Leica PaveSmart 3D
User Manual

- when it has to be **right**

Leica
Geosystems

Introduction

Purchase

Congratulations on your purchase of the Leica PaveSmart 3D Machine Control System. Leica PaveSmart 3D is the world's leading machine control system for increasing productivity in paving and milling applications.

This manual contains important safety directions as well as instructions for setting up the system and operating it. Refer to "6 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 observe the directions and instructions contained in the User Manual and Safety Handbook issued by the:
• Machine manufacturer,
• Controller manufacturer and
• Sensor manufacturer.

Product identification

The type and serial number of your product are indicated on the label on the base of the product.

Enter the model and serial number in your manual and always refer to this information when you contact your agency or Leica Geosystems authorised service workshop.

Type: MPC1310 Machine Computer	Serial number: _____
Type: MSS1200 Dual-Axis Slope Sensor	Serial number: _____
Type: TCPS27S/29S Ruggedised Radio Modem	Serial number(s):_____
Type: MCR-900 Ruggedised Radio Modem (900MHz, North America only)	Serial number: _____

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.

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Table of Contents

1   How to use this Manual

**Applicability of this manual**

This User Manual is for **Leica PaveSmart 3D**, for use to control paving and milling machines.

Introduction to Leica PaveSmart 3D

Traditionally, paving and milling machines are controlled for elevation and steering by a stringline. These stringlines are staked-out by a survey crew; positioning the pins and setting the wires is a demanding and error-prone surveying task. With stringlines in place, they cause a significant logistical problem for concrete or asphalt delivery and further present a safety risk for site operatives. Furthermore, damage caused to the stringline, from personnel or vehicles can seriously interfere with production. Undetected problems with position or elevation can result in the costly removal and replacement of expensive material.

With the **Leica PaveSmart 3D** control system, the machine is controlled without stringlines. One or two Leica Geosystems robotic total stations ("Robots" - or sometimes referred to as TPS) or GPS (herein GPS refers to an arrangement including both the United States' GPS and Russia's GLONASS constellations, and in future the European Union's GALILEO constellation) sensors continually measure the position of specific points on the machine. These measurements are transmitted by radio to the Leica Machine Computer (MPC1310), mounted on the machine. High-accuracy machine-mounted slope sensors provide additional information on the longslope (mainfall) and crossslope (crossfall) of the machine. From this pool of position, height and slope information, **Leica PaveSmart 3D** then continuously calculates the current or **Actual** position, elevation and slopes of the machine, and the heading (or direction of travel) of the machine.

These **Actual** position, elevation and slope values are compared to the computerised 3D **Design** model of the project. The results of this **Design-vs-Actual** comparison, are called **Corrections**. These corrections represent the amount of machine movement (in position, elevation and slope) required to bring back the machine **online** and **ongrade**. **Leica PaveSmart 3D** transmits these **Corrections** to the machine controller, which then regulates the hydraulics, in a similar way to controlling with the conventional stringline sensors.
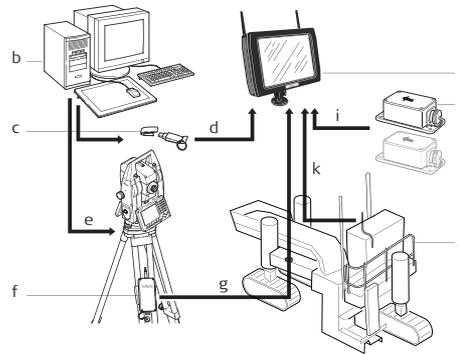
a) MPC1310
b) CAD-PC
c) USB storage device
d) Project data
e) Reference point list
   (OnBoard or hand-held application)
f) TCPS27S, TCPS29S or MCR-900 Radio modem
g) Measured value Hz, V, Dist
h) Slope sensor(s)
i) Actual longslope & crossslope of the machine
j) Machine
k) Parameters for position and height

Contents of this manual

The **Leica PaveSmart 3D** User Manual is designed into four main sections. System setup Information is presented in a step-by-step format:
   1. Getting Started (Daily Operations, Project Setup, Hints and Tips)
   2. System Components (Diagrams & Software Description)
   3. Troubleshooting (Detailed Troubleshooting Chart)
   4. Care and Transport/Safety Directions

Path

Work: Offset\Steer stands for this working sequence:
From the **Work** dialog, select **Offset** and then select **Steer**.
Leica PaveSmart 3D paths always start either in the **Work** dialog or in the **Menu** dialog.

Screen

Work\Elevation Offsets\Steer Offsets describes the name of the screen.

Fields and options

Fields displayed on the screen are described such as **<Speed:>** or **<Speed: ft/min>**, if "ft/min" is the selected speed unit.

Index

The index is at the end of the manual.

☞

Keys, fields and options on the screens which are considered as self-explanatory are not explained.

**Available documenta-
tion**

Name of documentation	Description
Leica PaveSmart 3D User Manual	All instructions required in order to operate the system to a basic level are contained in this User Manual. It provides an overview of the system together with technical data and safety directions.
Leica PaveSmart 3D Technical Reference Manual for : • Curb & Gutter • Milling • Road Paver • Mainline Paver • Trimmer	Overall comprehensive guide to the system functions. Included are detailed descriptions of special system settings and functions intended for technical specialists.
Leica TS15 User Manual	Contains important safety directions as well as instructions for setting up the TS15 and operating it.

Name of documentation	Description
Leica MNS1200 or PowerBox User Manual	Contains important safety directions as well as instructions for setting up the MNS1200 and operating it.
Leica Viva Technical Reference Manual	Contains detailed technical instructions for setting up the TS15 and operating it.
Leica GPS1200+ Technical Reference Manual	Contains detailed technical instructions for setting up the GPS1200+ and operating it. The manual can also be used for the PowerBox.
Leica Mguide User Manual	Contains instructions for setting up the Mguide onboard application for TS15 and operating it.
Leica TCPS27S or TCPS29S User Manual	Contains important safety directions as well as technical instructions for setting up the TCPS27S/TCPS29S and operating it. (optional)
MCR-900 Radio Manual (North America only)	Contains important safety directions as well as technical instructions for setting up the MCR-900 radio modems and operating them. (optional)
MPC1310 User Manual	Contains important safety directions as well as a general description of technical processes and instructions for using and operating the MPC1310.
Leica GNSS Machine Positioning User Manual	Contains important safety directions as well as instructions for setting up the Leica GNSS products and operating them.
Leica PowerTracker User Manual	Contains important safety directions as well as instructions for setting up the Leica PowerTracker product and operating it.
Leica iCON GPS 80 User Manual	Contains important safety directions as well as instructions for setting up the Leica iCON GPS 80 and operating it.
Leica iCON robot 60 User Manual	Contains important safety directions as well as instructions for setting up the Leica iCON robot 60 and operating it.

☞   All documents must be read before commencing working on the machine.

Format of the docu-mentation

The user manuals are available in printed form and can be downloaded on MyWorld.
NOTE: Leica Geosystems strongly advises reading the relevant machine operating & safety instructions, provided by your machine manufacturer.

2   Getting Started

## 2.1   Preparing the Leica PaveSmart 3D System

Further reading   Refer to the Leica PaveSmart 3D Technical Reference Manuals, the iCON site User Manual or to the TS15 User Manual on how to perform a Resection (Free Station), Known Point setup and how to take As-Built measurements.

Before production   **Connect the MPC Computer**: Attach the MPC1310 computer to the machine. Connect power, radio and CAN cables if available. Machines using CANBUS communication should be connected by the MJB1305 Paving Junction Box.
Set up all required sensors: Robot (and GPS reference station if applicable) with the required accessories - battery, radio and cables. Ensure that all robots are running either in MGuide with the appropriate configuration set, or correctly configured when working with a hand-held application iCON site or RoadRunner.
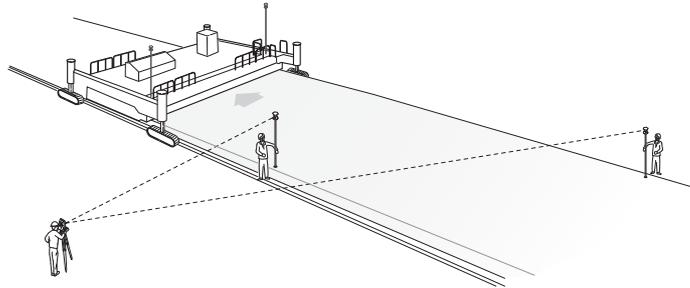
a) Max. 100 m (300 ft)*
b) Min. 5 m (15 ft)

 *depending on application tolerances. Milling and asphalt paving may be able to work up to 150m (450ft)

Set up Fixpoint Prisms over suitable fixpoints, noting their heights, ready for Free Station or Known Point Setups.

Once all robots and prisms are set up, on each Robot, **Level** and perform either a **Resection** (**Free Station**) or **Known Point Setup** (refer to the MGuide Application Program Manual or the Robot User Manual, depending on your type of instrument/work flow).

If working with GPS (GNSS) start the reference station to obtain correction data for the GPS machine sensor (refer to the Leica GPS Machine Positioning User Manual).

At the Leica PaveSmart 3D computer: In the dialog **Work\Sensors\Arrange,** select which sensor will be used as **〈Primary〉**, depending on configuration profile, and optionally as **〈Secondary〉** and **〈Spare〉**.

Switch on machine and allow **hydraulic system to warm** to a suitable operating temperature before starting work. This step is essential to ensure consistent machine behaviour, as the machine will have been "tuned" by a Leica Geosystems engineer during initial commissioning of the system at its normal operating temperature, engine speed and oil pressure.

2.2   Operating the MPC1310 Machine Computer

Starting the MPC1310

a) Power key
b) Power indicator LED

The power key is on the upper right side of the MPC1310.
When power is supplied for the MPC1310, press the power key to start the MPC1310. After pressing the key for 1 second, the power indicator LED will show green, and the MPC1310 will start booting-up.

Ensure that there is sufficient power supply. If not, switch on the ignition of machine or start the engine.

⚠ **Warning**   **ALWAYS** disconnect the Machine PC power and/or CAN-cable to the machine **before** conducting hot work/welding on the machine!
Reconnect the cabling only after completion of hot work/welding.

Main Menu Dialog

MAIN MENU - Multi_Stringline_Cigar - User Level   *Leica*

Projects

Sensors

Preferences

Leica PaveSmart 3D

SW Version	: 005.000.000.042
CCP Expiry	: UNLIMITED
License Expiry	: UNLIMITED
Current Project	: Multi_Stringline_Cigar
Reference Model	: Multi_Stringline_Cigar_0727_135720
Current Log File	: Quality_Log_P3D_2015-03-10_17-02...
Machine	: GT3600
Machine Type	: CurbAndGutter
Controller	: G21

Machine

Tools

Service

CONFIG

BACK

☞ In all dialogs, the following buttons are used to navigate, confirm or reject changes to settings.

CONTINUE — confirm changes to system settings and continue.

BACK — reject changes and go back to previous dialog.

The Menu dialog offers several opportunities to configure the Leica PaveSmart 3D software. The machine and the current task have an influence on the configuration required.

contains all project and job relevant dialogs to manage jobs, log files, as-built recordings and backups.

Define sensor configuration (Robot, Robot+GPS etc.) is being used and to configure all attached sensors.

General settings such as units, language, date/time etc.

To define machine profile, machine dimensions, control points, interval/periodic actions, locks and stops, production tolerances and advanced machine tuning options.

Diagnostic tools for data flow and the external radio configuration tools.

Unlock the protected dialogs (if disabled) - opens a dialog to enter the password.

Contains various tools for experienced service personnel only. Customer access only under Leica supervision.

See the Technical Reference Manuals for detailed information as dialog may be different depending on selected machine profile.

Center section

The center section provides a fast overview of the current setup.

Field	Description
SW Version	The build number of the software. Please quote this number to support.
CCP Expiry	The date of expiry for maintenance contract.
License Expiry	The next expiry date for any active license.
Current Project	The file name of the currently loaded project.
Reference Model	The currently loaded model from the loaded project.
Current Log File	The name of the log file currently being created.
Machine	The machine currently in use.
Machine Type	The machine type currently in use.
Controller	The controller type currently in use.

Config dialog

Optional protected by a password which can be set in the Settings/General dialog, containing settings which are usually not used in daily production and should only be edited by a trained system administrator (n.b. Default password = 007).

Service dialog

Password protected menu for Leica support personnel only.

Work Dialog

Depending on the machine type, a different machine profile is loaded. Milling, Concrete Curb&Gutter, Concrete Mainline Paver, Road (Asphalt) Paver or Trimmer Profiles are available, depending on the Licences purchased. Further licences can be purchased through your Leica Machine Control sales representative.
The Work dialog screen shows all the information needed while the machine is in operation.

Work Dialog Curb and Gutter:
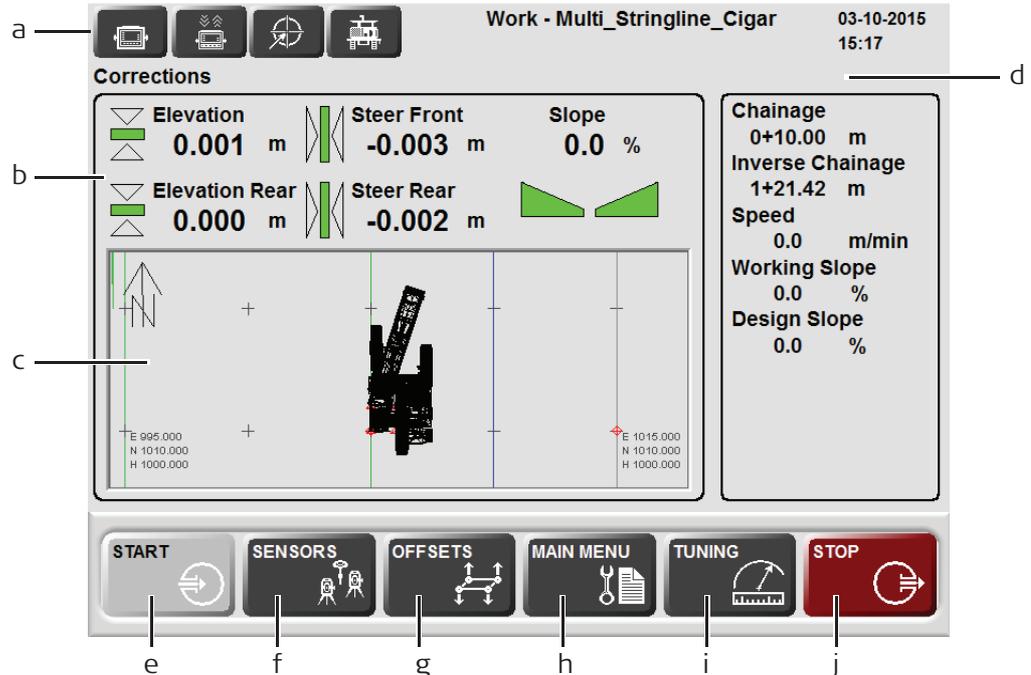
a) **Dashboard/Error messages**: the specific icon flashes yellow if a warning is detected or flashes red if an error occurs. By pressing the specific button additional information and troubleshooting tips will be displayed.
1.) MPC1310 messages
2.) Communication messages

3.) Sensor messages

4.) Machine messages

b) **Corrections**: indicates the mold "deviations", and required corrections for the elevation of the mold (front and rear) and the position of the mold (front and rear). For example, if the front height deviation shows -0.013 (in selected units), the machine has to raise (i.e. correct) the front of the mold by 0.013 (in m or ft). In normal operation, with the machine's controller set to Automatic, the deviations should be around zero at all times.

c) **Design Map display**: shows the whole project and the current machine position. Click on the map to select the desired ReferenceLine and SlopeLine for controlling the machine.

d) **Information**: provides information about the work progress.

- **Stationing** shows current Stationing or Chainage (in selected units).
- **Opposite Stationing** shows the inverted Stationing or Chainage, the difference to the end (in selected units).
- **Speed** indicates current Speed of the machine (in m/min or ft/min).
- **Working Slope** shows the current Working Slope, which is the Design Slope at the current position plus the Slope Offset.
- **Design Slope** is the Design Cross Slope at the current position. It is calculated out of the ReferenceLine and the SlopeLine.

e) Press and hold for at least 1 second to start active Control.

f) opens the Sensor dialog to manage Robot and GPS sensors.

g) opens the Offset dialog to set the working offsets relative to the selected Reference Line and Slope Line.

h) opens the Main Menu dialog to configure Leica PaveSmart 3D settings, such as Machine, Project, Sensors etc.

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i) opens the Tuning dialog to adjust the hydraulics sensitivity for the machine's elevation and steer (where applicable) control.

j) press and hold for at least 1 second to stop active Control and for at least 2 seconds to close the software and shut down the MPC1310.

Never power off the MPC1310 by holding down the Power Key! Always shut down the MPC1310 by using the Exit button to ensure that all data and system settings are saved.

