

Trimble® GCS900 Grade Control System for Excavators

Version 12.70
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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

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Release Notice

This is the April 2015 release (Revision A) of the GCS900 Grade Control System for Excavators Operator's Manual, part number 65129-07-ENG. It applies to version 12.70 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

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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.

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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 — When transporting machines with removable sensors such as GNSS receivers or UTS targets installed, if the sensor mounting bracket clamp loosens, then the sensor may be dislodged from the machine which may result in injury or death. Always remove and store removable sensors prior to transport.



WARNING — When removing or installing removable sensors such as GNSS receivers or UTS targets, if the sensor is accessed improperly, then a fall may result in injury or death. Always follow site, state or national Health and Safety guidelines when removing or installing removable sensors.



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 — 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 Operator's 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 — Do not operate this system unless you are fully trained on this equipment. To avoid injury, the machine's park brake must be engaged prior to starting the calibration. Maintain adequate clearance from people and objects as the blade may move abruptly during automatic hydraulic valve calibration.



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 in order 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.

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About This Manual

In this chapter:

- Scope and audience
- Trimble training classes and technical assistance
- To learn more about Trimble
- Your comments

Welcome to the *Trimble® GCS900 Grade Control System for Excavators 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
- Installation technicians
- Dealers
- 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.

Using the Control Box and Lightbars

In this chapter:

- Introduction
- How the system works
- Before you start
- Control box basics
- Working with control box information
- System beeper

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 Before you start

Before you start to use the system for grade guidance, make sure that the machine is measured up and the sensors are calibrated.

Machine measure-up is performed when the system is first installed on the excavator, and normally the machine would only need to be re-measured if servicing of the machine resulted in the machine dimensions changing or if the system is moved to a new machine that has not yet been measured up.

Angle sensor calibrations are performed when the system is first installed on the excavator. Sensors also need to be recalibrated when:

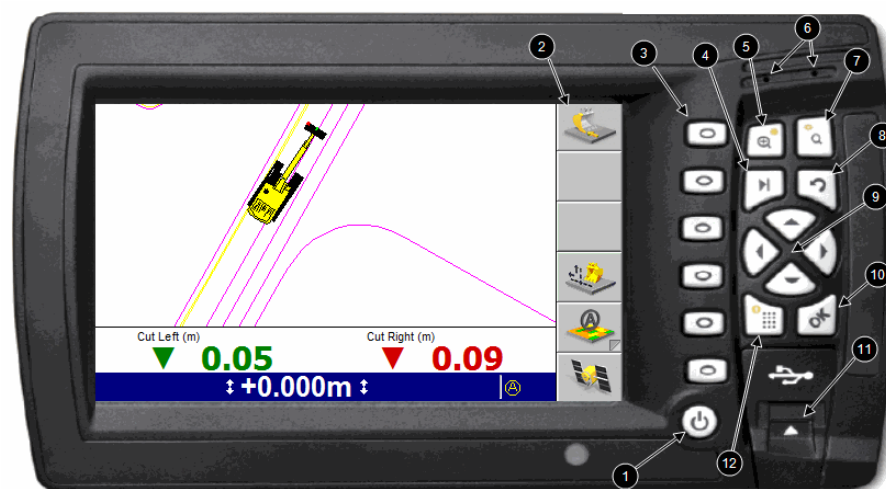
- The sensor mounting position has been changed. This is typically when a sensor is damaged and a new sensor mounting bracket has been installed.
- The machine dimensions have changed.

For more information, talk to your site supervisor or refer to the *GCS900 Grade Control System for Excavators Installation Manual*.

Note – When using an LC450 laser catcher, ensure the laser transmitter is correctly set up in a suitable location, and that the laser transmitter is turned on.

2.4 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 |
| ⓐ OK key | ⓑ USB flash drive port | ⓒ Menu key |

Figure 2.1 The control box

Description		Function
LCD screen		Displays guidance information
Softkey labels		See Softkey labels, page 29
Softkeys		See Softkeys, page 27
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 <i>Setup Menu – Configuration</i> dialog
USB flash drive port		See 2.4.2 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
Power key		See 2.4.1 Power key
Beeper		See 2.8 System beeper

2.4.1 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.

2.4.2 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.

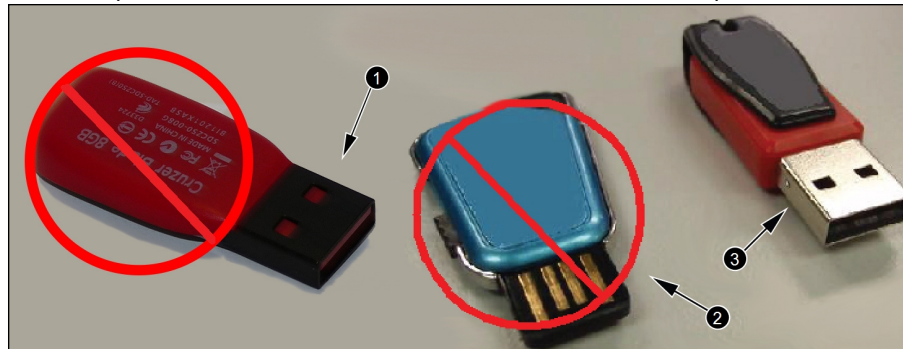
The USB flash drive folder structure:

- 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 — Only use a USB flash drive with a metal surround on the connector (❶), similar to the USB flash drive supplied with the product. When using a USB flash drive with plastic surrounding the connector (❷), the control box may fail to recognize the drive. When using a USB flash drive with no metal surround on the connector (❸), the drive can be inserted upside down, contact can be broken and the file transfer process can be interrupted.

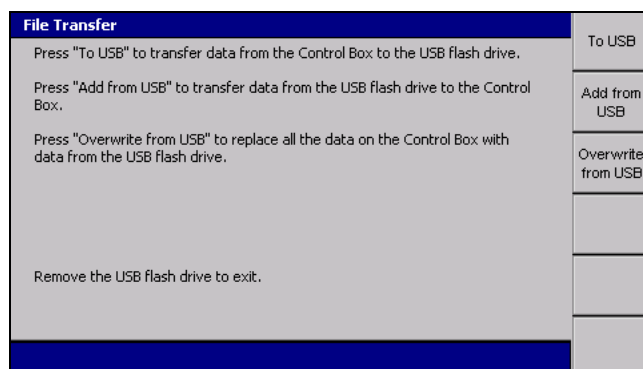


ATTENTION — The system only supports USB flash drives formatted as FAT32.

2.4.3 Transferring data to and from the control box

1. Start the control box.
2. Insert the USB flash drive into 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.

Note – .MAP files are not copied onto the USB flash drive during this type of file transfer: .MAP files are copied to a USB flash drive only when a complete control box backup is done.

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	✓	
Slope design files	✓	
Level design files	✓	
Profile design files	✓	
Program log files		✓
ZSnap and .gif files		✓

File type	Copy	Move
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.

- 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.

- 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.

- To exit, press  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  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  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

2.5 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 sensors installed on the machine. For example, some configuration screens are only available when particular sensors are installed.

- 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*.

2.5.1 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 set-up and configuration information, or view information about the state of system components.

The plan view guidance screen appears when you initially start the machine. If you navigate away from this screen before you enter configuration and set-up information into the system, press  until you escape back to any guidance screen view. Then press  to select a dialog and enter the required configuration and set-up information.

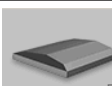
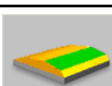
Softkeys

Softkeys are the six physical keys immediately to the right of the screen. Softkey labels are the graphical “keys” that appear down the side of the screen beside each physical softkey; the softkey labels identify the function of the physical softkeys.

The following tables list the softkey labels that display on the guidance screens, and briefly describe each softkey's meaning.

Generic 3D softkey icons

Icon	Functionality
	Direction: Unknown – Direction of motion is unknown. Press to open the <i>Direction</i> dialog.

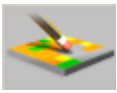
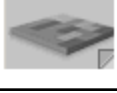
Icon	Functionality
	Direction: Forward – Direction of motion is calculated to be forwards. Press to open the <i>Direction</i> dialog.
	Direction: Reverse – Direction of motion is calculated to be in reverse. Press to open the <i>Direction</i> dialog.
	GNSS – Press to open the <i>GNSS</i> dialog.
	GNSS – The system is using xFill to propagate corrections. Press to open the <i>GNSS</i> dialog.
	UTS – Press to open the <i>UTS</i> dialog.
	Select Lane – Press to use lane guidance, and select a lane at the current machine guidance point. Press and hold to open the <i>Select Lane</i> dialog.
	Select Lane – Press to de-select the current lane. Press and hold to open the <i>Select Lane</i> dialog.

3D excavator softkey icons

Icon	Functionality
	Bucket Tip: Center – Focus is on the center of the bucket. Press to change the focus to the right side of the bucket.
	Bucket Tip: Left – Focus is on the left side of the bucket. Press to change the focus to the center of the bucket.
	Bucket Tip: Right – Focus is on the right side of the bucket. Press to change the focus to the left side of the bucket.
	Offsets – Press to open the <i>Offsets</i> dialog. Then press <value> Offset to switch between horizontal and vertical. (3D only)

Icon	Functionality
	Vertical Offset: Layered Lift – Press to open the <i>Vertical Offset</i> dialog.
	Vertical Offset: Perpendicular Lift – Press to open the <i>Vertical Offset</i> dialog.
	Vertical Offset: Vertical Lift – Press to open the <i>Vertical Offset</i> dialog.
	Vertical Offset: Reference Surface – Press to open the <i>Vertical Offset</i> dialog.

Mapping/Recording softkey icons

Icon	Functionality
	Reset Map – Press to open the <i>Reset Map</i> 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 <i>On</i> mode.
	Mapping: On – Map data is recording continuously. Press to stop recording map data.
	Mapping: Off – Map data is not recording. Press to change map recording to the <i>Auto</i> mode.
	Record Point – Record a point, when point recording is active.

Softkey labels

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

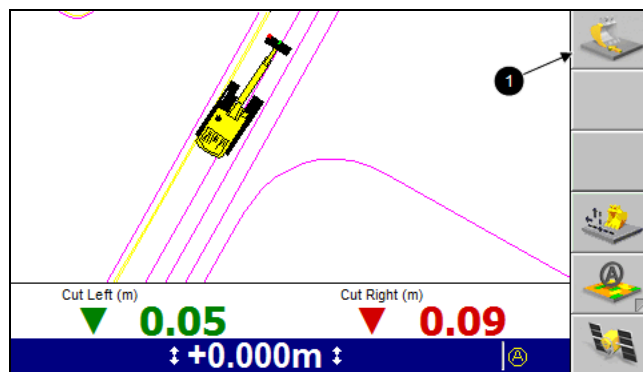
- A description of the operation that is performed when you press the softkey once.
- The setting that is currently selected. The text on the softkey label changes when you press the softkey to switch between options. The top line of the

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 **Bucket Tip: Center**, **Bucket Tip: Left** and **Bucket Tip: Right (1)** show the side of the bucket that is selected for horizontal guidance on 3D systems.



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

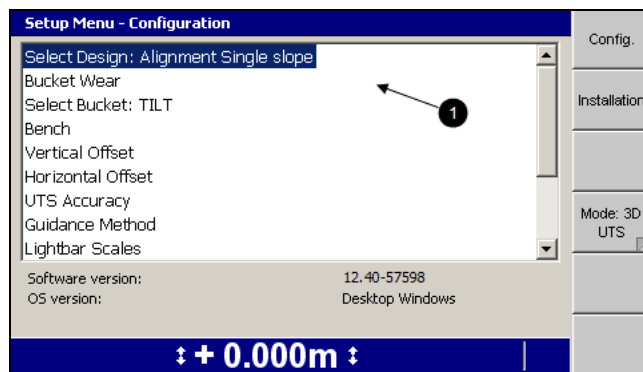
As a softkey's function relates to particular screens or dialogs, that functionality is only available when the appropriate screen or dialog appears. For example the **New Level** function is available only when the *Select Design File* screen appears, as that function relates only to that screen.

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.

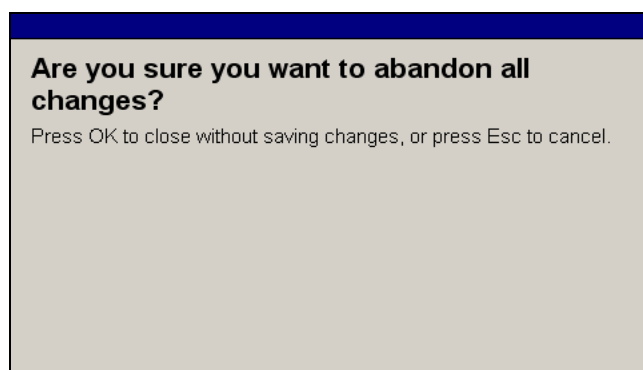
-  steps to the next character to the right.

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 .

2.5.2 Working with 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
- Cross-section view
- Profile view
- Split screen (profile and cross-section) view
- Level (bubble) view
- Text view 1
- Text view 2

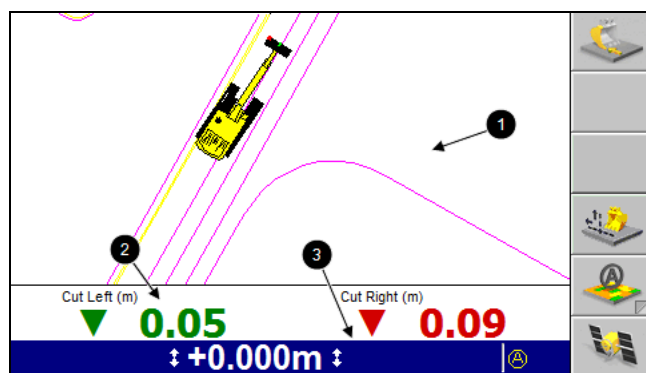
To move between guidance screens, press .

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

- sensors installed on the machine
- guidance configuration of the system
- operator configuration of the system
- 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 ①.** 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 ②.** 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 ③.** 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 35](#).

Machine icons

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

- The bucket icon provides information on the bucket 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 bucket, the icon mimics the movements on the screen.
- The red square on the bucket indicates the horizontal guidance point (the bucket focus), if applicable. The green line on the bucket 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
Excavator		

Machine type	Plan View icon	Profile View Icon
Excavator with variable angle boom		

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.

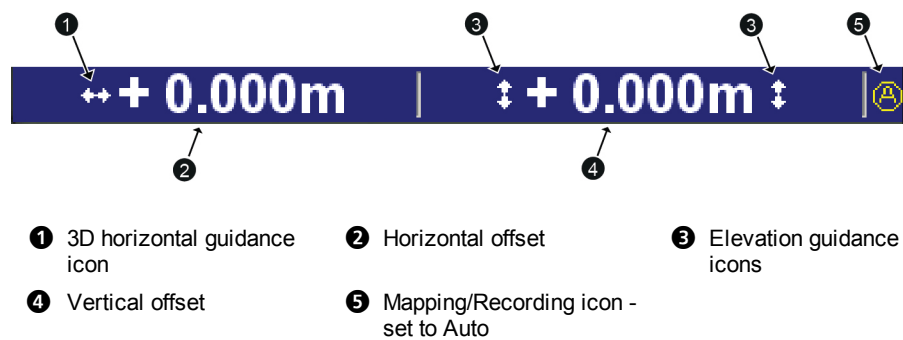


Figure 2.2 Example guidance setting area for a 3D excavator system

Table 2.2 — Guidance setting icons used by the system

Guidance setting icon	Meaning
	Elevation guidance is available. 3D vertical guidance information is being generated. For 2D systems, the system has been benched, but the benchmark elevation has not been referenced to a laser plane.
	3D horizontal guidance information is being generated.

Guidance setting icon	Meaning
	Slope guidance is available. Note – The icon illustrated indicates positive slope.
	Reliable bucket tilt data is temporarily unavailable, typically due to radial movement of the arm or curling of the bucket.
	Wi-Fi signal strength. No signal is indicated by a cross.
	Cellular signal strength. No signal is indicated by a cross.
No Avoid	No avoidance zone guidance is available.
 Auto	Mapping/Recording status.
 On	
 Off	

Zooming the 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.

2.5.3 Guidance views

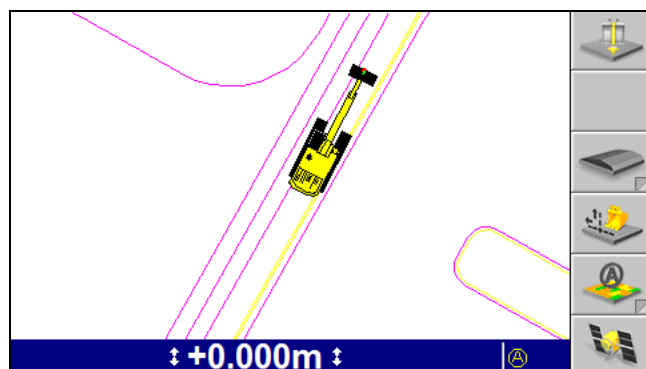
Guidance views enable you to view the machine guidance in a variety of ways.

Press  repeatedly to cycle through the guidance views.

Plan view

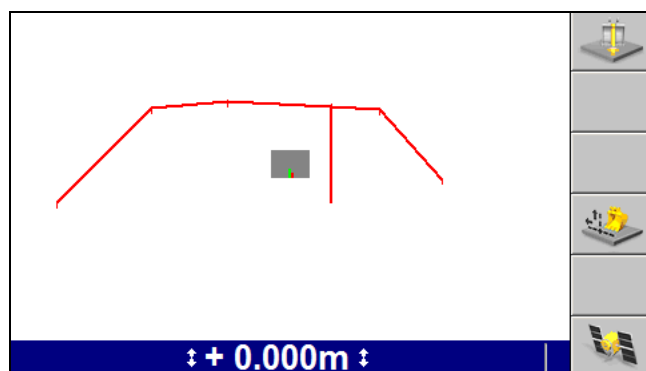
Plan view is the default view shown on a guidance screen.

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



Cross-section view

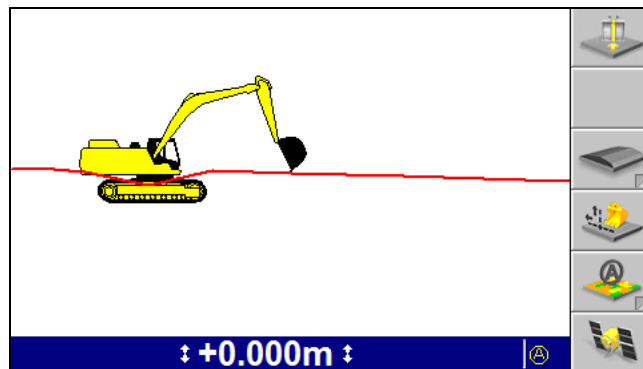
Cross-section view shows the cutting edge relative to the guidance surface.



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

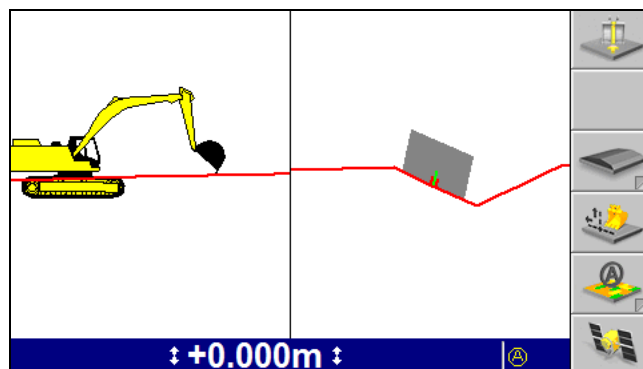
Profile view shows the machine as a side on view to the design to show the machine relative to the guidance surface.



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.

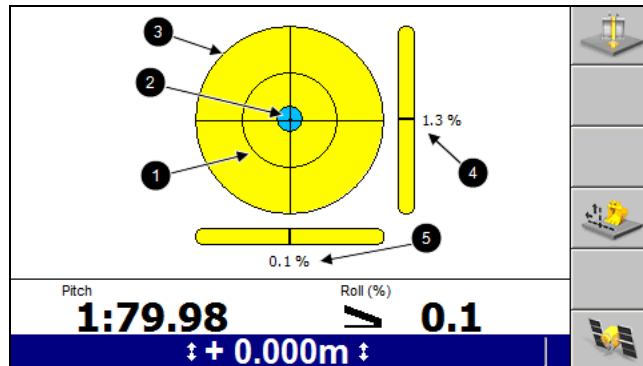
Level (bubble) view

Level view displays the current pitch and roll of an excavator, and is useful for helping you to level the machine.

Level view displays a level bubble, horizontal and vertical level bars, and an angle measurement. The level bubble provides a visual representation of the current pitch and roll information coming from the pitch and roll sensor(s). The *Pitch* and *Roll* text items appear in level view by default, and are the only text items available.

The outer ring represents 45°; the inner ring represents 22.5°.

The bubble, the horizontal and vertical level bars, and the text items all update as the machine moves and the pitch and roll readings change.



- ❶ Inner ring
- ❷ Level bubble
- ❸ Outer ring
- ❹ Machine pitch
- ❺ Machine roll

Figure 2.3 An example of a level view

The level bubble units are the same as the cross slope units set in the *Units* dialog.

