



FARO FOCUS LASER SCANNER USER MANUAL
DECEMBER 2019

Release Notice

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The FARO® Laser Scanner is protected by U.S. patent 7,869,005.

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Implementation Notes

The FARO Laser Scanner includes these third-party and open source resources:

Angular.js	libusb
angular-hammer	Linux API
crypto++ library	mmc_utils
google-breakpad library	mxt-app program

hammer.js	Open Sans and Droid Sans Mono Fonts
jsencrypt libraries and its submodules	Open Source Computer Vision Library
OpenCV	KissFFT library
paintlib	libtiff library
pikaday date picker	Volkswagen CAN Tools

The scanner's firmware is based in part on the work of the Independent JPEG Group.

For license and copyright information pertaining to the use of these resources, refer to the following document in the FARO Knowledge Base:

https://knowledge.faro.com/Essentials/General/3rd-Party_Open_Source_License_Information_for_FARO_Products#Overview

Table of Contents

Chapter 1: General Information

1.1 Notes and Signs	8
-------------------------------	---

Chapter 2: Introduction

Chapter 3: Equipment

Chapter 4: Safety Precautions

4.1 Intended Use	16
4.2 Improper Use	16
4.3 Operators	16
4.4 General Safety Information	16
4.5 Electrical Safety	17
4.5.1 Power Block Battery Safety Measures	18
4.5.2 Power Dock Battery Charger Safety Measures	18
4.6 Mechanical Safety	19
4.7 Transport	19
4.8 Storage	20
4.9 Servicing	20

Chapter 5: Parts and their Functions

5.1 Scanner Parts	22
5.1.1 Display Side	22
5.1.2 Battery Side	23
5.1.3 Front Side	24
5.1.4 Bottom Side	24
5.2 Power Dock Battery Charger	25
5.2.1 LED behavior when charging cradle connected to power source.	25

Chapter 6: Getting Started

6.1 Charging the Battery	28
6.1.1 Charging the Battery in the FARO Laser Scanner	29
6.1.2 Charging the Battery with the Power Dock Battery Charger	31
6.1.3 Tips for Using the Battery	32
6.2 Setting up the FARO Laser Scanner	33
6.3 Setting up the tripod	33
6.4 Mounting and using the quick release	35
6.5 SD Card	36
6.5.1 Preparing an SD Card	36
6.5.2 File Structure of the SD Memory Card	37
6.5.3 Inserting the SD Card	38
6.6 Switching the FARO Laser Scanner On	39
6.7 Initial Scanner Settings	39
6.7.1 Setting the Interface Language	40
6.7.2 Setting the Date and Time	41
6.7.3 Setting the Date Format	42
6.7.4 Changing Date and Time	42
6.7.5 Setting the Unit of Length and the Temperature Scale	43
6.7.6 Entering Scanner Information	44
6.8 Scanning	44
6.8.1 Setting the Scanning Parameters	44

6.8.2 Scanning Parameters Overview	52
6.8.3 Starting a Scan	53
6.9 LED Behavior	56
6.10 Data Security	57
6.11 Shutting Down the FARO Laser Scanner	57
6.12 Powering Off the FARO Laser Scanner	58
Chapter 7: Controller Software	
7.1 General Elements	60
7.1.1 Status Bar	60
7.1.2 Navigation Bar	61
7.1.3 Frequently Used Buttons	62
7.2 Home Screen	62
7.3 Scan parameters	64
7.3.1 Selected Profile	65
7.3.2 Resolution and Quality	66
7.3.3 Horizontal and Vertical Scan Range	67
7.3.4 Select Sensors	67
7.3.5 Scan with Color	68
7.3.6 Color Settings	68
7.4 Manage	72
7.4.1 Scan Projects and Clusters	73
7.4.2 Scan Profiles	78
7.4.3 Operators	82
7.4.4 Sensors	84
7.4.5 General Settings	91
7.4.6 On-Site Registration	104
7.4.7 Service	106
7.5 View Scans	113
7.6 Online Help and Notifications	114
7.6.1 Notifications	114
7.6.2 Help	114
Chapter 8: Special Scanning Modes	
8.1 Scanner Control	116
8.2 On-Site Registration	118
8.2.1 On-Site Registration Setup	118
8.2.2 Map Page	121
8.2.3 List Page	122
8.2.4 Scan Details Page	123
8.3 On-Site Compensation	124
8.3.1 Preparing the Compensation Station	124
8.3.2 Connect Laser Scanner to Computer through Wireless LAN	124
8.3.3 On-Site Compensation steps	125
8.3.4 Setup	125
8.3.5 Place target	126
8.3.6 Horizontal Alignment	127
8.3.7 Scan & Compensate	127
8.3.8 Troubleshooting	128
8.4 Scan Groups	129
8.4.1 Creating a scan group	130
8.5 Retaking Pictures	131
Chapter 9: Maintenance	
9.1 Cleaning Instructions for Optics	135

9.1.1 What's needed	135
9.2 Cleaning Slightly Contaminated Optics	136
9.2.1 Dry Pre-Cleaning (Non-Contact Cleaning)	137
9.2.2 Wet Cleaning by Tissue and Isopropyl Alcohol as a Cleaning Fluid. .	138
9.3 Cleaning of Strongly Contaminated Optics	143
9.3.1 Dry Pre-Cleaning (Non-Contact Cleaning)	144
9.3.2 Wet Cleaning by Water or Diluted Mild Soap Solution	145
 Chapter 10: Technical Data	
10.1 General	148
10.2 Laser (optical transmitter)	148
10.3 Data handling and control	149
10.4 Ranging unit	149
10.5 Color unit	150
10.6 Multi-Sensor	151
10.7 Interface Connection	151
10.8 Deflection unit	151
10.9 Ambient Conditions	152
10.10 Notes	152
10.11 Scanner Dimensions	153
10.12 Scanner Mount Dimensions	154
 Chapter 11: Error Messages	
 Chapter 12: Disposal	
 Chapter 13: Technical Support	
 Appendix A: Software License Agreement	
 Appendix B: Purchase Conditions	
 Appendix C: Industrial Service Policy	
 Appendix D: Industrial Products Service Policy	
 Appendix E: Certifications	
13.1 FCC Notice	176
13.2 Industry Canada (IC):	176
13.3 CE Conformity	177

Chapter 1: General Information

1.1 Notes and Signs

DANGER



A DANGER notice denotes a hazard. It calls attention to an operating procedure or practice that, if not correctly performed or adhered to, will result in personal injury or death. Do not proceed beyond a DANGER notice until the indicated conditions are fully understood and met.

WARNING



A WARNING notice denotes a hazard. It calls attention to an operating procedure or practice that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

CAUTION



A CAUTION notice denotes a hazard. It calls attention to an operating procedure or practice that, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

NOTICE



A NOTICE denotes a hazard. It calls attention to an operating procedure or practice that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a NOTICE notice until the indicated conditions are fully understood and met.



NOTE: A NOTE denotes additional information that aids you in the use or understanding of the equipment or subject. They are not used when a WARNING or CAUTION is applicable. They are not safety related and may be placed either before or after the associated text.

Chapter 2: Introduction

The FARO Laser Scanner is a high-speed three-dimensional laser scanner for detailed measurement and documentation. The FARO Laser Scanner uses laser technology to produce exceedingly detailed three-dimensional images of complex environments and geometries in only a few minutes. The resulting images are an assembly of millions of 3D measurement points.

Unless otherwise stated, we use the term FARO Laser Scanner for any of the FARO Laser Scanner Focus^M 70, Focus^S 70, Focus^S 150 or 350, Focus^S Plus 150 or 350.

The scanners are designed to scan objects in a distance range between 0.6 meters and approximately 70, 150, and 350 meters.

The laser scanners of the Focus^S series offer a higher accuracy than the Focus^M series.



Figure 2-1: FARO Laser Scanner

The main features are:

- HYPERMODULATION™
- high accuracy
- high resolution
- high speed
- intuitive control through the built in touchscreen display.
- high mobility due to its small size, low weight, and the integrated quick charge battery.

- High Dynamic Range (HDR) imaging method merges images captured with different exposure settings to one image with a greater dynamic range of luminosity.
- photorealistic 3D color scans due to the integrated color camera.
- integrated dual axis compensator to automatically level the captured scan data,
- integrated GPS sensor to determine the scanner position.
- integrated compass and altimeter to give the scans an orientation and a height information.
- WLAN to remotely control the scanner.

The FARO Laser Scanner works by sending an infrared laser beam into the center of a rotating mirror. The mirror deflects the laser beam on a vertical rotation around the environment being scanned; scattered light from surrounding objects is then reflected back into the scanner.

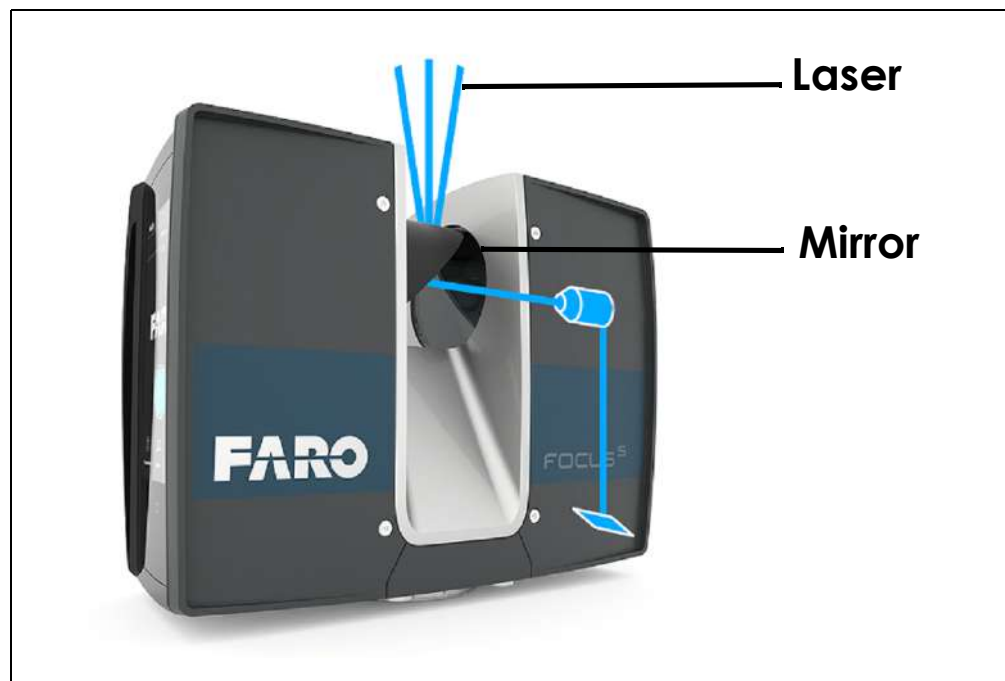


Figure 2-2: Laser Deflection

To measure the distance, FARO Laser Scanner uses phase shift technology, where constant waves of infrared light of varying length are projected outward from the scanner. Upon contact with an object, the light is reflected back to the scanner. The distance from the scanner to the object is accurately determined by measuring the phase shifts in the waves of the infrared light.

HYPERMODULATION™ greatly enhances the signal-to-noise ratio of the modulated signal with the help of a special modulation technology. The x, y, z coordinates of each point are then calculated by using angle encoders to measure the mirror rotation and the horizontal rotation of the FARO Laser

Scanner. These angles are encoded simultaneously with the distance measurement. The scanner covers a 360° x 300° field of view.

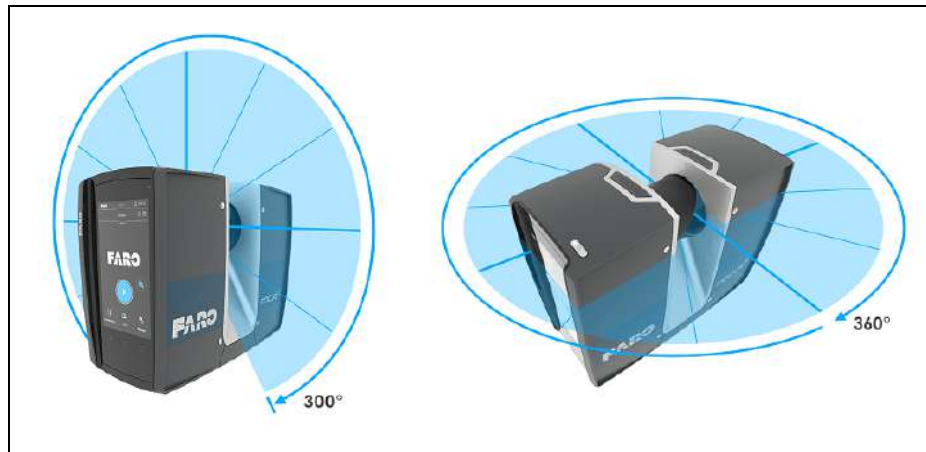


Figure 2-3: Vertical and Horizontal Rotation

Additionally, the FARO Laser Scanner determines the reflectivity of the captured surfaces by measuring the intensity of the received laser beam. In general, bright surfaces reflect a greater portion of the emitted light than dark surfaces. This reflectivity is used to assign a corresponding value to each single point.

The single point measurements are repeated up to 976,000 times per second. The result is a point cloud, a three-dimensional dataset of the scanner's environment (hereinafter referred to as the laser scan or simply scan). Depending on the selected resolution (points acquired per rotation) each point cloud consists of millions of scan points.



NOTE: The maximal single point measurement rate of the Focus^M 70 is 488,000 times per second.

The laser scans are recorded on a removable SD card, enabling easy and secure transfer to SCENE, FARO's point cloud manipulation software.

This manual provides an introduction to the FARO Laser Scanner. Read the safety information in chapter *Safety Precautions* on page 16 and the step-by-step guide in chapter *Getting Started* on page 28 before first use.

You can also find various training and tutorial videos on the Internet at tutorial.faroeurope.com

The scanner also has an onscreen help that can be accessed during operation by pressing the help button on the screen. For more information, see *Online Help and Notifications* on page 114.

A list of the potential fields of application of the FARO Laser Scanner can be found on the FARO web page www.faro.com.

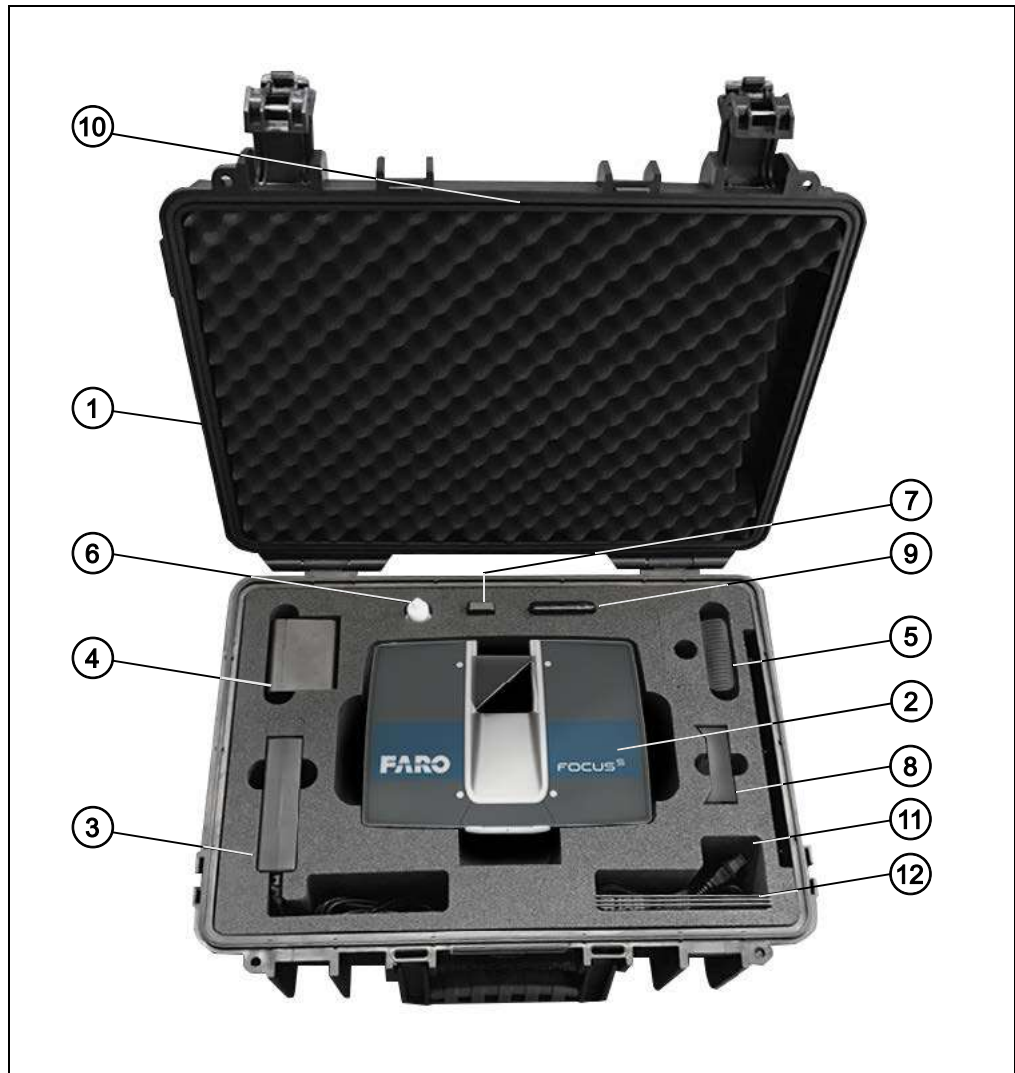
Differences between the scanners

The features that this manual describes are not available on all FARO scanners. The table below summarizes the differences between the four models. Refer to the *technical specifications* for a complete description of the differences in range, accuracy, speed, etc.

Feature	Focus^M 70	Focus^S 70	Focus^S 150 or 350	Focus^S Plus 150 or 350
Scanner base interface	not applicable	with version Focus ^S 70A	with version Focus ^S 150A / 350A	with version Focus ^S Plus 150A / 350A
Far distances scan profile	not applicable	not applicable	✓	✓
On-site compensation	not applicable	✓	✓	✓
On-site registration (with SCENE)	not applicable	✓	✓	✓
Accessory bay	not applicable	✓	✓	✓
Inverse mounting	✓	✓	✓	✓
Scanning speed (points / second)	up to 0.5 million	up to 1 million	up to 1 million	up to 2 million

Chapter 3: Equipment

The FARO Laser Scanner is shipped with the following standard equipment:



- ① Scanner transport and carry case
- ② Laser scanner. An SD card is already inserted in the scanner
- ③ Power supply unit
- ④ Power Block battery
- ⑤ Quick Release
- ⑥ Mirror cleaning liquid for optics
- ⑦ SD card reader
- ⑧ Power Dock battery charging cradle
- ⑨ SD card cover
- ⑩ Quick Start Guide, situated in the case lid

- ⑪ USB flash drive with SCENE software and this user's manual (optional)
- ⑫ AC power cable
- ⑬ Status Indicator (Not pictured. Only included with Focus^S Plus scanners.)

Required additional equipment:

- FARO-recommended tripod (FARO order number ACCSS8032)

Recommended additional equipment:

- Spare battery
- Status Indicator
- Thermal Cover

Retain all packing materials as you may need them later.

The SD memory card, a charged Power Block battery and a tripod are the minimum required equipment you need to carry out a scanning project.

Chapter 4: Safety Precautions

Read this User's Manual carefully and completely and refer to it before using the product. Pay close attention to all warnings and follow the instructions step by step.

4.1 Intended Use

Use the product with the operating conditions and limitations described in this user manual.

4.2 Improper Use

Improper use means using the product other than described in this instruction manual, or under operating conditions which differ from those described herein.

Improper use of the product can impair the protection provided by the product, and product damage or serious personal injury can be caused.

4.3 Operators

In the interests of safety, the laser scanner and its accessories should only be used by competent, suitably trained operators after they have read and understood this manual, and considered any hazard involved.

We recommend that operators participate in the trainings offered by FARO.

4.4 General Safety Information

CAUTION:

- Do not open the housing. By opening the housing, serious personal injury may be caused and you can damage the product, which will affect the product's warranty.
- Do not use parts which have not been supplied or recommended by FARO.
- Only replacement parts authorized by FARO may be used according to the instructions obtained from FARO.
- Do not expose the FARO Laser Scanner and its accessories to **extreme temperatures**. The ambient temperature must not be lower or higher than given in the specifications. Do not use the FARO Laser Scanner near heat sources such as radiators, heat registers, or other products (including amplifiers) that produce heat.
- Do not **immerse** the FARO Laser Scanner and its accessories into **water**. Liquid in the product enclosure can lead to damage, fire, or electric shocks.
- Properly dispose of the product and batteries in accordance to the national regulations. For more information, see [Disposal](#) on page 158.
- Do not use the FARO Laser Scanner and its accessories in an **explosive atmosphere**. Do not operate the instrument in the presence of flammable

gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

- Do not use the FARO Laser Scanner in vicinity of strong **magnetic or electrical fields**.
- Before operating the FARO Laser Scanner and its accessories in **hazardous areas**, contact the local safety authorities and safety experts.
- For **outdoor use**, use the Power Block battery as the power supply and ensure that the device is protected from rain or spray water. The scanner should be used in a non-condensing environment.
- When the product is transferred from a cold to a significantly warmer environment, water may condense on some elements inside the scanner. To avoid this, we recommend placing the scanner in an airtight plastic bag before bringing it from a cold to a significantly warmer environment. This allows the condensation to form on the bag and not inside the scanner. If you do not have the possibility to pack the scanner airtight, wait until observable **condensation water** evaporates from the scanner before switching the FARO Laser Scanner on.
- Properly **dispose** of the product and batteries in accordance to the national regulations.

DANGER



Do not operate the scanner while the external power supply is plugged in. The power cable might damage the turning scanner.

4.5 Electrical Safety

WARNING



Do not open the housing.

Dangerous high voltages are present inside the enclosure. Only qualified service personnel should open the housing. Never push objects of any kind into this product through openings as they may touch dangerous voltage points or cause short circuits. This could result in a fire, electric shock, and damage to the product.

- This product should be operated only from the power source or a battery supplied or recommended by FARO. Ensure that the specifications of the AC converter are met by your line voltage. If you do not know the power line voltage in your area, consult your local power company.
- To avoid electrical shock, use the power supply unit in dry indoor environments only.

4.5.1 Power Block Battery Safety Measures

Following safety measures must be followed when working with the Power Block battery:

- Only use the charger recommended by FARO to charge the battery.
- Do not charge or discharge damaged batteries.
- Do not charge the battery in the FARO Laser Scanner when it is stored in the transport case.
- Do not use wet or dirty batteries in the FARO Laser Scanner or with the charger.
- Charge within limits of 0°C (32°F) and 45°C (113°F) temperature. Recommended charging temperatures: 10°C (50°F) to 30°C (86°F).
- Discharge within limits of -20°C (-4°F) and 60°C (140°F) temperature. Recommended operating temperatures: 5°C (41°F) to 40°C (104°F).
- Insert or remove batteries from the laser scanner in dry and dust-free environments only.
- When the FARO Laser Scanner is not in use for a longer period of time, remove the battery.
- Store the battery only when it is charged (at least 60% charge state). It is recommended to charge the battery once a year when it is stored longterm.
- Storage temperatures: -20°C (-4°F) to 45°C (113°F), storage humidity range: 0% to 80%. Store in a well ventilated area. Do not store with metal objects. A short circuit can cause a fire.
- Do not bring metal objects into contact with the batteries' terminals. The terminals may short circuit and generate heat in this condition.
- Do not immerse batteries into water or fire (danger of explosion).
- Dispose of batteries in accordance with environmental regulations. Contact your local waste disposal management authority for guidelines concerning lithium ion batteries.

4.5.2 Power Dock Battery Charger Safety Measures

Observe the following safety measures when working with the FARO Power Dock battery charger:

- Do not charge any batteries other than the FARO Power Block batteries in the FARO Power Dock charger.
- Regularly check plug, cord, and the charger itself. In case of damage contact the FARO Customer Service.
- Do not bring metal objects or fluids into contact with the charger terminals. The terminals may short circuit and generate heat in this condition.
- To avoid electrical shock, use the charger and the power supply unit in dry indoor environments only.
- Do not operate the charger in an environment allowing exposure to moisture, combustible fluids or gases. Danger of explosion!
- The charger should be kept in a dry room, out of the reach of children.

4.6 Mechanical Safety

WARNING



Rotating Mirror

The mirror unit rotates with high speed while scanning and for a short period after the scan. While the mirror is rotating keep distance to the product and do not touch the rotating mirror unit with your hands, fingers or any objects at the risk of personal injury and damage to the FARO Laser Scanner.

CAUTION



General Use

The FARO Laser Scanner may only be used when set on a flat and stable surface. Injuries may result if the FARO Laser Scanner overturns. Only use equipment recommended by FARO and follow the setup instructions in this manual or in the manual of the manufacturer of the equipment.

Do Not Open the Housing

By opening the housing serious personal injury can be caused and you can damage the product.

NOTICE



Cart Usage

If using a cart, move the setup with special care. Never move the cart by pulling the power cables. Pushing or pulling of the cart with too much force, sudden stops, or an uneven surface can cause an upset of the FARO Laser Scanner.

Rotating Scanner

The FARO Laser Scanner will rotate clockwise up to 360 degrees when performing a scan. Ensure that the scanner head of the FARO Laser Scanner can rotate freely and will not hit any objects during the scan.

Replacement Parts

Only **replacement parts** authorized by FARO can be used according to the instructions obtained from FARO. Do not use **parts** which have not been supplied or recommended by FARO.

4.7 Transport

The following precautions must be taken when transporting the laser scanner equipment:

- The laser scanner must be turned off during transportation or shipping in a transport case.
- Remove the battery from the laser scanner before shipping.
- When carrying the laser scanner, take care not to drop it. Strong impact can damage the laser scanner and render it incapable of proper operation.
- Carry the laser scanner separately from its equipment or, for best protection, use the original transport case.
- When shipping and transporting the laser scanner by rail, sea, air, or in a road vehicle, make sure to use its original transport case and a suitable outer cardboard box for best protection against shock and vibration.
- The FARO batteries are lithium-ion batteries and are thus classified as *dangerous goods*. When transporting or shipping the FARO batteries, ensure that you observe all applicable local and international rules and regulations. For further information, contact your local forwarder before transportation or shipping.
- For lithium-ion batteries with less than 100 Wh energy content, an exemption is provided that allows you to carry such a battery without further paperwork. The maximum battery energy a single person can carry is 200 Wh.



NOTE: Make sure that the total energy content of all batteries that you (as a single person) carry is less than 200 Wh and that no single battery has more than 100 Wh energy content.

4.8 Storage

Prior to storing the laser scanner for a longer time:

- remove the battery.
- pack the scanner and the battery in its shipping case to protect it from environmental hazards, dust, and dirt.
- Store all components in an environment where
 - the humidity level is low,
 - the temperature is relatively stable,
 - they will not be subject to extreme temperatures, environmental conditions, or heavy vibrations.

4.9 Servicing

Servicing and repair must only be done by qualified service personnel authorized by FARO. **Unplug** this product from the power outlet, remove the battery **and refer servicing** to qualified service personnel under the following conditions:

- The power-supply cord or plug is damaged.
- The product has been exposed to rain, water, or other liquids.

- The product has been dropped or damaged in any way.
- Objects have fallen onto the product.
- The product does not operate normally by following the operating instructions.
- The product exhibits a distinct change in performance.
- The required service and calibration date is reached.

Chapter 5: Parts and their Functions

5.1 Scanner Parts

5.1.1 Display Side

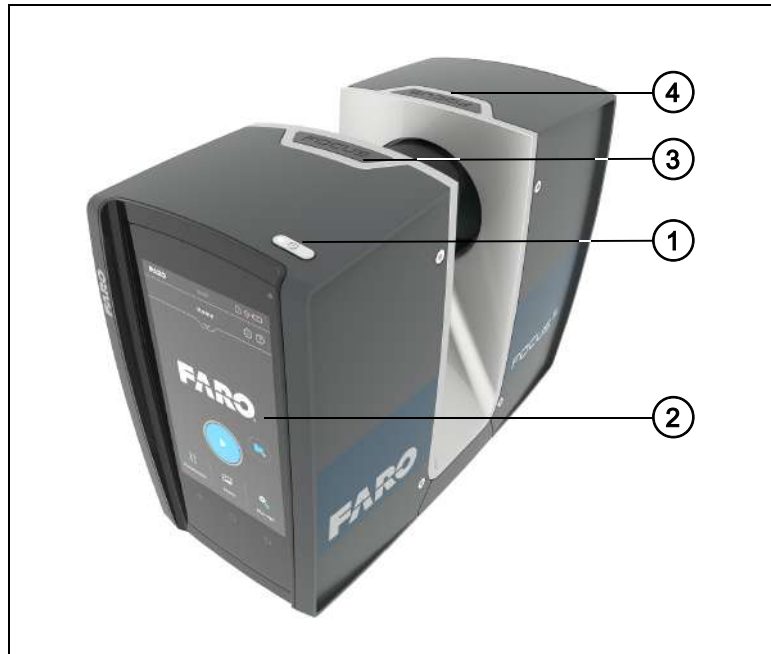


Figure 5-1: Display side of the FARO Laser Scanner

- ① Power On/Off button - Press this button to power on the FARO Laser Scanner. If the scanner is on and running, press this button to power it down. Pressing and holding the button more than 3 seconds will switch the FARO Laser Scanner off without shutting down. Use this option only in exceptional cases, for example, if the shutdown mechanism does not work or the FARO Laser Scanner is non-responsive.
- ② Touch-screen display
- ③ Accessory bay1
- ④ Accessory bay 2



NOTE: Ensure that the contacts in the accessory bay are clean before using. If not, clean with a cotton swab soaked in isopropyl alcohol.

The accessory bays are not available on all scanner models. See *Differences between the scanners* on page 12. For details about the electrical interfaces of FARO Laser Scanner Focus^S 70, Focus^S (150 and 350) and Focus^S Plus (150 and 350) check the related Automation Interface Manual.

5.1.2 Battery Side

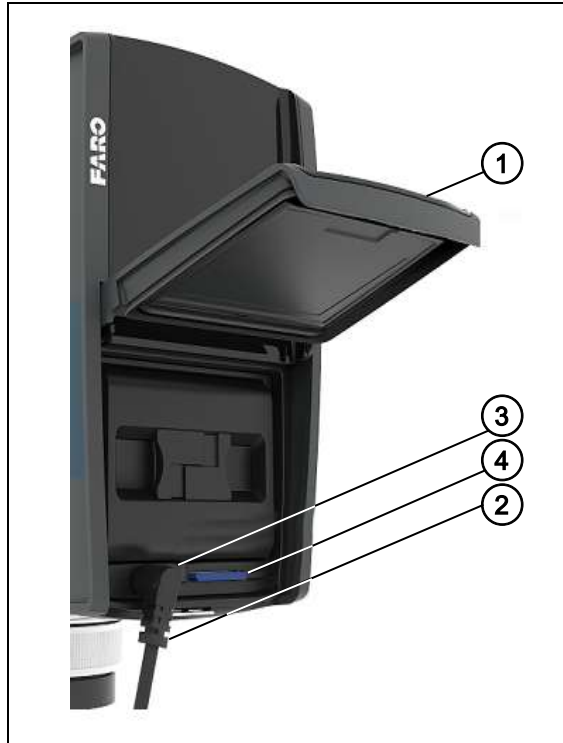


Figure 5-2: Battery Side of the FARO Laser Scanner

- ① Battery compartment cover
- ② Socket to plug an external power supply
- ③ LED showing battery status
- ④ SD card slot

5.1.3 Front Side



Figure 5-3: Front View of the FARO Laser Scanner

- ① Scanner mirror - for safety and cleaning instructions see [Mechanical Safety](#) on page 19 and [Cleaning Instructions for Optics](#) on page 135.
- ② Scanner mount
- ③ Reference area - used for self-referencing the distance measurements while scanning

5.1.4 Bottom Side

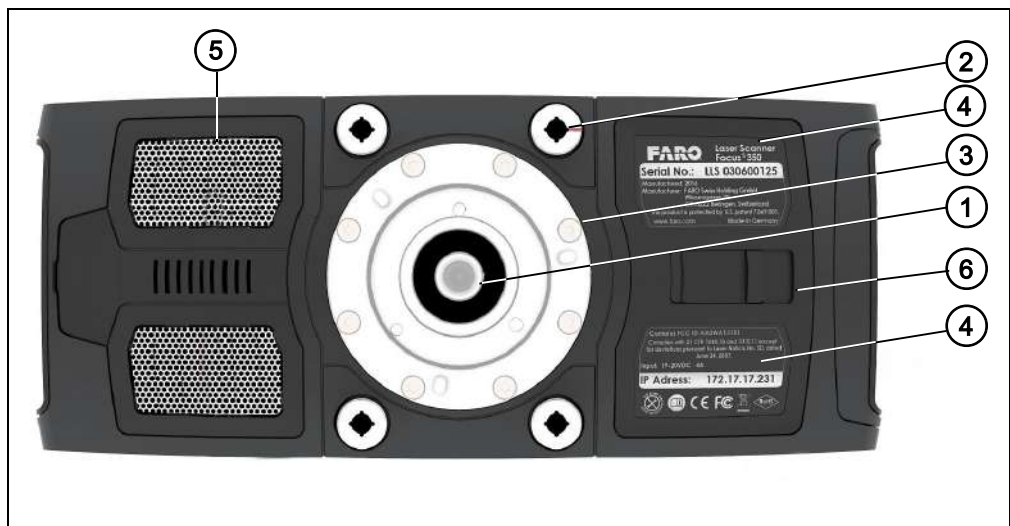


Figure 5-4: Bottom View of the FARO Laser Scanner

- ① 3/8" screw thread to mount the scanner to standard photo tripods.
- ② M5 screw threads to mount the scanner to customer specific fixtures.

- ③ Cover of the scanner base interface for automated applications. Remove to get access to the automation interface of the FARO Laser Scanner. For more information, read the FARO Laser Scanner automation interface manual. Cover the automation interface if it is not needed or not in use.



