



V2Pro **Localization and Navigation Module** **User Manual**

Multi-sensor localization for complex environments

Zhejiang MRDVS Technology Co., Ltd.

V0.1 · 2026-10-10

Quick Start

Connect to V2Pro

01

Connect your computer, then follow the steps to create a map.

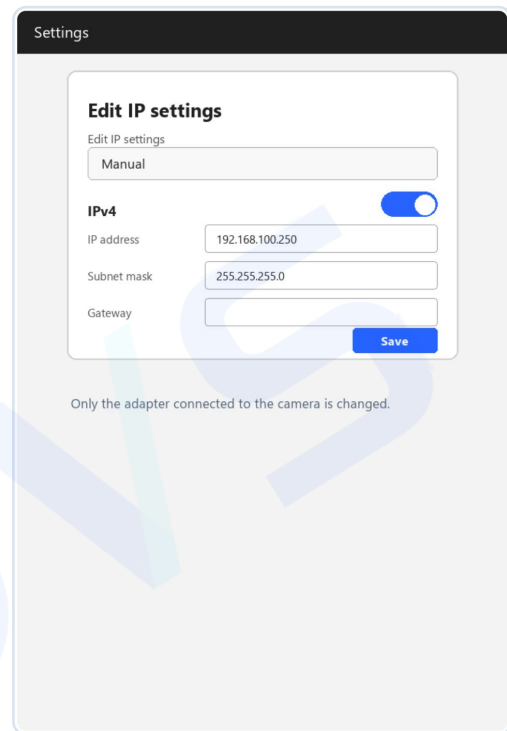
01 Power on and connect an Ethernet cable

On the computer, open Settings → Network & internet → Ethernet → IP assignment → Edit.
Choose Manual and turn on IPv4.

Computer IP

192.168.100.250

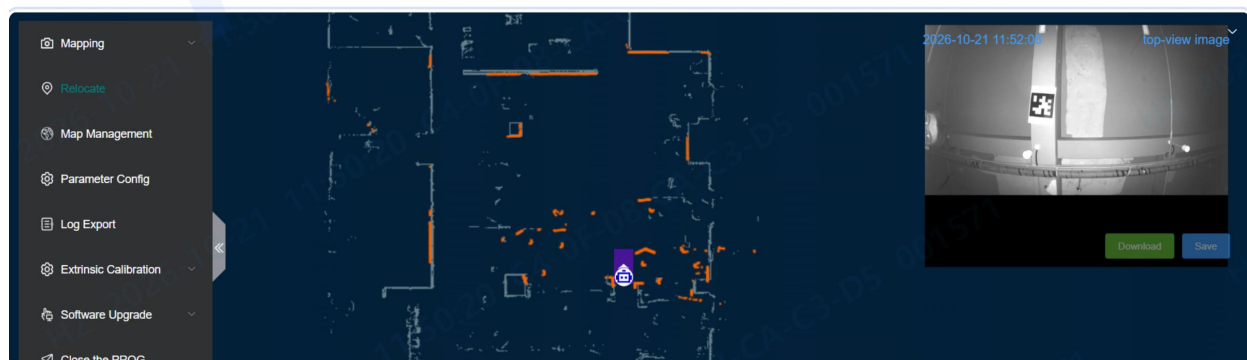
Subnet mask: 255.255.255.0 (/24)



Enter the values and select Save.

02 Open the device in a browser

192.168.100.201:9998



Detailed instructions [Connection and IP settings →](#)

Quick Start

Start mapping

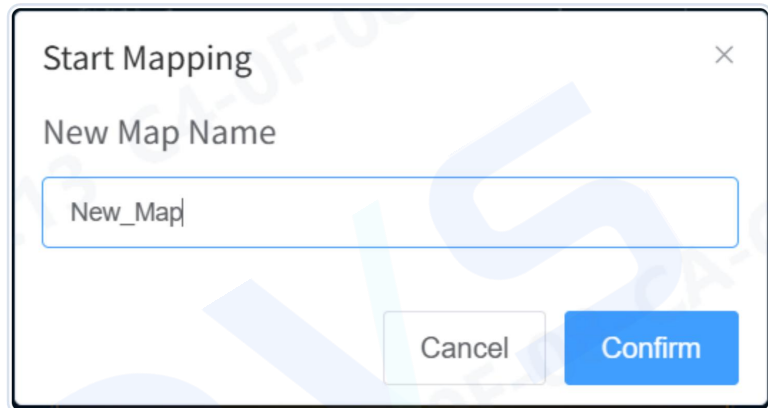
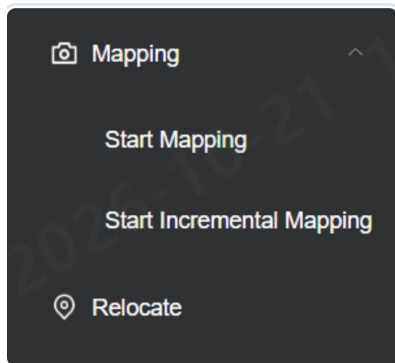
02

Start the session, name the map, then move through the area.

03 Start mapping and enter a map name

Mapping → Start Mapping → Enter a name → Confirm

Example name: Warehouse_A



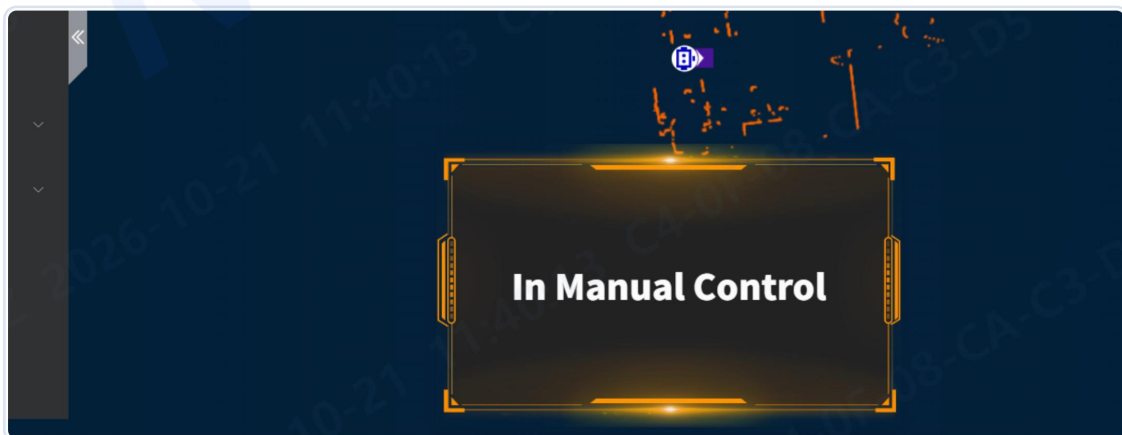
Select Start Mapping

Enter a name, then select Confirm

04 Move through the area to collect data

When "In Manual Control" appears, cover the required area.

Close the loop at the start point and cover internal aisles.



Detailed instructions [Create a map →](#)

Quick Start

Finish and apply the map

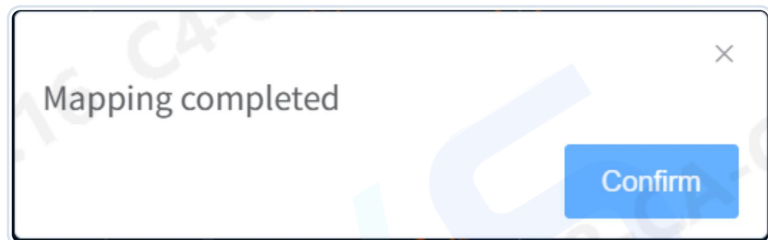
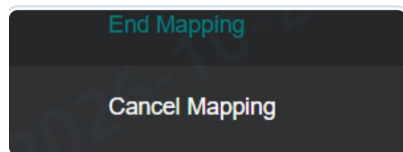
03

Stop, wait for map generation, then apply the result.

05 End mapping and wait for completion

Stop the vehicle, reconnect, and select End Mapping.

When "Mapping completed" appears, select Confirm.

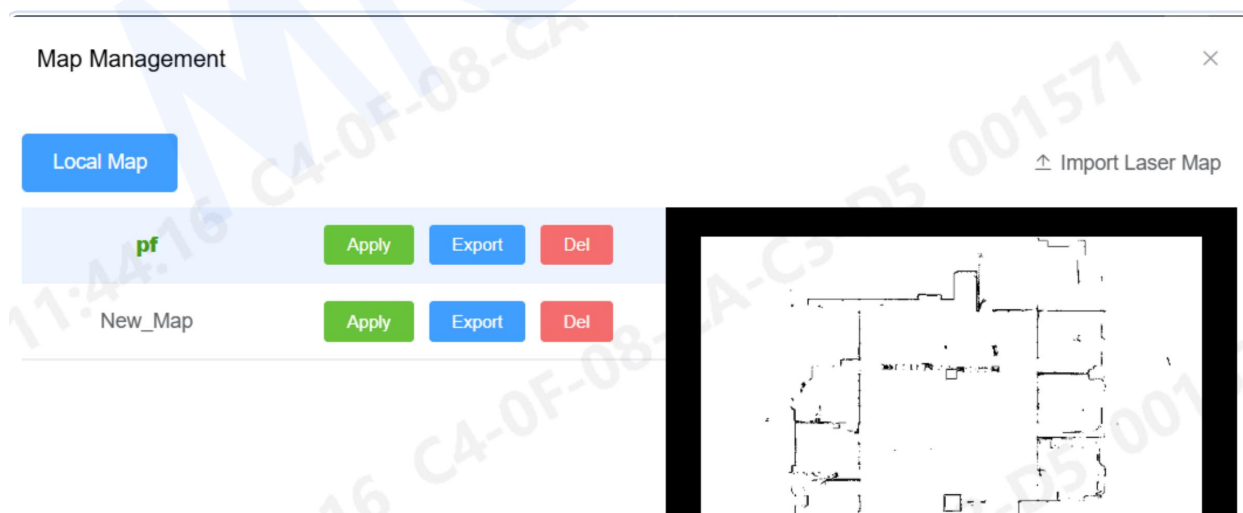


Select End Mapping

Wait, then select Confirm

06 Apply the new map

Open Map Management and select Apply beside the new map.



Detailed instructions [Apply a map →](#)

Quick Start

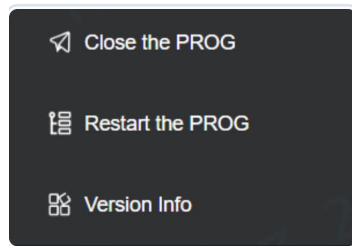
Restart and relocalize

04

Restart the device program to activate the applied map.

07 Restart the program and wait about 30 s

Select Restart the PROG in the left menu and wait.



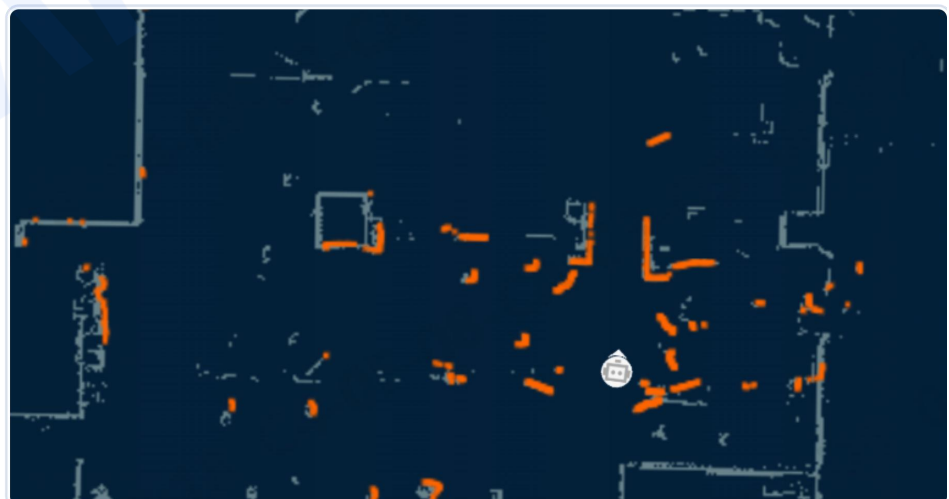
30

seconds

After the restart,
reopen the web interface.