When the pitch and/or roll sensor(s) are not connected, or when a value is not available, N/A appears for that value and the bubble does not appear.

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.

Northing (m)	693176.64	Easting (m)	419361.85	
Elevation (m)	239.11	Design Elev. (m)	240.94	
Station (m)	23.43	MA Offset (m)	-2.09	
V. GPS Err. (m)	0.020	Alignment	None	
Design Mainfall	-1:96.05	Design XSlope (%)	2.5	
± 0.000m ±				

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.

2.6 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.

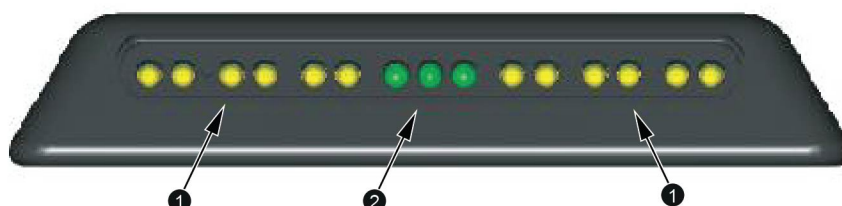
The CB460 control box supports either internal or external lightbars. The characteristics of internal and external lightbars differ as follows.

2.6.1 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:

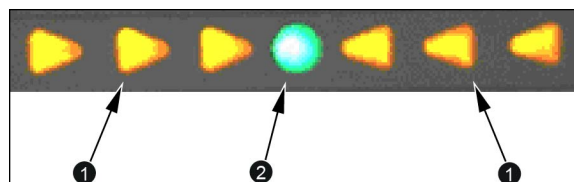


When the cutting edge is within half of the on-grade or on-line tolerance, only the central green LED is lit. When the cutting edge is within the on-grade or on-line tolerance, the central green LED and one other green LED are lit. If any LED, other than a green LED is lit, then the cutting edge is off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

2.6.2 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.

Excavator lightbar behavior depends on the system installed. The following sections describe how Depth and Slope and 3D guidance information is displayed using lightbars.

2.6.3 2D excavator lightbar behavior

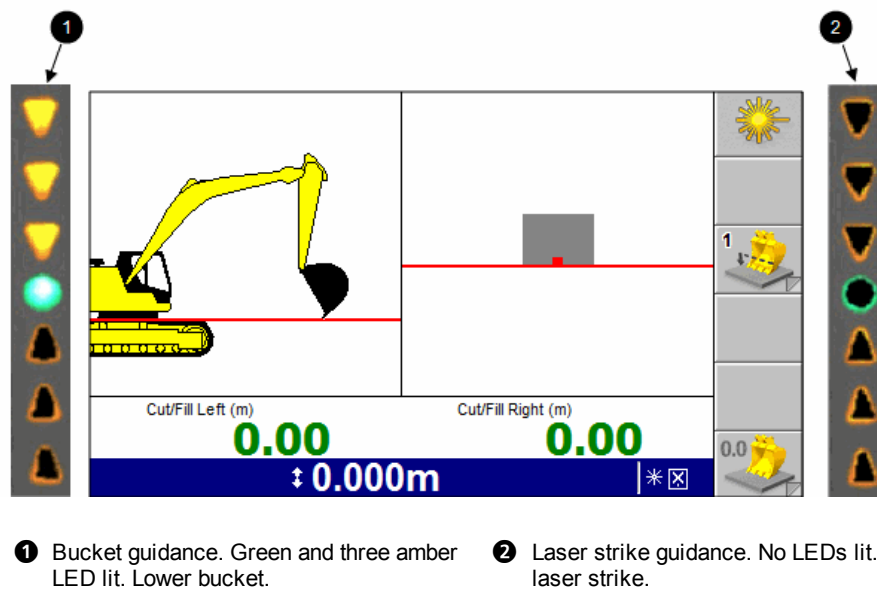


Figure 2.4 Using a 2D excavator's lightbars

The left lightbar displays cut/fill information. The cut/fill information is relative to the guidance surface under the bucket.

The right lightbar behaves in the following way when the laser catcher receives laser strikes:

- Green LED lit – laser strike detected in the center of the laser catcher window.
- Green and two amber LEDs lit – laser strike detected close to the center of the laser catcher window.
- Green and three amber LEDs lit – laser strike detected far from the center of the laser catcher window.
- No LEDs lit. No laser strike detected.

To set lightbar brightness, see [3.3.7 Lightbar brightness](#).

2.7 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:

2.7.1 3D remote switch

The 3D excavator system supports the use of a remote switch for:

- turning map recording events on and off:
 - Pass count coverage – On/Off/Auto.
 - Radio Map – On/Off/Auto.
 - Terrain – On/Off/Auto.
 - Cut/Fill Map – On/Off/Auto.
- recording a point.

Configuration of which of these events (if any) is available is managed by your Site Supervisor.

***Note** – 3D remote switch support is not available when using a 2D Depth and Slope system.*

2.8 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

Event	Sounds when ...	Pattern
Above Grade	The bucket 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 bucket is within the vertical tolerance of grade.	Continuous: On
Below Grade	The bucket 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
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
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 Alerts	A laser strike is detected in the laser catcher window.	Once only: 200 msec on
Key/Switch Beeps	A key or a switch is pressed.	Once only: 200 msec on

Preparing to Work

In this chapter:

- Power up checks
- Software option keys
- Work preparation checks
- Operating hours
- Configuring the machine radio
- Wi-Fi networking
- Exchanging files with a Connected Community filespace
- Setting depth and slope increment values
- Selecting an excavator bucket
- Selecting a 3D vertical guidance method
- Selecting a 2D guidance method

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 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	3.1.1 Lightbar power up
Control box power up	3.1.2 Control box power up

3.1.1 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
Cut / fill	Bottom to top
Left / right	Left to right
In / out (extend / retract)	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 3.1.2 Control box power up to check that the control box has started successfully. Use the procedure described in 3.3.7 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 3.1.2 Control box power up to check that the control box has started successfully. Use the procedure described in 3.3.7 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.

3.1.2 Control box power up

Observe the control box after the system has powered up.

You should see a guidance screen, softkeys, 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 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 wrong machine icon appears on the guidance screen	An incorrect machine configuration file has been loaded. Consult your site supervisor.

3.2 Software option keys

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

3.2.1 Software support

For new control boxes the software will self-generate the initial 12 months of software support. If no software support date is set then an initial dialog screen will be presented to the operator. The operator can either press **Accept** to activate 12 months of software support or decide not to do this at that time.

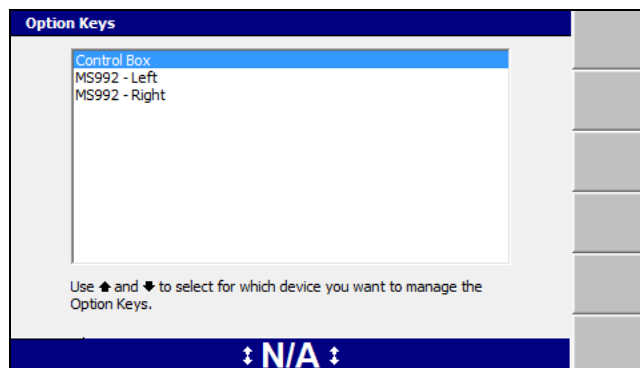
If software support is not activated, the software will function normally for 60 minutes after which time it will cease to calculate machine position, making the software unusable for machine control. On the next power cycle, if software support is still not set then the same initial screen is presented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

To extend this software support date, 12-month software support extension option keys are available via the Trimble Store.

3.2.2 Viewing the status of control box and GNSS receiver option keys

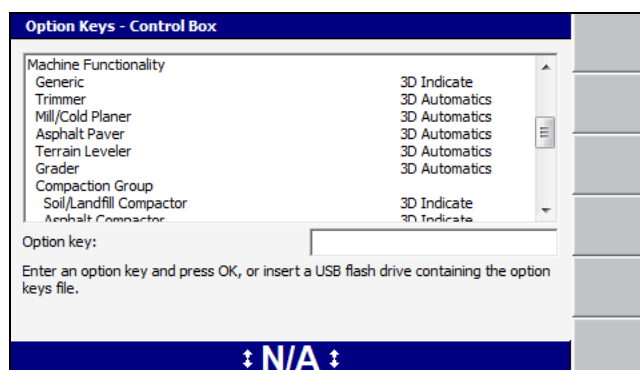
You can display option key information for the control box and GNSS receivers from the *Option Keys* dialog.

1. From the *Setup Menu – Installation* menu, select *Option Keys*.

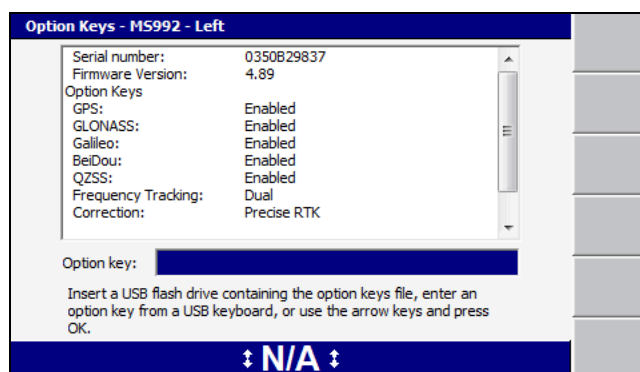


2. Select the device that you want to view option keys information about:

- Control box.



- GNSS receiver. GNSS receivers are labeled by their mounting location on the machine and details for the receiver only appear in the *Option Keys* dialog if the receiver is connected.



Detailed information about how to apply control box and GNSS option key files is described in the *GCS900 Grade Control System Site Supervisor's Manual*

3.2.3 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.

3.3 Work preparation checks



ATTENTION — Underwater excavation is only supported when using a dedicated underwater solution. When excavating underwater, **do not** submerge the sensors deeper than 1 meter (3.3 feet).

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	3.3.1 Machine settings
Mode selection	- When you restore machine settings - When devices have been added or removed - When you need to switch between guidance systems	3.3.2 Switching guidance modes
Main screen views	As required for the current job and environment	3.3.3 Main screen views
Display brightness	Every power-up	3.3.4 Display brightness
Display settings	As instructed by your site supervisor	3.3.5 Display settings
Keypad backlight brightness	Every power-up	3.3.6 Keypad backlight brightness
Lightbar brightness	Every power-up	3.3.7 Lightbar brightness
Lightbar tolerances	As instructed by your site supervisor, or when there is a significant change in material or accuracy requirements	3.3.8 Lightbar tolerances
Bucket wear	As instructed by your site supervisor	3.3.9 Checking bucket wear

3.3.1 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:

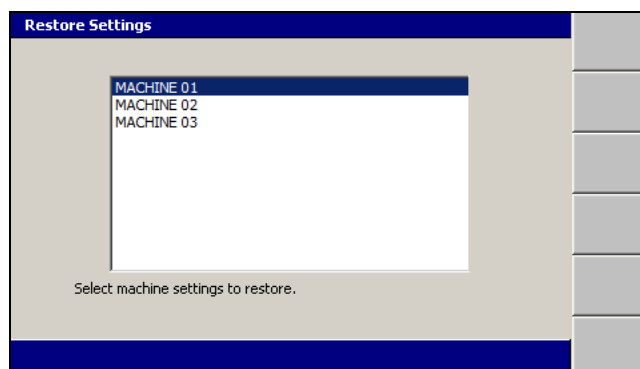
- AS45x sensors.

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

- To learn more about sensor calibration, refer to the *GCS900 Grade Control System Site Supervisor's Manual*.

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 *Bucket 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 bucket wear setting. To learn how to do this, see [3.3.9 Checking bucket wear](#).

Changes take effect immediately.

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

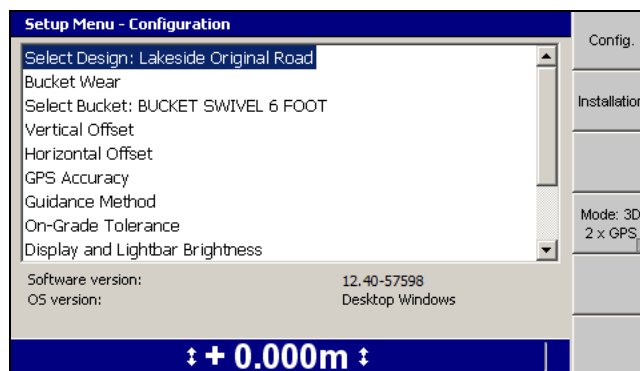
Problem	Action
Invalid machine settings file	The machine settings file is corrupt. The machine settings are for the wrong machine type. Consult your site supervisor.
No settings suitable for your machine	The machine settings data is incorrect. Consult your site supervisor.

3.3.2 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>**.

3.3.3 Main screen views

The *Main Screen Views* dialog enables 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 you can adjust in the *Main Screen Views* dialog.

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

Table 3.1 — 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.
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.
Level view	Yes / No	Yes - A level bubble view is available.

Table 3.2 — 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 - Increment Layer	- When Record Point is selected, press and hold Record Point or Mapping/Recording to display the Record Point dialog. - When Increment Layer is selected, press and hold Increment Layer to display the <i>Mapping/Recording</i> dialog.

3.3.4 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 .

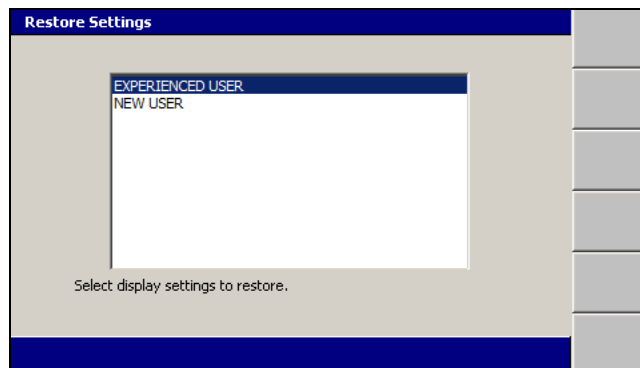
Note – You can also set the display brightness using the *Display and Lightbar Brightness* dialog from the *Setup Menu – Configuration menu*.

3.3.5 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*.



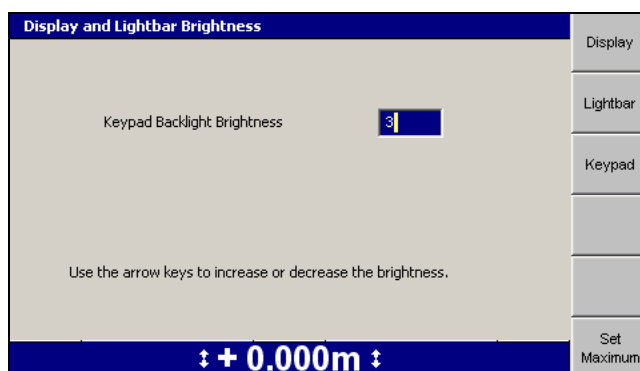
4. Select the correct setting file for your use.
5. To confirm the settings, press ; to exit without saving the changes, press .

3.3.6 Keypad backlight brightness

You can 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**.

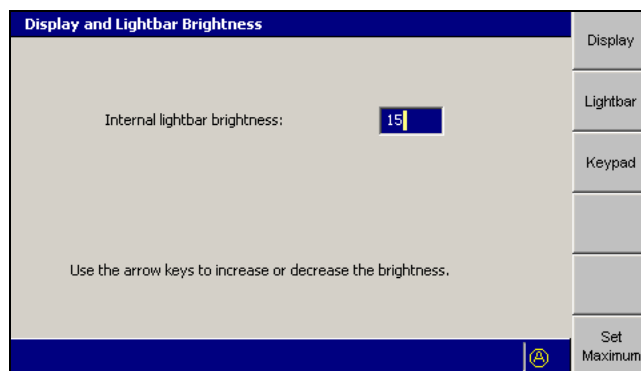


4. Use one of the following tools to set the keypad backlight brightness:
 - Use the arrow keys to increase or decrease the value of the *Keypad Backlight Brightness* field.
 - Press **Set Maximum** to set the value to the maximum of 15.
5. To confirm the settings, press ; to exit without saving the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

3.3.7 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 .

3.3.8 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*.

External Lightbar Scale		Vertical
Vertical Tolerance	<0.025 m	
0.050 m =	<0.050 m	Horizontal
Cut / Fill Text	<0.075 m	
Cut >0.050 m	<0.100 m	
On Grade	<0.200 m	Half Set 0.025
Fill >0.050 m	<0.400 m	Double Set 0.100
		Default Set 0.050

Internal Lightbar Scale		Vertical
Vertical Tolerance	<0.050 m	
0.050 m =	<0.100 m	Horizontal
Cut / Fill Text	<0.200 m	
Cut >0.050 m	<0.400 m	
On Grade		Half Set 0.025
Fill >0.050 m		Double Set 0.100
		Default Set 0.050

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

***Note** – The tolerances for both vertical lightbars are set to the same value. When a Depth and Slope guidance method is selected, only the left (cut/fill) lightbar is affected by the settings in the Lightbar Scales dialog.*
 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.

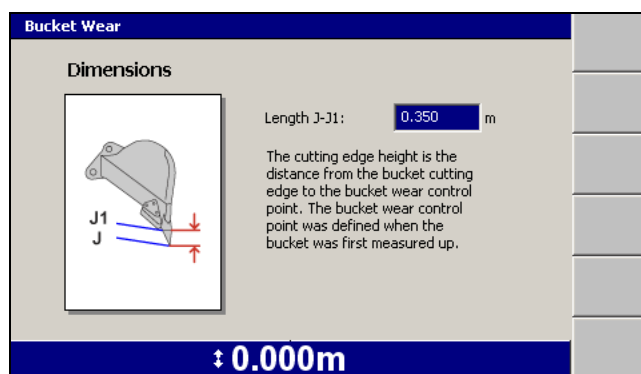
3.3.9 Checking bucket wear

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

1. Measure the cutting edge height to the bucket wear control point. The bucket wear control point was defined when the bucket was first measured up.

If the bucket 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 *Bucket Wear*.



4. If required, edit the *Length J-J1* field.

Note – If the bucket teeth are longer now than when the bucket was first measured up, enter a negative value.

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

The changes take effect immediately.

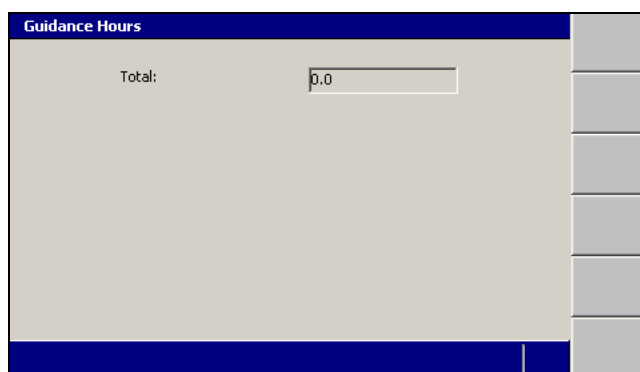
3.4 Operating hours

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.

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.*

3.5 Configuring the machine radio

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

Use this radio ...	With ...
SNR24xx or SNR2420	A UTS or GNSS system.
SNR9xx	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 [3.5.1 Machine radio configuration](#).
 - *Select Radio Band*. See [3.5.4 Select radio band](#).

Note – If a cellular radio is installed more options are available. See [3.6 Wi-Fi networking](#).

3.5.1 Machine radio configuration

1. From the *Connectivity Settings* dialog, select *Machine Radio Configuration*. The system searches for a radio.
2. The *Machine Radio Configuration* dialog displays different fields, depending on your radio type:
 - For a 900 MHz radio on a GNSS system:

The screenshot shows the 'Machine Radio Configuration' dialog box. It has a title bar with the same text. Inside, there's a section titled 'Machine Radio Configuration' with a 'Network:' dropdown menu set to '1'. Below it is a 'Region:' dropdown menu set to 'Unknown Country'. Further down, it shows 'Radio Status: Connected' and 'Radio Band: 900 MHz'. At the bottom, there's a blue bar with 'N/A' in the center and a small icon on the right.

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 GCS900 Grade Control System Site Supervisor's Manual.

- For a 220 MHz radio on a GNSS system:

The screenshot shows the 'Machine Radio Configuration' dialog box. It has a title bar with the same text. Inside, there's a section titled 'Machine Radio Configuration' with a 'Frequency:' dropdown menu set to '232.53750 MHz'. Below it is a 'Wireless Mode:' dropdown menu set to 'TRIMTALK v1 at 4800 bps'. Further down, it shows 'Radio Status: Connected' and 'Radio Band: 220 MHz'. At the bottom, there's a blue bar with 'N/A' in the center and a small icon on the right. On the right side of the dialog, there are two buttons: 'Manage Freq' and 'Wireless Mode'.

Use the arrow keys to select the *Network* or *Frequency* setting required. To save the changes, press ; to exit without saving changes, press .

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 [3.5.4 Select radio band](#).

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.

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

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

Note – The **Manage Freq** and **Wireless Mode** softkeys are only displayed when either a 220 MHz or 450 MHz radio is configured

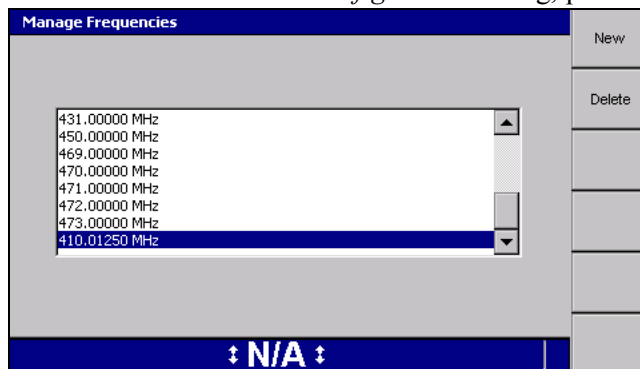
To manage and add a frequency, press **Manage Freq**.

