

# Leica AT403

## User Manual



Version 1.1  
**English**

- when it has to be **right**

**Leica**  
Geosystems

# Introduction

## Purchase



Congratulations on the purchase of a Leica AT403.

This manual contains important safety directions as well as instructions for setting up the product and operating it. Refer to "1 Safety Directions" for further information. Read carefully through the User Manual before you switch on the product.

## Product Identification

The model and serial number of your product are indicated on the type plate. Always refer to this information when you need to contact your agency or Leica Geosystems authorised service centre.

## Trademarks

- Windows is a registered trademark of Microsoft Corporation in the United States and other countries.

All other trademarks are the property of their respective owners.

## Validity of this manual

This manual applies to all product series instruments. Where there are differences between the various models they are clearly described.

## Available documentation

Name	Description/Format		
User Manual	All instructions required in order to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions.	-	✓

Name	Description/Format		
Quick Guide	Provides an overview of the product together with technical data and safety directions. Intended as a quick reference guide.	✓	✓
Tracker Pilot Reference Manual	Describes the specific software for sensor and field checks, compensations and system maintenance.	-	✓
TPI Programmers Manual	Describes the usage and commands of the Tracker Programming Interface (TPI).	-	✓

## Refer to the following resources for Absolute Tracker documentation/software:

- <http://www.leica-geosystems.com/metrology>

## Feedback

Your feedback is important as we strive to improve the quality of our documentation. We request you to make specific comments as to where you envisage scope for improvement.

Please use the following E-mail address to send your suggestions:  
[support.ims@leica-geosystems.com](mailto:support.ims@leica-geosystems.com)

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# 1

## 1.1

# Safety Directions

## General Introduction

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### Description

The following directions enable the person responsible for the product, and the person who actually uses the equipment, to anticipate and avoid operational hazards.

The person responsible for the product must ensure that all users understand these directions and adhere to them.

---

### About Warning Messages

Warning messages are an essential part of the safety concept of the instrument. They appear wherever hazards or hazardous situations can occur.

#### Warning messages...

- make the user alert about direct and indirect hazards concerning the use of the product.
- contain general rules of behaviour.

For the users' safety, all safety instructions and safety messages shall be strictly observed and followed! Therefore, the manual must always be available to all persons performing any tasks described here.

**DANGER, WARNING, CAUTION** and **NOTICE** are standardised signal words for identifying levels of hazards and risks related to personal injury and property damage. For your safety, it is important to read and fully understand the following table with the different signal words and their definitions! Supplementary safety information symbols may be placed within a warning message as well as supplementary text.

Type	Description
 <b>DANGER</b>	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
 <b>WARNING</b>	Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.
 <b>CAUTION</b>	Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor or moderate injury.
<b>NOTICE</b>	Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in appreciable material, financial and environmental damage.
	Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

## 1.2

# Definition of Use

---

### Intended use

- Measuring coordinates.
  - Recording measurements.
  - Computing with software.
  - Automatic target search, recognition and tracking.
  - Remote control of product.
  - Data communication with external appliances.
-

- Reasonably foreseeable misuse**
- Use of the product without instruction.
  - Use outside of the intended use and limits.
  - Disabling safety systems.
  - Removal of hazard notices.
  - Opening the product using tools, for example screwdriver, unless this is permitted for certain functions.
  - Modification or conversion of the product.
  - Use after misappropriation.
  - Use of products with recognizable damages or defects.
  - Use with accessories from other manufacturers without the prior explicit approval of Leica Geosystems.
  - Inadequate safeguards at the working site.
  - Deliberate dazzling of third parties.
  - Controlling of machines, moving objects or similar monitoring application without additional control and safety installations.

## 1.3

### Limits of Use

<b>Environment</b>	Suitable for use in an atmosphere appropriate for permanent human habitation: not suitable for use in aggressive or explosive environments.
 <b>DANGER</b>	Local safety authorities and safety experts must be contacted before working in hazardous areas, or close to electrical installations or similar situations by the person in charge of the product.
<b>Environment</b>	<b>For AC power supplies:</b> Suitable for use in dry environments only and not under adverse conditions. 

## 1.4

### Responsibilities

<b>Manufacturer of the product</b>	Leica Geosystems AG, CH-9435 Heerbrugg, hereinafter referred to as Leica Geosystems, is responsible for supplying the product, including the user manual and original accessories, in a safe condition.
<b>Person responsible for the product</b>	The person responsible for the product has the following duties: <ul style="list-style-type: none"><li>• To understand the safety instructions on the product and the instructions in the user manual.</li><li>• To ensure that it is used in accordance with the instructions.</li><li>• To be familiar with local regulations relating to safety and accident prevention.</li><li>• To inform Leica Geosystems immediately if the product and the application becomes unsafe.</li><li>• To ensure that the national laws, regulations and conditions for the operation of the product are respected.</li></ul>

## 1.5

## Hazards of Use

### CAUTION

Watch out for erroneous measurement results if the product has been dropped or has been misused, modified, stored for long periods or transported.

#### **Precautions:**

Periodically carry out test measurements and perform the field adjustments indicated in the user manual, particularly after the product has been subjected to abnormal use as well as before and after important measurements.

### WARNING

Mounting the sensor on unstable or uneven ground may cause the sensor to tip over or cause unreliable measurement results.

#### **Precautions:**

Ensure the ground is stable and even. Do not place the sensor over cracks in the floor.

### WARNING

Inadequate securing of the working site can lead to dangerous situations, for example in traffic, on building sites and at industrial installations.

#### **Precautions:**

Always ensure that the working site is adequately secured. Adhere to the regulations governing safety, accident prevention and road traffic.

### NOTICE

With the remote control of products, it is possible that extraneous targets will be picked out and measured.

#### **Precautions:**

When measuring in remote control mode, always check your results for plausibility.

### WARNING

During dynamic applications, for example stakeout procedures there is a danger of accidents occurring if the user does not pay attention to the environmental conditions around, for example obstacles, excavations or traffic.

#### **Precautions:**

The person responsible for the product must make all users fully aware of the existing dangers.

### WARNING

Cables deployed on the ground can be a hazard to pedestrians or vehicular traffic.

#### **Precautions:**

Ensure the power cable, LAN cable or any other cables do not lie in the path of pedestrian/vehicular traffic. Use appropriate cable cover and/or warning signs.

### WARNING

Do not lift the product with a crane.

#### **Precautions:**

The handles of the product are not designed for crane transport.



### CAUTION

If the accessories used with the product are not properly secured and the product is subjected to mechanical shock, for example blows or falling, the product may be damaged or people can sustain injury.

#### **Precautions:**

When setting up the product, make sure that the accessories are correctly adapted, fitted, secured, and locked in position.

Avoid subjecting the product to mechanical stress.

## CAUTION

During the operation of the product there is a hazard of squeezing extremities or entanglement of hair and/or clothes by moving parts.

### **Precautions:**

Keep a safe distance of the moving parts.



If the instrument moves unexpectedly during operation, stop the instrument via the ATC400 controller to prevent further movements.

## WARNING

During the transport, shipping or disposal of batteries it is possible for inappropriate mechanical influences to constitute a fire hazard.

### **Precautions:**

Before shipping the product or disposing it, discharge the batteries by the product until they are flat.

When transporting or shipping batteries, the person in charge of the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping contact your local passenger or freight transport company.

## WARNING

High mechanical stress, high ambient temperatures or immersion into fluids can cause leakage, fire or explosions of the batteries.

### **Precautions:**

Protect the batteries from mechanical influences and high ambient temperatures. Do not drop or immerse batteries into fluids.

## WARNING

If the product is used with accessories, for example masts, staffs, poles, you may increase the risk of being struck by lightning.

### **Precautions:**

Do not use the product in a thunderstorm.

## WARNING

If battery terminals are short circuited e.g. by coming in contact with jewellery, keys, metallised paper or other metals, the battery can overheat and cause injury or fire, for example by storing or transporting in pockets.

### **Precautions:**

Make sure that the battery terminals do not come into contact with metallic objects.

## WARNING

If the product is improperly disposed of, the following can happen:

- If polymer parts are burnt, poisonous gases are produced which may impair health.
- If batteries are damaged or are heated strongly, they can explode and cause poisoning, burning, corrosion or environmental contamination.
- By disposing of the product irresponsibly you may enable unauthorised persons to use it in contravention of the regulations, exposing themselves and third parties to the risk of severe injury and rendering the environment liable to contamination.
- The product includes parts of Beryllium inside. Any modification of some internal parts can release dust or fragments, creating health hazard.

### **Precautions:**



The product must not be disposed with household waste.

Dispose of the product appropriately in accordance with the national regulations in force in your country.

Always prevent access to the product by unauthorised personnel.

Product-specific treatment and waste management information can be received from your Leica Geosystems distributor.



Applies only for California.

The product contains CR Lithium Cell(s) with perchlorate material inside – special handling may apply. See <http://www.dtsc.ca.gov/hazardouswaste/perchlorate/>



## WARNING

Only Leica Geosystems authorised service centres are entitled to repair these products.

### 1.5.1

#### For AC Power Supplies



## WARNING

If unit is not connected to ground, death or serious injury can occur.

**Precautions:**

To avoid electric shock power cable and power outlet must be grounded.



## WARNING

The product is not designed for use under wet and severe conditions. If unit becomes wet it may cause you to receive an electric shock.

**Precautions:**

Use the product only in dry environments, for example in buildings or vehicles. Protect the product against humidity. If the product becomes humid, it must not be used!



## WARNING

If you open the product, either of the following actions may cause you to receive an electric shock.

- Touching live components
- Using the product after incorrect attempts were made to carry out repairs

**Precautions:**

Do not open the product. Only Leica Geosystems authorised service centres are entitled to repair these products.

### 1.6

#### 1.6.1

#### Laser Classification

##### General

##### General

The following chapters provide instructions and training information about laser safety according to international standard IEC 60825-1 (2014-05) and technical report IEC TR 60825-14 (2004-02). The information enables the person responsible for the product and the person who actually uses the equipment, to anticipate and avoid operational hazards.



According to IEC TR 60825-14 (2004-02), products classified as laser class 1, class 2 and class 3R do not require:

- laser safety officer involvement,
- protective clothes and eyewear,
- special warning signs in the laser working area

if used and operated as defined in this User Manual due to the low eye hazard level.



National laws and local regulations could impose more stringent instructions for the safe use of lasers than IEC 60825-1 (2014-05) and IEC TR 60825-14 (2004-02).

