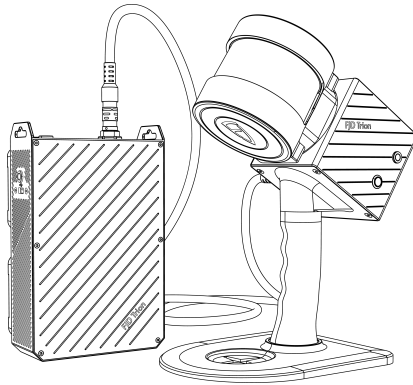




FJD Trion S1 3D LiDAR Scanner

User Manual



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Preface

Thank you for purchasing this FJD Trion S1 3D LiDAR Scanner. Before use, ensure that you have read this manual carefully and followed the instructions herein to better understand and operate the product.

Technical Support

Starting from the date of purchase, users will be provided with the technical support and upgrade services from FJD.

Contact FJD by any of the following methods:

Tel: +1 833-330-6660 (Global)

Tel: +49 6931 090130 (Europe)

Official website: <https://www.fjdynamics.com>



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1 Introduction

1.1 Overview

FJD Trion S1 3D LiDAR Scanner (S1) can acquire and process 3D point cloud data in real time through a high-performance Light Detection and Ranging (LiDAR) sensor. S1 can achieve great performance for both indoor and outdoor use without GNSS receivers. Powered by leading Simultaneous Localization and Mapping (SLAM) algorithm, S1 can also capture, process and display point cloud data on the mobile terminal in real time. A smart battery system where two hot-swappable batteries work in turns enables S1 to work continuously.

Features:

1. High accuracy
2. Dual batteries for redundant power supply
3. Indoor and outdoor scan
4. Large-scale scenario performance guarantee
5. Real-time processing
6. Real-time display of point cloud

1.2 Specifications

Range	120 m
Laser Wavelength	905 nm
Laser Class	Class 1 Eye Safe
FOV	360°×270°
Ingress Protection	IP54
Processing	Real-time
Display	Real-time preview on a mobile terminal
Battery System	Remov able, hot-swappable, dual battery system
Carrier of Data Logger	Backpack or shoulder strap
Scanner Weight	1.8 kg
Data Logger Weight (incl. single battery)	2.2 kg



Points per Second	320,000
No. of Sensors	16
Vertical Angular Resolution	2°
Horizontal Angular Resolution	0.36°
Accuracy	0.8 cm - 2 cm
Operating Temperature	-10°C - +50°C
Storage Capacity	512 GB
Power Supply	14.8 V DC
Battery Life (dual batteries)	4 h

1.3 Working Principle

S1 consists of the multi-line LiDAR and the Inertial Measurement Unit (IMU). It broadens the Field of View (FOV) by rotating the LiDAR.

Using the SLAM algorithm, S1 integrates the data from LiDAR and IMU to generate accurate 3D point clouds without GNSS receivers.

S1 measures the distance based on the Time of Flight (ToF) principle.

1. A laser diode emits a beam of ultrashort laser pulses onto the target object.
2. The laser pulses are reflected after hitting the target object. The returning beam is detected by an optical sensor.
3. Distance to the object can be accurately calculated based on the time the laser beam travels.




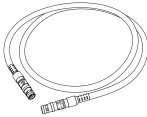
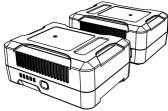
$$d = \frac{ct}{2}$$

d:distance;c:speed of light;t:travel time of the laser beam.



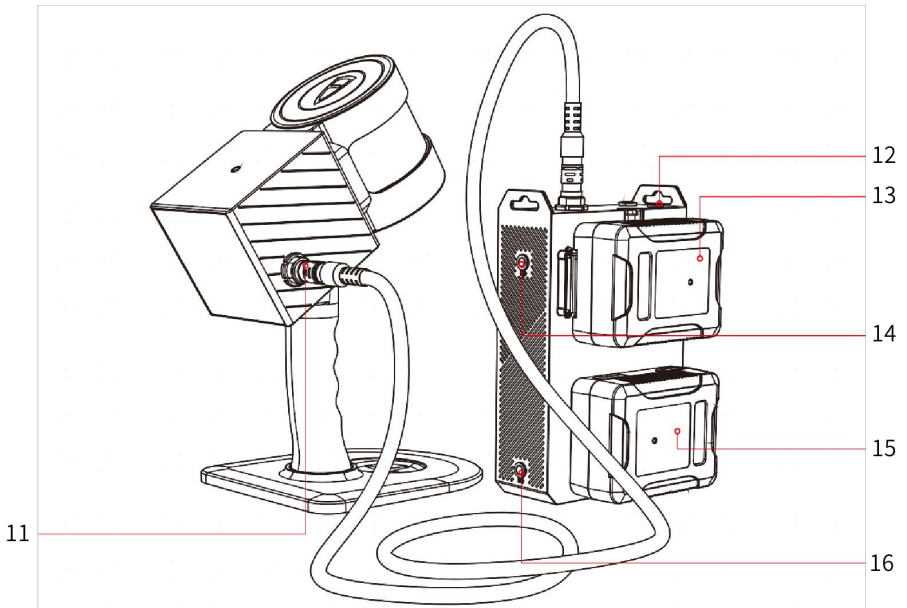
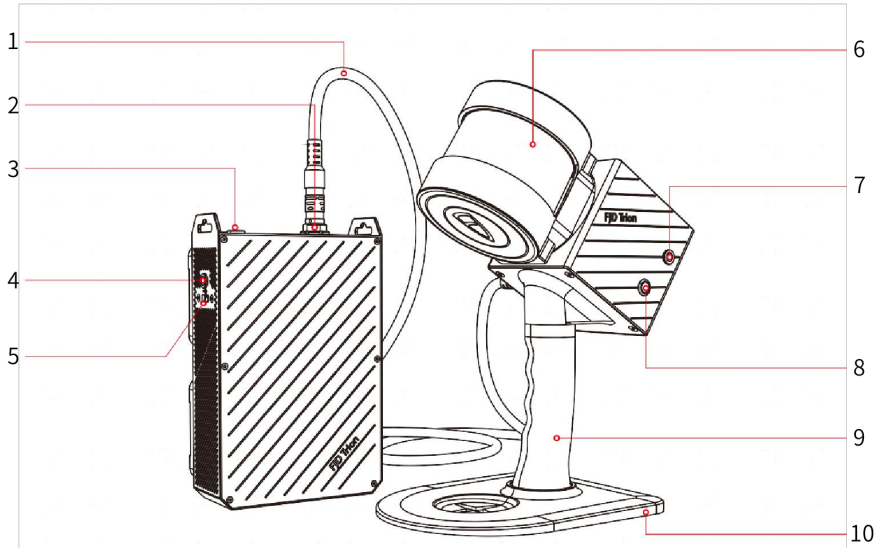
1.4 List of Components

