Leica PowerGrade

User Manual

Version 1.2
English

- when it has to be **right**

Leica Geosystems

Introduction

Purchase

Congratulations on your purchase of a PowerGrade system. The PowerGrade system is an ideal tool for increasing productivity in all aspects of the construction earthmoving industry.

This manual contains important safety directions as well as instructions for setting up the system and operating it. Refer to "4 Safety Directions" for further information.
Read carefully through the User Manual before you switch on the product.

To ensure safety when using the system, please also observe the directions and instructions contained in the User Manual and Safety Handbook issued by the:

- Machine manufacturer.

Product identification

The type and serial number of your products are indicated on the label on the base of the unit.
Enter the model and serial number in your manual and always refer to this information when you need to contact your agency or Leica Geosystems authorized service workshop.

Type:	PowerGrade control panel	Serial No.:	_____
	PowerGrade Cradle	Serial No.:	_____

Symbols

The symbols used in this manual have the following meanings:

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 and/or 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.

Validity of this manual

This manual applies to the PowerGrade control panel.

Table of Contents

In this manual

1 Product Overview

1.1 Product Description and Features

General

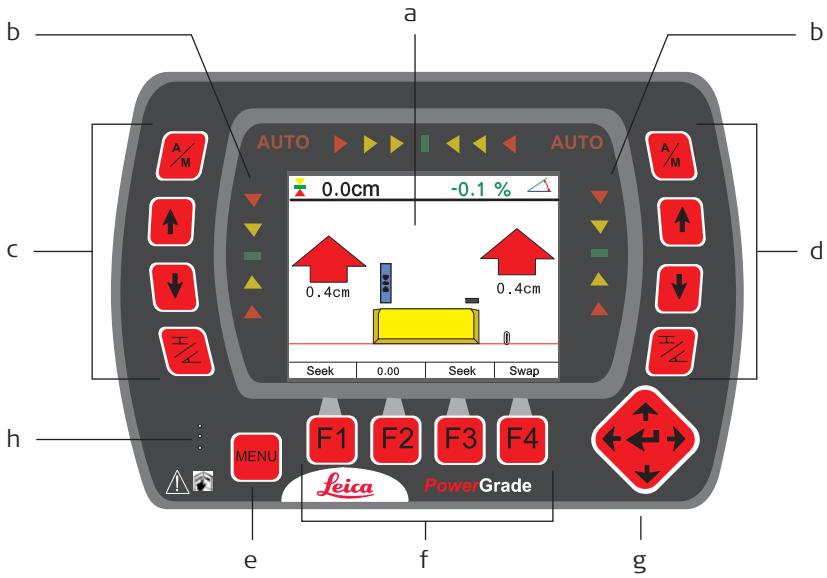
The control panel has keys surrounding the screen for user input. The 4" colour display, incorporates a state of the art LCD colour screen, making it easy to use, even in bright, sunny conditions.

The rugged IP56 enclosure is designed for harsh environments.

Power supply, communication

The control panel is powered from a cradle based on a sophisticated induction solution, while data is transferred wirelessly via infrared between the cradle and the control panel. Leica Geosystems recommends to use the "MMB1300 Cradle for control panel". "Cradle" will be used throughout this manual.

PowerGrade control panel



a) Graphical display
b) Grade indication led's
c) Left side sensor setup
d) Right side sensor setup
e) Menu key
f) Function keys
g) Enter key
h) Speaker

Warning

This product may be installed on building machinery only by an appropriately trained and qualified specialist.

Warning

Unauthorized modification of machines by mounting the product may alter the function and safety of the machine.

Precautions:

Follow the instructions of the machine manufacturer. If no appropriate instruction is available, ask the machine manufacturer for instructions before mounting the product.

Special keys

Up key

Down key

Enter key

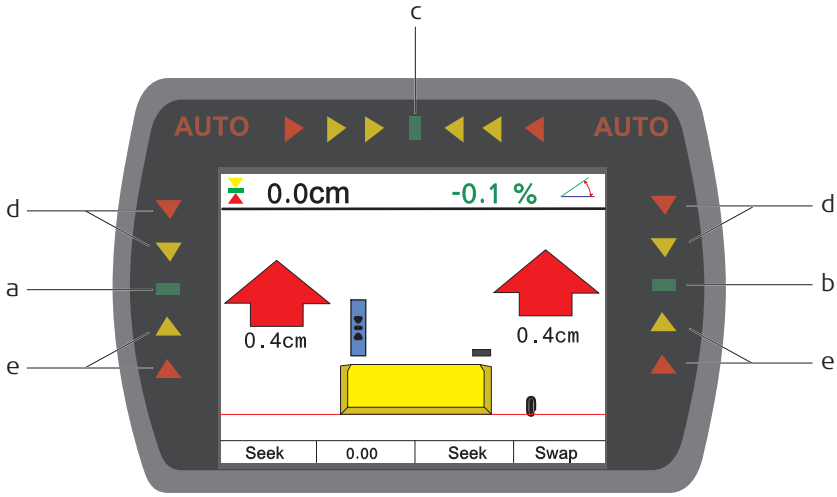
Auto/Manual key

Menu key

Sensor select key

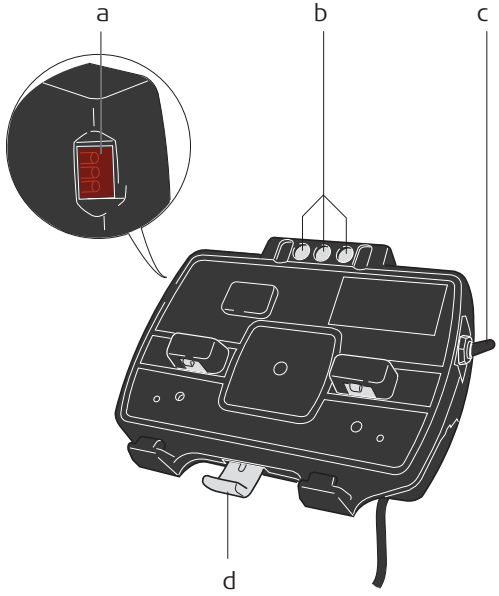
Fuction keys

Display



a) Left on-grade indication
b) Right on-grade indication
c) Side shift alignment indication
d) Above grade
e) Below grade

Cradle



a) Power and data transfer LED indicators
b) Holding magnets
c) On/off switch
d) Release key for control panel

System start

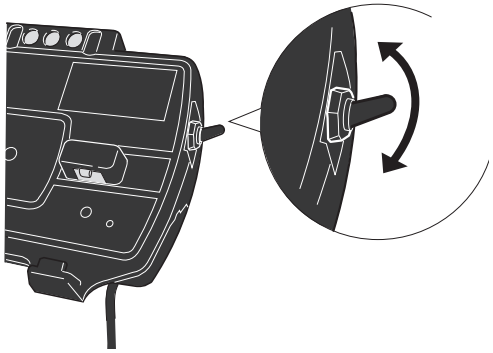
To get the system started complete the following steps:

1. Snap control panel onto cradle.

To connect the control panel to the cradle:

1. Put the control panel on the holding hooks in the bottom of the cradle.
2. Then snap the control panel onto the cradle by pressing it towards the cradle.

2. Turn on the control panel.



To turn the system on and off, use the power switch on the right side of the cradle. This is the master switch for the entire system.

Removing the panel will also turn off the power.

To release the control panel simply press the release key at the bottom of the cradle and pull the control panel towards you and then lift it up.

