

Leica DS2000

User Manual



Version 1.0
English

- when it has to be **right**

Leica
Geosystems

Introduction

Purchase

Congratulations on the purchase of the Leica DS2000.



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

Product Identification

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



Validity of this manual

This manual applies to both versions of the DS2000 (two-wheeled or four-wheeled). Differences between the versions are marked and described.

Trademarks

- Windows is a registered trademark of Microsoft Corporation in the United States and other countries
 - Google is a registered trademark of Google Inc.
- All other trademarks are the property of their respective owners.

Available documentation

Name	Description/Format		
DS2000 User Manual	All instructions required in order to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions.	-	✓

Refer to the following resources for all DS2000 documentation/software:

- the Leica USB stick
- <https://myworld.leica-geosystems.com>

Leica Geosystems Address Book

On the last page of this manual, you can find the address of Leica Geosystems headquarters. For a list of regional contacts, please visit http://leica-geosystems.com/contact-us/sales_support.

myWorld@Leica Geosystems (<https://myworld.leica-geosystems.com>) offers a wide range of services, information and training material.

With direct access to myWorld, you are able to access all relevant services whenever it is convenient for you, 24 hours a day, 7 days per week. This increases your efficiency and keeps you and your equipment instantly updated with the latest information from Leica Geosystems.

Service	Description
myProducts	Add all products that you and your company own and explore your world of Leica Geosystems: View detailed information on your products and update your products with the latest software and keep up-to-date with the latest documentation.
myService	View the current service status and full service history of your products in Leica Geosystems service centres. Access detailed information on the services performed and download your latest calibration certificates and service reports.
mySupport	View the current service status and full service history of your products in Leica Geosystems service centres. Access detailed information on the services performed and download your latest calibration certificates and service reports.
myTraining	Enhance your product knowledge with Leica Geosystems Campus - Information, Knowledge, Training. Study the latest online training material on your products and register for seminars or courses in your country.
myTrustedServices	Add your subscriptions and manage users for Leica Geosystems Trusted Services, the secure software services, that assist you to optimise your workflow and increase your efficiency.

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1

Safety Directions

1.1

General

Description

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

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

About Warning Messages





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

Warning messages...

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

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

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

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


1.2

Definition of Use

Intended use	<ul style="list-style-type: none">• Detecting and localising underground utilities, such as cables or pipes.• Measuring the depth of underground utilities.• Mapping underground utilities.• Surveying (underground utilities).• Recording raw data and computing coordinates using code signal from GNSS satellites (GNSS Systems).• Data communication with external appliances.
Reasonably foreseeable misuse	<ul style="list-style-type: none">• Use of the product without instruction.• Use outside of the intended use and limits.• Disabling safety systems.• Removal of hazard notices.• Opening the product using tools, for example screwdriver, unless this is permitted for certain functions.• Modification or conversion of the product.• Use after misappropriation.• Use of products with obvious damages or defects.• Use with accessories from other manufacturers without the prior explicit approval of Leica Geosystems.• Inadequate safeguards at the working site.

1.3

Limits of Use

Environment	Suitable for use in an atmosphere appropriate for permanent human habitation: not suitable for use in aggressive or explosive environments.
 DANGER	Local safety authorities and safety experts must be contacted before working in hazardous areas, or close to electrical installations or similar situations by the person in charge of the product.

1.4

Responsibilities

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

Exposure to Radio Frequency (RF) Signals

The product is normally operated at least 1 m away from the user. At a distance of at least 1 m or greater, the typical power density level is below $1 \mu\text{W}/\text{cm}^2$ ($0.01 \text{ W}/\text{m}^2$). This value is far below the level specified by the current regulations.



When operated in the normal manner of intended use, this product does not pose health or safety risks regarding radio frequency signals.



CAUTION

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

Precautions:

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



DANGER

Because of the risk of electrocution, it is dangerous to use poles, levelling staffs and extensions in the vicinity of electrical installations such as power cables or electrical railways.

Precautions:

Keep at a safe distance from electrical installations. If it is essential to work in this environment, first contact the safety authorities responsible for the electrical installations and follow their instructions.



WARNING

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

Precautions:

Do not use the product in a thunderstorm.



CAUTION

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

Precautions:

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

Avoid subjecting the product to mechanical stress.



WARNING

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

Precautions:

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



WARNING

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

Precautions:

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



WARNING

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

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

Precautions:

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



CAUTION

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

Precautions:

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

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



WARNING

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

Precautions:

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



WARNING

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

Precautions:

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



WARNING

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

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

Precautions:



The product must not be disposed with household waste.

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

Always prevent access to the product by unauthorised personnel.

Product-specific treatment and waste management information can be downloaded from the Leica Geosystems home page at <http://www.leica-geosystems.com/treatment> or received from your Leica Geosystems distributor.



WARNING

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

Description

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

**WARNING**

Electromagnetic radiation can cause disturbances in other equipment.

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

**CAUTION**

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

Precautions:

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

**CAUTION**

Disturbances caused by electromagnetic radiation can result in erroneous measurements.

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

Precautions:

Check the plausibility of results obtained under these conditions.

**CAUTION**

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

Precautions:

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

Radios or Digital Cellular Phones



WARNING

Use of product with radio or digital cellular phone devices:

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

Precautions:

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

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

1.7

FCC Statement, Applicable in U.S.



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



WARNING

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

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

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

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

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



WARNING

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

Labelling DS2000



012571_001

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.



This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

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



WARNING

This Class (A) digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe (A) est conforme à la norme NMB-003 du Canada.

Exposure to Radio Frequency (RF) Signals

The wireless device is a radio transmitter and receiver. It is designed and manufactured not to exceed the emission limit for exposure to radio frequency (RF) energy set by the OET Bulletin 65 Supplement C / Ministry of Health (Canada), Safety Code 6. These limits are part of comprehensive guidelines and established permitted levels of RF energy for the general population. These guidelines are based on the safety standards previously set by international standard bodies. These standards include a substantial safety margin designed to assure the safety of all persons, regardless of age and health.

This device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter.

This device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment / general public exposure limits specific in ANSI/IEEE C95.1-1992 and had been tested in accordance with the measurement procedures specified in IEEE Std. 1528-2003.

IC Canadian Compliance

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p) is not more than that necessary for successful communication. This device complies with Industry Canada license-exempt RSS standard(s).

Operation is subject to the following two conditions: (1) This device may not cause interference. (2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur. Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploita-

tion est autorisée aux deux conditions suivantes :(1) L'appareil ne doit pas produire de brouillage.

(2) L'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

2 Description of the System

2.1 General

Area of application The DS2000 system is intended for localising and mapping underground utilities and can therefore be used for civil engineering applications.

2.2 System Components

DS2000 System The DS2000 system consist of the following components:



- a) GPS antenna on a pole
- b) Laptop or Tablet with Overture software
- c) DS2000 (two-wheeled or four-wheeled)

2.3 Delivery Contents



The delivered components depend on the package ordered.

Stand-alone package

The stand-alone package of the DS2000 includes the following components:

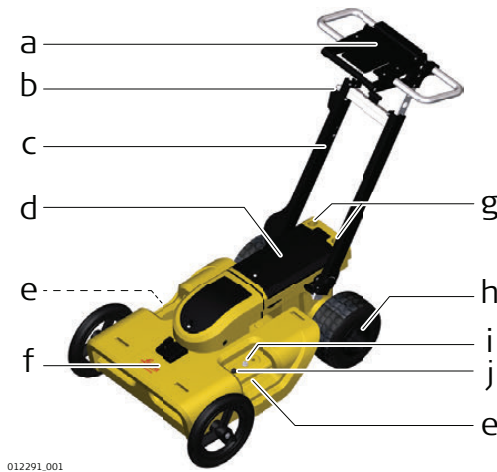
- DS2000 (two-wheeled or four-wheeled)
- Leica USB stick with Overture software and User Manuals
- Battery (rechargeable SLAB)
- Battery Charger
- Covers for antenna and wheels
- Spare Velcro strips (for the laptop/tablet support)



Other components of the DS2000 system need to be purchased separately.

