USER GUIDE

TRIMBLE® V10 IMAGING ROVER

Revision D
Part Number 57047029
October 2014

Trimble

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Release Notice

This is the October 2014 release Revision D of the Trimble V10 Imaging Rover User Guide Part Number 57047029

Product Limited Warranty Information

For applicable product Limited Warranty information, please refer to the Limited Warranty Card included with this Trimble product, or consult your local Trimble authorized dealer.

Registration

To receive product upgrades included with this Extended Limited warranty as well as information regarding updates and new products, please register by visiting the Trimble website at www.trimble.com/register. Upon registration you may select the newsletter, upgrade or new product information you desire.

Notices

USA

This product complies with Part 15 of 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.

Class B Statement – Notice to Users. This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the 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/TV technician for help.

Changes and modifications not expressly approved by the manufacturer or registrant of this equipment can void your authority to operate this equipment under Federal Communications Commission rules.

This product contains:
WLAN radio module with FCC ID: PVH0926
Bluetooth radio module with FCC ID: PVH092102

Canada

This Class B digital apparatus complies with Canadian ICES-003.
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 harmful interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.
Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.
Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:
(1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, meme si le brouillage est susceptible d'en compromettre le fonctionnement.

This product contains:
WLAN radio module with IC: 5325A-0926
Bluetooth radio module with IC: 5325A-092102

Europe

This product has been tested and found to comply with relevant requirements pursuant to European Council Directive, thereby satisfying the requirements for CE Marking and sale within the European Economic Area (EEA). These requirements are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential or commercial environment.

Applicable directives:

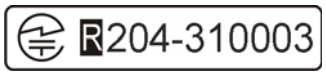
EMC Directive 2004/108/EC
R&TTE Directive 1999/5/EC
RoHS Directive 2011/65/EU

Australia and New Zealand

This product conforms with the regulatory requirements of the Australian Communications Authority (ACA) EMC framework, thus satisfying the requirements for RCM Marking and sale within Australia and New Zealand.

Japan

This product contains:
WLAN radio module with MIC ID: R204-310003



Environmental Information

Taiwan

The product contains a removable Lithium-ion battery. Taiwanese regulations require that waste batteries are recycled.

廢電池請回收

European Union

For product recycling instructions and more information, please go to www.trimble.com/ev.shtml.

Recycling in Europe: To recycle Trimble batteries and WEEE (Waste Electrical and Electronic Equipment, products that run on electrical power.), Call +31 497 53 24 30, and ask for the "WEEE Associate". Or, mail a request for recycling instructions to:
Trimble Europe BV
c/o Menlo Worldwide Logistics
Meerheide 45
5521 DZ Eersel, NL

Important Information

Before you use your Trimble product, make sure that you have read and understood all safety requirements.

WARNING – This alert warns of a potential hazard which, if not avoided, could result in severe injury or even death.

CAUTION – This alert warns of a potential hazard or unsafe practice that could result in minor injury or property damage or irretrievable data loss.

Note – *An absence of specific alerts does not mean that there are no safety risks involved.*

Battery Safety

WARNING – Do not damage the rechargeable Lithium-ion battery. A damaged battery can cause an explosion or fire, and can result in personal injury and/or property damage. To prevent injury or damage:

– Do not use or charge the battery if it appears to be damaged. Signs of damage include, but are not limited to, discoloration, warping, and leaking battery fluid.
– Do not expose the battery to fire, high temperature, or direct sunlight.
– Do not immerse the battery in water.
– Do not use or store the battery inside a vehicle during hot weather.
– Do not drop or puncture the battery.
– Do not open the battery or short-circuit its contacts.

WARNING – Avoid contact with the rechargeable Lithium-ion battery if it appears to be leaking. Battery fluid is corrosive, and contact with it can result in personal injury and/or property damage. To prevent injury or damage:

– If the battery leaks, avoid contact with the battery fluid.
– If battery fluid gets into your eyes, immediately rinse your eyes with clean water and seek medical attention. Do not rub your eyes!
– If battery fluid gets onto your skin or clothing, immediately use clean water to wash off the battery fluid.

WARNING – Charge and use the rechargeable Lithium-ion battery only in strict accordance with the instructions. Charging or using the battery in unauthorized equipment can cause an explosion or fire, and can result in personal injury and/or equipment damage. To prevent injury or damage:

– Do not charge or use the battery if it appears to be damaged or leaking.
– Charge the Lithium-ion battery only in a Trimble product that is specified to charge it. Be sure to follow all instructions that are provided with the battery charger.
– Discontinue charging a battery that gives off extreme heat or a burning odor.
– Use the battery only in Trimble equipment that is specified to use it.
– Use the battery only for its intended use and according to the instructions in the product documentation.

Contents

CHAPTER 1

Getting Started

In this chapter:

Welcome

Welcome to the Trimble V10 Imaging Rover user guide. This manual describes how to setup and use the Trimble V10 Imaging Rover. Trimble recommends that you spend some time reading this manual to learn about the special features of this product.

Related Information

For more information about this product, please visit our web site at:

www.trimble.com

Technical Assistance

If you have a problem and cannot find the information you need in the product documentation, contact your local Distributor. Alternatively, request technical support using the Trimble web site at:

www.trimble.com

Registration

To receive information regarding updates and new products please register on the Trimble web site.

www.trimble.com/register

The Trimble V10 Imaging Rover

Positions From Pictures

The Trimble V10 Imaging Rover with Trimble VISION™ technology is an integrated camera system that precisely captures 360 degree panoramas for visual documentation and measurement of the surrounding environment. Either stand alone or combined with a Trimble VX™ Spatial Station, S series Robotic Total Station or Trimble R series GNSS receiver, the Trimble V10 Imaging Rover provides the means to quickly capture rich data and create comprehensive deliverables. Together with Trimble Access™ field software on the Trimble Tablet Rugged PC or Trimble TSC3 Controller and Trimble Business Center office software, the Trimble V10 is the complete geospatial solution.

Rapid Data Capture

The Trimble V10 featuring Trimble VISION technology allows you to capture a 60 MP panorama image. A total of 12 calibrated cameras, seven panoramas and five downward looking, provide complete site documentation that can be used to make photogrammetric measurements. This metric imaging functionality is ideal to perform work where there are many features to collect, or where features are complex or difficult to capture.

Capture Data in Field and Measure in Office

In the field the Trimble V10 Imaging Rover captures data of the entire job site to be processed in the office. The measurement functionality in Trimble Business Center to measure and create points, lines, polygons and other imaging components.

Integration With GNSS and Total Stations

The Trimble V10 integrates with the Trimble R series GNSS receiver and Trimble robotic total stations, such as the Trimble VX Spatial Station. Associate collected images with positions to generate a highly accurate geospatial dataset or capture GNSS and total station data. With the existing data capture work flow in Trimble Access, add 360 degree panoramas to the dataset as needed for a complete integrated geospatial surveying solution.

Rugged Design

The Trimble V10 is designed to withstand field conditions and has an IP54 rating.

Features

- 12 Cameras
  - 7 Panoramic cameras
  - 5 Downward-facing cameras
- Dual axis tilt sensor
- Compass
- USB A Connector
- Mini USB B Connector for communication
- Quick release connector for add on equipment
- Bumper/sun light protection
- IP54 Rating
- Two Section Power Rod with shock absorbing tip

System Requirements

The system requirements for the PC needed to communicate with the Trimble V10 are as follows.

- Microsoft® Windows® 7
- USB 2.0

In the Transport Case

The equipment is delivered in transport cases designed to protect the instrument from damages. Always keep the instrument correctly placed in the transport cases during storage and transportation, see also Care & Maintenance, page 58 and Transportation, page 60.

Camera Head Kit Case

The case for the camera head is designed not only to contain the camera head, but also the Tablet, batteries, battery charger etc.

The Figure 1.1 shows the V10 camera kit case with accessories as delivered from Trimble.

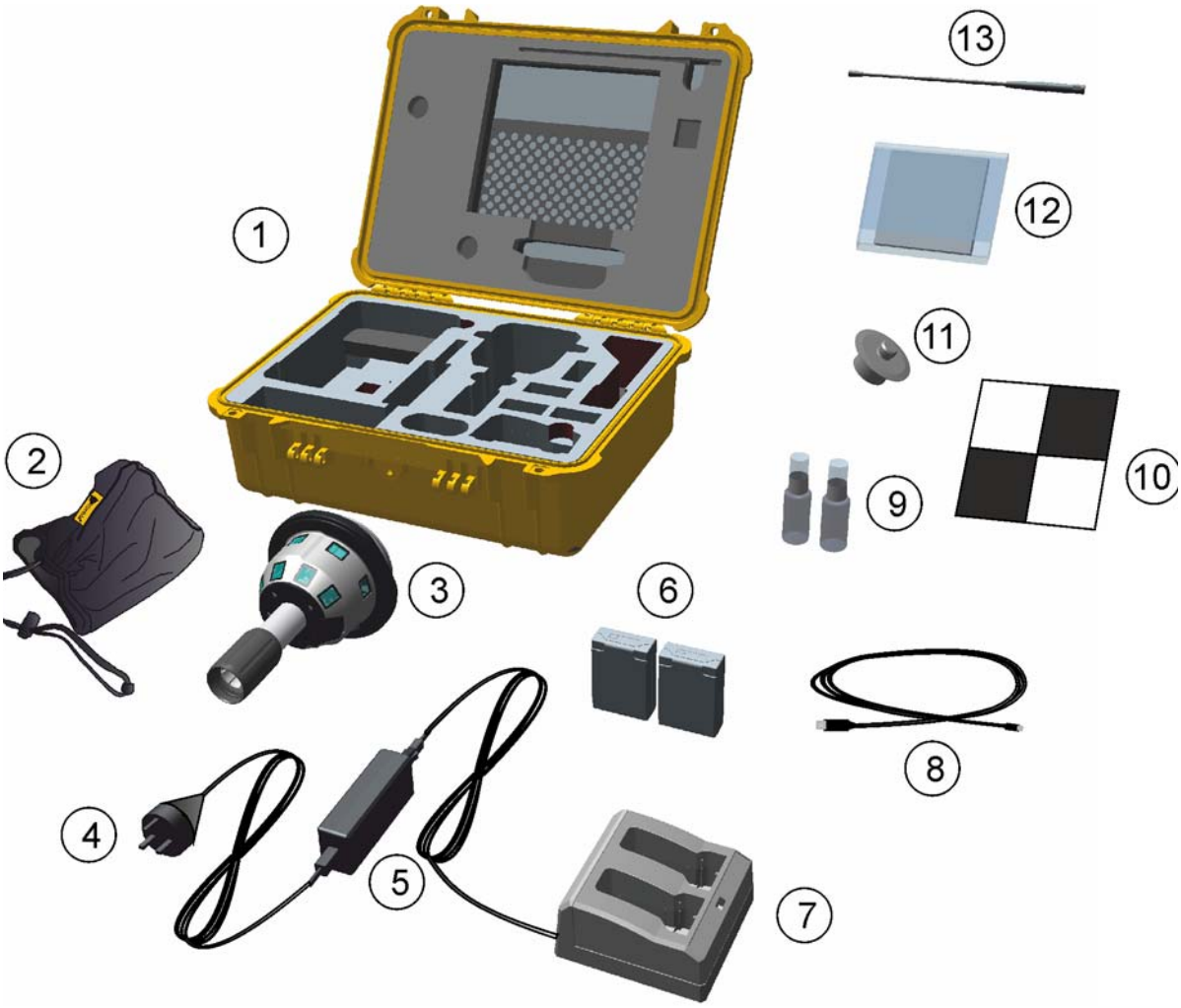


Figure 1.1 V10 Camera head kit case with accessories

Item	Description	Item	Description
1	V10 Instrument case	8	Cable USB - Mini B USB, 1.5m
2	V10 Camera head cover	9	Cleaning fluid (x2)
3	V10 Camera head	10	Adhesive targets (x10)
4	Country specific net adapters	11	Adapter for 360° Prism
5	Power supply for Dual battery charger	12	Cleaning cloths
6	Rechargeable battery (x2)	13	Trimble R10 GNSS Receiver radio antenna
7	Dual battery charger with slot inserts		Quick start guide, system poster, Warranty activation card and WEEE statement (not shown in figure)

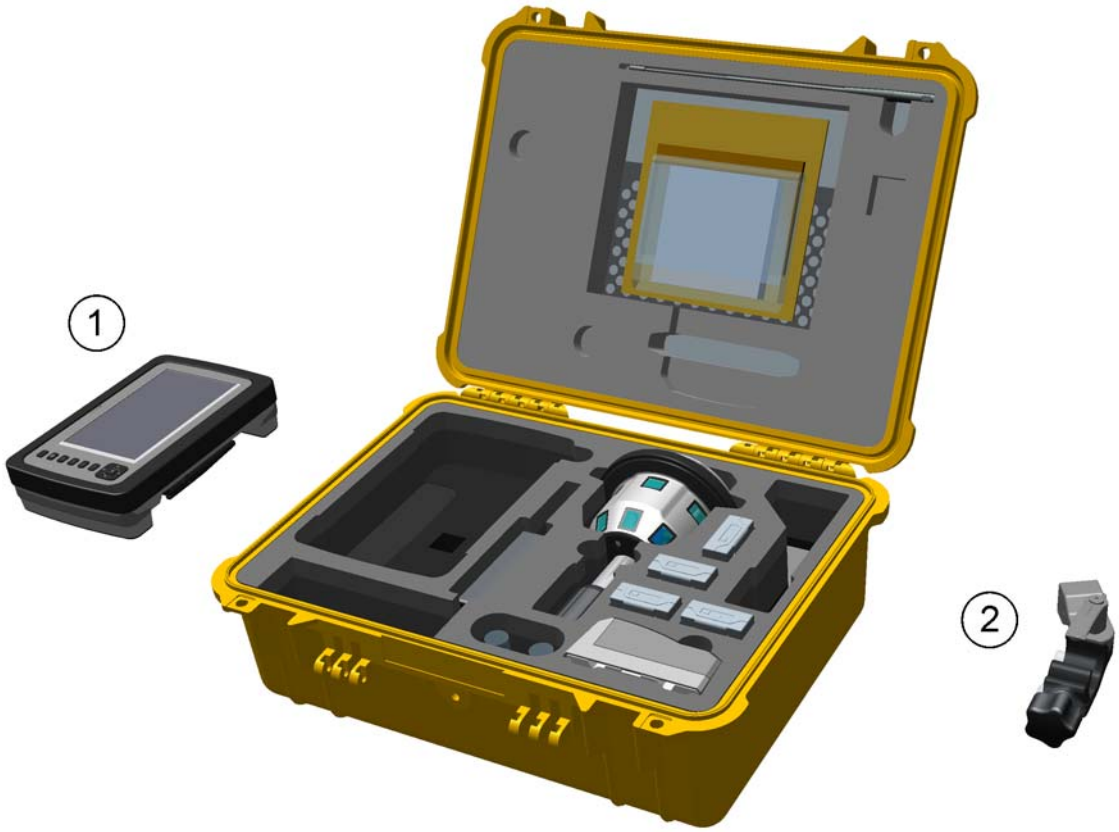


Figure 1.2 V10 Camera head kit case with additional equipment

Item	Description	Item	Description
1	Trimble Tablet Rugged PC	2	Rod bracket

Depending on which type of battery is installed on the Trimble Tablet Rugged PC, the case insert needs to be positioned differently so that the Trimble Tablet Rugged PC fits correctly in the case.

The Figure 1.3 shows the two different positions A and B. The inserts are here marked as red for clarity.

- Position A is used when the Trimble Tablet Rugged PC is equipped with a standard battery.
- Position B is used when the Trimble Tablet Rugged PC is equipped with a battery with extended capacity.

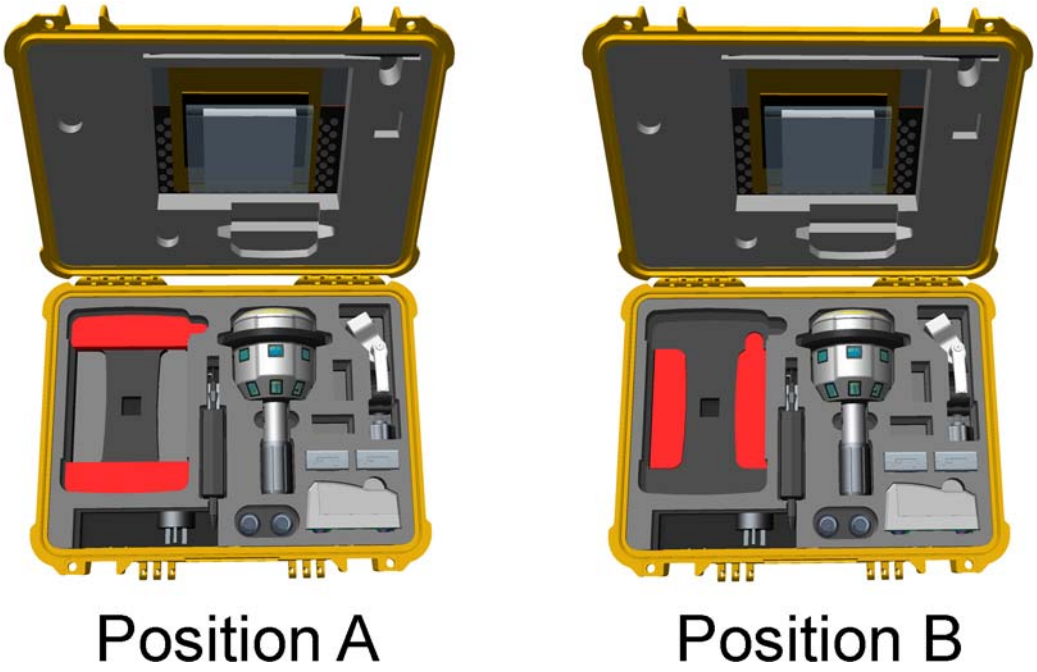


Figure 1.3 Different positions of case insert part, here marked as red.

Power Rod Kit Case

The Power Rod Kit is delivered in a carrying bag that is designed to contain the power rod and the bi-pod.

Figure 1.4 Power Rod Kit case

High Accuracy Kit Case

The High Accuracy Kit is delivered in a case designed to contain the power mount, prism base, tribrach, targets and a battery (Not part of the kit).

Figure 1.5 V10 High Accuracy kit case

Item	Description	Item	Description
1	V10 High Accuracy Kit case	4	V10 Power Mount
2	Tribrach	5	Targets (x2)
3	Prism base		

Description of the V10 Imaging Rover

The Trimble V10 Imaging Rover consists of two major parts, the camera head and the power rod. The camera head can easily be removed from the power rod.

Camera Head

The camera head is equipped with a bumper to protect the camera head from damage if dropped or bumped. The bumper will also serve as a sun light protection preventing the sun light from entering the cameras.

Note – *The bumper will protect the camera head from minor bumps and falls. The Trimble V10 Imaging Rover is a precision instrument and should be handled with care.*

A quick release cover on top of the camera head protects the quick release connection from humidity and dirt while not in use. The quick release cover or connected equipment is released from the connection with the quick release button.

The 12 cameras of the camera head are placed in two rows. An upper row of 7 cameras with a 360 degree field of view and a lower row of 5 cameras. The front camera (Cam 4) shown in Figure 1.6 is the camera used when shooting a video.

At the bottom of the camera head is a power rod joint to secure the camera head to the power rod. The power rod joint also includes the connectors for power supply to the camera head and communication to and from the batteries in the power rod.

Note – *The rotation of the camera head in relation to the power rod is keyed ant fits only in one position. This position must be found by rotating the camera head in relation to the power rod before they are screwed together.*

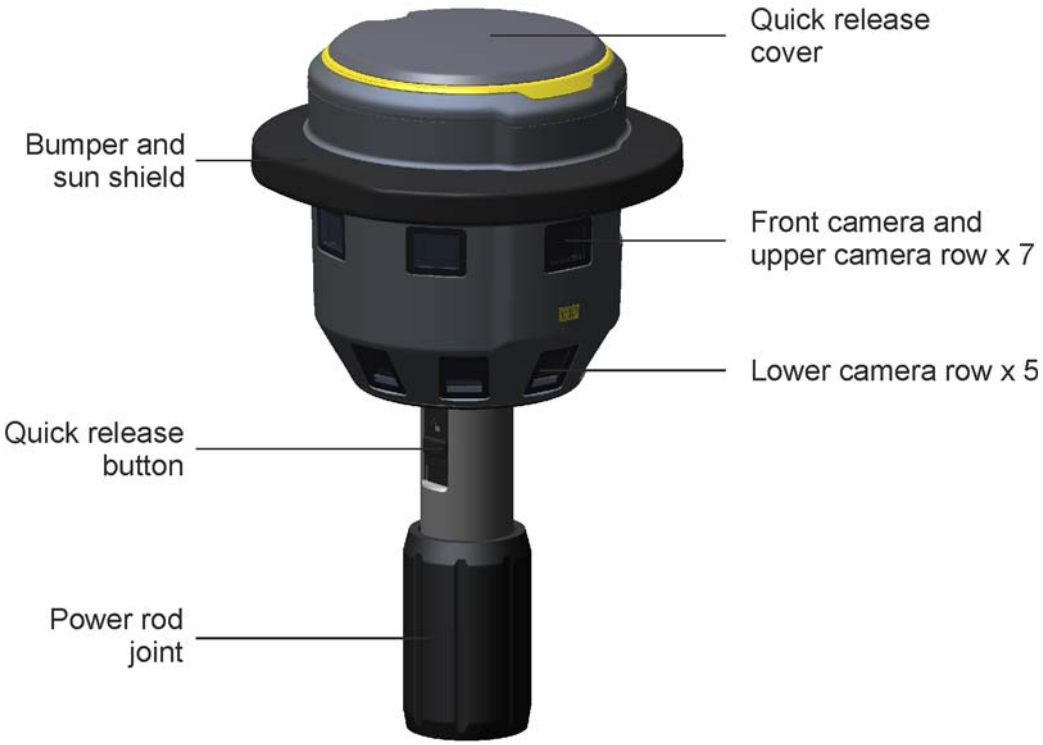


Figure 1.6 Description of camera head

Camera Head Bottom View

The instrument power button and two USB connectors are situated on the bottom side of the camera head.

The power button is a press and release button. Press and release once to switch the instrument on and press and release again to switch the instrument off. An LED in the power button will indicate when the instrument is on.

The Mini USB B connector is used to connect the camera head to a controller or a computer.

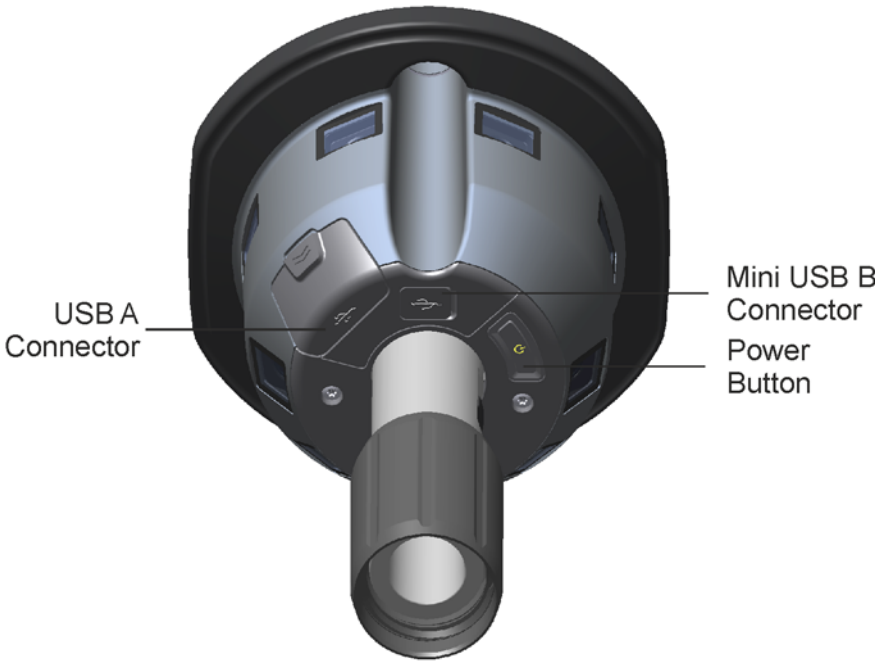


Figure 1.7 Description of camera head, bottom view

Camera Head Top View

When the protecting quick release cover is removed a quick release connector is revealed on top of the camera head, see also Quick Release Cover, page 41.