Work Screen for Milling Machines:

| | | | | Work - Multi_Stringline_Cigar | 03-10-2015 15:24 |

Values

	3D Height	Position	Cross Slope	Chainage
Set	0.000 m		Set 0.0 %	0+11.00 m
				Inverse Chainage
				1+20.42 m
				Speed
Act.	0.000 m	-0.003 m	Act. 0.0 %	0.0 m/min
	AUTO		AUTO	Milling Height
				997.998 m
				Design Height
				1000.000 m
				Layer Offset
				-1.999 m
				Slope Offset
				0.0 %

SENSORS   OFFSETS   MAIN MENU   TUNING   EXIT

e   f   g   h   i

a) **Dashboard/Error messages**: the specific icon flashes yellow if a warning is detected or flashes red if an error occurs. By pressing the specific button additional information and troubleshooting tips will be displayed.
1.) MPC1310 messages
2.) Communication messages
3.) Sensor messages
4.) Machine messages

b) **Corrections**: indicates the required corrections for the elevation and cross slope of the milling head and the position of the milling head. For example, if the height correction shows 0.010 (in m or ft), the machine has to lower the milling head by 0.010 (in selected units). The values and settings are exactly the same as those values displayed on the machine controller (Wirtgen DLS or LevelPro, or MOBAmatic) and can be changed manually on the controller or automatically through PaveSmart 3D.

c) **Design Map display**: shows the whole project and the current machine position. Click on the Map to select the desired Reference Line and Slope Line.

d) **Information**: provides information about the work progress.
- **Stationing** current Stationing or Chainage (in selected units).
- **Opposite Stationing** shows the inverted Stationing or Chainage, i.e. the distance to the end of the current Reference Line.
- **Speed** indicates current Speed of the machine (in m/min or ft/min).
- **Milling Height** - calculated height of the control point at the mast foot point.
- **Design Height** - project design height at the current machine position.
- **Layer Offset** - working height offset, added/subtracted to the design elevation.
- **Slope Offset** is the active offset when working with a slope side.

e) opens the Sensor dialog to manage Robot and GPS sensors.

f) opens the Offset dialog to set the working offsets relative to the ReferenceLine and SlopeLine.

g) opens the Menu dialog to configure the Leica PaveSmart 3D software.

h) press and hold for at least 1 second to stop active Control and at least 2 seconds to close the software and shut down the MPC1310.

Never power off the MPC1310 by holding down the Power Key! Always shut down the MPC1310 by using the Exit button to ensure that all data are saved.

Work Screen Road Paver (in Vögele NaviTronic configuration):

a —

Work - Multi_Stringline_Cigar   03-10-2015
15:42

Values

b —

3D Height	Steering	3D Height
Set **0.000** m		Set **0.000** m
Act. **-0.002** m	**-0.000** m	Act. **-0.005** m
M	M	M

Chainage
0+08.55   m
Speed
0.0   m/min
Elevation Offset
-3.749   m
Working Slope
0.0   %

c —

Screed Edge	Screed Width	Screed Edge
	2.500 m	
-0.004 m	1.250 m 1.250 m	**-0.001** m
M		M

d —

e —

SENSORS	OFFSETS	MAIN MENU	TUNING	EXIT

f   g   h   i   j

a) **Dashboard/Error messages**: the specific icon flashes yellow if a warning is detected or flashes red if an error occurs. By pressing on the specific button additional information and troubleshooting tips will be displayed.
   1.) MPC1310 messages
   2.) Communication messages
   3.) Sensor messages
   4.) Machine messages
b) **Corrections**: indicates the required corrections for steering/position deviation, elevation and cross slope. For example, if the Set value is 1.0 and the Actual value is 1.1 (in m or ft), the screed is too high, and machine has to lower the tow arm until the set- and actual values match (1.0). The values and settings are exactly the same as those values displayed on the machine controller (e.g. MOBAmatic, Vögele NaviTronic) and can be changed manually on the controller using the height correction buttons (Set Value).
c) **Screed Information**: for Vögele pavers only, indicates the corrections for the Screed Edge left and right. Inside the box the current total width of the screed and width for left side of the screed (1.250 m) and for the right side of the screed (1.260 m).
d) **Information**: provides information about the work progress.
   • **Stationing** shows current Stationing or Chainage (in m or ft).
   • **Speed** indicates current Speed of the machine (in m/min or ft/min).
   • **Layer Offset** shows the actual layer offset of PaveSmart 3D (Elevation Offsets).
   • **Working Slope** shows the current Working Slope, which is the Design Slope at the current position plus the Slope Offset.
e) **Design display**: shows the whole project and the current machine position. Click on the Map to select the ReferenceLine, SlopeLine and ScreedEdge Lines for active control.

f) opens the Sensor dialog to manage Robot and GPS sensors.

g) opens the Offset dialog to set the working mold offsets relative to the selected ReferenceLine, SLopeLine and ScreedEdge lines.

---

h) opens the Main Menu dialog to configure the Leica PaveSmart 3D software.

i) press and hold for more than 1 second to stop active Control and more than 3 seconds to close the system software and shut down the MPC1310.

☞   **Never power off the MPC1310 by holding down the Power Key!** Always shut down the MPC1310 by using the Exit button to ensure that all important project data are saved.

Work Screen Mainline Concrete Paver:

The Work dialog screen shows all the information needed while the machine is in operation.

a) **Dashboard/Error messages**: the specific icon flashes yellow if a warning is detected or flashes red if an error occurs. By pressing on the specific button additional information and troubleshooting tips will be displayed.

1.) MPC1310 messages
2.) Communication messages
3.) Sensor messages
4.) Machine messages

b) **Corrections**: indicates the required corrections for the four elevation cylinders of the mold (left/right and front/rear) and the position of the mold (steer front/rear) relative to the selected Reference Line, Slope Line and Working Offsets. For example, if the Left Front height correction shows -0.013 (in m or ft), the machine has to raise the left front of the mold by 0.013 (in m or ft).

c) **Information**: provides information about the work progress like Stationing/Chainage, Speed, Design Slope, Next Action and Sensor Information.

d) **Design Display**: shows the whole project and the current machine position. Click on the map to select the desired Reference Line and Slope Line.

e) Press and hold for at least 1 second to start Active Control. Control will only start if all required sensors are connected, machine dimensions and Primary/Secondary control points defined.

f) opens the Sensor dialog to manage Robot and GPS sensors.

g) opens the Offset dialog to set the working mold offsets relative to the selected ReferenceLine and SlopeLine.

h) **MAIN MENU** opens the Main Menu dialog to configure the Leica PaveSmart 3D software system operation.

i) **TUNING** opens the Tuning dialog to set the hydraulics parameters for the machine.

j) **EXIT** press and hold for at least 1 second to stop Active Control and at least 3 seconds to close the software and shut down the MPC1310.

☞ **Never power off the MPC1310 by holding down the Power Key!** Always shut down the MPC1310 by using the Exit button to ensure that all data are saved.

Work Screen Trimmer:

Work - Multi_Stringline_Cigar   03-10-2015 16:59

Corrections   Units: m,m/min,%

Elevation 0.000

Slope 0.0

Steer 0.003

Chainage 0+11.00
Speed 0.0
Design Slope 0.0

Pri   1   -.-

Slope

START   SENSORS   OFFSETS   MAIN MENU   TUNING   STOP

a b c d e f g h i j

a) **Dashboard/Error messages**: the specific icon flashes yellow if a warning is detected or flashes red if an error occurs. By pressing on the specific button additional information and troubleshooting tips will be displayed.
   1.) MPC1310 messages
   2.) Communication messages
   3.) Sensor messages
   4.) Machine messages
   5.) Software messages
b) **Corrections:** indicates the Trimmer head "deviations", and required corrections for the elevation of the Trimmer head and the position of the Trimmer head. For example, if the height deviation shows -0.002 (in selected units), the machine has to raise (i.e. correct) the Trimmer head by 0.002 (in m or ft). In normal operation, with the machine's controller set to Automatic, the deviations should be around zero at all times.
c) **Design Map display**: shows the whole project and the current machine position. Click on the map to select the desired ReferenceLine and SlopeLine for controlling the machine.
d) **Information**: provides information about the work progress.
   • **Chainage** shows current Stationing or Chainage (in selected units).
   • **Speed** indicates current speed of the machine (in m/min or ft/min).
   • **Design Slope** shows the Design Slope at the current position.
   • **Pri 1** shows the active Robot (R) or GPS sensor (G) on port 1 with status indication (green/red) and distance to machine.
   • **SP1** shows the spare Robot for leapfrog.
   • **Slope** shows the attached slope sensor with status indication (green/red).
e) Press and hold for at least 1 second to start active Control.
f) opens the Sensor dialog to manage Robot and GPS sensors.

g) opens the Offset dialog to set the working offsets relative to the selected Reference Line and Slope Line.

h) opens the Main Menu dialog to configure Leica PaveSmart 3D settings, such as Machine, Project, Sensors etc.

i) opens the Tuning dialog to adjust the hydraulics sensitivity for the machine's elevation and steer (where applicable) control.

j) press and hold for at least 1 second to stop active Control and for at least 2 seconds to close the software and shut down the MPC1310.

Never power off the MPC1310 by holding down the Power Key! Always shut down the MPC1310 by using the Exit button to ensure that all data and system settings are saved.

Numeric keyboard   By pressing on any editable value in a dialog, the numeric keypad will be opened automatically.

Front

0.000

1	2	3
4	5	6
7	8	9
.	0	DEL
OK	+/-	ESC

Edit the current, or enter a new value and press OK. The keyboard will close and the new value will be used. If you have made a mistake, simply press again to edit the number.
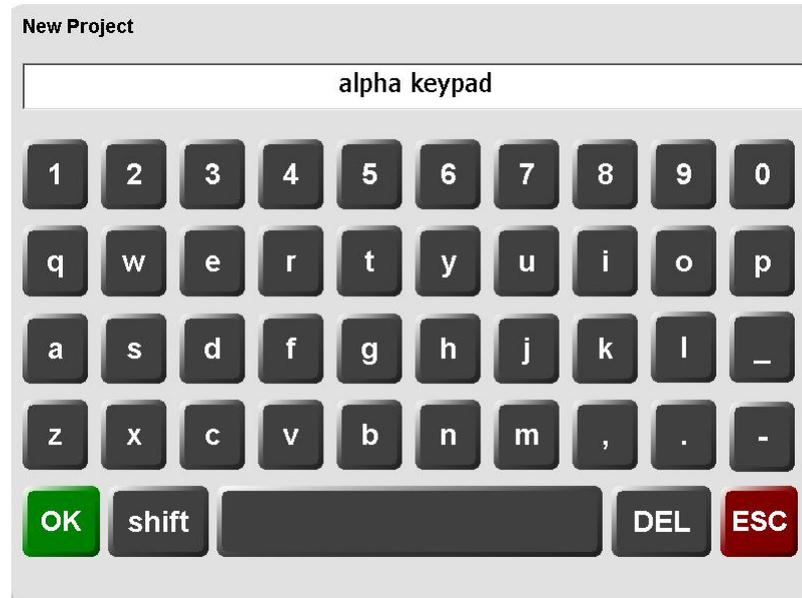
+/- key toggles the sign of the number between positive and negative.

DEL deletes entered values.

ESC abandons changes, and reverts to the initial value.

Text keyboard   By pressing in any text edit field the text keypad will be open automatically.

New Project

alpha keypad

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 |

| q | w | e | r | t | y | u | i | o | p |

| a | s | d | f | g | h | j | k | l | _ |

| z | x | c | v | b | n | m | , | . | - |

OK   shift   [   ]   DEL   ESC

Enter or edit text and press OK.
This keyboard operates similarly to the numeric keypad. Refer to "Numeric keyboard", page 33 for more information.

2.3   **Rules for Defining Projects**

Overview

Leica PaveSmart 3D requires accurate design data to be able to control the machines movements. The machine is only capable of following the information contained within the design data, therefore the quality of the final product is directly influenced by the quality of the data used.

The control process is also influenced by the design data. **The greater the number of segments contained within the design the greater the processing power required to run the system.** A balance must be found between the number of segments required to define the design and the processing power it will require.

The recommendations detailed below must be followed when creating designs.
Without following these rules Leica Geosystems cannot guarantee good quality paving performance.

Angle change between segments

Leica PaveSmart 3D is capable of using designs in a 3 dimensional format which may contain
• Straights
• Arcs
• Clothoids, entry and exit as well as partial
• Cubic parabolas
• Full/Partial Bloss curves (parabola of degree five)
Using these shapes only a small number of segments are required to define any 3 dimensional shapes.

Not all CAD systems are capable of producing curved 3-dimensional polylines. To overcome this curved line segments are broken up into a number of individual straight-line segments. The closer these straight segments are together the more accurate the original design data is approximated.

- When approximating curved 3 dimensional line segments the angle change between two connected line segments must never be greater than 1 degree (1°).
- When defining a straight line it is not necessary to add more points in the middle of a line.
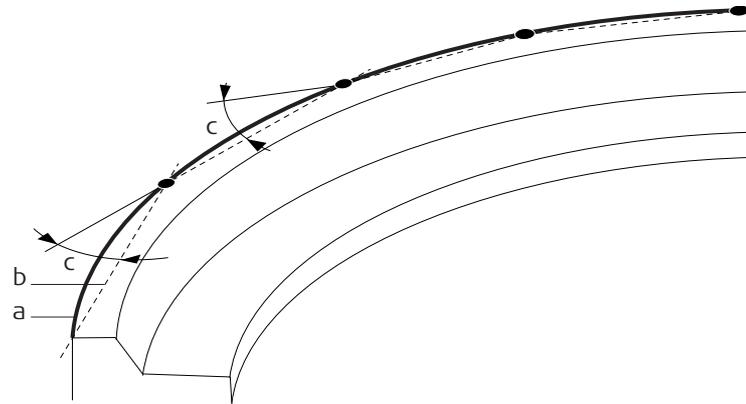
a) Reference line
b) Line segments
c) Angle change ≤ 1°

Number of Segments   The number of segments contained within a single job should ideally not exceed **3500 individual elements**. It is possible to have multiple stringlines on the same layer but each individual job should ideally not exceed 3500 elements.

If a single stringline requires more than 3500 elements it must be broken into more than one Reference Line, which must be paved separately.

2.4　　　　　　　　　Preparing the Leica PaveSmart 3D Software for the Current Project

Creating a new project

 start from Menu: Projects \ Current

 create a new project

Entering Name and Comment
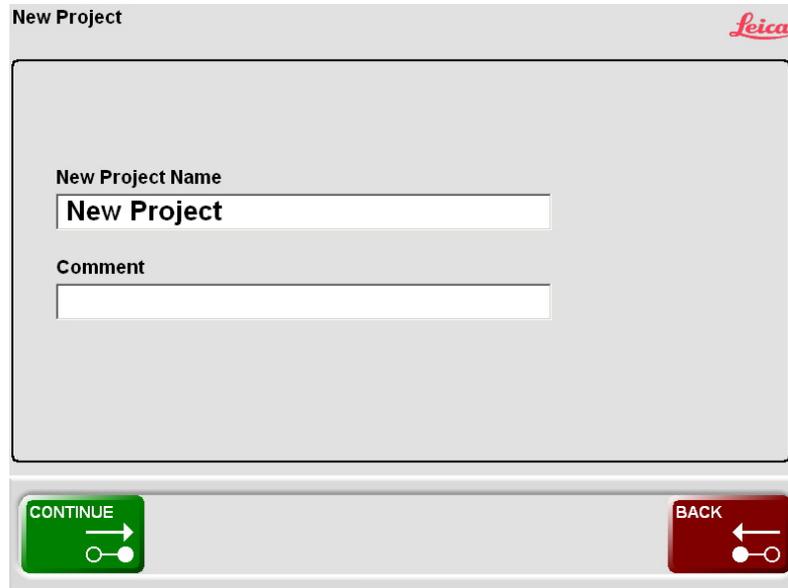
New Project

Leica

New Project Name

New Project

Comment

CONTINUE

BACK

‹New Project Name:› Enter the name of the new project. Project names cannot contain special characters and spaces.
‹Comment:› Enter a comment to describe the project in detail.

CONTINUE confirm the input and continue

☞ Before creating a new Project name, you must first have the design data available in DBX format on the external USB data stick in the \DBX folder. If the \DBX folder does not already exist on the stick, use Windows Explorer to create the folder.

Importing jobs from USB Port

a) MPC1310
b) USB storage device
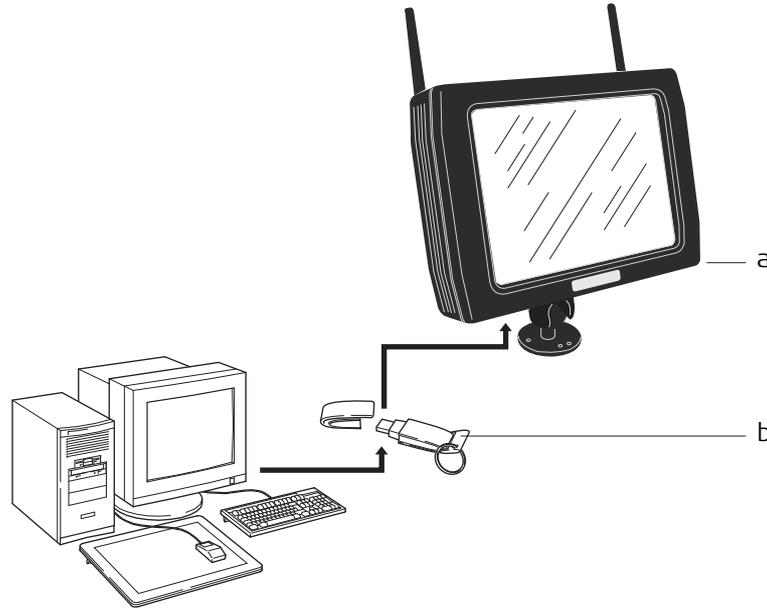
The USB port (labelled USB A) is located on the bottom of the MPC1310. Connect your USB storage device with the prepared design data on it to the USB port on the MPC1310.
☞ **The design data must be stored on the storage device in a folder named \DBX.**

Selecting Design Type and Layer

‹Design Type› defines the job type you want to work with:
- **‹StringLine›** is selected as the default ‹Design Type›.
- **‹StringLine Job›** shows the currently selected StringLine job. Only one layer from the stringline job can selected at a time. Select the appropriate layer from the **‹Layer›** dialog.

 confirm the selections and continue.