1.3 Sensor Setup Keys

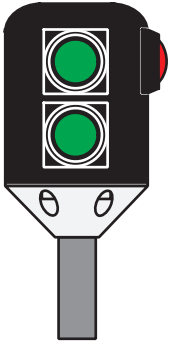
Sensor setup keys

The sensor setup keys are used to choose the type of sensor that the system should run with, and to find and set the reference point for that sensor.

The left and right hydraulic channel has four sensor setup keys each:

-  Auto/Manual key,
-  up key,
-  down key,
-  sensor select key.

External Multi Switch for Grader



The system can also be fitted with an External Multi Switch. This switch has three keys on it. One Auto/Manual key (Red) and a set of up and down keys (green). These keys have the same function as the corresponding keys on the control panel.

External switch for Dozer

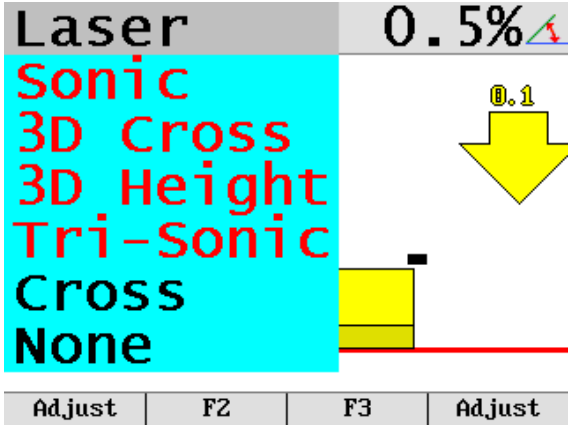
Toggle the master switch to **AUTO** to enable automatic control on all channels selected on the control panel. Toggling the master switch to **MAN** places all channels in manual control regardless of selection on the control panel.

2 Operation

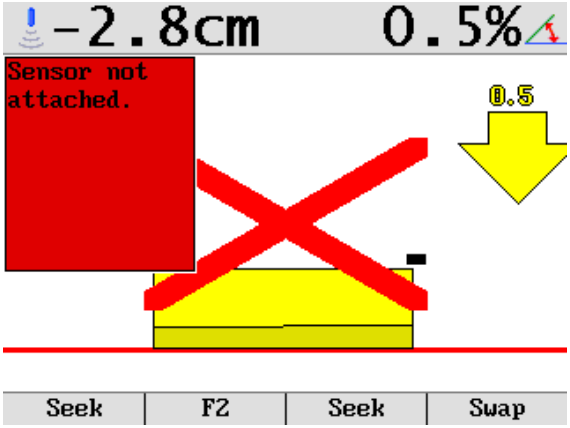
2.1 Select the Input Source

Sensor selection

1. Push the left or right key to open the sensor selection menu. Following screen appears:

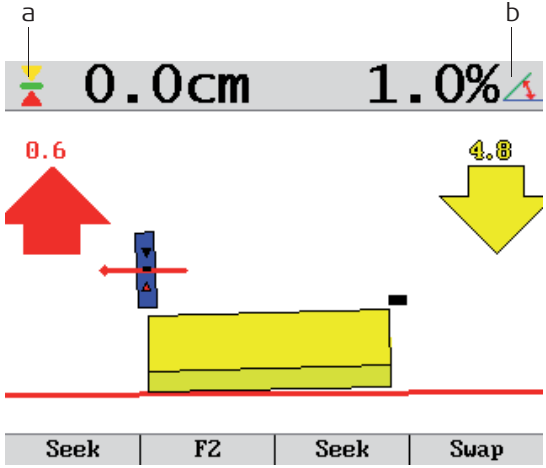


2. Use the ↑ / ↓ keys to scroll through the available sensors.
   a) If the sensor is connected and active it will show up in black.
   b) If it's not connected or inactive it will show in red, and a red cross will show up on the screen if that sensor is selected.



3. Highlight the sensor that is going to be used and exit the sensor selection menu by pressing ESC or ↵. The control panel will automatically exit the sensor selection menu if no key is pressed for ten seconds.

4. The chosen sensor is indicated by a small icon in the upper corner of the display, and by an icon shown on the blade in relation to the actual placement of the sensor.
Example:



a) Laser indication
b) Cross Slope

A cross slope is selected in the right side and in the left side a Laser Sensor is selected.

2.2 Setting a Reference Height

Inspection

When a sensor is selected the control panel automatically uses the last set reference height for that sensor.

There are two ways to change the reference:
- Manual mode
- Seek mode

Manual mode

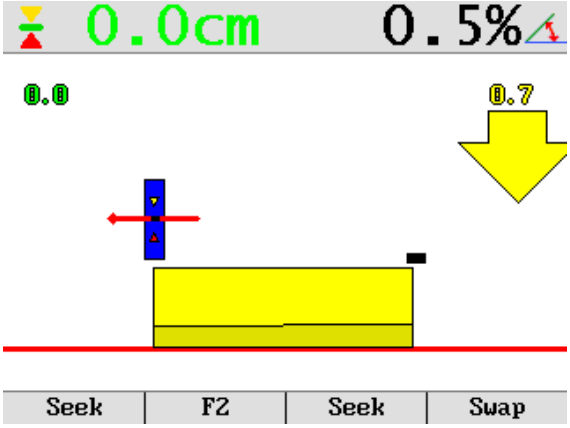
Use the  /  keys to change the reference height up or down.

Seek mode

Press the ↑ and ↓ keys simultaneously to enter the seek mode. In seek mode the screen shows the current sensor value of the selected sensor.
Pressing both keys simultaneously again exits the seek mode.

Or press F1 for seek mode.

While in Seek Mode, the height values at the top of the screen will be green.



If both keys are pressed, and held for more than three seconds, the control panel will take the current sensor value and store as the new reference height.
While holding these buttons, the F1 key will change from **Seek** to **0.0**. Once the new reference height has been set, the height values at the top of the screen will change back to black.

Automatic detection of the laser beam

For systems with a PowerMast, entering seek mode will start an automatic search for the laser beam.
If the laser sensor is out of beam the operator can select in which direction the mast should start moving to look for the laser beam using the  and  keys. The mast will then start moving in that direction until the laser sensor has the beam centered.
If the mast, during a seek reaches its top or bottom limit it will automatically switch moving direction, and continue to seek for the laser beam until it is found or it hits the next end point.

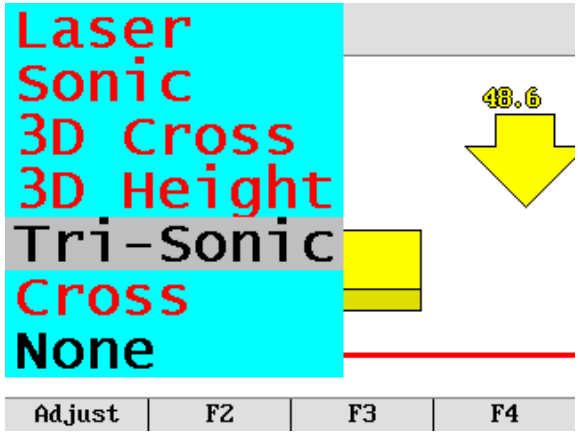
2.3 Using the Tri-Sonic Tracker

Using Tri-Sonic

The Tri-Sonic can also measure the horizontal distance to a stringline and therefore it can be used to control the sideshift on a grader. To do that, complete the following steps:

1. Place the machine so that the Tri-Sonic is above ground, the edge or stringline. The sensor needs an edge or string to follow before it can control the sideshift.
2. Move the blade to the working position.
3. Move the Tri-Sonic to a good working height. This is 40-70 cm above the reference.
4. Select the Tri-Sonic on the same side as where it is placed on the machine.

