



EDGE

FARO Edge and FARO Laser ScanArm Manual
September 2012

innovation to simplify

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Chapter 1: Introduction

Thank you for choosing FARO's Portable Measurement Arm - the FARO Edge, and FARO's Portable Laser Line Measurement Arm - the FARO Laser ScanArm. This document contains detailed instructions on how to use your new USB/TCP-IP communication-based or WLAN/Bluetooth wireless Edge, and the FARO Laser Line Probe. Additional information about probes and important guidelines on maintaining your new Edge/ScanArm is also included. If you have any questions or need further instructions about any procedure, contact your Customer Service Representative by Phone, Fax or E-Mail. See *"Technical Support"* on page 191.

Visit the FARO Customer Care area on the Web at www.faro.com to search our technical support database. The database is available 24 hours a day, 7 days a week, and contains hundreds of solutions to product and application questions.

Listed below are some visual and typographical conventions used in each of the sections.

ALL CAPITAL text	Indicates directory names, menu names, buttons, tabs, key names, acronyms, and modes.
monospaced text	Indicates alpha/numeric characters or values you enter in a field on the screen. For example, "Type 0.005 for the tolerance setting."
bold text	Anything you must enter exactly as it appears on your keyboard. For example, to type a:install , you would see text in bold type exactly as it should be entered.
SMALL CAPS text	Indicates dialog box, icon names, and window names.

You may also see a few new words. It is important that you understand the meaning of these words before proceeding.

digitize	Indicates the recording of XYZ coordinates of a point or location in 3D space. The word digitize is the same as the term <i>measure</i> when referring to points.
choose or select	Indicates that you are initiating an action. For example, “Select FILE < INSERT < CAD PARTS.”
left-click, right-click, click, or press	Indicates that you press and release the corresponding mouse button or keyboard key. Also used when referring to the hardware device buttons. For example, “After selecting a file from the OPEN FILE dialog box, <i>click</i> OK to open the file” or “ <i>Press</i> ESC at anytime to cancel a command.”
drag	Indicates that you press and hold the LEFT MOUSE button down and move the mouse. Release the mouse button to finish. This word is often used when changing the size of a window or toolbar.

Warning

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like 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, practice, or the like 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 **CAUTION** notice until the indicated conditions are fully understood and met.

Note

A **NOTE** notice denotes additional information that aids you in the use or understanding of the equipment or subject. Specifically, 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 as required.

General Information

The Edge is a 7-axis, articulated arm with a spherical working volume. Each joint has a rotary optical encoder. The signals from these encoders are processed, using advanced error coding and temperature compensation technology, and positional data is sent to the touch screen controller, or the host computer using various wired and wireless communication protocols.

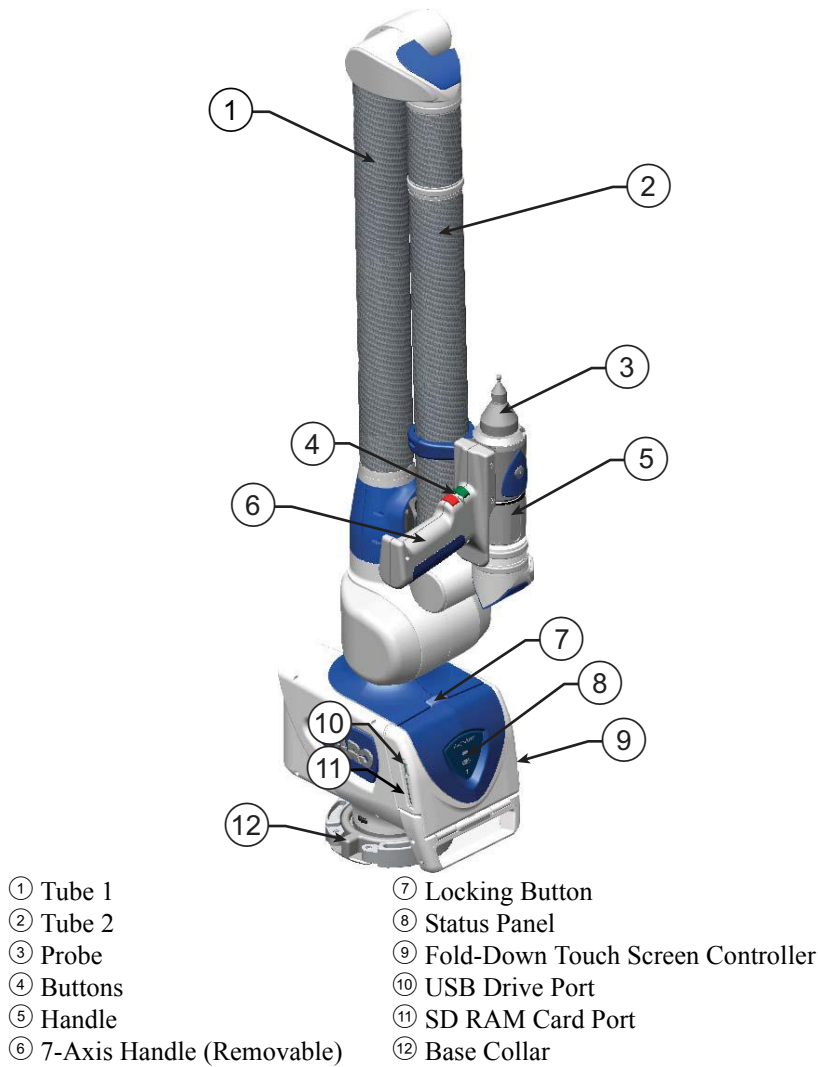
The Base Assembly contains the majority of the electronics, including a power switch, status indicators, fold-down touch screen controller, battery pack bay, and communication ports. There are five major communications ports on the Edge located on the Base Assembly:

- USB 2.0 Host Port (located on the fold-down controller)
- USB 2.0 Device
- Ethernet (802.3)
- Bluetooth (Internal Base Module)
- Wireless Local Area Network (WLAN 802.11 - Internal Base Module)

The Edge uses a non-volatile read/write FLASH memory. This memory stores programming and some compensation data for the Edge. There are proprietary methods that are capable of erasing, reading, and writing the FLASH memory. These methods are used during manufacturing and field updating. Security for the FLASH is limited to the anonymity of the access methods and the unavailability of documentation for the address structure of the FLASH memory.

The only dynamic data stored in the Edge are settings which relate directly to the operation of the Edge. Examples include the probe XYZ position, connection settings, etc. The Edge does not maintain in memory, or cache, measurement data of any type. Measurements recorded with the Edge are sent directly to the properly connected computer.

The Probe End Assembly is found at the farthest point from the base. It is free to rotate, has two control (Red and Green) buttons and two circular LED indicators that provide visual feedback to the user. This assembly provides for the attachment of probes and handle accessories.



NOTE: Newer Edge revisions do not have the ⑦ Locking Button.

Figure 1-1 FARO Edge front view

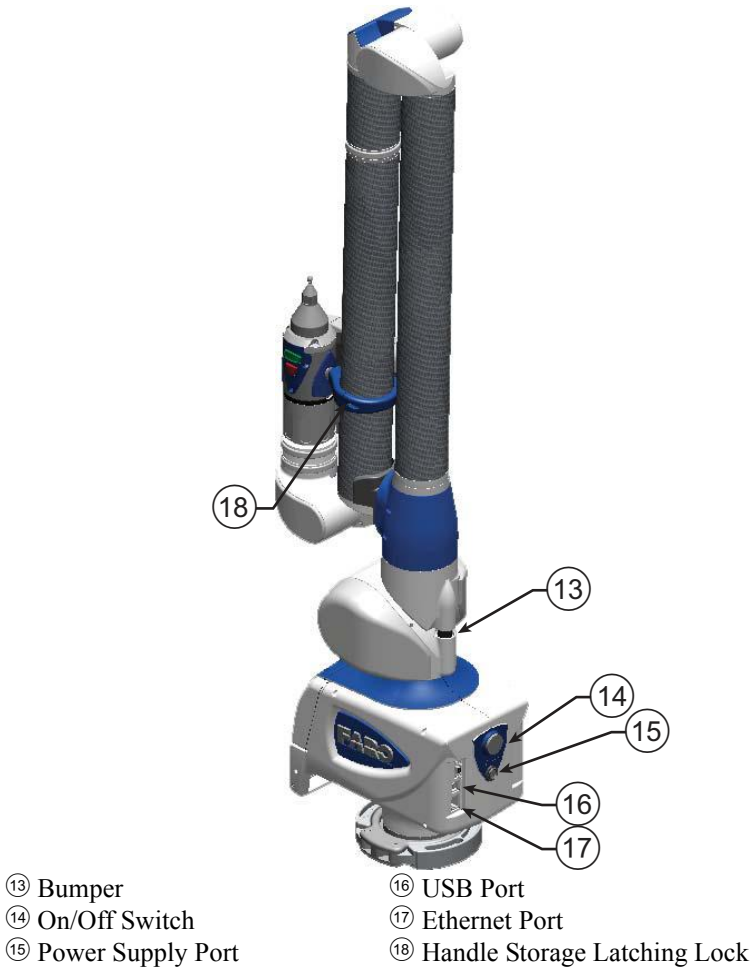
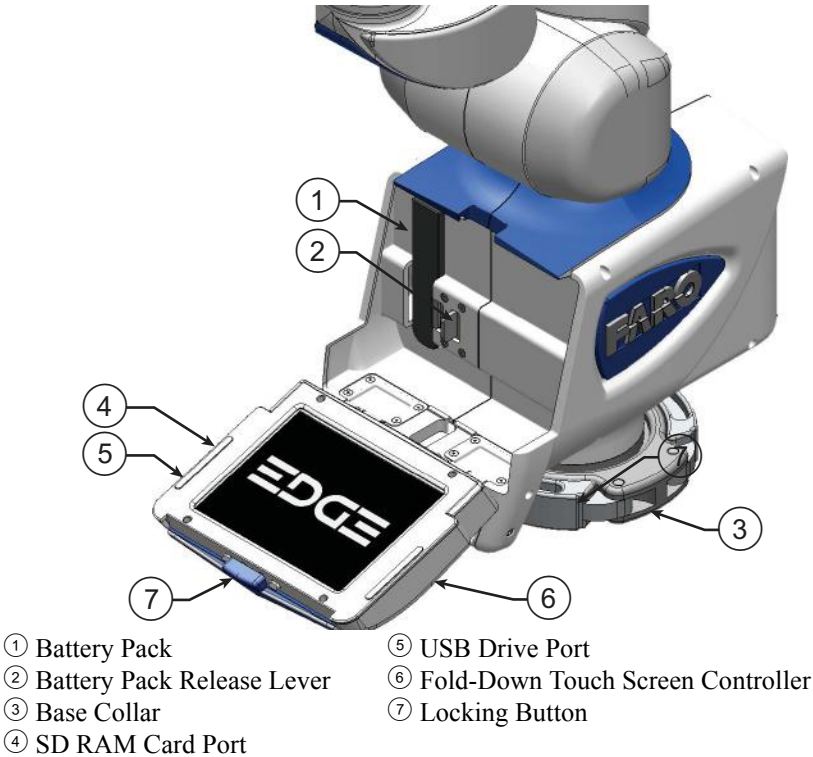


Figure 1-2 FARO Edge back view



NOTE: Newer Edge revisions do not have the ⑦ Locking Button.

Figure 1-3 FARO Edge Base

Regulatory Information

Regulatory information for the wireless components of the Edge is listed on the back of the base. Open the fold-down touch screen controller to see this label.



Bluetooth

FCC ID: ED9LMX9838

IC: 1520A-LMX9838

DECLARATION OF CONFORMITY

FCC Compliance Statement:

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.

Information To The User:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.

CAUTION: Any change or modification not expressly approved by FARO Technologies, Inc. may void the user's authority to operate the equipment.

NOTE: Bluetooth can be used concurrently with the USB Device and/or Ethernet ports but not the WLAN (802.11g) port. **The WLAN (802.11b/g) interface is disabled by hardware and firmware.**

DECLARATION OF CONFORMITY

Industry Canada Statement:

This device complies with RSS-210 of Industry Canada.

Operation is subject to the following two conditions:

- 1 This device may not cause interference, and
- 2 this device must accept any interference, including interference that may cause undesired operation of the device.

CAUTION: EXPOSURE TO RADIO FREQUENCY RADIATION

The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population: consult Safety Code 6, obtainable from Health Canada's website www.hc-sc.gc.ca/rpb

Wireless Local Area Network (WLAN 802.11)

FCC ID: YQM14000

IC: 9265A-14000

DECLARATION OF CONFORMITY

FCC Compliance Statement:

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.

Information To The User:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.

CAUTION: Any change or modification not expressly approved by FARO Technologies, Inc. may void the user's authority to operate the equipment.

NOTE: The WLAN (802.11b/g) can be used concurrently with the USB Device but not the LAN (Ethernet) or Bluetooth ports. **The Bluetooth interface is disabled by hardware and firmware.**

DECLARATION OF CONFORMITY

Industry Canada Statement:

This device complies with RSS-210 of Industry Canada.

Operation is subject to the following two conditions:

- 1** This device may not cause interference, and
- 2** this device must accept any interference, including interference that may cause undesired operation of the device.

CAUTION: EXPOSURE TO RADIO FREQUENCY RADIATION

The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population: consult Safety Code 6, obtainable from Health Canada's website www.hc-sc.gc.ca/rpb

Product Environmental Information

Legislation is now in place within the European Union (EU) that regulates waste from electrical and electronic equipment (WEEE). European Directive 2002/96/EC on Waste Electrical and Electronic Equipment (the WEEE Directive) stipulates that WEEE is now subject to regulations designed to prevent the disposal of such waste and to encourage design and treatment measures to minimize the amount of waste that is placed into the waste stream. The objective of the WEEE Directive is to preserve, protect and improve the quality of the environment, protect human health, and stimulate the practical use of natural resources. Specifically, the WEEE Directive requires that producers of electrical and electronic equipment be responsible for the collection, reuse, recycling and treatment of WEEE which the Producer places on the EU market after August 13, 2005.

FARO Technologies, Inc., as a producer of electrical and electronic equipment (EEE), has endeavored to meet these environmental responsibilities for managing WEEE. In so doing, FARO is providing the following to inform its customers about the WEEE collection process:

In order to avoid any potential dissemination of hazardous substances into the environment, FARO has labeled this product with the WEEE symbol (see below) in order to alert the end-user that it should be disposed of within the proper waste management system. That system will recycle, reuse, and dispose of materials from this product in an environmentally sound way.

The symbol represented below, and found on this FARO Technologies product, indicates that this product meets the European Directive 2002/96/EC on Waste Electrical and Electronic Equipment. This symbol, only applicable in European Union countries, indicates that when this product reaches the end of its useful life it should not be disposed of with normal household or municipal waste, but in an established waste stream for WEEE.

Each EU Member State country has established a system for the collection, disposal, and recycling of WEEE. End-users in the EU should contact their local waste administration system for collection instructions concerning this product.

Refer to www.faro.com for further environmental information concerning this product.



Precautions

The Edge is a precision measuring device that is ruggedized for shop use; however, care must still be exercised in the operating environment when using the Edge. Proper operation and care includes avoiding:

- Solvents.
- Abuse, such as dropping or twisting at end stops.
- Moisture and high humidity.
- Power fluctuations. *See “Edge Power Supply” on page 26.*
- Excessive temperature changes without appropriate elapsed time. *See “Temperature Considerations” on page 81.*

Your FARO Edge can give you many years of service when you treat it with care.

Chapter 2: Setup

This Chapter describes the basic setup and packing of the Edge. You should also refer to the *FARO Edge Assembly Instructions* booklet and the *Packing the FARO Edge* instruction sheet both found inside the lid of your Edge shipping case.

The Edge Packing Contents

The following components and accessories are standard items shipped with every system:

Edge - Packing List

- Shipping case
- Edge in portable storage case
- FARO Laser Line Probe (optional)
- Accessories case - items in pockets
 - Power Supply
 - USB cable
 - Lithium Ion Smart Battery Pack
 - Cap screws and wrench
 - FaroArm Driver CD
 - Edge Manual CD
 - FARO Edge Manual (this book)
 - FaroArm Accessories Manual
- Probe case:
 - Two probes
 - Renishaw Adapter (i-Probe case only)
 - FARO Compensation Cone
 - FARO Compensation Sphere (i-Probe case only)
 - 12mm wrench
 - FARO Probe Torque Wrench (i-Probe case only)
- 7-Axis Handle
- Surface Mount Plate
- Shipping case pouch
 - Edge Assembly Instructions
 - Packing the FARO Edge instruction sheet
 - Dust cover
 - Product Environmental Information European Union sheet
 - Edge Calibration Documents

NOTE: There are two different Probe Case options: Standard Probe Case, and i-Probe Case.

Shipping Case



- ① Portable Storage Case
- ② FARO Laser Line Probe Case
- ③ Accessories Case
- ④ Probe Case
- ⑤ 7-Axis Handle
- ⑥ Surface Mount Plate
- ⑦ Shipping case pouch

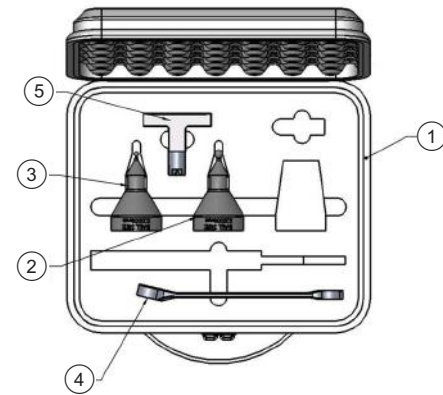
Figure 2-1 Edge Shipping case

Portable Storage Case

You can use the portable storage case to store and transport the Edge. This case is not designed for any type of shipping.

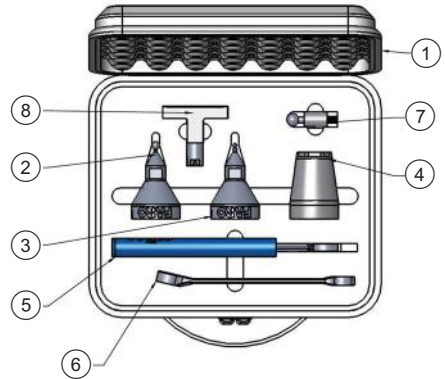
WARNING: The portable storage case *must* be packed into the shipping case for shipping the Edge. Shipping the portable case alone will VOID ALL PRODUCT WARRANTIES!

Probe Case



- ① Probe Kit Case
- ② Probe, 6mm Ball
- ③ Probe, 3mm Ball
- ④ 12mm wrench
- ⑤ Compensation Cone

Figure 2-2 Edge Standard Probe case



- ① Probe Kit Case
- ② i-Probe, 6mm Ball
- ③ i-Probe 3mm Ball
- ④ TP-20 Adapter
- ⑤ Probe Torque Wrench
- ⑥ 12mm wrench
- ⑦ Compensation Sphere
- ⑧ Compensation Cone

Figure 2-3 Edge i-Probe case

Optional Accessories

The *Accessories Manual* that is on your Edge Manual CD lists all of the optional accessories that you can order from FARO. Installation and detailed operational instructions are included.

The *Accessories Manual* is also available on FARO's Web site at www.faro.com. To purchase optional accessories, contact FARO's Customer Service by Phone, Fax or E-Mail. See "Technical Support" on page 191.

Hardware Setup

The following sections describe the proper setup of the Edge system. This includes attaching the Edge to your work surface and connecting the Edge to your computer.

Mounting the Base

The counterbalance by the tension spring generates torque at the base of the Edge; therefore, the mount must meet certain requirements to achieve optimum machine accuracy.

NOTE: The Edge *must* be mounted in a upright position. *Do Not* mount the Edge in an inverted (upside down) or sideways position.

If you are not using a tripod, attach the 3½” threaded ring and surface mount plate to any stable location. Tighten all cap screws to 100-inch pounds. To mount the Edge:

- 1 Remove the ①portable storage case from the shipping case.



Figure 2-4 Removing the portable storage case from the shipping case

- 2 Unclip the two straps to open the bottom cover. Place the Edge onto the 3½" ring of your tripod or surface mount plate. Thread the base collar onto the ring and hand tighten.



Figure 2-5 Mounting the Edge on the 3½" ring

- 3 Unclip the three straps to open the case and remove the portable storage case.



Figure 2-6 Opening the portable storage case

- 4 Tighten the base collar using the attached handles.



Figure 2-7 Mounting the Edge

For more information see “*Mounting Stiffness Test*” on page 80 and “*Edge Performance Verification Checklist*” on page 89.

Surface Mount Plate Dimensions

The Surface Mount Plate is used to clamp or bolt the Edge to a stable mounting surface. It is an assembly of a standard 3½” mounting ring and a FARO-designed base plate.

You can bolt the Surface Mount Plate directly to a surface using the mounting screws in the Accessories Case. Make sure to tighten each mounting screw to 100-inch pounds.

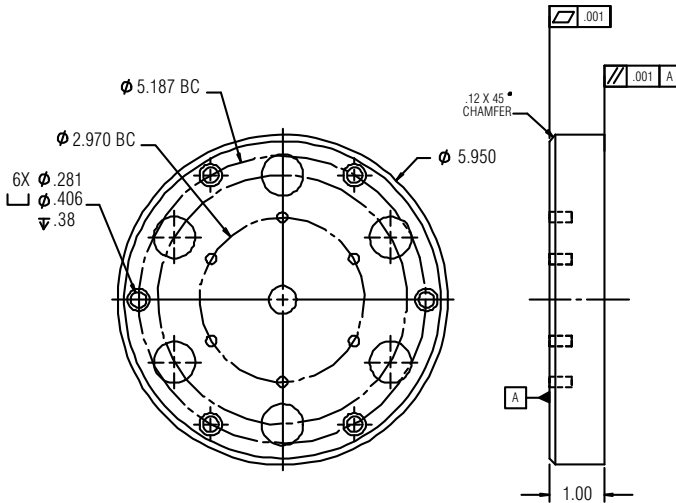


Figure 2-8 Surface Mount Plate dimensions

You can bolt the 3½" mounting ring directly to a surface using the mounting screws in the Probe Case. Make sure to tighten each mounting screw to 100-inch pounds.

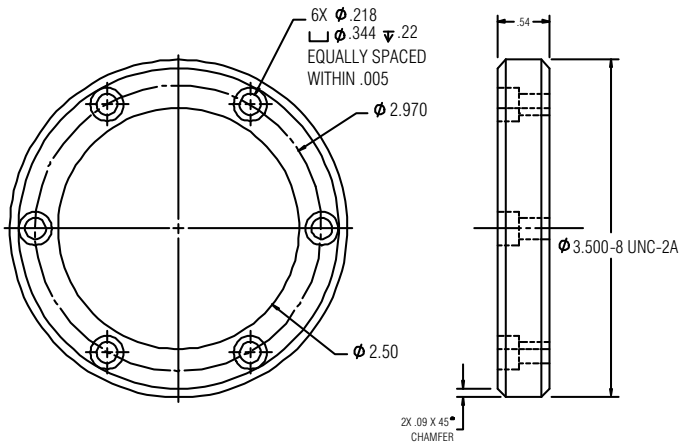


Figure 2-9 Standard 3½" Mounting Ring dimensions

Installing Probes

The probe attaches to the handle at the end of the Edge. Use the 12mm wrench in the Probe Case to install the probe.

NOTE: Use the FARO Probe Torque Wrench to tighten the FARO i-Probe. The probe wrench will break free when you apply the proper amount of torque.

- 1 Hold the button area near the end of the Edge with one hand.

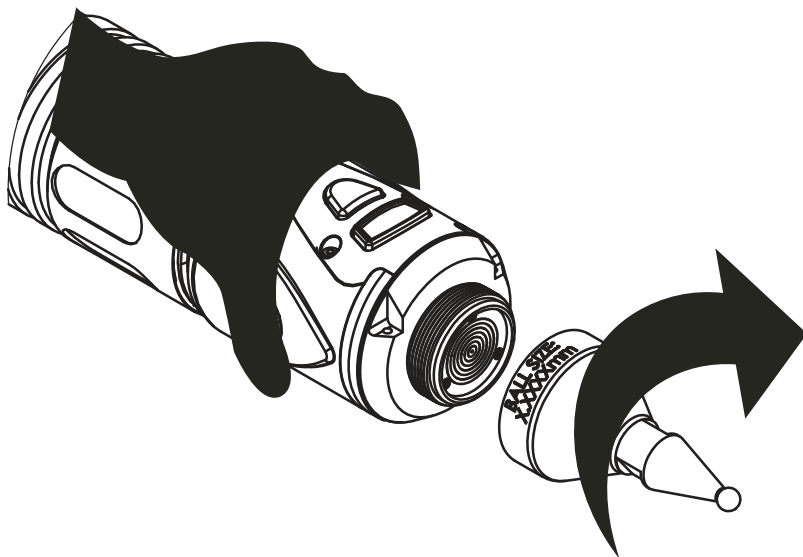


Figure 2-10 Installing a Probe

CAUTION: *Do not* hold the Edge except in the button area when installing a probe. Holding the Edge at the last joint may stress the tube and damage the system.

- 2 Rotate the probe clockwise and thread the probe into the Edge.
- 3 Use the 12mm wrench to hand-tighten the probe.

CAUTION: Only *hand-tighten* the probe with the 12mm wrench. *Do not* over-tighten the probe.

Before measuring with the Edge the probe must be compensated. Use the PROBES command on the controller, or your measuring software, to set up and compensate the probe.

For more information, see “Probes” on page 178.

Handle Storage

The Edge has a latching lock attached to Tube 2 for easy storage of the handle. This storage system helps prevent damage to the probe.

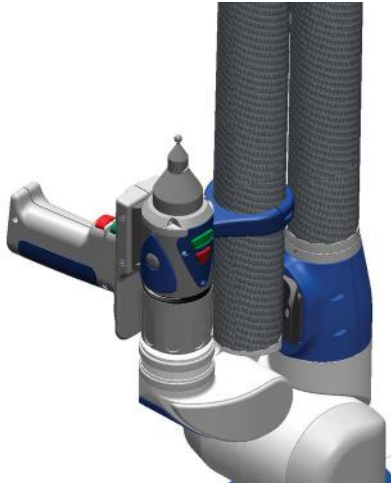


Figure 2-11 Handle Storage

Swing the handle up and rotate it until either metal circle is aligned with the lock attached to Tube 2, and press together until the lock engages.

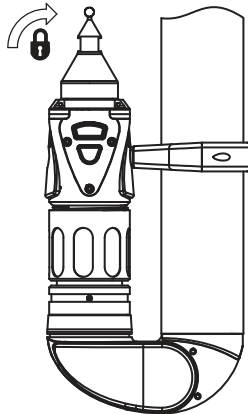


Figure 2-12 Locking the Handle

Press the side of the handle to unlock the handle.

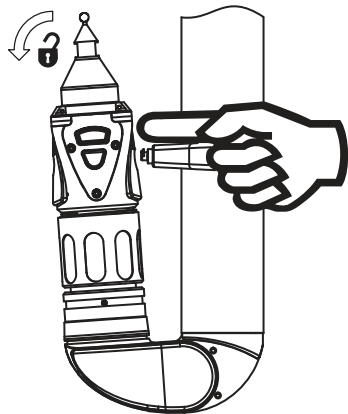


Figure 2-13 Unlocking the Handle

NOTE: In older models of the Edge a magnet is attached to Tube 2 for storage of the handle. Swing the handle up and rotate it until the metal circle is aligned with the magnet on either side of the handle.

7-Axis Handle

You can attach the 7-Axis Handle, a pistol-grip handle, to the Edge Handle to give you another control option. This handle stores in a cutout of the shipping case foam. The 7-Axis Handle *can* be attached/detached while the Edge is powered On. The FARO Laser Line Probe attaches in the same method. See “*FARO Laser Line Probe*” on page 54. To attach the handle:

- 1 Loosen the locking ring by turning it counterclockwise.

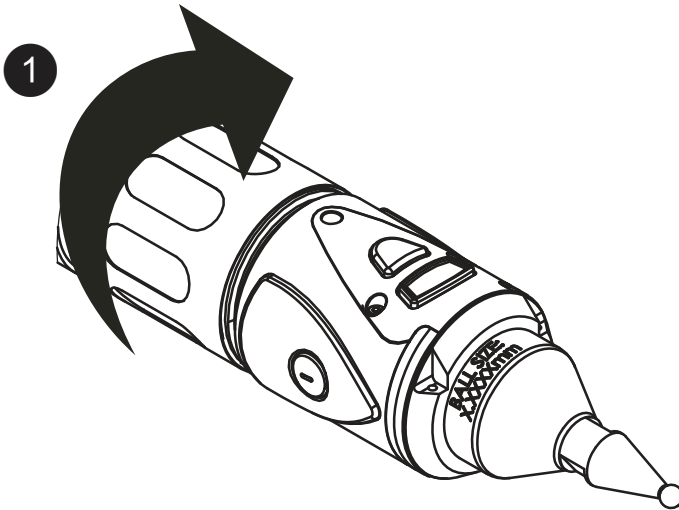


Figure 2-14 Attaching the 7-Axis Handle

- 2 Insert the front edge of the 7-Axis Handle into the slot.

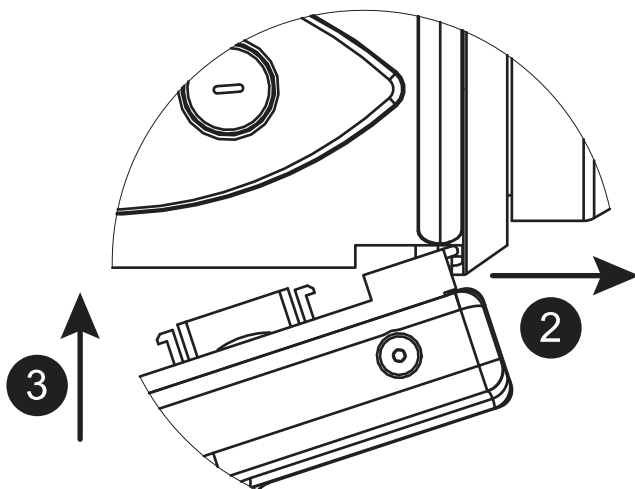


Figure 2-15 Attaching the 7-Axis Handle

- 3 Push the 7-Axis Handle in so that the connectors connect.
- 4 Tighten the locking ring by turning it clockwise. Do not over-tighten the ring.

NOTE: Remove the 7-Axis Handle from the Edge before packing. See “Packing the Edge” on page 30.

Fold-Down Touch Screen Controller

Located on the front side of the Edge base is a fold-down touch screen controller. The controller is built into a panel that folds down from the top of the base. Press the ① locking button at the top of the base to ② open the panel and access the controller.

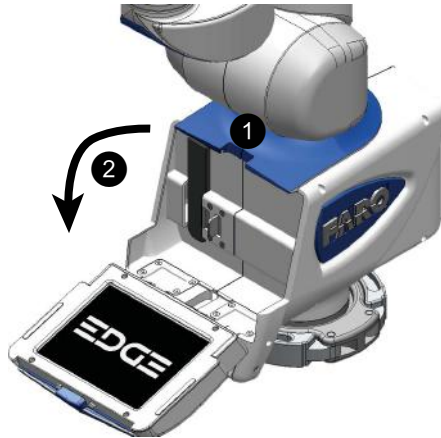


Figure 2-16 Installing the battery pack

NOTE: Newer Edge revisions do not have the ① Locking Button.

The controller has commands for part setup (alignment), measurement, running measurement macros, storing and managing measurement files, Edge settings, Edge diagnostics, and Edge probe management. *For more information, see “Software” on page 101.*

This controller makes it possible to measure parts *without* a host computer running measuring software.

Edge Power Supply

Power the Edge with the supplied power supply. The power supply is NRTL Listed for US and Canada. For IEC member countries and Europe, the power supply must be certified for the country in which the equipment is sold. Contact FARO's Customer Service to order a replacement. All servicing should be referred to qualified service personnel.

