in its normal mounting pose; run the olixOS™ bias action or `setBias` service.
Orientation zero	Use `setZeroQuaternion` to define the present orientation as the local reference. This operation is separate from bias calibration.
Magnetic calibration	For AHRS operation, calibrate in the installed environment and check for magnetic disturbances.

Mode, profile and range changes may request a service restart. Confirm the active settings after applying the configuration.

09 / MECHANICAL

Dimensions and installation

Compact metal housing with an integrated mounting base.

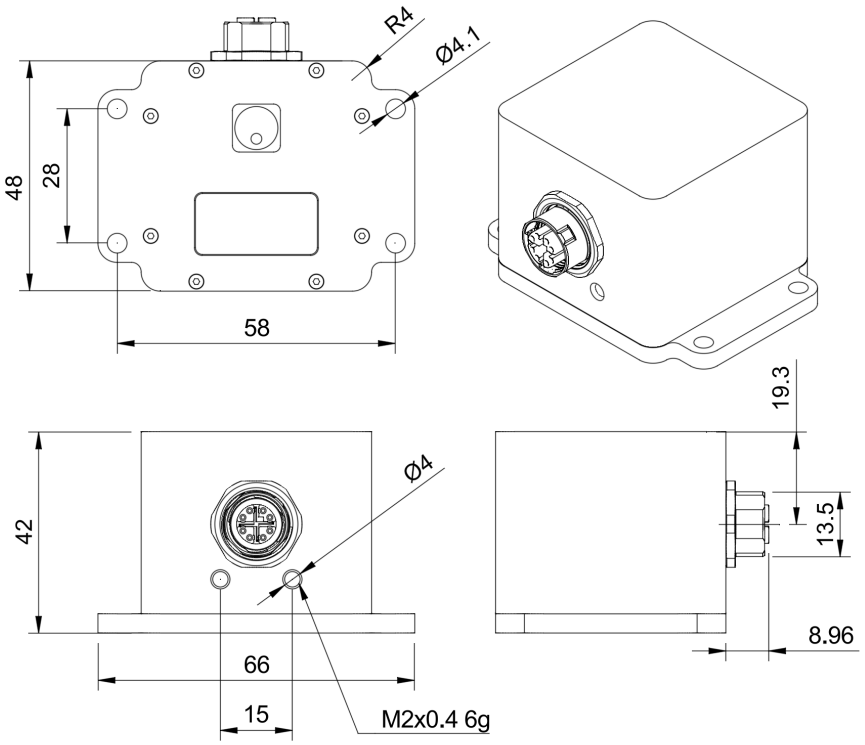


Figure 5. Supplied enclosure drawing. Dimensions in mm; use the controlled drawing for production tolerances.

Mechanical parameter	Nominal value
Overall envelope (W × D × H)	66 × 57 × 42 mm, including mounting tabs and sensor-side connector
Housing footprint	48 × 48 mm
Mounting base	66 × 48 × 4 mm
Mounting holes	4 × Ø4.1 mm
Connector projection	8.96 mm beyond the housing face
Mounting-hole centres	58 × 28 mm
Housing	Metal enclosure; finish according to ordered configuration
Network connection	Use the approved mating cable and order-specific connection drawing

Mount to a rigid surface and apply the sensor-to-robot transform from the virtual measurement origin. Allow clearance for the mating connector and cable bend. Overall depth is 56.96 mm, rounded up to a 57 mm nominal envelope.

10 / CONDITIONS AND ORDERING

Environment, accessories and ordering

Define the sensor configuration and installation accessories for your application.

Environmental design envelope[1]

Parameter	Value
Ambient operating temperature	−20 to +60 °C[1]
Storage temperature	−20 to +70 °C[1]
Relative humidity	10–90% RH, non-condensing[1]

[1] Subsystem-based design envelope; complete-assembly environmental qualification remains pending. Thermal behavior depends on processing load, enclosure conditions and mounting.



M12-to-RJ45 Ethernet cable

Specify the required cable length and connector arrangement with the order. The sensor uses a single cable for Ethernet data and PoE power.

Illustrated cable is a reference accessory; supplied appearance and configuration follow the quotation.

Ordering information

Item	Specify / confirm with the order
Product	olixSense™ X2 Ultra - Ethernet and isolated PoE
Processing configuration	olixOS™ with olixAI™; 4 GB memory / 64 GB eMMC, nominal
Cable and PoE source	Cable length, routing and mating connector; compatible IEEE 802.3af switch or injector
Integration configuration	IMU or AHRS mode, output frame, namespace and publication rate
Installation	Mounting location, available clearance and environmental requirements
Delivery contents	Sensor and accessories as itemized in the quotation
Integration documents	Product documentation; order-specific mechanical and connection drawings

For application-specific confirmation, request the assembled mass, measured operating power, connector pinout and applicable environmental or conformity documentation with the quotation.

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Product documentation



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