1.4.1 Main Components

No.	Name	Quantity	Illustration	Function
1	Scanner	1		Handheld LiDAR.
2	Data Logger	1		Data collecting device.
3	Base Plate	1		Fix the scanner on it.
4	Connecting Cable	1		Connect the scanner and the data logger.
5	Battery	2		Power supply.



1.4.2 Component Details





No.	Name	No.	Name
1	Connecting Cable	9	Handle
2	Data Logger Port	10	Base Plate
3	Power Button (with indicator)	11	Scanner Port
4	USB Indicator	12	DC Port
5	USB Port	13	Battery 01
6	LiDAR	14	Indicator for Battery 01
7	Scanner Status Indicator	15	Battery 02
8	Scanner Button	16	Indicator for Battery 02

!	Note: Above is the general configuration of S1 and only serves as a reference. The actual product may vary.
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2 Safety Instructions

1. To prevent device damage caused by misoperation, S1 can only be used by trained users. Do not operate the device with suspicious defects or obvious mechanical damage.
2. Use the components or accessories that come with the device, or other accessories recommended by FJD.
3. Always follow the safety instructions when operating the device to reduce or avoid personal injury.

2.1 Laser Safety



Laser Safety Notice - Laser Class 1

This device satisfies the requirements of the following standards:

IEC 60825-1:2014; and

21 CFR 1040. 10 and 1040. 11, except for deviations (IEC 60825-1 Ed. 3) pursuant to Laser Notice No. 56, dated May 8, 2019.

Although the device complies with Class 1 safety standards, do not use a microscope, a magnifying glass in any form, or other magnifying devices to look directly at the lasers.

For maximum self-protection, do not look directly at the running LiDAR.

2.2 Safety Instructions for Device Operation

1. The charger coming with the device is suitable for 220 V mains supply in the Chinese mainland. You need to select an adapter according to the local conditions when charging the batteries in places outside the Chinese mainland.
2. Do not cover the battery and the charger during charging.



3. Do not block or interrupt the LiDAR when it is rotating.
4. Keep the connecting cables stable when in use. Do not plug and unplug the connecting cables repeatedly.
5. Use the device at normal ambient temperatures and avoid exposing it to extreme temperatures. Otherwise, the battery life will be shortened or unpredictable risks may be caused.
6. When carrying the data logger with the shoulder strap, keep the data logger panel away from your body as it is the heat dissipation surface.
7. The device contains sensitive electrical and mechanical components. Do not forcibly bend or pull the connecting cables, and do not insert unrelated objects into the connectors.
8. Keep the device out of the reach of children.

2.3 Safety Instructions for Battery Operation

1. Do not immerse the batteries in water. Store the batteries in a cool and dry environment when they are not in use.
2. Do not use or place the batteries near heat sources, such as fire and heaters.
3. Charge the batteries with the charger provided.
4. Do not reverse the positive and negative poles of the batteries.
5. Do not directly plug the batteries into the power sockets.
6. Do not throw the batteries into fire or heaters.
7. Do not connect the positive and negative poles of the batteries with metal objects to avoid short circuit.
8. Do not transport or store the batteries together with metal objects.
9. Do not hit, drop, or step on the batteries.
10. Do not weld the batteries or pierce them with sharp objects.



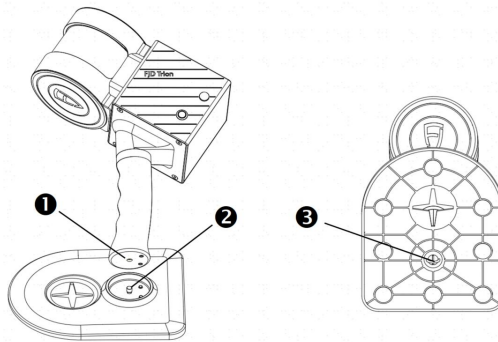
3 Scanning

This chapter describes how to assemble S1, use it to scan data, and obtain the scanning result.

3.1 Connecting the Hardware

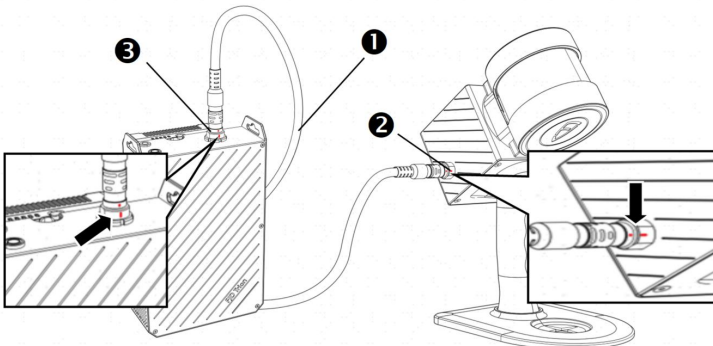
1. Connecting the Base Plate

As shown in the figure, align the threaded hole ❶ at the bottom of the handle with the captive screw ❷ on the base plate, and then fix the base plate by tightening the captive screw using the D ring ❸.



