Freestyle 2 User Manual

Legal Notices

Release Notice

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Contents

Chapter 1: General Information

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: Safety Precautions

Read this user 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. In this chapter Freestyle 2, the mobile PC and their accessories a referred to as *the devices*.

Intended Use

- The devices are designed to scan objects in a distance range between 0.4 m and approximately 5 m.

- Use the devices with the operating conditions and limitations described in this manual.

Improper Use

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

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

Users

In the interests of safety, the devices should only be used by competent, suitably trained users after they have read and understood this user manual, and considered any hazard that might be involved.

General Safety Information

Material Damage or Bad Measuring Accuracy

Do not expose the devices to the following:

- Do not open the housing. By opening the housing, serious personal injury may be caused and you can damage the product. This will affect the product's warranty.

- Do not use parts which have not been supplied or recommended by FARO.

- Use only replacement parts authorized by FARO and according to the instructions obtained from FARO.

- Do not expose the devices to extreme temperatures. The ambient temperature must not be lower or higher than given in the specifications. Do not use the devices near heat sources such as radiators, heat registers, or other products (including amplifiers) that produce heat.

- Do not expose the devices to water, including rain. Liquid in the product enclosure can lead to damage, fire, or electric shocks.

- Properly dispose of the product and batteries in accordance with national regulations. For more information, see *Disposal* .

- Do not use the devices 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 devices in the vicinity of strong magnetic or electrical fields.

- Before operating the devices in hazardous areas, contact the local safety authorities and safety experts.

- Do not expose the devices to rain or spray water. The devices should only 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 devices. To avoid this, we recommend placing the devices 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 devices. Remove the product from the bag before starting it. If you do not have the possibility to pack the devices airtight, wait until observable condensation water evaporates from the devices before switching on the devices.

- Do not expose to extreme temperatures. The ambient temperature should not be lower or higher than given in the specifications found in *Technical Data* on page 51.

- Do not expose to dust, sand or other abrasive materials which will damage the glass covers of the cameras.

Laser Safety

- The Freestyle 2 is classified as a **class 1 laser** in accordance with IEC 60825-1:2014 (ed. 3).

- Complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019.

- Freestyle 2 is safe under reasonably foreseeable conditions of operation. The maximum permissible exposure (MPE) cannot be exceeded. It is harmless to the eyes if it is used and maintained in accordance with the instructions in this user manual.

WARNING: Do not open the housing. The laser beam passes through a Diffractive Optical Element (DOE) before exiting the handset. The DOE splits the beam into multiple beams, each of which is safe and harmless to the eyes. The single, undiffracted beam *inside* the handset is not safe. Do not open the handset's housing, or use it if the housing has been damaged.

Electrical Safety

Damage to Electric or Electronic Components

- Do not immerse the devices into water or other liquids.

- Do not use the devices near strong magnetic or electrical fields.

- When the devices are transferred from a cold to a significantly warmer environment, water may condense on some of the components inside the devices. To avoid this, place the devices 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 device.

WARNING: Do not open the housing. 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 a battery supplied or recommended by FARO for this device. 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.

Mechanical Safety

Do not open the housing. By opening the housing:

• you can damage the device, which will affect the device's warranty.

• the calibration will be lost. Each handset passed an initial calibration before shipping. The compensation process described in *Scanning with Freestyle 2* on page 25 can not replace it.

• serious personal injury may occur and you can damage the product.

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

Take care that the vents of the devices are not blocked when they are switched on.

Data Safety

We strongly recommend that you do not connect the mobile PC with the Internet. The Mobile PC runs on a version of Windows 10 that does not allow updates or patches, and which does not have a functioning firewall. We prevent post-factory changes to ensure that nothing in the operating system is changed that could have an effect on the accuracy or function of the Freestyle 2 scanner. This means that if security holes are discovered in Windows after Freestyle 2 leaves the factory, they will not be fixed on the Mobile PC, and thus connecting the mobile PC to the Internet could leave the mobile PC vulnerable to malware or hackers. Use USB devices with caution and scan them with your desktop PC virus scanner before you connect them to the mobile PC. Never connect to the Internet with your smartphone while it is attached to the handset via USB tethering.

Safety During Work

Danger of Explosions or Fire

Do not use the devices:

• in an explosive atmosphere.

• in the presence of flammable gases or fumes.

Before operating the devices in hazardous areas, contact the local safety authorities and safety experts.

Damage to Electric or Electronic Components

• Do not use the devices in the vicinity of strong magnetic or electrical fields.

• When scanning outdoors or in dirty surroundings, protect the device from liquids and humidity, but also from dust and dirt which may damage the electronic in the devices.

• Do not use the devices near heat sources such as radiators, heat registers, or other products (including amplifiers) that produce heat.

WARNING: Strobe light
> The flashlight is a strobe light and can be hazardous to persons who are susceptible to photosensitive epileptic seizures. In case of doubt, switch the flashlight to OFF.

Transport

• When carrying the devices, take care not to drop them. Strong impact may damage the devices and render them incapable of proper operation.

• When shipping and transporting the devices 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: One fully-charged Power Block does not exceed 100 Wh.

Storage

Pack the devices in the transport case to protect them from environmental hazards.

Store in an environment with the following characteristics:

• low humidity level

• relatively stable temperature

• no extreme temperatures

• no extreme environmental conditions (dust, dirt, etc.)

• no heavy vibrations

Servicing

- Servicing and repair must only be done by qualified service personnel authorized by FARO.

- Contact FARO customer services under the following conditions:

  - A cable or plug is damaged.

  - The device has been exposed to heavy rain, water, or other liquids.

  - The device has been dropped or damaged in any way.

  - Objects have fallen onto the device.

  - The device does not operate normally when following the standard operating instructions.

Power Block Battery Safety Measures

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

- Charge the Power Block only in the Mobile PC or in a charger recommended by FARO to charge the Power Block.

- Do not charge or discharge damaged batteries.

- Do not charge the Power Block in the mobile PC 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 in dry and dust-free environments only.

- When the mobile PC is not in use for a longer period of time, remove the Power Block.

- Store the Power Block only when it is charged (at least 60% charge state). It is recommended to charge the Power Block once a year when it is stored long term.

- 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.

Chapter 3: Freestyle 2 Parts and their Functions

Included Equipment

- Transport and carry case

- Freestyle 2 Scanner

- USB flash drive with SCENE installation files, the reference plate file and this user manual

- Optical cleaning cloth

- Reference plate

- Three metallic stickers for the smartphone

- USB cable with ferrite core

- Mobile PC, wrench, strap, and belt-clip

- Power Block rechargeable battery

- Power supply

- 20 photogrammetric markers

NOTE: Retain all packaging materials as you may need them later.

Required Additional Equipment

- Samsung A71 phone (or other compatible Android phone having at least the same performance specification). Internet access is required to install the Freestyle 2 app.

- PC for SCENE. Refer to the SCENE manual for recommended specifications.

Optional Equipment and Replacement Parts

- Spare Power Block battery (Contact your FARO sales representative.)

- Power Dock battery charger (order number ACCSS8002)

- Power Supply for Power Dock (order number ACCSS8006)

- Spare Capture Clip for the Mobile PC (order number ACCSS8019)

- Reference plate (order number ACCSF0001)

- Extra Metallic Stickers (Contact your FARO sales representative.)

Freestyle 2 Handset

Figure 3-1 Freestyle 2 handset, top side components

❶ Start/Stop button and status LED lights

❷ Exhaust vent (on left side)

❸ Cooling vent

❹ Mobile phone

❺ Flashlight button (on, off, auto)

❻ Multi-purpose button

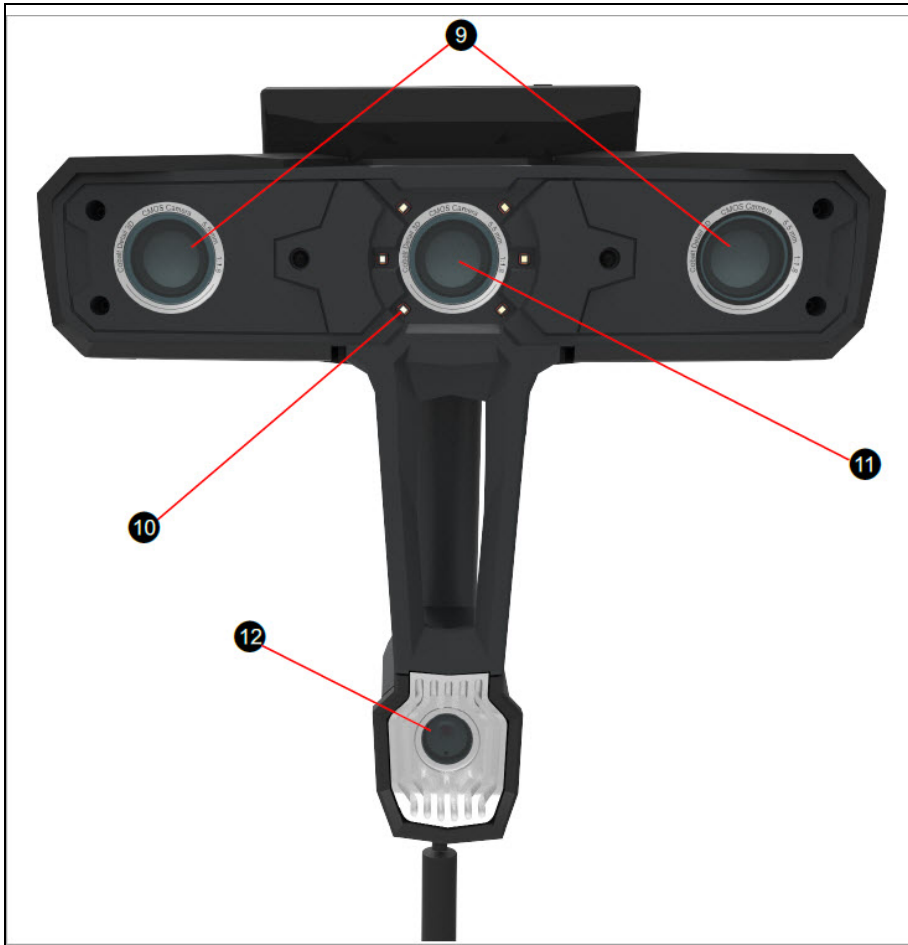❼ USB Port (and GPIO interface—not for customer use)

❽ Data and power cable

Figure 3-2 Freestyle 2 handset, bottom side components

9 Infrared cameras

10 LED Flashlight (6 total)

11 Color camera

12 Infrared projector with class 1 laser

Mobile PC

The device has multiple interfaces as shown in the figure below.