To configure the wireless mode, press **Wireless Mode**.

3.5.2 Manage frequencies

To manage available reception frequencies on a 450 MHz machine radio :

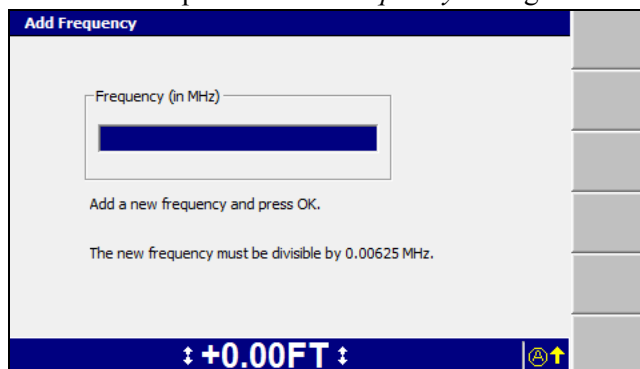
1. From the *Machine Radio Configuration* dialog, press **Manage Freq.**



From the *Manage Frequencies* dialog you can either add a new frequency or delete a frequency.

To add a new frequency to the list of available frequencies in the *Machine Radio Configuration* dialog:

1. Press **New** to open the *Add Frequency* dialog.



2. Enter a new frequency. The new frequency must be a multiple of 6.25 kHz.
3. Press  to save the new frequency, or press  to exit without saving, and return to the *Manage Frequencies* dialog.

An error message appears if you attempt to set a frequency that is:

- outside the range of the radio.
- already configured.
- not evenly divisible by 6.25 kHz.

If this occurs, the *Add Frequency* dialog reappears and you can edit the incorrect frequency.

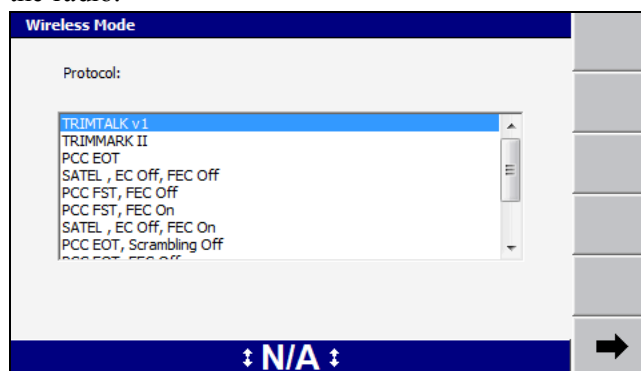
To delete a frequency:

1. From the *Manage Frequencies* dialog, use the arrow keys to highlight the frequency you want to delete.
2. Press **Delete**. A message appears asking you to confirm the deletion.
3. Press  to delete the frequency, or press  to exit without saving, and return to the *Manage Frequencies* dialog.

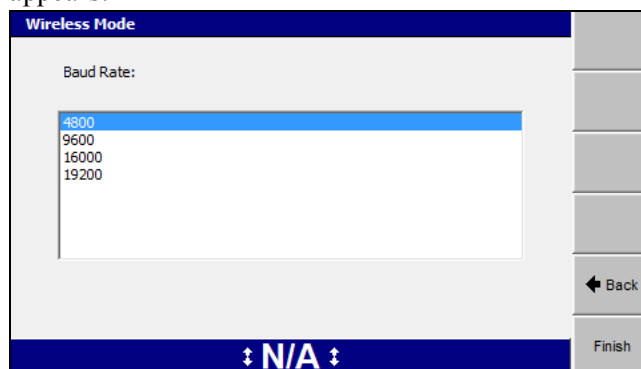
3.5.3 Specify wireless mode

To manage machine radio frequencies:

1. From the *Machine Radio Configuration* dialog, press **Wireless Mode**. The first screen of the *Wireless Mode* wizard appears, listing the available protocols for the radio:



2. Use the arrow keys to select the wireless mode from the list of available protocols, then press  or . The *Wireless mode - Baud Rate* screen appears:



3. Use the arrow keys to select the baud rate from the list of available rates and

press  or **Finish** to save and start using the configured wireless mode.

Otherwise, press  to exit without saving, and return to the *Machine Radio Configuration* dialog.

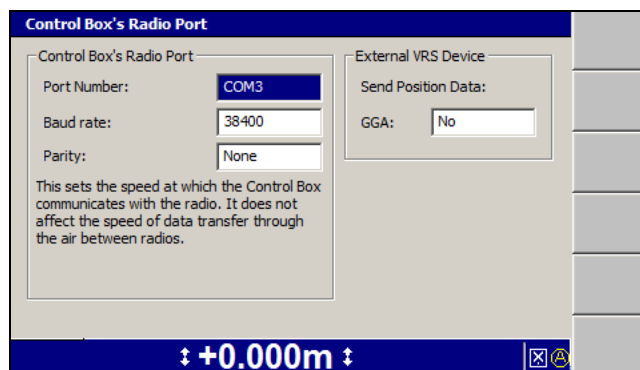
3.5.4 Select radio band

1. From the *Connectivity Settings* dialog, select *Select Radio Band*.
2. To change the radio band, press **Set 220MHz**, **Set 450 MHz**, **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 start-up, connection and reconfiguration, irrespective of the band chosen in the *Select Radio Band* dialog.

3.5.5 Configuring a third party radio

1. From the *Setup Menu – Installation* menu, select *Connectivity Settings*.
2. Press the up or down arrow keys on the control box to select *Control Box's Radio Port* and press  :



The dialog box titled "Control Box's Radio Port" contains the following fields and options:

- Control Box's Radio Port**
 - Port Number: COM3
 - Baud rate: 38400
 - Parity: None
- External VRS Device**
 - Send Position Data: GGA: No

Below the fields, a note states: "This sets the speed at which the Control Box communicates with the radio. It does not affect the speed of data transfer through the air between radios."

At the bottom of the dialog, there is a status bar showing "± +0.000m ±" and a close button.

The control box's radio port is the communications port on the control box that connects to the communications port on the data radio. For the system to work, the settings in the *Control Box's Radio Port* dialog must match the communication port settings in the data radio. If these settings do not match, do the following:

3. Use the arrow keys to select the correct port number, and then press .



Tip – COM 1 is reserved for use by wireless communications. If wireless communications are configured the COM port will be grayed out and set to COM 3.

Note – *If a third party radio is configured to COM 1 and a radio using wireless communications is added later, a warning message will be displayed and the third party radio port will automatically be changed to COM 3.*

4. Use the arrow keys to select the correct baud rate for the radio port, and then press .
5. Use the arrow keys to select the correct parity for the radio port.
6. If you use a VRS service and want to enable VRS on the machine, use the arrow keys to set *GGA:* to *Yes*.
7. To update the display's radio port settings and return to the *Connectivity Settings* dialog, press ; to return to the *Connectivity Settings* dialog without saving changes, press .
8. Press  to return to the *Setup Menu – Installation* dialog.

3.6 Wi-Fi networking

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

- The SNRxxx range of multi-band radio modems.
- The SNM940 Data Communications Module.

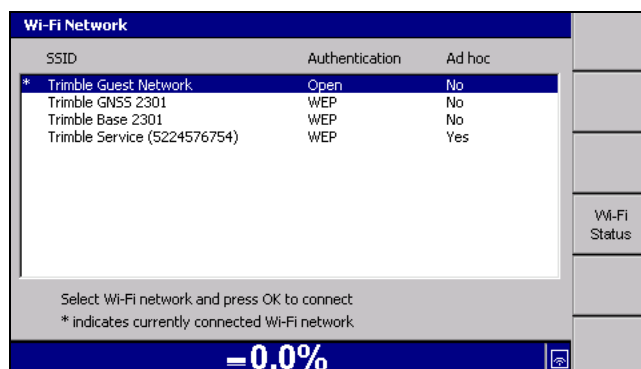
Wi-Fi networking manages two-way wireless IP (Internet Protocol) data transfer between two or more wireless devices and, optionally, a wired networking infrastructure. Wi-Fi is intended for medium to high speed data transfer over short distances and allows the exchange of data within a site without the installation of base radios or other major infrastructure.

3.6.1 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

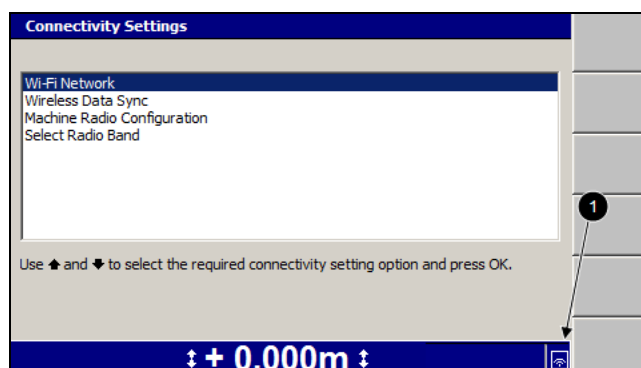
device and listed on the control box.



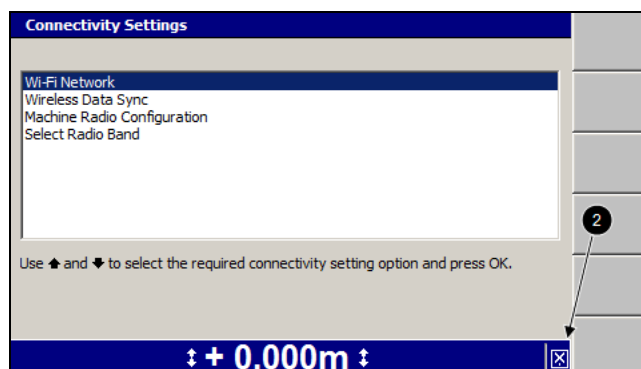
3.6.2 Connecting to a Wi-Fi network

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 (❌).

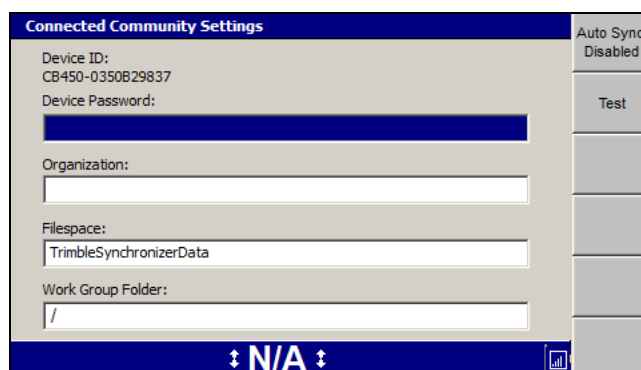


3.7 Exchanging files with a Connected Community filespace

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.

3.7.1 Configuring the Connected Community settings

1. From the *Setup Menu – Installation* menu, select *Connectivity Settings*.
2. Press the up or down arrow keys on the control box to select *Connected Community Settings* and press :



3. Use the arrow keys to enter your details.

The password is only readable until you press . When you open the *Connected Community Settings* dialog in future, the password will be displayed as "*****". To change the password, select the *Password:* field and press the left arrow. The existing password is cleared and the new one can be entered.

If the work group is left as the default "/", data will be synchronized to the Connected Community filespace:

"TrimbleSynchronizerData/<machine name>/Machine Control Data".

If the work group is edited, the machine data will be synchronized to the Connected Community filespace:
 "TrimbleSynchronizerData/<work group>/<machine name>/Machine Control Data".

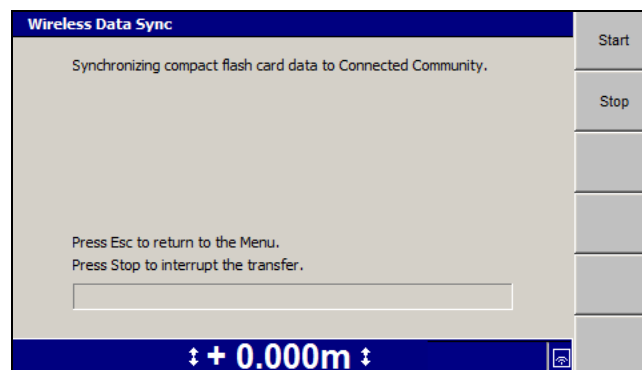
Note – The wireless file exchange system has been designed on the basis of one USB flash drive per machine name. Swapping USB flash drives in the control box (for a machine name) may result in the deletion of files from the Connected Community on future data synchronization.

4. To validate the login, press **Test**.
"Login failed" will be displayed if the password or organization are incorrect, or if the work group folder does not exist on the Connected Community. Press  to continue.
5. To save the settings and return to the *Connectivity Settings* dialog, press ; to return to the *Connectivity Settings* dialog without saving changes, press .
6. Press  to return to the *Setup Menu – Installation* dialog.

3.7.2 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 .

3.7.3 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.

You can use the **Auto Sync** softkey to toggle Auto Sync on or off. When Auto Sync is on, the display synchronizes with Connected Community every time a *.tag file is written. By default, these files are created every five minutes when *Data recording for office* is enabled in the *Mapping/Recording Settings* dialog.

While synchronizing the *.tag files, the system checks the display and Connected Community for other files that may need to be synchronized. If any are found, they are also synchronized.

Auto Sync **does not** enable the automatic synchronization of files between Connected Community and the display if:

- *.tag files are not being created
- there are problems with the Connected Community synchronization process, for example incorrect credentials

Using background synchronization

1. Start a data synchronization. See [3.7.2 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.

3.7.4 Troubleshooting Connected Community file exchange

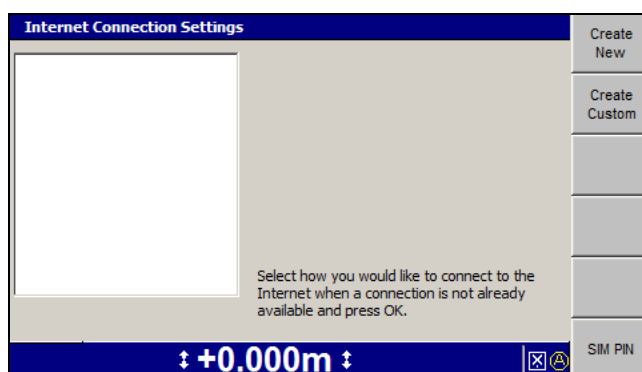
Use the following table to resolve Connected Community file exchange problems in the field:

Problem	Resolution
Is the wireless communications device installed correctly?	Check cables and connectors. See your site supervisor.
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 <i>Wireless Data Sync</i> dialog log in to the Connected Community server?	See 3.7.2 Initiating Connected Community file exchange from the machine

3.8 Internet Connection Settings

The *Internet Connection Settings* dialog lets you select how the control box will connect to the Internet when a connection is not already available. The control box sends the Access Point Name (APN) settings to the SNM940, instead of having to set them directly in the SNM940.

1. From the *Setup Menu – Installation* menu, select *Connectivity Settings*.
2. Press the up or down arrow keys on the control box to select *Internet Connection Settings* and press  :



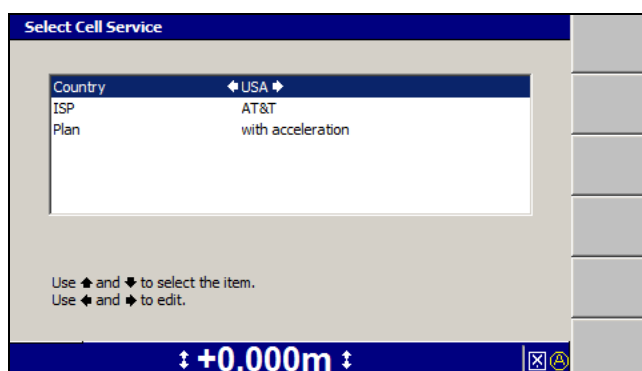
3. Press the up or down arrow keys on the control box to select how you would like to connect to the Internet and press .

If not connected, press **Create New** or **Create Custom**. If your connection requires a SIM pin number, press **SIM PIN** and enter your SIM card PIN number.

4. Press  to save your settings; press  to exit without saving.

3.8.1 Create New

1. From the *Internet Connection Settings* dialog, press **Create New**:



2. Use the arrow keys on the control box to select the service provider details and press .

The dialog box is titled "Internet Connection Settings". It has a list on the left with "AT&T-with acceleration-USA" selected. To the right, there are three input fields: "Country" with "USA", "ISP" with "AT&T", and "Plan" with "with acceleration". Below these fields is a text box with the instruction: "Select how you would like to connect to the Internet when a connection is not already available and press OK." On the right side of the dialog, there are four buttons: "Create New", "Create Custom", "Delete", and a button with a question mark icon. At the bottom, there is a status bar showing "0.000m" and a button with a question mark icon. A "SIM PIN" label is visible at the bottom right.

A summary of the selected service provider appears.

3. Press to save your settings.

A warning message appears advising you that sending settings to the Wi-Fi/Cell radio takes approximately five minutes and that it automatically restarts the radio.

4. Press to continue or press to cancel.

3.8.2 Create Custom

This dialog is for situations when the provider is not contained in the current service providers list. Ask your service provider for the APN. This specifies the external network that the cellular device can access.

1. From the *Internet Connection Settings* dialog, press **Create Custom**:

The dialog box is titled "Custom Connection Settings". It has three input fields: "APN:" (with a blue background), "Username:", and "Password:". To the right of these fields are four buttons: a button with a question mark icon, a button with a right arrow icon, a button with a left arrow icon, and a button with a question mark icon. At the bottom, there is a status bar showing "0.000m" and a button with a question mark icon.

2. Use the arrow keys on the control box to enter the Internet connection settings. Press to move to the next field.
3. To save the settings and return to the *Internet Connection Settings* dialog, press ; to return to the *Internet Connection Settings* dialog without saving changes, press .

A summary of the service provider details you created are displayed to the right of the *Internet Connection Settings* dialog.

3.8.3 Delete

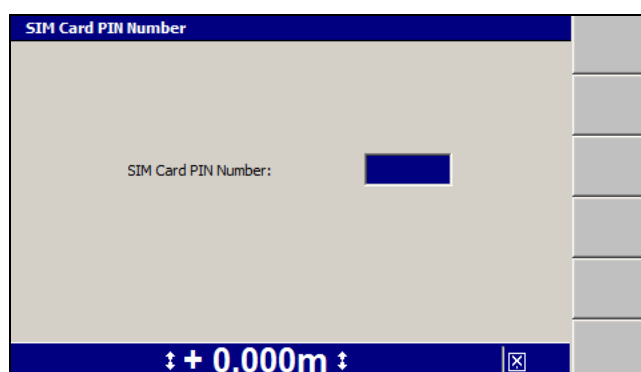
Note – Deleting internet settings from the *Internet Connection Settings* dialog does not remove them from the SNM940, just from the list.

1. From the list of configured internet service providers, select the service provider you want to delete, and press **Delete**. The *Delete ISP Configuration* dialog displays.
2. Press  to confirm deletion. The list of available service providers displays.

3.8.4 SIM PIN

Sometimes newly inserted SIM cards are locked at the time of purchase. To unlock the SIM card you need to enter the SIM card PIN.

1. From the *Internet Connection Settings* dialog, press **SIM PIN**:



2. Press the up or down arrow keys on the control box to enter the 4 digit PIN number.
3. To save the PIN and return to the *Internet Connection Settings* dialog, press ; to return to the *Internet Connection Settings* dialog without saving changes, press .
4. Press  to send the SIM PIN and APN to the SNM940.
A warning message appears advising you that sending a SIM PIN to the Wi-Fi/Cell radio takes approximately five minutes and that it automatically restarts the radio.
5. Press  to continue or press  to cancel.

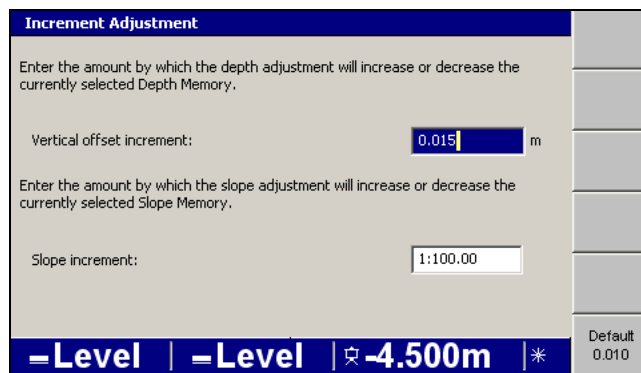
3.9 Setting depth and slope increment values

You can set the amount by which depth and slope values are incremented and decremented. These values appear on the increment and decrement softkeys in the *Depth Memories* and *Slope Memories* dialogs.

Note – The *Depth Memories* and *Slope Memories* dialogs are described in 4.4 *Selecting or creating a guidance model*.