2. Connecting the Scanner and Data Logger

Connect one end of the connecting cable ❶ to the scanner port ❷. Connect the other end of the connecting cable to the data logger port ❸. Ensure that the red lines (as shown by ➡) are aligned.





3.2 Scanning

S1 collects data in a highly automated manner. Ensure that the collected data is 3D point cloud generated and processed by using the SLAM algorithm configured for S1.

Read **Suggestions** carefully before using the device.

	Refer to section 3. 4 Suggestions .
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Perform the steps in the following table to collect data.

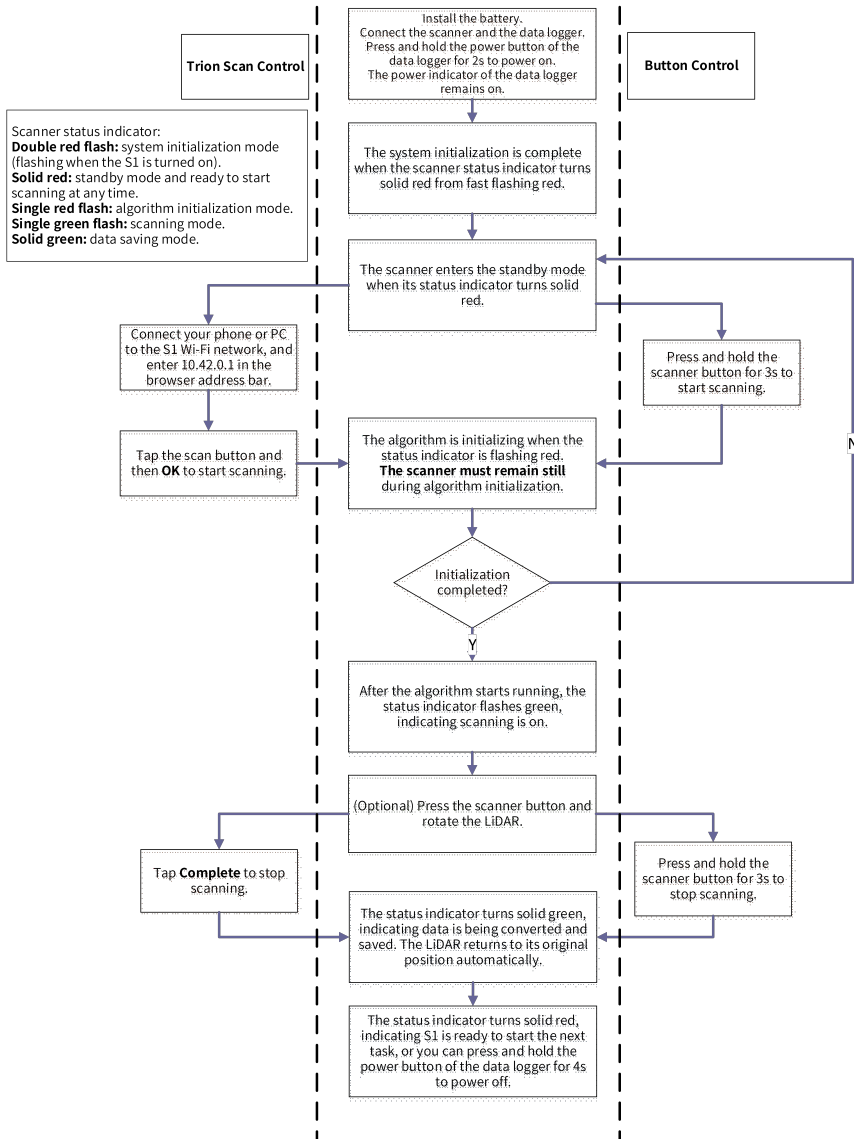
	For the software functions and operations involved in the following table, refer to chapter 4 Trion Scan .
--	---

Step No.	Overview	Description
1	Connecting the hardware according to 3. 1	Ensure that the batteries are fully charged and connected to the data logger. Connect one end of the connecting cable to the scanner port. Connect the other end of the connecting cable to the data logger port. Place S1 on a stable flat surface, and ensure that the LiDAR can be rotated flexibly.
2	Powering on the device	Press the power button on the data logger. The power button indicator on the data logger is on after the device is powered on.
3	Initializing the system	If the scanner status indicator double flashes red continuously , the device is in the system initialization mode.
4	Completing initialization and entering the standby mode	If the scanner status indicator is solid red , the device is in the standby mode and can execute the scanning task.
5	Starting scanning and initializing the algorithm	Manner 1: Connect the mobile phone to the device Wi-Fi, enter 10. 42. 0. 1 in the address bar of the browser, and tap the scan icon to start scanning and initializing the algorithm. Manner 2: Press and hold the scanner button for 3s to start scanning and initializing the algorithm. If the scanner status indicator flashes red , the device is in the algorithm initialization mode and needs to remain still.
6-1	Failing to initialize the	Return to step 3.