5. Enter the Tri-Sonic menu. First press the key, then press the **Adjust** function key.



Select between the different modes:

- Ground Mode
- Edge Mode
- Stringline

Press the or key to toggle between the modes. Once selected press the key.

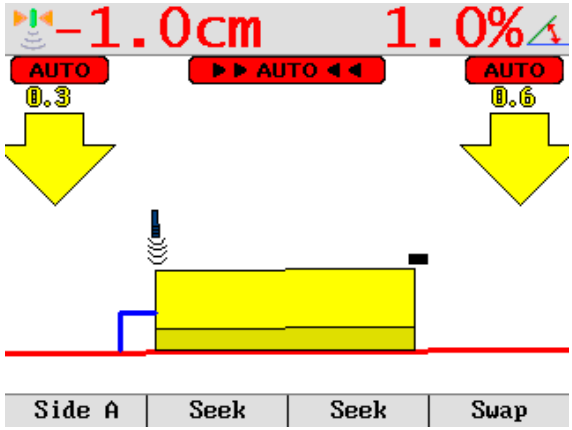
Following screens will appear by pressing the up ( ) or down ( ) Enter key to toggle between the screens.

Stringline describes the window where the Tri-Sonic will work within certain range. All readings outside of this range will be ignored.

Sideshift works only with the modes Edge and Stringline.

6. Go to the **Sideshift** menu option and set it to **Yes**.
7. Press both and keys simultaneously to set the control panel in seek mode.
8. Check that the height is approximately 40-70 cm.

9. Press both ↑ and ↓ keys simultaneously and keep them pressed for three seconds to set the reference height.
10. Press the right A/M key to set the machine in Auto-Mode.
11. Press the **Side A/M** function key to enable the automatic sideshift control.



2.3.1 Installation and Set Up Tri-Sonic

Mounting the Tri-Sonic

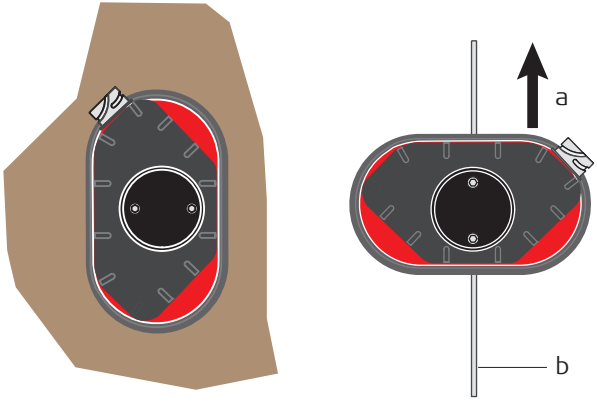
The Tri-Sonic can be installed quickly and easily with the simplest of tools.
Mount a support in a suitable location that is adjustable for height and lateral motion. This will enable setting up of the Tri-Sonic over any reference. The support may differ according to the machine and reference.

In case of large differences in temperature between the storage and working environments, allow 30 minutes for the sensor to adapt to the working environment prior to operation.

The direction of movement of the Tri-Sonic sensor

While ground and curb scanning, the Tri-Sonic should move longitudinally for the averaging of the scanned values.

For Stringline and Edge the Tri-Sonic should be placed at an angle of 90° to the reference with the face plate orientated to back of the machine.



a) Working direction
b) stringline

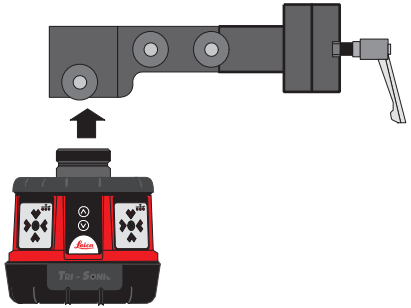
Stringline and Edge sensing

For stringline sensing, the Tri-Sonic must be positioned across the reference wire. The Automatic Side Shift control of the Tri-Sonic will keep the sensor always over the reference using the hydraulics of the third valve section to regulate the Blade in and out.

Mounting the Tri-Sonic on the support

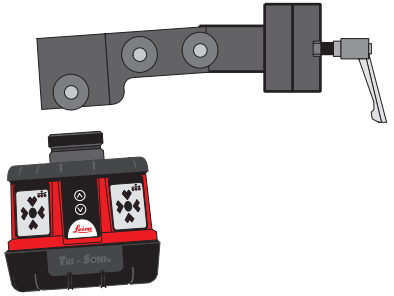
Normal operation

1. Release the clamping screw on the support.
2. Insert the round centering pivot on the top of the sensor housing vertically into the support.
3. Rotate the sensor to the required sensing mode (refer to previous page).
4. Lock the centering pivot of the sensor with the clamping screw.



Edge operation

For sensing Edges it is required to tilt the sensor toward the Edge, as shown on the picture. Slacken the knob on the bracket, tilt the bracket and tighten the knob again.



Caution

System Components can protrude from the machine, which could lead to bodily injury and/or product damage.

Precautions:

Exercise caution in operation to avoid striking any objects or persons near the working area.

2.3.2 Operation with the Tri-Sonic Sensor

PowerGrade system flexibility

Multifunctional and multitask - PowerGrade system can be operated in various combinations for the most demanding job requirements.

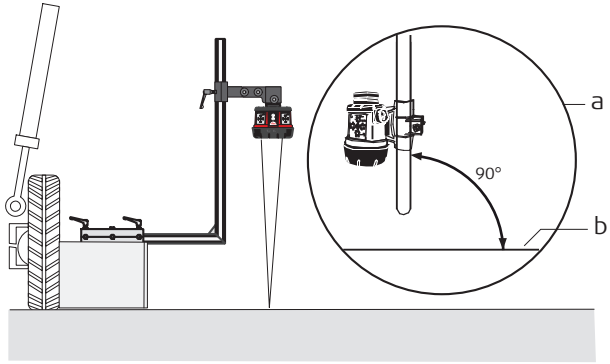
Mount the Tri-Sonic

Mount the Tri-Sonic to the appropriate height for its maximum performance according to the reference used. The sensing range shows the mimimum and maximum values possible, wherever it can be achieved to obtain the range of best perfomance.

