PiCUS TreeQinetic

Manual

With Passion and Precision

IML Electronic GmbH
Erich-Schlesinger-Straße 49D
18059 Rostock | Germany

Telefon: +49 0381 – 49681440

E-Mail: contact@iml-electronic.de
Web: www.iml-electronic.de

This manual is valid for PiCUS TreeQinetic systems of the following versions:

Hardware Version:	min. 0.1.0000
Firmware Version:	min. 0.0.0707
App Version:	1.6
PC-Software Version:	1.1.1.2
Manual version:	v1.0

1 Contents

2 Abbreviations and Agreements 5
3 General Information 5
3.1 Intended Use 5
3.2 Intended application 6
3.3 Disclaimer 6
3.4 Packing list (Starter) 7
4 Measurement devices 9
4.1 Description of system components 9
4.1.1 Com Unit 9
4.1.2 Forcemeter 11
4.1.3 Inclinometer 12
4.1.4 Elastometer 15
4.1.5 Overload-Indicator 17
4.1.6 Cables 19
4.1.7 Transport case 19
4.1.8 TreeQinetic-Hub (Optional) 20
4.1.9 Anemometer Version 1 (Optional) 21
4.1.10 Anemometer Version 2 (Optional) 22
4.2 General operating instructions 23
4.2.1 Environmental Conditions 23
4.2.2 Modul addresses 23
4.2.3 Automatic self-shutdown 24
4.2.4 Charging 24
4.2.5 Maintenance 25
4.2.6 Spread of Infections 25
4.3 Calibration 25
5 Software 26
5.1 General Notes 26
5.2 App 26
5.2.1 Installation 26
5.2.2 App-Start 26
5.3 PC-Software 27
5.3.1 Installation 27
5.3.2 Starting the Software 27
5.4 Differences between PC-Software and App 28
5.5 User Interface Concept 28
5.5.1 General 28
5.5.2 Context menu for list elements 29
5.6 Tab – Control 30

5.6.1 Page – Com Unit 30
5.6.2 Page – Settings 31
5.6.3 Page – Calibration 31
5.6.4 Page – Info 31
5.7 Tab – Project 32
5.7.1 Page – Management 32
5.7.2 Page – Tree data 32
5.7.3 Page – Tree height measurement tool 34
5.7.4 Page – Test setup 35
5.7.5 Page – Forcemeter 37
5.7.6 Page – Elastometer 37
5.7.7 Page – Inclinometer 38
5.7.8 Page – Anemometer 38
5.7.9 Page – Compass measurement tool 39
5.7.10 Determining Orientation without Compass Tool 40
5.8 Tab – Measure 41
5.8.1 Page – Control 41
5.8.2 Page – Live Numeric View 42
5.8.3 Page – Live Chart View 43
5.9 Tab – Data View 44
5.9.1 Page – Result 44
5.9.2 Chart Control 44
5.9.3 Page – Forcemeter 45
5.9.4 Page – Elastometer 45
5.9.5 Page – Inclinometer 45
5.9.6 Page – Anemometer 45
5.10 Additional Information / Background processes 46
5.10.1 Wireless Communication Interruption 46
5.10.2 Vibration Alert 46
5.10.3 Internal Calculations 47
5.11 Data Management 48
5.11.1 Project Structure 48
5.11.2 Data Transfer 49
5.11.3 Compatibility with Arbostat 52
6 Technical Information 53
6.1 PTQ Com Unit 53
6.2 PTQ Forcemeter 53
6.3 PTQ Inclinometer 54
6.4 PTQ Elastometer 54
6.5 PTQ Overload indicator 55

6.6 Bluetooth 5 - USB-Dongle 55
6.7 PTQ case 55
6.8 Requirements mobile devices 55
6.9 Requirements PC 55

2 Abbreviations and Agreements

PTQ	PiCUS TreeQinetic = Name oft he whole system
PTQ.App	Measurement software for use on mobile devices running Android or iOS
PTQ.Software	The PC-Version of the PTQ Software
Module/ Measurement device/ Sensor	Part of the PTQ system, it can refer to elastometers, inclinometers, forcemeters, or anemometers
PTQ Com unit/Central unit	Communication unit, the central control unit of the PTQ system, controls the measurement process, connects the modules to a PC or mobile device (data transfer), and serves as a charger for the modules

Inputs and displays in an app on the mobile phone, in software on the PC, or markings on the outside of a device are presented in **`bold and in Courier font`** in this manual.

This manual is valid for both the ***PTQ.Software*** and the ***PTQ.App***. Where there are significant differences between the two software versions or when referring to only one of the program versions, this is highlighted in color. When only “software“ is mentioned, both variants are meant.

Cross-references to other chapters of this manual or references to external sources are written in *italics and underlined*.

Important notes on potential errors and sources of danger are highlighted in ***bold and italic text***.

General notes are written in *plain italic text*.

3 General Information

This chapter deals with general information.

3.1 Intended Use

PiCUS tree measurement technology provides arborists with comprehensive diagnostic tools for the detection and assessment of defects in trees. The tree static pull test is currently the only method that allows conclusions to be drawn about both uprooting stability and breaking safety. PiCUS TreeQinetic measuring devices are optimized for conducting such pull tests and provide the necessary data foundation for safety calculations.

When using the system, it is important to adhere to the environmental conditions specified in the General Operating Instructions and Technical Information. Otherwise, the error-free operation of the system cannot be guaranteed.

The PiCUS product family represents measuring devices that not only provide precise results but are also designed to accompany users in the field for a long time with reliability. They are built to be correspondingly robust. However, they are highly sensitive electronic measuring instruments. Careful handling that takes this into account reduces failures and maintenance efforts, significantly increasing their lifespan and reliability.

3.2 Intended application

The PiCUS TreeQinetic System is intended for use as measurement technology in tree static pull tests. In a pull test, the tree under examination is subjected to a controlled load using a measured force, while the reaction of the trunk and roots to this load is recorded. The tree's response to the known load is compared to the expected wind load during a storm, and this ratio expresses its stability or break safety. The TreeQinetic system provides the user with the data needed to make calculations regarding tree statics.

The Forcemeter is used to record the force introduced into the tree and should be installed between the tree and the entire pulling apparatus. It is designed for loads of up to 60 kN (approximately 6 tons). The Forcemeter should only be attached using the shackles provided with it or those approved by the manufacturer.

The Elastometers measure the change in length between the two measurement points. They are attached to the provided needles, which are driven into the measuring body with the gauge. Elastometers are designed to measure elastic deformations or compressions in the range of up to several hundred micrometers.

Inclinometers detect the inclination of the tree part to which they are attached. First, the Inclino bracket is attached, and then the measuring device is mounted and aligned on it.

The radio central unit is intended to allow the reception and recording of measurement data at a safe distance from the tree in case of unforeseen failures.

The overload indicator assists the responsible person in terminating the non-destructive pull test in a timely manner.

In general, all components of the PiCUS TreeQinetic system communicate wirelessly. Should individual or all connections be disrupted or interrupted, replacement cables are included.

All PiCUS TreeQinetic sensor components are designed to measure fine movements and should never be subjected to impacts or falls. Only mount measuring devices when the respective holders are securely in place. Install the measuring equipment after the rope is in place and disassemble the measurement technology first to avoid contamination and damage during other work.

3.3 Disclaimer

The use of the PTQ on objects other than trees is not intended and may result in damage to the measuring devices or the object being measured.

The measurement results always require interpretation by qualified professionals.

Conclusions about the tree's condition derived from the measurement data and analyses generated with the PTQ are the sole responsibility of the person making those conclusions. Neither the manufacturer nor the seller can be held liable for the consequences arising from the use of the PTQ.

Damage to the equipment resulting from improper handling is not covered by the warranty. It is strongly recommended to handle all PTQ components with due care to keep them operational for an extended period.

All technical specifications are subject to change without notice.

3.4 Packing list (Starter)



Nbr.	Description	count
1	Transport case	1
2	Com Unit	1
3	Forcemeter	1
4	Inclinometer	1
5	Elastometer	1
6	Elastometer needles	10
7	Gauge for Elastometer needles	1
8	Overload indicator	1

Table 1: Packing list PTQ Starter Part I



Nbr.	Description	count
9	Measurement software and digital manual (USB stick)	1
10	Bluetooth 5 - USB-Dongle	1
11	Magnetic holder (inside the lid behind the foam mat)	2
12	Hex bit for Torx screws (T20x70)	1
13	Attachment screws for magnetic holder (with Torx drive)	4
14	Clear plastic box, screwable (for screws, bits, and needles)	1
15	PTQ charge cable	3
16	PTQ USB cable	1
17	Data cable 5 m (not usable for charging)	2
18	Data cable 30 m (Forcemeter, not usable for charging)	1
19	Shackles (Forcemeter)	2
20	Pliers for Elastometer needles (blind rivet pliers)	1
21	Charging adapter	1
22	IEC power cable	1

Table 2: Packing list PTQ Starter Part II

4 Measurement devices

4.1 Description of system components

This chapter provides an overview of the components, structure, and functions of the PiCUS TreeQinetic.

4.1.1 Com Unit

4.1.1.1 Device description

The PTQ Com Unit is the heart of the system. It sends command signals to the sensor modules, receives measurement data from them, and transmits it to the computer or mobile device. Furthermore, the Com Unit also serves as a charging distributor for the starter system.

NOTE:
There are different generations of Com Units. Only the version manufactured from mid-2020 onwards (recognizable by serial numbers ending in -BT5) is capable of communicating with mobile devices! To ensure communication with older computers, USB adapters for BT5 are included with those devices.



Nbr.	Description	Function
1	Charging channel / Data input	During charging, a sensor module can be connected with the charging cable (45 cm). If a cable connection is required during the measurement, a sensor module can be connected using a data cable.
2	DC-IN charge input	Connector for charging adapter
3	USB-connector	Connection for USB cable to the PC
4	**ESC** or **ON/OFF** button	Menu control or turning on/off the Com Unit
5	**Arrow** buttons	Menu control
6	**OK** button	Menu control
7	Display	Displays the status of the connected sensor modules
8	Radio antenna	Connection to the modules
9	Bluetooth antenna	Wireless connection to the PC

Tabelle 3: PTQ Com Unit: control- and display elements

4.1.1.2 Operation

The PTQ Com Unit is turned on or off by briefly pressing and holding the **ON/OFF** button. The display shows device information and the serial number after startup. After the device search is completed, the connected modules are listed in the display, sorted by device type.

The individual measuring devices (Elastometer, Inclinometer, Forcemeter, Anemometer) can be connected to the PTQ Com Unit via a wireless connection or a cable connection. Multiple modules with mixed connections can be used simultaneously.

Connect via radio:
- Turn off module
- Remove cable
- Turn on module

If measuring devices are turned on without a connected cable, they will start immediately in wireless mode.

Connect via cable:
- Turn off module
- Connect cable between module and PC
- Turn on module

The TreeQinetic system can be connected to a PC via Bluetooth or USB through the Com Unit.

Operation via USB
- Turn off Com Unit
- Use USB-cable to connect Com Unit with a USB-port of your PC
- Turn on Com Unit

Launch the measurement software after establishing the connection with the PC.

Operation via Bluetooth:
- Turn off Com Unit
- Remove USB-cable from the Com Unit
- Turn on Com Unit

If the Com Unit is turned on without a connected USB cable, it will start immediately in Bluetooth mode.

4.1.1.3 Wireless range

The range achievable with the Bluetooth connection from the Com Unit to the PC or mobile device is highly dependent on the Bluetooth module used in the respective device. The PTQ Com Unit and the included Bluetooth 5 USB dongle are both Long Range capable, which means that ranges of up to 50 meters can be achieved depending on environmental conditions. If a device is used that is only Short Range capable, the maximum achievable wireless range is 10 meters (strongly dependent on environmental conditions).

The wireless mode is displayed in the screen and the app (see *5.6.1 Page – Com Unit*). When available, Long Range is automatically selected.



BT5 - Long Range



BT5 - Short Range

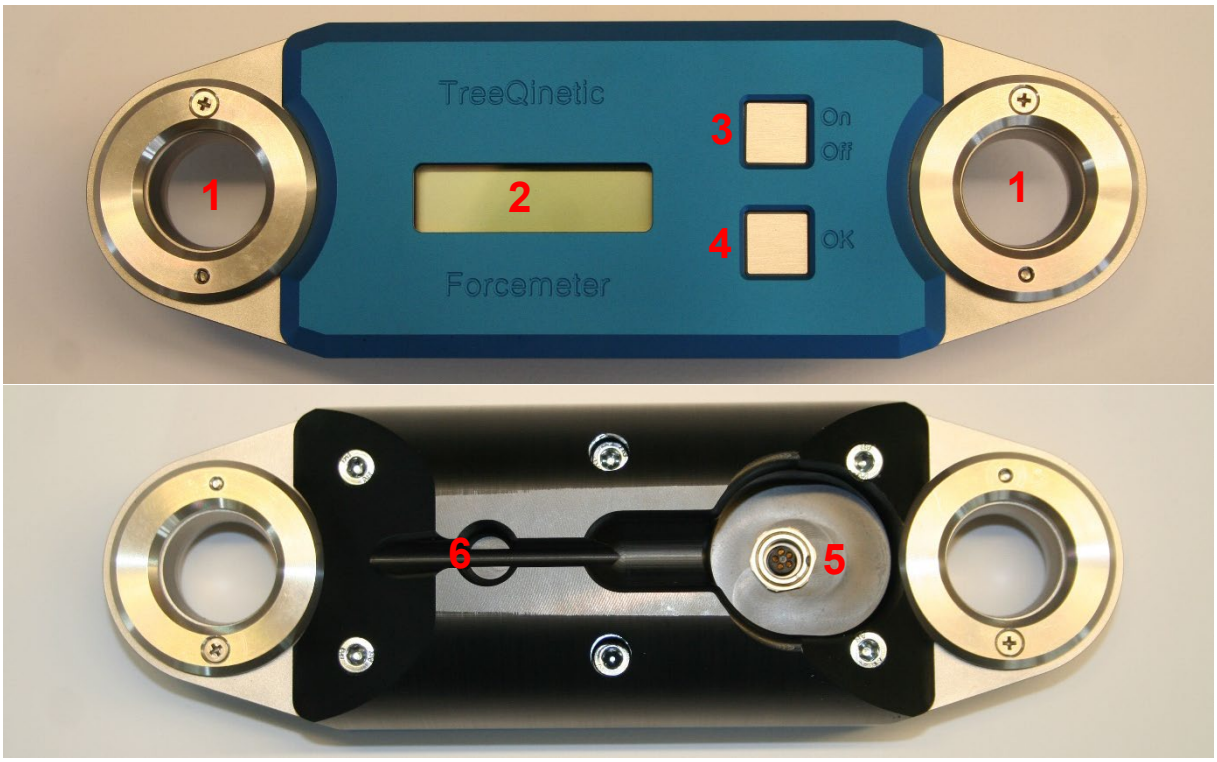


BT4.2 - Short Range

4.1.2 Forcemeter

4.1.2.1 Device description

The PTQ Forcemeter is installed in the rope assembly and measures the pulling force applied to the tree.



