VANTAGE

FARO Laser Tracker Vantage
User Manual
October 2020

FARO

Legal Notices

Release Notice

This is the October 2020 revision of the FARO Laser Tracker Vantage User Manual. It applies to the FARO Laser Tracker Vantage.

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Implementation Notes

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Trademarks

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Chapter 1: Introduction

Thank you for choosing FARO's Portable Laser Tracker - the FARO® Laser Tracker Vantage. This document contains detailed instructions on how to use your Vantage$^{S6, S}$ or Vantage$^{E6, E}$ with FARO® Tracker Utilities and CAM2® 2020 software. Additional information about accessories and important guidelines on maintaining your new Vantage is also included.

This introduction contains information on how to reach FARO, how to read the manual, and a brief overview of the Vantage. 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 164.*

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

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How to Use This Manual

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

Bold text	Indicates directory names, menu names, buttons, tabs, key names, dialog box names, dialog box items, acronyms, and modes.
`monospaced` text	Indicates alphanumeric characters or values you enter in a field on the screen. For example, "Type `0.005` for the tolerance setting."

It is important that you understand the meaning of the following 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 *measure* 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,	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, *click* **OK** to open the file" or *"Press* **ESC** at anytime to cancel a command."

click, or press	
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

WARNING: A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or event 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

CAUTION: A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or event 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

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 FARO Laser Tracker Vantage System is a portable, high accuracy, three-dimensional coordinate measurement device which has a measurement range of up to 80 meters (262 feet) with designated long range targets. The Vantage System consists of a Laser Tracker, the Power Supply, a retroreflecting target, and a computer to run the measurement software. The Vantage is compact, lightweight, quick to set up and to relocate, and is easily operated by a single person. The Power Supply is small, lightweight, and can be placed on the floor up to 3 meters (9.8 feet) from the Laser Tracker, or 10 meters (32.8 feet) with the optional extended cable.

For more information on the components of the Vantage system components, see *The Vantage System on page 10*.

The Vantage emits an eye-safe Class I visible **red** laser beam that a Retroreflector target, typically a Spherically Mounted Retroreflector (SMR), reflects back to the Laser Tracker and onto a position sensing detector. The position of the Laser Tracker's Azimuth and Zenith axis are continually updated using the feedback from this position sensing detector. The Laser Tracker has two rotary angular encoders and a laser-based distance measurement system. The coordinates of the target are determined by measuring the two angles and its radial distance.

The Vantage measures the radial distance to the target using a phase shift Absolute Distance Meter (ADM) system named iADM. The iADM system tracks and measures both angle and distance on the same beam. It also allows radial distance to be accurately measured in mid-air and lets the beam be reacquired in midair after a beam break has occurred. It is ready to work immediately after power up.

A fully-integrated weather station is standard with every Vantage system to ensure accurate radial distance measurement. A precision level sensor is also included inside the Laser Tracker allowing accurate measurement of the gravity vector.

The Vantage includes two Multi-View Color Cameras in the Laser Tracker to provide situational awareness and user overview. These two cameras assist in acquiring a target after the beam has been broken or during point-and-shoot applications. These integrated cameras allow you to find targets by clicking near the target image on the computer screen. The MultiView Cameras are the main component of Acquiring the Laser Beam with Follow Me and Acquiring the Laser Beam with Find Me, where the Vantage efficiently locates and locks the target after the laser beam is broken.

The electronics inside the Laser Tracker contain non-volatile memory used to store configuration, compensation and programming information required for easy and accurate measurements with the Laser Tracker. For security purposes, this memory does not store Laser Tracker measurements or pictures from the MultiView Cameras, and cannot be used to transfer information from one computer to another.

The FARO Laser Tracker Vantage System is IP52 rated, allowing use in demanding industrial conditions that may be exposed to water or large amounts of dust. *For more information, see "Ingress Protection (IP) Rating" on page 74.*

Component Options

Certain configurations of the Vantage do not include the cameras or the wireless transmitter. The absence of these components is indicated by the following symbols on the serial number label on the rear panel of the Laser Tracker:

No Camera

No Wireless

Regulatory Information

TheVantage's iADM outputs a single visible red laser, the source of which is a distributed feedback (DFB) laser with less than 390 milliwatt output. This Class I laser is harmless to your eye. You should avoid direct exposure to your eye at all times even though the human blink reaction to bright light provides a natural mechanism of protection to this visible laser beam.

This equipment is classified as a Class I laser product and meets the requirements of the Food and Drug Administration, Center for Devices and Radiological Health, Register 21 CPR parts 1000 and 1040, and those of the international standard IEC EN 60825-1 2007-03.

The Vantage is certified to comply with the protection requirements of the Council Directives 2014/30/EU (Electromagnetic Compatibility) and 2014/35/EU (Low Voltage Directive on Electrical Safety) and 1999/5/EC (R&TTE applies to radio equipment) as per requirements of the laws of the Member States.

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

The user must adhere to work safety laws as stated in UVV BGV B2, January 1993.

Wireless Regulatory Information

Regulatory information for the Vantage’s wireless components is listed on the rear of the Laser Tracker.

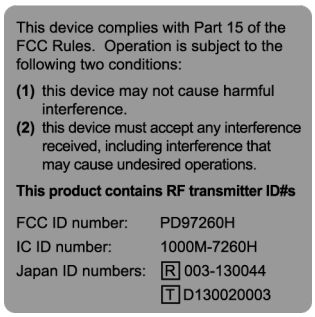


Figure 1-1 Wireless regulatory information label

The Vantage is incorporating the Intel wireless adapter, which is in compliance with local regulations.

“Contains FCC ID: PD97260H, Industry Canada IC ID: 1000M-7260H” displayed on the end product label.

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 A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful

interference when the equipment is operated in a commercial environment, this equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment is a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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.

CAUTION: Due to the fact that the frequencies used by 802.11a, 802.11b, 802.11g, 802.11n, and 802.11ac wireless LAN devices may not yet be harmonized in all countries, 802.11a, 802.11b, 802.11g and 802.11n products are designed for use only in specific countries, and are not allowed to be operated in countries other than those of designated use. As a user of these products, you are responsible for ensuring that the products are used only in the countries for which they were intended and for verifying that they are configured with the correct selection of frequency and channel for the country of use. The device transmit power control (TPC) interface is part of the Intel® PROSet/Wireless WiFi Connection Utility Software. Operational restrictions for Equivalent Isotropic Radiated Power (EIRP) are provided by the system manufacturer. Any deviation from the permissible power and frequency settings for the country of use is an infringement of national law and may be punished as such.

FCC Radio Frequency Interference Requirements:

This wireless adapter is restricted to indoor use due to its operation in the 5.15 to 5.25 and 5.470 to 5.75GHz frequency ranges. FCC requires this wireless adapter to be used indoors for the frequency ranges 5.15 to 5.25GHz and 5.470 to 5.75GHz to reduce the potential for harmful interference to co-channel mobile satellite systems. No configuration controls are provided for Intel wireless adapters allowing any change in the frequency of operations outside the FCC grant of authorization for U.S. operation according to Part 15.407 of the FCC rules:

- This wireless adapter is intended for OEM integrators only.
- This wireless adapter cannot be co-located with any other transmitter unless approved by the FCC based upon MPE/Power Density/RF exposure transmitting assessment.

Industry Canada Statement:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, 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*

CAUTION: When using IEEE 802.11a wireless LAN, this product is restricted to indoor use due to its operation in the 5.15- to 5.25-GHz frequency range. Industry Canada requires this product to be used indoors for the frequency range of 5.15 GHz to 5.25 GHz to reduce the potential for harmful interference to

co-channel mobile satellite systems. High power radar is allocated as the primary user of the 5.25- to 5.35-GHz and 5.65 to 5.85-GHz bands. These radar stations can cause interference with and/or damage to this device. The maximum allowed antenna gain for use with this device is 6dBi in order to comply with the E.I.R.P limit for the 5.25- to 5.35 and 5.725 to 5.85 GHz frequency range in point-to-point operation. To comply with RF exposure requirements all antennas should be located at a minimum distance of 20cm, or the minimum separation distance allowed by the module approval, from the body of all persons.

European Union:

The low band 5.15 -5.35 GHz is for indoor use only.

Japan:

5.15-5.35GHz indoor use only.

5GHz 帯は室内でのみ使用のこと

Indoor use only.

Singapore:

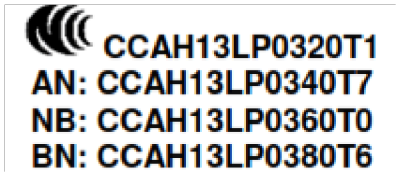
Complies with
IDA Standards
DB 02941

South Korea:

KCC-CRM-INT-7260HMW
AN: KCC-CRM-INT-7260HMWAN
NB: KCC-CRM-INT-7260HMWNB
BN: KCC-CRM-INT-7260HMWBN

당해 무선설비는 운용 중 전파혼신 가능성이 있음

Taiwan:



第十二條

經型式認證合格之低功率射頻電機，非經許可，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。

第十四條

低功率射頻電機之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。
前項合法通信，指依電信法規定作業之無線電通信。
低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

General Safety Information

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

- Solvents.
- Opening the Vantage. There are no user serviceable parts.
- Aiming the laser at anything except a measuring target. *See "Laser Radiation Emission" on page 25.*
- Abuse such as dropping, or moving the Vantage while the motors are on. *See "Motor On/Off" on page 156.*
- Power Fluctuations. *See "General Specifications and Rated Conditions " on page 79.*

CAUTION: The protection provided by this equipment can be impaired if using the Vantage in any manner not specified in this manual or other documentation.

Product Environmental Information

Legislation is now in place within the European Union (EU) that regulates waste from electrical and electronic equipment (WEEE). European Directive
2012/19/EU 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, Inc. product, indicates that this product meets the European Directive 2012/19/EU 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.

WEEE Symbol

Refer to *www.faro.com/support/rohs-and-weee-statement/* for further environmental information concerning this product.

This product is in compliance with the DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHs).

Chapter 2: The Vantage System

The major components of the Vantage system are the Laser Tracker, the Power Supply, a retroreflecting target, and the controlling computer running measuring software such as FARO CAM2 2020.

NOTE: The Vantage is only compatible with CAM2 2020, CAM2 Measure v10.6 and later. 6Probe operation requires CAM2 2020, CAM2 Measure v11.4 and later.

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Vantage

The Vantage contains the tracker axis, laser, optics, encoders, pressure and humidity sensors, and supporting electronics. The Vantage has a Power On/Off button and a WLAN On/Off button.

Figure 2-1 Laser Tracker Vantage Front View

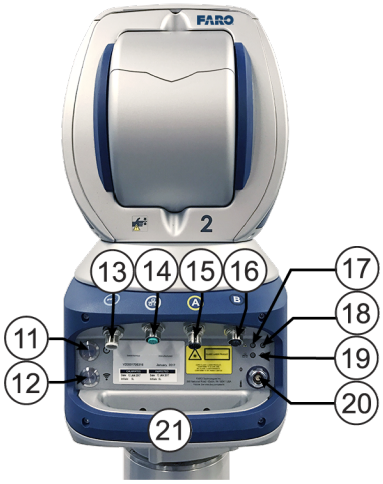

Figure 2-2 Laser Tracker Vantage Rear View

① Retractable Lifting Handle
② Indicator LEDs
③ Laser Aperture
④ MultiView Cameras
⑤ 1½" SMR Home Position
⑥ ⅞" SMR Home Position
⑦ ½" SMR Home Position
⑧ Wireless Antenna Connector
⑨ Barometer Hose Test Fitting (underneath base)
⑩ Mandrel

⑪ Power On/Off Button
⑫ WLAN On/Off Button
⑬ Power Supply Connector
⑭ Ethernet Connector
⑮ Auxiliary Box Connector A
⑯ Auxiliary Box Connector B
⑰ Laser Indicator LED
⑱ System Indicator LED
⑲ Network Indicator LEDs
⑳ Temperature Sensor Connector
㉑ Base Handle

Indicator LEDs

The Vantage lights indicate the following:

① **Red** Aperture Light
② **Green** Aperture Light
③ **Amber** Aperture Light
④ **Blue** Aperture Light

Figure 2-3 Vantage Indicator LEDs

All Lights Blinking - Boot Sequence

Red Aperture Light

- Solid - Vantage is measuring
- Blinking - Vantage is measuring in scan mode (multiple measurements)

Green Aperture Light

- Off - Not locked on target
- Solid - Locked on target, valid beam and target position
- Blinking - Locked on target, invalid beam and target position

---

NOTE: Before the Vantage is initialized the green aperture light may blink even if a target is not reflecting the beam back to the Vantage.

Amber Aperture Lights - Application specific indicator

- Solid
- Slow Blinking
- Fast Blinking

Blue Aperture Lights - Application specific indicator

- Solid
- Slow Blinking
- Fast Blinking

Figure 2-4 Laser Tracker Vantage Front Left View

Figure 2-5 Laser Tracker Vantage Front Right View

① Indicator LEDs

NOTE: The Blue and Amber Aperture Lights indications are explained later in this and other FARO user manuals. For more information, *seeAcquiring the Laser Beam with Follow Me on page 160 and Acquiring the Laser Beam with Find Me on page 161*.

Power Supply

This section describes that latest revision of the Power Supply. This revision change happened on new units shipped after June 2019. For detailed information about the previous revision, contact your Customer Service Representative by Phone, Fax or E-Mail. *See "Technical Support" on page 164.*

The Power Supply (FARO part # 820-000192-000) provides DC power to the Vantage. The Power Supply contains two connectors:

- AC Power Input
- DC Power Output

You will use two cables to connect it to your power source and the Vantage:

- AC Power cable (FARO part # 115-000080-NNN) connects between the AC Input connector and your power source (single phase receptacle with Earth GND).

NOTE: The last three digits of the power cord part number change for different countries. To find the correct part number for your country, contact your Customer Service Representative by Phone, Fax or E-Mail. *See "Technical Support" on page 164.*

- DC Power cable (FARO part # C-CBL-08701-000-10) connects between the DC output connector and the Power Supply connector on the Vantage. The DC Power cable has a pre-installed adapter (FARO part # 115-000214-000) to connect to the Power Supply.

NOTE: The last two digits of the power cable part number change for the length of the cable. To find the correct cable length, contact your Customer Service Representative by Phone, Fax or E-Mail. *See "Technical Support" on page 164.*

The AC and DC connectors are identified with appropriate symbols as shown in Figure 2-6.

1 AC Input Connector
2 DC Output Connector

Figure 2-6 Power Supply

CAUTION: The Vantage AC Power cable, 115-000080-NNN, is **Not** designated for general purpose use and shall only be used with the Vantage Power Supply (820-000192-000).

Figure 2-7 AC Power Cable and Power Supply

NOTE: The last three digits of the power cord part number change for different countries. To find the correct part number for your country, contact your Customer Service Representative by Phone, Fax or E-Mail. *See "Technical Support" on page 164.*

You can also power your Vantage with the Battery Box Kit (FARO part # C-ACC-08989-000-00) that provides portable power for up to 8 hours. For more information, *see the FARO Laser Tracker Accessories Manual.*

NOTE: The last two digits of the Battery Box Kit part number change for different countries. To find the correct part number for your country, contact your Customer Service Representative by Phone, Fax or E-Mail. *See "Technical Support" on page 164.*

Optical Targets

You can use a number of target types with the Vantage. The most common types are described below.

Spherically Mounted Retroreflector (SMR)

The Spherically Mounted Retroreflector (SMR) is the most commonly used target with the Laser Tracker. It consists of a hollow cornercube mirror precisely mounted within a tooling sphere. The distance between the outside of the sphere and the center of the tooling sphere is known (the radius of the tooling sphere) and the CAM2 software, and many other software packages, use this value to offset, or compensate, measurements. SMRs are available in 1½" (38.1 mm), ⅞" (22.225 mm) and ½" (12.7 mm) diameters. The SMR will reflect a laser beam with an incident angle of up to approximately ±30°.

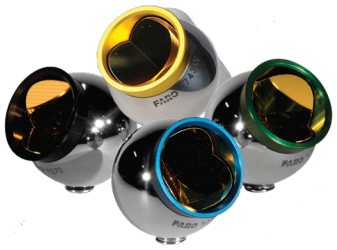

Figure 2-8 Spherically Mounted Retroreflector (SMR)

A colored ring band identifies each of the three SMR models available for each diameter size:

- **Black** - Standard Accuracy. The reflector vertex is centered within ± 0.0003" (0.0076mm).
- **Gold** - High Accuracy. The reflector vertex is centered within ± 0.0001" (0.0025mm).
- **Green** - Long Range. The reflector vertex is centered within ± 0.0003" (0.0076mm) and the dihedral angles have a tighter tolerance to permit the extended range.
- **Blue** - High Performance. The reflector vertex is centered within ± 0.0001" (0.0025mm) and the dihedral angles have a tighter tolerance to permit the extended range.

You can attach the SMR to a target adapter. The combination of the SMR and the adapter changes the compensation value. Use adapters to measure edges, inner and outer diameters and the position of bushed holes. There are a wide range of target adapters that are available from the FARO Electronic Product Catalog at *www.faro.com*.

6Probe

Part # 900-000102-000

The FARO® 6Probe is a wireless Six Degree of Freedom (6DoF) probing system for the Vantage^{S6} and Vantage^{E6} Laser Trackers. The 6Probe is battery powered and has a set of removable probe tips and extensions to measure your part.

NOTE: The 6Probe requires Vantage MCU firmware v2.11.0 or later.

1. Status LEDs
2. Power Indicator
3. Battery Power Indicator
4. Buttons 1- 4 (on side)
5. Battery Cover or 6Probe Handle
6. Battery Cover Locking Latch
7. Power On/Off Button
8. Kinematic Probe Adapter
9. Removable Probe Tip

Figure 2-9 6Probe Rear View

① 6DoF Sensors (11 total)
② 6Probe Corner Cube
③ Buttons 1- 4 (on side)
④ Kinematic Probe Adapter
⑤ Removable Probe Tip
⑥ Locking Handle

Figure 2-10 6Probe Front View

Indicator LEDs

The operational range of the 6Probe is 2.5 meters (8ft) to 15 meters (49ft) - 30 meters (98.4ft) spherical working volume. All setup, probe management, and measurement must be done within the operation range.

Figure 2-11 6Probe LED Indicators

The ① Power Indicator is **blue** when the 6Probe is powered and operating properly.

The ⑤ Battery Power Indicator displays the current battery level:

- **Green** - 60% to 100%

- **Orange** - 20% to 60%
- **Red** - 5% to 20%
- **Blinking Red** - less than 5%

The ③ Center Status LED displays the current pairing status:

- Off - no pairing
- **Blue** - successful pairing

The ② Left Status LED displays the probe tip and measurement status:

- Off - no pairing
- **Green** - Valid Probe Tip
- **Blinking Green** - Invalid Probe Tip
- **Red** - Measurement

The ④ Right Status LED displays the Corner Cube rotation to the Vantage:

- Off - Beam lost Off-Axis
- **Green** - On-Axis
- **Orange** - Moving towards Off-Axis

All ②③④ Three Status LEDs display the pairing process events:

- **Blinking Blue** - pairing in process
- **Blinking Red** - pairing failure, or loss of pairing

FARO RetroProbe

The RetroProbe is an optional accessory product which greatly increases the versatility of the Vantage System. There are two versions of the RetroProbe: 100 and 400. The FARO RetroProbe 100 facilitates the measurement of surface features such as holes, small pockets, corners, and other features which are difficult or impossible to probe with the standard SMR. The RetroProbe 400 expands on the versatility of the RetroProbe 100 by providing easier manipulation of the device and allowing you to measure in locations up to four inches in depth.

Figure 2-12 RetroProbe 400

RetroProbe 100 kit - FARO part # 950-00-016

RetroProbe 400 kit - FARO part # 950-00-054

Break Resistant Spherically Mounted Retroreflector (SMR)

Available in ⅞” (22.225 mm), ½” (12.7 mm) and 1½” (38.1 mm) diameters, the Break Resistant SMR is an impact resistant target built with centering accuracy up to 0.0003” (7.6 µm) for the ⅞” (22.225mm) and ½” (12.7 mm) targets and 0.0001” (2.5 µm) for the 1½” (38.1 mm) target.

Figure 2-13 Break Resistant SMR

Repeatability Targets

Use the Repeatability Target for repeatability and drift testing. Attach the target to a surface using hot glue or a similar adhesive, or use FARO part C-ACC-04140-000 - Repeatability Target Mount. Use this target only for repeatability measurements, *DO NOT* use it for accuracy measurements.

Figure 2-14 Repeatability Targets

Optical Target Care

Optical Target Care Overview

Optical Targets, such as the spherically mounted retroreflector (SMR), are an important part of the FARO Laser Tracker. Handle SMRs with great care to ensure accuracy and longevity.

Target care includes:

- Never touching the optical surfaces of the target.
- Never dropping the target.
- Keeping the target free of dust and moisture by storing it in the case when not in use.
- Cleaning the target *only* when there are problems acquiring the target or the Operational Checks indicates cleaning is necessary.
- Always using the proper cleaning materials and procedure when cleaning is required.

If the FAROLaser Tracker does not lock onto the target, use the Operational Checks command to check your SMR. If the Return Power value is “**GOOD**” your SMR does not need cleaning.

CAUTION: Unnecessary cleaning will degrade the reflective surface of the SMR and can cause damage to the coatings on silver surfaces that will eventually destroy the SMR. Only clean SMRs when required for good measurement and accuracy performance, not based on cosmetic conditions.

Cleaning Optical Targets

In many cases, the optical surfaces of the target are simply dusty and just require cleaning with compressed air from a can.

CAUTION: Do not clean with compressed air available from a hose in a workshop - the air is seldom clean and may coat the SMR with oil or some other contaminant.

- Spray the air away from SMR for a few seconds before spraying it onto the optical surfaces to remove any propellant in the can from the air nozzle. This prevents the propellant from being sprayed onto the SMR's optical surfaces. Always hold the can upright and never shake the can when spraying compressed air.

If the target is still not functional after blowing off any dust, use the following target specific procedures.

CAUTION: Never use a dry cotton swab or tissue to clean the optical surfaces because these will scratch the optical surfaces. Cleaning with any improper chemicals will destroy the reflective surface.

1. Breathe on the optical surfaces. The moisture in your breath will form a layer of condensation on the optical surfaces.
2. While condensation is still on the glass surface, gently slide a cotton swab in one direction while rotating it in the opposite direction. Use very little pressure; do not push the cotton swab onto the surface. Use one cotton swab for each pass and then discard it. You may need several swabs to clean the optical surfaces thoroughly. Using a cotton swab more than one time can cause debris to scratch the coatings. For silver SMRs, a scratch can lead to oxidation under the coatings and destroy the SMR.
3. If this does not successfully remove the residue, clean the optical surfaces with Optima Grade acetone for oil based residue or denatured alcohol for water based residue.
4. Moisten a clean cotton swab with solvent.
5. Gently slide the cotton swab in one direction while rotating it in the opposite direction. Use very little pressure; do not push the cotton swab onto the surface. Use one cotton swab for each pass and then discard it. You may need several swabs to clean the optical surfaces thoroughly.
6. Remove any remaining cotton dust with canned compressed air.

Controlling Computer

A PC based computer running a Microsoft Windows operating system controls the Vantage System. The computer communicates with the Vantage using the TCP/IP network protocol in either Wired or Wireless mode. In Wired mode, the cable connecting the computer and the Vantage is a CAT5 patch cable with a crossover for network communications terminated with an RJ-45 connector. In Wireless mode, the Vantage connects to the computer using the Wireless-N network adapter.

Software - FARO CAM2 2020

FARO CAM2 2020, is a CAD-based measurement and analysis software developed for use with a variety of 3D measurement instruments, including the Vantage. Use CAM2 2020 for simple go/no-go measurements or CAD-to-part comparison. CAM2 2020 allows you to measure details, create coordinate systems based on known datums, apply tolerancing (rectangular and GD&T), and create graphical reports. Simplify repeat inspections by creating a part measurement program which records all measurement instructions and then prompts a user through the entire inspection routine.

For more information about using the Vantage with CAM2 2020, *see Configuring the Vantage in FARO CAM2 2020 on page 150*.

Triggering Devices - RF Remote Control

The hand-held remote control is a wireless mouse with left and right click functions, and four auxiliary buttons. Program the buttons using the controlling software to perform basic Laser Tracker System commands from up to 30 meters (100 feet) away from the computer.

Refer the Assembly Instructions for the RF Remote, for setup and operation information.

Triggering Devices - Wired Control

The Vantage has an **External Sync Output** port and an **External Trigger-Input** port via the Auxiliary Box. Use the **External Sync Output** port to synchronize measurements with any other controller such as a robot, CNC, or other external device. The **External Trigger-Input** port enables measurement requests to be initiated via hardware control, such as from PLC equipment. An optional Multi-use Integrator cable (FARO part # C-CBL-08796-000-05 or C-CBL-08796-000-10) is available for the Auxiliary Box to provide access to both ports. The cable has four (4) pairs of shielded wires on the opposite end for connecting to another controller or external device. For more information on setup and operation of the Auxiliary Box, see the *FARO Laser Tracker Accessories Manual*.

FARO CAM2 2020, FARO Tracker Utilities Measure Pad, and the FARO Software Developer's Kit support this port.

External Trigger-Input

The **External Trigger-Input** works by using a +3.3 Volt CMOS (+5 Volt tolerant) input signal. The standard way to do this when using isolated contacts (External Trigger and GND signals) is to have the contacts normally open. This allows the internal 2.74 kΩ resistor to pull the signal up to +3.3V. When the contacts are closed, the input is pulled down to ground making this an active low trigger. When the Auxiliary Box senses this change, it causes the Vantage to record a measurement.

The External Trigger-Input uses the White-Brown and Brown wire pair of the Multi-use Integrator cable. The Brown wire is connected to the internal Auxiliary Box ground and the White-Brown wire is the external trigger signal input.

NOTE: Only use the Brown wire from the White-Brown and Brown pair for the ground. Using a wire from another pair can cause improper signaling. Isolate the remaining wire pairs to prevent a short circuit.

External Sync-Output

The **External Sync-Output** is a +3.3V CMOS logic level capable of 24mA drive. To use the CMOS output signal, use the White-Green and Green wire pair of the Multi-use Integrator cable. Connect the Green wire to ground of the external device and connect the White-Green wire to the signal input of the external device. The signal is configured as active low. The signal from the White-Green wire will be below +0.6V when measuring is active and higher than +2.2V when measuring is inactive.

NOTE: Only use the Green wire from the White-Green and Green pair for the ground. Using a wire from another pair can cause improper signaling. Isolate the remaining wire pairs to prevent a short circuit.

Optional Accessories

There are a variety of accessories for use with the Vantage System. *For more information, see "Optional Accessories" on page 31.*

Chapter 3: Vantage Safety

This chapter describes the various safety statements with the setup and operation of your Vantage. Please read this entire chapter before continuing with the setup and operation of your Vantage system.

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Rear Composite Label 26
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Laser Radiation Emission

When operating, a laser beam is emitted from the aperture on the Vantage. See Figure 3-1 for the location of the laser beam aperture.

Figure 3-1 Laser Aperture

Laser Emission Indicator

The emission indicator on the rear of the Vantage illuminates when the laser is energized and operating. See Figure 3-2 for the location of the laser emission indicator.

Figure 3-2 Laser Emission Indicator

Rear Composite Label

The composite label, located on the rear of the Vantage, combines the working logotype label, the certification label and the identification label into one. Figure 3-3

On the right side is the working logotype, which is required on all Class I laser products. It contains the wording:

LASER RADIATION, DO NOT STARE INTO BEAM.
637 nm Laser, 390 milliwatt max/cw.
CLASS I LASER PRODUCT.

To the left of the working logotype is the certification. It contains the wording:

PRODUCT COMPLIES WITH RADIATION PERFORMANCE STANDARDS UNDER THE FOOD, DRUG AND COSMETICS ACT AND INTERNATIONAL STANDARD IEC 60825-1 2007-03.

The bottom portion of the rear composite label contains the identification, which indicates the model number, the serial number, and the manufacturing date of your Vantage System.

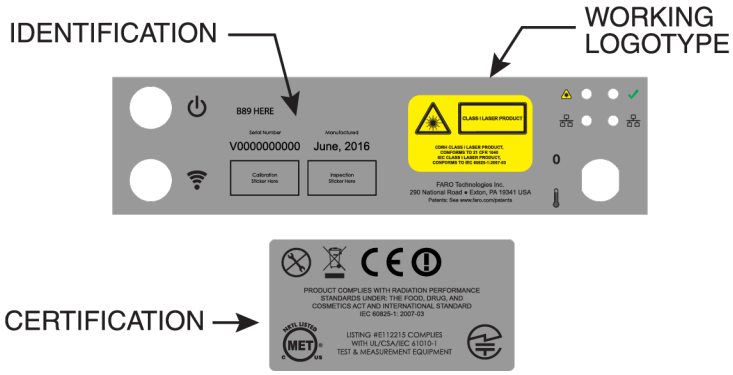

Figure 3-3 Rear Composite Labels

Lifting the Vantage

Follow safe lifting procedures when removing the Vantage from its portable storage case. Always use safe lifting procedures when placing the Vantage on, or removing the Vantage from, the instrument stand.

- Use the retractable handle and the base handle when removing it from the portable storage container.

Figure 3-4 Lifting the Vantage

- Use the retractable handle and the base handle when carrying and mounting the Vantage.

Figure 3-5 Mounting the Vantage

Pinch Points

Two labels that indicate pinch points are located on both the frontsight and the backsight side of the Vantage's center eye wheel. Avoid placing hands and fingers in these pinch points. See Figure 3-6 for the location of the pinch point labels.

Figure 3-6 Pinch Point Labels

EMC Warning

Keep the Vantage System and External Temperature Sensor cables separate from any other cables in the area in order reduce the likelihood of cross-coupled interference.

Two-way RF hand held transmitters may generate interference into the system. *Do Not* use these devices near the Vantage System during measurements.

One-way RF transmitters, such as the RF Remote sold by FARO Technologies, Inc., *do not* cause interference.

Chapter 4: Setting up the Vantage

This chapter describes the unpacking, mounting, connecting, powering up, startup checks, operational checks, compensations, and powering down of your Vantage System. You should also refer to the *FARO Laser Tracker Vantage Assembly Instructions* booklet in your shipping case.

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Cable Connections 40
Power Requirements 44
Startup Checks 46
Interim Test and Compensations 47
Powering Down 48
Wireless Connection 48
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Connection Problems 63

The Vantage Packing Contents

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

Vantage - Packing List
❑ Shipping case
❑FARO Laser Tracker Vantage
❑ Power Supply (FARO part # 820-000192-000)
❑ DC Power cable (FARO part # C-CBL-08701-000-03) - a 3 meter cable to connect the Vantage and Power Supply with attached DC Power Cable Adapter (FARO part # 115-000214-000).
❑ AC Power cable (FARO part # 115-000080-NNN) - a 2.5 meter cable to connect the Power Supply to your source of electrical power. This cable will have the correct AC plug for your country.
❑ Remote Air Temperature Sensor (FARO part # C-SNS-08793-000-03) - with 3 meter cable with a double-keyed connector that has 5 pins on the inside and a **blue** boot on the outside.
❑ Computer to Vantage Ethernet cable (FARO part # C-CBL-08702-000-10) - 1 Gbit Ethernet cable with and RJ45 connector (computer) and a circular connector (Vantage).
❑ Wireless Antennas - Two antennas to help transmit and receive wireless communication between your Vantage and your computer.
❑ Quick Release Mandrel Mount - Allows for quick mounting to an instrument stand.
❑ User Manuals - The following documentation is provided on a USB flash drive: *FARO Laser Tracker Vantage Vantage Users Manual*, and *FARO Laser Tracker Accessories Manual*.
❑ Accessories pocket: ❑ Dust cover ❑FARO Laser Tracker Vantage USB Drive ❑*FARO Laser Tracker Vantage Manual* (this book) ❑*FARO Laser Tracker Vantage Accessories Manual*
❑ Dust Cover - A cover to protect the Vantage when not in use. The cover is only necessary in very dirty environments.
❑ Documentation pocket: ❑ Documents - Certification documents showing traceability to NIST or other international standards. ❑ Assembly Instructions - FARO Laser Tracker Vantage Assembly Instructions, Optical Target Care, Folding Tripod Assembly Instructions (optional). ❑ Product Environmental Information European Union sheet
❑ Compensation Kit - equipment required for measurement and field compensation. Includes one tripod, and one tripod nest.