To set increment/decrement values:

1. From any guidance screen, press .
2. Select *Increment Adjustment*.



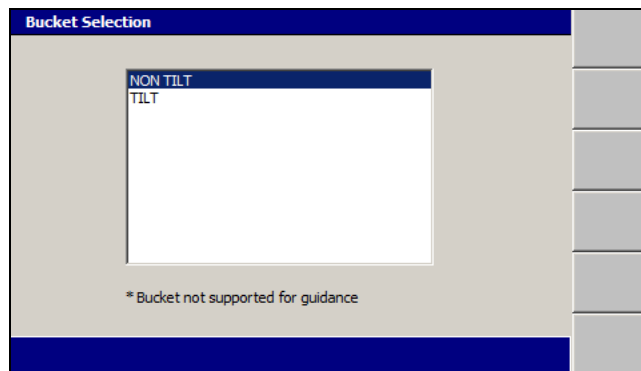
3. To set the vertical offset increment and/or the slope increment:
 - Edit the *Vertical offset increment* or *Slope increment* fields directly.
 - Press **Default <value>** to set the increment/decrement amount to its default value.
4. To confirm the settings, press ; to exit without saving the changes, press .

3.10 Selecting an excavator bucket

For excavators, the bucket model that the system uses to calculate guidance information must match the bucket you use on the job.

To check and/or select an excavator bucket model:

1. From any guidance screen, press . The *Setup Menu – Configuration* menu appears.
2. Select *Select Bucket*.



Note – An * following a bucket name indicates that specific bucket is not being supported for guidance.

3. Select the bucket model you are going to use for the job.
4. To confirm the settings, press ; to exit without saving the changes, press .

Some possible problems that can occur when you try to select an excavator bucket are:

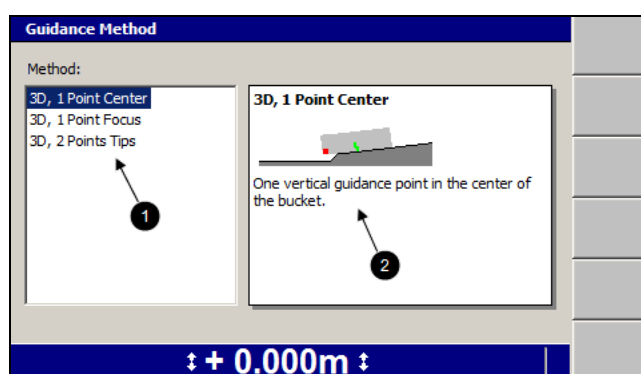
Problem	Action
No bucket models are available	The installation of the system has not been completed. Notify your site supervisor.
There is no bucket model available for the bucket you want to use	Choose another bucket, or ask your site supervisor to define a bucket model for you to use.

3.11 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 3.1 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 bucket.
3D, 1 Point Focus	One vertical guidance point inset 200 mm (8 inches) from the bucket focus.
3D, 2 Points Tips	Two vertical guidance points, inset 200 mm (8 inches) from the bucket tips.



Tip – 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 .

3.12 Selecting a 2D guidance method

This is covered in [Chapter 4, Using 2D Guidance in the Field](#).

To select a guidance method, see [4.4 Selecting or creating a guidance model](#).

Using 2D Guidance in the Field

In this chapter:

- Setting the focus point
- GNSS Receiver Support
- Cab Rotation Support
- Selecting or creating a guidance model
- Benching the elevation
- Establishing an elevation reference
- Working with 2D guidance

To generate guidance information, the GCS900 Grade Control System measures the cutting edge of the bucket position relative to a physical reference surface or laser plane. These systems are called conventional, or 2D, guidance methods.

Unlike 3D guidance methods, 2D 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 2D guidance systems, and use them in the field.

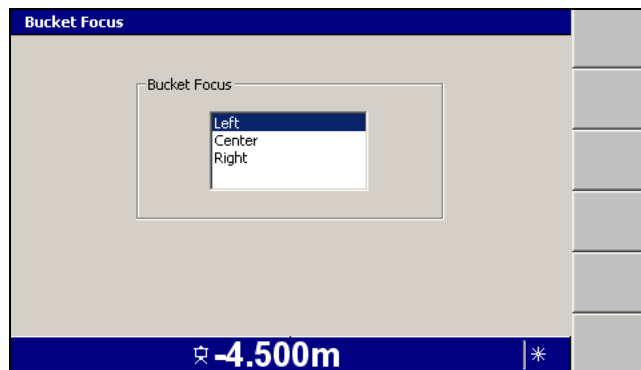
For more information about 2D guidance systems and their sensors, refer to the *GCS900 Grade Control System Reference Manual*.

4.1 Setting the focus point

The focus point is the point on the bucket used as the reference point when benching. By default, the focus is located at the center of the cutting edge of the bucket.

If you need to change the focus point:

1. From any guidance screen, press .
2. Select *Bucket Focus: <position>*.



3. Select one of the following positions for the focus point:
 - *Left* – the focus point is at the left end of the cutting edge of the bucket
 - *Center* – the focus point is at the center of the cutting edge of the bucket
 - *Right* – the focus point is at the right end of the cutting edge of the bucket
4. To confirm the settings, press ; to exit without saving the changes, press .

4.2 GNSS Receiver Support

GNSS Receiver Support is an add-on for 2D excavator systems, enabling:

- GNSS positioning of the machine to a relative benching point. This allows you to move around the site without needing to use Touch Point or accept a laser strike.
- The ability to create basic designs in the field without the need for external software support or surveying and infrastructure set up.

Note – *Measure mode is not available when GNSS Receiver Support is enabled.*

When GNSS Receiver Support is enabled the **Bench** softkey icon includes a stake symbol to represent a stake in the ground, referenced by the GNSS receiver. Once the system is benched you can continue digging after moving the machine, without needing to use Touch Point or accept a laser strike.

Bench softkey	Description
	Bench the system using the GNSS receiver

To enable GNSS Receiver Support:

1. From any guidance screen press .
2. Press **Installation**.
3. Select *GNSS Receiver Support*.
4. To confirm the settings, press ; to exit without saving the changes, press .

If the option is not available, see your site supervisor.

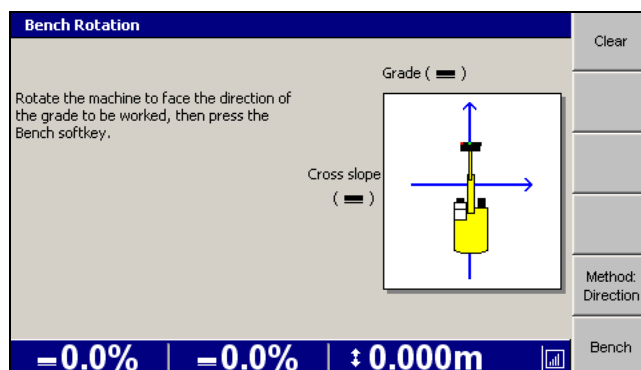
4.2.1 Bench rotation using two points

Note – *Bench rotation using two points is only available when GNSS Receiver Support is installed and configured.*

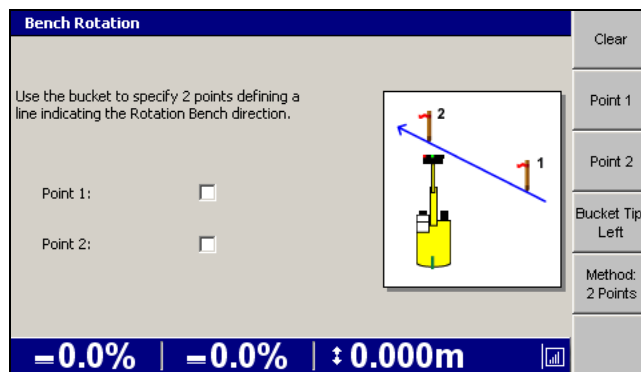
Bench rotation using two points allows you to use the bucket to specify two points defining a line indicating the rotation bench direction. This means the accuracy of the rotation bench can be fine-tuned as the machine is moved.

To bench the rotation using the two points method:

1. From any guidance screen press and hold **Bench Rotation**. The *Bench Rotation* dialog appears, showing the **Method: Direction** screen.



2. Press **Method: Direction**. The *Bench Rotation* dialog re-appears, showing the **Method: 2 Points** screen.



3. Use the bucket to specify two points defining a line indicating the rotation bench direction.
 - a. Place the bucket tip on the first point and press **Point 1**.
 - b. Place the bucket tip on the second point and press **Point 2**.
4. If required, press **Bucket Tip: <value>** to change the bucket tip position used.
5. If required, press **Clear** to clear the bench.
6. Press  to bench the rotation; press  to exit without saving.

4.3 Cab Rotation Support

Cab Rotation Support is an add-on for 2D excavator systems and supports the use of the HS410 heading sensor for 2D excavation. The heading sensor is designed to measure the excavator body sensor relative to the Earth's magnetic field, and incorporates a heading sensing unit. The system uses the heading sensor to measure the excavator body rotation.

When using the depth dual slope guidance method:

- The grade icon shows that:
 - the grade of the slope is in the direction in front of the machine
 - a positive grade is up and away from the cab
 - a negative grade is down and away from the cab
- The cross slope icon shows that:
 - a positive slope is up to the right
 - a negative slope is down to the right

To enable Cab Rotation Support, see your site supervisor.

4.4 Selecting or creating a guidance model

A guidance method consists of guidance models stored in system memory. Once you have selected a guidance method and created guidance models, you can then use a guidance screen softkey to switch between stored guidance models.

Guidance models are stored as Depth Memories, Slope Memories, Profiles, or Alignments and are accessed from the Guidance Method dialog.

A guidance method needs to be selected before you can receive cutting edge guidance. You can select a saved guidance method already stored in the system, or you can create a guidance method while you are working in the field.

Available guidance methods are listed in the following table:

Guidance Method	Description	For more information, see ...
Depth	Depth specifies the elevation of the design surface. Positive values of depth place the design surface above the benched elevation. If depth is combined with slope, then the depth specifies the elevation of the design surface directly above or below the benching point.	4.4.2 Depth and slope models
Depth Slope	Slope specifies the grade of a design surface. Positive values of slope cause the design surface to slope upwards away from the front of the machine. Slope is always used in combination with depth.	4.4.2 Depth and slope models
Depth Dual Slope	Reach and elevation guidance to a dual slope. Note – <i>Depth Dual Slope is only available when Cab Rotation or GNSS Receiver Support is installed and configured.</i>	4.4.3 Depth dual slope models
Profile	Profiles specify a linked sequence of line segments. The segments must be vertical or less than vertical.	4.4.4 Profile models
Alignments with Profiles	Elevation and slope guidance to an alignment and profile. Note – <i>Alignments with Profiles is only available when GNSS Receiver Support is installed and configured.</i>	4.4.5 Alignments with Profiles

4.4.1 Selecting a 2D guidance method

To check and/or select a guidance method:

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

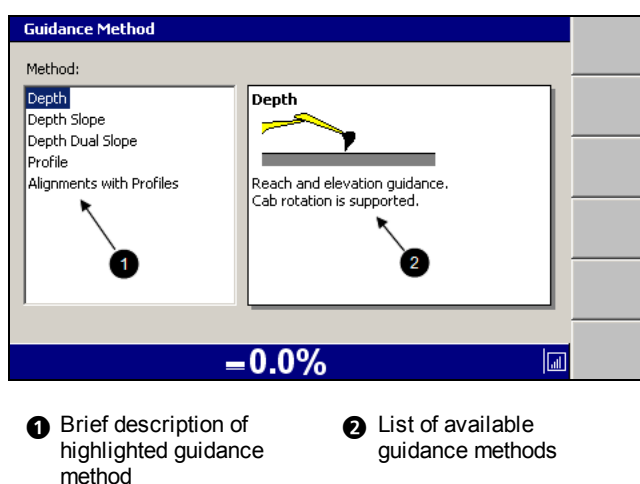


Figure 4.1 Example of a *Vertical Guidance Method* dialog

4. Highlight the vertical guidance method you want to use.
5. To confirm the settings, press ; to exit without saving the changes, press .

For a list of 2D excavator system softkeys, see [Softkeys, page 27](#)

4.4.2 Depth and slope models

Depths and slopes are stored on the control box in depth and slope memories respectively. These memories are only accessible when a vertical guidance method has been selected that requires the use of a model from the memory. For example, you can only access slope memory when the Depth Slope vertical guidance method has been selected.

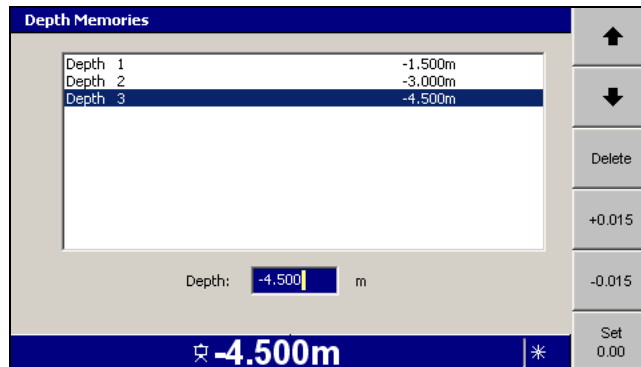
Selecting a depth or slope model from memory

Depth and slope models are selected from any guidance screen by pressing the **Depth** or **Slope** softkeys respectively. The softkey labels identify the model number that is selected, and that model's depth or slope.

There is always at least one depth and one slope model stored in each memory. If there is more than one model of a particular type in memory, then pressing the softkey will select the next model.

Creating a new depth model

1. From any guidance screen, press and hold **Depth**.



Note – You can also access *Depth Memories* by pressing **Depth Memories** from the *Guidance Method* dialog.

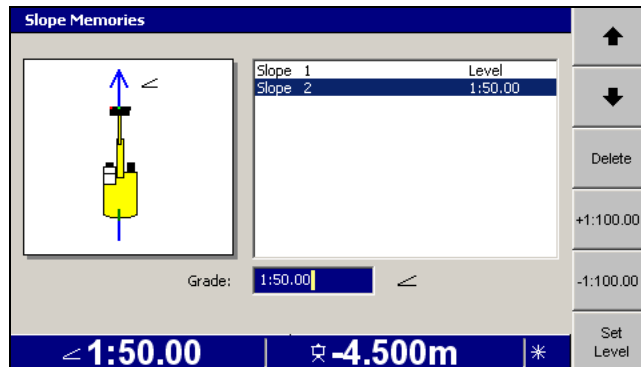
2. Press until the highlight bar moves past the last item in the current list. A new depth model is created, with a depth of zero.
3. Use any of the following tools to set the depth:
 - Edit the *Depth* field directly
 - Press **+0.015** or **-0.015** to add or subtract 0.015 m (0.6 inches) to or from the current depth

Note – The actual softkey labels displayed depend on the increment/decrement values that have been set and the units selected. For more information on setting the increment/decrement values, see [3.9 Setting depth and slope increment values](#).

 - Press **Set 0.00** to set the depth to zero
4. To confirm the changes, press ; to exit without saving the changes, press .

Creating a new slope model

1. From any guidance screen, press and hold **Slope**.



Note – You can also access *Slope Memories* by pressing **Slope Memories** from the *Guidance Method* dialog.

2. Press  until the highlight bar moves past the last item in the current list. A new slope model is created, with a slope of zero.
3. Use any of the following tools to set the slope:
 - Edit the *Slope* field directly
 - Press **+1:100.00** or **-1:100.00** to add or subtract the value from the current slope

Note – The actual softkey labels displayed depend on the increment/decrement values that have been set and the units selected. For more information on setting the increment/decrement values, see [3.9 Setting depth and slope increment values](#).

 - Press **Set Level** to set the slope to zero
4. To confirm the changes, press ; to exit without saving the changes, press .

Editing a depth or slope model

1. Select a depth or slope model from the *Depth Memories* or *Slope Memories* dialog.
2. Edit the model, and save changes, using the tools described in [Creating a new depth model](#), page 83 or [Creating a new slope model](#), page 84.



Tip – You can also save changes by pressing  or . This enables you to edit a number of designs in succession without leaving the dialog.

Deleting a depth or slope model

1. Select a depth or slope model from the *Depth Memories* or *Slope Memories* dialog.
2. Press **Delete**.
3. To confirm the changes, press ; to exit without saving the changes, press .

4.4.3 Depth dual slope models

Depth dual slope provides reach and elevation guidance to a dual slope. Cab rotation is supported.

A depth dual slope model is stored on the control box in the depth dual slope memory. You can only access depth dual slope memory when the Depth Dual Slope guidance method has been selected, and:

- the system is configured to use the HS410 cab rotation sensor, or
- GNSS Receiver Support is enabled

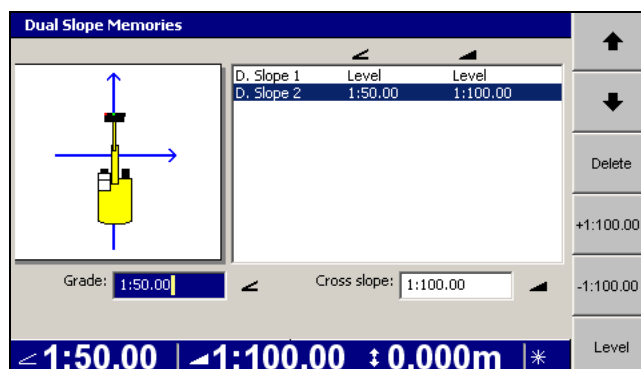
Selecting a depth dual slope model from memory

A depth dual slope model is selected from any guidance screen by pressing the **Depth Dual Slope** softkey.

There is always at least one depth dual slope model stored in each memory. If there is more than one model in memory, press **Depth Dual Slope** again to select the next model.

Creating a new depth dual slope model

1. From any guidance screen, press and hold **Depth Dual Slope**.



Note – You can also access Depth Dual Slope Memories from the Guidance Method dialog.

2. Press  until the highlight bar moves past the last item in the current list. A new depth dual slope model is created.
3. Use any of the following tools to set the grade and cross slope:
 - Edit the *Grade* and *Cross slope* fields directly.
 - Press **+1:100.00** or **-1:100.00** to increment or decrement the grade and cross slope values.

Note – The actual softkey labels displayed depend on the increment/decrement values that have been set and the units selected. For more information on setting the increment/decrement values, see [3.9 Setting depth and slope increment values](#).

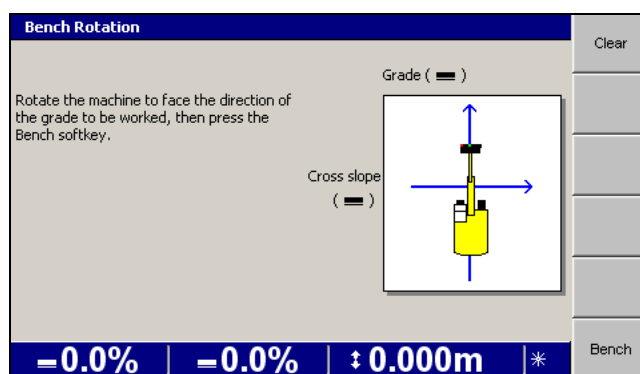
- Press **Level** to level the grade or cross slope values.
4. To confirm the changes, press ; to exit without saving the changes, press .

Bench rotation

Bench rotation benches the machine rotation so the system knows the direction of the main grade slope.

To bench the cab rotation sensor:

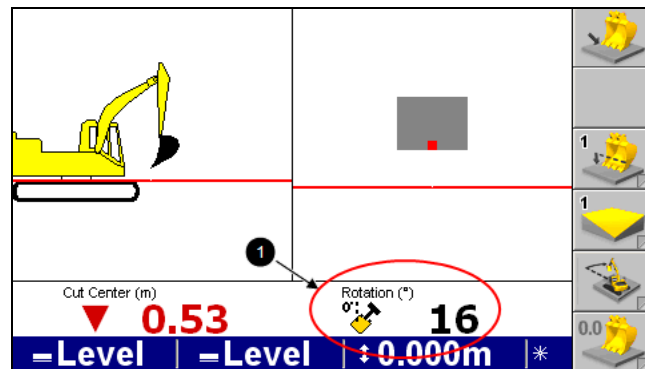
1. To bench the rotation on the current direction that the machine is facing, press **Bench Rotation**.
2. To clear the rotation bench or to establish a new rotation bench facing in a different direction, press and hold **Bench Rotation**.



- To clear the existing bench press **Clear**.
- To bench the system on a new position, rotate the machine to face the direction of the grade to be worked and press **Bench**.

Cab rotation text item

A "Rotation" text item (❶) is available when using a cab rotation sensor. See your site supervisor to set up Rotation as a text item.



The Rotation text item:

- Displays the current rotation of the cab up to $\pm 180^\circ$ around the benched rotation direction (16° in this example)
- Shows a small top-down excavator icon that indicates which side of the rotation bench direction the excavator is currently on (in this example, clockwise from the benched rotation)

When an HS410 is installed and configured, you can:

- Rotate the machine to catch a laser strike
- Rotate the machine to use the touch point feature when working on slopes (single and dual)

Enabling and disabling cab rotation support

To enable or disable the rotation sensor support, see your site supervisor.

Cab rotation sensor troubleshooting

The cab rotation sensor has an LED that indicates power:

- When lit the unit has power at the connector
- When not lit, the unit does not have power at the connector or there is an internal harness failure in the unit.