The quick release connector will give the operator the possibility to connect other equipment to the camera head, see also Connecting a Trimble R10 GNSS Receiver, page 42 and Connecting a Trimble R4, R6 or R8 GNSS Receiver, page 44

From the top down the side of the camera head is a slot for a radio antenna when an R10 GNSS Receiver is connected to the camera head.

Figure 1.8 Description of camera head, top view, with quick release cover removed

Power rod

The carbon fiber power rod has a fixed height, see Instrument Heights on Power Rod, page 52. On top of the rod is a camera head joint to connect to the camera head.

The power rod can be split into two sections for easier transport and storage.

Note – *The rotation of the upper and lower part of the power rod is keyed and fits only in one position. This position must be found by rotating the upper and lower part in relation to each other before they are screwed together.*

The battery compartment can hold two batteries for long operating time. A two battery system also enables the possibility to change batteries without switching off the instrument.

The shock absorbing tip will dampen the G-force that the instrument will be exposed too each time it is placed in position on the ground. For more information please read the Important Information, page 20.

CAUTION – The use of any other type of rod than a dampened type recommended by Trimble can cause damage to the camera head and will void the warranty.

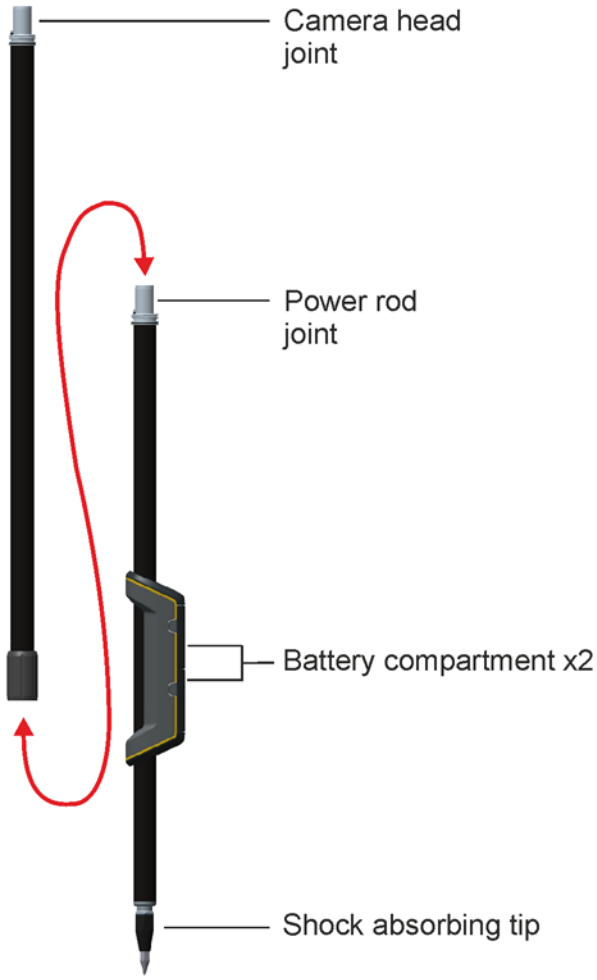


Figure 1.9 Description of two section Power rod

Description of the V10 High Accuracy Kit

The High Accuracy Kit is an optional accessory designed for high accuracy measurements. The High Accuracy Kit gives the operator the possibility to set up the camera head on a stable tripod or pillar.

Note – *Use only high quality tripod recommended by Trimble.*

The High Accuracy Kit is also used when performing a camera head calibration check, see Camera Head Calibration Check, page 61

Power Mount

The Power mount can hold one internal battery for power supply to the camera head and/or be connected to an external power supply via the Hirose connector. The option to connect two different power sources enables the possibility to change batteries without switching off the instrument.

The External power source connected via the Hirose connector is the primary and will be used as long as it is connected and in better condition than the internal battery.

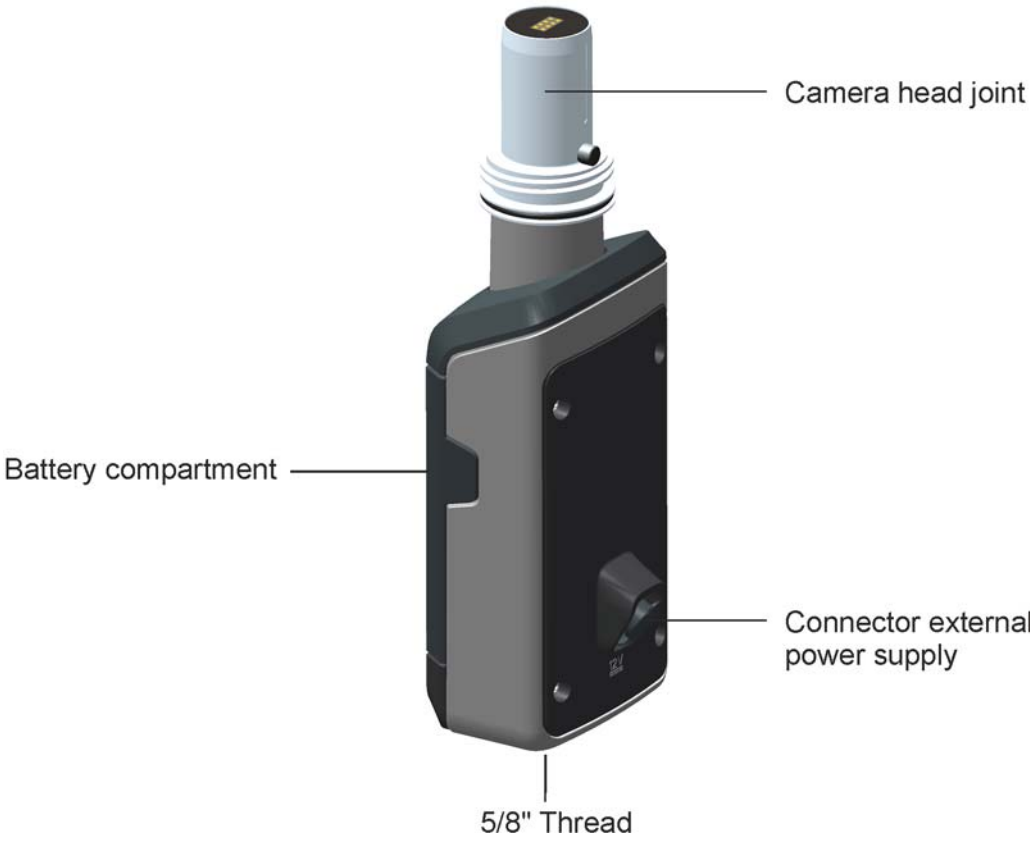


Figure 1.10 Description of Power Mount

Batteries

Before charging or using a battery it is important that you read and understand the battery safety and environment information.

Battery Safety and Environmental Information

Charge and use the battery only in strict accordance with the instructions provided.

WARNING – Do not damage the rechargeable Lithium-ion battery. A damaged battery can cause an explosion or fire, and can result in personal injury and/or property damage. To prevent injury or damage:
– Do not use or charge the battery if it appears to be damaged. Signs of damage include, but are not limited to, discoloration, warping, and leaking battery fluid.
– Do not expose the battery to fire, high temperature, or direct sunlight.
– Do not immerse the battery in water.
– Do not use or store the battery inside a vehicle during hot weather.
– Do not drop or puncture the battery.
– Do not open the battery or short-circuit its contacts.

WARNING – Avoid contact with the rechargeable Lithium-ion battery if it appears to be leaking. Battery fluid is corrosive, and contact with it can result in personal injury and/or property damage. To prevent injury or damage:
– If the battery leaks, avoid contact with the battery fluid.
– If battery fluid gets into your eyes, immediately rinse your eyes with clean water and seek medical attention. Do not rub your eyes!
– If battery fluid gets onto your skin or clothing, immediately use clean water to wash off the battery fluid.

WARNING – Charge and use the rechargeable Lithium-ion battery only in strict accordance with the instructions. Charging or using the battery in unauthorized equipment can cause an explosion or fire, and can result in personal injury and/or equipment damage. To prevent injury or damage:
– Do not charge or use the battery if it appears to be damaged or leaking.
– Charge the Lithium-ion battery only in a Trimble product that is specified to charge it. Be sure to follow all instructions that are provided with the battery charger.
– Discontinue charging a battery that gives off extreme heat or a burning odor.
– Use the battery only in Trimble equipment that is specified to use it.
– Use the battery only for its intended use and according to the instructions in the product documentation.

Disposal

Before disposal, discharge the battery.

Dispose of the used battery in an environmentally sensitive manner, according to local and national regulations, see also page ii.

Charging the Lithium-ion battery

The rechargeable Lithium-ion battery is supplied partially charged. Charge the battery completely before using it for the first time. Charging takes approximately 3 hours per battery at room temperature. If the battery has been stored for longer than three months, charge it before use.

WARNING – Charge and use the rechargeable Lithium-ion battery only in strict accordance with the instructions.Charging or using the battery in unauthorized equipment can cause an explosion or fire, and can result in personal injury and/or equipment damage.
To prevent injury or damage:
– Do not charge or use the battery if it appears to be damaged or leaking.
– Charge the Lithium-ion battery only in a Trimble product that is specified to charge it. Be sure to follow all instructions that are provided with the battery charger.
– Discontinue charging a battery that gives off extreme heat or a burning odor.
– Use the battery only in Trimble equipment that is specified to use it.
– Use the battery only for its intended use and according to the instructions in the product documentation.

To charge the battery, first remove the battery from the Power Rod or Power Mount, and then place it in the battery charger, which is connected to AC power.

Battery

The battery is a 7.4 V, 3.7 Ah rechargeable Lithium-ion smart battery.

The battery has a built in power gauge to indicate the power level. To check the power level press the button. When the button is pressed, four LED's will indicate the power level. Each LED corresponds to a power level of 25%, so when the power level is 100% all LED's are lit. If the battery is completely discharged, all LED's are off.

When the button is pressed and all the LED's flash, the battery needs to be reconditioned in the battery charger.

When the battery capacity is between 0 and 10% one LED is flashing.

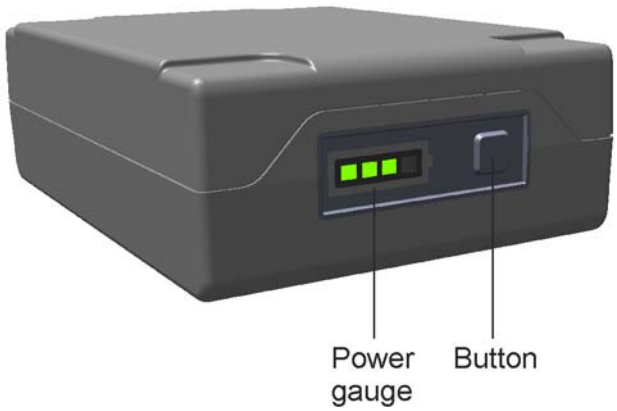


Figure 1.11 Battery with power level button pressed and power gauge indicating a 75% capacity.

Battery charger

The Charger Kit Dual Slot consists of:

- Charger dual-battery slot
- Power supply for charger
- Cable Kit-AC for power supply
- Charger battery slot inserts

For further information regarding the charger dual battery slot, please refer to the charger user guide supplied with the charger

Charger slots

The charger has two slots. When charging the smart battery, you must place the inserts into the battery slot before inserting the battery. Batteries are charged one at a time. Beside each slot are two LED indicators (red and green) to indicate the battery status.

Power Modes

Off

In Off mode the instrument is not connected to a power supply. LED in the power button is off.

On

The instrument is connected to an application. LED in the power button is solid on. If left unused for five minutes the instrument will turn off.

Power Mode Indicator

The LED in the power button will describe which power mode the instrument is in.

Power Mode	Power Button LED
Off	Off
On, healthy power	On
Low battery level	Flashing every second

CHAPTER 2

Set up

In this chapter:

Important Information

When using the V10 as a rover it is exposed to high G forces each time the rod is put on the ground. For this reason it is of high importance that the camera head is set up in a correct way.

Position 1 in Figure 2.12 shows a correct set up where the Power Rod that has a dampened tip is used. The dampening in the Power Rod will protect the camera head from high G forces.

Position 2 in Figure 2.12 shows an incorrect set up where the Power Mount has been used on an un-dampened rod. This set up can cause damages to the camera head.

Position 3 in Figure 2.12 shows the correct use of the Power Mount where it has been used on a fixed tripod.

⚠ **CAUTION –** The use of any other type of rod than a dampened type recommended by Trimble can cause damage to the camera head and will void the warranty.

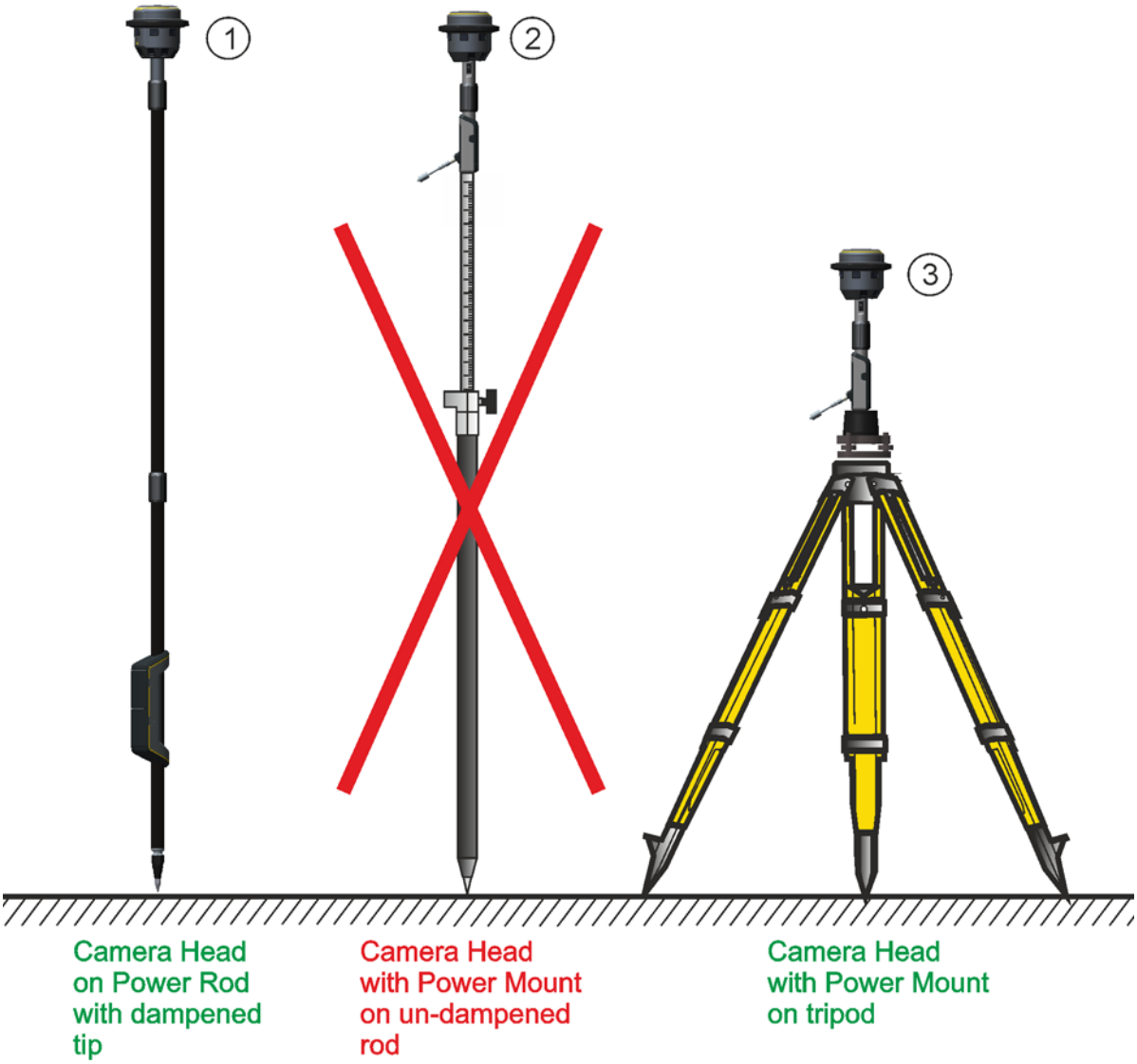


Figure 2.12 Correct and incorrect set up of the camera head

V10 Imaging Rover Set up

An instrument setup with good measuring stability will increase the precision in the measurement result and allow you to utilize the measurement precision of the Trimble V10 Imaging Rover to its full extent.

Take into account that instruments require sufficient time to adjust to the ambient temperature. The following rule-of-thumb for a high precision measurement applies: Temperature difference in degree Celsius (°C) x 2 = duration in minutes required for the instrument to adjust to the new temperature.

Connecting the Upper and Lower Power Rod Sections

In the joint between the upper and lower power rod sections is an electrical connector for communication and power supply. This connector must be lined up in order to function properly. For this reason the connection between the upper and lower power rod sections is keyed and can only fit together in one position.

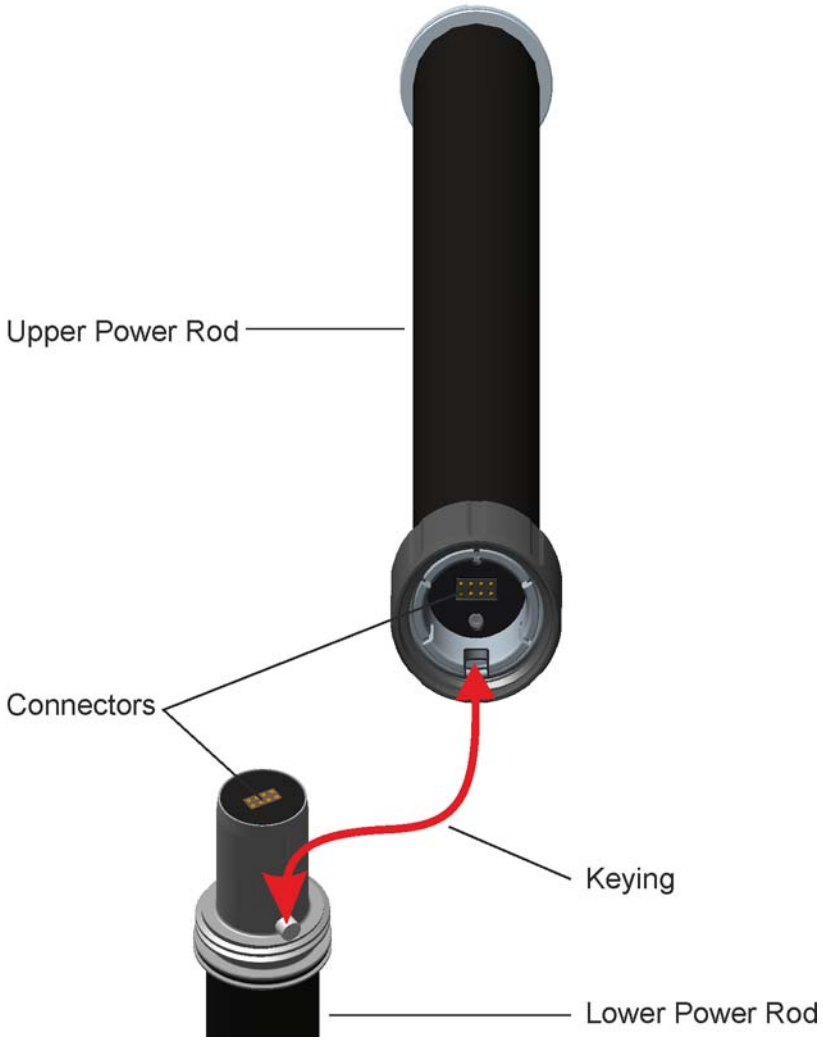


Figure 2.13 Connector and keying on the upper and lower power rod sections.

Connecting

To connect the upper and lower power rod sections:

1. Put the upper power rod section on to the lower power rod section
2. Turn the upper and lower power rod sections in relation to each other until the keying is found
3. Push the upper and lower power rod sections together
4. Lock the upper and lower power rod sections together by screwing the locking collar until stop

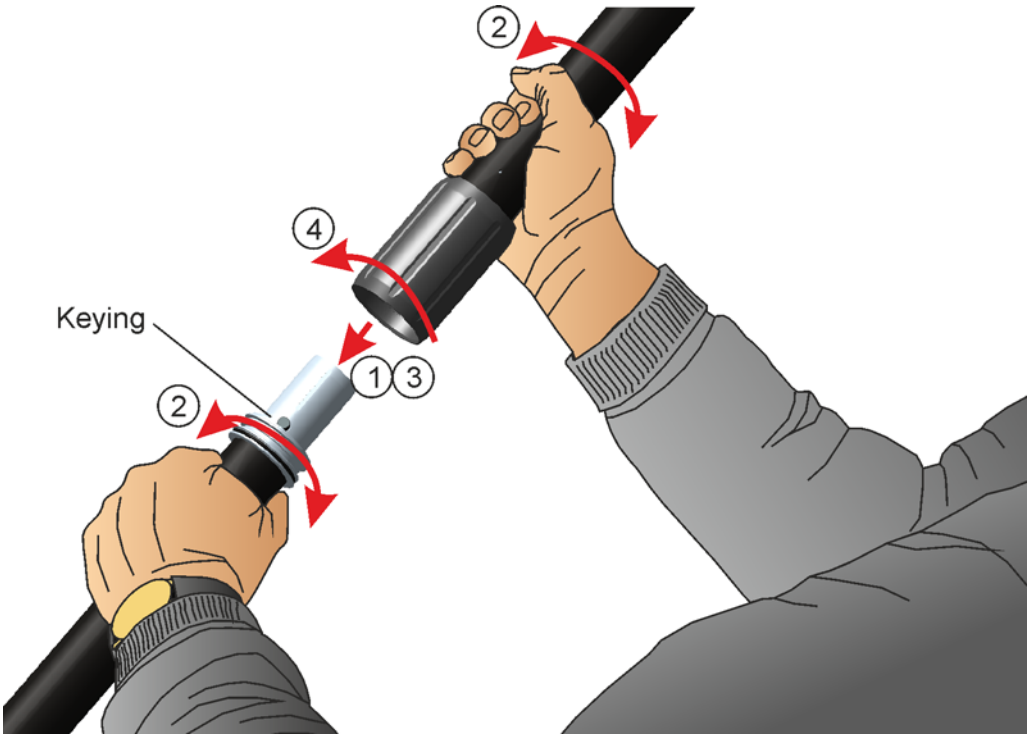


Figure 2.14 Connecting upper and lower Power rod sections

Connecting the Camera Head to the Power Rod

In the joint between the camera head and the power rod is an electrical connector for communication and power supply. This connector must be lined up in order to function properly. For this reason the connection between the camera head and the power rod is keyed and can only fit together in one position.