DS2000 (two-wheeled)

- a) Support for laptop or tablet
- b) Plug for Ethernet cable
- c) Adjustable handle
- d) Holes for GPS support
- e) Battery compartment
- f) Indentations for mounting a spray support
- g) Antenna box, containing dual-frequency antenna and control unit
- h) Encoders (placed inside the rear wheels)
- i) Plug for spray support cable
- j) Power button of control unit

DS2000 (four-wheeled)

- a) Support for laptop or tablet
- b) Plug for Ethernet cable
- c) Adjustable handle
- d) Battery compartment
- e) Indentations for mounting a spray support
- f) Antenna box, containing dual-frequency antenna and control unit
- g) Holes for GPS support
- h) Encoders (placed inside the rear wheels)
- i) Plug for spray support cable
- j) Power button of control unit

Description of the main components

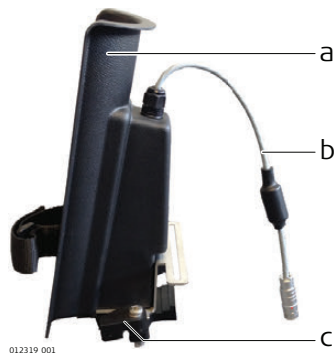
Component	Description
Dual-frequency antenna	The 700 MHz antenna detects small targets located close beneath the surface up to a depth of 2 m to 3 m, depending on the soil conditions. The 250 MHz antenna detects bigger, deeper located targets up to a depth of 4 m to 5 m.
Control unit	The control unit communicates with the antenna, the laptop/tablet and the encoders and ensures that they are working together correctly.
Encoders	The encoders are used for measuring the distance travelled from the starting point of a scan. The measured distance is constantly transferred to the control unit. The encoders are positioned inside the rear wheels of the DS2000 to ensure correct measurements even in rough terrain, when sometimes only one wheel is touching the ground.
Handle	The handle of the DS2000 can be adjusted both in height and inclination. For easy transport of the DS2000, the handle can be folded up. At the side of the handle bar is an Ethernet plug for connecting the laptop/tablet to the cable of the control unit.

Component	Description
Wheels	Both DS2000 versions: The rear wheels are tubeless tyres; the tyre pressure should be 2 bar. Four-wheeled version: The front wheels are solid rubber tyres.
Support for laptop or tablet	The support is designed to hold a Panasonic FZ G1 tablet. The inclination of the support can be adjusted to the optimal viewing angle.
Spray support (optional)	The spray support provides a holder for a vertical spray marker and can be attached to both sides of the antenna box. When the spray support is connected to the control unit, the valve of the spray can be controlled by the software to mark a target on the ground.
GPS support (optional)	The GPS support can be attached to the DS2000 to provide a holder for a GPS pole.

2.5

Accessories

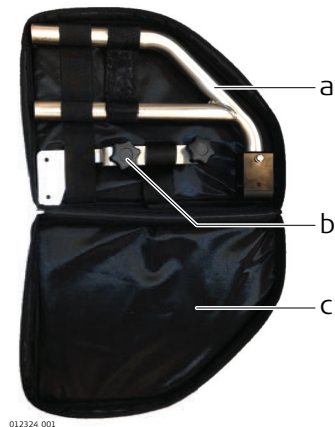
Components of the spray support



- a) Holder for vertical spray
- b) Cable for connecting the spray support to the control unit
- c) Locking lever (on each side)

The spray support is delivered with a storage bag that provides space for an extra spray can.

Components of the GPS support



- a) Upper part with pole clamp
- b) Lower part with tightening screws
- c) Storage bag



Charging

The permissible temperature range for charging is between 0°C to +40°C/+32°F to +104°F. For optimal charging, we recommend charging the batteries at a low ambient temperature of +10°C to +20°C/+50°F to +68°F if possible.

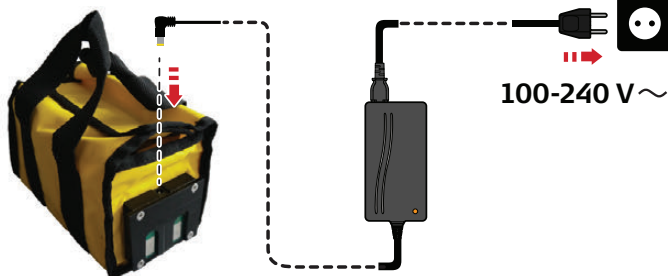
Operation/Discharging

- The batteries can be operated from –20 °C to +50 °C/–4 °F to +122 °F.
- Low operating temperatures reduce the capacity that can be drawn; high operating temperatures reduce the service life of the battery.

Storage

- Remove batteries from the product and the charger before storing.
- After storage recharge batteries before using.
- Protect batteries from damp and wetness. Wet or damp batteries must be dried before storing or use.
- The batteries can be stored from –20 °C to +50 °C/–4 °F to +122 °F.

Charging the battery

	You can charge the battery while it is inserted in the battery compartment. Alternatively, remove the battery from the battery compartment before charging it.
	You cannot turn on the DS2000 while the battery is charging.
1.	<p>Connect the battery charger to the battery and to a mains socket.</p>  <p>012573_001</p>
2.	<p>While charging, the LED of the battery charger lights up orange. When the battery is nearly charged, the LED turns yellow. When the battery is fully charged, the LED turns green.</p>

Requirements

The DS2000 can be used with a GPS antenna to position the scan data in real-time without the need to set up a measurement grid.

For using the DS2000 with a GPS antenna, the GPS antenna has to meet the following requirements:

- Dual frequency (L1+L2).
- Positioning update greater than 5 Hz.
- RTK (Real-Time Kinematic): connection to a base station using radio link (UHF or GSM) or connection to a Continuously Operating Reference Station (CORS) using internet.
- NMEA output.



To connect the GPS antenna to the laptop/tablet, a serial cable (RS232) is necessary. Alternatively, the GPS antenna can be connected using Bluetooth.

Procedure for setting up the DS2000

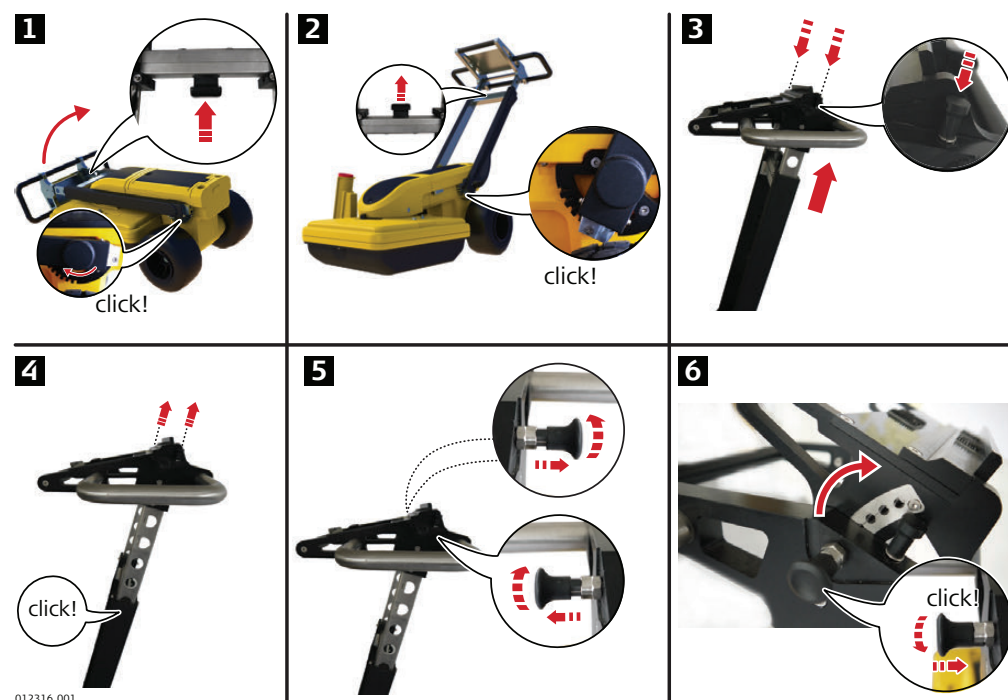
The setup procedure of the DS2000 consists of the following steps:

- Unfolding and adjusting the handle (refer to "3.1 Unfolding and Adjusting the Handle")
- Preparing the antenna (refer to "3.2 Preparing the Antenna")
- Attaching and connecting the laptop or tablet (refer to "3.3 Attaching and Connecting the Laptop or Tablet")
- Inserting the battery (refer to "3.3 Attaching and Connecting the Laptop or Tablet")
- Mounting the spray support (optional; refer to "3.4 Inserting the Battery")
- Mounting the GPS support (optional; refer to "3.6 Mounting the GPS Support")
- Calibrating the encoders (refer to "3.7 Calibrating the Encoders")