4.4.4 Profile models

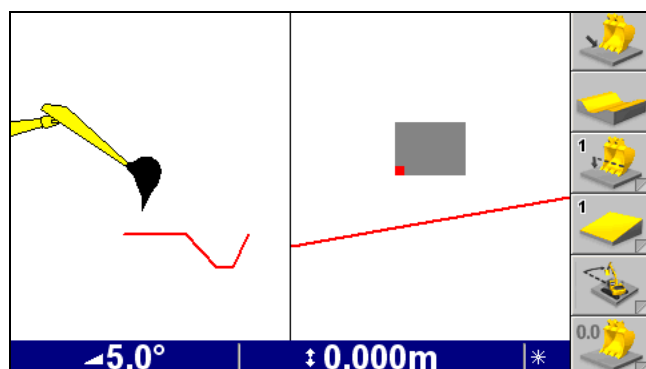
Profiles are stored in profile memory. This memory is only accessible when the Profile vertical guidance method has been selected.

Working with profiles

Note – Profile Slope memories are only available when Cab Rotation Support or GNSS Receiver Support is enabled.

Depth memories and Slope memories can be used with Profile guidance. This allows you to apply a depth and/or slope to a profile.

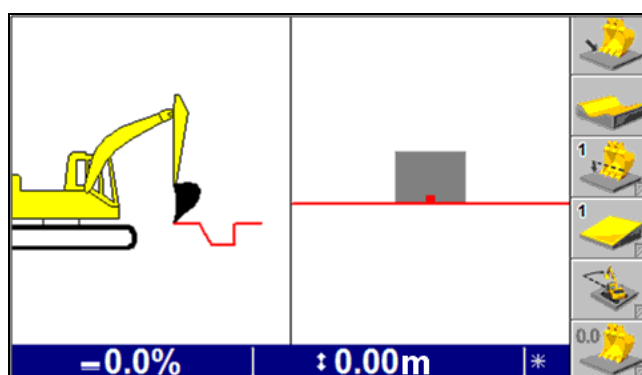
The following example shows a trench profile with a 5° mainfall slope.



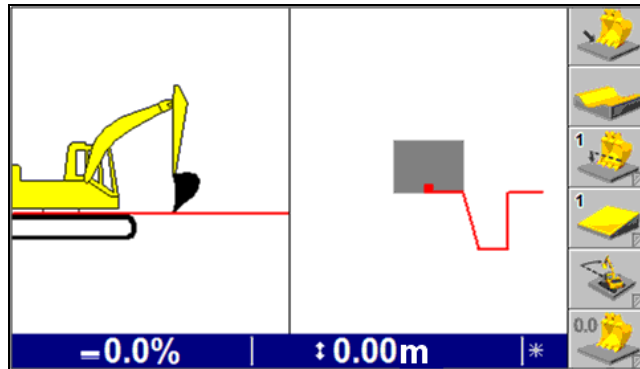
For more information, see [4.4.2 Depth and slope models](#).

When Cab Rotation Support or GNSS Receiver Support is enabled, the following additional ways of working with profiles are available:

- Square (perpendicular) to the benched alignment, for example working square to a trench.

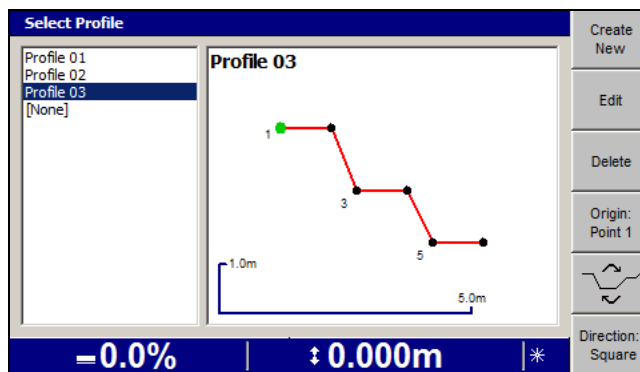


- Parallel to the benched alignment, for example working parallel to a trench.



Selecting a profile from memory

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

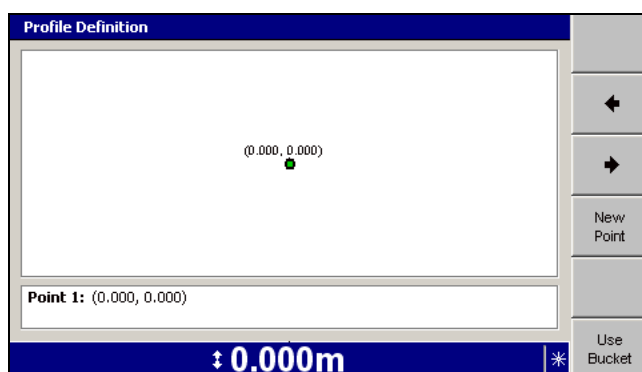


***Note** – You can also access Profile Memories by pressing **Select Profile** from the Guidance Method dialog.*

2. Press **Direction: Square** or **Direction: Parallel** to work with the profile either square to or parallel to the benched alignment.
3. Select the profile you require. The guidance screen re-appears, and the **Bench Elevation** flashing warning message is displayed. For information on benching, see [4.6 Establishing an elevation reference](#).

Creating a new profile

1. From any guidance screen, press **Profile**. The *Select Profile* dialog appears.
2. Press **Create New**. The *Profile Definition* dialog appears, with the point of origin of the profile displayed as a green point:

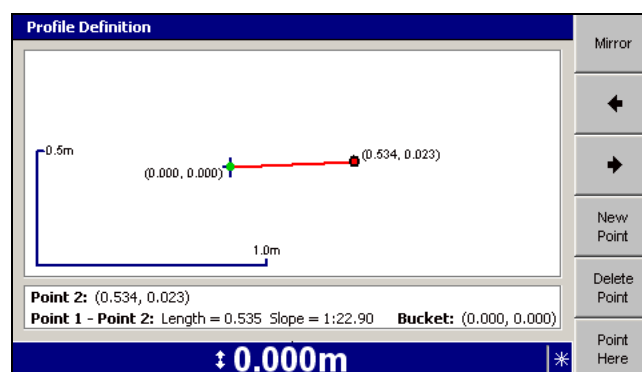


3. Use the following tools to create the new profile:

- Press **Use Bucket** to align the current position of the bucket focus to the origin of the profile. Move the bucket so that the bucket focus is at the origin of the profile you are creating, and press .

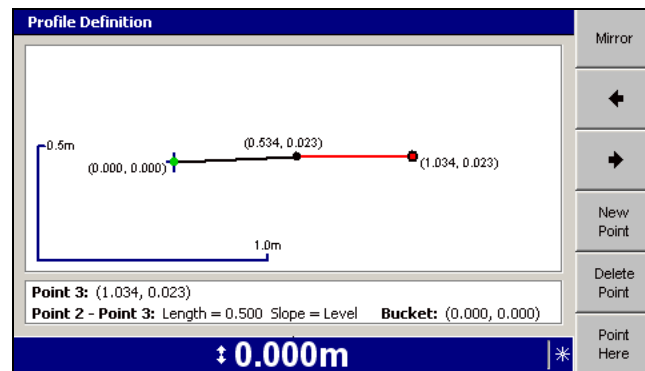
Cross hairs appear in the *Profile Definition* dialog's design pane, indicating the current position of the bucket relative to the origin, and the **Use Bucket** softkey is replaced with the **Point Here** softkey.

Once you have aligned the bucket focus with the origin (see previous tool), to add a line segment to the profile press **Point Here** at any time. A new point appears in the *Profile Definition* dialog's design pane at the current position of the bucket focus:



The new point defines a new line segment. Both the new point and the new line segment are displayed in red, indicating that the point has edit focus.

- To add a line segment to the profile, press **New Point**. A new point appears in the *Profile Definition* dialog's design pane:



Both the new point and the new line segment are displayed in red, indicating that the point has edit focus.

- Press the arrow keys on the control box to modify the position of the selected point.
 - Press  to move the edit focus forwards or  to move the edit focus backwards along the profile.
 - Press **Delete Point** to delete the point with edit focus.
4. When you have finished adding segments to the profile, press , to save the profile. The *Profile Name* dialog appears:

Note – The guidance model name must be unique on the control box. If a model of the same name already exists, you will be asked to choose a new name.

5. Do one of the following:
- Press  to accept the supplied name.
 - Edit the *Profile Name* field directly, and press . Profiles must have a unique name.

The *Select Profile* dialog re-appears with the name of the new profile highlighted in the profile list.

6. Press  to select the profile. The guidance screen re-appears.

Editing a profile

1. From the *Select Profile* dialog, select the profile to be edited.
2. Press **Edit**. The *Profile Definition* dialog appears, with the profile to be edited displayed.
3. Edit the profile, and save changes, using the tools described in [Creating a new profile](#), page 89.

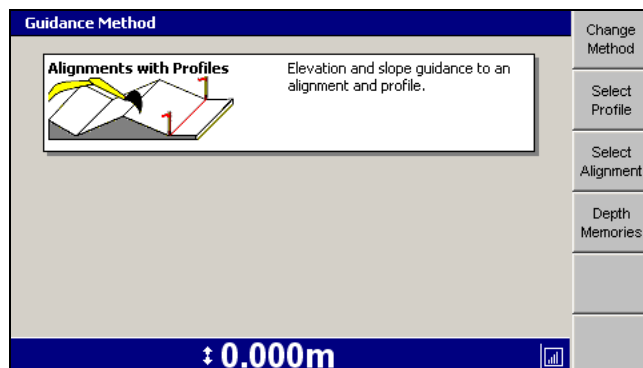
Deleting a profile

1. From the *Select Profile* dialog, select the profile to be deleted.
2. Press **Delete**.
3. To confirm the changes, press ; to exit without saving the changes, press .

4.4.5 Alignments with Profiles

Note – *Alignments with Profiles* is only available when *GNSS Receiver Support* is installed and configured.

Alignments are stored in alignment memory. This memory is only accessible when the *Alignments with Profiles* vertical guidance method has been selected.



Alignments with Profiles allows you to create an alignment in the field and then attach a profile at right angles to the alignment. For example, to dig a drainage-type ditch that does not go in a straight line.

In plan view on the control box the alignment is displayed as a red line with dots indicating where the stakes are located. The profile is attached to the alignment at its origin point.

Plan view displays stakes in the ground and the direction of slopes and alignments.

Workflow

This section provides a basic outline and description of the workflow when using alignments with profiles:

1. Place a new point on the design using the bucket tip.

The system saves the position of all stakes/points as these points define the alignment. This also means you can select different alignments and won't be required to re-position them on the ground as the system already knows where they are located as this was defined and saved when the Alignment was created.

2. Move the machine to a new location and place the bucket where the second point is to be located and press **New Point**.

Now that two points have been located using the bucket, you can record additional new points manually by using the **New Point** softkey and the control box arrow keys. The system also displays a scale bar, and cross-hairs to allow the point to be moved.

Use the arrow keys ( or ) to select points for editing if required. Each arrow key cycles through all the stakes and only moves in one direction at a time.

Use the control box arrow keys to move the position of the new point vertically in its current horizontal position. The red point moves with the cursor and the summary fields at the bottom of the dialog automatically update.

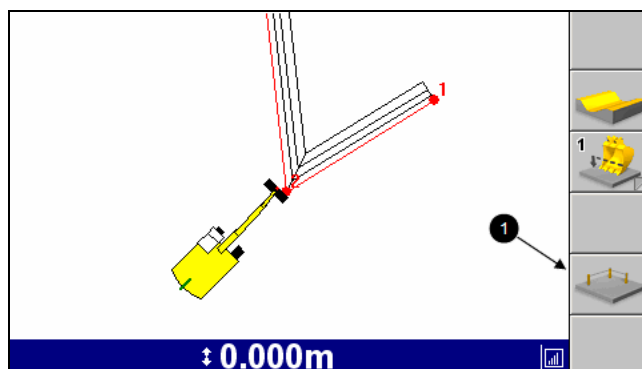
When displaying the alignment in profile view, the alignment unfolds in a straight line, and is always drawn unfolded from left to right on the screen. The summary at the bottom also displays the Slope distance, not the horizontal distance.

Note – **New Point** is not available in profile view as adding new points to the alignment has to be done using plan view.

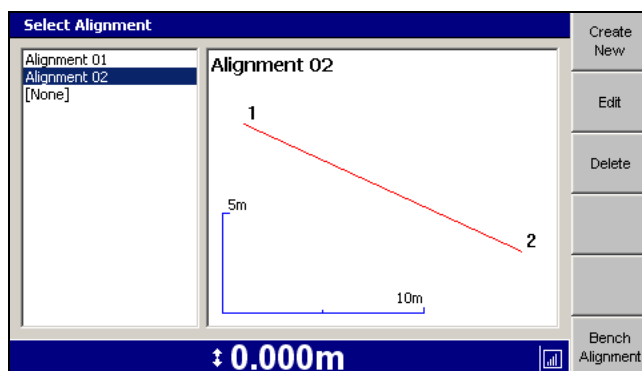
3. To edit an alignment press **Edit Point**. When in Edit mode you can:
 - delete the active point
 - reposition the active point using the control box arrow keys
 - reposition the active point using the **Point Here** softkey
 - change between plan view and profile view (and stay in the edit dialog)
 - use the 'Join' function to bypass points and have easy control of the slope between points along the alignment
4. When the cross-hairs are in the correct location press  to save the point.

Selecting an alignment from memory

1. From any guidance screen, press **Alignment** (1).



2. Select the alignment you require and press  to continue.

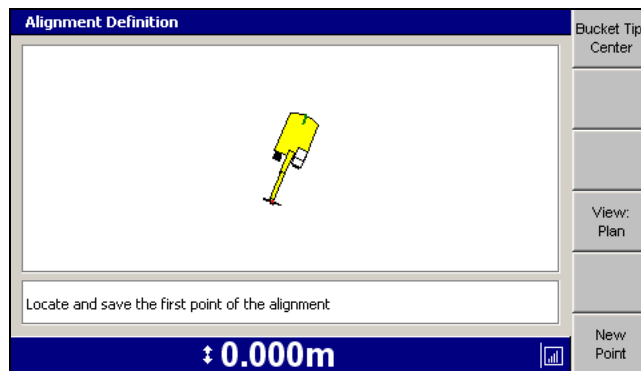


The guidance screen re-appears, and the **Rotate Machine** flashing warning message is displayed.

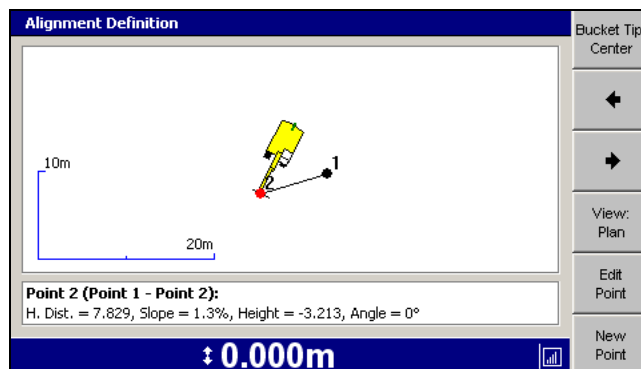
3. Rotate the machine to clear the flashing message.

Creating a new alignment

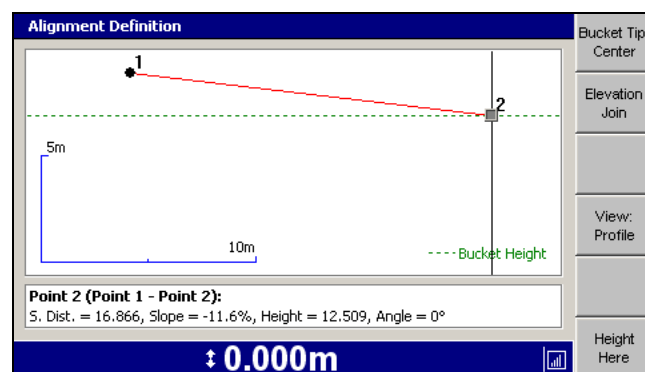
1. From any guidance screen, press **Alignment**. The *Select Alignment* dialog appears.
2. Press **Create New**. The *Alignment Definition* dialog appears:



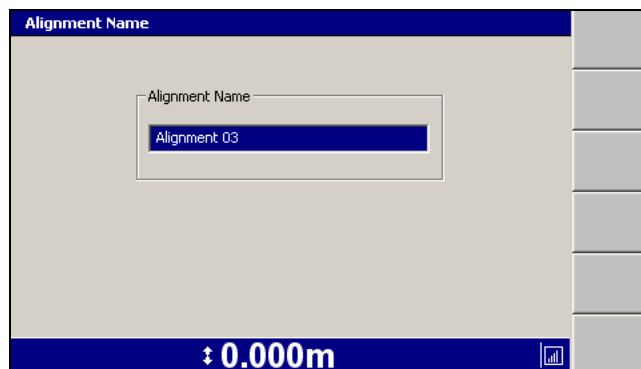
3. Move the excavator to the required alignment point and press **New Point** to save the first point of the alignment.
4. Move the excavator to the next alignment point and press **New Point** to save the second point of the alignment.



- To change the bucket tip focus, press **Bucket Tip: <value>**.
- To select a different alignment point, press  or .
- To change the view, press **View: Profile** or **View: Plan**. An example of Profile View is shown below.



- To edit the alignment press **Edit Point**. For more information, see [Editing an alignment](#)
5. When you have finished adding segments to the alignment, press  to save. The *Alignment Name* dialog appears:



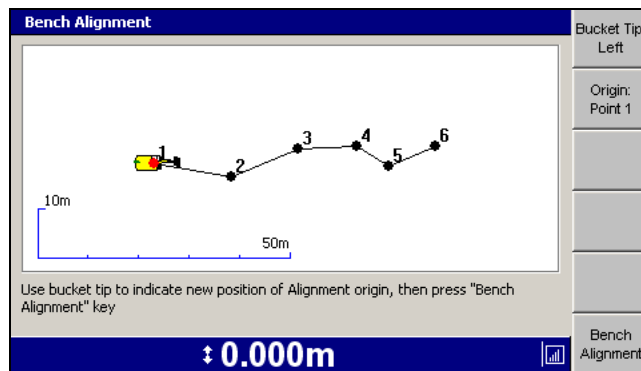
Note – The guidance model name must be unique on the control box. If a model of the same name already exists, you will be asked to choose a new name.

6. Do one of the following:
- Press  to accept the supplied name.
 - Edit the *Alignment Name* field directly. Each alignment must have a unique name.
- The *Select Alignment* dialog re-appears with the name of the new alignment highlighted.
7. Press  to select the alignment. The guidance screen re-appears.

Benching an alignment

Note – If you are getting GNSS corrections from VRS or IBSS, or a local base station that has not moved, you would not need to bench the alignment. Only use this option to reposition an alignment if you cannot set-up your base station in the same position as it was used last time.

1. Press **Alignment** and select the alignment for benching.
2. Press **Bench Alignment**. A dialog similar to the following appears.



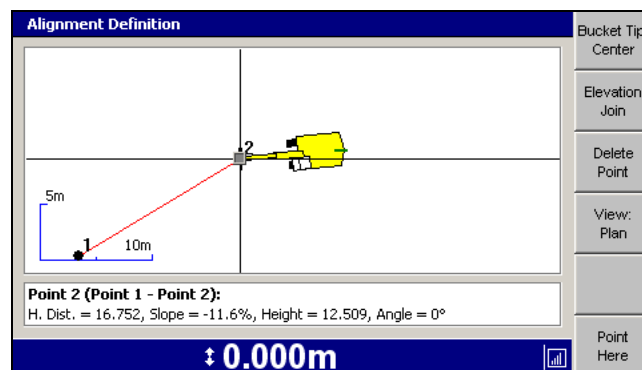
- To change the bucket tip focus, press **Bucket Tip: <value>**.
 - To change the origin, press **Origin: Point <value>**.
3. Use the bucket tip to indicate a new position of alignment origin, then press **Bench Alignment** again.

***Note** – When benching an alignment, you may be limited in your ability to use the bucket by the distance between points.*

Editing an alignment

1. From the *Select Alignment* dialog, select the alignment to be edited.
2. Use the arrow keys to select the point that you want to edit in the alignment, indicated by a red dot, and press **Edit**.
3. Press **Edit Point**. Cross hairs appear in the *Alignment Definition* dialog's design pane, indicating the current alignment point.

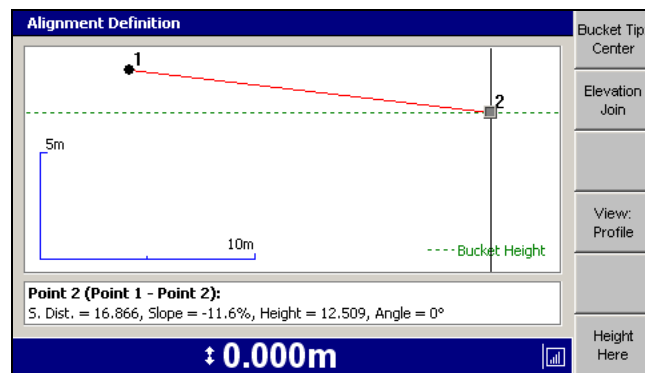
The following dialog shows an example of **Edit Point** in plan view:



To use the bucket tip to define a new point, position the bucket and press **Point Here**. The summary text shows the:

- Horizontal distance between the two points
- Slope between the two points
- Height difference between the two points
- Angle between the two stakes:
 - the angle between two points is always 0°
 - the angle between three points (2 lines) is always the internal (smallest) angle

The following dialog shows an example of **Edit Point** in profile view:



To use the bucket tip to define a new point, position the bucket and press **Height Here**. The summary text shows the:

- Slope distance between the two points
- Other definitions are the same as in plan view

Elevation Join

To edit the heights of multiple points in an alignment, press **Elevation Join**. This allows you to define a constant grade through the selected points. The currently selected point is shown as a green dot. To select a different point press  or . The new point is shown as a red dot. Press  to accept the new point.

