



V2 Pro Localization Module

Product White Paper

Multi-sensor fusion localization for complex environments

Zhejiang MRDVS Technology Co., Ltd.

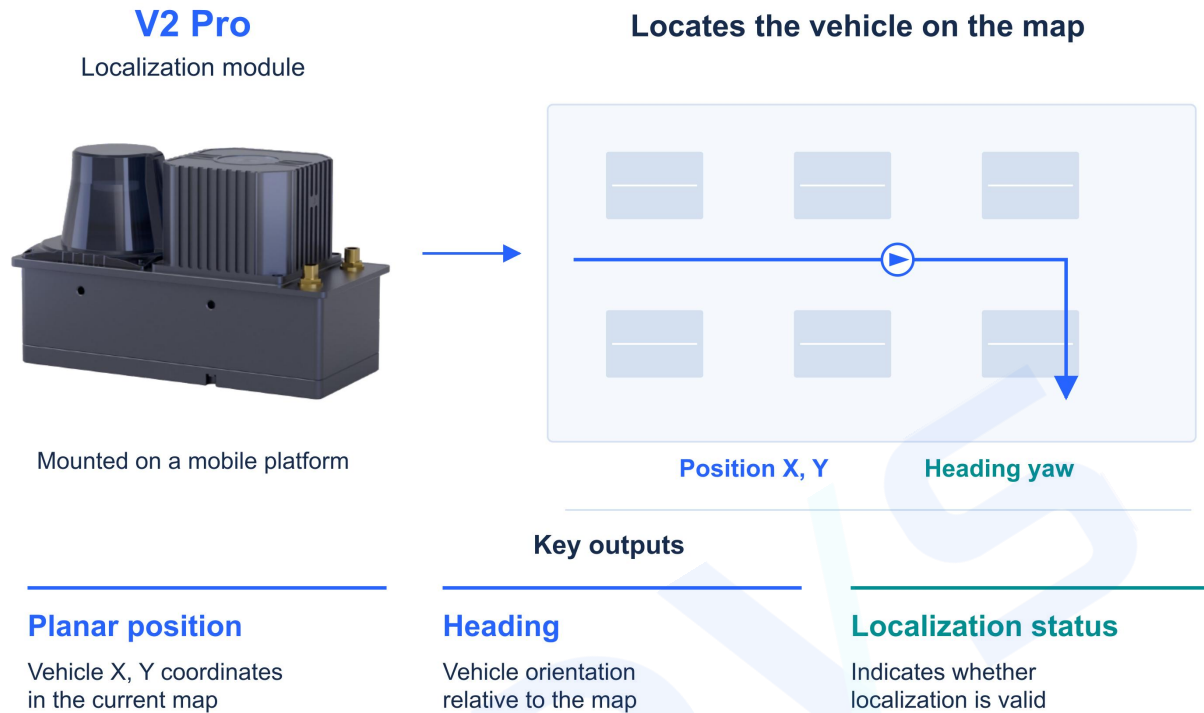
V1.1 · 2026-10-09

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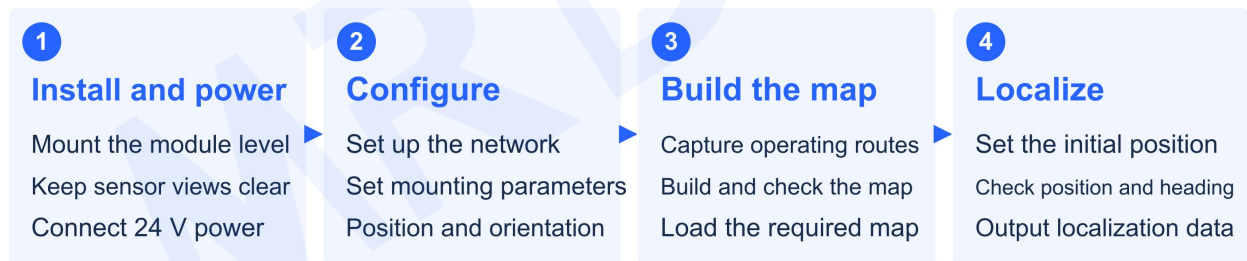
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1 Product Introduction

V2 Pro combines an upward-facing camera, 2D LiDAR, an IMU and onboard computing to build maps and provide real-time position, heading and localization status.



From installation to localization



Mounting parameters describe the module's position, orientation and height relative to the vehicle.

► [Watch the Live Demo on YouTube](#)

1.1 Development History

A decade of development, from upward-facing vision to sensor fusion



Origins in upward-facing visual localization

V2 Pro grew out of the localization system used in Lanxin Robotics' early autonomous platforms. An upward-facing infrared camera and visual simultaneous localization and mapping (VSLAM), enhanced by deep learning, provided an in-house localization engine for mobile platforms.

Field validation and continued development

Deployed on thousands of mobile platforms, the technology was refined through use in China's computer, communications and consumer electronics (3C), packaging, solar and automotive industries. In 2023, MRDVS built on this experience to advance spatial intelligence and safety for mobile robots.

Integrating LiDAR, vision and inertial sensing

The team added 2D LiDAR to the existing visual-inertial module, moving from sensors housed together to a more tightly integrated system. V2 Pro combines LiDAR, vision and an IMU in a single factory-calibrated module, with integration at both the hardware and algorithm levels.

From robotics technology to a standalone product

The localization technology first used in Lanxin mobile platforms became the standalone MRDVS V2 Pro module. Equipment manufacturers and system integrators can use it in forklift retrofits and new mobile equipment, with real-time position and heading data supporting safety applications and digital twins.

1.2 Key Advantages

01 Centimeter-level accuracy and real-time output

1–3 cm

Localization error

20 Hz

Valid pose output rate

<20 ms

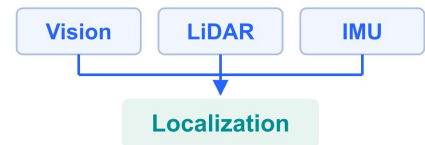
Output latency

02 Built for industrial localization

Fusion of upward-facing vision, LiDAR and IMU

Sensors and algorithms designed for industrial use

Avoids the cost of unnecessary sensors.