3.1

Unfolding and Adjusting the Handle

Unfold and adjust the handle

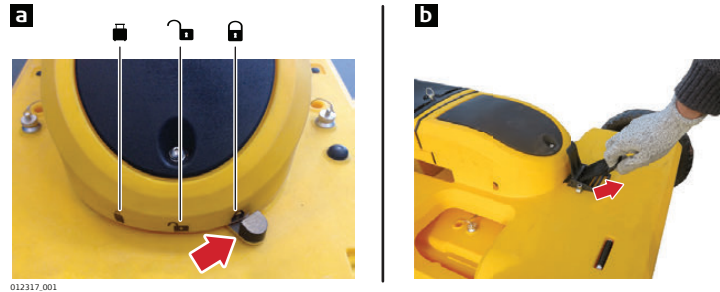


1.	Press and hold the central button on the handle and raise the handle.
2.	When the handle is at the desired angle, release the central button. The handle clicks into place.
3.	To adjust the height of the handle, press and hold the vertical buttons at the top of the handle. Pull up the upper part of the handle.
4.	When the handle is at the desired height, release the two vertical buttons. Slightly shift the handle until it clicks into place.
5.	At both sides of the laptop/tablet support, pull out the two horizontal locks and turn them slightly to keep them open.
6.	Incline the support to the desired angle and hold it in place. To fix the support and to close the horizontal locks, turn and release the locks until they click back into place.

3.2

Preparing the Antenna

Regulate the movement and height of the antenna



a) Two-wheeled version

- For transportation, push the lever to the left position.
- When using the DS2000 in rough terrain, push the lever to the middle position. The antenna has limited mobility.
- When using the DS2000 in smooth terrain, push the lever to the right position. The movement of the antenna is blocked.

b) Four-wheeled version

To raise the antenna slightly from the ground, pull the strap on the top of the antenna box.

3.3

Attaching and Connecting the Laptop or Tablet

Attach and connect the laptop/tablet

	<p>The support is designed to hold a Panasonic FZ G1 laptop. When using a different type of laptop or tablet, unscrew and remove the small plastic panel on top of the support.</p> <p>012569.001</p>
	<p>The support has several Velcro strips to allow fixing a tablet or laptop. If necessary, attach the spare Velcro strips delivered with the DS2000 to the currently used tablet or laptop.</p> <p>012570.001</p>
1.	To attach the laptop or tablet to the support, press it onto the support until the Velcro strips are securely attached to each other.
2.	Connect the laptop or tablet to the Ethernet cable of the DS2000.

3.4

Inserting the Battery

Insert the battery



1.	To open the battery compartment, turn the metallic ring and lift the cover of the compartment.
2.	Insert the battery with the battery connectors facing toward the front of the DS2000.
3.	Close the battery compartment and turn the ring to lock it.

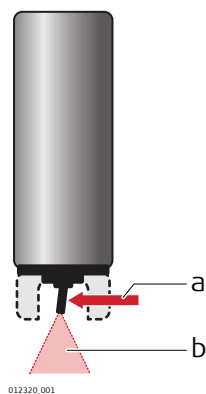
3.5

Mounting the Spray Support

Type of spray paint


Use only spray paint that functions in the following way:

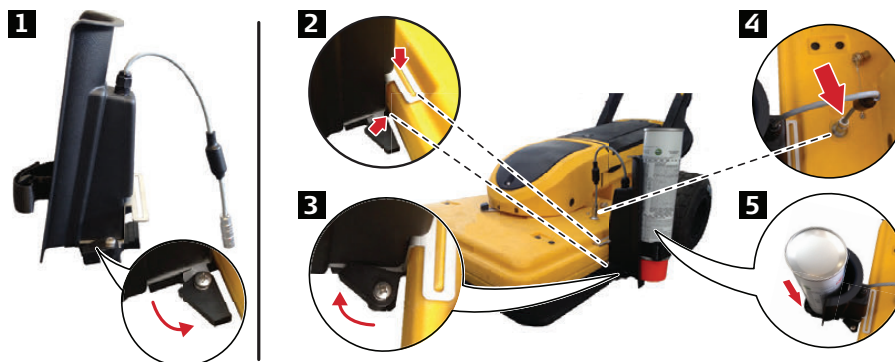
- The valve has to be pressed horizontally.
- The paint emerges from the top of the valve and flows along the elongation of the spray can (not perpendicular to it).





- a) Horizontal pressure on the valve
b) Spray paint

Mounting the Spray Support

 The spray support can be mounted on either side of the antenna box.



012322_001

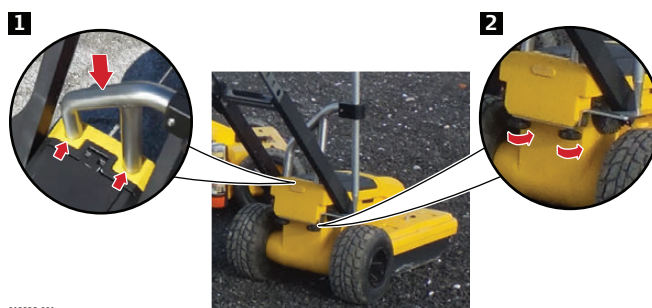
1.	Open the locking levers of the spray support.
2.	Attach the spray support to the side of the antenna box by first inserting the upper part and then the lower.
3.	Close the locking levers of the spray support.
4.	Connect the cable of the spray support to the plug on the antenna box.
5.	Insert the spray can into the holder of the support, with the valve facing downward.
	<p>Ensure that the hook of the spray support and the valve of the spray paint are positioned correctly.</p>  <p>a) Valve b) Hook</p>

012323_001

3.6

Mounting the GPS Support

Mount the GPS Support




012325_001

1.	Insert the upper part of the GPS support into the holes at the back of the battery compartment.
2.	Attach the lower part of the GPS support at the bottom of the battery compartment. Use the tightening screws to screw both parts together.

Calibration procedure

Calibrate the encoders when using the DS2000 for the first time or when the distance measured by the encoders deviates from the actual distance.

1.	Inflate the tyres of the rear wheels to a pressure of 2 bar.
2.	Measure out a distance of at least 10 m. The defined distance is used as a reference for the calibration procedure.
	Ensure that the laptop/tablet is connected to the control unit.
3.	Turn on the control unit of the DS2000. Turn on the laptop/tablet and start the Ouverture software.
4.	Start the calibration procedure with the Ouverture software. (Refer to "Procedure for calibrating the encoders" within "4.6.2 Hardware Settings").
5.	Move the DS2000 along the defined distance.
6.	Complete the calibration procedure with the Ouverture software and check the calibration result. If necessary, repeat the calibration.



After 30 scans, it is recommended to calibrate the encoder of each wheel separately. For a separate encoder calibration, lift one wheel during the calibration procedure, then repeat the procedure with the other wheel. Compare the results with the defined distance to ensure that both encoders work properly.

4

Software

4.1

Software Installation

Requirements for installing the Overture software

When purchasing a DS2000 package that includes a tablet, the Overture software is already installed on the tablet.

However, you can also operate the DS2000 with any laptop/tablet. When installing the Overture software on another laptop/tablet, respect the following requirements.

Minimum requirements:

- Processor: i3 1.7 GHz
- RAM: 1 GB
- Graphic adapter compatible with Open GL 2 or a higher version
- Operating system: Windows 7
- Ethernet port








Requirements for an optimal performance:

- Processor: i5 1.7 GHz
- RAM: 2 GB
- Graphic adapter compatible with Open GL 2 or a higher version
- Operating system: Windows 7
- Hard disk: 40 GB, shock-proof
- Serial port (RS232), only necessary, when using a GPS antenna
- USB port
- Ethernet port

4.2

Main Menu

Available functions

File		Click New Project to start a new project without using a reference line.
		Click New Assisted Project to start a new project based on a defined reference line.
		Click Open Project to review existing projects.
		Click Exit to close Overture.
Options		Click Settings to open the Settings dialogue.
Help		Select Help > Legacy Equipment to register legacy equipment.
		Select Help > About to display general information about the Overture software.