Figure 3-1 Parts of the Mobile PC

❶ USB Ports: Use these ports with a USB flash drive to transfer data from the Mobile PC, or to attach a mouse and keyboard.

❷ Power: Use only the included charger. When powered from an external power source your Mobile PC can run without a Power Block or charge an empty Power Block. For charging the Power Block the device need not be turned on.

❸ LED Indicator: LED at power socket. For more information, see Mobile PC LEDs on page 64.

❹ HDMI Port: Connect an external monitor here to get full access to the Windows operating system and installed software.

Figure 3-2 Back side of Mobile PC

❺ Power Block: Use only the FARO Power Block. Other batteries are not supported. NOTE: Older versions of the Power Block are not compatible with the Mobile PC and Freestyle 2. Ensure that your Power Block type label includes the designation HC.

❻ Data and power socket (only for connection to Freestyle 2).

❼ Blue LED in button: See Technical data on page 61 for blink codes.

❽ On/Off: Use this button to turn the device on or off.
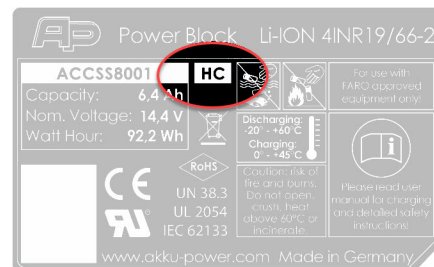
Chapter 4: How Freestyle 2 Works

The Freestyle 2 scanner enables you to record the dimensions and colors of objects and environments in three dimensions. To accomplish this, you move the handset along or around the object of interest. As you move the handset, three integrated sensors record what they capture. This data is processed and saved on the Mobile PC, and displayed in an app on your smartphone. The recorded points are then used to create a colored, 3D model of the captured object or environment.

After 3D data has been captured, you can view and analyze it in SCENE. (For example you can measure the actual size of objects.) You can also export the data to different file formats and import it into third party applications, such as Computer-Aided Design (CAD) programs.

The main features are:

• High accuracy.

• High resolution: you can scan thin cables, ribs of small skeletons, etc.

• Scanning range: 0.4 meters to 10 meters. (Accuracy is best with shorter distances.)

• Intuitive handling: no need for complex preparation—just scan!

• High mobility due to its small size and weight.

• Photorealistic 3D color scans due to the integrated color camera.

• Seamless integration with FARO Focus^s laser scanner scan data.

• No artificial targets required.

How it Works

The Freestyle 2 projects a pattern of small infrared dots on the surface of the object. The two infrared cameras take photographs of this pattern. The 3D coordinates of the infrared dots are then calculated using a mathematical method called triangulation.

Commonly Used Terms

Frame: a color photograph taken by Freestyle 2 along with the 3D points and other information that was recorded when the photograph was taken. Freestyle 2 records about 20 frames per second.

Features: 2D objects (e.g., planes) and textures that are recorded by Freestyle 2 and which can be identified by the Freestyle 2 software. Features are used during the *tracking* process.

Target: a physical object in the area to be scanned that can be detected by the software and used to register the scans. A target can be a naturally occurring plane such as a wall or desk, or a *marker*.

Tracking: the process of following features from frame to frame. Tracking makes it possible to reconstruct the movement of Freestyle 2 in space, thus putting the points of the individual frames into a common 3D context.

Scan: a set of frames resulting from one recording sequence and saved in one file.

Loop-closing: the process of correcting small tracking errors so that areas that are recorded more than once in a single scan are properly positioned with respect to all the frames in the scan.

Registration: the process of positioning one or more scans so that points created from the same objects are aligned with each other. (This is similar to the process of creating a large panorama from a collection of smaller images.) If *markers* or *targets* are present in the scan, software can usually register scans automatically—otherwise you must register them manually (also known as "placing" the scans).

Marker: an artificial target consisting of a special printed symbol that you can place in the scanning area to help SCENE software register scans. Markers are especially helpful when you want to register a Freestyle 2 scan with a Focus[S] scan. *For more information, see "Working with Markers" on page 48.*

Point cloud: a 3D representation of an area or object made of millions of points created from one scan or from several registered scans.

Chapter 5: Prepare to Scan

This chapter explains how to prepare your equipment before scanning. Some of these steps you need to do only once. Others you should do each time you scan.

Setting up the Mobile PC

Charge the Power Block

1. Insert the Power Block into the Mobile PC until the latches click into place.

NOTICE: Do not force the Power Block into the Mobile PC. If the latches do not click into place with gentle pressure, remove the Power Block, turn it 180 degrees and try again.

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2. Connect the power supply to the mains and insert into the Mobile PC; the LED will blink green for one second and then blink blue while charging. When charging is complete, the LED shines blue without blinking.

Decide How to Carry the Mobile PC

The Mobile PC can be carried either with a shoulder strap or with a belt clip. Choose the method you want to use and follow one set of instructions, below.

NOTICE: Use only mounting systems provided by FARO. Using another system or screw could damage the device.

Attaching the Shoulder Strap

Figure 5-1 Attaching the strap

Insert both ends of the strap to the round plugs that are attached to the Mobile PC. Make sure that you hear it click into place. Ensure that both endings of the strap are fully locked.

CAUTION: The Mobile PC has three air vents: one on the front and one on each side. The vents must not be obstructed while the Mobile PC is switched on. If the vents are obstructed, the device may overheat, causing damage and a fire.

To unlock the strap, push each round plug. While pushing, the strap can be released.

Mounting the Belt-Clip Plate and Belt-Clip
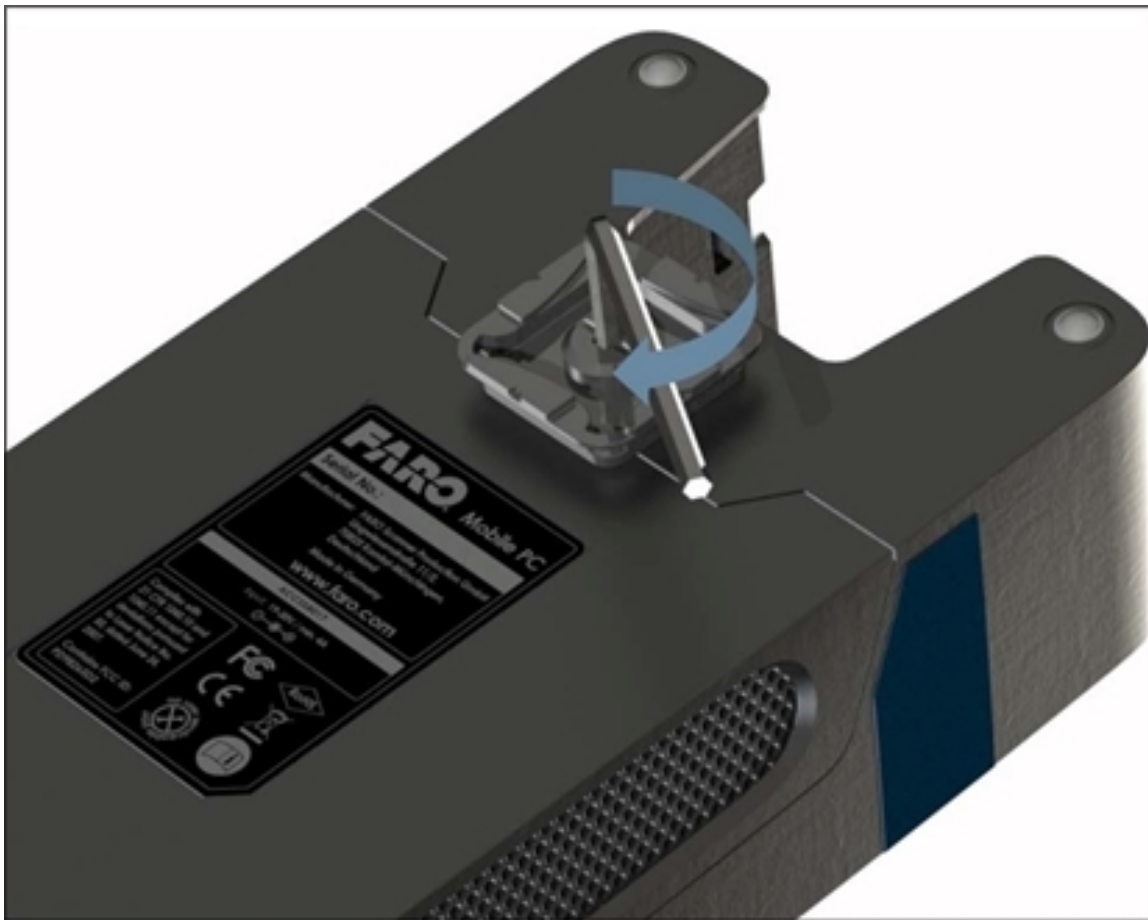
Figure 5-2 Attaching the Mounting Plate

Attach the included mounting plate using the screw as shown in the picture above onto the Mobile PC. Use an SW4 torque wrench to tighten the screw to between 0.5 Nm and 1.5 Nm. Too much torque can damage the housing, while too little may not firmly attach the mounting plate.