03 Large-area mapping and localization

Area per mapping session: 20,000 m²

Travel distance per mapping session: 2,000 m

Extend maps incrementally to cover large sites.

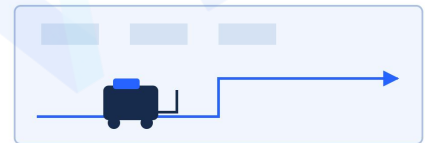


04 No localization base stations

Unlike typical UWB systems, no anchors are needed.

No anchor installation, cabling or maintenance.

Uses natural features; QR codes can aid recovery.



05 No external localization computer

Camera, LiDAR, IMU and processing in one module

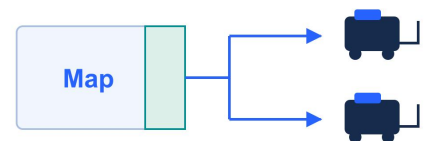
Mapping and localization run onboard V2 Pro.



06 Expandable maps shared across vehicles

Extend maps to new areas and share them across vehicles.

Expand localization coverage as operations grow.

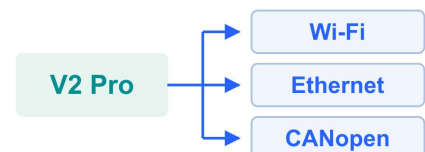


07 Wi-Fi and flexible connectivity

Wi-Fi, Ethernet and CAN (CANopen) connectivity.

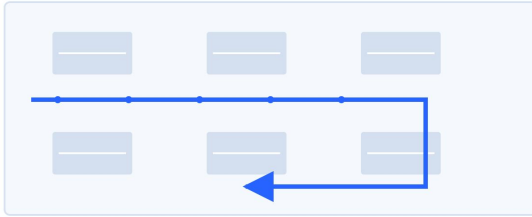
Integrate via UDP, HTTP, MQTT and ROS 1 / ROS 2.

Connect to the platform and existing control systems.



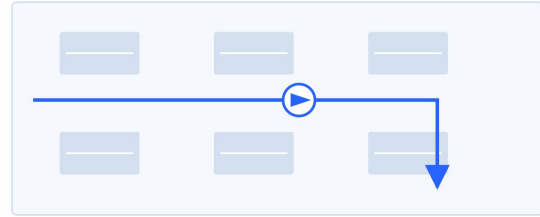
1.3 Main Functions

Create maps



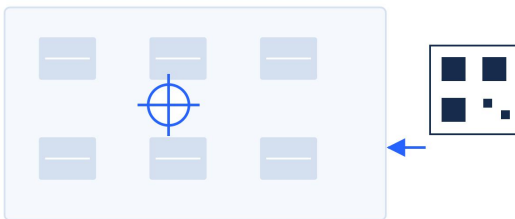
Scan the operating environment
Build a map for localization

Continuous localization



Localize within the mapped area
Output vehicle position and heading

Relocalization



Use a QR code or set the pose
Restore the vehicle's position

Map management



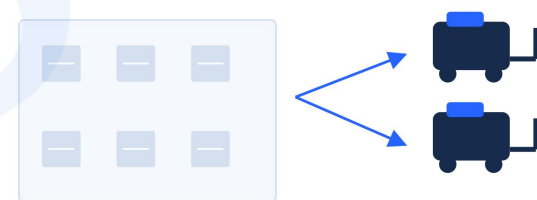
View and load maps on the device
Export or delete maps

Incremental mapping



Map previously missed areas
Extend maps into new areas

Map reuse



Share maps across vehicles
Subject to mounting and setup requirements

Optional vehicle odometry

Accepts wheel speed or vehicle odometry
Helps improve accuracy and localization success.



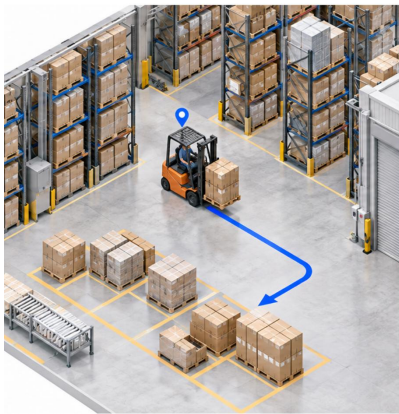
2 Applications

2.1 Application Scenarios

Position and heading data for mobile equipment in warehousing, manufacturing and intralogistics.

Warehouse handling

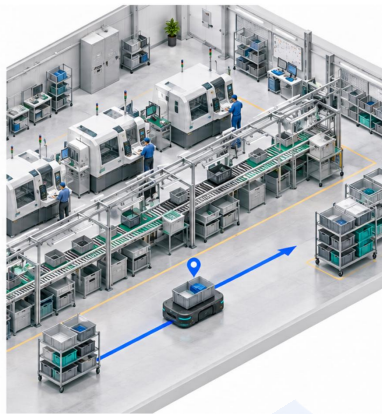
Aisles, receiving and dispatch areas



Inbound, outbound and internal pallet transport

Production logistics

Line-side storage and workstations



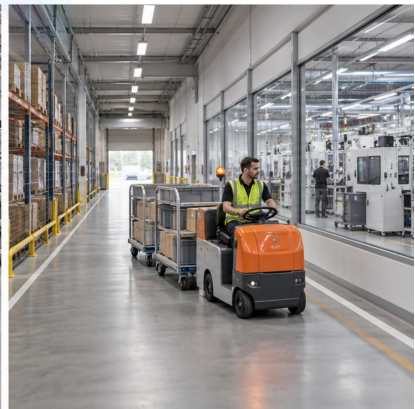
Material supply and workstation transfers