Rated Voltage:	100 - 240V ~ 47 - 63 Hz
Voltage Tolerance:	+10% or -10%
Rated Input:	1.4A
Sec. Voltage:	+18 VDC
Sec. Current:	3.6A
Pollution Category:	2
Installation Category:	2

CAUTION:  **INDOOR USE ONLY**

Supplying Power to the Edge

Place the Edge in an area with a properly grounded outlet receptacle. The On/Off switch is located on the back side of the base. Ensure the On/Off switch is in the *OFF* position before supplying power. Connect the power supply cord to the port on the back side of the base.



- ① On/Off Switch
- ② Power Supply Port

Figure 2-17 Edge Power

WARNING: Do not disconnect or isolate the ground pin on the power supply cord.

Select the proper power supply cord intended for installation in a protected environment. The power supply automatically adjusts to the voltage.

- For 120V Connection: Use a UL Listed, type SJT or SVT, 3-Conductor, 18 A.W.G. power supply cord, terminating in a molded-on plug cap rated 125 VAC, 15A minimum, with a minimum length of six feet.
- For 220 - 240V Connection: Use an international harmonized, 300V rated, PVC insulated jacket, three conductors of 0.75mm² minimum cross-sectional area, each with a molded-on plug cap marked with proper agency marking for the country where it will be used.

NOTE: Power surges, spikes, feedback, and fluctuation in the power source will affect the equipment and its electronic accessories. Please have your power source inspected by a professional to provide the cleanest power source possible.

FARO recommends you allow the Edge to warm-up for at least 30 minutes before using. For optimum performance, allow the Edge to warm-up for 60 minutes before using.

Edge Battery Pack

Your Edge may be powered using the supplied battery pack. Install the battery pack to power your Edge when you are not near a grounded power outlet. On the front side of the base, open the fold-down touch screen controller to access the battery pack slot.

NOTE: It is not necessary to install the battery pack if the Edge is connected to a grounded power outlet.

Installing the Battery Pack

Slide the battery pack in with the rounded side down.

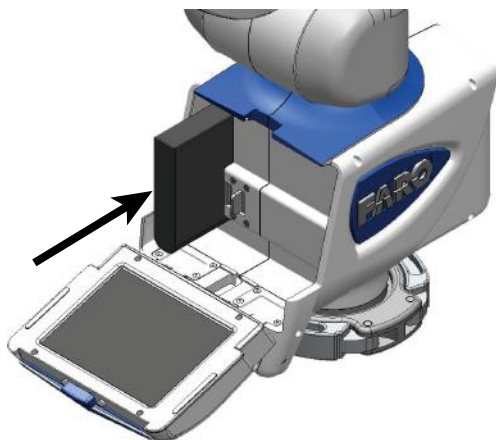


Figure 2-18 Installing the battery pack

Push the battery all the way in until it snaps into place.

Removing the Battery Pack

Push the ① battery pack release lever to the right and ② pull out the battery pack.

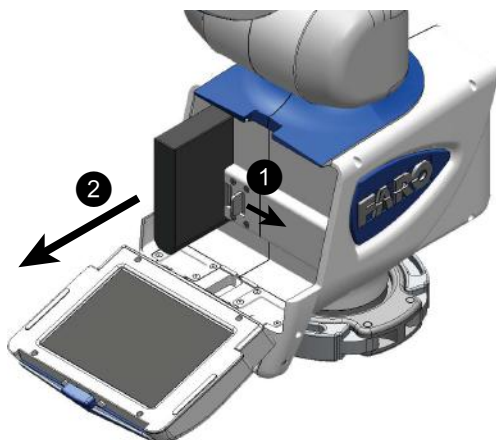


Figure 2-19 Removing the battery pack

Charging the Battery Pack

Install the battery pack and connect the Edge to a power outlet and the battery pack will begin to charge. The battery pack will charge if the On/Off switch is set to the *OFF* position. Charging automatically stops when the battery pack is completely charged. The battery pack has a built-in charge meter. Press the soft button near the connector and look at the LEDs to see the current charge.

- The DIAGNOSTICS dialog box displays the current status of the battery pack. *See “Diagnostics” on page 190.*
- The upper right corner of the Edge software screen has an indicator for the battery pack. *See “Screen Layout” on page 101.*

WARNING: Only use the rechargeable battery pack supplied with your Edge. For information on ordering additional or replacement battery packs, contact FARO’s Customer Service by Phone, Fax or E-Mail. *See “Technical Support” on page 191.*

USB Devices

You can attach certain USB devices to the port on the side of the fold-down touch screen controller. Any USB device that uses the standard Microsoft Windows hardware driver will install. If the device needs a specific driver for the hardware, it will not operate properly because there is not a way to load the driver.

Auxiliary Port

On the front side of the Edge base, an optional 9-pin communications port is available to connect external equipment. To get a list of approved FARO devices, contact your Customer Service Representative by Phone, Fax or E-Mail. See “*Technical Support*” on page 191.

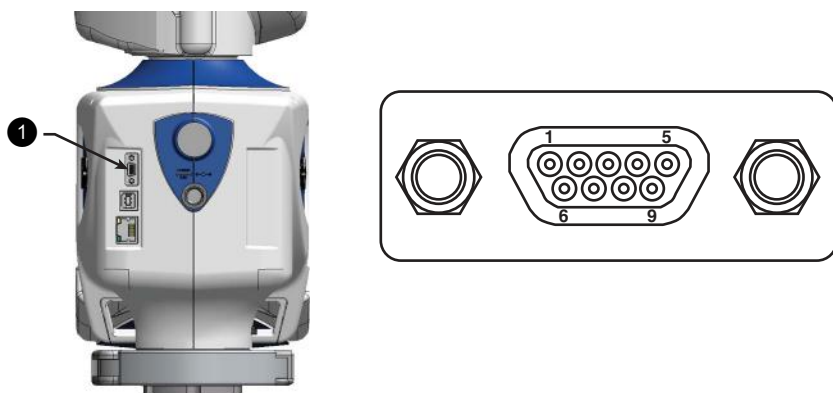


Figure 2-20 Edge Auxiliary port

WARNING: Only use FARO approved devices in this port. For more information about approved FARO devices, contact FARO’s Customer Service. Using other devices could damage your system and will void your maintenance/warranty service plan.

Packing the Edge

The Edge should be packed very carefully to prevent shipping damage. These instructions are also located in the shipping case pouch.

- 1 Turn off the Edge, remove the battery pack, disconnect all cables, and unlock the handle so it is hanging down.

NOTE: Remove the 7-Axis Handle from the Edge before packing. See “*7-Axis Handle*” on page 23.

- 2 Open the portable storage case and place it around the Edge. The case foam near the hinges should rest on the top of Edge base.



Figure 2-21 Portable case packing

- 3 Pull the handle slightly away from the base to fit into the case foam.

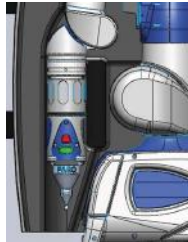


Figure 2-22 Handle packing

- 4 Close the case and secure each of the three straps.



Figure 2-23 Closing the portable storage case

- 5** Loosen the base collar.
- 6** Remove the Edge from the mounting ring and close the case bottom.



Figure 2-24 Closing the portable storage case bottom

Packing the Edge Shipping Case

- 1** Insert the ① portable storage case into the shipping case.



Figure 2-25 Insert the Edge into the shipping case

- 2** Pack the ②FARO Laser Line Probe (optional), ③Accessories Case, ④Probe Case, ⑤7-Axis Handle, and ⑥Surface Mount Plate as shown.



Figure 2-26 Pack the Additional Cases and Parts

- 3** Close the shipping case and secure all the case latches.

Chapter 3: Operation

This chapter describes the controls, visual indicators, and advanced connection options for the Edge. Make sure that you have read the setup instructions and set up your Edge properly. *For more information, see “Setup” on page 13.*

Numerical and Signal Processing

The Edge has a complete electronics system located within the body of the Edge. Signals from each joint are processed and positional data is sent out to the fold-down touch screen controller, or the host computer.

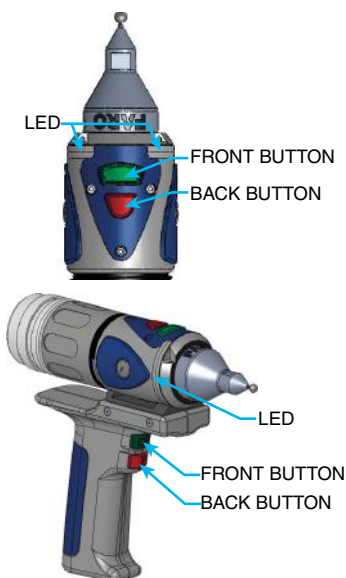
NOTE: The Edge electronics go into sleep mode, or turn off, after two hours of no encoder movement. Move the Edge joints to exit sleep mode and reference the encoders to continue measuring. *See “Referencing the Encoders” on page 38.* Sleep mode is an option. *See “Hardware Configuration” on page 178.*

Handle LED

After applying power to the Edge, the Handle LED is SOLID YELLOW while an internal startup check runs. After this is complete, the LED indicates the following:

- FLASHING BLUE - if the Edge successfully communicates with the computer, and the encoders are not referenced. *See “Referencing the Encoders” on page 38.*
- SOLID BLUE - if the Edge successfully communicates with the computer, and the encoders are referenced. *See “Referencing the Encoders” on page 38.*
- SOLID GREEN - if the Edge successfully communicates with the computer, and the encoders are referenced - Renishaw Probe only. *See “Renishaw TP-20 Probe Installation and Operation” on page 69.*
- SOLID RED - if there is an error in the Edge.

The LED will also indicate that a button is pressed. *See “Edge Handle Buttons” on page 36.*



Edge Handle Buttons

The Edge Handle has two buttons and an LED. When a button is pressed, the LED light turns on (green or red) and the fold-down touch screen controller or host computer sounds. See “Handle LED” on page 35.

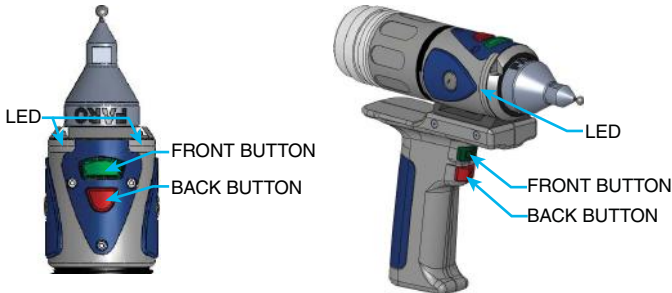


Figure 3-1 Edge Handle Buttons

Use the FRONT button to collect readings and accept a measurement.

- The FRONT button is green and nearest the probe.

Use the BACK button to record probe compensation or reject a measurement.

- The BACK button is red and is nearest the handle.

Error and Status Indicators

Visible on the controller and through the FaroArm driver interface to the measuring software, the Edge generates and displays errors in the END STOP/STRESS WARNING dialog box, and the Handle LED turns SOLID RED.

NOTE: The Edge does not output data until the error has been cleared.

- The encoder end stop warnings - This warning appears when an encoder reaches one end of its rotation.



Figure 3-2 Edge end stop warning

- The tube stress stop warnings - This warning appears when there is stress on one of the tubes or encoder joints. The stress stop warnings may be disabled.

See “Hardware Configuration” on page 178.



Figure 3-3 Edge stress stop warning

- The unknown FARO i-Probe warning - This warning appears when a FARO i-Probe is attached to the Edge and never compensated. For accurate measuring, you *must* compensate the probe. Use your measuring software to set up and compensate the probe. See “Probes” on page 178.



Figure 3-4 Unknown FARO i-Probe warning

- The missing FARO i-Probe warning - This warning appears when no probe is attached to the Edge.



Figure 3-5 Unknown FARO i-Probe warning

- Other errors appear in a message box.

Referencing the Encoders

You must first reference each of the seven encoders in the Edge. The REFERENCE ENCODERS dialog box shows all seven encoders in error until each is referenced. In a systematic manner, rotate joints 1 through 7 until each warning clears.



Figure 3-6 Referencing the encoders

NOTE: The Edge must be properly connected to the host computer running the measuring software to see the REFERENCE ENCODERS dialog box on the host computer.

Host Computer

The Edge output is accepted through any PC-compatible computer using the following communication protocols:

- USB 2.0 (Device)
- Ethernet (802.3)
- Bluetooth
- Wireless Local Area Network (WLAN 802.11)

You can use multiple communication protocols with the following limitations:

- USB, Ethernet, and Bluetooth are active at the same time, WLAN is disabled
- USB and WLAN are active at the same time, Bluetooth is disabled.
- WLAN is disabled if Ethernet is active
- WLAN is disabled if Bluetooth is active

Wired connections

The Edge is equipped to connect to your computer using different wireless connections.

CAUTION: Complete all cable connections before applying power to the computer and the Edge.

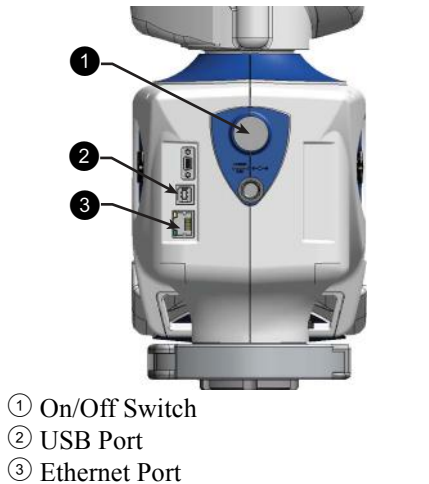


Figure 3-7 Edge wired communication ports

USB

USB communication connects from the Edge to the computer using a standard USB cable. High speed operation is supported.

The USB connector is located on the back side of the base.

Ethernet

Ethernet communication connects from the Edge to the computer using a regular or crossover twisted-pair Ethernet cable (Cat 5, Cat5e or Cat 6) with RJ-45 connectors. When Ethernet is used the Edge is configured as a DHCP (Dynamic Host Configuration Protocol) client.

The Ethernet connector is located on the back side of the base.

NOTE: In a multiple computer networking environment, you should consult your Information Technology (IT) department for assistance with installing the Edge.

After connecting the Ethernet cable, use the Fold-Down Touch Screen Controller to set up the Ethernet communication. *For more information, see “Ethernet” on page 152.*

Wireless Connections

The Edge is equipped to connect to your computer using different wireless connections.

FARO Wireless - Bluetooth

The Edge is a Bluetooth equipped device and can connect to your computer without using a cable.

Bluetooth wireless is a short-range communications technology intended to replace the cables connecting devices. The range of a Class 2 system, such as the Edge, is approximately 30 feet or 10 meters. Bluetooth devices are generally paired, or associated with each other, either openly or employing security, with one serving as the master device and the second as the slave. In the case of the Edge:

- The Edge is the slave.
- The host computer is the master.
- Basic PIN based security is employed.
- The host computer establishes an RS-232 emulation or Serial Port Profile (SPP) connection to the Edge.
- Once the connection is established, the PC and Edge can transfer data at a rate of 921600bits/second.

NOTE: If an Edge is connected with USB cable and Bluetooth, only the Bluetooth connection will be active.

To activate the Bluetooth signal:

- 1 Open the fold-down touch screen controller.
- 2 From the MAIN menu, choose CONNECTION.
- 3 Select the BLUETOOTH icon.

Using Bluetooth - Windows XP

Edge to the Computer Connection

Create the wireless connection between the host computer and the Edge created using:

- In Windows XP, software supplied with a Bluetooth equipped computer, or an aftermarket USB Bluetooth dongle and software.
- FARO Bluetooth Connection Setup utility software.

NOTE: Implementation will differ among software suppliers, but generally there is a platform specific Bluetooth Wizard that will search for all Bluetooth devices in range and display them graphically, or in a simple list.

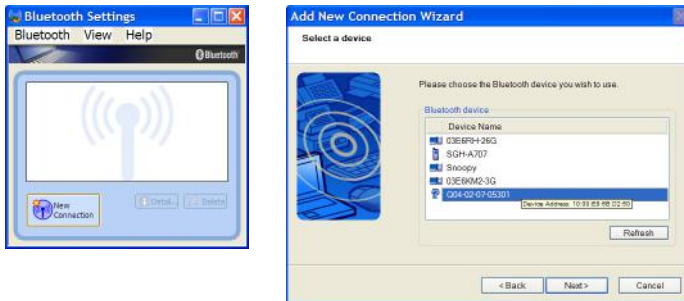


Figure 3-8 Connecting the Edge to the Computer

All Edges are identified by their serial number. Once an Edge is identified in the list, a persistent SPP connection must be created. Once the connection exists, the software will display the connection's COM port number, for example *COM10*.

Write down your SPP connection COM port _____

This number is important and will be used later.

NOTE: If the platform specific Bluetooth Wizard finds two COM ports, usually labeled “Incoming” and “Outgoing,” for the Edge, use the Outgoing COM port.

Computer to the FaroArm Driver Connection

The FaroArm driver connects to the SPP connection using the FARO Bluetooth Connection Setup utility software.

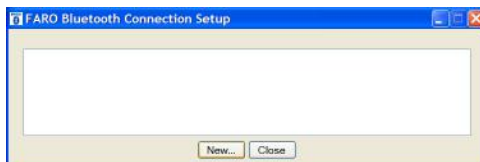


Figure 3-9 Connecting the Edge to the Computer

- Start the FARO Bluetooth Connection Setup utility software program.
- Click the NEW button.



Figure 3-10 Connection Name and COM port

- Type a name for your connection
- In the PORT list select the proper COM from the platform specific Bluetooth Wizard (e.g. COM10). This is the port that you previously wrote down.
- Click the OK button.

A test is automatically run to verify that the COM port is connected to the Edge.

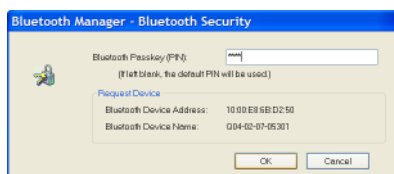


Figure 3-11 Edge Bluetooth PIN

- Enter the Edge PIN security code, faro.
- Click OK to save the connection.

An icon will be created for each Bluetooth pairing. The icon *with* the check box selected is an active connection. The icon *without* a check box selected is an inactive connection.



Figure 3-12 Connecting the Edge to the Computer

NOTE: No more than two (2) Edge pairings can be active at any one time, but any number can be defined.

Editing a Pairing

Right-click any Bluetooth pairing icon to edit. You can:

- Edit the name and the COM port.
- Test the pairing connection.
- Delete the pairing.

Using the Edge Bluetooth Pairing

When the measuring software is launched (CAM2 Q, CAM2 Measure, CAM2 Measure X, Geomagic, Polyworks, etc.) the FaroArm driver attempts to use any Edge connection - USB cable and any active Bluetooth pairings. It takes slightly longer, 8 or 10 seconds, for an Edge to connect and initialize via Bluetooth.

NOTE: If you choose not to connect the Edge to your computer using the wireless connection, deselect the icon check box in the FARO Bluetooth Connection Setup utility to deactivate the pairing and connect using the USB cable.

Once you start measuring, there is no difference in data transfer between using the Bluetooth connection or the USB cable.

Using Bluetooth - Windows 7

Create the wireless connection between the host computer and the Edge using:

- The Devices and Printers category of the Windows Control Panel.
- FARO Bluetooth Connection Setup utility software.

Edge to the Computer Connection

- 1 Click START < DEVICES AND PRINTERS. Choose ADD A DEVICE from the menu in the upper left corner of the window.

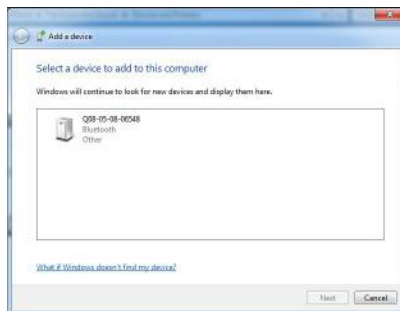


Figure 3-13 Connecting the Edge to the Computer

- 2 All Edges are identified by their serial number. Double-click your Edge.
- 3 Choose the ENTER THE DEVICE'S PAIRING CODE option.
- 4 Enter the Edge pairing code, `far0`, and click the NEXT button to create the SPP connection. Look at the status bar in the lower right corner of the screen to see what COM port is assigned to your Edge. This is usually COM3.

Write down your SPP connection COM port _____

This number is important and will be used later.

Computer to the FaroArm Driver Connection

The FaroArm driver connects to the SPP connection using the FARO Bluetooth Connection Setup utility software.

- Start FARO Bluetooth Connection Setup utility software program.

- Click the NEW button.
- Type a name for your connection
- In the PORT list select the proper COM from the Devices and Printers category of the Control Panel (e.g. COM3). This is the port that you previously wrote down.
- Click the OK button.

A test is automatically run to verify that the COM port is connected to the Edge.

An icon will be created for each Bluetooth pairing. The icon *with* the check box selected is an active connection. The icon *without* a check box selected is an inactive connection.

NOTE: No more than two (2) Edge pairings can be active at any one time, but any number can be defined.

Editing a Pairing

Right-click any Bluetooth pairing icon to edit. You can:

- Edit the name and the COM port.
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Using the Edge Bluetooth Pairing

When the measuring software is launched (CAM2 Q, CAM2 Measure, CAM2 Measure X, Geomagic, Polyworks, etc.) the FaroArm driver attempts to use any Edge connection - USB cable and any active Bluetooth pairings. It takes slightly longer, 8 or 10 seconds, for an Edge to connect and initialize via Bluetooth.

NOTE: If you choose not to connect the Edge to your computer using the wireless connection, deselect the icon check box in the FARO Bluetooth Connection Setup utility to deactivate the pairing and connect using the USB cable.

Once you start measuring, there is no difference in data transfer between using the Bluetooth connection or the USB cable.

FARO Wireless - WLAN

The Edge is a Wireless Local Area Network (WLAN) equipped device and can connect to your computer without using a cable.

A WLAN is a series of interconnected computers that communicate with each other over the air waves rather than through a network cable connected to each

computer. In a WLAN, a radio communications device called an access point, or wireless router, connects network computers and provides network access. The access point, or wireless router, and the wireless network card in the computer communicate by broadcasting data from their antennas over the air waves.

The Edge WLAN is normally configured as a DHCP Client. Due to the nature of an open air system, network security is very important. Before discussing Edge WLAN setup, a brief WLAN Primer is presented.

WLAN Primer

An Edge node or station can connect to a WLAN that complies with the IEEE 802.11g standard. The Wi-Fi Alliance (an industry group promoting 802.11 networks) has popularized the term Wi-Fi® for 802.11 compliant networks. The term WLAN, refers to the slightly more generalized concept of the wireless extension of a local area network (LAN), though in practice most implementations use Wi-Fi technology.

The IEEE 802.11 standard specifies a Medium Access Control (MAC) and physical layers (PHY) for wireless connectivity between stations (STAs). A set of stations that have joined the same network have access to the same network services. These services are called a Basic Service Set (BSS). Every BSS has a unique 48-bit identifier called the Basic Service Set Identifier (BSSID). The standard specifies two types of BSS; an Independent BSS (IBSS), and an Infrastructure BSS (BSS).

There are several different PHY layers specified in IEEE 802.11. The Edge uses 802.11g.

IEEE 802.11 further breaks up the 2.4 GHz frequency band into 14 overlapping channels. Each country in the world has its own rules and regulations regarding radio usage. Many countries join together to coordinate these regulations, forming “Regulatory Domains”. Most European, Middle Eastern, North and South American, and African countries, and Australia and Japan use the same regulations. However, there are differences with regard to which channels and power levels are permitted. The Edge can support all 14 channels - factory programming is performed for the specific country where the Edge is to be used (this is not a user option).

Independent BSS (IBSS)

An IBSS is used to form an Ad Hoc network between peer STAs. STAs share responsibility for maintaining the IBSS and distributing data to each other. IBSS is *NOT* supported for the Edge WLAN.

Infrastructure BSS (BSS)

In an Infrastructure BSS there is one special STA called the Access Point (AP). The AP is solely responsible for starting and maintaining the BSS and admitting (or excluding) other STAs. The AP receives all traffic either bound for or originating from every STA that it admits into its BSS. (Exception is contained in IEEE 802.11e amendment for Quality of Service - a special QoS BSS).

The STAs are known as Clients, the AP is known as a Server.

A Distribution System (DS) interconnects a set of APs to create an Extended Service Set (ESS). The ESS is a super set of all member STAs. The DS distributes data between ESS STAs. An ESS may include LANs (via a gateway).

The simplest and most common configuration is to have an ESS that includes exactly one AP. It is known as a Small Or Home Office (SOHO). This is the intended configuration for the Edge Stations.

In an Infrastructure BSS, the AP broadcasts Beacon frames that announce the identity and capabilities of its BSS.

Joining a WLAN

An STA joins a WLAN using a three-step process:

- 1** Scanning
- 2** Association
- 3** Authentication

Scanning

The STA generates a list of all BSSs (APs in the network) it can detect.

Association

In an Infrastructure BSS the Association process requires a frame exchange between the joining STA and the selected AP. This frame includes the STA's capabilities. The AP will accept or deny the request (Association Response Frame). The STA (Client) learns the BSSID (SSID - Service Set Identifier or WLAN name) and AP MAC address. If the STA is accepted the AP will issue an Association Identifier (AID - logical port) at this time.

Authentication

Apply Security - establish a secure wireless network. WPA2-Personal is recommended for the FARO WLAN security (based on IEEE 802.11i and Advanced Encryption Standard -AES). The password is the real key to security!

Establishing a FARO WLAN Connection

There are a minimum of three STAs to be configured. This may be performed in any order but the typical order is:

- 1 Set up an Access Point
- 2 Set up the Edge
- 3 Set up the Host Computer

Access Point (AP)

Normally the Access Point is configured first. This setup may have been done by the your IT department. If this is the case, IT should provide the Network Name (SSID) and Password.

All Clients must use the same SSID and Password as the AP.

The recommended security setting is either WPA-PSK (TKIP encryption algorithm) {Good} or WPA2-PSK (AES-CCMP encryption algorithm) {Better, if available}. You should use a Password of 10 or more random alphanumeric characters.

NOTE: Wi-Fi Protected Access (WPA).

Fold-Down Touch Screen Controller - WLAN Client Setup Sequence

The AP should be configured and running. For steps to enable the Edge for wireless communication, see “*WiFi*” on page 152.

The Host Computer Setup

The AP should be configured and running.

The ease of configuring client stations depends principally on the configuration utility used. Windows XP comes with its own configuration utility built in, Windows Zero Configuration Utility (WZC). However, there are other configuration utilities that offer better efficiency, easier configuration, and better wireless monitoring. Most Client cards come with their own wireless configuration utility, though others depend on Windows. Here we will describe the configuration of Client stations using WZC, which is the lowest common denominator for most users.

- 1 Add preferred network - Enter SSID (example here is “My Network SSID”).
- 2 Configure Client to the same settings as the AP. To do so, click on the PROPERTIES button. The SECURITY PROPERTIES dialog box appears. The first text box will already be filled in with the SSID selected for the preferred network name.
- 3 In the NETWORK AUTHENTICATION drop-down window, select WPA-PSK.
- 4 In the DATA ENCRYPTION drop-down window, select TKIP.

- 5 The last step is most important - the Network Key entered and confirmed must be the same as the network key (password) that was entered on the AP.

NOTE: Network keys are case sensitive.

Wireless Zero Configuration Reference

The Wireless Zero Configuration programming interface is no longer supported as of Windows Vista and Windows Server 2008. Instead, use the Native Wifi API, which provides similar functionality. For more information, see *About the Native Wifi API* on the Microsoft web site. [http://msdn.microsoft.com/en-us/library/ms705969\(v=VS.85\).aspx](http://msdn.microsoft.com/en-us/library/ms705969(v=VS.85).aspx)

This section contains information on the programming interface for the Wireless Zero Configuration service on Windows XP. The topics include:

- *Wireless Zero Configuration Functions*
[http://msdn.microsoft.com/en-us/library/ms706587\(v=VS.85\).aspx](http://msdn.microsoft.com/en-us/library/ms706587(v=VS.85).aspx)
- *Wireless Zero Configuration Structures*
[http://msdn.microsoft.com/en-us/library/ms706600\(v=VS.85\).aspx](http://msdn.microsoft.com/en-us/library/ms706600(v=VS.85).aspx)

Wireless Zero Configuration is a Windows service on Windows XP that is used to configure and manage wireless network connections on a wireless adapter. The Wireless Zero Configuration service is normally started at boot time. The programming interface for the Wireless Zero Configuration service can be used only if the Wireless Zero Configuration service has been started. If the Wireless Zero Configuration service is not started, then the Wireless Zero Configuration functions will return an error.

To enable the Wireless Zero Configuration service so it starts up automatically:

- Select the START button
- Select the SETTINGS option and then select CONTROL PANEL.
 - If you are using the Windows XP view, select the PERFORMANCE AND MAINTENANCE category and then select ADMINISTRATIVE TOOLS.
 - If you are using the Classic View, then select ADMINISTRATIVE TOOLS.
- Click the SERVICES icon in the left pane.
- Click the WIRELESS ZERO CONFIGURATION icon in the right pane and change the Startup Type drop-down window to AUTOMATIC. This setting will set the service to start automatically at boot time.
- Click the START button to start the Wireless Zero Configuration service and click the OK button.

The Wireless Zero Configuration can also be started and stopped from a command prompt. To start the Wireless Zero Configuration, run the following command:

```
net start wzcsvc
```

To stop the Wireless Zero Configuration, run the following command:

```
net stop wzcsvc
```

FARO Ethernet Setup

The FARO Ethernet set up program connects the Edge on the network to the FaroArm driver. To complete this connection:

- 1 Click START < ALL PROGRAMS < FARO < FARO ETHERNET SETUP.
- 2 In the FARO ETHERNET SETUP dialog box, choose the correct Host Adapter from the HOST ADAPTER drop-down list.

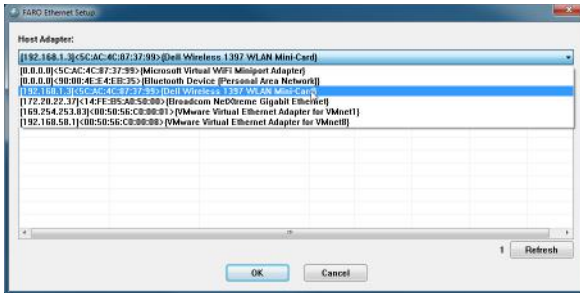


Figure 3-14 Connecting the Edge to the Computer

- 3 Select your Edge from the list. Click the Refresh button to search the adapter again if you do not see your Edge.

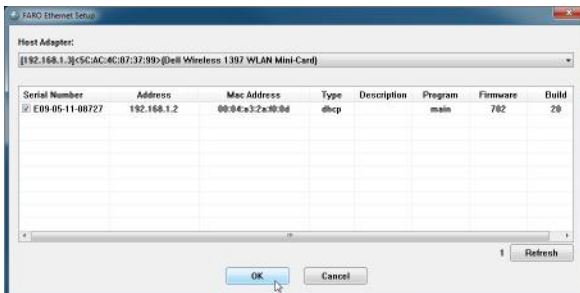


Figure 3-15 Connecting the Edge to the Computer

- 4 Click OK.

Chapter 4: Probes

This chapter describes the standard Edge probes and optional probes for speciality measurement. The Edge collects data by touching the part with a probe attached to the end of the handle. You can install a variety of probes on your Edge.

Once the probe is attached, it must be compensated. *See “Compensation” on page 160 and “Compensate Probe” on page 181.*

Edge Probes

Two standard probes, one (1) 6mm Ball and one (1) 3mm Ball, are supplied with the Edge. Each ball probe is stamped with the *exact* diameter of the ball (2.9997mm, 5.9994mm, etc.). This exact diameter must be entered in the probe settings section of the software. To enter the exact diameter value:

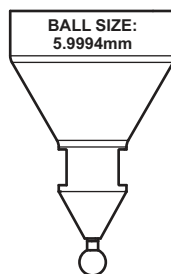
- On the Fold-Down Touch Screen Controller:
 - 1 Touch the PROBE COMPENSATION button.
 - 2 Touch the HOLE COMPENSATION or SPHERE COMPENSATION button.
 - 3 Touch the correct probe.
 - 4 Touch the SETTINGS button.
 - 5 Touch the Probe Diameter and enter the exact diameter.
 - 6 Touch OK.