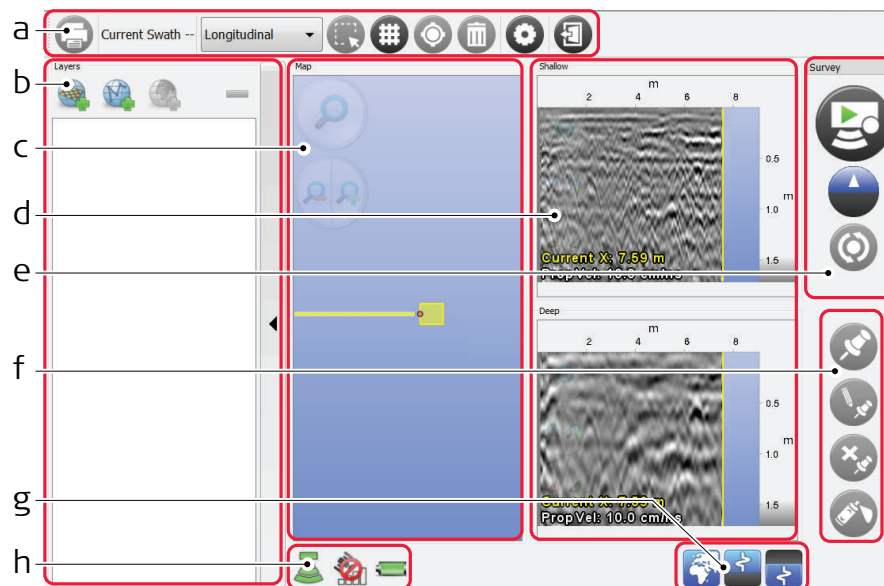
4.3

4.3.1

Acquisition of Scan Data

The Acquisition Screen

Elements of the Acquisition screen




012336.001

- a) Acquisition Menu
- b) **Layers** Section
- c) **Map** Section
- d) Radargrams (**Shallow** and **Deep**)
- e) Acquisition Commands
- f) Target Commands
- g) Menu for Visualisation of Maps and Radargrams
- h) System Status








Acquisition Menu

Button	Description
	Click this button to open the Survey Report dialogue for generating a report of the scan data. For a detailed description, refer to "4.3.6 Generating a Survey Report".
	Click this button to display or hide the grid on the radargrams.
	Click this button to delete the last acquired scan data.
	Click this button to view the current settings. The Survey Settings and Hardware Settings cannot be changed from within a project. To change these settings, return to the main menu and click the Settings button.
	Click this button to close the current project and return to the main menu.
The following buttons are only available for the New Assisted Project function.	
	Click this button to activate the "Scan Line Selection" mode. To select a single scan line on the defined grid, click a line while this mode is active. To select several lines, click and drag to create a selection frame over the lines. This function is available before starting an acquisition.




Button	Description
	Click this button to open the Starting Point Editor dialogue. This dialogue allows modifying the starting point of the next acquisition in relation to the defined grid. For a detailed description, refer to "Starting Point Editor". ☞ This function is available before starting an acquisition.

List of maps within the Layers section

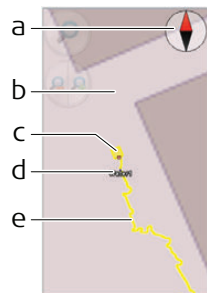
To visualise the scan lines and the targets on these lines, you can load one or more maps from a saved file or from the internet. The loaded maps are displayed as layers in the **Map** section.

Button	Description
	Click this button to load a saved map in the raster graphics format. The file format should be TIF or TIFF. ☞ Ensure that you load a map of the area that is currently scanned.
	Click this button to load a saved map in the vector graphics format. The file format should be SHP, KML or DXF. ☞ Ensure that you load a map of the area that is currently scanned.
	Click this button to load a map from the internet. The following maps are available for download: <div data-bbox="576 768 954 915" style="border: 1px solid gray; padding: 5px; margin-top: 10px;"> Google Satellite Google Street Google Terrain Google Hybrid Open Street Map </div>
	Click this button to remove a loaded map from the list.
	Click this button to hide a layer in the Map section.
	Drag the slider to change the transparency of a layer in the Map section.
	Click this button to display or hide the Map section.

Map section and radargrams

Button	Description
	Click this button to display the Map section or a radargram at its full extent.
	Click this button to zoom in or out.
	Only for the radargrams: Click this button to increase or reduce the contrast of the radargram.

Map Section



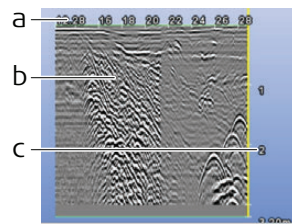
012462.001

- a) Compass
- b) Loaded map layers
- c) Current position of the DS2000 radar
- d) Inserted target
- e) Scan line

Radargrams

Shallow: 700 MHz radargram

Deep: 250 MHz radargram








012352.001

- a) Horizontal scale (distance travelled). The yellow line indicates the current position of the DS2000
- b) Real-time visualisation of the scan data
- c) Vertical scale (depth)








Click and drag the scroll bar to scroll horizontally through the scan data of the radargrams.




Acquisition Commands

Button	Description
	Click this button to choose the scan direction before starting an acquisition. (Shortcut: F2) Forward: to push the DS2000. Backward: to pull the DS2000.
	Click this button to start an acquisition. (Shortcut: F1)
	Click this button to stop and save the acquisition. (Shortcut: F1)
	 During the scan, the software evaluates the scan data from the previous half-meter. Based on the detected soil characteristics, the software calculates the best graphic settings for the radargrams and continually adjusts them. If the soil characteristics change suddenly, the software is not able to adjust the graphic settings properly. Click this button to refresh the graphic settings of the radargrams.


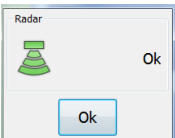

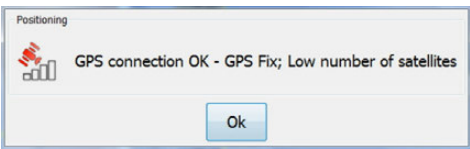

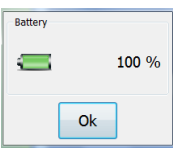
Target Commands

Button	Description
	Click this button to activate the "Insert Marker" mode. For a detailed description, refer to "4.3.5 Placing a Target".
	Click this button to activate the "Edit Marker" mode and click the marker to be edited.
	Click this button to activate the "Delete Marker" mode and click the marker to be deleted.
	 This command is only possible if the spray support is mounted and connected to the control unit. (Shortcut: F5) Click this button to mark a target on the ground.

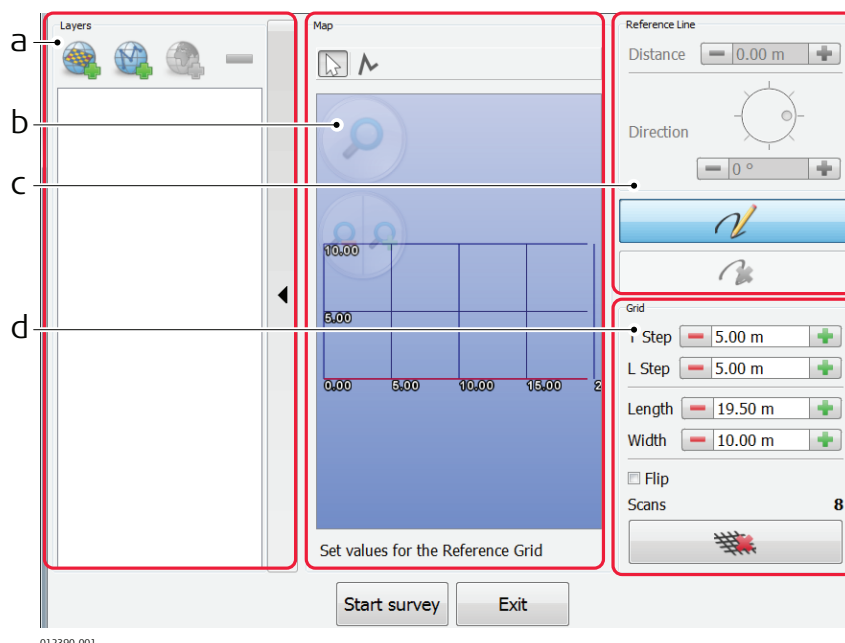
Menu for visualisation of maps and radargrams

Button	Description
	Click this button to display or hide the Map section.
	Click this button to display or hide the 700 MHz radargram (Shallow).
	Click this button to display or hide the 250 MHz radargram (Deep).