Nbr.	Description	Function
1	Attachment eyes	Connection point for shackles. Intended for use exclusively with the recommended steel shackles!
2	Display	Menu display
3	**ON/OFF** button	Turning on / Turning off
4	**OK** button	Menu control
5	Cable connector	Connection for charging cable or data cable
6	Relief screw	Strain relief for Forcemeter cable (cable channel)

Table 4 – Forcemeter: Control and display elements

4.1.2.2 Operation

The Forcemeter is turned on or off by briefly holding the **ON/OFF** button. The display shows the current measurements for force and rope angle, as well as the battery voltage and the module address.

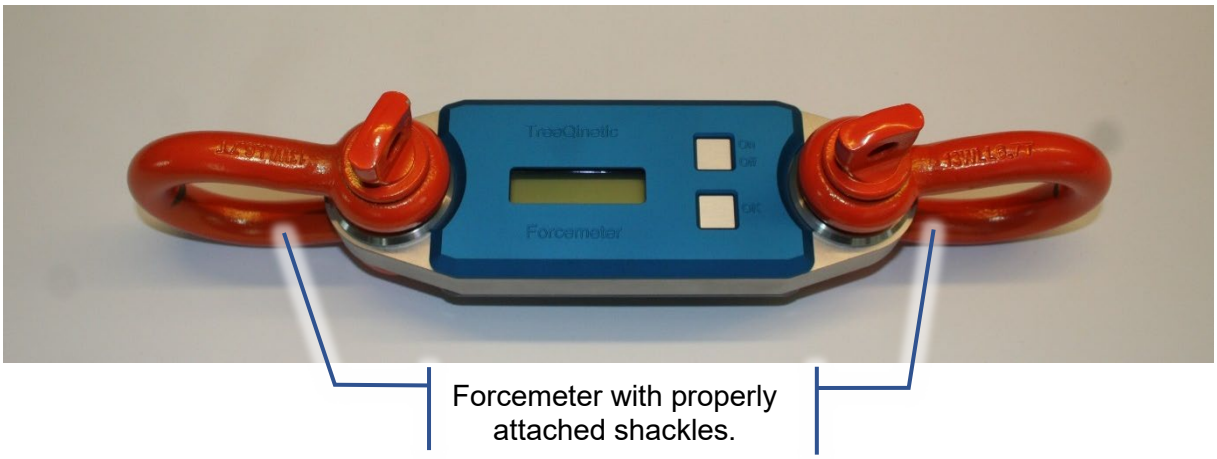
By pressing the **OK** button once, the Forcemeter enters the offset mode ('zeroing'). A further press of the **OK** button initiates a five-second calibration cycle of the offset value. In most applications, it is recommended to determine the offset value for all modules simultaneously by a command from the Com Unit. This should ideally be done immediately before the actual measurement, and the software can perform this automatically. There should be no load on the Forcemeter when setting the offset value ('zeroing').

If the **OK** button is held for 3 seconds, the Forcemeter enters the address menu. Here, the module address can be set by pressing the **OK** button. To save the set address, the **OK** button must be held for three seconds.

4.1.2.3 Installation

To attach the Forcemeter, one of the provided steel shackles is attached to each side. The threaded pin goes into the hole in the Forcemeter housing. The attached spacer rings center the Forcemeter; they are not designed to bear loads. The shackles are used to connect the pulling rope on one side and the tree on the other side to the measuring device.

CAUTION!
The Forcemeter is exclusively designed for use with the provided steel shackles! All other attachment tools such as carabiners, ropes, eyelets, hooks, so-called soft shackles, etc., can lead to incorrect measurement results and damage the shackle attachment, especially the fastening of the round spacer rings!



Forcemeter with properly attached shackles.

4.1.3 Inclinometer

4.1.3.1 Device description

PTQ Inclinometers measure the inclination of the tree part to which they are attached, typically at the base of the trunk. The measurement data from an Inclinometer can be used to perform calculations related to the tree's uprooting stability.

CAUTION!
Inclinometers exhibit a temperature drift, meaning that the displayed value changes with the temperature of the sensor.
It is recommended to allow the Inclinometers to acclimate to the local temperature before the measurement. 'Zeroing' should be done immediately before each pull. Protecting the inclinometers from direct sunlight during the measurement can help eliminate drift effects.



Nbr.	Description	Function
1	Display	Menu display
2	Direction indicator	Indicates the direction of inclination
3	**ON/OFF** button	Turning on / Turning off
4	**OK** button	Menu control
5	Status-LED	Blinks during the measurement
6	Ball magnet	Attachment and alignment on the magnetic holder
7	Cable connector	Connection for charging cable or data cable
8	Antenna	Wireless connection

Tabelle 5 – Inclinometer: Control and display elements

4.1.3.2 Operation

The Inclinometer is turned on or off by briefly holding the **ON/OFF** button. The display shows the current measurement value, as well as the battery voltage and the module address. After turning it on, the firmware version, module address, and the individual serial number of the respective measuring device are temporarily displayed.

Pressing the **OK** button once activates the direction indicator for aligning the Inclinometer. **Adjust** is displayed on the screen. The inclinometer must now be horizontally aligned so that the direction indicator blinks continuously in green at a fast rate. If any of the LEDs on the direction indicator are red, the device is tilted too much in that direction.

Another press of the **OK** button initiates a five-second calibration cycle ('zeroing') of the offset value. In most applications, it is recommended to determine the offset value for all modules simultaneously by a command from the central control unit. This should ideally be done immediately before the actual measurement, and the software can perform this automatically.

If the **OK** button is held for 3 seconds, the inclinometer enters the address menu. Here, the module address can be set by pressing the **OK** button. To save the set address, the **OK** button must be held for three seconds.

4.1.3.3 Installation

Inclinometers are connected with the ball on the back to a magnetic holder. The continuously adjustable guidance of the ball allows the inclinometer to be precisely aligned before the measurement. This means that the front side with the display is level, and the measurement values in the X and Y directions show zero with small decimal values.

The attachment of the holder must be completed before connecting the sensitive measuring device to it. The Inclinometer is removed before dismantling the holder.
Mechanical loads, such as those occurring during the attachment or removal of the magnetic holder, must not be applied to the measuring device!

There are two different versions of these magnetic holders. The newer design is pressed against the desired location on the bark and secured with a countersunk screw. Tightening the screw pulls the three tips against the surface, preventing slipping and twisting. The type of screw used should be adapted to the tree species and the intended use.



New magnetic holder, secured with a countersunk screw.

The older design is driven into the tree with two pointed spikes. It must be ensured that the holder, and thus the measuring device, is securely attached. The spikes are pulled out by gently levering under the base plate. Excessive tilting should be avoided, as it may cause the spikes to bend.

CAUTION!
Permanent magnets are very brittle and can be easily damaged by mechanical stress! Magnets should never be directly struck with a hammer; instead, the provided plastic protective cover should be used.



Attaching the Inclinometer holder: Before driving it in, place the protective cap over the magnet.

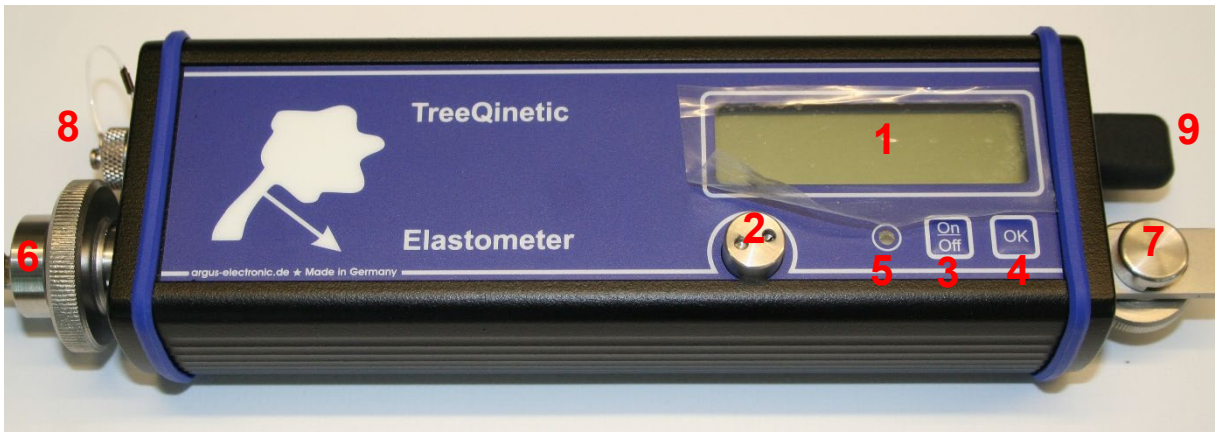


Remove the magnetic holder by gently levering it off. It is recommended to alternate between both sides while levering.

4.1.4 Elastometer

4.1.4.1 Device description

The PTQ Elastometer measures the change in the length of the wood fibres to which it is connected. This change in length can be both positive (extension) and negative (compression).



Nbr.	Description	Function
1	Display	Menu display
2	**Locking button**	Physical lock that secures the mechanical components during transportation and assembly
3	**ON/OFF** button	Turning on / Turning off
4	**OK** button	Menu control
5	Status-LED	Blinks during the measurement
6	Upper needle clamping bracket	Attachment to the upper needle
7	lower needle clamping bracket	Attachment to the lower needle
8	Cable connector	Connection for charging cable or data cable
9	Antenna	Wireless connection

Table 6 – Elastometer: Control and display elements

4.1.4.2 Operation

The Elastometer is turned on or off by briefly holding the **ON/OFF** button. The display shows the current measurement value, as well as the battery voltage and the module address. After turning it on, the firmware version, module address, and the individual serial number of the respective measuring device are temporarily displayed.

Pressing the **OK** button once switches the Elastometer to the offset mode ('zeroing'). Another press of the **OK** button initiates a five-second calibration cycle of the offset value. In most applications, it is recommended to determine the offset value for all modules simultaneously by a command from the central control unit. This should ideally be done immediately before the actual measurement, and the software can perform this automatically.

If the **OK** button is held for 3 seconds, the Elastometer switches to the address menu. Here, the module address can be set by pressing the **OK** button. To save the set address, the **OK** button must be held for three seconds.

Elastometers feature a mechanical locking mechanism for the actual measuring apparatus. When the **locking button** on the back (the side opposite the display) protrudes, the mechanism is locked. When the **locking button** protrudes on the display side, the mechanism is free and ready for measurement.

4.1.4.3 Installation

To attach an Elastometer to a tree, a pair of Elastometer needles, a needle gauge, and a hammer are needed. The needles are inserted into the gauge so that the tips point away from the handle and towards the tree. The guide is positioned where the Elastometer is to be attached, and then the needles are driven in at the specified distance provided by the gauge. The needles must be securely attached to the wood (xylem) to ensure the transfer of fibre length change to the measuring device. The gauge is then carefully removed.

CAUTION!
The needles must not be further driven in while the sensitive Elastometer is connected to them!

The locked Elastometer is placed on the lower needle using the lower needle holder (movable side of the mechanism) and initially held slightly tilted to the right. The underside of the display faces the tree. A slight tilting movement brings the upper needle holder closer to the upper needle. If the distance between the needles is correct, the holder aligns precisely. The Elastometer is positioned so that the holders come as close to the tree as possible without the device touching the tree.

The lower and upper knurled screws are tightened by hand to secure the measuring device. After tightening, the locking can be released. This should be done without significant resistance or tension.


Drive in the needles



Attach the Elastometer


Release the locking

The first measurement value of the Elastometer (before zeroing) should be in the range of at most a few hundred µm. If the value is above 1000 µm, the device has not been attached with sufficient precision.



To remove the needles without causing damage, blind rivet pliers (3.1 mm) should be used.