Move the current point

To move the current point, use the arrows on the control box.

- To change views, press **View: Plan** or **View: Profile**.
- Use Plan View when you need to move the position horizontally.

- Use Profile View when you need to move a point vertically.

Delete an alignment point

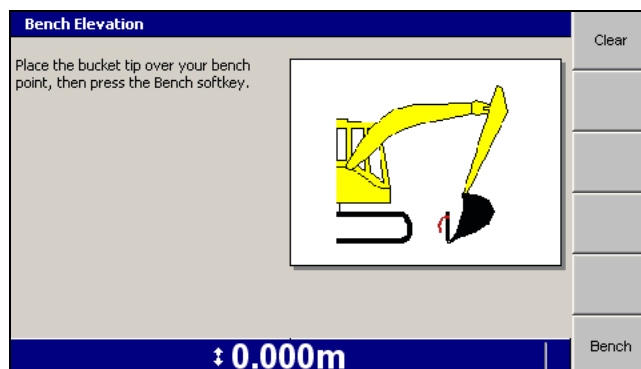
To delete the current alignment point, press **Delete Point**.

Deleting an alignment

1. From the *Select Alignment* dialog, select the alignment to be deleted.
2. Press **Delete**.
3. To confirm the changes, press ; to exit without saving the changes, press .

4.5 Benching the elevation

- To bench the system using the current bucket elevation press **Bench Elevation**.
- To clear an existing bench or to bench the system on a new bucket position, press and hold **Bench Elevation**.



- To clear the existing bench press **Clear**.
- To bench the system on a new bucket position, place the bucket tip over your bench point and press **Bench**.

4.6 Establishing an elevation reference

Before you begin working, or whenever you move the machine to a new working position, you must establish, or re-establish, your elevation reference. All depths are relative to this reference, and all slopes and profiles have their origins at this point.

Until you establish a reference elevation, no guidance information is available, and the **Bench Elevation** flashing warning message is displayed.

The system provides two methods for establishing an elevation reference:

- By benching using the elevation of the bucket focus as the reference.
- By using the elevation of a laser plane as the reference.

If using a cab rotation sensor, you must bench the rotation before you bench the elevation. To bench the cab rotation sensor, see [Bench rotation](#), page 86.

***Note** – The availability of a particular elevation reference will depend on the site infrastructure and the vertical guidance method chosen.*

4.6.1 Using the bucket focus as the reference elevation

To bench the system using the elevation of the bucket focus as the reference elevation:

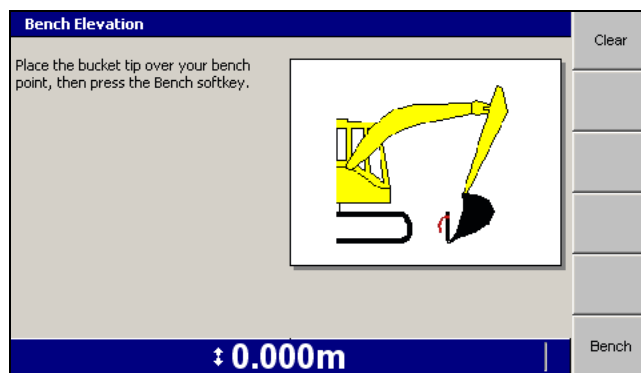
1. Place the machine in a convenient location to work the surface. If using a profile or a slope, orient the machine with the arm parallel to the long section of the profile, or parallel to the mainfall of the slope.



ATTENTION — Benching with the tilt bucket warning indicator  displayed may give poor results.

2. If using a profile, check the orientation and origin of the profile:
 - Press **Profile** to open the *Select Profile* dialog.
 - Press **Flip Profile** to reflect the profile about its vertical axis.
 - Press **Origin: Point <value>** as often as required to select a different point on the profile as the origin. This point will be at the bucket tip after benching.

These tools are useful if, for example, you want to work the surface from the opposite side.
3. Place the bucket focus on the benchmark, or at the location you want to make the origin of the profile, and press **Bench Elevation**. The bench elevation is accepted as the reference elevation, and all depths will be relative to the bench point.
4. If you have previously benched the system, press and hold **Bench Elevation** to open the *Bench Elevation* dialog.



- To clear the existing bench, press **Clear**.
- Press **Bench** to bench the system relative to the bucket tip.

4.6.2 Using a laser plane as the reference elevation

Note – This feature is not available with profiles.

If you have a depth model selected, check with your site supervisor to make sure the laser plane is level.

If you have a depth and slope model selected, check with your site supervisor to make sure the laser plane has been set up so that the:

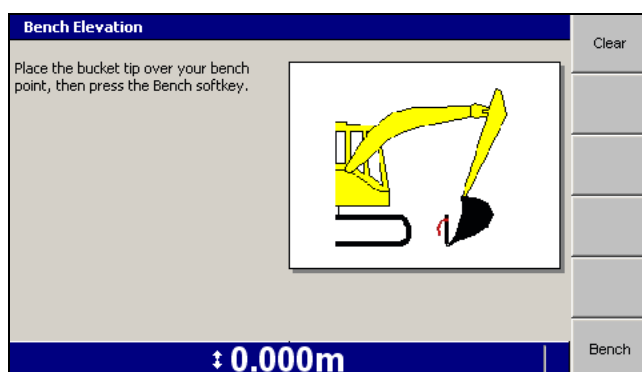
- Slope of the laser plane is parallel to the mainfall of the surface
- Slope is the same as the slope used on the machine (for example, if the machine slope is 15% the laser grade must also be 15%)



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.

To use a laser plane as the reference elevation:

1. Place the machine in a convenient location to work the surface. If using a slope model, orient the machine with the arm parallel to the mainfall of the slope.
2. If you have previously benched the system, press and hold **Bench Elevation** to open the *Bench Elevation* dialog.



To clear the existing bench, press **Clear**.

***Note** – If you do not clear the benching information, then the system will continue to use the bench elevation as the reference elevation, rather than the elevation of the laser plane.*

3. Raise the boom so that the laser lightbar indicates that the laser catcher is receiving laser strikes. The laser catcher must be reasonably steady in the laser plane. Once the system has detected valid strikes, the **Laser** softkey appears.

***Note** – The **Laser** softkey is displayed while the laser catcher is receiving laser strikes. The system stores the position of the arm at the time valid strikes were detected, and if strikes are lost, the arm position is retained for three seconds (3 s.). During this period the **Laser** softkey continues to be displayed, and can be pressed to accept the valid strike elevation.*

4. Press **Laser**. The laser strike elevation is accepted as the reference elevation, and all depths will be relative to the laser plane.

4.7 Working with 2D guidance

***Note** – This section does **NOT** apply to systems with GNSS Receiver Support enabled.*

Common tasks that you must perform when working with 2D guidance are shown below:

Task	When	To learn how, see ...
Carry bench data as you move around the site	Whenever you need to change the position of the machine after benching.	4.7.1 Transferring a benchmark reference elevation
Measure site features	Whenever you need to measure site features or store the slope of a site feature in a Slope Memory.	4.7.2 Using the bucket position to measure site features

4.7.1 Transferring a benchmark reference elevation

As you work you will typically move the machine, so you must re-bench the system after moving. If your original reference elevation was a benchmark, a move to a new working position may mean you are unable to reach the benchmark and still have the cab in the correct orientation for benching. In this case, you need to transfer the bench elevation with you as you move.

The system provides two methods for transferring a benchmark reference elevation around the site:

- Using a laser plane
- Using Touch Point

The choice of method will depend on:

- The type of surface model you are working
- How you are working with the surface model
- The sensors and site infrastructure you have available

Using a laser plane

If you have a depth model selected, check with your site supervisor to make sure the laser plane is level.

If you have a depth and slope or profile model selected, check with your site supervisor to make sure the laser plane has been set up so that the:

- Slope of the laser plane is parallel to the mainfall of the surface
- Slope is the same as the slope used on the machine (for example, if the machine slope is 15% the laser grade must also be 15%)

Using a laser plane is the most flexible method for transferring the benchmark elevation. You can use a laser elevation reference for all surface model types. However you do need a laser catcher installed and enabled on your machine, and a laser transmitter set up correctly to provide the laser plane.



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.

To use a laser plane to transfer a benchmark elevation:

1. Before you move the machine from the location in which it was benched, and with the cab in the “as benched” orientation, raise the boom and curl the stick

so that the laser catcher is vertical and receiving laser strikes. The laser light bar indicates that strikes are being received. The laser catcher must be reasonably steady in the laser plane. Once the system has detected valid strikes, the **Laser** softkey appears.

***Note** – The **Laser** softkey is only displayed while the laser catcher is receiving laser strikes. The system stores the position of the arm at the time valid strikes were detected, and if strikes are lost, the arm position is retained for three seconds (3 s.). During this period the **Laser** softkey continues to be displayed and can be pressed to accept the valid strike elevation.*

2. Press **Laser**. The laser strike elevation is accepted as a reference.
3. Move the machine to the new working location, and rotate the cab into the correct orientation for benching.
4. Again, raise the boom and accept the laser strike elevation, as described in step 1 and step 2. The system is now benching against the original benchmark elevation.
5. Repeat step 4 every time you move the machine.

Using Touch Point



ATTENTION — The Touch Point feature can be used with depth and slope models, however the common point must be chosen so that the machine will be in its “as benching” orientation when the Touch Point feature is used.

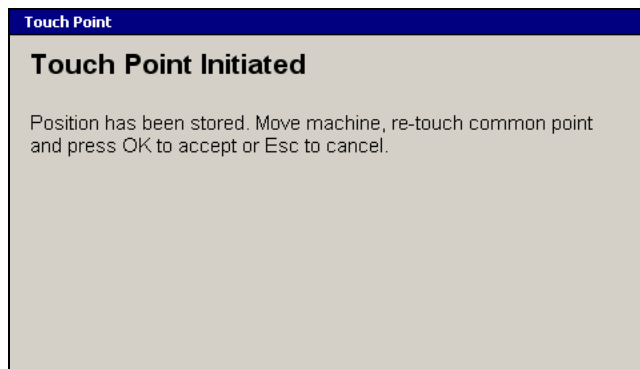
The Touch Point feature allows you to transfer the bench elevation simply by touching the bucket on a point easily accessible from both your original position and your new position. Using the Touch Point feature to transfer a bench elevation requires no additional site infrastructure, and is an easy way to transfer the bench elevation when working with depth models.

To use the Touch Point feature to transfer a benchmark elevation:



ATTENTION — Initiating Touch Point with the tilt bucket warning indicator  displayed may give poor results.

1. Before you move the machine from the location in which it was benching, touch the bucket focus to any easily identifiable point that can be reached from both your current, and your new, working positions. Press **Touch Point**. The *Touch Point* dialog appears:



2. Move the machine to the new working position, touch the focus of the bucket to the point you touched previously (the common point), and press . The system is now benched against the original benchmark elevation. The guidance screen re-appears.
3. Repeat step 1 and step 2 every time you move the machine.

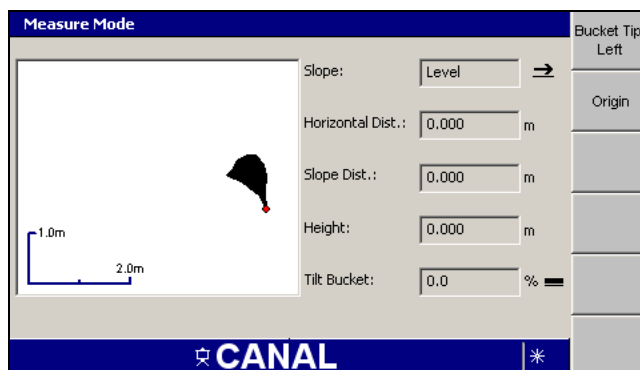
4.7.2 Using the bucket position to measure site features

The system lets you determine differences in reach and elevation, and calculate slope distances and slopes between points, by moving the arm and bucket. The calculated slope between two points can be saved into the slope memories.

Note – The measurement is taken to the tip of the bucket that has focus.

To measure between two points:

1. From any guidance screen, press .
2. Select *Measure Mode*.

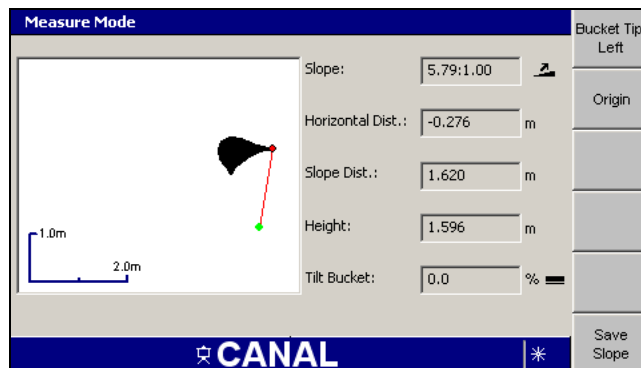


3. Check that the correct position for the bucket focus point has been selected. If required, press **Bucket Tip: <value>** to cycle through the focus point positions.

Note – If you change the bucket focus during the measurement procedure you will clear the stored origin position.

4. Move the focused bucket tip to the starting point of the measurement, and press **Origin**.
5. Without rotating or moving the machine, move the bucket focus to the end point of the measurement.

As shown below, once the bucket has moved enough to give a measurable change in position, the display changes to show the start point as a green mark and the current position of the bucket focus as a red mark on the bucket icon. In addition, a straight red line is drawn between the start and end points, and the **Save Slope** softkey appears.



6. With the focused bucket tip at the end point, record the measured values displayed. If required, press **Save Slope** to save the measured value of the slope into a slope memory. The slope is automatically assigned the next available name.
7. To exit, press  or .

Note – If you saved the slope value to a slope memory, and exit from the Measure Mode dialog by pressing , the slope value will still be held in memory.

8. If you had a slope selected for your model, and you saved the measured slope to memory, the new slope will be automatically selected for use in the model.

Using 3D Guidance in the Field

In this chapter:

- Introduction
- Preparing 3D sensors
- Checking 3D cutting edge guidance
- Loading or creating a design
- Lane guidance
- Working with 3D guidance

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 bucket focus on this surface. The system then calculates the difference between the bucket focus 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	5.2.8 Starting the UTS system
Start UTS positioning	When you need to use UTS position information for guidance	5.2.8 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	5.2.1 Benching a UTS target
Set UTS accuracy requirements	When you are having problems establishing a UTS system's orientation	5.2.2 Setting the UTS accuracy level
Initialize machine orientation	Every time you change the location of the machine	5.2.3 Initializing single-3D excavator orientation

Note – In this manual the term GNSS refers 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 ...
Initialize a GNSS system's direction and pitch	Every time you turn on the system, when a machine using a GNSS system has been moved with the system turned off	5.5.6 Re-initializing orientation after moving the machine

Task	When	To learn how, see ...
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
Initialize machine orientation	Every time you change the location of the machine	5.2.3 Initializing single-3D excavator orientation

5.2.1 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.

<i>Height from</i> 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.

If the *Height from* field displays “No heights”, you must bench the UTS target before you can use the UTS system.

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.

2. Enter the elevation of the benchmark into the *Bucket elevation* field.
3. Position the bucket on or beside the benchmark.
4. Depending on the part of the bucket you are using to reference the bench mark, press either **Bench Center**, **Bench Left**, or **Bench Right** to begin benching.

When benching finishes, the *Setup Menu – Configuration* menu appears.

5.2.2 Setting the UTS accuracy level

The system provides an interface that enables you to change the accuracy of the UTS data it uses to estimate the machine's orientation. Occasionally it may be difficult to get an orientation estimate, if, for example, the UTS instrument is operating at the limit of its range, or if the machine is rocking a lot. In these cases, if the system does not require high accuracy guidance information, you can relax the accuracy of the UTS data used to estimate orientation.

To adjust the accuracy of the UTS data required for an orientation estimate:

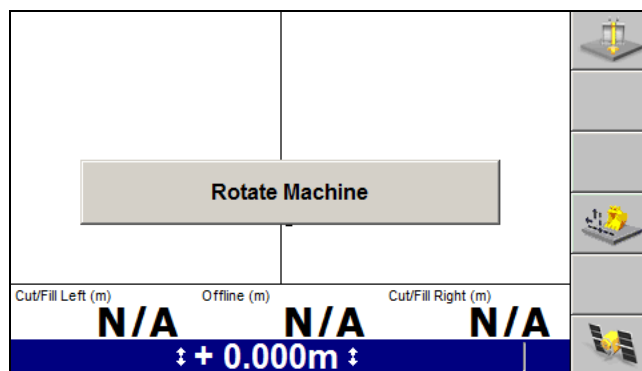
1. From any guidance screen, press .
2. Select *UTS Accuracy*.

Note – The UTS data generated when the machine's body swings is used to determine the machine's center of rotation. This information is used to estimate the machine's orientation.

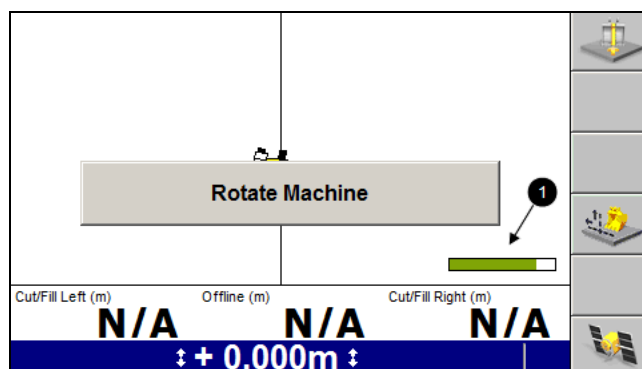
3. Highlight the appropriate accuracy level for your job.
4. To confirm the settings, press ; to exit without saving the changes, press .

5.2.3 Initializing single-3D excavator orientation

You must initialize the orientation of a single-3D machine when a single-3D system is first started, or when a single-3D machine is moved more than a very short distance. Until the machine orientation is initialized, guidance is not available and the following flashing warning message will be displayed:



To initialize the machine's orientation, without moving the tracks swing the machine's upper body in one direction. As the body begins to swing, a progress bar (1) displays, as shown in the following image.



As the initialization progresses, the bar's fill extends, and the fill color shades to green. The amount of rotation required to initialize the machine's orientation depends on the GNSS or UTS accuracy settings. The more GNSS or UTS accuracy required, the further you have to swing the cab.

***Note** – The estimated orientation of the machine is continually re-calculated, and as you swing the body while working, the orientation estimate improves.*

If the progress bar disappears and the **Rotate Machine** message flashes, then the initialization has failed. If the initialization fails, repeat the initialization procedure.

5.2.4 GNSS base configuration

If you are using relative corrections, both local and remote GNSS bases can be configured from the *GNSS Base Configuration* dialog.

***Note** – Changing between correction sources is not recommended as it may cause your position to shift. A warning message will be displayed if correction sources are changed to help prevent unwanted corrections being used.*

To open the *GNSS Base Configuration* dialog:

1. From the *Setup Menu – Installation* menu, select *Connectivity Settings*.
2. Press the up or down arrow keys on the control box to select *GNSS Base Configuration* and press .

The list of GNSS bases are displayed.

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*.

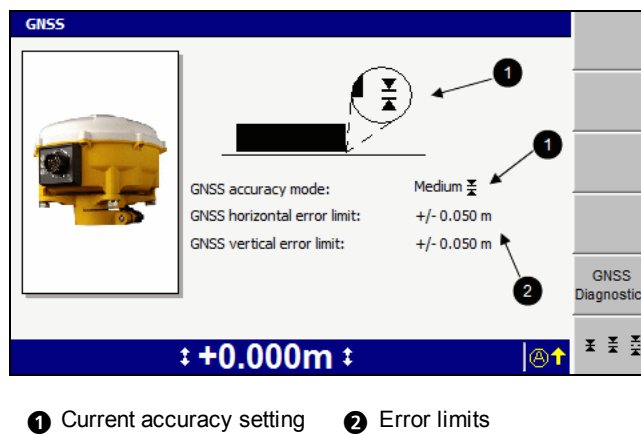


Figure 5.1 GNSS accuracy mode dialog

3. To swap between fine, medium, and coarse accuracy modes, press .

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 view left and right receiver, data link, and Sky Plot diagnostics, press **GNSS Diagnostics** to open the *GNSS diagnostics* dialog.
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 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 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:
 - With the arm within its normal working range of movement, place the bucket focus on the ground and then mark its position with paint. Remove the bucket. Use a total station or GNSS rover to measure the marked position of the bucket focus.
 - Position the body of the excavator so that when the bucket focus is placed on the control point, the arm is within its normal working range of movement. Position the bucket focus on 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.