System Status

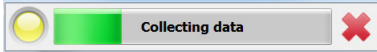

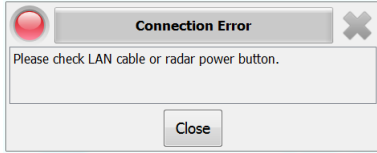

Button	Description
	Displays the radar status. Click this button to display further details. 
	Displays the GPS status. Click this button to display further details. If the number of satellites detected by the GPS antenna is low, the following dialogue window is displayed: 
	Displays the battery status. Click this button to display further details. 

Elements of the Assisted Project Setup screen



- a) **Layers** section
 b) **Map** section
 c) **Reference Line** section
 d) **Grid** section


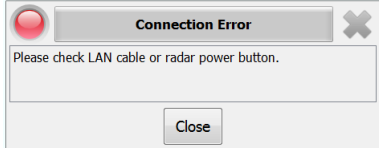

Starting an acquisition

1.	<p>Click the New Project button in the main menu. The software starts calibrating the radar. A dialogue box shows the progress of the calibration.</p> 
	<p>If the radar calibration fails, the following dialogue box is displayed.</p>  <p>Ensure that the Ethernet cable is connected properly to the laptop/tablet and that the control unit is turned on.</p>
	<p>If one of the radar channels does not work, an error screen indicates the faulty channel.</p>
2.	<p>As soon as the radar calibration is complete, the Acquisition screen is displayed. Use the acquisition commands to start and stop the acquisition of scan data. For a detailed description of these and other available functions, refer to "4.3.1 The Acquisition Screen".</p>



The length of a single scan must not exceed 800 m.





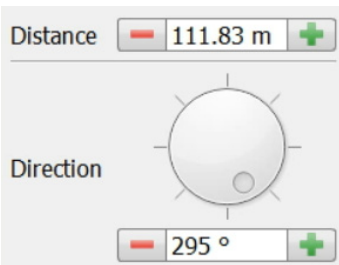
Starting an acquisition

1.	Click the New Assisted Project button in the main menu. The Assisted Project Setup screen is displayed.
2.	In the Assisted Project Setup dialogue, set up the measurement grid. For a detailed description, refer to "Setting up a measurement grid".
3.	When the setup of the measurement grid is finished, click the Start Survey button to start the acquisition. The software starts calibrating the radar. A dialogue box shows the progress of the calibration.
	<p>If the radar calibration fails, the following dialogue box is displayed.</p>  <p>Ensure that the Ethernet cable is connected properly to the laptop/tablet and that the control unit is turned on.</p>
	If one of the radar channels does not work, an error screen indicates the faulty channel.
4.	As soon as the radar calibration is complete, the Acquisition screen is displayed. Use the acquisition commands to start and stop the acquisition of scan data. For a detailed description of these and other available functions, refer to "4.3.1 The Acquisition Screen".

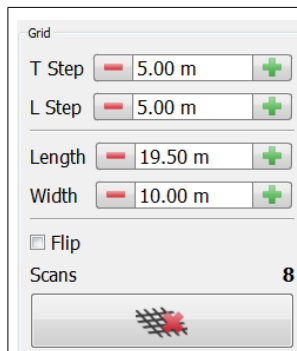


The length of a single scan must not exceed 800 m.

Setting up a measurement grid**Drawing and Editing the Reference Line of the Grid**

	Click this button to edit the reference line.
	To draw a new grid reference line, click the right button at the top of the Map section, then click on the map to place two or more points. The software connects the placed points to create the reference line.
	To pan the map, click the left button at the top of the Map section, then click and drag the map.
	Click this button to finish the drawing of the reference line.
	<p>To edit a single point of the reference line, select the point in the map and change the parameters in the Reference Line section.</p> <p>You can change the distance from the previous point and the angle relative to the previous segment of the line.</p>

Modifying the Grid Settings



In the **Grid** section you can define the following parameters:

- **T Step**: Distance between two grid lines in the transversal direction.
- **L Step**: Distance between two grid lines in the longitudinal direction.
- **Length**: Total length of the grid.
- **Width**: Total width of the grid.
- **Flip**: Option to flip the grid 180°.

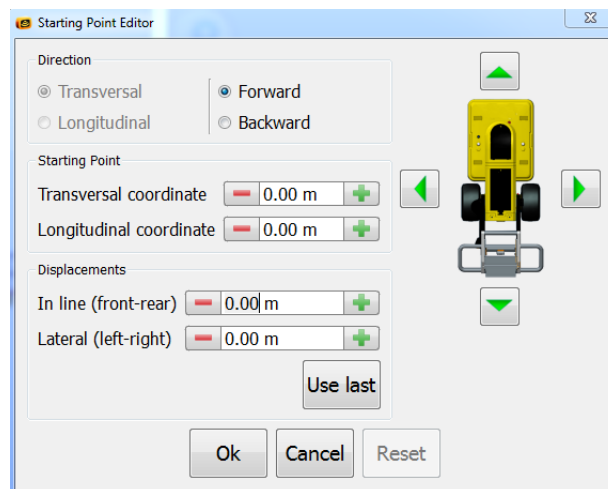
The field **Scans** displays the total number of scans that are necessary to complete the survey.



To reset the grid to the default, click the button beneath the **Grid** section.

Starting Point Editor

With the **Starting Point Editor** you can change the position of the DS2000 in relation to the measurement grid within the map.



Direction:

This section displays the direction of the selected scan line and the currently selected scan direction.

Select the desired scan direction for the data acquisition (forward or backward).

Starting Point:

In this section, you can edit the coordinates of the starting point.

To edit the values, click the green arrows in the interactive graphic or click the plus or minus buttons.

Displacements:

In this section, you can edit the in-line and lateral displacements.

To edit the values, click the green arrows in the interactive graphic or click the plus or minus buttons.






Note: The **Starting Point** and **Displacements** values are interdependent. Changing the values of one section changes the values of the other section accordingly.

The Place Target dialogue

012369.001

- a) **Target** section
 b) **Details** section
 c) **Propagation Velocity** section

1.	To insert a marker for a target, activate the "Insert Marker" mode and click directly on the detected object within the radargram. The Place Target dialogue is displayed.
2.	In the section Target , edit the information about the new marker. <ul style="list-style-type: none"> • Type: Define the type of the detected target.  • Name: Enter a name or select an existing name. Note: Based on the selected target type, a default name is proposed. Additionally, a list with names of previous inserted markers is available. The software connects all markers using the same name with a line in the Area Map to form a so-called "target". • Color: Define the colour of the marker. Based on the selected target type, a default colour is proposed. • Notes: Enter additional information, if necessary.
3.	If necessary, modify the displayed values in the section Propagation Velocity to find the best propagation velocity. To adjust the red hyperbola on the radargram, move the slider below the radargram or change one of the three parameters.
	Note: The parameters are interdependent. Changing one parameter changes the other two parameters accordingly.  To reset the parameter values to the default setting, click this button.
4.	To confirm all changes and insert the marker, click OK , otherwise click Cancel .

The Survey Report
dialogue

Report Type

Planimetry

Data analysis

Paper size

A4

Detailed planimetry scale

1:200

Output type

PDF

Survey Description

Survey Name

Survey_2016.04.06_001

Project Name

Location

Additional Notes

☒ Acquisition date and time

Header

Company

Operator

Date/Time

4/13/16 4:26 PM

Additional Figures

+

-

Save

Preview

Close

Report Type section	<p>The type of report (planimetry or data analysis) is selected by default.</p> <ul style="list-style-type: none">• Paper size: Choose between the A3 and A4 format.• Detailed planimetry scale: Select a scale between 1:50 and 1:1000.• Output type: Choose between the PDF and HTML format.
Survey Description section	<p>The survey name is generated automatically. Enter a project name and a short description of the job location.</p>
Header section	<p>Enter general information, such as company name, name of the operator, and date and time.</p> <p>To change the logo in the header of the report, click the logo and select a file from the directory.</p>
Additional Notes and Additional Figures section	<p>If necessary, enter additional information.</p>
<p>To view the report before saving, click Preview.</p> <p>To generate and save the report, click Save.</p> <p>To close the dialogue without saving the report, click Cancel.</p>	

4.4

4.4.1

Review of Scan Data

The Review Acquisition Screen

Elements of the Review Acquisition screen



012401.001

- a) Review Acquisition Menu
- b) **Map** Section
- c) Radargrams (**Shallow** and **Deep**)
- d) Target Commands
- e) Menu for Visualisation of Maps and Radargrams

Functions within the Review Acquisition screen

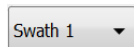
Radargrams

The general functions of the radargrams are the same as for the Acquisition screen. (Refer to "Map section and radargrams" within "4.3.1 The Acquisition Screen").