08 Relocalize and check the result

After the map loads, select Relocate. Set the pose, then Submit.
Check that the position and heading match the vehicle.



Detailed instructions [Verify localization →](#) | [Manual relocalization →](#)

Contents

Quick Start	2
1 Product Overview	7
1.1 Product and Intended Use	7
2 Before You Begin	8
2.1 Environment and Motion	8
2.2 Map and Installation Requirements	9
3 Installation and Network Connection	10
3.1 Mount the Module	10
3.2 Wiring and Power-on Checks	11
3.3 Find the IP Address and Open the Web Interface	12
3.4 Change the Computer IP Address	13
3.5 Change the V2Pro IP Address	15
4 Configuration and Calibration	16
4.1 Main Interface	16
4.2 Parameter Configuration	17
4.3 Calibrate Orientation and Position	20
5 Mapping and Localization	21
5.1 Plan the Mapping Route	22
5.1.1 Preparation and Route Coverage	22
5.1.2 Open Spaces and Route Adjustments	23
5.1.3 Tag Locations and Sizes	25
5.1.4 How Tags Are Recorded and Updated	28
5.2 Create a Map	29
5.3 Apply and Verify the Map	32
5.4 Incremental Mapping	33
5.5 Manual Relocalization	36
5.6 Verify Relocalization	37
5.7 Daily Checks	38
6 Map Management	39
6.1 Apply and Back Up Maps	39
6.2 Import, Delete and Reuse Maps	40
7 Communication Setup and Examples	41
7.1 UDP Receiver Example	42
7.2 MQTT Subscription Example	43
7.3 HTTP Interface	44
7.4 CAN and Digital I/O	45
8 Validate the Installation	46
9 Troubleshooting and Technical Support	47
9.1 Connection and Display Problems	47
9.2 Mapping and Localization Problems	48
9.3 Export Logs and Contact Support	49
10 Maintenance and Updates	50
10.1 Routine Maintenance and Changes	50
10.2 Software Updates and Program Control	51
Revision History and Support	52

1 Product Overview

1.1 Product and Intended Use

V2Pro combines an upward-facing camera, a 2D LiDAR and an IMU to map the environment and determine its position and heading. The module outputs planar position, heading and localization status to a vehicle controller or host system. Use the web interface for configuration, mapping, map management and monitoring.

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

This manual covers installation, commissioning, integration and maintenance. “Pose” means position and heading. “Relocalization” means determining the vehicle’s pose on the map again. “Device program” refers to the software running on the module.

2 Before You Begin

2.1 Environment and Motion

Check overhead features, structures visible to the LiDAR, lighting and floor conditions along the operating route. V2Pro is primarily intended for indoor use. Assess any short outdoor sections on the actual route before deployment.

Check	Requirement
Overhead features	Point the camera upward. Overhead structures must remain clearly recognizable. Camera-to-ceiling working distance: 1–15 m. Prolonged direct sunlight into the camera disables visual localization; artificial lighting does not.
LiDAR surroundings	Keep the scan area clear. Fixed structures must provide stable features. Maximum feature extraction distance: 40 m, depending on surface reflectivity and site conditions.
Lighting	Ambient illumination: 0–10 klux. Overhead details must still be distinguishable in the camera image.
Floor and motion	Mount the module securely and drive smoothly. Wheel slip can cause wheel odometry and LiDAR odometry to disagree, shifting the reported position. Validate performance on the actual vehicle under vibration and uneven-floor conditions.
Insufficient features	Continuous sections without distinct features must not exceed 20 m. Mapping and localization are not supported in 30 m corridors. In open spaces with no surrounding features, mapping and localization are unavailable in the central area.
Ramps	Changes in slope alter the viewing angle and may cause loss of localization. Assess sites with frequent ramps or large elevation changes before deployment.

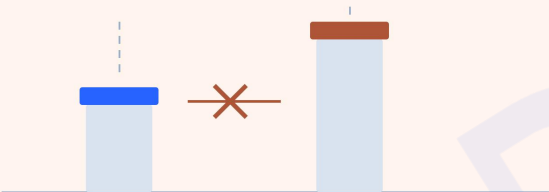
Vehicle Motion Limits

Item	Limit
Maximum travel speed during localization	15 km/h
Maximum travel speed during mapping	3 km/h for both new and incremental mapping
Turning rate	Approximately 30°/s
Speed when passing tags	Below 8 km/h

2.2 Map and Installation Requirements

Item	Requirement
One new mapping session	Area: up to 20,000 m ² . Total distance driven during acquisition: up to 2,000 m.
One incremental session	Repeat incremental mapping as needed. Each session may add up to 5,000 m ² . Start and finish within the existing map. Re-enter the mapped area as often as practical during acquisition.
Area layout	Mapping and localization are not supported in 30 m corridors or in the center of open spaces with no surrounding features.
Total map area	The web interface can display maps up to 250,000 m ² , including all extensions. This display limit does not apply to a map display frontend developed by the user.
Map dimensions	Maps are two-dimensional. Create a separate map for each floor and use the map for the vehicle's current floor.

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.

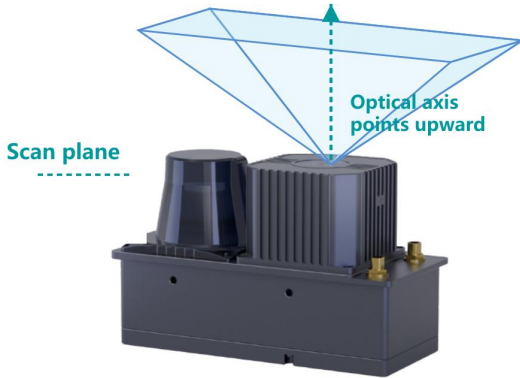
To reuse a map on another vehicle, keep the mounting height within 50 cm of the height used during mapping, with the same surrounding LiDAR features. Verify each vehicle's position, heading and operating route.

After a change Follow [Section 10.1](#) after changing the installation, vehicle or major site structures.

3 Installation and Network Connection

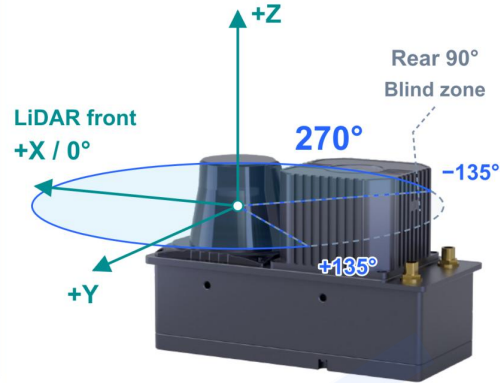
3.1 Mount the Module

Upward camera field of view
108° H × 57° V (±3°) • 3D view



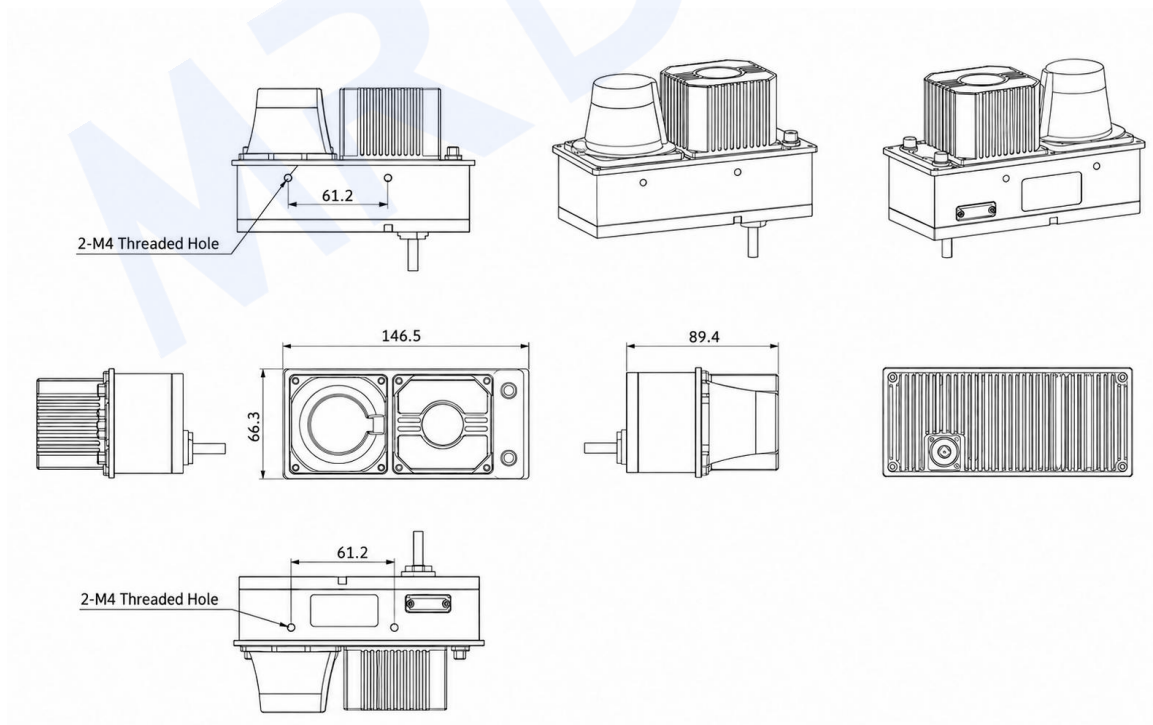
Mount level and keep sensor views clear.
Camera faces up; cable exits downward.

LiDAR field of view and axes



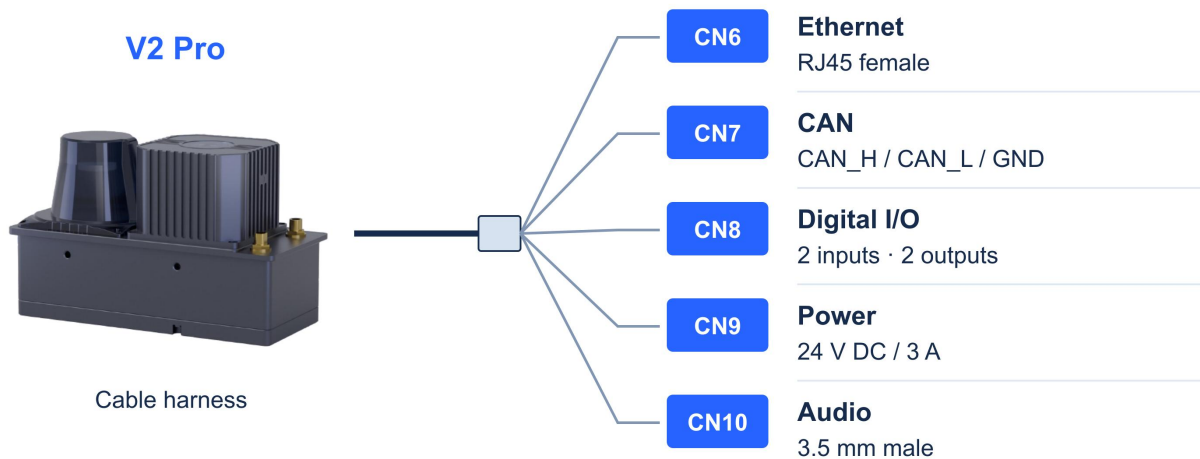
+X forward · +Y left · +Z up
Scan: -135° to +135° relative to +X

1. Choose a rigid mounting point on top of the vehicle or another unobstructed structure. Check for obstructions from the mast, loads and accessories throughout their operating range.
2. Mount the module level, with the LiDAR facing forward or backward along the vehicle's direction of travel. Keep the module fixed relative to the vehicle.
3. Secure the module. Leave room for cooling, cleaning, connectors and cable bends.
4. Record the mounting position, orientation and height for extrinsic configuration and future maintenance.