Optional Accessories

The *FARO Laser Tracker Accessories Manual* that is on your FARO Laser Tracker Vantage USB flash drive 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 164.*

Your Vantage system may also include one or more of the following options:

- Various Optical Targets and Tooling. The SMR Kit (FARO part # 950-03878) is a case to hold the 1½" (38.1 mm), ⅞" (22.225 mm) and ½" (12.7 mm) diameter SMRs.
- Remote Control Unit (FARO part # 13950) - Use this wireless RF remote control unit to control the Vantage system.
- Instrument Stand (Tripod) - A stand that allows for easy height adjustment and movement of the Vantage around the work environment, and provides stability during measurements.
- Uninterruptible Power Supply (UPS) - Protects the Vantage System from power spikes and provides a battery backup during a loss of power.
- Remote Air and Material Temperature Sensors with 10 meter cable.
- Target Tooling Kit - Tooling for the 1½" SMR. Includes drift nests, pin nests, a shankless nest, edge finders, etc. A Standard Tooling Kit contains the most common tooling. The kit is available in imperial (FARO part # C-ACC-05455-002) and metric (FARO part # C-ACC-05456-002) sizes.
- Extended Length DC Power cable - a 10 meter cable to connect the Vantage and the Power Supply.
- Hot glue gun and glue sticks.
- TrackArm Kit (FARO part # 21605, or part # 15336 or part # 950-02368) - Combines the Vantage with a FaroArm to create a six-degrees-of-freedom probe to measure hidden points.
- Battery Box Kit (FARO part # C-ACC-08989-000-00) - Provides portable battery power to operate the Vantage for up to 8 hours. You can also use it as an Uninterruptible Power Supply (UPS) when placed in series between the Power Supply and Vantage.
- Auxiliary Box (FARO part # C-ACC-08970-000) - Provides External Trigger and Sync capability and four additional external temperature sensor ports to the Vantage system.
- RemoteControls™ App and Android™ Tablet (FARO part # C-CMP-09827-000) - A small tablet computer and app to control the Vantage.
- FARO® 6Probe (FARO part # 900-000006-000) - a Six Degree of Freedom (6DoF) probing system for the Vantage^{S6} and Vantage^{E6} models.

NOTE: All Optional Equipment is shipped and stored in separate cases.

Shipping Case

① SMR (Spherically Mounted Retroreflector) Kit
② USB flash drive containing FARO Tracker Utilities, User and Accessory Manual, FARO Laser Tracker Vantage Assembly Instructions
③ Mandrel
④ SMR Mount for the Compensation Tripod
⑤ Compensation and Calibration Documents
⑥ FARO Laser Tracker Vantage
⑦ Power Supply
⑧ Cables: AC Power, DC Power, Ethernet, two wireless antenna, and Temperature Sensor

Figure 4-1 Vantage Shipping Case

Unpacking the System

The Vantage is packed in a shipping case which includes space for the Cables, Spherically Mounted Retroreflector (SMRs), and mounting hardware.

CAUTION: When removing the Vantage from the portable case, grasp the retractable handle located on top of the Vantage and the base handle. *For more information, see "Lifting the Vantage" on page 27.*

Shipping Case - 6Probe

1. Battery charger
2. 6Probe
3. Probe compensation nest
4. Batteries
5. Handle
6. Assembled Probe storage

Figure 4-2 6Probe Shipping Case

Probe Tip Case

1. Probe Tip Wrench
2. Probe Tip Wrench - small
3. Probe Tips

Figure 4-3 6Probe Probe Tip Case - Top Level

1. Kinematic Probe Adapter (2)
2. Hex Wrench
3. Probe Extension
4. Probe Extension Wrench

Figure 4-4 6Probe Probe Tip Case - Bottom Level

Hardware Setup

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

Mounting

You can mount the Vantage in any orientation without affecting the accuracy of its measurements. There are three mounting options for the Vantage:

1. Mount the Vantage in the vertical position on an instrument stand or a trivet through the use of its mounting mandrel. Screw the mandrel onto to the instrument stand using a 3.5”-8 UN-2B thread. Using the optional Side Mount and the mandrel, the Vantage can be mounted in the horizontal position on an instrument stand.
2. The mandrel receptacle at the bottom of the Vantage also has a bolt pattern that can also be used for mounting. This bolt pattern consists of four (4) 0.25”-20 UNC-2B holes spaced equally apart at 90 degree intervals. The bolt pattern forms a circle diameter of 3.5”.
3. The receptacle at the bottom of the Vantage is threaded into the bottom of the Vantage. This receptacle can be removed to expose the same 3.5”-8 UN-2B thread as the mandrel. Removing the mandrel receptacle allows the Vantage to be threaded directly onto an instrument stand or stand extension tube.

CAUTION: The mandrel mount is designed to hold the Vantage in only the upright vertical position or in the horizontal position. To mount the Vantage at any angle past horizontal, bolt it directly into a mounting fixture.

Setting Up the Instrument Stand

Place the instrument stand on a stable floor surface away from obstructions. Ensure that the instrument stand is resting on its feet or adjusting pins. Thread the Mandrel onto a stable Instrument Stand, and tighten using the handle. Leave the locking lever in the open position to receive the Vantage.

Figure 4-5 Threading the Mandrel onto the Instrument Stand

Check the complete Instrument Stand and make sure it is stable and tight.

NOTE: For safety reasons, do not mount the Vantage to a stand that is tilted more than 10° from vertical. When using the FARO Folding Stand with the legs in their lowest position, ensure that they are spread out as wide as possible with the center collar at the bottom of the center post. When the legs are extended, ensure that there is at least one meter between the legs for stability.

Mounting the Mandrel onto an Instrument Stand

The Mandrel allows you to attach the Vantage onto an instrument stand or similar mount by threading the mandrel onto a 3.5"-8 UN-2B thread pattern. The mandrel has two tightening levers that snap into its body that assist in threading or unthreading the mandrel from the instrument stand. To attach the mandrel onto the instrument stand:

1. Thread the mandrel onto the thread pattern.
2. Pull out the lever out from the side of the mandrel as shown in Figure 4-6 Use the lever to tighten the mandrel onto the stand.

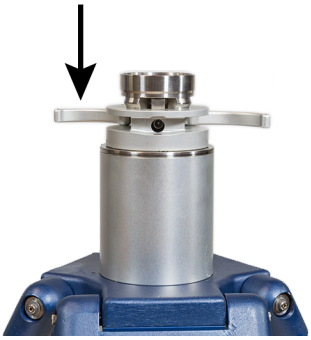

Figure 4-6 Tightening Side Lever

3. When the mandrel is fully threaded onto the stand, snap the lever back into the side of the mandrel.

Removing the Mandrel from an Instrument Stand

When measurements are complete, you can remove the mandrel from the instrument stand. To remove the mandrel from the instrument stand:

1. Pull out the other lever as shown in Figure 4-7 and use it to loosen the mandrel and unthread it from the stand.

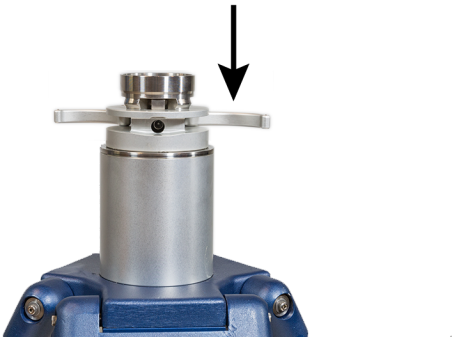

Figure 4-7 Loosening Side Lever

2. After removing the mandrel from the instrument stand, snap the lever back into the side of the mandrel.
3. Pack the mandrel in Shipping Case.

Mandrel Locking Lever Positions

The locking lever for the mandrel has three positions:

- open
- partially open
- locked

These positions change the location of the brass engagement tab that locks the Vantage into place.

Open Position Partially Open Position Locked Position

Figure 4-8 Mandrel Positions

Open Position

The open position allows the Vantage to be placed on or removed from the mandrel.

Partially Open Position

The partially open position moves the brass engagement tab preventing the Vantage from being placed on or removed from the mandrel, but it can still be easily rotate it on the mandrel. This position allows you to rotate the Vantage so the three Tracker Mounted Resets (TMR) or Home positions are in a position where you can easily access during the measurements.

NOTE: If you are doing a Pointing Interim Test which requires measurements at specific Az angles, this makes it easier to rotate the Vantage to obtain those angles as well. *For more information, see "Pointing Compensation" on page 132.*

Locked Position

The locked position completely engages the brass engagement tab and locks the Vantage securely into place. This is the position that should be used for all measurements.

Check the complete instrument stand and make sure it is stable and tight. After the mandrel has been tightened, check the stability of the mount by trying to turn the base of the Vantage. The Vantage should not move with normal turning pressure. If the base of the Vantage rotates easily on the mount, remove the Vantage, check for debris on the mandrel or receptacle, and repeat the process. If the Vantage still rotates easily, contact FARO Customer Service by Phone, Fax or E-Mail. *See "Technical Support" on page 164.*

Mounting the Vantage

1. Lift and lower the Vantage onto the Mandrel.

Figure 4-9 Mounting the Vantage

Once the Vantage is on the Mandrel, move the locking lever to the partially open (middle) position. This secures the Vantage to the Mandrel and allows you to rotate it.

2. Move the locking lever to the locked position and push the retractable lifting handle down. Make sure that the Vantage is secured.

Figure 4-10 Locking the Vantage

Cable Connections

There are four different cable connectors on the Vantage cabling. There is an alignment indicator on each cable connector and the socket for each connection. Ensure the indicators are aligned before trying to insert a cable.

DC Power cable

Ethernet cable

Remote Air Temperature Sensor cable

Figure 4-11 Aligning the Indicators

- **Remote Air Temperature Sensor cable** - Insert the connector until it snaps into the socket and locks. Pull the blue grip back to unlock the connector.
- **Ethernet cable** - Insert the connector and twist the locking ring clockwise approximately ¼ turn. Twist the locking ring counterclockwise to unlock the connector.
- **DC Power cable** - Insert the connector and twist the locking ring clockwise until hand tight. Twist the locking ring counterclockwise to unlock the connector.
- **AC Power cable** - Insert the connector and twist the locking ring clockwise until hand tight. Twist the locking ring counterclockwise to unlock the connector.

Installation

1. Make sure that the power switch on the Vantage is in the "**Off**" position. This is an momentary switch which defaults to "Off".

2. Connect the Remote Air Temperature Sensor to the port on the rear panel of the Vantage.

Figure 4-12 Connecting The Remote Air Temperature Sensor

3. Connect the Ethernet cable from the rear panel of the Vantage to your computer's network port.

Figure 4-13 Connecting the Ethernet Cable

4. Connect the DC Power cable from the rear panel of the Vantage to the DC Input connector of the Power Supply.

Figure 4-14 Connecting the DC Power Cable

5. Connect the AC Power cable to the AC Input connector on the Power Supply and the three prong plug to 120 or 240 VAC power source.

Figure 4-15 Connecting the AC Power Cable

NOTE: FARO recommends to use an Uninterruptible Power Supply (UPS) between the power source and the Power Supply.

Computer Configuration

The Vantage requires a Intel® Pentium® Core™ i5-4200M, Dual Core 2.5GHz processor PC (or better), running Windows 7 (or better), with an Ethernet card.

1. Only one Ethernet card should be enabled, and the Windows firewall turned off.
2. Set your Ethernet card TCP/IPv4 to a static IP address of 128.128.128.10, with a subnet mask of 255.255.255.0. In Windows 10:
   - Click **Start** > **Settings**.
   - Click **Network & Internet**.
   - Click **Change Adapter Options**.
   - Double-click your ethernet adapter card.

- In the **Ethernet Status** dialog box, click **Properties**.
- Choose the **Internet Protocol Version 4 (TCP/IPv4)** and click **Properties**.
- Select the **Use the Following IP address** radio button and enter the static IP address (128.128.128.10) and Subnet mask (255.255.255.0).

NOTE: You can set the Vantage to operate in DHCP mode. *For more information, see "Change Network Settings" on page 102.*

3. The Vantage system's factory IP address is 128.128.128.100. Connecting to the Vantage requires the supplied Ethernet cable.

NOTE: You can also enter your Vantage ID. The Vantage ID is the last four digits of the Vantage serial number.

4. Start FARO CAM2 2020, open the **Device Control** panel, and add a FARO Laser Tracker Device. The default IP address for the Vantage is 128.128.128.100. *For more information, see "Device Center" on page 151.*

NOTE: You can also enter your Vantage ID.

NOTE: If you need to set the Vantage to a specific IP address, start TrackerPad and start Change Network Settings. *See "Change Network Settings" on page 102.*

Power Requirements

The Vantage Power Supply operates between 100 – 250 VAC. It includes a worldwide AC input range that automatically detects the voltage and has built-in over-temperature protection (OTP), over-voltage protection (OVP), and over-current protection (short circuit protection). If an OTP or OVP condition occurs, the DC output is shut-off and the AC input will need to be reset to return to normal operation. During a short circuit condition the Power Supply enters a “hiccup mode” until the condition is removed, at which time the it will recover automatically and return to normal operation. These protection modes eliminate the need for replaceable fuses.

Powering Up

Power for the Vantage is provided by the Power Supply and the Power On/Off button located on the rear panel of the Vantage. Apply power to the Vantage by pressing the Power On/Off button on the rear panel of the Vantage.

Figure 4-16 Powering the Vantage

Immediately after pressing the Power On/Off button, all six colored indicators on the front of the Vantage light for a second and then go out. On the rear of the Vantage, the Laser and Power indicator lights and the System indicator flashes until the Start Up Checks are complete, and then remains lit.

NOTE: The Power On/Off may be disabled, start TrackerPad and start Disable/Enable Power Button. *See “Disable/Enable Power Button” on page 113.* If the Power On/Off is disabled, the Start Up Check begin as soon as the Power Supply is connected to power.

The Vantage continues with the Thermal Stabilization and Laser Stabilization. Apply power as soon as possible to begin the warm up. While the Vantage is thermally stabilizing, you can prepare other aspects of the inspection, such as programming or additional tooling.

Scheduled Power On

You can set a time to automatically power on the Vantage. Use the TrackerPad Scheduled Power On command and enter a date and time to automatically power on the Vantage. *See “Scheduled Power On” on page 113.*

Thermal Stabilization

Immediately after applying power, the Vantage System starts the “Thermal Stabilization.” During this time, the Power indicator on the back of the Vantage will blink and the Azimuth and Zenith motors may have slight

resistance. The Vantage is taking this time to stabilize its internal temperature so accurate measurements can be taken in its current ambient environment.

The Vantage is an electromechanical device and will operate at an elevated temperature compared to the ambient air temperature. All laser devices are required to warm up to achieve their specified accuracy as the sources of heat in the unit are not uniform and during the warm-up cycle the axis structure can change shape until a uniform operating temperature is propagated through all the structural parts.

The accuracy of the angular pointing system is most greatly impacted during the warm-up process so it is critical that the Vantage is thermally stabilized before running any compensations. If a compensation is completed while the Vantage is still warming up (if Thermal Stabilization is skipped), the system can drift out of tolerance as the axis structure continues to change shape working to the operating temperature and the stable geometry that is desired.

FARO's patented Smart Warm-up greatly reduces the required time for the Vantage to achieve a stable operating temperature by monitoring internal and external temperature sensors and using the Vantage's motors as heat sources.

The **Startup Checks** dialog box shows a timer showing the remaining amount of time for stabilization. When the Thermal Stabilization is complete, the blue light on the back of the Vantage stops blinking. If measurement is required immediately, you can skip the Thermal Stabilization routine by clicking **Skip Stability**.

If the time to begin measurements is critical and Thermal Stabilization must be skipped, you must click **Skip Stability** in the first 2 to 3 minutes after powering on the system. Thermal Stabilization uses the internal motors as heaters and after 2 to 3 minutes, the heat generated from the motors will cause the geometry of the axis to change and can cause angular errors to exceed the system tolerance. The basic principal is to either skip thermal stabilization as soon as the system is powered on or let it run the full period. Thermal Stabilization has three sections of operation:

1. The first section uses rapid heating of the system using the motors to raise the Vantage temperature to slightly higher than the target operational temperatures.
2. The second section is relaxation where the heat is allowed to equalize in the metal parts to provide a uniform and stable geometry of the trackers axis system.
3. If the Vantage is not started when thermal stabilization is complete, it will automatically enter the third section where the operational heat is maintained by the system by running the motors at a minimal level until the Vantage is started the motors are turned on for tracking.

NOTE: A Vantage that is stored in an environment that is hotter or colder than the current measurement environment requires a longer Thermal Stabilization time than if the Vantage was stored in the current measurement environment. When the Vantage needs to cool down to reach operational temperature, it is often faster to allow it to soak in the environment for a period of time to cool off before powering on. While Thermal Stabilization will calculate the required time to cool down, the Vantage naturally generates heat and will slow down the cooling process.

Startup Checks

Each time the Vantage is powered up, or when power to the system is interrupted, the system must be initialized or started. This is done through the Startup Checks which initialize the angular encoders and the position-sensing detector. The Startup Checks automatically run in FARO CAM2 2020 software when the Vantage is started as the current input device. *For more information, see "Startup Checks" on page 90.*

Interim Test and Compensations

Just as with all high accuracy precision instruments, the Vantage System must be verified regularly. FARO CompIT's Interim Tests allow you to test the Vantage System and its Compensations allow you to adjust the parameters when necessary. Compensations also address several potential sources of error and may be required after the Vantage System has been shipped or subjected to impact.

The FARO CompIT chapter describes these compensations in detail. *For more information, see "FARO CompIT" on page 116.*

Angular Accuracy Checks

The Angular Accuracy Checks in FARO CompIT quickly checks the accuracy of the Vantage System with minimal disruption of any measurements already in progress. Using Angular Accuracy Checks, you can check the accuracy of the Vantage System anywhere in the measurement volume. This makes it possible to check the angular accuracy during the measurement of a part without moving or rotating the Vantage. *For more information, see "Angular Accuracy Checks" on page 119.*

NOTE: Upon completion of Angular Accuracy Checks, CompIT may recommend a Quick Compensation to improve the Vantage's accuracy.

Quick Compensation

Quick Compensation is a routine that corrects for angular measurement error. It is a single point compensation and is the fastest method of compensating the Vantage System.

Click **Quick Compensation** in the CompIT main menu to start the routine. When complete (two to five minutes), the Vantage System is within the pointing accuracy specifications and ready to measure. *For more information, see "Quick Compensation" on page 124.*

NOTE: After the Quick Compensation routine, Angular Accuracy Checks should be used to verify the accuracy. If an Angular Accuracy Checks was not performed immediately before the Quick Compensation, CompIT will recommend one be performed.

Pointing Compensation

The Pointing Compensation routine is the best and most accurate method to determine and correct for backsight errors, or angular measurement error. The Pointing Compensation takes more time and requires more space than the Quick Compensation, however it can produce the best possible Angular Accuracy results, especially at longer distances. It is either run from the **Advanced** tab of CompIT or when CompIT has determined that it is required based on the previous test results. There are two parts of Pointing Compensation:

- An Interim Test (IT)
- Compensations

The Interim Test uses measurements at predetermined locations and calculates the backsight error. After measuring, the system will pass or recommend to continue with the Pointing Compensation routines.

If obstructions prevent the measurement of any remote points, rotate the Vantage on its stand. *For more information, see "Pointing Compensation" on page 132.*

ADM Checks

The ADM (Absolute Distance Meter) Checks verifies the accuracy of the ADM radial measurement. By comparing the ADM measurement to the angular measurement of the Vantage. *For more information, see "ADM Checks" on page 140.*

Powering Down

NOTE: The Power On/Off may be disabled, start TrackerPad and start Disable/Enable Power Button. *See "Disable/Enable Power Button" on page 113.* If the Power On/Off is disabled, the power down sequence starts as soon as the Power Supply is disconnected from power.

Use the following steps to power down the Vantage System:

1. Store the SMR and other targets in their protective cases.
2. Exit the CAM2 software and shut down the computer.
3. Press the Power On/Off button on the rear panel of the Vantage to power down the system.

NOTE: The Power On/Off button is a momentary switch. A single press will initiate the power down sequence of the Vantage. The Power On/Off button LED will then extinguish indicating the power down sequence is complete.

4. Disconnect the AC Power supply cable from the power source and the Power Supply.
5. Disconnect the remote air temperature sensor from the port on the rear panel of the Vantage.
6. Disconnect the Computer to Vantage Ethernet cable from the rear panel of the Vantage and from the computers network port.
7. Disconnect the DC Power cable from the rear panel of the Vantage and from the Power Supply.
8. Pack all cables into the shipping case.
9. Move the Mandrel handle to the open position. Using the retractable handle and the base handle, lift the Vantage off the Mandrel and place it into the shipping case.
10. Remove the Mandrel from the tripod and place it in the shipping case.

Wireless Connection

You can connect the Vantage to your computer using a wireless LAN connection (WLAN) instead of the Ethernet cable. In the factory configuration, the Vantage's wireless transmitter is automatically enabled when you press the Power On/Off button and start the system. When both the wired and wireless connections are correctly connected, the wireless connection takes priority.

NOTE: Press the WLAN On/Off button to switch off the wireless transmitter.

Hardware Setup

Remove the two (2) wireless Antenna from the shipping case, and thread each onto the Wireless Antenna Connector on each side of the Vantage. Thread until finger-tight, *do not* over tighten the Antenna.

Computer Setup

You must enable the wireless receiver in your computer. The Vantage connects to a wireless network using the Dynamic Host Configuration Protocol (DHCP) and will request a IP address from your computer or network.

NOTE: If you need to set the Vantage to a specific Service Set Identifier (SSID), start TrackerPad and start Change Network Settings. *See "Change Network Settings" on page 102.*

By default the wireless connection operates as a wireless access point (WAP) without any security.

Computer Configuration

The Vantage requires a Intel® Pentium® Core™ i5-4200M, Dual Core 2.5GHz processor PC (or better), running Windows 7 (or better), with a wireless receiver.

1. Ensure the WLAN On/Off button is set to the On position. The illuminated LED ring around the button indicates the wireless transmitter is on.
2. Connect the Vantage to your computer's wireless receiver. In Windows 10:
   - Click **Start** > **Settings**.
   - Click **Network & Internet**.
   - Click **Wi-Fi**.
   - Click **Show Available Networks**.
   - In the lower right corner of your computer screen, choose your Vantage from the list and click **Connect**. Look for your device serial number in the list of available wireless devices.
3. Start FARO CAM2 2020 and open the **Device Control** panel.
4. Add a FARO Laser Tracker Device and enter your Vantage ID. *For more information, see "Device Center" on page 151.*

6Probe Setup

The following sections describe the proper setup of the 6Probe. This includes installing and compensating the probe so it measures accurately.

NOTE: The Vantage must be completely setup, warmed up, and compensated before connecting the 6Probe.

CAUTION: The 6Probe may not pair with the Vantage or operate accurately outdoors, in direct sunlight, or in high Infrared (IR) light conditions.

Installing the Battery

Install the battery into the 6Probe.

1. Remove the 6Probe from the shipping case.
2. Turn the locking latch clockwise or counterclockwise.

Figure 4-17 Turning the locking latch

3. Remove the battery cover.

Figure 4-18 Remove the battery cover

4. Slide the battery upwards into the 6Probe until it locks into place.

Figure 4-19 Installing the battery

5. Replace the battery cover and secure it by turning the locking latch.

Figure 4-20 Securing the locking latch

NOTE: You can also install the handle after installing the battery.

Figure 4-21 Installing the Handle

Installing a Probe

1. Remove a probe tip from the probe tip case and thread it onto the threaded end of the Kinematic Probe Adapter. Tighten the probe tip with the one of the provided wrenches in the probe tip case.

NOTE: FARO Technologies, Inc. does not guarantee the accuracy of the 6Probe with the use of any probe extension.

2. Open the locking handle. Notice the arrow printed on the handle.

Figure 4-22 Opening the Handle

3. Rotate the probe so the arrows are aligned. Insert the probe into the 6Probe until it is flush in the seat.

Figure 4-23 Installing Probe

4. Close the handle to lock the probe into the 6Probe.

Figure 4-24 Closing the Handle

Powering the 6Probe

1. Press the Power Button to start the 6Probe. You will see the Power (**blue**) and Battery Power (**green**/**orange**/**red**) indicators on, but the other three Status LEDs will remain off.

Figure 4-25 Power Button

Pairing the 6Probe and the Vantage

NOTE: The 6Probe requires Vantage MCU firmware v2.11.0 or later.

CAUTION: The 6Probe may not pair with the Vantage or operate accurately outdoors, in direct sunlight, or in high Infrared (IR) light conditions.

NOTE: The operational range of the 6Probe is 2.5 meters (8ft) to 15 meters (49ft) - 30 meters (98.4ft) spherical working volume. All setup, probe management, and measurement must be done within the operation range.

Wirelessly connect the 6Probe to the Vantage and create a pairing. The first pairing will store the 6Probe serial number in the Vantage and measure the position.

1. Track the laser with any SMR away from the Home position.
2. Acquire the laser beam with 6Probe and track it out to at least 2.5 m (8 ft) from your Vantage.
3. Press any of the 6Probe's four buttons to start the pairing process. The Status LEDs will flash **blue** during this process.
4. Hold the 6Probe stable until the Status LEDs switch to **green** and the pairing process completes.

NOTE: If the Status LEDs switch to **blinking red**, the pairing process has failed. Press and hold any button to repeat. Release the button once the pairing process begins.

NOTE: If the middle Status LED switches to **solid red**, the pairing has also been lost. Power off/on the Vantage and the 6Probe and try the pairing again. If this continues, contact your Customer Service Representative by Phone, Fax or E-Mail. *See "Technical Support" on page 164.*

You will lose the pairing if:

- You track the Vantage behind an obstruction that blocks the RF signal.
- The 6Probe battery completely drains.
- You track the 6Probe out of the operational range.
- The Vantage is powered off.

Pairing the 6Probe with Multiple Vantages

You can use a 6Probe with multiple Vantage systems. However, you must power off/on the 6Probe before pairing with another Vantage.

NOTE: You do not need to compensate existing probes when you pair the 6Probe to another Vantage.

Probe Management

The **Probe Management** command in TrackerPad allows you to create, edit, compensate, and select each Kinematic Probe Adapter and Probe Tip combination for use with the 6Probe.

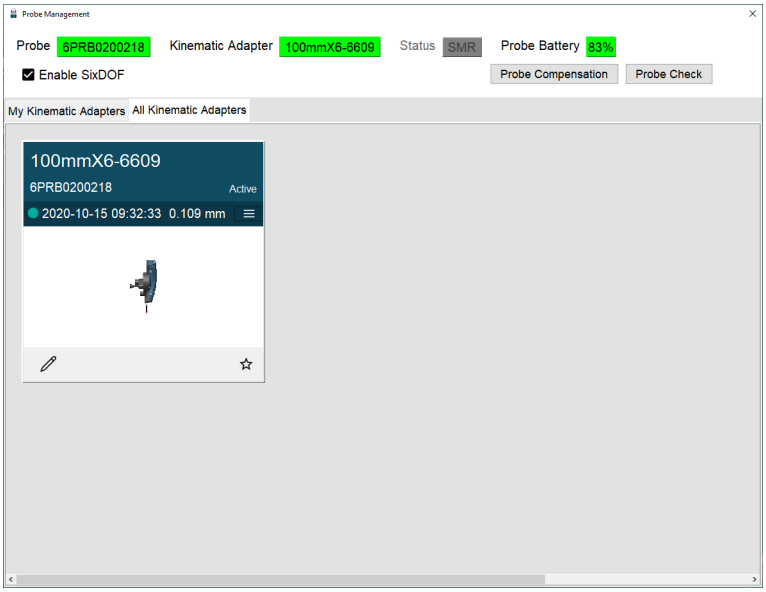

Figure 4-26 6Probe Probe Management

Start the Probe Management command in the CAM2 2020 Device Center or TrackerPad. *For more information, see "Probe Management" on page 103.*

To measure with the 6Probe, you must install a probe, edit, and enter the probe tip information. Once complete, you must compensate it. *See "Probe Compensation" on page 106.*

Installing the Wrist Strap

1. Remove the two straps from the 6Probe shipping case. Start with the longer strap with the cord loop on one end.
2. Feed the cord into the slot on top of the 6Probe. Ensure the loops on the strap are facing up.

Figure 4-27 Feed the Cord into the Slot

3. Pass the other end of this strap through the cord loop and pull tight.

Figure 4-28 Secure the strap

4. Attach the other strap. Feed the end without the plastic ring through the slot on the bottom of the 6Probe.

Figure 4-29 Feed the Strap into the Slot

5. Place the hooks on the loops of the strap to secure it to the 6Probe.

Figure 4-30 Secure the Strap

6. Feed the free end of the first strap through the plastic ring of the second strap. Press the hooks side of the first strap onto the loops side. Adjust the first strap until it fits your hand as you hold the 6Probe.

Figure 4-31 Connect the Straps

Connection Problems

This section covers troubleshooting and solutions to common connection problems between the Vantage and your computer. Remember that the normal IP settings for the Vantage and your computer are:

- Computer Local Area Connection - set IP address of 128.128.128.10.
- Computer Wireless Network Connection - Automatically set IP address.
- Vantage Local Area Connection - set IP address of 128.128.128.100.
- Vantage Wireless Network Connection - DHCP assigned by your computer.

Cannot connect to the computer using the Ethernet cable.

- Make sure the Ethernet cable is properly connected to the Vantage and to your computer.
- Disable any additional Ethernet network cards installed in your computer.
- Set the TCP/IP v4 properties of your adapter card (Local Area Connection) to the specific address of 128.128.128.10.
- Turn off the Windows Firewall or any 3rd party software firewalls.

Cannot connect to the computer using the wireless connection.

- Ensure to enable your computers wireless card. Check for a Wireless On/Off switch on the computer.
- Ensure the WLAN On/Off button is set to the On position.

Wireless Reset

In certain situations the wireless transmitter in the Vantage is on, but you cannot connect to the computer or the computer does not have a wireless receiver, you can reset the wireless transmitter by pressing the WLAN button on the Vantage to turn it off. Wait at least 10 seconds and press the button again to restart the wireless transmitter.

Chapter 5: Key Components of the Vantage

Key components of the Vantage are the Weather Station, the two Angular Encoders and the Absolute Distance Measurement (iADM) system.

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Weather Station

The Weather Station monitors the temperature, pressure, and humidity at the location of the sensor. For the ADM system, the phase shift of the laser beam is a function of the frequency of the reference oscillator and the prevailing environmental conditions. Because the ADM depends on current environmental conditions to calculate the speed of light and convert the measured waves into a distance, the accuracy of the temperature, pressure, and humidity sensors must be established during factory calibration.

Temperature Sensor

Calibration of the remote temperature sensor for the Vantage is performed at the factory by comparing its readings to a NIST (National Institute of Standards and Technology) traceable precision standard temperature sensor.

Pressure Sensor

Calibration of the pressure sensor in the Vantage is performed at the factory by comparing its readings to NIST traceable precision standard pressure sensor.

Humidity Sensor

Verification of the humidity sensor in the Vantage is performed at the factory by comparing its readings to an independent relative humidity sensor.

Distance Measurement System

iADM

iADM is FARO's Absolute Distance Measurement system that uses patented predictive algorithms to compensate for the acceleration and velocity of a moving target, such as the SMR. Calibration of the ADM frequency oscillator is performed using the cesium clocks within the Global GPS Network. The ADM System is then factory compensated using a reference interferometer. After the ADM System completes factory compensation, it is compared against an interferometer using the process defined in the International Organization for Standardization (ISO) 10360-10:2016 specification. The interferometer used during these procedures is certified to NIST or other international recognized standards.

Certificate of Calibration

Included with every Vantage is a Certificate of Calibration that provides a Certification of the Vantage's ADM radial measurement system that is performed in accordance with the ISO 10360-10:2016 specification. FARO's quality control process requires that several factory only compensations be performed followed by additional tests to verify Vantage's transverse system or angular measures within the accuracy specifications. FARO recommends annual recertification of the Vantage. *For more information, see "Product Specifications" on page 78.*

ISO 10360-10:2016 specification notes:

- Ranging test positions 36-40 are satisfied to 75 meters.
- Stylus and retroreflector combination calibration is tested in accordance with Annex G.3.

Spherically Mounted Retroreflector (SMR)

The accuracy of measurements made with the Vantage system depend on characteristics of the Spherically Mounted Retroreflector (SMR) such as:

- Ball diameter
- Vertex position
- Flatness of the optics
- Dihedral angle errors
- Reflectivity of the optics

The specifications for the Vantage system are valid when using SMRs certified by FARO. Mishandling of the SMR may change one or more of these characteristics and diminish the accuracy of the measurements taken with the Vantage. *See "Optical Target Care" on page 73.*

Chapter 6: Understanding Measurement Accuracy

In order to determine the uncertainty associated with a particular measuring session, carefully estimate the contribution of errors from all identifiable sources. However, since the effects of some environmental factors (excess vibration, mounting stability, and temperature effects such as temperature gradients, air turbulence, or air pockets of different temperatures in the path of the laser beam, etc.) are difficult to quantify, good metrology practice requires that the effects of all sources of error be minimized or eliminated. If the effects of environmental errors are left completely uncontrolled, the accuracy of the measurements may degrade to such an extent that the entire measuring session has to be rejected. Whenever possible, measure your part in a location where environmental factors are closely controlled and kept stable.