Target Commands








These commands are the same as for the Acquisition screen, except that the button for marking a target on the ground is not available. (Refer to "Target Commands" within "4.3.1 The Acquisition Screen").

Review Acquisition Menu



Use the drop-down menu to switch between the single scans of the survey.

Button	Description
	Click this button to start data acquisition in order to resume the saved survey, for example when lines are missing.
	Click this button to export targets to one of the following file formats: <ul style="list-style-type: none">• dat• shp• dxf
	Click this button to open the Survey Report dialogue for generating a report of the scan data. For a detailed description, refer to "4.3.6 Generating a Survey Report".

Button	Description
	Click this button to activate the "Scan Line Selection" mode. To select a single scan line on the defined grid, click a line while this mode is active. To select several lines, click and drag to create a selection frame over the lines.  This function is available before starting an acquisition.
	Click this button to display or hide the grid on the radargrams.
	Click this button to delete the scan data and markers of the currently selected scan.
	Click this button to view the current settings.  The settings cannot be changed from within a project. To change the settings, return to the main menu and click the Settings button.
	Click this button to close the current project and return to the main menu.

4.4.2

Review of Scan Data with the Open Project Function


Open an existing project

1.	Click the Open Project button in the main menu.
2.	Select a project file from the file directory and click Open . The Review Acquisition screen is displayed.
3.	The Map section and the radargrams allow you to review the existing scan data of the survey project.
4.	For a detailed description of available functions, refer to "4.4.1 The Review Acquisition Screen".

4.5

Export of Scan Data

Export scan data and inserted targets

1.	Click the Open Project button in the main menu.
2.	Select a project file from the file directory and click Open . The Review Acquisition screen is displayed.
3.	To export the scan data and inserted targets of the project, click the export button in the Review Acquisition menu. 
4.	Select a file format and click Export .

The Settings dialogue

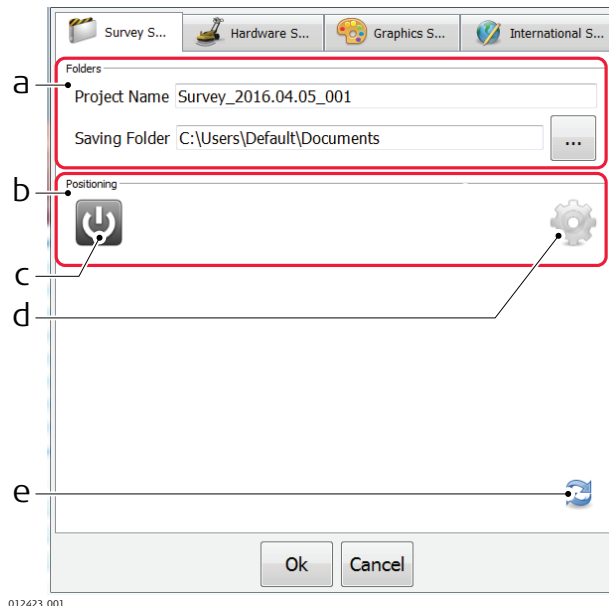
To open the **Settings** dialogue, click the **Settings** button in the main menu.
The **Settings** dialogue contains the following tabs:

- **Survey Settings** (refer to "4.6.1 Survey Settings")
- **Hardware Settings** (refer to "4.6.2 Hardware Settings")
- **Graphics Settings** (refer to "4.6.3 Graphics Settings")
- **International Settings** (refer to "4.6.4 International Settings")

4.6.1

Survey Settings

Available functions

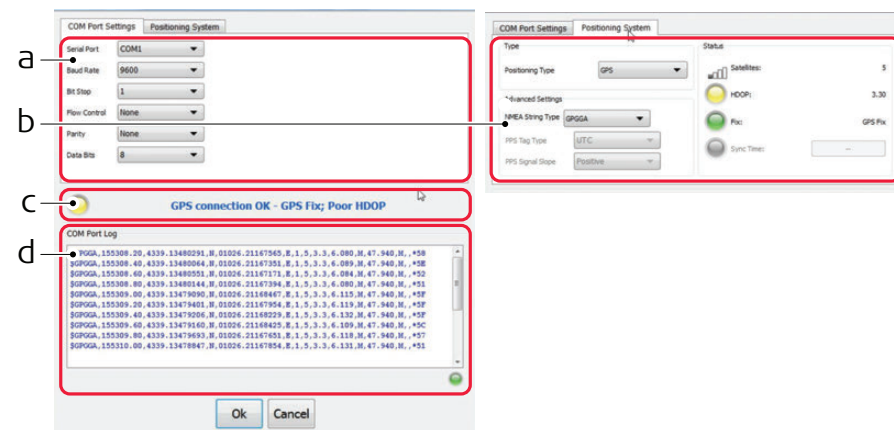


- Folders** section: Modify the project name and define the storage location for the project.
- Positioning** section
- Click this button to turn on or off the GPS.
- Click this button to open the **Positioning Settings** dialogue.
- Click this button to reset the settings to the default values.

The Positioning Settings dialogue

The **Positioning Settings** dialogue contains two tabs and a general section below those tabs:

- COM Port Settings tab
- Positioning System tab
- Status of the GPS
- Log of incoming NMEA strings



012424.001

COM Port Settings tab:

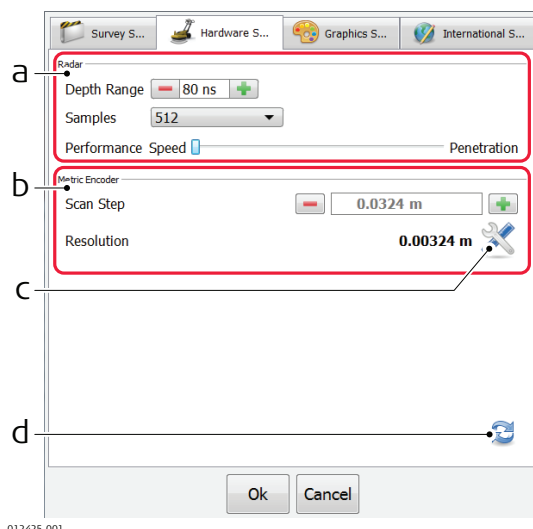
Select the same values that are used in the settings of the GPS antenna. Refer to the user manual of the GPS antenna.

Positioning System tab:

Check the status of the positioning system:



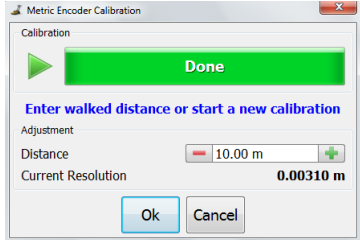
- Satellites:** Indicates the number of satellites from which the GPS antenna is receiving data. For a good signal at least 5 satellites are required.
- HDOP** (Horizontal Dilution Of Precision): The lower the number is, the better is the achieved accuracy. For a good positioning, this value should not be greater than 2.
- Fix:** Indicates the Real-Time Kinematic (RTK) status.
 - GPS Fix: without GPS
 - RTK Fix: without RTK
 - RKT Float Fix: no connection to the base station

Available functions

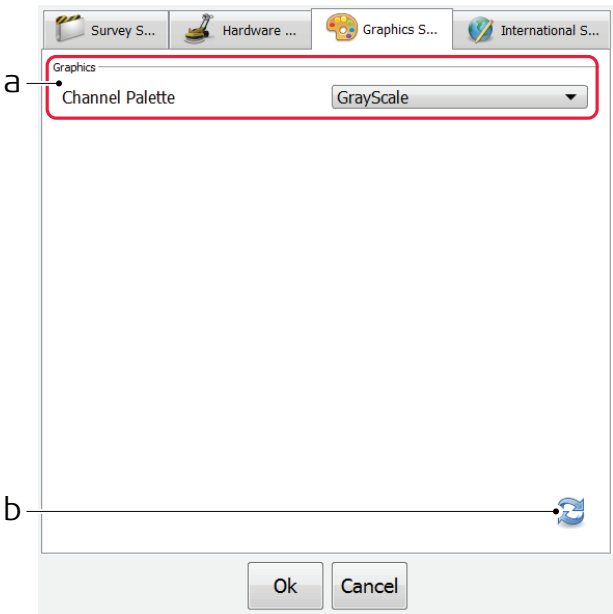


- a) **Radar** section: Modify the radar depth range (in ns) and the number of samples.
 b) **Metric Encoder** section
 c) Click this button to open the **Metric Encoder Calibration** dialogue.
 d) Click this button to reset the settings to the default values.

