Operator's Manual

Trimble® GCS900 Grade Control System for Motor Graders

Version 12.60
Revision A
Part Number
February 2014

Trimble

Contact Information

Trimble Engineering and Construction Division
5475 Kellenburger Road
Dayton, Ohio 45424-1099
USA
800-538-7800 (toll free in USA)
+1-937-245-5600 Phone
+1-937-233-9004 Fax
www.trimble.com

Copyright and Trademarks

Release Notice

This is the February 2014 release (Revision A) of the GCS900 Grade Control System for Motor Graders Operator's Manual, part number . It applies to version 12.60 of the GCS900 Grade Control System software.
The following limited warranties give you specific legal rights. You may have others, which vary from state/jurisdiction to state/jurisdiction.

Product Warranty Information

For applicable product warranty information, please refer to the warranty documentation included with this product or consult your dealer.

Notices

Class B Statement – Notice to Users. 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 communication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

Changes and modifications not expressly approved by the manufacturer or registrant of this equipment can void your authority to operate this equipment under Federal Communications Commission rules.

Canada

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus as set out in the radio interference regulations of the Canadian Department of Communications.
Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de Classe B prescrites dans le règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada.

Europe


This product has been tested and found to comply with the requirements for a Class B device pursuant to European Council Directive 89/336/EEC on EMC, thereby satisfying the requirements for CE Marking and sale within the European Economic Area (EEA). Contains Infineon radio module ROK 104001. These requirements are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential or commercial environment.

Australia and New Zealand


This product conforms with the regulatory requirements of the Australian Communications Authority (ACA) EMC framework, thus satisfying the requirements for C-Tick Marking and sale within Australia and New Zealand.

Taiwan – Battery Recycling Requirements


The product contains a removable Lithium-ion battery. Taiwanese regulations require that waste batteries are recycled.

Notice to Our European Union Customers


For product recycling instructions and more information, please go to www.trimble.com/environment/summary.html.

Recycling in Europe: To recycle Trimble WEEE (Waste Electrical and Electronic Equipment, products that run on electrical power), call +31 497 53 24 30 and ask for the "WEEE Associate", or mail a request for recycling instructions to:
Trimble Europe BV
c/o Menlo Worldwide Logistics
Meerheide 45
5521 DZ Eersel, NL

END-USER LICENSE AGREEMENT

IMPORTANT, READ CAREFULLY. THIS END USER LICENSE AGREEMENT (“AGREEMENT”) IS A LEGAL AGREEMENT BETWEEN YOU AND CATERPILLAR TRIMBLE CONTROL TECHNOLOGIES LLC (“CTCT”) and applies to the computer software provided by CTCT with the GCS, CCS, or PCS series machine control system (the “Product”) purchased by you (whether built into hardware circuitry as firmware, embedded in flash memory or a PCMCIA card, or stored on magnetic or other media), or provided as a stand-alone computer software product, and includes any accompanying printed materials and any “online” or electronic documentation (“Software”). The Software also includes any CTCT software (including, without limitation, upgrades and updates) relating to the Product that is furnished by Trimble Navigation Limited (“Trimble”) or its dealers (including, without limitation, CTCT software downloaded from Trimble’s or its dealers’ website(s)) unless accompanied by different license terms and conditions that will govern its use.

BY CLICKING ‘‘YES” OR “I ACCEPT” IN THE ACCEPTANCE BOX, OR BY INSTALLING, COPYING OR OTHERWISE USING THE SOFTWARE, YOU AGREE TO BE BOUND BY THE TERMS OF THIS AGREEMENT. IF YOU DO NOT AGREE TO THE TERMS OF THIS AGREEMENT, DO NOT USE THE PRODUCT OR COPY THE SOFTWARE. INSTEAD PROMPTLY RETURN THE UNUSED SOFTWARE AND ACCOMPANYING PRODUCT TO THE PLACE FROM WHICH YOU OBTAINED THEM FOR A FULL REFUND.

1 SOFTWARE PRODUCT LICENSE

1.1 License Grant. Subject to this Agreement, CTCT grants you a limited, non-exclusive, non-sublicensable right to use one (1) copy of the Software in a machine-readable form on the Product. Such use is limited to use with the Product for which it was intended and into which it was embedded. You may use the installation Software from a computer solely to download the Software to one Product. In no event shall the installation Software be used to download the Software onto more than one Product without securing a separate license. A license for the Software may not be shared or used concurrently on different computers or Products.

1.2 Other Rights and Limitations.

(1) You may not copy, modify, make derivative works of, rent, lease, sell, distribute or transfer the Software, in whole or in part, except as otherwise expressly authorized under this Agreement, and you agree to use all commercially reasonable efforts to prevent its unauthorized use and disclosure.

(2) The Software contains valuable trade secrets proprietary to CTCT and its licensors. You shall not, nor allow any third party to copy, decompile, disassemble or otherwise reverse engineer the Software, or attempt to do so, provided, however, that to the extent any applicable mandatory laws (such as, for example, national laws implementing EC Directive 91/250 on the Legal Protection of Computer Programs) give you the right to perform any of the aforementioned activities without CTCT’s consent in order to gain certain information about the Software for purposes specified in the respective statutes (i.e., interoperability), you hereby agree that, before exercising any such rights, you shall first request such information from CTCT in writing detailing the purpose for which you need the information. Only if and after CTCT, at its sole discretion, partly or completely denies your request, may you exercise such statutory rights.

(3) This Software is licensed as a single product. You may not separate its component parts for use on more than one Product.

(4) You may not rent, lease, or lend, the Software separate from the Product for which it was intended.

(5) No service bureau work, multiple-user license or time-sharing arrangement is permitted. For purposes of this Agreement “service bureau work” shall be deemed to include, without limitation, use of the Software to process or to generate output data for the benefit of, or for purposes of rendering services to any third party over the Internet or other communications network.

(6) You may permanently transfer all of your rights under this Agreement only as part of a permanent sale or transfer of the Product for which it was intended, provided you retain no copies, you transfer all of the Software (including all component parts, the media and printed materials, any upgrades, and this Agreement) and the recipient agrees to the terms of this Agreement. If the Software portion is an upgrade, any transfer must include all prior versions of the Software.

(7) You acknowledge that the Software and underlying technology may be subject to the export administration regulations of the United States Government relating to the export of technical data and products. This Agreement is subject to, and you agree to comply with, any laws, regulations, orders or other restrictions on the export of the Software from the United States which may be imposed by the United States Government or agencies thereof.

(8) At the request of CTCT, you agree to cooperate with CTCT to track the number of Products using Software at your site(s) to ensure compliance with the license grant and installation restrictions in this Agreement.

(9) Notwithstanding anything to the contrary in this Agreement, any Open Source Software that may be included as a part of the software package shall not constitute a portion of the Software as defined in this Agreement and is not licensed under the terms of this Agreement, but instead is subject to the terms of the applicable Open Source Software license. Unless otherwise required pursuant to the terms of an Open Source Software license, CTCT grants you no right to receive source code to the Open Source Software; however, in some cases rights and access to source code may be available to you directly from the licensors. If you are entitled to receive the source code from CTCT for any Open Source Software included with the software package, you may obtain the source code at no charge by written request to CTCT at Caterpillar Trimble Control Technologies LLC, 5475 Kellenburger Rd., Dayton, Ohio 45424 USA, Attn: GCS, CCS and PCS Series Products Manager. You must agree to the terms of the applicable Open Source Software license, or you may not use the subject Open Source Software.

For purposes of this Agreement, "Open Source Software" means those software programs or libraries that are identified in the software documentation, read me and/or about files as being subject to any open source software license, and all modifications, derivative works and executables based on or derived from such software programs or libraries, if such modifications, derivative works and/or executables are also subject to the applicable open source software license by its terms.

1.3 Termination. You may terminate this Agreement by ceasing all use of the Software. Without prejudice as to any other rights, CTCT may terminate this Agreement without notice if you fail to comply with the terms and conditions of this Agreement. In either event, you must destroy all copies of the Software and all of its component parts, and provide an affidavit to CTCT stating that you have done the same.

1.4 Copyright. All title and copyrights in and to the Software (including but not limited to any images, photographs, animations, video, audio, music, and text incorporated into the Software), the accompanying printed materials, and any copies of the Software are owned by CTCT and its licensors. You shall not remove, cover or alter any of CTCT's patent, copyright or trademark notices placed upon, embedded in or displayed by the Software or on its packaging and related materials.

1.5 U.S. Government Restricted Rights. The Software is provided with “RESTRICTED RIGHTS”. Use, duplication, or disclosure by the United States Government is subject to restrictions as set forth in this Agreement, and as provided in DFARS 227.7202-1(a) and 227.7202-3 (a)(1995), DFARS 252.227-7013(c)(1)(ii) (OCT 1988), FAR 12.212(a) (1995), FAR 52.227-19, or FAR 52.227-14(ALT III), as applicable.

2 LIMITED WARRANTY

2.1 Limited Warranty. CTCT warrants that the Software will perform substantially in accordance with the accompanying written materials for a period of one (1) year from the date of receipt. This limited warranty gives you specific legal rights, you may have others, which vary from state/jurisdiction to state/jurisdiction.

2.2 Customer Remedies. CTCT's and its licensors' entire liability, and your sole remedy, with respect to the Software shall be either, at CTCT's option, (a) repair or replacement of the Software, or (b) return of the license fee paid for any Software that does not meet CTCT's limited warranty. This limited warranty is void if failure of the Software has resulted from (1) accident, abuse, or misapplication; (2) alteration or modification of the Software without CTCT's prior written authorization; (3) interaction with software or hardware not supplied by CTCT or Trimble; (4) improper, inadequate or unauthorized installation, maintenance, or storage of the Software or Product; or (5) if you violate the terms of this Agreement. Any replacement Software will be warranted for the remainder of the original warranty period or thirty (30) days, whichever is longer.

2.3 NO OTHER WARRANTIES. TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, CTCT AND ITS LICENSORS DISCLAIM ALL OTHER WARRANTIES AND CONDITIONS, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, IMPLIED WARRANTIES AND CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, TITLE, AND NON INFRINGEMENT WITH REGARD TO THE SOFTWARE AND THE PROVISION OF OR FAILURE TO PROVIDE SUPPORT SERVICES. THE ABOVE LIMITED WARRANTY DOES NOT APPLY TO ERROR CORRECTIONS, UPDATES OR UPGRADES OF THE SOFTWARE AFTER EXPIRATION OF THE LIMITED WARRANTY PERIOD, WHICH ARE PROVIDED "AS IS" AND WITHOUT WARRANTY. BECAUSE THE SOFTWARE IS INHERENTLY COMPLEX AND MAY NOT BE COMPLETELY FREE OF NONCONFORMITIES, DEFECTS OR ERRORS, YOU ARE ADVISED TO VERIFY YOUR WORK. CTCT DOES NOT WARRANT THE RESULTS OBTAINED THROUGH USE OF THE SOFTWARE, OR THAT THE SOFTWARE WILL OPERATE ERROR FREE OR UNINTERRUPTED, WILL MEET YOUR NEEDS OR EXPECTATIONS, OR THAT ALL NONCONFORMITIES CAN OR WILL BE CORRECTED. TO THE EXTENT ALLOWED BY APPLICABLE LAW, IMPLIED WARRANTIES AND CONDITIONS ON THE SOFTWARE ARE LIMITED TO ONE (1) YEAR. YOU MAY HAVE OTHER LEGAL RIGHTS WHICH VARY FROM STATE/JURISDICTION TO STATE/JURISDICTION.

2.4 LIMITATION OF LIABILITY. CTCT'S ENTIRE LIABILITY UNDER ANY PROVISION OF THIS AGREEMENT SHALL BE LIMITED TO THE GREATER OF THE AMOUNT PAID BY YOU FOR THE SOFTWARE LICENSE OR U.S. $25.00. TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, IN NO EVENT SHALL CTCT OR ITS LICENSORS BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES WHATSOEVER (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION, OR ANY OTHER PECUNIARY LOSS) ARISING OUT OF THE USE OR INABILITY TO USE THE SOFTWARE, OR THE PROVISION OF OR FAILURE TO PROVIDE SUPPORT SERVICES, EVEN IF CTCT HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. BECAUSE SOME STATES AND JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES, THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

3 GENERAL

3.1 This Agreement shall be governed by the laws of the State of Ohio and applicable United States Federal law without reference to "conflict of laws" principles or provisions. The United Nations Convention on Contracts for the International Sale of Goods will not apply to this Agreement. Jurisdiction and venue of any dispute or court action arising from or related to this Agreement or the Software shall lie exclusively in or be transferred to the courts of the Montgomery County, Ohio, and/or the United States District Court for Ohio. You hereby consent and agree not to contest, such jurisdiction, venue and governing law.

3.2 Notwithstanding Section 3.1, if you acquired the Product in Canada, this Agreement is governed by the laws of the Province of Ontario, Canada. In such case each of the parties to this Agreement irrevocably attorns to the jurisdiction of the courts of the Province of Ontario and further agrees to commence any litigation that may arise under this Agreement in the courts located in the Judicial District of York, Province of Ontario.

3.3 Official Language. The official language of this Agreement and of any documents relating thereto is English. For purposes of interpretation, or in the event of a conflict between English and versions of this Agreement or related documents in any other language, the English language version shall be controlling.

Safety Information

Most accidents that involve product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.

Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or to other persons.

The hazards are identified by the “Safety Alert Symbol” and followed by a “Signal Word” such as “DANGER”, “WARNING” or “CAUTION”. The Safety Alert “WARNING” label is shown below.

WARNING — This alert warns of a potential hazard which, if not avoided, can cause severe injury.

The meaning of this safety alert symbol is as follows:

Attention! Become Alert! Your Safety is Involved.

The message that appears under the warning explains the hazard and can be either written or pictorially presented.

Operations that may cause product damage are identified by “NOTICE” labels on the product and in this publication.

Trimble cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are, therefore, not all inclusive. If a tool, procedure, work method or operating technique that is not specifically recommended by Trimble is used, you must satisfy yourself that it is safe for you and for others. You should also ensure that the product will not be damaged or be made unsafe by the operation, lubrication, maintenance or repair procedures that you choose.

The information, specifications, and illustrations in this publication are on the basis of information that was available at the time that the publication was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service that is

given to the product. Obtain the complete and most current information before you start any job. Dealers have the most current information available.

Safety (Laser)

The IEC and the United States Government Center of Devices for Radiology Health (CDRH) has classified this laser as a Class II laser product. The maximum radiant power output of this laser is less than 5 milliwatts.

Refer to the operator's manual of the laser transmitter for installation and operating instructions.

The laser supplied with your Laser System complies with all applicable portions of “Title 21” of the “Code of Federal Regulations, Department of Health and Human Services, Food and Drug Administration, Federal Register, Volume 50, Number 161, 20 August 1985”.

This laser complies with “OSHA Standards Act, Section 1518.54” for use without eye protection. Eye protection is not required or recommended. The following safety rules should be observed:

- Never look into a laser beam or point the beam into the eyes of other people. Set the laser at a height that prevents the beam from flashing directly into people's eyes.
- Do not remove any warning signs from the laser.
- Use of this product by personnel that are not trained on this product may result in exposure to hazardous laser light.
- If initial service requires the removal of the outer protective cover, removal of the cover must be performed by trained personnel.

Crushing Prevention and Cutting Prevention

Support the equipment properly when you work beneath the equipment. Do not depend on the hydraulic cylinders to hold up the equipment. An attachment can fall if a control is moved, or if a hydraulic line breaks.

Unless you are instructed otherwise, never attempt adjustments while the machine is moving. Also, never attempt adjustments while the engine is running.

Whenever there are attachment control linkages, the clearance in the linkage area will increase or the clearance in the linkage area will decrease with movement of the attachment. Stay clear of all rotating and moving parts.

Keep objects away from moving fan blades. The fan blade will throw objects or cut objects. Do not use a kinked wire cable or a frayed wire cable.

Wear gloves when you handle wire cable. When you strike a retainer pin with force, the retainer pin can fly out. The loose retainer pin can injure personnel. Make sure that the area is clear of people when you strike a retainer pin.

In order to avoid injury to your eyes, wear protective glasses when you strike a retainer pin.

Chips or other debris can fly off objects when you strike the objects. Make sure that no one can be injured by flying debris before striking any object.

Operation

Clear all personnel from the machine and from the area.

Clear all obstacles from the machine's path. Beware of hazards (wires, ditches, etc.).

Be sure that all windows are clean.

Secure the doors and the windows in the open position or in the shut position.

Adjust the rear mirrors (if equipped) for the best visibility close to the machine.

Make sure that the horn, the travel alarm (if equipped), and all other warning devices are working properly.

Fasten the seat belt securely.

Warm up the engine and the hydraulic oil before operating the machine.

Only operate the machine while you are in a seat.

The seat belt must be fastened while you operate the machine. Only operate the controls while the engine is running.

While you operate the machine slowly in an open area, check for proper operation of all controls and all protective devices. Before you move the machine, you must make sure that no one will be endangered.

Do not allow riders on the machine unless the machine has the following equipment:

- Additional seat
- Additional seat belt
- Rollover Protective Structure (ROPS)

Note any needed repairs during machine operation. Report any needed repairs.

Avoid any conditions that can lead to tipping the machine. The machine can tip when you work on hills, on banks and on slopes. Also, the machine can tip when you cross ditches, ridges or other unexpected obstructions.

Avoid operating the machine across the slope. When possible, operate the machine up the slopes and down the slopes.

Maintain control of the machine.

Do not overload the machine beyond the machine capacity.

Be sure that the hitches and the towing devices are adequate.

Never straddle a wire cable. Never allow other personnel to straddle a wire cable.

Before you maneuver the machine, make sure that no personnel are between the machine and the trailing equipment.

Always keep the Rollover Protective Structure (ROPS) installed during machine operation.

Monitor the location of mounted components. Ensure that the components do not come into contact with other parts of the machine during operation.

Warnings

WARNING — When replacement parts are required for this product Trimble recommends using Trimble replacement parts or parts with equivalent specifications including, but not limited to, physical dimensions, type, strength and material. Failure to heed this warning can lead to premature failures, product damage, personal injury or death.

WARNING — The cutting edge of the machine may move without warning when automatic controls are on. These sudden movements could cause injury to anyone near the cutting edge, or damage to the machine. Always put the system in Manual and engage the machine's park brake before you leave the machine, or when somebody is working near the cutting edge.

WARNING — When working with a raised blade, if you allow parts of your body to extend under the cutting edge of the blade or blade attachments, then unexpected movement of the blade may result in injury or death. Always maintain adequate clearance from the potential path of the cutting edge or blade attachments.

WARNING — If you create a ramp or other work platform that is too steep, machines and vehicles using the ramp or platform could become difficult to control. This could result in harm to the operator, to others, or damage to the machine. To ensure your safety and the safety of others, find out what the maximum slope for your site is and make sure you do not exceed it.

WARNING — Do not operate or work on this machine unless you have read and understand the instructions and warnings in the system manual. Failure to follow the instructions or heed warnings could result in injury or death. Contact your dealer for replacement manuals. Proper care is your responsibility.

WARNING — To prevent possible personal injury during installation and removal of the laser receivers, lower the mast to the minimum height and use an approved access system to reach the mounting locations of the laser receivers at the top of the mast. Do not climb on the machine.

WARNING — Movement of the transmitter could cause unexpected blade movement. Death or serious injury could occur. Turn off the transmitter before you move the transmitter or before you adjust the transmitter.

WARNING — Do not operate this system unless you are fully trained on this equipment.

WARNING — If the machine's direction is locked, for example if it is locked in the forward direction, the distance to avoidance zones will be calculated incorrectly when you are driving in the opposite direction, resulting in unreliable avoidance zone warnings. Entering an avoidance zone could cause personal injury or damage to the machine. Always be aware of nearby avoidance zones when operating a machine with direction lock on.

WARNING — In order to prevent personal injury during installation and removal of a GNSS receiver or a UTS target, use an approved access system to reach the mounting locations of the GNSS receiver or UTS target at the top of the mast.

WARNING — Do not stare into the laser beam when the laser transmitter is operating. For more information, refer to the documentation that came with your laser.

WARNING — Falling Hazard. Do not climb onto the machine in order to access the GNSS receiver or UTS target. Climbing on the machine could result in a fall which could cause serious injury or death. Use the raise and lower mechanism to access the GNSS receiver or UTS target for all required maintenance and service.

WARNING — When the cutting edge is not in operation, leaving it in the air could cause injury to you or others, or cause damage to the machine. Always place the cutting edge on the ground when it is not in use.

WARNING — Accidental engine starting can cause injury or death to personnel working on the equipment. To avoid accidental engine starting, disconnect the battery cable from the negative (–) battery terminal. Completely tape all metal surfaces of the disconnected battery cable end in order to prevent contact with other metal surfaces which could activate the engine electrical system. Place a Do Not Operate tag at the Start/Stop switch location to inform personnel that the equipment is being worked on.

WARNING — The cutting edge may move abruptly during hydraulic valve calibration. To avoid injury, make sure the machine's park brake is engaged and the calibrations are supervised by an operator in the machine cab. Maintain adequate clearance from people and objects during the hydraulic valve calibration.

WARNING — Ensure that all valve module connectors are correctly connected. Failure to do so can result in personal injury from crushing, and can cause permanent damage to the hydraulic system.

WARNING — Disconnect the negative battery terminal before commencing any welding. Ensure that power is removed from the system by disconnecting the power input cable(s). Failure to follow this warning may result in electric shock.

Contents

CHAPTER

1

About This Manual

In this chapter:

Welcome to the GCS900 Grade Control System for Motor Graders Operator's Manual. This manual provides procedural information for the day to day operation of the system. The system is designed specifically for earthmoving equipment in the construction industry.

1.1 Scope and audience

This manual is intended for personnel who operate the system, including:

- Machine operators
- Dealers
- Installation technicians
- Site Supervisors

This manual describes how to use the standard features of the system. To learn about the underlying concepts of the system, refer to the *Trimble GCS900 Grade Control System Reference Manual*.

For information on how to use features not described in this manual, refer to the *Trimble GCS900 Grade Control System Site Supervisor's Manual*.

Even if you have used other machine guidance systems before, Trimble recommends that you spend some time reading this manual to learn about the special features of this product.

Trimble manuals that are related to this product are available in PDF format on the GCS900 Grade Control System release media. To view or print the manuals, use Adobe Reader (provided on the media). Utilities that do not have an accompanying manual have integrated Help.

1.2 Trimble training classes and technical assistance

Contact your dealer for:

- Technical support, information notes, and other technical notes
- Information about:
  - the support agreement contracts for software and firmware
  - extended warranty programs for hardware
  - training classes

1.3 To learn more about Trimble

For an interactive look at Trimble, go to www.trimble.com.

1.4 Your comments

Your feedback about the supporting documentation helps us to improve it with each revision. Email your comments to readerfeedback@trimble.com.

CHAPTER

2

Using the Control Box and Lightbars

In this chapter:

As you work with the GCS900 Grade Control System , you need to set up and control the guidance system and understand the guidance information the system provides.

This chapter describes, in general terms, how these components are used.

For more information on these components, refer to the *GCS900 Grade Control System Reference Manual*.

2.1 Introduction

The control box is a computer that runs the system software. You control the guidance system with, and are given guidance information by, the following system components:

- the control box and lightbars
- the remote switches, if installed
- the audible alarm, or beeper

2.2 How the system works

The system uses a variety of different sensors to provide elevation and reach guidance for the bucket cutting edge. You can use this information to manually guide the bucket to a specified position relative to a benchmark position or to measure a slope between two points.

The system is made up of a number of different components and comes in a basic configuration with optional upgrades:

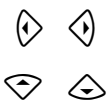
- AS455 bucket curl sensor
- LC450 stick angle sensor
- AS450 boom angle sensor
- AS460 pitch/roll sensor
- Optional sensors:
  - AS450 VA boom angle sensor (only required if your excavator has a variable angle boom, also known as an articulated boom)
  - AS455 tilt bucket sensor (only required if your excavator makes use of a tilting bucket)
  - HS410 Cab Rotation sensor

2.3 Control box basics

The control box has a color LCD screen to display guidance and other information, and push button controls to operate the system. In addition, the control box has internal lightbars, and a USB flash drive port for loading and saving machine and display configuration data, and for loading and saving data. See the following figure, and the following table that describes the items in the figure.

❶ Power button
❷ Softkey label area
❸ Softkeys
❹ Next key
❺ Zoom-in key
❻ Beeper
❼ Zoom-out key
❽ Escape key
❾ Arrow keys
❿ OK key
⓫ USB flash drive port
⓬ Menu key

Figure 2.1 The control box

Description		Function
LCD screen		Displays guidance information
Softkey labels		See Softkey labels, page 32
Softkeys		See Softkeys, page 28
Zoom-in key		Zoom in on the machine
Zoom-out key		Zoom out from the machine
Next key		View the next guidance screen or select the next field in a dialog
Menu key		View the *Setup Menu – Configuration* dialog
USB flash drive port		See 2.3.2 System memory and the USB flash drive
Arrow keys		Pan a guidance view, select an item in a list, or enter data in a field
OK key		Save changes made in a dialog, and exit the dialog
Escape key		Exit from a dialog without saving changes, or exit from a menu

Description	Function
Power key	See 2.3.1 Power key
Beeper	See 2.7 System beeper

2.3.1 Power key

The ⏻ key turns the control box on and off.

To turn on the control box and the system, press ⏻. After a brief pause, an opening screen appears.

Note – *If the system reports that there are upgrade files or other system files on the control box, or that the operating system is out of date, contact your site supervisor immediately.*

To turn off the control box and the system, press and hold ⏻ for two to three seconds until the control box shuts down. (This delay reduces the risk of you turning off the power accidentally.) You can turn off the system from any screen or dialog.

2.3.2 System memory and the USB flash drive

Files and data are stored on the control box in an area known as system memory. The files and data in system memory are used by the system and there is only limited site supervisor access via the control box.

To access the files and data in system memory, they need to be transferred from the control box onto a USB flash drive. The files and data on the USB flash drive can then be directly accessed from a laptop, an office computer, or SiteVision Office software.

Note – *When you insert a USB flash drive into the control box, system operation is temporarily disabled. System operation resumes when the USB flash drive is removed.*

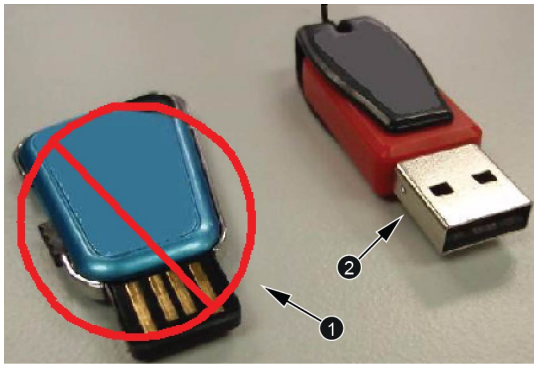
The USB flash drive folder structure:

- At the root directory level is a "***Machine Control Data***" folder.
- Within the "***Machine Control Data***" folder are machine specific folders based on machine names, which contain machine specific data.

Note – *If folders do not exist when files are transferred to the USB flash drive, the system will create them.*

ATTENTION — It is recommended to always use a USB flash drive with a metal surround on the connector. When using a USB flash drive with no metal surround on the connector, the drive can be inserted upside down, and due to the lack of the metal part of the connector, contact can be broken and the file transfer process can be interrupted.

ATTENTION — The system only supports USB flash drives formatted as FAT32.



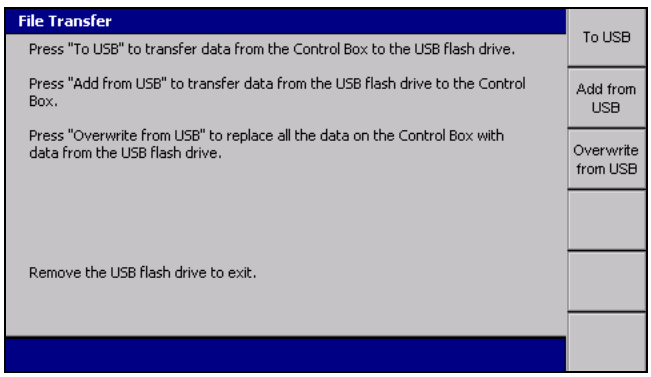
❶ No metal surround on the connector (NOT recommended)

❷ Metal surround on the connector (recommended)

Figure 2.2 USB flash drive connector examples

2.3.3 Transferring data to and from the control box

1. Start the control box.
2. Insert the USB flash drive into to the control box USB port. The *File Transfer* dialog appears.



Transferring files to the USB flash drive

Note – *If a file or folder to be transferred already has an item with a matching file name, but different contents on the USB flash drive, the destination item will be renamed to a backup name generated by appending the item's last-modified date to its file name.*

1. Press **To USB**.

   Only files that have been generated or modified on the control box transfer to the "***Machine Control Data***" folder on the USB flash drive and are written to the machine's sub-folder. The machine's sub-folder name is the same as the machine name set on the control box.

   The following table describes the action that is applied to each file type during a file transfer to the USB flash drive.

File type	Copy	Move
Design files	✓	
Map design files	✓	
Program log files		✓
ZSnap and .gif files		✓
Production .tag files (when 2-way data communication IS NOT enabled)		✓
Production .tag files (when 2-way data communication IS enabled)	✓	
Points .csv files		✓
RemoteBase.txt file	✓	
User defined Master Alignment	✓	

   Note – *A copy action copies the file and leaves the original file on the control box. A move action copies the file and deletes the original file from the control box.*

   A progress bar appears, showing the progress of the data transfer.

2. To exit, press  or remove the USB flash drive.

Transferring files from the USB flash drive

Two types of file transfer from the USB flash drive are available:

- Add from USB
- Overwrite from USB

Add from USB

Note – *If an existing file or folder on the control box has the same name as an item on the USB flash drive, then the item on the control box is backed up on the control box with a name created by appending the date and time of the item's last modification to its current name: <machine name>_**<yyyymmdd>**_**<hhmmss>**.mch. Files and folders on the USB flash drive with names using this naming convention will NOT be transferred from the USB flash drive to the control box.*

1. Press **Add from USB**.

   Data in the "***Machine Control Data*****MachineName**" folder and sub-folders, and the "***Machine Control Data*****All**" folder of the USB flash drive transfers to the control box.

   A progress bar appears, showing the progress of the data transfer.

2. To exit, press OK or remove the USB flash drive.

Overwrite from USB

Note – *Use with caution, as this transfer deletes all existing files from the control box.*

1. Press **Overwrite from USB**. The following actions occur:
   a. A warning is displayed. Read the warning message carefully and only press OK if you are sure you want to continue.
   b. The control box is backed up. All current files on the control box are saved to a backup folder on the USB flash drive. Your site supervisor can restore from backup.
   c. The entire data content is deleted from the control box.
   d. Data in the "***Machine Control Data*****MachineName**" folder and sub-folders, and the "***Machine Control Data*****All**" folder is transferred from the USB flash drive to the control box.

   A progress bar appears, showing the progress of the data transfer.

2. To exit, press OK or remove the USB flash drive.

Data transfer suspend and resume

If the USB flash drive is removed from the control box, or if the key is pressed during a file transfer operation, the file transfer is suspended and will resume when:

- the USB flash drive is re-inserted into the control box, and/or
- the relevant softkey is pressed to resume the last file transfer operation

Data transfer error messages

When transferring data, a warning message appears when there is insufficient space on either the control box or the USB flash drive.

Available control box file storage capacities are:

- CB450 - 450 MB
- CB460 - 3.5 GB

2.4 Working with control box information

When you work with the control box, you use a mix of keys, softkeys, menus, dialogs, and guidance screens. The availability of many of these items is determined by the following factors:

- The type of machine.
- The sensors installed on the machine. For example, some configuration screens are only available when particular sensors are installed.
- The availability of automatic controls.
- The guidance configuration of the system. Your selection of guidance method affects the guidance information available on the display and the guidance configuration options you get.
- The operator configuration of the system. The menus and screens selected for you by your site supervisor affect the setup information you can view and modify.

  ***Note** – This manual only covers the menu options that are available to operators by default.*

Any configuration and guidance options not covered in this manual are described in the *GCS900 Grade Control System Site Supervisor's Manual*.

2.4.1 Working with menus and dialogs

Before you can begin work, you must enter configuration and set-up information into the system, and view the current system state, by using screens called menus and dialogs. Menus let you select a dialog. Dialogs let you specify setup and configuration information, or view information about the state of system components.

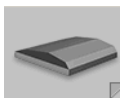
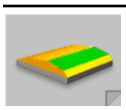
Softkeys

Softkeys are the six physical keys immediately to the right of the screen. The function of these physical keys depends on the information displayed and is identified by the softkey label beside the key.

Softkey labels are graphical “keys” that appear down the side of the screen.

The following tables list the softkey labels that display on the guidance screens of the control box with a brief description of each softkey's functionality.

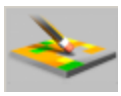
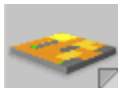
Generic 3D softkey icons

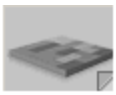
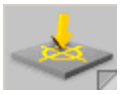
Icon	Functionality
	**Direction: Unknown** – Direction of motion is unknown. Press to open the *Direction* dialog.
	**Direction: Forward** – Direction of motion is calculated to be forwards. Press to open the *Direction* dialog.
	**Direction: Reverse** – Direction of motion is calculated to be in reverse. Press to open the *Direction* dialog.
	**GNSS** – Press to open the *GNSS* dialog.
	**UTS** – Press to open the *UTS* dialog.
	**Select Lane** – Press to use lane guidance, and select a lane at the current machine guidance point. Press and hold to open the *Select Lane* dialog.
	**Select Lane** – Press to de-select the current lane. Press and hold to open the *Select Lane* dialog.

Grading softkey icons

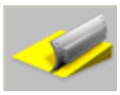
Icon	Functionality
	**Blade: Left** – Focus is on the left side of the blade. Press to change focus to the right side of the blade.
	**Blade: Right** – Focus is on the right side of the blade. Press to change focus to the left side of the blade.
	**Offsets** – Press to open the Offsets dialog. Then press **<value> Offset** to switch between horizontal and vertical.
	**Vertical Offset: Layered Lift** – Press to open the *Vertical Offset* dialog.
	**Vertical Offset: Perpendicular Lift** – Press to open the *Vertical Offset* dialog.
	**Vertical Offset: Vertical Lift** – Press to open the *Vertical Offset* dialog.
	**Vertical Offset: Reference Surface** – Press to open the *Vertical Offset* dialog.

Mapping/Recording softkey icons

Icon	Functionality
	**Reset Map** – Press to open the *Reset Map* dialog. By default, this softkey is only displayed in Manager Mode.
	**Mapping: Auto** – Map data is recorded when the machine is considered to be working. Press to change map recording to the *On* mode.
	**Mapping: On** – Map data is recording continuously. Press to stop recording map data.

Icon	Functionality
	**Mapping: Off** – Map data is not recording. Press to change map recording to the *Auto* mode.
	**Record Point** – Record a point, when point recording is active.
	**Ripper Mapping On** – Ripper map data is recording when the machine is moving forwards. Press to stop recording ripper map data. This softkey is only visible when the ripper mapping guidance screen is displayed. ***Note –*** *When the*  *symbol is shown on the status bar, this indicates that Ripper mapping is "On".*
	**Ripper Mapping Off** – Ripper map data is not recording. Press to start recording ripper map data. This softkey is only visible when the ripper mapping guidance screen is displayed.

Conventional guidance softkey icons

Icon	Functionality
	**Bench: Left** – Press and release to bench the left elevation sensor. Press and hold to open the *Laser* dialog.
	**Bench: Right** – Press and release to bench the right elevation sensor. Press and hold to open the *Laser* dialog.
	**Elevation Offset** – Press to open the *Elevation Offset* dialog.
	**Target Slope** – Press to open the *Target Slope* dialog.
	**Flip Target Slope** – Press to reverse the direction of the target blade slope.
	**Linked Elevation Adjustment** – Press to open the *Linked Elevation Adjustment* dialog.
	**EM400 Electric Mast** – Press to open the raise / lower mast dialog.

Conventional guidance "Sensors" softkey icons

Note *– For all instances of the* **Sensors** *softkey, pressing the softkey selects the next combination of available sensors. Press and hold the softkey to configure the favorites menu.*

Icon	Functionality
	Laser lift guidance on the left blade tip to maintain a constant elevation.
	Laser lift guidance on the right blade tip to maintain a constant elevation.
	Laser lift guidance on both blade tips - independent.
	Laser lift guidance on both blade tips - linked.
	Maintain a constant left cross slope.
	Maintain a constant right cross slope.
	Laser lift guidance on the left blade tip while maintaining a constant cross slope.
	Laser lift guidance on the right blade tip while maintaining a constant cross slope.
	Sonic tracer lift guidance on the right side of the machine.
	Sonic tracer lift guidance on the left side of the machine.
	Sonic tracer lift guidance on the left blade tip while maintaining a constant right cross slope.

Icon	Functionality
	Sonic tracer lift guidance on the right blade tip while maintaining a constant left cross slope.
	Laser lift guidance on the left blade tip with sonic tracer guidance on the right blade tip.
	Laser lift guidance on the right blade tip with sonic tracer guidance on the left blade tip.
	Sonic tracer lift guidance on both blade tips - independent.

Softkey labels

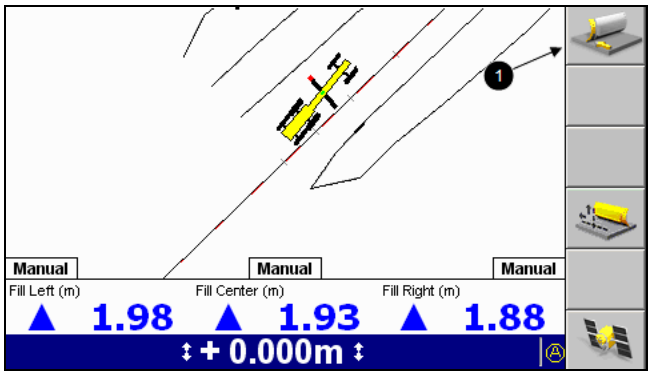
The text on a softkey label can show the following details:

- A description of the operation that is performed when you press the softkey once.
- The setting that is currently selected. The text on the softkey label changes when you press the softkey to switch between options. The top line of the softkey label ends with a colon (:) and the bottom line shows the current option or setting.

The icon on a softkey label can show the following details:

- A graphical representation of the operation that is performed when you press the softkey once.
- The setting that is currently selected. The icon on the softkey label changes when you press the softkey to switch between options.
- Softkeys that have a fold on the bottom right corner support press and hold functionality to directly access the associated operation.

For example, the softkey labels **Blade: Left** and **Blade: Right** (❶) show the side of the blade that is selected for horizontal guidance on 3D systems. The current side (Left or Right) shows on the bottom line of the label.



Some softkey labels appear in more than one screen, in which case the function of the softkey they identify is always the same.

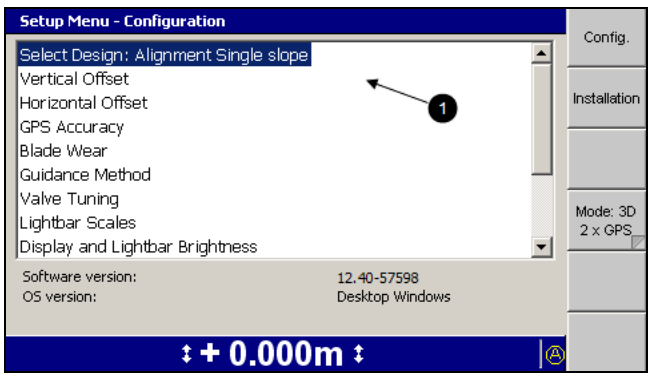
As a softkey's function relates to particular screens or dialogs, that functionality is only available when the appropriate screen or dialog appears. For example the **New Level** function is available only when the *Select Design File* screen appears, as that function relates only to that screen.

If a softkey has no function in a screen or dialog, the softkey label is blank.

By convention, this manual refers to a softkey and its associated function by softkey label.

Menus

Menus let you choose another menu or dialog from a list. To move up or down the list of menu items use the ⬘ or ⬙ keys. Once you highlight the item you want to view (❶), press ⬚ to select it. To leave a menu without making a selection, press ⬚.



Dialogs

Dialogs let you enter data into the system. Dialogs can contain any of the following items:

- Text fields. Text fields let you enter text information, such as the name of a machine. Once you select a field, you can enter data into it. A selected field appears as white text on a blue background.
- Number fields. Number fields let you enter numerical values, such as the height of a benchmark. Once you select a field, you can enter data into it. A selected field appears as white text on a blue background.
- Lists. Lists let you select a single item from a list of items, such as a list of machine settings files.
- Check lists. Check lists let you select one or more items, or no items, from a list of items, such as a list of sensors.
- Yes/No fields. Yes/No fields let you enable and disable particular features.
- Information to help you make your selection.

To move between fields in a dialog, press .

To enter data into a text or number field, use the arrow keys as follows:

- Press or to scroll through the upper case alphabet (A through Z), numbers (0 through 9), the decimal point (.), the negative sign (–), the positive sign (+), a space ( ), and back to A.

  Note – *Available values depend on the type of field that is selected. For example, the only values available for number fields are 0 through 9, the decimal point (.), –, and +.*

  When you change a character in a field, the keys start stepping from the existing character.

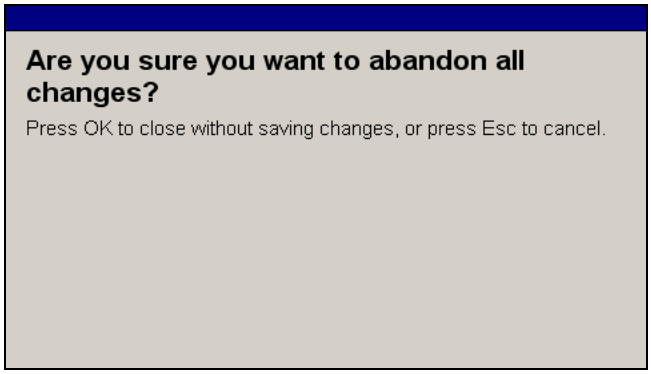
- steps to the next character to the right.

  In fields that allow spaces, press twice to insert a space.

- steps back one character to the left. This deletes the character in the space to the left.

To select an item from a list, press or to highlight the item you want to select, and press .

To leave the dialog without saving the new data or selection, press . If you have made changes to a dialog setting, and you choose to exit without saving those changes, the following warning appears.



To confirm that you want to abandon the changes you have made to the dialog, press .

2.4.2 Working with guidance screens

While you work, you read guidance information from the system using guidance screens.

Guidance screens display a mix of text and graphics that give you information such as the slope or elevation of the cutting edge or the position of the machine.

Depending on the configuration of the system, as setup by your site supervisor, you can view varying numbers of guidance screens:

- Plan view
- Terrain
- Cut/Fill pass count
- Radio coverage
- Ripper
- Cross-section view
- Profile view
- Split screen (profile and cross-section) view
- Text view 1
- Text view 2

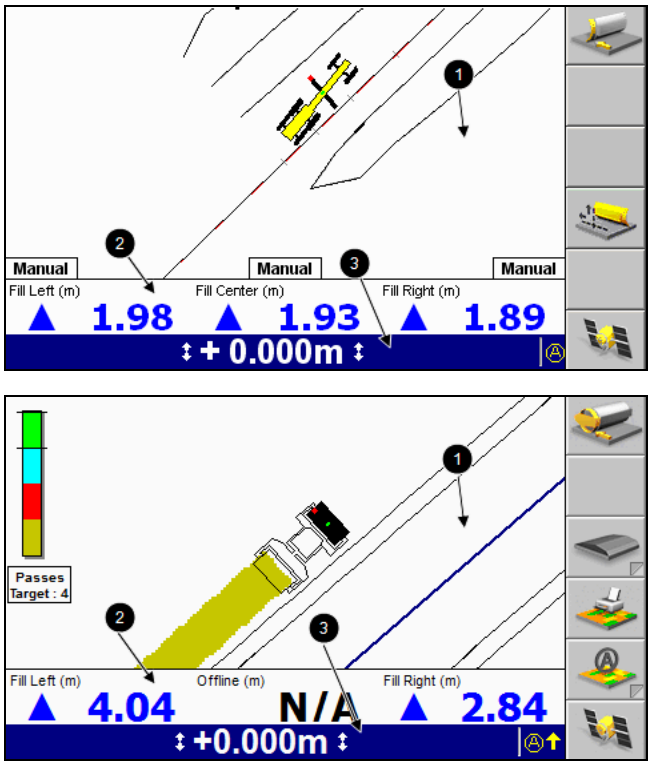
To move between guidance screens, press .

The availability of each screen, and the information the screen contains, changes with the following configuration items:

- The type of machine
- The sensors installed on the machine
- The availability of automatic controls
- The guidance configuration of the system
- The operator configuration of the system
- The type of design currently loaded

Guidance screen components

The following figure shows the main components of the guidance screens:



The three main areas of a guidance screen are:

- **The guidance view area ❶**. The guidance view area displays the machine relative to the surface being worked. There is no guidance view area in the text screens.
- **The optional text information area ❷**. The text information area lets you view user-selectable information. In the text screen guidance views, the text

information area uses the guidance view area.

If there are more than three text items selected for display, then the text information area appears down the right side of the screen.

If there is no text information configured for that view, the text information area does not appear.

- **The guidance settings status bar ❸**. The guidance settings status bar displays the current sensors and guidance settings being used to generate guidance information. For more information, see Guidance settings, page 38.