Selecting the current Project

Leica

Straight_Line_1000
Multi_Stringline_Cigar
Dog_Bone
Parking_Lot
BigJobs
MultiLineJobs

Comment

| CONTINUE | NEW | DELETE | | BACK |

The newly created project is automatically highlighted as the current project. If a different project is required it may be selected.

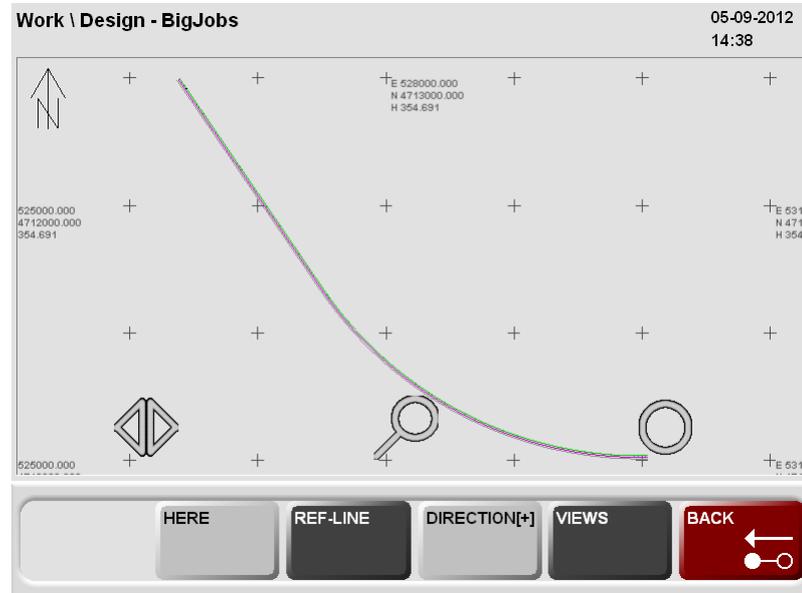CONTINUE confirm the selection and continue.

BACK New Project created, but not selected. Back to Menu.

2.5 Selecting Design Reference Lines

Design dialog   From the Work dialog click on the Design window to see the Work \ Design dialog:

HERE   set all deviations to zero. **This function is not available for all machine types.**

REFLINE to choose a reference line, a slope line (or automatically chosen), and Screed Edge lines (ScreedEdge lines are valid only for NaviTronic controllers).

DIRECTION[+] change the Working Direction (with or against Stationing/Chainage). This is only needed for a one-Robot or one-GPS solution.

VIEWS leads to the Work \ Design \ Graphics dialog where some more graphical functions such as 3D view are available.

Selecting Reference-Line and SlopeLine

REFLINE The selection of the Reference Lines is either done automatically or manually.

- **Automatically** means the system is determining automatically the next reference line on the left- and the right side of the machine (or its height control point) to calculate the design height- and slope.
- **Manually** you chose the ReferenceLine and optional a SlopeLine. When using the Road Paver profile this can be disabled in Menu \ Preferences \ General ‹ Disable Automatic Line Selection ›. When using the screed extension control with the Vögele NaviTronic controller, the procedure asks for the Edge Line definition after the steering line has been chosen.

Milling, Curb&Gutter, Mainline Paver and Trimmer: Line selection is always made manually, automatic line selection is not available.

Road Paver: Automatic line selection is by default disabled. By enabling, PaveSmart 3D automatically determines the relevant ReferenceLines.

After choosing a ReferenceLine, the procedure prompts the user to choose EdgeLines. Choose the EdgeLine for both sides of the screed. These are optional.
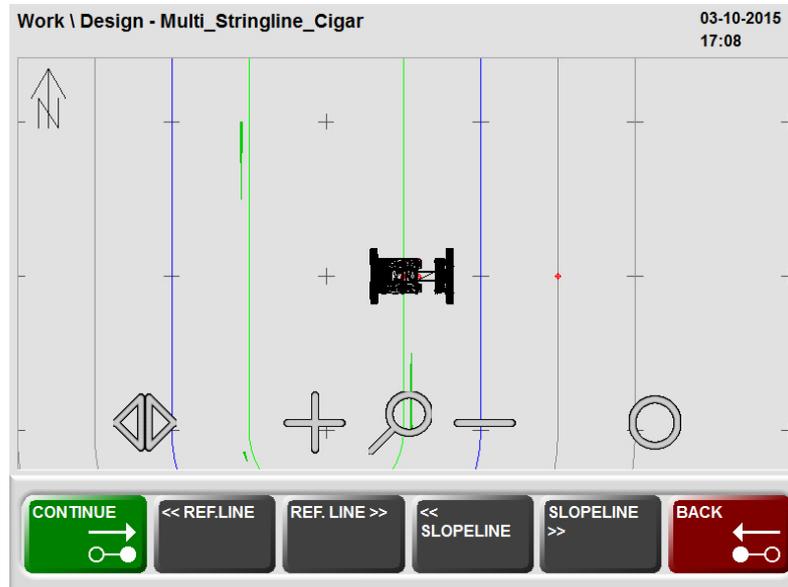
[⟨⟨] [⟩⟩] with the arrow buttons you can choose ReferenceLine, SlopeLine and EdgeLines , depending on the machine and configuration.

use the graphical pan function to shift the current design window over the project.

use the graphical zoom function to zoom in and out the current design window.

use the graphical rotation function to rotate the whole design.

CONTINUE confirm the highlighted ReferenceLine and continue.

Selecting EdgeLines   This feature is only available for the Vögele NaviTronic controller.

Line colours for   The RefLine is shown in green.
RefLine, SlopeLine and   The SlopeLine and the ScreenEdge line are shown in blue.
ScreenEdge

Entering offsets

OFFSETS start in **Work \ Offset**.

Work \ Elevation Offsets -
Straight_Line_1000

06-04-2015
09:22

Elevation Offsets

Units: m,m/min,%

Steer Front (SF)

Left Front (LF)
-0.002
0.000

Right Front (RF)
0.002
0.000

-0.000

Steer Rear (SR)

Left Rear (LR)
-0.002
0.000

Right Rear (RR)
0.002
0.000

-0.000

Chainage		0+07.98
Speed		0.0
Design Slope		0.0
Next Action		-.---
Pri	3 ℝ	2.201
Sec	1 ℝ	3.000
SP1	2 ℝ	3.123
Slope	Ⓢ Ⓢ	

STEER   RESET   BACK

👉 The offset dialog can look slightly different depending on the loaded profile and the attached sensors, the functionality is the same.

increase or decrease individually the specific **Working Offsets** step by step.

increase or decrease both **Front Offsets** together step by step.
The same button in RED affects all four Working Offsets together.

To enter a new offset manually press the specific offset field to get the numeric keyboard.

Front

| 0.000 |

1	2	3
4	5	6
7	8	9
.	0	DEL
OK	+/-	ESC

Enter a new offset and press OK.

from **Work \ Elevation Offsets \ Steer Offsets**
Enter the **‹Front›** or **‹Rear›** steering offsets in the same way as the elevation offsets.

from **Work \ Elevation Offsets \ Elevation Offsets**
Enter the **‹Front›** and or **‹Rear›**, **‹Left›** and or **‹Right›** elevation offsets. Refer to
Entering offsets in the beginning of this chapter.

from **Work \ Elevation Offsets \ Slope Offset**
Enter the **‹Cross Slope›** offset in the same way as the elevation offsets. The cross slope
offset determines catch / spill curb if there is no cross-slope information in the job. Only
available for machines using a cross slope sensor to control the slope.

2.6　Adjusting Working Offsets during Production

Description

As with stringline guidance, during operation the machine will require periodic adjustment of elevation and/or position due to external influences such as material characteristic changes, (e.g. wet or dry concrete with varying slump or mix design, asphalt temperature change), or milling/trimming drum wear. It is also very important to take into account slight errors within the project coordinate system – due to survey fixpoint errors, instrument calibration age, length of time an instrument is setup at one location, measurement range and atmospheric effects (e.g. temperature-cycling during the working period, pressure, humidity).

The importance of as-built checks (see "2.9 Taking As-Built Measurements") and good survey practice cannot be overstated; these will ensure any subtle errors and/or external influences do not impact on the accuracy and quality of the paving/milling process.

☞ **Adjustments to Working Offsets should only be made gradually, and after noticing a trend in one direction (e.g. a gradually increasing elevation error) over a number of measurements.**

As with stringline guidance, it is strongly recommended any adjustments to Elevation Working Offsets be by only 1mm (0.003') per 1 metre (3ft) of travel, to avoid undesired "steps" in the concrete, or the machine to "sit" on the fresh material. Smooth adjustment is the key to a quality finished product.

2.7   **Continue Working Depending on the Current Machine Position**

Introduction   The "Here" function is available for the milling application and is used especially in milling tasks when it is required to work in parallel lanes. The lanes depend on the milling head width and not on the design data. The function is used when one lane is finished, and the operator wants to turn the machine around and work along an existing edge. The operator can use the Here function, which brings the steering correction to zero by changing the steering offset. The function is also available for elevation and cross slope or all together.
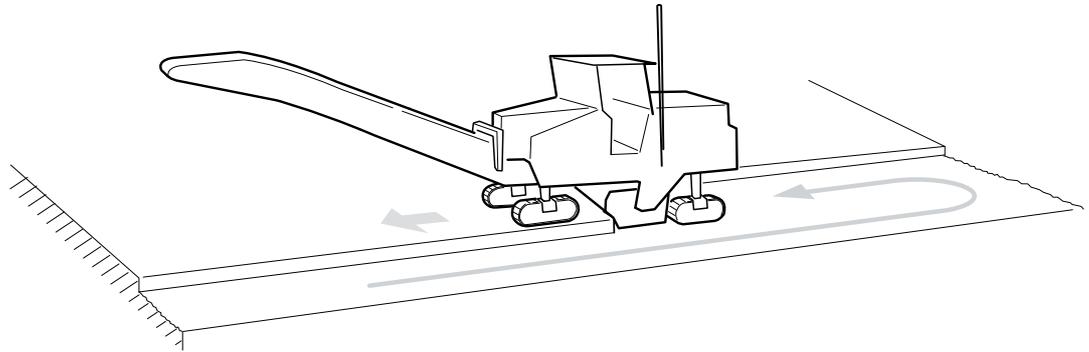
Here Function Steering　　From the Work dialog go **Work: Offsets \ Steer** to the following dialog:
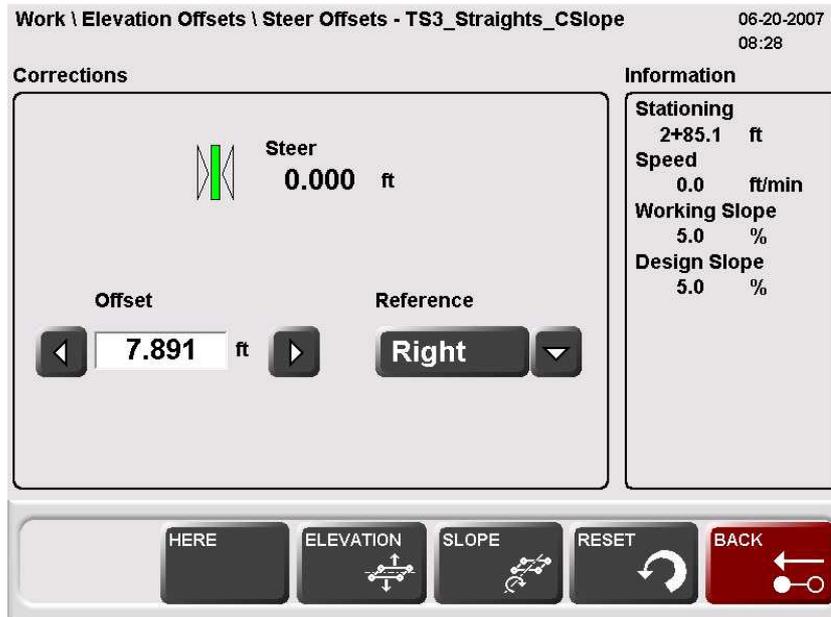
The setting **‹Reference: Right›** sets the offsets to be measured to the right side of the milling head. Other options are: **‹Reference: Center›** and **‹Reference: Left›**.

HERE

a new offset value is set corresponding to the indicated correction. After pressing the button, the correction is zero. The offset value is the distance between the reference line and the current machine position. The currently selected steer and slope lines will also be updated to the closest available.

This function is not enabled for all machines.
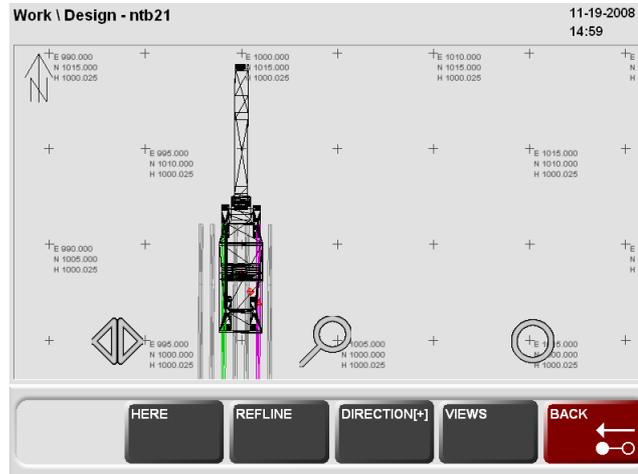
Here Function Road Paver / Steer Offsets : The milling head elevation Offsets and steering guide offset are adjusted individually.

≡ enters an Offset that makes the Correction zero - machine will mill at this elevation offset.

⏫ ⏬ : All 3 offsets are changed simultaneously / in parallel.

Here Function Elevation

From the Work dialog go **Work: Offsets** to the following dialog:
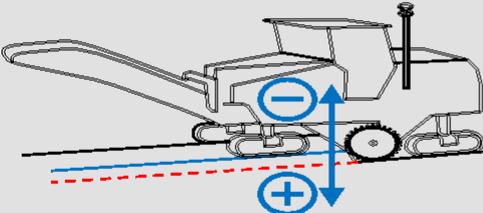
HERE

a new milling cutting depth is set corresponding to the indicated correction. After pressing the button, the correction is zero. The cutting depth is the difference in elevation between the design surface and the current milling head elevation.

Slope Here Function   From the Work dialog go **Offsets \ Slope** to the display following dialog:
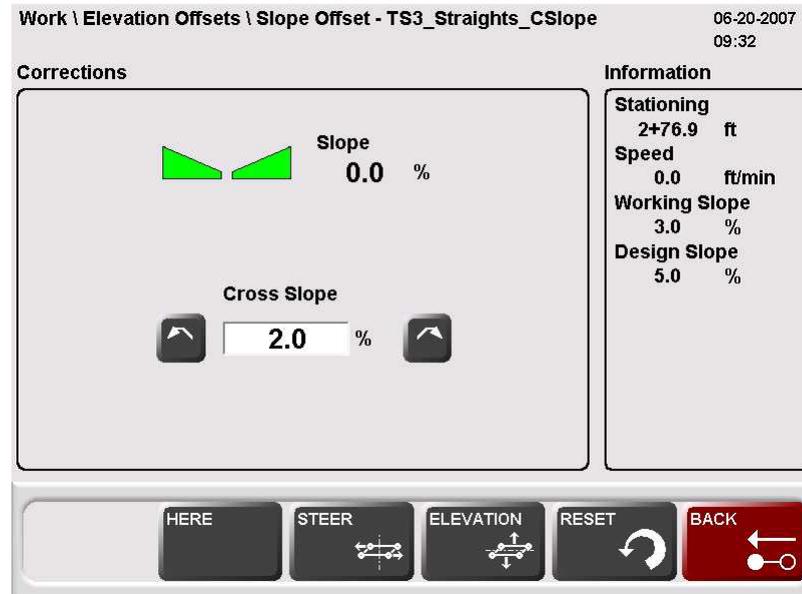
HERE a new cross slope offset is set corresponding to the indicated correction. After pressing the button, the correction is zero. The cross slope offset is the difference between the design slope and the current cross slope of the milling head.

Overall Here Function   From the Work dialog press on the Design Map graphic to get to the following dialog:
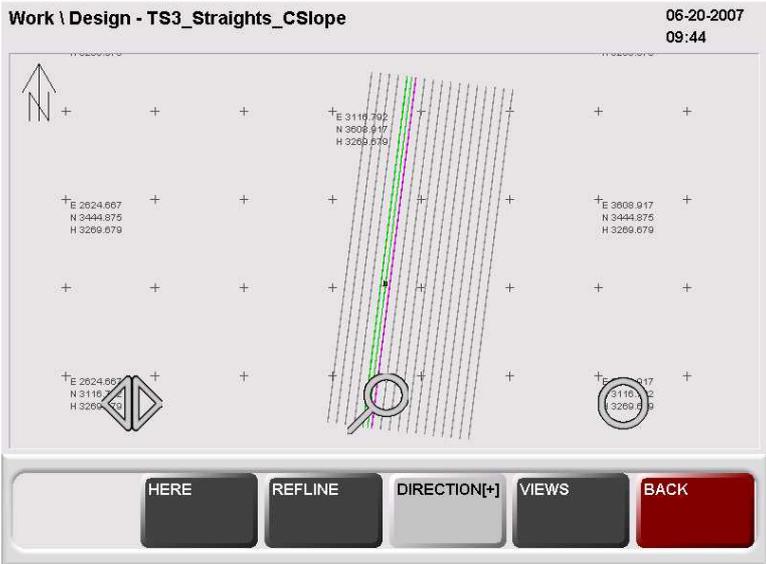
HERE

in the **Work: Design Dialog** all of the above mentioned Here Functions are combined. The Here button in the Graphic dialog sets the steering offset, the cutting depth and the slope offset simultaneously, so that all the corrections are zero.
This function is not enabled for all machines.