Intralogistics

Movement between work areas



Transport between operating areas

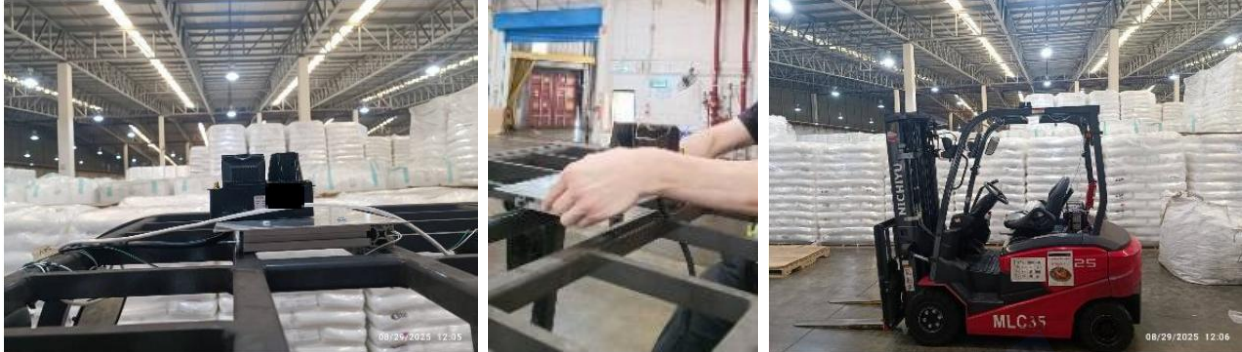


Illustrative scenes

2.2 Project Examples

2.2.1 Yusen Logistics Warehouse Validation

At Yusen Logistics' WH4 warehouse, V2 Pro was installed on a forklift to evaluate localization during travel, turns and load handling.



Site

Yusen Logistics WH4 warehouse

Vehicle

Forklift

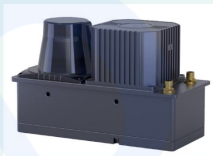
Validation scope

Mapping and continuous localization

Customer needs

- 1 Locate the forklift in real time
- 2 Determine its heading
- 3 Maintain localization while handling loads

V2 Pro solution



V2 Pro

- Camera observes overhead features
- LiDAR scans surrounding structures
- Module computes vehicle position

Position + heading

On-site validation

1

Map the warehouse

Capture the operating area
Generate a localization map

2

Test driving and turning

Check position and heading
during driving and turns

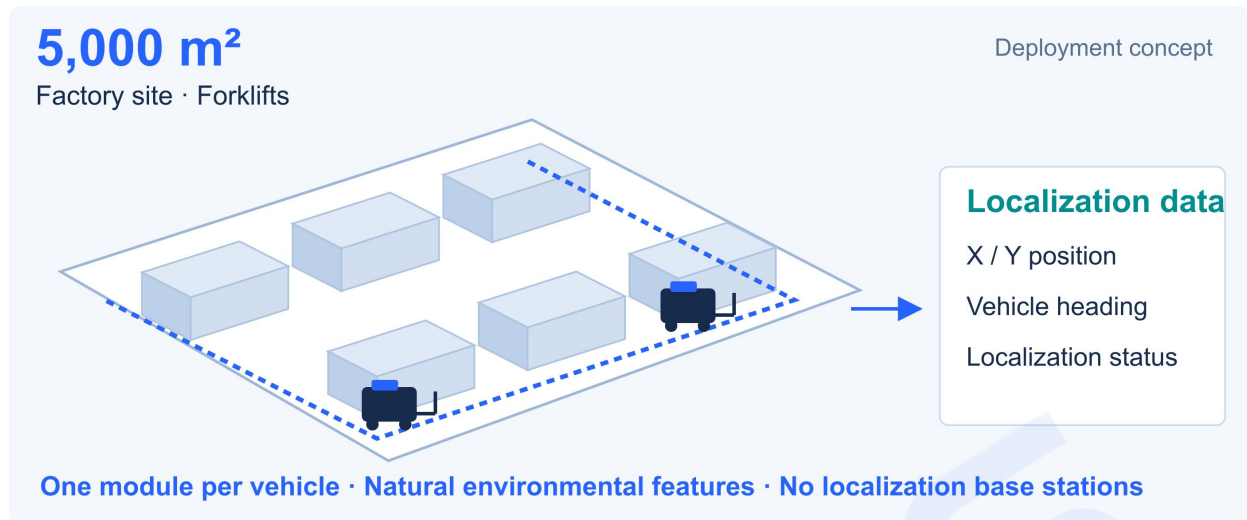
3

Test with a load

Check localization continuity
while carrying loads

2.2.2 Manufacturing Site Deployment

A compressor manufacturer needed to track a small fleet of forklifts across a 5,000 m² site while reducing investment in localization infrastructure.



Customer needs

- View forklift positions across the site
- Update positions as vehicles move
- Reduce localization infrastructure costs

V2 Pro deployment

- Mount a localization module on each forklift
- Compute position and heading onboard
- Build a map and send poses to the customer system

Project benefits

Vehicle visibility

Position and heading output
Shows each forklift's current location

Less infrastructure on site

Vehicle-mounted localization
No base stations required on site

System integration

Vehicle position data
Supports route tracking
in customer systems

3 Localization Principles

V2 Pro combines LiDAR odometry, visual sensing and map references to continuously estimate position and heading.

LiDAR odometry

Estimates relative motion from changes in the surroundings to support continuous tracking.



Motion reference

Visual sensing

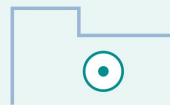
Detects overhead visual features as a reference for determining position and heading.



Visual reference

Map reference

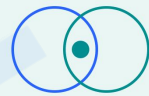
Uses the existing map as a spatial reference to limit accumulated drift and maintain consistency.



Position reference

Multi-source fusion

Combines complementary motion and environmental information to estimate position and heading.



Consistent pose

Complementary sensing for continuous localization

Motion estimates and environmental features support continuous localization as the surroundings change.

Localization output

Position · Heading · Localization status

Performance and operating conditions: see Chapters 4 and 5.

4 Localization Performance

Specifications cover accuracy, operating speeds, output timing and relocalization. They apply when installation, environmental and mapping requirements are met.

Localization Accuracy

1–3 cm

Localization error

$\pm 1^\circ$

Heading error

Motion Limits

15 km/h

Max. localization speed

3 km/h

Max. mapping speed

Approx. 28.6°/s

Max. yaw rate

Output and Startup

20 Hz

Valid pose output rate

<20 ms

Output latency

>99.9%

Localization availability

40 s

Time from power-on to localization

Relocalization

4 s

Relocalization time

99%

Relocalization success rate

<8 km/h

Speed within QR detection area

10 m

QR code detection range

Understanding the Specifications

Output rate and latency: A valid pose includes position, heading and a valid localization status. At 20 Hz, updates are 50 ms apart. This interval differs from output latency.