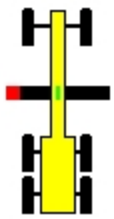
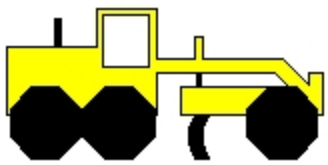
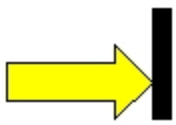
Machine icons

The system uses a variety of icons to identify the machine in the guidance views:

- The icon that appears on the screen depends on the machine type that the system is configured for.
- The blade icon provides information on the blade slope in cross-section view.
- The cutting edge tip in an icon corresponds exactly to the cutting edge tip of the machine.
- As you move the machine and blade, the icon mimics the movements on the screen.
- The red square on the blade indicates the horizontal guidance point (the blade focus), if applicable. The green line on the blade indicates the vertical guidance point(s).

***Note** – The position of symbols for other parts, in particular the tracks/wheels or rear corners, are approximate and for indication only.*

Table 2.1 — Machine type and icon

Machine type	Plan View icon	Profile View Icon
Motor grader		
Generic		

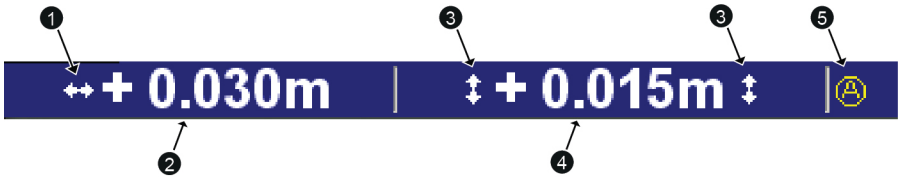
If the machine you are operating is not shown, contact your site supervisor.

Guidance settings

To display guidance settings, the system uses a variety of icons to identify the sensors being used to generate guidance information, and text to display numerical values.

❶ Sonic tracer icon ❷ Elevation offset ❸ Target slope
❹ Slope sensor icon

Figure 2.3 Example guidance setting area for a sonic tracer guided lift-plus-cross slope system



❶ Horizontal guidance icon ❷ Horizontal offset ❸ Vertical guidance icons
❹ Vertical offset ❺ Mapping/Recording icon - set to Auto

Figure 2.4 Example guidance setting area for a 3D system

Table 2.2 — Guidance setting icons used by the system

Guidance setting icon	Meaning
	3D vertical guidance information is being generated by one or more 3D sensors.
	3D horizontal guidance information is being generated by one or more 3D sensors.
	Blade or cross slope guidance information is being generated by a combination of one or more of mainfall, blade slope, and blade rotation sensors.
	Lift guidance information is being generated by a laser receiver.

Guidance setting icon	Meaning
	Lift guidance information is being generated by a sonic tracer.
	Cellular radio signal strength. No signal is indicated by a cross.
	Wi-Fi radio signal strength. No signal is indicated by a cross.
	No avoidance zone guidance is available.
 Auto  On  Off	Mapping/Recording status.
	Ripper mapping is "On", when the machine is moving forwards.

If automatic controls are installed and activated, the color of the sensor icon indicates the control state in the following way:

- **White**. Automatic control is turned off.
- **Green**. Automatic control is turned on.
- **Flashing red**. The automatic control switch is turned on, but automatic controls are deactivated.

Zooming the view

There are four possible ways of zooming a view:

- Press  to zoom in on the current view.
- Press  to zoom out of the current view.
- Press and hold  to zoom the machine.
- Press and hold  to zoom out as much as possible.

Tip – The system saves the sizes of the views when you turn off the control box. The views automatically load at their previous size when you next use the system.

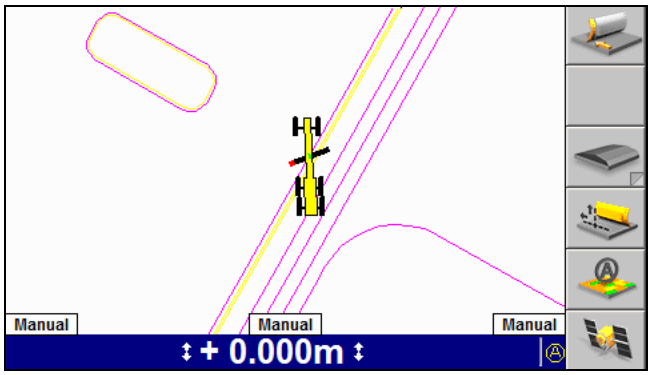
2.4.3 Guidance views

Guidance views enable you to view the machine guidance in a variety of ways. Press repeatedly to cycle through the guidance views.

Plan view

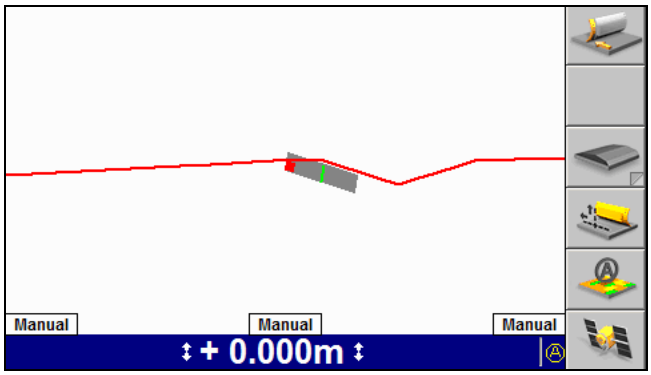
Plan view is the default view shown on a guidance screen.

Plan view shows the machine in a top-down view on the design.



Cross-section view

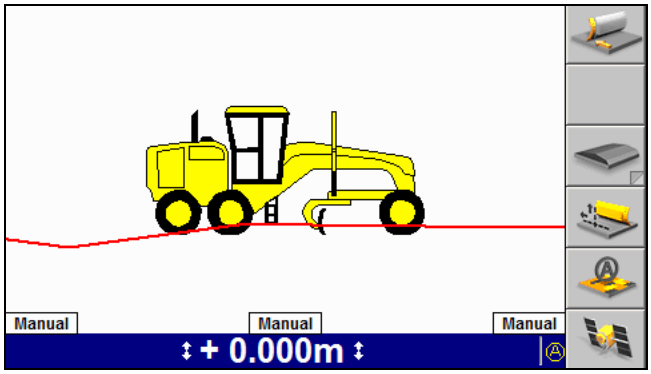
Cross-section view shows the cutting edge relative to the guidance surface.



***Note** – The system can be configured for either Split View or for Profile View and Cross-section View. Split View is not available when the system is set for Cross-section View.*

Profile view

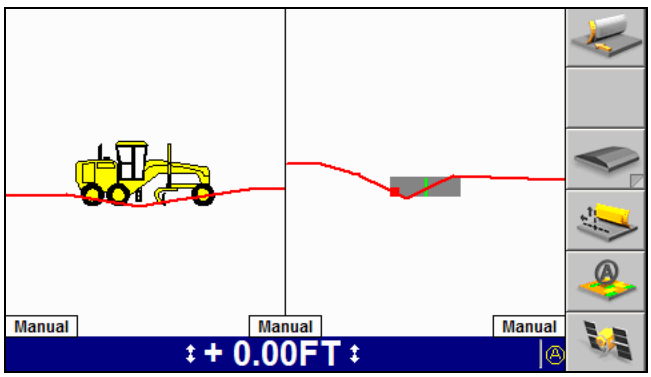
Profile view shows the machine as a side on view to the design to show the machine relative to the guidance surface.



***Note** – The system can be configured for either Split View or for Profile View and Cross-section View. Split View is not available when the system is set for Profile View.*

Split view

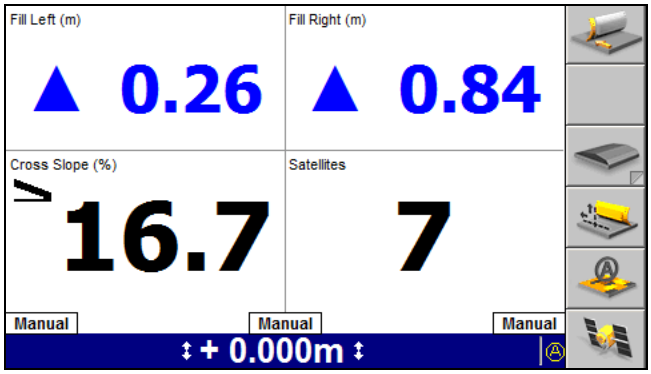
Split view displays both the profile view and cross-section view in a single screen. Split view is useful for monitoring the position of the cutting edge, relative to the guidance surface.



***Note** – Split view replaces both the cross-section and profile views. When split view is available, you cannot view the cross-section and profile views as full screen views.*

Text views

The site supervisor configures the text items that display in text view 1 and text view 2. The following figure shows an example text view guidance screen.



***Note** – Up to 10 text view items can be displayed in full screen view and the text size scales automatically to fit the available screen space.*

2.5 Understanding lightbar information

The system uses LED arrays, called lightbars, to provide you with guidance information.

Lightbars let you simultaneously view guidance information, the cutting edge, and the surface being worked.

Up to three lightbars can be used with the system. Each lightbar shows different information for the blade position:

- The vertical lightbars give cut/fill guidance to each end of the blade.
- The horizontal lightbar gives horizontal guidance.

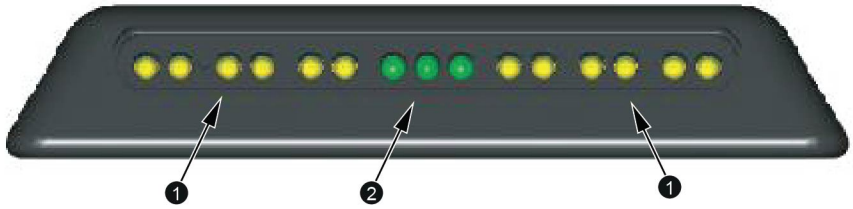
The CB460 control box supports either internal or external lightbars. The characteristics of internal and external lightbars differ as follows.

2.5.1 External lightbars

External lightbars can be installed in the cab, as required to replace the internal lightbars.

***Note** – External lightbars are only supported on CB460 control boxes.*

In each external lightbar there are six sets of amber LEDs (❶) and one set of green LEDs (❷), as shown below:

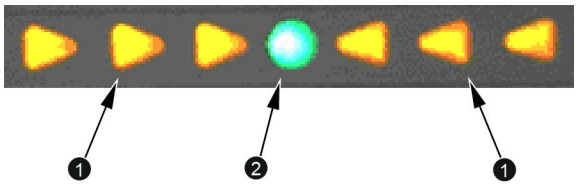


When the cutting edge is within half of the on-grade or on-line tolerance, only the central green LED is lit. When the cutting edge is within the on-grade or on-line tolerance, the central green LED and one other green LED are lit. If any LED, other than a green LED is lit, then the cutting edge is off grade or off line.

2.5.2 Internal lightbars

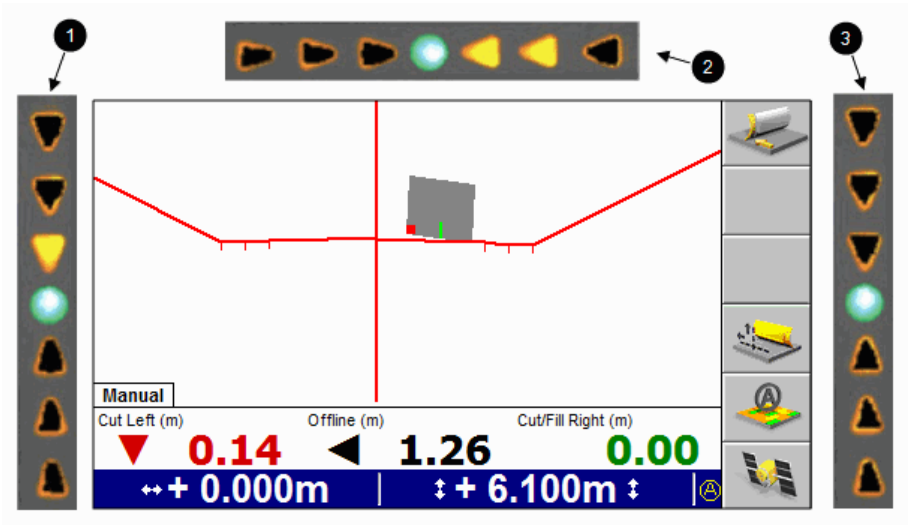
Internal lightbars are built into the control box and can be disabled if not required.

In each internal lightbar there are six amber LEDs (❶) and one green LED (❷), as shown below:



When the cutting edge is within the on-grade or on-line tolerance, only the central green LED is lit. If any LED, other than a green LED is lit, then the cutting edge is off grade or off line.

The following image shows how the lightbars provide guidance information and relate to the view displayed on the control box. The cut/fill information is relative to the design surface. The horizontal guidance information is relative to the selected alignment.

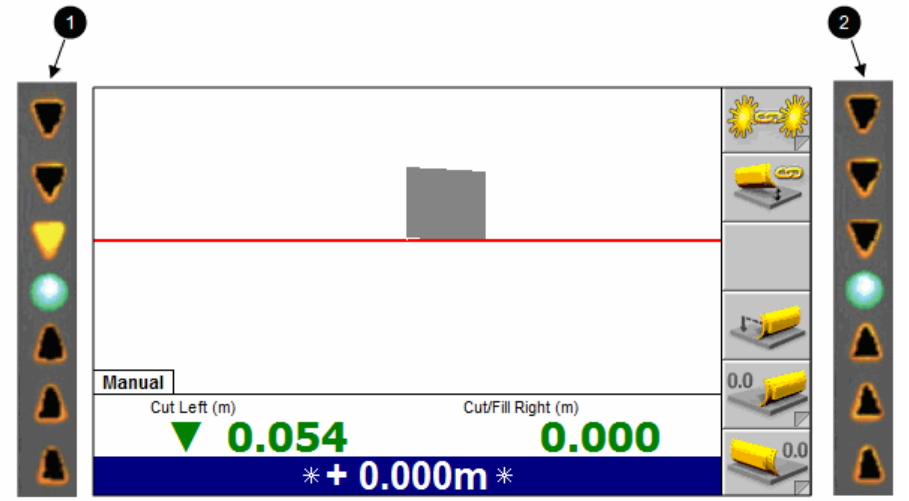


❶ Left guidance. One amber LED lit. Cut down.

❷ Horizontal guidance. Two amber LEDs lit. Steer left.

❸ Right guidance. Only central green LED lit. On-grade.

Figure 2.5 Using the 3D lightbars



❶ Left guidance. One amber LED lit. Cut down.

❷ Right guidance. Only central green LED lit. On-grade

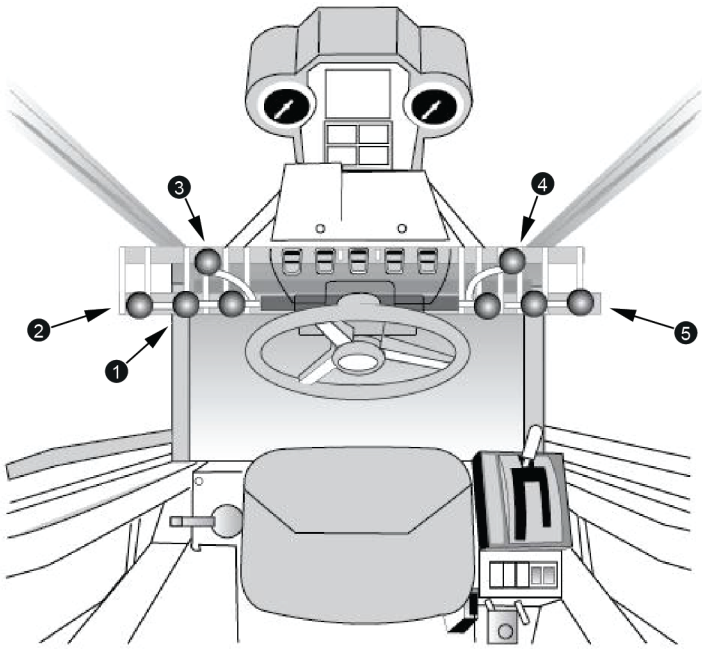
Figure 2.6 Using the 2D conventional lightbars

2.6 Operating the remote switches

The remote switches let you use commonly used features while keeping your hands close to the machine controls. The remote switches let you perform the following operations:

- Switch between Auto and Manual control
- Set an elevation or slope offset
- Raise or lower the cutting edge by the offset increment

The following image shows typical locations for a motor grader remote switch assembly:



❶ Sideshift Auto/Manual switch

❷ Left Auto/Manual switch on left Blade Lift lever

❸ Left offset increment switch on Moldboard Roll lever

❹ Right offset increment switch on Articulation lever

❺ Right Auto/Manual switch on right Blade Lift lever

Figure 2.7 Typical motor grader remote switch locations

2.6.1 Auto/Manual switches

The Auto/Manual switches enable and disable the automatic controls for their respective blade ends, and for blade sideshift.

Guidance methods that only provide guidance to one end of the blade, for example cross slope guidance, behave in the following way:

- Automatic control is given to the end of the blade that the Auto/Manual switch was put in the Auto position ***last***.
- The other end of the blade returns to manual control, until the Auto/Manual switch is toggled to Manual and then back to Auto.

3D guidance methods provide guidance to both ends of the blade. Because motor graders can have automatic controls turned on for each blade tip independently, automatic controls behave in the following way:

- If one Auto/Manual switch is in the Auto position, then the behavior of the blade depends on which tip is under automatic control:
  - If the end of the blade under automatic control has focus, then that end of the blade is automatically controlled to maintain the correct elevation. The other blade tip is manually controlled to maintain the correct cross slope.
  - If the end of the blade under automatic control does not have focus, then that blade tip is automatically controlled to maintain the cutting edge at the cross slope of the design. The other blade tip is manually controlled to maintain the correct elevation.
- If both Auto/Manual switches are in the Auto position, then both blade tips are automatically driven to design.
- If automatic sideshift is available and turned on, then the blade is automatically moved horizontally to design.

  Note – *At least one of the automatic lift switches must also be in the Auto position for automatic sideshift to operate.*

2.6.2 Elevation offset switches

Automatic motor grader systems support two elevation offset remote switches:

- In 2D mode, each switch controls the elevation offset applied to the end of the blade corresponding to the side that the switch is mounted on.
- In 3D mode, both switches control the one elevation offset value.

Toggling an elevation offset remote switch up or down increases and decreases, respectively, the value of the elevation offset. This is true even if the end of the

blade has its elevation controlled to maintain cross slope, for example the cross slope and lift plus cross slope guidance methods. For this reason, for certain combinations of blade slope and blade end being controlled, increasing the offset may decrease the working cross slope.

The amount the elevation offset or working slope is changed with each remote switch action is called the elevation offset increment. This increment can be changed by your site supervisor.

2.7 System beeper

In addition to the display and lightbars the system also uses an audible alarm, or beeper, to alert you to status changes and other events.

The following table lists the pattern of sounds generated by the beeper, and the events that cause them. By default, the beeper will sound for all the events listed in the table, but alerts for some events may be turned off by your site supervisor.

Table 2.3 — Beeper patterns

Event	Sounds when ...	Pattern
Inside Avoidance Zone	The machine is inside an avoidance zone.	Repeated: 150 msec on, 175 msec off, 300 msec on, 175 msec off
Above Grade	The blade is more than the vertical tolerance and less than four times the vertical tolerance above grade.	Continuous: 50 msec on, 50 msec off
On-Grade	The blade is within the vertical tolerance of grade.	Continuous: On
Below Grade	The blade is more than the vertical tolerance and less than four times the vertical tolerance below grade.	Continuous: 100 msec on, 100 msec off
Approach Avoidance Zone	The machine is within the warning distance of an avoidance zone.	Once only: 200 msec on, 200 msec off, 400 msec on
No Avoid	The No Avoid message appears.	Once only: 200 msec on
Warning Message Appears	A warning message appears.	Once only: 200 msec on, 200 msec off, 200 msec on
Warning Message Disappears	A warning message automatically disappears.	Once only: 200 msec on

Event	Sounds when ...	Pattern
GNSS Accuracy	The GNSS accuracy level changes.	Once only: 200 msec on
UTS Tracking	The UTS loses lock on the machine target.	Once only: 200 msec on
Laser Receiver	The laser receiver loses strike from the laser transmitter.	Once only: 200 msec on
Sonic Tracer	The sonic tracer loses valid measurements.	Once only: 200 msec on
Auto/Manual States	The guidance mode changes to Auto or Manual.	Once only: 200 msec on
Inactive Auto	The guidance mode changes to Inactive Auto.	Once only: 500 msec on
Key/Switch Beeps	A key or a switch is pressed.	Once only: 200 msec on

CHAPTER

3

Preparing to Work

In this chapter:

Before you begin work with the GCS900 Grade Control System , you need to check the state of the machine and its system components to ensure the system provides accurate guidance.

This chapter describes how to check the machine before you turn on the system, what to look for as the system powers up, and how to check the general system setup once the system is running.

3.1 Pre-power up checks

Before you power up the system, observe the state of the machine to make sure that it is configured to function correctly. See the following list of basic checks.

Check and set ...	When?	To learn how, see ...
Mast(s) perpendicular to wheelbase	For machines without mainfall and blade pitch sensors, every time you change the blade orientation	3.1 Pre-power up checks
Zero articulation and circle sideshift	Every time you begin a job using a conventional or single-3D sensor system	3.1 Pre-power up checks
Turn blade cushioning off	Every time you want to use automatic controls	3.1 Pre-power up checks

3.1.1 Best operating practice

This best operating practice list will assist you to achieve the best results with your system:

- Ensure the mast is perpendicular to the wheelbase, or use a blade pitch sensor
- Keep the circle centered under the gooseneck
- Do not lean the wheels
- Do not articulate the machine
- Where possible, set the blade rotation and leave it in the same position
- Where possible, run with the UTS machine target leading, not trailing

3.1.2 Mast orientation

If you have mast-mounted sensor,s and do not have a mainfall sensor and blade pitch sensor installed and configured, the mast or masts must be in the “as measured” position during operation. That is, the position the mast or masts were in during measure up. Typically, the mast(s) should be perpendicular to the wheelbase of the machine.

On some motor grader systems, you may be required to alter the angle of the mast (s). To do this, move the bolt that secures the rotating mast mount into another hole, as shown in the following image. If you change the location of the bolt, you ***must*** enter the change into the system. Contact your site supervisor to make this change.

Note *– The angle of a machine’s mast(s) relative to the wheelbase of the machine changes both when the blade is pitched and when the blade is rotated.*

❶ Bolt ❷ Bolt holes

Figure 3.1 Motor grader rotating mast mount

3.1.3 Zero articulation, circle centershift, and wheel lean

For motor grader systems that rely on the cross slope sensor group for guidance, such as conventional systems and single-3D sensor systems, you must make sure that the machine is not articulated and that there is no side shift applied to the circle. The front wheels must be upright (not on a lean).

Operating with wheel lean, circle centershift, or articulation can cause inaccuracy in the cross slope being cut:

- Wheel lean introduces an error in the reading from the mainfall sensor
- Articulation and circle centershift introduce unmeasured blade rotation

3.1.4 Blade cushioning off

Using a motor grader's blade cushioning device at the same time as the blade is being automatically controlled by the system results in poor automatic controls performance.

Make sure that blade cushioning, if installed, is turned off before working with automatic controls.

3.2 Power up checks

ATTENTION — In cold environments, when you start the machine to warm it up turn on the control box as well.

When you power up the system to begin work, observe the system's start-up sequence to make sure that all components function correctly.

See the following list of basic checks.

Check	For more information, see ...
Lightbar power up	3.2.1 Lightbar power up
Control box power up	3.2.2 Control box power up

3.2.1 Lightbar power up

Observe the lightbars during start-up and make sure that the lightbars work correctly.

To perform the lightbar start-up check:

1. To turn on the system power, press ⏻ on the control box.
2. Immediately observe the pattern of the lightbar LEDs.

The LEDs flash in the following sequence:

LEDs on this lightbar	Flash
Left	Bottom to top
Center (horizontal)	Left to right
Right	Top to bottom
All	Twice, simultaneously

The following problems may occur with internal lightbars:

Problem	Action
Lightbars do not illuminate	Use the methods described in 3.2.2 Control box power up to check that the control box has started successfully. Use the procedure described in 3.4.7 Lightbar brightness to check that the lightbar brightness is not set too low.

The following problems may occur when you power up the external lightbars:

Problem	Action
Lightbars do not illuminate	Use the methods described in 3.2.2 Control box power up to check that the control box has started successfully. Use the procedure described in 3.4.7 Lightbar brightness to check that the lightbar brightness is not set too low. Check the system harness between the control box and the lightbars.
Lightbars flash in the wrong sequence	The lightbars have probably been installed incorrectly. Consult your site supervisor.

3.2.2 Control box power up

Observe the control box after the system has powered up.

You should see a guidance screen, softkeys, automatic control status indicators, and optional text items (if configured).

If the machine has one or more 3D sensors installed and configured, the following items appear:

- A plan view guidance screen.
- The correct machine icon for your machine type.
- A site plan, if the system has a site plan file.
- A design or map, if one was loaded when the system was last powered down.

The following problems may occur when you power up the control box and the system:

Problem	Action
Control box does not start	Check that the master disconnect switch and machine power switch are on. Check the ignition switched power cable section of the system harness.
Start-up is interrupted by the “Error loading avoidance zone” error message	The avoidance zone file is corrupt. Consult your site supervisor.
Start-up completes but the *Direction* dialog appears	The machine direction monitor has failed. Consult your site supervisor. To continue, press  . A guidance screen appears. Before you begin work, press **Direction: Unknown** and set the machine’s direction.

Problem	Action
Start-up completes but the error message “Some of the required devices are not responding” appears	A device specified during system configuration is missing or not connected. Follow the procedure described in 7.3 Running system diagnostics.
Start-up completes but the error message “Check Machine Measurements” appears	The system has detected a discrepancy between a configured machine measurement, and an observed one, possibly because an incorrect machine configuration file has been loaded. Consult your site supervisor.
Start-up completes but the error message “New valve module detected” appears	The system has detected a discrepancy between the serial number of the valve module used for the current valve calibration and the serial number of the installed valve module, possibly because an incorrect machine configuration file has been loaded. Consult your site supervisor.
Start-up completes but the wrong machine icon appears on the guidance screen	An incorrect machine configuration file has been loaded. Consult your site supervisor.

3.3 Software option keys

The system supports an enhanced option key model based on specific machine types and functionality. For more information contact your dealer.

3.3.1 Software support

For new control boxes the software will self-generate the initial software support period. If no software support date is set then an initial dialog screen is presented to you. You can either press softkey 3 to activate software support or decide not to do this at this time.

If software support is not activated, the software will function normally for 60 minutes after which time it will cease to calculate machine positions, making the software unusable for machine control. On the next power cycle, if software support is still not set, then you are presented the same initial screen.

To extend this software support date, software support extension option keys are available via the Trimble Store.

3.3.2 Troubleshooting option keys

In the absence of a valid option key for at least one machine type, the system displays a persistent **Option not Installed** flashing message and does not resolve any machine position information.

When a machine settings file is restored that specifies a machine type not supported by the current option key set, the following full screen error message is displayed:

The system lacks the Option Keys necessary to support the configured machine type.

When a machine settings file specifies a supported machine type but includes settings relating to a level of functionality not currently supported, the settings are loaded but are not enabled. After the load has completed, the following full screen warning message is displayed:

Not all the settings in the selected machine settings file can be accessed, the system lacks the Option Keys necessary to fully support the specified machine configuration.

After the correct option key is loaded, the settings, as described by the loaded machine settings file, should be usable.

3.4 Work preparation checks

As you get ready to begin work, you need to prepare the system for the job. Perform the following work preparation tasks as and when described below:

Check and set ...	When	To learn how, see ...
Machine settings	As instructed by your site supervisor, or if an error in machine measurements is reported	3.4.1 Machine settings
Mode selection	• When you restore machine settings • When devices have been added or removed • When you need to switch between guidance systems	3.4.2 Switching guidance modes
Main screen views	As required for the current job and environment	3.4.3 Main screen views
Display brightness	Every power-up	3.4.4 Display brightness
Display settings	As instructed by your site supervisor	3.4.5 Display settings
Keypad backlight brightness	Every power-up	3.4.6 Keypad backlight brightness
Lightbar brightness	Every power-up	3.4.7 Lightbar brightness
Lightbar tolerances	As instructed by your site supervisor, or when there is a significant change in material or accuracy requirements	3.4.8 Lightbar tolerances
Blade wear	As instructed by your site supervisor	3.4.9 Checking blade wear

3.4.1 Machine settings

To ensure accurate guidance, you must use the correct machine settings. Machine settings are typically saved in a machine settings file.

To view your current machine settings:

1. Press from any guidance screen.
2. Press **Installation**.
3. Select *Machine Settings*.

   View your current settings. If not correct, contact your site supervisor.
4. Press to exit.

Saved settings include calibration settings for:

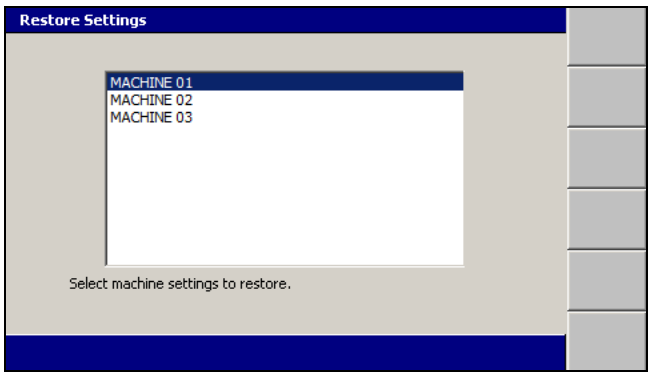
- EM400 electric masts.
- Hydraulic valves, if a valve module is installed and configured.

All saved machine settings are restored, with the following exceptions:

- Calibration settings for AS400 and RS400 sensors are not saved in a machine settings file, and are not restored when you restore the settings file.
- Valve calibrations that are older than the currently loaded valve calibration.
- To learn more about sensor calibration, see 3.9 Sensor calibration

To restore a machine settings file:

1. From any guidance screen, press .
2. Select *Restore Settings*.
3. Select *Machine Settings*.



4. Select the correct setting file for your machine.

5. To confirm the settings, press ; to exit without saving the changes, press .

ATTENTION — Always check the *Blade Wear* dialog. The machine cutting edge may have worn (or been renewed) since the *Machine Settings* were saved.

When you restore a machine settings file, a dialog warns you to check the blade wear setting. To learn how to do this, see 3.4.9 Checking blade wear.

Changes take effect immediately.

The following problems may occur when you try to restore machine settings:

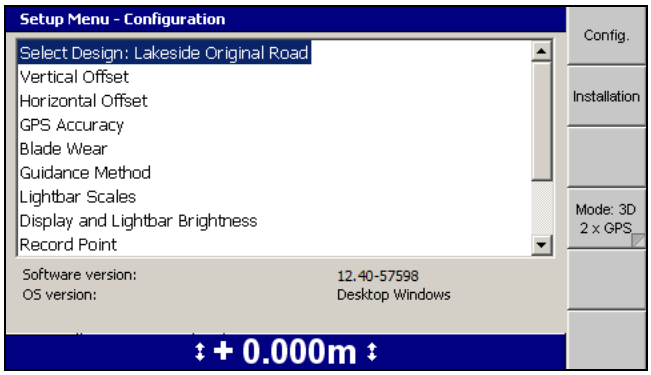
Problem	Action
Invalid machine settings file	The machine settings file is corrupt. The machine settings are for the wrong machine type. Consult your site supervisor.
No settings suitable for your machine	The machine settings data is incorrect. Consult your site supervisor.
New valve module detected	The machine settings file contains a valve calibration for a valve module not currently installed on your machine. Either: • Restore a machine settings file that contains a valve calibration for the installed valve module, or • Recalibrate the valves.

3.4.2 Switching guidance modes

You can use a variety of guidance modes even if the sensors required for a particular configuration are not detected.

Use the **Mode** softkey to switch between systems, as an alternative to using multiple machine settings files:

1. From any guidance screen, press . The **Mode:<value>** softkey indicates the current guidance mode.



2. If required, press **Mode: <value>** to switch to a different mode. When a new sensor or device is added to or removed from the machine, the system automatically updates the mode values.

***Note** – To choose from a list of available systems or to enable / disable specific systems, press and hold* **Mode: <value>**.

3.4.3 Main screen views

Main Screen Views allows you to configure some views on the main screen to suit the specifics of the current job and environment.

The following tables describe the functions that can be adjusted using *Main Screen Views*.

***Note** – Some of the items listed in the following table may not apply to your system.*

Table 3.1 — Main screen views - Plan views

Item	Options	Description
Rotation	Yes / No	Yes - Keeps the machine facing up the display. No - The plan view is drawn north-up.
Auto pan	Yes / No	Yes - Pans the display to keep the machine displayed. No - The plan view will not pan if the machine drives off the display.
Display recorded points	• Points only • Points and Names • None	• Only displays the points • Displays the points and point names • Does not display points

Table 3.2 — Main screen views - Cross section view

Item	Options	Description
View direction	Forwards / Backwards	Displays the machine icon direction of travel.

Table 3.3 — Main screen views - Active views

Item	Options	Description
Plan (no mapping)	Yes / No	Yes - A plan view with no mapping content is available.
Terrain	Yes / No	Yes - A plan view with terrain mapping is available.
Cut/Fill	Yes / No	Yes - A plan view with cut/fill mapping is available.
Pass count	Yes / No	Yes - A plan view with pass count is available.
Ripper	Yes / No	Yes - A plan view with ripper mapping is available.
Radio coverage	Yes / No	Yes - A plan view with radio coverage mapping is available.
Profile	Yes / No	Yes - A profile view is available.
Cross section	Yes / No	Yes - A cross section view is available.
Split view	Yes / No	Yes - A profile and cross section split view is available.
Text view 1	Yes / No	Yes - A text view is available.
Text view 2	Yes / No	Yes - A second text view is available.

Table 3.4 — Main screen views - Main Screen Softkeys

Item	Options	Description
Mapping Softkey	• None • Mapping: On/Off • Reset Maps • Record Point	Configure the function of the main screen view Mapping Softkey.
Press and Hold	• None • Record Point	When Record Point is selected, press and hold **Record Point** or **Mapping/Recording** to display the Record Point dialog.

3.4.4 Display brightness

Use the following key combinations to adjust the brightness of the control box display for your working conditions:

- To increase the display brightness, hold down  and press  .
- To decrease the display brightness, hold down  and press  .

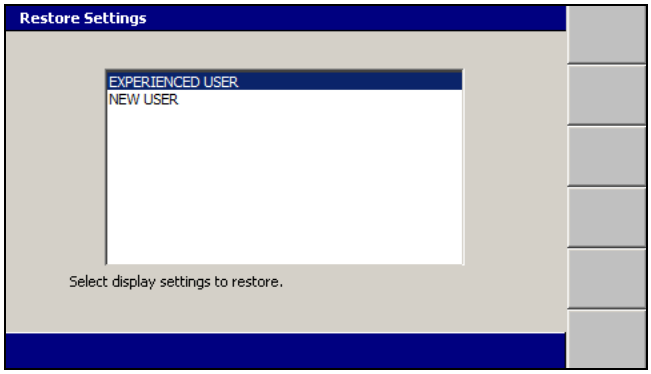
***Note** – You can also set the display brightness using the Display and Lightbar Brightness dialog from the Setup Menu – Configuration menu.*

3.4.5 Display settings

***Note** – You do not need to restore machine and/or display settings files every time you start the control box, as the system automatically saves and reloads the settings that were being used before the last shut down.*

Use the display configuration that has been created for you. To restore a display settings file:

1. From any guidance screen, press .
2. Select *Restore Settings*.
3. Select *Display Settings*.



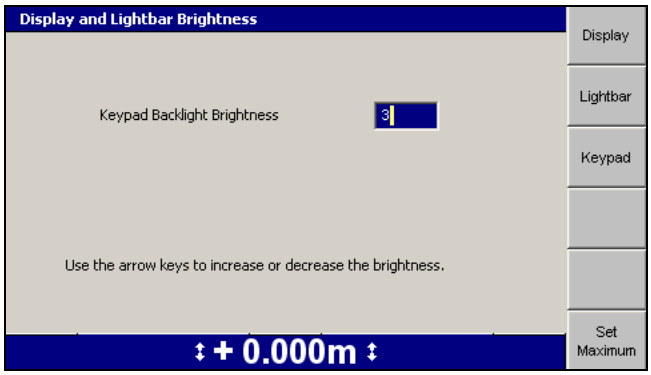
4. Select the correct setting file for your use.
5. To confirm the settings, press ; to exit without saving the changes, press .

3.4.6 Keypad backlight brightness

You can be adjust the control box keypad backlight brightness to suit operating conditions.

To check and adjust the keypad backlight brightness:

1. From any guidance screen, press .
2. Select *Display and Lightbar Brightness*.
3. Press **Keypad**.

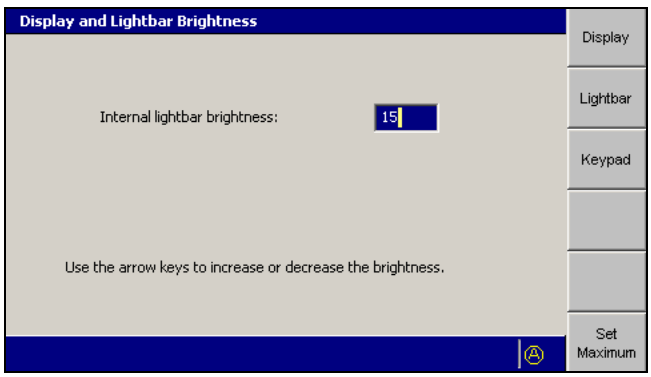


4. Use one of the following tools to set the keypad backlight brightness:
   - Use the arrow keys to increase or decrease the value of the *Keypad Backlight Brightness* field.
   - Press **Set Maximum** to set the value to the maximum of 15.
5. To confirm the settings, press ; to exit without saving the changes, press .

3.4.7 Lightbar brightness

To check and adjust the lightbar brightness for your working conditions:

1. From any guidance screen, press .
2. Select *Display and Lightbar Brightness*. The Display screen of the *Display and Lightbar Brightness* dialog appears.
3. Press **Lightbar**.



4. Use one of the following tools to set the lightbar brightness:
   - Use the arrow keys to increase or decrease the value of the *Lightbar brightness* field.
   - Press **Set Maximum** to set the value to the maximum of 15.

5. To confirm the settings, press ; to exit without saving the changes, press .

3.4.8 Lightbar tolerances

Note – *In systems that do not have lightbars configured, you should still check the on-grade tolerances for the Cut/Fill text items using the On-Grade Tolerance dialog in the Setup Menu – Configuration menu. The interface is similar to the interface described in this section.*

The lightbar tolerances control not only the way the lightbar LEDs are lit, but also how far the cutting edge can be from design before the **Off Grade** message is displayed, and the sensitivity of Cut/Fill map recording.

For example, cab mounted GNSS systems will fail to record deviations in cut/fill less than 0.3 m (about 1 ft.), when the lightbar or on-grade tolerance is set to the default value. In this case, you can follow this procedure to reduce the tolerance and increase map recording sensitivity.

To check and/or set the tolerance thresholds (scales) for the lightbars:

1. From any guidance screen, press .
2. Select *Lightbar Scales*.

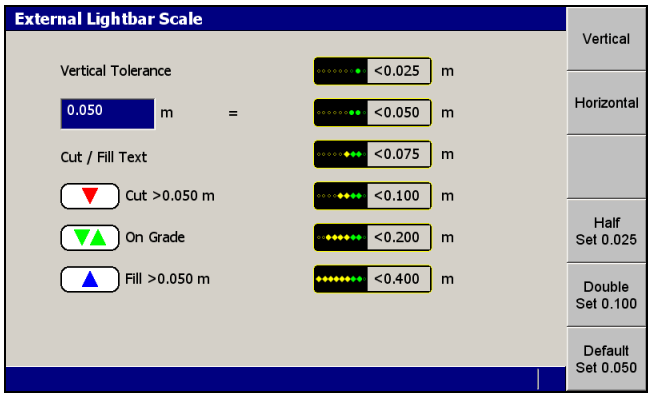


Figure 3.2 External lightbar scale dialog

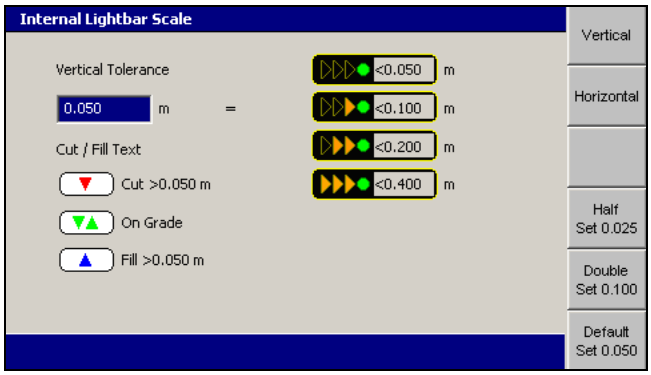


Figure 3.3 Internal lightbar scale dialog

3. Press either **Vertical** or **Horizontal** to view the current vertical or horizontal tolerance settings respectively.

   ***Note** – Conventional guidance systems do not provide horizontal guidance, and do not provide an interface for setting horizontal tolerances.*

   ***Note** – The tolerances for both vertical lightbars are set to the same value.*

4. If required, use the following tools to set the off grade distance at which the green LED(s) are lit. The value must be between 0 m and 12.5 m (41 ft):
   - Edit the *Vertical Tolerance* or *Horizontal Tolerance* field directly.
   - Press **Default Set <value>** to set the tolerance to the default value.
   - Press **Half Set <value>** to set the tolerance to half of the current value.
   - Press **Double Set <value>** to set the tolerance to twice the current value.

   ***Note** – The remaining threshold values are calculated automatically, and appear in the dialog. The values shown on these softkeys will change, depending on the current tolerance value.*

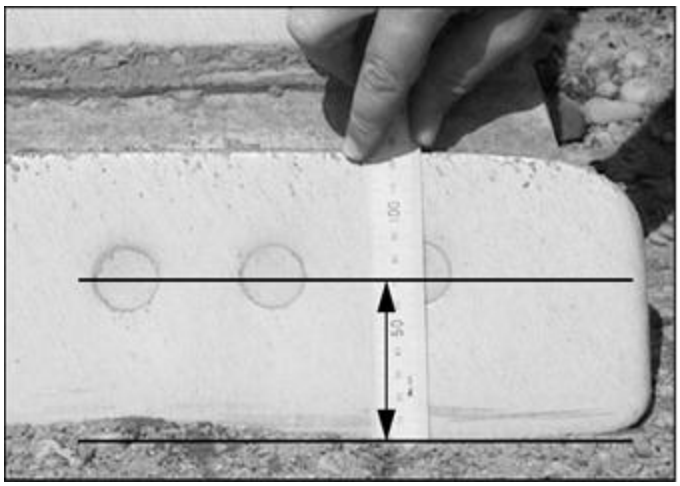
5. To confirm the settings, press ; to exit without saving the changes, press .

Any changes take effect immediately.

3.4.9 Checking blade wear

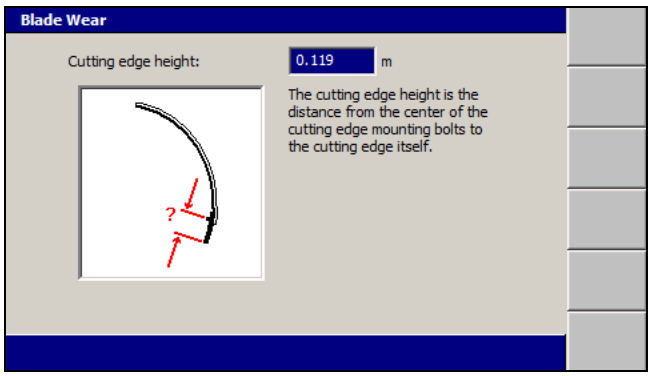
You must check the changes in the cutting edge measurements caused by blade wear regularly, or as instructed by your site supervisor. To check and/or set the blade wear compensation:

1. Measure the cutting edge height to the center of the bolt holes.



If the blade wears unevenly, use an average value. However, guidance will never be better than the range of the differences in cutting edge height.

2. From any guidance screen, press .
3. Select *Blade Wear*.



4. If required, edit the *Cutting edge height* field.
5. To confirm the settings, press ; to exit without saving changes, press .

The changes take effect immediately.

3.4.10 Conventional system valve speed

***Note** – Conventional system and 3D system valve speeds are NOT the same and need to be adjusted separately.*

Valve speed settings in the automatic control system depend on the type of material that you are moving (for example, sand, hard rock, or dirt) and the tasks you are doing (for example, base grade or finished grade).

A temporary design surface is created for adjusting the valve speeds. The lightbars provide guidance to the temporary design surface only while the *Valve Speed* dialog is open.