Installation drawing Assistance is available to prepare a drawing for your vehicle and mounting location. Complete installation before calibration and mapping.

3.2 Wiring and Power-on Checks



Interface	Connection
CN6 · Ethernet	RJ45, 100 Mbit/s. Connect to a computer or network switch.
CN7 · CAN	CAN_H, CAN_L and GND. CANopen; default 250 kbit/s, adjustable. Wire according to the vehicle integration plan.
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. Check polarity against the supplied harness labels.
CN10 · Audio	3.5 mm audio output.
Wi-Fi	2.4 GHz, two antennas. Connect to the configured site network.

1. With power off, connect and secure the cables. Check connectors, supply polarity and cable slack.
2. Switch on the power. Wait for the device to start, then check its IP address.
3. Open the web interface and check that the camera image and map data continue to update.

Power The module requires continuous external power. The RTC backup battery keeps the clock running when power is off; it cannot power localization.

3.3 Find the IP Address and Open the Web Interface

Open the web interface

Device_IP:9998

Factory IP: 192.168.100.201 · Web port: 9998

Default address: 192.168.100.201:9998

Use Ethernet for initial configuration. Connect the computer and V2Pro to the same network and subnet, using different IP addresses.

1. Power on V2Pro and connect it to the computer or the same network switch by Ethernet.
2. The factory IP is 192.168.100.201. If the address is unknown, find the device in LxCameraViewer and check its wired IP.
3. Record the wired IP address and subnet mask. Check the address of the computer's connected Ethernet adapter.
4. If the subnets differ, change the computer IP as described in [Section 3.4](#). To change the device address, follow [Section 3.5](#).

Wi-Fi address LxCameraViewer cannot currently display the Wi-Fi IP address. Use the site's network records or ask the network administrator.

Computer IP	V2Pro IP	Result
192.168.100.250	192.168.100.201	Same subnet; different addresses
192.168.1.10	192.168.100.201	Different subnets; unsuitable for the direct connection described here
192.168.100.201	192.168.100.201	Address conflict; change one address

The default subnet mask is 255.255.255.0, equivalent to a prefix length of 24 (/24). With this mask, use the same first three address numbers and a different final number. Follow the site's network plan where applicable.

Check the Web Interface

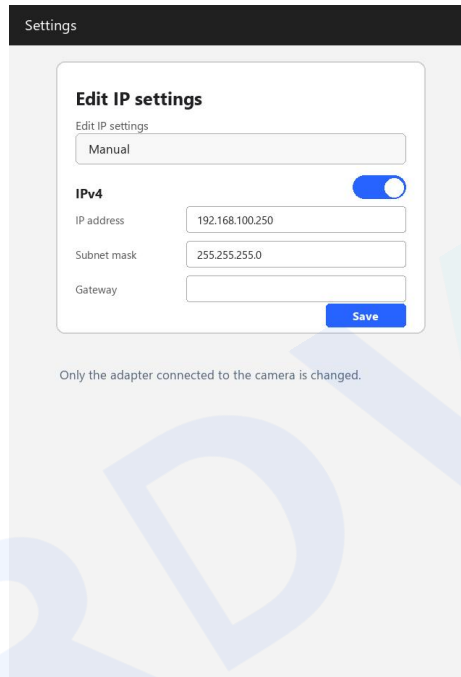
1. Enter Device_IP:9998 in the browser. Check the left menu, map area and camera image.
2. Open [Version Info] and record the front-end, back-end and device program versions.

Connection problems Follow [Section 9.1](#). The web port is 9998; the communication port in the Driver settings is for a different purpose.

3.4 Change the Computer IP Address

Windows

1. Record the existing network settings. Change only the adapter used to connect to V2Pro.
2. Open Settings → Network & internet → Ethernet and select the connected adapter. For Wi-Fi, select the active wireless connection.
3. Next to IP assignment, select Edit. Choose Manual and turn on IPv4.
4. Enter an unused IP address on the device subnet. Enter 255.255.255.0 for the subnet mask, or 24 if the field asks for a prefix length. Select Save.
5. Open Device_IP:9998 again and check that the page loads.

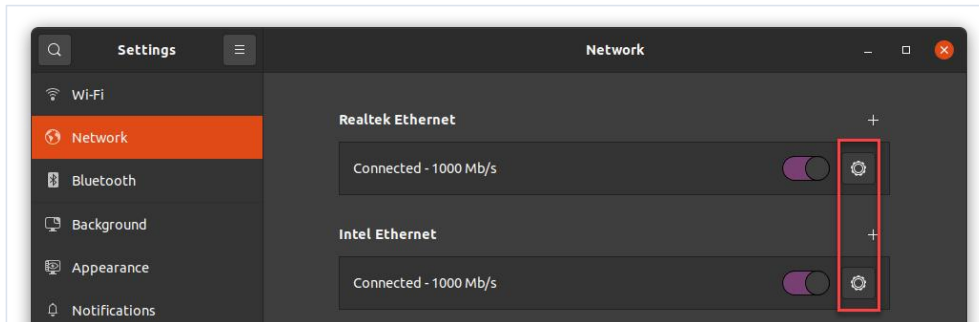


The screenshot shows the Windows Settings application with the 'Edit IP settings' dialog open. The 'Manual' option is selected under 'Edit IP settings'. The 'IPv4' toggle is turned on. The 'IP address' field contains '192.168.100.250', the 'Subnet mask' field contains '255.255.255.0', and the 'Gateway' field is empty. A blue 'Save' button is located at the bottom right of the dialog. Below the dialog, a message states: 'Only the adapter connected to the camera is changed.'

Gateway and DNS These may be left blank on an adapter used only for a direct V2Pro connection. Otherwise, follow the site network plan. Changing the IP address may temporarily disconnect existing sessions.

Linux (Ubuntu)

1. Open Settings → Network. Select the gear icon beside the wired adapter connected to V2Pro.

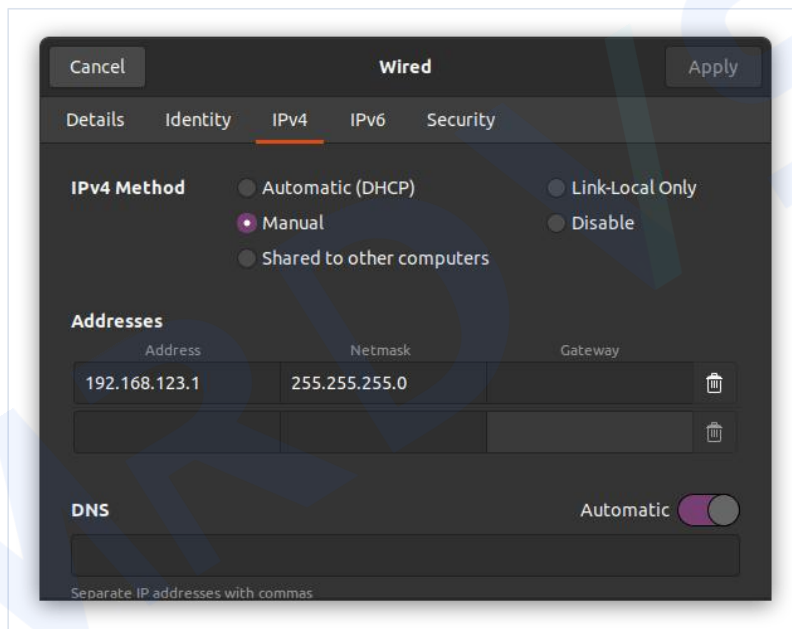


Ubuntu: open the wired connection settings

2. Select IPv4 → Manual. Enter the Address and Netmask.

Factory device IP: 192.168.100.201. Example computer IP: 192.168.100.250.

Subnet mask: 255.255.255.0. If a prefix length is required, enter 24.



Ubuntu: enter a static IPv4 address. Use the values above, not the example address in the screenshot.

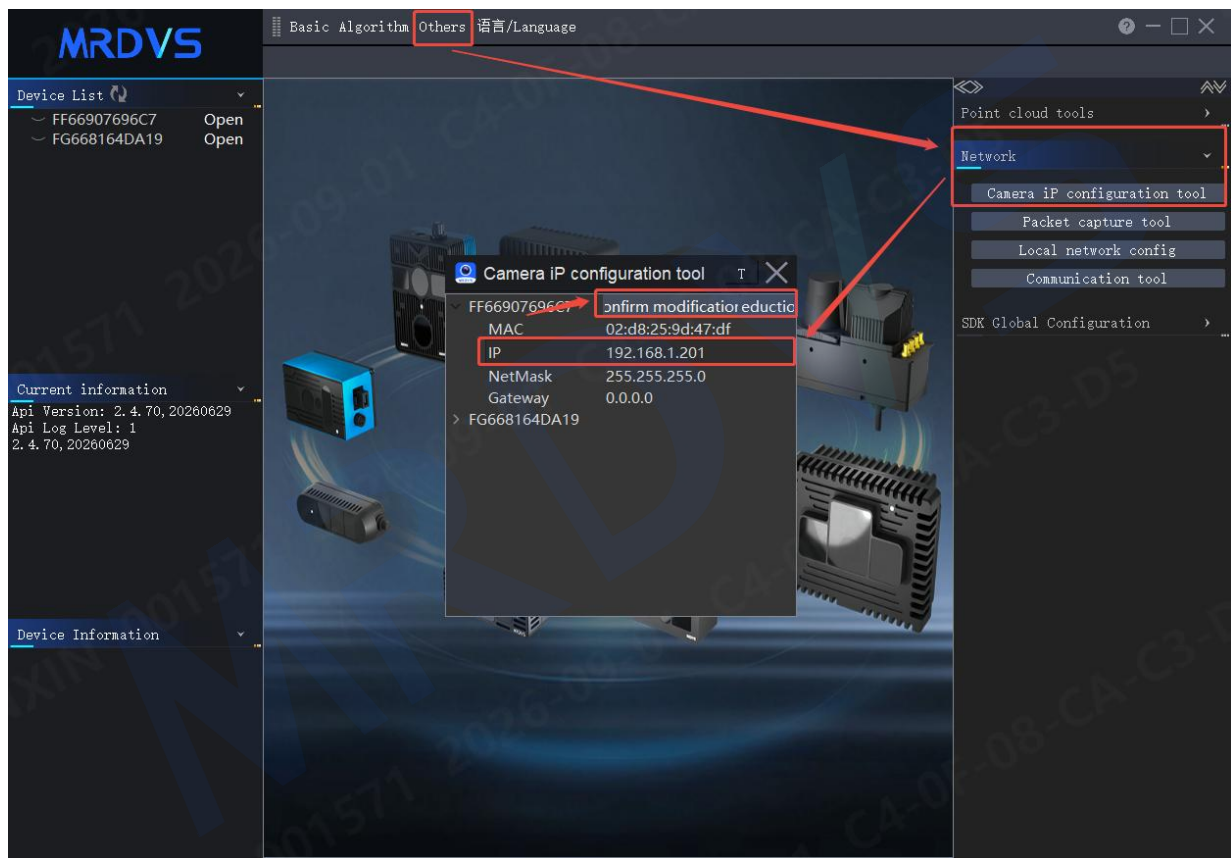
3. Select Apply and reconnect the adapter. Check that the new IP address has taken effect.
4. Open 192.168.100.201:9998 in a browser and check that the page loads.

Gateway and DNS Leave blank for a dedicated direct connection, or follow the site network plan. The computer and device must be on the same subnet with different IP addresses.

3.5 Change the V2Pro IP Address

Use LxCameraViewer to resolve a wired IP conflict or assign a planned address. Select the correct device by its identifier. This procedure does not change the Wi-Fi IP address.