4.1.5 Overload-Indicator

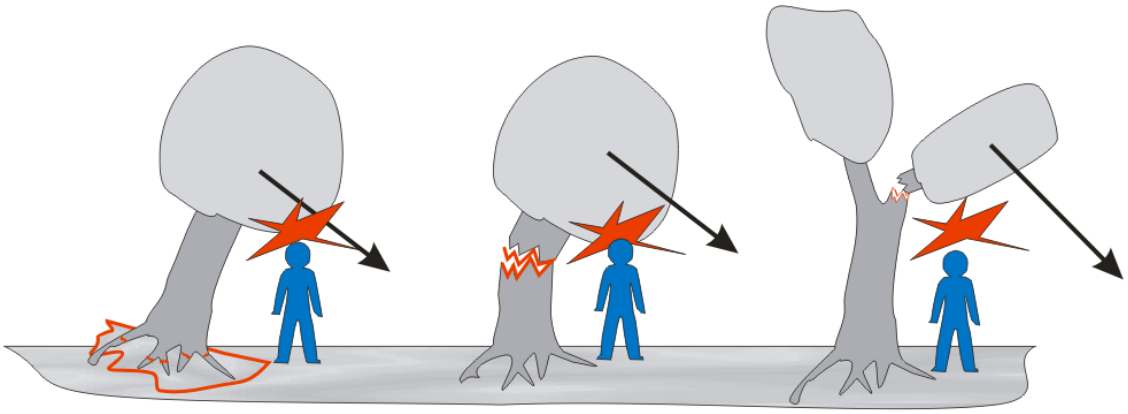
4.1.5.1 Safety first!

The static tree pulling test is an established method for assessing the stability and break safety of trees. However, conducting such a test requires a high level of expertise, experience, and care.

When applying large forces to the tree, extreme caution must be exercised because sudden and unexpected structural failure of the tree could result in it falling, in whole or in part, onto nearby individuals or infrastructure (vehicles, buildings, etc.).

Severe injuries or death can result from individuals being struck by parts of a falling tree!

In addition to personal injuries, incorrect application of the pull test can also cause irreparable damage to the tree itself. The tree could be uprooted, the trunk could break, or branches could be torn off.



Therefore, make absolutely sure that there are no individuals in the immediate danger zone during the execution of a pull test.

Always be sure to use the PTQ overload indicator when conducting tree pulling tests with the PiCUS TreeQinetic measuring system.

*Due to its nature, the PTQ overload warning device **cannot prevent** sudden structural failure of the tree.*

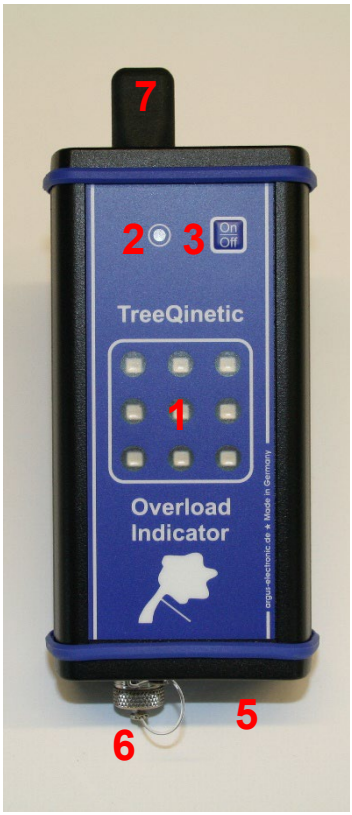
However, it can assist by providing audible and visual warnings to the winch operator, who typically cannot continuously monitor the measurement values, to prematurely and immediately abort the pull test when exceeding adjustable warning thresholds.

4.1.5.2 Device description

The PTQ overload indicator provides clear visual and audible signals when the upper limits of the allowable measurement values in the pull test are reached and exceeded by the other modules.

Nbr.	Description	Function
1	Flashlights	Optical warning
2	Status-LED	Status display
3	**ON/OFF** Taste	Turning on / Turning off
4	Ball magnet	Attachment and alignment on the magnetic holder (on the back side)
5	Speaker	Acoustic warning
6	Cable connector	Connection for charging cable or data cable
7	Antenna	Wireless connection

Table 7 – Overload indicator: Control and display elements



4.1.5.3 Operation

WARNING!
Do not look directly at the flashing lights during startup!
The overload indicator is turned on or off by briefly holding the ON/OFF button.
The flashing lights also indicate the measurement status.

- Blue blinking indicates the standby mode, where the device is not receiving data.
- Green light means that the indicator is connected to the system, and no measurement value exceeds the set limit.
- Red flashing, along with the alarm sound, signals that one or more measurement values exceed the set limits.

The limits are managed in the measurement software of the connected computer or the app on the mobile device.

NOTE:
In older systems, overload indicators are not displayed in the list of connected devices. If the indicator displays green at the beginning of the test, it is properly connected.

A red status LED indicates a weak battery.

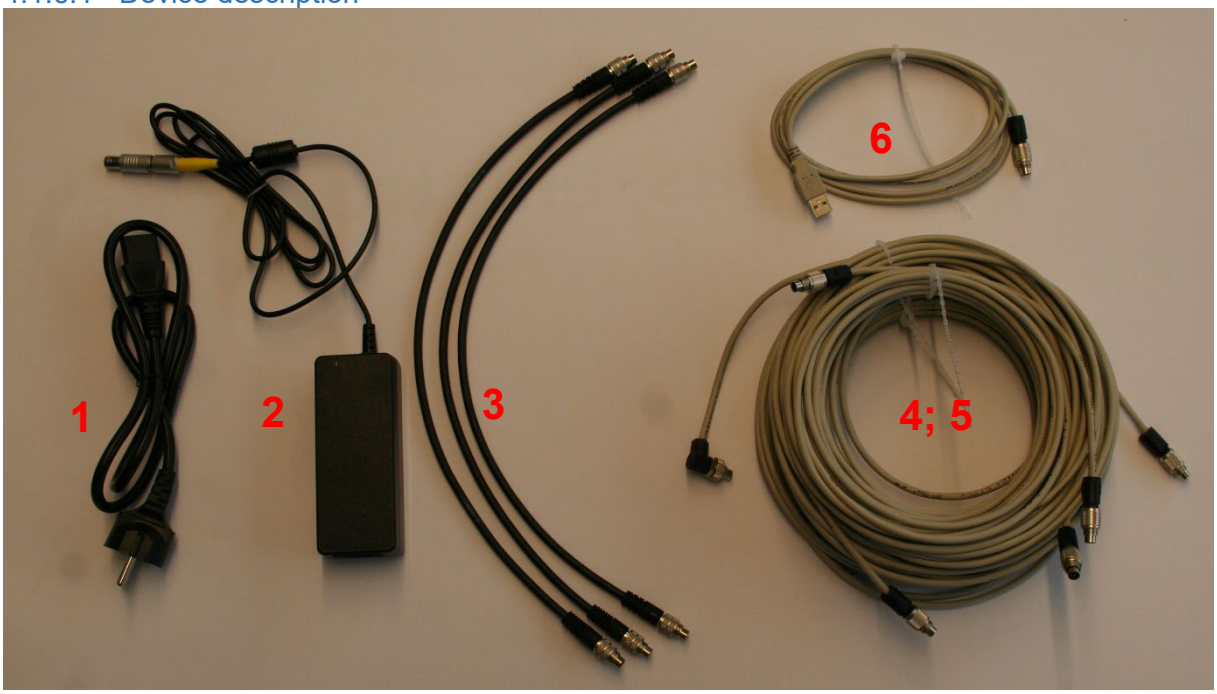
4.1.5.4 Installation

Overload indicators are attached to the tree using magnetic holders. However, since the overload indicators do not record any measurements themselves, other mounting locations are also possible.
They should always be positioned with a clear line of sight to the winch operator.

The magnetic holder must be attached before connecting the overload indicator. Before removing the magnetic holder, the overload indicator should be removed.
Mechanical stress that occurs during the attachment or removal of the magnetic holders should not affect the overload indicator!

4.1.6 Cables

4.1.6.1 Device description



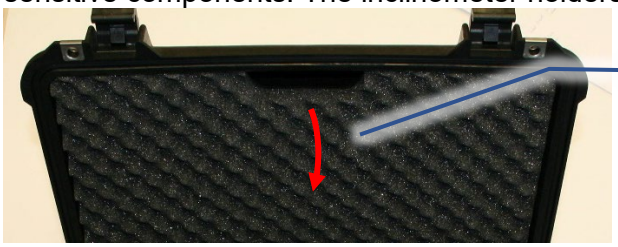
Nbr.	Description	Function
1	IEC power cable	Connects the tabletop power supply to the power source
2	Tabletop power supply	Provides power to the central unit or the PTQ Hub
3	Charging cable	Connects the modules to the central unit or the PTQ Hub
4	Data cable (5 m)	Connects the Elastometer or Inclinometer to the Com Unit for data transmission. Do not use for charging!
5	Data cable (30 m)	Connects the Forcemeter to the Com Unit for data transmission. Do not use for charging!
6	USB cable	Data backup for transferring data from the central unit to the PC (no charging!)

Tabelle 8 – Supplied Cables and their use

We offer additional charging and data cables as well as desktop power supplies as optional accessories to provide maximum convenience and reliability for your customized device setup, both for charging (see also *4.1.8 TreeQinetic-Hub (Optional)* and *4.2.4 Charging*) and field use.

4.1.7 Transport case

The PTQ is delivered in a convenient equipment case, which includes suitable holders for all sensitive components. The inclinometer holders can be stored in the lid.



Additional components are stored behind the foam mat in the lid. The upper edge can be folded forward.

The equipment case is lightweight, very sturdy, and waterproof. It's equipped with a pressure relief valve, making it suitable for air travel, and it has two metal eyelets for securing it with locks to prevent unauthorized access.

4.1.8 TreeQinetic-Hub (Optional)

4.1.8.1 Device description

Optional accessories for extended TreeQinetic systems include the TreeQinetic Hub. Its primary purpose is to charge up to eight PTQ modules simultaneously. However, this device can also serve as a data cable distributor during measurements, allowing you to connect more than three modules to the central unit.



Nbr.	Description	Function
1	Power input connector	Connects to the desktop power supply
2	Module connectors	connect the modules using the charging cables
3	Data cable connector	Used for a data connection to the Com Unit

Table 9 – PTQ Hub: connectors



In older systems, data cable distributors are sometimes used. Unlike the TreeQinetic Hubs, data cable distributors ***CANNOT*** be used for charging the modules.

4.1.8.2 Operation

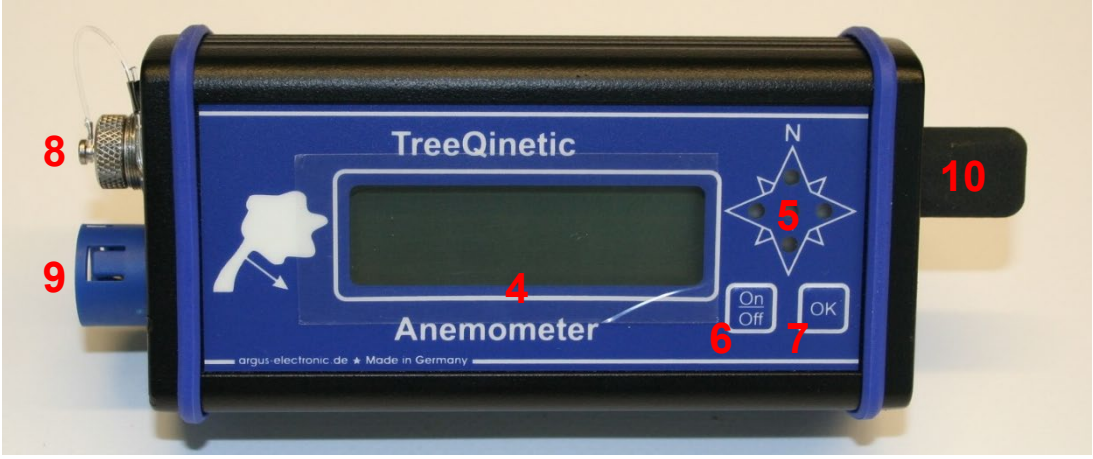
To charge up to eight modules, connect the desktop power supply to the DC-IN socket. The modules to be charged are connected to the eight sockets using the short charging cables. The communication unit is still charged directly with the desktop power supply.

For data transfer, connect the modules to the eight sockets using the long data cables. Connect the eight-fold charger to one of the data inputs of the communication unit with a data cable at the COM socket.
The tabletop power supply is not necessary for data transfer.

4.1.9 Anemometer Version 1 (Optional)

4.1.9.1 Device description

Wind measuring device for use with the PiCUS TreeQinetic. If, instead of the usual pull test, the effect of the wind on the tree is to be investigated, this anemometer is used to record wind parameters while Inclinometers and Elastometers record the tree's response. The wind measuring device is set up near the tree and transmits the current local wind speed for recording on the end device during the measurement.



Nbr.	Description	Function
Measurement unit (without picture)		
1	Anemometer	Cup anemometer for measuring wind speed
2	Wind Vane	Detects wind direction
3	Traverse	Mounting unit for attaching the measurement device to a mast
Transmission unit		
4	Display	Menu display
5	Direction indicator	Shows current wind direction
6	**ON/OFF** button	Turning on / Turning off
7	**OK** button	Menu control
8	Data Cable Connection	Connects the data cable for data transmission to the Com Unit (optional).
9	Measurement Unit Connection	Connects the cable of the measurement unit (mandatory)
10	Antenna	Used for wireless communication

Table 10 – Anemometer: Control and display elements

4.1.9.2 Operation

The anemometer is turned on or off by briefly holding the **ON/OFF** button. The display shows the current measurement value, battery voltage, and module address.

If you hold the **OK** button for 3 seconds, the anemometer enters the address menu. Here, you can set the module address by pressing the **OK** button. To save the configured address, hold the **OK** button for three seconds.

4.1.9.3 Installation

The actual measuring unit is typically attached to the optionally available 10-meter telescopic mast. The north marking must be observed and aligned to North. The pictured transmission unit can be attached to the mast near the ground for easier operation. Both components are connected using the cable of the sensor unit.

4.1.10 Anemometer Version 2 (Optional)



A newer version of the anemometer has been available since 2021. It is more compact and user-friendly. However, the basic function remains the same.

This device comes with a separate manual for instructions.

4.2 General operating instructions

4.2.1 Environmental Conditions

The PiCUS TreeQinetic System is designed for measurements under field conditions. However, it is essential to consider environmental conditions when using these highly sensitive instruments.
The recommended temperature range is 0 - 40 °C.