The AT403 is classified as laser class 2 in accordance with:

- IEC 60825-1 (2014-05): "Safety of laser products"

These products are safe for momentary exposures but can be hazardous for deliberate staring into the beam. The beam may cause dazzle, flash-blindness and afterimages, particularly under low ambient light conditions.

## CAUTION

From a safety perspective, class 2 laser products are not inherently safe for the eyes.

### Precautions:

- 1) Avoid staring into the beam or viewing it through optical instruments.
- 2) Avoid pointing the beam at other people or at animals.

## Labelling



The AT403 is classified as a laser class 2 system although the individual laser sources are classified as laser class 1. The possibility of simultaneous emission of the individual laser sources results in an overall classification as laser class 2.

## 1.6.2

### Absolute Distance Meter (ADM)

#### General

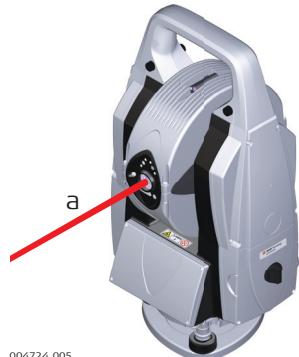
The Absolute Distance Meter built into this product produces an invisible laser beam which emerges from the telescope objective.

The laser product described in this section is classified as laser class 1 in accordance with:

- IEC 60825-1 (2014-05): "Safety of laser products"

These products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with this user manual.

Description	Value
Wavelength	795 nm
Maximum average radiant power	0.5 mW cw
Beam diameter	~ 10 mm
Beam divergence	< 1.5 mrad (collimated)



a) Laser beam

### 1.6.3

#### Automatic Target Recognition

##### General

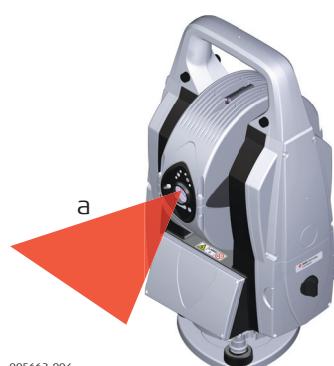
The Automatic Target Recognition built into the product produces an invisible laser beam which emerges from the telescope objective.

The laser product described in this section is classified as laser class 1 in accordance with:

- IEC 60825-1 (2014-05): "Safety of laser products"

These products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with this user manual.

Description	Value
Wavelength	905 nm
Maximum average radiant power	1.5 mW
Emitting aperture	5.5 mm
Beam divergence	0.63°
Pulse duration	0.2 ms to 5 ms
Pulse repetition frequency	10 Hz to 100 Hz



a) Laser beam

## 1.6.4

### Laser Pointer

#### General

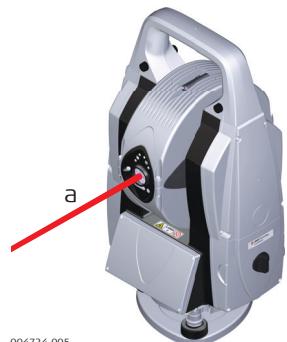
The laser pointer built into this product produces a visible laser beam which emerges from the telescope objective.

The laser product described in this section, is classified as laser class 1 in accordance with:

- IEC 60825-1 (2014-05): "Safety of laser products"

These products are safe under reasonably foreseeable conditions of operation and are not harmful to the eyes provided that the products are used and maintained in accordance with this user manual.

Description	Value
Wavelength	635 nm
Maximum average radiant power	0.35 mW cw
Emitting aperture	5.5 mm
Beam divergence	1.5 mrad



a) Laser beam

## 1.6.5

### PowerLock

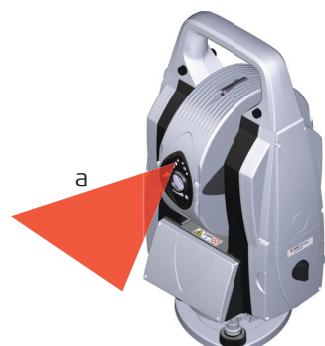
#### General

The PowerLock vision system built into the product produces an invisible LED beam which emerges from the front side of the telescope.



The product described in this section, is excluded from the scope of IEC 60825-1 (2014-05): "Safety of laser products".

The product described in this section, is classified as exempt group in accordance with IEC 62471 (2006-07) and does not pose any hazard provided that the product is used and maintained in accordance with this user manual.



a) Laser beam

## 1.6.6

### AT403 Instrument Status Indicator

#### General

The status LEDs built into the product produces a visible LED beam which emerges from the front side of the telescope.



The product described in this section, is excluded from the scope of IEC 60825-1 (2014-05): "Safety of laser products".

The product described in this section, is classified as exempt group in accordance with IEC 62471 (2006-07) and does not pose any hazard provided that the product is used and maintained in accordance with this user manual.



## 1.7

### Electromagnetic Compatibility EMC

#### Description

The term Electromagnetic Compatibility is taken to mean the capability of the product to function smoothly in an environment where electromagnetic radiation and electrostatic discharges are present, and without causing electromagnetic disturbances to other equipment.



#### WARNING

Electromagnetic radiation can cause disturbances in other equipment.

Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment may be disturbed.



#### CAUTION

There is a risk that disturbances may be caused in other equipment if the product is used with accessories from other manufacturers, for example field computers, personal computers or other electronic equipment, non-standard cables or external batteries.

##### Precautions:

Use only the equipment and accessories recommended by Leica Geosystems. When combined with the product, they meet the strict requirements stipulated by the guidelines and standards. When using computers or other electronic equipment, pay attention to the information about electromagnetic compatibility provided by the manufacturer.



#### CAUTION

Disturbances caused by electromagnetic radiation can result in erroneous measurements.

Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that the product may be disturbed by intense electromagnetic radiation, for example, near radio transmitters, two-way radios or diesel generators.

##### Precautions:

Check the plausibility of results obtained under these conditions.

## **CAUTION**

If the product is operated with connecting cables attached at only one of their two ends, for example external supply cables, interface cables, the permitted level of electromagnetic radiation may be exceeded and the correct functioning of other products may be impaired.

### **Precautions:**

While the product is in use, connecting cables, for example product to external battery, product to computer, must be connected at both ends.

## **Radios or Digital Cellular Phones**

## **WARNING**

Use of product with radio or digital cellular phone devices:

Electromagnetic fields can cause disturbances in other equipment, in installations, in medical devices, for example pacemakers or hearing aids and in aircraft. It can also affect humans and animals.

### **Precautions:**

Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment can be disturbed or that humans or animals can be affected.

- Do not operate the product with radio or digital cellular phone devices in the vicinity of filling stations or chemical installations, or in other areas where an explosion hazard exists.
- Do not operate the product with radio or digital cellular phone devices near to medical equipment.
- Do not operate the product with radio or digital cellular phone devices in aircraft.

## **1.8**

## **FCC Statement, Applicable in U.S.**



The greyed paragraph below is only applicable for products without radio.

## **WARNING**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules.

These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

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

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and 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.

## **WARNING**

Changes or modifications not expressly approved by Leica Geosystems for compliance could void the user's authority to operate the equipment.

## Labelling AT403 instrument



004727\_003

**Model: AT403** Art.No.: 123456  
 Power: 15V / 3A max.  
 Leica Geosystems AG S.No.: 123456  
 CH-9435 Heerbrugg  
 Manufactured: XX.20XX  
 Made in Switzerland  
 IEC 60825-1:2014 visible beam / invisible beam / invisible beam  
 wavelength 635 nm / 795 nm / 905 nm  
 maximum radiant power 0.35 mW cw / 0.5 mW cw / 1.5 mW 1.5 ms  
 Complies with FDA performance standards for laser products  
 Except for deviations pursuant to Laser Notice Nr. 50 June 24, 2007.  
 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.



## Labelling AT Controller 400



004728\_004

**Model: AT Controller ...** Art.No.: .....  
 Power: .....  
 Leica Geosystems AG S.No.: .....  
 CH-9435 Heerbrugg  
 Manufactured: XX.20XX  
 Made in Switzerland  
 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.  
 Contains Transmitter Module FCC-ID: XXXXXXXX  
 IC: XXXXX-XXXX



## Labelling internal battery GEB242



004729\_002

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.



## Labelling Power over Ethernet module



004730\_002

**Model: PoE+ Module** Art.No.: 771389  
 Input 2x 56 V--- 0.55 A max  
 Output 15 V--- 2.6 A max  
 Leica Geosystems AG  
 CH-9435 Heerbrugg  
 Manufactured: XX.20XX  
 Made in Germany  
 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.



## Labelling AT400 Remote Control



004731\_002

**Model: AT Remote Control 400** Art.No.: .....  
 Leica Geosystems AG S.No.: .....  
 CH-9435 Heerbrugg  
 Manufactured: 20XX  
 Made in China  
 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.  
 Battery type: 2xAAA



**WARNING**

This Class (B) digital apparatus complies with Canadian ICES-003.  
Cet appareil numérique de la classe (B) est conforme à la norme NMB-003 du Canada.

## Description of the System

### System Components

#### Introduction

The Leica Absolute Tracker system consists of:

- AT403 instrument
- AT Controller 400 (with built-in Meteo Station)
- AT400 Remote Control
- Tribrach with 5/8" thread
- Tripod (optional)
- Universal Stand Fixture
- Batteries, charger, mains adapter
- LAN cable

The terms "Absolute Tracker" and "Laser Tracker" are used as synonyms for all types of the Leica Geosystems Absolute Tracker. The term "AT Controller" is used as a synonym for the Leica AT Controller 400.

#### System components



Component	Description
AT403 instrument	Laser Tracker of highest accuracy for measuring, calculating and capturing data.
AT Controller 400	Controller running the system software which provides the interface to the Absolute Tracker.
Application Software	Third party metrology software with an interface to the Absolute Tracker for acquisition, analysis, management, automation and reporting of measurement data.
Tracker Pilot	System software to <ul style="list-style-type: none"> <li>• check the system accuracy and adjust (compensate) instrument parameters.</li> <li>• maintain and update the system software/firmware.</li> </ul>

## 2.2

## 2.2.1

### System Concept

#### Software Concept

#### General

The Absolute Tracker supports the following types of software applications.

## Software types

Software type	Description
System firmware	This software comprises the central functions of the Absolute Tracker AT403 and the AT Controller 400.
Tracker Pilot	The Tracker Pilot software provides functionality to check and adjust the Absolute Tracker system as well as maintaining and updating the system.
Third party application software	There are various computer based third party applications available for the Absolute Tracker. Please contact your Leica Geosystems representative for details.
Customised application programs	Customised software specific to user requirements can be developed using the Tracker Programming Interface (TPI). The TPI Software Development Kit including documentation is available on the Leica USB documentation card. Please contact your Leica Geosystems representative for further information.