See “Compensation” on page 160.

- In your measuring software (CAM2 Q, CAM2 Measure, CAM2 Measure X, Geomagic, Polyworks, etc.), edit the diameter of the existing 3mm and 6mm probes. Enter the exact diameter in the MODIFY PROBE dialog box for each ball probe. *See “Edit Probe” on page 180 and “Compensation” on page 160.*

The Edge’s point of measurement on any ball probe is the center of the ball. Third-party feature measurement or quality control software compensates for the radius of the ball probe. Point probes are only recommended when the software will not compensate for the radius of the ball probe. The point probe has an impact on measurement accuracy. The error depends on:

- The width of the point on the probe.
- The position and placement of the point on the object.



NOTE: For accurate measuring, you *must* compensate the probe. Use your measuring software to set up and compensate the probe. See “Probes” on page 178 and “Compensation” on page 160.

FARO i-Probe

The Edge uses the optional FARO i-Probe. This is an electronically serialized intelligent probe that automatically provides its actual *exact* ball diameter to the Edge and monitors probe body temperature to compensate for thermal deformation.

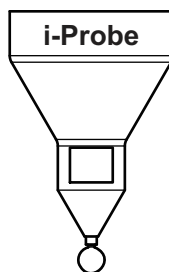
NOTE: FARO i-Probes will not attach to FaroArm Platinum or Fusion. Installing the i-Probe to anything other than a FaroArm Edge or a FaroArm Quantum damages the i-Probe.

You must activate the i-Probe:

- On the Fold-Down Touch Screen Controller:
 - 1 Touch the PROBE COMPENSATION button.
 - 2 Touch the HOLE COMPENSATION or HOLE COMPENSATION button.
 - 3 Touch the correct probe.
 - 4 Touch the SETTINGS button.
 - 5 Touch the ENABLE I-PROBE button.
 - 6 Touch OK.

See “Compensation” on page 160.

- In your measuring software (CAM2 Q, CAM2 Measure, CAM2 Measure X, Geomagic, Polyworks, etc.), select the USE I-PROBE check box in the PROBES dialog box. See “Probes” on page 178.



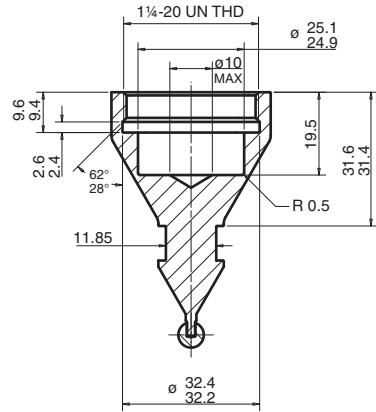
Custom Probes

You can create any size probe to attach to the Edge.

- The Edge probe thread size is 1¼"-20.
- The base of the probe should follow the shape of the FARO probes.

Your custom probe should be as rigid as possible. Any deflection in the probe will add inaccuracy to the Edge system.

NOTE: FARO Technologies, Inc. does not guarantee the accuracy of the Edge with the use of a custom probe.



Installing Probes

The probe attaches to the threaded handle at the end of the Edge. Use the 12mm wrench in the Probe Case to install the probe.

NOTE: Use the FARO Probe Torque Wrench to tighten the FARO i-Probe. The probe wrench will break free when you apply the proper amount of torque.

- Hold the button area near the end of the Edge with one hand.

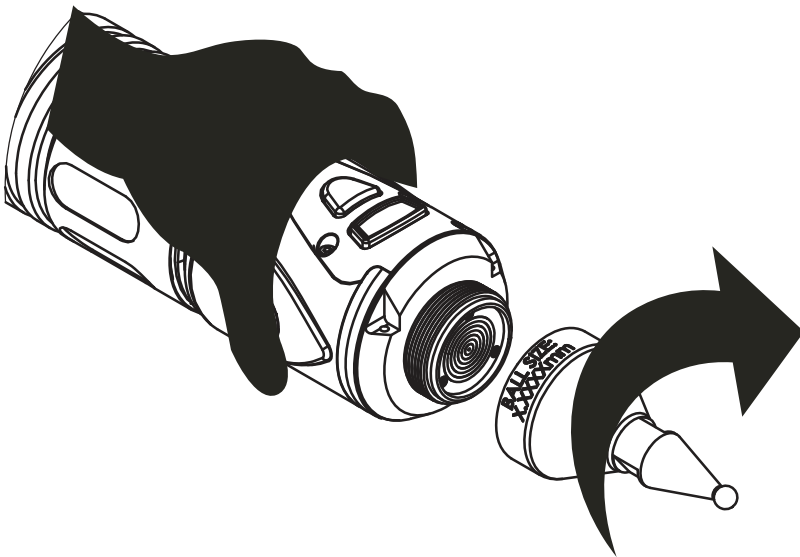


Figure 4-1 Installing a Probe

CAUTION: *Do not* hold the Edge except in the button area when installing a probe. Holding the Edge at the last joint may stress the tube and damage the system.

- Rotate the probe clockwise and thread the probe into the Edge.
- Use the 12mm wrench to hand-tighten the probe, or the FARO Probe Torque Wrench to tighten the i-Probe.

CAUTION: Only *hand-tighten* the probe with the 12mm wrench. *Do not* over-tighten the probe.

Use your measuring software to set up and compensate the probe. See “Probes” on page 178.

FARO Laser Line Probe

The FARO Laser Line Probe is a non-contact probe that collects digitized points using a laser and a camera. The laser is projected onto your part as a line, the camera takes a picture of the shape and position of the line, and creates several points. These individual points are then sent to the computer.

Computer Requirements

The FARO Laser Line Probe will generate thousands of points in a short amount of scanning time. When you add it to your Edge your computer must have a powerful Central Processing Unit (CPU) and a large amount of Random Access Memory (RAM). FARO recommends the following:

CPU - Intel i7 with 4 Cores (Quad Core)

RAM - 8GB minimum, 16 GB recommended

Laser Safety

The FARO Laser Line Probe outputs a visible red laser beam. Although this is a CDRH Class II and IEC Class 2M power level, operation of the device requires the operator to avoid direct exposure to eyes at all times.

You should avoid direct exposure to your eye at all times. Although the human blink reaction to bright light provides a natural mechanism of protection to this visible laser beam, use caution while handling the FARO Laser Line Probe by pointing it at only the target object.

CAUTION: USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS LASER LIGHT EXPOSURE.

Laser Radiation Emission

When the FARO Laser Line Probe is operating, a laser beam emits from the aperture at the front of the FARO Laser Line Probe. See Figure 4-2 for the location of the laser beam aperture.

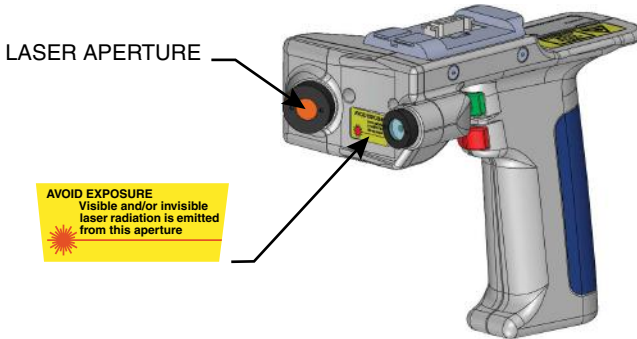


Figure 4-2 Laser Aperture

When the laser is operating, the Edge Handle LEDs illuminate. See Figure 4-3 for the location of the laser emission indicator.

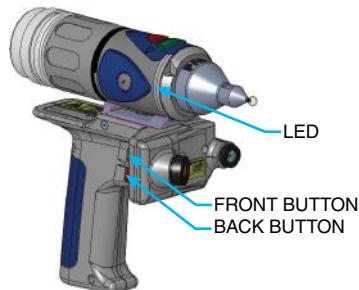


Figure 4-3 Laser emission indicator

These LEDs also indicate the range of the laser to the target surface. *For more information, see “Range Finder” on page 59.*

CAUTION: VIEWING THE LASER OUTPUT WITH CERTAIN OPTICAL INSTRUMENTS (EYE LOUPES, MAGNIFIERS, AND MICROSCOPES, ETC.) WITHIN A DISTANCE OF 100 MM MAY POSE AN EYE HAZARD.

Laser power up to 5 mW at 660 nm in a diverging beam could be accessible in the interior of the FARO Laser Line Probe.

WARNING: DO NOT ATTEMPT TO OPEN THE FARO LASER LINE PROBE CASE. THERE ARE NO USER SERVICEABLE PARTS.

Serial Number Label

The FARO Laser Line Probe Serial Number label contains the serial number, laser information, calibration, warning logotype and manufacturing date. See Figure 4-2 for the location of the laser beam aperture.

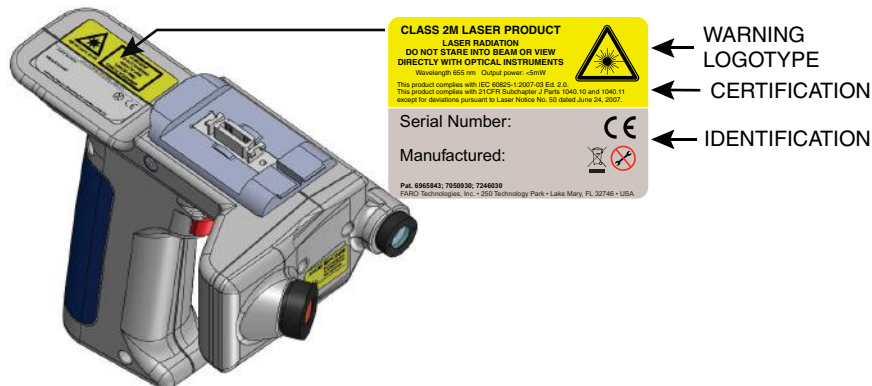


Figure 4-4 Serial Number label

Servicing

The FARO Laser Line Probe should only be serviced by FARO Customer Support technicians. There are no user serviceable parts in this device. DO NOT attempt to open the casing or disassemble the device at any time.

If the FARO Laser Line Probe is not operating properly, contact FARO Customer Support. If it has malfunctioned, power down the system, remove it from the Edge and return it to FARO Customer Support for repair.

WARNING: DO NOT ATTEMPT TO OPEN THE FARO LASER LINE PROBE CASE. THERE ARE NO USER SERVICEABLE PARTS.

Hardware Installation

The FARO Laser Line Probe is stored in case #2 in the shipping case. Installing it is similar to the Edge 7-Axis Handle. The FARO Laser Line Probe *can* be attached/detached while the Edge is powered On. To attach the probe:

- 1 Set up your Edge and install the 6mm or 3mm ball probe.

- 2 Loosen the handle locking ring by turning it counterclockwise.

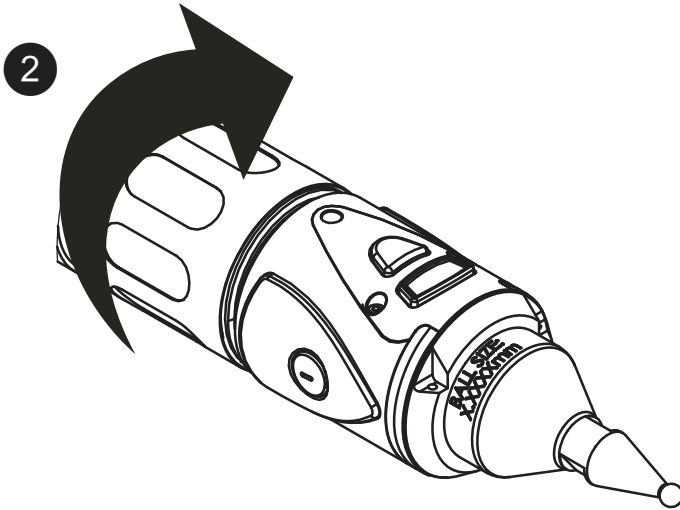


Figure 4-5 Attaching the 7-Axis Handle

- 3 Insert the front edge of the probe into the slot.

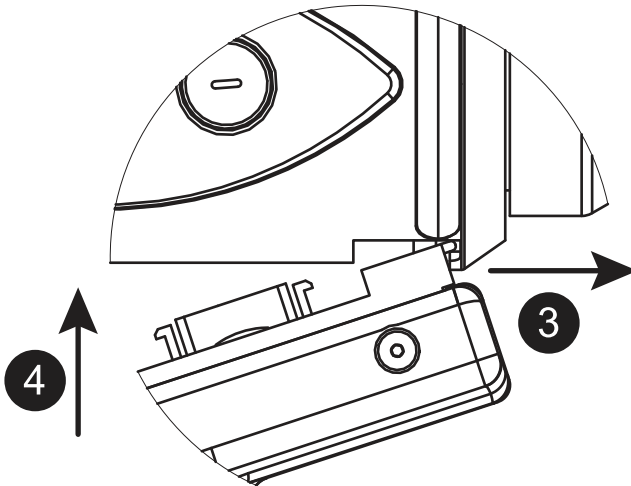


Figure 4-6 Attaching the 7-Axis Handle

- 4 Push the probe handle in so that the connectors connect.
- 5 Tighten the locking ring by turning it clockwise. Do not over tighten the ring.

NOTE: Remove the FARO Laser Line Probe from the Edge before packing.
See “Packing the Edge” on page 30.

Holding the FARO Laser Line Probe

Never grab the FARO Laser Line Probe while measuring. Simply hold the Edge's pistol grip.

NOTE: Avoid touching both lenses. Clean the left and right lenses with the cloth from the FARO Laser Line Probe Case. Dirt and grease on either lens can cause poor results.

Hardware Controls and Indicators

The Edge/FARO Laser Line Probe system uses the FRONT (Green) and BACK (Red) and the Handle LEDs.

Buttons

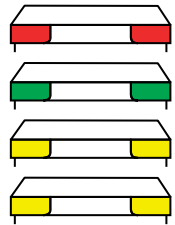
Use the buttons on the Edge handle or the buttons on the FARO Laser Line Probe handle to control measuring.

- Use the FRONT (green) button to start data collection. Points are only sent to the computer when the laser is in range. Once you start collecting data, press the FRONT button again to pause.
- Use the BACK (red) button to end any measurement command.

LEDs

The two Handle LEDs, indicate the distance to the target object from the FARO Laser Line Probe. Remember, data is only sent to the computer when the FARO Laser Line Probe is in range.

- Out of Range (two Red LEDs). The Laser Line Probe is too close or too far from the part.
- Center Range (two Green LEDs) The Laser Line Probe is in the center of the range.
- Near Range (two Yellow LEDs) The Laser Line Probe is in range, closer to the part.
- Far Range (two Yellow LEDs) The Laser Line Probe is in range, farther from the part.



Additionally, the software uses the Range Finder dialog box to show the distance and position from the FARO Laser Line Probe to your part.

Range Finder

The FARO Laser Line Probe software has a RANGE FINDER dialog box. This dialog box graphically displays the laser to part distance and the area of the laser line that the camera is processing.

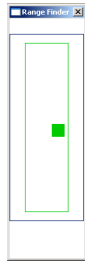


Figure 4-7 Laser Line Probe in range

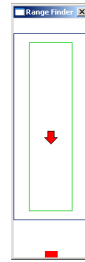


Figure 4-8 Laser Line Probe not in range

When the FARO Laser Line Probe is within the operating range, the center of the target displays as a small box in the RANGE FINDER dialog box, see Figure 4-7.

The box moves as the FARO Laser Line Probe moves:

- Up - as you move the Laser Line Probe closer to your part
- Down - as you move the Laser Line Probe farther from your part
- Left - the right side of the line is in range
- Right - the left side of the line is in range

The target box changes color:

- Green - all of the laser is in range
- Blue - some of the laser is in range
- Red - none of the laser is in range

When the FARO Laser Line Probe is outside of the operating range, the target box moves to a side of the RANGE FINDER dialog box and an arrow in the center of the dialog box points to the target box, see Figure 4-8.

If the FARO Laser Line Probe is set to automatic exposure, there is an additional symbol in the upper left corner of the RANGE FINDER dialog box. The symbol changes describes the exposure:

- Red Minus Sign (-) - low exposure
- Green Circle (O) - good exposure
- Red Plus Sign (+) - high exposure

For more information, see “FARO Laser Line Probe Settings” on page 64.

Software Setup

The Edge/FARO Laser Line Probe system can be used with many software packages. Refer to the particular application software for installation and proper use of the software with the FARO Laser Line Probe.

NOTE: Some software packages automatically add the FaroArm driver to your computer. To ensure that you have the latest version of the FaroArm driver, install the CD-ROM found inside your FARO Laser Line Probe Case.

Compensation

After you complete the installation and warm-up of the FARO Laser Line Probe and the standard probe, this system of probes must be compensated. Compensation requires measuring the FARO Compensation Plate, with a standard probe and the FARO Laser Line Probe.

NOTE: Clean the top and bottom lenses with the cloth from the FARO Laser Line Probe Case. Dirt and grease on either lens can cause poor results.

NOTE: Allow the FARO Laser Line Probe to warm-up for 30 minutes. For optimum performance, FARO recommends you allow the equipment to warm-up for 60 minutes.

- 1 In your measuring software, start the PROBE command.
- 2 Choose a standard ball probe, 6mm or 3mm.

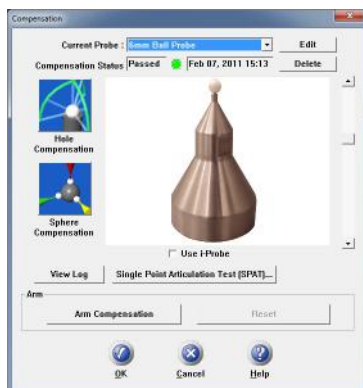


Figure 4-9 Standard ball probe

NOTE: If your ball probes are stamped with the *exact* diameter, enter the exact diameter in the MODIFY PROBE dialog box for each ball probe. See “*Edit Probe*” on page 180.

- 3 Calibrate the standard ball probe using the single hole compensation method.
See “Hole Compensation Method” on page 185.
- 4 In the PROBES dialog box, choose the Laser Probe probe in the CURRENT PROBE drop-down window.



Figure 4-10 Probes dialog box

NOTE: Ensure that HIGH ACCURACY MODE is disabled during compensation.
See “Line Probe Settings” on page 66.

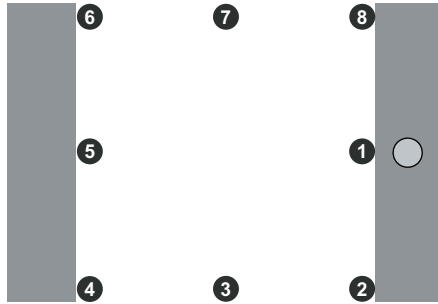
- 5 Choose the PLANE COMPENSATION.
- 6 You can choose to use the previously measured plane, or measure the plane.
Click OK to calibrate the FARO Laser Line Probe, or measure the plane.
 - The laser turns on and the laser beam is visible unless you are measuring the plane or sphere. After you successfully measure the plane or sphere, the laser turns on and the laser beam is visible.

Plane Compensation

Calibrate the FARO Laser Line Probe. You will digitize the FARO Compensation Plate, once with the ball probe, and then three times with the FARO Laser Line Probe.

- 1 Digitize the White area of the FARO Compensation Plate with the ball probe.
 - Touch the white surface with the ball probe and press the FRONT button.
 - Digitize eight points on the white surface.

NOTE: Digitize each point near an edge of the surface to avoid marring the middle of the surface.

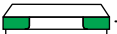


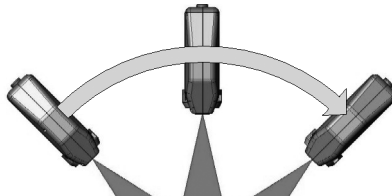
- Pull the probe away from the surface and press the BACK button.

The flatness of the white surface is calculated and the results are displayed in the dialog box. If the results *Fail*, click the RETRY button to redigitize the white surface. Click OK to continue.

NOTE: Avoid touching both lenses. Clean the top and bottom lenses with the cloth from the FARO Laser Line Probe Case. Dirt and grease on either lens can cause poor results.

- 2 Digitize the white area of the FARO Compensation Plate with the FARO Laser Line Probe in a sweeping motion. You should collect at least 200 scan lines in the FARO Laser Line Probe compensation. If not, repeat the compensation moving the FARO Laser Line Probe slower in each step.

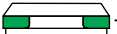
- Aim the laser line at the middle of the white surface.
- Move the FARO Laser Line Probe until the laser is in the Center Range. The diagram shows a horizontal bar with a green segment on the left and a green segment on the right, with a white segment in the middle.
- Press the FRONT button and move the FARO Laser Line Probe while pointing to the center of the white surface. Rotate the FARO Laser Line Probe as much as possible - at least 90 degrees.

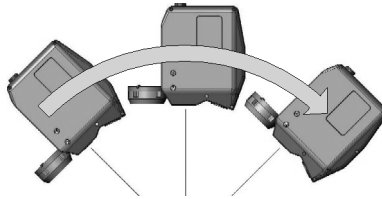


- Press the BACK button.

- 3 Digitize the white area of the FARO Compensation Plate with the FARO Laser Line Probe in a sweeping motion. You should collect at least 200 scan lines in

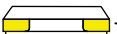
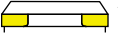
the FARO Laser Line Probe compensation. If not, repeat the compensation moving the FARO Laser Line Probe slower in each step.

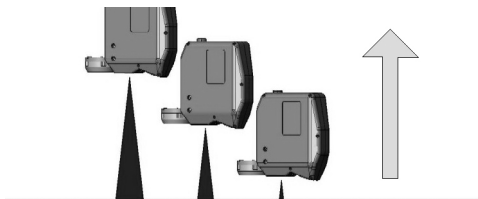
- Rotate the FARO Laser Line Probe 90°.
- Aim the laser line at the middle of the white surface.
- Move the FARO Laser Line Probe until the laser is in the Center Range. .
- Press the FRONT button and move the FARO Laser Line Probe while pointing to the center of the white surface. Rotate the FARO Laser Line Probe as much as possible - at least 90 degrees.



- Press the BACK button.

4 Digitize the White area of the FARO Compensation Plate with the FARO Laser Line Probe.

- Aim the laser line at the middle of the white surface.
- Move the FARO Laser Line Probe until the laser is closer than the Near Range. .
- Press the FRONT button and slowly move the FARO Laser Line Probe beyond the Far Range  while pointing to the center of the white surface.



- Press the BACK button.

The digitized compensation points then calculate and the COMPENSATION STATUS updates. If the probe passes, the current date and time is added to the probe information. You can view the details for all probe compensations by clicking the VIEW LOG button. See “View Log” on page 189.

You now have two probes to digitize your part. Use the PROBES command to switch between the standard ball probe and the FARO Laser Line Probe.

NOTE: If you remove the FARO Laser Line Probe, you *must* re-calibrate it again to guarantee the accuracy of the measurements. *For more information, see “Compensate Probe” on page 181.*

DRO

Some software packages add a Digital ReadOut (DRO) window to the screen. The DRO window displays the current location of the probe in the current coordinate system.

- If the FARO Laser Line Probe is in range, the X, Y, Z coordinate is the center of the laser line. Note that this may not be the center of the complete laser line because some part of the laser line may be out of range.
- If the FARO Laser Line Probe is out of range, then no coordinate is available and the DRO displays a row of asterisks (*****).

FARO Laser Line Probe Settings

Modify the settings of the FARO Laser Line Probe for your part. The default settings are for digitizing the compensation sphere or plane that has an opaque white surface. You can control the following:

- Scan Rate - the number of lines per second that the FARO Laser Line Probe records and sends to your current file. Fewer lines per second requires you to move the FARO Laser Line Probe slower.
- Scan Density - the amount of points each line contains. More points in each line creates a larger file. If you are digitizing a relatively flat surface, use less points.
- Material - controls the camera which records the laser line. Different part material colors and textures reflect the laser line differently.
- Advanced Settings - controls the exposure settings of the camera.

To change the FARO Laser Line Probe settings:



Figure 4-11 Probes dialog box

- Choose the Laser Probe probe in the PROBES dialog box
- Click the EDIT button.

In the MODIFY PROBE dialog box, you will see all of the information about the FARO Laser Line Probe.

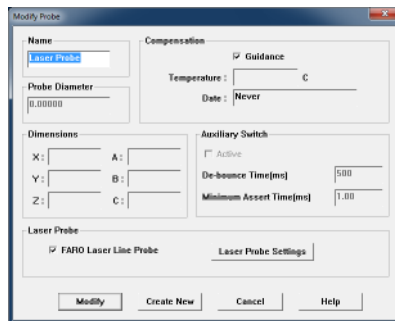


Figure 4-12 Modify Probe dialog box

- Click the LASER PROBE SETTINGS button to modify the settings of the FARO Laser Line Probe.

Line Probe Settings

Choose the LASER PROBE SETTINGS button to show the FARO LASER LINE PROBE CONTROL dialog box. When the FARO Laser Line Probe is within the operating range, you will see the line in the PREVIEW AREA of the dialog box.

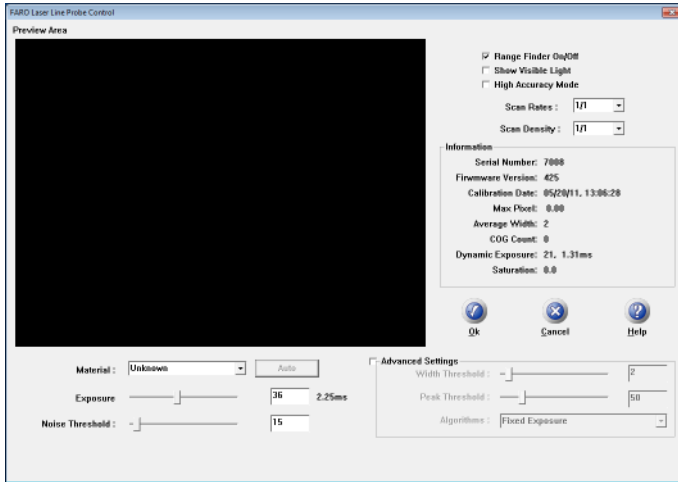


Figure 4-13 FARO Laser Line Probe Control dialog box

- Disable the RANGE FINDER dialog box by clearing the Range Finder On/Off check box.
- Select the SHOW VISIBLE LIGHT check box to add all visible light to the Preview window.

NOTE: Adding all visible light to the preview window will decrease the number of frames per second sent to the computer and should only be used when diagnosing problems with the FARO Laser Line Probe.

- Select the HIGH ACCURACY MODE check box to operate the FARO Laser Line Probe in the High Accuracy mode. High Accuracy mode can improve the performance of the FARO Laser Line Probe by up to 30%, but reduces your field of view by $\frac{1}{2}$ and shortens your effective maximum scan line width to $\frac{2}{3}$ of the normal width.

NOTE: Always clear this check box when compensating the FARO Laser Line Probe. See “Compensation” on page 60.

Scan Rate and Density

Use the Scan Rate Density settings for data reduction. Reducing the number of points the FARO Laser Line Probe collects can improve system performance, increase scanning speed and potentially reduce unwanted noisy data.

- Scan Rate - choose the number of scan lines per second. 1/1 is the normal rate of scan lines per second, set this to discard scan lines.

NOTE: Always set the scan rate to 1/1 when calibrating the FARO Laser Line Probe.

- Scan Density - choose the number of points on each scan line. 1/1 is all of the points on the laser line, set this to discard points on each line.
- Information - displays the unique information for the current FARO Laser Line Probe.

Basic Settings

- From the MATERIAL drop-down window choose any existing material setting. Use the commands in this drop-down window to save material settings.

NOTE: The current material setting is stored on your computer and in the Edge. If you connect the Edge to another computer, the current material will be *Unknown*. Save the material settings to copy the settings from the Edge to the new computer.

- Click the AUTO button to set the Exposure and Noise Threshold levels for the current material. Hold the FARO Laser Line Probe in position, pointing at the surface, until the process completes. You can also set the values manually:
 - Exposure - How long the “shutter” is open and the sensor is exposed to light in the camera. Enter a number from 1 to 80; the corresponding value in milliseconds appears next to it. Light colors and reflective surfaces are better captured with low exposure levels. Darker colors typically require higher exposure levels. The default value is 16.
 - Noise Threshold - The FARO Laser Line Probe measures the intensity, or return power, of all pixels and each pixel of the laser line projected onto a surface using a scale from 0 to 255. All data having intensity below the Noise Threshold value is considered noise or “chatter” that is too faint to be usable and is simply ignored. Dark colors or surfaces that tend to absorb light may benefit from a lower value. Increasing this value will filter out more data. Setting this value to 255 considers all data to be noise. The default value is 15.

Advanced Settings

- Select the ADVANCED SETTINGS check box to modify more material settings:
 - Width Threshold - When determining the Center of Gravity (COG) for the laser line, groups of pixels are analyzed. This sets the minimum number of pixels to define a COG group of pixels. The default value is 5. This means that if the FARO Laser Line Probe picks up several clusters of light in one

column, due to angle of incidence, reflection, or any other external interference, only clusters with at least 5 pixels will be considered COG candidates. Pixels must also meet the Noise Threshold criteria, which is a value of 2.

- **Peak Threshold** - For a COG group to be valid, one of the pixels must be above this value. The default value is 50. Increasing the Peak Threshold is useful with reflective surfaces that may shine or produce flares in the FARO Laser Line Probe. If a FARO Laser Line Probe column captures more than one laser light source, only the groups or clusters with at least one pixel at Peak Threshold will be considered. Groups must also meet Noise Threshold and Width Threshold criteria.
- **Algorithm** - Select an exposure setting:
 - *Automatic - Full*: As you digitize, the Exposure setting automatically adjusts to maintain the proper saturation level. This automatic mode uses the entire exposure range of the FARO Laser Line Probe. In this mode, you may notice a slight decrease in speed as the FARO Laser Line Probe automatically adjusts from one surface type to another.
 - *Automatic - Highly Reflective*: This is an automatic setting for use with reflective, or shiny, materials. This automatic mode uses the lower half of the exposure range of the FARO Laser Line Probe.
 - *Automatic - Normal*: This is an automatic setting for use with non-reflective, or dull, materials. This automatic mode uses the upper half of the exposure range of the FARO Laser Line Probe.
 - *Fixed Exposure* - The Exposure setting is constant.

NOTE: The three Automatic settings disable the AUTO button and ignore the Exposure and Noise Threshold sliders.

Choosing any of the three Automatic settings adds an exposure indicator to the RANGE FINDER dialog box. In the RANGE FINDER dialog box:

- A green dot in the upper left-hand corner of the RANGE FINDER dialog box indicates that the exposure has been adjusted and you are ready to scan.
- The indicator changes to either a red “+” (plus) or “-” (minus) sign indicating that the FARO Laser Line Probe is either over-exposed or under-exposed, and it is automatically adjusting the exposure. The FARO Laser Line Probe does not collect data during this adjustment, however this automatic adjustment process is very fast.

For more information, see “Range Finder” on page 59.

During the compensation of the FARO Laser Line Probe, this setting temporarily changes to *Automatic - Normal* except when using *Fixed Exposure*. For more information, see “*Compensation*” on page 60.

- Choose Save As... in the MATERIAL drop-down window to save a material setting.

In general, the default values for all settings described here will yield acceptable data on most surfaces. The EXPOSURE parameter requires more frequent adjustments based on the different surface finishes you are scanning.

Keep in mind that given the vast range of colors, textures and finishes, there is no exact science for these FARO Laser Line Probe Settings that work best on a particular surface. Finding the optimum settings may require some practice.