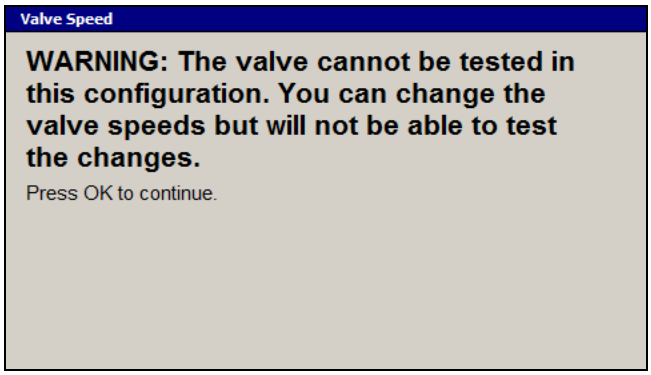
To adjust the conventional system valve speeds:

1. Make sure that the system is generating cutting edge position information consistent with the job you are to work on.
2. Make sure that the valves are calibrated.
3. Adjust the throttle so that the machine is at operating revs.

WARNING — The cutting edge of the machine may move without warning when automatic controls are on. These sudden movements could cause injury to anyone near the cutting edge, or damage to the machine. Always put the system in Manual and engage the machine's park brake before you leave the machine, or when somebody is working near the cutting edge.

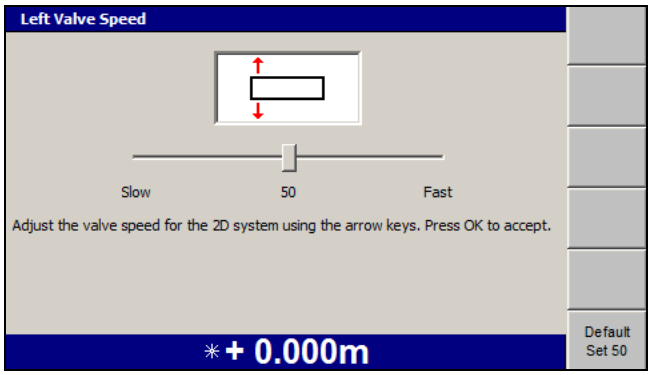
4. Using the automatic controls, cut a test pass in the material you are working, so that you can judge the current performance of the automatic controls.
   - If the cut surface shows long period waves (wave lengths greater than about 2 m or 6 ft) the valve speed may be too low.
   - If the cut surface shows the blade is “jittery”, the valve speed may be too high.
5. Set the Auto/Manual switches to Manual.
6. From the *Setup Menu – Configuration* menu, select *Valve Speed*. The temporary design surface is created, and if more than one valve is being used the *Valve Speed – Select Valve* dialog appears. Select the valve to adjust and press  .

   On a conventional system, the following full screen warning message appears.



If using a motor grader with sideshift, the message also tells you to center the blade.

7. Press . A dialog similar to the following appears:



8. Do one of the following:
   - To increase or decrease the valve speed, move the slider.
   - To set the speed to the default value, press **Default Set 50**.
9. To confirm the settings, press ; to exit without saving changes, press .

The valve speed is immediately updated.

Possible problems that may occur when you try to set the valve speed are as follows:

Problem	Action
Insufficient conventional position accuracy	If you are using lasers or sonic tracers to generate lift information, check that they are benched.

Problem	Action
Insufficient 3D position accuracy	Even if you are using a conventional vertical guidance method, if the system is receiving 3D position information, it must be high accuracy. If you are using a UTS system, check that the UTS is turned on and locked on the target. If you are using a GNSS system, check that the GNSS receivers are correctly configured.
Valves not calibrated	Ask your site supervisor to calibrate the automatic control valves.

Tip – You can also adjust the elevation and slope valve speed settings on machines with single or dual laser and slope configurations.

3.4.11 3D system valve speed

***Note** – Conventional system and 3D system valve speeds are NOT the same and need to be adjusted separately.*

Valve speed settings in the automatic control system depend on the type of material that you are moving (for example, sand, hard rock, or dirt) and the tasks you are doing (for example, base grade or finished grade).

A temporary design surface is created for adjusting the valve speeds. The lightbars provide guidance to the temporary design surface only while the *Valve Speed* dialog is open.

To adjust the 3D system valve speeds:

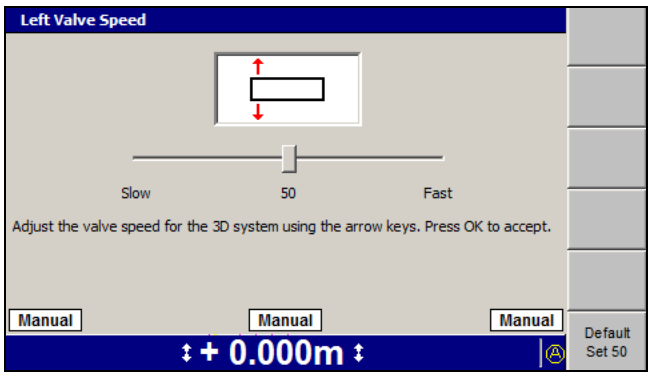
1. Make sure that the system is generating cutting edge position information that is consistent with the job you are to work on. For example, if you are using GNSS sensors, and are optimizing the valve performance for fine grade work, set the GNSS accuracy mode to *Fine*.
2. Make sure that the valves are calibrated.
3. Adjust the throttle so that the machine is at operating revs.

WARNING — The cutting edge of the machine may move without warning when automatic controls are on. These sudden movements could cause injury to anyone near the cutting edge, or damage to the machine. Always put the system in Manual and engage the machine's park brake before you leave the machine, or when somebody is working near the cutting edge.

4. Using the automatic controls, cut a test pass in the material you are working, so that you can judge the current performance of the automatic controls:

- If the cut surface shows long period waves (wave lengths greater than about 2 m or 6 ft), the valve speed may be too low.
- If the cut surface shows the blade is “jittery”, the valve speed may be too high.

5. Set the Auto/Manual switches to Manual.
6. From the *Setup Menu – Configuration* menu, select *Valve Speed*. A full screen warning message appears, telling you to raise the blade. If you have a machine with sideshift, the message also tells you to center the blade.
7. Follow the instructions in the warning message. This is the elevation at which the temporary design surface is created. Press . The temporary design surface is created and the *Valve Speed - Select Valve* dialog appears.
8. Select the valve to adjust. Press . A dialog similar to the following appears:



9. Do one of the following:
   - To increase or decrease the valve speed, move the slider.
   - To set the speed to the default value, press **Default Set 50**.
10. Move the blade until the lightbars indicate that the blade is above or below the on-grade position.
11. Set the Auto/Manual switches to Auto.
12. Watch how quickly or slowly the blade moves to the on-grade position:
    - If the blade moves slowly, but with no overshoot and correction, the valve speed may be too low.
    - If the blade moves quickly, but with overshoot and correction, the valve speed may be too high.

    ***Note** – The behavior of the automatic controls when they are not loaded by material does not by itself provide enough information to tune the valve speed. Always use this information in conjunction with the results of a test pass.*
13. Set the Auto/Manual switch to Manual.

14. To confirm the settings, press ; to exit without saving changes, press .
15. Repeat the above steps, making incremental changes to the valve speed, until the surface cut during the test pass meets your requirements.

Some problems that may occur when you try to set the valve speed are as follows:

Table 3.5 — Valve speed settings problems

Problem	Action
Insufficient 3D position accuracy	If you are using a UTS system, check that the UTS is turned on and locked on the target. If you are using a GNSS system, follow the procedure in 7.3.2 GNSS diagnostics and satellite monitoring.
Valves not calibrated	Ask your site supervisor to calibrate the automatic control valves.

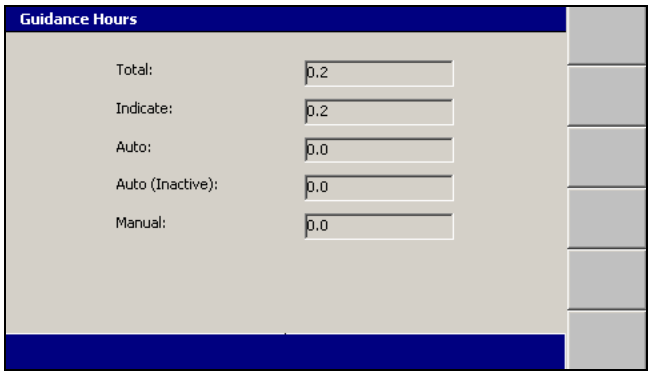
3.5 Operating hours

By default, the system logs the number of hours (that is, the 'guidance hours') that the system has been operational. This section describes how to view the *Guidance Hours* dialog.

The *Guidance Hours* dialog displays the cumulative operating hours for the control box.

***Note** – If you move the control box between machines, the hours do **not** reset.*

1. From any guidance screen, press .
2. Press **Installation**.
3. Select *Guidance Hours*.



Field	Explanation
Total	Total number of hours the guidance system has been operating.
Indicate	Number of hours the machine has worked in 3D indicate mode.
Auto	Number of hours the machine has worked in 3D auto mode.
Auto (Inactive)	Number of hours the machine has worked in 3D auto mode, with autos inactive.
Manual	Number of hours the machine has worked in manual mode.

4. Press or to exit the *Guidance Hours* dialog.

***Note** – Guidance hours are also recorded in the Program Log at start-up and shut down.*

3.6 Configuring the machine radio

The machine radio communicates with the UTS instrument radio or the GNSS base station radio.

Use this radio ...	With ...
SNR2410 or SNR2420	A UTS or GNSS system.
SNR910	A GNSS system.
SNRx10	A GNSS system.

To open the *Connectivity Settings* dialog:

1. From any guidance screen, press .
2. Press **Installation**.

3. Select *Connectivity Settings*. The options are:
   - *Machine Radio Configuration*. See 3.6.1 Machine radio configuration.
   - *Select Radio Band*. See 3.6.2 Select radio band.

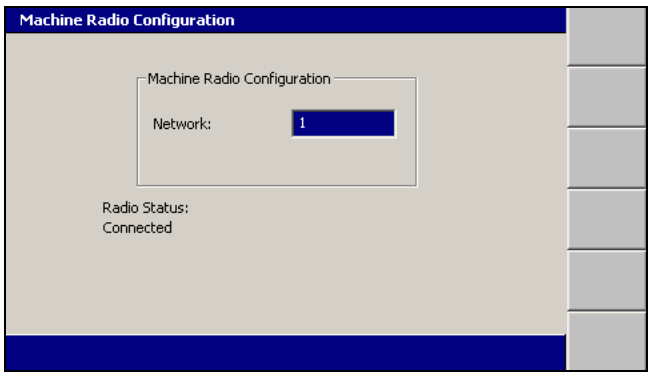
***Note** – If a cellular radio is installed more options are available. See 3.7 Wi-Fi networking.*

3.6.1 Machine radio configuration

1. From the *Connectivity Settings* dialog, select *Machine Radio Configuration*. The system searches for a radio.
2. Use the arrow keys to enter information into the *Machine Radio Configuration* dialog. To save the changes, press ; to exit without saving changes, press .

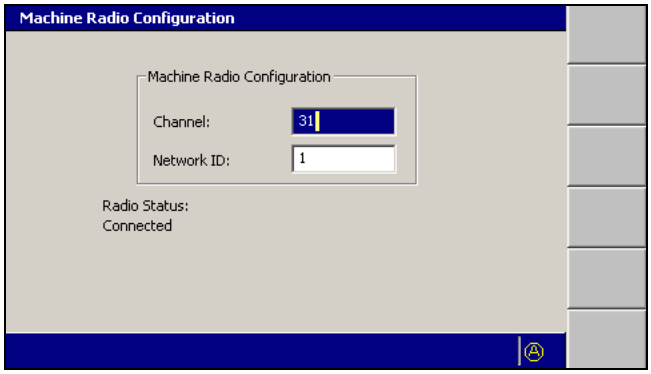
The *Machine Radio Configuration* dialog displays different fields, depending on your radio type:

- For a 900 MHz radio on a GNSS system:



***Note** – This release of the system requires the use of SiteVision Office 7.4 or later for wireless communications over 900 MHz radios. For more information, refer to the site supervisor's manual.*

- For a 2400 MHz radio on a UTS system:



The *Radio Status* field can provide the following messages:

This message ...	Displays when the ...
Not Found	System cannot communicate with the radio.
Configuring	Radio is currently being configured.
Configuration failed	Radio configuration failed.
Connected	Radio connects to the system.
App <version num.> required	Radio firmware must be upgraded to the specified version.
Loader <version num.> required	Radio firmware must be upgraded to the specified version.
System Error	Firmware is not installed correctly.
This radio type cannot be configured.	System connects to an unsupported radio.
UTS incompatible	System connects to a 900 MHz radio for use with an SPSx30 UTS.

The *Machine Radio Configuration* dialog enables you to configure the settings used for data communications. The following table outlines how to configure your machine radio:

To configure this radio ...	Confirm that you have turned on the ...	Enter this into the ***Machine Radio Configuration*** dialog ...	Also configure the same ...
SNR910	SNR910 machine radio	A network number between 1-40	Network number on the radio-modem (using the base station radio display)
SNR2410or SNR2420	SNR2410 or SNR2420 machine radio	• A channel number between 31-60 • A network ID between 0 and 255. Default is 1.	Channel number on the internal UTS radio (using the UTS face plate)

To configure this radio ...	Confirm that you have turned on the ...	Enter this into the *Machine Radio Configuration* dialog ...	Also configure the same ...
SNRx10 or SNR2420	SNRx10 or SNRx20	A frequency between 0-255. The system configures the same frequency in the machine radio and also programs the radio as a mobile radio	

***Note** – If your site uses both GNSS and UTS positioning systems with 900 MHz radios, then the GNSS radios and each UTS radio must be on a different network.*

***Note** – If you have a dual band SNRx10 radio, make sure that both radio modules are assigned a radio network ID so that you can switch between radio bands if necessary. For more information, see 3.6.1 Machine radio configuration.*

The changes take effect immediately. The network number is uploaded to the machine radio, and the machine radio is programmed as a rover radio.

For 900 MHz and 2400 MHz radios, the network number is stored in the control box. Whenever you start the system, the control box automatically sets the same network number in the machine radio. For example, if a radio is moved from one machine to another, the control box automatically sets the same radio network that was configured for the previous radio.

3.6.2 Select radio band

1. From the *Connectivity Settings* dialog, select *Select Radio Band*.
2. To change the radio band, press **Set 450 MHz**, or **Set 900 MHz** or **Set 2400 MHz**.

***Note** – The radio bands displayed depend on the modules available with your band configurable radio. In addition, the radio bands you can actually use depend on the system configuration. For example, you can only use the 2400 MHz band when the system is using a UTS for guidance. In this case, the radio will be configured to 2400 MHz on startup, connection and reconfiguration, irrespective of the band chosen in the Select Radio Band dialog.*

3.7 Wi-Fi networking

The system supports the use of the following Wi-Fi enabled wireless device(s):

- The SNRx20 range of modular radio modems.
- The SNM940 digital communications module.

Wi-Fi networking allows the exchange of data over short distances within a site without the installation of base radios or other major infrastructure.

3.7.1 About cellular modems

A cellular modem is a wireless device that enables the on-machine system to connect to a computer network, such as the Internet, over a cell phone network.

The GCS900 Grade Control System uses the cellular modem to:

- Connect to the Connected Community website.
- Connect to an IBSS (Internet Base Station Service) base station.
- Connect to VRS (Virtual Reference Station).

Note – *Wireless file exchange does not replicate all the features of the wireless communications feature. For example, you cannot use the file exchange feature to request a snapshot of the display.*

3.7.2 About Wi-Fi networking

Wi-Fi networking manages two-way wireless IP (Internet Protocol) data transfer between two or more wireless devices and, optionally, a wired networking infrastructure. Wi-Fi is intended for medium to high speed data transfer over short distances.

3.7.3 SNRx20 radio modem status indicators

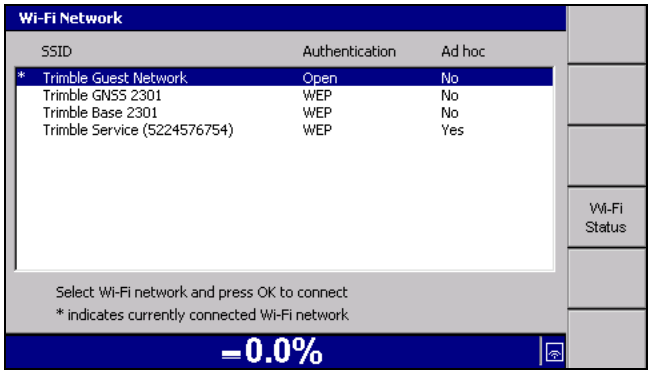
These are the same as the SNRx10 indicators. See 7.6.4 SNRx10 data radio status indicators.

3.7.4 Managing Wi-Fi networks

To connect to a Wi-Fi network:

1. From the *Setup Menu – Installation* menu, select *Connectivity Settings*.
2. Select *Wi-Fi Network*. The known networks are downloaded from the Wi-Fi

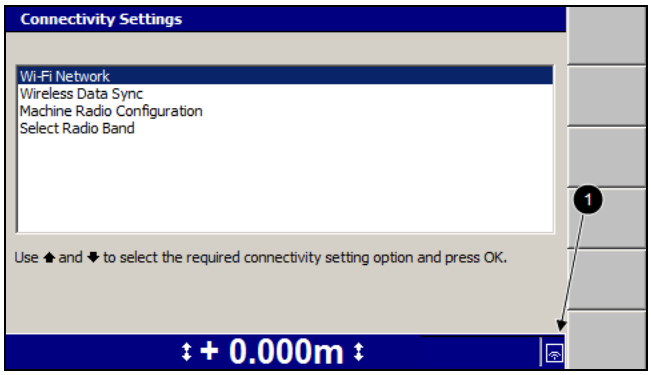
device and listed on the control box.



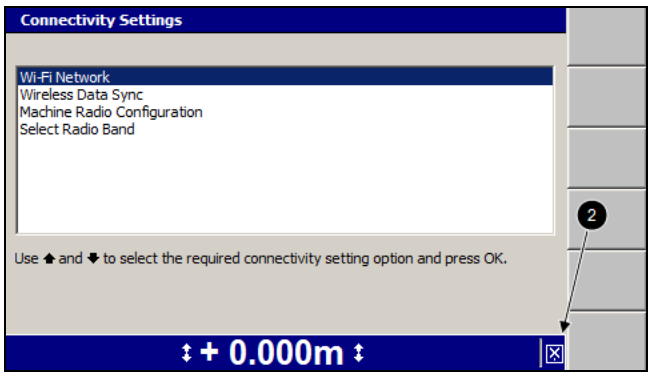
3.7.5 Connecting to a Wi-Fi network

***Note** – Before you can connect to a Wi-Fi network, the network details and authorization pass phrase must be entered into the list of known networks. For more information, see your site supervisor.*

1. From the list of known networks, select the Wi-Fi network you want to join and press .
2. The system attempts to connect to the selected Wi-Fi network. When the connection process completes, successfully or otherwise, the *Connectivity Settings* menu displays.
3. If the system has connected to the requested network the received Wi-Fi signal strength displays in the status bar (❶).



Otherwise, the "disconnected" icon is displayed (❷).



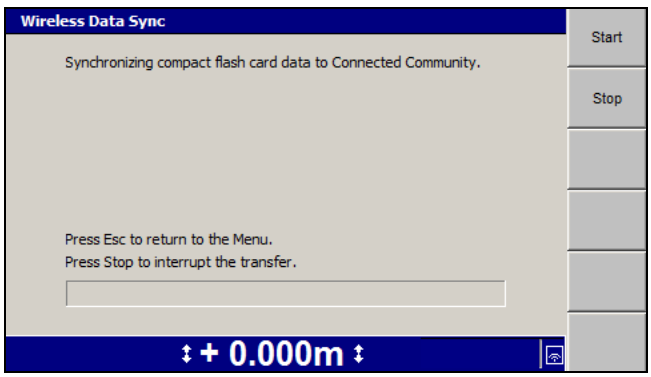
3.8 Exchanging files with a Connected Community filespace

The system supports the use of the Trimble® SNM940 cellular modem to exchange files with a customer's file space on the Connected Community website.

3.8.1 Initiating Connected Community file exchange from the machine

To synchronize the system to the Connected Community:

1. From the *Setup Menu – Installation menu*, select *Connectivity Settings*.
2. Select *Wireless Data Sync*.



3. Press **Start** to begin the synchronization.

   The system establishes a connection, logs into the Connected Community server and begins file exchange. The status of the file exchange is displayed in the dialog. The progress of the file exchange is displayed on the progress bar.

4. When the exchange is complete the status changes to *Synchronization complete*. To return to the *Connectivity Settings* menu, press .

3.8.2 Connected Community file synchronization

The system supports both automatic and background synchronization when transferring files between the Connected Community and the system. Background synchronization allows you to use the system with file synchronization running in the background.

The system also supports resuming a background file synchronization from the point at which the synchronization may have been interrupted.

Using auto synchronization

Auto synchronization allows you to keep the office and machine files up to date, without manually initiating a data synchronization. To enable auto synchronization, see your site supervisor.

Using background synchronization

1. Start a data synchronization. See 3.8.1 Initiating Connected Community file exchange from the machine
2. Press  at any time to return to the system and continue working while the synchronization continues to run in the background. Full system control and guidance is supported, including use of autos.
3. To return to the synchronization dialog, select *Wireless Data Sync*. The current status of the file exchange is displayed.

Stopping and resuming synchronization

From the *Wireless Data Sync* dialog:

- Press **Stop** to interrupt the file exchange.
- Press **Start** to resume the file exchange.

3.8.3 Troubleshooting Connected Community file exchange

Use the following table to resolve Connected Community file exchange problems in the field:

Problem	Resolution
Is the wireless communications device installed correctly?	Check cables and connectors. See your site supervisor.

Problem	Resolution
Is the wireless communications device configured to connect to your Internet service provider?	See your site supervisor.
Is the system configured to use a wireless communications device?	See your site supervisor.
Is the wireless communications device connected to the Connected Community?	See your site supervisor.
Does the *Wireless Data Sync* dialog log in to the Connected Community server?	See 3.8.1 Initiating Connected Community file exchange from the machine

3.9 Sensor calibration

The fixed sensors on your machine need to be calibrated regularly to make sure that accurate guidance information is generated. Fixed sensors ***must always*** be calibrated when:

- A new sensor is added
- Installed sensors are moved to new locations

Fixed sensors can include the following:

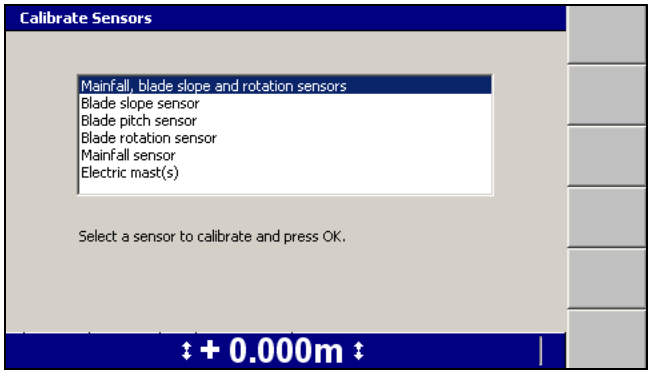
- AS400 mainfall sensor
- AS400 blade slope sensor
- AS400 blade pitch sensor
- RS400 rotation sensor
- EM400 electric mast

Before you carry out a sensor calibration, check the following items:

- Make sure that you have a suitable location to perform the calibrations. The location must be a hard, flat surface and there must be enough room to turn the machine around.
- Make sure that the centershift link bar is in the center hole.
- Remove all articulation, wheel-lean, and circle centershift.
- Check the pressure of all tires.
- Use the sideshift to center the moldboard.
- Use the chisel marks made during installation to align the blade.

To select a sensor calibration method:

1. From any guidance screen, press .
2. Select *Calibrate Sensors*:



The *Calibrate Sensors* dialog lists the calibration options that are available. The contents of the list depend on the sensors configured for your machine.

3. Select the calibration option that you require. Possible calibration options are listed below.

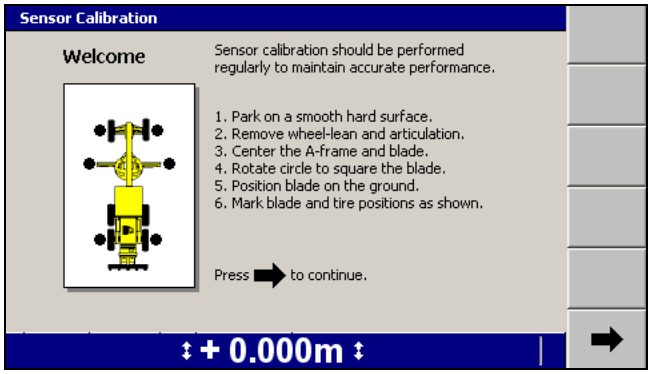
Option	Use to …	To learn how, see ...
Mainfall, blade slope and rotation sensors	Accurately calibrate one or more of the following sensors: • mainfall • blade slope • blade rotation	3.9.1 Cross slope sensor group calibration
Blade slope sensor	Quickly calibrate the blade slope sensor	3.9.2 Blade slope sensor calibration using a digital level
Blade pitch sensor	Quickly calibrate the blade pitch sensor	3.9.3 Blade pitch sensor calibration
Blade rotation sensor	Quickly calibrate the blade rotation sensor	3.9.4 Blade rotation sensor calibration
Mainfall sensor	Quickly calibrate the mainfall sensor	3.9.5 Mainfall sensor calibration
Electric mast(s)	Calibrate an electric mast after the mast has been installed or moved	3.9.6 Electric mast calibration
Linked EM Calibration	Calibrate dual electric masts after the masts have been installed or moved	3.9.7 Linked electric mast calibration

3.9.1 Cross slope sensor group calibration

Tip – Trimble recommends that the full sensor calibration is significantly more accurate than the mainfall sensor single point (quick) calibration.

To carry out a full sensor calibration:

1. Select *Mainfall, blade slope and rotation sensors*.

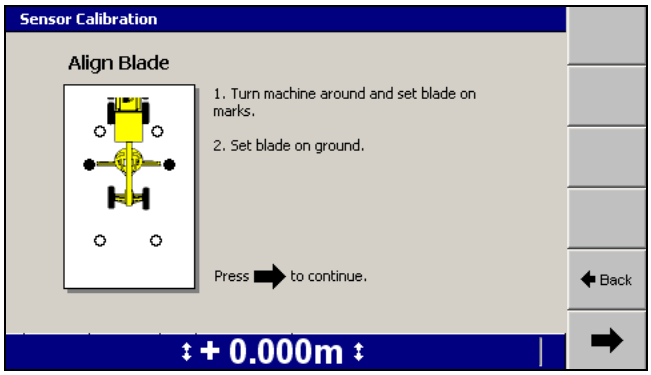


2. To prepare the machine for a cross slope sensor group calibration:
   a. Rotate the blade so that it is perpendicular to the center line of the machine. For motor graders, use the chisel marks made during installation to align the blade.

ATTENTION — As the rotation sensor is calibrated in this step, the more accurately the blade is aligned the more accurately the sensor is calibrated.

   b. Place the cutting edge of the blade firmly on the ground until the cylinder sockets are supporting no weight. For motor graders, the cylinder rods should rotate freely.
   c. Mark the position of the blade tips and the center of the front wheels, or front track rollers, and then mark a line that is about 600 mm (2 ft.) long running parallel to the front wheels, or front track rollers. Mark the center of the rear wheel, or rear track rollers, and then mark a line that is about 600 mm (2 ft.) long running parallel to the rear wheels, or rear track rollers.
3. Press ➡. The rotation sensor is calibrated, and mainfall and blade slope calibration readings are taken.

   ***Note** – If the machine moves while the system is calibrating the sensors, an error message appears. After the machine has been stationary for a few seconds, you can press ➡ to continue the sensor calibration.*
4. The *Align Blade* screen of the *Sensor Calibration* wizard, similar to the following, appears:

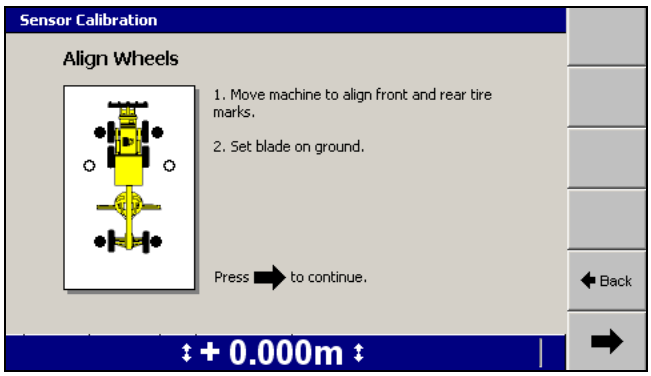


5. Raise the blade and then turn the machine 180°. Do not articulate the machine or not lean the wheels and do not change the circle position while executing the turn.

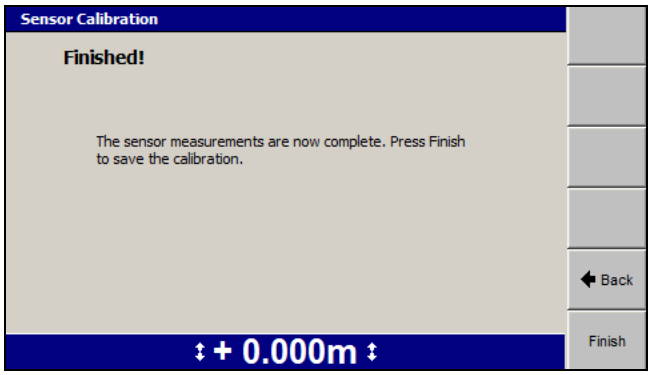
   Position the blade on the marks locating the blade tips made in step 2. You do not need to align the wheels or rollers on the wheel/roller marks at this stage. Place the blade firmly on the ground so that the cylinders are supporting no weight.

   ***Note** – If necessary, you can rotate the blade or sideshift the motor grader blade to place it on the marks made in step 2.*

6. Press ➡. The blade slope sensor is calibrated.
7. The *Align Wheels* screen of the *Sensor Calibration* wizard, similar to the following, appears:



8. Raise the blade and then position the wheels, or rollers, on the marks made in step 2. Place the blade firmly on the ground so that the cylinders do not support any weight.
9. Press ➡. The mainfall sensor is calibrated.

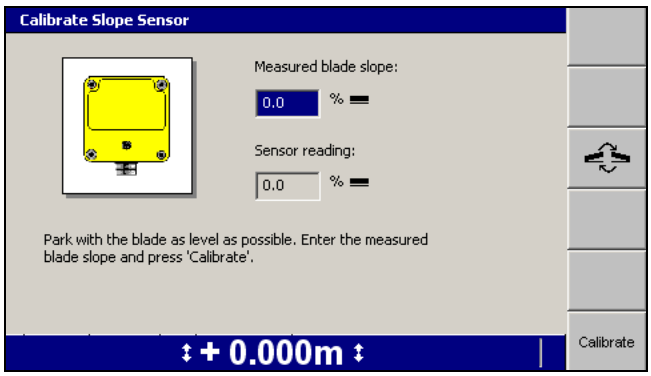


10. To accept the calibration and return to the *Calibrate Sensors* menu, press **Finish**. If you want to redo all or part of the calibration, press the back arrow softkey to return to the previous screen. To escape to the *Calibrate Sensors* menu without saving the calibration, press .

3.9.2 Blade slope sensor calibration using a digital level

To carry out a quick blade slope sensor calibration:

1. Select *Blade slope sensor*.



2. Make sure that the machine is parked and that the blade is square.

Tip – Check that the digital level is correctly calibrated before use.

WARNING — When working with a raised blade, if you allow parts of your body to extend under the cutting edge of the blade or blade attachments, then unexpected movement of the blade may result in injury or death. Always maintain adequate clearance from the potential path of the cutting edge or blade attachments.

3. Use either a digital level or similar leveling device to level the cutting edge. The *Sensor reading* field shows the current blade slope reading from the sensor.

4. To change the direction of the slope, press  .
5. Enter the measured blade slope from the digital level into the *Measured blade slope:* field.
6. Press **Calibrate**. The blade slope sensor is calibrated. The *Calibrate Slope Sensor* dialog closes. The *Calibrate Sensors* menu appears.

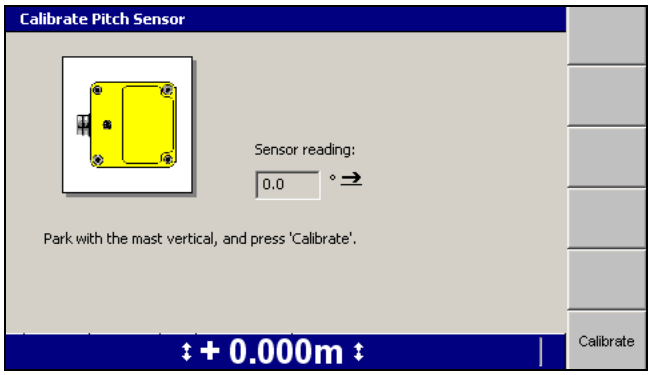
Before you move the blade, check the blade slope calibration:

1. Reselect the *Blade slope sensor* option. The *Calibrate Slope Sensor* dialog appears again.
2. Confirm that the blade slope reading shown in the *Sensor reading* field matches the blade slope measured with the digital level.

3.9.3 Blade pitch sensor calibration

To carry out only a blade pitch sensor calibration:

1. Select *Blade pitch sensor*.



2. Make sure that the machine is parked on a level surface and that the blade is square.

Tip – Check that the digital level is correctly calibrated before use.

WARNING — When working with a raised blade, if you allow parts of your body to extend under the cutting edge of the blade or blade attachments, then unexpected movement of the blade may result in injury or death. Always maintain adequate clearance from the potential path of the cutting edge or blade attachments.

3. Roll the blade into its operational position.
4. Adjust the bolt hole used to secure the mast angle bracket so that the mast is as vertical as possible and, if necessary, ask your site supervisor to change the

bolt hole in the *Adjust Bolt Hole* dialog. If you are calibrating a dual-GNSS system, then the left mast must be adjusted.

5. Using either a digital level or similar leveling device, roll the blade to make the mast vertical. If you are calibrating a dual-GNSS system, then the left mast must be made vertical.

   The *Sensor reading* field shows the current blade pitch reading from the sensor.

6. Press **Calibrate**. The blade pitch sensor is calibrated. The *Calibrate Pitch Sensor* dialog closes. The *Calibrate Sensors* menu appears.

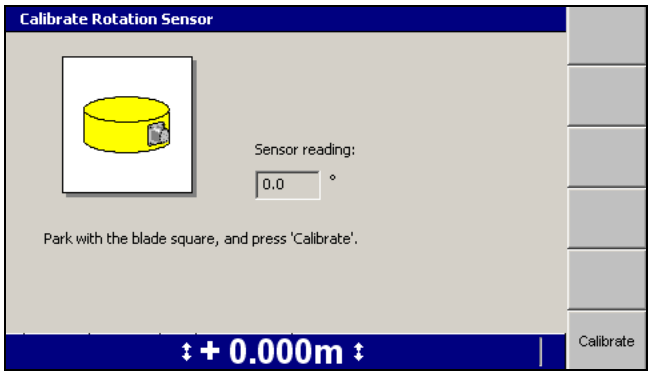
Before you move the blade, check the pitch sensor calibration:

1. Reselect the *Blade pitch sensor* option. The *Calibrate Pitch Sensor* dialog appears again.
2. Confirm that the pitch sensor reading shown in the dialog is zero.

3.9.4 Blade rotation sensor calibration

To carry out a quick blade rotation sensor calibration:

1. Select *Blade rotation sensor*.



2. Make sure that the machine is parked on flat ground and that the blade is square.

Tip – If on a motor grader, the installer will often leave calibration marks on the circle, which can be used when calibrating the rotation sensor.

3. Press **Calibrate**. The blade rotation sensor is calibrated. The *Calibrate Rotation Sensor* dialog closes. The *Calibrate Sensors* menu appears.

Before you move the blade, check the blade rotation calibration:

1. Reselect the *Blade rotation sensor* option. The *Calibrate Sensor* dialog appears again.

2. Confirm that the blade rotation sensor reading shown in the dialog is zero.

Tip – To check and adjust for slop or backlash on a motor grader circle, see your site supervisor.

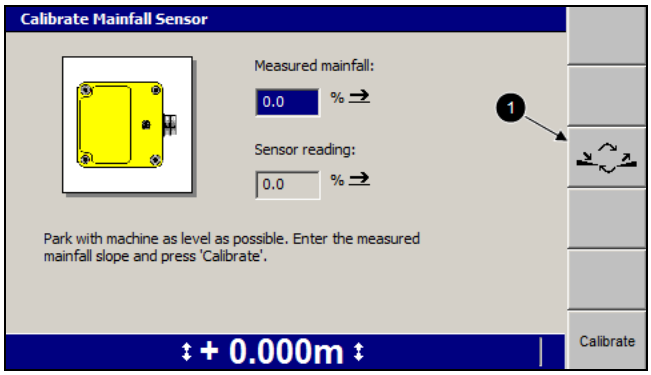
3.9.5 Mainfall sensor calibration

Tip – Trimble recommends that the full sensor calibration is significantly more accurate than the mainfall sensor single point (quick) calibration.

The mainfall sensor measures the rigid section of the machine in relation to horizontal. The system assumes that the mainfall is measured in the direction of travel of the machine.

To carry out a quick mainfall sensor calibration:

1. Select *Mainfall sensor*.



2. Park with machine as level as possible.
3. To change the slope direction, press **Sensor Slope** (❶).
4. Enter the measured mainfall slope value in the *Measured mainfall* field.
5. Press **Calibrate**. The mainfall sensor is calibrated. The *Calibrate Mainfall Sensor* dialog closes. The *Calibrate Sensors* menu appears.

Before you move the blade, check the mainfall sensor calibration:

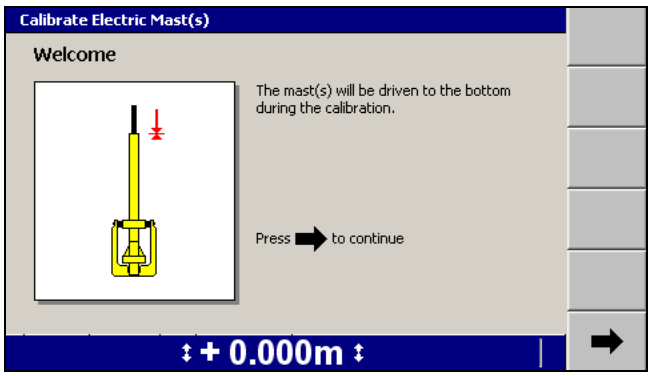
1. Reselect the *Mainfall sensor* option. The *Calibrate Mainfall Sensor* dialog appears again.
2. Confirm that the *Sensor reading* value has changed to the measured mainfall value that you entered in Step 4 above.

   ***Note** – The Measured mainfall field should now have a value of 0.0 to allow you to enter a new mainfall slope value, if required.*

3.9.6 Electric mast calibration

To carry out an electric mast calibration:

1. Select *Electric mast(s)*.

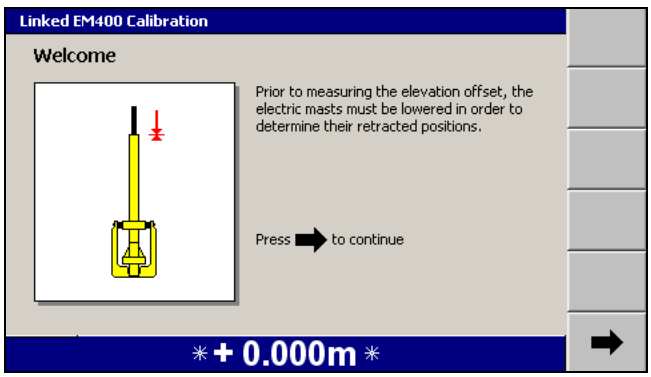


2. Press ➡. The masts are driven to the bottom of their travel range. Once calibration has finished, the *Finished!* screen of the *Calibrate Electric Mast(s)* wizard appears.
3. To return to the *Calibrate Sensors* menu, press **Finish**.

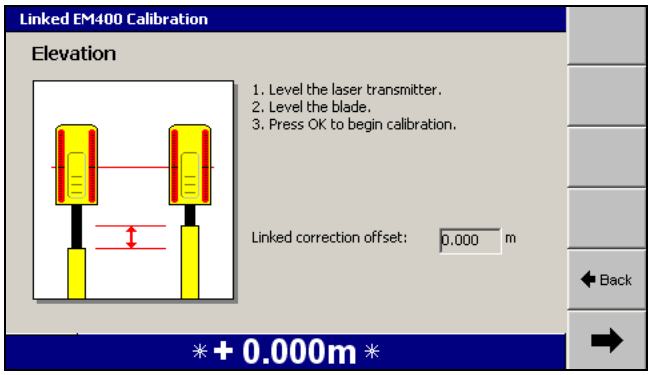
3.9.7 Linked electric mast calibration

To carry out a linked lift mast calibration:

1. Select *Linked EM400 Calibration*.



2. Press ➡. The masts are driven to the bottom of their travel range. Once calibration has finished, the *Elevation* screen of the *Linked EM400 Calibration* wizard appears:



Level the laser transmitter and the blade.

Tip – Check that the digital level is correctly calibrated before use.

3. Press ➡. The mast offset is measured. Once calibration has finished, the *Finished!* screen of the *Linked EM400 Calibration* wizard appears.
4. To return to the *Calibrate Sensors* menu, press **Finish**.

The following problem may arise during linked electric mast calibration:

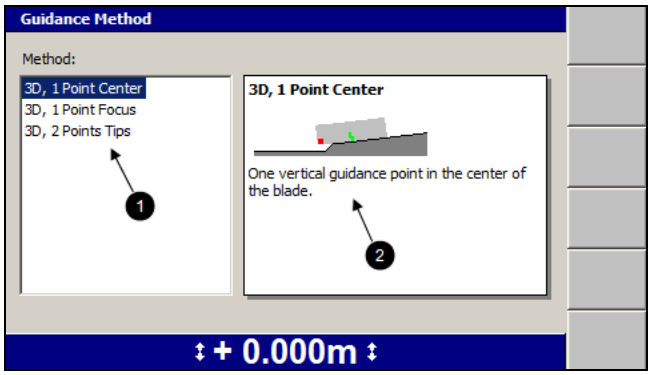
Problem	Action
Calibration fails	To check that you can get a laser strike on both receivers within the range of travel of the electric mast, use the procedure in 7.10.1 Adjusting electric masts to get laser strike. Check for unwanted laser strikes from reflections or another laser transmitter. Check the electric masts and laser receivers.

3.10 Selecting a 3D vertical guidance method

***Note** – Systems that use a single cab mounted 3D sensor do not provide an interface for selecting the vertical guidance method. Cab mounted sensor systems always use one point center guidance with no overcut protection.*

To check and/or select a vertical guidance method:

1. From any guidance screen, press .
2. Select *Guidance Method*.
3. Press **Change Method**.



❶ List of available vertical guidance methods

❷ Brief description of highlighted vertical guidance method

Figure 3.4 Example of a 3D *Guidance Method* dialog

4. Highlight the vertical guidance method you want to use.

   To use in the field, see Chapter 5, Using 3D Guidance in the Field.

Method	Description
3D, 1 Point Center	One vertical guidance point in the center of the blade.
3D, 1 Point Focus	One vertical guidance point inset 200 mm (8 inches) from the blade focus.
3D, 2 Points Tips	Two vertical guidance points, inset 200 mm (8 inches) from the blade tips.

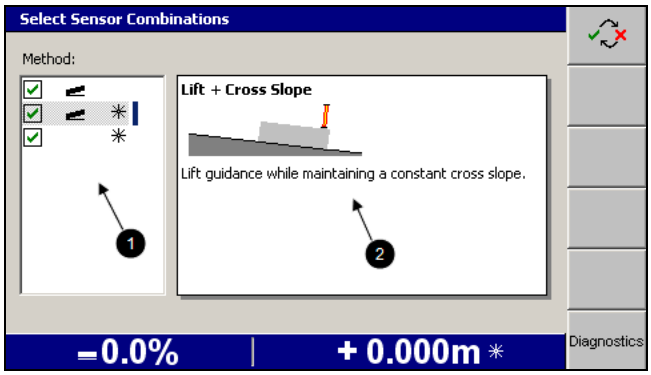
Tip – It is recommended that you use the default 3D, 1 Point Center method, unless you have a good reason to use another Vertical Guidance Method.

5. To confirm the settings, press ; to exit without saving the changes, press .

3.11 Selecting a conventional guidance sensor combination

To check and/or select sensor combinations:

1. From any guidance screen, press .
2. Select *Sensor Selection*. A dialog similar to the following appears:



❶ List of available sensor combinations

❷ Brief description of highlighted sensor combination

Figure 3.5 Example of a conventional *Select Sensor Combinations* dialog

3. Highlight your preferred sets of sensor combinations and press to enable or disable each selection. This forms a favorites list that can be selected from the guidance screen by pressing the **Sensors** softkey. To open the sensor selection list from the guidance screen, press and hold the **Sensors** softkey.

   To use in the field see Chapter 4, Using Conventional Guidance in the Field.

Method	Description
Blade Slope	Maintain a constant blade slope.
Lift + Blade Slope	Lift guidance on one tip while maintaining a constant blade slope.
Cross Slope	Maintain a constant cross slope.
Lift + Cross Slope	Lift guidance on one tip while maintaining a constant cross slope.
Lift	Lift guidance to maintain a constant elevation.
Lift + Lift, Independent	Lift guidance on both tips. Each tip is benched separately.
Lift + Lift, Linked	Lift guidance on both tips. Bench one tip and the blade will match the slope of the laser.