## Firmware upload

A firmware update of the Absolute Tracker can be done through the provided Tracker Pilot software.

 Refer to Tracker Pilot Reference Manual for details on updating the Absolute Tracker system.

## 2.2.2

### Power Concept

#### General

Use the batteries, chargers and accessories recommended by Leica Geosystems to ensure the correct functionality of the instrument.

#### Power options

Power for the instrument can be supplied either internally or externally.

Device	Power supply
AT403 instrument	Internally by GEB242 battery fitted into the battery compartment.
AT Controller 400	Internally by GEB242 battery fitted into the battery compartment, OR Externally by an AC/DC Adapter 15 V DC, OR Externally by a Power over Ethernet (PoE) module fitted into the battery compartment.

#### GEB242 Li-Ion internal battery



a) GEB242 internal battery  
b) Electrical contacts



It is required to fit a GEB242 battery into the battery compartment independently from the selected power source, even when the instrument is operated on mains power or Power over Ethernet (PoE).

## GKL311 Single-bay Charger

The provided GKL311 Single-bay Charger can be used in the following ways:

### Charging of one GEB242 battery



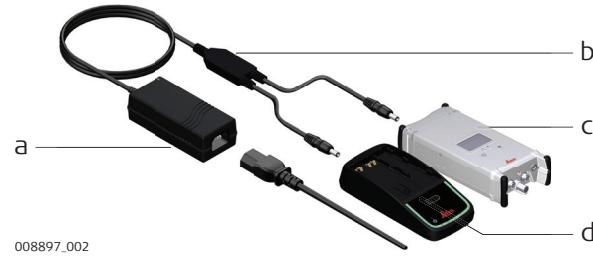
- a) AC power adapter
- b) GKL311 charger

### Charging of two GEB242 batteries simultaneously using the Y-cable provided



- a) AC power adapter
- b) Y-cable
- c) GKL311 charger

### Power supply for the AT Controller 400 and charging of one GEB242 battery using the Y-cable provided



- a) AC power adapter
- b) Y-cable
- c) AT Controller 400
- d) GKL311 charger

## 2.3

### Container Contents

#### Container for instrument and delivered accessories



- a) Cables
- b) Protective cover for AT403 instrument
- c) B-Probe (optional)
- d) AT400 Remote Control
- e) GKL311 Single-bay Charger
- f) AC power supply
- g) GEB242 batteries
- h) Quick Guide, Leica USB documentation card
- i) Universal Stand Fixture
- j) AT403 instrument and tribrach with 5/8" thread
- k) AT Controller 400

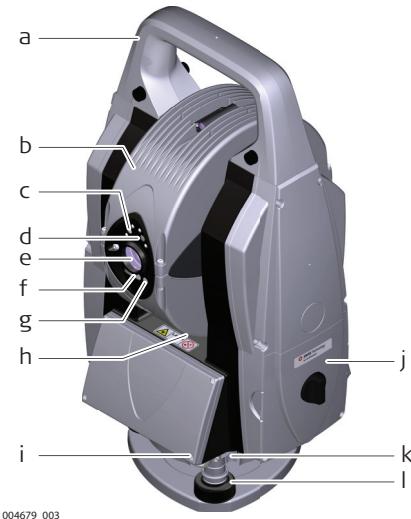
#### Outside pocket

A pocket is located on the top shell of the container. Various parts and accessories like notebook, cables, manuals etc. can be kept in this pocket.

## 2.4

### Instrument Components

#### AT403 instrument components



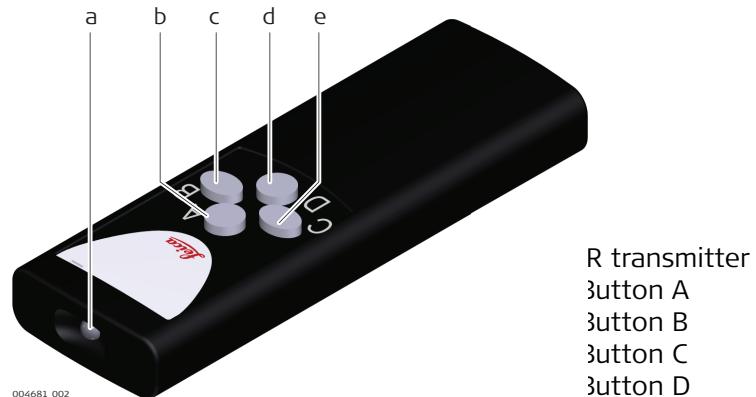
- a) Carry handle
- b) Telescope integrating ADM, ATR, PowerLock and Overview Camera
- c) PowerLock
- d) Overview Camera
- e) Coaxial optics for angle and distance measurement, and exit port for visible laser beam of the laserpointer
- f) Status LEDs and IR receiver
- g) PowerLock LED
- h) Circular level
- i) Tribrach securing screw
- j) Battery compartment
- k) Sensor cable connector
- l) Tribrach footscrew

#### 2.4.1

### AT400 Remote Control

#### Description

The AT400 Remote Control allows to control specific instrument functions remotely.



**Button assignments** The Tracker Pilot software has the following functions assigned to the AT400 Remote Control.

Button	Function
A	Start Measurement
B	Next (on Tracker Pilot wizard pages)
C	Back (on Tracker Pilot wizard pages)
D	Toggle between full sketch view, full DRO view and shared view

## Battery replacement

The AT400 Remote Control is powered by two 1.5 V AAA batteries.

Step	Description
	The battery compartment is located on the back of the AT400 Remote Control.
1.	Press the fluted part of the cover of the battery compartment and slide the cover open.
2.	Insert two AAA batteries as indicated on the bottom of the battery compartment.
3.	Close the cover of the battery compartment. A click indicates when the battery compartment cover is fully closed.

## 2.4.2

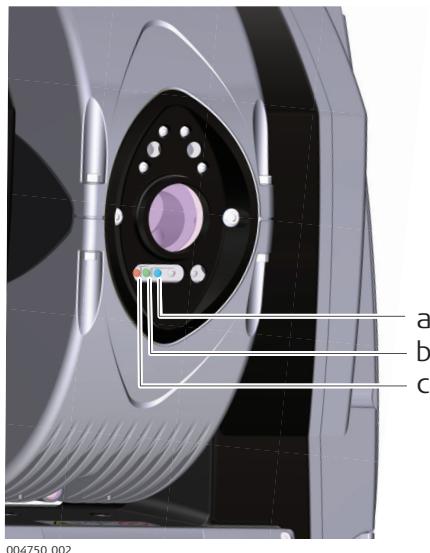
### AT403 Instrument Status LEDs

#### Status LEDs

#### Description

The AT403 has Light Emitting Diode indicators at the front side of the telescope. They indicate the following states.

#### Diagram of the Status LEDs



- a) Blue LED
- b) Green LED
- c) Red LED

#### Description of the Status LEDs

LED	LED Status	Status of the Instrument
Red, Green and Blue LED	Off	AT Controller 400 or AT403 instrument are off.
Red, Green and Blue LED	Static	The system is powered up, but connection between AT Controller 400 and AT403 instrument is not yet established.

<b>LED</b>	<b>LED Status</b>	<b>Status of the Instrument</b>
Red and Blue LED	Static	System is ready, no reflector is in the field of view. PowerLock is activated.
Red LED	Static	System is ready, no reflector is in the field of view. PowerLock is inactive.
Red LED	Flashing	Target is moving too fast during dynamic measurement or target is out of distance range (too close or too far).
Green LED	Static	Target is locked and stable. Ready to measure.
Green LED	Flashing (3 Hz to 5 Hz)	Measurement is in progress.

## 2.5

### 2.5.1

#### AT403 Instrument Measurement System

##### Angular System

##### Description

The angle measurement system mainly consists of a coded glass circle and four angular encoders using quadruple angle reading. The quadruple angle reading system eliminates systematic and periodical errors of the angle measurement which results in increased measurement accuracy.

##### 2.5.2

##### Inclination Sensor

##### Description

The dual-axis inclination sensor monitors the horizon of the Absolute Tracker. In the ideal case, the horizon of the instrument is perpendicular to the plumb-line. The inclination sensor detects the actual deviations of the verticality.

##### Operation modes

The inclination sensor of the AT403 instrument can operate in two different modes depending on the stability of the ground:

- Orient to gravity with full angle corrections applies
- Inclination sensor off

 Refer to Tracker Pilot Reference Manual or the relevant third party software application manual for details on setting the desired operation mode.

##### 2.5.3

##### Motorisation

##### Description

The AT403 instrument has two orthogonal, rotating axes. The motorisation of the axes uses direct drives based on the piezo principle. This guarantees the unrestricted operation of the direct drives in magnetic fields. Direct drives using piezo technology feature a significant longer lifetime compared to conventional drives.

##### 2.5.4

##### Absolute Distance Meter (ADM)

##### Description

The Absolute Distance Meter module uses a modulated and polarised infrared light beam, which allows a dynamic lock-on to a moving reflector still ensuring highest accuracy. The ADM supports measuring stationary points as well as continuous measurements of a moving reflector.

**Atmospheric influence** The accuracy of the measured distance is primarily dependent on the accuracy of the determination of:

- The ambient air temperature
- The air pressure

A change or a deviation in the atmospheric parameters affects the distance measurement accuracy as follows:

- $\pm 1^{\circ}\text{C}$  results in a change in distance of approximately 1 ppm
- $\pm 4 \text{ hPa}$  result in a change in distance of approximately 1 ppm.

## Additive constant

For an absolute distance measurement the following values must be known:

- The additive constant (ADM Offset)
- The scale factor

These values are precisely determined in the factory. In the field the additive constant can be verified through a sensor check or compensation process.

 Refer to the Tracker Pilot Reference Manual on details of the ADM check and compensation process.

## Reflector constant

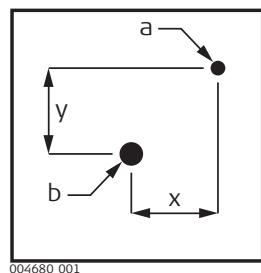
Glass prism reflectors like the Tooling Ball (TBR) have an internal reflector constant, which causes an apparent increase in the distance measurement. This reflector constant is indicated on the accompanying Producer Certificate.