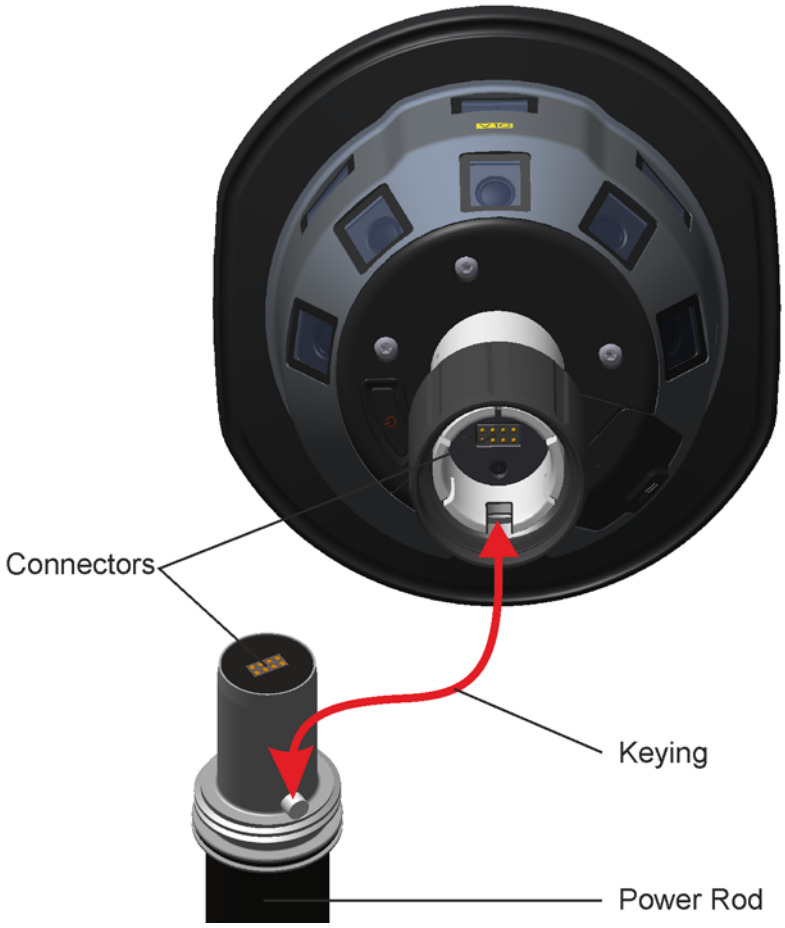


Figure 2.15 Connector and keying on the camera head and power rod

Connecting

To connect the camera head to the power rod:

1. Put the camera head on to the power rod
2. Turn the power rod until the keying is found
3. Push the camera head in position
4. Lock the camera head on to the power rod by screwing the locking collar until stop

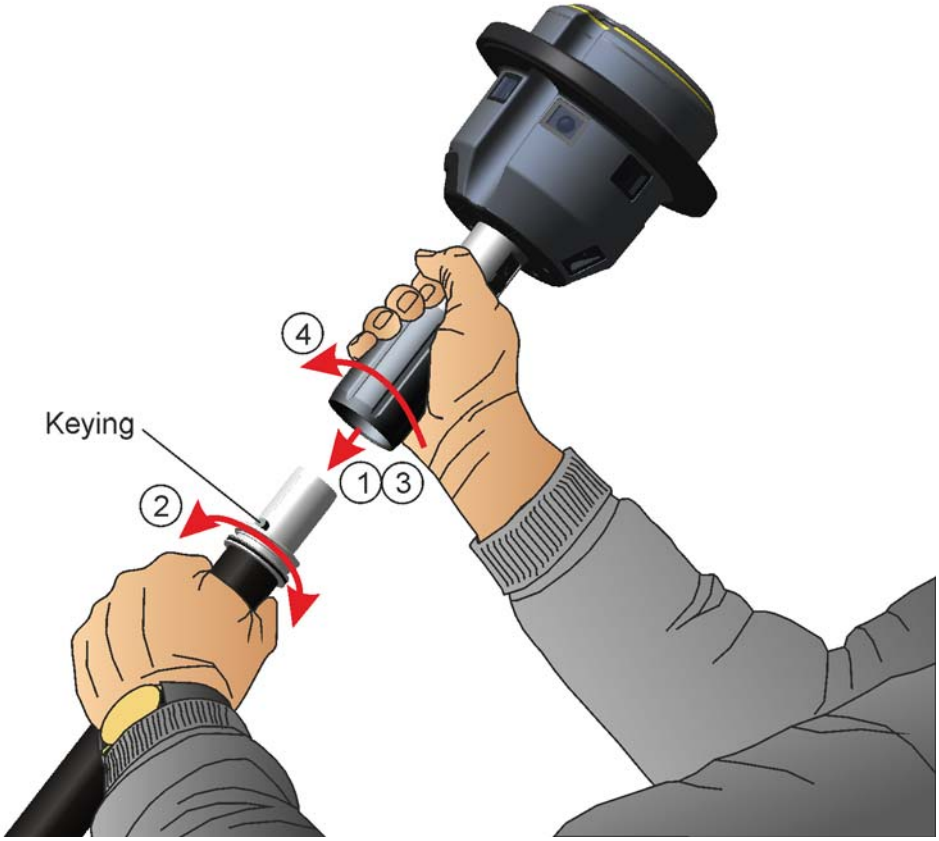


Figure 2.16 Connecting the camera head to the power rod

Connecting the Bi-pod

For high measurement stability it is recommended to use the bi-pod when capturing panoramas. The bi-pod is connected to the power rod with an integrated bracket. A lower bracket is also attached to the power rod to secure the bi-pod legs in position during transport.

Connecting

1. Slide the lower bi-pod bracket on to the power rod and tighten the lock screw.

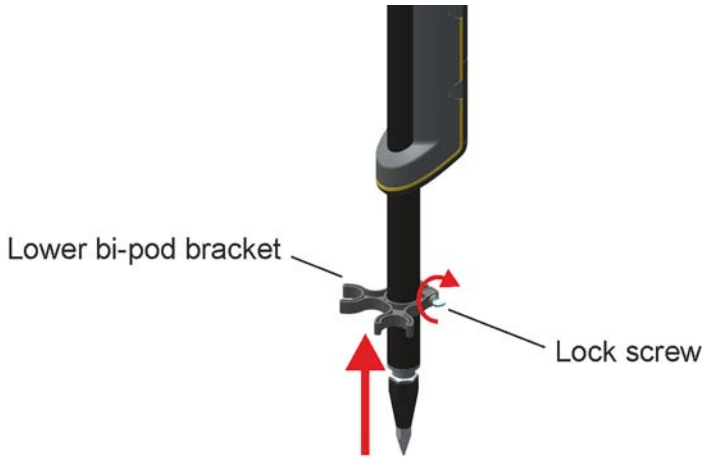


Figure 2.17 Mounting lower bi-pod bracket

2. With the bi-pod legs fully retracted attach the bi-pod to the power rod and tighten the bracket lock screw. Make sure that the bi-pod is mounted on the other side of the power rod in relation to the battery compartment.

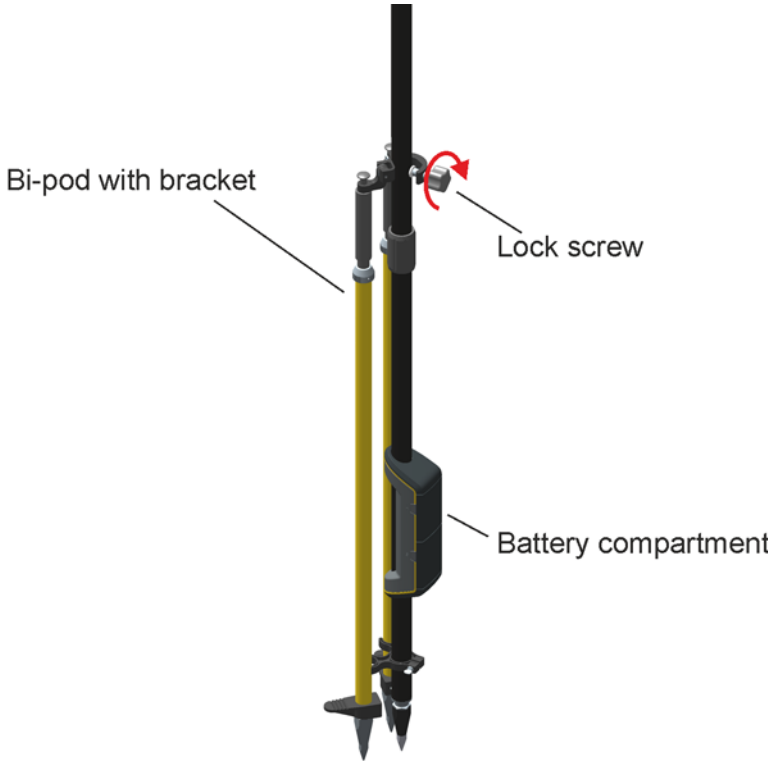


Figure 2.18 Mounting the bi-pod to the power rod

3. Hold the power rod with one hand and balance the power rod with the power rod tip firmly on the ground.
4. With the other hand pull out the two bi-pod legs in an angle from the power rod.

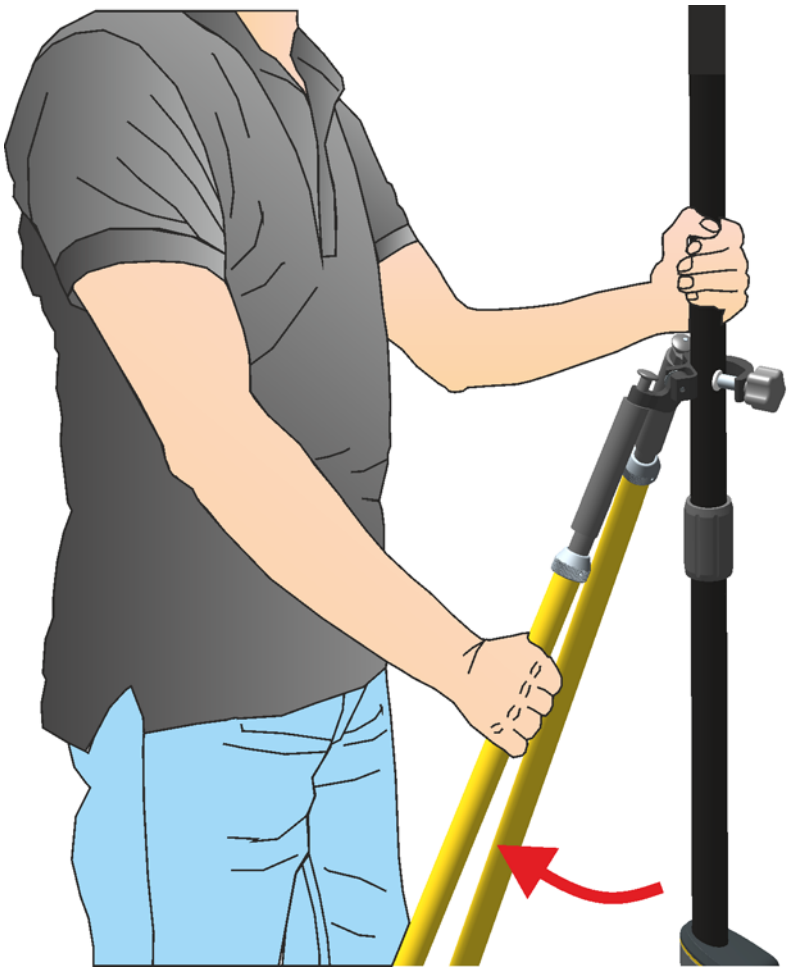


Figure 2.19 Pulling out the bi-pod legs

5. Hold each bi-pod leg with one hand and with the thumbs press the release buttons to extend the bi-pod legs.
6. While holding down the release buttons level the power rod.

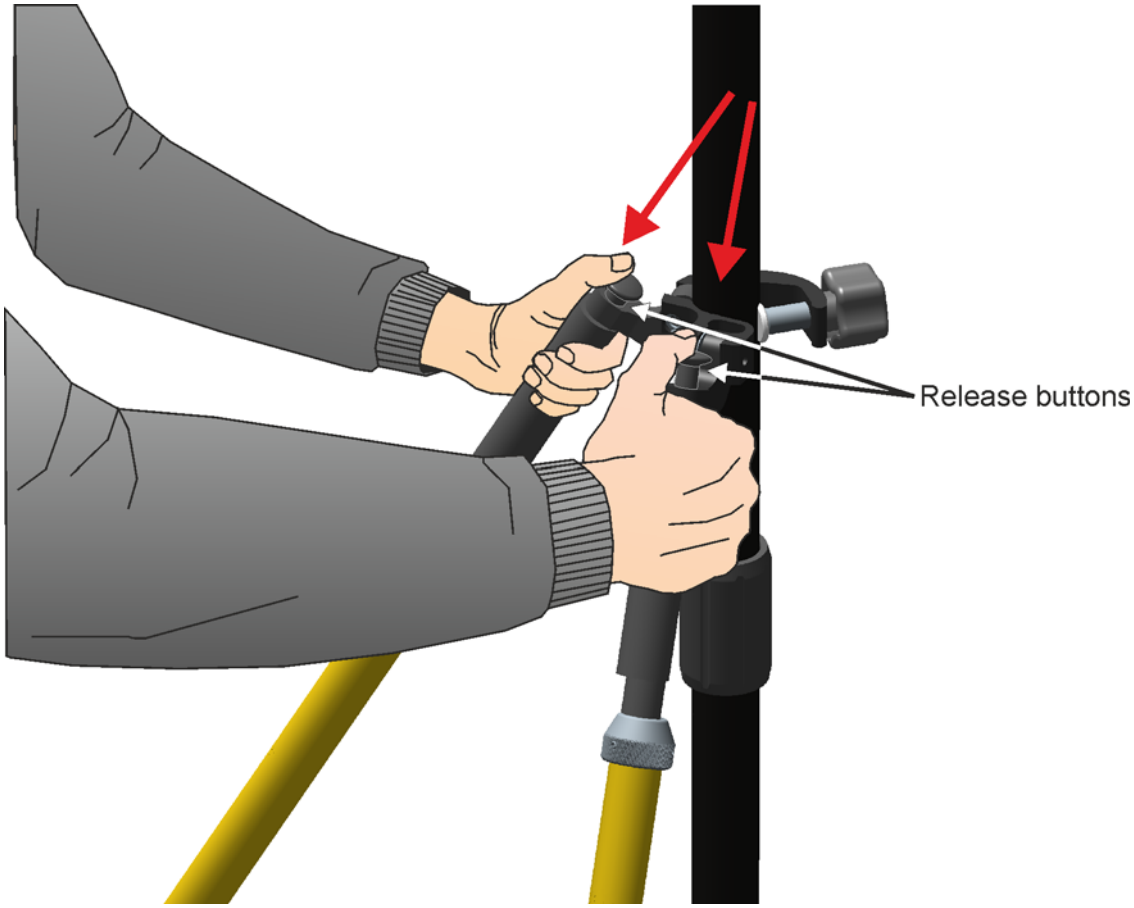


Figure 2.20 Adjusting the length of the bi-pod legs

7. When the rod is leveled release the button.

Connecting the Trimble Tablet PC

The Trimble Tablet PC is attached to the power rod with a bracket.

Connecting

1. Attach the bracket at a convenient height on the power rod and tighten the bracket lock screw.

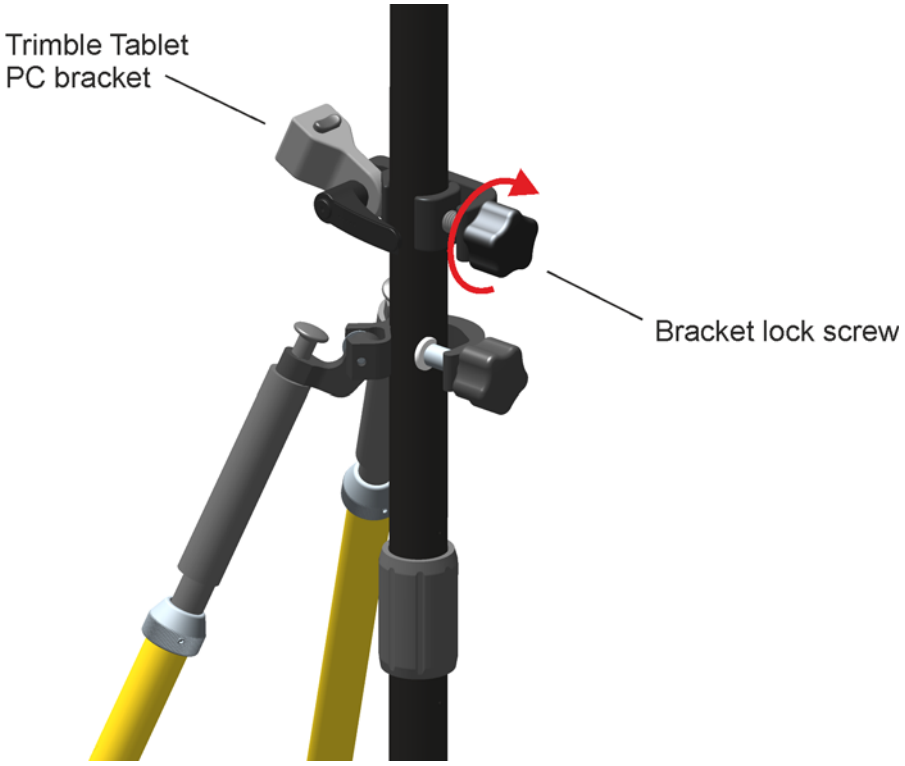


Figure 2.21 Mounting the tablet PC bracket to the power rod

2. Press the release button and attach the tablet PC to the bracket. Release the release button to lock the tablet PC in position.

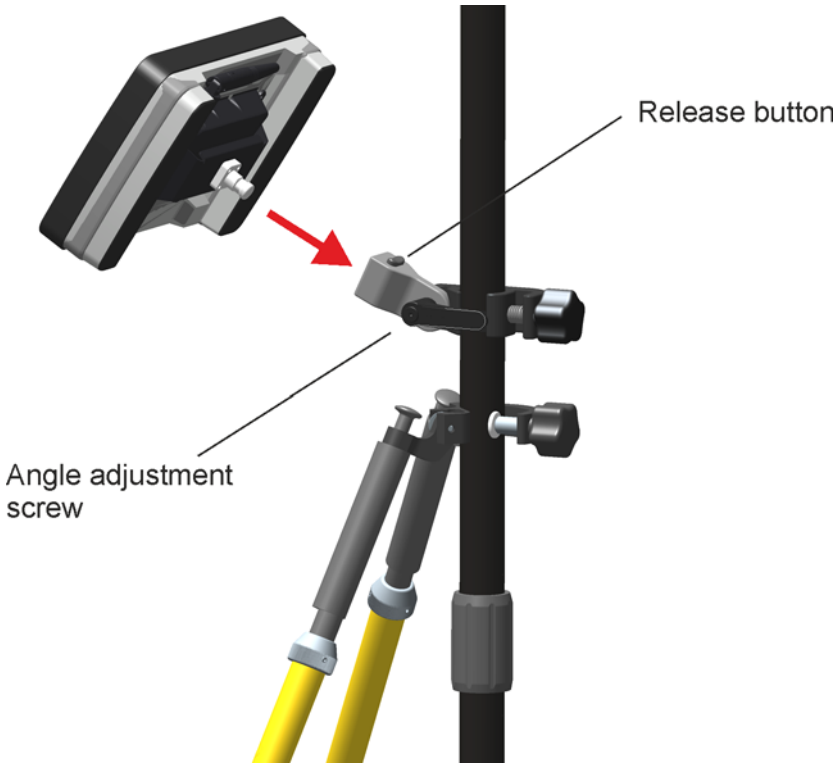


Figure 2.22 Mounting the tablet PC

3. Adjust the height of the bracket and the angle of the tablet PC to a convenient position. If needed adjust also the position of the bi-pod bracket.
4. Connect the tablet PC to the V10 camera head with a USB cable.

5. Put the radio antenna in an upright position.

Figure 2.23 Connecting the tablet PC

Connecting the Trimble TSC3 Controller

The Trimble TSC3 Controller is attached to the power rod with a bracket.

Connecting

1. Attach the bracket at a convenient height on the power rod and tighten the bracket to rod lock screw.

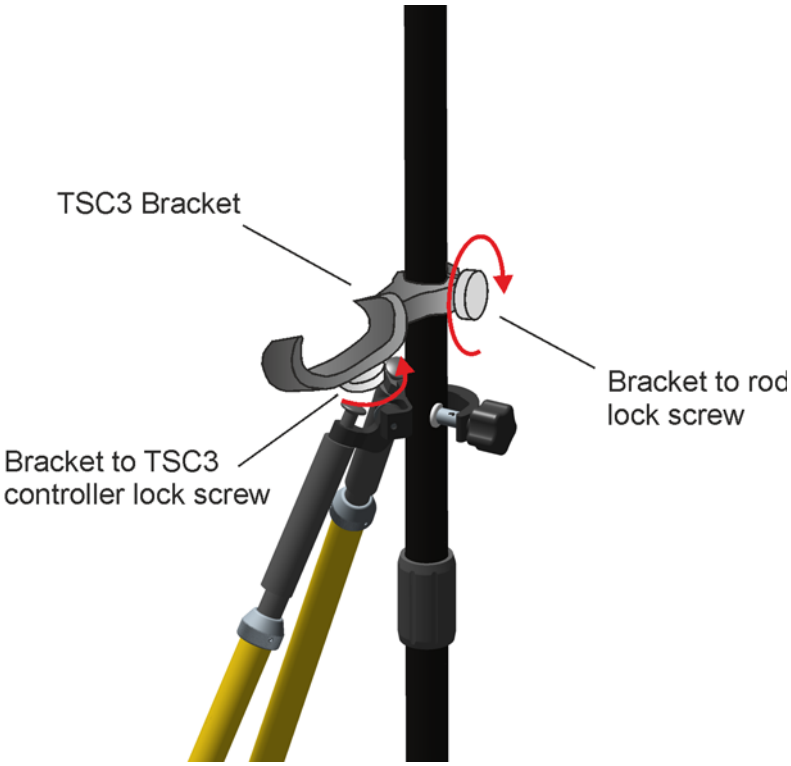


Figure 2.24 Mounting the TSC3 bracket to the rod

2. Attach the TSC3 Controller to the bracket and tighten the bracket to TSC3 controller lock screw, see Figure 2.24.
3. Adjust the height of the bracket and the angle of the TSC3 controller to a convenient position. If needed adjust also the position of the bi-pod bracket.
4. Connect the TSC3 controller to the V10 camera head with a USB cable.
5. Put the radio antenna in an upright position

⚠ **CAUTION –** When a TSC3 controller is attached to the power rod the imaging rover is not in balance. Take extra care so that the imaging rover does not tip over and fall to the ground.

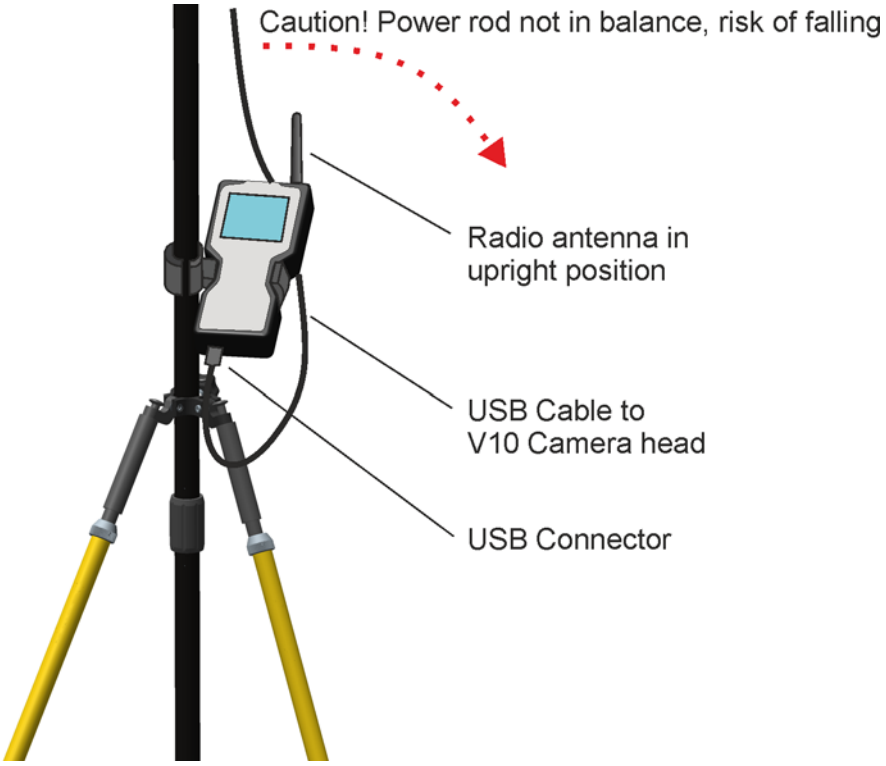


Figure 2.25 TSC3 Controller mounted on power rod

Connecting the batteries

The camera head is powered from the two batteries in the power rod. It is also possible to run the camera head on one battery alone, but two batteries gives longer operating time. The battery compartments are named A and B, where A is the upper and B the lower compartment.