Step No.	Overview	Description
	algorithm and returning to the standby mode	
6-2	Completing the algorithm initialization	The scanning is in progress. If the scanner status indicator flashes green , the device is in the scanning mode.
7	Rotating the LiDAR	(Optional) Press the scanner button for 1s to start rotating the LiDAR.
8	Completing scanning and saving data	Manner 1: Tap Complete on the scan screen. Manner 2: Press and hold the scanner button for 3s to complete scanning. The LiDAR returns to the initial position. If the scanner status indicator is solid green , the device is in the data saving mode.
9	Completing data saving and entering the standby mode	If the scanner status indicator is solid red , data saving is completed, and the device is in the standby mode and can execute a new scanning task.
10	Scanning	Repeat step 5 to step 9 for the next scanning task.
11	Powering off the device	Normal shutdown: Press the power button on the data logger for 2s to 4s in the standby mode. The power button indicator on the data logger flashes until the device is powered off. Forced shutdown: Press the power button on the data logger for 8s in the non-standby mode to forcibly power off the device. Then, the power button indicator on the data logger is off.

The operation procedure is shown below:





3.3 Downloading Data

Ensure that the data logger is turned on before downloading the scan data. Data can be downloaded via Trion Scan or a USB memory stick.

3.3.1 Downloading Data via Trion Scan

Connect your phone or PC to the S1 Wi-Fi network and open Trion Scan via the specified webpage to download data files.



Refer to section 4. 2. 4 **Downloading a Project File**.

3.3.2 Copying Data via a USB Memory Stick

After scanning, if you need to copy data from S1 with a USB memory stick, ensure that there is enough space on the memory stick. Three file systems are supported, namely exFAT, FAT32, and NTFS.

Insert the memory stick into the USB port. The USB indicator flashing green means the data is being transferred. It turns solid green when the transfer is complete. At that time, the data is exported to the root directory of the memory stick. Do not remove the memory stick when the indicator is flashing green. Wait until the transfer is complete.



Note: When the memory stick is inserted, data transfer will start automatically. Only those data that has never been downloaded will be transferred. Refer to section 3. 3. 1 **Downloading Data via Trion Scan** if you need to re-download the historical data.

3.4 Suggestions

3.4.1 Environment

When scanning the surroundings, S1 constructs maps and saves the point cloud data in real time. Without the need for a GNSS device, S1 can be widely used for indoor, outdoor, and underground surveying scenarios such as underground parking lots and tunnels. It has great advantages when working indoors and underground such as in tunnels and mine laneways, as it does not need and is not influenced by external light during use.

Do not point S1 toward a large group of moving people or objects, as it requires static data.



During scanning, the operator should work alone. If partners are needed, they must walk behind the operator to avoid being scanned.

S1 may not perform well in some scenarios. Keep in mind the following points when using the product.

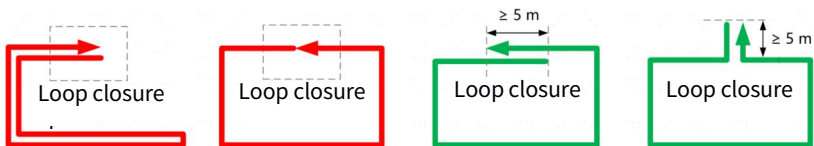
1. Scanning will be affected by specular refraction and reflection. Do not use S1 to scan spaces with a large area of glass.
2. As S1 relies on real-time matching of 3D environments, its accuracy will be affected in spaces with similar structures (for example, long straight passages and mazes showing no geometric difference in walls) and in spaces without clear structures (such as large and open lawns and squares).
3. Clear the area around S1 during initialization. It is recommended to perform the initialization with S1 placed at a certain height instead of on the ground.
4. Do not use S1 to scan an area with moving people and vehicles, like a crossroad.

3.4.2 Loop Closure

Plan the path before using the scanner. Proper path planning ensures the mapping accuracy.

1. Loop Closure at Start and End Positions

Close the loop where possible to minimize the cumulative error. It is to "close the loop" by re-surveying a known position, and the overlapping path should be at least 5 m. It is recommended to scan based on the green paths below.



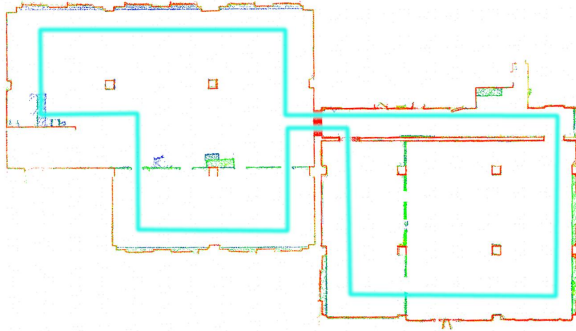
2. Loop Closure During Scanning

The error of point cloud accuracy accumulates as you walk. The error decreases with the increase of circular loop closures. Therefore, it is recommended to close the loop as often as possible to minimize the error.

Typically-sized environments (about 2,000 m²): Scan normally depending on the



environment.



Larger environments (about 10,000 m²): Close loops for several times during scanning.



3.4.3 Transitioning Between Environments

Take extra care when transitioning between environments, such as transitioning between rooms and indoor-outdoor transitioning, and when making a turn.

1. Transitioning Between Rooms

If the scanner is not normally held, there are not enough features in front, or you walk too fast, the scanner cannot capture enough features in the new room, delivering a poor scanning effect. In this case, point the scanner toward the room that has been scanned with your back toward the new room, and walk through the door slowly to ensure that there is a period when the scanner can view features on both sides of the doorway (i. e. in both rooms) .

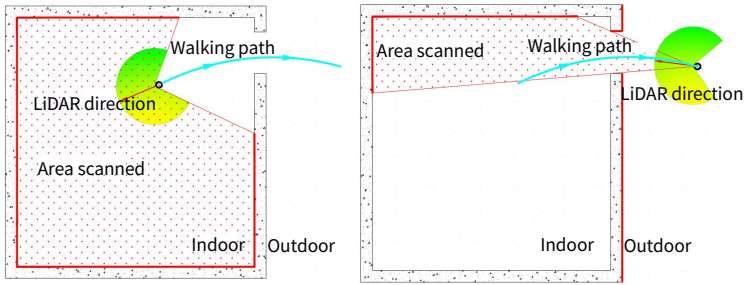


Open all doors before starting the scanning. Do not scan doors that are being opened.