Please note: Hollow Corner Cube Reflectors (RRR) do not have a reflector constant.

## 2.5.5 Automatic Target Recognition

### Description

The Automatic Target Recognition (ATR) is a sensor which recognises the position of a reflector by means of a CMOS image sensor. The light beam of the ATR represents the collimation axis of the Laser Tracker, the reflected beam is received by the CMOS image sensor. The position of the reflected spot in relation to the centre of the CMOS image sensor is computed. These ATR offsets are used to correct the horizontal and vertical angles. The ATR offsets are also used to control the motors which turn the instrument to centre the reflected spot closely to the centre of the CMOS image sensor.



- a) Centre of reflected spot
- b) Zero pixel of the ATR
- x, y) ATR offsets

### Tracking

The Automatic Target Recognition (ATR) is capable of tracking a moving reflector. When a target is within the field of view, the ATR will constantly measure and apply the offsets to the angular measurements and provide them to the motors of the Absolute Tracker to track the movements of the reflector.

### Field of view

The field of view of the Automatic Target Recognition (ATR) is  $0.6^{\circ}$ , which corresponds to a spot size of 105 x 105 mm at a distance of 10 meters.

## 2.5.6

### PowerLock

#### Description

By utilising an additional active off-axis vision system built into the sensor the Absolute Tracker can determine where a target is without the need for the ATR beam to be locked on and without operator intervention. This revolutionary vision system works with all standard reflectors and can lock on to the target as soon as it is within the field of view of the sensor.

To steer the beam into the field of view of the PowerLock use the Overview Camera or the optical sight mounted on the telescope. Once the beam is within the field of view it will automatically lock onto the target.

#### Field of view

The field of view of the PowerLock vision system is 10°, which corresponds to a spot size of 1750 x 1750 mm at a distance of 10 meters.

## 2.5.7

### Overview Camera

#### Description

The Overview Camera enables visualisation of reflectors. The camera is located at the front of the telescope above the aperture of the measurement beam, the focus and aperture are fixed. The Overview Camera is equipped with a target illumination LED. The LED sends out intermittent IR light, which highlights all targets in the field of view and makes them more recognisable on the image.

Infrared light cannot be directly seen by the human eye, but creates a highly visible spot on the CCD camera.

The Overview Camera can be used:

- To visually recognise reflectors and to target the measurement beam.
- As an intermitting, infrared illumination source. This intermitting illumination is reflected by the reflector and can be seen in the "Find Reflector" window.

## 2.6

### AT Controller 400

#### Controller components - top view



- a) Battery compartment
- b) Status display with different information pages
- c) Clip for Tripod mount (back side of the AT Controller 400)
- d) Power status LED
- e) WLAN status LED
- f) Scroll button to loop through status display pages
- g) Main power switch for AT Controller 400 and AT403
- h) Connectors

## Controller components - front view



- a) LAN port RJ45 (TCP/IP)
- b) Connector for object temperature sensor
- c) Socket for power supply unit
- d) Pressure and humidity sensor
- e) Connector for external ambient temperature sensor
- f) Connector for sensor cable

### Turn off

To turn off the system press the power switch 2 seconds. This ensures that the system software is shut down properly.

### Turn on

To turn on the AT403 instrument press the power switch on the front panel.

### Compatibility

The AT Controller 400 is compatible with the AT402 and the AT403 instrument. Other types of Leica Laser Trackers are not supported.

## 2.6.1 AT Controller 400 Display

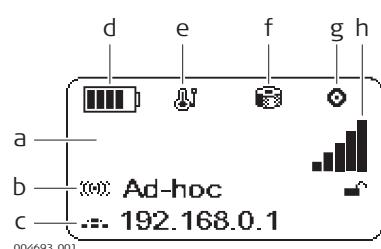
### Description

The AT Controller 400 has a monochrome LCD display with 8 lines. The display shows essential information about the Absolute Tracker system. The following pages are available:

- Connection page
- Power status page
- Meteo page
- Levelling page
- Status Information page
- Startup splash screen
- Shutdown splash screen

Use the scroll button to loop through the information pages.

### Connection page

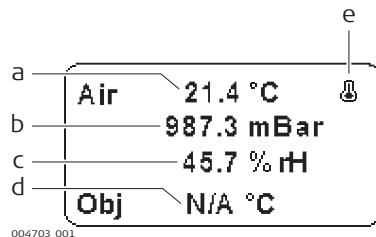


- a) Impediment (when applicable)
- b) WLAN connection details
- c) LAN connection details
- d) Power supply status
- e) Meteo data source
- f) Inclination sensor status
- g) Active measurement profile
- h) Connection status/WLAN signal strength

Icon	Description
	Absolute Tracker power source: Battery capacity (shown in steps from 0% to 100%).
	Absolute Tracker power source: connected to mains.

Icon	Description
PoE	Absolute Tracker power source: connected to Power over Ethernet (PoE).
⌚ ⓘ ⓘ	Meteo Data Source: Automatic reading, hand entered environmental data, external sensor attached.
☒ ☑ ☐	Inclination sensor state: Disabled, not in working range, enabled.
? ⚡ ⚡ ⚡ ⚡	Active measurement profile: Not used, Fast, Standard, Precise, Outdoor, Continuous Distance/Continuous Time.
!	Absolute Tracker not ready (Impediment).
No INIT OFF	Impediment detail (when applicable): System not initialized, no battery in AT403 instrument, inclination sensor not in working range, AT403 instrument is off.
===== -----	WLAN established and current signal strength.
WiFi	WLAN connection properties: Broadcasted SSID, connection type, IP address.
🔒 🔒	WLAN connection encryption status: Not encrypted, encrypted.
LAN	LAN connection properties: connection type, IP address.
🔗 WiFi	Network Connection State: No TCP/IP connection, LAN connection, WLAN connection.

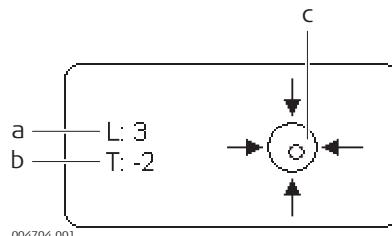
#### Meteo page



- a) Ambient air temperature
- b) Ambient air pressure
- c) Humidity
- d) Object temperature
- e) Meteo data source

Icon	Description
°C	Ambient air temperature in °C.
mBar	Ambient air pressure in mbar (hPa).
%orH	Relative humidity in %.
Obj	Temperature read by sensor connected to port labelled with "Object".
⌚ ⓘ ⓘ	Meteo Data Source: Automatic reading, hand entered environmental data, external sensor attached.

#### Levelling page



- a) Longitudinal tilt
- b) Transversal tilt
- c) Electronic level bubble

Icon	Description
L	Longitudinal tilt.
T	Transversal tilt.
N/A	No inclination values available (during start up)
Range!	Inclination sensor out of working range.

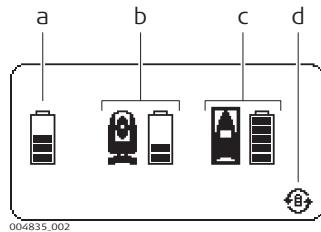
## Status information page



- a) Installed firmware version  
b) System type and serial number

Status	Description
Automatic Wake Up Restart: 0:0 h:m	AT403 instrument in stand-by mode. Automatic restart after displayed time.
UPDATE IN PROGRESS	A system update is currently in progress. Refer to the information screen in the Tracker Pilot software for information on the status of the update. Do not interrupt the update process.

## Power status page



- a) Power source  
b) AT403 instrument battery capacity  
c) AT Controller 400 battery capacity  
d) Battery hot swap possible

## Startup splash screen



Boot message

## Shutdown splash screen



Shutdown message

## 2.6.2

### AT Controller 400 Status LEDs

#### Status LEDs

#### Description

The AT Controller 400 has Light Emitting Diode indicators on the top side. They indicate the following states.

### Diagram of the Status LEDs



a) WLAN Status LED  
b) Power Status LED

### Description of the Status LEDs

LED	LED Status	Status of the instrument
Power Status LED and WLAN Status LED	Off	AT Controller 400 power is off.
Power Status LED	Green static	AT Controller 400 is powered up.
WLAN Status LED	Yellow static	WLAN module is activated.

## 2.6.3

### Meteo Station

#### Description

The air temperature, air pressure and humidity affect the refraction index of the air, which causes a change in velocity of propagation and wavelength of the measurement beam. These changes can influence the values of the distance measurements. The build-in Meteo Station provides environmental information on air temperature, air pressure and relative humidity, which is used to calculate the current refraction index of the surrounding atmosphere. The internal Meteo Station reads the information from an internal probe, optionally two additional external temperature sensors can be connected, one for the ambient air temperature and one for the object temperature.



To achieve the highest possible measurement accuracy it is strongly recommended to determine the ambient temperature using the provided external temperature sensor.



In case the Absolute Tracker is powered through the Power-over-Ethernet module it is mandatory to attach the external ambient temperature sensor.



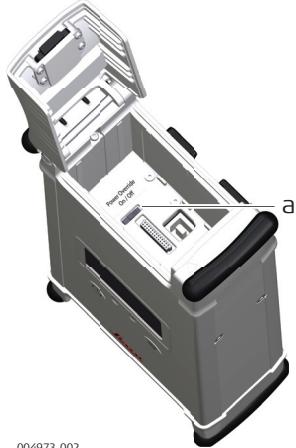
In case the AT Controller 400 is covered with the rain cover it is mandatory to attach the external ambient temperature sensor.

## 2.6.4

### Power Override

#### Description

The Absolute Tracker AT403 can be configured to allow remote power on or off with the Power Override switch located inside of the AT Controller 400 battery compartment. By default the Power Override switch is set to off. Move the switch into the position marked "On" to enable remote control.



004973\_002

a) Power Override switch

## 2.7

### Application Processor

#### Description

An application processor which runs the actual application software is required to operate the AT403. The Tracker Programming Interface (TPI) provides an open and flexible interface to third-party application programs.

The use of an Application Processor distributes the workload such as:

- The system software runs on the AT Controller 400 Processor, the application software runs on the Application Processor. The resources of the Application processor are fully available for data acquisition, handling, calculation and graphical display to support all user needs. The hardware requirements for the Application Processor depend on the specifications of the supplier of the application software.
- The interface between the system software and the application software is clearly defined, making it easier to maintain both, embedded and application software.