Attention:

Wood properties are influenced by various factors, with temperature being a crucial one. If the temperature falls below 0°C (32°F, 273 K) for an extended period, wood properties can change significantly. Therefore, measurements cannot be conducted during or immediately after periods of severe frost!

The TreeQinetic components do not have an IP rating, meaning they are not considered waterproof. While they may withstand light rain over the usual duration of a measurement, it is essential to ensure that water does not enter the housing.
Particularly, the Elastometers have necessary openings for the mechanical components that need to be protected from the ingress of dirt and water.

CAUTION!
If water enters the housings, it can cause severe damage to the electronics!

Direct sunlight on the sensors causes heating of the components and a minimal, material-specific change in size of the components. Data recorded during temperature changes can exhibit a phenomenon called temperature drift. The Inclinometer sensors are particularly affected by this. Make sure to calibrate the devices immediately before taking measurements, so that no further displacement occurs before collecting the data. If necessary, provide shade for Inclinometers during the test.

Protect the devices from avoidable contamination, moisture, and mechanical stress whenever possible. The waterproof case can be useful in this regard. Also, protect the instruments from falls and impacts during transportation and while they are inside the equipment case.

4.2.2 Modul addresses

Each sensor module has a unique address for identification in the measurement software and data storage. Each address is unique within a measurement system and consists of a device type (**X**) and module number (**Y**), preceded by a hash symbol: **#XY**.

*Each address is associated with a colour based on its second digit (**Y**), which typically corresponds to the colour of the seals on the housing. Therefore, it is not recommended to change the address.*

The colour assignment is as follows:

#X0 blue	**#X5 blue**
#X1 yellow	**#X6 yellow**
#X2 red	**#X7 red**
#X3 green	**#X8 green**
#X4 black	**#X9 black**

To change the address, turn on the device you want to change the address for. Hold down the OK button until **`Modul address #XY`** is displayed. Each press of the **`OK`** button increases the address (**`Y`**) by 1. After 10 steps, it starts counting from the beginning. Hold down the **`OK`** button again to save the new address.
The first digit (**`X`** or **`XX`**) of the module address depends on the device type:

`#8Y`: Inclinometer
`#9Y`: Elastometer
`#10Y`: Forcemeter
`#11Y`: Anemometer

For each device type, you can assign 10 addresses (X0 - X9). Overload indicators do not have adjustable module addresses. If an alarm is triggered, all overload indicators are activated simultaneously.

4.2.3 Automatic self-shutdown

The TreeQinetic components have an automatic self-shutdown feature to conserve energy. They will turn off after a certain period of inactivity and lack of communication. For the Central Control Unit and Sensor Modules, this period is 30 minutes, and for the Forcemeter, it's 60 minutes.

To prevent the automatic self-shutdown, you can briefly switch to the measurement mode just before it takes effect. After receiving control commands, the time for the sensor modules will reset, and the shutdown will be postponed.

4.2.4 Charging

The sensor modules must be charged only when they are turned off and at room temperature. The Forcemeter, Inclinometer, Elastometer, and Overload Warning Device are charged through the Central Control Unit. To do this, connect the tabletop power supply to the socket using the cold device cable and plug it into the DC-IN socket on the Central Control Unit. Use the short charging cables to connect the modules to the three sockets on the Central Control Unit.
The data cables are not suitable for charging.
While charging, the green LED next to the socket will be lit. When it turns off, the connected device is fully charged.

If a module is powered on after the charging process, it should display a battery voltage of 2.8 V to 3 V. The fully charged battery voltage for the Central Control Unit should be between 5.6 V and 6 V. When empty, the battery voltage is 2.3 V for the modules and 4.5 V for the Central Control Unit.

ATTENTION!
Do not turn on the devices while they are charging! If you need to charge more sensor modules than available charging channels, they must be charged one after the other. Sensor modules should always be connected directly to the Com Unit.

The sensor modules must not be charged using the data cable distributor! See also *4.1.8 TreeQinetic-Hub (Optional)*

To switch to a different module for charging, do not remove the power supply plug from the Central Control Unit. This can damage the battery of the Com Unit. Instead, disconnect the plug of the charging cable from the fully charged sensor module and plug it into the next device to be charged. ***Remove the power supply plug from the Com Unit only after removing all modules.***

As an alternative to the standard charging method through the Com Unit, you can order the PTQ Hub (see also *4.1.8 TreeQinetic-Hub (Optional)*). This charger handles the charging function for up to eight modules simultaneously. This charger can be operated using the power supply of the Com Unit, provided the number of pins (two or four) in the DC-IN socket matches.

NOTE:
The self-discharge rate of the accumulators is roughly estimated at 1% per day. Periodically check the condition of stored devices and recharge them at intervals of a few months.

NOTE:
If the charging LED turns off unusually quickly, premature shutdown has occurred. Check the device's temperature in this case. If it is higher than the ambient temperature, the full battery cannot absorb the energy and is already converting it into heat. In this case, further charging may damage the battery. Otherwise, the device should be disconnected and reconnected. The causes of premature shutdown can be deeply discharged batteries or significant differences between battery temperature and ambient temperature.

4.2.5 Maintenance

Maintenance work must be exclusively carried out by the IML Electronic GmbH workshop at the company's headquarters. Opening the devices leads to the loss of warranty claims and can result in damage to the respective devices.

Before each commissioning, a simple visual inspection by the user is recommended to ensure that all components are ready for use. Some things to consider include the smooth operation of the Elastometer mechanics, the ability to turn on all devices, their sufficient energy levels, and the output of plausible values.

With proper use and careful handling, the devices can be used for many years without the need for maintenance or repairs.

4.2.6 Spread of Infections

Theoretically, it cannot be ruled out that pathogens may be transported by the repeated use of fasteners on different trees. To prevent this, it is advisable to replace the fasteners or disinfect them before using them again.

You can consider the following methods:
- Heating (> 150°C for longer than 15 minutes; ***not suitable for magnets!***)
- High-percentage alcohol (with an exposure time of several hours)
- Using disinfectant for tree care tools (according to the instructions)
- Boiling water for at least 15 minutes (***not suitable for magnets!***)

4.3 Calibration

All PTQ modules are factory calibrated. This calibration does not deteriorate significantly over time due to use, so from a technical point of view a new calibration is not mandatory.
After damage or opening a measuring device, a new calibration may be necessary.

If you require certificates of the proper functioning of your measurement devices, you can send them back to the manufacturer for certification.

5 Software

5.1 General Notes

The software for controlling and configuring the PTQ measurement system, as well as recording and saving measurement data, exists in three variants:

- ***PTQ.App (Android)***
- ***PTQ.App (iOS)***
- ***PTQ.Software (Windows PC)***

These programs are similar in their structure, using the same symbols and pictograms. The workflow remains consistent across all versions. All program versions produce identical measurement files (compatible with Arbostat). Therefore, transitioning between the programs is seamless and does not require significant relearning.

The software is explained here exclusively using the Android app as an example. Platform-specific peculiarities will be highlighted separately and marked in colour.

5.2 App

5.2.1 Installation

The app is available for free on both the Google Play Store (for Android) and the Apple Store (for iOS).

Simply search:  PTQ.App

5.2.2 App-Start

Upon installation, launch the PTQ App by tapping the icon in the app list on your mobile device. After starting, you will initially land on the **`Control`** tab on the **`Com Unit`** page.



5.2.2.1 Permissions

Upon the first launch, the ***app*** will request up to 3 permissions (depending on your device type and operating system):

- **`Location`** (optional): When entering data for a tree pulling test, the app provides the option to determine the position of the tree under investigation via your ***mobile device's GPS***. Your permission to use the location system is required for this purpose.

- **`Camera`** (optional): For data collection during a tree pulling test, it is essential to take a crown projection photo of the tree under investigation. Additionally, it is recommended to document the measurement setup with images. The ***app*** offers you the option to take these photos directly and add them automatically to the project data. Your permission to use the ***camera*** is required for this purpose.

- **`Internal Storage`** (mandatory): Both the project data manually entered by you and the recorded data during a tree pulling test need to be stored on your mobile device's ***internal storage***. Your permission to use the storage for reading and writing is required for this purpose. Denying this permission will render the app inoperative, and it will automatically terminate.

5.2.2.2 Special features for Android

If you have denied one or more of these permissions and wish to change them afterward, there are 2 options for Android users:

- Through the app itself
  - If you have denied access to storage, the ***app*** will request permission each time it's restarted.
  - To grant permission for the camera or GPS after denial, you simply need to ***initiate the respective function within the app*** (take a photo or determine the tree's position), and you'll be prompted for permission again.

- Through your Android settings
  - If you chose ***Don't ask again*** when denying permissions, you can still modify the permissions afterward by directly accessing your device's system settings:
  - Swipe down from the top of your screen and tap on the gear icon in the upper right corner.
  - Then, select ***Apps*** and scroll down to find ***PTQ.App***. Tap on it.
  - Choose ***Permissions***.
  - Now, you'll see all the permissions the app requests. You can manually grant or deny these permissions using the ***toggle switches on the right***.

5.2.2.3 Special features for iOS

If you have denied one or more of these permissions and wish to change them afterward, you will need to do this through your device's system settings:

- Tap on the gear icon labeled ***Settings*** in the app list on your mobile device.
- Scroll down considerably until you find the list of installed apps. Then, select the entry ***PTQ.App***.
- Here, you'll see all the permissions requested by the app and can manually grant or deny these permissions by using the ***toggle switches on the right***.

5.3 PC-Software

5.3.1 Installation

The installation files for the measurement software are located on the USB stick (see also *3.4 Packing list (Starter)*). Alternatively, the software can be downloaded from the website www.iml-electronic.de.

Commence the installation by double-clicking on the **`setup.exe`** file. During the installation, optional information such as the username (User Name), company name (Organization), and an alternative installation path can be provided.

5.3.2 Starting the Software



Upon completing the installation, an icon will automatically be added to the desktop for launching the software.

Additionally, you can find the software in the Start menu under the **`PiCUS`** folder.

5.4 Differences between PC-Software and App

While modern mobile devices (phones and tablets) commonly include a ***camera*** and ***GPS receiver***, these functionalities are typically not available in desktop PCs and laptops. As a result, the PC software ***doesn't feature camera functionality or GPS positioning***.

Photos used to document trees and measurement setups must be captured with external devices and subsequently added to the project. Positioning data for projects must also be determined externally, either using a GPS-enabled device or via a map service.

In the app, completed measurements cannot be reloaded and viewed again, as further analysis of the measurement data is typically conducted using the Arbostat software, not the app.

In the PC software, the captured raw data can be displayed again at a later time. Similar to the app, further analysis is conducted using Arbostat.

When accessing saved projects, the PC software offers additional options:
- ***App***: only cloud upload of locally created projects and deleting local files.
- ***PC software***: cloud upload of local projects, download of projects stored in the cloud, as well as the ability to delete both local and cloud projects.

5.5 User Interface Concept

5.5.1 General

1. At the top, you see the ***title bar*** of the app. This is always visible and includes:
   a. The name of the app
   b. An icon that shows the connection quality to the PTQ System:

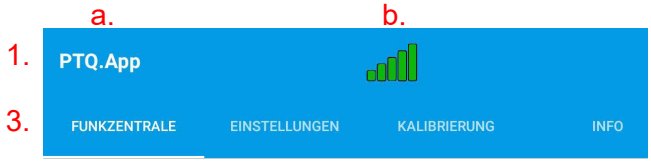


→ Full signal strength

→ Good signal strength

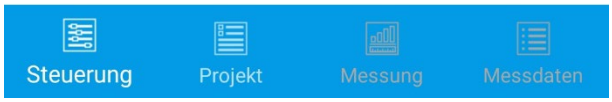
→ Weak signal

→ Connection interrupted



*The **connection quality is not always displayed in the PC software**, as it cannot be assumed that this information is available in all variants from internal or external Bluetooth modules.*

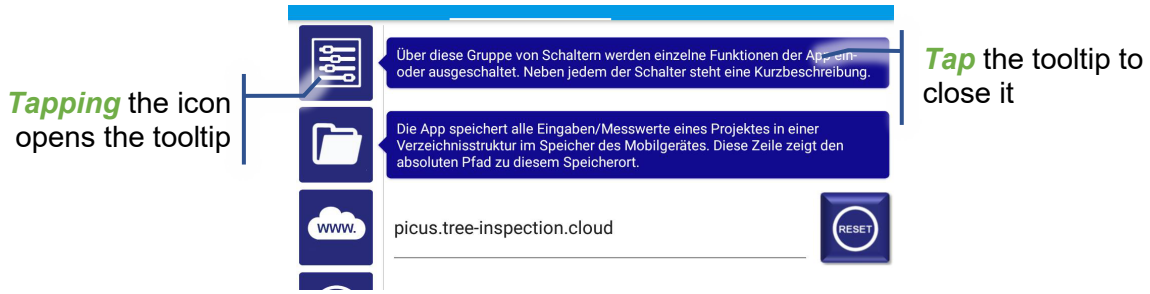
2. The app and PC software are fundamentally divided into 4 main tabs listed at the bottom of the screen. These tabs represent the 4 main functional areas of the app and are further explained from Chapter *5.6 Tab – Control* onwards.



3. Each tab contains a series of pages available for selection at the top. These pages allow you to input data, control the measuring devices, and more, depending on the function.

The functions of input fields or buttons are indicated by corresponding icons. Buttons are identifiable by a 3D effect on the icon. The background of these icons is typically blue. When a specific function is disabled, the icon will appear gray.

Additional information about the fields can be viewed by ***tapping the icons***. On a PC, these tooltips appear when the mouse cursor is ***briefly held over the icon***.



Note: When entering numerical values, pay attention to the correct physical unit! This unit is displayed in the placeholder (appearing in empty input fields) and is automatically appended to user inputs.