The figure shows how to insert the battery in to battery compartment A of the power rod, see Figure 2.26:

1. Press on both sides of the battery compartment door too release the locks.
2. Open the battery compartment door.
3. Slide the battery into the compartment with the battery connector facing downwards and inwards towards the rod.
4. Close the battery compartment door.

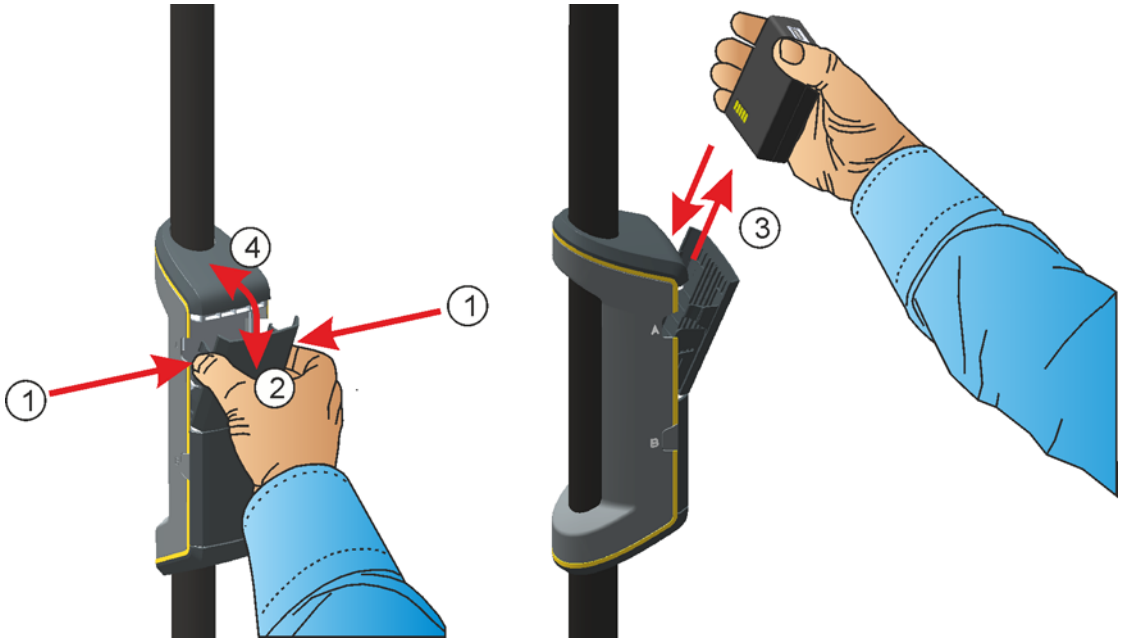


Figure 2.26 Inserting a battery in the power rod's battery compartment A.

V10 High Accuracy Kit Set up

An instrument setup with good measuring stability will increase the precision in the measurement result and allow you to utilize the measurement precision of the Trimble V10 Imaging Rover to its full extent.

Take into account that instruments require sufficient time to adjust to the ambient temperature. The following rule-of-thumb for a high precision measurement applies: Temperature difference in degree Celsius (°C) x 2 = duration in minutes required for the instrument to adjust to the new temperature.

Assembly

1. Put the tribrach on a tripod (or pillar) and secure it with the tripod screw.
2. Put the prism base on the tribrach.
3. Lock the prism base with the tribrach lock.
4. Put the Power mount on the prism base.
5. Screw the Power mount in place on the prism base 5⁄8" thread until stop.

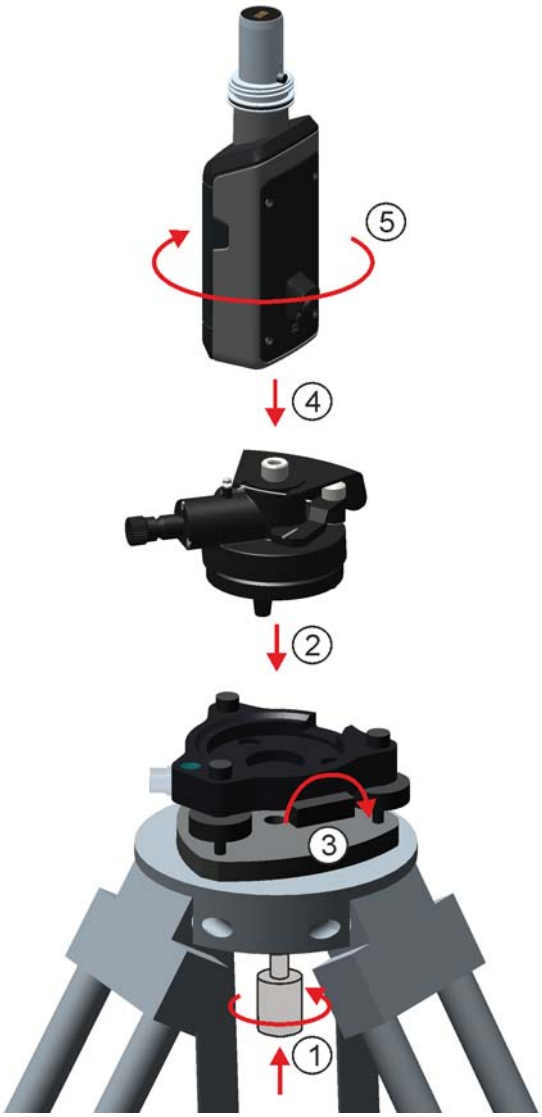


Figure 2.27 High Accuracy Kit assembly

Connecting the Camera Head to the Power Mount

In the joint between the camera head and the power mount is an electrical connector for communication and power supply. This connector must be lined up in order to function properly. For this reason the connection between the camera head and the power mount is keyed and can only fit together in one position.

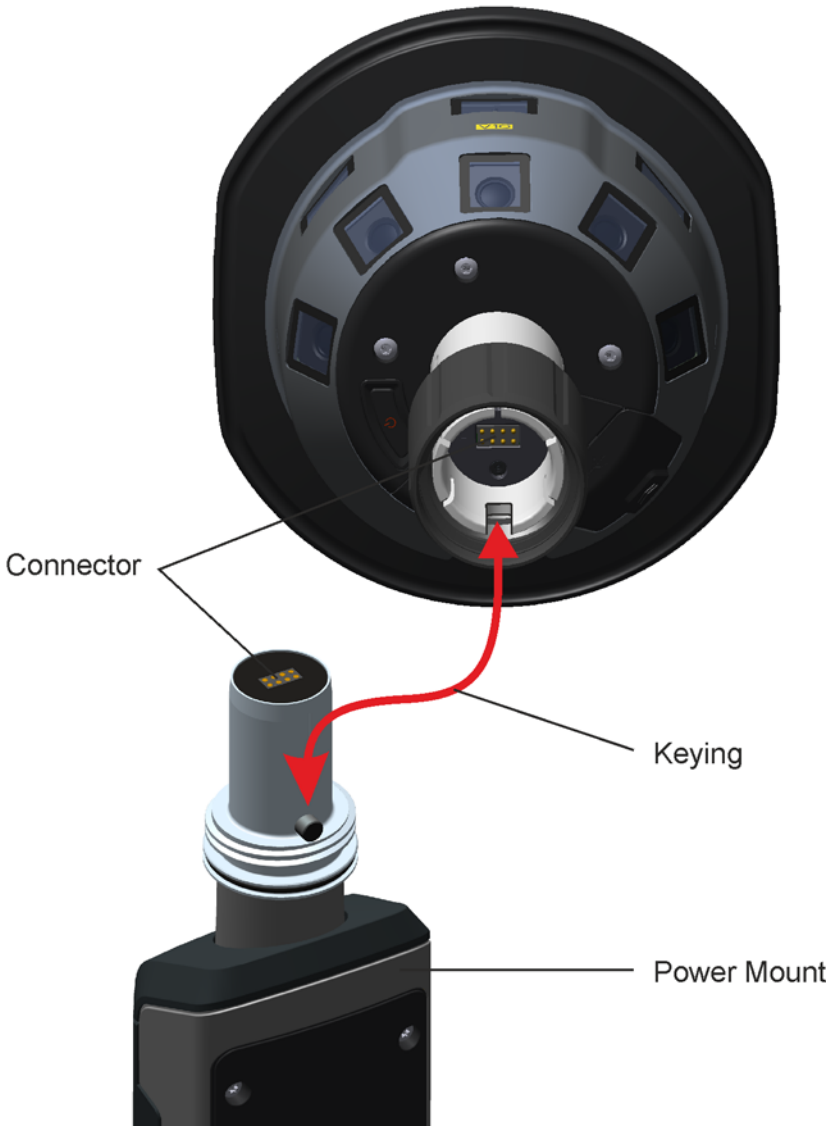


Figure 2.28 Connector and keying on the camera head and power mount

Connecting

To connect the camera head to the power mount:

1. Put the camera head on to the power mount
2. Turn the camera head until the keying is found
3. Push the camera head in position
4. Lock the camera head on to the power mount by screwing the locking collar until stop

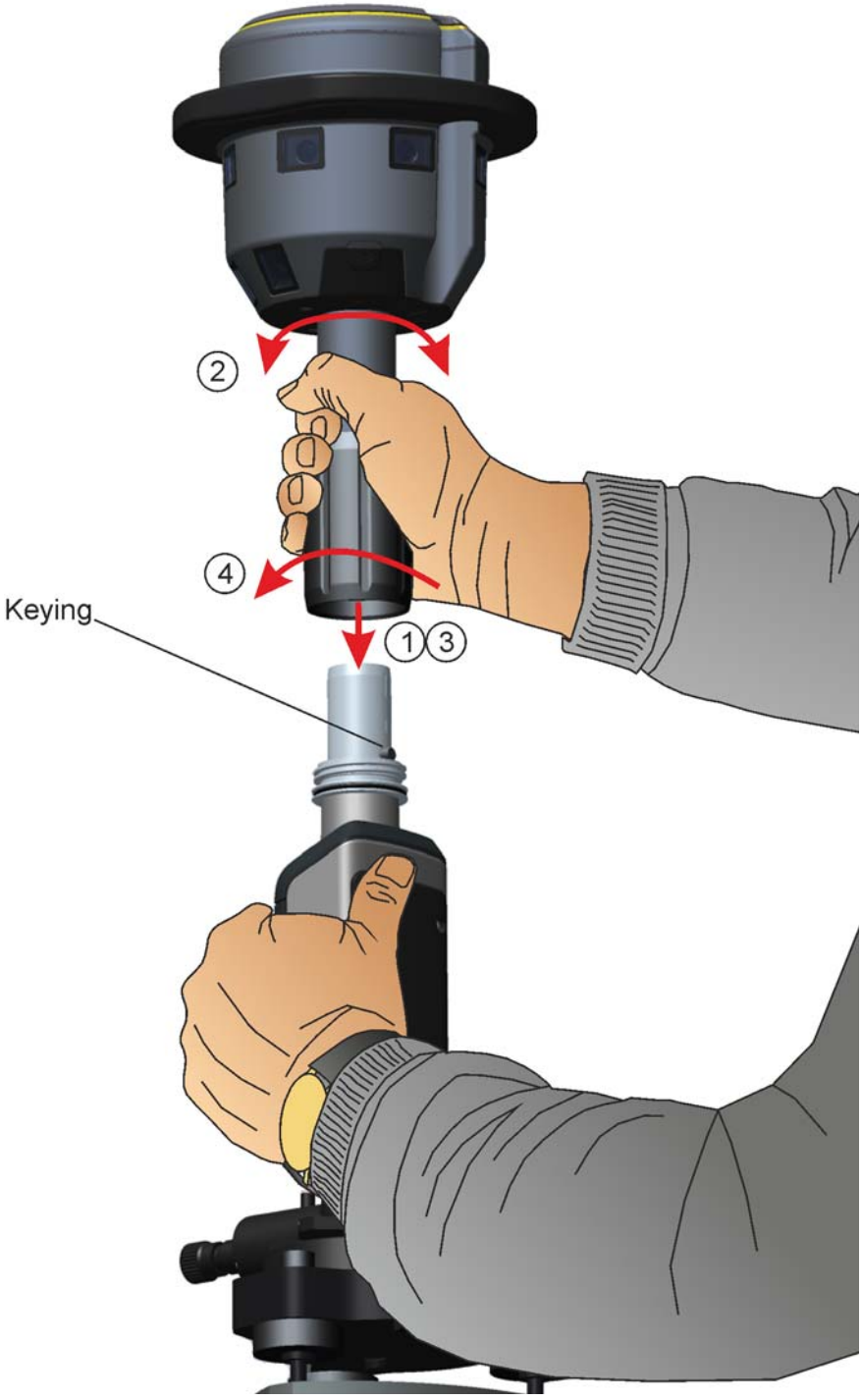


Figure 2.29 Connecting the camera head to the power mount

⚠ **CAUTION –** When rotating the camera head mounted on the high accuracy kit, do so by turning on the prism base. Rotating the camera head by turning on the power mount or camera head might cause the power mount and camera head to unscrew from the prism base 5/8" thread.

Figure 2.30 Rotate camera head by turning on the prism base

Connecting Power supply

The camera head is powered either from a battery in the power mount or from an external power supply via the Hirose connector for extended operating time.

The power mount contain a power source selection function that provide the Camera Head with a power feed from either the internal +7.2 Volt battery or the external power source with a nominal +12 Volt output. Seamless switching between the two sources provide uninterrupted Camera Head function when the connection to either source is established or lost when attached or removed.

The external power source is the primary selection if the following requirements are fulfilled:

- The external power source is not applied with reversed polarity.
- The external power source output voltage is stable and between 4.1 and 16 Volts.
- The external power source voltage exceed the battery potential

Connecting the battery

The figure shows how to insert the battery in to battery compartment of the power mount, see Figure 2.26:

1. Press on both sides of the battery compartment door too release the locks.
2. Open the battery compartment door.
3. Slide the battery into the compartment with the battery connector facing downwards and inwards.
4. Close the battery compartment door.

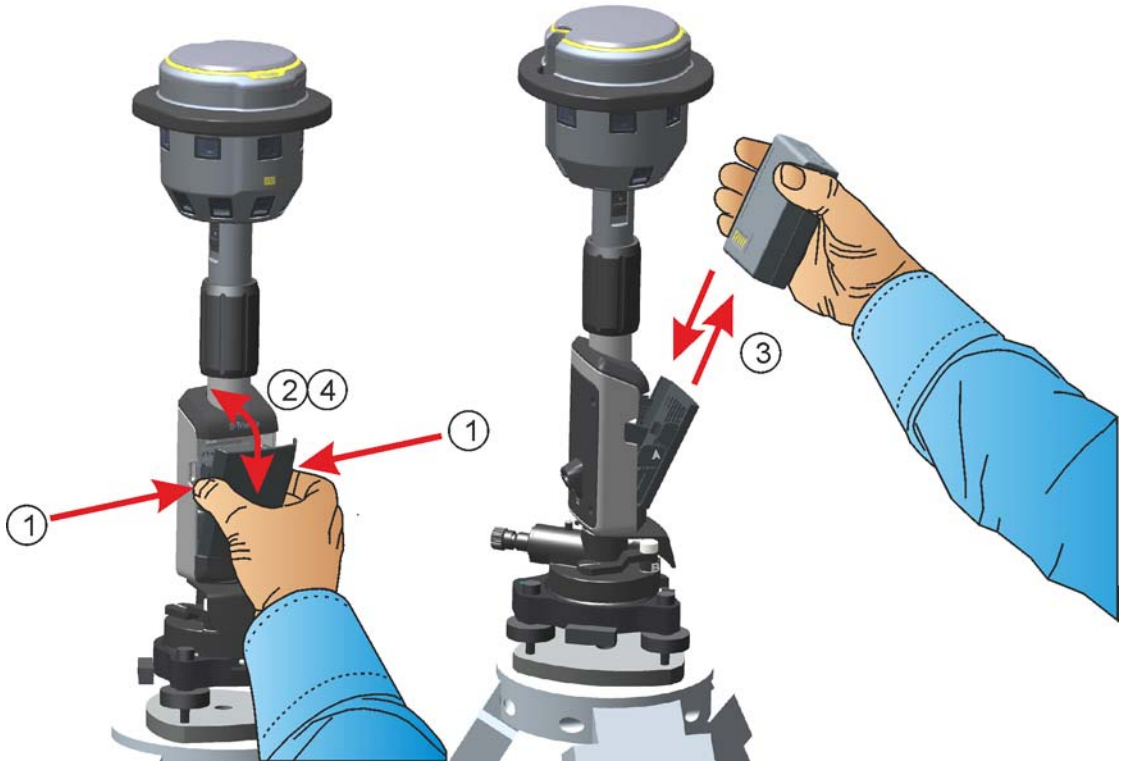


Figure 2.31 Inserting a battery in the power mount battery compartment.

Connecting External power supply

The figure shows how to connect external power supply to the power mount, see Figure 2.26:

Remove the dust cover on the Hirose connector and connect the cable to the Hirose connector.

Figure 2.32 Connecting external power supply.

Quick Release

The quick release connection on the camera head offers the possibility to attach optional equipment to the camera head.

The quick release is keyed so that the attached equipment only fits in one position, see Figure 2.33

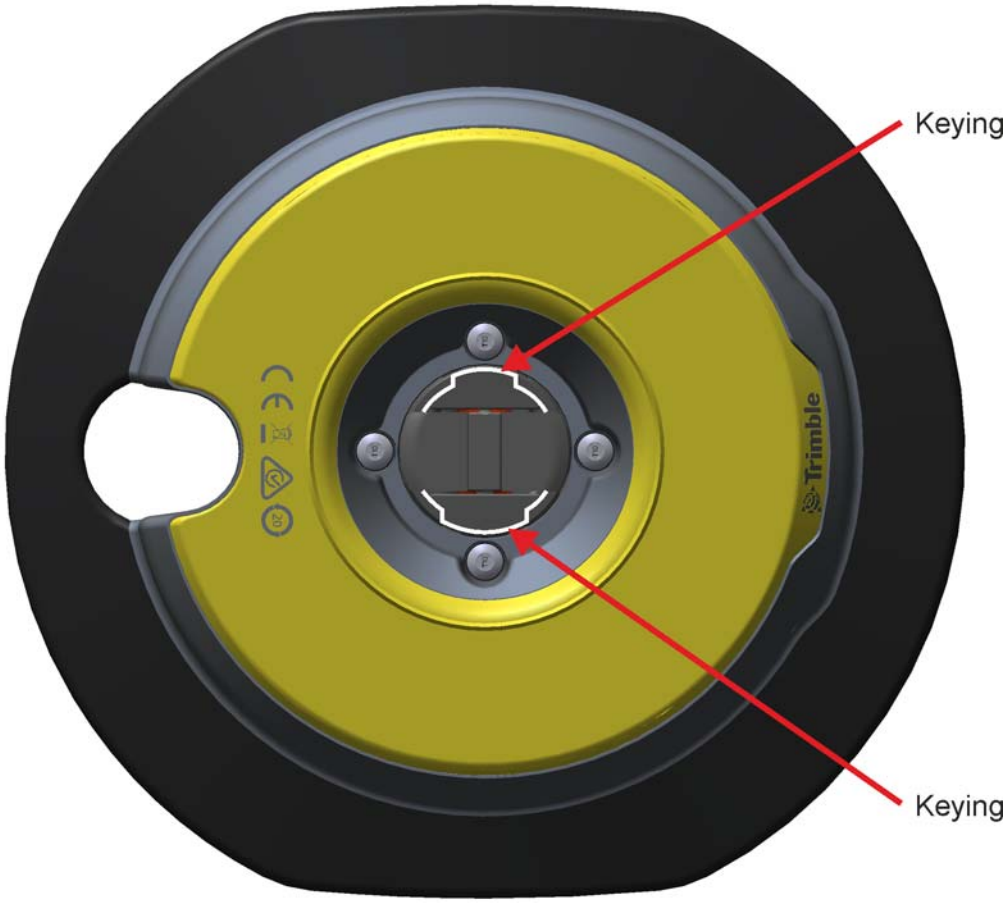


Figure 2.33 Quick release keying

Tip – Attach optional equipment to the camera head quick release before the camera head is connected to the power rod.

Quick Release Cover

The quick release cover protects the quick release when no additional equipment is attached.

To remove the quick release cover:

1. While holding the quick release cover. push the quick release button downward.
2. Remove the quick release cover.

To connect the quick release cover:

1. Push the quick release button downwards to make the connection easier.
2. While pushing the quick release button downwards, connect the quick release cover to the camera head. The quick release is keyed so the quick release cover may need to be turned to find the correct position.
3. Release the Quick release button.
4. Push the quick release cover firmly in place on the quick release. In order to get a water tight sealing between the quick release cover and the camera head, the yellow rubber sealing on top of the camera head needs to be compressed. Therefore a firm push is needed to get the quick release to lock in place.
5. Make sure that the quick release has locked correctly by checking that the quick release button is in top position, see Figure 2.35

Figure 2.34 Removing the quick release cover

Figure 2.35 Position of quick release button

Connecting a Trimble R10 GNSS Receiver

The Trimble R10 GNSS Receiver can be connected to the camera head with the quick release. The Trimble R10 GNSS Receiver is powered by it's own internal battery.

Note – *The Trimble R10 GNSS Receiver's internal battery needs to be inserted in the receiver before it is connected to the camera head.*

To connect the Trimble R10 GNSS Receiver to the Trimble V10 Imaging Rover:

1. On the Trimble R10 GNSS Receiver, remove the standard radio antenna and fit the radio antenna supplied in the Trimble V10 Camera Head Kit. This is only needed if a radio link is to be used.
2. Remove the quick release cover
3. Push the quick release button downwards to make the connection easier.
4. While pushing the quick release button downwards, connect the GNSS receiver to the camera head.
5. Release the Quick release button.
6. Push the GNSS receiver firmly down in place on the quick release. In order to get a water tight sealing between the GNSS receiver and camera head the yellow rubber sealing on top of the camera needs to be compressed. Therefore a firm push is needed to get the quick release to lock in place.
7. Make sure that the quick release has locked correctly by checking that the quick release button is in top position, see Figure 2.35

To disconnect the Trimble R10 GNSS Receiver from the Trimble V10 Imaging Rover:

1. While holding the GNSS receiver, push the quick release button downwards.
2. Remove the GNSS receiver from the camera head.
3. Fit the quick release cover to protect the quick release.