4. To confirm the settings, press ; to exit without saving the changes, press .

CHAPTER

4

Using Conventional Guidance in the Field

In this chapter:

Some guidance systems can measure the cutting edge's position relative to a physical reference surface to generate guidance information. These systems are called conventional guidance systems.

Unlike 3D guidance methods, conventional guidance methods do not rely on knowing the machine's three dimensional location. This can make the site infrastructure much easier to set up.

This chapter describes how to set up conventional guidance systems, and use them in the field.

For more information about conventional guidance systems and their sensors, refer to the Trimble *GCS900 Grade Control System Reference Manual*.

4.1 Preparing conventional sensors

Common tasks that you must perform before you can use sonic tracers and laser receivers are shown below:

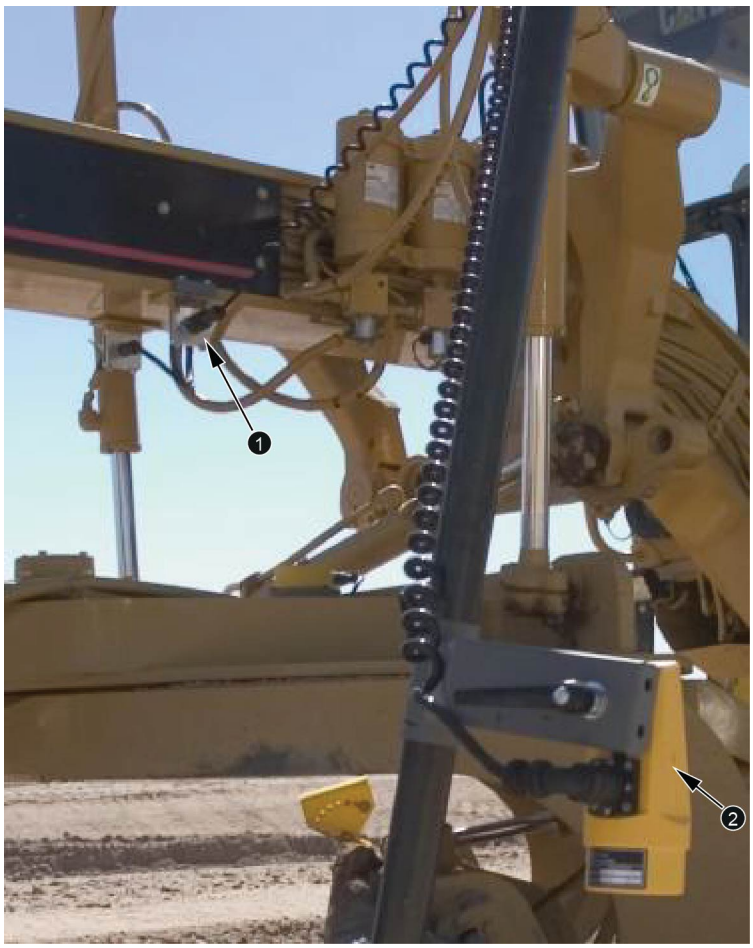
Task	When	To learn how, see ...
Connect a sonic tracer	When you need lift guidance and there is no lift sensor installed	4.1.1 Connecting a sonic tracer for lift guidance
Bench a sonic tracer	The first time you use a sonic tracer	4.1.2 Benching sonic tracers
Check for laser strike	The first time you use a laser receiver on a manual mast after it has powered up	4.1.3 Adjusting manual mast to get laser strike
Bench a laser receiver	The first time you use a laser receiver after it has powered up, or when you change from independent to linked lift guidance	4.1.4 Benching laser receivers

4.1.1 Connecting a sonic tracer for lift guidance

If a job requires lift guidance, you can add a sonic tracer to any system that supports conventional guidance, other than a lift plus lift system, using dual laser receivers.

To install a sonic tracer so that it can be used by the system:

1. Start the control box and make sure that you are in a guidance view.
2. Attach the sonic tracer to the mounting bracket. To do this, fit the circular mount on the rear of the tracer into the bracket and tighten with the ratchet handle assembly.
3. Use a 10-pin quick disconnect to 6-pin Amphenol cable to connect the sonic tracer to the system harness, as shown in the following image.



❶ System harness nose connector on gooseneck ❷ Sonic tracer

Figure 4.1 Connecting a sonic tracer to the system harness on a motor grader

Tip – If you are working in very dusty conditions, place the sonic tracer up-wind. Dirt and dust will be blown away from the sonic tracer.

4.1.2 Benching sonic tracers

1. Adjust the rotation and roll of the moldboard, so that the moldboard is in its working position.
2. Position the sonic tracer over the reference surface (for example, a kerb) or stringline by adjusting the L-shaped support tube. Adjust the support tube so that:
   - The sonic tracer is between 400 mm (16 inches) and 1 m (40 inches) horizontally from the blade tip

- The tube is perpendicular to the wheelbase of the machine
- The sonic tracer is centered directly over the elevation reference surface

3. Adjust the sonic tracer on the support tube so that its distance above the reference surface is one of the following:
   - Between 200 mm and 1300 mm (8 inches and 51 inches) for a kerb or design surface
   - Between 200 mm and 900 mm (8 inches and 36 inches) for a stringline

Tip – For ease of use, set the height of the sonic tracer so that the distance between the sonic tracer and the reference surface is kept close to the maximum distance. The greater the distance between the sonic tracer and the reference surface, the larger the sonic tracer's operating radius is, and the easier it is for you to maintain sonic guidance.

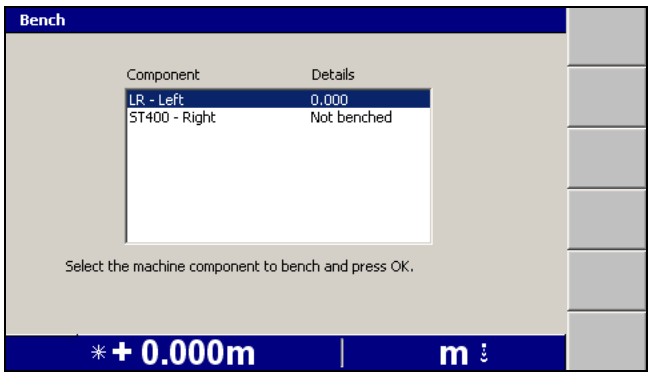
4. Adjust the sonic tracer in its mount so that it is approximately vertical.
5. Set the design cross slope, using the procedure in 4.2 Blade slope or cross slope set up.

WARNING — The cutting edge of the machine may move without warning when automatic controls are on. These sudden movements could cause injury to anyone near the cutting edge, or damage to the machine. Always put the system in Manual and engage the machine's park brake before you leave the machine, or when somebody is working near the cutting edge.

6. If automatic controls are fitted, enable automatic control of the slope controlled tip (typically the trailing tip) of the blade, and allow the cutting edge to drive to the design slope. Otherwise, manually drive the cutting edge to the design slope.
7. Adjust the height of the lift controlled tip (typically the leading tip) of the blade, until the blade tip is at one of the following elevations:
   - the design elevation
   - at a benchmark elevation
   - at a suitable position on the existing surface to begin working towards the design surface
8. If you are manually controlling the cross slope, check that the cutting edge is still on design slope. If the cross slope is controlled automatically, set the automatic controls to Manual.
9. From any guidance screen, press and hold down  .

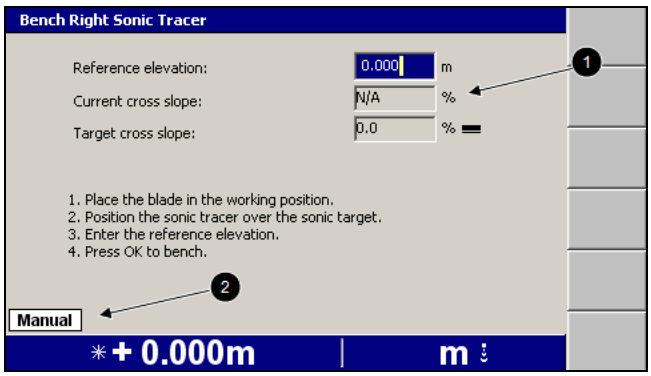
   ***Note** – Alternatively, to access the Bench dialog, press*  *and then from the Setup Menu – Configuration menu, select Bench.*

If there is more than one device that can be benched, a menu similar to the following appears:



Otherwise, the *Bench Sonic Tracer* dialog appears.

10. Select the sonic tracer to be benched. A dialog similar to the following appears:



❶ Measured cross slope ❷ Automatic control status

Figure 4.2 Example sonic tracer bench dialog

11. Edit the *Reference elevation* field as required. The reference elevation is calculated as follows:
    - If you are benching with the blade tip on the design surface or at the elevation to which you want guidance, the reference elevation is zero.
    - If you are benching against a benchmark, subtract the design elevation from the elevation of the benchmark.
    - If you are benching over a stringline or kerb, add the vertical distance from the blade tip to the stringline or kerb, to the vertical distance from the stringline or kerb to the design elevation under the blade tip.

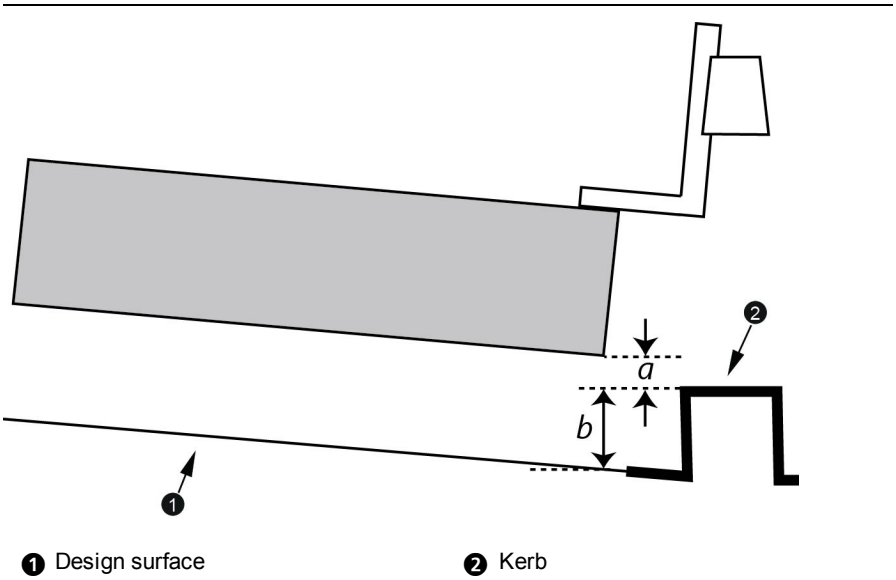


Figure 4.3 Measurements for benching a sonic tracer over a kerb

The reference elevation is *a*+*b*. If the blade tip is below the stringline or kerb, then *a* is negative, and the reference elevation is *b*–*a*.

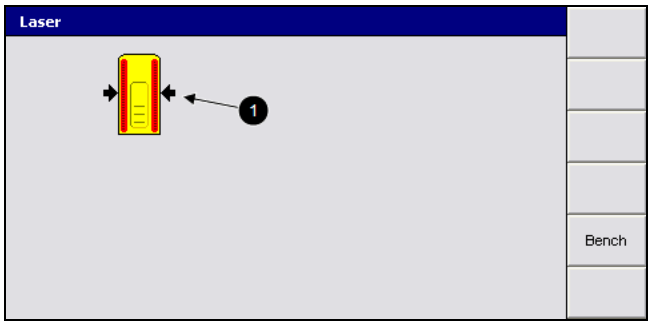
***Note** – When you calculate the reference elevation in this way, as you work you increase or decrease the elevation offset so that the value of the elevation offset approaches zero as the cutting edge approaches the design surface.*

12. To begin benching, press . When benching finishes, the *Vertical Guidance Setup* dialog appears.

4.1.3 Adjusting manual mast to get laser strike

Before you can bench laser receivers mounted on manual masts, you must adjust the masts so that they receive laser strikes. To adjust the height of a single or dual laser system using manual masts:

1. Manually adjust the cross slope of the blade so that the cutting edge is parallel to the laser plane.
2. From any guidance screen, press and hold *Bench Laser*.



❶ Strike indicator

Figure 4.4 Laser strike indication in the *Laser* dialog for a manual mast

WARNING — The cutting edge of the machine may move without warning when automatic controls are on. These sudden movements could cause injury to anyone near the cutting edge, or damage to the machine. Always put the system in Manual and engage the machine's park brake before you leave the machine, or when somebody is working near the cutting edge.

3. At the blade, adjust the height of the mast so that the laser receiver's status LEDs indicate that a strike is registered in the approximate center of the receiver. For more information, see 7.6.6 LR410 laser receiver status indicators.

   ***Note** – If you move the mast through its full range of movement and are unable to register a laser strike, ask your site supervisor to reposition the laser transmitter.*

4. In the cab, check the *Laser* dialog to make sure that the strikes are being reported to the system.

5. To return to the guidance screen, press .

4.1.4 Benching laser receivers

When benching a laser receiver on an electric mast pay attention to the mast height. The maximum extension of an electric mast when loaded with a laser receiver is 1.2 m (4 ft).

In general, electric masts should be extended the minimum amount consistent with operating requirements.

To prepare to bench one or two laser receivers:

1. Check with your site manager that the mainfall and cross slope of the laser plane matches the design mainfall and cross slope.
2. If required, adjust the rotation and roll of the moldboard, so that the moldboard is in its working position.
3. Set the design cross slope, using the procedure in 4.2 Blade slope or cross slope set up.

WARNING — The cutting edge of the machine may move without warning when automatic controls are on. These sudden movements could cause injury to anyone near the cutting edge, or damage to the machine. Always put the system in Manual and engage the machine's park brake before you leave the machine, or when somebody is working near the cutting edge.

4. If automatic controls and cross slope sensors are configured, enable automatic control of the slope controlled tip (typically the trailing tip) of the blade, and allow the cutting edge to drive to the design slope. Otherwise, manually drive the cutting edge to the design slope.
5. Adjust the height of the lift controlled tip (typically the leading tip) of the blade, until the blade tip is at design height or at a known benchmark elevation. This is the laser receiver that will be benched.
6. If the cross slope is being manually controlled, check that the cutting edge is still on design slope.

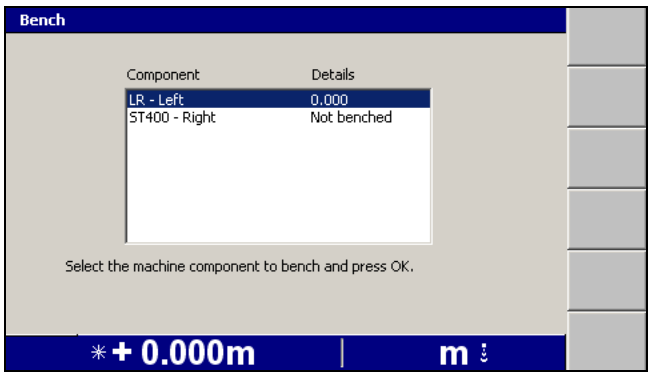
   If the cross slope is being automatically controlled, set the automatic controls to Manual.
7. If required, and if the masts are mounted on angle brackets, adjust the pitch of the masts so that they are perpendicular to the laser plane.

ATTENTION — If you change the bolt hole used to secure the mast in the angle bracket, you must ask your supervisor to change the bolt hole setting in the *Setup Menu - Configuration* menu.

8. If you are using a manual mast, check that the laser receiver is receiving laser strikes. For more information, see 4.1.3 Adjusting manual mast to get laser strike.
9. From any guidance screen, press and hold down  .

   ***Note** – Alternatively, to access the Bench dialog, press* **Laser** *and then press* **Bench** *from the Laser dialog, or press*  *and then from the Setup Menu – Configuration menu, select Bench.*

If you have a dual-laser receiver system or one or more sonic tracers are connected, then a *Bench* menu similar to the following appears:

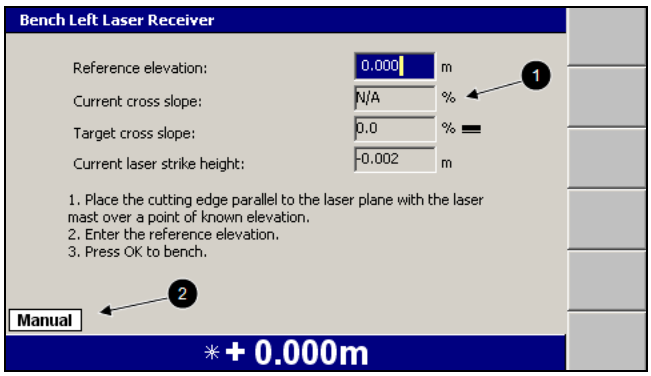


***Note** – The contents of the Bench menu will vary depending on the number of laser receivers and sonic tracers being used by the system.*

Bench a laser receiver in a single laser receiver system

To bench a single laser receiver on an electric or manual mast:

1. If the *Bench* menu is displayed, select the laser receiver to be benched. A *Bench Laser Receiver* dialog similar to the following appears:



❶ Measured cross slope ❷ Automatic control status

Figure 4.5 Single laser bench dialog

2. Edit the *Reference elevation* field as required. The reference elevation is calculated as follows:
   - If you are benching with the blade tip on the design surface or at the elevation to which you want guidance, the reference elevation is zero.
   - If you are benching against a benchmark, subtract the design elevation from the elevation of the benchmark.

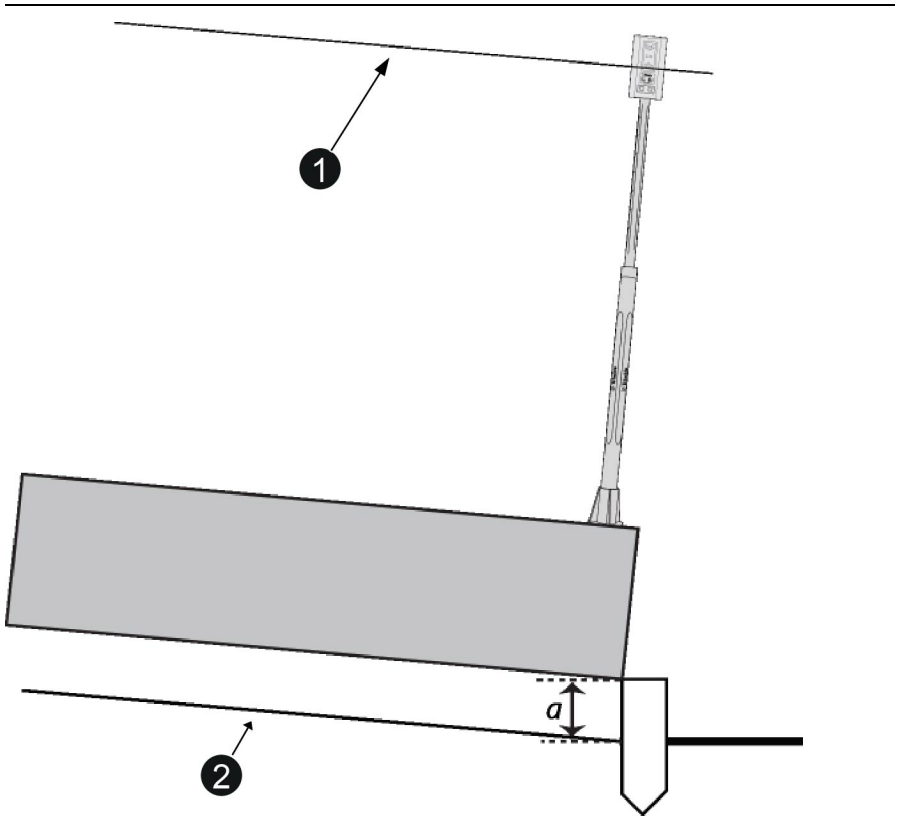


Figure 4.6 Measurements for benching a laser receiver over a benchmark

The reference elevation is *a*. If the benchmark is below the design surface, then *a* is negative, and the reference elevation is *–a*.

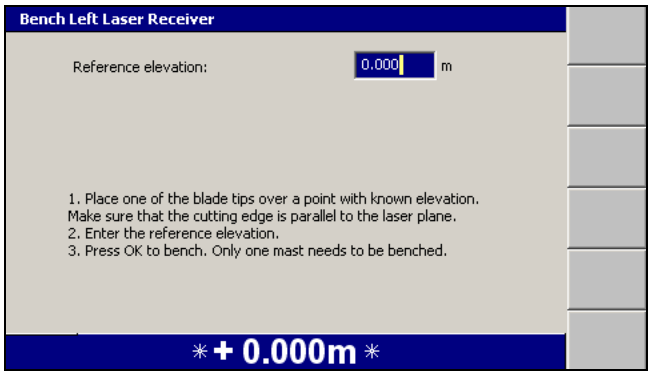
***Note** – When the reference elevation is calculated this way, as you work, you increase or decrease the elevation offset so the value of the elevation offset approaches zero as the cutting edge approaches the design surface.*

3. To begin benching, press . When benching finishes, a guidance screen appears.

Bench a laser receiver for linked lift guidance

To bench a laser receiver for linked lift guidance:

1. You need to bench only one laser in a linked lift laser system. Select the laser receiver to be benched. A *Bench Laser Receiver* dialog similar to the following appears:



2. Edit the *Reference elevation* field as required. The reference elevation is calculated as follows:
   - If you are benching against the design surface, the reference elevation is zero.
   - If you are benching against a benchmark, subtract the elevation of the design surface from the elevation of the benchmark.

   ***Note** – When the reference elevation is calculated this way, as you work, you increase or decrease the elevation offset so the value of the elevation offset approaches zero as the cutting edge approaches the design surface.*

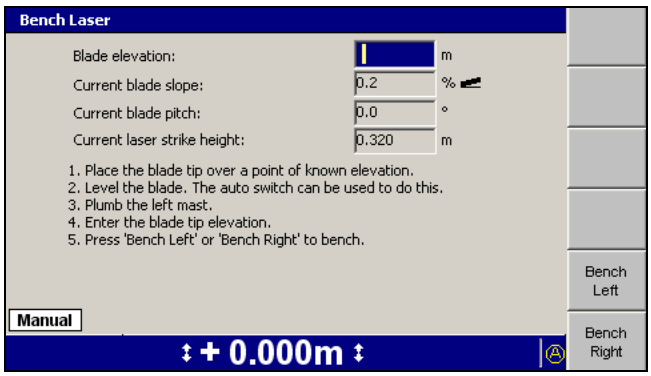
3. To begin benching, press . When benching finishes, a guidance screen appears.

4.1.5 Benching a survey laser receiver

You must bench a survey laser receiver every time the laser transmitter is set up. When the laser receiver needs benching, the **Bench Laser** flashing warning message appears.

To bench a survey laser receiver:

1. From any guidance screen, press and hold down .



***Note** – Alternatively, to access the Bench Laser dialog press*  *and then from the Setup Menu – Configuration menu, select Bench.*

2. To prepare for benching:
   a. Plumb the left mast to make it vertical.

WARNING — The cutting edge of the machine may move without warning when automatic controls are on. These sudden movements could cause injury to anyone near the cutting edge, or damage to the machine. Always put the system in Manual and engage the machine's park brake before you leave the machine, or when somebody is working near the cutting edge.

   b. Level the blade. You can monitor the blade slope in the *Current blade slope* field.

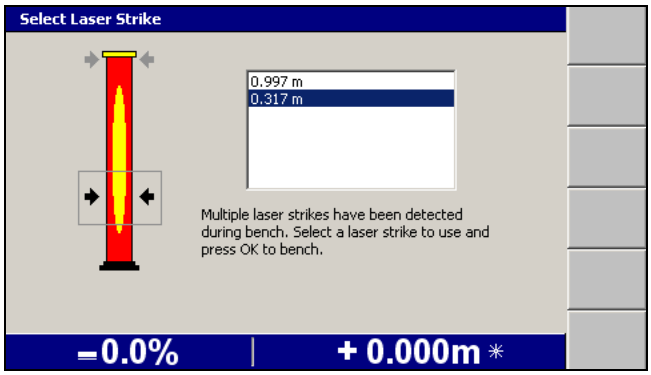
Tip – If you turn on automatic controls, the system levels the blade for you. You do not need to have a level design loaded.

   c. Position the end of the leveled blade that you want to bench, on or beside the benchmark.

Tip – For best results, bench the end of the blade that is under the laser receiver.

   d. Enter the elevation of the benchmark into the *Blade elevation:* field.
4. Check that a height is displayed in the *Current laser strike height:* field. If the field shows **N/A**, the laser receiver is not detecting any laser strikes.

   ***Note** – If the machine does not have a blade pitch sensor installed, the blade pitch is assumed to be 0°.*
5. To begin benching, press **Bench Left** or **Bench Right**, depending on the end of the blade that is on the benchmark.
6. If the laser receiver detects only a single laser transmitter, benching begins immediately. Otherwise, the *Select Laser Strike* dialog appears:



***Note** – By default, laser strikes must be at least 100 mm (4 inches) apart to be distinguished as coming from separate laser transmitters. It may take a few seconds for the system to gather enough data to distinguish between clusters of laser strikes from different transmitters. For this reason, there may be a short delay between pressing the* **Bench Left** *or* **Bench Right** *softkey, and the appearance of the Select Laser Strike dialog.*

The *Select Laser Strike* dialog lets you choose which laser transmitter to bench to. Use the arrow keys to select the strike height of the laser transmitter you want to use and then press .

7. When benching finishes, a guidance screen appears.
8. Return the mast to its operating position. Typically, this is perpendicular to the wheelbase of the machine.

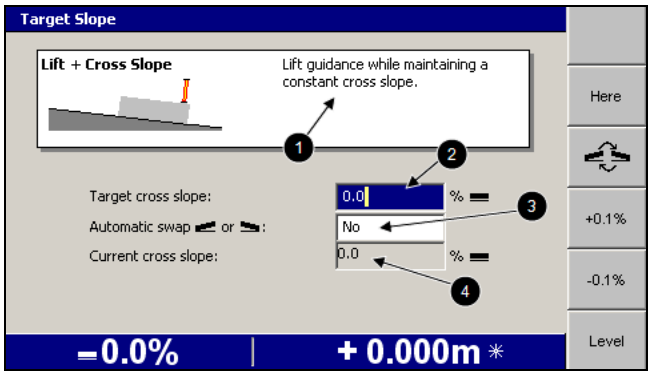
Some common laser benching problems are as follows:

Problem	Action
Not enough laser strikes during bench	Check that there is a clear line of sight between the receiver and the transmitter, and that the receiver is within range. Adjust the elevation of the laser transmitter so that the laser strikes half way up the laser receiver when the blade is at bench height.
The benchmark height you entered does not agree with the measured height	Check that the value entered in the *Blade Elevation* field agrees with the elevation of the focus point of the blade, as measured by the GNSS receiver, and the elevation of the benchmark. The allowable difference is 30 mm more than the GNSS accuracy limit (25 mm in Fine mode).
There is a mismatch between the measured height of the laser plane and the calculated height	Check the setup of the laser transmitter, particularly the direction and slope if you are using a sloped laser plane.
The laser signal is too noisy to complete the benching operation	Check the stability of the laser transmitter platform. If there is more than one laser transmitter being used on the site, check that the elevations of the laser transmitters are separated by more than 100 mm (4 inches). Clean the laser receiver to clear dust.
Low accuracy GNSS	You must be receiving high accuracy GNSS Easting and Northing positions to use the laser enhanced elevation feature.

4.2 Blade slope or cross slope set up

To set up blade slope or cross slope guidance:

1. From any guidance screen, press .
2. Select *Target Slope*. A dialog similar to the following appears:



1 Brief description of sensor selection
2 Target cross slope value
3 Automatic slope swap select
4 Current cross slope value

Figure 4.7 Example cross slope setup dialog

3. To enter the target slope value, use one or more of the following tools:
   - Edit the *Target cross slope* field directly.
   - Press **Here** to set the target slope at the current blade slope.
   - To increase or decrease the target slope in fractions of a percent, press **+0.1%** or **–0.1%** respectively.

     ***Note** – The increment and decrement softkeys change the target slope value by an amount equal to the increment value. By default, the increment is 0.1%, but your site supervisor can change this.*
   - Press **Level** to set the target slope to 0%.
4. To change the direction of the slope, press .
5. To toggle *Automatic swap* on or off select the *Automatic swap* field and use the arrow keys. For more information, see 4.4.7 Changing the target slope direction.
6. To confirm the settings, press ; to exit without saving settings, press . A guidance screen appears.

4.3 Checking cutting edge guidance

Before you start work, always check the accuracy of the system. To check cutting edge guidance, either compare previous passes or prepare and compare a test surface.

To prepare and compare a test surface:

1. Cut a short stretch of test surface at the target slope, with a known, preferably zero, elevation offset.
2. Measure the slope of the test surface with a calibrated digital level and then compare the slope with the target slope.
3. If required, measure the elevation of the edge of the test surface under the lift sensor and then compare the elevation to the design elevation.

4.4 Working with conventional guidance

The system assumes that the mainfall of the machine is measured in the direction of travel of the machine. Some machine configurations will result in the mainfall sensor and the direction of travel of the machine being misaligned. This will produce guidance errors.

Common tasks that you can perform while you work with a conventional guidance method are as follows:

Task	When …	To learn how, see ...
Adjust the linked calibrated offset with dual electric masts	You need to adjust pass to pass mismatches You need to recalibrate linked elevations due to blade wear You need to provide more accurate blade tip positioning	4.4.1 Linked elevation adjustment
Set an elevation offset from a design surface	You need to work towards the design surface in a number of passes	4.4.2 Setting elevation offset
Change the elevation offset using the remote switches	You are not carrying enough material, or when you are carrying too much material	4.4.3 Changing elevation offset with the remote switches
Change the target slope using the remote switches	You are not carrying enough material, or when you are carrying too much material	4.4.4 Changing the target slope with remote switches
Use the remote switches to swap the guidance used at each end of the blade.	You need to quickly swap guidance types between blade ends, for example, when you turn around at the end of a pass	4.4.5 Swapping guidance ends using the Auto/Manual switches

Task	When …	To learn how, see ...
Use a softkey to swap the guidance used at each end of the blade.	You need to quickly swap guidance types between blade ends, for example, when you turn around at the end of a pass, but the machine does not have remote switches installed	4.4.6 Conventional (elevation/slope) vertical guidance sensor selection
Change the direction of the target slope	You need to quickly change the direction of the target slope, while maintaining the slope's magnitude, for example, when you turn around at the end of a pass	4.4.7 Changing the target slope direction
Return mast(s) to bench height	You need to quickly return the electric masts to the laser receiver's benched height	4.4.8 Returning masts to bench height

4.4.1 Linked elevation adjustment

When using a system configured with dual electric masts and laser receivers, the calibrated linked elevation offset may need to be adjusted.

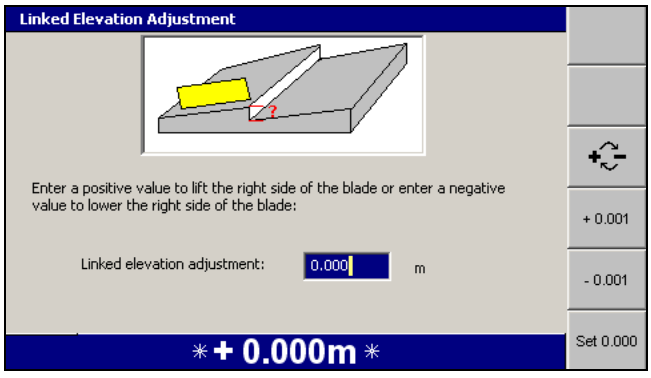
Linked elevation offset adjustment:

- allows you to adjust pass to pass mismatches without the need for the site supervisor's help
- avoids having to recalibrate linked elevations due to blade wear
- provides more accurate blade tip positioning

To adjust the offset between electric mast/laser receiver pairs running as linked elevation sensors:

1. From any guidance screen, press **Linked Elevation Adjustment**.

   ***Note** – You can also select Linked Elevation Adjustment from the Setup Menu – Configuration menu.*



2. Use any of the following tools to adjust the offset:

   a. Edit the *Linked Elevation Adjustment* field directly. Enter a positive value to lift the right side of the blade or enter a negative value to lower the right side of the blade.

      ***Note** – Left and right sides of the blade are as viewed from the machine cab.*

      Press  to toggle between positive and negative values.

   b. Press **+0.001** or **–0.001** to increase or decrease the offset by 0.001 m.

   c. Press **Set 0.000** to set the offset to zero.

   ***Note** – The maximum offset value is 0.030 m (0.01 ft). If the offset required is greater than this value, you should perform a full linked elevation calibration.*

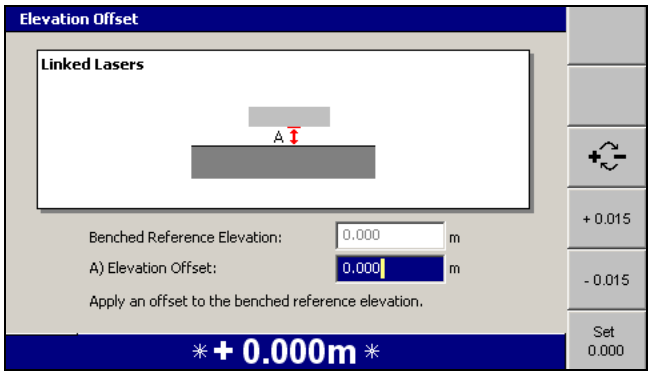
   If you perform another offset adjustment, the value is displayed as 0.000 as multiple changes are cumulative.

4.4.2 Setting elevation offset

For lift guidance methods, the elevation offset is first set when you specify the reference elevation during lift sensor benching.

To change the elevation offset:

1. From any guidance screen, press **Elevation Offset** or from the *Setup Menu – Configuration* menu, select *Elevation Offset*. A dialog similar to the following appears.



2. Use the following tools to set the elevation offset value:

   - Edit the *Elevation offset* field directly.
   - To change the offset sign, press  .
   - To increase the offset by 15 mm (0.05 ft), press **+ 0.015**. To decrease the offset by 15 mm (0.05 ft), press **– 0.015**.

***Note** – The increment and decrement softkeys change the elevation offset by an amount equal to the increment value. By default, the increment is 15 mm (0.05 ft.), but your site supervisor can change this.*

- To set the offset to zero, press **Set 0.000**.

3. To confirm the settings, press ; to exit without saving changes, press . A guidance screen appears.

4.4.3 Changing elevation offset with the remote switches

To change the elevation offset value, toggle the elevation offset remote switch or toggle the elevation offset remote switch for the end of the blade receiving lift guidance. If automatic controls are turned on, when you toggle the remote switch to the increment position the end of the blade receiving lift guidance moves ***upward***.

***Note** – For systems using a survey laser for lift guidance, once a survey laser receiver has been benched, the laser strike must remain within ±10 cm (±4 inches) of the bench position. If the strike moves outside this window, the* **Laser Outside Bench Window** *flashing warning message appears. If this warning appears, move the blade up or down to move the strike back into the window. If the system is in Auto mode, the Increment/Decrement offset switches move the bench window as the offset is increased or decreased.*

4.4.4 Changing the target slope with remote switches

To change the target slope value, toggle the elevation offset remote switch for the end of the blade receiving slope guidance. If automatic controls are turned on, when you toggle the remote switch to the increment position, the end of the blade receiving slope guidance moves ***upward***. In some cases, this causes the target slope value to ***decrease***.

4.4.5 Swapping guidance ends using the Auto/Manual switches

To swap the slope guidance from one end of the blade to the other, move the Auto/Manual switch of the unguided end of the blade in one of the following ways:

- If the switch is in the Manual position, move it to Auto.
- If the switch is in the Auto position, toggle it to Manual and then back to Auto.

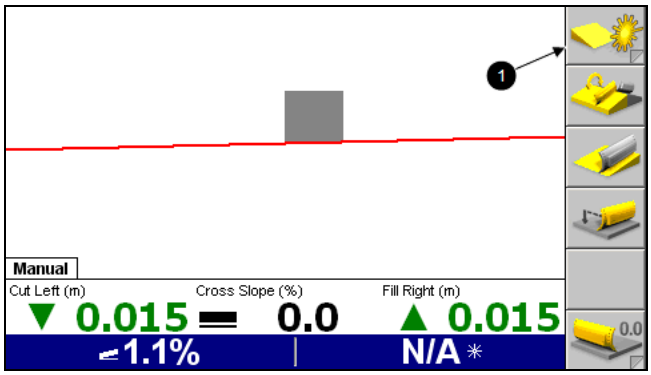
If automatic controls are in use, they remain in the Auto state.

***Note** – If the machine has a 3D system installed, swapping the end receiving guidance is the equivalent of pressing* **Blade: Left** *or* **Blade: Right**. *In this case, the blade focus also changes ends.*

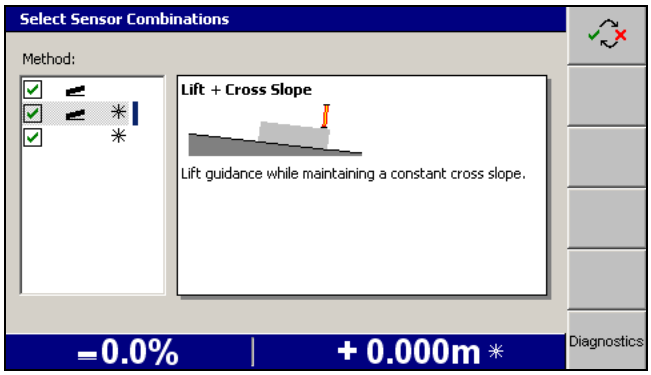
4.4.6 Conventional (elevation/slope) vertical guidance sensor selection

The **Sensors** softkey (❶) is used to swap between available conventional sensors.

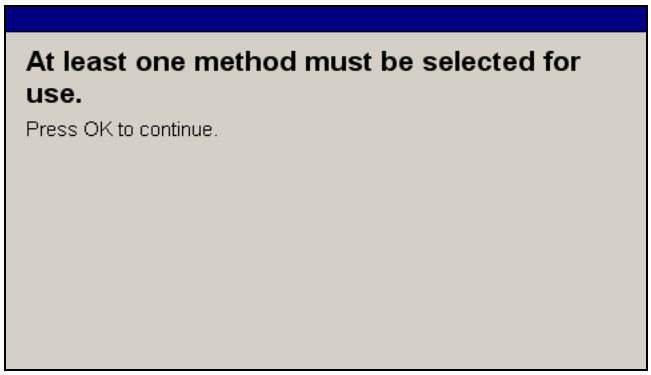
To access the *Sensor Selection* dialog, from a guidance screen press and hold **Sensors**, or from the *Setup Menu – Configuration* menu select *Sensor Selection*.



The following dialog shows the *Select Sensor Combinations* dialog for a *Cross Slope* system:



At least one guidance method must be selected. If all the options in the above dialog are unticked, when you exit the dialog a full screen warning message appears:



If a slope guidance method is selected, when you press **Sensors**, the end of the blade receiving slope guidance is changed and the direction of the design slope is reversed.

Blade slope or cross slope sensors configured

If a lift plus slope guidance method is selected, and sonic tracers are used, the **Sensors** softkey cycles through the guidance and sensor combinations shown below:

Sonic tracer installation	Available guidance methods
One – on any end of the blade	• Lift (sonic tracer) to sonic tracer tip plus slope to opposite tip • Slope to sonic tracer tip
Two	Lift (sonic tracer) to either tip plus slope to opposite tip

Single laser receiver and blade or cross slope configured

If a lift plus slope guidance method is selected, and sonic tracers are **not** used, the **Sensors** softkey cycles through the guidance and sensor combinations shown below:

- Slope to laser tip.
- Slope to opposite tip.
- Lift (laser) to laser tip plus slope to opposite tip.

If a lift plus slope guidance method is selected, and sonic tracers are used, the **Sensors** softkey cycles through the guidance and sensor combinations shown below:

Sonic tracer installation	Available guidance methods
One – at the opposite end of the blade to the laser receiver (opposite tip)	• Slope to opposite tip • Lift (sonic tracer) to opposite tip plus slope to laser tip • Lift (laser) to laser tip plus slope to opposite tip
One – at the same end of the blade as the laser receiver (laser tip)	• Slope to opposite tip • Lift (sonic tracer) to laser tip plus slope to opposite tip • Lift (laser) to laser tip plus slope to opposite tip
Two	• Lift (sonic tracer) to laser tip plus slope to opposite tip • Lift (sonic tracer) to opposite tip plus slope to laser tip • Lift (laser) to laser tip plus slope to opposite tip

4.4.7 Changing the target slope direction

There are three ways to change the direction of the design slope:

- Manually
- Automatically, using the automatic slope swap feature

- Automatically, by performing a sensor swap

If the automatic slope swap feature is turned off, you can manually change the direction of the design slope. To do this, from any guidance screen press  . If automatic controls are in use, they remain in the Auto state.

4.4.8 Returning masts to bench height

Sometimes you may need to lower the laser mast(s), for example, when you move the machine around the site. To lower the mast(s) press the **Lower Mast(s)** softkey in the *Laser* dialog.

If you are working to the same bench height, and the laser transmitter's elevation has not changed, press **Return to bench** in the *Laser* dialog to return the masts to their benched height.

CHAPTER

5

Using 3D Guidance in the Field

In this chapter:

This chapter describes how to set up 3D guidance systems and use them in the field.

For more information about 3D guidance systems and their sensors, refer to the *GCS900 Grade Control System Reference Manual*.

5.1 Introduction

Some systems store a three dimensional (3D) digital map of the design surface in the control box. Using 3D sensors, the system fixes the location and elevation of the machine and its cutting edge on this surface. The system then calculates the difference between the cutting edge elevation and the design elevation.

Systems that have this capability are called 3D guidance systems and use GNSS receivers, or a UTS (Universal Total Station) instrument, a type of robotic total station.

5.2 Preparing 3D sensors

Common tasks that you must perform before you can use a UTS system are:

Task	When	To learn how, see ...
Set up the UTS instrument	Every time the instrument is moved or when a new job is started	5.2.1 Starting the UTS system
Start UTS positioning	When you need to use UTS position information for guidance	5.2.1 Starting the UTS system
Bench a UTS target	Every time you set up a UTS instrument and do not know the instrument elevation, or if you want to use a benched elevation in preference to a measured elevation	5.2.2 Benching a UTS target
Initialize a single-3D sensor system's direction and pitch	Every time you turn on the system, when a single-3D sensor machine has been moved with the system turned off	5.2.4 Initializing a machine's orientation and pitch

***Note** – In this manual the term GNSS refer to global navigation satellite systems collectively. Specific constellations are still referred to by their constellation names, for example "GPS" and "GLONASS".*

Common tasks that you may need to perform before you can use a GNSS receiver system are:

Task	When	To learn how, see ...
Set a single-GNSS receiver's mast height	When the GNSS receiver is on an electric mast, and the mast extension must be altered to improve reception (raised) or reduce vibration (lowered)	5.2.3 Setting the GNSS electric mast height

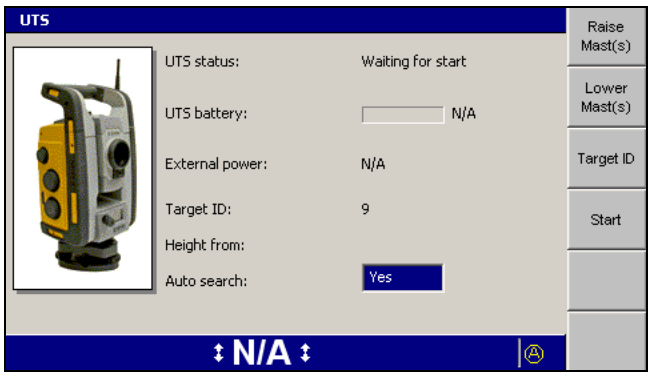
Task	When	To learn how, see ...
Initialize a single-3D sensor system's direction and pitch	Every time you turn on the system, when a single-3D sensor machine has been moved with the system turned off	5.2.4 Initializing a machine's orientation and pitch
Set GNSS accuracy requirements	Every time you begin a new job	5.2.5 Setting GNSS accuracy mode
Load a GNSS Geoid grid	When the GNSS position is out of the range of the loaded geoid grid	5.2.6 GNSS geoid grid support
Set up a survey laser receiver for enhanced elevation accuracy	Every time the laser transmitter is set up	5.2.7 Survey laser receiver set up
Turn on laser-based elevation measurement	Every time you need to use a laser receiver to improve elevation accuracy	Turning on laser enhanced elevation, page 127
Bench a survey laser receiver	Every time the laser transmitter is set up	Benching a survey laser receiver, page 102

5.2.1 Starting the UTS system

To learn how to set up your UTS instrument for machine control, talk to your site supervisor or refer to the *Trimble SCS900 Getting Started Guide*.

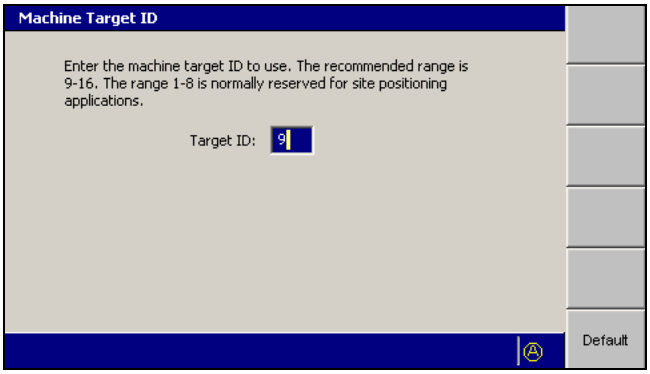
To start the UTS instrument, and connect the UTS instrument to the system:

1. From any guidance screen, press **UTS**.



2. Press **Raise Mast(s)** and/or **Lower Mast(s)** to position the mast so that line of sight with the UTS target is maintained, while at the same time keeping the mast low enough to minimize mast vibration. The maximum operating extension for an electric mast carrying a UTS target is 0.9 m (3 ft). In general, electric masts should be extended the minimum amount, consistent with operating requirements.
3. To set the target ID:

a. Press **Target ID**.