2.8   Positioning the Machine for Production

Get machine onto line and level

Note the current deviations with as-built checks. Liaise with the machine operator to get machine approximately onto line and level.

Curb&Gutter, Mainline and Trimmer

Ensure that the machine controller is set to the correct steering mode (e.g. Leica 3D Mode), with Steer & Elevation Sensitivities set to Minimum and all control loops set to Automatic. Start Leica PaveSmart 3D automatic control by pressing the START button for one second.

Milling

Scratch the surface with the drum and dial in the offset you calculated with your as-built checks. Ensure the controller is showing plausible actual values. Depending on application and material, go to your milling depth by start manually or directly in Automatic. Check milling depth immediately with some As-Built Measurements.

Road Paver

Ensure the underlying material to set the screed onto is on the correct height and the tow arms are in the correct position for the paving depth. Set the screed on blocks to provide the additional screed height to give the required compaction/roll-down factor (e.g. to achieve a 100 mm final rolled layer thickness, typically means adding 25% additional material, so a 125 mm paving layer thickness is required). Start paving in manual mode and the check surface height (and make manual corrections using the screed operators' panels). When the desired height is achieved and the screed has settled into its position and attack angle, set the corrections (set values) with the actual value and set the machine's levelling system (e.g. MOBAmatic or Vögele NaviTronic) into Automatic.

Automatic steering- and screed edge control:
Position the machine within 10 cm (0.3ft) accuracy and **parallel** to the project ReferenceLine.

Use the HERE function ( ) in the offset dialog to adjust the screed deviations after positioning the screed edge to its desired width.

2.9	**Taking As-Built Measurements**

Description

To check elevation and position during production, Leica PaveSmart 3D has an integrated as-built (Control) function, depending on the instrument type, to replace the manual "dipping" method used when working on string line. Regular, independent as-built measurements are **essential** to verify product is in project tolerances.

☞ Measurements are only possible if the instrument is correctly positioned and orientated within the project coordinate system (Free Station or Known Point setup)

Taking As-built control measurements

Refer to the MGUIDE User Manual for the instrument type and for detailed instructions on making as-built measurements. Customers using PowerTracker or iCON instruments refer to the PowerTracker or iCON User Manual and the Geo-Pad User Manual or Site Foreman User Manual on how to take As-built measurements.

Display and recording As-built control measurements

Immediately after an As-built control measurement has been made the results can be seen in the Work\Design dialog. The results are also recorded in the active project folder in the file **Asbuilt.abr**. **Work: Menu** \ **Projects** \ **AsBuilt**, and can be exported to provide a permanent quality-assurance record.

☞ Care must be taken when taking as-built measurements very close to a free-standing edge on freshly slipformed concrete or uncompacted asphalt - this may give misleading results, due to the uncontrollable **slump** of the material at the unsupported edge. It is also extremely important to ensure the correct Rod Height is used in the as-built checks, and that the tip of the survey pole does not "sink" into the fresh material. Always use a small footplate, adding its thickness to the Rod/Prism Height to ensure accurate measurements.

2.10   Leapfrogging (Swapping Robots)

Purpose   **Leapfrogging** is the method of transferring measurement of a machine prism from one Robot to another. This is usually required when the machine has reached a predetermined distance from the robot, e.g. 100m (300'). The actual distance should be determined by line-of-sight, surface smoothness and ideally any changes made while the machine is at a standstill (e.g. waiting for material or a truck).

Setting the leapfrog parameters   **Work \ Sensor \ Arrange **

Leapfrog tolerance: The maximum deviation between the currently measured prism coordinates and the newly measured prism coordinates must be set.
Use shortest measuring distance: The details of the robot for Position (Easting/Northing) and Elevation (Height) to be removed from active control process must be selected. If the "Leapfrog from the closest tracking Robot" option is selected, the robot measuring the shortest distance to the prism will be removed from active control. If this is not selected the longest measuring instrument will be removed from active control (the default setting).

Leapfrog Settings

Leapfrog Tolerance   0.060   m   0.060   m

☐ Leapfrog from the closest tracking Robot

**Swapping Robots -
making a leapfrog**

**Work \ Sensor \ LEAP **

The leapfrog function is a fully automated process. The operator must press the **⟨LEAP⟩** button to start the process. The "Leap" function is disabled if all required sensors are not available. Check the Sensor arrangement (Sensors \ Arrange).

☞

If a required robot sensor is not visible in PaveSmart 3D, first check the instrument is switched on, correctly positioned/orientated, then verify the battery condition and cabling, and finally that the radio communication settings (link number and COM Port) are correct. Ensure that the instrument uses the appropriate machine guidance application.

The system automatically takes the desired robot (nearest or furthest measuring) out of active control and assigns it as the Spare sensor, replacing it with the Robot previously defined as a Spare.
For example - in this screenshot you see three robots - the Primary Control (**P**) is on Channel 3, the Secondary (**S**) on Channel 1, and the Spare on Channel 4.

Work \ Sensors - Straight_Line_1000   07-05-2012 11:25

Information

Chainage
0+08.21 m
Speed
0.0 m/min
Working Slope
0.0 %
Design-Neigung
1.8 %

TPS(P)3
TPS(S)1
TPS(Sp)4

TPS(P)3 (10.22 m)
TPS(S)1 (9.78 m)
TPS(Sp)4 (79.28 m)

E 527470.001
N 4711380.000
H 401.332

E 527465.001
N 4711375.000
H 401.332

E 527470.001
N 4711370.000
H 401.332

B2

(P)
(S)

LEAP   SEARCH   CHECK   ARRANGE   BACK
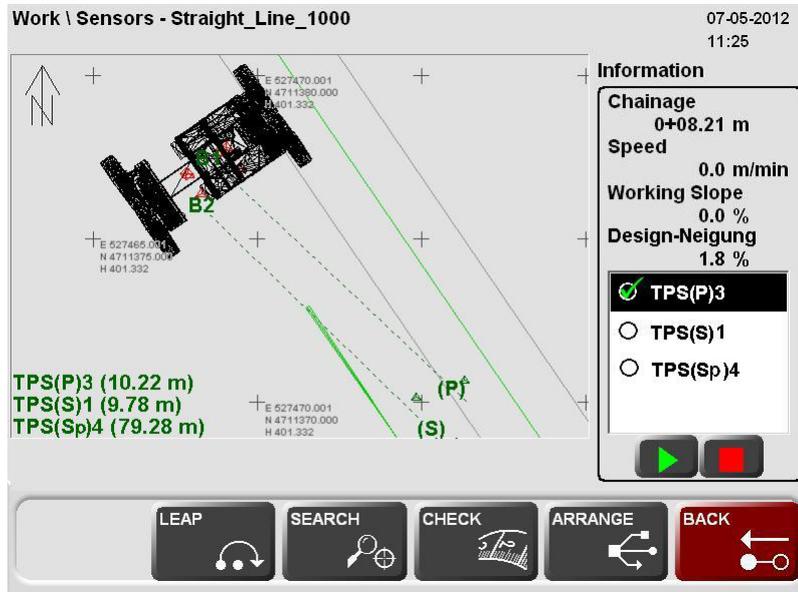
☞ Before leapfrogging a Robot, the machine must be at, or very close to, a stand-still. If the machine is moving the Spare Robot may not be able to lock onto the prism and wrong measurements may result.

Changing the offset to the design   After calculating the deviation between the Active Robot and the Spare Robot, the offsets to the design may need to be altered to prevent any steps or lines appearing in the surface. This usually occurs before the Spare Robot takes active control of the machine. "Steps" may be introduced due to minor changes/errors in the positions/orientations of the robots - the accuracy of the instrument position/orientation is heavily dependent on the quality and location of the local site reference points, and measurement distance.
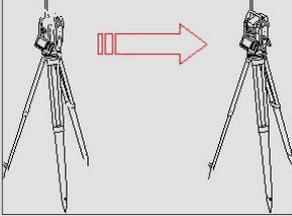
Auto 3D Offset adjustment	**Work \ Sensor \ Leapfrog \ Auto 3D**
	⟨Auto 3D⟩ changes **all** the current working offsets by subtracting the deviation between the current position and the new position from the current working offsets in both steering (front and rear) and elevation (front and rear) so no steps appear in the surface. For concrete pavers, the working Draft Offset (small elevation difference between front and rear of mold) is maintained automatically.
☞	**Auto 3D is the recommended method of adjusting offsets when an instrument is taken out of active control.** **If Manual Adjustment is selected, care must be taken to manually and gradually remove small offset changes if absolute position control (and paved/milled surface smoothness) is important.**
Auto Elevation Offset adjustment	**Work \ Sensor \ Leapfrog \ Auto Elev.**
	The Auto Elevation button will **only** change the elevation offsets by the difference in height between the "old" measurement and the "new" measurement at the front and rear of the mold. The steering offsets will remain as they were before the robot swap.
Auto Steer Offset adjustment	**Work \ Sensor \ Leapfrog \ Auto Steer**
	The Auto Steer button will shift **only** the position in the front and rear steer offsets by the difference between the existing deviation to the reference line and the new deviation to the reference line. The elevation offsets will remain as they were before the robot swap.
Manual Offset adjustment	No change is made to the Working Offsets. The operator must make any changes in the Offsets manually.

☞ For mainline and trimmer machines the offset value is applied directly to the prism East, Northing, Elevation values. These values can be removed by manually changing the Sensor Arrangement, or pressing the **RESET** button in Main Menu/Tools/Data Flow/Sensors/Primary or Secondary.

☞ For curb and gutter, milling and asphalt machines the leap frog corrections are applied by changing the users steering and elevation offsets. These corrections can be removed by altering the offset values to their original values.

2.11 Checking Instrument Setup Quality and Status

When to check?

Following survey best-practice is the key to maximum system accuracy with Leica PaveSmart 3D. Poorly positioned or orientated instruments may have a serious effect on product quality.

This procedure should be carried out regularly, ideally during breaks in machine operations, e.g. waiting for concrete, to ensure no undetected movement of the robots has occurred (e.g. due to excessive vibrations, bad sub-ground under the tripod, high wind, temperature cycling effects etc.). This is also very important when the instrument has been standing for a long time (e.g. › 2 hr) at the same setup.

TPS1200+ and Viva instruments

☞ **The fixpoint (reference point) job for the Robot setup is only stored on the instrument. During the Robot Setup process (Free Station/Resection or Known Point & Orientation) the user must preselect the desired Fixpoint Job in the MGuide application. Please refer to the MGuide User Manual for further information about working with Fixpoints.**

Using the Tiepoint Check function from the **Work** dialog press **SENSOR** and define the instrument with should be verified.

☞ Refer to the MGuide User Manual Chapter 5 for further details. TPS1200+ or Viva can only measure to the predefined point from the fixpoint job (see MGuide User Manual page 4-15). The horizontal-, distance- and height accuracy settings are also defined in the same TPS1200+ or Viva dialog.

Tiepoint Check
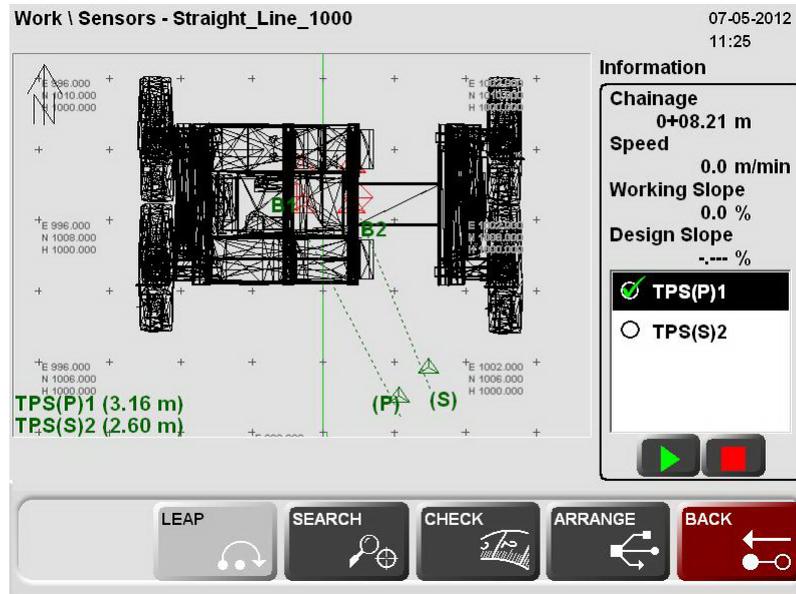
After the selection of the instrument press **CHECK**
Note: The Tiepoint Check can be only used with the robot which do support this function and not with GPS (GNSS Receivers).

Wait for the results to be displayed - this will take **several seconds** as the instrument turns to the required position and measures the prism. The instrument will then return to its previous position. The result is displayed after the robot measurement to the preselected fixpoint. If the result is within the tolerance the Correction is displayed with a green background colour.

☞ The TiePointCheck tolerances are set on the robot in the MGuide configuration section "Instruments".

Work \ Sensor \ TPS TiePointCheck - softroom   *Leica*

Sensor   TPS(Sp)5

Corrections   Distance = 0.056 m
                  Elevation = 0.111 m
                  Orientation = 0.009 m
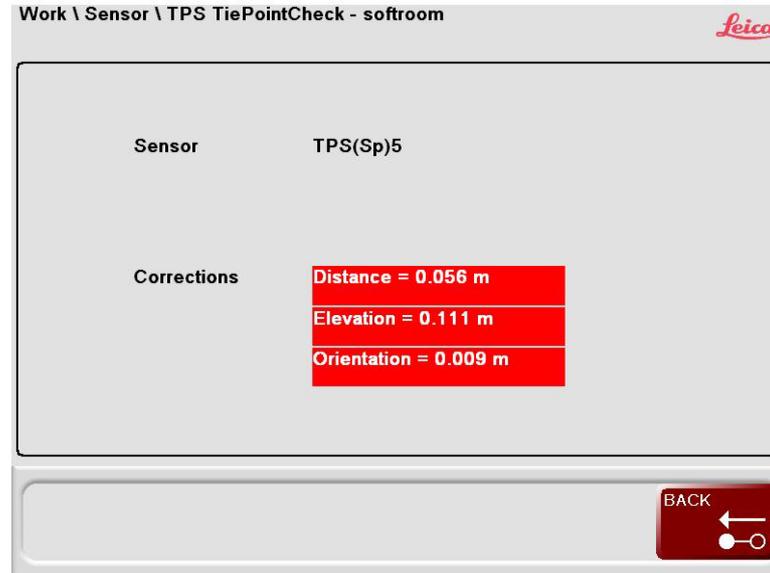
                                                          BACK

- If one predefined tolerance is **exceeded** the result of the Tiepoint Check is displayed with a red background colour.
- If the tolerance of one result is too large, a new setup of the robot is strongly recommended.
- If no measurement is possible, an error message will be displayed. Check the communication, the robot target line and the robot settings.

☞   Tie point check function is not available for all instruments.

Checking the Status of   In **Main Menu: Sensors \ GPS** the following status information is available:
GPS

The machine operator enters in the **‹Position Quality:›** the maximum value for the posi-
tion tolerance and in the **‹Height Quality:›** the maximum value for the height toler-
ance.**‹Heading Quality:›** the maximum value for the heading tolerance, only available
when the Advanced Heading (1Up) is defined and selected. As soon as these values are
exceeded, an error message is sent to the dashboard.

‹Firmware version› shows the current firmware version on the GPS sensor. The version is not available when using NMEA messages.

‹Timestamp›, the current GPS time is indicated here.

The number of satellites, which are theoretically available are listed in **‹#sats available›**. Out of these a certain number of satellites are sending data to the GPS receiver **‹#sats tracked›**.

‹HDOP›, **‹VDOP›** and **‹Status›** are geometrical values about the satellite constellation. From those values the **‹Pos Quality›** and the **‹Height Quality›** are calculated.

‹Easting:›, **‹Northing:›** and **‹Height:›** are the coordinates of the current sensor position. Depending on the GNSS receiver settings the Local Coordinates might not be displayed. For example when using the Advanced Heading (1Up) option. Refer to PaveSmart3D Technical Reference manuals for more details.

‹Heading Quality›, actual GNSS heading quality. Only available when the ORP message is defined and selected on the iCON GPS80 receiver.

PRIMARY and SECOND. are used to switch between the different sensors.

DEFAULT the **‹Position Quality›** and **‹Height Quality›** are set to the default values.

Benching for GPS   In the **Work\ Sensors** dialog, when you select a GPS sensor from the instrument list the
                              Bench button becomes active:

BENCH

open the following dialog:

By selecting the **‹Elevation Check Point: Right›** you have chosen the right side of the
milling head for the elevation check. Other options are: **‹Elevation Check Point: Center›**

and **‹Elevation Check Point: Left›**. The selected spot on the milling head is then measured or brought directly in relation to the control point hub.

The **‹Reference Point Elevation›** is manually entered by the operator.

MEASURE

the sensor starts measuring. This may take a few seconds as several measurements are taken during this time.

The **‹Measured Check Point Elevation›** is the current elevation of the milling head, measured with the GPS sensor.

The difference between the measurement and the reference point elevation is the **‹Current Sensor Elevation Offset›**.

CONTINUE

stores the current sensor elevation offset. From now on this offset is considered in the calculation until a new offset is determined with the Bench function again.

BACK

continues and rejects the currently determined offset. The previously used offset will be used again.

2.12	**Backup and Restore**

👉   ![Backup button] the Backup button is only active if PaveSmart 3D is in the Config level.