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Effects of Atmospheric Conditions

Atmospheric conditions can have multiple effects on Vantage measurements. Temperature gradients, air turbulence, or air pockets of different temperatures in the path of the laser beam will affect the direction of the laser beam resulting in a loss of accuracy in both the angular and radial distance measurements. Typically, gradients, turbulence, or air pockets are always changing, so this accuracy loss is not always the same magnitude or even the same direction. This effect creates poor repeatability in addition to the accuracy loss. Increasing the number of samples per reading can sometimes improve the repeatability of measurements in these conditions, but it does not necessarily improve the accuracy of each measured reading. Avoid these errors by not measuring near heating and air conditioning ducts, doors that frequently open, or any other source of these temperature effects. Airflow in general is not the issue as an environment with high airflow of a uniform temperature can result in very good measurements. It is the regions where two different air masses of different temperatures that causes the laser beam to bend. Another method to managed the effect of non-uniform temperature is to use a fan to mix the air so there is no pockets of different air temperatures in the measurement area.

As the temperature, barometric pressure, and relative humidity of air change, so does the index of refraction. Knowing the air’s index of refraction is critical for the accuracy of the radial distance measurements performed by the Vantage's ADM system because these systems need to convert the waves of light being measured into a distance and the speed of light changes based on environmental conditions. The index of refraction cannot be calculated correctly without accurate atmospheric condition values. The Vantage system is equipped with weather sensors that measure the temperature, pressure, and humidity of the ambient air every five seconds. A 1 part per million change in the index of refraction, and the resulting radial distance measurements, occurs for a 3 mmHg change in pressure, a 1°C change in temperature, or a 40% change in relative humidity at 40°C. Because the air temperature has a significant effect on the index of refraction, the Vantage's external air temperature sensor should be placed in air at the same temperature that the laser beam is traveling through and not inside a work cart, near heating or air conditioning ducts, or any other source of a thermal effect.

Environmental Conditions

Environmental effects such as excess vibration, mounting stability, and temperature can affect the accuracy and repeatability of the measurements. Eliminate these outside factors whenever possible.

Do not move heavy objects near the part before or during a measurement session. This may cause the floor to shift or move enough to disrupt measurement sessions. The magnitude of this effect depends largely on the weight of the object and the stability of the workshop floor foundations.

Support the part in the same manner for measurement as its intended function. This ensures that differential loading does not result in distortions in the part when it is put to use.

FARO recommends taking redundant readings for each measurement. Taking redundant readings provides a means of detecting gross errors or blunders, may reduce the environmental effects that you have not been able to eliminate, and provides better statistical sampling. For example, measure a planar surface with more than three readings.

Targets and Tooling

Regularly check the target nest and the SMR for metal filings or debris that may prevent the target from seating properly in the nest. Regularly inspect the tooling for ware, dings or dents that may cause the tooling not to contact the part or the SMR at the designed location. For the best results all tooling and SMRs should be part of the gage calibration system and checked for the proper dimensional values. Almost undetectable damage to

tooling can greatly exceed the accuracy specifications of the Vantage system and can lead to incorrect results of the measurement session.

Dimensional inaccuracies of target offsets are a frequent source of error during a measurement session. Before measuring, check the Probe settings in your measurement software to select any additional tooling to ensure the correct offset is being applied to the measurements. *For more information, see "Probes" on page 153.*

Physical Changes in the Part or Stand

Regularly inspect the instrument stand and the part to make sure that both remain stable throughout measuring; any change to the position of the instrument stand and the part degrades the measurement accuracy. When possible the instrument stand should be on the same section of flooring as the part and having the legs span two or more sections of flooring should be avoided.

An often overlooked source of measurement error is temperature changes of the instrument stand. If the instrument stand was stored in an area with an ambient temperature different than where you are now measuring, then stand movement may be occurring as it acclimates to its new environmental condition.

Temperature changes in the environment during measuring can degrade accuracy by causing thermal expansion or contraction of the part. The magnitude of this effect depends on the material of the part, the size of the part, the magnitude of the temperature change and the rate the temperature changed. Monitor this by regularly checking reference nests set up on the part. FARO Tracker Utilities, and most other inspection software, have methods to re-measure reference nests set up on the part and re-align while applying a scaling change to compensate for uniform thermal expansion or contraction in subsequent measurements. In some situations, this environmental change may change the Vantage's angular accuracy, so you may need to run an Angular Accuracy check before re-aligning to the part.

Whenever possible, shield the Vantage and the part from external heat sources. Radiant energy from the sun, hot lights, or space heaters during measurement can introduce non-uniform expansion in the measurement equipment or the part, degrading the measurement accuracy.

Angular Accuracy Checks

The Vantage reads the azimuth and zenith angles and the distance to the target for each reading in a measurement. A kinematic model corrects the readings. The model has parameters for the laser beams four degrees of freedom (two rotational and two translational), and two parameters for the gimbal (axis offset and axis non-squareness).

Verify the system accuracy using the Angular Accuracy Checks. *For more information, see "Angular Accuracy Checks" on page 119.*These checks compare a point reading taken in frontsight mode with one taken in backsight mode. The resulting deviation reports twice the worst-case error for a point measured at the range and position of the backsight reading.

Although the kinematic model is highly effective in minimizing measurement error, there are still many factors that are not accounted for by the model. Target quality, atmospheric induced errors, and thermal expansion are some of the errors not addressed by the model.

Positioning of the Vantage

All Vantage measurements consist of two angular measurements and one radial distance measurement. The angular measurement system and the radial measurement systems both have a specified maximum error. An additional source of error is known as the R0 parameter which is a radial offset. This is the error in the known

distance from the Vantage's origin to the SMR while it is sitting in the Tracker Mounted Reset (TMR), also known as the Home position. See Product Specifications, for the Maximum Permissible Error (MPE) for these items as well as equations for calculating the Maximum Permissible Error for the distance between two points.

All Vantage measurements contain all of these error sources. However, as shown in the information in Product Specifications, it is possible that the distance between two points measured from one Vantage position is more accurate than when measuring the distance between the same two points from a different Vantage position. For example, a Vantage measuring the length of a scale bar placed directly in line with the laser beam will be more accurate then the same scale bar placed horizontally of the Vantage. This is because:

1. The maximum permissible error of the Vantage's radial distance measurement system is lower than the maximum permissible error of the Vantage's angular measurement system.
2. The maximum permissible error of both the Vantage's angular measurement system and radial distance measurement system increase the further you move from the Vantage.
3. The contribution of R0 error of the distance between two points measured from one Vantage position is different than the same two points measured from a different Vantage position.

While every measurement session and geometry is unique, you can sometimes optimize the overall accuracy of the measurement session by reducing the angular movement used in its physical measurement compared to the dimension of interest. For example, if the straightness of a rail is more critical than its height or length, then placing the Vantage on the side of the rail so the radial measurement system is predominantly used to measure its straightness would typically produce more accurate measurements. If the length of the rail is more critical than its straightness, then placing the Vantage the end of the rail so the radial measurement system is predominantly measuring its length would typically produce more accurate measurements. This is assuming that the Vantage can be placed in these locations without introducing other sources of error such as floor vibration or air turbulence due to temperature gradients, etc.

Recommendations for Optimal Results

Errors associated with environmental conditions, targets or target tooling, movement or changes in the part or stand, etc. occur with most types of measurement equipment. However, these are some guidelines specific to the Vantage that, when followed, result in improved measurement accuracy.

- Optimal results will always occur in an environment that does not have large temperature changes, temperature gradients, air movement, floor vibrations, etc. Steps to minimize the sources of these in the environment should be taken prior to beginning measurements.
- Let the Vantage fully complete Thermal Stabilization in the Startup Checks. If this is skipped, a decrease in the Vantage's accuracy will occur.

NOTE: In order for the Vantage to perform within the published specifications, you must allow Thermal Stabilization to complete or the Vantage should be powered on and locked onto an SMR for 1 to 2 hours to warm-up as is typical of all Laser Tracker devices.

- Verify the Vantage's accuracy prior to beginning measurements running the Quick Compensation routine. You should then run the Angular Accuracy Checks and Pointing Compensation routines if the Angular Accuracy Checks fails and CompIT recommends it.
- Quick Compensation is the fastest compensation and is acceptable where the best accuracy is not required. However, Pointing Compensation yields lower backsight error or improved Angular Accuracy results. Calculating the very best kinematic parameters is important for high accuracy applications especially at longer distances. For very high accuracy measurements and /or measurements at long distances, having a properly warmed-up Vantage and running the Pointing Compensation routine is required.

- Periodically check for movement between the part and the Vantage using common points attached to the part. If excessive movement is detected or if the ambient temperature has changed more than approximately 2.8° Celsius (5° Fahrenheit), use the **Move Device** command in FARO CAM2 2020, or the equivalent in other software, to realign to the part if movement has occurred. Perform this check even in environments where ambient temperature changes and vibration are kept to a minimum.
- Periodically reset the SMR to the Home position for very high accuracy measurements. This resets the ADM distance to the known distance to the center of the SMR in the Home position and can eliminate very small changes that can occur over time or temperature in the radial measurements. This is also known as Tracker Mounted Reset (TMR). These very small changes do not affect most applications but can affect very high accuracy measurements.
- By default, an individual reading of a measurement uses a sampling rate of 1000 samples per reading resulting in a total measurement time of 1 second. When using a scanning or dynamic method to collect readings, reduce the total measurement time by lowering the total number of samples per reading. Moving the SMR over a curved surface while taking 1000 samples per reading typically used for the static measurement, results in a single reading that is the average of the SMR movement over a 1 second time period. A typical scan setting would be to lower the samples per reading to 5 resulting in an individual measurement time span of 5 milliseconds. Moving the SMR over a curved surface with this setting will result in a series of multiple readings that are identical to the path the SMR traveled around the curve. Use the **Device Center** command in the measurement software to change this setting. *See "Device Center" on page 151.*
- Do not turn the Vantage's motors off during breaks or shift changes. Turning the motors off for long periods of time can result in a slight change in the Vantage's internal operating temperature away from its stabilized condition. This can degrade accuracy in the measurements taken soon after turning the motors back on. Leaving the motors on will prevent this from occurring. Leaving the motors on will not harm the Vantage.
- Do not cover the Vantage while it is turned on. Only use the Vantage's dust cover when it is turned off. Using the dust cover while the system is turned on will not allow the Vantage to properly stabilize to the environments current ambient temperature. This can degrade accuracy in the measurements taken soon after removing the cover. If the environment is very dirty and you are concerned about dust on the embedded targets, you can track to the left or right side of the Vantage to rotate the Azimuth axis so that it covers these targets.

Chapter 7: Care of the Vantage

Use care in handling the Vantage system, especially while moving it from and one place to another; there are no user replaceable parts.

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Optical Target Care 73
Optical Target Care Overview 73
Cleaning Optical Targets 73
Storage 74
Transportation 74
Ingress Protection (IP) Rating 74

Cleaning the Vantage's Optics

The Vantage's aperture window and the embedded target covers may need occasional cleaning.

- Remove any dust from the window using canned compressed air. Before spraying the air onto the window, spray the canned air away from the window while holding the can upright to remove any propellant from the nozzle.
- If more cleaning is necessary, use water vapor and a clean cotton swab in the same manner as an SMR. If water vapor does not successfully remove the residue, use denatured alcohol. *See "Optical Target Care" below.*

Optical Target Care

Optical Target Care Overview

Optical Targets, such as the spherically mounted retroreflector (SMR), are an important part of the FARO Laser Tracker. Handle SMRs with great care to ensure accuracy and longevity.

Target care includes:

- Never touching the optical surfaces of the target.
- Never dropping the target.
- Keeping the target free of dust and moisture by storing it in the case when not in use.
- Cleaning the target *only* when there are problems acquiring the target or the Operational Checks indicates cleaning is necessary.
- Always using the proper cleaning materials and procedure when cleaning is required.

If the FAROLaser Tracker does not lock onto the target, use the Operational Checks command to check your SMR. If the Return Power value is "**GOOD**" your SMR does not need cleaning.

CAUTION: Unnecessary cleaning will degrade the reflective surface of the SMR and can cause damage to the coatings on silver surfaces that will eventually destroy the SMR. Only clean SMRs when required for good measurement and accuracy performance, not based on cosmetic conditions.

Cleaning Optical Targets

In many cases, the optical surfaces of the target are simply dusty and just require cleaning with compressed air from a can.

CAUTION: Do not clean with compressed air available from a hose in a workshop - the air is seldom clean and may coat the SMR with oil or some other contaminant.

- Spray the air away from SMR for a few seconds before spraying it onto the optical surfaces to remove any propellant in the can from the air nozzle. This prevents the propellant from being sprayed onto the SMR's optical surfaces. Always hold the can upright and never shake the can when spraying compressed air.

If the target is still not functional after blowing off any dust, use the following target specific procedures.

CAUTION: Never use a dry cotton swab or tissue to clean the optical surfaces because these will scratch the optical surfaces. Cleaning with any improper chemicals will destroy the reflective surface.

1. Breathe on the optical surfaces. The moisture in your breath will form a layer of condensation on the optical surfaces.
2. While condensation is still on the glass surface, gently slide a cotton swab in one direction while rotating it in the opposite direction. Use very little pressure; do not push the cotton swab onto the surface. Use one cotton swab for each pass and then discard it. You may need several swabs to clean the optical surfaces thoroughly. Using a cotton swab more than one time can cause debris to scratch the coatings. For silver SMRs, a scratch can lead to oxidation under the coatings and destroy the SMR.
3. If this does not successfully remove the residue, clean the optical surfaces with Optima Grade acetone for oil based residue or denatured alcohol for water based residue.
4. Moisten a clean cotton swab with solvent.
5. Gently slide the cotton swab in one direction while rotating it in the opposite direction. Use very little pressure; do not push the cotton swab onto the surface. Use one cotton swab for each pass and then discard it. You may need several swabs to clean the optical surfaces thoroughly.
6. Remove any remaining cotton dust with canned compressed air.

Storage

When storing for long periods of time, pack the Vantage system in its shipping cases to protect it from environmental hazards, dust, dirt, etc. Store the system in an environment between -20°C and 70°C where it will not be subject to rapid temperature changes, extreme environmental conditions, or heavy vibrations. The storage cases are not waterproof, so do not store the system outside or in an environment that does not remain dry at all times.

Transportation

When transporting a Vantage that is mounted on a heavy duty stand with wheels around a shop floor, you do not need to remove it from the stand. Although, before moving, lower the stands wheels and vertical extension tube. While in motion, avoid any divots or large gaps in the floor.

When transporting a Vantage that is mounted on a portable tripod without wheels around a shop floor, remove it from the tripod before moving. After the tripod is in the new location, mount the Vantage on top of the portable tripod.

When transporting the Vantage System long distances or between facilities, pack everything in the shipping cases. Always use straps to secure the shipping cases to a pallet when using a forklift, and gently lift and lower the pallet.

Ingress Protection (IP) Rating

The Vantage has an IP rating of 52 as defined in International Standard IEC 60529. This two digit rating is:

- First Digit (Solid Particle Protection): 5 - Dust Protected.
  Ingress of dust is not entirely prevented, but it must not enter in sufficient quantity to interfere with the satisfactory operation of the equipment; complete protection against contact.
- Second Digit (Water Protection): 2 - Dripping water when tilted up to 15°.
  Vertically dripping water shall have no harmful effect when the enclosure is tilted at an angle up to 15° from its normal position.

CAUTION: The Vantage system IP rating provides water protection equivalent to rainfall of 3 mm (0.12 in) per minute for 10 minutes. It does not provide protection from large volumes of water for extended periods of time, water spraying on the Vantage system at high pressures. Water protection is provided when the Vantage is in its normal, or upright, position.

NOTE: The Vantage Power Supply has an IP rating of 67, which protects the Power Supply alone for water immersion. This allows operation on shop floors or outdoors in which the ground (floor) moisture cannot always be controlled. However, an IP rating of 67 for the Power Supply does not extend to the entire Vantage system, which still maintains an IP52 rating.

Chapter 8: Getting Help

This chapter describes the different resource tools that you should use to get help with your Vantage system. These include electronic Help files, printed documentation, and the FARO Customer Service Department.

Online Help

FARO CAM2 2020 is the primary software product for use with the Vantage and contains a help file that covers an extensive range of topics.

Documentation

This User Manual covers topics associated with the use of the Vantage main hardware components. This manual also includes detailed procedures for performing diagnostic checks and completing various calibration and compensation routines.

See Operational Checks on page 91 and FARO CompIT on page 116.

Other FARO Publications include:

- FARO CAM2 2020 user manual which covers the use of the inspection software.
- The *FARO Laser Tracker Accessories Manual* which covers the setup and operation of the optional accessories for the Vantage system.

FARO Customer Service

FARO is proud to provide its customers with the best support in the industry. Our commitment to servicing our customers needs is evident in our products, services, and customer satisfaction. The following section explains how you can contact FARO Customer Service with any technical questions.

How to Contact FARO

To aid in our responsiveness, FARO asks that customers use one of the following methods to contact the Help desk with technical questions:

Internet
Visit the FARO WEB site at *www.faro.com* and enter the Support Center found under Customer Care.

Electronic Communication
Phone, Fax or E-Mail. *See "Technical Support" on page 164.*

Mailing Address
FARO Technologies, Inc.
250 Technology Park
Lake Mary, FL 32746

International Mailing Addresses

FARO Europe GmbH & Co. KG
Lingwiesenstrasse 11
D-70825 Korntal-Münchingen
Germany

FARO Japan, Inc
716 Kumada, Nagakute-shi,
Aichi 480-1144, Japan

FARO (Shanghai) Co., Ltd
1/F, Building No. 2,
Juxin Information Technology Park
188 Pingfu Road, Xuhui District
Shanghai 200231, China

FARO Singapore Pte Ltd
No.3, Changi South Street 2,
#01-01 Xilin Districentre Building B,
Singapore 486548

Chapter 9: Product Specifications

This chapter contains the Vantage technical specifications. For other FARO Laser Tracker models, please consult the original User Manual that shipped with your FARO Laser Tracker or contact FARO Customer Service by Phone, Fax or E-Mail. *See "Technical Support" on page 164.*

General Specifications and Rated Conditions 79
Spherically Mounted Retroreflector (SMR) 83
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ADM (radial) 84
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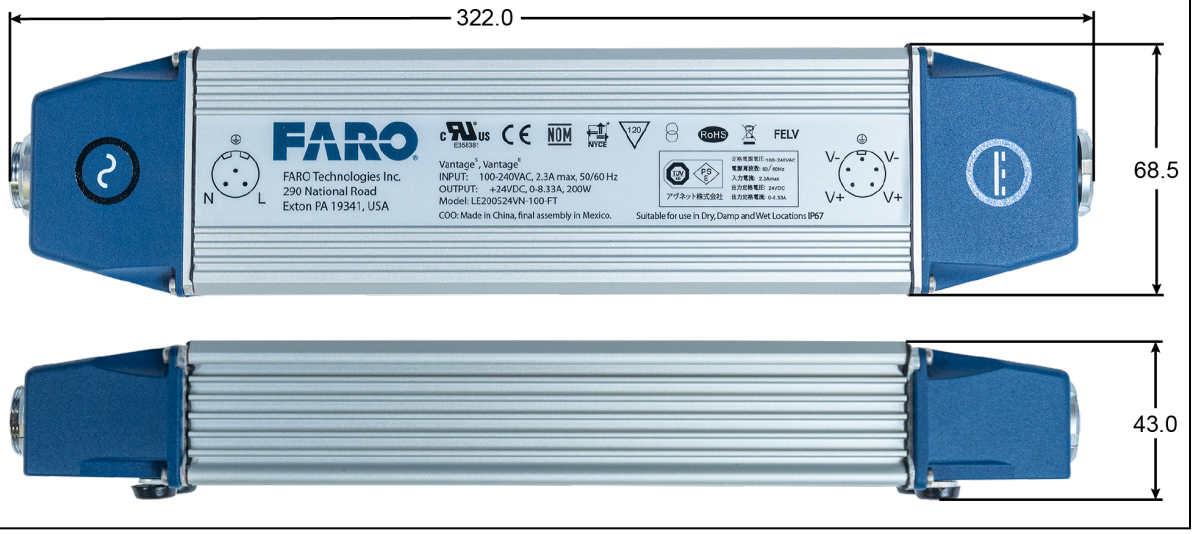
General Specifications and Rated Conditions

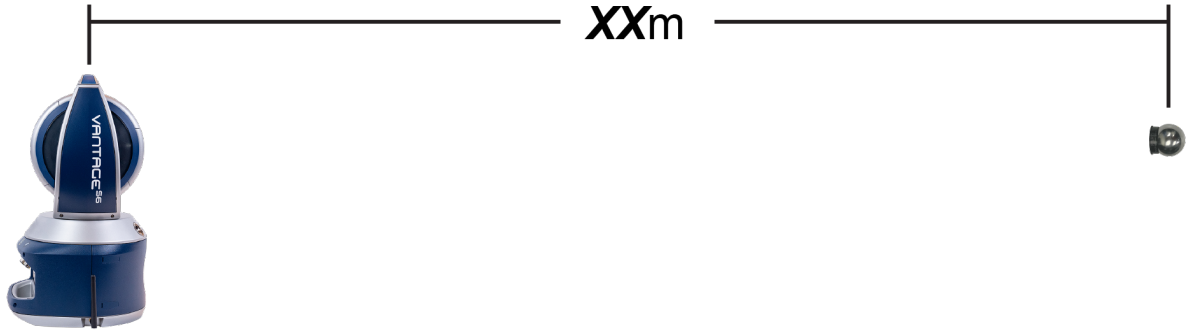
Vantage

Size	
Laser Tracker Vantage	226(W) x 415(H) x 239.5(D) mm 8.90(W) x 16.34(H) x 9.45(D) in

Power Supply/Communications Box	322(L) x 68.5(W) x 43(H) mm 12.7(L) x 2.7(W) x 1.7(H) in



Weight	
Laser Tracker	13.4kg 29.5lbs

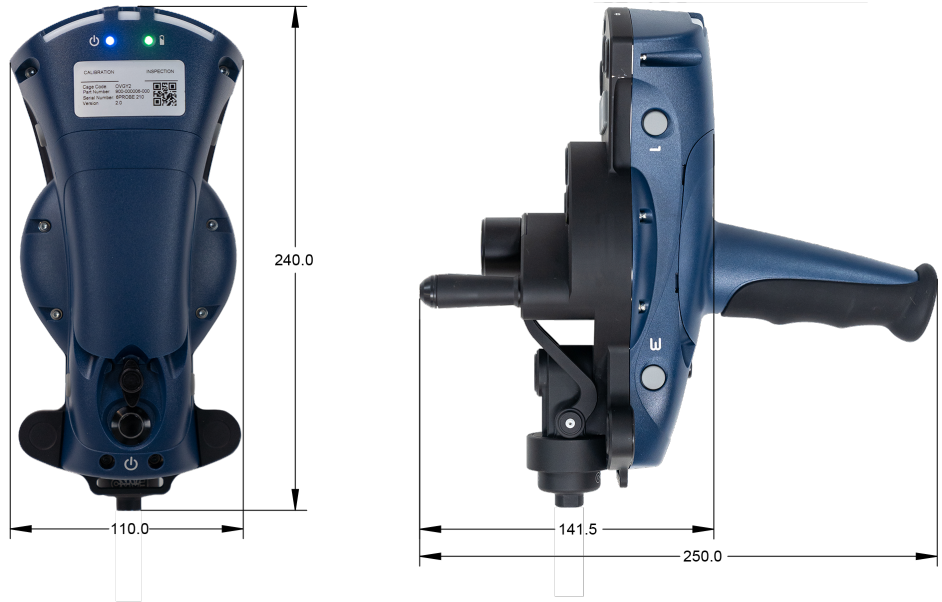
Rated Conditions	
Measurement Envelope Distance	
Vantage$^{S6, S}$	80m (262.5ft) with select targets 60m (196.9ft) with Standard 1½” SMR 40m (131.2ft) with Standard ⅞” SMR 30m (98.4ft) with Standard ½” SMR 15m (49.2ft) with 6Probe
Vantage$^{E6, E}$	35m (114.8ft) with Standard 1½” SMR 35m (114.8ft) with Standard ⅞” SMR 30m (98.4ft) with Standard ½” SMR 15m (49.2ft) with 6Probe
	
Range of horizontal angle *Range of vertical angle*	360 degrees - infinite rotation 130 degrees (+77.9/-52.1)
	
Temperature Range Operating	Min -15°C, Max 50°C Min 5°F, Max 122°F
Humidity Operating	Min 0% RH, Max 95% RH non-condensing

Rated Conditions	
IP Rating	IP52
Barometric Pressure Range Operating	 Min 225.50mmHG, Max 825.07mmHG Min 8.878inHG, Max 32.483inHG
Elevation Operating	 -700m to 9000m (-2,297ft to 29,527ft)
Ambient Light	Direct exposure to sunlight or flash lamps may compromise performance.
Electrical Voltage Current Frequency Surge Sag Max Transient Voltages and Duration	 100 - 250VAC ± 10% 2.3A (US), 1.1A (EU) 50/60Hz 1000V common, 500V differential, 1.25/50µs waveform 70% Nominal Voltage, 0.5s, 40% Nominal Voltage, 5.0s 1000 V common, 500v differential, 5/50 ns, 1 min waveform
Probe Type Diameter Reflector Type	 1½” (38.1mm), ⅞” (22.225mm), or ½” (12.7mm) Spherically Mounted Retroreflector (SMR)
Sampling Strategy Acquisition time Frequency	 1sec 1000points/sec

Limiting Conditions	
Storage Temperature Range	Min -20°C, Max 70°C Min -4°F, Max 158°F
Humidity Range	Min 0% RH, Max 100% RH
Barometric Pressure Range	7500mmHg overpressure 295.276inHG overpressure

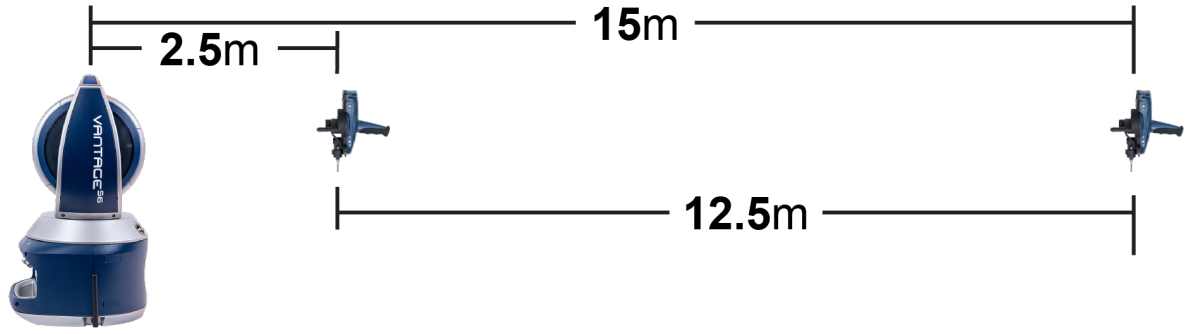
6Probe

Size	
6Probe	240(L) x110.0(W) x 141.5(D) mm 9.4(W) x 4.3(H) x 5.6(D) in



Weight	
6Probe	885 g 1.95 lb

Performance	
Accuracy (MPE)	95µm + 5µm/m with 40mm stylus length 0.0037in + 0.00006in/ft with 1.97in stylus length
Maximum Permissible Error (MPE) is per ISO 10360-10:2016 specification, reported as the radius of the minimum circumscribing sphere.	
Range	Min 2.5m (8.2 ft) Max 15m (49.2 ft)

Performance	
	
System Sample Rate	1,000 samples per second
Lithium-Ion Battery	Continuous usage 2-4 hours Typical usage 8+ hours
On-Axis position to laser beam	Pitch: ±25° Yaw: ±25° Roll: 360°

Rated Conditions	
Temperature Range Operating	Min -15°C, Max 40°C Min 5°F, Max 104°F
Humidity Operating	Min 0% RH, Max 95% RH non-condensing
Elevation Operating	-700m to 9000m (-2,297ft to 29,527ft)
IP Rating	IP52

Spherically Mounted Retroreflector (SMR)

The accuracy of measurements made with the Vantage system depend on characteristics of the Spherically Mounted Retroreflector (SMR) such as:

- Ball diameter
- Vertex position
- Flatness of the optics
- Dihedral angle errors
- Reflectivity of the optics

The specifications for the Vantage system are valid when using SMRs certified by FARO. Mishandling of the SMR may change one or more of these characteristics and diminish the accuracy of the measurements taken with the Vantage. *See "Optical Target Care" on page 73.*

Measurement Specifications

Angular Encoders (transverse)

Horizontal Envelope: ±360° - infinite rotation
Vertical Envelope: +77.9° to -52.1° - infinite rotation
Maximum Angular Measurement Velocity: 180°/sec.
Maximum Angular Acceleration: 860°/sec ² (15 rads/sec²)
Maximum Angular velocity: 180°/sec (π rads/sec²)

ADM (radial)

Sample Rate: 16,000 samples/second
Resolution: 0.5 µm
Maximum Radial Acceleration: 30m/sec ²
Maximum Radial Velocity: > 25m/s

Working Range

Vantage$^{S6, S}$

- Minimum Working Range:
  - 0 meters (0ft)
  - 2.5 meters (8.2 ft) with 6Probe
- Maximum Working Range:
  - 80 meters (262.5 ft) with select targets
  - 60 meters (196.9 ft) with standard 1½” & ⅞” SMR
  - 30 meters (98.4 ft) with standard ½” SMR
  - 15 meters (49.2 ft) with 6Probe

Vantage$^{E6, E}$

- Minimum Working Range:
  - 0m (0ft)
  - 2.5 meters (8.2 ft) with 6Probe
- Maximum Working Range:
  - 35 meters (114.8 ft) with select targets
  - 35 meters (114.8 ft) with standard 1½” & ⅞” SMR
  - 30 meters (98.4 ft) with standard ½” SMR
  - 15 meters (49.2 ft) with 6Probe

Level

Accuracy +/- 2 arc seconds

MultiView Cameras

Field of View: 50°
Range:

SMR Size	Vantage$^{S, E}$	Vantage$^{S6, E6}$
1½”	25 meters (82.0 ft)	45 meters (147.6 ft)
⅞”	25 meters (82.0 ft)	30 meters (98.4 ft)
½”	15 meters (49.2 ft)	25 meters (82.0 ft)

Data Acquisition

System Sample Rate 1,000samples per second
Point Acquisition Rate 1000points per second

Accuracy Specification and Formulas

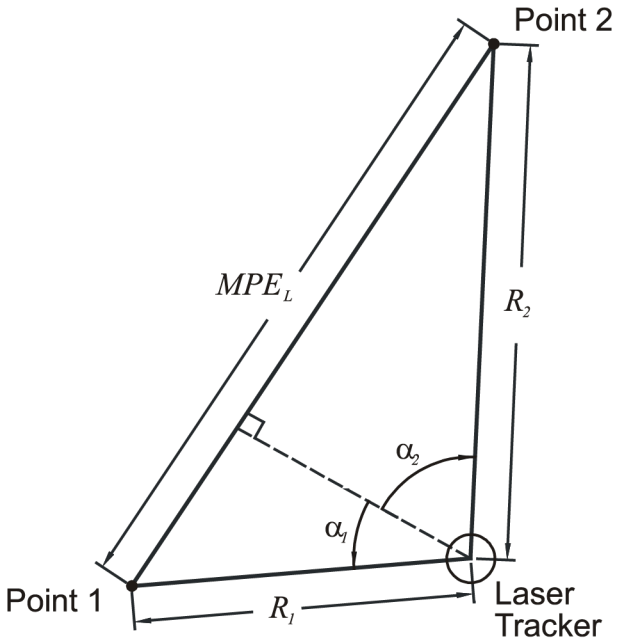
The following discussion presents details on the accuracy for the Vantage per the ISO 10360-10:2016 specification. Accuracy is expressed as Maximum Permissible Error (MPE). Typical performance is half the MPE values.

See Table 9-1 for the performance specifications for the Vantage.