## 2.8

### Accuracy

#### Description

The accuracy of measurements with the Absolute Tracker depends on the individual accuracy of the following components:

- Angle measurements
- Distance measurements
- Reflectors

#### 2.8.1

### Maximum Permissible Error (MPE)

#### Description

Accuracy specifications in the technical data of this manual are stated by means of the Maximum Permissible Error (MPE). The Automotive Society of Mechanical Engineers (ASME) defines Maximum Permissible Error (MPE) as the "extreme values of an error permitted by specification, regulations, etc. ... for a given instrument". The ASME B89.4.19-2006 standard further expands this definition by specifying that if during testing a corresponding measurement fails to meet the MPE requirements, then the failed measurement is allowed to be re-measured 5 times, with the magnitude of the largest error replacing the failed position value. If the new value fails to satisfy the MPE requirement, then the test is allowed to be done a second time (but not more than twice) with a failed result leading to a failed inspection test. Typical measurement results of the Absolute Tracker are half of the relevant MPE values.

## 2.8.2

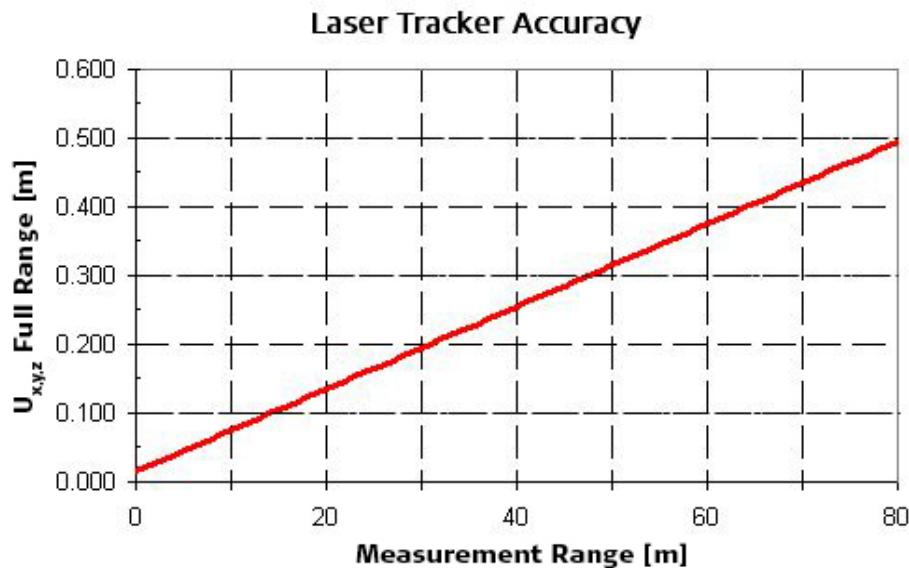
### Measurement Uncertainty

#### Description

The measurement uncertainty of a coordinate " $U_{x,y,z}$ " is defined as the deviation between a measured coordinate and the nominal coordinate of the measured point. This measurement uncertainty is specified as a function of the distance between the Laser Tracker and the measured point.

All accuracies are specified as Maximum Permissible Error (MPE) and calculated per ASME B89.4.19-2006 and ISO 10360-10:2016 using precision Leica 1.5" Red Ring Reflectors unless otherwise noted.

Range	Uncertainty
$U_{x,y,z}$ (MPE), (Stationary Measurement)	$\pm 15 \mu\text{m} + 6 \mu\text{m}/\text{m}$
$U_{x,y,z}$ (MPE), (Basic Dynamic Measurement, uncertainty of fitted sphere centre coordinate with known radius)	$\pm 30 \mu\text{m} + 12 \mu\text{m}/\text{m}$



Refer to "7 Technical Data" for detailed specifications of the product.

## 2.8.3

### Reflector

#### Reflectors

Hollow corner cube reflectors (RRR and BRR) and glass prisms (TBR) are available with the following tolerances:

Roundness (Ball)	Value
Red Ring Reflector (RRR)	$< \pm 1.5 \mu\text{m}$
Break Resistant Reflector (BRR)	$< \pm 1.5 \mu\text{m}$
Tooling Ball Reflector (TBR)	$< \pm 10 \mu\text{m}$

Centring of optics	Value
Red Ring Reflector (RRR)	$< \pm 3 \mu\text{m}$
Break Resistant Reflector (BRR)	$\leq \pm 10 \mu\text{m}$
Tooling Ball Reflector (TBR)	$< \pm 0 \mu\text{m}$

Reflector constant (ADM)	Value
Red Ring Reflector (RRR)	< $\pm 3 \mu\text{m}$
Break Resistant Reflector (BRR)	$\leq \pm 10 \mu\text{m}$
Tooling Ball Reflector (TBR)	< $\pm 30 \mu\text{m}$

 If repeatability of measurements is important, the reflector should always be used with the same orientation. The serial number and Leica logo on the reflector housing helps to maintain the orientation.

---

**Description**

This chapter describes the following accessories for the Laser Tracker systems:

- Reflectors

This is not the only type of accessory, various other products are available for different measurement tasks.

 Refer to the brochure "Leica Metrology Product Catalog" for detailed information on additional accessories.

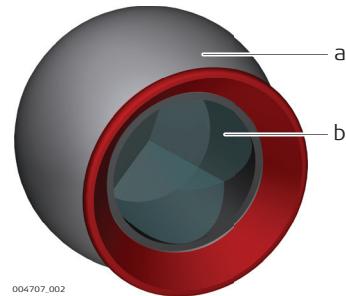


The use of accessories from third-party manufacturers without prior approval of Leica Geosystems is not permitted. Unauthorised modifications to the system make the warranty null and void.

**3.1****Reflectors****Reflector Types**

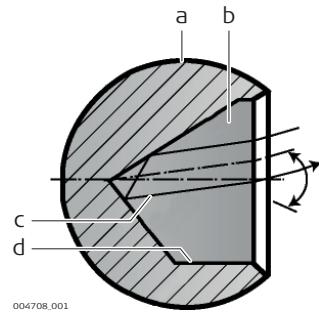
Leica Geosystems recommends using the following reflector types:

- Hollow corner cube (air path) reflector (Red Ring Reflector (RRR), Break Resistant Reflector (BRR)), consisting of three orthogonal mirrors. The mirrors are centred in a metal sphere and their reflective surfaces have an optimized coating.



a) Housing  
b) Reflective surfaces

- Small size glass prism (Tooling Ball Reflector (TBR)). For a small size glass prism, the influence of refraction for small entry angles ( $\pm 15^\circ$ ) can be neglected. Glass prism reflectors are recommended for static points, where it can be pointed towards the sensor unit during the actual measurement. To impede measurements with large entry angles of the laser beam, a collar can be mounted on the aperture of the TBR.



a) Reflector housing  
b) Solid glass prism  
c) Laser beam path  
d) Prism surface

**Entry Angle of Laser Beam**

Reflector Type	Max. Entry Angle
RRR/BRR	$\pm 30^\circ$
TBR	$\pm 22^\circ$

**Housing** Most reflectors are housed in a metal ball (Spherically mounted reflector, SMR), with the advantage of a constant offset when measuring surfaces. A three-point reflector support ensures reliable centering of the sphere.

---

**Reflector support** A reflector support is used, when the reflector needs to be fixed in a particular stable position. A magnet in the reflector support holds the reflector in the same position. Various kinds of reflector supports are available.

 Refer to the brochure "Leica Metrology Product Catalog" for detailed information.

---

**Damaged reflectors** A dropped reflector may be damaged, which will affect the measuring accuracy (true-ness of the optics and centering). Damages may not be immediately apparent. Dropped reflectors should be sent to your authorised Leica Geosystems representative for inspection.

 Secure the reflector with a lanyard when moving the reflector.

---

**General**

The first installation of the product should be done by authorised Leica Geosystems personnel. Installation by unauthorised personnel may cause damage and will make the warranty null and void.

**Setup step-by-step**

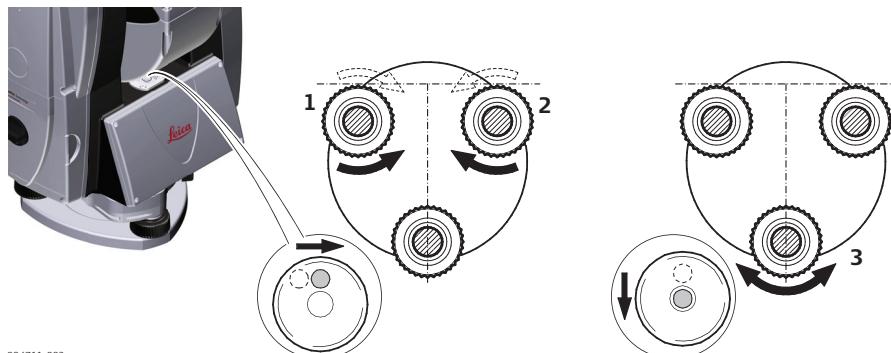
<b>Step</b>	<b>Description</b>
1.	Extend the tripod legs and place the tripod on a stable and even surface. Ensure the clamps on the legs are closed and the locking screw on the centre column is tightened.
2.	Fasten the tribrach and place the instrument on the tripod.
3.	Close the locking lever on the tribrach to secure the instrument.
4.	Attach a battery to the instrument.
5.	Attach the Universal Stand Fixture and the AT Controller 400 to one of the tripod legs and attach a battery or connect mains power to the AT Controller 400.
6.	Connect the sensor cable to the AT Controller 400.
7.	Connect the sensor cable to the AT403 instrument.
8.	Connect the external temperature sensor to the port of the Meteo Station labelled with "Air".
9.	For a wired connection connect the LAN cable to the Application Processor and to the AT Controller 400.
10.	Switch on the AT Controller 400.
11.	Level the sensor with the levelling footscrews of the tribrach according to "Coarse levelling" or "Electronic levelling".

Step	Description
12.	The system automatically detects when the warm-up cycle has finished. The user may be asked to initialise the system after the warm-up has finished. ☞ For the initialisation process it is required that a reflector is in the field of view of the AT403 instrument.
13.	Start the application software.

☞ Refer to the relevant application software manual for further details on carrying out measurements.

## Coarse levelling

The following steps provide a guideline to level the AT403 instrument.



Step	Description
1.	All three footscrews of the tribrach should close to the middle position of the pitch. A horizontal notch on the thread housing marks the centre of the pitch.
2.	Turn the sensor head that the telescope aligns over one of the footscrews.
3.	Turn footscrews 1 and 2 simultaneously in opposite directions (either to the inside or to the outside) until the level bubble is aligned to centre of the engraved circle.
4.	Turn the single footscrew 3 forward or backward until the bubble moves to the centre.