The app's structure generally follows the typical workflow of a tree pulling test. Accordingly, tabs and their pages are usually worked through from left to right, and the content of each page from top to bottom.

5.5.2 Context menu for list elements

On some pages, various elements are displayed in lists (e.g., project list on the **`Management`** page in the **`Project`** tab). On a few of these lists, additional functions can be accessed for individual list elements. To do so:



Android: Tapping and holding down an element will open a context menu that appears at the top of the screen.



iOS: If an item on the list is swiped to the left, a context menu will appear to the right of the element.



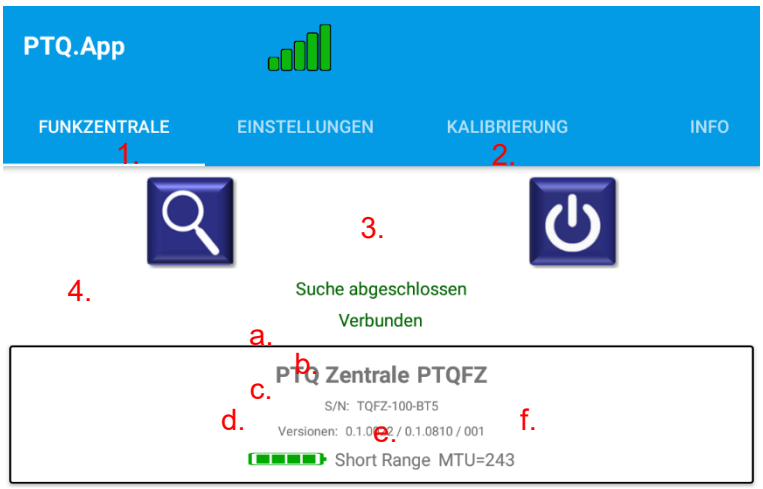
PC-Software: In the PC software, the context menu options appear as several buttons located to the right of the list, and are always visible.

5.6 Tab – Control

This tab contains elements for configuring the app and connecting to the PTQ measurement system.

5.6.1 Page – Com Unit

This tab contains elements for configuring the app and connecting to the PTQ measurement system.



1. **`Device Search`**: Tap here to search for active PTQ central units. This process takes a few seconds.

2. **`Deactivate System:`** Tap here to completely deactivate the currently connected PTQ measurement system (central unit and all sensor modules).

3. **`Status Bars`**: The upper one displays the current status of the device search. The lower one shows the current status of the Bluetooth connection.

4. **`Device List`**: This section displays all PTQ central units found during the last device search.

   - ***Tapping*** or ***double-clicking*** on one of the displayed devices attempts to establish a connection, which may take a few seconds. If the process is successful, detailed information about that device will be displayed:
     a. Device description
     b. Serial number of the device
     c. Version information
     d. Charge level of the Battery
     e. Type of the Bluetooth connection, see also *6 Technical Information*, *5.10.1 Wireless Communication Interruption* and *4.1.1 Com Unit*)
     f. Max. message size
   - ***Tapping*** or ***double-clicking*** again on an already connected device will disconnect it.
   - ***Tapping*** or ***double-clicking*** on another device while one is already connected will terminate the existing connection and subsequently connect the selected device.

5.6.2 Page – Settings

This page is for configuring the app and entering information required for its functionalities.



Automatic Zero Calibration: When this option is active, all modules' zero calibration is automatically performed when starting a measurement. A manual start of zeroing is always possible regardless of this function.



File Path: The app stores all entries/measurement values of a project in a directory structure in the memory of the mobile device. This line displays, under ***Android***, the absolute path to this storage location. In the ***PC software***, the storage location is not predetermined and can be adjusted (see also *5.11 Data Management*).



The software is capable of directly uploading your projects to the IML Cloud on-site. Here, the web address of the cloud is displayed. The correct address **picus.tree-inspection.cloud** is already pre-entered. No change is necessary!



To access the cloud, the app requires the account details provided to you with the PTQ System.
Enter the **login name** here.



Enter the **password** here.



Connection Test: This button initiates a connection test, checking the validity of your internet connection and the entered account details.

5.6.3 Page – Calibration

This page serves to calibrate specific functions within the app.





Calibrate: This button initiates the calibration of the tree height measuring tool. The subsequent page mirrors the regular measuring tool (refer to *5.7.3 Page – Tree height measurement tool*), with the difference that you not only input the distance to the object being measured but also its height. From the two measured sight angles and the known object distance, the tool calculates the uncorrected height of the object. By comparing this with the true object height you've entered, it derives a correction factor applied to all subsequent measurements. This factor is then displayed in this line.
For calibration, use an object whose height you precisely know or can measure, such as a door or a cupboard. The more accurate the measurement, the more precise the correction factor will be.
Calibration typically needs to be done only once.



Reset resets the correction factor back to 1, so height measurements are taken without any correction.

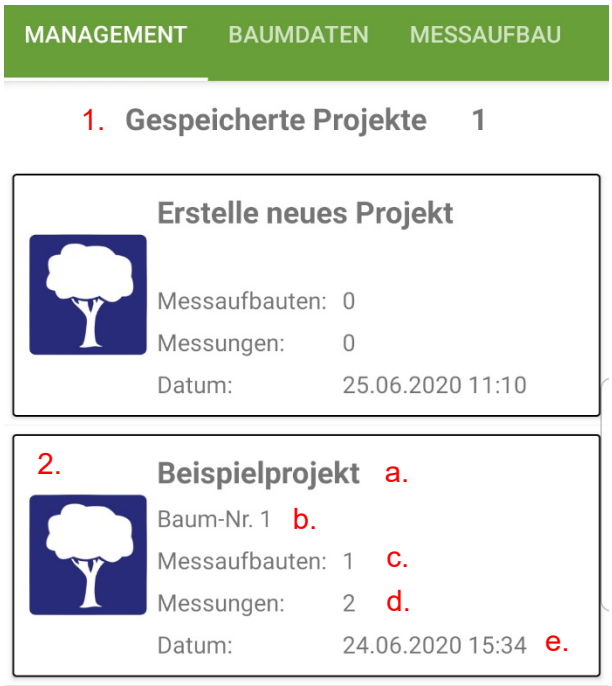
5.6.4 Page – Info

This page contains information about this app and a link to the IML Electronic GmbH website.

5.7 Tab – Project

5.7.1 Page – Management

This page manages the projects stored on the device.



1. Number of saved projects
2. List of saved projects
   For each saved project, a group of detailed information is displayed:
   a. Project name
   b. Tree number
   c. Number of measurement setups created in the project
   d. Number of measurements performed in the project
   e. Project creation date and time

- Create a new project by tapping on the first list entry ***Create new project*** or use the ***Add*** button on the right side of the list. The view will automatically switch to the next page, **`Tree Data`** (see also *5.7.2 Page – Tree data*).
- Open a saved project by ***tapping*** on one of the other list entries or using the ***Edit*** button. The view will automatically switch to the next page, **`Tree Data`** (see also *5.7.2 Page – Tree data*).
- Delete a saved project using the context menu of the respective list entry.

The ***PC Software*** offers additional options with regards to the cloud storage described in chapter *5.11.2.5 Download Projects from the IML Cloud*.

5.7.2 Page – Tree data

This page contains all relevant data about the project and the tree under examination, which is either entered or displayed upon loading a project.



`Project Name`: Give your project a name by which you can identify it later.




`Tree ID`: Enter the identification number of the tree under examination, such as the cadastral ID, tree number, or scan an arbotags barcode using the button.




`Camera`: Use this button to take crown projection photos of the tree, which will be automatically stored in the project.



`Genus` and **`Species`**: In the upper line, select the genus of the tree to be examined from the list. Then, in the lower line, add the species of the tree.



`Diameter`: Enter the tree diameter in the direction of pull, at a height of 1 meter, in [cm].



Diameter: Enter the tree diameter perpendicular to the pulling direction, at 1 meter height, in [cm].



Bark Thickness: Enter the bark thickness at 1 meter height, in [cm].




Using the ***GPS button***, the app determines the tree's position using your mobile device's GPS.

The color of the measured position provides an indication of the measurement's accuracy:

- Accuracy better than 10m
- Accuracy better than 30m
- Accuracy better than 100m
- Accuracy worse than 100m
- Error in position determination

In the PC version, the position cannot be determined directly. It is always possible to enter the position directly, for example, if using an external precision GPS or if the position is already known from a cadastre.



Open Map Service: This button displays the captured position on a map.




Tree Height: Enter the tree height in [m]. You can directly input the value into the provided field or tap on the button to initiate the integrated ***tree height measurement tool*** (see also *5.7.3 Page – Tree height measurement tool*).

To thoroughly examine a tree, multiple tree-pulling tests need to be performed, each with different pulling directions and sensor positions. Therefore, the dataset of the measurement setup is subordinate to the project.

The subsequent section includes a list of all measurement setups created within this project. Each list item displays the name as well as the count of measurements conducted with that setup.

- By tapping on the first list entry ***Create new measurement setup***, or by selecting the ***Add*** button, a new measurement setup is generated. The view automatically switches to the next page, **Measurement Setup** (*5.7.4 Page – Test setup*).
- Open a saved measurement setup by ***tapping*** or ***double-clicking*** on one of the other list entries; the view will automatically switch to the next page, **Measurement Setup** (*5.7.4 Page – Test setup*). A single click followed by the ***Edit*** button will have the same effect.
- Delete a saved measurement setup through the context menu of the respective list entry.

5.7.3 Page – Tree height measurement tool

This page represents a ***tool for measuring the tree height*** with minimal additional tools. It measures the angular views to the treetop and root plate using the ***mobile device*** and requires only the horizontal distance to the tree to calculate the total tree height.



In the upper half of the screen, you will see a live view from your camera with an artificial horizon projected onto it. Additionally, the current angle of the device is displayed at the bottom of the camera view. Follow these steps:

Begin at the base of the tree and take steps in a straight line away from the tree, measuring each step to be 1 meter in length. Alternatively, you can use a tape measure.
The distance should correspond to at least the estimated tree height.

Aim the artificial horizon at the **`treetop`** and tap on the measurement button located in the topmost row to measure the angle to the treetop.

Now, aim the artificial horizon at the **`tree base`** and tap the measurement button on the second row to measure the angle to the tree's base.

Next, enter the previously measured **`distance`** to the tree in the input field.

The **`calculated tree height`** will then be displayed in the last row.

The **`Save`** button saves the determined measurement value and returns to the **`calling`** page.

You can repeat these steps in any order and as many times as necessary.

Using the back button (arrow symbol at the top left), you can return to the calling page, without transferring the just-determined measurement result to the input field.

This functionality is not available in the PC software.

5.7.4 Page – Test setup

On this page, all relevant information about the measurement setup and the utilized sensor modules are entered or displayed after loading a measurement setup.



Name of the Measurement Setup: Provide a name to your measurement setup for future identification.



Force Meter Alarm Limit: Input the threshold value in [kN] at which all force meters used during a measurement should trigger an overload alarm.



Elastometer Alarm Limit: Specify the threshold value in [µm] at which all elastometers used during a measurement should trigger an overload alarm.



Inclinometer Alarm Limit: Set the threshold value in [°] at which all inclinometers used during a measurement should trigger an overload alarm.



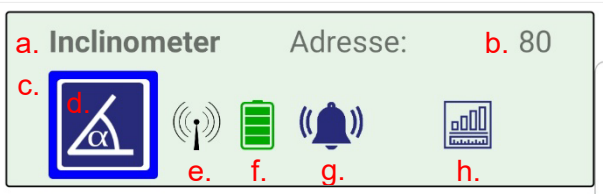
Camera: Use this button to take photos of the measurement setup, which will be automatically stored within the project.



Device Search: Initiate a search for available sensor modules by tapping this button. The discovered modules will be listed in the subsequent device list.

Below this, you'll find:

1. **Device List**: This list displays the discovered sensor modules sorted by type. Each list entry shows various details about the respective device:



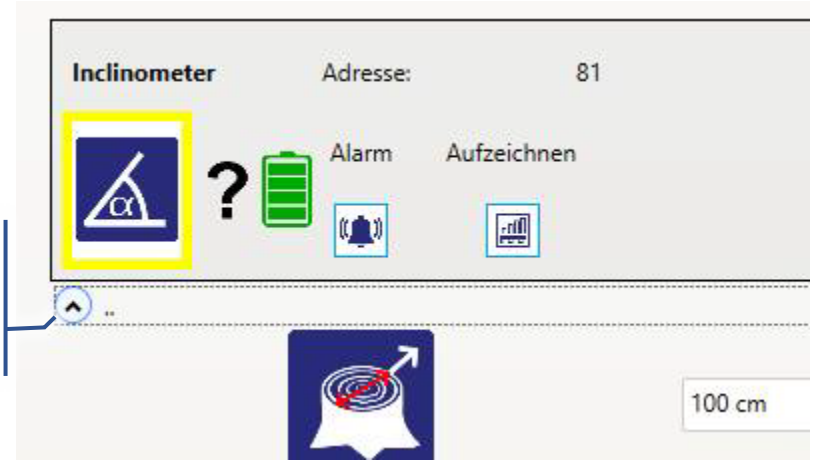
   a. Device type (Text)
   b. Device address
   c. Device colour (Border)
   d. Device type (Icon)
   e. Connection type
      Cable
      Wireless
      ? Could not be found upon re-scan
   f. Battery Charge Level
   g. Alarm Switch: Set whether this device is allowed to trigger an overload alarm or not.
      Active
      Inactive
   h. Measurement Switch
      Specify whether this device's measurements should be recorded or if the device should only appear in the live data display.
      Record data
      Live data only, no recording

When a device is found during a search, the list entry is displayed with a pale green background. If the same device is not found during a subsequent search, the list entry remains but is displayed with a gray background and a **?** icon instead of the connection type.