A possible problem that can occur with excavator guidance is:

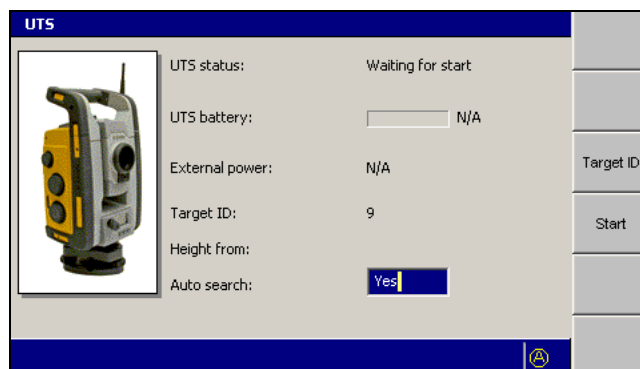
Problem	Action
Poor guidance	Possible causes are: • The orientation of one or more arm position sensors is not configured correctly. Ask your site supervisor to check the AS45x orientations. • The wrong bucket model has been selected for the bucket you are using. • incorrect machine measurements • incorrect calibrations • incorrect coordinate system loaded in the GNSS receiver (s)

5.2.8 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**.



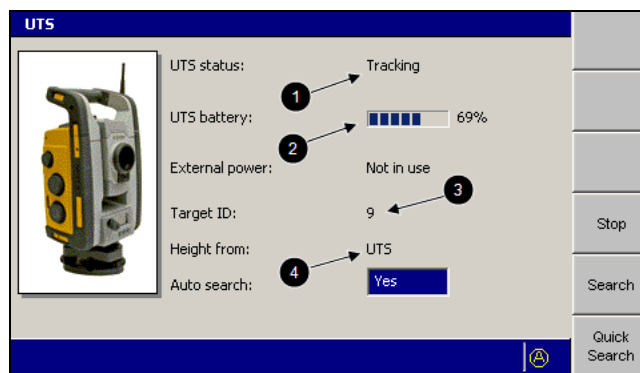
2. To set the target ID:

- 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.
3. 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 [5.5.5 Reacquiring UTS lock](#), to reacquire lock.
4. 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:



- ❶ UTS instrument status ❷ Battery charge
 ❸ Machine target ID ❹ Elevation exists on UTS instrument

Figure 5.2 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.

5. 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 <i>UTS</i> 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.

5.3 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.

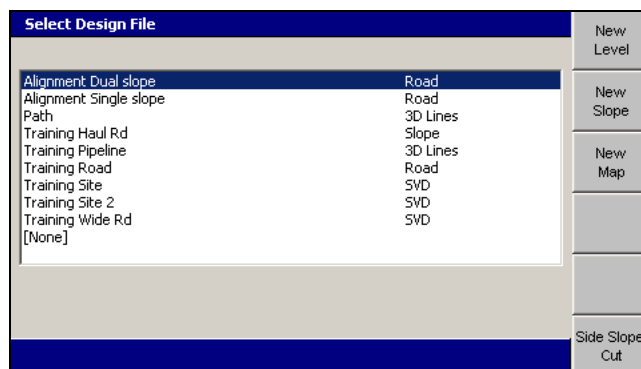
5.3.1 Loading a design

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*.

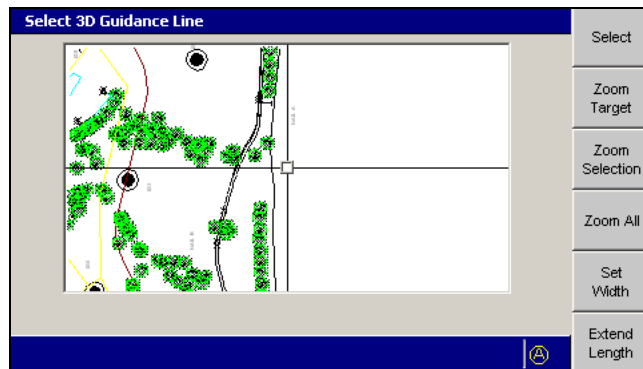


2. Highlight the design you want to load.
3. If the design you highlighted is a road design with sideslopes defined, make sure that the **Side Slope: <value>** displays either **Cut** or **Fill**:
 - Cut, if you are cutting down to the design surface.
 - Fill, if you are filling up to the design surface.
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 cross-hairs is selected. The selected 3D line appears as a thick red line.

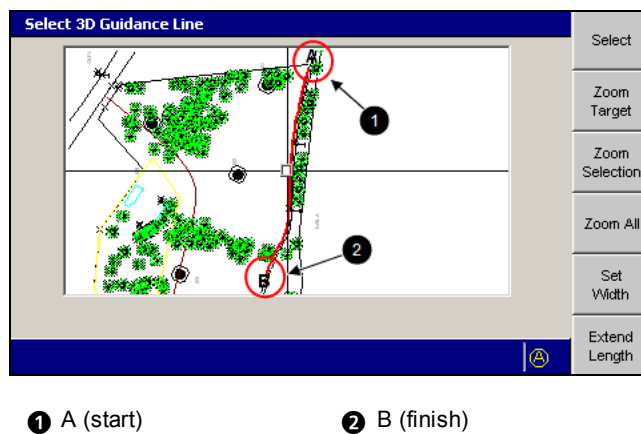
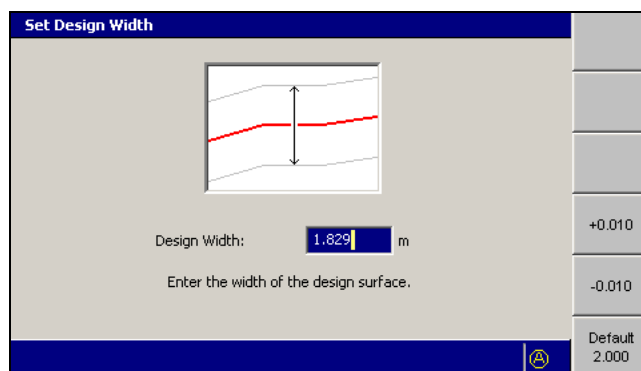


Figure 5.3 Selected 3D line

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 .

5.3.2 Creating a design

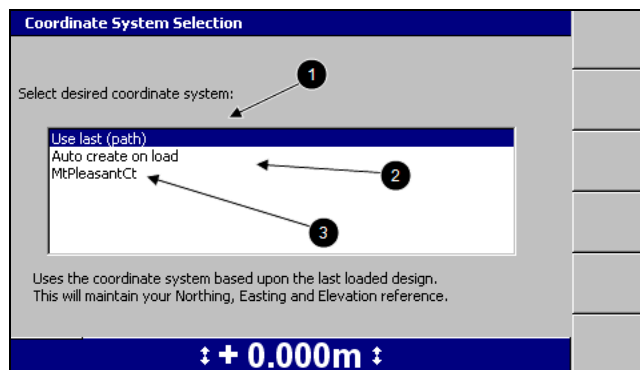
There are two simple design surfaces you can create in the field:

- Level designs
- Sloping designs

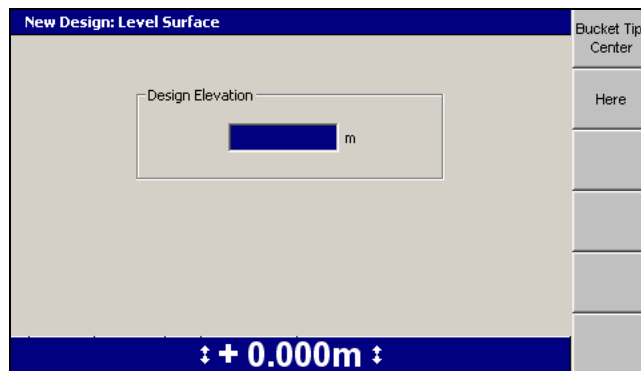
Creating a level design surface

To create a level surface design file:

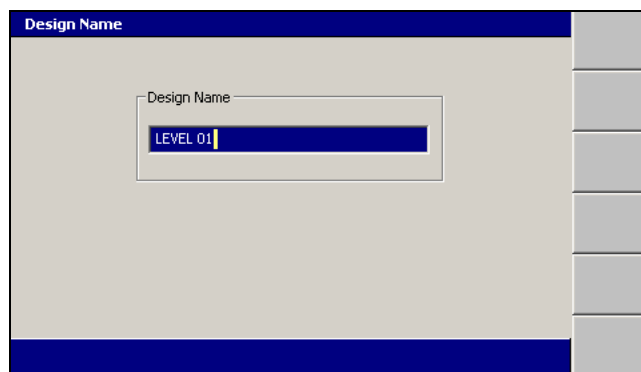
1. From the *Select Design File* dialog, press **New Level**, **New Slope**, or **New Map**.



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 **Bucket Tip: Left**, **Bucket Tip: Center**, or **Bucket Tip: 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

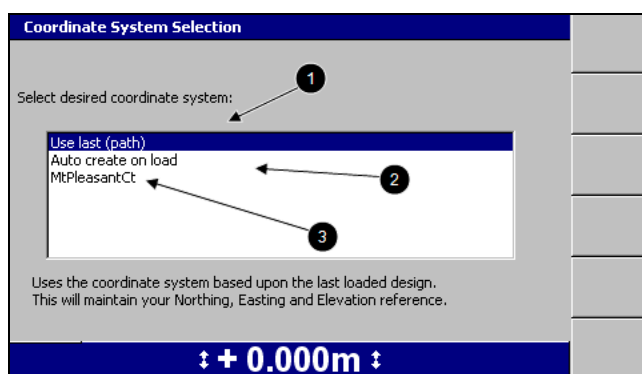


WARNING — If you create a ramp or other work platform that is too steep, machines and vehicles using the ramp or platform could become difficult to control. This could result in harm to the operator, to others, or damage to the machine. To ensure your safety and the safety of others, find out what the 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:
 - **1**: To use the same coordinate system as the last loaded design, select *Use last (<name>)*. This option maintains your Northing, Easting and Elevation reference.
 - **2**: 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.
 - **3**: 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 **Bucket Tip: Left**, **Bucket Tip: Right**, or **Bucket Tip: Center**.
2. Press **Point 2**. Use the procedure outlined in step 1 to specify Point 2.



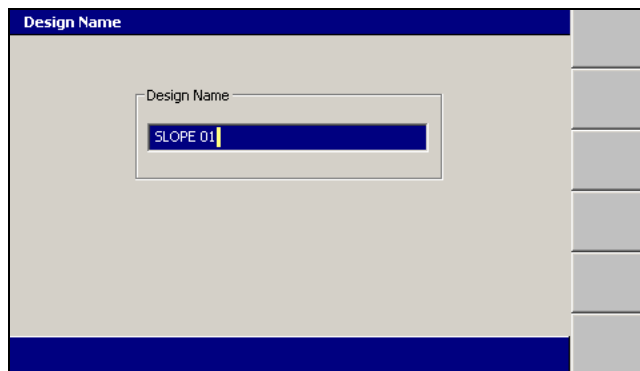
Tip – When both points are entered, the system calculates the direction and grade values. To view the calculated values, press **Method: 2 Points**.

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 **Bucket Tip: Left**, **Bucket Tip: Right**, or **Bucket Tip: Center**.
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 .



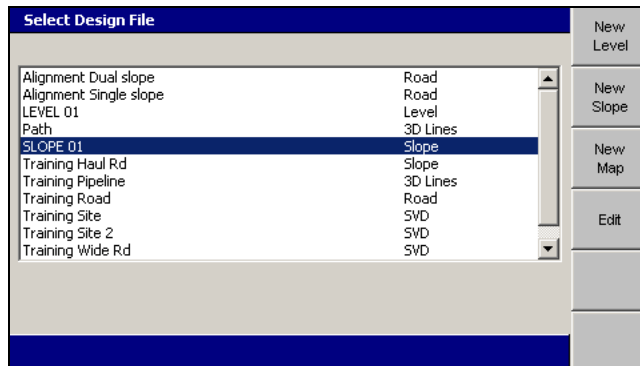
The system gives the design a default name.

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, see [Creating a level design surface, page 122](#).
 - To modify a sloping design, see [Creating a sloping design surface, page 124](#).

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

Design creation problems

Some common design creation problems 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.

5.4 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.

5.4.1 Troubleshooting lane guidance

Problems that may occur when setting up and using lane guidance:

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.
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.

Problem	Solution
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)

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.

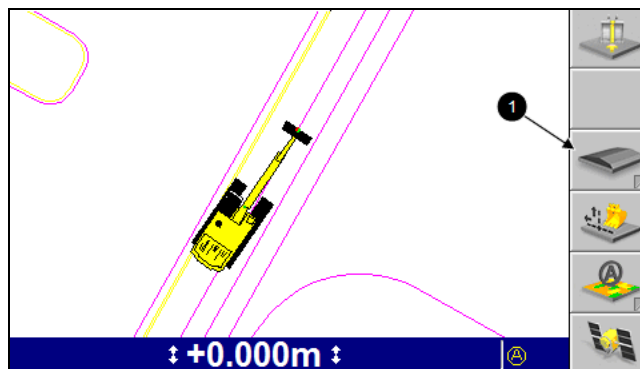


Tip – After de-selecting a lane and moving the machine to an area of the design where the guidance focus is no longer in the same lane, when you press **Select Lane** again a different lane will be selected.

- 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.

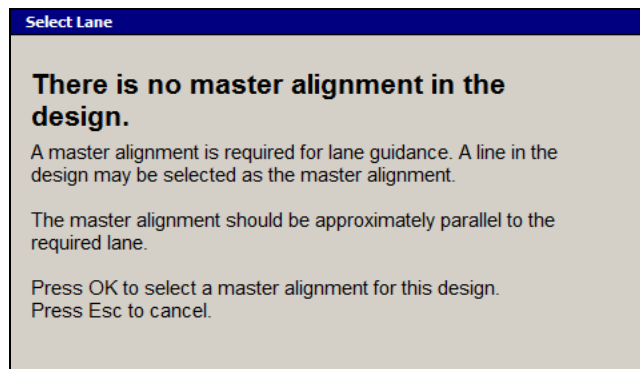
To configure lane guidance and select a lane:

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

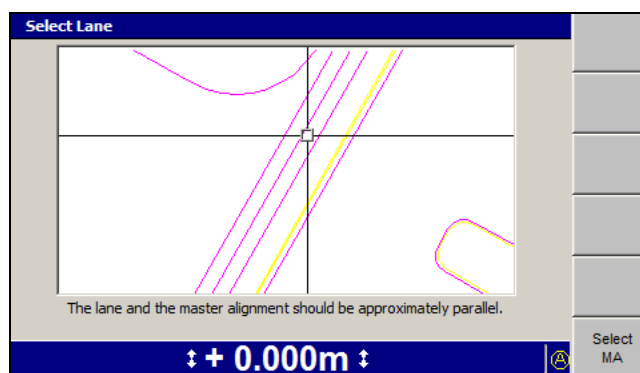


Or from the *Setup Menu – Configuration* menu, select *Select Lane*.

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

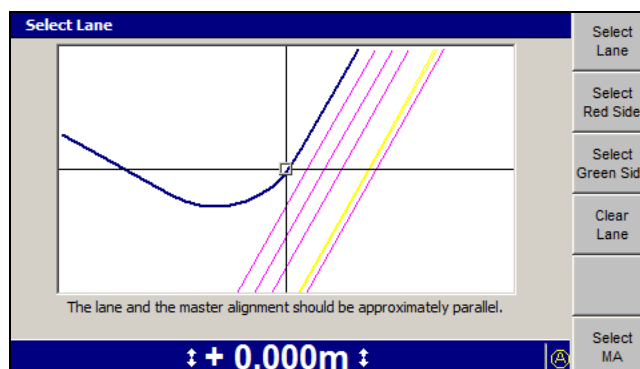


Press  to continue.



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

- 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:
 - 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.

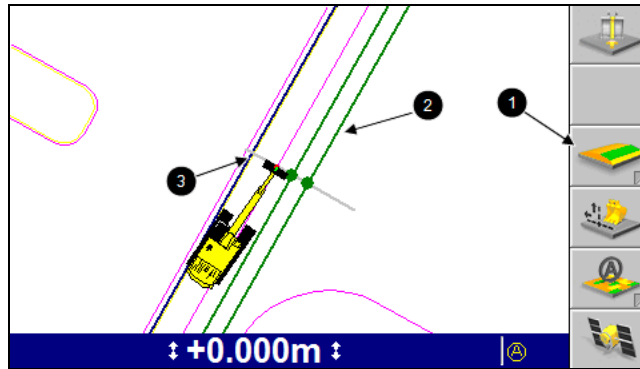
8. To confirm the settings, press ; to exit without saving changes, press .

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 Working with 3D guidance

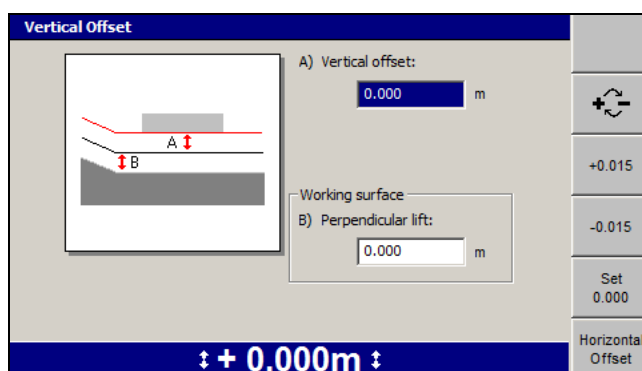
Common tasks that you may perform while you work with 3D guidance methods are:

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.	5.5.1 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.	5.5.9 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.	5.5.2 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.	5.5.3 Setting horizontal offset
Re-initialize machine orientation	Every time you move a single-3D sensor excavator.	5.5.6 Re-initializing orientation after moving the machine
Clear a UTS benching value	When you want to use the measured elevation of the UTS instrument in the guidance calculations.	5.5.7 Clearing the UTS benched elevation

5.5.1 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 27.

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 [5.5.3 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 <i>Select Design File</i> 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.

5.5.2 Selecting focus for horizontal guidance

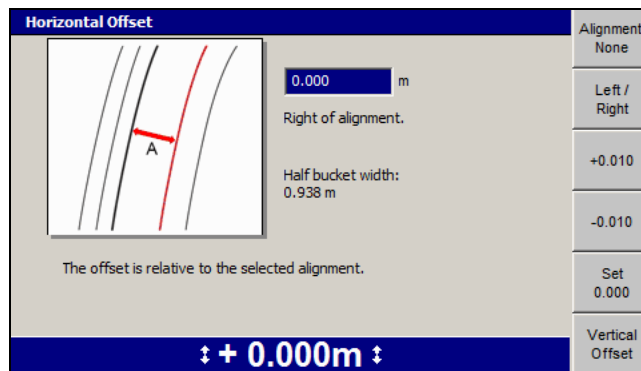
To set or change the focus that is given horizontal guidance:

1. If you have not already done so, select an alignment as described in [5.5.9 Selecting horizontal alignment](#). Until an alignment is specified, no horizontal guidance is given.
2. To change the focus point, press either **Bucket: Left**, **Bucket: Center**, or **Bucket: Right**.

5.5.3 Setting horizontal offset

1. If you have not already done so, select an alignment as described in [5.5.9 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 27.

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 [5.5.1 Setting the working surface lift and/or vertical offset](#).
5. To confirm the settings, press ; to exit without saving changes, press .

5.5.4 3D remote switch support

The system supports use of a remote switch to:

- Set map recording to on, off or auto.
- Record a point.

The remote switch is used to set the currently configured map recording function. It emulates the current function of the **Map Recording: <value>** softkey, when **Value** = **On** or **Off** or **Auto**.

Note – *The exception to this functionality is when the current map recording function is Record Point. In this instance, every time the operator presses the remote switch, the current point is stored. For more information, see [6.6 Point recording](#).*

5.5.5 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 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**.

5.5.6 Re-initializing orientation after moving the machine

After moving the machine you must re-initialize the orientation of the machine. For more information, see [5.2.3 Initializing single-3D excavator orientation](#).

5.5.7 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.*

2. Press **Clear Bench**.

***Note** – If the UTS instrument did not have an initial elevation, clearing the benching data stops guidance.*

5.5.8 Turning off UTS guidance

Before you turn off the system, turn off UTS guidance:

1. From any guidance screen, press **UTS**.
2. 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.

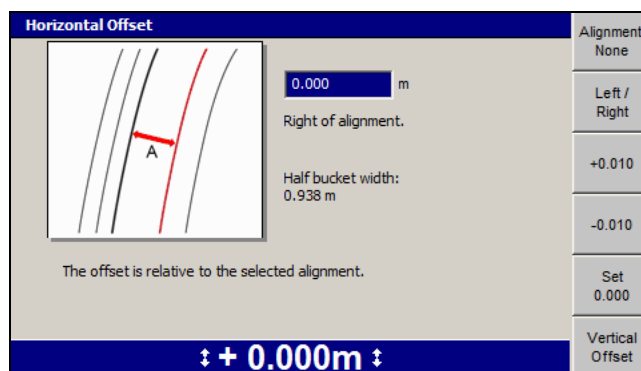
5.5.9 Selecting horizontal alignment

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

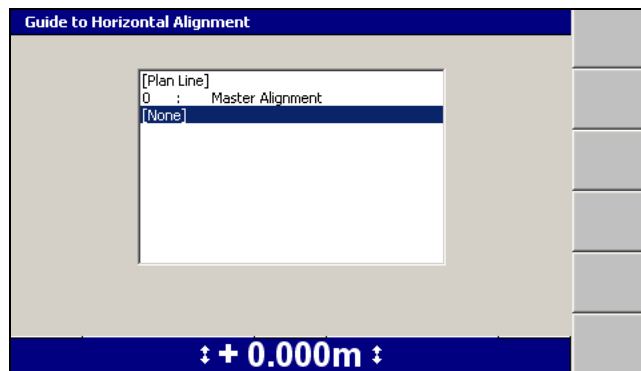
- If the only possible alignments in the loaded design are Site Map or Background Plan features, the *Guide to Horizontal Alignment* dialog is skipped, and the graphical selection screen appears.
- If you require guidance to side slopes in a road design.