Creating a Backup

A PaveSmart 3D Backup contains all projects, all logfiles and all current software settings. It can be used to re-establish a certain state on the machine computer for trouble shooting purposes. The Backup is also very useful to check the current state for service purposes. For example the user can send a Backup to a Leica service engineer to help troubleshoot a problem.

NOTE: Leica strongly recommends a Backup be made at the end of each Production shift.

In the dialog **Main Menu: Projects \ Backup** the operator chooses **‹Backup›** to get to the following dialog:

MAIN MENU \ Projects \ Backup   *Leica*

Backup

Restore

CONFIRMATION:

All Config and Project data
will be Zipped and copied
to the specified Internal or
External Backup directory

OK?

CONTINUE   BACK
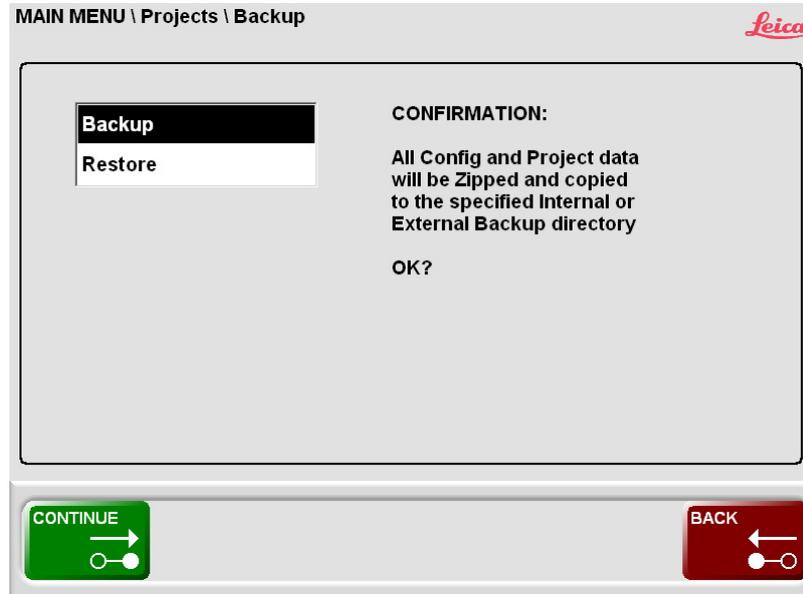
An **‹Internal›** Backup is stored on the local drive on the machine computer.
An **‹External›** Backup is stored on the external USB storage device.

To create a Backup may take up to a few minutes, depending on the amount of data that's stored on the machine computer. When finished a confirmation message will be shown. In this message the file name of the Backup zip-file is displayed.

Backup

Backup Zipfile made and copied to:
C:\ Program Files\ Leica Geosystems\
Leica PaveSmart 3D\ Backup\
P3D_2012-05-09_17-59-29.zip

OK

Restoring a Backup

In the **Main Menu \ Projects \ Backup** select **<Restore>** to open the following dialog:
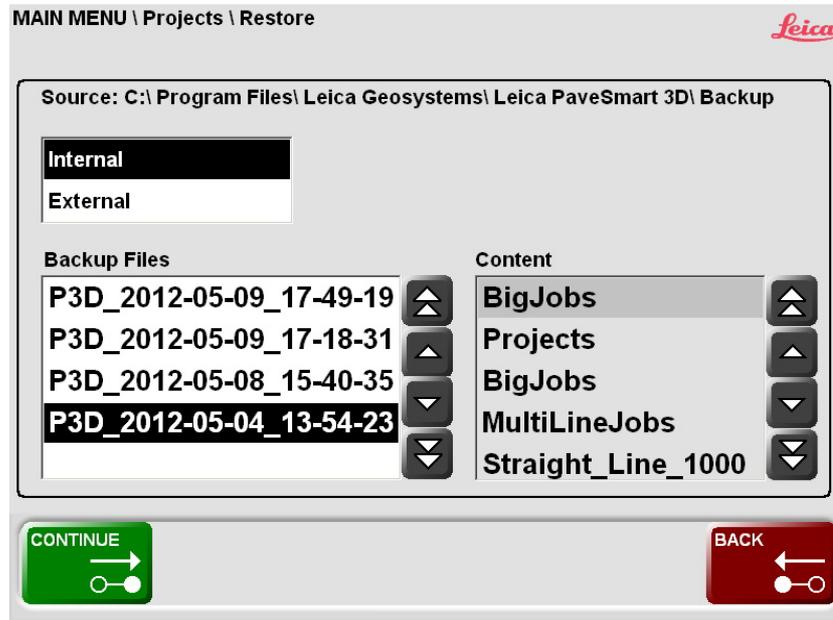
There are two sources for the restore process: **<Internal>** is the local storage on the machine computer and **<External>** is the external USB storage device.

The **<Backup Files>** of the selected source are shown in a list. The latest Backup is always on the top.

In the **<Content>** window all the projects of the currently selected Backup file are listed.

 restores the selected Backup and overwrites all projects, all logfiles and all current software settings. Before the current settings and data are over-written, an internal Backup is automatically done.

2.13 Stopping Work (End of Daily Production)

After Production
To Stop Tracking, press and hold Stop for one second.
The Stop button now displays **Exit**. Press and hold **Exit** for more than 1 second to display the Shutdown/Restart options dialog. Select **Shutdown** to exit PaveSmart 3D and power-off the MPC1310.

☞ **Never power off the MPC1310 by holding down the Power Key!** Always shut down the MPC1310 by using the Exit button to ensure all data are saved. Incorrect shutdown of the MPC1310 may risk unexpected data loss or corruption of the Windows system files!

After approx. 30 seconds when the MPC1310 display is black, turn off power.
Disconnect the power/data cables, radio cables.
Store all equipment in the MPC1310 carrycase.
Fit dust/water caps for machine-mounted connectors, where provided, to prevent rain or condensation build-up which may lead to electrical problems.

☞ Due to the risk of theft, lightning-strikes or vandalism, we strongly recommend removal of the radios, GPS and MPC1310 computer overnight.

⚠ **Warning**
If MPC1310, radios and cables are wet, only close the carry-case for a short period, while removing the equipment from the machine. It is **essential** to ensure the carry-case is left **open** overnight, to allow the equipment to dry out.

3   System Components, Diagrams, Software Description

3.1   Hardware Descriptions

General information   Even though the hardware components are designed for construction site conditions, the components have to be treated and transported in a careful manner. Therefore we strongly recommend use of the supplied packaging for transport and study the relevant documentation for cleaning and maintenance work (refer to "5 Care and Transport").

System hardware   The installed components on the machine comprise a Machine Computer with attached radio modem(s) to communicate with the robot(s), dual slope sensor, mast(s) with attached reflector or optional GPS antenna. As well as the installed components on the machine, Robot(s) with radio modem(s) need to be set up. In case of the GPS option without an available correction signal, a reference station setup is additionally required.

a) Reflector
b) GPS antenna
c) TCPS27S, TCPS29S or MCR-900 radio modem(s)
d) GPS sensor
e) Slope sensor
f) MPC1310
g) Robot(s) with radio modem(s)
h) GPS reference station
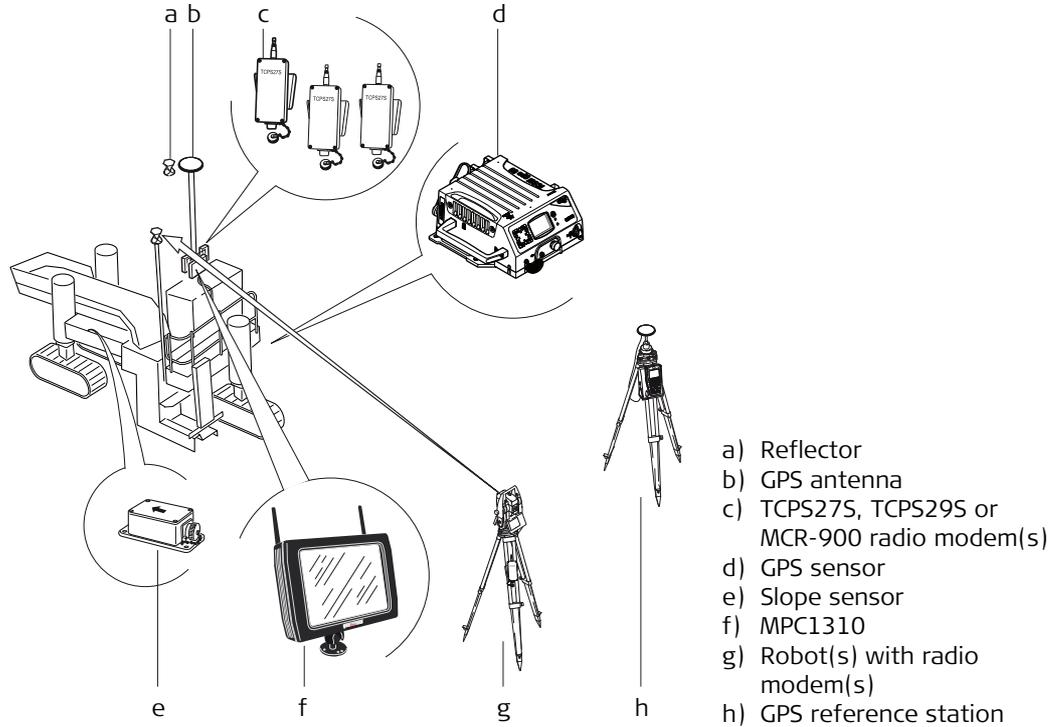
For further details on each component listed below, refer to the reference manual and/or the component-specific manuals.

Reflector

MPR122, 360° Reflector PRO, for machine automation.

GPS
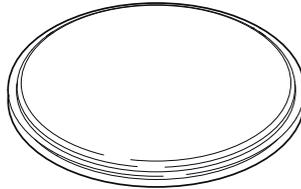
The MNA1202 GG antenna mounted on the secondary mast of the machine.

TCPS27S or TCPS29S Radio Modems
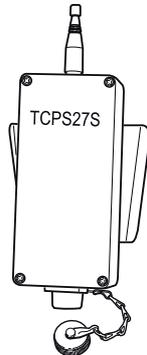
TCPS27S

Except North Americas, TCPS27S or TCPS29S radio modems with ITT Cannon connectors are used on the machine, and communicate with the TPS1200+ or Viva Radio Handle mounted on the instrument.
For further information, refer to the TCPS27/29 user manual.

GPS sensor
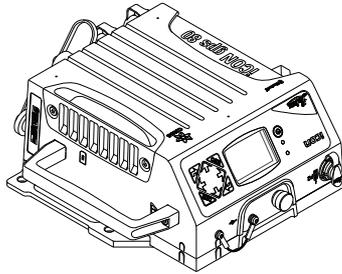
The GPS option supports the Leica iCON GPS80 series, MNS1230 or PowerBox receivers with power protection and mil-connectors.
For further information, refer to the Leica GPS user manual or the Leica GPS Machine Positioning user manual.

Slope sensor
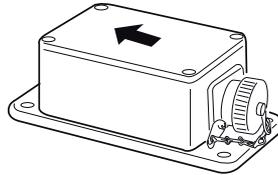
For all machines except mainline concrete pavers, one dual-axis slope sensor with a CAN interface is used. Mounted at the recommended position on the machine, and the arrow must always face the normal (forward) working direction.

Machine Computer

The MPC1310 is a ruggedised computer with Windows XP Embedded, touchscreen, milspec connectors for power, CAN, four serial (RS232) and USB interfaces. Bracket to mount Machine Computer for easy installation and removal at the end of the day, a power supply for office preparation, a carry-case and a USB CF-Card adapter are all supplied as part of the MPC1310 package.
For further information, refer to the MPC1310 user manual.

Robot(s)
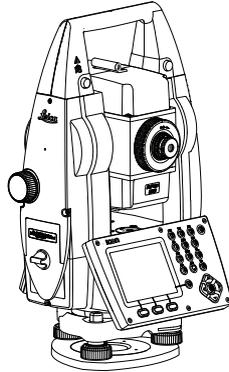
The system supports TPS1200+ and Viva Total Stations with the onboard software application MGuide and it supports the iCON Robot and Leica Captivate Total Stations with the onboard MC application. The radio modem is optionally integrated into the handle of the instrument.
For further information, refer to the instruments user manual.

Further Hardware

For further details on each component listed below, refer to the technical reference manual and/or the component-specific manuals.

3.2 System Wiring Diagrams

General information

The system wiring is dependent on the purchased/installed solution. The main installation is identical, only the serial port sensor combination may vary depending on the sensor equipment used. It is possible to attach up to four Robots (when linked to machines using CANBus interfaces) or up to 2 GPS sensors.

☞
- The MPC1310 must be mounted with the bracket supplied. The rear of the MPC1310 should be free from obstructions to allow sufficient cooling.
- Mast(s) must be fixed firmly to the frame of the machine so minimum vibration is experienced.
- Slope sensors must be mounted at the appropriate point of the machine with the arrow facing **forward in direction of production.**
  Use the machine-manufacturer-supplied slope sensor mounting bracket wherever possible.
- Where applicable: Alternatively to the TCPS27S or TCPS29S ruggedised radio modems, approved third party radio modems, such as MCR-900, with appropriate cables can be used. Refer to the Leica PaveSmart 3D Technical Reference Manual for machine-specific details.

1-Prism solution   The one prism solution uses one robot for continuous tracking of the machine. A second
                              optional robot can be attached for leapfrogging and/or as-built measurements.

☞   **The one prism solution can only be used with "one track steer" machines, such as
            Gomaco GT3200 series curb & gutter/offset paver, Wirtgen SP15, or PowerCurber
            5700 series offset pavers, or where the steer function rear track(s) of an all-track-
            steer machine are disabled (ensure to verify that track angle is perfectly parallel to
            the machine travel direction otherwise poor paving quality results!).**

a) Mast Position
   Primary prism (B1)
b) Direction of travel
c) Robot

System components for MOBA-matic or Wirtgen DLS/LevelPro equipped Road Paver and Milling machines:

a) MPC1310
b) TCPS29-S Radio modems
c) MCC 1301 Coiled Cable,COM1&2, TCPS2x-S.,6m
d) MSC1201 Straight Cable, 7S/7P CAN,3m
e) MJB1305 Junction Box, Paving
f) MOBAMatic Controller DLS v4.28
g) MCCS17, Coiled Cable Mach.(All Pins)/ MCCS18, Coiled cable (only Up/On) 3m
h) MJB15 Junction box left
i) Mast Slope Sensor
j) MCC1201,Coiled Cable CAN 7P, bayonet, 6m
k) MPR122 360° Reflector
l) MYC1307 Cable MPC-Generic CAN, 35cm
m) MSS24 3D Alarm box
n) MSC1201 Straight Cable,7S/7P CAN, 3m
o) MJB16 Junction box right
p) MMs8, MMatic Digi-Slope Sensor (CAN)

System components for Curb and Gutter/Offset paving machine:
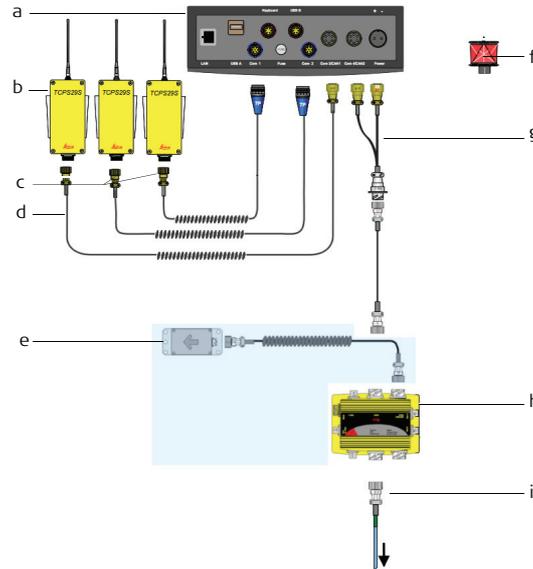
a) MPC1310
b) TCPS27S/29S radio modems
c) PWM cables for serial connection(s) to TCPS27S/29S
d) PWM cable for serial connection (COM3) to TCPS27S/29S
e) Dual-axis slope sensor
f) 360° Prism
g) Power/CAN connection
h) MJB1305 Junction box
i) Cable to machine, usually supplied by machine manufacturer as part of 3D Kit

System components for Trimmer machine:

a) MPC1310
b) TCPS27S/29S radio modems
c) PWM cables for serial connec-
tion(s) to TCPS27S/29S
d) Dual-axis slope sensor
e) MJB1305 Junction box
f) 360° Prism
g) Power/CAN connection
h) Cable to machine, usually
supplied by machine manu-
facturer as part of 3D Kit

1-GPS solution   The one GPS solution uses a single GPS sensor for continuous tracking of the machine. An optional robot can be attached for as-built measurements:
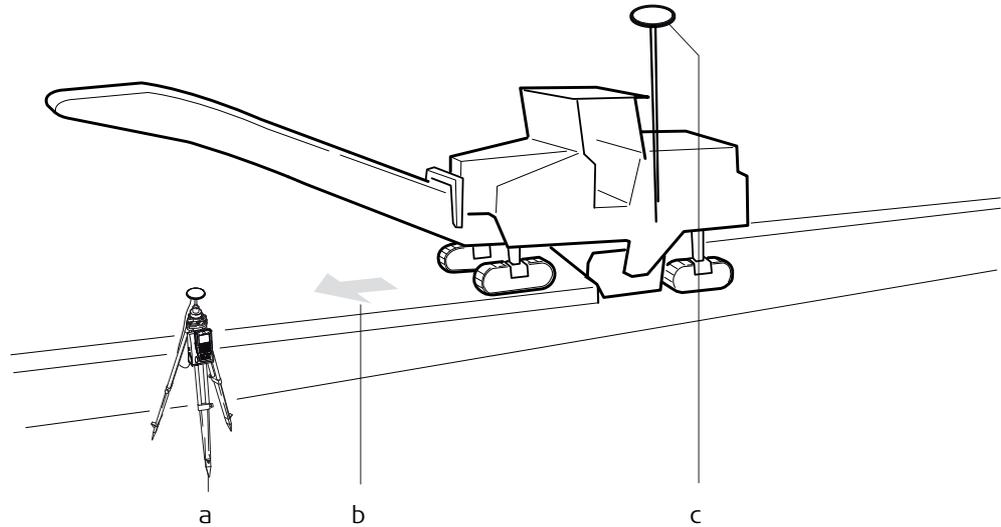
a) GPS reference station
b) Direction of travel
c) Mast Position GPS antenna Primary (B1)