NOTE: The scanner base interface is not available on all scanner models. See *Differences between the scanners* on page 12.

- ④ Type label.
- ⑤ Cooling fan openings - Keep these openings uncovered to ensure proper cooling of the scanner.
- ⑥ Battery compartment cover release mechanism.

5.2 Power Dock Battery Charger



Figure 5-5: Power Dock Battery Charger

- ① Safety clamps. To insert the battery, drag downwards.
- ② Connectors
- ③ Power socket
- ④ Power LED - for LED specifications, see the table below.

5.2.1 LED behavior when charging cradle connected to power source

When the charging cradle is connected to the scanner or power source, its LED displays the same status as the scanner LED.

Color	State
Cyan	Battery charging, state of charge is above 90% (charge done)
Orange	Battery charging

Color	State
Flashes orange	Battery charging, state of charge less than 10%
Red	Unknown power source. Battery and AC adapter are not detected
Flashes red	Battery deep discharge

Chapter 6: Getting Started

This chapter will provide preliminary steps and basic FARO Laser Scanner operations and will guide you step-by-step from setting up the FARO Laser Scanner to recording your first scan.

6.1 Charging the Battery

The Power Block battery can be charged in the FARO Laser Scanner or in the FARO Power Dock battery charger. Carefully read the safety measures described in [Power Block Battery Safety Measures](#) and [Power Dock Battery Charger Safety Measures](#) before using them.

It is recommended to fully charge the battery before use. Retain a spare battery, if required, during your scan project.

DANGER



Danger of explosion or fire

Do not immerse batteries into water or fire.

Do not bring metal objects into contact with the battery terminals. The terminals may short circuit and generate heat in this condition.

DANGER



Danger of fire or electric shocks

Ensure that the devices are protected from rain or spraying water.

The power supply unit and the Power Dock battery charger are not for outdoor use.

The power supply unit can be used in many countries. It is compatible with a 100 V AC to 240 V AC 50/60 Hz power source. Use a plug adapter when necessary.

6.1.1 Charging the Battery in the FARO Laser Scanner

1. Open the scanner's battery compartment cover.
2. Turn the battery so that its type label is directed upwards, point the battery contacts to the scanner, push the battery straight in, and slide it downward into the battery compartment until the fastener clicks into position.



Figure 6-1: FARO Laser Scanner with Battery

3. Connect the cable of the power supply unit to the power socket of the FARO Laser Scanner. If you forcibly insert the plug in a wrong direction, the plug and the FARO Laser Scanner can be damaged.
4. Connect the AC power cable to the power supply unit as well as to a power outlet. Check the input voltage on the type label before connecting.
5. If the FARO Laser Scanner is turned off, the LEDs of the scanner will start blinking blue while charging. The LEDs will stop blinking and will illuminate to constant blue when the battery is fully charged.
6. If the FARO Laser Scanner is turned on, you can check the charging state of the battery in the scanner's user interface under [Home](#) > [Manage](#) > [General Settings](#) > [Power Management](#). For more information, see [Power Management](#) on page 93.

7. When charging is finished, remove the cable of the power supply unit and close the battery compartment cover.



Figure 6-2: Power Supply connected to FARO Laser Scanner

DANGER



Do not operate the scanner while the external power supply is plugged in, as the power cable might damage the turning scanner.

The FARO Laser Scanner need not be switched on to charge the battery.



NOTE: Remove FARO Laser Scanner from the transport case before connecting the power supply to the scanner.

Before prolonged storage, remove the power supply unit and the battery from FARO Laser Scanner.

6.1.2 Charging the Battery with the Power Dock Battery Charger

1. Connect the cable of the power supply unit to the power socket of the FARO Power Dock battery charger. If you forcibly insert the plug in a wrong direction, the plug and the Power Dock battery charger can be damaged.

CAUTION



Place the FARO Power Dock battery charger on a flat, non-slip surface. Ensure that the cable is positioned so that it cannot be accidentally pulled by anything that passes by it.



Figure 6-3: Power Dock battery charger with connected power cable

2. Connect the AC power cable to the power supply unit as well as to a power outlet. Check the input voltage on the type label before connecting.
3. The LED of the Power Dock battery charger illuminates blue when power is connected correctly.
4. Place the battery on top of the Power Dock battery charger. Ensure that the battery terminals are aligned correctly with the pins of the charger. Let the battery snap into place.



Figure 6-4: Placing the battery on the Power Dock battery charger

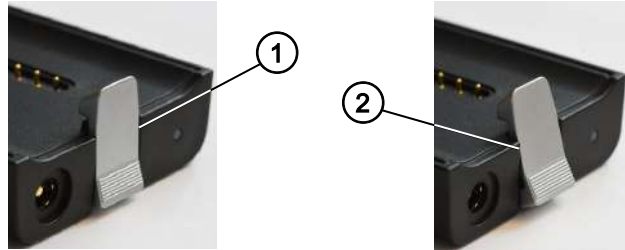
- Charging starts automatically; the LED blinks and illuminate according to the current charging state of the battery. For more information, see *Power Dock Battery Charger* on page 25.

After charging, carefully press the charger interlock mechanism and remove the battery out of position.

NOTICE



Check the Power Dock for damage before use. Check especially that the safety clamps have not been damaged, which can occur if the Power Dock falls when holding a Power Block:



- ① Undamaged safety clamp. Note the *vertical* position.
- ② Damaged safety clamp. Note the *slanted* position.

Do not use a damaged Power Dock. Doing so may damage the Power Block.

6.1.3 Tips for Using the Battery

- Charge the battery the day it is to be used or on the day before. A charged battery that is unused, will gradually lose power over time.
- If the battery becomes exhausted quickly after being fully charged, replace it with a new one.
- For best battery performance, an ambient temperature of 0°C (32°F) to 40°C (104°F) is recommended. In colder or warmer locations, battery performance and operation time may temporarily decrease.

6.2 Setting up the FARO Laser Scanner

WARNING



Danger of injuries, especially to children or kneeling persons

- Injuries may result if the FARO Laser Scanner overturns.
- The FARO Laser Scanner may only be used when set on a flat and stable surface.
- If using a cart, move the setup with special care. Never move the cart by pulling at the power cables. Pushing or pulling of the cart with too much force, sudden stops, or an uneven surface can cause an upset of the FARO Laser Scanner.
- In windy conditions, use sandbags to stabilize each foot of the tripod. You can also place a weight on the ground under the tripod, then stretch a rope or shock cord between the tripod's center hook and the weight.

6.3 Setting up the tripod

The scanner performs best if the base on which the scanner rests is *absolutely* motionless. Any vibration or oscillation in the tripod or the ground on which the tripod stands can reduce the accuracy of the scan, and can even lead to fringed or ghosted lines as shown in this example:

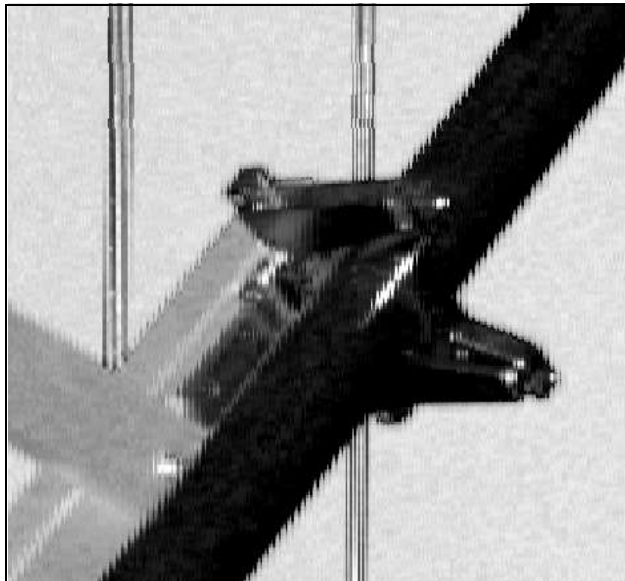


Figure 6-5: Sample scan result due to scanner vibration during data acquisition

- Use a high-quality tripod. FARO recommends the GITZO ACCSS8032, available only from your FARO sales representative.

When working with the laser scanner, two aspects must always be considered:

- Due to long recording times and high data-quality requirements, you must adjust the tripod to be as stable as possible.
- Because a laser scanner moves during operation, the tripod must always be as rigid as possible.

To achieve stability and rigidity, observe the following guidelines:

- Extend the tripod as little as possible. Less height means more accuracy.
- Extend the thicker segments of the legs before extending the thinner segments.
- When working with the laser scanner, two aspects must always be considered:
- Due to long recording times and high data-quality requirements, you must adjust the tripod to be as stable as possible.
- Because a laser scanner moves during operation, the tripod must always be as rigid as possible.

To achieve stability and rigidity, observe the following guidelines:

- Extend the tripod as little as possible. Less height means more accuracy.
- Extend the thicker segments of the legs before extending the thinner segments.
- It is acceptable to extend a leg segment only partially if necessary to achieve a specific height, but do not partially extend several segments of the same leg.
- Standard working height: the tripod has four leg segments, pull out the first three fully and leave the fourth one inserted. This results in a working height of approx. 148 cm, which allows an ergonomic operation of the scanner. Only pull out the smallest leg segments when you need a larger tripod height.
- The tripod is equipped with large adjustable rubber feet. Each time you move the tripod, check to ensure that the feet are correctly resting on the ground. If you need to place the tripod on unstable ground (e.g., grass, gravel, mud) use the supplied spikes instead of the rubber feet. Press the spikes individually into the ground until they reach a stable, load-bearing layer.
- After you set the tripod on the ground, check the leg latches. If any of the latches are loose, spread the legs slightly until the latches cannot be wiggled. This ensures that the tripod is firmly planted on the ground, and unlikely to shake or vibrate during scanning.
- The use of the center column significantly reduces the rigidity of the tripod. We recommend that you avoid using the center column when operating laser scanners. If you can't reach the tripod height you need in any other way, keep the extended length of the center column as short as possible. A better alternative, however, is to move the tripod to a different, higher position instead. Use the center column only as a last resort. If you often need high working heights, we recommend using a larger tripod.
- For scans close to the ground, slide all leg segments into each other before setting the leg angle to *flat*. The rubber feet have a recess that helps to

achieve full-surface contact even with a flat leg angle. To do this, you must turn the feet individually by hand.

- Ensure that the twist-lock sleeves for leg length adjustment, the central wing nut of the tripod shoulder, and the tripod head are always tightly screwed together.
- To achieve more grip on hard surfaces, it is advisable to slightly tension the tripod legs before starting a scan. Tension the legs by holding two of the three tripod legs as close to the ground as possible with your hands, pulling them slightly apart from each other and away from the third leg, and then pressing them into the ground.
- In windy conditions, use sandbags to stabilize each foot of the tripod. You can also stretch a rope or shock cord between the tripod's center hook and a weight, switchable magnetic base, or existing anchor point.

6.4 Mounting and using the quick release

The quick release enables you to quickly and safely attach and remove the scanner from the tripod. The quick release consists of these parts:

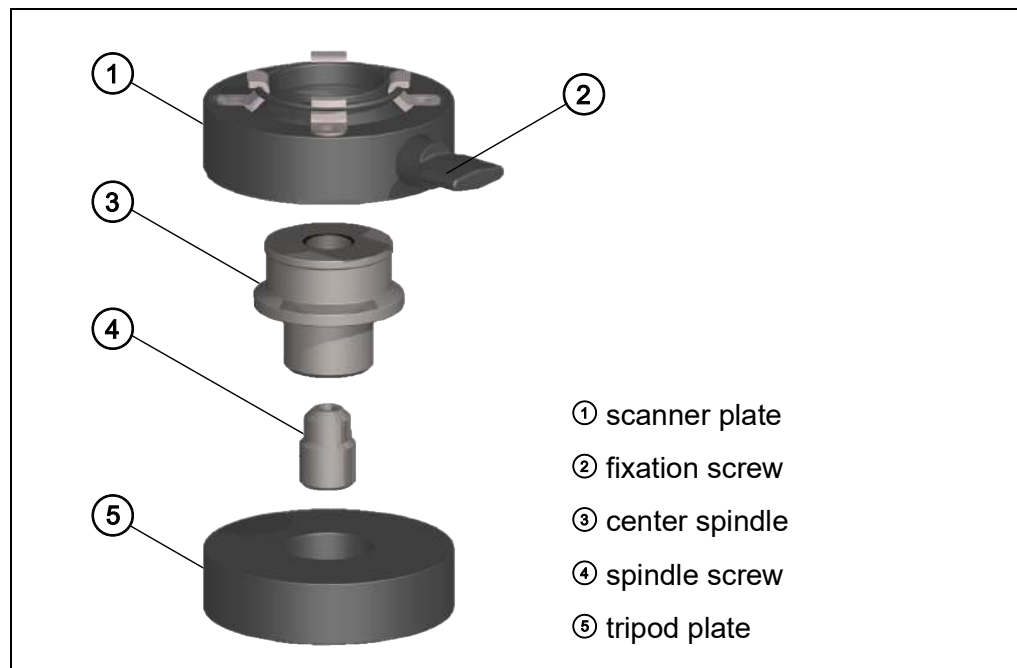


Figure 6-6: Quick release parts

Use the instructions below to mount the quick release.

Prepare the tripod:

1. Extend the tripod legs and place the tripod on a stable surface at a convenient height. Ensure that all legs of the tripod are secure.
2. Your tripod might be equipped with one or more set screws in the platform. Ensure that the set screws are recessed below the platform. They must not stick up out of the surface.
3. Place the tripod plate over the center screw of the tripod.

4. Ensure that the spindle screw is firmly screwed into the narrow side of the center spindle.
5. Screw the center spindle firmly onto the tripod

Prepare the scanner:

1. Place the scanner upside down on a stable, flat surface. Take care to protect the mirror from dirt, dust or falling objects.
2. Place the scanner plate onto the base of the scanner. Ensure that it slides into the circular depression that surrounds the center thread.
3. Use a 4 mm hex key to tighten the four screws so that the scanner plate is firmly attached to the scanner.

Use the Quick Release:

1. Ensure that the tripod is level and that the tripod plate is firmly attached to the tripod. Use your hand to tighten it, if necessary.
2. Ensure that the fixation screw in the scanner plate is unscrewed so that it won't block the scanner plate from sliding over the center spindle.
3. Holding the scanner from both sides, slide the scanner plate over the center spindle.
4. Using your fingers, tighten the fixation screw until the scanner plate is firmly attached to the center spindle.

You can now use the scanner. To remove the scanner, loosen the fixation screw and lift the scanner from the center spindle.

6.5 SD Card

6.5.1 Preparing an SD Card

The FARO Laser Scanner stores the recorded scans on a removable SD card. This memory card can also be used to create backups of the scanner settings, to import scanner settings, and to install firmware updates.

Before carrying out a scan project, you can use the SCENE software to set up an SD card with project relevant information and settings, like the project structure, scan profiles, or scanner operators. These settings can then be transferred to the scanner. For more information on scan project preparation with SCENE and transferring data to the scanner, see the SCENE user manual and [SD Card](#) on page 107.

SDHC or SDXC cards are highly recommended. Memory cards with a size up to 64 GB have been verified to operate with the scanner. We recommend using memory cards with a capacity of 4 GB or more. The speed of the card

must be Class 10 or better and its temperature range should be from -20 °C (-4 °F) to 85 °C (185 °F).



NOTE: The SD cards must be formatted in the FAT32 file system. When using an SD card other than one supplied with the scanner, format it with the scanner format function first. *For more information, see Service on page 106.*

SDHC cards may also be formatted with Windows. SDXC cards with a capacity of more than 32 GB cannot be formatted with the Windows format function as Windows will format those cards in its own file system. The Windows file system is not supported by the scanner. There exist freeware tools that allow formatting such cards with Windows as FAT32 but it is recommended to use the scanner's format function.

NOTICE



Risk of data loss

Do not remove the SD card from the scanner while it is busy, otherwise you risk corrupting the data on the card. A busy SD card is indicated by the SD card icon blinking in the status bar of the controller software. It is safe to remove the card from the scanner when this icon has disappeared from the status bar.

When removing a FARO Laser Scanner SD card from your computer, you should always use the "Safely Remove Hardware" option from the system tray in Windows, otherwise you risk corrupting the data on the SD card. To safely remove hardware in Windows, double-click the Safely Remove Hardware button in the system tray, then select the device you want to remove from the list.

6.5.2 File Structure of the SD Memory Card

The file structure of the FARO Laser Scanner SD cards is as follows:

Name	Size	Type
Backup		File Folder
Logfile		File Folder
Preview		File Folder
Projects		File Folder
Scans		File Folder
Updates		File Folder
FARO-LS	0 KB	File

Figure 6-7: SD Card File Structure

Backup - Scanner backups will be saved to this folder. The backup folder will be created automatically as soon as you start a scanner backup. See *Backup* on page 108.

Logfile - When exporting the log files from the scanner, they will be saved to this folder. This folder will be created automatically by the scanner. See *Log File* on page 108.

Preview - The preview pictures of captured scans will be saved to this folder. The folder will be created automatically as soon as you start a scan. See *Starting a Scan* on page 53.

Projects - Scan projects information will be saved to this folder. The folder will be created automatically by the scanner. See *Scan Projects and Clusters* on page 73.

Scans - The captured scans will be saved to this folder. The scans folder will be created automatically as soon as a scan has been started. See *Starting a Scan* on page 53.

Updates - Copy firmware updates to this folder. This folder must be created manually. See *Firmware Update* on page 111.

FARO-LS - Signature file, used to identify the SD card as a FARO Laser Scanner card. This file will be created automatically as soon as a scan has been started.

6.5.3 Inserting the SD Card



Figure 6-8: Inserting the SD Card

1. Open the battery compartment cover to find the SD card slot down on the right side.
2. Insert the formatted SD card with the notched edge in the direction as illustrated until it clicks.
3. Confirm the direction of the memory card. If you forcibly insert the memory card in a wrong direction, the SD card, the card slot or data on the card can be damaged.
4. Close the cover.

Ejecting the SD Card

To remove an SD card from the scanner, open the SD card slot cover and lightly push the memory card.

- Do not eject the memory card while it is busy.
- Take care that the memory card does not pop out and fall.

6.6 Switching the FARO Laser Scanner On

Pressing the scanner's **On/Off button** will start the boot process, which is indicated by the scanner LEDs blinking blue. If power is supplied by the battery and its charge state is too low to start the scanner, the scanner LEDs will blink orange.

When the FARO Laser Scanner is ready, the LEDs will stop flashing and will illuminate constantly blue, the **Home** screen of the scanner's controller software will appear on the integrated touch screen.

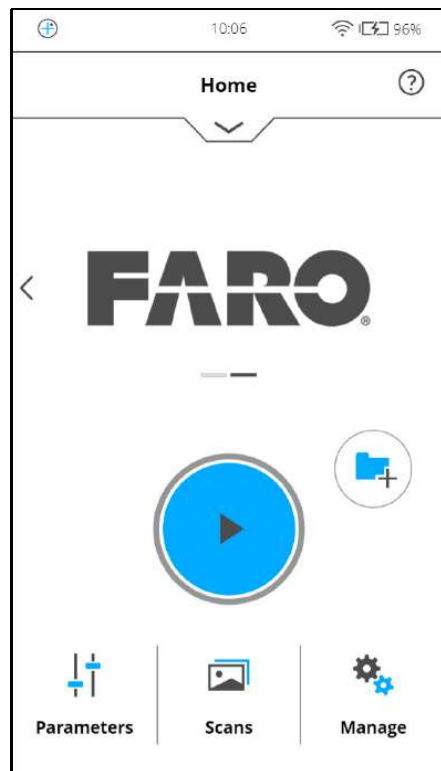


Figure 6-9: Home Screen of the controller software

The FARO Laser Scanner can be operated to its full extent by simply tapping the elements on the screen with your fingers. You can use a capacitive stylus to navigate through the user interface.

6.7 Initial Scanner Settings

This chapter gives you a brief description on how to set up initial scanner settings using the scanner's controller software on the integrated touch screen. See [Controller Software](#) for more information.

6.7.1 Setting the Interface Language

Starting from the Home screen, go to *Home* > *Manage* > *General Settings* > *Language* to change the language of the controller software.



Figure 6-10: Language Selection Screen

Select the language by tapping the corresponding button. The selected language will be highlighted.

If the list of available languages exceeds the screen size, scroll the list up or down.

6.7.2 Setting the Date and Time

To change the date and time settings, go to [Home](#) > [Manage](#) > [General Settings](#) > Date & Time.

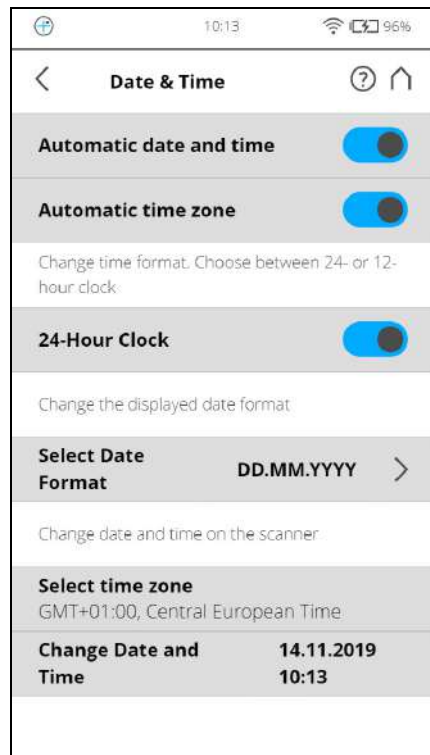


Figure 6-11: Date and Time Settings

Automatic date and time - Tap and slide the button to activate automatic date and time settings.

Automatic time zone - Tap and slide the button to activate automatic time zone settings.

24-Hour Clock - Tap to set the time format. The scanner can display time either in the 24-hour or the 12-hour clock format. Slide the button to ON to select the 24-hour clock. Slide the button to OFF to select the 12-hour clock.

Select Date Format - Tap to choose the date format. The currently selected date format is displayed with the option.

Select time zone - Tap to choose the date format. The currently selected date format is displayed with the option.

Change date and time - Tap to set the internal clock of the FARO Laser Scanner.

6.7.3 Setting the Date Format

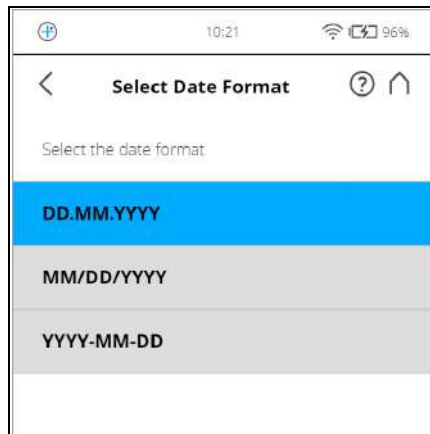


Figure 6-12: Change Date Format

Select the date format by touching the corresponding button. You can select between the date formats DD.MM.YYY, MM/DD/YYYY or YYYY-MM-DD, where YYYY is the year, DD the day and MM the month. The selected format will be highlighted.

6.7.4 Changing Date and Time

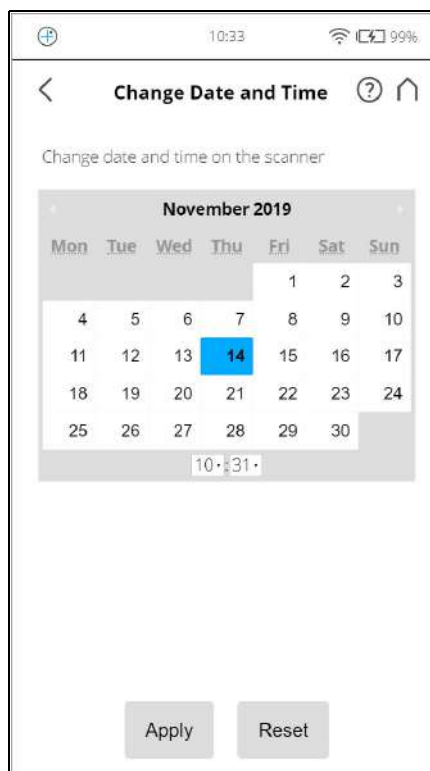


Figure 6-13: Change Date and Time

Select the **time field** in the list to change the time, then use the buttons on the left to set the hours, the buttons on the right to set the minutes.

Select the **year field** in the list to change the year, then use the buttons on the left or on the right to set the date.

Proceed accordingly with the **month** and the **day fields**.

Discard Changes - Tap to discard your changes.

6.7.5 Setting the Unit of Length and the Temperature Scale

You can change the units scale under *Home* > *Manage* > *General Settings* > *Units*.

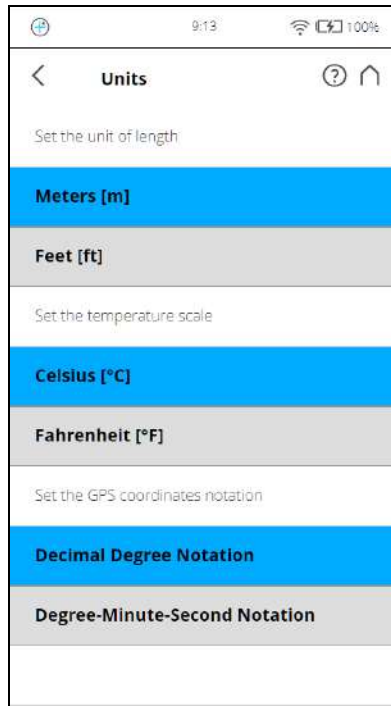


Figure 6-14: Change Unit of Length

Lengths will be displayed by the controller software either in meters or in feet. Select the favored unit of length by tapping the corresponding button.

Temperatures will be displayed either in Celsius or in Fahrenheit scale. Select the favored temperature scale by tapping the corresponding button.

GPS coordinates are either displayed in decimal degree notation (e.g., +34.9823450 °E) or in degree-minute-second notation (e.g., 34° 58' 56.44" E).

6.7.6 Entering Scanner Information

You can specify a scanner name and the owner of the FARO Laser Scanner. Starting from the **Home** screen, go to *Home* > *Manage* > *General Settings* > **Scanner Details**.

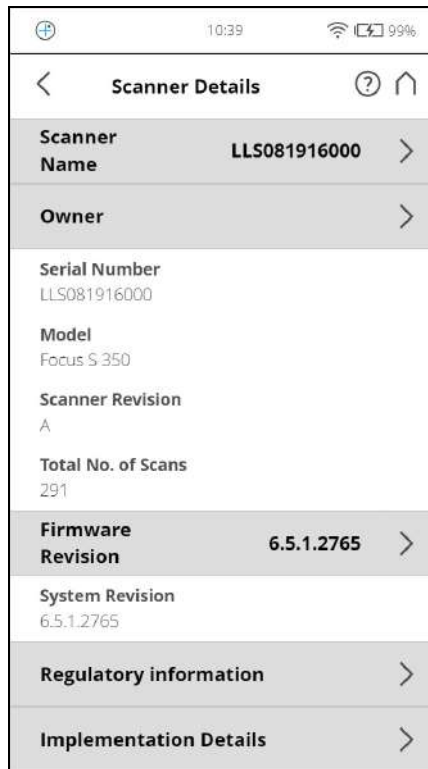


Figure 6-15: Scanner Details

Scanner name - Tap to change the name of the scanner.

Owner - Tap to enter the name of the company or person owning the scanner.

For more information, see *Scanner Details* on page 103.

6.8 Scanning

This chapter will give you a brief description on how to set the scanning parameters to capture your first scans. Normally, you would provide and enter project information before starting with your scan project. This will be described later. For more information, see *Scan Projects and Clusters* on page 73.

6.8.1 Setting the Scanning Parameters

(Home > Parameters)

Scanning parameters like resolution, quality or the scanning angles are the parameters used by the scanner for recording the scan data. There are two ways to set the scanning parameters: by changing them manually or by selecting a scan profile which is a predefined set of scanning parameters.

When selecting a scan profile, its settings will overwrite the scanning parameters.

To choose a predefined scan profile or to change the scanning parameters tap the **Parameters** button.

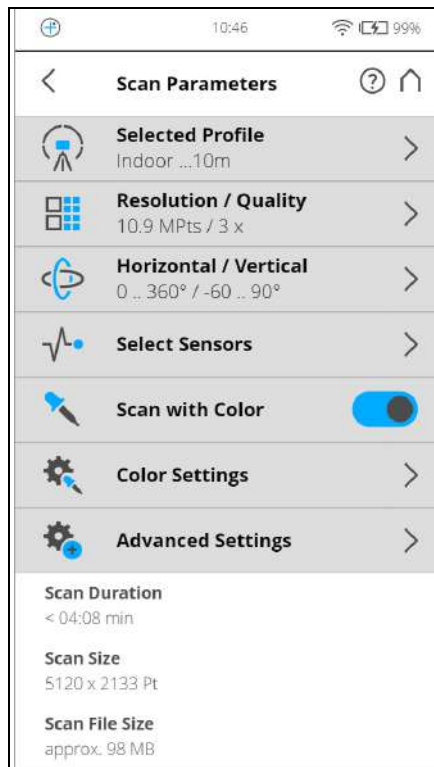


Figure 6-16: Change the Scan Parameters

Selected Profile - Shows the name of the selected scan profile. Tap to select a scan profile. If the scanning parameters differ from the selected profile, altered is appended to its name.



NOTE: Selecting a predefined scan profile overwrites all current scanning parameters with the settings of the selected scan profile.

Additionally, you may edit the scanning parameters individually by changing the following settings:

Resolution and Quality - Displays the selected resolution in megapoints and the selected quality. Tap the button to change these values.

Horizontal and Vertical Scan Range - Displays the scan range with the horizontal and the vertical start and end angles in degrees. Tap to adjust them.

Select Sensors - Opens the screen to enable or disable the automatic use of the data of the built-in sensors for the scan registration in SCENE.

Scan with Color - Switch colored scan recording on or off. If switched on, the scanner will also take color photos of the scanned environment with the integrated color camera. These photos will be taken right after the laser scan and will be used in the point cloud processing software SCENE to automatically colorize the recorded scan data.

Color Settings - Shows the current exposure metering mode used for taking the color photos. Tap to change the exposure metering mode.

Advanced Settings - Enable or disable the Clear Contour and Clear Sky filters. Enable or disable the Far Distance.

Scan Size [Pt] - Shows the size of the scan in points horizontally x vertically. The vertical size may only be changed by setting a new resolution or by changing the scan area angle.

Scan Duration, Scan File Size - Expected scan time and file size in Megabytes according to the chosen settings including preprocessing and postprocessing, resolution, selected exposure metering, scan area, quality value, and scan range. Note that the values shown here are approximate values.

Selecting a Scan Profile

([Home](#) > [Parameters](#) > Selected Profile)

Prior to capturing a scan, you can select a scan profile that fits the needs of the scene and the desired scan quality.

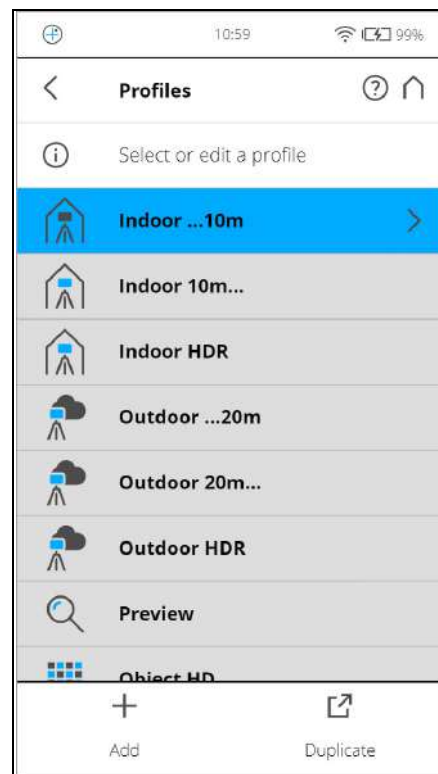


Figure 6-17: Select a Profile

This view shows a list of all available scan profiles. This list contains factory predefined profiles that are read-only and custom profiles that can be created and manipulated under [Manage > Profiles](#).

See [Factory Settings](#) on page 112 for an overview of the available factory predefined scan profiles. For more information, see [Selected Profile](#) on page 65.

Select a profile by tapping the corresponding button. The selected profile will be highlighted.

Setting Resolution and Quality

([Home](#) > [Parameters](#) > Resolution / Quality)

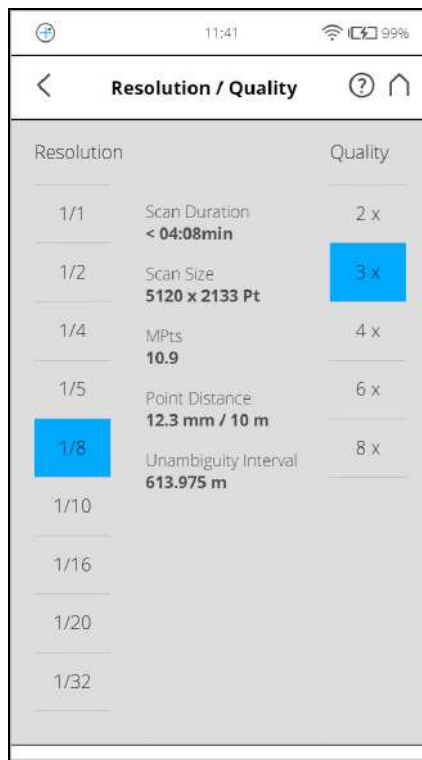


Figure 6-18: Change Scan Resolution and Quality

Resolution The resulting scan resolution. You can choose among 1/1, 1/2, 1/4, 1/5, 1/8, 1/10, 1/16, 1/20 and 1/32.

Quality Affects the quality of the scan and the scanning time at constant scan resolutions. It allows you to balance the needs of quality and speed. If speed is more important to you, choose a lower number. If the quality of the scan data is more important, choose higher numbers.

The resulting Scan Duration, vertical, and horizontal scan points (Scan Size [Pt]), as well as the resulting scan size in megapoints (MPts) will be displayed in the middle of the view. Point Distance [mm/10 m] / [in/30 ft] is the distance between the captured scan points in mm (in) in a scan distance of 10 meters (30 ft).