This can have various reasons, such as:
- Disrupted wireless connection due to repositioning of the sensor module or the wireless central unit
- Sensor module's depleted battery
- Sensor module has turned off due to prolonged inactivity

For device types like Force meter, Elastometer, Inclinometer, and Anemometer, additional information is required. The respective input pages are opened in the app by ***tapping the entries*** in the device list. In the PC software, a menu can be expanded using the ***arrow under the entry*** in the device list to access additional input options.

The ***arrow*** opens or closes the input area for configurable devices in the PC software



See also *5.9.3 Page – Forcemeter*, *5.9.4 Page – Elastometer*, *5.9.5 Page – Inclinometer* and *5.9.6 Page – Anemometer*.

2. **`List of Measurements`**

Here, all the measurements conducted with this setup are listed, showing each list item's name and the time at which the measurement was started.

- Start a new measurement by tapping the first list item ***Start New Measurement*** or by using the ***Add*** button. The view will automatically switch to the **`Measurement`** tab on the **`Control`** page (refer to *5.8.1 Page – Control*).
- Delete a saved measurement using the context menu of the respective list entry
- In the PC software, you can re-display the values of a completed measurement using the ***View*** button.

5.7.5 Page – Forcemeter

This page is for inputting device-specific data for each Forcemeter.



Enter the height of the **rope anchor point** in [m].



If you are using an older type of Forcemeter without an integrated inclinometer, you can manually input the **rope angle** at maximum tension. The rope angle is measured between the ground (horizontal) and the rope.




Indicate the **pulling direction** by either using the input field or tapping the button to activate the integrated ***compass measurement tool*** (refer to section (*5.7.9 Page – Compass measurement* tool).

5.7.6 Page – Elastometer

This page is intended for entering device-specific data for each Elastometer.



Enter the **tree diameter** in the pulling direction at the Elastometer height, in [cm].



Enter the **tree diameter** perpendicular to the pulling direction at the Elastometer height, in [cm].



Enter the **bark thickness** at the Elastometer height, in [cm].



Provide the **attachment height** of the Elastometer in [cm].




Specify the **orientation** of the Elastometer in [°]. You can input this directly into the field or use the button to activate the integrated ***Compass Measurement Tool*** (refer to section *5.7.9 Page – Compass measurement* tool).



Force Distribution: Input the estimated wind load acting on the tree stem being measured. If measuring the main stem, enter 100%. If two equally strong co-dominant stems with uniform crown structure do not shadow each other in the pulling direction (having the same wind-exposed area for wind loads), and only one stem is measured by the pulling test, you can enter 50%.



Comments: You can input additional documentary details in a free-text field.

5.7.7 Page – Inclinometer

This page is intended for entering device-specific data for each Inclinometer.



Enter the **tree diameter** in the pulling direction at the Inclinometer's height in [cm].



Enter the **tree diameter** perpendicular to the pulling direction at the Inclinometer's height in [cm].



Provide the **attachment height** of the Inclinometer in [cm].




Specify the **orientation** of the Inclinometer in [°]. You can input this directly into the field or use the button to activate the integrated ***Compass Measurement Tool*** (refer to section *5.7.9 Page – Compass measurement* tool).



Comments: You can input additional documentary details in a free-text field.

5.7.8 Page – Anemometer

This page is intended for entering device-specific data for the Anemometer.



Enter the **attachment height** of the Anemometer in [m].




Through this button, the app uses the ***GPS module*** of your mobile device to determine the **position** of the Anemometer.

The color of the measured position provides an indication of the measurement's accuracy:

- Accuracy better than 10m
- Accuracy better than 30m
- Accuracy better than 100m
- Accuracy worse than 100m
- Error in position determination

In the PC version, the position cannot be determined directly. However, it's always possible to input the position directly, for instance, if an external precision GPS is used, or if the Anemometer's position is known through other means.



Open Map Service: This button shows the measured position on a map.



Comments: This free-text field allows you to input additional documentary details.

5.7.9 Page – Compass measurement tool

This page represents a tool for measuring the orientation of the sensor modules without additional tools. It measures the ***orientation of the mobile device*** in relation to the magnetic North Pole using the ***integrated magnetic sensor*** (if available).

The structure of the page remains consistent, but the specific presentation is adapted to the context from which the tool was called. Here, for instance, the page is described as it would be when measuring the Inclinometer orientation.

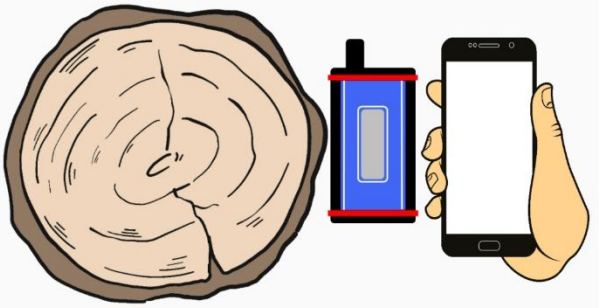
To correctly measure the orientation of all sensor modules in relation to each other, the upper half of the screen depicts and describes the intended measurement process for each device.
Please follow the instructions.

To perform the measurement, tap on the circular, blue button located at the center of the compass rose. This action will return the display to the page from which the tool was initiated. The captured measurement will automatically be input into the respective input field on that page.

The compass rose rotates according to the device's orientation. The red N or 0° always indicates the direction of the magnetic North Pole.

The green, triangular marker on the compass rose, along with the number in the center, indicates the current measurement value of the device's orientation.

As a special feature when measuring the orientation of inclinometers or elastometers: If the pull direction has already been measured, it is marked by a red arrow at the edge of the compass rose.



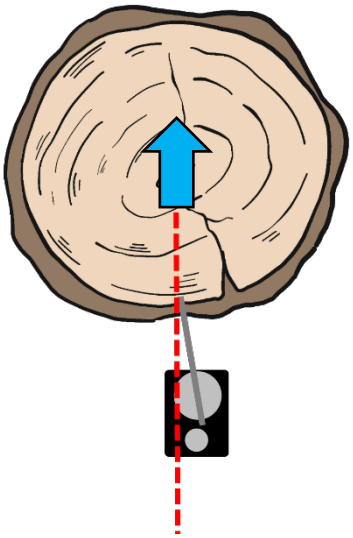
Halten Sie Ihr Mobilgerät parallel zur langen Gehäuseseite des Inclinometers, mit der Oberseite richtung Antenne zeigend!



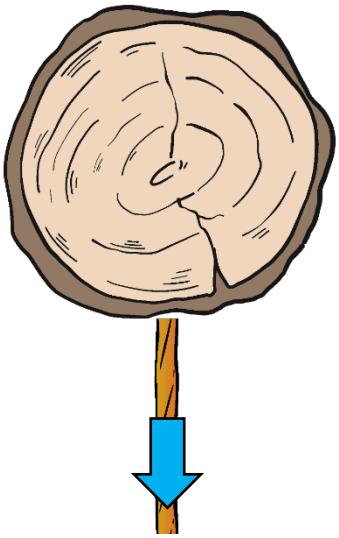
5.7.10 Determining Orientation without Compass Tool

Since not all mobile devices have a built-in magnetic field sensor, the compass tool might not always be available. This function is also not available in the PC software.

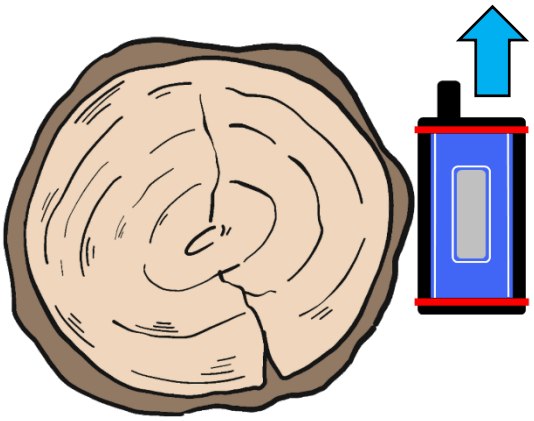
To maintain compatibility between measurements with and without the compass tool, the following details how the orientation is determined for each module. The blue arrow indicates the orientation to be determined.



Orientation Elastometer



Orientation pull direction/Forcemeter



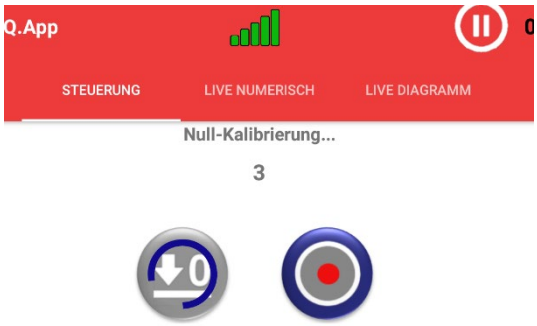
Orientation Inclinometer

5.8 Tab – Measure

5.8.1 Page – Control

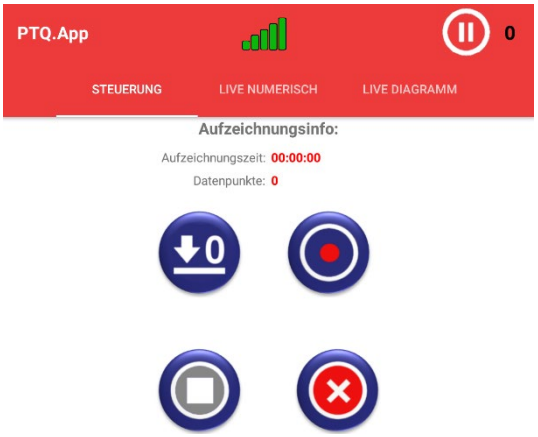
This page controls the data recording of a measurement.

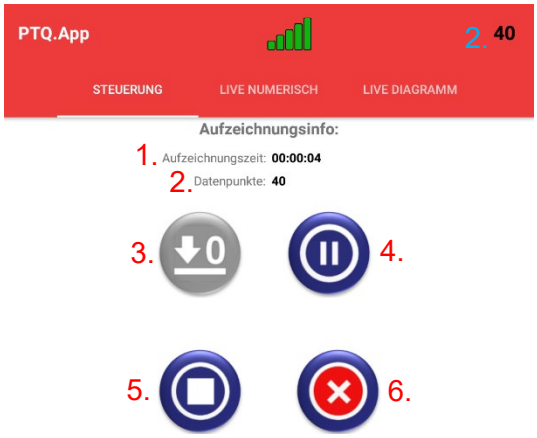
When a measurement is started, the app will automatically switch to this page.



The measurement is initialized by automatically performing the zero calibration of all sensor modules. During this process, a timer counts down the seconds until the data recording starts. The devices should not be touched during and after this calibration process!

Subsequently, the measurement runs in live mode, meaning the data recording is paused. You can identify this by the red status bars at the top, which remain unchanged, as well as the button at the upper right, displaying the classic recording symbol (image on the left).





The display and control elements are:

1. **`Recording time`**: Shows the duration for which data has been recorded (live updates during the recording mode).
2. **`Data points`**: Indicates the number of recorded measurement points (live updates during the recording mode). The sampling rate of the PTQ measurement system isn't constant; it depends on the number of modules used and the quality of the wireless connection. Data is collected as fast as the current system configuration allows. In the app, the number of recorded data points is also displayed in the top right, potentially with a pause symbol (blue "2."). This way, it's immediately visible in other tabs if data is currently being recorded.
3. **`Zero calibration`**: Performs a zero calibration of the entire system. *Note: In the app settings, a function can be activated that automatically performs a zero calibration after the start of each measurement* (refer to section *5.6.2 Page – Settings*).
4. **`Start / Pause data recording`**: Switches between modes. In live mode (the initial state of the measurement), the sensor module data is shown exclusively in real-time. In recording mode, the data is continuously collected and stored.

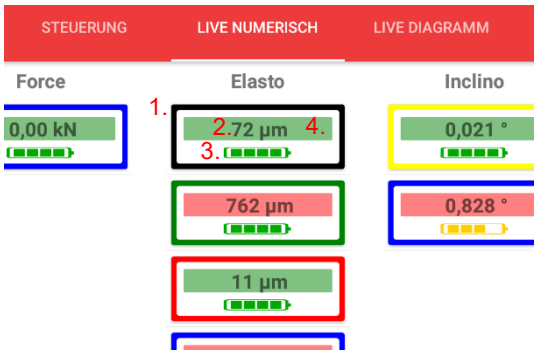
5. **Stop Measurements**: The measurement is concluded, and all recorded data is processed for display in the results section.
   → The view automatically switches to the **Results** page on the **Data View** tab (refer to section *5.9.1 Page – Result*)
6. **Cancel measurement**: Ends the measurement and discards all recorded data.
   →The view automatically returns to the **Test Setup** page on the **Project** tab (see also section *5.7.4 Page – Test setup*)

In the PC software, these display and control elements are not consolidated on a separate page. Instead, they are always visible at the bottom of the Measurement tab.

5.8.2 Page – Live Numeric View

This page displays the live measurement data in a numerical format, similar to what is known from the classical TreeQinetic PC software.