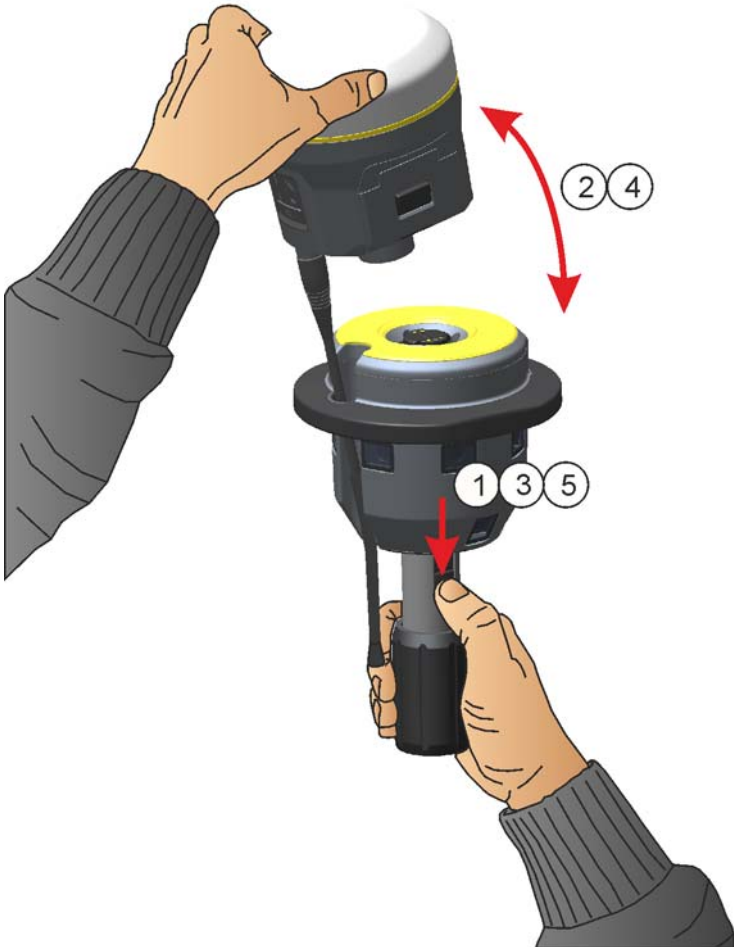


Figure 2.36 Connecting a Trimble R10 GNSS Receiver to the Trimble V10 Imaging Rover

Connecting a Trimble R4, R6 or R8 GNSS Receiver

To connect a Trimble R4, R6 or R8 GNSS receiver to the Trimble V10 camera head an adapter between the V10 quick release and the 5/8” thread of the GNSS receiver is needed. If the GNSS radio is used when connected to the V10 Camera head, a specially tuned antenna is needed. Please contact your local dealer for more information.

⚠ **CAUTION –** Due to the larger diameter of the Trimble R4, R6 and R8 GNSS receivers compared to the R10 GNSS receiver, the R4, R6 and R8 GNSS receivers are not protected by the V10 camera head bumper in case of a fall to the ground. Take extra care not to drop the R4, R6 and R8 GNSS receivers to the ground when mounted on the V10 camera head and power rod. The R4, R6 and R8 GNSS receivers may be damaged.

In order to get the position correct so that the radio antenna of the GNSS receiver fits into the slot for the radio antenna in the V10 the QR to 5/8” adapter needs to be adjusted.

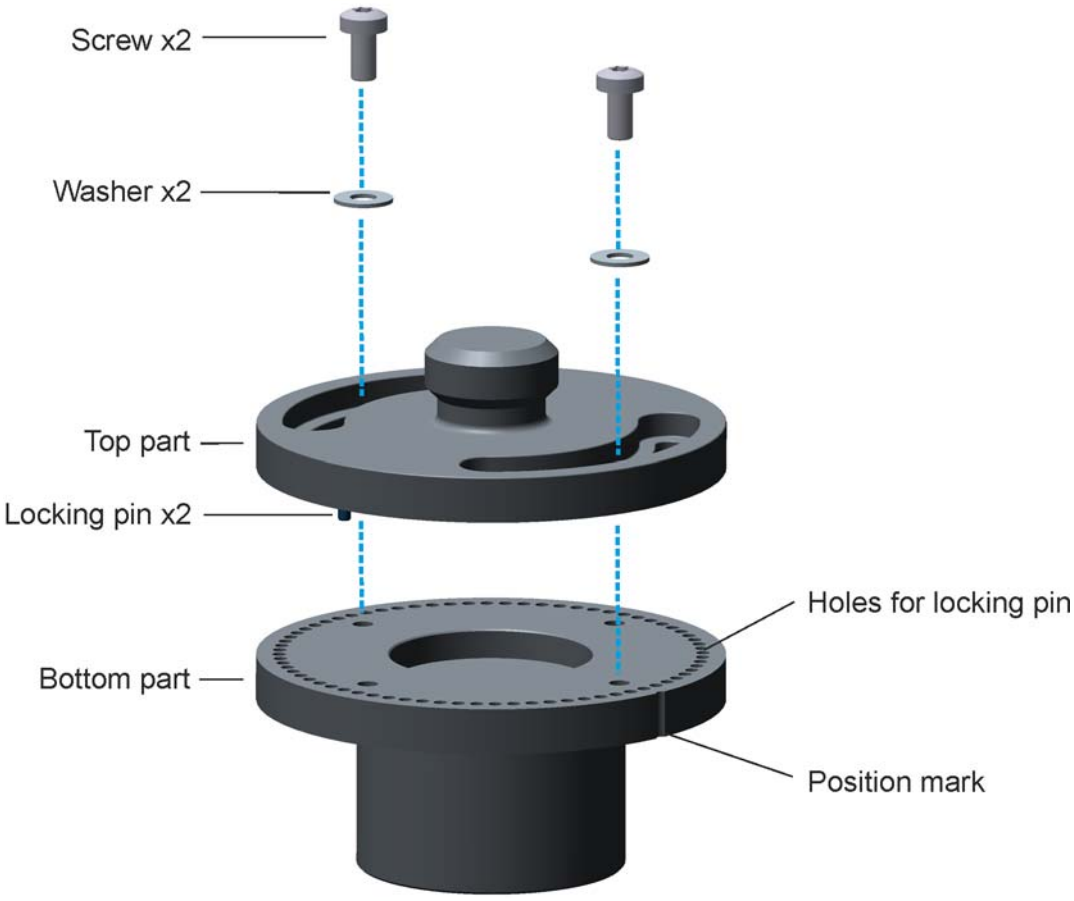


Figure 2.37 Description of the QR to 5/8” adapter kit

Adjustment of Adapter

1. Screw the top part of the adapter to the 5/8” thread of the GNSS receiver.

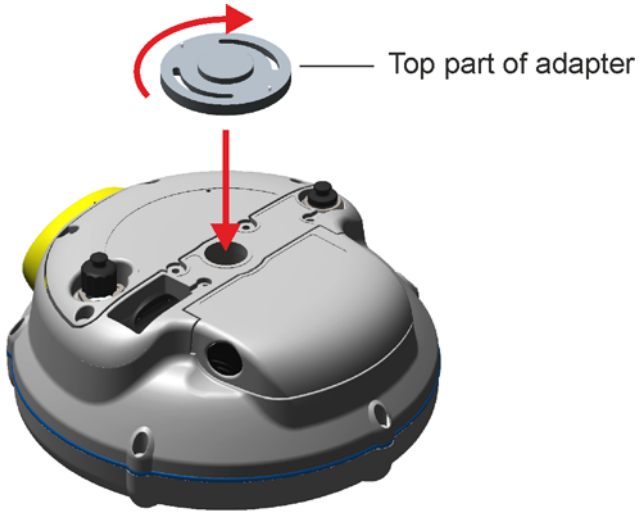


Figure 2.38 Mounting top part of adapter to the GNSS receiver

2. Mount the radio antenna on the GNSS receiver

Figure 2.39 Mounting radio antenna on the GNSS receiver

3. Attach the bottom part of the adapter to the V10 quick release.

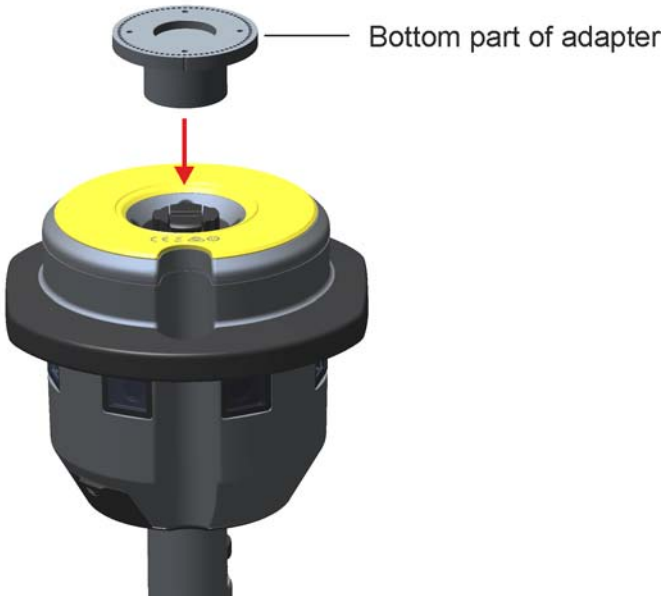


Figure 2.40 Mounting the bottom part of the adapter to the V10

4. Put the GNSS receiver on to the V10, so that the radio antenna of the GNSS receiver fits into the slot for radio antenna in the V10 housing.

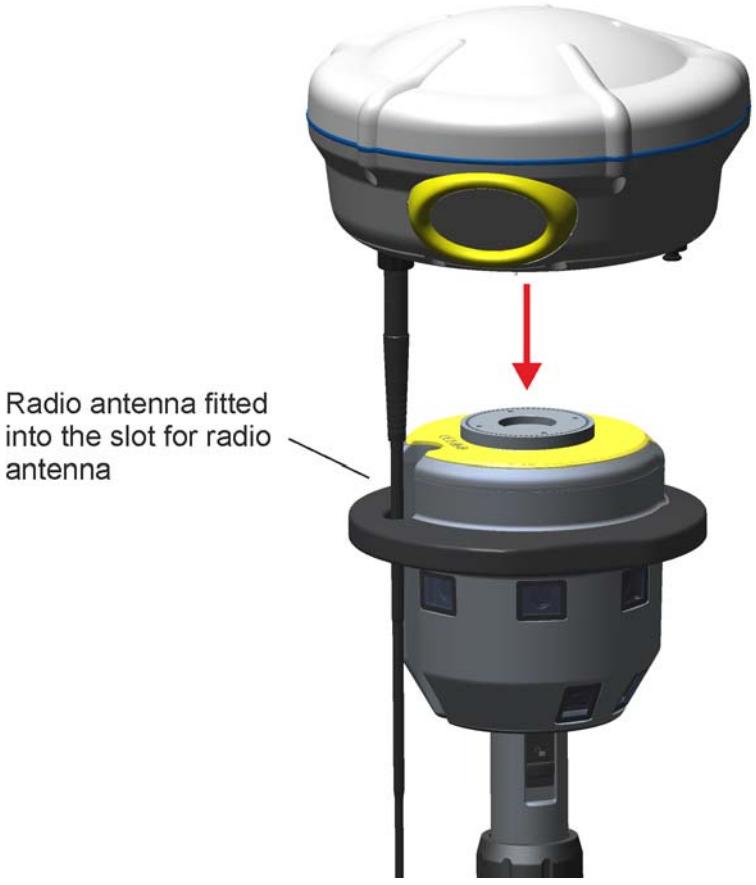


Figure 2.41 Mounting the GNSS receiver on to the V10

5. With a pencil, make a mark on the top part of the adapter that corresponds to the position mark on the bottom part of the adapter.

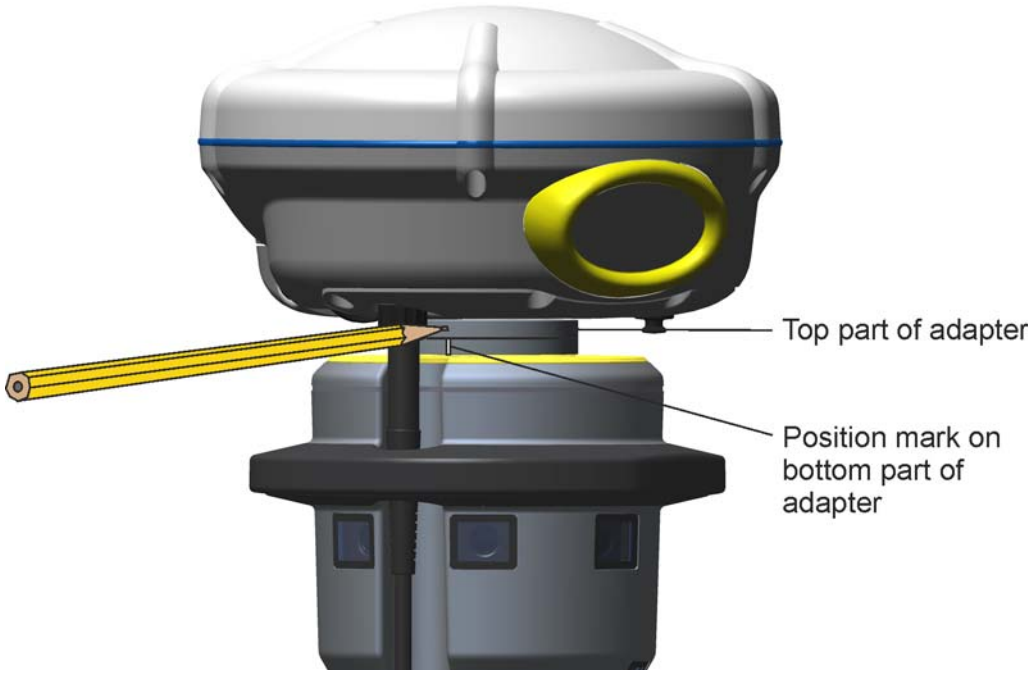


Figure 2.42 Making a reference mark on the top part of the adapter

6. Remove the GNSS receiver from the V10 Camera head.
7. Unscrew the top part of the adapter from the GNSS receiver. Take care so that the mark is not rubbed off when unscrewing the top part of the adapter.
8. Remove the bottom part of the adapter from the V10 Camera head quick release.
9. Put the top and bottom part of the adapter together so that the mark made with the pencil and the position mark line up.

10. Fix the top and bottom part of the adapter together with the two screws and washers using a Phillips screwdriver PH1.

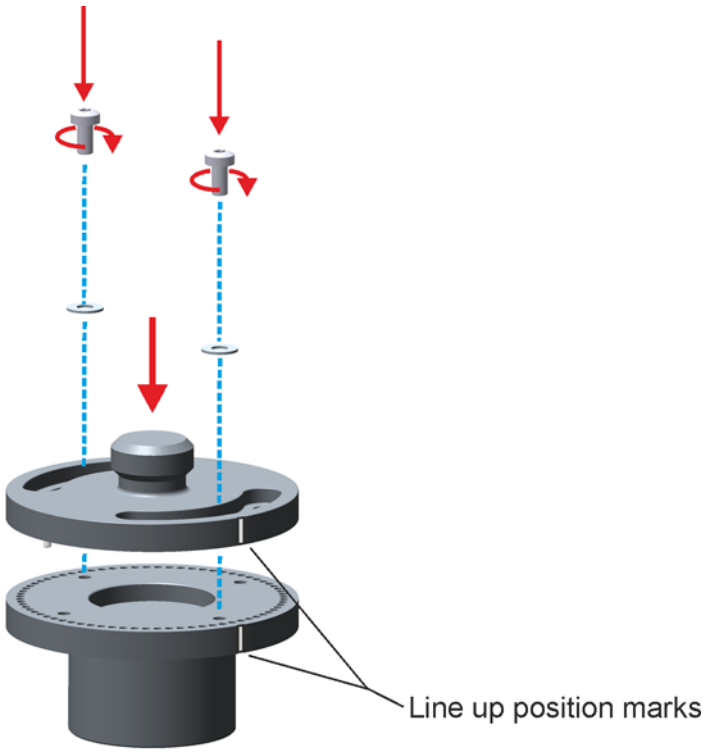


Figure 2.43 Putting the adapter parts together

11. Screw the complete QR to 5/8” adapter to the GNSS receiver.

Figure 2.44 Fitting the QR to 5/8” adapter to the GNSS receiver

12. The GNSS receiver can now be put onto the V10 Camera head using the quick release.

Figure 2.45 Trimble R4, R6 or R8 GNSS receiver on Trimble V10 Camera head

Connecting a 360° Prism

To be able to position a Trimble V10 Imaging Rover with a Trimble Total Station, a 360° Prism can be connected to the camera head with a quick release. Other Trimble targets are also supported, please contact your local dealer for more information.

To connect the 360° Prism to the Trimble V10 Imaging Rover:

1. Mount the adapter to the prism.
2. Remove the quick release cover
3. Push the quick release button downwards to make the connection easier.
4. Line up the keying on the 360° Prism to the camera head quick release and while pushing the quick release button downwards, connect the 360° Prism to the camera head. The 360° Prism may need to be turned to find the correct position.

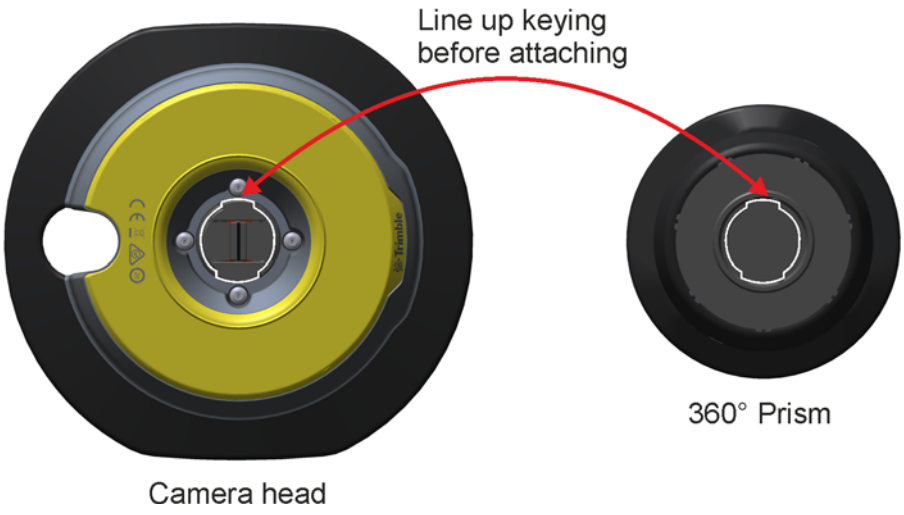


Figure 2.46 Line up keying before attaching the 360° Prism to the camera head quick release.

5. Release the Quick release button.
6. Push the 360° Prism firmly down in place on the quick release. In order to get a water tight sealing between the 360° Prism and camera head the yellow rubber sealing on top of the camera needs to be compressed. Therefore a firm push is needed to get the quick release to lock in place.
7. Make sure that the quick release has locked correctly by checking that the quick release button is in top position, see Figure 2.35

To disconnect the 360° Prism from the Trimble V10 Imaging Rover:

1. While holding the 360° Prism, push the quick release button downwards.
2. Remove the 360° Prism from the camera head.
3. Fit the quick release cover to protect the quick release.

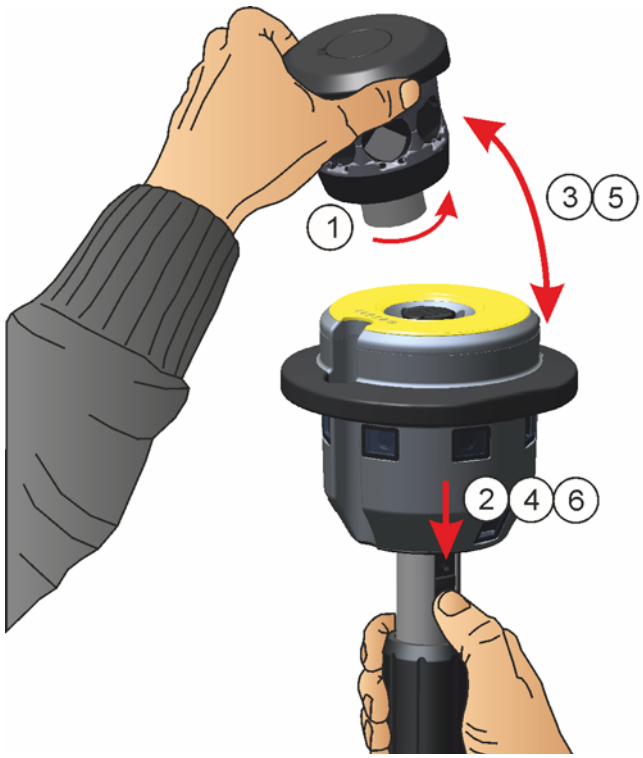


Figure 2.47 Connecting a 360° Prism to the Trimble V10 Imaging Rover

Connecting to a Controller/PC via Cable

The camera head can be connected to a Controller/PC with a cable from the Mini USB B connector.

1. Open the rubber cap.
2. Flip the rubber cap open.
3. Insert the 1.5 m cable delivered with the equipment to the mini USB connector.

Note – *Use only the 1.5m cable delivered with the equipment from Trimble.*

Figure 2.48 Connecting the 1.5m cable with mini USB connector

Instrument Heights on Power Rod

The power rod has a fixed height.

Instrument heights With R10 GNSS Receiver

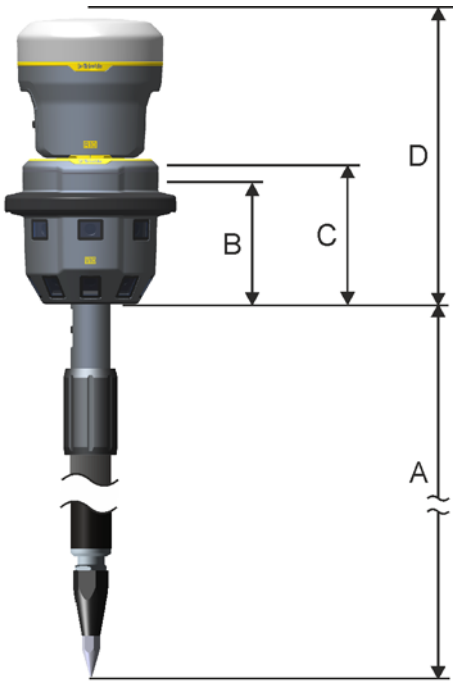


Figure 2.49 Instrument heights on power rod with R10 GNSS receiver

Measure	Description	Millimeter (mm)	Inch (in)
A	Tip of rod to bottom of V10	1952	76.850
B	Bottom of V10 to V10 quick release interface stop	97.56	3.8409
C	Bottom of V10 to V10 photogrammetry center	109.16	4.2976
D	Bottom of V10 to R10 nominal phase center	246.9	9.7204

Instrument heights With R4, R6, R8 GNSS Receiver

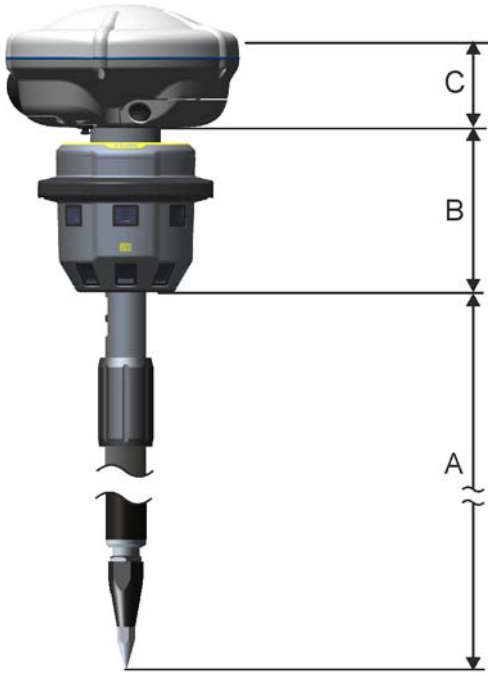


Figure 2.50 Instrument heights on power rod with R4, R6, R8 GNSS receiver

Measure	Description	Millimeter (mm)	Inch (in)
A	Tip of rod to bottom of V10	1952	76.850
B	Bottom of V10 to bottom of R4, R6, R8 Mounted on Adapter QR to 5⁄8”	128.96	5.0772
C	Bottom of R4, R6, R8 to R4, R6, R8 antenna phase center	64.9	2.5551

Instrument heights With Prism 360

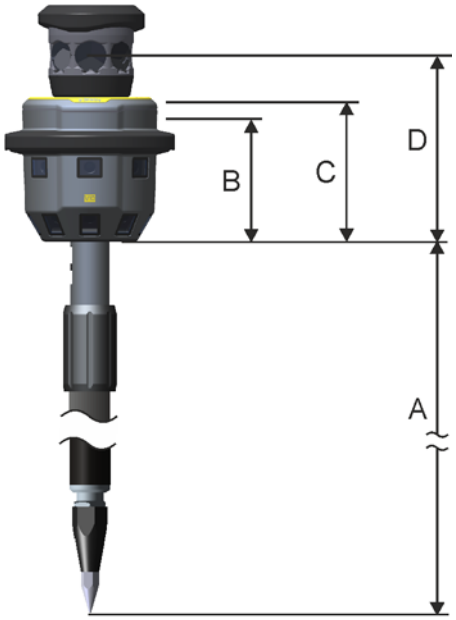


Figure 2.51 Instrument heights on power rod with Prism 360 1 inch p.c.2mm

Measure	Description	Millimeter (mm)	Inch (in)
A	Tip of rod to bottom of V10	1952	76.850
B	Bottom of V10 to V10 quick release interface stop	97.56	3.8409
C	Bottom of V10 to V10 photogrammetry center	109.16	4.2976
D	Bottom of V10 to Prism 360 center	151.46	5.9630

Instrument Height on Power Mount

Instrument height on tripod

The instrument height when using the High Accuracy Kit is measured from the point to the height measurement mark on the prism base.