2. Indoor-outdoor Transitioning

Indoor-outdoor transitioning refers to transitioning from an enclosed environment with plenty of features to an open environment with few features, for example, an open hall. In this case, the scanner also delivers a poor scanning effect.



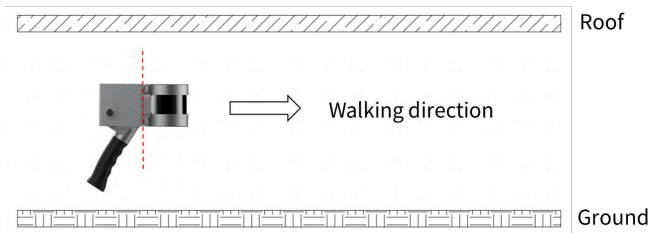
3. Making a U-turn or Turn

When making a u-turn or turn, reduce your walking speed to one third of the normal speed. Then, make the u-turn or turn slowly, and stay where you are for 1s - 2s, especially when in a corridor, to ensure that there is a period when the scanner can view features on both sides of the turn.

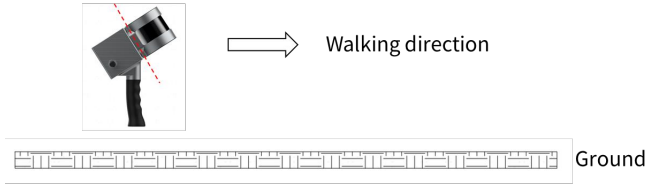
3.4.4 Scanner Holding Instructions

Hold the scanner stably, and wear a pressure-reduction device if necessary.

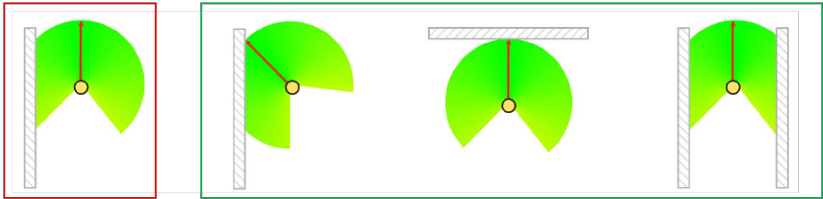
1. In open environments with few features or enclosed environments such as buried shelter, tunnel, long corridor, and sewage pipeline, tilt the handle to make the LiDAR parallel to the ground to ensure that the scanner captures as many features as possible, as shown in the figure below:



2. In open environments with plenty of features, such as underground parking lots, residential complexes, and parks, make the handle vertical to the ground or tilt the handle to make the LiDAR parallel to the ground, as shown in the figure below:



3. Ensure that there are features within 50 m directly in front of the scanner. If there are features only on one side of the scanner, the error may accumulate and the accuracy of the point cloud cannot be guaranteed. In this case, scan as shown in the green box below.



3.4.5 Walking Speed

You are recommended to walk at a constant speed (1 m/s) in typically-sized environments, and reduce the speed to 0.5 m/s or lower when passing through narrow spaces, such as long corridors, tunnels, and stair corners, so that the scanner can effectively and fully scan the spaces to ensure the output accuracy.

3.4.6 Minimum and Maximum Ranges

The survey range of the scanner is 0.5 m - 120 m.

Minimum Range: Accurate point cloud data within a small range of less than 0.5 m cannot be obtained. Avoid close proximity to walls and ceilings. Data may not be obtained on both sides in narrow spaces, so walk in the middle area where possible.

Maximum Range: The maximum range of the scanner is 120 m. This range can only be achieved in optimal conditions. The maximum range that LiDAR can guarantee the ranging accuracy is about 90 m in most conditions. Keep the scanning range about 60 m where possible to ensure a good point cloud effect.



3.4.7 Scanning Duration

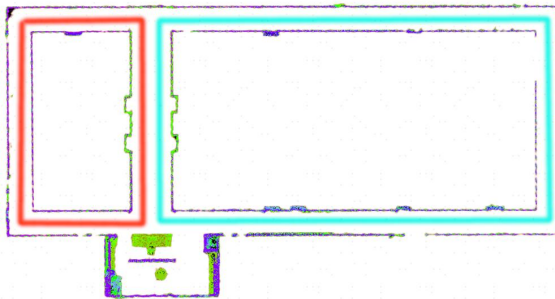
For overly large surveys, divide the project into multiple scan tasks, to keep the map size at a proper level and avoid saving failures due to limited storage space. Limit each scan task within 30 minutes.

3.4.8 Special Scenario

Scenario: long corridor

Long corridors over 80 m with smooth walls on both sides and few features may deliver poor scanning accuracy. In such corridors or similar scenarios, follow the following principles to ensure the mapping accuracy:

- 1. Scan separately:** If there is such a long corridor in the area to be scanned, scan the corridor separately.
- 2. Add features manually:** For a corridor with smooth walls on both sides and without obvious features, add features such as chairs manually. Place chairs in the farther half of the long corridor at unequal intervals of 5 m - 10 m.
- 3. Form small closed loops:** Plan as many small closed loops as possible when scanning a long corridor.



- 4. Turn slowly:** Walk and turn as slowly as possible at the end of the corridor. If the corner is followed by another long corridor, stay where you are for 1s - 2s after the turn to collect as much point cloud data as possible in such scenarios with sharp spatial alternations.



4 Trion Scan

Trion Scan can be run on a mobile or PC browser to assist in scan tasks.

This software:

- Displays the storage available, the battery power, and the project files;
- Visualizes the scan process;
- Manages and downloads project files from S1;
- Updates the software of S1.