Additional Considerations

- First, if accuracy is not an issue, even failing probe compensation will not prevent you from using the FARO Laser Line Probe to show the concept of gathering point clouds quickly and easily, directly into software applications. The ScanArm *does* use the new probe compensation, even if it fails.
- Second, if the probe compensation does fail, you should look at the probe compensation log to see by how much. If the error is acceptable, you should be able to scan effectively for medium accuracy applications.
- Third, if you need to measure in a high accuracy application, or you have a requirement that the probe compensation pass, make sure you allow the FARO Laser Line Probe to warm-up for the amount of time recommended for your model. See “*Diagnosing FARO Laser Line Probe Accuracy Problems*” on page 97.

Renishaw TP-20 Probe Installation and Operation

The Edge supports the Renishaw TP-20 touch-trigger probe by using the FARO i-Probe adapter to connect the TP-20 probe module to the Edge Handle. Simply attach this assembly just as you would any other probe. See “*Installing Probes*” on page 53.

The Renishaw TP-20 touch-trigger probe automatically digitizes a point by touching the stylus to the part.

NOTE: The Renishaw TP-2 Probe is *not* supported.

Edge TP-20 Probe Kit

The Edge TP-20 Probe Kit contains:

- A magnetized TP-20 probe body
- Medium Force Probe Module
- Renishaw (S1) C Spanner wrench
- Renishaw (S7) stylus tool
- Renishaw (CK200) cleaning kit
- Renishaw Probe tip: 2mm (M2 D2R L10)
- Renishaw Probe tip: 6mm (M2 D6R L10)
- Edge i-Probe adapter

NOTE: The product numbers in the parentheses are Renishaw part numbers. See the *Renishaw User's Manual* for more details.

To install the TP-20 Probe:

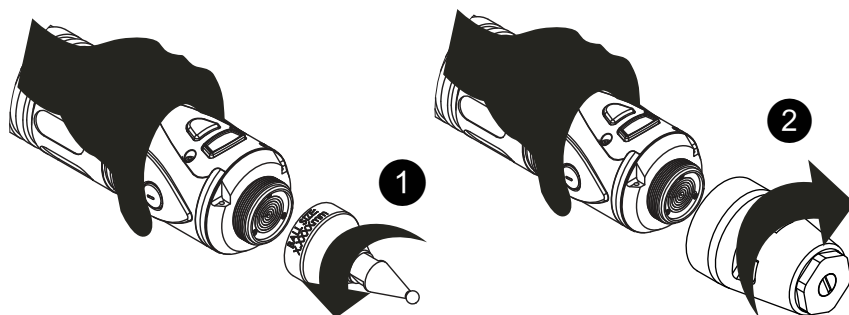


Figure 4-14 Installing a Renishaw Probe

- 1 Remove the current probe.
- 2 Install the Edge i-Probe adapter. Tighten using the 12mm torque wrench.
- 3 Screw the TP-20 probe body into the Edge i-Probe adapter and hand-tighten with the C Spanner (S1) wrench.
- 4 Attach a probe module to the TP-20 probe body. On the probe body and probe module are triangle, half-moon, and square markers that must be aligned for the probe to work properly.
- 5 Screw the Renishaw Probe tip into the probe module with the stylus tool (S7). Do not under- or over-tighten any of the components.

Probe Modules for the TP-20 Probe

Probe modules are available from Renishaw in three trigger force ratings:

- Standard Force Probe Module (Black cap)

- Medium Force Probe Module (Gray cap)
- Extended Force Probe Module (Brown cap)

Refer to the *Renishaw TP-20 Installation and User's Manual* for the TP-20 Probe assembly instructions.

Measuring Software

The measuring software must be configured for the probe. If you are using CAM2 Measure (4.0 and X), CAM2 Q, or CAM2 Measure (v10 or later):

- 1 Create a new probe:
 - In CAM2 Measure and CAM2 Q, choose the DEVICES < DEVICE CONTROL command and click the PROBE MANAGEMENT button. *See "Change Probe" on page 173.*
 - In CAM2 Measure v4 and X choose the PROBES command. *See "Probes" on page 178.*
- 2 Create a new probe and switch the auxiliary port to the ON position by placing a check mark in the Aux Switch check box. *See "Edit Probe" on page 180.*
- 3 Compensate the probe using the FARO Compensation Sphere, or any precision sphere, after installation. *See "Sphere Compensation Method" on page 187.*

If you are using the Edge software:

- 1 Create a new probe:
 - On the Fold-Down Touch Screen Controller, touch the PROBE COMPENSATION button.
 - Touch SPHERE METHOD button.
 - Touch the probe, enter a new name, and touch OK.
- 2 Press the SETTINGS button.
 - Touch the ENABLE I-PROBE button.
 - Enter a probe diameter.
 - Touch the OK button.
- 3 Compensate the probe using the FARO Compensation Sphere, or any precision sphere, after installation. *See "Sphere Compensation Method" on page 187.*

Some software packages have other probe options that must also be controlled. See the *Renishaw User's Manual* for more information.

Operation

The probe digitizes a point when it makes contact with an object. It may digitize multiple points when bounced off an object. Watch the Handle LED light and listen to the sounds of the computer to ensure that only one point was digitized. The Handle LED light turns off and the computer sounds when a point is digitized. Additional points will not record until after the de-bounce time has elapsed.

FARO Sensor

The FARO SENSOR is a dual function touch-trigger probe/scanning probe for the Edge. It attaches to the Edge like any standard probe. See “*Installing Probes*” on page 53.

NOTE: The Sensor will not attach to FaroArm Platinum or Fusion. Installing the Sensor to anything other than a FaroArm Edge or a FaroArm Quantum damages the Sensor.

Sensor Probe Kit

The Sensor Probe Kit contains:

- Sensor body
- 3mm Sensor styli
- 6mm Sensor styli
- Renishaw Wrench
- Renishaw (M4) stylus tool
- Renishaw (CK200) cleaning kit

NOTE: The product numbers in the parentheses are Renishaw part numbers. See the *Renishaw FARO SENSOR User’s Guide* for more details.

To instal the Sensor probe:

- 1 Remove the current probe.
- 2 Screw the threaded end of the Sensor body onto the Edge Handle.
- 3 Use the Wrench to tighten the Sensor body.
NOTE: Do not overtighten the Sensor body.
- 4 Screw the threaded end of either Sensor styli into the Sensor body.
- 5 Use the M4 Stylus tool to tighten the styli onto the Sensor body.

NOTE: Do not overtighten the Sensor styli.

Measuring Software

The measuring software must be configured for the probe. If you are using CAM2 Measure (4.0 and X), CAM2 Q, or CAM2 Measure (v10 or later):

- 1 Create a new probe:
 - In CAM2 Measure and CAM2 Q, choose the DEVICES < DEVICE CONTROL command and click the PROBE MANAGEMENT button. *See “Change Probe” on page 173.*
 - In CAM2 Measure v4 and X choose the PROBES command. *See “Probes” on page 178.*
- 2 Create a new probe and switch the auxiliary port to the ON position by placing a check mark in the AUX SWITCH check box. *See “Edit Probe” on page 180.*
- 3 Compensate the probe using the FARO Compensation Sphere, or any precision sphere, after installation. *See “Sphere Compensation Method” on page 187.*

If you are using the Edge software:

- 1 Create a new probe:
 - On the Fold-Down Touch Screen Controller, touch the PROBE COMPENSATION button.
 - Touch SPHERE METHOD button.
 - Touch the probe, enter a new name, and touch OK.
- 2 Press the SETTINGS button.
 - Touch the ENABLE I-PROBE button.
 - Enter a probe diameter.
 - Touch the OK button.
- 3 Compensate the probe using the FARO Compensation Sphere, or any precision sphere, after installation. *See “Sphere Compensation Method” on page 187.*

Some software packages have other probe options that must also be controlled. See the *Renishaw User’s Manual* for more information.

Operation

Refer to the Product Operation section of the *Renishaw FARO SENSOR User’s Guide* for information about the operation and measuring using the FARO Sensor.

Custom Probe Compensation

Any probe with a sphere or a point can be compensated. *See “Compensate Probe” on page 181.*

Chapter 5: Accuracy

This chapter describes the definitions and specifications of accuracy, or performance specification, for the Edge.

The Edge performance testing standard is the North American ASME or European ISO standard. Edge test methods are a subset of those given in the B89.4.22 standard. Single-point repeatability is measured using a hard probe in a reference hole. Volumetric performance is measured using a traceable length artifact. Measurements are well distributed in all regions of the working volume.

Compensation and Calibration

The Edge is designed to endure the typical stress and impact loads of a “factory floor” measuring tool, as well as survive multiple transportation cycles while maintaining its accuracy throughout its usable life. In order to fully appreciate what is meant by “Lifetime Calibration,” you must first understand several basic concepts of measurement equipment.

Compensation versus Calibration

In most cases, the terms “compensation and calibration” are used together, and are often mistakenly used interchangeably. This generally occurs because traditional Coordinate Measuring Machines are often compensated every time they are calibrated. In reference to the Edge, there are two types of compensation: the Edge compensation and the probe compensation.

Edge Compensation

Compensation is the procedure by which a measurement device is optimized to perform accurate measurements. This may be done through mechanical adjustments, as well as software corrections.

Specialists at FARO’s production facility perform the factory compensation. This compensation utilizes patented hardware and software (not available to the user) to determine the true dimensions and kinematics of the Edge. The results of the factory compensation are imprinted to memory located in the Edge electronics. The Edge is permanently compensated, such that it does not require mechanical adjustments during normal operation.

The Edge compensation becomes invalid (stop functioning within FARO’s published standards) if one or more of the following occurs:

- Bending of the transfer cases (long, tube sections).

- Damage to the encoder-bearing interface joints (where tubes, bearings and encoders are mated).
- Failure of the encoder-electronics system (changes motion into electrical data).
- Excessive impact with another object or an end-stop. The impact may cause the transfer cases to bend, the joint housings to deform, or the encoder-bearing interface pin system to loosen.

Any of these problems require FARO's Customer Service Department to disassemble the Edge, repair the necessary item(s), and perform a factory compensation. A factory compensation is necessary since the physical nature of the Edge has been changed.

Edge Calibration

The Edge software has commands that allow you to perform tests that certify the accuracy and repeatability of your Edge. The calibration commands allow you to test the Edge using a holes, a ball bar, or a step gauge.

The values measured in all of these calibrations include 100% of the measured points. We will always refer to this as the "Max. minus Min. over Two," or the Maximum measurement subtracting from the Minimum measurement divided by two (Max.-Min.)/2.

If any test fails, print the results and repeat the calibration two more times. Print all of the results and contact FARO's Customer Service by Phone, Fax or E-Mail. See *"Technical Support"* on page 191.

Repeatability

Perform the single point repeatability test to check the probe and repeatability using a hole or a cone. You must use a firmly secured object with a hole at least 1mm smaller than the ball probe. If a cone hole is used, extreme care must be taken to ensure that the probe is seated at each "measurement."

- Use a calibrated ball probe. See *"Installing Probes"* on page 53 and *"Compensate Probe"* on page 181.
- Run the Single Point Articulation Test (SPAT). See *"Single Point Articulation Test (SPAT)"* on page 94.

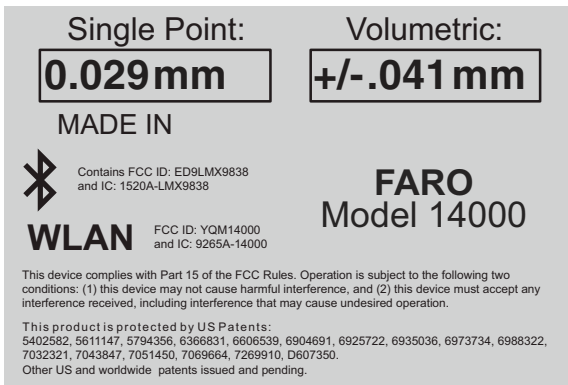
Volumetric Accuracy

Perform a Sphere to Sphere, Point to Point, or Plane to Plane length measurement in order to certify the volumetric accuracy of the equipment. This should be done using traceable length artifacts, which are measured at various locations and

orientations throughout the working volume of the Edge. This test is a method for determining articulating measurement machine accuracy.

- Use a calibrated ball probe. See *“Installing Probes”* on page 53 and *“Compensate Probe”* on page 181.
- Run the Sphere to Sphere, or Point to Point command. See *“Sphere to Sphere”* on page 118, or *“Point to Point”* on page 113, or *“Plane to Plane”* on page 116.
 - 1 Measure points on each feature, from multiple directions. Ensure that you digitize points on the entire Sphere or Plane surface.
 - 2 Make sure that you move the joints of the Edge while measuring the points.
 - 3 Do not digitize a point if any of the encoders reach their end stop. See *“Error and Status Indicators”* on page 36.
 - 4 Avoid a joint position where a degree of freedom is lost in the Edge. See *“Loss of a Degree of Freedom”* on page 77.

The specifications of your Edge are listed on the label to the right of the battery pack slot.



NOTE: For optimum performance, correctly mounting and operating the Edge is very important. For more information, see *“Edge Performance Verification Checklist”* on page 89.

Loss of a Degree of Freedom

In a working volume of the Edge there can be a loss of a degree of freedom (natural rotation of each joint). With this loss, temporary bending occurs on the transfer tubes of the Edge causing a movement of the probe position that cannot be recorded by the Edge’s encoder system. Measurement results taken in these

positions are not accurate. This condition is never encountered in the compensation of the Edge. Common areas of measurement where this loss occurs are:

- when an encoder has reached a hard end-stop,
- directly above the Edge, or
- in close to the base of the Edge.

The Edge should always feel fluid in its movement. If excessive force is needed to move to a measuring location, a degree of freedom has probably been lost. The following figures illustrate some of the possible positions of the Edge where a degree of freedom has been lost.

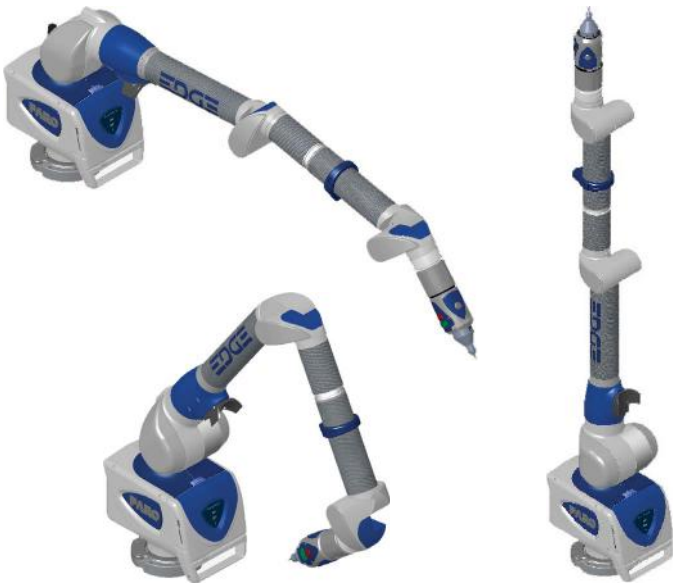


Figure 5-1 Loss of a Degree of Freedom

Chapter 6: Maintenance and Troubleshooting

This chapter describes the basic maintenance for your Edge and some examples of common problems with solutions. There are no user replaceable parts in the Edge.

Normal Maintenance

Edge

The Edge is a precision measurement device that contains many sensitive components, and it should be handled with care. Take the following precautions to prevent problems from developing with your system:

- Place a dust cover over the Edge when not in use.
- Clean with a dry dust cloth. For heavy dirt buildups, use a *very* small amount of warm water and gently clean the Edge. Be very careful not to bend the Edge while cleaning.
- Check the cables for damage to outside insulation, connectors, and pins.
- Do not lubricate the Edge.

The Edge is compensated at FARO's production facility and should only need to be recompensated after the unit has been subjected to a shock that removes surface material or causes bending. Periodic calibration tests should be completed to certify the Edge accuracy and repeatability. *See "Edge Calibration" on page 76.*

FARO recommends you return your Edge to a service center, once a year, for our annual calibration and a 15 point check up.

Host Computer

The computer is an electronic device containing many sensitive components. It should be handled with care. Here are some steps you can take to prevent damage to your system:

- Never use the computer in harsh environments where it may be subjected to rapid temperature change or excessive dust.
- Never expose the computer to excessive shock or vibration.

- Prevent overheating by keeping the computer's air vents clear of any obstructions.
- Never place anything on top of the computer when it is recharging or operating. This can cause the computer to overheat.
- Do not operate the computer from an AC outlet where voltage fluctuates excessively. Use a power strip with a surge protector.
- Do not use an AC adapter other than the one supplied with the computer.
- Do not push on the LCD screen excessively or subject it to shocks.
- Do not expose the LCD screen to direct sunlight, even through a window.
- Do not hold the computer by the LCD panel.
- Do not try to force the LCD screen beyond its fully opened position.

CAUTION: In the rare event that you should see or smell anything which indicates overheating (smoke or a strange smell), turn off the power immediately and contact your dealer.

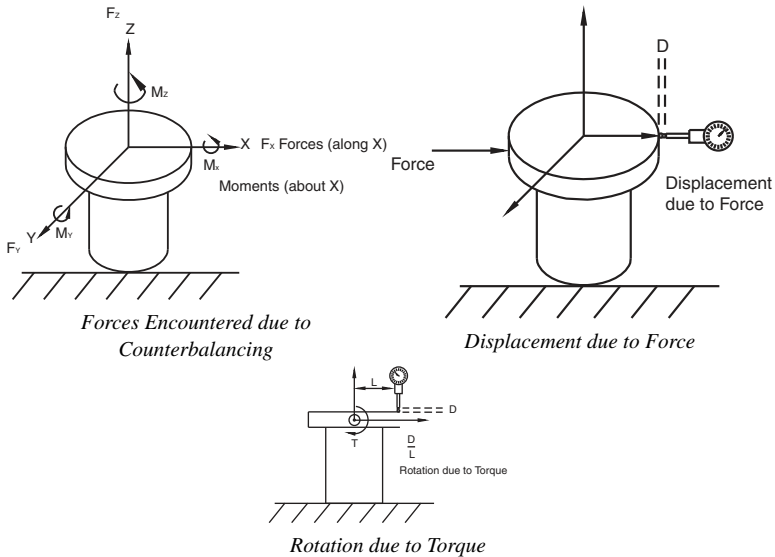
Mounting Stiffness Test

The Edge is portable and can be mounted in a variety of environments. The Edge is counterbalanced, and it is the nature of counterbalancing that restoring forces may exist in the mounting due to the applied forces generated by the counterbalancing mechanism. The reaction forces will result in deformations in the mounting, which degrade the performance of the Edge if the deformations are sufficiently large.

The primary forces encountered due to counterbalancing are translation and torsion. These forces are illustrated below. The forces can be further described along or about the three major axes of a coordinate system at the mounting base. The translation forces (F) along the axes and the moments (M) about the axes result in deformations of the base.

The deformation due to the translation force can be measured. You must apply forces (lb. or N) using a calibrated load cell at the mounting interface to the maximum level required and measure the associated deformation (in. or mm). The torsional forces or moments at the base are generated by using a calibrated torque wrench. The deformations can be described as a slope (in./in. or mm/mm)

and can be measured. The deformations must not exceed the deformation reported at calibration.



In general, the excessive translation deformations are added directly to the certified accuracy, while the excessive angular deformations of the base affect accuracy as a more complicated trigonometric function of the length of the reach.

Temperature Considerations

FARO was awarded the U.S. patent #5,402,582, and worldwide patents are pending, on the concept and the methods for temperature compensation of portable CMM devices. This brief overview is meant only as the most general of descriptions.

To maintain certified accuracy in a multitude of environments, the monitoring of temperature and the rate of temperature change is required. Only the Edge employs a software/hardware solution where a semiconductor temperature sensor is built into each joint.

The temperature is continuously monitored and the difference over time is then applied to the mathematical formulas or kinematics, which define the position of the Edge in three-dimensional space. Link length corrections are made constantly by the inboard processor, which adjusts the kinematics and constantly adapts the output to changing environmental temperature.

However, because different components heat or cool at different rates, the device is expected to reach a steady state temperature within a ± 3 degree (Celsius) bandwidth for five minutes before measurements can be taken. For convenience, the electronics system is programmed to generate an error message when the temperature exceeds a ± 3 degree bandwidth. There is also a built-in routine for the establishment of temperature stability; whereby, the device monitors itself for five minutes and indicates to the user that it is ready for use.

Electrostatic Discharge (ESD)

Electrostatic Discharge (ESD) refers to pulses generated by the discharge of loaded objects and/or people. The charge usually comes from friction between materials, at least one of which is a nonconductor.

- Although these units are protected against damage by ESD, extra care and proper ESD procedures still must be observed and followed.

If an error occurs because of ESD, check the Error Message displayed on the screen and follow the steps below to resume normal operation. If you experience anything out of normal operation:

- 1 Turn off the Edge.
- 2 Wait for at least five seconds before powering the unit on.

This should restore communication with the host computer.

ESD Best Practices

The following is a list of equipment and best practices to avoid ESD events.

Wrist Straps - Wrist straps fit snugly around a person's wrist and are connected to an ESD ground point (never earth ground) or to a grounded mat. A poor connection with a wrist strap is associated with a loose fit or dry skin (use an ESD lotion for dry skin). A wrist strap may be used if an approved ESD smock is not available. However, wrist straps do not shield ESD sensitive components from damage induced by the wearer's clothing.

Heel Straps - Heel straps should be placed so that they make contact with a person's ankle. Static charges are dissipated through the floor by means of a Conductive Flooring. When seated, heel straps do not offer the protections required to dissipate a static charge.

ESD Lotion - ESD lotion provides a better connection between the user and a smock, heel strap or wrist strap. This may need to be reapplied if the smock or straps are removed.

Smocks - ESD smocks are designed to dissipate static fields created by a wearer's shirt. These must be worn at all times within an ESD Sensitive area. All buttons must be secured when working. Smocks are to be connected to an ESD ground point (never earth ground) or to a grounded mat. While the smock is connected and properly grounded, wrist straps are unnecessary.

ESD Chairs - ESD chairs have a ground strap which comes in contact with a grounded mat or conductive flooring and dissipates charges safely to ground.

Table Mats - Table mats are made of a dissipative material and must be grounded individually to earth ground.

Hand Tool Requirements - Hand tools must be stored in non-insulating or charging stations. New hand tools should be ESD-safe (non-generating and dissipative).

Floor Mats - Floor mats are made of a dissipative material and must be grounded individually to earth ground. This is required if no conductive flooring is installed.

Ground Connections - Any earth ground connection is sufficient.

Conductive Flooring - Conductive flooring must be installed per manufacturer specifications and be connected to earth ground.

Wrist/Heel Strap Tester - These provide a method for checking the function of smocks, heels straps and cable connections on an individual user.

Ionizers - An Ionizer floods the air with positive and negative ions, which eliminate static charges. This must be installed so that the airflow blows across the workbench (or down on the workbench for overhead units).

Constant Ground Monitors - Constant monitors are connected to a workstation mat and operator and will sound an audible alarm if any ground is interrupted.

Troubleshooting

Error message on host computer or Fold-Down Touch Screen Controller.

- Contact FARO's Customer Service by Phone, Fax or E-Mail. *See "Technical Support" on page 191.* Have the message ready.

Probe compensation fails.

- Check that the diameter stamped on the probe tip matches the tip of the current probe. *See "Edit Probe" on page 180.*
- Make sure the Edge probe is secure. Only *hand-tighten* the probe with the 12mm wrench. *Do not* over-tighten the probe.

- Make sure that the compensation hole, cone or sphere is located about $\frac{2}{3}$ the distance of the Edge from the base.
- Make sure that the compensation cone, or sphere, is securely screwed into the holder and that the holder is securely fastened to a stable surface.
- Make sure that probe tip is in contact with hole, cone or sphere.
- Compensate the probe again, and check that all points were digitized properly.
- Use the other compensation method (sphere or hole).

Buttons (FRONT & BACK) will not respond.

- Make sure that all of the encoders are referenced. *See “Referencing the Encoders” on page 38.*
- Turn auxiliary port OFF. *See “Edit Probe” on page 180.*
- Check buttons in Diagnostic command. *See “Diagnostics” on page 190.*

Single-point calibration shows excessive error.

- You must use a ball probe. Check that it is installed correctly. *See “Installing Probes” on page 53.*
- Recomensate probe. *See “Compensate Probe” on page 181.*
- During the test, watch the probe to ensure flush seating in the hole. *See “Edge Calibration” on page 76.*

Power Issues

If the Edge is receiving power from the power source, or outlet, but not powering up the system, the source of this issue may lie in one or all of the following areas:

- Ensure you are using the correct cables.
- Check the cables and connectors for bent pins or damage and ensure that the connectors are secure. Replace all cables that show signs of damage.
- Check the power source (outlet) for proper voltage, current and grounding. *For more information, see “Edge Power Supply” on page 26.*
- Check the power supply for physical impacts or damage. **DO NOT** use a damaged power supply.
- Check functionality of the Edge. Look for error codes or operation issues.

NOTE: Power surges, spikes, feedback, and fluctuation in the power source will affect the equipment and its electronic accessories. Have your power source inspected by a professional to provide the cleanest power source possible.

Hardware Communication Issues

This section describes the many issues that prevent good communication between the Edge and the host computer.

PLEASE READ BEFORE BEGINNING THE PROCESS

If communication between the computer and the Edge is lost, or if it could not be established, the source of this issue may lie in one or all of the following areas:

- Ensure you are using the correct cables.

NOTE: Do not use a USB to Serial/Parallel adapter to connect the Edge.

- Check the cables and connectors for bent pins or damage and ensure that the connectors are secure. Replace all cables that show signs of damage.
- Check that unauthorized software or hardware is not conflicting with communications; PDAs, digital cameras, scanners, zip drives, modems and external devices are known to cause these conflicts.
- Check that only the Edge software is running on the computer. Ensure multiple sessions of the measuring software is not running.
- Check functionality of the Edge. Look for error codes or operation issues.
- Check functionality of power supply or serial box. Look for error codes or damage to the housing.
- Check functionality of your computer's hardware.
- Check power source for proper voltage, current and grounding. Remove any extension cords and ungrounded cables.
- Check area to eliminate interference. Large motors, welders or items that may cause vibration or spikes in the power source.

FARO Wireless Connection Issues

- You have set up your connection using your platform specific Bluetooth Wizard and the FARO Bluetooth Connection Setup utility, but software application does not find the Edge.
 - 1 Make sure the Edge is receiving power and the On/Off switch is set to the *ON* position. When the On/Off switch is set to the *ON* position, it lights blue.
 - 2 If you are using a Bluetooth USB dongle make sure it is plugged into a USB port. Also make sure the software associated with the dongle is running. If you are unsure about this, contact the vendor who supplied the Bluetooth hardware and software.

- 3 Open the platform specific Bluetooth Wizard and make sure the Edge is still in the list. If not, refresh the list.

If the Edge is switched on and the PC's Bluetooth hardware is connected correctly, and the connection is still unavailable contact FARO's Customer Service.

- 4 Open the platform specific Bluetooth Wizard and check which COM port is configured with the Edge.

- 5 Open the FARO Bluetooth Connection Setup utility program and confirm the COM port setting. Ensure it matches the same port in the platform specific Bluetooth Wizard list.

- Click OK. If the test passes, the Edge should work normally. If the test fails, contact FARO's Customer Service.
 - If the test passes but your software still does not connect, make sure your FaroArm driver software is current. The latest driver software may be on a separate CD-ROM that came with your Bluetooth equipped Edge, or any other FARO software package. If you are unsure about what version of the FaroArm driver you are running contact your Customer Service Representative by Phone, Fax or E-Mail. *See "Technical Support" on page 191.*
- You are within the maximum 30' Bluetooth range, but cannot get a reliable connection.
 - 1 Bluetooth works with a radio frequency, or RF, signal which can be blocked by obstructions. Metallic obstructions are especially degrading to the signal. For best results, ensure you have a clear path between your computer and the Edge.

FARO Wireless FAQ

- How fast is the connection?
1 Megabit/second.
- What is the range of the FARO Wireless connection?
Approximately 30 feet or 10 meters.
- How many simultaneous Bluetooth wireless connections can be established with the FaroArm driver?
Two.
- Can both USB and Bluetooth wireless Edges be connected simultaneously?
Yes.

- Can a single Edge connect using both Bluetooth wireless and a USB cable at the same time?

No. If both are properly connected, the Bluetooth wireless will be the only active connection for that Edge.

- Can I use a FARO Laser Line Probe with the FARO Wireless connection?

Yes.

- Can I add a Bluetooth wireless connection while the FaroArm driver is already running?

No, the FaroArm driver must be unloaded before changing any FARO Wireless settings.

- Why does it take longer for my measuring software to open when I use the FARO Wireless connection?

The FaroArm driver requires more time to initialize when using a FARO Wireless connection and this translates into slightly increased load times for the measuring software.

- Why does it take longer for the PROBES dialog box to go away when I am using a FARO Wireless connection.

Probe data saves in the Edge and requires more time for this information to transfer when using the FARO Wireless connection.

- What happens if I go out of range and lose my connection? What happens if I turn off the Edge while it is connected using the FARO Wireless connection?

Once the FaroArm driver detects that the Edge is no longer connected, after about 10 seconds, a message appears asking if you want to restore the FARO Wireless connection. If you click No, the connection stops. If you click Yes, attempts are made to restore the connection.

- Why do I continue to see the message asking if I want to continue to use the FARO Wireless connection?

Either the Edge has lost power, or it is out of the 30 feet or 10 meters wireless range. After correcting the problem, click Yes to restore the connection.

- Can I use all of the communication options at the same time?

You can use multiple communication protocols with the following limitations:

- USB, Ethernet, and Bluetooth are active at the same time, WLAN is disabled
- USB and WLAN are active at the same time, Bluetooth is disabled.

- WLAN is disabled if Ethernet is active
- WLAN is disabled if Bluetooth is active

FARO i-Probe FAQ

- Can I use an i-Probe on anything other than the Edge?

Yes. *ONLY* on a FaroArm Quantum. Installing the i-Probe to anything other than a FaroArm Quantum damages the i-Probe.

- Can I still use my old probes on the Edge?

Yes. However you must clear the USE I-PROBE check box in the PROBE dialog box. *For more information, see “Probes” on page 178.*

- I have an i-Probe attached but see this error dialog box and can not measure. What is wrong?



Compensate the i-Probe. *For more information, see “Compensate Probe” on page 181.*

- I have an i-Probe attached but see this error dialog box and can not measure. What is wrong?



Ensure that the i-Probe is threaded on all the way. If the system still does not recognize it, the i-Probe may be damaged and may need to be replaced.

- I have an old probe attached but see this error dialog box and can not measure. What is wrong?



You must clear the USE I-PROBE check box in the PROBE dialog box. *For more information, see “Probes” on page 178.*

- How many i-Probes can the Edge remember?

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Edge Performance Verification Checklist

If you are experiencing accuracy or repeatability problems with your Edge or FARO ScanArm system, this section details proper setup techniques to help you identify the potential sources of error.

It is important to clearly understand all the “do’s and don’ts” in order to get the most out of every Edge and ScanArm.

NOTE: The following checklist uses the Edge software on the fold-down touch screen controller. Some of this checklist can be completed using the FaroArm driver.

Issues That Will Degrade Accuracy

Mounting

- Deflection in mounting:
 - Do not mount to any type of wooden surface.
 - Do not mount to optical tables such as a “Vibraplane.” The steel sheet on the top of these tables is thin and will deflect.
- Folding tripods without using the stabilizing struts are unstable.
- Heavy-duty stands with wheels down and pins up are unstable.
- Part deformation due to excessive clamping force.

Compensation

- Deflection of compensation artifact.

FARO Laser Line Probe:

- Damage to compensation artifact.
 - Do not drag the probe over the FARO Compensation Plate during the plane measurement. Lift the probe in between points to avoid scratching the surface of the plate.
- Poor probe compensation technique.
 - Do not do short sweeps with the FARO Laser Line Probe during compensation.
- Dirty lens.
 - Clean the top and bottom lenses with the cloth from the FARO Laser Line Probe Case. Dirt and grease on either lens can cause poor results.

Probes

- Measuring with Point Probes.
- Measuring with chipped, loose or cracked ball probes.
- Measuring with probe extensions. The extensions will deflect.