System components for Wirtgen- or MOBA equipped milling machines:
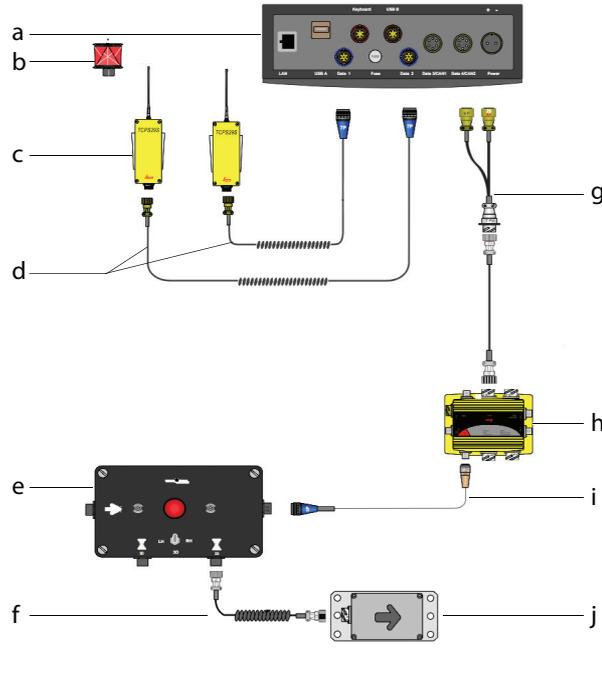
a) MPC1310
b) 360° Prism
c) TCPS27S/29S radio modems
d) PWM cable for serial connection to TCPS27S/29S
e) Alarm box
f) CAN cable to connect the Slope Sensor
g) Power/CAN connection
h) MJB1305 Junction box
i) CAN cable to connect Alarm box
j) Dual-axis slope sensor

The controls are normally an part of the machine. The components are connected directly to the standard (or optional) machine junction box and communication cables are connected by the machine's own CAN bus.

2-Prism solution   The two prism solution uses two robots for continuous tracking of the machine. A third optional robot can be attached for leapfrogging and/or as-built measurements.
For caterpillar-tracked Vögele roadpavers equipped with the latest NaviTronic system, this arrangement can also regulate automatic steering direction of the machine. Refer to Vögele for details of NaviTronic autosteer-compatible machines.

a) Mast position Primary reflector (B1)
b) Robot
c) Mast position Secondary reflector (B2)
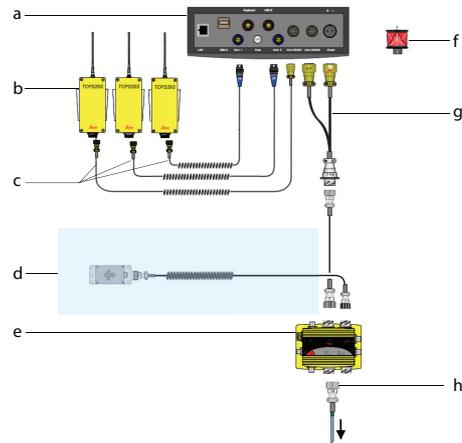d) Direction of travel
e) Robot
f) Spare robot (for as-built and leapfrog)
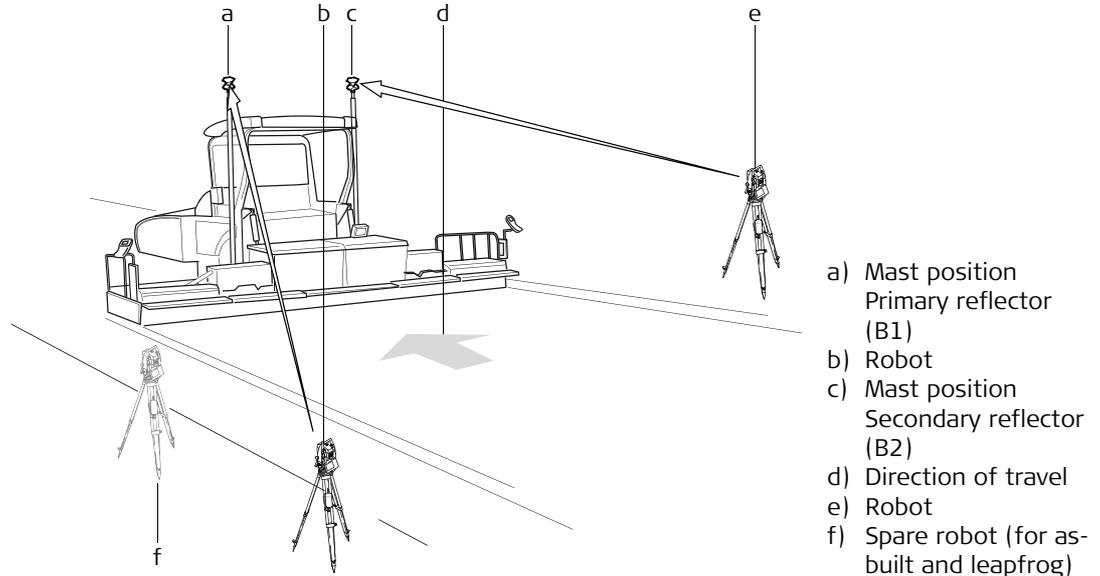
System components for Vögele Road Paver machine:
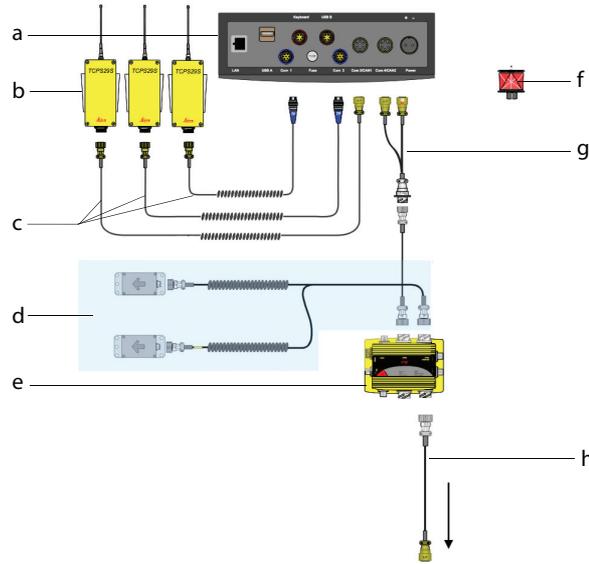
a) MPC1310
b) TCPS27S/29S radio modems
c) PWM cables for serial connec-
   tion(s) to TCPS27S/29S
d) Dual-axis slope sensor
e) MJB1305 Junction box
f) 360° Prism
g) Power/CAN Connection
h) Cable to machine

System Components for Mainline Paver:
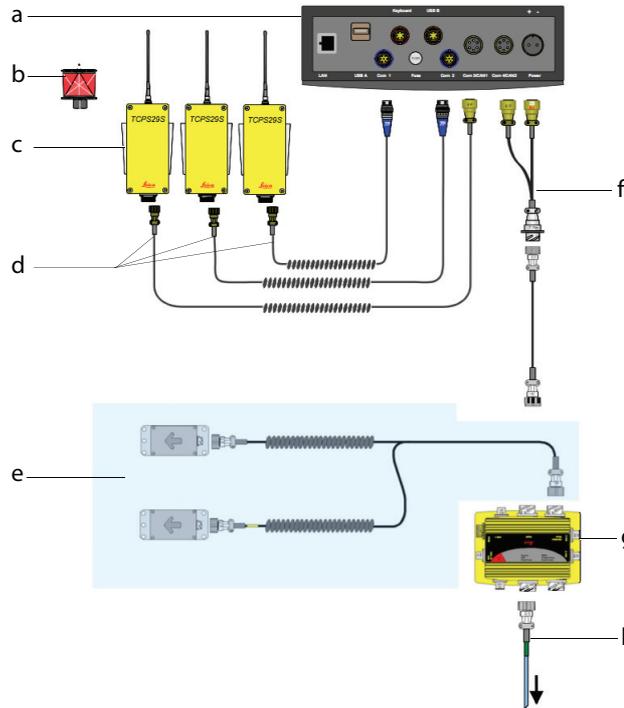
a) MPC1310
b) 360° Prism
c) TCPS27S/TCPS29S radio modems
d) PWM cables for serial connection(s) to TCPS27S/29S
e) Dual-axis slope sensors
f) Power/CAN connection
g) MJB1305 Junction box
h) Cable to machine

Robot+GPS solution   The GPS-Prism solution uses one robot and a GPS sensor for continuous tracking of the machine. A second optional robot can be attached for leapfrogging and/or as-built measurements:

a) Mast Position Primary Reflector (B1)
b) Mast Position GPS antenna Secondary (B2)
c) Direction of travel
d) GPS reference station
e) Robot (Primary)
f) Spare robot (for as-built and leapfrog)
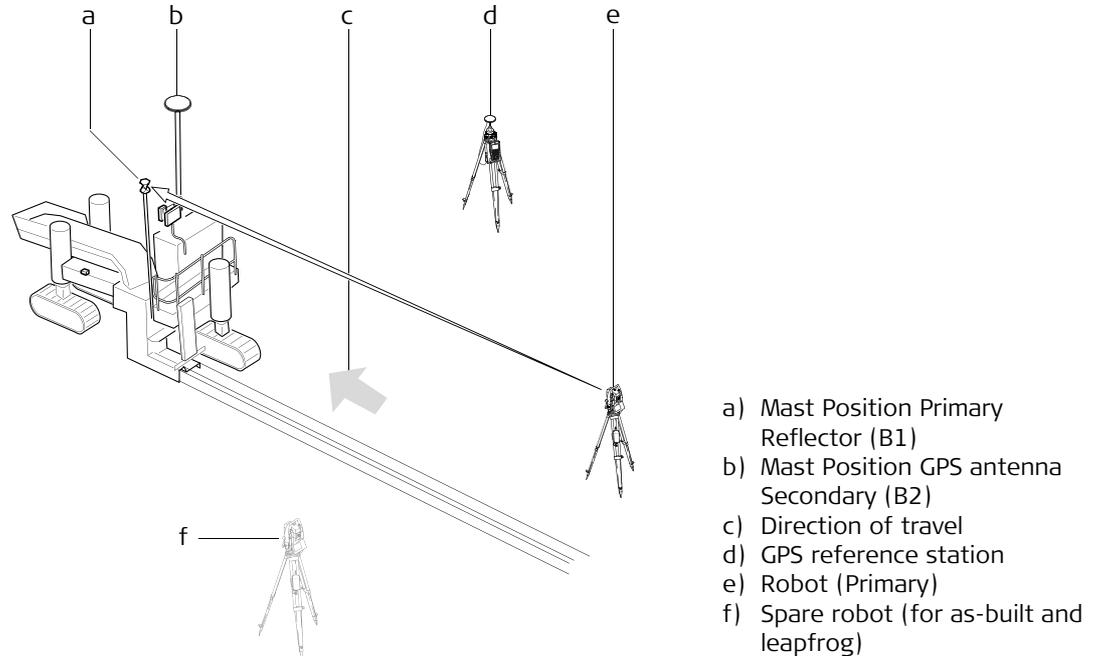
System components for Curb and Gutter machine:
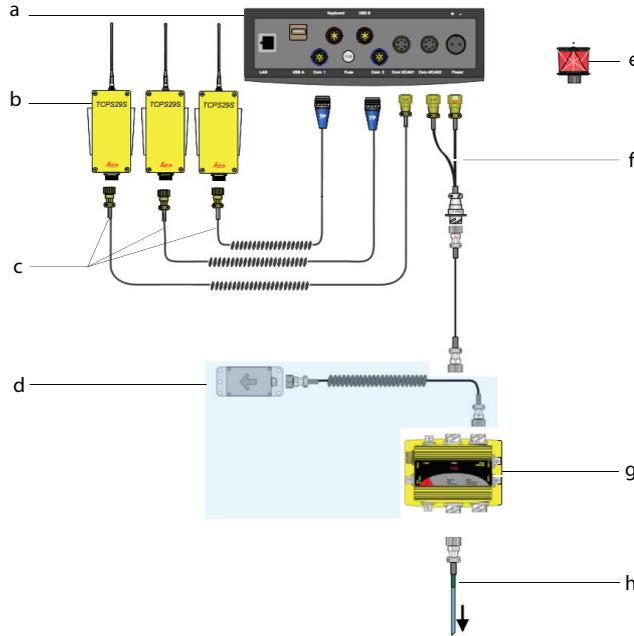
a) MPC1310
b) TCPS27S/29S radio modems
c) PWM cable for serial connec-
   tion to TCPS27S/29S
d) Dual-axis slope sensor
e) 360° Prism
f) Power/CAN connection
g) MJB1305 Junction box
h) Cable to machine

MPC1310
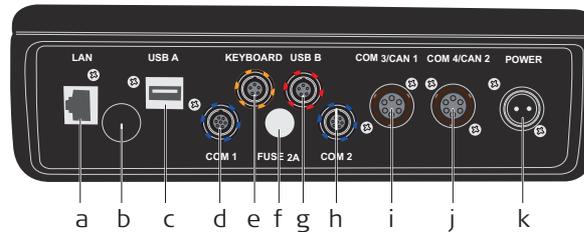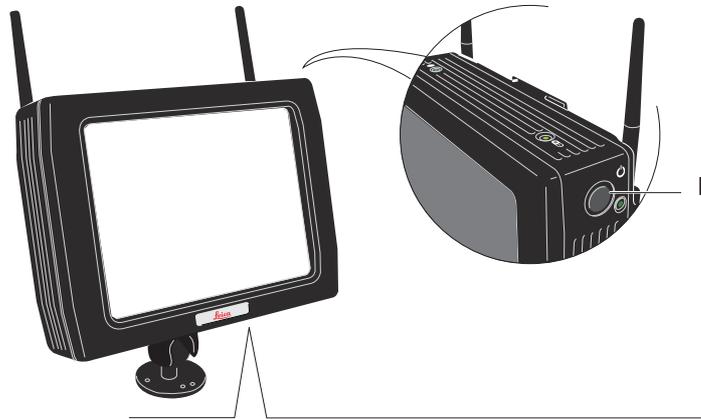
a) Ethernet connector
b) Ventilation cap
c) USB A Host connector
d) COM 1 serial port
e) Keyboard connector
f) 2A fuse for outgoing power
g) USB B Device connector
h) COM 2 serial port
i) COM 3 serial/CAN 1 port
j) COM 4 serial/CAN 2 port
k) Power connector
l) Power key

USB   USB connection supports Leica Geosystems USB storage device or standard USB keyboards supported by Windows XP Embedded only.

☞   Never remove the USB storage device until file read/write/copy operations are completed, as this may cause file loss or corruption.

☞   **Do not attach** any USB device which needs additional driver installation, as this may cause configuration corruption or installation problems.

System Components, Diagrams, Software Description

COM 1, 2, 3, 4	RS232 serial ports for Radio Modem connection to robot and connection to GPS sensor. Power output voltage: regulated +13.6 V
CAN 1, 2	CAN-bus ports.
POWER	Power in, 10-36 Volt DC, reverse polarity protected.
Power key	To turn On and Off the Machine Computer.
⚠ **Caution**	Never turn Off the Machine Computer without shutting down all running applications. This could result in unexpected data loss! **Precautions:** Black screen must be displayed after pressing the Shutdown button in Leica PaveSmart 3D software before switching the power off to the MPC1310.
KEYBOARD	Permits connection of external keyboards with compatible LEMO connectors. Contact Leica Geosystems for further information.

3.3　　　　　　　Software Description

General

PaveSmart 3D is a machine control application for paving and milling machines. The system software controls the steer-, elevation- and slope control loop of the machine.

The 3D design model is loaded onto the Machine Computer. The software compares the actual position of the machine with the design. The actual position is calculated with attached robot or GPS tracking data and the slope sensor(s) mounted on the machine. The calculated deviations are then according to the control parameters transformed into signals for the hydraulics, which are sent by CAN bus or serial port to the machine controller. Most supported machine controllers have a dedicated "3D Mode", therefore the sensitivities on the machine controller have to be deactivated or set to zero unless advised otherwise by a Leica Geosystems or machine manufacturer authorised support engineer.

Menu Structure

Password for configuration level
Default Config password = 007
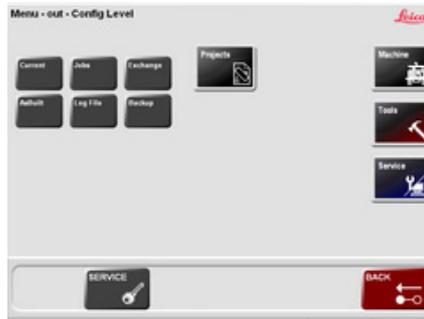
Menu in configuration level; all buttons accessible
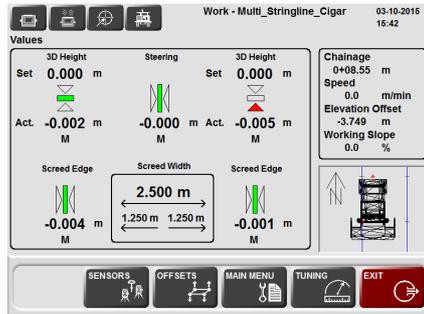
Work screen (Asphalt Paver Profile)

Dialogs   Refer to "2.2 Operating the MPC1310 Machine Computer" for more information about the Work and the Menu dialog.