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 27.



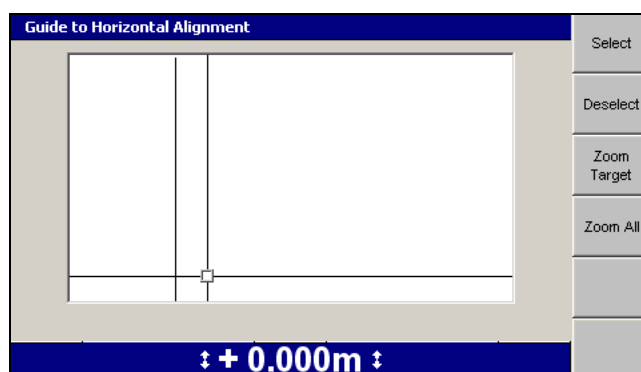
2. Press **Vertical Offset**. See [5.5.1 Setting the working surface lift and/or vertical offset](#).
3. Press **Alignment: <value>**. The following example shows the choices available in a .dc road design:



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	<i>[Auto Select Road Alignment]</i>
A layered lift alignment in a .dc road design	One of the <i>Layered Lift Alignment</i> options
A dynamic layered lift alignment in a .dc road design	One of the <i>Dynamic Lift Alignment</i> options
The master alignment in a sloping surface design	<i>Master Alignment</i>
The design boundary or linework in the Site Map or Background Plan	<i>[Plan Line]</i>
No alignment	<i>[None]</i>

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 119](#).

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.

Using Mapping/Recording in the Field

In this chapter:

- Automatic mapping
- Loading or creating a map
- Configuring Mapping/Recording
- Using Mapping/Recording
- Minimum height mapping
- Point recording

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

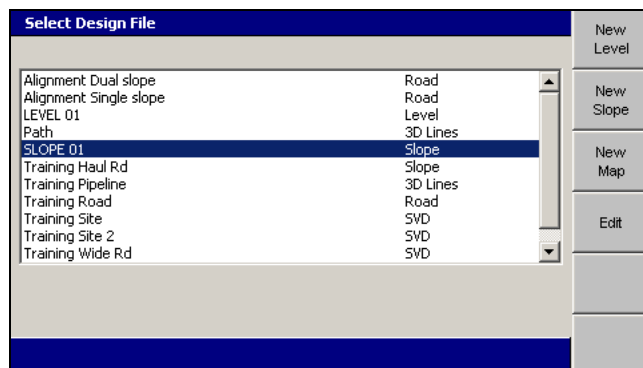
The following conditions can be combined to control mapping:

- 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.
- Bucket 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.
 - 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*.



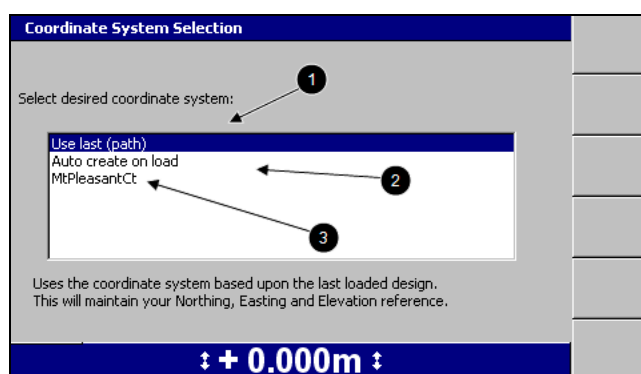
6.2.1 Loading a map file

To load an existing map file, follow the steps in [Loading a design, page 118](#).

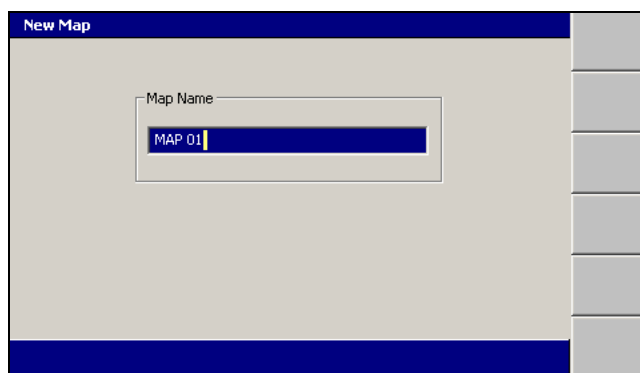
6.2.2 Creating a map file

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.

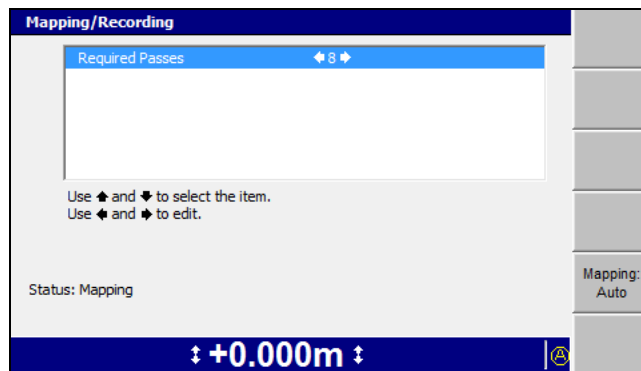
6.3 Configuring Mapping/Recording

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. The available options in the *Mapping/Recording* dialog are described below:
 - *Required passes* – The number of passes that must be made over the surface. The maximum number of passes that can be set is 50.
4. Press the left or right arrows on the control box to change the settings.
5. To change the mapping status, press **Mapping: <value>**. With each key press, the value cycles between **Auto**, **On** and **Off**.
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

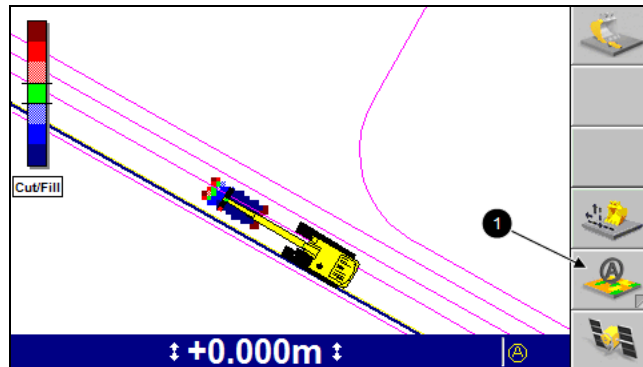
To view a list of the mapping/recording softkey icons, see [Softkeys, page 27](#).

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 (1) 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
- 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 enables you to record the 3D location of a point identified by the focus position.

Note – To use point recording, enable mapping/recording and load a design. 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 automatically increments with each new point. If a suffix is not specified, one is generated automatically. You can edit the name and the suffix as required.

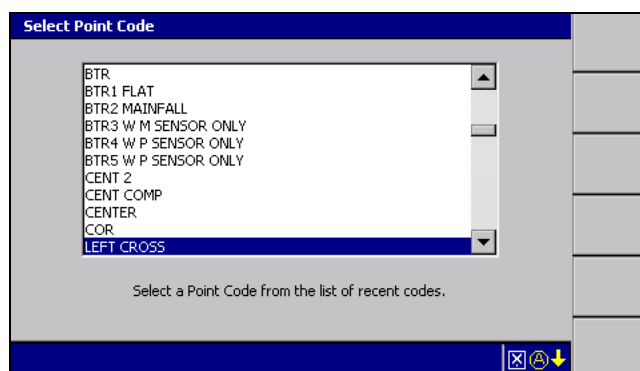
Press **Recent Names** to display a list of recently used point names.

An example point name is “PT”. When you record a new point, 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 .

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 appears each time the **Record Point** softkey is pressed. Otherwise, only a **Record Point** flashing message appears.

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 .

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.

Problem	Action
No Record Point softkey	• Enable <i>Map Recording</i>. • Load a design or map. • Configure <i>Main Screen Views</i> to display the Record Point softkey. See 3.3.3 Main screen views.

Troubleshooting in the Field

In this chapter:

- Remote Assistant
- General troubleshooting
- Running system diagnostics
- Troubleshooting flashing warning messages
- Troubleshooting error messages
- Troubleshooting system components
- Troubleshooting UTS systems
- Before you contact your dealer

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.

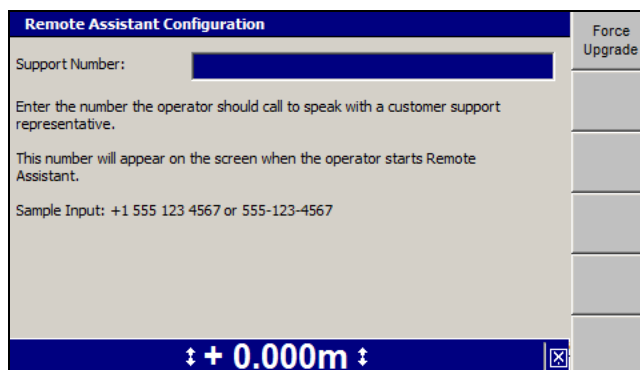
7.1.1 Remote Assistant Configuration

Note – To use Remote Assistant you need an SNM940 or SNRx20 radio and an active Connected Community session. For more information, see [3.7.1 Configuring the Connected Community settings](#).

Remote Assistant enables the operator to request online remote system support from a customer support representative.

Enter the support telephone number in the *Remote Assistant* dialog so you can call support to initiate a remote assistance session:

1. From the *Setup Menu – Installation* menu, select *Connectivity Settings*.
2. Press the up or down arrow keys on the control box to select *Remote Assistant Configuration* and press :



3. Use the arrow keys on the control box to enter the support telephone number.
4. If you want to upgrade the Remote Assistant client software on the control box, press **Force Upgrade**.

The Remote Assistant client software on the control box is deleted. The most current Remote Assistant client software will download the next time the Remote Assistant starts. Usually it should take less than 5 minutes to download, however, if it is done over a serial connection it could take up to 20 minutes.

5. To save the settings and return to the *Connectivity Settings* dialog, press ; to return to the *Connectivity Settings* dialog without saving changes, press .
6. Press  to return to the *Setup Menu – Installation* dialog.

7.1.2 Using Remote Assistant

Operators should be aware that:

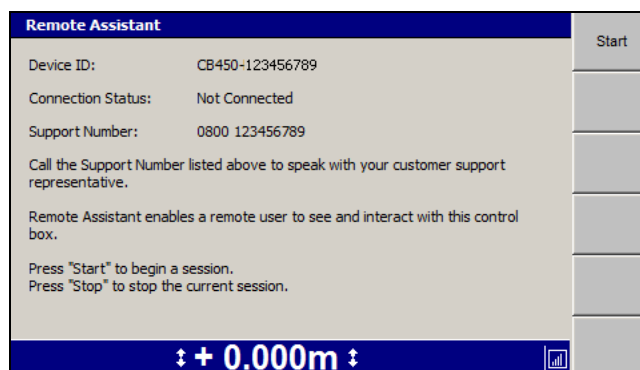
- When the office side connects to the control box via the Connected Community, both the machine and the office side can control most control box operations. This is intentional and enables either side to drive the control box.
- If the machine is running in Autos then the office side can change menu 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 bowl 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.

7.1.3 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 <i>Support Number</i> field is blank	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? Ask your site supervisor to check the arm position, arm length, and machine vector measurements provided in the advanced excavator diagnostics.
- 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*.

Diagnostics				GNSS
Device	Status	App.	Loader	
---Required---				
CB450	Connected	V12.60		
AS45x - Boom	Connected			
AS45x - Stick	Connected			
AS45x - Bucket	Connected			
AS460 - Pitch/Roll	Connected			
MS992 - Right	Connected	V4.89	V3.21	
MS992 - Left	Connected	V4.89	V3.21	
SNR910	Connected	V5.20	V1.11	
↑ N/A ↓				Recheck

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.
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.

UTS tracking status	Meaning
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 <i>UTS</i> 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 described 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 7.3.1 .

Field	Explanation
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. The status messages are listed in the table below.

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

- 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 described 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.

Field	Explanation
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.

- 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 described 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:

- From *Setup Menu – Configuration*, select *Diagnostics*.
- Press **GNSS**.

Diagnostics - GNSS

Receiver [Full RTK - GNSS]

Satellites: Used: 7 PDOP: 1.4

SVs Tracked with Signal: L1: 7 L2: 7

G1: 7 G2: 7

GNSS error (m): V: 0.020 H: 0.010

GNSS mode: RTK (Fixed)

RTK position status: OK

RTK search status: OK

Receiver

Data Link

Sky Plot

± +0.000m ±

The first *Diagnostics – GNSS* screen is the *Receiver* screen, if you have a single-GNSS receiver system. The following table describes the fields in this screen.

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.
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.

Field	Explanation
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.

3. Press **Right Receiver**, if available. the fields within this screen.
4. Press **Data Link**.

Diagnostics - GNSS

Data Link: 100s 15min 3hrs

Integrity: 90.2 % 80.0 % 70.2 %

Latency: 1.0 s

GNSS base station: Information received

Receiver

Data Link

Sky Plot

± +0.000m ±

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 described 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:

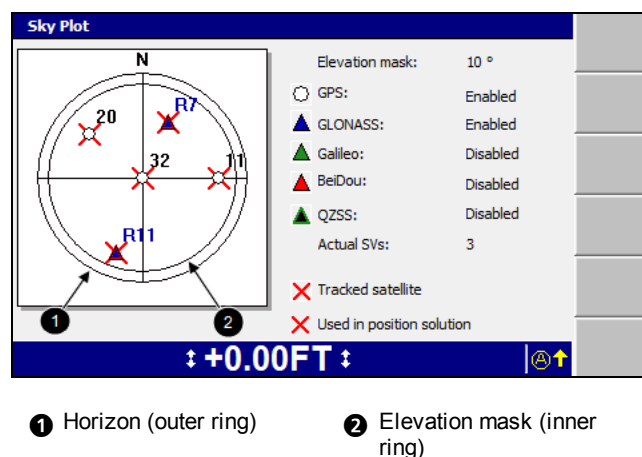
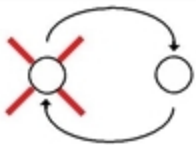
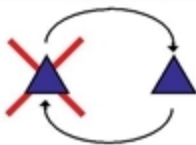


Figure 7.1 Sky Plot dialog

The following table describes the symbols that may appear in the *Sky Plot* dialog satellite map:

This symbol ...	Represents ...
	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.
3 seconds alternating	
	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.
	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.
3 seconds alternating	
	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.
	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.
	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.
3 seconds alternating	
	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.

This symbol ...	Represents ...
	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.
3 seconds alternating	
	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:

This field ...	Displays ...
Elevation mask	The current elevation mask.
Actual SVs	The actual or calculated number of GNSS satellites the system is using at the reference time.

7.4 Troubleshooting flashing warning messages

The system displays flashing warning messages when you need act to ensure that the system continues to provide accurate 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 7.2 — General warning messages

Message	Problem	Solution
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 3.3.1 Machine settings . Otherwise, ask your site supervisor to enter the correct machine measurements.

Message	Problem	Solution
Check Machine Type	The stored machine settings are invalid.	To restore a suitable machine settings file, use the procedure in 3.3.1 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 3.11 Selecting a 3D vertical guidance method .
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.
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 7.9 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 7.3 — 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 7.6.3 SNRxxx radio modem status indicator . 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 5.2.1 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 7.6.5 MT900 machine target status indicators .

Message	Problem	Solution
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.
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 5.2.8 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 5.5.5 Reacquiring UTS lock .
Start UTS	The UTS system is not providing guidance data.	To start the UTS system, use the procedure in 5.2.8 Starting the UTS system .

7.4.3 GNSS warning messages

Table 7.4 — 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 7.3 Running system diagnostics Check the cable to the radio.

Message	Problem	Solution
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.
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 – <i>Make sure that the new mode or limits are accurate enough for the work you need to do.</i>
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 Excavator warning messages

Table 7.5 — Excavator warning messages

Message	Problem	Solution
Check Boom Sensor	The system cannot communicate with the boom position sensor, or the sensor is out of operating range.	Ask your site supervisor to check the configured orientation of the boom sensor and the reported value of the boom angle in the <i>Calibrate Sensors — AS45x Sensor Orientations</i> dialog. If required, reconfigure the sensor orientation and then recalibrate the sensors. Check the sensor and cable for damage.
Check Bucket Linkage and Arm Measurements	The arm or linkage measurements are inconsistent with the measured cylinder extensions.	Ask your site supervisor to check the arm and bucket linkage measurements.
Check Bucket Sensor	The system cannot communicate with the bucket position sensor, or the sensor is out of operating range.	Ask your site supervisor to check the configured orientation of the bucket sensor and the reported value of the bucket angle in the <i>Calibrate Sensors — AS45x Sensor Orientations</i> dialog. If required, reconfigure the sensor orientation and then recalibrate the sensors. Check the sensor and cable for damage.
Check Bucket Tilt Sensor	The system cannot communicate with the bucket tilt sensor.	Check the sensor and cable for damage.
Check Pitch Sensor	The system cannot communicate with the body pitch sensor.	Check the sensor and cable for damage.
Check Stick Sensor	The system cannot communicate with the stick position sensor, or the sensor is out of operating range.	Ask your site supervisor to check the configured orientation of the stick sensor and the reported value of the stick angle in the <i>Calibrate Sensors — AS45x Sensor Orientations</i> dialog. If required, reconfigure the sensor orientation and then recalibrate the sensors. Check the sensor and cable for damage.
Check VA Boom Sensor	The system cannot communicate with the variable angle boom position sensor, or the sensor is out of operating range.	Ask your site supervisor to check the configured orientation of the boom sensor and the reported value of the VA boom angle in the <i>Calibrate Sensors — AS45x Sensor Orientations</i> dialog. If required, reconfigure the sensor orientation and then recalibrate the sensors. Check the sensor and cable for damage.

Message	Problem	Solution
Low Acc. (No Bucket)	There is no bucket model selected, because there was no bucket model defined during system installation.	Ask your site supervisor to enter a bucket model for the bucket used for measure up.
Rotate Machine	The machine's orientation has not been initialized.	Rotate the machine. See 5.2.3 Initializing single-3D excavator orientation .

In addition to the flashing warning messages listed above, excavator systems may also display the following warning icon in the guidance status bar:



Reliable bucket tilt data is temporarily unavailable, typically due to radial movement of the arm or curling of the bucket.

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.

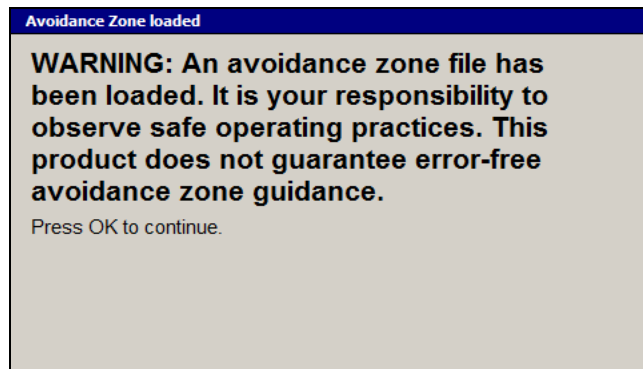
7.5.1 Software support option errors

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.

one of the following full-screen warning messages appear:

- **A site-wide avoidance file is no longer being used. Press  to continue.**
- or
- **A design specific avoidance file is no longer being used. Press  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.

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.

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.

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.

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.

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 [3.3.1 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 v12.70, 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 [3.3.1 Machine settings](#) or [3.3.5 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 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 .

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.

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  to accept the new master alignment.

Press  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  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  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  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  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 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.*

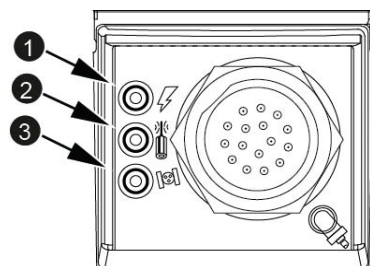
As well as providing guidance information, the external lightbar LEDs provide the system status information listed in the following table.

Table 7.6 — 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 <i>Lightbar Connections</i> dialog to check that all the external lightbar connections are correctly configured.
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 SNRxxx radio modem status indicator

The housing for the SNRxxx radio modems are 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.

7.6.4 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

7.6.5 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

7.6.6 Excavator arm sensor error indication

If the connection to an arm sensor is lost, the following full screen warning message appears

Some of the required system devices are not responding.

If this message is cleared without the fault being corrected, then in addition to the **Check <sensor> Sensor** flashing warning message, the arm segment with the missing sensor is displayed in red in the machine icon in plan view, and arm segments further along the arm are not displayed.

When an arm sensor is missing, profile and cross-section views are not available.

7.7 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:
 - [7.6.3 SNRxxx radio modem status indicator](#).
 - [7.6.4 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?

7.8 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?
 - 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 an SNRx10 radio with a 2400 MHz module installed.
- Use the information in [7.6.3 SNRxxx radio modem status indicator](#) 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. Rest the cutting edge on the ground.
 - c. 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](#).
 - d. 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?

7.9 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.