NOTE: If you don't have a torque wrench, tighten the screw until you cannot turn the mounting plate with your fingers easily. This is probably close to the required torque.

Mounting the Belt Clip

Figure 5-3 Belt clip

Unscrew the screws as shown—only as much as is necessary to swing open the clip. Put the clip around own belt if you choose to carry the Mobile PC in this way. It can also be mounted on the straps of a backpack or similar. Close the clip and safely fasten the screws.

WARNING: The Mobile PC has three air vents: one on the front and one on each side. The vents must not be obstructed while the Mobile PC is switched on. If the vents are obstructed, the device may overheat, causing damage and a fire.

Insert the mounting plate that is attached to your device into the clip. Make sure that you hear it click into place. Ensure that the clip is fully locked. For additional safety you can tighten the remaining screw on the right side of the clip.

To unlock the clip. push the button ❶. While pushing you can slide off the mounting plate from the clip.

Prepare the Smartphone

Your phone is held in place on the Freestyle 2 with a magnet. You must attach a metallic sticker (included with the Freestyle 2 kit) to the back of your phone so that it is attracted to the magnet. If you keep your phone in a protective cover, you can also attach the sticker to the cover, as long as the cover holds the phone securely. (The sticker must have direct, complete contact with Freestyle 2, otherwise the phone will not be held firmly in place).

① Camera lens. If the lens is on one side of the phone (as pictured), place the sticker on the other side of the phone.

② Rear side of smartphone.

③ Metallic sticker.

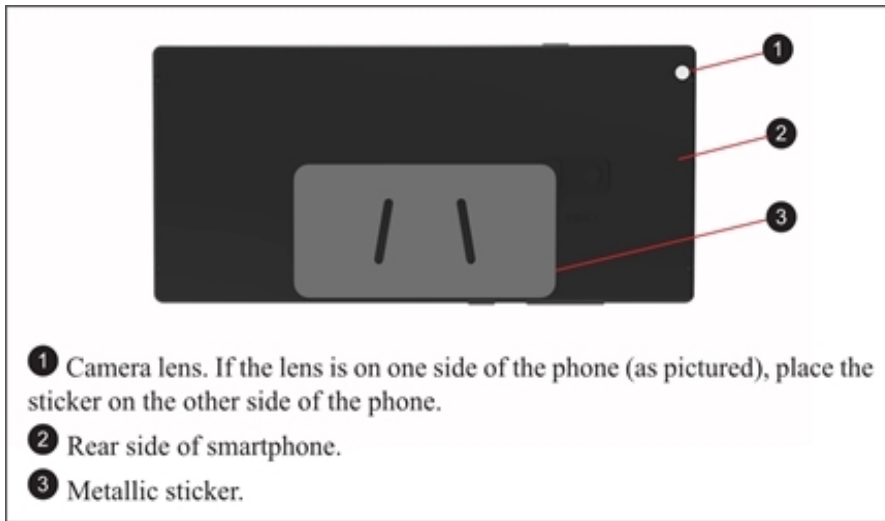*Figure 5-1 Correct position for the metallic sticker*

- If the Freestyle 2 app is not installed on the phone you intend to use, locate the app in the Google Play store and install on your phone.

NOTICE: Although the magnets hold the phone firmly in place on the handset, bumping the phone, or moving the handset quickly or in a jerking manner can cause the phone to separate from the device and fall.

Chapter 6: Scanning with Freestyle 2

Typical Workflow for a Freestyle 2 Scan Project

1. Attach Mobile PC to your belt or shoulder strap.

2. *Attach the Phone to the Handset* below.

3. *Place the Phone on the Handset* on the next page.

4. *Adjust the Recording Settings* on page 28

5. (Optional) *Adjust White Balance* on page 28.

6. *Start Scanning* on page 31.

7. *Process the Scan Project* on page 36.

8. *Use a Scan Project in SCENE* on page 38.

Attach the Phone to the Handset

Use the included USB cable to connect the phone to the handset.

Figure 6-1 USB connection

Place the Phone on the Handset

Place the phone on the handset as shown. The metallic sticker on the phone must hold the phone securely in place.

NOTE: The phone mount (that is, the part of the handset that contains the magnets) is removable.

Figure 6-1 Phone position on handset

Connect the Handset to the Mobile PC

Insert a charged Power Block into the Mobile PC. Slide the Power Block into the slot and press gently until the Power Block latches click into place.

NOTICE: Do not force the Power Block into the slot. If the Power Block does not easily click into place, check to ensure it is inserted in the correct orientation and try again.

Plug the handset's connector ③ into the Mobile PC data and power socket ②. The plug will slide into the socket with gentle pressure when it is correctly aligned

Figure 6-2 Mobile PC Connection

NOTICE: Do not connect or disconnect the handset while Mobile PC is switched on. Always switch off the Mobile PC before connecting or disconnecting the handset.

1. Start the Mobile PC by pressing the On/Off Button ①. The blue LED flashes during the booting process. The computer is ready when the On/Off button stops flashing and shows a constant blue light.

NOTE: A few seconds after switching on the power, the fans of the Mobile PC and handset will start. If this does not happen, it probably means that the battery is not sufficiently charged. In this case, switch off the power, charge the battery and try again.

NOTICE: The Mobile PC has three cooling vents, one on top and one on each side (shown here in red). These vents must be kept free whenever the Mobile PC is switched on. **Blocked vents can lead to a reduction in processing power and can damage the processor.**

2. You have two options to connect the phone to the system: USB cable or WiFi. Using the USB cable may result in a more fluent visualization of the data, while using WiFi enables more flexibility.

   • **If you want to use the USB cable**, disable WiFi on the phone. (The USB connection in the next step will not work unless WiFi is disabled.

   • **If you want to use WiFi**, open the camera app on your phone or a QR code reader and scan the QR code that is printed on the bottom of the Mobile PC. After scanning the code, a dialog box will appear aksing if you want to connect to the network. Tap yes and your phone will connect. You can also connect manually by searching for the WiFi of the Mobile PC and entering the password manually. (There is also a "fall back" option: if you connect your Mobile PC to a monitor with an HDMI cable, the QR code will be visible in a window and can also be scanned by a phone).

3. Start the Freestyle 2 app. If a WiFi connection to the Mobile PC is established, the app will lead you directly to the screen where capturing can be started.

   If you chose to use the USB cable, tap the **Enable USB** button and the app will automatically redirect you to the right settings page. Choose USB, then return to the app. Note that you must do this step each time the phone is reconnected.

4. The app connects automatically to the handset.

5. The Freestyle 2 app starts with the home screen by default.

6. The handset is ready to scan when the LED on the center button is blue.

Adjust the Recording Settings

Check and adjust the recording settings before you begin to scan. The default values will work in many situations, but take note of what you can adjust, according to environment you are scanning and the results you want to get.
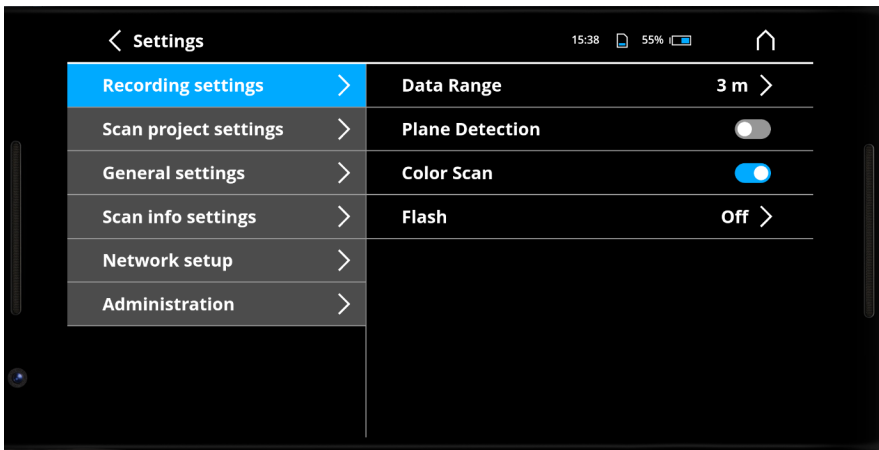

Figure 6-1 Default Scan Settings dialog

- **Data range**: Enter a number between 1 m and 10 m (3 ft and 33 ft). The Freestyle 2 will not record points that are further away than this distance. Use this setting when you want to exclude unimportant objects from your scan.

- **Plane detection**: Switch on when scanning an area with flat surfaces. When scanning in areas without flat surfaces, scanning without plane detection may lead to a slightly better performance.

- **Color Scan**: Switch this off if you prefer a grayscale scan.