***Note** – The* **Target ID** *softkey is only available when the UTS is stopped.*

b. Enter the selected target ID into the *Target ID* field. By convention, target IDs of 9 through 16 are used for machine control applications, with IDs of 1 through 8 reserved for surveying applications. Ask your site supervisor which target ID you should use. To set the default value of 9, press the **Default** softkey.

c. To confirm the settings, press ; to exit without saving changes, press . The UTS start-up dialog appears.

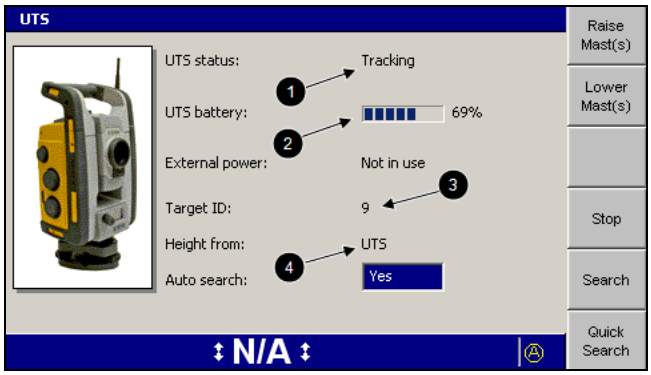
4. Set the *Auto search* status as required.

   If Auto search is turned on (*Yes*) and the UTS loses lock on the target, it will automatically attempt to locate and lock onto the target again by searching the area bounded by the search window defined during UTS set-up.

   If Auto search is turned off and the UTS loses lock, follow the steps in 5.6.8 Reacquiring UTS lock, to reacquire lock.

5. Press **Start**. The UTS system starts and the UTS instrument automatically searches for the target in the area bounded by the search window defined during UTS set-up.

   When the target is acquired, the *UTS* dialog changes to its “Tracking” layout, shown below:



1 UTS instrument status
2 Battery charge
3 Machine target ID
4 Elevation exists on UTS instrument

Figure 5.1 SPSx30 instrument start up dialog

Tip – If the UTS takes too long to find the target, press to stop the search and the UTS start-up.

6. To confirm the settings, press ; to exit without saving changes, press . A guidance screen appears.

Tip – The UTS instrument's power supply is automatically measured and displayed in the *UTS Battery:* field. If an external battery is used to power the UTS instrument, the UTS battery status is not available.

Some common UTS set up problems are as follows:

Problem	Action
No **Start** softkey in *UTS* dialog.	The machine data radio has not synchronized with the UTS instrument data radio. Follow the procedure described in 7.3 Running system diagnostics, to check that the UTS components are connected and running. Check that the UTS instrument data radio is turned on. Check the instrument battery.
Quick search fails immediately and a full search begins	The target must be more than 5 m away from the instrument for a quick search to succeed. Move the machine.
UTS fails to start	Ask your site manager to check that the radio channel, and network if applicable, are compatible with the instrument radio. Follow the procedure described in 7.3 Running system diagnostics, to check that the UTS components are connected and running.

See 7.3.1 UTS diagnostics for a description of the *UTS* dialog field values.

5.2.2 Benching a UTS target

You ***must*** bench the target if the UTS instrument was set up with northing and easting values, but no elevation was specified.

You ***may*** bench the target even if the UTS instrument's location was specified with an elevation value, in which case the benched elevation is used to calculate the target location, not the entered elevation of the UTS.

The *Height from* field in the *UTS* dialog displays the origin of the UTS height. The contents of the *Height from* field are shown below. If the *Height from* field displays "*No heights*", you must bench the UTS target before you can use the UTS system.

***Height from* field**	**Description**
Benching	The machine has been benched. Heights are in terms of the benchmark the machine was benched over.
UTS	The machine has not been benched. Heights are in terms of UTS height. UTS setup has station elevation and instrument height entered.
No heights	The machine has not been benched. No height information entered during UTS set up.

To bench the target:

1. From any guidance screen, press and hold down .

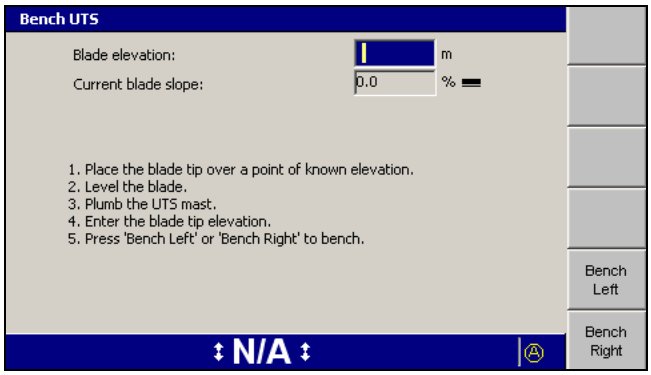
   Note – *Alternatively, to begin benching from the Setup Menu – Configuration menu, select Bench.*

   A full screen warning message appears, telling you to make the mast vertical.

2. Plumb the mast to make sure that it is vertical.

   Note – *If you are benching a system that does **not** have an optional blade pitch sensor for benching installed, and **cannot** roll its blade, the mast must be in the measure up position. Typically, the mast will have been measured when the blade was in the plane of the tracks. This means that the machine should be level and that the benchmark used for benching is in the same plane as the tracks.*

3. Press to continue benching.



4. Enter the elevation of the benchmark into the *Blade elevation* field.

WARNING — The cutting edge of the machine may move without warning when automatic controls are on. These sudden movements could cause injury to anyone near the cutting edge, or damage to the machine. Always put the system in Manual and engage the machine's park brake before you leave the machine, or when somebody is working near the cutting edge.

5. Level the blade. You can monitor the blade slope in the *Current blade slope* field.

Tip – If you turn automatic controls on, the system levels the blade for you. You do not need to have a level design loaded.

6. Position the focus of the blade over the control point.
7. Press either **Bench Left** or **Bench Right** to begin benching.

   ***Note** – You need to bench only one blade tip.*

   When benching finishes, the *Setup Menu – Configuration* menu appears.
8. Return the mast to its operating position. Typically, this is perpendicular to the wheelbase of the machine.

5.2.3 Setting the GNSS electric mast height

Single-GNSS receiver systems can have the GNSS receiver installed on an EM400 electric mast. This lets you quickly and easily swap between a GNSS receiver and a UTS target to meet changing job requirements.

ATTENTION — If you swap out a GNSS receiver for a UTS target, the GNSS coil-cable strain relief bracket at the top of the mast is no longer used. However, it is good practice to leave the bracket on the mast. If you remove this bracket, you will introduce a 4.5 mm error into the calculated height of the UTS target.

The value of the maximum extension of an electric mast is set by the system. The maximum extension for a UTS target is higher than the maximum extension for a GNSS receiver. For this reason, if you have the mast at maximum extension for a UTS target and then reconfigure the machine to use a GNSS receiver, the system prompts you to lower the mast with the **Left EM400 Out Of Range** or **Right EM400 Out Of Range** flashing warning message.

To set the electric mast height:

1. From any guidance screen, press **GNSS**.
2. Press **Raise Mast(s)** and/or **Lower Mast(s)** to position the mast so that the cab does not "shadow" the receiver, and so that the receiver does not receive reflected signals off the cab windows, while at the same time keeping the mast low enough to minimize mast vibration. The maximum operating extension for an electric mast carrying a GNSS receiver is 0.6 m (2 ft). In general, electric masts should be extended the minimum amount, consistent with operating requirements.

5.2.4 Initializing a machine's orientation and pitch

If a machine without a pitch or mainfall sensor is moved more than 10 m (33 ft) with the system turned off, when the system starts up it discards the old pitch information. The **Low Accuracy (Move)** flashing warning message appears in the guidance screens.

If the **Low Accuracy (Move)** flashing warning message appears, move the machine in a straight line for a short distance (a few meters) until the **Low Accuracy (Move)** message disappears. This initializes the machine's orientation and pitch.

5.2.5 Setting GNSS accuracy mode

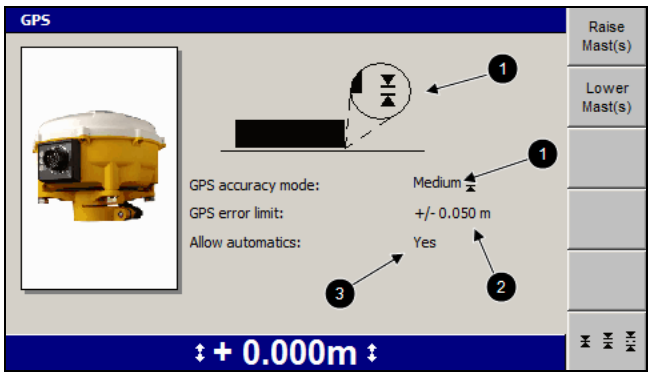
If you are using one or more GNSS receivers as position sensors, make sure that the selected GNSS accuracy mode is appropriate for the work you are about to do. Note that in certain conditions, poor quality signal transmission may mean that GNSS accuracy is continually less than that allowed by the error limit. Atmospheric conditions can impact upon the quality of signal transmissions broadcast from satellites. Also, the distance you are operating from the base station can affect signal quality. The higher the accuracy mode, the lower the tolerance for errors.

To check and/or set the GNSS accuracy mode:

1. From any guidance screen, press **GNSS**.

   Note – *GNSS accuracy mode can also be set from the GNSS Accuracy dialog in the Setup Menu – Configuration menu.*

2. From the *Setup Menu – Configuration* menu, select *GNSS Accuracy*.



❶ Current accuracy setting ❷ Error limit

❸ Automatic control availability

Figure 5.2 GNSS accuracy mode dialog

3. To swap between fine, medium, and coarse accuracy modes, press . For each mode, your site supervisor has specified if automatic controls are available or not.

   ***Note** – When coarse mode is selected, your site supervisor can enable the use of low accuracy corrections broadcast from satellites (SBAS). If you use SBAS GNSS, check with your site supervisor that you have a suitable GNSS configuration file loaded into the GNSS receiver(s).*

4. To raise or lower the electric masts, press **Raise Mast(s)** or **Lower Mast(s)**.

5. To confirm the settings, press ; to exit without saving changes, press .

5.2.6 GNSS geoid grid support

A small embedded geoid grid can be placed in a GNSS receiver configuration file. The geoid grid is used to determine the GNSS receiver elevation.

This gives you more accurate elevations, especially in highly mountainous areas where the geoid cannot be easily approximated with an inclined plane adjustment.

To load a geoid grid into the GNSS receiver configuration file, see your site supervisor.

When the GNSS position is out of the range of the loaded geoid grid, the following flashing message appears on the guidance screen.

Out of Geoid Range

When this flashing message appears:

- The positions that the GNSS receiver generates are flagged as:
  - not having a valid GNSS coordinate system
  - out of range from the geoid
- The design and the current machine position are still drawn on the plan view.
- All height information and values generated from that height information (such as cut/fill values) are marked invalid, and appear as N/A if they are text items.
- The machine does not appear on the profile or cross section view or any other view that would show the relative height of the machine to the design.

Move the machine until the flashing message disappears, or contact your site supervisor.

5.2.7 Survey laser receiver set up

ATTENTION — In dual GNSS systems, the cross slope of the cutting edge is calculated from the relative positions of the two GNSS receivers. Even if one GNSS receiver gains improved elevation accuracy through the use of a survey laser receiver, the other GNSS receiver will still be subject to normal GNSS errors. For this reason you must be using high accuracy GNSS positions to benefit from laser-enhanced elevation accuracy.

To use a survey laser receiver (SR300 laser receiver) to improve elevation accuracy (laser-enhanced elevation), you must perform the following tasks:

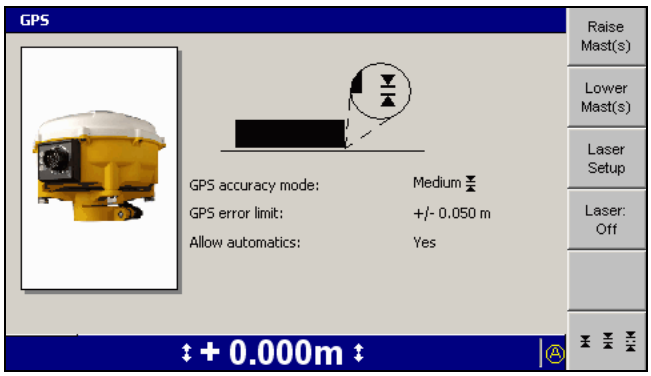
1. Specify the characteristics of the laser plane.
2. Turn on laser-based elevation measurement.
3. Bench the laser receiver. See 4.1.5 Benching a survey laser receiver.

These tasks are described in the following sections.

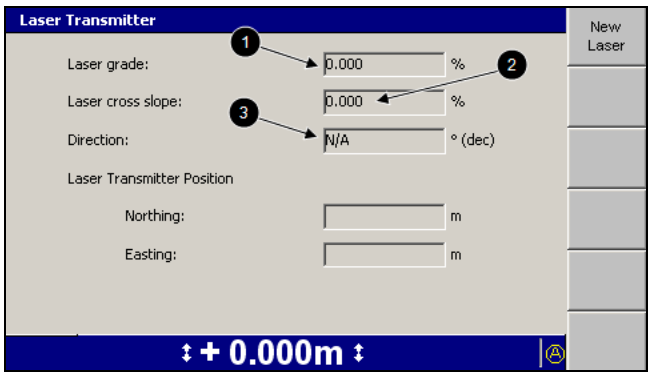
Specifying the laser plane

To check and, if required, specify the laser plane:

1. From any guidance screen, press **GNSS**.



2. Press **Laser Setup**.



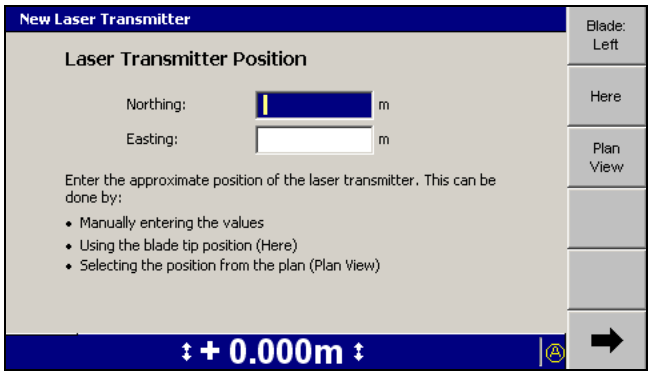
❶ Laser plane slope in direction of transmitter's grade axis

❷ Laser plane slope in direction of transmitter's cross slope axis

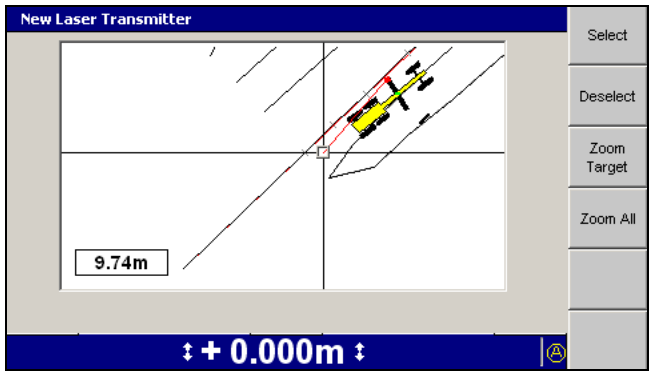
❸ Direction of transmitter's grade axis

Figure 5.3 Example *Laser Transmitter* dialog

3. Confirm that the location of the laser transmitter you will use is approximately correct, and that the grade, cross slope, and mainfall direction are correct. If you need to change any of these values, press **New Laser**. The first screen of the *New Laser Transmitter* wizard appears.



4. The position of the laser transmitter must be accurate to approximately 2 m (6 ft). Use any of the following tools to enter the position of the laser transmitter:
   - Edit the *Northing* and *Easting* fields directly.
   - To use the current position of the cutting edge focus point, press **Here**.
   - To change the cutting edge focus point, press either **Blade: Left** or **Blade: Right**.
   - Press **Plan View**. A dialog similar to the following appears:



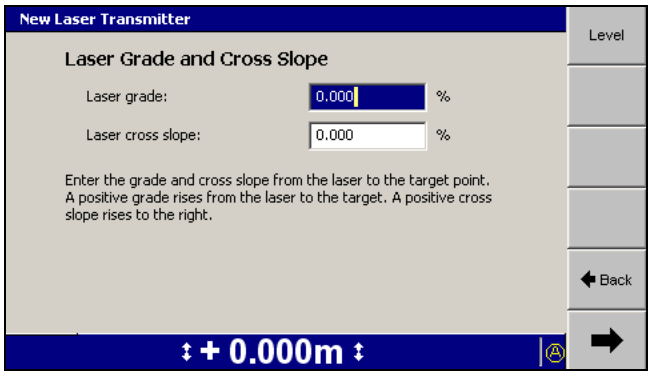
   Use the arrow keys to move the cross-hairs around the screen. As the cross-hairs move, the distance from the focus point on the cutting edge to the position indicated by the cross-hairs appears.

   To zoom the current view in or out, press  or  . To resize the current view to the immediate area around the cross-hairs, press **Zoom Target**. To view all of the linework, press **Zoom All**.

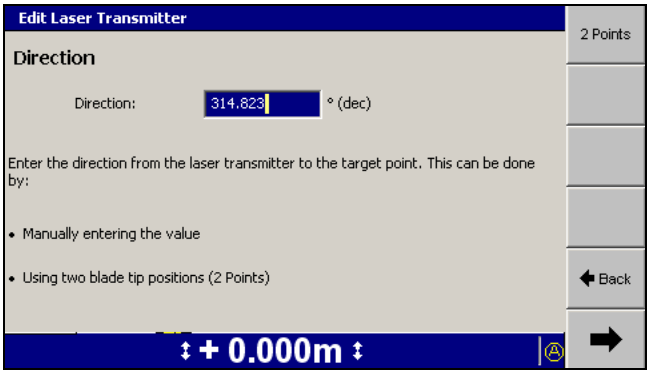
   To select the position of the cross-hairs as the position of the laser transmitter, press **Select**. To clear the currently selected position and choose a different position, press **Deselect**.

5. To confirm the settings, press  ; to exit without saving changes, press  . The first screen of the *New Laser Transmitter* wizard appears.

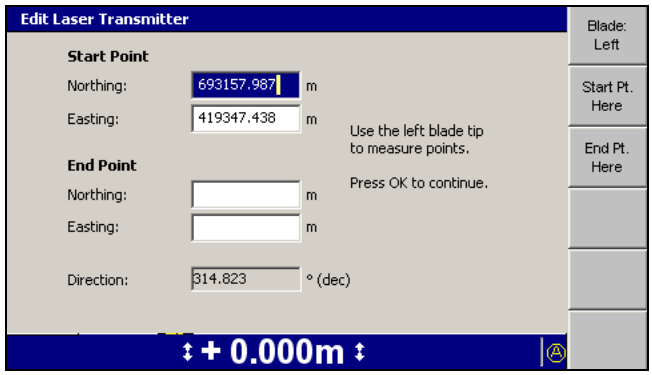
6. Press ➡. The second screen of the *New Laser Transmitter* wizard appears:



7. Use any of the following tools to enter the laser plane grade and cross slope:
   - Edit the *Laser Grade* and *Laser cross slope* fields directly.
   - To set both the grade and cross slope to zero, press **Level**.
8. Press ➡:
   - If you specified a level laser plane, the final screen of the *New Laser Transmitter* wizard appears. Press **Finish**. The *GNSS* dialog appears.
   - If you specified a sloping laser plane, the third screen of the *New Laser Transmitter* wizard appears:



9. Use either of the following tools, to enter the direction of the laser plane grade axis:
   - Edit the *Direction* field directly.
   - Press **2 Points**. A dialog similar to the following appears:



This dialog lets you specify the direction of the "grade" axis by defining a line segment that runs parallel to, and in the same direction as, the "grade" axis.

Edit the location of the start point and end point of the line directly. Alternatively press **Start Pt. Here** and/or **End Pt. Here** to set the locations of the start and end points respectively to the location of the cutting edge focus point.

To change the cutting edge focus point, press either **Blade: Left** or **Blade: Right**.

10. To confirm the settings, press ; to exit without saving changes, press . The third screen of the *New Laser Transmitter* wizard appears.

11. Press . The final screen of the *New Laser Transmitter* wizard appears. Press **Finish**. The *GNSS* dialog appears.

Some common laser set up problems are as follows:

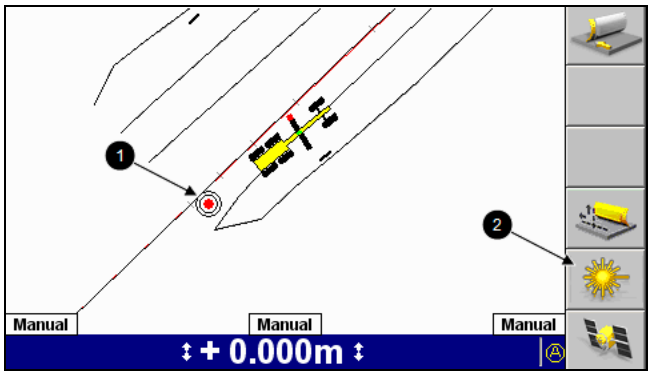
Problem	Action
No **Start Pt. Here** or **End Pt. Here** key.	You may be using low accuracy GNSS positions.
No machine icon in the *New Laser Transmitter* plan view screen.	Change your GNSS Accuracy Mode.
	Check the data radio and radio cable.
	Ask your site supervisor to adjust the accuracy limits.

Turning on laser enhanced elevation

Before the system can use the elevation information generated by a survey laser receiver, you must enable the laser receiver. To do this, press **Laser** (❷) from any guidance screen.

***Note** – The* **Laser** *softkey is also available in the GNSS dialog.*

The plan view guidance shows the location of the laser transmitter (❶):



Press **Laser** (❷) from any guidance screen to disable a survey laser receiver as a source of elevation information.

If the system receives no laser strikes for a period of more than one second, the **No Laser** flashing error message appears. An arrow appears in the *Laser Strike* text item. The arrow shows which direction the last laser strikes were received from. Move the blade of the machine in that direction in order to regain laser strikes.

To maintain accurate information from a laser transmitter:

- Do ***not*** operate lasers at dawn or dusk, or when conditions are foggy or raining.
- Make sure that the laser transmitter is regularly serviced and in good operating order before using it in the machine control environment.

5.3 Checking 3D cutting edge guidance

ATTENTION — Any movement of the cutting edge when the machine is stationary causes errors in the estimated orientation and pitch of the machine. These errors remain until the machine is moved with the cutting edge in a fixed position, and contribute to errors in the calculated position of the cutting edge tips. When you bench a 3D sensor, you can use sideshift to help position the focus tip over the benchmark; however, if you do use sideshift, you can only bench for elevation, ***not*** eastings and northings. When you check 3D guidance using a control point, you ***must*** place the focus tip at the control point without moving the cutting edge.

Before you start work, always check the accuracy of the system. Compare the coordinates of the cutting edge focus shown on the control box with the known 3D coordinates of a survey control point.

To check accuracy:

1. Check that the current coordinates (easting, northing, and elevation) of the cutting edge focus point are displayed on one of the guidance screens, typically

in one of the text view guidance screens. If the focus point coordinates are not available in one of the guidance screens, ask your site supervisor to configure a screen for you.

2. If you are using GNSS for guidance, select Fine accuracy mode. See 5.2.5 Setting GNSS accuracy mode.
3. Use one of these possible techniques to get a focus position:

   ***Note** – Make sure that the system has an accurate estimate of the blade pitch by moving the machine at least 5 m (16.4 ft) with the blade in the position it will be checked in.*

   - Using a fixed control point position the cutting edge focus point on the control point and then roll the blade so that the mast or masts are perpendicular to the wheelbase of the machine. Without moving the blade, move the machine at least 5 m (16.4 ft) away from the control point and then return to the control point, positioning the blade focus over the control point.
4. Compare the position on the display with the known position of the cutting edge focus point.

Tip – Trimble recommends that you regularly check the accuracy of the system. This helps determine the wear on the cutting edge. Always check the system accuracy after you restore a display or machine configuration.

5.4 Loading or creating a design

Before you can receive guidance, you must have a design loaded into the system. You can load a design supplied by an engineer in the office, or you can create a design while you are working in the field.

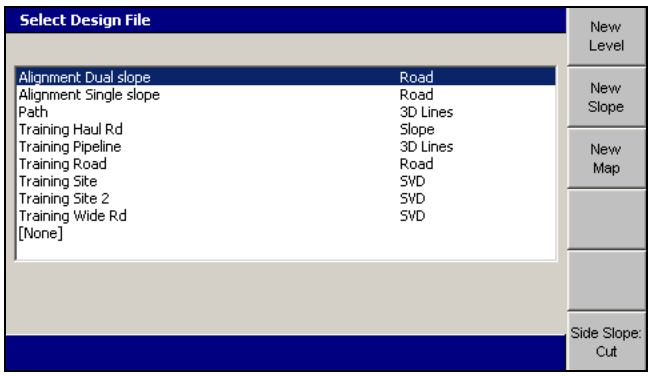
5.4.1 Loading a design

Most design types are loaded using a few simple key presses. However, if you are loading a 3D lines design file, once the file is loaded, you must select the 3D line you want to work with.

Loading the design file

To select and load a design:

1. From the *Setup Menu – Configuration* menu, select *Select Design*.

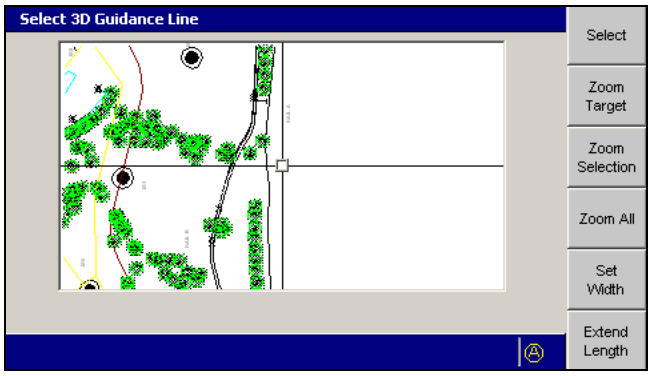


2. Highlight the design you want to load.
3. If the design you highlighted is a road design with sideslopes defined, make sure that the **Side Slope: <value>** displays either **Cut** or **Fill**:
   - Cut, if you are cutting down to the design surface.
   - Fill, if you are filling up to the design surface.
4. To confirm the settings, press ; to exit without saving changes, press .

   If the loaded design specifies only a single design surface, the plan view guidance screen appears.

Selecting a 3D line

If the loaded design is a 3D lines design, which may specify multiple design surfaces, the *Select 3D Guidance Line* dialog appears:



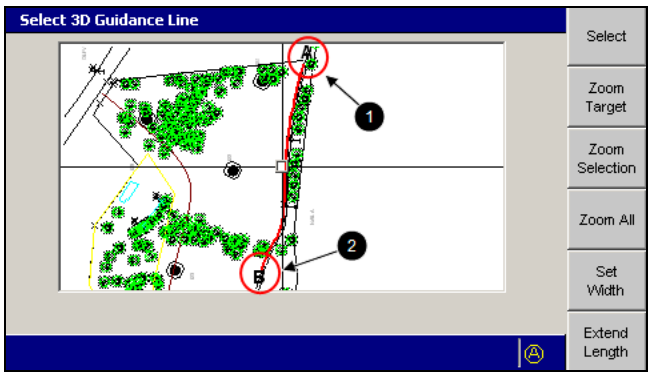
To select a 3D line for guidance:

1. From the *Select 3D Guidance Line* dialog, move the cross-hairs to the 3D line that you require. Use any of the following tools to move the cross-hairs:
   - To move the cross-hairs around the screen, use the arrow keys.
   - To zoom the current view in and out, press  or  .
   - To resize the current view to the immediate area around the cross-hairs, press **Zoom Target**.
   - To view all of the linework, press **Zoom All**.
   - To view the extents of the selected 3D line, press **Zoom Selection**.

   All linework for the design, including the site map and any avoidance zones, is shown in this dialog. You can only select a line that is a 3D line.

Tip – If several lines are grouped closely, press **Zoom Target** to zoom in for easier selection. Alternatively, move the cross-hairs to an area where the lines are more easily seen. To move the cross-hairs large distances across the screen, zoom out and then hold down an arrow key. This lets you move rapidly across the design.

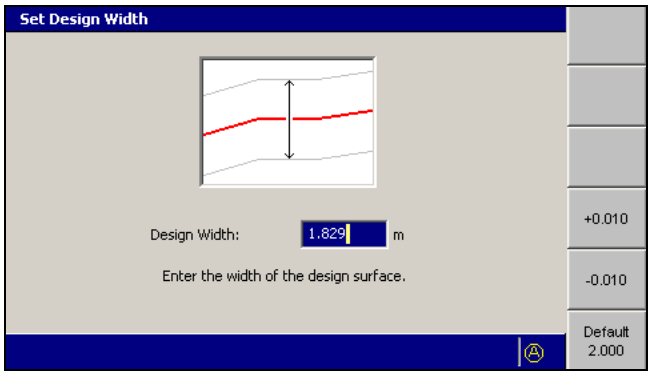
2. To select the 3D line for horizontal and vertical guidance, press **Select**. The line closest to the center of the crosshairs is selected. The selected 3D line appears as a thick red line.



❶ A (start) ❷ B (finish)

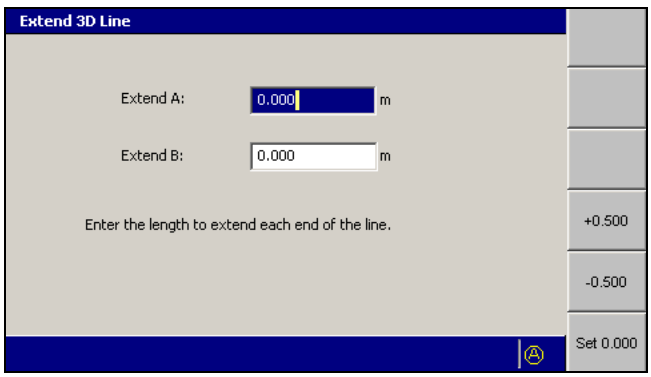
Figure 5.4 Selected 3D line

3. Press **Set Width**.



4. If required, use one or more of the following tools to specify the width of the design:
   - Edit the *Design Width* field directly.
   - To add or subtract 10 mm (0.4 inches) to or from the current width, press **+0.010** or **-0.010**.
   - To set the width to 2.0 m (6.5 ft), press **Default 2.000**.

   To confirm the settings, press ; to exit without saving changes, press .
5. Press **Extend Length**.



6. If required, to extend the line at one or both of the *A* and *B* ends, use one of the following tools:
   - Edit the *Extend A* and/or *Extend B* fields directly.
   - To add or subtract 500 mm (20 inches) to or from the current extension, press **+0.500** or **-0.500**.
   - To reset the extension to zero, press **Set 0.000**.

   To confirm the *Extend 3D Line* settings, press ; to exit without saving changes, press . The *Select 3D Guidance Line* dialog appears.

7. To confirm the *Guidance Line* settings, press ; to exit without saving changes, press .

5.4.2 Creating a design

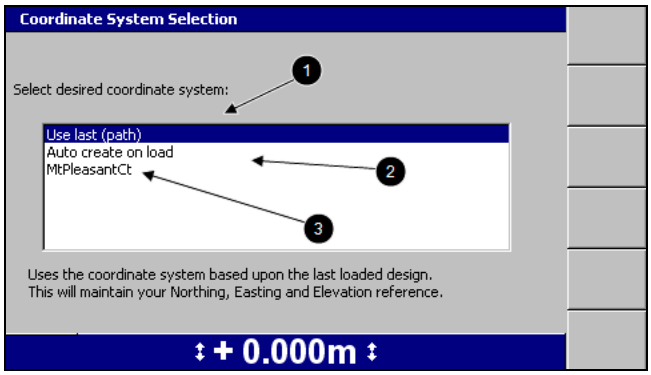
There are two simple design surfaces you can create in the field:

- Level designs
- Sloping designs

Creating a level design surface

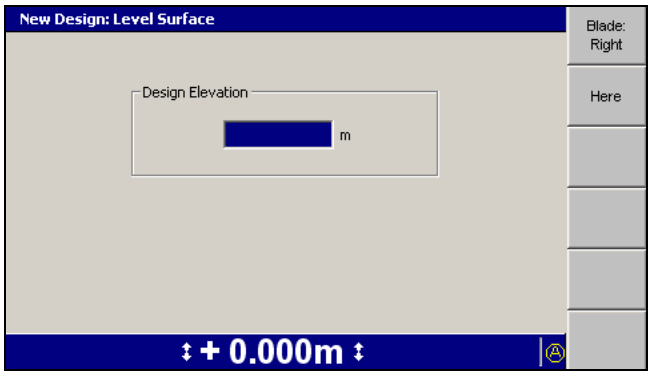
To create a level surface design file:

1. From the *Select Design File* dialog, press **New Level**, **New Slope**, or **New Map**.

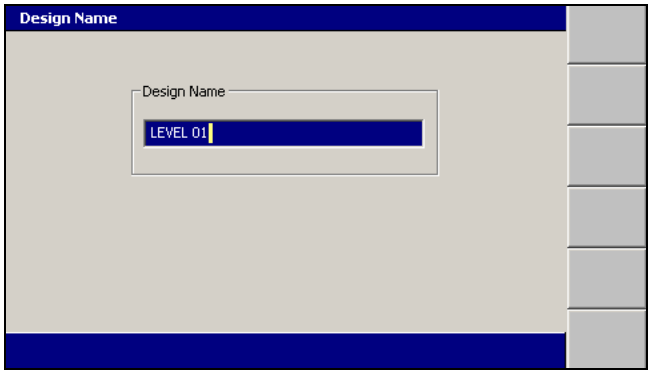


2. Select one of the following options:
   - ❶: To use the same coordinate system as the last loaded design, select *Use last (<name>)*. This option maintains your Northing, Easting and Elevation reference.
   - ❷: To automatically create a new coordinate system based on your current position, select *Auto create on load*. (MS9x2-based systems only, with firmware version 4.40 or later).

     ***Note** – This option is only available when no site wide avoidance zone is loaded.*
   - ❸: To use an existing coordinate system stored in the root directory of the control box file system, select the coordinate system name.
3. Press . The *New Map* dialog, the *New Design: Level Surface* dialog, or the *New Design: Sloping Surface* dialog appears.



4. Use any of the following tools to specify the design elevation:
   - Edit the *Design Elevation* field directly.
   - To use the current elevation of the focus point, press **Here**.
   - To change the focus point, press either **Blade: Left** or **Blade: Right**.
5. To confirm the settings, press .



The system gives the design a default name.

6. If required, edit the default name and press . The *Select Design File* dialog appears. The design just created is highlighted.
7. To load the new level surface design, press . The *Setup Menu – Configuration* menu appears.

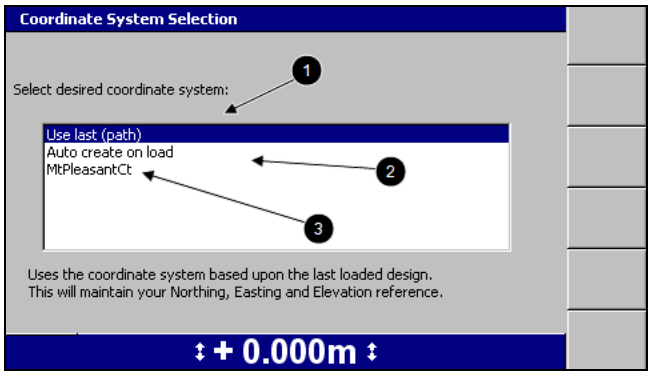
Creating a sloping design surface

WARNING — If you create a ramp or other work platform that is too steep, machines and vehicles using the ramp or platform could become difficult to control. This could result in harm to the operator, to others, or damage to the machine. To ensure your safety and the safety of others, find out what the maximum slope for your site is and make sure you do not exceed it.

***Note** – To learn more about the elements that make up a sloping surface, refer to the GCS900 Grade Control System Reference Manual.*

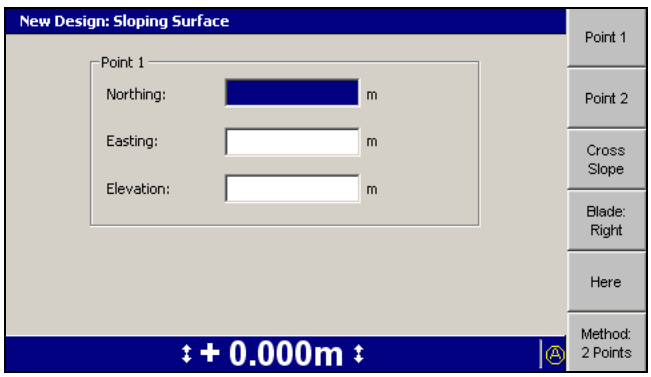
To create a sloping surface design file:

1. From the *Select Design File* dialog, press **New Level**, **New Slope**, or **New Map**.



2. Select one of the following options:
   - ❶: To use the same coordinate system as the last loaded design, select *Use last (<name>)*. This option maintains your Northing, Easting and Elevation reference.
   - ❷: To automatically create a new coordinate system based on your current position, select *Auto create on load*. (MS9x2-based systems only, with firmware version 4.40 or later).

     ***Note** – This option is only available when no site wide avoidance zone is loaded.*
   - ❸: To use an existing coordinate system stored in the root directory of the control box file system, select the coordinate system name.
3. Press . The *New Map* dialog, the *New Design: Level Surface* dialog, or the *New Design: Sloping Surface* dialog appears.



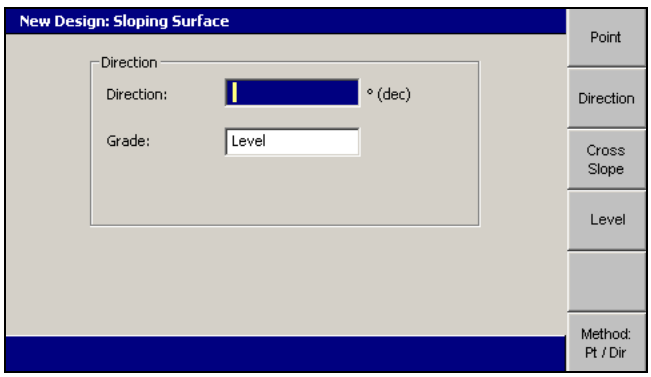
By default, the dialog shows the softkeys and fields needed to define a sloping surface using the *2-Points* method.

If you want to define the surface by using the *Point-and-Direction* method, go to step 3 below:

1. Use any of the following tools to specify Point 1:
   - Edit the *Northing*, *Easting,* and *Elevation* fields directly.
   - To use the current northing, easting, and elevation of the focus point, press **Here**.
   - To change the focus point, press either **Blade: Left** or **Blade: Right**.
2. Press **Point 2**. Use the procedure outlined in step 1 to specify Point 2.

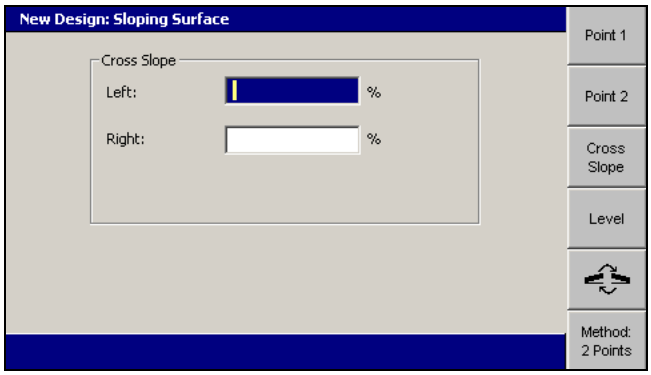
Tip – When both points are entered, the system calculates the direction and grade values. To view the calculated values, press **Method: 2 Points**.
The *2 Points* and *Pt / Dir* dialogs update each other with information. The Point 1 and Cross Slope values are always the same in both dialogs. Enter Point 2 values and then change to the *Pt/Dir* dialog to see the calculated direction and grade. Check that the calculated direction and grade are within design limits. If you change the Direction setting or change the Grade setting in the *Pt / Dir* dialog, the change clears the value of Point 2 in the *2 Points* dialog, as there is not enough information to calculate the new position.

3. To use the Point-and-Direction method, press **Method: 2 Points**. The softkey changes to **Method: Pt / Dir** and the **Point 1** position fields are shown.
4. Use one or more of the following tools to specify Point 1:
   - Edit the *Northing*, *Easting,* and *Elevation* fields directly.
   - To use the current northing, easting, and elevation of the focus point, press **Here**.
   - To change the focus point, press either **Blade: Left** or **Blade: Right**.
5. Press **Direction**.

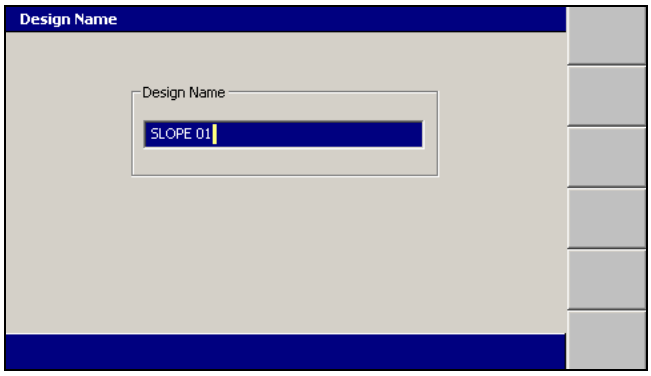


6. Edit the *Direction* field to specify the direction of the master alignment relative to Point 1.

7. Use any of the following tools to specify the grade of the master alignment:
   - Edit the *Grade* field directly.
   - To set the grade to 0%, press **Level**.
8. Press **Cross Slope**.



9. Use the following tools to specify the left and right cross slope:
   - Edit the *Left* and *Right* fields directly.
   - To set the cross slope to 0%, press **Level**.
   - To change the direction of the cross slope, press . The symbols beside the cross slope fields indicate the direction of slope, as seen from your position.
10. To confirm the settings, press .



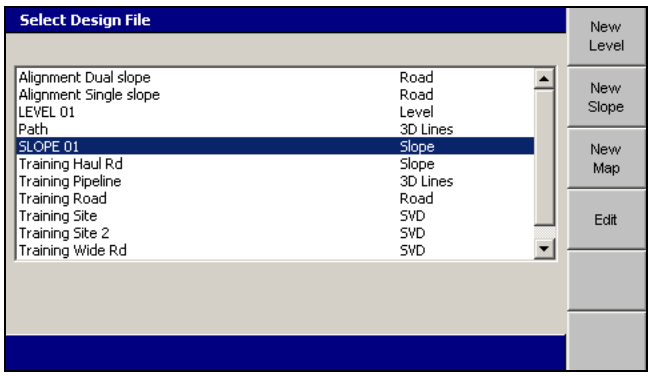
The system gives the design a default name.

11. If required, edit the default name and press . The *Select Design File* dialog appears. The design just created is highlighted.
12. To load the new sloping surface design, press . The *Setup Menu – Configuration* menu appears.

Modifying level and sloping design surfaces

Once a level or sloping surface design is created, you can complete the following steps to change the design parameters:

1. From the *Setup Menu – Configuration* menu, select *Select Design*.



2. Highlight the level or sloping surface design that you want to modify.
3. Press **Edit**, then do one of the following:
   - To modify a level design, follow the procedure described in Creating a level design surface, page 133.
   - To modify a sloping design, follow the procedure described in Creating a sloping design surface, page 134.

***Note** – If the surface design was already loaded, the edited design is automatically reloaded. This happens whether or not you press* OK *or* ↩ *to exit the Select Design File dialog.*

Design creation problems

Some common design creation problem are:

Problem	Action
No **Here** button	A high accuracy position is not available. Use the procedure described in 7.3 Running system diagnostics to check the GNSS receiver status.
No "Auto create on load" option	• Feature not supported on the GNSS receiver model installed. • Feature not supported by the firmware installed in the GNSS receiver.

5.5 Lane guidance

When lane guidance is selected, the machine is guided vertically to the surface of the specified lane, extended 1 km right and 1 km left of the defined lane limits.

The two main ways to use lane guidance are:

- to hold the machine guidance point onto a specified surface or lane
- to extend a lane sideways, which allows you to deliberately or temporarily get extended guidance

To use lane guidance:

- the loaded design must be an SVD design with an accompanying SVL file
- a master alignment is required:
  - If the current design does NOT include a master alignment, you must select a master alignment before you can select a lane.
  - If a master alignment is included in the current design, that master alignment is automatically selected.

Tip – A master alignment can be included in an SVL/SVD design by using Trimble Business Center – HCE software in the office.

When using Cut/Fill mapping/recording with lane guidance, no updates occur when a lane is changed and the Cut/Fill mapping/recording must be reset.

If the map is not reset and the guidance point passes over the same area again, the Cut/Fill color coding is updated with respect to the current design surface.