NOTE: The unambiguity interval specifies the maximum distance at which the scanner can accurately measure points with the selected settings. For technical reasons, points created for objects farther than this distance appear much closer to the scanner than the objects actually are.

If this happens, you can remove the points later using SCENE software, but this can be time-consuming. It's better to choose a combination of resolution and quality with an unambiguity interval that is larger than the most distant object that you plan to scan.

If you plan to capture several scans from the same position (with different resolutions) and if it is important that these scans have the same horizontal start angle, then you should neither switch off the scanner nor change the quality between the recordings of these scans.

Setting the Scan Range

([Home](#) > [Parameters](#) > Horizontal / Vertical)

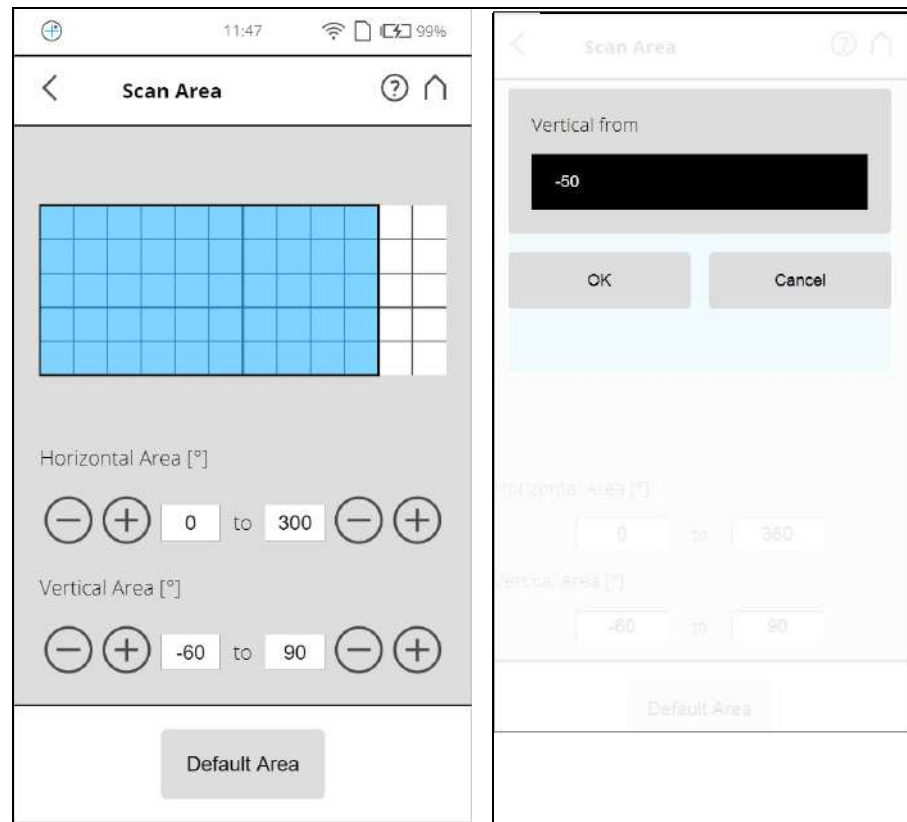


Figure 6-19: Setting the Scan Range

Vertical area - The size of the vertical scan area in degrees. Tap the fields to enter the values of the vertical start angle and vertical end angle.

Horizontal area - The size of the horizontal scan area in degrees. Tap the fields to enter the values of the horizontal start angle and horizontal end angle.

Default Area button - Tap to reset the values to the default scan area (vertical from -60° to 90° and horizontal from 0° to 360°).

The rectangle in this view illustrates the full scan area. If there are scans on the inserted SD card, the preview picture of the last recorded scan is displayed. If there is no preview picture available, a grid is displayed, where the space between the horizontal and vertical lines is equivalent to 30° . The highlighted rectangle illustrates the selected scan area.

Selecting the Sensors

([Home](#) > [Parameters](#) > Select Sensors)

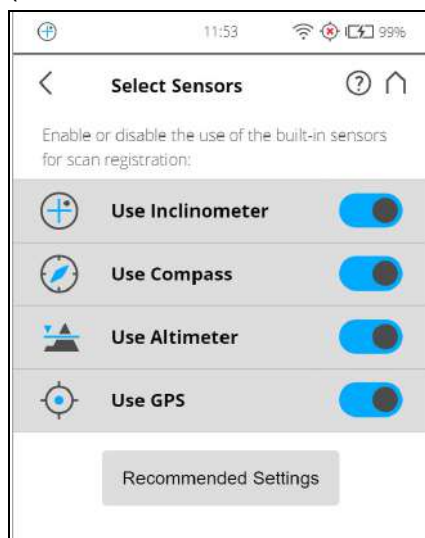


Figure 6-20: Selecting the Sensors

Use Inclinometer - Enable or disable the automatic use of the inclination measurement of the built-in dual axis compensator (inclinometer) for the scan registration in SCENE. However, regardless of your setting, the data of this sensor is always measured and attached to each scan. If the use of the inclinometer data is switched ON, it will automatically be used to register the scans in SCENE; if it is switched off, the data will be ignored. You can still change this behavior later in SCENE. See the SCENE user manual for more information. You can jump directly to **Use Inclinometer** by tapping the quick access icon (⊕) at the top of the screen.



NOTE: To get the most reliable data from the dual axis compensator, make sure that the scanner's inclination is less than 2°. For more information, see *Inclinometer (Dual Axis Compensator)* on page 85.

Use Compass - Enable or disable the automatic use of the data of the built-in compass for the scan registration in SCENE. The data of the compass is always measured and attached to each scan during scanning and will automatically be used for the scan registration, if this button is switched to ON. For more information, see *Compass* on page 87.

Use Altimeter - Enable or disable the automatic use of the altimeter data for the scan registration in SCENE. Just like with the inclinometer, the data of the altimeter is always measured and attached to each scan during scanning and will automatically be used for the scan registration, if this button is switched to ON. You may want to enter a reference height before starting your scan project. This reference height will then act as basis for all the measurements made by the altimeter. You will find the altimeter settings under *Manage > Sensors > Altimeter*. For more information, see *Altimeter* on page 89.

Use GPS - Turn the GPS sensor ON or OFF. Unlike the other sensors, the GPS data is only recorded during scanning and will thus only be available for

scan registration in SCENE if this button is switched to ON. For more information, see *GPS* on page 88.

Recommended Settings button to enable the use of all sensors.

Color Settings

([Home](#) > [Parameters](#) > Color Settings)

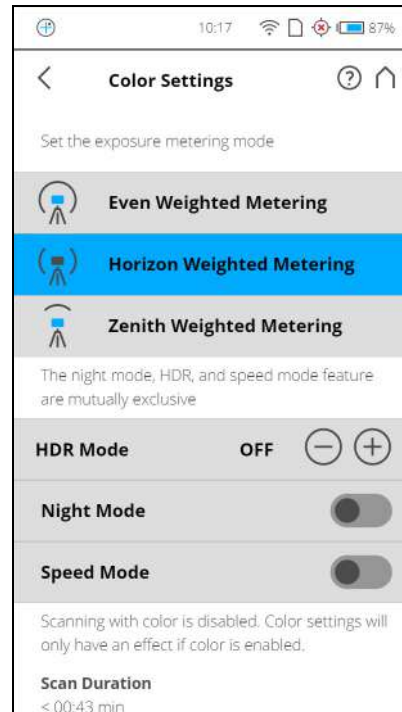


Figure 6-21: Color Settings

Set the exposure metering mode - Set the way in which the integrated color camera determines the exposure for taking the color photos (if colored scan recording is switched on).

Even Weighted Metering - To determine the exposure settings, the camera will use the light information coming from the entire scene and averages without giving weighting to a particular area.

Horizon Weighted Metering - With horizon weighted metering mode, the camera will use the light information coming from the horizon to determine its exposure setting. This mode is commonly used in scenarios with bright light coming from directly above (e.g., indoors with bright ceiling lighting or outdoors with bright sunlight)

Zenith Weighted Metering - With zenith weighted metering, the camera will use the light information coming from above the scanner to determine its exposure setting. Use this mode if there is very bright light coming from e.g., windows and if you want to achieve the most correct balance of light and exposure for objects at the ceiling of building.

HDR mode

The High Dynamic Range (HDR) imaging method merges images captured with different exposure settings to one image with a greater dynamic range of luminosity.

Scanning with HDR capturing

Set the HDR capturing by tapping the + or - button from 2x to 5x. This setting corresponds to the exposure levels. If no option is selected, then OFF selection is displayed.



NOTE: When HDR is enabled, the larger number of captured images will result in a longer capturing time. The processing time will be longer in SCENE.

Night Mode

Select the night mode to improve the quality of the color photos in relatively dark lighting conditions. The image noise will be reduced in low light situations. However, enabling the night mode will increase the scan duration significantly.



NOTE: The best scanning results can be achieved if **Night Mode** is enabled along with **Horizon Weighted Metering** or **Zenith Weighted Metering**. However, very dark lighting conditions may lead to a poor picture quality even if night mode is activated. This can lead to grainy images and other artifacts.

Speed Mode

Select the Speed Mode to reduce the scan duration at the cost of a reduced color picture quality. It cannot be combined with the HDR or Night Mode feature.

Advanced Settings

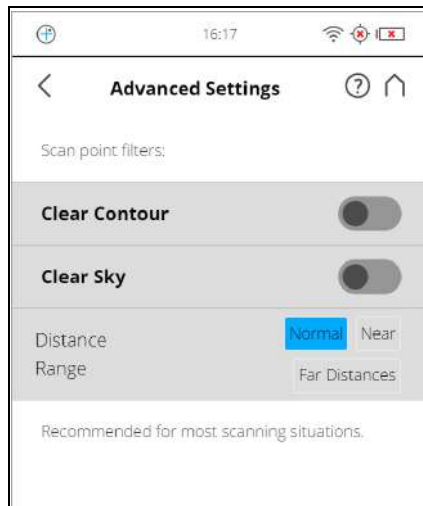


Figure 6-22: Advanced Scanning Settings

Clear Contour - Enables the dynamic contour filter. This hardware filter removes scan points resulting from hitting two objects with the laser spot, which mainly happens at the edges of objects.

Clear Sky - Enables the dynamic sky filter. During scanning, this hardware filter will remove scan points resulting from scanning empty spaces in the sky.

Distance Range - The Distance Range setting configures the scanner to increase the quality of the points captured at specified distances.

- **Normal** - Select this option to scan most objects.
- **Near** - Select this option to scan near objects.
- **Far Distances** - Select this option when scanning outer spaces where the scan surfaces are located at distances greater than 20 meters from the scanner position. This setting is not recommended when scanning indoors.



NOTE: The Far Distances option is not available on all scanner models. See *Differences between the scanners* on page 12.

Recommended Settings - Enables the Clear Contour and Clear Sky filters. Disables Far Distance Optimization.

6.8.2 Scanning Parameters Overview

The following table shows the scanning parameters and net scan time for all the resolution and quality settings that are available.

Resolution	Quality	Mio. Pts (full scan)	Net Scan Time	Point Distance	pt/360°
1/1	½x	699.1	0:07:22	1.5mm/10m	40,960
1/1	1x	699.1	0:14:38	1.5mm/10m	40,960
1/1	2x	699.1	0:29:07	1.5mm/10m	40,960
1/1	3x	699.1	0:58:19	1.5mm/10m	40,960
1/1	4x	699.1	1:57:18	1.5mm/10m	40,960
1/2	½x	174.8	0:02:02	3.1mm/10m	20,480
1/2	1x	174.8	0:03:49	3.1mm/10m	20,480
1/2	2x	174.8	0:07:23	3.1mm/10m	20,480
1/2	3x	174.8	0:14:36	3.1mm/10m	20,480
1/2	4x	174.8	0:29:07	3.1mm/10m	20,480
1/2	6x	174.8	1:57:18	3.1mm/10m	20,480
1/4	1x	43.7	0:01:15	6.1mm/10m	10,240
1/4	2x	43.7	0:02:01	6.1mm/10m	10,240
1/4	3x	43.7	0:03:45	6.1mm/10m	10,240
1/4	4x	43.7	0:07:21	6.1mm/10m	10,240
1/4	6x	43.7	0:29:06	6.1mm/10m	10,240
1/4	8x	43.7	1:57:18	6.1mm/10m	10,240
1/5	2x	28.0	0:01:24	7.7mm/10m	8,192
1/5	3x	28.0	0:02:29	7.7mm/10m	8,192
1/5	4x	28.0	0:04:46	7.7mm/10m	8,192
1/5	6x	28.0	0:18:40	7.7mm/10m	8,192

Resolution	Quality	Mio. Pts (full scan)	Net Scan Time	Point Distance	pt/360°
1/8	2x	10.9	0:00:48	12.3mm/10m	5,120
1/8	3x	10.9	0:01:06	12.3mm/10m	5,120
1/8	4x	10.9	0:01:57	12.3mm/10m	5,120
1/8	6x	10.9	0:07:22	12.3mm/10m	5,120
1/8	8x	10.9	0:29:07	12.3mm/10m	5,120
1/10	3x	7.0	0:00:49	15.3mm/10m	4,096
1/10	4x	7.0	0:01:19	15.3mm/10m	4,096
1/10	6x	7.0	0:04:46	15.3mm/10m	4,096
1/10	8x	7.0	0:18:40	15.3mm/10m	4,096
1/16	3x	2.7	0:00:34	24.5mm/10m	2,560
1/16	4x	2.7	0:00:40	24.5mm/10m	2,560
1/16	6x	2.7	0:01:57	24.5mm/10m	2,560
1/16	8x	2.7	0:07:22	24.5mm/10m	2,560
1/20	4x	1.7	0:00:32	30.7mm/10m	2,048
1/20	6x	1.7	0:01:19	30.7mm/10m	2,048
1/20	8x	1.7	0:04:46	30.7mm/10m	2,048
1/32	4x	0.7	0:00:28	49.1mm/10m	1,280
1/32	6x	0.7	0:00:40	49.1mm/10m	1,280
1/32	8x	0.7	0:01:57	49.1mm/10m	1,280

6.8.3 Starting a Scan

Remember that the scanner is turning and the mirror unit is rotating with high speed. Ensure that the scanner can move freely and that no objects can touch the mirror unit.

Start the scan by tapping on the **Start Scan** button on the **Home screen** of the controller software

If there is not enough space on the SD card, you will be warned and the scanner will refuse to scan. In this case, remove scan data from the memory card or insert a new card and try again.

When the scan process starts, the laser of the scanner will be switched ON and the scanning view will be displayed. The scanner's LEDs blink red as long as the laser of the scanner is switched ON. During scanning, the scanner rotates clockwise by 180°. If you are scanning with color, the scanner will continue to turn 360° to take the pictures.



NOTE: If pictures are taken that include objects that were *not* scanned by the laser (e.g., if a person or vehicle moves into the camera's field of view at the wrong time, you can retake those pictures if this feature is enabled before scanning. For more information, see *Retaking Pictures* on page 131.

The executed processing steps are displayed in the status area of the scanning screen, the time remaining is indicated by a timer. Tap the drop-down tab to display more information about the scan. Figure 6-23 shows the expanded tab.

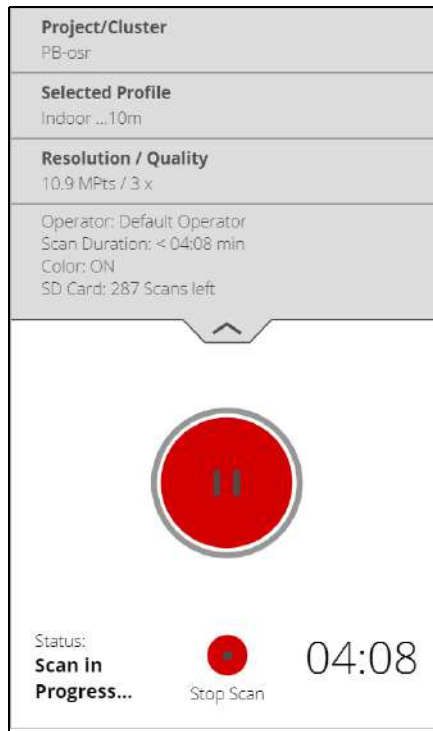


Figure 6-23: Scanning View

During most of the scanning process, you can pause a scan using the scan pause button. You might want to pause to avoid scanning a moving object, such as a car or piece of machinery. Resume scanning by tapping the resume scanning button. Avoid pausing the scan while the scanner is scanning a target. Pausing and resuming a scan directly on a target can cause automatic target detection to fail for that target. Note, too, that it is essential that the scanner remain absolutely motionless when paused, and that it is recommended to pause it via a connected browser, rather than tapping the scanner's screen.

To stop a scan, touch the **Stop Scan** button in the scanning view. You will then be asked to keep or delete the incomplete scan.



NOTE: After having completed scanning and capturing the pictures, depending on environmental conditions, the scanner may make another full turn to capture inclination data. It is important **NOT** to move the scanner while it is capturing the inclination data, or the inclination data of the scan may be inaccurate and may not be usable for the scan registration.

As soon as the entire scanning process is complete, the scanner plays a notification sound (if not turned off in the settings) and a new screen appears

with a preview picture of the captured scan. Now, you may move the scanner to the next scan position and start a new scan.



Figure 6-24: Scan Preview

The scan preview shows a grayscale picture of the captured scan to verify the scan itself and to check if all objects (e.g., targets) are clearly visible. This preview does not show color. The preview may contain also detail scans that belong to the same scan group. (For more information, see See *Scan Groups* on page 129.)

Parameters button - Tap to change the scanning parameters for the next scans.

Start Scan button - Start a scan.


Tap the **Info** button (i) in the pop-up dialog of a selected detail scan to view the scan properties.

Delete button (trash icon) - Delete the displayed scan. In case of scan groups only the primary scan (as named in the title) will be deleted. Embedded detail scans are not affected.

Delete button in the pop-up of detail scans - Delete the selected detail scan.

Add Scans to Group button (↻) See *Scan Groups* on page 129.

Use the mouse-wheel (or pinch gestures) to zoom in the preview image

The **Reset Zoom** button  is only visible when you zoom into the scan picture. With this button the scan picture can be zoomed back to its original size.

When zoomed in you can move the zoomed picture by dragging it with your fingers in any direction.

The **Inclination** in degrees is displayed in the header bar

The following inclination warning message is displayed if the current inclination of the scanner is above 5°.

Strong scanner inclination

Inclination of the scanner is not within +/- 5°. This could result in slightly inexact scan measurements.

Try to position the scanner so that its inclination is between +/-5°. To get reliable measurements from the built-in dual axis compensator you should set up the scanner with an inclination less than 5° before starting your next scan. For this, you may use either a bubble inclinometer at the tripod or the inclinometer screen. Tap this button to get to the inclinometer screen.

6.9 LED Behavior

Scanner Status	LED at Power ON/OFF button
Scanner off, external power supply not connected	off
Regular boot process	flashes blue and fast
Battery operation	constantly blue
Power On/Off	flashes blue

Scanner Status	LED next to the battery
Scanner off, external power supply not connected	off
Regular boot process	flashes blue and fast
Battery operation	constantly blue
Low battery operation at battery state less than 10%	flashes blue
Low battery operation at battery state less than 5%	flashes violet
AC adapter operation only (no battery)	green

Scanner Status	LED next to the battery
Battery charging, state of charge is above 90% (charge done)	cyan
Battery charging	orange
Battery charging, state of charge less than 10%	flashes orange
Battery charging, deep discharge	flashes red
Unknown power source. Battery and AC adapter are not detected	constantly red

6.10 Data Security

Scans are **hashed and cryptographically signed** to make it possible to detect whether the recorded scan data has been modified. The hash value of a scan can be manually checked on the scanner GUIs *Scan Properties* page. In addition, the hash and signature of a scan can be verified with an external tool that is available on FARO's Knowledge Base (knowledge.faro.com/Hardware/3D_Scanners/Focus/Scan_Verification_Tool_Download_and_Manual).

6.11 Shutting Down the FARO Laser Scanner

To shut down the FARO Laser Scanner, press its **Power On/Off** button for **2 or 3 seconds** or tap the **Power** button in the user interface drop-down list under *Home*. The top LEDs will start blinking blue. As soon as the FARO Laser Scanner has finished the shutdown process the LEDs will stop blinking and you can safely remove the battery and the power supply.

CAUTION



Damages to the scanner's internal PC and loss of data.

Do not turn off the power of the FARO Laser Scanner before the shut down cycle is complete.

The FARO Laser Scanner has an integrated PC with a hard drive. This internal PC must be shut down before turning off the power supply. If the power supply is disconnected or switched off without the FARO Laser Scanner being previously shut down, it may damage the internal PC and might lead to a loss of data.

If the FARO Laser Scanner has not been shut down properly, the next boot process could take more time as usual as the FARO Laser Scanner might check its hard disk for errors.

Pressing and holding the button more than 10 seconds will switch the FARO Laser Scanner off without shutting down. Use this option only if the FARO Laser Scanner does not shut down regularly because of a malfunction.

6.12 Powering Off the FARO Laser Scanner

Once the FARO Laser Scanner has been completely shut down, remove the battery and secure the equipment in protective cases.

1. Open the battery compartment cover.
2. Release the interlock mechanism of the charger to release the battery.
3. Remove the battery.
4. Close the battery compartment cover.

Chapter 7: Controller Software

7.1 General Elements

7.1.1 Status Bar



Figure 7-1: Status Bar

- ① **Inclinometer shortcut**
- ② **Clock** - shows the current time of the scanner. See [Setting the Date and Time](#) on page 41 for information on how to change the date and time of the scanner.
- ③ **WLAN** is turned on, and the signal strength is displayed.









④ **SD card status**

	SD card is busy. Do not remove the SD card from the scanner while it is busy, otherwise you risk corrupting the data on the card.
	No SD card inserted.
	SD card is write-protected. Remove write protection to be able to scan with this card.
	Unknown SD card inserted. The card cannot be read. This might be due to the SD card being formatted in an unsupported file system. You should format the SD card with the scanner's format function. See <i>SD Card</i> on page 107.

⑤ **GPS signal**

	GPS signal available.
	No GPS signal, or vague position.

- ⑥ **Battery** - shows the status and charge state of the internal battery:

	Battery is fully charged.
	Charge state > 75% and < 100%.
	Charge state > 50% and < 75%.
	Charge state > 25% and < 50%.
	Charge state > 10% and < 25%, you should switch the batter as soon as possible.
	Battery is almost empty; FARO® Laser Scanner will automatically shut down within the next minutes.
	Battery is charging.
	No battery in the FARO® Laser Scanner.

The exact charge state of the battery can be viewed under Home > Manage > General Settings > [Power Management](#) (see [Power Management](#) on page 93).

If the charge state of the battery is below 25 percent, you will get a warning. Switch to the spare battery as soon as possible.

If the charge state of the battery reaches 10 percent, the FARO® Laser Scanner will stop scanning and will automatically shut down.

⑦ Shows the exact amount of charge remaining in the battery

7.1.2 Navigation Bar

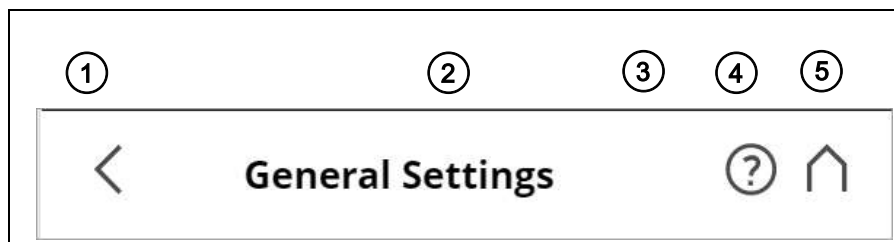



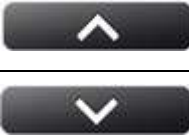




Figure 7-2: Navigation Bar

- ① **Back** - returns you to the previous screen.
- ② The name of the screen that is currently shown.
- ③ **Errors and Warnings** - this button only appears if warning or errors are present. Tapping the button opens a screen that informs about details of the existent warnings or errors. See *Errors and Warnings* on page 106.
- ④ **Help** - opens the online help of the currently active screen and provides access to the User Manual. See *Online Help and Notifications* on page 114.

⑤ **Home** - returns you to the Home screen. See *Home Screen* on page 62.

7.1.3 Frequently Used Buttons

	Add button. Adds new scan profiles, projects or operators.
	Duplicate button. Adds new scan profiles, projects or operators by duplicating the selected list element.
	Delete button. Deletes selected list elements, like projects, scan profiles or operators. This button is grayed if the selected list element can not be deleted.
	Scroll up and down buttons. Appear on the bottom of the screen if the content of a screen exceeds the screen height. Tap the button to scroll the screen up or down.
	A arrow on buttons indicates that this button opens a new screen with further details or settings.
	On/Off slider. Used to turn functions on or off. Here, the function is turned on.

7.2 Home Screen



Figure 7-3: Home Screen

- ① **Start Scan** button - Starts a scan. See *Starting a Scan* on page 53.
- ② **Parameters** button - Opens the dialog to select another scan profile and to edit the current scanning parameters. For more information, see *Setting the Scanning Parameters* on page 44.
- ③ **Info box** - Tap the arrow button underneath **HOME** to show or hide the info box. The info box informs about the currently selected operator, project, and scan profile. It also shows information about the current scanning parameters resolution in megapoints, quality, scan duration and color.

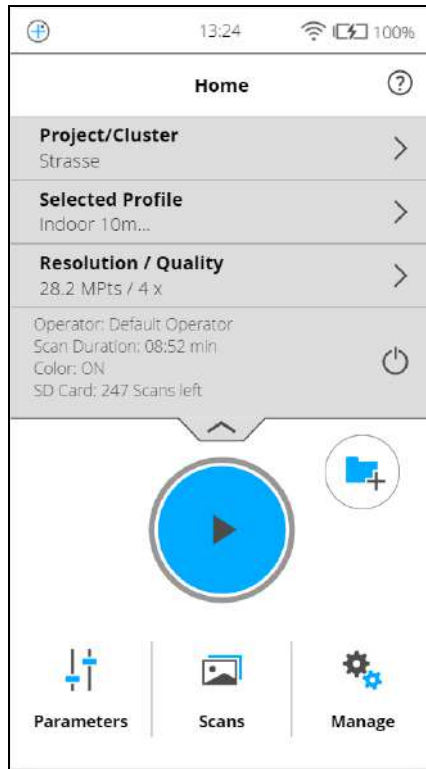


Figure 7-4: Home Screen with Info Box

- ④ **Add cluster** button - Tap to add a cluster to the currently selected project.
- ⑤ **View Scans** button - Preview the scans that are stored on the SD card. See *View Scans* on page 113.
- ⑥ **Manage** button - Manage scan profiles, projects, operators, and the scanner. See *Manage* on page 72.

- ⑦ **Scan Mode** button - Tap or swipe to access the on-site registration scan mode.

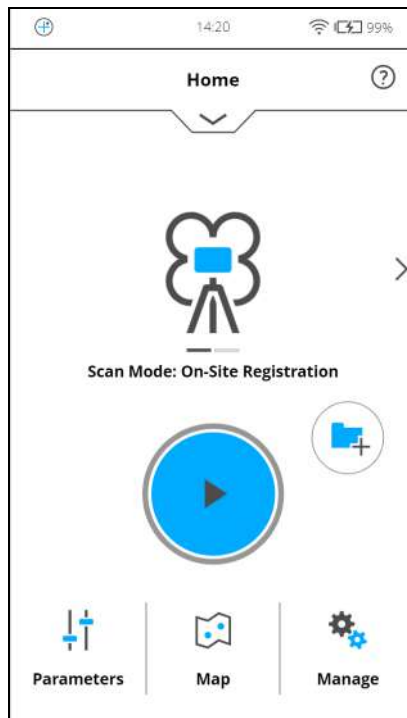


Figure 7-5: On-Site Registration home screen

7.3 Scan parameters

Scanning parameters like resolution, quality or the scanning angles are the parameters used by the scanner for recording the scan data.

There are two ways to set the scanning parameters:

- by changing them manually
- by selecting a scan profile which is a predefined set of scanning parameters.

To select a predefined scan profile or to change the scanning parameters, tap the **Parameters** button on the **Home** screen.

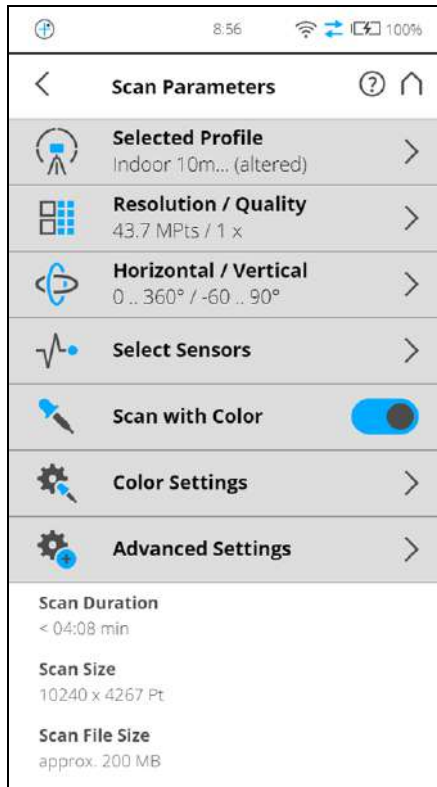


Figure 7-6: Change the Scan Parameters

7.3.1 Selected Profile

Shows the name of the selected scan profile. Tap to select a scan profile. If the scanning parameters differ from the selected profile, **altered** is appended to its name.



NOTE: Selecting a predefined scan profile overwrites all current scanning parameters with the settings of the selected scan profile.

7.3.2 Resolution and Quality

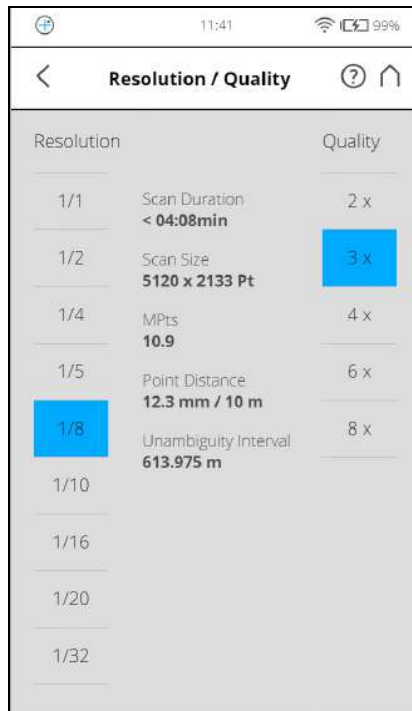


Figure 7-7: Scan Parameters, Resolution, and Quality

Displays the selected resolution in megapoints, and the selected quality. Tap the button to change these values.

7.3.3 Horizontal and Vertical Scan Range

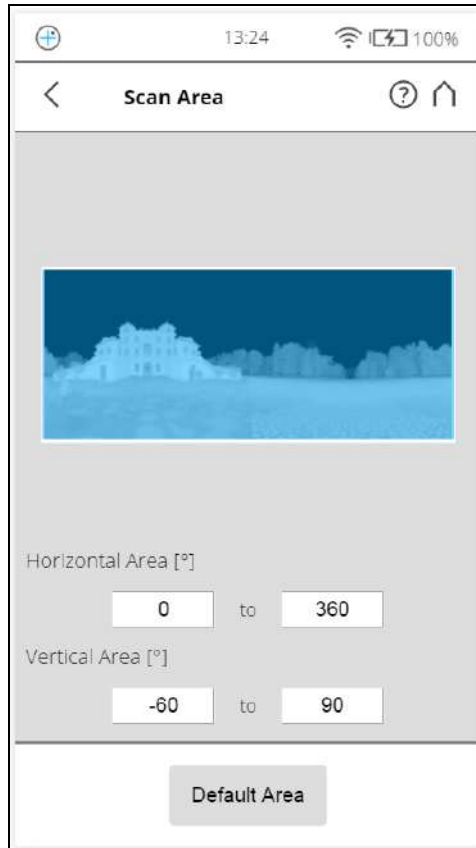


Figure 7-8: Scan Parameters - Scan Area

Displays the scan range with the horizontal and the vertical start and end angles in degrees. Tap to adjust them.

7.3.4 Select Sensors

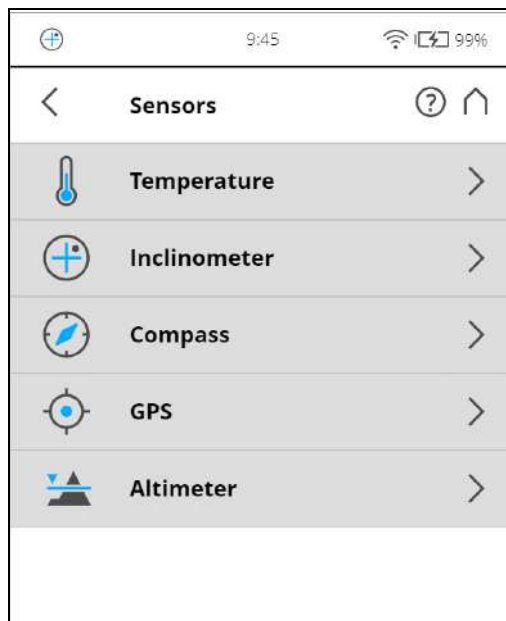


Figure 7-9: Scan Parameters - Select sensors

Opens the screen to enable or disable the automatic use of the data of the built-in sensors and external Scan Localizer for the scan registration in SCENE.



NOTE: When Scan Localizer option is enabled, the GPS option must be disabled and vice versa.

7.3.5 Scan with Color

Switch colored scan recording on or off. If switched on, the scanner will also take color photos of the scanned environment with the integrated color camera. These photos will be taken immediately after the laser scan and will be used in the point cloud processing software SCENE to automatically colorize the recorded scan data.