1. Search for V2Pro in LxCameraViewer. Check the device identifier and record its existing IP address, subnet mask and gateway.
2. Open [Others] → [Network] → [Camera IP configuration tool].
3. Expand the target device. Enter the new address in [IP] and the subnet mask in [NetMask]. Set [Gateway] if required by the site network.
4. Check that the address is unused and on the computer's subnet. Select [Confirm modification] for that device.
5. Restart the device program and wait about 30 seconds. Search again to confirm the new IP, then open New_IP:9998 in the browser.



Check Confirm that the new address works and the image and position data update. Configure devices one at a time and keep a record of each device identifier and IP address.

4 Configuration and Calibration

4.1 Main Interface



Area	Purpose and checks
Left menu	Access mapping, relocalization, maps, parameters, logs and maintenance. Use the arrow to collapse the menu.
Map	View the map, vehicle position and heading, and live LiDAR scans. Compare the vehicle marker with its actual location.
Camera image	Check the camera feed, overhead features and obstructions. The image and timestamp should update. Download and Save are available when enabled in the interface.
Current Position	View planar position and heading. Values should follow vehicle motion. A displayed value alone does not confirm valid localization.
Current Speed	Check motion feedback while stationary and moving.
Mouse Position	Shows the cursor's position on the map, not the vehicle's actual position.
Language and status	Select the language at the top right. Connection, localization and task status appear at the bottom and in messages.

Device and web interface Mapping and localization run on the module. The web interface provides controls and monitoring. After mapping starts, acquisition can continue offline; reconnect to end it. For connection problems, see [Section 9.1](#).

4.2 Parameter Configuration

Wi-Fi for Wireless Access

1. Open [Parameter Config] → [On-Site Config] and expand Wi-Fi.
2. Enter the network name in [Wi-Fi Name] and the password in [Wi-Fi Password].
For a static IP address, enter yes in Static and set IP Address, Gateway and Subnet Mask. The default subnet mask is 255.255.255.0 (/24). Otherwise, keep the existing settings.
3. Select [Save], then power-cycle V2Pro.
4. Connect the computer to the same Wi-Fi network. Open WiFi_IP:9998 using the address assigned by the site network.

The screenshot shows the 'Parameter Config' web interface. At the top, there are three tabs: 'On-Site Config' (selected), 'Robot Configuration', and 'Sensor Calibration Value'. Below the tabs is a search bar labeled 'Enter Keywords To Filter'. Under the 'On-Site Config' tab, there is a 'Wi-Fi' section. This section contains several input fields: 'IP Address:', 'Gateway:', 'Static:', 'Wi-Fi Name:', 'Wi-Fi Password:', and 'Subnet Mask:'. Each input field has a corresponding 'key' button (orange) and a 'Sub-Key' button (green). To the right of the 'Wi-Fi' section, there is a 'Sub-Key' button (green) and a 'Key-Value Pair' button (blue). At the bottom right of the form, there are 'Reset' (orange) and 'Save' (green) buttons.

Wi-Fi settings: enter the network name and password.

UDP Receiver for Localization Data

1. Open [Parameter Config] → [Robot Configuration] and expand the UDP configuration.
2. Change only [portName] (receiver IP address) and [portCode] (receiver port).
3. Select [Save] → [Restart the PROG]. Wait about 30 seconds, then check that the receiver gets data.

Parameter Config

On-Site Config **Robot Configuration** Sensor Calibration Value

Enter Keywords To Filter

▼ Driver

▼ 1

Baud Rate: 115200

disThre: 1.3

initParams: 986 Restore Default

odomType: 6 Restore Default

portCode: 8987 Restore Default

portName: 192.168.100.201 Restore Default

protocol: main

▼ Laser

Reset Show Configured Show Modified Save

Set portName to the receiver IP and portCode to its listening port. For a complete example, see [Section 7.1](#).

Check the Mounting Extrinsics

1. Open [Parameter Config] → [Sensor Calibration Value].
2. Check and enter the extrinsics for the module's mounting position and orientation. Use the reference point, coordinate axes and units specified for the installation.
3. After making changes, select [Save] → [Restart the PROG]. Wait about 30 seconds, then check the settings.

Parameter Config

On-Site Config Robot Configuration **Sensor Calibration Value**

camera

Top View Camera

Camera Intrinsic File:

camera_pitch:

camera_roll:

camera_x:

camera_y:

camera_yaw:

camera_z:

cx:

cy:

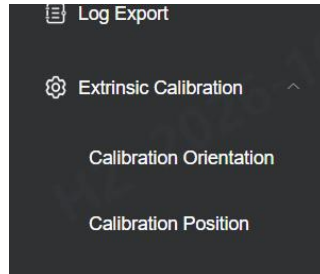
Mounting extrinsics describe the module relative to the vehicle reference point: x / y / z specify position; roll / pitch / yaw specify orientation.

Other parameters Leave LiDAR, localization algorithm, camera intrinsics and other settings as supplied.

4.3 Calibrate Orientation and Position

When to calibrate Complete this section only when wheel odometry is connected; otherwise, skip it. Wheel odometry is motion data supplied by the vehicle.

Open [Extrinsic Calibration]. Check that the module is secure and both LiDAR and wheel odometry data are available.



Orientation: Drive Straight for 3 m

This aligns the direction of motion measured by LiDAR and wheel odometry. Select [Calibration Orientation], start acquisition as prompted, drive straight and smoothly for 3 m, then save the result.

Position: Complete Two Full Rotations

This calibrates the LiDAR mounting offset relative to the odometry reference point. Select [Calibration Position], start acquisition as prompted, turn smoothly through two full revolutions, then save the result.

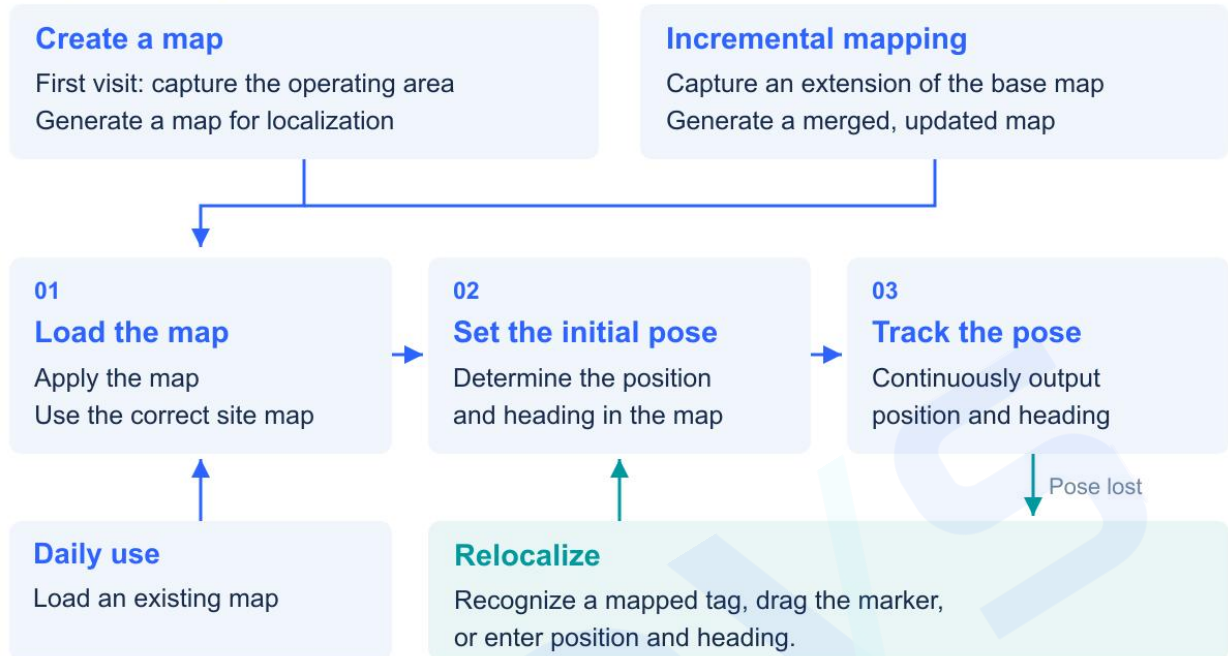
Check Restart the device program and wait about 30 seconds. Drive straight and turn; confirm that position and heading changes match the actual motion.

Repeat calibration if the mounting position, orientation or odometry reference point changes.

5 Mapping and Localization

For first use, create a map, apply it and verify localization. Apply an existing map for daily use. Use incremental mapping to extend coverage or update tag positions.

Prepare a map



A common position reference

The 2D map defines the X, Y and heading reference within the mapped area.

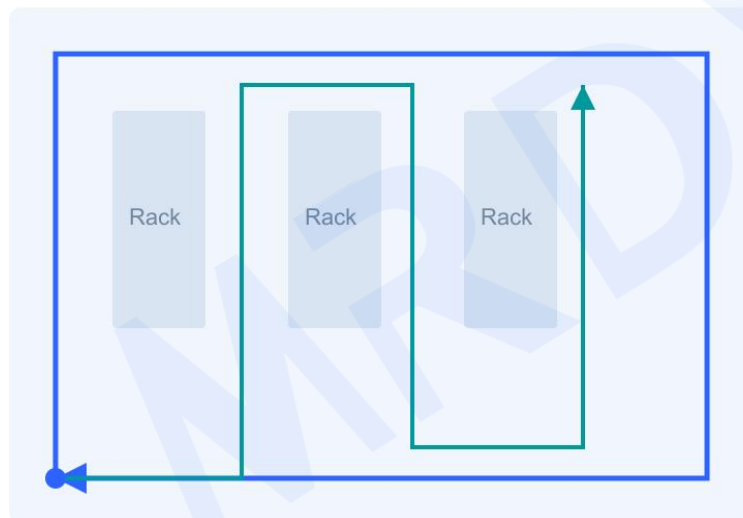
Where to start Create a map in [Section 5.2](#); apply and verify it in [Section 5.3](#); extend it in [Section 5.4](#). If the position or heading is incorrect, relocalize using [Section 5.5](#).

5.1 Plan the Mapping Route

5.1.1 Preparation and Route Coverage

Check	Requirement
Installation and configuration	Module level and secure; camera facing upward; LiDAR view clear. Settings applied. Calibration complete if wheel odometry is connected.
Power and data	Maintain power throughout. Check the camera and LiDAR data before starting. Acquisition can run offline; reconnect to end mapping.
Site	Overhead and LiDAR features must be stable. Assess long featureless sections and large slope changes before mapping.
Single-session coverage	Area $\leq 20,000 \text{ m}^2$; distance driven $\leq 2,000 \text{ m}$. Map floors and operating areas separately.
Motion limits	New and incremental mapping: speed $\leq 3 \text{ km/h}$; turning rate approximately $30^\circ/\text{s}$.
Existing maps	Before mapping, export any maps you need to retain from [Map Management] and check that the files are saved.

Route: Close the Perimeter Loop, Then Cover Internal Aisles



Blue: perimeter loop Teal: internal aisles

Follow clear aisles. Do not cross racks or obstacles.

Drive a loop around the perimeter, then make smaller loops through the interior. Cover aisles, intersections, corners and work areas. Retrace sections only where an open area extends beyond the effective range of LiDAR odometry.

Large sites Above $5,000 \text{ m}^2$, cover internal aisles section by section. Each session must stay within the area and distance limits.

01 Map the perimeter

Follow the accessible boundary.

02 Cover the interior

Capture every aisle and work area.

03 Close the loops

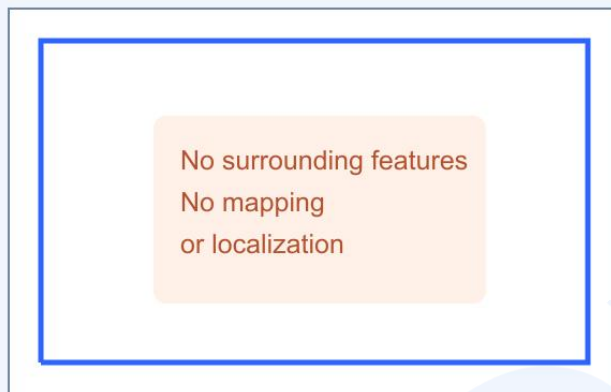
Return to a previously mapped area.