Measurement Environment

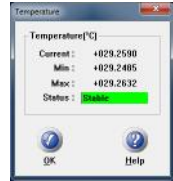
- Measuring close to an end stop can induce unwanted stress.
- Binding or hyper-extending the Edge can cause unnecessary stress.
- “Leap Frogging” or repositioning the device using the Move Device Position command.
- Excessive vibration in the surrounding area can produce unwanted results.
- Rapid changes in ambient temperature can cause errors in the Edge's automatic temperature compensation.
- Measuring using poor techniques; minimum number of measured points per feature, moving while recording individual points, small coverage area, etc.

NOTE: If the Edge is mounted on granite, do not measure objects that are not mounted to the granite.

Edge Setup

- ☐ Turn equipment on and allow to warm-up for at least 30 minutes. For optimum performance, FARO recommends you allow the equipment to warm-up for 60 minutes.
- ☐ Check that ambient temperature is not fluctuating more than 3°C (5.4°F) over a five minute period.
 - On the Fold-Down Touch Screen Controller:
 - Touch the DIAGNOSTICS button.

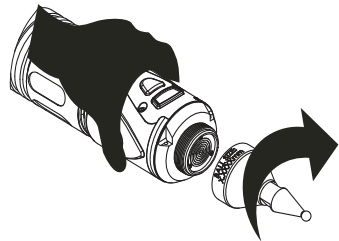
- Touch the TEMPERATURE button.
- Touch the STABILITY button.
- *For more information, see “Stability” on page 157.*
- In CAM2 Measure, run the DEVICES >TEMPERATURE command and monitor the temperature in the TEMPERATURE dialog box.
- In CAM2 Q, run the DEVICES >DEVICE CONTROL PANEL command and click the TEMPERATURE button.
- *For more information, see “Temperature” on page 190.*



☐ Do not calibrate probes during warm-up time.

Probe Setup

- ☐ Check probe seating.
- ☐ Install by hand.
- ☐ Use the 12mm wrench to hand-tighten the probe, or the FARO Probe Torque Wrench to tighten the i-Probe.
- ☐ Verify that the probe has no chips or cracks, is not loose, and that it has no flat spots.



Probe Compensation

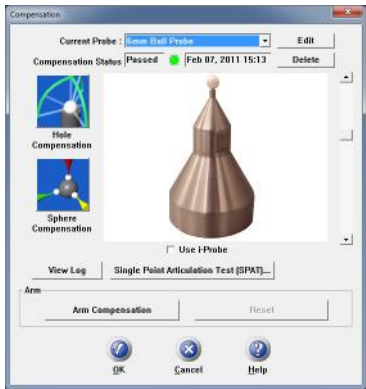
- ☐ Place the compensation cone approximately $\frac{2}{3}$ of the Edge's reach away from its base.
- ☐ Perform the probe compensation at least 3 times. *For more information, see “Hole Compensation Method” on page 185.*



- ❑ Look in the probe compensation log and compare the X, Y and Z values. Each value should repeat to within the accuracy of the device.

Compensation Log										
Name	X	Y	Z	2 Sigma	Max Error	Date	Serial Number	Method	Points	Guid...
6mm Ball Probe	-0.0024...	-0.0018...	9.4933...	0.0014...	0.00176...	Feb 21, 2011 13:16	E09-05-11-08727	Hole	277	OK
6mm Ball Probe	-0.0022...	-0.0014...	9.4915...	0.0010...	0.00135...	Feb 21, 2011 13:11	E09-05-11-08727	Hole	505	OK

NOTE: If one person is able to repeat better than another person, review probe compensation procedure. A “green light” does not guarantee a good probe compensation. It simply indicates that the data collected was within specification.

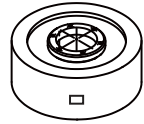


Mounting

Most accuracy and repeatability problems can be attributed to improper mounting of the Edge. These issues are not always obvious. An apparently stable mount can actually be moving more than the accuracy of the device, directly impacting results and causing system performance degradation.

- ❑ If using a magnetic mount, check that mating surfaces are clean and free of debris.

NOTE: Small metal shavings can cause the magnetic mount to rock back and forth. The magnet will naturally attract these shavings.



Base Deflection

- 1 Open the Fold-Down Touch Screen Controller. Touch DIAGNOSTICS < MOUNT < BASE DEFLECTION.
- 2 Set up the FARO compensation cone, or a hole on your part, approximately $\frac{2}{3}$ of the Edge's reach away from its base.
- 3 Place a properly compensated probe firmly in the cone. The probe *must* be well-seated in the hole.
- 4 Press the GREEN button and move the tubes and joints of the Edge while keeping the probe firmly seated in the cone.
 - Press the GREEN button to reset the screen at any time.
- 5 Press the RED button to stop.
- 6 Any deflection of the base is recorded and displayed on the screen. All of the points must be within the circle on the graph.



Tilt

- 1 Touch DIAGNOSTICS < MOUNT < TILT.

- 2 Hold the handle in the air approximately $\frac{2}{3}$ of the Edge's reach away from its base.
- 3 Move the tubes and joints of the Edge.

- Any tilt of the base is recorded and displayed on the screen. All of the points must be within the circle on the graph.
- Press the RESET button to clear the screen.



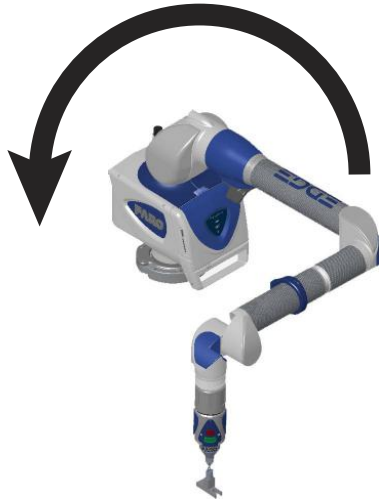
NOTE: If the Base Deflection test fails and the Tile test passes, check the stability of your part.

Single Point Articulation Test (SPAT)

Mounting should always be tested prior to a SPAT test. The SPAT test checks the repeatability of the Edge's X, Y and Z coordinates throughout its range of motion.

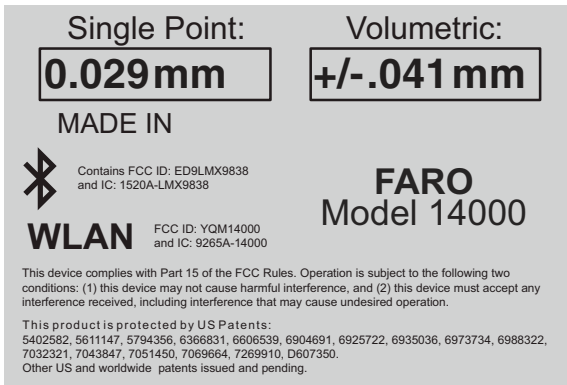
- ☐ Set up the FARO compensation cone, or a hole on your part, approximately $\frac{2}{3}$ of the Edge's reach away from its base.
- ☐ In CAM2 software, start the SPAT routine from the DIAGNOSTICS dialog box.
 - In CAM2 Measure, run the DEVICES > DIAGNOSTICS command and click the SINGLE POINT ARTICULATION TEST (SPAT) button in the DIAGNOSTICS dialog box.
 - In CAM2 Q, run the DEVICES > DEVICE CONTROL PANEL command, click the DIAGNOSTICS button in the FARO DEVICE CONTROL PANEL. Then click the SINGLE POINT ARTICULATION TEST (SPAT) button in the DIAGNOSTICS dialog box.
 - *For more information, see “Diagnostics” on page 190.*
- ☐ Place and hold the calibrated probe in the compensation cone or any conical socket.

- ❑ Start with the elbow of the Edge to one side and press the FRONT button.
- ❑ Slowly sweep the elbow so that it ends up on the opposite side. **NOTE:** Measurements automatically record as the elbow moves.
 - In the dialog box, watch the status bar. Sweep the elbow all the way to the opposite side.



- ❑ The SPAT automatically completes. The set of measurements from each sweep are compared for repeatability. If the sets are not repeatable, you must repeat the test.

NOTE: The Edge movement should feel fluid. Be careful not to stress the Edge while taking these points or get too close to an end stop since stresses can be amplified near end stops.
- ❑ Note the deviations in X, Y, and Z. The (Max-Min)/2, or Single Point repeatability value, of each coordinate should be lower than the value printed on the Edge.



- ❑ Click the YES button to generate a detailed report of the test, or the NO button to end the test.

If not using CAM2, simply export your list of points to Microsoft Excel and calculate (Max.- Min.)/2 for each coordinate.

User Compensation

If the SPAT results are higher than the SINGLE POINT value printed on your arm, you can run the ARM COMPENSATION command in the COMPENSATION dialog box.

- Click the ARM COMPENSATION BUTTON and follow the same measuring steps as the SPAT, see steps above.
- Look at the before and after results. Click the YES button to generate and save a detailed report of the test to a comma-separated values text file (*.csv file), or the NO button to save the new arm compensation.
- Repeat the SPAT with the compensation cone or conical socket in a different location. This will verify the new arm compensation.

The new arm compensation will remain in your Edge until changed or reset. Click the RESET button to restore the FARO Factory compensation.

Calibrated Artifact

Measure an artifact of certified dimensions (i.e.: ring gage or gage block).

- ☐ Ring Gage should be measured as a cylinder.
- ☐ Gage Block should be measured plane-to-plane, or point-to-plane (surface point).

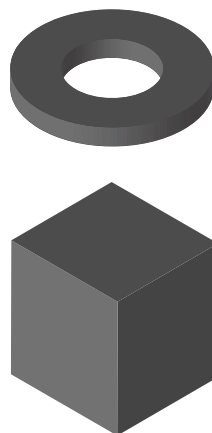
NOTE: The dimension of calibrated artifacts is usually specified at a temperature of 20°C (68°F). If the current temperature is different, use the Material Temperature Compensation function in CAM2, or the following formula:

Actual Length = Specified Length*(1 + CTE*(Current centigrade temperature - 20°C)), where CTE is the Coefficient of Thermal Expansion of the material in ppm/°C.

EXAMPLE: A 150mm ring gage measured at 25°C made of Steel 1020 will be:
 $150\text{mm} * (1 + 11.7\text{e-}6/\text{C}*(25^\circ\text{C} - 20^\circ\text{C})) = 150.00585\text{ mm}$

If additional support is required, please contact customer support. When contacting FARO's Customer Service, please provide the following information:

- 1 The serial number of the device(s).
- 2 A copy of the probe compensation log.



- 3 A copy of the event log.
- 4 A copy of the Single Point Articulating Test (SPAT).
- 5 Pictures of the setup.

Diagnosing FARO Laser Line Probe Accuracy Problems

Always diagnose the Edge prior to diagnosing the FARO Laser Line Probe. If the Edge is not mounted correctly, or the hard probe is not accurately compensated, then the FARO Laser Line Probe will produce inaccurate results.

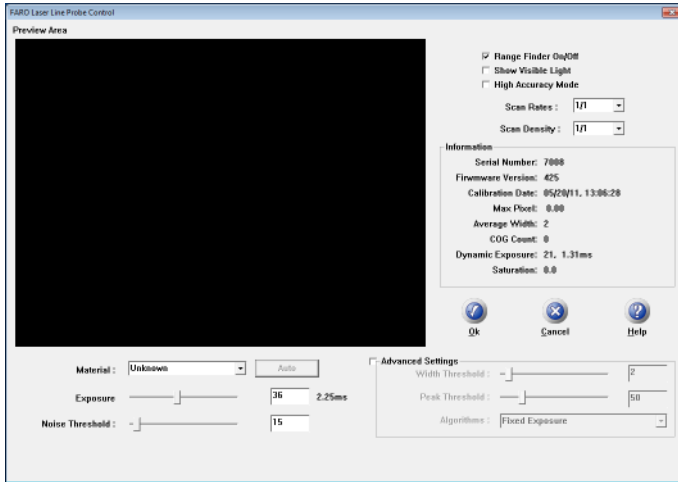
- ☐ Allow the FARO Laser Line Probe to warm-up for 30 minutes. For optimum performance, FARO recommends you allow the equipment to warm-up for 60 minutes.
- ☐ Clean the top and bottom lenses with the cloth from the FARO Laser Line Probe Case. Dirt and grease on either lens can cause poor results.
- ☐ Place the FARO Compensation Plate approximate $\frac{2}{3}$ of the Edge's reach away from its base.



NOTE: Secure the plate firmly to the table. If you are clamping at more than one location, make sure that the surface is flat so that the plate does not bend. Clamping only on one end may create a “spring board” effect.

FARO Laser Line Probe Compensation

- ❑ Ensure the Scan Rate and Scan Density are set 1/1. From the host application select “Scanner Options” or “Scanner Controls” to access the settings dialog box.



- ❑ Perform the compensation at least 3 times. See “Compensation” on page 60.

NOTE: Never grab the FARO Laser Line Probe while measuring. Simply hold the Edge's pistol grip. Holding the FARO Laser Line Probe can cause inaccuracy due to bending of its mounting bracket.

When sweeping from side to side and front to back, make sure you sweep through at least 90 degrees.

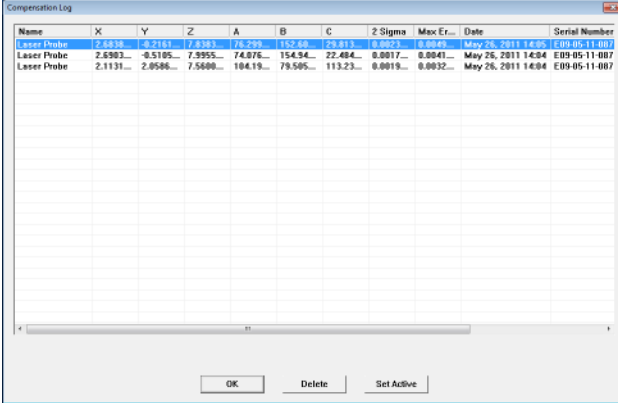
Typically, you should take about 200 scans during the compensation process.

❑ In the probe compensation log, look at the X, Y, Z values. Each value should repeat to within:

X: 100 μm (0.0039 in)

Y: 50 μm (0.0019 in)

Z: 50 μm (0.0019 in)



Name	X	Y	Z	A	B	C	2 Sigma	Max Er...	Date	Serial Number
Laser Probe	2.5903...	0.5105...	7.5500...	74.076...	154.94...	22.404...	0.0017...	0.0041...	May 26, 2011 14:24	E09-05-11-087
Laser Probe	2.1131...	2.0586...	7.5500...	104.19...	79.505...	113.23...	0.0019...	0.0032...	May 26, 2011 14:04	E09-05-11-087

If additional support is required, please contact customer support. When contacting FARO's Customer Service, please provide the following information:

- 1 The serial number of the device(s).
- 2 A copy of the probe compensation log.
- 3 A copy of the event log.
- 4 A copy of the Single Point Articulating Test (SPAT).
- 5 Pictures of the setup.

Chapter 7: Software

This chapter covers the Edge software. Open the Fold-Down Touch Screen Controller to access the MAIN menu. If it is already open when you apply power to the Edge, you will see a “FARO” screen as the system loads, and then an “Edge” screen as the software loads.

Screen Layout



Figure 7-1 Edge Screen

Across the top of the screen are:



Figure 7-2 Edge Screen Indicators

- ① **Menu: Indicator** - displays the name of the current menu screen.
- ② **Wireless Indicator** - displays any wireless interface that is currently active.
- ③ **Battery Pack Indicator** - displays the current charge level of the Edge battery pack, that it is not currently installed, or that the Edge is connected to the power supply.

Across the bottom of the screen are:



Figure 7-3 Edge Screen Indicators

- ① HOME icon - touch to return to the MAIN menu.
- ② BACK icon - touch to return to the previous menu.
- ③ COMPENSATION icon - touch to enter the COMPENSATION menu. *See “Compensation” on page 160.*
- ④ UNITS icon - touch to switch the current measurement units.

NOTE: The HOME and BACK buttons do not appear on the MAIN menu.

Other icons:

OK 

CANCEL 

Main Menu

The MAIN menu, or HOME screen, shows the six groups of commands in the Edge software. Touch a group icon to see the commands in that group.



Figure 7-4 Edge Main menu

New Part

Use this command to quickly create a new file and discard any existing measurements. This creates a new blank Macro file, and a new blank Part file. *For more information, see “Files” on page 146.*


- 1 Enter the part name. The part name is not necessary to save the new part file, you can enter a part name after measuring using the SAVE PART command. *See “Save Parts” on page 148.*
- 2 Enter the part serial number. The serial number is not necessary to save the new part file, you can enter a serial number after measuring using the SAVE PART command. *See “Save Parts” on page 148.*
- 3 Touch OK.

Construct

Use the commands in the CONSTRUCT menu to create a Part Setup (coordinate system), Lengths, Angles, and Features using existing features in your file.



Figure 7-5 Edge Construct menu

NOTE: You can also directly measure features in these commands by touching the MEASURE NOW  icon next to the drop-down field.

Part Setup

Use the commands in the PART SETUP menu to create a coordinate system and align to your part. All coordinate systems solve using the Right-Hand Rule.

Right-Hand Rule

Cartesian coordinates describe the position of points in space relative to three mutually perpendicular axes X, Y, & Z. The intersection of these axes form the origin, or zero of the system.

Each axis emanates from the origin according to the Right-Hand rule. The Right-Hand rule defines the positive direction of each axis, such that when the hand is positioned according to the figure below, the + Z points along the thumb, the + X axis points along the index finger, and the + Y axis points along the middle finger.

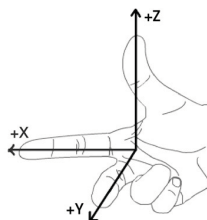


Figure 7-6 Right-Hand Rule

Plane Line Line

From the MAIN menu, touch CONSTRUCT > PART SETUP > PLANE LINE LINE. Use this command to create a coordinate system on your part.

The plane defines the XY plane, the first line defines the X-Axis, and the intersection of the first and second lines defines the origin of the coordinate system.

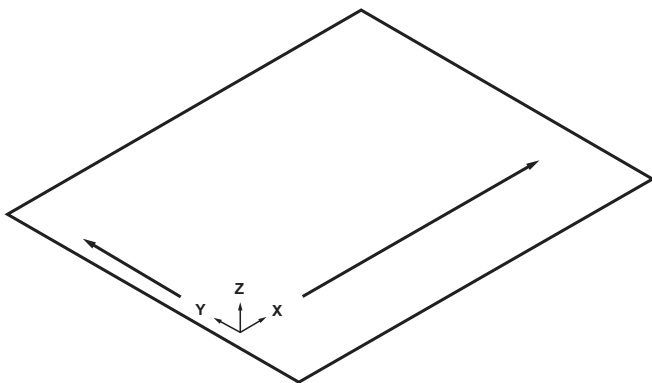





Figure 7-7 Plane Line Line part setup

- 1** Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the plane:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 2** Choose an existing line in the LINE drop-down list or touch the MEASURE NOW  icon to measure the first line:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least two points for a line. The first two points define the direction of the line. Hold the RED button to remove any unwanted readings.
 - Pull away from the edge, and press the RED button to define probe compensation and complete the measurement.
 - Look at the line results. Press the GREEN button to accept, or the RED button to reject and remeasure.

3 Choose an existing line in the **LINE** drop-down list or touch the **MEASURE NOW**  icon to measure the second line:

- Place the ball probe on the part and digitize points by pressing the **GREEN** button. You must digitize at least two points for a line. The first two points define the direction of the line. Hold the **RED** button to remove any unwanted readings.
- Pull away from the edge, and press the **RED** button to define probe compensation and complete the measurement.
- Look at the line results. Press the **GREEN** button to accept, or the **RED** button to reject and remeasure.

The coordinate system solves and then you will see the live XYZ readout to check the origin and the direction of each axis.

NOTE: The values are shown from the probe center and are not compensated for the probe radius.

4 Press the **GREEN** button to accept the coordinate system, or press the **RED** button to reject and remeasure all the features. If you reject the part setup, the three features remain in the file. Delete any unwanted features using the **REVIEW FEATURES** command. See “*Review Features*” on page 143.

See measuring “Plane” on page 138, and “Line” on page 137.

Plane Plane Plane

From the MAIN menu, touch CONSTRUCT > PART SETUP > PLANE PLANE PLANE. Use this command to create a coordinate system on your part.

The plane defines the XY plane, the intersection of the first and second planes defines the X-Axis, and the intersection of all three planes defines the origin of the coordinate system.

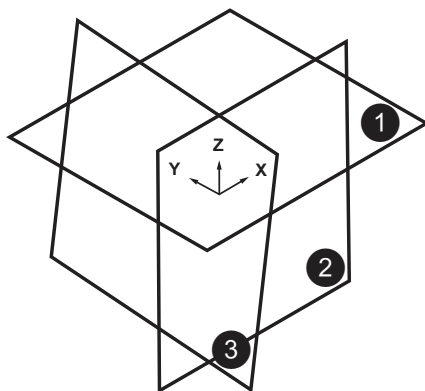





Figure 7-8 Plane Plane Plane part setup

- 1** Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the first plane:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 2** Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the second plane:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.

- 3 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the third plane:
- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.

The coordinate system solves and then you will see the live XYZ readout to check the origin and the direction of each axis.

NOTE: The values are shown from the probe center and are not compensated for the probe radius.

- 4 Press the GREEN button to accept the coordinate system, or press the RED button to reject and remeasure all the features. If you reject the part setup, the three features remain in the file. Delete any unwanted features using the REVIEW FEATURES command. See “Review Features” on page 143.

See measuring “Plane” on page 138.

Plane Line Circle

From the MAIN menu, touch CONSTRUCT > PART SETUP > PLANE LINE CIRCLE. Use this command to create a coordinate system on your part.

The plane defines the XY plane, the first line defines the X-Axis, and the center point of the circle defines the origin of the coordinate system.

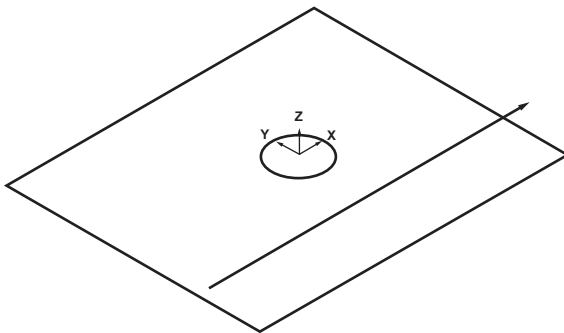





Figure 7-9 Plane Line Circle part setup

- 1 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the plane:

- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
- Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
- Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.

2 Choose an existing line in the LINE drop-down list or touch the MEASURE NOW  icon to measure the line:

- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least two points for a line. The first two points define the direction of the line. Hold the RED button to remove any unwanted readings.
- Pull away from the edge, and press the RED button to define probe compensation and complete the measurement.
- Look at the line results. Press the GREEN button to accept, or the RED button to reject and remeasure.

3 Choose an existing circle in the CIRCLE drop-down list or touch the MEASURE NOW  icon to measure the circle:

- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a circle. Hold the RED button to remove any unwanted readings.
- Pull away from the hole, or post, and press the RED button to define probe compensation and complete the measurement.
- Look at the circle results. Press the GREEN button to accept, or the RED button to reject and remeasure.

The coordinate system solves and then you will see the live XYZ readout to check the origin and the direction of each axis.

NOTE: The values are shown from the probe center and are not compensated for the probe radius.

4 Press the GREEN button to accept the coordinate system, or press the RED button to reject and remeasure all the features. If you reject the part setup, the three features remain in the file. Delete any unwanted features using the REVIEW FEATURES command. *See “Review Features” on page 143.*

See measuring “Plane” on page 138, “Line” on page 137, and “Circle” on page 134.

Plane Circle Circle

From the MAIN menu, touch CONSTRUCT > PART SETUP > PLANE CIRCLE CIRCLE. Use this command to create a coordinate system on your part.

The plane defines the XY plane, the line from the first circle to the second circle defines the X-Axis, and the center point of the first circle defines the origin of the coordinate system.

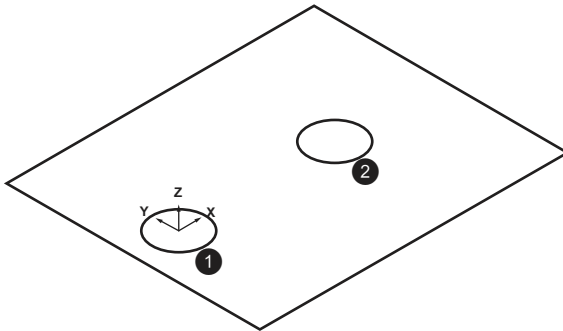





Figure 7-10 Plane Circle Circle part setup

- 1** Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the plane:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 2** Choose an existing circle in the CIRCLE drop-down list or touch the MEASURE NOW  icon to measure the first circle:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a circle. Hold the RED button to remove any unwanted readings.
 - Pull away from the hole, or post, and press the RED button to define probe compensation and complete the measurement.
 - Look at the circle results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 3** Choose an existing circle in the CIRCLE drop-down list or touch the MEASURE NOW  icon to measure the second circle:

- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a circle. Hold the RED button to remove any unwanted readings.
- Pull away from the hole, or post, and press the RED button to define probe compensation and complete the measurement.
- Look at the circle results. Press the GREEN button to accept, or the RED button to reject and remeasure.

The coordinate system solves and then you will see the live XYZ readout to check the origin and the direction of each axis.

NOTE: The values are shown from the probe center and are not compensated for the probe radius.

- 4 Press the GREEN button to accept the coordinate system, or press the RED button to reject and remeasure all the features. If you reject the part setup, the three features remain in the file. Delete any unwanted features using the REVIEW FEATURES command. See “Review Features” on page 143.

See measuring “Plane” on page 138, and “Circle” on page 134.

Plane Line Cylinder

From the MAIN menu, touch CONSTRUCT > PART SETUP > PLANE LINE CYLINDER. Use this command to create a coordinate system on your part.

The plane defines the XY plane, the line defines the X-Axis, and the intersection of the cylinder and the plane defines the origin of the coordinate system.

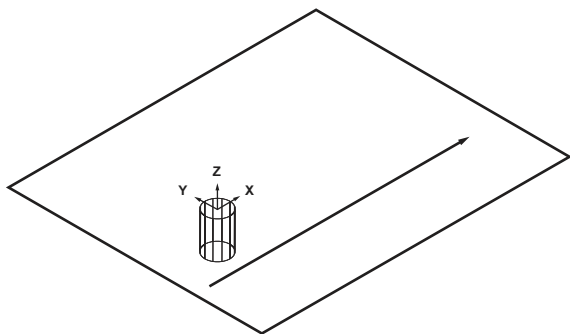





Figure 7-11 Plane Cylinder Line part setup

- 1 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the plane:
- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.

- Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 2** Choose an existing line in the LINE drop-down list or touch the MEASURE NOW  icon to measure the line:
- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least two points for a line. The first two points define the direction of the line. Hold the RED button to remove any unwanted readings.
 - Pull away from the edge, and press the RED button to define probe compensation and complete the measurement.
 - Look at the line results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 3** Choose an existing cylinder in the CYLINDER drop-down list or touch the MEASURE NOW  icon to measure the cylinder:
- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least six points for a cylinder. Hold the RED button to remove any unwanted points.
 - Pull away from the hole, or post, and press the RED button to define probe compensation and complete the measurement.
 - Look at the circle results. Press the GREEN button to accept, or the RED button to reject and remeasure.

The coordinate system solves and then you will see the live XYZ readout to check the origin and the direction of each axis.

NOTE: The values are shown from the probe center and are not compensated for the probe radius.

- 4** Press the GREEN button to accept the coordinate system, or press the RED button to reject and remeasure all the features. If you reject the part setup, the three features remain in the file. Delete any unwanted features using the REVIEW FEATURES command. See “Review Features” on page 143.

See measuring “Plane” on page 138, “Line” on page 137, and “Cylinder” on page 136.

Cylinder Cylinder Plane

From the MAIN menu, touch CONSTRUCT > PART SETUP > CYLINDER CYLINDER PLANE. Use this command to create a coordinate system on your part.

The cylinder defines the XY plane, the first cylinder defines the X-Axis, and the intersection of the first cylinder and the plane defines the origin of the coordinate system.

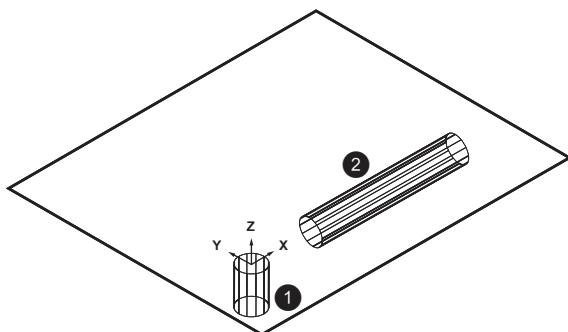





Figure 7-12 Plane Line Line part setup

- 1 Choose an existing cylinder in the CYLINDER drop-down list or touch the MEASURE NOW  icon to measure the first cylinder:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least six points for a cylinder. Hold the RED button to remove any unwanted points.
 - Pull away from the hole, or post, and press the RED button to define probe compensation and complete the measurement.
 - Look at the circle results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 2 Choose an existing cylinder in the CYLINDER drop-down list or touch the MEASURE NOW  icon to measure the second cylinder:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least six points for a cylinder. Hold the RED button to remove any unwanted points.
 - Pull away from the hole, or post, and press the RED button to define probe compensation and complete the measurement.
 - Look at the circle results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 3 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the plane:

- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
- Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
- Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.

The coordinate system solves and then you will see the live XYZ readout to check the origin and the direction of each axis.

NOTE: The values are shown from the probe center and are not compensated for the probe radius.

- 4 Press the GREEN button to accept the coordinate system, or press the RED button to reject and remeasure all the features. If you reject the part setup, the three features remain in the file. Delete any unwanted features using the REVIEW FEATURES command. *See “Review Features” on page 143.*



See measuring “Cylinder” on page 136, and “Plane” on page 138.


Lengths

The LENGTHS commands are length, or distance, measurements that are automatically calculated after measuring simple features.

Point to Point

From the MAIN menu, touch CONSTRUCT > LENGTHS > POINT TO POINT. Use this command to measure a length between two points on your part.



- 1 Choose an existing point in the POINT drop-down list or touch the MEASURE NOW  icon to measure the first point:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least one point. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the point results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 2 Choose an existing point in the POINT drop-down list or touch the MEASURE NOW  icon to measure the second point:


- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least one point. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the point results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 3** The length solves; look at the length results. Press the GREEN button to accept the length, or press the RED button to reject and remeasure. If you reject the length, the two features remain in the file. Delete any unwanted features using the REVIEW FEATURES command. *See “Review Features” on page 143.*
- 4** Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

See measuring “Point” on page 139.

Point to Plane



From the MAIN menu, touch CONSTRUCT > LENGTHS > POINT TO PLANE. Use this command to measure a length between a point and a plane on your part.


- 1** Choose an existing point in the POINT drop-down list or touch the MEASURE NOW  icon to measure the point:
- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least one point. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the point results. Press the GREEN button to accept the length, or the RED button to reject and remeasure.
- 2** Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the plane:
- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.

- 3 The length solves; look at the length results. Press the GREEN button to accept, or press the RED button to reject and remeasure. If you reject the length, the two features remain in the file. Delete any unwanted features using the REVIEW FEATURES command. *See “Review Features” on page 143.*
- 4 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*
- See measuring “Plane” on page 138, and “Point” on page 139.*

Point to Line

From the MAIN menu, touch CONSTRUCT > LENGTHS > POINT TO LINE. Use this command to measure a length between a point and a line on your part.