7.3.6 Color Settings

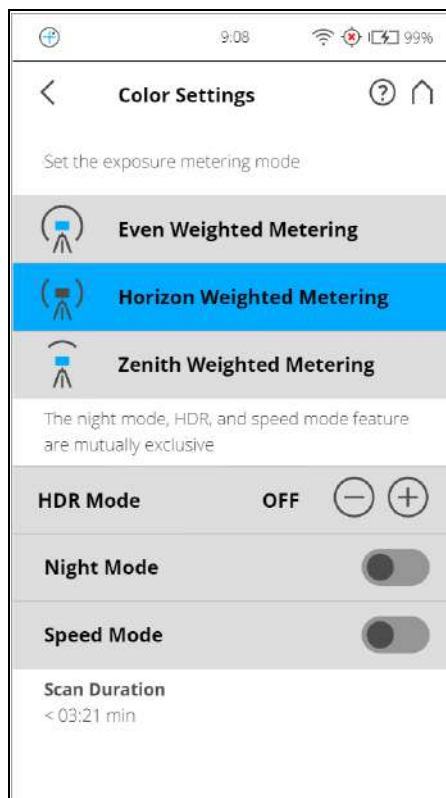


Figure 7-10: Scan Parameters, Color Settings

Set the exposure metering mode - Sets the way in which the integrated color camera determines the exposure for taking the color photos (if colored scan recording is switched on). Select between three exposure metering modes to meet the requirements of the current lighting conditions and to get best possible results for the area of interest.

Even Weighted Metering - To determine the exposure settings, the camera will use the light information coming from the entire scene and averages

without giving special weighting to a particular area. Use this setting in scenarios with even lighting conditions.

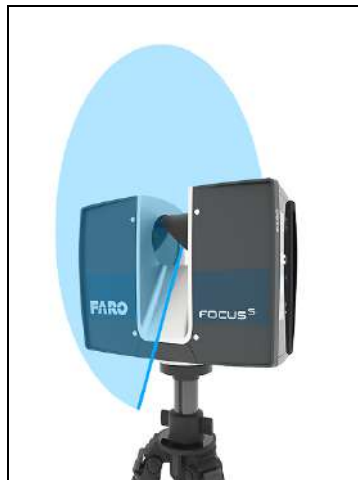


Figure 7-11: Even weighted metering

Horizon Weighted Metering - With horizon weighted metering mode, the camera will use the light information coming from the horizon to determine its exposure setting. This mode is commonly used in scenarios with bright light coming from directly above (e.g., indoors with bright ceiling lighting or outdoors with bright sunlight coming from directly above) and if you want to achieve the most correct balance of light and exposure for objects at the horizon. This mode is the default setting. Compared to even weighted metering, this mode will increase scan duration by approximately 14 seconds.



Figure 7-12: Horizon weighted metering

If the vertical scan area is limited, then the area used to determine the exposure (i.e., the exposure metering area) might move away from the horizon. This is the case if the vertical start angle is set to a value $> -30^\circ$ or if the vertical end angle is set to a value $< 30^\circ$. The exposure metering area will

then be moved up or down and set to the center of the remaining vertical scan area. The following figures illustrate this behavior.

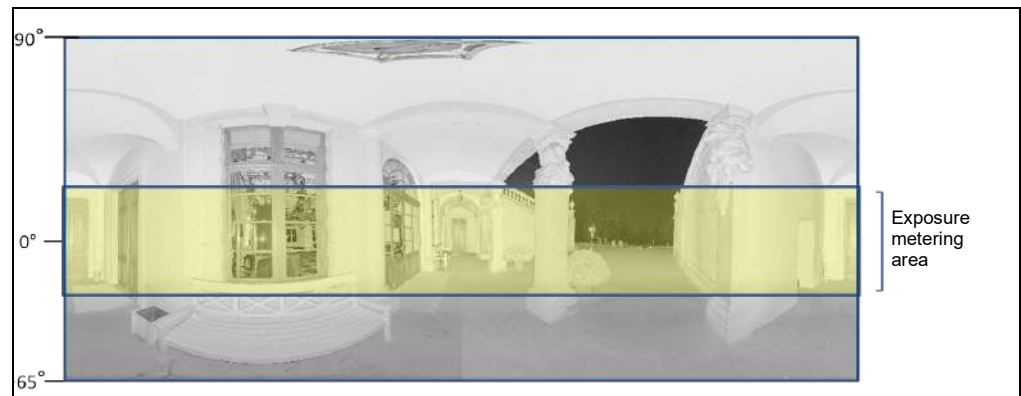


Figure 7-13: Exposure metering area (highlighted yellow) for the full vertical scan area



Figure 7-14: Exposure metering area for a limited vertical scan area set to e.g., 10° to 90°

Zenith Weighted Metering - With zenith weighted metering, the camera will use the light information coming from above the scanner to determine its exposure setting. Use this mode if there is very bright light coming from windows or other sources, and if you want to achieve the most correct balance of light and exposure for objects at the ceiling of building (e.g., for ceiling

paintings in historical buildings). Compared to even weighted metering, this mode will increase scan duration by approximately 14 seconds.



Figure 7-15: Zenith weighted metering

HDR Mode

The High Dynamic Range (HDR) imaging method merges images captured with different exposure settings to one image with a greater dynamic range of luminosity.

Scanning with HDR capturing

Set the HDR capturing by tapping the + or - button from 2x to 5x. This setting corresponds to the exposure levels. Typically, settings from 2x, 3x or 5x are sufficient for most applications. Choose OFF to disable HDR.



NOTE: When HDR is enabled, the larger number of captured images will result in a longer capturing time. The processing time will be longer in SCENE.



NOTE: The **HDR Mode** and **Night Mode** are both mutually exclusive. Enabling HDR mode will switch off night mode and enabling night mode will switch off the HDR mode.

Night Mode

Select the night mode to improve the quality of the color photos in relatively dark lighting conditions. The image noise will be reduced in low light

situations. However, enabling the night mode will increase the scan duration significantly if the **Scan with Color** option is switched on.



NOTE: The best scanning results can be achieved if **Night Mode** is enabled along with **Horizon Weighted Metering** or **Zenith Weighted Metering**. However, very dark lighting conditions may lead to a poor picture quality even if night mode is activated. This can lead to grainy images and other artifacts.

7.4 Manage

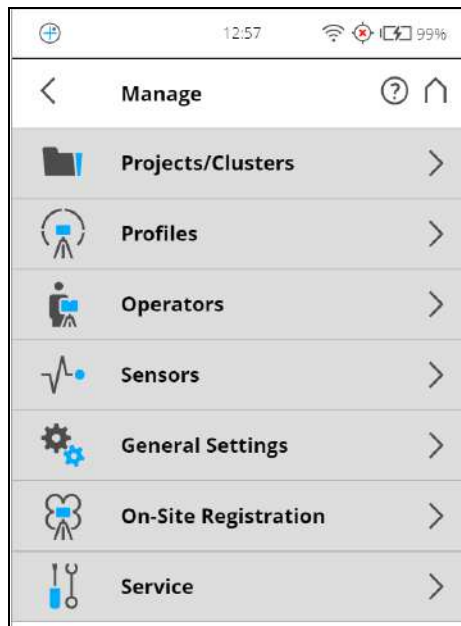


Figure 7-16: Manage

Projects/Clusters

Select the current scan project, add new or edit existing projects. Tap to get a list of all available projects.

See [Scan Projects and Clusters](#) on page 73 for additional information

Profiles

Select the current scan profile, create new or edit existing scan profiles.

See [Scan Profiles](#) on page 78.

Operators

Select the current scanner operator, create new or edit existing operators.

See [Operators](#) on page 82.

Sensors

See [Sensors](#) on page 84.

General Settings

Opens the menu of the general scanner settings.

See [General Settings](#) on page 91.

On-Site Registration

See [On-Site Registration](#) on page 104.

Service

Opens the menu for scanner services, like firmware updates, backups or viewing errors and warnings.

See *On-Site Registration* on page 104.

7.4.1 Scan Projects and Clusters

The Projects/Clusters page displays the structure of your real scan projects. A scan project can consist of a main project that has several sub-projects called clusters. For example, if you are scanning a multi-level building as a project, each floor of this building might represent one cluster and each of these floors or clusters can have further clusters, for rooms.

The structure of the scan project might then be like this:

- Office building
 - Floor 1
 - Room 1
 - Room 2
 - Room 3
 - Floor 2
 - Room 1
 - Room 2

Before starting with your scan project, you may enter this structure here. You can reproduce the complete structure of your scan project within the scanner software; or with SCENE software and transfer the project to the scanner through the SD card. Read the SCENE software manual for more information.

Once the project structure has been created, assign the single scans to the corresponding clusters. To do this, select a scan project and cluster before starting a scan. This project should correspond to the current scanner position. For example, if you take scans in the office building on floor 2, in room 2, select "room 2" from the project list and then start taking the scans in this room. The next scans are then assigned to the selected project or sub project "room 2" until you select another cluster. This information will be attached to each scan and helps SCENE to automatically combine the scans to scan clusters and thus to automate the registration of the scans. For more information on scan registration and combining scans to cluster, see the SCENE user manual.

You can enter scan projects with the controller software of the scanner or, more conveniently, with SCENE and then transfer the project to the scanner

through the SD card. Read the SCENE user manual for more information on this.



NOTE: Every project and cluster gets a unique internal identification number when it is created. Combining the scans to scan clusters during post processing in SCENE will be done according to this identification number and not on the basis of the project name. This is particularly relevant when working with several scanners on the same scan project. In this case, you must create the project structure once as a master and then transfer it to all of your scanners. Thus, it is not recommended to create or edit a project of the same scan project separately on each scanner. Even if the separately created projects and clusters have the same name, they will get different identification numbers and will be treated as different projects by SCENE.

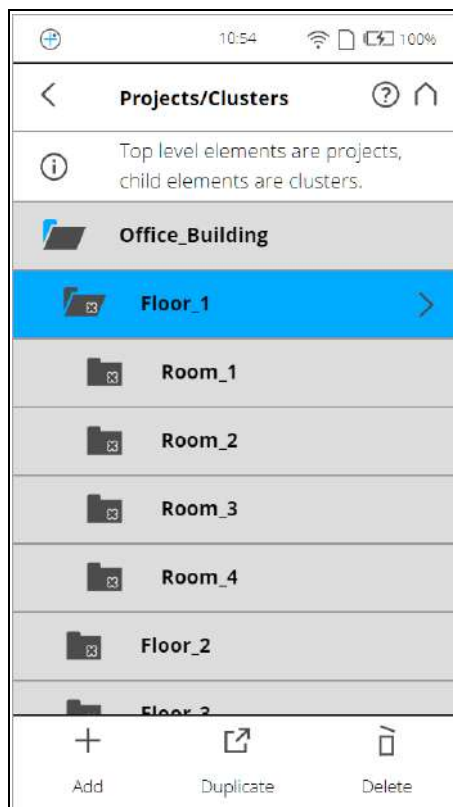


Figure 7-17: Projects List

This view shows a list of all created scan projects/clusters.

The *Default_Project* is a standard project that can be selected when working in no particular scan project. The *Default_Project* is not deletable and you can not change its name or parent project.

Add a scan project or cluster

To add a project, tap the + button at the bottom of the projects list. A new subproject called *Default_Project.1* will be added to the selected project. Tap the field to open its parameters.

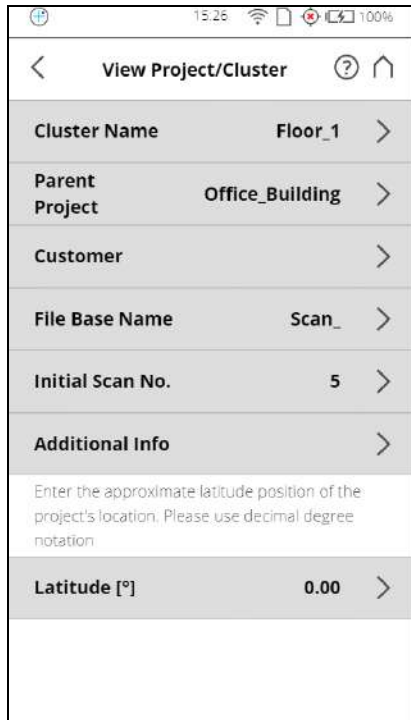


Figure 7-18: View Project

Here, you can change the name and enter further details of the new project. If you want the new project to be a main project without any parent projects, you must either change its parent project to *No Parent Project*, or select the *Default_Project* before adding the new project. With the *Default_Project*, selected new projects will be added as a main project without parent projects.

Project Name

The name of the item. Tap to change the name. A name must start with a letter and may contain letters, digits, and underscores.

Parent Project

The parent project of the displayed item. “No Parent Project” means that the current item is a project and not a cluster. Tap this button to change the parent project or parent cluster. A new screen appears with a list of all available parent projects or parent clusters. Select the parent project/cluster from this

list. The currently edited item will then be assigned as a cluster to this project/cluster.



Figure 7-19: Select Parent Project/Cluster

This view shows all available projects and clusters that are applicable to be a parent project/cluster. Tap on a button to select the parent project/cluster. The selected parent project/cluster will be highlighted.

No Parent Project

Tap this button if the project is supposed to be a project with no parent project.

Project Information

Customer

If you are carrying out the scan project for a customer, you can enter that name here.

File Base Name

The scan will be saved with a file name consisting of this base name followed by the current scan number.

Initial Scan No.

Automatically increments with each successive scan. Can be reset and can be used to indicate the number of scans per scan session.

Additional Info


Additional project information.

Latitude [°]

Enter the approximate (+/- 10° is sufficient) latitude position of the scan project. This information helps to improve the accuracy of the inclination sensor and leads to better scan registration results. Enter the latitude value in decimal degree notation.

Duplicate a scan project

Instead of adding a completely new project or cluster, you can also create new projects by duplicating existing ones. For this, select the project that you want

to duplicate and tap the **Duplicate**  button at the bottom of the list. The newly created project has the same settings and properties as the original project.

Delete a scan project

To delete a project or cluster, select it in the list and tap on the **Delete** button. If the project or cluster has subordinates, they will be deleted too.

How scan projects are saved

Scan projects are stored on the SD card. If you remove the SD card from the scanner, the entire structure of the currently selected project and cluster, as well as the *Default_Project* remain on the scanner. All other projects will be removed from the list, but will be kept on the removed SD card of course. If you insert a new SD card, the selected project will be saved to the new SD card as soon as you make changes to it, or as soon as a scan has been started. If the new SD card already contains projects, it will be added to the projects list.

Editing a Scan Project

To edit a scan project, select it in the list and tap it once again to reach to its details view.

Selecting a Scan Project

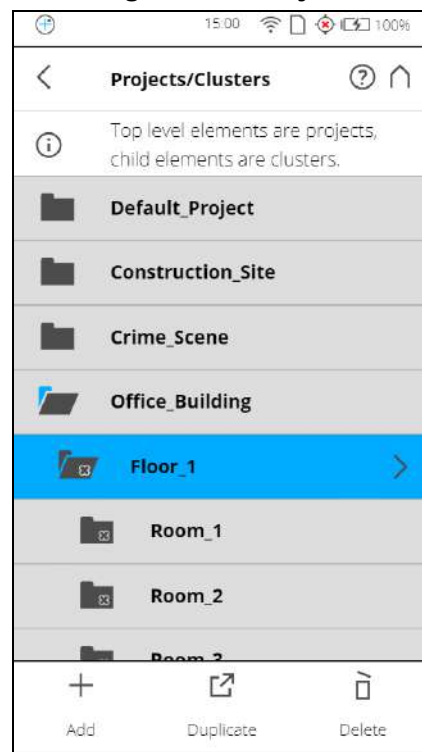


Figure 7-20: Project List




The project list contains the currently selected project and all further projects stored on the SD card.

To select a project, tap its button in the list. The selected project will be highlighted. To view or change details of the selected project, tap its button once more.

To display available clusters of a project, select it and the list will be expanded. Proceed accordingly with further clusters.

If the list of projects exceeds the screen size, scroll the list up or down with the buttons on the bottom.

Description of the icons on the project buttons:

	Project
	Cluster
	Project has clusters which are currently shown (list is expanded accordingly)

7.4.2 Scan Profiles

Selecting scan profiles to use their parameters for the next scan has already been described in *See [Setting the Scanning Parameters](#) on page 44*. This chapter will describe how to add new and how to edit existing scan profiles.

The **Profiles** page displays a context sensitive toolbar at the bottom to add, duplicate, delete, or modify profiles

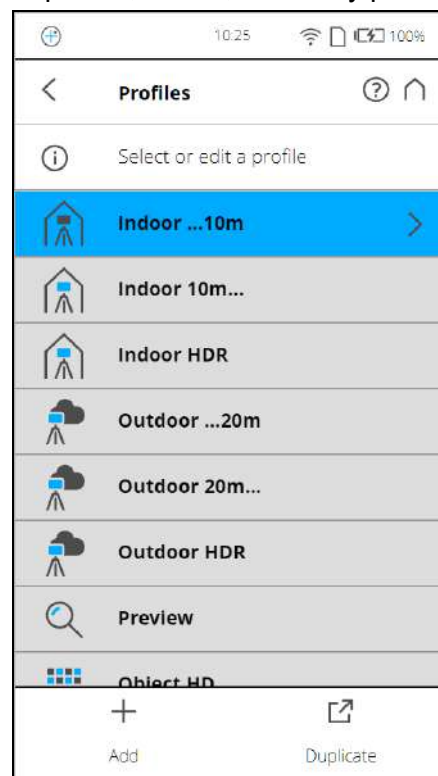


Figure 7-21: Profiles

As previously mentioned, the FARO Laser Scanner comes with factory predefined scan profiles (see [Factory Settings](#) on page 112 for an overview of the available factory predefined scan profiles). These scan profiles are read-

only and cannot be changed or deleted. But you can of course add and manage your own custom scan profiles.

This view shows all scan profiles that are available on the scanner.

To add a new profile, tap the **Add** button. You can also add new profiles by duplicating existing profiles. To do this, select the profile that you want to duplicate and tap the **Duplicate** button. Tap again on the profile. A new screen appears to enter the profile name and to adjust its scan parameters.

To delete a custom scan profile, select it and tap the **Delete** button. You cannot delete factory predefined profiles.

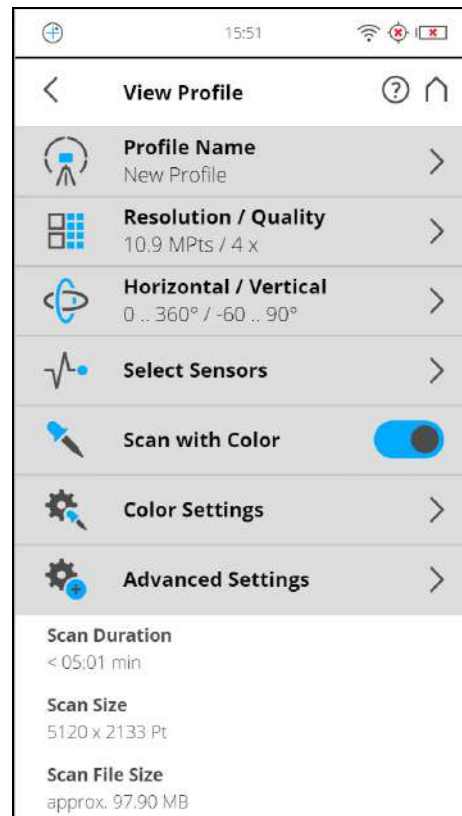


Figure 7-22: Scan Profile Details

Profile Name: name of the scan profile. Tap to change it.

The further settings in this view are similar to the settings of the scanning parameters. For more information, see *Scan parameters* on page 64.

Editing a Scan Profile

To edit a scan profile, select it in the list and tap it again to view its details. You cannot edit predefined profiles.

To view the details of the selected profile, tap once again.

Factory Predefined Scan Profiles Overview

	Indoor...10 m	Indoor 10 m...	Outdoor... 20 m	Outdoor 20 m...	Preview	Object HD
Description	Scan indoors where the distances from the scanner to the main objects of interests are less than 10 m	Scan indoors where the distances from the scanner to the main objects of interests are greater than 10 m	Scan outdoors where the distances from the scanner to the main objects of interests are less than 20 m	Scan outdoors where the distances from the scanner to the main objects of interests are greater than 20 m	Capture a fast and rough preview scan of the environment in low resolution.	Scan certain objects or areas in very high resolution. It is recommended to limit the scan area to the object or area of interest, else the scan might take very long to complete.
Quality	3x	4x	4x	4x	4x	6x
Vertical Area	-60° - 90°	-60° - 90°	-60° - 90°	-60° - 90°	-60° - 90°	-60° - 90°
Hor. Area	0° - 360°	0° - 360°	0° - 360°	0° - 360°	0° - 360°	0° - 360°
Inclinometer	ON	ON	ON	ON	ON	ON
Compass	ON	ON	ON	ON	ON	ON
Altimeter	ON	ON	ON	ON	ON	ON
Use GPS	OFF	OFF	ON	ON	ON	ON
Color	ON	ON	ON	ON	OFF	ON
Clear Contour	ON	ON	ON	ON	ON	ON
Clear Sky	ON	ON	ON	ON	ON	ON
Distance Range	Near	Near	Normal	Far Distances	Normal	Near
The following values refer to full area scans (360° horizontally / 300° vertically):						
Resolution (MPts)	11	28.2	28.2	44	2.8	176.0
Net Scan Duration (hh:mm:ss)	00:05:11	00:08:52	00:08:52	00:09:12	00:01:27	01:58:49
Scan File Size (mb)	190.70	243.88	243.88	171.18	8.53	2338.20
Scan Size (Pt)	5156 x 2134	8248 x 3414	8248 x 3414	10310 x 4268	2578 x 1068	20622 x 17066

Factory Predefined Scan Profiles Overview

	Indoor HDR	Outdoor HDR	Outdoor: Far Distances
Description	Scan indoors where the distances from the scanner to the main objects of interests are less than 20 m with HDR quality.	Scan indoors where the distances from the scanner to the main objects of interests are more, with HDR quality.	Scan outdoors where the distances from the scanner to the main objects of interests are far.
Quality	4x	4x	4x
Vertical Area	-60° - 90°	-60°...- 90°	-60° - 90°
Horizontal Area	0° - 360°	0° - 360°	0° - 360°
Inclinometer	ON	ON	ON
Compass	ON	ON	ON
Altimeter	ON	ON	ON
Use GPS	OFF	ON	ON
Color	ON	ON	ON
Clear Contour	ON	ON	ON
Clear Sky	ON	ON	ON
Distance Range	Normal	Normal	Normal
The following values refer to full area scans (360° horizontally / 300° vertically):			
Resolution (MPts)	28.2	44	44
Net Scan Duration (hh:mm:ss)	00:07.42	00:10:16	00:11:27
Scan File Size (mb)	243.88	292.95	292.95
Scan Size (Pt)	8248 x 3414	10310 x 4267	10310 x 4267



NOTE: When taking color scans, the **Night Mode** may significantly increase the exposure time and lead to a much longer overall scan time.



NOTE: Outdoor: Far Distances is not available on all scanner models. See *Differences between the scanners* on page 12.

7.4.3 Operators

Information about which scanner operator has recorded which scans might be useful for the person who is post-processing the scans; especially when there are several scanner operators working on the same scan project.

You can assign scanner operators to the captured scans. To do this, select the operator in the operators list. Create an operator profile first if it does not already exist. The information about the selected operator is then stored in the data of the next scans and can be accessed in SCENE during the post processing of the scans.

Creating an Operator Profile



Figure 7-23: Operator Profiles list

To add a new operator profile, tap the **Add** button. You can also add new operator profiles by duplicating an existing operator profile. To do this, select the operator profile you want to duplicate and tap the **Duplicate** button. Tap again to view a screen to enter the operator profile details.

To delete an operator profile, select it and tap the **Delete** button.

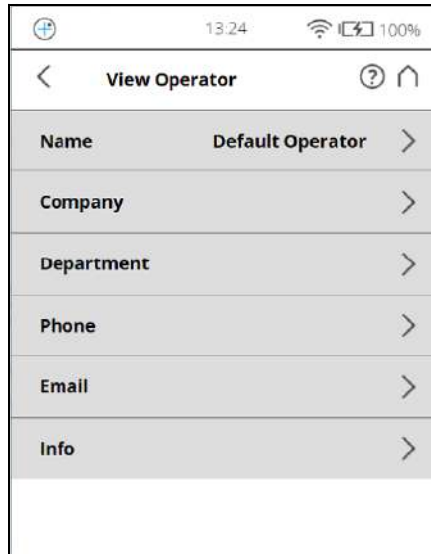


Figure 7-24: Operator Profile details

Name - The name of the scanner operator.

Company - The name of the company providing the scanning service.

Department - The department the operator works for.

Phone - The operator's phone number.

Email - The operator's email address.

Info - Any additional information required by the service provider or shift leaders, project managers, and so on.

Editing an Operator Profile

To edit an operator profile, select it in the list and tap it once again to find its details.

Selecting an Operator Profile

Select an operator profile in the list by tapping the corresponding button. The selected operator profile will be highlighted and assigned to the next captured scans until another operator profile is selected. To view or edit the details of the selected operator profile, tap its button once again.

7.4.4 Sensors

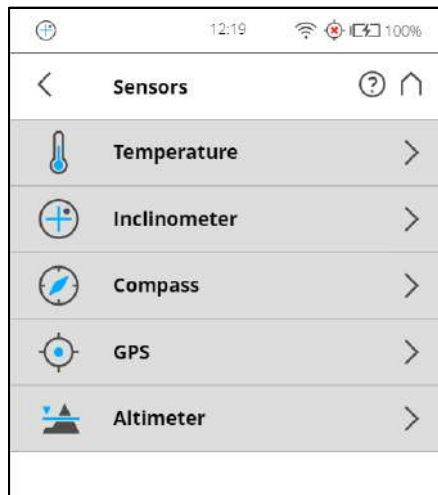


Figure 7-25: Sensors

Temperature - Tap to view the current scanner temperature and to switch the scanner's fan on or off. See *Temperature Sensors* on page 84.

Inclinometer - Tap to level the scanner. See *Inclinometer (Dual Axis Compensator)* on page 85.

Compass - Tap to view the orientation of the scanner. See *Compass* on page 87.

GPS - Tap to view details about the current GPS position and accuracy. See *GPS* on page 88.

Altimeter - Tap to view the currently measured altitude of the scanner's position and to sync the altimeter with a reference height. See *Altimeter* on page 89.

Scan Localizer - Tap to view details about the current scanner position and accuracy through Scan Localizer. See *Scan Localizer* on page 90.

Temperature Sensors

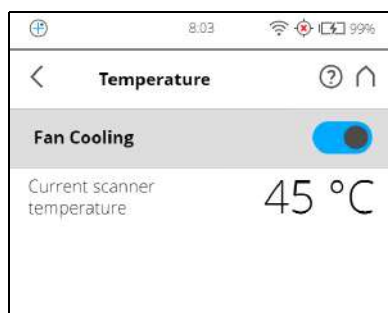


Figure 7-26: Temperature Sensors

The scanner has several integrated temperature sensors that measure the temperature at different positions inside the scanner. This screen shows the temperature of the sensor with the currently most critical value.

If a sensor is outside of the recommended operating temperature, but not yet critical, the temperature display will be highlighted in yellow. Scanning will still

be possible but it is recommended to warm or cool down the scanner until the temperature display is highlighted in green again.

If the temperature is too high or too low, the temperature display will be highlighted in red. In that case, scanning will not be possible anymore and the scanner will shut down within the next minutes.

Fan cooling switches the scanner's integrated fan on or off.

If the temperature is above the critical limit, check if the fan is switched on. If not, switch it on. The temperature should drop within a short period of time.

NOTICE



Switch the fan off in exceptional cases only!

If the fan is switched off for a long period of time, the scanner can overheat and abort scanning or be damaged.

Inclinometer (Dual Axis Compensator)

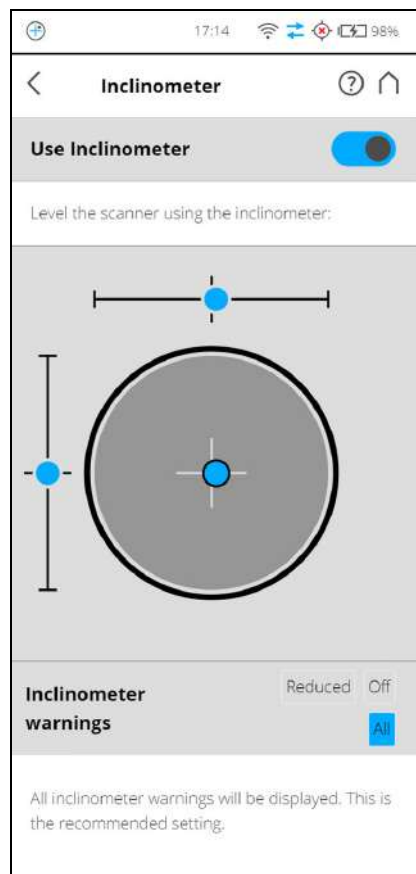


Figure 7-27: Inclinometer

Level the Scanner using Inclinometer

The view displays a bulls eye bubble level inclinometer as it would appear if mounted on top of the scanner. If the background color is gray, the inclinometer is leveled within 2 degrees. The background color of the inclinometer turns yellow, if the scanner is tilted more than 2°. In this case the accuracy of the inclination measurement is reduced.

If the inclination is larger than 5°, the background color of the level will turn red. This has two consequences: the inclinometer accuracy will be further reduced, and the scan quality may be affected.



The two linear levels describe the direction of inclination: If the bubble in the upper level is on the left side, the scanner is tilted to the right (if you are standing in front of the display). If the scanner is tilted towards you, the bubble in the left level is in the upper half.



NOTE: The inclinometer needs to know the latitude of the scanner so that it can compensate for natural variations in the earth's gravitational field. Without this information, scans in a project may have an incorrect inclination, which can increase registration errors.

If you use the inclinometer, ensure that you set the latitude for the project. See *Latitude [°]* on page 76.

Inclinometer Warnings

An Inclination Warning icon in the header bar is only visible when the current inclination of the scanner is above 2° (the icon becomes yellow)  or the icon becomes red  if the scanner is tilted more than 5°.

To get reliable measurements from the built-in dual axis compensator you must set up the scanner with an inclination less than 5° before starting your next scan. Note that inclinations greater than 2° are measured with less precision, which can affect the scan registration. To align the scanner you can use either a bubble inclinometer at the tripod or the inclinometer screen.

The displayed warnings can be configured as follows:

All

An inclinometer warning will be displayed if the scanner is tilted more than 2°. This is the recommended setting.

Reduced

An inclinometer warning will be displayed if the scanner is tilted more than 5°.

Off

No inclinometer warnings will be displayed in the header bar.

Compass

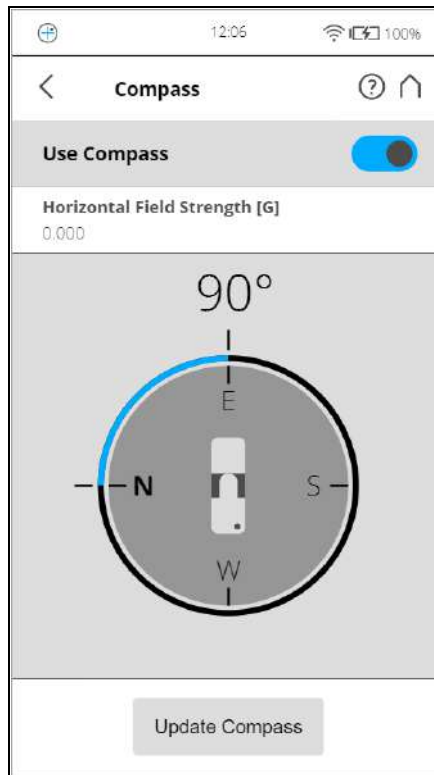


Figure 7-28: Compass

The built-in electronic compass measures the orientation of the scanner on the earth's surface which is useful information for the registration process.

This information is attached to each scan and can be used for the scan registration in SCENE (see SCENE user manual for more information).

If you want SCENE to use the compass data for the scan registration, switch the **Use Compass** button to ON, otherwise switch it to OFF. This setting affects the current scanning parameters and has the same function as the equivalent button in the parameters settings. See *Setting the Scanning Parameters* on page 44.

You can monitor the current orientation of the scanner on this screen. Initially, when entering this screen, the orientation is not displayed. To see the current orientation of the scanner, tap the **Update Compass** button on the bottom. For the measurement, the scanner needs to turn horizontally by 360 degrees. Ensure that the scanner can move freely and do not move the scanner during the measurement.

As soon as the scanner has completed the rotation and determined its orientation, a compass will be displayed as it would appear if mounted on top of the scanner. This compass illustrates the current scanner orientation. Additionally, the measured orientation value will be displayed in degrees.

To get updated orientation data, for example, if the scanner has been moved to another position, you need to tap the **Update Compass** button again.

This manual compass measurement only affects the output on this screen and it is not necessary for the orientation data measured during scanning. During scanning an orientation measurement is performed automatically.

The accuracy of compass measurements can be affected by magnetic or other environmental interference. An indicator of the strength of environmental interference and thus of the current compass measurement accuracy is the displayed **Horizontal field strength** of the magnetic field. The typical strength of the earth's magnetic field depends on geographical position and varies from 0.3 to 0.6 gauss (G). The displayed horizontal field strength is lower than the absolute field strength because of the inclination of the field. For example, the typical horizontal field strength for Europe is about 0.2 gauss.

If the measured field strength differs significantly from the expected field strength, there might be a strong artificial magnetic field near the scanner that probably affects the measurement. To get the most reliable orientation data for the scan registration, avoid positioning the scanner near to strong magnetic fields. If the measured horizontal field still significantly differs, you can switch the use of the compass data to OFF.

GPS

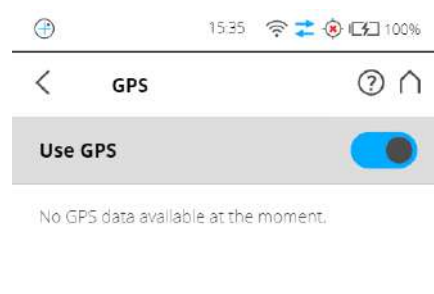


Figure 7-29: GPS

The position information of the scanner's position provided by the built-in GPS sensor is attached to each scan and is automatically used for the scan registration in SCENE, if the use of the GPS sensor is switched ON.