Laser Tracker Subsystem	Symbol	Maximum Permissible Error	
Absolute Distance Meter (ADM)	e_{ADM}	$16\mu m + R * 0.8\mu m/m$	(1)
R0 parameter (R0)	e_{R0}	$16\mu m$	(2)
Transverse	e_T	$20\mu m + R * 5\mu m/m$	(3)

Table 9-1 Vantage Performance Specifications

The geometrical arrangement of a Laser Tracker that measures the coordinates of points 1 and 2 is shown in Figure 9-1. From these coordinates, the length d is determined. The maximum permissible error (MPE) in this length measurement is the maximum error permitted by the performance verification tests. The MPE of measured length d, MPE_D, is calculated using Equation (6) below.



$$MPE_D = \left(e_{R1}^2 \sin\alpha_1^2 + e_{R2}^2 \sin\alpha_2^2 + e_{R0}^2(\sin\alpha_1 + \sin\alpha_2)^2 + e_{T1}^2 \cos\alpha_1^2 + e_{T2}^2 \cos\alpha_2^2\right)^{\frac{1}{2}} \quad (6)$$

Figure 9-1 Laser Tracker geometry

The angles α_1 and α_2 are positive in the directions shown in Figure 9-1 and negative in the opposite directions. The quantities e_{R1}, e_{R2}, e_{R0}, e_{T1}, and e_{T1} are calculated using Equations (1) - (3). The subscript 1 refers to path 1 and the subscript 2 refers to path 2. So, for example, $e_{T1} = 20\mu m + R * 5\mu m/m$.

A special case is the outside buck-in measurement in which the Laser Tracker is aligned with points 1 and 2 as shown in Figure 9-2.

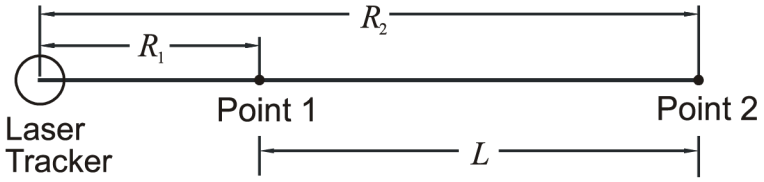


Figure 9-2 Laser Tracker Buck-In geometry

Point 1 establishes the reference for the measurement, much as the home position establishes the reference point for many other measurements. Also, in this case, the air temperature of the beam path between the Laser Tracker and point 1 is the same for both measurements. Under these conditions, the two coordinate measurements are correlated, permitting Equation (6) to be rewritten as:

$$MPE_L = 16\mu m + (0.8\mu m/m) * L \quad (7)$$

Another special case is that of the two-face measurement. In this measurement, the coordinates of a point are first measured in the usual mode, referred to as front-sight mode, and then in the backsight mode. To put the Laser Tracker in backsight mode, the azimuth axis is rotated by 180 degrees and then flipped about the zenith axis to point the laser beam back at the target. The transverse distance between the frontsight and backsight coordinates is the backsight error. The two-face test is a challenging test of performance because most of the Laser Tracker transverse errors are doubled. The two-face MPE is:

$$MPE_{two-face} = 2e_{T1} \quad (7)$$

Probing Error

This section presents details on the probing accuracy for the Vantage per the ISO 10360-10:2016 specification. The calibration artifact is a 51 mm diameter sphere located at a range of 2 meters.

Probing Measurement	Symbol	Maximum Permissible Error
Size	Psize	20 µm
R0 parameter (R0)	Pform	30 µm

Table 9-2 ISO 10360-10: 2016 Probing Errors

The ISO 10360-10: 2016 probing errors are satisfied for measurements acquired with SMRs conforming to the specifications of less than ¼ wave wavefront distortion and a maximum algebraic dihedral angle difference of less than 1 arcsecond.

Maximum Permissible Error

Vantage calibration begins with the required test length positions and MPEs. All scale bars used are 2.30 meters long.

Formula for MPEs 1-35 & 41: Figure 9-1, Table 9-1, and Equation (6) of this manual.
Formula for Ranging MPEs (positions 36-40): Figure 9-2, and Equation (7) of this manual.

Test Length Position	MPE (µm)		Test Length Position	MPE (µm)
1	39		22	41
2	39		23	49
3	48		24	49
4	48		25	49
5	48		26	49
6	48		27	49
7	48		28	49
8	48		29	49
9	48		30	49
10	48		31	71
11	70		32	71

Test Length Position	MPE (µm)		Test Length Position	MPE (µm)
12	70		33	71
13	70		34	71
14	70		35	71
15	70		36	71
16	70		37	71
17	70		38	71
18	70		39	71
19	70		40	49
20	41		41	49
21	41			

NOTE: ISO 10360-10:2016 ranging test positions 36-40 satisfied to 75 meters.

Chapter 10: FARO Tracker Utilities

This chapter describes the FARO Tracker Utilities for the Vantage. Some of these commands are found in the CAM2 2020 Device Center.

NOTE: The Vantage is only compatible with Tracker Utilities v4.0 and later.

Startup Checks 90
Operational Checks 91
TrackerPad 96
Diagnostics 114
Asynchronous Messages 114
Measure Pad 114
CompIT 114
Firmware Loader 114
Select Units 114
Extract Log Files 115

From the Windows Start menu, choose the **FARO** group and then click **Tracker Utilities**.

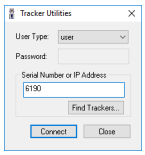


Figure 10-1 FARO Tracker Utilities Connection

- To connect to the Vantage, enter the IP address. With later models, you can also enter its Index number (last 4 digits of the Vantage's serial number).
- Click **Connect**.
- The **Tracker Utilities** menu appears.

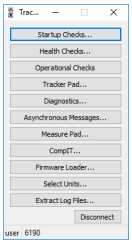


Figure 10-2 FARO Tracker Utilities Menu

Startup Checks

Each time the Vantage is powered up, or when power to the system is interrupted, the system must be initialized or started. This is done through the Startup Checks which initialize the angular encoders and the position-sensing detector. The Startup Checks automatically run in FARO CAM2 2020 software when the Vantage is started as the current input device. *For more information, see "Device Center" on page 151.*

1. Start the CAM2 2020 software.
2. CAM2 2020 software automatically starts the Startup Checks.

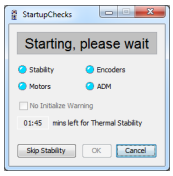


Figure 10-3 Startup Checks

NOTE: The Thermal Stabilization may take more than 40 minutes to complete, depending on the initial temperature. You can skip Thermal Stabilization by clicking **Skip Stability**.

Click **OK** to begin the Startup Checks. Keep your hands away from the Vantage as the motors turn on and the top of the Vantage rotates. This procedure takes approximately one minute.

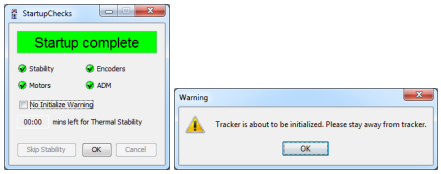


Figure 10-4 Startup Checks

The Startup Checks are now complete. Click **OK** to continue.

NOTE: You can set a time to automatically power on the Vantage and complete the Startup Checks. Use the TrackerPad Scheduled Power On command and enter a date and time to automatically power on the Vantage. *See "Scheduled Power On" on page 113.*

Operational Checks

This chapter describes the Operational Checks for the Vantage. These checks use commands found in FARO CAM2 2020.

NOTE: The Vantage is only compatible with FARO CAM2 2020 and CAM2 Measure v10.6.7 and later.

The Operational Checks determine the operating condition of the Vantage as well as verifying that environmental factors such as air movement and vibration will not degrade measurement accuracy.

References

FARO Vantage Assembly Instructions (FARO Part # 462-000023-000 or 462-000017-000 for older models)

See "FARO CompIT" on page 116.

Equipment

1. Vantage and support equipment
2. Spherically Mounted Retroreflector (SMR)
3. Calibration Tripod, or nest, to hold the SMR securely at the reference position

When to Perform

Run the Operational Checks to ensure that the Vantage System is operating/performing at the expected level of stability and repeatability in its current environment.

NOTE: If you move the system to a new operating environment, you should always run the Operational Checks.

Preparation

Set up, supply power to, and start the Vantage System. *For more information, see "Setting up the Vantage" on page 29.*

NOTE: Powering down the system is not necessary at the end of the day; restarting is only necessary just after powering up.

Start your computer and the CAM2 2020 software.

Procedure

The following procedures cover the Operational Checks of the Vantage. In the CAM2 2020 software, open the **Operational Checks** dialog box:

- On the **Devices** tab, select **Device Center**. Double-click your Vantage and click **Operational Checks**. You can also press the **P** hot key to show the **Device Center** panel.

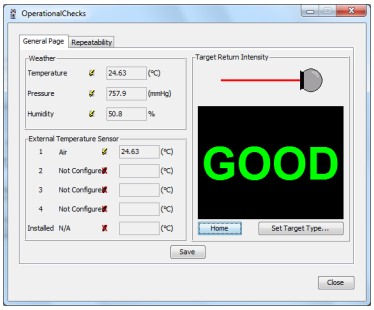


Figure 10-5 Operational Checks dialog box

General Page

View the Weather information and verify the SMR Return Power on the **General Page** tab of the **Operational Checks** dialog box.

Use **Save** and **Save As** to save the test results to an ASCII text file.

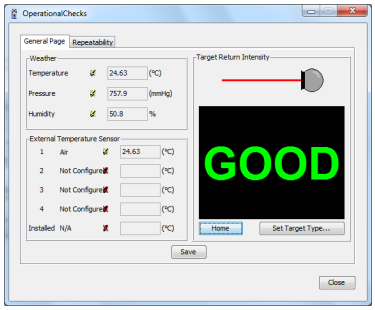


Figure 10-6 General Page of the Operational Checks

Weather

View the temperature, pressure, and humidity of the measuring environment. An icon indicates the source of the reading:

- Lightning Bolt - the reading originates from the Vantage's internal sensors.
- Pencil - the reading has been manually entered.

NOTE: Use the Set Weather Configuration on the TrackerPad to manually enter the temperature, pressure, and humidity of the measuring environment. *See "Set Weather Configuration" on page 101.*

Target Return Intensity

The Target Return Intensity is the measure of the laser intensity as it returns to the Vantage from an SMR. Intensity appears as:

- Good

- Marginal
- No Target

NOTE: A dirty SMR is the most common cause for a Marginal Target Return Intensity. If the SMR is very dirty, it may even read No Target. *For more information, see "Optical Target Care" on page 73.*

To check the SMR Return Power:

1. Choose **Set Target Type...** and select your SMR. Click **OK** to continue.

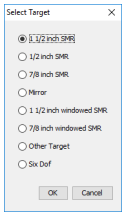


Figure 10-7 Set Target Type

2. Place the SMR at the Home position on the Vantage and click **Home**.

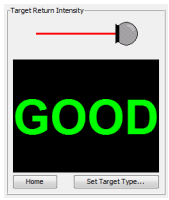


Figure 10-8 Target Return Intensity

Repeatability

The repeatability of measurements taken with the Vantage depends on the mounting of the Vantage, the stability of the SMR, and environment factors such as air flow, temperature changes, vibration, etc. The Repeatability Page contains tests to ensure the Vantage is consistent in its measurements in the current environment.

Choose the **Repeatability** tab of the **Operational Checks** dialog box to start the Repeatability Checks.

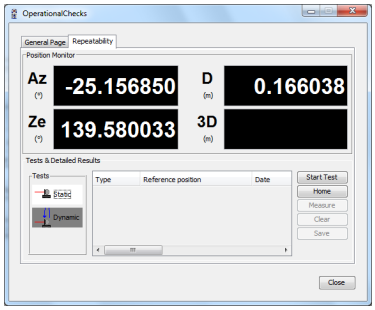


Figure 10-9 Repeatability

- The **Position Monitor** section shows the real time position of the target expressed in the unit's spherical coordinate system: Azimuth angle (Az), Zenith angle (Ze), and Radial distance (D). The "dT" value shows the last measurement result.
- The **Tests** section contain buttons to activate one of the three repeatability tests.
  - Click **Start Test** and **Measure** to carry-out the specific tests, and **Home** to reset the laser should a beam break occur.

- The **Tests & Detailed Results** section shows the results of each test in detail. Click **Clear** to remove any test results.
- Click the **Save** and **Save As** to save the test results to an ASCII text file.

Static Repeatability

The Static Repeatability check determines whether the Vantage System can repeat the measured position of the SMR in a fixed position. The SMR remains at the reference position and does not move at all during the test. This check is critical for determining whether the Vantage, part, and drift points are stable in the current environment.

1. Place the SMR in the Tracker Mounted Reset (TMR) or Home position.
2. From the **Repeatability** tab of the **Operational Checks** dialog box, click **Home** to reset the laser.
3. Position the tripod or use an available nest approximately six (6) meters from the Vantage. Angular position is not critical to this check. Use a control point on the part if the position is approximately six (6) meters from the Vantage.
4. Remove the SMR from the home position and track to the reference position.
5. Click Static and click **Start Test**.
    - Enter a time delay between measurements, or use the default, and click **OK**.

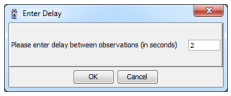


Figure 10-10 Enter Delay

    - The Vantage first measures the reference position, then after the time delay, measures the reference position again. Allow it to collect about ten (10) measurements.
6. Click **Stop Test** and review the results.
    - Look at the “Total” values in the **Test Results** section. The total error should be less than 0.025mm.
7. If the total error is greater than 0.025mm, repeat this check at two other locations.

NOTE: If the total error is consistently high, check the stability of the Vantage, mandrel, stand and the tripod/nest, and eliminate any possible causes of air movement in the laser beams path before repeating the Static Repeatability Test. If the Static Repeatability Test continues to fail, contact FARO Customer Service by Phone, Fax or E-Mail. *See “Technical Support” on page 164.*

Dynamic Repeatability

This check determines whether the Vantage can repeat the measured position of the SMR at multiple positions throughout the measurement volume. This check is critical for determining whether the Vantage, part, and drift points are stable while measuring with the SMR.

1. Place the SMR in the Tracker Mounted Reset (TMR) or Home position.
2. From the **Repeatability** tab of the **Operational Checks** dialog box, click **Home** to reset the laser.
3. Use an available monument/nest affixed to a stable stand or on the measurement object as the reference position approximately six (6) meters from the Vantage. Use a control point on the part if the position is approximately six (6) meters from the Vantage.

NOTE: The calibration tripod supplied with the Vantage is NOT a suitable stand to use for this test.

---

4. Remove the SMR from the TMR and track to the reference position.
5. Click Dynamic and click **Start Test**.

- The Vantage first measures the reference position. Then, track the SMR around the measurement volume.

6. Return the SMR to the Reference position and click **Measure**.
7. Click **Stop Test** and review the results.
   - Look at the "Total" values in the **Test & Detailed Results** section. The total error should be less than 0.025mm.
8. If the total error is greater than 0.025mm, repeat this check at two other locations.

NOTE: If the total error is consistently high, check the stability of the Vantage, mandrel, stand and the tripod/nest, and eliminate any possible causes of air movement in the laser beams path before repeating the Dynamic Repeatability Test. If the Dynamic Repeatability Test continues to fail, contact FARO Customer Service by Phone, Fax or E-Mail. *See "Technical Support" on page 164.*

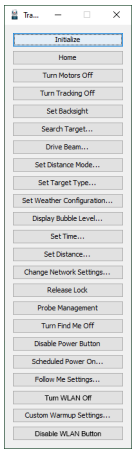
Following the Checks

Your Vantage System is now ready to perform repeatable measurements. In addition to these Operational Checks, always complete Quick Compensation and Angular Accuracy Checks prior to any measurement session to verify the accuracy of the system. *See* Quick Compensation, *and* Angular Accuracy Checks.

TrackerPad

NOTE: Some of the TrackerPad commands are not available when started from FARO CAM2 2020.

Click **TrackerPad** to start TrackerPad. In the **TrackerPad** dialog box, you can:



- **Initialize** - Initialize the Vantage System.
- **Home** - Send the Vantage laser beam to the Tracker Mounted Reset (TMR) or Home position.
- **Turn Motors On/Off** - Switch the Vantage motors on and off.
- **Turn Tracking On/Off** - Switch the Vantage target tracking on and off.
- **Set Backsight** - Switch the Vantage into backsight or frontsight measurement.
- **Search Target** - Initiate a search for a target.
- **Drive Beam** - Drive the laser beam to a specific Location.
- **Set Distance Mode** - Set the measurement distance mode.
- **Set Target Type** - Set the current SMR or target.
- **Set Weather Configuration** - View and configure the weather measurement settings.
- **Display Bubble Level** - View the bubble level.
- **Set Time** - Set the Vantage's internal Date and Time.
- **Set Distance** - Set the Interferometer base distance - ION models only.
- **Change Network Settings** - Set the Vantage's wired and wireless IP address.
- **Release Lock** - Temporarily stop the Vantage from tracking the SMR or target.
- **Probe Management** - Manage and compensate the 6Probe's removable probe tips.
- **Find Me On/Off** - Switch the Vantage's Find Me on and off.
- **Disable/Enable Power Button** - Disable the Power On/Off button.
- **Scheduled Power On** - Shut down the Vantage and automatically power on at a specific time in the future.
- **Follow Me Settings** - Switch Follow Me on and off and set the search radius.
- **Turn WLAN On/Off** - Switch the Vantage WLAN transmitter on and off.
- **Custom Warmup Settings** - Set a specific warmup time for the Vantage.
- **Disable/Enable WLAN Button** - Disable and enable the WLAN button.

Figure 10-11 Tracker Pad dialog box

Initialize

Runs the angular encoder initialization sequence. This is necessary if the motors shut down. The Vantage motors will shut down as a protective measure if the axis is forced or over-torqued.

Home

Click **Home** to send the Vantage laser beam to the Tracker Mounted Reset (TMR) or Home position.

Turn Motors On/Off

Switch the Vantage motors on and off. Click **Turn Motors Off** to switch on or off the motors that control the movement of the laser beam. The text of this button will change as you switch the motors on or off.

Turn Tracking On/Off

Switch the Vantage target tracking on and off. This will stop the Vantage from tracking a moving target. The text of this button will change as you switch the tracking on or off.

Set Backsight

Switches the Vantage between frontsight and backsight modes.

Search Target

Initiates a spiral search for a target.

Drive Beam

Drive Options: These options allow you to manually move, or drive, the laser beam to locations where tracking the SMR is difficult.

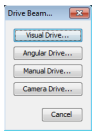


Figure 10-12 Drive Options dialog box

Angular Drive: Move the laser beam to a target by keying in specific azimuth and zenith positions.

To use the Angular Drive option:

1. Enter the Azimuth and Zenith positions in radian units. If necessary, select the **Use Estimated Distance** check box and enter the estimated distance.

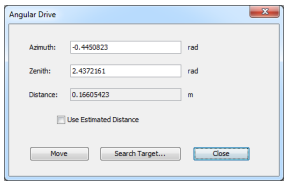


Figure 10-13 Angular Drive dialog box

2. Click **Move** to move the laser beam to the position. Repeat until the laser beam is pointing near the target.
3. Click **Search…**, key in the search parameters, and click **Search** to acquire the target.
4. Click **Close** to exit the command.

Manual Drive: Manually move the laser beam to a target. Starting this command automatically switches the Vantage's motors off.

To use the Manual Drive option:

1. Carefully move the Vantage and move the laser beam near the target.

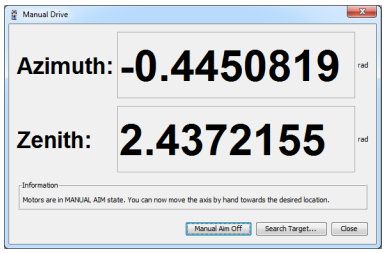


Figure 10-14 Manual Drive dialog box

2. Click **Manually Aim Off**.
3. Click **Search** to acquire the target.
4. Click **Close** to exit the command.

Visual Drive: Move the laser beam to a target using your computers mouse or arrow keys.

To use the Visual Drive option:

1. Click and hold near the cross hairs in the center of the dialog box.

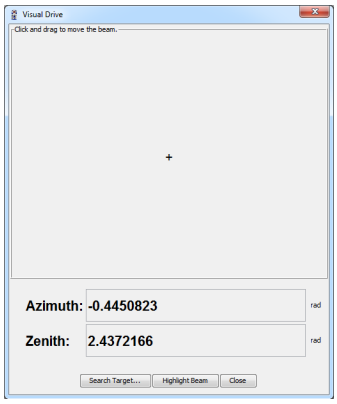


Figure 10-15 Visual Drive dialog box

2. Slowly drag the mouse in any direction until the Vantage is pointing near the target. Use the arrow keys to direct the beam.
3. Click **Search…**, key in the search parameters, and click **Search** to acquire the target.
4. Click **Close** to exit the command.

Camera Drive: Use the Vantage's MultiView Cameras to acquire a target in the camera's field of view.

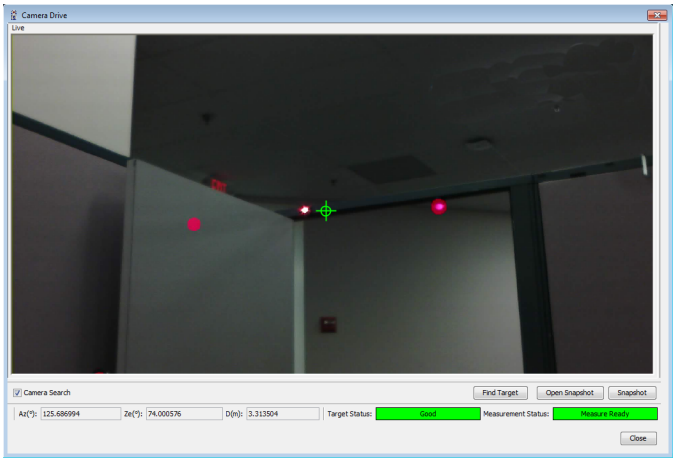


Figure 10-16 Camera Drive dialog box

NOTE: There is a distance limit to find targets with Camera Drive:

SMR Size	Vantage$^{S, E}$	Vantage$^{S6, E6}$
1½"	25 meters (82.0 ft)	45 meters (147.6 ft)
⅞"	25 meters (82.0 ft)	30 meters (98.4 ft)
½"	15 meters (49.2 ft)	25 meters (82.0 ft)

Camera Search check box - automatically runs a simple search for any visible target after the Vantage moves.

Find Target - starts a searches for any visible target.

NOTE: If there are multiple SMRs or targets in the field of view, the Vantage will point to the one closest to the center of the field of view. Click another target in the view to move the laser.

Target Status - shows the status of the laser beam and the target:

- **Good** when the Vantage is locked on a target with a valid beam and target position.
- **No Target** when the Vantage is not locked on a target.

Measurement Status - shows the status of the laser beam and the target:

- **Measure Ready** when the Vantage is locked on a target with a valid beam and target position, and is ready to measure.
- **System Not Ready** when the Vantage is not locked on a target or processing a current measurement.

To use the Camera Drive option:

1. Look at the video image in the **Camera Drive** dialog box. Any visible target appears as a round pink circle.

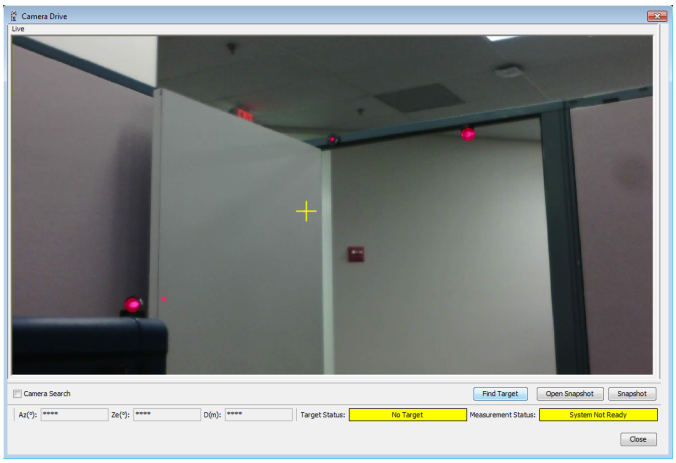


Figure 10-17 Searching for Targets

2. If you do not see any targets in the **Camera Drive** dialog box video image, click the Top, Bottom, Left, or Right edge of the video image to move the Vantage in that direction.

NOTE: You can also press the arrow keys on the computer keyboard to move the Vantage in that direction.

3. When the **Camera Search** check box is selected, the camera will do a simple search for any visible targets.

NOTE: To save time, clear the **Camera Search** check box if you need to move the Vantage more than one window length.

4. Click **Find Target** to lock onto a target if the camera search does not lock onto a target.

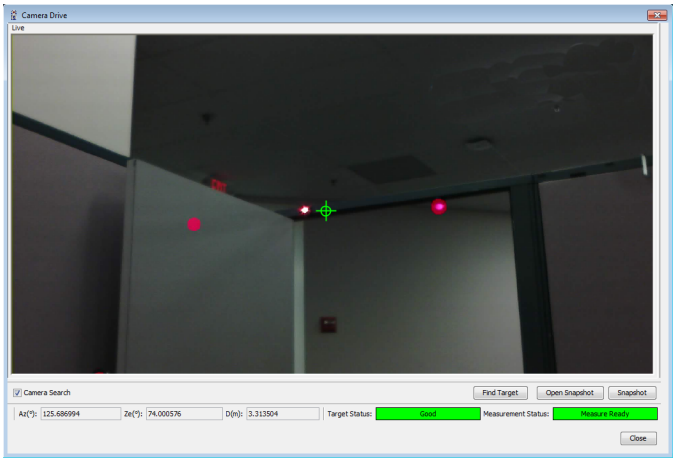


Figure 10-18 Finding a Target

NOTE: You can also click the pink circle in the video image to lock onto that target.

5. Click **Close** to exit the command.

The **Camera Drive** dialog box also contains the following buttons to create a snapshot, a saved visual location:

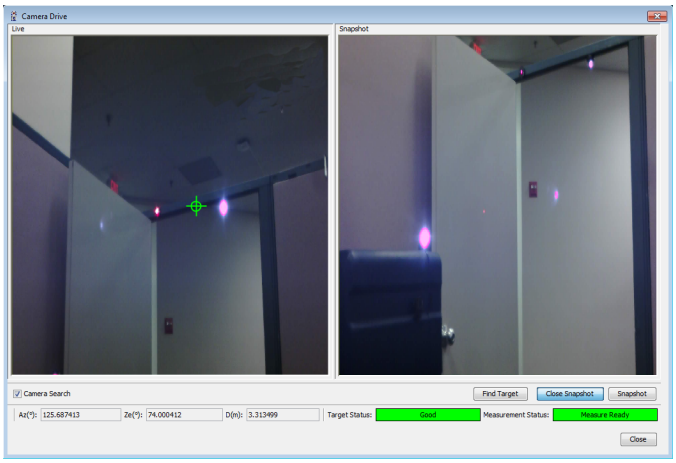


Figure 10-19 Snapshot

- **Open Snapshot** - opens the **Snapshot** window and saves the current video image location. Click anywhere in the **Snapshot** window to return to this location after moving the Vantage.
- **Snapshot** - updates the **Snapshot** window with the current video image.

Set Distance Mode

Set the measurement distance mode. The Vantage only has one mode, Absolute Distance Measurement (ADM).
For more information, see "Distance Measurement System" on page 65.

Set Target Type

Set the current SMR or target.

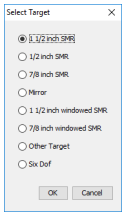


Figure 10-20 Set Target Type

Set Weather Configuration

Select and configure the source for the weather information. The **Hardware** option uses the Vantage's integrated weather station. The **Manual** option uses the entered weather information.

CAUTION: Manually entering values that do not represent the current air properties can result in inaccurate measurements.

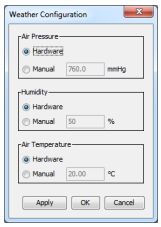


Figure 10-21 Weather Configuration

To manually enter weather information:

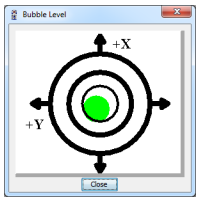
1. Click each **Manual** radio button.
2. Enter the weather information.
3. Click **Apply** to apply the changes, and then click **OK** to exit the command.

NOTE: Clicking **Cancel** before clicking **Apply** exits the command *without* making changes.

NOTE: All weather configuration settings will revert to **Hardware** if the Vantage is powered off.

Display Bubble Level

View the orientation of the Vantage with respect to gravity.



Set Time

Set the Vantage's internal Date and Time.

Set Distance

Set the Interferometer base distance - ION models only.

Change Network Settings

Set the Vantage's wired and wireless settings. Choose the **Wired** or **Wireless** tab.

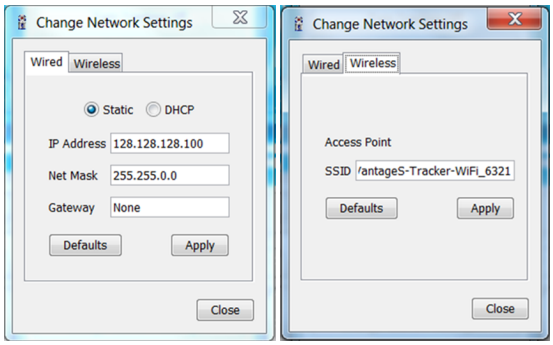


Figure 10-22 Change Network Settings dialog box

Release Lock

Temporarily stop the Vantage from tracking the SMR or target. Use the **Turn Tracking On/Off** command to stop the Vantage from tracking SMRs and targets. *See "Turn Tracking On/Off" on page 97.*

Probe Management

Create, edit, select, compensate, and check, each Kinematic Probe Adapter and Probe Tip combination for use with the 6Probe. Kinematic Probe Adapters that have been installed to the current 6Probe are automatically added.

NOTE: The 6Probe requires Vantage MCU firmware v2.11.0 or later.

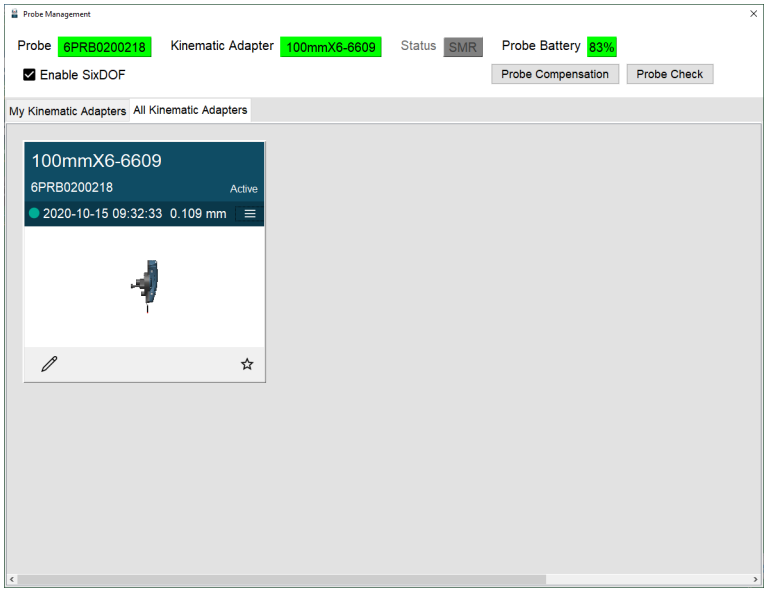
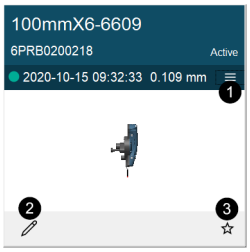


Figure 10-23 6Probe Probe Management

NOTE: Click the **Edit Probe** button to add the probe tip diameter information to the current probe.



1. Compensation Menu Button
2. Edit the Probe
3. Add to the **My Kinematic Adapters** tab

Figure 10-24 6Probe Probe

1. Select a probe and click **Edit Probe**.

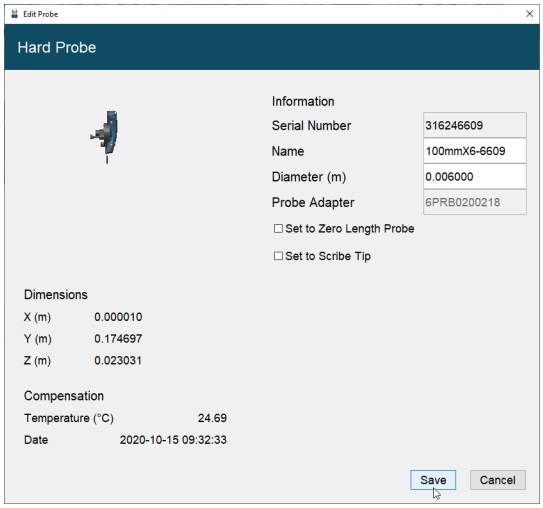


Figure 10-25 6Probe Edit a Probe

- Notice the 6Probe serial number (last four digits) is added to the probe name.
- Enter the name and probe tip diameter and click **Save**.

2. Select a probe to make it active.

Figure 10-26 Select a Probe

- Click the **Menu** button to see the last five compensations.

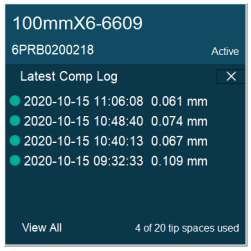


Figure 10-27 View Recent Compensations

- Click **View All** button to see the complete compensation history.