Availability and relocalization success: Availability indicates whether localization remains usable during operation. The relocalization success rate is the percentage of attempts that successfully restore localization.

Startup and relocalization: Localization takes 40 s after power-on. Restoring localization takes 4 s.

Yaw rate: The maximum rate of change in heading is approximately 28.6°/s. Wheel slip can cause vehicle odometry and LiDAR odometry to disagree, resulting in localization drift.

QR relocalization: Vehicle speed must remain below 8 km/h within the QR code detection area. The detection range is 10 m. The QR code must be registered in the current map.

5 Operating Limits

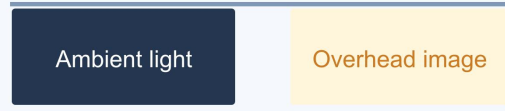
5.1 Environmental Requirements

V2 Pro is designed primarily for indoor use. Short outdoor sections may be supported, subject to assessment along the intended route.



Short outdoor routes

Short outdoor sections are supported.
Assess conditions along the intended route.
Not intended for continuous outdoor use.



Lighting and overhead features

Ambient light: 0–10 klux.
Artificial light has no effect; overhead texture is required.
Prolonged direct sunlight can disable visual localization.



Environmental features and range

Maximum continuous featureless section: 20 m
Maximum LiDAR feature extraction range: 40 m
Assess sparse features and repetitive structures.
Lower reflectivity reduces effective range.



Unobstructed sensor views

Keep both the camera and LiDAR fields of view clear.



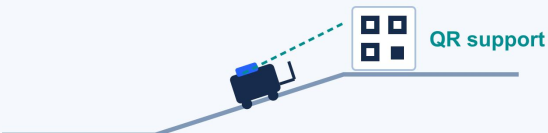
Dynamic environments

Handles dynamic sites and major structural changes.
LiDAR odometry helps the system adapt to changes.
Small shifts in structures over large areas need attention.



Turning and vehicle motion

Maximum yaw rate: approx. 28.6°/s
Wheel slip can cause odometry estimates to disagree, leading to localization drift.
Localization ≤15 km/h; mapping ≤3 km/h



Slopes and uneven floors

Slopes may disrupt localization; QR codes can help.
Assess frequent slopes or large height changes.



Vibration and bumps

Mount the module securely.
For significant vibration or bumps, validate localization performance on site.

5.2 Mapping and Map Use

Keep each mapping session within the specified distance and area limits, and avoid long, narrow areas. Map extensions must overlap the existing map. Map reuse also depends on how the module is mounted.

Path length per mapping session

2,000 m

Area per mapping session

20,000 m²

Area added per map extension

5,000 m²

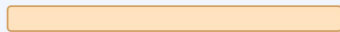
Total area per map, including extensions: 250,000 m²

This limit primarily reflects the platform's map display capacity. It does not apply to customers who use their own interface to send relocalization coordinates and monitor localization.

The 2,000 m limit is the distance traveled in a single mapping session, not the length of the site.

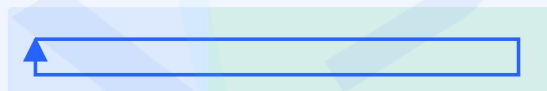
Site shape and incremental mapping

Avoid long, narrow areas with few features



Long, narrow areas with few features can distort the map.
Assess the site's length, shape and intended route.
The same limits apply to new maps and extensions.

New coverage must overlap the base map



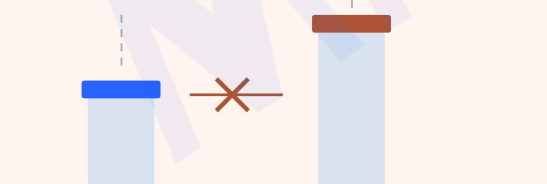
Base map

New area

Start and finish in the base map.
Add overlap points along the route.

2D maps and mounting height

No direct reuse at a different height



Mapping height

New height

The same map cannot be used directly at a different mounting height.

Small height changes must meet both conditions



≤50 cm

Relative to mapping height

Surrounding LiDAR features unchanged

Validate localization on the intended routes.

Localization uses a 2D map and outputs X, Y and heading.

6 Hardware and Installation

The camera, 2D LiDAR, IMU and processor are housed in a single module.

2D LiDAR

Scans surrounding geometry

Upward-facing camera + IR

Detects overhead textures and features

IMU and processor

Motion sensing and sensor fusion

Wi-Fi antenna connectors

Connect external antennas

146.5 × 66.3 × 89.4 mm

Overall dimensions

6.6 W / 15.3 W

Average / maximum power

24 V DC / 3 A

Power supply

Hardware	Specification
Upward-facing camera	Working distance to overhead features: 1–15 m; 20 fps Field of view: 108° (H) × 57° (V), ±3° Ambient light: 0–10 klux Resistant to glare and ambient light interference Built-in infrared illumination
2D LiDAR	270° scan angle; scan rate adjustable from 15–25 Hz Range: 15 m at 10% / 40 m at 90% reflectivity
LiDAR measurement	Typical ranging accuracy: ±30 mm; angular resolution: 0.25°
IMU and processing	Built-in IMU; 8-core ARM processor; 6 TOPS NPU
Dimensions	146.5 × 66.3 × 89.4 mm
Weight	Approx. 543 g
Memory and storage	4 GB RAM; 64 GB storage