Use GPS - Turn the GPS sensor ON or OFF. Unlike the other sensors, GPS data is only recorded and attached to each scan if this sensor is turned ON. This function is also available under Scanning Parameters.

For more information, see *Setting the Scanning Parameters* on page 44. After the GPS sensor is switched ON, it automatically begins searching for GPS satellites. Note that it can take some minutes to find all the available satellites and to determine a precise position information. It is recommended to switch the GPS sensor OFF if it is not needed or if a GPS signal is not available (for example, if you are scanning indoor).

GPS information - Provides information about the currently measured GPS coordinates latitude, longitude, and the altitude as well as the UTC time of the last satellite contact and the number of satellites that are currently in view. The GPS receiver needs the signal of at least three satellites to calculate a 2D position (latitude and longitude). With four or more satellites in view, the receiver can determine the scanner's 3D position (latitude, longitude, and altitude).

The signal strength bars below the GPS information appear for each satellite in view with the appropriate satellite number underneath. They indicate the signal strength for each satellite.

GPS precision - Provides information about the precision of the currently measured coordinates in meters or feet. The DOP (dilution of precision) values are an indicator of the quality of the geometry of the current satellite constellation. In general, good position measurements can be achieved, when the satellites are located at wide angles relative to each other. In this case the DOP values are low. Higher DOP values indicate a poor satellite geometry which might have a negative effect on the position accuracy.

The current GPS status and signal quality is indicated by different GPS icons in the status bar of the operating software.

Before starting a scan, you should always look at the GPS icon and the indicated quality. If no GPS data is available or position deviation is high, try to find a position with better signal quality.

A limited GPS signal can have many different causes. As with portable navigation devices, make sure that the scanner always has an unobstructed view of the sky. Obstructions can block the signal reception, causing position inaccuracy or no position data. The GPS signal can also be reflected by objects (for example, buildings or mountains), causing the measured position to wander. The more satellites the sensor has in view, the better the fix is.

Altimeter

(Manage > Sensors > Altimeter)

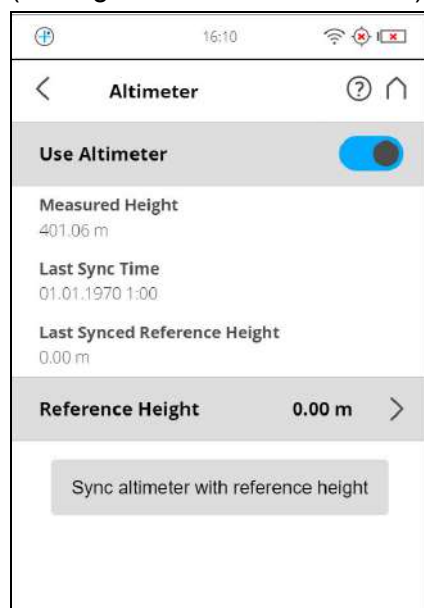


Figure 7-30: Altimeter

The barometric height sensor (altimeter) determines the altitude of the current scanner position. The altitude determination is based on the measurement of the atmospheric pressure. The measured altitude is attached to each scan and can be used for the scan registration in SCENE (see SCENE user manual for more information). If you want SCENE to automatically use the measured altitude for the scan registration, switch the **Use Altimeter** button to ON, else switch it to OFF. This setting affects the current scanning parameters and has the same function as the equivalent button in the parameters settings.

For more information, see *Setting the Scanning Parameters* on page 44.

To see the currently measured altitude on this screen, the use of the altimeter must be switched ON.

For scan registration it is sufficient to know the difference in altitude of the various scanner positions. Before starting your scan project, you should pick a position of your scanning site which you would like to use as the reference for the altitude measurements. Move the scanner to this reference position, enter any height you would like to use for this position and reset the altimeter to this reference height by tapping on the **Sync Reference Height** button. All further altimeter measurements will then be done on the basis of this reference height.

If you want comparable height measurements across different projects, you can sync the altimeter with a real altitude. For this, pick a reference position of your scanning site where you know the approximate **altitude above sea level**. You can get this value from GPS, a topographic map, or from Google Earth.

As the altimeter determines the altitude based on the measurement of the atmospheric pressure, changes in the air pressure caused by changing weather conditions have an effect on the resulting altitude. To have precise altitude measurements, you should therefore check the reference altitude from time to time, at least at the beginning of each project day or if you experience changes in the weather. To do this, move the scanner to your reference position again and compare the altitude reading with the reference height. If there is a difference, sync the altimeter with the reference height again.

Scan Localizer

The corresponding settings are also available under **Parameters > Sensors > Scan Localizer**.



NOTE: When Scan Localizer option is enabled, the GPS option must be disabled and vice versa.

7.4.5 General Settings

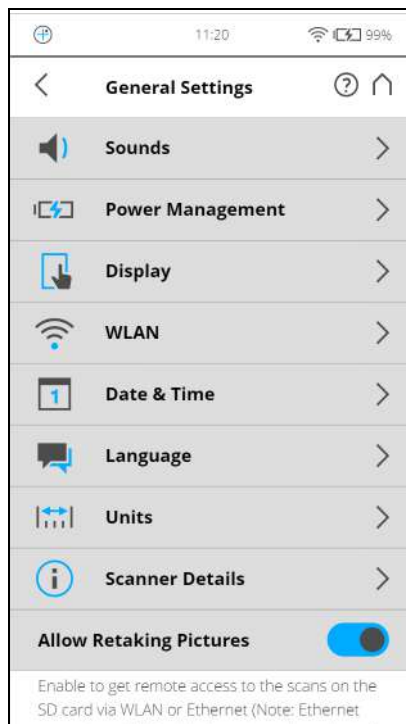


Figure 7-31: General Settings

Sounds - Change the volume of the scanner sounds, enable or disable scanner sounds.

See *Sounds* on page 92.

Power Management - View detailed settings regarding the administration of power like the battery charge level; enable or disable start on power; modify display settings to optimize power usage.

See *Power Management* on page 93.

Display - Set the brightness of the screen or change the theme of the Home screen to **Dark** or **Bright**.

See *Display* on page 93.

Date & Time - Change the displayed time and date format and change the date and time of the scanner.

See *Setting the Date and Time* on page 41.

Language - Change the language of the controller software.

See *Setting the Interface Language* on page 40.

Units - Change the displayed unit of lengths.

See *Setting the Unit of Length and the Temperature Scale* on page 43.

Scanner Details - View and change details of the scanner.

See *Scanner Details* on page 103.

Allow Retaking Pictures - Enable the functionality that allows you to retake any pictures immediately after the scan completes. Note that when this option is enabled, you must take extra steps to close the scan.

See *Retaking Pictures* on page 131.

Remote Access to Scans Enabling this function will allow you to have access to the scans on the inserted SD card on remote devices that are connected to the scanner through WLAN or Ethernet.

For more information, see *WLAN* on page 95.

NOTICE



Risk of data loss

- Use only if you're about to access scan files through network. Absolutely make sure not to remove the SD card until remote access is disabled again.
- The status of the SD card will be set to busy as long as this function is enabled. Disable it before you remove the SD card from the scanner. Remote access will automatically be disabled when shutting down the scanner, you will have to enable it again after reboot.

Sounds

The scanner has a built-in speaker. The scanner signals certain events with various sounds. You can change the speaker volume here and switch the sound effects ON or OFF.

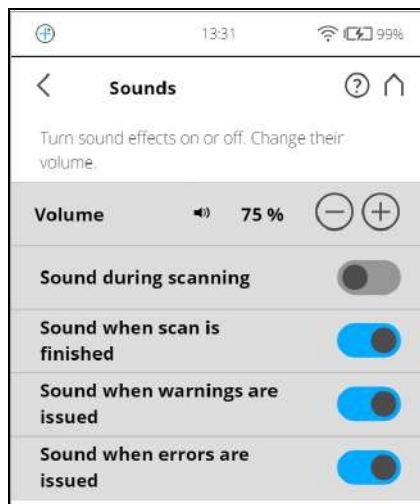


Figure 7-32: General Settings, Sounds

Volume - Increase or decrease the volume of the scanner sounds.

Sound during scanning - If switched on, the scanner will give a warning signal when laser is switched on and scanning starts.

Sound when scan is finished - If switched on, the scanner will inform about scan completion with a sound.

Sounds when warnings are issued - If switched on, the scanner produces a warning sound when a warning is issued.

Sounds when errors are issued - If switched on, the scanner produces a sound when an error is issued.

Power Management

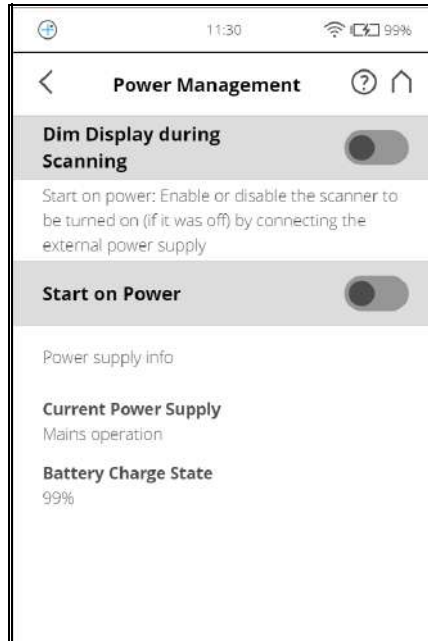


Figure 7-33: General Settings, Power Management

Screensaver - If the screen has not been touched for a certain period of time, a screensaver appears on the screen. Change the length of time before the screensaver appears by tapping the plus or minus buttons. Deactivate the screensaver by setting the time to “never”. When the screensaver is visible, simply tap the screen to return into operation mode.

Dim display during scanning - If switched on, the brightness of the screen will be decreased during scanning to save battery power. Switching this option to ON is particularly useful for long scans.

Start on Power - Enable the scanner to be turned on (if it was turned off) by connecting it to the external power supply. This option is useful, for example, for automation applications.

Power supply info - Informs about the current power supply and the exact charge state of the battery.

Display

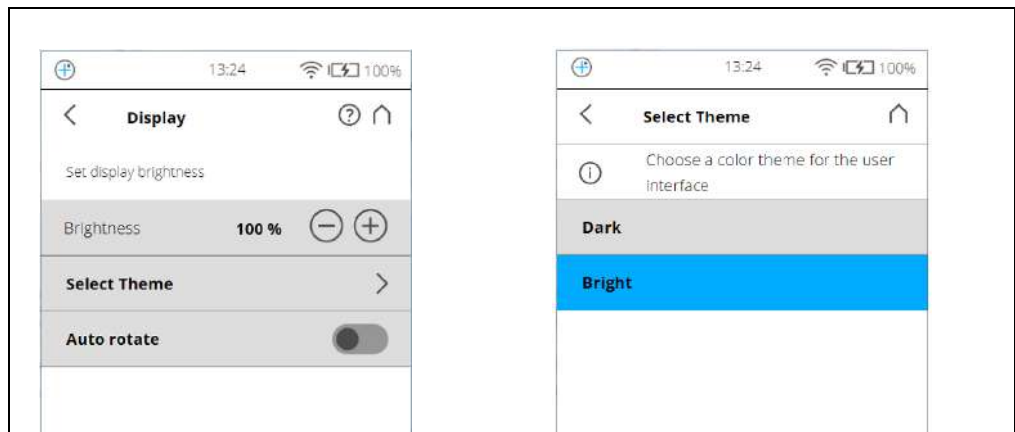


Figure 7-34: General Settings, Display

Brightness - Set the brightness of the screen.

Select Theme - Change the theme of the **Home** screen. Tap to get the screen background theme options to **Dark** or **Bright**.

Calibrate the display - If you experience the touch screen to be slightly misaligned, you can recalibrate it. Tap this button and follow the instructions on the screen that appears. We recommend using a stylus to calibrate the display. If the calibration of the touch screen is corrupted you must reset the calibration of the display to its factory settings.

- Shut down the scanner using the **Power** button.
- Wait until the scanner has shut down, then press and hold down the Power button for at least five seconds until the LED on the sensor side of the scanner illuminates yellow, then release the button again. The scanner will then boot up and reset the calibration of the touch screen to its factory settings.

Auto rotate - Turn on to let the display rotate depending on the scanner orientation. This option is helpful when the scanner is located upside down.

Date and Time

See *Setting the Date and Time* on page 41.

Language

See *Setting the Interface Language* on page 40.

Units

See *Setting the Unit of Length and the Temperature Scale* on page 43.

WLAN

The WLAN interface can be used for remote connections, especially if your scanner is not equipped with an automation interface connection.

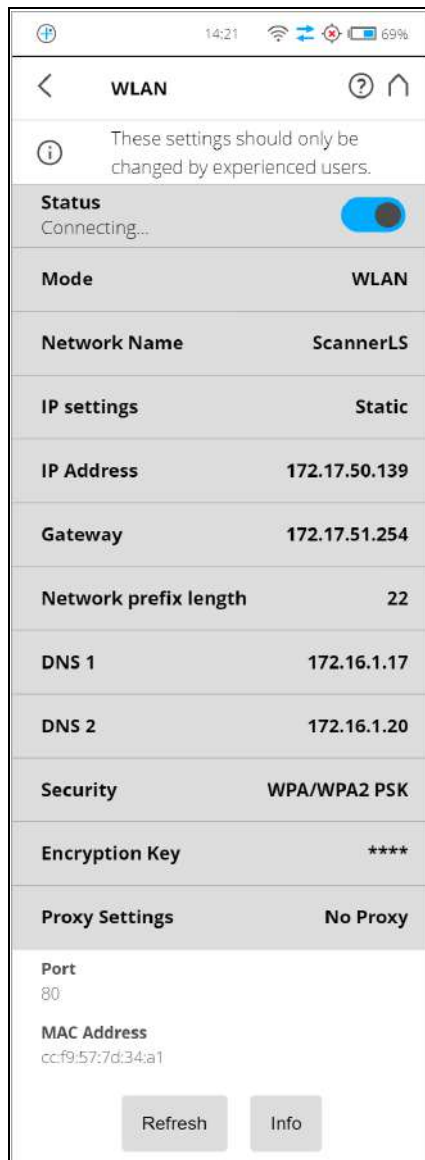


Figure 7-35: WLAN Settings

The scanner has an integrated WLAN module that allows you to remotely connect to the scanner with portable devices, such as notebooks, PDAs or tablet computers. Connect your remote device to the scanner through WLAN, and remotely access the scanner user interface with a standard web browser. The WLAN option also provides remote access to the scan files on the scanner SD memory card.

It is possible to turn WLAN off from a remote interface. Since this might disable the connection to the remote interface, a warning is displayed.



NOTE: The scanner user-interface can be accessed through the following desktop browsers: Chrome, Mozilla Firefox, Safari, Opera, Internet Explorer (Version 11). The WLAN option also provides remote access to the scan files on the inserted SD card if *Remote Access to Scans* is enabled on the “General Settings” page.

Mobile browsers: Android Chrome, Android Browser, IOS Safari. WLAN settings can only be modified on the scanner user interface, and not with the remote interface.

Changes to the WLAN settings are only possible if WLAN is turned off.

Status

Tap this button to turn ON or OFF. Indicates if WLAN is available. If WLAN is not needed, it is recommended to turn it off.

Note that changes to the WLAN settings are only possible if WLAN is turned off.

Two different WLAN operating modes are possible:

- **WLAN:** This setting is also known as infrastructure mode. The network is configured such that the scanner can connect to an external access point. Data transfer rates depend on the network and can reach 150 Mbit/s.
- **Access Point:** The scanner network is configured as an access point. The data transfer rate is limited to 54 Mbit/s.

**WLAN Mode
Scanner Settings**

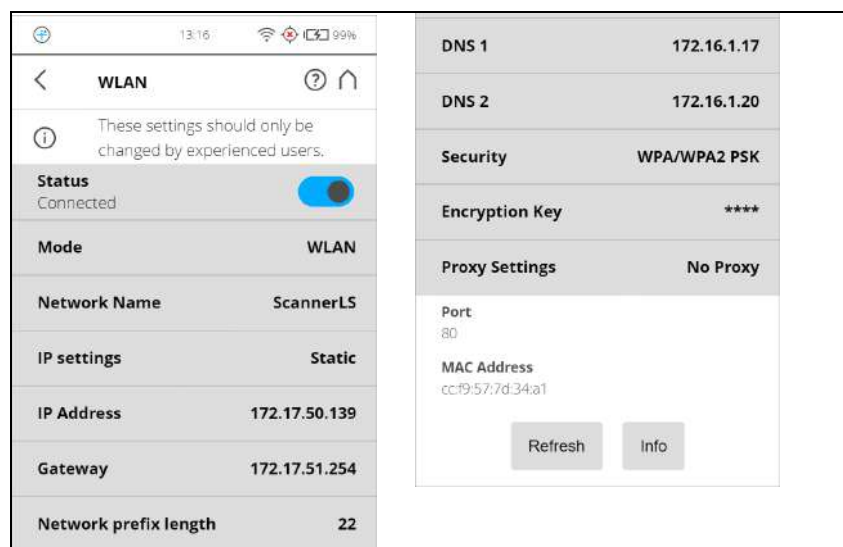


Figure 7-36: WLAN Mode

Network Name

The name of the wireless network. Tap it to enter a screen where the available networks are displayed and can be selected.

IP settings

Set a static IP Address or obtain one automatically through DHCP.

The IP settings determine whether an IP address is assigned by a server using DHCP or set manually (“Static”):

- **DHCP:** This is the default/recommended setting.
- **Static:** The IP address is assigned manually. The following settings have to be provided.

IP Address

The IP address of the scanner. A unique IP address must be preset on the WLAN network. If your remote device is connected to the scanner, enter this address into the address field of your web browser (for example, **http://172.17.16.23**) to access the controller software. Tap to change the scanner’s IP address.

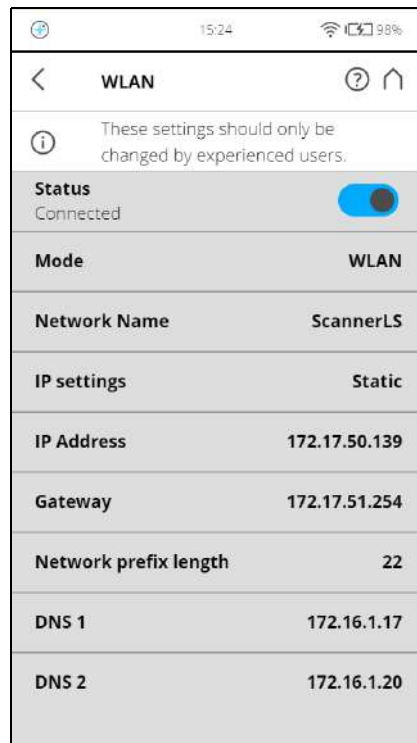


Figure 7-37: Connection to Scanner Interface through web browser

If you prefer secured, encrypted communication with the scanner GUI, enable the secure connection **https://172.17.16.23** in the address field of your web

browser. You will receive a security warning from the browser before connecting to the GUI; confirm to proceed.

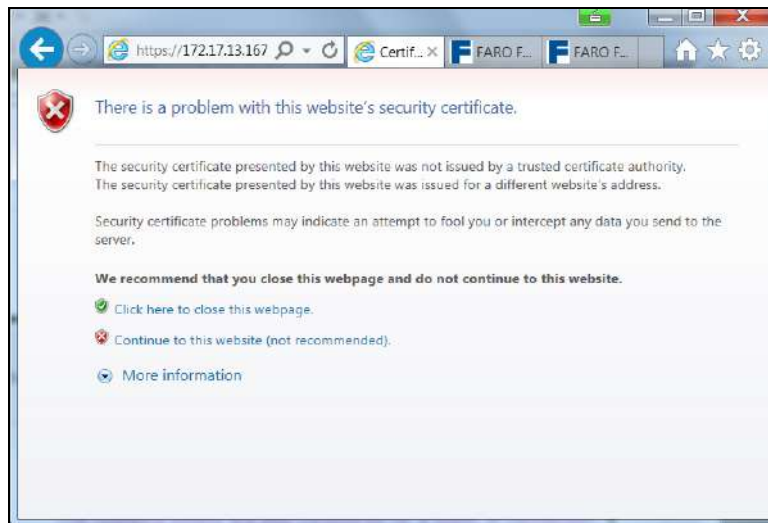


Figure 7-38: Scanner secure connection: Warning

Be aware that setting an IP address manually can result in a conflict, if two devices on the same wireless network claim to have the same IP address.

The following details are also considered for a Static IP connection:

Gateway The gateway used to access the WLAN network.

Network prefix length The subnet mask used in the WLAN network.

DNS 1 First dynamic name server to use in the WLAN network.

DNS 2 Second dynamic name server to use in the WLAN network.

Security Choose the security protocol that the access point to which the scanner will connect uses. The possible options are:

- **Open:** Connect to an open network that can be accessed by anyone without a password. The information exchange is not secured.
- **WEP:** Connect to a network that is secured by WEP. This option requires an encryption key with 8 to 63 characters. This security level is insecure.
- **WPA:** First version of the WLAN Protected Access. Not recommended.
- **WPA2 PSK:** Connect to a network that is secured by WPA2. This option requires an encryption key with 8 to 63 characters. This is the default/recommended option.

Encryption key

The scanner network is encrypted with a WPA2 key. Enter this key on your remote device when prompted to establish the connection to the scanner. If you want to change the encryption key, tap the button and enter your own key. The key must consist of 10 to 63 arbitrary digits.

Proxy Settings

Settings related to connection through a proxy.

- **No Proxy:** Don't use a proxy. Choose this option if the network that the scanner will connect to has direct Internet access.

- **Manual:** Use a manually configured proxy. Configuration includes:
 - **Host:** The host name (or IP address) of the proxy server.
 - **Port:** The port through which to connect to the proxy server.
 - **Exclusion List:** A comma-separated list of hosts for which no proxy will be used.
 - **User Name:** The user name used to log in to the proxy server (if required).
 - **Password:** The password used to log in to the proxy server (if required).

Refresh

Tap this button to refresh the WLAN settings displayed in this screen.

Reset

Tap this button to reset the WLAN settings to default.

If a connection cannot be established, the status will turn off immediately after the message “Enabling” is displayed. Check especially the Network Name and the Encryption Key when a connection in WLAN mode must be established.

Access Point Mode Settings

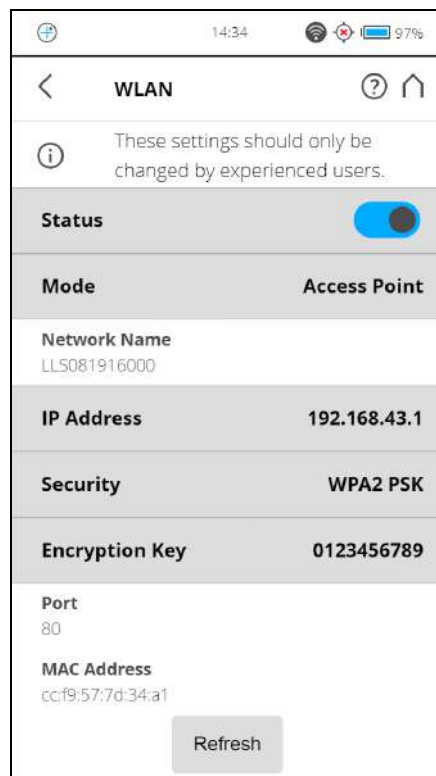


Figure 7-39: Access Point Mode Settings

The following section describes the additional or special settings for Access Point Mode.

Network Name

The name of the network that the scanner will create. The scanner serial number is used as the Network Name. Your remote device will display the scanner with this name in the list of the wireless connections. If the scanner is not listed, refresh the network list. After a few seconds the remote device will find the scanner and display it in the list.

Scanner IP Address

The IP Address of the scanner is set. Use this IP to access the remote user interface.

Update

Tap this button to update the displayed settings. This might be necessary, if a connection is lost, for example, because the scanner was out of range.

Example configuration of a notebook with Microsoft Windows**Connecting the scanner**

1. Click the wireless network button on the bottom right of the task bar. A list with the available wireless network connections appears.
2. Select the scanner network in this list (the scanner is listed with the above mentioned network name).
3. Click the **Connect** button.
4. When prompted, enter the WLAN encryption key.

Notebooks in ad hoc mode

For the WLAN running in ad hoc mode, assign a static IP address to your notebook.

- Open Control Panel > Network and Internet > Network and Sharing Center.



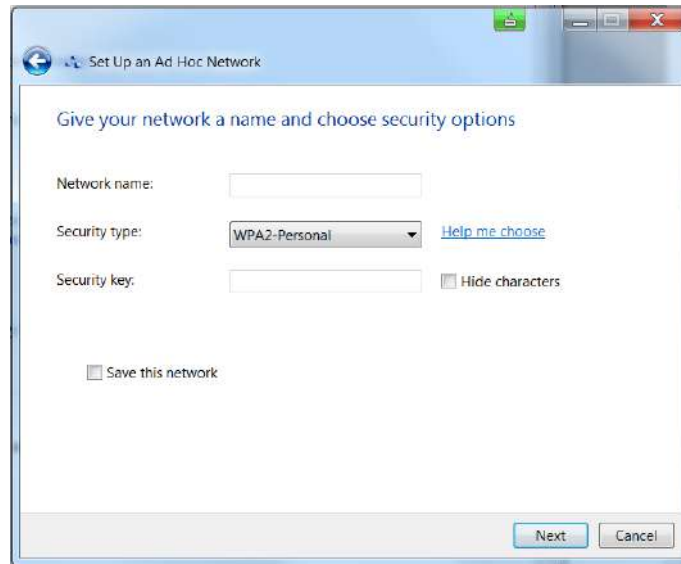
Set up a new connection or network

Set up a wireless, broadband, dial-up, ad hoc, or VPN connection; or set up a router or access point.



Set up a wireless ad hoc (computer-to-computer) network

Set up a temporary network for sharing files or an Internet connection.



- In the Internet Protocol dialog, use the option “Use the following IP address” and provide a valid IP address and subnet mask. The IP address and subnet mask of your notebook must be compatible with the scanner’s. Take the IP address of the scanner and change the last number. For example, if the scanner has 172.17.16.23, you can enter 172.17.16.100. The subnet mask must be identical to the one of the scanner. You might have to disconnect and connect again to get the connection working.

Open user interface in the web browser

- When the notebook is connected to the scanner, open your web browser.
- In the address field of the web browser enter the WLAN IP address of the scanner (for example, http://172.17.16.23 or https://172.17.16.23 for a secure connection) to access the controller software.

- The **Home** screen of the controller software appears in your web browser and you can control the scanner as usual.

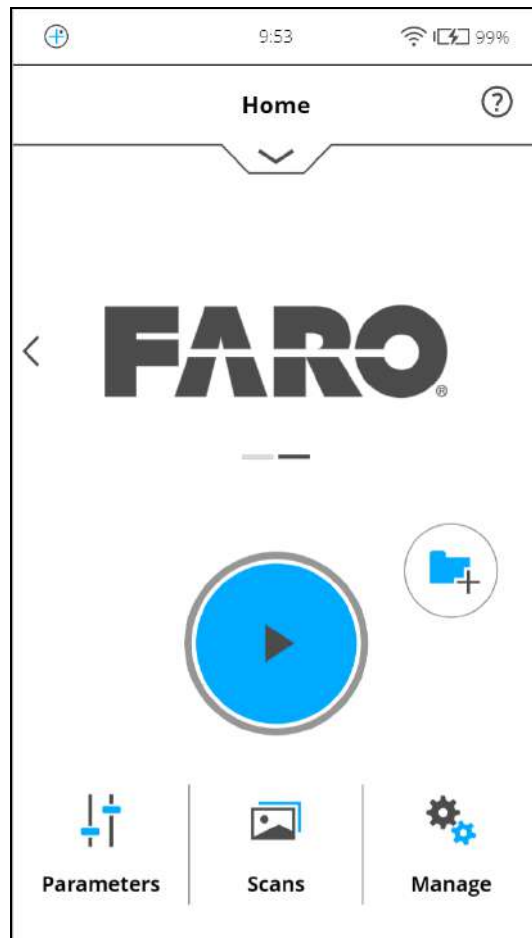


Figure 7-40: Controller software in web browser of a remote device

Remotely accessing the scans on the SD card

If you would like to access the scan files that are stored on the scanner's removable SD card from a connected remote device, enable remote access in the scanner's controller software.

1. Tap [Home](#) > [Manage](#) > [General Settings](#).
2. Open a file explorer on your remote device (for example, Windows Explorer) and enter the following address into its address bar:
ftp://WLAN_IP_ADDRESS_OF_SCANNER/Scans (for example, **ftp://172.17.16.23/Scans**). You should have access to the scans now.
3. You can download the scans to your remote device by simple file operations. Note that copying the files from the scanner through WLAN can take a while, depending on connection speed and signal strength.

Scanner Details

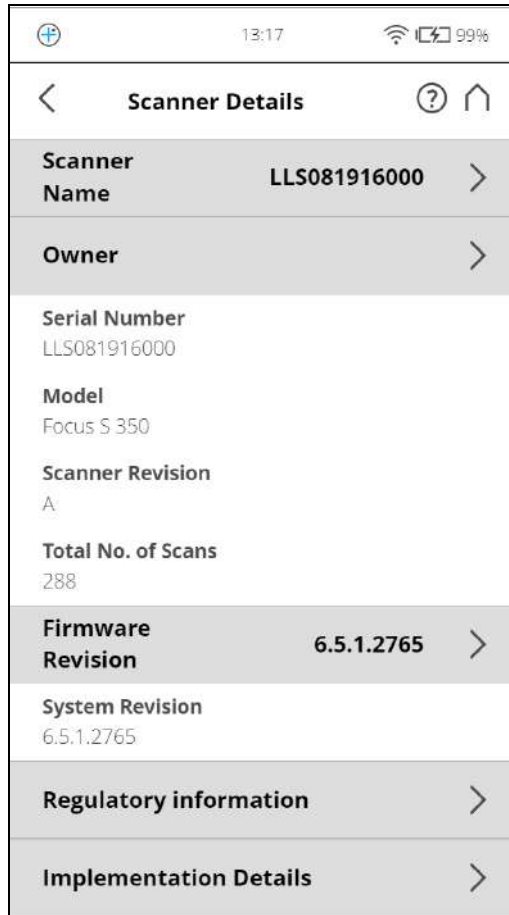


Figure 7-41: Scanner Details

Scanner Name - Give your scanner a name.

Owner - Enter the owner of the scanner.

LAN IP Address -The Ethernet IP address of the scanner.

Subnet Mask -The Ethernet subnet mask of the scanner.

Serial Number - Serial number of the scanner. This number is unique for each scanner.

Model - The scanner type.

Total No. of Scans - The total number of scans captured with this scanner.

Firmware Revision / System Revision - The revisions of the currently installed firmware and system software.

7.4.6 On-Site Registration

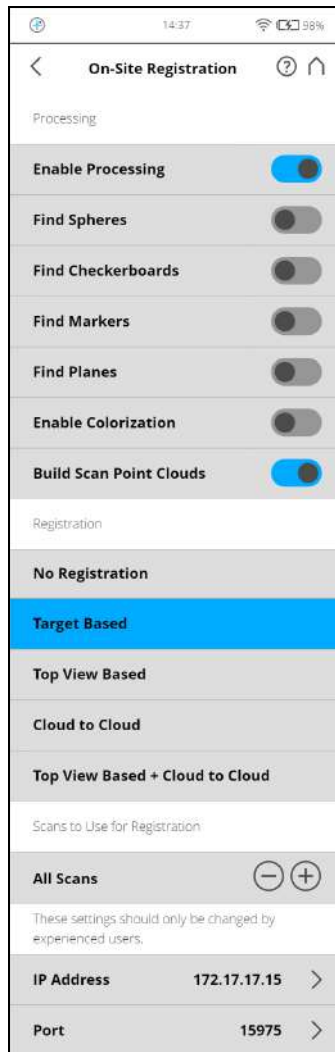


Figure 7-42: On-Site Registration Settings

This page displays the available settings to upload, process, and register scans on a connected SCENE instance.

All uploaded scans will be continuously processed and registered according to the following settings.

Refer to the *Processing* and *Registration* chapters in SCENE manual for details about the processing and registration related settings.

Processing

The Processing section contains settings that define important processing options that can be run remotely on SCENE after the scans have been uploaded.

Find Spheres

Slide to turn this option ON to automatically detect spheres in the uploaded scans. Select this setting when you use spheres as external targets for a target based registration.

Find Checkerboards

Turn this option ON to automatically detect checkerboards in the uploaded scans. Select this setting when you use checkerboards as external targets for a target based registration.

Find Markers

Turn this option ON to automatically detect checkerboards in the uploaded scans. Select this setting when you use checkerboards as external targets for a target based registration.

Find Planes

Turn this ON to automatically detect planes in the uploaded scans. This setting can improve a target based registration.

Enable Colorization

Turn this ON to enable the colorization of the uploaded scans.

Build Scan Point Clouds

Turn this ON to build a point cloud from the uploaded scans. Scan point clouds facilitate a fast visualization of scan points.

Registration

The Registration settings determine the method used to align and join the uploaded scans to each other in SCENE.

No Registration

Select this to skip the registration step.

Target based

Select this option to perform a target based registration for the uploaded scans. The target based registration uses targets to place the scans. In general, this could be artificial targets (for example, spheres, checkerboards) or natural targets. Enable the corresponding settings in the Processing section for this type of registration.

Top view based

Select this to perform a top view based registration. This method is sufficient in most cases and does not require additional targets.

Cloud to Cloud

Select this option to perform a cloud to cloud registration. This method can be used to refine the registration of scans. It can be very time consuming.

Top view based + Cloud to Cloud

Select this option to perform a top view based registration followed by a cloud to cloud registration.

Network Settings

The following settings define the network address of the computer running SCENE.

IP Address

The IP address of the computer running SCENE is automatically updated.

Port

The port number of the computer running SCENE is automatically updated.