4.1 Starting Trion Scan

1. Power on the data logger. The indicator on the scanner double flashes red, indicating that the system is initializing, and turns to solid red in about 30s, indicating that the initialization is completed.
2. Access the Wi-Fi settings screen on your phone or PC, and connect to the S1 Wi-Fi. The Wi-Fi name is the product SN, which can be found on the certificate of conformity, scanner label, and warranty card, and the password is "fjdrtrions1".
3. Open your mobile or PC browser, enter


"10.42.0.1" in the address bar, and press **Enter** to open the software screen, which displays the project files.

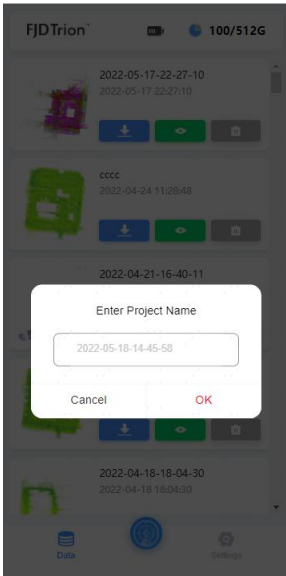


4.2 Using Trion Scan

4.2.1 Creating and Executing a Scan Task

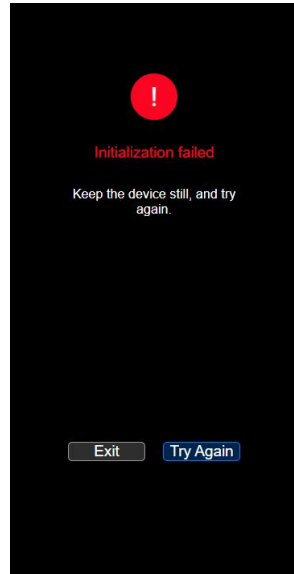
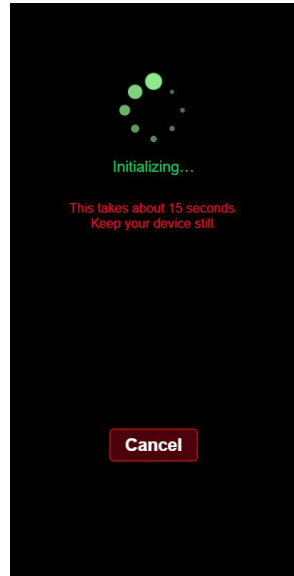
4.2.1.1 Entering a Project Name

Tap the scan button  on the home screen, enter the project name or use the default name, and tap **OK** to start initialization.



4.2.1.2 Initialization

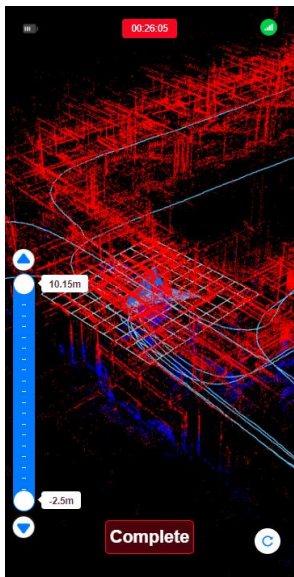
The initialization screen is shown in the figure below. The scanner must remain still for 15 seconds, or the initialization may fail. Tap **Exit** to exit this scan task and return to the **Data** screen, or tap **Try Again** to start the initialization again. When the initialization is completed successfully, the scanning screen is displayed.





4.2.1.3 Performing the Scan

During the scan, you can view the point cloud, path, walking direction, battery power, and duration of the scan in real time.

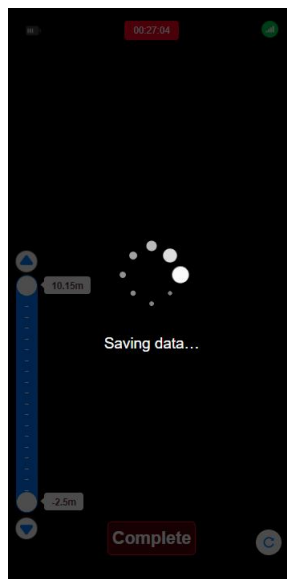
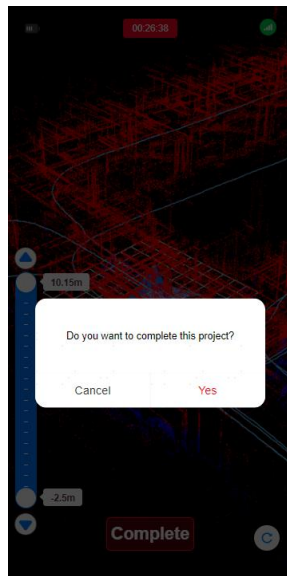


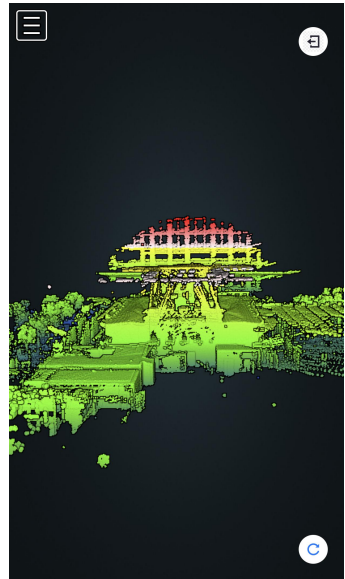
4.2.1.4 Ending the Scan Task

Tap **Complete** at the bottom of the screen, and tap **Yes** to end the current scan task. The system saves the scan data automatically, while "Saving data..." is displayed, and then returns to the **Data** screen.


Note: After the task is completed, data will be saved automatically and then available for preview. Duration of this process is dependent on the file size. The larger file,

the longer time it takes.