- **Flash**: Use this to switch the flashlight on and off. Note that you can also switch the flash on and off while scanning by using the handset buttons. See *Freestyle 2 Handset* on page 14.

Adjust White Balance

White balance (also called color balance) is the adjustment of the intensity of primary colors to produce images that match what the human eye sees under different lighting conditions. The white balance function helps you adjust the color camera in the handset so that it produces images that look like what you actually see. If accurate color in scans is important to you, you should adjust the white balance right before scanning, or whenever the amount or type of light changes.
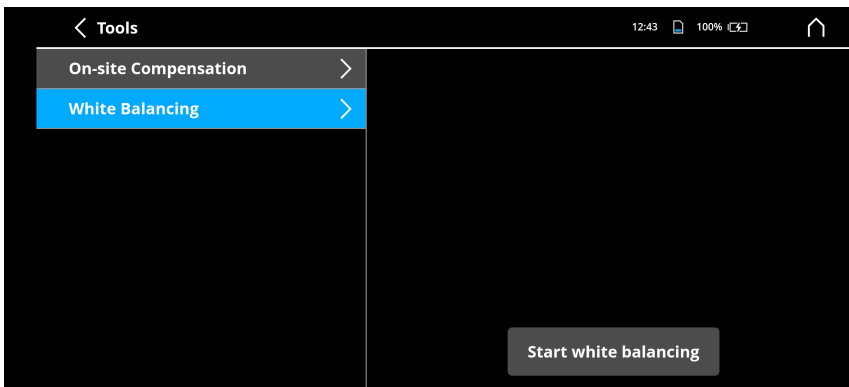
Figure 6-1 Tools screen

To Adjust the White Balance

1. Start the app and select Tools > **White Balance**.

2. Point the handset at an object that is white or gray, and position the handset so that the box on screen is completely filled with one color. (If nothing in the area you plan to scan is white or gray, you can use the reference plate, or even just a piece of white paper.) If you expect to scan with the flashlight, you can press the left button to **Start Flash**.
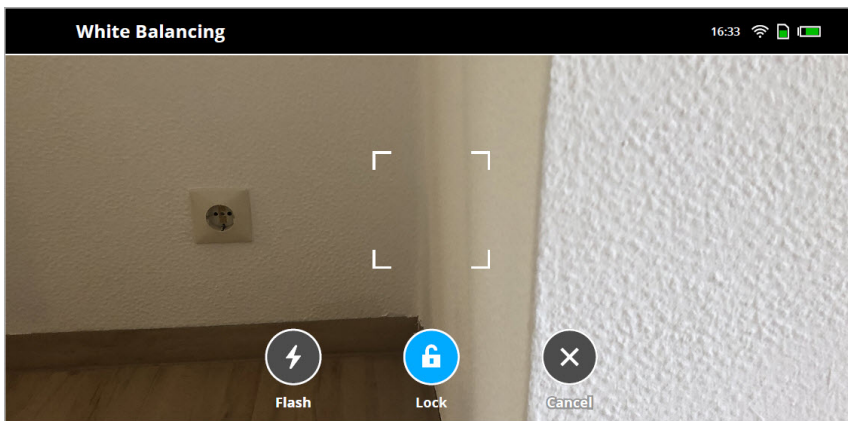

Figure 6-2 White balance and reference plate

3. When the selection box is filled with a white or gray object, press the center button on the handset to lock the white balance.

4. Move handset around in the area, looking at the colors represented on screen and comparing them with the colors you actually see. If the colors match, press the center button on the handset to **Apply** the changes and exit white balancing. If they don't match, press the right button to try again.

Scanning

Tips for Successful Scanning

Scanning with Freestyle 2 is easy, but there are some guidelines which will help you get the best results.

- Plan how you will scan the objects of interest before you begin, taking the following contradictory recommendations into consideration:

- The longer a single scan takes, the longer the processing time will be. Try to keep scan times as short as possible—under 5 minutes is best.

- It is better to have one scan that captures all objects of interest than to have several scans. Fewer scans means less registration.

- Move the handset slowly and constantly, avoid jerky movements. Fast and jerky movements may lead to inaccurate data or tracking may be lost.

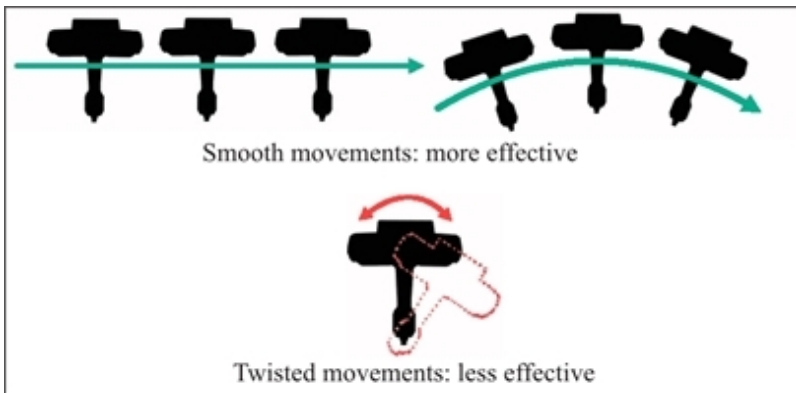- Accuracy and tracking may be improved if you avoid excessive twisting movements while scanning:

Figure 6-1 Avoid twisting moments

- Make sure that the objects of interest are within the specified maximum range and minimum range of the handset.

- Objects or surfaces may have an increased noise or reduced data if they are directly illuminated by bright sunshine.

- Use markers for high accuracy tasks

- Avoid:

  - scanning your shadow while making outdoor scans

  - having only plain-colored surfaces (e.g., a white wall) in the handset's field of view

  - having only shiny surfaces in the handset's field of view, example metal rails, or high-gloss lacquer

  - having only highly absorbing surfaces in the field of view, for example black furniture

  - scanning when the temperature is lower than 0 °C or higher than 40 °C

  - high concentrations of dust, fog, rain or snowfall. This may result in bad measurements. Avoid scanning under these conditions.

- Try to move the handset in circles or loops. This helps with loop-closing.

- When scanning all sides of an object, start and stop at "less interesting" positions. For example, when scanning a person, start and stop at the back.

- Try to finish a scan at the place where you began. This helps with loop-closing.

- Objects must not move while they are captured.

- If the number of features is low or badly distributed, try to move the handset's field of view to areas with more structures.

- Scanning areas with few features or without texture can be difficult. Add markers or other artificial targets for better results.

- If the lighting conditions are bad, use the flashlight to get better results.

- If you are not able to scan dark areas, treat these with developer spray.

- If you are not able to scan shiny areas, treat these with anti-glare spray.

Scanning Tutorials

The app provides an assortment of scanning tutorials. The tutorials put the Freestyle 2 into a special mode that does not save the scan, but instead provides real-time feedback about what parameters it is recording. Parameters that are not good enough for the Freestyle 2 to create good scans are shown in red. This lets you see how adjustments to your scanning technique affect the information that the Freestyle 2 is able to collect.

Start Scanning

WARNING: Eye injuries caused by laser beams

Although the handset is classified as a laser class 1 device, it might be dangerous if the laser beams point to someone's eyes.Be careful when scanning people or animals. Do not aim at eyes from a close distance.

NOTICE: Damage to electric or electronic components

In certain situations, you may be statically charged. As soon as you touch the metal parts of Freestyle 2, high voltage will discharge to the device and may cause serious damage.

Always hold Freestyle 2 by its handle. Do not touch the metal rings around the glass covers on the front side of Freestyle 2.

NOTE: Always hold Freestyle 2 by its handle; never by one of its arms. Because the Freestyle 2 is a high-precision measuring device, even the slightest bending of the device will result in inaccuracies or even errors.
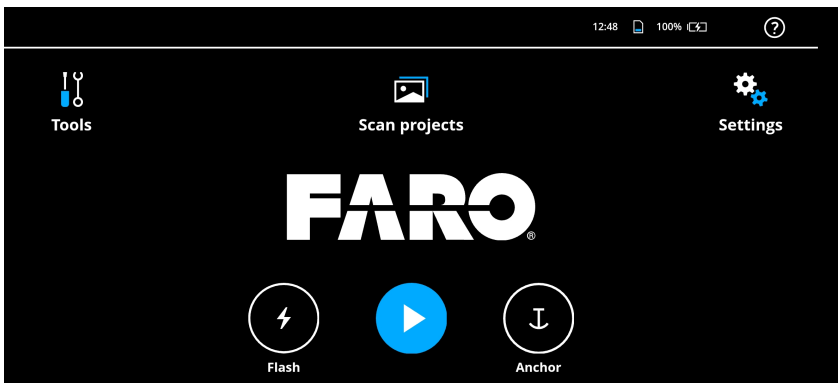
Create a Scan Project

Figure 6-2 App Home Screen

You can just push the center button on the handset or tap the blue button on the app to start scanning, or you can specifically create the scan project first:

1. Tap **Scan Projects**.

2. Tap **Add Project**.

3. Enter a project name.

4. Tap **OK**. The project is created.

5. Tap home icon (⌂) to return to home screen.

Start capturing by one of the following:

* Tap the (⊙)button in the app.

* Press the center button on top of Freestyle 2. (Tip: You can start scanning with this button no matter what the app currently shows.)