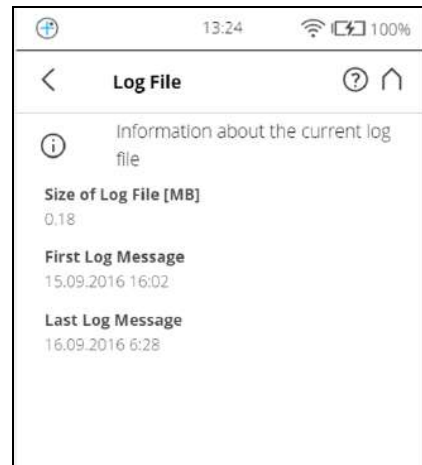
7.4.7 Service

Figure 7-43: Service

Errors & Warnings - Tap the Notifications button in the navigation bar to receive warnings and other status messages. This button will not be enabled if there are no warnings or errors. See *Errors and Warnings* on page 106.

SD Card - View details about the currently inserted SD card or format the SD card. See *SD Card* on page 107.

Log file -Export the log file to the SD card. See *Log File* on page 108.

Backup - Backup scan profiles, operators, color themes, and scanner parameters as scanner snapshots to the SD card. See *Backup* on page 108.

Restore - Restore scan profiles, operators, color themes, and scanner parameters from scanner snapshots or restore scanner snapshots that have been created with SCENE. See *Restore* on page 110.

Firmware update - Update the scanner with new firmware versions. See *Firmware Update* on page 111.

Factory Settings - Reset the scanner to its factory settings. See *Factory Settings* on page 112.

FARO Customer Support - View the FARO Customer Support contact data.

Command Prompt - Command prompt to send commands to the scanner. This function is for FARO Service purposes only.

Last Service Date - Date of the last scanner maintenance and certification service.

Errors and Warnings

This view provides a list of present warnings and errors. Tap a list item to view details of the corresponding warning or error.

Warnings and errors disappear from the list when they have been fixed.



NOTE: If an empty or full SD card is inserted, the LED turns red and a permanent notification is displayed. However, when the SD card is removed, both warnings remain active until the scanner is shut down.

This screen shows a description of the warning or error and provides a possible solution to solve the problem.

Warning ID / Error ID - The identification number of the warning or error.

Description - A detailed description of the warning or error.

Possible solution - The notifications consist of an ID followed by a detailed description of the warning or error and a possible solution to solve the problem.

SD Card

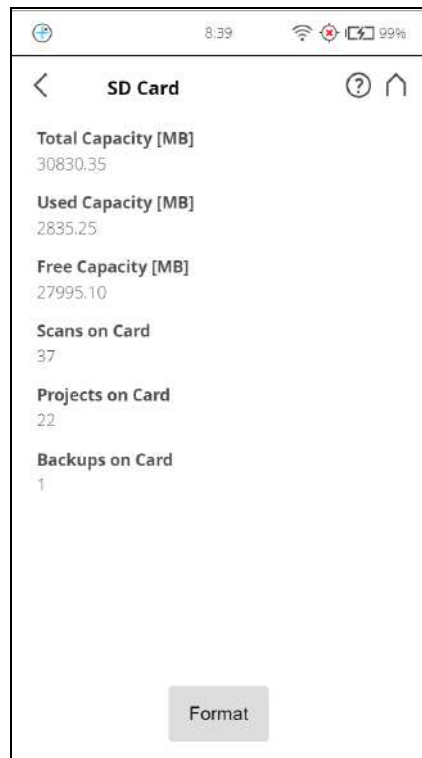


Figure 7-44: Service, SD Card

This view provides information about the currently inserted SD card and its contents.

Format Card - Format the inserted SD card.

NOTICE



Format the inserted SD card.

This operation will delete all scans and other data of the SD card. Always use this formatting function for SDXC cards with a capacity of 64 GB or more as Windows will format such cards with its own file system which is not supported by the scanner.

For more information, see *Preparing an SD Card* on page 36.

Log File

Important scanner operations, sensor data as well as warnings and errors will be saved to the log file that can help customer service to identify problems and the cause of possible errors.

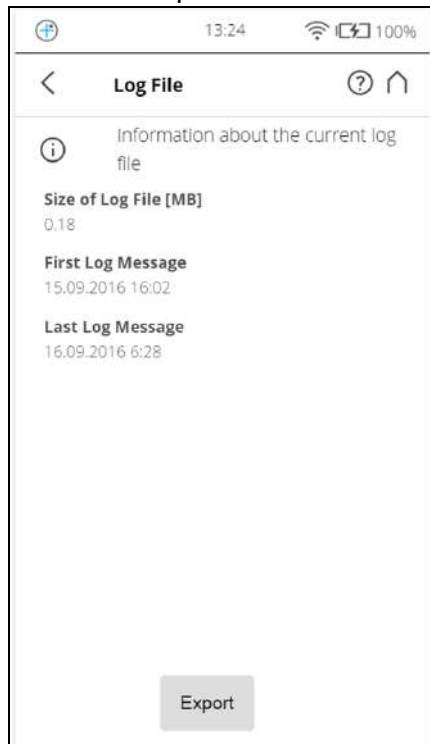


Figure 7-45: Service, Log File

Export - Writes the scanner log file to the SD card. It will be saved to a folder called *Logfile*.

Backup

Automatic backup

The scanner creates an automatic backup of the scanner settings and saves it to the inserted SD card. This backup will automatically be updated with the current scanner settings each time you start a scan. It includes the current scan profiles, scanning parameters, operators, and general settings.

Manual backup

Additionally, you can also create manual backups of certain scanner settings. This manual backup option saves scanner parameters, operators, and scan profiles to the SD card.

The manual backup option creates snapshots of this scanner data and helps you to protect it from accidental loss if your scanner hardware or storage media fails. It creates a duplicate copy of your data on your SD card; you can then archive the data on another storage device or modify it with SCENE and transfer the modified data back to your scanner.

If you own more than one scanner, you can also transfer operators, scan profiles from one scanner to another without the need of entering the data individually.

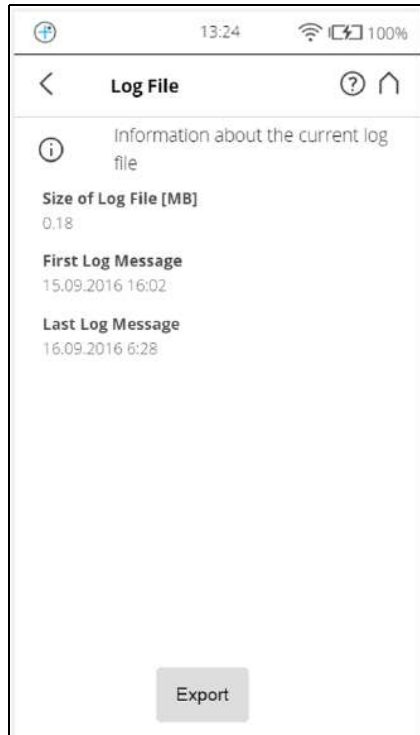


Figure 7-46: Service, Backup

Backup Name - Tap to enter the name of the backup package. Data will be saved to the following directory on your SD card: /Backup/Your_backup_name/.

After having specified the name of the backup folder, select the data you want to backup and tap the **Backup** button to start the operation.

Restore

With this function you can

- restore operators, scan profiles, scanner parameters and wallpapers from archived backups or scanner snapshots.
- import operators, profiles, and wallpapers that were newly created with SCENE.
- import formerly backed up operators, profiles, and wallpapers that were modified with SCENE.
- import operators, profiles, wallpapers, and scanner parameters from other scanners.



NOTE: The number behind **Operators** and **Profiles** informs about the number of operators, scan profiles and wallpapers on the scanner.

To restore data, it must be saved to an SD card. For this, create a directory on the SD card, named “Backup”, and then copy the folder with the data you want to restore to this directory. If you use SCENE to create new or modify backed up data, this will be done automatically by SCENE.

When finished, insert the SD card with the data you want to restore.

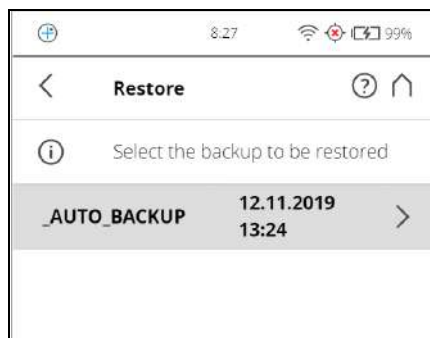


Figure 7-47: Service, Restore - Select Backup File

This screen shows you a list of all backup packages on the inserted SD card. **_AUTO_BACKUP** is the automatically generated scanner snapshot (see [Backup](#) on page 108). **_SCENE_BACKUP** is the scanner snapshot that has been created or modified with SCENE. Tap on the backup package you want to restore. A new screen will appear.

Select the data from the backup package you want to restore and tap the **Restore** button to start the restore operation

NOTICE



The restored data will override existing data on the scanner.

For example, if you want to restore or import scan profiles, all the existing scan profiles on the scanner will be overridden by the new profiles. The scanner's default profiles remain unaffected from this operation. **FARO recommends backing up your data before restoring.**

Firmware Update

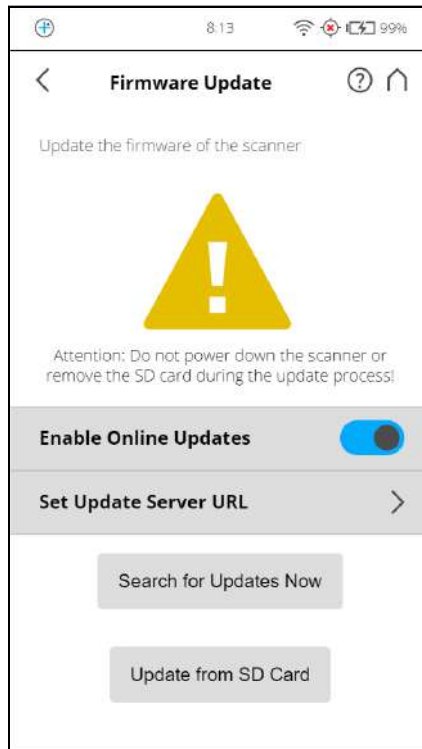


Figure 7-48: Service, Firmware Update

There are two ways to update the firmware of your FARO Laser Scanner:

- The scanner is online and can fetch the firmware from a server
- The firmware is transferred with the SD card

The update process can take up to 30 or 40 minutes depending on the extent of the update. Note that the scanner must be connected to power and have a fully-charged battery to begin the firmware update.

Online Updates

Enable Online Updates. Slide this button to turn ON or OFF

Select **Set Update Server URL** to set the URL link of the server that provides the online firmware updates.

Tap the Search for Updates Now button to search for firmware updates online.

Update via SD card

If you have the firmware update file on your computer, you can use the SD card to transfer it to the scanner. Copy the update file to the folder **“Updates”** on your SD card first. If this folder does not exist, you must create it manually.

Pay attention to lower and uppercase when entering the folder name. Then insert the SD card into the scanner, and tap the **Update from SD Card** button.

NOTICE



Risk of data loss!

Do not manually shut down or power off the scanner during the update process!

After the update is complete the scanner might restart automatically, depending on the nature of the updates.

Factory Settings

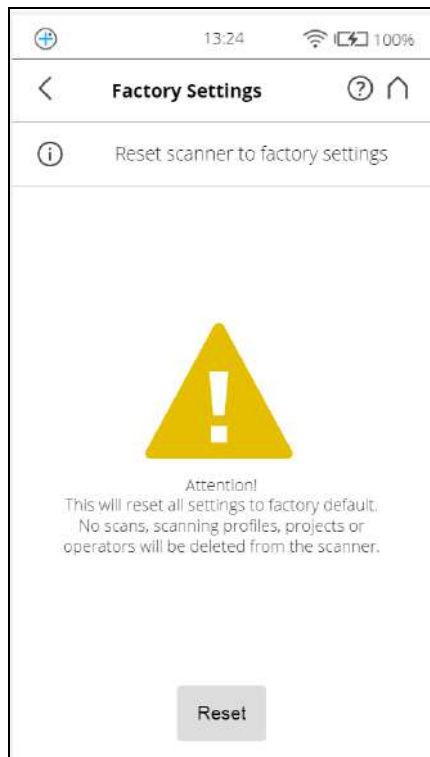


Figure 7-49: Service, Reset to Factory Settings

This function will reset your scanner settings to factory default. Use this option in exceptional cases only.

The scans, scan profiles, scan projects, and operators that are saved on the scanner remain unaffected by this operation.

7.5 View Scans

You can examine preview pictures of the scans stored on the inserted SD card. A list of all available scans will be displayed:



Figure 7-50: Scans List

This list contains all scans that are available on the SD card, displayed with their name. The list is sorted according to the creation date of the scans.

Tap a scan in the list to see its preview picture.

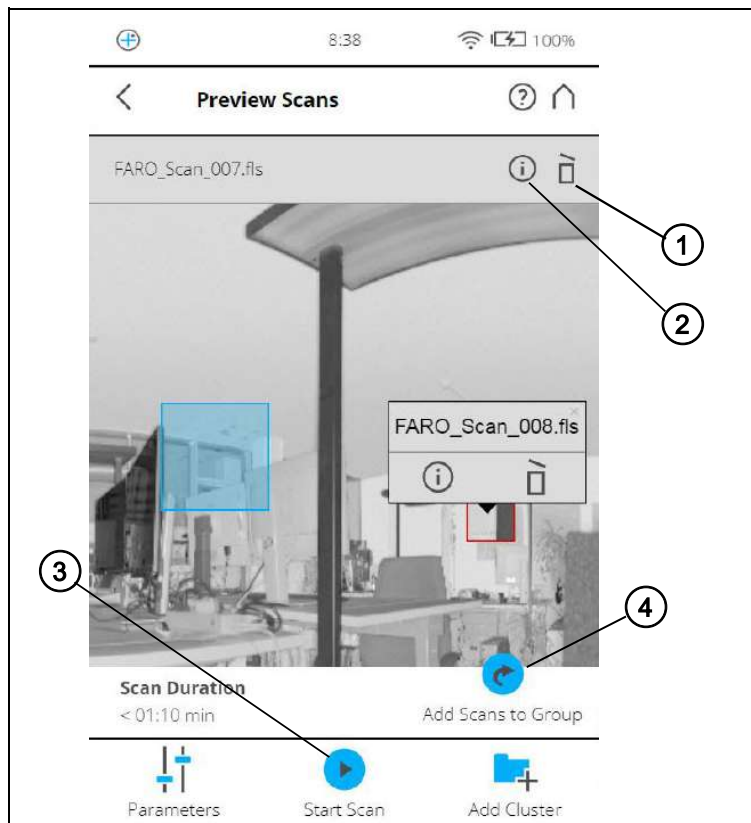



Figure 7-51: Preview of a Scan/Scan Group

- ① **Delete** button - Deletes the currently displayed scan from the SD card.
- ② **Info** - Tap to view the scan properties.
- ③ **Start Scan** button - Starts a scan or resumes the previous scan.
- ④ **Add Scans to Group button** - adds a new detail scan to the group.


For scan groups the detail scans are shown together with the primary scan - zoom-in via gesture (mouse wheel) to enlarge the preview of the detail scan. Tapping (clicking) on the detail scan will display a pop-up window with the name of the detail scan, a link to the related Scan Properties page, and the possibility to delete the detail scan.

7.6 Online Help and Notifications

7.6.1 Notifications

Tap the **Notifications** button  in the navigation bar to receive warnings and other status messages. This button will not be enabled if there are no warnings or errors.

7.6.2 Help

You can open a description of the currently displayed view by tapping the **Help** button  in the navigation bar.

The online help provides useful information about the currently active view.

Chapter 8: Special Scanning Modes

In combination with an external computer, some special scanning modes are available:

- On-Site Registration
- On-Site Compensation

The external computer must run SCENE and connect to the FARO Laser Scanner via WLAN.

By default, SCENE is not configured to offer these modes in the Workflow Bar. If you want to use them, activate the Scanning category in the settings under **Settings > General > User Interface > Show Scanning Category**.

In addition to On-Site Registration and On-Site Compensation, the Scanning category also offers to control the scanner from within SCENE.



Figure 8-1: Scanning toolbar

8.1 Scanner Control

To connect to the scanner:

1. Enter the IP address of the scanner.

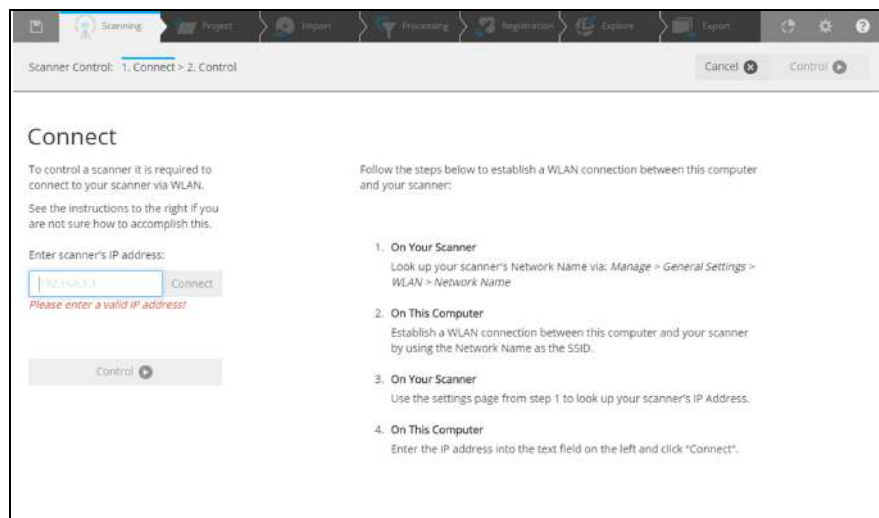


Figure 8-2: Connect page: Enter the IP address

2. Click **Connect** to retrieve the details of the scanner. The page will be updated.

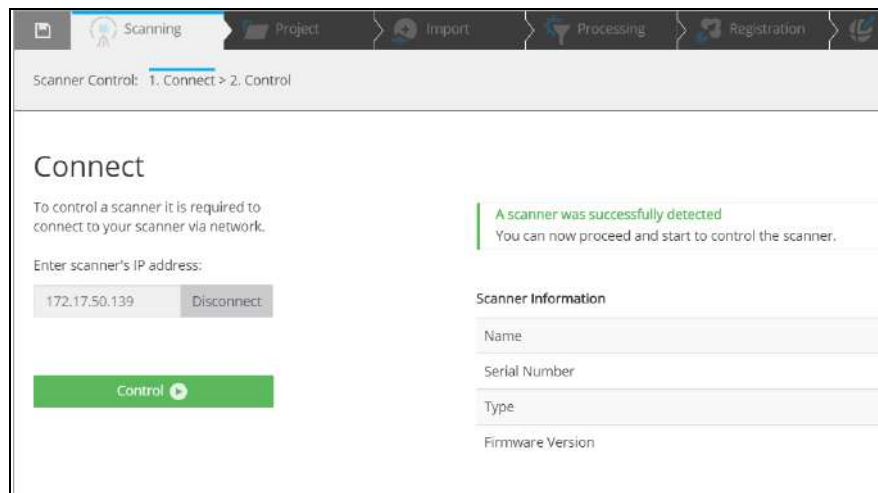


Figure 8-3: Connect to Scanner

3. If the IP address is not associated to an active laser scanner, an error message is displayed.
4. If a connection is successful to a supported FARO Focus Laser Scanner, the **Control** button becomes active and green. Click to control the scanner through the HTML user interface.

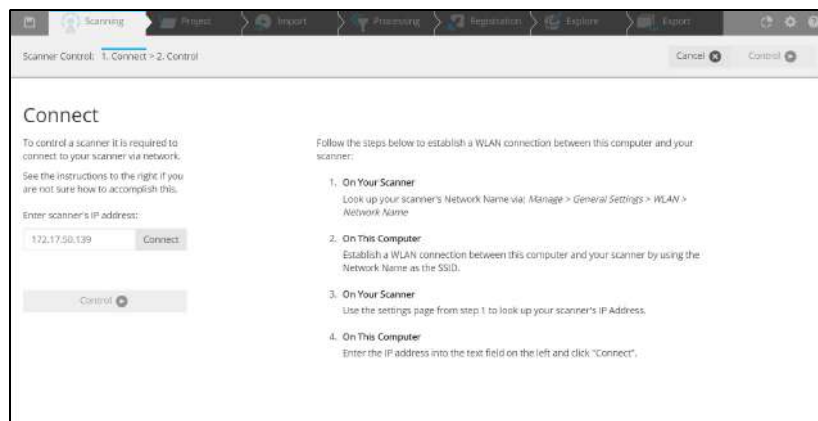


Figure 8-4: Click to Control the Scanner

5. SCENE starts the **Scanner Control** task and displays the scanner user interface. You can control the scanner remotely through this HTML interface.

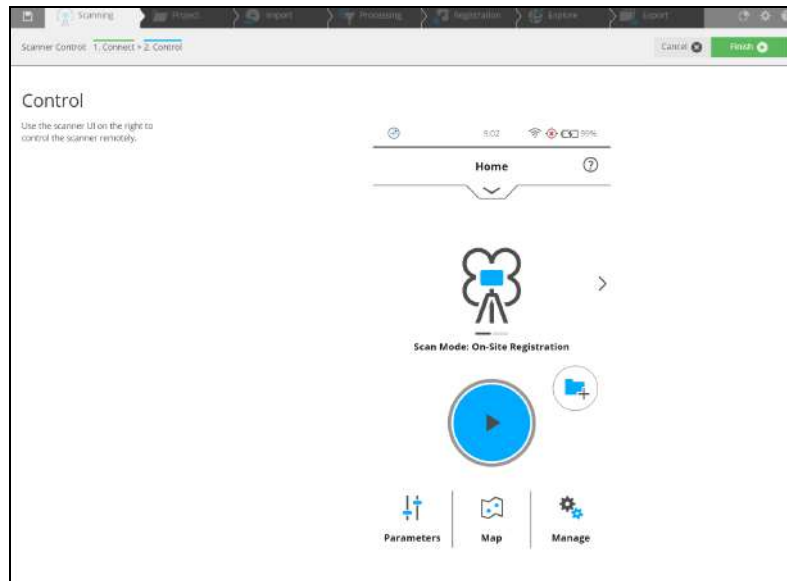


Figure 8-5: Finish or Cancel task

6. Click the **Finish** or **Cancel** button to close the scanner user interface, scanner control task and disconnect from the scanner.

8.2 On-Site Registration

The On-Site Registration feature enables you to process and register scans while on-site. The scanner must be connected to a computer running SCENE because processing and registration of the scans are performed in SCENE.

After you make the initial setup you can operate On-Site Registration functionality in one of the following ways:

- directly on the scanner
- through a connected device such as a phone or tablet, showing the scanner user interface
- within SCENE



NOTE: On-Site Registration is not available on all scanner models. See *Differences between the scanners* on page 12.

8.2.1 On-Site Registration Setup

Use the procedure below to setup on-site registration:

On the Scanner**Configure the scanner**

1. Configure the WLAN connection on the laser scanner. (See [WLAN](#) on page 95.)
2. Configure scan project/cluster, scan name, scan parameters.

On your Computer**Configure SCENE**

1. Configure the WLAN network of the computer.



NOTE: The scanner and computer must be continuously connected to the same WLAN network.

2. Start SCENE on the computer.
3. Start **On-Site Registration** task in the **Scanning** category of SCENE.
4. Enter the IP address of the laser scanner. You can find the IP address of the laser scanner by tapping **Manage > General Settings > WLAN > IP Address** on the scanner user interface. Enter the IP address as it is, following exactly the given scheme of digits.
5. Connect to the FARO laser scanner after entering the IP address in the **On-Site Registration** task.
6. Click the left or right arrow (or swipe) until the Home screen changes to the **On-Site Registration** scan mode. Note the change in the available buttons at the bottom of the screen: instead of the **Scans** button, the **Map** button appears.
7. Click **Manage > On-Site Registration** to change On-Site Registration specific settings. Consider also the following:
 - **Processing:** Enable Processing to find spheres, checkerboards, markers, planes, to enable colorization, or to build the scan point cloud. You can disable all scan processing during On-Site Registration to save time and computing power. The scans can be processed later, off-site.
 - **Registration:** Choose a registration type. The Registration settings determine the method used to align the uploaded scans to each other in SCENE. Refer to the SCENE user manual for detailed information about the different registration methods. Ensure that processing and the relevant marker detection is enabled when using the Target Based registration.
 - **Scans to Use for Registration:** You can set the number of scans that you want to use for registration. (SCENE first tries to register a new scan with the most recent previous scan. If this registration attempt fails, SCENE tries to register with the scan made immediately before that, and so on. If you make a new scan that has no connection to any previous scan, SCENE will attempt to register the new scan with all the scans in the project. This can take a long time if you have many scans in the

project. In this case, it is better to set a low number of scans to use for registration.)

- **IP Address and Port:** You can enter the IP address of the running SCENE instance manually. Note that these settings are automatically set by SCENE and should only be changed by experienced users. Leave these unchanged unless you have a specific reason for doing so.
8. On the scanner home page click the **Map** button. A map is displayed with the available scans in a project.

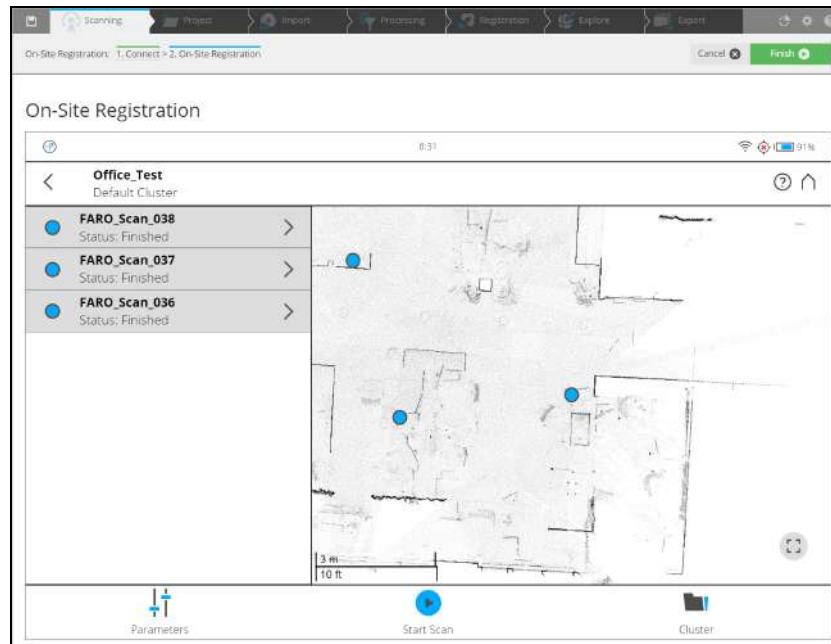


Figure 8-6: On-Site Registration overview map with list and status of scans

9. Click **Start Scan** button to start a new scan on your scanner, or remotely in SCENE. All recorded scans on the current cluster or project opened on the scanner will be uploaded to SCENE. The scans will be automatically processed by SCENE.



NOTE: If one scan fails to register, run a connection scan with the scanner placed between the area of the two different scans. To validate the registration of scans, highlight their points in the map. For more details, refer to the [Registration](#) chapter.

8.2.2 Map Page

The map page shows an overview of the area that was scanned so far.



Figure 8-7: Map page

The Map page has the following components:

Overview Map

Displays the map of a top down view of all scans in the current cluster or project that have been successfully registered. Scan positions are shown by blue markers. Click the markers to highlight the points of one scan in the map. A small popup menu opens showing the name of the scan. Tap the scan point on the map to open the **Scan Details** page. Tap the button in the lower right corner of the map to reset the view so that all markers are visible.

Status Bar

The status bar is shown below the overview map.

On large screens, the list of scans with their processing status is shown left to the map. It shows you the most important information. The following different messages may be shown:

- 'Number of scans' failed: This status is displayed when any part of the scanning, processing, scan import, or registration process failed.
- 'Number of scans' scans in progress.
- 'Number of scans' scans finished.
- 'Number of scans' unknown: This status is displayed when the scans have been initiated on the scanner and their completion status is not known.

Click the status bar to switch to the list page. For details, see [List Page](#)

Scan Controls

At the bottom of the screen three Scan Controls are available:

- **Parameters:** Tap to view the Parameters page.
- **Start Scan:** Tap to start a scan.
- **Cluster:** Tap to switch to Project or Cluster selection.

8.2.3 List Page

The list page shows a list of all scans in the current cluster/project. In large screens, the list is shown left to the map. In small screens, the list can be accessed by clicking the status bar below the map. The on-site registration status of each scan is shown on the left of the page. Tap on the right arrow to view the [Scan Details page](#) for the particular scan.

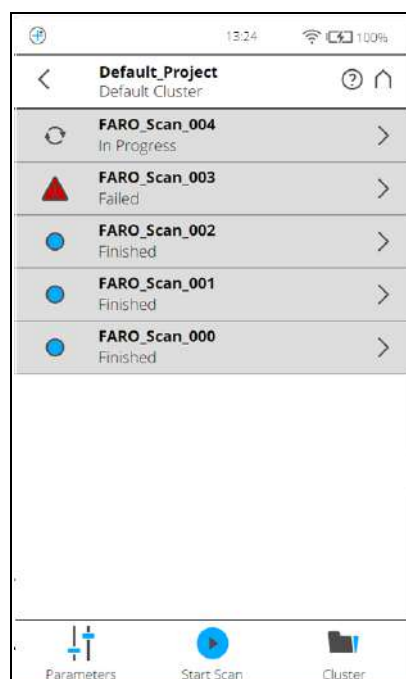


Figure 8-8: List Page

Every list item for a scan contains the following information:

- The status indicator displays the scan name and status of the scan as follows:
 - Processing: The scan is in progress.
 - Registration Successful: The scan is completed.
 - Registration Failed:
 - Waiting for Processing The scan must be processed.
 - Status Unknown The scan is initiated but the status is unknown.

Tap the arrow on the right of the scans to go to the [Scan Details Page](#) for further actions on the particular scan.

8.2.4 Scan Details Page

The scan details page shows detailed information for one scan. The page contains the following elements:

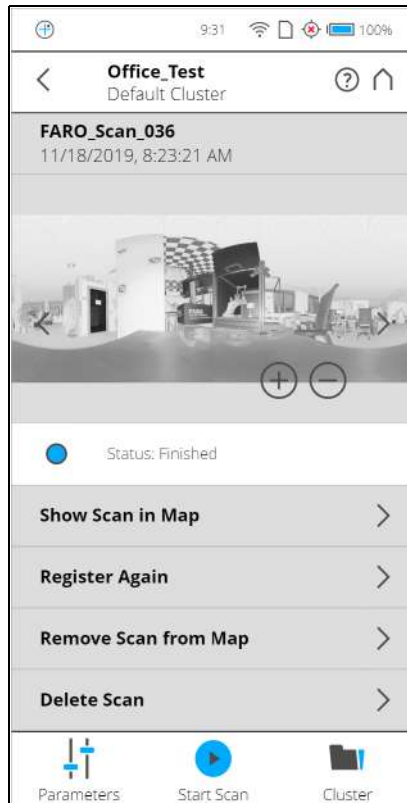


Figure 8-9: Scan Details Page

Preview image: The preview image of the scan. As in the preview page, the current scan can be switched by clicking the arrows on the left and right of the preview image.

Status bar: Displays the information about the On-Site Registration status of the scan.

List of actions: The different actions that can be performed on the scans depending on the status of the scan, are shown as a list below the status bar.

If it is not possible to perform an action, the listed item is grayed out. Possible actions:

Show scan in map

This option is only available for finished scans. Tap the right arrow to view the map page. The selected scan is centered and marked in the map.

Register again

This option is available for scans that were registered successfully or registration failed.

A dialog pops up when you tap the right arrow. Tap **Confirm** if you want to register the scan again. The scan is registered again and the registration status is displayed as **Unknown** until the process is completed.

Remove scan from map

This option is available for scans shown in the map that were registered successfully.

A dialog pops up when you tap the right arrow. **Confirm** to remove the scan from map. The scan is removed from the map. However the scan is not deleted and the scan status will later show as 'Registration Failed'.

Delete scan

This option is only available for all scans that are not **In Progress**.

Tap the right arrow to view the **Delete scan** dialog is shown. **Confirm** to delete the scan. The scan is deleted from the cluster or project.

8.3 On-Site Compensation

On-Site Compensation process is a procedure to test and improve the angular accuracy of the scanner using SCENE software.



NOTE: On-Site Compensation is not available on all scanner models. See *See Differences between the scanners* on page 12.

8.3.1 Preparing the Compensation Station

Site Setup

Before you begin the On-Site Compensation process, ensure that the scan site has the following facilities:

- Target sheets must be setup at the scan site at regular distance to the laser scanners between 1.5 m to 3 m.
- No windows or other reflective planes: The markers on the target sheets would be reflected if the scan site has any windows or reflective surfaces. This can cause incorrect measurements.
- Lighting conditions are less important because On-Site Compensation is done with the laser, video images are not used.

8.3.2 Connect Laser Scanner to Computer through Wireless LAN

To be able to transfer the scanned data directly to your computer, you must connect the computer with the laser scanner and through WLAN to remotely access and control the scanner.

Using the scanner as a WLAN access point



NOTE: Disable the proxy server to make the connection work. If this is not possible for some reason, enter the addresses of both devices in the Exceptions field. We recommend to use a WLAN card that supports IEEE 802.11n.

On your scanner

1. Enable WLAN on your scanner (see [WLAN](#) on page 95).
2. Look up your scanner's network name by tapping **Manage > General Settings > WLAN > Network Name** on the scanner's user interface.



On your Computer

Establish a WLAN connection between the computer or tablet and the scanner by using the network name as the SSID.

8.3.3 On-Site Compensation steps

On your computer

Select Output folder

1. Click **Start On-Site Compensation** button  in the Scanning toolbar by selecting the "Scanning" toolbar.
2. All data captured during On-Site Compensation, including the **Compensation Report** will be stored in the output folder.
3. Click the **Browse** button  to open the file system browser.
4. Browse to the folder. Click **OK**.