5.1.2 Open Spaces and Route Adjustments

Check Whether Localization Is Possible Along the Route

Site condition	Action
Distant walls or columns; sparse LiDAR returns	If the center has no surrounding features, mapping and localization are unavailable there. Mapping along the walls does not resolve this.
Repetitive corridor with few distinct features	Mapping and localization are not supported in 30 m corridors. Changing the route does not resolve this limitation.

Mapping along walls does not make a featureless center usable



Blue: wall route. Shaded center: featureless area.

Assess the site first

A wall route does not solve missing features in the center. Repeated passes cannot create features.

30 m corridors are not supported.

1. Inspect LiDAR returns and the camera image along the planned route. Identify sections with insufficient features.
2. Where the center has no surrounding features, mapping and localization are unavailable. Driving along the walls or repeatedly across the center cannot resolve this.
3. Retrace a section only when usable features exist but part of the route exceeds the effective LiDAR odometry range. Stop and investigate any map distortion, misalignment or ghosting.
4. Plan tag locations in areas prone to losing localization, such as open spaces and ramps. Install them before mapping.

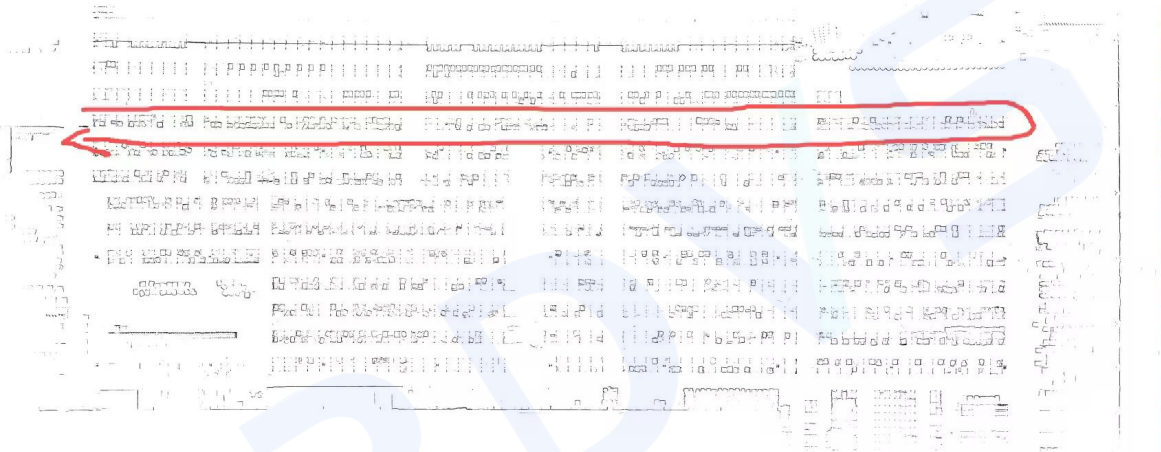
Corridor limitation Mapping and localization are not supported in 30 m corridors. Detours or tags cannot resolve the lack of distinct features in a repetitive corridor.

Route Examples

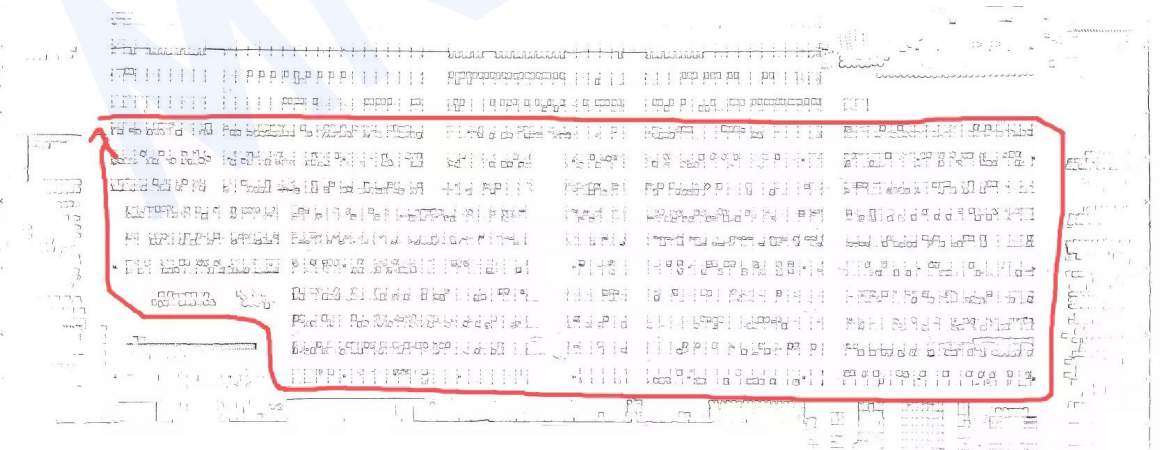
Unsuitable corridor: the map bends. Repetitive structures and insufficient features cannot be corrected simply by driving a loop.



Suitable route: form a loop through the operating aisles. This example shows aisle coverage; it does not require every aisle to be driven twice.



Suitable route: close the perimeter loop, then cover internal aisles. A central area with no surrounding features still cannot support mapping or localization.



5.1.3 Tag Locations and Sizes

Tag Placement at Frequently Used Locations

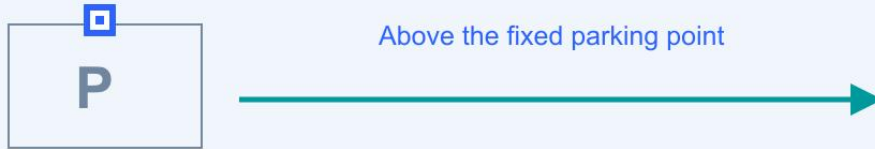
■ Tag location

→ Direction of travel

Not to scale

01 Frequent power-on / power-off points

Place the tag where it is visible while parked, before the vehicle moves.



02 Work areas requiring high accuracy

Place the tag on the approach so the vehicle corrects its pose before work.



03 Frequently used intersections

Use one tag per intersection, visible from the usual approach directions.



Only one tag in view at a time. Use a different ID at each location.

Areas Prone to Losing Localization

■ Tag location

Not to scale

04 Ramps

Place tags on level ground near the ramp entrance and exit.



05 Open spaces

Use fixed structures at entrances, exits and along the usual routes.



06 Frequently changing surroundings

Mount on structures that do not move with goods, racks or equipment.



07 Outdoor / indoor transitions

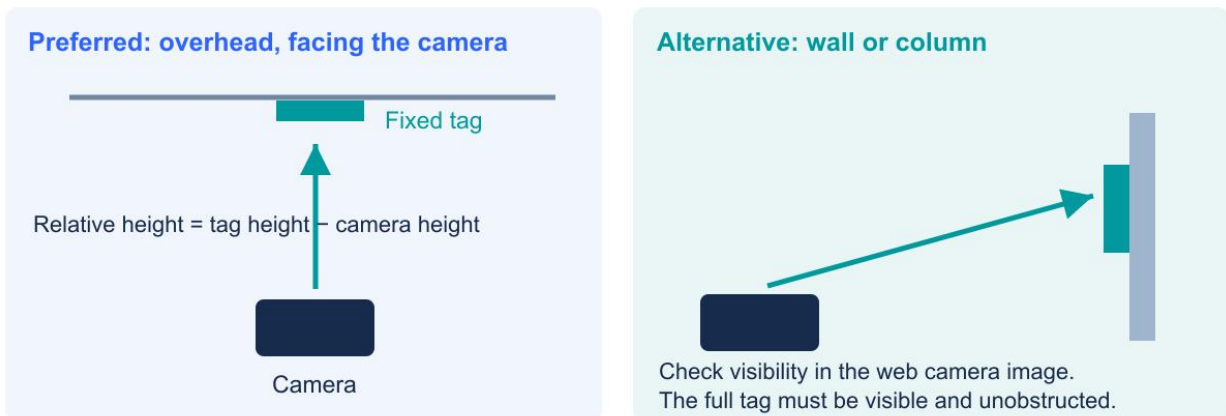
Mount at the transition or indoor entrance, fully visible as the vehicle passes.



Check the camera image along the route: complete tag, no obstruction, only one tag in view.

Choose a Tag Size and Install It

[Download official tag artwork · V2Pro_QRcode_tags.zip](#)



1. Download the official AprilTag 36H11 artwork. Do not generate your own tags.
2. Select the size and ID range for the height difference between the camera and tag.

Relative height	Black square side	Side including border	Available IDs
<3 m	30 cm	37.5 cm	000–099
4 m	40 cm	50 cm	100–199
5 m	50 cm	62.5 cm	200–299
6 m	60 cm	75 cm	300–399
7 m	70 cm	87.5 cm	400–499
>8 m	80 cm	100 cm	500–587

These heights follow the official sizing table. For intermediate or boundary heights, confirm the size and test recognition on site.

3. Use a toner-based laser printer. Do not use an inkjet printer.

Print at the original size with the full white border. Use a matte, non-reflective surface.

4. After mounting, inspect the [top-view image] along the route. The entire tag must be visible and unobstructed. Adjust wall or column tags if the camera cannot see the complete tag.

Spacing and IDs Use one tag per intersection. Two tags must not appear in the camera view at the same time. Never use the same ID at different positions in one map. Do not resize the artwork.

5.1.4 How Tags Are Recorded and Updated

Keep tags fixed after mapping Moving a tag makes its physical location differ from the map record and affects localization.

01 Install tags

Keep each tag fixed.
Use a unique ID at each location.

02 Record tags

Mapping records the ID
and position automatically.

03 Verify

Apply the map and restart.
Wait about 30 s, then verify.

Incremental mapping: the last observed position is retained

Seen again → update

The latest observed position
replaces the previous record.

Not seen again → retain

Removing a physical tag
does not delete its map record.

When a Tag Needs to Change

Change	Action
Add a tag	Recognize it during incremental mapping. Generate and apply the resulting map, then verify localization.
Move a tag	Stop using the affected map. Recognize the tag at its new position during incremental mapping, generate and apply the result, then verify localization.
Remove a tag	Its record remains in the map. Contact technical support if the record needs to be deleted.
Replace a damaged tag	Use the same ID and size, at exactly the same position and orientation. Verify localization afterward.

Speed and recognition During new or incremental mapping, pass tags at ≤ 3 km/h. During normal localization, pass at < 8 km/h. Recognition distance: ≤ 10 m.

5.2 Create a Map

1 Open Start Mapping

Expand [Mapping] and select [Start Mapping].



The Mapping menu contains Start Mapping and Start Incremental Mapping.

2 Enter a Map Name

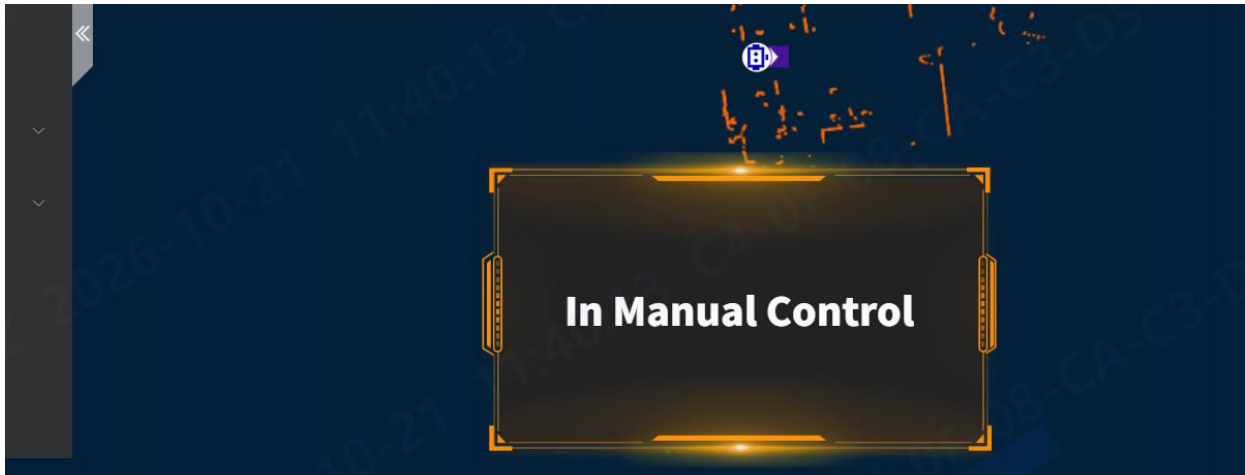
Enter a recognizable name and select [Confirm]. Use letters, numbers or underscores, beginning with a letter; for example, Warehouse_A.