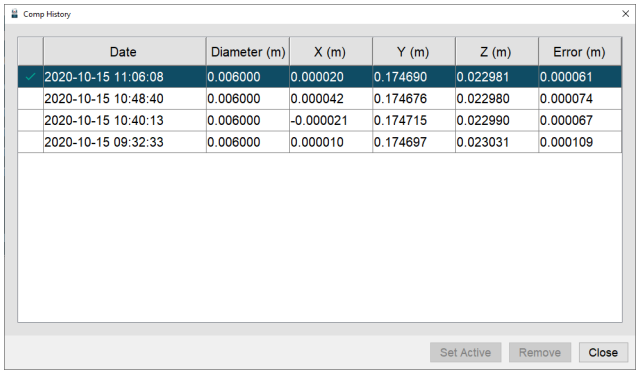


Figure 10-28 Compensation History

- Choose a compensation and click **Set Active** to use it.
- Click a compensation and click **Remove** to permanently delete the compensation.

3. Click **Probe Compensation** to compensate the probe. You must compensate each combination to measure accurately. Always compensate a Kinematic Adapter and Probe Tip combination after removing and reinstalling a probe tip or probe extension.
   - Click **Probe Check** to measure the probe and quickly check the active compensation. *See "Probe Check" on page 111.*

NOTE: It is not necessary to compensate a Kinematic Adapter and Probe Tip combination if removed and then later installed onto the 6Probe.

Probe Compensation

Probe compensation is a localized process by which a measurement device is optimized to perform measurements accurately. Since the probe tips are manually interchangeable, you must compensate, or measure, with the probe installed to determine the center of the ball location.

NOTE: Once a probe is compensated to a 6Probe, it is not necessary to compensate it again if paired with another Vantage.

Figure 10-29 6Probe Probe Compensation

NOTE: Once paired with the Vantage, the Center Status LED is **blue** and the Left Status LED blinks **green** indicating a successful pairing but an unsuccessful probe compensation.

1. Select a probe and click **Probe Compensation**.

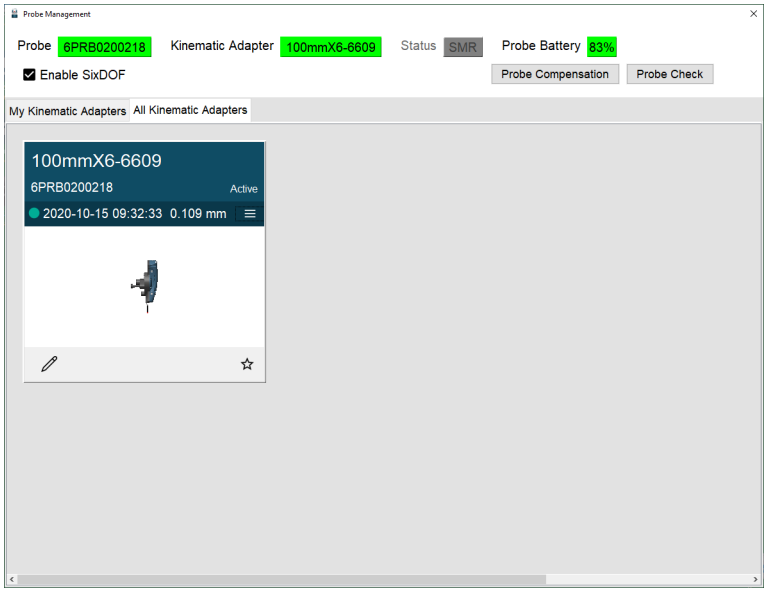


Figure 10-30 Select a Probe

2. Attach the probe compensation nest to a stable work surface between 3 m (10 ft) and 5 m (25 ft) from the Vantage.
   - Click **Continue**.
3. Acquire any SMR and track it to the center of the compensation nest. Once stable, the SMR is automatically measured.

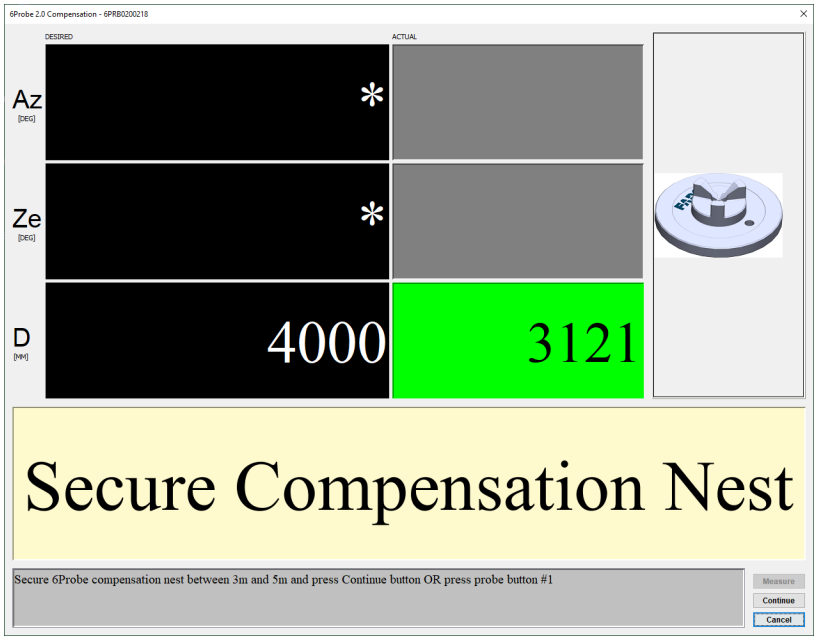


Figure 10-31 Secure the Compensation Nest

CAUTION: Ensure the compensation nest is secured to the measuring surface using the hole in the base or hot glue. If the nest moves at any time on the compensation process, the probe compensation may fail.

4. Track the SMR to position 1 on the base of the compensation nest. Once stable, the SMR is automatically measured.

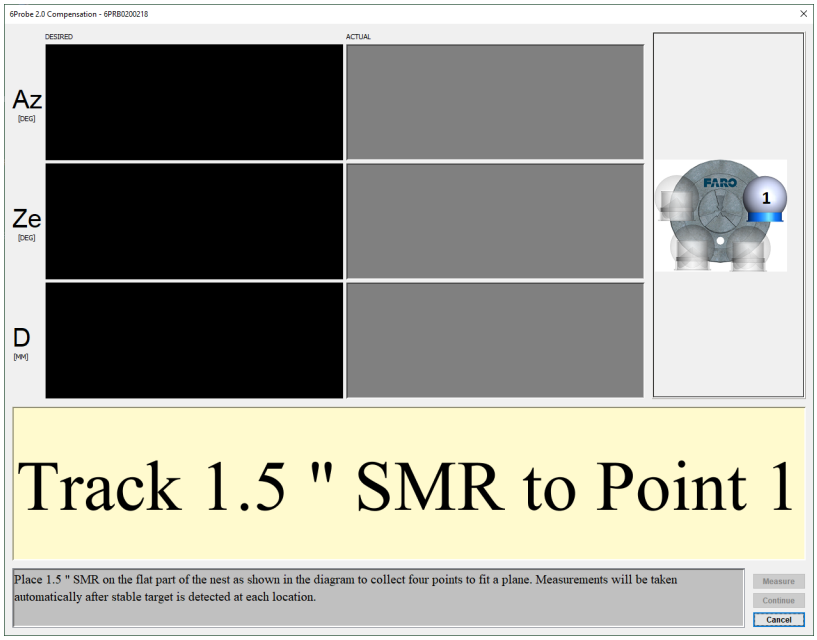


Figure 10-32 Measuring the Compensation Nest base

- Continue for positions 2 through 4 around the base of the compensation nest.

5. Acquire the 6Probe and track it to the center of the compensation nest and place the probe tip into the nest. You will measure a minimum of five points in different orientations.

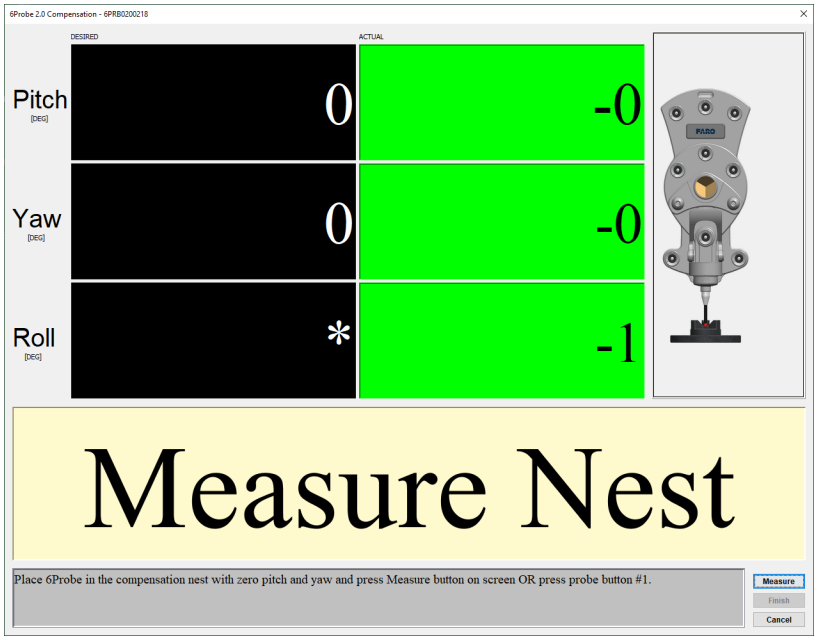


Figure 10-33 6Probe in Position 1

- Move and twist the 6Probe until it is straight up and directly facing the Vantage. The Pitch, Yaw and Roll values should be as close to zero (0) as possible.
- Press button **1** to measure position 1.

6. Continue measuring points in different orientations keeping the probe tip seated in the compensation nest. Press button **1** to measure each position.
   - Move the 6Probe 45° to each side (Roll Angle) for positions 2 and 3.
   - Move the 6Probe back to vertical center and then 15° forwards and backwards (Pitch angle) for positions 4 and 5.
   - If necessary, measure additional points in other orientations.
   - Press button **2** to continue.

CAUTION: The probe tip must be well-seated in the compensation nest when measuring all compensation points. Even one or two poorly measured points significantly affects the optimization process, which then has an effect on the accuracy of the 6Probe.

7. Compensation results:

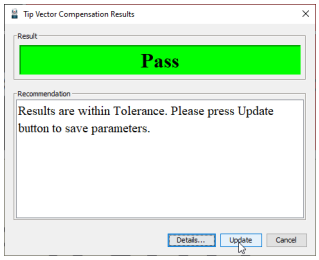


Figure 10-34 Probe Compensation Results

- **Pass** - Click **Update** to store the probe compensation and exit. The 6Probe is now ready for use.
- **Fail** - If the compensation fails, click **Cancel** and repeat the compensation.

CAUTION: *Do Not* remove the probe or power off the 6Probe until the command ends and the compensation information is written to the 6Probe.

Probe Compensation Details

Click **Details** to see the probe compensation details:

- XYZ values showing the previous and the current probe location.

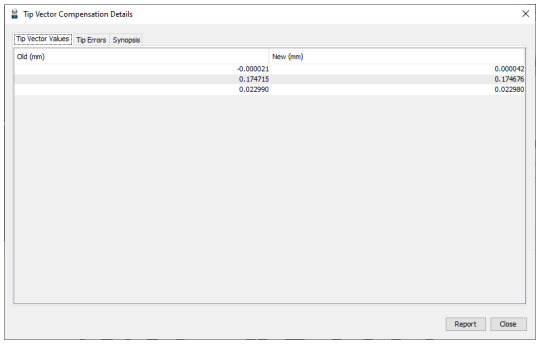


Figure 10-35 Probe XYZ Location

- Individual compensation point results.

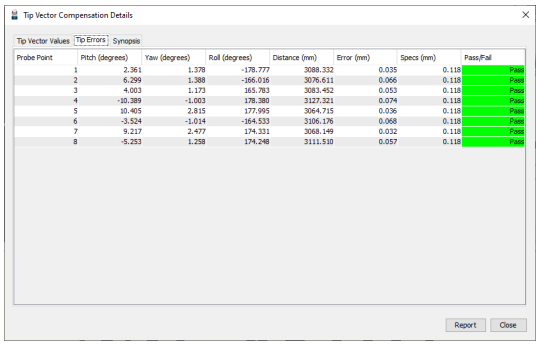


Figure 10-36 Probe Compensation Points

- Compensation Information.

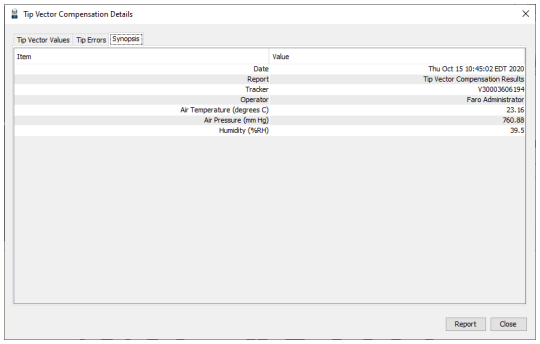


Figure 10-37 Probe Compensation Information

Probe Check

Probe Check is a method to measure the probe and compare it to the last stored compensation. This is useful when you remove and replace a probe or if you are not sure of the compensation of a probe.

Figure 10-38 6Probe Probe Check

1. Select a probe and click **Probe Check**.

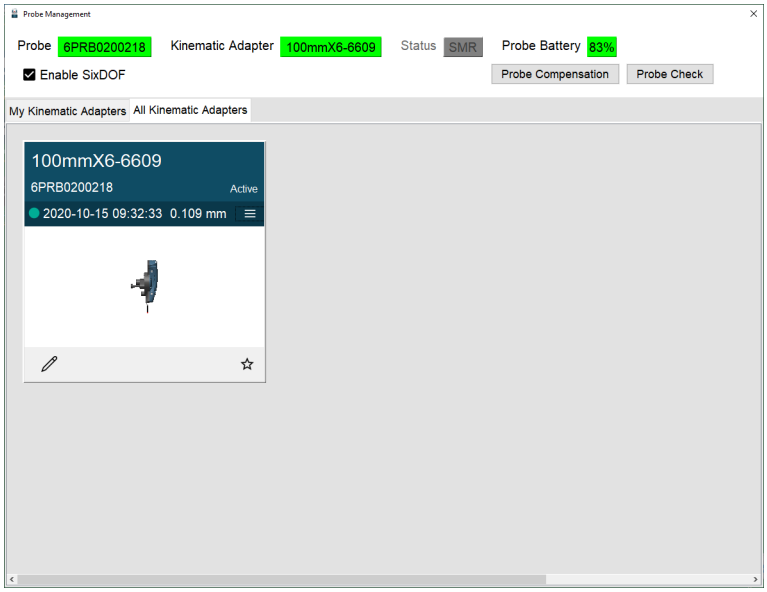


Figure 10-39 Select a Probe

2. Place the probe tip in the compensation nest or any hole smaller than the probe tip diameter.
3. Move and twist the 6Probe and watch the **green** indicators in the dialog box.

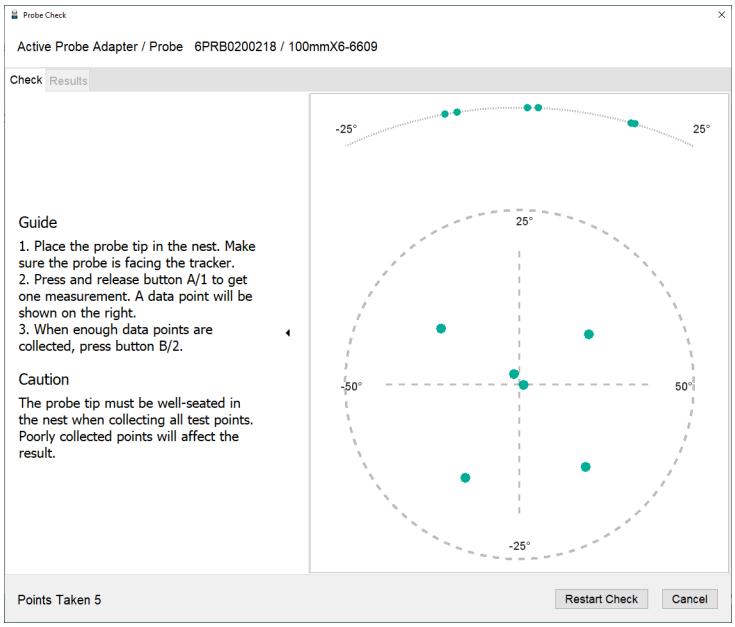


Figure 10-40 Probe Check Measurements

- Press button **1** to measure a point.

4. Measure at least four different points in different orientations.
   - Press button **2** to continue.
5. Probe Check results are Pass or Fail. If the probe fails, compensate it again. *For more information, see "Probe Compensation" on page 106.*
6. Click the **Results** tab to see the details.

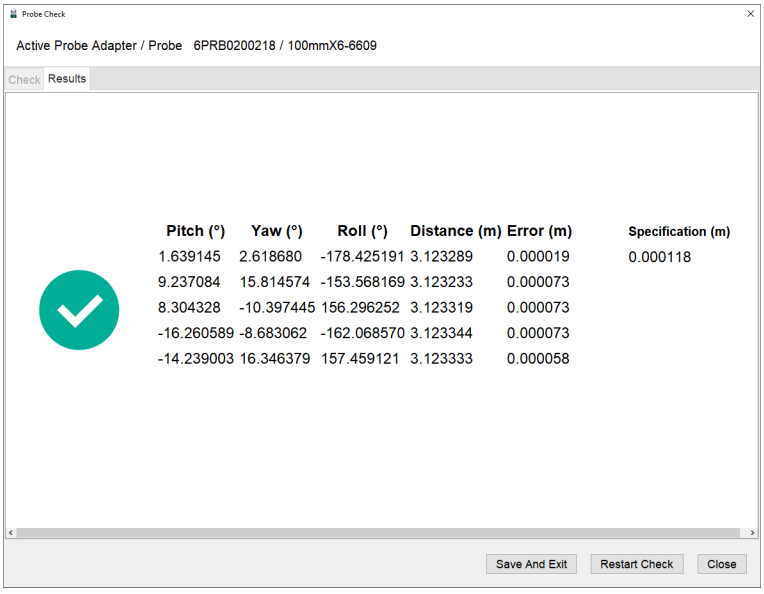


Figure 10-41 Probe Check Results

Find Me On/Off

Switch the Vantage's Find Me on and off. *For more information, see "Acquiring the Laser Beam with Find Me" on page 161.*

Disable/Enable Power Button

Disable and enable the Power On/Off button that allows the Vantage to power up as soon as the Power Supply is connected to power. *For more information, see "Powering Up" on page 44.*

Scheduled Power On

Set a future date and time to power on the Vantage. When complete, this starts the shut down of the Vantage.

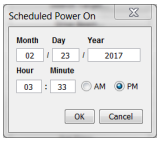


Figure 10-42 Scheduled Power On dialog box

- Enter a future date and time. This should be about an hour before you want to measure with the Vantage so it has time for Thermal Stabilization. *For more information, see "Startup Checks" on page 90.*
- Click **OK**.
- Click **OK** to confirm that you want to schedule the Vantage to power on.
- Notice the message and click **Yes** to power down the Vantage and exit TrackerPad.

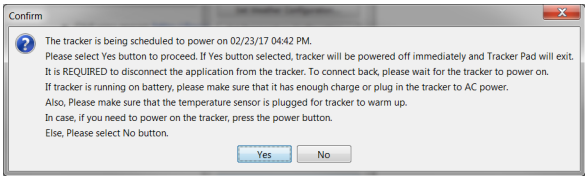


Figure 10-43 Scheduled Power On Confirmation message

Follow Me Settings

Switch Follow Me on and off and set the search radius.

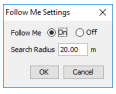


Figure 10-44 Scheduled Power On dialog box

For more information, see "Acquiring the Laser Beam with Follow Me" on page 160.

Turn WLAN On/Off

Switch the Vantage WLAN transmitter on and off. Click **Turn WLAN Off** to switch on or off the wireless network connection. The text of this button will change as you switch the transmitter on or off.

Custom Warmup Settings

Set a specific warmup time for the Vantage. Select the **ON** radio button and enter a time. This time will remain for every startup until changed or switched off.

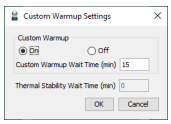


Figure 10-45 Custom Warmup Settings dialog box

Disable/Enable WLAN Button

Disable and enable the WLAN button that allows you to control the Vantage WLAN transmitter. The text of this button will change as you switch the button on or off.

Diagnostics

Use this command with the assistance of a FAROCustomer Service Representative to view the operational details of the Vantage. Contact your Customer Service Representative by Phone, Fax or E-Mail. *See "Technical Support" on page 164.*

Asynchronous Messages

Use this command to directly send Asynchronous Message commands to the Vantage.

Measure Pad

Use this command to preform simple point measurement with the Vantage.

CompIT

Click **CompIT** to start FARO CompIT. *For more information, see "FARO CompIT" on page 116.*

Firmware Loader

Use this command to load firmware from a folder onto your Vantage. The latest firmware is available on the FARO Knowledge base. *https://knowledge.faro.com/Hardware/Laser_Tracker/Tracker*

For assistance, contact your Customer Service Representative by Phone, Fax or E-Mail. *See "Technical Support" on page 164.*

Select Units

Use this command change the unit of measurement in your Vantage.

NOTE: Most measurement software will automatically change the unit of measurement once the Vantage connects.

Extract Log Files

Use this command with the assistance of a FARO Customer Service Representative to collect all the internal log files of your Vantage. Contact your Customer Service Representative by Phone, Fax or E-Mail. *See "Technical Support" on page 164.*

Chapter 11: FARO CompIT

This chapter is a reference guide for FARO CompIT. Before continuing, you must have a working knowledge of the Vantage System and FARO CAM2 2020 or FARO Tracker Utilities.

The CompIT software provides interim tests that allow for quick assessment of the system's pointing accuracy, ADM accuracy and precision level accuracy. It also provides compensation routines to adjust parameters that compensate the Vantage's pointing accuracy. During all tests and compensations, CompIT will compare the results to the Maximum Permissible Error (MPE) of the Vantage per the ISO 10360-10:2016 specification as defined in Product Specifications. *For more information, see "Product Specifications" on page 78.*

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Standard Tab 119
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Quick Compensation 124
Self Compensation 128
Camera Compensation 130
Advanced Tab 132
Pointing Compensation 132
ADM Checks 140
Level Check 146
Settings 147
Customize 147

Getting Started

Prior to running any test or compensations in FARO CompIT, set up, power up and start the Vantage. *See "Setting up the Vantage" on page 29.*

After the Vantage is properly set up, you can start CompIT from the FARO CAM2 2020 **Device Center** or from the Windows Start Menu.

FARO CAM2 2020

 In FARO CAM2 2020, click **Device Center** from the **Devices** tab to show the **Device Center** panel. You can also press the **P** hot key to show the **Device Control** panel.

Figure 11-1 Device Center Panel

- Double-click your Vantage.

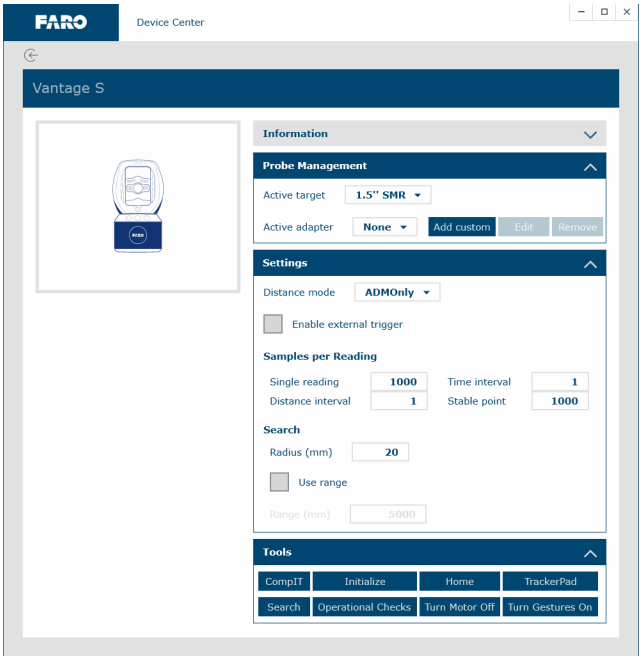

Figure 11-2 Device Center Panel

- Click **CompIT** to start the FARO CompIT program.

Windows Menu

CompIT is also accessible directly from the Windows Start menu by opening the FARO Tracker Utilities program, connecting to the Vantage, and clicking **CompIT**.

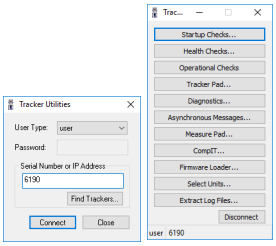

Figure 11-3 FARO Tracker Utilities

- To connect to the Vantage in FARO Tracker Utilities, either enter the IP address. With later models, you can also enter its Index number (last 4 digits of the Vantage's serial number).

Standard Tab

Clicking **CompIT** displays the **CompIT** dialog box.

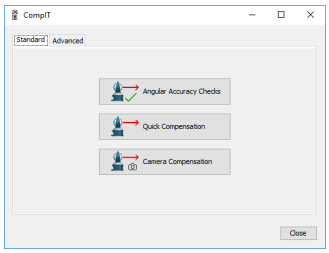

Figure 11-4 FARO CompIT dialog box

The **Standard** tab of the **CompIT** dialog box contains the three most frequently used functions: Angular Accuracy Checks, Quick Compensation, and Camera Compensation.

NOTE: Self Compensation replaces Quick Compensation if a Laser Tracker ION is connected.

Angular Accuracy Checks starts the Angular Accuracy test. *See "Angular Accuracy Checks" below.*

Quick Compensation starts the Quick Compensation routine. *See "Quick Compensation" on page 124.*

Self Compensation starts the Self Compensation routine. *See "Self Compensation" on page 128.*

Camera Compensation starts the Camera Compensation routine. *See "Camera Compensation" on page 130.*

Angular Accuracy Checks

Run this check after Startup Checks, before each measurement session, or if the temperature has changed more than approximately 2.8° Celsius (5° Fahrenheit). The Angular Accuracy Check verifies the system's accuracy during the course of a measurement session with minimal disruption. The CompIT Angular Accuracy Check measures the SMR in both frontsight and backsight, and calculates the difference between the angular component of these two measurements, or the Backsight Error. The Angular Accuracy Check can collect backsight deviations anywhere in the measurement volume.

The Angular Accuracy checks compares the measured error to the Vantage's Maximum Permissible Error (MPE) based on your Vantage's specifications per the ISO 10360-10:2016 specification. If the measured error is greater than the MPE, CompIT recommends a Quick Compensation.

The Angular Accuracy Checks require a 1½" Spherically Mounted Retroreflector (SMR) and stable nests to place hold the SMR. You can use either the Calibration Tripod or heavy duty nests attached to your part. If the nests are not stable during the duration of the measurement, the Angular Accuracy test may not be able to finish or its results can be poor.

1. In the **CompIT** dialog box, click **Angular Accuracy Checks**. The **Select Mode** dialog box appears with two options:

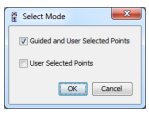

Figure 11-5 Select Mode dialog box

- **Guided and User Selected Points** first measures the Angular Accuracy at three specific locations recommended by CompIT with the option to measure additional locations after.

- **User Selected Points** measures the Angular Accuracy at any location you choose. When using this option, you must use a minimum of three locations. The points should be at multiple distances and should cover the measurement volume of your part or tool.

2. After selecting a mode, the measurement screen appears:
   - Place the SMR in the Tracker Mounted Reset (TMR) or Home position. Allow the Vantage to measure the TMR position.

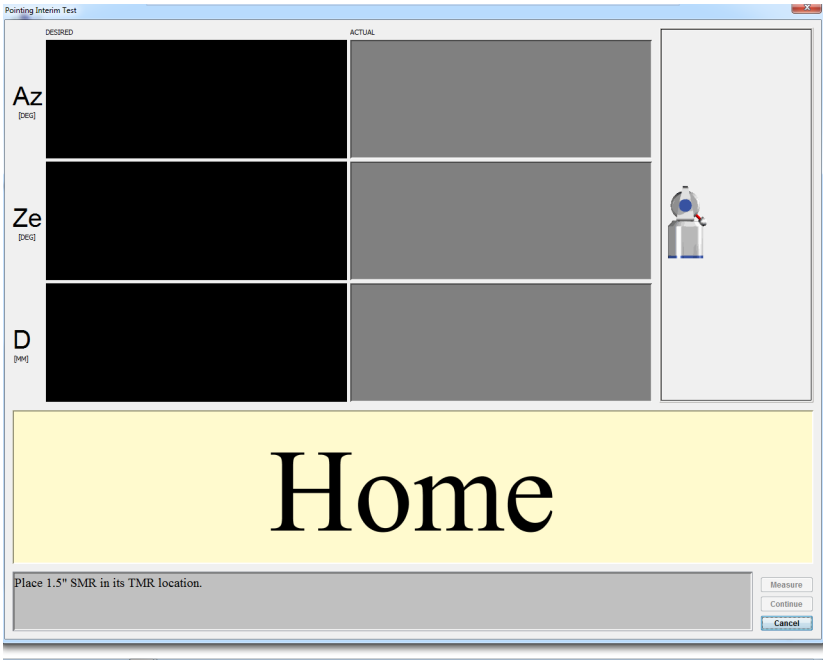

Figure 11-6 Guided and User Selected Points - Home

3. After the Vantage automatically measures the Home position, track the SMR on the tripod to the desired location.

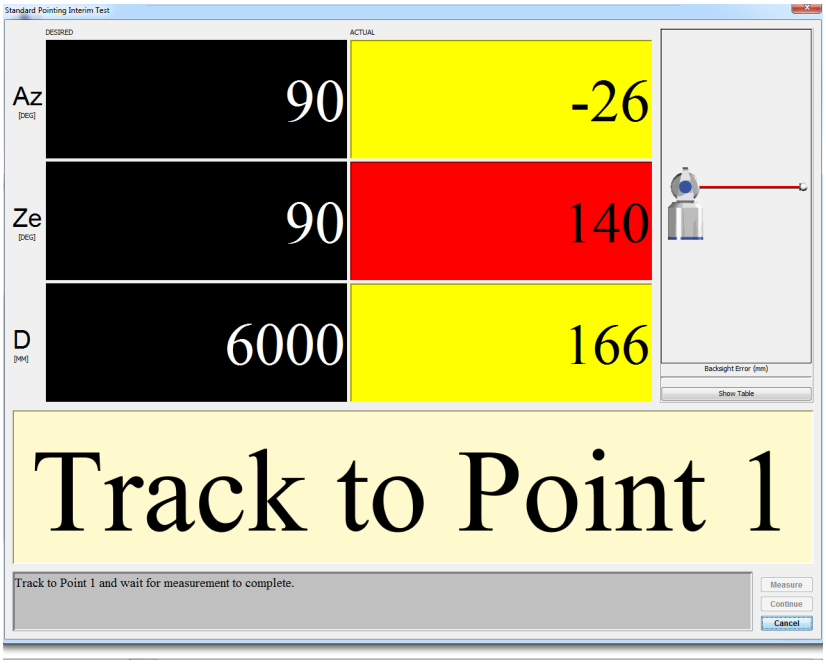

Figure 11-7 Guided and User Selected Points - Track to Point 1

- **DESIRED** value: When measuring Guided Points, these are the target values for Azimuth, Zenith and the Radial Distance. When measuring User Selected Points, the value is an *.
- **ACTUAL** value: The current Azimuth, Zenith, and Radial Distance values of the SMR. When all of the values are green, the system waits five (5) seconds for stability before measuring the SMR. When measuring User Selected Points, the values will always be green. When measuring Guided Points, the values switch to green when the SMR is in an acceptable zone around the desired values. The Radial distance value switches to red if the SMR is beyond its desired value.

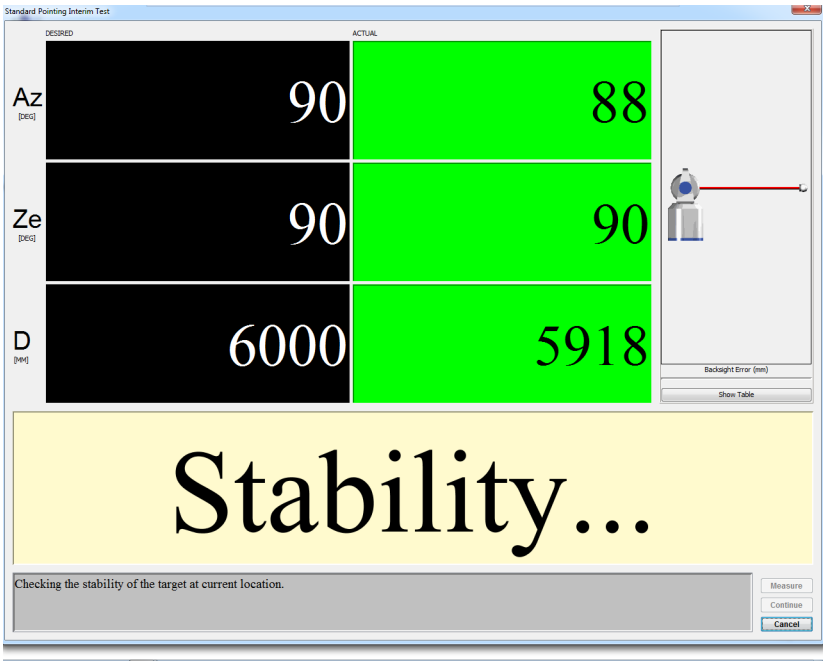

Figure 11-8 Stability

If the SMR does not stabilize within 60 seconds, an error message appears. Check the stability of the SMR and the Vantage before trying again.