Certification and compliance

✓ EMC

CE-EMC

Passed emissions and immunity tests

✓ Radio and electrical safety

RED

Completed RF, health and electrical safety tests

✓ Laser safety

EN 60825

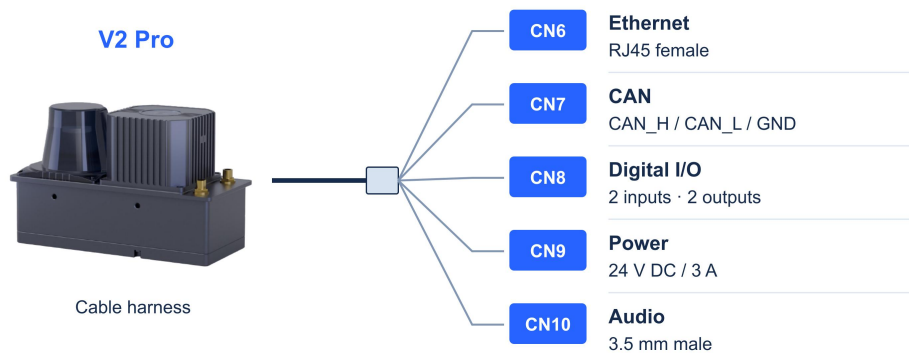
Completed laser safety testing

✓ Substance compliance

RoHS · REACH

Restricted substances and chemical compliance

6.1 Interfaces and Electrical Specifications



Interface	Specification
CN6 · Ethernet	RJ45; 100 Mbit/s Ethernet
CN7 · CAN	CANopen; 250 kbit/s default, adjustable
CN8 · Digital I/O	2 inputs: 5–24 V, active high 2 outputs: push-pull, 24 V / 100 mA
CN9 · Power	24 V DC / 3 A; input range: 19.2–28.8 V
CN10 · Audio	3.5 mm audio output
Wi-Fi	2.4 GHz; 2 antennas

Network interfaces: HTTP, MQTT, UDP, ROS 1 / ROS 2.

Operating conditions

Parameter	Specification
Power consumption	6.6 W average; 15.3 W maximum
Operating temperature	–20 to 60 °C
Storage temperature	–40 to 80 °C
Ingress protection	IP54
Power source	Continuous external power required
Storage humidity	≤95% RH, non-condensing
ESD immunity	±4 kV contact; ±8 kV air discharge (tested)

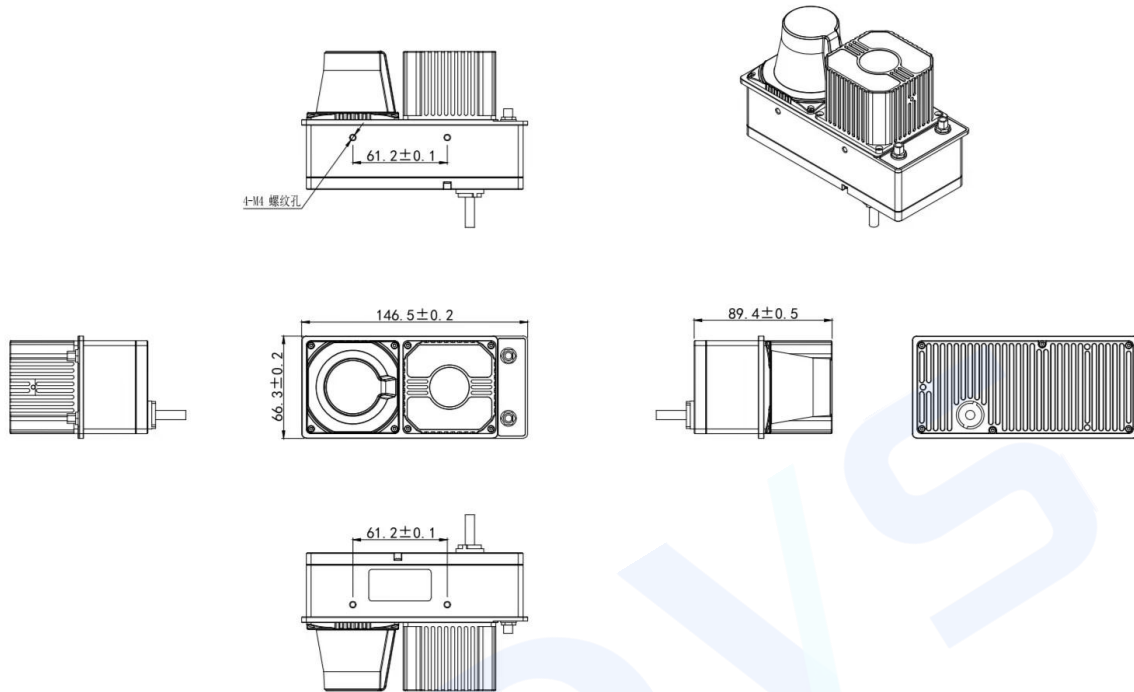
RTC Backup Battery

Parameter	Specification
Purpose	Keeps the real-time clock running when main power is off; does not power localization
Electrical ratings	Rechargeable; nominal voltage: 3.0 V; rated capacity: 5.8 mAh
Size and weight	6.8 mm diameter × 2.1 mm height; approx. 250 mg
Installation and service	Soldered in place; cannot be removed or replaced by the user

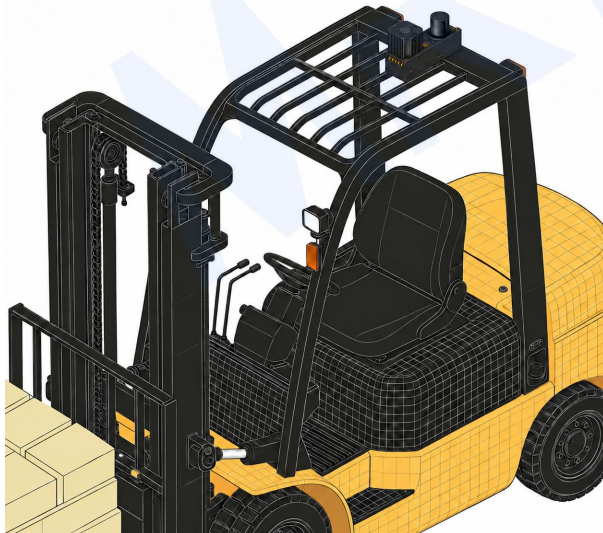
6.2 Dimensions and Mounting Location

146.5 × 66.3 × 89.4 mm

Length × width × height. All drawing dimensions are in mm.



Roof mounting on a forklift



Example: operator-driven forklift

Mounting location

In this example, the LiDAR faces the rear of the vehicle to avoid obstruction by the mast. Secure the module to a rigid roof structure and keep the scan area clear.

Clearance

Leave enough space for cables to exit downward, heat dissipation, cleaning and connector access.