8.3.4 Setup

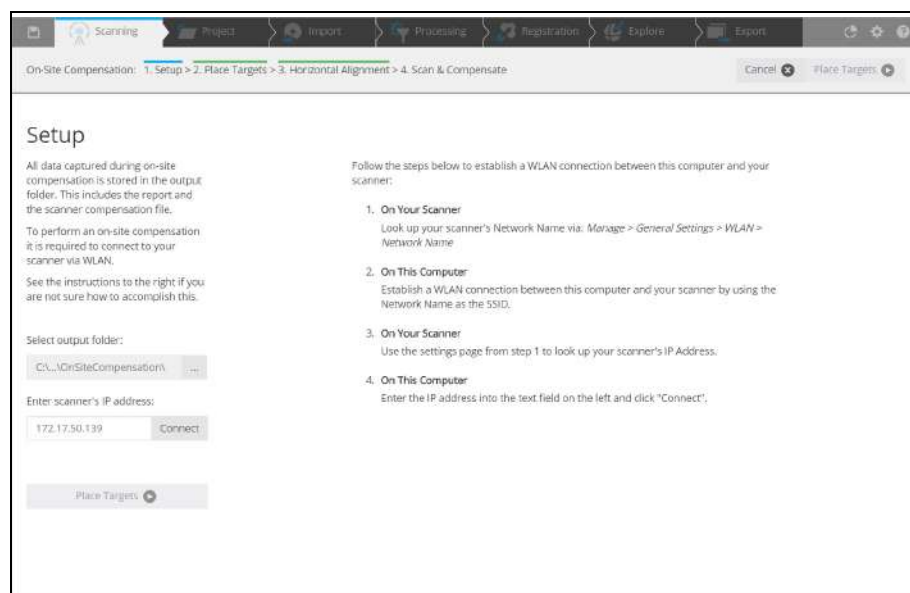


Figure 8-10: Setup: Select Output Folder and Enter IP Address

Enter Scanner IP Address

1. Enter the IP address of the laser scanner. You can find the IP address of the laser scanner by tapping **Manage > General Settings > WLAN > IP Address** on the scanner user interface. Enter the IP address as it is, following exactly the given scheme of digits and dots.
2. Click the **Connect** button.
3. In the dialog, click the **Place Targets** button to continue with the next step.

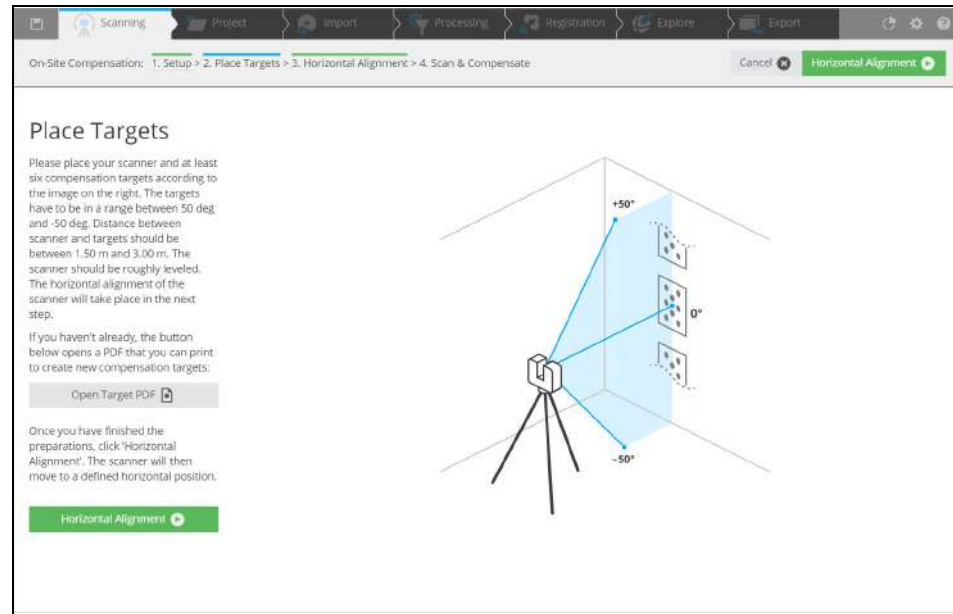


Figure 8-11: Place Targets

8.3.5 Place target

Print target sheets

On your Computer

1. In the **Place Targets** page, a picture is shown that describes how to place the targets and the scanner for the compensation.
2. If the 6 Target Sheets are not available, click the **Open Target PDF** button in the toolbar.
3. Select among the DIN/ISO A4 format, or US letter format. Your standard PDF viewer will open, showing the target PDF sheet.
4. Print at least 6 marker sheets.



NOTE: We recommend that you glue the target sheets on suitable, rigid plates, especially if On-Site Compensation is done at an outdoor location.

On Site

Place at least 6 Target sheets on site as follows:

- The target sheets must be placed in a vertical range of -50° to $+50^{\circ}$ from the scanner device. Note that under some circumstances, $+50^{\circ}$ can only be achieved if the target is placed on the ceiling.
- Distribute the target sheets uniformly over the specified range. At least one board must be close to the horizon (0°).
- The distance between the target sheets and the scanner must be between 1.5 m to 3 m.
- All target sheets must be vertically aligned.

Laser Scanner Placement

- Mount the laser scanner on a tripod.
- Place tripod and scanner on stable, flat surface. The tripod must not move during scanning.

8.3.6 Horizontal Alignment

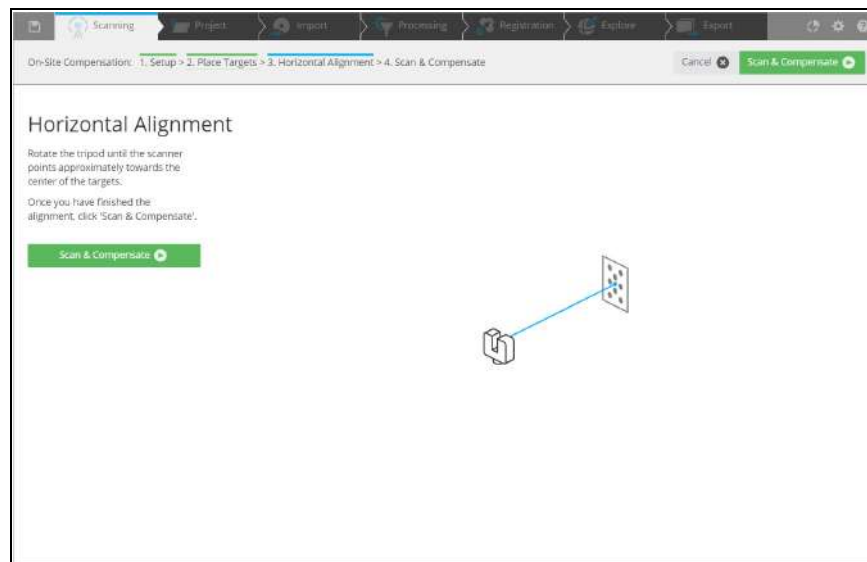


Figure 8-12: Horizontal Alignment

Horizontally align the scanner tripod as follows:

- Rotate the tripod of the scanner to point approximately towards the center of the targets.
- Start scanning and compensation by clicking the button “**Scan & Compensate**”
- During the compensation process, the status of progress is displayed. You can cancel the process if required.

8.3.7 Scan & Compensate

- Select whether you want to apply the compensation data to the scanner.
- Click **disconnect** to disconnect from scanner and finish the On-Site compensation.
- To apply this compensation to the scanner choose **yes** and click **Finish**. Choose *no* if you do not want to apply this compensation.

- When the compensation is finished, the Compensation Report is displayed with the results of the compensation. Open the compensation report as PDF by clicking the button **Open Report**. The **Compensation Report** is saved as PDF to the location specified in the left side of the page.

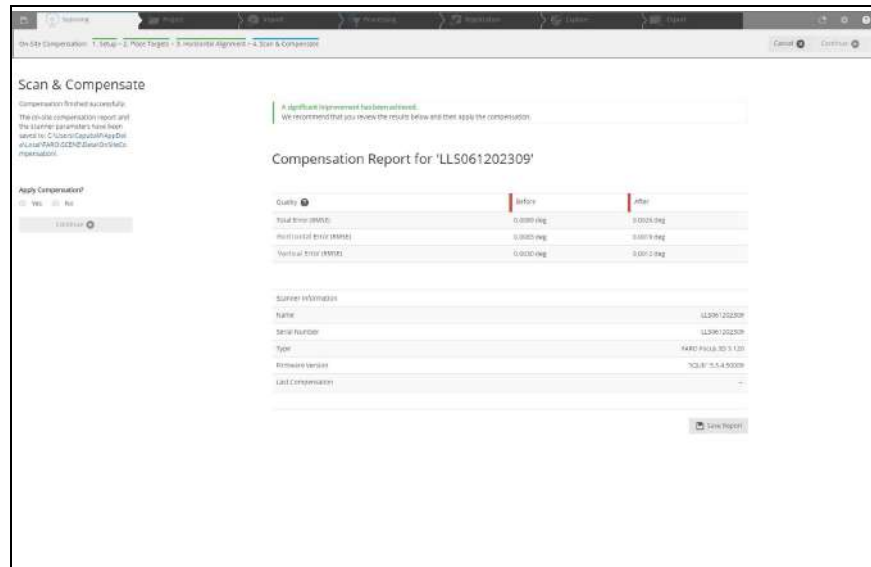


Figure 8-13: Compensation Report

8.3.8 Troubleshooting

Error

Reading and writing to the selected data output folder failed.

Solution

Make sure that you have permission to read and write in the selected output folder. Ensure that you have sufficient disk space. Approximately 330MB are necessary to perform an On-Site compensation.

Error

The process did not identify enough targets for compensation.

Solution

In the output folder a targetImage.png file is stored. This image shows the identified markers as blue circles. Areas with a sufficient amount of detected targets have a green background color. In case of an insufficient amount of detected targets the background color is red.

Error

No consistent solution could be determined.

Solution

Make sure that the tripod and the targets did not moving during the procedure.

Error

The SD card of the scanner could not be accessed.

Solution

Make sure that the SD card is inserted and that it is not write-protected and has sufficient free space left (approximately 330MB).

Error

Communication with the scanner failed.

Solution

Make sure that the WLAN connection to the scanner is stable.

If this error appears when connecting to the scanner or applying the compensation parameters, try to repeat the corresponding step.

8.4 Scan Groups

A *scan group* is one scan grouped together with one or more *detail scans* that were taken using the scan group function. The scanner records fixed spatial relationships among all the scans in the group. The scans in a scan group are represented as a group in SCENE.

Use scan groups to reduce scanning time

To keep scanning time to a minimum, you usually select the lowest resolution that will capture the physical details you need for your scan project. But this resolution may not scan registration targets with the detail you need for accurate registration. Rather than making the entire scan with a higher resolution, you can use a scan group to first make one complete, 360° scan (referred to here as the *primary scan*), then make several higher-resolution *detail scans* of the targets that are visible in the first scan. This reduces the total time needed to scan the area, while still getting high-quality scans of the targets to ensure that registration is accurate.

About detail scans

Detail scans are different from ordinary scans. They contain no high-precision inclinometer and compass data, and are generally useful only in the context of their scan group.

8.4.1 Creating a scan group

NOTICE



The primary scan and the detail scans must all be taken from the same scanner position. Ensure that the scanner tripod or other mount will not move throughout the procedure. If possible, use WLAN and operate the scanner from a remote user interface (See [WLAN](#) on page 95.). If you must use the touchscreen, do not tap the screen hard enough to disturb the scanner.

1. Create a scan. For more information, see *Scanning* on page 44. When the scan is finished, the screen will switch to the Preview Scans page. This scan is the primary scan of the group.
2. Locate a registration target (or other object) that you want to scan at a higher resolution. Use the mouse-wheel (or pinch gestures) to zoom in the preview image.
3. Click a target to select it. A blue selection rectangle appears. You can drag it to adjust the position.



Figure 8-14: Adding detail scans to group

4. Click the selection rectangle to open the detail scan pop-up window.

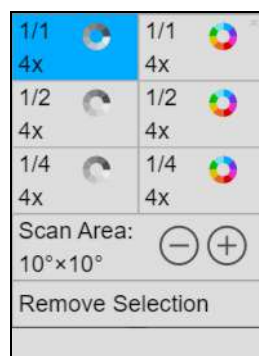


Figure 8-15: Detail scan pop-up

5. Select the resolution, quality, and color type for the detail scan. You can also change the size of the scan area, or remove the selection. Click the “X” in the upper-right corner of the window to dismiss it.
6. Repeat steps 2 through 5 for each target that you want to scan.

7. When you have selected all the targets you want, click **Add Scans to Group**. The scanner will begin to make the detail scans. The scanner screen will keep you informed about the progress.



Figure 8-16: Detail scans completed

When all the detail scans are complete, the preview image of the primary scan is displayed. The positions of the completed detail scans appear as red squares. If you want to make more detail scans, repeat the procedure above. Remember to make all the detail scans you need before moving the scanner or making a new primary scan.



Figure 8-17: Scan group

You can see the scan groups on the SD card by returning to the scanner's start page and clicking the **Scans** button. All scans that belong to a scan group are shown indented below the caption *Scan Group* and the scan group's name (which is always the name of the primary scan).



NOTE: Scan groups are supported by SCENE 2018 and later. If you import scan groups into an older version of SCENE, the detail scans will be treated as if they were normal scans, but are likely to have limited use for registration.

8.5 Retaking Pictures

When making color scans, photographs are used to colorize the points recorded by the laser. If a person or vehicle or other object moves into the camera's field of vision after scanning, but while pictures are being taken, it can result in scan points with incorrect colors. If you have set the scanner to allow pictures to be retaken, you can check the pictures on the scanner

immediately after they are taken, select any pictures that include objects that were not part of the laser scan, and retake them without the incorrect objects.



1. Before beginning the scan, make sure that Retake Pictures is enabled. For more information, see *General Settings* on page 91.

NOTICE



Risk of data loss:

When the Retake Pictures feature is enabled, the scan is not completed until you exit the Color Preview page. Ensure that the scan is closed and that the SD card symbol in the status bar is not blinking before removing the SD card or switching off the scanner.

2. Begin the scan as usual.
When the scan completes, the Color Preview page is displayed.
3. Examine the pictures. If any pictures contain objects that were not part of the laser scan or need to be retaken for any other reason, select them by tapping or clicking. (If no pictures need to be retaken, close the scan by leaving the “Color Preview” page.)
4. After you have selected all the pictures you want to retake, tap the retake picture button . The scanner will retake and replace the pictures.
5. If some pictures need to be taken again, repeat the last two steps.
Otherwise, close the scan by pressing the finalize scan button .



NOTE: The scan is not complete until you decide to close it, and so it is not visible to other devices while you are retaking pictures. This can affect on-site registration, which will not begin until the scan is closed.

Chapter 9: Maintenance

We recommend that you check your FARO Laser Scanner at least once a month. This enables you to spot trouble before it starts and helps provide you with an efficient measuring system.

The FARO Laser Scanner is a precision instrument that contains many sensitive components, and it must be handled with care. Follow these procedures to prevent problems with your system:

- Check the cables for damage to outside insulation, connectors, and pins.
- Check the housing of the scanner for damage.
- Check the housing and the connectors of the battery for damage.
- Place a dust cover over the scanner when it is not in use.
- Do not lubricate the FARO Laser Scanner.

To ensure proper functioning of the scanner, it should be checked by FARO customer service on a regular basis within the yearly maintenance and certification service. The service intervals should not exceed a maximum period of one year. Contact your local FARO Customer Service team for more information.

9.1 Cleaning Instructions for Optics

Major contamination and improper cleaning of optics and lenses can impact the scanning quality. Major damage or wear could require a complete replacement of the part.

NOTICE



Damage or wear of the scanner's mirrors and lenses

- To avoid unnecessary damage or wear, clean the optics only if the degree of contamination requires cleaning for proper function, for example, if an increase in noise or a decrease of the scan range is observed. Major contamination can impact the scanning quality. In this case, proper cleaning of the outer optics (rotating mirror module or sensor cover glass) is recommended.
- In either case, cleaning must be performed by trained personnel only, as self-caused damages can result in a complete replacement of the part at the expense of the customer. In case of any doubt, contact the customer service at FARO (See *Technical Support* on page 160.).
- Do not touch the optical surfaces with bare hands or laboratory gloves if possible.
- We recommend using latex gloves. If you are suffering from latex allergies use gloves that are suitable for you. Lightly rub the gloves after taking them off with laboratory cloths. Use isopropyl alcohol to remove grease and dirt.
- Do not touch the mirror with tweezers or forceps.
- Use only acetone-free cleaning fluids.

9.1.1 What's needed

Gather the supplies listed below before you begin the procedures in this chapter.

1. **Compressed air, non-flammable spray (oil-free)** such as *Techspray DUSTER 1671* (highly recommended by FARO), available from optical supply stores such as:
 - <https://www.techspray.com/duster-7>
 - <https://www.thorlabs.de/thorproduct.cfm?partnumber=CA4-US>
(United States and Canada compliant duster with integrated nozzle)
 - <https://www.thorlabs.de/thorproduct.cfm?partnumber=CA4-EU>
(European Union compliant duster with integrated nozzle)
2. **Acetone-free, non-flammable optics cleaning fluid** such as *Dust-Aid Ultra Clean Liquid* (highly recommended by FARO), available from optical supply stores such as:
 - <https://dust-aid.com/dslr-camera-sensor-cleaning-liquid/>
(Order via sales@dust-aid.com)

3. **Lens tissue**, available from optical supply stores such as:
 - <https://www.thorlabs.de/thorproduct.cfm?partnumber=MC-5>
4. **Small dropping bottle and medium wash bottles**, available from optical or chemical supply stores such as:
 - <https://www.thorlabs.de/thorproduct.cfm?partnumber=B2939>
5. **Stainless steel forceps**, available from optical or chemical supply stores such as:
 - <https://www.thorlabs.de/thorproduct.cfm?partnumber=FCP>
(Forceps, solid stainless steel)
 - <https://www.thorlabs.de/thorproduct.cfm?partnumber=FCPA>
(Angled Forceps, solid stainless steel)
6. **Powder-free lab gloves** (PVC or silicone), available from optical or chemical supply stores.
7. For strongly contaminated optics, **Mild neutral soap**, available from optical or chemical supply stores.

9.2 Cleaning Slightly Contaminated Optics

WARNING



Hand injuries

- If the scanner is accidentally switched on, the mirrors might start to turn. Before starting any cleaning activity:
- shut down the laser scanner module and remove the battery pack.
- when using an external power supply, remove the power line.

This will prevent the mirror from turning during the cleaning work.

9.2.1 Dry Pre-Cleaning (Non-Contact Cleaning)

Always start to remove dust or liquid droplet contamination on mirror or sensor cover by using compressed dry air or special duster sprays (dry cleaning gas).

NOTICE



Do not shake the Duster Spray bottle.

While using the duster spray, ensure that you do not shake the bottle or turn it upside down.



Figure 9-1: Dry pre-cleaning with compressed air or duster cleaning spray

NOTICE



Damage of the scanner's mirrors and lenses

Avoid any direct contact with the optical surface at any time!

1. Gently blow off particles from the optical surface with compressed air.
2. Perform visual inspection.
3. Repeat dry cleaning as required.
4. Proceed with step 9.2.2.

9.2.2 Wet Cleaning by Tissue and Isopropyl Alcohol as a Cleaning Fluid

NOTICE



Damage of the scanner's mirrors and lenses
Use a clean (new) pair of gloves for the following steps.

Prepare the cleaning pad



Figure 9-2: Assemble the cleaning pad

1. Combine 2 or 3 sheets of optics cleaning tissue.



Figure 9-3: Folding the cleaning pad (1)



Figure 9-4: Folding the cleaning pad (2)

2. Repeatedly fold the cleaning pads in half as shown in the pictures above. Fold twice on the long side, then turn 90°, fold twice more to create a soft pad that is about 30 mm long.

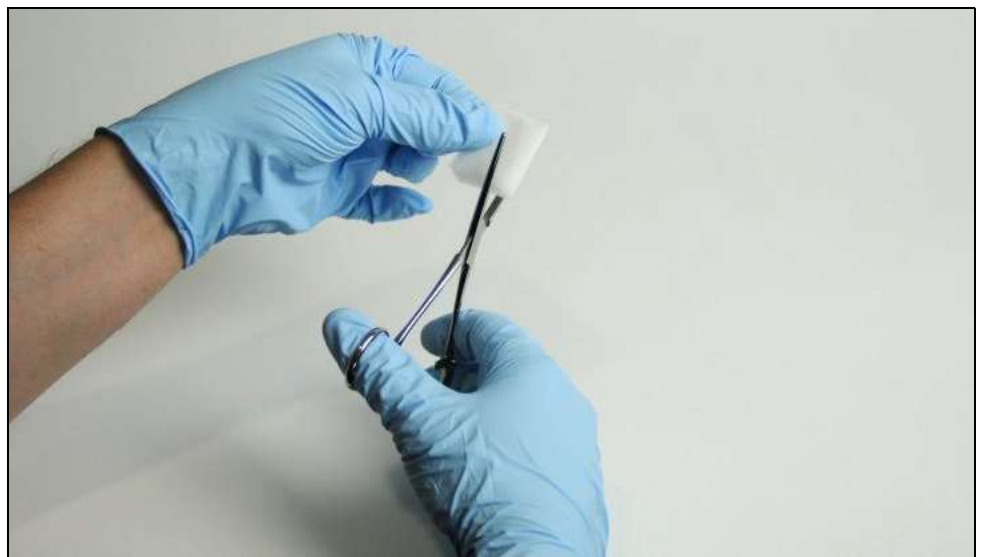


Figure 9-5: Fix the cleaning pad

3. Use the forceps to fix the cleaning pad as shown in picture. Leave at least 2-3 mm between the edge of the pad and the forceps.



Figure 9-6: Creating a T-shaped cleaning pad (1)



Figure 9-7: Creating a T-shaped cleaning pad (2)

4. Slightly compress the pad on top of the spare cleaning tissues to create a T-shaped cleaning pad as shown in the two pictures above.



Figure 9-8: Soaking the cleaning pad

5. Use the small drop bottle to soak the cleaning pad with isopropyl alcohol or cleaning fluid (Picture 7).

Cleaning mirror module or sensor cover



Figure 9-9: Cleaning mirror module with pad and isopropyl alcohol or cleaning fluid



Figure 9-10: Cleaning sensor cover with pad and isopropyl alcohol or cleaning fluid

NOTICE



Damage of the scanner's mirrors and lenses

Ensure to avoid any contamination of the cleaning tissue!
Do not apply pressure when wiping, as this might cause damage to the optical surface!

6. With a single, constant linear motion from one end to the other, gently wipe the mirror or sensor cover glass with the cleaning pad (Pictures 8 and 9).

7. After each cleaning cycle, discard the cleaning pad and prepare a new pad as described above.
8. Repeat the cleaning such that the full mirror or sensor cover aperture has been wiped once.
9. Check cleaning status by visual inspection.
10. Prepare another cleaning pad with isopropyl alcohol or optics cleaning fluid (Ref. [2], recommended) to finalize the procedure.
11. Gently wipe the whole mirror surface with low pressure and in linear direction once.
12. Check cleaning status by visual inspection. Ensure that no contamination is left. Otherwise repeat cleaning by isopropyl alcohol or optics cleaning fluid, if necessary.

9.3 Cleaning of Strongly Contaminated Optics

WARNING



Hand injuries

If the scanner is accidentally switched on, the mirrors might start to turn. Hence, before starting any cleaning activity,

- shut down the laser scanner module and remove the battery pack.
- when using an external power supply, remove the power line.

This will prevent the mirror from turning during the cleaning work.

9.3.1 Dry Pre-Cleaning (Non-Contact Cleaning)

Always start to remove dust or liquid droplet contamination on mirror or sensor cover by using compressed dry air or special duster sprays (dry cleaning gas).

NOTICE



Do not shake the Duster Spray bottle.

While using the duster spray, ensure that you do not shake the bottle or turn it upside down.



Figure 9-11: Dry pre-cleaning by compressed air or duster cleaning spray

NOTICE



Damage of the scanner's mirrors and lenses

Avoid any direct contact with the optical surface at any time!

1. Gently blow off particles from the optical surface.
2. Perform visual inspection.
3. Repeat dry cleaning as required.
4. Proceed with step 9.3.2.

9.3.2 Wet Cleaning by Water or Diluted Mild Soap Solution

Provide a rigid base, for example, table or transport box topside, as a safe basis for the following cleaning procedure.

1. Remove laser scanner unit from tripod.



Figure 9-12: Transport box with laser scanner turned and laid on top, with the mirror module facing outwards

2. Turn and lay down scanner on its long side.

3. Ensure that mirror is free to move and easily accessible for wet cleaning.

NOTICE**Damage of the scanner's mirrors and lenses**

Use dust-free gloves for all following steps!

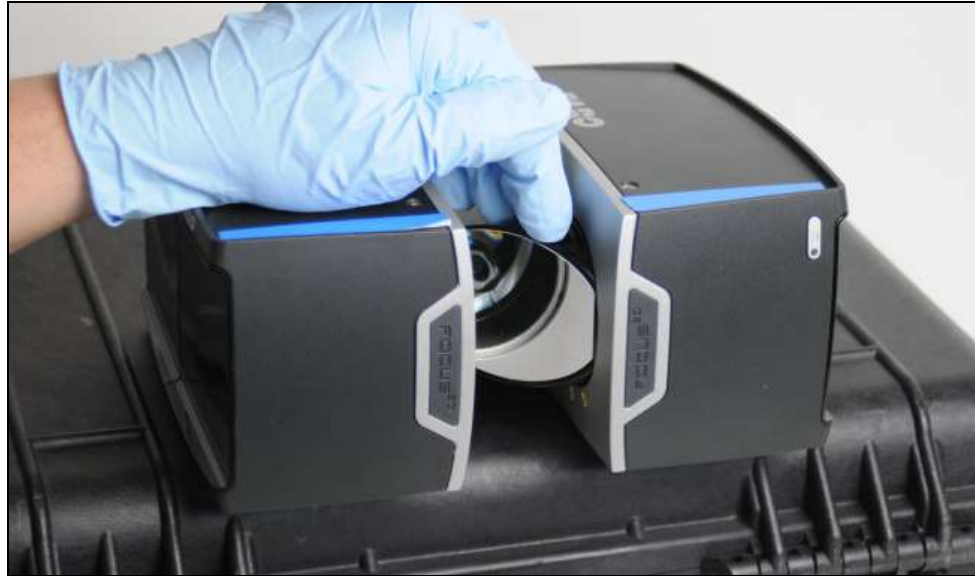


Figure 9-13: Fix the mirror with your finger tips to keep it in this position

4. Turn the mirror module into vertical position, i.e., the mirror points away from scanner. Fix the mirror with your finger tips to keep it in this position.



Figure 9-14: Cleaning mirror module or sensor cover

5. Clean the mirror module (analogue: sensor cover) by rinsing with water or diluted neutral soap solution in oscillation motion.

NOTICE



Damage to the scanner's mirrors and lenses

Wait for the cleaning liquid to drain and dry off! **DO NOT** try to dry the optics by wiping with tissue at this stage, as residual contamination might still cause severe damaging to the optics!


1. Perform visual inspection of cleaning status.
2. Repeat the rinsing step until contamination is significantly reduced or even removed.
3. Wait for the optics to dry.
4. Turn laser scanner into upright (normal) position and ensure stable placement. For example, place scanner on a table or transport box. Alternatively, use tripod for mounting.
5. Proceed with *Wet Cleaning by Tissue and Isopropyl Alcohol as a Cleaning Fluid* on page 138.

Chapter 10: Technical Data

10.1 General

Power supply voltage:	19 V (external supply) 14.4 V (internal battery)
Power consumption:	15 W (when device is idle) 25 W (while scanning) 80 W (while battery charges)
Battery life:	4.5 hours
Operating temperature:	5 °C to 40 °C
Cable connector:	Located in scanner mount
Weight:	4.2 kg
Size:	240 x 200 x 100 mm
Maintenance / calibration:	Annual

10.2 Laser (optical transmitter)

Laser class:	Laser class 1	
Wavelength:	1550 nm	
Beam divergence:	Typical 0.3 mrad (0.024°)(1/e)	
Beam diameter at exit:	Typical 2.12 mm (1/e)	

10.3 Data handling and control

Data storage:	SD cards of type SDHC™ and SDXC™; 32 GB card included
Scanner control:	Through touchscreen display and WLAN connection. Access by mobile devices through HTML5.

10.4 Ranging unit

Focus^S Plus

Distance Accuracy:	1 mm
Angular Accuracy:	Horizontal: 19 arcsec Vertical: 19 arcsec
Unambiguity interval:	614 m for up to 0.5 Mio. pts/s; 307 m at 1 Mio. pts/s; 153 m at 2 Mio. pts/s
Range Focus ^S Plus 150:	0.6 m to 150 m indoor or outdoor with upright incidence to a 10% reflective surface
Range Focus ^S Plus 350:	0.6 m to 350 m indoor or outdoor with upright incidence to a 10% reflective surface
Measurement speed (pts/sec):	up to two million
Ranging error ¹ Focus ^S :	±1 mm

Ranging noise ²	@10 m	@25 m
@ 90% refl.	0.1 mm	0.2 mm
@ 10% refl.	0.3 mm	0.5 mm

Focus^S

Distance Accuracy:	1 mm
Angular Accuracy:	Horizontal: 19 arcsec Vertical: 19 arcsec
Unambiguity interval:	614 m for up to 0.5 Mio. pts/s; 307 m at 1 Mio. pts/s;
Range Focus ^S 70:	0.6 m to 70 m indoor or outdoor with upright incidence to a 10% reflective surface
Range Focus ^S 150:	0.6 m to 150 m indoor or outdoor with upright incidence to a 10% reflective surface
Range Focus ^S 350:	0.6 m to 350 m indoor or outdoor with upright incidence to a 10% reflective surface
Measurement speed (pts/sec):	up to one million
Ranging error ¹ Focus ^S :	±1 mm

Ranging noise ²	@10 m	@25 m
@ 90% refl.	0.3 mm	0.3 mm
@ 10% refl.	0.4 mm	0.5 mm

Focus^M

Unambiguity interval:	614 m for up to 0.5 Mio. pts/s;
Range Focus ^M 70:	0.6 m to 70 m indoor or outdoor with upright incidence to a 10% reflective surface
Ranging error ¹ Focus ^M 70:	±3 mm
Measurement speed (pts/sec):	up to 0.5 Million

10.5 Color unit

Resolution:	Up to 165 megapixel color
HDR:	2x, 3x, 5x
Parallax:	Co-axial design

10.6 Multi-Sensor

Dual axis compensator:	Levels each scan: Accuracy 0.019°; Range $\pm 2^\circ$
Height sensor:	Via an electronic barometer the height relative to a fixed point can be detected and added to a scan.
Compass ³ :	The electronic compass gives the scan an orientation.
GPS:	Integrated GPS receiver

10.7 Interface Connection

WLAN: 802.11n (150 Mbit/s)
Ad-hoc and Infrastructure mode

10.8 Deflection unit

Field of view:	(vertical/horizontal): $300^\circ / 360^\circ$
Step size:	(vertical/horizontal): 0.009° (40,960 3D-Pixel on 360°) / 0.009° (40,960 3D-Pixel on 360°)
Max. vertical scan speed:	5,820 rpm or 97 Hz

10.9 Ambient Conditions

Ambient Temperature:	5 °C to 40 °C
Extended operating temperature:	-20 to 55°C Low temperature operation: the scanner must be powered on while internal temperature is at or above 15 °C High temperature operation: additional accessory required, further information on request.
Humidity:	Non-condensing
Altitude:	< 2000 m

10.10 Notes

- ¹ Ranging error is defined as a systematic measurement error at around 10 m and 25 m, one sigma.
- ² Ranging noise is defined as a standard deviation of values about the best-fit plane for measurement speed of 122,000 points/sec.
- ³ Ferromagnetic objects and electromagnetic fields can disturb the earth magnetic field. This, as well as local variations in earth magnetic field (magnetic declination/variation) can lead to inaccurate measurements.
- ⁴ 2x150° - Homogeneous point spacing is not guaranteed.

10.11 Scanner Dimensions

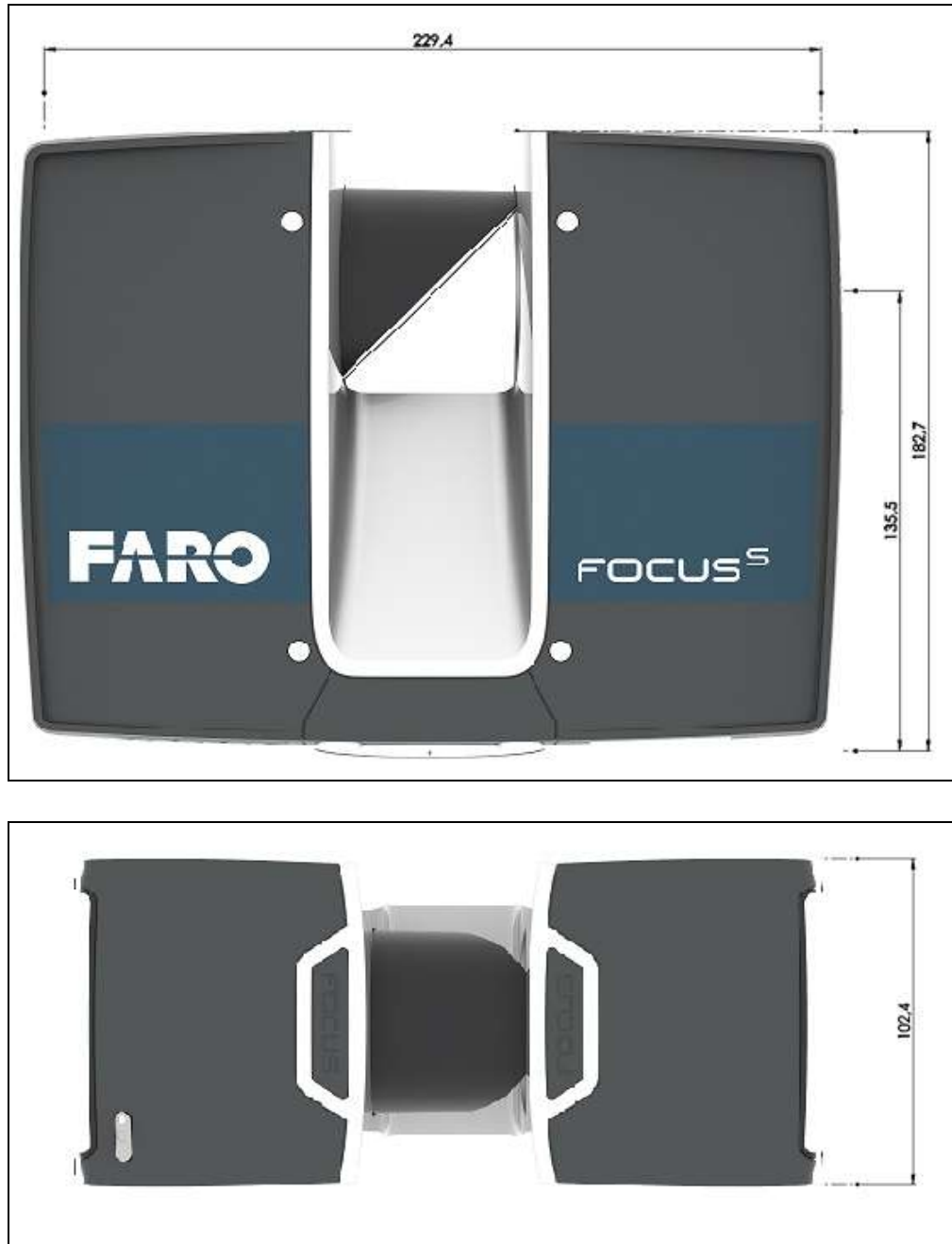


Figure 10-1: Scanner Dimensions

All dimensions are in mm.