NOTE: If the Vantage and SMR are mounted properly and the measurement still does not stabilize or takes longer than normal, please check for airflow or other environmental issues.

When the measurement is complete, the backsight error shows on the left side of the screen. After taking multiple measurements, click **Show Table** to show a list of any previous backsight errors.

NOTE: You can change the stability delay by clicking **Customize** in the **Advanced** tab of the **CompIT** dialog box. *See "General" on page 148.* You can disable the Auto Measure function by clicking **Settings** in the **Advanced** tab of the **CompIT** dialog box. *See "Settings" on page 147.* When Auto Measure is disabled, take measurements by clicking **Measure**.

4. When the backsight measurements at the first location are complete, move the SMR to the second location. Track the SMR to the next location and wait for stability.

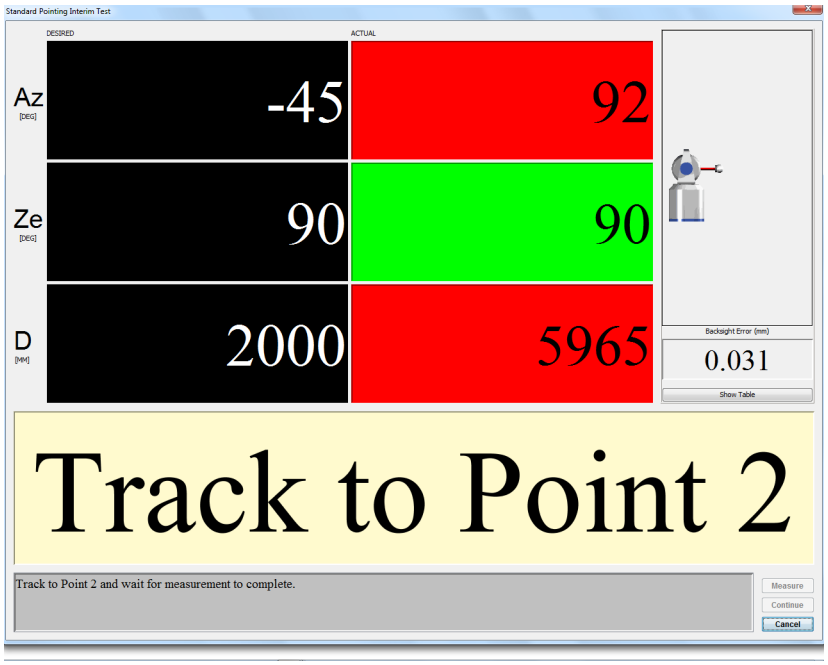

Figure 11-9 Guided and User Selected Points - Track to Point 2

5. After completing the last backsight measurement, click **Continue**. You will see the results of this check in the **Angular Accuracy Results** dialog box.

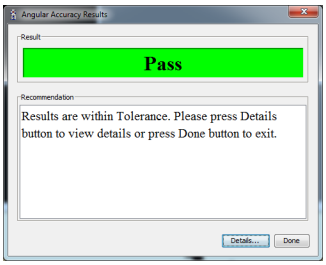

Figure 11-10 Angular Accuracy Results dialog box

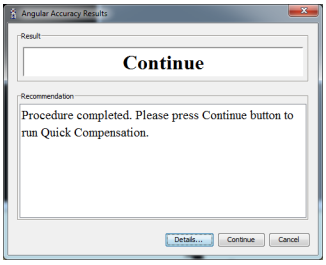

Figure 11-11 Angular Accuracy Check complete

CompIT compares the measured Angular Accuracy to the Vantage's Maximum Permissible Error (MPE) based on your Vantage's specifications per the ISO 10360-10:2016 specification. The Results Dialog box will report PASS if the results are in tolerance and will report **Continue** with a recommendation to run the Quick Compensation Routine if they are out of tolerance.

6. Click **Done,** or **Continue** to follow CompIT's recommendation, or click **Details** to see the detailed results.

Click the **Angular Accuracy Check Deviations** tab to view the detailed results of the backsight measurements. The measurement location, the error, the tolerance (MPE) and if the measurement is In Tolerance or Out of Tolerance appears.

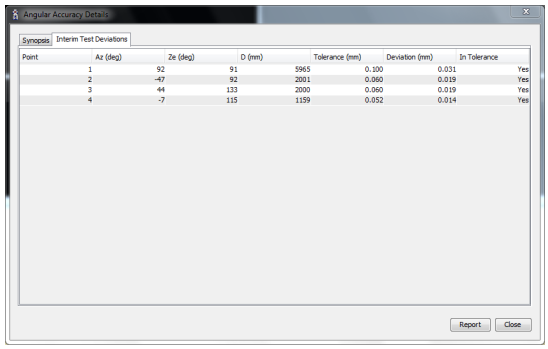

Figure 11-12 Angular Accuracy Check Deviations tab

7. Click **Close** to continue.
8. The Angular Accuracy Checks automatically close.

Quick Compensation

Quick Compensation is a Vantage-only routine that adjusts parameters in the Vantage to improve its accuracy. Its purpose is to provide Angular Accuracy Results that are within your Vantage's specifications for the current working range of the system, or lower than the Vantage's Maximum Permissible Error (MPE) based on your Vantage's specifications per the ISO 10360-10:2016 specification.

Quick Compensation can be performed prior to performing the Angular Accuracy Checks using the steps below. When running the Quick Compensation prior to performing the Angular Accuracy Checks, FARO recommends that you verify the Quick Compensation results with an Angular Accuracy Check.

NOTE: Quick Compensation is the preferred compensation for most applications, however Pointing Compensation from the **Advanced** tab of CompIT can yield lower backsight error or improved Angular Accuracy results, especially at longer distances, or when the full range of the system is required. Therefore, for measurement applications that require the highest possible accuracy and when measuring at long distances, Pointing Compensation can produce an improvement in overall measurement accuracy.

The Quick Compensation requires a 1½" Spherically Mounted Retroreflector (SMR) and a stable nest to place hold the SMR. You can use either the Calibration Tripod or heavy duty nests attached to your part. Several measurements are taken to ensure movement, vibration, etc does not affect the compensation, therefore if the nest or environment is not stable during the duration of the measurement, the Quick Compensation may not be able to finish.

1. In the **CompIT** dialog box, click **Quick Compensation**. This step is not necessary if you chose to continue onto the Quick Compensation directly from the results of the Angular Accuracy Checks.
2. CompIT begins the Quick Compensation routine. This routine requires tracking the SMR to one location. The routine takes approximately five minutes to complete.
3. Place the SMR in the Home position and wait until the measurement of the SMR is complete.

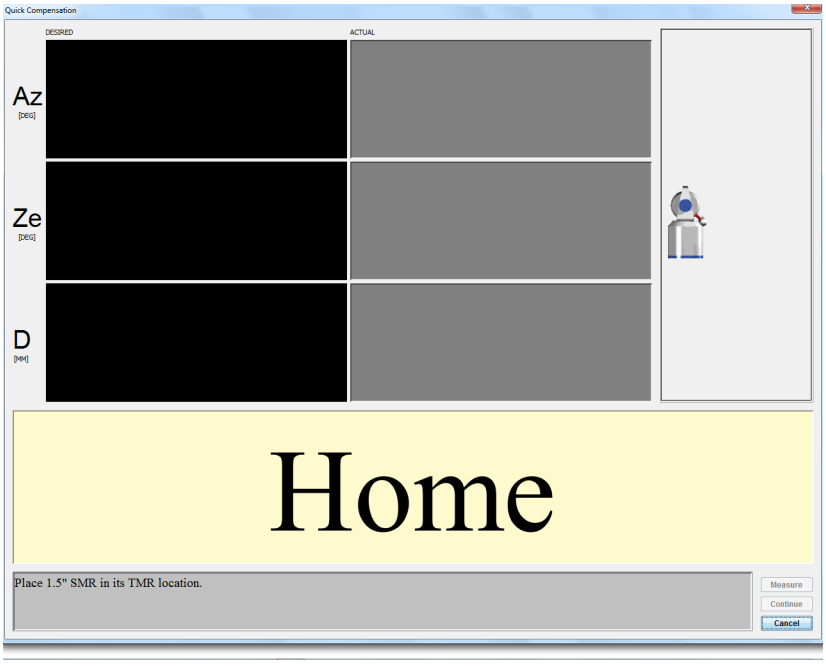

Figure 11-13 Quick Compensation - Home

4. Track the SMR to any location.

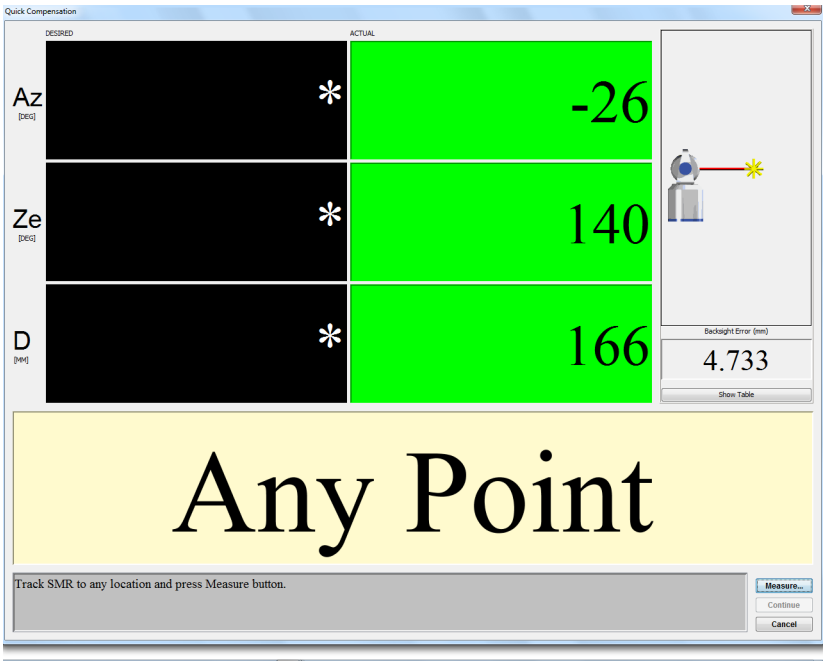

Figure 11-14 Quick Compensation - Track to Any Point

- CompIT automatically checks for stability of the SMR at the location.

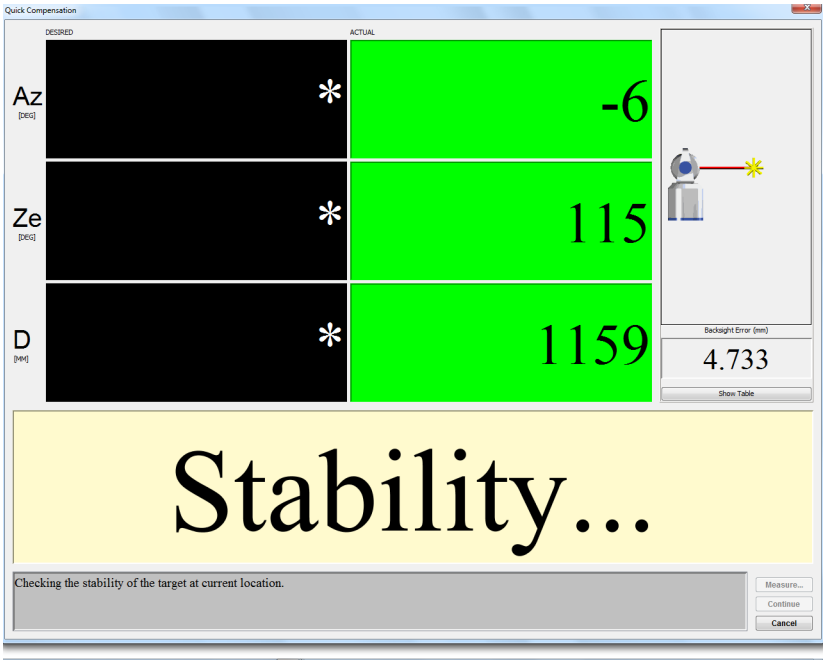

Figure 11-15 Quick Compensation - Checking Stability

- Once stable, CompIT automatically measures the location in both frontsight and backsight modes.

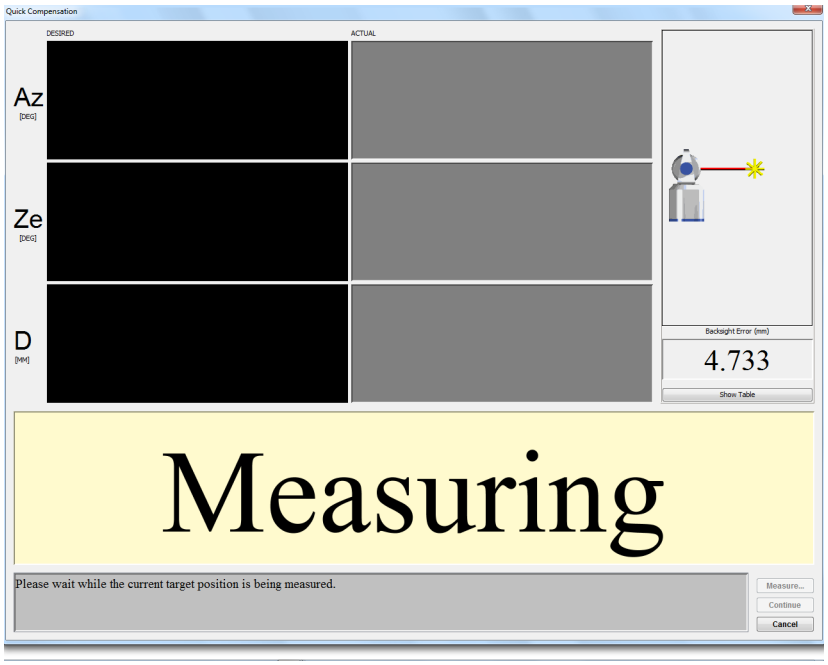

Figure 11-16 Quick Compensation - Measuring

5. After the routine is completed, you will see the results in the **Quick Compensation Results** dialog box with a recommendation.
   - If Quick Compensation was run directly from the **CompIT** dialog box, click **Update** to update the Vantage compensation parameters.

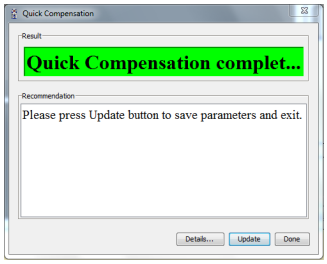

Figure 11-17 Quick Compensation - Passing Results

   - If Quick Compensation was run directly from an Angular Accuracy Checks that did not have a passing results, the previous Angular Accuracy Checks measurements will be used to verify that the Quick Compensation has improved the Vantage's angular accuracy and it is now within its specifications. If these new results are not within the Vantage's accuracy specifications, CompIT will recommend that you press CONTINUE to perform a Pointing Interim Test and Pointing Compensation. *See "Pointing Compensation" on page 132.*

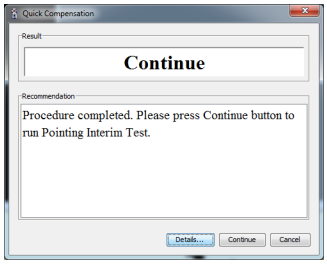

Figure 11-18 Quick Compensation - Passing Results

- Click **Done** to exit the Quick Compensation routine without making any updates.

CAUTION: The Vantage's compensation will not be changed. Click **Update** to use the previous measurements to improve the Vantage's accuracy.

- Click **Details** to see detailed results.

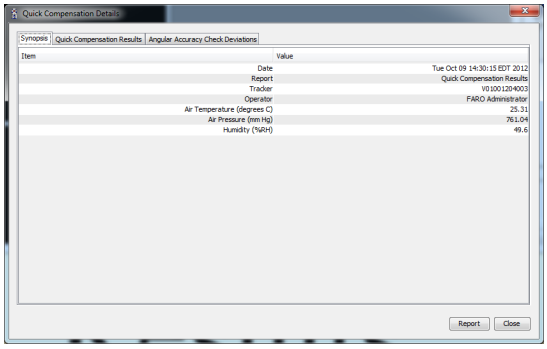

Figure 11-19 Synopsis tab

- Click Report to save the results to a text file.

If Quick Compensation was run directly from an Angular Accuracy Checks that did not have a passing results, an ANGULAR ACCURACY CHECK DEVIATIONS appears. Click this tab to view the new backsight results of the previously measured points. Also view the measurement location, the error, the tolerance (MPE) and if the measurement is In Tolerance or Out of Tolerance. Click the **Quick Compensation** tab to view the Before, After and Change in system parameters. Quick Compensation adjusts the two rotational (RX and RY) and two translational (CTX and CTY) parameters. While these parameters are displayed and able to be saved for archival purposes, the values or the change do not indicate the current angular accuracy or backsight error of the Vantage. The Angular Accuracy Checks or Backsight results is used to evaluate the accuracy of the Vantage, not these parameters.

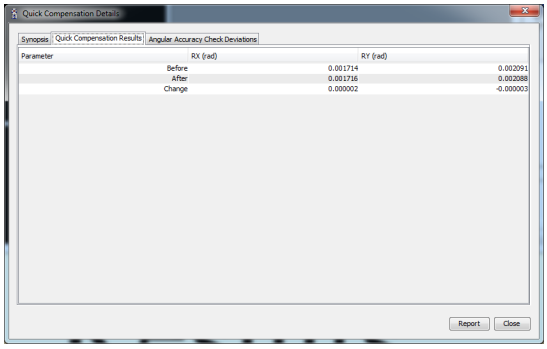

Figure 11-20 Quick Compensation Results tab

Self Compensation

Self Compensation is a ION-only routine that adjusts parameters in the Laser Tracker to improve its accuracy. Its purpose is to provide Angular Accuracy Results that are within your Laser Tracker's specifications for the full range of the system, or lower than the trackers Maximum Permissible Error (MPE) based on your Laser Tracker's specifications per the ISO 10360-10:2016 specification.

Self Compensation is not necessary if the Angular Accuracy Checks have recently been performed with passing results. Self Compensation can also be performed prior to performing the Angular Accuracy Checks using the steps below. When running the Self Compensation prior to performing the Angular Accuracy Checks, FARO recommends that you verify the Self Compensation results with an Angular Accuracy Check.

NOTE: Self Compensation is the fastest compensation for most applications but will not provide the best possible accuracy that the system is capable of measuring. Pointing Compensation from the **Advanced** tab of CompIT will produce lower backsight error or improved Angular Accuracy results, especially at longer distances. Therefore, for some measurement applications, especially when the best possible accuracy is desired or when measuring at long distances, Pointing Compensation will produce an improvement in overall measurement accuracy when compared to Self Compensation.

Self Compensation uses the targets embedded on the tracker. It does not require an SMR or nests for measurements.

1. In the **CompIT** dialog box, click **Self Compensation**. This step is not necessary if you chose to continue onto the Self Compensation directly from the results of the Angular Accuracy Checks.
2. CompIT begins the Self Compensation routine. This routine does not require tracking the SMR to any locations, it is automatic. The routine takes approximately five minutes to complete.
3. After the routine is completed, you will see the results in the **Self Compensation Results** dialog box with a recommendation.
   - If Self Compensation was run directly from the **CompIT** dialog box, a recommendation to press Update will be given (shown below).
   - If Self Compensation was run directly from an Angular Accuracy Checks that did not have a passing results, the previous Angular Accuracy Checks measurements will be used to verify that the Self Compensation has improved the tracker's angular accuracy and it is now within its specifications. If these new results are not within the trackers accuracy specifications, CompIT will recommend that you press CONTINUE to perform a Pointing Interim Test and Pointing Compensation. *See "Pointing Compensation" on page 132.*

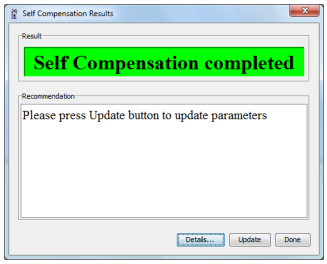

Figure 11-21 Self Compensation results

   - Click **Update** to save the results to the system If Self Compensation was run without performing the Angular Accuracy Checks immediately before or directly from the **CompIT** dialog box, before, CompIT will ask if you would like to run the Angular Accuracy Checks after Updating the parameters. FARO

recommends that you run them to verify the accuracy of the Laser Tracker. Click YES to run the Angular Accuracy Checks, or NO to exit. *Angular Accuracy Checks on page 119*

- Click **Done** to exit the Self Compensation routine without making any updates.
- Click **Details** to see detailed results.

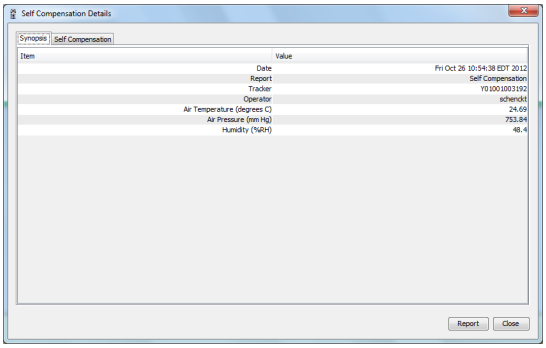

Figure 11-22 Synopsis tab

- Click **Report** to save the results to a text file.

If Self Compensation was run directly from an Angular Accuracy Checks that did not have a passing results, an ANGULAR ACCURACY CHECK DEVIATIONS appears. Click this tab to view the new backsight results of the previously measured points. Also view the measurement location, the error, the tolerance (MPE) and if the measurement is In Tolerance or Out of Tolerance. Click the **Self Compensation** tab to view the Before, After and Change in system parameters. Self Compensation only adjusts the two rotational (RX and RY) and two translational (CTX and CTY) parameters. While these parameters are displayed and able to be saved for archival purposes, the values or the change do not indicate the current angular accuracy or backsight error of the tracker. The Angular Accuracy Checks or Backsight results is used to evaluate the accuracy of the tracker, not these parameters.

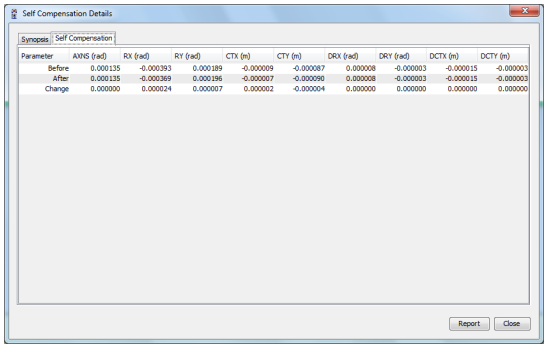

Figure 11-23 Self Compensation tab

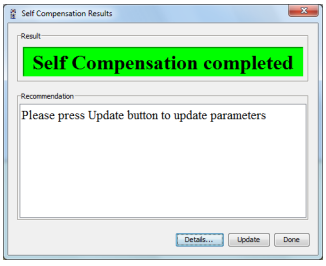

Figure 11-24 Self Compensation routine complete

Camera Compensation

Run this compensation to compensate the Vantage cameras. The Camera Compensation verifies the cameras

The Camera Compensation measures the SMR with the laser and then with the cameras.

NOTE: You should successfully complete the Quick Compensation and the Angular Accuracy Checks before starting this compensation. *See Quick Compensation on page 124 and Angular Accuracy Checks on page 119.*

The Camera Compensation requires a 1½" Spherically Mounted Retroreflector (SMR) and stable nests to place hold the SMR. You can use either the Calibration Tripod or heavy duty nests attached to your part. If the nests are not stable during the duration of the measurement, the Camera Compensation test may not be able to finish or its results can be poor.

NOTE: You must be able to track the SMR at least 10 Meters from the Vantage.

1. In the **CompIT** dialog box, click **Camera Compensation**.
   - **DESIRED** value: When measuring Guided Points, these are the target values for Azimuth, Zenith and the Radial Distance. When measuring User Selected Points, the value is an *.

NOTE: For this compensation the Azimuth and Zenith values are ignored.

   - **ACTUAL** value: The current Azimuth, Zenith, and Radial Distance values of the SMR. When all of the values are green, the system waits five (5) seconds for stability before measuring the SMR. When measuring User Selected Points, the values will always be green. When measuring Guided Points, the values switch to green when the SMR is in an acceptable zone around the desired values. The Radial distance value switches to red if the SMR is beyond its desired value.

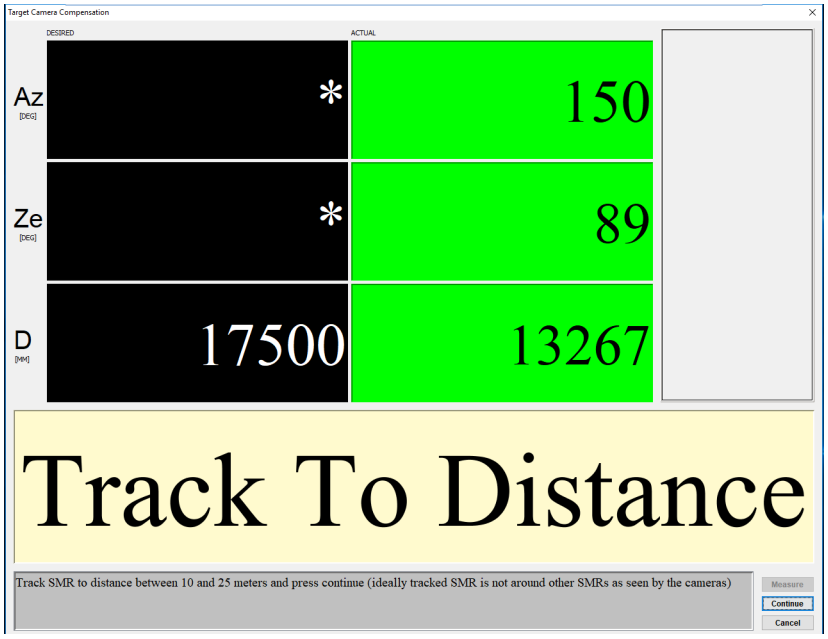

Figure 11-25 Camera Compensation dialog box

   - Track the SMR out to the desired distance and click **Continue**.

2. The Vantage checks for good stability and then measures the SMR with the laser and the camera.

If the SMR does not stabilize within 60 seconds, an error message appears. Check the stability of the SMR and the Vantage before trying again.

NOTE: If the Vantage and SMR are mounted properly and the measurement still does not stabilize or takes longer than normal, please check for airflow or other environmental issues.

When the measurement is complete, the backsight error shows on the left side of the screen. After taking multiple measurements, **Show Table** can be used to show a list of any previous backsight errors.

NOTE: You can change the stability delay by clicking **Customize** in the **Advanced** tab of the **CompIT** dialog box. *See "General" on page 148.*

3. The Vantage measures the SMR with the cameras.
4. The camera compensation is calculated. After the routine is completed, you will see the results.

If the compensation error is too high, the Camera Distance Compensation routine starts.

1. Choose a maximum distance for the compensation.
2. Track the SMR out to the first desired distance. When the SMR is in the desired range, the Vantage checks for good stability and then measures the SMR with the laser and the camera.

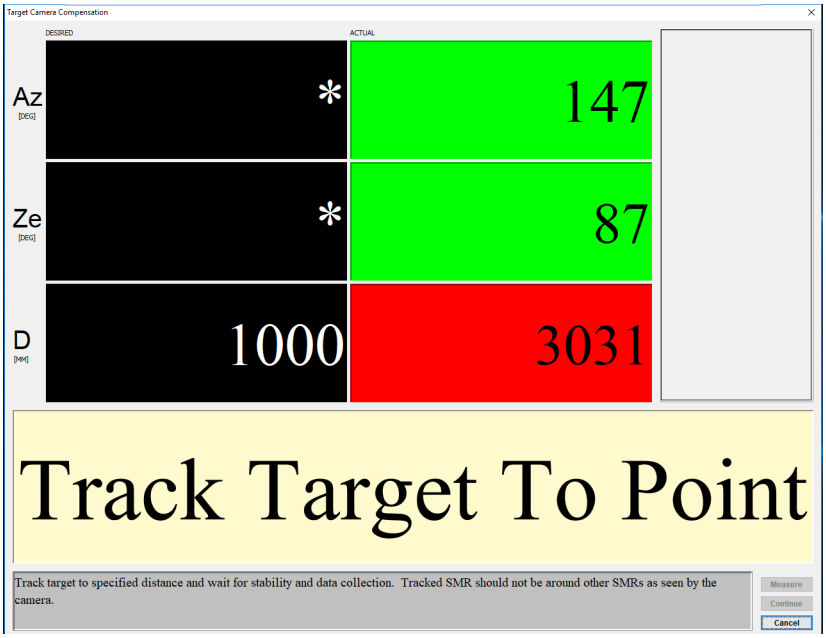

Figure 11-26 Camera Distance Compensation dialog box

3. Repeat for the remaining desired distances.
4. The Camera Distance Compensation is calculated. Press
   - Click **Update** to save the results to the system.
5. Click **Done** to exit.

Advanced Tab

Clicking the **Advanced** tab on **CompIT** dialog box shows additional items that are used in less often than the items on the **General** tab:

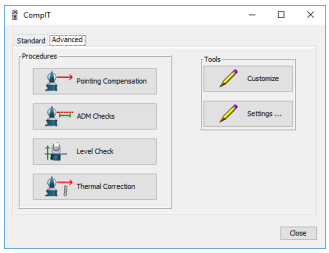

Figure 11-27 FARO CompIT dialog box - Advanced tab

The **Advanced** tab of the **CompIT** dialog box contains: Pointing Compensation, ADM Checks, Level Check, Customize and Settings.

See Pointing Compensation below, *ADM Checks on page 140*, *Level Check on page 146*, *Customize on page 147*, *and Settings on page 147*.

Pointing Compensation

The Pointing Compensation, similar to the Quick Compensation, is a routine that adjusts parameters in the Vantage to improve its accuracy. The purpose of both compensations routines is to provide Angular Accuracy Results that are within your Vantage's specifications for the full range of the system, or lower than the Vantage's Maximum Permissible Error (MPE) based on your Vantage's Specifications per the ISO 10360-10:2016 specification.

Compared to the Quick Compensation, the Pointing Compensation requires additional measurements and time to perform. Therefore the Quick Compensation is the preferred compensation for most applications. However, compared to the Quick Compensation, the Pointing Compensation can yield lower backsight error or improved Angular Accuracy results, especially at longer distances. Therefore, for some measurement applications, especially when measuring at long distances, Pointing Compensation can produce an improvement in overall measurement accuracy.

The Pointing Compensation consists of three parts:

- Pointing Interim Test: A preliminary check of the Angular Accuracy or backsight error at various locations in the Vantage's working volume.
- Pointing Compensation: Measurements taken at specific distances from the Vantage. The purpose of these points is to improve the Angular Accuracy as the radial distance from the Vantage increases.
- Axis Non-Squareness Compensation: Additional measurements that may further improve the Angular Accuracy. The purpose of these points is to improve the Angular Accuracy as the Vantage's Zenith axis changes.

Equipment

The Pointing Interim Test and Compensations will require a 1½" Spherically Mounted Retroreflector (SMR) a stable nests to place the SMR in. Use either the Calibration Tripod or heavy duty nests attached to your part.

If the nests are not stable during the duration of the measurement, the Pointing Interim Test and Compensations may not be able to finish or the results can be poor.

Setup

Use this procedure with the Vantage in the normal upright position and requires an area that can accommodate the following:

- Placing a target located at the same elevation as the Vantage at a maximum distance of 10 meters.
- The origin of the Vantage (center of the beam steering assembly) approximately 1.25 m to 1.65 m above the floor.

Procedure

NOTE: For best results, allow the Vantage thermally stabilize in the working environment.

Pointing Interim Test

1. In the **CompIT** dialog box, click the **Advanced** tab and then click **Pointing Compensation**. This routine requires measurement at the Home position and the following locations:
   - 90 degrees azimuth, 90 degrees zenith, 6 meters distance.
   - -45 degrees azimuth, 90 degrees zenith, 2 meters distance.
   - 45 degrees azimuth, 135 degrees zenith, 2 meters distance.
   - Any user defined positions.

NOTE: You can loosen the mandrel mount and rotate the Vantage to adjust the Azimuth angle to the target. Make sure to tighten the mandrel mount during the Stability check.