Procedure for calibrating the encoders

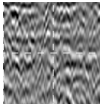
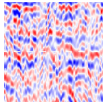
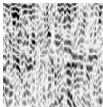
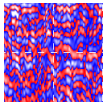
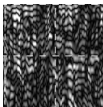
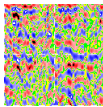
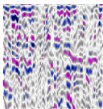
1.	To open the Metric Encoder Calibration dialogue, click the Settings button in the main menu, select the Hardware Settings tab and click the button within the Metric Encoder section. Alternatively, you can use the shortcut F3.
2.	To start the calibration procedure, click the START button.  A bar indicates the progress of the calibration procedure.
3.	To complete the calibration procedure, click the STOP button. 
4.	Enter the distance travelled with the DS2000. The software calculates the new spatial resolution of the encoders. 
5.	To start a new calibration procedure, repeat the steps 2 to 4. To save the calibration result and close the dialogue, click OK . To close the dialogue without saving, click Cancel .

Available functions

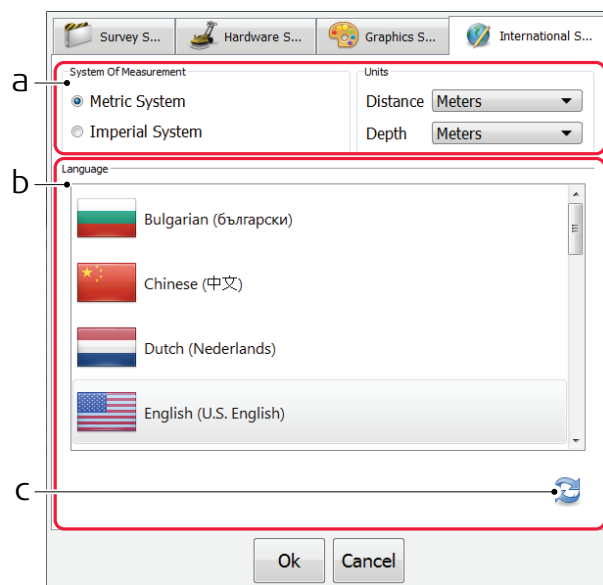


012465_001

- a) **Graphics** section: Select the display mode for the radargrams.
- b) Click this button to reset the settings to the default values.

Available Display Modes	
Gray Scale 	ZCE 
B-W-B 	PHE 
W-B-W 	Russian 
BGP 	

Available functions



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- a) **System Of Measurement** and **Units** section: Select the type of measurement system and the units for distance (metres, feet, yards) and depth (metres, centimetres, inches, feet).
- b) **Language** section: Select the preferred language. The change of the language becomes only effective after restarting the software.
- c) Click this button to reset the settings to the default values.

Jobsite Investigation

To carry out a survey with the DS2000 in the most efficient way, gather all available information:

- Make yourself familiar with the jobsite features.
- Obtain technical maps about existing utilities on the jobsite.
- Supplement the acquired scan data by opening manholes onsite.

Jobsite Features

The basic requirement for carrying out a survey is understanding the features of the jobsite. When gathering information about the jobsite, keep in mind the objectives of the survey. Consider the following points when preparing the survey:

- Do you need any specific permissions to carry out the survey on the jobsite, for example, access permission to pedestrian zones or permission to interrupt the traffic flow?
- Are there any difficulties in accessing the jobsite? (Available space, any architectural features forming an obstacle, etc.).
- Is the jobsite in an area with a high level of urban traffic, such as streets, squares or pavements? Are there parked cars that could be in the way during the survey?

Technical Maps of existing utilities

Technical maps of existing utilities are normally created by public utility companies. Such maps give a schematic overview about the type and position of utilities that are constructed and managed by the public utility companies. Even if these maps are generic, they can give a first impression of the existing utilities and provide additional information during the data acquisition and interpretation phase.



To obtain technical maps of the jobsite, contact the cartographic or planning office of the different utility companies. Clearly specify the streets and areas of interest. Request the maps early enough in advance to the survey, to ensure that the maps are available for the data acquisition phase.

The following list contains the most important types of utilities that need to be considered:

- Street lights
- Low, medium and high-voltage electricity cables
- Telephone cables
- Gas pipes
- Water supply pipes
- Sewage pipes

Opening manholes

Once the data acquisition is complete, the opening of manholes on site can provide you with further information regarding depth, diameter and direction of the utility. This information serves as reference data during the interpretation phase and allows you to estimate the propagation velocity in order to calculate the depth of a utility as precisely as possible.


6

Procedures for Working with the DS2000

6.1

Preparing an Acquisition

Steps to be taken



	Before departing to the jobsite, ensure that the laptop/tablet and the DS2000 battery are fully charged.
1.	At the jobsite, set up the DS2000 and mount the accessories, if available. Refer to "3 Setup".
2.	Depending on the purpose of the survey and the available accessories, carry out one of the procedures described in the following paragraphs: <ul style="list-style-type: none">• Marking out targets on site• Mapping utilities without using GPS• Mapping utilities using GPS

6.2

Marking Out Targets on-Site






Procedure for marking out targets

Follow these steps when the mapping of detected utilities is not necessary.

	Ensure that the spray support is mounted. Ensure that the laptop/tablet is connected to the control unit.
1.	Press the power button to turn on the control unit of the DS2000.
2.	Turn on the laptop/tablet and start the Ouverture.
3.	Click the New Project button. The software starts calibrating the radar. As soon as the radar calibration is complete, the Acquisition screen is displayed.
4.	Check the radar and battery status. (Refer to " System Status" within "4.3.1 The Acquisition Screen").
	For a better visualisation of the radargrams, turn off the Map section. (Refer to " Map section and radargrams" within "4.3.1 The Acquisition Screen").
5.	Select the scan direction depending on whether the DS2000 is being pushed or pulled. (Refer to " Acquisition Commands" within "4.3.1 The Acquisition Screen"). Position the DS2000 at the starting point of the line to be scanned.
6.	Start the acquisition with the respective acquisition command. (Refer to " Acquisition Commands" within "4.3.1 The Acquisition Screen"). Start moving the DS2000 along the scan line.
7.	When a target is detected, stop and move the DS2000 back until the vertical yellow line of the radargram is on top of the target.
8.	Insert a marker and estimate the correct depth. (Refer to "4.3.5 Placing a Target").
9.	Mark the target on the ground using the spray paint. (Refer to " Target Commands" within "4.3.1 The Acquisition Screen").
10.	When reaching the end of the scan line, stop the acquisition with the respective acquisition command. (Refer to " Acquisition Commands" within "4.3.1 The Acquisition Screen").
11.	Position the DS2000 at the starting point of the next line to be scanned. Repeat the steps 6 to 10 until the jobsite is covered.




Procedure for mapping utilities without GPS

If a GPS antenna is not available, follow these steps to map the detected utilities based on a measurement grid.

	If available, mount the spray support. Ensure that the laptop/tablet is connected to the control unit.
1.	Press the power button to turn on the control unit of the DS2000.
2.	Turn on the laptop/tablet and start the Ouverture.
3.	Click the New Assisted Project button. The Assisted Project Setup screen is displayed.
4.	If available, load a map from a saved cartographic file or from the internet. (Refer to "List of maps within the Layers section" within "4.3.1 The Acquisition Screen").
5.	Set up the measurement grid. (Refer to "Setting up a measurement grid" within "4.3.4 Data Acquisition with the New Assisted Project Function").
6.	When the setup of the measurement grid is finished, click the Start Survey button to start the acquisition. The software starts calibrating the radar. As soon as the radar calibration is complete, the Acquisition screen is displayed.
7.	Check the radar and battery status. (Refer to "System Status" within "4.3.1 The Acquisition Screen").
8.	Select the scan direction depending on whether the DS2000 is being pushed or pulled. (Refer to "Acquisition Commands" within "4.3.1 The Acquisition Screen").
9.	Position the DS2000 on the line of the measurement grid suggested by the software.
	To skip the line suggested by the software, select a new line.
	To edit the starting point position and the scan direction, open the Starting Point Editor . (Refer to "Starting Point Editor" within "4.3.4 Data Acquisition with the New Assisted Project Function").
10.	Start the acquisition with the respective acquisition command. (Refer to "Acquisition Commands" within "4.3.1 The Acquisition Screen"). Start moving the DS2000 along the scan line.
11.	When a target is detected, stop and move the DS2000 back until the vertical yellow line of the radargram is on top of the target.
12.	Insert a marker and estimate the correct depth. (Refer to "4.3.5 Placing a Target").
13.	If the spray support is mounted, mark the target on the ground using the spray paint. (Refer to "Target Commands" within "4.3.1 The Acquisition Screen").
14.	When reaching the end of the scan line, stop the acquisition with the respective acquisition command. (Refer to "Acquisition Commands" within "4.3.1 The Acquisition Screen").
15.	Repeat the steps 9 to 14 until the measurement grid is covered.
16.	Before returning to the main menu, save a report of the survey with the Survey Report dialogue. (Refer to "4.3.6 Generating a Survey Report").
	If necessary, you can review the acquired scan data. (Refer to "4.4 Review of Scan Data").
	If necessary, you can export the scan data to be edited in AutoCad. (Refer to "4.5 Export of Scan Data").