10.12 Scanner Mount Dimensions

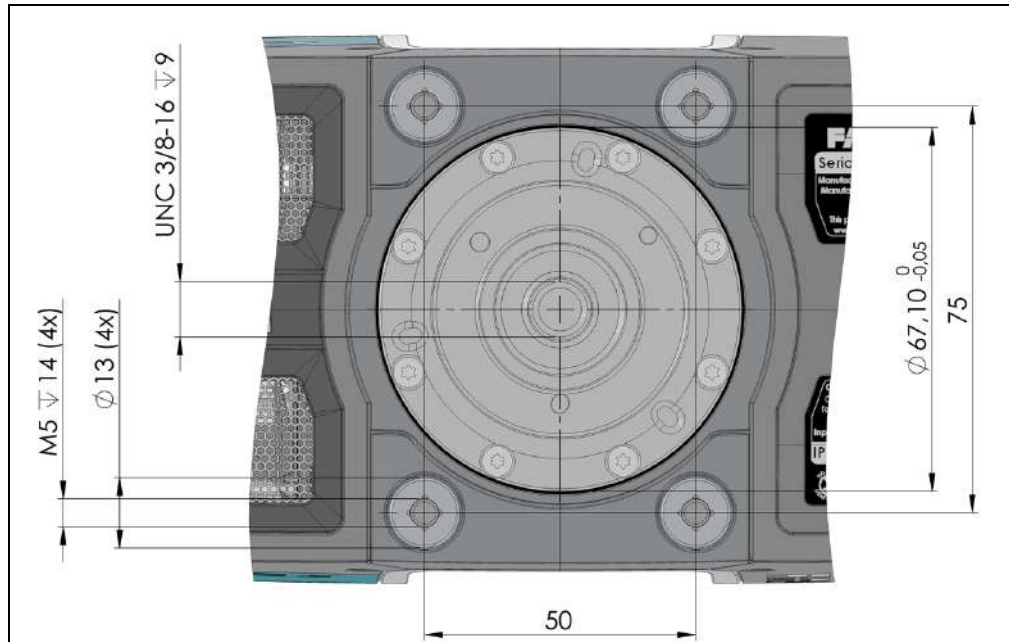


Figure 10-2: Scanner mount

The 3/8 in. central thread can be used to mount a fixation device below the scanner.

The scanner has 4 M5 tapped holes as interface for helical operation.

All dimensions are in mm.

Chapter 11: Error Messages

Error Message	Description	Action
Internal Error: Invalid parameter	The scanner parameters are inconsistent.	Restart scanner. If the problem still occurs after restart, contact FARO Customer Service.
Distance measurement tolerance exceeded	The white reference area on the scanner's base gave inconsistent measurements.	Check cleanliness of this reference area, mirror, and lenses.
error	The device could not be found.	Restart scanner. If the problem still occurs after restart, contact FARO Customer Service.
Color acquisition failure	Color acquisition has stopped unexpectedly. Probably color acquisition is not complete.	Save log file and contact FARO Customer Service.
Out of time failure	This indicates an internal scanner error.	Restart scanner. If the problem still occurs after restart, contact FARO Customer Service.
Module Status Error	Module Status Error: Data version mismatch.	Internal scanner communication problem. Ask FARO Customer Service for a firmware upgrade.
Scanner Operation Failure	Internal scanner error.	Restart scanner. If the problem still occurs after restart, contact FARO Customer Service.
Command not executed	Command could not be executed because of a previous running scan operation. A scan is still active, you cannot start the next operation now.	Wait until the scan has finished.
Scanner temperature too low	Temperature of the scanner is too low. Scanning is not possible.	Warm up the scanner before further use.
Temperature too high	Temperature of the scanner is too high. Scanning is not possible.	Shut down the scanner and let it cool down or check if the fan is running. If not enable fan cooling under Manage - Sensors - Temperature.
Internal memory full	The internal scanner hard drive is full.	Try to free some space by deleting wallpapers, operators, projects or profiles. If that does not help, contact FARO customer service.

Error Message	Description	Action
Possible file system corruption on SD card detected. Do you want the scanner to repair the file system on the SD card?	The scanner has detected file system corruptions on the inserted SD card. Damages to the file system may occur when you remove the SD card from your computer without using the option <i>Safely Remove Hardware</i> in Microsoft Windows.	It is recommended to let the scanner repair the SD card. Note that repairing might delete erroneous files from the SD card. If you see this error message again and again, you should consider replacing the SD card. To prevent damages to the file system when removing the SD card from your computer, always use the option <i>Safely Remove Hardware</i> in Microsoft Windows.
Warning	Permanent warning error. If an empty or full SD card is inserted, the LED turns red and a permanent notification is displayed. However, when the SD card is removed, both warnings remain active until the scanner is shut down.	Restart scanner. If the problem still occurs after restart, contact FARO Customer Service.
Unknown error	An unknown error occurred.	Restart scanner. If the problem still occurs after restart, contact FARO Customer Service.

Chapter 12: Disposal

At the end of its lifecycle, this product must not be disposed with normal waste, but instead must be returned to a recycling facility for electric and electronic devices.

Contact your local government or local waste disposal operators to ensure you comply with local laws.



Figure 12-1: WEEE

Chapter 13: Technical Support

FARO Technologies, Inc. is committed to providing the best technical support to our customers. Our Service Policy is detailed in [Industrial Service Policy](#) on page 170 this manual. If you have any problem using one of our products, follow these steps before contacting our Technical Support Team:

- Be sure to read the relevant sections of the documentation to find the help you need.
- Visit the FARO Customer Care area on the Web at www.faro.com to search our technical support database. This is available 24 hours a day 7 days a week.
- Document the problem you are experiencing. Be as specific as you can. The more information you have, the easier the issue will be to solve.
- If you still cannot resolve your issue, have your device's serial number available *before calling*.
- Email or faxes sent outside regular working hours usually are answered before 12:00 p.m. the next working day. Should our staff be on other calls, leave a voice mail message; calls are always returned within 24 hours. Remember to leave a detailed description of your question and your device's serial number. Do not forget to include your name, fax number, telephone number and extension so we can reach you promptly.

North America	<p>Support Hours (Monday through Friday)</p> <p>8:00 a.m. to 7:00 p.m. Eastern Standard Time (EST)</p> <p>Email: support@faro.com</p> <p>Phone: +1 800 736 2771, +1 407 333 3182 (Worldwide)</p> <p>Mexico: 866-874-1154</p> <p>Fax: +1 407-562-5294</p>
Europe	<p>Support Hours (Monday through Friday)</p> <p>8:00 a.m. to 5:00 p.m. Central European Standard Time (CET)</p> <p>Email: support.emea@faro.com</p> <p>Phone: +800 3276 7378, +49 7150 9797-400 (Worldwide)</p> <p>Fax: +800 3276 1737, +49 7150 9797-9400 (Worldwide)</p>

Asia	Support Hours (Monday through Friday) 8:30 a.m. to 5:30 p.m. Singapore Standard Time (SST) Email: supportap@faro.com Phone: +1 800 511 1360, +65 6511 1350 (Worldwide) Fax: +65 6543 0111
Japan	Support Hours (Monday through Friday) 9:00 a.m. to 5:00 p.m. Japan Standard Time (JST) Email: supportjapan@faro.com Phone: +81 561 63 1411 (Worldwide) Fax: +81 561 63 1412
China	Support Hours (Monday through Friday) 8:30 a.m. to 5:30 p.m. China Standard Time (CST) Email: supportchina@faro.com Phone: +400.677.6826 Fax: +86 21 6494 8670
India	Support Hours (Monday through Friday) 9:30 a.m. to 5:30 p.m. India Standard Time (IST) Email: supportindia@faro.com Phone: 1800.1028456 Fax: +91 11.4646.5660

Appendix A: Software License Agreement

This Software License Agreement is part of the Operating Manual for the product and software System which you have purchased from FARO TECHNOLOGIES, INC. (collectively, the “Licensor”) By your use of the software you are agreeing to the terms and conditions of this Software License Agreement. Throughout this Software License Agreement, the term “Licensee” means the owner of the System.

I. The Licensor hereby grants the Licensee the non-exclusive right to use the computer software described in this Operating Manual (the “software”). The Licensee shall have no right to sell, assign, sublicense, rent or lease the software to any third party without the Licensor’s prior written consent.

II. The Licensor further grants the Licensee the right to make a backup copy of the software media. The Licensee agrees that it will not decompile, disassemble, reverse engineer, copy, transfer, or otherwise use the software except as permitted by this section. The Licensee further agrees not to copy any written materials accompanying the software.

III. The Licensee is licensed to use the Software only in the manner described in the Operating Manual. Use of the Software in a manner other than that described in the Operating Manual or use of the software in conjunction with any non-Licensor product which decompiles or recompiles the software or in any other way modifies the structure, sequence or function of the software code, is not an authorized use, and further, such use voids the Licensor’s set forth below.

IV. The only warranty with respect to the software and the accompanying written materials is the warranty, if any, set forth in the Quotation/Purchase Order and *Appendix B: "Purchase Conditions"* pursuant to which the software was purchased from the Licensor.

V. THIS WARRANTY IS IN LIEU OF OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE SOFTWARE AND WRITTEN MATERIALS. IN NO EVENT WILL THE LICENSER BE LIABLE FOR DAMAGES, INCLUDING ANY LOST PROFITS OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE SOFTWARE, NOTWITHSTANDING THAT THE LICENSER HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, THE LICENSER WILL NOT BE LIABLE FOR ANY SUCH CLAIM BY ANY OTHER PARTY.

VI. In the event of any breach by the Licensee of this Agreement, the license granted hereby shall immediately terminate and the Licensee shall return the software media and all written materials, together with any copy of such media or materials, and the Licensee shall keep no copies of such items.

VII. The interpretation of this Agreement shall be governed by the following provisions:

A. This Agreement shall be construed pursuant to and governed by the substantive laws of the State of Florida (and any provision of Florida law shall not apply if the law of a state or jurisdiction other than Florida would otherwise apply).

B. If any provision of this Agreement is determined by a court of competent jurisdiction to be void and non-enforceable, such determination shall not affect any other provision of this Agreement, and the remaining provisions of this Agreement shall remain in full force and effect. If any provision or term of this Agreement is susceptible to two or more constructions or interpretations, one or more of which would render the provision or term void or non-enforceable, the parties agree that a construction or interpretation which renders the term of provision valid shall be favored.

C. This Agreement constitutes the entire Agreement, and supersedes all prior agreements and understandings, oral and written, among the parties to this Agreement with respect to the subject matter hereof.

VIII. If a party engages the services of an attorney or any other third party or in any way initiates legal action to enforce its rights under this Agreement, the prevailing party shall be entitled to recover all reasonable costs and expenses (including reasonable attorney's fees before trial and in appellate proceedings).

Appendix B: Purchase Conditions

All Purchase Orders (hereafter, the “Order”) for FARO-provided products and services (hereafter, the “Product”) are subject to the following terms and conditions, which are agreed to by the Purchaser. All capitalized terms are defined in Section [8.00 Definitions](#) hereafter.

1.00 Payment of Purchase Price

1.01 Purchaser hereby promises to pay to the order of FARO all deferred portions of the Purchase Price, together with interest on late purchase price payments payable at 1.5% per month (18% per annum).

1.02 The Purchaser grants to FARO a security interest in the products sold pursuant to the Order, which may be perfected by UCC-1 Financing Statements to be recorded in the applicable County of the Purchaser’s business location and filed with the Secretary of State’s Office, which security interest will remain in effect until payment in full of the purchase price together with interest on late purchase price payments payable thereon had been received by FARO.

1.03 If the Purchaser fails to make full payment of the purchase price within the period set out in the Order, FARO shall at its option have the following remedies, which shall be cumulative and not alternative:

- a) the right to cancel the Order and enter the Purchaser’s premises to re-take possession of the Product, in which event the Purchaser agrees that any down-payment or deposit shall be forfeited to FARO, as liquidated damages and not as a penalty, and all costs incurred by FARO in connection with the removal and subsequent transportation of the Product shall be payable by the Purchaser upon written demand;
- b) the right to enter the Purchaser’s premises and remove any Software, components of the Product or other items necessary in order to render the Product inoperative;
- c) the right to withhold all services which would otherwise be required to be provided by FARO pursuant to the Warranties set out in Section [4.00 Warranties and Limitation of Liability](#) hereof;
- d) terminate any existing software license agreement and
- e) pursue any other available remedy, including suing to collect any remaining balance of the purchase price (i.e., accelerate the payment of the purchase price causing the entire balance to immediately become due and payable in full).
- f) Customer will be charged a 20% restocking fee for refusal to accept equipment as delivered. Equipment must be returned unopened within 10 business days of receipt at customer facility.

1.04 If Purchaser fails to make payment(s) in accordance with the terms of this Order, the Purchaser’s Products may be rendered inoperable until such payment terms are met.

No waiver by FARO of its rights under these conditions shall be deemed to constitute a waiver of subsequent breaches or defaults by the Purchaser. In the event more than one Product is being purchased pursuant to the Order, unless otherwise set forth herein, each payment received by FARO from

Purchaser shall be applied pro rata against the cost of each product rather than being applied to the purchase price of any product.

2.00 Delivery and Transportation

2.01 Delivery dates are estimates and not guarantees, and are based upon conditions at the time such estimate is given.

2.02 FARO shall not be liable for any loss or damage, whether direct, indirect or consequential, resulting from late delivery of the Product. The Purchaser's sole remedy, if the Product is not delivered within 90 days of the estimated delivery date, shall be to cancel the Order and to recover from FARO without interest or penalty, the amount of the down-payment or deposit and any other part of the purchase price which has been paid by the Purchaser.

Notwithstanding the foregoing, such right of cancellation shall not extend to situations where late delivery is occasioned by causes beyond FARO's control, including, without limitation, compliance with any rules, regulations, orders or instructions of any federal, state, county, municipal or other government or any department or agency thereof, force majeure, acts or omissions of the Purchaser, acts of civil or military authorities, embargoes, war or insurrection, labor interruption through strike or walkout, transportation delays and other inability resulting from causes beyond FARO's control to obtain necessary labor, manufacturing facilities or materials from its usual sources. Any delays resulting from such causes shall extend estimated delivery dates by the length of such delay.

2.03 Responsibility for all costs and risks in any way connected with the storage, transportation, and installation of the Product shall be borne entirely by the Purchaser. If any disagreement arises as to whether or not damage to the Product was in fact caused in storage, transit or on installation, the opinion of FARO's technical advisors, acting reasonably, shall be conclusive.

3.00 Installation and Operator Training

3.01 The Purchaser shall be responsible for installation of the Product, including, without limitation, the preparation of its premises, the uncrating of the Product and setting up of the Product for operation. Purchaser may elect to order contract services from FARO to perform this service should they elect to do so.

4.00 Warranties and Limitation of Liability

4.01 FARO warrants that (subject to Section 4.06), the Product shall be free from defects in workmanship or material affecting the fitness of the Product for its usual purpose under normal conditions of use, service, and maintenance. A complete statement of FARO's maintenance/warranty service is set forth in *Appendix B: "Purchase Conditions"*.

4.02 FARO warrants that the Software shall operate according to specifications and the System shall operate and perform in the manner contemplated in connection with the usual purpose for which it is designed.

4.03 The maintenance/warranty set out in paragraphs 4.01 shall expire at the end of the twelve (12) month period commencing on the date of shipment from the FARO factory (the "Maintenance/Warranty Period").

4.04 Subject to the limitations contained in Section 4.06, the Warranties shall apply to any defects found by the Purchaser in the operation of the Focus Laser Scanner and reported to FARO within the Maintenance/Warranty

Period. If the Focus Laser Scanner or the Software is found by FARO, acting reasonably, to be defective, and if the defect is acknowledged by FARO to be the result of FARO's faulty material or workmanship, the Focus Laser Scanner will be repaired or adjusted to the extent found by FARO to be necessary or at the option of FARO, replaced with a new Focus Laser Scanner or parts thereof at no cost to the Purchaser.

4.05 Claims under the Warranties shall be made by delivering written notice to FARO of the defect in the System, the Focus Laser Scanner. Within a reasonable time of receipt of such notice, FARO shall have the System and Focus Laser Scanner diagnosed by its service personnel, and maintenance/warranty service will be provided at no cost to the Purchaser if the System and Focus Laser Scanner is found by FARO to be defective within the meaning of this Section.

(If, in the reasonable opinion of FARO after diagnosis of the system and the Focus Laser Scanner are not defective, the Purchaser shall pay the cost of service, which shall be the amount that FARO would otherwise charge for an evaluation under a non-warranty service evaluation.

4.06 The Warranties do not apply to:

- a) Any defects in any component of a System where, in the reasonable opinion of FARO, the Focus Laser Scanner, Software or System has been improperly stored, installed, operated, or maintained, or if Purchaser has permitted unauthorized modifications, additions, adjustments, and/or repair to any hard drive structure or content, or any other part of the System, or which might affect the System, or defects caused or repairs required as a result of causes external to FARO workmanship or the materials used by FARO. As used herein, "unauthorized" means that which has not been approved and permitted by FARO.
- b) The Warranties shall not cover replacement of expendable items, including, but not limited to, fuses, diskettes, printer paper, printer ink, printing heads, disk cleaning materials, or similar items.
- c) The Warranties shall not cover minor preventive and corrective maintenance, including, but not limited to, replacement of fuses, disk drive head cleaning, fan filter cleaning and system clock battery replacement.
- d) Any equipment or its components which was sold or transferred to any party other than the original Purchaser without the expressed written consent of FARO.

4.07 Factory Repairs

- a) IF SYSTEM IS UNDER MAINTANENCE/WARRANTY: The Purchaser agrees to ship the Product to FARO in the original packing containers. FARO will return the repaired or replacement Product. FARO will incur the expense of the needed part and all return shipping charges to the Purchaser. FARO may authorize the manufacturer of a component of the Product to perform the service.
- b) IF SYSTEM IS UNDER PREMIUM SERVICE PLAN: When practical and subject to availability, FARO will make available to the Purchaser substitute component parts or Focus Laser Scanner's ("Temporary Replacements") while corresponding parts of the Purchaser's system or Focus Laser Scanner are undergoing repair at FARO's factory. Shipping charges for

these “Temporary Replacement” parts or Focus Laser Scanner’s will be the responsibility of FARO.

c) IF SYSTEM IS NOT UNDER MAINTANENCE/WARRANTY: The Purchaser is responsible for the cost of the replacement part or software, and all shipping charges. All charges shall be estimated and prepaid prior to commencement of repairs.

d) Replacement parts used for repair may be new, refurbished, or contain refurbished materials.

4.08 Nothing herein contained shall be construed as obligating FARO to make service, parts, or repairs for any product available after the expiration of the Maintenance/Warranty Period.

4.09 Limitation of Liability

FARO shall not be responsible under any circumstances for special, incidental or consequential damages, including, but not limited to, injury to or death of any operator or other person, damage or loss resulting from inability to use the System, increased operating costs, loss of production, loss of anticipated profits, damage to property, or other special, incidental or consequential damages of any nature arising from any cause whatsoever whether based in contract, tort (including negligence), or any other theory of law. FARO’s only liability hereunder, arising from any cause whatsoever, whether based in contract, tort (including negligence) or any other theory of law, consists of the obligation to repair or replace defective components in the System or Focus Laser Scanner subject to the limitations set out above in this section.

This disclaimer of liability for consequential damage extends to any such special, incidental or consequential damages which may be suffered by third parties, either caused directly or indirectly resulting from test results or data produced by the system or any component thereof and the Purchaser agrees to indemnify and save FARO harmless from any such claims made by third parties.

4.10 The foregoing shall be FARO’s sole and exclusive liability and the Purchaser’s sole and exclusive remedy with respect to the system.

THE SOLE RESPONSIBILITY OF FARO UNDER THE WARRANTIES IS STATED HEREIN AND FARO SHALL NOT BE LIABLE FOR CONSEQUENTIAL, INDIRECT, OR INCIDENTAL DAMAGES, WHETHER THE CLAIM IS FOR BREACH OF WARRANTY, NEGLIGENCE, OR OTHERWISE.

OTHER THAN THE EXPRESS WARRANTIES HEREIN STATED, FARO DISCLAIMS ALL WARRANTIES INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS.

4.11 FARO does not authorize any person (whether natural or corporate) to assume for FARO any liability in connection with or with respect to the Products. No agent or employee of FARO has any authority to make any representation or promise on behalf of FARO, except as expressly set forth herein, or to modify the terms or limitations of the Warranties. Verbal statements are not binding upon FARO.

4.12 The Maintenance/Warranties extend only to the Purchaser and are transferable, only under the following conditions:

- The Focus Laser Scanner is currently under maintenance/warranty.

- New owner is, or becomes, a certified user.
- A FARO maintenance/warranty transfer form is completed, and submitted to Customer Service.

All claims under the Warranties must originate with the Purchaser, or any subsequent owner, and the Purchaser will indemnify and save FARO harmless from any claims for breach of warranty asserted against FARO by any third party.

4.13 Oral representations of FARO or its sales representatives, officers, employees or agents cannot be relied upon as correctly stating the representations of FARO in connection with the system. Refer to this purchase order, any exhibits hereto and any written materials supplied by FARO for correct representations.

4.14 PURCHASER ACKNOWLEDGES THAT IT HAS PURCHASED THE SYSTEM BASED UPON ITS OWN KNOWLEDGE OF THE USES TO WHICH THE SYSTEM WILL BE PUT. FARO SPECIFICALLY DISCLAIMS ANY WARRANTY OR LIABILITY RELATED TO THE FITNESS OF THE SYSTEM FOR ANY PARTICULAR PURPOSE OR ARISING FROM THE INABILITY OF THE PURCHASER TO USE THE SYSTEM FOR ANY PARTICULAR PURPOSE.

5.00 Design Changes

5.01 The Focus Laser Scanner, the Software and the System are subject to changes in design, manufacture, and programming between the date of order and the actual delivery date. FARO reserves the right to implement such changes without the Purchaser's consent, however, nothing contained herein shall be construed as obligating FARO to include such changes in the Focus Laser Scanner, Software or System provided to the Purchaser.

6.00 Non-Disclosure

6.01 All Software including, without limitation, the Operating System Program and any FARO special user programs, provided to the Purchaser as part of the system, either at the time of or subsequent to the delivery of the Focus Laser Scanner, is the intellectual property of FARO. The Purchaser shall not reproduce or duplicate, disassemble, decompile, reverse engineer, sell, transfer or assign, in any manner the Software or permit access to or use thereof by any third party. The Purchaser shall forthwith execute any further assurances in the form of non-disclosure or licensing agreements which may reasonably be required by FARO in connection with the software.

7.00 Entire Agreement / Governing Law / Miscellaneous / Guarantee

7.01 These Purchase conditions constitute the entire agreement between FARO and the Purchaser in respect to the Product. There are no representations or warranties by FARO, express or implied, except for those herein contained and these conditions supersede and replace any prior agreements between FARO and the Purchaser.

7.02 No representative of FARO has any authority to modify, alter, delete or add to any of the terms or conditions hereof. Any such modifications shall be absolutely void unless made by instrument in writing properly executed by an actual authorized employee or agent of FARO.

7.03 The terms and conditions hereof shall be binding upon FARO and the Purchaser, and shall be construed in accordance with the laws of the State of Florida, United States of America.

7.04 FARO shall be entitled to recover all of its reasonable fees and costs including, but not limited to, its reasonable attorney's fees incurred by FARO in connection with any dispute or litigation arising thereunder or in connection herewith, including appeals and bankruptcy or creditor reorganization proceeds.

7.05 These conditions shall not be construed more strictly against one party than another as a result of one party having drafted said instrument.

8.00 Definitions

8.01 "FARO" means FARO Technologies, Inc.

8.02 "Purchaser" means the party buying the Product and who is legally obligated hereunder.

8.03 "Software" means all computer programs, disk drive directory organization and content, including the computer media containing such computer programs and disk drive directory organization and content, sold pursuant to the Order.

8.04 "Product" means the Focus Laser Scanner, the Software, operating manuals and any other product or merchandise sold pursuant to the Order. If the Purchaser is buying only a Focus Laser Scanner, or the Software, Product will mean the product being purchased by the Purchaser pursuant to the Order.

8.05 "System" means a combination of the Focus Laser Scanner, the Software, the Computer, and optional parts and accessories associated with the Focus Laser Scanner.

8.06 "Purchase Order" means the original document issued from the Purchaser to FARO, listing all parts and/or services to be purchased and the agreed purchase price.

8.07 "Maintenance/Warranty Transfer Form" means a document to be completed for the transfer of the FARO Maintenance/Warranty. This document is available from FARO upon request.

Appendix C: Industrial Service Policy

This Service Plan (hereafter, the “Plan”) is part of the Operating Manual for the FARO manufactured product purchased from FARO TECHNOLOGIES INC. (hereafter, “FARO”). The Plan and all of the optional additions, are subject to the conditions in Appendices A, B, & C, and are subject to change. This appendix refers to FARO’s service plans as written in the sales advertising literature, and is meant to provide additional details that the literature does not permit.

1.00 The purchase of the Plan shall occur with the purchase of the FARO products.

1.01 The plan shall apply to systems exclusively created or authored by FARO.

1.02 The plan shall include FARO product hardware only, and can not be extended or transferred through the sale of any part of the system to a third party unless the entire system has been sold or transferred.

1.03 The plan shall not cover Hardware or Software which has been subjected to misuse or intentional damage. FARO reserves the right to determine the condition of all returned Hardware and/or Software.

1.04 FARO shall determine the service method and contractor to service/repair all hardware which is not directly manufactured by FARO. All outside contractor terms and conditions are available from FARO and are incorporated herein by reference.

1.05 FARO shall not be responsible for any non-FARO authored software which inhibits the operation of the system. Furthermore the plan will not cover the re-installation of any software.

1.06 The Hardware and Software are subject to changes in design, manufacture, and programming. All updates are as follows:

- a) Hardware - The Focus^S150 and all of the associated optional parts, and the Computer are not subject to updates.
- b) Software - All computer programs, authored by FARO, which are used in conjunction with the FARO provided Hardware, will be updated (maintenance upgrades) for the life of the Purchaser’s current version. All enhancement and functionality upgrades must be purchased.
- c) 3rd Party Software - All computer programs not authored by FARO will not be updated under the Plan. The purchaser is responsible for the acquisition of all 3rd party software updates and warranty service or claims.

1.07 In the event that FARO replaces any product or replacement product, FARO retains all right, title, and interest in and to all products or portions of products that were replaced by FARO.

2.00 Definitions

2.01 “FARO” means FARO Technologies, Inc.

2.02 “Purchaser” means the party buying the Product and who is legally obligated hereunder.

2.03 “Software” means all computer programs, disk drive directory organization and content, including the diskettes containing such computer

programs and disk drive directory organization and content, sold pursuant to the Order.

2.04“Product” means the FARO® Laser Scanner FocusS 150, the Software, operating manuals and any other product or merchandise sold pursuant to the Order. If the Purchaser is buying only a FARO® Laser Scanner FocusS 150, or the Software, Product will mean the product being purchased by the Purchaser pursuant to the Order.

2.05“System” means a combination of the Hardware, the Software, the Computer, and optional parts associated with the FARO® Laser Scanner FocusS 150.

2.06“Hardware” means the scanner and all of the associated optional parts, and the Computer if provided by FARO.

2.07“Software” means all computer programs, authored by FARO, which are used in conjunction with the FARO provided Hardware.

The following is a layman’s definition of the coverage.

Standard Service Plans

All shipping times below are to destinations within the Continental United States. Outside the Continental U.S., FARO will ship equipment directly to the customs broker.

- Standard Service Plans are contracted at time of purchase or at any time while a unit is covered by a FARO hardware service plan (as described in more detail later).
- The Standard Service Plan covers the FARO® Laser Scanner FocusS 150 and controller box.
- Shipping costs, including insurance from the Purchaser to FARO are the responsibility of the Purchaser. FARO will be responsible for all return shipping costs including insurance.
- All reasonable efforts will be made to keep the service repair time within 7 (FaroArm) or 14 (Laser Tracker and Laser Scanner) working days. The equipment will be returned via 2-Day air service, therefore, total service repair time will vary due to return shipping location.
- Since the Focus^S150 is designed to be used with many other software packages not authored by FARO, this service plan can be purchased in its entirety to cover only FARO produced or authored products. For items not produced or authored by FARO, the customer is responsible for securing their own separate warranty or service plan coverage.

Hardware Coverage

FARO SCENE Covered

- All parts and labor for FARO® Laser Scanner FocusS 150s failing under normal use as described in Appendix B.
- Annual calibration and re-certification of the FARO® Laser Scanner FocusS 150.

Not Covered

- Misuse
- Intentional damage
- Wear and tear of probes, ball bars, auxiliary hardware products such as cables, wrenches, hex keys, screwdrivers, etc.

Computer Covered

- FARO contracts with 3rd party service providers for this service for up to 3 years. The terms and conditions of FARO's contract with the provider apply herein and are incorporated herein by reference.
- Typically, these services include repair of the computer, memory cards, and video monitors.

Not Covered

- All exclusions contained in the 3rd party service providers policy which is incorporated herein by reference.
- Software operating system installation.
- User intentional or unintentional removal of key software property or files.

Software Coverage**Covered**

- Periodically, FARO Technologies may release maintenance updates of its proprietary software. This will be supported through the life of the product version. All enhancement and functionality upgrades will be available in the next full version for a fee.

Not Covered

- End users are responsible for the procurement and installation of 3rd party authored or S/W updates as required to use with FARO authored software products, unless FARO Technologies resold these packages to the end user as an authorized reseller. Examples of 3rd party authored S/W are: DOS, Windows, AutoCAD, AutoSurf, SurfCAM, and others.

Premium Service Plans

The Premium Service Plans additionally provide loaner FARO® Laser Scanner FocusS 150s and Computers when service is required. All equipment shipping costs are paid for by FARO (both ways). FARO will make its best effort to ship all loaner Focus^S150s within 24 hours of the receipt of the purchasers request. Once the need for a service has been verified by FARO, FARO will make its best effort to ship all loaner computers within 72 hours of the receipt of the purchaser's request.

Appendix D: Industrial Products Service Policy

A one-year maintenance/warranty comes with the purchase of new FARO manufactured hardware products.

The most regular of the FARO Standard Maintenance Terms and Conditions can be found in the FARO Knowledge base.

FARO Software

All FARO Software users will receive maintenance releases until the end of life for the version at no charge electronically or at a minimal fee for the computer media package. All enhancement and functionality upgrades will be available for purchase upon release.

Hardware & Software Training

FARO's training program is designed to instruct trainees in the operation of FARO's hardware and software, which the customer has purchased. The training classes are set up for each trainee to obtain valuable hands on application exposure. This will help the trainees in their everyday use of the hardware and software. FARO also feels that once the trainee completes the training, finding solutions to problems or applying applications will be simpler.

Appendix E: Certifications

E.1 FCC Notice

FCC Equipment Authorization

Trade name: FARO

Product Name: Focus

These devices comply with Part 15 of the FCC Rules

Operation is subject to the following conditions:

1. The devices may not cause harmful interference, and
2. The devices must accept any interference received, including interference that may cause undesired operation.

Contains FCC ID: PV7-WIBEAR11N-SF1

Note:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is not likely to cause harmful interference

E.2 Industry Canada (IC):

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

- (1) This device may not cause interference.
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence.

L'exploitation est autorisée aux deux conditions suivantes:

- (1) l'appareil ne doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Contains IC ID: 7738A-WB11NSF1

E.3 CE Conformity



EC Declaration of Conformity



The manufacturer,

FARO Swiss Holding GmbH
Wiesengasse 20
8222 Beringen
Switzerland

Name and address of the person authorised
to compile the technical file:

FARO Scanner Production GmbH
Lingwiesenstraße 11/2
70825 Korntal-Münchingen
Germany

Declares under his sole responsibility that the product:

Generic Designation: **Laser product for measurement, control and laboratory use**
Type: **3D Laser Scanner**
Function: **3D data capturing, indoor and outdoor measurements**
Model: **Focus M 70, Focus S 70, S150, S Plus 150, S 350, S Plus 350**
Serial Number: **081609000 - 082020000.**

Is in conformity with the relevant Community harmonisation legislation:

EU Directives
2006/42/EC - Machinery
2014/53/EU - RED
2011/65/EU - RoHS

Standards
EN 50581:2012
EN 60825-1:2014
EN 61010-1:2010
EN 61326-1:2013
ETSI EN 300 328 V2.1.1
ETSI EN 301 489-1 V1.9.2

Beringen, 07.11.2019


Sanjay Sharma
Director of Total Quality

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