- 1 Choose an existing point in the POINT drop-down list or touch the MEASURE NOW  icon to measure the point:
- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least one point. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the point results. Press the GREEN button to accept the length, or the RED button to reject and remeasure.
- 2 Choose an existing line in the LINE drop-down list or touch the MEASURE NOW  icon to measure the plane:
- ACTIVE PLANE - the last measured plane feature. Touch the plane to choose another plane or NEW... to measure a plane. If none exist in the file, you must measure a plane. *See “Plane” on page 138.*
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least two points for a line. The first two points define the direction of the line. Hold the RED button to remove any unwanted points.
 - Pull away from the edge, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 3 The length solves; look at the length results. Press the GREEN button to accept, or press the RED button to reject and remeasure. If you reject the length, the two features remain in the file. Delete any unwanted features using the REVIEW FEATURES command. *See “Review Features” on page 143.*

- 4 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

See measuring “Point” on page 139, and “Point” on page 139.




Plane to Plane

From the MAIN menu, touch CONSTRUCT > LENGTHS > POINT TO PLANE. Use this command to measure a length two planes on your part.

- 1 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the plane:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
 - 2 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the second plane:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
 - 3 The length solves; look at the length results. Press the GREEN button to accept the length, or press the RED button to reject and remeasure. If you reject the length, the two features remain in the file. Delete any unwanted features using the REVIEW FEATURES command. *See “Review Features” on page 143.*
 - 4 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*
- See measuring “Plane” on page 138.*

Circle to Circle




From the MAIN menu, touch CONSTRUCT > LENGTHS > CIRCLE TO CIRCLE. Use this command to measure a length between two circles on your part.

- 1 Choose an existing circle in the CIRCLE drop-down list or touch the MEASURE NOW  icon to measure the first circle:
 - ACTIVE PLANE - the last measured plane feature. Touch the plane to choose another plane or NEW... to measure a plane. If none exist in the file, you must measure a plane. *See “Plane” on page 138.*
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a circle. Hold the RED button to remove any unwanted readings.
 - Pull away from the hole, or post, and press the RED button to define probe compensation and complete the measurement.
 - Look at the circle results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 2 Choose an existing circle in the CIRCLE drop-down list or touch the MEASURE NOW  icon to measure the second circle:
 - ACTIVE PLANE - the last measured plane feature. Touch the plane to choose another plane or NEW... to measure a plane. If none exist in the file, you must measure a plane. *See “Plane” on page 138.*
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a circle. Hold the RED button to remove any unwanted readings.
 - Pull away from the hole, or post, and press the RED button to define probe compensation and complete the measurement.
 - Look at the circle results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 3 The length solves; look at the length results. Press the GREEN button to accept the length, or press the RED button to reject and remeasure. If you reject the length, the two features remain in the file. Delete any unwanted features using the REVIEW FEATURES command. *See “Review Features” on page 143.*
- 4 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

See measuring “Circle” on page 134.

Sphere to Sphere

From the MAIN menu, touch CONSTRUCT > LENGTHS > SPHERE TO SPHERE. Use this command to measure a length between two spheres on your part.

- 1** Choose an existing sphere in the SPHERE drop-down list or touch the MEASURE NOW  icon to measure the first sphere:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least four points for a sphere. Hold the RED button to remove any unwanted points.
 - Pull away from the surface, and press the RED button to define probe compensation and complete the measurement.
 - Look at the sphere results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 2** Choose an existing sphere in the SPHERE drop-down list or touch the MEASURE NOW  icon to measure the second sphere:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least four points for a sphere. Hold the RED button to remove any unwanted points.
 - Pull away from the surface, and press the RED button to define probe compensation and complete the measurement.
 - Look at the sphere results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 3** The length solves; look at the length results. Press the GREEN button to accept the length, or press the RED button to reject and remeasure. If you reject the length, the two features remain in the file. Delete any unwanted features using the REVIEW FEATURES command. *See “Review Features” on page 143.*
- 4** Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*




See measuring “Sphere” on page 140.

Angles

The ANGLES commands are angle measurements that are automatically calculated after measuring simple features.

Plane to Plane




From the MAIN menu, touch CONSTRUCT > ANGLES > PLANE TO PLANE. Use this command to measure an angle between two planes on your part.

- 1 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the first plane:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 2 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the second plane:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 3 The angle solves; look at the angle results. Press the GREEN button to accept the angle, or press the RED button to reject and remeasure. If you reject the angle, the two features remain in the file. Delete any unwanted features using the REVIEW FEATURES command. *See “Review Features” on page 143.*
- 4 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

See measuring “Plane” on page 138.

Plane to Cylinder




From the MAIN menu, touch CONSTRUCT > ANGLES > PLANE TO CYLINDER. Use this command to measure an angle between a plane and a cylinder on your part.

- 1** Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the first plane:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 2** Choose an existing cylinder in the CYLINDER drop-down list or touch the MEASURE NOW  icon to measure the cylinder:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least six points for a cylinder. Hold the RED button to remove any unwanted points.
 - Pull away from the hole, or post, and press the RED button to define probe compensation and complete the measurement.
 - Look at the cylinder results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 3** The angle solves; look at the angle results. Press the GREEN button to accept the angle, or press the RED button to reject and remeasure. If you reject the angle, the two features remain in the file. Delete any unwanted features using the REVIEW FEATURES command. *See “Review Features” on page 143.*
- 4** Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

See measuring “Plane” on page 138, and “Cylinder” on page 136.

Line to Line




From the MAIN menu, touch CONSTRUCT > ANGLES > LINE TO LINE. Use this command to measure an angle between two lines on your part.

- 1 Choose an existing line in the LINE drop-down list or touch the MEASURE NOW  icon to measure the plane:
 - ACTIVE PLANE - the last measured plane feature. Touch the plane to choose another plane or NEW... to measure a plane. If none exist in the file, you must measure a plane. *See “Plane” on page 138.*
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least two points for a line. The first two points define the direction of the line. Hold the RED button to remove any unwanted points.
 - Pull away from the edge, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 2 Choose an existing line in the LINE drop-down list or touch the MEASURE NOW  icon to measure the plane:
 - ACTIVE PLANE - the last measured plane feature. Touch the plane to choose another plane or NEW... to measure a plane. If none exist in the file, you must measure a plane. *See “Plane” on page 138.*
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least two points for a line. The first two points define the direction of the line. Hold the RED button to remove any unwanted points.
 - Pull away from the edge, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 3 The angle solves; look at the angle results. Press the GREEN button to accept the angle, or press the RED button to reject and remeasure. If you reject the angle, the two features remain in the file. Delete any unwanted features using the REVIEW FEATURES command. *See “Review Features” on page 143.*
- 4 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

See measuring “Line” on page 137.

Apex

From the MAIN menu, touch CONSTRUCT > ANGLES > APEX. Use this command to measure an angle between two circles using a third as an apex point on your part.

- 1** Choose an existing circle in the CIRCLE drop-down list or touch the MEASURE NOW  icon to measure the first circle:
 - ACTIVE PLANE - the last measured plane feature. Touch the plane to choose another plane or NEW... to measure a plane. If none exist in the file, you must measure a plane. *See “Plane” on page 138.*
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a circle. Hold the RED button to remove any unwanted readings.
 - Pull away from the hole, or post, and press the RED button to define probe compensation and complete the measurement.
 - Look at the circle results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 2** Choose an existing circle in the CIRCLE drop-down list or touch the MEASURE NOW  icon to measure the second circle:
 - ACTIVE PLANE - the last measured plane feature. Touch the plane to choose another plane or NEW... to measure a plane. If none exist in the file, you must measure a plane. *See “Plane” on page 138.*
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a circle. Hold the RED button to remove any unwanted readings.
 - Pull away from the hole, or post, and press the RED button to define probe compensation and complete the measurement.
 - Look at the circle results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 3** Choose an existing circle in the CIRCLE drop-down list or touch the MEASURE NOW  icon to measure the apex circle:
 - ACTIVE PLANE - the last measured plane feature. Touch the plane to choose another plane or NEW... to measure a plane. If none exist in the file, you must measure a plane. *See “Plane” on page 138.*
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a circle. Hold the RED button to remove any unwanted readings.
 - Pull away from the hole, or post, and press the RED button to define probe compensation and complete the measurement.

- Look at the circle results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 4 The angle solves; look at the angle results. Press the GREEN button to accept the angle, or press the RED button to reject and remeasure. If you reject the angle, the three features remain in the file. Delete any unwanted features using the REVIEW FEATURES command. See “Review Features” on page 143.
- 5 Touch the LABEL field to change the feature name. Touch the NOMINALS \pm icon to enter nominal values. See “Nominals” on page 143.

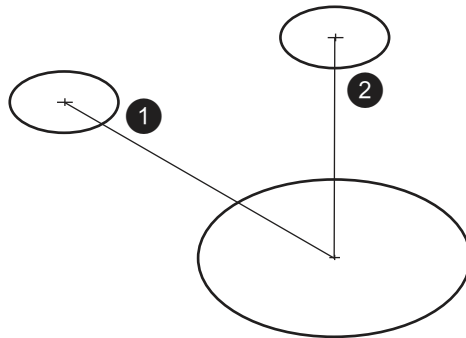


Figure 7-13 Apex Angle


See measuring “Circle” on page 134.

Features

The FEATURES commands are feature constructions that use existing features in your file. Some of these commands create an exact feature and others create a feature that is best-fit from a selection of existing features.


Circle: Best Fit

From the MAIN menu, touch CONSTRUCT > FEATURES > CIRCLE > BEST FIT. Use this command to construct a best fit circle using a plane and a minimum of three point-reducible features.

- 1 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the plane:
- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.

- Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 2 Choose a minimum of three point-reducible features. Choose a selected feature to remove it from the selection group.

3 Touch OK

- 4 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

See measuring “Plane” on page 138 and “Best Fit Circle” on page 166.


Line: Best Fit

From the MAIN menu, touch CONSTRUCT > FEATURES > LINE > BEST FIT. Use this command to construct a:

- 2D best fit line using a plane and a minimum of two point-reducible features.

OR

- 3D best fit line using a minimum of two point-reducible features.


- 1 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the plane:

- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
- Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
- Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.

NOTE: Touch the CHECKMARK button to prevent the points from projecting to the plane before the best-fit calculation.

- 2 Choose a minimum of two point-reducible features. Choose a selected feature to remove it from the selection group.


3 Touch OK

- 4 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*


See measuring “Line” on page 137 and “Best Fit Line” on page 167.

Line: Project to Plane

From the MAIN menu, touch CONSTRUCT > FEATURES > LINE > PROJECT TO PLANE. Use this command to construct a projected line using a plane and a line.


1 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the plane:

- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
- Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
- Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.

2 Choose an existing line in the LINE drop-down list or touch the MEASURE NOW  icon to measure the plane:

- ACTIVE PLANE - the last measured plane feature. Touch the plane to choose another plane or NEW... to measure a plane. If none exist in the file, you must measure a plane. *See “Plane” on page 138.*
- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least two points for a line. The first two points define the direction of the line. Hold the RED button to remove any unwanted points.
- Pull away from the edge, and press the RED button to define probe compensation and complete the measurement.
- Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.


3 Touch OK

4 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*


See measuring “Plane” on page 138, and “Line” on page 137.

Line: From 2 Planes

From the MAIN menu, touch CONSTRUCT > FEATURES > LINE > FROM 2 PLANES. Use this command to construct a line from the intersection of two planes.


1 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the plane:

- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
- Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
- Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.

2 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the second plane:

- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
- Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
- Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.


3 Touch OK

4 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*


See measuring “Plane” on page 138.

Line: Parallel

From the MAIN menu, touch CONSTRUCT > FEATURES > LINE > PARALLEL. Use this command to construct a parallel line through a point.

1 Choose an existing plane in the POINT drop-down list or touch the MEASURE NOW  icon to measure the point:


- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least one point. Hold the RED button to remove any unwanted points.
- Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
- Look at the point results. Press the GREEN button to accept the length, or the RED button to reject and remeasure.

2 Choose an existing line in the LINE drop-down list or touch the MEASURE NOW  icon to measure the plane:

- ACTIVE PLANE - the last measured plane feature. Touch the plane to choose another plane or NEW... to measure a plane. If none exist in the file, you must measure a plane. *See “Plane” on page 138.*

- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least two points for a line. The first two points define the direction of the line. Hold the RED button to remove any unwanted points.
- Pull away from the edge, and press the RED button to define probe compensation and complete the measurement.
- Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.

3 Touch OK


- 4** Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

See measuring “Point” on page 139 and “Line” on page 137.

Plane: Best Fit

From the MAIN menu, touch CONSTRUCT > FEATURES > PLANE > BEST FIT. Use this command to construct a best fit plane using a minimum of three point-reducible features.


- 1** Choose a minimum of three point-reducible features. Choose a selected feature to remove it from the selection group.
- 2** Touch OK


- 3** Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

See “Best Fit Plane” on page 167..

Plane: Parallel


From the MAIN menu, touch CONSTRUCT > FEATURES > PLANE > PARALLEL. Use this command to construct a parallel plane through a point.

- 1** Choose an existing plane in the POINT drop-down list or touch the MEASURE NOW  icon to measure the point:
- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least one point. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the point results. Press the GREEN button to accept the length, or the RED button to reject and remeasure.

2 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the plane:

- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
- Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
- Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.

3 Touch OK

4 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*


See measuring “Point” on page 139 and “Plane” on page 138.

Point: Best Fit

From the MAIN menu, touch CONSTRUCT > FEATURES > POINT > BEST FIT. Use this command to construct a best fit point using a minimum of three point-reducible features.

1 Choose a minimum of three point-reducible features. Choose a selected feature to remove it from the selection group.


2 Touch OK

3 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

See “Best Fit Point” on page 167.

Point: From 2 Lines


From the MAIN menu, touch CONSTRUCT > FEATURES > POINT > FROM 2 LINES. Use this command to construct a point from the intersection of two lines.

1 Choose an existing line in the LINE drop-down list or touch the MEASURE NOW  icon to measure the first line:

- ACTIVE PLANE - the last measured plane feature. Touch the plane to choose another plane or NEW... to measure a plane. If none exist in the file, you must measure a plane. *See “Plane” on page 138.*
- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least two points for a line. The first two points

define the direction of the line. Hold the RED button to remove any unwanted points.


- Pull away from the edge, and press the RED button to define probe compensation and complete the measurement.
- Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.

2 Choose an existing line in the LINE drop-down list or touch the MEASURE NOW  icon to measure the second line:

- ACTIVE PLANE - the last measured plane feature. Touch the plane to choose another plane or NEW... to measure a plane. If none exist in the file, you must measure a plane. *See “Plane” on page 138.*
- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least two points for a line. The first two points define the direction of the line. Hold the RED button to remove any unwanted points.
- Pull away from the edge, and press the RED button to define probe compensation and complete the measurement.
- Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.


See measuring “Line” on page 137.

3 Touch OK




4 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

Point: From 3 Planes

From the MAIN menu, touch CONSTRUCT > FEATURES > POINT > FROM 3 PLANES. Use this command to construct a point from the intersection of three planes.

1 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the first plane:


- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
- Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
- Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.



- 2 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the second plane:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 3 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the third plane:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 4 Touch OK
- 5 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

See measuring “Plane” on page 138.

Point: Line Intersect Plane

From the MAIN menu, touch CONSTRUCT > FEATURES > POINT > LINE INTERSECT PLANE. Use this command to construct a point from the intersection of a line and a plane.



- 1 Choose an existing line in the LINE drop-down list or touch the MEASURE NOW  icon to measure the first line:
 - ACTIVE PLANE - the last measured plane feature. Touch the plane to choose another plane or NEW... to measure a plane. If none exist in the file, you must measure a plane. *See “Plane” on page 138.*
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least two points for a line. The first two points define the direction of the line. Hold the RED button to remove any unwanted points.
 - Pull away from the edge, and press the RED button to define probe compensation and complete the measurement.

- Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 2** Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the plane:
- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 3** Touch OK
- 4** Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

See measuring “Plane” on page 138, and “Line” on page 137.


Point: Project to Line

From the MAIN menu, touch CONSTRUCT > FEATURES > POINT > PROJECT TO LINE. Use this command to construct a point from a point and a line.

- 1** Choose an existing plane in the POINT drop-down list or touch the MEASURE NOW  icon to measure the point:
- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least one point. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the point results. Press the GREEN button to accept the length, or the RED button to reject and remeasure.
- 2** Choose an existing line in the LINE drop-down list or touch the MEASURE NOW  icon to measure the plane:
- ACTIVE PLANE - the last measured plane feature. Touch the plane to choose another plane or NEW... to measure a plane. If none exist in the file, you must measure a plane. *See “Plane” on page 138.*
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least two points for a line. The first two points define the direction of the line. Hold the RED button to remove any unwanted points.

- Pull away from the edge, and press the RED button to define probe compensation and complete the measurement.
- Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.


3 Touch OK

- 4 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*


See measuring “Point” on page 139, and “Line” on page 137.

Point: Project to Plane

From the MAIN menu, touch CONSTRUCT > FEATURES > POINT > PROJECT TO PLANE. Use this command to construct a point from a point and a plane.


- 1 Choose an existing plane in the POINT drop-down list or touch the MEASURE NOW  icon to measure the point:

- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least one point. Hold the RED button to remove any unwanted points.
- Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
- Look at the point results. Press the GREEN button to accept the length, or the RED button to reject and remeasure.

- 2 Choose an existing plane in the PLANE drop-down list or touch the MEASURE NOW  icon to measure the plane:

- Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
- Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
- Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.

3 Touch OK

- 4 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*


See measuring “Point” on page 139, and “Plane” on page 138.

Sphere: Best Fit

From the MAIN menu, touch CONSTRUCT > FEATURES > SPHERE > BEST FIT. Use this command to construct a best fit sphere using a minimum of four point-reducible features.

1 Choose a minimum of four point-reducible features. Choose a selected feature to remove it from the selection group.

2 Touch OK

3 Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. See “Nominals” on page 143.

See “Best Fit Sphere” on page 168..

Measure

Use the commands in the MEASURE menu to measure features, lengths, and angles on your part.





Figure 7-14 Edge Measure menu

You can add nominal and tolerance values, and view the deviation values. Using the optional USB digital camera, you can add pictures with measurement targets to the each measurement feature.

Single Point or Scan Recording

There are two digitizing modes in the Edge software:

-  Single Point - Press the GREEN button to collect a single point as you touch the part with the probe.
-  Scan - Press and hold the GREEN button to collect points as you touch and move the probe across the part. Adjust the 3D distance between points in the Application Preference. See “Application” on page 151.

In the lower left corner of each measuring screen is the Single Point icon. Touch the Single Point icon to switch to Scan mode. Touch the Scan icon to switch to Single Point mode.


Features


The FEATURE commands are simple geometric features to measure with the Edge.

Circle

From the MAIN menu, touch MEASURE > FEATURES > CIRCLE. Use this command to measure round holes and posts. You must record at least three points to solve the circle.

- Choose an existing plane, or New to measure a plane. The digitized points are projected to the plane before the best-fit calculation. If no plane is available then measure a plane. *See “Plane” on page 138.*
- Measure the circle:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a circle. Hold the RED button to remove any unwanted readings.

NOTE: Touch the SCAN  icon to enable scanning. When enabled, press and hold the GREEN button to collect points as you touch and move the probe across the part. *For more information, see “Application” on page 151.*

- Pull away from the hole, or post, and press the RED button to define probe compensation and complete the measurement.
- Look at the circle results. Press the GREEN button to accept, or the RED button to reject and remeasure. Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

NOTE: If you measured a new plane in this feature command and rejected the circle results, the plane remains in the file. Delete any unwanted features using the REVIEW FEATURES command. *See “Review Features” on page 143.*

- You can continue and measure another circle, or press the RED button to cancel the command.

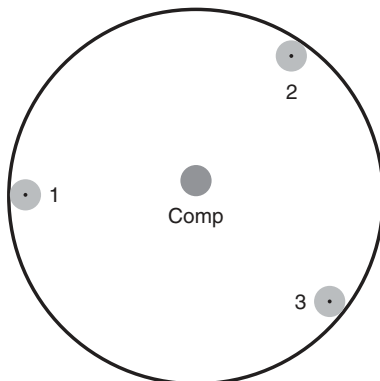




Figure 7-15 Measure Circle

See “Best Fit Circle” on page 166.

Cylinder

From the MAIN menu, touch MEASURE > FEATURES > CYLINDER. Use this command to measure deep round holes and posts. You must record at least six points to solve the cylinder.

- Measure the cylinder:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least nine points for a cylinder. Hold the RED button to remove any unwanted points.

NOTE: Touch the SCAN  icon to enable scanning. When enabled, press and hold the GREEN button to collect points as you touch and move the probe across the part. *For more information, see “Application” on page 151.*
 - Pull away from the hole, or post, and press the RED button to define probe compensation and complete the measurement.
 - Look at the cylinder results. Press the GREEN button to accept, or the RED button to reject and remeasure. Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

You can continue and measure another cylinder, or press the RED button to cancel the command.

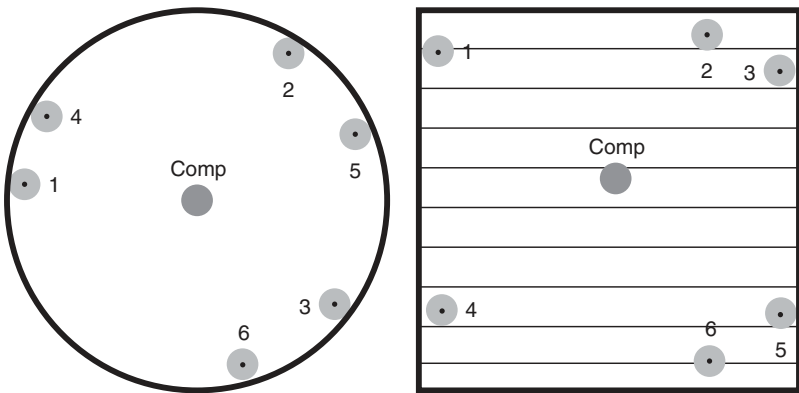



Figure 7-16 Measure Cylinder


See “Best Fit Cylinder” on page 166.

Line

From the MAIN menu, touch MEASURE > FEATURES > LINE. Use this command to measure straight edges. You must record at least two points to solve the line.

- Choose an existing plane, or New to measure a plane. The digitized points are projected to the plane before the best-fit calculation. If no plane is available then measure a plane. See “Plane” on page 138.
- Measure the line:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least two points for a line. The first two points define the direction of the line. Hold the RED button to remove any unwanted readings.

NOTE: Touch the SCAN  icon to enable scanning. When enabled, press and hold the GREEN button to collect points as you touch and move the probe across the part. For more information, see “Application” on page 151.

- Pull away from the edge, and press the RED button to define probe compensation and complete the measurement.
- Look at the line results. Press the GREEN button to accept, or the RED button to reject and remeasure. Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. See “Nominals” on page 143.

NOTE: If you measured a new plane in this feature command and rejected the line results, the plane remains in the file. Delete any unwanted features using the REVIEW FEATURES command. See “Review Features” on page 143.

You can continue and measure another line, or press the RED button to cancel the command.

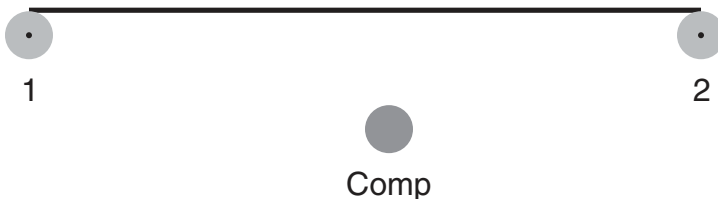




Figure 7-17 Measure Line

See “Best Fit Line” on page 167.

Plane

From the MAIN menu, touch MEASURE > FEATURES > PLANE. Use this command to measure flat faces. You must record at least three points to solve the plane.

- Measure the plane:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
NOTE: Touch the SCAN  icon to enable scanning. When enabled, press and hold the GREEN button to collect points as you touch and move the probe across the part. *For more information, see “Application” on page 151.*
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure. Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

You can continue and measure another plane, or press the RED button to cancel the command.

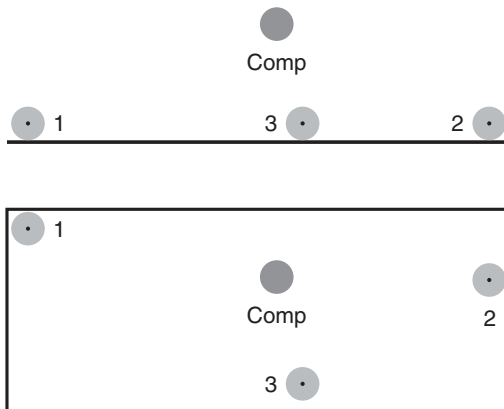



Figure 7-18 Measure Plane


See “Best Fit Plane” on page 167.

Point

From the MAIN menu, touch MEASURE > FEATURES > POINT. Use this command to measure a single point, often in a cone, or a hole that is slightly smaller than the current probe. You must record at least one point to solve the point.

- Measure the point:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least one point. Hold the RED button to remove any unwanted points.

NOTE: Touch the SCAN  icon to enable scanning. When enabled, press and hold the GREEN button to collect points as you touch and move the probe across the part. *For more information, see “Application” on page 151.*



- Pull away from the face, and press the RED button to complete the measurement.
- Look at the point results. Press the GREEN button to accept, or the RED button to reject and remeasure. Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

NOTE: The results are shown from the probe center and are not compensated for the probe radius.

You can continue and measure another point, or press the RED button to cancel the command. *See “Best Fit Point” on page 167.*

Sphere

From the MAIN menu, touch MEASURE > FEATURES > SPHERE. Use this command to measure round spheres. You must record at least four points to solve the sphere.

- Measure the sphere:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least four points for a sphere. Hold the RED button to remove any unwanted points.
NOTE: Touch the SCAN  icon to enable scanning. When enabled, press and hold the GREEN button to collect points as you touch and move the probe across the part. *For more information, see “Application” on page 151.*
 - Pull away from the surface, and press the RED button to define probe compensation and complete the measurement.
 - Look at the sphere results. Press the GREEN button to accept, or the RED button to reject and remeasure. Touch the LABEL field to change the feature name. Touch the NOMINALS  icon to enter nominal values. *See “Nominals” on page 143.*

You can continue and measure another sphere, or press the RED button to cancel the command.

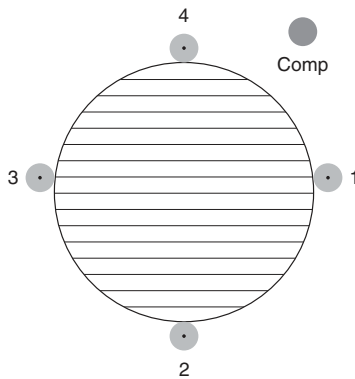


Figure 7-19 Measure Sphere

See “Best Fit Sphere” on page 168.

Check Feature


From the MAIN menu, touch MEASURE > FEATURES > CHECK FEATURE. Use this command to view a live deviation of a feature at any location on the feature.



Figure 7-20 Check Feature

You can also use this command as a 3D Height Gage and view the distance of the probe to a plane feature.


NOTE: The live view coordinates are automatically compensated for the probe diameter, and in some situations you may need to choose a Manual Compensation mode. See “Manual Compensation” on page 142.

- 1 Choose an existing feature in the FEATURE drop-down list or touch the MEASURE NOW  icon to measure a plane:
 - Place the ball probe on the part and digitize points by pressing the GREEN button. You must digitize at least three points for a plane. Hold the RED button to remove any unwanted points.
 - Pull away from the face, and press the RED button to define probe compensation and complete the measurement.
 - Look at the plane results. Press the GREEN button to accept, or the RED button to reject and remeasure.
- 2 Touch the surface of the feature and view the deviation of the probe location to the feature.
- 3 Touch the BACK button to return to the MEASURE menu, or the HOME button to return to the MAIN menu.

See measuring “Plane” on page 138.

Temporary Zero

You can set a temporary zero location. This adds a second deviation value to the screen.

- 1 Move the probe to the temporary zero location.
- 2 Press the RED button, or touch the TEMPORARY ZERO  icon, to set a temporary zero location.
- 3 Move the probe to another location and view the deviation from the first feature and the temporary zero location.
- 4 Touch the BACK button to return to the MEASURE menu, or the HOME button to return to the MAIN menu.

Manual Compensation

The Automatic Compensation mode uses the vector of the probe to determine the direction to compensate the deviation value. You should always try to point the probe towards the feature.

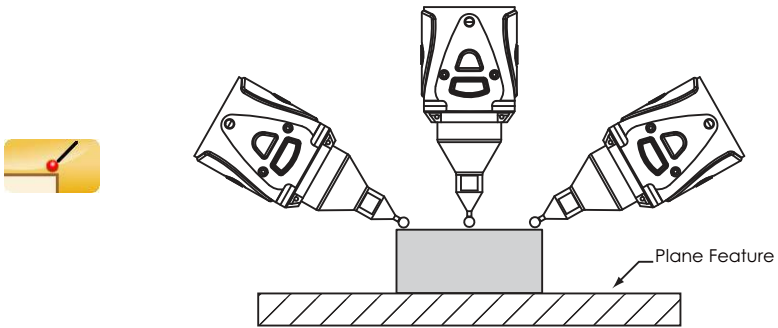


Figure 7-21 Automatic Compensation

The Manual Compensation mode allows for the correct compensation when you can not point the probe towards the feature.

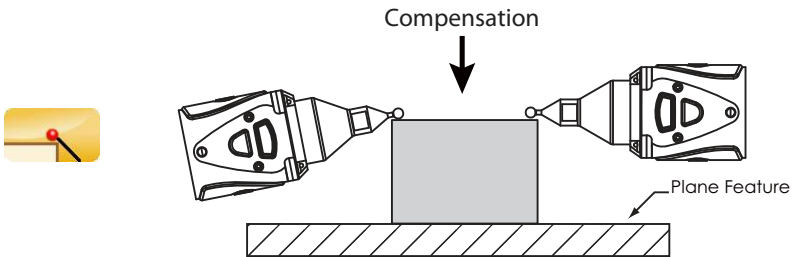






Figure 7-22 Manual Compensation


Review Features

Use this command to review existing measurement features. Touch a feature to see the measurement values for the feature. If a feature is dependent on another feature, those features also highlight.

- Touch the LABEL  field to change the feature name.
- Touch the DELETE  icon to remove the feature.
- Touch the NOMINALS  icon to enter nominal and tolerance values for the feature.
- Touch the CAMERA  icon to add a picture and measurement targets to the feature.

NOTE: You cannot delete a feature that is needed by another. For example, a plane that is needed by a circle, a sphere that is needed by a length, or a line that is needed by a coordinate system.

Nominals



Touch the NOMINALS  icon to enter nominal and tolerance values for the feature. Touch each area to access the touch screen keyboard. After typing a value touch the ENTER button.

NOTE: The default tolerance value is an Application setting. *See “Application” on page 151.*

By default, each nominal field is blank. When a nominal field is blank its value will not appear on any results screen or in a report file. *See “Save Report” on page 149.*

Measurement Pictures

You can add a measurement picture to the feature using the optional camera.

- 1 Touch the CAMERA  icon and point the camera at your part. Look at the screen and move the camera around the part until the image on the screen is correct.
- 2 Push the CAMERA  icon to take the picture.
- 3 Preview the picture. Touch OK to accept the picture, or touch the RETRY button to discard the picture and recapture.
- 4 Add a Green Ball per point, or a single picture with multiple Green Balls.
 - Add a Green Ball for the first point and touch OK to continue.
 - Add a Green Ball for the other points.

- 5** Add a single Red Ball to show the probe compensation point and touch OK to continue.

The nominal and tolerance values, and the measurement pictures, save with the features in Macro files. *See “Save Macro” on page 147.*

Printing

USB printers will not install properly if attached to the Edge. To print data, save a report file and copy it to a computer. You can open the report file on your computer using Microsoft Excel. *For more information, see “Save Report” on page 149.*

Position Display

Use this command to get a live XYZ readout of probe position without measuring any points. The default origin (0,0,0 location) is the center of the Edge.



Figure 7-23 Position Display

NOTE: The values are shown from the probe center and are not compensated for the probe radius.


- Touch the ZERO  icon to set the current probe position to 0,0,0. Exit the command to reset.



Figure 7-24 Zero Position

- Touch the DETAIL VIEW (+ button) to see Edge Handle Button status, temperatures, and encoder angle values. Touch the SIMPLE VIEW button (- button) to return.