2. Place the SMR in the Home position and wait until the measurement of the SMR is complete.

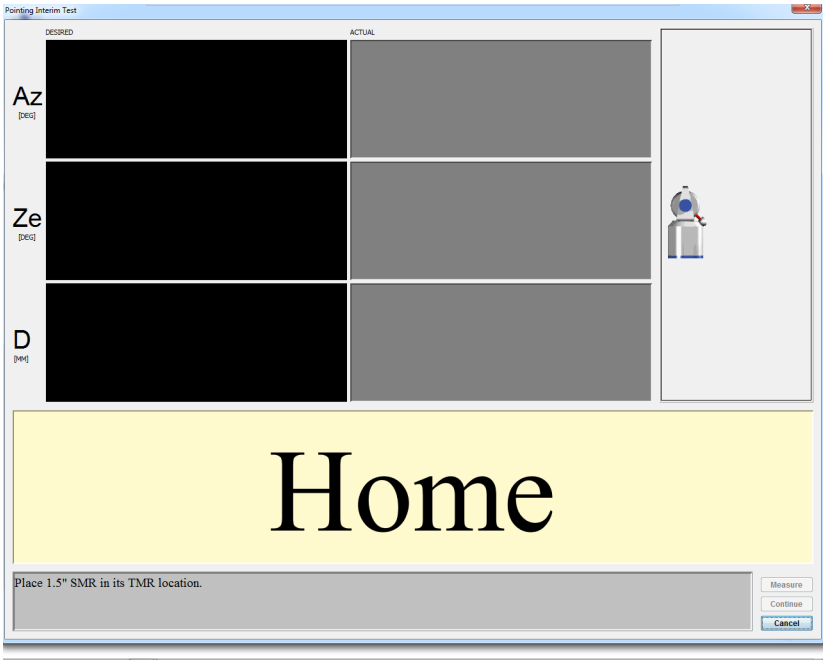

Figure 11-28 Pointing Compensation - Home

3. Track the SMR to the first location. CompIT checks for stability at the location and then automatically measures the location in both frontsight and backsight modes. The calculated difference between the two measurements is the Backsight Error.

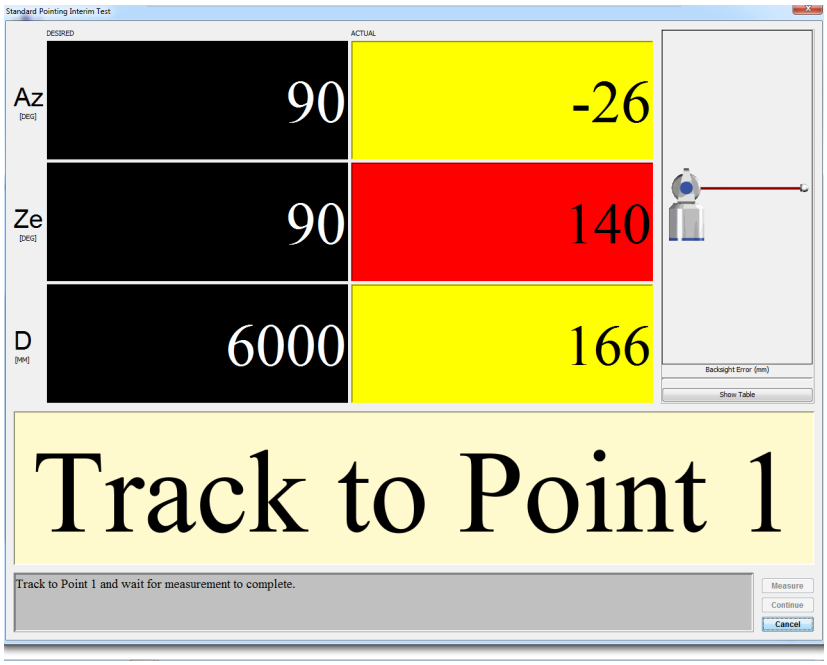

Figure 11-29 Pointing Compensation - Track to Point 1

- **DESIRED** value: The target values for Azimuth, Zenith, and Radial Distance.
- **ACTUAL** value: The current Azimuth, Zenith, and Radial Distance values of the SMR. The angle and distance values will be either red or yellow until you track the SMR to the desired values. The Radial distance value switches to red if the SMR is beyond its desired value. The values switch to green when the SMR is in an acceptable zone. When all of the values are green, the system waits five (5) seconds for stability before measuring the SMR.

NOTE: Check the tightness of the mandrel each time by trying to manually rotate the Vantage on the instrument stand.

- **Backsight Error**: The backsight error or the previously measured point. Click **Show Table** to show a list of the backsight errors for all of the previously measured points.
- **Cancel**: Exits the Interim Test without saving any data or parameters.

4. Track the SMR to the second location. CompIT checks for stability at the location and then automatically measures the location.

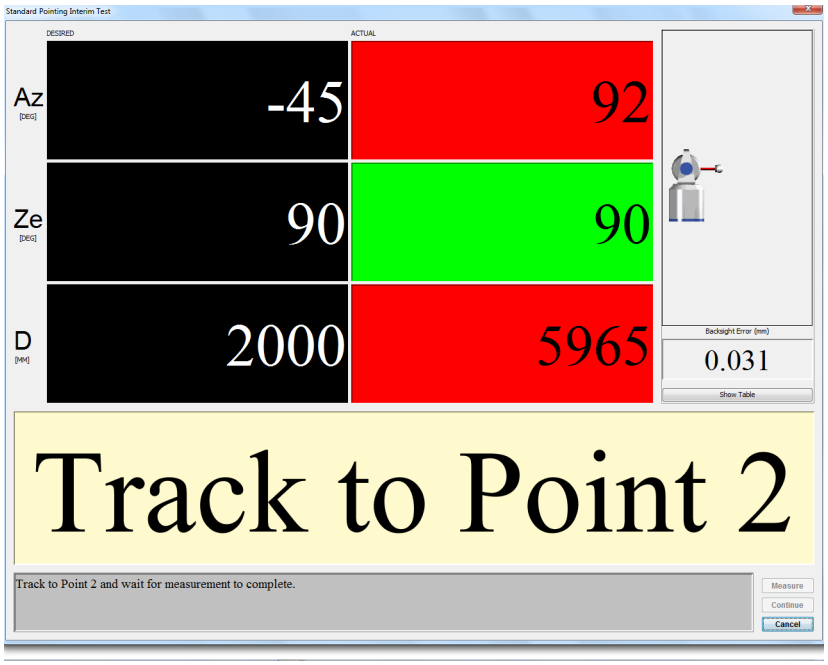

Figure 11-30 Pointing Compensation - Track to Point 2

5. Track the SMR to the third location. CompIT checks for stability at the location and then automatically measures the location.

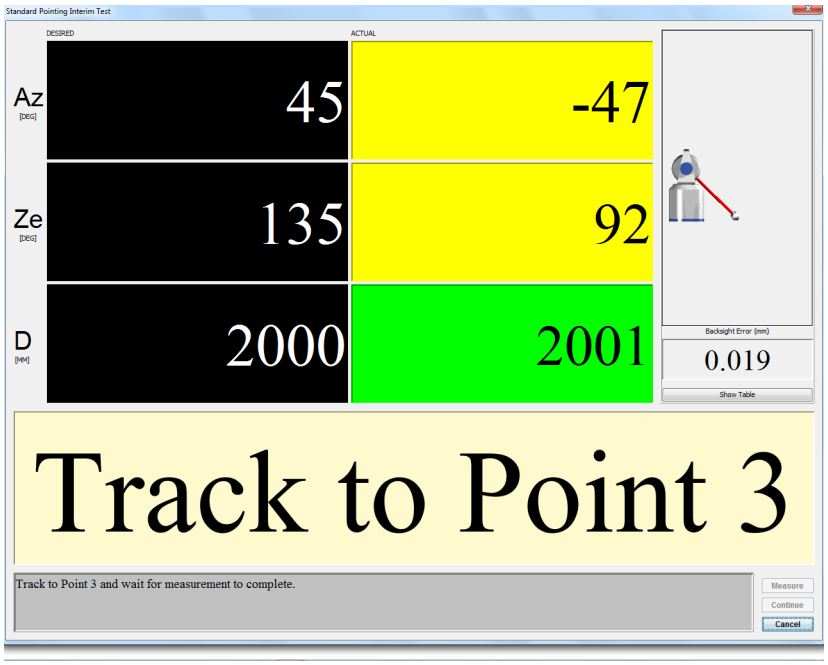

Figure 11-31 Pointing Compensation - Track to Point 3

6. Track the SMR to a user defined location. CompIT checks for stability at the location and then automatically measures the location.

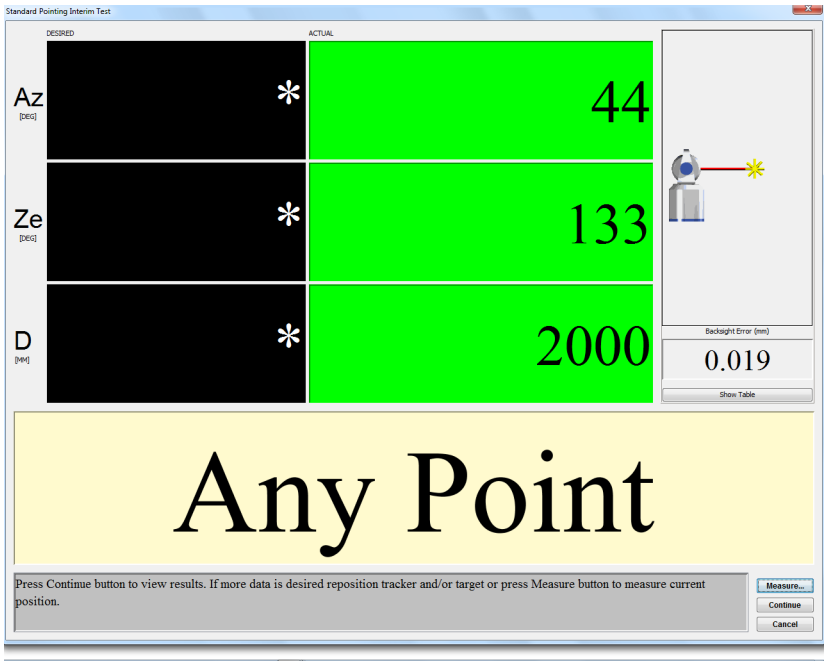

Figure 11-32 Pointing Compensation - Track to Any Point

You can continue measuring "user-defined locations." These locations should include the full working volume or create an envelope around the object you are currently measuring. Examples include control points and points near the extreme of your part.

7. After completing the last measurement, click **Continue**. You will see the results of this test in the **Angular Accuracy Results** dialog box.

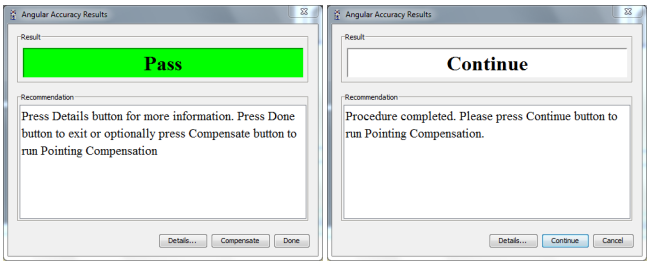

Figure 11-33 Pointing Interim Test results

8. CompIT will make a recommendation based on the results of the Interim Test:
   - If all of the points are in tolerance or below the Maximum Permissible Error, accurate measurements will be able taken with the Vantage and CompIT will report a result of PASS. Click **Done** to exit and return to the **CompIT** dialog box. You can optionally click **Compensate** to continue on with the Pointing Compensation to further improve the Angular Accuracy.
   - If one or more points are out of tolerance or greater than the Maximum Permissible Error, CompIT recommends continuing onto the Quick Compensation. Click **Continue** to start the Quick Compensation routine.
   - Click **Details** to view detailed results. Click **Report** to save the results to a text file.

Pointing Compensation

Clicking **Compensate** in the **Angular Accuracy Results** dialog box appears the **Standard Pointing Compensation** dialog box. This routine requires measurement at the Home position and the following locations:

- any azimuth position, 90 degrees zenith, 2.0 meters distance.
- any azimuth position, 90 degrees zenith, 3.6 meters distance.
- any azimuth position, 90 degrees zenith, 5.2 meters distance.
- any azimuth position, 90 degrees zenith, 6.8 meters distance.
- any azimuth position, 90 degrees zenith, 8.4 meters distance.
- any azimuth position, 90 degrees zenith, 10.0 meters distance.

1. Place the SMR in the Home position and wait until the measurement of the SMR is complete.
2. Place the SMR in the calibration tripod or in another stable nest and track the SMR to the first desired location. CompIT checks for stability and automatically measures the point in both frontsight and backsight modes.
3. Continue for each of the remaining desired locations.
4. After completing the last measurement, click **Continue**. You will see the results of this test in the **Angular Accuracy Results** dialog box.

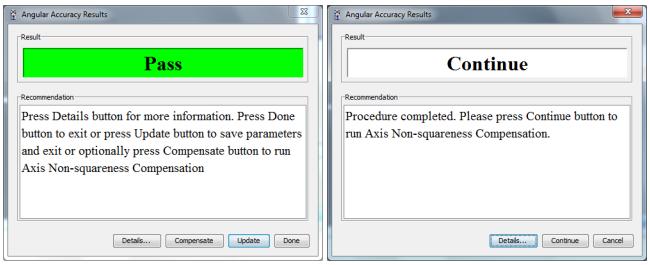

Figure 11-34 Pointing Compensation Results

CompIT will calculate new parameters generated by the Pointing Compensation, apply them to the previously measured Interim Test Points and make a recommendation based on these results:

- If all of the points are in tolerance or below the Maximum Permissible Error, accurate measurements will be able taken with the Vantage and CompIT will report a result of PASS. Click **Update** to save the results and exit the routine. You can optionally press **Compensate** to continue on with the Axis Non-Squareness Compensation to further improve the Angular Accuracy.
- If one or more points are out of tolerance or greater than the Maximum Permissible Error, CompIT recommends continuing onto the Axis Non-Squareness Compensation. Press **Continue** to start the Axis Non-Squareness Compensation routine.
- Click **Details** to view detailed results. Click **Report** on the Details page to save the results to a text file.

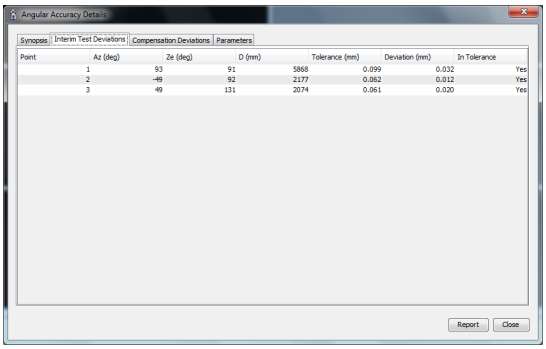

Figure 11-35 Pointing Compensation Results - Interim Test Deviations

Click the **Parameters** tab to view the Before, After and Change in system parameters. Pointing Compensation adjusts the two rotational (RX and RY) and two translational (CTX and CTY) parameters.

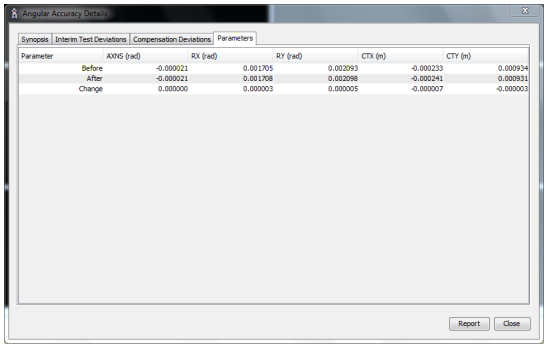

Figure 11-36 Pointing Compensation Results - Parameters

NOTE: The information presented on the **Parameters** tab is for information only. The Angular Accuracy Checks or Backsight results is used to evaluate the accuracy of the Vantage, not these parameters.

- Click **Report** to save the results to a text file.
- Click **Close** to exit and return to the **Angular Accuracy Results** dialog box.

Axis Non-Squareness Compensation

This routine requires measurement at the Home position and the following locations:

- 0 degrees azimuth, 135 degrees zenith, 2.0 meters distance.
- 0 degrees azimuth position, 110 degrees zenith, 4.0 meters distance.
- 0 degrees azimuth position, 110 degrees zenith, 4.0 meters distance.
- 0 degrees azimuth position, 102 degrees zenith, 6.0 meters distance.

1. Place the SMR in the Home position and wait until the measurement of the SMR is complete.
2. Place the SMR in the calibration tripod or in another stable nest and track the SMR to the first desired location. CompIT checks for stability and automatically measures the point in both frontsight and backsight modes.
3. Continue for each of the remaining desired locations.
4. After completing the last measurement, click **Continue**. You will see the results of this test in the **Angular Accuracy Results** dialog box.

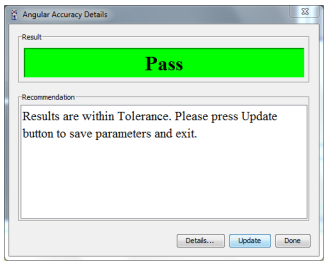

Figure 11-37 Axis Non-squareness Compensation results

- Click UPDATE to save the results to the Vantage System.
- Click DONE to exit the Axis Non-squareness routine without saving the results.
- Click DETAILS to see the results.

ADM Checks

The ADM Interim Test compares the distance between two points measured from a position that uses a large amount angular rotation to the distance between the same two points measured from a position that uses almost all radial measurements or a very small amount of angular rotation. These two measurement orientations have different sources of error and can therefore be used as a field check for the Vantage's ADM System.

FARO recommends to perform this test immediately after performing a Pointing Compensation.

The ADM Interim Test will require a 1½" Spherically Mounted Retroreflector (SMR) and two stable nests to place the SMR in. The Calibration Tripod used for the Angular Accuracy Checks and Pointing Compensations cannot be used for this test. Two points glued to the floor can be used but two points on heavy duty instrument stands can provide better alignment percentages.

Alternatively, you can perform this test with a bar with two fixed targets where the bar moves to different locations and the Vantage remains in the same location. If you use a bar with two fixed targets, securely mount the bar during the measurements to prevent any changes in its length from bending or flexing.

For best results, FARO recommends to run this test immediately after performing a Pointing Compensationfrom the **Advanced** tab. *See "Pointing Compensation" on page 132.*

1. In the **CompIT** dialog box, click the **Advanced** tab and then click **ADM Checks**.

   The first position for the interim test is with the Vantage set up to measure two points from the side. This setup should maximize the use of the Vantage's angular encoders. FARO recommends to set up the Vantage three (3) meters away from two points that are one (1) or more meters apart. After measuring the second point, the software reports the percentage of the measurement that is made with the encoders. FARO recommends a percentage of 80% or higher to obtain a meaningful result in this test. To obtain a percentage of 80% from this position, place the points at the following locations:

   - Point 1: 110 degrees Azimuth, 90 degrees Zenith, 3000 mm Radial Distance
   - Point 2: 80 degrees Azimuth, 90 degrees Zenith, 3000 mm Radial Distance

Figure 11-38 Move to Station S1

2. Move the Vantage to Station S1 and click Continue.

3. Move the SMR to the Home position. An auto-adjust completes at the Home position to normalize the ADM for the test.
4. Track or send the beam to Point 1. To send the beam, click **Motors Off** and manually steer the beam to the target.

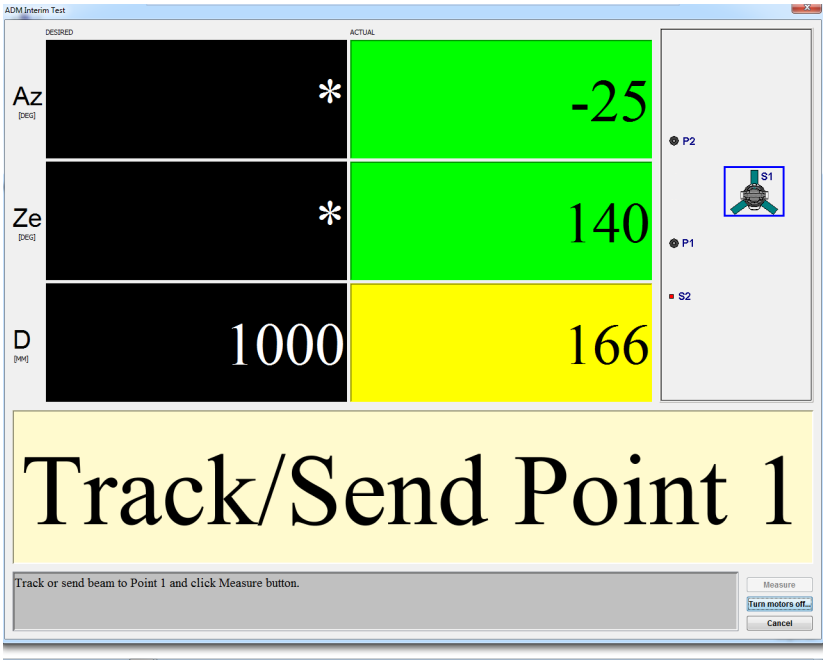

Figure 11-39 Beam to Point 1

5. Measure Point 1 by clicking **Measure**. A check is made to ensure the target is stable and then the measurement is taken.

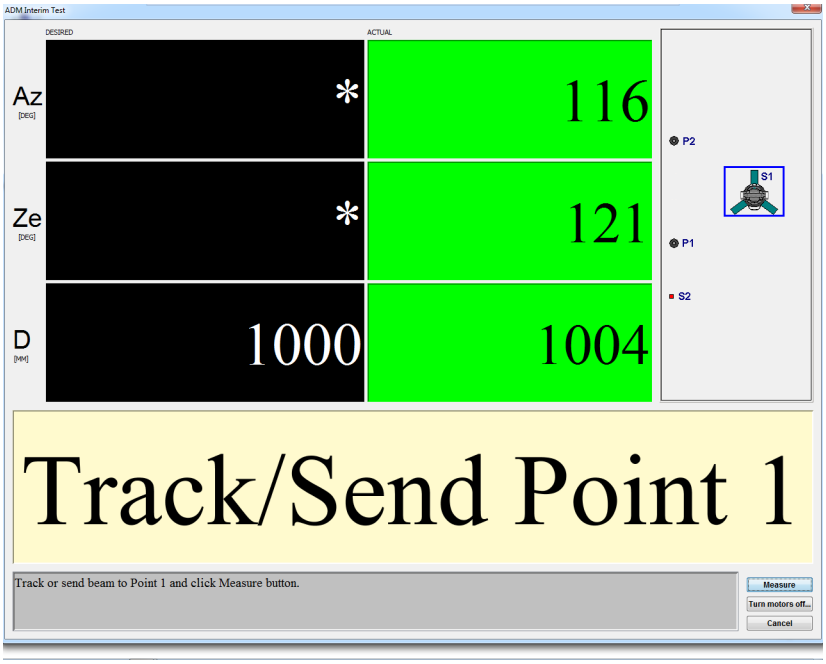

Figure 11-40 Measure Point 1

6. Track, or send, the beam to Point 2. A pie chart indicates the percentage of the measurement that is made with the angular encoders. FARO recommends to achieve a percentage of greater than 80%. If the target position yields a number lower than 80%, a message box appears and tells you where to move the SMR.

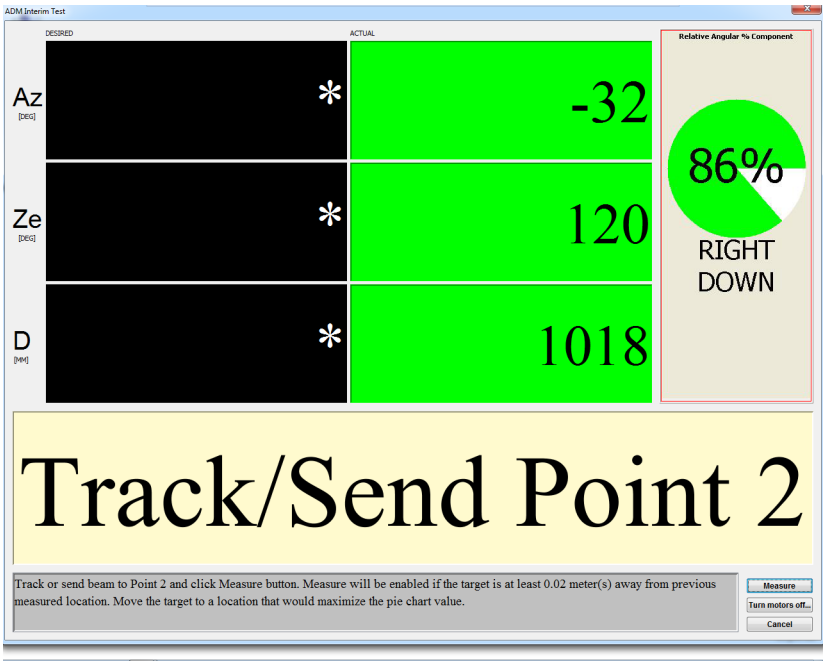

Figure 11-41 Beam to Point 2

7. Click **Measure** to measure Point 2.
8. If the pie chart shows a percentage greater than 80%, the setup for the first measurement is good. Click **Continue** to proceed. If the percentage is less than 80% FARO recommends that you re-measure. Click **Retry** to re-measure the two points with a setup that yields greater than 80%.

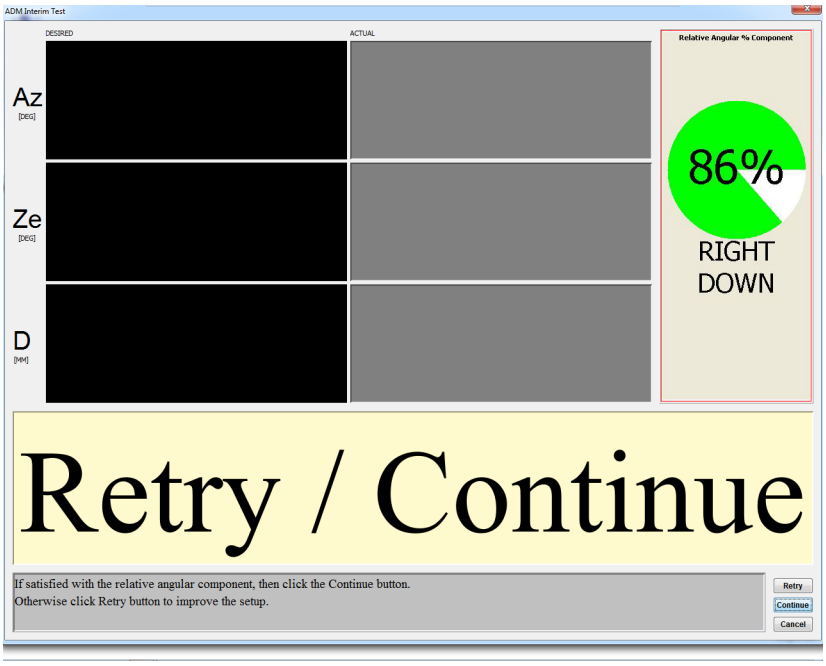

Figure 11-42 Retry/Continue 2

Position #2

1. Move the Vantage to Position 2. Position 2 should orient the Vantage in such a way as to maximize the distance measurement component of the measurement; that is, the laser beam should be in line with the two measurement points. Use a range of 1 to 2 meters from point one; however, you can use any distance.

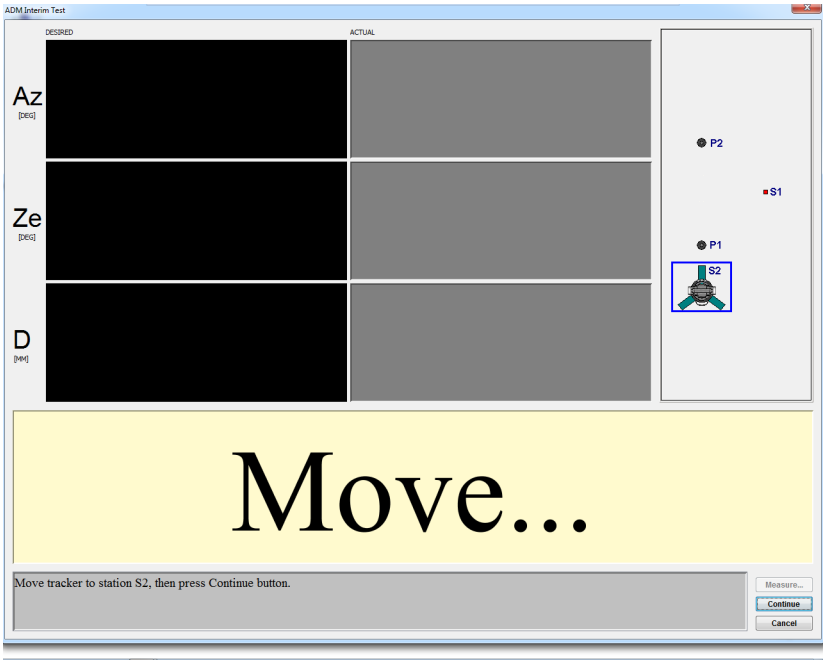

Figure 11-43 Move to Position 2

2. Click **Measure** to measure Point 1. A check is made to ensure the target is stable before the measurement is taken.
3. Track or send the beam to Point 2. A pie chart indicates the percentage of the measurement that is made with ADM. FARO recommends to use a percentage of greater than 80%. If the target position yields a number lower than 80%, a message box appears and tells you where to move the Vantage (or bar if a bar with two targets is used).

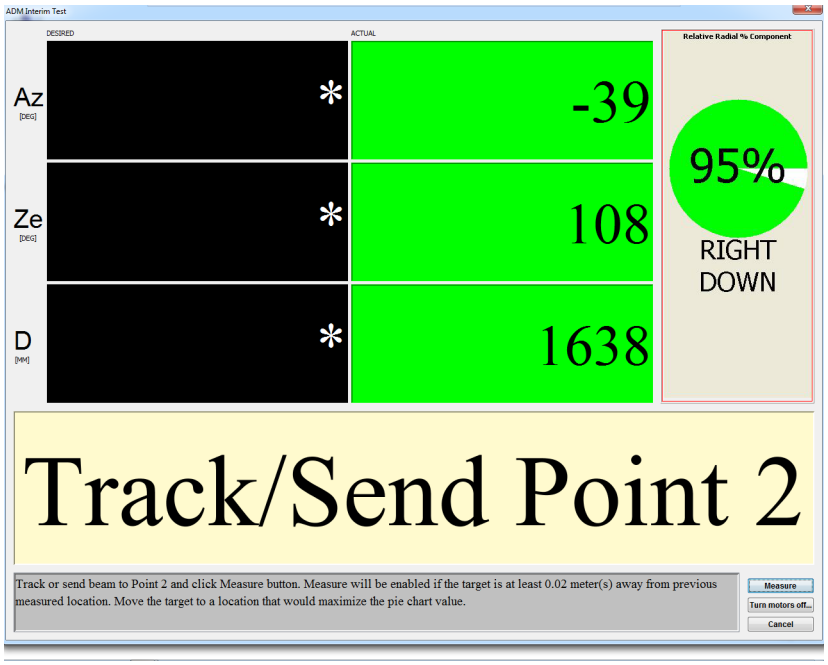

Figure 11-44 Beam to Point 2

4. Click **Measure** to measure Point 2.
5. If the pie chart shows a percentage greater than 80%, then the setup for the second position is good. Click **Continue** to proceed. If the percentage is less than 80% FARO recommends that you move the Vantage and re-measure. Click **Retry** to re-measure the two points with a setup that yields greater than 80%.
6. The **ADM IT** results dialog indicates the distances measured between the two points from the two setups and the percentage of angular and distance measurements. A result from setups with greater than 80% indicates a valid test. The difference between the two measurements is shown along with the Maximum Permissible Error (MPE), which is derived from the system's angular specifications. A result (Pass/Fail) appears.

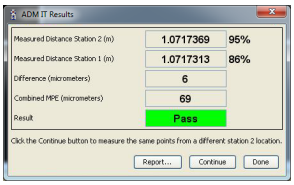

Figure 11-45 ADM IT Checks dialog box

7. Click **Report** to open a dialog to save the results to a comma delimited text file. A check box is available to append the report to a previous report. Appending the report creates a log file of the test results. Click **Done** to close the results page.
8. The **Measure More Points** button returns to the Move screen and prompts for another set of two points from another Vantage (or bar) position. This allows for additional distances to be measured in the testing of the ADM. For example, measure from two (2), four (4), and six (6) meters.

Figure 11-46 Measure More Points

9. Click **Exit** to end the test.

Level Check

The Level Check verifies that the Vantage's level sensor is able to measure accurately. It compares its angular measurements to the Vantage's angular encoders while moving the axis in very small increments.

The Level Check requires the Vantage to be setup on a stable stand in the upright position and leveled out using the Vantage's Electronic Bubble Level from the TrackerPad. *See "TrackerPad" on page 154.* The Level Check does not require the use of any SMR's.