Procedure for mapping utilities with GPS

If a GPS antenna is available, follow these steps to create a georeferenced map of the detected utilities.

	If available, mount the spray support. Mount the GPS support on the DS2000 and attach the pole with the GPS antenna. Ensure that the laptop/tablet is connected to the control unit and to the antenna.
1.	Press the power button to turn on the control unit of the DS2000.
2.	Turn on the laptop/tablet and start the Ouverture.
3.	Select Settings > Survey Settings > Positioning Settings to connect and configure the GPS. (Refer to "4.6.1 Survey Settings").
4.	Click the New Project button. The software starts calibrating the radar. As soon as the radar calibration is complete, the Acquisition screen is displayed.
5.	Check the radar, GPS and battery status. (Refer to "System Status" within "4.3.1 The Acquisition Screen").
6.	If available, load a map from a saved cartographic file or from the internet. (Refer to "List of maps within the Layers section" within "4.3.1 The Acquisition Screen").
7.	Select the scan direction depending on whether the DS2000 is being pushed or pulled. (Refer to "Acquisition Commands" within "4.3.1 The Acquisition Screen"). Position the DS2000 at the starting point of the line to be scanned.
8.	Start the acquisition with the respective acquisition command. (Refer to "Acquisition Commands" within "4.3.1 The Acquisition Screen"). Start moving the DS2000 along the scan line.
9.	When a target is detected, stop and move the DS2000 back until the vertical yellow line of the radargram is on top of the target.
10.	Insert a marker and estimate the correct depth. (Refer to "4.3.5 Placing a Target").
11.	If the spray support is mounted, mark the target on the ground using the spray paint. (Refer to "Target Commands" within "4.3.1 The Acquisition Screen").
12.	When reaching the end of the scan line, stop the acquisition with the respective acquisition command. (Refer to "Acquisition Commands" within "4.3.1 The Acquisition Screen").
13.	Position the DS2000 at the starting point of the next line to be scanned. Repeat the steps 8 to 12 until the jobsite is covered.
14.	Before returning to the main menu, save a report of the survey with the Survey Report dialogue. (Refer to "4.3.6 Generating a Survey Report").
	If necessary, you can review the acquired scan data. (Refer to "4.4 Review of Scan Data").
	If necessary, you can export the scan data to be edited in AutoCad. (Refer to "4.5 Export of Scan Data").

7 Care and Transport


7.1 Transport

Shipping	When transporting the product by rail, air or sea, always use the complete original Leica Geosystems packaging, transport container and cardboard box, or its equivalent, to protect against shock and vibration.
Shipping, transport of batteries	When transporting or shipping batteries, the person responsible for the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping, contact your local passenger or freight transport company.

7.2 Storage

Product	Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to "8 Technical Data" for information about temperature limits.
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7.3 Cleaning and Drying

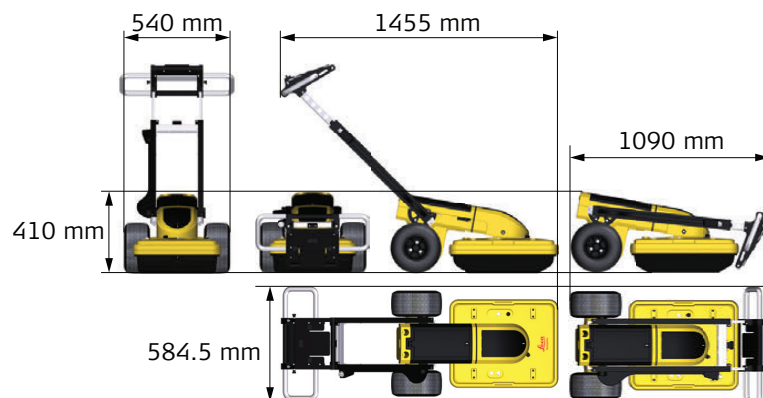
 WARNING	Risk of electric shock during cleaning and drying If the product is turned on during cleaning or drying you may receive an electric shock. Precautions: <ul style="list-style-type: none">• Ensure that all cables are disconnected, including the power supply cable.• Before cleaning the product, turn off the product and all other devices connected to the product.• Ensure that the product is dry before reconnecting cables and turning on the product.
Product and Accessories	<ul style="list-style-type: none">• Use only a clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with water or soapy water. Do not use other liquids; these may attack the product surface.
Cables and plugs	Keep plugs clean and dry. Blow away any dirt lodged in the plugs of the connecting cables.
Connectors with dust caps	Wet connectors must be dry before attaching the dust cap.

8 Technical Data

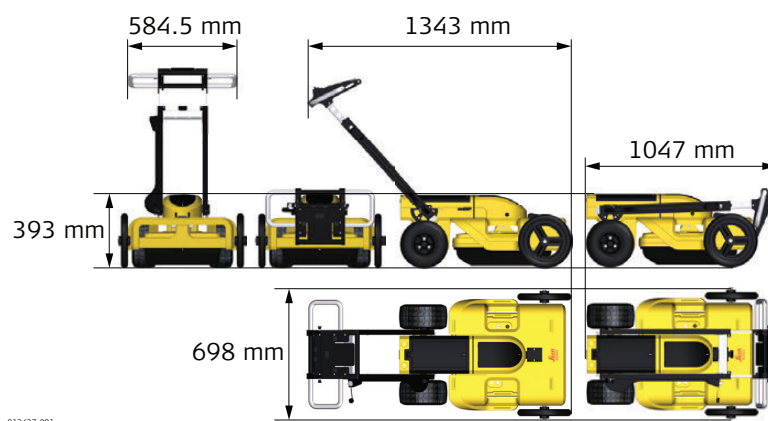
8.1 General

Dimensions

DS2000 (two-wheeled version)



DS2000 (four-wheeled version)



Weight

	Without battery and laptop/tablet
DS2000 (two-wheeled)	24 kg
DS2000 (four-wheeled)	27 kg

Control Unit

	Specifications
Power Consumption	13.3 W
Power Supply	SLAB (Sealed Lead Acid Battery) 12 V DC, 12 Ah

Dual-frequency antenna

	Specifications
Antenna Footprint	40 cm x 50 cm
Number of Hardware Channels	2
Antenna Central Frequencies	250 MHz and 700 MHz
Antenna Orientation	Perpendicular, broadside
Sampling Frequency	400 kHz

Data Acquisition

	Specifications
Acquisition Speed	more than 10 km/h
Scan Rate per Channel for 512 Samples per scan	381 scans per second
Scan Interval	42 scans per metre
Positioning	Two integrated encoders and/or GPS - Total Station

Battery

Type:	Rechargeable SLAB (Sealed Lead Acid Battery)
Voltage:	12 V
Capacity:	12 Ah

Environmental specifications

Temperature

Operating temperature [°C]	Storage temperature [°C]
-10 to +40	-40 to +70

Protection against water, dust and sand

Protection
IP65 (IEC 60529)

Humidity

Protection
Max 95% non-condensing The effects of condensation are to be effectively counteracted by periodically drying out the instrument.

8.2

Conformity to National Regulations

Conformity to national regulations

For products with radio

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the DS2000 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity may be consulted at <http://www.leica-geosystems.com/ce>.



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

- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.

Software Licence Agreement

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

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- when it has to be **right**

Leica
Geosystems