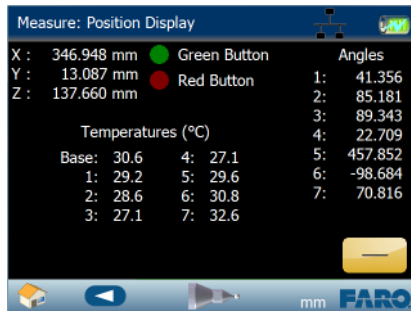


Figure 7-25 Position Display Detail View

- Touch the BACK button to return to the MEASURE menu, or the HOME button to return to the MAIN menu.

Files

Store measurement steps, nominal and tolerance values, measurement pictures, and part data in files.



Figure 7-26 Edge Files menu

The Edge system uses three different file types:

- Macro files - files that hold measurement steps (*.Macro).
- Part Data files - files that hold part data (*.Data).
- Report files - files that hold formatted report data in simple text format (*.txt).

NOTE: To delete a file, transfer it to the Trash Can. See “Transfer Files” on page 147.

If you are measuring a single part, you may not need to save a Macro file, just the measurement data in a Part file.

If you are measuring a series of the same part, you should create a single Macro file and then use it to measure each part. This automatically creates a Part file for each separate serialized part.

File Backup

It is very important to save and/or transfer Macro, Part Data, and Report files to a SD RAM Card or USB Drive.

- If there is a failure of the local drive in the Edge, you may lose all of your Macro, Part Data, and Report files.
- If you return your Edge for factory service, the files stored on the local drive may be erased in the repair service.

Load Macro

Use this command to load a previously saved Macro file.

1 Touch the location:

- Local
- SD RAM Card
- USB Drive

2 Touch the Macro file.

This automatically runs the Macro file. Measure your part following the steps in the Macro file. If the Auto Save option is selected in the Macro file, a Part file will automatically save when the measurement steps are completed. You can repeat the measurement steps again or quit.

Save Macro

Use this command to save a set of measurement steps in a Macro (*.Macro) File. Macro files are measurement steps, or commands, without actual measurement data. These files also include all nominal and tolerance values, and measurement pictures.

1 Enter a name for the Macro file. There are some options to set with a Macro file. Touch the OPTIONS button:

- The Auto Save option automatically saves a part file and a report file after the measurement steps are completed. Touch to select or clear the Auto Save option.
- Touch the units for the Macro file.

2 Touch the location:

- Local
- SD RAM Card
- USB Drive

NOTE: Touch the other location buttons to quickly save the Part file to multiple locations.

3 Touch the BACK button to return to the FILES menu, or the HOME button to return to the MAIN menu.

Transfer Files

Use this command to transfer Macro, Part Data, and Report files from one location to another.

NOTE: To delete any file, transfer it to the Trash Can.

1 Touch the location:

- Local
- SD RAM Card
- USB Drive

2 Touch a File.

3 Touch another location:

- Local
- SD RAM Card
- USB Drive
- Trash Can

4 Touch the BACK button to return to the FILES menu, or the HOME button to return to the MAIN menu.

NOTE: You should use this command often to backup or copy your Macro, Part Data, and Report files to a SD RAM Card or USB Drive.

Load Parts

Use this command to load a Part file. You can then look at the part data using the Review Features command. *See “Review Features” on page 143.*

1 Touch the location:

- Local
- SD RAM Card
- USB Drive

2 Touch a File.

3 Touch the BACK button to return to the FILES menu, or the HOME button to return to the MAIN menu.

Save Parts

Use this command to save part data to a Part Data (*.Data) file. This data is always in the Edge coordinate system. Use the SAVE REPORT command to save the part data in a simple text file for printing. *See “Save Report” on page 149.*

1 Enter the part name.

2 Enter the part serial number.

3 Touch the location:

- Local
- SD RAM Card
- USB Drive

NOTE: Touch the other location buttons to quickly save the Part Data files to multiple locations.

- 4 Touch the BACK button to return to the FILES menu, or the HOME button to return to the MAIN menu.

NOTE: Part Data files are automatically saved when running Macro files. *See “Save Macro” on page 147.*

Save Report

Use this command to save part data to a text (*.txt) file. This data is in the current PART SETUP, and you can open it with Microsoft Excel on your computer. *See “Part Setup” on page 103.*

NOTE: If a nominal field is blank it will not appear on any results screen or in a report file. *See “Nominals” on page 143.*

- 1 Enter the part name.
- 2 Enter the part serial number.
- 3 Touch the location:
 - Local
 - SD RAM Card
 - USB Drive

NOTE: Touch the other location buttons to quickly save the Report files to multiple locations.

- 4 Touch the BACK button to return to the FILES menu, or the HOME button to return to the MAIN menu.

NOTE: Report files are automatically saved when running Macro files. *See “Save Macro” on page 147.*

Using Report Files in Excel

You can view, edit, and print your simple text (*.txt) part file in Excel.

- 1 Remove the SD RAM Card or USB Drive from the Edge.
- 2 Insert the SD RAM Card or USB Drive into your computer.
- 3 Start Excel and open the part file using one of two methods.
 - Use the OPEN command:
 - Click the Office Button and choose OPEN.
 - Click the FILES OF TYPE drop-down list and choose TEXT FILES.
 - Navigate to the SD RAM Card or USB Drive location on your computer.
 - Click on the part file and click OPEN.

- Click the NEXT button twice and the FINISH button once to accept all of the Text Import Wizard default options.
- Drag the File into Excel.
 - From the WINDOWS START menu, click MY COMPUTER.
 - Double-click the SD RAM Card or USB Drive location on your computer.
 - Select the part file and drag it onto the Excel window.

4 Print the file.

Settings

Use the commands in the SETTINGS menu to configure your Edge.



Figure 7-27 Edge Settings menu

Application

Use this command to set options for the Edge application software.

- Enable or Disable Scanning. If enabled, enter a 3D distance. When measuring, press and hold the GREEN button and points are automatically collected when the probe moves the 3D distance. Set the 3D distance to zero (0) to record points whenever you press and hold the GREEN button.
- Enter a default tolerance value. This value applies to all features created after this change; it does not change an existing feature's tolerancing.
- Set the Time. Touch the up and down arrows to adjust the Hour and Minute. Touch AM, PM, or 24 Hour.
- Touch the BACK button to return to the SETTINGS menu, or the HOME button to return to the MAIN menu.

For more information, see “Nominals” on page 143.

Connection

Use this command to set communication options for the Edge. USB and Ethernet communication are always on. Touch to select or clear any of the following options:

- Bluetooth
- Ethernet
- WiFi

For details on these communication options, see “Wireless Connections” on page 40.

Bluetooth

- 1 From the MAIN menu, choose CONNECTION.
- 2 Select the BLUETOOTH icon.

For details on the setup of your computer, see “*FARO Wireless - Bluetooth*” on page 40.

- 3 Connect the Edge using Bluetooth to the FaroArm driver. See “*FARO Wireless - Bluetooth*” on page 40.

NOTE: If the WiFi is enabled, the Bluetooth automatically disables.

Ethernet

- 1 From the MAIN menu, touch SETTINGS.
- 2 From the SETTINGS menu, touch CONNECTION.
- 3 Touch the ETHERNET button.
- 4 Touch DHCP or Static IP for the Ethernet connection. DHCP automatically assigns the Edge an IP address. If you are working on a network and need a specific IP address every time you connect the Edge, touch Static IP.
 - If you choose Static IP, touch the NEXT button.
 - Enter the IP address, Subnet Mask, and Gateway.
- 5 Touch the OK button.

For details on the setup of your computer, see “*Ethernet*” on page 39.

- 6 Connect the Edge on the network to the FaroArm driver. See “*FARO Ethernet Setup*” on page 49.

WiFi

WiFi or Wireless Local Area Network (WLAN) allows you to connect to an existing wireless network access point, or configure the Edge as an access point.

NOTE: Using the Edge as an access point is *not* password protected.

- 1 From the MAIN menu, touch SETTINGS.
- 2 From the SETTINGS menu, touch CONNECTION.
- 3 Touch the WiFi button to enable WiFi.
 - Touch DHCP or Static IP for the WiFi to Network connection. DHCP automatically assigns the Edge an IP address. If you are working on a network and need a specific IP address every time you connect the Edge, touch Static IP.

- Touch the NEXT button.
- Select a network connection from the list and touch the NEXT button. If you selected Static IP, enter the IP address, Subnet Mask, and Gateway. and touch the NEXT button.
- Type in the network password and touch the NEXT button.
- Touch the HOME button to return to the MAIN menu.

OR

- Touch the WiFi to PC/Laptop button to use the Edge as a network access point.
- Touch the OK button.
- Touch the HOME button to return to the MAIN menu.

For details on the setup of your wireless connection, see “*FARO Wireless - WLAN*” on page 44.

4 Connect the Edge on the network to the FaroArm driver. See “*FARO Ethernet Setup*” on page 49.

NOTE: If the WiFi is enabled, the Bluetooth automatically disables.

Display

Use this command to set the options for the screen in the Fold-Down Touch Screen Controller. See “*Fold-Down Touch Screen Controller*” on page 25.

- Transitions - Enable or Disable screen transitions, or fades, between menu screens.
- Touch the BACK button to return to the SETTINGS menu, or the HOME button to return to the MAIN menu.

Sound

Use this command to enable or disable the speaker in the Edge.

- Touch to select or clear the SOUND button.
- Touch the BACK button to return to the SETTINGS menu, or the HOME button to return to the MAIN menu.

Language

Use this command to switch the Edge software language.

- Choose a Language.

- Touch the BACK button to return to the SETTINGS menu, or the HOME button to return to the MAIN menu.

Software Update

Use this command to update the Edge software. Use this command only after receiving an Edge software update USB drive, or downloading the update file and copying it to your USB drive.

- 1** Insert the USB Drive into the port on the left side of the Fold-Down Touch Screen Controller. *See “Fold-Down Touch Screen Controller” on page 25.*
- 2** On the MAIN menu, touch SETTINGS > UPDATE SOFTWARE.
- 3** Notice the existing software version and the new software version on the USB drive to make sure that they are different.
- 4** Touch the button to update the system.

When the software update is complete, the Edge will automatically restart. If there is any problem in this process, the original software version will be automatically restored.

Diagnostics

Use the commands in the DIAGNOSTICS menu to test the mounting, accuracy, temperature, and environment information of your Edge.



Figure 7-28 Edge Diagnostics menu

Mount

Use the commands in the MOUNT menu to test the physical setup of your Edge. Use these commands to test the stability of your part and the Edge.

Tilt

Use this command to check for any tilt in the base of the Edge. This command uses the Edge's internal inclinometer.

- 1 Touch DIAGNOSTICS > MOUNT > TILT.
- 2 Move the tubes and joints of the Edge.
 - Any tilt of the base is recorded and displayed on the screen. All of the points must be within the circle on the graph.
 - Touch the RESET button to clear the screen.
- 3 Touch the BACK button to return to the DIAGNOSTICS menu, or the HOME button to return to the MAIN menu.

If the Base Deflection test fails and the Tilt test passes, check the stability of your part.

Level

Use this command to compare the Edge to level. This command uses the Edge's internal inclinometer. The Edge should never lean more than $\pm 5^\circ$ from level.

- 1 Look at and adjust the mounting until the yellow dots are centered in each bubble.
- 2 Touch the BACK button to return to the DIAGNOSTICS menu, or the HOME button to return to the MAIN menu.

Base Deflection

Use this command to check for any deflection in the base of the Edge and your part. If this test fails, run the TILT command to test for any tilt in the base of the Edge.

- 1 Set up the FARO compensation cone approximately $\frac{2}{3}$ of the Edge's reach away from its base.
- 2 Place a properly compensated probe firmly in the cone.
- 3 Touch DIAGNOSTICS > MOUNT > BASE DEFLECTION.
- 4 Press the GREEN button and move the tubes and joints of the Edge while keeping the probe firmly seated in the cone.

NOTE: Press the GREEN button to reset the screen at any time.

- 5 Press the RED button to stop.
- 6 Any deflection of the base is recorded and displayed on the screen. All of the points must be within the circle on the graph.
- 7 Touch the BACK button to return to the DIAGNOSTICS menu, or the HOME button to return to the MAIN menu.

Temperature

Use the Temperature commands to monitor the temperature of the Edge.

Graph

Use this command to view the recorded temperature of the Edge over a long period of time.

- Notice the temperature for each section of the Edge. Touch the 30 Minutes, 12 Hour, or 24 Hour buttons to change the graph.
- Touch the BACK button to return to the DIAGNOSTICS menu, or the HOME button to return to the MAIN menu.

Stability

Use this command to view the ambient temperature change of the Edge over a five minute period of time.

- Notice the ambient temperature for the Edge. Check that ambient temperature is not fluctuating more than 3°C (5.4°F) over a five minute period.
- Touch the BACK button to return to the DIAGNOSTICS menu, or the HOME button to return to the MAIN menu.

Convert Units

Use this command to convert a value from one unit to another.

- 1 Touch DIAGNOSTICS > CONVERT UNITS.
- 2 Touch a unit group:
 - Length
 - Angle
 - Temperature
- 3 Type in a value and touch the units in the left column.
- 4 Touch a unit in the right and view the value in the new units.
- 5 Touch the BACK button to return to the DIAGNOSTICS menu, or the HOME button to return to the MAIN menu.

Calculator

Use this command to open a standard calculator.

- 1 Touch DIAGNOSTICS > CALCULATOR.
- 2 Touch the BACK button to return to the DIAGNOSTICS menu, or the HOME button to return to the MAIN menu.

Event Log

Use this command to generate a report of hardware system events. Save this report to an external location.

- 1 Touch a location for the file:
 - SD RAM Card
 - USB Drive
- 2 Touch the BACK button to return to the DIAGNOSTICS menu, or the HOME button to return to the MAIN menu.

NOTE: Only use this command when instructed by FARO Customer Service.

Environment Log

Use this command to generate a report of environmental events. Save this report to an external location.

1 Touch a location for the file:

- SD RAM Card
- USB Drive

2 Touch the BACK button to return to the DIAGNOSTICS menu, or the HOME button to return to the MAIN menu.

NOTE: Only use this command when instructed by FARO Customer Service.

System Information

Use this command to view the system information of the Edge.

- View the information for the hardware and software systems of the Edge.
- Touch the BACK button to return to the DIAGNOSTICS menu, or the HOME button to return to the MAIN menu.

FARO Edge Compensation

Use this command to perform the compensation of the Edge.

CAUTION: This should only be done if the Single Point Articulating Test (SPAT) fails. See “*Single Point Articulating Test (SPAT)*” on page 164.

- 1** Set up the FARO compensation cone approximately $\frac{2}{3}$ of the Edge's reach away from its base.
- 2** Place a properly compensated probe firmly in the cone.
- 3** Touch COMPENSATION > FAROARM COMPENSATION.

- 4 Press the GREEN button and move the elbow of the Edge from one side to the other, and back. Points are automatically measured as you move the elbow.
- 5 After moving the elbow from one side to the other and automatically measuring all the necessary points, the command processes the measurements.
 - The two sets of points are compared and if they are not repeatable, you must repeat the test.
 - If they are repeatable, touch OK to accept.
- 6 After completing an Edge compensation, move the cone to a different location and perform another Single Point Articulating Test (SPAT). See “Single Point Articulating Test (SPAT)” on page 164.
- 7 Touch the BACK button to return to the COMPENSATION menu, or the HOME button to return to the MAIN menu.



Compensation

The COMPENSATION menu contains the commands for the compensation of the Edge and the Edge probes.



Figure 7-29 Edge Construct menu

The Probe Compensation commands are also available in CAM2 Measure and CAM2 Q. See “Probes” on page 178 and “Device Control Panel” on page 173.

For more information, see “Probe Compensation Overview” on page 180.

Hole Compensation

Touch the HOLE COMPENSATION button from the COMPENSATION menu.

For standard probes:

- 1 Touch the PROBES field and choose a probe from the list and touch the ENTER button.
- 2 Touch the SETTINGS button.
 - Touch the PROBE DIAMETER field and enter the exact diameter that is stamped on the probe and touch the ENTER button.
 - Touch the OK button.

For FARO i Probes:

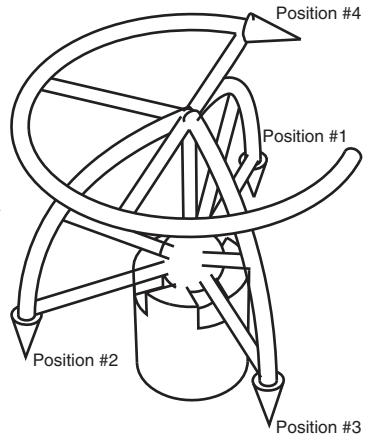
- 1 Touch the PROBES field and choose a probe from the list and touch the ENTER button.
- 2 Touch the SETTINGS button.
 - Touch the ENABLE I-PROBE button. The exact probe diameter is automatically set.
 - Touch the OK button.

For all probes:

- 3 Place the ball probe in the FARO Compensation Cone and digitize points by pressing and holding the GREEN button. Release the GREEN button to move to the next position. To remove any unwanted points, press and hold the RED button.
 - Sweep down to each of the three positions.
 - Rotate the handle for the forth position.

- 4 Look at the compensation results. Press the GREEN button to accept, or the RED button to reject and remeasure.

For more information, see “Hole Compensation Method” on page 185.



Sphere Compensation

Touch the SPHERE COMPENSATION button from the COMPENSATION menu.

For standard probes:

- 1 Touch the PROBES field and choose a probe from the list and touch the ENTER button.
- 2 Touch the SETTINGS button.
 - Touch the PROBE DIAMETER field and enter the exact diameter that is stamped on the probe and touch the ENTER button.
 - Touch the OK button.

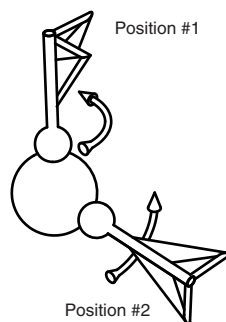
For FARO i Probes:

- 1 Touch the PROBES field and choose a probe from the list and touch the ENTER button.
- 2 Touch the SETTINGS button.
 - Touch the ENABLE I-PROBE button. The exact probe diameter is automatically set.
 - Touch the OK button.

For all probes:

- 3 Place the probe against the surface of the FARO Compensation Sphere and Press the GREEN button to digitize a point. To remove any unwanted points, press and hold the RED button.

- Digitize 11 points around the top hemisphere of the sphere with the probe pointing in position #1. Hold the handle in the same direction and orientation for every point.
- Rotate the handle 90 degrees. Digitize 11 points around the top hemisphere of the sphere with the probe pointing in position #1. Hold the handle in the same direction and orientation for every point.
- Digitize 11 points around the front hemisphere of the sphere with the probe pointing in position #2. Hold the handle in the same direction and orientation for every point.



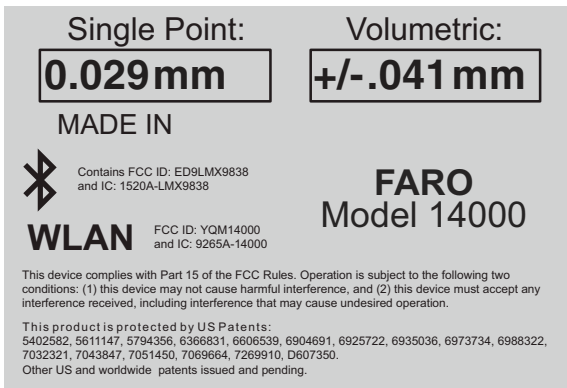
- 4 Look at the compensation results. Press the GREEN button to accept, or the RED button to reject and remeasure.

For more information, see “Sphere Compensation Method” on page 187.

Compensation Log

The COMPENSATION LOG screen displays the compensation history of the current probe.

- 1 Select any compensation to see the differences to other existing compensations.
 - The X, Y, Z values are the location of the center of the ball probe in the last joint coordinate system.
 - The 2 Sigma value is the deviation of all the points taken during the compensation.
 - The Max. Error column displays the displacement of the point with the largest displacement. In order to pass compensation, this value has to be less than the single point accuracy specification of the Edge.



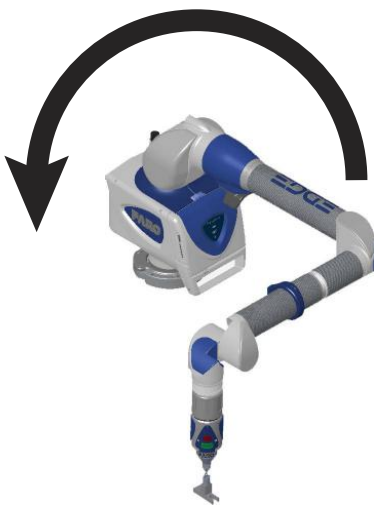
- 2 Touch the SET ACTIVE button to set any selected compensation to active, or touch DELETE to delete it.
- 3 Touch the BACK button to return to the COMPENSATION menu, or the HOME button to return to the MAIN menu.

Single Point Articulating Test (SPAT)

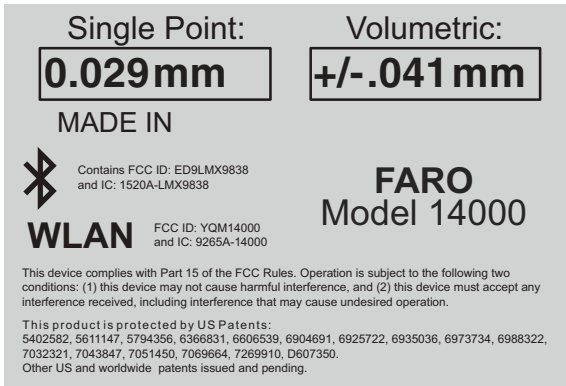
Use this command to perform the Single Point Articulating Test (SPAT) to verify the repeatability of the Edge's X, Y and Z coordinates throughout its range of motion. Mounting must be tested prior to a SPAT test.

- 1 Set up the FARO compensation cone approximately $\frac{2}{3}$ of the Edge's reach away from its base.
- 2 Place a properly compensated probe firmly in the cone or any conical socket.
- 3 Touch COMPENSATION > SPAT.
- 4 Start with the elbow of the Edge to one side and press the GREEN button.
- 5 Slowly sweep the elbow so that it ends up on the opposite side. **NOTE:** Measurements automatically record as the elbow moves.
 - In the dialog box, watch the status bar. Sweep the elbow all the way to the opposite side.
- 6 The SPAT automatically completes. The set of measurements from each sweep are compared for repeatability. If the sets are not repeatable, you must repeat the test.

NOTE: The Edge movement should feel fluid. Be careful not to stress the Edge joints while taking these points or get too close to an end stop since stresses can be amplified near end stops.



- 7 Note the deviations in X, Y, and Z. The (Max-Min)/2, or Single Point repeatability value, of each coordinate should be lower than the value printed on the Edge.



NOTE: For optimum performance, correctly mounting and operating the Edge is very important. *For more information, see “Edge Performance Verification Checklist” on page 89.*

- 8 Touch the BACK button to return to the COMPENSATION menu, or the HOME button to return to the MAIN menu.

Best Fit Examples

The following figures show examples of how features are best-fit when more than the minimum amount of points are digitized.

Best Fit Circle

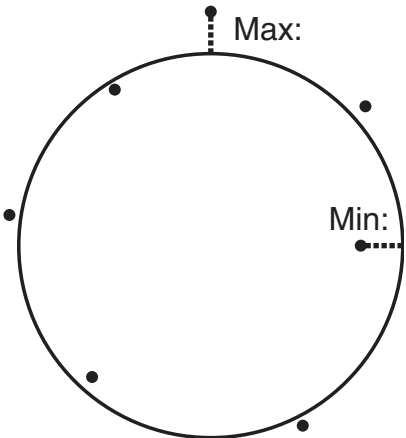


Figure 7-30 Best Fit Circle

Best Fit Cylinder

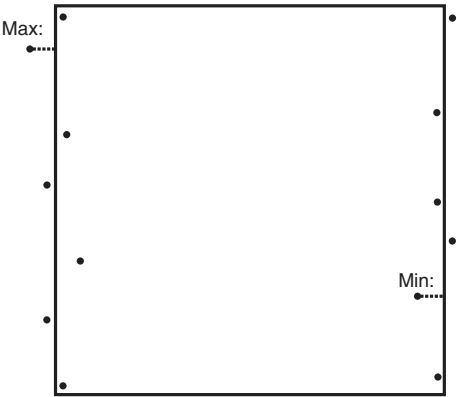


Figure 7-31 Best Fit Cylinder

Best Fit Line

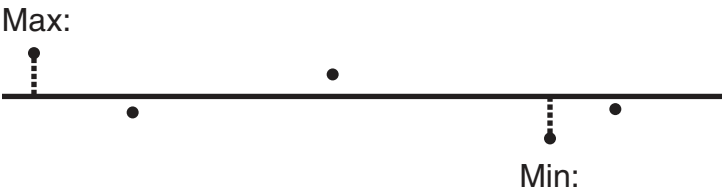


Figure 7-32 Best Fit Line

Best Fit Plane

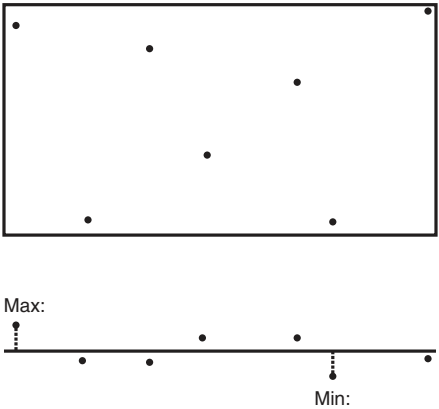


Figure 7-33 Best Fit Plane

Best Fit Point

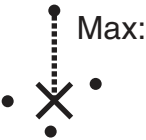


Figure 7-34 Best Fit Point

Best Fit Sphere

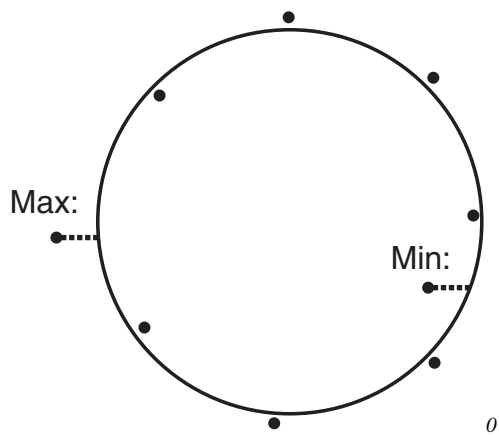


Figure 7-35 Best Fit Sphere

Chapter 8: Configuring the FARO Edge in CAM2 Measure

NOTE: This chapter describes the operation of your Edge with CAM2 Measure v10, or later. For previous versions of CAM2 Measure, see *“Configuring the FARO Edge in CAM2 Measure” on page 177.*

The DEVICE CONTROL panel contains all the commands for configuring the Edge. In CAM2 Measure choose **HARDWARE CONFIGURATION** on the **DEVICES** tab to show the panel. You can also press the **P** hot key on the keyboard.



Device Control Panel

The **DEVICE CONTROL** panel contains a list of all active devices with the properties of each associated device.



Figure 8-1 Device Control Panel

Choose the Edge from the list to see the probe details.

- Click the >> button to hide the list of devices.
- Click the << button to show the list of devices.

Add a Device

From the **DEVICE CONTROL** panel, click the **ADD NEW DEVICE** button. Select an eligible device from the **ADD NEW DEVICE** dialog and click **CONNECT**.

Change Probe

From the DEVICE CONTROL panel, click the PROBE MANAGEMENT button to show the COMPENSATION dialog box. *For more information, see “Probes” on page 178.*

Hole Compensation

From the DEVICE CONTROL panel, click the PROBE COMPENSATION POINT button to compensate the probe. *For more information, see “Hole Compensation Method” on page 185.*

Sphere Compensation

From the DEVICE CONTROL panel, click the PROBE COMPENSATION SPHERE button to compensate the probe. *For more information, see “Sphere Compensation Method” on page 187.*

Hardware Configuration

From the DEVICE CONTROL panel, click the HARDWARE CONFIGURATION button to change the setup of the Edge. *For more information, see “Hardware Configuration” on page 178.*

Diagnostics

From the DEVICE CONTROL panel, click the DIAGNOSTICS button to show the Edge DIAGNOSTICS dialog box. *For more information, see “Diagnostics” on page 190.*

Temperature

From the DEVICE CONTROL panel, click the TEMPERATURE button to show the TEMPERATURE dialog box. *For more information, see “Temperature” on page 190.*

Measurement Mode Setting

From the DEVICE CONTROL panel, click the MEASUREMENT MODE SETTING button to set the default collection mode in the MODE drop-down window of the MEASUREMENT WINDOW for this device.

NOTE: The MEASUREMENT WINDOW appears when the CAM2 Measure ADD READINGS command is started, or when any measure feature command is started in MEASURE mode.

In the MODE SETTINGS dialog:

- *Single Point:* press the FRONT button, or the G key, to collect a single reading.
- *Distance Interval:* press the FRONT button, or the G key, to start the distance interval. Collect a single reading when the probe moves a distance. Choose this option, enter the distance value and press OK.
- *Time Interval:* press the FRONT button, or the G key, to start the time interval. Collect a single reading over time. Choose this option, enter the time value and press OK.

NOTE: If the current probe is a Laser Line Probe on the FaroArm, it is best to use the TIME INTERVAL setting with a very small time interval. Setting the time interval to 0ms collects point data at the FaroArm's maximum speed.

Chapter 9: Configuring the FARO Edge in CAM2 Q

The DEVICE CONTROL panel contains all the commands for configuring a measuring device. In CAM2 Q choose DEVICE < DEVICE CONTROL PANEL to show the panel. You can also press the P hot key on the keyboard.



Device Control Panel

The DEVICE CONTROL panel appears when CAM2 Q is launched, and contains a list of all active (detected) devices. The DEVICE CONTROL panel contains a list of all active devices with the properties of each associated device.



Figure 9-1 Device Control Panel

Choose the Edge from the list to see the probe details.

- Click the >> button to hide the list of devices.
- Click the << button to show the list of devices.

Add a Device

From the DEVICE CONTROL panel, click the ADD NEW DEVICE button. Select an eligible device from the ADD NEW DEVICE dialog and click CONNECT.

Change Probe

From the DEVICE CONTROL panel, click the PROBE MANAGEMENT button to show the COMPENSATION dialog box. *For more information, see “Probes” on page 178.*

Hole Compensation

From the DEVICE CONTROL panel, click the PROBE COMPENSATION POINT button to compensate the probe. *For more information, see “Hole Compensation Method” on page 185.*

Sphere Compensation

From the DEVICE CONTROL panel, click the PROBE COMPENSATION SPHERE button to compensate the probe. *For more information, see “Sphere Compensation Method” on page 187.*

Hardware Configuration

From the DEVICE CONTROL panel, click the HARDWARE CONFIGURATION button to change the setup of the Edge. *For more information, see “Hardware Configuration” on page 178.*

Diagnostics

From the DEVICE CONTROL panel, click the DIAGNOSTICS button to show the Edge DIAGNOSTICS dialog box. *For more information, see “Diagnostics” on page 190.*

Temperature

From the DEVICE CONTROL panel, click the TEMPERATURE button to show the TEMPERATURE dialog box. *For more information, see “Temperature” on page 190.*

Measurement Mode Setting

From the DEVICE CONTROL panel, click the MEASUREMENT MODE SETTING button to set the default collection mode in the MODE drop-down window of the MEASUREMENT WINDOW for this device.

NOTE: The MEASUREMENT WINDOW appears when the CAM2 Q ADD READINGS command is started, or when any measure feature command is started in MEASURE NOW mode.

In the MODE SETTINGS dialog:

- *Single Point:* press the FRONT button, or the G key, to collect a single reading.

- *Distance Interval*: press the FRONT button, or the G key, to start the distance interval. Collect a single reading when the probe moves a distance. Choose this option, enter the distance value and press OK.
- *Time Interval*: press the FRONT button, or the G key, to start the time interval. Collect a single reading over time. Choose this option, enter the time value and press OK.