Sensing range

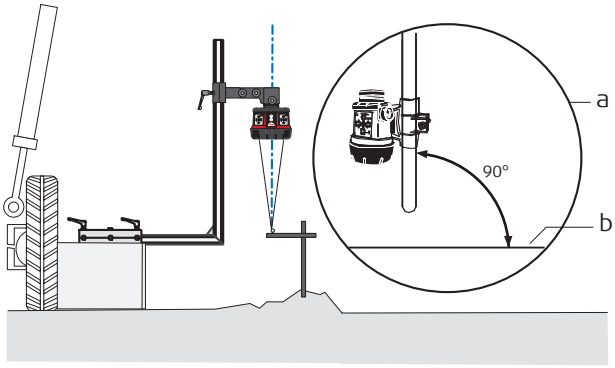
Reference	Sensing Range	Best Performance
String	15-36 inch (38-91 cm)	24 inch (60 cm)
Edge	15-36 inch (38-91 cm)	24 inch (60 cm)
Flat Ground	15-99 inch (38-250 cm)	24 inch (60 cm)

Reference ground



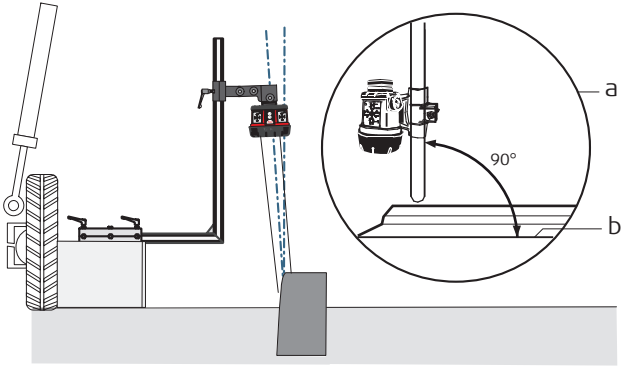
a) Side View
b) Ground

Reference stringline



a) Side View
b) String

Reference edge



a) Side View
b) Edge

Setting up the Tri-Sonic

Setting up the Tri-Sonic sensor over a reference - When setting the Tri-Sonic sensor over a reference (string, curb, or previous pass), the best performance will be achieved when the sensor is positioned square to the reference (not turned or leaning).

Setup over a curb

When setting the Tri-Sonic sensor over a curb, it is generally recommended to use the GROUND mode and use the flat surface of the gutter as the reference as shown here.

Setup over an EDGE

Use of the curb edge as a reference requires extra care be taken to ensure a proper distance and control of PowerGrade system. Unlike a string or a flat surface, a curb edge can present some special problems. It is best that this mode be used only by experienced operators.

Over any reference

It is important to rotate and roll the blade of the motorgrader to its approximate working position before setting and adjusting the Tri-Sonic sensor, the blade edge, and the reference.

2.4 Swap Function

Set up and operation

The swap function allows the operator to quickly and easily swap sensors, turn the machine around, and grade in the opposite direction by following the previously pass.

There are two levels to the swap function available:

- **Level 1**: Swap the cross slope by inversing the actual target cross slope.
  For example: +2,3% -› -2,3%
- **Level 2**: Swap the cross slope by inversing the actual target cross slope and swap the side of the motorgrader that is controlled by ultrasonic.

Level 1

By pressing F4 / **SWAP** the actual target slope will be inversed.

Level 2

Requirements: Two Tri-Sonic sensors must be connected and the system must be in motor-grader mode.

1. Move the motorgrader to a flat level ground
2. Set the moldboard level with the machine
3. Select slope on left side and sonic on right side. Choose ground mode for the Tri-Sonic.
4. Manually set the cross slope of the blade to level.
5. Set the height for the right sonic by pressing and holding F3 / **SEEK** for 2 sec.
6. Press F1 / **SWAP** and the sensors will switch sides.
7. Set the height for the left sonic by pressing and holding F2 / **SEEK** for 2 sec.

The machine is now ready for the final grade following the previously pass.

It is possible to have different heights and mode settings for the two Tri-Sonic sensors.

2.5 Using the Laser Sensor

Laser Sensor

The Laser Sensor is used to measure the elevation of the blade. This is done by measuring the distance from where the laser beam is hitting the laser and the centerline on the Laser Sensor.

When the Laser Sensor detects a laser beam this is indicated on the display by a red line through the laser icon.
If at some point the laser beam is lost while the control panel is set in auto mode, it will give a beep and a red cross will appear with a text message saying **laser beam lost**.

Laser Sensor and manual mast

To use the Laser Sensor with a manual mast for controlling the elevation of the blade complete the following steps:

1. Select the Laser Sensor on one of the sides.
2. Place the cutting edge of the blade at the desired height.
3. Move the mast up or down until the Laser Sensor detects the laser beam. Continue to move the mast until the indication led's on the Laser Sensor is showing a green line.
4. Press the left  key to set the machine in Auto-Mode.
5. When the control panel is in Auto-Mode the machine will start to move the raise/lower hydraulic cylinders so that the laser beam always is in the center of the Laser Sensor.

Laser Sensor and power mast

To use the Laser Sensor with a power mast for controlling the elevation of the blade complete the following steps:

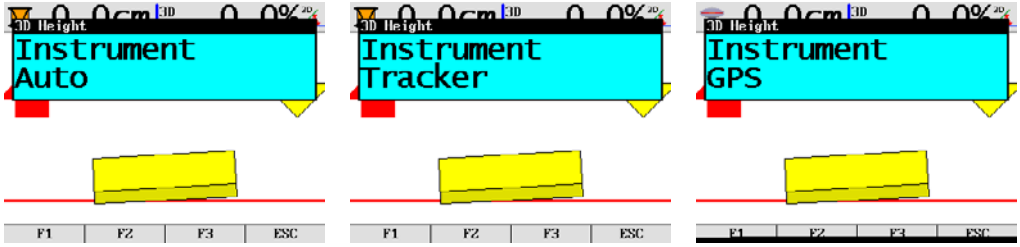
1. Select the Laser Sensor in one of the sides.
2. Place the cutting edge of the blade at the wanted height.
3. Enter **SEEK** mode.
4. Press the  or  key to tell the mast in which direction it should start to seek. The mast will now move in the given direction until the Laser Sensor detects the laser beam, and has it in the center of the sensor.
5. Press the left  key to set the machine in Auto-Mode.
6. The  and  keys can now be used to move the mast up or down, and thereby changing the elevation reference.

2.6 3D Sensors

How to set 3D sensors

To select 3D Height, press the **left or right (sensor) key** once, and then press the **Adjust** function key to enter the adjust menu.
Note that it's only the current selected sensor in either left or right side that is adjusted.

If the 3D system is configured to indicate which sensor is currently in use, select **AUTO**. If not, then select either **TRACKER** or **GPS** from the menu.



Once **Auto** / **GPS** / **Tracker** is selected, it is required to **EXIT** from this menu for the change to take effect and then re-enter the menu to adjust gains.

Gains need to be set for both GPS or Tracker depending on which sensor is used. If AUTO is selected, the PowerGrade will use the gains set in the Tracker and GPS settings.

Use the right arrow key to enter the gains settings.

Refer to chapter "2.7 Setting the Value for Gain and Deadband" for configuring Gains.

To select 3D Slope, Press the **left or right (sensor) key** once, and then press the **Adjust** function key to enter the adjust menu.
Note that it's only the current selected sensor in either left or right side that is adjusted.
Set gains for 3D Slope as explained in chapter "2.7 Setting the Value for Gain and Dead-band".

2.7 Setting the Value for Gain and Deadband

Adjust the gain and deadband

To adjust the gain and deadband of each of the sensors complete the following steps:

1. Press the left or right  key once, and then press the **Adjust** function key to enter the adjust menu.
   Note that it's only the current selected sensor in either left or right side that is adjusted.
2. Use the  or  key to scroll through the settings.
3. Use the  or  key to change the value.
4. To exit the adjust menu press the menu key.

DEADBAND

The deadband controls the precise motion of machine hydraulics. These values do not correspond to accuracy but only to hydraulic speeds. These values should not be confused with overall machine performance and/or precision.

Adjust the deadband for each sensor. This is done in the adjust menu for each sensor.

Sensor	Dozer	Grader
GPS	1.0 cm	1.0 cm
Laser	0.7 cm	0.7 cm
Cross slope	0.6 %	0.3 %
Tracker	0.5 cm	0.5 cm
Sideshift	---	2.0 cm

GAIN

This is the scaling of hydraulic speeds for each of the sensors. These values should be measured at the initial calibration but can be fine tuned as needed (heavy or rough material, wet dirt, fine grading, etc.).