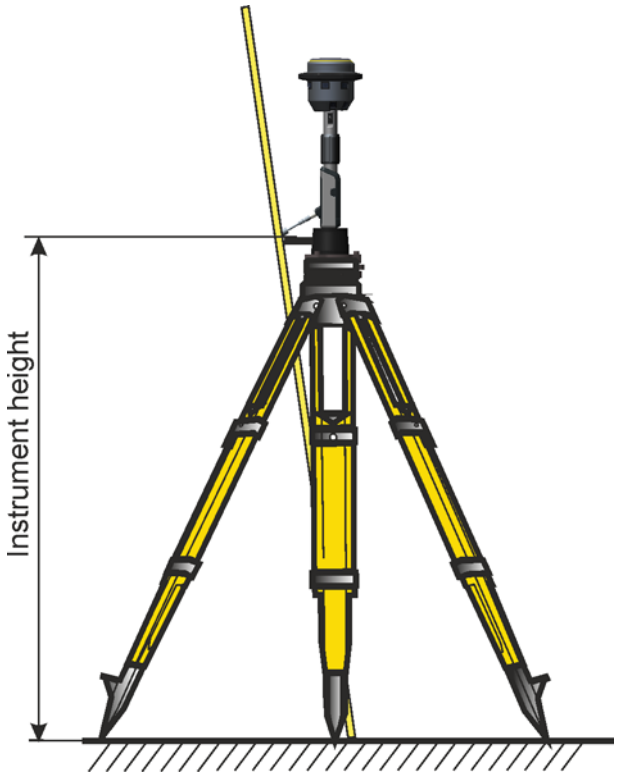


Figure 2.52 Instrument height with power mount

The instrument heights from the height measurement mark on the prism base to the bottom of the V10 Camera head and to the photogrammetry center is described in the figure and table below.

Instrument height on power mount

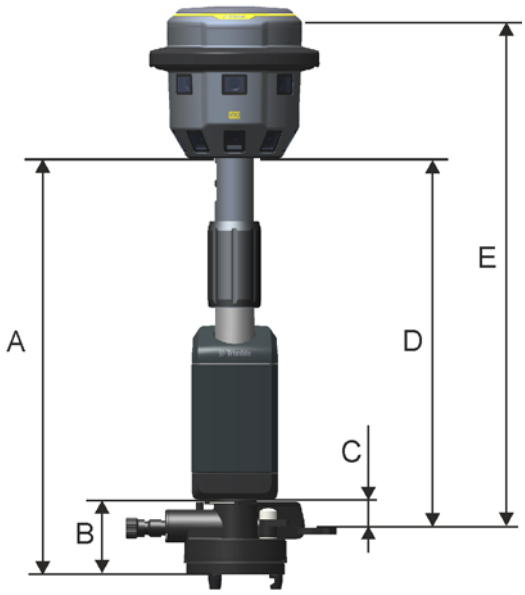


Figure 2.53 Instrument heights on power mount

Measure	Description	Millimeter (mm)	Inch (in)
A	Bottom of prism base interface to tribrach to bottom of V10	337.5	13.287
B	Bottom of prism base interface to tribrach to bottom of power mount	61	2.4016
C	Height measurement mark on prism base to bottom of power mount	22.69	0.8933
D	Height measurement mark on prism base to bottom of power mount	299.19	11.779
E	Height measurement mark on prism base to V10 photogrammetry center	408.35	16.077

CHAPTER 3

Maintenance

In this chapter:

- Care & Maintenance
- Transportation
- Firmware
- Camera Head Calibration Check
- Replacing the tip

Care & Maintenance

The Trimble V10 Imaging Rover is designed and tested to withstand field conditions, but like all precision instruments, it requires care and maintenance. Trimble recommends that you take the following steps to get the best results from your instrument:

- Do not subject the instrument to rough jolts or careless treatment.
- Keep the instrument protected, preferably in the instrument case when not in use.
- Keep the lenses clean.
- For precise measurements, make sure that the instrument has adapted to the surrounding temperature. Significant variations in instrument temperature can affect precision.

⚠ **CAUTION –** Do not remove the instrument cover from the instrument. A Trimble V10 Imaging Rover is designed to withstand normal electromagnetic disturbance from the environment but it contains circuits that are sensitive to static electricity. If an unauthorized person opens the instrument cover, the function of the instrument is not guaranteed and the warranty is invalidated.

⚠ **CAUTION –** In this user guide the V10 camera head is shown without cover for clarity. However, Trimble recommends to always keep the cover on to protect the optics from finger prints, dirt, scratches, etc. until it is to be used.

Figure 3.54 Trimble recommends to always keep the cover on to protect the optics from finger prints, dirt, scratches, etc. until it is to be used

Cleaning

Use caution when cleaning the instrument as sand or dust gathered on the lenses might cause fine scratches in the lens coating and /or on the lens itself when wiped off. Never use coarse or dirty cloth or hard paper. Use only the lens paper and cleaner that is delivered with the instrument.

1. Spray some of the cleaner on to a lens paper, see Figure 3.55

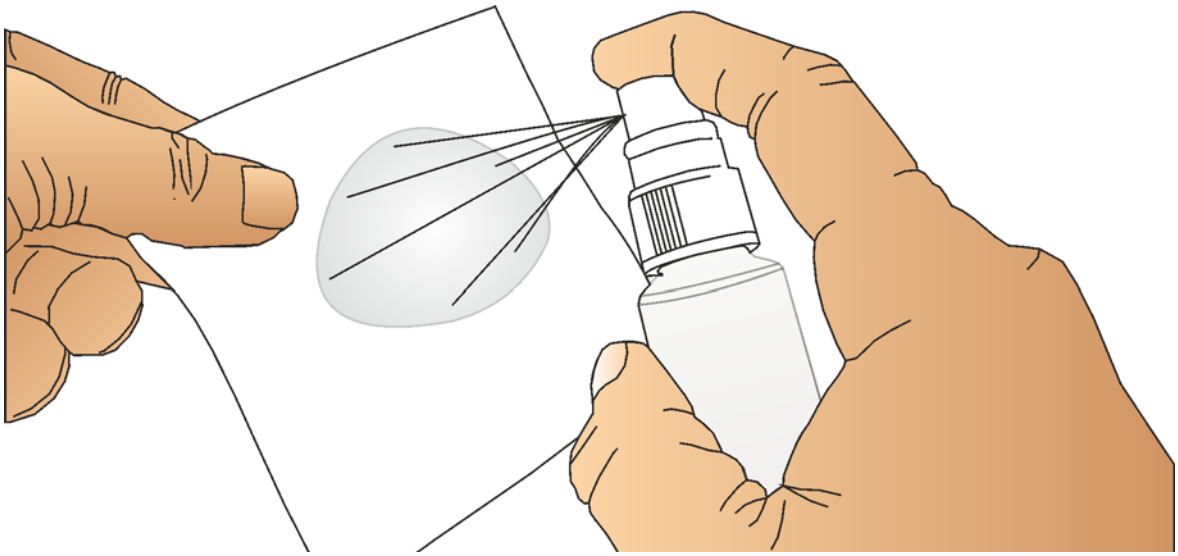


Figure 3.55 Applying cleaner to the lens paper

2. Wipe the window with the moistened lens paper.
3. While the window is still wet, wipe the window dry with a lens paper.

Figure 3.56 Cleaning the instrument windows

Getting Rid of Moisture

If the instrument has been used in damp weather, take the instrument indoors and remove the instrument from the instrument case. Leave the instrument to dry naturally. If condensation forms on the lenses, allow the moisture to evaporate naturally. Leave the carrying case open until all moisture has evaporated.

Transportation

Always transport the instrument in a locked instrument case. For longer trips, transport the instrument in the instrument case and inside the original shipping container.

Service

If your instrument is in need of service, please contact your nearest authorized Trimble dealer.

Please go to www.trimble.com to find your nearest Trimble authorized service provider.

Firmware

The firmware is constantly being developed and improved. Trimble recommends that the latest firmware is always used in the instrument.

Download Firmware

The latest firmware version can be downloaded from www.trimble.com.

Save the firmware file on the PC.

Update instrument Firmware

The instrument firmware is updated from a PC via a USB cable to the camera head.

1. Connect the Mini USB B connector to the camera head, see Connecting to a Controller/PC via Cable, page 51.
2. Connect the USB cable to the PC.
3. Start the instrument. The camera head needs to be attached to the power rod or power mount for power supply. Make sure that the batteries used are fully charged.
4. Double click on the firmware self extracting file and follow the instructions.

Camera Head Calibration Check

The cameras are calibrated in relation to each other and to the center point of the camera head. This calibration is made before delivery from the factory.

If an instrument needs to be calibrated it must be sent to a Trimble authorized service provider.

With a camera calibration check the operator can verify the status of the calibration.

Trimble recommends that a calibration check is performed routinely as follows:

- After any long uncontrolled transport of the instrument
- After any accidental knock or drop
- At any time when highest accuracy is required
- Routinely on a periodic basis (Monthly, weekly etc.)

Equipment

Apart from the equipment delivered in the Trimble V10 Camera Head Kit, the following equipment are needed to perform a calibration check

- Trimble V10 High Accuracy Kit
  - Trimble V10 Power Mount
  - Prism base
  - Tribrach
  - Calibration target (x2)
- Tripod
- Trimble Tablet Rugged PC or Trimble TSC3 Controller
- Trimble Access
- TBC Trimble Business Center software

Calibration Check Setup

To perform a calibration check the camera head must be set up together with two calibration targets, one on the wall and one on the floor.

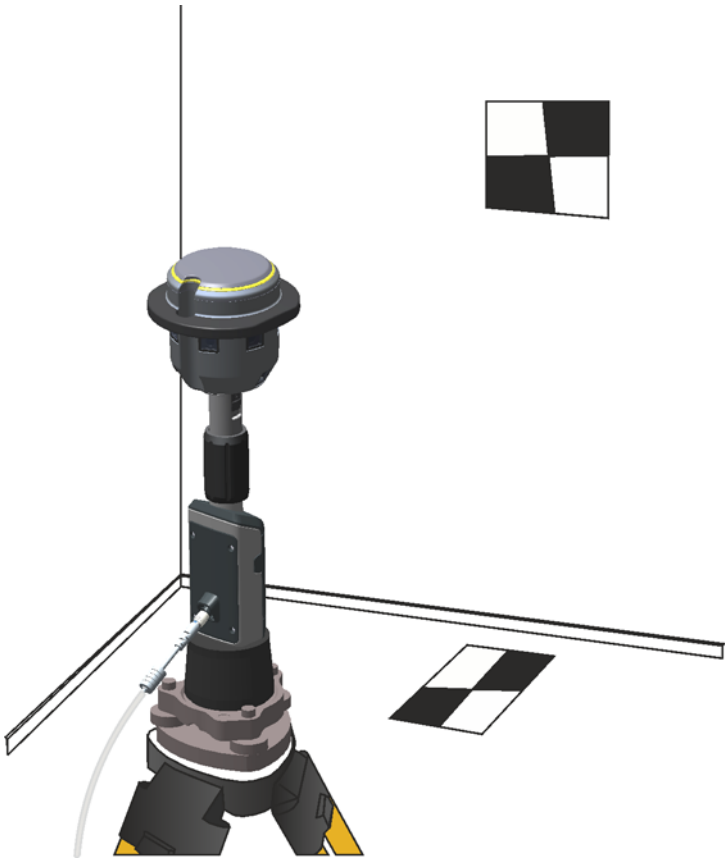


Figure 3.57 Camera head calibration check set up

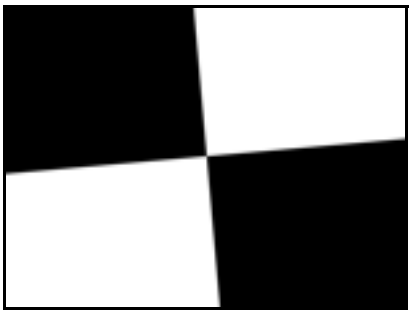


Figure 3.58 Calibration target

Illumination

Each camera in the camera head determines the exposure automatically. The exposure is determined from an average of the light conditions in the entire image area. If any brighter or darker areas are within the image area the determined exposure could cause the calibration target to be over or under exposed. An over or under exposed calibration target might cause the calibration check to fail.

The size of the image area is about 3.80m wide and 1.90m high on the 2m calibration check distance. The illumination conditions within these camera image areas on both sides of the target, see Figure 3.59, should be evenly illuminated.

Make a temporary set up of the calibration check targets. Capture a panorama and evaluate the exposure of the calibration target. See Figure 3.60 and Figure 3.61 for some examples of target illuminations.

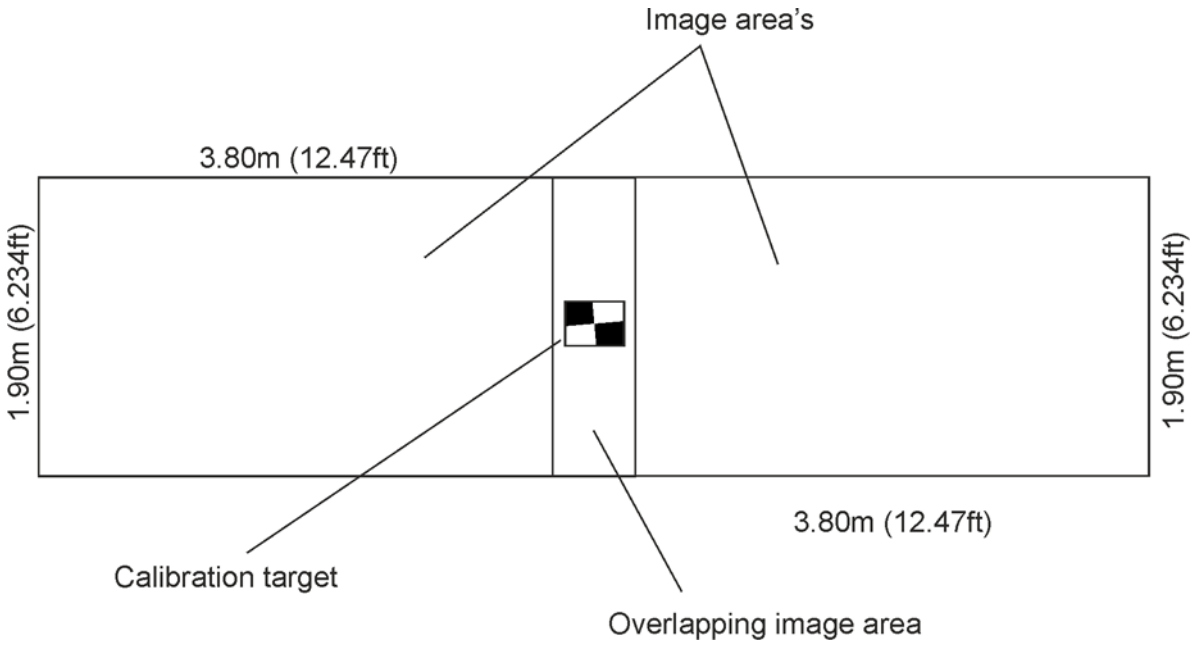


Figure 3.59 The size of the image area is about 3.80m wide and 1.90m high on the 2m calibration check distance

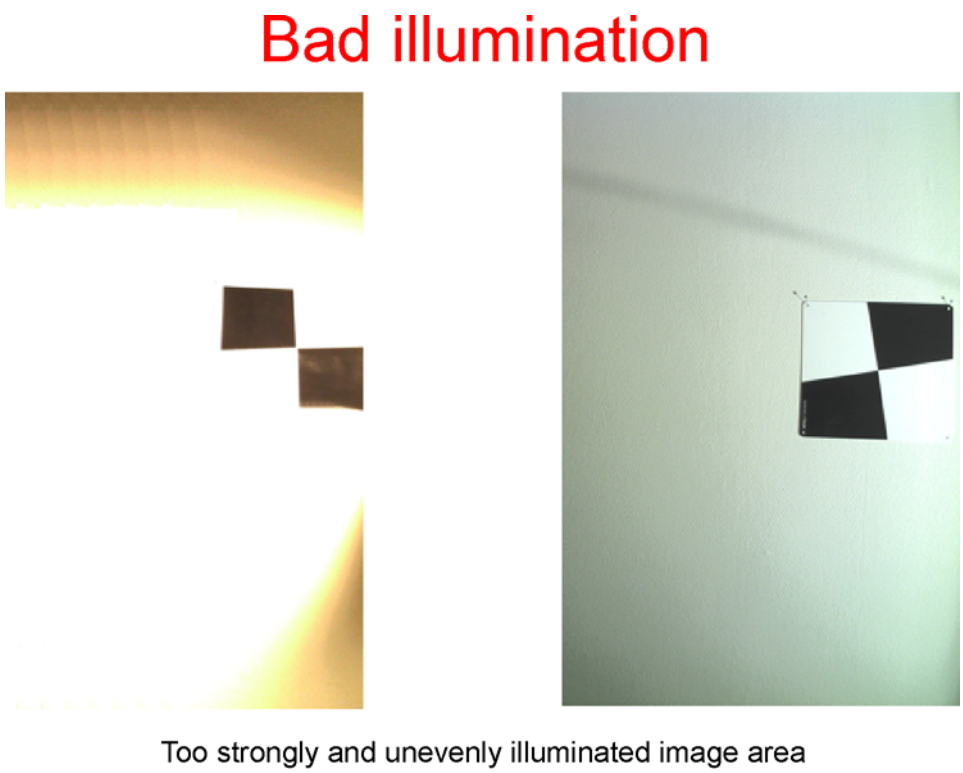


Figure 3.60 Examples of bad target illuminations

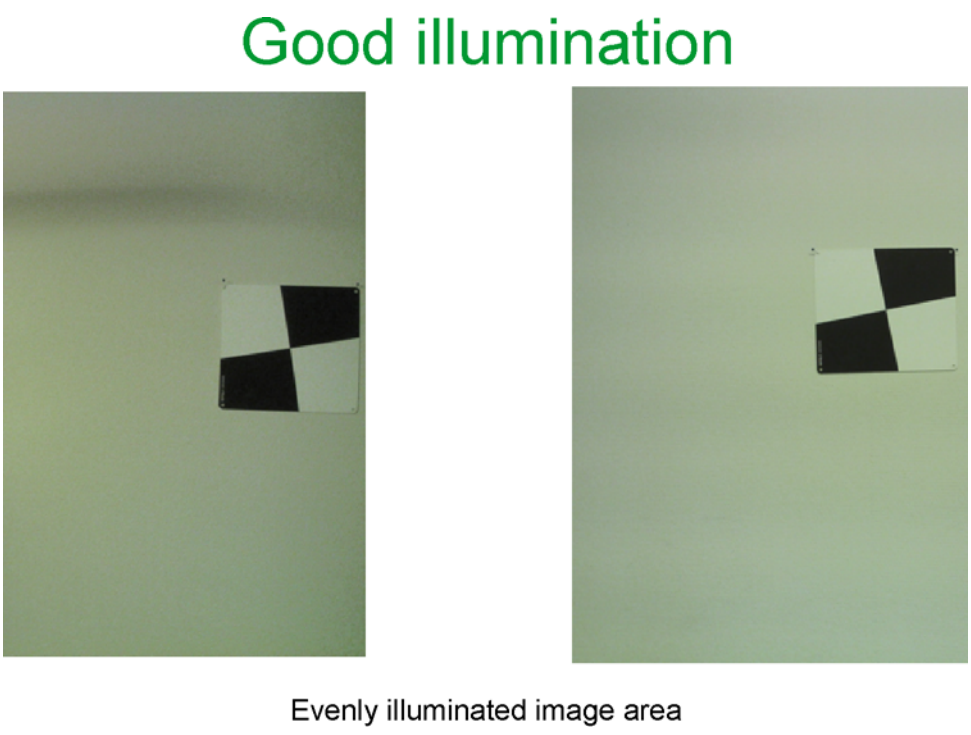


Figure 3.61 Examples of good target illumination

Wall Target Set Up

The wall target is placed on a vertical wall at height of 1.45m +/- 0.05m (4.75ft +/-2in) from the floor to the center of the target. Rotate the target as landscape.

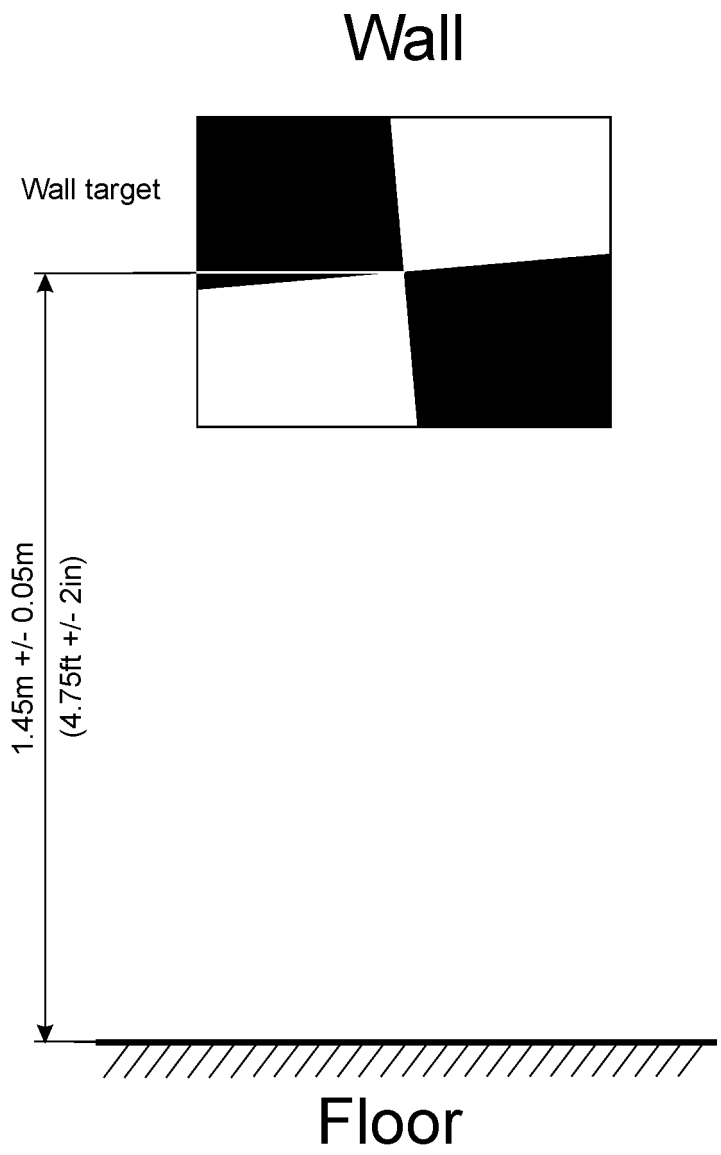


Figure 3.62 Wall target set up

Floor Target Set Up

The floor target is placed on the floor below the vertical wall target at 0.4m +/- 0.05m (1.3ft +/- 2in) from the wall to the center of the target. Rotate the target as portrait.