4   Troubleshooting

Troubleshooting

Problem	Possible cause(s)	Suggested remedies
Computer does not boot or start up or keeps rebooting	Inadequate or missing power supply Power regulator failed Reversed power supply polarity	Check machine power supply, fuses and voltage regulator Check connections to the MPC1310
	Damaged Machine Computer	Contact Leica Geosystems
	Damaged power cable	Check all cables for damage
Leica PaveSmart 3D does not start	Auto-Start is not enabled Configuration corrupted	Restore Auto-Start link Copy backup from USB storage device
Configuration is lost or strange behaviour of Leica PaveSmart 3D	Configuration corrupted	Restore back up in the Projects menu
Robot fails to initialise	Communication parameters on instrument are not set correctly Baud rate is not identical on instrument and in the software	Choose appropriate Config Set (TCRP RCS-RH1200 or TCRP RCS-TCPS27) Green LED's on a radio modem pair need to be On
	Radio modems have not the same Link/baud rate configuration	Configure radio modems to the same Link/baud rate configuration
	• Low battery at instrument	• Instrument is in a configuration menu or in As-Built menu

Problem	Possible cause(s)	Suggested remedies
	• Radio interference or cabling damaged • MGuide is not installed • Low power at machine	• Install MGuide application and choose appropriate Config Set • Contact Leica Geosystems • Ensure that the radio handle is on the correct way with the lights facing the operator and the antenna facing the paver. • Turn on the paver as power supply may not be sufficient if the paver is not running
Robot does not react on commands	• MGuide application is in configuration mode • MGuide is in As-Built dialog • Auto-Shutdown at instrument	• Change to MGuide main menu • Solve instrument error message (refer to robot manual) • Unplug power cable and restart robot
GPS sensor is not initialised	• Communication parameters on sensor are not set correct • Baud rate is not identical on instrument and in the software	• Set correct Config Set on sensor • Check communication parameters on sensor • Contact Leica Geosystems
GPS position accuracy is bad	• Wrong transformation file loaded • No reference signal available • Bad satellite distribution • Not enough satellite available	• Check transformation file on sensor • Check reference signal • Contact Leica Geosystems • Check radio configuration between GPS and base station

Troubleshooting

Problem	Possible cause(s)	Suggested remedies
Leica PaveSmart 3D is not reacting to user input by touchscreen or keyboard	• Flash disk is full • System has crashed	• Remove unnecessary Jobs or log files • Reboot computer
Strange behaviour - machine lifts legs incorrectly and/or drives off steering line	• Slope sensor incorrectly orientated/adjusted • Robot incorrectly oriented • Machine not in Leica/Automatic mode • Hydraulic tuning not appropriate • Mold Adjust values may be required to compensate for poor mold/frame alignment	• Check installation and readjust slope sensor as required • Perform a Tiepoint check to verify robot orientation (if necessary new Resection) • Check Machine Controller: All control loops must be in automatic • Refer to Mold Adjust instructions in this Manual

Problem	Possible cause(s)	Suggested remedies
Strange steering behaviour when Leica PaveSmart 3D is sending correct values to machine	• Steering in Manual Mode on machine panel • Tracks/feedback pots incorrectly adjusted • Machine may be unable to overcome resistance from concrete or sideplates have become embedded in the ground, causing the machine to twist • Hydraulic hose connections to steering may be incorrect (reversed)	• Set Steer for each Leg into Automatic • Check and readjust machine steering as required • Adjust Working Offsets, and/or Mold Adjust values; check sideplates are not in heavy contact with ground • Check that hydraulic hose connections are correct, using manual steer controls on the operator console
Nervous over-reactive steering behaviour	• Steering Sensitivity too high	• Set Steer Sensitivity to Minimum on machine panel • Adjust steer tuning parameters

Problem	Possible cause(s)	Suggested remedies
System starts Tracking, but no deviations are displayed on screen and dashboard blinks	• System has detected a problem and stops for safety • Wrong prism targeted or wrong moving prism as-signed to robot • Wrong reference line of Job activated in Design dialog • Machine is outside the limits of the project	• Check dashboard message • Target correct prism and reassign prism to robot (B#, only with two prism solution) • Perform a Tiepoint check to verify robot orientation (if necessary new Resection) • Check loaded Job and assigned reference line • Drive the machine within the design extents manually
Dashboard blinks red continuously	• Tolerances exceeded	• Press appropriate dashboard button and check error message
Machine stops, all deviations are shown as "-" or error	• Wrong Job or reference line is loaded in the Job dialog • Machine is out of project	• Check in the Job dialog to see which design is selected • Check that the selected Reference Line is correct • Check Offsets
System is tracking OK but machine does not move	• Stop Rule is active and machine is outside of the defined tolerance range	• In Pro Deactivate Stop rule and drive machine to design position • As a short-term measure, deviation can be reduced with the offset and the machine driven to the design position • Care must be taken to re set stop rules

Problem	Possible cause(s)	Suggested remedies
Position offsets are wrong	• Wrong Job or reference line is chosen • Offsets are wrong	• Check the chosen Job in the Job dialog • Check the chosen reference line • Check the steering offsets
Slopes and elevations become gradually imprecise while paving	• After paving for a long period the geometry of the machine may change (mold settles, wear and tear, vibration etc.) • Instrument adjustment drift	• Check and readjust mold slope sensor regularly • Readjust robot(s)
No log files saved	• Disk space full • Log files have not been properly activated	• Delete unnecessary data in the Manage dialog
Strange behaviour - wrong machine parameters saved	• System crashed (power supply)	• Close system. Restore the configuration settings.
Machine starts to undulate during paving	• Too much head of concrete, asphalt or subgrade in front of machine • Hydraulic lift pressure incorrect	• Reduce head of material, refer to machine manual, check hydraulic system

Problem	Possible cause(s)	Suggested remedies
Machine height is controlled in wrong direction e.g. correction up -> machine goes down and vice versa	• Hydraulic tuning parameters incorrect • Slope sensor mounted in the wrong direction	• Contact Leica Geosystems • Reset the default tuning parameter in elevation and Steer. Retune machine before paving
Robot or GPS Battery does not hold charge	• Battery has previously only been partially discharged before recharging • Suffering from memory effect	• Refer to the charger manual for discharge/recharge cycle instructions

5   Care and Transport

5.1   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 to avoid unintended damage and/or instrument(s) going out of adjustment.

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.

5.2   Storage

Product   Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to the "7 Technical Data" chapter for information about temperate limits for each component. This information may be contained in the component-specific manual.
It is always recommended to store the MPC1310 and robots in their supplied cases, protected against influences of the weather during longer working breaks (for example: overnight, at weekends).

5.3 Cleaning and Drying

General

Blow all dust off. Use only 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.

Damp products

Dry the product, the transport container, the foam inserts and the accessories at a temperature not greater than 40 °C / 108 °F and clean them. Do not repack until everything is completely dry.

⚠ Warning

Never leave wet components in a sealed carry-case for extended periods of time - for example overnight. Always leave the carry-cases open overnight in a warm location, to allow moisture to evaporate fully before resealing carry cases.

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 completely dry before attaching the dust cap.

5.4 Maintenance

Control measurements

During paving, milling or trimming, control measurements must be made regularly to determine possible changes in the machine geometry or in the sensors. Accuracy is influenced by jobsite conditions such as temperature, visibility and material consistency and can be adjusted through offsets.

6 Safety Directions

6.1 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.

6.2 Intended Use

Permitted use

- Guidance of construction machines by means of the position signals (The subordinated machine control system has to provide all safety functions. This machine control system has to be checked prior to placing it into operation).
- Contact-free determination of the position of construction machines
- Computation and evaluation of data by means of software
- Visualisation of the data
- Recording of data

Reasonable foreseeable misuse

- 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 recognisable damages or defects.

- Use with accessories from other manufacturers without the prior explicit approval of Leica Geosystems.
- Inadequate safeguards at the surveying/working site, for example when measuring 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.

6.3   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.

6.4	**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 safety regulations relating to accident prevention.
• To inform Leica Geosystems immediately if the equipment becomes unsafe.
• To ensure that the national laws, regulations and conditions for the operation of radio transmitters are respected.

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

6.5 Software Licence Agreement

International Warranty

The International Warranty can be downloaded from the Leica Geosystems home page at http://www.leica-geosystems.com/internationalwarranty or received from your Leica Geosystems dealer.

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 pursuant to prior authorisation from Leica Geosystems. Such software is protected by copyright and other laws and its use is defined and regulated by the Leica Geosystems Software Licence Agreement, which covers aspects such as, but not limited to, Scope of the Licence, Warranty, Intellectual Property Rights, Limitation of Liability, Exclusion of other Assurances, Governing Law and Place of Jurisdiction. Please make sure, that at any time you fully comply with the terms and conditions of the Leica Geosystems Software Licence Agreement.

Such agreement is provided together with all products and can also be found at the Leica Geosystems home page at http://www.leica-geosystems.com/swlicense or your Leica Geosystems dealer.

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

6.6   **Microsoft End User License Agreement ("EULA")**

END USER LICENSE AGREEMENT FOR MICROSOFT EMBEDDED SYSTEMS

- You have acquired a device ("DEVICE") that includes software licensed by Leica Geosystems from Microsoft Licensing, GP or its affiliates ("MS"). Those installed software products of MS origin, as well as associated media, printed materials, and "online" or electronic documentation ("SOFTWARE") are protected by international intellectual property laws and treaties. The SOFTWARE is licensed, not sold. All rights reserved.
- IF YOU DO NOT AGREE TO THIS END USER LICENSE AGREEMENT ("EULA"), DO NOT USE THE DEVICE OR COPY THE SOFTWARE. INSTEAD, PROMPTLY CONTACT LEICA GEOSYSTEMS FOR INSTRUCTIONS ON RETURN OF THE UNUSED DEVICE(S) FOR A REFUND. **ANY USE OF THE SOFTWARE, INCLUDING BUT NOT LIMITED TO USE ON THE DEVICE, WILL CONSTITUTE YOUR AGREEMENT TO THIS EULA (OR RATIFICATION OF ANY PREVIOUS CONSENT)**.
- GRANT OF SOFTWARE LICENSE. This EULA grants you the following license:
  - You may use the SOFTWARE only on the DEVICE.
  - **NOT FAULT TOLERANT**. THE SOFTWARE IS NOT FAULT TOLERANT. LEICA GEOSYSTEMS HAS INDEPENDENTLY DETERMINED HOW TO USE THE SOFTWARE IN THE DEVICE, AND MS HAS RELIED UPON LEICA GEOSYSTEMS TO CONDUCT SUFFICIENT TESTING TO DETERMINE THAT THE SOFTWARE IS SUITABLE FOR SUCH USE.
  - **NO WARRANTIES FOR THE SOFTWARE.** THE SOFTWARE is provided "AS IS" and with all faults. THE ENTIRE RISK AS TO SATISFACTORY QUALITY, PERFORMANCE, ACCURACY, AND EFFORT (INCLUDING LACK OF NEGLICENCE) IS WITH YOU. ALSO, THERE IS NO WARRANTY AGAINST INTERFERENCE WITH YOUR ENJOYMENT OF THE SOFTWARE OR AGAINST INFRINGEMENT. **IF YOU HAVE RECEIVED ANY WARRANTIES REGARDING THE DEVICE OR THE SOFTWARE, THOUSE WARRANTIES DO NOT ORIGINATE FROM, AND ARE NOT BINDING ON, MS.**
  - No Liability for Certain Damages. **EXCEPT AS PROHIBITED BY LAW, MS SHALL HAVE NO LIABILITY FOR ANY INDIRECT, SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES ARISING FROM OR IN CONNECTION WITH THE USE OR PERFORMANCE**

OF THE SOFTWARE. THIS LIMITATION SHALL APPLY EVEN IF ANY REMEDY FAILS OF ITS ESSENTIAL PURPOSE, IN NO EVENT SHALL MS BE LIABILE FOR ANY AMOUNT IN EXCESS OF U.S. TWO HUNDRED FIFTY DOLLARS (U.S.$250.00).

- **Limitations on Reverse Engineering, Decompilation, and Disassembly.** You may not reverse engineer, decompile, or disassemble the SOFTWARE, except and only to the extent that such activity is expressly permitted by applicable law notwithstanding this limitation.
- **SOFTWARE TRANSFER ALLOWED BUT WITH RESTRICTIONS.** You may permanently transfer rights under this EULA only as part of a permanent sale or transfer of the Device, and only if the recipient agrees to this EULA. If the SOFTWARE is an upgrade, any transfer must also include all prior versions of the SOFTWARE.
- **EXPORT RESTRICTIONS.** You acknowledge that SOFTWARE is subject to U.S. export jurisdiction. You agree to comply with all applicable international and national laws that apply to the SOFTWARE, including the U.S. Export Administration Regulations, as well as end-user, end-use and destination restrictions issued by U.S. and other governments. For additional information, see http://www.microsoft.com/exporting/.

PRODUCT SPECIFIC TERMS

- **RESTRICTED FUNCTIONALITY**. You are licensed to use the SOFTWARE to provide only the limited functionality (specific tasks or processes) for which the DEVICE has been designed and marketed by Leica Geosystems. This license specifically prohibits any other use of the SOFTWARE programs or functions, or inclusion of additional software programs or functions that do not directly support the limited functionality on the DEVICE.

  a) Notwithstanding the foregoing, you may install or enable on the DEVICE systems utilities, resource management or similar software (including without limitation anti-virus software) (collectively, "Support Software") solely for the purpose of administration, performance enhancement and/or preventive maintenance of the DEVICE. You acknowledge and agree that with respect to any Support Software: (i) the Support Software may not be compatible with the SOFTWARE installed on your DEVICE; (ii) no warranty is provided by MS, Microsoft Corporation or their affiliates for any Support Software that you may install on your DEVICE; and (iii) neither MS, Microsoft Corporation nor their affiliates is responsible for technical support of any Support Software you may install on your DEVICE. Please contact Leica Geosystems if you have any questions regarding any Support Software that you are considering installing on your DEVICE.

  b) The DEVICE may use terminal services protocols (such as Remote Desktop Protocol, Remote Assistance or Independent Computer Architecture) to connect or access Applications (as defined below) running on a server; however, these Applications may not run locally on the DEVICE. For purposes of this provision, "Applications" mean software that provides any of the following functionality: consumer or business tasks or processes performed by a computer or computing device, including email, word processing, spreadsheets, database, scheduling, or personal finance.

- **DEVICE CONNECTIONS**. The SOFTWARE may not be used by more than two (2) processors at any one time on the DEVICE. You may permit a maximum of ten (10) computers or other electronic devices to connect by Server Message Block (SMB) to the DEVICE to utilise one or more of the following services of the SOFTWARE: (a) file services, print services, (b) Internet information services and/or (c) remote access (including connection

sharing). The ten connection maximum includes any indirect connections made through "multiplexing" or other software or hardware which pools or aggregates connections. This ten connection maximum does not apply to other uses of the SOFTWARE. Unlimited simultaneous inbound connections are permitted by TCP/IP.

- **CLIENT ACCESS LICENSES**. If you use the DEVICE to access or utilise the services or functionality of Microsoft Windows Server products (such as Microsoft Windows Server 2003), or use the DEVICE to permit workstation or computing devices to access or utilise the services or functionality of Microsoft Windows Server products, you may be required to obtain a Client Access License for the DEVICE and/or each such workstation or computing device. Please refer to the end-user license agreement for your Microsoft Windows Server product for additional information.

- **REMOTE DESKTOP FEATURES/NETMEETING/REMOTE ASSISTANCE**. The SOFTWARE may contain NetMeeting, Remote Assistance, and Remote Desktop technologies that enable the SOFTWARE or other applications installed on the DEVICE to be used remotely between two or more computing devices, even if the SOFTWARE or application is installed on only one DEVICE. You may use NetMeeting, Remote Assistance, and Remote Desktop with all Microsoft products; provided however, use of these technologies with certain Microsoft products may require an additional license. For both Microsoft products and non-Microsoft products, you should consult the license agreement accompanying the applicable product or contact the applicable licensor to determine whether use of NetMeeting, Remote Assistance, or Remote Desktop is permitted without an additional license.

- **REMOTE BOOT FEATURE**. Your DEVICE may be enabled with a Remote Boot feature which includes the Remote Boot Installation Service tool. You may (i) use the Remote Boot Installation Service tool to install one (1) copy of the SOFTWARE onto your server solely for the purpose of deploying the SOFTWARE to one or more DEVICEs on which you

are licensed to run the SOFTWARE (i.e. DEVICEs to which the appropriate Certificate of Authenticity is affixed)); (ii) download the SOFTWARE over your internal network only onto such licensed DEVICEs; and (iii) use the Remote Boot Installation Service only for deployment of the SOFTWARE to licensed DEVICEs as part of the Remote Boot process. Please refer to the DEVICE documentation, if provided with your DEVICE, or contact Leica Geosystems for additional information.