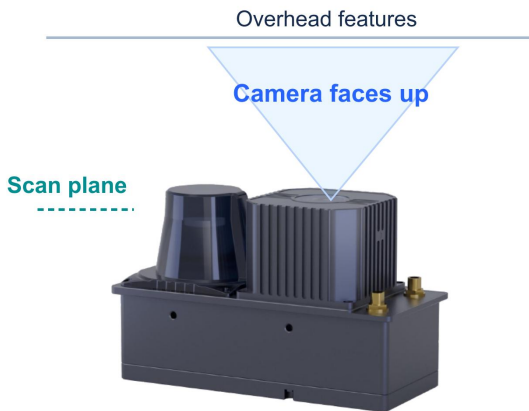
Installation drawing support

We can help prepare an installation drawing to suit the vehicle structure and mounting location.

6.3 Mounting Requirements and Procedure

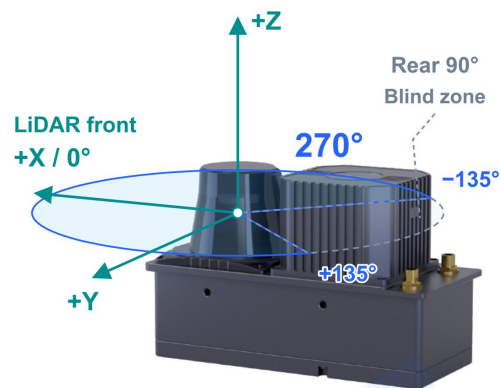
Mounting requirements

Sensor views



Mount level and keep sensor views clear.
Camera faces up; cable exits downward.

LiDAR field of view and axes



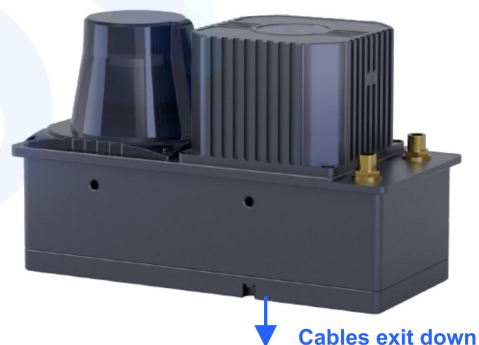
+X forward · +Y left · +Z up
Scan: -135° to $+135^{\circ}$ relative to +X

Installation guide

Mount level



Cable exit at base



01 Choose the location: Mount on a rigid part of the vehicle. Keep the camera and LiDAR fields of view clear.

02 Mount the module level: Keep it horizontal, with the LiDAR facing forward or rearward along the direction of travel.

03 Connect the cables: Route cables downward from the base. Secure them and allow enough clearance to avoid tight bends.

04 Configure and verify: Configure the network and mounting parameters. Power on, check operation and validate localization along the intended routes.

7 Software Overview

7.1 Platform Connection and Overview

One interface to configure the device, build maps, restore localization and monitor position.



01 Device setup

Configure the network, mounting parameters and device settings.

02 Mapping and map management

Create maps, monitor mapping progress and manage saved maps.

03 Relocalization

Set the vehicle's position and heading on the map.

04 Localization monitoring

View vehicle position, heading and localization status.

How the platform and V2 Pro work together

Software platform

Sends settings and commands
Displays maps and localization data



V2 Pro module

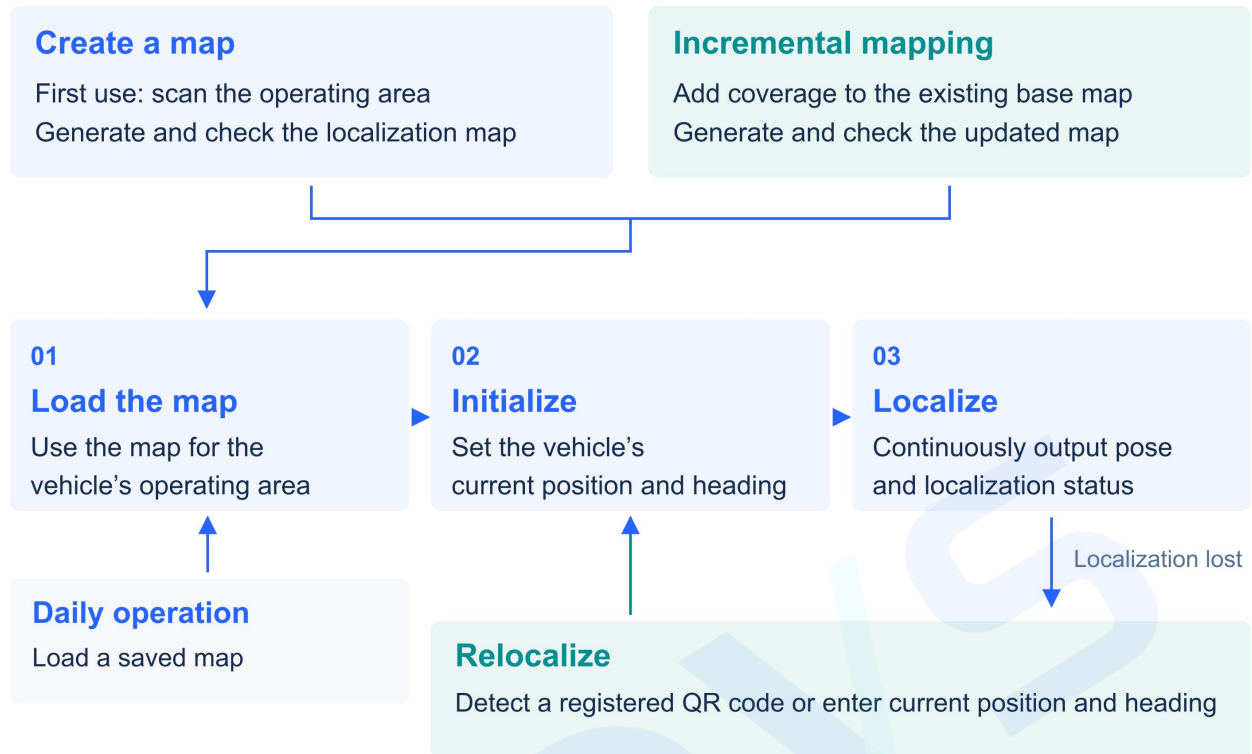
Collects sensor data
Builds maps and estimates vehicle pose

Customer systems can use position data to manage zones, analyze routes and monitor operations.