To enter **Gains** select the **Lower Left** or **Lower Right** buttons to open up the available sensors. Select appropriate sensor and then the F1 or F4 key (depending on left or right side) to enter the **Adjust** Menu.

Adjust the gain of the hydraulic system for each sensor. This is done by pressing the test button in the adjust menu for each sensor. The "error" and "time" settings are set by default to 1cm/4% and 2 seconds; these settings should not be changed.

Please follow the on-screen instructions!

Elevation:
Press the Test button to adjust the value so that it corresponds to the below distances. For example, during 2 seconds of movement, the blade should move 8 cm for GPS.

Sensor	Dozer	Grader
Laser/Sonics/Tri-Sonics/GPS	8 cm	13 cm
Tracker	4 cm	7 cm

Second laser for cross slope:
This should be measured 1.5 meters from the centre of the blade. Press the Test button to adjust the value so that it corresponds to the below distances. For example, during 2 seconds of movement, the blade should move 8 cm for a laser sensor controlling tilt.

Laser: 8cm

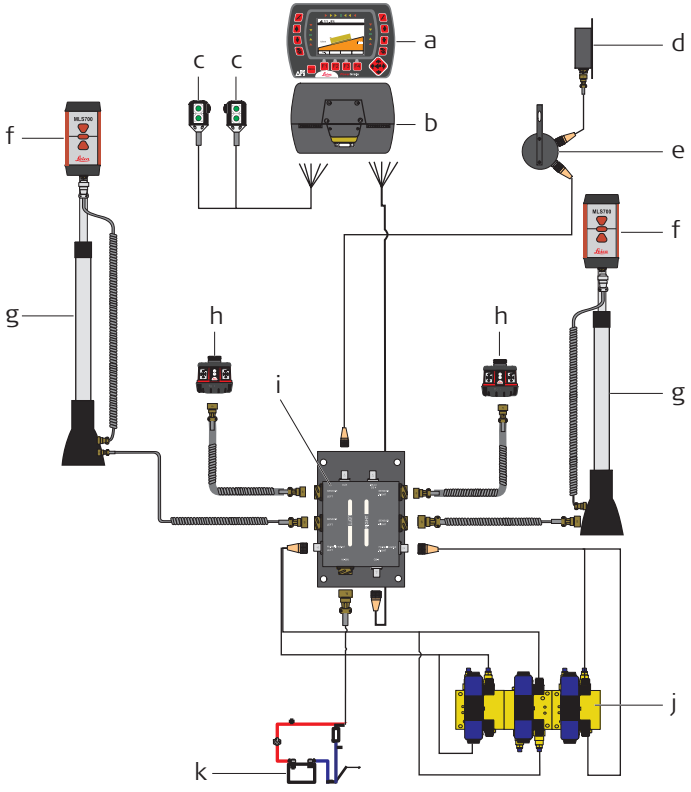
2D and 3D cross slope sensor:
This should be measured 1,5 meters from the centre of the blade. Press the Test button to adjust the value so that it corresponds to the below distances. For example, during 2 seconds of movement, the blade should move 6,5 cm for 3D cross-slope.

Sensor	Dozer	Grader
2D and 3D cross-slope	6.5 cm	17 cm

Sideshift (Grader only):
Enter the Tri-Sonic or 3D height adjust menu. Press the Test button to adjust the value so that it corresponds to the below distances.

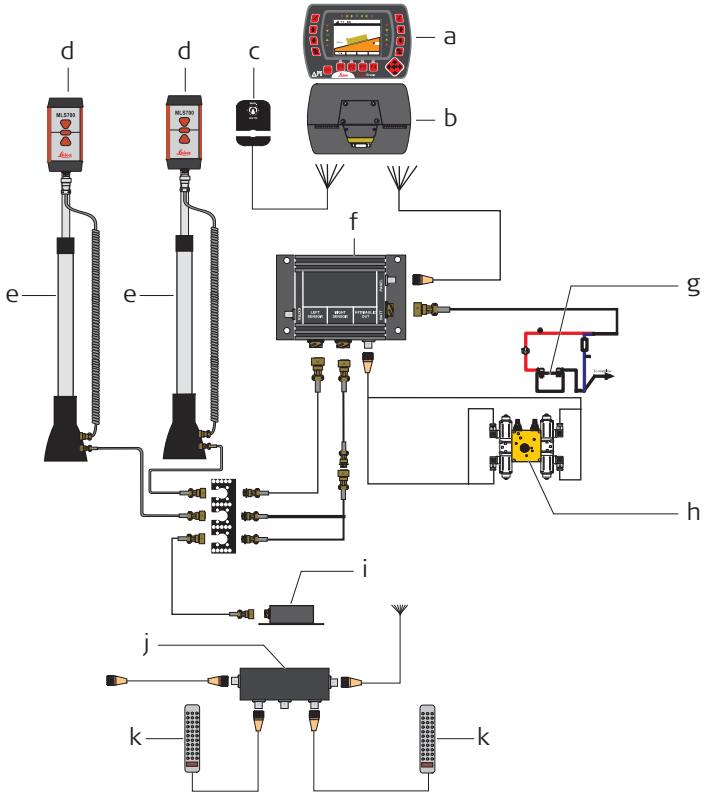
2D and 3D sideshift: 13 cm

Grader Setup



a) MCP1300 Control panel, 764836
b) MMB1300 Cradle, 764910
c) External Multi Switch, 764850
d) Cross slope sensor, 767439
e) Rotation sensor, 767435
f) Laser receiver, 760862
g) Power mast/manual mast, 760863/764847
h) Sonic tracker, 764031
i) MJB1301 Junction box Grader, 767438
j) Hydraulic valve
k) Machine battery

Dozer Setup



a) MCP1300 Control panel, 764836
b) MMB1300 Cradle, 764910
c) External Switch for Dozer, 764849
d) Laser receiver, 760862
e) Power mast/manual mast, 760863/764847
f) MJB1300 Junction box Dozer, 767437
g) Machine battery
h) Hydraulic valve
i) Cross slope sensor, 767439
j) Remote junction box, 764856
k) Remote display, 764841

3 Care and Transport

3.1 General Notices

General information	Servicing the system only requires a minimum of time. All electronic components are enclosed in robust housings to safeguard them against mechanical damage.
Periodic checks	If any PowerGrade components are subjected to severe impact, be sure to check for proper operation prior to performing any work with the system.

3.2 Transport

Transport in the field	When transporting the equipment in the field, always make sure that you carry the product in its original transport container.
Transport in a road vehicle	Never carry the product loose in a road vehicle, as it can be affected by shock and vibration. Always carry the product in its transport container and secure it.
Shipping	When transporting the product by rail, air or sea, always use the complete original Leica Geosystems packaging, transport container and cardboard box, or its equivalent, to protect against shock and vibration.

3.3 Storage

Product

Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to "5 Technical Data" for information about temperature limits.

3.4 Cleaning and Drying

Product

- Blow off dust.
- Use a clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with water or pure alcohol.
  Do not use other liquids; these may attack the polymer components.

Cables and Plugs

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

Damp products

Dry the products at a temperature not greater than 40°C/108°F and clean them. Do not repack until everything is completely dry.

4 Safety Directions

4.1 General

Description

The following directions should 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.