4.2.2 Opening an Ongoing Scan Task


Tap the scan button  at the bottom of the screen. The scanning screen is displayed if S1 is executing a scan task.

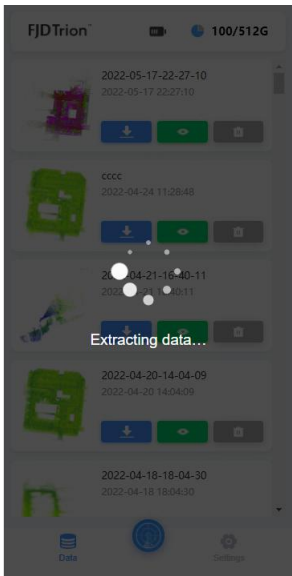
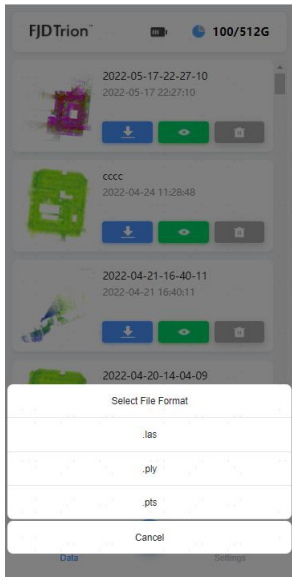
4.2.3 Previewing the Scan Result

Tap the preview button  on a project file to view the point cloud map.

4.2.4 Downloading a Project File


You can download project files in S1 to your phone or PC through Trion Scan.


Open Trion Scan and tap the download button  on a project file to download it into the default folder. The file format can be LAS, PTS, or PLY, and the default format is LAS for S1. To download project files in another format, the file format needs to be converted, and the duration depends on the file size.

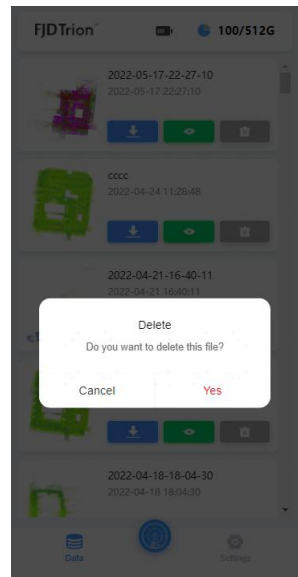


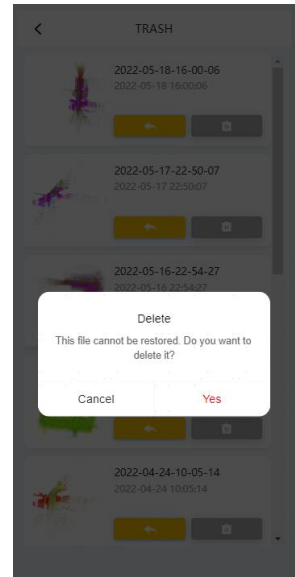
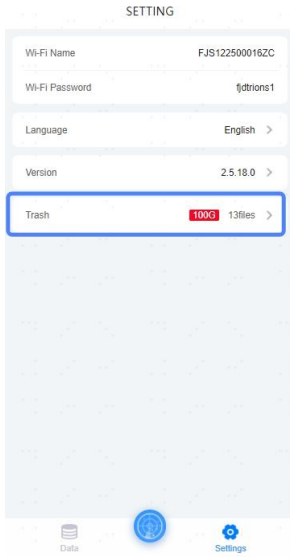
4.2.5 Deleting a Project File

If the storage space is insufficient, or the scan result is unsatisfactory, you can delete project files through Trion Scan.

Open the software, tap the delete button  on a project file to move it to **Trash**.

Files in **Trash** may be restored with the restore button . To delete a project file thoroughly, delete it in **Trash**.



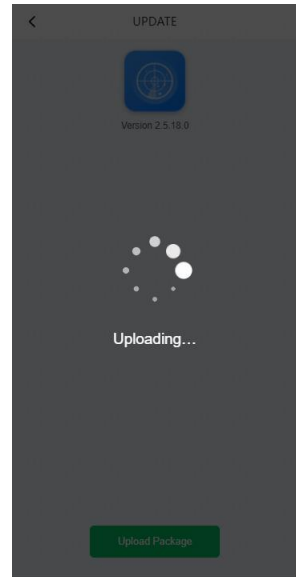
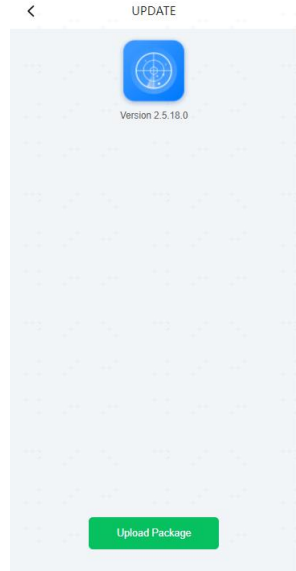
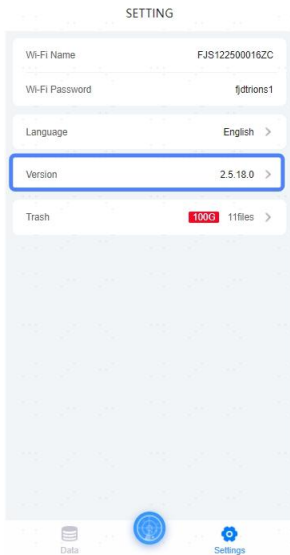