## Electronic levelling

Step	Description
1.	Navigate to the levelling page or the AT Controller 400 using the scroll button.
2.	Turn the footscrews of the tribrach according to the coarse adjustment described in "Coarse levelling" until the L and T values are close to zero.
3.	Return to the main screen of the AT Controller 400 display.

### WARNING

Mounting the sensor on unstable or uneven ground may cause the sensor to tip over or cause unreliable measurement results.

#### Precautions:

Ensure the ground is stable and even. Do not place the sensor over cracks in the floor.

## 4.2

## Connecting to an Application Computer

### Connection types

There are two basic connection types available:

- Point-to-point configuration (TCP/IP), Static IP
- Network configuration (TCP/IP), Connect to Network

### 4.2.1

### Wired Connection

#### Automatic mode

The AT Controller 400 can automatically detect whether it is connected to the application computer through a point-to-point or a network connection. Changes between connection types are detected automatically and do not require manual configuration. Nevertheless the network settings can still be configured manually through Tracker Pilot, if necessary.

#### Static IP (point-to-point)

The Static IP connection connects the Application Processor (AP) to the AT Controller 400 through point-to-point configuration. Third-party application software is using the Leica Metrology Foundation (LMF) as low-level interface to the AT Controller 400. The connection requires the following component:

- CAT5 LAN Cable RJ45

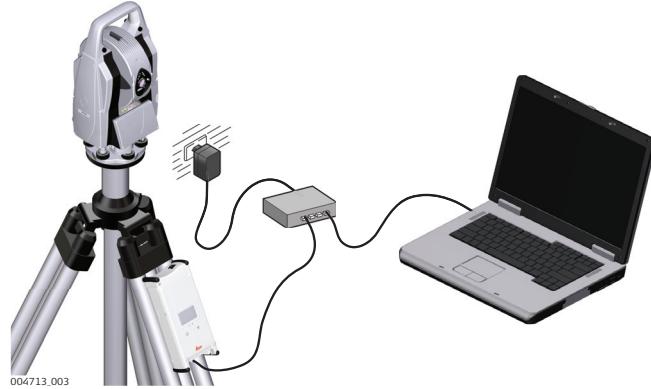


#### Network configuration

The LAN configuration provides a network-based access from the Application Processor to the AT Controller 400.

The connection requires the following components:

- CAT5 LAN Cable RJ45 for the connection between the AT Controller 400 and the network hub.
- CAT5 LAN Cable RJ45 for the connection between the Application Processor and the network hub.
- Hub for LAN connection to AT Controller 400, Application Processor and network.



## 4.2.2

### WLAN Connection

<b>WLAN configuration</b>	As alternative to the wired connection the AT Controller 400 and the Application Processor can be operated in a wireless LAN (WLAN) network. The AT Controller 400 supports the following wireless topologies:
	<ul style="list-style-type: none"><li>• Access Point Mode: The AT Controller 400 serves as Access Point to allow multiple clients to establish a connection. For example, application computer, remote control or multiple Absolute Tracker setups.</li><li>• Connect to an external Access Point: The AT Controller 400 connects as client to an external Access Point. For example, to a company network or as a client to a different Absolute Tracker in the same network.</li></ul>



The setup is similar to the wired configuration. Install and configure the WLAN module for the Application Processor.

- Refer to Tracker Pilot Reference Manual for detailed instructions on setting up a WLAN connection.



For certain countries with special regulations for operating wireless networks the WLAN module will be decommissioned by the factory. The user of the product will not be able to activate the WLAN module in this case. Please contact your local Leica Geosystems representative for further details on wireless network regulations.

## 4.3

### Application Processor

#### Description

The Application Processor runs the application software. The application software must be installed beforehand.

- Refer to the manual of the application software for further details.

## 4.4

### 4.4.1

#### Batteries

#### Operating Principles

#### First-time Use/Charging Batteries

- The battery must be charged before using it for the first time because it is delivered with an energy content as low as possible.
- The permissible temperature range for charging is from 0 °C to +40 °C/+32 °F to +104 °F. For optimal charging, we recommend charging the batteries at a low ambient temperature of +10 °C to +20 °C/+50 °F to +68 °F if possible.
- It is normal for the battery to become warm during charging. Using the chargers recommended by Leica Geosystems, it is not possible to charge the battery once the temperature is too high.

- For new batteries or batteries that have been stored for a long time (> three months), it is effectual to make only one charge/discharge cycle.
- For Li-Ion batteries, a single discharging and charging cycle is sufficient. We recommend carrying out the process when the battery capacity indicated on the charger or on a Leica Geosystems product deviates significantly from the actual battery capacity available.

## Operation / Discharging

- The batteries can be operated from  $-20^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$ / $-4^{\circ}\text{F}$  to  $+131^{\circ}\text{F}$ .
- Low operating temperatures reduce the capacity that can be drawn; high operating temperatures reduce the service life of the battery.
- When operating the system at low temperatures it is recommended to pre-warm the batteries to  $> 0^{\circ}\text{C}$  in advance before booting up the system.
- When operation the system with a battery in the sensor unit AT403 and a battery in the AT Controller 400, the sensor unit will discharge its internal battery first before it switches to draw power from the AT Controller 400 battery.
- It is recommended to charge the battery mounted in the sensor unit in regular intervals to avoid damaging the battery.

### 4.4.2

#### Battery for the AT403 Instrument

##### Change battery step-by-step

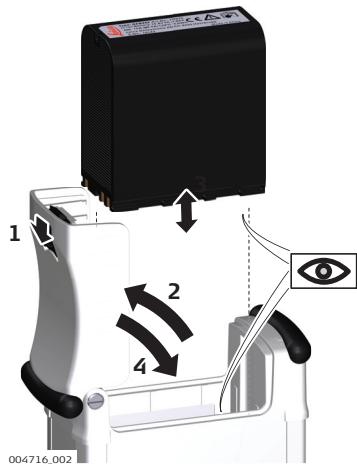


Step	Description
1.	Face the instrument so that the battery compartment is on the left. Turn the knob counterclockwise to the vertical position, opening the lid of the battery compartment.
2.	Pull out the battery housing.
3.	Pull the battery from the battery housing.
4.	A pictogram of the battery is displayed inside the battery housing. This pictogram is a visual aid to assist in placing the battery correctly.
5.	Place the battery into the battery housing, ensuring that the contacts are facing outward. Click the battery into position.
6.	Place the battery housing into the battery compartment. Push the battery housing in until it fits completely into the battery compartment.
7.	Turn the knob to lock the battery compartment. Ensure that the knob is returned to its original horizontal position.

#### 4.4.3

#### Battery for the AT Controller 400

##### Change battery step-by-step



Step	Description
1.	Hold the AT Controller 400 upright with the battery compartment facing up. Unlock the locking lever.
2.	Open the lid of the battery compartment.
3.	Pull the battery from the battery housing and place the new battery into the battery housing, ensuring that the contacts are facing to the correct side. Push the battery into position.
4.	Close the lid of the battery compartment and ensure the lid snaps into the locked position.

#### 4.4.4

#### Hot Swapping

##### Description

The Absolute Tracker system allows to change both batteries during operation without a need to shutdown the system.

##### AT403 battery

When removing the AT403 instrument battery the system software suspends the connection to the sensor unit and tries to reconnect repeatedly until the sensor unit is powered up again. The hot plugging state is communicated through the Tracker Programming Interface (TPI) to the application running on the application processor.

##### AT Controller 400 battery

The AT Controller 400 battery can be exchanged during operation without loosing the connection to the instrument. An internal battery buffers the power for 10 seconds. Within this time the battery needs to be replaced.

Prerequisite: The AT403 instrument needs to be powered by its own sensor unit battery during the hot swap process.

#### 4.5

#### Power over Ethernet (PoE+) Module (optional)

##### Description

The Absolute Tracker system can be powered through Power over Ethernet (PoE).

##### Components

The Power over Ethernet module consists of the following components:

- Power over Ethernet (PoE+) module
- PoE Midspan
- LAN cable, Cat5 straight (red)
- LAN cable, Cat5 crossed (grey)

## Installation



Step	Description
1.	Hold the AT Controller 400 upright with the battery compartment facing up. Unlock the locking lever.
2.	Open the lid of the battery compartment.
3.	Place the Power over Ethernet (PoE)+ module into the battery housing. Ensure to align the arrows on the PoE+ module and on the housing of the AT Controller 400. Push the module into position.
4.	Close the lid of the battery compartment. Ensure the lid snaps into the locked position.
	Ensure to fit a GEB242 battery into the Absolute Tracker AT403 when the system is operated through Power over Ethernet (PoE).
	Ensure to attach the external temperature sensor to the port labelled with "Air" of the AT Controller 400 when the system is operated through Power over Ethernet (PoE).



Disconnect the Midspan from mains power before unplugging or plugging either of the LAN cables!



The total LAN cable length between AT Controller 400 and application computer should not exceed 70 meter.



Refer to "Leica MPS10 PoE+ Set User Manual" for details on installing the PoE+ set.

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<b>Description</b>	<p>Leica Geosystems products are manufactured, assembled and adjusted to the best possible quality. Quick temperature changes, frequent movements of the product, shock or stress can cause deviations and decrease the measurement accuracy. It is therefore recommended to check and adjust (compensate) the product from time to time. This can be done onsite by running through specific sensor check or compensation measurements. If sensor checks do not provide satisfying results repeatedly, a full compensation of the product is recommended.</p> <p>The following product parameters can be checked and adjusted electronically to a product specific parameter file:</p> <ul style="list-style-type: none"><li>• Inclination sensor longitudinal and transversal index correction (L, C)</li><li>• Vertical index, related to the standing axis (i)</li><li>• Hz collimation correction (c)</li><li>• Tilting axis correction (j)</li><li>• ADM Offset (AC)</li></ul> <p> Please refer to "Compensation" or "Sensor Check" in the Tracker Pilot Reference Manual for details on the Sensor Check and Compensation process.</p>
<b>Measurement precision</b>	<p>To achieve precise measurement results in the daily work, it is important to check and adjust (compensate) the product from time to time. During the manufacturing process the product parameters are carefully determined.</p> <p>As mentioned above, these values can change and it is highly recommended to check or adjust the product in the following situations:</p> <ul style="list-style-type: none"><li>• Before the first use of the product</li><li>• Before taking high precision measurements</li><li>• After long transportations</li><li>• After long working periods</li><li>• After long storage periods</li><li>• After mechanical shock of the product, for example drop</li><li>• In a high or low temperature environment</li></ul> <p> Before starting to work the product has to become acclimatised the ambient temperature, especially if the product has been stored under different temperature conditions. Ensure sufficient acclimatisation to the environment before taking precision measurements.</p>

### Adjusting the circular level step-by-step



Step	Description
1.	Place and secure the instrument into the tribrach and onto a tripod.
2.	Level the instrument precisely with the electronic level on the display of the AT Controller 400 using the footscrews.
3.	Check the position of the circular level on the instrument and tribrach.
4.	<p>a) If both circular levels are centred, no adjustments are necessary.</p> <p>b) If one or both circular levels are not centred, adjust as follows:</p>
	<b>Instrument:</b> If the bubble extends beyond the engraved circle, use the supplied allen key to centre it with the adjustment screws. Turn the sensor unit by 180°. Repeat the adjustment procedure if the bubble of the circular level does not stay centred.
	<b>Tribrach:</b> If the bubble extends beyond the engraved circle, use the supplied allen key to centre it with the adjustment screws.
	After the adjustments, all adjusting screws must have the same tightening tension and no adjusting screw should be loose.