After a few seconds, a window appears with the 3D Point Cloud View. The Freestyle 2 tries to find a starting point for the scan. To do this, it needs to scan an area with features that it can identify. If you start to scan an area that is mostly featureless (for example, a white wall), this may be difficult. In this case, move to an area with more features and continue.
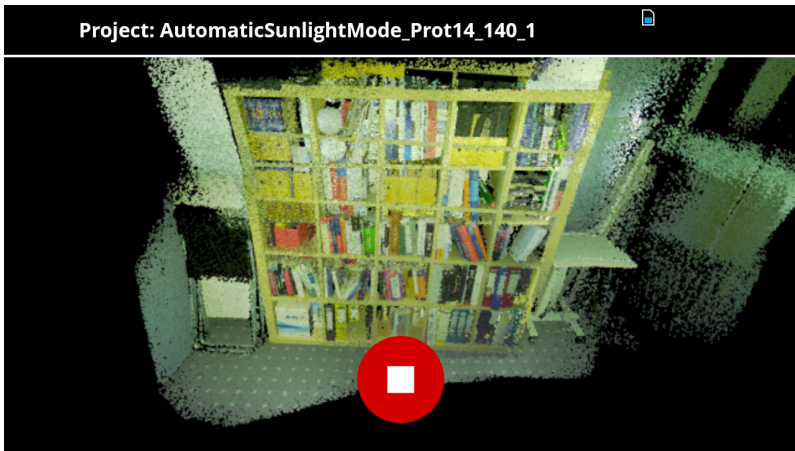
Figure 6-3 Scanning

Tracking Lost: Resume Tracking

If tracking is lost, you can resume it. As soon as the tracking is lost, the view changes. You see what the handset sees, superimposed on a static picture of the place where tracking was lost. Move the handset to align the active picture with the static picture. When the two are in alignment, tracking will resume.
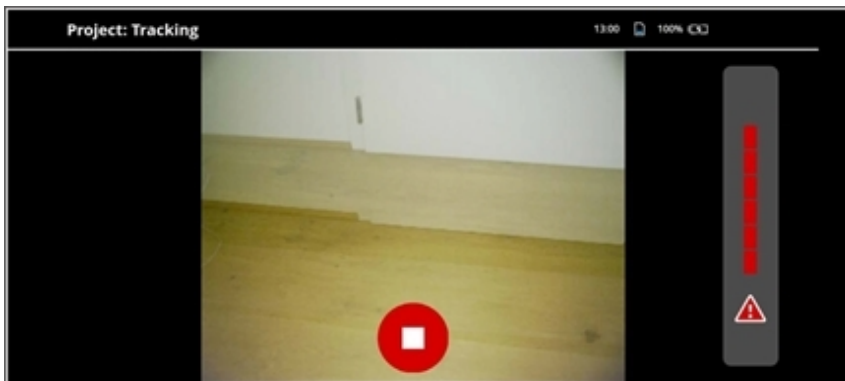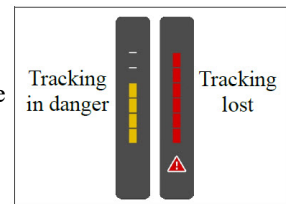
Figure 6-4 Live video screen of lost tracking

NOTE: In certain situations, it might be difficult to resume tracking. If the app can't resume tracking within 20 seconds, it automatically stops capturing and starts with a new scan. When you process your scan project later on, you can decide whether the aborted scan is useful.

Low Storage Space and Battery

While you are capturing, the Freestyle 2 app checks whether there is sufficient storage space on the Mobile PC, and if enough power is left in the battery.

As soon as the storage space or battery power gets low, a warning icon is displayed.

If this icon is shown, finish the scan as intended. You do not need to stop the capturing immediately. The app will then finalize and save the scan project.

Stop Capturing

Stop capturing by doing one of the following:

- Press the center button on the top of the handset.

- Tap the 🔴 button.

After you stop scanning, examine the scan and ensure that you captured everything that you wanted. If anything is missing, make an additional scan of that area, making sure to also scan some areas that are in the first scan. It's important for the scans to overlap so that they can be registered later.

In the scan's properties, more information is displayed, i.e., some statistics and the history.

Your First Results

Tap a scan's name in the project's workspace. The 3D View will be shown.

Look at your scan and check it. You can rotate the object since rotation mode is set by default. Tap on the 3D View and use two fingers to and move the scan.

NOTE: The app does not process and display all the captured data. So the scans may appear in a lower quality. After the scan project is processed, you will see the real quality.

Process the scan data, then look again. (Note that you cannot process and scan at the same time.)

Automatic Leveling

Freestyle 2 uses built-in sensors to level scans automatically. The z-direction is "up" for all scans.

Anchor Points

Anchor points help to optimize the results of larger scans. It may be helpful to place an anchor point at the beginning of a scan and scan the same area again at the end of the scan.

If you open a scan that was captured including anchor points, even without processing, the alignment of the scan will be optimized by the anchor points.

Per default, the functionality of setting anchor points is connected to the right hardware button of the device. You can press the button while scanning, and the software searches for a virtual anchor point approximately in the direction that the device is pointing. An anchor point can be found at regions where 3 plans intersect, e.g., the corner of a room. Make sure that the planes are at least as big as the reference plate. If a corner point is recognized after pushing the button, a green icon will be displayed. If no anchor point was found, a red icon will appear. If an anchor point is found successfully, after a few seconds a green sphere will be visible in the 3D view at this area.

Figure 6-1 Set Anchor Point

If you come back during your scan to that area, the software will automatically search for the anchor point in the 3D point cloud, and it will display in blue if it is detected and aligned properly.
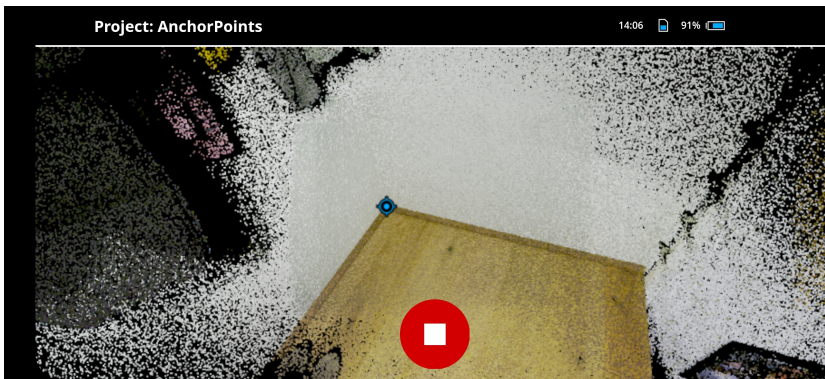
Chapter 7: Process the Scan Project

Processing is a series of manipulations to the scan data in a project that improve the quality of the scan. This chapter will give you a description of how to process a scan project.

Processing

The usual case is to process an entire scan project, though you can also process single scans.

1. Select the project you want to process. (Tap **Scan Projects**, **Select**, and tap the project you want to process.) You can also open a project first, and then select just one scan to process. Select the project that contains the scans you want to process.

2. Tap **Process**.

3. Choose the processing options you want to use. Two presets are available **Fast Processing** and **Accurate Processing**. Choose one, modify as necessary, and select **Start processing**. See below for a description of the different processing options.

User-Defined Processing
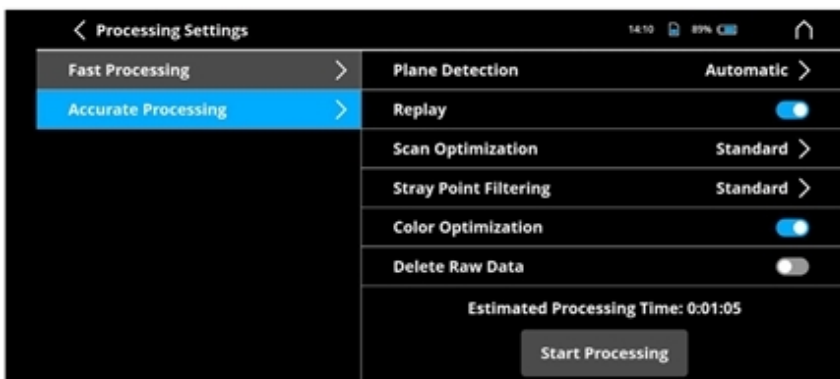

Figure 7-1 Processing settings

Plane Detection

On switches on detection for all processing. **Auto** switches on plane detection only if it was switched on when the scan was created.

Replay

If scans have already passed some processing steps, Replay restarts the processing from the beginning. Processing is then executed with higher precision than was done during capturing.

Scan Optimization

This adjusts all frames of a scan to minimize displacements errors. The function searches for loops in the scan and tries to close those loops. Loop closing is necessary because small errors from frame to frame may accumulate over time, resulting in gaps if you return to the same position again. The **Extended** setting may give better results, but will take longer.

Stray Point Filtering

Removes stray points, creating a cleaner overall look. Select **Standard** to remove stray points without additional 3D smoothing. This setting tends to make edges and corners look better. Select **Smooth** to add additional 3D smoothing. This setting tends to make planes look better.

Color Optimization

Averages the color of scan points in overlapping areas within the selected scan, and adjusts color effects caused by different lighting situations.

Delete Raw Data

Deletes the raw scan data and the project history after processing is complete. Select this option if you want to save space and reduce project size, but only if you are sure that you never want to process the scan again

---

NOTE: The **Delete raw data** feature is meant to be used after a scan project is finalized. Do not use it during the process because of the following reasons:

The scan project history is deleted. All information about the history of a project will be lost. You will no longer be able to revert the project to a previous revision afterwards.

The camera files are deleted. It is not longer possible to process the scan project.