4.2 Intended Use

Permitted use

- Determine the position of a dozer/grader blade or excavator bucket.
- Calculate the distance between the blade/bucket and a reference model (surface, line or point).
- Automatic adjustment of a dozer/grader hydraulic system in order to match the blade to the reference model.

Adverse use

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

Warning

Adverse use can lead to injury, malfunction and damage.
It is the task of the person responsible for the equipment to inform the user about hazards and how to counteract them.
The product is not to be operated until the user has been instructed on how to work with it.

⚠ Warning

Unauthorized modification of building and constructions machines by mounting or installing the product may alter the function and safety of the machine.

Precautions:

Follow the instructions of the machine manufacturer. If no appropriate instruction is available, ask machine manufacturer for instructions before mounting or installing the product.

4.3 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 in close proximity to electrical installations or similar situations by the person in charge of the product.

4.4 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 completely safe condition.

Manufacturers of non Leica Geosystems accessories

The manufacturers of non Leica Geosystems accessories for the product are responsible for developing, implementing and communicating safety concepts for their products, and are also responsible for the effectiveness of those safety concepts in combination with the Leica Geosystems product.

Person in charge of the product

The person in charge of the product has the following duties:

- To understand the safety instructions on the product and the instructions in the user manual.
- 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.

Warning

The person responsible for the product must ensure that it is used in accordance with the instructions. This person is also accountable for the training and the deployment of personnel who use the product and for the safety of the equipment in use.

Warning

Unauthorized modification of machines by mounting the product may alter the function and safety of the machine.

Precautions:

Follow the instructions of the machine manufacturer. If no appropriate instruction is available, ask machine manufacturer for instructions before mounting the product.

Warning

This product may be installed on building machinery only by an appropriately trained and qualified specialist.

4.5 Hazards of Use

Warning

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

Caution

Installing near mechanically moving machine components may damage the product.
Precautions:
Deflect the mechanically moving machine components as far as possible and define a safe installation zone.

Warning

Beware of inadequate steering if machine is defective like after a crash or other damaging events or alterations to the machine.
Precautions:
Periodically perform control measurements and field adjustments on the machine as specified in the User Manual. While working, construction and grading should be checked by appropriate means, for example spirit level, tachymeter, before and after important measuring tasks.

Warning

While steering or navigating the machine accidents may occur due to a) the operator not paying attention to the surroundings (persons, ditches, traffic, etc.), or b) malfunctions (...of a system component, interference, etc).
Precautions:
The operator assures that the machine is operated, guided and monitored by a qualified user (e.g. driver). The user has to be able to take emergency measures, for example an emergency stop.

Warning

The absence of instruction, or the inadequate imparting of instruction, can lead to incorrect or adverse use, and can give rise to accidents with far-reaching human, material, financial and environmental consequences.

Precautions:

All users must follow the safety directions given by the manufacturer and the directions of the person responsible for the product.

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 and before and after important operations.

Danger

Because of the risk of electrocution, it is very dangerous to use poles 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

During dynamic applications, 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

Inadequate securing of the work site can lead to dangerous situations, for example in traffic, on building sites, and at industrial installations.
Precautions:
Always ensure that the work site is adequately secured. Adhere to the regulations governing safety and accident prevention and road traffic.

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 may sustain injury.
Precautions:
When setting-up the product, make sure that the accessories, for example tripod, tribrach, connecting cables, are correctly adapted, fitted, secured, and locked in position.
Avoid subjecting the product to mechanical stress.

Warning

If the product is improperly disposed of, the following can happen:
- If polymer parts are burnt, poisonous gas 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 unauthorized 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:
Dispose of the product appropriately in accordance with the regulations in force in your country.
Always prevent access to the product by unauthorized personnel.

4.6 Electromagnetic Compatibility EMC

Description

The term Electromagnetic Compatability 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 distur-bances to other equip-ment.

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 in conjunction with accessories from other manufacturers, for example field computers, personal computers, two-way radios, 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 guide-lines and standards. When using computers and two-way radios, pay attention to the infor-mation 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 very intense electromagnetic radiation, for example, near radio transmitters, two-way radios or diesel generators.
Precautions:
Check the plausibility of results obtained under these conditions.

Warning

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.

4.7 FCC Statement, Applicable in U.S.

Warning

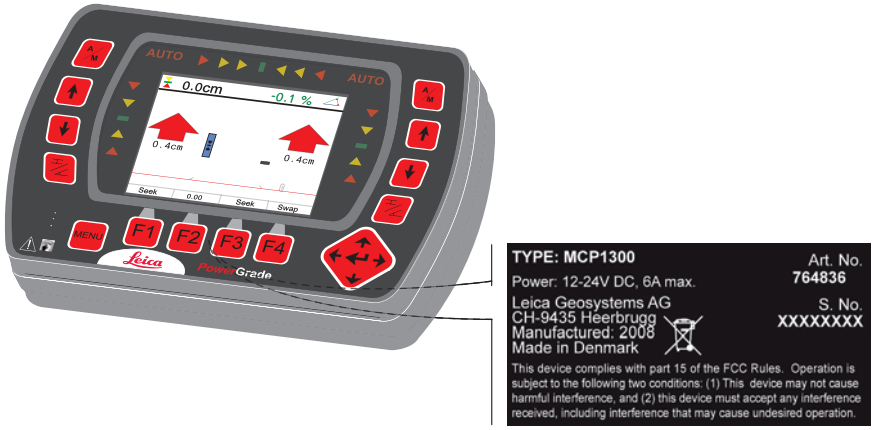
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules.
These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates, uses and can radiate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