The data displays for different types of sensors are organized in columns. For each sensor module found during the device search, a cell is shown with the following information:



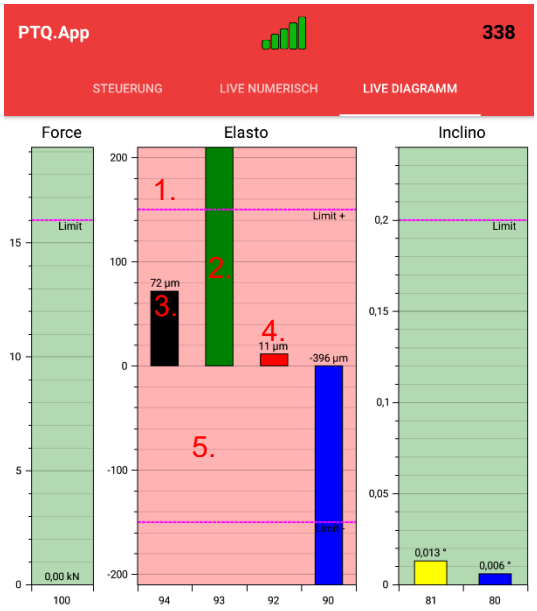
1. Device colour (Border)
2. Current measurement value
3. Battery charge level
4. Alarm state (Background colour of the measurement value)
   Green: No alarm
   Yellow: Measurement value is > 90% of the current alarm limit
   Red: Overload alarm, measurement value has reached the alarm limit
   Grey: The wireless connection to this module is interrupted.
   NOTE: Modules for which the alarm has been deactivated will never display yellow or red. See also 5.7.4 Page – Test setup.

After the zero calibration, it can be checked here whether all modules show a value close to zero. The values are never exactly zero but always overlaid with very low basic noise.

5.8.3 Page – Live Chart View

This page displays the live measurement data in clear bar charts.

NOTE: For Inclinometer and Forcemeter, only the absolute values of the measured data are displayed. For Forcemeter, it's inherently the tension, while for inclinometers, it's the resulting inclination angle without indicating a directional component.



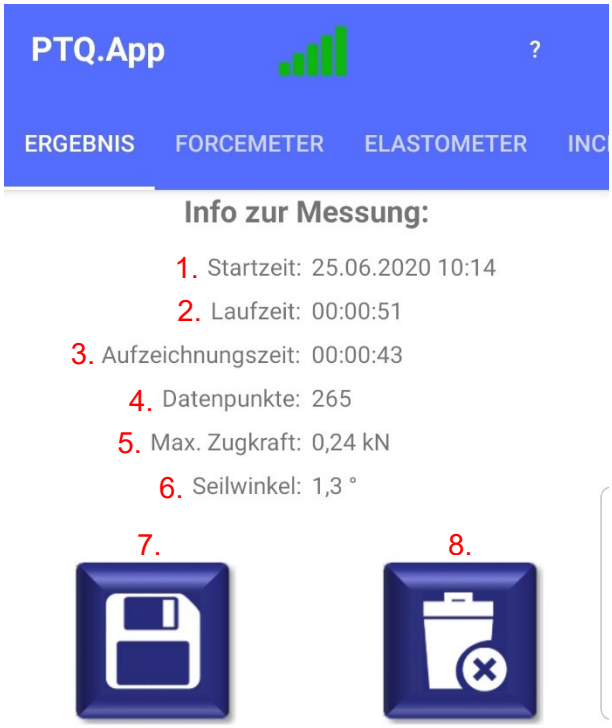
Each device type is represented by a bar chart displaying data for each sensor module found during the device search. The information presented includes:

1. Set alarm threshold for this device type
2. Device colour
   Note: If the wireless connection to a module is interrupted, the bar colour changes to grey. When the connection is interrupted, the bar length is not meaningful and DOES NOT represent the last received measurement value.
3. Current measurement value (length of the bar)
4. Current numerical measurement value (on each bar)
5. Alarm state (background colour of the diagram)
   Green: No alarm
   Yellow: Measurement value of at least one of the sensor modules is > 90% of the set alarm threshold
   Red: Overload alarm, the measurement value of at least one of the sensor modules has reached the alarm threshold

5.9 Tab – Data View

5.9.1 Page – Result

This page provides a short summary of the measurement you just conducted



1. Start time of the measurement
2. Total duration of the measurement
3. Total time during which data was recorded
4. Number of recorded measurement points
5. Maximum tensile force during the measurement (see for details *5.10.3.1 Max. pulling force*)
6. Rope angle at maximum tensile force (see for details *5.10.3.2 Rope angle*)
7. Button: Save Measurement The recorded measurement data is stored as a file on the mobile device's memory.
   → The view automatically switches back to the **`Test Setup`** page on the **`Project`** tab (see also *5.7.4 Page – Test setup*)
8. Button: Discard Measurement
   All recorded measurement data will be discarded.
   → The view automatically switches back to the **`Test Setup`** page on the **`Project`** tab (see also *5.7.4 Page – Test setup*)

5.9.2 Chart Control

The chart display in the results section on the following pages of the **`Data View`** tab is slightly different in the app and on the PC.

In the app, zooming on both axes can be done by using the common ***two-finger pinch gesture***. Apply the gesture either to the chart area to zoom both axes simultaneously or directly on one of the axes to adjust only that axis. Moving the displayed chart area freely can be done with a ***one-finger drag***.

In the PC software, the ***mouse wheel can be used to zoom***. Similar to the app, use the mouse cursor in the chart area to zoom both axes or hover over one of the axes to zoom only that specific axis. To freely move the chart view, ***press and hold the right mouse button***.

NOTE The X-axis / time axis is continuous. Therefore, if data recording is paused during the measurement and later resumed, the graphs will have corresponding blank areas. This applies to all charts on the **`Data View`** *tab.*

5.9.3 Page – Forcemeter

This page displays the entire recorded measurement values of all Forcemeters involved in a line chart.
By tapping the buttons below the chart, the data display of each Forcemeter can be adjusted:

- **`F & A`**: Shows force and rope angle measurement curves in [kN] and [°], along with markings for the determined maximum force and the cable angle averaging window.
- **`Force`**: Only displays the force measurement curve in [kN], along with the marking for the determined maximum force (see details in *5.10.3.1 Max. pulling force*)
- **`Angle`**: Only displays the cable angle measurement curve in [°], along with the marking for the cable angle averaging window (see details in *5.10.3.2 Rope angle*)
- **`Off`**: No measurement curves are displayed.

The magenta-colored line represents the set alarm threshold of the Forcemeters.

5.9.4 Page – Elastometer

This page displays in a line chart the entire recorded measurement history of all participating Elastometers in the measurement.
By tapping the buttons below the chart, the data display of each Elastometer can be adjusted:

- **`ON`**: Displays the curve of length change in [µm]
- **`OFF`**: Curve measurement is not displayed

The two magenta-colored lines represent the set alarm threshold (positive and negative) of the Elastometers.

5.9.5 Page – Inclinometer

This page displays in a line chart the entire recorded measurement history of all participating Inclinometers in the measurement. By tapping the buttons below the chart, the data display of each Inclinometer can be adjusted:

- **`X & Y`**: Displays the value curve of the calculated resulting inclination angle in [°] (see for details *5.10.3.3 Resulting Angle of Inclination*)
- **`X`**: Displays only the X component of the measurement
- **`Y`**: Displays only the Y component of the measurement
- **`OFF`**: Data curve is not displayed

Die Magenta-farbene Linie stellt die eingestellte Alarmgrenze der Inclinometer dar.

5.9.6 Page – Anemometer

This page displays in a line chart the entire recorded measurement history of all participating Anemometers in the measurement.
By tapping the buttons below the chart, the data display of each Anemometer can be adjusted:

- **`Speed`**: Displays the data curve of the wind speed in [m/s]
- **`Direction`**: Displays the data curve of the wind direction in [°]
- **`OFF`**: No data curve will be displayed

5.10 Additional Information / Background processes

5.10.1 Wireless Communication Interruption

The Bluetooth connection between the mobile device or PC and the PTQ radio gateway can be affected by various external factors and, in the worst case, interrupted. This can be recognized by the ***signal strength icon*** in the header of the app (refer to *5.5.1 General*) or by missing measurement data. The reasons for this could be:

- Too much distance between the mobile device and the PTQ Com Unit
- Obstacles between the mobile device and the PTQ Com Unit
- Empty battery of the PTQ Com Unit
- Radio interference caused by external sources

If the connection is briefly interrupted (for a few seconds), it will automatically be reestablished once the disrupting influence vanishes. In this case, a running measurement will continue, and only a few data points might have been lost.

If the connection is interrupted for a longer time, the app attempts to restore the connection every 10 seconds. However, in this situation, the PTQ Com Unit will have automatically stopped a running measurement. Therefore, it will need to be restarted.

The reasons mentioned above for broken wireless connections also apply to connections between the radio gateway and modules. In the case of an interruption, the modules and the gateway will autonomously try to restore the connection. A running measurement does not terminate; only the data from the disrupted modules will be missing.

To avoid connection problems, the following measures can be taken:

- Fully charge all devices before use
- Keep distances as short as possible
- Place devices relative to each other to avoid radio shadows caused by obstacles (buildings, vehicles, trees)
- Switch to a cable connection between the PTQ Com Unit and the modules (refer to *4.1.6 Cables*)
- Switch to a ***USB cable*** connection between the PTQ Com Unit and the PC (refer to *4.1.6 Cables*)

5.10.2 Vibration Alert

During an ongoing measurement, if the reading of any of the sensor modules exceeds the set alarm limit, this event will not only be graphically displayed on the live data pages, but it will also trigger the ***vibration alert on the mobile device*** (if available).

5.10.3 Internal Calculations

5.10.3.1 Max. pulling force

The app automatically calculates the maximum applied pulling force during the measurement. The algorithm is designed to detect the typical plateau at the top end of the stress curve and positions the point of maximum force just behind the first peak after reaching the plateau. The result then averages the measured force over a 5-second window around this point.



This means for optimal calculation, the tree pulling test should involve creating such a plateau. To do this, pull the tree to the maximum intended load and maintain the tensile force there for approximately 10 seconds before releasing the tree.

5.10.3.2 Rope angle

The app automatically calculates the rope angle present during the range of the maximum applied pulling force.
The algorithm uses the time frame before the previously determined maximum pulling force and averages the rope angle measurements over a 5-second window around that point.

5.10.3.3 Resulting Angle of Inclination

The inclinometers measure the angle of inclination through the two horizontal, orthogonal vector components. These two measurements are saved in the measurement data files as X and Y values. However, for the sake of simplicity during live measurement display, only the resulting angle of inclination from these two components is shown.

The calculation is performed using the Pythagorean theorem:

$$\alpha = \sqrt[2]{x^2 + y^2}$$

In the results graph, users can switch between the resulting angle of inclination and the individual X and Y components.

Within the resulting measurement data file, the X and Y components of the inclinometer are listed separately. This allows determining the actual direction of inclination relative to the direction of the rope, together with the attachment angle of the inclinometer (refer to section *5.7.9 Page – Compass measurement tool*).

5.11 Data Management

5.11.1 Project Structure

The software automatically generates an organized project structure, where all components of a project (project data, tree data, measurement setup data, photos, measurement data) are arranged.

This project structure is identical in both the ***app*** and ***PC software***. The only difference lies in the location of the projects depending on the platform used. See the following chapter *5.11.2 Data Transfer* for more details.

The main folder in the ***app*** is always called **`PicusTQdata`**. Within it, a subfolder (the project folder) is created for each project. The structure appears independent of the platform and is as follows:

- **`DATE_TIME_PROJECTNAME`**
  - The folder name is derived from the creation date (YYMMDD), creation time (HHMMSS), and the entered project name.
  - Within each project folder, additional subfolders and a file are created:
  - **`project.json`**
    - This file contains all user-input data related to the project and the tree under investigation.
  - **`CrownPics`**
    - This directory stores all crown images captured with the app.
    - The naming convention for crown images is derived from the date (YYMMDD) and time (HHMMSS) of capture: **`Crown_DATE_TIME.png`**
  - **`TIME_SETUP-NAME`**
    - For each measurement setup created within this project, a subfolder (the setup folder) is established. The folder name is generated from the setup creation time and the inputted name.
    - Each setup folder contains another subfolder and various files:
    - **`setup.json`**
      - This file contains all user-input data related to the measurement setup.
    - **`SetupPics`**
      - This directory stores all documentation images of the setup captured with the app.
      - The naming convention for setup images is derived from the date (YYMMDD) and time (HHMMSS) of capture: **`Setup_DATE_TIME.png`**
    - **`PTQ_Meas_ZEIT.txt`**
      - For each measurement conducted within this project and with this setup, a measurement data file is generated. This file contains the recorded measurement values.
      - The filename is derived from the measurement start time (HHMMSS).
      - This file is compatible with the *Arbostat measurement data file format*.

5.11.2 Data Transfer

The project structure created by the software is designed to consolidate all data related to a project, particularly with an eye toward later evaluation in the context of a tree assessment.

Therefore, it's highly recommended that when copying/moving measurement data between a mobile device and a PC or MAC, you should always copy the entire project folder of your project.

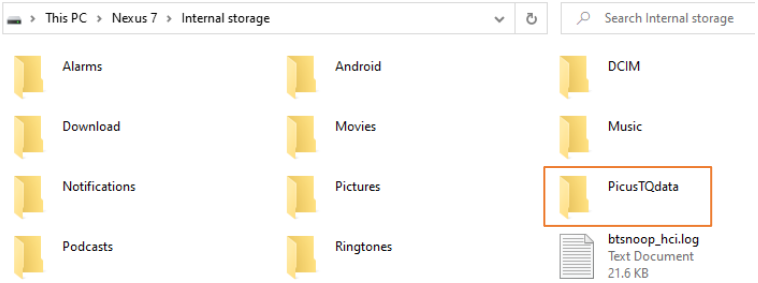
When using the IML Cloud, this process occurs automatically.

5.11.2.1 From Android via USB cable to PC

Connect your mobile device to a PC using a USB cable. Pay attention to your mobile device's display; you may need to confirm that data exchange with the PC is allowed. Next, navigate to the data folder of the PTQ.App on your mobile device in the file browser you're using (e.g., Windows Explorer) on. You can find the path to this folder within the PTQ.App on the Settings page (*5.6.2 Page – Settings*).
Please note that the initial part of the path **`/storage/emulated/0`** refers to the location of your device's **`internal storage`**.