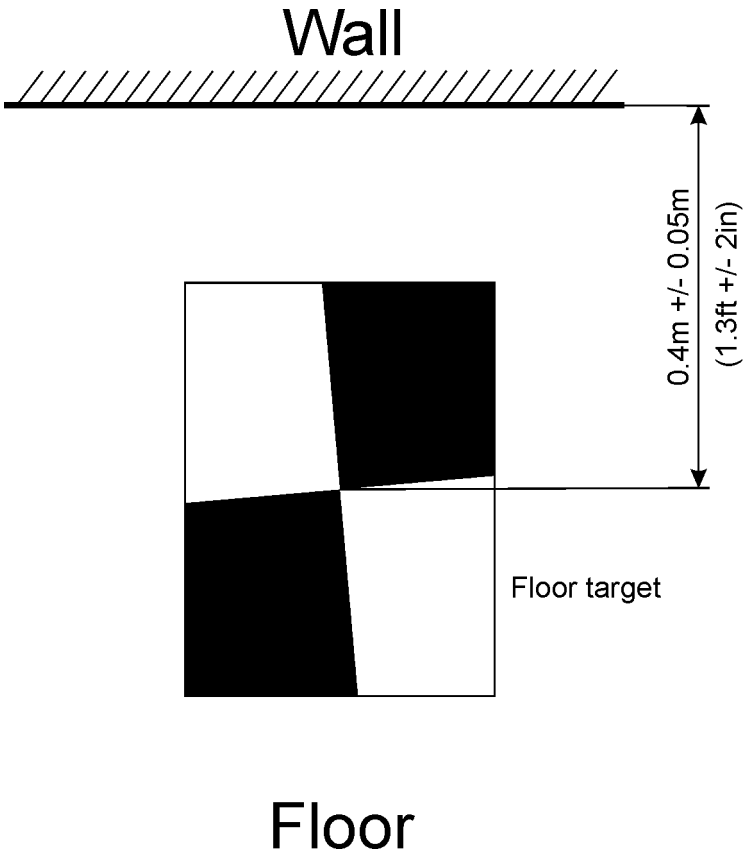


Figure 3.63 Floor target set up

Instrument Set Up

Set up the camera head on a stable tribrach 2m +/- 0.3m (6.5ft +/- 1ft) from the wall target to the center point of the camera head and with an instrument height of 1.05m +/- 0.05m (4.75ft +/-2in), measured from the height measurement lever arm on the prism base to the point straight underneath the instrument.

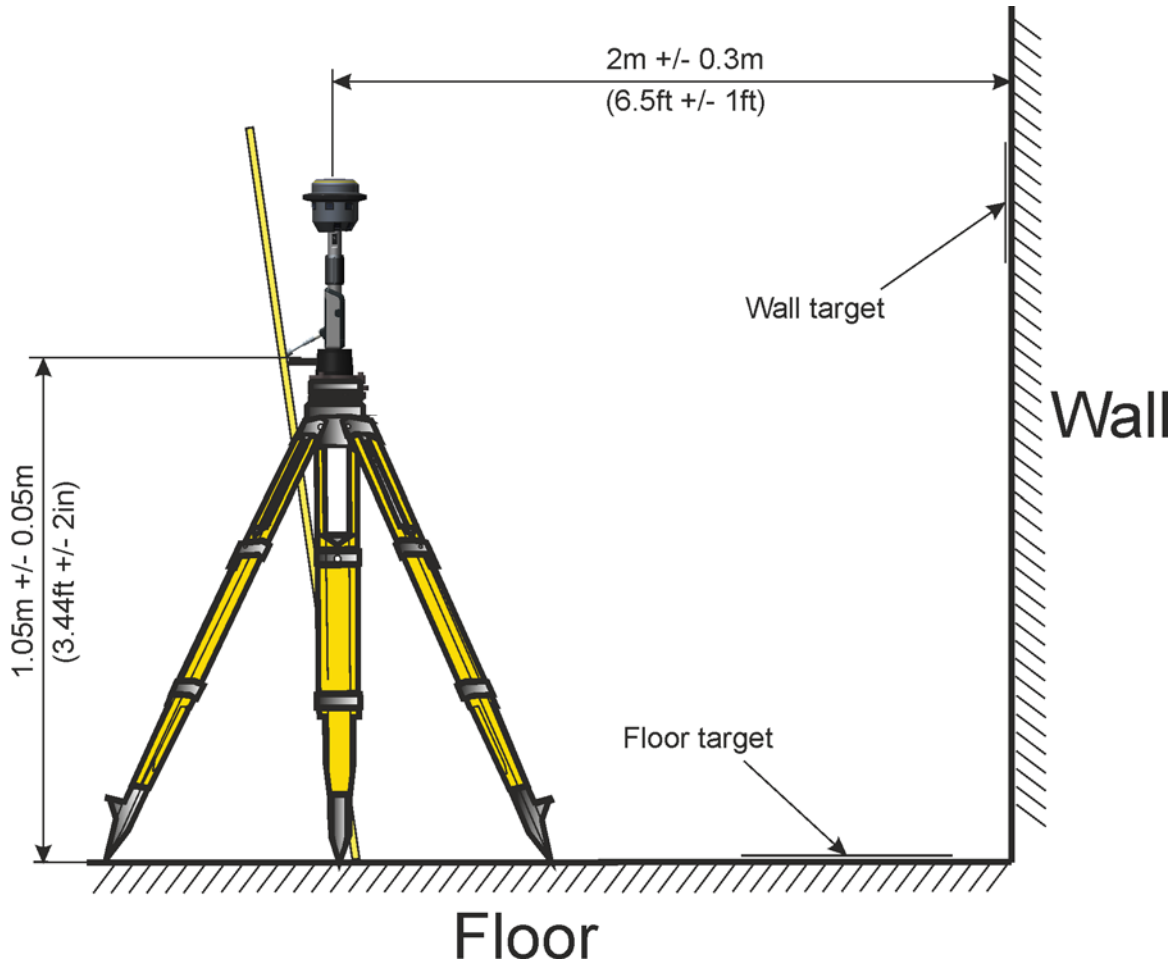


Figure 3.64 Camera head set up

Calibration Check Performance

During the calibration check each camera is aimed at the calibration target. When aimed towards the target a picture is taken with this camera of the target and the camera positioned next to it. Please refer to the Trimble Access documentation for more information.

Note – *When rotating the camera head during the calibration check, do so by turning on the prism base, not on the power mount or camera head as this might cause the power mount to unscrew from the prism base.*

Calibration Check validation

The TBC software is used to process the data collected from the calibration check to validate if the camera head is within the calibration tolerance. Please refer to the TBC documentation for more information.

If the presented result is within tolerance the camera head can continue to be used with results within the specified tolerances. If the calibration check fails the camera head needs to be sent to an authorized Trimble dealer for calibration.

Replacing the tip

The tip of the power rod is made of durable titanium. However, with frequent usage the tip will eventually wear down. In order to keep the instrument height within tolerances the tip needs to be replaced.

The tip can be replaced by the operator with two 1 inch hexagon spanners and a new tip that can be ordered from your authorized Trimble dealer.

1. Put spanner one on the hexagon head marked 1 in figure Replacing the power rod tip, page 69 and hold.
2. Put spanner two on the hexagon head marked 2 in figure Replacing the power rod tip, page 69 and loosen the tip.
3. Unscrew the tip and replace it with a new one.
4. Tighten the new tip with the spanners.

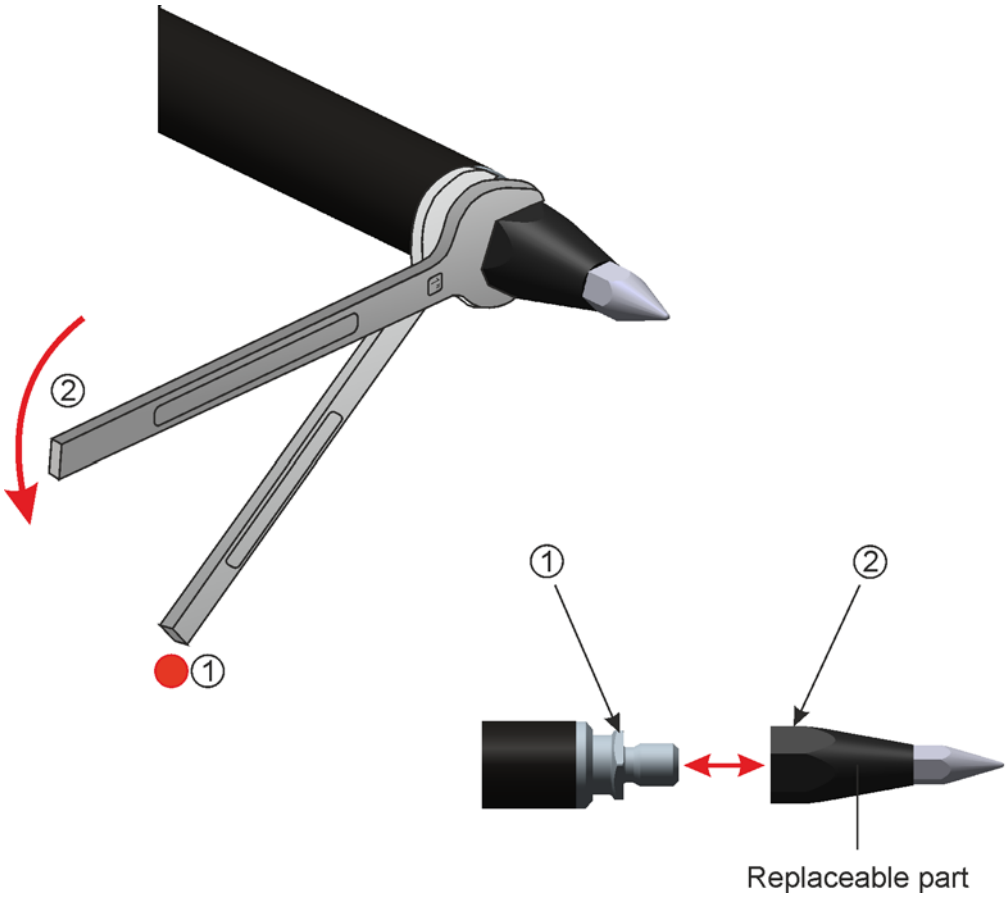


Figure 3.65 Replacing the power rod tip

CHAPTER 4

Basic Measurement Knowledge

In this chapter:

- Field of View
- Distance to accuracy
- Base length
- Intersection Angle
- Optimum Angle Intersection Areas
- Position of the Instrument
- Tie Points
- HDR Pictures

Field of View

The field of view will describe how much of the surrounding objects the cameras will see. This will determine how much information is in the pictures and how many panoramas must be captured to get all information needed to finish the job.

Horizontal Field of View

The horizontal field of view is 360° for a full panorama from the upper row of cameras. However the lower row of cameras are tilted downwards for a close range field of view and covers 200°. A full row of cameras in the lower row would still not give a full panorama since the operator would obstruct the field of view. To get a full panorama in the close range field two panoramas needs to be made by rotating the rod 180° between the panoramas.

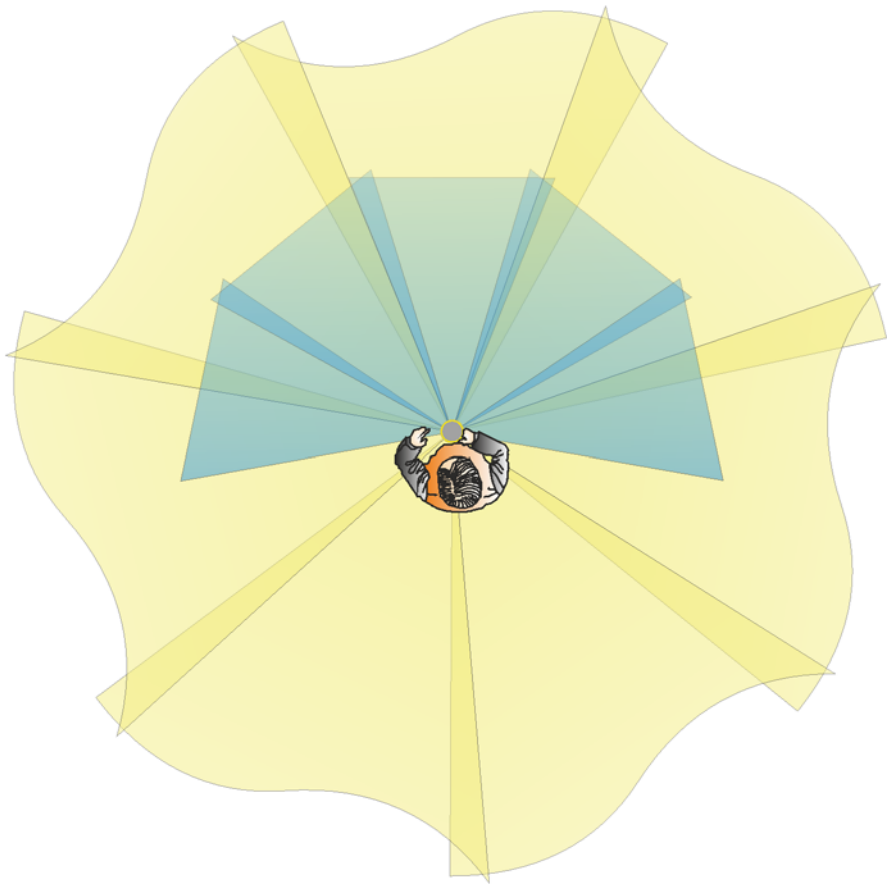


Figure 4.1 Horizontal field of view. Upper camera row yellow and lower camera row blue.

Upper row

The seven cameras in the upper row covers a 360° degree panorama from the instrument to infinity. With a 57.5° horizontal field of view for each camera.

Lower row

The five cameras in the lower row covers 200°. With a 43° horizontal field of view for each camera.

Vertical Field of View

The vertical field of view is dependent of the distance to the target. By increasing the distance to the target the field of view will be greater, but increasing the distance to the target will reduce the accuracy.

Upper row

The seven cameras in the upper row covers an object that is 10m (33ft) in height from a distance of 20 m (66ft). With a 43° vertical field of view. The cameras in this row are tilted 2° downwards.

Lower row

The five cameras in the lower row covers 200° from 0.6m (2ft) to 6.6m (21.6ft). With a 57.5° vertical field of view. The cameras in this row are tilted 45° downwards.

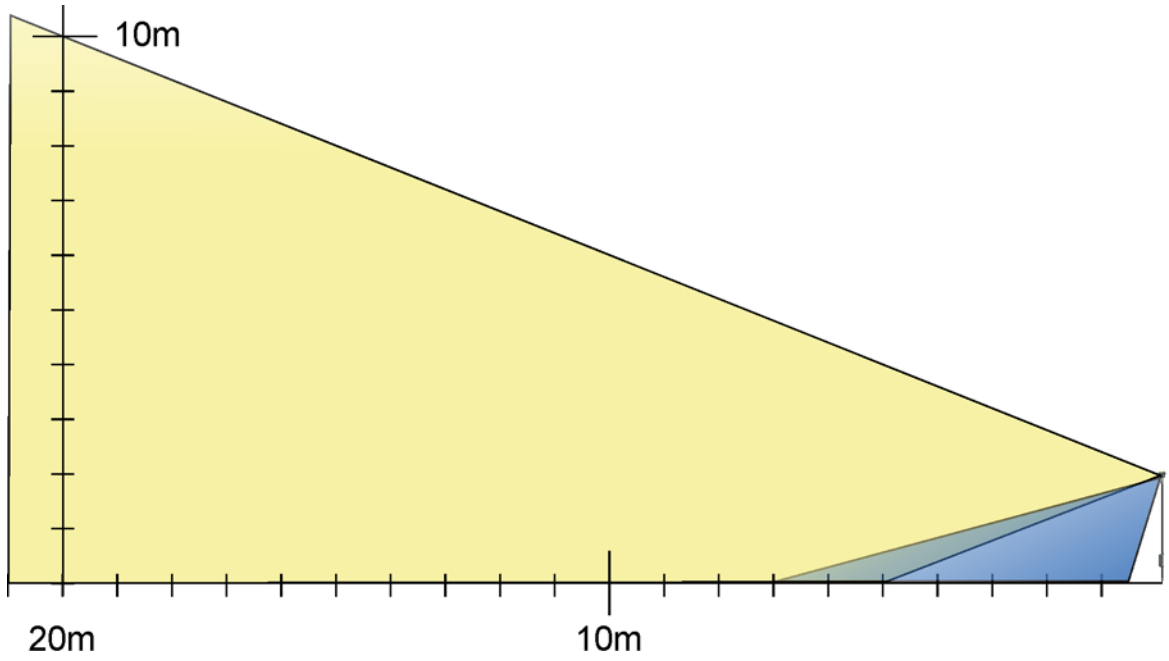


Figure 4.2 Vertical field of view. Upper camera row yellow and lower camera row blue.

Distance to accuracy

The obtainable measurement accuracy is dependent on the distance from the instrument to the object.

Scale Factor

This depends of the proportion between the distance (D) to the object and the focal length (f) of the camera. The cameras in the camera head have a fixed focal length, so the only thing that can change the proportion is the distance to the object.

In Figure 4.3 figure A and B describe the proportion between the size of one pixel on the camera chip and the corresponding size of one pixel on the object (X). In figure B the distance to the object is longer and therefore the size (X) becomes larger.

The obtainable accuracy from the camera image is higher in figure A than in figure B, but the field of view is larger in figure B than in figure A.

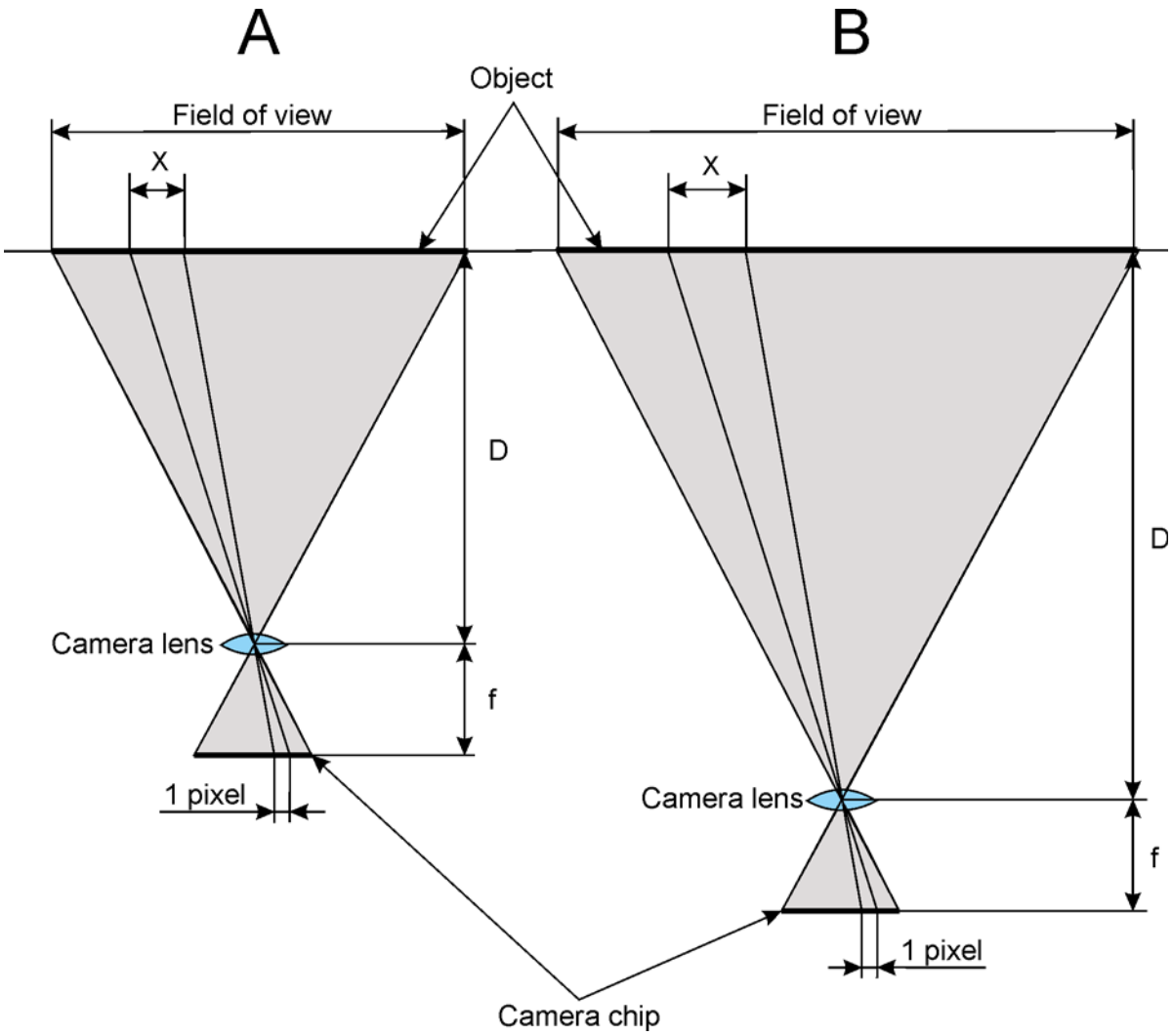


Figure 4.3 Obtainable accuracy in proportion to the distance in an image

The corresponding size of one pixel on the object (X) in proportion to the distance to the object is described in the table below.

Distance to object	Corresponding size of one pixel on the object (X)
1m	0.4mm
10m	4mm
100m	40mm

To obtain high photogrammetry measurement accuracy from the images taken by the instrument, the distance between the instrument and the object must be kept short. Since this will give a reduced field of view the number of panoramas needs to be increased to cover the complete object.

If a lower photogrammetry measurement accuracy is accepted less panoramas needs to be made to cover the object since the field of view is increased.

Different Accuracy in an Image

The obtainable photogrammetry measurement accuracy can be different in the same image if the distance to the object is not the same in the whole image.

Angle to object

If a sighting is made towards an object that is in an angle to the camera chip the accuracy will not be the same in the whole image.

As shown in Figure 4.4 the figure A describes that corresponding size of the pixels on the object X_1 and X_2 will be the same size when the camera chip is perpendicular to the object surface as the distance between the instrument and the target is the same for both X_1 and X_2. The obtainable photogrammetry measurement accuracy will be the same for X_1 and X_2.

In figure B the object is tilted in relation to the camera chip. The distance between the object and the instrument will be between Dmin and Dmax. This means that corresponding size of the pixels on the object X_1 and X_2 will be different for X_1 and X_2. The obtainable photogrammetry measurement accuracy will be different for X_1 and X_2.