1. In the **CompIT** dialog box, click the **Advanced** tab and then click **Level Check**. The Level Check will take approximately 5 minutes to complete. You will see the Vantage's axis rotate around several times while performing the test.
2. Upon completion of the Level Check, the **Level Check Results** dialog box appears:

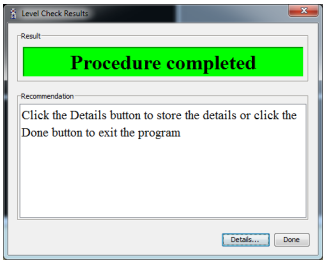

Figure 11-47 Level Check Results dialog box

Press **Details** to see the detailed results:

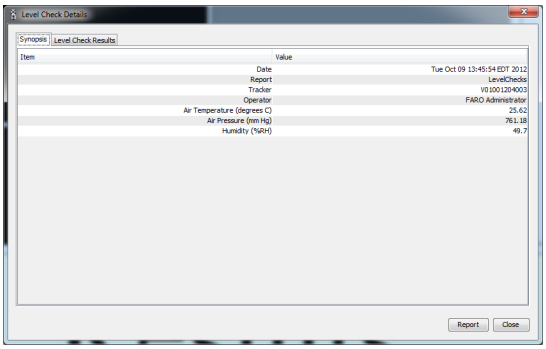

Figure 11-48 Level Check Details dialog box

- **Encoder Movement** (arc seconds): The angular movement of the Vantage's axes measured by the its encoders.
- **Level Movement** (arc seconds): The angular movement of the Vantage's axes measured by the Level sensor.
- **Difference** (arc seconds): The measured Level sensor error or difference between the two systems.
- **MPE** (arc seconds): Maximum Permissible Error per the system's specifications.
- **In Tolerance**: Yes if the measured error is below the MPE.

3. Click **Close** to exit the Level Check Results.
4. The Level Checks procedure automatically exits.

Settings

By default, the Angular Accuracy Checks, the Pointing Interim Test and the ADM Checks automatically measures after the target is in a stable location. The CompIT settings allows you to change this.

In the **CompIT** dialog box, click the **Advanced** tab and then click **Settings**.

This opens the **CompIT Settings** dialog box which has three check boxes to set the Auto Measure function for ADM, Angular Accuracy and Pointing Interim Tests.

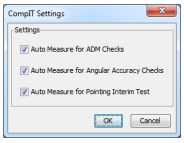

Figure 11-49 CompIT Settings dialog box

If any Auto Measure setting is clear, a **Measure** button is available in each dialog box. Click **Measure** to manually start measuring in any of the tests.

- Click **OK** to apply any changes and continue.
- Click **Cancel** to exit without applying changes.

Customize

Use the Customize command to change the default settings of CompIT.

CAUTION: Changing parameters may result in a less than optimal compensation and decreased measurement accuracy.

In the **CompIT** dialog box, click the **Advanced** tab and then click **Customize**. This opens the **Customize FARO CompIT** dialog box which has four separate tabs which allow you to customize the General, Pointing Compensation, Repeatability, and Pointing Interim Test settings.

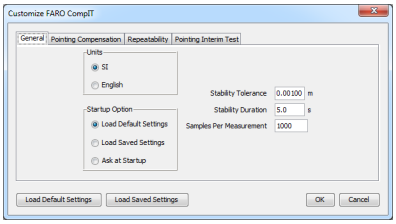

Figure 11-50 Customize dialog box

- Click **Load Default settings** to load the default or factory settings.
- Click **Load Saved settings** to load any settings that you have previously saved.
- Click **OK** to apply any changes and continue.
- Click **Cancel** to exit without applying changes.

General

Use the **General** tab in the **Customize FARO CompIT** dialog box to set the general parameters of CompIT.

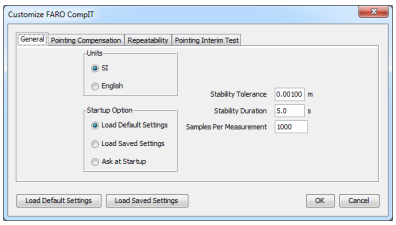

Figure 11-51 General tab

- Units - The unit of measurement for all of the routines when CompIT is started from the FARO Tracker Utilities program. Choose SI for Millimeters or English for Inches.
- Stability Tolerance - The maximum allowable movement of the SMR during the stability checks performed prior to an automatic measurement.
- Stability Duration - The amount of time the SMR must remain stable before the any measurement starts.
- Samples Per Measurement - The number of measurement samples for each measurement. Each measurement is an average of the samples.
- Load Default Settings - Choose this to load the factory default CompIT settings when starting CompIT.
- Load Saved Settings - Choose this to load custom CompIT settings saved to the computer when starting CompIT.
- Ask at Startup - Ask which setting you would like to use when starting CompIT, factory default or custom settings saved to the computer.

Pointing Compensation

Use the **Pointing Compensation** tab in the **Customize FARO Tracker Utilities** dialog box to set the parameters for the Pointing Compensation routine.

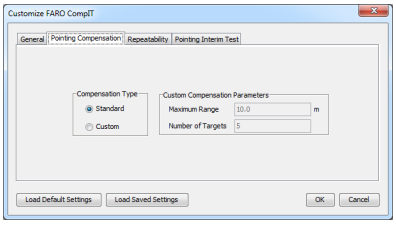

Figure 11-52 Pointing Compensation tab

Use the **Standard** Compensation Type or choose the **Custom** radio button and set the following parameters:

- **Maximum Range**: The maximum distance for the ADM CompIT routine. Each desired distance locations is a proportional distance of the maximum distance.
- **Number of Targets**: The number of targets to measure in the routine.

Repeatability

Use the **Repeatability** tab in the **CustomizeFARO CompIT** dialog box to set the repeatability parameters for CompIT.

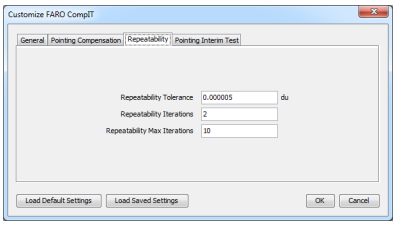

Figure 11-53 Repeatability tab

- **Repeatability Tolerance**: Set the maximum error for consecutive measurements for each location during the Pointing Compensation and Squareness Compensation.
- **Repeatability Iterations**: Set the number of repeating consecutive measurements for each location during the Pointing Compensation and Squareness Compensation.
- **Repeatability Max Iterations**: Set the maximum number of measurement attempts for each measurement before generating an error message prompts you to review your environment.

Pointing Interim Test

Use the **Pointing Interim Test** tab in the **CustomizeFARO CompIT** dialog box to set the parameters for all Pointing Interim Tests.

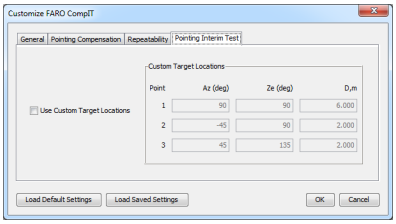

Figure 11-54 Pointing Interim Test tab

- Select the **Use Custom Target Locations** check box and enter values for the three target locations.

Chapter 12: Configuring the Vantage in FARO CAM2 2020

The **Devices** tab of the FARO CAM2 2020 ribbon contains all the commands for configuring and controlling your Vantage. You can also press the **P** hot key on the keyboard to show the **Device Center** panel.

You can also use the Vantage in a measurement Survey. Surveying is an automated, repetitive measurement process used to track the position(s) of one or more targets over time. For more information about the **Survey** command, see the *Survey* section of the *Navigation Window* chapter in the FARO CAM2 2020 manual.

NOTE: The Vantage is only compatible with FARO CAM2 2020 and CAM2 Measure v10.6.7 and later. This chapter explains operation with FARO CAM2 2020 v2020.0.

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Vantage Controls and Settings 153
FARO Laser Tracker Group 156
Measuring with the Vantage 158

Device Center

The **Device Center** command opens the **Device Center** panel and contains a list of all active (detected) devices. The **Device Center** panel contains a list of all active devices with the properties of each associated device. You can also press the **P** hot key to show the **Device Center** panel.

Figure 12-1 Device Center Panel

Double-click the Vantage from the list to see the details. *For more information, see "Vantage Controls and Settings" on page 153.*

Add a Device

FARO CAM2 2020 automatically searches for any Laser Tracker connected to your computer.

If you do not see your Vantage, click **Add New Device** (Plus Sign (+)):

- FARO CAM2 2020 searches for any Laser Tracker. Click the serial number of your Vantage and notice that there may be a wired and a wireless option.

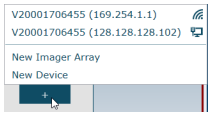

Figure 12-2 Device Center Panel

If you do not see your Vantage, click **New Device**.

- In the **Select Device Type** dialog, choose **FARO Laser Tracker**. Click **Next**.
- FARO CAM2 2020 automatically searches for any Laser Tracker connected to your computer. If you do not see your Vantage, click **Unable to find your device** and enter the IP address.
- Enter the Vantage IP address.
- Click **Finish**.

NOTE: The Vantage ID is the last four digits of your Vantage serial number.

- When set in Wired mode, the default IP address for a Vantage is 128.128.128.100.
- When set in Wireless mode, use your Vantage ID. For more information on connecting the Vantage to your computer, *see Wireless Connection on page 48*.

Multiple Vantage Users

A lock system prohibits two or more users on different computers from performing write functions (such as changing probes, changing distance modes, etc.) to the same Vantage concurrently. Read functions (such as taking readings) are not affected by the lock system.

The **Device Center** panel will overwrite the probe setting in the device with the probe setting from the local file on startup, which creates a conflict if two users attempt to access the device with two different probe sizes.

For more information on connecting, configuring, and measuring with multiple Vantages, see the *Multiple Devices* section of the *Devices* chapter in the FARO CAM2 2020 manual.

Vantage Controls and Settings

Double-click your Vantage to see the controls and settings screen.

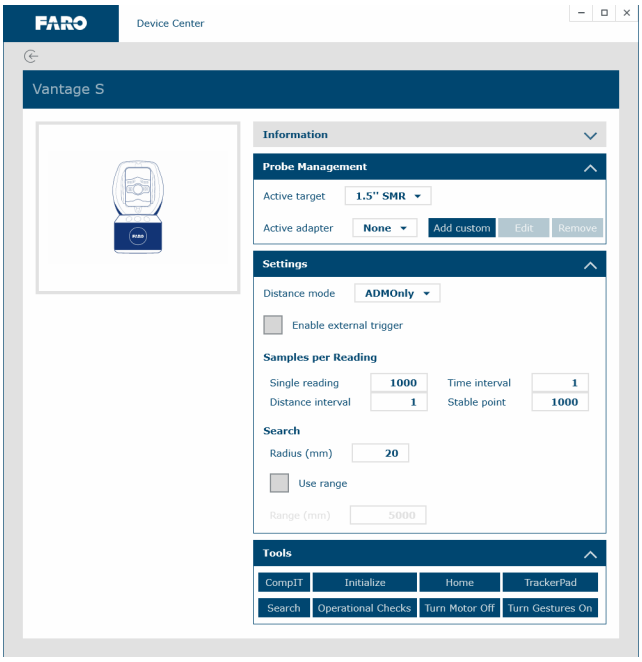

Figure 12-3 Device Center Panel - Vantage Controls and Settings

Information

The **Information** section contains the model and serial number of your Vantage and the Initialization status. If necessary, click **Initialize** in the **Tools** section.

Probes

The **Probe Management** section of the **Device Center** panel shows the current SMR and Adapter.

NOTE: If the 6Probe is paired, click **Manage** to set an active probe tip. *For more information, see "Probe Management" on page 103.*

Change Probe

From the **Device Center** panel, double-click your Vantage and scroll down to **Probe Management**.

- Choose an **Active Target** (SMR).
- Choose an **Active Adapter**, if necessary.
- Click **OK**.

NOTE: You can also choose the SMR and Adapter from the drop-down lists in the **Measurement** panel. *See "Adding Readings" on page 159.*

NOTE: You can also click **Change Adapter** in the **Devices** tab.

Adding Adapters

The default list in the Active Target drop-down list are standard FARO adapters. Add, Edit or Delete a custom SMR adapter:

- Click **Add** Custom to create a new adapter. In the **Custom Adapter** dialog box:
  - Enter a name for the adapter.
  - Choose an Adapter Type.
  - Enter a height value in the **Height Offset** field.

Settings

The **Settings** section contains buttons to configure and control your Vantage. Some of these commands are available directly on the **Devices** tab of the FARO CAM2 2020 ribbon.

Distance Mode: The Vantage operates using iADM and the **Distance Mode** drop-down list only contains the ADM Only option.

Samples Per Reading: Control the amount samples, or individual measurement of your target, for each reading of a FARO CAM2 2020 measurement feature. These samples are best fit into a single reading.

Search: Set the maximum search radius.

Tools

The **Tools** section contains buttons to configure and control your Vantage.

CompIT

Click **CompIT** to start FARO CompIT. *For more information, see "FARO CompIT" on page 116.*

Initialize

Runs the angular encoder initialization sequence. This is necessary if the motors shut down. The Vantage motors will shut down as a protective measure if the axis is forced or over-torqued.

Home

Click **Home** to send the Vantage laser beam to the Tracker Mounted Reset (TMR) or Home position.

TrackerPad

Click **TrackerPad** to open the TrackerPad utility. *For more information, see "TrackerPad" on page 96.*

Manage Devices

The **Manage Devices** command accesses the **Device Manager** panel and configure the device properties of the Vantage. For more information, see the *Manage Devices* section of the *Devices* chapter in the FARO CAM2 2020 manual.

Move Device

The **Move Device** command accesses the **Move Device Position** wizard and perform measurements to move your Vantage around the part. You can also press the **M** hot key on the keyboard. For more information, see the *Manage Devices* section of the *Devices* chapter in the FARO CAM2 2020 manual.

FARO Laser Tracker Group

The **FARO Laser Tracker** group in the **Devices** tab contains the most common commands necessary to interface with your Vantage using FARO CAM2 2020. For more information, see the *Tracker* section of the *Devices* chapter in the FARO CAM2 2020 manual.

Quick Compensation

The **Quick Compensation** command starts the Self Compensation routine. *For more information, see "Quick Compensation" on page 124.*

Angular Accuracy Checks

The **Angular Accuracy Checks** command starts the Self Compensation routine. *For more information, see "Angular Accuracy Checks" on page 119.*

Measure Level

The **Measure Level** command measures a plane using the internal measure level plane. You can measure an optional single point to position this plane.

Motor On/Off

The **Motors On/Off** command switches the motors On or Off. *For more information, see "Turn Motors On/Off" on page 96.*

Find Me

The **Find Me** command automatically searches and points the laser to an SMR in the field of view. If there are multiple SMRs or targets in the field of view, the Vantage will point to the one closest to the center of the field of view.

NOTE: This command is disabled when the 6Probe is the current target.

Use the **Drive Beam** > **Camera** command to point to a specific SMR or target in the field of view. *For more information, see "Drive Beam" on page 97.*

6Probe Management

Manage and compensate the 6Probe's removable probes.

NOTE: This command is only available if the 6Probe is paired. *For more information, see "Pairing the 6Probe and the Vantage" on page 58.*

6Probe Setup

Set the functions for each 6Probe button.

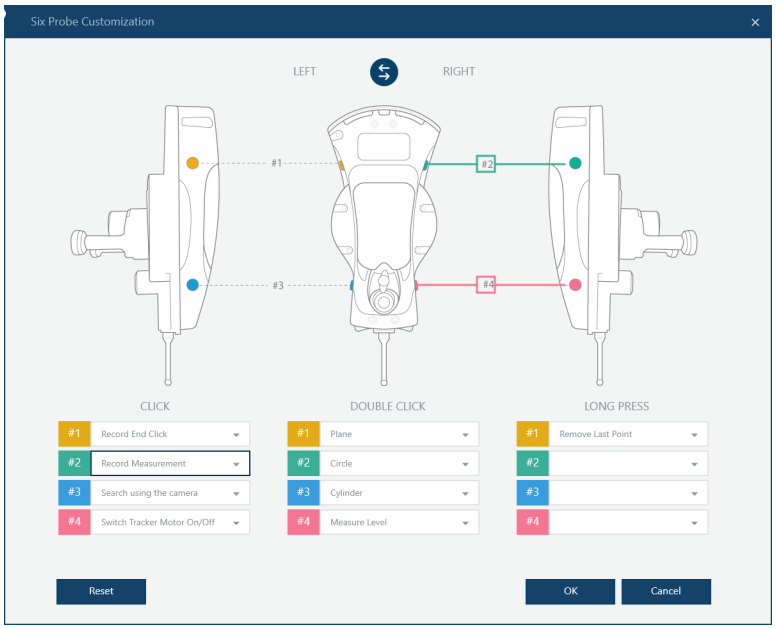

Figure 12-4 6Probe Setup

- Click **Switch** to reverse the 1/2 and 3/4 definitions. This switches the button definitions for left-handed operation.
- Click **Reset** to return the definitions to the factory defaults.

NOTE: This command is only available if the 6Probe is paired. *For more information, see "Pairing the 6Probe and the Vantage" on page 58.*

Survey

Survey is a Laser Tracker specific command in FARO CAM2 2020. Surveying is an automated, repetitive measurement process used to track the position(s) of one or more targets over time. The output is a statistical analysis of the change in positions for each target. Optionally, you can use the Survey command to automatically reposition a measurement device once you detect sufficient movement.

For more information, see the *Survey* section of the *Navigation Window* chapter in the FARO CAM2 2020 manual.

Measuring with the Vantage

When measuring with an SMR ❶, the location of the center of the SMR records as a point each time you press the **G** key. Because each SMR has a known diameter, there is a known distance between the center of the SMR and the outer edge of the SMR. This distance needs to be specified (projected) for the point to record in the correct location.

The distance between the SMR point of contact ❷ with the surface being measured and the center of the SMR ❸ is known as SMR Offset ❹. This transfer of the point from the center of the SMR to the correct location is known as SMR compensation.

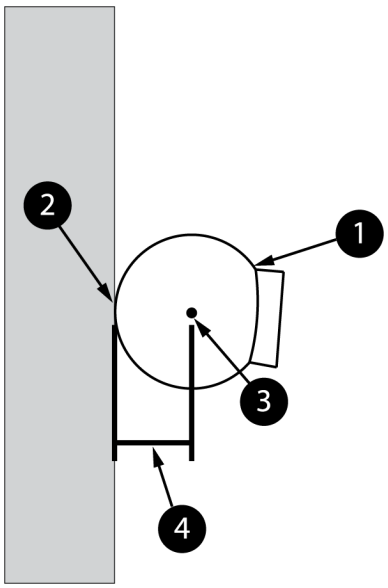

Figure 12-5 Measuring with the SMR

Measuring with the 6Probe

When measuring with a ball probe tip ❶, the location of the center of the probe tip records as a point each time you press button **2**. Because each probe tip has a known diameter, there is a known distance between the center of the probe tip and the outer edge of the probe tip. This distance needs to be specified (projected) for the point to record in the correct location.

The distance between the probe tip point of contact ❷ with the surface being measured and the center of the probe tip ❸ is known as Probe Offset ❹. This transfer of the point from the center of the probe tip to the correct location is known as probe compensation.

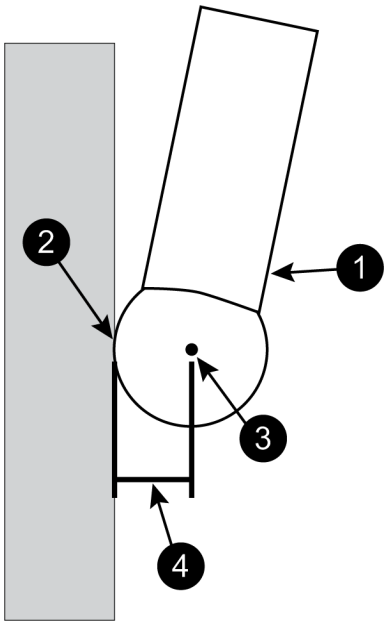

Figure 12-6 Measuring with the 6Probe Probe Tip

While touching the probe tip to the surface of your part, make sure the corner cube is pointing back towards the Vantage. The Right Status LED indicates this:

- **Green** - On-Axis
- **Orange** - Moving towards Off-Axis
- Off - Beam lost Off-Axis

Twist the 6Probe to move the corner cube back to On-Axis with the Vantage.

Adding Readings

Use commands to control the Vantage instead of hardware buttons. Buttons (and their associated hot keys) on the **Measurement** panel are used for recording a reading (**G** key), recording an end click (**H** key), and removing the last reading (**Backspace** key). You can also click the icons in the **Measurement** panel.

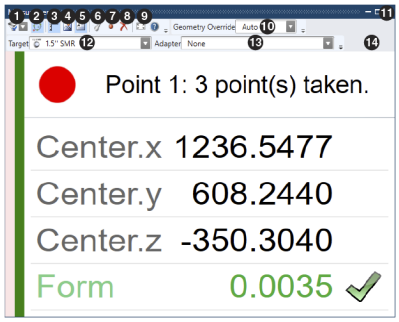

Figure 12-7 Measurement Panel

6. **Record Measurement**
7. **Record End Click**
8. **Remove Last Reading**

Adding Readings with 6Probe

You can assign these commands, and others, to the four buttons on the 6Probe. By default:

- Press button **2** to record a reading.
- Press button **1** to record an end click.
- Press and hold button **1** to remove the last reading.

For more information, see "6Probe " on page 17.

For more information, see the *Measurement Panel* section of the *Measure* chapter in the FARO CAM2 2020 manual.

Acquiring the Laser Beam with Follow Me

As you move the SMR, the Vantage tracks and remembers the direction of movement. When you break or lose the laser beam because of a solid obstacle, you can simply move and hold the SMR in front of the Vantage and it will automatically use the cameras to aim the laser beam back to your target.

NOTE: This command starts as soon as the beam is broken. If there are other SMRs in the field of view, the Vantage will automatically aim at the closest available SMR in the field of view. When this happens, use the Find Me SMR movements to aim the beam at the correct SMR. *See "Acquiring the Laser Beam with Find Me" on the next page.*

This command operates within the following distance limits:

- 30 meters (98 feet) with a 1½" or ⅞" SMR
- 15 meters (49 feet) with a ½" SMR
- Minimum distance is 1 meter (3.2 feet)

NOTE: By default, Follow Me is enabled and the command to switch off Follow Me is located in the TrackerPad command. *See "TrackerPad" on page 154.*

Operation

You are moving the SMR and the Vantage is tracking the movement. The SMR passes behind a solid obstacle or the SMR mirrors are no longer pointed at the laser aperture:

1. The laser beam shuts off and the green aperture light turns off.
2. The cameras automatically start to look for any SMR in the field of view and the amber aperture light turns on.

3. Ensure the SMR mirrors are always facing directly at the Vantage.
4. The cameras locate an SMR and the amber aperture light turns off.

NOTE: The search command may start to help find the SMR.

5. The laser beam turns on and the green aperture light turns on.

NOTE: If the cameras do not find any SMR within five seconds, the amber aperture light will start to blink. Hold an SMR with the mirrors facing directly at the Vantage to start these steps again.

Acquiring the Laser Beam with Find Me

When you break or lose the laser beam, you can simply move the SMR in front of the Vantage and it will aim the beam back to your target. The Vantage cameras recognize a series of three movements that starts an internal command to automatically point the laser beam to the center of the SMR.

NOTE: This command is disabled when the 6Probe is the current target.

This command operates within the following distance limits:
- 30 meters (98 feet) with a 1½" or ⅞" SMR
- 15 meters (49 feet) with a ½" SMR
- Minimum distance is 1 meter (3.2 feet)

NOTE: By default, the recognition of the SMR movements is enabled and the command to switch off Find Me is located in the TrackerPad command. *See "TrackerPad" on page 154.*To acquire the laser beam with the SMR movements:

1. Move your SMR into the MultiView Camera's field of view.

NOTE: Ensure that the SMR mirrors are always facing directly at the Vantage. Avoid twisting The SMR during the SMR movements.

2. Perform the SMR movements:
   - Move the SMR slowly, no faster than 6 inches (150 millimeters) per second in any single direction.
   - Stop and move the SMR in the reverse direction.
   - Stop and move the SMR in the original direction.

NOTE: The MultiView cameras have a 50° field of view. If the SMR is very close to the Vantage, the movement must be short. For example, 4 inches (10 centimeters) when the SMR is 10 feet (3 meters) from the Vantage and 10 inches (25 centimeters) at when the SMR is 100 feet (30 meters) from the Vantage.

3. If necessary, repeat the SMR movements until the **Blue** Aperture Lights on the Vantage illuminate and start to blink quickly.

NOTE: Using the Vantage outdoors can cause the Blue Aperture Lights to start blinking. This is a false event and will quickly correct.

4. Stop and hold the SMR still. While the cameras locate the SMR, the **Amber** Aperture Lights on the Vantage illuminate solid.

5. When the laser beam locks on to the SMR, the **Green** Aperture Light on the Vantage illuminate solid.

NOTE: If there are multiple SMRs in the field of view, the Vantage only points at the moving SMR.

The Vantage recognizes the SMR movements in three direction groups:

- Horizontal - Left to Right
- Vertical - Up and Down
- Diagonally - Back and Forth

The Vantage will not recognize a forwards and backwards or any circular movements.

Technical Support

FARO Technologies, Inc. is committed to providing the best technical support to our customers. If you have any problem using one of our products, 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 Knowledge Base. 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:
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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 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.

End User Documents

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

Glossary

3

3D
Three dimensional

A

Accuracy
The deviation between the measured value and the nominal or actual value.

B

Best Fit
Creating a feature that fits a set of points so each point is the shortest distance to the feature.

Bluetooth
Bluetooth is a wireless technology standard used for exchanging data between fixed and mobile devices over short distances using short-wavelength UHF radio waves in the industrial, scientific and medical radio bands,and building personal area networks (PANs).

Button
Refers to the switches on the Laser Tracker.

C

Calibration
A series of measurements that check the accuracy of the Laser Tracker against known standards.

Capture (of data)
Digitizing or Scanning. Storing data points in the computer system. See also "Digitizing." See also "Scanning."

Circle
A closed planar curve in which every point on the curve is equidistant from the center.

Circularity
Circularity measures the form deviation of a circle.

CMM
Coordinate Measuring Machine

Collinear
Data points which lie on the same line.

Compensated points
Refers to the compensation for the radius of the SMR.

Compensation
The procedure by which the Laser Tracker is optimized to perform accurate measurements. Thousands of data points are captured to determine the true geometry and kinematics of each Laser Tracker. This electronic “finger print” is stored on the device.

Coordinate Measuring Machine (CMM)
These machines capture 3D data from objects to give the position (XYZ) of the object.

Coordinate System
A system of representing points in a space of given dimensions by coordinates, such as the Cartesian coordinate system or the system of celestial longitude and latitude. A

coordinate system is a system by which uses one or more features, or coordinates, to uniquely determine the position of a point or other geometric element as a frame of reference.

Custom tooling
Tooling for the Laser Tracker that attaches to tartgets and SMRs.

Cylinder
A geometric feature formed by extruding a circle along its centerline in a direction normal to its plane.

Cylindricity
Cylindricity measures the form deviation of a cylinder.

D

Datum
A datum (plural datums or data) is a reference from which measurements are made. In engineering and drafting, a datum is a reference point, surface, or axis on an object against which measurements are made.

Datum Coordinate
The XYZ values of a feature used to establish an alignment.

Device
A piece of equipment or a mechanism designed to serve a special purpose or perform a special function. Measurement device; FARO CAM2 2020.

Dial indicator
Dial indicators are instruments used to accurately measure a small distance. They may also be known as a Dial Gauge, Dial Test Indicator (DTI), or as a “clock”.

Diameter
The width of a circular of cylindrical feature.

Digitizing
Storing data points in the computer system. See also "Scanning."

DRO
Digital ReadOut. The display of XYZ coordinates on the screen.

E

Electrostatic Discharge (ESD)
Electronic pulses generated by the discharge of loaded objects and/or people.

End Click
To accept collected readings by pressing the H keyboard shortcut.

ESD
Electronic pulses generated by the discharge of loaded objects and/or people.

Ethernet
Ethernet is a family of computer networking technologies commonly used in local area networks (LAN), metropolitan area networks (MAN) and wide area networks (WAN).

F

Flatness
Flatness measures the form deviation of a plane.

Form
The maximum bandwidth (Max. Error added to the Min. Error) of error that a set of measured points deviates from the true form of the resultant feature calculated from that set of points.

H

Hardware
Refers to the mechanical portion of a computer-based system. Opposite of Software.

Hot Keys
See also "Keyboard Shortcuts."

I

Inputting
Refers to the keying in of data.

Intersection
A meeting or crossing at a point.

ISO
International Organization for Standardization

J

Jump drive
See also "USB Drive."

K

Key-in
To manually enter data using a keyboard.

Keyboard Shortcuts
One keystroke commands which invoke a software function.

M

Max. (Maximum) Error
The largest distance from a reading above or outside a best-fit feature.

Maximum Permissible Error (MPE)
The extreme value of measurement error, with respect to a known reference quantity value, permitted by specifications or regulations for a given measurement, measuring instrument, or measuring system.

Measure
To capture data points to determine the size, position, and form of feature. See also "Digitizing" and "Scaning."

Min. (minimum) Error
The largest distance from a reading below or inside a best-fit feature.

N

NIST
National Institute of Standards and Technology

O

Origin
The point from which the axes of a coordinate system emanate.

Orthogonal coordinates
Coordinates which are perpendicular.

P

Plane
A geometric feature defined by a point and a vector. A flat surface.

Plane Compensation
The movement of a measured plane in a direction the distance of the SMR radius.

R

Readout
The visual display of data on a computer screen. See also "Digital ReadOut."

Repeatability
The ability of a device to obtain consistent results. Although the terms are generally used interchangeably, repeatability differs from accuracy in that a device can consistently obtain the wrong result.

Resolution
The number of decimal places that a measurement device can reliably display.

Right Hand Rule
A coordinate system where the positive direction of each axis is described by three fingers of the right hand.

Rotation
Angular motion about a specified point or axis.

Roundness
The deviation of the measured data points from the true form of the resultant circle.

S

Scanning
To capture large quantities of data points quickly and storing the points in the computer system. See also "Digitizing."

SMR Compensation
The ability of the software to account for the distance between the SMR point of contact with the surface being measured and the center of the SMR. Measured readings are moved this distance in a specific direction during the calculation of a feature. Gross errors can result if this is not done correctly. See also "Compensation."

Software
Refers to the application of a computer-based system. Opposite of Hardware.

Spherically Mounted Retroreflector (SMR)
Spherically Mounted Retroreflector The probe for the Laser Tracker

Stream
A continuous input of data points.

T

Temperature Compensation
The ability of a measurement device to adjust to changes in ambient temperature. A measurement device that is temperature compensated will maintain its accuracy through a wide range of temperatures. A device that is not temperature compensated cannot.

Thread
A screw thread. A machined surface with a helical shape. Normally parts are fastened together with a screw and a threaded hole or a threaded bolt and nut.

Thread mount
A metal piece that is used as an interface between a mating thread and a tripod or a mating thread and a table mountable device.

Tolerance
A zone of accuracy in both size and placement of a feature. For example, a hole of a diameter of 1.00 ± 0.01 located at the x, y, z of 1.000, 1.000, 0.000 ± 0.005 means a 1 unit diameter hole can be between 1.01 and 0.99 in size and the location can be plus or minus 0.005 units from the specified nominal location. You determine the quality of a part by comparing your actual values to the nominal values within a tolerance range.

Traditional CMM
There are many types of CMMs that fall into this category. These include the bridge type, cantilever type, gantry type, etc. These are floor-mounted machines that require you to bring the parts to the CMM, unlike FARO's "portable" CMM, the Laser Tracker.

U

Unit Vector
A directional line with a non-dimensional magnitude of one. The line may be associated with the normal vector of a surface at a specific location. The vector is described in relation to the current alignment using the letters I, J, and K that are associated to X, Y, and Z.

Universal Serial Bus (USB)
Universal Serial Bus (USB) is an industry standard that establishes specifications for cables and connectors and protocols for connection, communication and power supply (interfacing) between computers, peripherals and other computers.

USB
Universal Serial Bus (USB) is an industry standard that establishes specifications for cables and connectors and protocols for connection, communication and power supply (interfacing) between computers, peripherals and other computers.

USB Drive
A storage device integrated with the USB interface.

V

Vector
A term used to describe the direction of a line or object that may or may not have a magnitude. The line may be associated with the normal vector of a surface at a specific location. The vector is described in relation to the current alignment using the letters I, J, and K that are associated to X, Y, and Z.

Volume
The amount of space occupied in three dimensions.

X

X, Y, Z

Refers to the Cartesian Coordinate System for three-dimensional space.

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