Searching for this path, for instance, **`/storage/emulated/0/PicusTQData`**:

- On the device itself:
  - Open the file explorer of your device (on Samsung, for example, use the **`My Files`** app).
  - Select **`Internal Storage`**.
  - Here, you will find the folder named **`PicusTQData`**.
- On Windows, when the device is connected via USB to the PC:
  - Open the File Explorer on your PC.
  - Navigate to your device node and open it.
  - The **`Internal Storage location`**, where you'll find the **`PicusTQData`** folder, will be automatically displayed.



As described in section *5.11.1 Project Structure*, this folder contains the project folders of all the projects you've created using the PTQ.App. Now, simply copy or move the project folders of the projects you wish to further process to your PC's hard drive.

***NOTE** With older versions of Android, it might be necessary to restart the phone for the main folder to become visible on the PC.*

5.11.2.2 Transferring from iOS via USB cable to a MAC

Connect your Apple mobile device to a MAC using a USB cable.
Navigate through the file browser you're using (e.g., Finder) to access your mobile device (located under **Locations**). Switch to the **Files** tab where all the apps sharing files are listed. Open the entry for the **PTQApp**. Here, you'll find the main folder called **PicusTQData**.

In contrast to Android, the MAC file browser cannot navigate deep into the folder structure. Therefore, you'll need to copy the entire main folder to your MAC's hard drive.

5.11.2.3 To the IML Cloud

The software provides the option to upload your projects directly to the IML Cloud on-site. This allows them to be instantly available for download and further processing from any location.

To do this, navigate within the software to the **Management** page in the **Projects** tab (refer to section *5.7.1 Page – Management*). Open the context menu of the project you wish to upload and tap on **Cloud Upload** (in the ***app***) or **Upload** (on the ***PC***).
In the ***app***, this prompts a security confirmation, which should be affirmed with a **yes**.

Next, the ***app*** will ask if the associated project photos (crown photos and setup test photos) should also be uploaded. These images, due to their size, may significantly extend the required time and potentially strain limited data volumes.
On the ***PC***, all images associated with the project are always uploaded.

Once you've responded to this query, the upload process begins and opens the **Cloud Upload Report** page. Throughout the upload process, each step and its outcome are displayed here. Please wait until the line **Upload successfully completed!** appears.

5.11.2.4 Ordnerablage auf dem PC

Within the PC software, you have the freedom to choose the location where projects are stored. The default storage path is:
C:\Users\USERNAME\Documents\PicusTQdata
The project storage path is set in the **Settings** page on the **Control** tab (refer to section *5.6.2 Page – Settings*).

5.11.2.5 Download Projects from the IML Cloud

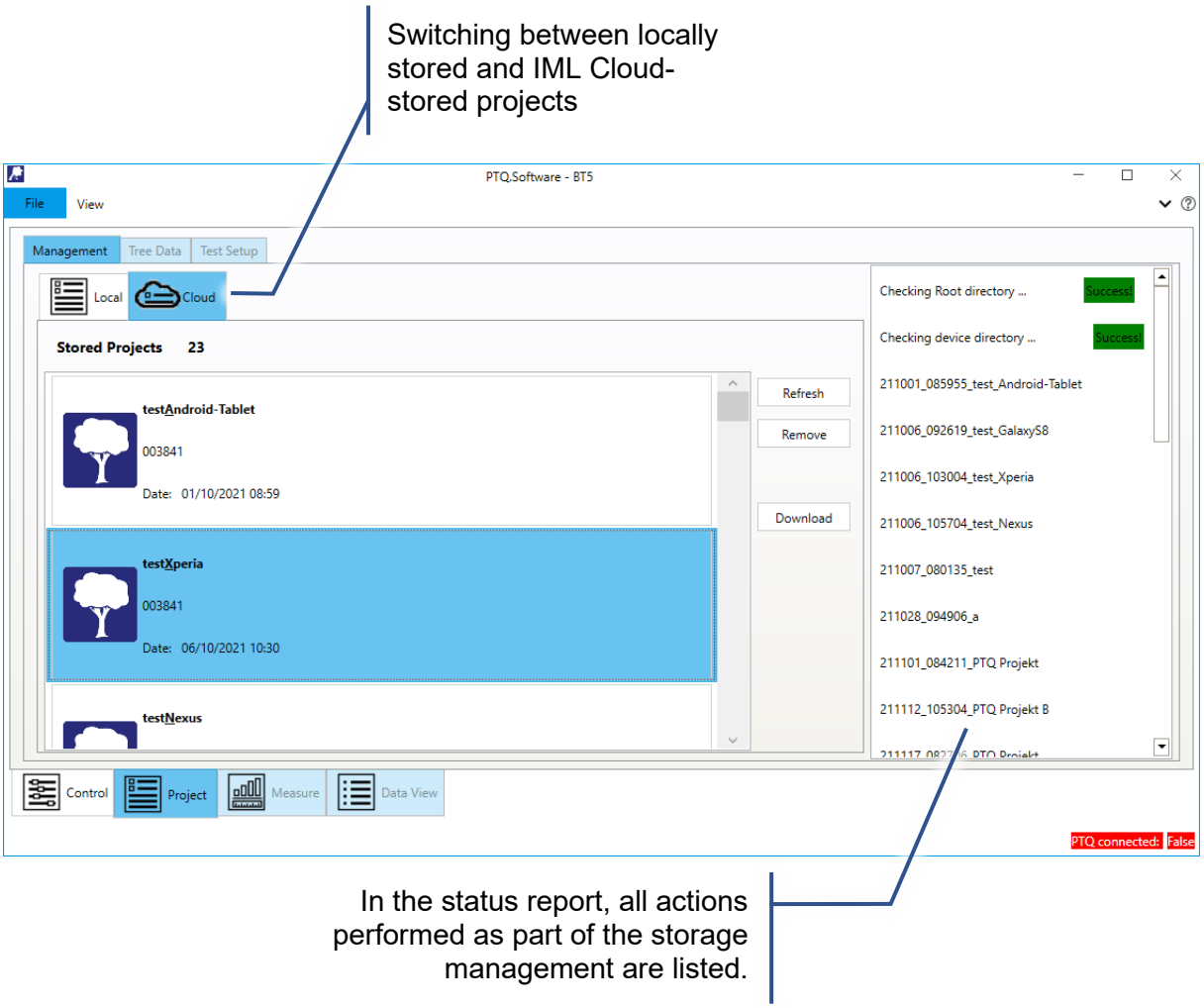
The download function is only available in the ***PC software***.
The **`Management`** page in the **`Projects`** tab (also refer to *5.7.1 Page – Management*) is divided into two subpages:

- ***Local***: All projects in the set local storage path
- ***Cloud***: All projects uploaded to the IML Cloud

Both the local storage path and the cloud access details are specified on the **`Settings`** page in the **`Control`** tab (refer to section *5.6.2 Page – Settings*)

With the buttons **`Download`** or **`Upload`**, a project can be copied to the other respective storage area. The **`Delete`** button removes a project from the currently selected storage. The **`Refresh`** button synchronizes the list of all projects in the IML Cloud with the display in the software.

For an existing project, you'll be asked whether to overwrite it or skip downloading this project. During the download process, the **`status report`** opens. The individual steps and their outcomes are displayed as the download process runs.



5.11.3 Compatibility with Arbostat

The classic PC software for analysing tree pulling test data captured with the PiCUS TreeQinetic measurement system is Arbostat. The measurement data files generated by PTQ.App and PTQ.Software conform to the format expected by Arbostat and are therefore completely compatible.

The only difference is that now, the data from all tree pulling tests performed with the new software is already organized in a well-structured, convenient project format. Thus, it's no longer necessary to manually compile and sort the measurement data from a laptop, documentary photos from a camera, and any handwritten notes.

So, if you want to process a measurement from one of your projects in Arbostat, navigate to the respective project folder for importing measurement data and then to the subfolder of the setup you used for that measurement. There, you'll find the saved measurement data files, which you can import into Arbostat as usual (see also *5.11.1 Project Structure*). Additionally, all captured crown photos are available in the project folder, within the **`CrownPics`** subfolder.

6 Technical Information

All devices within the system utilizing a built-in battery operate using NiMH batteries.

6.1 PTQ Com Unit

Property	Value
general	
Weight	690 g
Dimensions	240 mm x 110 mm x 35 mm
Battery	
Capacity	2000 mAh
Operation time (Average under typical operation conditions)	10 hours
Max. charge current	800 mA
Charge duration	ca. 2,5h
Recommended charging temperature	5 – 35 °C (ambient temperature)
Max. charging temperature	0 – 40 °C (ambient temperature)
Communication	
To the mobile device	Bluetooth 5.0 (in limited fashion also 4.2) Long-Range-Mode dependant on mobile device
To the PC	USB 2.0 / Bluetooth 5 - USB-Dongle or internal BT-module
range	With free line of sight Long Range up to 50m Short Range up to10m
Charging channels	
3 charging channels for external modules	800 mA each

6.2 PTQ Forcemeter

Property	Value
general	
Weight	1970 g
Dimensions	235 mm x 75 mm x 60 mm
Battery	
Capacity	2000 mAh
Operation time (Average under typical operation conditions)	ca. 15 h
Charging	Through PTQ Com unit or PTQ Hub
Max. charge current	800 mA
Charge duration	ca. 2,5 h
Recommended charging temperature	5 – 35 °C (ambient temperature)
Max. charging temperature	0 – 40 °C (ambient temperature)
Measurement	
Accuracy pulling force	0,3 kN
Resolution pulling force	0,01 kN
Measurement range pulling force	0 - 60 kN
Accuracy rope angle	1° (in range of 0 - 30°)
Resolution rope angle	0,1°
Measurement range rope angle	0 – 90°
Operating temperature	-20 – +50 °C
Accuracy voltage measurement	0,01 V
Communication	
Wireless connection to PTQ Com Unit	868 MHz, 14 dBm, 115,2 kBps Range with free line of sight > 150 m

6.3 PTQ Inclinometer

Property	Value
general	
Weight	280 g
Dimensions	140 mm x 60 mm x 55 mm
Battery	
Capacity	2000 mAh
Operation time (Average under typical operation conditions)	ca. 15 h
Charging	Through PTQ Com unit or PTQ Hub
Max. charge current	800 mA
Charge duration	ca. 2,5 h
Recommended charging temperature	5 – 35 °C (ambient temperature)
Max. charging temperature	0 – 40 °C (ambient temperature)
Measurement	
Accuracy angle measurement	0,005°
Resolution angle measurement	0,002°
Measurement range angle measurement	+/- 30°
Operating temperature	-20 – +50 °C
Accuracy voltage measurement	0,01 V
Communication	
Wireless connection to PTQ Com Unit	868 MHz, 14 dBm, 115,2 kBps Range with free line of sight > 150 m

6.4 PTQ Elastometer

Property	Value
general	
Weight	590 g
Dimensions	220 mm x 60 mm x 38 mm
Distance between Elastometer needles	200 mm
Battery	
Capacity	2000 mAh
Operation time (Average under typical operation conditions)	ca. 15 h
Charging	Through PTQ Com unit or PTQ Hub
Max. charge current	800 mA
Charge duration	ca. 2,5 h
Recommended charging temperature	5 – 35 °C (ambient temperature)
Max. charging temperature	0 – 40 °C (ambient temperature)
Measurement	
Accuracy distance measurement	1 µm
Resolution distance measurement	0,1 µm
Measurement range distance measurement	+/- 2000 µm (= +/- 2 mm)
Operating temperature	-20 – +50 °C
Accuracy voltage measurement	0,01 V
Communication	
Wireless connection to PTQ Com Unit	868 MHz, 14 dBm, 115,2 kBps Range with free line of sight > 150 m

6.5 PTQ Overload indicator

Property	Value
general	
Weight	280 g
Dimensions	140 mm x 60 mm x 55 mm
Battery	
Capacity	2000 mAh
Operation time (Average under typical operation conditions)	Ca. 20 h
Charging	Through PTQ Com unit or PTQ Hub
Max. charge current	800 mA
Charge duration	ca. 2,5 h
Recommended charging temperature	5 – 35 °C (ambient temperature)
Max. charging temperature	0 – 40 °C (ambient temperature)
Communication	
Wireless connection to PTQ Com Unit	868 MHz, 14 dBm, 115,2 kBps Range with free line of sight > 150 m

6.6 Bluetooth 5 - USB-Dongle

Property	Value
Dimensions	68 mm x 25 mm x 10mm
Wireless standard	Bluetooth 5
compatibility PTQ Com Unit	Only PTQ Com Units with serial numbers ending on **-BT5**
Drivers	FTDI-USB-driver (on the Software Stick) manual installation might be necessary under Windows 7

6.7 PTQ case

Property	Value
dimensions	Ca. 500 mm x 400 mm x 200 mm
Weight, empty	Ca. 2,7 kg
Weight, with full Starter-Kit	Ca. 11 kg

6.8 Requirements mobile devices

Platform	Android – devices	Apple – devices
Operating system	Android 6 or newer	iOS8 or newer
Hardware	Bluetooth 5.0 for maximum Range (Long-Range-Modus up to 50 m) Bluetooth 4.2 (minimum requirement, up to 10 m range) GPS recommended Camera recommended	
Free disk space	100 MB	100MB

6.9 Requirements PC

Operating system	Windows 10 (Version 2004), Windows 11
Hardware	Processor 1GHz (Intel recommended / x86 Processor architecture) minimum 1GB RAM (8 GB recommended) USB 2.0 or newer
Free disk space	100 MB (potentially more for .net 4.7.2 Runtime)
Registration	Internet connection recommended After registration fully usable offline



With Passion and Precision

IML Electronic GmbH
Erich-Schlesinger-Straße 49D
18059 Rostock | Germany

Telefon: +49 0381 – 49681440

E-Mail: contact@iml-electronic.de
Web: www.iml-electronic.de