5.5.1 Using lane guidance

***Note** – Lane guidance is only available when an SVD/SVL design has been loaded.*

Use one of the following methods to select a lane:

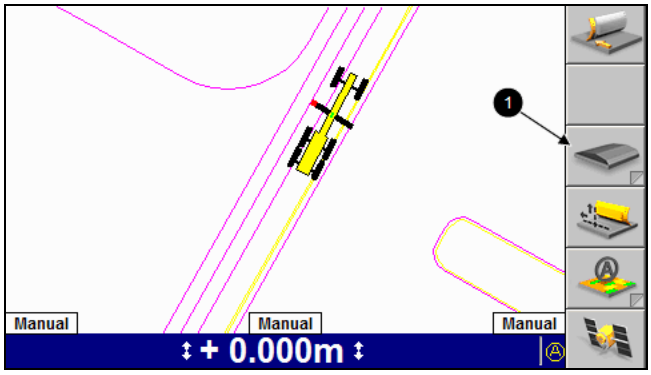
- Position the machine with the guidance focus in the required lane and press **Select Lane**. To de-select the lane, press **Select Lane** again.

Tip – After de-selecting a lane and moving the machine to an area of the design where the guidance focus is no longer in the same lane, when you press **Select Lane** again a different lane will be selected.

- To choose the lane boundaries, press and hold **Select Lane**. This enables you to select any linework to define the lane, provided the lines do not diverge 90° or more away from the master alignment.

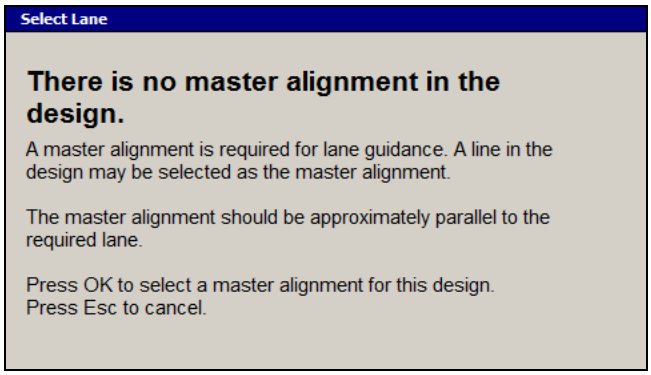
To configure lane guidance and select a lane:

1. From any guidance screen, press and hold **Select Lane** (❶).

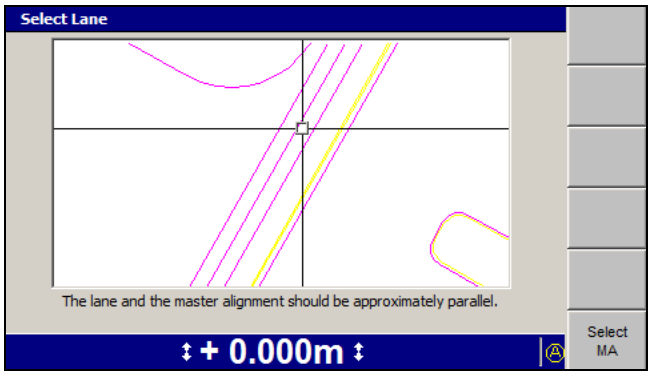


Or from the *Setup Menu – Configuration* menu, select *Select Lane*.

If there is no master alignment in the design the following full screen warning message is displayed.

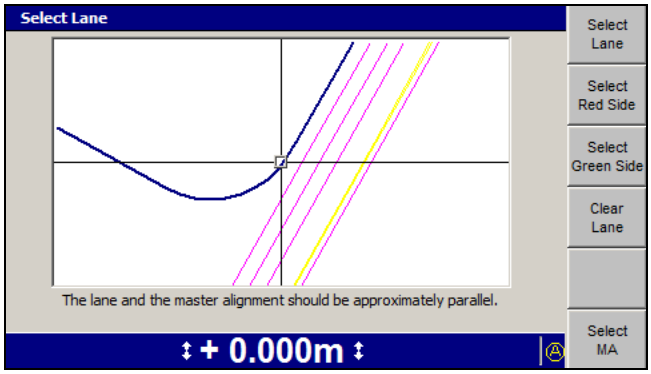


Press ⏻ to continue.



***Note** – When there is no master alignment in the current design, only the* **Select MA** *softkey is displayed.*

2. To select a master alignment, move the cross-hairs to the required line and press **Select MA**. To move the cross-hairs around the screen, use the arrow keys.



The selected line is shaded double-thick blue and the lane guidance softkeys are displayed.

3. From the *Select Lane* dialog, move the cross-hairs to the line that you require. Use any of the following tools to move the cross-hairs:
   - To move the cross-hairs around the screen, use the arrow keys
   - To zoom the current view in and out, press or

All linework for the design, including the site map and any avoidance zones, is shown in this dialog.

Tip – If several lines are grouped closely, move the cross-hairs to an area where the lines are more easily seen. To move the cross-hairs large distances across the screen, zoom out and then hold down an arrow key. This lets you move rapidly across the design.

4. To select a lane using the one-click method, position the cross-hairs between two lines and press **Select Lane**.
5. To de-select an existing lane, press **Clear Lane**.
6. To define one side of the lane as the red side, press **Select Red Side**. The line closest to the center of the cross-hairs is selected. The selected line appears as a thick red line.
7. Move the cross-hairs to the other side of the required lane and press **Select Green Side**. The line closest to the center of the cross-hairs is selected. The selected line appears as a thick green line.

   ***Note** – The red and green lines do not need to be adjacent to each other and the red and green colors are arbitrary.*

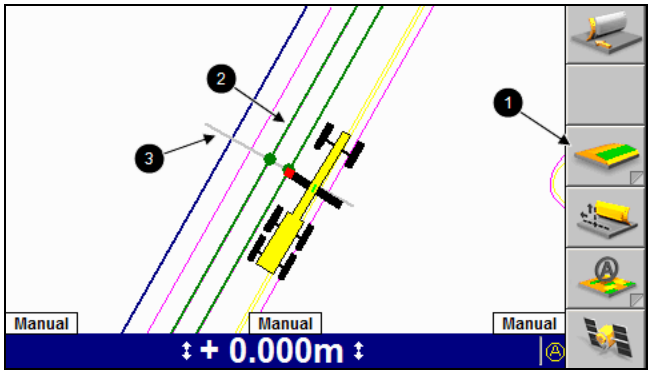
Tip – A selected lane is defined by two lines which are the sides of the lane. Red and Green sides could also be thought of as side 1 and side 2 or left and right sides.

8. To confirm the settings, press ; to exit without saving changes, press .

To use lane guidance, from a guidance screen press **Select Lane**.

When a lane is selected:

- the **Select Lane** softkey color changes from gray to yellow and also displays a green stripe (❶) to indicate that a lane is selected
- the lane sides are defined by thick green lines (❷).
- the lane guidance indicator (❸) consists of a line drawn across the lane, with lane focus points defining the lane edges. The lane guidance indicator moves with the machine.



When a lane is de-selected:

- the lane edges return to their original colors
- the **Select Lane** softkey changes to gray to indicate that no lane is selected
- the lane guidance indicator is no longer displayed

5.5.2 Troubleshooting lane guidance

Problems that may occur when setting up and using lane guidance are listed in the following table:

Problem	Solution
You have changed the master alignment for this design	A different master alignment could give different vertical guidance to the same section of the design. It is recommended that the same master alignment be used with the same lane. Press to accept the new master alignment. Press to cancel.

Problem	Solution
The selected lane cannot be used with the master alignment of this design	Select a lane within the range of the master alignment or do not use lane guidance on this section of the design. or Select lane sides that are within range of the master alignment or do not use lane guidance on this section of the design. Press  to continue.
The lane cannot be defined	The selected point is not between two lines. Select a different lane or do not use lane guidance on this section of the design. Press  to continue.
There is no master alignment in the design	A master alignment is required for lane guidance. A line in the design may be selected as the master alignment. The master alignment should be approximately parallel to the required lane. Press  to select a master alignment for this design. Press  to cancel.
The selected lane cannot be used with the current master alignment of this design	Select a lane within the range of the master alignment, select a different master alignment or do not use lane guidance on this section of the design. or Select lane sides that are within range of the master alignment, select a different master alignment, or do not use lane guidance on this section of the design. Press  to continue.
Lane guidance unavailable	This flashing message is displayed when: • there is no SVD surface beneath one or both of the lane sides; or • the machine position is beyond the end of the lane; or • the lane width is less than 0.3 meters (12 inches)

5.6 Working with 3D guidance

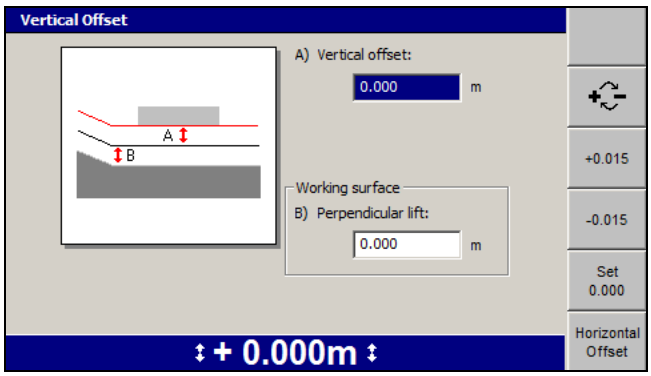
Common tasks that you may perform while you work with 3D guidance methods are:

Task	When	To learn how, see ...
Select a working surface and set the vertical offset for vertical guidance	Every time you begin a new job or load a new design.	5.6.1 Setting the working surface lift and/or vertical offset
Select an alignment for horizontal guidance	Every time you begin a new job, load a new design, or need to use a different horizontal alignment.	5.6.2 Selecting horizontal alignment
Select the focus given horizontal guidance	Every time you select a new horizontal alignment, or when you finish a pass, turn around, and want to swap the end given horizontal guidance.	5.6.3 Selecting focus for horizontal guidance
Set an offset from the horizontal alignment	Every time you select a new horizontal alignment, or you want to work a new section of design surface using the same alignment.	5.6.4 Setting horizontal offset
Increase or decrease the vertical offset while working	When you are not carrying enough material, or when you are carrying too much material.	5.6.5 Changing the vertical offset with remote switches
Automatically control only one blade tip for elevation or slope, while retaining manual control of the other blade tip	When you are working a long way from the design surface, for example when you are roughing-in, or to lower or lift the cutting edge at the beginning or end of a pass.	5.6.6 Automatically control only one blade tip on a motor grader
Roll the moldboard during a pass	When you need to adjust the pitch of the moldboard during a pass.	5.6.7 Changing blade pitch when working
Reacquire UTS lock	Every time you lose UTS lock during a pass.	5.6.8 Reacquiring UTS lock
Clear a UTS benching value	When you want to use the measured elevation of the UTS instrument in the guidance calculations.	5.6.9 Clearing the UTS benched elevation
Stop using UTS data for guidance	Every time you finish using guidance information from a UTS system.	5.6.10 Turning off UTS guidance
Stop using a survey laser receiver for enhanced elevation accuracy	When you want to use elevation data from the GNSS system for guidance.	5.6.11 Turning off laser enhanced elevation

5.6.1 Setting the working surface lift and/or vertical offset

1. From any guidance screen, press **Offsets**. For a list of softkey icons and their functions, see Softkeys, page 28.

If your site supervisor has selected a working surface other than the design surface for you to work to, the following dialog appears.



***Note** – If the design surface is the working surface, the Working surface section is unavailable.*

2. If required, use any of the following tools to set the vertical offset value:
   - Edit the *A) Vertical offset* field directly.
   - To change the sign of the offset, press .
   - To set the offset to zero, press **Set 0.000**.
   - To increase or decrease the offset, press **+0.015** or **-0.015**.

   ***Note** – The offset increment and decrement softkeys change the vertical offset by an amount equal to the vertical offset increment value. By default, the vertical offset increment is 15 mm (0.6 inches), but your site supervisor can change this value.*
3. If required, and if the *Working surface* section is available, use one or more of the following tools to set the working surface lift value:
   - Edit the *B) Perpendicular lift* field directly.

     ***Note** – Depending on the selected working surface, this field could also be B) Layered Lift, B) Vertical Lift, or B) Reference Surface.*
   - To change the sign of the offset, press .
   - To set the offset to zero, press **Set 0.000**.
   - To increase or decrease the offset, press **+0.015** or **-0.015**.
4. To set the horizontal offset, press **Horizontal Offset**. See 5.6.4 Setting horizontal offset.
5. To confirm the settings, press ; to exit without saving changes, press .

The most common lift and offset problem is:

Problem	Action
Unable to lift or drop a layered lift working surface	The allowable offset direction of a layered lift working surface from a design surface is determined by the setting of the **Side slope: <value>** softkey that appears in the *Select Design File* dialog when a .dc road design is selected. For example, if **Side slope: Fill** is shown, the layered lift working surface must be ***below*** the design surface, and the offset of the layered lift must be ***negative***. ***Note –*** *This restriction does not apply to road files that have been exported from SiteVision Office to support dynamic layered lifts.*

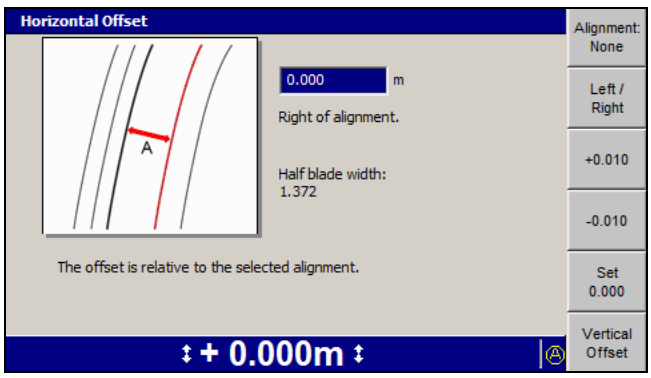
5.6.2 Selecting horizontal alignment

In most cases, use the *Guide to Horizontal Alignment* dialog to select a design feature to use as a horizontal alignment. The exceptions are:

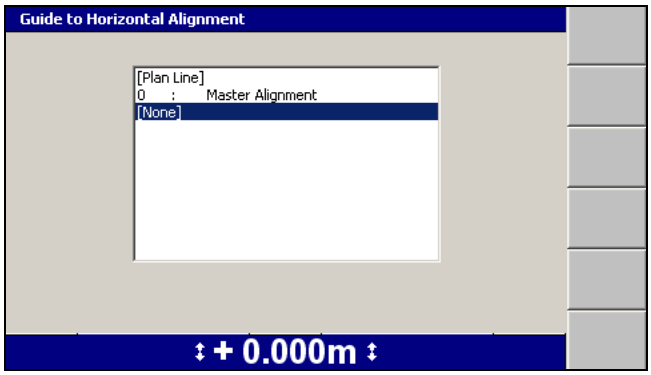
- If the only possible alignments in the loaded design are Site Map or Background Plan features, the *Guide to Horizontal Alignment* dialog is skipped, and the graphical selection screen appears.
- If you require guidance to side slopes in a road design.

To select a feature to use as a horizontal alignment:

1. From any of the guidance views, press **Offsets**. For a list of softkey icons and their functions, see Softkeys, page 28.



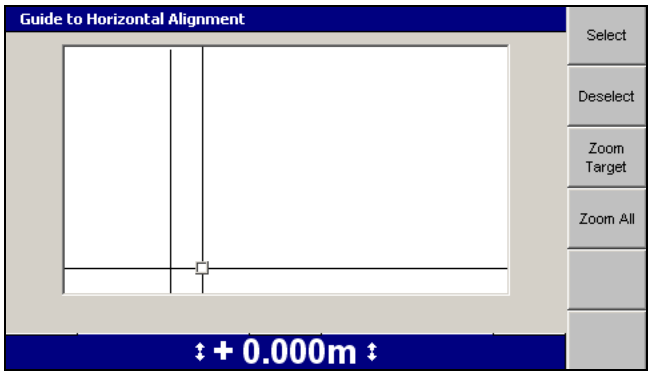
2. To set the vertical offset, press **Vertical Offset**. See 5.6.1 Setting the working surface lift and/or vertical offset.
3. Press **Alignment: <value>**. The following example shows the choices available in a .dc road design:



4. Highlight the required alignment option. The following options may be available in the *Guide to Horizontal Alignment* dialog, depending on the type of design loaded:

To select ...	Choose ...
A road alignment in a road design	The alignment by name
A road alignment in an .svd road design automatically	*[Auto Select Road Alignment]*
A layered lift alignment in a .dc road design	One of the *Layered Lift Alignment* options
A dynamic layered lift alignment in a .dc road design	One of the *Dynamic Lift Alignment* options
The master alignment in a sloping surface design	*Master Alignment*
The design boundary or linework in the Site Map or Background Plan	*[Plan Line]*
No alignment	[None]

5. If you selected a plan line or a 3D line for horizontal alignment, either the *Guide to Horizontal Alignment* or the *Select 3D Guidance Line* dialog appears. The *Guide to Horizontal Alignment* dialog is shown below:



***Note** – For more information on using the Select 3D Guidance Line dialog, see Selecting a 3D line, page 130.*

Use any of the following tools to move the cross-hairs in the *Guide to Horizontal Alignment* dialog:

- Use the arrow keys to move the cross-hairs around the screen.
- To zoom the current view in and out, press  or  .
- To resize the current view to the immediate area around the cross-hairs, press **Zoom Target**.
- To view all of the linework, press **Zoom All**

All linework for the design, including the site map and any avoidance zones, is shown in this dialog.

Tip – If several lines are grouped closely, press **Zoom Target** to zoom in for easier selection. Alternatively, move the cross-hairs to an area where the lines are more easily seen. To move the cross-hairs large distances across the screen, zoom out and then hold down an arrow key. This lets you move rapidly across the design.

6. To select the line for horizontal guidance, press **Select**. The line closest to the center of the cross-hairs is selected. The selected line appears as a thick red line.

   To deselect the current horizontal alignment without selecting another line, press **Deselect**.

7. To confirm the settings, press  ; to exit without saving changes, press  . A guidance screen appears. If in use, automatic controls are in the Inactive Auto state.

5.6.3 Selecting focus for horizontal guidance

To set or change the focus that is given horizontal guidance:

1. If you have not already done so, select an alignment as described in 5.6.2 Selecting horizontal alignment. Until an alignment is specified, no horizontal guidance is given.
2. To change the focus point, press either **Blade: Left** or **Blade: Right**.

If in use, automatic controls remain in the Auto state.

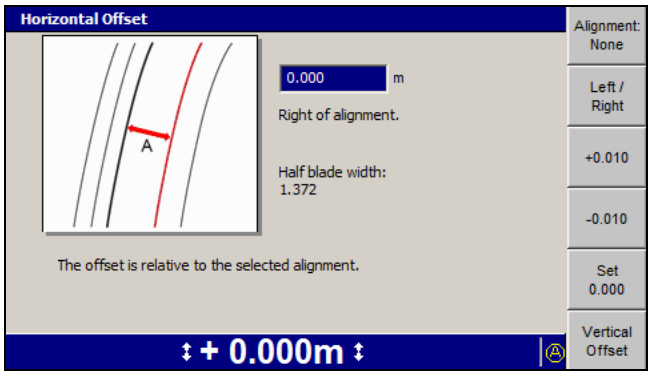
5.6.4 Setting horizontal offset

1. If you have not already done so, select an alignment as described in 5.6.2 Selecting horizontal alignment. Until an alignment is specified, any horizontal

offset has no effect.

2. From any of the guidance views, press **Offsets**. For a list of softkey icons and their functions, see Softkeys, page 28.

   The example below shows the *Horizontal Offset* dialog when a road alignment has been chosen for horizontal guidance.



3. If required, use one or more of the following tools to set the horizontal offset value:
   - To select the side of the alignment the offset is applied to, press **Left / Right**.
   - Directly edit the *Right of alignment* number field.
   - To reset the offset value to zero, press **Set 0.000**.
   - To increase or decrease the offset by 10 mm (0.4 inches), press **+0.010** or **-0.010**.
4. To set the vertical offset, press **Vertical Offset**. See 5.6.1 Setting the working surface lift and/or vertical offset.
5. To confirm the settings, press ; to exit without saving changes, press . If in use, automatic controls are in the Inactive Auto state.

5.6.5 Changing the vertical offset with remote switches

To change the vertical offset value in an automatic system, toggle either of the vertical offset remote switches.

If automatic controls are turned on, toggle the remote switch to the increment position to move the blade ***upward***.

5.6.6 Automatically control only one blade tip on a motor grader

Toggle one Auto/Manual switch to the Auto position. That blade tip is automatically controlled in the following way:

- If the automatically controlled blade tip has focus, the ***elevation*** of that tip is controlled to match the design elevation. The other tip must be manually controlled to maintain design slope.
- If the automatically controlled blade tip does not have focus, the ***cross slope*** of the blade is controlled to match the design slope. The other tip must be manually controlled to maintain design elevation.

Tip – Because automatic control of at least one lift ram must be activated before automatic control of the sideshift ram is activated, you can leave auto-sideshift turned on and activate the automatic control of both the lift ram and the sideshift ram using just the lift Auto/Manual switches.

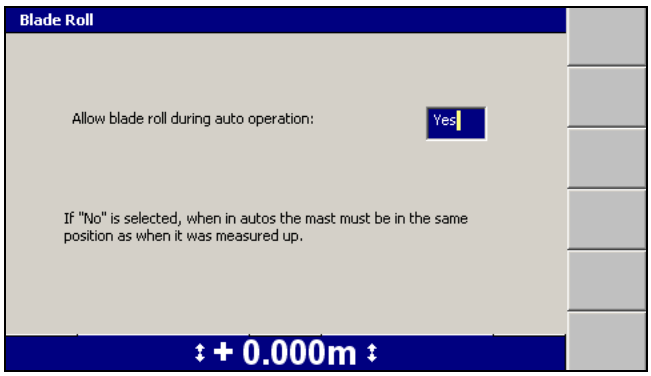
5.6.7 Changing blade pitch when working

ATTENTION — If you are using an SR300 survey laser receiver to improve elevation accuracy, make sure that you do not pitch the blade so far that the laser receiver output becomes unreliable. An SR300 laser receiver should not be operated more than 10° out of vertical.

Certain system configurations let you roll the blade while you are working with automatic controls turned on, and still create an accurate surface. By default, this feature is enabled on machines that support it.

To check if the feature is supported and enabled:

1. From any guidance screen, press .
2. If the feature is supported the *Blade Roll* option will be available in the *Setup Menu – Configuration* menu. If it is available, select *Blade Roll*.



3. Check that the *Allow blade roll during auto operation:* field is set to *Yes*.
4. You can now roll the blade while the automatic controls are turned on.

Tip – You will achieve the best results when the blade is rolled smoothly.

5.6.8 Reacquiring UTS lock

If the UTS loses lock on the target while you are working, the **No UTS Data** message flashes on the guidance screen. To reacquire lock:

1. Stop the machine as soon as safely possible in clear view, and within 15 m to 300 m (50 ft to 985 ft), of the UTS.

   ***Note** – To acquire lock, the target **must** be within the search window defined during UTS set up.*

2. If automatic controls are in use, put the controls into Manual.
3. If Auto Search is enabled, wait for the UTS to reacquire lock on the target.

   Otherwise, from any guidance screen, press **UTS**. The *UTS* dialog appears. Use one or more of the following tools to reacquire lock:

   - To initiate a search of the entire search window, press **Search**.
   - To initiate a search of an area of the search window within 20 m (66 ft) horizontally and 10 m (33 ft) vertically of your last known position, press **Quick Search**.

5.6.9 Clearing the UTS benched elevation

If you benched a UTS system, where the UTS instrument was set up with a known elevation, the benched elevation of the instrument is used for position calculation instead of the elevation specified during set up.

To clear the benched elevation and return to using the set up elevation:

1. From any guidance screen, press and hold down  .

   ***Note** – Alternatively, to begin benching from the Setup Menu – Configuration menu, select Bench.*

   When no pitch sensor is configured, a full screen warning message appears, telling you to make your mast vertical. Press  .

2. Press **Clear Bench**.

***Note** – If the UTS instrument did not have an initial elevation, clearing the benching data stops guidance.*

5.6.10 Turning off UTS guidance

Before you turn off the system, turn off UTS guidance:

1. If automatic controls are in use, put the controls into Manual.
2. From any guidance screen, press **UTS**.
3. Press **Stop** and then wait for the UTS status to change to *Waiting for Start*.

***Note** – Turning off UTS guidance **does not** turn off the UTS instrument. You must manually turn off the power at the UTS instrument.*

5.6.11 Turning off laser enhanced elevation

Once you finish using a survey laser receiver for enhanced elevation accuracy and you want to return to using GNSS as the elevation data source for vertical guidance, press **Laser: On** from any guidance screen. The softkey label changes to **Laser: Off**.

***Note** – The **Laser: On** softkey is also available in the GNSS dialog.*

To confirm the settings, press  ; to exit without saving changes, press  . A guidance screen appears.

5.7 John Deere EHC motor grader support

The system supports John Deere motor graders that have electro-hydraulic controllers (EHCs) and integrated blade rotation sensors.

The system is operated in the usual way, with the exception of the switches used to activate the automatic controls and increment and decrement the design offset.

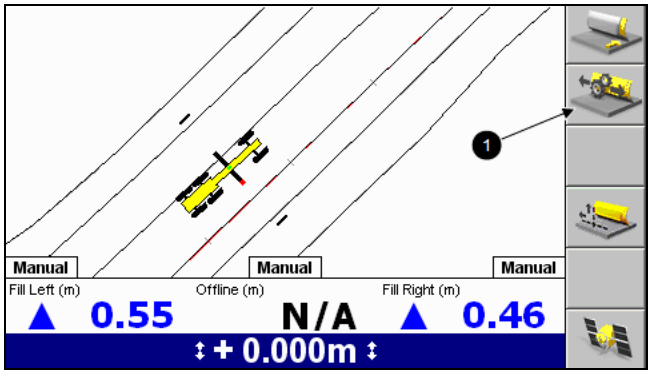
These differences are described in the following sections.

5.7.1 Using the integrated switches

The John Deere EHC motor grader uses integrated switches to turn on automatic control of blade elevation and slope, and to increment and decrement the design offset.

5.7.2 Turning on sideshift automatic control

The John Deere EHC motor grader does not have an integrated switch for turning on automatic control of the sideshift ram. To turn on sideshift automatic control, from any guidance view press **Sideshift Autos** (❶), as shown below:



Pressing **Sideshift Autos** toggles the automatic control of sideshift on and off.

Note *– The* **Sideshift Autos** *softkey does not indicate the state of the sideshift automatic controls. To check the state of the sideshift automatic controls, observe the center auto/manual indicator on the screen.*

Tip – At least one of the blade lift rams must be under automatic control before sideshift automatic control operates. You can leave sideshift automatic control toggled on during a run, and activate and deactivate sideshift automatic control using the blade lift controls described in the previous section.

3D Plus Sonic Tracer Guidance

In this chapter:

This chapter describes how to set up 3D plus sonic tracer guidance systems and use them in the field.

Introduction

3D plus sonic tracer guidance is a combination of 3D guidance, used to determine the height of one blade tip, and conventional lift guidance, provided by a sonic tracer, for the opposite blade tip.

3D plus sonic tracer guidance enables you to simultaneously:

- Set and maintain the height of one tip of the cutting edge relative to a reference elevation using the sonic tracer.
- Control the height of the other tip of the cutting edge, to match the 3D design elevation at the current blade location, independent of the mainfall and cross slope of the machine and the rotation of the blade.

3D plus sonic tracer is useful for grading to a 3D design while matching the elevation of an existing reference surface, such as a kerb. For machines with automatic controls, you can control the height of both blade tips in the following way:

- The automatic controls adjust the height of one blade tip to maintain a preset elevation relative to a reference surface.
- The automatic controls adjust the height of the other blade tip to maintain the 3D design elevation.

5.8 Prepare hybrid sensor systems

5.8.1 Preparing 3D sensors

For information on preparing 3D sensors, Chapter 5.2, Preparing 3D sensors.

5.8.2 Preparing sonic tracers

Common tasks that you must perform before you can use sonic tracers in a hybrid system are described below:

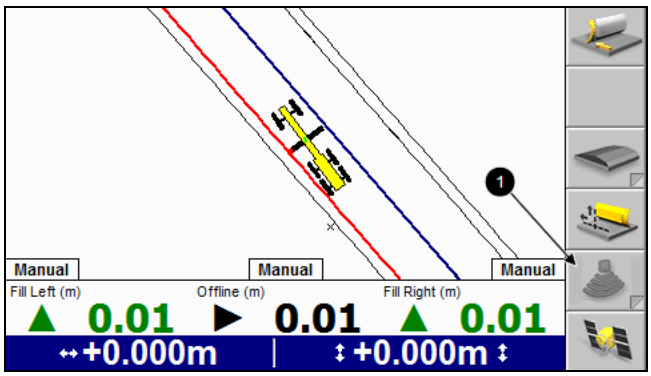
Task	When	To learn how, see ...
Connect a sonic tracer	When you need lift guidance and there is no lift sensor installed	Preparing conventional sensors
Bench a sonic tracer	The first time you use a sonic tracer	Benching a sonic tracer

5.8.3 Benching a sonic tracer

1. Position the machine at the start of the grading run.
2. Load the required design. For more information, see Loading or creating a design.
3. Adjust the rotation and roll of the moldboard, so that the moldboard is in its working position.

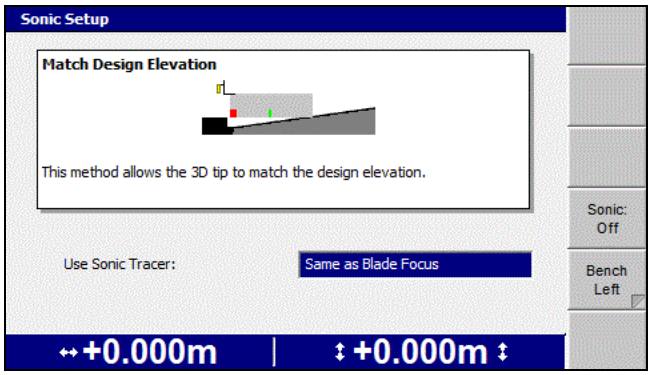
ATTENTION – If the working position of the moldboard is changed, then you must re-bench the sonic tracer.

4. From any guidance screen, press . From the *Setup Menu - Configuration* menu press **Mode: <current mode>** repeatedly until one of the following messages displays:
   - **3D Dual GNSS + Sonic**, for dual GNSS systems
   - **3D Single GNSS <side> + Sonic**, for single GNSS systems
   - **3D UTS <side> + Sonic**, for UTS systems
5. Press to return to the guidance screen. The Sonic tracer lift guidance softkey ❶ is displayed.



6. If the system has a single sonic tracer installed, press softkey ❶ to enable 3D plus sonic tracer mode.

   If the system has two sonic tracers installed, press and hold softkey ❶ to select the sonic tracer to use. The *Sonic Setup* dialog appears:



***Note** – Alternatively, to access the Sonic Setup dialog, press* *and then from the Setup Menu – Configuration menu, select Sonic Setup.*

a. Press or to select the sonic tracer; one of *Same as Blade Focus*, *Opposite of Blade Focus*, *Fixed Left* or *Fixed Right*.

b. Press **Sonic: Off** to toggle 3D plus sonic tracer mode on.

c. Press to save the settings and return to the guidance screen.

7. If the system has two sonic tracers installed, and the sonic tracer used is selected by setting the blade focus (Step 4.a), then ensure that the correct blade tip is selected for focus.
8. Position the sonic tracer over the reference surface (for example, a kerb) or stringline by adjusting the L-shaped support tube. Adjust the support tube so that:
   - The sonic tracer is between 400 mm (16 inches) and 1 m (40 inches) horizontally from the blade tip
   - The tube is perpendicular to the wheelbase of the machine
   - The sonic tracer is centered directly over the elevation reference surface
9. Manually adjust the height of the blade tip controlled by the sonic tracer, until the blade tip is at the required elevation.

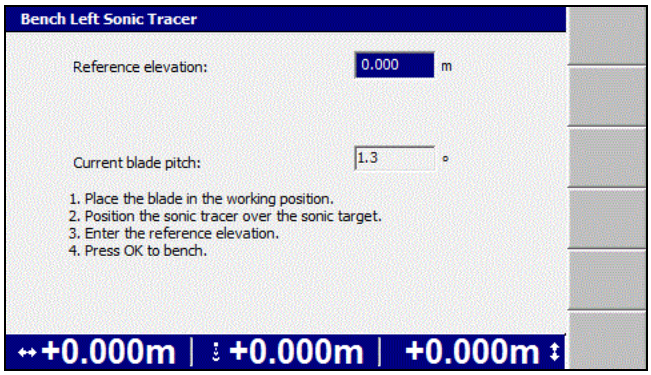
   While you are adjusting the height of the blade tip controlled by the sonic tracer, manually adjust the height of the 3D tip to maintain the design elevation, as indicated by the cut/fill value at the 3D tip, or the 3D tip lightbar.
10. Adjust the sonic tracer on the support tube so that its distance above the reference surface is one of the following:
    - Between 200 mm and 1300 mm (8 inches and 51 inches) for a kerb or design surface
    - Between 200 mm and 900 mm (8 inches and 36 inches) for a stringline

Tip – For ease of use, set the height of the sonic tracer so that the distance between the sonic tracer and the reference surface is kept close to the maximum distance. The greater the distance between the sonic tracer and the reference surface, the larger the sonic tracer's operating radius is, and the easier it is for you to maintain sonic guidance.

11. Adjust the sonic tracer in its mount so that it is approximately vertical.
12. From any guidance screen, press and hold .

    ***Note** – Alternatively, to access the benching dialog, press and hold , and then select Bench, or press and hold the Sonic tracer lift guidance softkey ❶, and then press and hold Bench <blade tip>*

    The *Bench <blade tip> Sonic Tracer* dialog appears.



13. Edit the *Reference elevation* field as required. The reference elevation is calculated as follows:
    - If you are benching with the blade tip on the design surface or at the elevation to which you want guidance, the reference elevation is zero.
    - If you are benching against a benchmark, subtract the design elevation from the elevation of the benchmark.
    - If you are benching over a stringline or kerb, add the vertical distance from the blade tip to the stringline or kerb, to the vertical distance from the stringline or kerb to the design elevation under the blade tip.

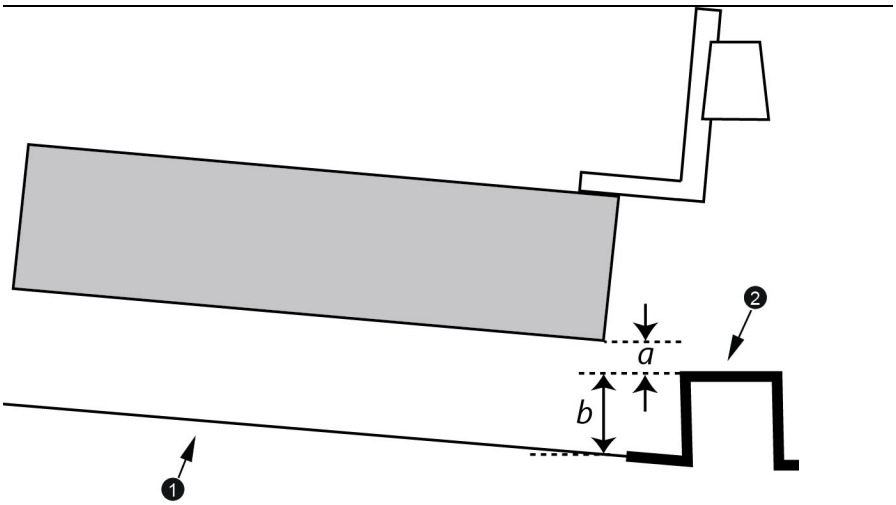


Figure 5.5 Measurements for benching a sonic tracer over a kerb

The reference elevation is *a*+*b*. If the blade tip is below the stringline or kerb, then *a* is negative, and the reference elevation is *b*–*a*.

***Note** – When you calculate the reference elevation in this way, as you work you increase or decrease the elevation offset so that the value of the elevation offset approaches zero as the cutting edge approaches the design surface.*

14. To begin benching, press . When benching finishes, the previous screen appears.

5.9 Working with hybrid guidance

Common tasks that you may perform while you work with hybrid guidance are:

Task	When	To learn how, see ...
Turn on 3D plus sonic tracer guidance.	When you want to work in hybrid mode.	See Turn on hybrid guidance
Turn off 3D plus sonic tracer guidance.	When you want to work in full 3D mode.	See Turn off hybrid guidance
Select a working surface and set the vertical offset for vertical guidance.	Every time you begin a new job or load a new design.	See Select a working surface and set vertical and horizontal offsetsand section Using 3D Guidance in the Field.

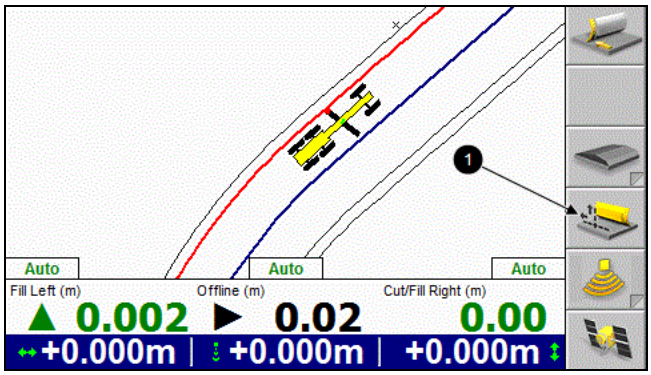
Task	When	To learn how, see ...
Select an alignment for horizontal guidance.	Every time you begin a new job, load a new design, or need to use a different horizontal alignment.	See section Using 3D Guidance in the Field
Select the focus given horizontal guidance.	Every time you select a new horizontal alignment, or when you finish a pass, turn around, and want to swap the end given horizontal guidance.	See section Using 3D Guidance in the Field.
Set an offset from the horizontal alignment.	Every time you select a new horizontal alignment, or you want to work a new section of design surface using the same alignment.	See Select a working surface and set vertical and horizontal offsets and section Using 3D Guidance in the Field.

5.9.1 Turn on hybrid guidance

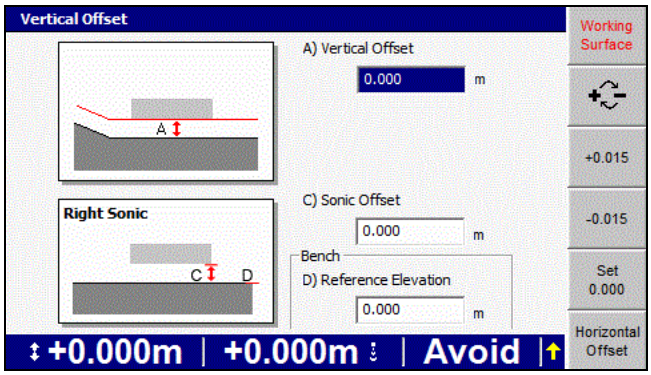
From any guidance screen, press . From the *Setup Menu - Configuration* menu press **Mode: <current mode>** repeatedly until one of the following messages displays:

- **3D Dual GNSS + Sonic**, for dual GNSS systems
- **3D Single GNSS <side> + Sonic**, for single GNSS systems
- **3D UTS <side> + Sonic**, for UTS systems

5.9.2 Select a working surface and set vertical and horizontal offsets



1. From any guidance screen press the **Offsets** softkey (❶). The *Vertical Offset* dialog appears:

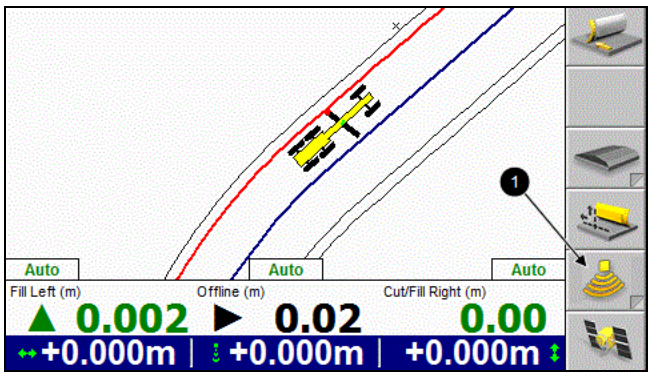


2. Enter one or both of the following:
   - the offset of the 3D tip from design into the *Vertical Offset:* field
   - the offset of the sonic tracer from the benched elevation into the *Sonic Offset:* field

   ***Note** – The Vertical and Sonic Offsets may be independently adjusted using the increment/decrement switches for the 3D and conventional blade tips.*

To access the *Horizontal Offset* dialog, from the *Vertical Offset* dialog. press **Horizontal Offset**.

5.9.3 Turn off hybrid guidance



WARNING — The cutting edge of the machine may move without warning when automatic controls are on. These sudden movements could cause injury to anyone near the cutting edge, or damage to the machine. Always put the system in Manual and engage the machine's park brake before you leave the machine, or when somebody is working near the cutting edge.

To turn off 3D plus sonic tracer guidance, and return to 3D guidance, from any guidance screen press the Sonic tracer lift guidance softkey ❶.

CHAPTER

6

Using Mapping/Recording in the Field

In this chapter:

This chapter describes procedures for setting up and using mapping/recording in the field.

For more information about mapping/recording, refer to the *GCS900 Grade Control System Reference Manual*.

6.1 Automatic mapping

The system supports the automatic control of map recording. You can control under what conditions maps are recorded by selecting from a number of pre-configured rules. The availability of a particular rule may depend on machine type and sensor configuration. For more information, see your site supervisor.

6.1.1 Fixed mapping rules

The following conditions must always be satisfied, and are not configurable:

- Mapping must be turned on, and a design or map loaded and at least one mapping type enabled.
- The system must be receiving high accuracy positions.
- The machine must have moved at least 0.25 m (10 inches) since the last map update.
- The machine must have moved less than 10 m (33 ft) since the last map update.

6.1.2 Machine mapping rules

The following mapping types can be subject to automatic mapping control:

- Pass Count
- Terrain
- Radio
- Cut/Fill

The following conditions can be combined to control mapping:

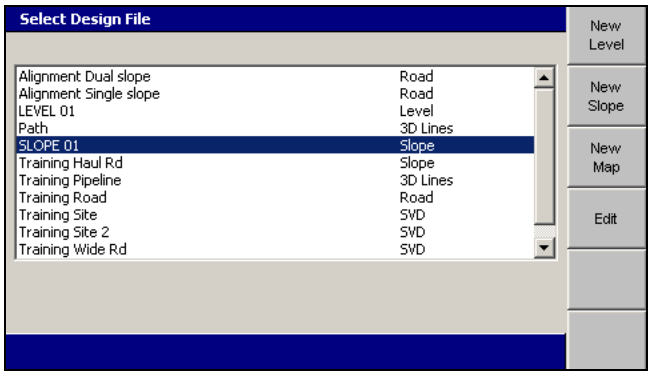
- Minimum height – this condition is satisfied when the elevation of a cell on the current pass is less than the elevation of the same cell on any previous pass.
- Blade tip – this condition is satisfied when a condition, selected from the following list, is satisfied:
  - Driving forwards – this condition is satisfied when the machine is moving forwards
  - Automatics on – this condition is satisfied when the automatic controls are turned on
  - Auto+forward – this condition is satisfied when the machine is moving forwards and the automatic controls are tuned on

- Blade on ground sensor – this condition is satisfied when the "blade-on-ground" sensor group estimates that the machine's cutting edge is at, or below, ground level and the machine is moving dirt
- Always – this condition is always deemed to be satisfied

6.2 Loading or creating a map

Map recording data is stored in either the design file of a loaded design or in a map file in a named directory on the system. If you are not working to a design or do not have a design loaded, then you must load an existing map file or create a new map file.

To create or load a map file, from the *Setup Menu – Configuration* menu select *Select Design*.



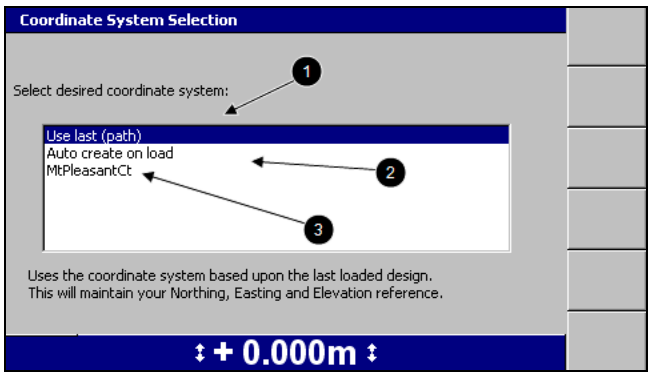
6.2.1 Loading a map file

To load an existing map file, follow the steps in Loading a design, page 129.

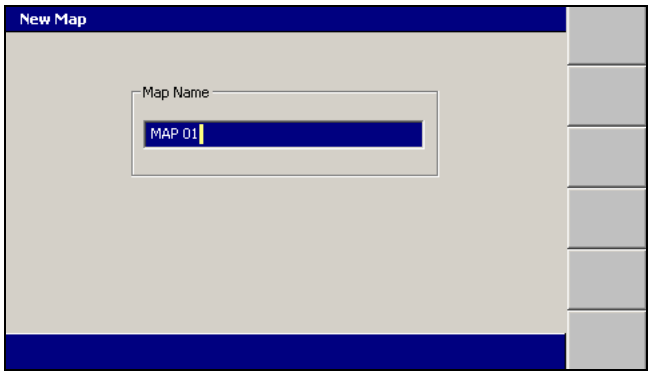
6.2.2 Creating a map file

To create a named, empty, map directory to hold map recording data:

1. From the *Select Design File* dialog, press **New Map**.



2. Select one of the following options:
   - ❶: To use the same coordinate system as the last loaded design, select *Use last (<name>)*. This option maintains your Northing, Easting and Elevation reference.
   - ❷: To automatically create a new coordinate system based on your current position, select *Auto create on load*. (MS9x2-based systems only, with firmware version 4.40 or later).
   - ❸: To use an existing coordinate system stored in the root directory of the control box file system, select the coordinate system name.
3. Press . The *New Map* dialog appears.