## 6

### 6.1

## Care and Transport

### Transport

#### General

The equipment is sensitive to shock, vibration, temperature, humidity and air pressure.

#### 6.1.1

### Transport on Site

#### Laser Tracker

When transporting the equipment onsite, always make sure that you

- either carry the product in its original transport container,
- or carrying the tripod keeping the attached product upright.



#### WARNING

Do not lift the product with a crane.

#### Precautions:

The handles of the product are not designed for crane transport.



#### AT Controller 400

The AT Controller 400 can be transported on site

- either in the main container,
- or attached to the tripod in the tripod mount.

#### Transport in a road vehicle

Never carry the product loose in a road vehicle, as it can be affected by shock and vibration. Always carry the product in its transport container, original packaging or equivalent and secure it.

#### Shipping

When transporting the product by rail, air or sea, always use the complete original Leica Geosystems packaging, transport container and cardboard box, or its equivalent, to protect against shock and vibration.

#### Shipping, transport of batteries

When transporting or shipping batteries, the person responsible for the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping, contact your local passenger or freight transport company.

#### Field adjustment

Periodically carry out test measurements and perform the field adjustments indicated in the User Manual, particularly after the product has been dropped, stored for long periods or transported.

## 6.2

### Storage

#### Product

Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to "7 Technical Data" for information about temperature limits.

#### Protection Cover

The sensor unit and its external optical parts can be protected from dust with the Protection Cover. Use the Protection Cover whenever the Laser Tracker is not in use.

#### Field adjustment

After long period of storage inspect the field adjustment parameters given in this user manual and the Tracker Pilot reference manual before using the product.

## **Li-Ion batteries**

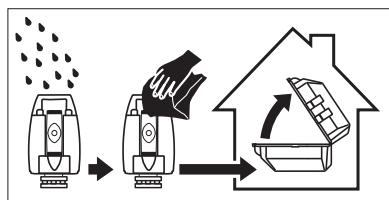
- Refer to "Technical Data" for information about storage temperature range.
- Remove batteries from the product and the charger before storing.
- After storage recharge batteries before using.
- Protect batteries from damp and wetness. Wet or damp batteries must be dried before storing or use.
- A storage temperature range of 0 °C to +30 °C / +32 °F to +86 °F in a dry environment is recommended to minimize self-discharging of the battery.
- At the recommended storage temperature range, batteries containing a 40% to 50% charge can be stored for up to one year. After this storage period the batteries must be recharged.

## **6.3**

### **Cleaning and Drying**

#### **Damp products**

Dry the product, the transport container, the foam inserts and the accessories at a temperature not greater than 40°C/104°F and clean them. Remove the battery cover and dry the battery compartment. Do not repack until everything is completely dry. Always close the transport container when using in the field.



#### **Cables and plugs**

Keep plugs clean and dry. Blow away any dirt lodged in the plugs of the connecting cables.

#### **Battery charger**

Use only a clean, soft, lint-free cloth for cleaning.

## **6.3.1**

### **Cleaning Optical Parts**

#### **General**

Optical elements, like the cover glass and reflectors, are sensitive to dirt moisture and mechanical damage, which may influence the following factors:

- General functionality (loss of tracking)
- System accuracy (angular and distance accuracy)
- Intensity of laser beam (cover glass)

The cleaning intervals depend on the local conditions of use.

The following optical parts must be cleaned regularly:

- Cover Glass
- Retroreflectors



a) Cover glass

## NOTICE

Cleaning of all optical parts requires great care. Improper cleaning can destroy optical surfaces which may lead to a malfunction.

### Precautions:

Only use appropriate cleaning material and follow the cleaning procedure described in this User Manual.

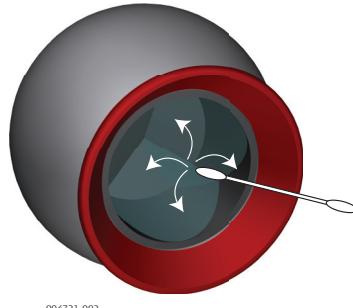
## Cleaning liquid

Use Isopropanol as cleaning liquid to soak tissues or cleaning swabs.

- ☞ Keep the content of the liquid container clean. Do not dip the swabs into the liquid container, pour the liquid onto the swab or tissue.
- ☞ Do not use common liquid cleaners or cleaning tissues for eyeglasses. They can damage or leave a residue on the optical surfaces.

## Cleaning optical parts

To clean optical parts like cover glass, reflectors etc., use the following procedure:



004721\_002

- 1) Use hand blower to clear out dirt.
- 2) Never touch any glass surfaces with your fingers.
- 3) Use a hairbrush to loosen and remove remaining dirt.
- 4) Repeat procedure with the hand blower and brush until the residues of dirt have been removed.
- 5) Use the cotton swabs or cleaning tissues soaked in cleaning liquid to remove any remaining dirt.

## BRR

A special procedure applies for the cleaning of Break Resistant Reflectors.



### CAUTION

For the cleaning of Break Resistant Reflectors (BRR) never use any mechanical force like brushes or cotton swabs to clean the coated surfaces!

### Precautions:

For cleaning of Break Resistant Reflectors (BRR) follow the procedure described in the Product Information delivered with the product.

## 6.4

## Maintenance

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### Service

The product is a high-precision measuring instrument and to be handled with care. Maintenance of the equipment must be carried out by a Leica Geosystems authorised Service Centre.

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### CAUTION

There are no user-serviceable parts inside the product.

#### Precautions:

Do not open the product. Breaking the warranty seals will void the warranty.  
Refer to "1 Safety Directions" for further details.

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### Service Intervals

The periodicity of service intervals is dependent on the conditions of use. We recommend a service contract with a yearly maintenance of the equipment. Please contact your local Leica Geosystems representative for details.

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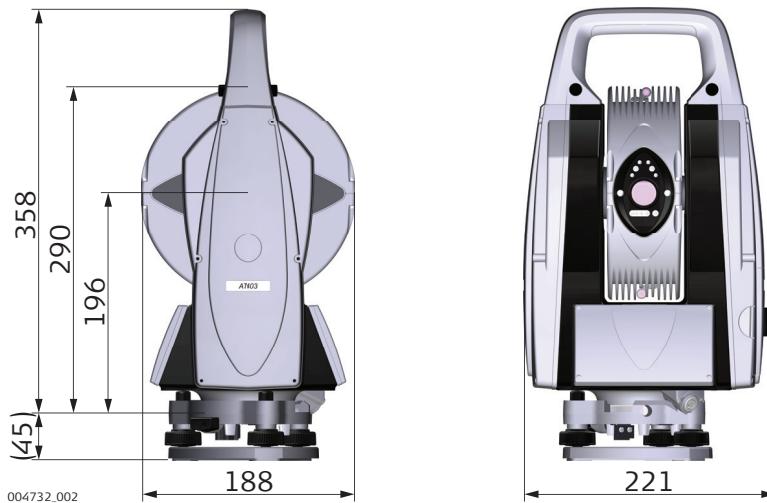
### Repairs

In case of visible damage, system failure or errors, contact your local Leica Geosystems representative.

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**Physical Dimensions**

<b>AT403 instrument</b>	<b>Dimensions</b>
Size	358 mm x 221 mm x 188 mm
Transit Axis height	196 mm
Weight (AT403)	7.3 kg
Weight (internal battery GEB242)	0.43 kg
Weight (tribrach)	0.8 kg
Tribrach thread	5/8" - 11 UNC



<b>AT Controller 400</b>	<b>Dimensions</b>
Size	250 mm x 112 mm x 63 mm
Weight (AT Controller 400)	0.84 kg
Weight (internal battery GEB242)	0.43 kg

<b>AT400 Remote Control</b>	<b>Dimensions</b>
Size	126 mm x 42 mm x 17 mm
Weight (AT400 Remote Control)	0.04 kg
Weight (2 AAA batteries)	0.02 kg

**Sound Pressure Level**

<b>Instrument</b>	<b>Sound pressure level</b>
All instruments	< 70 dB(A)

**Electrical power**

<b>AC/DC Adapter for AT Controller 400 and GKL212</b>	<b>Value</b>
Input Voltage	100 V to 240 V AC
Output Voltage	15.0 V DC
Frequency	50 Hz to 60 Hz
Power	60 W
Max. input AC current	1.7 A
Max. input AC current (over current protection)	4 A

**Battery**

<b>Internal battery GEB242</b>		<b>Value</b>
Type		Li-Ion
Voltage		14.8 V
Capacity		5.8 Ah
Typical operating time (AT403 instrument and AT Controller 400 battery attached)		6 h to 8 h

**Environmental specifications****Temperature**

<b>Type</b>	<b>Operating temperature [°C]/[°F]</b>	<b>Storage temperature [°C]/[°F]</b>
AT403 instrument	-15 to +45/+5 to +113	-25 to +70/-13 to +158
AT Controller 400	-15 to +45/+5 to +113	-25 to +70/-13 to +158
Battery GEB242	-15 to +45/+5 to +113	-40 to +70/-40 to +158

**Humidity**

<b>Type</b>	<b>Protection</b>
All instruments	Max 95 % non condensing The effects of condensation are to be effectively counteracted by periodically drying out the instrument.