Exporting Point Clouds

The point cloud export functionality provides an export of a scan in the XYZ or E57 file format. The XYZ file format also includes normals, which may be helpful for meshing approaches.

1. Make sure that a USB flash drive is inserted in one of the USB ports of the Mobile PC.

2. Select the scan from which you want to export the point cloud.

3. Select **Export.**

4. Choose the file format.

Chapter 8: Use a Scan Project in SCENE

SCENE is the FARO software that you can use to work with your scans. In SCENE, you can measure distances and areas, add annotations, view the project with Virtual Reality equipment, etc. You can also export the data to SCENE WebShare Cloud, and to many other file formats. You can create meshes which can be used to print 3D models of parts of your scan. Use the instructions below to import your projects into SCENE.

NOTE: SCENE is a complex and flexible application that provides you with many ways to manipulate your scan data. This document explains how to transfer your scan project to SCENE, but does not provide more information about how to use the program. Make sure to read the SCENE documentation carefully. Videos and Training materials are also available at the FARO Knowledge Base (**https://knowledge.faro.com/Software/FARO_SCENE/SCENE**) to help you become a SCENE expert.

(Optional) Export the Project to a USB Flash Drive

Process the project before you export the project. *Process the Scan Project* on page 36

1. Insert USB flash drive in the Mobile PC.

2. From the projects view, tap **Select**.

3. Tap the project you want to export to select it.

4. Tap **Export**. The project will be exported to the USB flash drive as
   `/Exported_Projects/ProjectName`

Import and Open a Scan Project

1. Insert the USB flash drive that contains the scan project into the computer where you have installed SCENE.

2. Open SCENE.

3. Click **Create Project** and create a new project.

4. Click the **Import** tab.

5. Click **Import Projects**.

6. Navigate to the USB flash drive and locate your project under
   `/Exported_Projects/.`

7. Open the *.lsproj file. The scan project will import into SCENE.

Processing

When the project import is complete, select the Processing tab.

NOTE: If the project was already processed in the app, you only need to process it again if you want to use a different processing configuration.

---

1. Click, **Process Scans.**

2. Click, **Select scans or clusters.**

3. Click, **Configure Processing.**

4. Change processing settings as needed for your situation.

5. Click **Start Processing**. Depending on the size of your project and the power of your PC, this can take some time.

Registration

When the project processing is complete, you will need to register the scans in your project if it contains more than one.

1. Select the Registration tab.

2. Select **Automatic Registration with targets**.

3. Select the scans cluster.

4. Click **Select Method** and adjust settings as necessary

5. Click **Register and Verify**. If the registration is not successful, try manual registration instead.

Scan Repair

If a scan shows misalignments in the 3D data, the *Scan Repair* mechanism can be used to improve the results.

1. Select the **Processing** tab

2. Select **Handheld Scan Repair**

3. Follow the instructions on the left side of the screen.

Chapter 9: Freestyle 2 App Settings

This chapter provides a brief description of app settings not previously documented.
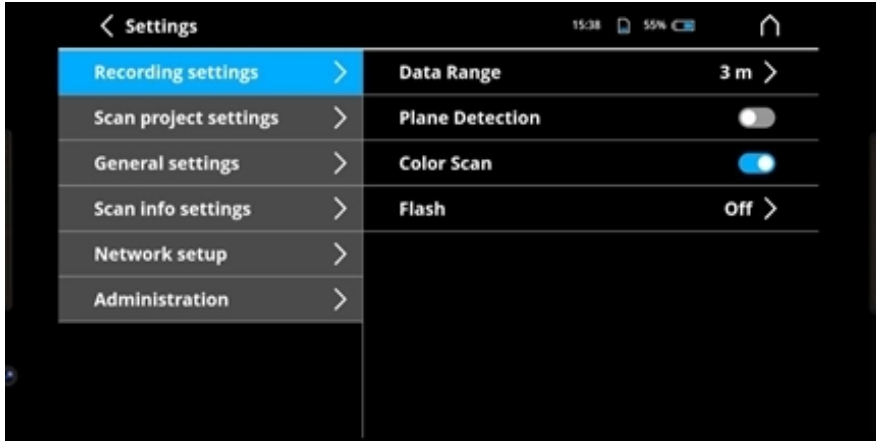
Figure 9-1 Default Scan Settings dialog

Recording Settings

For more information, see "Adjust the Recording Settings" on page 28.

Scan Project Settings

- **Project base name**: Sets the default project base name. You can override this manually when creating a project.

- **Scan base name**: Sets the default scan base name. You can override this manually when creating a scan.

- **Delete Exported Projects**: Deletes all scan projects that have already been exported.

General Settings

- **Length unit**: Set the default units to meters or feet.

- **Theme**: Set the app theme to bright or dark.

- **Unmount External USB Storage**: Unmounts the USB flash drive so you can remove it safely.

Scan Info Settings

- **Histogram**: Show a histogram of the depth data captured.

- **Show detected markers**: Markers will be displayed in the 3D view after processing.

- **Scan time**: Show the time since the scan was started.

- **Data size**: Display size of captured data.

- **Number of frames**: Display number of frames captured.

- **Number of 3D points**: Show number of 3D points in current frame.

- **Acoustic feedback**: Switch this on if you want the app to play a sound when tracking lost or recovered.

- **Vibration feedback**: Switch this on if you want the phone to vibrate in critical situations (too near to subject, too far from subject).

Help

- **Training videos**: Videos that provide information about how to get the best results from Freestyle 2.

- **Scanning tutorials**: Scanning modes that do not save data, but instead provide real-time feedback about the information that the Freestyle 2 is capturing. Use this mode to learn about how to best move the handset, or to test scanning conditions before you actually begin with a scan project. *For more information, see "Scanning Tutorials" on page 31.*
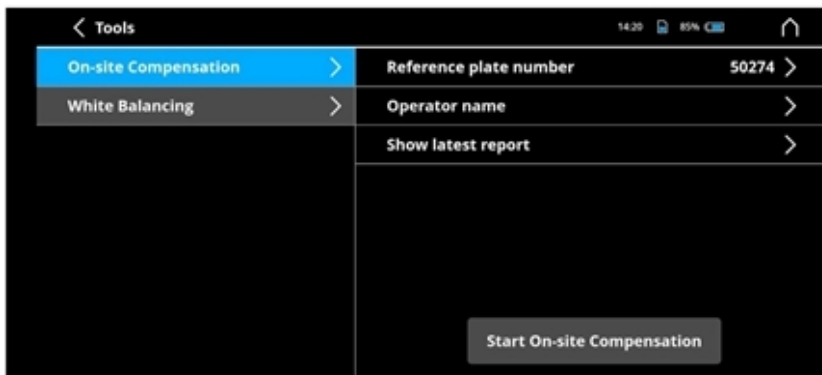
Tools

Figure 9-1 Tools menu

- **On-site compensation**: *For more information, see "On-Site Compensation" on page 42.*

- **White balance**: *For more information, see "Adjust White Balance" on page 28.*

Chapter 10: Maintenance

General

The Freestyle 2 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:

• Store the handset and accessories in its transport case when not in use.

• Protect the devices from shaking, shocks, vibration, and large variations in temperature.

• Check the cable for damage to outside insulation, connectors, and pins.

• Check the housing of the handset for damage.

To ensure a complete manufacturing recalibration of the Freestyle 2, we recommend that you request the yearly maintenance and certification service offered by FARO. Contact your local FARO Customer Service team for more information.

On-Site Compensation

The Freestyle 2 scanner is calibrated before shipping, but if you drop or knock the handset, or if it has been subjected to large changes in temperature, you should compensate it—just to be sure that it is ready to accurately capture. The best time to compensate the device is on-site, right before capturing.

Each Freestyle 2 kit includes a reference plate and a corresponding calibration file which is found on the provided USB flash drive.

Preparation

Compensation involves capturing the reference plate from different angles and at different heights. Use the following procedure to calibrate the device:

1. Switch on the Mobile PC and plug-in the provided USB flash drive. Leave the flash drive in for about 10 seconds. A calibration file for your reference plate will be transferred to the Mobile PC. This step is only required once for each reference plate.

2. Get the reference plate and note the number that is written on the back. You will need that number later in the procedure.

NOTICE: Treat the reference plate with care. Although it is quite rugged, it is possible to scratch the printing. Store the reference plate in its place in the Freestyle 2 transport case when not in use to avoid scratching.

3. Place the reference plate on a flat, stable surface, for example, the floor. The markers must face upward and each marker must be visible.