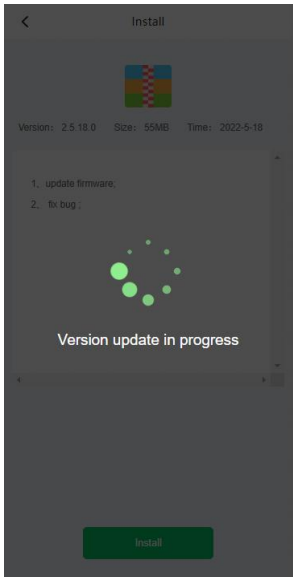
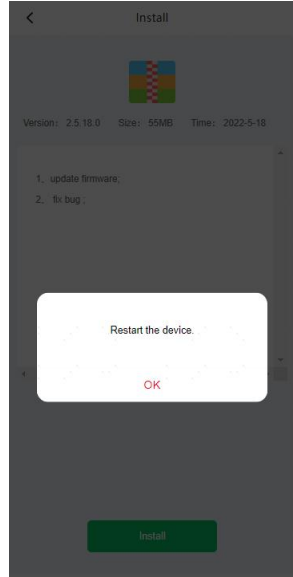
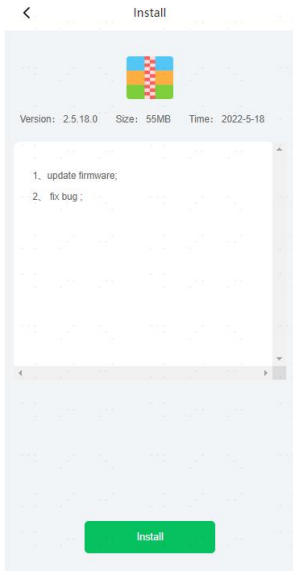


4.2.6 Updating the Software

To update the software of S1, contact your dealer to get the latest software package, choose **Settings** > **Version**, and then upload and install the software package.

! **Note:** During the update, ensure that S1 is in the standby mode.





4.3 Recommended Browsers

To ensure stable operation of Trion Scan, it is recommended to use the following browsers:

1. Chrome (PC);
2. Chrome or Edge (Android);
3. Safari (iOS).



5 Power Supply

S1 may be powered by batteries or DC power supplies.

The battery power supply is applicable to outdoors operations, while the DC power supply is applicable to scenarios such as vehicle-mounted operations.



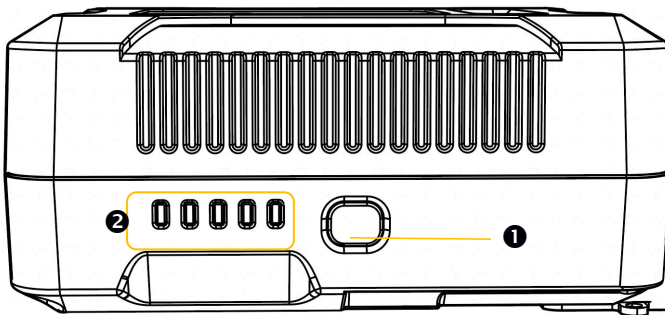
Note: The power supply cannot be changed once the operation starts, please select a power supply method before operation.

5.1 Battery Power Supply

1. S1 comes with two batteries, each of which has an output voltage of 14.8 V and a capacity of 9400 mAh.
2. The redundant power supply system consists of two removable and hot-swappable batteries. When fully charged, the two batteries can alternately power S1 for four hours.
3. Before an operation, press the button **1** on the battery, and check the battery level based on the number of battery power indicators **2** lit.



Note: Ensure that the batteries you install are fully charged. When only one battery power indicator is lit, charge the batteries immediately to avoid operation interruption.



4. To charge the batteries, remove and charge them with the dedicated charger provided.



5.2 DC Power Supply

S1 supports DC power supplies. The accessories need to be purchased separately.

The DC power input is 10 V to 24 V and 10 A max. The recommended power input is 12 V to 22 V.



6 Maintenance

1. Wipe S1 with a clean cotton cloth and put it in the case after use.
2. Avoid rough actions, such as impact, bending, throw, and disassembly, on S1, and do not put debris on it.
3. Do not disassemble S1 on your own. If a fault occurs, contact the local dealer.
4. Hot swapping is prohibited. Do not plug or unplug the cable when S1 is powered on.
5. At a certain time interval, shake the LiDAR component gently to check for abnormal sounds. If any abnormal sound is heard, check the screws of the LiDAR component. Anti-loosening measures are taken for all the S1 screws so that they do not loosen easily. However, to ensure safety, if any screw is loose, contact the local dealer.
6. Only qualified personnel can repair S1.



7 Common Faults and Solutions

Fault	Solution
The data logger cannot be powered on.	Check whether the battery is properly installed. Ensure that the battery power is sufficient. Ensure that the scanner and the data logger are properly connected with the cable.
The phone or PC cannot detect the Wi-Fi signal of S1.	Check whether the status indicator of the scanner is solid red.
The phone or PC cannot access the scanning screen.	Check whether the phone or PC is connected to the S1 Wi-Fi. Use the recommended mobile browser. Refresh the screen to try again.
The LiDAR cannot rotate normally, or the rotation speed is abnormal.	Check whether the LiDAR rotation area is blocked.
The phone or PC cannot display the scanning process in real time.	Check whether the status indicator of the scanner flashes green.
Initialization fails.	Keep the scanner still, and avoid vertical movement.
No data is copied into the USB memory stick after it is plugged into the data logger.	Check whether the data has already been copied. When the USB memory stick is plugged into the data logger, only data that has not been copied is automatically copied into the USB flash drive.
S1 automatically powers off during an operation.	Check whether the battery power is sufficient. Ensure good contact of the battery ports and cable ports.

If the fault persists, contact the local dealer.



8 Disposal

This product contains metallic materials and electronic components. For environmental protection, hand over the wastes, including the packing materials, metallic parts, and electronic components, to a qualified recycling company according to the local laws and regulations.



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