   The system gives the new map a default name.
4. If required, edit the default name, then press to accept the name and return to the *Select Design File* dialog. The map just created is highlighted.

5. Press  to load the new map and return to the *Setup Menu – Configuration* menu.

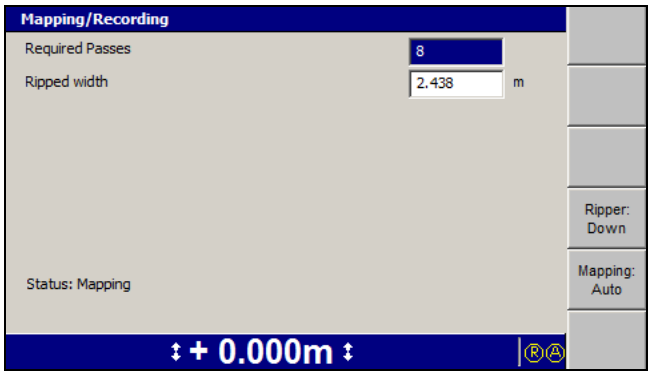
6.3 Configuring Mapping/Recording

The *Mapping/Recording* menu item is only available when:

- a design or map has been loaded, AND
- mapping for the main screen views has been enabled by your site supervisor.

To configure mapping/recording:

1. From any guidance screen, press  .
2. Select *Mapping/Recording*.



3. Edit the following fields as required:
   - *Required passes* – The number of passes that must be made over the surface. The maximum number of passes that can be set is 50.
   - *Ripped width* – The width of each ripped pass.
4. To change the mapping status, press **Mapping: <value>**. With each key press, the value cycles between **Auto**, **On** and **Off**.
5. To change the Ripper mapping status, press **Ripper: <value>**. The available values are **Ripper: Up** and **Ripper: Down**.
   - When the Ripper mapping status is set to **Ripper: Down**, Ripper mapping is "On" and the  (Ripper mapping symbol) is shown on the status bar.
   - When the Ripper mapping status is set to **Ripper: Up**, Ripper mapping is "Off", and no Ripper mapping symbol is shown on the status bar.
6. Press  to confirm the settings, or  to exit without saving.

ATTENTION — Map recording is intended to provide guidance to the operator, not record detailed terrain and attribute information. A map recording (*.map) file stores a “snapshot” of the map on the control box, that is, it stores the location of a cell and a numerical value for the color fill. To record detailed terrain (Northing, Easting, and elevation) and attribute data, make sure production reporting is turned on. If you need production reporting data, but the *Map Recording* dialog displays the message “WARNING: Production Reporting is off.”, ask your site supervisor to turn on production reporting.

6.4 Using Mapping/Recording

Mapping/Recording provides an on-screen map and log file of the job being currently worked.

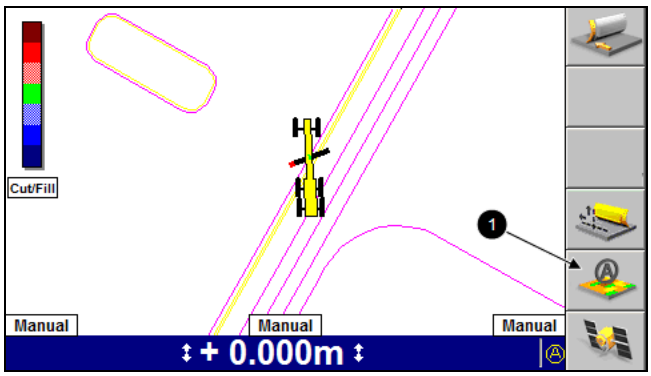
6.4.1 Mapping/Recording states

To view a list of the mapping/recording softkey icons, see Softkeys, page 28.

The Mapping/Recording symbol on the status bar shows the current mapping/recording state, as one of the following options:

- Auto
- On
- Off
- None (Mapping/Recording is not enabled)

When Mapping/Recording is enabled and the **Mapping** softkey (❶) is enabled as *Mapping: On/Off*, you use the **Mapping** softkey to select the required mapping type.



There is difference between **Mapping: Auto** and **Mapping: On**. If configured as **Mapping: Auto**, the system may have more requirements before it will record data. If the system was configured as **Mapping: On** it will always map.

For example, the system is set to *Minimum Height Mapping* as an auto rule and you are working with mapping set to **Mapping: Auto**. When you want to quickly change

from cutting to placing material and want to map as you place this material, all you need to do is change the mapping softkey to be set to **Mapping: On**. This ignores the minimum height mapping setting associated with **Mapping: Auto**.

6.4.2 Plan view mapping types

On any mapping/recording enabled guidance screen, press  to move between the plan view mapping types. Multiple mapping types enable you to see the current progress of each mapping type.

Mapping types are configured by your site supervisor and include:

- Terrain (or Min. Elev. Terrain, when *Minimum height mapping* is set to *Yes*)
- Cut/Fill (or Min. Elev. Cut/Fill, when *Minimum height mapping* is set to *Yes*)

  ***Note** – You must have a design loaded in order to select Cut/Fill mapping.*
- Passes Target
- Ripper mapping
- Radio coverage

6.5 Minimum height mapping

You can constrain Cut/Fill and Terrain mapping so that swathe data for a cell is only updated when the latest pass is lower than any previous pass over that cell. This prevents incorrect data being displayed in jobs that involve cutting down to the design surface.

To configure your system for minimum height mapping, see your site supervisor.

6.6 Point recording

Point recording is a mapping feature that allows you to record the 3D location of a point identified by the focus position.

***Note** – To use point recording, mapping/recording must be enabled and a design must be loaded. To enable mapping/recording, see 6.3 Configuring Mapping/Recording.*

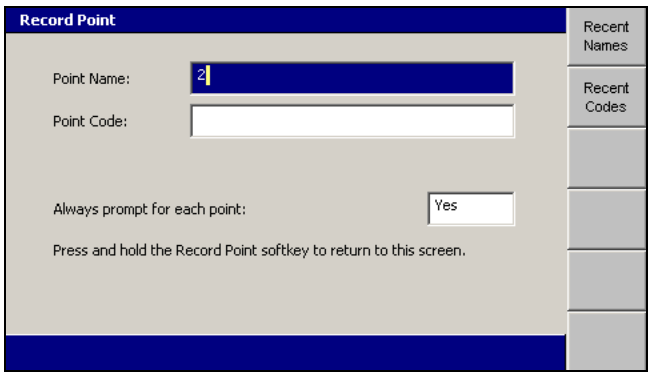
Tip – The **Record Point** softkey is visible when *Record Point* has been set as the Mapping Softkey in Main Screen Views. If *Mapping: On/Off/Auto* has been set as the Mapping Softkey and Record Point has been enabled for Press and Hold, you can record a point by pressing and holding the **Mapping/Recording** softkey.

To use the point recording feature:

1. Place the focus on the point to be recorded.

   Note – *The machine does not need to be stationary to record a point. If the machine is moving, the current focus position is recorded.*

2. From any guidance screen, press **Record Point**.



3. Enter the following information:

   - *Point Name* – This value must be unique. The suffix is automatically incremented for each new point. If a suffix is not specified, one is generated automatically. You can edit the name and the suffix as required.

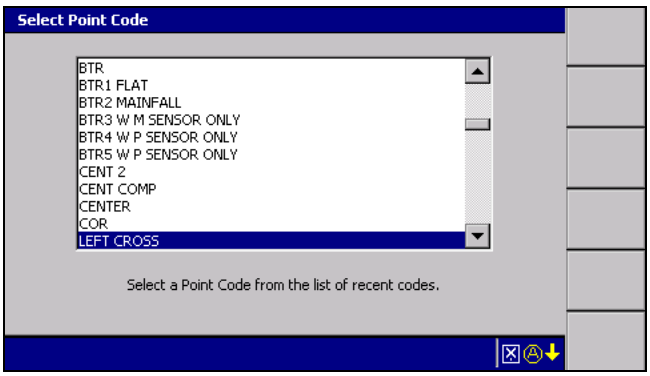
     Press **Recent Names** to display a list of recently used point names.

     An example point name is “PT”. When a new point is recorded, an incremental numeric suffix will be appended, giving an example result of “PT1”.

   - *Point Code* – This value is an arbitrary alpha-numeric value that helps to identify the type of point being recorded.

     From the Record Point dialog, press **Recent Codes** to display a list of recently used point codes.

     If a Codes.txt file exists, a list of predefined point codes in the order they are contained within the Codes.txt file appears.



Select the point code you require and press OK.

Note – *You cannot edit the name of a Point Code selected from a Codes.txt file in the Record Point dialog.*

Note – *Recent names and codes are only available after you start to record points and are only relevant to the current points file you are recording. For example, if you change designs and start recording new points the recent names and codes from your last job will not be available.*

- Prompting behavior – If *Always prompt for each point:* is set to *Yes*, the *Record Point* dialog is displayed each time the **Record Point** softkey is pressed. Otherwise, only a **Record Point** flashing message is displayed.

  Note – *If Always prompt for each point: is set to No, you can access the Record Point dialog by pressing and holding* **Record Point**.

4. Press OK.

The following problems may occur when you perform a point store operation:

Problem	Action
Error recording point	The system is in a low accuracy state. See your site supervisor.
No **Record Point** softkey	• Enable *Map Recording*. • Load a design or map. • Configure *Main Screen Views* to display the **Record Point** softkey. See 3.4.3 Main screen views.

CHAPTER

7

Troubleshooting in the Field

In this chapter:

Occasionally, problems will occur. Good troubleshooting techniques can significantly reduce the time it takes to isolate the problem and, ultimately, reduce the length of downtime.

The approach you take to troubleshooting depends on the configuration of the system you are working with.

The following sections outline some basic troubleshooting strategies.

7.1 Remote Assistant

Remote Assistant allows you to request online remote system support from your dealer or site supervisor.

When Remote Assistant is enabled, the support person can view or take control of the control box.

Remote Assistant is enabled by installing and configuring a wireless connection to the Internet, and also requires an active Connected Community subscription.

For more information, see your Site Supervisor.

The support telephone number is entered by the site supervisor so you can call support to initiate a remote assistance session.

7.1.1 Using Remote Assistant

Operators should be aware that:

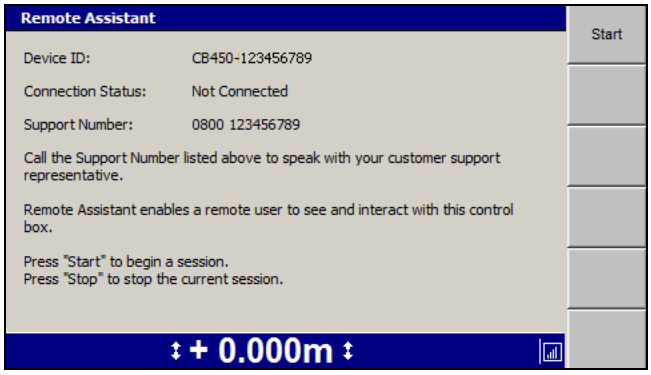
- When the office side connects to the control box via the Connected Community, both the machine and the office side can control most control box operations. This is intentional and enables either side to drive the control box.
- If the machine is running in Autos then the office side can change menu selections, which will force the machine out of Autos; you should be aware that Auto operation will stop.
- The office side cannot put the system into Autos; only the machine side can engage Autos.
- The office side cannot drive the blade directly in any way, even for diagnostic tests. To perform these actions, the office side must:
  - observe operator selections
  - listen to operator observations and advise appropriately

When Remote Assistant has been enabled and configured, you can call the support desk, using the provided support telephone number, and request remote assistance.

After you start Remote Assistant on the control box the support desk will initiate the remote assistance session from their end.

To access the support telephone number and start a Remote Assistant session:

1. From the *Setup Menu – Configuration* dialog, select *Remote Assistant*.



2. Press **Start** to begin a session.

   The Remote Assistant client is downloaded from the Connected Community during the first session. In most cases this should take less than five minutes to download, however, it could take up to 20 minutes.

   ***Note** – The Remote Assistant client is downloaded during the first session only. Subsequent sessions will connect faster, as the client has already been downloaded.*

3. Press **Stop** to stop the current session.

   ***Note** – The* **Stop** *button is only visible once the* **Start** *button has been pressed.*

7.1.2 Troubleshooting Remote Assistant

Problems that may occur when setting up and using Remote Assistant are listed in the following table:

Problem	Solution
Please check your Internet connection and try again	• Check that your cables are connected properly to your radio • Ask your site supervisor to enable a valid Internet connection
Remote Assistant fails to connect	Check your Internet connection
Login failed (Connected Community Settings)	Ask your site supervisor to check/validate the Connected Community login details
The *Support Number* field is blank	Ask your site supervisor to configure Remote Assistant

7.2 General troubleshooting

Check these items when troubleshooting:

- Is there a warning or error message that indicates a problem? Use the information in 7.4 Troubleshooting flashing warning messages, and 7.5 Troubleshooting error messages, to understand errors and warnings.

  Make a note of any messages that appear on the screen. You can also check the program log file (LOG_<machine name>_<date&time>.txt).
- Are all the devices on the system receiving power? Use the information in 7.6 Troubleshooting system components to quickly check the status of the easily accessible devices.
- Are all the devices in the system communicating? Use the information in 7.3 Running system diagnostics to make sure all the required devices have been detected.
- Do the devices have the correct firmware versions loaded? Use the information in 7.3 Running system diagnostics and the program log file to check current firmware versions. Contact your site supervisor to get a list of correct firmware versions.
- Are the orientations of installed slope sensors configured correctly?
- Are the machine measurements correct?
- Are all cables and connections secure and undamaged?
- What were the steps that led to the problem occurring?
- Can the problem be repeated?

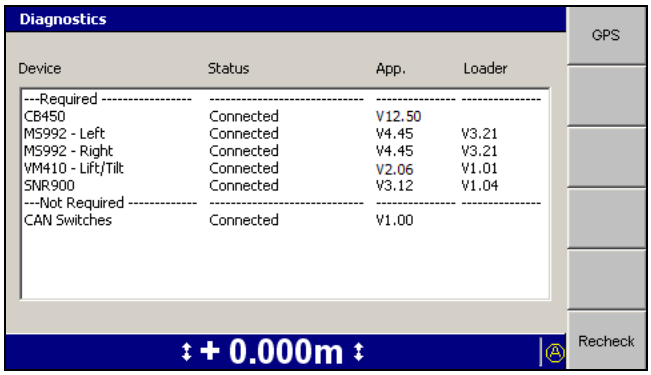
7.3 Running system diagnostics

The system expects certain components to be connected, depending on the system configuration.

When you first turn on the system, it automatically completes an initial check for devices that are configured to be connected to the CAN bus. If the system does not detect one or more of the devices, the Diagnostics dialog appears so that you can identify the problem.

To view a list of expected components and their status:

1. From any guidance screen, press  .
2. Select *Diagnostics*.



Devices showing as **Not Required** are connected, but are not required by the currently configured system.

3. Press **Recheck** at any time to refresh the data in this screen.
4. Press to exit.

Note – *If a configured device does not respond while the system is running, the following message appears:*

Some of the required system devices are not responding. Press to check the details in the Diagnostics item of the Setup Menu, or press to continue.

The screen displays a list of devices that are currently connected to the system. The *Diagnostics* dialog lists each device and reports the following information:

- The device name.
- The status of the device.
- The application firmware version number.
- The loader firmware version.

The application firmware must be the correct version before the device can be used in the system.

The application firmware version number indicates which devices are detected and which devices have the correct version of the firmware loaded.

Note – *When none of the devices display "old version", you can use the system.*

Note – *With some older radios, the diagnostics are unable to report a version number, but the system is usable. Also, the status of third party radios is not reported, and the radio is not shown in the Diagnostics dialog.*

If either the firmware or the loader is too old, the device is detected, but you cannot use the system until the device firmware is updated. The *Status* column displays the minimum firmware required.

If the message **Not Found** appears beside a device, the system is configured to use the device, but the device was not detected.

You cannot use the system if a device is not found.

Tip – If the configuration file sent to the GNSS receiver failed, try loading a design surface to send another configuration file.

To view detailed diagnostics about the UTS system, press **UTS**.

To view detailed diagnostics about the GNSS receiver and GNSS data link, press **GNSS**.

7.3.1 UTS diagnostics

The *Diagnostics* dialog *Status* field values and the *UTS* dialog *UTS status:* field values unique to UTS systems are listed in the following table.

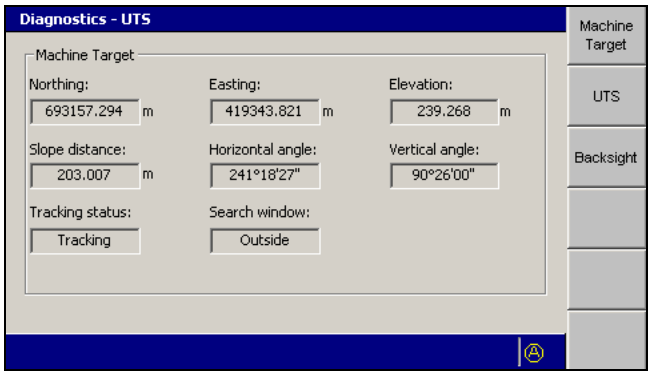
Table 7.1 — Values of the *Status* and *UTS status:* field for UTS systems

UTS tracking status	Meaning
UTS battery is low	The UTS instrument battery is too low to operate reliably.
UTS configuration failed	UTS instrument configuration failed.
UTS does not support Active Target ID <num>	The UTS instrument does not support the MT900 target ID specified.
UTS not level	The tilt compensator on the UTS instrument is out of range.
UTS not benched	The UTS elevation was not set at the instrument, so the target must be benched before use.
UTS not supported	The firmware in the UTS instrument is not interoperable with the system.
UTS not supported: Cannot determine firmware version	The firmware in the UTS instrument is not interoperable with the system.
UTS not supported: No Positioning support	The firmware in the UTS instrument is not interoperable with the system.
UTS not supported: No Tracker support	The firmware in the UTS instrument is not interoperable with the system.
UTS not supported: Not a construction UTS	The firmware in the UTS instrument is not interoperable with the system.
Auto Searching ...	The UTS instrument is searching for the machine target. Only occurs if you have selected auto search.
Check machine radio	The system cannot communicate with the machine radio.
Check machine target	The system cannot communicate with the machine target.

UTS tracking status	Meaning
Check radio channel	The radio network ID/channel number combination set up for your system is also being used by another machine within radio range.
Comms timed out	The delay in the response from the UTS instrument was greater than the maximum allowed.
Configuring UTS	The UTS instrument is being configured.
Connecting UTS	The system is establishing a radio link with the UTS instrument.
Disconnecting UTS	The system is dropping the radio link to the UTS instrument.
Full Searching for Target ...	The UTS instrument is carrying out a full search for the machine target.
Machine target search failure	System error.
Measuring Error	System error.
Multiple UTS detected	The radio network ID/channel number combination setup for your machine and instrument is also being used by another instrument within radio range.
Quick Searching ...	The UTS instrument is carrying out a quick search for the machine target.
Search Error	System error.
Target Lost	The UTS instrument has lost track of the machine target.
Tracking	The UTS instrument is correctly tracking the machine target.
Waiting for UTS	Occurs when you first start the UTS and when you enter the *UTS* dialog. The system is waiting for information from the UTS instrument.
Waiting for start	Waiting for the UTS system to start.

To view detailed UTS diagnostics:

1. From the *Diagnostics* dialog, press **UTS**.



The first *Diagnostics – UTS* screen is *Machine Target*. This is the screen that appears if you press **Machine Target**. The fields in this screen are explained below:

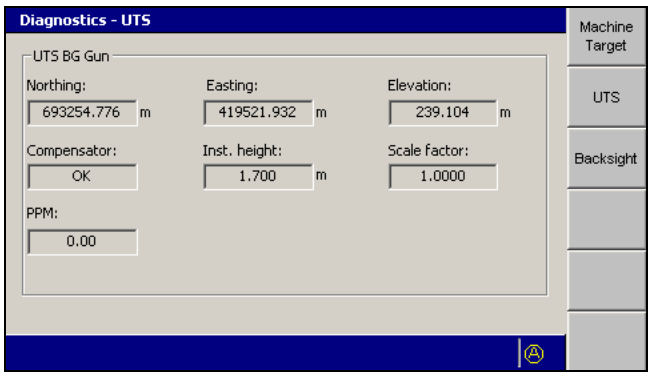
Field	Explanation
Northing Easting Elevation	The computed location of the machine target, in terms of northing, easting and elevation.
Slope distance Horizontal angle Vertical angle	The observed location of the machine target relative to the UTS, in terms of slope distance, horizontal angle and vertical angle.
Tracking status	UTS tracking status. See Table 7.2.
Search window	The position of the machine target relative to the search window specified during UTS set up.

The UTS instrument reports its tracking status to the system. UTS tracking status message are listed in Table 7.1.

Table 7.2 — UTS Tracking Status messages

Tracking Status	Meaning
N/A	No data being received from the instrument
No signal	No target is being tracked
Tracking	A target is being tracked

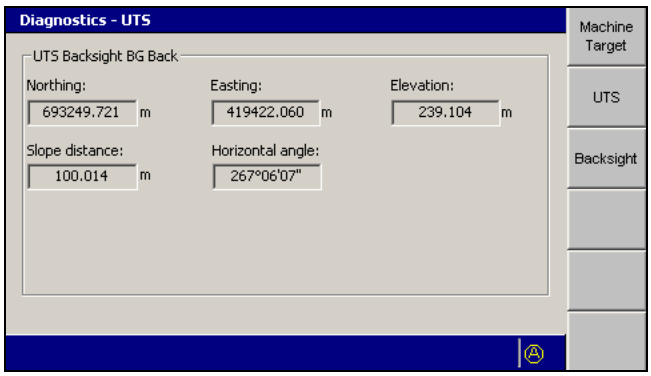
2. From any screen in the *Diagnostics – UTS* dialog, press **UTS**.



This screen displays the name of the point at which the UTS instrument was set up, if the point has a name, in the form *UTS <name>*. For example, *UTS South*. The fields within this screen are explained below.

Field	Explanation
Northing Easting Elevation	The known or measured setup location of the UTS instrument, in terms of northing, easting and elevation.
Compensator	The instrument's compensator status.
Inst. height	The setup height of the instrument.
Scale factor	The scale factor.
PPM	Parts per million. The instrument's Electronic Distance Meter (EDM) is affected by the temperature and pressure at which the instrument is being operated. Accurate entry of the ambient air temperature and barometric pressure correctly adjusts the EDM measurements for the PPM (parts per million) error associated with this effect.

3. From any screen in the *Diagnostics – UTS* dialog, press **Backsight**.



This screen displays information about the backsight taken to establish the orientation of the UTS instrument. The fields within this screen are explained below.

Field	Explanation
Northing Easting Elevation	The known location of the control point used for the backsight, in terms of northing, easting and elevation
Slope distance Horizontal angle	The observed location of the control point relative to the UTS, in terms of slope distance and horizontal angle

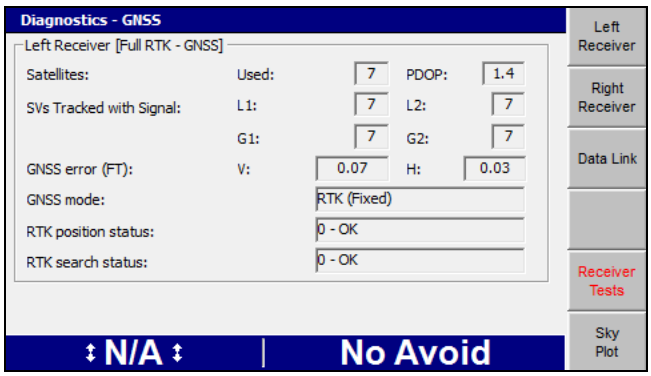
7.3.2 GNSS diagnostics and satellite monitoring

The system lets you view detailed diagnostics information and also access satellite orbit information for planning purposes.

GNSS diagnostics

To view detailed GNSS diagnostics:

1. From the *Diagnostics* dialog, press **GNSS**.



The first *Diagnostics – GNSS* screen is the *Receiver* screen, if you have a single-GNSS receiver system. The following table explains the fields in this screen.

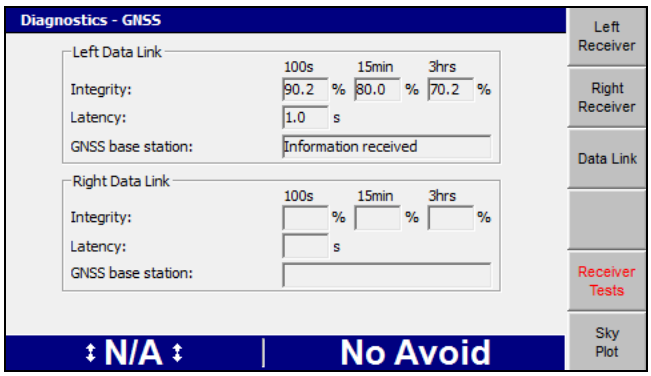
Table 7.3 — GNSS receiver fields

Field	Explanation
Satellites: Used	Number of satellites used for the current position solution. The satellites must be visible by both the base station and the machine. You need five or more satellites to initialize, and four or more to continue working.
Satellites: PDOP	PDOP (Positional Dilution of Precision) is a quality indicator of the current GNSS position solution. A small PDOP is better. The PDOP must be less than seven.
SVs Tracked with Signal: L1	Number of good quality GPS L1 signals being received at both the base and the machine. ***Note –*** *The number of L1 signals being received may be more than the number of satellites used for the position solution.*
SVs Tracked with Signal: L2	Number of good quality GPS L2 signals being received at both the base and the machine. ***Note –*** *The number of L2 signals being received may be more than the number of satellites used for the position solution.*

Field	Explanation
SVs Tracked with Signal: G1	Number of good quality GLONASS G1 signals being received at both the base and the machine. ***Note –*** *The number of G1 signals being received may be more than the number of satellites used for the position solution.*
SVs Tracked with Signal: G2	Number of good quality GLONASS G2 signals being received at both the base and the machine. ***Note –*** *The number of G2 signals being received may be more than the number of satellites used for the position solution.*
GNSS Error (m): V GNSS Error (m): H	An estimate of the current GNSS error in the horizontal and vertical directions.
GNSS mode	Type of GNSS solution.
RTK position status	Quality of the RTK position solution.
RTK search status	Quality of the satellite signal tracking.

Note *– Because of the bandwidth limitations imposed by 2-way wireless communications, a Trimble GNSS base station will only transmit GLONASS corrections when it is tracking six GNSS satellites or less. The on-machine and the base station GNSS receivers need to track at least three common GLONASS satellites, before GLONASS satellites can be used in the position solution.*

2. Press **Right Receiver**, if available. Table 7.3 explains the fields within this screen.
3. Press **Data Link**.



Note – *The screen shown above is an example of a GNSS data link diagnostics screen for a single-GNSS system. The Data Link screen for dual-GNSS systems, or systems using a base station configured to send corrections in RTCM V3.0 format, will differ from that shown.*

The *Data Link* screen reports the data radio statistics for the Compact Measurement Record (CMR) messages received from the base station. The fields in this screen are explained below:

Field	Explanation
Integrity: 100s	Percentage of CMR messages that were good in the last 100 seconds.
Integrity: 15min	Percentage of CMR messages that were good in the last 15 minutes.
Integrity: 3hrs	Percentage of CMR messages that were good in the last 3 hours.
Latency	The latency (or age) of the CMR correction used.
GNSS base station	"Information received" shows that the GNSS base station has broadcast its position. You need the GNSS base station position to initialize the GNSS receiver(s) on your machine.

GNSS satellite monitoring

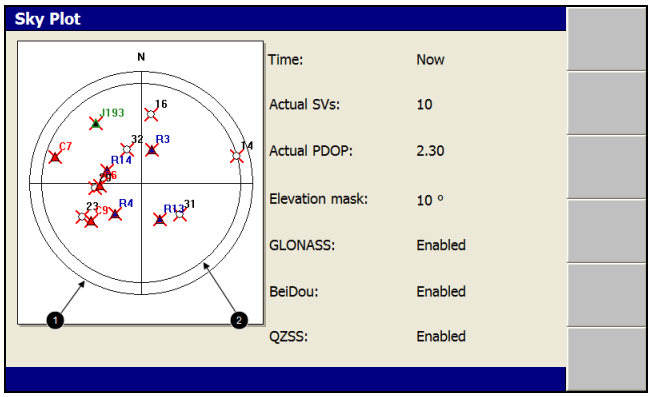
The system provides a tool for monitoring, in real-time, satellite position information and the quality of the current position solution.

This information is useful in diagnosing problems that may be caused by the distribution of satellites in the sky (the satellite constellation), such as too few satellites to calculate an RTK Fixed position solution.

Note – *The system does not use data from satellites marked as "unhealthy", and does not display their position in the Sky Plot view.*

This information is presented in the *Sky Plot* dialog. To access the *Sky Plot* dialog:

1. From *Setup Menu – Configuration*, select *Diagnostics*.
2. Press **GNSS**.
3. Press **Sky Plot**. Satellite data is downloaded from the GNSS receiver(s), and the *Sky Plot* dialog planning view appears:



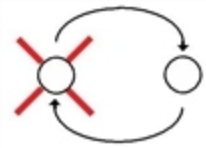
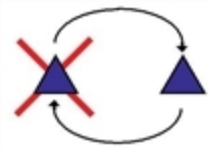
❶ Horizon (outer ring)

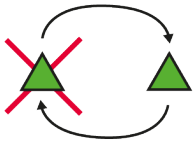
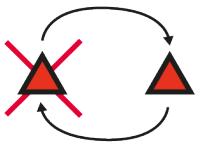
❷ Elevation mask (inner ring)

Figure 7.1 Sky Plot dialog

The following table describes the symbols that may appear in the *Sky Plot* dialog satellite map:

Table 7.4 — Sky Plot satellite map symbols

This symbol ...	Represents ...
 3 seconds alternating	A GPS satellite that the system is tracking and using in the position solution. The satellite's identifier is displayed next to the satellite's symbol.
	A GPS satellite that the system is tracking but not using in the position solution. The satellite's identifier is displayed next to the satellite's symbol.
	A satellite that is currently below the elevation mask. The satellite's identifier is displayed next to the satellite's symbol.
 3 seconds alternating	A GLONASS satellite that the system is tracking and using in the position solution. The satellite's identifier is displayed, prefixed with an "R", next to the satellite's symbol.
	A GLONASS satellite that the system is tracking but not using in the position solution. The satellite's identifier is displayed, prefixed with an "R", next to the satellite's symbol.

This symbol ...	Represents ...
	A GLONASS satellite that is currently below the elevation mask. The satellite's identifier is displayed, prefixed with an "R", next to the satellite's symbol.
 3 seconds alternating	A QZSS satellite that the system is tracking and using in the position solution. The satellite's identifier is displayed, prefixed with an "J", next to the satellite's symbol.
	A QZSS satellite that the system is tracking but not using in the position solution. The satellite's identifier is displayed, prefixed with an "J", next to the satellite's symbol.
	A QZSS satellite that is currently below the elevation mask. The satellite's identifier is displayed, prefixed with an "J", next to the satellite's symbol.
 3 seconds alternating	A BeiDou satellite that the system is tracking and using in the position solution. The satellite's identifier is displayed, prefixed with an "C", next to the satellite's symbol.
	A BeiDou satellite that the system is tracking but not using in the position solution. The satellite's identifier is displayed, prefixed with an "C", next to the satellite's symbol.
	A BeiDou satellite that is currently below the elevation mask. The satellite's identifier is displayed, prefixed with an "C", next to the satellite's symbol.

The following table describes the fields that appear in the Sky Plot dialog:

Table 7.5 — Sky Plot data fields

This field ...	Displays ...
Time	The reference time for the satellite constellation or PDOP calculations.
Actual SVs	The actual or calculated number of GNSS satellites the system is using at the reference time.
Actual PDOP	The calculated PDOP of the position solution at the reference time.
Elevation mask	The current elevation mask.
GLONASS	*Enabled*, if the system is able to use GLONASS satellites in the position solution.

7.4 Troubleshooting flashing warning messages

The system generates flashing warning messages in situations where you need to take some action to ensure that the system continues to provide accurate guidance information. These warning messages are also written to the program log file (LOG_<machine name>_<date&time>.txt).

7.4.1 General warning messages

Table 7.6 — General warning messages

Message	Problem	Solution
Adjust Bolt Hole	The current rotating mast bolt hole setting does not have valid mast measurements specified.	Ask your site supervisor to enter valid measurements for the required bolt hole. Otherwise, ask your site supervisor to set a bolt hole that has valid measurements.
Avoidance Zone Entered	You have entered an Avoidance Zone. This is an area that has been designated as unsuitable for machine operation.	Use plan view to guide the machine out of the Avoidance Zone.
Check Machine Measurements	The set of measurements that was entered is incomplete, or inconsistent with a machine measurement that can be measured by the system.	To restore a suitable machine settings file, use the procedure in 3.4.1 Machine settings. Otherwise, ask your site supervisor to enter the correct machine measurements.
Check Machine Type	The stored machine settings are invalid.	To restore a suitable machine settings file, use the procedure in 3.4.1 Machine settings. Otherwise, ask your site supervisor to correct the system configuration.
Check Guidance Method	The guidance method selected is not compatible with the attached or configured sensors.	To check the status of the sensors, use the procedure in 7.3 Running system diagnostics. To choose a guidance method supported by the available sensors, follow the procedure described in 3.10 Selecting a 3D vertical guidance method.
Direction Unknown	The system is unsure of the direction the machine is moving.	The direction indicator has failed. Contact your site supervisor. To continue working, press **Direction:** and use the *Direction* dialog to initialize the machine direction.
Loading Data	The control box is loading the current design information or Layered Lift surface.	Wait for the message to stop. It will disappear after a short period.

Message	Problem	Solution
Option Not Installed	You have tried to use a feature that needs a valid option key entered.	Ask your site supervisor to provide an option key for the feature you want to use.
Unknown Status	The system has encountered an unexpected error.	Use the procedure in 7.11 Before you contact your dealer, to take a zsnap snapshot of the system, and then contact your dealer.

7.4.2 UTS warning messages

Table 7.7 — UTS warning messages

Message	Problem	Solution
Check UTS Battery	The system detected that the UTS instrument battery is low.	Check that the battery is still connected to the instrument. Otherwise, replace the instrument battery with a fully charged one.
Check UTS Radio	The system cannot communicate with the UTS instrument's data radio.	Check that the instrument's radio is powered. Check the cable to the radio.
Check Machine Radio	The system cannot communicate with the machine's data radio.	To check that the radio is powered, use the procedure in 7.6.4 SNRx10 data radio status indicators. Check the cable to the radio.
Bench UTS	The target needs to be benched because the UTS height was not entered when the instrument was set up.	To bench the target, use the procedure in 5.2.2 Benching a UTS target. Otherwise, ask your site supervisor to set up the instrument with an elevation.
Check Machine Target	The system cannot communicate with the target.	Check that the target is powered and that the visible LEDs are flashing. Check the cable to the target. To check the MT900 machine target, use the information in 7.6.7 MT900 machine target status indicators.
Check Radio Channel	The radio network ID/channel number combination set up for your system is also being used by another machine within radio range.	Contact your site supervisor.
Level UTS and Check UTS Setup	The tilt compensator on the UTS instrument is out of range.	Stop the UTS positioning on the machine, remove power to the instrument, and repeat the instrument setup, making sure the instrument is level. Power up the instrument, and repeat the SPSx30 setup.

Message	Problem	Solution
Multiple UTS Detected	The radio network ID/channel number combination set up for your machine and instrument is also being used by another instrument within radio range.	Contact your site supervisor.
No UTS Data	The UTS is not currently operating as part of the system.	To check that the UTS system is running and tracking the machine, use the procedure in 7.3 Running system diagnostics, particularly 7.3.1 UTS diagnostics. Check that the target ID is set correctly. To check the MT900 machine target ID, use the procedure in 5.2.1 Starting the UTS system.
Search For Machine Target	The UTS instrument lost lock on the target, or was unable to acquire the target after searching.	Check that there is a clear line of sight between the instrument and the target, that the target is within range of the instrument, and that the machine is within the search window and then search for the machine target, using the procedure in 5.6.8 Reacquiring UTS lock.
Start UTS	The UTS system is not providing guidance data.	To start the UTS system, use the procedure in 5.2.1 Starting the UTS system.

7.4.3 GNSS warning messages

Table 7.8 — GNSS warning messages

Message	Problem	Solution
Check Machine Radio	The system cannot communicate with the machine's data radio.	To check that the data radio has been detected, use the procedure in 7.3 Running system diagnostics. To check that the radio is powered, use the information in 7.6 Troubleshooting system components Check the cable to the radio.
Check GNSS Config.	There is a problem with a GNSS receiver output configuration. The coordinate system may be missing from a GNSS receiver configuration.	Check that there is a valid configuration (*.cfg) file in the root folder on the system. If there is, turn off the power to the system, and then turn the power on. Otherwise, check to see if there is a valid configuration file in the folder for the design you are using. If there is, load the design. Otherwise, see your site supervisor.

Message	Problem	Solution
Low Accuracy (GNSS)	The GNSS error estimate has exceeded the limit set by the GNSS Accuracy Mode.	To check that you are receiving good quality GNSS signals, use the procedure in 7.3 Running system diagnostics, particularly 7.3.2 GNSS diagnostics and satellite monitoring. To change the GNSS Accuracy Mode, use the procedure in 5.2.5 Setting GNSS accuracy mode, or ask your site supervisor to adjust the GNSS accuracy limits. ***Note –*** *Make sure that the new mode or limits are accurate enough for the work you need to do.*
Low Accuracy (Move)	The machine has not traveled far enough in its current direction to determine machine pitch and heading.	To initialize the machine pitch, use the procedure in 5.2.4 Initializing a machine's orientation and pitch.
No GNSS Data (Center)	No positions are being generated for a GNSS receiver on a single-GNSS system.	To check that you are receiving good quality GNSS signals, use the procedure in 7.3 Running system diagnostics, particularly 7.3.2 GNSS diagnostics and satellite monitoring. Check the cable, power, and connections for the center receiver. If problems continue, contact your site supervisor.
No GNSS Data (Left)	Positions are being generated for the right GNSS receiver but not for the left.	To check that you are receiving good quality GNSS signals, use the procedure in 7.3 Running system diagnostics, particularly 7.3.2 GNSS diagnostics and satellite monitoring. Check the cable, power, and connections for the left receiver. If problems continue, contact your site supervisor.
No GNSS Data (Right)	Positions are being generated for the left GNSS receiver but not for the right.	To check that you are receiving good quality GNSS signals, use the procedure in 7.3 Running system diagnostics, particularly 7.3.2 GNSS diagnostics and satellite monitoring. Check the cable, power, and connections for the right receiver. If problems continue, contact your site supervisor.

Message	Problem	Solution
No GNSS Receiver Data	There has been no GNSS data coming from one or both GNSS receivers for at least 1.5 seconds. This could be caused by: • different firmware versions on the GNSS receivers of a dual GNSS system • a problem with a GNSS receiver • a cabling fault • a problem with a GNSS receiver configuration	To check that the GNSS receivers have been detected and that the firmware versions are the same, use the procedure in 7.3 Running system diagnostics. To check that the receivers are powered, use the information in 7.6.2 GNSS receiver status indicators. Check the cable, power, and connections. Check the physical condition of the GNSS receivers. Turn off the control box and turn it back on. If problems continue, contact your site supervisor.
Old Position	A position is not being generated by one, or both, GNSS receivers.	To check that the GNSS receivers have been detected, use the procedure in 7.3 Running system diagnostics, particularly 7.3.2 GNSS diagnostics and satellite monitoring. To check that the receivers are powered, use the information in 7.6.2 GNSS receiver status indicators. Check the cable, power, and connections. Check the physical condition of the GNSS receivers.
Very Low Accuracy (GNSS)	The system is receiving autonomous GNSS positions from one or both GNSS receivers.	To check that the data radio has been detected, use the procedure in 7.3 Running system diagnostics. To check that the radio is powered and synchronized, use the information in 7.6 Troubleshooting system components Check that the channel setting for the radio matches that of the base station. Check the data radio cable. Ask your site supervisor to check that the GNSS base station and any repeaters in the radio network are working correctly.
Out of Geoid Range	The GNSS position is out of the range of the loaded geoid grid.	Move the machine into range or contact your site supervisor.

7.4.4 Survey laser (SR300) warning messages

Table 7.9 — SR300 warning messages

Message	Problem	Solution
Bench Laser	The survey laser receiver has not been benched, and is not providing elevation data.	To bench the survey laser receiver, use the procedure in 4.1.5 Benching a survey laser receiver.

Message	Problem	Solution
Check Laser Receiver	The system cannot communicate with the survey laser receiver.	To check that the laser receiver has been detected, use the procedure in 7.3 Running system diagnostics. Check the laser receiver cable.
Laser Outside Bench Window	For systems using a survey laser for lift guidance, the laser strike is no longer within ±10 cm (4 inches) of the benched position.	To check that the laser strike is within the strike window, use the procedure in 7.10.3 Checking a survey receiver is getting laser strikes. Move the blade up or down to return the laser strike to within ±10 cm (4 inches) of the benched position. The Increment/Decrement offset switches move the bench window as the offset is increased or decreased. To re-bench the laser receiver to a more suitable height, use the procedure in Benching laser receivers, page 98.
GNSS - Laser Mismatch	The measured height of the laser plane is different from the height calculated using the laser setup information. Allowable difference is 30 mm more than the GNSS accuracy limit (25 mm in Fine mode).	To check that the correct slope, slope direction, and location information has been entered, use the procedure in 5.2.7 Survey laser receiver set up . To re-bench the laser receiver, use the procedure in 4.1.5 Benching a survey laser receiver.
Laser Out Of Range	The measured height of the laser plane is very different from the height calculated using the laser setup information.	To check that the correct slope, slope direction, and location information has been entered, use the procedure in 5.2.7 Survey laser receiver set up . To re-bench the laser receiver, use the procedure in 4.1.5 Benching a survey laser receiver.
No Laser Transmitter Setup	The laser transmitter you want to work with has not been selected and/or configured.	To choose or configure a laser transmitter to work with, use the procedure in 5.2.7 Survey laser receiver set up .
No Laser	The system can communicate with the survey laser receiver, but the laser receiver is not generating data.	To check that the laser receiver is receiving laser strikes, access the *Bench Laser* dialog and use the procedure in 4.1.5 Benching a survey laser receiver. Make sure the laser receiver is within 10° of vertical. Check the laser transmitter is visible to the laser receiver. Check that the laser transmitter is turned on.
No Laser (Tilt)	The survey laser receiver is tilted too far out of vertical to give accurate elevation readings.	Reduce the tilt of the machine or the slope of the blade, so that the laser receiver is less than 10° out of vertical.

7.4.5 Conventional laser receiver warning messages

***Note** – Errors caused by survey laser receivers (SR300) used in 3D guidance systems are listed in 7.4.4 Survey laser (SR300) warning messages.*

Table 7.10 — Conventional laser receiver warning messages

Message	Problem	Solution
Bench Center Laser	The laser receiver will not generate lift information until it is benched.	To bench the laser receiver, use the procedure in 4.1.4 Benching laser receivers.
Bench Left Laser	The laser receiver will not generate lift information until it is benched.	To bench the laser receiver, use the procedure in 4.1.4 Benching laser receivers.
Bench Right Laser	The laser receiver will not generate lift information until it is benched.	To bench the laser receiver, use the procedure in 4.1.4 Benching laser receivers.
Check Center Laser Receiver	The system cannot communicate with the laser receiver.	To check that the laser receiver has been detected, use the procedure in 7.3 Running system diagnostics. To check that the laser receiver is powered, use the information in 7.6.6 LR410 laser receiver status indicators. Check the laser receiver cable.
Check Left Laser Receiver	The system cannot communicate with the laser receiver.	To check that the laser receiver has been detected, use the procedure in 7.3 Running system diagnostics. To check that the laser receiver is powered, use the information in 7.6.6 LR410 laser receiver status indicators. Check the laser receiver cable.
Check Right Laser Receiver	The system cannot communicate with the laser receiver.	To check that the laser receiver has been detected, use the procedure in 7.3 Running system diagnostics. To check that the laser receiver is powered, use the information in 7.6.6 LR410 laser receiver status indicators. Check the laser receiver cable.
No Center Laser Strikes	The center laser receiver is not detecting any laser strikes.	To check that the laser receiver is receiving laser strikes, use the procedure in 4.1.3 Adjusting manual mast to get laser strike. Check that the laser transmitter is visible to the laser receiver. Check that the laser transmitter is turned on.
No Left Laser Strikes	The left laser receiver is not detecting any laser strikes.	To check that the laser receiver is receiving laser strikes, use the procedure in 4.1.3 Adjusting manual mast to get laser strike. Check that the laser transmitter is visible to the laser receiver. Check that the laser transmitter is turned on.