4. Ensure that the reference plate is well illuminated. The illumination intensity should be at least 250 Lux (25 fc).

5. Ensure that the reference plate is not covered by hard shadows. This may happen easily, so check in advance if parts of your body, Freestyle 2, or something else could produce a hard shadow on the reference plate during the compensation procedure.
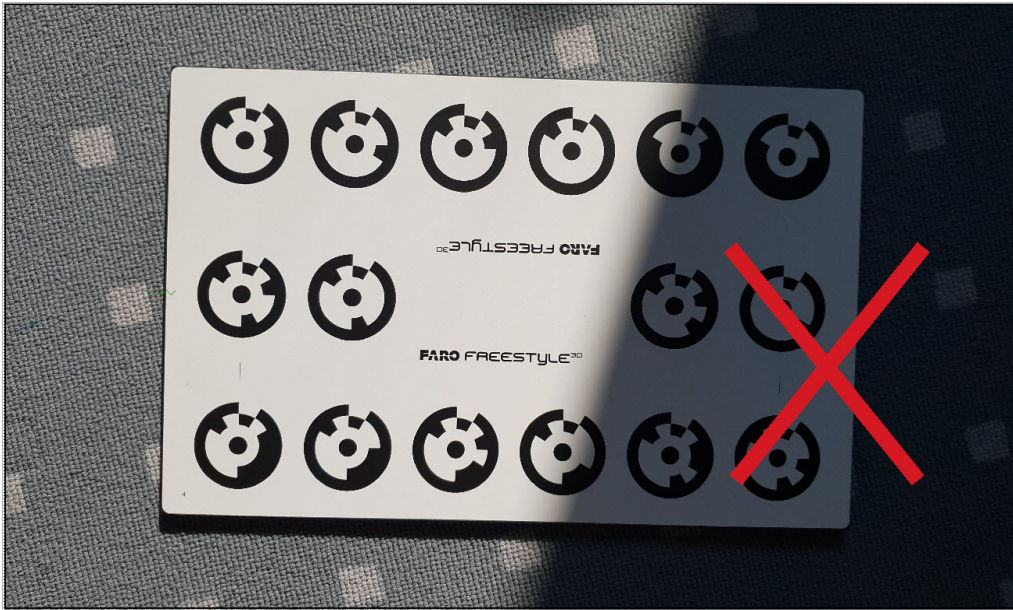
Figure 10-1 Hard shadow on the reference plate

6. With the handset switched on and the app started, select **Tools** > **On-site Compensation**
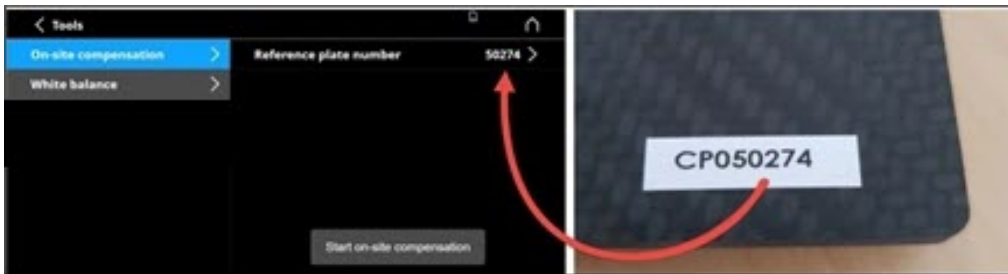
Figure 10-2 Reference plate number dialog

7. Enter the reference plate's number (leaving out "CP" and any leading zeros) and tap the **OK** button.

8. The start window of the compensation is displayed. Start compensation by tapping **Start on-site compensation**, and then pressing the middle button on the Freestyle 2 handset.

Rotational Compensation

9. The handset now starts to capture. You will see a stylized view of the reference plate, a drawing of the handset, and a diagonal line representing the approximate place and angle at which you should hold the handset in relation to the reference plate.
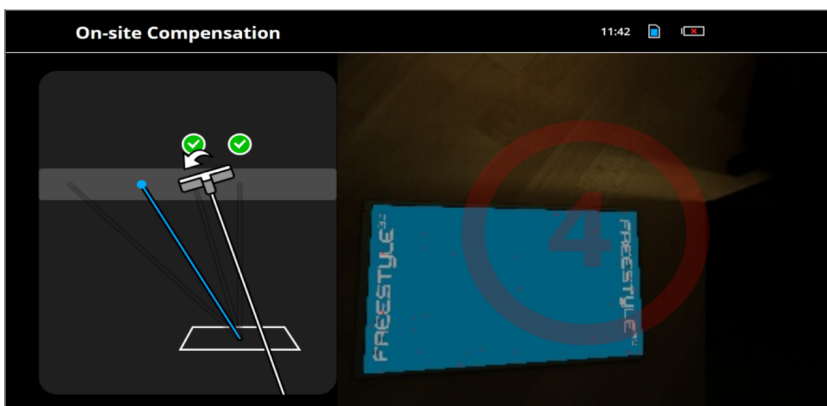
Figure 10-3 Rotational compensation Video View

10. Hold the handset above the reference plate. When the handset starts scanning the plate, an animation on screen will show you the appropriate position of the handset in relation to the reference plate.

11. Move the handset so that it is scanning at the angle shown by the blue line, and from the height represented by the blue dot. A black band across the background of the animation will turn gray when you have the proper height. Note that the white line illustrating the scanning angle does not have to match up with the blue line--it only needs to be parallel to it as long as the scanner is still scanning the reference plate. A white arrow may appear to tell you the direction that you need to rotate the handset to get the correct angle. When the position of the handset is correct, the red **4** on the right side of the screen will turn green and quickly count down to 0. If the handset remains in the correct position during the countdown, then green a circle with a check mark will appear at the first compensation position, and the second position will appear.

12. Repeat the step above for all compensation positions.

13. When the rotational compensation is complete, the vertical compensation begins.

Vertical Compensation

14. A vertical bar with a drawing of the handset is shown at the left, together with a vertical line and a measurement showing an approximate height from the reference plate.

Figure 10-4 Video View with cone and Freestyle 2 icon bar

15. Hold the handset directly and horizontally over the reference plate. A black band across the background of the animation will turn gray when you have the proper height. Note that the white line

illustrating the scanning angle does not have to match up with the blue line--it only needs to be parallel to it as long as the scanner is still scanning the reference plate. A white arrow may appear to tell you the direction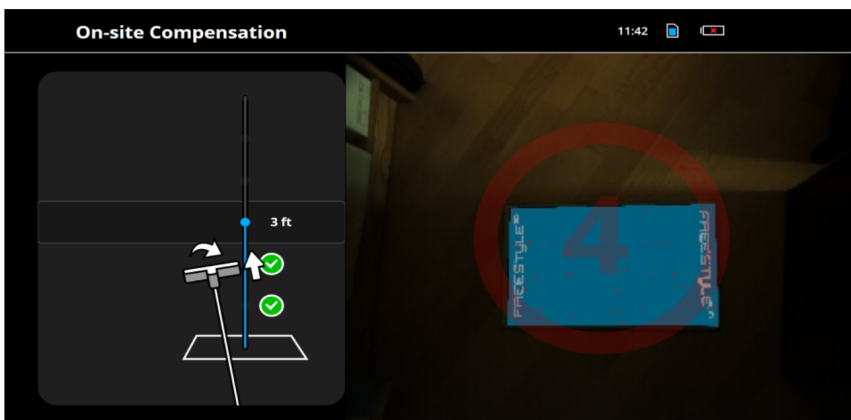 that you need to rotate the handset to be perpendicular and parallel to the reference plate. When the position of the handset is correct, the red **4** on the right side of the screen will turn green and quickly count down to 0. If the handset remains in the correct position during the countdown, then a green circle with a check mark will appear at the first compensation position, and the second position will appear.

16. Repeat the step above for all compensation positions.

As soon as all positions have a green check mark the calibration of the device is checked, and, if necessary, adjusted. After that, on-site compensation is finished.

Compensation Data and Report

The compensation data can be found on the Mobile PC under:

    C:\ProgramData\FARO\Freestyle\cameras\

Compensation Report

The compensation report is saved as a PDF file. You can find it in your scan project folder, in a subfolder called compensationReports. The Compensation report states whether the on-site compensation was successful, and it shows some important data including the information below which may be necessary for verification of accuracy.
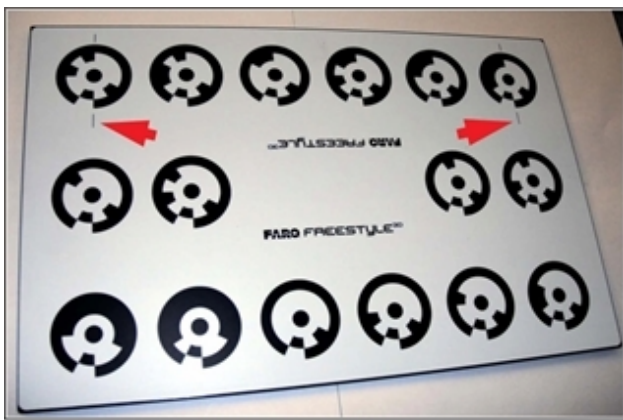
Figure 10-5 Control markers on the reference plate

Target value of control marker distance: This is the factory measurement of the distance between the two control markers on the reference plate. The measurement is made photogrammetrically, and is accurate to +/- 0.02 mm.

Measured control marker distance: This is the distance that the sensor measured between the two control markers immediately after the compensation process.

Distance deviation to target value: This is the variation between the **Target value of control marker distance** and the **Measured control marker distance**.

Cleaning Instructions for Lens Protection

The Freestyle 2 lenses are covered with protective glass that should be cleaned if it becomes dirty.

NOTICE: Unnecessary damage or wear

> To avoid unnecessary damage or wear, only clean the protective glass when the degree of contamination has an impact on the scan quality (that is, an increase in range noise or a decrease in scan range).
>
> Major contamination and improper handling to clean the glass may impact the scanning quality. Self-inflicted damage can result in the need to replace a part at your expense.
>
> **Do not use cleaning fluid with alcohol or acetone**. The sealings could be dissolved. We recommend alcohol-free lens cleaner that can be found in most optical supply stores.

What's Needed

- Tissues (if those in the transport case are no longer usable, we recommend tissues that can be found in optical supply stores)
- In the case of extremely contaminated glass, use an alcohol-free cleaning fluid in spray bottle.

Slightly Dirty Glass

- Wipe the contaminated glass with the tissue.