The screenshot shows a 'Start Mapping' dialog box. It has a title bar with a close button (X). Inside, it says 'New Map Name' above a text input field. The input field contains the text 'New_Map'. At the bottom right, there are two buttons: 'Cancel' and 'Confirm'.

Before starting Check the route and tags. Export any maps you need to retain from [Map Management] and confirm that the backup is saved.

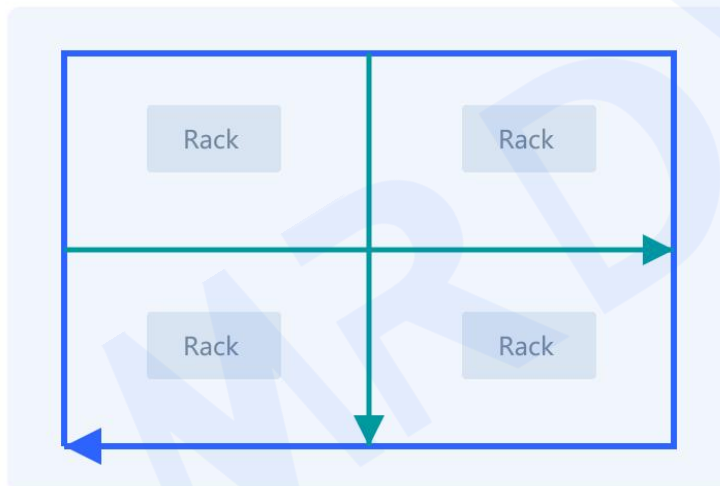
3 Start Acquisition and Drive the Route

When the start operation succeeds and “In Manual Control” appears, drive the perimeter loop, then cover the internal aisles with smaller loops.



Once mapping starts, you may disconnect the network or computer. Acquisition continues on the device. Keep power connected throughout.

Route: perimeter loop → smaller internal loops



Blue: perimeter Teal: internal aisles

Follow clear aisles. Slow down at turns and intersections.

01 Close the perimeter loop

Follow the accessible boundary.
Return to a mapped section.

02 Make smaller loops

Cover aisles, intersections and
work areas throughout the site.

Retrace only in open areas



Only where usable features exist
but LiDAR odometry range is exceeded.

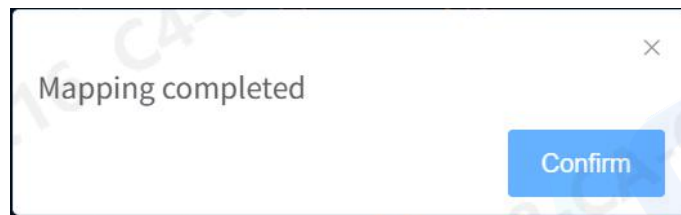
During acquisition Speed ≤ 3 km/h; turning rate approximately $30^\circ/\text{s}$. Slow down for turns and keep sensor views clear. If online monitoring shows stalled data or obvious drift, stop and investigate.

4 Stop the Vehicle and End Acquisition

After completing the route, stop the vehicle and reconnect to the web interface if needed. Check the following, then select [End Mapping].

Before ending	Confirm
Coverage	All required aisles, intersections and work areas have been captured.
Loop closure	The perimeter forms a loop; internal areas form smaller loops where practical.
Data	Acquisition was continuous. Any obstruction, stalled data or obvious drift has been resolved.

5 Wait for the Map to Finish



When “Mapping completed” appears, select [Confirm]. Open [Map Management] and check the new map’s name and preview.

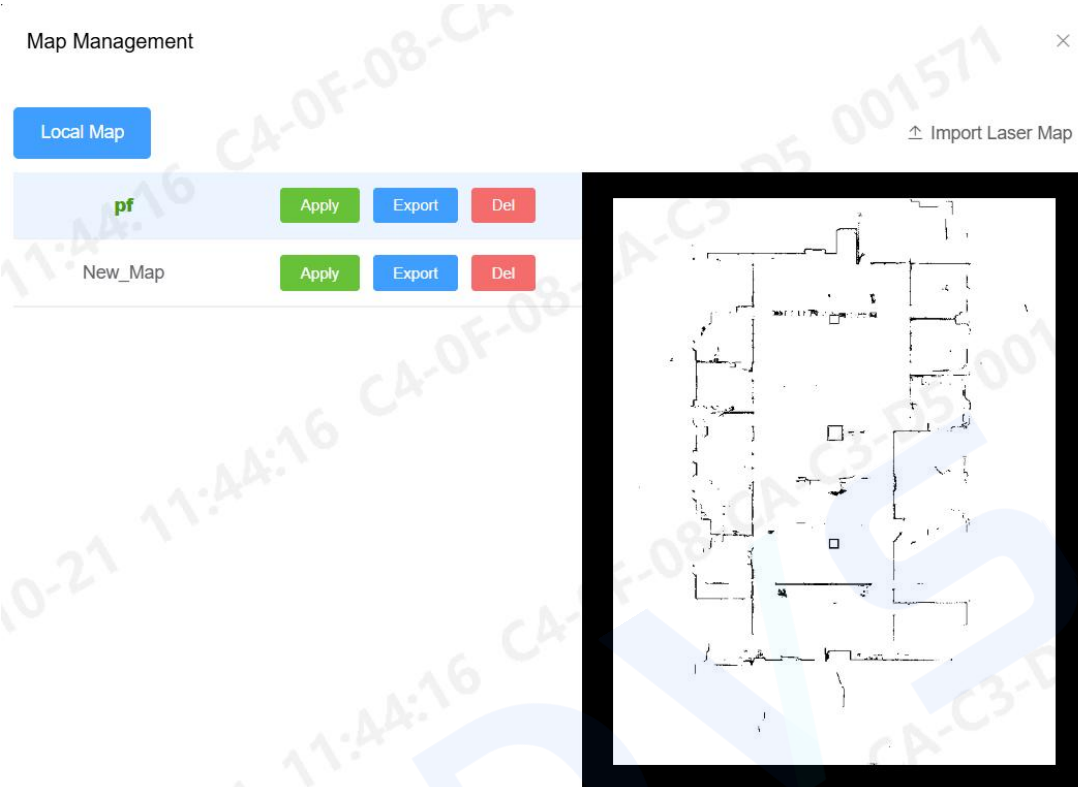
During generation Keep the device powered and its program running until “Mapping completed” appears.

Next Step

Apply the map and verify localization as described in [Section 5.3](#).

5.3 Apply and Verify the Map

1. Open [Map Management]. Check the new map's name and preview for complete coverage, misalignment and ghosting.



2. Select [Apply] for the map, then [Restart the PROG]. Wait about 30 seconds and reconnect to the web interface.
3. After the new map loads, use [Relocate] as described in [Section 5.5](#). Then check that the displayed position and heading match the vehicle.
4. Drive slowly along the operating route, including turns, intersections and key work areas.

Completion criteria The marker has the correct position and heading and follows vehicle motion. Localization is valid and receiver data update continuously. See [Section 5.6](#) for the checks.

5.4 Incremental Mapping

Incremental mapping adds or updates areas in an existing map to extend coverage or update tag positions. The existing map is the “base map.” Use the latest result as the base for each new session.

Back up before mapping Export the base map from [Map Management] and confirm that the file is saved. If you manually apply the base map, restart the program and wait about 30 seconds. Check position and heading before starting.

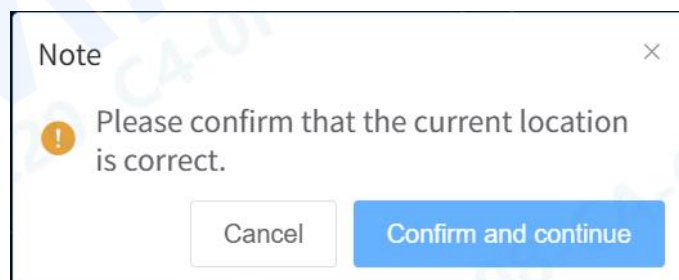
1 Select Start Incremental Mapping

Expand [Mapping] and select [Start Incremental Mapping].



2 Confirm the Current Pose

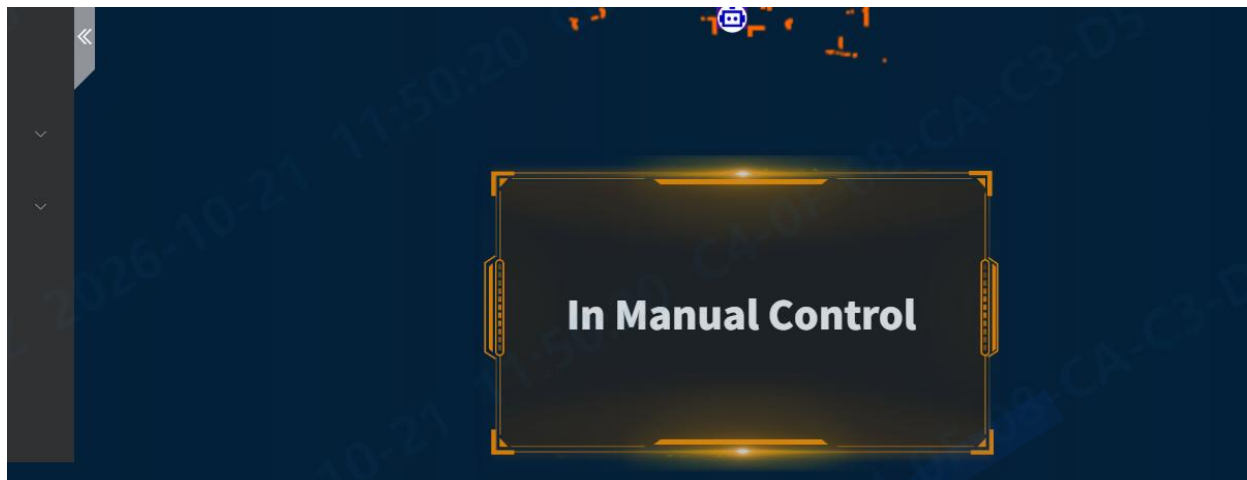
Check that the vehicle’s position and heading on the map match its actual pose. Select [Confirm and continue].



Tag check Install new tags before starting. Never reuse an ID at different positions in one map. Existing tags not seen again remain recorded in the map.

3 Start Acquisition and Cover the New Area

Start from a correctly localized position in the existing map. Re-enter the mapped area as often as practical during acquisition. You may disconnect the network or computer; keep the device powered throughout.



Incremental route: base map → new area → base map



Start and finish in the existing map; re-enter it as often as practical.

Form loops in the new area and cover all required aisles. Do not cross obstacles.

During acquisition Speed ≤ 3 km/h; turning rate approximately $30^\circ/\text{s}$; added area $\leq 5,000$ m² per session. To abandon the session, stop, select [Cancel Mapping] and confirm.

4 End Acquisition and Generate the Map

Return to the base-map area and stop. Reconnect to the web interface, select [End Mapping], and wait for “Mapping completed”.

5 Apply the Result and Restart

Apply the resulting map in [Map Management]. Restart the device program, wait about 30 seconds, then reconnect. Once the new map loads, relocalize using [Section 5.5](#).