**Elevation**

<b>Elevation</b>	<b>Range</b>	
	<b>[m]</b>	<b>[ft]</b>
Operation	-700 to +5500	-2300 to +18000
Storage	-700 to +21000	-2300 to +70000

**Protection against water, dust and sand**

<b>Type</b>	<b>Protection</b>
AT403 instrument	IP54 (IEC 60529)
AT Controller 400 (with rain cover)	IP54 (IEC 60529)

**Meteo Station**

<b>Device</b>	<b>Range (Automatic Reading Mode)</b>
Temperature (internal sensor)	-15 °C to +60 °C/+5 °F to +158 °F
Temperature (external sensor)	-15 °C to +60 °C/+5 °F to +158 °F
Pressure	500 hPa to 1100 hPa
Humidity	0% to 95%

 Between -10 °C and -15 °C the ambient temperature is displayed as integer values only.

<b>Device</b>	<b>Measurement uncertainty</b>	<b>Applicable range</b>
External Air/Object temperature	±0.3 °C	-10 °C to +45 °C/+14 °F to +113 °F
External Air/Object temperature	±1.0 °C	Outside the above mentioned range.
Pressure	±1.0 hPa	0 °C to +40 °C/+32 °F to +104 °F (750 hPa to 1100 hPa)

<b>Device</b>	<b>Measurement uncertainty</b>	<b>Applicable range</b>
Pressure	±2.0 hPa	Outside the above mentioned range.
Humidity	±5% *	-

\* Prerequisite: External air temperature sensor is connected.

#### Overview Camera

<b>Description</b>	<b>Value</b>
Focal length	16.3 mm
Field of view	Hz = 11.1°, V = 8.4° @ 10 m: Hz = 1954 mm, V = 1465 mm
Focus	~ 17 m (55.7 ft)
Aperture	2.5 mm (0.98 in)
Video Output	LAN/WLAN through AT Controller 400
Target Illumination	LED, infrared, invisible

#### WLAN module

<b>Description</b>	<b>Value</b>
Standard	WLAN according to IEEE 802.11n, compatible with IEEE 802.11b/g
Channels	<ul style="list-style-type: none"> <li>• 1 to 11 (for Access Point Mode)</li> <li>• 1 to 13 (for Client Mode)</li> </ul>
Frequencies	<ul style="list-style-type: none"> <li>• 2.412 GHz to 2.462 GHz (for Access Point Mode)</li> <li>• 2.412 GHz to 2.4835 GHz (for Client Mode)</li> </ul>
Data Rate	Up to 150 Mbit/s
Operation Modes	<ul style="list-style-type: none"> <li>• Access Point Mode</li> <li>• Client Mode (connect to external Access Point)</li> </ul>
Encryption	<ul style="list-style-type: none"> <li>• WPA2 PSK</li> <li>• None</li> </ul>
FCC-ID	2AJY6MORIN01
IC	22172-MORIN01

#### AT400 Remote Control

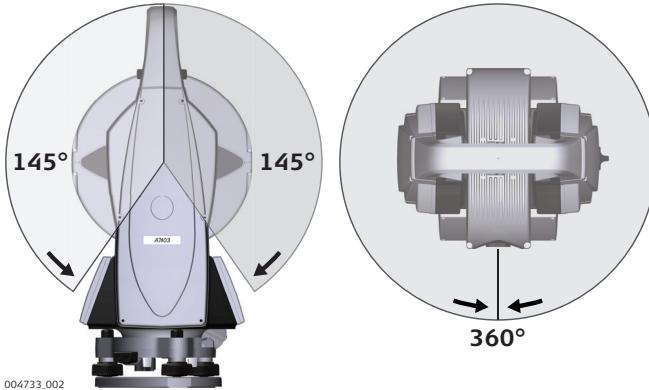
<b>Description</b>	<b>Value</b>
Frequency (Infrared)	38 kHz
Range	0 m to 20 m
Power Supply	2 x 1.5 V AAA Battery

#### Motorisation

<b>AT403 instrument</b>	<b>Value</b>
Maximum acceleration	360°/s <sup>2</sup>
Maximum rotation speed	180°/s
Tracking speed lateral (> 2.5 m)	70 gon/s
Tracking speed radial	Unlimited
Tracking speed dynamic measurements	> 150 mm/s

## Measurement Range

Measurement range	Value
Horizontal	360 deg (endless rotation)
Vertical	$\pm 145$ deg (endless rotation)
Distance (typical)	> 160 m (with selected 1.5" RRR reflectors)
Shortest measurement distance	< 0.8 m



## Data Output Rate

Description	Value
Measurement Data Output Rate	Up to 10 points/s

## Distance Measurement

Description	Value
Working principle	Modulation of Polarization
Resolution	0.3 $\mu$ m
Distance accuracy, 0.8 m to 80 m range	$\pm 10 \mu\text{m}$

## Angular Measurement

Description	Value
Resolution	0.07 arc sec
Angular repeatability, 0.8 m - 80 m range	$\pm 7.5 \mu\text{m} + 3 \mu\text{m}/\text{m}$
Angular accuracy, 0.8 m - 80 m range	$\pm 15 \mu\text{m} + 6 \mu\text{m}/\text{m}$

## Inclination Sensor

Description	Value
Setting accuracy	$\pm 1.0$ arc sec ( $2\sigma$ )
Compensated measuring range for Orient to Gravity (OTG)	$\pm 227$ arc sec
Measuring range	$\pm 616$ arc sec
Compensation method	Length- and crosswise

## 7.1

### 7.1.1

### Conformity to National Regulations

### AT403 Instrument, PoE module, GEB242, AT400 Remote Control

#### Conformity to national regulations



- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product is in compliance with the essential requirements and other relevant provisions of the applicable European Directives. The declaration of conformity may be consulted at <http://www.leica-geosystems.com/ce>.

### 7.1.2

### AT Controller 400

#### Conformity to national regulations



- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product AT Controller 400 with WLAN module is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at <http://www.leica-geosystems.com/ce>.

Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA Member state.

- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law (電波法) and the Japanese Telecommunications Business Law (電気通信事業法).
  - This device should not be modified (otherwise the granted designation number will become invalid).

#### Frequency band

Type	Frequency band [GHz]
WLAN	<ul style="list-style-type: none"><li>• 2.412 to 2.462 (for Access Point Mode)</li><li>• 2.412 to 2.4835 (for Client Mode)</li></ul>

#### Output power

Type	Output power [dBm]
WLAN	+20 dBm (802.11n mode)

#### Antenna

Type	Gain [dBi]
AT Controller 400, WLAN (internal antenna)	0

### 7.1.3

### Dangerous Goods Regulations

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#### Dangerous Goods Regulations

Many products of Leica Geosystems are powered by Lithium batteries. Lithium batteries can be dangerous under certain conditions and can pose a safety hazard. In certain conditions, Lithium batteries can overheat and ignite.

- ☞ When carrying or shipping your Leica product with Lithium batteries onboard a commercial aircraft, you must do so in accordance with the **IATA Dangerous Goods Regulations**.
  - ☞ Leica Geosystems has developed **Guidelines** on "How to carry Leica products" and "How to ship Leica products" with Lithium batteries. Before any transportation of a Leica product, we ask you to consult these guidelines on our web page (<http://www.leica-geosystems.com/dgr>) to ensure that you are in accordance with the IATA Dangerous Goods Regulations and that the Leica products can be transported correctly.
  - ☞ Damaged or defective batteries are prohibited from being carried or transported onboard any aircraft. Therefore, ensure that the condition of any battery is safe for transportation.
-

### Software Licence Agreement

This product contains software that is preinstalled on the product, or that is supplied to you on a data carrier medium, or that can be downloaded by you online according to prior authorisation from Leica Geosystems. Such software is protected by copyright and other laws and its use is defined and regulated by the Leica Geosystems Software Licence Agreement, which covers aspects such as, but not limited to, Scope of the Licence, Warranty, Intellectual Property Rights, Limitation of Liability, Exclusion of other Assurances, Governing Law and Place of Jurisdiction. Please make sure, that at any time you fully comply with the terms and conditions of the Leica Geosystems Software Licence Agreement.

Such agreement is provided together with all products and can also be referred to and downloaded at the Leica Geosystems home page at  
<http://leica-geosystems.com/about-us/compliance-standards/legal-documents>  
or collected from your Leica Geosystems distributor.

You must not install or use the software unless you have read and accepted the terms and conditions of the Leica Geosystems Software Licence Agreement. Installation or use of the software or any part thereof, is deemed to be an acceptance of all the terms and conditions of such Licence Agreement. If you do not agree to all or some of the terms of such Licence Agreement, you must not download, install or use the software and you must return the unused software together with its accompanying documentation and the purchase receipt to the distributor from whom you purchased the product within ten (10) days of purchase to obtain a full refund of the purchase price.

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## Appendix A

## Abbreviations

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### Abbreviations

The following abbreviations may be found in this manual:

Term	Description
ADM	Absolute Distance Meter
AELs	Accessible Emission Limits
AP	Application Processor
AT	Absolute Tracker
BRR	Break Resistant Reflector
CCR	Corner Cube Reflector
EMC	Electromagnetic Compatibility
EN	Standard of the European Committee for Standardization
IEC	International Electrotechnical Commission
Li-Ion	Lithium-Ion
MPE	Maximum Permissible Error
RJ45	Registered Jack 45, standardized physical interface for connecting telecommunication equipment.
RRR	Red Ring Reflector
SMR	Spherically Mounted Reflector
TBR	Tooling Ball Reflector
TCP/IP	Transmission Control Protocol/Internet Protocol
TPI	Tracker Programming Interface

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## Appendix B

## Regional Contact Addresses

### Regional Contact Addresses

<b>People's Republic of China</b> Hexagon Metrology (Qingdao) Co., Ltd. 188 Zhuzhou Road 266101 Qingdao China P.R. China Phone +86 532 8870 2188 Fax +86 532 8870 3060	<b>France</b> Hexagon Metrology SAS Service Client Leica Immeuble Le Viking 32, Avenue La Baltique 91978 Courtaboeuf Cédex France Phone +33 01 69 29 12 00 Fax +33 01 69 29 00 32
<b>Germany</b> Hexagon Metrology GmbH Siegmund-Hiepe-Straße 2 - 12 35578 Wetzlar Germany Phone +49 6441 207 207 Fax +49 6441 207 122	<b>Great Britain</b> Hexagon Metrology Ltd Hexagon House Michigan Drive Tongwell Milton Keynes MK15 8HT Phone +44 (0)870 446 2667 Fax +44 (0)870 446 2668
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