- **AUTOMATIC INTERNET-BASED SERVICES**. The SOFTWARE features described below are enabled by default to connect by the Internet to Microsoft computer systems automatically, without separate notice to you. You consent to the operation of these features, unless you choose to switch them off or not use them. Microsoft does not use these features to collect any information that will be used to identify you or contact you. For more information about these features, please see the privacy statement at http://go.microsoft.com/fwlink/?LinkId=25243
  - **Web Content Features**. Under the SOFTWARE's default configuration, if you are connected to the Internet, several features of the SOFTWARE are enabled by default to retrieve content from Microsoft computer systems and display it to you. When you activate such a feature, it uses standard Internet protocols, which transmit the type of operating system, browser and language code of your DEVICE to the Microsoft computer system so that the content can be viewed properly from your DEVICE. These features only operate when you activate them, and you may choose to switch them off or not use them. Examples of these features include Windows Catalog, Search Assistant, and the Headlines and Search features of Help and Support Center.
  - **Digital Certificates**. The SOFTWARE uses digital certificates based on the x.509 standard. These digital certificates confirm the identity of Internet users sending x.509 standard encrypted information. The SOFTWARE retrieves certificates and updates certificate revocation lists. These security features operate only when you use the Internet.

- **Auto Root Update**. The Auto Root Update feature updates the list of trusted certificate authorities. You can switch off the Auto Root Update feature.
- **Windows Media Player**. Some features of Windows Media Player automatically contact Microsoft computer systems if you use Windows Media Player or specific features of it: features that (A) check for new codecs if your DEVICE does not have the correct ones for content you attempt to play (this feature may be switched off), and (B) check for new versions of Windows Media Player (this feature will operate only when you are using Windows Media Player).
- **Windows Media Digital Rights Management**. Content providers are using the digital rights management technology for Windows Media contained in this SOFTWARE ("WM-DRM") to protect the integrity of their content ("Secure Content") so that their intellectual property, including copyright, in such content is not misappropriated. Portions of this SOFTWARE and third-party applications such as media players use WM-DRM to play Secure Content ("WM-DRM Software"). If the WM-DRM Software's security has been compromised, owners of Secure Content ("Secure Content Owners") may request that Microsoft revoke the WM-DRM Software's right to copy, display and/or play Secure Content. Revocation does not alter the WM-DRM Software's ability to play unprotected content. A list of revoked WM-DRM Software is sent to your DEVICE whenever you download a license for Secure Content from the Internet. Microsoft may, in conjunction with such license, also download revocation lists onto your DEVICE on behalf of Secure Content Owners. Secure Content Owners may also require you to upgrade some of the WM-DRM components in this SOFTWARE ("WMDRM Upgrades") before accessing their content. When you attempt to play such content, WM-DRM Software built by Microsoft will notify you that a WM-DRM Upgrade is required and then ask for your consent before the WM-DRM Upgrade is downloaded. WMDRM Software built by third parties may do the same. If you decline the upgrade, you will not be able to access content that requires the WM-DRM Upgrade; however, you will still be able to access unprotected content and Secure Content that does not require the upgrade. WM-DRM features that access the Internet, such as acquiring new licenses

and/or performing a required WM-DRM Upgrade, can be switched off. When these features are switched off, you will still be able to play Secure Content if you have a valid license for such content already stored on your DEVICE.

- **WINDOWS UPDATE AGENT (ALSO KNOWN AS SOFTWARE UPDATE SERVICES)**. If the SOFTWARE includes Windows Update Agent ("WUA") (also known as Software Update Services) functionality that may enable your DEVICE to connect to and access updates ("Windows Updates") from a server installed with the required server component then the following conditions apply:
  - Without limiting any other disclaimer in this EULA, or any EULA accompanying a Windows Update, you acknowledge and agree that no warranty is provided by MS, Microsoft Corporation or their affiliates with respect to any Windows Update that you install or attempt to install on your DEVICE;
  - In addition, you acknowledge and accept that (i) Windows Updates may not be necessary or suitable for installation on or use with your DEVICE or the SOFTWARE, and (ii) if installed or attempted to be installed on your DEVICE, Windows Updates may not function on the DEVICE or may malfunction and/or cause harm to the DEVICE, to operators of the DEVICE or to other persons or property. If you connect to a server that installs a Windows Update, you agree that you assume all risk and liability with regard to any Windows Update that you install or attempt to install on your DEVICE using functionality provided by SOFTWARE. You further agree that neither MS, Microsoft Corporation nor their affiliates have any liability to you with respect to any Windows Update that you install or attempt to install on your DEVICE; and
  - Leica Geosystems is solely responsible for providing technical support, if any, to you in connection with your installation of Windows Updates installed on your DEVICE using WUA functionality provided by the SOFTWARE. Please contact Leica Geosystems if you have any questions regarding any Windows Update that you are considering installing on your DEVICE or otherwise regarding the WUA functionality.

NOTICES REGARDING THE MPEG-4 VISUAL STANDARD. The SOFTWARE may include MPEG-4 visual decoding technology. This technology is a format for data compression of video information. For this technology, MPEG LA, L.L.C. requires this notice:

> "USE OF THIS PRODUCT IN ANY MANNER THAT COMPLIES WITH THE MPEG-4 VISUAL STANDARD IS PROHIBITED, EXCEPT FOR USE DIRECTLY RELATED TO (A) DATA OR INFORMATION (i) GENERATED BY AND OBTAINED WITHOUT CHARGE FROM A CONSUMER NOT THEREBY ENGAGED IN A BUSINESS ENTERPRISE, AND (ii) FOR PERSONAL USE ONLY; AND (B) OTHER USES SPECIFICALLY AND SEPA-RATELY LICENSED BY MPEG LA, L.L.C.

If you have questions regarding this notice, please contact MPEG LA, L.L.C., 250 Steele Street, Suite 300, Denver, Colorado 80206; Telephone 303 331.1880; FAX 303 331.1879; www.mpegla.com."

GENERAL TERMS

- **PRODUCT SUPPORT**. Product support for the SOFTWARE is not provided by MS, Microsoft Corporation or their affiliates. For product support, please refer to Leica Geosystems support number provided in the documentation for the DEVICE. Should you have any questions concerning this EULA, or if you desire to contact Leica Geosystems for any other reason, please refer to the address provided in the documentation for the DEVICE.

- **END USER PROOF OF LICENSE**. If you acquired the SOFTWARE installed on the DEVICE, or on a compact disc or other media, a genuine Microsoft "Proof of License"/Certificate of Authenticity label with a genuine copy of the SOFTWARE identifies a licensed copy of the SOFTWARE. To be valid, the label must be affixed to the DEVICE, or appear on Leica Geosystems' software packaging. If you receive the label separately other than from the Leica Geosystems it is invalid. You should keep the label on the DEVICE or packaging to prove that you are licensed to use the SOFTWARE. This End User License Agreement ("EULA") is valid and grants the end-user rights ONLY if the SOFTWARE is genuine and a genuine Certificate of Authenticity for the SOFTWARE is included. For more information on identifying whether your SOFTWARE is genuine, please see http://www.micro-soft.com/piracy/howtotell.

- **BACKUP COPY**. You may make one (1) backup copy of the SOFTWARE. You may use this backup copy solely for your archival purposes and to reinstall the SOFTWARE on the DEVICE. Except as expressly provided in this EULA or by local law, you may not otherwise make copies of the SOFTWARE, including the printed materials accompanying the SOFT-WARE. You may not loan, rent, lend or otherwise transfer the backup copy to another user.
- **RESTRICTED USE**. The SOFTWARE is not designed or intended for use or resale in hazardous environments requiring fail-safe performance, such as in the operation of nuclear facilities, aircraft navigation or communication systems, air traffic control, or other devices or systems in which a malfunction of the SOFTWARE would result in foreseeable risk of injury or death to the operator of the device or system, or to others.
- **NO RENTAL/COMMERCIAL HOSTING**. You may not rent, lease, lend or provide commercial hosting services with the SOFTWARE to others.
- **SEPARATION OF COMPONENTS**. The SOFTWARE is licensed as a single product. Its component parts may not be separated for use on more than one device computer.
- **CONSENT TO USE OF DATA**. You agree that MS, Microsoft Corporation and their affiliates may collect and use technical information gathered in any manner as part of product support services related to the SOFTWARE. MS, Microsoft Corporation and their affiliates may use this information solely to improve their products or to provide customised services or technologies to you. MS, Microsoft Corporation and their affiliates may disclose this information to others, but not in a form that personally identifies you.
- **INTERNET GAMING/UPDATE FEATURES**. If the SOFTWARE provides, and you choose to utilise, the Internet gaming or update features within the SOFTWARE, it is necessary to use certain computer system, hardware, and software information to implement the features. By using these features, you explicitly authorise MS, Microsoft Corporation, their affiliates and/or their designated agent to use this information solely to improve their products or to provide customised services or technologies to you. MS, Microsoft Corporation or their affiliates may disclose this information to others, but not in a form that personally identifies you.

- **TRADEMARKS**. This EULA does not grant you any rights in connection with any trademarks or service marks of Leica Geosystems, MS Microsoft Corporation or their affiliates and suppliers.
- **LINKS TO THIRD PARTY SITES**. You may link to third-party sites through the use of the SOFTWARE. The third-party sites are not under the control of MS, Microsoft Corporation or their affiliates. Neither MS, Microsoft Corporation nor their affiliates is responsible for contents of any third-party sites, any links contained in third-party sites, or any changes or updates to third-party sites, or any changes or updates to third-party sites. Neither MS, Microsoft Corporation nor their affiliates is responsible for webcasting or any other form of transmission received from any third-party sites. MS, Microsoft Corporation or their affiliates are providing these links to third-party sites to you only as a convenience, and the inclusion of any link does not imply an endorsement by MS, Microsoft Corporation or their affiliates of the third-party site.
- **ADDITIONAL SOFTWARE/SERVICES**. This EULA applies to updates, supplements, add on components, product support services, or Internet-based services components ("Supplemental Components"), of the SOFTWARE that you may obtain from Leica Geosystems, MS, Microsoft Corporation or their affiliates after the date you obtain your initial copy of the SOFTWARE, unless you accept updated terms or another agreement governs. If other terms are not provided along with such Supplemental Components and the Supplemental Components are provided to you by MS, Microsoft Corporation or their affiliates then you will be licensed by such entity under the same terms and conditions of this EULA, except that (i) MS, Microsoft Corporation or their affiliates providing the Supplemental Components will be the licensor with respect to such Supplemental Components in lieu of the "COMPANY" for the purposes of the EULA, and (ii) TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, THE SUPPLEMENTAL COMPONENTS AND ANY (IF ANY) SUPPORT SERVICES RELATED TO THE SUPPLEMENTAL COMPONENTS ARE PROVIDED AS IS AND WITH ALL FAULTS. ALL OTHER DISCLAIMERS, LIMITATION OF DAMAGES, AND SPECIAL PROVISIONS PROVIDED HEREIN AND/OR OTHERWISE WITH THE SOFTWARE SHALL APPLY TO SUCH SUPPLEMENTAL COMPONENTS. MS, Microsoft Corporation or their affiliates reserve

the right to discontinue any Internet-based services provided to you or made available to you through the use of the SOFTWARE.

• **RECOVERY MEDIA**. If SOFTWARE is provided by Leica Geosystems on separate media and labelled "Recovery Media" you may use the Recovery Media solely to restore or reinstall the SOFTWARE originally installed on the DEVICE.

• **TERMINATION**. Without prejudice to any other rights, Leica Geosystems or MS may terminate this EULA if you fail to comply with the terms and conditions of this EULA. In such event, you must destroy all copies of the SOFTWARE and all of its component parts.

• **NOTICE REGARDING SECURITY**. To help protect against breaches of security and malicious software, periodically back up your data and system information, use security features such as firewalls, and install and use security updates.

6.7　Hazards of Use

⚠ **Warning**

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

Precautions:

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

⚠ **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 adjustment indicated in the user manual, particularly after the product has been subjected to abnormal use and before and after important measurements.

⚠ **Caution**

Beware of inadequate steering if machine is defective, e.g. like after an accident or after 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, paving and grading should be checked by appropriate means, for example spirit level, tachymeter, before and after important measuring tasks.

⚠️ **Danger**   While steering or navigating the machine accidents may occur due a) to the operator not paying attention to the surroundings (e.g. persons, ditches, traffic etc.) or b) malfunctions (e.g. 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 (e.g. an emergency stop, ...).

⚠️ **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.

⚠️ **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**	By operating this system during a thunderstorm you are at risk from lightning. **Precautions:** Do not carry out field surveys during thunderstorms.
⚠ **Warning**	Inadequate securing of the surveying site can lead to dangerous situations, for example in traffic, on building sites, and at industrial installations. **Precautions:** Always ensure that the survey site is adequately secured. Adhere to the regulations governing safety and accident prevention and road traffic.
⚠ **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**	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**	Incorrect fastening of the external antenna to vehicles or transporters poses the risk of the equipment being broken by mechanical influence, vibration or airstream. This may result in accident and physical injury. **Precautions:** Attach the external antenna professionally. The external antenna must be secured additionally, for example by use of a safety cord. Ensure that the mounting device is correctly mounted and able to carry the weight of the external antenna (>1 kg) safely.

⚠ **Warning**	**ALWAYS** disconnect the Machine PC power and/or CAN-cable to the machine **before** conducting hot work/welding on the machine! Reconnect the cabling only after completion of hot work/welding.
⚠ **Warning**	Only Leica Geosystems authorised service workshops are entitled to repair these products.

⚠ Warning If computers intended for use indoors are used in the field there is a danger of electric shock.

Precautions:
Adhere to the instructions given by the computer manufacturer with regard to field use in conjunction with Leica Geosystems products.

⚠ 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 dealer.

6.8	**Electromagnetic Compatibility EMC**

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

⚠ **Warning**   Electromagnetic radiation can cause disturbances in other equipment.
Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment may be disturbed.

⚠ **Caution**   There is a risk that disturbances may be caused in other equipment if the product is used 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 guidelines and standards. When using computers and two-way radios, 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 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.
Radios, digital cellular phones	Use of product with radio, digital cellular phone devices or similar: Electromagnetic radiation 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.
⚠ **Warning**	**Precautions:** Although the product meets in combination with radio or digital cellular phone devices recommended by Leica Geosystems 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 or that humans or animals may 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. Do not operate the product with radio or digital cellular phone devices for long periods immediately next to your body.

6.9   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 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.

Labeling Dual-Axis Slope Sensor
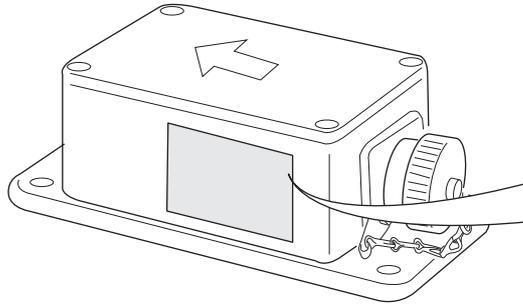
Type: MSS1201

Power: 11-30V ⎓, 50mA
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured 2004
Made in Germany
Ident 1: 04-21-20016
Ident 2: 100-XXX-XXX

Art.No.
667344
S.No.
000100

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 interferences received, including interference that may cause undesired operation.

Labelling, further Information

For details on labelling, please refer to the user manual of the corresponding system component.

7   Technical Data

Leica PaveSmart 3D

Parameter	Data
Elevation accuracy* of machine position	5 - 10 mm (approx. 0.02') / 200m (600 ft)
Position accuracy* of machine	5 - 10 mm (approx. 0.02' - 0.03') / 200 m (600 ft)
GNSS Position, Elevation and Heading accuracy* of machine	10-25mm (depending on GNSS and slope conditions)
Maximum Range (recommended)	± 200 m (600 ft)
Measuring frequency	10 Hz
Supply voltage	12 VDC or 24 VDC
Supply Current (max, at 24V DC)	3 A

*   Standard deviation; depends on the condition the machine is in, the paving material, the paving distance, accuracy of reference points (fixpoints), atmospheric influences and the chosen sensor option:

- For robots line of sight interruptions, severe heat shimmer and moving objects within the line of sight path can result in deviations of the specified accuracy.
- For GPS sensors, the accuracy is dependent upon various factors including the number of satellites tracked, constellation geometry, observation time, ephemeris accuracy, ionospheric disturbance, multipath and resolved ambiguities. A coordinate transformation must be carried out to link the local coordinate system with the WGS 84 GNSS coordinate system prior to any paving works being carried out. The transformation must be verified before paving begins and the control points used, must surround the extents of the area to be paved.

  Refer to the Leica PaveSmart 3D and GPS technical reference manuals for more information, and details on limitations and precautions which should be taken prior to paving.

* For paving work on tight curves the accuracy depends on the physical machine setup, the subground and the paving material.

Slope sensor(s)

Parameter	Data
Humidity	max. 95% RH, non condensing
Vibration	10-500 Hz / 5g / ± 0.35 mm (0.014")
Bump	25 g / 6 ms
Operating temperature	-10°C to +70°C / +14°F to +158°F
Storage temperature	-25°C to +85°C / -13°F to +185°F
Operating voltage range	10 ... 30 Volt DC
Current consumption	approx. 50 mA
Principle of measurement	Liquid sensor
Measuring range	-170% ... +170%, typical -60° ... +60°
Internal resolution	0.015% 0.01°
Linearity	±0.2% of range
Temperature coefficient (Zero)	<0.001% /K <5*10 -4 °/K
Temperature coefficient (Amplifier)	<0.02 %/K <1*10 -2 °/K
Reproducibility	0.035% 0.02°
Time constants (T90)	min. 0.3 sec settable
Sensing frequency	max. 100 Hz settable
CAN interface	ISO 11898 - 24 V
CAN communication rate	125 or 250 kBits/sec
Polarity protection	exists
Enclosure protection	IP 65 (IEC60529)

Parameter	Data
Mounting	RAM mounting

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- when it has to be **right**

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