Very Dirty Glass

- Mist a tissue with the cleaning fluid (do not soak).
- Carefully wipe the contaminated glass with the tissue.

Mobile PC

We recommend checking your device at least once a month. This enables you to spot trouble before it starts and helps provide you with an efficient measuring system. The computer contains sensitive components, and it must be handled with care. Follow these procedures to prevent problems with your system:

- Do not use the Mobile PC in dusty environments. If the ventilation covers begin to show an accumulation of dust, contact your FARO representative for maintenance.
- Avoid knocking or dropping the device.
- Examine the external interfaces to ensure that they are not damaged.

CAUTION: Do not run the Mobile PC when it is in the case.

Chapter 11: 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 1-1 WEEE Symbol

Appendix A: Working with Markers

Usually, neither Freestyle 2 nor SCENE require artificial targets, so-called markers, to produce scans that can be registered. But there are situations where markers can be helpful, for example when the area you are scanning does not have well-defined planes, or if you want to register a Freestyle 2 scan with a FARO Focus Scan. A set of 20 unique markers is included with the Freestyle 2 kit. **Markers** for printing can be downloaded from the FARO Knowledge Base.

Figure 1-1 Sample Markers

Rules for Using Markers

- The markers are numbered. Ensure that every marker plate in the scan has a unique number. Do not use plates with duplicate numbers.

- When using self-printed markers, place them only on flat surfaces.

- Do not move the markers until the scan project is finished. Especially outdoors, you can place weights (e.g., stones) on the corners of the markers. The weights must not cover or cast a shadow on the pattern on the marker plate.

- The pattern must be easily and clearly visible.

- Position the markers in an irregular pattern. Do not position symmetrically.

- Place in different distances to the object. Avoid a linear alignment.

- Ideally, a marker plate should be captured at least twice in a scan.

Appendix B: Technical Support

FARO Technologies, Inc. is committed to providing the best technical support to our customers. 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 Internet 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*.

- Emails 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.

NOTICE: Back up all data on the Mobile PC before sending it for service. **All scan data and any other files you may have copied to the Mobile PC will be erased** and the operating system and applications will be reinstalled before the PC is returned.

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

End User Documents

All documents related to the Software End User License Agreement, Purchase Conditions, and FARO Products Service Policy can be found on the FARO Knowledge Base at the following URL: **https://knowledge.faro.com/Essentials/General/FARO_End_User_License_Agreement_Location.**

Appendix C: Technical Data

General

Type of device:	Hand-held 3D laser scanner
Power supply voltage:	19 V
Average Power when scanning (Mobile PC+Freestyle 2):	67 W
Peak power when scanning (Mobile PC+Freestyle 2):	95 W
Freestyle 2 maximum power:	21.6 W
Operating temperature:	0 °C to 40 °C
Freestyle 2 IP Rating:	IP 52
Mobile PC IP Rating:	None
Cable connector:	1.3 m (not removable from the handset) for power and data
Weight:	1.43 kg
Dimensions:	width: 285 mm length: 256 mm (without cable) height: 130 mm

Performance Specifications

Resolution at 0.5 m:	Identifiable feature: Up to 0.2 mm
3D point accuracy/whole scan accuracy:[a]	≤ 0.5 mm
[a]*1 sigma standard deviation measured on reference scales of lengths between 0.3 m and 1 m, in 1 m distance, for a lateral scanner movement of 1 m, using targets for distance measurement.*	
Single image point density:	Up to 45,000 points/m^2 in 0.5 m distance Up to 10,500 points/m^2 in 1 m distance
Range:	0.4 m - 5 m (up to 10 m with limited data quality)
Typical noise (RMS):	0.3 mm @ 0.4 m distance 0.75 mm @ 1 m distance

	10 mm @ 3 m distance 35 mm @ 5 m distance 100 mm @ 10 m distance
Typical field of view (HxW):	420 mm x 550 mm @ 0.5 m 930 mm x 1170 mm @ 1 m 1880 mm x 2160 mm @ 2 m 2740 mm x 3160 mm @ 3 m 3600 mm x 4160 mm @ 4 m 4470 mm x 5150 mm @ 5 m
Compensation:	Optional user compensation with supplied reference plate
Scan volume	39.5 m^3 (at max range 5 m)
Light source:	In-built LED flash

Laser (Optical Transmitter)

Eye safety:	Laser class 1
Pulse duration:	$\leq$ 7 ms
Wavelength:	798 nm to 816 nm

Cameras

Recorded 3D points[a]:	Up to 220,000 points/s, point cloud density increases with time
Best points filter[b]:	Noise reduction of typically 40% when scanning the same object from different distances
Exposure time:	0.1 ms to 7 ms (auto exposure)
Texture color:	24 bit
Lighting conditions[c]:	Full daylight, 10,000-45,000 Lux (reduced performance in direct sunlight)

[a]Point density depends on scanned surface and lighting conditions.

[b]Noise reduction for equal scan times at 0.5 m, 1 m, 2 m and 3 m distance from object.

[c]Limited range and point density in sunlight.

Mobile PC

Dimensions	215 x 123 x 70 mm
Weight	870 g without Power Block 1300 g with Power Block
Processor	Intel® Core™ i7-8650U Processor
RAM	16 GB RAM DDR4-2400 1.2 V SO-DIMM
Solid State Drive	250 GB
Power supply voltage:	19 V
Power consumption:	15 W (when device is idle) 25 W (while scanning) 80 W (while Power Block charges)
Operating temperature:	0 °C to 40 °C

Mobile PC LEDs

On/Off LED	Condition
No light	Device is switched off
Blue flashing (slow)	Device has booted, but no sensor is connected
Blue flashing	Device is booting or shutting down
Blue	Device operable
Blue flashing (quick)	Device error

Power Block Status LED	Condition
Blue	In battery operation: battery charge >15%. When power cord connected: fully charged (>95%).
Blue, 0.5 Hz blinking	When power cord connected, battery charging. Independent of state of Mobile PC (on/off). Also included in this state: charge current equals 0 or charging is disabled
Violet, 0.5 Hz blinking	Battery operation at battery state less than 15%
Green, for 1 second	Immediately after power cord is plugged in, when the device is already

	running on battery, and external power from power cord is detected.
Red constant	Power supply system corrupt - No work possible!
Green flashing	External power source is connected. Mobile PC is switched off.

NOTE: When scanning, the Freestyle 2 app shows a warning when the remaining scan time is less than 5 minutes. Stop scanning as soon as possible and recharge the Power Block.

Freestyle 2 LED Codes

The three LEDs on the top of the device.

Color	State
All 3 LEDs flash blue	Freestyle 2 connecting to the Mobile PC
Center LED blue	Ready to scan
All three LEDs flash blue	Connection to Mobile PC lost
Center LED red flash 1 Hz continuously	Tracking lost
All three LEDs continuously on red	All other severe errors

Appendix D: Glossary

A

Anchor point: A combination of features (e.g., three intersecting planes) that the user marks in a part of the recorded point cloud during scanning. The software automatically detects the anchor point when the part is scanned again in the same scan. Anchor points improve scan results when detected at different times during a scan, e.g., at the beginning and at the end of a scan.

F

features: 2D Objects (e.g., planes) and textures that are recorded by the Freestyle 2 and which can be identified by Freestyle 2 software. Features are used during the tracking process.

frame: A color photograph taken by Freestyle 2 along with the 3D points and other information that was recorded when the photograph was taken. Freestyle 2 records about 20 frames per second.

G

GPIO: General Purpose Input Output. A digital signal that has no predefined purpose, but which can be defined by the designer of the circuit.

L

loop-closing: The process of correcting small tracking errors so that areas that are recorded more than once in a single scan are properly positioned with respect to all the frames in the scan.

M

marker: An artificial target consisting of a special printed symbol that you can place in the scanning area to help the Freestyle 2 app register scans.

O

on-site compensation: The process of checking the accuracy of the device and making software adjustments to compensate for any errors.

P

point cloud: A 3D representation of an area or object made of millions of points created from one scan or from several registered scans.

Power Block: A rechargeable lithium ion battery manufactured by FARO for some FARO devices.

processing: A series of software manipulations to the scan data in a project that improve the quality of the scan.

R

reference plate: A flat, carbon fiber plate with markers printed on it. The plate is used to compensate the device on site.

registration: The process of positioning one or more scans so that points created from the same objects are aligned with each other. (This is similar to the process of creating a large panorama from a collection of smaller images.) If markers are present in the scan, software can usually register scans automatically—otherwise you must register them manually (also known as "placing" the scans).

S

scan: A set of frames resulting from one recording sequence and saved in one file.

T

target: A physical object in the area to be scanned that can be detect by the software and used to register the scans. A target can be a naturally occurring plane such as a wall or desk, or a marker.

tracking: The process of following features from frame to frame. Tracking makes it possible to reconstruct the movement of Freestyle 2 in space, thus putting the points of the individual frames into a common 3D context.

W

white balance: The adjustment of the intensity of primary colors to produce images that match what the human eye sees under different lighting conditions.

Appendix E: FCC and IC Equipment Authorization

The following statement relates to the Mobile PC.

FCC Statement

This device contains FCC ID PD98265NG

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and

2. This device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by FARO could void the user's authority to operate the equipment.

IC Statement

Contains IC 1000M-8265NG

This device complies with Industry Canada's license-exempt RSSs. Operation is subject to the fol-lowing two conditions:

1) This device may not cause interference; and

2) This device must accept any interfer-ence, including interference that may cause undesired operation of the device.

Contient IC 1000M-8265NG

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;

2) l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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