Message	Problem	Solution
No Right Laser Strikes	The right laser receiver is not detecting any laser strikes.	To check that the laser receiver is receiving laser strikes, use the procedure in 4.1.3 Adjusting manual mast to get laser strike. Check that the laser transmitter is visible to the laser receiver. Check that the laser transmitter is turned on.
Offset Too Large	When using manual masts, the increment/decrement switch has changed the elevation offset value such that the laser receiver is no longer receiving laser strikes.	Use the increment/decrement switch to move the laser receiver into the laser beam. To check that the laser receiver is receiving laser strikes, use the procedure in 4.1.3 Adjusting manual mast to get laser strike. Then, to bench the laser use the procedure in 4.1.4 Benching laser receivers.

7.4.6 Sonic tracer warnings messages

Table 7.11 — Sonic tracer warning messages

Message	Problem	Solution
Bench Left Sonic Tracer	The left sonic tracer is not benched.	To bench the sonic tracer, use the procedure in 4.1.2 Benching sonic tracers.
Bench Right Sonic Tracer	The right sonic tracer is not benched.	To bench the sonic tracer, use the procedure in 4.1.2 Benching sonic tracers.
Check Left Sonic Tracer	The system cannot communicate with the left sonic tracer.	To check that the sonic tracer has been detected, use the procedure in 7.3 Running system diagnostics. Check the sonic tracer cable.
Check Right Sonic Tracer	The system cannot communicate with the right sonic tracer.	To check that the sonic tracer has been detected, use the procedure in 7.3 Running system diagnostics. Check the sonic tracer cable.
Left Sonic Tracer Out Of Range	Automatic controls are turned on and the sonic tracer measures a distance greater than ±7 cm (2.8 inches) from the bench distance.	Check that the sonic tracer is over the reference surface or stringline. Move the blade so that it is within 7 cm (2.8 inches) of the bench distance. ***Note –*** *After 60 seconds out of range, automatic controls go to the Inactive-Auto state.* To re-bench the sonic tracer, use the procedure in 4.1.2 Benching sonic tracers.

Message	Problem	Solution
Right Sonic Tracer Out Of Range	Automatic controls are turned on and the sonic tracer measures a distance greater than ±7 cm (2.8 inches) from the bench distance.	Check that the sonic tracer is over the reference surface or stringline. Move the blade so that it is within 7 cm (2.8 inches) of the bench distance. ***Note –*** *After 60 seconds out of range, automatic controls go to the Inactive-Auto state.* To re-bench the sonic tracer, use the procedure in 4.1.2 Benching sonic tracers.

7.4.7 Electric mast warnings messages

Table 7.12 — Electric mast warning messages

Message	Problem	Solution
Center EM Not At Bench Height	The center electric mast has been moved from its benched extension using the *Raise* and *Lower Mast (s)* softkeys.	To return the mast to its benched extension, use the procedure in 4.4.8 Returning masts to bench height.
Center EM Out of Range	When changing the elevation offset using the remote switches, the center electric mast cannot be raised or lowered any further.	Ask your site supervisor to change the elevation of the laser transmitter to a suitable height for the working position of the blade. Then, to re-bench the laser receiver, use the procedure in 4.1.4 Benching laser receivers or 4.1.5 Benching a survey laser receiver.
Check Center EM	The system cannot communicate with the center electric mast.	To check that the electric mast has been detected, use the procedure in 7.3 Running system diagnostics. Check cables.
Check Left EM	The system cannot communicate with the left electric mast.	To check that the electric mast has been detected, use the procedure in 7.3 Running system diagnostics. Check cables.
Check Right EM	The system cannot communicate with the right electric mast.	To check that the electric mast has been detected, use the procedure in 7.3 Running system diagnostics. Check cables.
Left EM Not At Bench Height	The left electric mast has been moved from its benched extension using the *Raise* and *Lower Mast (s)* softkeys.	To return the mast to its benched extension, use the procedure in 4.4.8 Returning masts to bench height.
Left EM Out Of Range	When changing the elevation offset using the remote switches, the left electric mast cannot be raised or lowered any further.	Ask your site supervisor to change the elevation of the laser transmitter to a suitable height for the working position of the blade. Then, to re-bench the laser receiver, use the procedure in 4.1.4 Benching laser receivers or 4.1.5 Benching a survey laser receiver.

Message	Problem	Solution
Right EM Not At Bench Height	The right electric mast has been moved from its benched extension using the *Raise* and *Lower Mast (s)* softkeys.	To return the mast to its benched extension, use the procedure in 4.4.8 Returning masts to bench height.
Right EM Out Of Range	When changing the elevation offset using the remote switches, the right electric mast cannot be raised or lowered any further.	Ask your site supervisor to change the elevation of the laser transmitter to a suitable height for the working position of the blade. Then, to re-bench the laser receiver, use the procedure in 4.1.4 Benching laser receivers or 4.1.5 Benching a survey laser receiver.

7.4.8 Angle and rotation sensor warning messages

Table 7.13 — Angle and rotation sensor warning messages

Message	Problem	Solution
Blade Rotated Too Far	The RS400 blade rotation sensor is reporting a blade rotation of more than 35°. Automatic sideshift is suspended.	Typically indicates a damaged sensor or a bad sensor calibration. Check the sensor for physical damage. Ask your site supervisor to check the reported value of the blade rotation in the *Diagnostics – Sensors* dialog against the observed value of the blade rotation. To re-calibrate the sensors, use the procedure in 3.9.4 Blade rotation sensor calibration.
Blade Pitch Sensor at Operational Limit	The AS400 blade pitch sensor is reporting a blade pitch of more than 50°.	Typically indicates a damaged sensor or a bad sensor calibration. Check the sensor for physical damage. Ask your site supervisor to check the reported value of the blade pitch in the *Diagnostics – Sensors* dialog against the observed value of the blade pitch. To re-calibrate the sensor, use the procedure in 3.9.3 Blade pitch sensor calibration.
Blade Slope Sensor at Operational Limit	The AS400 blade slope sensor is reporting a blade slope of more than 50°.	Typically indicates a damaged sensor or a bad sensor calibration. Check the sensor for physical damage. Ask your site supervisor to check the measured value of the blade slope in the *Diagnostics – Sensors* dialog against the observed value of the blade slope. To re-calibrate the sensor, use the procedure in 3.9.2 Blade slope sensor calibration using a digital level.

Message	Problem	Solution
Check Blade Pitch Sensor	The system cannot communicate with the blade pitch sensor.	To check that the sensor has been detected, use the procedure in 7.3 Running system diagnostics. Check cables. Otherwise, ask your supervisor to remove the sensor from the machine configuration. The system will assume the blade pitch is 0°.
Check Blade Slope Sensor	The system cannot communicate with the blade slope sensor.	To check that the sensor has been detected, use the procedure in 7.3 Running system diagnostics. Check cables. Otherwise, ask your supervisor to remove the sensor from the machine configuration. The system will assume the blade slope is 0°.
Check Mainfall Sensor	The system cannot communicate with the mainfall sensor.	To check that the sensor has been detected, use the procedure in 7.3 Running system diagnostics. Check cables. Otherwise, ask your supervisor to remove the sensor from the machine configuration. The system will assume the machine mainfall is 0°.
Check Rotation Sensor	The system cannot communicate with the blade rotation sensor.	To check that the sensor has been detected, use the procedure in 7.3 Running system diagnostics. Check cables. Otherwise, ask your supervisor to remove the sensor from the machine configuration. The system will assume the blade rotation is 0°. Subsequent blade rotation will result in poor guidance.
Mainfall Sensor at Operational Limit	The AS400 mainfall sensor is reporting a mainfall of more than 50°.	Typically indicates an incorrect sensor mounting configuration, a bad sensor calibration, or a damaged sensor. Ask your site supervisor to check the reported value of the mainfall in the *Diagnostics – Sensors* dialog against the observed value of the mainfall. Ask your site supervisor to check the configured sensor mounting direction in the *Edit Machine* wizard against the observed mounting direction. If required, re-calibrate the sensor by using the procedure in 3.9.5 Mainfall sensor calibration. Check the sensor for physical damage.

7.4.9 Automatic controls warning messages

Table 7.14 — Automatic controls warning messages

Message	Problem	Solution
Check Valve Module	The system cannot communicate with the valve module.	To check that the valve module has been detected, use the procedure in 7.3 Running system diagnostics. Check cables.

Message	Problem	Solution
Calibrate Left Valve	The left blade lift ram automatic control valve has not been calibrated. Valve calibration has not been completed, or an incomplete valve calibration was loaded when machine settings were restored.	Restore a machine settings file with a complete valve calibration for the valve module installed on your machine. Otherwise, ask your site supervisor to complete the valve calibration.
Calibrate Lift Valve	The blade lift ram automatic control valve has not been calibrated. Valve calibration has not been completed, or an incomplete valve calibration was loaded when machine settings were restored.	Restore a machine settings file with a complete valve calibration for the valve module installed on your machine. Otherwise, ask your site supervisor to complete the valve calibration.
Calibrate Right Valve	The right blade lift ram automatic control valve has not been calibrated. Valve calibration has not been completed, or an incomplete valve calibration was loaded when machine settings were restored.	Restore a machine settings file with a complete valve calibration for the valve module installed on your machine. Otherwise, ask your site supervisor to complete the valve calibration.
Calibrate Sideshift Valve	The blade sideshift ram automatic control valve has not been calibrated. Valve calibration has not been completed, or an incomplete valve calibration was loaded when machine settings were restored.	Restore a machine settings file with a complete valve calibration for the valve module installed on your machine. Otherwise, ask your site supervisor to complete the valve calibration.
Calibrate Tilt Valve	The blade tilt ram automatic control valve has not been calibrated. Valve calibration has not been completed, or an incomplete valve calibration was loaded when machine settings were restored.	Restore a machine settings file with a complete valve calibration for the valve module installed on your machine. Otherwise, ask your site supervisor to complete the valve calibration.
Calibrate Valves	The automatic control valves for two or more blade rams have not been calibrated.	Restore a machine settings file with a complete valve calibration for the valve module installed on your machine. Otherwise, ask your site supervisor to complete the valve calibration.
Low Accuracy (Move)	The system does not have any reliable machine pitch data.	To re-initialize the machine pitch data for single 3D sensor machines and for dual-GNSS machines, use the procedure in 5.2.4 Initializing a machine's orientation and pitch
Move Forward	The machine is moving backward with automatic sideshift control activated.	Automatic control of sideshift is available only when the machine is moving forwards. Deactivate automatic control of sideshift. Otherwise, drive the machine forwards.

Message	Problem	Solution
No Design Loaded	No design is loaded. The previously loaded design may not be on the system.	Load a design, or check that the design is still on the system.
No Alignment Selected	Automatic sideshift control was activated, but no horizontal alignment is selected.	Set sideshift control to Manual. To select a horizontal alignment, use the procedure in 5.6.2 Selecting horizontal alignment. Set sideshift control to Auto.
No Sideshift Data	Automatic control of sideshift has been activated, and an alignment is selected, but no sideshift corrections can be calculated.	Typically caused by: • reaching a gap in the selected alignment. • moving past the end of the selected alignment. • being more than 300 m (985 ft.) from the selected alignment.
Off Design	While in the Auto state, one or both blade tips are outside the area covered by the design.	Drive back onto the design. ***Note –*** *After 60 seconds off design, automatic controls go to the Inactive-Auto state.*
Off Grade	A blade tip that is in the Auto state is above or below the working surface by more than half the vertical tolerance for longer than three seconds.	Manually adjust the position of the blade tip(s). Adjust the elevation offset to a suitable setting. Pass over the area again.
Out of Auto Range	One or both blade tips have moved above or below the working surface by more than 20 cm (8 inches).	Adjust the elevation offset to move the working surface closer to the blade position, or move the blade closer to the working surface. Otherwise, ask your site supervisor to set the *Auto Controls Range Limit* to *[None]*. ***Note –*** *After 60 seconds out of range, automatic controls go to the Inactive-Auto state.*
Out of Sideshift Range	The blade tip with focus is more than 20 cm (8 inches) from the horizontal alignment.	Adjust the horizontal offset to move the working alignment closer to the blade focus, or move the blade focus closer to the working alignment.

7.5 Troubleshooting error messages

The system generates error messages when you need to take some action, or when the system cannot perform the selected function.

These error messages occupy the full display screen and are also written to the program log file (LOG_<machine name>_<date&time>.txt).

Many of these errors cannot be resolved by you, in which case make a note of the error message and the actions which caused the message to display, and then contact your site supervisor.

Only errors that can be resolved by you or the site supervisor are listed in the following sections.

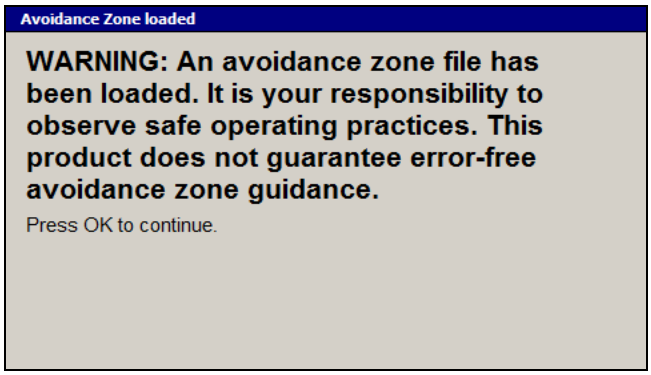
7.5.1 Software support option errors

When you first start up, the software checks that the correct software option keys are entered. If the keys are not found, a message appears. If this occurs, talk to your site supervisor.

7.5.2 Avoidance zone warnings

When entering an avoidance zone a red triangle warning icon appears on the machine. The following full-screen warning message appears when:

- A design with a site-wide or design specific avoidance zone is loaded.
- A machine settings file is restored.



When a design with a site-wide or design specific avoidance zone:

- Is unloaded.
- When the system mode is changed from 3D mode to 2D mode.

one of the following full-screen warning messages appear:

- **A site-wide avoidance file is no longer being used. Press OK to continue.**

  or

- **A design specific avoidance file is no longer being used. Press OK to continue.**

***Note** – These messages are displayed as warnings for the operator.*

7.5.3 Other selected error messages

A system error has occurred. The application has been shut down for safety.

On start-up, one or more of the system's software components failed to start.

Contact your site supervisor.

An error has been detected that may result in inaccurate guidance: measured blade dimensions do not agree with configured blade dimensions!

Dual GNSS systems automatically check the configured blade width against the blade width measured by the two GNSS receivers. If the two blade widths differ by more than 100 mm (4 inches), this error message appears.

This check makes sure that the configured blade width matches the blade width of the machine the system is installed on. An error may indicate that an incorrect machine settings file is loaded, or that the GNSS receiver positions on the machine have changed (for example, if the receiver masts have been damaged and are not in their original position).

Confirm the correct machine settings file is loaded. Check your GNSS receivers and receiver mounts for any signs of damage and confirm they are securely mounted. Contact your site supervisor to measure and enter the machine measurements again.

***Note** – The results of this check are recorded in the Program Log file.*

AS400 ...

The AS400 has reported a fault. Faults may occur while the AS400 updates its settings during, or immediately after, a firmware update or pitch calibration.

Try one of the following actions:

- Wait two minutes for the settings to take effect.
- Check all cable connections.
- To check that all devices are responding, use the procedure in 7.3 Running system diagnostics.

If problems persist, contact your dealer.

Bench height value not consistent with blade tip elevation.

This error can occur when you try to bench a survey laser being used for enhanced elevation accuracy in a 3D system. The error occurs when the value entered into

the *Blade elevation* field of the *Bench Laser* dialog does not match the estimated value calculated on the basis of the configured slope and elevation of the laser plane, and the configured machine measurements.

Check the following points:

- Are you benching the correct blade tip?
- Are you benching against the correct bench mark?
- Is the entered height of the bench mark correct?

File Access Error. The design you selected could not be loaded.

The "current.csd" file in use does not reference the coordinate system required by the *.cal file in the design folder.

Contact your site supervisor to get the correct "current.csd" file and/or *.cal file.

Linked Elevation Calibration failed. Check for unwanted laser strikes from reflections or another laser transmitter. Check Electric Masts and Laser Receivers.

Linked electric mast calibration failed because the laser strike data was unreliable. This may be due to multiple laser strikes or equipment problems.

New valve module detected. Please restore the correct machine settings or calibrate the valves.

You have restored a machine settings file containing a valve calibration for a valve module not currently installed on your machine.

Try one of the following actions:

- Restore a machine file containing valve calibrations for the installed valve module.
- Recalibrate the valves.

No band configurable radio found. You must attach a band configurable radio before using this tool.

You have tried to configure the radio band on a system that does not have a band configurable radio.

To clear the message, press  .

No coordinate system could be found for this design

All GNSS-based systems need to have a valid coordinate system loaded onto the GNSS receivers. If you attempt to load a design that does not contain a coordinate system, you will experience one of two outcomes:

- If the previously loaded coordinate system was created manually (a *.cfg file), then press or to load the coordinate system.
- If the previously loaded coordinate system was created automatically (a *.acs file), then you cannot use the design, and it will not be loaded.

In either case, tell your site supervisor that you have been given a design with no coordinate system.

No data

The system is not receiving any information from a sensor.

Try one of the following actions:

- Check the cable connections.
- Inspect the sensor for physical damage.
- To check that all the required components are responding, use the procedure in 7.3 Running system diagnostics.
- Switch off the power and then switch it on again.

No devices were detected on the CAN bus

The system uses a CAN bus to pass data and commands between its components (for example, the control box and a sensor). If this message is displayed, the components are not responding. You cannot use the automatic controls until all the required devices respond.

Try one of the following actions:

- Check all cabling.
- To check that all the required components are responding, use the procedure in 7.3 Running system diagnostics.

If problems persist, contact your dealer.

No Linked EM400 Calibration

You have tried to bench a dual-laser, linked lift system, before a linked-lift calibration has been performed. To perform the calibration, use the procedure in

3.9.7 Linked electric mast calibration.

Not enough memory to load the …

The control box has run out of memory to load the design, design Avoidance Zone, Site Map file, or Background Plan file. This may occur when using large:

- Designs
- Design Avoidance Zones
- Site Map files
- Background Plan files

As the Site Map and Background Plan files do not contain vertical guidance information, you can continue working if they fail to load.

Failure to load the design Avoidance Zone will result in the design being unloaded.

Try one of the following actions:

- Shut down the control box and then restart it.
- Ask the design staff to reduce the size of the files.

Out of memory!

The control box has run out of memory. You may have turned on wireless communications support when a large design or Background Plan file is loading.

Try one of the following actions:

- Shut down the control box and then restart it.
- Ask the design staff to reduce the size of the files.

Parameter Value Error

The value entered in the current field may exceed the recommended limits, or the value is invalid. Check the value entered.

Reverting to factory default settings

This message appears after you update the control box firmware. All the settings in the control box are reset to the default values.

Try one of the following actions:

- To restore the settings file for your machine, use the procedure in 3.4.1 Machine settings.

- Ask your site supervisor to configure the system for use on your machine. Save the new settings in a settings file.

Some of the required system devices are not responding

The system uses a CAN bus to pass information between its components (for example, to a slope sensor). In this situation, some of the components are not responding. You cannot use the system until all the devices respond.

Try one of the following actions:

- Check the cables.
- To check which devices are not responding, use the procedure in 7.3 Running system diagnostics.

If problems persist, contact your dealer.

Some of the required system devices have old firmware versions

To use the coordinate systems and coordinate adjustments supported by the GCS900 Grade Control System v12.60, the system must use MS9x2 GNSS receiver firmware v4.89 or later.

Contact your site supervisor.

Some settings are missing or invalid, and will be reset to factory defaults

On start-up, or after restoring display or machine settings files, some of the settings on the control box are missing or invalid. These will be set to the default values.

Try one of the following actions:

- To restore the settings file for your machine, use the procedure in 3.4.1 Machine settings or 3.4.5 Display settings.
- Ask your site supervisor to configure the system for use on your machine. Save the new settings in a settings file.

System Startup Error

On start-up, one or more of the system's software components failed to start.

Contact your site supervisor.

The current GNSS Accuracy mode does not allow automatic controls

The current GNSS Accuracy mode is configured with automatic controls disabled.

Try one of the following actions:

- To check the current setting and to select a mode that allows automatic controls, use the procedure in 5.2.5 Setting GNSS accuracy mode.
- Contact your site supervisor to configure the system to allow the use of automatic controls in the GNSS Accuracy mode you are using.

The design cannot be loaded. It uses a CAL file to define the coordinate system and this is not compatible with MS990 receivers.

The coordinate system specified by the *.cal file in the design folder is not supported by the GNSS receivers on the machine.

Contact your site supervisor to install an MS9x2 GNSS receiver with the correct firmware, or to add a *.cfg file to the design folder.

The design cannot be loaded because it requires a <coordinate system> file which is missing. The design will be unloaded.

The *.cfg file in the design folder does not contain a coordinate system file, or the *.cal file in the design folder requires a coordinate system file that cannot be found in the \GeoData folder.

Contact your site supervisor to add the required coordinate system file to the *.cfg file, or the required coordinate system file and/or coordinate adjustment file to the \GeoData folder.

The design contains more than one receiver configuration file and cannot be loaded. The design will be unloaded.

Two or more *.cfg files and/or *.cal files are present in the design folder being loaded. A design folder may only contain one *.cfg file and/or one *.cal file.

Contact your site supervisor to remove the incorrect files.

The GNSS receivers do not recognize the antenna type being transmitted by the base station

The on-machine GNSS receiver(s) do not recognize the base station antenna type, and are unable to correct for the elevation difference between the antenna reference point and the antenna phase center.

Contact your site supervisor.

The Machine name has not been set

Machines are given names at the time of installation. If you restore a machine settings file from version 10.80 or earlier onto a later system, this message is displayed.

To clear the message, press  .

The valve speed cannot be updated because controls are not working

One of the required system devices was not found. To check that all required devices are detected, use the procedure in 7.3 Running system diagnostics. Reconnect the appropriate devices.

There has been an initialization error in producing a Sky Plot. Check your GNSS receivers then try again. If the problem persists contact your site manager.

The Sky Plot planning tool has been unable to retrieve satellite information from the GNSS receivers. Check the receivers are connected to the harness and are tracking satellites. Check that the receivers are running the correct version of firmware.

This radio does not support the required protocol

The on-machine data radio does not support the data transfer protocol used by the UTS instrument.

Timed out waiting for laser receiver to bench

During laser benching, the system was unable to adjust the extension of one or more electric masts to position the laser strike in the center of the laser receiver.

Check that the electric mast is not at the limit of its travel. If the electric mast is at the limit of its travel, move the laser plane closer to the center of the electric mast's range of travel by asking your site supervisor to adjust the elevation of the laser transmitter.

Too much laser strike variation during bench

During laser benching, there was too much variation in the elevation of the laser strike to complete the benching process.

Check that the laser transmitter is set up in a stable position, and is free of vibration caused by machinery movement and wind gusts.

On sites where there are multiple laser transmitters, check that there is not a second laser strike being detected by the receiver. For survey laser receivers, a second

laser strike within 16 cm (6.3 inches) of the laser strike you are trying to bench against will cause this error.

Too much vehicle movement during bench

During benching, there was too much variation in the output of the machine's angle sensors to complete the benching process.

Wait until the machine is stable and then try re-benching.

VM410 ... or VM420 ...

The VM410 or VM420 has reported a fault. Faults may occur while the VM410 or VM420 updates its settings during, or immediately after, a firmware update or valve calibration.

Try one of the following actions:

- Wait two minutes for the settings to take effect.
- Check all cable connections.
- To check that all devices are responding, use the procedure in 7.3 Running system diagnostics.
- Contact your site supervisor to recalibrate the valves.

If problems persist, contact your dealer.

WARNING: Your GNSS base station coordinates have changed. Continued operation may give poor results.

The base station may have been moved, possibly accidentally, or you may be receiving corrections from the wrong base station. Guidance may be wrong. Do not continue operation until your site supervisor has checked the base station coordinates.

Your GNSS base station coordinates have changed

The GNSS base station has moved since you last used the system. This means that a change in the base station position values was detected.

Contact your site supervisor immediately to check the base station coordinates. Check that you are receiving corrections from the correct base station. Continued operation may cause bad results.

You have changed the master alignment for this design.

A different master alignment could give different vertical guidance to the same section of the design.

It is recommended that the same master alignment be used with the same lane.

Press OK to accept the new master alignment.

Press Cancel to cancel.

The selected lane cannot be used with the master alignment of this design.

Select a lane within the range of the master alignment or do not use lane guidance on this section of the design.

Press OK to continue.

The selected lane cannot be used with the current master alignment of this design.

Select a lane within the range of the master alignment, select a different master alignment or do not use lane guidance on this section of the design.

Press OK to continue.

No lane can be defined.

Please choose a different lane or do not use lane guidance for this part of the design.

Press OK to continue.

Your chosen lane cannot be used with the master alignment of this design.

Either choose lane sides that are within range of your master alignment or do not use lane guidance on this section of the design.

Press OK to continue.

There is no master alignment in the design.

A master alignment is required for lane guidance. A line in the design may be selected as the master alignment.

The master alignment should be approximately parallel to the required lane.

Press OK to select a master alignment for this design.

Press to cancel.

The lane cannot be defined.

Lane width must be greater than 0.3 m.

Select a different lane or do not use lane guidance on this section of the design.

Press to continue.

A design with that name is already present on the Control Box.

Change the name of the design.

Press to continue.

7.6 Troubleshooting system components

Some system components are installed on the machine in easily accessible locations. To help you troubleshoot problems, inspect the component's status indicators (typically LEDs).

7.6.1 External lightbar system status indicators

Note *– External lightbars are only available on CB460 control box systems.*

As well as providing guidance information, the external lightbar LEDs provide the system status information listed in the following table.

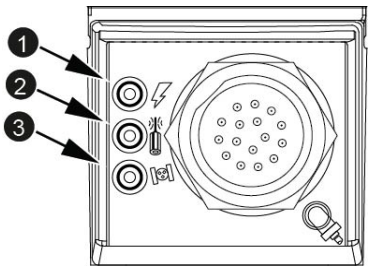
Table 7.15 — External lightbar system status indicators

Problem	Cause	Solution
The LEDs on the external lightbars do not light on power up, and remain off	There is no power to the external lightbar.	Check cables and connections.
On power up, the LEDs on the external lightbars flash, in sequence, from the center out. After the system starts, the LEDs flash in groups, in sequence, from left to right, then flash together twice, and then remain off	The external lightbar has not been assigned a position.	Ask your site supervisor to access the *Lightbar Connections* dialog to check that all the external lightbar connections are correctly configured.

Problem	Cause	Solution
The LEDs at each end of the external lightbars flash repeatedly	• The error estimate limit set by the GNSS accuracy mode has been exceeded. • The UTS lock is unreliable.	• Move away from obstructions and make sure that the data radio is working. • Check that you are within range of, and have a clear line of sight to, the UTS instrument.
Both the ends and the center groups of LEDs flash	The external lightbars have power, but are not receiving data from the control box.	Check cabling and check that the control box is running.

7.6.2 GNSS receiver status indicators

The MS9xx GNSS receivers have three LEDs next to the harness connector. The behavior of these LEDs indicate the status of the receiver, as shown in the following figure.



❶ Power ❷ Data link ❸ Satellite

Figure 7.2 MS9xx status LEDs

The meaning of the receiver status LED activity is shown below:

LED	Off	Slow flash	Flash	Fast flash	On solid
Power	No power			Beta test period expired[1]	Power on
Data link	No CMR™ data received or too few satellites		CMR data type 0 being processed		10 Hz CMR data being processed
Satellite	No satellites being tracked	Tracking four satellites or more		Tracking three satellites or less	Monitor mode[2]

[1] In addition to the power LED, the data link and satellite LEDs will also flash, and at the same rate as the power LED.

[2] In addition to the satellite LED, the power LED will also be on solid, and the data link LED will flash.

When GNSS is working correctly in a single-GNSS system, you will see the following activity:

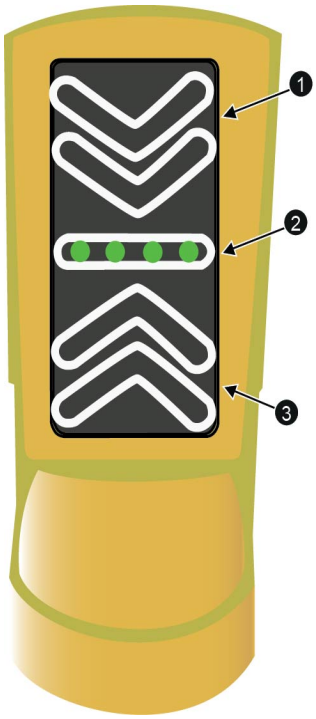
- The power LED will be on solid.
- The data link LED will flash at 1 Hz.
- The satellite LED will flash slowly.

When GNSS is working correctly in a dual-GNSS system, you will see the following activity:

- The left GNSS receiver's LEDs will behave as described above in the single-GNSS system.
- The right GNSS receiver's power LED will be on solid.
- The right GNSS receiver's data link LED will be on solid.
- The right GNSS receiver's satellite LED will flash slowly.

7.6.3 ST400 sonic tracer status indicators

The LED display of an ST400 indicates some common error conditions.



❶ Over grade LEDs (Down arrows) ❷ On-grade LEDs ❸ Under grade LEDs (Up arrows)

Figure 7.3 ST400 LED display

ST400 sonic tracer LED error patterns and their meanings are listed in the following table:

Table 7.16 — ST400 sonic tracer LED error patterns

LED pattern	Meaning
Down arrows flashing alternately	Above the sonic gate.
Up arrows flashing alternately	Below the sonic gate.
Outer up and down arrows flashing alternately	No echo detected. The sonic tracer may not be benched.

7.6.4 SNRx10 data radio status indicators

The SNRx10 data radio housing is fitted with an LED data/power indicator light (❶).

The LED can flash in a number of different patterns depending on the situation, as shown below:

LED pattern	Status
Off	No power to radio.
On solid	Power is available, but the radio is not synchronized with the base station.
Irregular flashing	Power is available, the radio is synchronized, but the radio is losing data.
Steady flashing at 1 Hz	Power is available, the radio is synchronized, and receiving data.

7.6.5 SNM940 cellular radio status indicators

The SNM940 has two LED indicators on the front face as shown in the image below. The green LED (❶) shows power and GNSS status. The amber LED (❷) shows the wireless communications status.

The LEDs indicate the device status as described in the following table:

SNM940 status	Green LED	Amber LED
Powered and Initializing	On solid	Off
GNSS providing a position	Blink	N/A
No GNSS signal or poor position quality	Fast blink	N/A
Cellular data connection	N/A	On solid
WLAN (Wireless Local Area Network) data connection	N/A	Blink
WLAN and cellular connection	N/A	Slow blink
Poor or no wireless connection	N/A	Fast blink
Low power standby	Off	Off

Blink rates:

- Slow blink – 3 seconds on / 3 seconds off
- Blink – 1 second on / 1 second off
- Fast blink – 200 milliseconds on / 200 milliseconds off

7.6.6 LR410 laser receiver status indicators

The status LEDs (❶) indicate if the unit is receiving power and laser strikes.

Laser receiver LED patterns and their meanings are as follows:

LED flashing pattern	Meaning
Not illuminated	No power
Slow flash (0.4 seconds on, 1 second off)	No strike
Flash (0.2 seconds on, 0.2 seconds off)	Strike detected above center of the receiver
Fast Flash (0.1 second on, 0.1 second off)	Strike detected below center of the receiver
On continuously	Strike detected at the center of the receiver

7.6.7 MT900 machine target status indicators

The status indicators (❶) show if the unit is receiving power and functioning correctly. There are four status indicators visible.

The indicator patterns showing the machine target's status are as follows:

Indicator flashing pattern	Meaning
Slow flash (0.1 second on, 0.9 seconds off)	Normal operation
Not illuminated	No power
Fast flash (0.1 second on, 0.1 second off)	Power up (approximately 0.5 seconds), otherwise low battery (<9 VDC)
Blink (3 seconds on, 0.1 second off)	Hardware fault

7.7 Troubleshooting UTS systems

To quickly assess the UTS components of a system, check the following:

- Are the yellow MT900 machine target LEDs, located at the top of the target, flashing? If these LEDs are not flashing, then the UTS instrument will not be able to lock onto the target.

  ***Note** – The red LEDs do not flash and do not indicate target lock.*

- Use the information in 7.3 Running system diagnostics, particularly 7.3.1 UTS diagnostics, to check the following:
  - Is the UTS connected?
  - Is the electric mast connected?
  - Does the UTS instrument have the correct software and firmware loaded? Contact your site supervisor to find out what the correct software and firmware is for the UTS.
  - Place the cutting edge focus point at a control point. Is the position of the focus calculated correctly?
- Check that the correct model of radio is installed:
  - For an SPSx30 UTS instrument, use a SNRx10 radio with a 2400 MHz module installed.
- Use the information in 7.6.4 SNRx10 data radio status indicators to check the following:
  - Is the data radio getting power?
  - Is the data radio synchronized?
  - Are you on the correct radio channel?
- Use the information from the *UTS* dialog to check the following:
  - Is the UTS tracking?
  - Does the UTS have adequate power?
- Is the UTS instrument free from vibrations caused by passing machinery or the wind? Complete the following procedure:
  a. Stop the machine.
  b. Put the automatic controls in Manual.
  c. Rest the cutting edge on the ground.

d. To view the *Machine Target* screen of the *Diagnostics – UTS* dialog, use the procedure in 7.3 Running system diagnostics, particularly 7.3.1 UTS diagnostics.

e. Observe the Northing, Easting, and Elevation values. At a distance of 150 m (492 ft) you would not expect to see any variation in the Northing and Easting values, and no more than ±5 mm (±0.2 inches) variation in elevation.

- Observe the site and work area, and check the following:
  - Is the UTS machine target between 15 m (50 ft) and 300 m (985 ft) from the UTS instrument?
  - Does the UTS instrument have a continuous line of sight to the UTS target? Check for occasional passing vehicles or dust clouds which could block the line of sight. Check that the line of sight is maintained for all machine orientations across the whole work area. Note that if the UTS machine target is outside the current search window, you can manually move the UTS instrument while it is searching and point it towards the UTS machine target.
  - Is the work area within the search window specified when the UTS instrument was started?
  - Are the lenses of the UTS instrument clean?

7.8 Troubleshooting GNSS systems

To quickly assess the GNSS components of a system, do the following:

- Use the information in 7.3 Running system diagnostics, particularly 7.3.2 GNSS diagnostics and satellite monitoring, to check the following:
  - Are the GNSS receivers connected?
  - Do the GNSS receivers have the correct software version loaded?
  - Are they reporting an *RTK (Fixed)* position status?
  - Is the data link operating effectively?

    The left data link should be operating with less than 0.3 seconds latency and an integrity of about 90%.

    The right data link should be operating with less than 0.3 seconds latency and an integrity of about 100%.
- Use the information in 7.6.2 GNSS receiver status indicators to check the following:

  - Is the GNSS receiver getting power?
  - Is the GNSS receiver tracking four or more satellites?
  - Is the left GNSS receiver, or the receiver in a single receiver system, processing 1 Hz Compact Measurement Records™ (CMR) data?
  - Is the right GNSS receiver processing 10 Hz CMR data?
- Is the data radio getting power and is the data radio synchronized? To check, use the information in:
  - 7.6.4 SNRx10 data radio status indicators.
  - 7.6.5 SNM940 cellular radio status indicators.
- Observe the site and work area, and check the following:
  - Do you have an unobstructed view of the sky to within about 10° of the horizon across the entire work area? If some, or all, of your work area has a limited view of the sky, ask your site supervisor what is the best time for you to work.
  - Are you working near any large reflective surfaces that could cause the GNSS signal to “ghost” (multipathing)?
- Ask your site supervisor to check the operation of the GNSS base station. Are the GNSS receiver and base data radio operating correctly? Observe the base station area, and check the following:
  - Does the base station have an unobstructed view of the sky to within about 10° of the horizon across the entire work area?
  - Is the base station near any large reflective surfaces that could cause the GNSS signal to “ghost” (multipathing)?
  - Is the base station area subject to heavy vehicle movements that could shadow the base station antenna from the GNSS signal?
- Is your machine in the line of sight of the base station radio antenna? If not, you may need to ask your site supervisor to install a repeater radio.
- Do you rely on repeater radios to make contact with the base station? If so, ask your site supervisor to check the operation of any data radio repeaters on the site. Is data being relayed correctly?

7.9 Troubleshooting automatic controls

In general, problems with automatic controls fall into two groups:

- Error conditions or system states that cause automatic control to be suspended, or that prevent you from turning on automatic controls.

- Automatic control behavior that causes poor quality or inaccurate finished surfaces.

7.9.1 Error conditions and system states

To troubleshoot automatic control errors and system state problems, check the state of the system, against the following list, which may prevent the automatic controls from being used:

- You access one of the following guidance set-up dialogs:
  - *Select Design*
  - *Guidance Method*
  - *Sensor Selection*
  - *Horizontal Offset*
  - *Elevation Offset*
  - *Target Slope*
  - *Setup Menu - Configuration*
  - *Diagnostics*
- There is no design loaded.
- The machine is off the design when automatic controls are turned on.
- The machine is off the design for more than 60 seconds.

  ***Note** – During the period you are off design and before the system goes into the Inactive-Auto state, automatic control is suspended.*
- A sonic tracer is out of range of the reference surface for more than 60 seconds.

  ***Note** – During the period that the sonic tracer is out of range of the reference surface and before the system goes into the Inactive-Auto state, lift control is suspended. However, if cross-slope control is turned on for the other end of the blade, cross-slope control continues for 60 seconds. If you put the end of the blade with the sonic tracer into Manual within those 60 seconds, cross-slope control for the other end of the blade continues indefinitely.*
- The machine is in a state that is incorrect for automatic controls, for example, it is in “Park”.

  ***Note** – This restriction does not apply to valve calibrations.*
- The automatic valves are not calibrated.

- The automatic valves have not been driven (the valves have been inactive) for 60 seconds or longer.
- A device can no longer be detected or stops working.
- The control box starts and the Auto/Manual switch is set to Auto.
- The control box shuts down.
- You receive low accuracy GNSS positions continuously for more than 60 seconds.

  ***Note** – During the period you are receiving low accuracy GNSS positions and before the system goes into the Inactive-Auto state, automatic control is suspended.*

- The UTS loses lock on the target.

To understand any error messages that appear, use the information in 7.4 Troubleshooting flashing warning messages.

The system provides a number of default automatic controls ranges, depending on the machine model selected during installation.

The default range for a motor grader is 25 cm (10 inches).

In addition, your site supervisor is able to configure the automatic controls range. It is possible to set automatic controls range limit to 0 (zero), in which case automatic controls will be suspended as soon as they are engaged.

7.9.2 Poor results

It is beyond the scope of this manual to cover troubleshooting poor results in detail. However, when you talk about the problem with your site supervisor or dealer, consider the following possible causes:

- ***Poor guidance information***. Noisy or inaccurate guidance information can result in an uneven or inaccurate final surface. If you suspect poor guidance information, consider the following possible causes:
  - Incorrect machine configuration. For example, if a conventional or single 3D sensor motor grader system is not cutting the correct cross slope, make sure that there is ***no wheel lean***. Wheel lean introduces an error in the reading from the mainfall sensor. Make sure the circle is positioned directly under the machine – ***no circle centershift***. Make sure that the machine is operated in the straight frame position – ***no articulation***. Articulation and circle centershift introduce unmeasured blade rotation. Operating with wheel lean, circle centershift, or articulation can cause inaccuracy in the cross slope being cut.

  - Incorrect choice of GNSS accuracy mode and/or the system is configured to allow low accuracy GNSS positions to drive the automatic controls.
  - Incorrect installation. For example, incorrectly setting a sensor direction, performing a poor sensor calibration or loading an out of date sensor calibration.
  - Inaccurate machine measure up. For example, on a motor grader setting the wrong bolt hole value when using rotating mast mounts.
  - Inaccurate sensor calibration.
  - Inaccurate benching.
  - Inaccurate GNSS measurements from the GNSS base station.
  - Poor UTS instrument setup.
  - Poor laser transmitter setup.
  - Multipath GNSS signal reception.
  - Multiple laser sources or multipath laser strike.
- ***Poor technique***. Cutting too fast, trying to move too much material, or causing the machine to move awkwardly are the most significant cause of poor results, as they extend the system beyond its design limits. Some common examples include the following:
  - Operating too fast for the task being carried out and the material being worked. For example, a motor grader performing finish grading should be working at less than 4 km/h (2.5 mph).
  - Cutting a surface when the machine is bouncing or duckwalking. This can result in an uneven final surface.
- ***Poor automatic control tuning***. An incorrect choice of valve speed, or bad valve calibration data, can result in poor automatic controls performance. Common tuning problems include the following:
  - The valve speed setting is too high, causing the cutting edge to continually overshoot the target surface and overcut.
  - The valve calibration has produced bad data by, for example, using an inaccurate slope distance measurement for the valve calibration limits, or by performing the calibration with the machine revs too low, or by manually moving the cutting edge during the valve calibration procedure.
  - Low quality or out of date valve calibration data due to, for example, the hydraulic system being serviced or modified, and then the machine being operated without the valves being recalibrated.
- ***Poor hydraulic system performance***.

7.10 Checking for laser strike

The procedure for checking that a laser receiver is registering laser strikes depends on the type of masts installed on the machine. The system uses three common mast types:

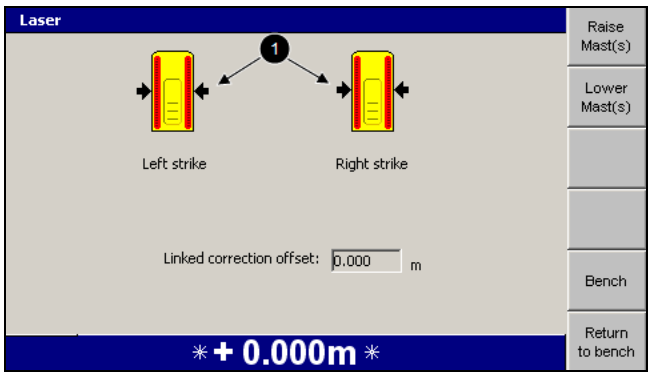
- Electric masts.
- Manual masts.
- Fixed masts.

The following sections describe how to check for laser strikes.

7.10.1 Adjusting electric masts to get laser strike

To adjust the elevation of a single or dual laser system using electric masts:

1. Manually adjust the cross slope of the blade so that the cutting edge is parallel to the laser plane.
2. From any guidance screen, press *Laser*.



3. Use one of the following tools to adjust the mast height so that the laser strike indicator (❶) is approximately centered on the laser receiver graphic:
   - To raise the mast and move the strike point downward, press **Raise Mast (s)**.
   - To lower the mast and move the strike point upward, press **Lower Mast(s)**.
   - To stop the mast movement, press .
4. To return to the guidance screen, press .

If you move the masts through their full range of movement and are unable to register a laser strike, ask your site supervisor to reposition the laser transmitter.

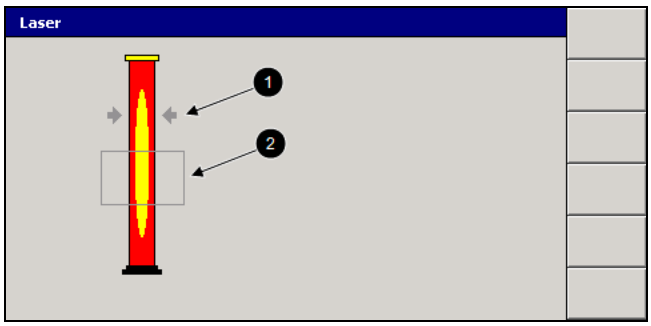
7.10.2 Adjusting manual masts to get laser strike

To adjust the elevation of a single or dual laser system using manual masts, use the procedure in 4.1.3 Adjusting manual mast to get laser strike.

7.10.3 Checking a survey receiver is getting laser strikes

To check that a survey receiver is registering laser strikes:

1. Manually adjust the cross slope of the blade so that the cutting edge is parallel to the laser plane.
2. From any guidance screen, press and hold *Bench Laser*.



3. Check that a strike indicator (❶) is shown.

   ***Note** – The Laser dialog also displays a strike window indicator. If the laser strike falls outside the strike window (❷), the strike indicator and window indicator are colored gray. If the strike is outside the strike window, you must re-bench the laser receiver before you can use it for guidance.*

   If a laser strike is not registered, ask your site supervisor to reposition the laser transmitter.

7.11 Before you contact your dealer

The more information you can provide for the support personnel, the less time it will take them to solve your problem. It is ***essential*** that you provide the following information:

- A system state "snapshot". To generate the system state snapshot files, hold down  and press the fourth softkey from the top.

  ***Note** – The system can only store a few minutes worth of data. Make sure you take the snapshot as soon as possible after encountering a problem.*

  The software creates:

- A “snapshot” of the current system state and saves it as a .zsnap file in the root directory of the system.
- A bitmap file of the current display and saves it as a .gif file in the root directory of the system.

The names of the files indicate the date and time that the files were created. You can view the bitmap file in a drawing package on an office computer, such as Microsoft Paint. You cannot view the system state snapshot file. Your site supervisor can arrange to access these files.

- The system log. The system log data is written to the program log file (LOG_ <machine name>_<date&time>.txt) located in the root directory of the system. Your site supervisor can arrange to access this file.
- A description of the problem, including the steps that led to the problem.

Make sure that you contact the correct person for support. In the first instance this is your site supervisor, then your dealer, and finally Trimble support.

Index