6 Verify and Back Up

Area to check	Confirm
New area	Coverage is complete, with no obvious misalignment or ghosting in aisles and outlines.
Connection to the base map	Drive across the overlap in both directions. Position and heading remain continuous and match the vehicle.
Existing work areas	Localization still works at the original key locations.
Tags	IDs and mounting locations are correct. Tags are recognized and localization works as the vehicle passes.

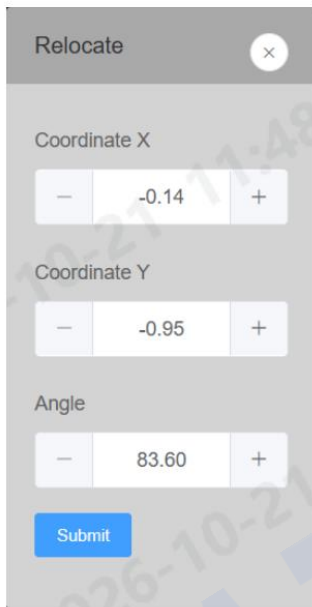
Export a backup after all checks pass. For another extension, use this result as the next base map.

Tag position updates If an existing ID is recognized again, its record is updated to the last position observed during the session. Keep tags fixed after the map is generated.

5.5 Manual Relocalization

If the position is unknown or the heading is incorrect, first check the active map. After a manual map change, restart the device program and wait about 30 seconds.

1. With the vehicle stationary, open [Relocate].
2. Set the position: drag the vehicle marker with the left mouse button, or enter [Coordinate X] and [Coordinate Y].
3. Set the heading: hold the right mouse button in the map and drag left or right to rotate the marker. Alternatively, enter [Angle] in degrees and fine-tune with [+] or [-].
4. Check the position and heading, then select [Submit]. Wait for processing to finish and compare the resulting pose with the vehicle.




Set position, then heading. Select Submit when correct.

While adjusting the pose, compare live LiDAR returns with mapped walls and columns to identify the correct aisle and heading.

After submission Verify the result using [Section 5.6](#).

5.6 Verify Relocalization

Use the vehicle's actual position and heading to judge the result; the success message is only a guide. Start at a known location, then drive straight and turn slowly. Check the results below.

Check	Method and pass criteria
Position	Compare with the site: the marker is in the vehicle's actual aisle or work area.
Heading	The marker faces the same direction as the vehicle, with no reversal.
Motion	Drive straight and turn slowly. Position and heading follow vehicle motion; live LiDAR returns correspond to mapped walls and columns.
Output	Confirm valid localization and advancing timestamps at the receiver before resuming use.

Incorrect pose Check the map, initial position and heading, then sensor images and environmental features. Save the error messages and logs.

5.7 Daily Checks



Before Each Shift

1. Check the lens, LiDAR window, mount and cables. Tags must not be moved, covered or damaged.
2. Connect to the web interface and check the active map. Confirm that the camera and LiDAR data update.
3. If the pose is unknown or incorrect, let the camera see a complete mapped tag, or use [Relocate] to set the actual position and heading.
4. Check position, heading and motion as described in [Section 5.6](#).
5. Confirm that the receiver gets valid, current data continuously before starting work.

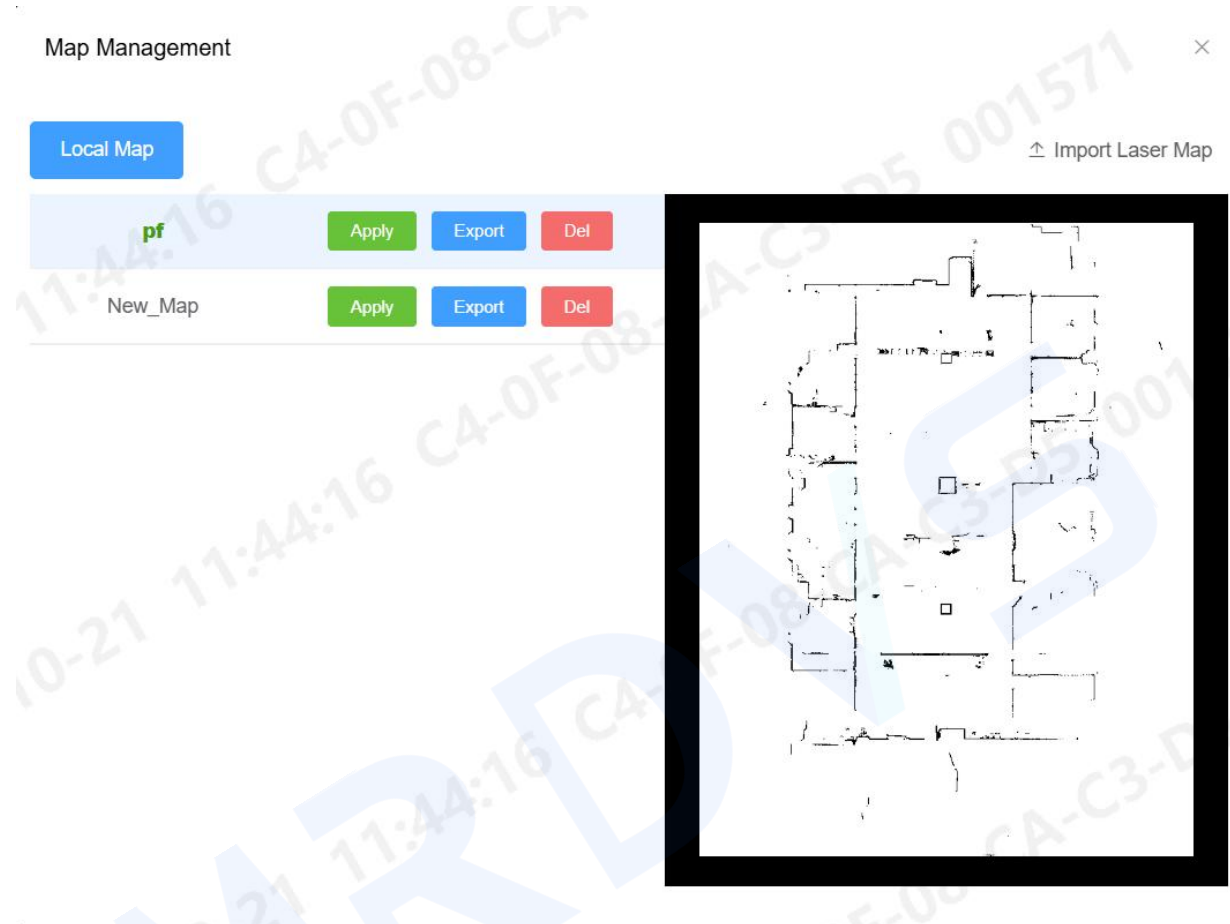
Automatic map switching Recognize a complete mapped tag → The device switches to the corresponding map and relocalizes → Check the map, position and heading. No manual program restart is needed.

Tag changes Before moving, removing or replacing a tag, follow [Section 5.1.4](#) to handle its map record.

6 Map Management

6.1 Apply and Back Up Maps

Open [Map Management]. Maps stored on the device appear on the left, with a preview on the right. Each map has [Apply], [Export] and [Del] controls.



Export a Backup

1. Select the map and check its name and preview.
2. Select [Export] and save the file when prompted by the browser.
3. Check that the file is saved. Record the map name, site area, software version and installation conditions used during mapping.

Apply an Existing Map

1. Select the map for the current area. Check its name and preview, then select [Apply].
2. Select [Restart the PROG], wait about 30 seconds, and reconnect.
3. Verify localization using [Section 5.6](#). If the position or heading is incorrect, relocalize using [Section 5.5](#) first.

Floors and maps Use the map for the vehicle's current floor and area. For automatic tag-triggered switching, see [Section 5.7](#).

6.2 Import, Delete and Reuse Maps

Import a LiDAR Map

1. Select [Import Laser Map] at the top right of [Map Management].
2. Choose a LiDAR map file in a format supported by the current software. Follow the prompts to import it.
3. Check the imported map and preview, then apply it and verify localization as described in [Section 6.1](#).

File requirements Import only supported LiDAR map files. Do not upload arbitrary images or a complete visual-map backup.

Delete a Map

1. Check the map name and area, and confirm that the map is no longer needed.
2. Export and check a backup first. Then select [Del] for that map and follow the prompts.
3. Refresh or reopen the list to confirm deletion. Check that the correct map is active before continuing.

Map Reuse Records

Record the map source, mounting height and orientation, site area, software version and validation route. On each additional vehicle, check position and heading and verify the route.

7 Communication Setup and Examples

Network interfaces include HTTP, MQTT, UDP and ROS 1 / ROS 2. CAN and digital I/O are also available. Select the interface required for your installation, configure the receiver, and verify the data.

Protocols and examples on GitHub: github.com/Lanxin-MRDVS/V2Pro-Kit

Data category	Integration content
Control inputs	Mapping and map commands, map names, and initial position and heading for relocalization.
Optional motion inputs	Vehicle speed, pose, wheel speed, displacement, steering angle and timestamps. Select the data type that matches the vehicle.
Localization outputs	Planar position, heading, pose timestamp and localization status.
Map and device information	Current map name and device identifier to identify the data source.
Task and fault feedback	Mapping status and progress, service responses and error information.

Before Using Pose Data

1. Check the device identifier and active map.
2. Confirm that localization is valid.
3. Check that pose timestamps advance and the data meet the vehicle's freshness requirements.
4. Read X, Y and heading. Apply the units, coordinate conventions and encoding specified by the protocol.

Do not use stale data An interface may still return an old position when localization is invalid. Check both validity and timestamp before use.

Command Acceptance and Task Completion

A successful command response confirms receipt, not completion. Wait for the task to finish and check the map or localization result. Use the supplied protocol for message formats and timeout handling.

7.1 UDP Receiver Example

This example sends V2Pro localization data to a computer. The device uses its factory IP address; the receiver address and port are examples.

Device	Example settings
V2Pro	IP: 192.168.100.201
Receiving computer	IP: 192.168.100.250; UDP listening port: 9000

1 Set the Receiver

Open [Parameter Config] → [Robot Configuration] and select the UDP protocol used for your installation.

Parameter	Example value
portName	192.168.100.250 (receiver IP)
portCode	9000 (receiver listening port)

2 Save and Restart

Save the settings and select [Restart the PROG]. Wait about 30 seconds, reconnect, and check the map and localization.

3 Receive and Check Data

Start a UDP receiver on the computer and listen on port 9000. After successful relocalization, check that localization messages arrive continuously.

Pose field	Interpretation
X, Y	Read as 32-bit integers in mm, as specified by the protocol.
Theta	Read as a 32-bit integer in units of 0.001 rad.
Timestamp	Check that it advances. Do not use cached messages.

Use the correct port portCode is the receiver's listening port. Commands sent to V2Pro use device port 8001.

[Full message format: V2 Pro UDP Communication Protocol](#)

7.2 MQTT Subscription Example

This example subscribes to the device's pose. Obtain the MQTT broker address and credentials for your installation first.

1 Connect to the Broker

Open your MQTT client, enter the connection details below, and connect.

Setting	Value
Server and port	Broker address and port supplied for the installation.
Username and password	Authentication credentials supplied for the installation.

2 Subscribe to the Device Pose

The example uses the topic prefix hontai/v1/robots and device ID robot-001. Replace these with the values configured for your installation.

Topic hontai/v1/robots/robot-001/telemetry/pose

3 Check the Received Data

Field (example value)	Check
map_name: factory-a	Matches the active operating map.
localized: true	Use position and heading only when localization is valid.
timestamp_ms	Timestamp continues to advance.
x: 1.235; y: -0.42	Position in m.
theta: 1.5708	Heading in rad; approximately 90° in this example.

This table shows selected message fields. Field names match the protocol.

The first message may be old The pose topic may deliver a retained message. Confirm advancing timestamps, valid localization and the correct map before using the data.

[Full topics and messages: V2 Pro MQTT Communication Protocol](#)

7.3 HTTP Interface

Use HTTP to query versions, the active map and pose, or to control mapping, map management and relocalization. Refer to the GitHub protocol for request parameters and the complete interface.