For detailed instructions, see the V2 Pro User Manual.

7.2 Mapping and Localization

Prepare a map



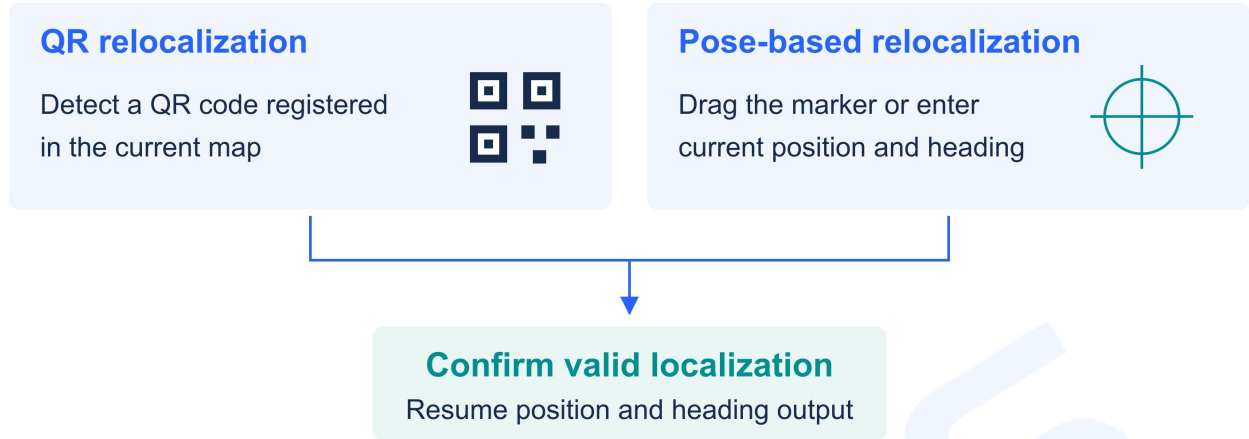
A common spatial reference

Provides X, Y position and heading within the mapped area.

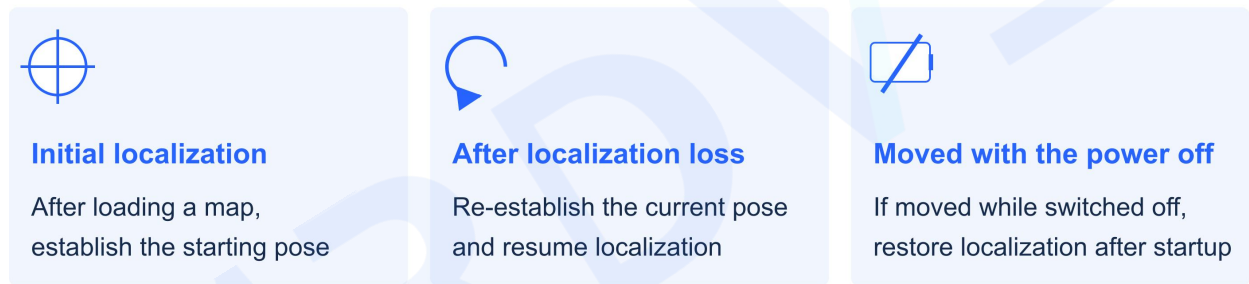
7.3 Relocalization

Restore localization by detecting a registered QR code, dragging the vehicle marker on the map, or entering the current position and heading.

Two ways to restore localization



When to use it



Before relocalizing, confirm that the loaded map matches the vehicle's operating area.

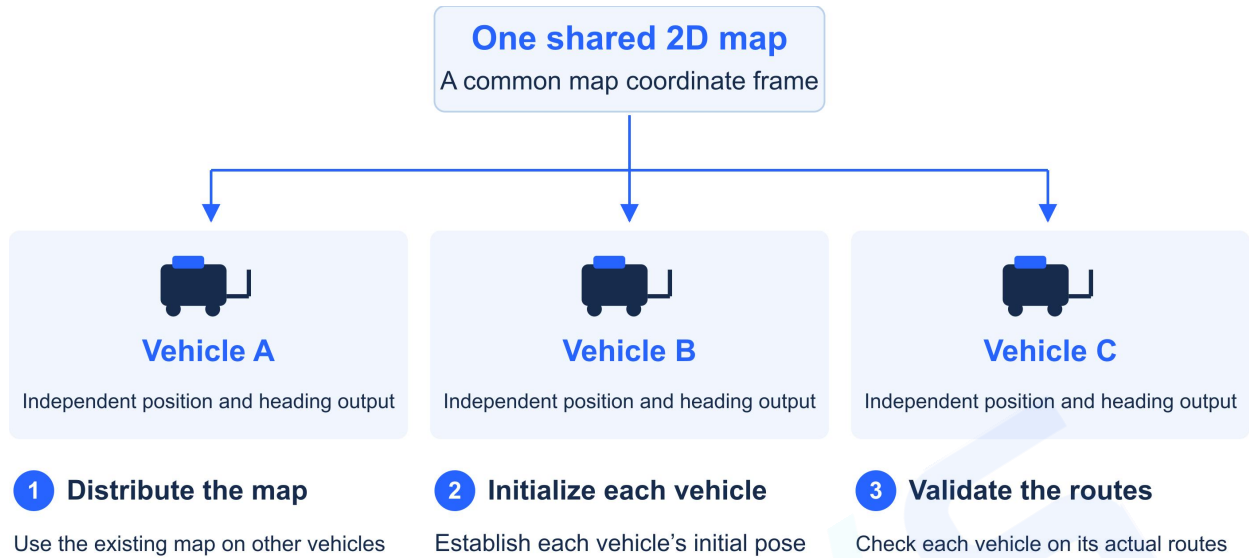
When QR codes are needed

In typical environments, V2 Pro uses natural features for localization and does not require dedicated QR codes. QR codes can assist in unusual environments, areas with few distinctive features, or locations where slopes affect localization.