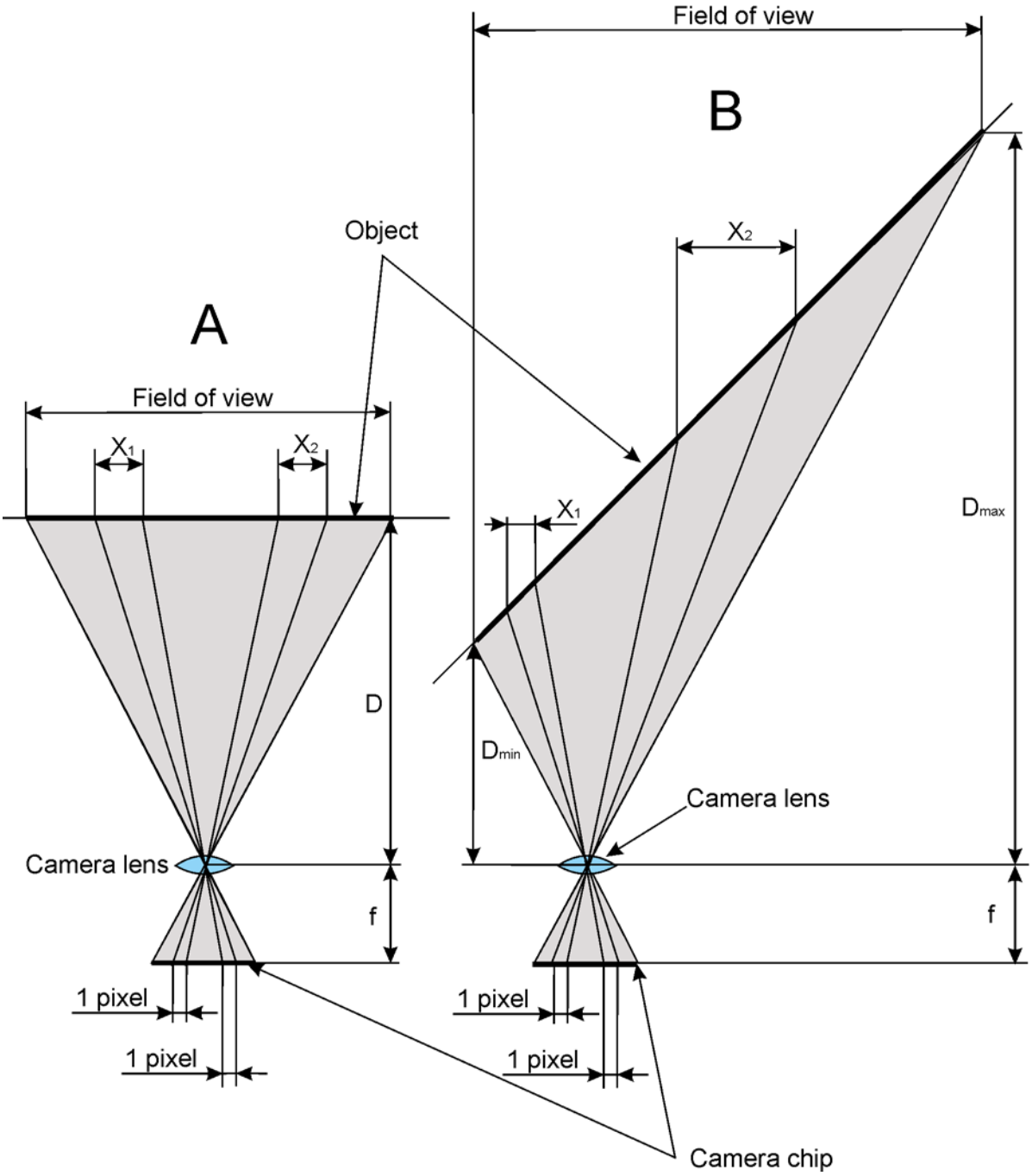


Figure 4.4 Difference in accuracy in proportion to the distance in an image due to object being in an angle in relation to the camera chip.

Multiple objects

If a sighting is made towards multiple objects the accuracy might not be the same in the whole image.

As shown in Figure 4.5 the figure A describes that corresponding size of the pixels on the object X_1 and X_2 will be the same size when the camera chip is perpendicular to the object surface as the distance between the instrument and the target is the same for both X_1 and X_2. The obtainable photogrammetry measurement accuracy will be the same for X_1 and X_2.

In figure B two objects at different distances from the instrument. The distance between the objects and the instrument will be D_1 and D_2. This means that corresponding size of the pixels on the object X_1 and X_2 will be different. The obtainable photogrammetry measurement accuracy will be different for X_1 and X_2 although the objects are perpendicular to the camera chip.

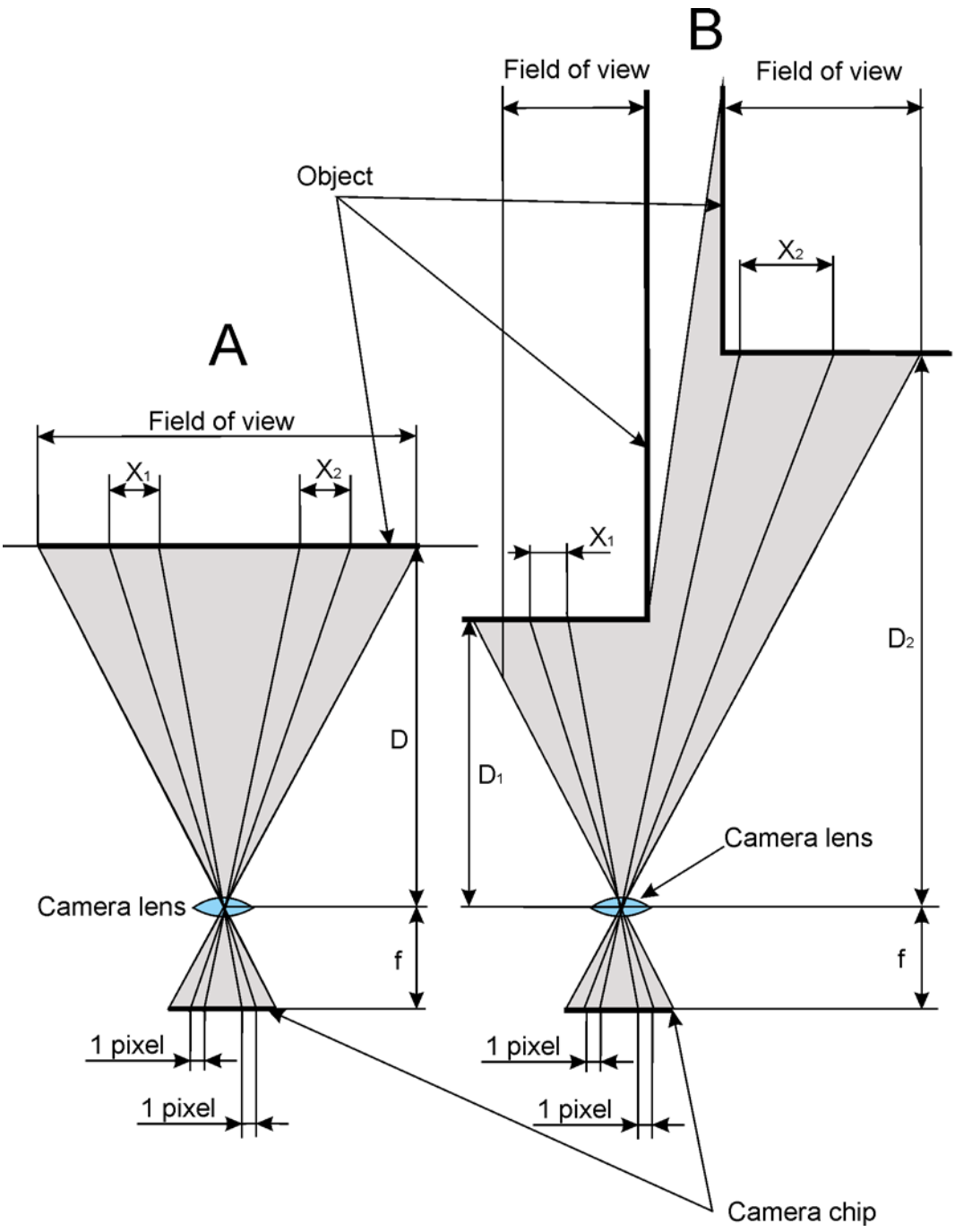


Figure 4.5 Difference in accuracy in proportion to the distance in an image due to multiple objects at different distances from the instrument.

Different Accuracy in a panorama

When a panorama is captured each camera can have different accuracy within the image as mentioned above. Each camera can also have different accuracy in relation to each other.

In Figure 4.6 the three forward facing cameras have a shorter distances to the object then the four backward facing cameras. The images taken by the forward facing cameras will therefore provide higher photogrammetry measurement accuracy then the images taken by the backward facing cameras.

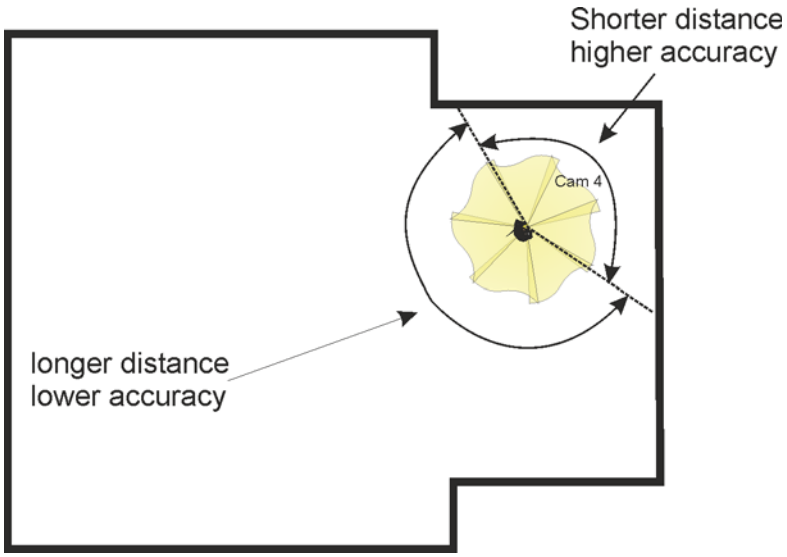


Figure 4.6 Difference in accuracy between cameras in a panorama sighting

To obtain the same photogrammetry measurement accuracy to all the objects, several panoramas must be captured as described in Figure 4.7

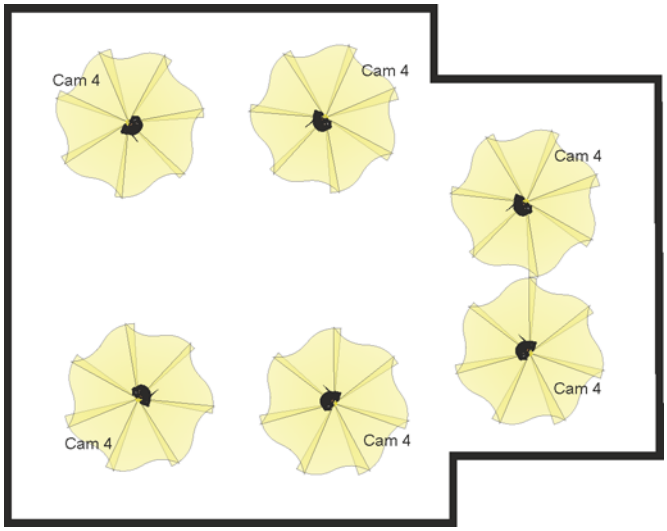


Figure 4.7 Several panoramas made to obtain the same photogrammetry measurement accuracy.

Base length

In normal close range photogrammetry the angle between the panorama and the object should not be allowed to be less than 20° for distinct object structures, sufficient projection sizes and contrast can then be achieved.

To achieve panorama angles more than 20° towards the object the base length between the sightings can not be too long.

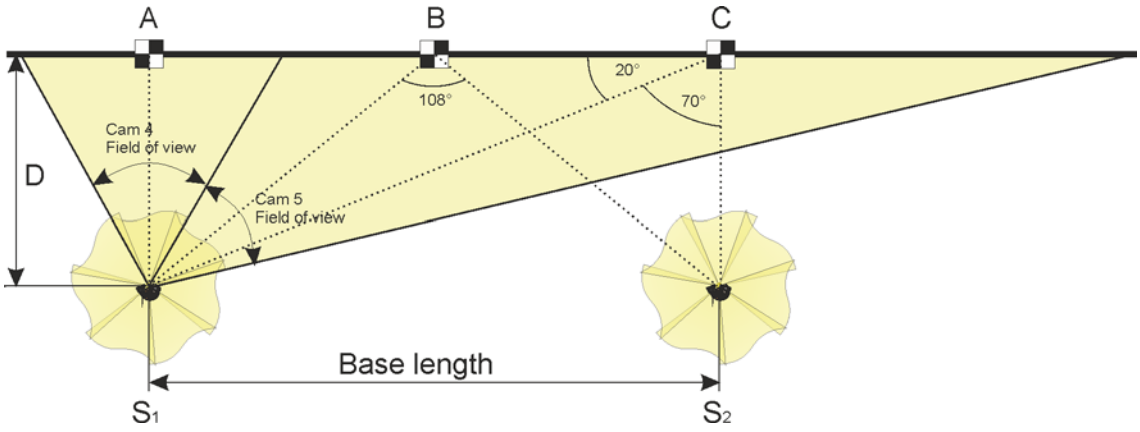


Figure 4.8 Base length

In Figure 4.8 Camera 4 is sighting perpendicular towards target A from the station point S_1. Target C can be seen with camera 5 at a sighting angle of 20°. The next station S_2 should be selected so that camera 4 is perpendicular to the target C. This will give sighting angles between target A and C of 20° to 90°.

The maximum base length between two sightings is 2.75 x D, where D is the distance between the instrument and the object.

Distance D	Base length
10m (33ft)	27.5m (90ft)
20m (65ft)	55m (180ft)

A good rule is not to let the base length be longer than 2.5 times the distance between the instrument and the object.

Intersection Angle

The size of the intersection angle between different sightings is of vital importance for the accuracy of the photogrammetry measurement. The optimum angle is 90°,but the number of points with 90° is limited. Therefore smaller and larger intersection angles must be tolerated.

In the example shown in Figure 4.8 the intersection angles are between 70° and 108°. Smaller intersection angles than 30° are too narrow and should be avoided if possible.

In Figure 4.9 the figure A shows an optimum intersection configuration for highest accuracy. In figure B the intersection angle becomes smaller and the accuracy of the point decrease.

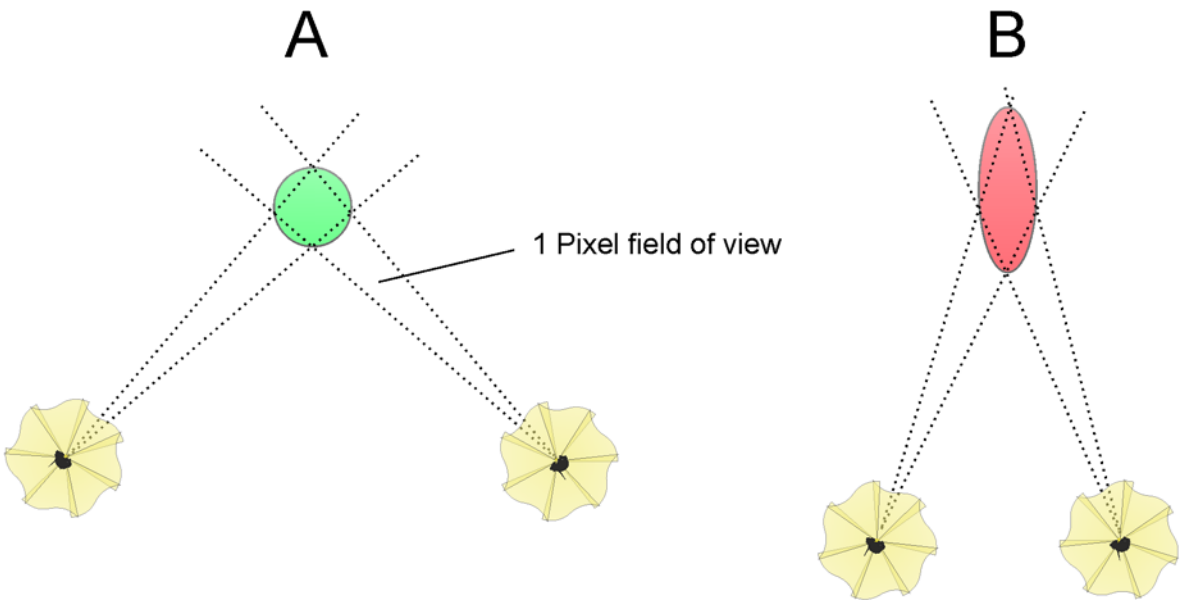


Figure 4.9 Intersection configurations

Optimum Angle Intersection Areas

In relation to the base length between two panoramas an optimum area to measure objects can be found.

Within the green area good intersection angles can be achieved. Outside this area the intersection angles are too small and in the area between the stations the angles are too large, see Figure 4.10

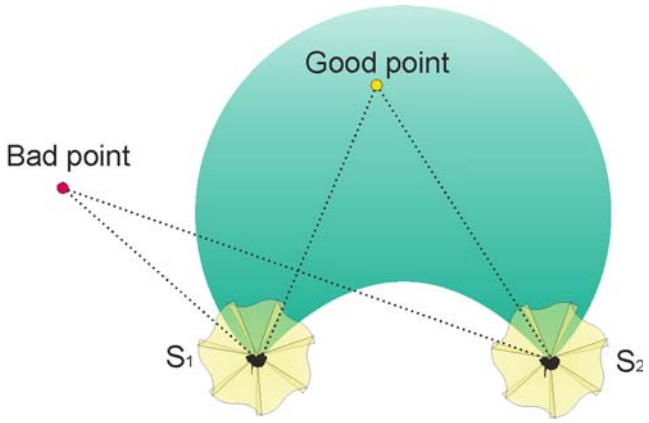


Figure 4.10 Intersection angle area

With full panoramas the same good intersection angle area is provided also on the opposite side of the base, see Figure 4.11

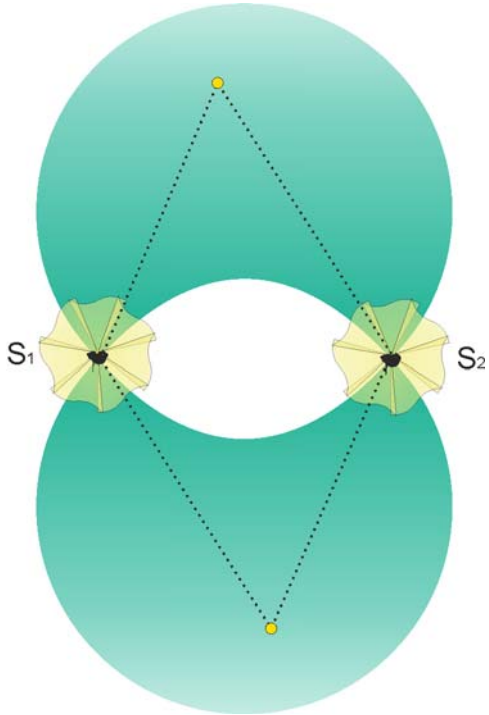


Figure 4.11 Opposite intersection angle area

When taking panoramas and establishing each of the panoramas with positions from a GNSS receiver the panoramas should never be positioned in a straight line. It is recommended to make the panoramas in a zigzag manner, see Figure 4.12.

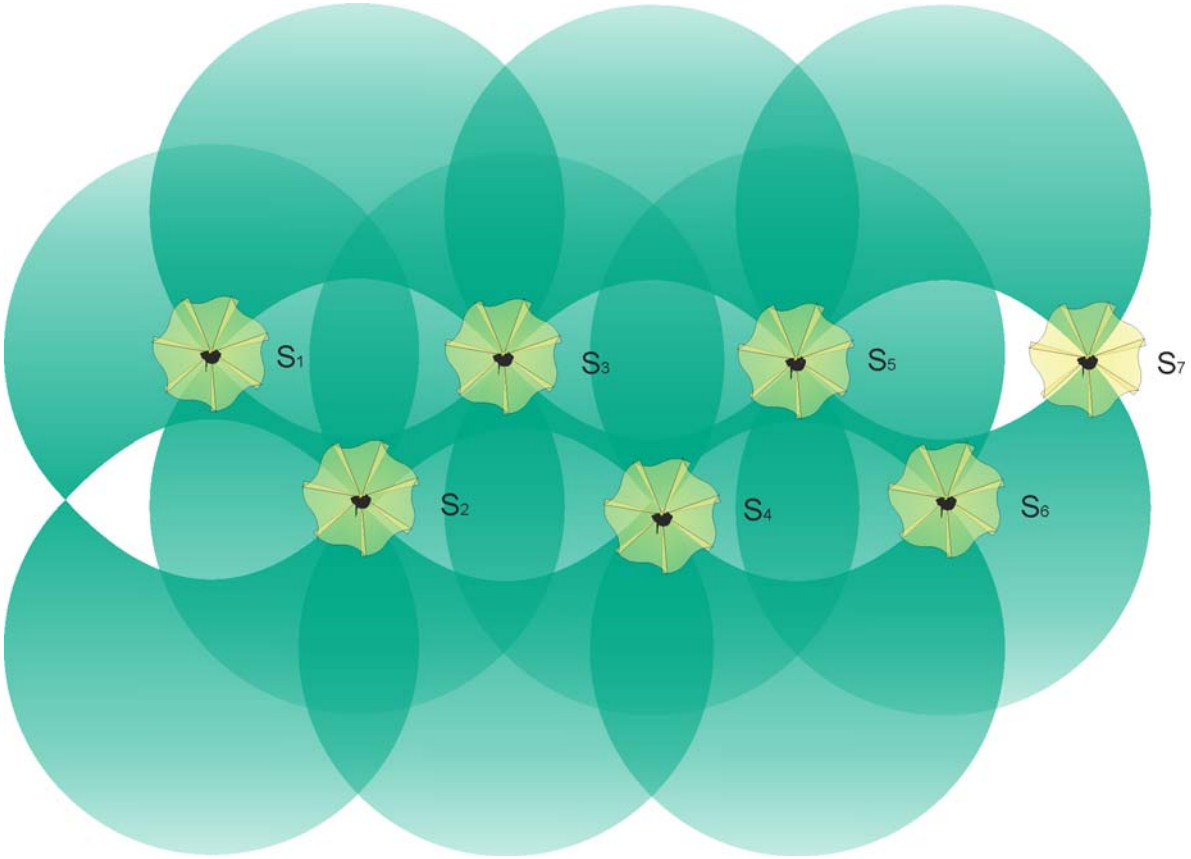


Figure 4.12 Panoramas in a zigzag manner with optimized coverage.

Position of the Instrument

To calculate the position of points measured in the images that are taken by the cameras in the instrument, the position of the instrument must be known. There are different methods to determine the instrument position.

GNSS Receiver

With the Trimble R4, R6, R8 or R10 GNSS Receiver connected via the quick release to the instrument the position of the instrument can be determined.

Figure 4.13 Trimble V10 Imaging Rover with Trimble R10 GNSS Receiver attached

Total Station

With the 360° prism connected to the quick release connector an optical total station can measure to the instrument and determine the position of the instrument.

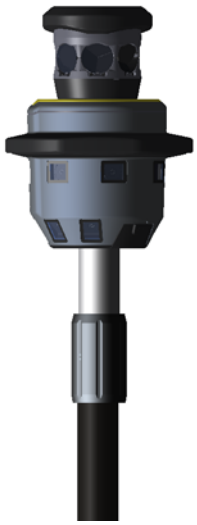


Figure 4.14 Trimble V10 Imaging Rover with Trimble 360° Prism attached

Stand Alone

If a position can not be determined with a GNSS receiver or a total station, it must be assured that control points are visible in some images to be measured as photo points.

Control points can be provided by placing targets over a number of known points.

Figure 4.15 Trimble V10 Imaging Rover as stand alone

Tie Points

Tie points are points that can be seen in images taken from two or more panoramas. These points are used to tie the different panoramas together and fix the rotation of each panorama.

With the help of a Trimble R10 GNSS Receiver connected to the instrument or a total station measuring towards a 360° prism connected to the instrument the position of the instrument can be determined.

The built in compass and tilt sensors will provide initial information about the rotation parameters needed for the calculations done in Trimble Business Center.

HDR Pictures

HDR is the abbreviation for High Dynamic Range. Applied to images this means that the captured light range is high compared to a normal image.

A normal image may contain bright and dark areas, where the details are not visible. In a HDR image the details in the dark and bright areas are better visible.

Figure 4.16 Normal exposure compared with HDR

To accomplish this the camera takes three images with different exposures. Under, normal and over exposed

Figure 4.17 Different exposures to create HDR pictures

1. The 12 images of the panorama are captured synchronously in the auto exposure mode.
2. New exposure values are calculated for the over exposed image series (+2EV) and executed in the 12 cameras synchronously.
3. New exposure values are calculated for the under exposed image series (-2EV) and executed in the 12 cameras synchronously.

All three exposures are captured within 0.6 seconds.

The three different exposures are combined in a way where the best exposed image parts of the three different exposures are used. Since there are no seams it is called HDR fusion. As an example: the under exposed image may have well exposed clouds while the over exposed image has well exposed shadows. Those well exposed areas get a larger weight in the fusion of the three images than poorly exposed areas.

Use the HDR pictures in scenes with high contrast and where the details are in both bright and dark areas.

When capturing HDR pictures the camera must be held still. A bi-pod must be used.