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

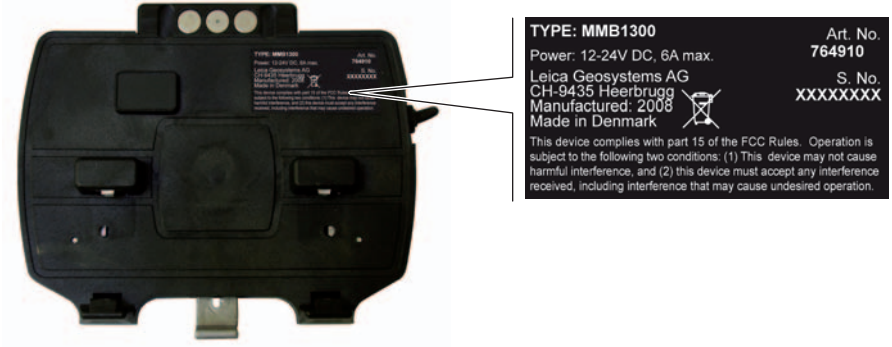
Warning

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

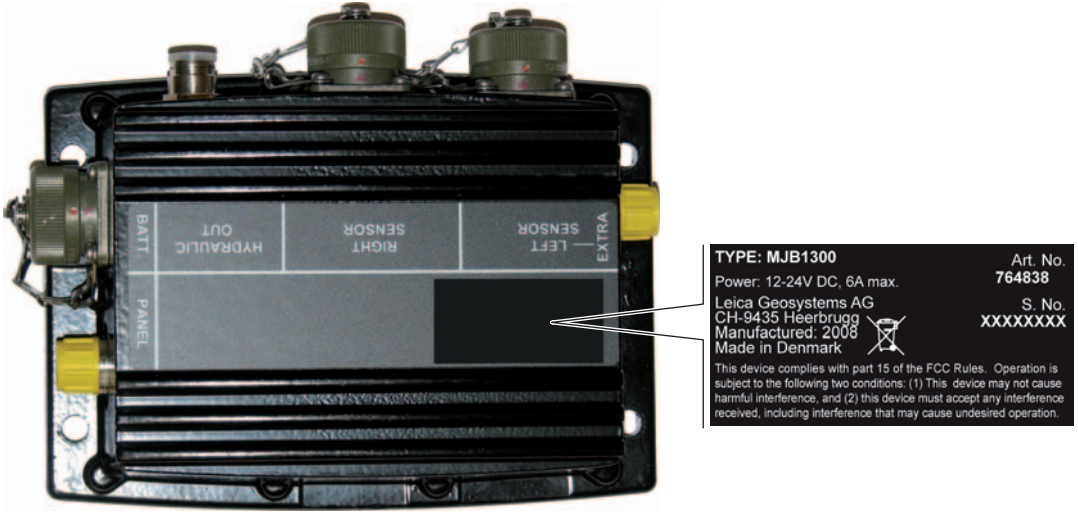
Labelling PowerGrade control panel



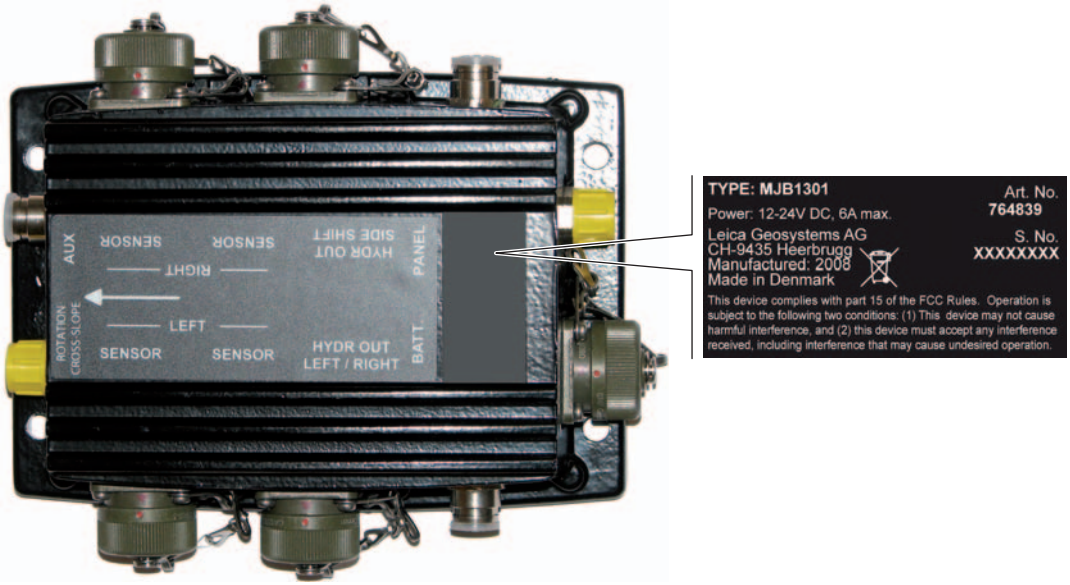
Labelling PowerGrade cradle



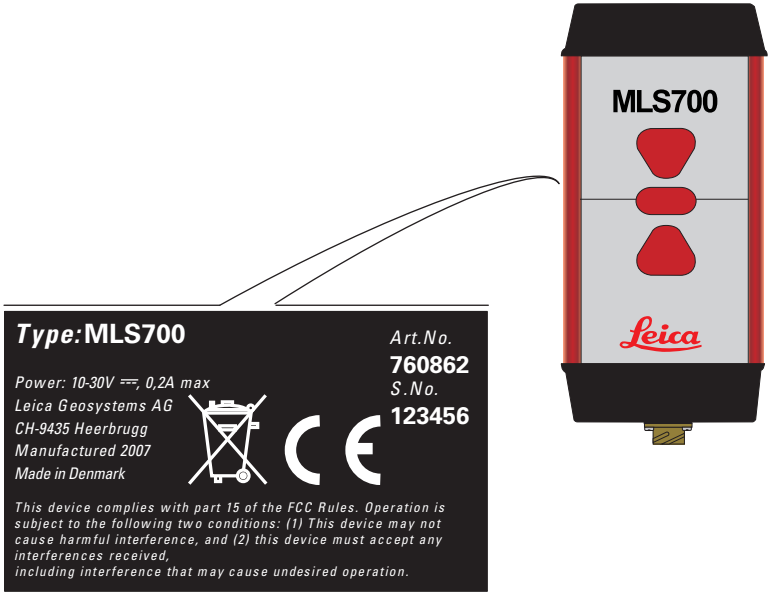
Labelling junction box Dozer



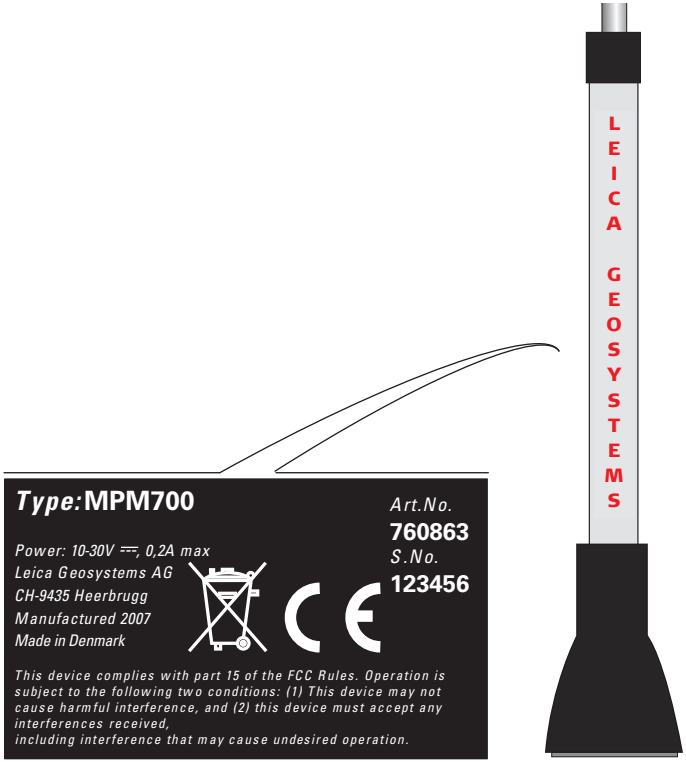
Labelling junction box Grader



Labelling laser receiver



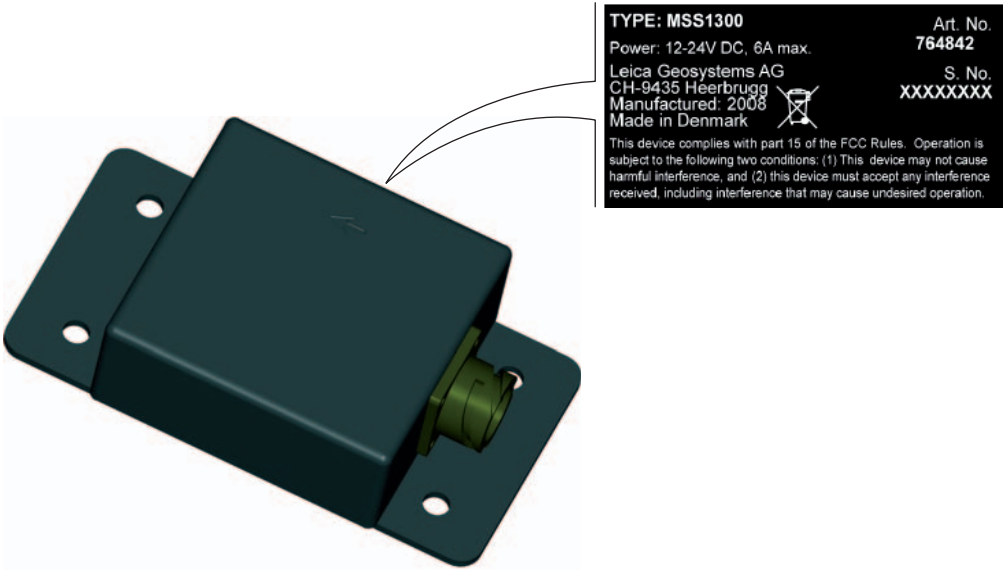
Labelling PowerMast



Labelling Tri-Sonic

Labelling rotation sensor

Labelling cross slope sensor



5 Technical Data

5.1 PowerGrade Technical Data

The PowerGrade system is designed to operate from standard vehicle power systems at 12V DC or 24V DC - check to ensure proper connection and polarity.