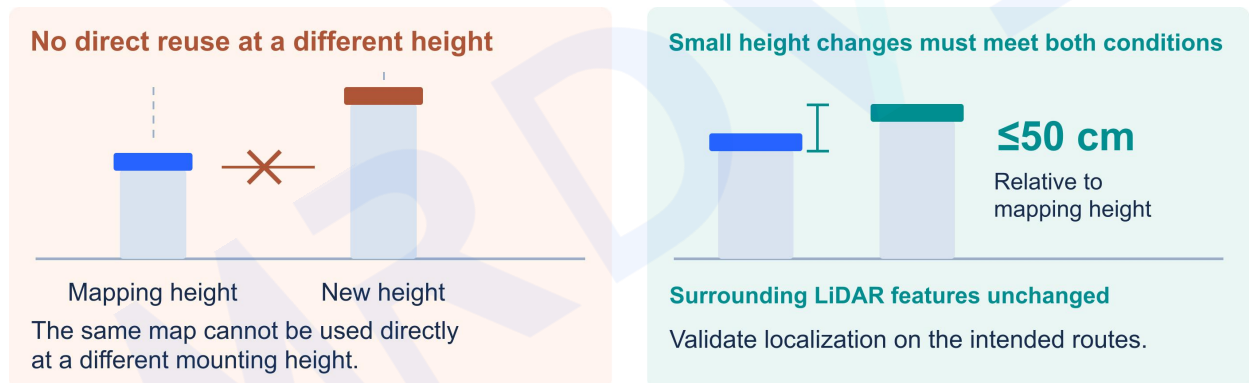
QR codes must be registered in the current map and within the camera's detection range.

7.4 Map Reuse Across Vehicles

Vehicles can share a map, with each vehicle establishing and reporting its own position and heading. Each floor requires a separate map; use the map for the current floor.



Mounting height and map reuse



Localization uses a 2D map and outputs X, Y and heading.

8 Communications and Data Integration

V2 Pro exchanges localization, map and device information with vehicle controllers or management systems.

8.1 Connections and Protocols

Connection	Protocols and data interfaces
Ethernet / Wi-Fi	UDP · HTTP · MQTT · ROS 1 / ROS 2
CAN	CANopen · 250 kbit/s default (adjustable)

8.2 Inputs and Outputs

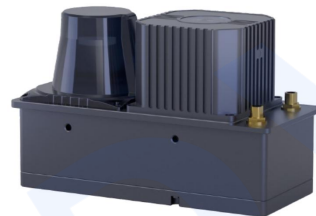
INPUT

Mapping and localization

Mapping, map loading, extension, relocalization

External odometry (optional)

Vehicle motion data



V2 Pro

OUTPUT

Pose and localization status

Position, heading, validity

Device and service feedback

Progress, results, errors

Input fields

Mapping and map control

Control command, map name

Relocalization

Initial position, initial heading

External odometry

Body-frame velocity, pose, wheel speed
Displacement, steering angle, timestamp

Output fields

Localization

Position, heading, pose timestamp, localization status

Map and device

Map name, device ID

Task and error feedback

Mapping status, mapping progress
Service response, error information

9 Frequently Asked Questions

9.1 Deployment, Mapping and Localization

01 How do I access the software platform?

Access the platform in a browser over Ethernet or Wi-Fi to configure the device, build and manage maps, and monitor localization.

02 Is calibration required without vehicle odometry?

No. Heading and position calibration align the LiDAR with the vehicle odometry reference frame. They are needed only when vehicle odometry is connected.

03 What are the limits of a single mapping session?

A single standard mapping session covers up to 20,000 m² and 2,000 m of travel. Incremental mapping extends the map beyond the initial session.

04 Can environmental changes affect localization?

LiDAR odometry helps V2 Pro handle dynamic environments, including major structural changes. Small shifts in structures across large areas require attention. Obstructions and prolonged direct sunlight on the camera can also affect localization.

05 Can localization be restored after the device is moved?

Yes. Set the position by dragging the marker on the map or entering coordinates manually. Registered QR codes within view of the camera can also help restore localization.

06 Are QR codes required?

V2 Pro normally uses natural environmental features for localization without dedicated QR codes. QR codes can help where these features are insufficient.

07 Can multiple devices or floors share a map?

Devices in the same area can share a map. The mounting height may differ by up to 50 cm from the mapping height if surrounding LiDAR features remain unchanged. Each floor requires its own map.

9.2 Data, Integration and Support

01 Are wheel speed data or encoders required?

No. V2 Pro operates independently; vehicle odometry is optional. Wheel slip can cause vehicle odometry and LiDAR odometry to disagree, resulting in localization drift.

02 Does a communication outage cause loss of localization?

Not necessarily. Localization runs onboard the module. A communication outage does not, by itself, mean that localization has failed.

03 Do received coordinates guarantee valid localization?

No. Localization status and timestamps must also be checked. Previously recorded positions may still be output when localization is invalid.

04 Is the localization algorithm open source?

The algorithm is proprietary to MRDVS. Customers use the communication interfaces to send control commands and receive localization data.

05 Can vehicle position data be used to track pallets or goods?

Tracking goods also requires item IDs and loading or unloading records. RFID or barcode data can link items to these records.

06 Can I use a different camera or LiDAR sensor?

V2 Pro is an integrated module. Replacing a sensor requires a project-specific assessment of interface and algorithm compatibility; sensors are not directly interchangeable.

07 What technical support is available?

Technical support is tailored to project needs. The scope of service and fees are agreed with the customer.

10 Global Partners

Regional partners provide support for vehicle localization and system integration.

Europe · Japan

Countries

Germany / Japan

Kudan

Visual localization, robot navigation and mapping.

www.kudan.io

Southern Europe

Country

Spain

SleuthX

Real-time localization and object recognition for industry and logistics.

www.sleuthx.com

South America

Country

Brazil

GTP Automation

Warehouse automation, item identification and tracking.

gtpautomation.com

Southeast Asia · India

Country

Singapore

Movel AI

Robotics software, fleet management and system integration.

www.movel.ai

Revision History and Technical Support

Version	Date	Revision
V1.1	2026-10-09	Initial English release: product overview, applications, installation, sensor fusion, performance, operating limits, communications and map use.

Technical Support

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Knowledge Community: <https://docs.mrdvs.com/en>

LinkedIn: <https://www.linkedin.com/company/mrdvs>



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