Connect and Query

1. Check network connectivity to the device. Use its actual IP address and port 9998.
2. Call the interface as specified by the protocol. Check the returned code and data.

Function	Interface path
Query versions	/tool/rob/getRobotVersion
Query active map	/tool/rob/getVehicle
Query pose	/tool/rob/getPose
Start / end mapping	/tool/rob/startMapping /tool/rob/stopMapping
Switch map	/tool/rob/changeCurrentRunMap

Example Pose Query URL

<http://192.168.100.201:9998/tool/rob/getPose>

In the returned pose, x and y represent planar position and yaw represents heading. Interpret the response according to the supplied protocol and check localization validity and the actual position before use.

After manually switching maps through HTTP, restart the device program and wait about 30 seconds. Then check the active map and position.

[Complete HTTP interface and parameters · GitHub](#)

7.4 CAN and Digital I/O

Use these interfaces to connect to a vehicle controller or site control system. CAN exchanges data; digital I/O carries discrete signals. Configure their functions according to the supplied protocol.

CAN · CN7

Item	Specification
Connections	CAN_H, CAN_L and GND.
Protocol and bit rate	CANopen; default 250 kbit/s, adjustable.
Integration documents	Use the supplied CAN protocol to confirm node settings, the object dictionary and data definitions.

1. Wire with power off. Check CAN_H, CAN_L and GND.
2. Configure both ends according to the supplied protocol and use the same bit rate.
3. Power on and verify communication and received data.

Digital I/O · CN8

Signal	Electrical rating
2 inputs	5–24 V, active high.
2 outputs	Push-pull, 24 V / 100 mA.

1. Check channel assignments, signal direction and levels against the supplied wiring diagram.
2. Test each channel against the assigned I/O function. Confirm correct triggering and feedback.

Refer to the supplied documents for the CAN object dictionary, messages and I/O function mapping. Electrical ratings alone do not define control functions.

[Development resources and protocols · GitHub](#)

8 Validate the Installation

Test on the actual vehicle in this order: stationary → straight travel → turns → full route. Pass each stage before proceeding.

Test	Checks and records
Stationary	At a known location, record coordinates, heading, validity and timestamps. Confirm continuous output updates.
Straight travel	Move in a known direction. Check the direction and distance of position changes for reversed coordinate axes.
Turns and intersections	Heading changes match actual turns, with no obvious jumps or persistent offset at key corners.
Full operating route	Cover aisles, loading points, mast and load obstruction conditions, and assessed complex sections.
Relocalization	Relocalize on the correct map. Check actual position and heading and fresh, valid output at the receiver. A success message alone is not sufficient.
Communication recovery	After reconnecting, confirm fresh data at the receiver before resuming operation.
Additional vehicles or map changes	Check each vehicle's mounting conditions, the connection between old and new areas, and existing key work areas.

Records to Keep

Keep these records for commissioning and future checks:

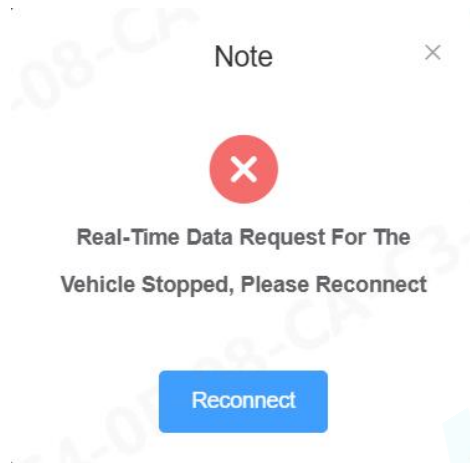
Category	Records
Device and installation	Device identifier, versions, installation photos, dimensions and extrinsic parameters.
Maps and settings	Map files and names, network settings and communication settings.
Validation	Test route, key-point results, fault times and corresponding logs.

Reference performance The white paper specifies position error of 1–3 cm, heading accuracy of $\pm 1^\circ$, and a valid pose output rate of 20 Hz. These depend on the specified installation, environment, mapping and motion conditions. Do not use the web refresh rate to measure the interface output rate.

9 Troubleshooting and Technical Support

Troubleshooting order Restore the connection, then check the map and localization. If the problem persists, export logs and contact support as described in [Section 9.3](#).

9.1 Connection and Display Problems



1. Refresh the page when a disconnection message appears.
2. If it still cannot connect, check Ethernet or Wi-Fi, the IP address and subnet, and device power.
3. Restore the network connection, then select [Reconnect]. If the device IP changed, use the new address.
4. Check that the camera image, status and position data update. Confirm valid localization and the actual pose.

Symptom	Checks
Web page will not open	Check Device_IP:9998, the network connection, actual IP, computer subnet and port access.
Display is frozen	Check connection messages and the camera timestamp. Confirm data resume updating after reconnection.
Coordinates are zero or unchanged after reconnecting	Do not assume zero or old values are the actual position. Check the device program, sensor inputs and localization status.
Communication works but the pose is incorrect	Check the active map and actual position. Relocalize and verify if needed.

After reconnecting Confirm that new, valid localization results are arriving before resuming use.

9.2 Mapping and Localization Problems

Check sensor inputs first, then the map and initial pose, followed by installation and site conditions. Keep other algorithm parameters as supplied.

Symptom	Checks and action
Camera image is black or overexposed	Check camera connection, lens, obstructions, overhead lighting and visible features. Save the image and logs.
LiDAR display is missing or abnormal	Check LiDAR connection, field of view, model and network settings. Confirm that the mount and orientation have not changed.
Map generation has not finished	Acquisition and map generation are separate stages. Check progress and the completion message. Record task time and logs if progress stalls.
Map is misaligned or has ghosting	Check smooth motion, continuous coverage, suitable site layout and features, installation, and wheel-odometry extrinsics.
Relocalization fails or gives the wrong position	Check the map, then initial position and heading, environmental features and mapped tags.
Large offset during turns	Check the mount, wheel slip and obstructions. If wheel odometry is connected, recheck orientation and position calibration.
Unstable after changing vehicles or mounting height	Check map reuse conditions, height difference and visible features. Remap if needed.
Coordinates are present but unusable by the vehicle	Check validity, timestamps, units, coordinate frame and map identifier. Rule out cached data.

After Recovery

1. Confirm continuous updates from sensor images and motion data.
2. At a known location, check the map, position and heading.
3. Drive straight for a short distance and turn. Confirm fresh, valid results at the vehicle receiver.
4. Resume operation and keep a record of the fault and repair.

9.3 Export Logs and Contact Support

Record the problem Note the fault time, save screenshots and record the preceding steps.

Open [Log Export] and save the logs as follows.

The screenshot shows a web interface for exporting logs. At the top, there's a 'Log' header with a close button. Below it are filters: 'Type of fault' (dropdown), 'Module' (input), a 'Search' button, a time range selector (10-21 10:32 To 10-21 11:32), and 'Export' and 'Del' buttons. The main part is a table with 4 columns: 'Serial number', 'Category', 'Module', and 'Log File'. The table contains 7 rows of log entries. Row 4 is highlighted, indicating it is selected. The 'Log File' column lists files like laser.log, camera.log, driver.log, Platform.log, localization.log, slam.log, and loc_master.log.

Serial number	Category	Module	Log File
1	Driver	Laser Driver	laser.log
2	Driver	Standard Camera Driver	camera.log
3	Driver	Chassis Serial Driver	driver.log
4	Main Program	Main Body Process	Platform.log
5	Main Program	Positioning	localization.log
6	Main Program	Laser Mapping	slam.log
7	Main Program		loc_master.log

1. Select a time range covering the fault. Filter by fault type or module if needed.
2. Select the relevant logs, choose [Export], and check the saved file.
3. Send support the logs, fault time, device identifier, map name, versions, screenshots and steps taken.

Which Logs to Include

Problem area	Recommended logs
All log packages	Contain version.log, which records version updates.
Inputs or drivers	laser.log and camera.log; include driver.log when vehicle data are connected.
Device program and localization	Platform.log, localization.log and loc_master.log.
Mapping	slam.log, plus the related device program and localization logs.

Export before clearing Check that the exported files are usable before deleting logs. Keep logs from related modules for the same period around the fault.

10 Maintenance and Updates

10.1 Routine Maintenance and Changes

Item	Action and checks
Lens and LiDAR window	Inspect for contamination, obstructions and damage. Clean according to the equipment instructions, then check the camera and LiDAR display.
Mount and cables	Check supports, fasteners, connectors and cable bends for looseness, tension or wear.
Environment	Check temperature, condensation, strong light and new obstructions. Operating temperature: -20 to 60 °C. Ingress protection: IP54.
Maps and settings	Keep recoverable map backups and configuration records. Reassess maps after major site changes.
RTC battery	Maintains the clock when power is off. Soldered in place; not user-removable or user-replaceable.

After a Change

Change	Required checks
Module moved or reoriented	Check mounting parameters. With wheel odometry, repeat the relevant extrinsic calibration. Verify the map and localization.
Network or vehicle communication settings changed	Save, restart the program and wait about 30 seconds. Power-cycle for Wi-Fi changes. Reconnect and check sensor inputs and receiver data.
Different vehicle or reused map	Check mounting height, field of view and extrinsics. Verify each vehicle's pose and route.
Site changed or operating area expanded	Assess map updates or extensions. Validate overlap areas and all key work locations.
Program updated or restored	Record the new version. Recheck settings, maps, sensors, communication and relocalization.

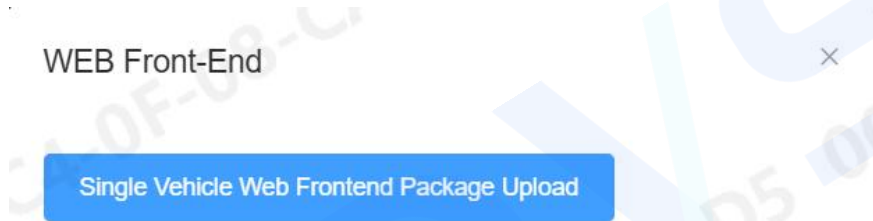
Records Keep the changes and validation results. Do not resume automatic operation using localization data until normal operation is confirmed.

10.2 Software Updates and Program Control

Open [Software Upgrade] for [Firmware Update] and [WEB Front-End]. Before updating, record versions and back up required maps and settings. Use a supplied package compatible with the device and installed version.



1. Open [Software Upgrade] → [Firmware Update]. Select [View Package (Local)] to check the package, then follow the prompts for the installed version.
2. Before using [Restore Package], confirm the target package and compatible version. Follow the supplied restoration instructions.
3. Reconnect, check [Version Info], and verify sensors, maps and localization.



1. Open [Software Upgrade] → [WEB Front-End]. Select [Single Vehicle Web Frontend Package Upload].
2. Choose a compatible front-end package and follow the upload prompts.
3. Reopen the web interface and check its version and main functions.

Restore scope Check the supplied instructions for the items restored by [Restore Package].

Stop or Restart the Device Program

Before connecting camera software to the camera, stop the device program to release it. Restart the program when finished.

1. Stop the vehicle, pause operation, and save the required maps and settings.
2. Select [Close the PROG] or [Restart the PROG] and respond to the confirmation prompt.
3. After restarting, wait about 30 seconds. Reconnect and check the map, sensor inputs and localization.

Revision History and Support

Version	Date	Changes
V0.1	2026-10-10	Initial release: installation, connections, configuration, wheel-odometry extrinsic calibration, mapping, localization, maps, communication checks, troubleshooting and maintenance. Includes incremental mapping, pose verification and acquisition checks.

Technical Support

Zhejiang MRDVS Technology Co., Ltd.

Email: service@mrdvs.com

Website: www.mrdvs.com

Knowledge base: hub.mrdvs.cn

Support information Logs + fault time and screenshots + device and version details + steps taken

For log export instructions, see [Section 9.3](#). Describe what happened before the fault and whether it can be reproduced.



Scan to open the MRDVS knowledge base