System accuracy

± 3mm (Standard Deviation)
Depending on sensors in use, atmospheric condition, machine condition, machined material.

PowerGrade control panel

Parameter	Specification
Voltage range	12/24 V DC (nom.) Nominal voltage 24 V DC, Range 10 V-30 V
Power consumption	< 200 mA
Graphic display	4" LCD colour screen
Keypad	18 keys, with backlight
Interfaces	Infrared
Dimensions	12.5 x 18.0 x 3.7 cm
Weight	0.5 kg

PowerGrade cradle

Parameter	Specification
Voltage range	12/24 V DC (nom.) Nominal voltage 24 V DC, Range 10 V-30 V

Parameter	Specification
Power consumption	< 2.5 A with control panel connected and no load at 12 V
Dimensions	12.4 x 15.2 x 4.4 cm
Weight	0.320 kg
Communication (Infrared)	1 Mbit
Output	2x RS232, RX, TX, 12V/2Amp, GND, 2 x MikroCAN and J1939

Junction box

Parameter	Specification
Voltage range	12/24 V DC (nom.) Nominal voltage 24 V DC, Range 10 V-30 V
Power consumption	< 0.5 A with no sensors and valve connected
Dimensions	Dozer: 13.8 x 18.3 x 6.4cm Grader: 14.5 x 18.3 x 6.4cm
Weight	2 kg
Hydraulic Output Settings	Proportional valves
Interfaces	Battery MIL Cradle M12 Valves 2x MIL CAN A MIL CAN B MIL CAN A M12

MUS1300 Tri-Sonic

Parameter	Specification
Dimensions	17.2 x 18.3 x 14 cm
Weight	2.5 kg
Accuracy	within ±0.125 cm @ 30.5 cm
Input voltage	11 to 30 V DC
Power Consumption	0.5 A max.

MPM700 PowerMast

Parameter	Specification
Voltage range	12/24 V DC (nom.) Nominal voltage 24 V DC, Range 10 V-30 V
Power consumption	< 2.5 A
Mast height (extended)	2.9 m
Mast height (retracted)	1.7 m
Mast travel	1.2 m
Mast travel speed	85 mm per second
Positions repeatability	±1 mm
Weight	30 kg

Manual mast

Parameter	Specification
Height (extended)	3.257 m

Parameter	Specification
Height (retracted)	1.857 m
Travel	1.4 m
Scale	Metric/Inch
Weight	14 kg

MLS700 Laser receiver

Parameter	Specification
Voltage range	12/24 V DC (nom.) Nominal voltage 24 V DC, Range 11 V-30 V
Power consumption	< 500 mA
Dimensions	28 x 12 x 7.2 cm (without mounting bracket)
Weight	2.5 kg (incl. clamp)
Detection angle	360°
Linear detection height	190 mm
Operating range	300 m radius
Accuracy dead bands	1 = 2 mm 2 = 7 mm 3 = 11 mm 4 = 15 mm 5 = 25 mm
Sensor pick-up range	18.5 cm

Parameter	Specification
Laser requirement	All Rotating Lasers (HeNe or Infrared Laser diodes visible and invisible)
Pulsed display	5 pulses per second

The Laser sensor can be used for manual (visual) control by connecting directly to the battery.

Cross slope sensor

Parameter	Specification
Voltage range	12/24 V DC (nom.) Nominal voltage 24 V DC, Range 10 V-30 V
Power consumption	< 0.25 A
Dimensions	15.3 x 8.7 x 3.9 cm
Weight	0.855 kg
Accuracy cross slope	±0.1 % slope at ±25°
Working range	±80°
Interfaces	CAN MIL

Rotation sensor

Parameter	Specification
Voltage range	12/24 V DC (nom.) Nominal voltage 24 V DC, Range 10 V-30 V
Power consumption	< 0.25 A

Parameter	Specification
Dimensions	Ø16.0 x 22.6 x 5.9 cm
Weight	1.56 kg
Working range	0-360°

Environmental specifications

Temperature

Type	Operating temperature [°C]	Storage temperature [°C]
PowerGrade control panel	-20 to +60	-30 to +70
PowerGrade cradle	-20 to +60	-30 to +70
Junction box Grader	-20 to +60	-30 to +70
Junction box Dozer	-20 to +60	-30 to +70
MPM700 PowerMast	-20 to +60	-30 to +70
MLS700 Laser receiver	-20 to +60	-30 to +70
MUS1300 Tri-Sonic	-20 to +65	-40 to +85
Cross slope sensor	-20 to +60	-40 to +80
Rotation sensor	-20 to +60	-40 to +80

Protection against water, dust and sand

Type	Protection
PowerGrade control panel	IP67
PowerGrade cradle	IP54
Junction box Grader	IP67

Type	Protection
Junction box Dozer	IP67
MPM700 PowerMast	IP45
MLS700 Laser receiver	IP68
MUS1300 Tri-Sonic	IP54
Cross slope sensor	IP68
Rotation sensor	IP67

Humidity

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

5.2 Conformity to National Regulations

Conformity to national regulations

CE Hereby, Leica Geosystems AG, declares that the PowerGrade control panel is in compliance with the essential requirements and other relevant provisions of the applicable European Directives. The declaration of conformity may be consulted at http://www.leica-geosystems.com/ce.

6 International Limited Warranty, Software License Agreement

International Limited Warranty

This product is subject to the terms and conditions set out in the International Limited Warranty which you can download from the Leica Geosystems home page at http://www.leica-geosystems.com/internationalwarranty or collect from your Leica Geosystems distributor.

The foregoing warranty is exclusive and is in lieu of all other warranties, terms or conditions, express or implied, either in fact or by operation of law, statutory or otherwise, including warranties, terms or conditions of merchantability, fitness for a particular purpose, satisfactory quality and non-infringement, all of which are expressly disclaimed.

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Total Quality Management: Our commitment to total customer satisfaction.

Leica Geosystems AG, Heerbrugg, Switzerland, has been certified as being equipped with a quality system which meets the International Standards of Quality Management and Quality Systems (ISO standard 9001) and Environmental Management Systems (ISO standard 14001).

Ask your local Leica Geosystems dealer for more information about our TQM program.

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Leica Geosystems AG
Heinrich-Wild-Strasse
CH-9435 Heerbrugg
Switzerland
Phone +41 71 727 31 31
www.leica-geosystems.com

- when it has to be **right**

Leica Geosystems