Chapter 10: Configuring the FARO Edge in CAM2 Measure

NOTE: This chapter describes the operation of your Edge with CAM2 Measure v4.0 and X. For later versions of CAM2 Measure, see *“Configuring the FARO Edge in CAM2 Measure”* on page 169.

The DEVICES menu contains all the commands used to configure a measuring device. These commands are also available on the Devices toolbar.



Device Setup

Select DEVICES < DEVICE SETUP from the DEVICES menu. Choose a primary input device from the DEVICE SETUP dialog box. The default device is the Edge. To change the primary input device, select the device name and click the START button. This establishes communication with the selected device.

When CAM2 Measure starts, the software attempts to initialize communication with the primary input device.

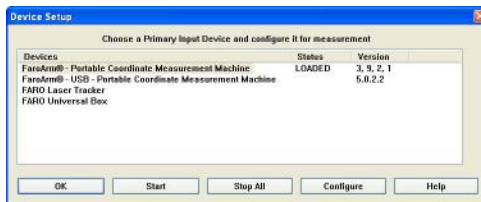


Figure 10-1 Device Setup dialog box

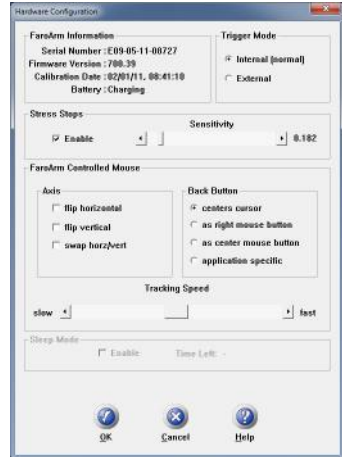


Hardware Configuration

Select **DEVICES < HARDWARE CONFIG** from the **DEVICES** menu. In the **HARDWARE CONFIGURATION** dialog box you can:

- View the current information about the Edge.
- Set the Trigger mode.
- Enable/disable Stress Stops and adjust the sensitivity. See *“Error and Status Indicators”* on page 36.
- Set the arm controlled mouse settings.
- Enable/disable Sleep Mode.

Click **OK** to accept the changes. Click the **CANCEL** button to discard any changes and exit the command.



Stress Stops: The default value is 0.182 and should rarely be set any lower.

FaroArm Controlled Mouse: The movement of the mouse cursor can be switched as it relates to the movement of the probe.

Set an option for the device’s **BACK** (Red) button. These options are ignored during any measurement command.

- Application Specific - sends a special signal to the application software. The software can use this special signal to launch any command. For example, this repeats the last command in FARO’s CAM2 Measure X.

Tracking Speed: Adjust the speed of the cursor is adjusted using the Tracking Speed slider.

Sleep Mode: The Edge shuts down with no activity after two hours. **TIME LEFT** is the remaining time before the Edge shuts down.



Probes

Select **DEVICES < PROBES** from the **DEVICES** menu. In the **COMPENSATION** dialog box you can:

- Select the current probe and view the **COMPENSATION STATUS**.
- Create, Edit or Delete a probe.

- Compensate the current probe.
- View the compensation log for the current probe.
- Enable or disable the use of FARO i-Probes with the Edge.
- Start the Single Point Articulation Test (SPAT).
- Run an Arm Compensation or reset to the FARO Factory Arm Compensation.

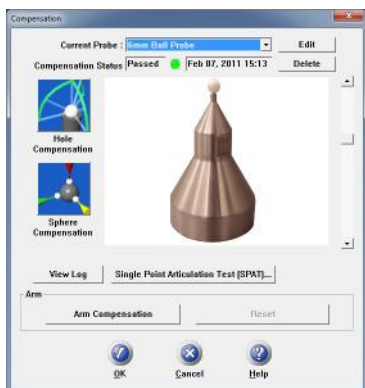


Figure 10-2 FaroArm Platinum/Fusion Compensation dialog box

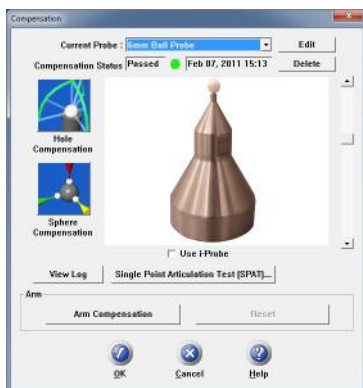


Figure 10-3 FaroArm Edge and Quantum Compensation dialog box

The COMPENSATION STATUS and compensation date display for every probe. The four standard probes for the Edge (3mm, 6mm, Point and FARO Laser Line Probe) are created by default. Compensate each of these probes before you begin measuring your parts. See “Probe Compensation Overview” on page 180 and “Compensate Probe” on page 181

Click the PERFORM SINGLE POINT ARTICULATION TEST (SPAT) button to run a Single Point Articulation Test (SPAT) with your Edge. You can save this report to a file which you can send to FARO’s Customer Service Department. For more information, see “Single Point Articulation Test (SPAT)” on page 94.

Click the ARM COMPENSATION button to create a user arm compensation for your Edge. For more information, see “User Compensation” on page 96.

Using FARO i-Probes

When a FARO i-Probe is attached to the Edge, it is automatically added to the CURRENT PROBE list. You do not need to edit any parameters of the FARO i-Probe.

NOTE: FARO i-Probes will not attach to the FaroArm Platinum or Fusion. Installing the i-Probe to anything other than the FaroArm Quantum or Edge damages the i-Probe.

Edit Probe

Click the EDIT button in the COMPENSATION dialog box to modify the details of the current probe. Change any settings and click the MODIFY button to continue.

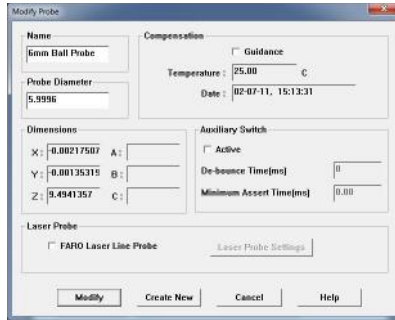


Figure 10-4 Modify Probe dialog box

To create a new probe:

- 1 Enter a new Name for the probe.
- 2 Enter the diameter of the probe in the correct unit. Check the status bar at the bottom of your screen for the current units.
- 3 Select the AUXILIARY SWITCH check box, and enter a De-bounce Time if necessary.
- 4 Select the GUIDANCE check box to use the guidance feature in Hole Compensation. See “Hole Method - Guidance” on page 182, and “Hole Compensation Method” on page 185.
- 5 Click the CREATE NEW button.

The new probe is now current. You *must* compensate the new probe.

Probe Compensation Overview

Probe compensation is a localized process by which a measurement device is optimized to perform measurements accurately.

To understand probe compensation, you must first understand the Edge's reference system. The Edge is factory compensated from the base to the last joint or axis, and the position of this joint is defined by the coordinate system which originates at the base of the Edge. The last axis of the Edge has its own coordinate system, and the location of the center of the ball probe is reported in the probe's coordinate system. After the probe's coordinates are established, these

are translated into Edge coordinates and you are ready to start taking measurements.

Measurement accuracy relies on probe compensation under optimal conditions. If the probe compensation passes, measurements will be accurate. If the probe compensation fails, measurements will not be as accurate. Proper mounting and technique are critical compensation factors.


To optimize compensation and minimize stress-induced errors during this critical procedure, place the Edge in a single position in which the elbow joint remains relatively stationary without any obstructions or restrictions in movement while the compensation is performed. Do not let the elbow joint fall during compensation. Only exercise the last joint of the Edge for the software to accurately compensate the probe tip. To maximize accuracy, minimize elbow joint movement and focus on the probe and last arm joint during compensation.



Compensate Probe

When changing the style or dimension of the probe at the end of the Edge, you must compensate it for the Edge to measure and function accurately. Probe compensation is an optimization procedure that requires you to digitize points. The two methods of compensation are:

- Hole 

- Sphere 

Click either button to compensate the current probe. The Hole Compensation method differs depending on whether the GUIDANCE check box is selected or cleared. See *“Edit Probe” on page 180.*

- See *“Hole Method - Guidance” on page 182.*
- See *“Hole Compensation Method” on page 185.*
- See *“Sphere Compensation Method” on page 187.*



Hole Method - Guidance

Perform the Hole Compensation using the FARO probe compensation cone. If the GUIDANCE check box is selected for the current probe, use the following steps. See “Edit Probe” on page 180.

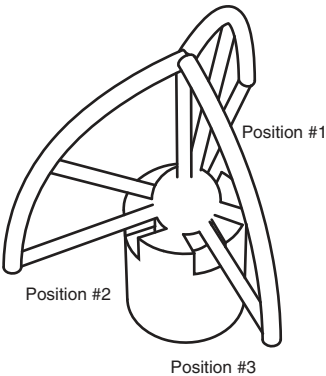
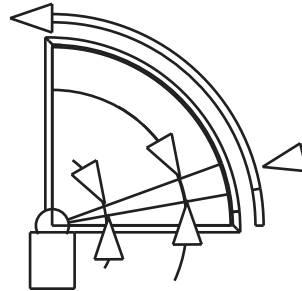


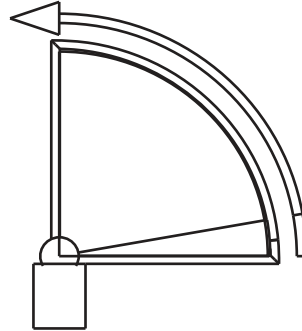
Figure 10-5 Hole Method

Collect all of the points in this method by holding down the FRONT button. The Edge will collect points as fast as possible (“scanning”) until you release the FRONT button. Digitize at least 200 points in each of the four different positions.

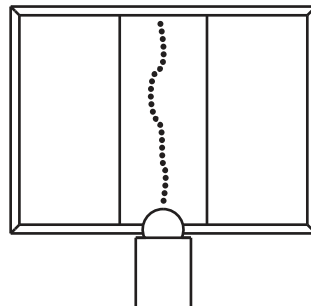
- 1 Place the ball probe in the cone.
- 2 Seat the probe firmly in the cone, move the handle down until the shaft of the probe is parallel with the top of the cone.



- Look at the dialog box and move the handle until you reach the starting position.

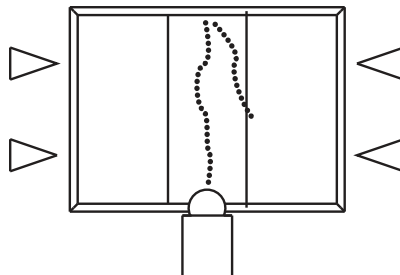


- 3 Press and hold the FRONT button. Sweep the handle up to the vertical position, making sure to move in a straight line. Be sure that the ball probe remains seated in the hole.



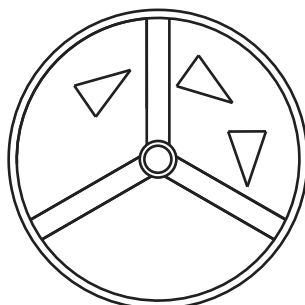
- Release the FRONT button to pause.
- Look at the dialog box to help you stay within the zone.

- 4 Sweep again until all 200 points are digitized. Look at the dialog box to help you digitize all of the points.



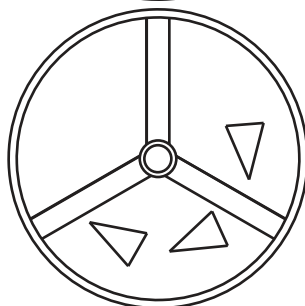
5 Rotate the probe to the next position. Look at the dialog box and move the handle until you reach the start of the next position.

- Repeat steps 1 through 4 and digitize 200 more points in this position.



6 Rotate the probe to the next position. Look at the dialog box and move the handle until you reach the start of the next position.

- Repeat steps 1 through 4 and digitize 200 more points in this position.



CAUTION: The probe *must* be well-seated in the hole when digitizing all compensation points. Even one or two poorly digitized points significantly affects the optimization process, which then has an effect on the accuracy of the Edge.

The digitized compensation points then calculate and the COMPENSATION STATUS updates. If the probe passes, the current date and time is added to the probe information.

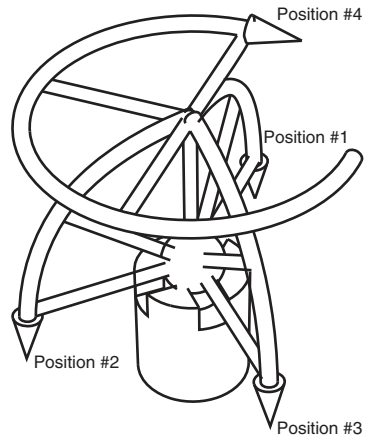
You can view the details for all of the compensations of a probe by clicking the VIEW LOG button. See “View Log” on page 189.



Hole Compensation Method

Perform the Hole Compensation using the FARO probe compensation cone or a 5mm diameter machine drilled hole. The hole does not have to be exactly 5mm, but it must be smaller than the probe's diameter and have a smooth seat.

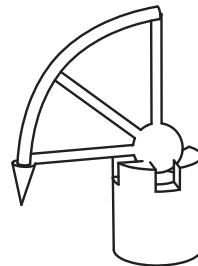
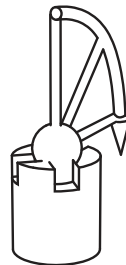
Collect all of the points in this method by holding down the GREEN button. The Edge will collect points as fast as possible ("scanning") until you release the GREEN button.



- 1 Place the ball probe in the hole. Start in a vertical position.
- 2 Press and hold the GREEN button. Sweep the handle down to one of the horizontal positions. Be sure that the ball probe remains firmly seated in the hole.
- 3 Release the GREEN button to move to the next position.

NOTE: To remove any unwanted points, press and hold the RED button.

- 4 Repeat for each position.
 - Digitize points in the hole and sweep to position #1.
 - Digitize points in the hole and sweep to position #2.



- Digitize points in the hole and sweep to position #3.
- Digitize points in the hole and rotate the handle to position #4.

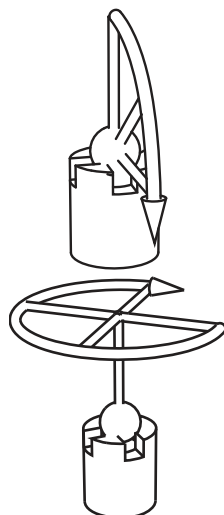


Figure 10-6 Hole Compensation Method

CAUTION: The probe *must* be well-seated in the hole when digitizing all compensation points. Even one or two poorly digitized points significantly affects the optimization process, which then has an effect on the accuracy of the Edge.

The digitized compensation points then calculate and the COMPENSATION STATUS updates. If the probe passes, the current date and time is added to the probe information.

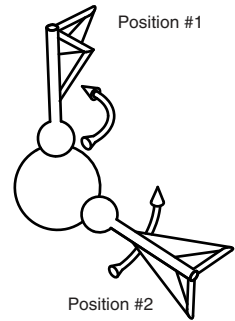
You can view the details for all of the compensations of a probe by clicking the View Log button. See “View Log” on page 189.



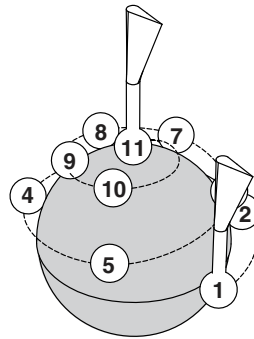
Sphere Compensation Method

Perform the Sphere Compensation using a precision sphere or tooling ball. The sphere should be at least 10mm (3/8") diameter or larger. You will digitize 44 individual points in specific locations around the sphere by pressing the GREEN button for each.

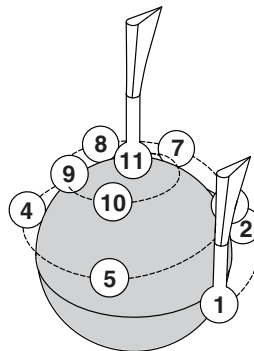
CAUTION: The ball probe *must* remain in contact with the sphere while digitizing points. Even one or two poorly digitized points significantly affects the optimization process, which then has an effect on the accuracy of the Edge.



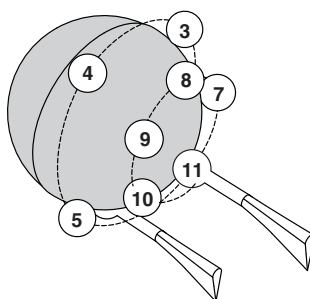
- Digitize 11 points around the top hemisphere of the sphere with the probe pointing in position #1. Hold the handle in the same direction and orientation for every point.



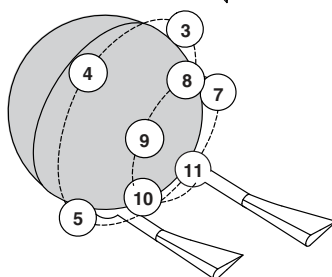
- Rotate the handle 90 degrees. Digitize 11 points around the top hemisphere of the sphere with the probe pointing in position #1. Hold the handle in the same direction and orientation for every point.



- Digitize 11 points around the front hemisphere of the sphere with the probe pointing in position #2. Hold the handle in the same direction and orientation for every point.



- Rotate the probe 90 degrees. Digitize 11 points around the front hemisphere of the sphere with the probe pointing in position #2. Hold the handle in the same direction and orientation for every point.

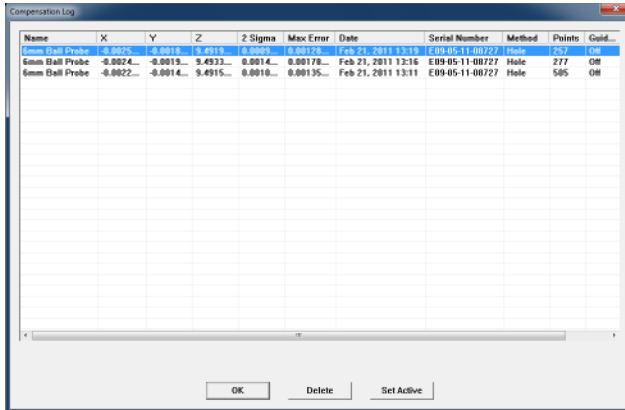


The digitized compensation points then calculate and the COMPENSATION STATUS updates. If the probe passes, the current date and time is added to the probe information.

You can view the details for all of the compensations of a probe by clicking the View Log button. See “View Log” on page 189.

View Log

The COMPENSATION LOG dialog box displays the compensation history of the current probe. You can set to active or delete any previous compensation. You can also select the compensation values and copy them to the windows clipboard.



Name	X	Y	Z	2 Sigma	Max Error	Date	Serial Number	Method	Points	Guid...
Compensation Log	0.0000	0.0000	0.0000	0.0000	0.0000	Feb 21, 2011 13:11	E09-05-11-00727	Hole	277	OM
6mm Ball Probe	-0.0024...	-0.0019...	9.4933...	0.0014...	0.00178...	Feb 21, 2011 13:16	E09-05-11-00727	Hole	595	OM
6mm Ball Probe	-0.0022...	-0.0014...	9.4915...	0.0010...	0.00135...	Feb 21, 2011 13:11	E09-05-11-00727	Hole	595	OM

Figure 10-7 Compensation Log dialog box

- The X, Y, Z values are the location of the center of the ball probe in the last joint coordinate system.
- The 2 Sigma value is the deviation of all the points taken during the compensation.
- The Max. Error column displays the displacement of the point with the largest displacement. In order to pass compensation, this value has to be less than the single point accuracy specification of the arm.


Single Point:

0.029mm

Volumetric:

+/- .041 mm

MADE IN



WLAN

Contains FCC ID: ED9LMX9838
and IC: 1520A-LMX9838

FCC ID: YQM14000
and IC: 9265A-14000

FARO
Model 14000

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.

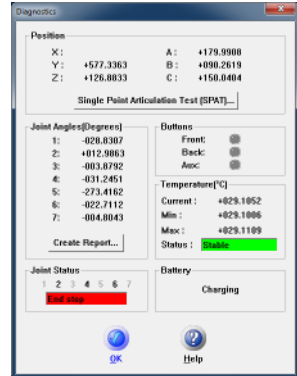
This product is protected by US Patents:
5402502, 5611147, 5794356, 6366831, 6606539, 6904691, 6925722, 6935036, 6973734, 6988322,
7032321, 7043847, 7051450, 7069664, 7269910, D607350.
Other US and worldwide patents issued and pending.



Diagnostics

Select **DEVICES < DIAGNOSTICS** from the **DEVICES** menu. The **DIAGNOSTICS** dialog box displays:

- X, Y, Z Machine Coordinates.
- Encoder angles for each joint of the Edge.
- **FRONT** (Green) and **BACK** (Red) button, and Auxiliary Port operations.
- The Temperature of the Edge's internal sensor.
- The Joint Status of each joint of the Edge which also includes the encoder end stop warnings.
- The status of the Edge battery pack.



Click the **PERFORM SINGLE POINT ARTICULATION TEST (SPAT)** button to run a Single Point Articulation Test (SPAT) with your Edge. You can save this report to a file which you can send to FARO's Customer Service Department. *For more information, see "Single Point Articulation Test (SPAT)" on page 94.*



Temperature

-Select **DEVICES < TEMPERATURE** from the **DEVICES** menu. This command displays the current temperature of the Edge and the elapsed time of the temperature sampling.

Because different components heat up or cool down at different rates, the Edge must be at a steady state temperature (within $\pm 3^{\circ}$ Celsius for five minutes) before measuring with the device.



Technical Support

FARO Technologies, Inc. is committed to providing the best technical support to our customers. Our Service Policy is detailed in *Appendix C: FARO Products Service Policy* of this manual. If you have any problem using one of our products, please 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 problem will be to solve.
- If you still cannot resolve your problem, have your device's Serial Number available *before calling*.

Support Hours (Monday through Friday)

North America:

8:00 a.m. to 7:00 p.m. Eastern Standard Time (EST).

Europe:

8:00 a.m. to 5:00 p.m. Central European Standard Time (CET).

Asia:

8:30 a.m. to 5:30 p.m. Singapore Standard Time (SST).

Japan:

9:00 a.m. to 5:00 p.m. Japan Standard Time (JST).

China:

8:30 a.m. to 5:30 p.m. China Standard Time (CST).

India:

9:30 a.m. to 5:30 p.m. India Standard Time (IST).

You can also e-mail or fax any problems or questions 24 hours a day.

• **Phone**

North America:

800 736 2771, +1 407 333 3182 (Worldwide)

Mexico:

866-874-1154

Europe:

+800 3276 7378, +49 7150 9797-400 (Worldwide)

Asia:

1800 511 1360, +65 6511 1350 (Worldwide)

Japan:

+800 6511 1360, +81 561 63 1411 (Worldwide)

China:

+800 6511 1360, +86 21 6191 7600 (Worldwide)

India:

000800 650 1397, +91 11 4167 6330/1 (Worldwide)

- **Fax**

North America:

+1 407 333 8056

Europe:

+800 3276 1737, +49 7150 9797-9400 (Worldwide)

Asia:

+65 6543 0111

Japan:

+81 561 63 1412

China:

+86 21 6494 8670

India:

+91 11 4167 6332

- **E-Mail**

North America:

support@faro.com

Europe:

support@faroeurope.com

Asia:

salesap@faro.com

Japan:

support_japan@faro.com

China:

chinainfo@faro.com

India:

infoindia@faro.com

E-Mails 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, please leave a voice mail message; calls are always returned within 4 hours. Please 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.

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, sub-license, 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 LICENSOR 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 C: FARO Products Service Policy*.

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 Edge and reported to FARO within the Maintenance/Warranty Period. If the Edge 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 Edge will be repaired or adjusted to the extent found by FARO to be necessary or at the option of FARO, replaced with a new Edge 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 Edge. Within a reasonable time of receipt of such notice, FARO shall have the System and Edge diagnosed by its service personnel, and maintenance/warranty service will be provided at no cost to the Purchaser if the System and

Edge 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 Edge 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, if in the reasonable opinion of FARO, the Edge, 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 Edge’s (“Temporary Replacements”) while corresponding parts of the Purchaser’s system

or Edge are undergoing repair at FARO's factory. Shipping charges for these "Temporary Replacement" parts or Edge'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.

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 Edge 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 Edge 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 Edge, 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 Edge, 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 Edge, 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 Edge, the Software, operating manuals and any other product or merchandise sold pursuant to the Order. If the Purchaser is buying only a Edge, 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 Edge, the Software, the Computer, and optional parts and accessories associated with the Edge.

8.06 “Certified user” means any person who has completed and passed the written exam issued by FARO. The exam is available upon request.

8.07 “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.

8.08 “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: FARO Products Service Policy

A one-year maintenance/warranty comes with the purchase of new FARO manufactured hardware products. Supplemental Service Plans are also available at additional cost. See *Appendix D: FARO Service Policy* for further details.

FARO Hardware under Maintenance/Warranty

The following is a summary of what services can be obtained under the original warranty or Supplemental Service Plan.

- 1 Factory repairs on FARO-manufactured hardware products at any FARO Service Center.
- 2 Factory repairs are targeted for completion within 7 (FaroArms) or 14 (Laser Trackers and Laser Scanners) working days of FARO's receipt of the defective item. The customer is responsible for returning the hardware to a FARO Service Center in the original packing container or custom case.
- 3 FARO will return the hardware via 2-day air service to the Continental U.S. Outside the Continental U.S., FARO will return the hardware to the customs broker via 2-day air service. Expedited service can be arranged at the customer's expense.
- 4 Upon expiration of original warranty a Supplemental Service Plan may be purchased and can be renewed annually on FARO-manufactured hardware products.
- 5 All Supplemental Service Plans will be due for renewal at the end of the month in which the Service Plan or warranty was purchased, plus 12 months.
- 6 The original warranty and Supplemental Service Plan are transferable to subsequent owners under certain conditions:
 - The Edge is currently under the original warranty and Supplemental Service Plan.
 - New owner is, or becomes, a certified user.
 - A FARO Transfer of Original Warranty or Service Plan Agreement form is completed and submitted to Customer Service.

- 7 FARO will continue to repair FARO-manufactured hardware products for a period of 7 years from the last day of FARO product production. Contact FARO's Customer Service Department for the exact last day of production for your specific Edge model.

FARO Hardware NOT under Maintenance/Warranty

Factory assessments and repairs on FARO-manufactured products will follow the following procedure:

- 1 The customer obtains a service number from FARO's Customer Service Department.
- 2 The customer ships the part to a FARO Service Center with the service number on the label along with payment or a corporate purchase order for system testing and evaluation, which includes compensation and calibration.
- 3 The payment will be applied toward the total service cost beyond the initial payment. The estimated repair cost will be given to the customer prior to the repair. The total cost must be paid prior to beginning the service.
- 4 System testing and evaluation can take up to 30 days. FARO-manufactured part repairs can take up to 60 days. However, the part will be scheduled for service as soon as it arrives at a FARO Service Center.
- 5 The customer is responsible for all shipping charges to and from FARO, including import and export fees for international customers.
- 6 FARO will continue to repair FARO-manufactured hardware products for a period of 7 years from the last day of FARO product production. Contact FARO's Customer Service Department for the exact last day of production for your specific Edge model.

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. Details are as follows:

- 1 The training class will prepare attendees to successfully attain an operators certification (see *Certification Requirements* section for more details).
- 2 The fee schedules for advanced additional training courses can be obtained from Customer Service, or the Sales department.

Certification Requirements

The Edge operator's inherent ability to understand 3D concepts may be in their background training. However, the precision with which the operator performs 3D measurements with the Edge is critical in establishing the accuracy and repeatability of the results of subsequent measurements.

In order to establish the proficiency of Edge operators, FARO has instituted an Operator Certification program, where each operator's knowledge and understanding of the Edge is evaluated. The successful operator is awarded a certificate which identifies him/her as an accredited Edge operator. The requirements are as follows:

- 1 Attend a FARO-conducted basic training course, either at a FARO Facility or on site at your facility.
- 2 Certification will be awarded once the class has been completed, and then the certified user will be registered for hardware and software support.

To certify an operator, call FARO's Training Department, 800.736.0234 (North America), +1 407.333.9911 (Worldwide), for updated information.

Edge Repair Fee Schedule

(Out of Maintenance/Warranty Owners Only!)

System Testing and Evaluation Fee - Contact your local FARO Service Center for pricing.

A fee is charged for any system testing and evaluation. This includes system diagnosis, compensation and/or calibration, and applies to all Edges. However, this fee does not include disassembly/repair costs if required. An estimated cost for disassembly/repair will be given to the customer prior to the repair. The disassembly/repair charges must be paid in full prior to the actual disassembly/repair. However, if no repairs are needed the fee will be applied to the cost of system testing and evaluation. All evaluations contain a compensation. Calibration will be performed on an “as needed” basis.

Contact your local FARO Service Center for the current system testing and evaluation fee pricing.

Repair Times

Compensation and/or Calibration Only - Can take up to 14 days to complete.

Disassembly and Repair - Can take up to 60 days to complete. This time is dependent on the supply of purchased components.

*Includes Compensation and Calibration



Transfer of Original Warranty or Service Plan Agreement

(SELLER'S CORPORATE OR INDIVIDUAL NAME AS APPLICABLE),
hereby waives all rights under the warranty service policy for
Edge Serial Number _____
CAM2 Port Lock Number _____
purchased originally on _____ (DATE).

(BUYER'S CORPORATE OR INDIVIDUAL NAME AS APPLICABLE),
hereby assumes all rights and obligations of the Hardware and/or Software Warranty
Service Policy from _____ (DATE OF TRANSFER).
This transfer is only valid under the following conditions.

- 1 The Edge is currently under maintenance/warranty
- 2 New owner is, or becomes, a certified user.
- 3 This maintenance/warranty transfer form is completed and submitted to FARO Customer Service.

AGREED

(PRINT SELLER'S CORPORATE OR
INDIVIDUAL NAME AS
APPLICABLE)

(PRINT SELLER'S CORPORATE OR
INDIVIDUAL NAME AS
APPLICABLE)

BY _____
X _____
(PRINT NAME OF SIGNATORY)
FARO Technologies, Inc.

BY _____
X _____
(PRINT NAME OF SIGNATORY)

Approved by x _____

(PRINT NAME OF SIGNATORY)

Appendix D: FARO 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 Edge 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 Edge, the Software, operating manuals and any other product or merchandise sold pursuant to the Order. If the Purchaser is buying only the Edge, 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 Edge, the Software, the Computer, and optional parts associated with the Edge.

2.06 “Hardware” means the Edge 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 Edge 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 Edge 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

Edge

Covered

- All parts and labor for Edges failing under normal use as described in Appendix B.
- Annual compensation and calibration of the Edge.

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 Edges 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 Edges 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.

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FARO Technologies, Inc.

250 Technology Park
Lake Mary, FL 32746
800-736-2771 U.S. / +1 407-333-3182 Worldwide
E-Mail: support@faro.com

FARO Europe GmbH & Co. KG

Lingwiesenstrasse 11/2
D-70825 Korntal-Münchingen, Germany
FREECALL +800 3276 7378 / +49 7150/9797-400
FREEFAX +800 3276 1737 / +49 7150/9797-9400
E-Mail: support@faro-europe.com

FARO Singapore Pte. Ltd.

3 Changi South Street 2
#01-01 Xilin District Centre Building B
SINGAPORE 486548
TEL: 1800 511 1360, +65 6511.1350
FAX: +65 6543.0111
E-Mail: salesap@faro.com

FARO Japan Inc.

716 Kumada, Nagakute-Cho
Aichi-Gun, Aichi-Ken
480-1144 JAPAN
TEL: +800 6511 1360, +81 561 63 1411
FAX: +81 561 63 1412
E-Mail: support_japan@faro.com

FARO (Shanghai) Co., Ltd.

1/F, Building No.2
Juxin Information Technology Park
188 Pingfu Road
Xuhui District, Shanghai, 200233
CHINA
TEL: +800 6511 1360, +86 21.6191.7600
FAX: +86 21.6494.8670
E-Mail: chinainfo@faro.com

